FANUC AC SPINDLE MOTOR αi series
FANUC AC SPINDLE MOTOR βi series
FANUC BUILT-IN SPINDLE MOTOR Bi series

PARAMETER MANUAL

JR AUTOMATION TECHNOLOGY
JDOWLING

B-65280EN/11

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In this manual we have tried as much as possible to describe all the various matters.
However, we cannot describe all the matters which must not be done, or which cannot be done, because there are so many possibilities.
Therefore, matters which are not especially described as possible in this manual should be regarded as "impossible".

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The parameters described in this manual must be set correctly according to the relevant descriptions. If the parameters are not set correctly, vibrations and unpredictable motions can occur. When setting and updating the parameters, place top priority on safety in operation by taking actions, such as heightening the speed step by step and performing an operation so that an emergency stop can be initiated immediately, until the settings are confirmed to be appropriate.

- When an abnormality such as an alarm or a hardware failure occurs, the operations described in the specifications are not guaranteed unless otherwise specifically noted. When action corresponding to the abnormality is specifically described, take the action. When no action is described, please contact FANUC.
- Generally, safety functions represent functions that protect the operators from machine danger. The signals and functions described in the specifications cannot be used separately for the safety functions unless otherwise described as being usable for the safety functions. Their specifications are not assumed to be used as the safety functions in this case, an unexpected danger may be caused. For information about the safety functions, please contact FANUC.
- A wrong device connection or setting can lead to unpredictable operation. When starting to operate the machine for the first time after assembling the machine, replacing components, or modifying parameter settings, exercise the greater care.

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SAFETY PRECAUTIONS

DEFINITION OF WARNING, CAUTION, AND NOTE

This manual includes safety precautions for protecting the user and preventing damage to the machine. Precautions are classified into Warning and Caution according to their bearing on safety. Also, supplementary information is described as a Note. Read the Warning, Caution, and Note thoroughly before attempting to use the machine.

⚠ WARNING
Used if a danger resulting in the death or serious injury of the user is expected to occur if he or she fails to observe the approved procedure.

⚠ CAUTION
Used if a danger resulting in the minor or moderate injury of the user or equipment damage is expected to occur if he or she fails to observe the approved procedure.

NOTE
Used if a supplementary explanation not related to any of WARNING and CAUTION is to be indicated.

Even those matters described under "CAUTION" may lead to serious consequences depending on the situation. Thus, be sure to observe the approved procedure.

* Read this manual carefully, and store it in a safe place.

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PREFACE

This manual describes the parameters and functions of the FANUC servo amplifier α*i*/β*i* series spindle. This manual is divided into five parts and appendix. This manual includes Part I, which provides a description related to the α*i* series spindle and B*i*I series spindle, Part II, which provides a description related to the β*i* series spindle, Part III, which provides a description related to the β*i*Ic series spindle, and Part IV, which provides a description related to the B*i*S series spindle.
Unless otherwise noted, the parameter numbers for FANUC Series 30*i*-MODEL A are used in the text. When using any other model, reference the corresponding parameter numbers.
The table below indicates the abbreviated model names used with the parameter numbers.

Product name	Abbreviated model name in text	Abbreviated model name in table
FANUC Series 30*i*-MODEL A	Series 30*i*-A	30*i*
FANUC Series 31*i*-MODEL A	Series 31*i*-A	
FANUC Series 32*i*-MODEL A	Series 32*i*-A	
FANUC Series 30*i*-MODEL B	Series 30*i*-B	
FANUC Series 31*i*-MODEL B	Series 31*i*-B	
FANUC Series 32*i*-MODEL B	Series 32*i*-B	
FANUC Series 35*i*-MODEL B	Series 35*i*-B	
FANUC Series 0*i*-MODEL D	Series 0*i*-D	0*i*-D or 0*i*
FANUC Series 0*i*-MODEL F	Series 0*i*-F	0*i*-F or 0*i*

For detailed information indicating which model each function described in this manual can be used with, refer to the manual of each CNC. For the package specifications, in particular, refer to the CNC manual.

The spindle software series and the reference items of the manual (Parts I to IV) vary depending on the spindle amplifier models. The table below lists the spindle software series and reference item for each spindle amplifier model.

Amplifier drawing number	Model	Software series	Reference item	Remarks
A06B-61xx-Hxxx#H550	α*i*/SP	9D50/9D5A	Part I	9D5A is the successor to 9D50*.
A06B-61xx-Hxxx#H553	α*i*/SP	9D53/9D5D	Part III	9D5D is the successor to 9D53*.
A06B-6167-Hxxx#H560	β*i* SVSPc	9D60	Part II	
A06B-61xx-Hxxx#H570	α*i*/SP	9D70/9D7A	Part I/Part III	9D7A is the successor to 9D70*.
A06B-61xx-Hxxx#H580	α*i*/SP	9D80/9D8A	Part I/Part III	9D8A is the successor to 9D80*.
A06B-6164-Hxxx#H580	β*i* SVSP			
A06B-61xx-Hxxx#H590	α*i*/SP	9D90/9D9A	Part I/Part III	9D9A is the successor to 9D90*.
A06B-62xx-Hxxx#H600	α*i*/SP/SVP	9DA0/9DAA	Part I/Part III	9DAA is the successor to 9DA0*.
A06B-62xx-Hxxx#H610	α*i*/SP/SVP-B	9DB0	Part I/ Part III	
A06B-63xx-Hxxx	β*i* SVSP-B			
A06B-62xx-Hxxx#H610	α*i*/SP/SVP-B	9DB0	Part II	Sensorless motor control
A06B-63xx-Hxxx	β*i* SVSP-B			

* The first edition (01 edition) and later of the successor series support the functions available with the conventional series.

The following table indicates the manuals related to the α*i*/β*i* series spindle. This manual is indicated by the * marks in the following tables.

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(a) Manuals related to motor and amplifier.

Manual name	Drawing number	
FANUC AC SPINDLE MOTOR α*i* series DESCRIPTIONS	B-65272EN	
FANUC AC SPINDLE MOTOR β*i* series DESCRIPTIONS	B-65312EN	
FANUC BUILT-IN SPINDLE MOTOR B*i*I series DESCRIPTIONS	B-65292EN	
FANUC SYNCHRONOUS BUILT-IN SPINDLE MOTOR B*i*S series DESCRIPTIONS	B-65342EN	
FANUC SERVO AMPLIFIER α*i* series DESCRIPTIONS	B-65282EN	
FANUC SERVO AMPLIFIER α*i* series for CNC 30*i*-B series DESCRIPTIONS	B-65412EN	
FANUC SERVO AMPLIFIER β*i* series DESCRIPTIONS	B-65322EN	
FANUC AC SERVO MOTOR α*i*S series FANUC AC SERVO MOTOR α*i* series FANUC AC SPINDLE MOTOR α*i* series FANUC SERVO AMPLIFIER α*i* series MAINTENANCE MANUAL	B-65285EN	
FANUC AC SERVO MOTOR β*i*s series FANUC AC SPINDLE MOTOR β*i* series FANUC SERVO AMPLIFIER β*i* series MAINTENANCE MANUAL	B-65325EN	
FANUC AC SPINDLE MOTOR α*i* series FANUC AC SPINDLE MOTOR β*i* series, FANUC BUILT-IN SPINDLE MOTOR B*i* series PARAMETER MANUAL	B-65280EN	*

(b) Manuals related to CNC.

Manual name	Drawing number	
FANUC Series 30*i*-MODEL A FANUC Series 31*i*-MODEL A FANUC Series 32*i*-MODEL A CONNECTION MANUAL (FUNCTION)	B-63943EN-1	
FANUC Series 30*i*-MODEL B FANUC Series 31*i*-MODEL B FANUC Series 32*i*-MODEL B CONNECTION MANUAL (FUNCTION)	B-64483EN-1	
FANUC Series 35*i*-MODEL B CONNECTION MANUAL (FUNCTION)	B-64523EN-1	
FANUC Series 0*i*-MODEL D FANUC Series 0*i* Mate-MODEL D CONNECTION MANUAL (FUNCTION)	B-64303EN-1	
FANUC Series 0*i*-MODEL F CONNECTION MANUAL (FUNCTION)	B-64603EN-1	
FANUC Series 30*i*-MODEL A FANUC Series 31*i*-MODEL A FANUC Series 32*i*-MODEL A MAINTENANCE MANUAL	B-63945EN	
FANUC Series 30*i*-MODEL B FANUC Series 31*i*-MODEL B FANUC Series 32*i*-MODEL B MAINTENANCE MANUAL	B-64485EN	

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Manual name	Drawing number	
FANUC Series 35*i*-MODEL B MAINTENANCE MANUAL	B-64525EN	
FANUC Series 0*i*-MODEL D FANUC Series 0*i* Mate-MODEL D MAINTENANCE MANUAL	B-64305EN	
FANUC Series 0*i*-MODEL F MAINTENANCE MANUAL	B-64605EN	

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H.1 PARAMETERS WITH DIFFERENT MEANINGS 879

ADDITIONAL INFORMATION

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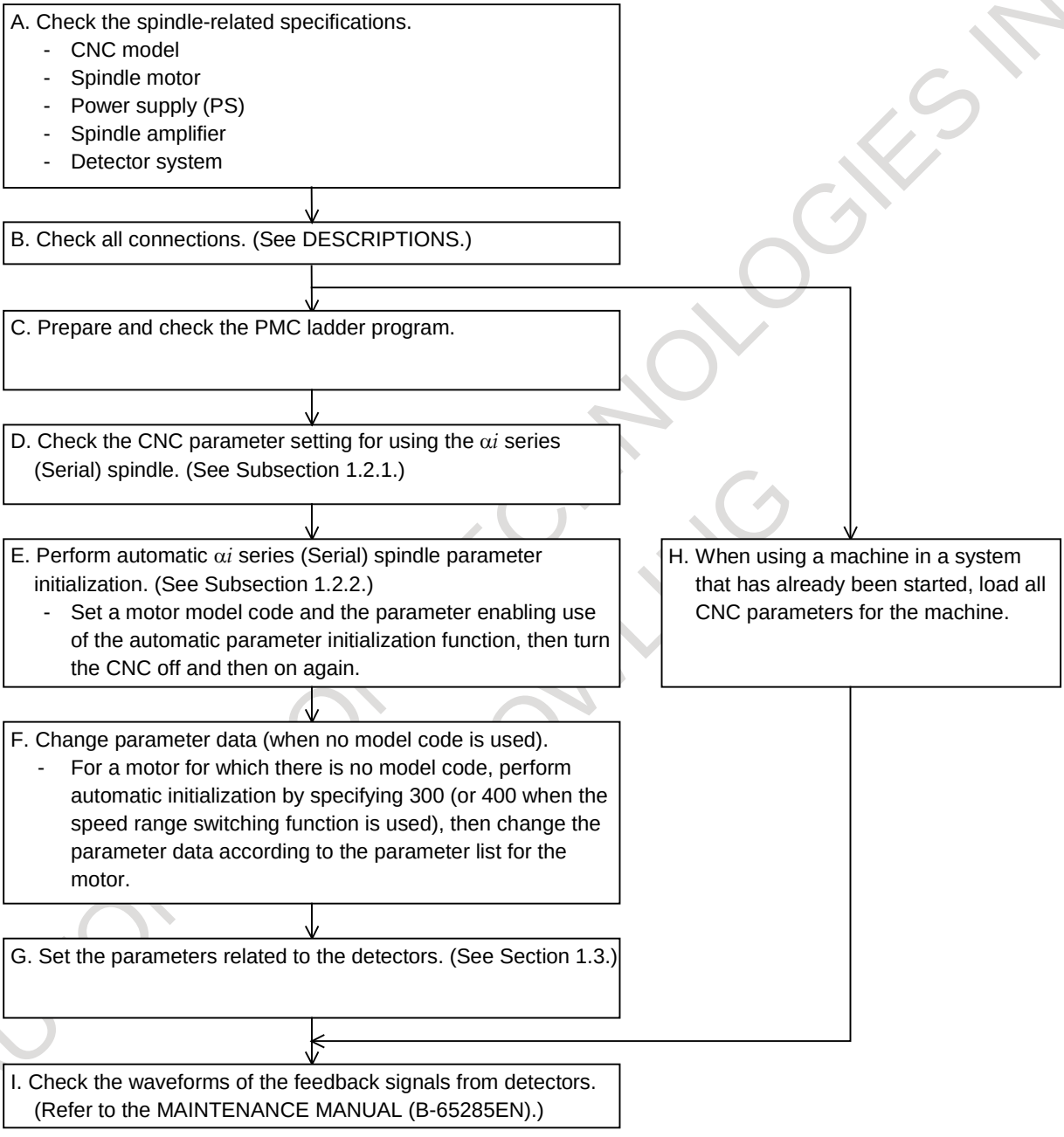
I. FANUC AC SPINDLE MOTOR αiI series
FANUC AC SPINDLE MOTOR βiI series
FANUC BUILT-IN SPINDLE MOTOR BiI series

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1 START-UP

1.1 START-UP PROCEDURE



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1.2 SPINDLE SERIAL INTERFACE (OPTIONAL FUNCTION)

1.2.1 Parameters Related to Spindle Serial Output

This subsection provides a list of the parameters related to spindle serial output only. For details of each parameter, refer to "SPINDLE SERIAL OUTPUT" of the Connection Manual (Function) of each CNC.

Parameter No.		Description
0*i*-D / 30*i*-A	0*i*-F / 30*i*-B	
3716#0	3716#0	Selection of a spindle (analog/serial) (Set "1")
3702#1	3702#1	Multi-spindle control function (Whether to use the multi-spindle control function)
3717	3717	Amplifier number of each spindle
3718	3718	Spindle indication subscript (main spindle)
3719	3719	Spindle indication subscript (sub-spindle)
—	24000 to 24095	ATR value corresponding to slave on each FSSB line *2
10339#1	—	Setting for use spindle amplifier 30*i*-B series to 0*i*-D *3 (For use spindle amplifier / 30*i*-B, sets this parameter to "1")

NOTE
*1 To use the spindle serial interface, the CNC software option is required.
*2 Setting for use FSSB connection between CNC and spindle amplifier. For details, refer to "FSSB Setting" of the Connection Manual (Function) of each CNC.
*3 Setting for use spindle amplifier 30*i*-B series to 0*i*-D. For details, refer to Section 4.64, "OTHER PARAMETERS (2 OF 2)" of the Parameter Manual of 0*i*-D.

1.2.2 Automatic Spindle Parameter Initialization

NOTE
When automatic spindle parameter initialization is performed, the parameter settings that have already been adjusted (such as sensor settings and orientation stop positions) are also initialized. To prevent the adjusted parameter settings from being initialized, do not perform automatic initialization.

(1) Parameter list

Parameter No.		Description
0*i*	30*i*	
4019#7	4019#7	Function for automatically initializing spindle parameters
4133	4133	Spindle motor model code

(2) Procedure for automatic spindle parameter initialization

Perform automatic spindle parameter initialization by following the procedure below.

<1> Set the model code for the desired motor for automatic parameter initialization.

Parameter No.		Description
0*i*	30*i*	
4133	4133	Model code

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NOTE
*1 The control method usable with the αi series spindle is spindle HRV control only. The conventional control method is not supported.
*2 When using a spindle motor that has no model code, set model code “300” (“400” for a spindle motor with speed range switching control) for automatic parameter setting, then manually input data according to the parameter table for each motor model.

<2> Set the relevant parameter to enable automatic spindle parameter initialization.

Parameter No.		Description
0*i*	30*i*	
4019#7	4019#7	1

NOTE
This bit is reset to its original value after automatic parameter initialization.

<3> Turn the CNC off, then on again. Then, the spindle parameters specified with a model code are automatically initialized.

(3) Alarm SP9034

During initial setting or adjustment of the parameters, alarm SP9034 (illegal parameter range) may be issued.
If alarm SP9034 is issued, the number (internal data number in the spindle software) of a parameter that caused the alarm is displayed on the CNC diagnosis screen (diagnosis 720). Check the number as described below.

<1> When diagnosis 720 is 0
There is an error in the motor model code for initial parameter loading.
Check parameter No. 4133 (main side of spindle switching) and parameter No. 4309 (sub-side of spindle switching).

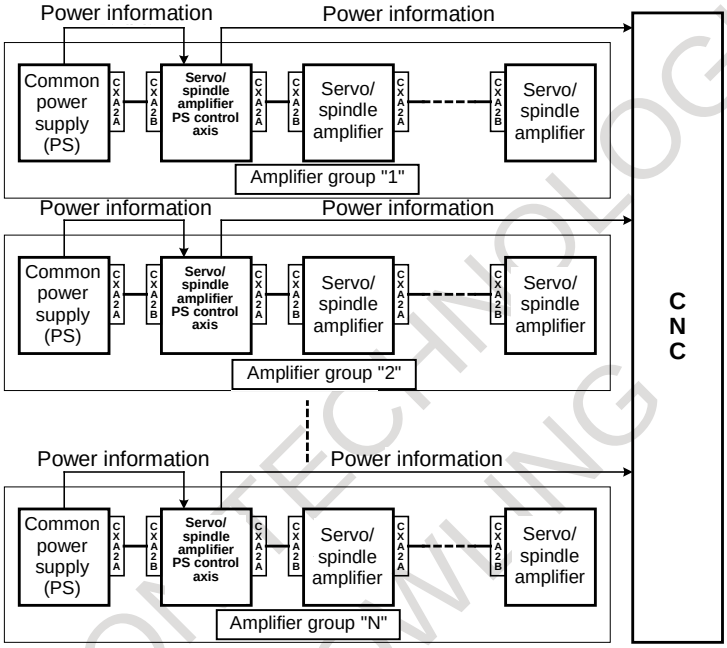
<2> When diagnosis 720 is not 0
The internal data number of a parameter that caused SP9034 is displayed. Check the parameter corresponding to an internal data number (F-xxx) listed in Appendix A, “SPINDLE PARAMETER TABLE”.

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1.2.3 Automatic Setting of the Parameter for Specifying the PS Control Axis

* To use the 30*i*-B/0*i*-F series SP, the following operation is required.

For the power supply (PS) for the 30*i*-B series, control is now performed by software. On the CNC, this allows you to know power information. Since the PS cannot communicate with the CNC directly, power information is transferred to the CNC through an SV or SP called a PS control axis.
(The PS control axis refers to an SV or SP connected in the closest vicinity of the PS in the amplifier connection using CXA2x connectors.)



To enable the CNC software to recognize the PS control axis, an amplifier group number must be set in one of the following parameters:

Parameter No. 2557 when the PS control axis is an SV
Parameter No. 4657 when the PS control axis is an SP

The parameters can be set automatically by following the procedure below.

* If the amplifier configuration is changed, an invalid PS control axis specification alarm occurs immediately after CNC start-up. Perform automatic setting again.

<1> Set the relevant parameter to enable automatic PS control axis setting.

Parameter No. 30*i*-B	Description
11549#0	1

NOTE
This bit is reset to its original value after automatic setting.

<2> Turn the CNC off, then on again. Then, the PS control axis parameter is automatically set.

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1.2.4 Diagnosis (Diagnosis Screen)

This subsection provides a list of the diagnosis (diagnosis screen) indications related to spindle serial output only. For details, refer to “SPINDLE SERIAL OUTPUT” of the Connection Manual (Function) of each CNC.

(1) For Series 30*i*

Address	Description
400	Information including spindle control
408	Information about spindle serial output interface communication errors

(3) For Series 0*i*-D

Address	Description
400	Information including spindle control
408	Information about spindle serial output interface communication errors

1.2.5 Alarm

This subsection provides a list of the alarms related to spindle serial output only. For details of each alarm, refer to “SPINDLE SERIAL OUTPUT” of the Connection Manual (Function) of each CNC.

(1) For Series 0*i* and Series 30*i*

Alarm No.		Description
0*i*	30*i*	
SP1220	SP1220	The cable connected to the serial spindle amplifier is disconnected, or no serial spindle amplifier is connected.
SP1225	SP1225	A CRC error (communication error) occurred in communication between the CNC and serial spindle amplifier.
SP1226	SP1226	A framing error occurred in communication between the CNC and serial spindle amplifier.
SP1227	SP1227	A receive error occurred in communication between the CNC and serial spindle amplifier.
SP1228	SP1228	A communication error occurred in communication between the CNC and serial spindle amplifier.
SP1229	SP1229	A CRC error (communication error) occurred in communication between the CNC and serial spindle amplifier.
SP1245 to SP1247	SP1245 to SP1247	A communication data error was detected on the CNC side.
SP1976 to SP1979	SP1976 to SP1979	An error occurred with the spindle control software.
SP1980 to SP1984	SP1980 to SP1984	The SIC-LSI on the serial spindle amplifier side is faulty.
SP1985 to SP1987	SP1985 to SP1987	The SIC-LSI on the CNC side is faulty.
SP1988 to SP1989	SP1988 to SP1989	An error occurred with the spindle control software.
SP1996	SP1996	Spindle motor assignment is incorrect. Check the parameters indicated hereafter. (No.3716, No.3717)

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1.3 PARAMETERS RELATED TO DETECTORS

NOTE

*1 Note that the specifications of parameters related to detectors for the α*i* series spindle amplifiers differ from those of parameters for the α series spindle amplifiers.

*2 The terms “motor sensor” and “spindle sensor” used in the text mean the speed/position detectors connected to the connectors described below.

(i) Motor sensor :
Detector connected to connector JYA2 or JYA3
(α*i*M sensor, α*i*MZ sensor, α*i*BZ sensor of a built-in motor, α*i*CZ sensor (analog, serial) of a built-in motor)

(ii) Spindle sensor :
Detector connected to connector JYA3 or JYA4
(α*i* position coder, α position coder S, separate α*i*BZ sensor, separate α*i*CZ sensor (analog, serial), and so forth)

1.3.1 List of Parameters for Detectors

Parameter No.		Description
0*i*	30*i*	
3720	3720	Number of pulses of the position coder
4000#0	4000#0	Direction of spindle and spindle motor rotation
4001#4	4001#4	Spindle sensor mounting direction
4002#3,2,1,0	4002#3,2,1,0	Spindle sensor type setting
4003#7,6,5,4	4003#7,6,5,4	Setting of the number of spindle sensor gear teeth
4004#3,2	4004#3,2	External one-rotation signal (proximity switch) setting
4006#1	4006#1	Gear ratio increment system
4007#5	4007#5	Whether to detect disconnection of feedback signals
4007#6	4007#6	Whether to detect alarms related to position feedback signals (on non-Cs contouring control mode)
4010#2,1,0	4010#2,1,0	Motor sensor type setting
4010#3	4010#3	Phase order of A/B phase signal signals for speed sensor†
4011#2,1,0	4011#2,1,0	Setting of the number of motor sensor gear teeth
4016#0	4016#0	Phase order of A/B phase signal in Distance coded sensor†
4017#2	4017#2	Setting for Z phase signal detection†
4016#5	4016#5	Whether to detect alarms related to position feedback (in Cs contouring control mode)
4016#6	4016#6	Whether to detect alarms related to threading feedback
4016#7	4016#7	Setting of the function of detecting the one-rotation signal again each time position control mode is set.
4394#2	4394#2	Setting of the detection lower limit of the one-rotation signal
4394#5	4394#5	Whether to detect the alarm related to spindle sensor polarity erroneous setting
4056~4059	4056~4059	Spindle-to-motor gear ratio data (This data is selected by spindle control input signals CTH1A and CTH2A.)
4098	4098	Maximum speed for position feedback signal detection
4171 4173	4171 4173	Denominator of arbitrary gear ratio between motor sensor and spindle (This data is selected by spindle control input signal CTH1A.)
4172 4174	4172 4174	Numerator of arbitrary gear ratio between motor sensor and spindle (This data is selected by spindle control input signal CTH1A.)
4334	4334	Arbitrary number of motor sensor teeth
4355	4355	Motor sensor signal amplitude ratio compensation

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Parameter No.		Description
0*i*	30*i*	
4356	4356	Motor sensor signal phase difference compensation
4357	4357	Spindle sensor signal amplitude ratio compensation
4358	4358	Spindle sensor signal phase difference compensation
4361	4361	Arbitrary number of spindle sensor teeth
4394#2	4394#2	Condition of Z phase signal detection †
4500 4502	4500 4502	Denominator of arbitrary gear ratio between spindle sensor and spindle (This data is selected by spindle control input signal CTH1A.)
4501 4503	4501 4503	Numerator of arbitrary gear ratio between spindle sensor and spindle (This data is selected by spindle control input signal CTH1A.)
4623	4623	Distance coded sensor Nominal increment 1 †
4624	4624	Distance coded sensor Nominal increment 2 †
4625	4625	Distance coded sensor Compensation data for Z phase signal position †

NOTE
They are used when distance coded sensors are used in spindles. For details of the parameters, see Section 5.22, “HOW TO USE A DISTANCE CODED SENSOR FOR A SPINDLE”.

1.3.2 Details of Parameters for Detectors

This subsection details the serial spindle parameters (in the four thousands) among the detector-related parameters. For details of other parameters, refer to “SPINDLE SPEED CONTROL” of the Connection Manual (Function) of each CNC.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4000	4000								ROTA1

ROTA1 Indicates the relationship between the rotation directions of spindle and spindle motor.
0 : Rotates the spindle and spindle motor in the same direction.
1 : Rotates the spindle and spindle motor in the reverse direction.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4001	4001				SSDIRC				

SSDIRC Indicates the mounting direction of spindle sensor.
0 : Rotates the spindle and spindle sensor in the same direction.
1 : Rotates the spindle and spindle sensor in the reverse direction.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4002	4002					SSTYP3	SSTYP2	SSTYP1	SSTYP0

SSTYP3 to SSTYP0 Spindle sensor type
This parameter sets the type of a separate detector to be attached to the spindle (detector to be connected to connector JYA3 or JYA4).

SSTYP3	SSTYP2	SSTYP1	SSTYP0	Spindle sensor type
0	0	0	0	None (No position control function is used.)
0	0	0	1	Uses the motor sensor for position feedback
0	0	1	0	α*i* position coder
0	0	1	1	Separate α*i*BZ sensor, α*i*CZ sensor (analog)
0	1	0	0	α position coder S

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SSTYP3	SSTYP2	SSTYP1	SSTYP0	Spindle sensor type
0	1	1	0	Separate αiCZ sensor (serial)
1	1	1	0	Separate αiBZ sensor, αiCZ sensor (analog) [Setting for detecting the one-rotation signal at less than 10 min^{-1} (*3)] Sinusoidal wave A/B phase sensor from another company

NOTE
*1 When using a rectangular wave phase A/B, 1024-p/rev position coder, set the same settings as for the αi position coder (0,0,1,0).
*2 It is not possible to use the αiCZ sensor (serial) as both motor sensor and spindle sensor.
*3 When this setting is made in combination with the setting for detecting the one-rotation signal regardless of the spindle speed (bit 2 of parameter No. 4394 =1), the one-rotation signal can be detected at less than 10 min^{-1}.
However, the position at which to detect the one-rotation signal varies with a change in the temperature of the sensor. Usually, set 0,0,1,1. Refer to "FANUC SERVO AMPLIFIER αi series Descriptions" (B-65282EN) for information about the extent to which the position at which to detect the one-rotation signal varies.

0i	30i	#7	#6	#5	#4	#3	#2	#1	#0
4003	4003	PCPL2	PCPL1	PCPL0	PCTYPE				

PCPL2, PCPL1, PCPL0, PCTYPE Gear teeth number setting of the spindle sensor

This parameter sets the number of teeth of a separate detector to be attached to the spindle (detector to be connected to connector JYA3 or JYA4).

PCPL2	PCPL1	PCPL0	PCTYPE	Gear teeth number of the spindle sensor
0	0	0	0	256λ/rev
0	0	0	1	128λ/rev
0	1	0	0	512λ/rev
0	1	0	1	64λ/rev
1	0	0	0	768λ/rev
1	0	0	1	1024λ/rev
1	1	0	0	384λ/rev

NOTE
*1 Set "0, 0, 0, 0" when using an αi position coder (bits 3, 2, 1, 0 of No. 4002 = 0, 0, 1, 0) or an α position coder S (bits 3, 2, 1, 0 of No. 4002 = 0, 1, 0, 0).
*2 When the motor sensor is used for position feedback (bits 3, 2, 1, 0 of No. 4002 = 0, 0, 0, 1), this parameter need not be set.
*3 When the number of αi BZ sensor teeth is 96 λ/rev, 192 λ/rev, 640 λ/rev, 768 λ/rev, or 1024 λ/rev, set 0,0,0,0 in this parameter, and set the number of teeth in the parameter specifying an arbitrary number of spindle sensor teeth (parameter No. 4361).

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0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4004	4004					RFTYPE	EXTRF		

EXTRF, RFTYPE External one-rotation signal setting

This parameter sets the type of an external one-rotation signal (proximity) switch to be attached to the spindle (to be connected to connector JYA3).

RFTYPE	EXTRF	External one-rotation signal (proximity switch)
0	0	None
0	1	Detects the leading edge.
1	1	Detects the trailing edge.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4006	4006							GRUNIT	

GRUNIT Sets a gear ratio setting resolution:

0 : 1/100 unit

1 : 1/1000 unit

Select a gear ratio data setting resolution from the following:

(a) Resolution based on motor rotation increased by a factor of 100 relative to one spindle rotation

(b) Resolution based on motor rotation increased by a factor of 1000 relative to one spindle rotation

Depending on the setting of this parameter, the increment system of the parameters indicated in the table below changes.

Parameter No.		Description
0*i*	30*i*	
4056 to 4059	4056 to 4059	Spindle-to-motor gear ratio data

NOTE
Usually, use the 1/100 unit (setting “0”).

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4007	4007		PCALCH	PCLS					

PCLS Determines feedback signal disconnection detection.

0 : Performs disconnection detection.

1 : Does not perform disconnection detection.

When this bit is set to “0”, spindle alarms 27 (Position coder signal disconnection), 73 (Motor sensor disconnection), and 84 (Spindle sensor disconnection) are checked.

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NOTE
*1 Usually, set “0”.
*2 When adjusting the waveform of a motor/spindle sensor feedback signal, set “1” temporarily to disable disconnection detection. **After completion of adjustment, be sure to return the setting to “0” to enable disconnection detection.**
*3 If dual check safety function is enabled, this parameter is invalid and disconnection detection is performed.
*4 Set it to "0" when using the αiCZ sensor (serial). Setting it to "1" results in a spindle state error (error 43).

PCALCH Determines whether to use alarms related to position feedback signals (on non-Cs contouring control mode).
0 : Detects alarms.
1 : Does not detect alarms.
When this bit is set to “0”, spindle alarms 41, 42, 47, 81, 82, 83, 85, 86, and 87 are checked.

NOTE
Set it to "0" when using the αiCZ sensor (serial). Setting it to "1" results in a spindle state error (error 43).

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4010	4010					MTSDRC	MSTYP2	MSTYP1	MSTYP0

MSTYP2, MSTYP1, MSTYP0 Motor sensor type
This parameter sets the type of a detector built into the motor (detector to be connected to JYA2 or JYA3).

MSTYP2	MSTYP1	MSTYP0	Motor sensor type
0	0	0	αiM sensor
0	0	1	αiMZ sensor, αiBZ sensor, αiCZ sensor (analog)
0	1	1	αiCZ sensor (serial)
1	1	1	αiMZ sensor, αiBZ sensor, αiCZ sensor (analog) [Setting for detecting the one-rotation signal at less than 10 min^{-1} (*3)] Sinusoidal wave A/B phase sensor from another company

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NOTE

*1 It is not possible to use the αiCZ sensor (serial) as both motor sensor and spindle sensor.

*2 If the αiCZ sensor (serial) is used as the motor sensor, it is not possible to use the following:
- αi position coder
- External one-rotation signal (proximity switch)

*3 When this setting is made in combination with the setting for detecting the one-rotation signal regardless of the spindle speed (bit 2 of parameter No. 4394 =1), the one-rotation signal can be detected at less than 10 min^{-1}.
However, the position at which to detect the one-rotation signal varies with a change in the temperature of the sensor. Usually, set 0,0,1. Refer to "FANUC SERVO AMPLIFIER αi series Descriptions" (B-65282EN) for information about the extent to which the position at which to detect the one-rotation signal varies.

MTSDRC Motor sensor mounting direction
0 : Normal direction
1 : Direction opposite to the normal direction
Set "1" when the motor sensor mounting direction (A/B phase order) is opposite to the normal direction.

0i	30i	#7	#6	#5	#4	#3	#2	#1	#0
4011	4011						VDT3	VDT2	VDT1

VDT1 to VDT3 Gear teeth number setting of the motor sensor
This parameter sets the number of teeth of a detector built into the motor (detector to be connected to JYA2 or JYA3).

VDT3	VDT2	VDT1	Gear teeth number of the motor sensor
0	0	0	64λ/rev
0	0	1	128λ/rev
0	1	0	256λ/rev
0	1	1	512λ/rev
1	0	0	192λ/rev
1	0	1	384λ/rev

NOTE

*1 When using a sensor with αiCZ sensor (analog, serial) 768 λ/rev or 1024 λ/rev, set 0,0,0 in this parameter, and set 768 or 1024 in the parameter specifying an arbitrary number of motor sensor teeth (parameter No. 4334).

*2 When the number of αi BZ sensor teeth is 96 λ/rev, 640 λ/rev, 768 λ/rev, or 1024 λ/rev, set 0,0,0 in this parameter, and set the number of teeth in the parameter specifying an arbitrary number of motor sensor teeth (parameter No. 4334).

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Motor models and corresponding αiM and αiMZ sensors

Motor model	Number of gear teeth of the detection ring on the αiM or αiMZ sensor
αiI0.5	64λ/rev
αiI1 to αiI3	128λ/rev
αiI6 to αiI50 αiIP12 to αiIP60	256λ/rev

WARNING
If the gear tooth number setting of the motor sensor is not correct, the spindle motor may rotate at a high speed above the specified speed. Check the gear tooth number of the motor sensor and set it correctly.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4016	4016	RFCHK3	RFCHK2	RFCHK1					

RFCHK1 Determines whether to detect alarms related to position feedback (in Cs contouring control mode).
0 : Does not detect alarms.
1 : Detects alarms.
When this bit is set to “1”, Spindle alarms 81, 82, 85, and 86 are checked.

NOTE
Set it to "1" when using the αiCZ sensor (serial). Setting it to "0" results in a spindle state error (error 43).

RFCHK2 Determines whether to detect the alarm related to threading position detection signal feedback (spindle alarm 46).
0 : Does not detect alarms.
1 : Detects alarms.

NOTE
Set it to "1" when using the αiCZ sensor (serial). Setting it to "0" results in a spindle state error (error 43).

RFCHK3 Setting of the function of detecting the one-rotation signal again each time position control mode is set.
0 : The one-rotation signal is not detected each time the operating mode changes.
Once the one-rotation signal has been detected, it is not detected again until the power goes off.
1 : The one-rotation signal is detected each time the operating mode changes.

NOTE
If the αiCZ sensor (serial) is used, this parameter is invalid.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4394	4394			A21DEN			ZPHDTC		

ZPHDTC Sets the detection lower limit of the one-rotation signal.
0 : The one-rotation signal is detected when the spindle speed is 10 min^{-1} or more.
1 : The one-rotation signal is detected regardless of the spindle speed.

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NOTE
*1 This parameter is valid with 9D50 series E (05) edition or later, 9D70 series A (01) edition or later, 9D80 series A (01) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later, and 9DB0 series A (01) edition or later.
*2 This parameter is enabled when the spindle sensor is an α*i* position coder or α position coder S.
*3 When the spindle sensor is the α*i*MZ, α*i*BZ, or α*i*CZ sensor (analog), and if the sensor type (bits 2, 1, 0 of parameter No. 4010 = 1, 1, 1 for the motor sensor or bits 3, 2, 1, 0 of parameter No. 4002 = 1, 1, 1, 0 for the spindle sensor) is set in combination with this parameter, the one-rotation signal is detected regardless of the spindle speed.
*4 When the spindle sensor is the α*i*CZ sensor (serial), the one-rotation signal is detected regardless of the setting of this parameter and the spindle speed.

A21DEN Whether to detect the spindle sensor polarity erroneous setting alarm (spindle alarm 21).
0 : The spindle sensor polarity erroneous setting alarm is detected.
1 : The spindle sensor polarity erroneous setting alarm is not detected.
When the spindle sensor polarity erroneous setting alarm is incorrectly detected due to the following reasons, set this bit to disable the alarm detection.
- When the spindle is mechanically separated from the motor.
- When the belt between the spindle and the motor slips.

NOTE
This parameter is valid with 9D50 series E (05) edition or later, 9D70 series A (01) edition or later, 9D80 series A (01) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later, and 9DB0 series A (01) edition or later.

0*i*	30*i*	
4056	4056	**Gear ratio (HIGH) CTH1A=0, CTH2A=0**
4057	4057	**Gear ratio (MEDIUM HIGH) CTH1A=0, CTH2A=1**
4058	4058	**Gear ratio (MEDIUM LOW) CTH1A=1, CTH2A=0**
4059	4059	**Gear ratio (LOW) CTH1A=1, CTH2A=1**

Unit of data : (Motor rotation for one rotation of spindle) / 100
(When parameter No. 4006 #1 (GRUNIT) is 1, motor rotation / 1000)
Valid data range : 0 to 32767
Initial setting : 100
These data are used to set the gear ratio between spindle and spindle motor.
Example :
When the spindle rotates once, set “250” as the data when the motor rotates 2.5 times.
A parameter is selected with the CTH1A and CTH2A input signals.
Set the gear or clutch status to correspond to the clutch/gear signal (CTH1A, CTH2A).

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NOTE
When an improper value is set in these parameters, an unexpected operation can occur. For example, the spindle can continue rotating without stopping at the time of orientation. So, be sure to set a proper gear ratio.

0*i*	30*i*	
4098	4098	**Maximum speed for position feedback signal detection**

Unit of data : $1min^{-1}$ (Unit of 10 min^{-1} when bit 2 (SPDUNT) of parameter No. 4006 = 1)
Valid data range : 0 to 32767
Initial setting : 0
This parameter sets a maximum spindle speed that enables the detection of a motor/spindle sensor feedback signal.
When "0" is set in this parameter, up to the maximum motor speed can be detected.

NOTE
*1 Usually, set "0".
*2 If the α*i*CZ sensor (serial) is used, this parameter is invalid.

0*i*	30*i*	
4134	4134	**Motor overheat level**

Unit of data : 1C
Valid data range : 0 to 180
Initial setting : Motor characteristic value
This parameter sets a motor overheat alarm level. You can reduce the initial setting value.

NOTE
*1 Don't set the value that is higher than an initial setting value in this parameter. The security of the motor is not secured.
*2 This valid data range is valid with 9D5A series W (23) edition or later, 9D7A series L (12) edition or later, 9D8A series J (10) edition or later, 9D90 series W (23) edition or later, 9DAA series A (01) edition or later, and 9DB0 series A (01) edition or later. As for the software before than these editions, the valid data range is 90 to 180.

0*i*-	30*i*	
4171	4171	**Denominator of arbitrary gear ratio between motor sensor and spindle (HIGH) CTH1A=0, CTH2A=0**
4172	4172	**Numerator of arbitrary gear ratio between motor sensor and spindle (HIGH) CTH1A=0, CTH2A=0**
4651	4651	**Denominator of arbitrary gear ratio between motor sensor and spindle (MEDIUM HIGH) CTH1A=0, CTH2A=1**
4652	4652	**Numerator of arbitrary gear ratio between motor sensor and spindle (MEDIUM HIGH) CTH1A=0, CTH2A=1**
4653	4653	**Denominator of arbitrary gear ratio between motor sensor and spindle (MEDIUM LOW) CTH1A=1, CTH2A=0**
4654	4654	**Numerator of arbitrary gear ratio between motor sensor and spindle (MEDIUM LOW) CTH1A=1, CTH2A=0**
4173	4173	**Denominator of arbitrary gear ratio between motor sensor and spindle (LOW) CTH1A=1, CTH2A=1**

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4174	4174	**Numerator of arbitrary gear ratio between motor sensor and spindle (LOW) CTH1A=1, CTH2A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0

These parameters set conversion coefficients (numerator, denominator) for using the detection arbitrary gear ratio function (DMR function) by multiplying a motor sensor (αiM or αiMZ sensor) feedback signal by a gear ratio to produce a spindle position feedback signal.
When the spindle rotates Q times while the motor shaft rotates P times (there is no common divisor other than 1 for P and Q), settings are:

No. 4171 (No. 4173 when CTH1A = 1) = P
No. 4172 (No. 4174 when CTH1A = 1) = Q

In the case of these setting parameters are "0", each parameter are handled as follows.

PARAMETER	GEAR	Handling when set to "0"
4171, 4172	HIGH	It is handled as "1"
4651, 4652	MEDIUM HIGH	When No.4651=0 or No.4652=0, gear ratio of LOW(CTH1A=1,CTH2A=1) is handled MEDIUM HIGH(CTH1A=0,CTH2A=1)
4653, 4654	MEDIUM LOW	When No.4653=0 or No.4654=0, gear ratio of LOW(CTH1A=1,CTH2A=1) is handled MEDIUM HIGH(CTH1A=1,CTH2A=0)
4173, 4174	LOW	It is handled as "1"

NOTE
*1 When using the external one-rotation signal (proximity switch), use the detection arbitrary gear ratio function (DMR function) by setting an arbitrary gear ratio between the motor sensor and spindle in this parameter.
*2 If the αi CZ sensor (serial) is used, this parameter is invalid.
*3 No.4651 to No.4654 are valid with 9D9A series B (02) edition or later, 9DAA series E (05) edition or later and 9DB0 series C (03) edition or later.
If not indicated above edition, CTH2A signal is not refered, HIGH or LOW is selected by CTH1A signal only.

0*i*	30*i*	
4334	4334	**Arbitrary number of motor sensor teeth**

Unit of data : 1λ/rev (Number of motor sensor teeth)
Valid data range : 0, 32 to 4096
Initial setting : 0

When the number of motor sensor teeth is other than 64, 128, 192, 256, 384, and 512, set this parameter.
When "0" is set in this parameter, the setting of bits 2, 1, 0 (VDT3, VDT2, VDT1) of parameter No. 4011 is valid.

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⚠ WARNING
If the gear tooth number setting of the motor sensor is not correct, the spindle motor may rotate at a high speed above the specified speed. Check the gear tooth number of the motor sensor and set it correctly.

0*i*	30*i*	
4355	4355	**Motor sensor signal amplitude ratio compensation**
4357	4357	**Spindle sensor signal amplitude ratio compensation**

Unit of data : 1%
Valid data range : -8 to 8
Initial setting : 0

These parameters set an amplitude ratio compensation value for the sensor feedback signal (phase A/B of the sinusoidal wave).
For details, refer to Section 4.3, "AMPLITUDE RATIO/PHASE DIFFERENCE COMPENSATION FUNCTION" in Part I.

NOTE
If the α*i* CZ sensor (serial) is used, this parameter is invalid.

0*i*	30*i*	
4356	4356	**Motor sensor signal phase difference compensation**
4358	4358	**Spindle sensor signal phase difference compensation**

Unit of data : 1%
Valid data range : -4 to 4
Initial setting : 0

These parameters set a phase difference compensation value for the sensor signal (phase A/B of the sinusoidal wave).
For details, refer to Section 4.3, "AMPLITUDE RATIO/PHASE DIFFERENCE COMPENSATION FUNCTION" in Part I.

NOTE
If the α*i* CZ sensor (serial) is used, this parameter is invalid.

0*i*	30*i*	
4361	4361	**Arbitrary number of spindle sensor teeth**

Unit of data : 1λ/rev (Number of spindle sensor teeth)
Valid data range : 0, 64 to 4096
Initial setting : 0

When the number of spindle sensor teeth is other than 64, 128, 256, 384, 512, and 1024 set this parameter.
When "0" is set in this parameter, the setting of bits 7, 6, 5, 4 (PCPL2, PCPL1, PCPL0, PCTYPE) of parameter No. 4003 is valid.

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0*i*	30*i*		
4500	4500	**Denominator of arbitrary gear ratio between spindle sensor and spindle (HIGH)**	**CTH1A=0**
4501	4501	**Numerator of arbitrary gear ratio between spindle sensor and spindle (HIGH)**	**CTH1A=0**
4502	4502	**Denominator of arbitrary gear ratio between spindle sensor and spindle (LOW)**	**CTH1A=1**
4503	4503	**Numerator of arbitrary gear ratio between spindle sensor and spindle (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0

These parameters set conversion coefficients (numerator, denominator) for using the detection arbitrary gear ratio function (DMR function) by multiplying a spindle sensor (α*i* position coder, α position coder S, separate α*i*BZ sensor, or separate α*i*CZ sensor (analog)) feedback signal by a gear ratio to produce a spindle position feedback signal.
When the spindle rotates Q times while the motor shaft rotates P times (there is no common divisor other than 1 for P and Q), settings are:

No. 4500 (No. 4502 when CTH1A = 1) = P
No. 4501 (No. 4503 when CTH1A = 1) = Q

When one of these parameters is set to "0", it is assumed to be "1".

NOTE
*1 This parameter is valid with 9D50 series F (06) edition or later, 9D70 series A (01) edition or later, 9D80 series A (01) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later, and 9DB0 series A (01) edition or later.
*2 When this parameter is used in a configuration having no external one-rotation signal (proximity switch), set the following parameters.
No.4007#6=1 : Alarms related to positional feedback signals (in non-Cs mode) are not detected.
No.4016#5=0 : Alarms related to positional feedback signals (in Cs mode) are not detected.
*3 If the α*i* CZ sensor (serial) is used, this parameter is invalid.

0*i*	30*i*	
4565	4565	**Alarm detection level of SP9081 or SP9085**

Unit of data : 1/32768rev
Valid data range : 0 to 32767
Initial setting : Depends on positioning accuracy

0 : Alarm detection level is 1λ of position sensor.
≠0 : Alarm detection level is specified by setting value.

When the distance between two one-rotation signals becomes far from correct value ±1 sinusoidal pitch, which we show as 1λ in this document, one-rotation signal false detection alarm SP9081 (motor sensor) or SP9085 (spindle sensor) is detected.
You can change the alarm detection level with setting of this parameter.
When less than 1λ of position sensor is required as detection of spindle positioning error in the machine, please use this parameter.

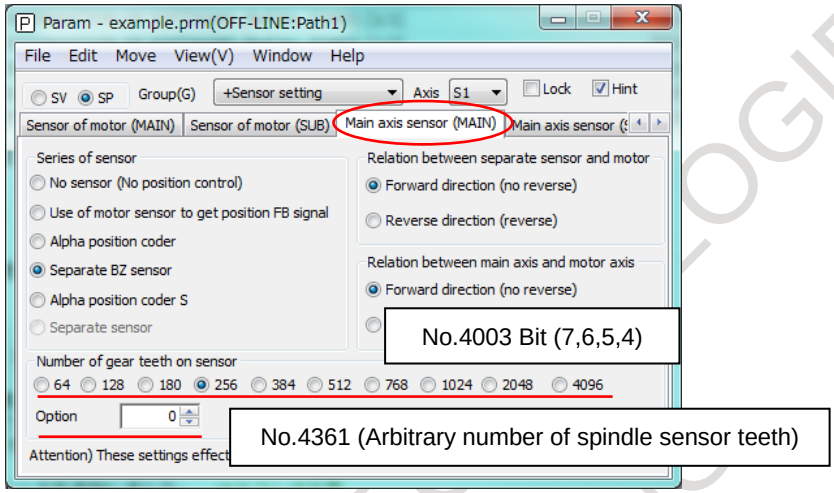
(Example)
Assume that the number of position sensor teeth is 128λ, the default alarm detection level is about 0.008rev (1rev/128λ).
When you want to detect an error of 0.001 rev, please set 32 in this parameter (alarm detection level becomes 32/32768rev).

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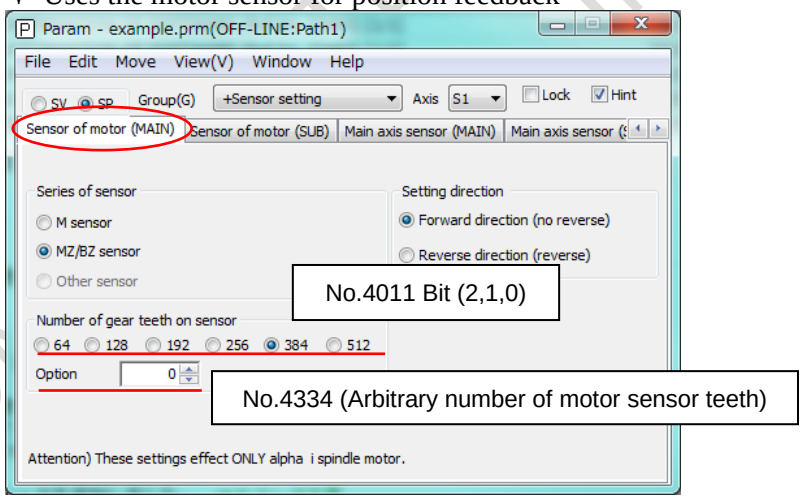
NOTE
*1 This parameter is valid with 9DAA series R (18) edition or later, and 9DB0 series R (18) edition or later.
*2 You cannot change the alarm detection level large than 1λ.
*3 This setting is not applied to the serial sensor (αiCZ sensor (serial)).

- How to check the number of the position sensor teeth (Parameter window of SERVO GUIDE)

✧ Uses the main axis sensor



✧ Uses the motor sensor for position feedback



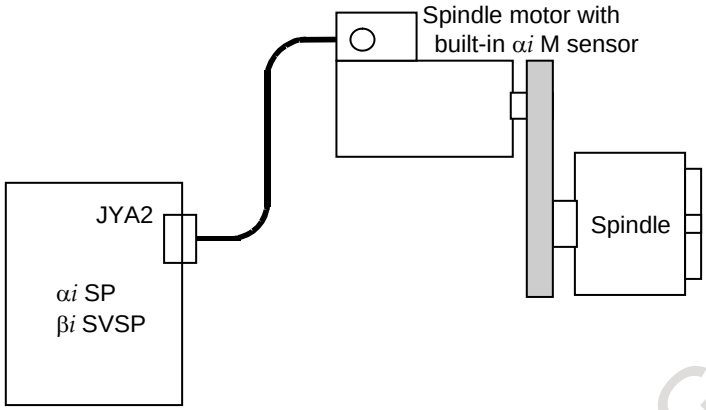
1.3.3 Typical Detector Configurations

This subsection describes typical detector configurations and the parameter setting procedures for the detector configurations.
The detector circuitry hardware is set according to the parameter setting. For this reason, an alarm such as a disconnection alarm may be output while parameters related to detectors are being set.
To initialize the hardware, after setting the parameters related to detectors, turn the power to the amplifier off once.

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(1) When position control is not exercised

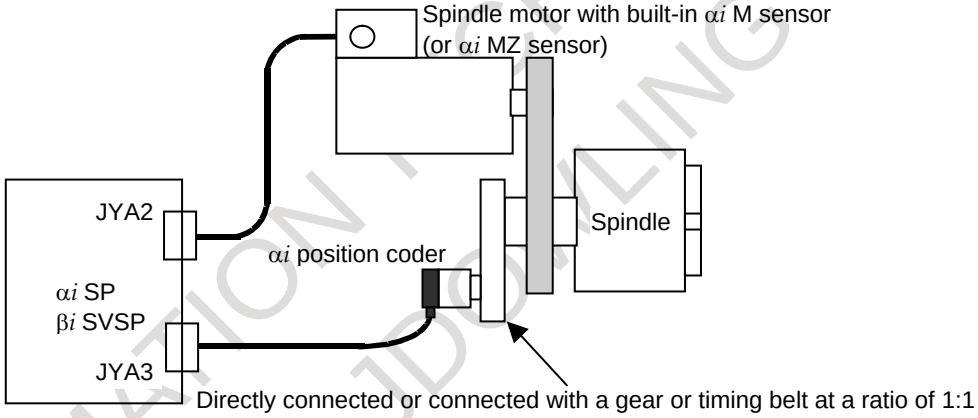
[Sample system configuration]



Parameter No.	Settings	Description
4002 #3,2,1,0	0,0,0,0	Does not exercise position control.
4010 #2,1,0	Depends on the detector.	Sets the type of motor sensor.
4011 #2,1,0	Depends on the detector.	Sets the number of motor sensor gear teeth.

(2) When the αi position coder is used

[Sample system configuration]

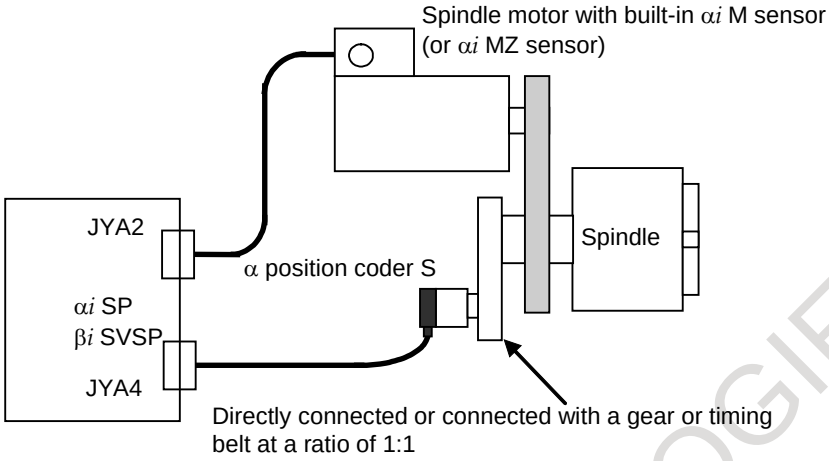


Parameter No.	Settings	Description
4000 #0	Depends on the configuration.	Rotation directions of the spindle and motor
4001 #4	Depends on the configuration.	Spindle sensor mounting direction
4002 #3,2,1,0	0,0,1,0	Uses the αi position coder as the spindle sensor.
4003 #7,6,5,4	0,0,0,0	Sets the number of spindle sensor gear teeth.
4010 #2,1,0	Depends on the detector.	Sets the type of motor sensor.
4011 #2,1,0	Depends on the detector.	Sets the number of motor sensor gear teeth.
4056 to 4059	Depends on the configuration.	Gear ratio between the spindle and motor

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(3) When the α position coder S is used

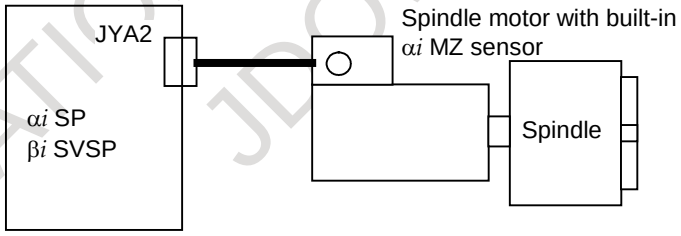
[Sample system configuration]



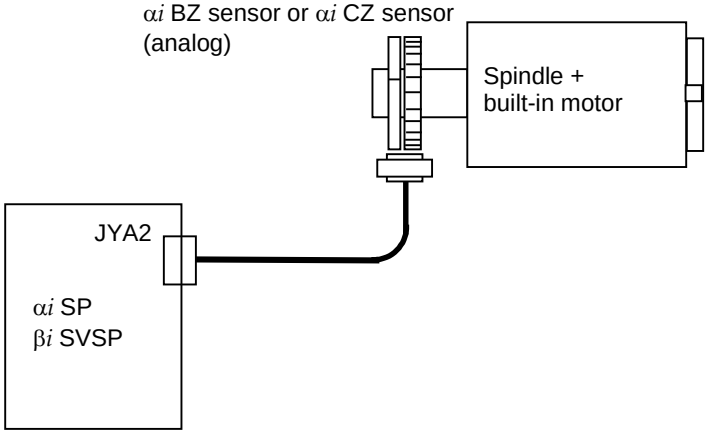
Parameter No.	Settings	Description
4000 #0	Depends on the configuration.	Rotation directions of the spindle and motor
4001 #4	Depends on the configuration.	Spindle sensor mounting direction
4002 #3,2,1,0	0,1,0,0	Uses the α position coder S as the spindle sensor.
4003 #7,6,5,4	0,0,0,0	Sets the number of spindle sensor gear teeth.
4010 #2,1,0	Depends on the detector.	Sets the type of motor sensor.
4011 #2,1,0	Depends on the detector.	Sets the number of motor sensor gear teeth.
4056 to 4059	Depends on the configuration.	Gear ratio between the spindle and motor

(4) When the αiMZ, αiBZ, or αiCZ sensor (analog) is used

[Sample system configuration 1]

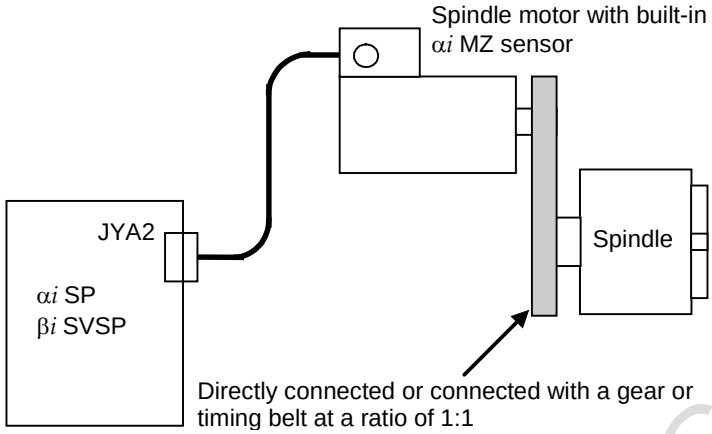


[Sample system configuration 2]



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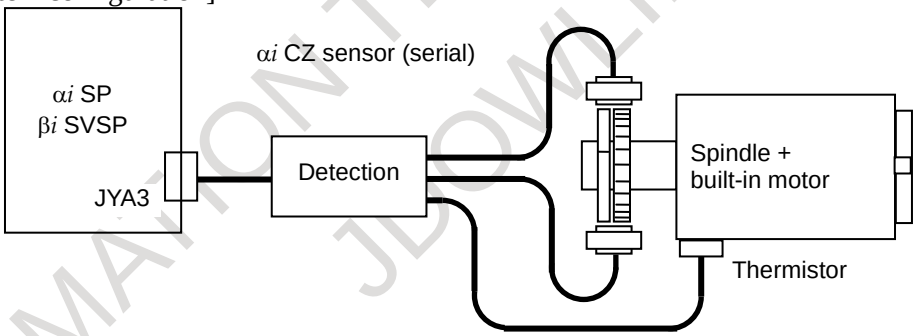
[Sample system configuration 3]



Parameter No.	Settings	Description
4000 #0	0	Rotation directions of the spindle and motor
4002 #3,2,1,0	0,0,0,1	Uses the motor sensor for position feedback.
4010 #2,1,0	0,0,1	Uses the αiMZ , αiBZ, or αiCZ sensor (analog) as the motor sensor.
4011 #2,1,0	Depends on the detector.	Sets the number of motor sensor gear teeth.
4056 to 4059	100 or 1000	Gear ratio between the spindle and motor 1 : 1

(5) When the αiCZ sensor (serial) is used

[Sample system configuration]



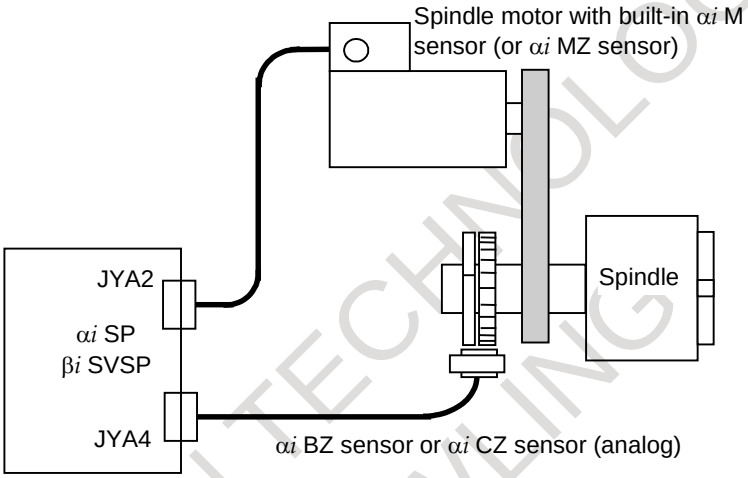
Parameter No.	Settings	Description
4000 #0	0	Rotation directions of the spindle and motor
4002 #3,2,1,0	0,0,0,1	Uses the motor sensor for position feedback.
4007 #5	0	Feedback signal disconnection detection is enabled.
4007 #6	0	Alarms related to position feedback signals are enabled.
4010 #2,1,0	0,1,1	Uses the αiCZ sensor (serial) as the motor sensor.
4011 #2,1,0	Depends on the detector.	Sets the number of motor sensor gear teeth.(For 512λ/rev)
4016 #5	1	Alarms related to position feedback signals are enabled.
4016 #6	1	Alarms related to threading position feedback signals are enabled.
4056 to 4059	100 or 1000	Gear ratio between the spindle and motor 1 : 1
4334	Depends on the detector.	Sets the number of motor sensor gear teeth.(For 768λ/rev、1024λ/rev)

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NOTE
When using the αiCZ sensor (serial), use spindle software of the following series and editions:
- 9D80 series E (05) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later or 9DB0 series A (01) edition or later when the number of teeth is 512 λ or 1024 λ
- 9D80 series F (06) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later or 9DB0 series A (01) edition or later when the number of teeth is 768 λ

(6) When the separate type αiBZ sensor or separate type αiCZ sensor (analog) is used

[Sample system configuration]

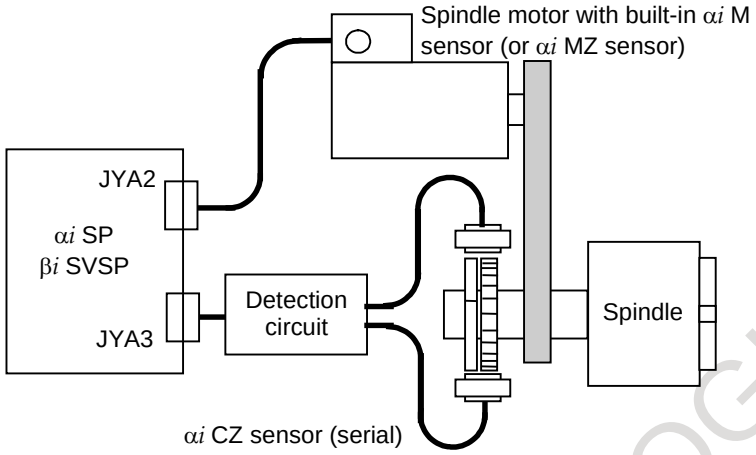


Parameter No.	Settings	Description
4000 #0	Depends on the configuration.	Rotation directions of the spindle and motor
4001 #4	Depends on the configuration.	Spindle sensor mounting direction
4002 #3,2,1,0	0,0,1,1	Uses the αiBZ sensor or αiCZ sensor (analog) as the spindle sensor.
4003 #7,6,5,4	Depends on the detector.	Sets the number of spindle sensor gear teeth.
4010 #2,1,0	Depends on the detector.	Sets the type of motor sensor.
4011 #2,1,0	Depends on the detector.	Sets the number of motor sensor gear teeth.
4056 to 4059	Depends on the configuration.	Gear ratio between the spindle and motor

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(7) When the separate type αiCZ sensor (serial) is used

[Sample system configuration]



Parameter No.	Settings	Description
4000 #0	Depends on the configuration.	Rotation directions of the spindle and motor
4001 #4	Depends on the configuration.	Spindle sensor mounting direction
4002 #3,2,1,0	0,1,1,0	Uses the αiCZ sensor (sensor) as the spindle sensor.
4003 #7,6,5,4	Depends on the detector.	Sets the number of spindle sensor gear teeth.
4007 #5	0	Feedback signal disconnection detection is enabled.
4007 #6	0	Alarms related to position feedback signals are enabled.
4010 #2,1,0	Depends on the detector.	Sets the type of motor sensor.
4011 #2,1,0	Depends on the detector.	Sets the number of motor sensor gear teeth.
4016 #5	1	Alarms related to position feedback signals are enabled.
4016 #6	1	Alarms related to threading position feedback signals are enabled.
4056 to 4059	Depends on the configuration.	Gear ratio between the spindle and motor

NOTE

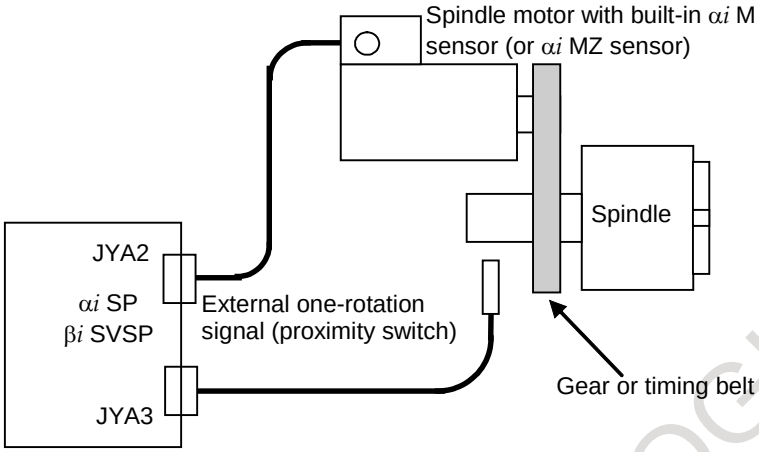
When using the αiCZ sensor (serial), use spindle software of the following series and editions:

- 9D80 series E (05) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later or 9DB0 series A (01) edition or later when the number of teeth is 512 λ or 1024 λ
- 9D80 series F (06) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later or 9DB0 series A (01) edition or later when the number of teeth is 768 λ

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(8) When the external one-rotation signal (proximity switch) is used

[Sample system configuration]

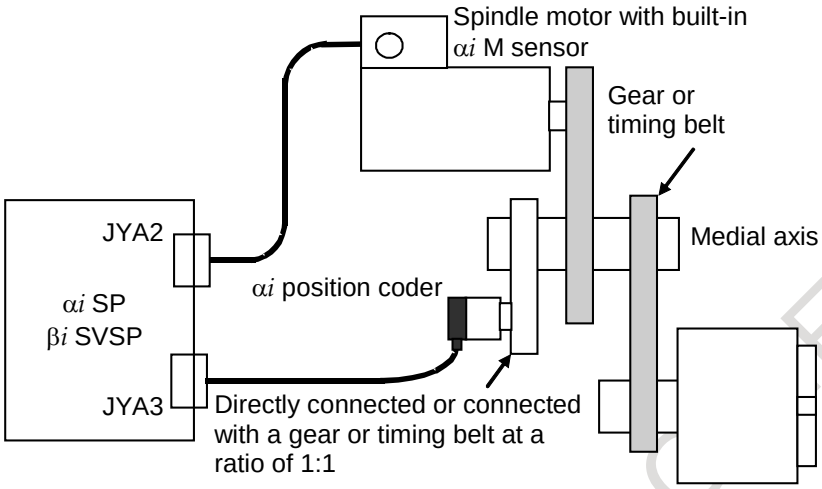


Parameter No.	Settings	Description
4000 #0	Depends on the configuration.	Rotation directions of the spindle and motor
4002 #3,2,1,0	0,0,0,1	Uses the motor sensor for position feedback.
4004 #2	1	Uses the external one-rotation signal.
4004 #3	Depends on the detector.	Sets the external one-rotation signal type.
4010 #2,1,0	Depends on the detector.	Sets the type of motor sensor.
4011 #2,1,0	Depends on the detector.	Sets the number of motor sensor gear teeth.
4056 to 4059	Depends on the configuration.	Gear ratio between the spindle and motor
4171 to 4174	Depends on the configuration.	Arbitrary gear ratio between the motor sensor and spindle
4003#3,2 4000#4 4000#3	Prepared by CCW (counter clockwise direction) or CW (clockwise dorection)	Setting of rotation direction at spindle orientation Reference position return direction on servo mode (rigid tapping/spindle positioning) Reference position return direction on Cs contouring control To detect the one-rotation signal securely, prepare setting of the rotatory direction.
4324 or 4038 (selected by the orientation method) 4074	50 to 100[min^{-1}]	4324:One-rotation signal detection speed (Optimum orientation) 4038:Spindle orientation speed (Conventional method orientation and High-speed spindle orientation) Reference position return speed on Cs contouring control/servo mode To detect the one-rotation signal securely, prepare setting of detection speed

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(9) When the axis on which the spindle sensor is mounted is not the spindle

[Sample system configuration]



Parameter No.	Settings	Description
4000 #0	Depends on the configuration.	Rotation directions of the spindle and motor
4001 #4	Depends on the configuration.	Spindle sensor mounting direction
4002 #3,2,1,0	Depends on the configuration.	Type of spindle sensor
4003 #7,6,5,4	Depends on the detector.	Sets the number of spindle sensor gear teeth.
4010 #2,1,0	0, 0, 0	Uses the αiM sensor as the motor sensor.
4011 #2,1,0	Depends on the detector.	Sets the number of motor sensor gear teeth.
4007 #6	1	Alarms related to positional feedback signals (in non-Cs mode) are not detected.
4016 #5	0	Alarms related to positional feedback signals (in Cs mode) are not detected.
4056 to 4059	Depends on the configuration.	Gear ratio between the spindle and motor
4500 to 4503	Depends on the configuration.	Arbitrary gear ratio between the spindle sensor and spindle

NOTE
Those functions such as the orientation function that require a one-rotation signal cannot be used.

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1.4 INTRODUCTION OF SPINDLE FUNCTIONS

This section introduces some typical functions described in this manual.

1.4.1 Control Mode

There are five basic control modes as follows.

Control mode	Use	Option	Reference
Velocity control mode	Rotation by the velocity command	Unnecessary	I-2.1
Spindle orientation	Stop at a fixed position (tool change, workpiece change)	Necessary	I-2.2
Rigid tapping	Tapping	Necessary	I-2.3
Cs contouring control	Interpolation with servo axes (contouring control)	Necessary	I-2.4
Spindle synchronous control	Spindle velocity synchronization, spindle phase synchronization	Necessary	I-2.5

Following table shows typical applied functions.

Applied function	Use	Option	Reference
Speed range switching control	Output characteristics switching corresponding to the rotation speed	Necessary	I-5.1
Spindle switching control	Driving two spindle motors with one spindle amplifier.	Unnecessary	I-5.2
Optimum orientation	Stop at a fixed position by using maximum spindle power automatically.	Unnecessary	I-2.2
Incremental command type spindle orientation	Control of spindle rotation for turret indexing	Unnecessary	I-5.3
Spindle orientation during spindle synchronization control	Stop at a fixed position during spindle synchronous control.	Unnecessary	I-5.5
Magnetic sensor method spindle orientation	Stop at a fixed position using magnetic sensor mounted on spindle.	Unnecessary	I-5.13
Smart rigid tapping	High speed tapping by using maximum spindle power automatically.	Unnecessary	I-5.24
Spindle EGB	Rotation synchronization between the two spindle in such gear processing machine	Necessary	I-5.7
Velocity tandem control function	Drive a large rotary table or a high power spindle with two spindle motors	Necessary	I-5.10

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1.4.2 Adjustment Function, Adjustment Parameter

This section introduces frequently used adjustment functions and adjustment parameters.

■ Velocity control

Following diagram shows the configuration of velocity control loop of spindle.

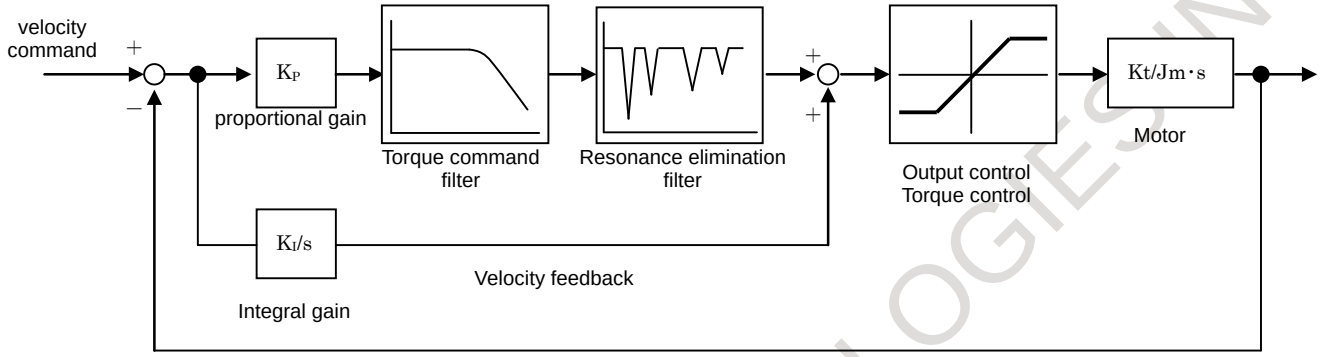


Fig1.4.2 (a) Configuration of velocity control rope of spindle

The following table shows the adjustment items for velocity control.

Purpose	Adjustment item	Reference item and parameter	Remark
Improvement of control characteristic (the response characteristics and stability)	Velocity Gain	I-4.1 No.4040 to No.4055	Automatic adjustment function of SERVO GUIDE is available
	Torque command filter	I-4.2 No.4121	
	Resonance elimination filter	I-4.2 No.4391 to No.4393, No.4416 to No.4424	
Limit the maximum torque*1	Torque limit value	No.4025	Valid in all control mode
Limit the maximum output *1	Output limit value	I-2.1 No.4028, No.4029	The load meter calculated by the output of after limit

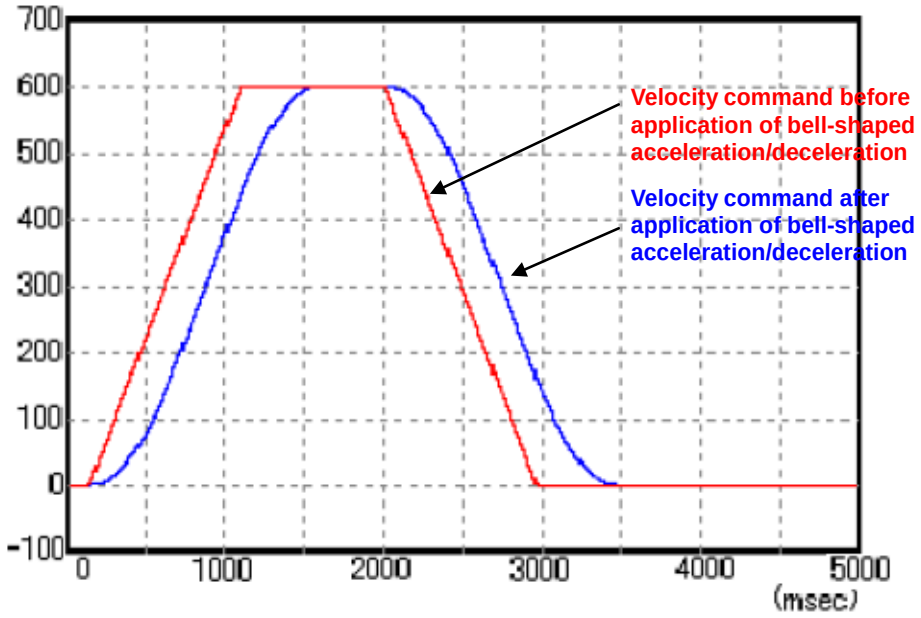
*1: Normally, there is no need to limit.

■ Velocity command (Soft start-stop function)

In velocity control mode, the velocity command is changed in stepwise manner, so there are some cases that the mechanical shock occurs during acceleration/deceleration.
In such case mechanical shock can be suppressed by using soft start-stop function.

Acc./dec. Pattern	Adjustment item	Reference item and parameter	Remark
Constant acc./dec.	Soft start-stop setting time	I-2.1 No.4030	Valid in velocity control mode
Bell-shaped add./dec.	Soft start-stop bell-shaped acceleration/deceleration time constant	I-2.1 No.4519	Valid in velocity control mode

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■ Position control

In spindle orientation, rigid tapping, Cs contouring control and spindle synchronous control, spindle operates with position control. Following table shows frequently used functions for position control. Note that, some parameters such as velocity loop gain are prepared separately for each control mode.

Function	Overview	Reference item	Remark
Magnetic flux boost function	Reduction of the switching time from velocity control mode to position control mode	I-5.16	・Rigid tapping ・Cs contouring control
Dual position feedback function	Stability improvements of machine having a large backlash	I-5.9	・Rigid tapping ・Cs contouring control
Spindle backlash acceleration function	Improvement of the delay at reversal point by the gear backlash and shaft friction	I-5.14	・Cs contouring control
Smart backlash compensation function	Improvement at the reversal time by the measurement of gear backlash	I-5.29	・Cs contouring control
Tandem disturbance elimination	Resonance elimination due to the interference between the speed tandem master and slave axis.	I-5.11	・Velocity tandem control

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1.4.3 Monitor Function

Following table shows frequently used monitor functions.

Function	Overview	Reference item	Remark
Smart load meter	Display cutting load accurately and show remaining duration time to find the optimum cutting condition.	I-5.28	
Inertia estimation function	Estimate the load inertia to optimize acc./dec. time constant and velocity gain	I-5.23	
Arbitrary data output(*1)	Diagnosis screen display of No.720 and No.722.	See below table	

*1: Diagnosis screen display of No.720 and No.722 are switched by parameter setting of No.4532.

No.4532	Contents	Reference item
2	AMR offset data	III-1.5
6	Search result of adaptive resonance elimination filter	I-4.2
9	Amplitude and offset of αiCZ serial sensor	I-1.5
11	Inertia estimation value	I-5.23
13	Distance Coded Encoder Data output for adjusting	I-5.22
14	Distance Coded Encoder Data output for adjusting 2	I-5.22
15	Data output of analog sensor	I-1.5
18	Integral value of position feedback data output	I-1.6
19	Counter for detecting the spindle malrotation alarm（SP9168）	I-5.26
20	Counter for detecting the spindle malrotation alarm（SP9168）; (semi-closed loop/closed loop velocity difference method)	I-5.26
21	Limiting rate of smart thermal control output	I-5.25
22	One-rotation signal detecting state	I-1.7

1.4.4 Protection Function

Following table shows frequently used functions for machine and motor protection.

Function	Overview	Reference item	Remark
Power failure backup function	Axis stop at the time of power faiure, management of the drive power supply at the time of retraction	I-5.20	In some cases not adapted the machine configuration and backup time
Smart thermal control	Limit the output during acc./dec. automatically to avoid overheat of spindle motor	I-5.25	・Velocity control ・Smatt rigid tapping

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1.5 DISPLAYING THE AMPLITUDE AND OFFSET INFORMATION OF THE MOTOR SENSOR AND SPINDLE SENSOR

On the diagnosis (diagnosis screen), you can check the amplitude and offset information of a sensor signal, which you should check when mounting the αiBZ sensor or the like.

1.5.1 αiBZ Sensor and αiCZ Sensor (Analog)

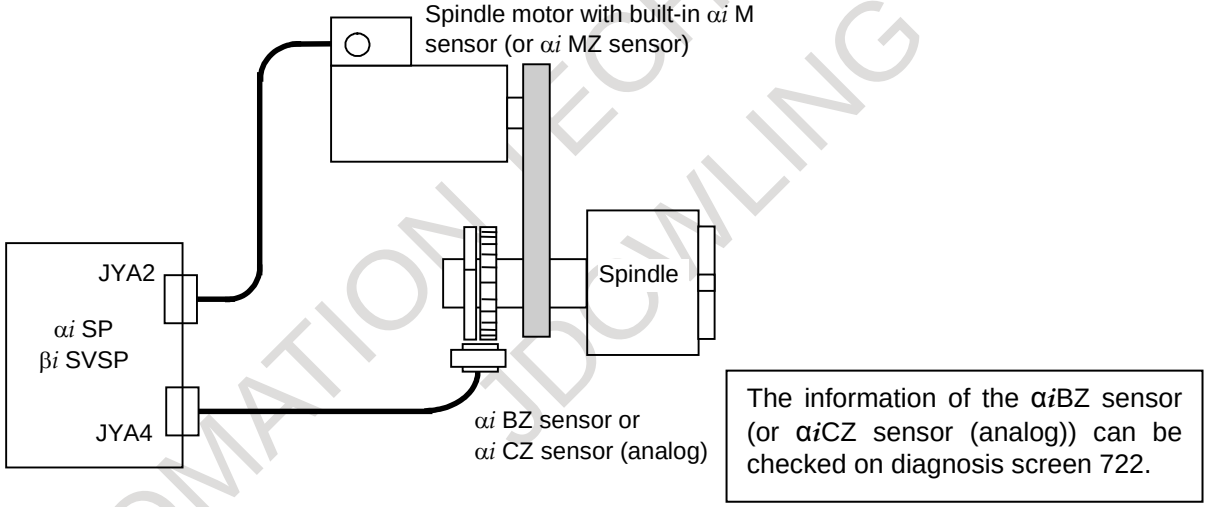
1.5.1.1 Series and editions of applicable spindle software

Spindle software

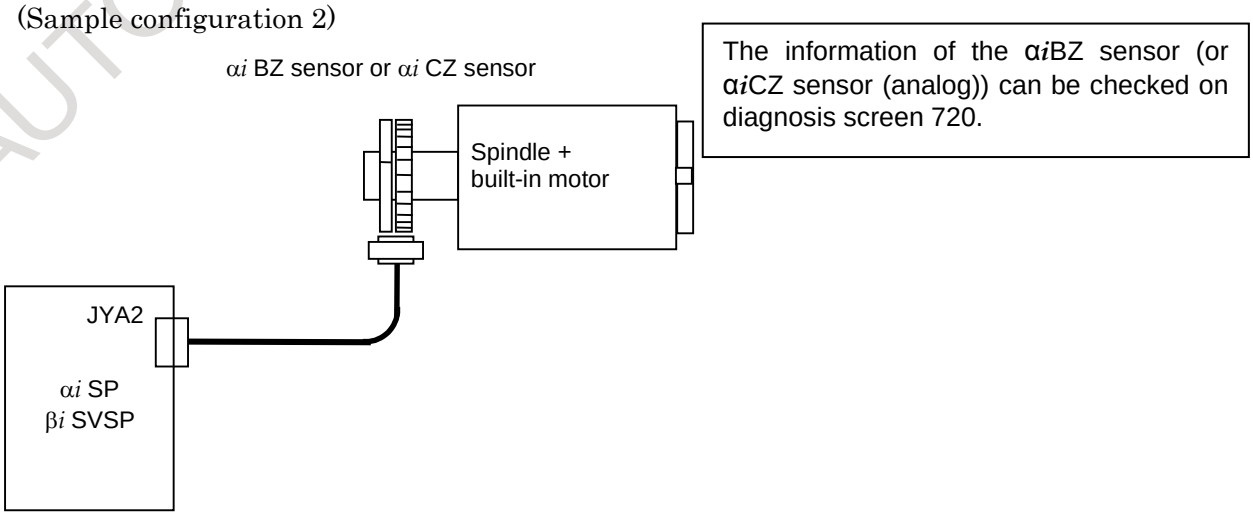
Series	Edition	Usable CNC
9D90	Q (17)	FS0*i*-D, FS30*i* / FS31*i* / FS32*i*-A
9DA0	T (20)	FS0*i*-D, FS30*i* / FS31*i* / FS32*i*-B
9DB0	A (01)	FS0*i*-F, FS30*i* / FS31*i* / FS32*i*-B

1.5.1.2 Applicable detector configurations

(Sample configuration 1)



(Sample configuration 2)



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1.5.1.3 Parameters

0*i*	30*i*	
4532	4532	**Arbitrary data output function number (for the diagnosis screen display)**

Initial setting : 0

When "15" is set in this parameter, the amplitude and offset information of the spindle analog sensor are displayed on the diagnosis screen.
Diagnosis 720: The amplitude and offset of the motor sensor (JYA2 connection) are displayed. (Sample configuration 1)
Diagnosis 722: The amplitude and offset of the spindle sensor (JYA4 connection) are displayed. (Sample configuration 2)

1.5.1.4 Diagnosis screen display

720	**Amplitude and offset information of phase A/B of the motor sensor (JYA2 connection)**

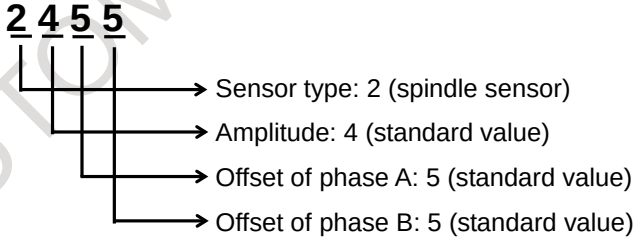
Thousands: The motor sensor (JYA2 connection) is indicated. Value of 1: motor sensor
Hundreds: The amplitude value is indicated as level 1 to 9. The standard value is 3 to 7.
Tens: The offset value of phase A is indicated as level 1 to 9. The standard value is 3 to 7.
Ones: The offset value of phase B is indicated as level 1 to 9. The standard value is 3 to 7.

722	**Amplitude and offset information of phase A/B of the spindle sensor (JYA4 connection)**

Thousands: The spindle sensor (JYA4 connection) is indicated. Value of 2: spindle sensor
Hundreds: The amplitude value is indicated as level 1 to 9. The standard value is 3 to 7.
Tens: The offset value of phase A is indicated as level 1 to 9. The standard value is 3 to 7.
Ones: The offset value of phase B is indicated as level 1 to 9. The standard value is 3 to 7.

NOTE
- Other information is displayed when parameter No. 4532 is not 15.
- Check the above display on the diagnosis screen during rotating. (10 to 100 min^{-1})

(Sample display)



NOTE
The above "standard values" are criterion values based on the specifications of FANUC analog sensors. The amplitude and offset levels are displayed also when an analog sensor from another company is connected. In this case, however, the displayed levels cannot be used for checking purposes because the standard values of analog sensors from another company are unknown. When analog sensors from another company are used, directly observe waveforms using an oscilloscope or the SERVO GUIDE, and then check whether the specifications of each analog sensor are satisfied.

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1.5.2 αiCZ Sensor (Serial)

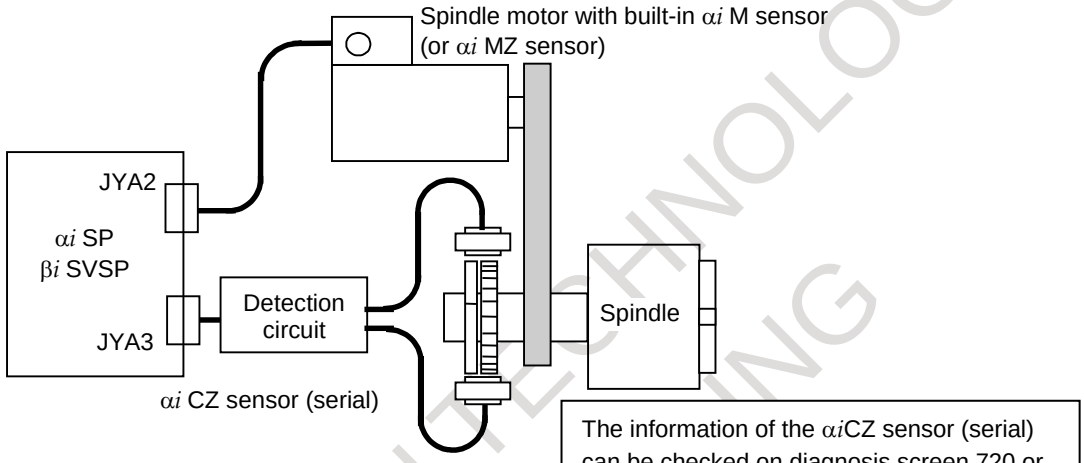
1.5.2.1 Series and editions of applicable spindle software

Spindle software

Series	Edition	Usable CNC
9D80	M (13)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9D90	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	A (01)	FS0*i* -D, FS0*i*-F, FS30*i* / FS31*i* / FS32*i* -B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B

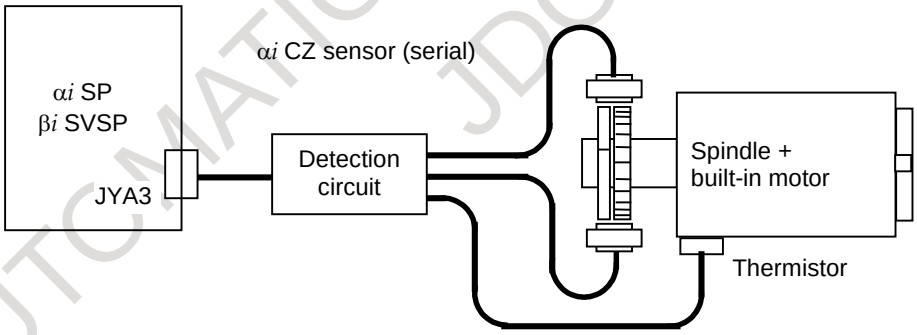
1.5.2.2 Applicable detector configurations

(Sample configuration 1)



The information of the αiCZ sensor (serial) can be checked on diagnosis screen 720 or 722.

(Sample configuration 2)



The information of the αiCZ sensor (serial) can be checked on diagnosis screen 720 or 722.

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1.5.2.3 Parameters

0*i*	30*i*	
4532	4532	**Arbitrary data output function number (for the diagnosis screen display)**

Initial setting : 0

When "9" is set in this parameter, the amplitude and offset information of sensor head 1 and sensor head 2 of the α*i*CZ sensor are displayed on the diagnosis screen.
Diagnosis 720: Amplitude and offset information of sensor head 1
Diagnosis 722: Amplitude and offset information of sensor head 2

1.5.2.4 Diagnosis screen display

720	**Amplitude and offset information of phase A/B of sensor head 1**

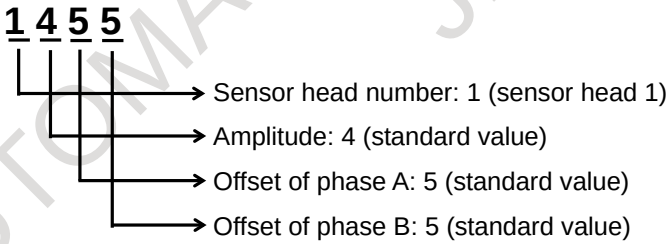
Thousands: The sensor head number is indicated. Value of 1: sensor head 1
Hundreds: The amplitude value is indicated as level 1 to 9. The standard value is 3 to 7.
Tens: The offset value of phase A is indicated as level 1 to 9. The standard value is 3 to 7.
Ones: The offset value of phase B is indicated as level 1 to 9. The standard value is 3 to 7.

722	**Amplitude and offset information of phase A/B of sensor head 2**

Thousands: The sensor head number is indicated. Value of 2: sensor head 2
Hundreds: The amplitude value is indicated as level 1 to 9. The standard value is 3 to 7.
Tens: The offset value of phase A is indicated as level 1 to 9. The standard value is 3 to 7.
Ones: The offset value of phase B is indicated as level 1 to 9. The standard value is 3 to 7.

NOTE
- Other information is displayed when parameter No. 4532 is not 9.
- Check the above display on the diagnosis screen during rotating. (10 to 100 min^{-1})

(Sample display)



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1.6 DISPLAY INTEGRATION OF POSITION FEEDBACK ON DIAGNOSIS SCREEN

It is possible to check the integration of position feedback of motor and spindle on diagnosis screen. The gear ratio and teeth number setting of motor sensor / spindle sensor can be checked by comparing the position feedback of motor and spindle.

1.6.1 Series and Editions of Applicable Spindle Software

Spindle software

Series	Edition	Usable CNC
9D90	R (18)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	U (21)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B

1.6.2 Parameter

0*i*	30*i*	
4532	4532	**Arbitrary data output function number (for the diagnosis screen display)**

Initial setting : 0

When “18” is set in this parameter, integration of position feedback of motor and spindle are displayed on the diagnosis screen.
Diagnosis 720: Integration of position feedback of motor
Diagnosis 722: Integration of position feedback of spindle

1.6.3 Diagnosis Screen Display

720	**Integration of position feedback of motor**

Integration of position feedback is displayed, which is calculated from movement of motor
Unit of data: 1/2^24 (1/16777216) per revolution

722	**Integration of position feedback of spindle**

Integration of position feedback is displayed, which is calculated from movement of spindle
Unit of data: 1/2^24 (1/16777216) per revolution

NOTE
- Other information is displayed when parameter No. 4532 is not 18.
- Please check on rotating about the above diagnosis screen display. (10 to 100 min^{-1})

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1.7 DISPLAY OF ONE-ROTATION SIGNAL ON DIAGNOSIS SCREEN

There are some cases that one-rotation signal (Z phase signal) can't be detected when spindle sensor has something failure or the fixing of the sensor is wrong. In the cases the oscilloscope is used normally to monitor sensor waveform to find out the reason of trouble. In order to simplify troubleshooting, we added the display of One-rotation signal (Z phase signal) of spindle sensor on diagnosis screen.
In this specification manual, "Display of One-Rotation Signal on Diagnosis Screen" is described.

1.7.1 Series and Editions of Applicable Spindle Software

Spindle software

Series	Edition	Usable CNC
9DAA	I（09）	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B
9DB0	J（10）	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

1.7.2 Parameter

0*i*	30*i*	
4532	4532	**Arbitrary data output function number (for the diagnosis screen display)**

Initial setting : 0

When "22" is set in this parameter, information of One-rotation sigenal are displayed on the diagnosis screen.
Diagnosis 720: One-rotation signal (Z phase signal) detecting state
Diagnosis 722: Pulse number between two One-rotation signal (Z phase sigenl)

NOTE
- As arbitrary data output function parameter (No.4532) is used in this function, the other function which uses arbitrary data output function parameter (No.4532) cannot be used at the same time. When you investigate One-rotation signal (Z phase signal), change No.4532 temporarily, and don't forget to return No.4532 back after investigating.
- To use this function, spindle velocity should be in the following range.
  10 min^{-1}≤spindle velocity≤60min^{-1}
  *1) The Z phase signal might not be detected when the spindle speed is below 10 min^{-1}
  *2) This function shows "1" in DGN720 for 0.5sec when Z phase signal is detected. Therefore DGN720 shows "1" all time if the speed is faster than 60min^{-1}.

1.7.3 Diagnosis Screen Display

720	**One-rotation signal (Z phase signal) detecting state**

0: not detected
1: detected (Once One-rotation signal (Z phase signal) is detected, "1" is shown for 0.5sec.)

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722	Pulse number between two One-roattion signal (Z phase signal)

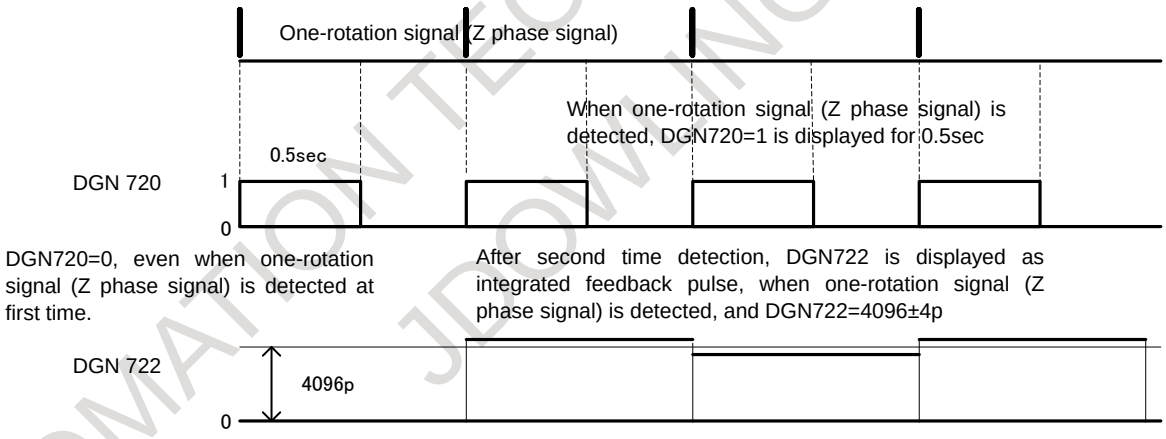
Unit of data: 4096p/rev
Valid data range: 0~32767

When spindle velocity is lower than $60min^{-1}$ and feedback pulses and one-rotation signal is detected correctly, the fluctuation of display value should be in ±4 pulses.

The diagnosis display and probable failure reason

DGN720	DGN722	Description	Probable failure reason
"0" is shown stably	0	One-rotation signal (Z phase) is not detected	・ Connection failure in One-rotation signal (Z phase) ・ Sensor fixing failure
"0" or "1" is shown iternatively	≈4096(stable) (fluctuation ≤4p)	One-rotation signal (Z phase) is detected correctly	-
	≠4096(unstable) (fluctuation >4p)	One-rotation signal (Z phase), or A/B phase can't be detected stably	・ Influence of noise
"1" is shown stably	-	One-rotation signal (Z phase) is detected stably	・ The upper speed limit of this function is $60min^{-1}$

1.7.4 Timing Chart

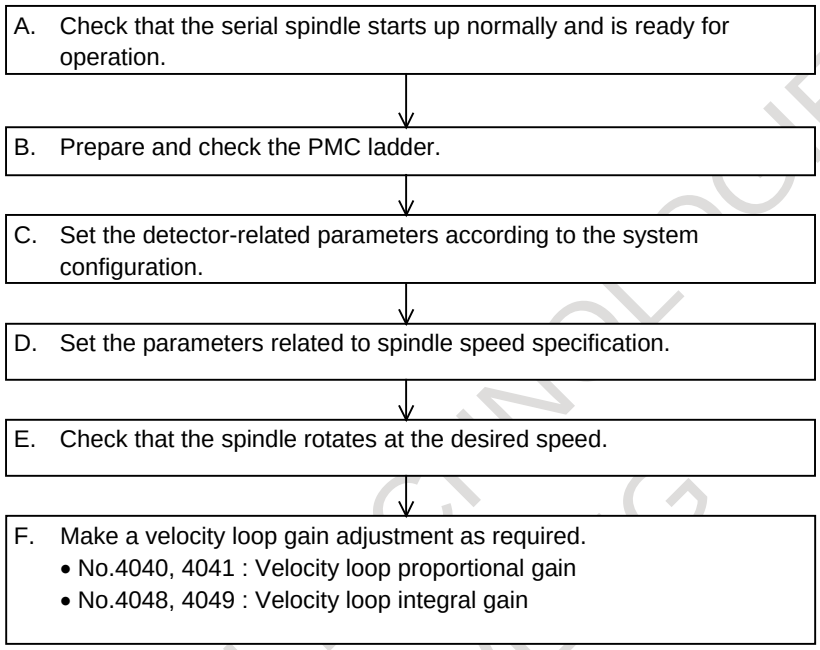


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2 EXPLANATION OF OPERATION MODES

2.1 VELOCITY CONTROL MODE

2.1.1 Start-up Procedure



2.1.2 Overview

The velocity control mode is a function for exercising velocity control to rotate the spindle motor according to a velocity command from the CNC. For high resolution of velocity command, refer to “Resolution of Spindle Velocity Command” of the CONNECTION MANUAL (FUNCTION) of each CNC.

NOTE
On a CNC screen (such as the spindle monitor screen and the adjustment screen), the velocity control mode is indicated as “NORMAL OPERATION MODE”.

2.1.3 System Configuration

The velocity control mode is applicable to all detector configurations. For system configurations, see Subsection 1.3.3, “TYPICAL DETECTOR CONFIGURATIONS”.

2.1.4 List of I/O Signals (CNC↔PMC)

This Subsection provides a list of the I/O signals related to the velocity control mode only. For details of each signal, refer to “SPINDLE SPEED CONTROL” of the CONNECTION MANUAL (FUNCTION) of each CNC.

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For details of the I/O signals common to the CNCs, see Chapter 3, "I/O SIGNALS (CNC↔PMC)", in Part I.

(1) Input signals (PMC→CNC)

(a) Series 0*i*

		#7	#6	#5	#4	#3	#2	#1	#0
Common to all axes	G027				*SSTP2 (*1)	*SSTP1 (*1)		SWS2 (*1)	SWS1 (*1)
Common to all axes	G028						GR2	GR1	
Common to all axes	G029		*SSTP	SOR	SAR				
Common to all axes	G030	SOV7	SOV6	SOV5	SOV4	SOV3	SOV2	SOV1	SOV0
1st-	G032	R08I	R07I	R06I	R05I	R04I	R03I	R02I	R01I
2nd-	G034	R08I2	R07I2	R06I2	R05I2	R04I2	R03I2	R02I2	R01I2
1st-	G033	SIND	SSIN	SGN		R12I	R11I	R10I	R09I
2nd-	G035	SIND2	SSIN2	SGN2		R12I2	R11I2	R10I2	R09I2

NOTE
*1 These signals are valid in multi-spindle control.

(b) Series 30*i*

		#7	#6	#5	#4	#3	#2	#1	#0
Common to all axes	G027				*SSTP2 (*1)	*SSTP1 (*1)		SWS2 (*1)	SWS1 (*1)
Common to all axes	G028						GR2	GR1	
Common to all axes	G029		*SSTP	SOR	SAR				
Common to all axes	G030	SOV7	SOV6	SOV5	SOV4	SOV3	SOV2	SOV1	SOV0
1st-	G032	R08I	R07I	R06I	R05I	R04I	R03I	R02I	R01I
2nd-	G034	R08I2	R07I2	R06I2	R05I2	R04I2	R03I2	R02I2	R01I2
1st-	G033	SIND	SSIN	SGN		R12I	R11I	R10I	R09I
2nd-	G035	SIND2	SSIN2	SGN2		R12I2	R11I2	R10I2	R09I2

NOTE
*1 These signals are valid in multi-spindle control.

(d) Common to CNCs

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G070	G070	MRDYA		SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
2nd-	G074	G074	MRDYB		SFRB	SRVB	CTH1B	CTH2B	TLMHB	TLMLB
1st-	G071	G071				SOCNA			*ESPA	
2nd-	G075	G075				SOCNB			*ESPB	
1st-	G072	G072				OVRA				
2nd-	G076	G076				OVRB				

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(2) Output signals (CNC→PMC)

(a) Series 0*i*

	#7	#6	#5	#4	#3	#2	#1	#0
F001				ENB				
F007						SF		
F022	S07	S06	S05	S04	S03	S02	S01	S00
F023	S15	S14	S13	S12	S11	S10	S09	S08
F024	S23	S22	S21	S20	S19	S18	S17	S16
F025	S31	S30	S29	S28	S27	S26	S25	S24
F034						GR3O (*1)	GR2O (*1)	GR1O (*1)
F036	R08O	R07O	R06O	R05O	R04O	R03O	R02O	R01O
F037					R12O	R11O	R10O	R09O

NOTE
*1 These signals are valid with the M series only.

(b) Series 30*i*

	#7	#6	#5	#4	#3	#2	#1	#0
F001				ENB				
F007						SF		
F022	S07	S06	S05	S04	S03	S02	S01	S00
F023	S15	S14	S13	S12	S11	S10	S09	S08
F024	S23	S22	S21	S20	S19	S18	S17	S16
F025	S31	S30	S29	S28	S27	S26	S25	S24
F034						GR3O (*1)	GR2O (*1)	GR1O (*1)
F036	R08O	R07O	R06O	R05O	R04O	R03O	R02O	R01O
F037					R12O	R11O	R10O	R09O

NOTE
*1 These signals are valid with the M series only.

(c) Common to CNCs

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F045	F045		TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	
2nd-	F049	F049		TLMB	LDT2B	LDT1B	SARB	SDTB	SSTB	

2.1.5 Related Parameters

Parameter No.		Description
0*i*	30*i*	
3705#0	3705#0	Sets SF signal output and the S code for an S command.
3705#2	3705#2	Gear switch method (M series only)
3705#4	3705#4	Sets SF signal output and the S code for an S command (T series only).
3705#5	3705#5	Sets SF signal output when constant surface speed control is exercised and an S code is specified (M series only).
3705#6	3705#6	Sets SF signal output (M series only).
3706#4	3706#4	Spindle gear selection method (M series only)
3706#7,6	3706#7,6	Spindle speed command polarity (valid when input signal SSIN = 0)
3709#0	3709#0	Number of sampling operations at spindle speed calculation time
3735	3735	Minimum clamp speed of the spindle motor (M series only)
3736	3736	Maximum clamp speed of the spindle motor (M series only)

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Parameter No.		Description
0*i*	30*i*	
3740	3740	Time until the spindle speed arrival signal is checked
3741	3741	Maximum spindle speed for gear 1
3742	3742	Maximum spindle speed for gear 2
3743	3743	Maximum spindle speed for gear 3
3744	3744	Maximum spindle speed for gear 4 (T series only)
3751	3751	Spindle motor speed at the switch point between gear 1 and gear 2 (M series only)
3752	3752	Spindle motor speed at the switch point between gear 2 and gear 3 (M series only)
3772	3772	Maximum allowable spindle speed
3031	3031	Allowable number of S code characters
3720	3720	Number of position coder pulses
3721	3721	Number of gear teeth on the position coder side on velocity control (for feed per revolution, threading, etc.)
3722	3722	Number of gear teeth on the spindle side on velocity control (for feed per revolution, threading, etc.)
4006#5	4006#5	Sets an analog override range.
4009#4	4009#4	Whether to output the load detection signals (LDT1, LDT2) during acceleration/deceleration
4009#6	4009#6	Analog override type
4012#7	4012#7	Sets the spindle HRV function. (Set “1”.)
4019#7	4019#7	Automatic spindle parameter setting function
4352#1	4352#1	Sets the peak hold function for load meter output.
4020	4020	Maximum motor speed
4022	4022	Speed arrival detection level
4023	4023	Speed detection level
4024	4024	Speed zero detection level
4025	4025	Torque limitation value
4026	4026	Load detection level 1
4027	4027	Load detection level 2
4028[L]	4028[L]	Output limitation pattern (for high-speed/low-speed winding)
4028[H]	4028[H]	Output limitation pattern (for low-speed winding)
4029	4029	Output limitation value (for high-speed/low-speed winding)
4030	4030	Soft start/stop setting time
4040 4041	4040 4041	Velocity loop proportional gain on the velocity control mode (A parameter is selected by the PMC input signal CTH1A.)
4048 4049	4048 4049	Velocity loop integral gain on the velocity control mode (A parameter is selected by the PMC input signal CTH1A.)
4056 to 4059	4056 to 4059	Spindle and motor gear ratio data (A parameter is selected by the PMC input signals CTH1A and CTH2A.)
4081	4081	Delay time until the motor power is turned off
4082	4082	Acceleration/deceleration time
4083	4083	Motor voltage on the velocity control mode
4136	4136	Motor voltage on the velocity control mode (for low-speed characteristics)
4171 4173	4171 4173	Denominator of an arbitrary gear ratio between the motor sensor and spindle (A parameter is selected by the input signal CTH1A.)
4172 4174	4172 4174	Numerator of an arbitrary gear ratio between the motor sensor and spindle (A parameter is selected by the input signal CTH1A.)
4399#2	4399#2	Specifies whether to enable the soft start/stop function when emergency stop operation is performed.
4508	4508	Rate of change in acceleration at soft start/stop
4519	4519	Bell-shaped acceleration/deceleration time constant for soft start/stop
4626	4626	Output limitation value (for low-speed winding)

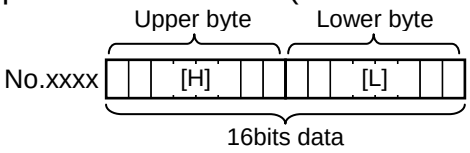
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NOTE

*1 For the detector-related parameters, see Section 1.3, “PARAMETERS RELATED TO DETECTORS”, in Part I.

*2 For velocity loop proportional/integral gain adjustment, see Section 4.1, “VELOCITY LOOP GAIN ADJUSTMENT”, in Part I.

*3 “[H]” and ”[L]” suffix of parameter number show the upper byte and lower byte of parameter No.xxxx. (See below figure)



Example:

Assume that

No.4028[L]：Output power limitation pattern(MAIN/High-speed) =3

No.4028[H]：Output power limitation pattern(MAIN/Low-speed) =5

The setting value of parameter No. 4028 becomes as follows:

No.4028 = 5×256+3 = 1283

2.1.6 Details of Related Parameters

This Subsection details the serial spindle parameters (in the four thousands) among the parameters related to the velocity control mode. For details of other parameters, refer to “SPINDLE SPEED CONTROL” of the CONNECTION MANUAL (FUNCTION) of each CNC.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4006	4006			ALGOVR					

ALGOVR Sets a spindle analog override range.

0 : 0 to 100% (Initial setting value)

1 : 0 to 120%

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4009	4009		OVRTYP		LDTOUT				

LDTOUT Whether to output the load detection signals (LDT1 and LDT2) during acceleration/deceleration

0 : Not output during acceleration/deceleration. (Initial setting value)

1 : Output (at all times) during acceleration/deceleration if the parameter-set level is exceeded.

OVRTYP Analog override type

0 : Override of linear function type (Initial setting value)

1 : Override of quadratic function type

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4012	4012	SPHRV							

SPHRV Sets the spindle HRV control function.

0 : Disables spindle HRV control.

1 : Enables spindle HRV control. (Initial setting value)

Set to “1”.

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NOTE
The control method usable with the αi series spindle is spindle HRV control only. The conventional control method is not supported.

0i	30i	#7	#6	#5	#4	#3	#2	#1	#0
4019	4019	PRLOAD							

PRLOAD Automatic parameter setting function
0 : Does not perform automatic parameter setting. (Initial setting value)
1 : Performs automatic parameter setting.
After setting a desired motor model code in parameter No. 4133 and setting this bit to 1, turn off the power to the CNC, then turn on the power to the CNC again. The parameters (No. 4000 to No. 4175) for the αi series spindle corresponding to the model code are automatically initialized. Upon completion of automatic setting, this bit is automatically set to 0.

0i	30i	#7	#6	#5	#4	#3	#2	#1	#0
4352	4352							PKHALW	

PKHALW Sets the peak hold function for load meter output.
0 : Does not use the peak hold function. (Initial setting value)
1 : Uses the peak hold function.

0i	30i	
4020	4020	Maximum motor speed

Unit of data : $1min^{-1}$ (Unit of 10 min^{-1} when bit 2 (SPDUNT) of parameter No. 4006 = 1)
Valid data range : 0 to 32767
Initial setting value : Depends on the motor model.
This parameter sets a maximum spindle motor speed.

⚠ WARNING
The spindle motor may rotate at the maximum spindle motor speed specified by this parameter. Therefore, this parameter must not be set to a value greater than the maximum rotation speed indicated by the specification of the spindle motor.

0i	30i	
4022	4022	Speed arrival detection level

Unit of data : 0.1%
Valid data range : 0 to 1000
Initial setting value : 150
This parameter sets a speed arrival signal (SARA) detection range.
When the motor speed reaches within ±(setting data/10)% of a specified speed, the speed arrival signal (SARA) is set to 1.

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0*i*	30*i*	
4023	4023	**Speed detection level**

Unit of data : 0.1%
Valid data range : 0 to 1000
Initial setting value : 30

This parameter sets a speed detection signal (SDTA) detection range.
When the motor speed is (setting data/10)% of a maximum speed or less, the speed detection signal (SDTA) is set to 1.

0*i*	30*i*	
4024	4024	**Speed zero detection level**

Unit of data : 0.01%
Valid data range : 0 to 10000
Initial setting value : 75

This parameter sets a speed zero detection signal (SSTA) detection range.
When the motor speed is (setting data/100)% of a maximum speed or less, the speed zero detection signal (SSTA) is set to 1.

0*i*	30*i*	
4025	4025	**Torque limitation value**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting value : 50

This parameter sets a torque limitation value to be applied when the torque limitation command HIGH (TLMHA) or the torque limitation command LOW (TLMLA) is specified.
The data indicates limitation values when the maximum torque is 100%.

Torque limitation command LOW(TLMLA)	Torque limitation command HIGH(TLMHA)	Description
0	0	No torque limitation is imposed.
0	1	The torque is limited to the value set in this parameter.
1	0	The torque is limited to a half of the value set in this parameter.
1	1	

0*i*	30*i*	
4026	4026	**Load detection level 1**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting value : 83

This parameter sets a load detection signal 1 (LDT1A) detection range.
When the output of the spindle motor is (setting data)% of the maximum output or more, load detection signal 1 (LDT1A) is set to 1.

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0*i*	30*i*	
4027	4027	**Load detection level 2**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting value : 95

This parameter sets a load detection signal 2 (LDT2A) detection range.
When the output of the spindle motor is (setting data)% of the maximum output or more, load detection signal 2 (LDT2A) is set to 1.

NOTE
By default, this signal is not output in 10 seconds (set in parameter No. 4082) after the status of the speed command signal changes so that Load detection signal cannot be output by load of acceleration and deceleration. If the default time (No.4082) is not suited with the real acceleration and deceleration time, please refer to explanation of the parameter No.4082 and modify the value.
If “1” is set to the parameter No.4009#4, Load detection signal is always output when load meter is beyond set level ,instead of the acceleration and deceleration.

0*i*	30*i*	
4028[L]	4028[L]	**Output limitation pattern (for high-speed/low-speed winding)**
4028[H]	4028[H]	**Output limitation pattern (for low-speed winding)**

Unit of data :
Valid data range : 0～9 (No.4028(L)), (0~9)×256 (No.4028(H))
Initial setting value : 0

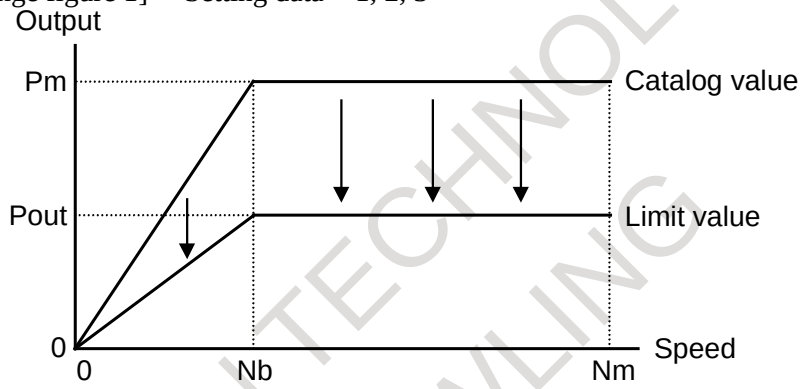
When low-speed winding parameter No. 4028(H) is set as 0, parameter No. 4028(L) is used as a setting for both high-speed winding and low-speed winding.
Select an appropriate pattern from the following:

A : Output is limited only at acceleration time and deceleration time for gradual acceleration/deceleration, and the rated output is used for steady-state rotation. (Setting data: 1, 4, or 7)
B : Maximum output is used at acceleration time and deceleration time, and output is limited in steady-state rotation. (Setting data: 2, 5, or 8)
C : Using the same motor and amplifier, a machine with a different output specification is produced. (Setting data: 3, 6, or 9)

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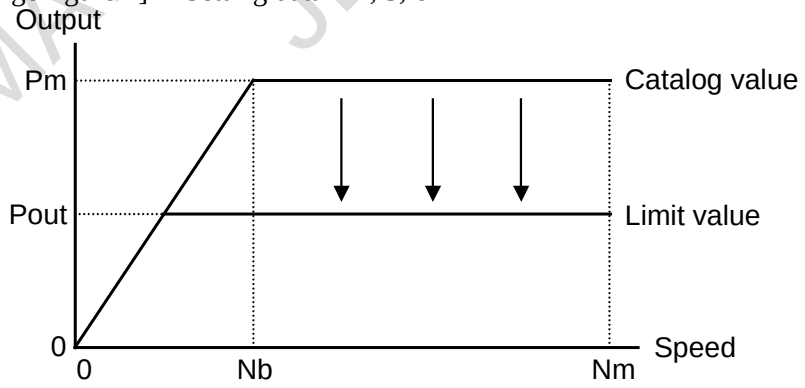
Description	Setting data		
	Output curve change figure 1	Output curve change figure 2	Output curve change figure 3
No output limitation is imposed.	0	0	0
A. Output is limited only at acceleration time and deceleration time for gradual acceleration/deceleration. The rated output is used for steady-state rotation.	1	4	7
B. Output is not limited at acceleration time and deceleration time, but output is limited in steady-state rotation.	2	5	8
C. Output is limited in all operations. (This pattern is used to implement a different output specification using the same motor and amplifier.)	3	6	9

[Output curve change figure 1]--- Setting data = 1, 2, 3 ---



$$Pout = \frac{\text{Setting in parameter No. 4029}}{100} \times Pm$$

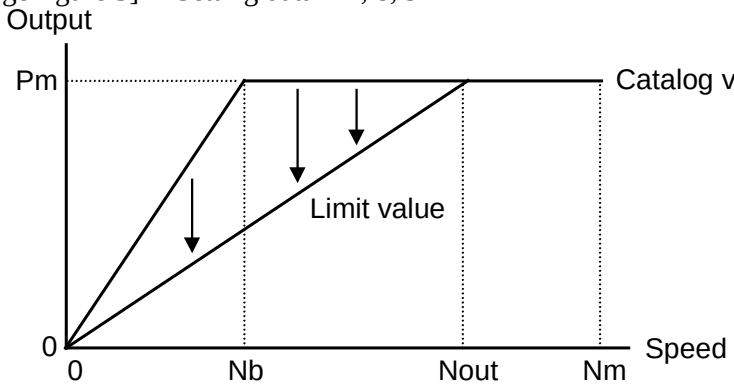
[Output curve change figure 2]--- Setting data = 4, 5, 6 ---



$$Pout = \frac{\text{Setting in parameter No. 4029}}{100} \times Pm$$

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[Output curve change figure 3]--- Setting data = 7, 8, 9 ---



$$Nout = \frac{100}{\text{Setting in parameter No. 4029}} \times Nb$$

NOTE
*1 Parameter No. 4028[H] is valid with 9D90 series P (16) edition or later, 9DA0 series S (19) edition or later and 9DB0 series A (01) edition or later.
*2 When output limitation by parameter No. 4028 is valid, the load meter indication value at maximum output time after limitation is the maximum value of the load meter (setting value of parameter No. 4127).
*3 This parameter is also valid in a mode other than the velocity control mode.

0*i*	30*i*	
4029	4029	**Output limitation value (for high-speed/low-speed winding)**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting value : 100

This parameter sets a desired limitation value, with the maximum output (overload tolerance) being 100%.
This setting becomes valid when output is limited by setting parameter No. 4028.

0*i*	30*i*	
4626	4626	**Output limitation value (for low-speed winding)**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting value : 0

When "0" is set in low-speed winding parameter No. 4626, the setting value of parameter No. 4029 is used. This parameter sets a desired limitation value, with the maximum output (overload tolerance) being 100%.
This setting becomes valid when output is limited by setting parameter No. 4028.

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NOTE

*1 Parameter No. 4626 is valid with 9D90 series P (16) edition or later, 9DA0 series S (19) edition or later and 9DB0 series A (01) edition or later.

*2 Set following parameters if you want to apply power limitation only in High-speed winding or in Low-speed winding.

In case of applying output power limitation only in High-speed winding

Output power limitation pattern (High-speed winding)	Output power limitation pattern (Low-speed winding)	Output power limitation value (High-speed winding)	Output power limitation value (Low-speed winding)
No.4028(L)	No.4028(H)	No.4029	No.4626
Arbitrary pattern	0	Arbitrary value	100

In case of applying output power limitation only in Low-speed winding

Output power limitation pattern (High-speed winding)	Output power limitation pattern (Low-speed winding)	Output power limitation value (High-speed winding)	Output power limitation value (Low-speed winding)
No.4028(L)	No.4028(H)	No.4029	No.4626
0	Arbitrary pattern	100	Arbitrary value

0*i*	30*i*	
4030	4030	**Soft start/stop setting time**

Unit of data : $1min^{-1}$/sec (Unit of $10min^{-1}$/sec when bit 2 (SPDUNT) of parameter No. 4006 = 1)
Valid data range : 0 to 32767
Initial setting value : 0

This parameter sets an acceleration value (speed change rate) when the soft start/stop function is enabled (when the soft start/stop signal SOCNA = 1).

NOTE
When 0 is set, the soft start/stop function is disabled.

0*i*	30*i*		
4040	4040	**Velocity loop proportional gain on velocity control mode (HIGH)**	**CTH1A=0**
4041	4041	**Velocity loop proportional gain on velocity control mode (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting value : 10

This data is used to set the velocity loop proportional gain on velocity control mode.
When the input signal CTH1A = 0, (HIGH) is selected. When the input signal CTH1A = 1, (LOW) is selected.

0*i*	30*i*		
4048	4048	**Velocity loop integral gain on velocity control mode (HIGH)**	**CTH1A=0**
4049	4049	**Velocity loop integral gain on velocity control mode (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting value : 10

This data is used to set the velocity loop integral gain on velocity control mode.
When the input signal CTH1A = 0, (HIGH) is selected. When the input signal CTH1A = 1, (LOW) is selected.

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0*i*	30*i*		
4056	4056	**Gear ratio (HIGH)**	**CTH1A=0, CTH2A=0**
4057	4057	**Gear ratio (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4058	4058	**Gear ratio (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4059	4059	**Gear ratio (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : (Motor rotation for one rotation of spindle) / 100
(When parameter No. 4006 #1 (GRUNIT) is 1, motor rotation / 1000)
(When parameter No. 4005#5 is 1, motor rotation / 10)
Valid data range : 0 to 32767
Initial setting value : 100

These data are used to set the gear ratio between spindle and spindle motor.
Example :

When the spindle rotates once, set “250” as the data when the motor rotates 2.5 times.

A parameter is selected with the CTH1A and CTH2A input signals.
Set the gear or clutch status to correspond to the clutch/gear signal (CTH1A, CTH2A).

NOTE
When an improper value is set in these parameters, an unexpected operation can occur. For example, the spindle can continue rotating without stopping at the time of orientation. So, be sure to set a proper gear ratio.

0*i*	30*i*	
4081	4081	**Delay time until the motor power is turned off**

Unit of data : 10ms
Valid data range : 0 to 1000
Initial setting value : 20 (200ms)

This parameter sets a period of time from the stop of the motor (detection of the speed zero detection signal SSTA set to 1) until the power to the motor is turned off if the SFR/SRV signal is off.

NOTE
When a small value is set in this parameter, the motor can coast after the power to the motor is turned off.

0*i*	30*i*	
4082	4082	**Setting of acceleration/deceleration time**

Unit of data : 1sec
Valid data range : 0 to 255
Initial setting value : 10

This parameter sets a period of time in which alarm detection is disabled by assuming that the spindle motor is being accelerated or decelerated even if the velocity error exceeds the velocity error excess alarm (spindle alarm 02) level after start of acceleration/deceleration on the velocity control mode.
In the velocity control mode, a step-by-step speed command is specified. So, the spindle motor cannot follow up the command immediately after start of acceleration/deceleration, and the velocity error exceeds the velocity error excess alarm level. This parameter is used to prevent the velocity error excess alarm (spindle alarm 02) from being detected incorrectly immediately after start of acceleration/deceleration.

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NOTE
With a machine tool such as a lathe that has a large load inertia, the acceleration/deceleration time becomes longer. In such a case, set the value corresponding to the acceleration/deceleration time of the machine in this parameter.

0*i*	30*i*	
4083	4083	**Motor voltage setting on velocity control mode**
4136	4136	**Motor voltage setting on velocity control mode (for low-speed characteristics)**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting value : Depends on the motor model.

This parameter sets the motor voltage under the no-load condition in velocity control mode.
The motor voltage to be set depends the motor model, the most usual setting is 30.
If an abrupt application of a heavy load in the no-load condition lowers the motor speed, adjust this parameter to around 50 to 70 to improve the torque response characteristic.
Note that, however, setting a large value causes heating and large activation sound during no-load motor operation.

The following problems may be removed by increasing the setting value.

(a) In low-speed and heavy-load cutting, the motor stops immediately after the start of cutting.
(b) At the start of hobbing or threading, the motor speed fluctuates, causing the thread precision to be degraded.

0*i*	30*i*	
4171	4171	**Denominator of an arbitrary gear ratio between the motor sensor and spindle (HIGH)CTH1A=0**
4172	4172	**Numerator of an arbitrary gear ratio between the motor sensor and spindle (HIGH) CTH1A=0**
4173	4173	**Denominator of an arbitrary gear ratio between the motor sensor and spindle (LOW)CTH1A=1**
4174	4174	**Numerator of an arbitrary gear ratio between the motor sensor and spindle (LOW) CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting value : 0

These parameters set conversion coefficients (numerator, denominator) for using the detection arbitrary gear ratio function (DMR function) by multiplying a motor sensor (α*i*M sensor) feedback signal by a gear ratio to produce a spindle position feedback signal.
When the spindle rotates Q times while the motor shaft rotates P times (there is no common divisor other than 1 for P and Q), the settings are:

No. 4171 (No. 4173 when CTH1A = 1) = P
No. 4172 (No. 4173 when CTH1A = 1) = Q

When 0 is set in any of these parameters, the setting of 1 is assumed.

NOTE
*1 When performing feed per revolution with the detection arbitrary gear ratio function (DMR function), set an arbitrary gear ratio between the motor sensor and spindle in this parameter.
*2 Threading using the detection arbitrary gear ratio function (DMR function) is not supported.

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0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4399	4399						SOSALW		

SOSALW When the motor rotation operation is quitted *),
0: the acc./dec. by soft start/stop is not executed. (Initial setting)
1: the acc./dec. by soft start/stop is executed.

When this bit is 1 and the acceleration setting for soft start/stop is valid (parameter No. 4030 ≠ 0 and SOCNA = 1), deceleration is performed at the acceleration for soft start/stop (parameter No. 4030) if the motor rotation operation is quitted by an emergency stop or the like.

*) "Quitting the motor rotation operation" refers to any of the following operations:
- Input of emergency stop signal
- Input of external reset signal
- Input of reset and rewind signal
- In put of reset signal from MDI
- Release of axis selection signal

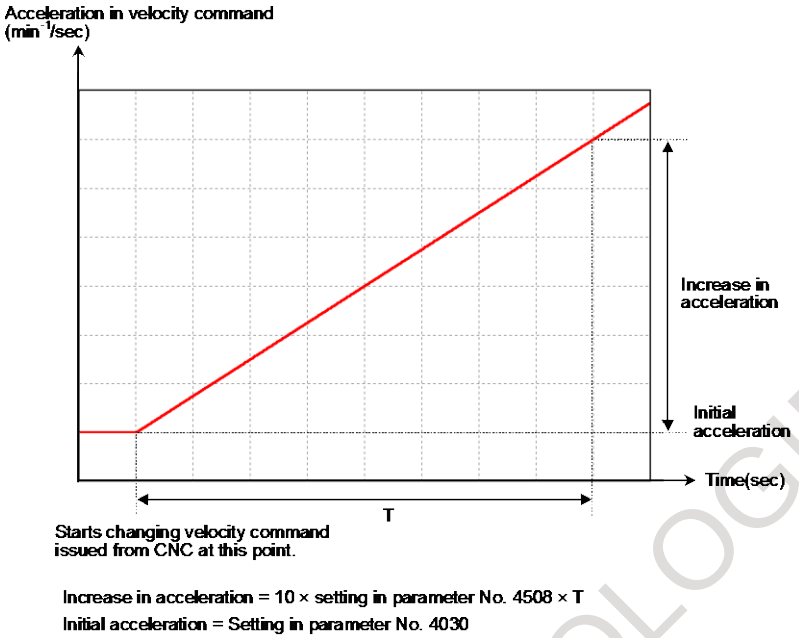
NOTE
*1 This parameter is valid with 9D50 series O (15) edition or later, 9D70 series F (06) edition or later, 9D80 series A (01) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later and 9DB0 series A (01) edition or later.
*2 Quitting a reference position return operation for Cs contouring control or rigid tapping is supported in 9D5A series J (10) edition or later, 9D53 series W (23) edition or later, 9D70 series X (24) edition or later, 9D80 series U (21) edition or later, 9D90 series F (06) edition or later, 9DA0 series I (09) edition or later and 9DB0 series A (01) edition or later.

0*i*	30*i*	
4508	4508	**Rate of change in acceleration at soft start/stop**

Unit of data : $10min^{-1}/sec^2$
Valid data range : 0 to 32767
Initial setting value : 0

This parameter sets the jerk (the rate of change in acceleration) when the soft start/stop function is enabled (soft start/stop signal SOCNA = 1).

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Increase in acceleration = 10 × setting in parameter No. 4508 × T
Initial acceleration = Setting in parameter No. 4030

NOTE
*1 This parameter is valid with 9D50 series G (07) edition or later, 9D70 series A (01) edition or later, 9D80 series A (01) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later and 9DB0 series A (01) edition or later.
*2 If 0 is set, a liner type velocity command is observed when the soft start/stop function is enabled.

0*i*	30*i*	
4519	4519	**Bell-shaped acceleration/deceleration time constant for soft start/stop**

Unit of data : 1msec
Valid data range : 0 to 512
Initial setting value : 0

This parameter sets the bell-shaped acceleration/deceleration time constant when the soft start/stop function is used (parameter No. 4030 ≠ 0, SOCN = 1).

This parameter can be set to enable bell-shaped acceleration/deceleration for soft start/stop.

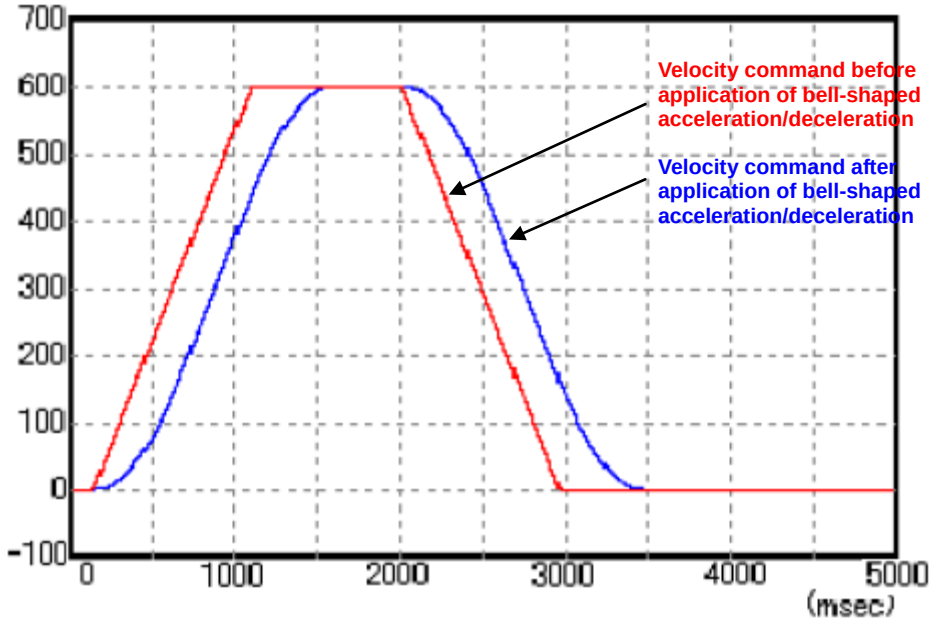
This parameter is useful for reducing a shock at the start or end of acceleration/deceleration in the velocity control mode.

If a specified value exceeds the valid data range, the value is clamped to 512.

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■Application example

Parameter No. 4030 = 600 (min^{-1}/sec), parameter No. 4519 = 512



NOTE

*1 This parameter is valid with 9D50 series O (15) edition or later, 9D53 series G (07) edition or later, 9D70 series F (06) edition or later, 9D80 series A (01) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later and 9DB0 series A (01) edition or later.

*2 If 0 is set, a linear type velocity command is observed when the soft start/stop function is enabled.

2.1.7 Troubleshooting

If the spindle motor does not operate normally, take an action by referencing the items listed below according to the state of trouble.
For an action to be taken when an alarm is issued, refer to the MAINTENANCE MANUAL.

	State of trouble
(i)	When the motor does not rotate
(ii)	When the motor does not rotate at a specified speed
(iii)	When the motor vibrates and makes an abnormal sound when rotating
(iv)	When an overshoot or hunting occurs
(v)	When the cutting capability is degraded
(vi)	When the acceleration/deceleration time is long

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(i) When the motor does not rotate

(1) Check the connections. (Refer to Descriptions.)
  (a) Motor power line phase order
  (b) Feedback signal cable connection
  (c) DC link connection between the common power supply (PS) and spindle amplifier

(2) Check the parameter settings.
  (a) Parameter data for each motor model
  (b) Detector-related parameter data (Refer to Subsection 1.3.2, "Details of Parameters for Detectors", in Part I)
  (c) Setting of a maximum motor speed

0*i*-	30*i*	Description
4020	4020	Maximum motor speed

  (d) For parameters related to spindle velocity command, refer to "SPINDLE SPEED CONTROL" of the CONNECTION MANUAL (FUNCTION) of each CNC.

(3) Check the input signals.
  (a) Input signals for spindle control (PMC→CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G070	G070	MRDYA		SFRA	SRVA				
2nd-	G074	G074	MRDYB		SFRB	SRVB				
1st-	G071	G071							*ESPA	
2nd-	G075	G075							*ESPB	

(4) Check the feedback signal.
  (a) Feedback signal level (Refer to Maintenance Manual.)
  (b) Shielding and grounding (Refer to Descriptions.)

(ii) When the motor does not rotate at a specified speed

(1) Check the connections. (Refer to Descriptions.)
  (a) Motor power line connection
  (b) Feedback signal cable connection point

(2) Check the parameter settings.
  (a) Parameter data for each motor model
  (b) Detector-related parameter data (Refer to Subsection 1.3.2, "Details of Parameters for Detectors", in Part I)
  (c) Setting of a maximum motor speed

0*i*	30*i*	Description
4020	4020	Maximum motor speed

  (d) For parameters related to spindle velocity command, refer to "SPINDLE SPEED CONTROL" of the CONNECTION MANUAL (FUNCTION) of each CNC.

(3) Check the feedback signal.
  (a) Feedback signal level (Refer to Maintenance Manual.)
  (b) Shielding and grounding (Refer to Descriptions.)

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(iii) When the motor vibrates and makes an abnormal sound when rotating

(1) Check the feedback signal.
  (a) Feedback signal level (Refer to Maintenance Manual.)
  (b) Shielding and grounding (Refer to Descriptions.)

(2) Check the parameter settings.
The velocity loop gain may be too large. Adjust the following parameters:

0*i*	30*i*	Description	Setting data
4040	4040	Velocity loop proportional gain (HIGH)	Decrease the setting values.
4041	4041	Velocity loop proportional gain (LOW)	
4048	4048	Velocity loop integral gain (HIGH)	
4049	4049	Velocity loop integral gain (LOW)	

(3) Make a comparison with the case of motor coasting.
If vibration and sound produced when the motor coasts are extremely smaller than those produced when the motor is driven, the control circuit is faulty. If sound produced remains unchanged, the motor or the machine may be faulty. If the feedback signal cable from the motor is disconnected during motor rotation, an alarm is issued, and the motor coasts. Before performing the coasting of the motor, consult with the machine tool builder for confirmation. Depending on the sequence, the brake may be applied.

(iv) When an overshoot or hunting occurs

(1) Check the parameter settings.
  (a) The velocity loop gain may be too large. Adjust the following parameters:

0*i*	30*i*	Description	Setting data
4040	4040	Velocity loop proportional gain (HIGH)	Decrease the setting values.
4041	4041	Velocity loop proportional gain (LOW)	
4048	4048	Velocity loop integral gain (HIGH)	
4049	4049	Velocity loop integral gain (LOW)	

(v) When the cutting capability is degraded

(1) Check the parameter settings.
  (a) Parameter data for each motor model
  (b) Output limitation pattern and output limitation value

0*i*	30*i*	Description
4028	4028	Output limitation pattern
4029	4029	Output limitation value

(2) Check the input signals.
  (a) Torque limitation commands (TLMH, TLML)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G070	G070							TLMHA	TLMLA
2nd-	G074	G074							TLMHB	TLMLB

(3) Check the machine.
  (a) Belt tension, and so forth

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(vi) When the acceleration/deceleration time is long

(1) Check the parameter settings.
  (a) Parameter data for each motor model
  (b) Output limitation pattern and output limitation value

0*i*	30*i*	Description
4028	4028	Output limitation pattern
4029	4029	Output limitation value

  (c) Regenerative power limitation (Check if the same value as in the parameter table for each motor model is set.)

0*i*	30*i*	Description
4080	4080	Regenerative power limitation
4166	4166	Regenerative power limitation (for low-speed characteristics)

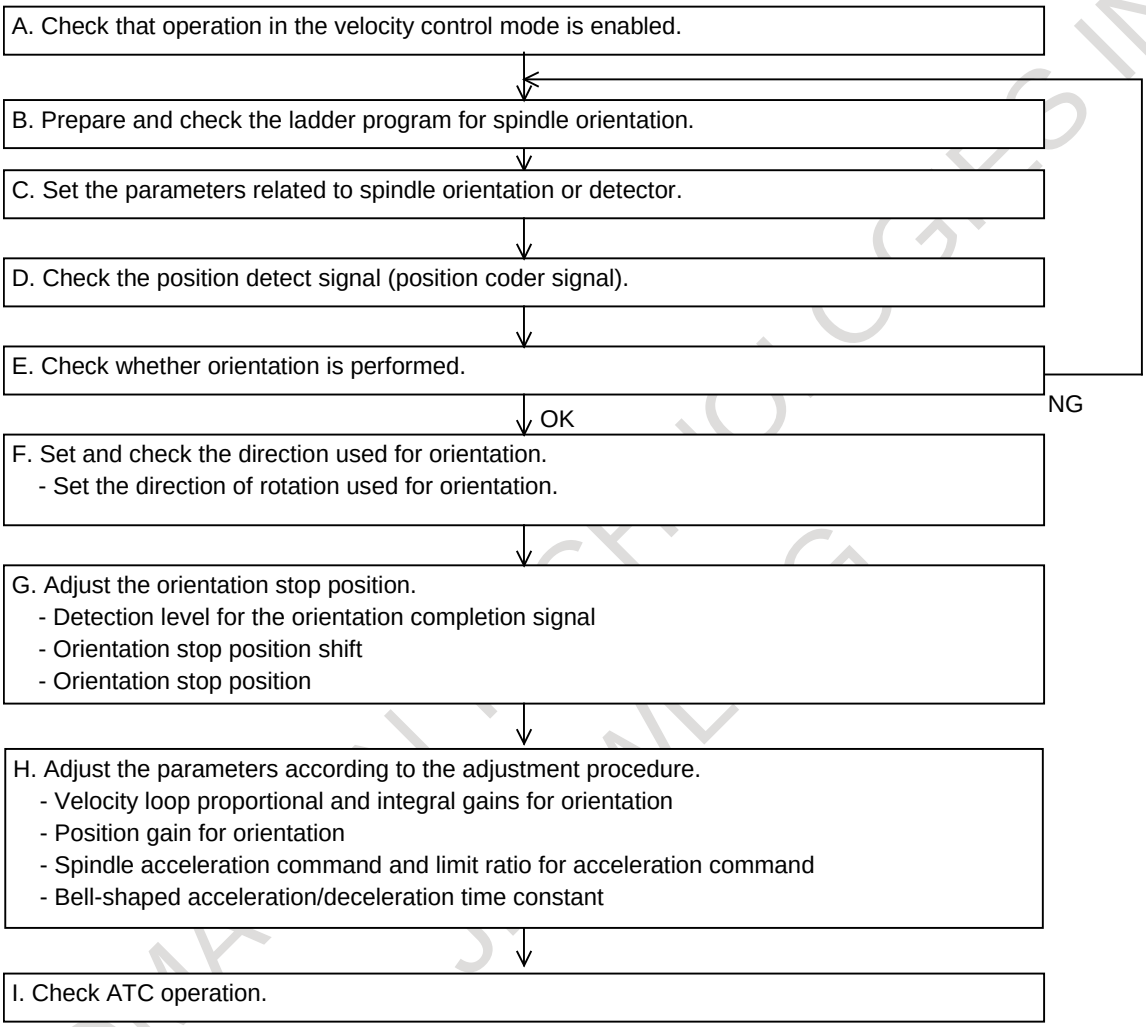
(2) Check the input signals.
  (a) Torque limitation commands (TLMH, TLML)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G070	G070							TLMHA	TLMLA
2nd-	G074	G074							TLMHB	TLMLB

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2.2 POSITION CODER METHOD SPINDLE ORIENTATION (OPTIMUM ORIENTATION)(OPTIONAL FUNCTION)

2.2.1 Start-up Procedure



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2.2.2 Overview

Unlike a function for stopping the spindle at a predetermined position mechanically, for example, by using a stopper, the spindle orientation function stops the spindle at a predetermined position by directly reading the position feedback signal from a position detector attached to the spindle of the machine.

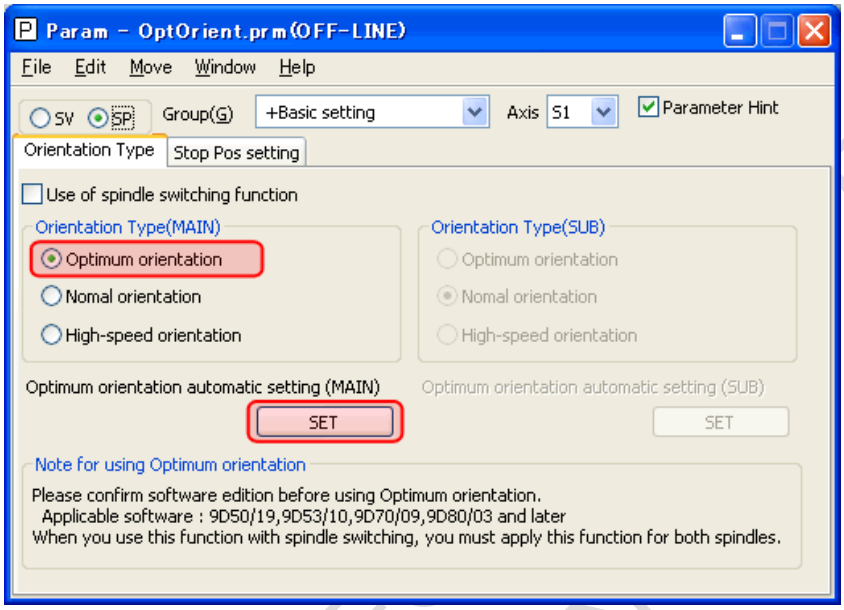
Furthermore, by applying the optimum orientation function, the spindle acceleration command is automatically optimized. This is expected to reduce the positioning time required by conventional method orientation. It is, therefore, recommended to apply the optimum orientation function.

NOTE
*1 To use this function, the CNC software option is required.
*2 For an explanation of the changes that must be made to parameters to migrate from conventional method orientation to optimum orientation, see Subsection 2.2.3, "Migration from Conventional Method Orientation to Optimum Orientation", in Part I.
*3 Optimum orientation function can be used with 9D50 series S (19) edition, 9D70 series I (09) edition, 9D80 series C (03) edition, 9D90 series A (01) edition, 9DA0 series A (01) edition or later and 9DB0 series A (01) edition or later.
*4 For an explanation of conventional method orientation, see Section 5.4, "CONVENTIONAL METHOD ORIENTATION", in Part I.
*5 If using the output switching function together, do not change the motor winding during spindle orientation (input signal: ORCMA = 1).
*6 If using the spindle switching function together, use this function on both MAIN and SUB sides.
*7 For high resolution of stop position, refer to “SPINDLE ORIENTATION” of the CONNECTION MANUAL (FUNCTION) of each CNC.

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2.2.3 Transition from Conventional Method Orientation to Optimum Orientation

Open the parameter window of the SERVO GUIDE, and select **"SP"-"Orientation"-"Basic setting"-"Orientation Type"**. For Orientation Type, select "Optimum orientation" and click the automatic setting button.



NOTE
*1 Usually, this operation alone successfully performs the migration. If adjustment is necessary, see Subsection 2.2.13, "Tuning Procedure".
*2 When the external one-rotation signal (proximity switch) is used, select **"SP"-"Orientation"-"Optimum orientation"** and set the one-rotation signal detection speed (50 to 100 min^{-1}) according to the sensor specifications. However, if problems not occur such as instability stop position by increasing the orientation speed, you can use the value higher than 100 min^{-1}.
*3 If setting parameters from the "SYSTEM>parameter screen" of the CNC, see Subsection 2.2.13, "Tuning Procedure".
*4 Optimum orientation parameter setting using the parameter window can be used with the SERVO GUIDE Ver5.00 or later.

2.2.4 Feature

(1) Elimination of a mechanical section used for stopping at a predetermined position
Only a position detector needs to be connected to the spindle. A mechanical section (such as a stopper and pin) used to mechanically stop the spindle at a predetermined position for spindle orientation is unnecessary.

(2) Reduction in orientation time
A spindle motor attached to the spindle is used. So, orientation is enabled directly at high speed, independently of gear shifting, thus resulting in a remarkable reduction in orientation time.
Furthermore, by applying the optimum orientation function, the spindle acceleration command is automatically optimized, which can reduce the positioning time required by conventional method orientation.

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(3) Simplified power magnetic sequence
The required sequence consists of only a command for stopping at a predetermined position, completion signal, and clutch/gear signal. No other signals are required. Sequences for an orientation speed command and torque limitation command are unnecessary.

(4) Reliability
This function is based on a purely electric method. So, an external shock does not damage the mechanical section, thus improving reliability.

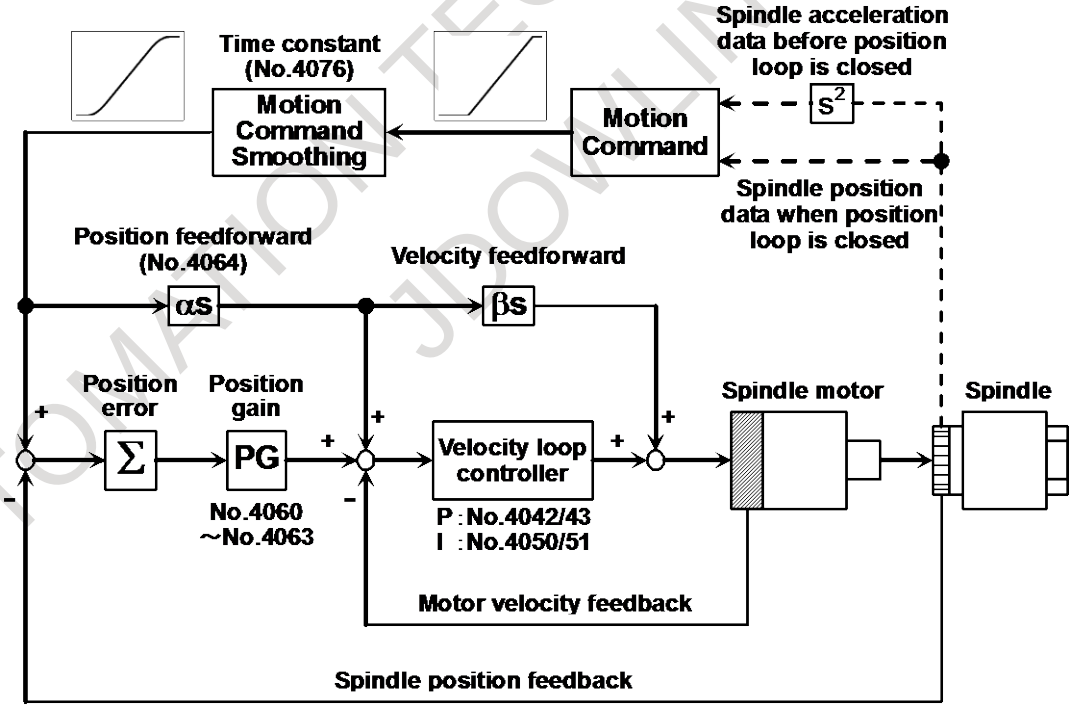
(5) High precision and high rigidity
The precision and rigidity of the spindle stopping at a predetermined position are sufficiently high for tool change operation (ATC).

(6) Workpiece positioning
On a lathe, a workpiece can be positioned to align the workpiece attachment/detachment direction.

(7) Reduction in the number of processes in boring
When a boring process ends, the workpiece can be positioned in the same direction as the direction of spindle rotation. So, the workpiece is not damaged by the tool tip.
Moreover, the tool tip can be attached or detached in a constant direction relative to the workpiece, so that a program can be created easily.

2.2.5 Block Diagram

A block diagram of optimum orientation is shown below.
The spindle amplifier detects the spindle acceleration after spindle orientation is specified by the time position loop is closed. The spindle acceleration command (= the slope of motion command) is automatically optimized based on this detected value.

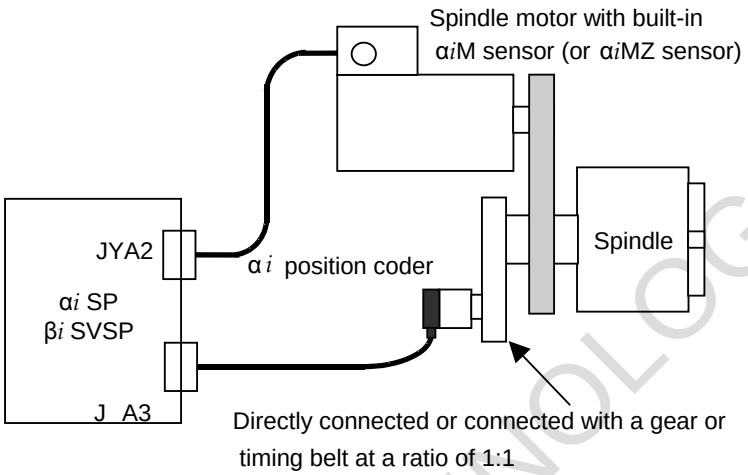


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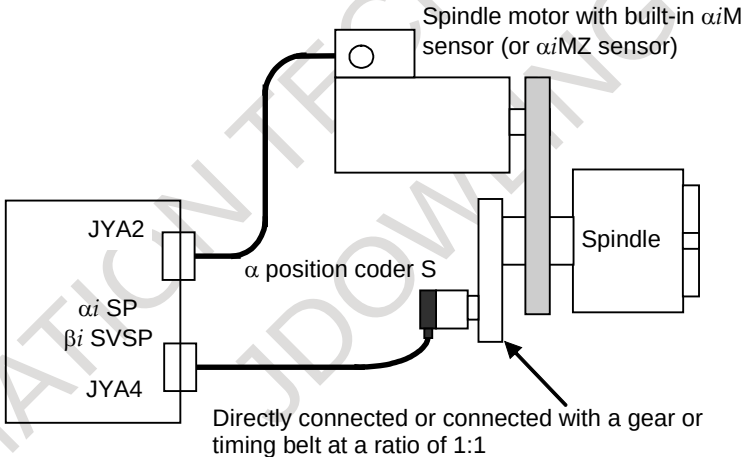
2.2.6 System Configuration

The system configurations that enable the use of the position coder method orientation (optimum orientation) function are shown below.

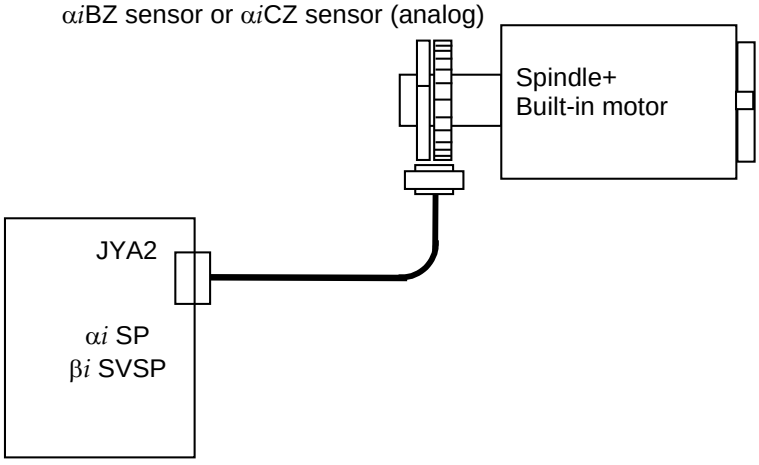
(1) When the αi position coder is used



(2) When the α position coder S is used

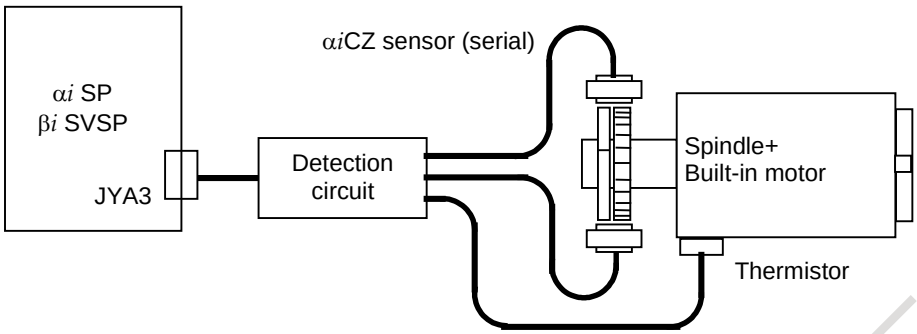


(3) When the built-in motor (αiBZ sensor, αiCZ sensor (analog)) is used

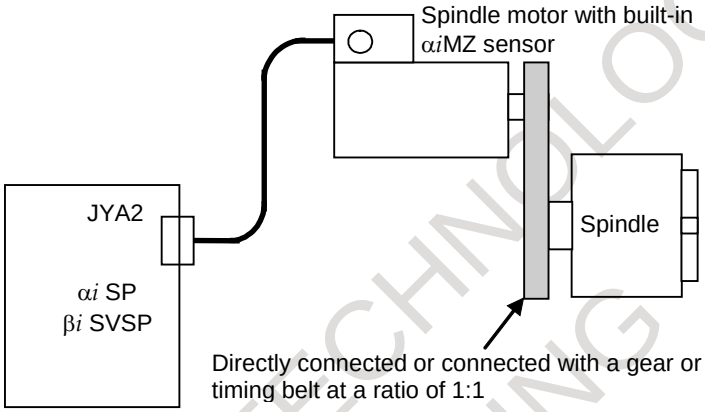


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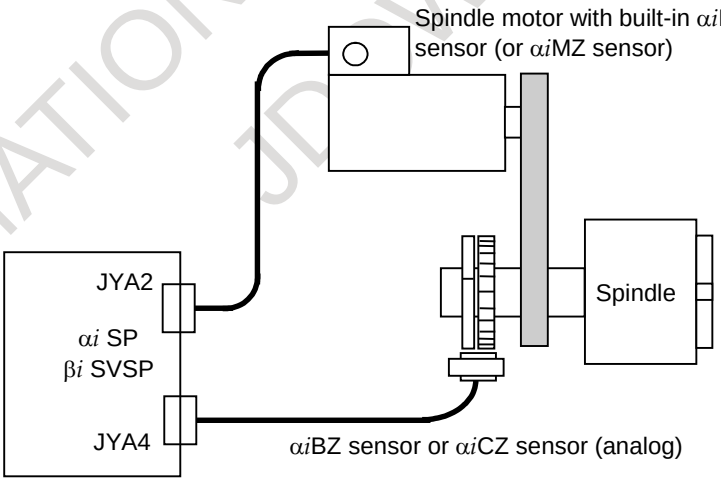
(4) When the built-in motor (α*i*CZ sensor (serial)) is used



(5) When the spindle motor with built-in α*i*MZ sensor is used

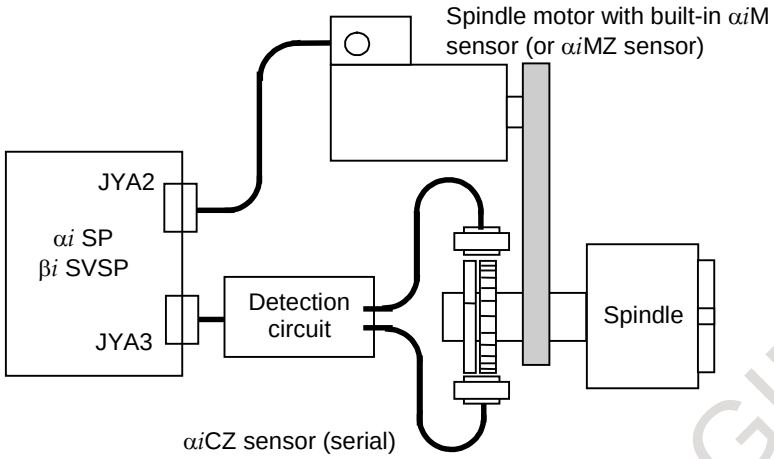


(6) When the separate type α*i*BZ sensor or the separate type α*i*CZ sensor (analog) is used

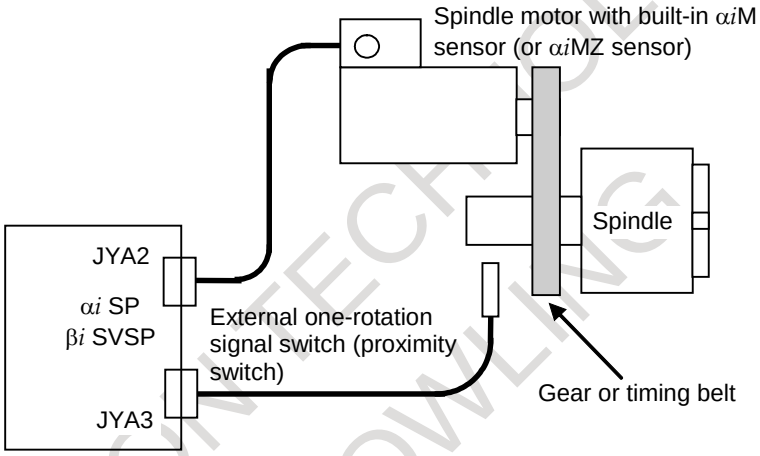


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(7) When the separate type αiCZ sensor (serial) is used



(8) When the external one-rotation signal (proximity switch) is used



NOTE

*1 To detect the one-rotation signal securely, fix the direction (bits 3 and 2 of parameter No. 4003) in which the spindle rotates during spindle orientation to one direction.

*2 Specify the type (bits 3 and 2 of parameter No. 4004) of an external one-rotation signal (proximity switch).

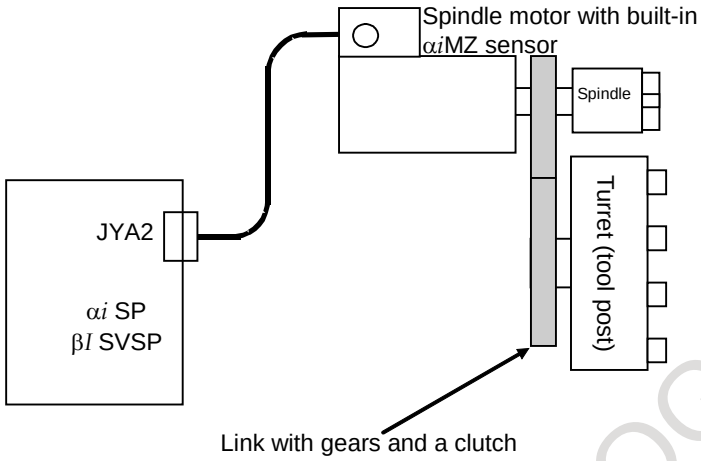
*3 To detect the one-rotation signal securely, set the spindle orientation speed (parameter No. 4038) to a value between 50 and 100 min^{-1} according to the specification of the external one-rotation signal (proximity switch).
However, if problems not occur such as instability stop position by increasing the orientation speed, you can use the value higher than 100min^{-1}.

*4 A sequence for detecting the one-rotation signal is started after the orientation speed has been reached.

*5 Specify the denominator/numerator parameters (Nos. 4171 to 4174) of an arbitrary gear ratio between the motor sensor and spindle.

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(9) System in which the turret and the motor with a built-in αiMZ sensor are linked with gears and a clutch (for turret indexing)



2.2.7 Stop Position Specification Method

Stop position specification method	Description
Parameter-based specification	Set the number of pulses (±4095 pulses) from the one-rotation signal to a stop position (360° = 4096 pulses).
External setting for stop position specification	Specify the number of pulses (0 to 4095 pulses) from the one-rotation signal to a stop position with a PMC signal (360° = 4096 pulses). The sum of the number of pulses set in the parameter and the number of pulses specified with a PMC signal represents a final stop position.

2.2.8 I/O Signals (CNC↔PMC)

(1) Address list of input signals (PMC→CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st SP	G070	G070		ORCMA			CTH1A	CTH2A		
2nd SP	G074	G074		ORCMB			CTH1B	CTH2B		
1st SP	G072	G072						NRROA	ROTAA	INDXA
2nd SP	G076	G076						NRROB	ROTAB	INDXB
1st SP	G078	G078	SHA07	SHA06	SHA05	SHA04	SHA03	SHA02	SHA01	SHA00
2nd SP	G080	G080	SHB07	SHB06	SHB05	SHB04	SHB03	SHB02	SHB01	SHB00
1st SP	G079	G079					SHA11	SHA10	SHA09	SHA08
2nd SP	G081	G081					SHB11	SHB10	SHB09	SHB08

(2) Details of input signals (PMC→CNC)

(a) Orientation command (ORCMA)

(i) This signal is used to stop the spindle at a predetermined position in order to change the tool or attach or detach a workpiece.

(ii) If this signal is set to 1, the spindle, when rotating, is immediately decelerated to stop at a predetermined position.

(iii) If an orientation command is issued for safety, set the forward/reverse spindle rotation command (SFRA/SRVA) and the speed command to 0. With these settings, the spindle does not start rotation even if ORCMA is set to 0 during tool change operation.

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(iv) Set this signal to 0 with the tool change completion signal or the workpiece attachment/detachment completion signal.
(v) At power-on time, be sure to set the orientation command signal to 0.
(vi) If an alarm is issued or an emergency stop operation is performed during orientation, ensure that the orientation command signal is reset (to 0). At power-on time, return the ATC arm to a safe position so that the arm and associated equipment are not damaged when the spindle and tool rotate.

⚠ CAUTION
Do not change status of following signals during spindle orientation command is active (i.e. ORCMA=1)
CTH1A, CTH2A: Clutch / gear signals
RSLA: Output switching request signal

(b) Clutch/gear signals (CTH1A, CTH2A)

(i) These signals are used to select spindle control parameters (position gain, gear ratio, and velocity loop gain) when there are two or more gear change stages between the spindle and spindle motor.
(ii) Make settings as indicated in the table below according to the state of the clutch or gear. The names such as HIGH GEAR are given for convenience, and the correspondence to the actual gears is free.

CTH1A	CTH2A	
0	0	HIGH GEAR
0	1	MEDIUM HIGH GEAR
1	0	MEDIUM LOW GEAR
1	1	LOW GEAR

⚠ CAUTION
Do not change status of following signals during spindle orientation command is active (i.e. ORCMA=1)
CTH1A, CTH2A: Clutch / gear signals

(c) Spindle orientation stop position change command (INDXA)

(i) This signal is used to change to another orientation position after a spindle orientation operation is performed by stop position external setting type orientation.
This signal is valid when the spindle orientation command (ORCMA) = 1.
(ii) When this signal makes a transition from 1 to 0, the spindle is oriented to the position (arbitrary position in one rotation: absolute position command) specified by new stop position data (SHA11 to 00) within one rotation.
(iii) The direction of orientation rotation is specified by the shortcut command (NRROA) and the rotation direction command (ROTAA).
(iv) This function is valid when the CNC parameter for the stop position external setting type orientation function is set.

(d) Spindle orientation stop position change shortcut command (NRROA)

(i) This signal is used for shortcut (within ±180 degrees) positioning at the next stop position when a rotation direction is specified to change the orientation position after a spindle orientation operation.
(ii) When this signal is set to 1, shortcut positioning is performed, regardless of the spindle orientation stop position change rotation direction command (ROTAA).

(e) Spindle orientation stop position change rotation direction command (ROTAA)

(i) This signal is used to specify a rotation direction when the orientation position is successively changed to another orientation position after a spindle orientation operation.
When this signal is set to 0, the spindle rotates CCW and stops.
When this signal is set to 1, the spindle rotates CW and stops.

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(ii) This signal is valid when the spindle orientation stop position change shortcut command (NRROA) is set to 0.

(f) Spindle orientation external stop position command (SHA11 to SHA00)

(i) With the stop position external setting type spindle orientation function, a stop position is set. A stop position is determined by the expression indicated below. This command specifies an absolute position during one rotation.

$$\text{Stop position (degrees)} = \frac{360}{4096} \times \sum_{i=0}^{11} (2^i \times Pi)$$

Pi = 0 when SHAi = 0. Pi = 1 when SHAi = 1.

(ii) When the stop position external setting type spindle orientation function is used, the position coder method spindle orientation stop position setting parameter (No. 4031) is invalid.

(3) Address list of output signals (CNC→PMC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st SP	F045	F045	**ORARA**							
2nd SP	F049	F049	**ORARB**							

(4) Details of output signals (CNC→PMC)

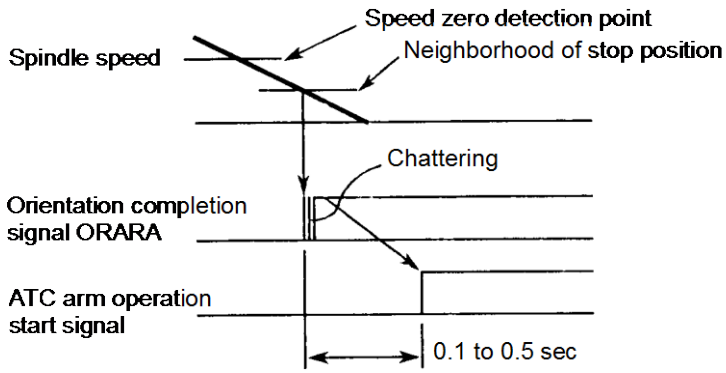
(a) Spindle orientation completion signal (ORARA)

(i) This signal is set to 1 when the spindle stops in the neighborhood of a predetermined position (±1°, for example) after an orientation command is input.
ORARA is set to 1 when the following three conditions are satisfied:
- ORCMA="1"
- SSTA(speed zero detection signal)="1"
- The spindle is in the neighborhood of a predetermined position.

The condition for the neighborhood of a predetermined position is set using parameter No. 4075 (orientation completion signal detection level). Only when all of the three conditions are satisfied, the orientation completion signal is output. Such a state that the orientation completion signal is not output when a certain time has elapsed after the input of an orientation command is abnormal. In this case, issue an orientation alarm by detecting this state with a power magnetic sequence.

(ii) When this signal is set to 1, start a tool change operation and workpiece attachment/detachment operation.

(iii) The orientation completion signal is output when the spindle is in the neighborhood of a predetermined position. This means that this signal does not represent a complete stop signal. With some machines, the operation time for the arm to grasp the tool of the spindle may be short. In this case, insert a time (0.1 to 0.5 second) before operating the arm for ATC so that the arm grasps the tool when the spindle has stopped completely.



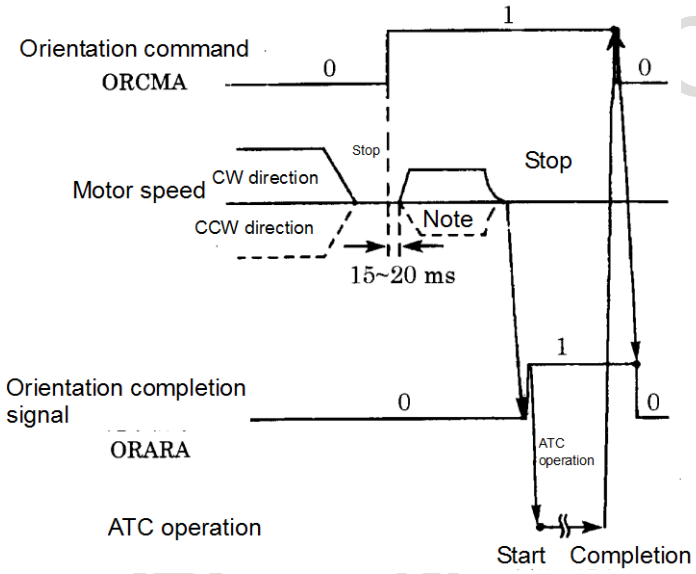
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(iv) This signal is set to 0, for example, when the spindle is moved out of the neighborhood of a predetermined stop position as in a case where an external force is applied. In this case, use a sequence that stops tool change operation. However, do not cancel the orientation command, but execute a tool change operation after the orientation completion signal is set to 1 again.

(v) If the ATC of the machine has a structure that can cause a serious accident such as destruction due to a circuit failure, create a signal for indicating an automatic tool change enable area by using a proximity switch to make a double safety check with a power magnetic sequence before changing the tool.

2.2.9 Examples of Sequences

Orientation command at stop time

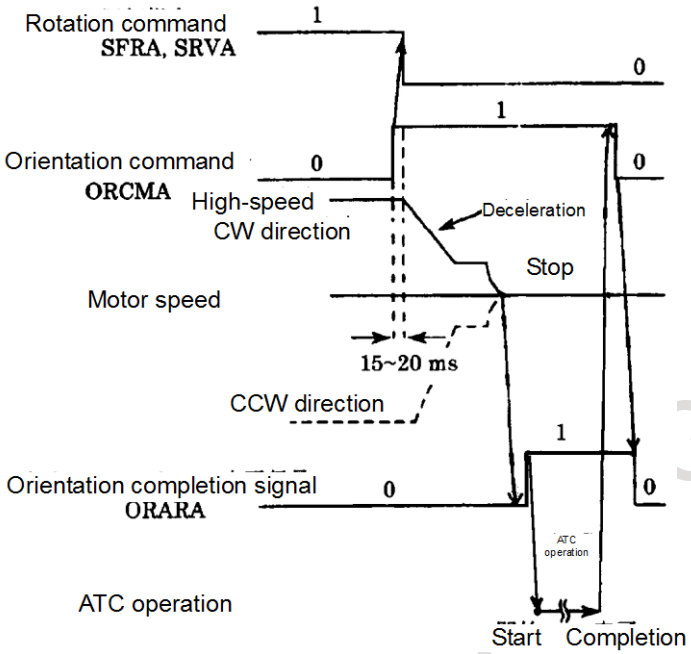


NOTE

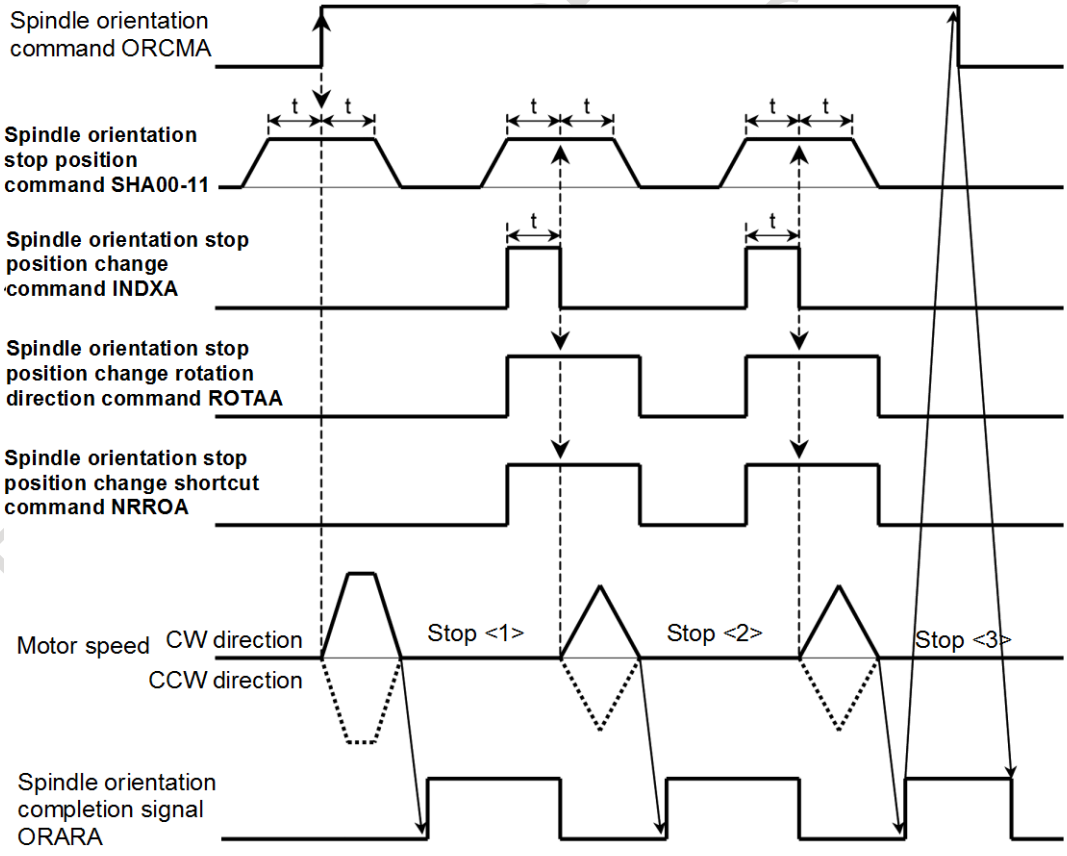
The rotation direction of the spindle motor can be selected by parameter settings. With the initial settings, the spindle rotates in the direction specified before the orientation command signal is issued and then it stops at a predetermined position.

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Orientation command during high-speed rotation



Stop position external setting type spindle orientation



Note) Set t = 50 msec or more.

Stop <1>

- Predetermined stop position based on the normal orientation command
- The rotation direction of the spindle motor is determined by parameter setting.
- After the power is turned on, the spindle rotates at the orientation speed and seizes the one-rotation signal before stopping at a predetermined position for the first time. After the first stop, the spindle stops at a predetermined position within one rotation.
- When the stop position external setting type spindle orientation function is used, the spindle stops at a predetermined position after shifting by the stop position data read on the rising edge of the spindle orientation command signal if the data of the spindle orientation stop position command SHA00-SHA11 is set after the first stop.

Stop <2>, <3>

- Predetermined stop positions based on the stop position external setting type spindle orientation function
- The rotation direction of the spindle motor depends on the spindle orientation stop position change rotation direction command (ROTAA) and the spindle orientation stop position change shortcut command (NRROA).

NOTE

*1 The spindle orientation stop position change command INDXA is valid only when the spindle orientation command ORCMA is set to 1.

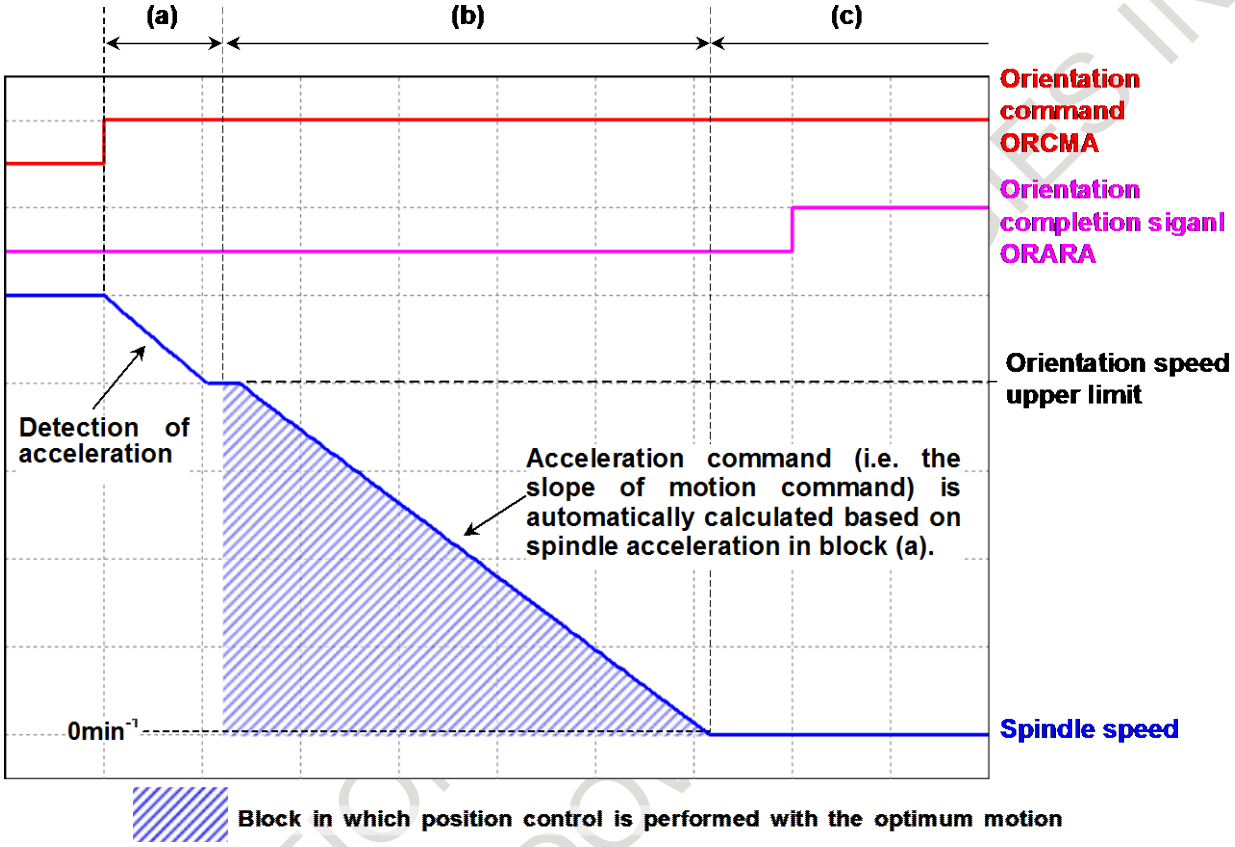
*2 The spindle does not stop at a correct position unless the orientation command ORCM or the stop position change command INDX is issued when the stop position command SHA00-11 is set.

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2.2.10 Explanation of Operation

This subsection describes the operation of optimum orientation.

(1) Starting spindle orientation when the spindle is rotating at or faster than the orientation speed upper limit



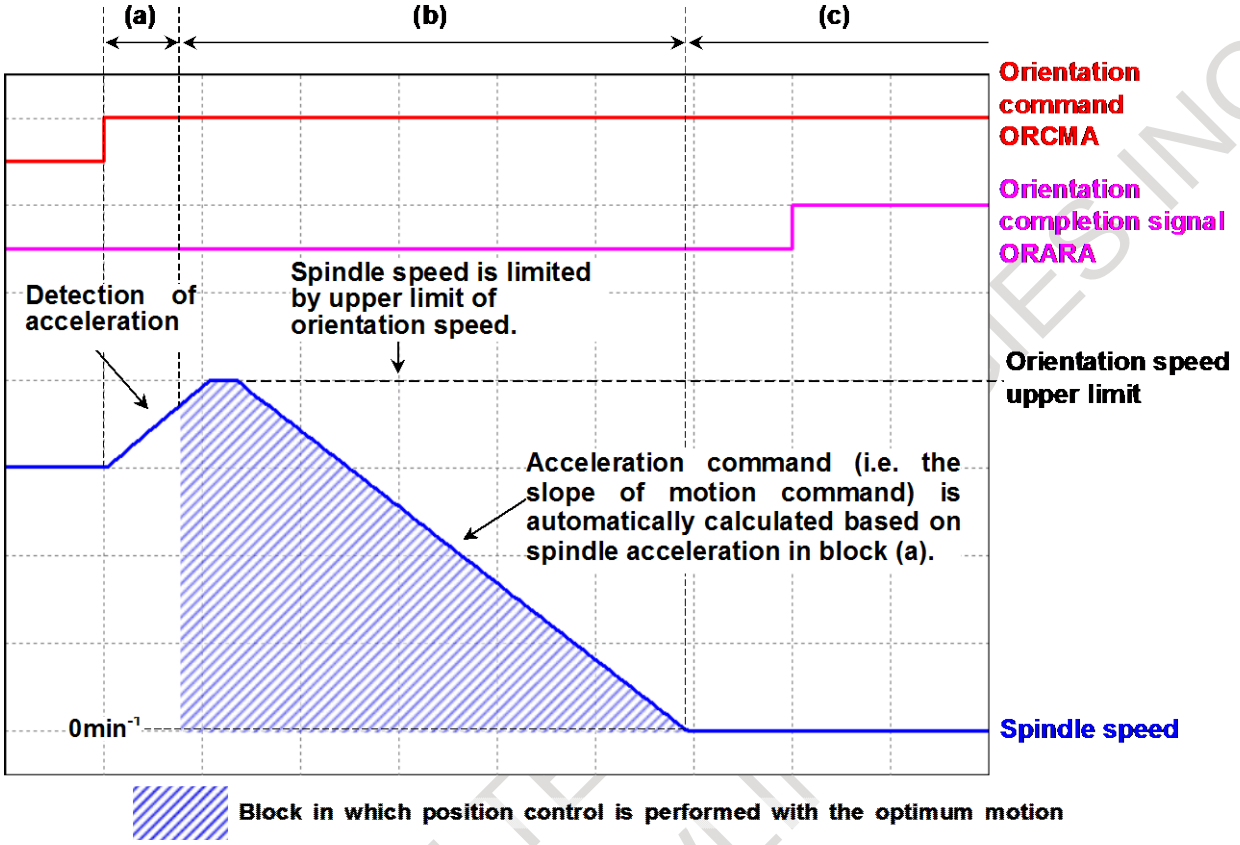
(a) Spindle amplifier decelerates spindle to the speed specified in parameter No. 4038 (upper limit of orientation speed) and detects spindle acceleration. The one-rotation signal is also detected in case of the first-time orientation after power-on.

(b) Optimum motion command based on spindle acceleration detected in block (a) is calculated and spindle position control is performed.

(c) Spindle orientation completion signal (ORARA) is output when motion command distribution is finished and position error become less than or equal to the number of pulses specified in parameter No. 4075 (orientation completion signal detection level).

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(2) Starting spindle orientation when the spindle is rotating at or slower than the orientation speed upper limit



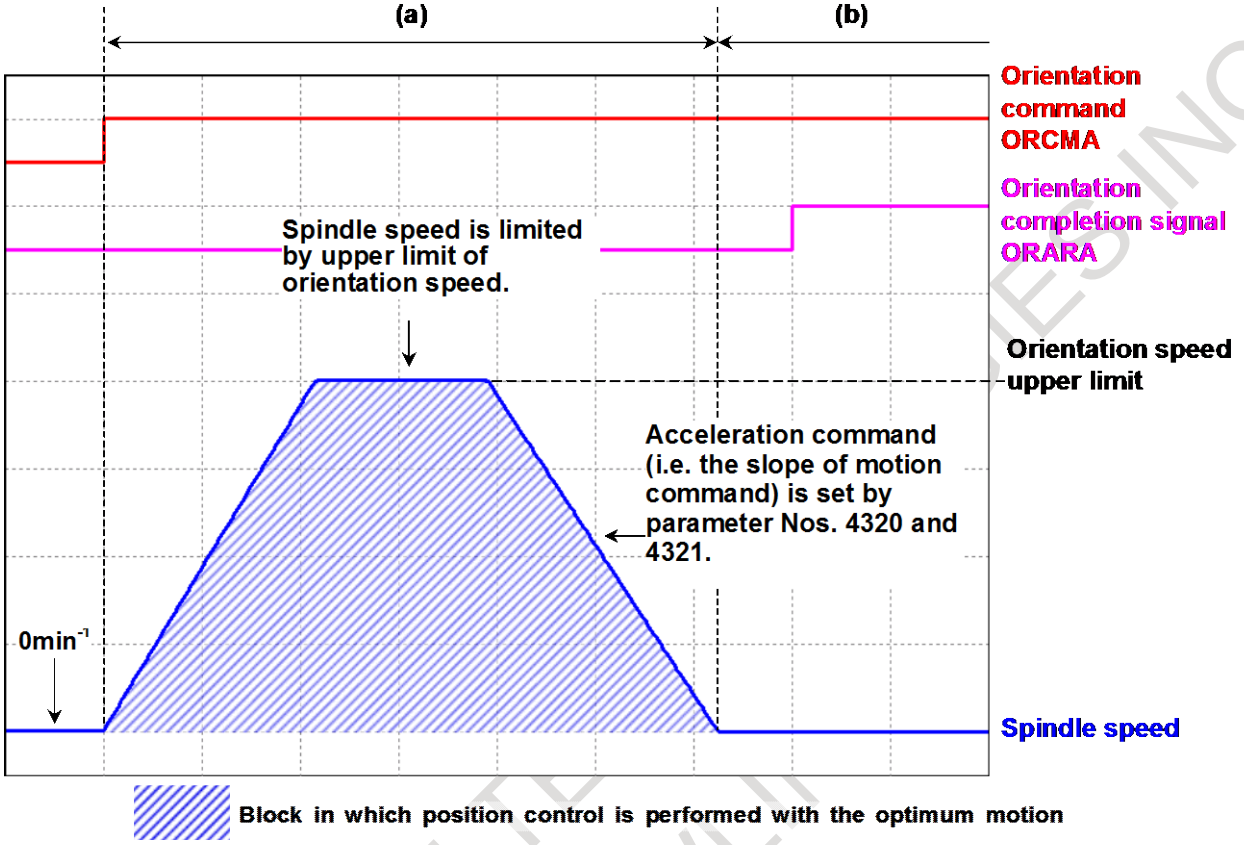
(a) Spindle amplifier accelerates spindle until the time specified in parameter No.4076 [high byte] (delay time for acceleration detection) passed and detects spindle acceleration. The one-rotation signal is also detected in case of the first-time orientation after power-on.

(b) Optimum motion command based on spindle acceleration detected in block (a) is calculated and spindle position control is performed.

(c) Spindle orientation completion signal (ORARA) is output when motion command distribution is finished and position error become less than or equal to the number of pulses specified in parameter No. 4075 (orientation completion signal detection level).

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(3) Starting spindle orientation when the spindle is in the zero-speed state (Zero-speed detection signal SSTA = 1)



(a) Spindle amplifier calculates optimum motion command based on spindle acceleration command specified in parameters Nos. 4320 and 4321 and performs spindle position control. In case of the first-time after power-on, the same operation as that described in (2) is performed.

(b) Spindle orientation completion signal (ORARA) is output when motion command distribution is finished and position error become less than or equal to the number of pulses specified in parameter No. 4075 (orientation completion signal detection level).

2.2.11 Related Parameters

Parameter No.		Description
0*i*	30*i*	
4015#0	4015#0	Specifies whether to use the spindle orientation function. (The CNC software option is required.)
3729#0	3729#0	Specifies whether to use the spindle orientation function with the stop position external setting type.
4003#3 #2	4003#3 #2	Direction of rotation in spindle orientation
4003#0	4003#0	Choice of orientation method (To be set to 0 for the position coder method)
4017#7	4017#7	Shortcut function when orientation is specified in stop state
4018#6 #3	4018#6 #3	Type of position coder method orientation (Bits 6 and 3 to be set to 0 and1)
4018#5 #4	4018#5 #4	Optimum orientation: Setting of velocity feedforward (These bits are selected by the input signal CTH1A)
4019#6	4019#6	Optimum orientation: Whether to use spindle acceleration command compensation

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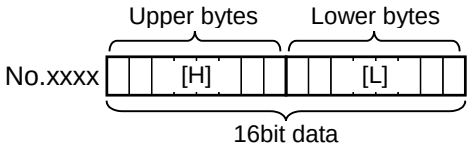
Parameter No.		Description
0*i*	30*i*	
4031	4031	Stop position for position coder method orientation (This parameter is disabled when spindle orientation with an externally set stop position or an externally set incremental command is used.)
4038	4038	Optimum orientation: Orientation speed upper limit
4042 4043	4042 4043	Velocity loop proportional gain for orientation (A parameter is selected by the CTH1A input signal.)
4050 4051	4050 4051	Velocity loop integral gain for orientation (A parameter is selected by the CTH1A input signal.)
4056 to 4059	4056 to 4059	Spindle-to-motor gear ratio (A parameter is selected by the CTH1A and CTH2A input signals.)
4060 to 4063	4060 to 4063	Position gain for orientation (A parameter is selected by the CTH1A and CTH2A input signals.)
4064	4064	Rate of change in the position gain upon completion of spindle orientation
4075	4075	Detection level for the spindle orientation completion signal
4076	4076	Speed limit ratio for spindle orientation
4077	4077	Spindle orientation stop position shift
4084	4084	Motor voltage for spindle orientation
4320 4321	4320 4321	Optimum orientation: Spindle acceleration command (These parameters are selected by the input signal CTH1A)
4324	4324	Optimum orientation: One-rotation signal detection speed
4326 4327	4326 4327	Optimum orientation: Limit ratio for acceleration command / Optimum orientation: Time constant for overshoot compensation (These parameters are selected by the input signal CTH1A)
4328	4328	Command multiplier for orientation
4370	4370	Filter time constant for spindle acceleration detection
4590 4591	4590 4591	Orientation speed limit ratio 1/orientation speed limit ratio 2
4607	4607	Motor voltage after completion of optimum orientation

NOTE
*1 For the parameters related to detectors, see the Section 1.3, “PARAMETERS RELATED TO DETECTORS” in the Part I.
*2 For velocity loop proportional/integral gain adjustment, see Section 4.1, "VELOCITY LOOP GAIN ADJUSTMENT", in Part I.

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2.2.12 Details of Related Parameters

NOTE
The "[H]" and "[L]" suffixes of parameter No. express the upper bytes and lower bytes of parameter No. xxxx. (See illustration below.)



Example:
When No. 4076[L] : Bell shaped acc./dec time constant = 100
No. 4076[H] : Delay time for acceleration detection = 25
the setting value of parameter No. 4076 is as follows:
No.4076 = 25 × 256+100 = 6500

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4015	4015								ORIENT

ORIENT: Whether to use the spindle orientation function (The CNC software option is required.)
0: Does not use the spindle orientation function.
1: Use the spindle orientation function.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4003	4003					DIRCT2	DIRCT1		PCMGSL

DIRCT2, DIRCT1 Setting of rotation direction at spindle orientation

DIRCT2	DIRCT1	Rotation direction at spindle orientation
0	0	By rotation direction immediately before (It is CCW at the power on.)
0	1	By rotation direction immediately before (It is CW at the power on.)
1	0	CCW (counterclockwise) direction looking from shaft of motor
1	1	CW (clockwise) direction looking from shaft of motor

NOTE
When using the external one-rotation signal (proximity switch), fix the orientation-time rotation direction at CCW or CW for stable detection of the one-rotation signal.
(Bits 3, 2 of No. 4003) = 1, 0 or 1, 1)

PCMGSL Selects the type of orientation.
Set this bit to 0.

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0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4017	4017	**NRROEN**							

NRROEN Specifies whether to use the shortcut function when orientation is specified in the stop state.

0 : Does not use the function.

1 : Uses the function.

When this bit is set to 1, short cut operation is performed when the following conditions are satisfied:

- Bit 7 of parameter No. 4016 (RFCHK3) is set to 0.
- Zero speed detection output signal SSTA is set to 1.
- Shortcut command input signal NRROA is set to 1.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4018	4018		**ORTYP1**	**OOTCML**	**OOTCMH**	**ORTYP0**			

ORTYP1、ORTYP0 Type of position coder method orientation

ORTYP1	ORTYP0	Orientation type
0	0	Conventional method orientation
0	1	Optimum orientation
1	0	High-speed spindle orientation

Set "0,1" (optimum orientation).

OOTCMH: Optimum orientation : Setting of velocity feedforward (CTH1A=0)

OOTCML: Optimum orientation : Setting of velocity feedforward (CTH1A=1)

0: Velocity feedforward is unavailable

1: Velocity feedforward is available

Set 1.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4019	4019		**ORACMP**						

ORACMP Optimum orientation: Whether to use spindle acceleration command compensation

0: Uses compensation.

1: Does not use compensation.

This parameter specifies whether to use spindle acceleration command compensation at the start of spindle orientation operation when the spindle is rotating at or slower than the orientation speed upper limit.

Normally, set “1”.

0*i*	30*i*	
4031	4031	**Stop position of position coder method orientation**

Unit of data : 1pulse (360deg /4096)

Valid data range : 0 to 4095

Initial setting value : 0

This data is used to set the stop position of position coder method orientation. This parameter is invalid for stop position external setting-type and incremental command external setting-type spindle orientation. Instead, the stop position commands (input signals: SHA11 to SHA00) are valid.

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0*i*	30*i*	
4038	4038	**Optimum orientation : Spindle orientation speed**

Unit of data : $1min^{-1}$ ($10min^{-1}$ when bit 2 of parameter No.4006(SPDUNT) is set to 1)
Valid data range : 0 to 32767
Initial setting value : 0

This parameter is used to set the upper limit of spindle velocity command after position loop is closed.
If the setting is "0", "base speed of spindle motor(High:No.4100,Low:No.4138)/gear ratio between spindle and motor" is automatically assumed, using the settings of parameters Nos. 4056 to 4059 (gear ratio data between spindle and motor).

NOTE
When an improper value is set in any of parameters Nos. 4056 to 4059, the upper limit of the orientation speed is not calculated correctly and unexpected operation can occur.
Be sure to set proper gear ratios in parameters Nos. 4056 to 4059.

0*i*-	30*i*	
4042	4042	**Velocity loop proportional gain on orientation (HIGH) CTH1A=0**
4043	4043	**Velocity loop proportional gain on orientation (LOW) CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting value : 10

This data is used to set the velocity loop proportional gain on orientation.

0*i*	30*i*	
4050	4050	**Velocity loop integral gain on orientation (HIGH) CTH1A=0**
4051	4051	**Velocity loop integral gain on orientation (LOW) CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting value : 10

This data is used to specify a velocity loop integral gain for spindle orientation.

0*i*	30*i*		
4056	4056	**Gear ratio (HIGH)**	**CTH1A=0, CTH2A=0**
4057	4057	**Gear ratio (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4058	4058	**Gear ratio (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4059	4059	**Gear ratio (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : (Motor rotation for one rotation of spindle) / 100
(When parameter No. 4006 #1 (GRUNIT) is 1, motor rotation / 1000)
(When parameter No. 4005 #5 is 1, motor rotation / 10)
Valid data range : 0 to 32767
Initial setting value : 100

These parameters set the gear ratio of the spindle motor relative to the spindle.
When the motor rotates 2.5 times, for every rotation of the spindle, for example, set 250 in the parameter.
A parameter is selected by the CTH1A and CTH2A input signals.
The gear or clutch status must correspond to the status of the CTH1A and CTH2A input signals.

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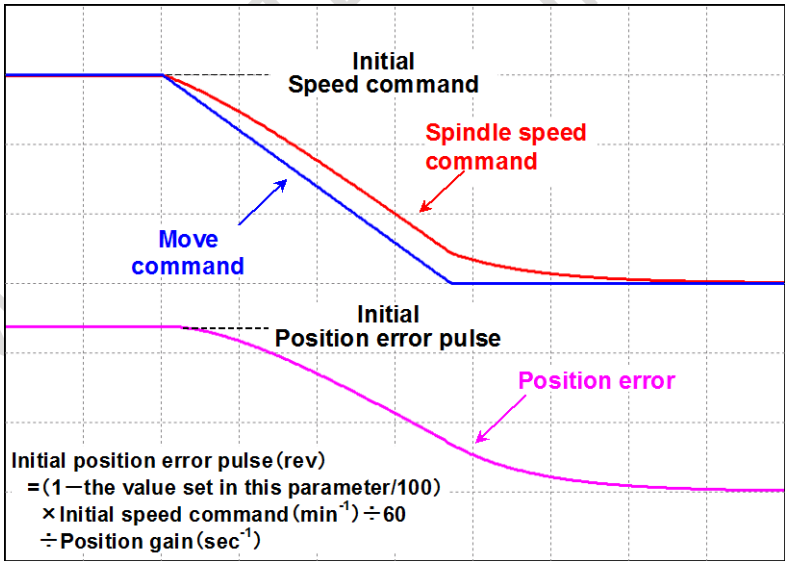
NOTE
When an improper value is set in these parameters, an unexpected operation can occur. For example, the spindle can continue rotating without stopping at the time of orientation. So, be sure to set a proper gear ratio.

0*i*	30*i*		
4060	4060	**Position gain on orientation (HIGH)**	**CTH1A=0, CTH2A=0**
4061	4061	**Position gain on orientation (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4062	4062	**Position gain on orientation (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4063	4063	**Position gain on orientation (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : $0.01sec^{-1}$
Valid data range : 0 to 32767
Initial setting value : 1000
These parameters set the position gain for orientation.

0*i*	30*i*	
4064	4064	**Optimum orientation: Position feedforward coefficient**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting value : 100
This parameter is used to set position feedforward coefficient.
Normally, set 100.



0*i*	30*i*	
4075	4075	**Orientation completion signal detection level (limits of in-position)**

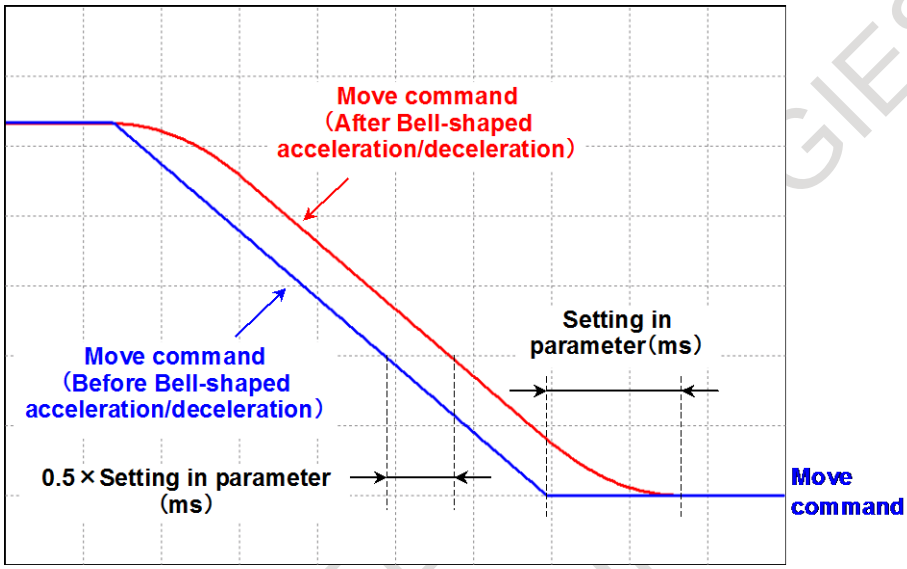
Unit of data : ±1 pulse unit (360 degrees/4096)
Valid data range : 0 to 100
Initial setting value : 10
This data is used to set the detecting level of orientation completion signal (ORARA). ORARA is assumed to be 1 if the position error is within the setting.

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0*i*	30*i*	
4076[L]	4076[L]	**Optimum orientation : Bell-shaped acceleration/deceleration time constant**

Unit of data : 1msec
Valid data range : 0 to 255
Initial setting value : 0

This data is used to set bell-shaped acceleration/deceleration time constant.
If the setting is "0", "31" (= 31 msec) is assumed to be set in the parameter.
Normally, set 0.



0*i*	30*i*	
4076[H]	4076[H]	**Optimum orientation: Delay time for acceleration detection**

Unit of data : 10msec
Valid data range : 0 to 125
Initial setting value : 0

This data is used to set the lower limit of the time between the instant when the orientation command ORCMA is input and the instant when position loop is closed. The acceleration command is automatically set based on the acceleration data detected by the time position loop is closed.
If the setting is "0", "2" (= 20 msec) is assumed to be set in the parameter.
Normally, set 0.

0*i*	30*i*	
4077	4077	**Orientation stop position shift value**

Unit of data : ±1 pulse unit (360 degrees/4096)
Valid data range : -4095 to 4095
Initial setting value : 0

In the position coder method orientation, set this data to shift stop position. If a positive value is specified, the position where the spindle stops is shifted counterclockwise (CCW).

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0*i*	30*i*	
4084	4084	**Motor voltage setting on orientation**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting value : The value may vary, however, depending on the motor model.
This parameter sets the motor voltage for orientation.
Normally, set 100.

0*i*	30*i*		
4320	4320	**Optimum orientation : Spindle acceleration command (HIGH)**	**CTH1A=0**
4321	4321	**Optimum orientation : Spindle acceleration command (LOW)**	**CTH1A=1**

Unit of data : 10min^{-1}/sec
Valid data range : -10000 to 10000
Initial setting value : 0

When setting value is zero or positive

When orientation is commanded in the rotating state, the spindle acceleration command is automatically set based on the spindle acceleration detected from the time the orientation command (ORCMA) is input until the position loop is closed.
These parameters are used to set spindle acceleration command in case of

- Orientation when spindle is zero-speed state (Zero-speed detection signal SST = 1)
- Incremental command external setting-type orientation

If the setting is "0", "133" (= 1330 min^{-1}/sec) is assumed to be set in the parameter.

When setting value is negative

These parameters are used to set spindle acceleration command regardless of the spindle speed when orientation is commanded. (The absolute value of the setting value is treated as acceleration command.)

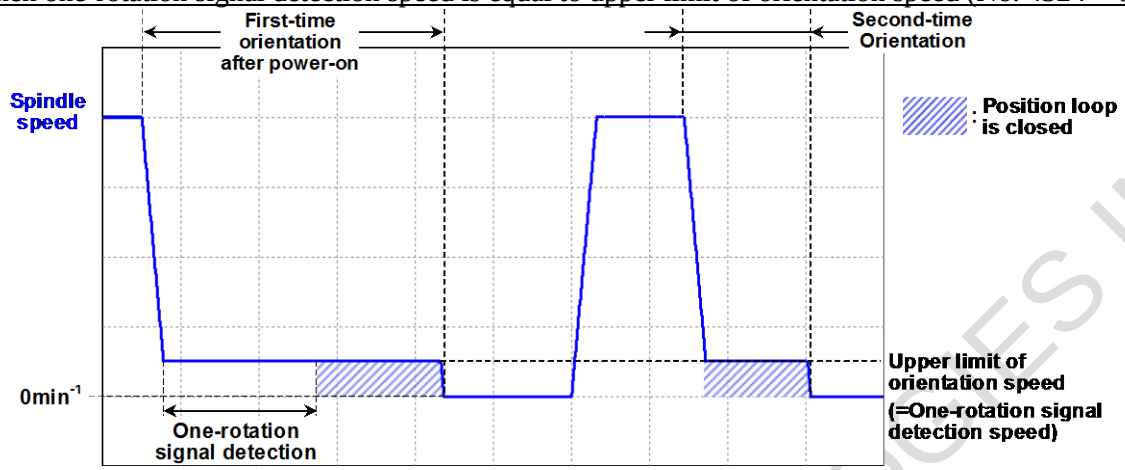
0*i*	30*i*	
4324	4324	**Optimum orientation : One-rotation signal detection speed**

Unit of data : 1min^{-1} ($10\ \text{min}^{-1}$ when bit 2 (SPDUNT) of parameter No. 4006 =1)
Valid data range : 0 to 32767
Initial setting value : 0

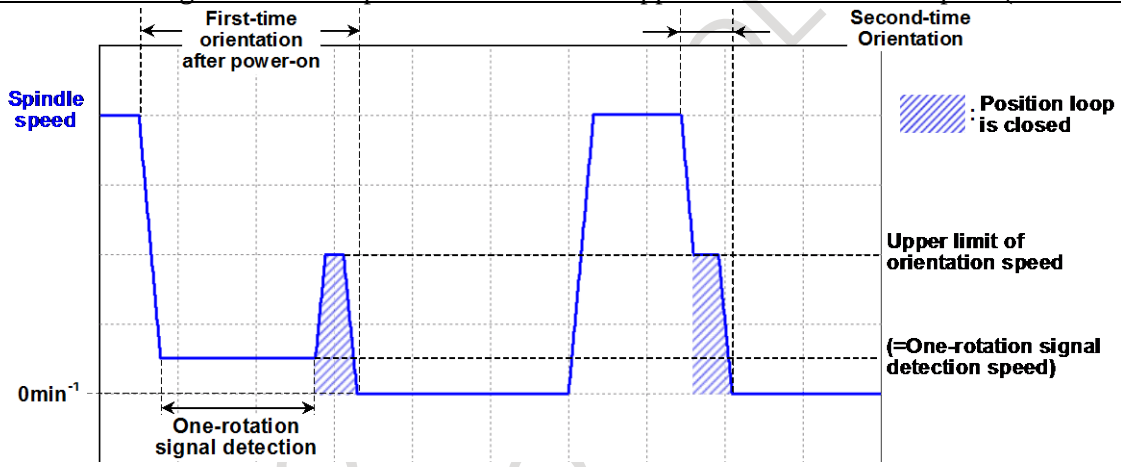
In case of the first-time orientation command (ORCMA) after power-on, the spindle accelerates or decelerates toward the speed set by this parameter and detects one-rotation signal.
If the setting is "0", setting value of parameter No. 4038 (upper limit of orientation speed) is assumed to be set in the parameter.
If the external one-rotation signal (proximity switch) is used, setting this parameter and the upper limit of orientation speed separately can reduce orientation time of second-time or later after power-on.

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When one-rotation signal detection speed is equal to upper limit of orientation speed (No. 4324 = 0)



When one-rotation signal detection speed is different from upper limit of orientation speed (No. 4324 ≠ 0)

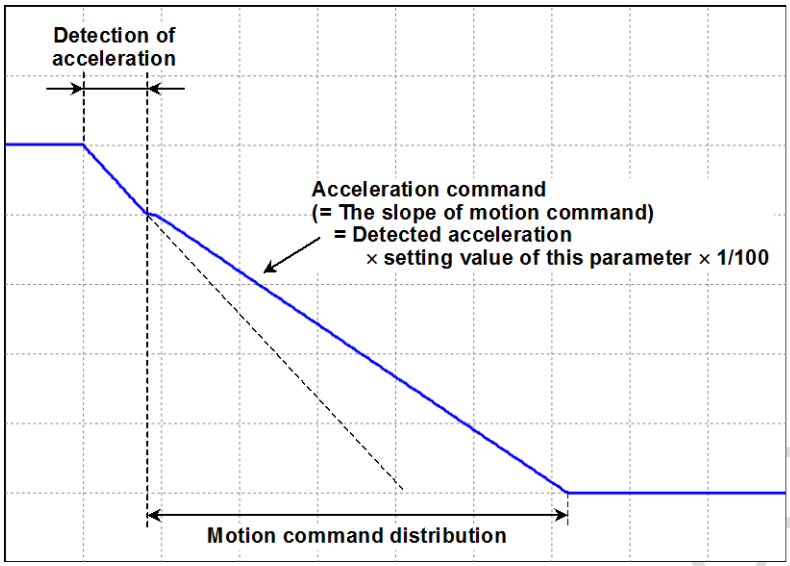


0*i*	30*i*		
4326[L]	4326[L]	Optimum orientation : Limit ratio of acceleration command(HIGH)	CTH1A=0
4327[L]	4327[L]	Optimum orientation : Limit ratio of acceleration command(LOW)	CTH1A=1

Unit of data : 1%
Valid data range : 0 to 100
Initial setting value : 0

This parameter is used to set limit ratio for acceleration command.
If the setting is “0”, “95”(=95%) is assumed to be set in the parameter.
Usually, specify “0”.

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0*i*	30*i*		
4326[H]	4326[H]	**Optimum orientation : Time constant for overshoot compensation (HIGH)**	**CTH1A=0**
4327[H]	4327[H]	**Optimum orientation : Time constant for overshoot compensation (LOW)**	**CTH1A=1**

Unit of data : 1msec
Valid data range : 0 to 125
Initial setting value : 0

This parameter is used to set time constant for overshoot compensation.
If the setting is “0”, “5”(=5msec) is assumed to be set in the parameter.
Usually, specify “0”.

0*i*	30*i*	
4328	4328	**Command multiplier for spindle orientation by a position coder**

Unit of data :
Valid data range : 0 to 32767
Initial setting value : 0

Set a command multiplier for the orientation function with an externally set incremental command.
If this parameter is set to "0", the multiplier is automatically assumed to be "1" (= ×1).
If this parameter is set to a value other than "0", the incremental command is
"Incremental command data (SHA11 to SHA00) × setting of this parameter"
To use spindle rotation speed control, set this parameter to "4096", because the resolution commanded for orientation is 4096 pulses per spindle rotation.

NOTE
*1 For an explanation of the incremental command type spindle orientation function, see Section 5.3, "INCREMENTAL COMMAND TYPE SPINDLE ORIENTATION (SPINDLE ROTATION SPEED CONTROL)", in Part I.
*2 In case of optimum orientation, the maximum number of revolution (incremental command) that can be specified is
30000 revolution (= 30000 × 4096 pulses).

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0*i*	30*i*	
4370	4370	**Filter time constant for spindle acceleration detection**

Unit of data : 1msec
Valid data range : 0 to 100
Initial setting value : 0

This parameter is used to set filter time constant for spindle acceleration detection.
The following are the recommended settings for the individual types of spindle sensor.

Type of spindle sensor	Setting value
Except for α*i* position coder (No.4002#3,2,1,0 ≠ 0, 0, 1, 0)	5 to 15
α*i* position coder (No.4002#3,2,1,0 = 0, 0, 1, 0)	10 to 20

If the setting is "0",
"5" (= 5 msec): except for α*i* position coder
"10" (= 10 msec): α*i* position coder
is assumed to be set in this parameter.

0*i*	30*i*		
4590[L]	4590[L]	**Optimum orientation: Orientation speed limit ratio 1 (HIGH)**	**CTH1A=0**
4590[H]	4590[H]	**Optimum orientation: Orientation speed limit ratio 2 (HIGH)**	**CTH1A=0**
4591[L]	4591[L]	**Optimum orientation: Orientation speed limit ratio 1 (LOW)**	**CTH1A=1**
4591[H]	4591[H]	**Optimum orientation: Orientation speed limit ratio 2 (LOW)**	**CTH1A=1**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting value : 0

These parameters are used to set orientation speeds, in conjunction with parameter No. 4038 for setting the orientation speed upper limit. Normally, set “0” in these parameters because they need not be adjusted.

[Reference]
When an orientation operation is started at a speed near the orientation speed upper limit (parameter No. 4038), the orientation time may be reduced by limiting the orientation speed with these parameters.

Orientation speed limit ratio 1, ORSCF1, is used to define orientation speed lower limit, ORSPDL, as shown below:

$$\mathrm{ORSPDL} = \frac{100 - \mathrm{ORSCF1}}{100} \times \mathrm{ORSPDU}$$

Then, the following can be used to calculate orientation speed, ORSPD, as shown below:

- Spindle speed for the orientation command : ORSINI
- Orientation speed upper limit (set in parameter No. 4038): ORSPDU
- Orientation speed lower limit : ORSPDL
- Orientation speed limit ratio 2 : ORSCF2

$$\mathrm{ORSPD} = \frac{\mathrm{ORSCF2}}{100} \times \mathrm{ORSINI} + \frac{100 - \mathrm{ORSCF2}}{100} \times \mathrm{ORSPDL}$$

(Clamping is performed so that ORSPDL ≤ ORSPD ≤ ORSPDU.)

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0*i*	30*i*	
4607	4607	**Motor voltage after completion of optimum orientation**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting value : 0

This parameter is used to set a motor voltage after completion of optimum orientation. The rigidity at the orientation stop can be increased by adjusting this parameter setting. Normally, set “0” in this parameter because it need not be adjusted.

- When this parameter is “0”:
  Motor voltage after completion of orientation = parameter No. 4083 (motor voltage on the velocity control mode [for high-speed winding])
- When this parameter is other than “0”:
  Motor voltage after completion of orientation = parameter No. 4607

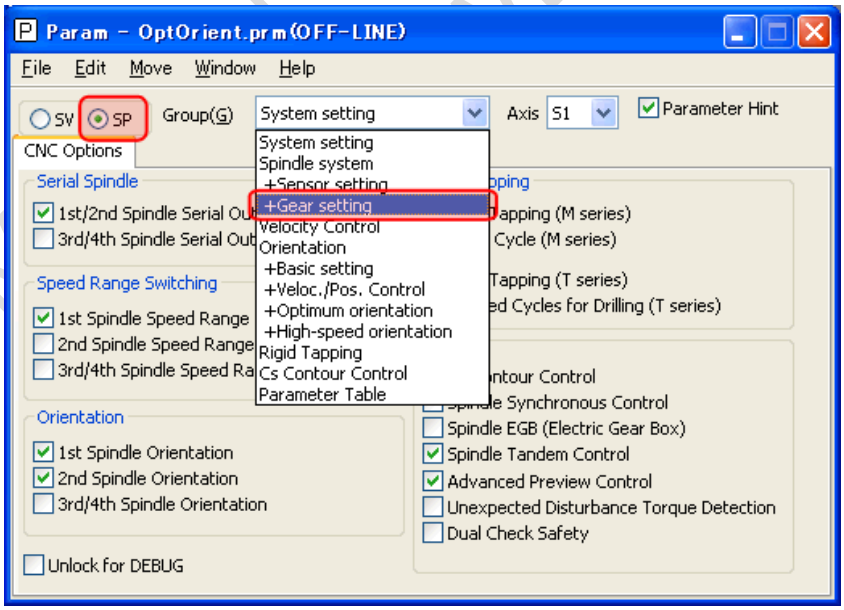
2.2.13 Tuning Procedure

(1) Standard settings of parameters

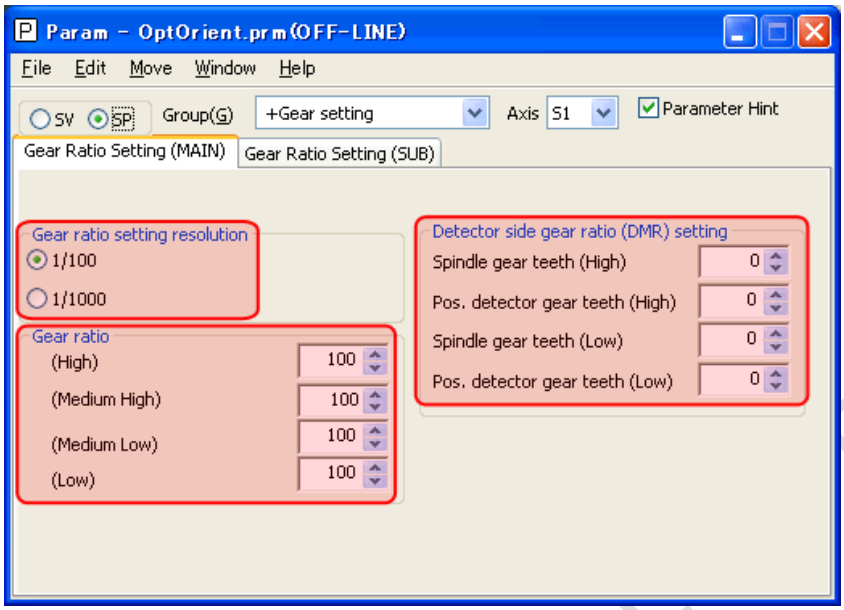
(A) If making settings from the parameter window of the SERVO GUIDE

(i) Open the parameter window of the SERVO GUIDE, and select "**SP**"-"**Spindle system**"-"**Gear setting**", and set
- Gear ratio setting resolution
- Gear ratio
- Detector side gear (DMR) setting

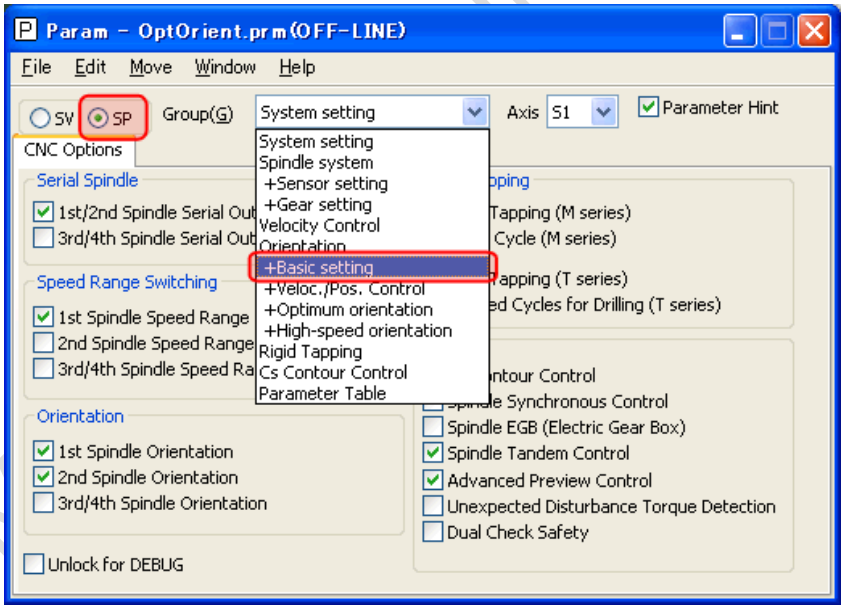
according to the system configuration.



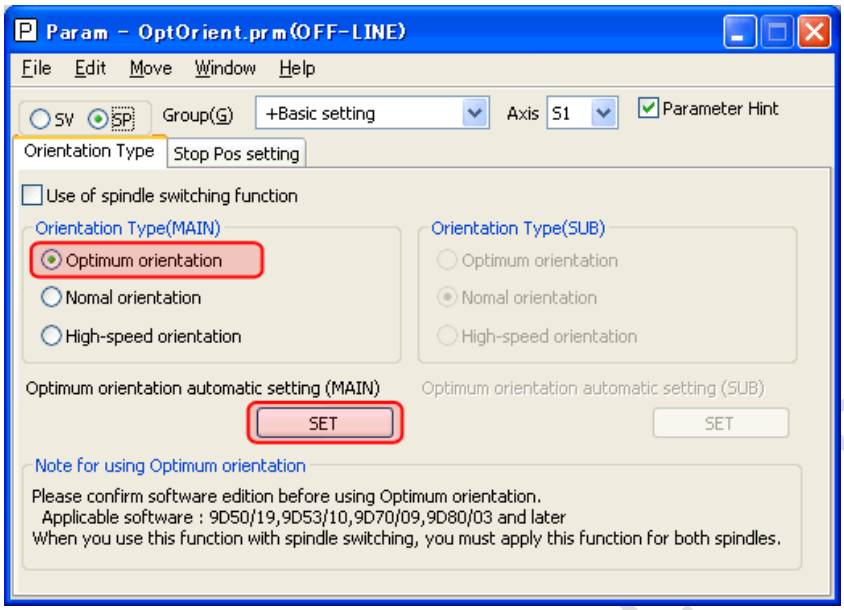
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(ii) Select **"SP"-"Orientation"-"Basic setting"-"Orientation Type"**. For Orientation Type, select "Optimum orientation" and then click the automatic setting button.

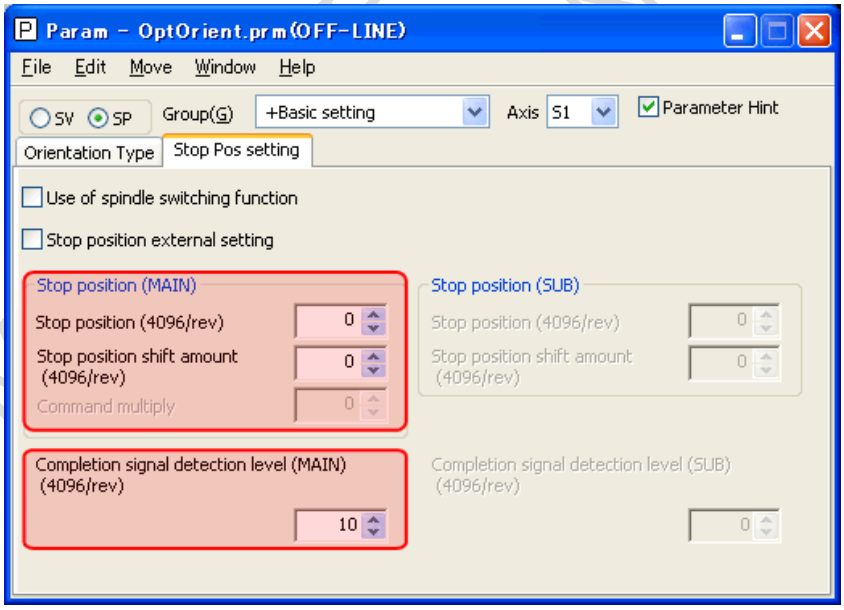


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(iii) Select **"SP"-"Orientation"-"Basic setting"-"Stop Pos setting"**, and set
- Stop position
- Stop position shift amount
- Command multiply
- Completion signal detection level

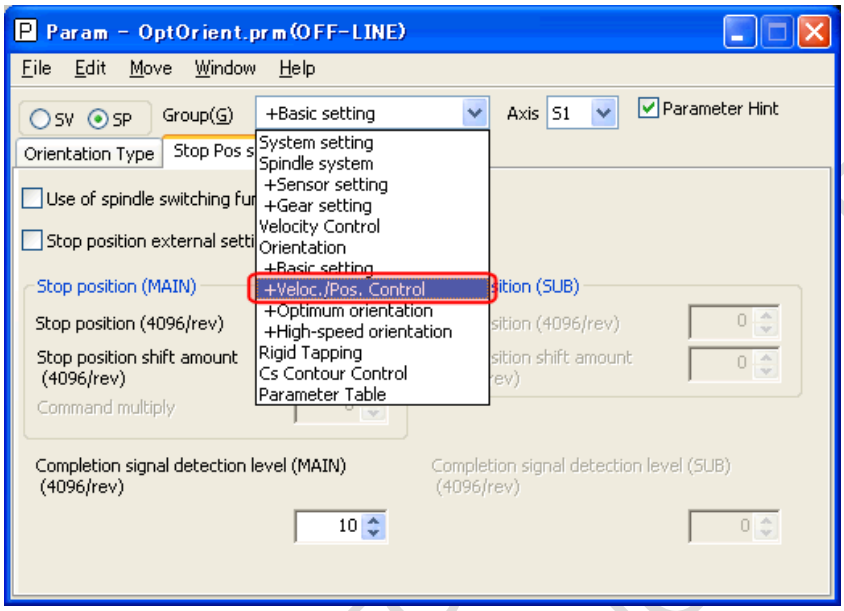
according to the use.

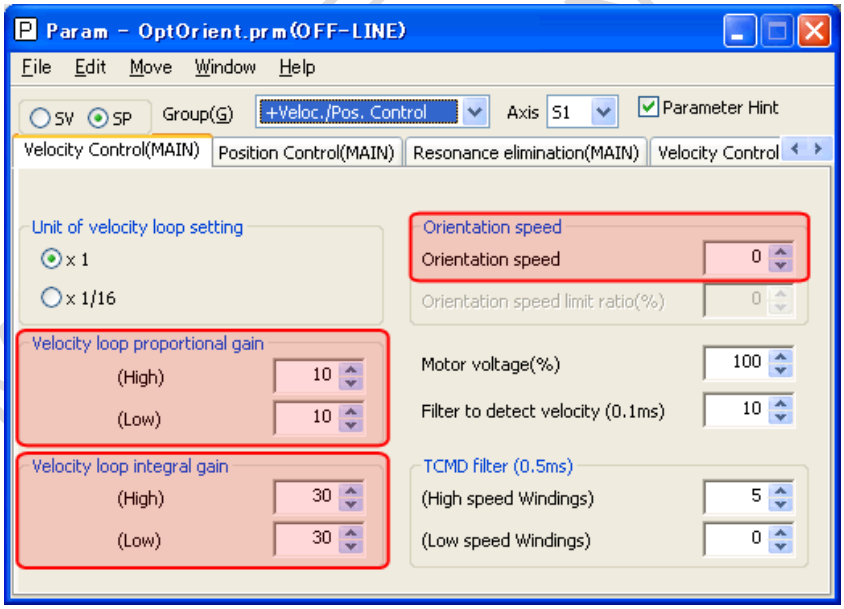


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(iv) Select **"SP"-"Orientation"-"Veloc./Pos. Control"-"Velocity Control"**, and set
- Velocity loop proportional gain: 10
- Velocity loop integral gain: 30

If wishing to limit the spindle speed during position control, set the upper limit for
- Orientation speed





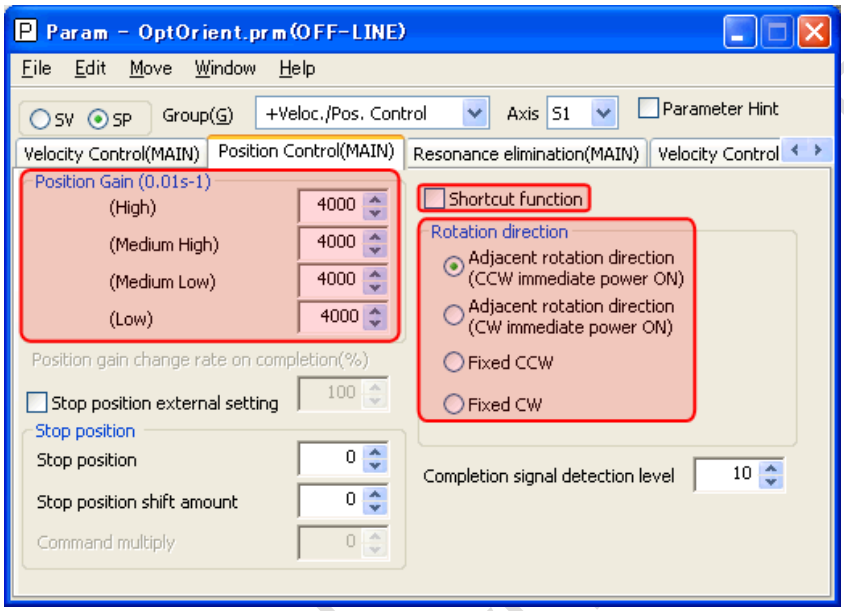
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(v) Select **"SP"-"Orientation"-"Veloc./Pos. Control"-"Position Control"**, and set
- Position Gain: 3000 to 4000

Set
- Shortcut function
- Rotation direction

according to the use.

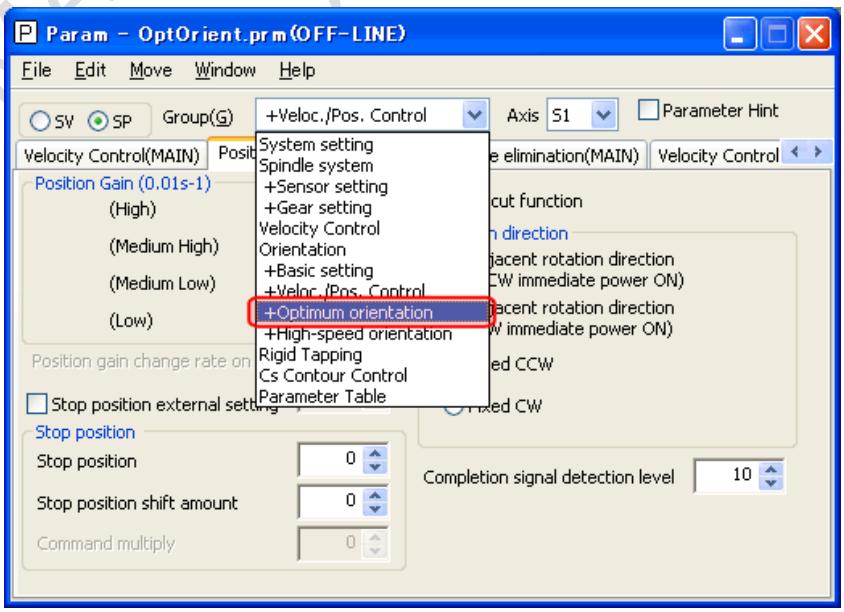
If using the external one-rotation signal (proximity switch), set Rotation direction to either Fixed CCW or Fixed CW



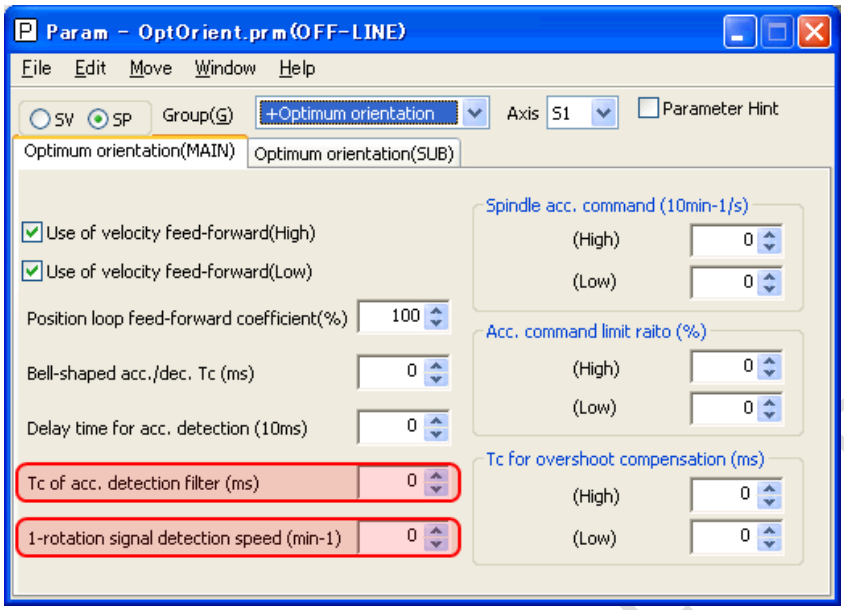
(vi) Select **"SP"-"Orientation"-"Optimum orientation"**, and set
- Tc of acc. detection filter: 0

If using the external one-rotation signal (proximity switch), set
- 1-rotation signal detection speed: 50 to 100

according to the sensor specifications.



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(B) If making settings from the SYSTEM> parameter screen of the CNC

Initialize the parameters as listed below.
Orientation may work well with following settings. Tune parameters if necessary.

No.	Description	Standard setting value
4003#0	Selecting a spindle orientation type	0
4003#3,2	Spindle rotation direction at orientation	Select a rotation direction. *1
4006#1	Unit of gear ratio setting	Specify an appropriate value depending on the system configuration.
4017#7	Short-cut function when spindle orientation from stopped state is specified	Specify an appropriate value according to the use of the machine.
4018#6,3	Type of position coder method orientation	0, 1
4018#4,5	Setting of velocity feedforward	1, 1
4019#6	Whether to use spindle acceleration command compensation	1
4031	Spindle orientation stop position	Specify a stop position.
4038	Spindle orientation speed upper limit	0*2
4042,4043	Velocity proportional gain on orientation	10
4050,4051	Velocity integral gain on orientation	30
4056 to 4059	Gear ratio	Specify an appropriate value depending on the system configuration.
4060 to 4063	Position gain on orientation	3000~4000
4064	Percentage limit to an acceleration during deceleration	100
4075	Orientation completion signal detection level	Specify an appropriate value according to the use of the machine.
4076	Bell-shaped acc./dec. time constant / Delay time for acceleration detection	0
4077	Orientation stop position shift value	Specify a stop position.
4084	Motor voltage on orientation	100
4171,4173	Denominator of the motor sensor-to-spindle arbitrary gear ratio	Specify an appropriate value depending on the system configuration.
4172,4174	Numerator of the motor sensor-to-spindle arbitrary gear ratio	Specify an appropriate value depending on the system configuration.
4320,4321	Acceleration during motor deceleration	0
4324	One-rotation signal detection speed	0 *3
4326,4327	Limit ratio for spindle acceleration command / Time constant for overshoot compensation	0

No.	Description	Standard setting value
4328	Command multiplier for orientation	Specify an appropriate value according to the use of the machine.
4370	Filter time constant for spindle acceleration detection	0
4590,4591	Orientation speed limit ratio 1/ Orientation speed limit ratio 2	0
4607	Motor voltage after completion of optimum orientation	0

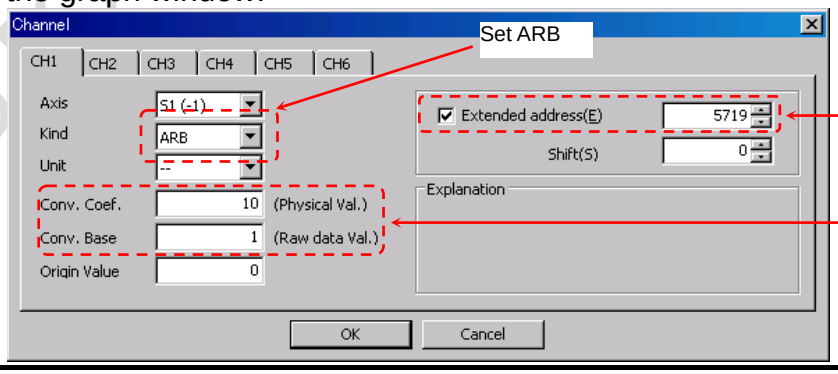
NOTE
*1 Fix the rotation direction at one direction when the external one-rotation signal (proximity switch) is used.
*2 Set upper limit if it is necessary to specify the maximum speed of spindle during position control.
*3 Set 50 to 100 min^{-1} according to the specification of the sensor when the external one-rotation signal (proximity switch) is used.
However, if problems not occur such as instability stop position by increasing the orientation speed, you can use the value higher than 100 min^{-1}.

(2) Spindle data related to optimum orientation

The following table shows channel setting to measure the data for adjusting optimum orientation by SERVO GUIDE.
Refer to FANUC SERVO GUIDE OPERATOR'S MANUAL (B-65404EN) or online help for details.

Data	Kind	Unit	Conv. Coef.	Conv. Base	Shift	Remarks
Spindle speed	SPSPD	1/min	1	1	-12	
Spindle acceleration*1	SPACC	—	10	1	0	Unit:1min^{-1}/sec
Orientation sequence data*2	ORSEQ	—	1	1	0	
Position error at orientation	ORERR	pulse	0.25	1	-10	4096 pulses/rev
Torque command	TCMD	%	100	16384	0	
Torque command status*3 (bit12 of spindle flag 1)	SFLG1#12 (TCSAT)	—	1	1	0	0:TCMD isn't saturated 1:TCMD is saturated

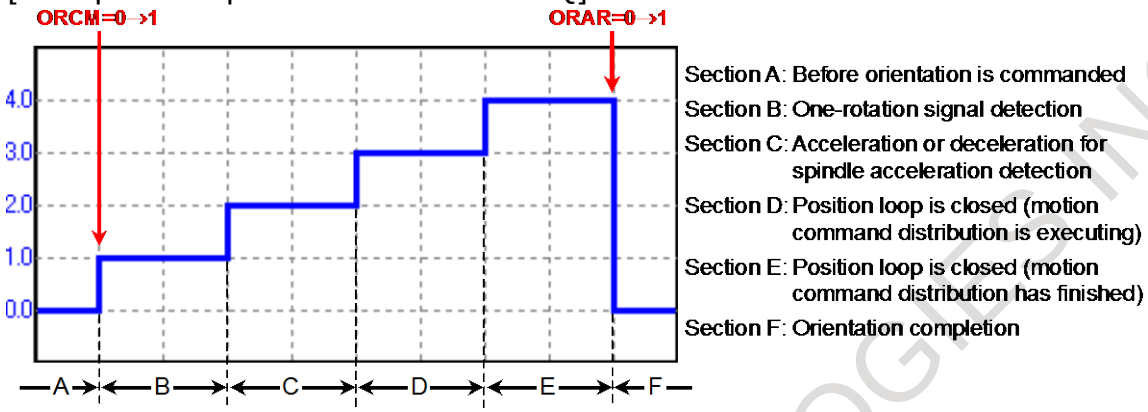
NOTE
*1 Available in SERVO GUIDE version 4.10 or later.
In former version, make the following settings on the channel setting screen of the graph window.



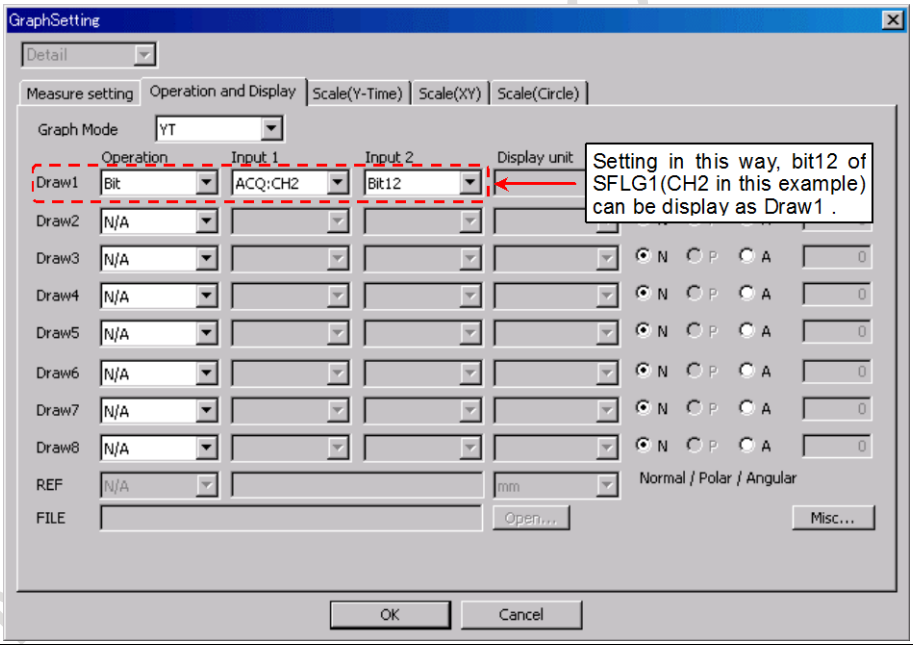
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NOTE

*2 Orientation sequence (ORSEQ) shows the internal states of orientation.
[example of output waveform of ORSEQ]



*3 To display the torque command status flag, SFLG1 on the channel setting screen of the graph window, and make the following settings on the Graph Setting screen.



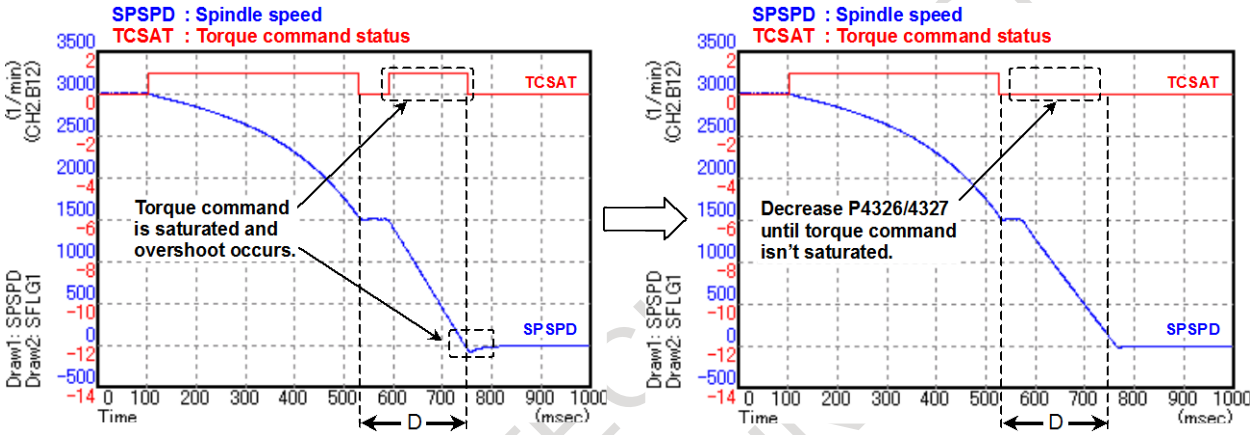
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(3) Tuning example 1: If specifying orientation when the spindle is rotating

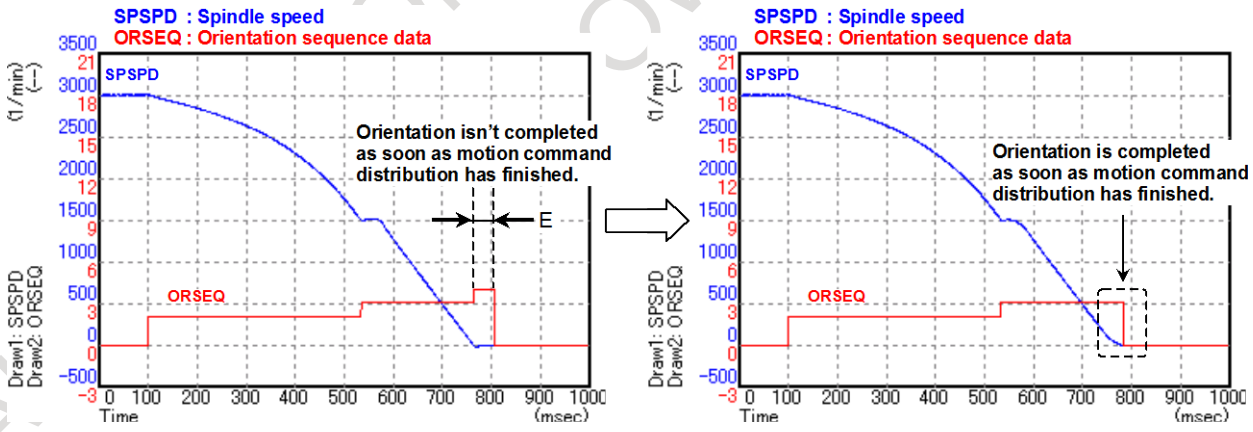
(a) Tuning the velocity loop proportional gain (Nos. 4042/4043) and integral gain (Nos. 4050/4051)
Detach the load inertia (tool and workpiece) from the spindle. Then tune the velocity proportional/integral gain by referring to Section 4.1, "VELOCITY LOOP GAIN ADJUSTMENT", in Part I.

(b) Tuning the position gain (Nos. 4060 to 4063)
Basically, the position gain needs no changes from the standard values mentioned in the preceding section. If an overshoot is large, decrease the setting values.

(c) Tuning the limit ratio for acceleration command (Nos. 4326/4327)
Perform orientation from maximum spindle speed. If the torque command is saturated (TCSAT = 1) while motion command distribution is executing (Section D: ORSEQ = 3), decrease the limit ratio for the acceleration command (Nos. 4326/4327) in steps of 5% from the initial value of 95%.



(d) Tuning the bell-shaped acc./dec. time constant (No. 4076)
If the time from the end of motion command distribution to orientation completion (Section E: ORSEQ = 4) is long, increase the bell-shaped acc./dec. time constant (No. 4076) in steps of 4 ms from the initial value of 32 ms.



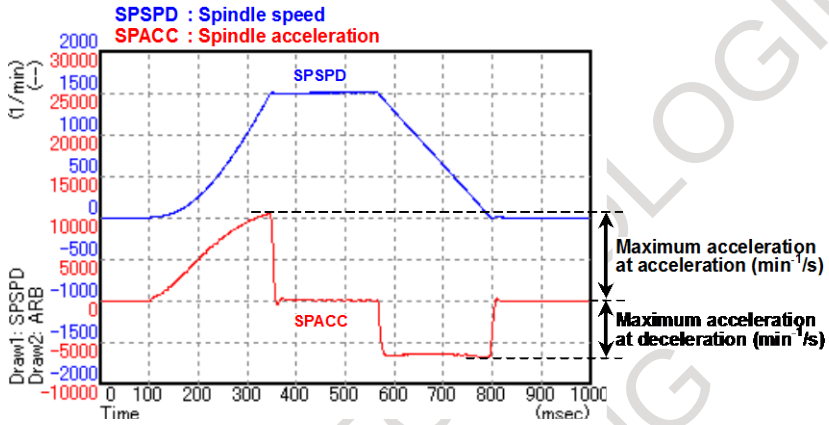
(e) Checking orientation with the load inertia attached
Attach the load inertia to the spindle and check orientation from the maximum spindle speed.

(4) Tuning example 2: If specifying orientation when the spindle is zero-speed state

(a) Tuning the velocity loop proportional gain (Nos. 4042/4043) and integral gain (Nos. 4050/4051)
Attach the load inertia (tool and workpiece) to the spindle. Then tune the velocity proportional/integral gain by referring to Section 4.1, "VELOCITY LOOP GAIN ADJUSTMENT", in Part I.

(b) Tuning the position gain (Nos. 4060 to 4063)
Basically, the position gain needs no changes from the standard values mentioned in the preceding section. If an overshoot is large, decrease the setting values.

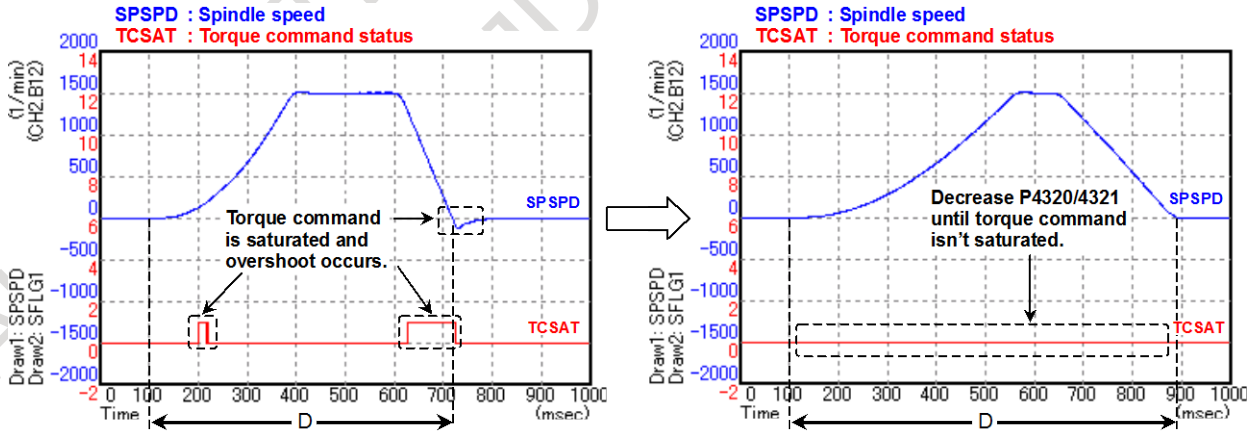
(c) Specifying the [provisional value] of the spindle acceleration command (Nos. 4320/4321)
Perform acc./dec. form 0 min^{-1} to maximum speed in velocity control mode, and measure spindle acceleration.



Specify the spindle acceleration command (Nos. 4320/4321) as follows:

Setting value = 0.1 × min (|max. acceleration at acc.|, |max. acceleration at dec.|)

(d) Tuning the spindle acceleration command (Nos. 4320/4321)
Perform orientation from the state in which motor excitation is off. If the torque command is saturated (TCSAT = 1) while motion command distribution is executing (Section D: ORSEQ = 3), decrease the spindle acceleration command (Nos. 4320/4321) until torque command is not saturated.



(e) Tuning the bell-shaped acc./dec. time constant (No. 4076)
Tune the bell-shaped acc./dec. time constant (No. 4076) in the same way as that described in (2).

2.2.14 Adjusting the Orientation Stop Position Shift Parameter

Adjust the orientation stop position shift parameter by following the procedure below.

(a) Specify parameters as follows:
Bit 1 of No. 3117 = 1 (to enable the display function of diagnosis screen No. 445)
Bit 7 of No. 4016 = 0
No. 4031 = 0 (When external signals are used for setting, set the input signals SHA11 to SHA00 to 0.)
No. 4077 = 0

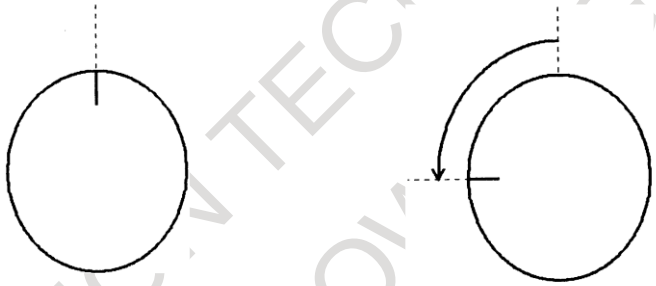
(b) Enter an orientation command (ORCMA) to stop orientation.

(c) After orientation is stopped, check that diagnosis screen No. 445 displays "0".
Cancel the orientation command and set the emergency stop state to deactivate the motor.

(d) Rotate the spindle manually to the position where you want the spindle to stop then read the displayed value of diagnosis screen No. 445.

(e) Set the displayed value of (d) as the parameter data for an orientation stop position shift amount (No. 4077).
[Example]

Value displayed in No. 445 when orientation is stopped = "0" ⇨ Value displayed in No. 445 when the spindle is rotated manually in the emergency stop state = "1024"



Value to be specified in the parameter No. 4077 = 1024

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2.2.15 Supplementary Descriptions

Correspondence of parameter Nos. when the spindle switching control function is used

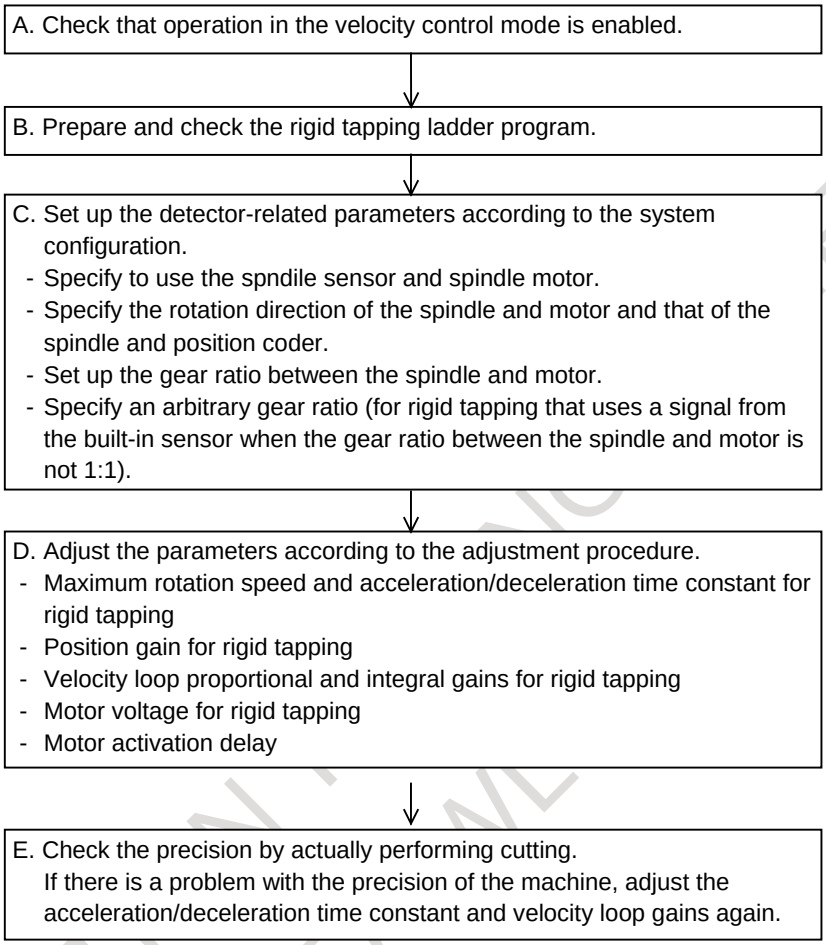
0*i*		30*i*		Description
MAIN	SUB	MAIN	SUB	
4015#0	←	4015#0	←	Whether the spindle orientation function is available
4003#3 #2	4179#3 #2	4003#3 #2	4179#3 #2	Rotation direction for orientation
4003#0	4179#0	4003#0	4179#0	Orientation method selection
4017#7	4193#7	4017#7	4193#7	Short-cut function when spindle orientation from stopped state is specified
4018#6 #3	4194#6 #3	4018#6 #3	4194#6 #3	Type of position coder method orientation
4018#4	4194#4	4018#4	4194#4	Setting of velocity feedforward (HIGH)
4018#5	4194#5	4018#5	4194#5	Setting of velocity feedforward (LOW)
4019#6	4195#6	4019#6	4195#6	Whether the spindle orientation function is available
4031	4204	4031	4204	Spindle orientation stop position
4038	4205	4038	4205	Upper limit of orientation speed
4042	4208	4042	4208	Velocity loop proportional gain for orientation (HIGH)
4043	4209	4043	4209	Velocity loop proportional gain for orientation (LOW)
4050	4213	4050	4213	Velocity integral gain for orientation (HIGH)
4051	↑	4051	↑	Velocity integral gain for orientation (LOW)
4056	4216	4056	4216	Gear ratio data between spindle and motor (HIGH)
4057	↑	4057	↑	Gear ratio data between spindle and motor (MEDIUM HIGH)
4058	↓	4058	↓	Gear ratio data between spindle and motor (MEDIUM LOW)
4059	4217	4059	4217	Gear ratio data between spindle and motor (LOW)
4060	4218	4060	4218	Position gain for orientation (HIGH)
4061	↑	4061	↑	Position gain for orientation (MEDIUM HIGH)
4062	↓	4062	↓	Position gain for orientation (MEDIUM LOW)
4063	4219	4063	4219	Position gain for orientation (LOW)
4064	4220	4064	4220	Position feedforward coefficient
4075	4226	4075	4226	Orientation completion signal detection level
4076	4227	4076	4227	Bell-shaped acc./dec. time constant / Delay time for acceleration detection
4077	4228	4077	4228	Orientation stop position shift value
4084	4237	4084	4237	Motor voltage for orientation
4320	4322	4320	4322	Spindle acceleration command (HIGH)
4321	4323	4321	4323	Spindle acceleration command (LOW)
4324	4325	4324	4325	One-rotation signal detection speed
4326	4330	4326	4330	Limit ratio for acceleration command (HIGH) / Time constant for overshoot compensation (HIGH)
4327	4331	4327	4331	Limit ratio for acceleration command (LOW) / Time constant for overshoot compensation (LOW)
4328	4329	4328	4329	Command multiplier for orientation
4370	4383	4370	4383	Filter time constant for spindle acceleration detection
4590	4720	4590	4720	Orientation speed limit ratio 1 (HIGH)/ Orientation speed limit ratio 2 (HIGH)
4591	4721	4591	4721	Orientation speed limit ratio 1 (LOW)/ Orientation speed limit ratio 2 (LOW)
4607	4737	4607	4737	Motor voltage after completion of optimum orientation

NOTE
Use the optimum orientation function for both MAIN spindle and SUB spindle when the spindle switching control function is used concurrently.

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2.3 RIGID TAPPING (OPTIONAL FUNCTION)

2.3.1 Start-up Procedure



2.3.2 Overview

Rigid tapping is a function for performing high-precision tapping by exercising position control so that the spindle rotation is synchronized with tapping axis feed at all times.
This Subsection describes the specifications of the rigid tapping function related to the serial spindle.

NOTE
To use this function, the CNC software option is required.

2.3.3 FSSB High-speed Rigid Tapping

In rigid tapping, when high-speed communication is used through the FSSB connection between the spindle amplifier and servo amplifier, it is possible to reduce the synchronous error and to shorten the cycle time while maintaining precision.

However, FSSB high-speed rigid tapping cannot be used for the following:

- Rigid tapping through spindle control by an analog spindle or servo motor
- Rigid tapping with two or more spindles and one servo axis through spindle command synchronization
- Rigid tapping with two or more servo axes simultaneously used for one spindle
- Rigid tapping using β*i*SVSP (β*i*SVSP-B is available).

2.3.3.1 Series and edition of applicable FSSB high-speed rigid tapping software

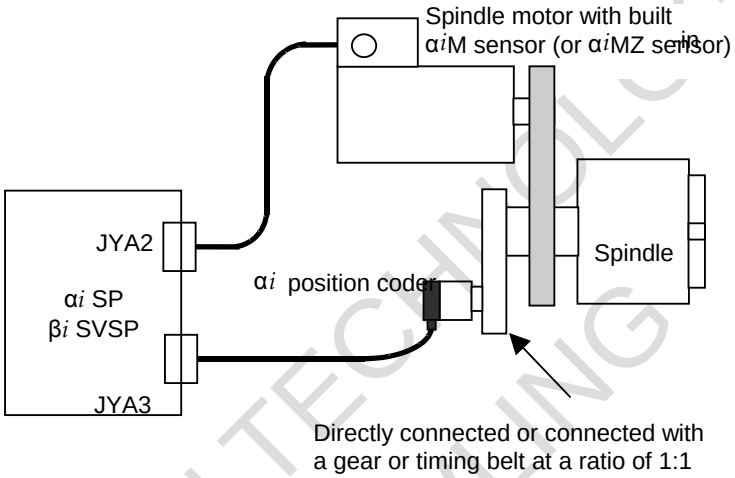
Spindle software

Series	Edition	**Usable CNC**
9DA0	G (07)	FS30*i* -B / FS31*i*-B / FS32*i*-B / FS35*i*-B, Fs0*i*-F
9DB0	A (01)	FS30*i* -B / FS31*i*-B / FS32*i*-B / FS35*i*-B, Fs0*i*-F

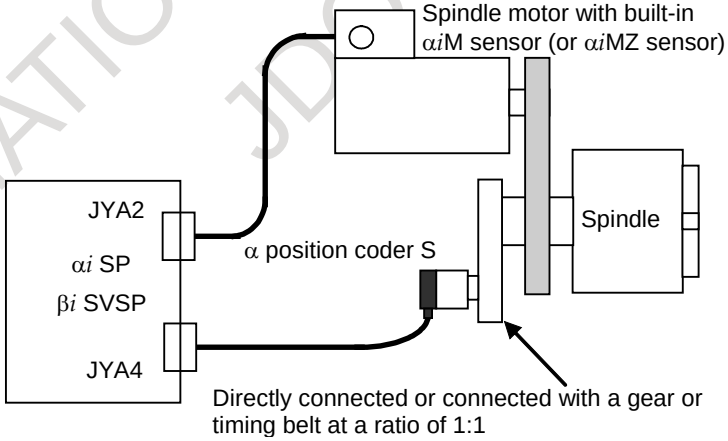
2.3.4 System Configuration

The system configurations that enable the use of rigid tapping are shown below.

(1) When the α*i* position coder is used

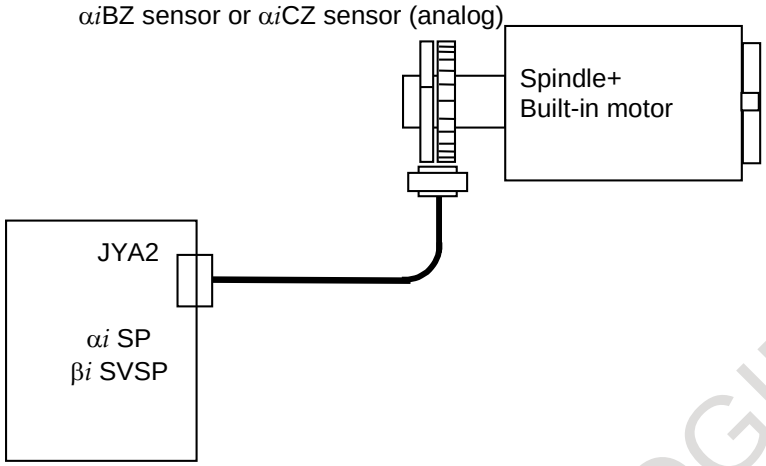


(2) When the α position coder S is used

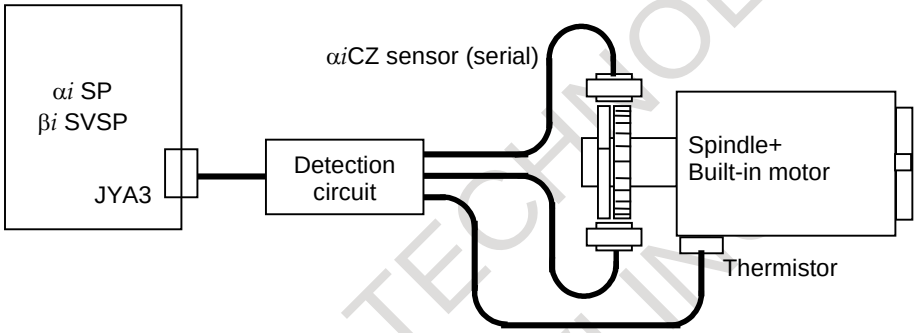


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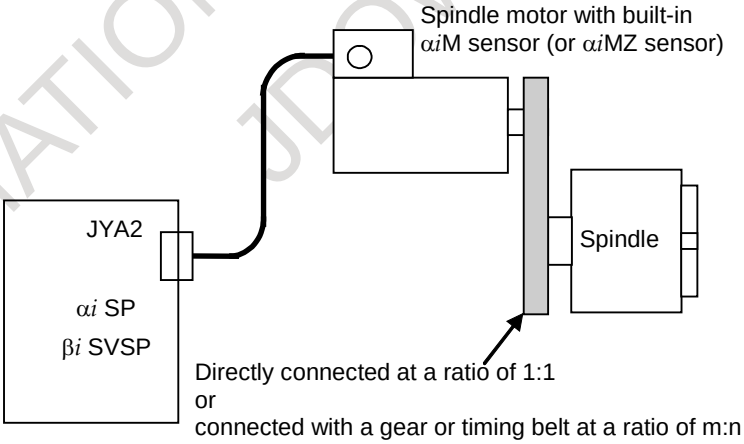
(3) When the built-in motor (αiBZ sensor or αiCZ sensor (analog)) is used



(4) When the built-in motor (αiCZ sensor (serial)) is used



(5) When the spindle motor with built-in αiM sensor (or αiMZ sensor) is used



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NOTE

*1 When performing rigid tapping by using a signal from the sensor built into the motor as a position feedback signal, use one of the following functions if the gear ratio between the motor and spindle is other than 1:1
(a) Detection arbitrary gear ratio function (DMR function)
(b) Command arbitrary gear ratio function (CMR function)

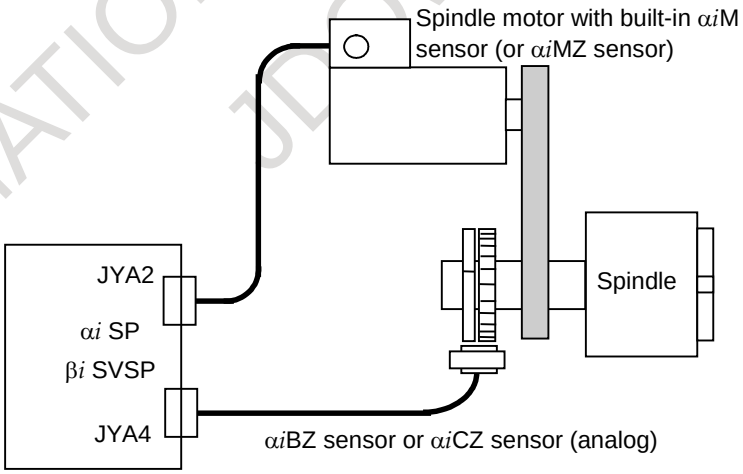
*2 When using the detection arbitrary gear ratio function (DMR function), set the following:
- Parameters (No. 4171 to No. 4174) for the numerator/denominator of an arbitrary gear ratio between the motor sensor and spindle

*3 When using the detection arbitrary gear ratio function (DMR function) with a motor containing a built-in αiMZ sensor, set bit 6 of No. 4007 to 1 so that the alarms related to the position feedback signal (when non-Cs contouring control is exercised) are not detected.

*4 When using the command arbitrary gear ratio function (CMR function), set the following:
- Enable the setting of the command arbitrary gear ratio function (CMR) on rigid tapping (bit 7 of No. 4006 = 1).
- Set the parameters for specifying the number of gear teeth on the spindle side (No. 5221 to No. 5224).
- Set the parameters for specifying the number of gear teeth on the position coder side (No. 5231 to No. 5234).

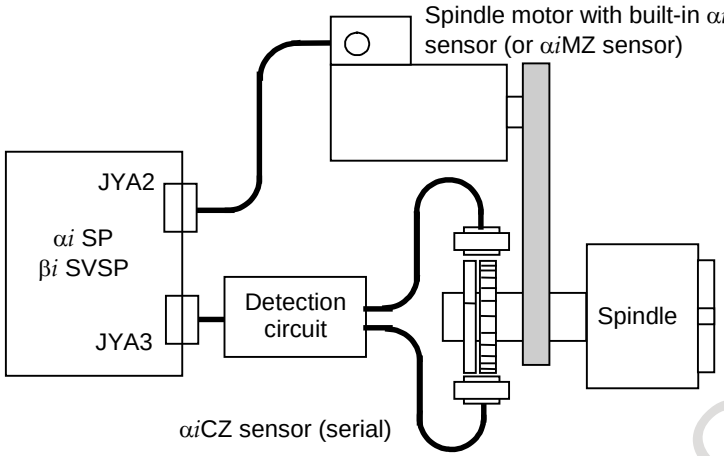
*5 Reference position return can be performed when a motor with a built-in αiMZ sensor is used and the spindle is directly connected to the motor or the spindle is connected to the motor at a ratio of 1:1.

(6) When the separate type αiBZ sensor or separate type αiCZ sensor (analog) is used

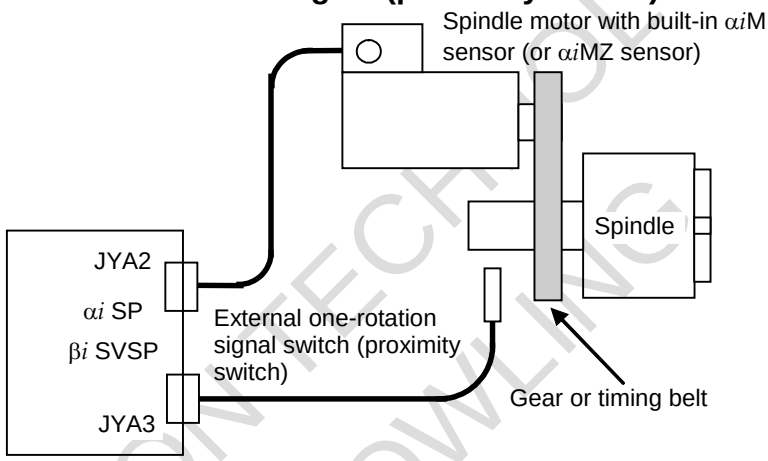


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(7) When the separate type αiCZ sensor (serial) is used



(8) When the external one-rotation signal (proximity switch) is used



NOTE

*1 When using the external one-rotation signal (proximity switch), use the detection arbitrary gear ratio function (DMR function).

*2 When using the detection arbitrary gear ratio function (DMR function), set the following:
- Parameters (No. 4171 to No. 4174) for the numerator/denominator of an arbitrary gear ratio between the motor sensor and spindle

*3 Set the type of the external one-rotation signal (proximity switch) (bits 3 and 2 of No. 4004).

*4 For stable detection of the one-rotation signal, set a reference position return speed (No. 4074) from 50 to 100 min^{-1} according to the specification of the used external one-rotation signal (proximity switch).
However, if problems not occur such as instability stop position by increasing the reference position return speed, you can use the value higher than 100 min^{-1} .

*5 When orientation based on the external one-rotation signal is used together, match the reference position return speed and direction with the orientation speed and direction.

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2.3.5 List of I/O Signals (CNC↔PMC)

This Subsection provides a list of the I/O signals related to rigid tapping only. For details of each signal, refer to "RIGID TAPPING" of the CONNECTION MANUAL (FUNCTION) of each CNC.

For details of the I/O signals common to the CNCs, see Chapter 3, "I/O SIGNALS (CNC↔PMC)", in Part I.

(1) Input signals (PMC→CNC)

(a) Series 0*i*

	#7	#6	#5	#4	#3	#2	#1	#0
G027							SWS2 (*1)	SWS1 (*1)
G028						GR2	GR1	
G029							GR22 (*2)	GR21 (*2)
G061								RGTAP

NOTE
*1 The rigid tapping of the second spindle is available by the multi-spindle control function.
When SWS1 is set to 1 (regardless of whether SWS2 is set to 0 or 1), rigid tapping is performed using the 1st spindle. When SWS1 is set to 0, and SWS2 is set to 1, rigid tapping is performed using the 2nd spindle.
*2 This signal is used when the rigid tapping of the second spindle.
According to the GR21 signal, the individual gear parameters for gear 1 or 2, also used for the 1st spindle, are selected.

(b) Series 30*i*

	#7	#6	#5	#4	#3	#2	#1	#0
G027							SWS2 (*1)	SWS1 (*1)
G028						GR2	GR1	
G029							GR22 (*2)	GR21 (*2)
G061								RGTAP

NOTE
*1 The rigid tapping of the second spindle is available by the multi-spindle control function.
When SWS1 is set to 1 (regardless of whether SWS2 is set to 0 or 1), rigid tapping is performed using the 1st spindle. When SWS1 is set to 0, and SWS2 is set to 1, rigid tapping is performed using the 2nd spindle.
*2 This signal is used when the rigid tapping of the second spindle.

(c) Common to CNCs

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G070	G070			SFRA	SRVA	CTH1A	CTH2A		
2nd-	G074	G074			SFRB	SRVB	CTH1B	CTH2B		

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(2) Output signals (CNC→PMC)

(a) Series 0*i*

	#7	#6	#5	#4	#3	#2	#1	#0
F034						GR3O (*1)	GR2O (*1)	GR1O (*1)
F065							RGSPM (*1)	RGSPP (*1)
F076					RTAP			

NOTE
*1 These signals are effective when M series.

(b) Series 30*i*

	#7	#6	#5	#4	#3	#2	#1	#0
F034						GR3O (*1)	GR2O (*1)	GR1O (*1)
F065							RGSPM (*1)	RGSPP (*1)
F076					RTAP			

NOTE
*1 These signals are effective when M series.

2.3.6 Sequence

For a rigid tapping sequence, refer to "RIGID TAPPING" of the CONNECTION MANUAL (FUNCTION) of each CNC.

2.3.7 Related Parameters

Parameter No.		Description
0*i*	30*i*	
5210	5210	M code of rigid tapping command
5202#0	5202#0	Whether to perform orientation (reference position return) when starting rigid tapping
3720	3720	Number of pulse of the position coder
5221 5222 5223 5224	5221 5222 5223 5224	Teeth number of spindle side at arbitrary gear ratio (command) setting (No. 5224 is used for the T series only.)
5231 5232 5233 5234	5231 5232 5233 5234	Teeth number of position coder side at arbitrary gear ratio (command) setting (No. 5234 is used for the T series only.)
5280 5281 to 5284	5280 5281 to 5284	Position gain of tapping axis at rigid tapping (No. 5284 is used for the T series only.)
5241 5242 5243 5244	5241 5242 5243 5244	Spindle maximum speed at rigid tapping (No. 5244 is used for the T series only.)
5261 5262 5263 5264	5261 5262 5263 5264	Acc/Dec time constant (No. 5264 is used for the T series only.)

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Parameter No.		Description
0*i*	30*i*	
5200#4	5200#4	Override selection at extracting
5211	5211	Override value at extracting
5201#2 5271 to 5274	5201#2 5271 to 5274	Time constant at extracting (No. 5274 is used for the T series only.)
5203#2	5203#2	Feed-forward function at rigid tapping
5300	5300	In-position width of tapping axis
5301	5301	In-position width of spindle
5310	5310	Allowable level of position error of tapping axis at moving
5311	5311	Allowable level of position error of spindle at moving
5312	5312	Allowable level of position error of tapping axis at stop
5313	5313	Allowable level of position error of spindle at stop
5321 5322 to 5324	5321 5322 to 5324	Backlash of spindle (No. 5324 is used for the T series only.)
5203#5	5203#5	Selection of the bell-shaped acceleration/deceleration function for rigid tapping (the CNC software option (bell-shaped acceleration/deceleration for rigid tapping) is required.)
5365 5366 5367 5368	5365 5366 5367 5368	Bell-shaped acceleration/deceleration time constant for rigid tapping (No. 5368 is used for the T series only.)
4000#4	4000#4	Reference position return direction on servo mode
4002#5	4002#5	Whether to enable the rotation direction signal (SFR/SRV) on servo mode
4006#7	4006#7	Setting of the command arbitrary gear ratio function (CMR) on rigid tapping
4016#4	4016#4	Setting related to the motor voltage control characteristics on Cs contouring control or servo mode
4017#7	4017#7	Shortcut function when orientation is specified in stop state
4037	4037	Velocity loop feed-forward coefficient
4044 4045	4044 4045	Velocity loop proportional gain on servo mode/spindle synchronous control (It is selected by input signal CTH1A/B.)
4052 4053	4052 4053	Velocity loop integral gain on servo mode/spindle synchronous control (It is selected by input signal CTH1A/B.)
4056 to 4059	4056 to 4059	Gear ratio between spindle and motor (It is selected by input signal CTH1A or CTH2A)
4065 to 4068	4065 to 4068	Spindle position gain on servo mode/spindle synchronous control (It is selected by input signal CTH1A or CTH2A)
4073	4073	Grid shift amount on servo mode
4074	4074	Reference position return speed on Cs contouring control/servo mode
4085	4085	Motor voltage (for high-speed characteristics) on servo mode/spindle synchronous control
4137	4137	Motor voltage (for low-speed characteristics) on servo mode/spindle synchronous control
4091	4091	Position gain change ratio at reference position return time on servo mode
4099	4099	Delay time for stable motor excitation
4171 4173	4171 4173	Denominator of an arbitrary gear ratio between the motor sensor and spindle (A parameter is selected by the input signal CTH1A.)
4172 4174	4172 4174	Numerator of an arbitrary gear ratio between the motor sensor and spindle (A parameter is selected by the input signal CTH1A.)
4344 (*)	4344 (*)	Advanced preview feed-forward coefficient (*) This parameter sets the coefficient for rapid traverse when bit 4 of parameter No. 4542 is 1.
4406	4406	Acceleration/deceleration time constant for Cs contouring control/servo mode
4540#1	4540#1	Setting related to motor voltage control characteristics on servo mode
4542#4	4542#4	Cutting feed/rapid traverse feed-forward function
4549#1	4549#1	Setting for FSSB high-speed rigid tapping

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Parameter No.		Description
0*i*	30*i*	
4627 (*)	4627 (*)	Advanced preview feed-forward coefficient for cutting feed (*) This parameter is valid when bit 4 of parameter No. 4542 is 1.

NOTE
*1 For the parameters related to detectors, see Section 1.3, “PARAMETERS RELATED TO DETECTORS” in the Part I.
*2 For velocity loop proportional/integral gain adjustment, see Section 4.1, “VELOCITY LOOP GAIN ADJUSTMENT”, in Part I.

2.3.8 Details of Related Parameters

This Subsection details the serial spindle parameters (in the four thousands) among the parameters related to rigid tapping. For details of other parameters, refer to “RIGID TAPPING” of the CONNECTION MANUAL (FUNCTION) of each CNC.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4000	4000				RETSV				

RETSV Reference position return direction on servo mode (rigid tapping/spindle positioning)
0 : The spindle performs a reference position return operation in the CCW(counterclockwise) direction.
1 : The spindle performs a reference position return operation in the CW(clockwise) direction.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4002	4002			SVMDRT					

SVMDRT Whether to enable the rotation direction signal (SFR/SRV) function on servo mode (rigid tapping/spindle positioning)
0 : Enables the rotation direction function.
If a move command from the CNC is positive (+),
(a) The spindle rotates in the CCW direction when the input signal SFR (bit 5 of G70) = 1.
(b) The spindle rotates in the CW direction when the input signal SRV (bit 4 of G70) = 1.
1 : Disables the rotation direction function.
If a move command from the CNC is positive (+), the spindle rotates in the CCW direction when the input signal SFR = 1 or SRV = 1.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4006	4006	RGTCMR							

RGTCMR Sets the command arbitrary gear ratio function (CMR) on rigid tapping.
0 : Disables the command arbitrary gear ratio function.
1 : Enables the specified arbitrary gear ratio function.
Set this parameter to 1 when rigid tapping is performed using a signal from the sensor built-into the motor as a position feedback signal and the gear ratio between the motor and spindle is other than 1:1.
When using the command arbitrary gear ratio function (CMR function), set the following as well:

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- Enabling an arbitrary gear ratio between the spindle and position coder (bit 1 of No. 5200 = 1)
- Parameters for the number of gear teeth on the spindle side (No. 5221 to No. 5224)
- Parameters for the number of gear teeth on the position coder side (No. 5231 to No. 5234)

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4016	4016				**IDLPTN**				

IDLPTN Setting related to the motor voltage control characteristics on Cs contouring control or servo mode (rigid tapping)
Set this bit to 1 when setting a value less than 100 as the motor voltage on Cs contouring control (No. 4086) or as the motor voltage on servo mode (No. 4085).

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4017	4017	**NRROEN**							

NRROEN Specifies whether to use the shortcut function when orientation is specified in the stop state.
0 : Does not use the function.
1 : Uses the function.
When the setting is 1, shortcut operation is performed when the following conditions are satisfied:
i) Bit 7 (RFCHK3) of parameter No. 4016 is set to 0.
ii) Zero speed detection output signal SSTA is set to 1.
iii) Shortcut command input signal NRROA is set to 1.

0*i*	30*i*	
4037	4037	**Velocity loop feed-forward coefficient**

Unit of data :
Valid data range : 0 to 32767
Initial setting value : 0

This parameter sets a velocity loop feed-forward coefficient for using feed-forward control. Set the result of calculation of the following expression:

$$\text{Setting} = 214466 \times \frac{[\text{spindle inertia} + \text{rotor inertia}](\text{kg}\cdot\text{m}^2)}{\text{Maximum motor torque (N}\cdot\text{m)}}$$

0*i*	30*i*		
4044	4044	**Velocity loop proportional gain on servo mode/spindle synchronous control (HIGH)**	**CTH1A=0**
4045	4045	**Velocity loop proportional gain on servo mode/spindle synchronous control (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting value : 10

These parameters set a velocity loop proportional gain on servo mode (rigid tapping/spindle positioning) or spindle synchronous control.
When the input signal CTH1A = 0, (HIGH) is selected. When the input signal CTH1A = 1, (LOW) is selected.

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0*i*	30*i*		
4052	4052	**Velocity loop integral gain on servo mode/spindle synchronous control (HIGH)**	**CTH1A=0**
4053	4053	**Velocity loop integral gain on servo mode/spindle synchronous control (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting value : 10

These parameters set a velocity loop integral gain on servo mode (rigid tapping/spindle positioning) or spindle synchronous control.
When the input signal CTH1A = 0, (HIGH) is selected. When the input signal CTH1A = 1, (LOW) is selected.

0*i*	30*i*		
4056	4056	**Gear ratio (HIGH)**	**CTH1A=0, CTH2A=0**
4057	4057	**Gear ratio (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4058	4058	**Gear ratio (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4059	4059	**Gear ratio (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : (Motor rotation for one rotation of spindle) / 100
(When parameter No. 4006 #1 (GRUNIT) is 1, motor rotation / 1000)
(When parameter No. 4005 #5 is 1, motor rotation / 10)
Valid data range : 0 to 32767
Initial setting value : 100

These data are used to set the gear ratio between spindle and spindle motor.
Example :
When the spindle rotates once, set “250” as the data when the motor rotates 2.5 times.
A parameter is selected with the CTH1A and CTH2A input signals.
Set the gear or clutch status to correspond to the clutch/gear signal (CTH1A, CTH2A) in input signals.

NOTE
When an improper value is set in these parameters, an unexpected operation can occur. For example, the spindle can continue rotating without stopping at the time of orientation. So, be sure to set a proper gear ratio.

0*i*	30*i*		
4065	4065	**Spindle position gain on servo mode/spindle synchronous control (HIGH)**	**CTH1A=0, CTH2A=0**
4066	4066	**Spindle position gain on servo mode/spindle synchronous control (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4067	4067	**Spindle position gain on servo mode/spindle synchronous control (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4068	4068	**Spindle position gain on servo mode/spindle synchronous control (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : $0.01sec^{-1}$
Valid data range : 0 to 32767
Initial setting value : 1000

These parameters set a position gain on servo mode (rigid tapping/spindle positioning) or spindle synchronous control.
A parameter is selected according to the input signals CTH1A and CTH2A.

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0*i*	30*i*	
4073	4073	**Grid shift amount on servo mode**

Unit of data : 1 pulse unit (360 degrees/4096)
Valid data range : 0 to 4095
Initial setting value : 0

This parameter is used to shift the reference position on servo mode (rigid tapping/spindle positioning).
The reference position of the spindle is shifted in the CCW direction by the specified number of pulses.

0*i*	30*i*	
4074	4074	**Reference position return speed on Cs contouring control/servo mode**

Unit of data : 1min^{-1}
Valid data range : 0 to 32767
Initial setting value : 0

- When 0 is set
  The orientation speed is the reference position return speed in servo mode (rigid tapping/spindle positioning).
- When a value other than 0 is set
  The value set in this parameter is used as a reference position return speed on servo mode (rigid tapping/spindle positioning).

NOTE
*1 When using an external one-rotation signal (proximity switch), for stable detection of the one-rotation signal, set a reference position return speed (parameter No. 4074) from 50 to 100 min^{-1} according to the specification of the external one-rotation signal (proximity switch) you want to use.
However, if problems not occur such as instability stop position by increasing the reference position return speed, t you can use the value higher than 100min^{-1}.
*2 When using optimum orientation, set a value other than “0”.

0*i*	30*i*	
4085	4085	**Motor voltage (for high-speed characteristics) on servo mode/ spindle synchronous control**
4137	4137	**Motor voltage (for low-speed characteristics) on servo mode/ spindle synchronous control**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting value : Depends on the motor model.

These parameters set a motor voltage on servo mode (rigid tapping, spindle positioning, and so forth) and spindle synchronous control.
When performing rigid tapping, set "100" usually.
When the maximum speed for rigid tapping (in terms of motor axis) is higher than the base speed of the spindle motor (No. 4100 for high-speed characteristics and No. 4138 for low-speed characteristics), set a value less than "100" as the motor voltage for rigid tapping (No. 4085 for high-speed characteristics and No. 4137 for low-speed characteristics), according to the following expression:

$$\text{Motor voltage (\%)} = 100 \times \frac{\text{Spindle motor base speed}}{\text{Maximum speed for rigid tapping (in terms of motor axis)}}$$

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In this case, set "1" for the setting related to the motor voltage control characteristics (bit 4 of parameter No. 4016) or the setting related to the motor voltage control characteristics on servo mode (bit 1 of parameter No. 4540).

0*i*	30*i*	
4091	4091	**Position gain change ratio at reference position return time on servo mode**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting value : 100

This parameter sets a position gain change ratio at reference position return time on servo mode (rigid tapping, spindle positioning, and so forth).

NOTE
An overshoot can occur at reference position return time for a cause such as an excessively high reference position return speed and an excessively large spindle inertia. In this case, an overshoot can be avoided by setting a small value in this parameter.

0*i*	30*i*	
4099	4099	**Delay time for stable motor excitation**

Unit of data : 1ms
Valid data range : 0 to 32767
Initial setting value : 0

This parameter sets a period of time required until motor excitation becomes stable at the time of switching to rigid tapping or Cs contouring control.

NOTE
In switching from the velocity control mode to rigid tapping mode, the stop time excessive error alarm can be issued intermittently. This is because the excitation state of the spindle motor changes abruptly, and therefore a transient state occurs in the motor, thus moving the motor shaft slightly.
In such a case, set this parameter. In general, set a value from about 300 to 400 (300 to 400 msec).

0*i*	30*i*		
4171	4171	**Denominator of an arbitrary gear ratio between the motor sensor and spindle (HIGH)**	**CTH1A=0**
4172	4172	**Numerator of an arbitrary gear ratio between the motor sensor and spindle (HIGH)**	**CTH1A=0**
4173	4173	**Denominator of an arbitrary gear ratio between the motor sensor and spindle (LOW)**	**CTH1A=1**
4174	4174	**Numerator of an arbitrary gear ratio between the motor sensor and spindle (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting value : 0

These parameters set conversion coefficients (numerator, denominator) for using the detection arbitrary gear ratio function (DMR function) by multiplying a motor sensor (αiM sensor or αiMZ sensor) feedback signal by a gear ratio to produce a spindle position feedback signal.

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When the spindle rotates Q times while the motor shaft rotates P times (there is no common divisor other than 1 for P and Q), the settings are:

No. 4171 (No. 4173 when CTH1A = 1) = P
No. 4172 (No. 4174 when CTH1A = 1) = Q

When 0 is set in any of these parameters, the setting of 1 is assumed.

NOTE
When using the external one-rotation signal (proximity switch), use the detection arbitrary gear ratio function (DMR function) by setting an arbitrary gear ratio between the motor sensor and spindle with this parameter.

0*i*	30*i*	
4344	4344	**Advanced preview feed-forward coefficient**

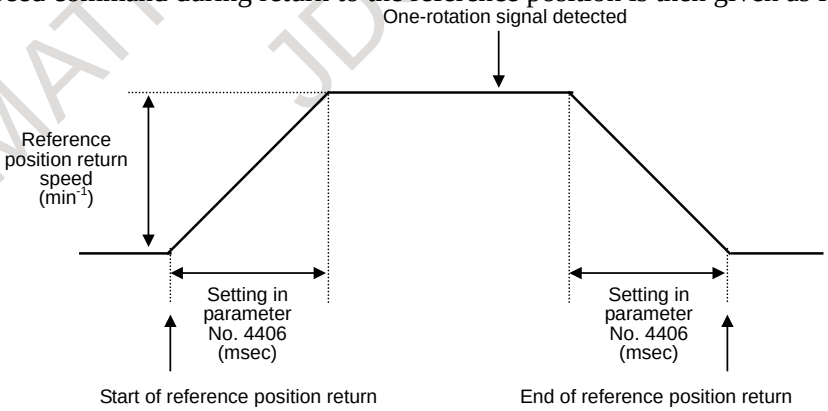
Unit of data : 0.01%
Valid data range : 0 to 10000
Initial setting value : 0

This parameter sets a feed-forward coefficient for using feed-forward control. Set the same value as for the servo axis simultaneously subjected to interpolation.

0*i*	30*i*	
4406	4406	**Acceleration/deceleration time constant for reference position return on Cs contouring control/servo mode**

Unit of data : 1msec
Valid data range : 0 to 32767
Initial setting value : 0

This parameter sets a reference position return acceleration for Cs contouring control or servo mode (rigid tapping/spindle positioning). Use of this parameter can reduce the shock due to acceleration/deceleration during return to the reference position. The spindle speed command during return to the reference position is then given as follows:



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NOTE
*1 When 0 is set in this parameter, a velocity command is assumed as follows.
- Before detecting the one-rotation signal: Reference position return speed (step-type velocity command)
- After detecting the one-rotation signal: Distance to the reference position × Position gain

*2 This parameter is enabled when soft start/stop signal SOCNA is 1.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4540	4540							EXPTRG	

EXPTRG Setting related to the motor voltage control characteristics on servo mode (rigid tapping)
Set this bit to 1 when setting a value less than 100 as the motor voltage on servo mode (parameter No. 4085).
This bit is valid only for the setting for the motor voltage on servo mode (parameter No. 4085).

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4542	4542				FFCHG				

FFCHG The cutting feed/rapid traverse feed-forward function is:
0: Disabled.
1: Enabled.

NOTE
1 This parameter is valid with 9D8A series C (03) edition or later, 9D90 series R (18) edition or later, 9DA0 series U (21) edition or later and 9DB0 series A (01) edition or later.
2 When setting '1' in this parameter, set '1' in bit 3 (FFR) of parameter No. 1800 (feed-forward control for rapid traverse is enabled).

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4549	4549							FHRSP	

FHRSP Setting for FSSB high-speed rigid tapping
0 : FSSB high-speed rigid tapping is disabled.
1 : FSSB high-speed rigid tapping is enabled.

0*i*	30*i*	
4627	4627	Advanced preview feed-forward coefficient for cutting feed

Unit of data : 0.01%
Valid data range : 0 to 10000
Initial setting value : 0
This parameter sets an advanced preview feed-forward coefficient for cutting feed. Set the same value as for the servo axis simultaneously subjected to interpolation.

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NOTE
1 This parameter is valid with 9D8A series C (03) edition or later, 9D90 series R (18) edition or later, 9DA0 series U (21) edition or later and 9DB0 series A (01) edition or later.
2 This parameter is valid when the cutting feed/rapid traverse feed-forward function is enabled (bit 4 of parameter No. 4542 is 1).

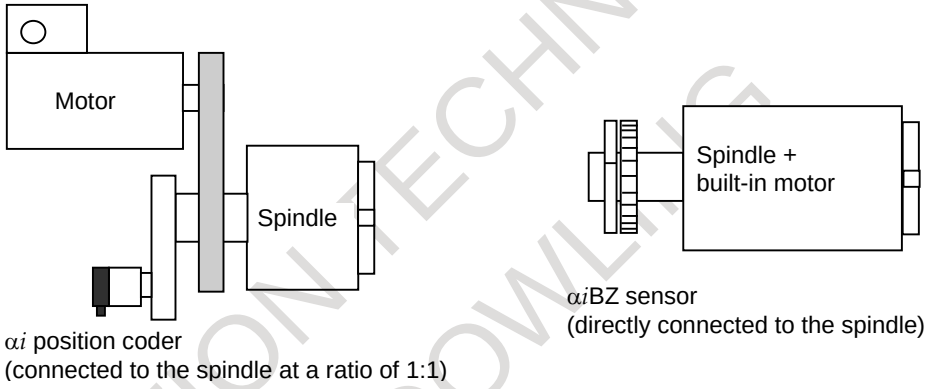
2.3.9 Parameter Setting Procedure

(1) Command arbitrary gear ratio (CMR)

(a) For a configuration in which the sensor built into the motor is used for position detection and the gear ratio between the spindle and motor is not 1:1, as shown in sample system configuration 2 below, the command arbitrary gear ratio (CMR) is used.

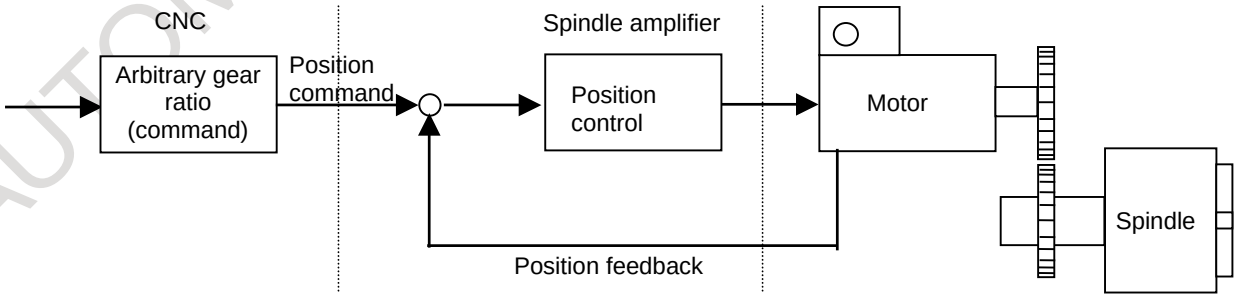
[Sample system configuration 1]

When the position detector is connected to the spindle at a ratio of 1:1, the command arbitrary gear ratio (CMR) function is not used.



[Sample system configuration 2]

When the sensor built into the motor is used as the position detector in a configuration in which the gear ratio between the spindle and motor is not 1:1, the command arbitrary gear ratio (CMR) function is used.

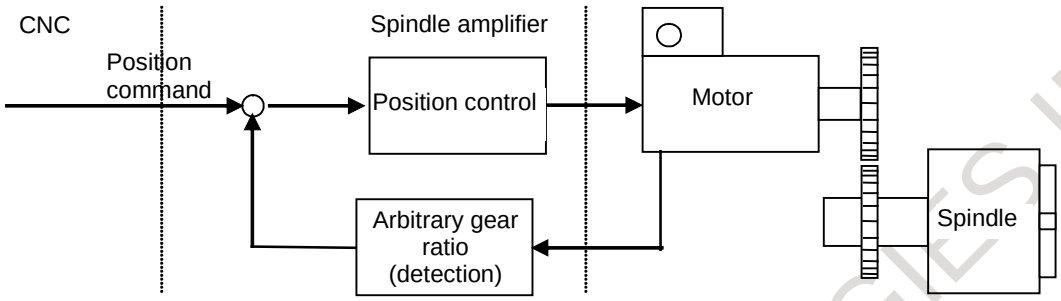


NOTE
This system configuration also enables the detection arbitrary gear ratio function (DMR function) to be used.

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[Sample system configuration 3]

When orientation by the external one-rotation signal is used in a configuration in which the gear ratio between the spindle and motor is not 1:1, the detection arbitrary gear ratio function (DMR function) is used, and the command arbitrary gear ratio function (CMR function) is not used.



(b) To use the command arbitrary gear ratio (CMR), set the following parameters:

0*i*	30*i*	Setting data
4006#7	4006#7	1

0 : The command arbitrary gear ratio (CMR) is not used.
1 : Rigid tapping is performed using the command arbitrary gear ratio (CMR) with the sensor built into the motor.

(c) Set the parameter "the arbitrary gear ratio between the spindle and the position coder" according to each CNC.

[Series 0*i*-D]

(1) Set the gear teeth number of the spindle side.
Each parameter is selected according to the gear selection signal.
Standard machining [M series] : GR3O, GR2O, GR1O
Turning [T series] and machining [M series] with surface speed constant option : GR2, GR1
Second spindle of turning [T series] : GR21 (Multi-spindle control option is needed)

Standard machining [M series]

Gear signal			Parameter No.
GR1O	GR2O	GR3O	
1	0	0	5221
0	1	0	5222
0	0	1	5223

Turning [T series] and machining [M series] with surface speed constant

Gear signal			Parameter No.	
1st. sp		2nd. sp		
GR1	GR2	GR21	T series	M series
0	0	0	5221	
1	0	1	5222	
0	1	−	5223	
1	1	−	5224	5223

(2) Set the gear teeth number of the position coder side.
Each parameter is selected according to the gear selection signal.
Standard machining [M series]: GR3O, GR2O, GR1O
Turning [T series] and machining[M series] with surface speed constant option : GR2, GR1
Second spindle of turning [T series] : GR21 (Multi- spindle control option is needed)

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Standard machining [M series]

Gear signal			Parameter No.
GR1O	GR2O	GR3O	
1	0	0	5231
0	1	0	5232
0	0	1	5233

Turning [T series] and machining [M series] with surface speed constant

Gear signal			Parameter No.	
1st. sp		2nd. sp		
GR1	GR2	GR21	T series	M series
0	0	0	5231	
1	0	1	5232	
0	1	−	5233	
1	1	−	5234	5233

[Series 30*i* and Series 0*i*-F]

(1) Set the gear teeth number of the spindle side.
Each parameter is selected according to the gear selection signal.
Standard machining [M series] : GR3O, GR2O, GR1O
Turning [T series] and machining [M series] with surface speed constant option : GR2, GR1
Second spindle : GR21, GR21 (Multi-spindle control option is needed)

Standard machining [M series]

Gear signal			Parameter No.
GR1O	GR2O	GR3O	
1	0	0	5221
0	1	0	5222
0	0	1	5223

Turning [T series] and machining [M series] with surface speed constant

Gear signal		Parameter No.	
GRs1*	GRs2*	T series	M series
0	0	5221	
1	0	5222	
0	1	5223	
1	1	5224	5223

* First spindle: GR1, GR2 / Second spindle: GR21, GR22

(2) Set the gear teeth number of the position coder side.
Each parameter is selected according to the gear selection signal.
Standard machining [M series]: GR3O, GR2O, GR1O
Turning [T series] and machining[M series] with surface speed constant option: GR2, GR1
Second spindle : GR21, GR21
(Multi-spindle control option is needed)

Standard machining [M series]

Gear signal			Parameter No.
GR1O	GR2O	GR3O	
1	0	0	5231
0	1	0	5232
0	0	1	5233

Turning [T series] and machining [M series] with surface speed constant

Gear signal		Parameter No.	
GRs1*	GRs2*	T series	M series
0	0	5231	
1	0	5232	
0	1	5233	
1	1	5234	5233

* First spindle: GR1, GR2 / Second spindle: GR21, GR22

(2) Gear ratio between the spindle and the motor

The loop gain constant (position gain constant) parameter is not used in the α*i* series (serial) spindle system.
"Gear ratio between the spindle and the motor" parameter should be set instead of it.
Each parameter is selected according to the gear selection signal (CTH1A/B, CTH2A/B).

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[1st. sp]

Gear signal		Parameter No.	
CTH1A	CTH2A	0*i*	30*i*
0	0	4056(S1)	4056(S1)
0	1	4057(S1)	4057(S1)
1	0	4058(S1)	4058(S1)
1	1	4059(S1)	4059(S1)

[2nd. sp]

Gear signal		Parameter No.	
CTH1B	CTH2B	0*i*	30*i*
0	0	4056(S2)	4056(S2)
0	1	4057(S2)	4057(S2)
1	0	4058(S2)	4058(S2)
1	1	4059(S2)	4059(S2)

(3) Position gain

In rigid tapping, the tapping axis and spindle are controlled to be synchronized. So, the position gains of the tapping axis and spindle must be set to the same value.

[Series 0*i* and Series 30 *i*]

The position gain parameter of the tapping axis in the rigid tapping is selected as follows according to the gear selection signal.
Standard machining [M series]: GR3O, GR2O, GR1O
Turning [T series] and machining [M series] with surface speed constant option : GR2, GR1
Second spindle of turning [T series]: GR21 (Multi-spindle control option is needed)

Standard machining [M series]

Gear signal			Parameter No.
GR1O	GR2O	GR3O	
1	0	0	5281
0	1	0	5282
0	0	1	5283

Turning [T series] and machining [M series] with surface speed constant

Gear signal		Parameter No.	
GRs1*	GRs2*	T series	M series
		5280(*1)	
0	0	5281	
1	0	5282	
0	1	5283	
1	1	5284	5283

* First spindle: GR1, GR2 / Second spindle: GR21, GR22

NOTE
1 When this parameter is “0”, each gear parameter becomes valid.
When this parameter is not “0”, each gear parameter becomes invalid, and this parameter is always used.

The position gain parameter of the spindle in the rigid tapping is selected as follows according to the gear selection signal (CTH1A/B, CTH2A/B). (This is common T series and M series)

[1st. sp]

Gear signal		Parameter No.
CTH1A	CTH2A	
0	0	4065 (S1)
0	1	4066 (S1)
1	0	4067 (S1)
1	1	4068 (S1)

[2nd. sp]

Gear signal		Parameter No.
CTH1B	CTH2B	
0	0	4065 (S2)
0	1	4066 (S2)
1	0	4067 (S2)
1	1	4068 (S2)

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> **⚠ CAUTION**
> Take care to input the gear selection signal GR1, GR2, GR21, GR22, GR1O, GR2O, GR3O and CTH1A/B, CTH2A/B according to the real gear state in order to get the same position gain of the tapping axis and that of the spindle, because GR1, GR2, GR21, GR22, GR1O, GR2O, GR3O and CTH1A/B, CTH2A/B are inputted independently.

(4) Acceleration/deceleration time constant [Series 0*i* and Series 30*i*]

(1) Each parameter can be set for each gear and is selected according to the gear selection signal. By setting the following parameter, the different time constant between the cutting in and cutting out (extracting) becomes available.

5201 #2

0 : The same time constant between cutting in and out. (No. 5261 to 5264)

1 : The different time constant between cutting in and out.
Cutting in : No. 5261 to 5264
Cutting out: No. 5271 to 5274

Standard Machining [M series]: GR3O, GR2O, GR1O
Turning [T series] and Machining [M series] with surface speed constant : GR2, GR1
2nd. sp : GR21, GR21 (Multi- spindle control option is needed)

Standard machining [M series]

Gear signal			Time constant (Cutting in) Parameter No.	Time constant (Cutting out) Parameter No.	Spindle max. speed at rigid tapping Parameter No.
GR1O	GR2O	GR3O			
1	0	0	5261	5271	5241
0	1	0	5262	5272	5242
0	0	1	5263	5273	5243

Turning [T series] and machining [M series] with surface speed constant

Gear signal		Time constant (Cutting in) Parameter No.	Time constant (Cutting out) Parameter No.	Spindle max. speed at rigid tapping Parameter No.	
GRs1*	GRs2*			T series	M series
0	0	5261	5271	5241	5241
1	0	5262	5272	5242	5242
0	1	5263	5273	5243	5243
1	1	5264 (*1)	5274 (*1)	5244 (*1)	-

* First spindle: GR1, GR2 / Second spindle: GR21, GR22

> **NOTE**
> 1 This is not available for Machining (M series).

(2) The override at extracting.

5200 #4

0 : The override at extracting is not valid.

1 : The override at extracting is valid.
(Set override value at No. 5211)

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2.3.10 Adjustment Procedure

(1) Parameters used for adjustment

The table below lists and describes the parameters used for adjusting rigid tapping.

Parameter No. (FS0*i*,30*i*)	Description
5241 to 5244	Maximum spindle speed on rigid tapping (Depends on the GR signal. No.5244 is for the T series only.)
5261 to 5264	Acceleration/deceleration time constant on rigid tapping (Depends on the GR signal. No.5264 is for the T series only.)
5280 to 5284	Position gain of tapping axis on rigid tapping (No.5280 is for all gears. No.5281 to No.5284 depend on the GR signal. No.5284 is for T series only.)
4065 to 4068	Spindle position gain on rigid tapping (depends on CTH1A and CTH2A signals)
4044 to 4045	Velocity loop proportional gain on rigid tapping (depends on CTH1A signal)
4052 to 4053	Velocity loop integral gain on rigid tapping (depends on CTH1A signal)
4085	Motor voltage on rigid tapping (for high speed characteristics)
4137	Motor voltage on rigid tapping (for low speed characteristics)
4016#4	Motor voltage control characteristic settings on rigid tapping
4099	Delay time for motor excitation.
4540#1	Setting for motor voltage control characteristics on rigid tapping

(2) Initialization

Before adjustment, initialize the parameters related to rigid tapping with a spindle motor.

Parameter No. (FS0*i*-D,30*i*)	Initial setting
5241 to 5244	Set the maximum spindle speed on rigid tapping.
5261 to 5264	Set them with either of the methods <1> and <2> below. <1> Method to set parameters from the spindle acceleration time In velocity control mode, measure the acceleration time [ms] required to achieve the maximum spindle speed on rigid tapping (Nos. 5241 to 5244), and set the value equal to the acceleration time multiplied by 1.5 to 2. <2> Method to set the acceleration/deceleration constant from an expression $tr[\mathrm{ms}] = \frac{Jm[\mathrm{kgm}^2] + JL[\mathrm{kgm}^2]}{T\max(Nr)[\mathrm{Nm}]} \times \frac{2\pi}{60} \times Nr[\mathrm{min}^{-1}] \times Gear \times 1000 \times 1.2$ *tr* [ms] : Acceleration/deceleration time constant on rigid tapping (Nos. 5261 to 5264) *Nr* [min^{-1}] : Maximum spindle speed on rigid tapping (Nos. 5241 to 5244) *Gear* : Gear ratio data between spindle and motor (motor speed per one spindle rotation) *T*max*(Nr)* [Nm] : Maximum torque of the spindle motor at *Nr* *Jm* [kgm^2] : Rotor inertia of the spindle motor *JL* [kgm^2] : Spindle load inertia (converted for the motor shaft)
5280 to 5284	3000
4065 to 4068	3000
4044 to 4045	10
4052 to 4053	10
4085	100 When the maximum speed for rigid tapping (in terms of motor axis) is higher than the base speed of the spindle motor (No. 4100 for high-speed characteristics), set the value calculated from the following expression: Motor voltage (%)= $100 \times \frac{\text{Spindle motor base speed (No.4100)}}{\text{Maximum speed for rigid tapping (in terms of motor axis)}}$

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Parameter No. (FS0*i*-D,30*i*)	Initial setting
4137	100 When the maximum speed for rigid tapping (in terms of motor axis) is higher than the base speed of the spindle motor (No. 4138 for low-speed characteristics), set the value calculated from the following expression: $\text{Motor voltage (\%)} = 100 \times \frac{\text{Spindle motor base speed (No.4138)}}{\text{Maximum speed for rigid tapping (in terms of motor axis)}}$
4016#4	0 Set this bit to 1 when setting parameter No. 4085 or 4137 to a value less than 100.
4099	300
4540#1	0 Set this bit to 1 when setting parameter No. 4085 or 4137 to a value less than 100.

(3) Spindle data used for adjustment

Adjust the parameters while observing the motor speed, torque command, velocity error, synchronous error, and other waveform by using SERVO GUIDE. The table below lists output signals of SERVO GUIDE for observing the waveform.

Symbols in SERVO GUIDE	Output Signals
VERR	Velocity deviation
TCMD	Torque command
SYNC	Synchronization error (Converted for spindle , 4096 pulse/rev)
SPEED	Motor speed

NOTE
No. 3700, #7 = 1:
Uses the synchronous error output (maintenance function).
(Return the setting to 0 after the observation is completed.)
No. 5203, #7 = 1 :
Sets a synchronous error update cycle.
(Return the setting to 0 after the observation is completed.)
No. 5204, #0 = 0 :
Displays the synchronous error on the diagnosis screen.

(4) Adjustment procedure

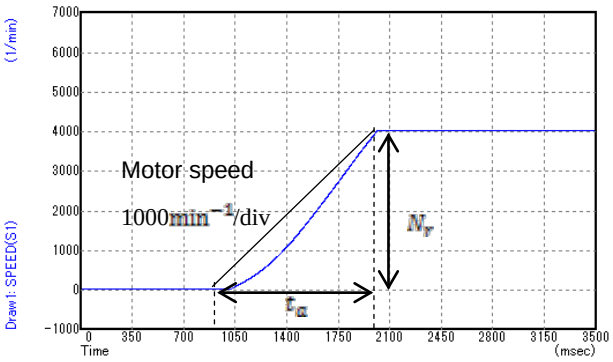
(4)-1 Specifying an acceleration/deceleration time constant (1): Specifying a provisional value

Before optimizing the acceleration/deceleration time constant, adjust the gain to improve the response. Following (a) or (b) below, specify a provisional acceleration/deceleration time constant according to the target maximum speed.

(a) Specifying a provisional time constant according to the velocity waveform in actual acceleration/deceleration

Observe the motor velocity waveform (velocity control mode) in acceleration up to the maximum rigid tapping speed. Specify such a provisional time constant that the inclination (acceleration) during rigid tapping acceleration becomes about a half of the inclination of a tangent to the motor velocity waveform near the location of maximum speed. See the sample waveform shown below.

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Nr: Maximum rigid tapping speed (No. 5241 to 5244) 4000 min^{-1} in this example
ta: Time of acceleration by the maximum torque at *Nr* About 900 ms in this example
tr: Rigid tapping acceleration/deceleration time constant (No. 5261 to 5264) 1800 ms, which is two times *ta*, in this example

In this example, the maximum rigid tapping speed *Nr* is set to 4000 min^{-1}. To determine the acceleration/deceleration time constant, the motor velocity waveform in acceleration up to 4000 min^{-1} is observed. If the acceleration is performed with the maximum motor torque at 4000 min^{-1}, the acceleration time *ta* needed to attain 4000 min^{-1} is about 900 ms, as shown above. This is the minimum value of acceleration/deceleration time constant *tr*, which can be specified without consideration of cutting load. A time constant that can be specified in consideration of cutting load is usually about 1.2 to 1.5 times this value. As a provisional value for gain adjustment, approximately double (1800ms) is specified here.

(b) Specifying a value calculated from the relationship between the maximum torque and spindle inertia

Specify an acceleration/deceleration time constant calculated from the following expression:

$$tr[\mathrm{ms}] = \frac{Jm[\mathrm{kgm}^2] + JL[\mathrm{kgm}^2]}{T\max(Nr)[\mathrm{Nm}]} \times \frac{2\pi}{60} \times Nr[\mathrm{min}^{-1}] \times GR \times 1000 \times 2$$

tr[ms] : Acceleration/deceleration time constant on rigid tapping (No. 5261 to 5264)
Nr[min^{-1}] : Maximum spindle speed on rigid tapping (No. 5241 to 5244)
GR : Spindle-motor gear ratio (Motor rotation per spindle rotation)
Tmax(Nr) [Nm]: Maximum torque of spindle motor at *Nr*
Jm[kgm^2] : Rotor inertia of spindle motor
JL[kgm^2] : Spindle load inertia(converted for the motor shaft)

(4)-2Specifying a position gain

Specify an initial value of about 2000(20 sec^{-1}) to 3000(30 sec^{-1}), then adjust the value as needed. Basically, specify identical values for the spindle and tapping axis.
After specifying the position gain, check whether the spindle is operating as designed. For that purpose, check that the position error (value displayed on the CNC screen) during stable rotation at the maximum speed is almost the same as the theoretical value. This theoretical value is calculated as shown below. If the theoretical value is substantially different, re-check the parameters related to position gain, gear ratio, and detector.

$$Perr(Nr)[pulse] = \frac{Nr[\mathrm{min}^{-1}]}{60} \times 4096[pulse/rev] \times \frac{1}{PG[\mathrm{sec}^{-1}]}$$

Perr(Nr) [pulse] : Position error in stable rotation at *Nr*
Nr [min^{-1}] : Maximum speed on rigid tapping
PG [sec^{-1}] : Position gain on rigid tapping

If the gear ratio is 1:1 at *Nr*=4000 min^{-1} and *PG*=3000 (30 sec^{-1}), the position error in stable rigid tapping at *Nr* is calculated as follows:

$$Perr(Nr) = \frac{4000}{60} \times 4096 \times \frac{1}{30} = 9102[pulse]$$

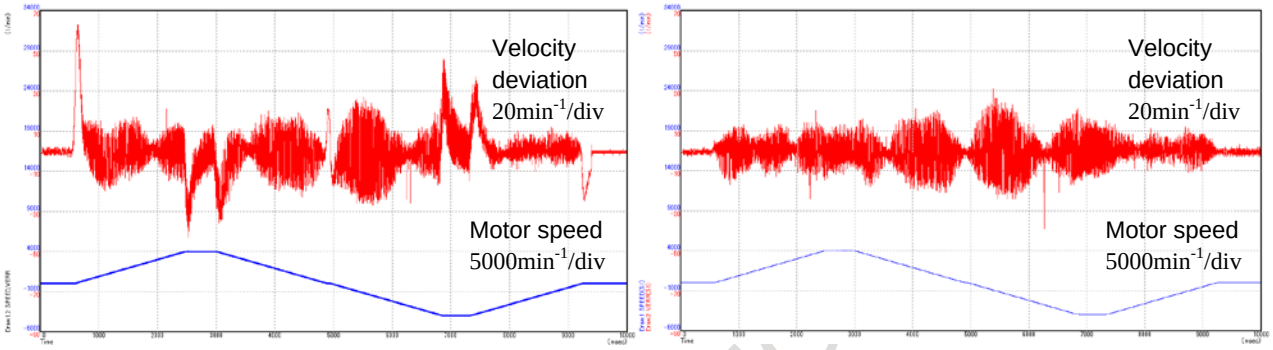
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(4)-3Specifying a velocity loop gain

Refer to Section 4.1, “VELOCITY LOOP GAIN ADJUSTMENT” for details of the velocity loop proportional/integral gain. Adjust the velocity loop proportional/integral gain so that the velocity error decreases.

During the adjustment, observe the velocity error and motor speed. Sample waveforms before and after the adjustment are shown below:

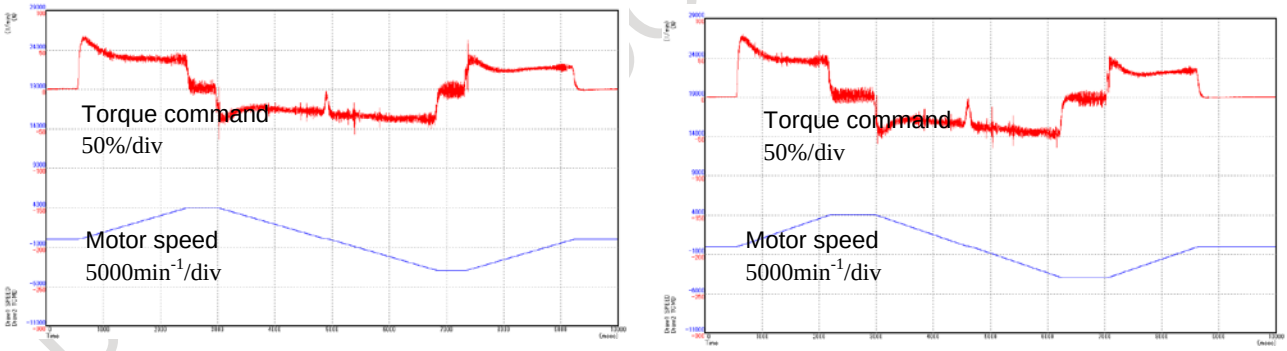
(a) Waveform before adjustment(No.4044=10,No.4052=10） (b)Waveform after adjustment(N0.4044=93,No.4052=864)



(4)-4Specifying an acceleration/deceleration time constant (2) : Specifying an optimum value

Observing the torque command and motor speed, make a final adjustment of the time constant. Adjust the time constant in consideration of the actual cutting load, so that the peak torque at air cut becomes about 70% to 80% (3.5 to 4.0 V) of the maximum value. Sample waveforms before and after the adjustment are shown below:

(a) 調整前（N0.5261=1900） (b) 調整後（N0.5261=1600）



(4)-5Checking the synchronous error

The spindle adjustment ends when the adjustments described in above procedures are completed. After the spindle adjustment, check the synchronous error between the spindle and servo axis, which will be an index of rigid tapping precision.

The synchronous error is a difference between the spindle position error and the servo axis position error converted for the spindle.

SYNCER[pulse] = *PERsp*[pulse] – *PERsv*[pulse]

SYNCER [pulse]: Synchronous error (4096 pulses per spindle rotation)
PERsp [pulse]: Spindle position error
PERsv [pulse]: Servo axis position error converted for the spindle

(4)-6Making adjustments for FSSB high-speed rigid tapping

In conventional method rigid tapping, if the spindle torque at acceleration/deceleration is saturated, the synchronous error becomes worse extremely. The acceleration/deceleration time constant must therefore be adjusted to a value with an adequate margin with respect to the spindle torque of 100%.
In contrast, FSSB high-speed rigid tapping is a method by which the servo follows up the spindle, so it is possible to prevent the synchronous error from becoming worse even when the spindle torque is saturated to some degree. The cycle time can be shorter than ever before by adjusting the acceleration/deceleration time constant so that a torque command for tapping at the maximum possible load can be used as closely as possible to 100%.
If FSSB high-speed rigid tapping is used when the torque is saturated extremely, the synchronous error does not become much worse. However, an overshoot may occur at a hole bottom. Ensure that no overshoot occurs, and then adjust the acceleration/deceleration time constant. In addition, when the optimum rigid tapping acceleration/deceleration function (option) is also used, the spindle torque can always be used up to the limit according to the tapping speed, so the effect of FSSB high-speed rigid tapping is further enhanced.
For details of adjustments, see Section 5.17, “ADJUSTING FSSB HIGH-SPEED RIGID TAPPING”.

2.3.11 Diagnosis (Diagnosis Screen)

This Subsection provides a list of the diagnosis (diagnosis screen) indications related to rigid tapping only. For details, refer to “RIGID TAPPING” of the CONNECTION MANUAL (FUNCTION) of each CNC.

(1) Series 0*i*

Address	Description	Unit
0300	Position error pulse of the tapping axis (error)	Pulse
0450	Position error pulse of the spindle (error)	Pulse
0451	Interpolation pulse of the spindle	Pulse
0454	Integrated interpolation pulse of the spindle	Pulse
0455	Difference of move command converted for the spindle (instantaneous)	Pulse
0456	Difference of position error converted for the spindle (instantaneous)	Pulse
0457	(In terms of spindle) Width of synchronous error (maximum)	Pulse

Note
Note the following data:
0455: Difference of move command converted for the spindle (instantaneous)
0456: Difference of position error converted for the spindle (instantaneous)
0457: (In terms of spindle) Width of synchronous error (maximum)
The data is displayed only when bit 0 (DGN) of parameter No. 5204 is set to 0. Usually, set 0.

(2) Series 30*i*

Address	Description	Unit
0300	Position error pulse of the tapping axis (error)	Pulse
0450	Position error pulse of the spindle (error)	Pulse
0451	Interpolation pulse of the spindle	Pulse
0454	Integrated interpolation pulse of the spindle	Pulse
0455	Difference of move command converted for the spindle (instantaneous)	Pulse
0456	Difference of position error converted for the spindle (instantaneous)	Pulse
0457	(In terms of spindle) Width of synchronous error (maximum)	Pulse

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2.3.12 Alarm

This Subsection provides a list of the alarms related to rigid tapping only. For details, refer to "RIGID TAPPING" of the CONNECTION MANUAL (FUNCTION) of each CNC.

(1) Series 0*i*

(a) Program error (P/S Alarm)

Alarm number	Description
PS0200	S command is over the range or not inputted.
PS0201	F command is not inputted.
PS0202	The interpolation pulse for the spindle is over the range
PS0203	The commanded place of M29 or S command is not proper.
PS0204	The axis move command is inserted between M29 and G84 (G74).
PS0205	The rigid mode input signal is not ON during G84 (G74) although M29 is commanded. The rigid mode DI signal does not go ON. The rigid mode input signal goes OFF during the rigid tapping.
PS0206	The plane change is commanded during the rigid tapping. (M series only)
PS0207	In rigid tapping, the lead is too short or too long. (M series only)

(b) Servo alarm

Alarm number	Description
SV0410	The position error of the tapping axis or the spindle at stop exceeds the alarm level.
SV0411	The position error of the tapping axis or the spindle at moving exceeds the alarm level.
SV0413	Tapping axis LSI overflow (error counter overflow)
SP0740	Position error at rest on the spindle side is larger than the predetermined value (No. 5313).
SP0741	The positional deviation during movement on the spindle side is larger than the setting of No. 5311, or the synchronous error is larger than the setting of No. 5214.
SP0742	Spindle LSI overflow (error counter overflow)

(2) Series 30*i*

(a) Program error (P/S Alarm)

Alarm number	Description
PS0200	S command is over the range or not inputted.
PS0201	F command is not inputted.
PS0202	The interpolation pulse for the spindle is over the range
PS0203	The commanded place of M29 or S command is not proper.
PS0204	The axis move command is inserted between M29 and G84 (G74).
PS0205	The rigid mode input signal is not ON during G84 (G74) although M29 is commanded. The rigid mode DI signal does not go ON. The rigid mode input signal goes OFF during the rigid tapping.
PS0206	The plane change is commanded during the rigid tapping. (M series only)
PS0207	In rigid tapping, the lead is too short or too long. (M series only)

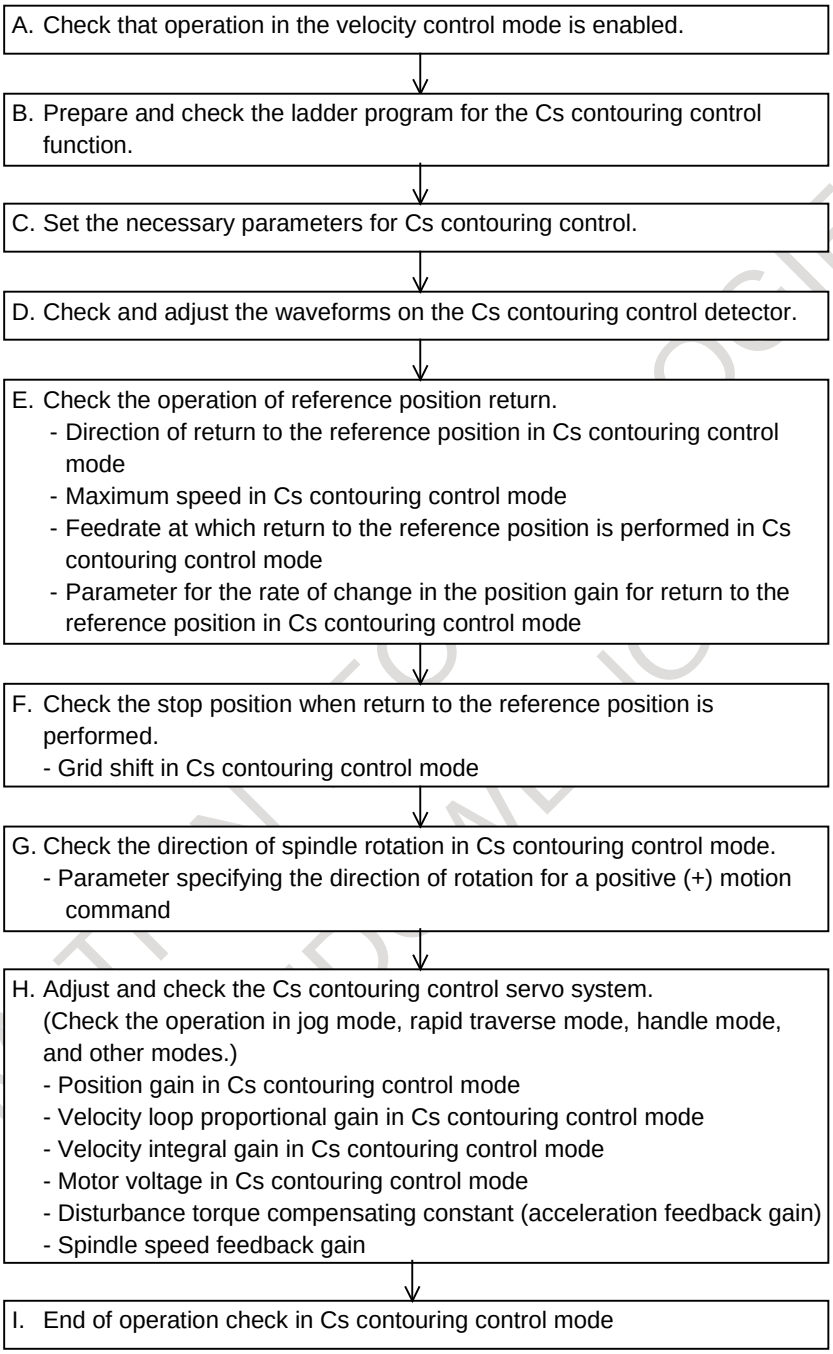
(b) Servo alarm

Alarm number	Description
SV0410	The position error of the tapping axis or the spindle at stop exceeds the alarm level.
SV0411	The position error of the tapping axis or the spindle at moving exceeds the alarm level.
SV0413	Tapping axis LSI overflow (error counter overflow)
SP0740	Position error at rest on the spindle side is larger than the predetermined value (No. 5313).
SP0741	The positional deviation during movement on the spindle side is larger than the setting of No. 5311, or the synchronous error is larger than the setting of No. 5214.
SP0742	Spindle LSI overflow (error counter overflow)

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2.4 Cs CONTOURING CONTROL (OPTIONAL FUNCTION)

2.4.1 Start-up Procedure



2.4.2 Overview

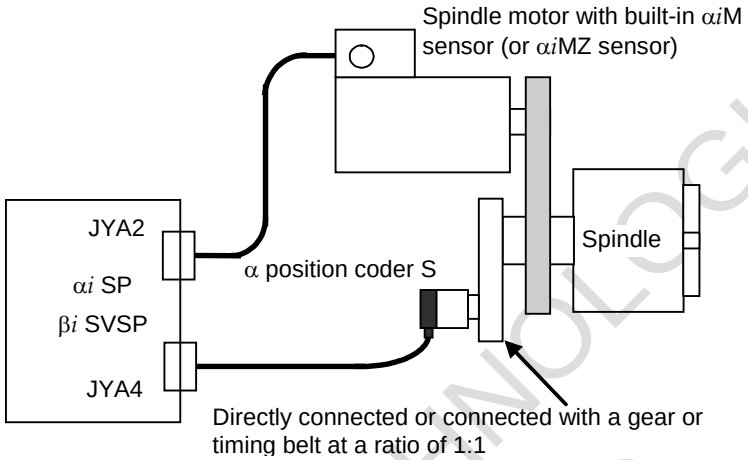
Cs contouring control is a function for exercising position control by handling the spindle as a CNC controlled axis with an αiMZ sensor, αiBZ sensor, αiCZ sensor (analog, serial), or α position coder S. This function enables positioning and interpolation with another servo axis. This means that linear interpolation, circular interpolation, and so forth can be specified between the spindle and a servo axis.

NOTE
To use this function, the CNC software option is required.

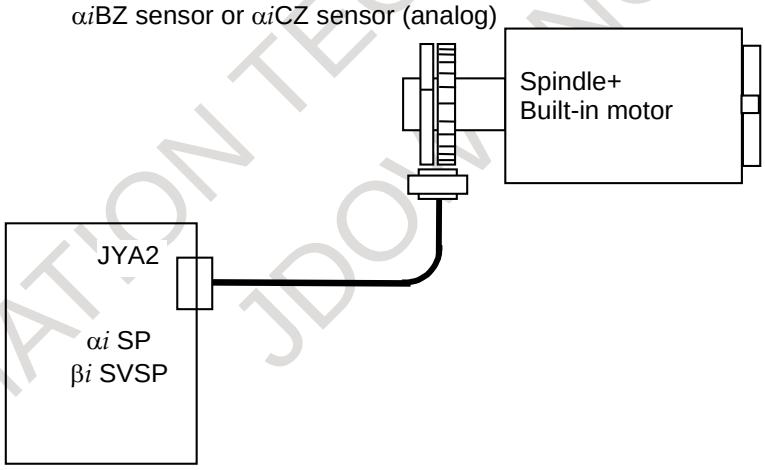
2.4.3 System Configuration

The system configurations that enable the use of the Cs contouring control function are shown below.

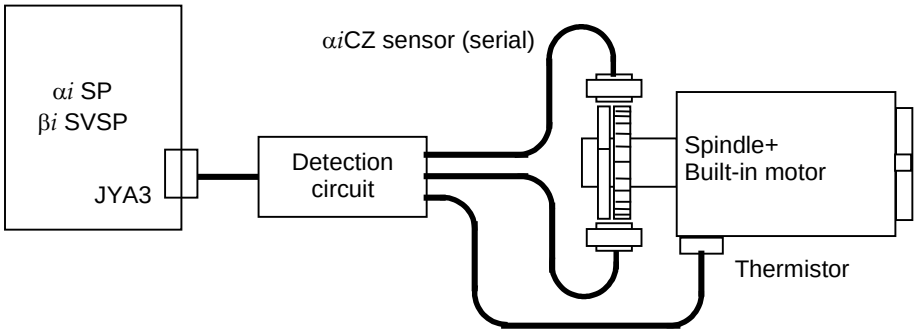
(1) When the α position coder S is used



(2) When the built-in motor (αiBZ sensor, αiCZ sensor (analog)) is used



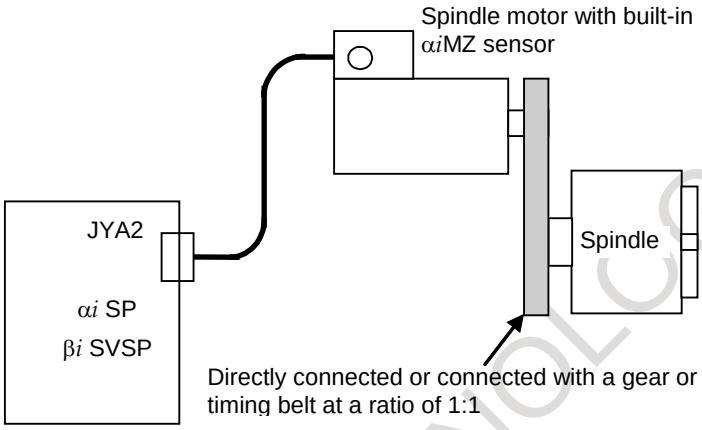
(3) When the built-in motor (αiCZ sensor (serial)) is used



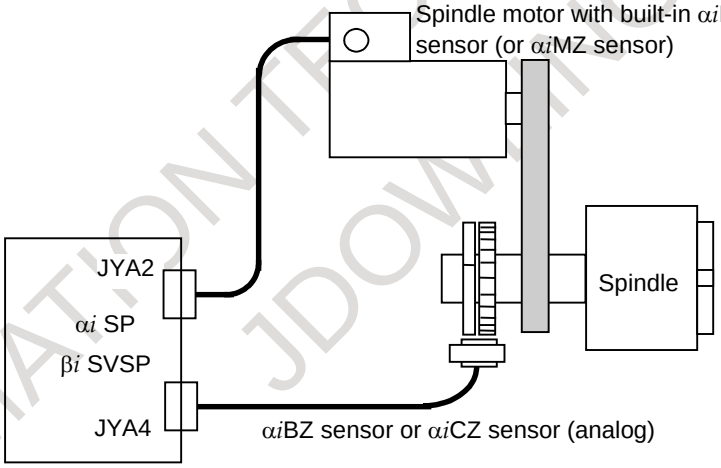
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NOTE
In a configuration in which the αiCZ sensor (serial) is used as a motor sensor, to start Cs contouring control immediately after the power on, use spindle software 9D80 series H (08) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later and 9DB0 series A (01) edition or later.

(4) When the spindle motor with built-in αiMZ sensor is used

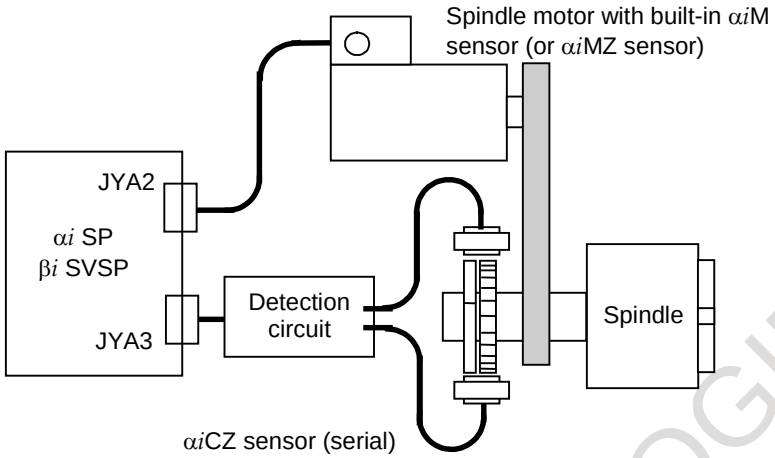


(5) When the separate type αiBZ sensor or separate type αiCZ sensor (analog) is used



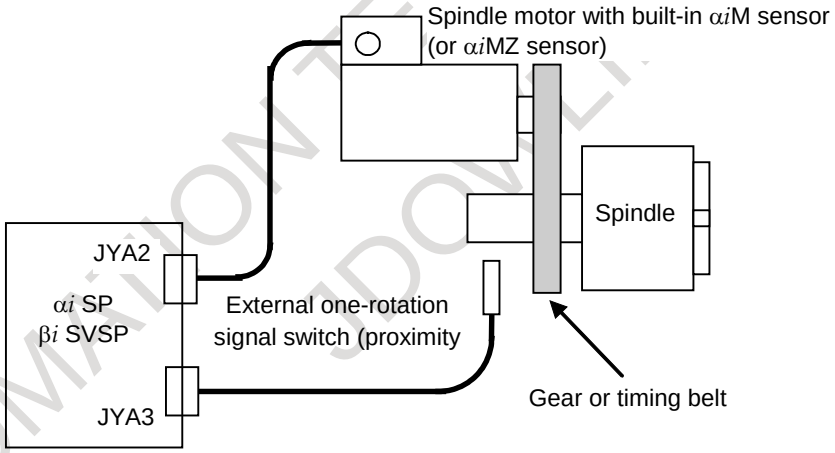
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(6) When the separate type αiCZ sensor (serial) is used



NOTE
In a configuration in which the αiCZ sensor (serial) is used as a spindle sensor, to start Cs contouring control immediately after the power on, use spindle software 9D80 series H (08) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later and 9DB0 series A (01) edition or later.

(7) When the external one-rotation signal (proximity switch) is used

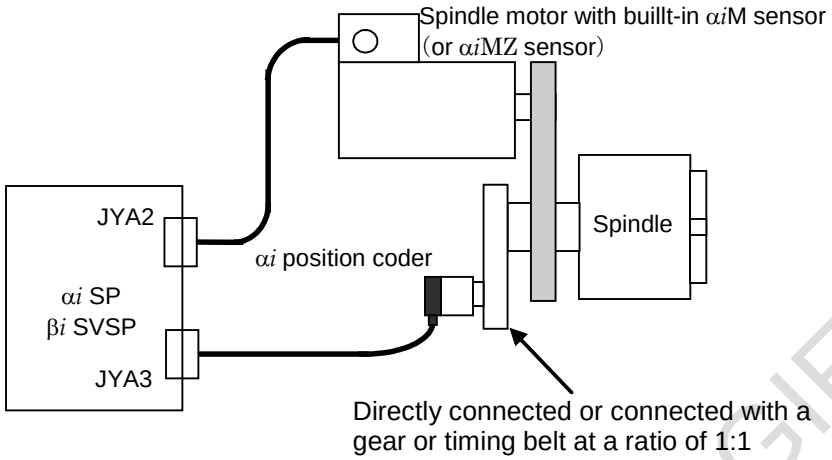


NOTE
*1 Set the type of the external one-rotation signal (proximity switch) (bits 3 and 2 of No. 4004).
*2 When using the detection arbitrary gear ratio function (DMR function), set the following:
- Parameters (No. 4171 to No. 4174) for the numerator/denominator of an arbitrary gear ratio between the motor sensor and spindle

*3 In the case of proximity switch, it becomes unstable detected position of one rotation signal by the response of sensor and the rotational direction and speed at the time of direction. Also, positioning accuracy depends on the gear accuracy and backlash.

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(8) When an αi position coder is used



When an αi position coder is used to spindle sensor, the resolution of feedback is 4096p/rev but functionally Cs contouring control operation is possible. For performing Cs contouring control in this configuration, set the following parameters.

Parameter (0*i*)	Setting	Description
No. 4171 to No. 4174	Depends on the configuration	Sets the gear ratio between the spindle and motor when the position coder feedback interpolation function is used.
No. 4398#0	"1"	Sets the position coder feedback interpolation function.

2.4.4 List of I/O Signals (CNC↔PMC)

This Subsection provides a list of the I/O signals related to Cs contouring control only. For details of each signal, refer to "Cs CONTOUNING CONTROL" of the CONNECTION MANUAL (FUNCTION) of each CNC.
For details of the I/O signals common to the CNCs, see Chapter 3, "I/O SIGNALS (CNC↔PMC)", in Part I.

(1) Input signals (PMC→CNC)

(a)Series 0*i*

	#7	#6	#5	#4	#3	#2	#1	#0
G027	CON							
G028						GR2	GR1	

(b)Series 30*i*

	#7	#6	#5	#4	#3	#2	#1	#0
G027	CON							
G028						GR2	GR1	

(c) Common to CNCs

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G070	G070			SFRA	SRVA	CTH1A	CTH2A		
2nd-	G074	G074			SFRB	SRVB	CTH1B	CTH2B		
1st-	G071	G071			INTGA					
2nd-	G075	G075			INTGB					

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(2) Output signals (CNC→PMC)

(a)Series 0*i*

	#7	#6	#5	#4	#3	#2	#1	#0
F034						GR3O (*1)	GR2O (*1)	GR1O (*1)
F044							FSCSL	
F094	ZP8	ZP7	ZP6	ZP5	ZP4	ZP3	ZP2	ZP1

NOTE
*1 These signals are valid with the M series only.

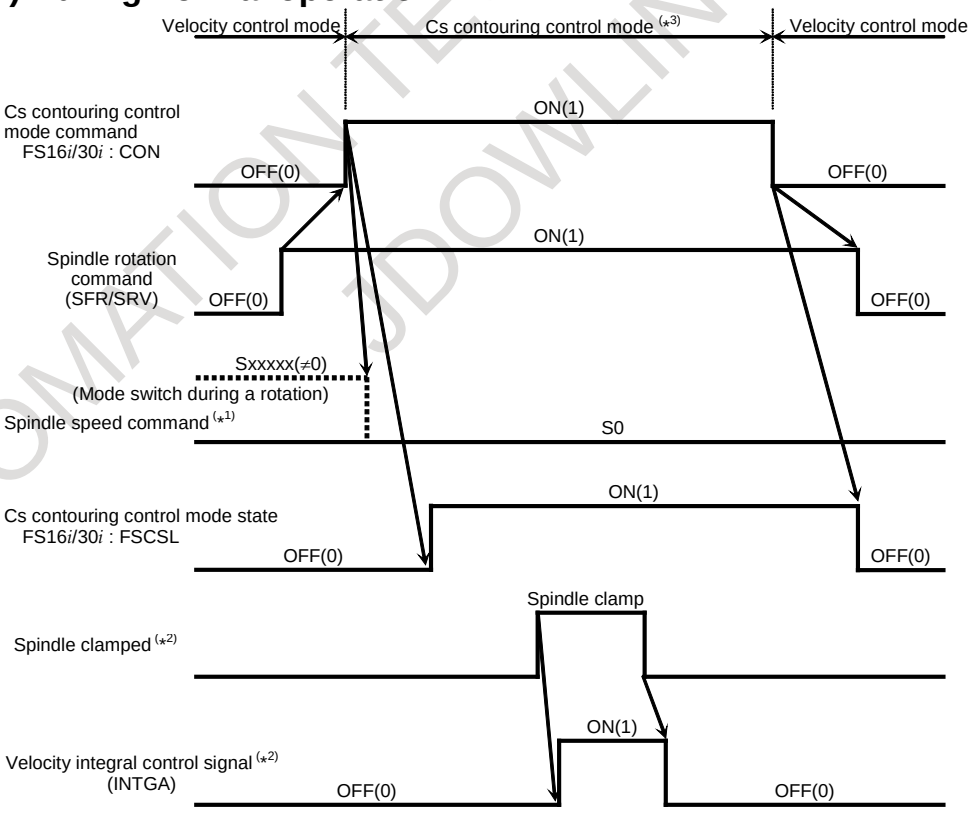
(b) Series 30*i*

	#7	#6	#5	#4	#3	#2	#1	#0
F034						GR3O (*1)	GR2O (*1)	GR1O (*1)
F044							FSCSL	
F094	ZP8	ZP7	ZP6	ZP5	ZP4	ZP3	ZP2	ZP1

NOTE
*1 These signals are valid with the M series only.

2.4.5 Examples of Sequences

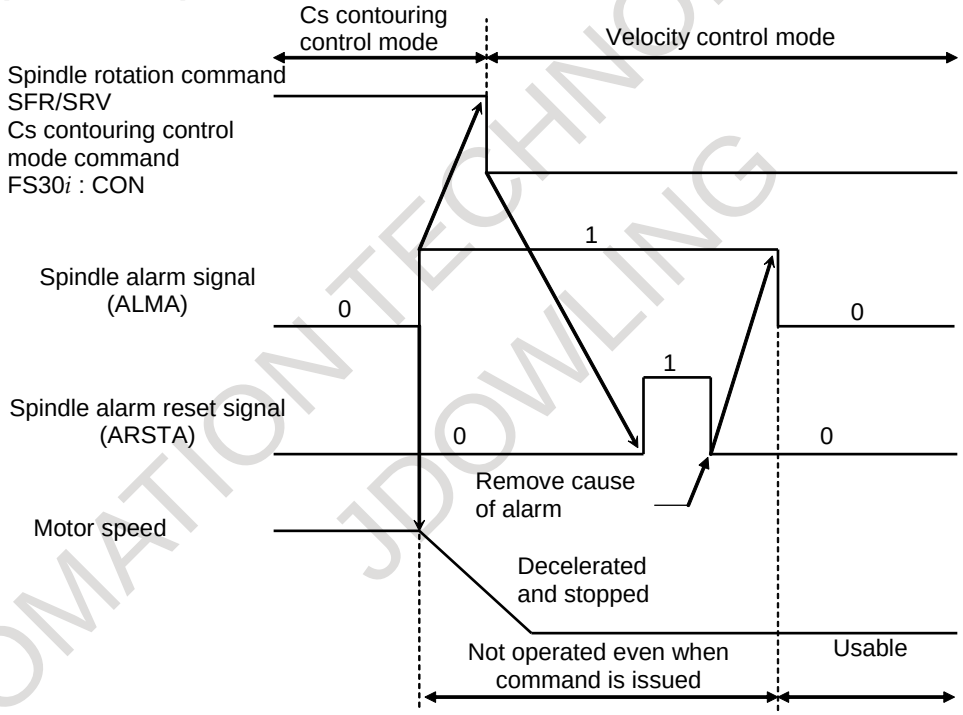
(Example 1) During normal operation



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NOTE
1 In Cs contouring control mode, reset the spindle speed command (specify S0) for safety.
2 When the spindle is clamped to perform machining such as drilling after positioning based on Cs contouring control, the spindle may be clamped at a position slighted shifted from the specified position. In such a case, the velocity loop integral function attempts to move the spindle to the specified position, so that an excessively high current can flow through the motor.
To prevent this, turn on (set to 1) the velocity integral control signal (INTGA) to disable the velocity loop integral function, or turn off the power to the motor with the servo-off signal.
3 In Cs contouring control, do not perform spindle gear switching. Be sure to perform spindle gear switching, if needed, on the velocity control mode.
4 For Cs contouring control, use either of the SFR and SRV signals.
5 In the Cs contouring control mode, do not change the SFR (SRV) signal.

(Example 2) When a spindle alarm is issued



NOTE
1 If a spindle alarm is issued, release the Cs contouring control mode. Resetting the alarm without releasing the mode and restarting operation may cause a miss positioning.
2 With the following series and editions, the alarm reset signal is valid only in the velocity control mode (in other modes, inputting the alarm reset signal does not release the alarm):
9D50 series P (16) edition or later
9D70 series G (07) edition or later
9D80 series A (01) edition or later
9D90 series A (01) edition or later
9DA0 series A (01) edition or later
9DB0 series A (01) edition or later

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2.4.6 Velocity Loop Gains Override Function on Cs Contouring Control Mode

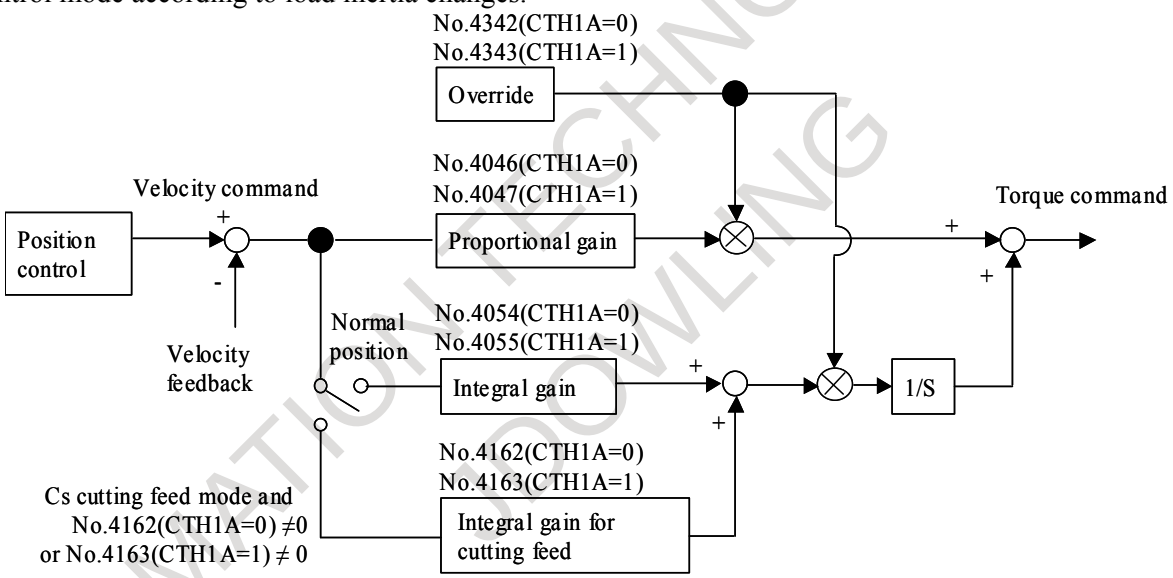
2.4.6.1 Series and editions of applicable spindle software

Spindle software

Series	Edition	Usable CNC
9D50	S (19)	FS0*i* -D
9D70	I (09)	FS30*i* / FS31*i* / FS32*i* -A
9D80	C (03)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9D90	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	A (01)	FS0*i* -D, Fs0*i*-F, FS30*i* / FS31*i* / FS32*i* -B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B

2.4.6.2 Block diagram

Shown below is a block diagram of the velocity loop for Cs contouring control mode.
The velocity loop gains override function is used to override the velocity loop gain on Cs contouring control mode according to load inertia changes.



NOTE
The override function is effective only for Cs contouring control mode (override fixed at 100% for the other modes).

2.4.7 Cutting Feed/Rapid Traverse PWM Frequency Switching Function in Cs Contour Control

2.4.7.1 Overview

This function sets a PWM frequency higher than the normal setting for cutting feed in Cs contour control mode. In addition, this function switches the current gain and velocity gain upon switching the PWM frequency. High current control loop and velocity control loop gains can then be applied for cutting feed in Cs contour control mode, enabling machining with higher precision. For details of this function, see Section 5.18, “CUTTING FEED/RAPID TRAVERSE PWM FREQUENCY SWITCHING FUNCTION IN Cs CONTOUR CONTROL”.

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2.4.7.2 Series and Edition of Applicable Software

Combination of the spindle software and CNC

Software series	Edition	CNC		
		0*i*-D	0*i*-F	30*i*-B/31*i*-B/32*i*-B
9DA0	M (13) edition or later	○	○	○
9DB0	A (01) edition or later	○	○	○

○: Usable

2.4.8 Related Parameters

Parameter No.		Description
0*i*	30*i*	
1005#0	1005#0	Whether to use the reference position return function
1006#0	1006#0	Sets a linear axis/rotation axis. (Set “1”.)
3700#1	3700#1	Specifies whether to enable the reference position return function for the first G00 command received after switching to Cs contouring control.
3712#2	3712#2	Sets the Cs axis coordinate establishment function.
1013 #3,2,1,0	1013 #3,2,1,0	Increment system (Usually, set and use IS-B.)
1020	1020	Program axis name
1022	1022	Sets an axis of the basic coordinate system. (Set “0”.)
1023	1023	Servo axis number (Set “-1”.)
1260	1260	Movement per rotation of rotation axis (Set “360.0”.)
1420	1420	Rapid traverse rate
1620	1620	Linear acceleration/deceleration time constant for rapid feed
1820	1820	Command multiplication (Usually, set “2” [= CMR 1].)
1826	1826	In-position width
1828	1828	Position error limit during movement
1829	1829	Position error limit when stopped
3900 3910 3920 3930 3940	3900 3910 3920 3930 3940	Servo axis number subject to interpolation with the Cs contouring control axis
3901 to 3904 3911 to 3914 3921 to 3924 3931 to 3934 3941 to 3944	3901 to 3904 3911 to 3914 3921 to 3924 3931 to 3934 3941 to 3944	Position gain of a servo axis subject to interpolation with the Cs contouring control axis
4000#1	4000#1	Spindle rotation direction for a positive motion command on Cs contouring control mode
4000#3	4000#3	Direction of reference position return when the system enters Cs contouring control mode
4002#4	4002#4	Whether to use the rotation direction signal (SFR/SRV) function on Cs contouring control
4005#0	4005#0	Sets the detection unit for Cs contouring control.
4016#3	4016#3	Sets the smoothing function in feed-forward control.
4016#4	4016#4	Setting related to the motor voltage control characteristics on Cs contouring control or servo mode
4021	4021	Maximum spindle speed on Cs contouring control mode
4037	4037	Velocity loop feed-forward coefficient
4046 4047	4046 4047	Velocity loop proportional gain on Cs contouring control mode (A parameter is selected by the CTH1A input signal sent from the PMC.)

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Parameter No.		Description
0*i*	**30*i***	
4054 4055	4054 4055	Velocity loop integral gain on Cs contouring control mode (A parameter is selected by the CTH1A input signal sent from the PMC.)
4056 to 4059	4056 to 4059	Spindle-to-motor gear ratio (A parameter is selected by the CTH1A and CTH2A input signals sent from the PMC.)
4069 to 4072	4069 to 4072	Position gain for axes subject to Cs contouring control (A parameter is selected by the CTH1A input signal sent from the PMC.)
4074	4074	Feedrate for reference position return on Cs contouring control mode or servo mode
4086	4086	Motor voltage on Cs contouring control mode
4092	4092	Rate of change in the position gain when reference position return is performed on Cs contouring control mode
4094	4094	Disturbance torque compensating constant (acceleration feedback gain)
4097	4097	Spindle speed feedback gain
4099	4099	Motor excitation delay
4131	4131	Velocity detection filter time constant (on Cs contouring control)
4135	4135	Grid shift on Cs contouring control mode
4162 4163	4162 4163	Velocity loop integral gain for cutting feed on Cs contouring control (A parameter is selected by the PMC input signal CTH1A.)
4171 to 4174	4171 to 4174	Arbitrary gear ratio between the motor sensor and spindle (Setting for the position coder feedback interpolation function is used.)
4342 4343	4342 4343	Velocity loop gain override in Cs contouring control. (These parameters are selected by the input signal CTH1A of PMC.)
4344 (*)	4344 (*)	Advanced preview feed-forward coefficient * This parameter sets the coefficient for rapid traverse when bit 4 of parameter No. 4542 is 1.
4353#5	4353#5	Sets the Cs axis position data transfer function
4398	4398	Sets the position coder feedback interpolation function
4406	4406	Acceleration/deceleration time constant at return to the reference position in Cs contouring control/servo mode
4540#0	4540#0	Setting related to motor voltage control characteristics on Cs contouring control
4542#4	4542#4	Cutting feed/rapid traverse feed-forward function
4598	4598	Variable proportional gain function in the stop state for Cs control: magnification in the stop state
4599	4599	Variable proportional gain function in the stop state for Cs control: judgment level for the stop state
4627 (*)	4627 (*)	Advanced preview feed-forward coefficient for cutting feed * This parameter is valid when bit 4 of parameter No. 4542 is 1.

NOTE
1 For the detector-related parameters, see Section 1.3, “PARAMETERS RELATED TO DETECTORS”, in Part I.
2 For velocity loop proportional/integral gain adjustment, see Section 4.1, “VELOCITY LOOP GAIN ADJUSTMENT”, in Part I.

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2.4.9 Details of Related Parameters

This Subsection details the serial spindle parameters (in the four thousands) among the parameters related to Cs contouring control. For details of other parameters, refer to "Cs CONTOURING CONTROL" of the CONNECTION MANUAL (FUNCTION) of each CNC.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4000	4000					RETRN		ROTA2	

ROTA2 Indicates the spindle direction by the move command (+). (Only effective on Cs contouring control)

0 : When the value of a move command from the CNC is positive (+), the spindle rotates in the CCW direction.

1 : When the value of a move command from the CNC is positive (+), the spindle rotates in the CW direction.

Change the setting of this parameter when changing the rotation direction of the spindle on Cs contouring control.

RETRN Indicates the reference position return direction on Cs contouring control.

0 : Returns the spindle from the CCW direction to the reference position (counter clockwise direction).

1 : Returns the spindle from the CW direction to the reference position (clockwise direction).

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4002	4002				CSDRCT				

CSDRCT Whether to use the rotation direction signal (SFR/SRV) on Cs contouring control

0 : Rotation direction function enabled

(1) When bit 1 (ROTA2) of No. 4000 = 0, and the value of a move command from the CNC is positive (+)

(a) The spindle rotates counterclockwise when input signal SFR(G70#5) is set to 1.

(b) The spindle rotates clockwise when input signal SRV(G70#4) is set to 1.

(2) When bit 1 (ROTA2) of No. 4000 = 1, and the value of a move command from the CNC is positive (+)

(a) The spindle rotates clockwise when input signal SFR(G70#5) is set to 1.

(b) The spindle rotates counterclockwise when input signal SRV(G70#4) is set to 1.

1 : Rotation direction function disabled

The rotation direction function of the SFR/SRV signal is disabled. Only the function for enabling spindle motor excitation is available.

(1) When bit 1 (ROTA2) of parameter No. 4000 is set to 0

When the value of a move command from the CNC is positive (+), and SFR/SRV = 1, the spindle rotates in the CCW direction.

(2) When bit 1 (ROTA2) of parameter No. 4000 is set to 1

When the value of a move command from the CNC is positive (+), and SFR/SRV = 1, the spindle rotates in the CW direction.

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0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4005	4005								**CS360M**

CS360M Sets the detection unit for Cs contouring control.
0 : 0.001°
1 : 0.0001°
Set 0 usually. When a αiCZ sensor (analog, serial) is used as the position detector and the setting unit IS-C is used, set 1.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4016	4016				**IDLPTN**	**FFSMTH**			

FFSMTH Specifies whether to use the smoothing function under feed-forward control.
0 : Don't use the smoothing function.
1 : Uses the smoothing function.
This bit specifies whether to use the smoothing function under feed-forward control on Cs contouring control mode.

IDLPTN Setting related to the motor voltage control characteristics on Cs contouring control or servo mode (rigid tapping)
Set this bit to 1 when setting a value less than 100 as the motor voltage on Cs contouring control (No. 4086) or as the motor voltage on servo mode (No. 4085).

0*i*	30*i*	
4021	4021	**Maximum speed on Cs contouring control mode**

Unit of data : 1min^{-1} (10min^{-1} when parameter No.4006#2 (SPDUNT) is set to 1)
Valid data range : 0 to 32767
Initial setting : 100
This parameter specifies the maximum speed of a spindle operating on Cs contouring control mode.
When 0 is specified as the parameter for the feedrate for reference position return on Cs contouring control mode (parameter No. 4074), reference position return is performed at the speed specified as the maximum speed in this parameter.

0*i*	30*i*	
4037	4037	**Velocity loop feed-forward coefficient**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0
Set a velocity loop feed-forward coefficient when feed-forward control is executed on Cs contouring control. Use the following expression to determine a value to be set:

$$\text{Setting} = 214466 \times \frac{[\text{spindle inertia} + \text{rotor inertia}](\text{kg}\cdot\text{m}^2)}{\text{Maximum motor torque (N}\cdot\text{m)}}$$

0*i*	30*i*		
4046	4046	**Velocity loop proportional gain on Cs contouring control (HIGH)**	**CTH1A=0**
4047	4047	**Velocity loop proportional gain on Cs contouring control (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 30

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These parameters specify the proportional gains of the velocity loop on Cs contouring control mode.
When the input signal CTH1A = 0, (HIGH) is selected. When the input signal CTH1A = 1, (LOW) is selected.

NOTE
The initial setting of the gain with some motor models may be so high that oscillation can occur. In such a case, decrease the gain.

0*i*	30*i*		
4054	4054	**Velocity loop integral gain on Cs contouring control (HIGH)**	**CTH1A=0**
4055	4055	**Velocity loop integral gain on Cs contouring control (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 50
These parameters specify the integral gains of the velocity loop for Cs contouring control mode.
When the input signal CTH1A = 0, (HIGH) is selected. When the input signal CTH1A = 1, (LOW) is selected.

NOTE
The initial setting of the gain with some motor models may be so high that oscillation can occur. In such a case, decrease the gain.

0*i*	30*i*		
4056	4056	**Gear ratio (HIGH)**	**CTH1A=0, CTH2A=0**
4057	4057	**Gear ratio (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4058	4058	**Gear ratio (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4059	4059	**Gear ratio (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : (Motor rotation for one rotation of spindle) / 100
(When parameter No. 4006 #1 (GRUNIT) is 1, motor rotation / 1000)
(When parameter No. 4005 #5 (GRUNIT) is 1, motor rotation / 10)

Valid data range : 0 to 32767
Initial setting : 100
These parameters set the gear ratio of the spindle motor to the spindle.
When the motor rotates 2.5 times for every rotation of the spindle, for example, set 250 in the parameter.
A parameter is selected by the CTH1A and CTH2A input signals.
The gear or clutch status must correspond to the status of the CTH1A and CTH2A input signals.

NOTE
When an improper value is set in these parameters, an unexpected operation can occur. For example, the spindle does not stop but keeps rotating at the time of orientation. So, be sure to set a proper gear ratio.

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0*i*	30*i*		
4069	4069	**Position gain on Cs contouring control (HIGH)**	**CTH1A=0, CTH2A=0**
4070	4070	**Position gain on Cs contouring control (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4071	4071	**Position gain on Cs contouring control (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4072	4072	**Position gain on Cs contouring control (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : $0.01sec^{-1}$
Valid data range : 0 to 32767
Initial setting : 3000

These parameters specify the position gains used on Cs contouring control mode.
A parameter is selected by the input signals CTH1A and CTH2A.

0*i*	30*i*	
4074	4074	**Speed for return to reference position on Cs contouring control mode/servo mode**

Unit of data : $1min^{-1}$
Valid data range : 0 to 32767
Initial setting : 0

- When 0 is set
  The value set in No. 4021 (maximum spindle speed) is used as a reference position return speed on Cs contouring control.
- When a value other than 0 is set
  The value set in this parameter is used as a reference position return speed on Cs contouring control.

NOTE
An overshoot can occur at reference position return time for a cause such as an excessively high reference position return speed by setting the parameter No. 4021 (maximum spindle speed on Cs contouring control mode). In this case, set this parameter.

0*i*	30*i*	
4086	4086	**Motor voltage setting on Cs contouring control**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 100

Set the motor voltage to “100”, when Cs contouring control is in operation.

NOTE
When the maximum speed for Cs contouring control (in terms of motor axis) is higher than the base speed of the spindle motor (No. 4100 for high-speed characteristics and No. 4138 for low-speed characteristics), set a value less than "100" in this parameter.

$$\text{Motor voltage (\%)} = 100 \times \frac{\text{Spindle motor base speed}}{\text{Maximum speed in Cs contouring control (in terms of motor shaft)}}$$

In this case, also set bit 4 of parameter No. 4016 to "1" as the setting related to motor voltage control characteristics on Cs contouring control.

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0*i*	30*i*	
4092	4092	**The reduction rate of position loop gain in returning to the reference position on Cs contouring mode**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 100

This parameter specifies a rate of change in the position gain used for reference position return on Cs contouring control mode.

NOTE
An overshoot can occur at reference position return time for a cause such as an excessively high reference position return speed and an excessively large spindle inertia. In this case, an overshoot can be avoided by setting a small value in this parameter.

0*i*	30*i*	
4094	4094	**The constant of the torque disturbance compensating (Acceleration feedback gain)**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0

This parameter specifies the constant for compensating for a disturbance torque on Cs contouring control mode.

NOTE
By setting this parameter, stability in cutting can be improved.
In this parameter, set a value from 500 to 2000.
Do not set a value exceeding 4000.

0*i*	30*i*	
4097	4097	**Spindle speed feedback gain**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0

This parameter is set to feed back spindle speed and compensate for torque disturbance on Cs contouring control in systems where spindles and spindle motors are linked by gears or belts.

NOTE
When a belt is used to connect the spindle with the motor, control stability may be improved by feeding back the spindle speed.
In this parameter, set about the same value (10 to 50) as specified in parameter No. 4046 (velocity loop proportional gain), or a smaller value.

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0*i*	30*i*	
4099	4099	**Delay time for motor excitation**

Unit of data : 1ms
Valid data range : 0 to 32767
Initial setting : 0

This parameter specifies the time required to achieve stable motor excitation on rigid tapping mode or Cs contouring control mode.

NOTE
At the time of switching from the velocity control mode to Cs contouring control mode, the stop time excessive error alarm can be issued intermittently.
This is because the excitation state of the spindle motor changes abruptly, and therefore a transient state occurs in the motor, thus moving the motor shaft slightly.
In such a case, set this parameter. In general, set a value from about 300 to 400 (300 to 400 msec).

0*i*	30*i*	
4131	4131	**Velocity detection filter time constant (on Cs contouring control)**

Unit of data : 0.1ms
Valid data range : 0 to 10000
Initial setting : 0

This parameter sets a filter time constant for the velocity feedback signal on Cs contouring control. Usually, set 0.

0*i*	30*i*	
4135	4135	**Grid shift amount on Cs contouring control**

Unit of data : 1 pulse unit (=0.001°) (0.0001° when bit 0 (CS360M) of parameter No. 4005 is set to 1)
Valid data range : -360000 to +360000
(-3,600,000 to +3,600,000 when bit 0 (CS360M) of parameter No. 4005 is set to 1)
Initial setting : 0

Use this parameter to shift the machine reference position on Cs contouring control.
The machine reference position of the spindle shifts by the set number of pulses in the CCW direction.

0*i*	30*i*		
4162	4162	**Velocity loop integral gain for cutting feed on Cs contouring control(HIGH)**	**CTH1A=0**
4163	4163	**Velocity loop integral gain for cutting feed on Cs contouring control(LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0

These parameters set a velocity loop integral gain for cutting feed (G01, G02, G03) on Cs contouring control.
When the input signal CTH1A = 0, (HIGH) is selected. When the input signal CTH1A = 1, (LOW) is selected.

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NOTE
When 0 is set in these parameters, the values set in No. 4054 and No. 4055 (velocity loop integral gain on Cs contouring control) are valid.

0*i*	30*i*		
4342	4342	**Velocity loop gain override in Cs contouring control (HIGH)**	**CTH1A=0**
4343	4343	**Velocity loop gain override in Cs contouring control (LOW)**	**CTH1A=1**

Unit of data : 1%
Valid data range : 0 to 3000
Initial setting : 0

These parameters specify override of velocity loop proportional gain and integral gain for Cs contouring control mode.
If the set value is "0", it is treated as "100".

NOTE
This parameter is valid with
9D50 series S (19) edition or later
9D70 series I (09) edition or later
9D80 series C (03) edition or later
9D90 series A (01) edition or later
9DA0 series A (01) edition or later.
9DB0 series A (01) edition or later.

0*i*	30*i*	
4344	4344	**Advanced preview feed-forward coefficient**

Unit of data : 0.01%
Valid data range : 0 to 10000
Initial setting : 0

This parameter sets a feed-forward coefficient for exercising feed-forward control when Cs contouring control is used.

NOTE
This parameter sets a feed-forward coefficient specific to rapid traverse when the cutting feed/rapid traverse feed-forward function is enabled (bit 4 of parameter No. 4542 is 1).

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4353	4353			**CSPTRE**					

CSPTRE Sets the Cs axis position data transfer function.
0 : Disables the Cs axis position data transfer function.
1 : Enables the Cs axis position data transfer function.
Set this parameter to 1 when using the Cs axis coordinate establishment function.

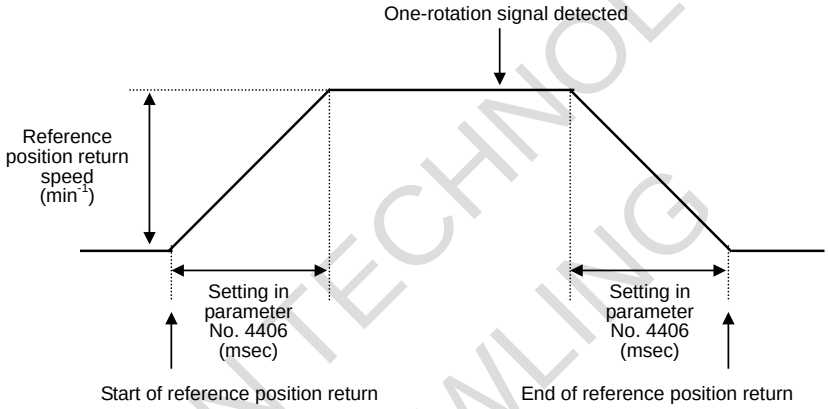
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NOTE
This parameter is valid with 9D50 series G (07) edition or later, 9D70 series A (01) edition or later, 9D80 series A (01) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later and 9DB0 series A (01) edition or later.

0*i*	30*i*	
4406	4406	**Acceleration/deceleration time constant for Cs contouring control/servo mode**

Unit of data : 1msec
Valid data range : 0 to 32767
Initial setting : 0

This parameter set the reference position return acceleration for Cs contouring control or servo mode (rigid tapping/spindle positioning). Use of this parameter can reduce the shock due to acceleration/deceleration during return to the reference position. The spindle speed command during return to the reference position is then given as follows:



NOTE
1 When 0 is set in this parameter, a velocity command is assumed as follows.
- Before detecting the one-rotation signal: Reference position return speed (step-type velocity command)
- After detecting the one-rotation signal:
  Distance to the reference position × Position gain

2 This parameter is enabled when soft start/stop signal SOCNA is 1.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4540	4540								**EXPTCS**

EXPTCS Setting related to motor voltage control characteristics on Cs contouring control
Set this bit to 1 when setting a value less than 100 as the motor voltage on Cs contouring control (parameter No. 4086).
Bit 4 of parameter No. 4016 is valid for all of Cs contouring control, rigid tapping (servo mode), and spindle synchronous control. Use this parameter to set each mode independently.
This parameter is valid only when bit 4 of parameter No. 4016 = 0.

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0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4542	4542				FFCHG				

FFCHG The cutting feed/rapid traverse feed-forward function is:
0: Disabled.
1: Enabled.

NOTE
1 This parameter is valid with 9D8A series C (03) edition or later, 9D90 series R (18) edition or later, 9DA0 series U (21) edition or later and 9DB0 series A (01) edition or later.
2 When setting '1' in this parameter, set '1' in bit 3 (FFR) of parameter No. 1800 (feed-forward control for rapid traverse is enabled).

0*i*	30*i*	
4598	4598	**Variable proportional gain function in the stop state for Cs control: magnification in the stop state**

Unit of data : 1%
Valid data range : 0~100 (0 means that the function is disabled.)
After a stop is checked in the Cs contouring control state, the variable proportional gain function in the stop state for Cs control suppresses vibration in the stop state by decreasing the velocity loop proportional gain to the level specified with the relevant parameter. In this parameter, set a magnification of the gain to be applied in the stop state. The function is enabled when a value other than 0 is set in this parameter.

0*i*	30*i*	
4599	4599	**Variable proportional gain function in the stop state for Cs control: judgment level for the stop state**

Unit of data : Detection unit (0.001° (when bit 0 of parameter No. 4005 = 0), 0.0001° (when bit 0 of parameter No. 4005 = 1))
Valid data range : 0 to 32767
Initial setting : 0
This parameter is used for stop state judgment in the Cs control state. After a move command for the Cs axis has become 0 and the time five times the reciprocal of the set position gain has elapsed, the spindle is regarded as being stopped when the position error becomes lower than or equal to the level set in this parameter.
Setting example) In parameter No. 4599, set a value larger than the absolute value of the position error of vibration in the stop state, and in parameter No. 4598, adjust a magnification in the stop state in a range of 25% to 90%.

0*i*	30*i*	
4627	4627	**Advanced preview feed-forward coefficient for cutting feed**

Unit of data : 0.01%
Valid data range : 0~10000
Initial setting : 0
This parameter sets an advanced preview feed-forward coefficient for cutting feed. Set the same value as for the servo axis simultaneously subjected to interpolation.

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NOTE
1 This parameter is valid with 9D8A series C (03) edition or later, 9D90 series R (18) edition or later, 9DA0 series U (21) edition or later and 9DB0 series A (01) edition or later.
2 This parameter is valid when the cutting feed/rapid traverse feed-forward function is enabled (bit 4 of parameter No. 4542 is 1).

0*i*	#7	#6	#5	#4	#3	#2	#1	#0
4398								PCCSCM

PCCSCM Sets the position coder feedback interpolation function
0 : Disables the position coder feedback interpolation function.
1 : Enables the position coder feedback interpolation function.
When an αi position coder is used for spindle position feedback to exercise Cs contouring control, this function improves control performance with position coder feedback pulse interpolation using high-resolution motor side feedback. To use this function, set this parameter to 1.
This function is valid only when the spindle sensor is an αi position coder. When the gear ratio between the spindle and motor is not 1:1, be sure to set an arbitrary gear ratio (No. 4171 through No. 4174) between the spindle and motor.

NOTE
1 This parameter is valid with 9D50 series H (08) edition or later, 9D70 series B (02) edition or later,.9D80 series A (01) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later and 9DB0 series A (01) edition or later,
2 When Cs contouring control is exercised in a system where an αi position coder is used as the position sensor, the position feedback resolution is 0.088 deg. In this case, the position error may not converge to 0, depending on the specified position. So, a value greater than 88 pulses (0.088deg) must be set as the effective area (No. 1826).

0*i*		
4171	Denominator of an arbitrary gear ratio between the motor sensor and spindle (HIGH)	CTH1A=0
4172	Numerator of an arbitrary gear ratio between the motor sensor and spindle (HIGH)	CTH1A=0
4173	Denominator of an arbitrary gear ratio between the motor sensor and spindle (LOW)	CTH1A=1
4174	Numerator of an arbitrary gear ratio between the motor sensor and spindle (LOW)	CTH1A=1

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0

These parameters set conversion coefficients (numerator, denominator) for using the detection arbitrary gear ratio function (DMR function) by multiplying a motor sensor (α*i*M sensor) feedback signal by a gear ratio to produce a spindle position feedback signal. When the spindle rotates Q times while the motor shaft rotates P times (there is no common divisor other than 1 for P and Q), the settings are:

No. 4171 (No. 4173 when CTH1A = 1) = P
No. 4172 (No. 4173 when CTH1A = 1) = Q

When 0 is set in any of these parameters, the setting of 1 is assumed.

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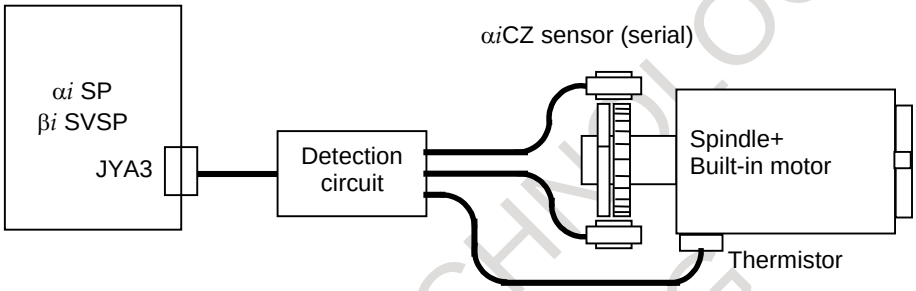
NOTE
Note that if an improper value is set in this parameter, the position coder feedback interpolation function does not function normally.

2.4.10 Adjusting Cs Contouring Control

2.4.10.1 Overview

In recent years, a high-resolution spindle sensor such as the α*i*CZ sensor has been used for a built-in spindle motor, enabling high-precision Cs contouring control. To enable this type of control, this Subsection describes how to make adjustments to improve servo characteristics (responsiveness and stability) for Cs contouring control.

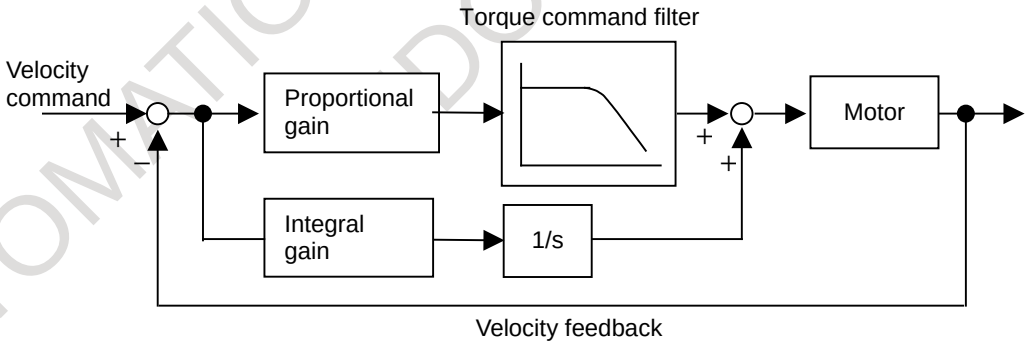
[Example of the use of the α*i*CZ sensor]



2.4.10.2 Adjustment procedure

To improve servo characteristics for Cs contouring control, make adjustments by following the adjustment procedure below.

(1) Before adjusting the velocity loop gains, change the torque command filter setting.

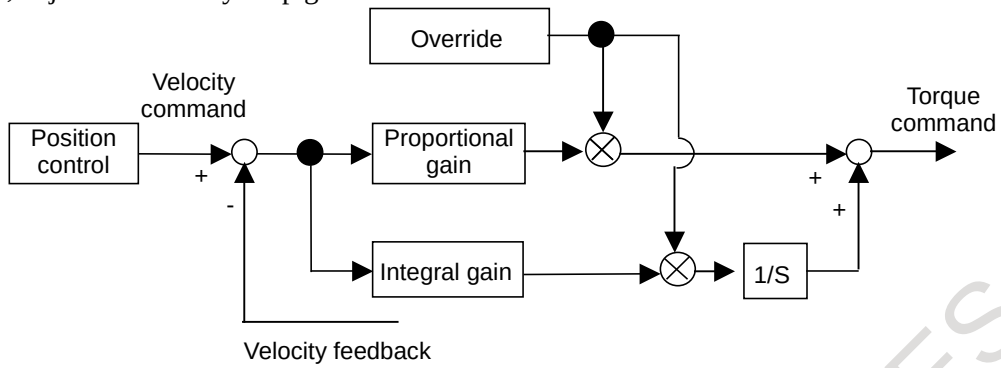


0*i*	30*i*	
4121	4121	**Torque command filter time constant**
4157	4157	**Torque command filter time constant (for low-speed characteristics)**

When automatic setting is performed, 5 is set in the parameter of the torque command filter time constant. The standard value of 5 is set assuming that a low-resolution sensor is used.
When using a high-resolution spindle sensor such as the α*i*CZ sensor, change this value, with 2 as a guideline, to improve the responsiveness of the velocity loop.
After changing this value, operate the axis and check to see if an abnormality such as an unusual sound occurs.

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(2) Next, adjust the velocity loop gains.



0*i*	30*i*	
4046	4046	**Velocity loop proportional gain on Cs contouring control (CTH1A=0)**
4047	4047	**Velocity loop proportional gain on Cs contouring control (CTH1A=1)**

0*i*	30*i*	
4054	4054	**Velocity loop integral gain on Cs contouring control (CTH1A=0)**
4055	4055	**Velocity loop integral gain on Cs contouring control (CTH1A=1)**

0*i*	30*i*	
4342	4342	**Velocity loop gain override on Cs contouring control (CTH1A=0)**
4343	4343	**Velocity loop gain override on Cs contouring control (CTH1A=1)**

Set the motor model-specific standard values for the velocity loop proportional and integral gains. (For an explanation of the motor model-specific standard parameters, see Subsection 2.4.9.3.)

The velocity loop gain override is a parameter that should basically be set according to the load inertial value.

$$Ovr\ [\%] = \left(\frac{JL\,[\mathrm{kgm}^2]}{Jm\,[\mathrm{kgm}^2]} + 1\right) \times 100$$

Ovr [%] : Velocity loop gain override
JL [kgm^2] : Spindle load inertia (converted for the motor shaft)
Jm [kgm^2] : Rotor inertia of spindle motor

Since this parameter serves as a magnification for both velocity loop proportional and integral gains, however, set this parameter value as large as possible in order to improve the responsiveness of the entire velocity loop. Be sure to adjust the final setting to approximately 80% of the oscillation limit.

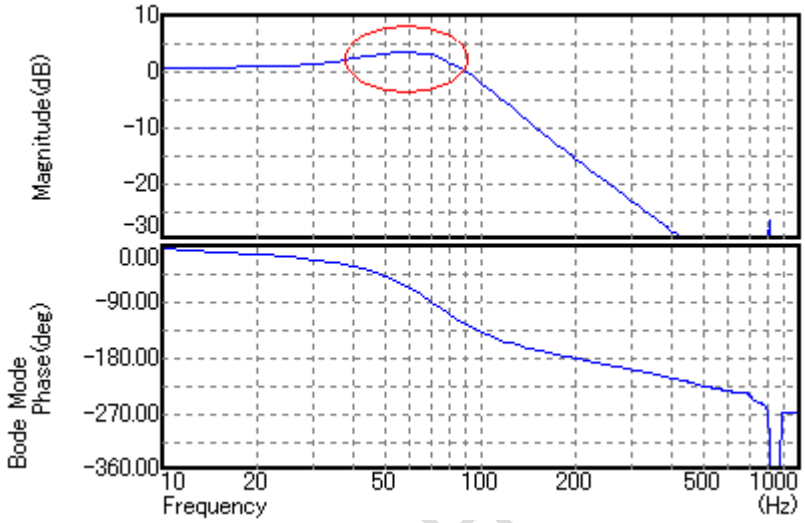
Parameter	Setting data
Velocity loop proportional gain	Motor model-specific standard value
Velocity loop Integral gain	Motor model-specific standard value
Velocity loop gain override	Adjusted value

When the values calculated from the above expression are set, and if any of the following oscillations occurs because, for example, the rigidity of the spindle is low, decrease the override to a value with a margin.

- The vibration sound of spindle occurs.
- Vibration of a torque command becomes large.
- Vibration of position error becomes large in the stop state.

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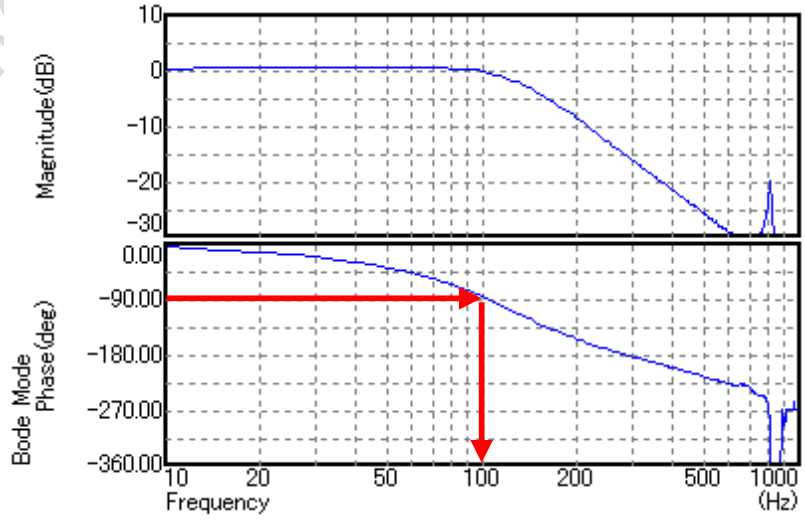
When you can use the SERVO GUIDE, you should measure velocity loop frequency response, and make adjustments to increase the gains while observing the response. Basically, increase the velocity loop gain override to increase the response band. If there is a rise in the gain characteristic at a frequency near 40 to 70 Hz, however, make an adjustment to decrease the velocity loop integral gain slightly. The guideline for a rise is approximately 5 dB.
Example) Rise in the gain characteristic



(3) Finally, adjust the position loop gain.
Determine the position gain limit value while observing low-frequency vibration when the motor is stopped and when the motor rotates. Since the position gain is generally suited to the servo axis for simultaneous contouring control, it cannot be determined from the characteristic for the Cs axis only; consider the guideline for the setting of the Cs axis as approximately 80% of the limit value.

When you can use the SERVO GUIDE, you can measure velocity loop frequency response, check the cut-off frequency, and know the guideline for the position gain setting from that frequency.
In the Bode diagram, the cut-off frequency is a frequency with a phase of -90°.
When a built-in spindle motor is used and the cut-off frequency is F (Hz), the guideline for the position gain limit value is F (s^{-1}) or greater.

Example) Frequency response of a built-in spindle motor



Cut-off frequency of 100 Hz

In the above example, the cut-off frequency is 100 Hz, and it is therefore likely that a position gain of 100 s^{-1} or greater can be ensured.

2.4.10.3 Standard parameters of velocity loop gain for Cs contouring control for each motor model

NOTE

1 If the motor model is not included in the list , calculate gain according the following equation.

No. 4046 (or No. 4047) = 30159/ (Tmax/J_m)

No. 4054 (or No. 4055) = 280735/ (Tmax /J_m)

where

(For α*i* series spindle motors)

Tmax = Short time rated torque at constant torque range × 1.2 [Nm]

(For β*i* series spindle motors)

Tmax = Short time rated torque at constant torque range × 1.1 [Nm]

J_m = Motor rotor inertia [kgm^2]

2 Set the standard value in parameters (Nos. 4046/4047 and Nos. 4054/4055) for the selected winding (high-speed/low-speed).

(a) SPINDLE MOTOR α*i* I series

Motor model	Velocity loop proportional gain No.4046/ No.4047	Velocity loop Integral gain No.4054/ No.4055
α*i* I 0.5/10000	3	30
α*i* I 1/10000	10	98
α*i* I 1.5/10000	5	42
α*i* I 2/10000	8	75
α*i* I 3/10000	10	90
α*i* I 6/10000	9	88
α*i* I 8/8000	10	92
α*i* I 12/7000	18	171
α*i* I 15/7000	18	165
α*i* I 18/7000	19	175
α*i* I 22/7000	18	167
α*i* I 30/6000	24	223
α*i* I 40/6000	31	287
α*i* I 50/4500	24	223
α*i* I 1/15000	11	100
α*i* I 1.5/15000	8	71
α*i* I 2/15000	7	65
α*i* I 3/12000	10	90
α*i* I 6/12000 (Low-speed winding)	9	83
α*i* I 6/12000 (High-speed winding)	20	183
α*i* I 8/10000 (Low-speed winding)	10	92
α*i* I 8/10000 (High-speed winding)	26	245
α*i* I 12/10000 (Low-speed winding)	18	171
α*i* I 12/10000 (High-speed winding)	49	457
α*i* I 15/10000 (Low-speed winding)	19	179
α*i* I 15/10000 (High-speed winding)	51	476
α*i* I 18/10000 (Low-speed winding)	19	175
α*i* I 18/10000 (High-speed winding)	50	467
α*i* I 22/10000 (Low-speed winding)	19	181
α*i* I 22/10000 (High-speed winding)	52	482

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(b) SPINDLE MOTOR αi IP series

Motor model	Velocity loop proportional gain No.4046/ No.4047	Velocity loop Integral gain No.4054/ No.4055
αi IP 12/8000	12	114
αi IP 12/8000	18	171
αi IP 15/6000	13	122
αi IP 15/8000	20	184
αi IP 18/6000	10	95
αi IP 18/8000	18	167
αi IP 22/6000	11	104
αi IP 22/8000	17	155
αi IP 30/6000 (Low-speed winding)	17	156
αi IP 30/6000 (High-speed winding)	24	224
αi IP 40/6000 (Low-speed winding)	14	131
αi IP 40/6000 (High-speed winding)	20	186
αi IP 50/6000 (Low-speed winding)	18	166
αi IP 50/6000 (High-speed winding)	37	347
αi IP 60/4500 (Low-speed winding)	17	160
αi IP 60/4500 (High-speed winding)	32	300

(c) SPINDLE MOTOR αi IT series

Motor model	Velocity loop proportional gain No.4046/ No.4047	Velocity loop Integral gain No.4054/ No.4055
αi IT 1.5/15000	4	35
αi IT 2/15000	6	52
αi IT 3/12000	12	107
αi IT 6/12000 (Low-speed winding)	13	121
αi IT 6/12000 (High-speed winding)	7	63
αi IT 8/12000 (Low-speed winding)	11	100
αi IT 8/12000 (High-speed winding)	5	47
αi IT 8/15000 (Low-speed winding)	17	157
αi IT 8/15000 (High-speed winding)	17	156
αi IT 15/10000 (Low-speed winding)	24	224
αi IT 15/10000 (High-speed winding)	14	131
αi IT 15/12000 (Low-speed winding)	12	108
αi IT 15/12000 (High-speed winding)	11	100
αi IT 22/10000 (Low-speed winding)	37	347
αi IT 22/10000 (High-speed winding)	17	160

(d) SPINDLE MOTOR αi IL series

Motor model	Velocity loop proportional gain No.4046/ No.4047	Velocity loop Integral gain No.4054/ No.4055
αi IL 8/20000 (Low-speed winding)	10	92
αi IL 8/20000 (High-speed winding)	24	224
αi IL 15/15000 (Low-speed winding)	11	102
αi IL 15/15000 (High-speed winding)	47	436
αi IL 26/15000 (Low-speed winding)	18	163
αi IL 26/15000 (High-speed winding)	42	393

(e) PINDLE MOTOR αi I series (400V)

Motor model	Velocity loop proportional gain No.4046/ No.4047	Velocity loop Integral gain No.4054/ No.4055
αi I 0.5/10000HV	3	30
αi I 1/10000HV	10	91

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Motor model	Velocity loop proportional gain No.4046/ No.4047	Velocity loop Integral gain No.4054/ No.4055
αi I 1.5/10000HV	5	42
αi I 2/10000HV	8	71
αi I 3/10000HV	10	92
αi I 6/10000HV	9	85
αi I 8/8000HV	10	96
αi I 12/7000HV	18	171
αi I 15/7000HV	14	131
αi I 22/7000HV	19	179
αi I 30/6000HV	24	224
αi I 40/6000HV	32	302
αi I 60/4500HV	20	184
αi I 100/4000HV (Low-speed winding)	26	240
αi I 100/4000HV (High-speed winding)	52	480

(f) SPINDLE MOTOR αi IP series (400V)

Motor model	Velocity loop proportional gain No.4046/ No.4047	Velocity loop Integral gain No.4054/ No.4055
αi IP 15/6000HV (Low-speed winding)	13	122
αi IP 15/6000HV (High-speed winding)	20	184
αi IP 22/6000HV (Low-speed winding)	11	104
αi IP 22/6000HV (High-speed winding)	17	157
αi IP 40/6000HV (Low-speed winding)	14	131
αi IP 40/6000HV (High-speed winding)	20	189
αi IP 50/6000HV (Low-speed winding)	18	166
αi IP 50/6000HV (High-speed winding)	37	347
αi IP 60/4500HV (Low-speed winding)	17	160
αi IP 60/4500HV (High-speed winding)	32	300

(g) SPINDLE MOTOR αi IT series (400V)

Motor model	Velocity loop proportional gain No.4046/ No.4047	Velocity loop Integral gain No.4054/ No.4055
αi IT 1.5/15000HV	15	143
αi IT 2/15000HV	17	155
αi IT 3/12000HV	3	29
αi IT 6/12000HV (Low-speed winding)	9	88
αi IT 6/12000HV (High-speed winding)	25	234
αi IT 8/12000HV (Low-speed winding)	7	62
αi IT 8/12000HV (High-speed winding)	15	137
αi IT 8/15000HV (Low-speed winding)	10	92
αi IT 8/15000HV (High-speed winding)	26	245
αi IT 15/10000HV (Low-speed winding)	19	179
αi IT 15/10000HV (High-speed winding)	51	476
αi IT 15/12000HV (Low-speed winding)	11	102
αi IT 15/12000HV (High-speed winding)	39	364
αi IT 22/10000HV (Low-speed winding)	19	181
αi IT 22/10000HV (High-speed winding)	52	482

(h) SPINDLE MOTOR αi IL series (400V)

Motor model	Velocity loop proportional gain No.4046/ No.4047	Velocity loop Integral gain No.4054/ No.4055
αi IL 8/20000HV (Low-speed winding)	10	92
αi IL 8/20000HV (High-speed winding)	24	224

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Motor model	Velocity loop proportional gain No.4046/ No.4047	Velocity loop Integral gain No.4054/ No.4055
αi IL 15/15000HV (Low-speed winding)	11	102
αi IL 15/15000HV (High-speed winding)	47	436
αi IL 26/15000HV (Low-speed winding)	18	163
αi IL 26/15000HV (High-speed winding)	42	393

(i) SPINDLE MOTOR BiI series (standard type)

Motor model	Velocity loop proportional gain No.4046/ No.4047	Velocity loop Integral gain No.4054/ No.4055
BiI 50L/25000	1	13
BiI 80S/20000 (Low-speed winding)	11	100
BiI 80S/20000 (High-speed winding)	11	106
BiI 80M/15000	11	100
BiI 80L/8000	4	40
BiI 100S/12500	9	79
BiI 112SS/20000 (Low-speed winding)	4	38
BiI 112SS/20000 (High-speed winding)	19	178
BiI 112S/15000 (Low-speed winding)	5	47
BiI 112S/15000 (High-speed winding)	25	235
BiI 112M/15000	9	88
BiI 112L/15000 (Low-speed winding)	5	44
BiI 112L/15000 (High-speed winding)	13	122
BiI 112LL/15000 (Low-speed winding)	5	44
BiI 112LL/15000 (High-speed winding)	12	109
BiI 132M/14000 (Low-speed winding)	4	39
BiI 132M/14000 (High-speed winding)	14	133
BiI 132L/14000 (Low-speed winding)	5	43
BiI 132L/14000 (High-speed winding)	23	210
BiI 160S/13000 (Low-speed winding)	8	72
BiI 160S/13000 (High-speed winding)	14	135
BiI 160M/13000 (Low-speed winding)	7	69
BiI 160M/13000 (High-speed winding)	8	79
BiI 160L/13000 (Low-speed winding)	9	81
BiI 160L/13000 (High-speed winding)	19	180
BiI 160LL/13000 (Low-speed winding)	7	67
BiI 160LL/13000 (High-speed winding)	27	247
BiI 180M/6000 (Low-speed winding)	15	139
BiI 180M/6000 (High-speed winding)	27	248
BiI 180L/6000 (Low-speed winding)	16	145
BiI 180L/6000 (High-speed winding)	34	318
BiI 180LL/8000 (Low-speed winding)	13	120
BiI 180LL/8000 (High-speed winding)	42	391
BiI 200M/6000 (Low-speed winding)	12	111
BiI 200M/6000 (High-speed winding)	22	206
BiI 200L/6000 (Low-speed winding)	11	103
BiI 200L/6000 (High-speed winding)	20	187
BiI 250M/3000 (Low-speed winding)	19	180
BiI 250M/3000 (High-speed winding)	35	325

(j) SPINDLE MOTOR BiI series (high-speed type)

Motor model	Velocity loop proportional gain No.4046/ No.4047	Velocity loop Integral gain No.4054/ No.4055
BiI 40S/70000	20	183
BiI 80S/40000	17	159

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BiI 100S/20000 (Low-speed winding)	6	51
BiI 100S/20000 (High-speed winding)	9	86
BiI 112S/20000 (Low-speed winding)	6	56
BiI 112S/20000 (High-speed winding)	9	87
BiI 112M/20000 (Low-speed winding)	4	42
BiI 112M/20000 (High-speed winding)	24	225
BiI 112L/20000 (Low-speed winding)	5	50
BiI 112L/20000 (High-speed winding)	20	187
BiI 112L/25000 (Low-speed winding)	4	41
BiI 112L/25000 (High-speed winding)	12	111
BiI 132L/25000 (Low-speed winding)	5	49
BiI 132L/25000 (High-speed winding)	27	247
BiI 160M/20000 (Low-speed winding)	6	60
BiI 160M/20000 (High-speed winding)	34	312
BiI 160L/20000 (Low-speed winding)	9	82
BiI 160L/20000 (High-speed winding)	21	200
BiI 160LL/20000 (Low-speed winding)	11	106
BiI 160LL/20000 (High-speed winding)	68	635

(k) SPINDLE MOTOR βiI series

Motor model	Velocity loop proportional gain No.4046/ No.4047	Velocity loop Integral gain No.4054/ No.4055
βiI 3/10000	6	28
βiI 6/10000	8	40
βiI 8/10000	7	33
βiI 12/10000	8	37

2.4.11 Divided Backlash Compensation Output in Non-Cutting Mode for Cs Contour Control

2.4.11.1 Overview

There is an axis for which a gear ratio between the spindle motor and spindle is large and a backlash in motor reversal is large; for example, an axis in a large rotary table. For such an axis, to improve a delayed reversal along the Cs contour control axis in cutting, a method may be used by which backlash compensation is applied only to the error counter on the semi-closed side while the dual position feedback function for the spindle is enabled. In this case, to improve the reversal behavior in cutting, relatively large backlash compensation must be set. However, if large backlash compensation is output at once together with a large move command in non-cutting mode(NOTE), a shock may occur in the machine.
In non-cutting mode, when backlash compensation is divided before being output, the backlash compensation can be output gently rather than in one shot, thereby making it possible to reduce a shock.

NOTE
Non-cutting mode refers to, for example, rapid traverse mode, jog feed mode, and manual handle feed mode. Division of compensation is disabled during a manual handle interrupt in automatic operation mode.

2.4.11.2 Series and editions of applicable spindle software

Spindle software

Series	Edition	Usable CNC
9D5A	N (14)	FS0*i* -D
9D5D	B (02)	FS0*i* -D

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Series	Edition	Usable CNC
9D7A	C (03)	FS30*i* / FS31*i* / FS32*i* -A
9D8A	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9D90	P (16)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	S (19)	FS0*i* -D, FS0*i* –F, FS30*i* / FS31*i* / FS32*i* -B
9DB0	A (01)	FS0*i* –F, FS30*i* / FS31*i* / FS32*i* -B

2.4.11.3 Related parameters

Parameter No.		Description
0*i*	**30*i***	
1851	1851	Backlash compensation
4600	4600	Divided compensation for backlash compensation
4005#2	4005#2	Setting for applying backlash compensation for dual position feedback

2.4.11.4 Details of Related Parameters

0*i*	30*i*	
1851	1851	**Backlash compensation**

Unit of data : Detection unit
Valid data range : -9999 to 9999

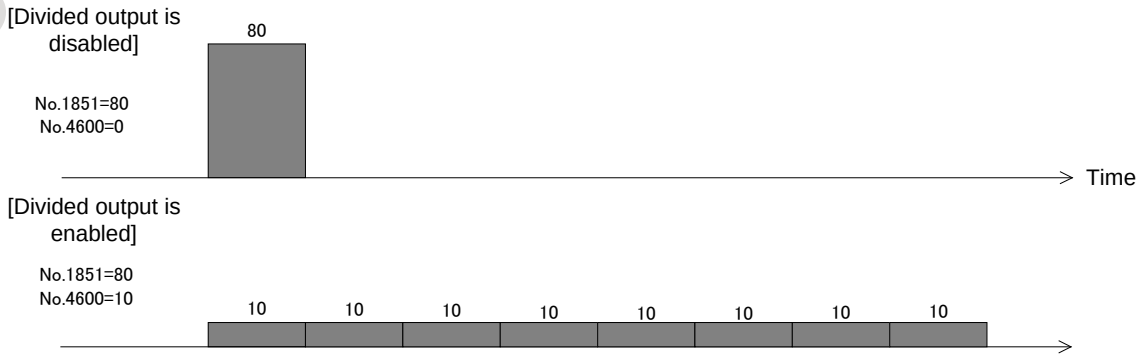
This parameter sets backlash compensation for each axis.

0*i*	30*i*	
4600	4600	**Divided compensation for backlash compensation**

Unit of data : Detection unit
Valid data range : -9999 to 9999

With respect to the backlash compensation set in parameter No. 1851, this parameter sets divided backlash compensation to be output in non-cutting mode. Compensation larger than that in parameter No. 1851 cannot be output.

The figure below shows an example in which backlash compensation (parameter No. 1851) is set as “80” and divided compensation (parameter No. 4600) is set as “10”.
For normal backlash compensation, “80” is output in a single step. When the divided compensation “10” is set, however, “10” is output in each of eight different steps.
(If the backlash compensation is indivisible, the remainder is output in the last one step.)



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0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4005	4005						HBKLEN		

HBKLEN When the dual position feedback function is used, backlash compensation is:
0 : Reflected on the error counter on the full-closed side.
1 : Reflected on the error counter on the semi-closed side.

Normally, set "0". To reflect backlash compensation only on the error counter on the semi-closed side when the dual position feedback is used, set this bit to "1".

2.4.12 Diagnosis (Diagnosis Screen)

Address		Description	Unit
0*i*	**30*i***		
0418	0418	Position error value of the spindle	Pulse

2.4.13 Alarm

This Subsection provides a list of the alarms related to Cs contouring control only. For details of alarms, refer to "Cs CONTIYRING CONTROL" of the CONNECTION MANUAL (FUNCTION) of each CNC.

(1) Series 0*i*

Alarm No.	Description
PS0194	Cs contouring control is specified in serial spindle synchronous control mode.
PS0197	A move command was issued from a program when the input signal CON (bit 7 of G027) is off.
SP0752	Switching to Cs contouring control mode is not terminated normally.

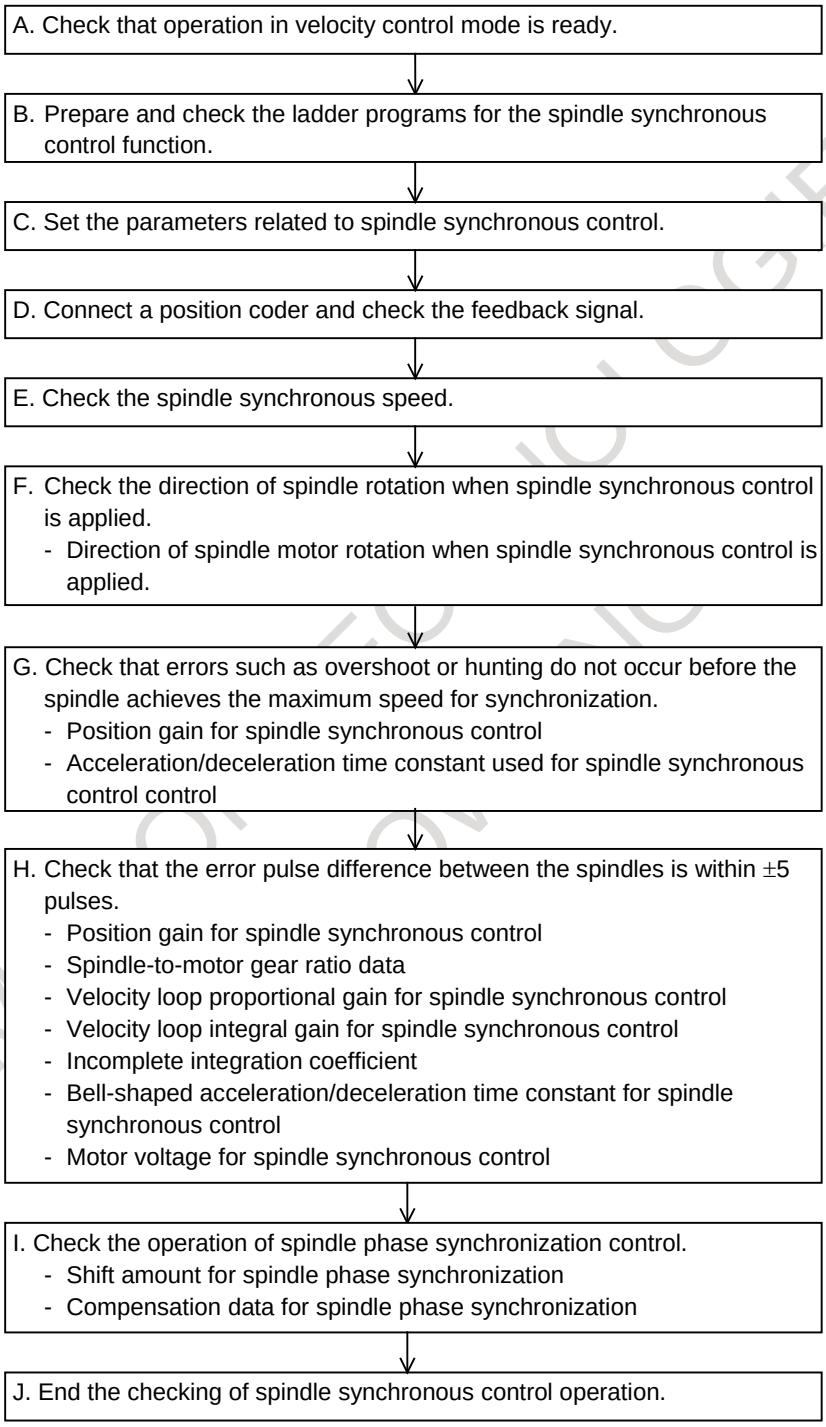
(2) Series 30*i*

Alarm No.	Description
PS0194	Cs contouring control is specified in serial spindle synchronous control mode.
PS0197	A move command was issued from a program when the input signal CON (bit 7 of G027) is off.
SP0752	Switching to Cs contouring control mode is not terminated normally.

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2.5 SPINDLE SYNCHRONOUS CONTROL (OPTIONAL FUNCTION)

2.5.1 Start-up Procedure



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2.5.2 Overview

When, on a machine (such as a lathe) that has two facing spindles, workpiece seizure is to be switched from the first spindle to the second spindle during spindle rotation, or acceleration/deceleration is performed while the first spindle and second spindle hold a workpiece, the two spindles must rotate at the same speed.
When the seizure of a uniquely shaped workpiece is to be switched from one spindle to the other, the two spindles must have the same spindle rotation phase (angular displacement).
The spindle synchronous control function exercises synchronous control between two spindles in these cases.

NOTE
1 To use this function, the CNC software option is required.
2 When the 30*i*-B series (FSSB communication) is used, place the spindle motors subjected to spindle synchronous control on the same FSSB line.

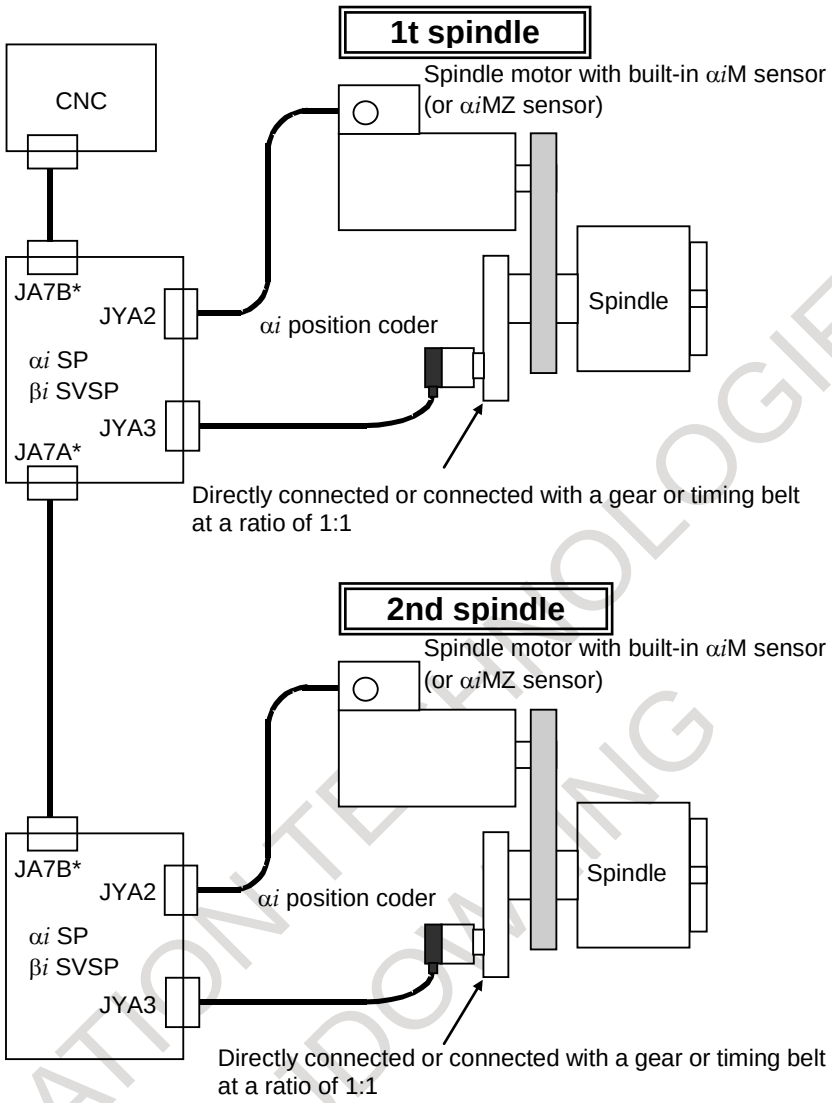
2.5.3 System Configuration

The system configurations that enable the use of the spindle synchronous control function are shown below.

NOTE
1 Spindle synchronous control between spindles each having a different detector configuration is possible.
2 Spindle synchronous control between different path is possible. For details, see "FANUC Series 30*i*/31*i*/32*i* -MODEL A CONNECTION MANUAL (FUNCTION): B-63943EN-1 section 11.14 'SPINDLE SYNCHRONOUS CONTROL' ", "FANUC Series 30*i*/31*i*/32*i* -MODEL B CONNECTION MANUAL (FUNCTION): B-64483EN-1 section 11.14 'SPINDLE SYNCHRONOUS CONTROL' ", "FANUC Series 0*i* -MODEL D CONNECTION MANUAL (FUNCTION): B-64303EN-1 section 10.14 'SPINDLE SYNCHRONOUS CONTROL' ", "FANUC Series 0*i* -MODEL F CONNECTION MANUAL (FUNCTION): B-64603EN-1 section 10.14 'SPINDLE SYNCHRONOUS CONTROL' ",

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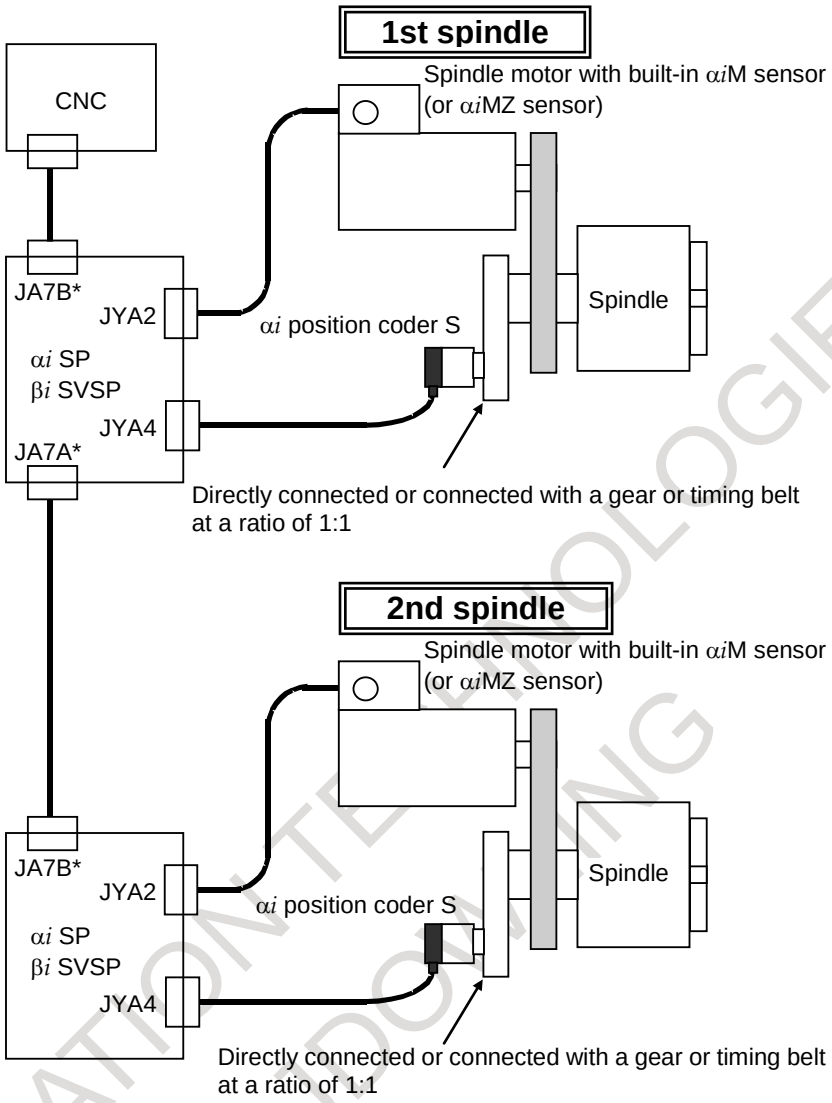
(1) When the αi position coder is used



* For the FS30*i*-B series CNC, 0*i* -F(FSSB communication), use COP10A/COP10B instead of JA7A/JA7B.

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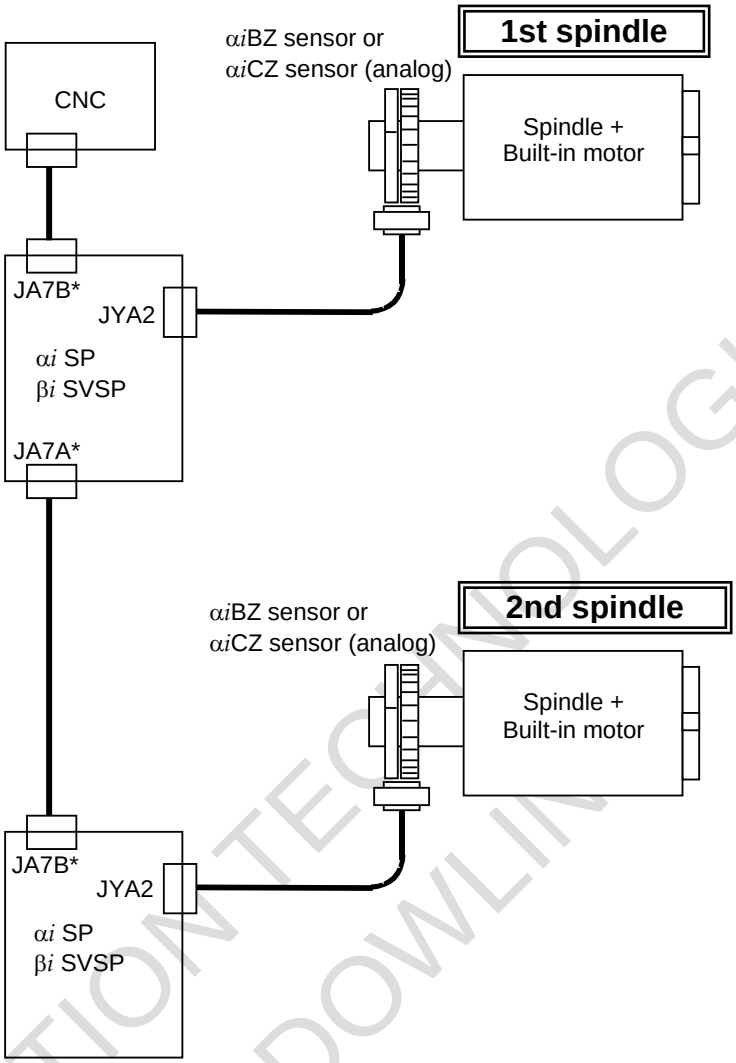
(2) When the α position coder S is used



* For the FS30*i*-B series CNC, 0*i* -F (FSSB communication), use COP10A/COP10B instead of JA7A/JA7B.

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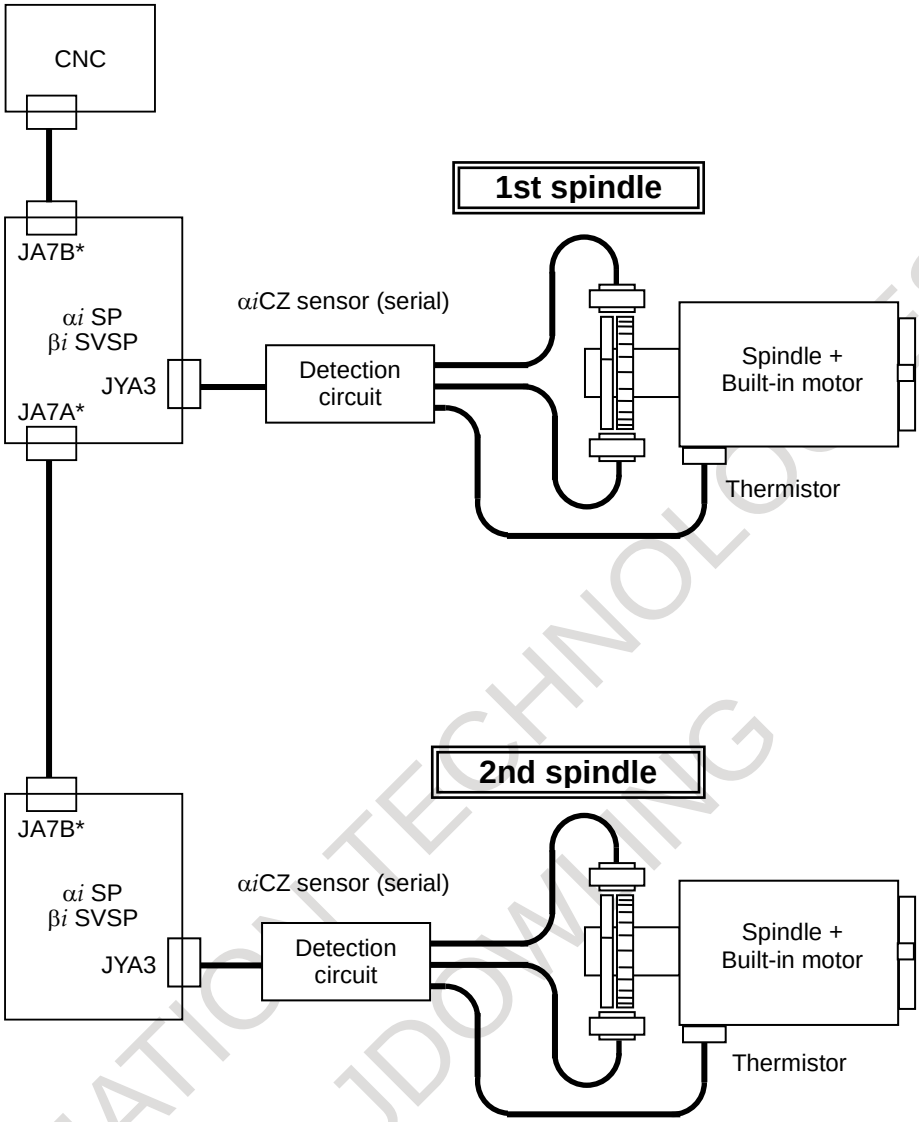
(3) When the built-in motor (α*i*BZ sensor, α*i*CZ sensor (analog)) is used



* For the FS30*i*-B series CNC , 0*i* -F (FSSB communication), use COP10A/COP10B instead of JA7A/JA7B.

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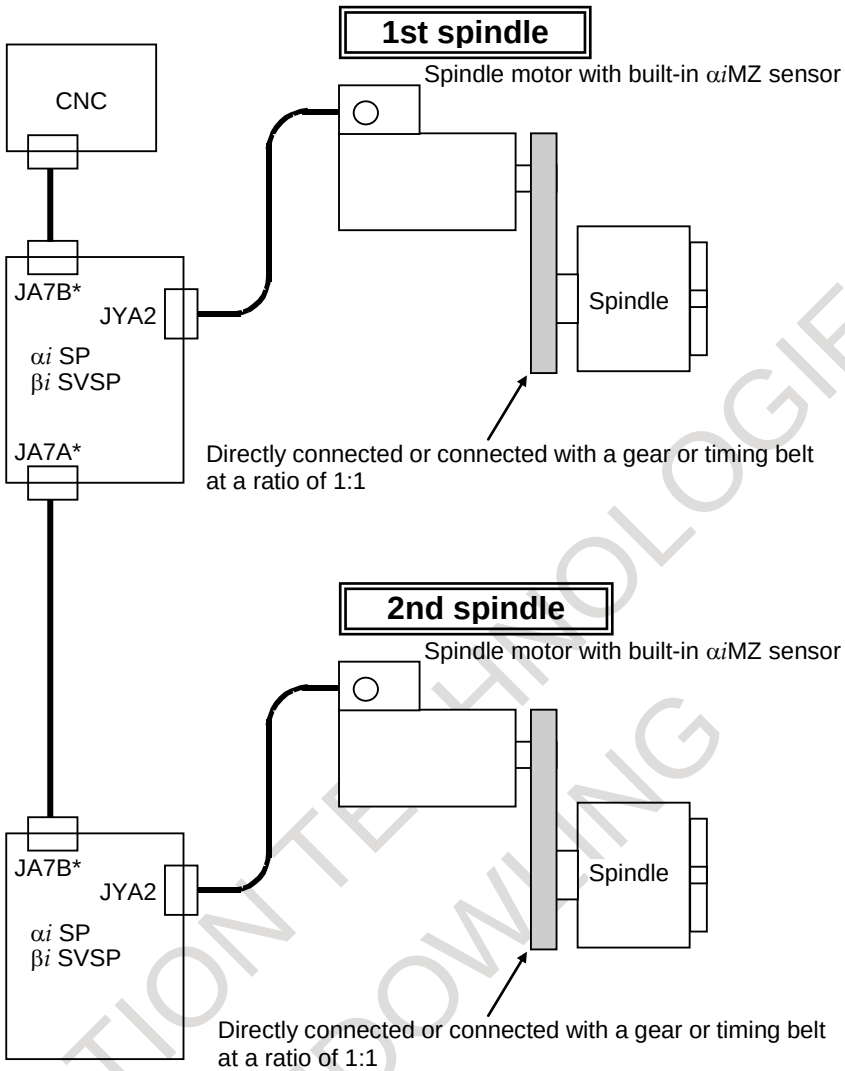
(4) When the built-in motor (α*i*CZ sensor (serial)) is used



* For the FS30*i*-B series CNC, 0*i* -F (FSSB communication), use COP10A/COP10B instead of JA7A/JA7B.

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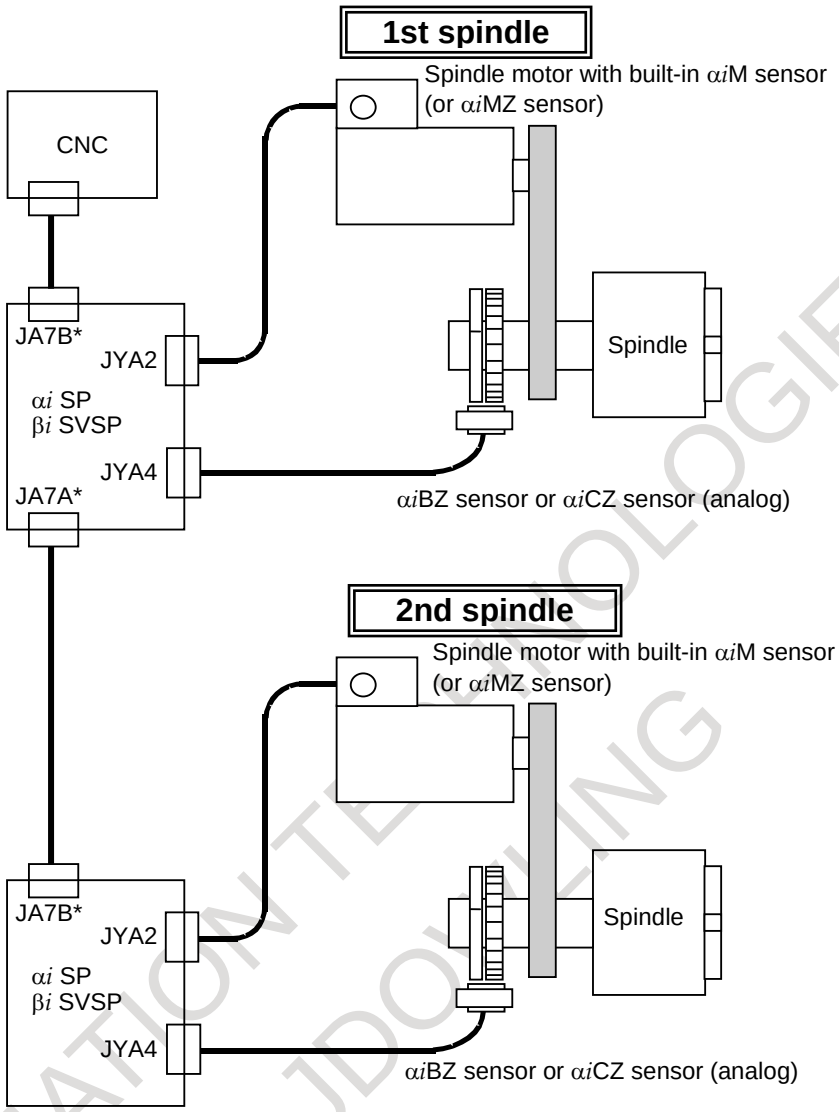
(5) When the spindle motor with built-in αiMZ sensor is used



* For the FS30*i*-B series CNC, 0*i* -F (FSSB communication), use COP10A/COP10B instead of JA7A/JA7B.

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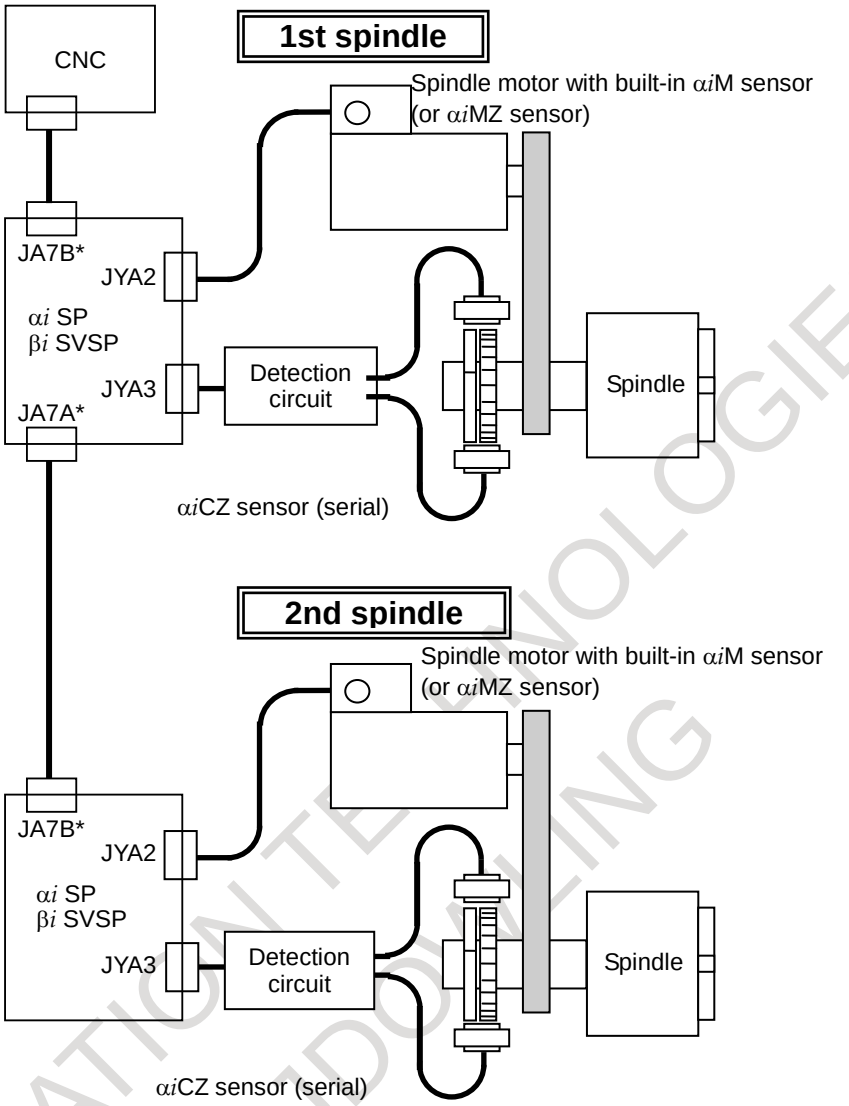
(6) When the separate type αiBZ sensor or separate type αiCZ sensor (analog) is used



* For the FS30*i*-B series CNC , 0*i* -F (FSSB communication), use COP10A/COP10B instead of JA7A/JA7B.

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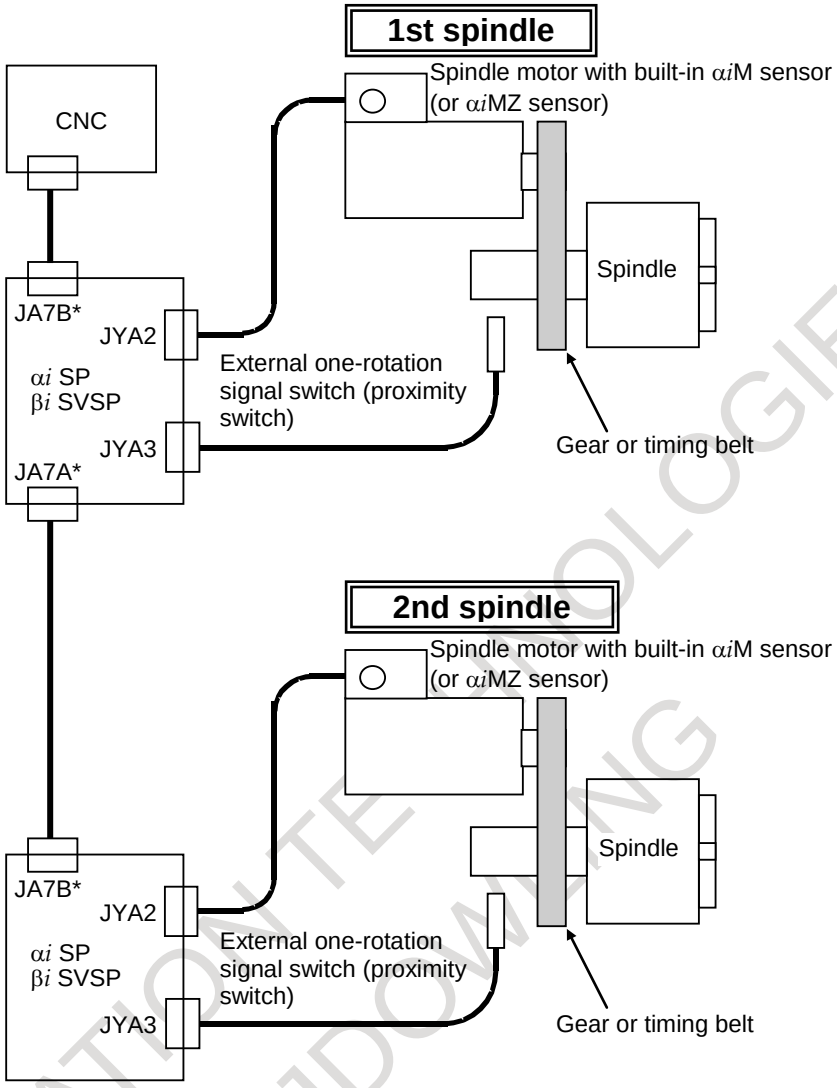
(7) When the separate type αiCZ sensor (serial) is used



* For the FS30*i*-B series CNC, 0*i* -F (FSSB communication), use COP10A/COP10B instead of JA7A/JA7B.

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(8) When the external one-rotation signal (proximity switch) is used



* For the FS30*i*-B series CNC, 0*i* -F (FSSB communication), use COP10A/COP10B instead of JA7A/JA7B.

NOTE
1 When using the external one-rotation signal (proximity switch), use the detection arbitrary gear ratio function (DMR function).
2 When using the detection arbitrary gear ratio function (DMR function), set the following:
 - Parameters (No. 4171 to No. 4174) for the numerator/denominator of an arbitrary gear ratio between the motor sensor and spindle
3 Set the type of the external one-rotation signal (proximity switch) (bits 3 and 2 of No. 4004).
4 For stable detection of the one-rotation signal, detect the one-rotation signal by performing spindle orientation before entering spindle synchronous control mode. For orientation based on the external one-rotation signal, see Section 2.2, “POSITION CODER METHOD ORIENTATION”, in Part I.

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2.5.4 Explanation of Operation

(i) If spindle synchronous control is commanded when the two spindles are rotating at different speeds (including stop state), the two spindles are accelerated or decelerated to the commanded speed then enter synchronous control state.

(ii) If the synchronous speed command is changed after synchronous control state is entered, the spindles are accelerated or decelerated to the new commanded speed with the parameter-set acceleration while synchronous control state is held. If the synchronous speed command is 0 min^{-1}, the spindles stops in synchronism.

(iii) If spindle synchronous control at a synchronous speed of 0 min^{-1} is commanded when the spindles are in stop state, each spindle automatically makes two to three turns to detect the position coder one-rotation signal (as a preparation for spindle phase synchronous control), then enters synchronous control state.
Next, when the synchronous speed command is changed, the spindles are accelerated with the parameter-set acceleration while synchronous control state is held, until the speed command is changed.

(iv) When the seizure of a uniquely shaped workpiece needs to be switched between the two spindles, the rotation phase (angular displacement) of one spindle must match that of the other.
If a spindle phase synchronous control command is entered when the two spindles are rotating in synchronous control state, each spindle is controlled to have the parameter-set rotation phase (a momentary speed change occurs at this time), then enters synchronous control state again.
A rotation phase match can be secured by matching the reference positions of the two spindles by parameter setting beforehand.

(v) If the two spindles enter synchronous control state at a specified synchronous speed of 0 min^{-1}, and a phase synchronous control command is then entered, each spindle rotates and stops to achieve a parameter-set phase. This operation is performed as if spindle positioning (spindle orientation) is performed while the spindles are stopped. As a result, the reference position of one spindle matches that of the other (phase synchronization).
If the synchronous speed command is changed after the two spindles seize a uniquely shaped workpiece, the two spindles are accelerated to the new specified speed with the parameter-set acceleration while synchronous control state is held.

(vi) Even in the state where the two spindles are seizing a workpiece in synchronous control state, constant surface speed control can be exercised.
However, even if a speed change greater than the parameter-set acceleration is commanded, the speed changes within the parameter-set acceleration.

(vii) Do not change the rotation direction command (SFRA, SRVA) during synchronous control.

NOTE
For details, see “SPINDLE SYNCHRONOUS CONTROL” in connection manual for each CNC.

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2.5.5 List of I/O Signals (CNC↔PMC)

(1) Address list of input signals (PMC→CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
Common to all axes	G038	G038					SPPHS	SPSYC		
Common to all axes	G032	G032	R08I	R07I	R06I	R05I	R04I	R03I	R02I	R01I
Common to all axes	G033	G033			SSGN		R12I	R11I	R10I	R09I
1st-	G070	G070			SFRA	SRVA	CTH1A	CTH2A		
2nd-	G074	G074			SFRB	SRVB	CTH1B	CTH2B		
1st-	G071	G071			INTGA					
2nd-	G075	G075			INTGB					

(2) Details of input signals (PMC→CNC)

(a) Spindle synchronous control signal SPSYC

[Function] Specifies switching to spindle synchronous control mode.

[Operation] When this signal is set to 1, spindle synchronous control mode is set.
When this signal is set to 0, spindle synchronous control mode is cancelled.

(b) Spindle phase synchronous control signal SPPHS

[Function] Specifies spindle phase synchronous control mode (phase matching).

(i) This function is valid when the spindle synchronous control signal SPSYC is 1.

(ii) After the spindle synchronous speed control completion signal FSPSY is set to 1, specify this signal.

(iii) A spindle phase synchronous control operation is performed on the rising edge of this signal. So, the phase once matched is not shifted by setting this signal to 0.
However, a phase matching operation is performed when this signal is changed from 0 to 1 again.

[Operation] When this signal makes a transition from 0 to 1, spindle phase synchronous control is exercised.

(c) Velocity integral control signal INTGA

[Function] Enables or disables velocity integral control.

[Operation] When this signal is set to 1

⇒ The velocity loop integral function is disabled. This has the same effect as the setting of a velocity loop integral gain of 0.

When this signal is set to 0

⇒ The velocity loop integral function is enabled.

NOTE

1 When the two spindles seize the same workpiece, a spindle may be fixed at a position slightly displaced from the specified position because the two spindles are mechanically connected.
In this case, an excessively high current can flow because the velocity loop integral function attempts to return the spindle to the specified position.
To prevent this, turn on (set to 1) the velocity integral control signal INTGA to disable the velocity loop integral function if the two spindles are mechanically connected.

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NOTE
2 When the velocity integral control signal INTGA is turned on (set to 1), the velocity loop integral function is disabled. So, an increased synchronous error can occur. When the two spindles do not seize the same workpiece, turn off (set to 0) the velocity integral control signal INTGA to enable the velocity loop integral function.

(3) Address list of output signals (CNC→PMC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
Common to all axes	F044	F044				SYCAL	FSPPH	FSPSY		
1st-	F045	F045					SARA			
2nd-	F049	F049					SARB			

(4) Details of output signals (CNC→PMC)

(a) Spindle synchronous speed control completion signal FSPSY

[Function]

Posts that spindle synchronous control (speed synchronization) is completed.

[Output condition]

This signal is set to 1 when the following condition is satisfied:

(i) This signal is output when the two spindles have reached the speed corresponding to a specified spindle synchronous speed and the speed difference between the two spindles is equal to or less than the value set in parameter No. 4033 on spindle synchronous control mode.

This signal is set to 0 when any of the following conditions is satisfied:

(i) The two spindles have not reached the speed corresponding to a specified spindle synchronous speed on spindle synchronous control mode.
(ii) The speed difference between the two spindles is greater than the value set in parameter No. 4033 on spindle synchronous control mode.
(iii) Spindle synchronous control mode is not set.

NOTE
Even if this signal is set to 1 once, this signal is set to 0 when the speed difference becomes equal to or greater than the value set in parameter No. 4033 for a cause such as cutting load variation.

(b) Spindle phase synchronous control completion signal FSPPH

[Function]

Posts that spindle phase synchronous control (phase matching) is completed.

[Output condition]

This signal is set to 1 when the following condition is satisfied:

(i) This signal is output when phase matching is completed with the spindle phase synchronous control signal (the error pulse difference between the two spindles is equal to or less than the value set in parameter No. 4810) after the two spindles have reached the speed corresponding to a specified spindle synchronous speed on spindle synchronous control mode.

This signal is set to 0 when any of the following conditions is satisfied:

(i) Phase matching between the two spindles is not completed on spindle synchronous control mode. The error pulse difference between the two spindles is greater than the value set in parameter No. 4810 on spindle synchronous control mode.
(ii) Spindle phase synchronous control mode is not set.

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NOTE
Even if this signal is set to 1 once, this signal is set to 0 when the speed difference becomes equal to or greater than the value set in parameter No. 4033 for a cause such as cutting load variation.

(c) Phase error monitoring signal SYCAL

[Function]

Posts that the error pulse difference between the two spindles is greater than the parameter-set value on spindle synchronous control mode.

[Output condition]

This signal is set to 1 when the following condition is satisfied:

(i) The error pulse difference between the two spindles after spindle synchronous control is completed is greater than the value set in parameter No. 4811 on spindle synchronous control mode.

This signal is set to 0 when any of the following conditions is satisfied:

(i) The error pulse difference between the two spindles is equal to or less than the value set in parameter No. 4811 on spindle synchronous control mode.

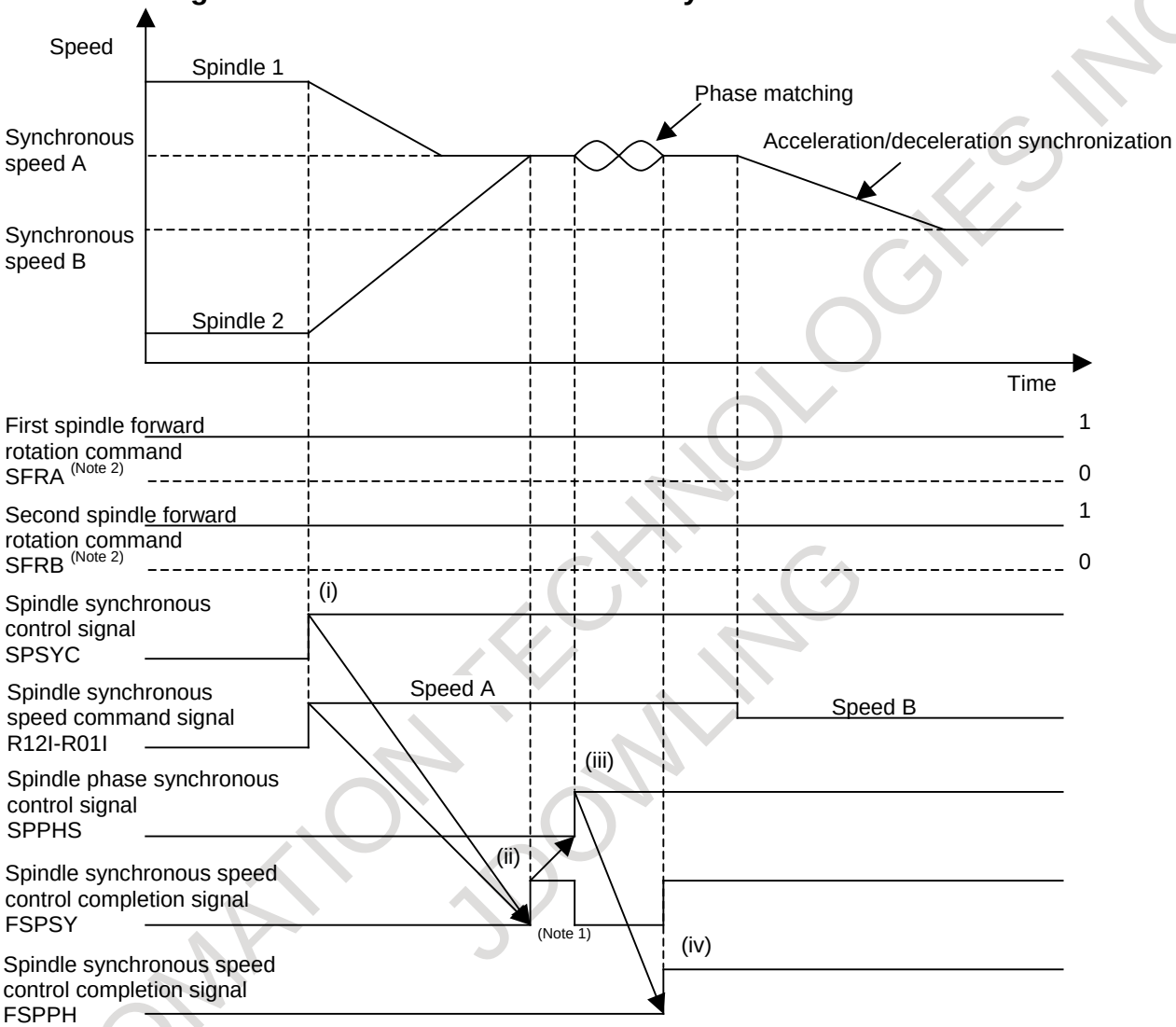
(ii) Spindle phase synchronous control mode is not set.

NOTE
Use this signal to take an action if an error such as an excessive synchronous error occurs for a cause on spindle synchronous control mode.

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2.5.6 Examples of Sequences

(1) While spindle 1 is rotating, spindle 2 is accelerated for synchronization with spindle 1, and phase matching is performed. Then, the synchronous speed is also changed for acceleration/deceleration synchronization.

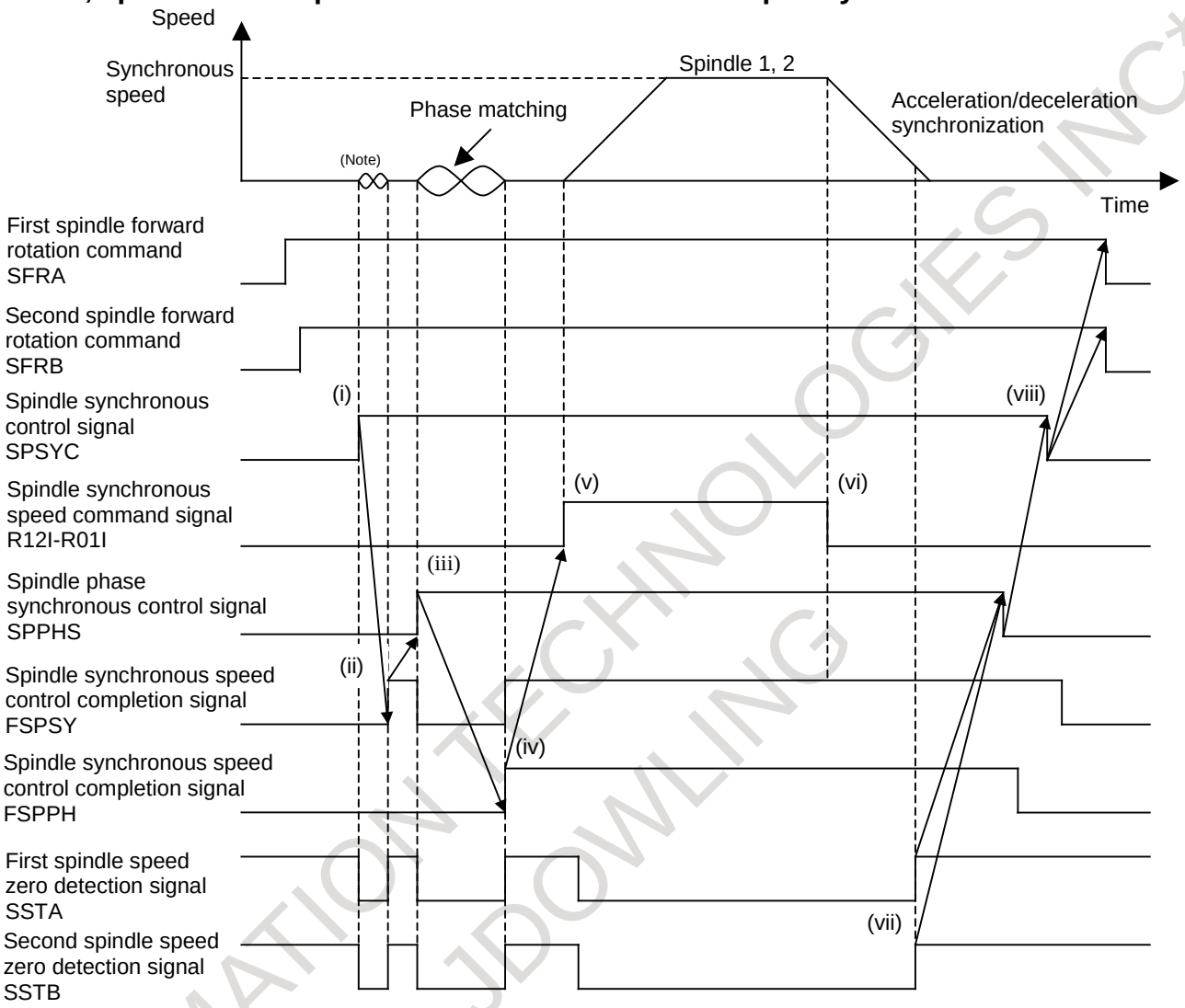


(i) The spindle synchronous speed command signal is input to set the spindle synchronous control signal SPSYC to 1.
(ii) The spindle synchronous speed control completion signal FSPSY set to 1 is awaited.
(iii) The spindle phase synchronous control signal SPPHS is set to 1.
(iv) The spindle phase synchronous control completion signal FSPPH set to 1 is awaited.

NOTE
1 When the spindle phase synchronous control signal is input, the spindle synchronous speed control completion signal is once set to 0, then is set to 1 again upon completion of phase synchronization.
2 Set the spindle forward rotation command SFR (or the spindle reverse rotation command SRV) to 1 at all times during spindle synchronous control.

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(2) Spindle 1 and spindle 2 perform phase matching in stop state, then are accelerated in synchronism.
Next, spindle 1 and spindle 2 are decelerated to a stop in synchronism.

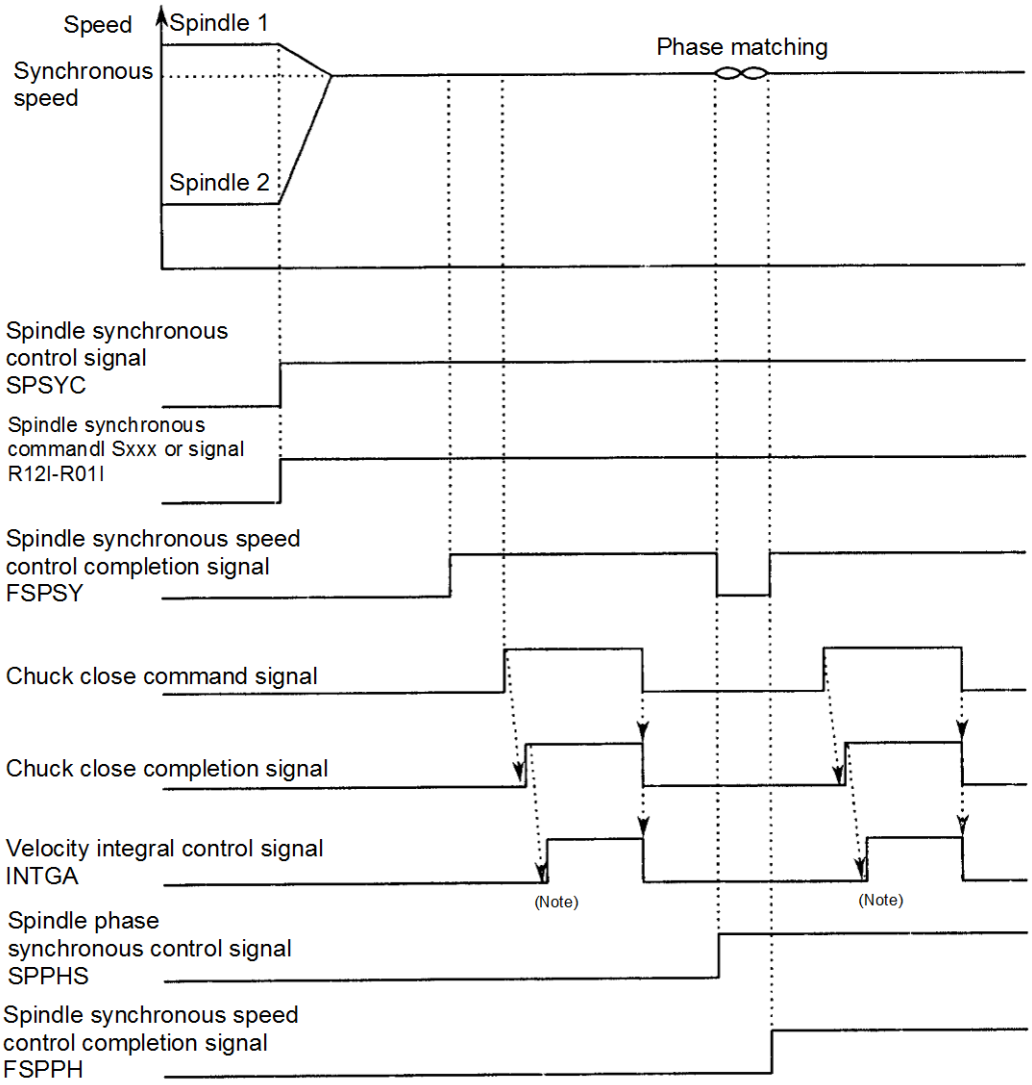


(i) The spindle synchronous speed command signal is set to 0, and the spindle synchronous control signal SPSYC is set to 1.
(ii) The spindle synchronous speed control completion signal FSPSY set to 1 is awaited.
(iii) The spindle phase synchronous control signal SPPHS is set to 1.
(iv) The spindle phase synchronous control completion signal FSPPH set to 1 is awaited.
(v) The spindle synchronous speed command signal is input.
(vi) The spindle synchronous speed command signal is set to 0.
(vii) The speed zero detection signal of both spindles set to 1 is awaited.
(viii) The spindle phase synchronous control signal SPPHS is set to 0 and the spindle synchronous control signal SPSYC is set to 0, then the forward rotation command SFR of both spindles is set to 0.

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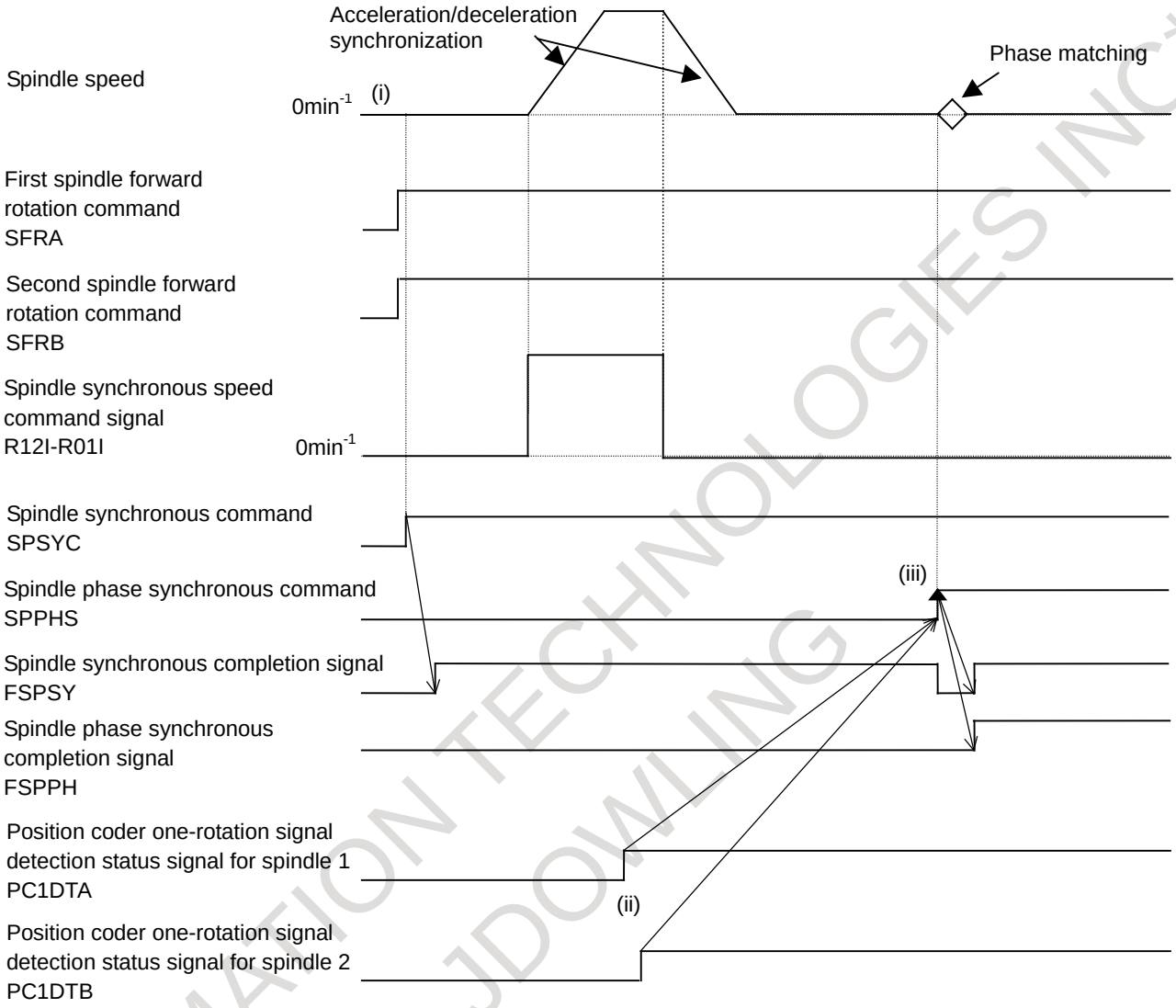
NOTE
If the mode is switched to the spindle synchronous control mode when a one-rotation signal is undetected, a one-rotation signal detection operation is automatically performed. So, the spindle automatically makes 2 to 3 turns even if such turns are not attempted. If both spindles are mechanically connected with each other and one-rotation signal detection operation is disabled, or spindle phase synchronous control is not exercised, automatic detection can be disabled by setting bit 3 of parameter No. 4006.

(3) When the velocity integral control signal is used



NOTE
Turn on (set to 1) the velocity integral control signal INTGA only when the two spindles are seizing the same workpiece. If the signal is turned on (set to 1) in other cases, the velocity loop integral function is disabled. So, an increased synchronous error can result.

(4) When phase synchronous control is performed without automatically detecting the one-rotation signal (Parameter No. 4006#3=1)



(i) When a spindle synchronous command is input, the one-rotation signal detection operation is not performed, and the spindle is stopped.
(ii) During rotation at a speed of several ten min^{-1} or higher, the one-rotation signal is detected automatically, and the position coder one-rotation signal detection status signal is set to 1.
(iii) Before inputting the phase synchronous command, check that the position coder one-rotation signal detection status signals of both spindles have been set to 1.

2.5.7 Related Parameters

Parameter No.		Description
0*i*	30*i*	
4801#0	4801#0	Direction of rotation of each spindle motor while synchronous control is applied
4810	4810	Error pulse difference between the two spindles for which to output the spindle phase synchronous control completion signal
4811	4811	Error pulse difference between the two spindles for which to output the phase synchronous error monitor signal (SYCAL)
4001#1	4001#1	Lower limit setting of the acceleration for polygon machining with two spindles

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Parameter No.		Description
0*i*	30*i*	
4002#6	4002#6	Whether to enable the rotation direction signal (SFR/SRV) function on spindle synchronous control
4006#1	4006#1	Gear ratio increment system
4006#3	4006#3	Setting for disabling automatic one-rotation signal detection at spindle synchronous control mode switching time
4540#3	4540#3	Setting related to motor voltage control characteristics on spindle synchronous control
4032	4032	Acceleration used for spindle synchronous control (The same value must be set for both the 1st and 2nd spindles.)
4033	4033	Spindle synchronous speed arrival level
4034	4034	Shift amount for spindle phase synchronous control
4035	4035	Compensation data for spindle phase synchronous control
4044 4045	4044 4045 (*)	Velocity loop proportional gain for spindle synchronous control (A parameter is selected by the CTH1A PMC input signal.) * When parameter No. 4550 ≠ 0 (No. 4551 ≠ 0), parameter No. 4550 (No. 4551) is valid.
4052 4053	4052 4053 (*)	Velocity loop integral gain for spindle synchronous control (A parameter is selected by the CTH1A PMC input signal.) * When parameter No. 4552 ≠ 0 (No. 4553 ≠ 0), parameter No. 4552 (No. 4553) is valid.
4056 to 4059	4056 to 4059	Spindle-to-motor gear ratio data (A parameter is selected by the CTH1A and CTH2A PMC input signals.)
4065 to 4068	4065 to 4068 (*)	Position gain for spindle synchronous control (The same value must be specified for both the 1st and 2nd spindles.) (A parameter is selected by the CTH1A and CTH2A PMC input signals.) * When parameters Nos. 4554 to 4557 ≠ 0, parameters Nos. 4554 to 4557 are valid.
4085	4085(*)	Motor voltage for spindle synchronous control (for high-speed characteristics) * When parameter No. 4558 ≠ 0, parameter No. 4558 is valid.
4137	4137(*)	Motor voltage for spindle synchronous control (for low-speed characteristics) * When parameter No. 4559 ≠ 0, parameter No. 4559 is valid.
4171 4173	4171 4173	Denominator of arbitrary gear ratio between motor sensor and spindle (This data is selected by spindle control input signals CTH1A.)
4172 4174	4172 4174	Numerator of arbitrary gear ratio between motor sensor and spindle (This data is selected by spindle control input signals CTH1A.)
4336	4336	Magnetic flux switching point used for calculating an acceleration/deceleration time constant used for spindle synchronous control (The same value must be specified for both the 1st and 2nd spindles.)
4340	4340	Bell-shaped acceleration/deceleration time constant for spindle synchronous control (The same value must be specified for both the first and second spindles.)
4346	4346	Incomplete integration coefficient
4515	4515	Excessive speed deviation alarm detection level on spindle synchronous control
4516	4516	Excessive positional deviation alarm detection level on spindle synchronous control
4550 4551	4550 4551	Velocity loop proportional gain for spindle synchronous control (A parameter is selected by the CTH1A PMC input signal.)
4552 4553	4552 4553	Velocity loop integral gain for spindle synchronous control (A parameter is selected by the CTH1A PMC input signal.)
4554 to 4557	4554 to 4557	Position gain for spindle synchronous control (The same value must be specified for both the 1st and 2nd spindles.) (A parameter is selected by the CTH1A and CTH2A PMC input signals.)
4558	4558	Motor voltage for spindle synchronous control (for high-speed characteristics)
4559	4559	Motor voltage for spindle synchronous control (for low-speed characteristics)

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NOTE
1 For the detector-related parameters, see Section 1.3, “PARAMETERS RELATED TO DETECTORS”, in Part I.
2 For velocity loop proportional/integral gain adjustment, see Section 4.1, “VELOCITY LOOP GAIN ADJUSTMENT”, in Part I.

2.5.8 Spindle Parameters for Rigid Tapping and Spindle Synchronous Control

Of the spindle parameters for rigid tapping (servo mode) and spindle synchronous control, the velocity loop gains, position gains, and motor voltages can be set individually. The settings to be used exclusively for spindle synchronous control can be made in parameters Nos. 4550 to 4559; when the parameters ≠ 0, these parameters are valid for spindle synchronous control, and when the parameters = 0, the common parameters are valid as usual.

(1) Related Parameters

	Rigid tapping	Spindle synchronous control	Condition
Velocity loop proportional gain (HIGH) CTH1A=0	No.4044	No.4044	No.4550＝0
		No.4550	No.4550≠0
Velocity loop proportional gain (LOW) CTH1A=1	No.4045	No.4045	No.4551＝0
		No.4551	No.4551≠0
Velocity loop integral gain (HIGH) CTH1A=0	No.4052	No.4052	No.4552＝0
		No.4552	No.4552≠0
Velocity loop integral gain (LOW) CTH1A=1	No.4053	No.4053	No.4553＝0
		No.4553	No.4553≠0
Position gain (HIGH) CTH1A=0,CTH2A=0	No.4065	No.4065	No.4554＝0
		No.4554	No.4554≠0
Position gain (MEDIUM HIGH) CTH1A=0,CTH2A=1	No.4066	No.4066	No.4555＝0
		No.4555	No.4555≠0
Position gain (MEDIUM LOW) CTH1A=1,CTH2A=0	No.4067	No.4067	No.4556＝0
		No.4556	No.4556≠0
Position gain (LOW) CTH1A=1,CTH2A=1	No.4068	No.4068	No.4557＝0
		No.4557	No.4557≠0
Motor voltage (for high-speed characteristics)	No.4085	No.4085	No.4558＝0
		No.4558	No.4558≠0
Motor voltage (for low-speed characteristics)	No.4137	No.4137	No.4559＝0
		No.4559	No.4559≠0

2.5.9 Details of Related Parameters

This Subsection details the serial spindle parameters (in the four thousands) among the parameters related to spindle synchronous control. For details of other parameters, refer to “SPINDLE SYNCHRONOUS CONTROL” of the CONNECTION MANUAL (FUNCTION) of each CNC.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4001	4001							**POLYM**	

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POLYM The lower limit setting of the acceleration (parameter No. 4032) for polygon machining with two spindles is:

0 : Normal setting
For FS30*i* : 916
For FS0*i*-D : 229

1 : Extended setting
For FS30*i* : 1
For FS0*i*-D : 1

NOTE
1. This parameter is valid with 9D5A series D (04) edition or later, 9D53 series R (18) edition or later, 9D70 series R (18) edition or later, 9D80 series N (14) edition or later, 9D90 series B (02) edition or later, 9DA0 series A (01) edition or later and 9DB0 series B (01) edition or later.
2. Use this bit only when spindle software of any of the above series and editions is applied to both spindle amplifiers for polygon machining with two spindles. Do not set this bit to 1 if the software is not applied.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4002	4002		SYCDRT						

SYCDRT Whether to enable the rotation direction signal (SFR/SRV) function on spindle synchronous control

0 : Enables the rotation direction function.
If a move command from the CNC is positive (+),
(a) The spindle rotates in the CCW (counterclockwise) direction when the input signal SFR (bit 5 of G70) = 1.
(b) The spindle rotates in the CW (clockwise) direction when the input signal SRV (bit 4 of G70) = 1.

1 : Disables the rotation direction function.
If a move command from the CNC is positive (+), the spindle rotates in the CCW (counterclockwise) direction when the input signal SFR = 1 or SRV = 1.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4006	4006					SYCREF		GRUNIT	

GRUNIT Sets a gear ratio setting resolution:

0 : 1/100 unit
1 : 1/1000 unit

Select a gear ratio data setting resolution from the following:

(a) Resolution based on motor speed increased by a factor of 100 relative to one spindle rotation
(b) Resolution based on motor speed increased by a factor of 1000 relative to one spindle rotation

Depending on the setting of this parameter, the increment system of the parameters indicated in the table below changes.

Parameter No.		Description
0*i*	30*i*	
4056 to 4059	4056 to 4059	Spindle-to-motor gear ratio data

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NOTE
1 Usually, use the 1/100 unit (setting "0").
2 When the 1/100 unit is set as the gear ratio setting resolution (with the bit set to 0), a steady-state synchronous error may be indicated due to the fraction of the gear ratio.
In such a case, the synchronous error can be improved when the 1/1000 unit is set as the gear ratio setting resolution (with the bit set to 1).

SYCREF Setting for function performing automatic detection of the one-rotation signal on spindle synchronous control

0 : Automatic detection of the one-rotation signal carried out

1 : Automatic detection of the one-rotation signal not carried out. (When spindle phase synchronous control is not carried out)

When the mode is switched to spindle synchronous control mode after power-on, the two spindles automatically perform a one-rotation signal detection operation. So, the spindles automatically make two to three turns even if such turns are not intended.

This operation is required because the one-rotation signal must be detected to enable spindle phase synchronous control.

If the two spindles are mechanically connected to disable each spindle from performing a one-rotation signal detection operation, or if spindle phase synchronous control is not exercised, the operation above can be disabled by setting this bit to 1.

When this parameter is set to "1", check that the one-rotation signal has been detected for both spindles (output signal PC1DTA = 1) before applying the spindle phase synchronous control signal (SPPHS).

If the one-rotation signal is not detected, specify a speed of several ten min^{-1} or higher in spindle synchronous control mode, and wait until the one-rotation signal is detected. (See sequence example (4).)

When polygon machining with two spindles is performed, set this parameter to "0". If "1" is set, and if the polygon machining command is issued while the one-rotation signal is not detected, alarm SP9167 (spindle control sequence error) may occur.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4540	4540					EXPTSY			

EXPTSY (#3) Setting related to motor voltage control characteristics on spindle synchronous control

Set this bit to 1 when setting a value less than 100 as the motor voltage on spindle synchronous control (parameter No. 4085 (for high-speed winding) or No. 4137 (for low-speed winding)).

This parameter is valid only when bit 4 of parameter No. 4016 = 0.

0*i*	30*i*	
4032	4032	**Acceleration at spindle synchronous control**

Unit of data : $1min^{-1}$/sec (when parameter No. 4006#2 (SPDUNT) = 1, 10 min^{-1}/sec)

Valid data range : 0 to 32767

Initial setting : 0

This parameter is used for spindle synchronous control or polygon machining with two spindles. For polygon machining with two spindles, when bit 1 (POLYM) of parameter No. 4001 = 1, the allowable data range is not limited.

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	Data range				
Spindle synchronous control	0 to 32767				
Polygon machining with two spindles	POLYM =0				POLYM=1
	FS0*i*-D		FS30*i*		0 to 32767
	SPDUNT=0	SPDUNT=1	SPDUNT=0	SPDUNT=1	
	0, 229 to 32767	0, 23 to 32767	0, 916 to 32767	0, 92 to 32767	

NOTE
1 Set exactly the same data for 1st spindle and 2nd spindle. When different data is set, synchronization between the two spindles is not guaranteed.
2 When this parameter is set to 0, motor doesn't accelerate/decelerate, so, be sure to set proper value in this parameter.

0*i* 30*i*
4033 4033 **Spindle synchronous speed arrival level**

Unit of data : $1 min^{-1}$ (when parameter No. 4006#2 (SPDUNT) = 1, $10 min^{-1}$)
Valid data range : 0 to 32767
Initial setting : 10
For the synchronous speed command at spindle synchronous control, if the error of the respective spindle motor speeds are within the setting level, the spindle synchronous control complete signal (FSPSY) becomes "1".

0*i* 30*i*
4034 4034 **Shift amount at spindle phase synchronous control**

Unit of data : 1 pulse unit (360 degrees/4096)
Valid data range : 0 to 4095
Initial setting : 0
Sets the shift amount from the reference position (one-rotation signal) at spindle phase synchronous control.

0*i* 30*i*
4035 4035 **Spindle phase synchronous compensation data**

Unit of data : 1 pulse/2msec
Valid data range : 0 to 4095
Initial setting : 10
This parameter reduces speed fluctuations when aligning phase of spindles in spindle phase synchronous control.
When this parameter is "0", since the phase alignment amount is only issued once, the position error quickly becomes large, and there are large speed changes on phase alignment.
It is possible to perform smooth phase alignments through issuing separate commands for phase alignment amounts for the number of 2 msec pulses set in this parameter.

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0i-	30i		
4044	4044	**Velocity loop proportional gain on spindle synchronous control (HIGH)**	**CTH1A=0**
4045	4045	**Velocity loop proportional gain on spindle synchronous control (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10

This sets velocity loop proportional gain on spindle synchronous control.
It is selected HIGH when CTH1A=0 of input signal, and It is selected LOW when CTH1A=1 of input signal.

NOTE
When parameters Nos. 4550 and 4551 are set to values other than 0, the values set in parameters Nos. 4550 and 4551 are valid.

0i	30i		
4052	4052	**Velocity loop integral gain on spindle synchronous control (HIGH)**	**CTH1A=0**
4053	4053	**Velocity loop integral gain on spindle synchronous control (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10

This sets velocity loop integral gain on spindle synchronous control. It is selected HIGH when CTH1A=0 of input signal, and It is selected LOW when CTH1A=1 of input signal.

NOTE
When parameters Nos. 4552 and 4553 are set to values other than 0, the values set in parameters Nos. 4552 and 4553 are valid.

0i	30i		
4056	4056	**Gear ratio (HIGH)**	**CTH1A=0, CTH2A=0**
4057	4057	**Gear ratio (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4058	4058	**Gear ratio (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4059	4059	**Gear ratio (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : (Motor rotation for one rotation of spindle) / 100
(When parameter No. 4006 #1 (GRUNIT) is 1, motor rotation / 1000)
(When parameter No. 4005 #5 is 1, motor rotation / 10)
Valid data range : 0 to 32767
Initial setting : 100

These parameters set the gear ratio of the spindle motor to the spindle.
When the motor rotates 2.5 times for each turn of the spindle, for example, set 250 in the parameter.
A parameter is selected by the CTH1A and CTH2A input signals.
The gear or clutch status must correspond to the status of the CTH1A and CTH2A input signals.

NOTE
When an improper value is set in these parameters, an unexpected operation can occur. For example, the spindle does not stop but keeps rotating at the time of orientation. So, be sure to set a proper gear ratio.

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0*i*	30*i*		
4065	4065	**Position gain on synchronous control (HIGH)**	**CTH1A=0, CTH2A=0**
4066	4066	**Position gain on synchronous control (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4067	4067	**Position gain on synchronous control (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4068	4068	**Position gain on synchronous control (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : $0.01sec^{-1}$
Valid data range : 0 to 32767
Initial setting : 1000

This sets position gain in spindle synchronous control. It is selected by CTH1A or CTH2A of input signal.

NOTE
When parameters Nos. 4554, 4555, 4556, and 4557 are set to values other than 0, the values set in parameters Nos. 4554, 4555, 4556, and 4557 are valid.

0*i*	30*i*	
4085	4085	**Motor voltage setting on spindle synchronous control (for high-speed characteristics)**
4137	4137	**Motor voltage setting on spindle synchronous control (for low-speed characteristics)**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : Depend on motor model.

Set a motor voltage for spindle synchronous control.

NOTE
1 Usually, set the same value as for the setting of a motor voltage (No. 4083) on the velocity control mode.
2 When parameters Nos. 4558 and 4559 are set to values other than 0, the values set in parameters Nos. 4558 and 4559 are valid.

0*i*	30*i*		
4171	4171	**Denominator of arbitrary gear ratio between motor sensor and spindle (HIGH)CTH1A=0**	
4172	4172	**Numerator of arbitrary gear ratio between motor sensor and spindle (HIGH)**	**CTH1A=0**
4173	4173	**Denominator of arbitrary gear ratio between motor sensor and spindle (LOW)**	**CTH1A=1**
4174	4174	**Numerator of arbitrary gear ratio between motor sensor and spindle (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0

These parameters set conversion coefficients (numerator, denominator) for using the detection arbitrary gear ratio function (DMR function) by multiplying a motor sensor (α*i*M or α*i*MZ sensor) feedback signal by a gear ratio to produce a spindle position feedback signal.

When the spindle rotates Q times while the motor shaft rotates P times (there is no common divisor other than 1 for P and Q), settings are:

No. 4171 (No. 4173 when CTH1A = 1) = P
No. 4172 (No. 4174 when CTH1A = 1) = Q

When 0 is set in any of these parameters, the setting of 1 is assumed.

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NOTE
When using the external one-rotation signal (proximity switch), set the detection arbitrary gear ratio (DMR) between the motor sensor and spindle by using this parameter.

0*i*	30*i*	
4336	4336	**Acceleration switch point on spindle synchronous control**

Unit of data 1min^{-1} (when parameter No. 4006#2 (SPDUNT) = 1, 10 min^{-1})
Valid data range : 0 to 32767
Initial setting : 0

The acceleration for spindle synchronous control changes according to the speed set in this parameter as follows:

- Area where the spindle speed does not exceed the speed set in this parameter
  The acceleration for spindle synchronous control is constant (as set in parameter No. 4032).
- Area where the spindle speed exceeds the speed set in this parameter
  The acceleration for spindle synchronous control decreases in inverse proportion to the speed.

NOTE
1 Set the same data for the first spindle and second spindle. If different data is set, synchronization between the two spindles is not guaranteed.
2 When this parameter is set to 0, linear acceleration/deceleration (constant acceleration) is performed.

0*i*	30*i*	
4340	4340	**Bell-shaped acceleration/deceleration time constant for spindle synchronous control**

Unit of data : 1msec
Valid data range : 0 to 512
Initial setting : 0

This parameter sets a bell-shaped acceleration/deceleration time constant for spindle synchronous control.
This parameter is applied to the move command after "Acceleration at spindle synchronous control" (parameter No. 4032) is applied.
When this parameter is set, the spindle synchronous speed control completion signal (FSPSY), output when the synchronous speed is first reached after the spindle synchronous control mode is entered, is delayed by the set time.

NOTE
Set the same data for the first spindle and second spindle. If different data is set, synchronization between the two spindles is not guaranteed.

0*i*	30*i*	
4346	4346	**Incomplete integration coefficient**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0

Set this parameter to use incomplete integration for velocity loop integration control.

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NOTE
Usually, this parameter need not be adjusted.

0*i*	30*i*	
4515	4515	**Excessive speed deviation alarm detection level on spindle synchronous control**

Unit of data : $1min^{-1}$ ($10min^{-1}$ when bit 2 (SPDUNT) of parameter No. 4006 is set to 1)
Valid data range : 0 to 32767
Initial setting : 0

This parameter sets a level for detecting the excessive speed deviation alarm under spindle synchronous control.
If the positional deviation (position error) or the difference between the speed command for the spindle end calculated from the position gain and the actual spindle speed exceeds the value set in this parameter in the spindle synchronous control mode, the excessive speed deviation alarm under spindle synchronous control (spindle alarm C8) is detected. When this parameter is set to 0, alarm detection is disabled.
If the speed integration control signal (INTG) is used, the speed deviation increases for a cause such as acceleration/deceleration and cutting load. The spindle speed deviation that causes torque command saturation is indicated below. Set an alarm level by using a calculated value as a guideline. (During spindle synchronous control, ensure that torque command saturation does not take place.)

Spindle speed deviation $[min^{-1}] = 1024 \times A / P \times B / G$
where

No.4006#1	No.4009#0	A	B
0	0	1	100
0	1	16	100
1	0	1	1000
1	1	16	1000

P: Velocity loop proportional gain on spindle synchronous control (No.4044, 4045)
G: Gear ratio (No.4056 to 4059)

NOTE
This parameter is valid with
9D50 series N (14) edition or later
9D70 series D (04) edition or later
9D80 series A (01) edition or later
9D90 series A (01) edition or later
9DA0 series A (01) edition or later.
9DB0 series A (01) edition or later.

0*i*	30*i*	
4516	4516	**Excessive positional deviation alarm detection level on spindle synchronous control**

Unit of data : 100 pulses (weight of 4096 pulses/rev)
Valid data range : 0 to 32767
Initial setting : 0

This parameter sets a level for detecting the excessive positional deviation alarm under spindle synchronous control.
If the positional deviation (position error) exceeds the value set in this parameter in the spindle synchronous control mode, the excessive positional deviation alarm under spindle synchronous control (spindle alarm C9) is detected. When this parameter is set to 0, alarm detection is disabled.

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As an alarm level, set a value greater than the positional deviation (position error) equivalent to the spindle speed specified in the spindle synchronous control mode. The positional deviation equivalent to the spindle speed can be calculated from the following expression:

Positional deviation [pulse]
= Spindle speed [min^{-1}] / 60 × 4096 × 100 / PG
where
PG: Position gain on synchronous control (Nos.4065 to 4068)

NOTE
This parameter is valid with
9D50 series N (14) edition or later
9D70 series D (04) edition or later
9D80 series A (01) edition or later
9D90 series A (01) edition or later
9DA0 series A (01) edition or later.
9DB0 series A (01) edition or later.

0*i*	30*i*	
4550	4550	**Velocity loop proportional gain on spindle synchronous control (HIGH) CTH1A=0**
4551	4551	**Velocity loop proportional gain on spindle synchronous control (LOW) CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10
This sets velocity loop proportional gain on spindle synchronous control.
It is selected HIGH when CTH1A=0 of input signal, and It is selected LOW when CTH1A=1 of input signal.

NOTE
1 This parameter is valid with 9D70 series O (15) edition or later, 9D80 series K (11) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later and 9DB0 series A (01) edition or later.
2 When parameters Nos. 4550 and 4551 are set to 0, the values set in parameters Nos. 4044 and 4045 are valid.

0*i*	30*i*	
4552	4552	**Velocity loop integral gain on spindle synchronous control (HIGH) CTH1A=0**
4553	4553	**Velocity loop integral gain on spindle synchronous control (LOW) CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10
This sets velocity loop integral gain on spindle synchronous control. It is selected HIGH when CTH1A=0 of input signal, and It is selected LOW when CTH1A=1 of input signal.

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NOTE
1 This parameter is valid with 9D70 series O (15) edition or later, 9D80 series K (11) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later and 9DB0 series A (01) edition or later.
2 When parameters Nos. 4552 and 4553 are set to 0, the values set in parameters Nos. 4052 and 4053 are valid.

0*i*	30*i*	
4554	4554	**Position gain on synchronous control (HIGH) CTH1A=0, CTH2A=0**
4555	4555	**Position gain on synchronous control (MEDIUM HIGH) CTH1A=0, CTH2A=1**
4556	4556	**Position gain on synchronous control (MEDIUM LOW) CTH1A=1, CTH2A=0**
4557	4557	**Position gain on synchronous control (LOW) CTH1A=1, CTH2A=1**

Unit of data : $0.01sec^{-1}$
Valid data range : 0 to 32767
Initial setting : 1000
This sets position gain in spindle synchronous control. It is selected by CTH1A or CTH2A of input signal.

NOTE
1 This parameter is valid with 9D70 series O (15) edition or later, 9D80 series K (11) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later and 9DB0 series A (01) edition or later.
2 When parameters Nos. 4554, 4555, 4556, and 4557 are set to 0, the values set in parameters Nos. 4056, 4057, 4058, and 4059 are valid.

0*i*	30*i*	
4558	4558	**Motor voltage setting on spindle synchronous control (for high-speed characteristics of speed range switching)**
4559	4559	**Motor voltage setting on spindle synchronous control (for low-speed characteristics of speed range switching)**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : Depend on motor model.
Set a motor voltage for spindle synchronous control.

NOTE
1 This parameter is valid with 9D70 series O (15) edition or later, 9D80 series K (11) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later and 9DB0 series A (01) edition or later.
2 Usually, set the same value as for the setting of a motor voltage (No. 4083) on the velocity control mode.
3 When parameters Nos. 4558 and 4559 are set to 0, the values set in parameters Nos. 4085 and 4137 are valid.

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2.5.10 Number of Error Pulses in Spindle Synchronous Control

This Subsection describes the method of calculating the number of error pulses (position error) of each spindle on spindle synchronous control mode, and also describes the items to be checked when a calculated value differs from the actual number of error pulses.

(1) Calculating the number of error pulses on spindle synchronous control

When the spindle is rotating at a constant speed, the number of error pulses is calculated as follows:

$$\text{Number of error pulses(pulse)} = 4096(\text{pulse/rev}) \times \frac{\text{Spindle synchronization speed}(\text{min}^{-1})}{60(\text{sec})} \times \frac{1}{\text{Position gain}(\text{sec}^{-1})}$$

Example :

When spindle synchronous speed = 1000 min^{-1}, and position gain = 20 sec^{-1}

$$\textit{Number of error pulses} = 4096 \times \frac{1000}{60} \times \frac{1}{20} = \textit{Approx.}3413\,(\text{pulse})$$

(2) Checking the number of error pulses on spindle synchronous control

If the number of error pulses on spindle synchronous control checked by diagnosis (diagnosis screen) differs greatly from the calculated value, check the following:

(a) Spindle speed (This can be checked using the actual rotation speed indication of the CNC.)
(b) Motor speed indication on the spindle monitor screen or SERVO GUIDE.
(c) Actual gear ratio between the spindle and motor found from the spindle speed and motor speed checked by (a) and (b)
(d) Spindle-to-motor gear ratio parameters (Nos. 4056 to 4059)
(e) Position gain parameters (Nos. 4065 to 4068)
(f) How the gear selection signals (CTH1A, CTH2A) are used for selection (This item can be checked on the spindle motor screen or the PMC signal status screen.)

NOTE

When the 1/100 unit is set as the gear ratio setting resolution (with bit 1 of No. 4006 set to 0), the actual number of error pulses may differ from the calculated value by several pulses due to the fraction of the gear ratio.

In such a case, the difference between the actual number of error pulses and the calculated value can be decreased when the 1/1000 unit is set as the gear ratio setting resolution (with bit 1 of No. 4006 set to 1).

2.5.11 Specifying a Shift Amount for Spindle Phase Synchronous Control

The following describes an example of determining the shift amount for phase synchronization in synchronous control of the spindle phase.

(1) Apply synchronous control of the spindle phase by setting the following:
  (a) SFR (or SRV)=1 for the 1st and 2nd spindles : M03 (M04)
  (b) Spindle synchronous speed command = 0 min^{-1} : S0
  (c) For the 1st and 2nd spindles, set 0 in the parameter (No.4034) for the shift amount for spindle phase synchronous control.
(2) After establishing spindle phase synchronization, set SFR/SRV for the 2nd spindle to 0 (to deactivate the motor).
  The motor for the 2nd spindle is placed in power-off state at this time, so that the 2nd spindle can be rotated manually.

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(3) Rotate the 2nd spindle manually from the position of (1) to the position for spindle phase synchronization, then check the spindle position data (No. 445) on the diagnosis (diagnosis screen). This value serves as data to be set in the parameter for the shift amount used for spindle phase synchronous control.

(4) Set the number of pulses found by (3) as shift amount parameter data (No. 4034) for spindle phase synchronous control of the 2nd spindle.
In general, set 0 in the parameter for the shift amount for spindle phase synchronous control for the 1st spindle.

(5) After canceling the spindle synchronous control command, perform another spindle phase synchronization operation, according to the following settings, to check that phase synchronization has been established as expected:
   (a) SFR (or SRV)=1 for the 1st and 2nd spindles : M03 (M04)
   (b) Spindle synchronous speed command = 0 min^{-1} : S0

2.5.12 Diagnosis (Diagnosis Screen)

Address		Description	Unit
0*i*	30*i*		
0418	0418	Positional error of each spindle in spindle synchronous control mode	Pulse
0425	0425	Synchronous error of each spindle in spindle synchronous control mode	Pulse

2.5.13 Alarms

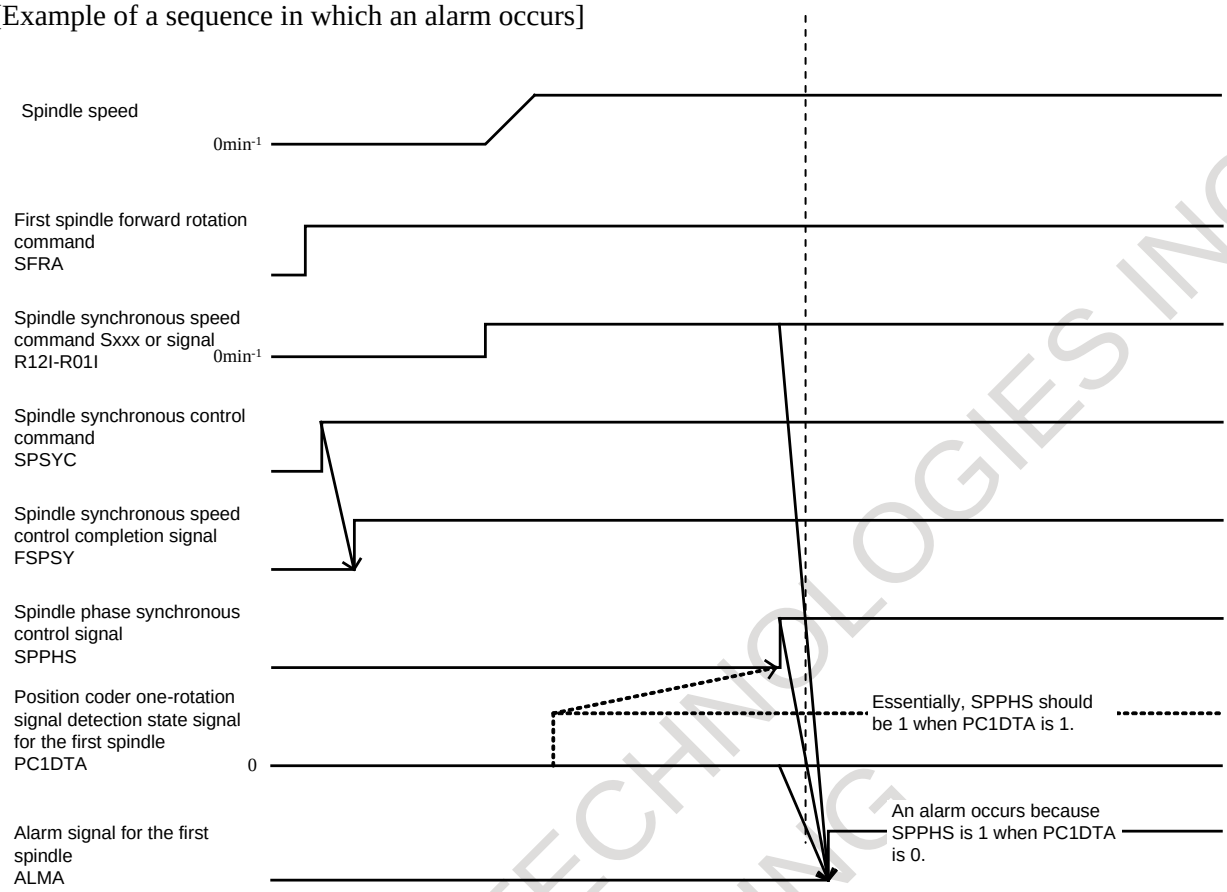
(1) Spindle control sequence error alarm during phase alignment

If a phase synchronous control single is input under the following conditions during spindle synchronous control operation, a spindle control sequence error alarm (SP9167) is issued.

- A setting is made to disable automatic detection of the one-rotation signal (bit 3 of parameter No. 4006 is 1).
- The position coder one-rotation signal detection state signal for any or both of the axes subjected to spindle control is “0". (The one-rotation signal is not detected.)
- The spindle synchronous speed command is not 0 min^{-1}.

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[Example of a sequence in which an alarm occurs]



A spindle control sequence error alarm (SP9167) is issued due to several causes. It is possible to observe the spindle state error number to determine the alarm causes on the CNC diagnosis screen.
The state error number indicating a sequence error of the phase synchronous signal is “60”.

Diagnostic number FS30*i*/FS0*i*	Description
710	State error number

When the phase synchronous signal is used with a setting for disabling automatic detection of the one-rotation signal (bit 3 of parameter No. 4006 is 1), check that the position coder one-rotation signal for both axes subjected to spindle synchronous control is “1”, and then input the phase synchronous signal.

(2) Synchronous axis spindle command alarm

The following provides only an overview of a synchronous axis spindle command alarm. For details, refer to “SPINDLE SYNCHRONOUS CONTROL” of the CONNECTION MANUAL (FUNCTION) of each CNC.

(1) Series 0*i*

Alarm No.	Description
PS194	Cs contouring control is specified in serial spindle synchronous control mode.

(2) Series 30*i*

Alarm No.	Description
PS194	Cs contouring control is specified in serial spindle synchronous control mode.

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2.6 SPECIFICATIONS COMMON TO ALL OPERATION MODES

2.6.1 Overview

This section describes the I/O signals (CNC↔PMC), parameters, diagnosis signals, and alarms common to all operation modes.

2.6.2 List of I/O Signals (CNC↔PMC)

This Subsection provides a list of the I/O signals related to spindle speed control only. For details of each signal, refer to "SPINDLE SPEED CONTROL" of the CONNECTION MANUAL (FUNCTION) of each CNC.
For details of the I/O signals common to the CNCs, see Chapter 3, "I/O SIGNALS (CNC↔PMC)", in Part I.

(1) Input signals (PMC→CNC)

(a) Series 0*i*

		#7	#6	#5	#4	#3	#2	#1	#0
Common to all axes	G027				*SSTP2 (*1)	*SSTP1 (*1)		SWS2 (*1)	SWS1 (*1)
Common to all axes	G028						GR2	GR1	
Common to all axes	G029		*SSTP	SOR	SAR				
Common to all axes	G030	SOV7	SOV6	SOV5	SOV4	SOV3	SOV2	SOV1	SOV0
1st-	G032	R08I	R07I	R06I	R05I	R04I	R03I	R02I	R01I
2nd-	G034	R08I2	R07I2	R06I2	R05I2	R04I2	R03I2	R02I2	R01I2
1st-	G033	SIND	SSIN	SGN		R12I	R11I	R10I	R09I
2nd-	G035	SIND2	SSIN2	SGN2		R12I2	R11I2	R10I2	R09I2

NOTE
*1 These signals are valid in multi-spindle control.

(b) Series 30*i*

		#7	#6	#5	#4	#3	#2	#1	#0
Common to all axes	G027				*SSTP2 (*1)	*SSTP1 (*1)		SWS2 (*1)	SWS1 (*1)
Common to all axes	G028						GR2	GR1	
Common to all axes	G029		*SSTP	SOR	SAR				
Common to all axes	G030	SOV7	SOV6	SOV5	SOV4	SOV3	SOV2	SOV1	SOV0
1st-	G032	R08I	R07I	R06I	R05I	R04I	R03I	R02I	R01I
2nd-	G034	R08I2	R07I2	R06I2	R05I2	R04I2	R03I2	R02I2	R01I2
1st-	G033	SIND	SSIN	SGN		R12I	R11I	R10I	R09I
2nd-	G035	SIND2	SSIN2	SGN2		R12I2	R11I2	R10I2	R09I2

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NOTE
*1 These signals are valid in multi-spindle control.

(c) Common to CNCs

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G070	G070	MRDYA		SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
2nd-	G074	G074	MRDYB		SFRB	SRVB	CTH1B	CTH2B	TLMHB	TLMLB
1st-	G071	G071							*ESPA	ARSTA
2nd-	G075	G075							*ESPB	ARSTB
1st-	G073	G073				DSCNA		MPOFA		
2nd-	G077	G077				DSCNB		MPOFB		

(2) Output signals (CNC→PMC)

(a) Series 0*i*

	#7	#6	#5	#4	#3	#2	#1	#0
F001				ENB				
F007						SF		
F022	S07	S06	S05	S04	S03	S02	S01	S00
F023	S15	S14	S13	S12	S11	S10	S09	S08
F024	S23	S22	S21	S20	S19	S18	S17	S16
F025	S31	S30	S29	S28	S27	S26	S25	S24
F034						GR3O (*1)	GR2O (*1)	GR1O (*1)
F036	R08O	R07O	R06O	R05O	R04O	R03O	R02O	R01O
F037					R12O	R11O	R10O	R09O

NOTE
*1 These signals are valid with the M series only.

(b) Series 30*i*

	#7	#6	#5	#4	#3	#2	#1	#0
F001				ENB				
F007						SF		
F022	S07	S06	S05	S04	S03	S02	S01	S00
F023	S15	S14	S13	S12	S11	S10	S09	S08
F024	S23	S22	S21	S20	S19	S18	S17	S16
F025	S31	S30	S29	S28	S27	S26	S25	S24
F034						GR3O (*1)	GR2O (*1)	GR1O (*1)
F036	R08O	R07O	R06O	R05O	R04O	R03O	R02O	R01O
F037					R12O	R11O	R10O	R09O

NOTE
*1 These signals are valid with the M series only.

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(c) Common to CNCs

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F045	F045		TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	ALMA
2nd-	F049	F049		TLMB	LDT2B	LDT1B	SARB	SDTB	SSTB	ALMB
1st-	F047	F047				EXOFA				PC1DTA
2nd-	F051	F051				EXOFB				PC1DTB

2.6.3 Parameters

This Subsection describes those parameters that are common to all operation modes by dividing them into several types.

NOTE
For the detector-related parameters, see Section 1.3, “PARAMETERS RELATED TO DETECTORS”, in Part I.

(1) List of parameters specific to spindle motor driving

This item provides a list of the motor parameters specific to spindle motor driving (with no speed range switching). Usually, the settings of these parameters need not be changed. Use the values indicated on a parameter table for each motor model without modification.

Parameter No.		Description
0*i*	30*i*	
4006#2	4006#2	Sets the unit of speed.
4008#4	4008#4	Sets the method of output control.
4011#3	4011#3	Sets the number of motor poles.
4011#4	4011#4	Sets a maximum output for acceleration/deceleration.
4011#7	4011#7	Sets the number of motor poles.
4012#2,1,0	4012#2,1,0	Sets a PWM carrier frequency.
4012#7	4012#7	Sets the spindle HRV function.
4013#6 to 2	4013#6 to 2	Sets current dead-band data.
4013#7	4013#7	Sets a PWM carrier frequency in low-speed characteristics area of speed range switching.
4020	4020	Maximum motor speed
4039	4039	Slip compensation coefficient
4080	4080	High-speed area regenerative power limit/regenerative power limit
4083	4083	Motor voltage on velocity control
4084	4084	Motor voltage on orientation
4085	4085	Motor voltage on servo mode/spindle synchronous control
4086	4086	Motor voltage on Cs contouring control
4100	4100	Base speed for motor output specification
4101	4101	Torque limitation value for motor output specification
4102	4102	Excitation voltage saturation speed with no load
4103	4103	Base speed limit ratio
4104	4104	Current loop proportional gain
4106	4106	Current loop integral gain
4108	4108	Current loop integral gain zero speed
4109	4109	Filter time constant in voltage command saturation processing
4110	4110	Current conversion constant
4111	4111	Secondary current coefficient
4112	4112	Voltage command saturation decision level/PWM command clamp value
4113	4113	Slip constant

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Parameter No.		Description
0*i*	30*i*	
4114	4114	Slip compensation coefficient for a high-speed area/slip compensation coefficient at deceleration time
4115	4115	PWM command clamp value at deceleration time
4116	4116	Motor leakage constraint
4117	4117	Voltage compensation coefficient for a high-speed area in steady state/motor voltage coefficient in steady state
4118	4118	Voltage compensation coefficient for a high-speed area at deceleration time/motor voltage coefficient at deceleration time
4119	4119	Time constant for excitation current change at deceleration time/time constant for excitation current change
4120	4120	Dead-band rectangular wave component zero voltage/dead-band data
4127	4127	Load meter indication value at maximum output time
4128	4128	Compensation coefficient between the specification and true base/maximum torque curve compensation coefficient
4129	4129	Secondary current coefficient on rigid tapping
4130	4130	Current loop proportional gain velocity coefficient/current phase delay compensation constant
4133	4133	Motor model code
4134	4134	Motor overheat level (2 words)
4169	4169	Temperature monitoring time constant
4362	4362	Load meter compensation 1
4363	4363	Load meter compensation 2
4364	4364	Load meter compensation 3

(2) List of parameters related to alarm detection

This item provides a list of the parameters related to alarm detection conditions.

Parameter No.		Description
0*i*	30*i*	
4009#2	4009#2	Motor power turn-off method when spindle alarm 24 (serial data transfer error) is issued
4087	4087	Overspeed level
4088	4088	Velocity error excess detection level when the motor is bound
4089	4089	Velocity error excess detection level when the motor is rotating
4090	4090	Overload detection level
4123	4123	Short-time overload detection period
4464	4464	Velocity command-dependent over speed (spindle alarm 92) detection offset level
4465	4465	Excessive speed deviation level 2
4466	4466	Excessive speed deviation detection time 2
4527	4527	Temperature difference between warning level and alarm level

(3) Other parameters

This item provides a list of the parameters common to all operation modes except the parameters listed in Items (1) and (2) above.

Parameter No.		Description
0*i*	30*i*	
4001#0	4001#0	Whether to use the MRDY signal (machine ready signal)
4006#1	4006#1	Gear ratio increment system
4006#2	4006#2	Sets the unit of speed.
4009#0	4009#0	Velocity loop gain increment system

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Parameter No.		Description
0*i*	30*i*	
4009#4	4009#4	Whether to output the load detection signals (LDT1, LDT2) during acceleration/deceleration
4019#2	4019#2	Whether to perform torque clamping when the speed is zero
4019#7	4019#7	Automatic parameter setting function
4352#1	4352#1	Sets the peak hold function for load meter output.
4395#3	4395#3	Sets parameter transfer from the CNC to spindle software.
4022	4022	Speed arrival detection signal
4023	4023	Speed detection level
4024	4024	Speed zero detection level
4025	4025	Torque limitation value.
4026	4026	Load detection level 1
4027	4027	Load detection level 2
4056	4056	Gear ratio (High)
4057	4057	Gear ratio (Medium High)
4058	4058	Gear ratio (Medium Low)
4059	4059	Gear ratio (Low)
4095	4095	Speedometer output voltage adjustment value
4096	4096	Load meter output voltage adjustment value
4122	4122	Speed detection filter time constant
4170	4170	Monitor constant of winding temperature (Heat coefficient)
4345	4345	Detection level of the spindle motor speed command
4346	4346	Incomplete integral coefficient
4351	4351	Current detection offset compensation

2.6.4 Details of Parameters

This Subsection details the serial spindle parameters (in the four thousands for 16*i*, in the four thousands for 30*i*, and in the three thousands for 15*i*) among the parameters common to all operation modes. For details of other parameters, refer to “SPINDLE SPEED CONTROL” of the CONNECTION MANUAL (FUNCTION) of each CNC.

(1) List of parameters specific to spindle motor driving

Usually, the settings of the motor parameters specific to spindle motor driving need not be changed. Their details are omitted.

(2) List of parameters related to alarm detection

This item details the parameters related to alarm detection conditions.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4009	4009						**ALSP**		

ALSP Motor power turn-off method when spindle alarm 24 (serial data transfer error) is issued
0 : Turns off the power after the motor is decelerated and stopped.
1 : Turns off the power to the motor immediately.
Set this parameter to 1 to turn off the power to the motor immediately when any spindle alarm is issued

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0*i*	30*i*	
4087	4087	**Overspeed level**

Unit of data : 1%
Valid data range : 0 to 115
Initial setting : 115

This parameter sets an overspeed level.
When the speed exceeds [maximum motor speed (No. 4020) × setting data (%)], the overspeed alarm (spindle alarm 07) is issued.

NOTE
Standard setting of 115% is higher value that takes into account up to the low setting of maximum rotational speed. If you want to use to close to the maximum rotational speed of the spindle motor, it is possible to set the alarm level by reducing the value to close to the maximum rotational speed. In this case, Please change the value to check the status of the overshoot of motor speed in the actual equipment.

⚠ **WARNING**
Make sure this parameter is set to the initial setting value. Do not change the value.

0*i*	30*i*	
4088	4088	**Velocity error excess detection level when the motor is bound**

Unit of data : 0.01%
Valid data range : 0 to 10000
Initial setting : 75

This parameter sets a velocity error excess (spindle alarm 31) detection level when the motor is bound.
If a velocity error equal to or greater than [maximum motor speed (No. 4020) × setting data (%)] occurs when the motor is bound, for example, the motor binding alarm (spindle alarm 31) is issued.

0*i*	30*i*	
4089	4089	**Velocity error excess detection level when the motor is rotating**

Unit of data : 0.1%
Valid data range : 0 to 1000
Initial setting : 200

This parameter sets a velocity error excess detection level when the motor is rotating.
If a velocity error equal to or greater than [maximum motor speed (No. 4020) × setting data (%)] occurs, the velocity error excess alarm (spindle alarm 02) is issued.

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0*i*	30*i*	
4090	4090	**Overload detection level**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 90 (The value of β*i* series spindle motor is 95)

This parameter sets a condition for detecting the short-time overload alarm (spindle alarm 29).

If the state where a load equal to or greater than setting data (%) (maximum motor output [load meter full scale] = 100%) is imposed on the spindle motor lasts for a specified period (set in No. 4123) or more, the short-time overload alarm (spindle alarm 29) is issued.

0*i*	30*i*	
4123	4123	**Short-time overload detection period**

Unit of data : 1sec
Valid data range : 0 to 500
Initial setting : 30

This parameter sets the timing for detecting the short-time overload alarm (spindle alarm 29).

If the state where a load equal to or greater than the specified value (set in parameter No. 4090) is imposed on the spindle motor lasts for at least the period specified in this parameter, the short-time overload alarm (spindle alarm 29) is issued.

0*i*-D	30*i*	
4464	4464	**Velocity command-dependent over speed detection offset level**

Unit of data : 0.1%
Valid data range : -1, 0 to 500
Initial setting : 0

This parameter sets the offset speed level for detecting the over speed (spindle alarm 92) according to the velocity command.

When the spindle motor reaches the velocity command plus the maximum motor speed (No. 4020) × setting data% the velocity command-dependent over speed alarm (spindle alarm 92) is issued. This detection level is automatically updated if the velocity command increases or changes to 0 or if control mode (such as speed mode or orientation mode) changes.

If the setting is "0", the offset level is 15%.

If spindle alarm 92 must be invalidated temporarily for adjustment and other purposes, set this parameter to "-1 (alarm 92 is invalid)".

NOTE
This parameter is valid with
9D50 series R (18) edition or later
9D70 series H (08) edition or later
9D80 series B (02) edition or later
9D90 series A (01) edition or later
9DA0 series A (01) edition or later
9DB0 series A (01) edition or later.

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0*i*	30*i*	
4465	4465	**Excessive speed deviation level 2**

Unit of data : If the setting is positive, 1 min^{-1}
(When bit 2 (SPDUNT) of parameter No. 4006 is 1, 10 min^{-1})
If the setting is negative: 0.1%
Valid data range : -1000 to 32767
Initial setting : 0

This parameter sets the alarm level for excessive speed deviation alarms (spindle alarms 02 and 31) in units of 1 min^{-1} (motor speed) or as a ratio to the motor velocity command. Depending on the setting of this parameter, the alarm level (min^{-1}) for the excessive speed deviation alarms is as follows:

- If the setting is positive: Setting of parameter No. 4465 (min^{-1})
- If the setting is negative: |Velocity command × Setting of parameter No. 4465/1000| (min^{-1})

If the setting is "0", this parameter is excluded from the excessive speed deviation alarm detection conditions.

NOTE
This parameter is valid with
9D50 series S (19) edition or later
9D70 series I (09) edition or later
9D80 series C (03) edition or later
9D90 series A (01) edition or later
9DB0 series A (01) edition or later.

0*i*	30*i*	
4466	4466	**Excessive speed deviation detection time 2**

Unit of data : 0.1sec
Valid data range : 0 to 1000
Initial setting : 0

This parameter sets the period from the time the motor speed deviation exceeds the alarm level of the excessive speed deviation alarm set in parameter No. 4465 until an excessive speed deviation alarm (spindle alarm 02 or 31) is issued.

If the motor speed deviation goes below the alarm level within the period of time set in this parameter, the period of time is reset.

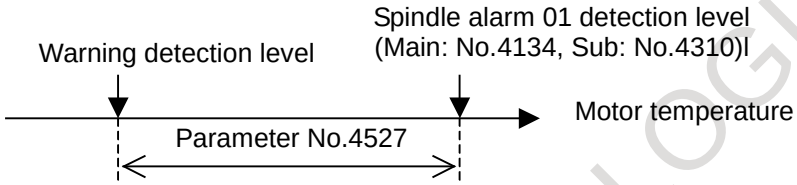
NOTE
This parameter is valid with
9D50 series S (19) edition or later
9D70 series I (09) edition or later
9D80 series C (03) edition or later
9D90 series A (01) edition or later
9DA0 series A (01) edition or later.
9DB0 series A (01) edition or later

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0*i*	30*i*	
4527	4527	**Temperature difference between warning level and alarm level**

Unit of data : 1K
Valid data range : 0 to 50
Initial setting : 0

This parameter sets the difference between motor overheat alarm detection temperature and the warning detection temperature. If the parameter setting is 0, the spindle motor overheat warning function is disabled.
While the motor temperature exceeds the warning detection temperature, the motor overheat warning (warning number 01) is issued.



(3) Other parameters

This item details the parameters common to all operation modes except the parameters listed in Items (1) and (2) above.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4001	4001								**MRDY1**

MRDY1 Whether to use the MRDYA signal (machine ready signal)
0 : Does not uses the MRDYA signal (MRDYA = 1 at all times).
1 : Uses the MRDYA signal.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4006	4006						**SPDUNT**	**GRUNIT**	

GRUNIT Sets a gear ratio setting resolution:
0 : 1/100 unit
1 : 1/1000 unit
Select a gear ratio data setting resolution from the following:
(a) Resolution based on motor speed increased by a factor of 100 relative to one spindle rotation
(b) Resolution based on motor speed increased by a factor of 1000 relative to one spindle rotation
Depending on the setting of this parameter, the increment system of the parameters indicated in the table below changes.

Parameter No.		Description
0*i*	**30*i***	
4056 to 4059	4056 to 4059	Spindle-to-motor gear ratio data

NOTE
Usually, use the 1/100 unit (setting “0”).

SPDUNT Sets the unit of speed.
0 : Sets the 1 min^{-1} unit.
1 : Sets the 10 min^{-1} unit.

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When a type of motor whose maximum speed exceeds 32767 min^{-1} is used, set this parameter to 1.
The setting of this parameter changes the increment systems of the parameters listed in the table below.

Parameter No.		Description	Increment system of parameter	
0*i*	30*i*		1 min^{-1} unit	10 min^{-1} unit
4020	4020	Maximum motor speed	1min^{-1}	10min^{-1}
4021	4021	Maximum spindle speed on Cs contouring control	1min^{-1}	10min^{-1}
4030	4030	Soft start/stop setting time	1min^{-1}/sec	10min^{-1}/sec
4032	4032	Acceleration on spindle synchronous control	1min^{-1}/sec	10min^{-1}/sec
4033	4033	Spindle synchronous speed arrival level	1min^{-1}	10min^{-1}
4074	4074	Reference position return speed on Cs contouring control/servo mode	1min^{-1}	10min^{-1}
4098	4098	Maximum speed for position feedback signal detection	1min^{-1}	10min^{-1}
4100	4100	Base speed for motor output specification	1min^{-1}	10min^{-1}
4102	4102	Excitation voltage saturation speed with no load	1min^{-1}	10min^{-1}
4108	4108	Current loop integral gain zero speed	1min^{-1}	10min^{-1}
Low-speed characteristics parameters (when the speed range switching control function is used)				
4138	4138	Current loop integral gain zero speed	1min^{-1}	10min^{-1}
4140	4140	Base speed for motor output specification	1min^{-1}	10min^{-1}
4144	4144	Excitation voltage saturation speed with no load	1min^{-1}	10min^{-1}
4160	4160	Current loop integral gain zero speed	1min^{-1}	10min^{-1}

NOTE
1 Usually, set the 1 min^{-1} unit (by setting the parameter to 0).
2 After changing the setting of this parameter, turn the CNC off, then on again.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4009	4009				LDTOUT				VLPGAN

VLPGAN Velocity control loop gain increment system
0 : Uses ordinary setting.
1 : Divides ordinary setting data by 16 for processing.

NOTE
Usually, set this parameter to 0.

LDTOUT Whether to output the load detection signals (LDT1, LDT2) during acceleration/deceleration
0 : Does not output the load detection signals during acceleration/ deceleration (initial setting value).
1 : Outputs the load detection signals during acceleration/ deceleration (at all times) when the parameter-set level is exceeded.

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0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4012	4012	SPHRV							

SPHRV Sets the spindle HRV control function.
0 : Disables spindle HRV control.
1 : Enables spindle HRV control. (initial setting value)
Set this parameter to 1.

NOTE
The control method usable with the α*i* series spindle is spindle HRV control only.
The conventional control method is not supported.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4019	4019	PRLOAD					SSTTRQ		

SSTTRQ Whether to perform torque clamping when the speed is zero
0 : Performs clamping.
1 : Does not perform clamping.

NOTE
Usually, set this parameter to 1 not to perform clamping.

PRLOAD Automatic parameter setting function
0 : Does not perform automatic parameter setting (initial setting value).
1 : Performs automatic parameter setting.
After setting a desired motor model code in parameter No. 4133 and setting this bit to 1, turn off the power to the CNC, then turn on the power to the CNC again. The parameters (No. 4000 to No. 4175) for the α*i* series spindle corresponding to the model code are automatically initialized. Upon completion of automatic setting, this bit is automatically set to 0.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4352	4352							PKHALW	

PKHALW Sets the peak hold function for load meter output.
0 : Does not use the peak hold function. (initial setting value)
1 : Uses the peak hold function.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4395	4395					PRIMED			

PRIMED Sets parameter transfer from the CNC to spindle software.
0 : Regards parameters as valid one second after they are transferred from the CNC. (initial setting value)
1 : Regards parameters as valid as soon as they are transferred from the CNC.

NOTE
This parameter is valid with 9D50 series F (06) edition or later, 9D70 series A (01) edition or later, 9D80 series A (01) edition or later, 9D90 A (01) edition or later, 9DA0 series A (01) edition or later and 9DB0 series A (01) edition or later.

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0*i*	30*i*	
4020	4020	**Maximum motor speed**

Unit of data : $1min^{-1}$ (Unit of 10 min^{-1} when bit 2 (SPDUNT) of parameter No. 4006 = 1)
Valid data range : 0 to 32767
Initial setting : Depends on the motor model.
This parameter sets a maximum spindle motor speed.

0*i*	30*i*	
4022	4022	**Speed arrival detection level**

Unit of data : 0.1%
Valid data range : 0 to 1000
Initial setting : 150
This parameter sets a speed arrival signal (SARA) detection range.
When the motor speed reaches within ±(setting data/10)% of a specified speed, the speed arrival signal (SARA) is set to 1.

0*i*	30*i*	
4023	4023	**Speed detection level**

Unit of data : 0.1%
Valid data range : 0 to 1000
Initial setting : 30
This parameter sets a speed detection signal (SDTA) detection range.
When the motor speed is (setting data/10)% of a maximum speed or less, the speed detection signal (SDTA) is set to 1.

0*i*	30*i*	
4024	4024	**Speed zero detection level**

Unit of data : 0.01%
Valid data range : 0 to 10000
Initial setting : 75
This parameter sets a speed zero detection signal (SSTA) detection range.
When the motor speed is (setting data/100)% of a maximum speed or less, the speed zero detection signal (SSTA) is set to 1.

0*i*	30*i*	
4025	4025	**Torque limitation value.**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 50
This parameter sets a torque limitation value to be applied when the torque limitation command HIGH (TLMHA) or the torque limitation command LOW (TLMLA) is specified.
The data indicates limitation values when the maximum torque is 100%.

Torque limitation command LOW(TLMLA)	Torque limitation command HIGH(TLMHA)	Description
0	0	No torque limitation is imposed.
0	1	The torque is limited to the value set in this parameter.
1	0	The torque is limited to a half of the value set in this parameter.
1	1	

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0*i*	30*i*	
4026	4026	**Load detection level 1**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 83

This parameter sets a load detection signal 1 (LDT1A) detection range. When the output of the spindle motor is (setting data)% of the maximum output or more, load detection signal 1 (LDT1A) is set to 1.

0*i*	30*i*	
4027	4027	**Load detection level 2**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 95

This parameter sets a load detection signal 2 (LDT2A) detection range. When the output of the spindle motor is (setting data)% of the maximum output or more, load detection signal 2 (LDT2A) is set to 1.

NOTE
By default, this signal is not output in 10 seconds (set in parameter No. 4082) after the status of the speed command signal changes so that Load detection signal cannot be output by load of acceleration and deceleration. If the default time (No.4082) is not suited with the real acceleration and deceleration time, please refer to explanation of the parameter No.4082 and modify the value.
If “1” is set to the parameter No.4009#4, Load detection signal is always output when load meter is beyond set level ,instead of the acceleration and deceleration.

0*i*	30*i*		
4056	4056	**Gear ratio (HIGH)**	**CTH1A=0, CTH2A=0**
4057	4057	**Gear ratio (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4058	4058	**Gear ratio (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4059	4059	**Gear ratio (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : (Motor rotation for one rotation of spindle) / 100
(When parameter No. 4006 #1 (GRUNIT) is 1, motor rotation / 1000)
(When parameter No. 4005 #5 is 1, motor rotation / 10)
Valid data range : 0 to 32767
Initial setting : 100

These data are used to set the gear ratio between spindle and spindle motor.
Example :
When the spindle rotates once, set “250” as the data when the motor rotates 2.5 times.
A parameter is selected with the CTH1A and CTH2A input signals.
Set the gear or clutch status to correspond to the clutch/gear signal (CTH1A, CTH2A) in input signals.

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NOTE
When an improper value is set in these parameters, an unexpected operation can occur. For example, the spindle can continue rotating without stopping at the time of orientation. So, be sure to set a proper gear ratio.

0*i*	30*i*	
4095	4095	**Speedometer output voltage adjustment value**

Unit of data : 0.1%
Valid data range : -1000 to +100 (-100% to +10%)
Initial setting : 0
Set this parameter when making a fine adjustment of speedometer output voltage.
Positive (+) data increases the output voltage.

NOTE
Usually, this parameter need not be adjusted.

0*i*	30*i*	
4096	4096	**Load meter output voltage adjustment value**

Unit of data : 0.1%
Valid data range : -1000 to +100 (-100% to +10%)
Initial setting : 0
Set this parameter when making a fine adjustment of load meter output voltage.
Positive (+) data increases the output voltage.

NOTE
Usually, this parameter need not be adjusted.

0*i*	30*i*	
4122	4122	**Speed detection filter time constant**

Unit of data : 0.1ms
Valid data range : 0 to 10000
Initial setting : 0
This parameter sets a time constant for a filter to be applied to the velocity feedback signal.

NOTE
Usually, this parameter need not be adjusted.

0*i*	30*i*	
4346	4346	**Incomplete integral coefficient**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0
Set this parameter to use incomplete integral function for velocity loop integral control.

NOTE
Usually, this parameter need not be adjusted.

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0*i*	30*i*	
4351	4351	**Current detection offset compensation**

Unit of data :
Valid data range : 0 to ±32767
Initial setting : 0

NOTE
Usually, this parameter need not be adjusted.

2.6.5 Diagnosis (Diagnosis Screen)

This Subsection provides a list of the diagnosis (diagnosis screen) indications common to all operation modes only. For details, refer to "DIAGNOSIS FUNCTION" of the CONNECTION MANUAL (FUNCTION) of each CNC.

(1) Series 30*i*-A/0*i*-D

Address	Description
400	Information including spindle control information
403	First spindle motor temperature [°C] (*1)
408	Information related to spindle serial output interface communication errors
410	Load meter indication for the first spindle [%]
411	Speedometer indication for the first spindle [min^{-1}]
417	Position coder feedback signal for the first spindle [pulse]
445	First spindle position data
710	First spindle error state (*1)
712	First spindle warning state (*1)

(2) Series 30*i*-B/0*i*-F

Address	Description
403	First spindle motor temperature [°C]
410	Load meter indication for the spindle [%]
411	Speedometer indication for the spindle [min^{-1}]
417	Position coder feedback signal for the spindle [pulse]
445	Spindle position data
710	Spindle error state
712	Spindle warning state
1702	State of spindle leakage detection function
1703	Spindle leakage resistance data
1722	State of internal cooling fan for spindle amplifier
1725	State of radiator cooling fan for spindle amplifier

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3 I/O SIGNALS (CNC↔PMC)

This chapter explains the functions of the signals directly input from the PMC to spindle amplifier (SP) via the CNC and the address for signals of the first spindle or second spindle. For other spindle-related I/O signals, refer to "SPINDLE FUNCTION" of the Connection Manual (Function) of each CNC.

⚠ WARNING
1 Operation of each signal described in this chapter is not guaranteed if an alarm is issued or if a hardware failure or abnormal operation occurs.
2 A signal described in this chapter can be used as a safety function only when it is described that "the signal can be used as a safety function".

⚠ CAUTION
Each signal described in this chapter is disabled and its operation is not guaranteed after power-on until the parameters have been transferred from the CNC to the spindle amplifier. After checking spindle operation ready signal SRSRDY and other signals (refer to the Connection Manual for the relevant CNC) to see the ready status, use the signals described in this chapter.

3.1 INPUT SIGNALS (PMC→CNC→SP)

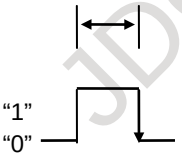
This section describes the functions of the signals directly input from the PMC to spindle amplifier (SP) via the CNC and also describes the signal addresses of the first spindle and second spindle. For other spindle-related input signals, refer to "SPINDLE FUNCTION" of the Connection Manual (Function) of each CNC.

3.1.1 List of Input Signals

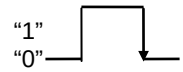
	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G070	G070	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
2nd-	G074	G074	MRDYB	ORCMB	SFRB	SRVB	CTH1B	CTH2B	TLMHB	TLMLB
1st-	G071	G071	RCHA	RSLA	INTGA	SOCNA	MCFNA	SPSLA	*ESPA	ARSTA
2nd-	G075	G075	RCHB	RSLB	INTGB	SOCNB	MCFNB	SPSLB	*ESPB	ARSTB
1st-	G072	G072	RCHHGA	MFNHGA	INCMDA	OVRA	DEFMDA	NRROA	ROTAA	INDXA
2nd-	G076	G076	RCHHGB	MFNHGB	INCMDB	OVRB	DEFMDB	NRROB	ROTAB	INDXB
1st-	G073	G073				DSCNA	SORSLA	MPOFA	SLVA	
2nd-	G077	G077				DSCNB	SORSLB	MPOFB	SLVB	

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3.1.2 Explanation of Input Signals

Symbol	Name	Description
TLMLA, B	Torque limit command LOW	These signals limit the output torque of the spindle motor. The limit value is set in spindle parameter No. 4025. TLML TLMH 0 0 : Torque not limited 0 1 : Limited to the parameter-set value 1 0 : Limited to about half of the parameter-set value 1 1 : Limited to about half of the parameter-set value
TLMHA, B	Torque limit command HIGH	
CTH1A, B CTH2A, B	Clutch/gear signal	These signals set the conditions listed below according to the clutch or gear status. The signals can also be used for selecting spindle control parameters. The names such as HIGH GEAR are given for convenience, and the correspondence to the actual gears is free. CTH1 CTH2 0 0 : HIGH GEAR 0 1 : MEDIUM HIGH GEAR 1 0 : MEDIUM LOW GEAR 1 1 : LOW GEAR
SRVA, B	Reverse rotation command	These signals set the rotation direction of the spindle motor when viewed from the shaft side. SRV SFR 0 0 : Stopped 0 1 : Forward rotation (CCW: Counterclockwise direction) 1 0 : Reverse rotation (CW: Clockwise direction) 1 1 : Stopped
SFRA, B	Forward rotation command	
ORCMA, B	Spindle orientation command	This signal is used to perform spindle orientation control. 0: Turns off the spindle orientation command. 1: Performs spindle orientation control.
MRDYA, B	Machine ready signal	0: Motor excitation is off. 1: Ready for operation
ARSTA, B	Spindle alarm reset signal	This signal is used to reset spindle alarms.  32 msec min. An alarm is reset when the signal status changes from “1” to “0”.
*ESPA, B	Emergency stop signal	0: Emergency stop 1: Normal operation
SPSLA, B	Spindle switching request signal	This signal is used to select a spindle motor in spindle switching control. 0: Selects the main spindle motor. 1: Selects the sub-spindle motor.
MCFNA, B	Magnetic contactor status signal for the sub-spindle motor	This signal is used in spindle switching control. 0: The MCC on the sub-spindle motor side is OFF (the main spindle motor is selected). 1: The MCC on the sub-spindle motor side is ON (the sub-spindle motor is selected).
SOCNA, B	Soft start/stop signal	0: Disables the soft start/stop function. 1: Enables the soft start/stop function.
INTGA, B	Velocity integral control signal	0: Enables velocity integral control. 1: Disables velocity integral control.
RSLA, B	Speed range switching request signal	This signal is used to select output characteristics in speed range switching control. 0: Selects the high-speed range characteristics. 1: Selects the low-speed range characteristics.

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Symbol	Name	Description
RCHA, B	Magnetic contactor status signal for the low-speed characteristics	This signal is used in speed range switching control. 0: The MCC on the low-speed characteristics side is OFF (the high-speed characteristics are selected). 1: The MCC on the low-speed characteristics side is ON (the low-speed characteristics are selected).
INDXA, B	Orientation stop position change command	 This signal is used in orientation with the stop position set external setting type. When the status of this signal changes from "1" to "0", new position stop data is input, and a movement to the new position then a stop take place.
ROTAA, B	Rotation direction command at orientation stop position change	This signal is used in orientation with the stop position set external setting type. 0: CCW (counterclockwise) 1: CW (clockwise)
NRROA, B	Shortcut command at orientation stop position change	This signal is used in orientation with the stop position set external setting type. 0: The rotation direction depends on the ROTA signal setting. 1: Shortcut control (within ±180°)
OVRA, B	Analog override command	0: Disables analog override. 1: Enables analog override.
INCMDA, B	Incremental command	1: Incremental command spindle orientation 0: Ordinary orientation
MFNHGA, B	Magnetic contactor status signal for the main spindle motor	0: The MCC on the main spindle motor side is OFF. 1: The MCC on the main spindle motor side is ON.
RCHHGA, B	Magnetic contactor status signal for the high-speed characteristics	0: The MCC on the high-speed characteristics side is OFF. 1: The MCC on the high-speed characteristics side is ON.
MPOFA, B	Motor power turn-off signal	1: Turns off the motor power.
SORSLA, B	Synchronous orientation request command	This signal requests a synchronous orientation operation. 0: Cancels synchronous orientation. 1: Requests synchronous orientation.
DSCNA, B	Disconnection detection disable signal	This signal is used to detach the feedback cable between the amplifier and motor. 0: Enables disconnection and overheat detection. 1: Disables disconnection and overheat detection.
DEFMDA, B	Differential speed mode command signal	0: Disables differential speed mode. 1: Enables differential speed mode.
SLVA, B	Tandem operation command	0: Disables tandem operation. 1: Enables tandem operation.

3.1.3 Details of Input Signals

(a) Torque limit command signals (TLMLA, TLMHA)

(1) A torque limit is used to rotate the spindle motor by decreasing the output torque of the spindle motor temporarily at the time of mechanical spindle orientation and so forth.
(2) For each machine, the machine tool builder must set the output torque and speed applied at the time of orientation so that hitting against the machine stopper produces less impact.
(3) The output torque at orientation can be adjusted with parameter No. 4025.

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(4) If the torque limit command signals are set to 1, the torque limit state is entered. (Even when 1 is specified during motor rotation, it becomes valid immediately.) As soon as the torque limit state is entered, the torque limit status signal (TLMA) is output externally.

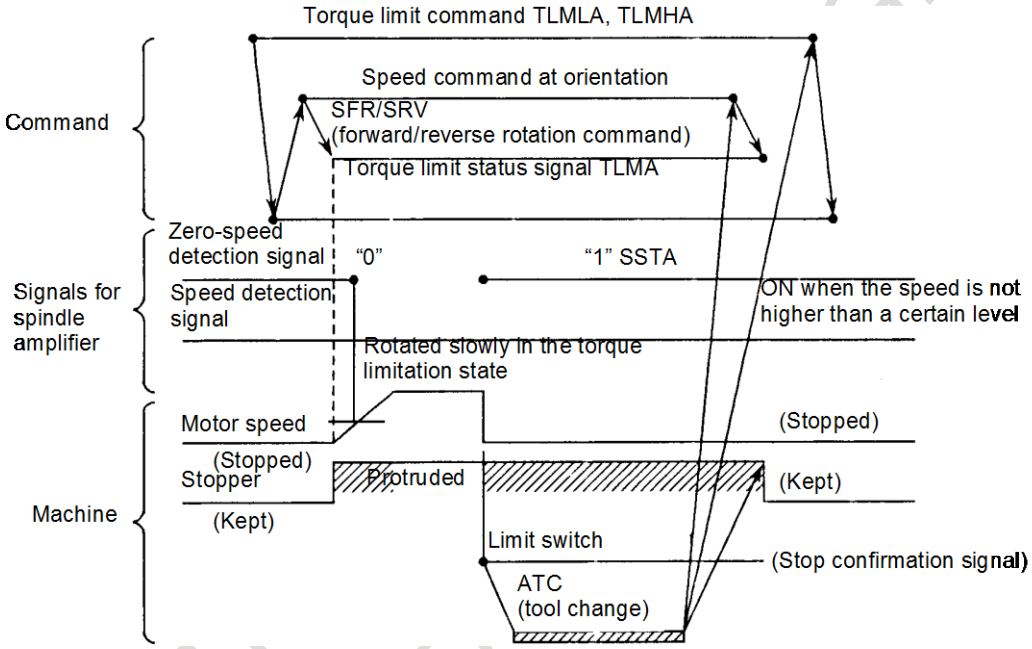
(5) When mechanical orientation is to be performed at the time of ATC of a machining center, the power magnetic sequence design must take the following into consideration not to damage the machine stopper:

<1> The output torque at orientation time must not be excessively large.

<2> The speed at orientation time must not be excessively high. Interlock must be provided so that, for example, when the speed detection signal detects an excessively high speed, the protrusion of the stopper is suppressed.

<3> When the torque limit is canceled, the stopper must have been certainly kept in place.

Example of a mechanical orientation sequence



* If the above conditions are hard to satisfy, employ purely electrical spindle orientation (a CNC software option is required), which does not use the stopper.

(b) Clutch/gear signals (CTH1A, CTH2A)

(1) When there are two or more gear change stages between the spindle and spindle motor, these signals are used to select spindle control parameters (position gain, gear ratio, and velocity loop gain) for each gear. These signals are also used for a motor having an speed range switching function to select control parameters for each winding.

(2) Make settings as listed in the table below according to the state of the clutch or gear. The names such as HIGH GEAR are given for convenience, and the correspondence to the actual gears is free.

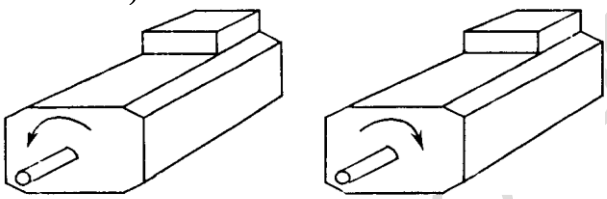
CTH1A	CTH2A	
0	0	HIGH GEAR
0	1	MEDIUM HIGH GEAR
1	0	MEDIUM LOW GEAR
1	1	LOW GEAR

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(c) Forward rotation command signal (SFRA) and reverse rotation command signal (SRVA)

(1) When the following four conditions are satisfied, the spindle motor starts forward or reverse rotation according to the speed command (a positive value):
<1> Emergency stop signal *ESPA is set to 1.
<2> Machine ready signal MRDYA is set to 1.
<3> Forward rotation command signal SFRA or reverse rotation command signal SRVA is 1.
<4> The contact signal between ESP and 24 V (CX4 of the common power supply (PS)) is ON (closed).

(2) While SFRA is 1, the spindle motor rotates counterclockwise as viewed from the shaft side at a specified speed (a positive value).
While SRVA is 1, the spindle motor rotates clockwise as viewed from the shaft side according to the speed command (a positive value).



(3) When SFRA is set to 0 or when SRVA is set to 0, the spindle motor is stopped by regenerative braking. After the spindle motor is stopped, the power element excitation signal is turned off to interrupt power supply to the spindle motor.

> ⚠ **CAUTION**
> This signal is disabled while the spindle motor is rotating in the free-running (coast) mode. The spindle motor is not stopped with control even if this signal is set to 0 and it does not rotate at the specified speed even if the signal is set to 1.

> **NOTE**
> If the forward rotation command signal (SFRA) and reverse rotation command signal (SRVA) are specified at the same time, the spindle status error (error 14) occurs, and the spindle motor is stopped.

(d) Spindle orientation command (ORCMA)

For details of this signal, see Section 2.2, “POSITION CODER METHOD SPINDLE ORIENTATION”, in Part I.

(e) Machine ready signal (MRDYA)

(1) This signal is used as follows according to the parameter settings:

Mode	Parameter setting FS0i : 4001 #0 FS30i : 4001 #0	Description
A	0	The machine ready signal is not used. In this case, the spindle motor is made ready only by inputting the emergency stop signal.
B	1	The machine ready signal is used so that the spindle motor can be made ready by two signals. When MRDYA = 0, the excitation signal for the power element of the inverter is turned off to interrupt power.

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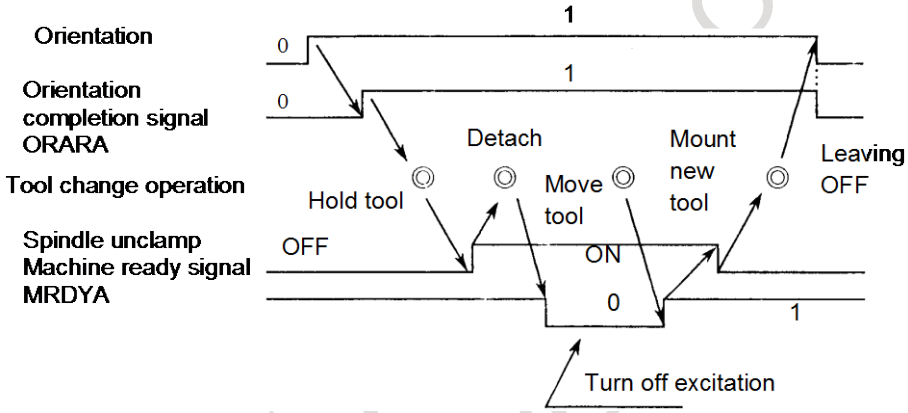
(2) Mode A
Mode A is used to minimize input signals.

(3) Mode B

<1> In a machine in which the spindle motor is clamped by the tool unclamp signal during an orientation operation for automatic tool change (ATC), a slight displacement from the orientation stop position may increase the load meter indication, allowing a large motor current to flow.
To prevent this, set MRDYA to 0 to release the orientation state while the tool unclamp state is present. At the end of the tool unclamp state, setting MRDYA to 1 can restore the orientation state.

<2> In the application explained <1> above, if the orientation command signal ORCMA is kept 1, setting MRDYA to 0/1 causes a movement just by the amount of the displacement from the stop position, so another one-rotation operation and orientation operation need not be performed.

Timing chart (mode B)



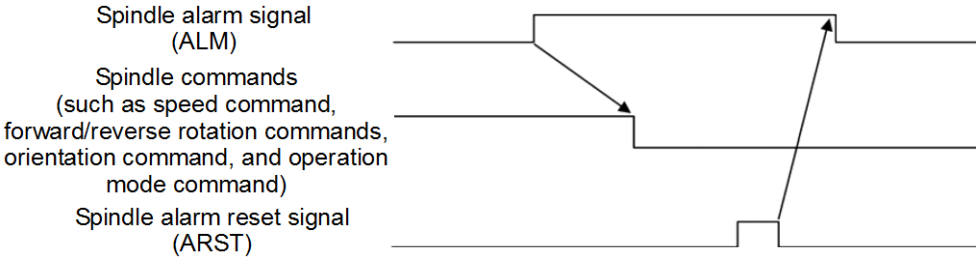
(f) Spindle alarm reset signal (ARSTA)

(1) After the cause of an alarm such as a motor overheat, excessively large velocity error, over speed, and overload is removed, inputting this alarm reset signal releases the alarm, making the spindle usable.

(2) When no alarm is issued, inputting this signal causes nothing.

(3) Alarms detected in the common power supply (PS) and part of spindle alarms (such as overcurrent) cannot be released by this signal. (The power must be turned off once.)

(4) If a spindle alarm is issued, cancel the spindle commands (such as the speed command, forward/reverse rotation commands, orientation command, and operation mode command), then reset the alarm.



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NOTE

With the following series and editions, the alarm reset signal is valid only in the velocity control mode (in other modes, inputting the alarm reset signal does not release the alarm):

Series 9D50 P (16) and subsequent editions
Series 9D70 G (07) and subsequent editions
Series 9D80 A (01) and subsequent editions
Series 9D90 A (01) and subsequent editions
Series 9DA0 A (01) and subsequent editions
Series 9DB0 A (01) and subsequent editions

(g) Emergency stop signal (*ESPA)

(1) When *ESPA = 1, the spindle motor and spindle amplifier become ready for operation. When *ESPA = 0, the spindle amplifier outputs to the common power supply (PS) a signal for turning off the MCC, and the spindle motor does not operate.

(2) As soon as *ESPA is set to 0 during motor rotation, the spindle motor decelerates and stops. When the zero speed detection signal SSTA is set to 1, the motor is deactivated, and a signal for turning off the MCC is output.

(3) When *ESPA is set to 1 again, the spindle motor becomes ready for rotation, so the spindle motor will start rotating as soon as a rotation command is issued. Therefore, when inputting the emergency stop signal, reset the command signals (speed command, forward and reverse rotation commands) to the spindle amplifier at the same time.

(4) This signal (*ESPA) and the emergency stop signal (connector CX4) of the common power supply (PS) function as signals having the same meaning for the spindle amplifier (SP).

⚠ WARNING

1 The spindle motor runs freely (coasts) due to a power failure, alarm, or command from the ladder program (MPOFA signal). While the spindle motor runs in the free-running mode, it does not stop even when the emergency stop signal is input.
2 When the power is off, the spindle motor may also run freely.
3 The emergency stop signal receive circuit in the amplifier is an electronic circuit. For this reason, the motor may not stop due to a failure in the electronic circuit even when the emergency stop signal is input to the amplifier.

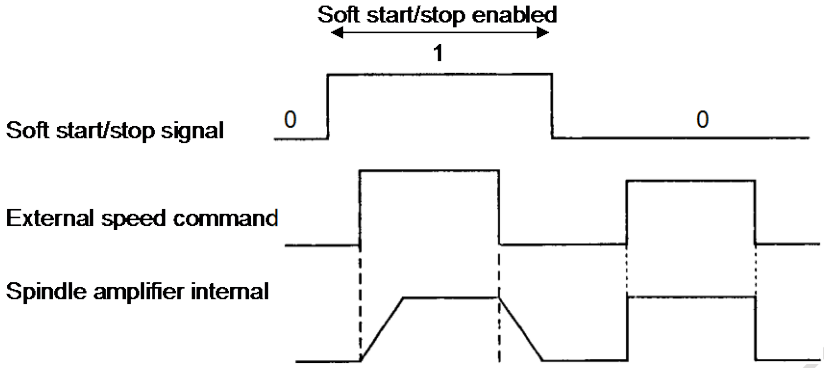
(h) Spindle switching request signal (SPSLA), magnetic contactor status signal for the sub-spindle motor (MCFNA), and magnetic contactor status signal for the main spindle motor (MFNHGA)

For details of these signals, see Section 5.2, “SPINDLE SWITCHING CONTROL”, in Part I.

(i) Soft start/stop signal (SOCNA)

(1) The soft start/stop function makes acceleration/deceleration of the spindle motor gradual. When the soft start/stop signal is set to 1, the soft start/stop function is enabled, which allows the speed command change rate at acceleration/deceleration to be set as shown below.

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(2) The soft start/stop function is valid in the velocity control mode. This signal is also used for enabling the acceleration/deceleration time constant at return to the reference position in Cs contouring control or rigid tapping (parameter No. 4406), however.

(3) When emergency stop signal *ESPA or machine ready signal MRDYA is set to 0, the soft start/stop function is disabled automatically.

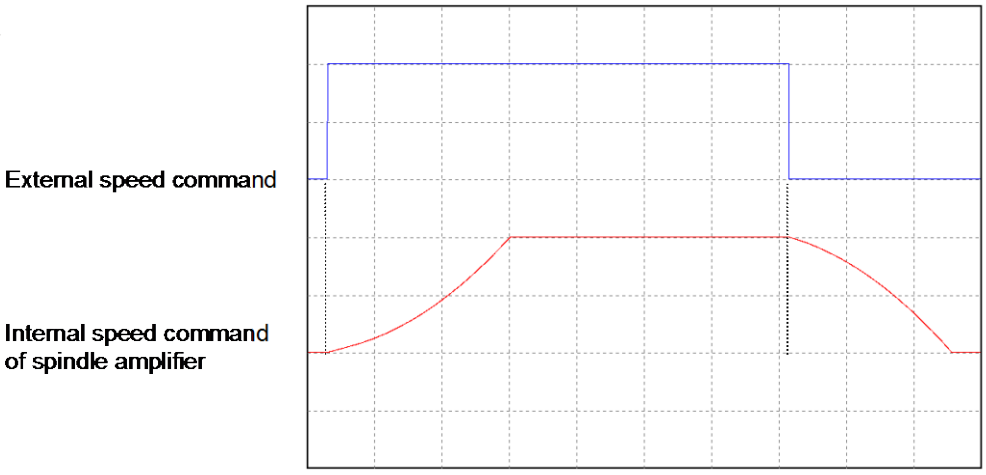
NOTE

With the following series and editions, setting the relevant parameter (bit 2 of parameter No. 4399 to 1) enables the soft start/stop function even when the spindle motor is being decelerated according to *ESPA = 0 or MRDYA = 0:

Series 9D50 O (15) and subsequent editions
Series 9D70 F (06) and subsequent editions
Series 9D80 A (01) and subsequent editions
Series 9D90 A (01) and subsequent editions
Series 9DA0 A (01) and subsequent editions
Series 9DB0 A (01) and subsequent editions

(4) The speed command change rate is set in parameter No. 4030. When 0 is set in the parameter, the soft start/stop function is disabled.

(5) When the rate of the change in acceleration command (parameter No. 4508) is set, a quadratic function type speed command can be given in the spindle amplifier (quadratic function type soft start/stop function).
Use this function when you want to reduce the shock due to a change in speed specified at the start of acceleration/deceleration.
In this case, the internal speed command of the spindle amplifier changes as follows:

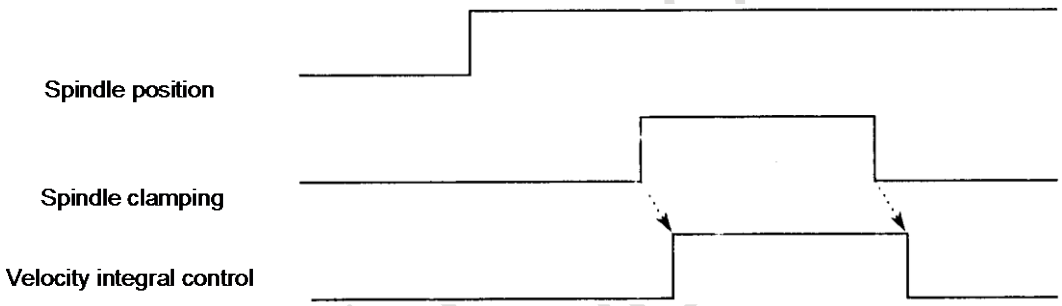


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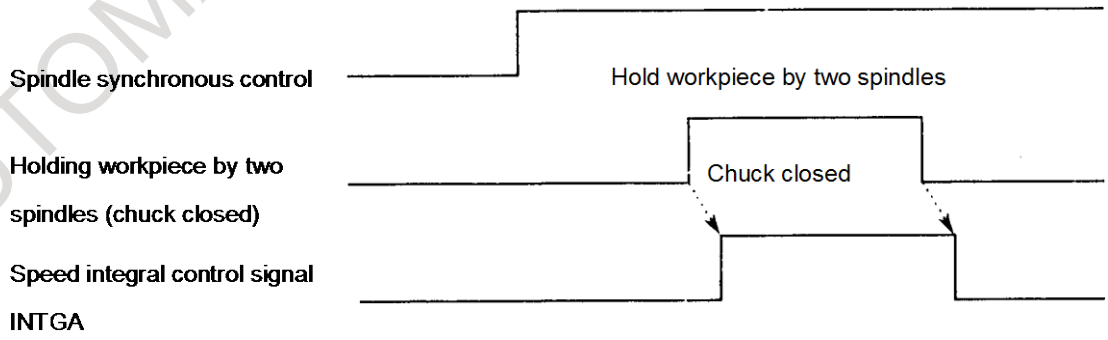
NOTE
With the following series and editions, the quadratic function type soft start/stop function can be used:
Series 9D50 G (07) and subsequent editions
Series 9D70 A (01) and subsequent editions
Series 9D80 A (01) and subsequent editions
Series 9D90 A (01) and subsequent editions
Series 9DA0 A (01) and subsequent editions
Series 9DB0 A (01) and subsequent editions

(j) Velocity integral control signal (INTGA)

(1) When spindle position control (spindle orientation control, spindle positioning control, Cs contour control, and so on) is performed, the spindle is sometimes clamped by the brake or the like. If the spindle is kept clamped with a minute position error, velocity integral control may allow an excessively large current to flow into the motor, attempting to eliminate the position error to zero.
In such a case, use of this signal disables velocity integral control to prevent an excessively large current from flowing into the motor even when a minute position error occurs.



(2) Also when two spindles are used to hold a workpiece in spindle synchronous control, a minute synchronous error generated at the time of the hold operation may cause velocity integral control to attempt to eliminate the error to zero, and as a result, an excessively large current may flow into the motor.
In this case, this signal can be used to disable velocity integral control and prevent an excessively large current from flowing into the motor even when a minute synchronous error occurs.



(k) Speed range switching request signal (RSLA), magnetic contactor status signal for low-speed characteristics (RCHA), and magnetic contactor status signal for high-speed characteristics (RCHHGA)

For details of these signals, see Section 5.1, “SPEED RANGE SWITCHING CONTROL”, in Part I.

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(l) Orientation stop position change command (INDXA), rotation direction command at orientation stop position change (ROTAA), shortcut command at orientation stop position change (NRROA), and incremental command (INCMDA)

For details of these signals, see Section 2.2, "POSITION CODER METHOD SPINDLE ORIENTATION", in Part I and Section 5.3, "INCREMENTAL COMMAND TYPE SPINDLE ORIENTATION", in Part I.

(m) Spindle analog override command (OVRA)

(1) In the velocity control mode, the speed command can be overridden with the voltage externally applied to the spindle amplifier directly in an analog form.

(2) The analog override function is valid when this signal is 1. The function is valid only in the velocity control mode (including the soft start/stop function).

(3) The upper limit (100% or 120%) of analog override is parameter-set as follows:

Parameter No.		Description
0*i*	30*i*	
4006 #5	4006 #5	Sets the input range of spindle analog override. 0 : 0 to 100% 1 : 0 to 120%

The upper limit of analog override input voltages is +4.5 V. When the speed command value obtained by multiplication by the override value exceeds the parameter-set maximum speed, the speed is clamped at the maximum speed.

(4) The override type is parameter-set as follows:

Parameter No.		Description
0*i*	30*i*	
4009 #6	4009 #6	Sets the override type. 0: Linear function type override 1: Quadratic function type override

<1> Linear function type override

The override value actually used corresponds to the input override value on a one-to-one basis.

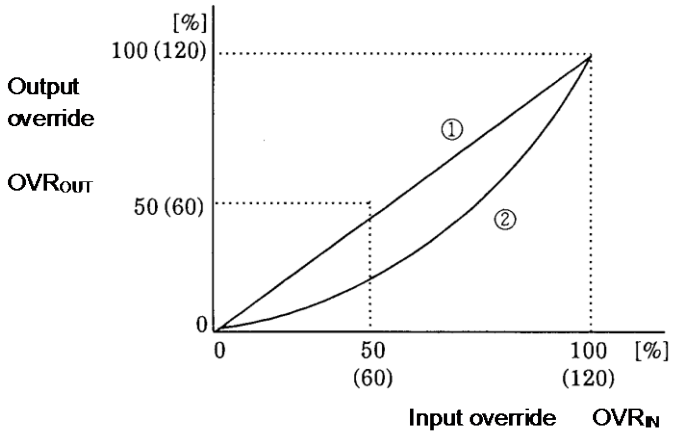
$OVR_{OUT} = OVR_{IN}$

<2> Quadratic function type override

The override value actually used corresponds to the input override value in the quadratic function manner.

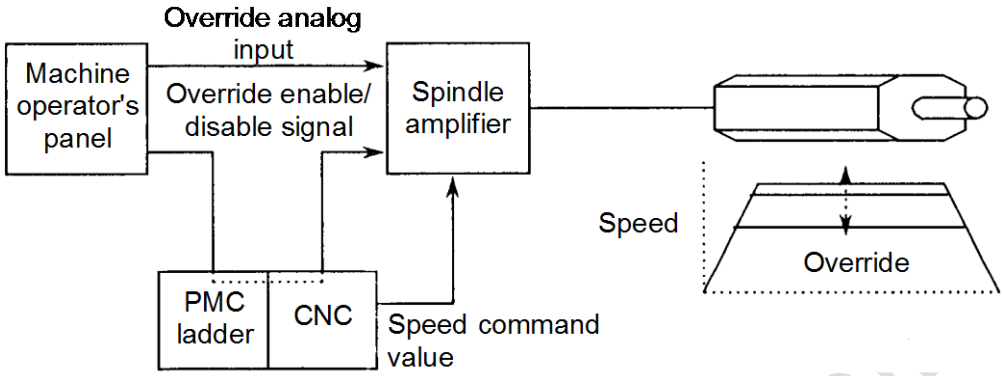
When compared with the linear function type, the quadratic function type has rougher speed resolution for the input override in the high-speed region and has a finer speed resolution in the low-speed region.

$$OVR_{OUT} = OVR_{MAX} \times \left(\frac{OVR_{IN}}{OVR_{MAX}} \right)^2$$

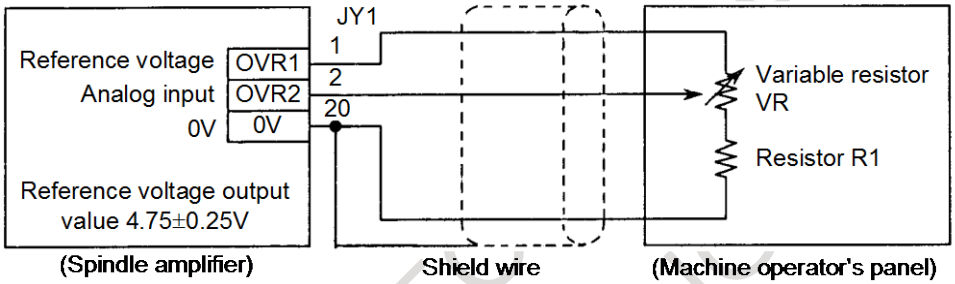


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(5) The following shows the system configuration when attention is focused on the analog override function:



(6) The analog override input is connected as shown in the figure below. The input voltage equivalent to the upper override limit (100% or 120%) to OVR2 is 4.5 V. Override values are set in steps of 1%.



Use resistors so that the total resistance of VR and R1 ranges from 2 KΩ to 10 KΩ.

(7) Because the hysteresis characteristic is provided to prevent override fluctuation, an override of 0% is not set even when the input voltage is 0 V.

(8) When a signal for enabling or disabling the status of the analog override function is issued, or the setting of the upper override limit parameter is changed, the motor speed may change largely. So, before changing the status or setting, stop the motor.

(n) Motor power turn-off signal (MPOFA)

(1) When an abnormality occurs during spindle synchronous control or during machining with a machine such as a gear machining tool, this signal is used to immediately turn off the power to the spindle motor and allow the motor to run freely.

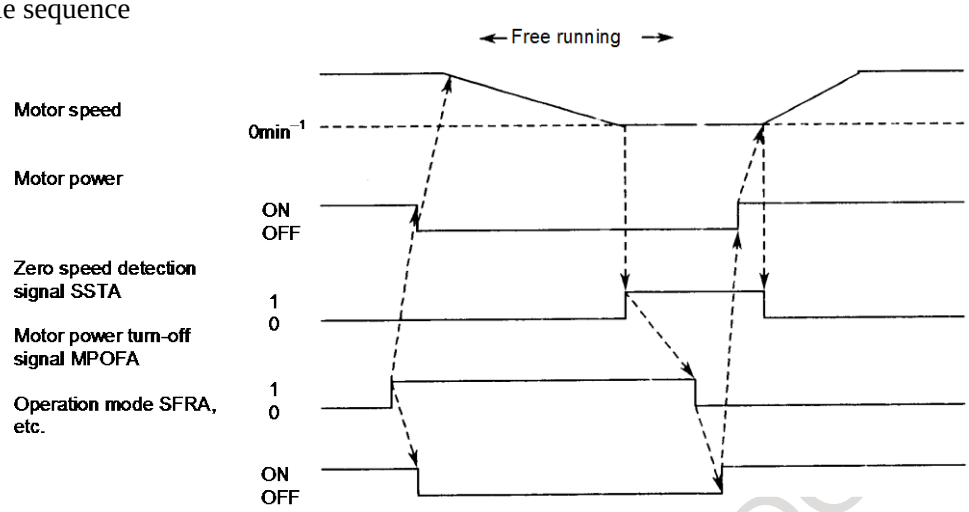
(2) This signal turns off the motor power only.

(3) The motor power can be supplied again after the motor is stopped (zero speed signal SSTA = 1). Even when this signal is canceled, the power cannot be supplied while the motor is rotating (SSTA = 0).

(4) After turning off the motor power, cancel all operation modes to ensure safety. After the motor is stopped (SSTA = 1), specify operation modes again.
When the power is turned off during position control, the position control operation is performed continuously, so an alarm such as an alarm due to an excessively large position error may be issued.

Operation mode examples:
- Forward rotation command (SFRA)
- Reverse rotation command (SRVA)
- Spindle orientation (ORCMA)
- Rigid tapping (RGTP, RGTAP)
- Spindle synchronous control (SPSYC, SPPHS)
- Spindle positioning
- Cs contour control (CON, SCNTR1, SCNTR2, and so on)
- Speed difference mode (DEFMDA)

(5) Sample sequence



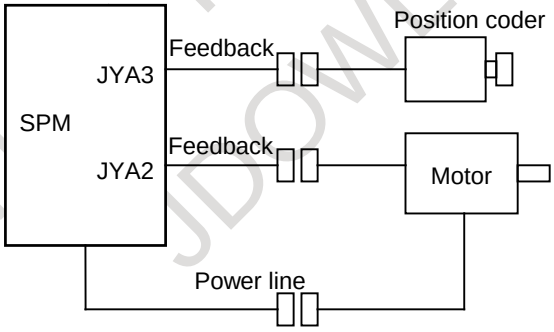
(6) If bit 2 of parameter No. 4009 is set to 1, the motor power can be turned off immediately when spindle alarm 24 (serial transfer data error) occurs. Normally, when spindle alarm 24 occurs, the spindle motor is decelerated then stopped.

(o) Synchronous orientation request command (SORSLA)

For details of this signal, see Section 5.5, "SPINDLE ORIENTATION DURING SPINDLE SYNCHRONIZATION CONTROL", in Part I.

(p) Disconnection detection disable signal (DSCNA)

(1) This signal is used when the connection between the spindle amplifier and spindle motor needs to be disconnected temporarily.

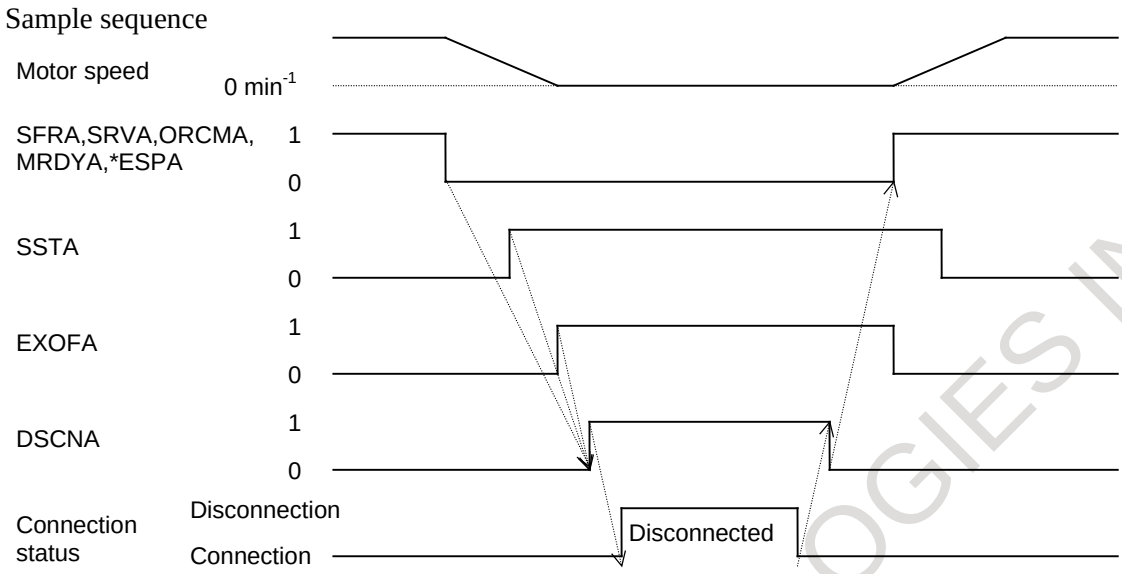


(2) When this signal is used to detach the feedback signal, motor overheat and the issuance of a feedback signal disconnection alarm can be prevented.

(3) A motor excitation OFF state confirmation signal (EXOFA) is provided to confirm that the motor is not excited before the connected power line is detached.

(4) Before setting this signal to 1 and disconnecting the feedback signals and power line, set all the SFRA, SRVA, ORCMA, MRDYA, and *ESPA commands to 0, and confirm that the motor excitation OFF state confirmation signal (EXOFA) has been set to 1. After completing re-connection, reset this signal to 0.

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⚠ CAUTION
When this signal is set to 1, a motor overheat or feedback signal error is not detected, and a status signal related to a feedback signal may not be output correctly. When the motor is driven, be sure to set this signal to 0.

NOTE
1 When the dual check safety function is enabled, this signal is disabled. When the CNC is FS30*i*-B, however, this signal can be used in combination with the Safety Check Pause signal. For details, refer to the explanation of the dual check safety in the Connection Manual (B-64483EN-2).

(q) Differential speed mode command signal (DEFMDA)

For details of this signal, see Section 5.9, “DIFFERENTIAL SPINDLE SPEED CONTROL” in Part I.

(r) Tandem operation command (SLVA)

For details of this signal, see Section 5.11, “TORQUE TANDEM CONTROL FUNCTION” in Part I.

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3.2 OUTPUT SIGNALS (SP→CNC→PMC)

This section describes the functions of the signals directly input from the PMC to spindle amplifier (SP) via the CNC and also describes the signal addresses of the first spindle and second spindle. For other spindle-related output signals, refer to "SPINDLE FUNCTION" of the Connection Manual (Function) of each CNC.

3.2.1 List of Output Signals

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F045	F045	ORARA	TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	ALMA
2nd-	F049	F049	ORARB	TLMB	LDT2B	LDT1B	SARB	SDTB	SSTB	ALMB
1st-	F046	F046				SLVSA	RCFNA	RCHPA	CFINA	CHPA
2nd-	F050	F050				SLVSB	RCFNB	RCHPB	CFINB	CHPB
1st-	F047	F047				EXOFA	SORENA		INCSTA	PC1DTA
2nd-	F051	F051				EXOFB	SORENB		INCSTB	PC1DTB
1st-	F048	F048				CSPENA				
2nd-	F052	F052				CSPENB				

3.2.2 Explanation of Output Signals

Symbol	Name	Description
ALMA, B	Spindle alarm signal	This signal is output when a spindle alarm is issued. 0: Normal state 1: Alarm state
SSTA, B	Zero-speed detection signal	This signal is output when the actual rotation speed of the spindle motor has decreased to the zero-speed detection level or lower. 0: Rotating 1: Zero-speed state
SDTA, B	Speed detection signal	This signal is output when the actual rotation speed of the spindle motor has decreased to a predetermined rotation speed or lower. 0: Above predetermined speed 1: Predetermined speed or lower
SARA, B	Speed arrival signal	This signal is output when the actual rotation speed of the spindle motor has achieved a predetermined range for a speed command. 0: Speed not achieved 1: Speed achieved
LDT1A, B	Load detection signal 1	These signals are output when load at a set load detection level or higher is detected. Different levels can be set for LDT1A and LDT2A. 0: Lower than the set load 1: Set load or higher
LDT2A, B	Load detection signal 2	
TLMA, B	Torque limit status signal	This signal is output when the torque is being limited by the TLMLA or TLMHA signal. 0: Torque not being limited 1: Torque being limited
ORARA, B	Orientation completion signal	This signal is output when the spindle stops in the neighborhood of a predetermined position after an orientation command is input. 0: Orientation not completed 1: Orientation completed

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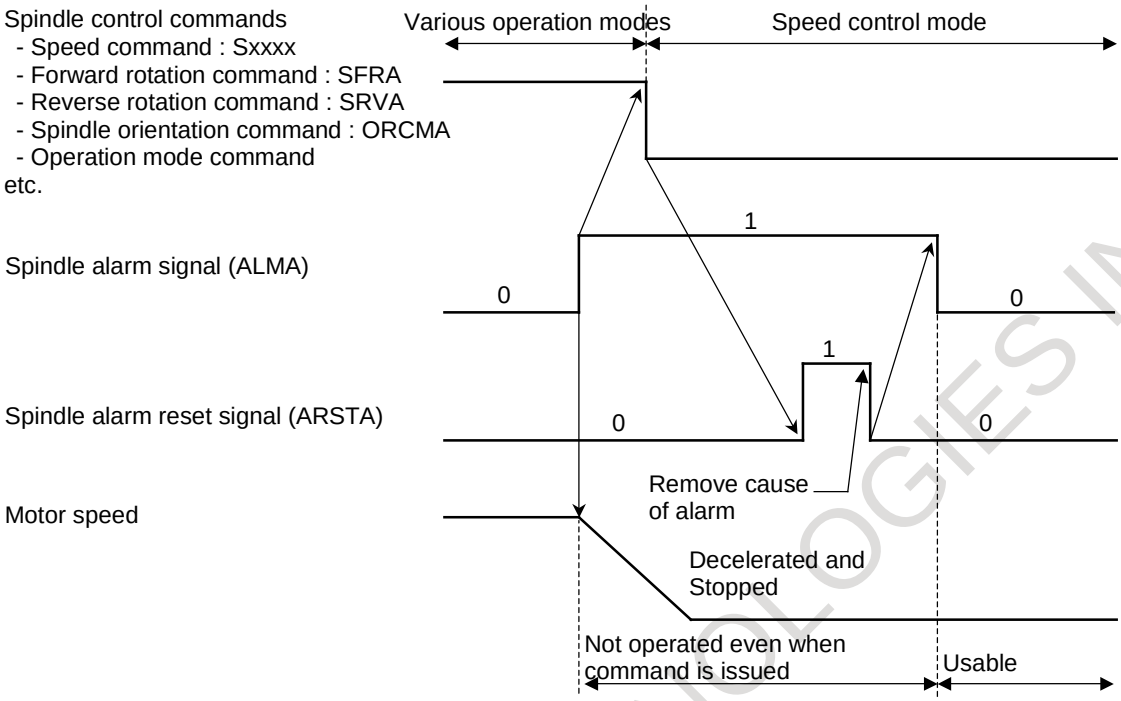
Symbol	Name	Description
CHPA, B	Power line switching signal	This signal is used in spindle switching control. 0: Selects the MCC on the main spindle motor side. 1: Selects the MCC on the sub-spindle motor side.
CFINA, B	Spindle switching completion signal	This signal is used in spindle switching control. 0: Controls the main spindle motor. 1: Controls the sub-spindle motor.
RCHPA, B	Power line switching signal	This signal is used in speed range switching control. 0: Selects the MCC on the high-speed range characteristics side. 1: Selects the MCC on the low-speed range characteristics side.
RCFNA, B	Speed range switching completion signal	This signal is used in speed range switching control. 0: Control with high-speed range characteristics 1: Control with low-speed range characteristics
PC1DTA, B	Position coder one-rotation signal detection state signal	This signal is used to confirm whether the position coder one-rotation signal is detected or not. 0: Position coder one-rotation signal not detected 1: Position coder one-rotation signal detected
INCSTA, B	Incremental orientation signal	This signal is used to confirm whether incremental spindle orientation is being performed or not. 0: Incremental spindle orientation is not in progress. 1: Incremental spindle orientation is in progress.
SORENA, B	Synchronous orientation enable signal	This signal is used to confirm whether synchronous orientation is enabled or not. 0: Disables synchronous orientation. 1: Enables synchronous orientation.
EXOFA, B	Motor excitation off state signal	This signal is used to confirm whether motor excitation is off. 0: Motor excitation is in progress. 1: Motor excitation is off.
SLVSA, B	Tandem operation state signal	This signal is used with the spindle tandem function. 0: Tandem operation is not in progress. 1: Tandem operation is in progress.
CSPENA, B	Cs reference position establishment state signal	This signal is used to indicate whether Cs axis coordinate establishment processing is possible. 0: Coordinate establishment processing is impossible (with a reference position not established). 1: Coordinate establishment processing is possible (with a reference position established).

3.2.3 Details of Output Signals

(a) Spindle alarm signal (ALMA)

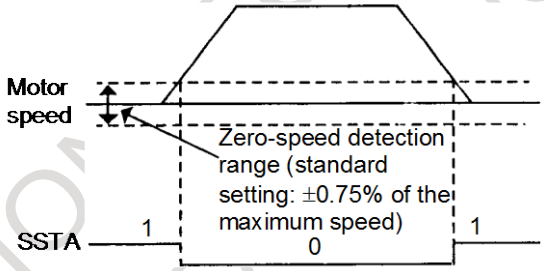
(1) When continuation of spindle motor operation becomes impossible, the power to the spindle motor is turned off to stop the spindle motor.
(2) At the same time, spindle alarm signal ALMA is set to 1. For the meaning of the alarm, check the CNC screen and the indicator of the spindle amplifier.
(3) Use the alarm signal output to reset the command signals sent to the spindle amplifier (speed command, forward and reverse rotation commands, spindle orientation command, operation mode command and so on). Unless the reset state has been entered (the signals issued from the PMC have been all cleared), the spindle motor may rotate when the alarm on the spindle amplifier is released, which presents a dangerous situation.
(4) At the same time when the alarm signal is output, the power to the spindle motor is turned off, and the spindle motor coasts. Therefore, it is necessary to enter the feed hold state by setting the emergency stop state on the CNC or power magnetic cabinet.
(5) When the alarm state is entered, ALMA is set to 1. While the alarm signal is 1, the spindle motor is placed in the coast state regardless of external commands.
(6) The following diagram shows the relationship between the alarm signal and alarm reset signal:

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(b) Zero-speed detection signal (SSTA)

(1) When the actual rotation speed of the spindle motor has decreased to the zero-speed detection level or lower for a stop command, SSTA is set to 1.



(2) The zero-speed detection point is 0.75% (initial standard setting in the parameter) of the maximum speed. For a motor of which maximum speed is 6000 min^{-1}, for example, the zero-speed detection point is 45 min^{-1}.

(3) When the above condition is satisfied, this signal is output regardless of the rotation command (SFR, SRV).

(4) The minimum pulse width of this signal is approximately 40 ms.

(5) When SSTA setting is 1, if the state of speed direction level is higher than +5 rpm is elapsed time to more than 40 ms, SSTA setting become to 0,

⚠ CAUTION

1 If a motor feedback signal disconnection alarm (spindle alarm 73) is issued, the status of this signal is undefined.

2 When bit 5 of parameter No. 4007 is set to "1", the detection operation of the feedback signal disconnection alarm is not performed.
Set the parameter to "0" when not required, to enable alarm detection.

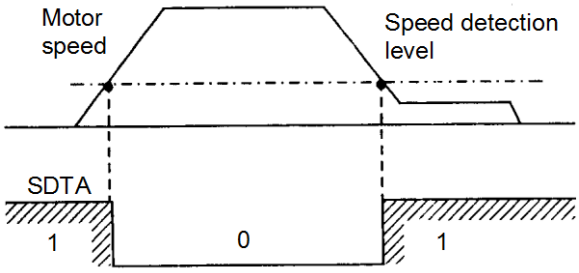
3 If an error which cannot be detected in the motor free-running (coast) state occurs in the motor feedback system, this signal may not be output correctly in the motor free-running mode after an alarm is reset.

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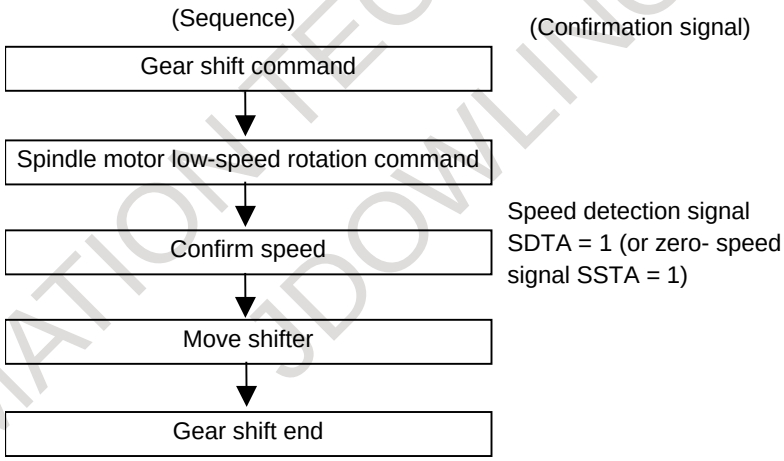
(c) Speed detection signal (SDTA)

(1) When the spindle motor speed has decreased to a parameter-set speed level or lower, SDTA is set to 1.

(2) This signal is used to confirm that the speed has decreased to a predetermined speed such as a clutch changeable speed or gear changeable speed.

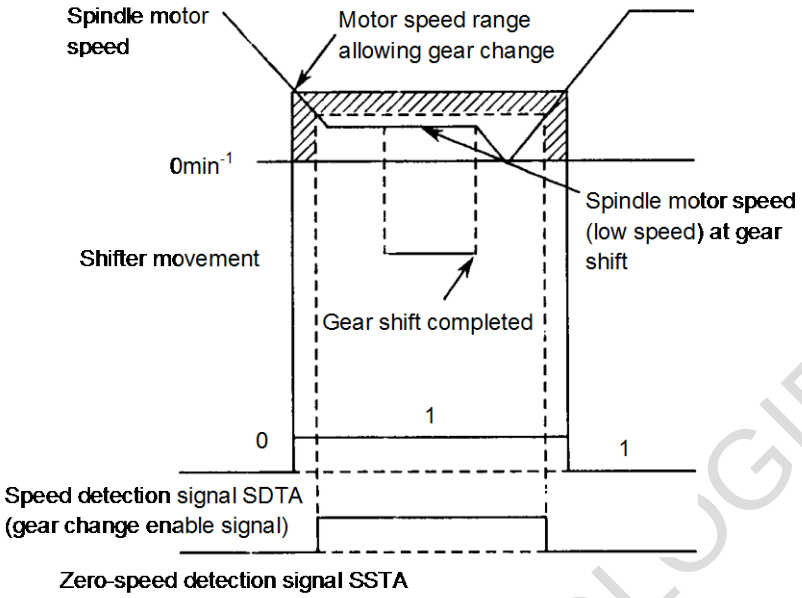


(3) This signal is output regardless of the rotation command (SFR, SRV).
<Reference> Gear shift sequence
In CNC machine tools, gear shift, which is one of sequence controls, causes a shift of the gear section of a spindle, which is an important component of a machine. In this case, to perform gear change safely, it is necessary to confirm that the spindle motor is rotated at a low speed.
A sample gear shift sequence using the speed detection signal (gear change enable signal) is given below. Please use this sample as a reference material when designing gear shift power magnetic sequence.



To perform a gear change safely, confirm that the spindle motor speed is low by using the speed detection signal before moving the shifter. When the zero-speed detection signal is also used, duplicate checking for safety can be made.
(Why the confirmation is required) If the shifter moves while the spindle motor rotates, the gear is damaged.

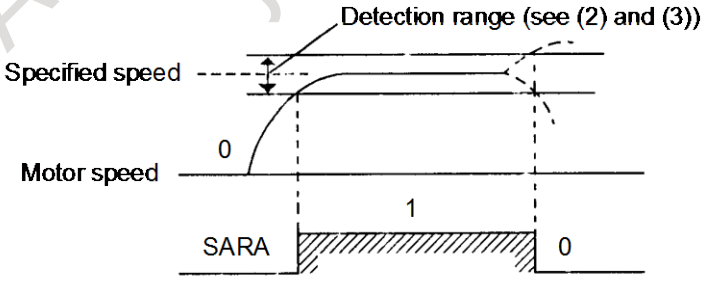
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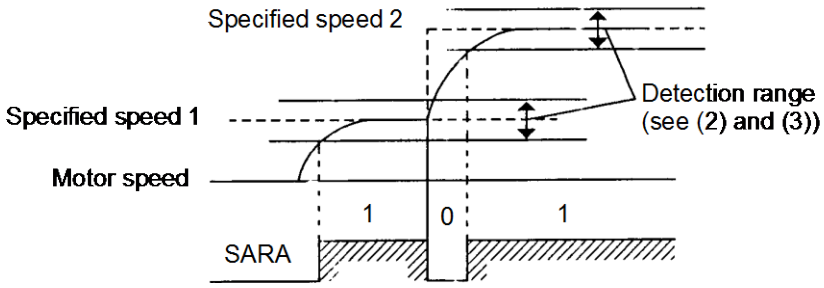


⚠ CAUTION
1 If a motor feedback signal disconnection alarm (spindle alarm 73) is issued, the status of this signal is undefined.
2 When bit 5 of parameter No. 4007 is set to "1", the detection operation of the feedback signal disconnection alarm is not performed.
Set the parameter to "0" when not required, to enable alarm detection.
3 If an error which cannot be detected in the motor free-running (coast) state occurs in the motor feedback system, this signal may not be output correctly in the motor free-running mode after an alarm is reset.

(d) Speed arrival signal (SARA)

(1) When the actual rotation speed of the spindle motor has reached a predetermined range for a speed command, SARA is set to 1.

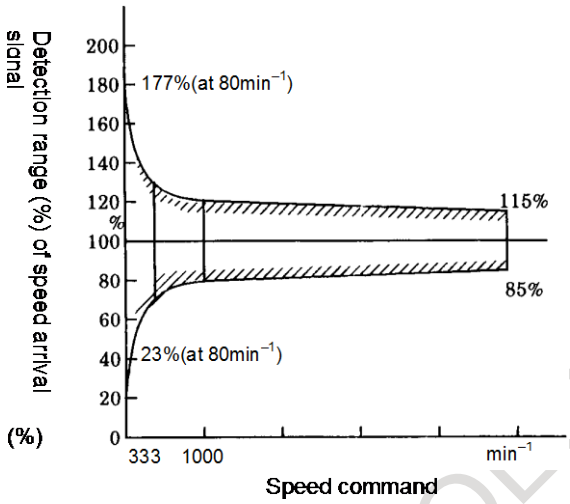




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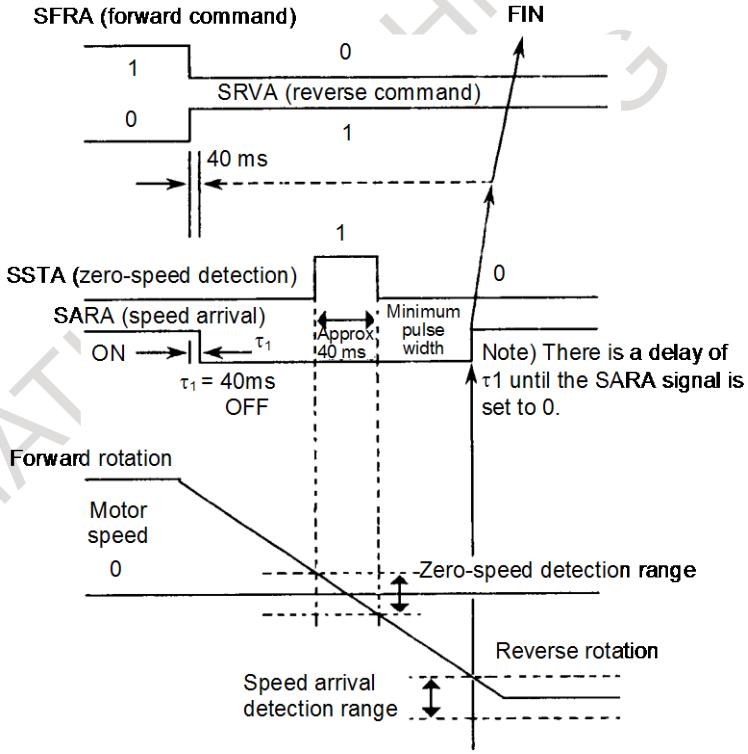
(2) The setting range is ±1 to 100% of a specified speed. When a speed not higher than 10% of the maximum rotation speed is specified, however, the detection range is wider than the set range.

(3) The standard setting is ±15%. The detection range of this speed arrival signal widens for low speeds as shown below.



(4) This signal is output when SFRA or SRVA is set to 1.

(5) This signal can be used to control reverse rotation in a tapping cycle as follows:



When a reserve rotation command is issued, the spindle motor starts decelerating, and 40 ms later the speed arrival signal is set to 0. Then, after the speed reaches zero, the speed arrival signal being set to 1 is detected. This completes the reverse spindle rotation command.

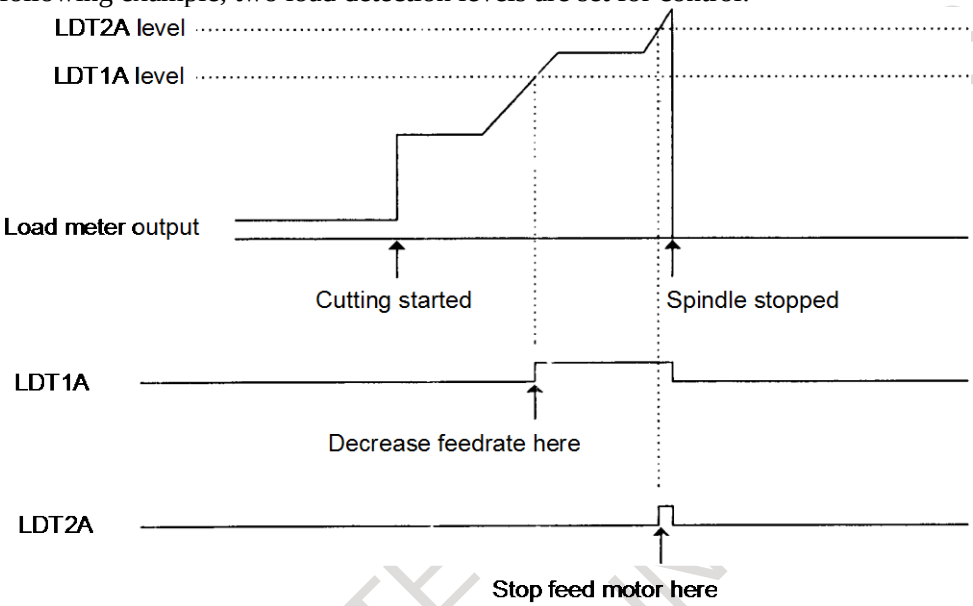
(6) This signal is used as a confirmation signal (FIN signal) for forward rotation (M03) and reverse rotation (M04) commands.

> ⚠ **CAUTION**
> When a spindle alarm is issued, this signal is disabled.

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(e) Load detection signals (LDT1A, LDT2A)

(1) When the maximum output level (10 V) of the load meter (LM) is assumed to be 100%, the load detection signal is set to 1 if the load meter output indicates a parameter-set value (%) or greater.
(2) Two different levels (LDT1A and LDT2A) can be set.
(3) These signals are used in PMC control. For example, to prevent the spindle from stopping when a cutting overload is applied to the spindle during cutting, these signals are used to decrease the feedrate or stop the feedrate.
(4) An application example is given below.
In the following example, two load detection levels are set for control:



(5) The above shows an example of control using two levels. When the feed motor is to be stopped immediately by using just one level, control must be provided according to the machine specification.

(6) By default, these signals are not output in 10 seconds (set in parameter No. 4082) after the status of the speed command signal changes so that Load detection signals can not be output by load of acceleration and deceleration. If the default time (No.4082) is not suited with the real acceleration and deceleration time, please refer to explanation of the parameter No.4082 and modify the value.

They are always output when the value on the load meter exceeds the set level according to the parameter setting (bit 4 of parameter No. 4009 to 1), however.

(f) Torque limit status signal (TLMA)

For details of this signal, see Subsection 3.2.2, “Explanation of Output Signals”, in Part I.

(g) Orientation completion signal (ORARA)

For details of this signal, see Section 2.2, “POSITION CODER METHOD SPINDLE ORIENTATION”, in Part I.

(h) Power line switching signal (CHPA) and spindle switching completion signal (CFINA)

For details of these signals, see Section 5.2, “SPINDLE SWITCHING CONTROL”, in Part I.

(i) Power line switching signal (RCHPA) and speed range switching completion signal (RCFNA)

For details of these signals, see Section 5.1, “SPEED RANGE SWITCHING CONTROL”, in Part I.

(j) Position coder one-rotation signal detection state signal (PC1DTA)

For details of this signal, see Subsection 3.2.2, “Explanation of Output Signals”, in Part I.

(k) Incremental orientation signal (INCSTA)

For details of this signal, see Section 5.3, “INCREMENTAL COMMAND TYPE SPINDLE ORIENTATION”, in Part I.

(l) Synchronous orientation enable signal (SORENA)

For details of this signal, see Section 5.5, “SPINDLE ORIENTATION DURING SPINDLE SYNCHRONIZATION CONTROL”, in Part I.

(m) Motor excitation off state signal (EXOFA)

For details of this signal, see Subsection 3.1.3(p), “Disconnection detection disable signal (DSCNA)”, in Part I.

(n) Tandem operation state signal (SLVSA)

For details of this signal, see Section 5.11, “TORQUE TANDEM CONTROL FUNCTION”, in Part I.

(o) Cs reference position establishment state signal (CSPENA)

When the Cs axis coordinate establishment function is used, this signal indicates that coordinate establishment processing is enabled.
If reference position return operation is performed in the Cs mode when bit 5 of parameter No. 4353 is set to 1, this signal is set to 1 from 0 to enable coordinate establishment processing.
This signal is set to 0 when the power is turned off or a spindle alarm is issued.

NOTE
With the following series and editions, this signal can be used:
Series 9D50 G (07) and subsequent editions
Series 9D70 A (01) and subsequent editions
Series 9D80 A (01) and subsequent editions
Series 9D90 A (01) and subsequent editions
Series 9DA0 A (01) and subsequent editions
Series 9DB0 A (01) and subsequent editions

When Serial communication type sensors (such as aiCZ sensors) or Distance coded sensors are used, there are some possibilities that reference return may be not necessary in case of using “Cs contour control axis coordinate establishment”, because CSPENA becomes “1” just after detecting Z phase signal in such sensors.

And if the serial communication sensors, which can know the zero position even just after turning on CNC, the reference return becomes unncessary, because CSPENA is always “1” without zero return.
The following list shows the example of such sensors.
- HEIDENHAIN
  RCN2390F
  RCN2590F
  RCN5390F
  RCN5590F
  RCN8390F
  RCN8590F

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NOTE
With the following series and editions, these serial sensors can be used:
Series 9D90 H (08) and subsequent editions
Series 9DA0 K (11) and subsequent editions
Series 9DB0 A (01) and subsequent editions

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4 ADJUSTMENT

4.1 VELOCITY LOOP GAIN ADJUSTMENT

4.1.1 Overview

Optimum adjustment of the velocity loop gain increases the position loop gain, therefore significantly enhancing disturbance suppression performance, positioning speed and accuracy. So, the adjustment of the velocity loop gain is very important in servo adjustments, and it should be performed first. This section explains the parameters for velocity loop gain adjustment and the adjustment procedure.

4.1.2 Parameters

There are five operation modes in spindle control: velocity control mode, orientation, servo mode (rigid tapping and spindle positioning), spindle synchronous control, and Cs contour control. There are parameters corresponding to each operation mode and to the clutch/gear signals (CTH1A and CTH2A). The following shows the parameters for each operation mode.

(1) Velocity control mode

0*i*	30*i*		
4040	4040	**Velocity loop proportional gain on velocity control mode (HIGH)**	**CTH1A=0**
4041	4041	**Velocity loop proportional gain on velocity control mode (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10

0*i*	30*i*		
4048	4048	**Velocity loop integral gain on velocity control mode (HIGH)**	**CTH1A=0**
4049	4049	**Velocity loop integral gain on velocity control mode (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10

(2) Orientation

0*i*	30*i*		
4042	4042	**Velocity loop proportional gain on orientation (HIGH)**	**CTH1A=0**
4043	4043	**Velocity loop proportional gain on orientation (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10

0	30*i*		
4050	4050	**Velocity loop integral gain on orientation (HIGH)**	**CTH1A=0**
4051	4051	**Velocity loop integral gain on orientation (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10

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(3) Servo mode (Rigid tapping and spindle positioning)

0*i*	30*i*		
4044	4044	**Velocity loop proportional gain on servo mode (HIGH)**	**CTH1A=0**
4045	4045	**Velocity loop proportional gain on servo mode (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10

0*i*	30*i*		
4052	4052	**Velocity loop integral gain on servo mode (HIGH)**	**CTH1A=0**
4053	4053	**Velocity loop integral gain on servo mode (LOW)**	**CTH1A=1**

Unit of data :
Unit of data :
Valid data range : 0 to 32767
Initial setting : 10

(4) Spindle synchronous control

0*i*	30*i*		
4044	4044	**Velocity loop proportional gain on spindle synchronous control (HIGH)**	**CTH1A=0**
4045	4045	**Velocity loop proportional gain on spindle synchronous control (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10

0*i*	30*i*		
4052	4052	**Velocity loop integral gain on spindle synchronous control (HIGH)**	**CTH1A=0**
4053	4053	**Velocity loop integral gain on spindle synchronous control (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10

0*i*	30*i*		
4550	4550	**Velocity loop proportional gain on spindle synchronous control (HIGH)**	**CTH1A=0**
4551	4551	**Velocity loop proportional gain on spindle synchronous control (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10

0*i*	30*i*		
4552	4552	**Velocity loop integral gain on spindle synchronous control (HIGH)**	**CTH1A=0**
4553	4553	**Velocity loop integral gain on spindle synchronous control (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10

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NOTE
Parameters Nos. 4550, 4551, 4552, and 4553 are valid with 9D70 series O (15) edition or later, 9D80 series K (11) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later and 9DB0 series A (01) edition or later..
When parameters Nos. 4550, 4551, 4552, and 4553 are set to 0, parameters Nos. 4044, 4045, 4052, and 4053 are valid.
Parameters Nos. 4044, 4045, 4052, and 4053 are common to spindle synchronous control and servo mode.

(5) Cs contour control

0*i*	30*i*		
4046	4046	**Velocity loop proportional gain on Cs contouring control (HIGH)**	**CTH1A=0**
4047	4047	**Velocity loop proportional gain on Cs contouring control (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 30

0*i*	30*i*		
4054	4054	**Velocity loop integral gain in Cs contouring control (HIGH)**	**CTH1A=0**
4055	4055	**Velocity loop integral gain in Cs contouring control (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 50

4.1.3 Adjustment Procedure

(1) Start of each operation mode

In preparation for the adjustment, settings must be made so that a stable operation takes place in each mode without overshoot or oscillation.
See Chapter 2, “EXPLANATION OF OPERATION MODES”, temporarily set parameters (acceleration/deceleration time constant, position gain, and so on) to make operations stable in each operation mode, and confirm operations.

NOTE
When a motor with a large torque-to-inertia ratio (for example, low-speed winding of a motor with an speed range switching function) is used, or when the rigidity of the spindle is low, the initial setting of the velocity loop gain may be so high that oscillation can occur. In such a case, decrease the velocity loop gain.

(2) Adjustment

When adjusting the velocity loop gain, check the operation mode and clutch/gear signal, and modify corresponding parameters. Follow the steps below to adjust the parameters:

<1> Determining the oscillation limit
Basically, determine the oscillation limit based on torque commands, position errors, vibration, sound, and so on when the motor is stopped (for orientation, after completion of the operation) or when the motor rotates at a certain speed not higher than the base speed. Normally, increase the proportional gain and integral gain settings in steps of about 5; for a motor with a large torque-to-inertia ratio, increase these settings in steps of about 2. As the settings are increased gradually, the symptoms below start to appear at a certain setting level. The settings at this level are determined to be the oscillation limit:
- The machine vibrates or produces large sound.

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- Vibration of a torque command becomes large.
- Position errors at stop time vary largely.

NOTE
The oscillation limit varies with the spindle inertia. In a machine in which the inertia varies largely according to the tool and workpiece used, adjustment must be made in the smallest inertia state.

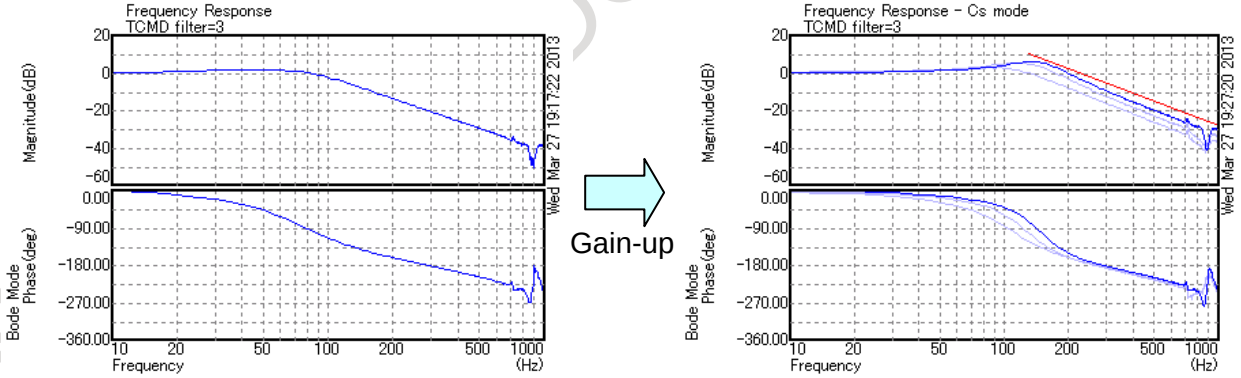
<2> Final settings
Set proportional gain of approximately 70% of the oscillation limit. As the integral gain, the same value as the proportional gain is basically set. When increasing the setting, however, make an adjustment so that the integral gain is typically about twice or five times as high as the proportional gain.

<3> Elimination of machine resonance
At the time of velocity loop gain adjustment, the gain cannot sometimes be increased because of machine resonance. In such a case, the machine resonance elimination function (a torque command filter and resonance elimination filter) described in the next section can be adjusted to increase the velocity loop gain while avoiding machine resonance. See Section 4.2, “MACHINE RESONANCE ELIMINATION”, and make adjustments as necessary.

(3) Automatic tuning

You can use tuning navigator of SERVO GUIDE for automatic tuning of velocity loop gain.
See “HELP” of SERVO GUIDE for details.

<1> Initial tuning
First, select “Gain-Tuning (Spindle)” from tuning navigator to determine the initial value of velocity gain with sufficient margin for the oscillation limit. The frequency characteristics (bode diagram) is displayed in tuning navigator as the follows.
Frequency characteristics in each operating modes is measured, because optimum gain for each operation modes is different.



After the initial tuning, it will be possible to find exact resonance frequency by next “Automatic tuning”.
<2> Automatic tuning
After the initial tuning, perform the tuning of “Resonance Elimination Filter” according to “4.2.2 (6).
As a result, it will be possible to set higher velocity loop gain.
Finally, perform the gain tuning again by using “Gain-Tuning (Spindle)” of tuning navigator to determined final velocity lop gain.

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4.1.4 Additional Information (Position Gain Adjustment)

Although the limit value of the position gain is determined basically depending on the velocity loop characteristics, the setting standards may vary depending on the operation mode. See Chapter 2, "EXPLANATION OF OPERATION MODES", and make adjustments accordingly.

4.2 MACHINE RESONANCE ELIMINATION

4.2.1 TCMD Filter

(1) Overview

The torque command filter applies a primary low-pass filter to torque commands. When the machine system resonates at frequencies as high as several hundreds Hz or higher, this function can avoid such high-frequency resonance.

(2) Series and editions of applicable spindle software

9D50 series A(01) edition or later
9D70 series A(01) edition or later
9D80 series A(01) edition or later
9D90 series A(01) edition or later
9DA0 series A(01) edition or later
9DB0 series A (01) edition or later

(3) Details

Fig. 4.2.1 (a) shows a velocity loop configuration including the torque command filter.
When the machine system has a high resonance frequency, the speed feedback may include a resonance component, and this component may be amplified by the proportional gain (Kp).
The torque command filter prevents machine resonance by applying a primary low-path filter to the proportional of the torque command to remove high-frequency components of the torque command.

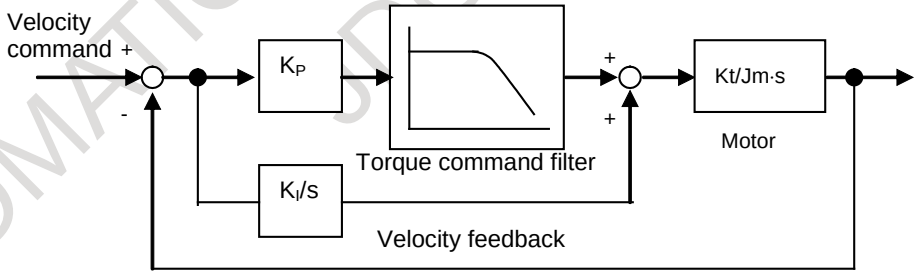


Fig. 4.2.1 (a) velocity loop configuration including the torque command

(4) Setting parameters

0*i*	30*i*	
4121	4121	**Torque command filter time constant**
4157	4157	**Torque command filter time constant: for low-speed characteristics**

Unit of data : 0.5msec
Valid data range : 0 to 32767
Initial setting : 5

Basically, use the initial setting value 5 (time constant: 2.5 ms). When a value greater than the initial setting value needs to be set, make an adjustment and typically set a value not greater than 15. When a value greater than 15 needs to be set, decrease the velocity loop gain.

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4.2.2 Resonance Elimination Filter

(1) Overview

The resonance elimination filter can attenuate signals which are in certain frequency band. When a strong resonance point is present in an area not lower than 200 Hz, and it is impossible to increase the velocity loop gain, the velocity loop gain can be increased by using this filter.

NOTE
For machines in which the rigidity of the part connecting the spindle and motor is considered to change with time, or for machines whose spindle inertia changes largely depending on the tool or workpiece used, do not use the resonance elimination filter.

(2) Series and editions of applicable spindle software

Spindle software

Series	Edition	Usable CNC
9D50	E (05) edition or later	
9D70	A (01) edition or later	
9D80	A (01) edition or later	
9D90	A (01) edition or later	
9DA0	A (01) edition or later	
9DB0	A (01) edition or later	

* When the resonance elimination filter disable signal is used, the following spindle and CNC software products must be used.

Spindle software

Series	Edition	Usable CNC
9D50	W (23) edition or later	
9D70	L (12) edition or later	
9D80	H (08) edition or later	
9D90	A (01) edition or later	
9DA0	A (01) edition or later	
9DB0	A (01) edition or later	

CNC software (Resonance elimination filter disable signal supported)

Series	Edition	Usable CNC
G002/G012/ G022/G032	W (23) edition or later	FANUC Series 30*i* /300*i* /300*i*s-A
G003/G013/ G023/G033	F (06) edition or later	
G121/G131	W (23) edition or later	FANUC Series 31*i* /310*i* /310*i*s-A5
G123/G133	F (06) edition or later	
G101/G111	W (23) edition or later	FANUC Series 31*i* /310*i* /310*i*s-A
G103/G133	F (06) edition or later	
G201	W (23) edition or later	FANUC Series 32*i* /320*i* /320*i*s-A
G203	F (06) edition or later	

* For the series 30*i*-B and 0*i*, the first edition and later support the signal.

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(3) Details

Fig. 4.2.2 (a) shows the resonance elimination filter configuration.

The resonance elimination filter is applied to the proportional (the value immediately after the torque command filter in Fig. 4.2.1) of the torque command after the command is passed through the torque command filter. The resonance elimination filter attenuates signals in a set frequency band to avoid machine resonance.

Four filter stages in total can be applied. For each stage, filter characteristics are set by using three parameters including the center frequency, band width, and damping.

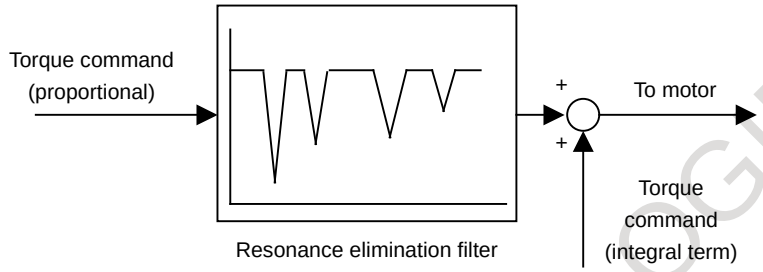


Fig.4.2.2 (a) Resonance elimination filter configuration

(4) I/O Signals (CNC↔PMC)

(4-1) Input signals (PMC→CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G305	G305					HF4A	HF3A	HF2A	HF1A
2nd-	G309	G309					HF4B	HF3B	HF2B	HF1B

HF1A Resonance elimination filter disable signal 1 (for 1st spindle)
HF1B Resonance elimination filter disable signal 1 (for 2nd spindle)
0: Enables resonance elimination filter 1
1: Disables resonance elimination filter 1
Resonance elimination filter 1 (set with parameter Nos. 4391 to 4393) is disabled.

HF2A Resonance elimination filter disable signal 2 (for 1st spindle)
HF2B Resonance elimination filter disable signal 2 (for 2nd spindle)
0: Enables resonance elimination filter 2
1: Disables resonance elimination filter 2
Resonance elimination filter 2 (set with parameter Nos. 4416 to 4418) is disabled.

HF3A Resonance elimination filter disable signal 3 (for 1st spindle)
HF3B Resonance elimination filter disable signal 3 (for 2nd spindle)
0: Enables resonance elimination filter 3
1: Disables resonance elimination filter 3
Resonance elimination filter 3 (set with parameter Nos. 4419 to 4421) is disabled.

HF4A Resonance elimination filter disable signal 4 (for 1st spindle)
HF4B Resonance elimination filter disable signal 4 (for 2nd spindle)
0: Enables resonance elimination filter 4
1: Disables resonance elimination filter 4
Resonance elimination filter 4 (set with parameter Nos. 4422 to 4424) is disabled.

> ⚠ **CAUTION**
> When motor excitation is in progress (motor excitation off state signal: EXOFx = 0), do not change the status of the following signals:
> HF1x, HF2x, HF3x, and HF4x

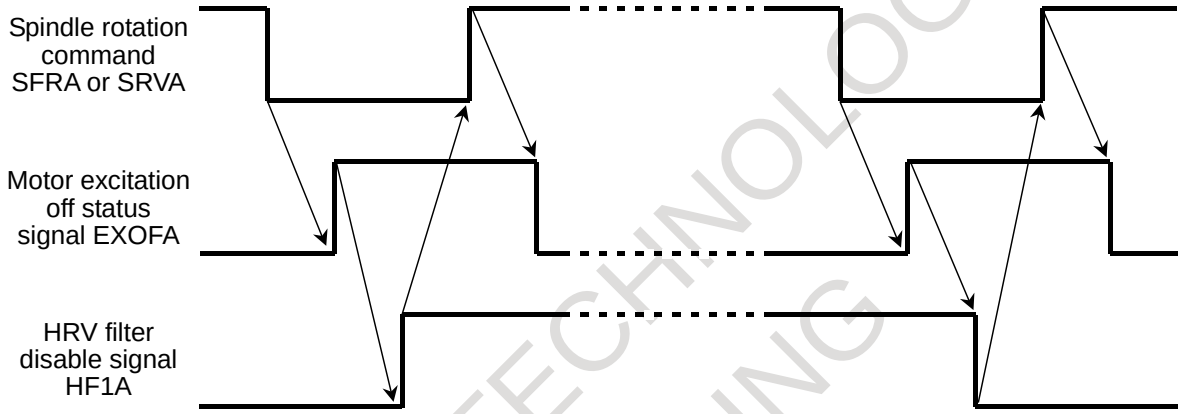
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(4-2) Output signals (CNC→PMC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F047	F047				EXOFA				
2nd-	F051	F051				EXOFB				

EXOFA Motor excitation off status signal (for 1st spindle)
EXOFB Motor excitation off status signal (for 2nd spindle)
0: Motor excitation is on.
1: Motor excitation is off.
Make sure that status of this signal is '1' before changing status of resonance elimination filter disable signal HF1x, HF2x, HF3x and HF4x.

(4-3) Examples of Sequences



(5) Setting parameters

0*i*	30*i*	
4391	4391	**Resonance elimination filter 1 - attenuation center frequency**
4392	4392	**Resonance elimination filter 1 - attenuation bandwidth**
4393	4393	**Resonance elimination filter 1 - damping**

0*i*	30*i*	
4416	4416	**Resonance elimination filter 2 - attenuation center frequency**
4417	4417	**Resonance elimination filter 2 - attenuation bandwidth**
4418	4418	**Resonance elimination filter 2 - damping**

0*i*	30*i*	
4419	4419	**Resonance elimination filter 3 - attenuation center frequency**
4420	4420	**Resonance elimination filter 3 - attenuation bandwidth**
4421	4421	**Resonance elimination filter 3 - damping**

0*i*	30*i*	
4422	4422	**Resonance elimination filter 4 - attenuation center frequency**
4423	4423	**Resonance elimination filter 4 - attenuation bandwidth**
4424	4424	**Resonance elimination filter 4 - damping**

Attenuation center frequency :
Unit of data : 1Hz
Valid data range : 96 to 3000
Initial setting : 0

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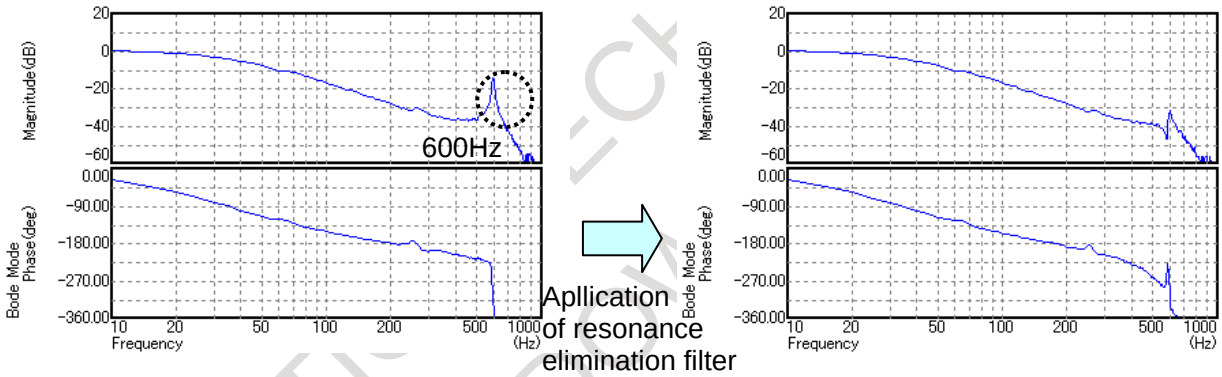
Attenuation bandwidth :
Unit of data : 1Hz
Valid data range : 10 to 3000
Initial setting : 0

Damping :
Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 0

For each filter stage, set three parameters including the attenuation center frequency, attenuation bandwidth, and damping. When a filter stage is not to be used, set 0 (initial setting) in all the three parameters. When input signal HFx (x: 1 to 4) is set to 1, the resonance elimination filter x is disabled.

(6) Adjustment

If there is a strong machine resonance in relatively high frequency (200Hz or more) region, to adjust the resonance elimination filter. You can adjust the resonance elimination filter to suppress the machine resonance by using the tuning navigator of SERVO GUIDE. The following is adjustment example by machine having one resonance frequency (600Hz). The gain at resonance frequency is reduced by the resonance elimination filter. See “HELP” of SERVO GUIDE for details.



(7) Additional information (cautions)

When the resonance elimination filter is used, inappropriate parameter setting may make velocity loop control unstable, resulting in abnormal oscillation by a torque command. There is a high possibility that velocity loop control becomes unstable when a “low” center frequency, “high” bandwidth, and “small” damping coefficient are set.

1. The motor may accelerate to a speed higher than the specified one with an acceleration/deceleration function depending on the degree of oscillation. Before using the resonance elimination filter, fully consider the following points and adjust the parameters:
   The use of the resonance elimination filter is allowed when the center frequency is 200 Hz or higher.
2. The standard attenuation bandwith is up to 30% of the center frequency. Set as small a value as possible.
3. Set as large a damping coefficient as possible.
4. When the center frequency of machine resonance is 200 Hz or lower, adjust the parameters with observing the instructions described in items (2) and (3) while checking that no torque command causes abnormal oscillation.
5. When you do not use the resonance elimination filter, set all three parameters (attenuation center frequency, attenuation bandwidth, and damping) for resonance elimination filters 1 to 4 to “0.”

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4.2.3 Adaptive Resonance Elimination Filter

(1) Overview

The adaptive resonance elimination filter function causes one of the four resonance elimination filters to follow up resonance frequency changes.

(2) Series and Editions of Applicable Spindle Software

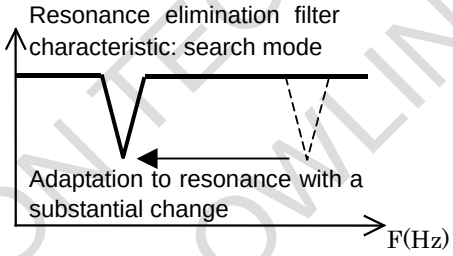
Spindle software

Series	Edition	Usable CNC
9D90	A (01) edition or later	FS0*i*-D, FS30*i* / FS31*i* / FS32*i*-A
9DA0	A (01) edition or later	FS0*i*-D, FS0*i*-F, FS30*i* / FS31*i* /FS32*i*-B
9DB0	A (01) edition or later	FS0*i*-F, FS30*i* / FS31*i* /FS32*i*-B

(3) Details

(1) This function enables searches for resonance frequency changes for:
- Individual differences in machines
- Secular changes in machines
- Individual differences in workpieces

(2) When the search mode signal is input, a search for machine resonance is started within a set search range. Of the frequencies that exceed a set detection level, the one with the largest amplitude is detected as a resonance frequency. The detected frequency is set as a center frequency for resonance elimination filter 1.



(3) While the search mode signal is being input, a search for machine resonance is made continuously. If a different frequency is detected, the setting of the center frequency for resonance elimination filter 1 is updated with the detected frequency.

(4) The detected frequency can be checked on the diagnosis screen.

NOTE
- This function is enabled only for resonance elimination filter 1 (parameters Nos. 4391, 4392, and 4393).
- This function is enabled when excitation is on.
- This function is disabled when the resonance elimination filter 1 disable signal is input (bit 0 of G305 = 1).
- The center frequency parameter for resonance elimination filter 1 cannot be updated automatically.
- When the spindle adjustment function of the SERVO GUIDE is used, turn off the search mode signal.

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(4) I/O Signals (CNC↔PMC)

(4-1) Input signals (PMC→CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G304	G304	FRFSMA							
2nd-	G308	G308	FRFSMB							

FRFSMA : Adaptive resonance elimination filter search mode signal (for 1st spindle)
FRFSMB : Adaptive resonance elimination filter search mode signal (for 2nd spindle)
0 : Stops (disables) the search mode.
1 : Starts the search mode.
When the FRFSM signal is set to 1, a search for a resonance frequency is started.
While the signal is being input, the search is continued even after search completion signal FRDTE becomes 1. If another vibration frequency is detected, the internally set center frequency for resonance elimination filter 1 is updated with the detected frequency.

NOTE
Even when the FRFSM signal is input, searches cannot be made in any of the following cases:
1 Resonance elimination filter 1 disable signal HF1 (bit 0 of G305) is 1.
2 Excitation is off.
3 The polarity is not detected (for synchronous spindle motor drive).

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G305	G305								HF1A
2nd-	G309	G309								HF1B

HF1A : Resonance elimination filter 1 disable signal (for 1st spindle)
HF1B : Resonance elimination filter 1 disable signal (for 2nd spindle)
0 : Enabled
1 : Disabled
When the HF1 signal is 1 (disabled), resonance elimination filter 1 set with parameters Nos. 4391, 4392, and 4393 is disabled. In this case, the adaptive resonance elimination filter function is also disabled.

(4-2) Output signals (CNC→PMC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F307	F307								FRDTEA
2nd-	F309	F309								FRDTEB

FRDTEA : Adaptive resonance elimination filter search completion signal (for 1st spindle)
FRDTEB : Adaptive resonance elimination filter search completion signal (for 2nd spindle)
0 : Uncompleted state
1 : Completed state
Once search start signal FRFSM has been input, and when two searches have been finished in the search range specified with the relevant parameters (search start frequency (= parameter No. 4391 - parameter No. 4561) to search end frequency (= parameter No. 4391 + parameter No. 4561) ≤ 2000 Hz), the FRDTE signal becomes “1”.

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NOTE

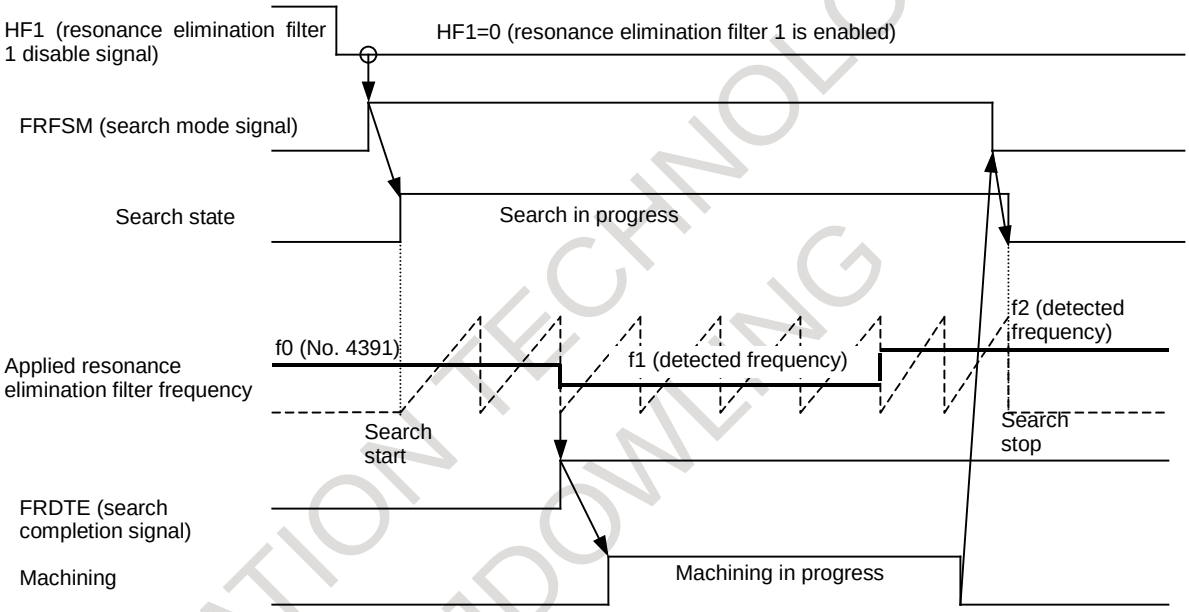
The FRDTE signal is cleared in any of the following cases:

1 Resonance elimination filter 1 disable signal HF1 (bit 0 of G305) is 1 (disabled).
2 The adaptive resonance elimination filter is disabled (bit 3 of parameter No. 4396 = 0).
3 The center frequency (parameter No. 4391) for resonance elimination filter 1 is rewritten.
4 Search start signal FRFSM (bit 7 of G304) rises from 0 to 1.

(4-3) Examples of Sequences

Example 1) To always make a search during machining

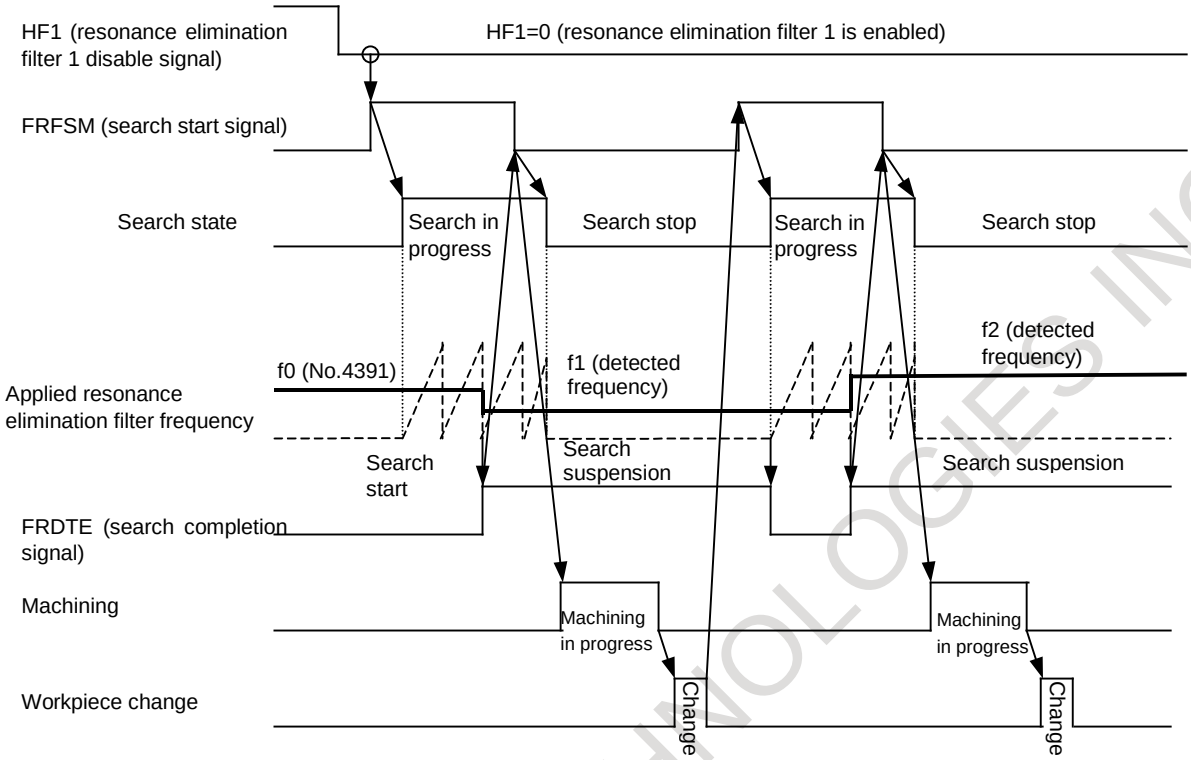
When a resonance frequency changes during machining, it is possible to adapt to the frequency changes by continuing a search without turning off the search start signal.



Example 2) To fix the search result during machining

When resonance frequencies are different for individual workpieces, but during machining, you do not want to change the frequency components that should be attenuated, it is possible to fix the center frequency during machining by turning off the search start signal after a search is completed.

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(5) Setting parameters

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4396	4396					ACREF			

ACREF Adaptive resonance elimination filter function
0 : Disables the adaptive resonance elimination filter function.
1 : Enables the adaptive resonance elimination filter function.
Set this bit to 1 to use the adaptive resonance elimination filter function. This function works for resonance elimination filter 1.

NOTE
This function is enabled only for resonance elimination filter 1. The function is disabled for the other resonance elimination filters (resonance elimination filter 2 (parameters Nos. 4416, 4417, and 4418), resonance elimination filter 3 (parameters Nos. 4419, 4420, and 4421), and resonance elimination filter 4 (parameters Nos. 4422, 4423, and 4424)).

0*i*	30*i*	
4391	4391	**Resonance elimination filter 1: center frequency**

Unit of data : 1Hz
Valid data range : 96 to 3000
Initial setting : 0
When the adaptive resonance elimination filter function is enabled, a search is made around the center frequency set in this parameter in the search range set in parameter No. 4561.

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NOTE
When this parameter is rewritten, search results are discarded.

0*i*	30*i*	
4392	4392	**Resonance elimination filter 1: band**

Unit of data : 1Hz
Valid data range : 0 to 3000
Initial setting : 0

NOTE
When this parameter is 0, the filter function itself is disabled, but searches for resonance frequencies can be made, and search results can be checked on the diagnosis screen.

0*i*	30*i*	
4393	4393	**Resonance elimination filter 1: attenuation rate**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 0

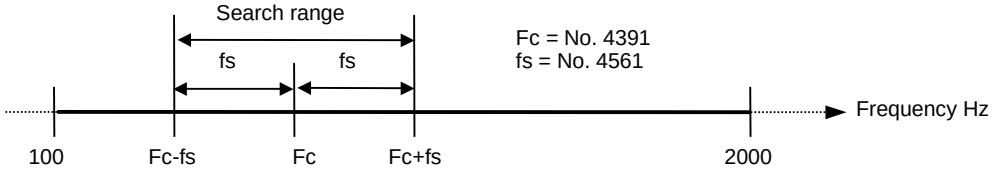
0*i*	30*i*	
4560	4560	**Adaptive resonance elimination filter: detection level**

Unit of data : 0.1% Unit [100%⇒maximum torque]
Valid data range : 0 to 1000
Initial setting : 0
Set the minimum detection level of vibration spectra. When a vibration spectrum is lower than or equal to this level, its wave number is not regarded as a resonance frequency. When this setting is 0, the detection level is assumed to be “8” (0.8%).

NOTE
If a small value is set, frequencies may not be detected correctly due to the effect of noise. When applying this parameter, be sure to use the actual machine to check that proper follow-up is performed.

0*i*	30*i*	
4561	4561	**Adaptive resonance elimination filter: search range**

Unit of data : 1Hz
Valid data range : 0, 100 to 1900
Initial setting : 0
Set the search range for the adaptive resonance elimination filter.
A search is made in a frequency range of (parameter No. 4391 ± search range). If a frequency to be found is beyond a range of 100 to 2000 Hz, a search is made within this range. When this setting is “0”, the search range is assumed to be fs = 1900.



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(6) Checking search results

When the following parameter is set, the results of searches made by the adaptive resonance elimination filter can be checked on the CNC diagnosis screen.

0*i*	30*i*	
4532	4532	**Arbitrary data output function number**

Unit of data :
Valid data range : 0 to +32767
Initial setting : 0

When this parameter is set to "6", the following data for which search processing is performed can be checked on the CNC diagnosis screen display. When diagnosis 722 = 1, the value displayed in diagnosis 720 is the center frequency that has been found.
Diagnosis 720: Displays the center frequency (search result) for resonance elimination filter 1 that has been found and internally set.
Diagnosis 722: Displays the state of search completion signal FRDTE, 0 (search completed state) or 1 (search uncompleted state).

4.3 AMPLITUDE RATIO/PHASE DIFFERENCE COMPENSATION FUNCTION

(1) Overview

This function compensates for errors in speed and position detection due to the amplitude ratio and phase difference of phase A/B of speed and position detection sensors.
By using this function, improvements in positioning and feed accuracy at the time of Cs contour control can be expected.

(2) Series and editions of applicable spindle software

9D50 series C(03) edition or later
9D70 series A(01) edition or later
9D80 series A(01) edition or later
9D90 series A(01) edition or later
9DA0 series A(01) edition or later
9DB0 series A(01) edition or later

NOTE
When the α*i*CZ sensor (serial) is used, this function cannot be used.

(3) Details

The feedback signals from the α*i*M sensor, α*i*MZ sensor, α*i*BZ sensor, and α*i*CZ sensor (analog) are used for speed or position detection in the spindle amplifier, and they are two sine wave signals (phase A/B) having the same amplitude and a phase difference of 90°. Based on these phase A/B signals, the detection circuit of the spindle amplifier generates feedback data used for speed and position detection. If the feedback signals are in the ideal state (having the same amplitude and a phase difference of 90°), accurate feedback data is generated. Actually, however, the amplitude and phase difference are slightly deviated from the ideal state. This deviation causes a feedback data error, which lowers the accuracy of speed and position detection.
When the feedback data has an error due to the deviation in amplitude and phase difference of the feedback signals as described above, this function performs compensation of feedback data generation processing (interpolation processing) of the detection circuit by setting compensation data for the detection circuit to minimize the error.

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Use of this function improves the accuracy in speed and position detection. As a result, positioning and feed accuracy can be improved, and also improvement in rigidity can be expected because of the increase in velocity loop gain and position loop gain.

NOTE
This function does not simplify sensor installation work by directly performing compensation of the feedback signals. The sensor signals must satisfy the specification. So, before using this function, check that the feedback signals satisfy the specification.

(4) Setting parameters

0*i*	30*i*	
4355	4355	**Compensation of motor sensor signal amplitude ratio**

Unit of data : 1%
Valid data range : -8 to +8
Initial setting : 0

0*i*	30*i*	
4356	4356	**Compensation of motor sensor signal phase difference**

Unit of data : 1°
Valid data range : -4 to +4
Initial setting : 0

0*i*	30*i*	
4357	4357	**Compensation of spindle sensor signal amplitude ratio**

Unit of data : 1%
Valid data range : -8 to +8
Initial setting : 0

0*i*	30*i*	
4358	4358	**Compensation of spindle sensor signal phase difference**

Unit of data : 1°
Valid data range : -4 to +4
Initial setting : 0

When compensation of the feedback signal of the motor sensor connected to spindle amplifier JYA2 is performed, the settings of parameter Nos. 4355 and 4356 are adjusted. When compensation of the feedback signal of the spindle sensor connected to JYA4 is performed, the settings of parameter Nos. 4357 and 4358 are adjusted.
When as with a built-in motor the speed sensor and position sensor are the same (the feedback signal of JYA2 is used for speed detection and position detection), compensation is performed for JYA2 only. When the speed sensor and position sensor are provided separately (the feedback signal of JYA2 is used for speed detection, and the feedback signal of JYA4 is used for position detection), compensation is performed for both JYA2 and JYA4.

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(5) Preparation for adjustment

With this function, parameters are adjusted by rotating the spindle at a certain speed in the velocity control mode and observing feedback data. The measuring devices required for the adjustment and the settings made at the time of adjustment are explained below.

<1> Speed and rotation direction at adjustment time

For adjustment on the motor sensor side, issue a speed command and rotation direction command (SFR or SRV) so that the motor rotates in the forward direction (counterclockwise) at speed N (see the equation below). For adjustment on the spindle sensor side, issue the commands so that the spindle rotates in the forward direction (counterclockwise) at speed N.

N [min^{-1}] = 4685/Number of sensor gear teeth [λ/rev]

Example: When the number of sensor gear teeth = 256 [λ/rev]

N = 4685/256 = approx.18 [min^{-1}]

Please adjust the S command to be about the above value respectively, for motor speed at the time of motor sensor adjustment and spindle speed at the time of spindle sensor adjustment,

<2> Setting observation data

Please set for observing the following data in SERVO GUIDE.

(a) In case of adjusting motor sensor : MFBDF (feedback differential data on the motor side)
(b) In case of adjusting spindle sensor : SFBDF (feedback differential data on the spindle side)

(6) Adjustment procedure

After completing the preparation for adjustment mentioned previously, follow the steps below to adjust parameter settings in the MDI mode.

<1> Rotation in the velocity control mode

Set all the amplitude ratio and phase difference compensation parameters to 0, and rotate the spindle (motor) in the previously mentioned direction and at speed N in the velocity control mode.

<2> Adjusting the phase difference compensation parameter

Set the parameter for amplitude ratio compensation (parameter No. 4355 or 4357) to 0, and adjust the phase difference compensation parameter (parameter No. 4356 or 4358). Please adjust parameters as the fluctuation range of feedback differential data in rotation is minimized.

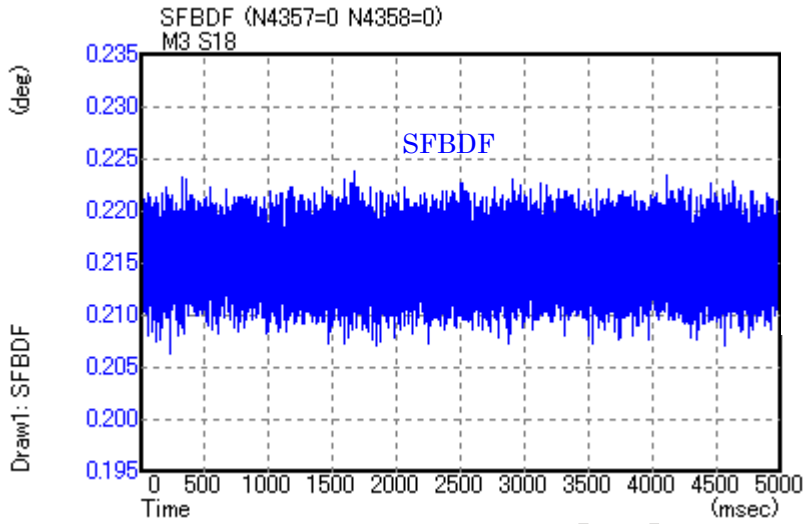
<3> Adjusting the amplitude ratio compensation parameter

After adjusting phase difference compensation to an optimum value, adjust amplitude ratio compensation. Please adjust parameters as the fluctuation range of feedback differential data in rotation is minimized as with adjusting the phase difference compensation parameter.

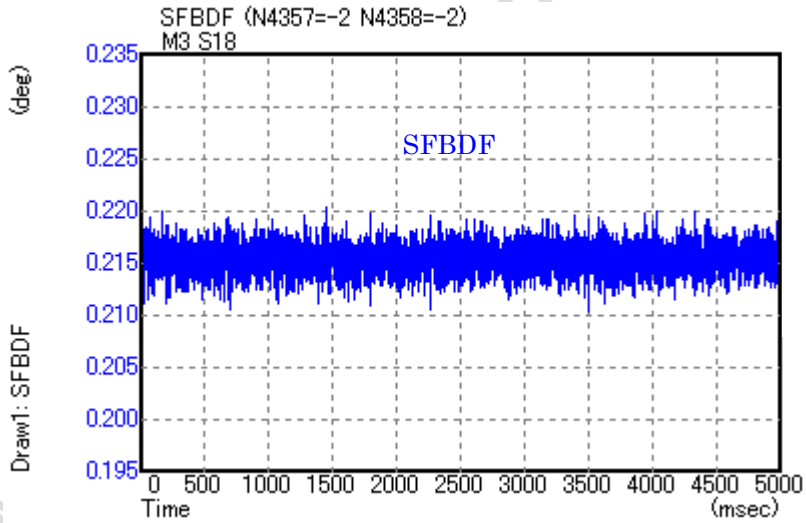
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Example of adjusting (spindle sensor)

(a) Before adjust (No. 4357=0, No. 4358=0)



(b) After adjust (No. 4357=-2, No. 4358=-2)



ADDITIONAL INFORMATION

Whichever compensation, amplitude ratio compensation or phase difference compensation, may be adjusted first, the same adjustment result can be obtained. So, steps <2> and <3> may be performed in reverse order.

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5 FUNCTION DESCRIPTIONS

5.1 SPEED RANGE SWITCHING CONTROL (OPTIONAL FUNCTION)

5.1.1 Overview

Speed range switching control switches the output characteristic (winding) of a spindle motor (motor designed for speed range switching control) that has two types of windings (winding with low-speed output characteristic and winding with high-speed output characteristic).

NOTE
1 Using this function requires the CNC software option.
2 This function cannot be used with sensorless motor.

5.1.2 Series and Editions of Applicable Spindle Software

Spindle software

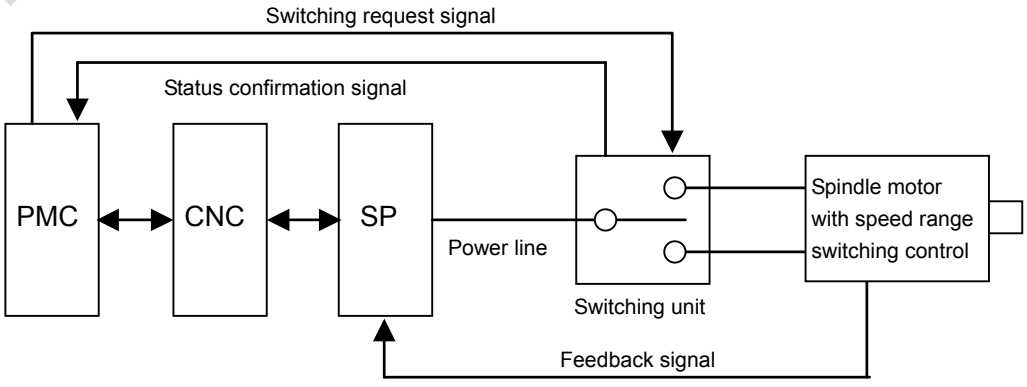
Series	Edition	Usable CNC
9D50	A (01)	FS0*i* -D
9D70	A (01)	FS30*i* / FS31*i* / FS32*i* -A
9D80	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9D90	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	A (01)	FS0*i* -D, FS0*i* -F , FS30*i* / FS31*i* / FS32*i* / FS35*i* -B
9DB0	A (01)	FS0*i* -F , FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

5.1.3 Configuration

Shown below is a machine configuration for using speed range switching control.
This function requires the following items in addition to a spindle amplifier (SP).

- Switching unit (a magnetic contactor and a relay for driving it are included)
- Signals between the PMC and switching unit

Refer to "FANUC SERVO AMPLIFIER αi series Descriptions" (B-65282EN) for the specification of the switching unit and detailed descriptions about their connection.



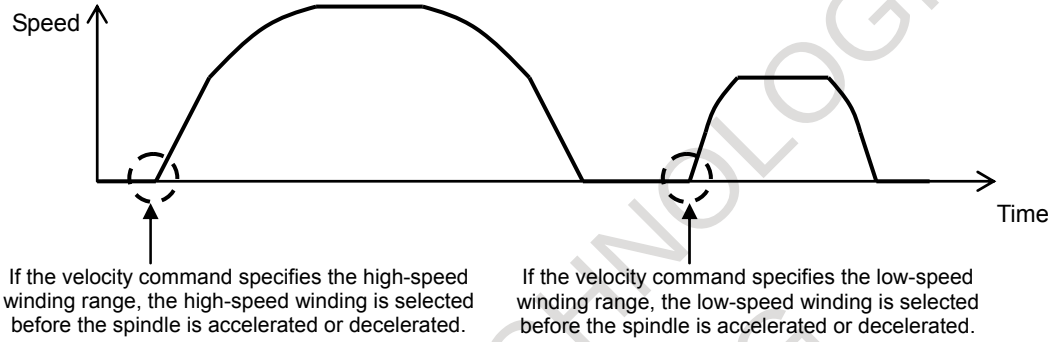
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5.1.4 Using Speed Range Switching Control

While there are two methods of using speed range switching control, it is recommended to adopt the method that switches the winding based on the velocity command.

- Switching the winding based on the velocity command (recommended method)
- Switching the winding based on the actual motor speed

With the method that switches the winding based on the velocity command, the winding is selected based on the specified speed while the spindle is stopped and then the spindle is accelerated, as shown in the figure below. Generally, this method enables a short acceleration time before reaching the maximum speed and a smooth acceleration operation. The method is also advantageous in terms of the contact life of the magnetic contactor.



The following table compares the two methods.

	Method that switches the winding based on the velocity command	Method that switches the winding based on the actual motor speed
Acceleration time from stop state to maximum speed	This method uses only the high-speed winding and does not switch the winding during acceleration. Therefore, the time for the switching operation (typically 200 to 300 ms) is not required and the acceleration time from the start of acceleration generally becomes short.	This method performs the switching from the low-speed winding to the high-speed winding during acceleration. Therefore, the time for the switching operation (typically 200 to 300 ms) is required. In cases where the switching operation time is short relative to the acceleration time, such as when the inertia is large, this method that also uses the low-speed winding may result in a short acceleration time.
Speed fluctuation during acceleration	Since this method does not switch the winding during acceleration, the acceleration operation is not interrupted, resulting in smooth acceleration.	Since this method switches the winding during acceleration, the acceleration operation is interrupted when the switching is performed and acceleration is not smooth.
Life of magnetic contactor	Since this method switches the winding only when necessary, it is advantageous in terms of the contact life of the magnetic contactor.	Since this method switches the winding whenever the spindle is accelerated to the high-speed winding range, it can be said that the method is disadvantageous in terms of the contact life of the magnetic contactor.

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(a) Method that switches the winding based on the velocity command

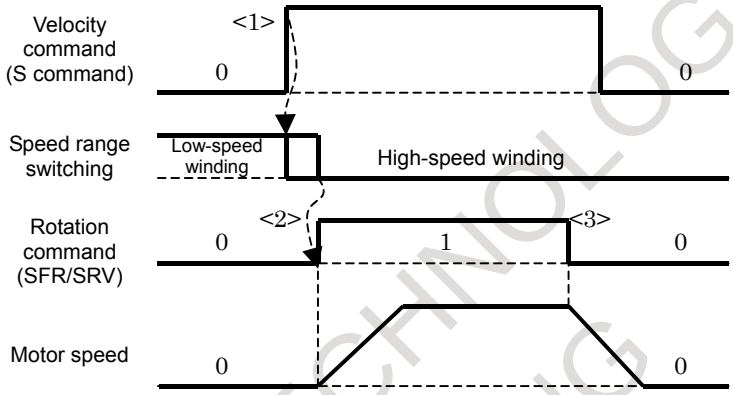
This method references the spindle velocity command (S command) and switches the winding by judging whether the specified speed is the low-speed winding range or high-speed winding range. Determine the winding to be selected, by using the S code output (S31 to S00) or S12 bit code output (R12O to R01O).

(1) Starting and stopping the spindle

<1> Reference the spindle velocity command (S command) and switch to the low-speed winding if the specified speed is the low-speed winding range or to the high-speed winding if the specified speed is the high-speed winding. If the desired winding is already selected, the switching is not necessary and the time is reduced.

<2> Rotate the spindle after the switching is completed.

<3> When stopping the spindle, stop it with the winding that is selected while it is rotating.



(2) Changing the velocity command

If the winding needs to be changed when the velocity command is changed while the spindle is rotating, it is possible to stop the spindle temporarily, change the winding, and then accelerate the spindle to the specified speed, as in mechanical gear switching. Note, however, that this method requires a longer acceleration/deceleration time because it stops the spindle temporarily.
Described below is a method to reduce the operation time by changing the winding during rotation.

(2)-1 High-speed winding → low-speed winding

To change the velocity command from the high-speed winding area to the low-speed winding area, set bit 4 of parameter No.4019 to 1. Also, set the detection level of the speed detection signal (SDT) to the switching speed.
These settings ensure that the sequence does not proceed until the motor decelerates to the low-speed winding range and the speed detection signal (SDT) is set to 1, even if the switching from the high-speed winding to the low-speed winding starts. This means that they prevent the low-speed winding from being selected in the high-speed winding range.

<1> Reference the spindle velocity command (S command) and start the switching to the low-speed winding if the specified speed is the low-speed winding range.

<2> If the motor decelerates to the set speed level, the speed detection signal (SDT) is set to 1 and the switching operation is performed.

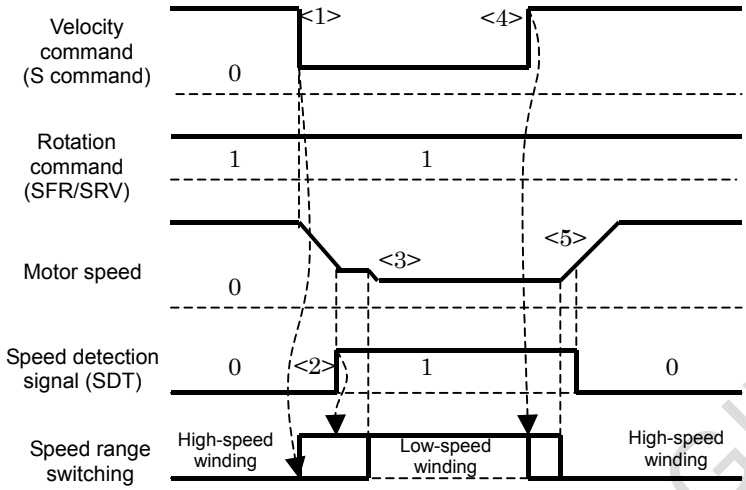
<3> After the switching is completed, the motor decelerates further to the specified speed.

(2)-2 Low-speed winding → high-speed winding

<1> Reference the spindle velocity command (S command) and switch to the high-speed winding if the specified speed is the high-speed winding range.

<2> After the switching is completed, the spindle accelerates to the specified speed.

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(b) Method that switches the winding based on the actual motor speed

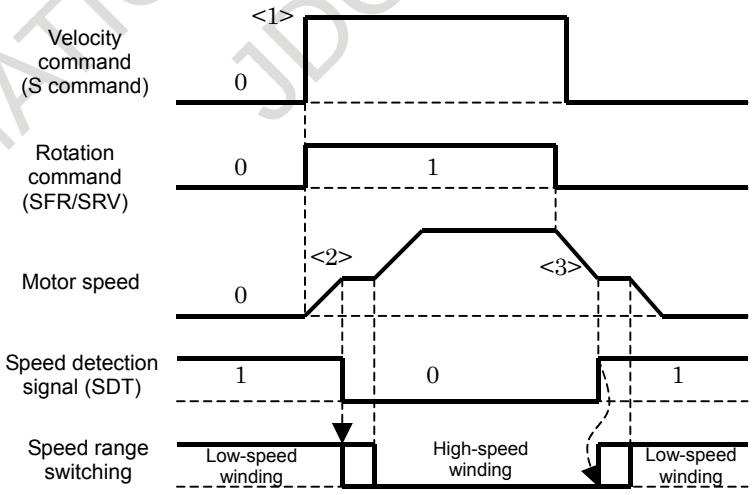
This method switches the winding when the motor reaches the switching speed. Switch the winding when the speed detection signal (SDT) changes. The speed detection signal is set to 1 when the speed level specified by the parameter is lower than the actual motor speed or to 0 when the speed level is higher. Set the detection level (parameter No. 4023) to the switching speed.

(1) Starting and stopping the spindle

<1> Input the spindle velocity command (S command) and rotation command to accelerate the spindle.

<2> Accelerate the spindle until the detection speed of the speed detection signal (SDT) is reached. When the SDT signal changes, perform the speed range switching. When the switching of the winding is completed, the spindle accelerates further to the specified speed.

<3> When the spindle is stopped, the speed detection signal (SDT) also changes during deceleration. When the SDT signal changes, perform the switching of the winding. After the switching to the low-speed winding is completed, the spindle decelerates and stops.



(2) Changing the velocity command

(2)-1 High-speed winding → low-speed winding

<1> Using the spindle velocity command of the low-speed winding range, start deceleration.

<2> When the spindle decelerates to the detection speed of the speed detection signal (SDT) and the SDT signal changes, perform the speed range switching.

<3> When the switching of the winding is completed, the spindle decelerates further to the specified speed.

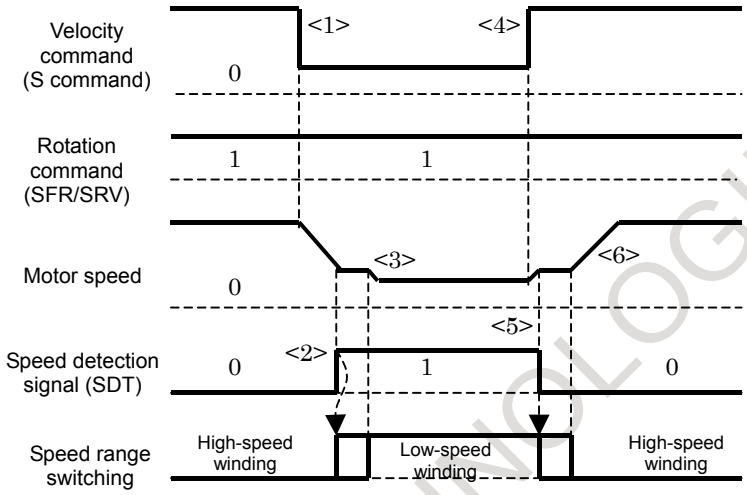
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(2)-2 Low-speed winding → high-speed winding

<1> Using the spindle velocity command of the high-speed winding range, start acceleration.

<2> When the spindle accelerates to the detection speed of the speed detection signal (SDT) and the SDT signal changes, perform the speed range switching.

<3> When the switching of the winding is completed, the spindle accelerates further to the specified speed.



(c) Cautions

While speed range switching control can be performed regardless of whether the motor is stopped or rotating, it should not be performed during cutting or position control. Since the motor current control is stopped during the switching operation, the motor does not generate torque. For this reason, the motor may become unable to cut or rotate as specified, thus causing an alarm.

Be sure to select the winding before the motor enters any of the following control modes in order to prevent the switching operation from being performed while the motor is operating in one of these modes.

- Spindle orientation (lower than or equal to the orientation speed)
- Rigid tapping
- Cs contouring control
- Spindle synchronous control
- Spindle positioning

The speed detection signal (SDT) may change in the cases described below. Avoid using the SDT signal in these cases.
In constant surface speed control, the spindle speed becomes high to reach the detection level of the SDT signal.
(When performing constant surface speed control with the low-speed winding, it is possible to prevent the speed from reaching the detection level of the SDT signal by clamping the maximum speed using the spindle maximum speed clamp command (G92 and G50).)
During cutting, the cutting load causes a speed fluctuation and the speed reaches the detection level of the SDT signal.

Note that the SDT signal may change when the speed is changed by spindle override.

Basically, make a sequence so that the status of the auxiliary contact of the magnetic contactor is checked, then the next operation starts. In a sequence in which the next operation starts when a specified time has elapsed, power may be turned on before magnetic contactor switching is completed, which may cause an overcurrent alarm.

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5.1.5 I/O Signals (CNC↔PMC)

(1) Address list of input signals (PMC→CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G070	G070					CTH1A	CTH2A		
2nd-	G074	G074					CTH1B	CTH2B		
1st-	G071	G071	RCHA	RSLA						
2nd-	G075	G075	RCHB	RSLB						
1st-	G072	G072	RCHHGA							
2nd-	G076	G076	RCHHGB							

(2) Details of input signals (PMC→CNC)

(a) Speed range switching request signal (RSLA)

(1) The RSLA signal is used as a command signal for selecting an output characteristic.
0: The high-speed characteristic is selected.
1: The low-speed characteristic is selected.

(2) Method of specifying the RSLA signal according to the speed command (S command)
Input the RSLA signal in such a way that, if the specified speed is lower than or equal to the switching speed, the low-speed characteristic is selected and, if the specified speed is higher than or equal to the switching speed, the high-speed characteristic is selected. When this signal changes from 0 to 1 in a rotation speed range that is higher than or equal to the switching speed, the low-speed characteristic is selected immediately. To avoid this symptom, set, to 1, a parameter (bit 4 of parameter No. 4019) for selecting the low-speed characteristic after the speed detection signal (SDTA) has changed to 1. This method requires that the detection level of the SDTA signal be set to the switching speed.

(3) Method of using the speed-detected signal (SDTA)
Input the speed range switching request signal according to the output of the SDTA signal. This method requires that the detection level of the SDTA signal be set to the switching speed.
Note that the SDTA signal changes in the following cases:

- If the motor speed crosses the speed detection level during constant surface speed control
  When the motor is used with the low-speed characteristic, clamping the maximum rotation speed of the spindle under constant surface speed control to the switching speed (using the G50 and G92 commands) prevents speed range switching.
- If the motor speed crosses the speed detection level when the speed is changed under spindle override
- If the motor speed crosses the speed detection level during cutting

(4) Because the motor is switched off during speed range switching, select an output characteristic, whichever is necessary, before entering any of the following control modes. Do not change the speed range switching request signal during operation.

- Rigid tapping
- Cs contouring control
- Spindle synchronous control
- Spindle positioning
- Spindle orientation (lower than or equal to the orientation speed)

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(b) Low-speed characteristic magnetic contactor status signal (RCHA)

(1) Input an open/closed status signal for the magnetic contactor (MCC) used for the low-speed characteristic of the spindle motor.
0: The low-speed characteristic magnetic contactor is open (off).
1: The low-speed characteristic magnetic contactor is closed (on).

(2) Usually, specify the status of the auxiliary contact (contact A) of the low-speed characteristic magnetic contactor without modifying it.

(3) If bit 3 of parameter No. 4014 = 0, the RCHA signal is used as a confirmation signal for the status of the power line. So, specify the selected status of the magnetic contactor for switching the output characteristic of the spindle motor.
0: The high-speed characteristic is selected.
1: The low-speed characteristic is selected.
To switch from low-speed characteristic to high-speed characteristic, after making sure that the low-speed characteristic magnetic contactor is switched off and the high-speed characteristic magnetic contactor is switched on, change this signal from 1 to 0. Similarly, to switch from high-speed characteristic to low-speed characteristic, after making sure that the high-speed characteristic magnetic contactor is switched off and the low-speed characteristic magnetic contactor is switched on, change this signal from 0 to 1.

(c) High-speed characteristic magnetic contactor status signal (RCHHGA)

(1) Input an open/closed status signal for the magnetic contactor (MCC) used for the high-speed characteristic of the spindle motor.
0: The high-speed characteristic magnetic contactor is open (off).
1: The high-speed characteristic magnetic contactor is closed (on).

(2) Usually, specify the status of the auxiliary contact (contact A) of the high-speed characteristic magnetic contactor without modifying it.

(3) The RCHHGA signal is valid if bit 3 of parameter No. 4014 = 1.

(3) Address list of output signals (CNC→PMC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F045	F045						SDTA		
2nd-	F049	F049						SDTB		
1st-	F046	F046					RCFNA	RCHPA		
2nd-	F050	F050					RCFNB	RCHPB		

(4) Details of output signals (CNC→PMC)

(a) Power line switching signal (RCHPA)

(1) The RCHPA signal is a command signal for selecting a magnetic contactor used to switch the output characteristic of the spindle motor.
0: The high-speed characteristic magnetic contactor is selected.
1: The low-speed characteristic magnetic contactor is selected.

(2) The RCHPA signal is output in response to an incoming speed range switching request signal (RSLA). Switch the magnetic contactor according to the RCHPA signal.

(3) When the speed range is switched from low speed to high speed, the RCHPA signal changes from 1 to 0 in response to an incoming speed range switching request signal (RSLA). When the speed range switching request signal is received, the motor power is automatically switched off. So, first switch off the low-speed magnetic contactor. After making sure that the low-speed magnetic contactor has been switched off, switch on the high-speed magnetic contactor.

(4) When the speed range is switched from high speed to low speed, the RCHPA signal changes from 0 to 1 in response to an incoming speed range switching request signal (RSLA). When the speed range switching request signal is received, the motor power is automatically switched off. So, first switch off the high-speed magnetic contactor. After making sure that the high-speed magnetic contactor has been switched off, switch on the low-speed magnetic contactor.

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(b) Power line switching completion signal (RCFNA)

(1) After spindle motor speed range switching is completed, indicate which speed range is selected.
0: The spindle is running with the high-speed characteristic.
1: The spindle is running with the low-speed characteristic.
(2) After making sure that the speed range switching request signal (RSLA) has changed and the RCFNA signal matches the RSLA, go to the next operation.

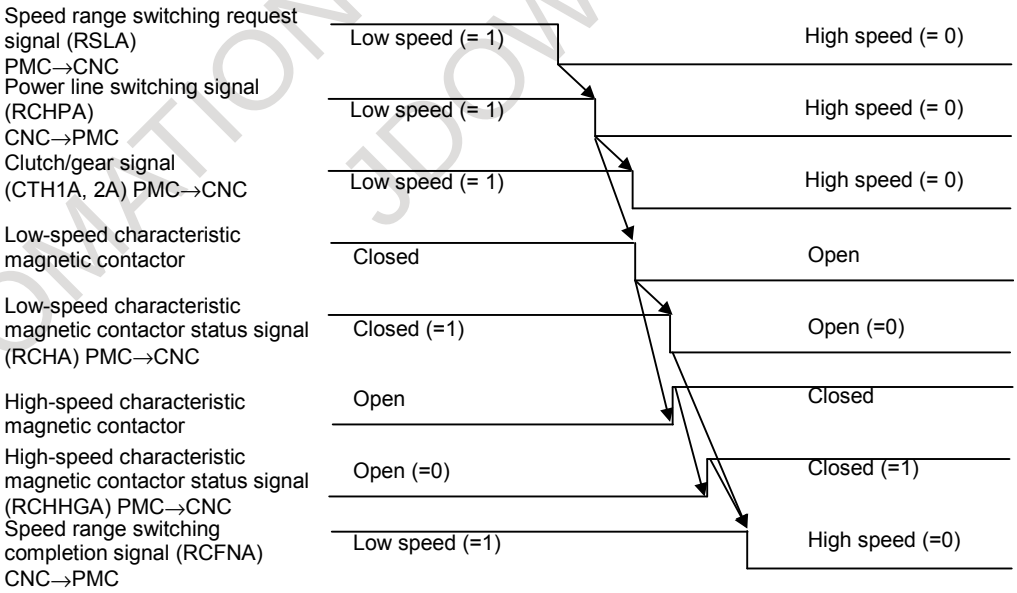
(c) Speed detection signal (SDTA)

(1) Output a signal for indicating whether the motor speed is not lower than or not higher than the speed level specified in parameter No. 4023.
0: The motor is rotating at or faster than the specified speed level.
1: The motor is rotating at or lower than the specified speed level.
(2) The SDTA signal can be used to detect the speed for speed range switching by setting the speed detection level to the switching speed.
(3) Be careful when using the SDTA signal for speed range switching, because the signal may change because of speed fluctuations when the machine runs at or near the switching speed.
(4) The SDTA signal has hysteresis. The hysteresis width is initially set to 20 min^{-1}. The setting can be changed, using parameter No. 4160. See Subsection 5.1.7, “Details of Related Parameters”, for the setting.

5.1.6 Sequence

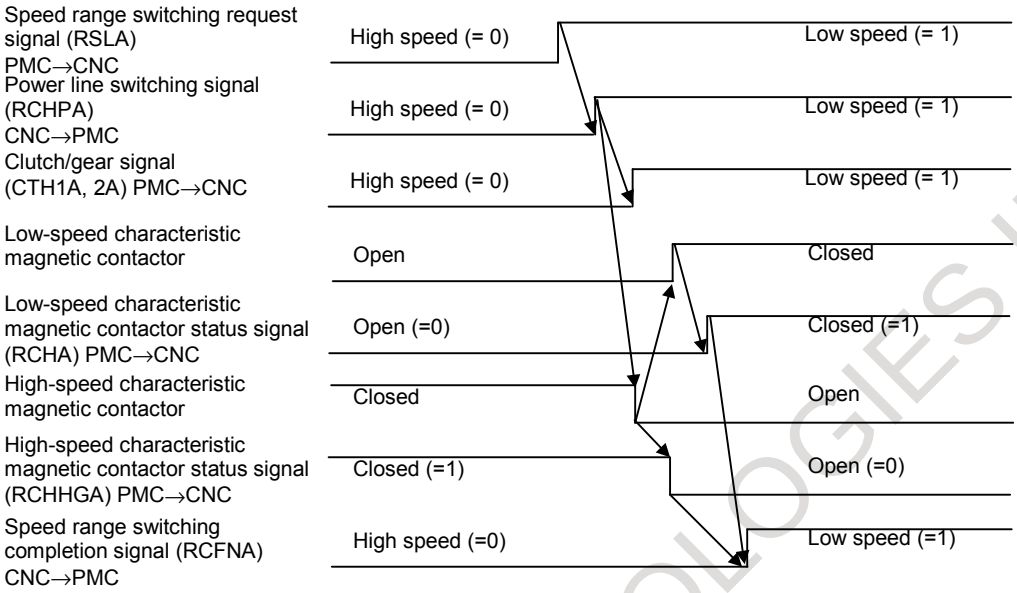
(1)Performing speed range switching by checking the status of both contacts of the low-speed characteristic magnetic contactor status signal (RCHA) and high-speed characteristic magnetic contactor status signal (RCHHGA) (bit 3 of parameter No. 4014 = 1)

(a) Switching from low-speed characteristic to high-speed characteristic



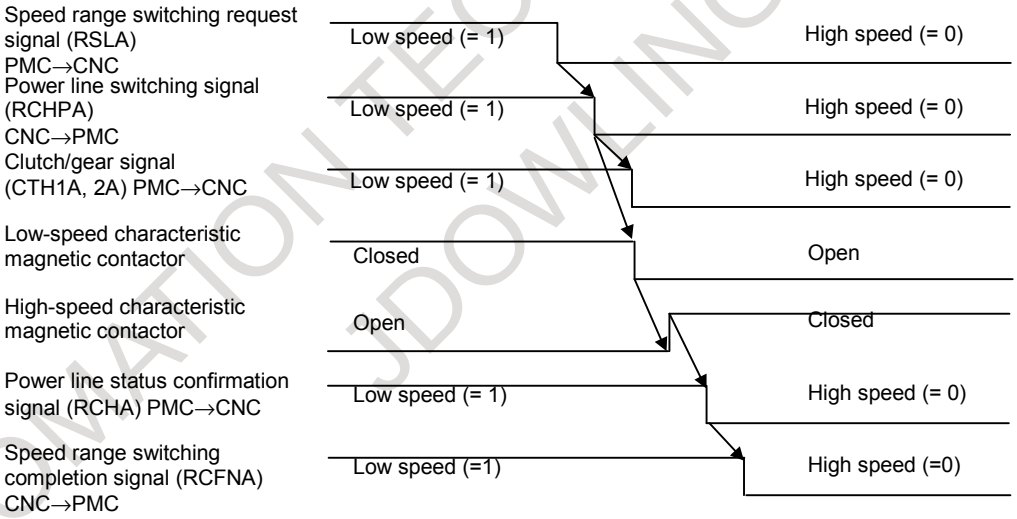
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(b) Switching from high-speed characteristic to low-speed characteristic



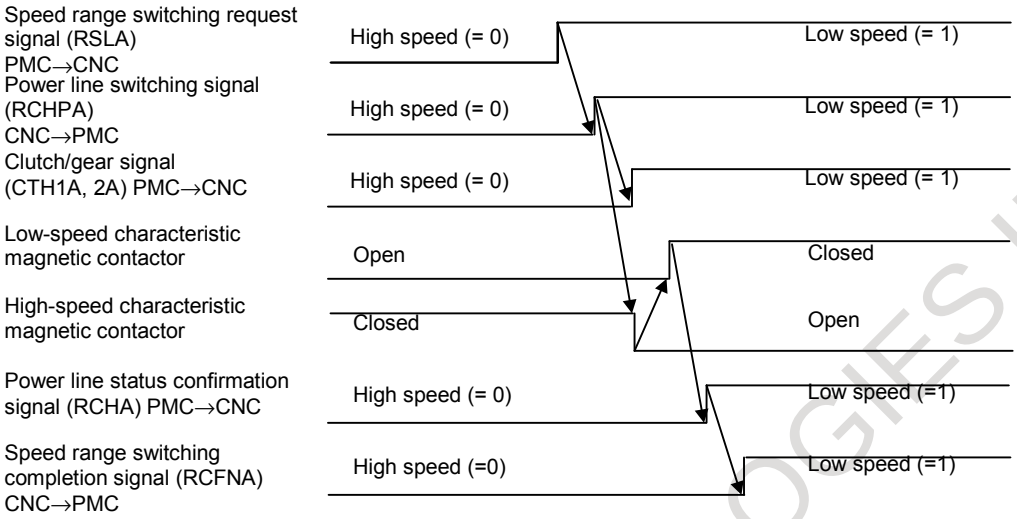
(2) Performing speed range switching by checking only the power line status confirmation signal (RCHA) (bit 3 of parameter No. 4014 = 0)

(a) Switching from low-speed characteristic to high-speed characteristic



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(b) Switching from high-speed characteristic to low-speed characteristic



NOTE
1 A parameter can specify that switching from high-speed output characteristic to low-speed output characteristic be not performed at a speed higher than or equal to the switching speed (speed detection signal SDTA = 0) even if a switching request is issued.
2 Switch the clutch/gear signals (CTH1A and CTH2A) in such a way that the velocity loop gain can be specified for low- and high-speed characteristics separately.
3 Spindle alarm 15 is issued unless the magnetic contactor status signal is input within one second after the power line switching signal is output. So, input the magnetic contactor status signal within one second after the power line switching signal is output.
4 If you want to check the selection status of magnetic contactors MCC1 and MCC2 only with the auxiliary contact of magnetic contactor MCC1, allow a delay time of at least 50 ms between the instant when switching between MCC1 and MCC2 is performed with the power line switching signal (RCHPA) and the instant when the power line status confirmation signal (RCHA) changes, because a delay occurs in the operation of the magnetic contactors.

5.1.7 List of Related Parameters

Parameter No.		Description
0*i*	30*i*	
4015 #2	4015 #2	Whether the speed range switching control function is available (The CNC software option is required.)
4014 #3	4014 #3	Function of checking the both magnetic contactor contacts for high-/low-speed characteristics in speed range switching
4019 #4	4019 #4	Function of checking the speed detection signal when switching is performed from high-speed characteristic to low-speed characteristic
4023	4023	Speed detecting level
4160	4160	Speed detection level hysteresis

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5.1.8 Details of Related Parameters

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4015	4015						SPDSW		

SPDSW Presence of speed range switching function (To use this function, the CNC software option is required.)
0 : Without speed range switching function
1 : With speed range switching function

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4014	4014					CHGSLT			

CHGSLT Function of checking the both magnetic contactor contacts for high-/low-speed characteristics in speed range switching
0: A check is made, using the power line status confirmation signal (RCH).
1: The contacts of both high- and low-speed characteristic magnetic contactors are checked.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4019	4019				SDTCHG				

SDTCHG Specifies whether to switch from high-speed range to low-speed range, upon the speed detection signal (SDT) being set to "1", when speed range switching is used.
0 : Switches from the high-speed to low-speed range regardless of the speed detection signal (SDT).
1 : Switches from the high-speed to low-speed range after the SDT signal has changed to "1".
If this data is "0", switching from high-speed characteristic to low-speed characteristic occurs no matter what the status of the speed detection signal (SDT) is.
If this data is "1", switching from high-speed characteristic to low-speed characteristic does not occur when the speed detected signal (SDT) is "0". The switching occurs only after the SDT signal has changed to "1".
To make switching to low-speed characteristic occur securely at or near the switching speed, set the speed detection level (parameter No. 4023) to a level slightly higher than the switching speed level.

0*i*	30*i*	
4023	4023	Speed detecting level

Unit of data : 0.1%
Valid data range : 0 to 1000
Initial setting : 0
This data is used to set the detecting level of speed detecting signal (SDT).
When the motor speed reaches (setting data/10) % or less of maximum speed, the speed arrival signal (SDT) is set to "1".

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0*i*	30*i*	
4160	4160	**Speed detection level hysteresis**

Unit of data : 1min^{-1} (When parameter No. 4006 #2 (SPDUNT)=1, 10 min^{-1})
Valid data range : 0 to 32767
Initial setting : 0

Specify the hysteresis of the detection level of the speed detection signal (SDT).
The speed detection signal (SDT) changes from 1 to 0 with the set speed detection level + hysteresis motor speed, and changes from 0 to 1 with the set speed detection level motor speed. If this data is set to 20 min^{-1} or less, the hysteresis is automatically set to 20 min^{-1}.
If the speed detection signal (SDT) is used in speed range switching control, increase the data setting in situations where the switching circuit is likely to cause chattering close to the motor speed for the speed detection level.
Set the hysteresis width to a speed change measured during switching with a margin (about twice the measured speed change).
A rough estimate of the hysteresis width can be obtained from the following expression (on the assumption that the motor load torque at switching is 20% of the maximum output torque):

$$\text{Hysteresis width}[\text{min}^{-1}] = \frac{\text{Speed range switching time}}{\text{Acceleration time until the maximum rotation speed is reached}} \times \text{Maximum rotation speed} \times 0.2$$

5.1.9 Parameter-specified Switching between High- and Low-speed Characteristics

(1) Clutch/gear signals (CTH1A and CTH2A)
In speed range switching control, clutch/gear signals (CTH1A and CTH2A) are input to switch high- and low-speed velocity loop gain, position gain, and gear ratio data.
Usually, the clutch/gear signals are intended to select spindle parameters (velocity loop gain, position gain, and gear ratio) that correspond to the selected clutch/gears.
In speed range switching control, switching must be done in conjunction with winding selection.

CTH1A	CTH2A	Selection status of clutch/gears	Selection status of winding
0	0	HIGH GEAR (HIGH)	High-speed output characteristic winding
0	1	MEDIUM HIGH GEAR (HIGH)	-
1	0	MEDIUM LOW GEAR (LOW)	-
1	1	LOW GEAR (LOW)	Low-speed output characteristic winding

(2) Relationships between the clutch/gear signals and spindle parameters
(a) When the high-speed output characteristic winding is selected (CTH1A = 0 and CTH2A = 0)

0*i*	30*i*	
4040	4040	**Velocity loop proportional gain on the velocity control mode (HIGH)**
4042	4042	**Velocity loop proportional gain on orientation (HIGH)**
4044	4044	**Velocity loop proportional gain on servo mode (HIGH)**
4046	4046	**Velocity loop proportional gain on Cs contouring control (HIGH)**
4048	4048	**Velocity loop integral gain on the velocity control mode (HIGH)**
4050	4050	**Velocity loop integral gain on orientation (HIGH)**
4052	4052	**Velocity loop integral gain on servo mode (HIGH)**

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0*i*	30*i*	
4054	4054	**Velocity loop integral gain on Cs contouring control (HIGH)**
4060	4060	**Position gain on orientation (HIGH)**
4065	4065	**Position gain on servo mode (HIGH)**
4069	4069	**Position gain on Cs contouring control (HIGH)**

(b) When the low-speed output characteristic winding is selected (CTH1A = 1 and CTH2A = 1)

0*i*	30*i*	
4041	4041	**Velocity loop proportional gain on the velocity control mode (LOW)**
4043	4043	**Velocity loop proportional gain on orientation (LOW)**
4045	4045	**Velocity loop proportional gain on servo mode (LOW)**
4047	4047	**Velocity loop proportional gain on Cs contouring control (LOW)**
4049	4049	**Velocity loop integral gain on the velocity control mode (LOW)**
4051	4051	**Velocity loop integral gain on orientation (LOW)**
4053	4053	**Velocity loop integral gain on servo mode (LOW)**
4055	4055	**Velocity loop integral gain on Cs contouring control (LOW)**
4063	4063	**Position gain on spindle orientation (LOW)**
4068	4068	**Position gain on servo mode (LOW)**
4072	4072	**Position gain on Cs contouring control (LOW)**

5.2 SPINDLE SWITCHING CONTROL

5.2.1 Overview

Spindle switching control is a function that drives two spindle motors with a single spindle amplifier, one at a time by switching them. The function is suitable for a machine in which two spindle motors are not driven simultaneously.

NOTE
1 This function cannot be used with sensorless motor.

5.2.2 Series and Editions of Applicable Spindle Software

Spindle software

Series	Edition	Usable CNC
9D50	E (05)	FS0*i* -D
9D70	A (01)	FS30*i* / FS31*i* / FS32*i* -A
9D80	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9D90	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	A (01)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B
9DB0	A (01)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

NOTE
When the α*i*CZ sensor (serial) is used, this function cannot be used.

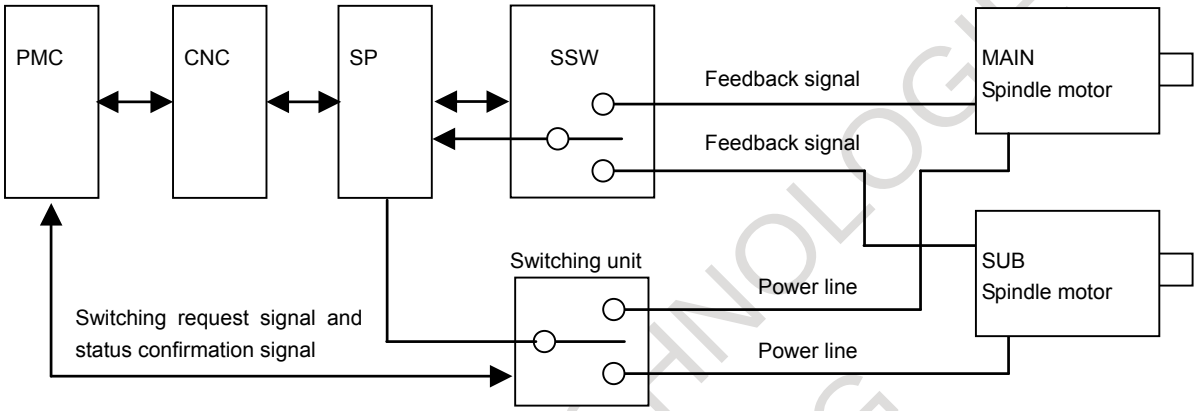
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5.2.3 Configuration

Shown below is a machine configuration for using spindle switching control.
The following items are required for spindle switching control in addition to a spindle amplifier (SP) and two spindle motors:

- Sub module SW (SSW)
- Switching unit (a magnetic contactor and a relay for driving it are included)
- Signals between the PMC and switching unit

Refer to "FANUC SERVO AMPLIFIER αi series Descriptions" for the specification of the submodule SW (hereafter SSW), switching unit, and detailed descriptions about their connection.



5.2.4 Details of Specifications

(1) The spindle amplifier and SSW are used to select one of two spindle motors and drive the selected spindle motor. They cannot be used to drive two spindle motors simultaneously or switch between a motor with a 200 V input and a motor with a 400 V input (HV). Nor can they be used to drive the spindle motor (speed sensor-less motor) of the βiIc or αCi series.

(2) Any spindle motors that can be driven with the spindle amplifier can be combined as a main spindle or sub-spindle.
The capacity of the spindle amplifier used for two spindle motors must be large enough for the larger of the two. The required parameters may have to be re-set depending on the combination of the motors and amplifier.

(3) The SSW switches the feedback signal according to the switching command from the spindle amplifier. The detectors that can be used are as follows:
Detectors incorporated in the motor (speed detectors): αiM sensor, αiMZ sensor, αiBZ sensor (for built-in motors), and αiCZ sensor (analog) (for built-in motors)
Detectors mounted on the spindle (position detectors): Position coder, αiBZ sensor (when SP TYPE B is used), αiCZ sensor (analog) (when SP TYPE B is used), and proximity switch

(4) Speed range switch control can be used for both the main spindle and sub-spindle.

(5) Rigid tapping can be used for both the main spindle and sub-spindle.

(6) Position coder-based spindle orientation can be used for both the main spindle and sub-spindle as long as it uses a method of specifying a stop position with a parameter.

(7) The status information about the magnetic contactors of both the main spindle and sub-spindle can be input so that the status of the power line can be checked securely. This function is enabled by setting the following parameters.
Bit 2 of parameter No. 4014 = 1

(8) A switching error is detected and spindle alarm 15 is issued unless the magnetic contactor status signal (MCFNA or MFNHGA) is not input within one second after the power line switching signal (CHPA) is output.

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5.2.5 Restrictions

(1) Spindle synchronous control can be used only for the main spindle.
(2) Spindle positioning can be used only for the main spindle.
(3) Cs contouring control can be used only for the main spindle.
(4) For the sub-spindle motor, up to two gear switching stages can be specified using a parameter.
(5) The dual position feedback function can be used on the main side only.

5.2.6 I/O Signals (CNC↔PMC)

(1) Address list of input signals (PMC→CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G071	G071					MCFNA	SPSLA		
2nd-	G075	G075					MCFNB	SPSLB		
1st-	G072	G072		MFNHGA						
2nd-	G076	G076		MFNHGB						

(2) Details of input signals (PMC→CNC)

(a) Spindle switching request signal (SPSLA)

(1) The SPSLA signal is used as a command signal to select a spindle motor.
0: The main spindle motor is selected.
1: The sub-spindle motor is selected.
(2) After stopping the spindle motors, change the SPSLA signal.
The zero-speed signal (SSTA) can be used as an output signal to check that the spindle motors are at a halt.
(3) Reset the rotation commands (SFRA and SRVA) and spindle orientation command (ORCMA) to 0, because switching requires that the motor power be off.

(b) Sub-spindle motor magnetic contactor status signal (MCFNA)

(1) Input the open/closed status of the sub-spindle motor magnetic contactor (MCC).
0: The sub-spindle motor magnetic contactor is open (off).
1: The sub-spindle motor magnetic contactor is closed (on).
(2) Usually, specify the status of the auxiliary contact (contact A) of the sub-spindle motor magnetic contactor without modifying it.
(3) If bit 2 of parameter No. 4014 = 0, the MCFNA signal is used as a confirmation signal for the status of the power line. So, specify the selection status of the magnetic contactor for switching the power line of the spindle motor.
0: The main spindle motor is selected.
1: The sub-spindle motor is selected.
To switch from the sub-motor to the main motor, after making sure that the sub-motor magnetic contactor is switched off and the main motor magnetic contactor is switched on, change this signal from 1 to 0. Similarly, to switch from the main motor to the sub-motor, after making sure that the main motor magnetic contactor is switched off and the sub-motor magnetic contactor is switched on, change this signal from 0 to 1.

(c) Main spindle motor magnetic contactor status signal (MFNHGA)

(1) Input the open/closed status of the main spindle motor magnetic contactor (MCC).
0: The main spindle motor magnetic contactor is open (off).
1: The main spindle motor magnetic contactor is closed (on).
(2) Usually, specify the status of the auxiliary contact (contact A) of the main spindle motor magnetic contactor without modifying it.
(3) The MFNHGA signal is valid if bit 2 of parameter No. 4014 = 1.

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(3) Address list of output signals (CNC→PMC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F045	F045							SSTA	
2nd-	F049	F049							SSTB	
1st-	F046	F046							CFINA	CHPA
2nd-	F050	F050							CFINB	CHPB

(4) Details of output signals (CNC→PMC)

(a) Power line switching signal (CHPA)

(1) The CHPA signal is a command signal for selecting a magnetic contactor used to switch the power line of the spindle motor.
0: The main spindle motor magnetic contactor is selected.
1: The sub-spindle motor magnetic contactor is selected.

(2) When the spindle switching request signal (SPSLA) is input, a check is made to see if the motors are at a stop and their power is off. Once it has been confirmed that the motors are at a stop and their power is off, the CHPA signal is output. Switch the magnetic contactor according to the CHPA signal.

(3) When switching from the sub-motor to the main motor occurs, the CHPA signal changes from 1 to 0 in response to an incoming spindle switching request signal (SPSLA) provided that the sub-motor is at a stop and its power is off. After this signal change has occurred, first switch off the sub-motor magnetic contactor. After making sure that the sub-motor magnetic contactor has been switched off, switch on the main motor magnetic contactor.

(4) When switching from the main motor to the sub-motor occurs, the CHPA signal changes from 0 to 1 in response to an incoming spindle switching request signal (SPSLA) provided that the main motor is at a stop and its power is off. After this signal change has occurred, first switch off the main motor magnetic contactor. After making sure that the main motor magnetic contactor has been switched off, switch on the sub-motor magnetic contactor.

(b) Spindle switching completion signal (CFINA)

(1) After spindle switching is completed, it is indicated which spindle motor is currently under control.
0: The main spindle motor is currently under control.
1: The sub-spindle motor is currently under control.

(2) After making sure that the spindle switching request signal (SPSLA) has changed and the CFINA signal matches the SPSLA, go to the next operation.

(3) Keep the rotation commands (SFRA and SRVA) and spindle orientation command (ORCMA) turned off during switching, because switching requires that the motor power be off.

(c) Zero-speed signal (SSTA)

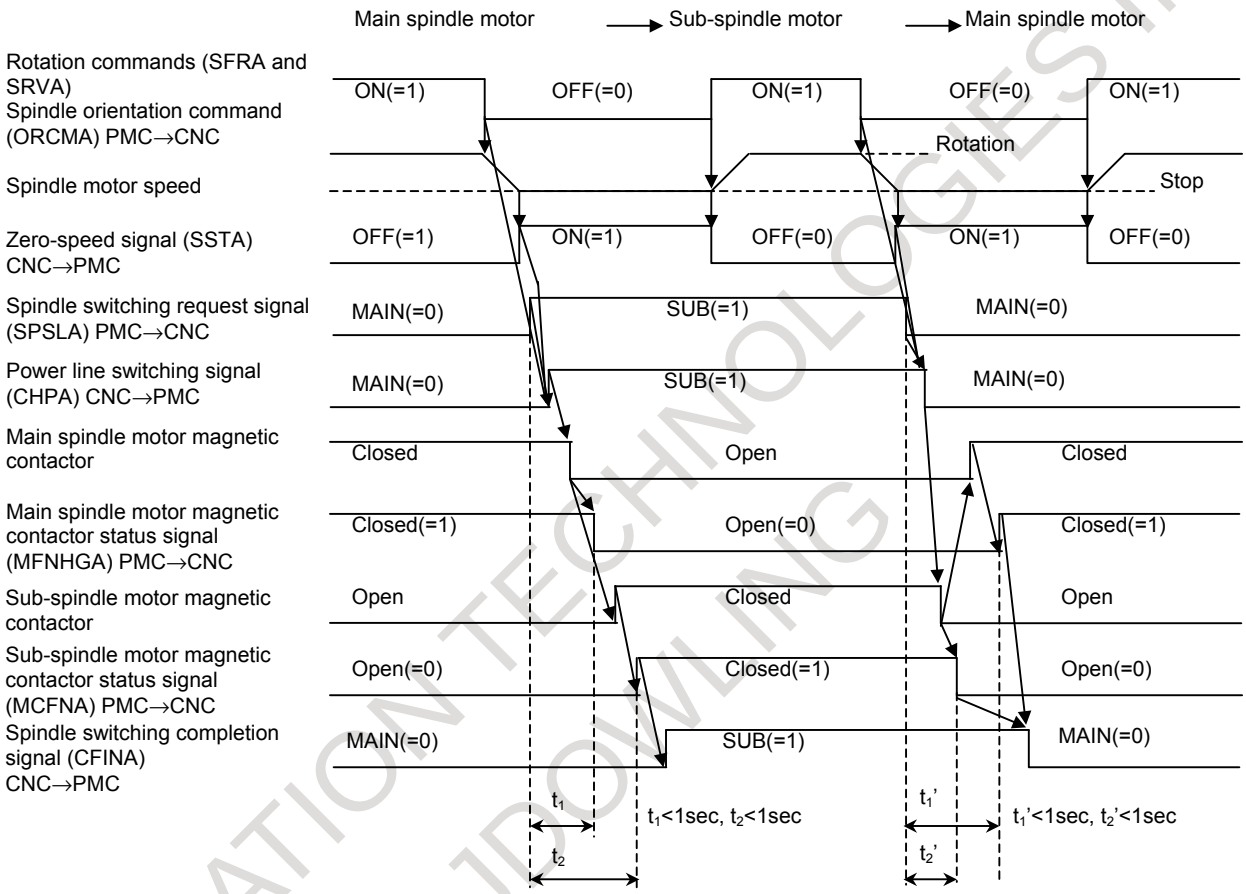
(1) It is indicated whether the spindle motor speed is not lower or not higher than the zero-speed detection level (parameter-specified speed level).
0: The motor is rotating at or faster than the speed detection level.
1: The motor is rotating at or slower than the speed detection level.

(2) The motor must be at a halt during spindle switching. Use the SSTA signal to check that that the motor is at a halt.

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5.2.7 Sequence

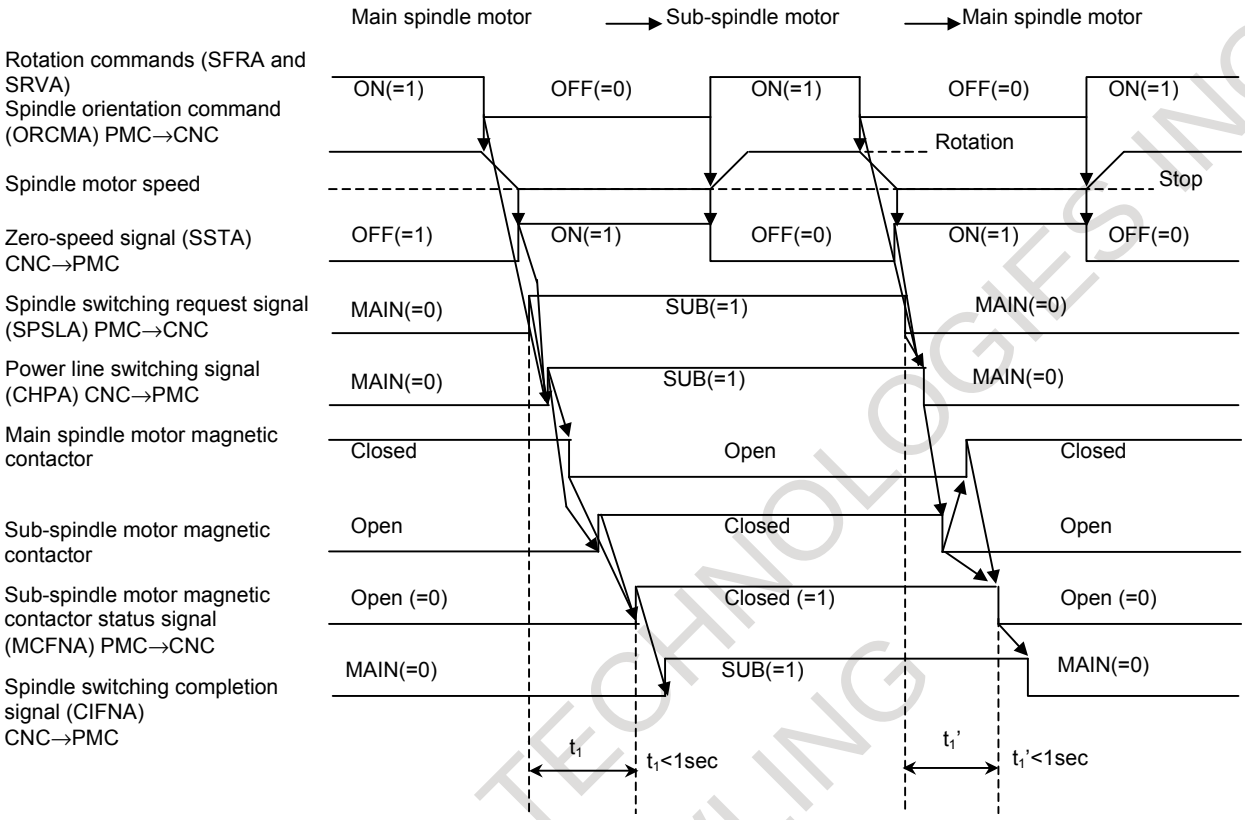
(1)Performing spindle switching by checking the status of both contacts of the sub-spindle motor magnetic contactor status signal (MCFNA) and main spindle motor magnetic contactor status signal (MFNHGA) (bit 2 of parameter No. 4014 = 1)



NOTE
Spindle alarm 15 is issued unless the main spindle motor status signal (MFNHGA) and sub-spindle motor status signal (MCFNA) change within one second after the switching request signal (SPSLA) signal has changed.

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(2) Performing spindle switching by checking only with the power line status signal (MCFNA) (bit 2 of parameter No. 4014 = 0)



NOTE
1 When checking the selection status of magnetic contactors MCC1 and MCC2 only with the auxiliary contact of magnetic contactor MCC1, allow a delay time of at least 50 ms between the instant when switching between MCC1 and MCC2 is performed with the power line switching signal (CHPA) and the instant when the power line status confirmation signal (MCFN) changes, because a delay occurs in the operation of the magnetic contactors.
2 Spindle alarm 15 is issued unless the power line magnetic contactor status signal (MCFNA) changes within one second after the switching request signal (SPSLA) has changed.

5.2.8 List of Related Parameters

Parameter No.		Description
0*i*	30*i*	
4019#7	4019#7	Parameter automatic setting function (MAIN)
4133	4133	Motor model code (MAIN)
4195#7	4195#7	Parameter automatic setting function (SUB)
4309	4309	Motor model code (SUB)
4014#0	4014#0	Whether the spindle switching function is available (to be set to “1”)
4014#2	4014#2	Function of checking the both magnetic contactor contacts for main spindle and sub-spindle motors in spindle switching
4013 #6 to #2	4013 #6 to#2	Current dead-band data (MAIN)
4024	4024	Speed zero detecting level (MAIN)

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Parameter No.		Description
0*i*	30*i*	
4110	4110	Current conversion constant (MAIN/high-speed characteristic)
4146	4146	Current conversion constant (MAIN/low-speed characteristic)
4189 #6 to #2	4189 #6 to #2	Current dead-band data (SUB)
4199	4199	Zero-speed detection level (SUB)
4264	4264	Current conversion constant (SUB/high-speed characteristic)
4294	4294	Current conversion constant (SUB/low-speed characteristic)

5.2.9 Details of Related Parameters

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4014	4014						AXSLCT		AXISSL

AXISSL Whether the spindle switching control function is available
0: No spindle switching function is available.
1: The spindle switching function is available (to be set to "1").

AXSLCT Function of checking the contents of both the main spindle and sub-spindle motor magnetic contactor contacts in spindle switching
0: The check is based on the power line status signal (MCFN)
1: The check is made on the contacts (MCFN and MFNHG) of both the main and sub-spindle motor magnetic contactors.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
MAIN: 4013	4013		DS5	DS4	DS3	DS2	DS1		
SUB: 4189	4189		DS5	DS4	DS3	DS2	DS1		

DS5 to DS1 Current dead-band data
This parameter is determined according to the spindle amplifier model to be used.
In spindle switching control, the amplifier model to be used may differ from the amplifier that supports the motor. In this case, change the parameter setting according to the amplifier to be used, while referencing the following table.

■α*i*SP(A06B-6111(6112,6121,6122)-Hxxx#H550(H553,H570))

Amplifier model		Parameter setting				
200V-input	400V-input	DS5	DS4	DS3	DS2	DS1
α*i*SP2.2 to 15	α*i*SP5.5HV to 15HV	0	0	0	1	1
α*i*SP22 to 37	α*i*SP30HV to 45HV	1	0	1	0	0
α*i*SP45 to 55	α*i*SP75HV to 100HV	0	0	1	1	0

■α*i*SP(A06B-6141(6142,6151,6152)-Hxxx#H580, A06B-6144(6154)-Hxxx#H590)
α*i*SP-B/α*i*SVP-B (A06B-62xx-Hxxx#H600, A06B-62xx-Hxxx#H610)
β*i*SVSP-B (A06B-6320(6321, 6330, 6331)-Hxxx)

Amplifier model		Parameter setting				
200V-input	400V-input	DS5	DS4	DS3	DS2	DS1
All models common	All models common	0	0	0	1	1

NOTE
Be careful when no correct data is specified, because it is likely that switching elements in the power circuit may break down.

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0*i*	30*i*	
4024	4024	**Speed zero detecting level (MAIN side)**
4199	4199	**Speed zero detecting level (SUB side)**

Unit of data : 0.01%
Valid data range : 0 to 10000
Initial setting : 75

This data is used to set the detecting level of speed zero detection signal (SSTA).
When the motor speed reaches (setting data/100)% or less of maximum speed, the speed zero detection signal (SSTA) is set to "1".

0*i*	30*i*	
4110	4110	**Current conversion constant (MAIN side, high-speed characteristic)**
4146	4146	**Current conversion constant (MAIN side, low-speed characteristic)**
4264	4264	**Current conversion constant (SUB side, high-speed characteristic)**
4294	4294	**Current conversion constant (SUB side, low-speed characteristic)**

Unit of data :
Valid data range : 0 to 32767
Initial setting : This parameter is intended to specify a current detection weight that varies depending on the motor model to be used.
If a motor and a spindle amplifier are in a combination that is not originally intended, it is necessary to change the setting according to the spindle amplifier to be used. Use the following conversion formula to determine a value to be specified in the parameter.

$$ICONV2 = ICONV1 \times \frac{G1}{G2}$$

ICONV1 : Current conversion constant before change
ICONV2 : Current conversion constant after change
G1 : Current detection gain for the spindle amplifier initially intended for the motor
G2 : Current detection gain for the spindle amplifier to be used in spindle switching

The current detection gains (G1 and G2) vary from one amplifier model to another. The following table lists the current detection gains that correspond to each amplifier model.

Amplifier model		**Current detection gain**
200V-input	**400V-input**	**(G1,G2)**
α*i*SP2.2, 5.5	α*i*SP5.5HV, 11HV	60
α*i*SP11	α*i*SP15HV	30
α*i*SP15	α*i*SP30HV	20
α*i*SP22	α*i*SP45HV	15
α*i*SP26	α*i*SP60HV	10
α*i*SP30, 37	α*i*SP75HV	7.5
α*i*SP45	α*i*SP100HV	6.67
α*i*SP55	-	4.29
	β*i*SVSP-11HV-B	60
β*i*SVSP-7.5-B	-	37.5
β*i*SVSP-11-B	β*i*SVSP-15HV-B β*i*SVSP-18HV-B	30
β*i*SVSP-15-B	-	20
β*i*SVSP-18-B	-	15

NOTE
If no correct data is specified, the motor fails to deliver the rated power, and it is likely that switching elements in the power circuit may break down.

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5.2.10 Parameter Setting Procedure

(1) Motor-specific parameter setting

<1> Motor model code setting

Specify the model code of a motor to be subjected to automatic setting. If the motor has no model code, specify "300" (for a motor with no speed range switching function) or "400" (for a motor with a speed range switching function).

CNC	Parameter No.		Setting value
	MAIN side	SUB side	
0*i*	No.4133	No.4309	Model code
30*i*	No.4133	No.4309	

<2> Parameter automatic setting

After the following parameters are specified, switch the CNC power off and on again. The spindle parameter specified with a model code is automatically set up. Once automatic setting is completed, the following parameters are re-set to their previous values.

CNC	Parameter No.		Setting value
	MAIN side	SUB side	
0*i*	No.4019#7	No.4195#7	1
30*i*	No.4019#7	No.4195#7	1

<3> Motor-specific parameter setting (for motors with no model code)

If the motor has no model code, once automatic setting is completed, specify motor-specific parameters by entering values manually according to the parameter tables for individual motor models.

NOTE
Set the parameters for the sub-spindle according to the list of the motor-specific parameter numbers in Subsection 5.2.11, "Supplementary Descriptions about Parameters," in Part I.

(2) Parameter re-setting for spindle switching

If the motor and spindle amplifier are not in a standard combination, change the current dead-band data and current conversion constant as described in the previous item.

(3) Parameter setting related to detectors

Specify parameters related to detectors according to the system configuration of the spindle.
See Section 1.3 for explanations about how to specify parameters related to detectors.

5.2.11 Supplementary Descriptions about Parameters

(1) The spindle amplifier drives the motor using the relevant parameters according to the selected spindle (main spindle or sub-spindle for spindle switching).
For the parameter numbers for the main spindle and sub-spindle, see Appendix B, "LIST OF SPINDLE PARAMETER NUMBERS."

(2) The following table lists the motor-specific parameter numbers for the main spindle and those for the sub-spindle.
Set a motor-specific parameter for the sub-spindle according to the table below.

Parameter No.				Description
0*i*		30*i*		
MAIN	SUB	MAIN	SUB	
4007	4183	4007	4183	Bit type parameter
4008	4184	4008	4184	Bit type parameter
4009	4185	4009	4185	Bit type parameter
4010	4186	4010	4186	Bit type parameter

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Parameter No.				Description
0*i*		30*i*		
MAIN	SUB	MAIN	SUB	
4011	4187	4011	4187	Bit type parameter
4012	4188	4012	4188	Bit type parameter
4013	4189	4013	4189	Bit type parameter
4019	4195	4019	4195	Bit type parameter
4020	4196	4020	4196	Maximum motor speed
4023	4198	4023	4198	Speed detection level
4039	4254	4039	4254	Slip compensation gain [for high-speed characteristics of speed range switching]
4080	4231	4080	4231	Regenerative power limit for high-speed zone/regenerative power limit [for high-speed characteristics of speed range switching]
4083	4236	4083	4236	Motor voltage on velocity control mode [for high-speed characteristics of speed range switching]
4093	4279	4093	4279	Value displayed on load meter at maximum output [for low-speed characteristics of speed range switching]
4100	4256	4100	4256	Base speed of motor output specifications [for high-speed characteristics of speed range switching]
4101	4257	4101	4257	Output limit for motor output specifications [for high-speed characteristics of speed range switching]
4102	4258	4102	4258	Excitation voltage saturation speed at no-load [for high-speed characteristics of speed range switching]
4103	4259	4103	4259	Base speed limit ratio [for high-speed characteristics of speed range switching]
4104	4260	4104	4260	Current loop proportional gain [for high-speed characteristics of speed range switching]
4106	4261	4106	4261	Current loop integral gain [for high-speed characteristics of speed range switching]
4108	4262	4108	4262	Velocity at which the current loop integral gain is zero [for high-speed characteristics of speed range switching]
4109	4263	4109	4263	Filter time constant for processing saturation related to the voltage command [for high-speed characteristics of speed range switching]
4110	4264	4110	4264	Current conversion constant [for high-speed characteristics of speed range switching]
4111	4265	4111	4265	Secondary current coefficient [for high-speed characteristics of speed range switching]
4112	4266	4112	4266	Criterion level for saturation related to the voltage command/PWM command clamp value [for high-speed characteristics of speed range switching]
4113	4267	4113	4267	Slip constant [for high-speed characteristics of speed range switching]
4114	4268	4114	4268	Slip compensation coefficient for a high-speed zone/slip compensation coefficient at deceleration [for high-speed characteristics of speed range switching]
4115	4269	4115	4269	PWM command clamp value at deceleration [for high-speed characteristics of speed range switching]
4116	4270	4116	4270	Motor leakage constant [for high-speed characteristics of speed range switching]
4117	4271	4117	4271	Regular-time voltage compensation coefficient for high-speed zone/regular-time motor voltage coefficient [for high-speed characteristics of speed range switching]
4118	4272	4118	4272	Acceleration-time voltage compensation coefficient for high-speed zone/acceleration-time motor voltage coefficient [for high-speed characteristics of speed range switching]

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Parameter No.				Description
0*i*		30*i*		
MAIN	SUB	MAIN	SUB	
4119	4280	4119	4280	Deceleration-time excitation current change time constant/excitation current change time constant [for high-speed characteristics of speed range switching]
4127	4274	4127	4274	Value displayed on load meter at maximum output [for high-speed characteristics of speed range switching]
4128	4275	4128	4275	Compensation coefficient between the specification and true base/maximum torque curve compensation coefficient [for high-speed characteristics of speed range switching]
4129	4276	4129	4276	Secondary current coefficient for rigid tapping [for high-speed characteristics of speed range switching]
4130	4277	4130	4277	Current loop proportional gain speed coefficient/current phase delay compensation coefficient [for high-speed characteristics of speed range switching]
4134	4310	4134	4310	Motor overheat detect level
4136	4284	4136	4284	Motor voltage on velocity control mode [for low-speed characteristics of speed range switching]
4138	4286	4138	4286	Base speed of motor output specifications [for low-speed characteristics of speed range switching]
4139	4287	4139	4287	Output limit for motor output specifications [for low-speed characteristics of speed range switching]
4140	4288	4140	4288	Excitation voltage saturation speed at no-load [for low-speed characteristics of speed range switching]
4141	4289	4141	4289	Base speed limit ratio [for low-speed characteristics of speed range switching]
4142	4290	4142	4290	Current loop proportional gain [for low-speed characteristics of speed range switching]
4143	4291	4143	4291	Current loop integral gain [for low-speed characteristics of speed range switching]
4144	4292	4144	4292	Velocity at which the current loop integral gain is zero [for low-speed characteristics of speed range switching]
4145	4293	4145	4293	Filter time constant for processing saturation related to the voltage command [for low-speed characteristics of speed range switching]
4146	4294	4146	4294	Current conversion constant [for low-speed characteristics of speed range switching]
4147	4295	4147	4295	Secondary current coefficient [for low-speed characteristics of speed range switching]
4148	4296	4148	4296	Criterion level for saturation related to the voltage command/PWM command clamp value [for low-speed characteristics of speed range switching]
4149	4297	4149	4297	Slip constant [for low-speed characteristics of speed range switching]
4150	4298	4150	4298	Slip compensation coefficient for a high-speed zone/slip compensation coefficient at deceleration [for low-speed characteristics of speed range switching]
4151	4299	4151	4299	PWM command clamp value at deceleration [for low-speed characteristics of speed range switching]
4152	4300	4152	4300	Motor leakage constant [for low-speed characteristics of speed range switching]
4153	4301	4153	4301	Regular-time voltage compensation coefficient for high-speed zone/regular-time motor voltage coefficient [for low-speed characteristics of speed range switching]
4154	4302	4154	4302	Acceleration-time voltage compensation coefficient for high-speed zone/acceleration-time motor voltage coefficient [for low-speed characteristics of speed range switching]

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Parameter No.				Description
0*i*		30*i*		
MAIN	SUB	MAIN	SUB	
4156	4255	4156	4255	Slip compensation gain [for low-speed characteristics of speed range switching]
4158	4304	4158	4304	Compensation coefficient between the specification and true base/maximum torque curve compensation coefficient [for low-speed characteristics of speed range switching]
4159	4305	4159	4305	Secondary current coefficient for rigid tapping [for low-speed characteristics of speed range switching]
4161	4306	4161	4306	Current loop proportional gain speed coefficient/current phase delay compensation coefficient [for low-speed characteristics of speed range switching]
4165	4308	4165	4308	Deceleration-time excitation current change time constant/excitation current change time constant [for low-speed characteristics of speed range switching]
4166	4307	4166	4307	Regenerative power limit for high-speed zone/regenerative power limit [for low-speed characteristics of speed range switching]
4169	4349	4169	4349	Temperature monitoring time constant

(3) The following parameters are common to the main and sub-spindle motors. They cannot be specified separately for these motors.

Parameter No.		Description
0*i*	30*i*	
4027	4027	Load detecting level 2
4030	4030	Soft start/stop setting time
4087	4087	Overspeed level
4088	4088	Velocity error excess detecting level on motor shaft lock condition
4089	4089	Velocity error excess detecting level on motor rotation
4090	4090	Overload detecting level
4095	4095	Adjustment of speedometer output voltage
4096	4096	The adjustment of load meter output voltage
4098	4098	Maximum speed of position feedback signal detection
4099	4099	Delay time for motor excitation
4123	4123	Setting the overload detection time
4160	4160	Speed detection level hysteresis
4341	4341	Unexpected disturbance torque detection level
4344	4344	Advanced feed-forward coefficient
4346	4346	Incomplete integration coefficient

(4) For the sub-spindle motor, up to two gear switching stages can be specified. The input signal CTH1A is used to select one of the gear stages. (For the main spindle motor, up to four gear switching stages can be specified, using CTH1A and CTH2A.)

Parameter No.		Description	CTH1A
0*i*	30*i*		
4216	4216	Gear ratio(SUB side/HIGH)	0
4217	4217	Gear ratio(SUB side /LOW)	1
4218	4218	Position gain on orientation(SUB side/HIGH)	0
4219	4219	Position gain on orientation(SUB side/LOW)	1
4221	4221	Position gain on servo mode(SUB side/HIGH)	0
4222	4222	Position gain on servo mode(SUB side/LOW)	1

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(5) For the sub-spindle motor, only one velocity integral gain stage can be specified. The CTH1A signal cannot be used for switching.

Parameter No.		Description
0*i*	30*i*	
4212	4212	Velocity loop integral gain on the velocity control mode (SUB side)
4213	4213	Velocity loop integral gain on orientation (SUB side)
4214	4214	Velocity loop integral gain on servo mode (SUB side)

5.3 INCRMENTAL COMMAND TYPE SPINDLE ORIENTATION (SPINDLE ROTATION SPEED CONTROL)

5.3.1 Overview

Incremental command type spindle orientation is a function that expands the spindle orientation in which a stop position is specified externally using a position coder.
This function is intended to move the spindle from the position where it was when a spindle orientation command was input to a position specified incrementally. It positions the spindle as follows:
The spindle rotates from the position where it was when a spindle orientation command was input through an incremental angle specified from the PMC via the CNC. When the spindle orientation is completed, a completion signal is sent to the PMC via the CNC.
Using the function enables:
(i) Spindle motor-based turret indexing
(ii) Spindle rotation speed control if a command multiplier value (parameter-specified value) is set to "4096"

NOTE
1 Using this function requires the spindle orientation CNC software option.
2 The maximum spindle speed that can be specified is shown below:
9D50 series N edition or earlier, 9D70 series E edition or earlier: 120 rotations
9D50 series O edition or later, 9D70 series F edition or later, 9D80 series A edition or later: 30000 rotations
3 This function can be used with sensorless motor.

5.3.2 Series and Editions of Applicable Spindle Software

Spindle software

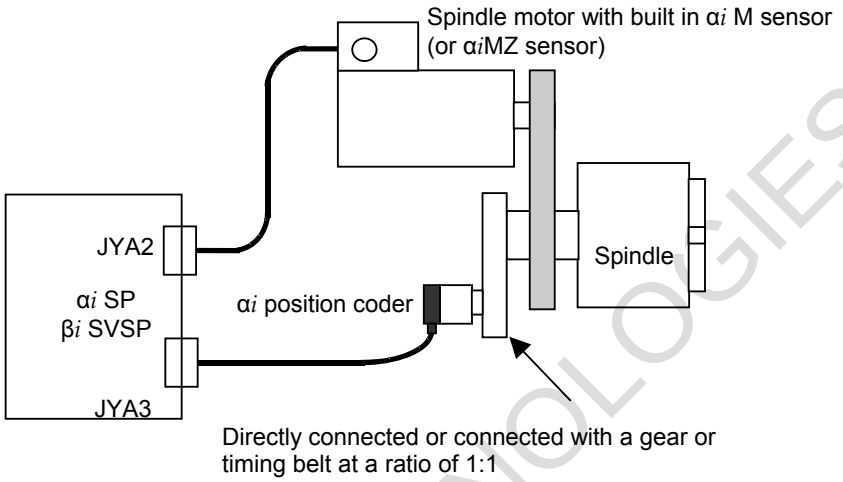
Series	Edition	Usable CNC
9D50	A (01)	FS0*i* -D
9D70	A (01)	FS30*i* / FS31*i* / FS32*i* -A
9D80	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9D90	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	A (01)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

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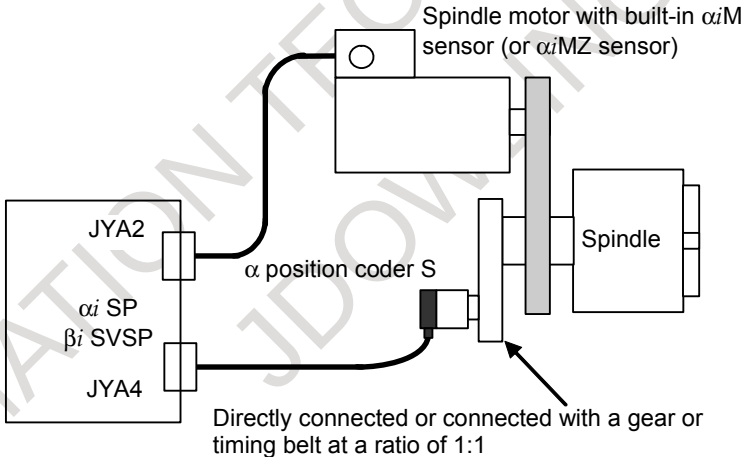
5.3.3 System Configuration

The incremental command type spindle orientation function can be used in the following system configuration.

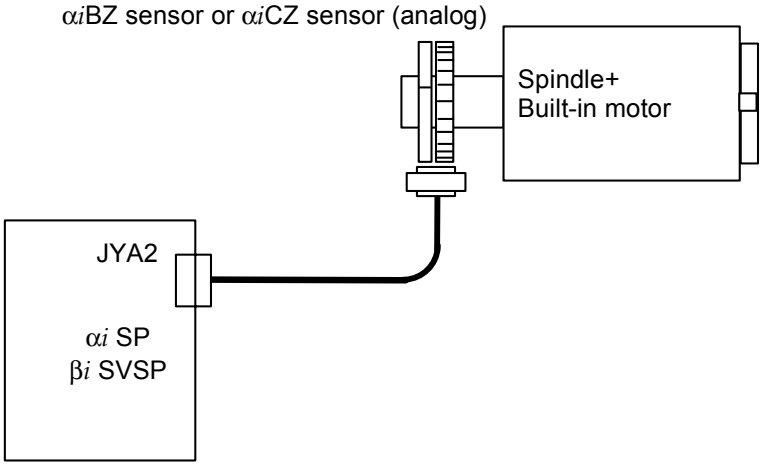
(1) When the αi position coder is used



(2) When the α position coder S is used

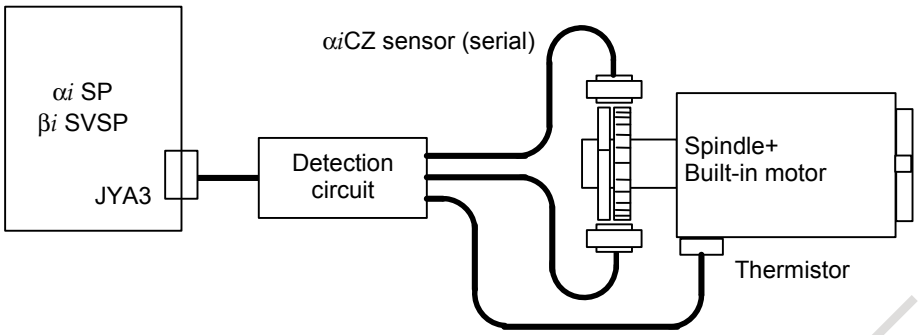


(3) When the built-in motor (αiBZ sensor, αiCZ sensor (analog)) is used

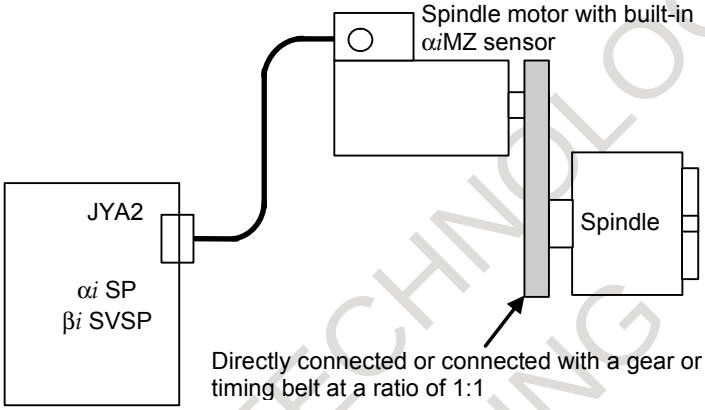


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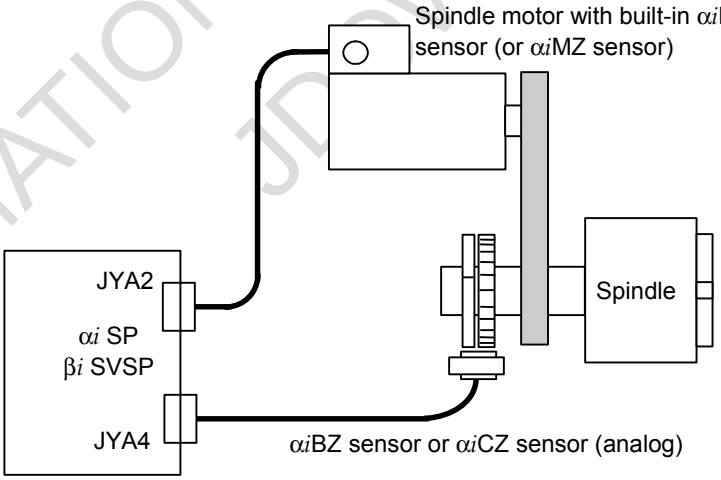
(4) When the built-in motor (αiCZ sensor (serial)) is used



(5) When the spindle motor with built-in αiMZ sensor is used

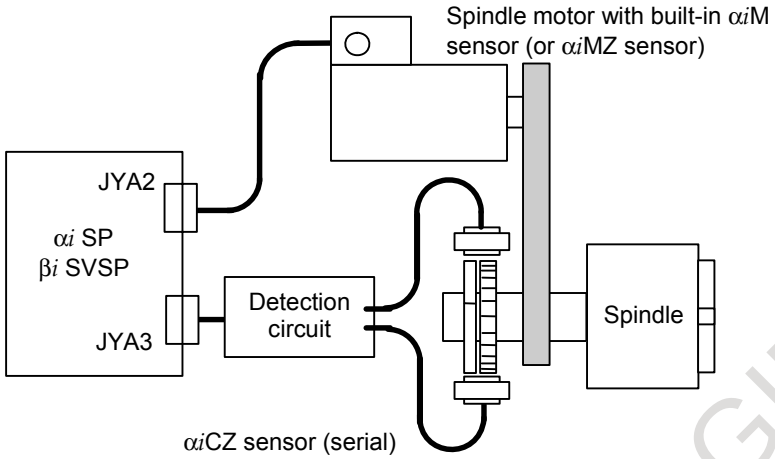


(6) When the separate type αiBZ sensor or the separate type αiCZ sensor (analog) is used

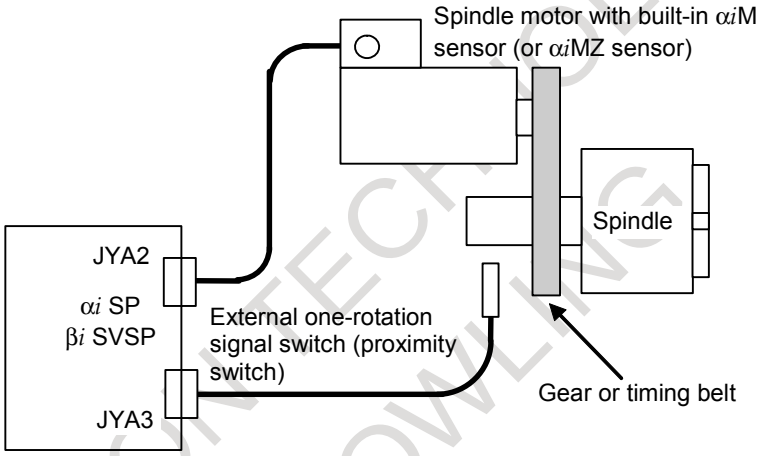


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(7) When the separate type αiCZ sensor (serial) is used



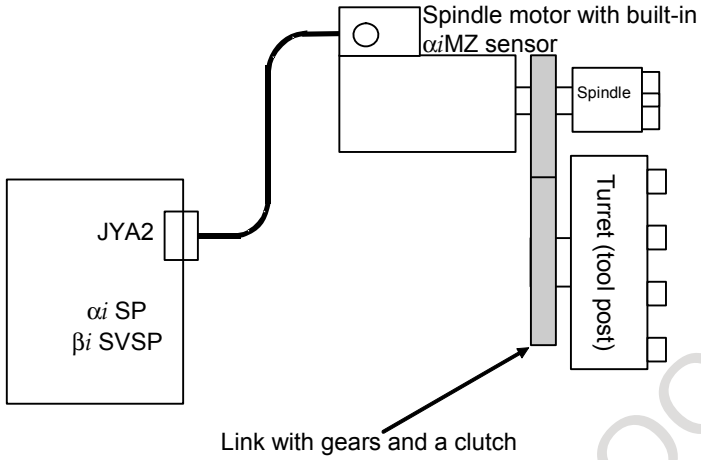
(8) When the external one-rotation signal (proximity switch) is used



NOTE
1 To detect the one-rotation signal securely, fix the direction (bits 3 and 2 of parameter No. 4003) in which the spindle rotates during spindle orientation to one direction.
2 Specify the type (bits 3 and 2 of parameter No. 4004) of an external one-rotation signal (proximity switch).
3 To detect the one-rotation signal securely, set the spindle orientation speed (parameter No. 4038) to a value between 50 and 100 min^{-1} according to the specification of the external one-rotation signal (proximity switch).
However, if problems not occur such as instability stop position by increasing the orientation speed, you can use the value higher than 100min^{-1}.
4 A sequence for detecting the one-rotation signal is started after the orientation speed has been reached.
5 Specify the denominator/numerator parameters (Nos. 4171 to 4174) of an arbitrary gear ratio between the motor sensor and spindle.

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(9) System in which the turret and the motor with a built-in αiMZ sensor are linked with gears and a clutch (for turret indexing)



5.3.4 I/O Signals (CNC↔PMC)

(1) Address list of input signals (PMC→CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G070	G070		ORCMA			CTH1A	CTH2A		
2nd-	G074	G074		ORCMB			CTH1B	CTH2B		
1st-	G072	G072			INCMDA			NRROA	ROTAA	INDXA
2nd-	G076	G076			INCMDB			NRROB	ROTAB	INDXB
1st-	G078	G078	SHA07	SHA06	SHA05	SHA04	SHA03	SHA02	SHA01	SHA00
2nd-	G080	G080	SHB07	SHB06	SHB05	SHB04	SHB03	SHB02	SHB01	SHB00
1st-	G079	G079					SHA11	SHA10	SHA09	SHA08
2nd-	G081	G081					SHB11	SHB10	SHB09	SHB08

(2) Details of input signals (PMC→CNC)

(a) Incremental command data selection signal (INCMDA)

The INCMDA signal is for selecting the data type (stop position data or incremental command data) of externally specified data (SHA00 to SHA11).

0: Stop position data
1: Incremental command data

(b) Short-cut command for spindle orientation stop position change (NRROA)

The NRROA signal is disabled if incremental command type spindle orientation is enabled (INCMDA = 1).

(c) Spindle orientation command (ORCMA)
(d) Clutch/gear signals (CT1HA and CTH2A)
(e) Spindle orientation stop position change command (INDXA)
(f) Rotation direction command for spindle orientation stop position change (ROTAA)

The functions of the input signals ORCMA, CTH1A, CTH2A, INDXA, and ROTAA are the same as for position coder-method spindle orientation. See Section 2.2, "POSITION CODER METHOD SPINDLE ORIENTATION" in Part I.

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(g) Spindle orientation external stop position commands (SHA11 to SHA00)

These commands are treated as incremental command data if INCMDA = 1.

(3) Address list of output signals (CNC→PMC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F045	F045	ORARA							
2nd-	F049	F049	ORARB							
1st-	F047	F047							INCSTA	
2nd-	F051	F051							INCSTB	

(4) Details of output signals (CNC→PMC)

(a) Incremental command mode status signal (INCSTA)

The INCSTA signal indicates the status of the INCMDA (incremental command data selection signal).

0: INCMDA = 0
1: INCMDA = 1

Before performing incremental command type spindle orientation, make sure that this signal is “1”.

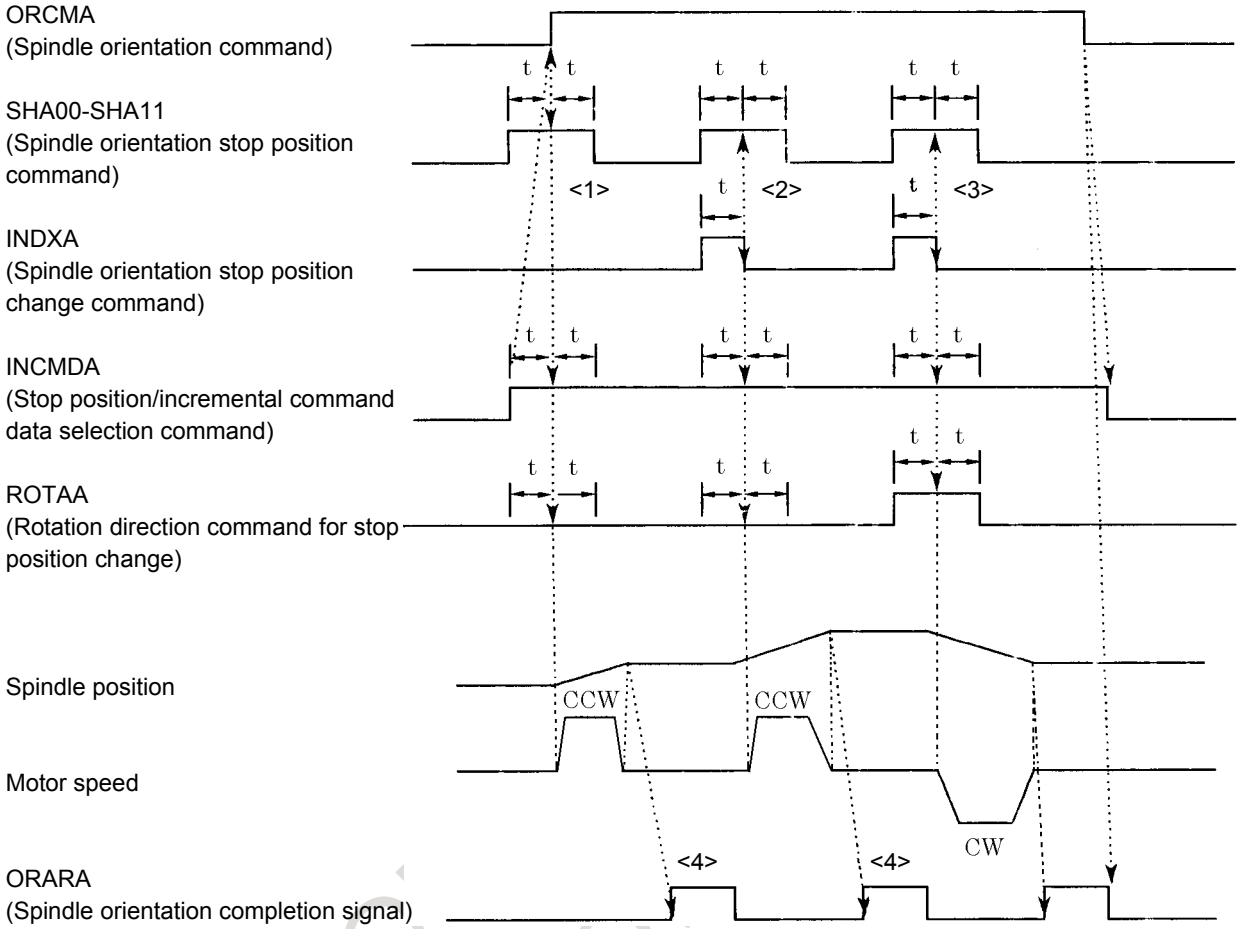
(b) Spindle orientation completion signal (ORARA)

The function of the output signal ORARA is the same as for position coder-method spindle orientation. See Section 2.2, “POSITION CODER METHOD SPINDLE ORIENTATION” in Part I.

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5.3.5 Examples of Sequences

(1) Incremental operation



NOTE
Set time t to 50 ms or over so that each signal can be confirmed.

<1> The SHA00 to SHA11 data is read as incremental command data if ORCMA rises under the condition of INCMDA = "1" when the spindle is at a halt (zero-speed detection signal SSTA = "1"). The spindle rotates through the specified incremental angle, starting from the position where it rested, and then stops. Its rotation direction is determined by ROTAA.

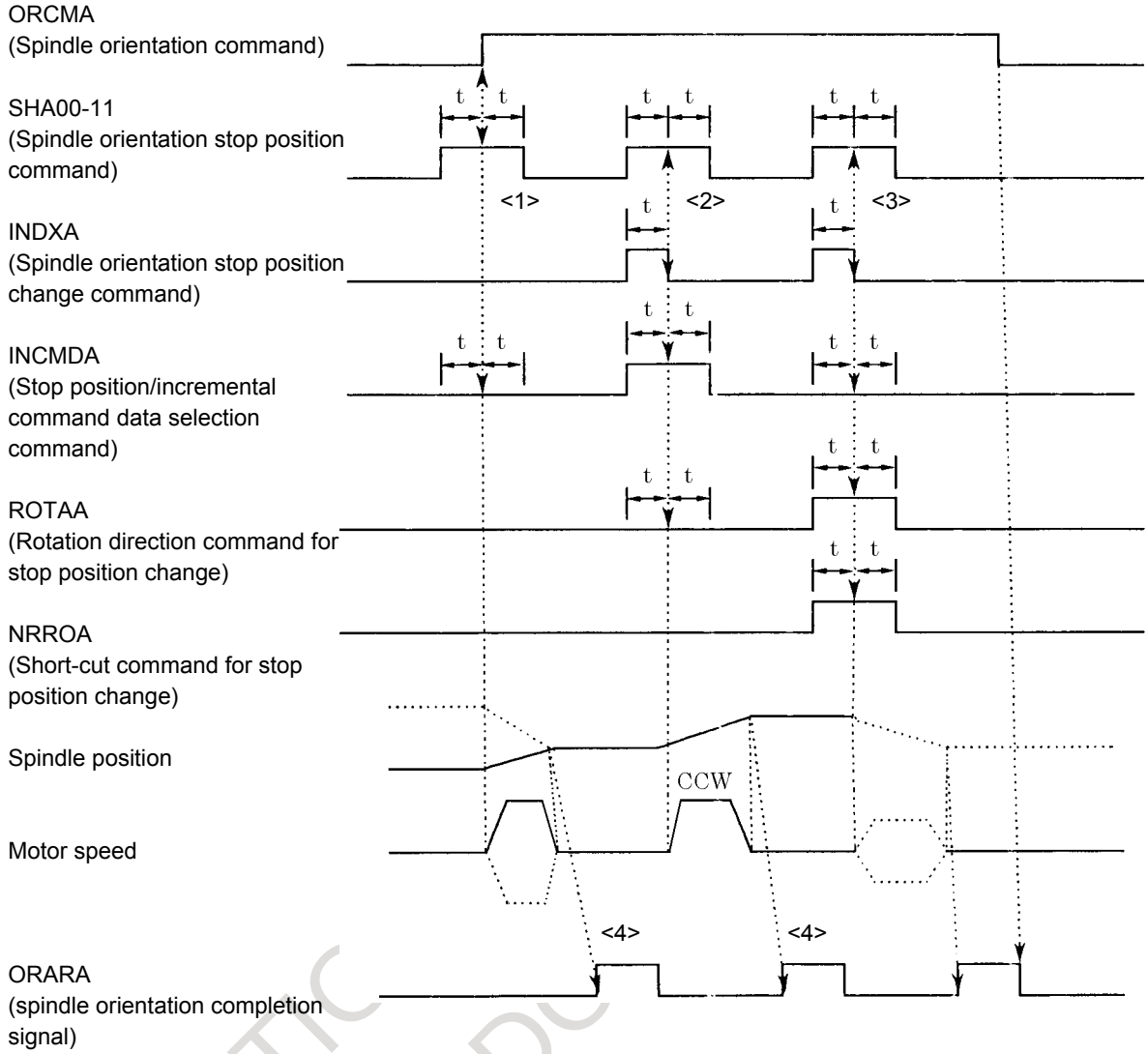
<2> If incremental operation is continued, the SHA00 to SHA11 data is read as incremental command data if INDXA falls under the condition of ORCMA = "1" and INCMDA = "1". The spindle rotates through the specified incremental angle, starting from the position where it rested, and then stops. Its rotation direction is determined by ROTAA.

<3> Incremental command data is specified in pulse units in a range from 0 to +4095 pulses.
The rotation direction of the spindle is determined by ROTAA.
If the command multiplier parameter (No. 4328) is specified, the spindle rotates through [command multiplier parameter] × [incremental command data] and then stops. The rotation direction parameter NRROA (bits 2 and 3 of parameter No. 4003) is disabled during incremental operation.

<4> When the position error gets in a parameter-specified range, the completion signal ORARA is output.

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(2) Example of using spindle orientation and incremental movement together



NOTE
Set time t to 50 ms or over so that each signal can be confirmed.

<1> Stop at a fixed position as directed with an ordinary spindle orientation command

- In the first-time orientation after the power is switched on, the spindle rotates at the orientation speed. After detecting a one-rotation signal, it stops at a fixed position. In the second- and subsequent-time spindle orientation, the spindle stops at a fixed position within one rotation.
- The direction in which the spindle motor rotates depends on the setting of the rotation direction parameter (bits 2 and 3 of parameter No. 4003).
- The SHA00 to SHA11 data is read as stop position command data if ORCMA rises under the condition of INCMDA = "0". The spindle rotates through the angle determined by [SHA00 to SHA11 value] + [value specified in the orientation stop position shift amount parameter (No. 4077)], and then stops there.

<2> Stop at a fixed position as directed with an incremental command

- See the previous page for incremental operations.
- If the command multiplier parameter (No. 4328) = 4096, spindle rotation speed control can be performed.

<3> Fixed position specified with fixed position stop external setting

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- The SHA00 to SHA11 data is read as stop position command data if INDXA falls under the condition of ORCMA = "1" and INCMDA = "0", the spindle rotates to a specified position and then stops there.
- The direction in which the spindle rotates is determined by NRROA and ROTAA.
  If NRROA = "1", the spindle rotates from the current stop position to a specified stop position through the shorter route (within ±180°).
  If NRROA = "0", the direction in which the spindle rotates is determined by ROTAA.

<4> If the position error gets in a parameter-specified range, the completion signal ORARA is output.

5.3.6 List of Related Parameters

Parameter No.		Description
0*i*	30*i*	
4015 #0	4015 #0	Whether the spindle orientation function is available (The CNC software option is required.)
3729#0	3729#0	Whether the stop position external setting-type spindle orientation function is available (to be set to "1")
4328	4328	Command multiplier for incremental command external setting data

NOTE
This subsection describes only the parameters specific to incremental command type spindle orientation. See Section 2.2, "POSITION CODER METHOD SPINDLE ORIENTATION" in Part I, for parameters related to other types of spindle orientation.

5.3.7 Details of Related Parameters

This subsection describes only the parameters specific to incremental command type spindle orientation. See Section 2.2, "POSITION CODER METHOD SPINDLE ORIENTATION" in Part I, for parameters related to other types of spindle orientation.

0*i*	30*i*	
4328	4328	**Command multiplier for spindle orientation by a position coder**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0

Set a command multiplier for the spindle orientation function with an externally set incremental command.
If this data is "0", the multiplier is automatically assumed to be 1.
Incremental command = incremental command data (SHA11 to SHA00) × data (multiplier) specified in this parameter
To use spindle rotation speed control, set this parameter to "4096", because one rotation of the spindle corresponds to 4096 pulses.

NOTE
The maximum speed (incremental command) that can be specified is:
120 rotations (= 120 × 4096 pulses)
9D50/N edition or earlier, 9D70/E edition or earlier
30000 rotations (= 30000 × 4096 pulses)
9D50/O edition or later, 9D70/F edition or later, 9D80 series

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5.4 CONVENTIONAL METHOD ORIENTATION (OPTIONAL FUNCTION)

5.4.1 Overview

Conventional method orientation is a function for stopping the spindle at a specified position by controlling the position using the spindle sensor signal at up to a certain spindle speed.

NOTE
*1 To use this function, the CNC software option is required.
*2 by applying the optimum orientation function, the spindle acceleration command is automatically optimized. This is expected to reduce the positioning time required by conventional method orientation. It is, therefore, recommended to apply the optimum orientation function.
For an explanation of the optimum orientation function, see Section 2.2, "POSITION CODER METHOD SPINDLE ORIENTATION (OPTIMUM ORIENTATION)", in Part I.
*3 For an explanation of the high resolution of stop position, see "SPINDLE ORIENTATION", in the Connection Manual (Function) of the relevant CNC.
*4 This function can be used with sensorless motor.

5.4.2 Series and Editions of Applicable Spindle Software

Spindle software

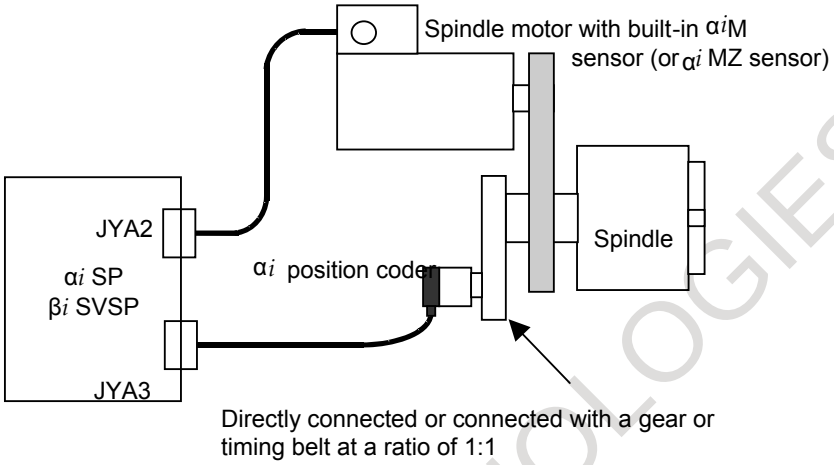
Series	Edition	Usable CNC
9D50	A (01)	FS0*i* -D
9D70	A (01)	FS30*i* / FS31*i* / FS32*i* -A
9D80	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9D90	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	A (01)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

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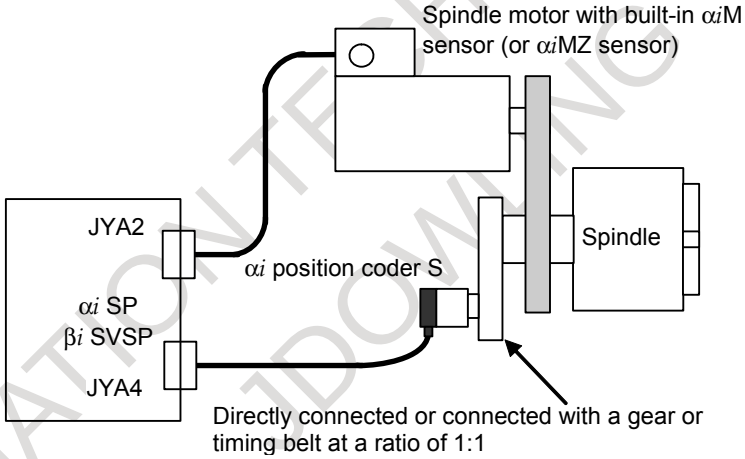
5.4.3 Configuration

Explained below is a system configuration in which the conventional orientation function is usable.

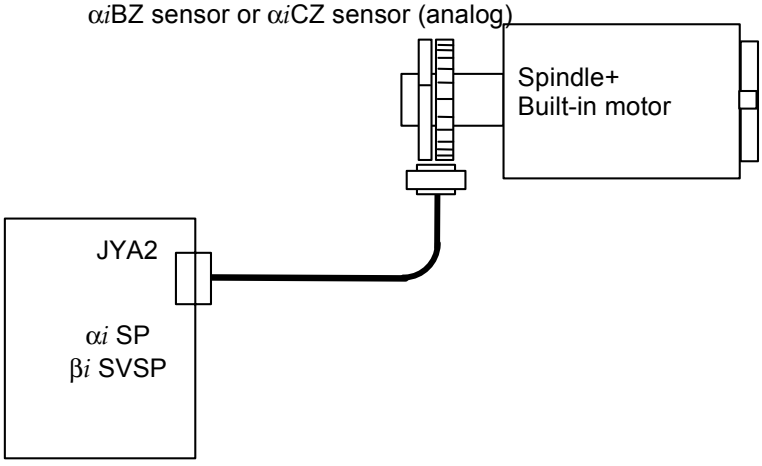
(1) When the αi position coder is used



(2) When the α position coder S is used

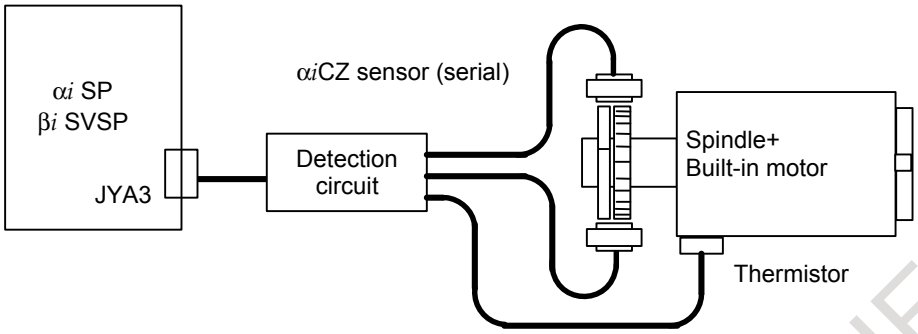


(3) When the built-in motor (αiBZ sensor, αiCZ sensor (analog)) is used

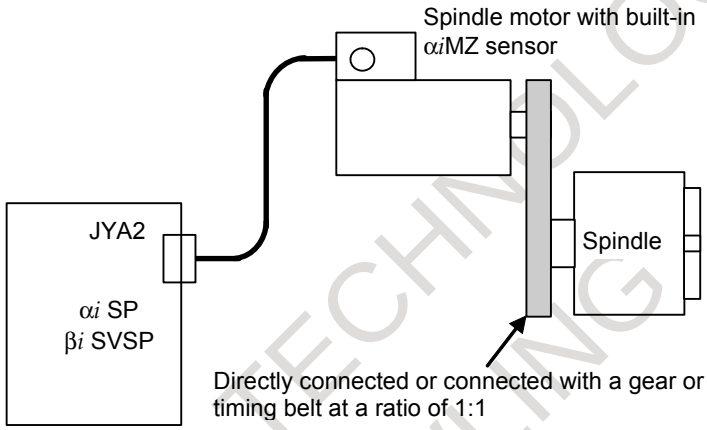


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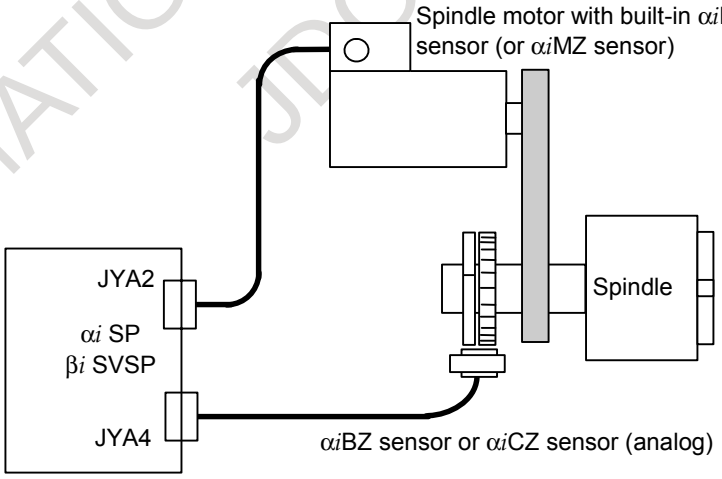
(4) When the built-in motor (α*i*CZ sensor (serial)) is used



(5) When the spindle motor with built-in α*i*MZ sensor is used

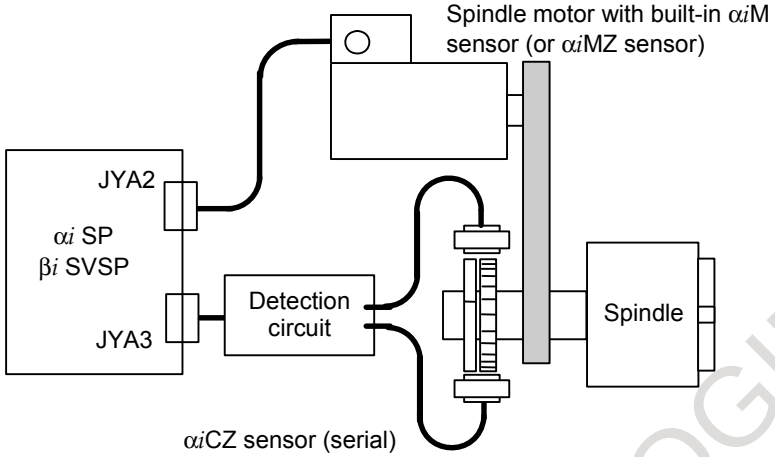


(6) When the separate type α*i*BZ sensor or the separate type α*i*CZ sensor (analog) is used

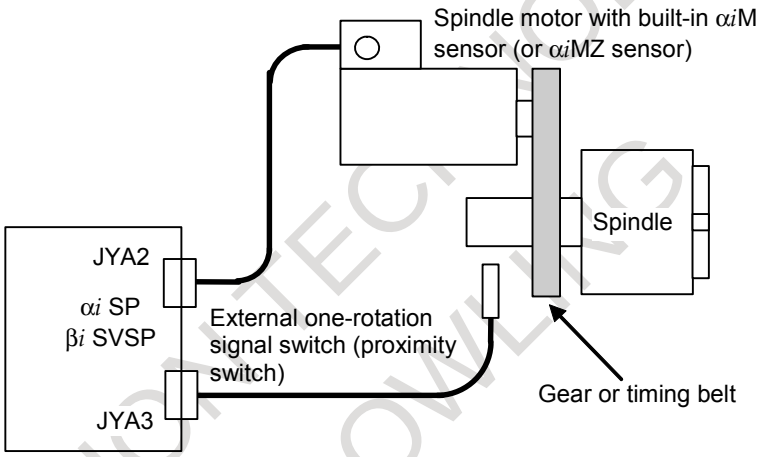


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(7) When the separate type αiCZ sensor (serial) is used



(8) When the external one-rotation signal (proximity switch) is used



NOTE
1 For stable detection of the one-rotation signal, fix the rotation direction (bits 3 and 2 of No. 4003) for orientation at one direction.
2 Set the type (bits 3 and 2 of No. 4004) of the external one-rotation signal (proximity switch).
3 For stable detection of the one-rotation signal, set an orientation speed (No. 4038) from 50 to 100 min-1 according to the specification of the external one-rotation signal (proximity switch).
However, if problems not occur such as instability stop position by increasing the orientation speed, you can use the value higher than 100min^{-1}.
4 The detection of the one-rotation signal starts after the orientation speed is reached.
5 Set the parameters (No. 4171 to No. 4174) for the numerator/denominator of an arbitrary gear ratio between the motor sensor and spindle.

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5.4.4 I/O Signals (CNC↔PMC)

(1) Address list of input signals (PMC→CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G070	G070		ORCMA			CTH1A	CTH2A		
2nd-	G074	G074		ORCMB			CTH1B	CTH2B		
1st-	G072	G072			INCMDA			NRROA	ROTAA	INDXA
2nd-	G076	G076			INCMDB			NRROB	ROTAB	INDXB
1st-	G078	G078	SHA07	SHA06	SHA05	SHA04	SHA03	SHA02	SHA01	SHA00
2nd-	G080	G080	SHB07	SHB06	SHB05	SHB04	SHB03	SHB02	SHB01	SHB00
1st-	G079	G079					SHA11	SHA10	SHA09	SHA08
2nd-	G081	G081					SHB11	SHB10	SHB09	SHB08

(2) Details of input signals (PMC→CNC)

(a) Spindle orientation command (ORCMA)
(b) Clutch/gear signals (CTH1A and CTH2A)
(c) Spindle orientation stop position change command (INDXA)
(d) Rotation direction command for spindle orientation stop position change (ROTAA)
(e) Short-cut command for spindle orientation stop position change (NRROA)
(f) Incremental command data selection signal (INCMDA)
(g) Spindle orientation external stop position commands (SHA11 to SHA00)

The functions of the input signals ORCMA, CTH1A, CTH2A, INDXA, ROTAA, NRROA, INCMDA, and SHA11 to SHA00 are the same as for position coder-method spindle orientation and incremental command type spindle orientation. See Sections 2.2, "POSITION CODER-METHOD SPINDLE ORIENTATION," and 5.3, "INCREMENTAL COMMAND TYPE SPINDLE ORIENTATION" in Part I.

(3) Address list of output signals (CNC→PMC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F045	F045	ORARA							
2nd-	F049	F049	ORARB							
1st-	F047	F047							INCSTA	
2nd-	F051	F051							INCSTB	

(4) Details of input signals (CNC → PMC)

(a) Incremental command mode status signal (INCSTA)
(b) Spindle orientation completion signal (ORARA)

The functions of the output signals ORARA and INCSTA are the same as for position coder-method spindle orientation and incremental command type spindle orientation. See Sections 2.2, "POSITION CODER METHOD SPINDLE ORIENTATION," and 5.3, "INCREMENTAL COMMAND TYPE SPINDLE ORIENTATION" in Part I.

5.4.5 Sequence

For this subsection, see Sections 2.2, "POSITION CODER METHOD SPINDLE ORIENTATION (OPTIMUM ORIENTATION)", and 5.3, "INCREMENTAL COMMAND TYPE SPINDLE ORIENTATION (SPINDLE ROTATION SPEED CONTROL)" in Part I.

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5.4.6 List of Related Parameters

Parameter No.		Description
0*i*	30*i*	
4015 #0	4015 #0	Specifies whether to use the spindle orientation function. (The CNC software option is required.)
3729#0	3729#0	Specifies whether to use the spindle orientation function with the stop position external setting type.
4003 #0	4003 #0	Choice of orientation method (To be set to 0 for the position coder method)
4003#3,2	4003#3,2	Direction of rotation in spindle orientation
4017#7	4017#7	Shortcut function when orientation is specified in stop state
4018#6 #3	4018#6 #3	Type of position coder method spindle orientation (Sets bits 6 and 3 to 0,0.)
4031	4031	Stop position for position coder method orientation (This parameter is disabled when spindle orientation with an externally set stop position or an externally set incremental command is used.)
4042 4043	4042 4043	Velocity loop proportional gain for orientation (A parameter is selected by the CTH1A input signal.)
4050 4051	4050 4051	Velocity loop integral gain for orientation (A parameter is selected by the CTH1A input signal.)
4056 to 4059	4056 to 4059	Spindle-to-motor gear ratio (A parameter is selected by the CTH1A and CTH2A input signals.)
4060 to 4063	4060 to 4063	Position gain for orientation (A parameter is selected by the CTH1A and CTH2A input signals.)
4064	4064	Rate of change in the position gain upon completion of spindle orientation
4075	4075	Detection level for the spindle orientation completion signal
4076	4076	Speed limit ratio for spindle orientation
4077	4077	Spindle orientation stop position shift
4084	4084	Motor voltage for spindle orientation
4038	4038	Spindle orientation speed
4171 4173	4171 4173	Denominator of an arbitrary gear ratio between the motor sensor and spindle (A parameter is selected by the input signal CTH1A.)
4172 4174	4172 4174	Numerator of an arbitrary gear ratio between the motor sensor and spindle (A parameter is selected by the input signal CTH1A.)

NOTE
1 For the parameters related to detectors, see the Section 1.3, “PARAMETERS RELATED TO DETECTORS” in the Part I.
2 For velocity loop proportional/integral gain adjustment, see Section 4.1, "VELOCITY LOOP GAIN ADJUSTMENT", in Part I.
3 When using the external one-rotation signal (proximity switch), fix the orientation-time rotation direction (bits 3 and 2 of No. 4003) at one direction.
4 When using the external one-rotation signal (proximity switch), set the type of the external one-rotation signal (bits 3 and 2 of No. 4004).
5 When using the external one-rotation signal (proximity switch), set an orientation speed from 50 to 100 min^{-1} (No. 4038) according to the specification of the used external one-rotation signal.
However, if problems not occur such as instability stop position by increasing the orientation speed, you can use the value higher than 100min^{-1}.
6 When using the external one-rotation signal (proximity switch), set the numerator/denominator of an arbitrary gear ratio between the motor sensor and spindle (No. 4171 to No. 4174).

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5.4.7 Details of Related Parameters

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4003	4003					DIRCT2	DIRCT1		PCMGSL

DIRCT2, DIRCT1 Setting of rotation direction at spindle orientation

DIRCT2	DIRCT1	Rotation direction at spindle orientation
0	0	By rotation direction immediately before (It is CCW at the power on.)
0	1	By rotation direction immediately before (It is CW at the power on.)
1	0	CCW (counterclockwise) direction looking from shaft of motor
1	1	CW (clockwise) direction looking from shaft of motor

NOTE
When using the external one-rotation signal (proximity switch), fix the orientation-time rotation direction at CCW or CW for stable detection of the one-rotation signal.
(Bits 3, 2 of No. 4003) = 1, 0 or 1, 1)

PCMGSL Selects the type of orientation.
Set this bit to 0 (orientation by a position coder).

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4004	4004					RFTYPE	EXTRF		

EXTRF, RFTYPE Sets the external one-rotation signal (proximity switch).

RFTYPE	EXTRF	External one-rotation signal (proximity switch)
0	0	None
0	1	Detects the rising edge.
1	1	Detect the falling edge.

NOTE
When using the external one-rotation signal (proximity switch), set the type of the external one-rotation signal (proximity switch) by using this parameter.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4017	4017	NRROEN							

NRROEN Specifies whether to use the shortcut function when orientation is specified in the stop state.
0 : Does not use the function.
1 : Uses the function.
When this bit is set to 1, short cut operation is performed when the following conditions are satisfied:

- Bit 7 of parameter No. 4016 (RFCHK3) is set to 0.
- Zero speed detection output signal SST is set to 1.
- Shortcut command input signal NRROA is set to 1.

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0i	30i	#7	#6	#5	#4	#3	#2	#1	#0
4018	4018		ORTYP1			ORTYP1			

ORTYP1、ORTYP0 Type of position coder method orientation

ORTYP1	ORTYP0	Type of orientation
0	0	Conventional method orientation
0	1	Optimum orientation
1	0	Optimum orientation

Specify "0,0" (conventional method orientation).

0i	30i	
4031	4031	Position coder method orientation stop position

Unit of data : 1 pulse unit (360 degrees/4096)
Valid data range : 0 to 4096
Initial setting : 0

This data is used to set the stop position of position coder method spindle orientation. It can be set at every 360 degrees/4096.
When stop position external command type orientation and incremental command external type orientation are set, this parameter becomes invalid.
Stop position command (SHA11-SHA00) of input signal instructed becomes valid.

0i	30i	
4038	4038	Spindle orientation speed

Unit of data : $1min^{-1}$ ($10min^{-1}$ when bit 2 of parameter No.4006(SPDUNT) is set to 1)
Valid data range : 0 to 32767
Initial setting : 0

This parameter sets the orientation speed at the end of the spindle.
When 0 is specified for this parameter, the orientation speed is determined depending on the position gain and the motor speed limit ratio for orientation.

NOTE
When using the external one-rotation signal (proximity switch), set an orientation speed from 50 to 100 min^{-1} according to the specification of the used external one-rotation signal (proximity switch) for stable detection of the one-rotation signal.
However, if problems not occur such as instability stop position by increasing the orientation speed, you can use the value higher than $100min^{-1}$.

0i	30i		
4042	4042	Velocity loop proportional gain on orientation (HIGH)	CTH1A=0
4043	4043	Velocity loop proportional gain on orientation (LOW)	CTH1A=1

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10

This parameter sets the velocity loop proportional gain for spindle orientation.
When the CTH1A input signal is set to 0, proportional gain for the HIGH gear is selected.
When the CTH1A input signal is set to 1, proportional gain for the LOW gear is selected.

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0*i*	30*i*		
4050	4050	**Velocity loop integral gain on orientation (HIGH)**	**CTH1A=0**
4051	4051	**Velocity loop integral gain on orientation (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10

This parameter sets the velocity loop integral gain for spindle orientation.
When the CTH1A input signal is set to 0, integral gain for the HIGH gear is selected.
When the CTH1A input signal is set to 1, integral gain for the LOW gear is selected.

0*i*	30*i*		
4056	4056	**Gear ratio (HIGH)**	**CTH1A=0, CTH2A=0**
4057	4057	**Gear ratio (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4058	4058	**Gear ratio (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4059	4059	**Gear ratio (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : (Motor rotation for one rotation of spindle) / 100
(When parameter No. 4006 #1 (GRUNIT) is 1, motor rotation / 1000)
Valid data range : 0 to 32767
Initial setting : 100

These parameters set the gear ratio of the spindle motor relative to the spindle.
When the motor rotates 2.5 times, for every rotation of the spindle, for example, set 250 in the parameter.
A parameter is selected by the CTH1A and CTH2A input signals.
The gear or clutch status must correspond to the status of the CTH1A and CTH2A input signals.

NOTE
When an improper value is set in these parameters, an unexpected operation can occur. For example, the spindle can continue rotating without stopping at the time of orientation. So, be sure to set a proper gear ratio.

0*i*	30*i*		
4060	4060	**Position gain on orientation (HIGH)**	**CTH1A=0, CTH2A=0**
4061	4061	**Position gain on orientation (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4062	4062	**Position gain on orientation (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4063	4063	**Position gain on orientation (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : 0.01sec^{-1}
Valid data range : 0 to 32767
Initial setting : 1000

These parameters set the position gain for orientation.
A parameter is selected by the CTH1A and CTH2A input signals.

0*i*	30*i*	
4064	4064	**Modification rate of position gain on orientation completion**

Unit of data : 1%
Valid data range : 0 to 799
Initial setting : 100

This data is used to set the modification rate of position gain on spindle orientation completion.

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0*i*	30*i*	
4075	4075	**Orientation completion signal detection level (limits of in-position)**

Unit of data : ±1 pulse unit (360 degrees/4096)
Valid data range : 0 to 100
Initial setting : 10

This data is used to set the detecting level of orientation completion signal (ORARA). When the spindle position is located within the setting data on orientation completion, the bit of orientation completion signal (ORARA) in the spindle control signals is set to "1". When the orientation command (ORCMA) is turned off (= 0), the orientation completion signal (ORARA) is set to "0".

0*i*	30*i*	
4076	4076	**Motor speed limit ratio on orientation**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 33

This data is used to set motor speed limit ratio on orientation.
The value calculated from the position gain (No. 4060 to No. 4063) and this parameter as indicated below is used as an orientation speed and reference position return speed on servo mode (rigid tapping/spindle positioning).

$$\text{Orientation speed of motor (motor speed)} = 60 \times \frac{(\text{Position gain})}{100} \times (\text{Gear ratio}) \times \frac{(\text{Speed limit ratio})}{100} [\text{min}^{-1}]$$

0*i*	30*i*	
4077	4077	**Orientation stop position shift value**

Unit of data : ±1 pulse unit (360 degrees/4096)
Valid data range : -4095 to 4095
Initial setting : 0

In the position coder method orientation, set this data to shift stop position.
Spindle is shift numbers of setting pulse in CCW direction, and stops by data (+).

0*i*	30*i*	
4084	4084	**Motor voltage setting on orientation**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 30

This parameter sets the motor voltage for orientation. Usually, set 30. The value may vary, however, depending on the motor model.

0*i*	30*i*		
4171	4171	**Denominator of arbitrary gear ratio between motor sensor and spindle (HIGH)**	**CTH1A=0**
4172	4172	**Numerator of arbitrary gear ratio between motor sensor and spindle (HIGH)**	**CTH1A=0**
4173	4173	**Denominator of arbitrary gear ratio between motor sensor and spindle (LOW)**	**CTH1A=1**
4174	4174	**Numerator of arbitrary gear ratio between motor sensor and spindle (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0

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These parameters set conversion coefficients (numerator, denominator) for using the detection arbitrary gear ratio function (DMR function) by multiplying a motor sensor (αiM or αiMZ sensor) feedback signal by a gear ratio to produce a spindle position feedback signal.
When the spindle rotates Q times while the motor shaft rotates P times (there is no common divisor other than 1 for P and Q), settings are:

No. 4171 (No. 4173 when CTH1A = 1) = P
No. 4172 (No. 4174 when CTH1A = 1) = Q

When 0 is set in any of these parameters, the setting of 1 is assumed.

NOTE
When using the external one-rotation signal (proximity switch), set an arbitrary gear ratio between the motor sensor and spindle by using this parameter.

5.4.8 Adjusting the Orientation Stop Position Shift Parameter

For this subsection, see Section 2.2, "POSITION CODER METHOD SPINDLE ORIENTATION (OPTIMUM ORIENTATION)", in Part I.

5.4.9 Calculating the Position Gain for Orientation

(1) When the spindle orientation speed parameter (No. 4038) is set to "0", the orientation speed is determined using the following expression:

$$\mathrm{Nori} = 60 \times \mathrm{PG} \times \mathrm{Rori} \times \mathrm{GEAR}$$

where, Nori : Orientation speed (motor speed) [min^{-1}]
Rori : Motor speed limit ratio for orientation (parameter No. 4076)
PG : Position gain on orientation [sec^{-1}] (parameter Nos. 4060 to 4063)
GEAR : Spindle-to-motor gear ratio (parameter Nos. 4056 to 4059)

(2) The position gain for spindle orientation is obtained using the following expression:

$$\mathrm{PG} \le \sqrt{\left(\frac{\mathrm{Tm}}{2\pi \times (\mathrm{Jm} + \mathrm{Jl}) \times \mathrm{Rori} \times \mathrm{GEAR}}\right)}$$

where, PG : Position gain for orientation [sec^{-1}] (parameter Nos. 4060 to 4063)
Tm : 30-min rated torque for the motor when rotating at Nori [min^{-1}] [Nm]
Jm : Rotor inertia [kgm^2]
Jl : Load inertia converted to motor shaft inertia [kgm^2]
Rori : Motor speed limit ratio for orientation (parameter No. 4076)
GEAR : Spindle-to-motor gear ratio (parameter Nos. 4056 to 4059)

(3) Calculation example when motor model αiI6 is being used alone

$$\mathrm{Tm} = \frac{7500[\mathrm{W}]}{1500[\mathrm{min}^{-1}] \times 0.1047} = 47.8[\mathrm{Nm}]$$

$$\mathrm{Jm} = 0.0179[\mathrm{kgm}^2]$$

$$\mathrm{Rori} = 33[\%]$$

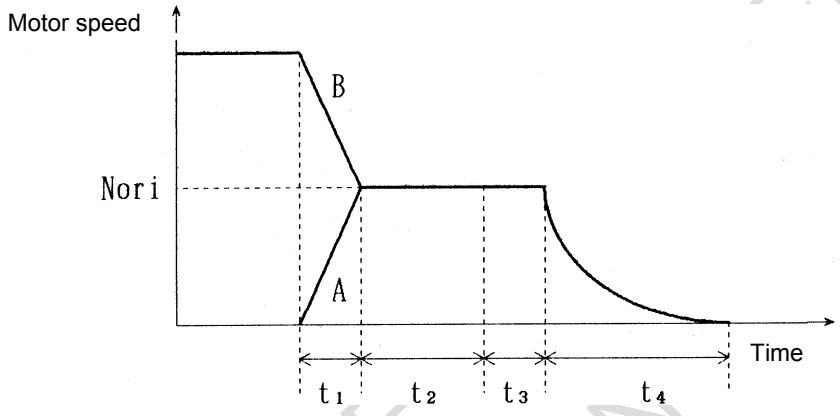
$$\therefore \mathrm{PG} \le \sqrt{\left(\frac{47.8}{2\pi \times 0.0179 \times 0.33}\right)} = 35.9[\mathrm{sec}^{-1}]$$

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5.4.10 Calculating the Orientation Time

The time required for orientation differs between the first orientation (before the one-rotation signal has first been detected) and the second and subsequent orientations (once the one-rotation signal has been detected).

(1) Before the one-rotation signal has first been detected (first orientation)
The time, from the input of an orientation command until orientation stops, is divided into four periods.
In the following figure, A indicates that the motor in the stop state starts rotating and is accelerated to the orientation speed. B indicates that the already rotating motor is decelerated to the orientation speed.



t_1 : Time required to achieve orientation speed Nori [sec]
t_2 : Time from the detection of a one-rotation signal (0 to 1 rotation) after Nori is achieved, until the number of pulses output before the next one-rotation signal has been checked [sec]
t_3 : Time from the completion of the checking of the number of pulses until deceleration starts [sec]
t_4 : Time from the start of deceleration until orientation is completed [sec]

(a) Normally, t_1 is measured on the actual machine.
Orientation speed Nori [min^{-1}] is calculated from position gain PG [sec^{-1}] and motor speed limit ratio for orientation Rori.

$$\text{Nori} = \text{PG} \times 60 \times \text{Rori}$$

(b) t_2 is the time required for the motor to rotate one to two turns at orientation speed Nori [min^{-1}].

$$\frac{1 \times 60}{\text{Nori}} \le t_2 \le \frac{2 \times 60}{\text{Nori}}$$

$$\therefore \frac{1}{\text{PG} \times \text{Rori}} \le t_2 \le \frac{2}{\text{PG} \times \text{Rori}}$$

(c) t_3 is the time required for the motor to rotate zero to one turn at orientation speed Nori [min^{-1}].

$$\frac{0 \times 60}{\text{Nori}} \le t_3 \le \frac{1 \times 60}{\text{Nori}}$$

$$\therefore 0 \le t_3 \le \frac{1}{\text{PG} \times \text{Rori}}$$

(d) t_4 is the time from the start of deceleration until orientation has been completed.
Let the orientation completion width be within ±10 pulses. Then, t_4 can be calculated as follows:

$$t_4 = \frac{1}{\text{PG}} \times \ln \frac{4096 \times \text{Rori}}{10}$$

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(e) Therefore, orientation time t [sec] (= $t_1 + t_2 + t_3 + t_4$) can be expressed as follows:

$$t_1 + \frac{1}{PG \times Rori} + \frac{1}{PG} \ln \frac{4096 \times Rori}{10} \le t \le t_1 + \frac{3}{PG \times Rori} + \frac{1}{PG} \ln \frac{4096 \times Rori}{10}$$

(2) Once the one-rotation signal has been detected (second and subsequent orientations)

(a) Once the one-rotation signal has been detected, the time required to detect the signal is no longer necessary.
Therefore, when orientation is started from the rotating state, orientation time t [sec] (= $t_1 + t_3 + t_4$) is expressed as follows:

$$t_1 + \frac{1}{PG} \ln \frac{4096 \times Rori}{10} \le t \le t_1 + \frac{1}{PG \times Rori} + \frac{1}{PG} \ln \frac{4096 \times Rori}{10}$$

(b) Whenever orientation is started from the stop state, orientation must be completed and the motor must enter the stop state within one-rotation. In this case, orientation time t [sec] is expressed as follows:

$$0 \le t \le \frac{1 - Rori}{PG \times Rori} + \frac{1}{PG} \ln \frac{4096 \times Rori}{10}$$

(3) Calculation examples
Time required to achieve orientation speed $t_1 = 0.5$ [sec]
Position gain PG = 20 [sec^{-1}]
Motor speed limit for orientation Rori = 0.33 (= 33%)

(a) Orientation time before the one-rotation signal has been detected

$$0.5 + \frac{1}{20 \times 0.33} + \frac{1}{20} \times \ln \frac{4096 \times 0.33}{10} \le t \le 0.5 + \frac{3}{20 \times 0.33} + \frac{1}{20} \times \ln \frac{4096 \times 0.33}{10}$$

$$\therefore 0.896[\text{sec}] \le t \le 1.196[\text{sec}]$$

(b) Orientation time when orientation is started from the rotating state (once the one-rotation signal has been detected)

$$0.5 + \frac{1}{20} \times \ln \frac{4096 \times 0.33}{10} \le t \le 0.5 + \frac{1}{20 \times 0.33} + \frac{1}{20} \times \ln \frac{4096 \times 0.33}{10}$$

$$\therefore 0.746[\text{sec}] \le t \le 0.896[\text{sec}]$$

(c) Orientation time when orientation is started from the stop state (once the one-rotation signal has been detected)

$$0 \le t \le \frac{1 - 0.33}{20 \times 0.33} + \frac{1}{20} \ln \frac{4096 \times 0.33}{10}$$

$$\therefore 0[\text{sec}] \le t \le 0.346[\text{sec}]$$

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5.5 SPINDLE ORIENTATION DURING SPINDLE SYNCHRONIZATION CONTROL

5.5.1 Overview

This function performs orientation stop operation (orientation during spindle synchronous control) in the direction/stop position specified externally while keeping synchronization between spindles during spindle synchronous control.
Using spindle orientation during spindle synchronous control (hereafter simply called synchronous orientation) enables the following operations:

- Loading/unloading of an irregular-shape workpiece during spindle synchronous control
- Side-facing of a workpiece that must be held at both ends (such as a long workpiece) after it is indexed

NOTE
1 Using this function requires the CNC software option for spindle synchronous control.
2 This function is an add-on to the spindle synchronous control function. This section focuses on the add-on.
3 Using this function requires the enabling of the stop position externally setting spindle orientation function.
4 Some parameter specifications related to the αi series spindle amplifiers differ from those related to the α series. See Subsection 5.5.7, “Details of Related Parameters”.
5 This function cannot be used with sensorless motor.

5.5.2 Series and Editions of Applicable Spindle Software

Spindle software

Series	Edition	Usable CNC
9D50	E (05)	FS0*i* -D
9D70	A (01)	FS30*i* / FS31*i* / FS32*i* -A
9D80	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9D90	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	A (01)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

5.5.3 Specification

Synchronous orientation

During spindle synchronous control, inputting the synchronous orientation command (SPPHS rising edge when SORENA = 1) can stop spindle orientation with two spindles kept in synchronization.

NOTE
1 If bell-shaped Acc./Dec. is already enabled, it is kept enabled during synchronous orientation.
2 If you changed parameters or sequences, disconnect each spindle for safety purposes, and then run the machine to check carefully the direction in which each spindle rotates, the position where each spindle stops, and whether a synchronous error occurs.

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Reference position (phase) setting

Before issuing a synchronous orientation command, it is necessary to perform reference position (phase) setting for the two spindles.

Set the reference position of each of the spindles using spindle phase synchronous control.

If spindle phase synchronous control is performed with synchronous speed command = "0", the spindles stop at:

[One-rotation signal position] + [shift amount during spindle synchronous control (parameter No. 4034)]

This position is used as a reference position (stop position where SHA11 to SHA00 are all 0s) for the synchronous orientation stop position.

NOTE
1 Before inputting the spindle phase synchronous control command (SPPHS), make sure that both the spindles are rotating at the synchronous speed and they remain synchronized (FSPSY = 1). If the synchronous control command is issued before the spindles start rotating at the synchronous speed, they get out of phase.
2 In addition, before inputting the phase synchronous command, disconnect both spindles.

Synchronous orientation stop position

SHA11 to SHA00 are used to specify the spindle stop position for synchronous orientation. Specify the desired shift amount relative from the reference position explained above.

NOTE
1 Be sure to specify the same reference position for both the spindles. If you fail to specify the same spindle position, it is impossible to maintain spindle synchronization.
2 Also specify the direction in which each spindle rotates during synchronous orientation, using ROTAA. The direction in which each spindle must rotate to keep itself in synchronization with the other spindle varies depending on the machine configuration. Be sure to specify the correct direction according to the machine condition so that the spindles are maintained in synchronization. If you fail to specify the correct direction, it is impossible to maintain spindle synchronization.
3 Keep these signals (SHA11 to SHA00 and ROTAA) in the stated status until synchronous orientation is completed.

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5.5.4 I/O Signals (CNC↔PMC)

(1) Address list of input signals (PMC→CNC)

(a) For path 1

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
	G038	G038					SPPHS	SPSYC		
1st-	G072	G072							ROTAA	
2nd-	G076	G076							ROTAB	
1st-	G073	G073					SORSLA			
2nd-	G077	G077					SORSLB			
1st-	G078	G078	SHA07	SHA06	SHA05	SHA04	SHA03	SHA02	SHA01	SHA00
2nd-	G080	G080	SHB07	SHB06	SHB05	SHB04	SHB03	SHB02	SHB01	SHB00
1st-	G079	G079					SHA11	SHA10	SHA09	SHA08
2nd-	G081	G081					SHB11	SHB10	SHB09	SHB08

(b) For path 2

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
	G1038	G1038					SPPHS	SPSYC		
1st-	G1072	G1072							ROTAA	
2nd-	G1076	G1076							ROTAB	
1st-	G1073	G1073					SORSLA			
2nd-	G1077	G1077					SORSLB			
1st-	G1078	G1078	SHA07	SHA06	SHA05	SHA04	SHA03	SHA02	SHA01	SHA00
2nd-	G1080	G1080	SHB07	SHB06	SHB05	SHB04	SHB03	SHB02	SHB01	SHB00
1st-	G1079	G1079					SHA11	SHA10	SHA09	SHA08
2nd-	G1081	G1081					SHB11	SHB10	SHB09	SHB08

(2) Details of input signals (PMC→CNC)

(a) Spindle synchronous control command (SPSYC)

Setting the SPSYC signal to "1" directs the spindles to enter the spindle synchronous control mode. Before issuing this command, specify SORSLA (SORSLA) = "0".
Maintain the condition of SPSYC = "1" during synchronous orientation.

(b) Spindle phase synchronous control command or synchronous orientation command (SPPHS)

If SORENA (SORENB) = "0", the spindle phase synchronous control command is issued at the rising edge of the SPPHS signal. (See Section 2.5, "SPINDLE SYNCHRONIZATION CONTROL" in Part I .)
If SORENA (SORENB) = "1", the synchronous orientation command is issued at the rising edge of the SPPHS signal. When the synchronous orientation command is issued, the synchronous speed command becomes disabled, and synchronous orientation begins.
Keep satisfying synchronous speed command = "0" during synchronous orientation.
Before issuing the synchronous orientation command, make sure that SORSLA (SORSLB) = "1" and SORENA (SORENB) = "1" are satisfied for both the spindles.
Keep in mind that the meaning of the SPPHS signal changes according to the state of the SORENA (SORENB) signal.

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To issue the synchronous orientation command after spindle phase synchronous control is performed, it is necessary to reset the SPPHS signal to "0" previously. The spindle phase synchronous control completion signal is kept at "0" while the SPPHS signal is "0".

NOTE
*1 Once you change the control mode, make sure that you have to execute orientation during spindle synchronization after phase synchronization is completed.

(c) Synchronous orientation request command (SORSLA)

The SORSLA signal is a signal for requiring synchronous orientation.
In response to this signal, the spindle amplifier outputs a synchronous orientation permission signal (SORENA or SORENB).
If SORSLA (SORSLB) = "1" is input, the synchronous orientation command (SPPHS) becomes enabled when SORENA (SORENB) = "1" is satisfied.
Keep the current state of the SORSLA signal until synchronous orientation is completed.
If SORSLA (SORSLB) = "0" is input, synchronous orientation is released and the synchronous speed command becomes enabled, when SORENA (SORENB) = "0" is satisfied.

(d) Synchronous orientation external stop position command (SHA11 to SHA00)

This command is used to specify the stop position for synchronous orientation.
If all of the SHA11 to SHA00 signals are "0", the position where each spindle is to rest (reference position) is as stated below if the spindle phase synchronous command is issued under the condition of synchronous speed command = "0":

[One-rotation signal position] + [shift amount during spindle synchronous control (parameter No. 4034)]

The shift amount relative from the reference position is:

$$\text{Shift amount (degrees)} = \frac{360}{4096} \times \sum_{i=0}^{11} \left(SHAi \times 2^i \right)$$

Assert the SHA11 to SHA00 signals at least 50 ms before the synchronous orientation command is input, and keep them asserted until synchronous orientation is completed.

(e) Rotation direction command for synchronous (ROTAA)

This command specifies the direction in which the spindle rotates during synchronous orientation.
0: The spindle rotates CCW.
1: The spindle rotates CW.
To make both the spindles rotate in the same direction, it is necessary to input the ROTAA signal correctly. Because the correct rotation direction changes depending on the machine configuration, specify it exactly while paying attention to the way each spindle is linked to its motor and the positional relationship between the spindles.
Assert the ROTAA signals at least 50 ms before the synchronous orientation command is input, and keep it asserted until synchronous orientation is completed.

(3) Address list of output signals (CNC→PMC)

(a) For path 1

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
	F044	F044				SYCAL	FSPPH	FSPSY		
1st-	F047	F047					SORENA			
2nd-	F051	F051					SORENB			

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(b) For path 2

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
	F1044	F1044				SYCAL	FSPPH	FSPSY		
1st-	F1047	F1047					SORENA			
2nd-	F1051	F1051					SORENB			

(4) Details of output signals (CNC→PMC)

(a) Synchronous orientation permission signal (SORENA)

If this signal is "1", the synchronous orientation command is issued at the rising edge of the SPPHS signal.
If this signal is "0", the spindle phase synchronous command is issued at the rising edge of the SPPHS signal. If this signal becomes "0" during synchronous orientation, the synchronous orientation is released.
In this case, reset the synchronous speed command for both the spindles to "0". SORENA (SORENB) = "1" is output if SORSLA (SORSLB) = "1" is satisfied, and SORENA (SORENB) = "0" is output if SORSLA (SORSLB) = "0" is satisfied.

(b) Spindle speed synchronous control completion signal (FSPSY)

If the spindle synchronous control command is issued, the FSPSY signal becomes "1" when both spindles reach the specified synchronous speed.
Before issuing the spindle phase synchronous control command for reference position setting, make sure that the synchronous speed command is "0" and the FSPSY signal is "1".
The signal becomes "1" if the velocity error between the spindles is smaller than the value specified in parameter No. 4033.

(c) Spindle phase synchronous control completion signal or synchronous orientation completion signal (FSPPH)

If the spindle phase synchronous control command is issued, the FSPPH signal becomes "1" when phase synchronization is completed.
If the synchronous orientation command is issued, the signal becomes "1" when synchronous orientation is completed.
The signal is kept at "0" while SPPHS (spindle phase synchronous control command or synchronous orientation command) = "0".
After the spindle phase synchronous control command has been issued, the signal is output if the following conditions are satisfied.

- The velocity error between the spindles is smaller than the value specified in parameter No. 4034.
- The synchronous error between the spindles is smaller than the value specified in parameter No. 4810.

After the synchronous orientation command has been issued, the signal is output if the following conditions are satisfied.

- The synchronous error between the spindles is smaller than the value specified in parameter No. 4810.
- The position error between the spindles is smaller than the value specified in parameter No. 4075.

(d) Phase synchronous error monitor signal (SYCAL)

This signal is used to detect when a synchronous error becomes large when the spindles are under synchronous control.
If the signal is detected, the PMC usually performs alarm processing.
The signal becomes "1" if the synchronous error between the two spindles becomes larger than or equal to the value specified in parameter No. 4811 when the spindles are under synchronous control.

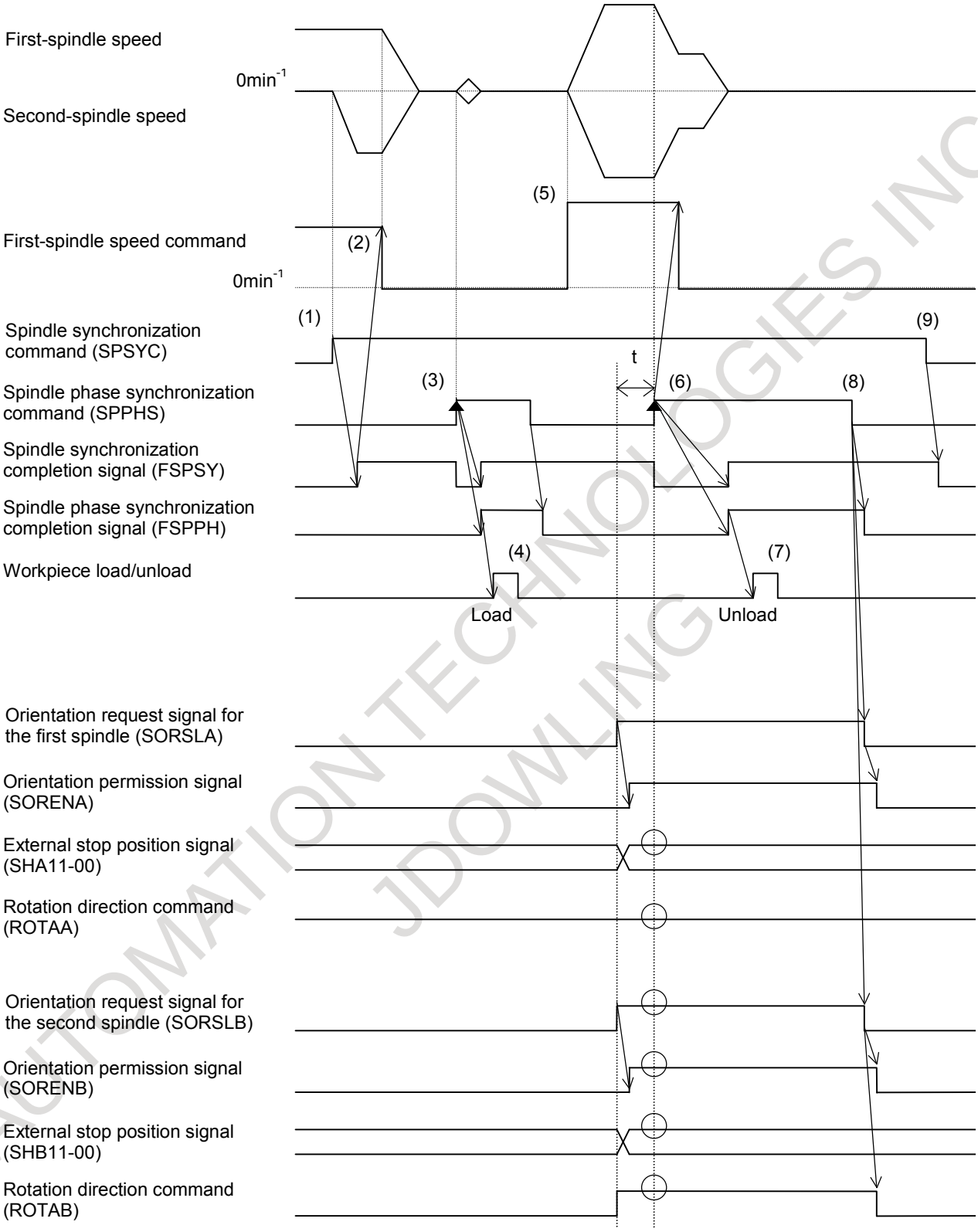
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5.5.5 Sequence

Shown below is an example of a sequence in which synchronous orientation is used. In this example sequence, the first and second spindles are put under spindle synchronous control to perform the machining described below.

(1) The spindle synchronous control command is issued with the first spindle rotating and the second at rest.
(2) Upon completion of spindle synchronization, synchronous speed command = "0" is specified.
(3) The spindle phase synchronous control command is issued for reference position setting.
(4) Upon completion of spindle phase synchronization, a workpiece is loaded.
(5) The workpiece is machined by running the spindles under spindle synchronous control.
(6) The spindles are stopped at a fixed position, using synchronous orientation.
(7) Upon completion of synchronous orientation, the workpiece is unloaded.
(8) Synchronous orientation is released.
(9) Spindle synchronous control is released.

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NOTE
Set time t to at least 50 ms so that each signal can be asserted securely.

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5.5.6 List of Related Parameters

Parameter No.		Description
0*i*	30*i*	
4801,#0	4801#0	Direction in which each of spindles rotates under spindle synchronous control
4810	4810	That error pulse difference between two spindles on which the spindle phase synchronous completion signal is output
4811	4811	That error pulse difference between two spindles on which the spindle phase synchronous error monitor signal is output
3729#0	3729#0	Whether the stop position external setting-type spindle orientation function is available
4006#3	4006#3	Setting for disabling automatic detection of a one-rotation signal when the spindle synchronous control mode is switched
4014#6	4014#6	Whether the synchronous orientation function is available
4032	4032	Acceleration at spindle synchronous control (It is necessary to specify the same value for the first and second spindles.)
4033	4033	Spindle synchronous speed arrival level
4034	4034	Shift amount at spindle phase synchronous control
4035	4035	Spindle phase synchronous compensation data
4044 4045	4044 4045	Velocity proportional gain on spindle synchronous control (This parameter is selected with the input signal CTH1A.)
4052 4053	4052 4053	Velocity integral gain on spindle synchronous control (This parameter is selected with the input signal CTH1A.)
4056 to 4059	4056 to 4059	Gear ratio data between spindle and motor (These parameters are selected with the input signals CTH1A and CTH2A.)
4065 to 4068	4065 to 4068	Position gain on spindle synchronous control (It is necessary to specify the same value for the first and second spindles.) (These parameters are selected with the input signals CTH1A and CTH2A.)
4075	4075	Orientation completion signal detection level
4085	4085	Motor voltage setting on spindle synchronous control
4336	4336	Acceleration magnetic flux switching point for spindle synchronous control (It is necessary to specify the same value for the first and second spindles.)
4340	4340	Bell-shaped acceleration/deceleration time constant for spindle synchronous control (It is necessary to specify the same value for the first and second spindles.)
4369	4369	Synchronous orientation deceleration coefficient

NOTE
1 See Section 1.3, “PARAMETERS RELATED TO DETECTORS”, in Part I for parameters related to detectors.
2 See Section 4.1, “VELOCITY LOOP GAIN ADJUSTMENT”, in Part I for velocity loop proportional/integral gain tuning.
3 See “Function Description: Spindle Synchronous Control” for parameters related to the spindle synchronous control function.

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5.5.7 Details of Related Parameters

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
3729	3729								ORT_S

ORT_S The stop position external setting-type spindle orientation function is:
0 : Disabled
1 : Enabled
Set to "1".

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4014	4014		SYCORI						

SYCORI : The synchronous orientation function is:
0 : Disabled
1 : Enabled
Set to "1" for both the spindles.

0*i*	30*i*	
4075	4075	Orientation completion signal detection level

Unit of data : 1 pulse unit (360 degrees/4096)
Valid data range : 0 to 100
Initial setting : 10
This parameter is used to specify the synchronous orientation completion pulse width. When the synchronous orientation command is issued, the synchronous orientation completion signal (FSPPH) becomes "1" if the spindle stop position is within the setting data range.
Specify the same value for both the spindles.
This parameter is used also for regular orientation.

0*i*	30*i*	
4369	4369	Synchronous orientation deceleration coefficient

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 0
This parameter is used to specify a change that occurs in the spindle speed during synchronous orientation as a ratio to the acceleration during spindle synchronous control (parameter No. 4032). If the setting is "0", it is assumed to be 100%. (The change ratio specified in parameter No. 4032 is used without modification.)
Specify the same value for both the spindles.

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5.6 UNEXPECTED DISTURBANCE TORQUE DETECTION FUNCTION (OPTIONAL FUNCTION)

5.6.1 Overview

This function estimates disturbance torque due to machining load, and detects the unexpected disturbance torque detection alarm when the estimated toruque exceed the alarm detection level.
And you can monitor the estimated disturbance torque.
So, it can be used to detect a broken tool and to manage the tools for service life.

NOTE
1 Using this function requires the CNC software option for the unexpected disturbance torque detection function.
2 A broken or worn tool may or may not be able to be detected depending on the machine condition.
3 This function can be used with sensorless motor.

5.6.2 Series and Editions of Applicable Spindle Software

Series	Edition	Remark
9D50	A (01)	FS0*i* -D
9D70	A (01)	FS30*i* / FS31*i* / FS32*i* -A
9D80	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9D90	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	A (01)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B–
9DB0	A (01)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

5.6.3 I/O Signals (CNC↔PMC)

(1) Address list of output signals (CNC→PMC)

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
F090	F090					ABTSP3	ABTSP2	ABTSP1	
F091	F091				ABTSP4				

(2) Details of output signals (CNC→PMC)

(a) First-spindle unexpected disturbance torque detection signals (ABTSP1)
(b) Second-spindle unexpected disturbance torque detection signals (ABTSP2)
(c) Third-spindle unexpected disturbance torque detection signals (ABTSP3)
(d) Fourth-spindle unexpected disturbance torque detection signals (ABTSP4)

These signals are output "1" when the estimated load torques on the respective spindles become higher than or equal to the set level. Refer to "UNEXPECTED DISTURBANCE TORQUE DETECTION" of an applicable CNC Connection Manual (Function) for details.

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5.6.4 List of Related Parameters

Parameter No.		Description
0*i*	30*i*	
4015 #1	4015 #1	Whether the unexpected disturbance torque detection function is available (The CNC software option is required.)
4248	4248	Torque constant for spindle load torque monitoring (for high-speed output switching characteristics)
4281	4281	Torque constant for spindle load torque monitoring (for low-speed output switching characteristics)
4249	4249	Observer gain 1 for spindle load torque monitoring
4250	4250	Observer gain 2 for spindle load torque monitoring
4341	4341	Unexpected disturbance torque detection level

5.6.5 Details of Related Parameters

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4015	4015							SPLDMT	

SPLDMT : Whether the unexpected disturbance torque detection function is available
0 : Unavailable
1 : Available
This parameter is specified automatically by the software option.

0*i*	30*i*	
4248	4248	**Torque constant for spindle load torque monitoring (for high-speed output switching characteristics)**
4281	4281	**Torque constant for spindle load torque monitoring (for low-speed output switching characteristics)**

Unit of data :
Valid data range : 0 to 32767
Initial setting :

Specify the torque constant Kt for calculating the spindle load torque, using the following calculation:

$$Kt = \frac{T\max}{Jm + Jl} \times 4.889$$

*T*max : Motor maximum output torque [Nm] (Use the maximumrated torque or 120% of the short time rated torque as a rough standard.)
Jm : Motor rotor inertia [kgm^2]
Jl : Spindle inertia (in terms of motor axis inertia) [kgm^2]

0*i*	30*i*	
4249	4249	**Observer gain 1 for spindle load torque monitoring**
4250	4250	**Observer gain 2 for spindle load torque monitoring**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 500
Specify the gain (usually “500”) for the spindle load torque estimation observer.

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0*i*	30*i*	
4341	4341	**Unexpected disturbance torque detection level**

Unit of data : 0.01%
Valid data range : 0 to 10000
Initial setting : 0

The level to change is set to "1" for the spindle unexpected disturbance torque detection signal, using a percentage to the motor maximum output torque. If this parameter is "0", detection is invalid, and spindle unexpected disturbance torque detection signal is not change to "1".
After setting of the torque constant (No.4248), the detection level is set using torque data of the processing.

5.6.6 Parameter Tuning Procedure

(1) Parameter initialization

Initialize the parameters related to the unexpected disturbance torque detection function as listed below.

No.	Description	Initial setting
4015#1	Whether the unexpected disturbance torque detection function is available (The CNC software option is required.)	1
4248	Torque constant for spindle load torque monitoring	Specify an appropriate value according to the spindle inertia (see the following expression).
4249	Observer gain 1 for spindle load torque monitoring	500
4250	Observer gain 2 for spindle load torque monitoring	500
4341	Unexpected disturbance torque detection level	0 (to be changed to an appropriate value according to the use of the machine)

(2) Initial setting of the torque constant (parameter No. 4248)

Using the following expression, calculate the initial torque constant setting according to the spindle inertia and specify it in the corresponding parameter.

$$Kt = \frac{T\max}{Jm + Jl} \times 4.889$$

*T*max : Motor maximum output torque [Nm] (Use the maximum rated torque or 120 % of sort time rated as a rough standard)
Jm : Motor rotor inertia [kgm^2]
Jl : Spindle inertia (in terms of motor axis inertia) [kgm^2]

Example) Initial torque constant setting for the α*i*I3/10000

Letting motor rotor inertia Jm, motor maximum output torque Tmax, and spindle inertia Jl be, respectively, 0.0148 kgm^2, 35.0 × 1.2 = 42.0 Nm, and 0.0250 kgm^2, the torque constant is:

Kt = 42.0/(0.0148 + 0.0250) × 4.889 = 5159.24

So, set parameter No. 4248 to "5159".

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(3) Tuning the torque constant (parameter No. 4248)

Described below is how to tune the torque constant while observing the spindle torque data, using SERVO GUIDE. Refer to an applicable maintenance manual for detailed explanations about how to use SERVO GUIDE. First set up SERVO GUIDE as listed below.

Kind of data	Unit of data observed
SPEED（The speed of motor）	[min^{-1}]
DTRQ（Torque of load of spindle）	[%]

With the above settings, direct the machine to run at a speed that matches your machining program, cause it to perform acceleration/deceleration with no load, and observe the load torque on the spindle.
While observing the waveform of the spindle load torque, tune the torque constant so that the spindle load torque during acceleration will get close (and flat) to 0.
See the following charts for details.

Fig. <1>: Parameter No. 4248 = 10000

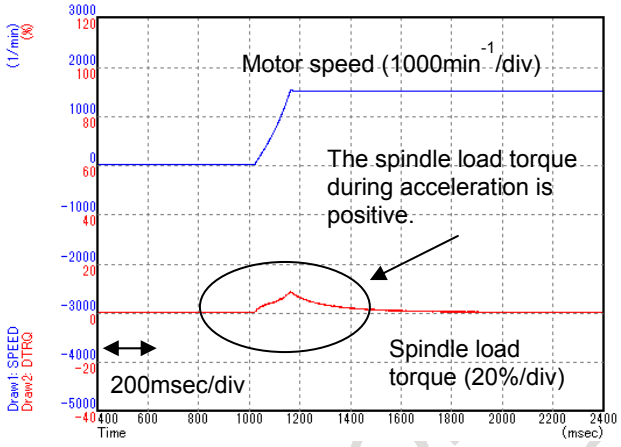


Fig. <2>: Parameter No. 4248 = 15000

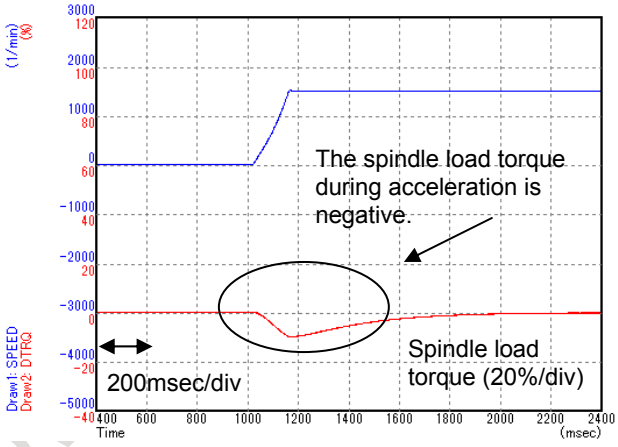
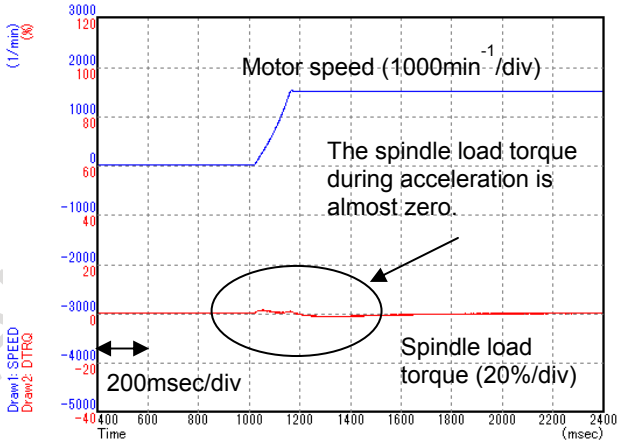


Fig. <3>: Parameter No. 4248 = 9000



NOTE
If you read the spindle load torque by PMC window function, 16384 is equivalent to T_{max} (maximum output torque of motor).

5.7 SPINDLE EGB (SPINDLE ELECTRONIC GEAR BOX) (OPTIONAL FUNCTION)

5.7.1 Overview

The spindle EGB function is intended to use one of spindles in a pair as a tool axis (master axis) and the other as a workpiece axis (slave axis) and cause the slave axis to rotate in synchronization with the master axis at a specified synchronous ratio. Refer to "SPINDLE ELECTRONIC GEAR BOX" of an applicable CNC Connection Manual (Function) for details of this function.

NOTE
1 Using this function requires the CNC software option.
2 Using this function requires α*i*SP TYPE B or α*i*SP-B for both the master and slave axes (β*i*SVSP/β*i*SVSP-B does not support this function).
3 For the master and slave axes, use the spindle software of the same series and edition.
4 This function cannot be used together with the toque tandem control function.
5 This function cannot be used with the FANUC Series 32*i*-A.
6 T series only used this function in FS0*i*-F.
7 There are no limitations on the assignment of the master and slave axes.
For descriptive purposes, this specification assumes:
Master spindle amplifier: 1st spindle
Slave spindle amplifier: 2nd spindle
8 When using the 30*i*-B series (FSSB communication), connect the spindle motors for the master and slave axes for the spindle EGB to the same FSSB line.
9 This function cannot be used with sensorless motor.

5.7.2 Series and Editions of Applicable Spindle Software

Spindle software

Series	Edition	Remark
9D80	A (01)	FS30*i* / FS31*i* -A
9D90	A (01)	FS30*i* / FS31*i* -A
9DA0	B (02)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B

NOTE
When using the α*i*CZ sensor (serial) as the motor or spindle sensor, use 9D80 series H (08) edition.

CNC software*

Series	Edition	Remark
G003/G013/ G023/G033/ G00C/G01C G02C/G03C	28 edition or later	FANUC Series 30*i*/300*i* /300*i*s-A
G004/G014 G024/G034	01 edition or later	

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Series	Edition	Remark
G123/G133 G12C/G13C	28 edition or later	FANUC Series 31*i*/310*i* /310*i*s-A5
G124/G134	01 edition or later	
G103/G113	28 edition or later	FANUC Series 31*i*/310*i* /310*i*s-A
G104/G114	01 edition or later	

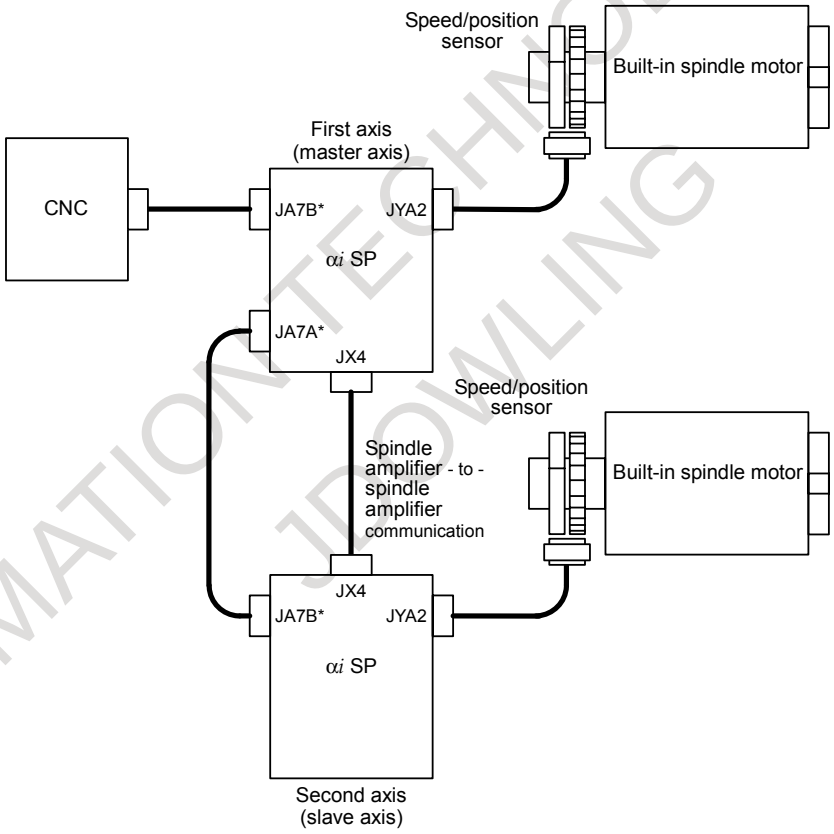
* The FANUC Series 30*i*-B supports any editions including the first edition.

5.7.3 System Configuration

The spindle EGB function is usable in the following system configuration.

NOTE
The spindle EGB function is usable between spindles having a different detector configuration.

(1) System configuration with built-in motors



* For the FS30*i*-B series CNC, 0*i*-F (FSSB communication), use COP10A/COP10B instead of JA7A/JA7B.

NOTE
When using the α*i*CZ sensor (serial) as the speed/position sensor, connect the feedback cable to JYA3.

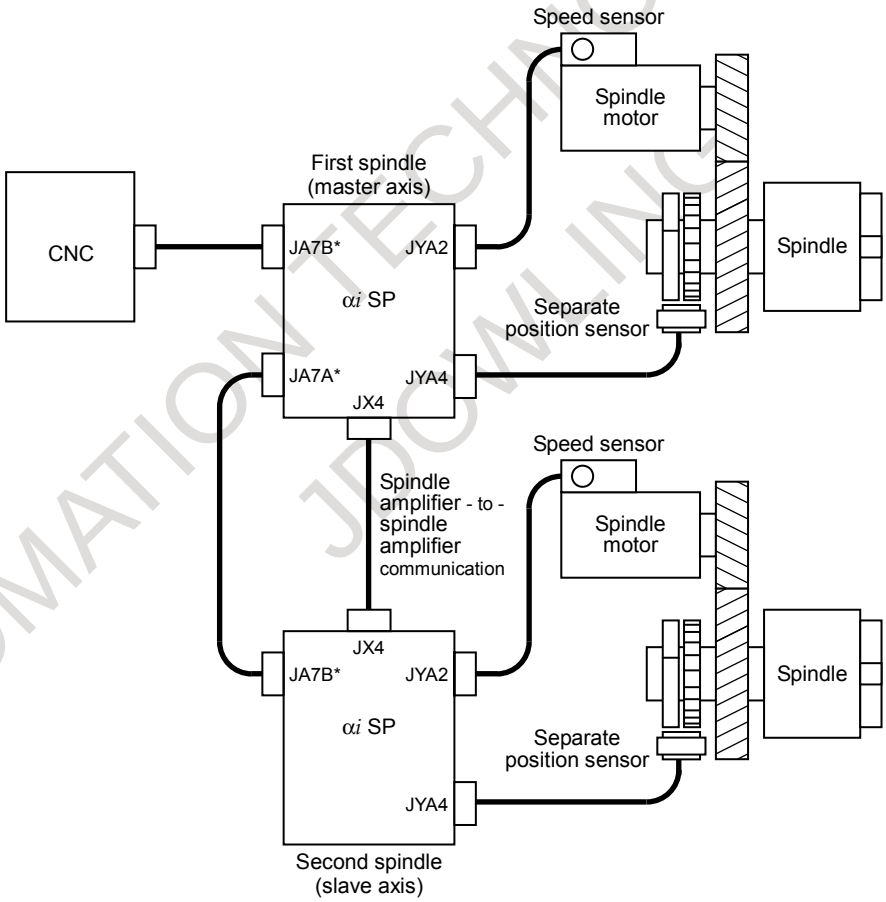
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Parameter settings related to detectors

Parameter	Setting	Description
4000#0	0	The spindle and motor rotates in the same direction.
4002#3,2,1,0	0,0,0,1	The motor sensor is used for position feedback.
4003#7,6,5,4	0,0,0,0	It is unnecessary to specify the number of the spindle sensor teeth.
4010#2,1,0	0,0,1	αiMZ/αiBZ/αiCZ sensor (analog)
	0,1,1	αiCZ sensor (serial)
4011#2,1,0 or 4334	Depending on the sensor.	Setting for the number of motor sensor (speed sensor) teeth
4056 to 4059	100 or 1000	The spindle-to-motor gear ratio is 1:1. (The settings for these parameters vary depending on the gear ratio increment system specified in bit 1 or parameter No. 4006.)
4386 (*)	Depending on the sensor.	Setting for the number of master-axis motor sensor (speed sensor) teeth

(*) This parameter is valid only for the slave axis (second spindle).

(2) System configuration with separate αiBZ sensors or separate αiCZ sensors



* For the FS30i-B series CNC, 0i-F (FSSB communication), use COP10A/COP10B instead of JA7A/JA7B.

NOTE
When using the αiCZ sensor (serial) as the separate position sensor, connect the feedback cable to JYA3.

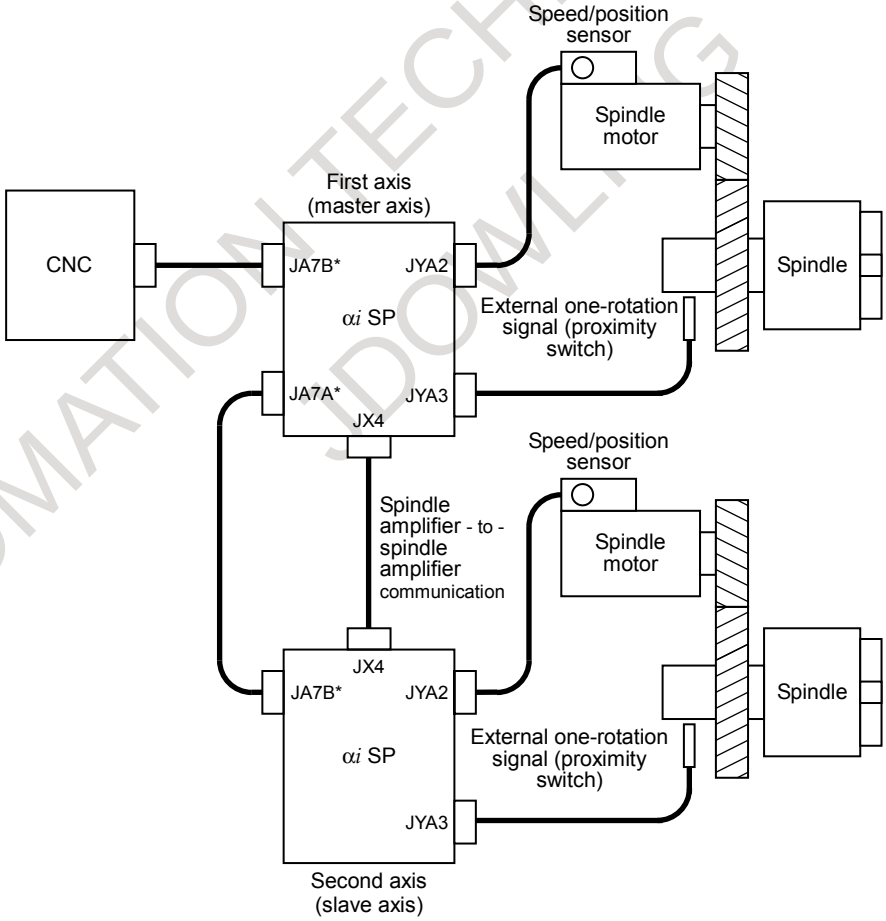
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Parameter settings related to detectors

Parameter	Setting	Description
4000#0	Depending on the spindle configuration	Setting for the relationship between the rotation directions of the spindle and motor
4001#4	Depending on the spindle configuration	Setting for the orientation in which the spindle sensor is mounted
4002#3,2,1,0	0,0,1,0	αiBZ sensor, αiCZ sensor (analog)
	0,1,1,0	αiCZ sensor (serial)
4003#7,6,5,4 or 4361	Depending on the sensor	Setting for the number of spindle sensor (position sensor) teeth.
4010#2,1,0	0,0,0	αiM sensor
	0,0,1	αiMZ sensor
4011#2,1,0 or 4334	Depending on the sensor	Setting for the number of motor sensor (speed sensor) teeth
4056 to 4059	Depending on the spindle configuration	Setting for the spindle-to-motor gear ratio
4386 (*)	Depending on the sensor	Setting for the number of master-axis separate position sensor teeth

(*) This parameter is valid only for the slave axis (second spindle).

(3) System configuration where an external one-rotation signal (proximity switch) is used



* For the FS30*i*-B series CNC, 0*i*-F (FSSB communication), use COP10A/COP10B instead of JA7A/JA7B.

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Parameter settings related to detectors

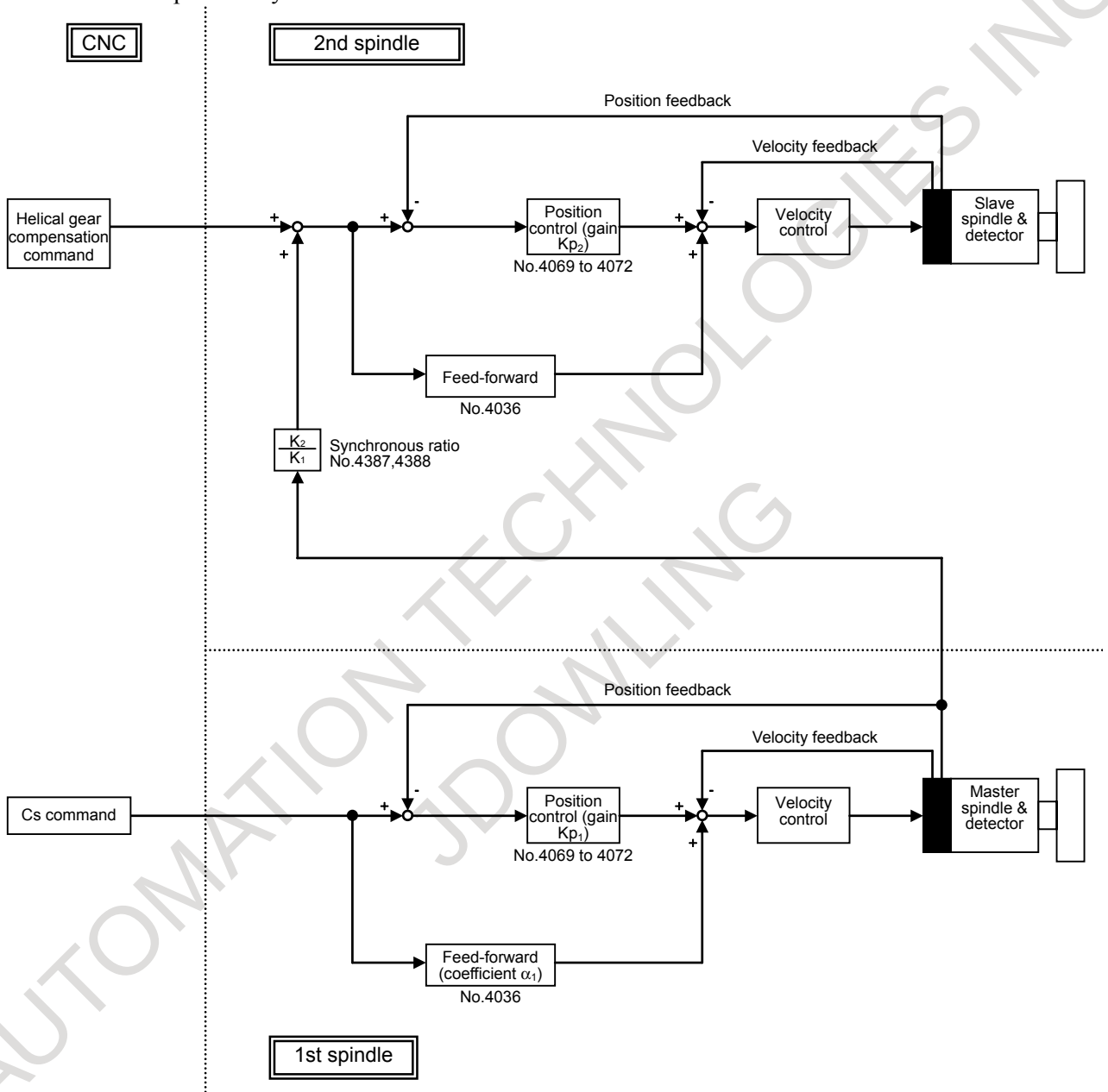
Parameter	Setting	Description
4000#0	Depending on the spindle configuration	Setting for the relationship between the rotation directions of the spindle and motor
4002#3,2,1,0	0,0,0,1	To be used for the position feedback of the motor sensor
4003#7,6,5,4	0,0,0,0	It is unnecessary to specify the number of teeth on the spindle sensor.
4004#2	1	An external one-rotation signal (proximity switch) is used.
4004#3	Depending on the sensor	Setting for the type of the external one-rotation signal (proximity switch)
4010#2,1,0	0,0,1	αiMZ/αiBZ/αiCZ sensor (analog)
4011#2,1,0 or 4334	Depending on the sensor	Setting for the number of motor sensor (speed sensor) teeth
4056 to 4059	Depending on the spindle configuration	Setting for the spindle-to-motor gear ratio
4171 to 4174	Depending on the spindle configuration	Setting for the spindle-to-motor gear ratio (arbitrary gear ratio).
4386 (*)	Depending on the sensor	Setting for the number of master-axis motor sensor (speed sensor) teeth
4498, 4499 (*)	Depending on the spindle configuration	Setting for the master-axis spindle-to-motor gear ratio (arbitrary gear ratio)

(*) This parameter is valid only for the slave axis (second spindle).

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5.7.4 Block Diagram

Shown below is the block diagram of a system configuration in which the spindle EGB is used.
In this system configuration, it is possible to use one of spindles in a pair as a tool axis (master axis) and the other as a workpiece axis (slave axis) and cause the slave axis to rotate in synchronization with the master-axis at a specified synchronous ratio.



NOTE
1 It is possible to drive the master axis (first spindle) on the velocity control mode.
2 To drive the master axis at a constant speed in the Cs contouring control mode, use the position control function for the PMC axis control constant-speed command.

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5.7.5 I/O Signals (CNC↔PMC)

This subsection lists only the input/output signals related to the spindle EGB. Refer to "SPINDLE ELECTRONIC GEAR BOX" of an applicable CNC Connection Manual (Function) for details of each signal.

(1) Input signals (PMC→CNC)

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
G066	G066				RTRCT				

(2) Output signals (CNC→PMC)

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
F065	F065		SYNMOD		RTRCTF				

5.7.6 Examples of Sequences

Refer to "SPINDLE ELECTRONIC GEAR BOX" of an applicable CNC Conection Manual (Function) for spindle EGB sequences.

5.7.7 List of Related Parameters

Parameter No.		Description
0*i*	30*i*	
7700#0	7700#0	Setting for releasing the synchronous control mode at a reset
7700#2	7700#2	Direction for helical compensation
7709	7709	Axis number for helical gear axial feed axis
7710	7710	Spindle EGB slave axis number
7772	7772	The number of pulses the position sensor generates at each rotation of the tool axis (master axis) (Specify 360,000 for the IS-B.)
7773	7773	The number of pulses the position sensor generates at each rotation of the workpiece axis (slave axis) (Specify 360,000 for the IS-B.)
7778	7778	Acceleration for workpiece axis acceleration/deceleration
8005#4	8005#4	Setting for the type of the PMC axis control constant-speed command function
8007#2	8007#2	Setting for the velocity command for PMC axis control
8028	8028	30*i*: Time for calculating the acceleration and deceleration for the velocity command for PMC axis control
8032	8032	Feedrate for calculating the acceleration rate for the velocity command for PMC axis control
8040	8040	Number of pulses the position sensor generates at each rotation of the spindle on a PMC-controlled axis (Specify 360,000 for the IS-B.)
4016#3	4016#3	Setting for the feed-forward smoothing function
4352#4	4352#4	Feed-forward setting
4352#6	4352#6	Inter-spindle amplifier communication slave axis setting
4352#7	4352#7	Inter-spindle amplifier communication master axis setting
4036	4036	Feed forward coefficient
4037	4037	Velocity loop feed forward coefficient
4046 4047	4046 4047	Velocity proportional gain on Cs contouring control (This parameter is selected with the PMC input signal CTH1A.)

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Parameter No.		Description
0*i*	30*i*	
4054 4055	4054 4055	Velocity integral gain on Cs contouring control (This parameter is selected with the PMC input signal CTH1A.)
4069 to 4072	4069 to 4072	Position gain on Cs contouring control (This parameter is selected with the PMC input signal CTH1A.)
4386	4386	Number of master-axis spindle sensor teeth
4387	4387	Synchronous ratio numerator
4388	4388	Synchronous ratio denominator
4498	4498	Denominator of the master-axis motor sensor-to-spindle arbitrary gear ratio
4499	4499	Numerator of the master-axis motor sensor-to-spindle arbitrary gear ratio
4396#2	4396#2	Setting for on-off switching of the EGB command on Cs contouring control
4548#6	4548#6	Setting for 100% of feed forward for the EGB command
4616	4616	Speed for changing slave axis acceleration in EGB automatic phase matching

NOTE
1 See Section 1.3, “PARAMETERS RELATED TO DETECTORS”, in Part I for parameters related to detectors.
2 See Section 4.1, “VELOCITY LOOP GAIN ADJUSTMENT”, in Part I for velocity loop proportional/integral gain tuning.

5.7.8 Details of Related Parameters

This subsection details the serial spindle parameters related to the EGB (in the four thousands). It also briefly describes the parameters related to the position control function for the PMC axis control constant-speed command. Refer to “SPINDLE ELECTRONIC GEAR BOX” of an applicable CNC Conection Manual (Function) for details of other parameters.

(1) Summary of parameters related to the position control function for the PMC axis control constant-speed command

This paragraph summarizes parameters related to the position control function for the PMC axis control constant-speed command. Refer to “PMC AXIS CONTROL” of an applicable CNC Conection Manual (Function) for details of this function and PMC axis control.

NOTE
To drive the master axis at a constant speed in the Cs contouring control mode, use the position control function for the PMC axis control constant-speed command.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
8005	8005				PMCPOS				

PMCPOS Setting for the type of the PMC axis control constant-speed command function
0 : Velocity control
1 : Position control
To be set to “1”

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0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
8007	8007						VCP		

VCP Velocity command for PMC axis control
0 : FS15 specification
1 : FS16 specification
To be set to "1"

0*i*	30*i*	
8028	8028	Time for calculating the acceleration and deceleration for the velocity command for PMC axis control

Unit of data : 1msec
Valid data range : 0 to 32767
Initial setting : 0
Sets the acceleration rate of parameter No. 8032 and this parameter in the velocity command for PMC axis control.

0*i*	30*i*	
8032	8032	Feedrate for calculating the acceleration and deceleration for the velocity command for PMC axis control

Unit of data : min^{-1}
Valid data range : 0 to 32767
Initial setting : 0
Sets the acceleration rate of this parameter and parameter No. 8028 in the velocity command for PMC axis control.

0*i*	30*i*	
8040	8040	Number of pulses the position sensor generates at each rotation of the spindle on a PMC-controlled axis

Unit of data : Minimum detection unit
Valid data range : 1 to 999,999,999
Initial setting : 0
Specify the number of pulses the position sensor generates at each rotation of the spindle on a PMC-controlled axis.
Specify "360,000" for the IS-B.

(2) Details of parameters related to serial spindles

This paragraph details the serial spindle parameters related to the EGB (in the four thousands). See Section 2.4, "Cs CONTOURING CONTROL", in Part I for details of parameters related to Cs contouring control.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4016	4016					FFSMTH			

FFSMTH Setting of smoothing function on feed forward control
0 : Without smoothing function
1 : With smoothing function
Sets the presence of smoothing function on feed forward control of Cs contouring control.
Specify "1" to use spindle EGB control.

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0i	30i	#7	#6	#5	#4	#3	#2	#1	#0
4352	4352	MASTER	SLAVE		FFALWS				

MASTER Inter-spindle amplifier communication master axis setting
0 : Non-inter-spindle amplifier communication master axis
1 : Inter-spindle amplifier communication master axis (Set 1 for the master axis.)

SLAVE Inter-spindle amplifier communication slave axis setting
0 : Non-inter-spindle amplifier communication slave axis
1 : Inter-spindle amplifier communication slave axis (Set 1 for the slave axis.)

FFALWS Feed-forward setting
0 : Feed-forward is enabled only during cutting feed.
1 : Feed-forward is always enabled.
Set 0 for the spindle EGB master axis (first spindle) and 1 for the slave axis (second spindle).

0i	30i	
4036	4036	Feed-forward coefficient

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 0
Set the feed forward coefficient when feed forward control is executed on Cs contouring control.
Set 100 for the spindle EGB slave axis (second spindle).

0i	30i	
4037	4037	Velocity loop feed forward coefficient

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0
Set the velocity loop feed forward coefficient when feed forward control is executed on Cs contouring control. Set the following calculation equation.

$$\text{Setting} = 214466 \times \frac{[\text{spindle inertia} + \text{rotor inertia}]\ (\text{kgm}^2)}{\text{motor maximum torque (Nm)}}$$

0i	30i	
4386	4386	Number of master-axis spindle sensor teeth

Unit of data : 1λ / rev
Valid data range : 0, 64 to 4096
Initial setting : 0
Specify the number of master-axis spindle sensor teeth (position sensor). If "0" is specified, EGB synchronous ratio is assumed to be "0".

NOTE
This parameter is valid only for the slave axis (second spindle).

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0*i*	30*i*	
4387	4387	**Synchronous ratio numerator**

Valid data range : -32767 to 32767
Initial setting : 0
Specify the numerator of a synchronous ratio.

NOTE
This parameter is valid only for the slave axis (second spindle).

0*i*	30*i*	
4388	4388	**Synchronous ratio denominator**

Valid data range : 1 to 65535
Initial setting : 0
Specify the denominator of a synchronous ratio.

NOTE
This parameter is valid only for the slave axis (second spindle).

0*i*	30*i*	
4498	4498	**Denominator of the master-axis motor sensor-to-spindle arbitrary gear ratio**
4499	4499	**Numerator of the master-axis motor sensor-to-spindle arbitrary gear ratio**

Valid data range : 0 to 32767
Initial setting : 0
Specify conversion coefficients (numerator and denominator) to be used when the detection arbitrary gear ratio function (DMR function) is used where the master-axis spindle position feedback signal is obtained by multiplying the feedback signal of the master-axis motor sensor (αiM or αiMZ sensor) by the gear ratio.
If the spindle makes Q turns while the motor shaft makes P turns (where P and Q are mutually prime), the settings are:
Parameter No. 4498 = P and parameter No. 4499 = Q
If the parameters are “0”, they are assumed to be “1”.

NOTE
This parameter is valid only for the slave axis (second spindle).

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4396	4396						**EGBRNX**		

EGBRNX Setting for on-off switching of the EGB command on Cs contouring control
0 : Does not carry the remainder of the EGB move command that is produced when the EGB mode is turned off to the next time.
1 : Carries the remainder of the EGB move command that is produced when the EGB mode is turned off to the next time.
Specifies whether to reflect the remaining data of the EGB move command (= synchronous ratio × travel distance along the master axis) that is produced when the EGB mode is turned off to the next time when the EGB mode is turned on.
Set "1" when repeatedly turning the spindle EGB mode on and off while Cs contouring control is kept on.

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NOTE
*1 This parameter is valid only for the slave axis (second spindle).
*2 This parameter is valid with 9D50 series X (24) edition or later, 9D70 series M (13) edition or later, 9D80 series I (09) edition or later, 9D90 series A (01) edition or later, 9DA0 series B (02) edition or later and 9DB0 series B (02) edition or later.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4548	4548		EGBTFF						

EGBTFF The feed-forward coefficient for the EGB move command:
0 : Depends on the setting of parameter No. 4036.
1 : Is 100%.

NOTE
This parameter is valid with 9D90 series J (10) edition or later, 9DA0 series M (13) edition or later and 9DB0 series B (02) edition or later.

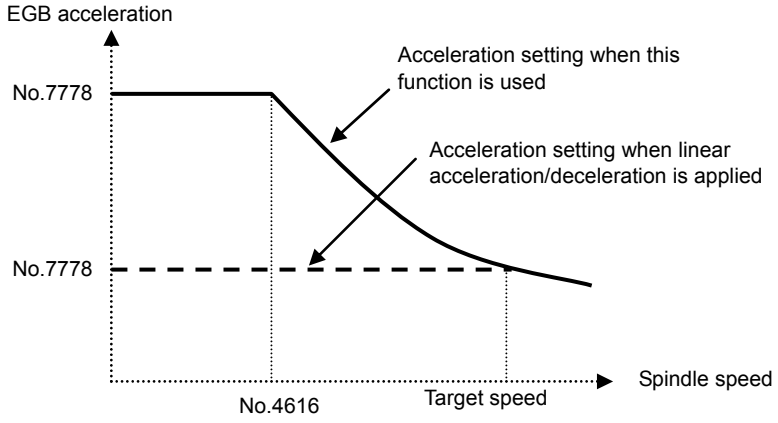
0*i*	30*i*	
4616	4616	**Speed for changing slave axis acceleration in EGB automatic phase matching**

Unit of data : 1 min^{-1} (Unit of 10 min-1 when bit 2 (SPDUNT) of parameter No. 4006 = 1)
Valid data range : 0 to 32767
Initial setting : 0

This parameter changes the acceleration pattern during acceleration/deceleration according to the speed in spindle EGB automatic phase matching. You can use this parameter to reduce the time required for linear acceleration/deceleration.

In EGB automatic phase matching, the slave axis acceleration is changed according to the setting of this parameter:
When the spindle speed does not exceed the setting of parameter No. 4616: The acceleration is fixed (setting of parameter No. 7778).
When this spindle speed exceeds the setting of parameter No. 4616: The acceleration is reduced in inverse proportion to the speed.

When this parameter is set to 0, linear acceleration/deceleration (with the constant acceleration set in parameter No. 7778) is applied until the target speed is reached.



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NOTE
This parameter is valid with 9D90 series G (07) edition or later, 9DA0 series J (10) edition or later and 9DB0 series J (10) edition or later.

5.7.9 Diagnosis Signal Related to Spindle EGB

Address		Description	Unit
0*i*	30*i*		
0716	0716	Synchronous error between master and slave axes. (Weight is slave side)	Pulse

5.7.10 Status Errors Related to Spindle EGB

Error No.	Description	Measure
33	Invalid hardware configuration	Check the model of the CNC in use.
34	An attempt was made to enable both the spindle EGB and FAD functions.	To use the spindle EGB function, disable the spindle FAD function.

5.7.11 Alarms

(1) Spindle alarm

Error No.	Description	Measure
66	An error occurred in inter-spindle amplifier communication.	Check the connection of the cable (JX4).
80	An alarm was issued on the destination amplifier of inter-spindle amplifier communication.	Correct the cause of the alarm on the destination spindle amplifier.

(2) CNC alarm

Refer to “SPINDLE ELECTRONIC GEAR BOX” of an applicable CNC Conection Manual (Function).

Alarm No.	Description
PS1593	Parameter setting mistake related to the EGB
PS1594	Invalid block format of the EGB command
PS1595	A command that should not be issued during EGB synchronization was issued.
PS1596	An overflow occurred for the synchronization coefficient calculation.

5.8 DIFFERENTIAL SPINDLE SPEED CONTROL

5.8.1 Overview

The differential spindle speed control function controls the velocity of one spindle (slave axis) relative to the velocity of the other of spindle (master axis).
Applying this function to rigid tapping enables tapping the center of a workpiece while rotating a spindle (master axis) that holds a workpiece at a constant speed. Therefore, the time required for stopping the workpiece axis (master axis) can be reduced.

NOTE
1 This function cannot be used with sensorless motor.

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5.8.2 Series and Editions of Applicable Spindle Software

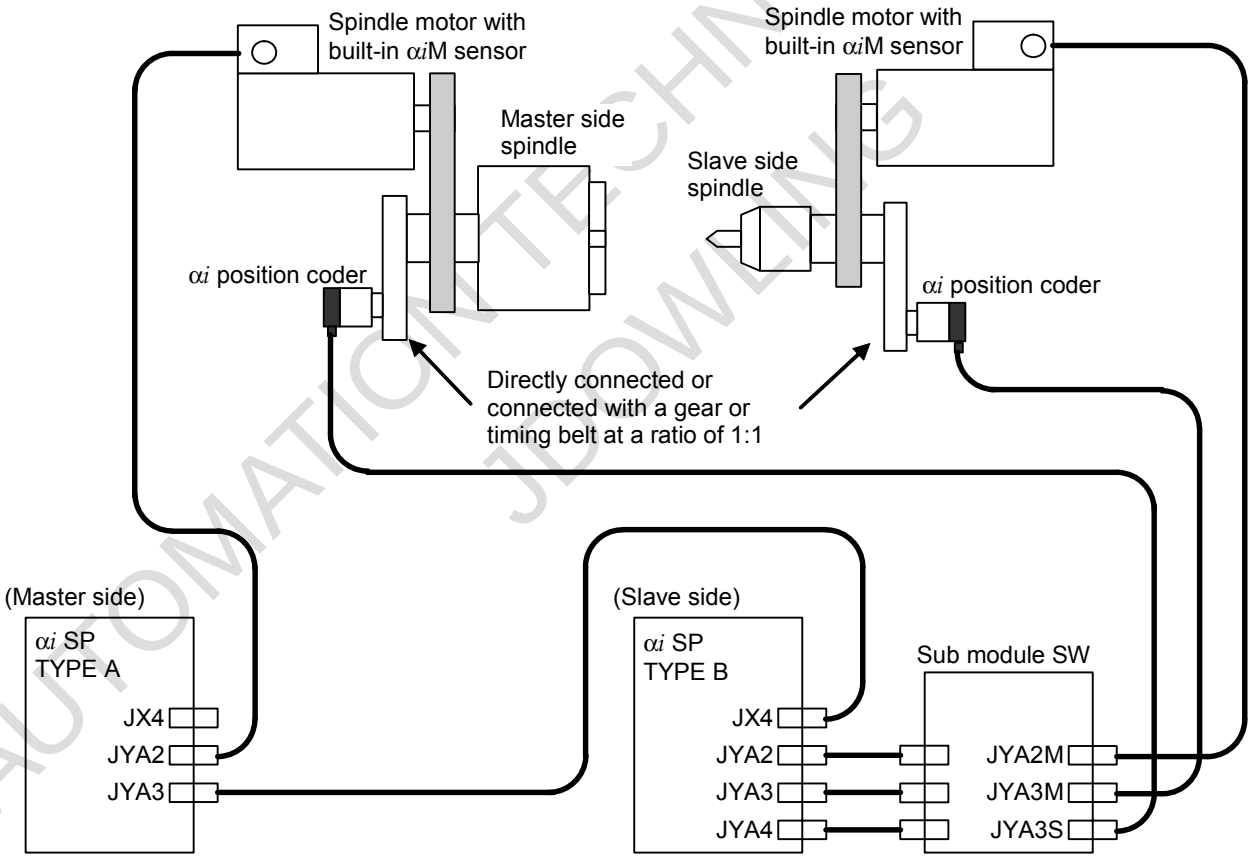
Spindle software

Series	Edition	Usable CNC
9D50	F (06)	FS0*i* -D
9D70	A (01)	FS30*i* / FS31*i* / FS32*i* -A
9D80	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9D90	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	A (01)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

NOTE
1 When the α*i*CZ sensor (serial) is used, this function cannot be used.
2 This function can not be used in β*i*SVSP.

5.8.3 Configuration

The following figure shows an example of a configuration used for differential spindle speed control.



NOTE
1 The sub module SW (SSW) is required in addition to the spindle amplifier to receive the position coder signal from the master side.
2 When the position coder output of connector JX4 is used, spindle amplifier (SP) TYPE B is used (The maximum speed available for the position coder output is 20000 min^{-1}).

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5.8.4 Description

(1) The position coder must be connected to the master side spindle at the ratio of 1:1.
(2) The position coder signal from the master side received by the sub module SW is output from JX4.
(3) Differential spindle speed control can be used only during speed control mode or rigid tapping. It cannot be used during Cs contouring control, spindle synchronous control, or spindle orientation.
(4) When differential spindle speed control is applied to rigid tapping (Differential speed rigid tapping), sum of the velocity of master spindle and the velocity command of rigid tapping for slave spindle must not exceed the maximum speed of slave spindle.
(5) The master side spindle must be kept at a constant speed during rigid tapping. Acceleration or deceleration cannot be performed.
(6) Since the output torque of the motor is normally reduced in high-speed rotation areas, the rigid tapping acceleration/deceleration constant must be set to a greater value.

5.8.5 I/O Signals (CNC↔PMC)

(1) Address list of input signals (PMC→CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G072	G072					DEFMDA			
2nd-	G076	G076					DEFMDB			

(2) Details of input signals (PMC→CNC)

(a) Speed differential mode specification signal (DEFMDA)

This signal is used to specify whether differential spindle speed mode is enabled.
0: Differential spindle speed mode disabled
1: Differential spindle speed mode specified

While this signal is set to 1, the spindle is controlled in differential spindle speed mode.
The velocity of the slave axis in differential spindle speed mode is controlled by the sum of the velocity of the master spindle and the velocity command of the slave spindle.

(3) Output signals (CNC→PMC)

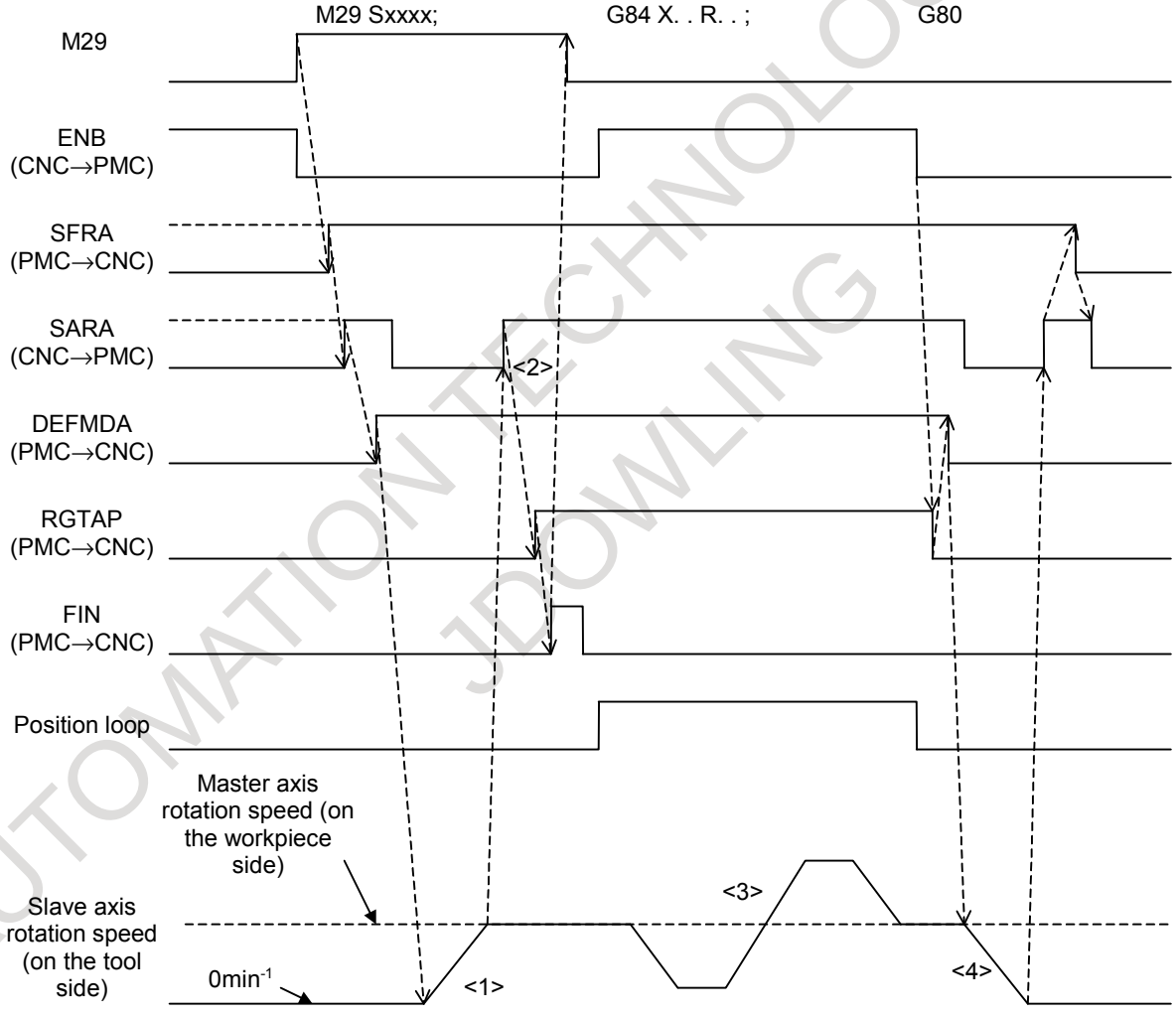
There are no output signals.

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5.8.6 Examples of Sequences

The following shows examples of sequences used when differential speed rigid tapping is performed using the first spindle as the slave axis (on the tool side).

<1> When differential spindle speed mode is commanded to slave spindle, the slave spindle accelerates to the velocity of the master spindle.
<2> After making sure that the slave spindle accelerates to the velocity of the master spindle, start rigid tapping.
<3> Perform differential speed rigid tapping.
<4> When the velocity command of the slave spindle is 0 min^{-1}, if differential spindle speed mode is released upon completion of rigid tapping, the slave spindle stops. If the velocity command of the slave spindle is commanded not equal to 0 min^{-1}, the slave spindle accelerates or decelerates to the velocity commanded.



5.8.7 List of Related Parameters

Parameter No.		Description
0*i*	30*i*	
4000 #5	4000 #5	Whether the differential spindle speed control function is available (to be set to 1)
4000 #6	4000 #6	Setting of direction for differential spindle speed control
4017#0	4017#0	Setting of speed integration operation when differential spindle speed control is exercised

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5.8.8 Details of Related Parameters

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4000	4000		DEFDRT	DEFFNC					

DEFFNC Whether differential spindle speed control function is available
0 : Differential spindle speed control is not available
1 : Differential spindle speed control is available (to be set to 1)

DEFDRT Setting of the direction for differential spindle speed control(feedback polarity on the master side)
0 : Direction same as the feedback signal
1 : Direction opposite to the feedback signal

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4017	4017								VINTDC

VINTDC This parameter sets speed integration operation when differential spindle speed control is exercised.
Set this parameter to 1.

NOTE
This parameter is valid with 9D50 series M (13) edition or later, 9D70 series C (03) edition or later, 9D80 series A (01) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later and9DB0 series A (01) edition or later.

5.8.9 Status Errors on Differential Spindle Speed Control

Error No.	Description	Measure
10	Differential spindle speed mode and Cs mode are specified at the same time.	Check the sequences.
12	Differential spindle speed mode is specified during spindle synchronous control.	Check the sequences.
13	Differential spindle speed mode is specified during spindle orientation.	Check the sequences.
16	Differential spindle speed mode is specified with speed differential control disabled.	Check the parameter settings and sequences.

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5.9 DUAL POSITION FEEDBACK FUNCTION

5.9.1 Overview

When position control is performed by Cs contouring control or rigid tapping with a machine having a large backlash, vibration can be generated in closed loop mode while stable operation is possible in semi-closed loop mode. For such a machine system, the dual position feedback function provides stable control equivalent to control in semi-closed loop mode.

NOTE
1 To use this function, a CNC software option for Cs contouring control or rigid tapping is required.
2 Here, the semi-closed loop refers to positional control by motor sensor, and the closed loop refers to positional control by spindle sensor.
3 The dual position feedback function cannot be used on the spindle switch control SUB side.
4 This function cannot be used with sensorless motor.

5.9.2 Series and Editions of Applicable Spindle Software

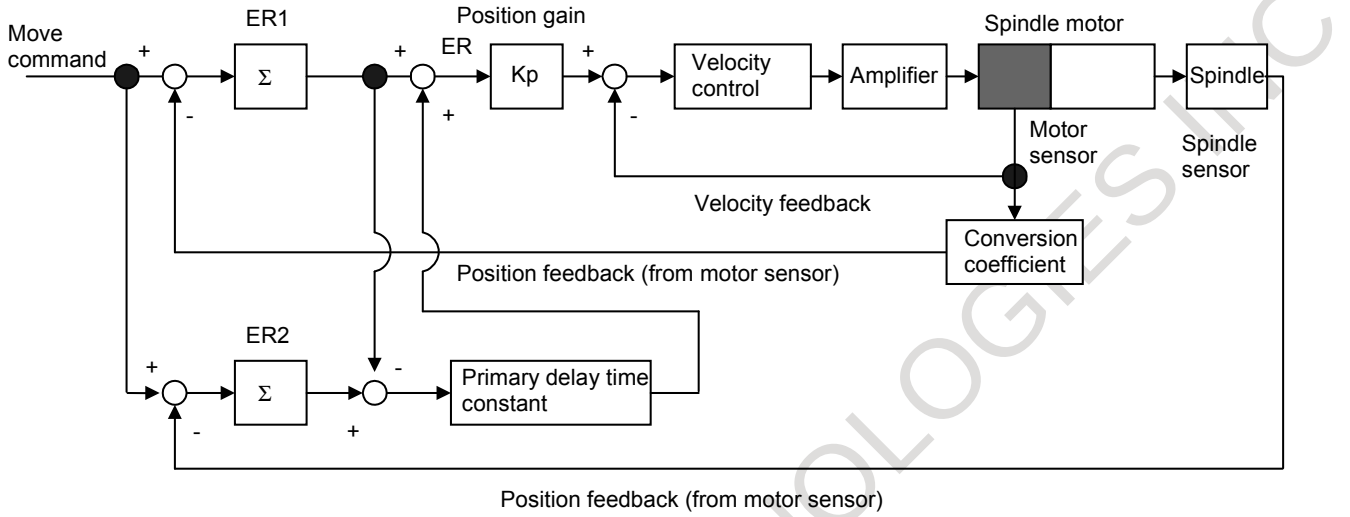
Spindle software

Series	Edition	Usable CNC	Remarks
9D50	A (01)	FS0*i* -D FS30*i* / FS31*i* / FS32*i* -A	Usable only for the dual position feedback function in Cs contouring control
	M (13)		Usable for the dual position feedback function in the servo mode (rigid tapping/spindle positioning)
9D70	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A	Usable only for the dual position feedback function in Cs contouring control
	C (03)		Usable for the dual position feedback function in the servo mode (rigid tapping/spindle positioning)
9D80	A (01)	FS0*i* -D	
9D90	A (01)	FS30*i* / FS31*i* / FS32*i* -A	
9DA0	A (01)	FS0*i* -D, FS0*i* –F, FS30*i* / FS31*i* / FS32*i* / FS35*i*-B	
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i*-B	

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5.9.3 Block Diagram

The following shows a block diagram of dual position feedback:



As shown in the above diagram, error counter ER1 in the semi-closed loop and error counter ER2 in the closed loop are prepared. The primary delay time constant is expressed as follows:

Primary delay time constant = $(1 + \tau s)^{-1}$

Here, consider actual error ER by time constant.

(1) When time constant $\tau = 0$: $(1 + \tau s)^{-1} = 1$
ER = ER1 + (ER2 - ER1) = ER2 (error counter in the closed loop)

(2) When time constant $\tau = \infty$: $(1 + \tau s)^{-1} = 0$
ER = ER1 (error counter in the semi-closed loop)

From the primary delay time constant, control can be provided in the semi-closed loop when a transition state is present, and control can be provided in the closed loop when positioning is performed. According to this principle, vibration during movement can be suppressed to a level equivalent to the level obtained in the semi-closed loop.

5.9.4 List of Related Parameters

Parameter No.		Description
0*i*	**30*i***	
4014#7	4014#7	Setting of dual position feedback
4171	4171	Denominator of conversion coefficient (HIGH) CTH1A=0, CTH2A=0
4172	4172	Numerator of conversion coefficient (HIGH) CTH1A=0, CTH2A=0
4651	4651	Denominator of conversion coefficient (MEDIUM HIGH) CTH1A=0, CTH2A=1
4652	4652	Numerator of conversion coefficient (MEDIUM HIGH) CTH1A=0, CTH2A=1
4653	4653	Denominator of conversion coefficient (MEDIUM LOW) CTH1A=1, CTH2A=0
4654	4654	Numerator of conversion coefficient (MEDIUM LOW) CTH1A=1, CTH2A=0
4173	4173	Denominator of conversion coefficient (LOW) CTH1A=1, CTH2A=1

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Parameter No.		Description	
0*i*	30*i*		
4174	4174	Numerator of conversion coefficient (LOW) CTH1A=1, CTH2A=1	
4215	4215	Primary delay time constant in dual position feedback	[in Cs contouring control]
4224	4224	Maximum amplitude in dual position feedback	[in Cs contouring control]
4225	4225	Dual position feedback zero width	[in Cs contouring control]
4354	4354	Excessive semi-closed loop/closed loop position error alarm detection level	[in Cs contouring control]
4520	4520	Primary delay time constant in dual position feedback	[in servo mode]
4521	4521	Maximum amplitude in dual position feedback	[in servo mode]
4522	4522	Dual position feedback zero width	[in servo mode]
4523	4523	Excessive semi-closed loop/closed loop position error alarm detection level	[in servo mode]

NOTE
1 This subsection lists only those parameters that are specific to dual position feedback. For parameters related to Cs contouring control, see Section 2.4, “Cs CONTOURING CONTROL”, in Part I. For parameters related to rigid tapping, see Section 2.3, “RIGID TAPPING”, in Part I.
2 The dual position feedback function in the servo mode (rigid tapping/spindle positioning) is usable with the following series and editions:
9D50 series M edition (13 edition) or later
9D70 series C edition (03 edition) or later
9D80 series A edition (01 edition) or later
9D90 series A edition (01 edition) or later
9DA0 series A edition (01 edition) or later
9DB0 series A edition (01 edition) or later

5.9.5 Details of Related Parameters

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4014	4014	DUALFB							

DUALFB Setting of dual position feedback
0 : Disables dual position feedback.
1 : Enables dual position feedback.
To use the dual position feedback function, set “1”.

0*i*-	30*i*	
4171	4171	**Denominator of arbitrary gear ratio between motor sensor and spindle (HIGH) CTH1A=0, CTH2A=0**
4172	4172	**Numerator of arbitrary gear ratio between motor sensor and spindle (HIGH) CTH1A=0, CTH2A=0**
4651	4651	**Denominator of arbitrary gear ratio between motor sensor and spindle (MEDIUM HIGH) CTH1A=0, CTH2A=1**
4652	4652	**Numerator of arbitrary gear ratio between motor sensor and spindle (MEDIUM HIGH) CTH1A=0, CTH2A=1**
4653	4653	**Denominator of arbitrary gear ratio between motor sensor and spindle (MEDIUM LOW) CTH1A=1, CTH2A=0**
4654	4654	**Numerator of arbitrary gear ratio between motor sensor and spindle (MEDIUM LOW) CTH1A=1, CTH2A=0**
4173	4173	**Denominator of arbitrary gear ratio between motor sensor and spindle (LOW) CTH1A=1, CTH2A=1**

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4174	4174	**Numerator of arbitrary gear ratio between motor sensor and spindle (LOW) CTH1A=1, CTH2A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0

These parameters set conversion coefficients (numerator, denominator) for using the detection arbitrary gear ratio function (DMR function) by multiplying a motor sensor (α*i*M or α*i*MZ sensor) feedback signal by a gear ratio to produce a spindle position feedback signal.
When the spindle rotates Q times while the motor shaft rotates P times (there is no common divisor other than 1 for P and Q), settings are:

No. 4171 (No. 4173 when CTH1A = 1) = P
No. 4172 (No. 4174 when CTH1A = 1) = Q

In the case of these setting parameters are "0", each parameter are handled as follows.

PARAMETER	GEAR	Handling when set to "0"
4171, 4172	HIGH	It is handled as "1"
4651, 4652	MEDIUM HIGH	When No.4651=0 or No.4652=0, gear ratio of LOW(CTH1A=1,CTH2A=1) is handled MEDIUM HIGH(CTH1A=0,CTH2A=1)
4653, 4654	MEDIUM LOW	When No.4653=0 or No.4654=0, gear ratio of LOW(CTH1A=1,CTH2A=1) is handled MEDIUM HIGH(CTH1A=1,CTH2A=0)
4173, 4174	LOW	It is handled as "1"

NOTE
*1 When using the external one-rotation signal (proximity switch), use the detection arbitrary gear ratio function (DMR function) by setting an arbitrary gear ratio between the motor sensor and spindle in this parameter.
*2 If the α*i* CZ sensor (serial) is used, this parameter is invalid.
*3 No.4651 to No.4654 are valid with 9D9A series B (02) edition or later, 9DAA series E (05) edition or later and 9DB0 series C (03) edition or later.
If not indicated above edition, CTH2A signal is not refered, HIGH or LOW is selected by CTH1A signal only.

0*i*	30*i*	
4215	4215	**Primary delay time constant in dual position feedback [in Cs contouring control]**

Unit of data : 1msec
Valid data range : 0 to 32767
Initial setting : 0

This parameter sets a primary delay time constant in dual position feedback when Cs contouring control is exercised.
If hunting occurs during acceleration/deceleration, set a larger value.
If this parameter is set to 0, the same setting as for a closed loop (= dual position feedback disabled) results.
Setting "32767" provides control equivalent to the semi-closed loop.

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0*i*	30*i*	
4224	4224	**Maximum amplitude in dual position feedback [in Cs contouring control]**

Unit of data : 64 pulses (=0.064deg)
Valid data range : 0 to 32767
Initial setting : 0

This parameter sets a maximum amplitude in dual position feedback when Cs contouring control is exercised.
If an error between the position in the semi-closed loop and the position in the closed loop exceeds the setting, correction clamping occurs.
If "0" is set, correction clamping does not occur.

0*i*	30*i*	
4225	4225	**Dual position feedback zero width [in Cs contouring control]**

Unit of data : 1 pulse (=0.001deg)
Valid data range : 0 to 32767
Initial setting : 0

This parameter sets a dual position feedback zero width when Cs contouring control is exercised.
Positioning is performed so that the difference in position between the closed loop and semi-closed loop does not exceed the pulse width equivalent to the parameter-set value.
Set "0" first, and if an unstable condition is observed when the machine is stopped, increase the setting.

0*i*	30*i*	
4354	4354	**Excessive semi-closed loop/closed loop position error alarm detection level [in Cs contouring control]**

Unit of data : 64 pulses (=0.064deg)
Valid data range : 0 to 32767
Initial setting : 0

This parameter sets an excessive semi-closed loop/closed loop position error alarm (spindle alarm 61) when Cs contouring control is exercised.
When the position difference (semi-closed loop/closed loop position error) between the semi-closed loop and the closed loop exceeds the value set in this parameter, the alarm (spindle alarm 61) is issued.

0*i*	30*i*	
4520	4520	**Primary delay time constant in dual position feedback [in servo mode]**

Unit of data : 1msec
Valid data range : 0 to 32767
Initial setting : 0

This parameter sets a primary delay time constant in dual position feedback in the servo mode (rigid tapping/spindle positioning).
If hunting occurs during acceleration/deceleration, set a larger value.
If this parameter is set to 0, the same setting as for a closed loop (= dual position feedback disabled) results.
Setting "32767" provides control equivalent to the semi-closed loop.

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NOTE
This parameter is valid with 9D50 series M (13) edition or later, 9D70 series C (03) edition or later, 9D80 series A (01) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later and 9DB0 series A (01) edition or later.

0*i*	30*i*	
4521	4521	**Maximum amplitude in dual position feedback [in servo mode]**

Unit of data : 1 pulse unit (=360/4096 degrees)
Valid data range : 0 to 4095
Initial setting : 0

This parameter sets a maximum amplitude in dual position feedback in the servo mode (rigid tapping/spindle positioning).
If an error between the position in the semi-closed loop and the position in the closed loop exceeds the setting, correction clamping occurs.
If "0" is set, correction clamping does not occur.
If a value not within the valid data range is set, the value is clamped to the maximum allowable value.

NOTE
This parameter is valid with 9D50 series M (13) edition or later, 9D70 series C (03) edition or later, 9D80 series A (01) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later and 9DB0 series A (01) edition or later.

0*i*	30*i*	
4522	4522	**Dual position feedback zero width [in servo mode]**

Unit of data : 1 pulse unit (=360/4096 degrees)
Valid data range : 0 to 4095
Initial setting : 0

This parameter sets a dual position feedback zero width in the servo mode (rigid tapping/spindle positioning).
Positioning is performed so that the difference in position between the closed loop and semi-closed loop does not exceed the pulse width equivalent to the parameter-set value.
Set "0" first, and if an unstable condition is observed when the machine is stopped, increase the setting.
If a value not within the valid data range is set, the value is clamped to the maximum allowable value.

NOTE
This parameter is valid with 9D50 series M (13) edition or later, 9D70 series C (03) edition or later, 9D80 series A (01) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later and 9DB0 series A (01) edition or later.

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0*i*	30*i*	
4523	4523	**Excessive semi-closed loop/closed loop position error alarm detection level [in servo mode]**

Unit of data : 1 pulse unit (=360/4096 degrees)
Valid data range : 0 to 4095
Initial setting : 0

This parameter sets an excessive semi-closed loop/closed loop position error alarm (spindle alarm 61) in the servo mode (rigid tapping/spindle positioning).
When the position difference (semi-closed loop/closed loop position error) between the semi-closed loop and the closed loop exceeds the value set in this parameter, the alarm (spindle alarm 61) is issued.
If a value not within the valid data range is set, the value is clamped to the maximum allowable value.

NOTE
This parameter is valid with 9D50 series M (13) edition or later, 9D70 series C (03) edition or later, 9D80 series A (01) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later and 9DB0 series A (01) edition or later.

5.9.6 Spindle Alarm

Error No.	Description	Measure
61	The difference (semi-closed loop/closed position error) between the semi-closed loop and the closed loop exceeds the set value.	Correct the cause of the semi-closed loop/closed position error.

5.10 VELOCITY TANDEM CONTROL FUNCTION (OPTIONAL FUNCTION)

5.10.1 Overview

Spindle tandem control is a function that drives the spindle with two motors to provide a large output that cannot be obtained with one motor. The following two types are available:
(1) Velocity tandem control
(2) Torque tandem control (induction spindle motor only)

While velocity control is disabled on the slave side in torque tandem control, it is enabled in velocity tandem control. For this reason, velocity tandem control offers greater slave axis stability. Therefore, when applying spindle tandem control, select velocity tandem control under normal circumstances.
Note that, in cases where you do not want the slave axis to exert velocity control (you want both axes to have the same torque although they widely differ in speed), as in wheel lathing, you need to adopt torque tandem control.

The velocity tandem control function drives two spindle motors connected to the spindle using the same velocity command.

NOTE
1 This function has been added to spindle tandem control, which is a CNC software option.

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NOTE

2 When the NC is 0*i*-D or 30*i*-B, the spindle tandem control function is included in the spindle synchronous control option.
3 To apply this function, α*i*SP TYPE B or α*i*SP-B is required (β*i*SVSP/β*i*SVSP-Bdoes not support this function).
4 For the master and slave axes, use the spindle software of the same series and edition.
5 The motors of both axes must be of the same model (both must be induction spindle motors or synchronous spindle motors).
6 Position and velocity control is exerted by the master axis, and the velocity command and the torque command for the velocity integral term of the master axis are passed to the slave axis. The slave axis outputs the torque of obtaining by adding the velocity integral term and the velocity-controlled velocity proportional term.
7 If the gear ratio to the spindle differs between the two axes, the velocity command that the slave axis receives from the master axis is used by converting it with the gear ratio set for it.
8 The effect of backlash between gears can be reduced by combining the master and slave axes with preloads applied on them.
9 The slave axis preload can be scaled in case the characteristics of the two axes are different.
10 This function can be enabled or disabled by turning on or off the PMC signal to the master and slave axes. When the function is disabled, each motor can be operated individually.
11 This function can be used in velocity control mode, spindle orientation, rigid tapping mode, or Cs contour control.
12 Make sure that the motors of both axes are stopped when performing the speed range switching operation.
13 This function cannot be used together with the following functions:
- Spindle synchronous control function
- Spindle switching function
- Position coder signal output function
- Spindle EGB function
- Spindle repetitive control function

14 This function cannot be used for twin drives (two-winding motors and induction machines only).
15 No limitation is imposed on master and slave axis assignment.
In the descriptions herein, the following assignment is used for convenience:
Master spindle amplifier: First spindle
Slave spindle amplifier: Second spindle
16 Depending on the type of spindle sensor in use, there may be a limitation on the detection speed for a one-rotation signal.
17 When using the 30*i*-B series (FSSB communication), connect the spindle motors for the master and slave axes for velocity tandem control to the same FSSB line.
18 This function cannot be used with sensorless motor.

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5.10.2 Series and Editions of Applicable Spindle Software

Spindle software

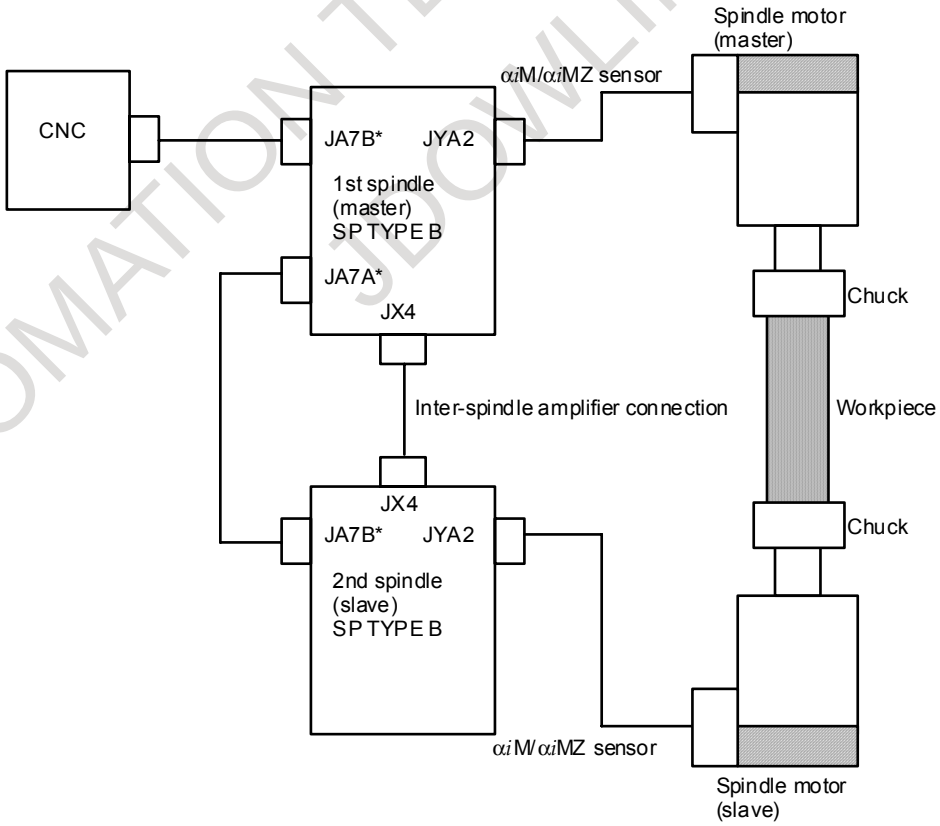
Series	Edition	Usable CNC
9D90	B (02)	FS0*i*–D / FS30*i*-A / FS31*i*-A
9DA0	F (06)	FS0*i*–D / FS0*i* –F / FS30*i*-B / FS31*i*-B / FS32*i*-B
9DB0	A (01)	FS0*i* –F / FS30*i*-B / FS31*i*-B / FS32*i*-B

NOTE
To use the αiCZ sensor (serial), the 9D90 series G (07) edition or later or the 9DA0 series I (09) edition or later is required or the 9DB0 series A (01) edition or later.

5.10.3 System Configuration

NOTE
1 For connection details of each cable, refer to "FANUC SERVO AMPLIFIER αi series DESCRIPTIONS (B-65282EN)".
2 The common power supply (PS) emergency stop signal (connector CX4) needs to be input for each common power supply (PS).

(1) Sample configuration 1: System where the master spindle and slave spindle are mechanically connected or disconnected when a workpiece is attached or detached

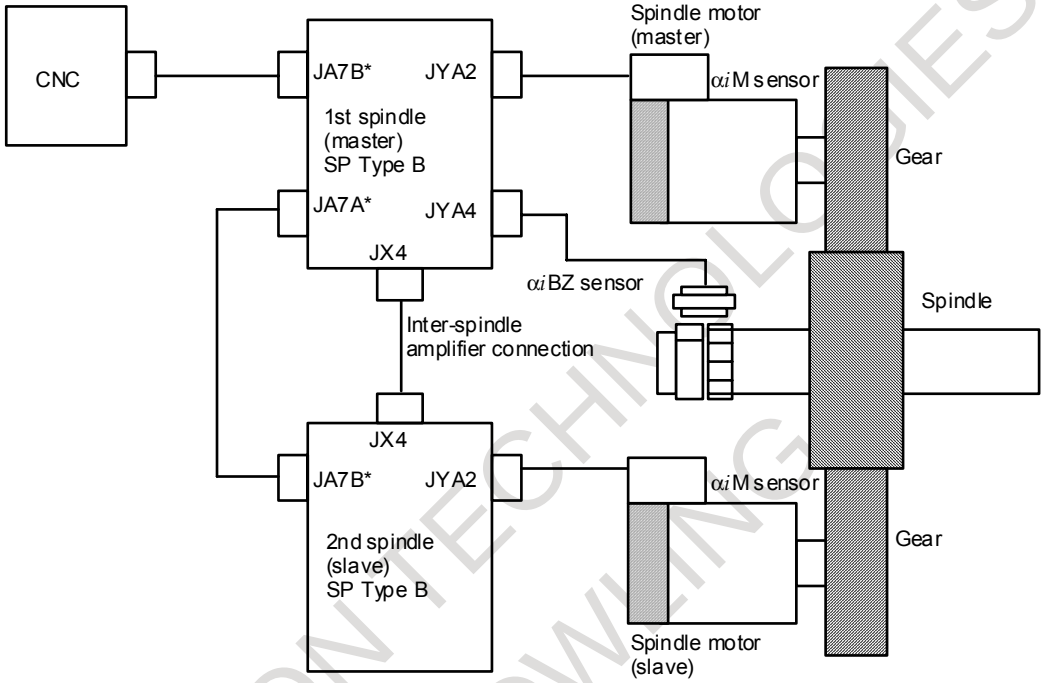


* For the FS30*i*-B series CNC, 0*i*-F (FSSB communication), use COP10A/COP10B instead of JA7A/JA7B.

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NOTE
1 When the master and slave are mechanically disconnected, velocity tandem control cannot be used. In this case, cancel the tandem operation mode.
2 When a synchronous spindle motor is used, the power line between the amplifier and the motor needs to be connected via the sub module SM (SSM).
3 To perform pole detection when a synchronous spindle motor is used, release the mechanical connection to free the synchronous spindle motor.

(2) Sample configuration 2: System where the table axis is driven by two motors



* For the FS30*i*-B series CNC, 0*i*-F (FSSB communication), use COP10A/COP10B instead of JA7A/JA7B.

NOTE
The synchronous spindle motor B*i*S series is a built-in motor and cannot be used for a system such as the above one.

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5.10.4 I/O Signals (CNC↔PMC)

NOTE
1 A command for the spindles engaged in tandem operation is issued to the master spindle amplifier.
The input signal specifications are the same as for ordinary spindles (for which the torque tandem function is not used).
For details of signals used in each control mode, see Chapter 3, “I/O SIGNALS”, in Part I.
2 During tandem operation, no signal needs to be input from the PMC to the tandem function slave spindle amplifier. Those signals that are required to drive the slave spindle amplifier are transferred from the master spindle amplifier by inter-spindle amplifier communication.
3 During tandem operation, use a signal output from the master spindle amplifier for sequence determination (such as speed arrival determination and alarm detection). (No signal output from the slave spindle amplifier is needed.)

(1) Input signals (PMC→CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G070	G070					CTH1A	CTH2A		
2nd-	G074	G074					CTH1B	CTH2B		

CTH1A,CTH2A Clutch/gear signal (for the first spindle)
CTH1B,CTH2B Clutch/gear signal (for the second spindle)
0,0 : HIGH GEAR
0,1 : MEDIUM HIGH GEAR
1,0 : MEDIUM LOW GEAR
1,1 : LOW GEAR
Set these signals based on the status of the clutch or gear. They are used to select the spindle control parameters.

NOTE
In the case of velocity tandem control, note the following:
1 In the velocity tandem control mode, the gear signal (CTH1/CTH2)m for the master axis takes effect for both the master and slave axes. This means that the gear signal for the slave axis is internally linked with the gear signal for the master axis (to prevent the input of the wrong gear signal).
2 For the reason mentioned above, make sure that the numbers of the parameters selected by the gear signal in the velocity tandem control mode are the same for both the master and slave axes.
3 In the normal operation (the velocity tandem control mode is off), the respective gear signals (CTH1/CTH2)m and (CTH1/CTH2)s take effect individually for the master and slave axes.
4 In the velocity tandem control mode, the gear signal for the slave axis (CTH1/CTH2)s does not take effect but may be input in the same way as the gear signal for the master axis (CTH1/CTH2)m.
5 The value of bit 2 of parameter No. 4006 for setting the speed unit needs to be the same for both the master and slave axes.

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	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G071	G071				SOCNA				
2nd-	G075	G075				SOCNB				

SOCNA Soft start/stop signal (for the first spindle)
SOCNB Soft start/stop signal (for the second spindle)
0 : Disables the soft start/stop function.
1 : Enables the soft start/stop function.
These signals enable or disable the soft start/stop function.
Use these signals when limiting the specified acceleration rate to reduce a mechanical shock during acceleration/deceleration.
During tandem operation (SLVx = 1), the signals need not be input to the slave spindle amplifier.

NOTE
1 When using the soft start/stop function, set the acceleration rate in parameter No. 4030.

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G073	G073						MPOFA	SLVA	
2nd-	G077	G077						MPOFB	SLVB	

SLVA Tandem operation command (for the first spindle)
SLVB Tandem operation command (for the second spindle)
0 : Makes a request to disable tandem operation.
1 : Makes a request to enable tandem operation.
These signals enable or disable tandem operation.
When using the tandem function, set these signals to 1 for both of the master and slave.

NOTE
1 Both of the master and slave must be stopped before these signals can be switched.
During rotation, these signals cannot be accepted.
2 Switch these signals in the velocity control mode. In a mode other than the velocity control mode, these signals cannot be accepted. Tandem operation commands for both axes must be turned on simultaneously, or the communication alarm between spindle amplifiers will be detected.
3 When the master and slave are mechanically disconnected with each other, do not set these signals to 1.
4 To input the SLV signal when a synchronous spindle motor is used, make sure that the pole detection complete state EPFIXx is set to 1 for the motors of both axes (first spindle: F048#7 and second spindle: F052#7). Turn off the SLV signal when the pole detection incomplete state is set.

MPOFA Motor power turn-off signal (for the first spindle)
MPOFB Motor power turn-off signal (for the second spindle)
0 : Normal operation
1 : Turns off the power to the motor.
These signals turn off the power to the motor.

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During tandem operation (SLVx = 1), these signals need not be input to the slave spindle amplifier.

NOTE
1 If any abnormality, such as an excessive master-slave speed difference, is detected when the velocity tandem operation is enabled, the power to both the master and slave motors needs to be turned off in order to minimize mechanical damage.
Turn off the power to the motors by using these signals.
2 When a synchronous spindle motor is used, the motors decelerate to a stop using the SSM, rather than coast to a stop, even if these signals are input.

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G306	G306						TDFCANA		
2nd-	G310	G310						TDFCANB		

TDFCANA Preload and multi-axis integrator copy disable signal (for 1st spindle)
TDFCANB Preload and multi-axis integrator copy disable signal (for 2nd spindle)
0 : Enabled.
1 : Disabled.

NOTE
For details, see "Additional information 3: Preload and multi-axis integrator copy".

(2) Output signals (CNC→PMC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F045	F045							SSTA	
2nd-	F049	F049							SSTB	

SSTA Speed zero detection signal (for the first spindle)
SSTB Speed zero detection signal (for the second spindle)
0 : The spindle motor is rotating.
1 : The spindle motor is in the speed zero (stopped) state.
After checking that these signals are set to 1 with both of the master and slave, switch the tandem operation command SLVx.
When these signals are set to 0, the tandem operation command cannot be accepted.

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F046	F046				SLVSA				
2nd-	F050	F050				SLVSB				

SLVSA Tandem operation state signal (for the first spindle)
SLVSB Tandem operation state signal (for the second spindle)
0 : Tandem operation is disabled.
1 : Tandem operation is enabled.
After checking that these signals are set to 1 with both of the master and slave, issue a command to the master spindle amplifier.

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	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F047	F047						MSOVRA		
2nd-	F051	F051						MSOVRB		

MSOVRA Master-slave speed difference state signal(for the first spindle)
MSOVRB Master-slave speed difference state signal (for the second spindle)

0 : The speed difference between the master and slave is less than the set value.
1 : The speed difference between the master and slave is equal to or greater than the set value.

These signals indicate whether or not the speed difference between the master motor and slave motor is less than the value set in the parameter (FS30*i*: No. 4347).
The signal for the slave spindle amplifier need not be monitored. (At all times, 0 is output.)

⚠ CAUTION
1 If a motor feedback signal disconnection alarm (spindle alarm 73) is issued, the status of this signal is undefined.
2 When bit 5 of parameter No. 4007 is set to "1", the detection operation of the feedback signal disconnection alarm is not performed.
Set the parameter to "0" when not required, to enable alarm detection.

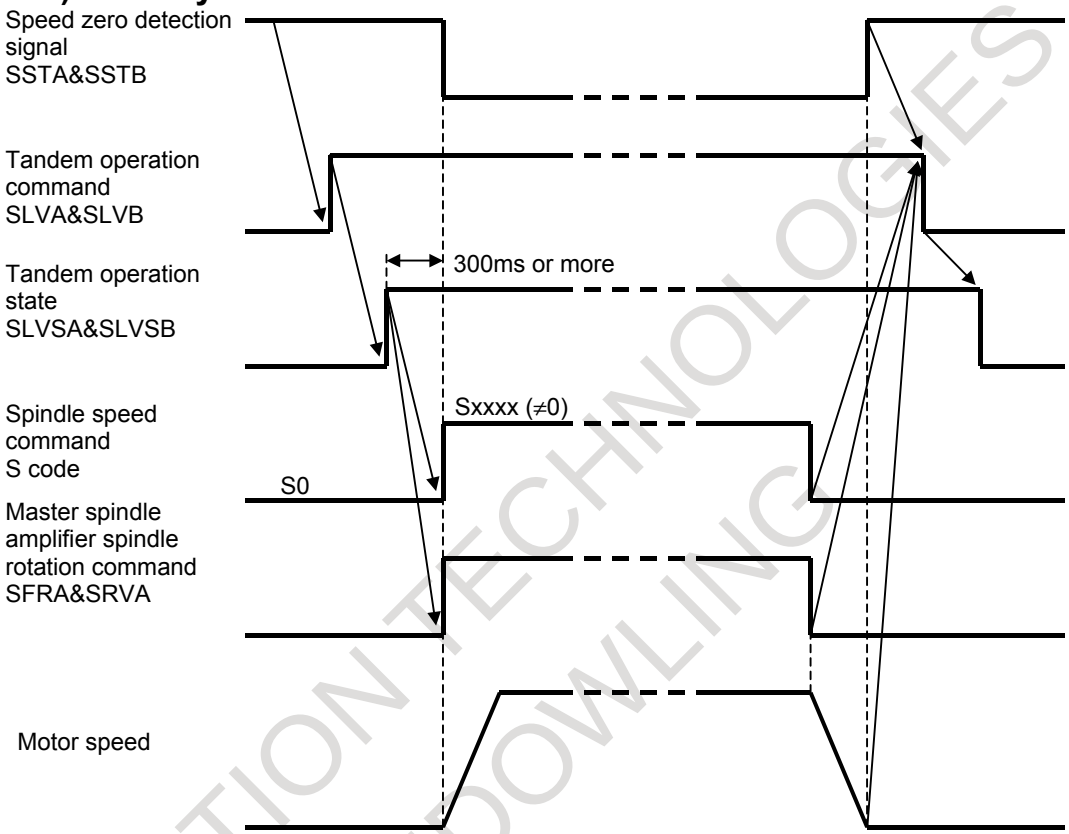
NOTE
Monitor the states of these signals on the PMC. Ensure that an alarm is issued if an error occurs (for example, if the state of 1 lasts for a certain period of time).

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5.10.5 Examples of Sequences

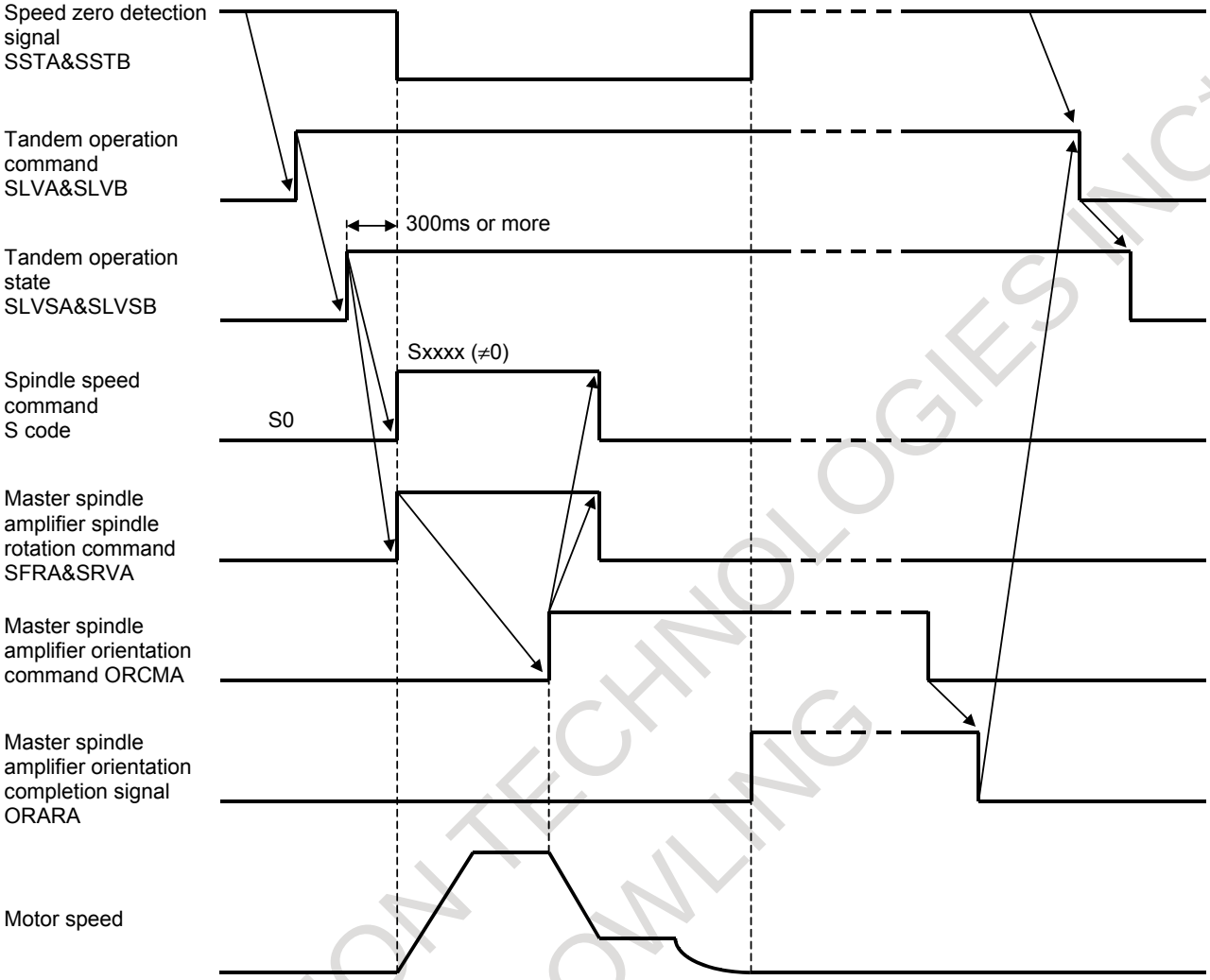
NOTE
Examples of sequences are given below assuming the following:
First spindle: Master spindle amplifier
Second spindle: Slave spindle amplifier

(Example 1) Velocity control mode



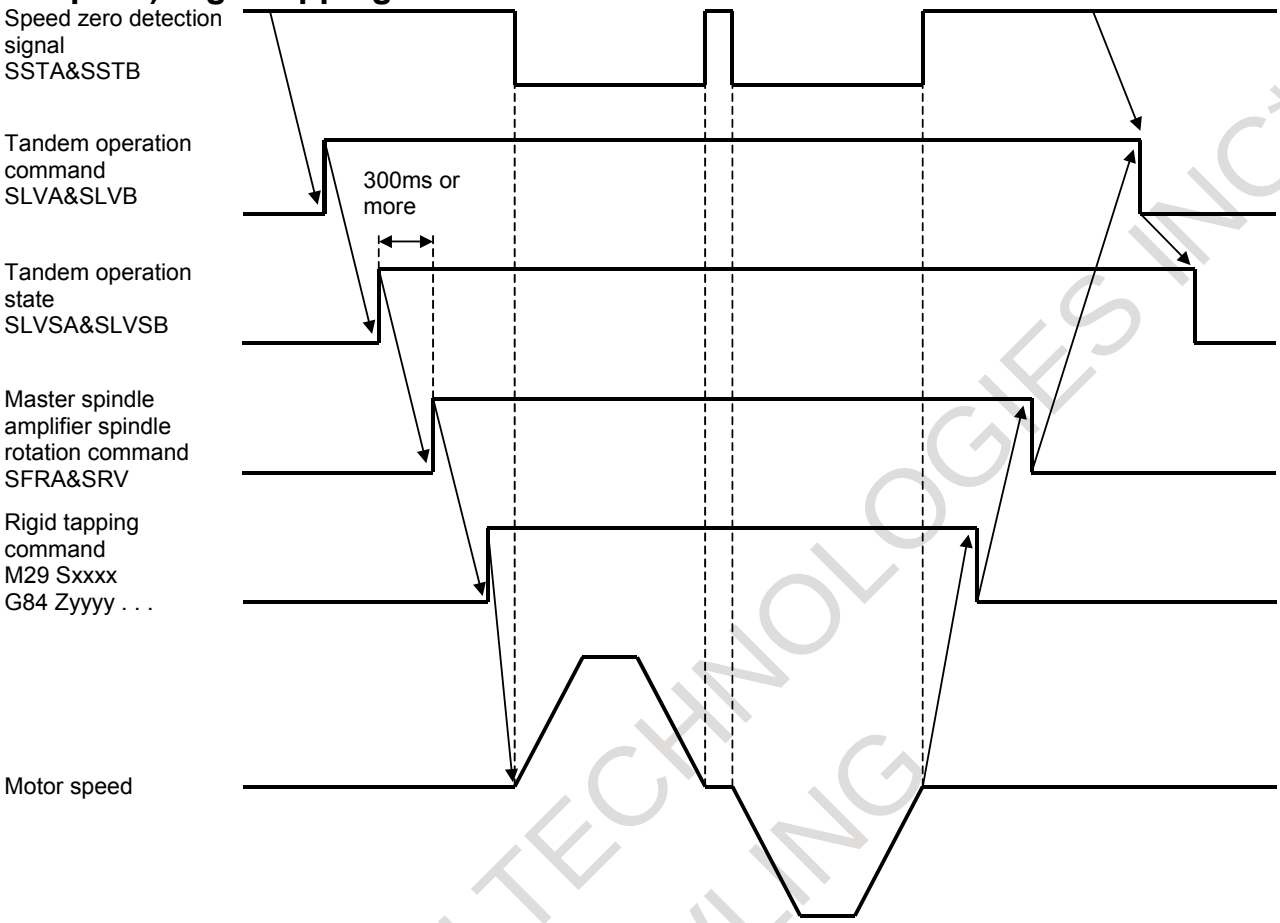
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(Example 2) Spindle orientation



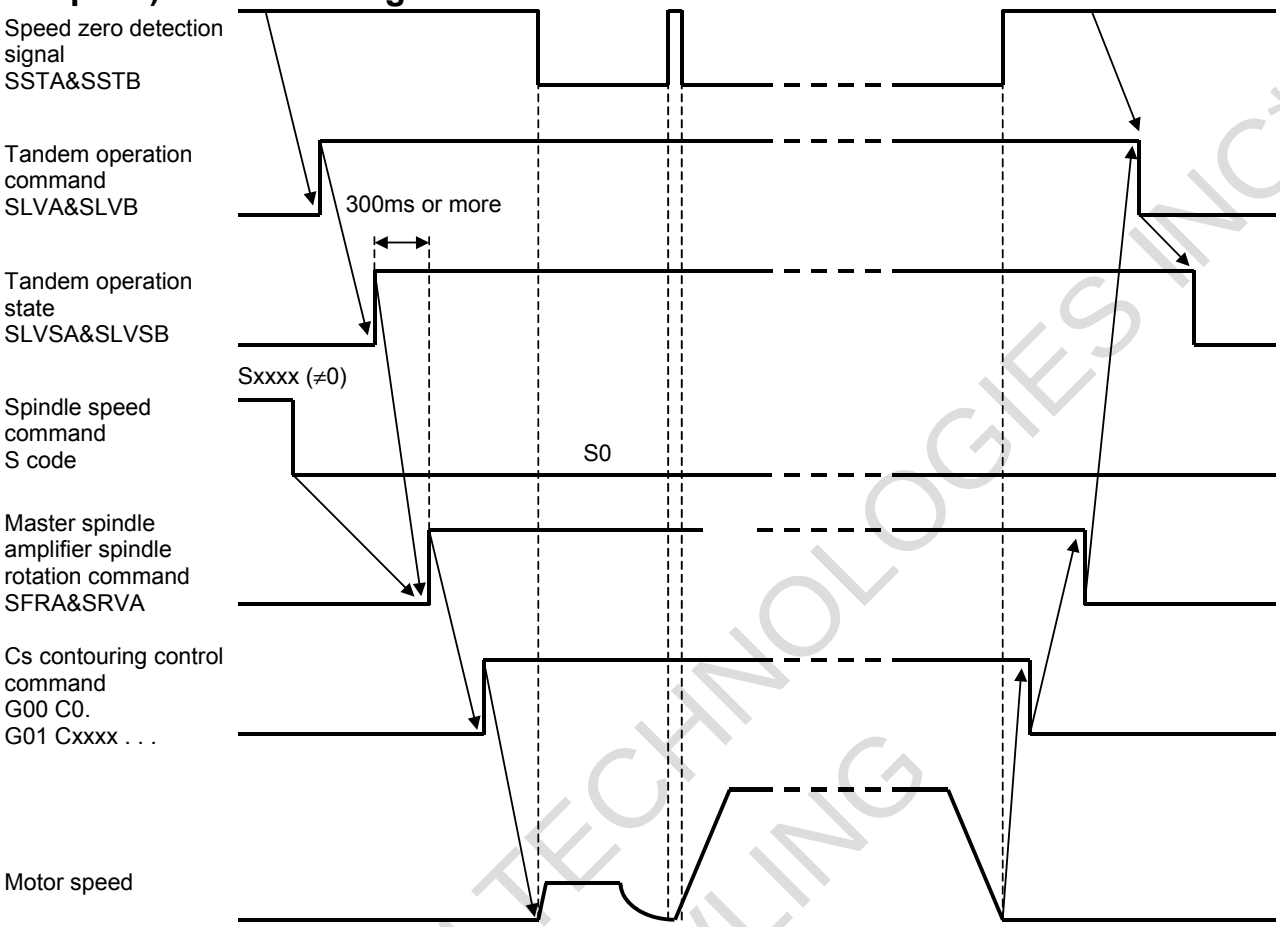
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(Example 3) Rigid tapping



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(Example 4) Cs contouring control



5.10.6 Parameters

(1) Cautions

For the master spindle amplifier and slave spindle amplifier, set the same parameters except for the following specific parameters:

Parameter No.		Description	Master setting	Slave setting
0*i*	30*i*			
4002#3 to 0	4002#3 to 0	Spindle sensor type	Depending on the spindle configuration	Depending on the spindle configuration
4353#2	4353#2	Relationship of master/slave motor rotation directions in tandem operation	Depending on the spindle configuration	0
4352#7 ,6	4352#7 ,6	Inter-spindle amplifier communication setting	1, 0	0, 1
4360	4360	Preload value	Machine by machine (adjustment value)	0*
4606	4606	Preload constant	Machine by machine (adjustment value)	0*

NOTE
If the slave axis preload value is set to No.4360≠0, the slave preload time constant No.4606 please set to same value as master axis.

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(2) List of parameters

Parameter No.		Description
0*i*	30*i*	
4009#2	4009#2	Motor power turn-off method when spindle alarm 24 (serial data transfer error) is issued
4015#3	4015#3	Whether to use the spindle tandem function
4352#7, 6	4352#7, 6	Inter-spindle amplifier communication setting
4353#1	4353#1	Velocity feedback signal setting in tandem operation
4353#2	4353#2	Relationship of master/slave motor rotation directions in tandem operation
4398#3	4398#3	Whether to use the twin drive function
4398#4	4398#4	Whether to use the velocity tandem function
4398#5	4398#5	Whether to use the velocity integrator copy function
4398#6	4398#6	Whether to detect a speed polarity error (spindle alarm d0) in tandem operation
4402#3	4402#3	Whether to use the torque tandem function (for 30i-B)
4347	4347	Output value for the master-slave speed difference state signal
4360	4360	Preload value
4606	4606	Preload constant
4541#3	4541#3	Scaling function for the slave axis preload during velocity tandem control
4541#4	4541#4	Scaling function for the slave axis velocity command during velocity tandem control
4541#5	4541#5	Tandem command SLV acceptance condition setting
4541#6	4541#6	Master/slave motor rotation direction relationship for the multi-axis integrator copy
4542#3, 2	4542#3, 2	Setting related to the preload and multi-axis integrator copy disable signal (TDFCANx)
4597	4597	Setting for the multi-axis integrator copy

(3) Details of Parameters

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4009	4009						**ALSP**		

ALSP Motor power turn-off method when spindle alarm 24 (serial data transfer error) is issued
0 : Turns off the power after the motor is decelerated to a stop.
1 : Turns off the power immediately. (Set this parameter to 1.)

NOTE
If an alarm is issued during tandem operation, the power to both of the master motor and slave motor must be turned off simultaneously to prevent the machine from being damaged. When using the tandem function, be sure to set this parameter to 1 to turn off the power to the motors immediately if a CNC-SP communication error occurs.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4015	4015					**SPDTDM**			

SPDTDM Whether to use the spindle tandem function (The CNC software option is required.)
0 : Does not use the spindle tandem function.
1 : Uses the spindle tandem function.

NOTE
If this bit is set to 0, the tandem function does not operate normally. When this bit is set to 0, check the software option.

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0i	30i	#7	#6	#5	#4	#3	#2	#1	#0
4352	4352	MASTER	SLAVE						

SLAVE Inter-spindle amplifier communication slave axis setting
0 : Non-inter-spindle amplifier communication slave axis
1 : Inter-spindle amplifier communication slave axis (Set this parameter to 1 for the slave spindle amplifier.)

MASTER Inter-spindle amplifier communication master axis setting
0 : Non-inter-spindle amplifier communication master axis
1 : Inter-spindle amplifier communication master axis (Set this parameter to 1 for the master spindle amplifier.)

NOTE
If both SLAVE and MASTER setting are 1, the state error 38 will occur.

0i	30i	#7	#6	#5	#4	#3	#2	#1	#0
4353	4353						RVSVC2	VFBAV	

VFBAV Velocity feedback signal setting in tandem operation
0 : For speed control, the master spindle amplifier motor speed only is used.
1 : For speed control, the average speed of the master spindle amplifier and slave spindle amplifier is used.
By exercising speed control using the average speed feedback value of the master and slave, vibration caused by spindle backlash may be suppressed.

RVSVC2 Relationship of master/slave motor rotation directions in tandem operation
0 : The master motor and slave motor rotate in the same direction at spindle rotation time (as viewed from the motor shaft).
1 : The master motor and slave motor rotate in the opposite directions at spindle rotation time (as viewed from the motor shaft).
This parameter sets the polarity for a speed command and feedback signal in torque tandem operation.

NOTE
1 This parameter need not be set for the slave spindle amplifier side. (The setting for the master spindle amplifier is transferred to the slave spindle amplifier by inter-spindle amplifier communication.)
2 If the setting of this parameter is improper, the tandem function does not operate normally.
If the spindle is rotated in this state, the speed polarity error alarm (spindle alarm d0) is issued in tandem operation.

0i	30i	#7	#6	#5	#4	#3	#2	#1	#0
4398	4398		A130DN	WSVCP	VTAN	WNDTDM			

WNDTDM Whether to use the twin drive function
Set this parameter to 0.

NOTE
If this bit is set to 1, the torque tandem function does not operate normally. Be sure to set this bit to 0.

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VTAN Whether to use the velocity tandem function
0 : Does not use the velocity tandem function.
1 : Uses the velocity tandem function.

WSVCP Whether to use the velocity integrator copy function
0 : Does not use the velocity integrator copy function.
1 : Uses the velocity integrator copy function.

When using the velocity tandem function, set WSVCP and VTAN to 0 and 1 (velocity tandem control only) or 1 and 1 (velocity tandem control + velocity integrator copy function), respectively.

A130DN Whether to detect the speed polarity error (spindle alarm d0) during tandem control
0 : Detects the error.
1 : Does not detect the error.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4402	4402					TRQTDM			

TRQTDM Whether to use the torque tandem function
Set this parameter to 0.

NOTE
1 While this bit is valid when the NC is 30*i*-B, set it to "0" also when the NC is 30*i*-A.
2 When this bit is set to "1", the velocity tandem function does not work normally. Be sure to set it to "0".

0*i*	30*i*	
4347	4347	Master-slave speed difference state signal output setting

Unit of data : 1min^{-1} *(10min^{-1} when bit 2 (SPDUNT) of parameter No. 4006 is set to 1)
Valid data range : 0 to 32767
Initial setting : 0
This parameter sets a level for detecting the master-slave speed difference state signal (MSOVRA:F47#2, MSOVRB:F51#2).
If this parameter is set to 0, the setting of 100 is assumed.

0*i*	30*i*	
4360	4360	Preload value

Unit of data : ±16384 equivalent to a torque command of 100%
Valid data range : -8192 to 8192(-50% to +50%)
Initial setting : 0
This parameter sets a preload value.
This parameter may suppress stop-time vibration caused by backlash.

NOTE
1 When "0" is set for the slave axis, the value set for the master axis is used as the slave axis preload. Note that its polarity is determined by the polarity set by N4360 for the master axis and N4353#2.

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NOTE
2 When a value other than "0" is set for the slave axis, the value set for the slave axis is used as the slave axis preload.
Since the preload torque is always added to the torque command, as shown in the block diagram of Subsection 5.11.7, set the preload values depending on the motor rotation directions of the master and slave axes, as follows.
When the rotation directions are the same: The values set for the master and slave axes have different signs.
When the rotation directions are different: The values set for the master and slave axes have the same sign.
3 When two motors having different characteristics are used, set the slave axis, taking into consideration the ratio of the maximum torque Tmax of the motor of the master axis to that of the slave axis.
Absolute value set for the slave axis = (Master axis Tmax/slave axis Tmax)・Absolute value set for the master axis

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4541	4541			NSSTTD	DIFRED	DIFMTC			

DIFMTC Scaling function for the slave axis preload during velocity tandem control
0 : Disables the scaling function for the slave axis preload.
1 : Enables the scaling function for the slave axis preload.
When the motors of the two axes have different characteristics, the preload data of the slave axis is scaled based on the difference in the base speed so that the actual preload values of both axes become equal. To use this function, set "1" for the slave axis.

NOTE
1 When using this function, be sure to set a preload value for the slave axis as well by using N4360.
2 Refer to "Additional information 1: When using two motors having different gear ratios or different characteristics" in this section.

DIFRED Scaling function for the slave axis velocity command during velocity tandem control
0 : Disables the scaling function for the slave axis velocity command.
1 : Enables the scaling function for the slave axis velocity command.
By setting "1" for both axes when the gear ratio between the motor and spindle is different for the two axes, the gear ratio is taken into consideration for the velocity command for the slave axis during velocity tandem control.

NOTE
1 Refer to "Additional information 1: When using two motors having different gear ratios or different characteristics" in this section.

NSSTTD Tandem command SLV acceptance condition setting
0 : Accepts the SLV signal when the speed is 0 (the SLV signal is not accepted when the motor is rotating).
1 : Accepts the SLV signal even when the speed is not 0 (the SLV signal can be accepted even when the motor is rotating).

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0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4542	4542					TDFCS1	TDFCS0		

TDFCS1,TDFCS0 Setting related to the preload and multi-axis integrator copy disable signal (TDFCANx)

0,0 : Input signal TDFCANx is disabled.
0,1 : When input signal TDFCANx = 1, preload is disabled.
1,0 : When input signal TDFCANx =1, preload and multi-axis integrator copy are disabled.
1,1 : Do not set this value. If this value is set, operation equivalent to that performed when the setting is 1,0 is performed.

NOTE
For details, see "Additional information 3: Preload and multi-axis integrator copy".

0*i*	30*i*	
4606	4606	Preload time constant

Unit of data : 100msec
Valid data range : 0～50
Initial setting : 0

Sets the time constant of the rise of the preload that can be used for spindle tandem control. If this parameter is set to 0, 32 msec is assumed.

NOTE
1 If a preload value (No. 4360) is set when spindle tandem control is exerted, a mechanical shock may occur when the preload torque rises after excitation. Setting a larger value in this parameter helps mitigate this mechanical shock.
2 If the slave axis preload value (No.4360) is set to 0, preload time constant(No4060) shoud be set to same value as master axis.

The following parameter needs to be set when an integral copy is made between two axes that are driven by spindle simple synchronous control during tandem drive using four or more spindle motors (multi-axis integrator copy). For information about this setting, see also "Additional information 2: Spindle drive using four or more spindle motors" in Subsection 5.11.9, "Additional Information".

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4541	4541		RVDPOL						

RVDPOL Master/slave motor rotation direction relationship for the multi-axis integrator copy

0 : The rotation directions of the master and slave motors are the same during spindle rotation (when viewed from the motor shaft).
1 : The rotation directions of the master and slave motors are opposite during spindle rotation (when viewed from the motor shaft).

Set this parameter for the slave axis for the multi-axis integrator copy function.

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0*i*	30*i*	
4597	4597	**Setting for the multi-axis integrator copy**

Initial setting : 0

Sets the master and slave axes for the multi-axis integrator copy.

0: The function is disabled.

-1: Setting of the master axis: When "-1" is set, the master axis for the multi-axis integrator copy is used.

Larger than 0: Setting of the slave axis: Specify the master axis number to be received in data transfer.
(Use a logical spindle number to specify which spindle is to be used as the master axis.)

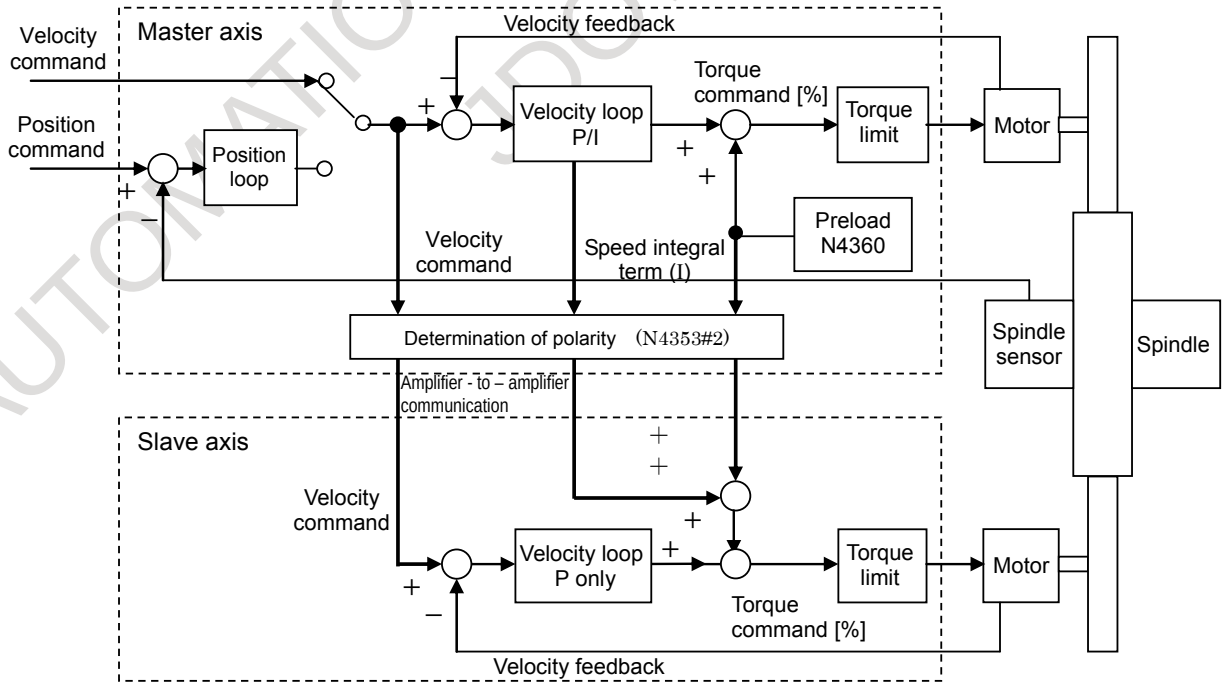
NOTE
If an invalid value is set in this parameter or a spindle amplifier not supported for this parameter is used, the following alarm occurs:
SP1252 Invalid spindle parameter setting (tandem)

5.10.7 Block Diagram for the Velocity Tandem Operation

The following figure shows the rough block diagram for the velocity tandem operation.

(1) The velocity command, speed integral term, and preload value are passed from the master axis to the slave axis according to the polarity determined by the parameter that defines the master/slave connection direction.

(2) The slave axis performs proportional term processing based on the received velocity command (when the speed integral copy function is disabled (N4398#5=0), the slave axis also performs integral term processing). It then adds the received speed integral term and preload value to create a torque command.



(*) In the torque command, [%] represents the torque in percentage with the maximum torque of the master and slave motors being 100%.

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5.10.8 Alarm and Status Error

(1) Spindle alarm

Alarm No.	Description	Measure
66	An inter-spindle amplifier communication error occurred.	Check the connection of the cable (JX4).
80	An alarm was issued on the destination spindle amplifier of inter-SPM communication.	Correct the cause of the alarm on the destination spindle amplifier.
d0	The relationship between the speed polarity of the master motor and the speed polarity of the slave motor is abnormal.	Check the rotation direction relationship setting (No.4353#2).

(2) Spindle amplifier status error

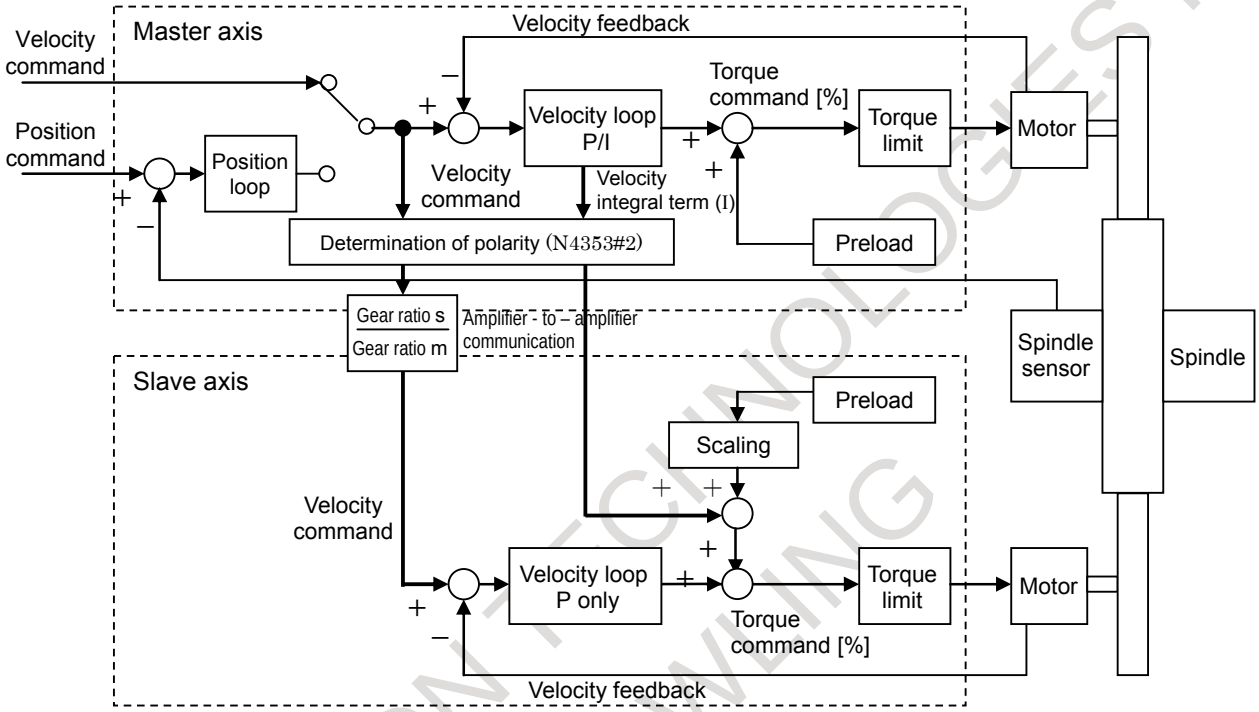
Error No.	Description	Measure
21	A tandem operation command was input when spindle synchronous control is enabled.	Input a tandem operation command after canceling spindle synchronous control.
22	Spindle synchronous control was specified when tandem operation is enabled.	Specify spindle synchronous control after canceling tandem operation.
23	A tandem operation command is input even if the option is not specified.	Tandem control requires the CNC software option. Check the option.
38	- Parameters related to inter-spindle amplifier communication are not set correctly. - Functions that cannot be used together with the torque tandem function are set.	Check the parameters.

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5.10.9 Additional Information

(1) Additional information 1: When using two motors having different gear ratios or different characteristics

The following additional information applies when two motors having different gear ratios or different characteristics are used in the velocity tandem operation.
During the velocity tandem operation, control is exerted as shown in the rough block diagram below.

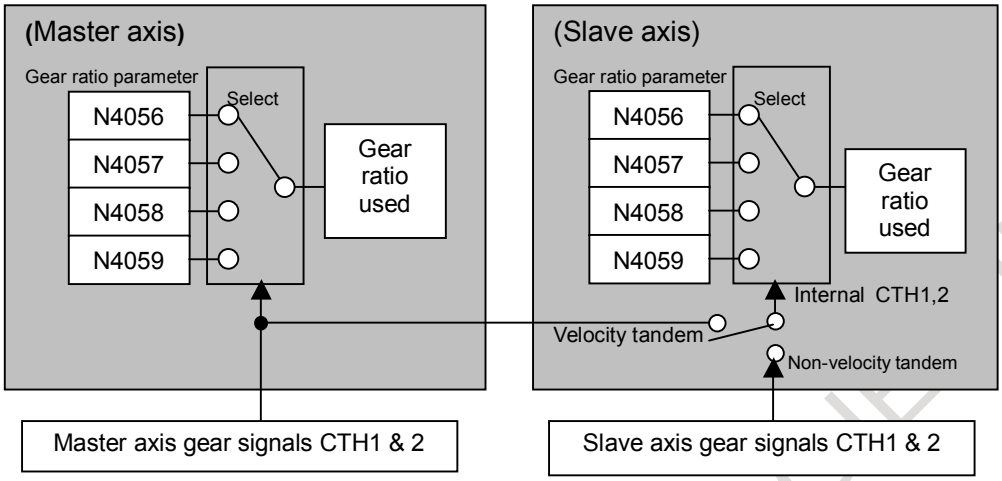


(*) In the torque command, [%] represents the torque in percentage with the maximum torque of the master and slave motors being 100%.

(1) The velocity command and speed integral term are passed from the master axis to the slave axis.
The velocity loop of the slave axis is processed only for the proportional term, and the velocity integral term and preload value received from the master axis are added to create a torque command.
The polarity of the velocity command and velocity integral term passed to the slave axis is determined by bit 2 of parameter N4353 of the master axis.

(2) If the gear ratio for the spindle differs between the two axes, the scale of the velocity command to be used and the actual speed of the other side can be converted as follows, by enabling the velocity command scaling function. The subscripts m and s represent the master axis and slave axis, respectively.
[Velocity command scaling equation] (Velocity command)s = (Gear ratio)s × (Velocity command)m/(Gear ratio)m
The gear ratios used in the above equation are **the parameter values that the master and slave axes select from their respective gear ratio parameters N4056 to N4059**. Note that, in this case, the gear signals CTH1 and CTH2 of the master axis are copied as the internal gear signals CTH1 and CTH2 of the slave axis, as shown in the following figure. Therefore, the slave axis selects gear ratios according to the gear signals of the master axis.

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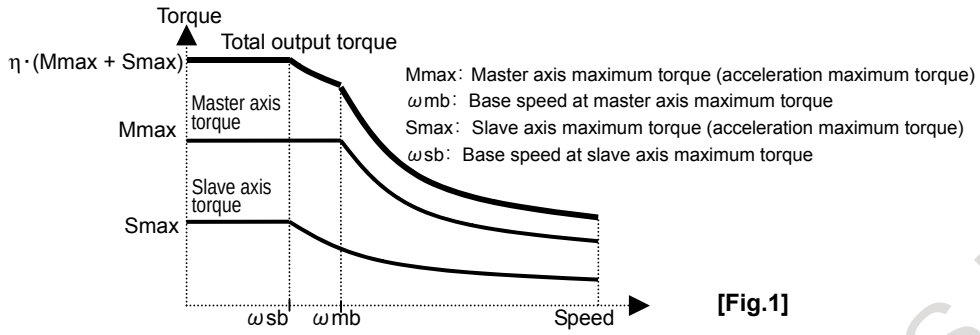
NOTE
When using the velocity command scaling function, note the following:
1 Since the gear signals CTH1 and CTH2 of the master axis take effect for both the master and slave axes, the gear ratio parameter (N4056 to N4059) for each axis is selected according to the gear signals of the master axis.
2 By using the gear ratio parameters selected as described above, the two axes perform their respective shares of the processing. The sending side carries out the spindle-end conversion of the velocity command (or actual speed) and sends the result and the receiving side carries out the motor-end conversion of the received value, in order to obtain the values appropriate for the two axis ends. Because of this processing, a slight error may occur for the velocity command to be used by the slave axis.
3 If the calculated velocity command exceeds the maximum spindle speed of the slave axis, it is clamped to the maximum spindle speed.
4 The value of bit 2 of parameter N4006 for setting the speed unit needs to be the same for both axes.

(3) When velocity tandem control is used for two motors having different gear ratios or different characteristics, use a slave motor whose maximum torque below the base speed is equal to or smaller than that of the master motor.

(4) The following figure shows a conceptual diagram of the motor output and total output in this case.

NOTE
The following conceptual diagram (Fig. 1) shows how the torques of two motors are totaled. In reality, the total value needs to be estimated at a smaller value according to the efficiency η (0% to 100%) of each machine.

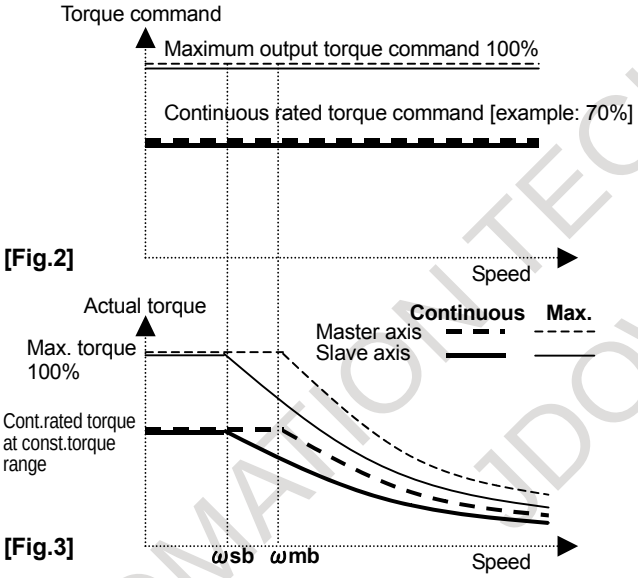
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[Fig.1]

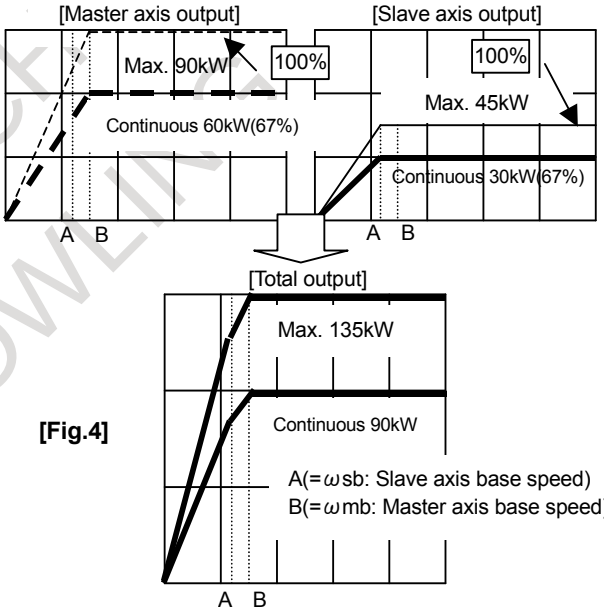
(5) The ratio of the maximum torque and the continuous rated torque is assumed to be the same for both axes (Fig. 2). Therefore, if this torque ratio is widely different, the sharing of motor output may become unbalanced relative to the continuous rated torque.

Note that, even when the torque ratio is the same as shown in Fig. 2, the actual torque of the motor of each axis becomes different as shown in Fig. 3, if the base speeds of the two axes are different. In this case, the total torque characteristics are as shown in Fig. 1, while the output characteristics are as shown in Fig. 4.



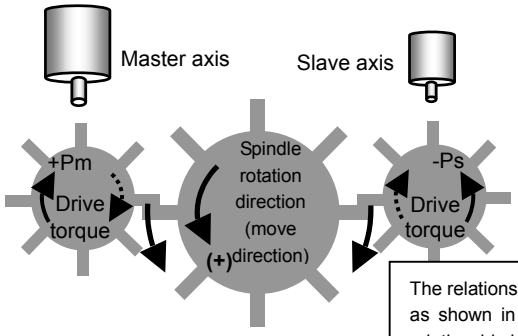
[Fig.2]

[Fig.3]



[Fig.4]

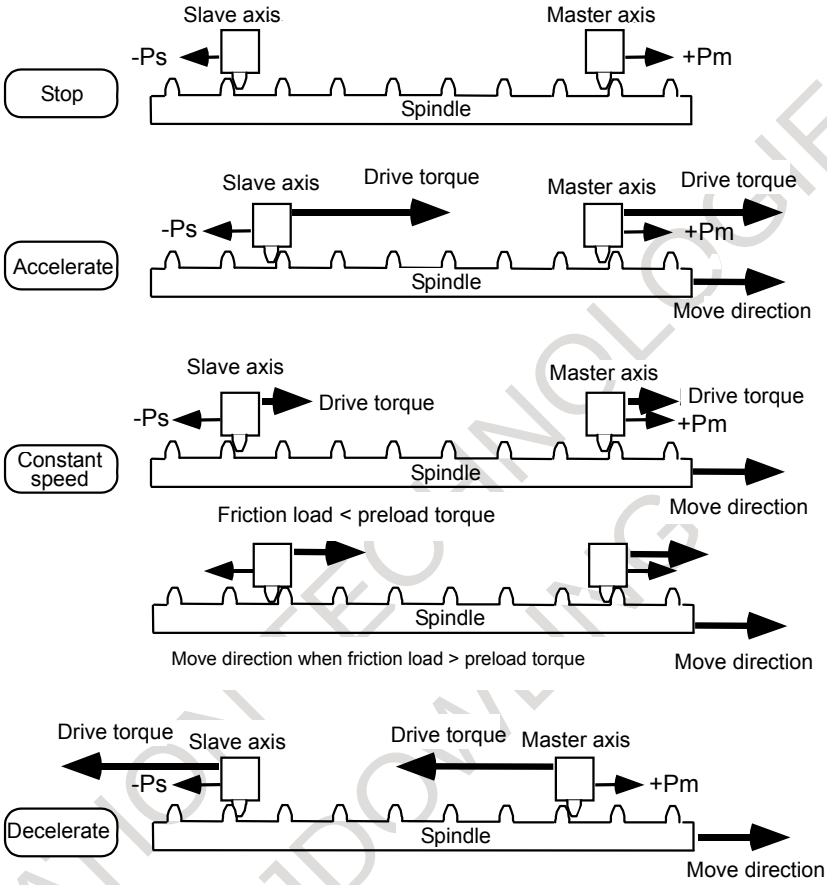
(6) The preload is a function that combines the master and slave axes with an offset applied in the direction opposite to that of the motor of each axis in relation to the torque to be controlled so as to reduce the effect of the backlash between the master and slave axes.



The relationship of the preload, drive torque, and move direction are as shown in this figure. For an illustrative diagram depicting this relationship in a horizontal dimension, see Fig. 6 on the next page.

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For example, when the preload for the master axis is +Pm and that for the slave axis is −Ps, torque is generated as shown in Fig. 5.
When a large torque is necessary in cases such as during acceleration or deceleration, the two motors generate torque in the same direction (load sharing mode).
When almost no torque is necessary in cases such as when the motors are stopped, the motors pull each other (anti-backlash mode).
The preload cannot be used when the anti-backlash mode is always desired.



[Fig. 5: Pattern Diagram of Torque Change When Preload Is Used]

(7) Regarding the setting of the preload, it is necessary to note the following:
Since the actual torque needs to be the same for the preload, it is necessary to take into consideration the ratio of the maximum torques of the two axes when setting the preload. Therefore, set the preload such that the following relationship is established. The subscripts m and s represent the master axis and slave axis, respectively.

(Preload %)m・(Maximum torque Nm)m＝(Preload %)s・(Maximum torque Nm)s

The signs of the preload values are to be set as described below.
As shown in the block diagram at the beginning of this subsection, the preload torque is always added to the torque command. Therefore, set the preloads according to the motor rotation directions of the master and slave axes during spindle rotation, as follows.

When rotation directions are the same: The values set for the master and slave axes have different signs.

When rotation directions are different: The values set for the master and slave axes have the same sign.

Setting example)

When you want to set the master axis maximum torque to 100 Nm, slave axis maximum torque to 80 Nm, and preload to 5 Nm for a machine in which the motor rotation directions of the two axes during spindle rotation are the same, set the preload values as follows:

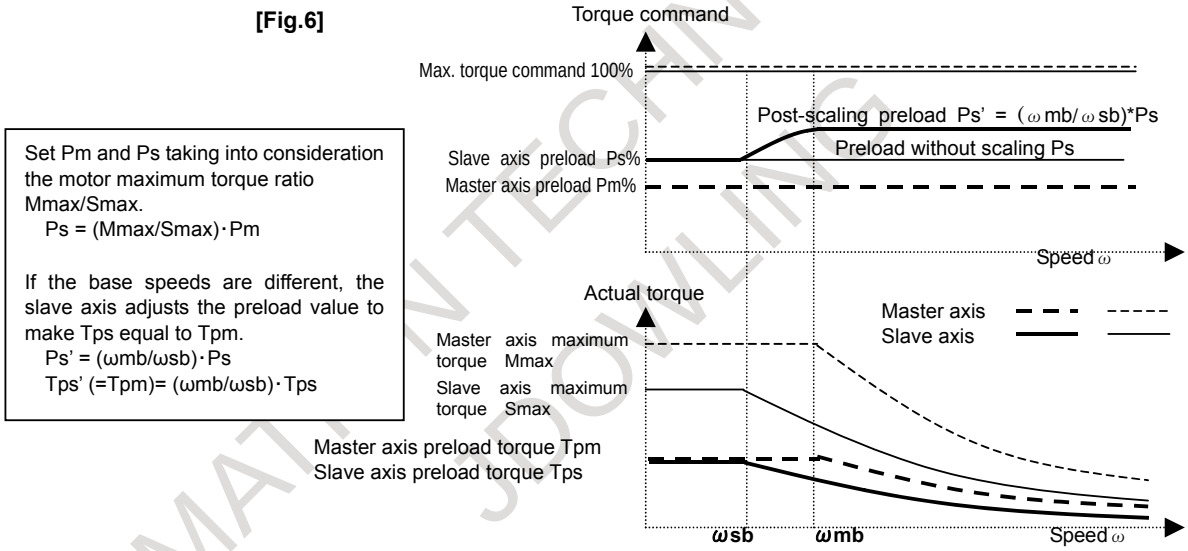
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Master axis preload
5Nm ➔ 5% preload ➔ N4360m = 16384*5/100 = 819
Slave axis preload (Set the – sign because the rotation direction is the same.)
N4360s = - 100 / 80 * 819/16384 * 16384 = -1024 (-6.25%)

NOTE
When you use preload in tandem control with different output motor, note the following about motor selection:
1 If the spindle (rotary table) rotates both direction during tandem control, the load of slave side motor becomes large accoding to the direction. So, you have to consider this situation when you select the slave motor.
2 If you want to apply preload at all times, you have to select the motor that has enough power itself to drive the spindle (rotary table).
3 If you want to avoid fluctuation at the stop state only, it is not necessary to prepare large motor.

(8) If the base speeds of the two axes are different, the slave axis can perform scaling to adjust the difference. See Fig. 6.

[Fig.6]



(9) When using the preload, it is necessary to note the following:
When preloads are set, the torque commands for the motors of the two axes are different in the tandem operation. Therefore, it is necessary to check No. 410 (load meter display) in the diagnosis screen and ensure that the motors of the two axes are used in a range where they operate at the continuous rated torque.
Note also that, in this case, even if the total load value of the two axes is the same for both clockwise and counterclockwise rotation, the total actual torque is different. This is because the torque command of the motor of each axis is different for clockwise and counterclockwise rotation and the maximum torque of the motors are different. See the example below.
[Example] Mmax: Master axis maximum torque, Smax: Slave axis maximum torque
TD: Drive torque [%]
Pm: Master axis preload [%], Ps: Slave axis preload [%]
(Master axis torque command) = TDm＋Pm＝Td＋Pm
(Slave axis torque command) = TDm (received integral term)－Ps＝Td－(Mmax/Smax)·Pm

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Smax/Mmax=2/3, Pm=10%	Clockwise rotation		Counterclockwise rotation	
	Torque command (load)	Master axis converted actual torque (%)	Torque command (load)	Master axis converted actual torque (%)
Master axis	70 (%) = 60 + 10	70 (%)	-45 (%) = -55 + 10	-45 (%)
Slave axis	45 (%) = 60 - 15	30 (%) = 45* (2/3)	-70 (%) = -55 - 15	-46.7 (%) = -70* (2/3)
Total value	115 (%) = 70 + 45	100 (%) = 70 + 30	-115 (%) = -45 + (-70)	-91.7 (%) = -45 + (-46.7)

(2) Additional information 2: Spindle drive using four or more spindle motors

A function called velocity tandem control is available that drives the spindle with two spindle motors to gain a large output. If the output from two motors is insufficient, it is necessary to drive a single spindle with multiple velocity tandems. In this case, the master axis of each velocity tandem is controlled by "spindle simple synchronous control (or spindle command synchronous control in the case of 30i-B)".
This section contains information necessary to control a machine that drives the spindle with multiple velocity tandems using spindle simple synchronous control.

When using this function, also refer to Section 11.17, "Spindle Simple Synchronous Control" of B-63943EN (FS30i-A Connection Manual) and Section 11.17, "Spindle Command Synchronous Control" of B64483EN (FS30*i*-B Connection Manual).

NOTE
1 To use this function, the CNC software options "spindle tandem control" and "spindle simple synchronous control" are required.
2 When the CNC is FS0*i*-D, FS0*i*-F or FS30*i*–B, these two functions are included in the CNC software option "spindle synchronous control".
3 To use this function, all the motors to be used need to be of the same specifications.
4 To use this function, the spindle amplifier needs to be of TYPE B for A06B-61xx-Hxxx because inter-spindle amplifier communication is used.
5 For the master and slave axes, use the spindle software of the same series and edition.

(1) Usable software

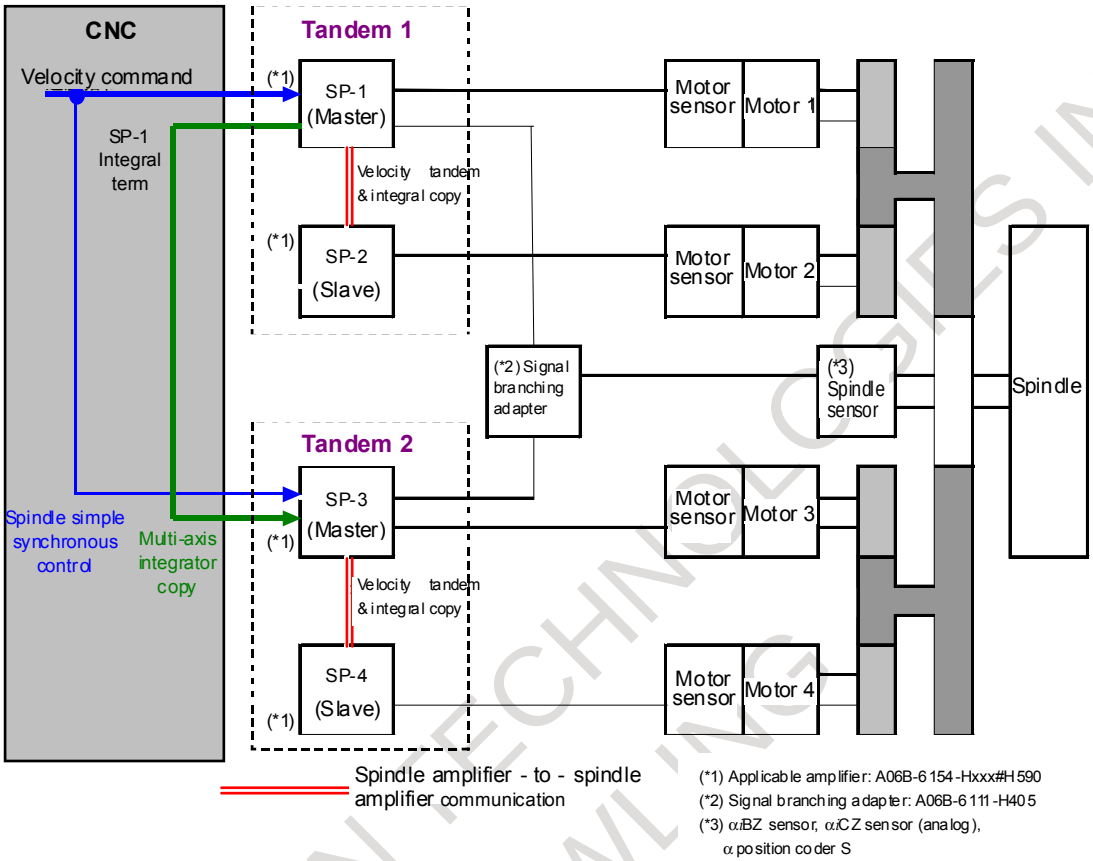
Spindle software

Series	Edition	Usable CNC
9D90	B (02)	FS0*i* –D / FS30*i*-A / FS31*i*-A
9DA0	F (06)	FS0*i* –D / FS0*i* –F / FS30*i*-B / FS31*i*-B / FS32*i*-B
9DB0	A (01)	FS0*i* -F / FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

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(2) System configuration

The following figure shows an example where the velocity tandem function is applied to a machine that drives the spindle with four spindle motors using spindle simple synchronous control.



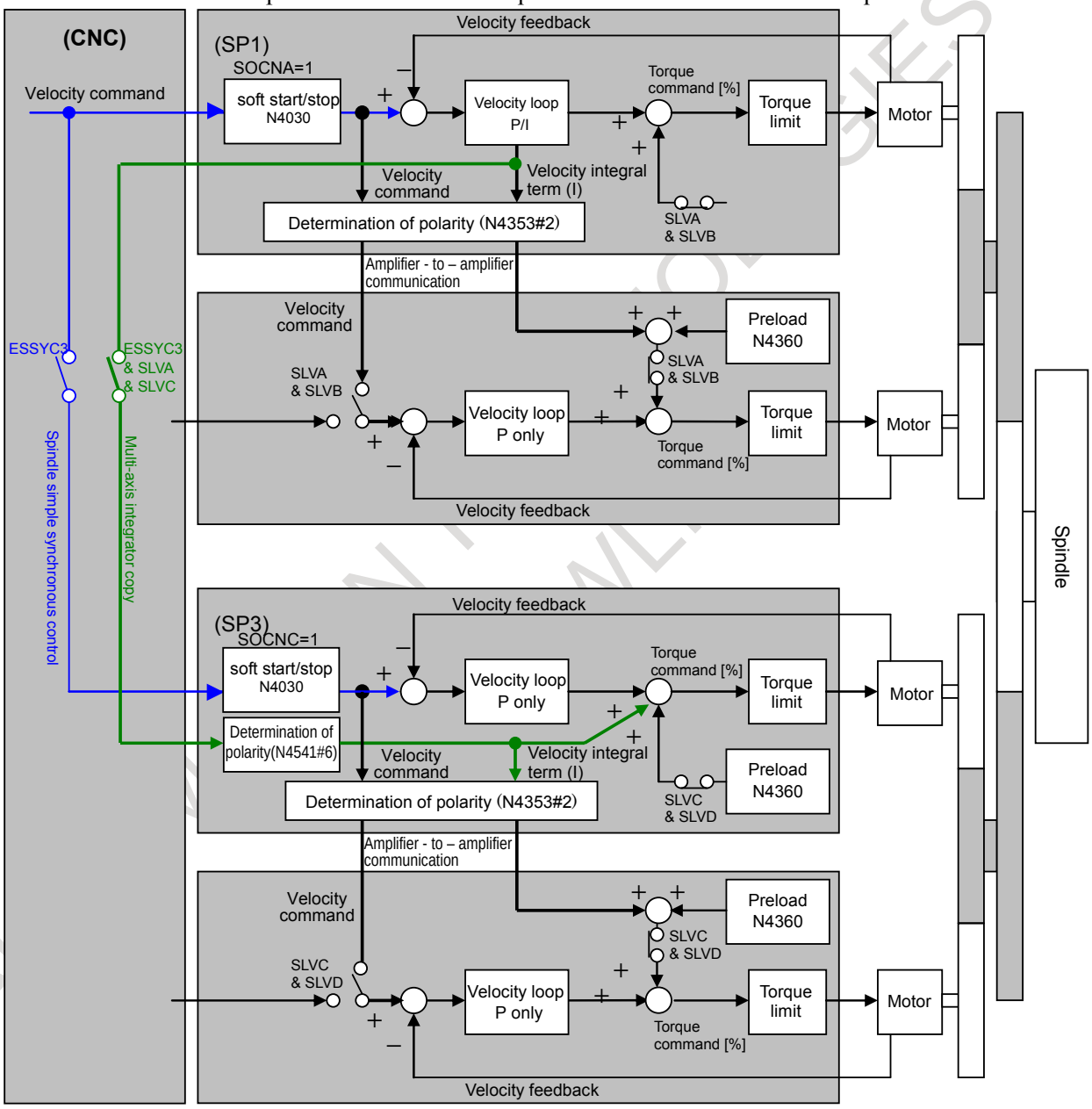
<1> The spindle is driven by four spindle motors.
<2> The master axes SP-1 and SP-3 of the two tandems are controlled by spindle simple synchronous control.
<3> In this case, the speed integral term can be copied from SP-1 engaged in spindle simple synchronous control to SP-3. This is called "multi-axis integrator copy".
<4> The slave axes SP-2 and SP-4 of the two tandems receive the velocity command and speed integral term from the master axes SP-1 and SP-3 of the tandems and use the received values as their own velocity command and velocity integral term (velocity tandem control).

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(3) Block diagram

The following figure shows a control block diagram applicable when this function operates using four spindle motors.

<1> The velocity command from the CNC are passed to SP1 and SP3. The soft start/stop function limits the specified acceleration rate to reduce the mechanical shock, and SP1 and SP3 pass the limited command to SP2 and SP4, respectively. Then, each motor exerts velocity control.
<2> SP2 and SP3 receive the integral term from SP1, and SP4 receives the integral term from SP3. They add the received integral term to the proportional term to create a torque command.
<3> Each SP adds the set preload value to this torque command to create a final torque command.



(4) I/O signals (CNC ⇔ PMC)

(4-1) Input signals (PMC → CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st SP	G073	G073							**SLVA**	
2nd SP	G077	G077							**SLVB**	
3rd SP	G207	G207							**SLVC**	
4th SP	G269	G269							**SLVD**	

SLVx Tandem operation command for each spindle

0 : Makes a request to disable tandem operation.

1 : Makes a request to enable tandem operation.

These signals specify whether to enable or disable tandem operation.

To use velocity tandem, set "1" for all of the four spindles.

NOTE

1 When switching these signals, make sure that the four spindles are stopped. When the spindles are rotating, a request to switch these signals cannot be accepted.

2 Switch these signals in the velocity control mode. In a mode other than the velocity control mode, these signals cannot be accepted.

3 When the four spindles are mechanically disconnected with each other, do not set these signals to "1".

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
Gn064	Gn064		**ESRSYC**						

ESRSYC Spindle simple synchronous control signal (when spindle simple synchronous control is exerted by the first and second spindles)

0 : Makes a request to disable spindle simple synchronous control.

1 : Makes a request to enable spindle simple synchronous control.

When "1" is set in this signal, the spindle simple synchronous control mode is enabled, and the second spindle operates as the slave axis of the first spindle.

NOTE

This signal is valid when "0" is set in bit 5 (SSY) of parameter No. 3704.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
Gn264	Gn264					**ESSYC4**	**ESSYC3**	**ESSYC2**	**ESSYC1**

ESSYCx Spindle simple synchronous control signal for each individual spindle

0 : Makes a request to disable spindle simple synchronous control.

1 : Makes a request to enable spindle simple synchronous control.

When "1" is set in any of these signals, the spindle corresponding to that signal operates as the slave axis for spindle simple synchronous control.

NOTE

1 These signals are valid when "1" is set in bit 5 (SSY) of parameter No. 3704.

2 The master axis with which the slave axis is to be synchronized is defined by parameter No. 4821.

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(4-2) Output signals (CNC → PMC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st SP	F045	F045							**SSTA**	
2nd SP	F049	F049							**SSTB**	
3rd SP	F168	F168							**SSTC**	
4th SP	F266	F266							**SSTD**	

SSTx Speed zero detection signal for each individual spindle
0 : The spindle motor is rotating.
1 : The spindle motor is in the speed zero (stopped) state.
When switching the tandem operation command SLVx, make sure that "1" is set in the signals for all the four spindles.
The tandem operation command cannot be accepted when "0" is set in any of these signals.

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st SP	F046	F046				**SLVSA**				
2nd SP	F050	F050				**SLVSB**				
3rd SP	F169	F169				**SLVSC**				
4th SP	F267	F267				**SLVSD**				

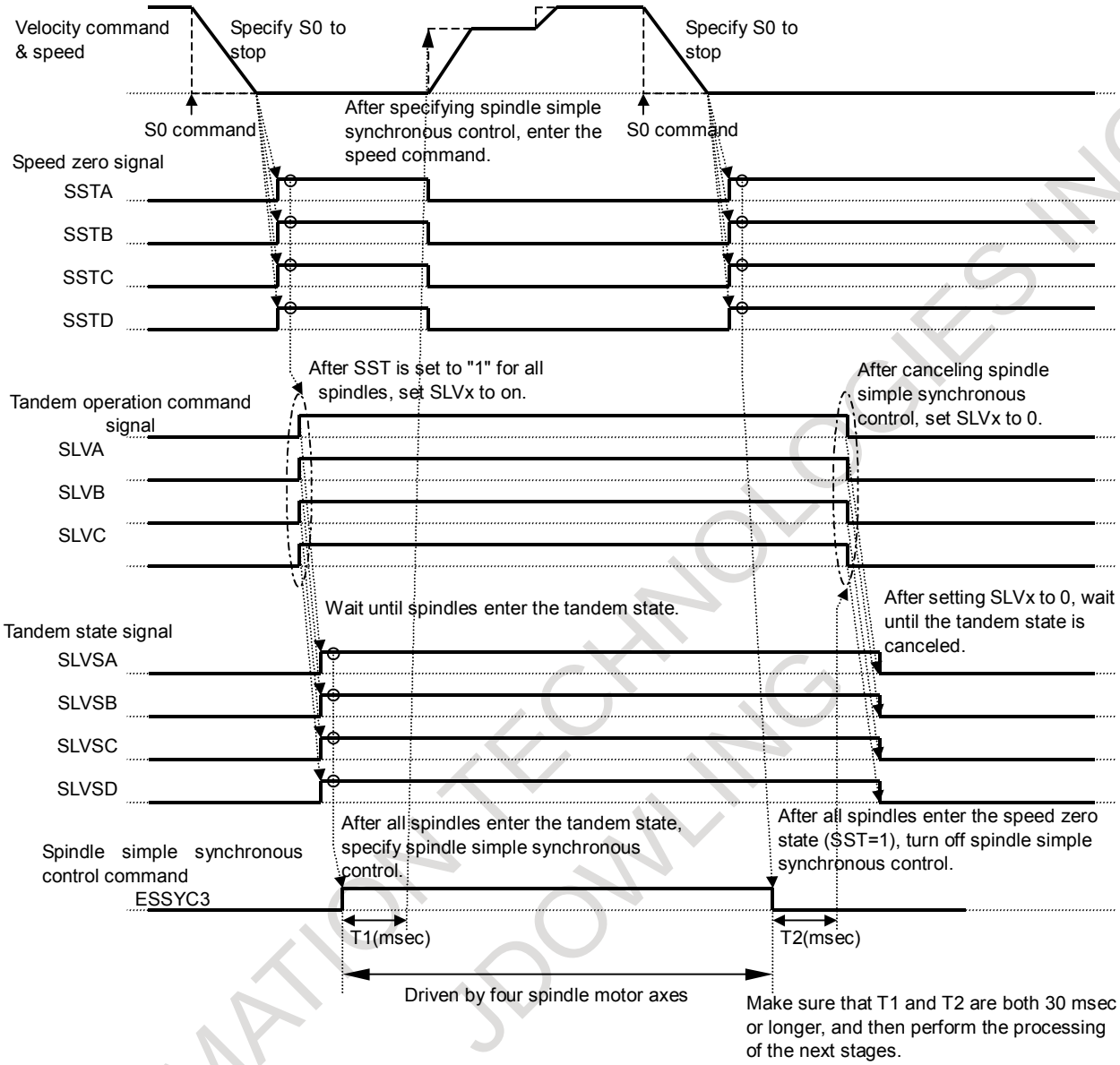
SLVSx Tandem operation state signal for each individual spindle
0 : Disables tandem operation.
1 : Enables tandem operation.
Before specifying spindle simple synchronous control for the spindle amplifier that is to operate as the slave axis for spindle simple synchronous control, make sure that "1" is set in the signals for all the four spindles.

(4-3) Examples of Sequences

To switch spindle simple synchronous control or spindle tandem control, you need to have the velocity control mode on, the velocity command set to 0, and the speed zero state (SST = 1) set for the spindle. To reduce the mechanical shock, use also the soft start/stop function (N4030 and G071#4(SOCNA): for the first spindle) for all the tandem master axes.

<1> Specify 0 (S0) for the velocity mode to stop all the spindles.
<2> Check that the speed zero signal (SST) is set to the speed zero state (1) for all the spindles.
<3> Specify velocity tandem control for all the spindles of all the tandems (SLVx = 1).
<4> Check that all the spindles are set to the tandem mode (SLVSx = 1).
<5> Next, specify spindle simple synchronous control for the slave axis for spindle simple synchronous control (ESSYC3 = 1).
<6> Check that the parking signal is set to 0, and enter the velocity command to drive the spindles.
<7> When position control is enabled, the phase synchronous error monitor signal SYCAL is output according to the phase error state. By monitoring this signal, the PMC can perform processing appropriate for the phase error state.
<8> Specify 0 to stop the spindles.
<9> Check that the speed zero signal (SST) is set to the speed zero state (1) for all the spindles.
<10> Next, cancel the spindle simple synchronous control state (ESSYC3 = 0).
<11> Cancel velocity tandem control for all the spindles of each tandem (SLVx = 0).
<12> Check that the tandem state has been canceled for all the spindles (SLVSx = 0).

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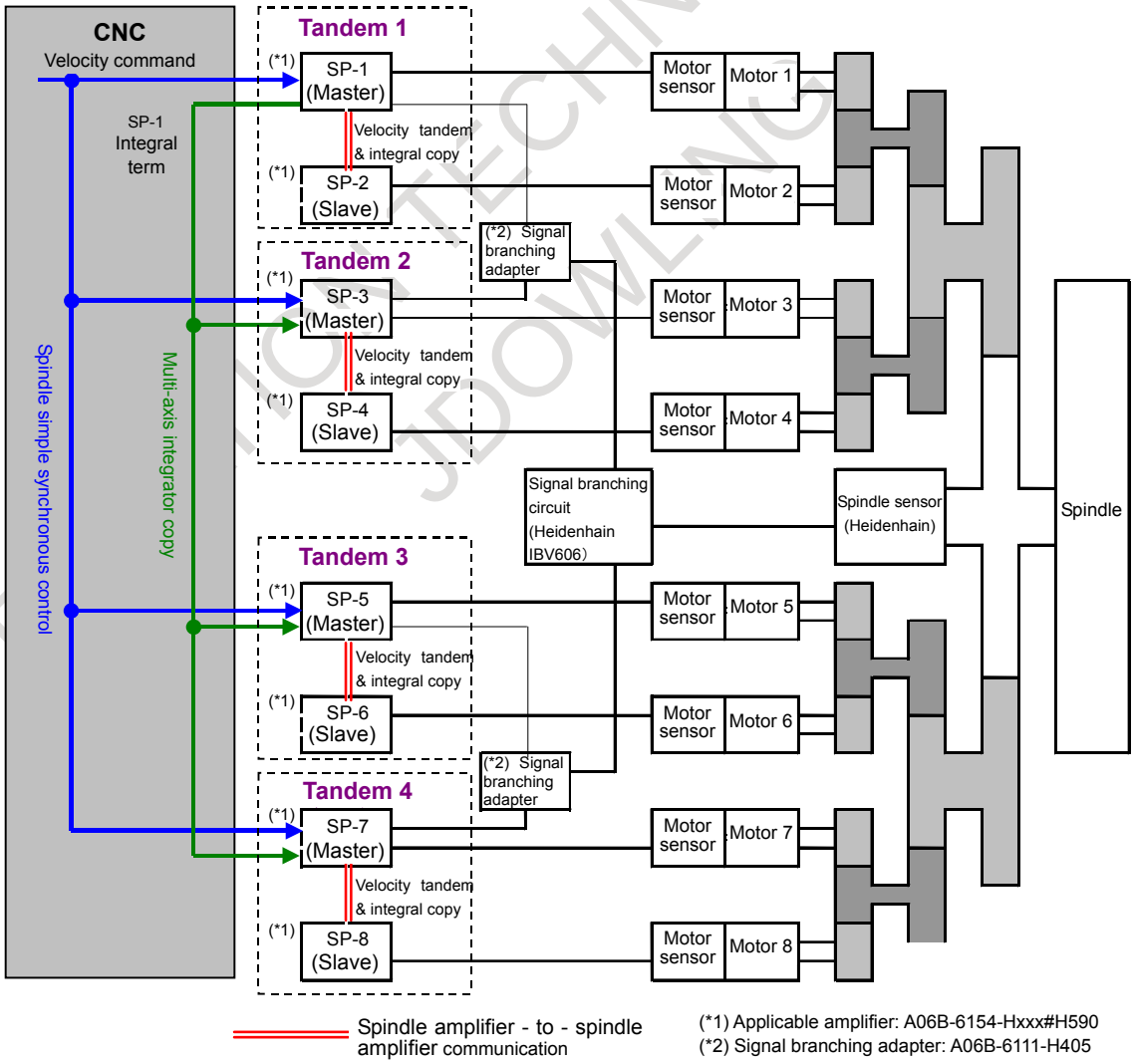


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(5) Setting examples of the parameters related to the integral copy

When the spindle is driven by four velocity tandems (eight motors) as shown in the following figure, the settings related to the velocity integral copy are to be made as indicated by the examples given below.

SP	N4398#5,4,3	N4353#2	N4541#6	N4597	Remarks
SP-1	1,1,0	1	0	-1	Spindle simple synchronous control (+ multi-axis integrator copy) master axis Velocity tandem 1 (+ integral copy) master axis
SP-2	1,1,0	-	0	0	Velocity tandem 1 (+ integral copy) slave axis
SP-3	1,1,0	1	0	1	Spindle simple synchronous control (+ multi-axis integrator copy) slave axis Velocity tandem 2 (+ integral copy) master axis
SP-4	1,1,0	-	0	0	Velocity tandem 2 (+ integral copy) slave axis
SP-5	1,1,0	1	0	1	Spindle simple synchronous control (+ multi-axis integrator copy) slave axis Velocity tandem 3 (+ integral copy) master axis
SP-6	1,1,0	-	0	0	Velocity tandem 3 (+ integral copy) slave axis
SP-7	1,1,0	1	0	1	Spindle simple synchronous control (+ multi-axis integrator copy) slave axis Velocity tandem 4 (+ integral copy) master axis
SP-8	1,1,0	-	0	0	Velocity tandem 4 (+ integral copy) slave axis



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(6) Spindle orientation

When the spindle is driven by four velocity tandems (eight motors) as shown in the following figure, the settings related to the velocity integral copy are to be made as indicated by the examples given below.

Spindle orientation can be used in spindle tandem control four, six, or eight spindle motors. The following options are required:

- Spindle orientation
- Spindle orientation extension

The valid spindle orientation command signal (ORCM) and spindle orientation stop position change command signal (INDX) are the signals of the master axis for which the parameter No. 4597 is set to -1. The signals of the slave axis are ignored. The method of setting the stop position for position coder method spindle orientation can be selected using bit 0 (ORT) of parameter No. 3729. In bit 0 (ORT) of parameter No. 3729, set the same value for all the spindles used for spindle tandem control. Set the stop position as follows.

- For orientation with a fixed stop position (bit 0 (ORT) of parameter No. 3729 = 0)
  Set the stop position in parameter Nos. 4031 and 4077. Set the same value for all the spindles used for spindle tandem control.

- For orientation with an externally set stop position (bit 0 (ORT) of parameter No. 3729 = 1)
  Set the stop position using the spindle orientation external stop position command signals (SH00 to SH11). Set the stop position in the signals of the master axis for which the parameter No. 4597 is set to -1. The signals of the slave axis are ignored.

NOTE
Arrange that a one-rotation signal is detected regardless of the spindle speed.
If the spindle sensor is a Heidenhain-made 1Vpp encoder, set the parameters as follows:
Bits 3, 2, 1, and 0 of parameter No.4002 = 1, 1, 1, and 0
Bit 2 of parameter No. 4394 = 1

(3) Additional information 3: Preload and multi-axis integrator copy

This section contains the following specifications added to the software described in (1):

- Preloads between multiple twin-drive motors
- Preload and multi-axis integrator copy enable/disable signals used for multiple tandems (including twin drives)

NOTE
*1 To use this function, the following CNC software options are required:
For FS30*i*-A or FS31*i*-A
- Spindle tandem control
- Spindle simple synchronous control

*) FS32*i*-A does not support spindle tandem control.
For FS0*i*-D, FS30*i*-B, FS31*i*-B, FS32*i*-B, or FS35*i*-B
- Spindle synchronous control

(1) Usable software

Spindle software

Series	Edition	Usable CNC
9D90	N (14)	FS0*i*-D / FS30*i*-A / FS31*i*-A
9DA0	O (17)	FS0*i* –D / FS0*i* –F / FS30*i*-B / FS31*i*-B / FS32*i*-B
9DB0	A (01)	FS0*i* -F / FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

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(2) I/O signals (CNC ⇔ PMC)

(2-1) Input signals (PMC → CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st SP	G306	G306					TDFCANA			
2nd SP	G310	G310					TDFCANB			
3rd SP	G314	G314					TDFCANC			
4th SP	G318	G318					TDFCAND			

TDFCANx Preload between multiple motors (including twin-drive motors) or multi-axis integrator copy is:
0 : Enabled.
1 : Disabled.

NOTE
When using this signal TDFCANx, note the following:
- The function of this signal differs depending on the setting of bits 3 and 2 of parameter No. 4542. See the explanation of bits 3 and 2 of parameter No. 4542.
- If you want to use this signal to disable preload or multi-axis integrator copy, input the TDFCANx signal to all relevant spindles.

Example 1) When preload and multi-axis integrator copy are applied between two twin-drive motors, input the TDFCANx signal to the master axis of each twin drive.
Example 2) When preload is applied for all axes of two velocity tandems (parameter No. 4360 is not set to 0 for all axes), input the TDFCANx signal to all axes.

(3) Related parameters

(3-1) Details of parameters

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4541	4541		RVDPOL						

RVDPOL Master/slave motor rotation direction relationship for the multi-axis integrator copy
0 : The rotation directions of the master and slave motors are the same during spindle rotation (when viewed from the motor shaft).
1 : The rotation directions of the master and slave motors are opposite during spindle rotation (when viewed from the motor shaft).
Set this parameter for the slave axis for the multi-axis integrator copy function.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4542	4542					TDFCS1	TDFCS0		

TDFCS1,TDFCS0 Setting related to the preload and multi-axis integrator copy disable signal (TDFCANx)
0 : The rotation directions of the master and slave motors are the same during spindle rotation (when viewed from the motor shaft).
1 : The rotation directions of the master and slave motors are opposite during spindle rotation (when viewed from the motor shaft).
Set this parameter for the slave axis for the multi-axis integrator copy function.
0,0 : Input signal TDFCANx is disabled.
0,1 : When input signal TDFCANx = 1, preload is disabled.
1,0 : When input signal TDFCANx = 1, preload and multi-axis integrator copy are disabled.

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1,1 : Do not set this value. If this value is set, operation equivalent to that performed when the setting is 1,0 is performed.

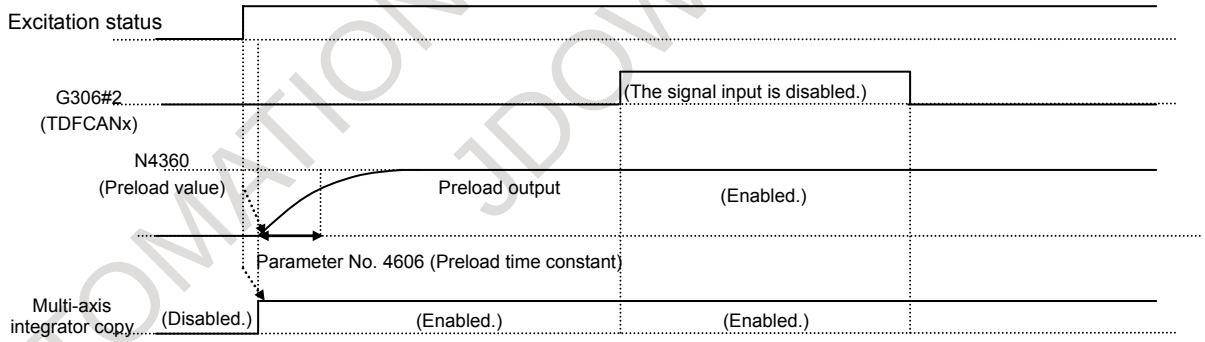
NOTE

Set bits 3 and 2 of parameter No. 4542 properly as follows:

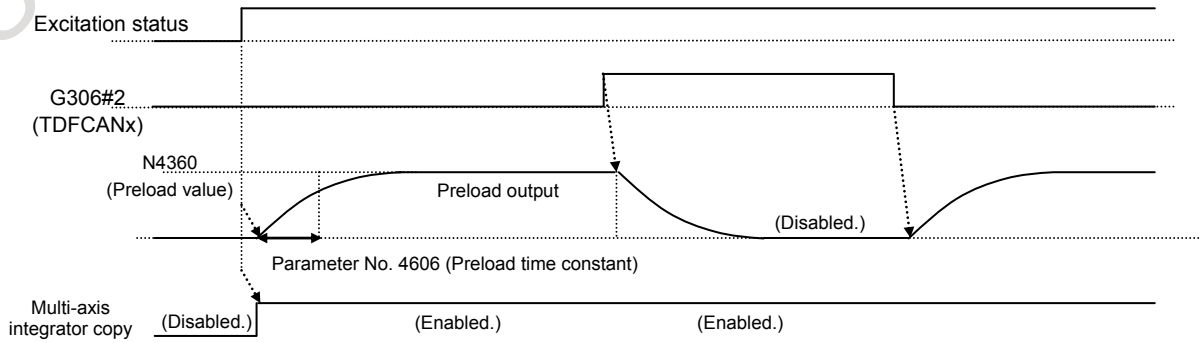
- Setting bits 3 and 2 of parameter No. 4542 to 0,0
  Set this value when multiple tandems (including twin drives) are always connected mechanically and it is not necessary to turn preload or multi-axis integrator copy off or on.
- Setting bits 3 and 2 of parameter No. 4542 to 0,1
  Set this value when multiple tandems (including twin drives) are always connected mechanically, but they are disconnected only at a gear change. Use this setting, for example, if you want to temporarily disable only preload only at a gear change.
- Setting bits 3 and 2 of parameter No. 4542 to 1,0
  Set this value when multiple tandems (including twin drives) may or may not mechanically be connected when driven. When they are not connected, both the preload and multi-axis integrator copy can be disabled.

[Differences in behavior when the TDFCANx signal is input depending on the parameter setting]
The following figures show differences in response when the TDFCANx signal is input depending on the setting of bits 3 and 2 of parameter No. 4542. In the following figures, each tandem axis is assumed to have already been put in the tandem operation mode and response from only one spindle is indicated. For this reason, it is necessary to input the TDFCANx signal corresponding to the other spindle actually.

[When bits 3 and 2 of parameter No. 4542#3,2 = 0,0] The input of signal TDFCANx is disabled.

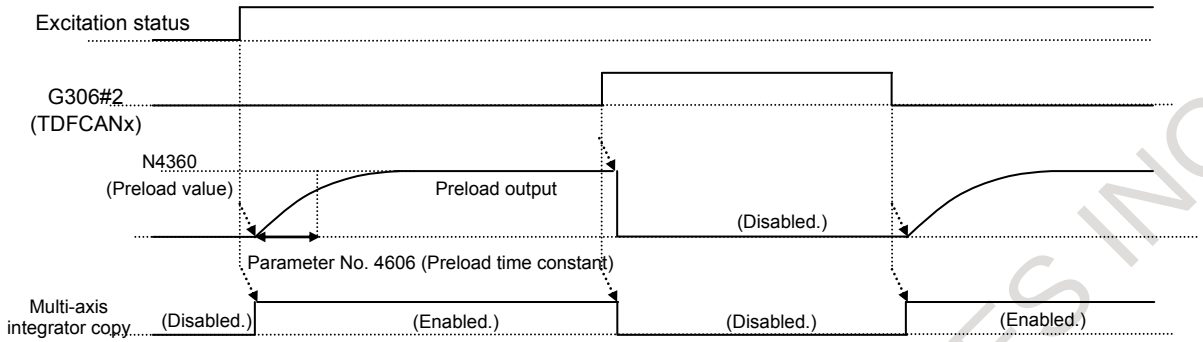


[When bits 3 and 2 of parameter No. 4542 = 0,1]



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[When bits 3 and 2 of parameter No. 4542 = 1,0]



0*i*	30*i*	
4597	4597	**Setting for the multi-axis integrator copy**

Standard setting : 0

Sets the master and slave axes for the multi-axis integrator copy.

= 0 : The function is disabled.

= -1 : Setting of the master axis: When "-1" is set, the master axis for the multi-axis integrator copy is used.

> 0 : Setting of the slave axis: Specify the master axis number to be received in data transfer.

(Use a logical spindle number to specify which spindle is to be used as the master axis.)

0*i*	30*i*	
4360	4360	**Preload value**

Unit of data : ±16384 equivalent to a torque command of 100%

Valid data range : -8192 to 8192(-50% to +50%)

Standard setting : 0

This parameter sets a preload value. It may suppress stop-time vibration caused by backlash.

0*i*	30*i*	
4606	4606	**Preload time constant**

Unit of data : 100 msec

Valid data range : 0 to 50

Standard setting : 0

A preload time constant is set to reduce the mechanical shock in the preload on state. Set a preload time constant. When this parameter is set to 0, 32 msec is assumed.

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5.11 TANDEM DISTURBANCE ELIMINATION CONTROL (OPTIONAL FUNCTION)

5.11.1 Overview

This function suppresses the vibration caused by the interference between the master and slave axes when the axes use position tandem (spindle simple synchronous) or velocity tandem control.
The function remains in effect only when the PMC signal indicating whether the two axes are mechanically connected is set to 1 (connected). Note that the function requires the inter-spindle amplifier communication function.

NOTE
1 To use this function, the CNC software option "tandem disturbance elimination control" is required.
2 To use this function, α*i*SP TYPE B or α*i*SP–B is required for the 06B-61xx-Hxxx amplifier (β*i*SVSP/β*i*SVSP-B does not support this function).
3 This function can be used together with velocity tandem control.
4 This function cannot be used together with the spindle EGB.
5 This function cannot be used for twin drives (two-winding motors and induction machines only).
6 This function can be used between a pair of a master and a slave axis connected via inter-spindle amplifier communication.
7 Inter-spindle amplifier communication is used. Prepare inter-spindle amplifier communication cables.
8 This function needs to be disabled when the master and slave axes are not mechanically connected. In this case, turn off the machine connection notification signal (tandem command signal) SLV for both axes.
9 This function cannot be used with sensorless motor.

5.11.2 Series and Editions of Applicable Spindle Software

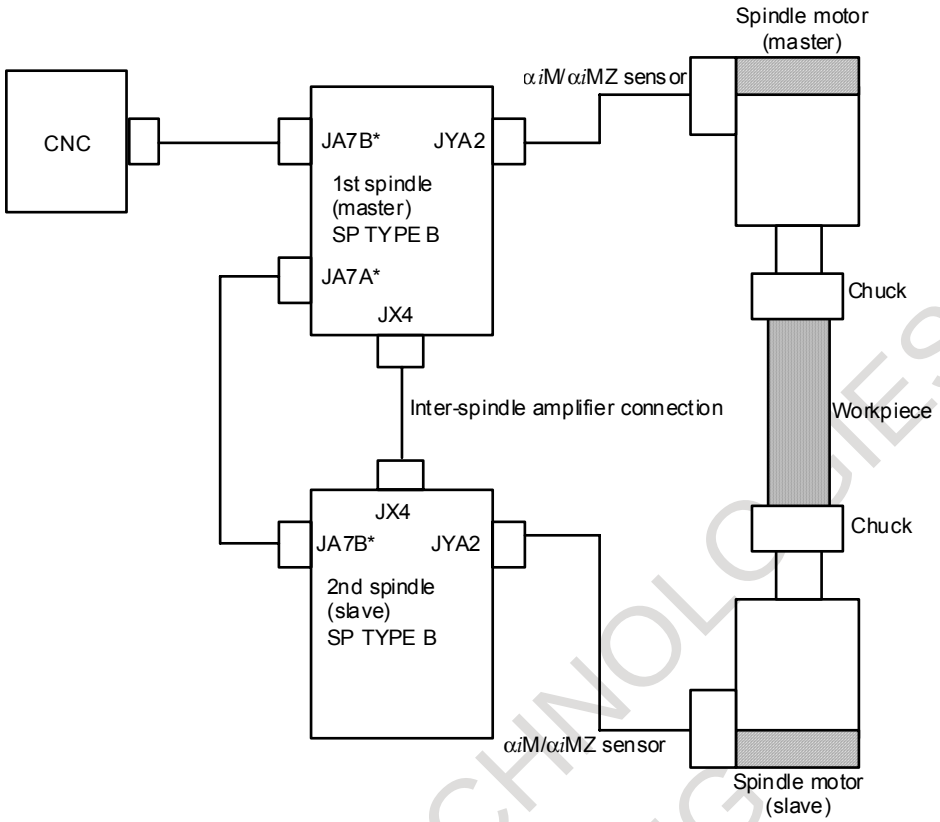
Spindle software

Series	Edition	Usable CNC
9D90	B (02)	FS0*i*-D / FS30*i*-A / FS31*i*-A
9DA0	F (06)	FS0*i*-D / FS0*i*-F / FS30*i*-B / FS31*i*-B / FS32*i*-B
9DB0	A (01)	FS0*i*-F / FS30*i*-B / FS31*i*-B / FS32*i*-B / FS35*i*-B

5.11.3 System Configuration

A system is assumed to have a configuration like the one shown below in which the machine is driven by two spindles and the connection between the two axes is relatively stiff. In such a configuration, the power interference between the motors may cause vibration. Tandem disturbance elimination control is used for a machine like this.

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* For the FS30*i*-B series CNC (FSSB communication), use COP10A/COP10B instead of JA7A/JA7B.

NOTE
1 When the master and slave are mechanically disconnected with each other, cancel the tandem operation mode.
2 When the motor to be used is a synchronous spindle motor of the B*i*S series, the power line between the amplifier and the motor needs to be connected via the sub module SM (SSM).
3 To perform pole detection when the motor to be used is a synchronous spindle motor of the B*i*S series, release the mechanical connection to free the synchronous spindle motor. In this case, cancel the tandem operation mode as well.

5.11.4 I/O Signals (CNC↔PMC)

(1) Input signals (PMC→CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G073	G073						MPOFA	SLVA	
2nd-	G077	G077						MPOFB	SLVB	

SLVA Mechanical connection notification signal (for the first spindle)
SLVB Mechanical connection notification signal (for the second spindle)
These signals notify the amplifiers of the two axes whether the axes are mechanically connected.
The two axes are mechanically:
0 : Disconnected (tandem disturbance elimination control is disabled)
1 : Connected (tandem disturbance elimination control is enabled)

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NOTE
While these signals are operation command signals for the tandem function, they are also used for tandem disturbance elimination control.

(1) Before setting SLVx to 1 for the two spindles, set "0" in the position command or velocity command for both spindles to stop them and check that SSTx is set to 1 (speed zero) as well as that the two spindles are mechanically connected.

(2) Before setting SLVx to 0 for the two spindles, set "0" in the position command or velocity command for both spindles to stop them and check that SSTx is set to 1 (speed zero). Then, disconnect the machine.

NOTE
1 When the two spindles are mechanically disconnected with each other, do not set these signals to 1.
2 When using a synchronous spindle motor, specify the commands with pole detection completed for both axes.
3 Before changing the spindle connection state notification signal SLVx, check that "0" is set in the position command or velocity command (position control/velocity control mode) and SSTx is set to 1 (speed zero state) for both spindles.
4 To return the axes to the origin in position tandem (spindle simple synchronous control), turn off these signals (SLVx = 0) and return each axis to the origin individually.
5 To use the parking signal in position tandem (spindle simple synchronous control), turn off these signals and disable tandem disturbance elimination control.

MPOFA Motor power turn-off signal (for the first spindle)
MPOFB Motor power turn-off signal (for the second spindle)
0 : Normal operation
1 : Turns off the power to the motor.

NOTE
1 If any abnormality, such as an excessive master-slave speed difference, is detected when tandem disturbance elimination control is enabled, turn off the power to the motors of both the master and slave axes by using these signals in order to minimize mechanical damage.
2 When a synchronous spindle motor is used, the motors decelerate to a stop using the SSM, rather than coast to a stop, even if these signals are input.

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(2) Output signals (CNC→PMC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F045	F045							SSTA	
2nd-	F049	F049							SSTB	

SSTA Speed zero detection signal (for the first spindle)
SSTB Speed zero detection signal (for the second spindle)
0 : The spindle motor is rotating.
1 : The spindle motor is in the speed zero (stopped) state.

Check that these signals are set to "1" for both the master and slave axes, before the switching the mechanical connection notification signal SLVx.
If these signals are set to "0", a request to change the switching the mechanical connection notification signal SLVx cannot be accepted.

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F046	F046				SLVSA				
2nd-	F050	F050				SLVSB				

SLVSA Mechanical connection answer signal (for the first spindle)
SLVSB Mechanical connection answer signal (for the second spindle)
Tandem disturbance elimination control is:
0 : Disabled (received a notification that the two axes are mechanically disconnected)
1 : Enabled (received a notification that the two axes are mechanically connected)
Check that these signals are set to "1" for both the master and slave axes, and then specify the same command for the spindle amplifiers of the two axes.

NOTE
While these signals are operation command signals for the tandem function, they are also used for tandem disturbance elimination control.

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F047	F047						MSOVRA		
2nd-	F051	F051						MSOVRB		

MSOVRA Master-slave speed difference state signal(for the first spindle)
MSOVRB Master-slave speed difference state signal (for the second spindle)
0 : The speed difference between the master and slave is less than the set value.
1 : The speed difference between the master and slave is equal to or greater than the set value.
These signals indicate whether or not the speed difference between the master motor and slave motor is less than the value set in the parameter (No. 4347). The signal for the slave spindle amplifier need not be monitored. (At all times, 0 is output.)

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⚠ CAUTION

1 If a motor feedback signal disconnection alarm (spindle alarm 73) is issued, the status of this signal is undefined.
2 When bit 5 of parameter No. 4007 is set to "1", the detection operation of the feedback signal disconnection alarm is not performed.
Set "0" in principle to enable alarm detection.

NOTE

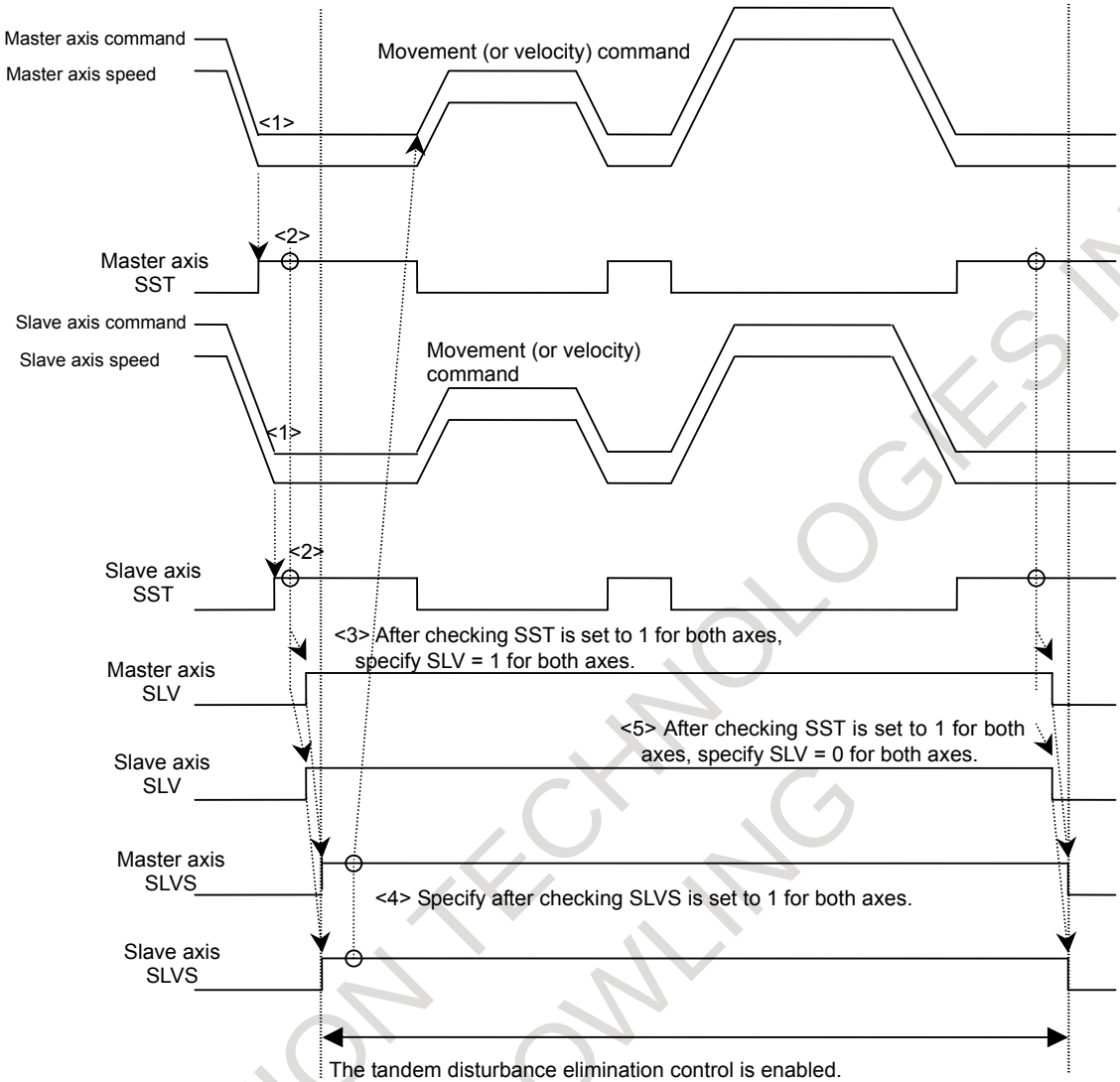
Monitor the states of these signals on the PMC. Ensure that an alarm is issued if an error occurs (for example, if the state of 1 lasts for a certain period of time).

5.11.5 Examples of Sequences

The sequence is as follows.

<1> Stop both axes.
<2> After connecting the two axes mechanically, check that SSTx is set 1 (speed zero state) for both axes.
<3> Input the spindle connection notification signal SLVx to the two axes, with the value of 1 set in the signal. When the answer signal SLVSx is set 1 for both axes, tandem disturbance elimination control is enabled.
<4> When tandem disturbance elimination control is enabled, specify the same command for both axes.
<5> To disable the function, check that SSTx is set 1 (speed zero state) for both axes and input the spindle connection notification signal SLV to the two axes, with the value of 0 set in the signal.
<6> After checking that the answer signal SLVSx is set 0 for both axes, disconnect the spindle mechanically.

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5.11.6 Parameters

Details of the parameters related to tandem disturbance elimination control are given below.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4015	4015					SPDTDM			

SPDTDM Whether to use the spindle tandem control option (Since this parameter is automatically set, it cannot be set manually; it is only allowed to reference the parameter.)

NOTE
To use tandem disturbance elimination control for velocity tandem control, the spindle tandem control option is required (SPDTDM needs to be set to 1). If SPDTDM is set to 0, check the software option.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4403	4403								TDEOPT

TDEOPT Whether to use the tandem disturbance elimination control option (Since this parameter is automatically set, it cannot be set manually; it is only allowed to reference the parameter.)

NOTE
When this bit is set to "0", tandem disturbance elimination control is disabled. If the bit is set to "0", check the software option.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4540	4540			TANDMP					

TANDMP Tandem disturbance elimination control
0 : Tandem disturbance elimination control is disabled.
1 : Tandem disturbance elimination control is enabled.
This parameter is valid when bit 0 (TDEOPT) of parameter No. 4403 is set to 1. To use tandem disturbance elimination control, set "1" in this bit for both the master and slave axes.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4398	4398			WSVCP	VTAN	WNDTDM			

WNDTDM Whether to use the twin drive function (two-winding motor drive and induction machine only)
VTAN Whether to use the velocity tandem function
WSVCP Whether to use the velocity integrator copy function
By combining these bit parameters as shown on the next page, tandem disturbance elimination control can be used.
The settings (1) and (2) are intended for speed tandem operation, and the settings (3) and (4) are intended for position tandem (spindle simple synchronous control) operation.

Setting	TANDMP	TDEOPT	WSVCP	VTAN	WNDTDM	SPDTDM	Enabled function
(1)	1	1	0	1	0	1	Velocity tandem control + Tandem disturbance elimination control

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Setting	TANDMP	TDEOPT	WSVCP	VTAN	WNDTDM	SPDTDM	Enabled function
(2)	1	1	1	1	0	1	Velocity tandem control + Velocity integral copy function + Tandem disturbance elimination control
(3)	1	1	0	0	0	0	Tandem disturbance elimination control
(4)	1	1	1	0	0	0	Velocity integral copy function + Tandem disturbance elimination control

Note) WNDTDM is a parameter used for two-winding motors (induction machines only). This function cannot be used for two-winding motors. Be sure to set WNDTDM to 0.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4402	4402					TRQTDM			

TRQTDM Whether to use the torque tandem function
Set this parameter to 0.

NOTE
*1 While this bit assumes the NC for FS30*i*-B, set "0" for 30*i*-A as well.
*2 When this bit is set to "1", tandem disturbance elimination control does not work normally. Be sure to set "0".

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4352	4352	MASTER	SLAVE						

SLAVE Inter-spindle amplifier communication slave axis setting
0 : Non-inter-spindle amplifier communication slave axis
1 : Inter-spindle amplifier communication slave axis (Set 1 for the master axis.)
MASTER Inter-spindle amplifier communication master axis setting
0 : Non-inter-spindle amplifier communication master axis
1 : Inter-spindle amplifier communication master axis (Set 1 for the master axis.)

NOTE
1 For inter-spindle amplifier communication, set (MASTER,SLAVE)=1,0 for the master axis and (MASTER,SLAVE)=0,1 for the slave axis.
2 Setting (MASTER,SLAVE)=1,1 causes the state error "38".

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4353	4353						RVSVC2		

RVSVC2 Relationship of master/slave motor rotation directions when the spindles are connected
0 : The master motor and slave motor rotate in the same direction (when viewed from the motor shaft).

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1 : The master motor and slave motor rotate in the opposite directions (when viewed from the motor shaft).

This parameter determines the polarity of the actual motor speed that one spindle receives from the other.

NOTE
1 Set this parameter on the master side. The value set on the master side (the spindle for which bit 7 of parameter No. 4352 is set to 1) is transferred to the slave side via inter-spindle amplifier communication.
2 If this parameter is not set properly, tandem disturbance elimination control does not work normally.

0*i*	30*i*	
4601	4601	**Tandem disturbance elimination control Proportional gain Kp**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0

While this parameter may be used for a machine generating much friction, it is generally not used.

0*i*	30*i*	
4602	4602	**Tandem disturbance elimination control Integral gain Ki**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0

This parameter compensates the spring element of the machine. When stiffness is high, the value becomes large (torque/inertia).
The larger the ratio, the smaller the value.

0*i*	30*i*	
4603	4603	**Tandem disturbance elimination control Phase compensation α**

Unit of data :
Valid data range : 0, 51 to 512($0.1 < \alpha < 1$)
Initial setting : 0

This parameter is used with coefficient T below to compensate for the delay of adjustment.
When the parameter is set to 0, the value is internally handled as 512 ($\alpha = 1$).
When α is 1, phase compensation is not done.

0*i*	30*i*	
4604	4604	**Tandem disturbance elimination control Phase compensation T**

Unit of data : 1msec
Valid data range : 0 to 20
Initial setting : 0

This parameter is used with coefficient α above to compensate for the delay of adjustment. If the interference frequency is 100 Hz or higher, try setting α to 102 and T to 3.

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0*i*	30*i*	
4605	4605	**Tandem disturbance elimination control Incomplete integral time constant τ**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0

Setting a large value for integral gain Ki may cause low frequency vibration (10 Hz or lower).
In this case, set a smaller value for the incomplete integral time constant. See the following table for reference. When the parameter is set to 0, the value is internally handled as 32682.

Time constant (sec)	Parameter value
0.1	32682
0.05	32596
0.02	32341

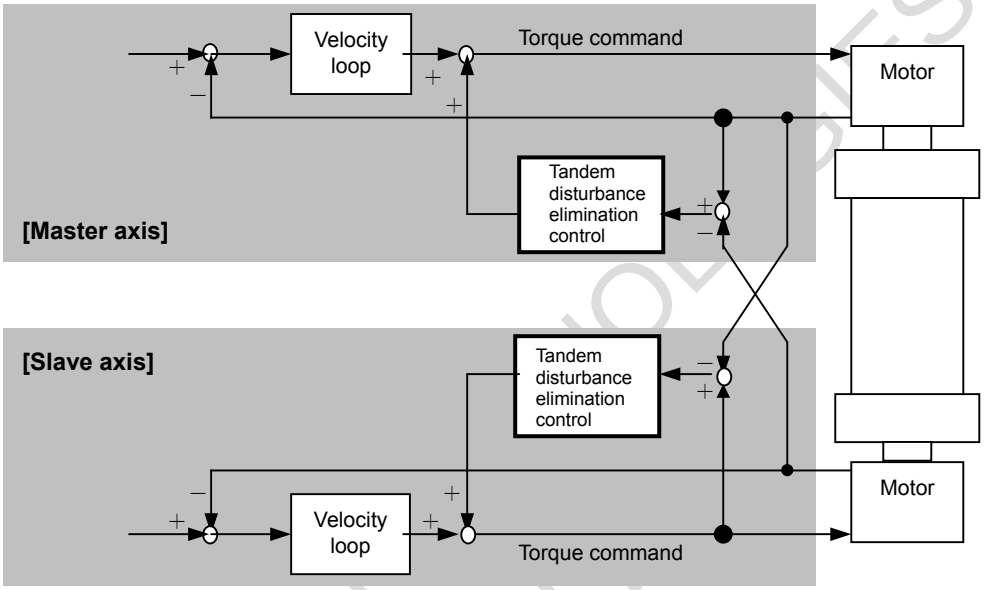
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5.11.7 Block Diagram

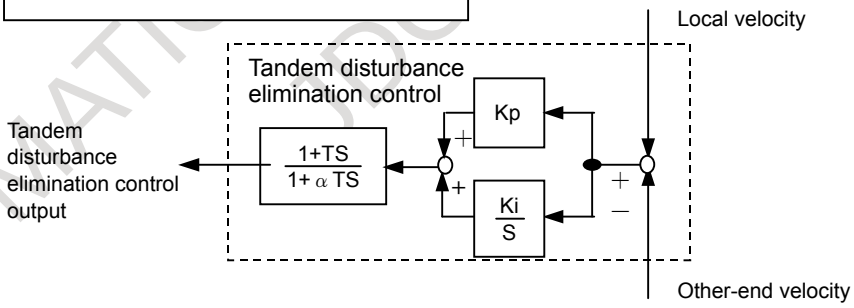
Details of the parameters related to tandem disturbance elimination control are given below.

The block diagram for tandem disturbance elimination control is as shown below.

<1> Calculate the deviation from the local velocity and the other-end velocity.
<2> Calculate the proportional integral for the calculated deviation.
<3> Perform phase compensation for the result of the proportional integral calculation and add the amount of torque compensation to the torque command for each axis.



Internal block diagram for tandem disturbance elimination control



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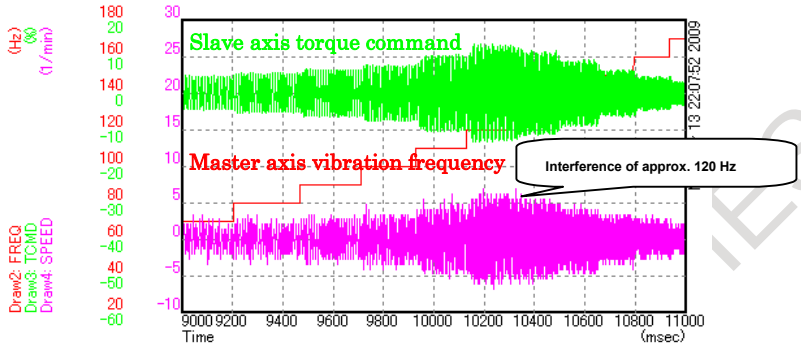
5.11.8 Adjustment

- Check the torque command (or motor speed) of the two axes by using the servo guide.
- If the waveforms of the two axes have opposite phases (in the case of forward connection) or the same phase (in the case of backward connection), it is likely that interference (vibration) is occurring due to the spring element between the axes.
- Enable tandem disturbance elimination control, and adjust integral gain Ki for tandem disturbance elimination control.
- Increment the value of integral gain Ki gradually starting from "0" (set the same value for both axes), and check how the interference (vibration) changes. There should be an optimum value of Ki. Setting too large a value may increase the interference (vibration).
- Since changing the velocity loop gain changes the frequency of the vibration, change Ki to make the vibration weaker.
- If the vibration frequency exceeds 100 Hz, the effect of tandem disturbance elimination control becomes small. This may be improved by setting the phase compensation coefficients, α and T, of the two axes (set the same value for both axes).

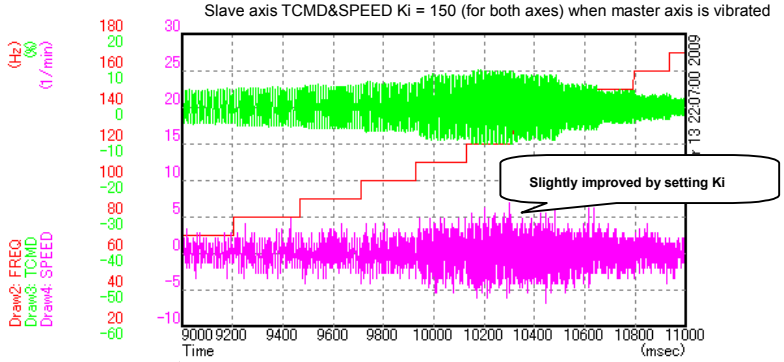
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(Adjusted waveform example)
Vibration frequency observed when the master axis is vibrated using the disturbance input function and torque command and velocity of the slave axis

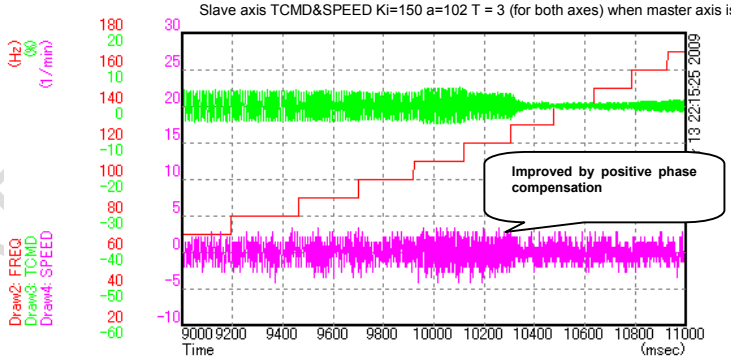
Slave axis TCMD&SPEED Ki = 0 (tandem disturbance elimination control disabled) when master axis is vibrated



Slave axis TCMD&SPEED Ki = 150 (for both axes) when master axis is vibrated



Slave axis TCMD&SPEED Ki=150 a=102 T = 3 (for both axes) when master axis is vibrated



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5.12 TORQUE TANDEM CONTROL FUNCTION (OPTIONAL FUNCTION)

5.12.1 Overview

Spindle tandem control is a function that drives the spindle with two motors to provide a large output that cannot be obtained with one motor. The following two types are available:
(1) Velocity tandem control
(2) Torque tandem control (induction spindle motor only)

While speed control is disabled on the slave side in torque tandem control, it is enabled in velocity tandem control. For this reason, velocity tandem control offers greater slave axis stability. Therefore, when employing spindle tandem control, select velocity tandem control under normal circumstances.
Note that, in cases where you do not want the slave axis to exert speed control (you want both axes to have the same torque although they widely differ in speed), as in wheel lathing, you need to adopt torque tandem control.

The torque tandem control function controls two mechanically connected spindle motors by using the same torque command.

NOTE
1 To use this function, the CNC software option (spindle tandem control) is required.
2 When the NC is 30*i*-B, the spindle tandem control function is included in the spindle synchronous control option.
3 To use this function, α*i*SP TYPE B or α*i*SP–B is required (β*i*SVSP/β*i*SVSP-B does not support this function).
4 When this function is used, the spindle amplifiers and spindle motors of the master and slave must be of the same model.
5 For the master and slave axes, use the spindle software of the same series and edition.
6 This function cannot be used together with the following functions:
- Spindle synchronous control function
- Speed range switching function
- Spindle switching function
- Position coder signal output function
- Spindle EGB function
- Spindle repetitive control function
- Synchronous built-in spindle motor driving

7 No limitation is imposed on master and slave axis assignment.
In the descriptions below, the following assignment is used for convenience:
Master spindle amplifier: First spindle
Slave spindle amplifier: Second spindle
8 When using the 30*i*-B series (FSSB communication), connect the spindle motors for the master and slave axes for the torque tandem to the same FSSB line.
9 This function cannot be used with sensorless motor.

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5.12.2 Series and Editions of Applicable Spindle Software

Spindle software

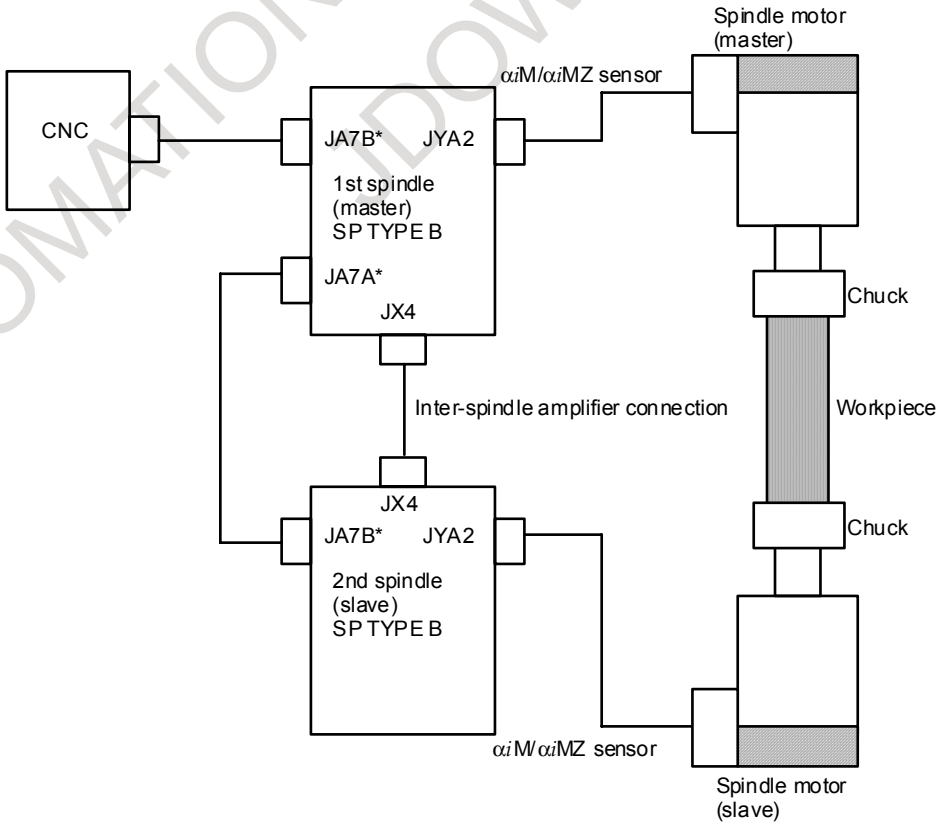
Series	Edition	Usable CNC
9D50	M (13)	FS0*i* -D
9D70	C (03)	FS30*i* / FS31*i* / FS32*i* -A
9D80	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9D90	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	A (01)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

NOTE
To use the α*i*CZ sensor (serial), the 9D90 series G (07) edition or later, the 9DA0 series I (09) edition or later is required or the 9DB0 series A (01) edition or later. This function cannot be used with the 9D50, 9D70, or 9D80 series.

5.12.3 System Configuration

NOTE
1 For connection details of each cable, refer to "FANUC SERVO AMPLIFIER α*i* series DESCRIPTIONS (B-65282EN)".
2 The common power supply (PS) emergency stop signal (connector CX4) needs to be input for each common power supply (PS).

(1) Sample configuration 1: System where the master spindle and slave spindle are mechanically connected or disconnected when a workpiece is attached or detached

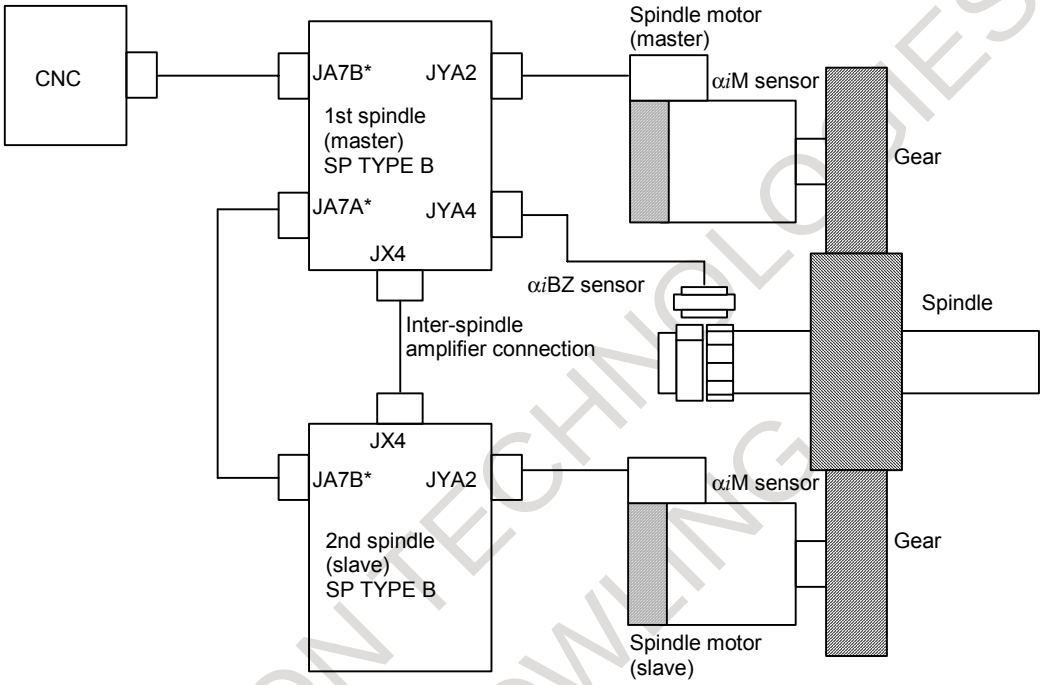


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* For the FS30*i*-B series CNC (FSSB communication), use COP10A/COP10B instead of JA7A/JA7B.

NOTE
When the master and slave are mechanically disconnected, torque tandem control cannot be used. In this case, cancel the tandem operation mode.

(2) Sample configuration 2: System where the table axis is driven by two motors



* For the FS30*i*-B series CNC (FSSB communication), use COP10A/COP10B instead of JA7A/JA7B.

5.12.4 I/O Signals (CNC↔PMC)

NOTE
1 A command for the spindles engaged in tandem operation is issued to the master spindle amplifier.
The input signal specifications are the same as for ordinary spindles (for which the torque tandem function is not used).
For details of signals used in each control mode, see Chapter 3, “I/O SIGNALS”, in Part I.
2 During tandem operation, no signal needs to be input from the PMC to the tandem function slave spindle amplifier. Those signals that are required to drive the slave spindle amplifier are transferred from the master spindle amplifier by inter-spindle amplifier communication.
3 During tandem operation, use a signal output from the master spindle amplifier for sequence determination (such as speed arrival determination and alarm detection). (No signal output from the slave spindle amplifier is needed.)

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(1) Input signals (PMC→CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G071	G071				SOCNA				
2nd-	G075	G075				SOCNB				

SOCNA Soft start/stop signal (for the first spindle)
SOCNB Soft start/stop signal (for the second spindle)
0 : Disables the soft start/stop function.
1 : Enables the soft start/stop function.
These signals enable or disable the soft start/stop function.
Use these signals when limiting the specified acceleration rate to reduce a mechanical shock during acceleration/deceleration.
During tandem operation (SLVx = 1), the signals need not be input to the slave spindle amplifier.

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G073	G073						MPOFA	SLVA	
2nd-	G077	G077						MPOFB	SLVB	

SLVA Tandem operation command (for the first spindle)
SLVB Tandem operation command (for the second spindle)
0 : Makes a request to disable tandem operation.
1 : Makes a request to enable tandem operation.
These signals enable or disable tandem operation.
When using the torque tandem function, set these signals to 1 for both of the master and slave.

NOTE
1 Both of the master and slave must be stopped before these signals can be switched.
During rotation, these signals cannot be accepted.
2 Switch these signals in the speed control mode. In a mode other than the speed control mode, these signals cannot be accepted.
3 When the master and slave are mechanically disconnected with each other, do not set these signals to 1.

MPOFA Motor power turn-off signal (for the first spindle)
MPOFB Motor power turn-off signal (for the second spindle)
0 : Normal operation
1 : Turns off the power to the motor.
These signals turn off the power to the motor.
During tandem operation (SLVx = 1), these signals need not be input to the slave spindle amplifier.

NOTE
If an error such as an excessive master-slave speed difference is detected when torque tandem operation is enabled, the power to both of the master motor and slave motor must be turned off simultaneously to minimize damage to the machine. In such a case, be sure to turn off the power to both motors by using these signals.

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(2) Output signals (CNC→PMC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F045	F045							SSTA	
2nd-	F049	F049							SSTB	

SSTA Speed zero detection signal (for the first spindle)
SSTB Speed zero detection signal (for the second spindle)
0 : The spindle motor is rotating.
1 : The spindle motor is in the speed zero (stopped) state.
After checking that these signals are set to 1 with both of the master and slave, switch the tandem operation command SLVx.
When these signals are set to 0, the tandem operation command cannot be accepted.

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F046	F046				SLVSA				
2nd-	F050	F050				SLVSB				

SLVSA Tandem operation state signal (for the first spindle)
SLVSB Tandem operation state signal (for the second spindle)
0 : Tandem operation is disabled.
1 : Tandem operation is enabled.
After checking that these signals are set to 1 with both of the master and slave, issue a command to the master spindle amplifier.

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F047	F047						MSOVRA		
2nd-	F051	F051						MSOVRB		

MSOVRA Master-slave speed difference state signal(for the first spindle)
MSOVRB Master-slave speed difference state signal (for the second spindle)
0 : The speed difference between the master and slave is less than the set value.
1 : The speed difference between the master and slave is equal to or greater than the set value.
These signals indicate whether or not the speed difference between the master motor and slave motor is less than the value set in the parameter (FS16*i*: No. 4347).
The signal for the slave spindle amplifier need not be monitored. (At all times, 0 is output.)

⚠ CAUTION
1 If a motor feedback signal disconnection alarm (spindle alarm 73) is issued, the status of this signal is undefined.
2 When bit 5 of parameter No. 4007 is set to "1", the detection operation of the feedback signal disconnection alarm is not performed.
Set the parameter to "0" when not required, to enable alarm detection.

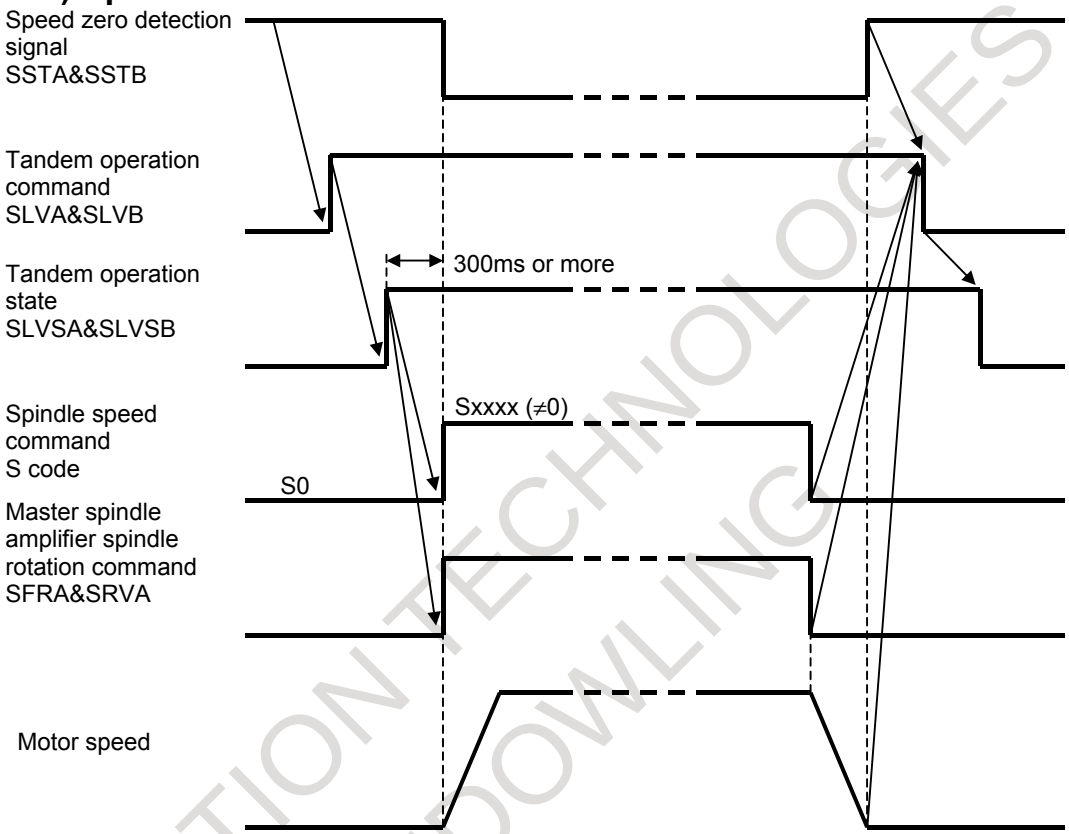
NOTE
Monitor the states of these signals on the PMC. Ensure that an alarm is issued if an error occurs (for example, if the state of 1 lasts for a certain period of time).

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5.12.5 Examples of Sequences

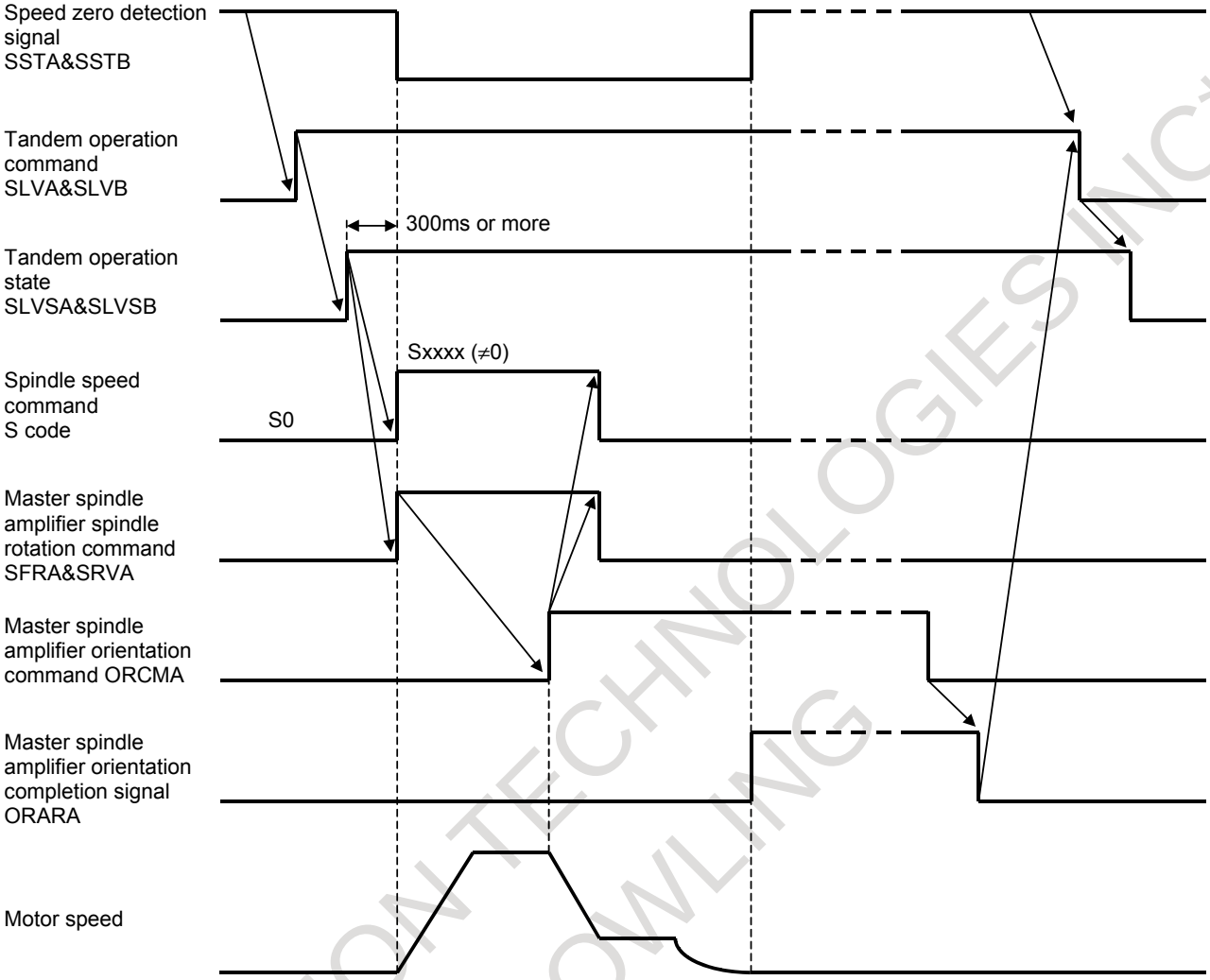
NOTE
Examples of sequences are given below assuming the following:
First spindle: Master spindle amplifier
Second spindle: Slave spindle amplifier

(Example 1) Speed control mode



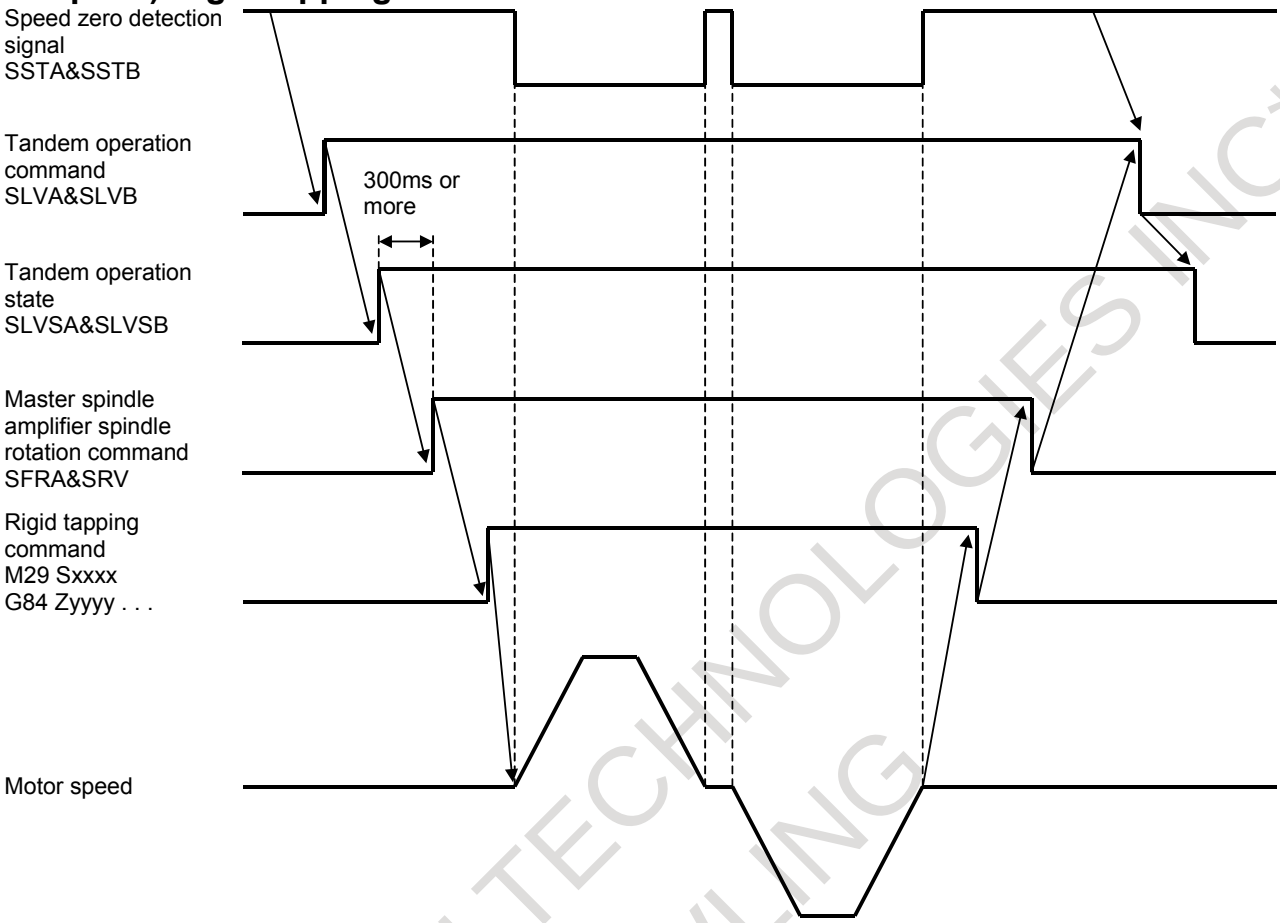
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(Example 2) Spindle orientation



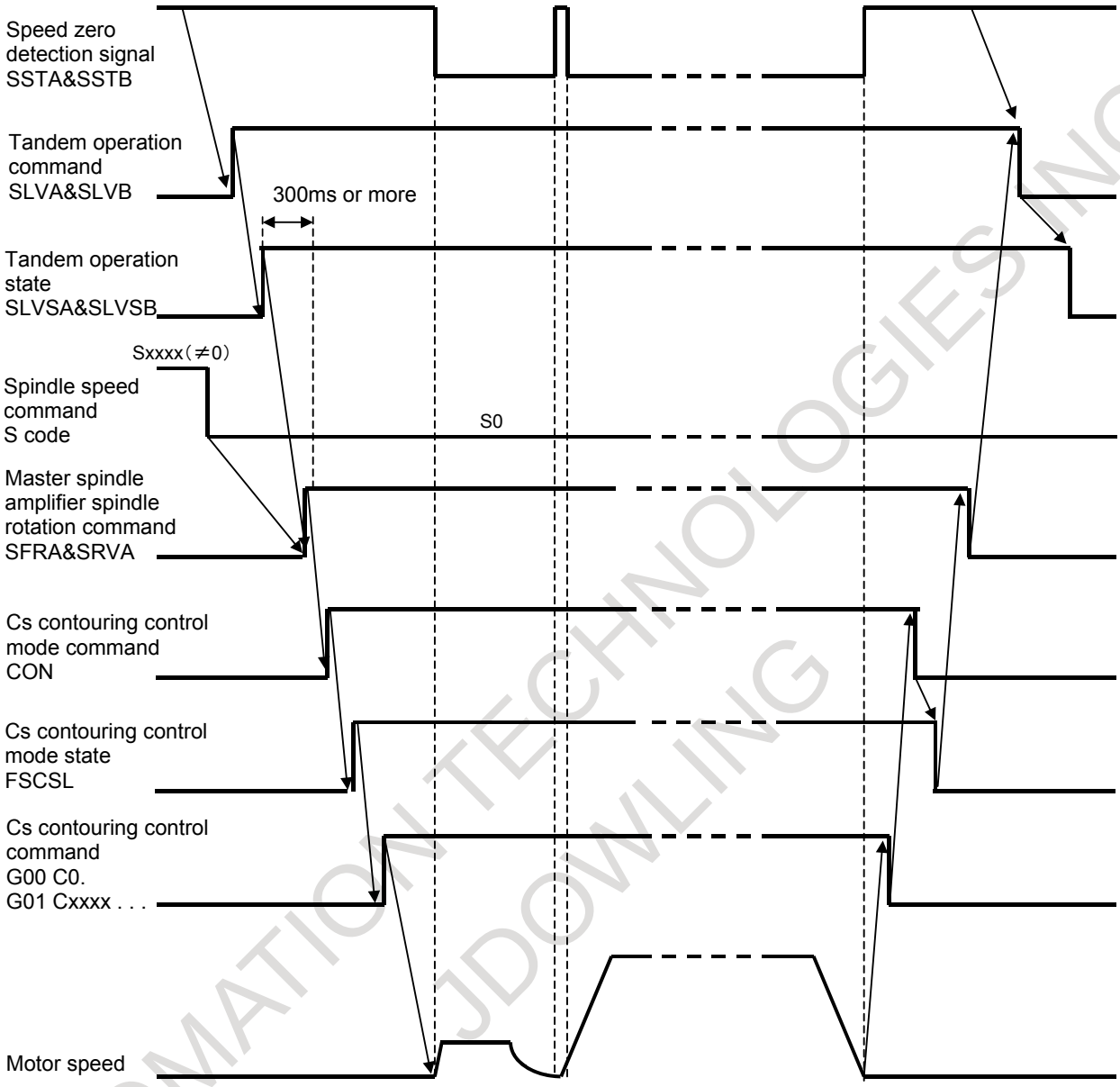
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(Example 3) Rigid tapping



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(Example 4) Cs contouring control



5.12.6 Parameters

(1) Cautions

For the master spindle amplifier and slave spindle amplifier, set the same parameters except for the following specific parameters:

Parameter No.		Description	Master setting	Slave setting
0*i*	30*i*			
4002#3 to 0	4002#3 to 0	Spindle sensor type	Depending on the spindle configuration	Depending on the spindle configuration
4353#2	4353#2	Relationship of master/slave motor rotation directions in torque tandem operation	Depending on the spindle configuration	0

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Parameter No.		Description	Master setting	Slave setting
0*i*	30*i*			
4352#7,6	4352#7,6	Inter-spindle amplifier communication setting	1, 0	0, 1
4360	4360	Preload value	Machine by machine (adjustment value)	0

(2) List of parameters

Parameter No.		Description
0*i*	30*i*	
4009#2	4009#2	Motor power turn-off method when spindle alarm 24 (serial data transfer error) is issued
4353#2	4353#2	Relationship of master/slave motor rotation directions in torque tandem operation
4015#3	4015#3	Whether to use the spindle tandem function
4353#1	4353#1	Velocity feedback signal setting in torque tandem operation
4398#3	4398#3	Whether to use the twin drive function
4398#4	4398#4	Whether to use the velocity tandem function
4398#5	4398#5	Whether to use the velocity integrator copy function
4402#3	4402#3	Whether to use the torque tandem function
4398#6	4398#6	Whether to detect a speed polarity error (spindle alarm d0) in torque tandem operation
4352#6	4352#6	Inter-spindle amplifier communication slave axis setting
4352#7	4352#7	Inter-spindle amplifier communication master axis setting
4347	4347	Master-slave speed difference state signal output setting
4360	4360	Preload value

(3) Details of Parameters

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4009	4009						**ALSP**		

ALSP Motor power turn-off method when spindle alarm 24 (serial data transfer error) is issued
- 0 : Turns off the power after the motor is decelerated to a stop.
- 1 : Turns off the power immediately. (Set this parameter to 1.)

NOTE
If an alarm is issued during torque tandem operation, the power to both of the master motor and slave motor must be turned off simultaneously to prevent the machine from being damaged. When using the torque tandem function, be sure to set this parameter to 1 to turn off the power to the motors immediately if a CNC-SP communication error occurs.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4015	4015					**SPDTDM**			

SPDTDM Whether to use the spindle tandem function (The CNC software option is required.)
- 0 : Does not use the spindle tandem function.
- 1 : Uses the spindle tandem function.

NOTE
If this bit is set to 0, the torque tandem function does not operate normally. When this bit is set to 0, check the software option.

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0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4352	4352	MASTER	SLAVE						

SLAVE Inter-spindle amplifier communication slave axis setting
0 : Non-inter-spindle amplifier communication slave axis
1 : Inter-spindle amplifier communication slave axis (Set this parameter to 1 for the slave spindle amplifier.)

MASTER Inter-spindle amplifier communication master axis setting
0 : Non-inter-spindle amplifier communication master axis
1 : Inter-spindle amplifier communication master axis (Set this parameter to 1 for the master spindle amplifier.)

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4353	4353						RVSVC2	VFBAV	

VFBAV Velocity feedback signal setting in torque tandem operation
0 : For speed control, the master spindle amplifier motor speed only is used.
1 : For speed control, the average speed of the master spindle amplifier and slave spindle amplifier is used.
By exercising speed control using the average speed feedback value of the master and slave, vibration caused by spindle backlash may be suppressed.

RVSVC2 Relationship of master/slave motor rotation directions in torque tandem operation
0 : The master motor and slave motor rotate in the same direction at spindle rotation time (as viewed from the motor shaft).
1 : The master motor and slave motor rotate in the opposite directions at spindle rotation time (as viewed from the motor shaft).
This parameter sets the polarity for a speed command and feedback signal in torque tandem operation.

NOTE
1 This parameter need not be set for the slave spindle amplifier side. (The setting for the master spindle amplifier is transferred to the slave spindle amplifier by inter-spindle amplifier communication.)
2 If the setting of this parameter is improper, the torque tandem function does not operate normally.
If the spindle is rotated in this state, the speed polarity error alarm (spindle alarm d0) is issued in torque tandem operation.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4398	4398		A130DN	WSVCP	VTAN	WNDTDM			

WNDTDM Whether to use the twin drive function
VTAN Whether to use the velocity tandem function
WSVCP Whether to use the velocity integrator copy function
Set this parameter to 0,0,0.

NOTE
If "1" is set in these bits, the torque tandem function does not work normally. Be sure to set "0,0,0".

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A130DN Whether to detect a speed polarity error (spindle alarm d0) in torque tandem operation
0 : Detects the error.
1 : Does not detect the error.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4402	4402					TRQTDM			

TRQTDM Whether to use the torque tandem function
0 : Disables the torque tandem function.
1 : Enables the torque tandem function.

NOTE
Set it to "0" when the NC is FS30*i*-A.

0*i*	30*i*	
4347	4347	**Master-slave speed difference state signal output setting**

Unit of data : 1min^{-1} *(10min^{-1} when bit 2 (SPDUNT) of parameter No. 4006 is set to 1)
Valid data range : 0 to 32767
Initial setting : 0
This parameter sets a level for detecting the master-slave speed difference state signal (MSOVRA:F47#2, MSOVRB:F51#2).
If this parameter is set to 0, the setting of 100 is assumed.

0*i*	30*i*	
4360	4360	**Preload value**

Unit of data : ±16384 equivalent to a torque command of 100%
Valid data range : -8192 to 8192(-50% to +50%)
Initial setting : 0
This parameter sets a preload value.
This parameter may suppress stop-time vibration caused by backlash.

NOTE
This parameter need not be set for the slave spindle amplifier side. (The setting for the master spindle amplifier is transferred to the slave spindle amplifier by inter-spindle amplifier communication.)

5.12.7 Alarm and Status Error

(1) Spindle alarm

Alarm No.	Description	Measure
66	An inter-spindle amplifier communication error occurred.	Check the connection of the cable (JX4).
80	An alarm was issued on the destination spindle amplifier of inter-SPM communication.	Correct the cause of the alarm on the destination spindle amplifier.
d0	The relationship between the speed polarity of the master motor and the speed polarity of the slave motor is abnormal.	Check the rotation direction relationship setting.

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(2) Spindle amplifier status error

Error No.	Description	Measure
21	A tandem operation command was input when spindle synchronous control is enabled.	Input a tandem operation command after canceling spindle synchronous control.
22	Spindle synchronous control was specified when tandem operation is enabled.	Specify spindle synchronous control after canceling torque tandem operation.
23	A tandem operation command is input even if the option is not specified.	Torque tandem control requires the CNC software option. Check the option.
38	- Parameters related to inter-spindle amplifier communication are not set correctly. - Functions that cannot be used together with the torque tandem function are set.	Check the parameters.

5.13 MAGNETIC SENSOR METHOD SPINDLE ORIENTATION (OPTIONAL FUNCTION)

5.13.1 Overview

Magnetic sensor method spindle orientation is a function for stopping the spindle at a specified position by receiving a position feedback signal from a magnetic sensor directly attached to the spindle of the machine.

NOTE
1 To use this function, the CNC software option (spindle orientation) is required.
2 To use this function, SP TYPE B is required for the A06B-61xx-Hxxx amplifier.
3 This function cannot be used with sensorless motor.

5.13.2 Series and Editions of Applicable Spindle Software

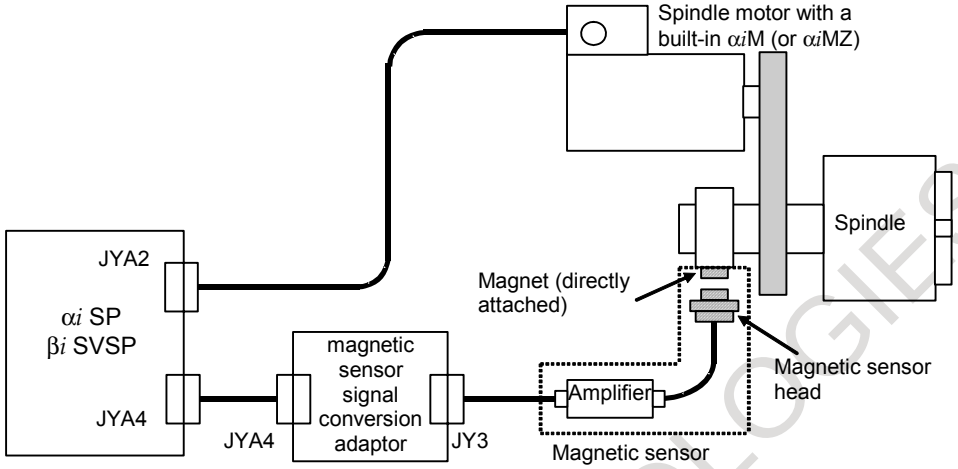
Spindle software

Series	Edition	Usable CNC
9D50	F (06)	FS0*i* -D
9D70	A (01)	FS30*i* / FS31*i* / FS32*i* -A
9D80	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9D90	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	A (01)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

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5.13.3 System Configuration

The magnetic sensor method spindle orientation function can be used with the following system configuration:



NOTE
For the hardware specifications of the magnetic sensor and magnetic sensor signal conversion adaptor and connection details of each cable, refer to "FANUC SERVO AMPLIFIER αi series DESCRIPTIONS (B-65282EN)".

5.13.4 I/O Signals (CNC↔PMC)

The specifications of I/O signals are the same as for position coder method spindle orientation. For details of the specifications, see Section 2.2, "POSITION CODER METHOD SPINDLE ORIENTATION", in Part I.

(1) Address list of input signals (PMC→CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G070	G070		ORCMA			CTH1A	CTH2A		
2nd-	G074	G074		ORCMB			CTH1B	CTH2B		

(2) Address list of output signals (CNC→PMC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F045	F045	ORARA							
2nd-	F049	F049	ORARB							

5.13.5 Examples of Sequences

The sequence is the same as for position coder method spindle orientation. For details of the specifications, see Section 2.2, "POSITION CODER METHOD SPINDLE ORIENTATION", in Part I.

5.13.6 Parameters

(1) List of parameters

Parameter No.		Description
0*i*	30*i*	
4015 #0	4015 #0	Whether the spindle orientation function is available (The CNC software option is required.)

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Parameter No.		Description
0*i*	30*i*	
4001#3	4001#3	Magnetic sensor attachment direction
4003 #0	4003 #0	Whether to use the position coder method spindle orientation function or magnetic sensor method spindle orientation function (to be set to 1 to use the magnetic sensor method)
4003#3,2	4003#3,2	Rotation direction for spindle orientation
4042 4043	4042 4043	Velocity proportional gain on orientation (These parameters are selected with the input signal CTH1A.)
4050 4051	4050 4051	Velocity integral gain on orientation (These parameters are selected with the input signal CTH1A.)
4056 to 4059	4056 to 4059	Gear ratio data between spindle and motor (These parameters are selected with the input signals CTH1A and CTH2A.)
4060 to 4063	4060 to 4063	Position gain on orientation (These parameters are selected with the input signals CTH1A and CTH2A.)
4064	4064	Ratio of position gain change upon completion of spindle orientation
4075	4075	Orientation completion signal detection level
4076	4076	Spindle orientation speed limit ratio
4077	4077	Orientation stop position shift value
4078	4078	MS signal constant
4079	4079	MS signal gain adjustment
4084	4084	Motor voltage on spindle orientation
4038	4038	Spindle orientation speed

(2) Details of parameters

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4001	4001					MGDIR			

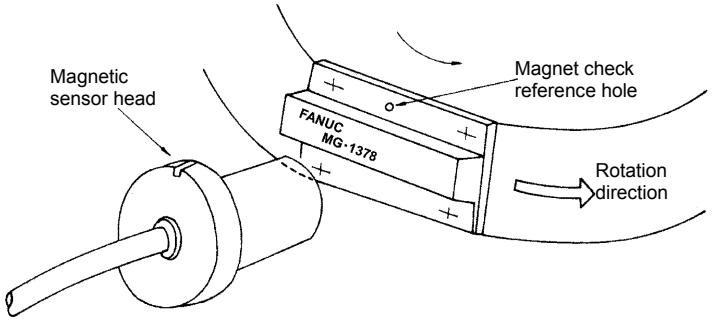
MGDIR Magnetic sensor attachment direction

0 : The motor and magnetic sensor rotate in the opposite directions.

1 : he motor and magnetic sensor rotate in the same direction.

The spindle motor rotates counterclockwise as viewed from the motor shaft when the forward rotation command SFRA = 1.

Make such an arrangement that the check hole of the magnet and the pin groove of the magnetic sensor face each other so that the magnetic sensor and magnet rotate in the directions shown in the figure below when SFRA = 1. In this case, set this bit to 1. If the arrangement is opposite to that shown in the figure below, set this bit to 0.



NOTE
Note that the specification of this parameter is different from the α series.

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0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4003	4003					DIRCT2	DIRCT1		PCMGSL

DIRCT1, DIRCT2 : Rotation direction at spindle orientation

DIRCT2	DIRCT1	Rotation direction
0	0	By rotation direction immediately before (CCW for the first-time spindle orientation after the power is switched on)
0	1	By rotation direction immediately before (CW for the first-time spindle orientation after the power is switched on)
1	0	CCW direction looking from shaft of motor
1	1	CW direction looking from shaft of motor

PCMGSL : Orientation method selection
Set this bit to 1 (magnetic sensor method).

0*i*	30*i*	
4038	4038	**Spindle orientation speed**

Unit of data : $1min^{-1}$ ($*10min^{-1}$ when bit 2 (SPDUNT) of parameter No. 4006 is set to 1)
Valid data range : 0 to 32767
Initial setting : 0
This data is used to set an orientation speed at the spindle end.
If this data is set to 0, an orientation speed is determined from the position gain and the motor speed limit ratio in orientation.

0*i*	30*i*		
4042	4042	**Velocity proportional gain on orientation (HIGH)**	**CTH1A=0**
4043	4043	**Velocity proportional gain on orientation (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10
This data is used to set the velocity loop proportional gain on spindle orientation.
When the input signal CTH1A = 0, (HIGH) is selected. When the input signal CTH1A = 1, (LOW) is selected.

0*i*	30*i*		
4050	4050	**Velocity integral gain on orientation (HIGH)**	**CTH1A=0**
4051	4051	**Velocity integral gain on orientation (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10
This data is used to specify a velocity loop integral gain for spindle orientation.
When the input signal CTH1A = 0, (HIGH) is selected. When the input signal CTH1A = 1, (LOW) is selected.

0*i*	30*i*		
4056	4056	**Gear ratio (HIGH)**	**CTH1A=0, CTH2A=0**
4057	4057	**Gear ratio (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4058	4058	**Gear ratio (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4059	4059	**Gear ratio (LOW)**	**CTH1A=1, CTH2A=1**

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Unit of data : Number of motor rotations per spindle rotation / 100
(Number of motor rotations per spindle rotation / 1000 if bit 1 of parameter No. 4006 (GRUNIT) = 1)
Valid data range : 0 to 32767
Initial setting : 100
This data is used to set a gear ratio between the spindle and spindle motor.
For example, if the motor makes 2.5 rotations while the spindle makes 1 rotation, set 250 in this parameter.
A parameter is selected according to the values of the input signals CTH1A and CTH2A.
Ensure that the state of the gear or clutch corresponds to the values of CTH1A and CTH2A.

NOTE
If an improper value is set in these parameters, an unexpected operation such as endless spindle rotation at orientation time can result.
So, be sure to set a proper gear ratio.

0*i*	30*i*		
4060	4060	**Position gain on orientation (HIGH)**	**CTH1A=0, CTH2A=0**
4061	4061	**Position gain on orientation (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4062	4062	**Position gain on orientation (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4063	4063	**Position gain on orientation (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : $0.01sec^{-1}$
Valid data range : 0 to 32767
Initial setting : 1000
These data are used to set the position gain on spindle orientation.
A parameter is selected according to the values of the input signals CTH1A and CTH2A.

0*i*	30*i*	
4064	4064	**Ratio of position gain change upon completion of spindle orientation**

Unit of data : 1%
Valid data range : 0 to 1000
Initial setting : 100
This data is used to set a position gain change ratio upon completion of orientation.

0*i*	30*i*	
4075	4075	**Orientation completion signal detection level (effective area for in-position check)**

Unit of data : ±0.1deg
Valid data range : 0 to 100
Initial setting : 10
This data is used to set the detecting level of orientation completion signal (ORARA).
The orientation completion signal (ORARA) is set to 1 if the spindle position is within the set data range when orientation is stopped.
When the orientation command (ORCMA) is turned off (= 0), the orientation completion signal (ORARA) is set to 0.

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0*i*	30*i*	
4076	4076	**Spindle orientation speed limit ratio**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 33

This data is used to set an orientation speed limit ratio.

$$\text{Orientation speed (motor speed)} = 60 \times \frac{\text{Position gain}}{100} \times \text{gear ratio} \times \frac{\text{Speed limit ratio}}{100} \quad [\text{min}^{-1}]$$

0*i*	30*i*	
4077	4077	**Orientation stop position shift value**

Unit of data : ±0.01deg
Valid data range : -100 to 100
Initial setting : 0

This data is used to shift the stop position.
When a plus (+) value is set, the spindle stop position is shifted in the CCW direction by the set number of pulses.

0*i*	30*i*	
4078	4078	**MS signal constant**

Unit of data :
Valid data range : 81 to 1000
Initial setting : 200

This data is used to set a value calculated from the expression below.

$$\text{Settings} = \frac{L}{2} \times \frac{1}{2\pi \times H} \times 4096$$

where
L : Magnet length [mm]
H : Distance from the spindle center to magnet [mm]

Example When H = 100 mm and L = 50 mm

$$\text{MS signal constant} = \frac{(50/2)}{2\pi \times 100} \times 4096 \fallingdotseq 163$$

0*i*	30*i*	
4079	4079	**MS signal gain adjustment**

Unit of data :
Valid data range : -128 to 127
Initial setting : 0

This data is used to adjust the amplitude of the MS signal. Usually, use the values indicated in the table below as standard values.

Name	Specification drawing number	Magnet		MS signal gain
		Type	Length [mm]	
Not specified. Standard	A57L-0001-0037	Standard (TYPE II)	50	0
Magnetic sensor N	A57L-0001-0037/N			0
Magnetic sensor P	A57L-0001-0037/P	Compact type (TYPE III)	50	-20
Magnetic sensor Q	A57L-0001-0037/Q	Cylinder type with diameter of ϕ40 (TYPE IV)	31	70

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Name	Specification drawing number	Magnet		MS signal gain
		Type	Length [mm]	
Magnetic sensor R	A57L-0001-0037/R	Cylinder type with diameter of ϕ50 (TYPEV)	37	50
Magnetic sensor S	A57L-0001-0037/S	Cylinder type with diameter of ϕ60 (TYPEVI)	43	70
Magnetic sensor T	A57L-0001-0037/T	Cylinder type with diameter of ϕ70 (TYPEVII)	49	40

0*i*	30*i*	
4084	4084	**Motor voltage setting on orientation**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 30

This data is used to specify the motor voltage for spindle orientation.
Depending on the motor model, set 30 usually.

5.14 SPINDLE BACKLASH ACCELERATION FUNCTION

5.14.1 Overview

The spindle backlash acceleration function improves a figure error caused by the delayed reversal along the Cs contouring control axis.

NOTE
1 To use this function, the CNC software option (Cs contouring control) is required.
2 This function is valid for advanced preview feed-forward in the Cs contouring control mode.
3 This function is unavailable for the sub-spindle for spindle switching.
4 This function cannot be used together with the spindle EGB function.
5 This function cannot be used with sensorless motor.

5.14.2 Series and Editions of Applicable Spindle Software

Spindle software

Series	Edition	Usable CNC
9D50	O (15)	FS0*i* -D
9D70	F (06)	FS30*i* / FS31*i* / FS32*i* -A
9D80	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9D90	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	A (01)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

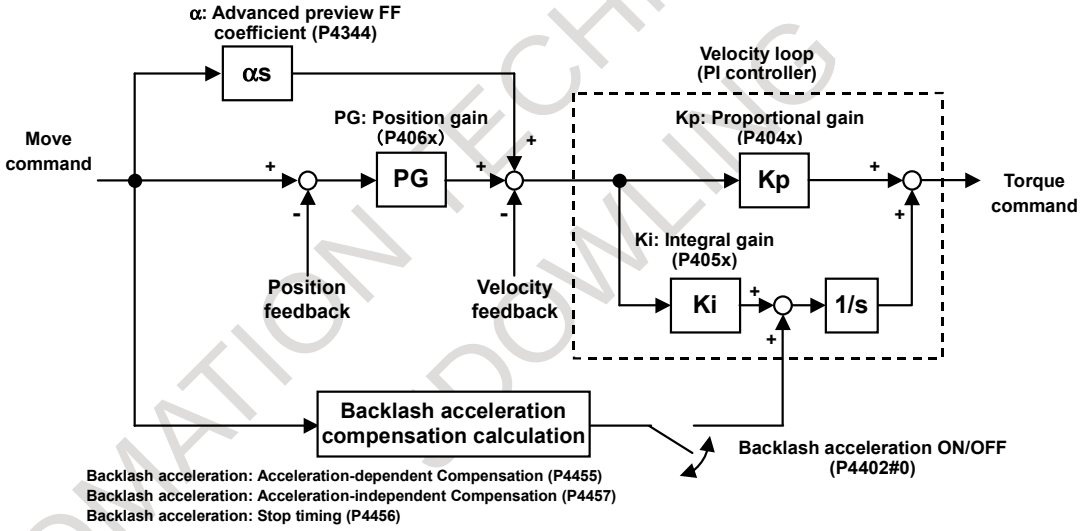
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NOTE
*1 We added the following two improvements about spindle backlash acceleration in 9D5A/M(13), 9D5D/A(01), 9D7A/B(02), 9D80/Y(25), 9D90/J(10), and 9DA0/M(13).
- The improvement to give an enough effenct even in the low speed revesal movement
- The improvement for a problem that backlash acceleration doesn't work correctly in some setting cases of relationship between motor direction and spindle direction, relationship between spindle direction and sensor direction.

*2 We added the following two improvements about spindle backlash acceleration in 9D90/X(24), and 9DAA/B(02).
- The setting parameter for calculation time of acceleration at axis reverse point is newly prepared.
- The finish timing of backlash acceleration can be specified by the movement amount of spindle motor in additon to a method to specify it by the movement amount of spindle.

5.14.3 Block Diagram

The following shows a block diagram of spindle backlash acceleration.



NOTE
*1 Parameter No. 4457 "acceleration-independent compensation" is valid with 9D5A series M (13) edition or later, 9D5D series A (01) edition or later, 9D7A series B (02) edition or later, 9D80 series Y (25) edition or later, 9D8A series A (01) edition or later, 9D90 series J (10) edition or later, 9DA0 series M (13) edition or later and 9DB0 series A (01) edition or later.
*2 Parameter No. 4641 "calculation time of acceleration" and No. 4642 "stop timing(motor travel distance)" are valid with 9D90 series X (24) edition or later, 9DAA series B (02) edition or later and 9DB0 series A (01) edition or later.

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5.14.4 Parameters

(1) List of parameters

Parameter No.		Description
0*i*	30*i*	
4402#0	4402#0	Backlash acceleration ON
4402#1	4402#1	Setting of the feed-forward coefficient when the backlash acceleration function is enabled
4353#0	4353#0	Improvement of backlash acceleration for low speed reverse (Note1)
4641	4641	Backlash acceleration : Calculation time of acceleration (Note2)
4455	4455	Backlash acceleration: Acceleration-dependent compensation
4457	4457	Backlash acceleration: Acceleration-independent compensation
4456	4456	Backlash acceleration : Stop timing (movement amount of spindle)
4642	4642	Backlash acceleration : Stop timing (movement amount of spindle motor) (Note2)
4458	4458	Backlash acceleration : Time for judgement as axis stop (Note1)

NOTE
*1 (NOTE 1) parameters are valid with 9D5A series M (13) edition or later, 9D5D series A (01) edition or later, 9D7A series B (02) edition or later, 9D80 series Y (25) edition or later, 9D8A series A (01) edition or later, 9D90 series J (10) edition or later, 9DA0 series M (13) edition or later and 9DB0 series A (01) edition or later.
*2 (NOTE2) parameters are valid with 9D90 series X (24) edition or later, 9DAA series B (02) edition or later and 9DB0 series A (01) edition or later.

(2) Details of parameters

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4402	4402							MDLINF	BKAFNC

BKAFNC Whether to enable the backlash acceleration function
0 : Disables the backlash acceleration function.
1 : Enables the backlash acceleration function.

MDLINF Sets the advanced preview feed-forward coefficient when the backlash acceleration function is enabled.
Set "0" when the advanced preview feed-forward coefficient is less than 100% (parameter No. 4344 is not 10000) or
"1" when the coefficient is 100% (parameter No. 4344 is 10000).

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4353	4353								BKAITP

BKAITP Improvement of backlash acceleration for low-speed reverse operation is:
0 : Disabled.
1 : Enabled.

Set this parameter to 1 to make backlash acceleration efficient even at low speed.
Note that behavior may slightly differ depending on whether this parameter is used or not when the backlash acceleration function is used.

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NOTE
This parameter is valid with 9D5A series M (13) edition or later, 9D5D series A (01) edition or later, 9D7A series B (02) edition or later, 9D80 series Y (25) edition or later, 9D8A series A (01) edition or later, 9D90 series J (10) edition or later, 9DA0 series M (13) edition or later and 9DB0 series A (01) edition or later.

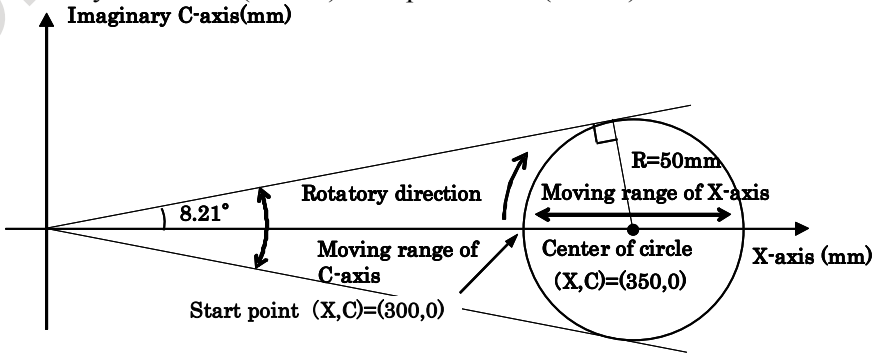
0*i*	30*i*	
4641	4641	**Backlash acceleration : Calculation time of acceleration**

Unit of data : 1ms
Valid data range : 0, 8, 16, 24, 32, 40, 48, 56, 64
Initial setting : Refer to the table below lists

Spindle backlash acceleration changes compensation amount according to the acceleration at reversal point automatically. An average acceleration value in some time near reversal point is used as the representative acceleration. In the case that backlash acceleration for low speed reverse is valid (No.4353#0=1), this parameter becomes valid and average time for calculations of reversal acceleration should be set. When the setting value is not set valid data, it is treated as near value to the valid data smaller than the setting value internally. (Example: The value "35" is treated as "32" internally, and the value "7" is treated as "0" internally.) Because resolution of calculated reversal acceleration is decided by the setting value, please set the parameter referring to the following table considering the smallest reversal acceleration in operations. (The longer calculation time is, the finer the resolution of acceleration data becomes, but on the other hand, the later the response to change of acceleration becomes).

Calculation time of acceleration (ms)	Resolution of acceleration (rad/s^2)
8	5.85×10^{-3}
16	1.46×10^{-3}
24	6.50×10^{-4}
32	3.66×10^{-4}
40	2.34×10^{-4}
48	1.63×10^{-4}
56	1.19×10^{-4}
64	9.14×10^{-5}

As an example for setting of the calculation time of acceleration, operating the eccentric circle by servo axis (X-axis) and spindle axis (C-axis) is shown.



The reversal acceleration of the spindle shown in the figure can be calculated approximately by following formula.

$$a_\omega \cong \tan\theta \times \left(\frac{v \div 60}{R}\right)^2$$

v : feed rate(mm/min)
R : radius of circle(mm)

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When the axes are moved along this path of circle at feed rate 100mm/min, the approximate value of reversal acceleration of spindle is

$$a_{\omega} \cong \tan\left((8.21/180)\pi\right) \times \left(\frac{100 \div 60}{50}\right)^2 = 1.60 \times 10^{-4}\left(rad/s^2\right)$$

Therefore, the parameter for calculation time of acceleration should be set to 56ms (resolution of acceleration = $1.19*10^{-4} < 1.60*10^{-4}$) to recognize the reversal acceleration of the operation shown in the upper figure.

NOTE
This parameter is valid with 9D90 series X (24) edition or later, 9DAA series B (02) edition or later and 9DB0 series A (01) edition or later.

0*i*	30*i*	
4455	4455	Backlash acceleration: Acceleration-dependent compensation

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0

This parameter sets the backlash acceleration compensation in proportion to the spindle reverse acceleration.
Use this parameter to compensate reverse delay at a relatively high speed.

0*i*	30*i*	
4457	4457	Backlash acceleration: Acceleration-independent compensation

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0

This parameter sets the fixed backlash acceleration compensation applied independently of the spindle reverse acceleration.
Use this parameter to compensate reverse lay at low speed.
This parameter is valid only when bit 0 of parameter No. 4353 is set to 1 (improvement of backlash acceleration for low-speed reverse operation is enabled).

NOTE
This parameter is valid with 9D5A series M (13) edition or later, 9D5D series A (01) edition or later, 9D7A series B (02) edition or later, 9D80 series Y (25) edition or later, 9D8A series A (01) edition or later, 9D90 series J (10) edition or later, 9DA0 series M (13) edition or later and 9DB0 series A (01) edition or later.

0*i*	30*i*	
4456	4456	Backlash acceleration: Stop timing (movement amount of spindle)

Unit of data : 0.001deg
Valid data range : 0 to 32767
Initial setting : Around 5

This parameter sets the timing of the termination of backlash acceleration by movement amount of spindle motor.
After the spindle reverses rotation and backlash acceleration starts, when the spindle moves by the distance set with this parameter, backlash acceleration terminates.

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If an extremely small value is set, backlash acceleration terminates immediately and acceleration of reverse operation is not effective.
On the other hand, if an extremely large value is set, after the motor starts reverse operation, compensation data is continuously output until the distance is reached, resulting in overcompensation.

0*i*	30*i*	
4642	4642	Backlash acceleration: Stop timing (movement amount of spindle motor)

Unit of data : 0.001deg
Valid data range : 0 to 32767
Initial setting : Around 5

This parameter determines the finish timing of backlash acceleration by movement amount of spindle motor.
Backlash acceleration will stop after the spindle motor moves the distance specified by this parameter from reversal point.
Please adjust stop timing by movement of spindle (No.4456) normally. But, there are some cases that you can not tune backlash acceleration optimally by using No.4456 when rigidity between spindle and spindle motor is low (torsion is large). In the case please adjust stop timing by movement amount of spindle motor (No.4642).
When setting value is "0", stop timing by movement amount of spindle motor becomes invalid.

NOTE
This parameter is valid with 9D90 series X (24) edition or later, 9DAA series B (02) edition or later and 9DB0 series A (01) edition or later.

0*i*	30*i*	
4458	4458	Backlash acceleration: **Spindle stop check time**

Unit of data : 1ms
Valid data range : 0 to 32767
Initial setting : 0 (when the setting is 0, 200 ms is assumed.)

After backlash acceleration terminates, when the spindle stops for at least the time specified with this parameter, the output of backlash acceleration compensation data terminates.
Generally, the termination of acceleration is managed using parameter No. 4456 (stop timing). If the spindle stops after performing reverse rotation by a minute distance smaller than the distance specified as the stop timing, the backlash acceleration compensation data is continuously output. To avoid this, use this parameter to manage the acceleration also with a time.

When this parameter is set to 0, 200 ms is assumed.
This parameter is valid only when bit 0 of parameter No. 4353 is set to 1 (improvement of backlash acceleration for low-speed reverse operation is enabled).

During circular operation at a very low speed, the spindle may hardly move at the reverse section, and backlash acceleration may not function due to the setting of this parameter. In this case, set at least 200 for this parameter.

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NOTE
This parameter is valid with 9D5A series M (13) edition or later, 9D5D series A (01) edition or later, 9D7A series B (02) edition or later, 9D80 series Y (25) edition or later, 9D8A series A (01) edition or later, 9D90 series J (10) edition or later, 9DA0 series M (13) edition or later and 9DB0 series A (01) edition or later.

(3) Reference parameters

When the motor and spindle are connected with some gears, mechanical backlash may be large and reverse delay may not be able to be compensated only with the backlash acceleration function.
In this case, reverse delay may be able to be compensated as follows:

- Use the dual position feedback function.
- Set the value equivalent to the mechanical backlash for the backlash compensation parameter (No. 1851).
- Make setting to reflect the backlash compensation to the error counter in the semi-closed loop in dual position feedback.

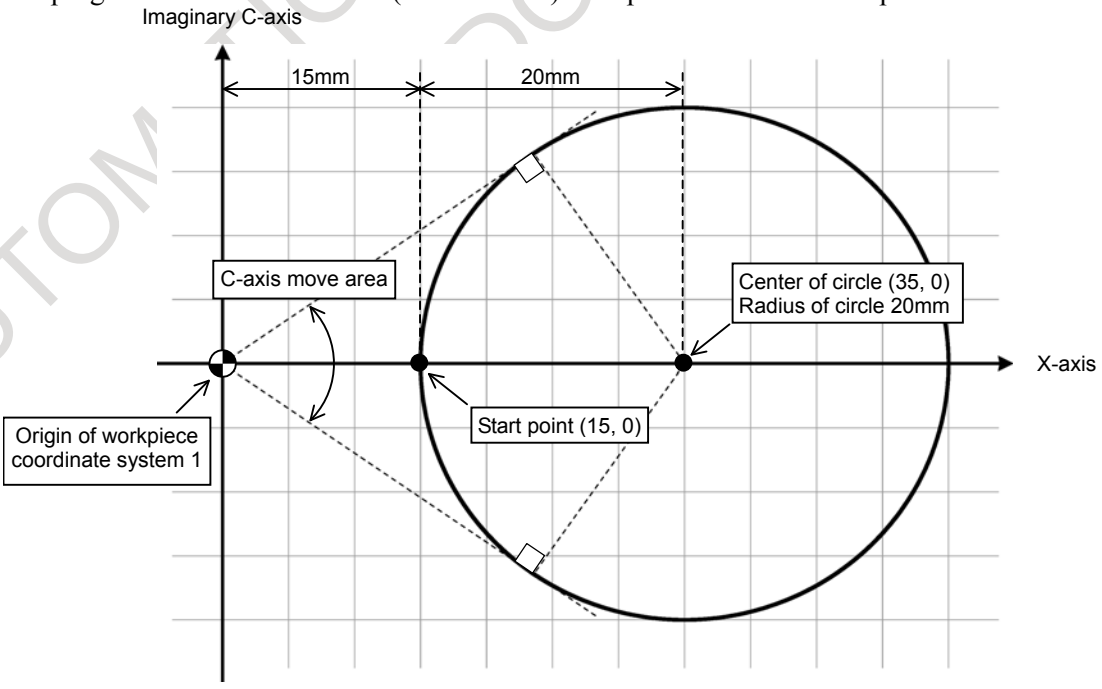
0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4005	4005						HBKLEN		

HBKLEN When the dual position feedback function is used, the backlash compensation is reflected to:
0 : Error counter in the full-closed loop.
1 : Error counter in the semi-closed loop.

5.14.5 Example of Adjustment

(1) CNC program

Prepare a program which draws an arc (eccentric arc) with polar coordinate interpolation as shown below:



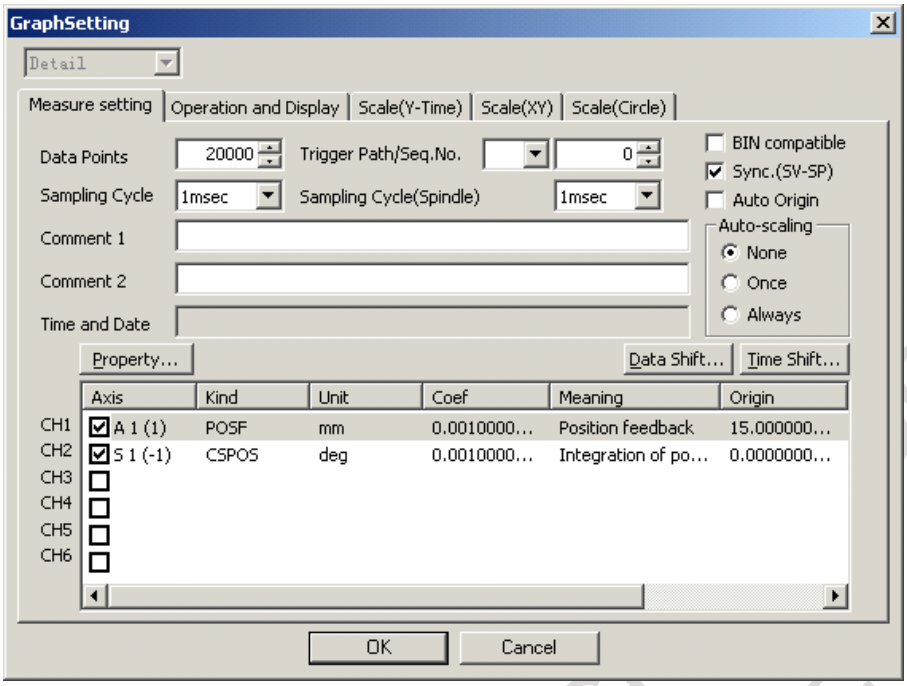
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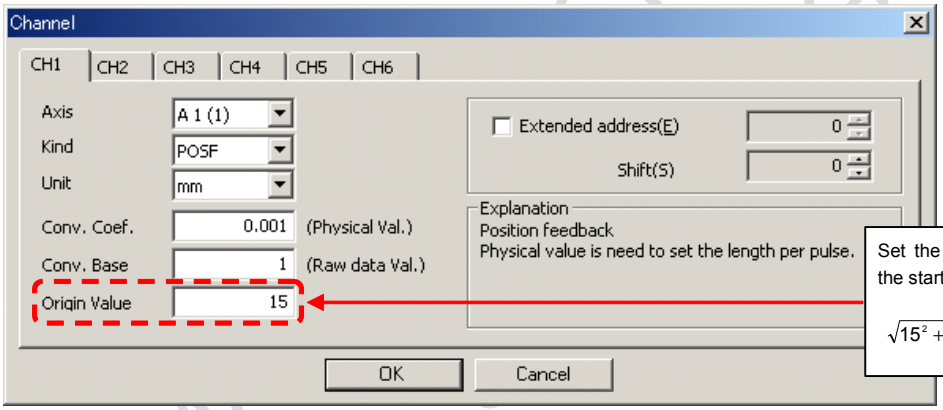
G90	←	Absolute
G54	←	Select workpiece coordinate system 1.
G00 X15. C0.	←	Move to the start point.
G5.1 Q1	←	Turn AI contouring control on.
G12.1	←	Turn polar coordinate interpolation on.
G04 X5.	←	Dwell. Press the “origin” button (see Item (3)).
G02 I20. J0	←	Draw an arc.
G13.1	←	Turn polar coordinate interpolation off.
G5.1 Q0	←	Turn AI contouring control off.
M99	←	End

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(2) Preparation for data measurement using the SERVO GUIDE

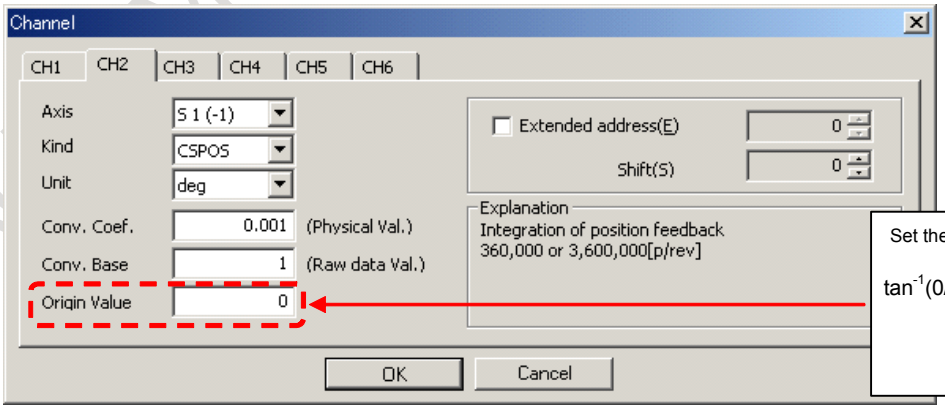
Open the graph window of the SERVO GUIDE and set channels as follows:





Set the distance between the start point and origin.

$\sqrt{15^2+0^2}=15(\mathrm{mm})$



Set the angle at the start point.

$\tan^{-1}(0/15) = 0$ (deg)

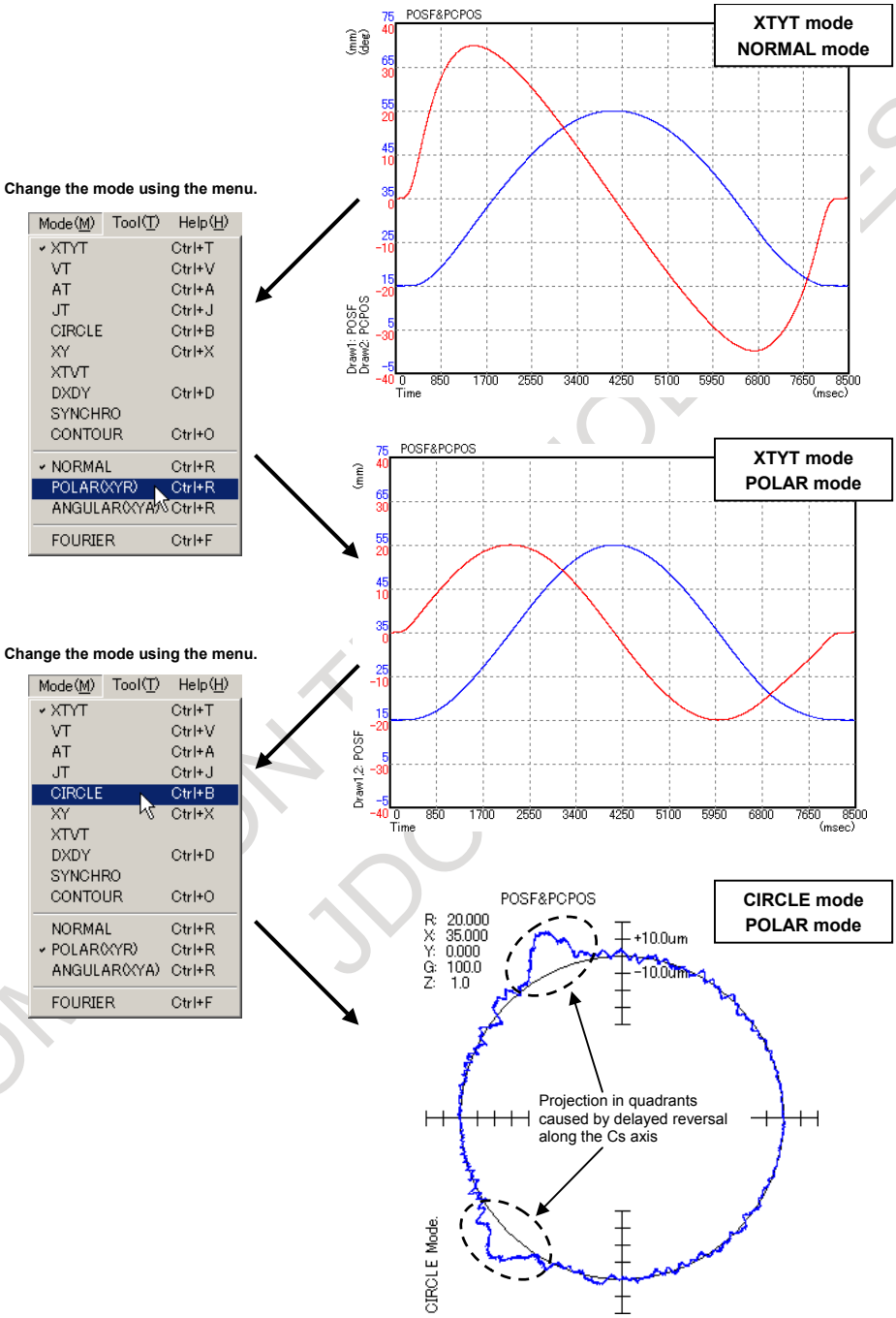
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(3) Data measurement and display using the SERVO GUIDE

Execute the program described above and press the button while the spindle stops at the start point to perform origin operation.

Then, press the button before the spindle moves to start measurement.

After the completion of data measurement, change the graph window display mode as follows to display an arc.



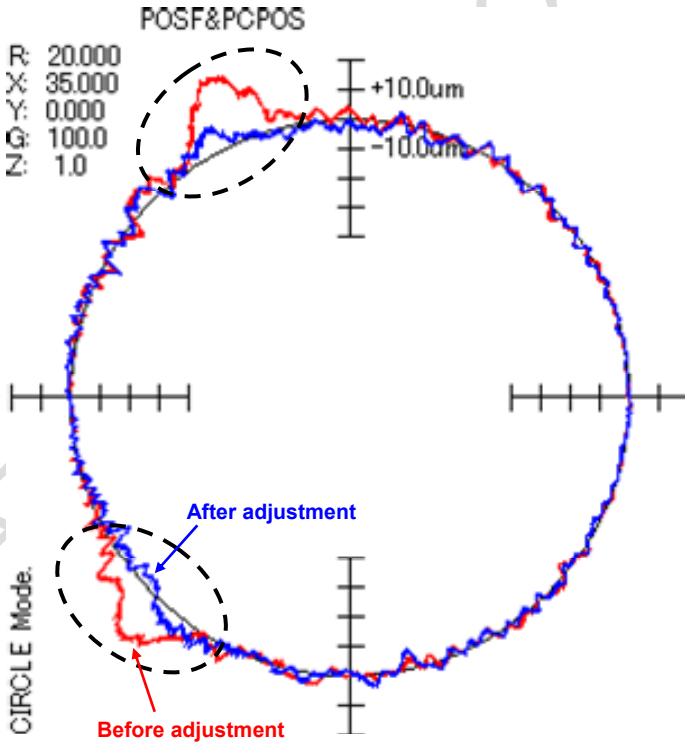
(4) Adjustment

Follow the adjustment steps below while observing the arc figure in the CIRCLE mode in the graph window:

(a) Set the initial values listed below for compensation, stop timing, and other parameters:
Improvement of backlash acceleration for low-speed reverse operation (bit 0 of parameter No. 4353): 1 (enabled)
Backlash acceleration: Acceleration-dependent compensation (parameter No. 4455): 5
Backlash acceleration: Stop timing (parameter No. 4456): 100
Backlash acceleration: Acceleration-independent compensation (parameter No. 4457): 100
Backlash acceleration: Spindle stop check time (parameter No. 4458): 0

(b) Increase the compensation value corresponding to the spindle reverse operation speed (high or low speed) (parameter No. 4455 for high-speed operation or parameter No. 4457 for low-speed operation) to minimize the peak value for the projection in each quadrant. If the waveform cuts into the circle, decrease the setting.

(c) Increase the stop timing to minimize the peak value of the projection in each quadrant.
If the waveform cuts into the circle, decrease the setting.



Note: The adjustment described above is available when the improvement of backlash acceleration for low-speed reverse operation is enabled. When the improvement is disabled, use parameters Nos. 4455 and 4456 for adjustment.

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5.15 HIGH-SPEED SPINDLE ORIENTATION (OPTIONAL FUNCTION)

5.15.1 Overview

This high-speed spindle orientation function shortens the time required for spindle orientation of the spindle by:

<1> Making the most of the ability of the motor to decelerate

<2> Increasing the gain of the position loop

NOTE

1 Using this function requires the CNC software option for spindle orientation.

2 This function cannot be used for spindle orientation during spindle synchronous control.

3 This function does not support the speed unit 10 min^{-1}.

4 For high resolution of stop position, refer to “Spindle Orientation” of the Connection Manual (Function) of each CNC.

5 This function cannot be used with sensorless motor.

5.15.2 Series and Editions of Applicable Spindle Software

Spindle software

Series	Edition	Usable CNC
9D50	A (01)	FS0*i* -D
9D70	A (01)	FS30*i* / FS31*i* / FS32*i* -A
9D80	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9D90	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	A (01)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

5.15.3 System Configuration

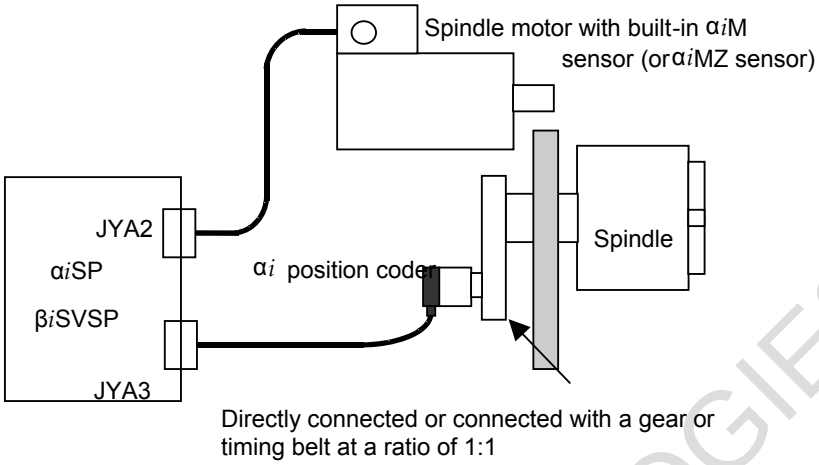
Explained below is a system configuration in which the high-speed spindle orientation function is usable.

NOTE

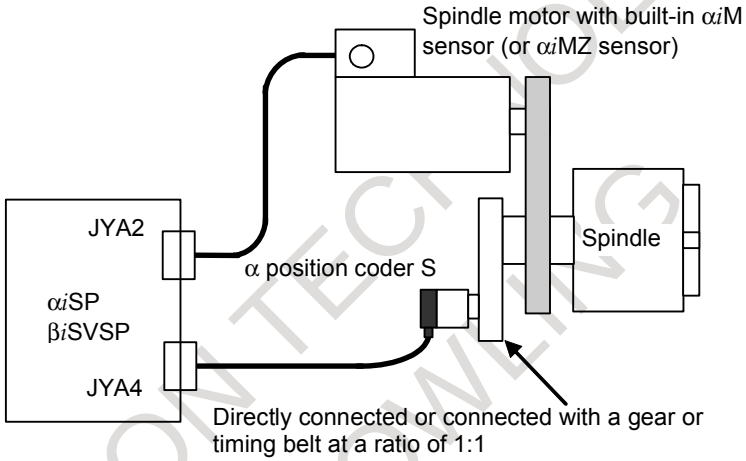
This function cannot be used in an external one-rotation signal-based spindle orientation system in which a proximity switch is used.

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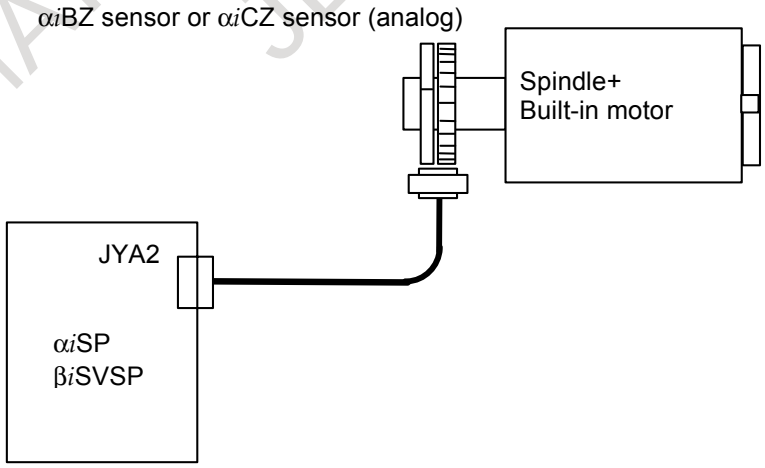
(1) When the αi position coder is used



(2) When the α position coder S is used

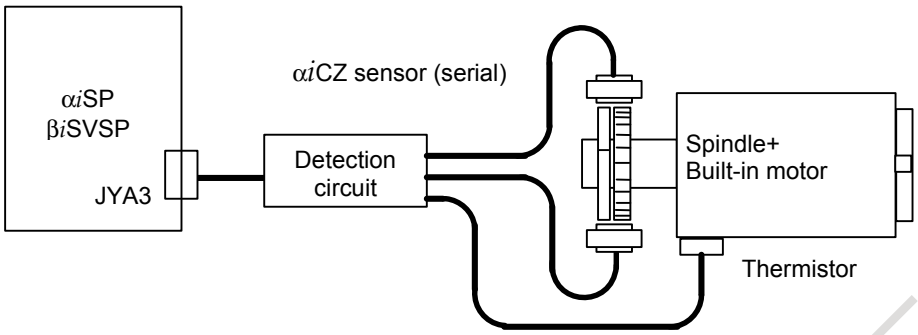


(3) When the built-in motor (αiBZ sensor, αiCZ sensor (analog)) is used

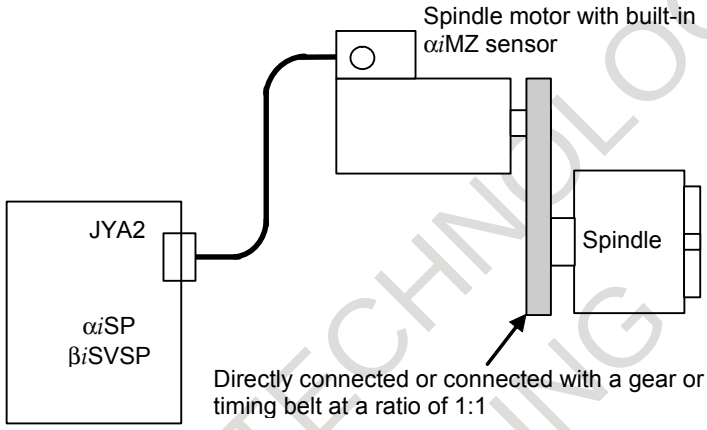


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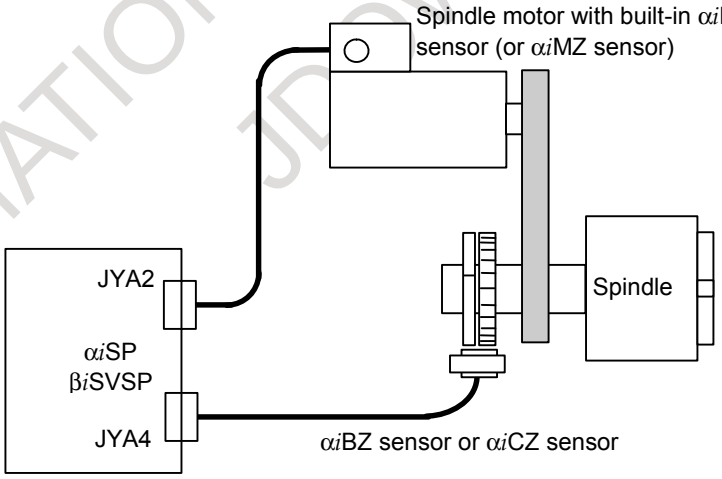
(4) When the built-in motor (αiCZ sensor (serial)) is used



(5) When the spindle motor with built-in αiMZ sensor is used

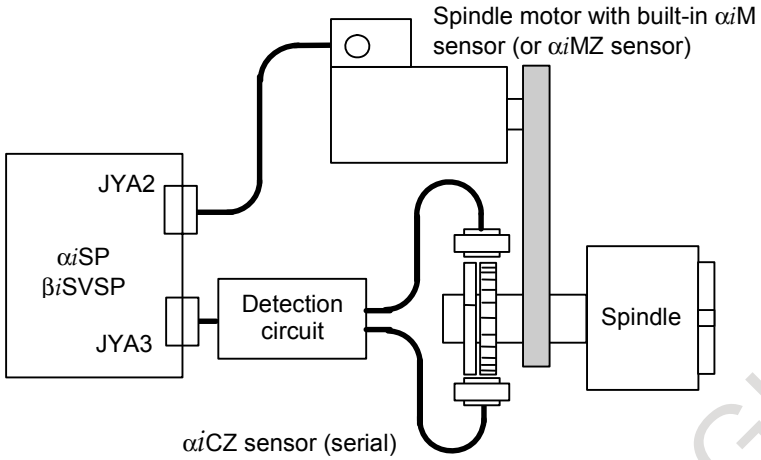


(6) When the separate type αiBZ sensor or separate type αiCZ sensor (analog) is used



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(7) When the separate type αiCZ sensor (serial) is used



5.15.4 I/O Signals (CNC↔PMC)

(1) Address list of input signals (PMC → CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G070	G070		ORCMA			CTH1A	CTH2A		
2nd-	G074	G074		ORCMB			CTH1B	CTH2B		
1st-	G072	G072			INCMDA			NRROA	ROTAA	INDXA
2nd-	G076	G076			INCMDB			NRROB	ROTAB	INDXB
1st-	G078	G078	SHA07	SHA06	SHA05	SHA04	SHA03	SHA02	SHA01	SHA00
2nd-	G080	G080	SHB07	SHB06	SHB05	SHB04	SHB03	SHB02	SHB01	SHB00
1st-	G079	G079					SHA11	SHA10	SHA09	SHA08
2nd-	G081	G081					SHB11	SHB10	SHB09	SHB08

(2) Details of input signals (PMC → CNC)

(a) Spindle orientation command (ORCMA)
(b) Clutch/gear signals (CTH1A and CTH2A)
(c) Spindle orientation stop position change command (INDXA)
(d) Rotation direction command for spindle orientation stop position change (ROTAA)
(e) Short-cut command for spindle orientation stop position change (NRROA)
(f) Incremental command data selection signal (INCMDA)
(g) Spindle orientation external stop position commands (SHA11 to SHA00)

The functions of the input signals ORCMA, CTH1A, CTH2A, INDXA, ROTAA, NRROA, INCMDA, and SHA11 to SHA00 are the same as for position coder-method spindle orientation and incremental command type spindle orientation. See Sections 2.2, "POSITION CODER-METHOD SPINDLE ORIENTATION," and 5.3, "INCREMENTAL COMMAND TYPE SPINDLE ORIENTATION" in Part I.

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(3) Address list of input signals (CNC → PMC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F045	F045	ORARA							
2nd-	F049	F049	ORARB							
1st-	F047	F047							INCSTA	
2nd-	F051	F051							INCSTB	

(4) Details of input signals (CNC → PMC)

(a) Incremental command mode status signal (INCSTA)

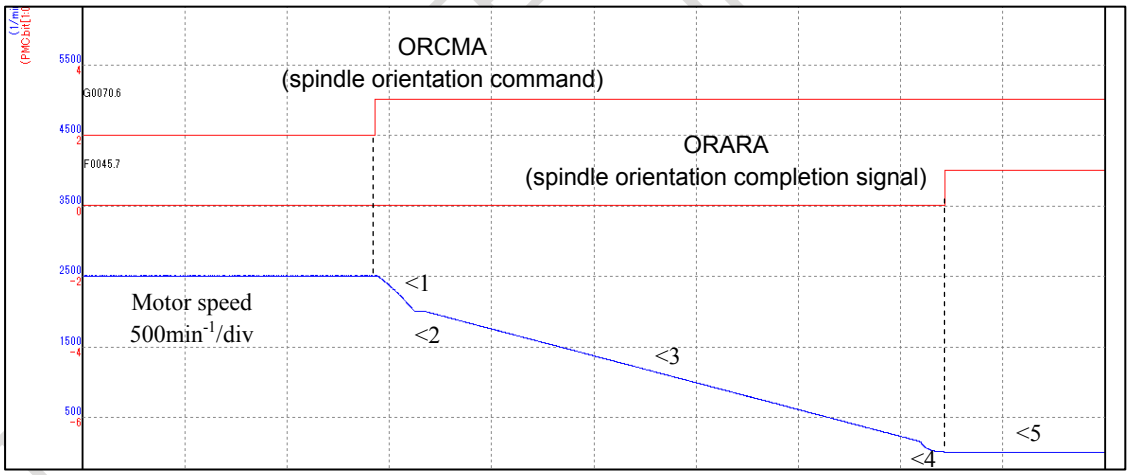
(b) Spindle orientation completion signal (ORARA)

The functions of the output signals ORARA and INCSTA are the same as for position coder-method spindle orientation and incremental command type spindle orientation. See Sections 2.2, "POSITION CODER METHOD SPINDLE ORIENTATION," and 5.3, "INCREMENTAL COMMAND TYPE SPINDLE ORIENTATION" in Part I.

5.15.5 Sequence

This subsection describes the operations of high-speed spindle orientation. See Sections 2.2, "POSITION CODER-BASED SPINDLE ORIENTATION," and 5.3, "INCREMENTAL COMMAND TYPE SPINDLE ORIENTATION" in Part I, for concrete examples of sequences

(1) Starting spindle orientation when the spindle is rotating at or faster than the orientation speed upper limit



<1> If the spindle orientation command (ORCMA) is input when the spindle is rotating at or faster than the orientation speed upper limit specified in parameter No. 4038, the spindle is decelerated to the orientation speed upper limit.

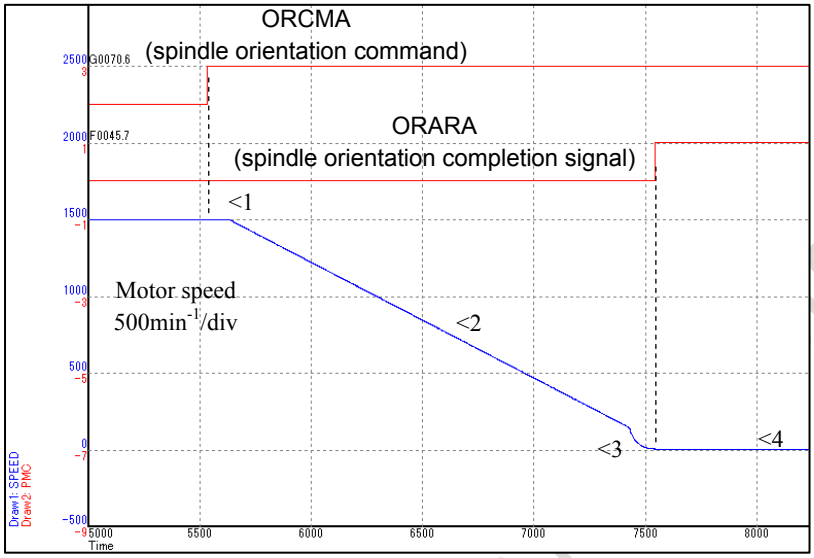
<2> A one-rotation signal is detected (only at the first-time spindle orientation after the power is switched on).

<3> The spindle decelerates at the acceleration specified as an acceleration during motor deceleration in parameter Nos. 4320 to 4323.

<4> When the spindle speed becomes lower than or equal to the value calculated within the software, the position loop is controlled at the position gain specified as a spindle orientation position gain in parameter Nos. 4060 to 4063.

<5> When the position error becomes lower than or equal to the number of pulses specified as a spindle orientation completion signal level in parameter No. 4075, the spindle orientation completion signal (ORARA) is output.

(2) Starting spindle orientation when the spindle is rotating at a speed between the orientation speed lower limit and the orientation speed upper limit



<1> If the spindle orientation command (ORCMA) is input when the spindle is rotating at a speed between the orientation speed upper limit specified in parameter No. 4038 and the orientation speed lower limit (calculated within the software), a one-rotation signal is detected (only at the first-time spindle orientation after the power is switched on).

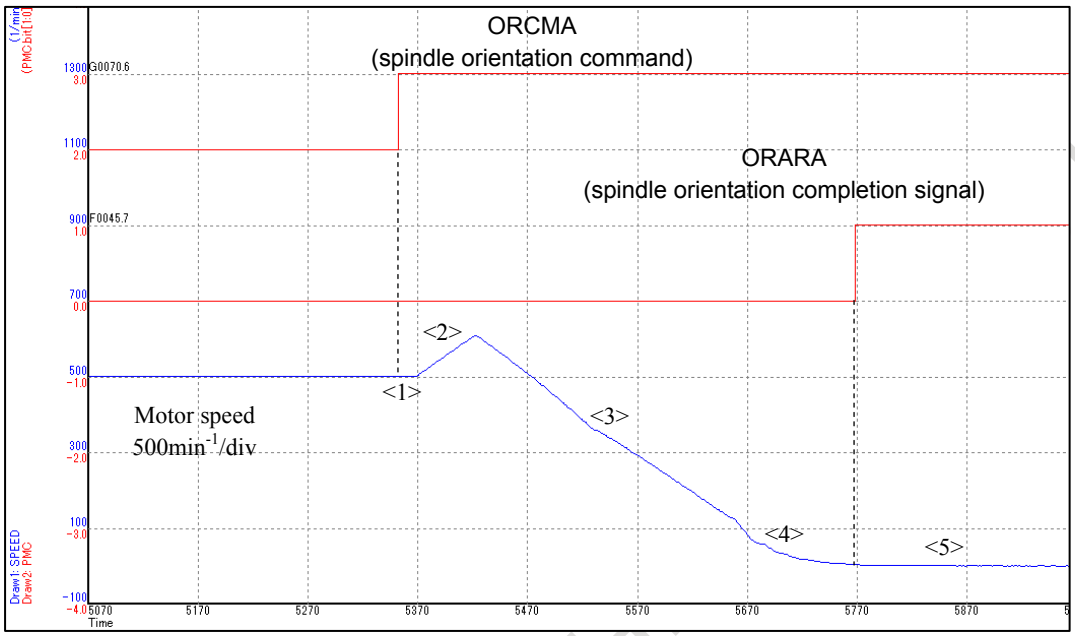
<2> The spindle decelerates at the acceleration specified as an acceleration during motor deceleration in parameter Nos. 4320 to 4323.

<3> When the spindle speed becomes lower than or equal to the value calculated within the software, the position loop is controlled at the position gain specified as a spindle orientation position gain in parameter Nos. 4060 to 4063.

<4> When the position error becomes lower than or equal to the number of pulses specified as a spindle orientation completion signal level in parameter No. 4075, the spindle orientation completion signal (ORARA) is output.

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(3) Starting spindle orientation when the spindle is rotating at or slower than the orientation speed lower limit



<1> If the spindle orientation command (ORCMA) is input when the spindle is rotating at or slower than the orientation speed lower limit (calculated within the software), a one-rotation signal is detected (only at the first-time spindle orientation after the power is switched on).
<2> The spindle accelerates at the acceleration specified as an acceleration during motor deceleration in parameter Nos. 4320 to 4323.
<3> The spindle decelerates at the acceleration specified as an acceleration during motor deceleration in parameter Nos. 4320 to 4323.
<4> When the spindle speed becomes lower than or equal to the value calculated within the software, the position loop is controlled at the position gain specified as a spindle orientation position gain in parameter Nos. 4060 to 4063.
<5> When the position error becomes lower than or equal to the number of pulses specified as a spindle orientation completion signal level in parameter No. 4075, the spindle orientation completion signal (ORARA) is output.

5.15.6 List of Related Parameters

Parameter No.		Description
0*i*	30*i*	
4015 #0	4015 #0	Whether the spindle orientation function is available (The CNC software option is required.)
4018 #6 #3	4018 #6 #3	Type of position coder method orientation (Set 1 in bit 6 and 0 in bit 3.)
3729#0	3729#0	Whether the stop position external setting-type spindle orientation function is available
4003#0	4003#0	Spindle orientation type selection (to be reset to "0")
4003#3,2	4003#3,2	Rotation direction for spindle orientation (to be reset to "0, 0" or to be set to "0, 1")
4017#7	4017#7	Short-cut function when spindle orientation from stopped state is specified
4018#5	4018#5	Whether the speed command correction function for high-speed spindle orientation is available

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Parameter No.		Description
0*i*	30*i*	
4031	4031	Spindle orientation stop position (This parameter is invalid for stop position external setting type and incremental command external setting type.)
4038	4038	Orientation speed upper limit
4042 4043	4042 4043	Velocity proportional gain on orientation (These parameters are selected with the input signal CTH1A.)
4050 4051	4050 4051	Velocity integral gain on orientation (These parameters are selected with the input signal CTH1A.)
4056 to 4059	4056 to 4059	Gear ratio data between spindle and motor (These parameters are selected with the input signals CTH1A and CTH2A.)
4060 to 4063	4060 to 4063	Position gain on orientation (These parameters are selected with the input signals CTH1A and CTH2A.)
4064	4064	Percentage limit to an acceleration during deceleration
4075	4075	Orientation completion signal detection level
4077	4077	Orientation stop position shift value
4084	4084	Motor voltage on orientation
4320 to 4323	4320 to 4323	Acceleration during motor deceleration (These parameters are selected with the input signals CTH1A and CTH2A.)
4326 4330	4326 4330	Acceleration limitation start speed during deceleration (These parameters are selected with the input signal CTH1A.)
4328	4328	Command multiplier for orientation

NOTE
1 See Section 1.3, "PARAMETERS RELATED TO DETECTORS" in Part I, for parameters related to detectors.
2 See Section 4.1, "VELOCITY LOOP GAIN ADJUSTMENT" in Part I, for velocity loop proportional/integral gain tuning.
3 When using the high-speed spindle orientation function, set the parameters (bits 3 and 2 or parameter No. 4003) for rotation direction for spindle orientation with the previous rotation direction (0, 0 or 0, 1).

5.15.7 Details of Related Parameters

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4018	4018		ORTYP1	HSVCM		ORTYP0			

HSVCM: Velocity command compensation function in high-speed spindle orientation is:
0: Disabled.
1: Enabled.
Normally, set 1.

ORTYP1、ORTYP0 Type of position coder method spindle orientation

ORTYP1	ORTYP0	Type of orientation
0	0	Conventional method orientation
0	1	Optimum orientation
1	0	High-speed spindle orientation

Specify "1,0" (high-speed spindle orientation).

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0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4003	4003					DIRCT2	DIRCT1		PCMGSL

DIRCT1、DIRCT2 Rotation direction at spindle orientation

DIRCT2	DIRCT1	Rotation direction
0	0	By rotation direction immediately before (CCW for the first-time spindle orientation after the power is switched on)
0	1	By rotation direction immediately before (CW for the first-time spindle orientation after the power is switched on)
1	0	CCW direction looking from shaft of motor
1	1	CW direction looking from shaft of motor

NOTE
When using the high-speed spindle orientation function, specify the rotation direction for spindle orientation to be the previous rotation direction (bits 3 and 2 of parameter No. 4003 = 0 and 0 or 0 and 1).

PCMGSL : Orientation method selection
Set to 0.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4017	4017	NRROEN							

NRROEN The short-cut function when spindle orientation from stopped state is specified is:
0: Unavailable
1: Available
If the setting is "1", a short-cut is made provided that the following conditions are satisfied.
i) Bit 7 of parameter No. 4016 (RFCHK3) = 0
ii) Zero-speed detection signal (output signal) SST = 1
iii) Short-cut command (input signal) NRROA = 1

0*i*	30*i*	
4031	4031	Position coder method orientation stop position

Unit of data : 1 pulse unit (360 degrees/4096)
Valid data range : 0 to 4095
Initial setting : 0
This data is used to set the stop position of position coder method spindle orientation. This parameter is invalid for stop position external setting-type and incremental command external setting-type spindle orientation. Instead, the stop position commands (SHA11 to SHA00) (input signals) are valid.

0*i*	30*i*	
4038	4038	Spindle orientation speed upper limit

Unit of data : $1min^{-1}$
Valid data range : 0 to 32767
Initial setting : 0
This data is used to specify the upper limit to the orientation speed of an spindle end. If the setting is "0", the parameter is assumed to be set with a value converted for the spindle from the excitation voltage saturation speed with no load on the motor (parameter No. 4102, low-speed characteristic parameter No. 4140).

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0*i*	30*i*		
4042	4042	**Velocity proportional gain on orientation (HIGH)**	**CTH1A=0**
4043	4043	**Velocity proportional gain on orientation (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10
This data is used to set the velocity loop proportional gain on orientation.

0*i*	30*i*		
4050	4050	**Velocity integral gain on orientation (HIGH)**	**CTH1A=0**
4051	4051	**Velocity integral gain on orientation (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10
This data is used to specify a velocity loop integral gain for spindle orientation.

0*i*	30*i*		
4056	4056	**Gear ratio (HIGH)**	**CTH1A=0, CTH2A=0**
4057	4057	**Gear ratio (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4058	4058	**Gear ratio (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4059	4059	**Gear ratio (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : Number of motor rotations per spindle rotation / 100
(Number of motor rotations per spindle rotation / 1000 if bit 1 of parameter No. 4006 (GRUNIT) = 1)
Valid data range : 3 to 3000
(33 to 30000 if bit 1 of parameter No. 4006 (GRUNIT) = 1)
Initial setting : 100

NOTE
The range of gear ratios supported by this function is:
1:30 to 30:1

0*i*	30*i*		
4060	4060	**Position gain on orientation (HIGH)**	**CTH1A=0, CTH2A=0**
4061	4061	**Position gain on orientation (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4062	4062	**Position gain on orientation (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4063	4063	**Position gain on orientation (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : $0.01sec^{-1}$
Valid data range : 0 to 32767
Initial setting : 1000
These data are used to set the position gain on spindle orientation.

0*i*	30*i*	
4064	4064	**Percentage limit to an acceleration during deceleration**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 100
This data is used to specify the percentage limit to an acceleration during deceleration if spindle orientation is started when the spindle speed is lower than or equal to the limitation start seed for an acceleration during deceleration (parameter Nos. 4326 and 4330). Usually, specify "100".

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0*i*	30*i*	
4075	4075	**Orientation completion signal detection level (effective area for in-position check)**

Unit of data : ±1 pulse unit (360 degrees/4096)
Valid data range : 0 to 100
Initial setting : 10
This data is used to set the detecting level of orientation completion signal (ORARA). ORARA = 1 is satisfied if the position error is within the setting.

0*i*	30*i*	
4077	4077	**Orientation stop position shift value**

Unit of data : ±1 pulse unit (360 degrees/4096)
Valid data range : -4095 to 4095
Initial setting : 0
This data is used to specify the shift amount of the spindle orientation stop position. If a positive value is specified, the position where the spindle stops is shifted counterclockwise.

0*i*	30*i*	
4084	4084	**Motor voltage setting on orientation**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : Depends on the motor model.
This data is used to specify the motor voltage for spindle orientation. For high-speed spindle orientation, usually specify "100".

0*i*	30*i*		
4320	4320	**Acceleration during motor deceleration (HIGH)**	**CTH1A=0, CTH2A=0**
4321	4321	**Acceleration during motor deceleration (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4322	4322	**Acceleration during motor deceleration (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4323	4323	**Acceleration during motor deceleration (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : $10\text{min}^{-1}/\text{sec}$
Valid data range : 0 to 6400
Initial setting : 0
This data is used to specify the acceleration during motor deceleration for high-speed spindle orientation. If the setting is "0", the high-speed spindle orientation function is disabled, and the standard-type spindle orientation function is enabled. The setting for the parameter is obtained, using:

$$\text{Acceleration during deceleration} = \frac{\tau}{\text{J}} \times \frac{60}{2\pi} \times (0.8 \text{ to } 0.9)$$

where
τ(Nm) : Motor maximum torque at spindle orientation speed upper limit (parameter No. 4038)
J(kgm2) : Motor inertia + load inertia

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0*i*	30*i*		
4326	4326	**Acceleration limitation start speed during deceleration (HIGH)**	**CTH1A=0**
4330	4330	**Acceleration limitation start speed during deceleration (LOW)**	**CTH1A=1**

Unit of data : $1min^{-1}$
Valid data range : 0 to 32767
Initial setting : 0

This data is used to specify the motor speed at which limitation on the acceleration during deceleration is started. If the setting is "0", the parameter is assumed to be set with the spindle orientation lower limit speed calculated within the software.

0*i*	30*i*	
4328	4328	**Command multiplier for spindle orientation by a position coder**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0

Set a command multiplier for the spindle orientation function with an externally set incremental command.
When 0 is set in this parameter, 1 is assumed to have been specified.

5.15.8 Spindle Data Used in Tuning

This subsection describes high-speed spindle orientation-related data that can be observed using the SERVO GUIDE.

(1) Motor speed (Graph data: SPEED)

This is spindle motor speed data. The maximum resolution of this dada is $1/4096min^{-1}$. (Data shift setting "0"). The default resolution is $1min^{-1}$. (Data shift setting "-12")

(2) Motor speed (Graph data: VCMD)

This is verocity command data. The maximum resolution of this dada is $1/4096min^{-1}$. (Data shift setting "0"). The default resolution is $1min^{-1}$. (Data shift setting "-12")

(3) Torque command (Graph data: TCMD)

This is motor torque command data. "16384" is equivalent to maximum motor torque.

(4) Spindle orientation sequence (Graph data: ORSEQ)

This data indicates the states during spindle orientation. You can check the status (orientation start, acc./dec.state, position loop close, …etc) during orientation mode.
See following tables for relation of ORSEQ and control state.

Optimum orientation

ORSEQ	Control mode
0→1	Orientation command ON (ORCM=0→1).
1	One-rotation signal detection.
2	Acceleration/deceleration for spindle acceleration detection.
3	Close position loop. (Motion command distribution is execting).
4	Close position loop. (Motion command distribution has finished).
4→0	Completion of orientation (ORAR=0→1).

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High speed orientation

ORSEQ	Control mode
0→1	Orientation command ON (ORCM=0→1).
1	Acceleration/deceleration to orientation speed. Preparing for position control.
1→3	Close position loop
3	Deceleration according to Prm. No.4320-No.4323.
3→7	Transition to positioning by position gain
7	Positioning by position gain.
7→0	Completion of orientation (ORAR=0→1)

Normal orientation

ORSEQ	Control mode
0→2	Orientation command ON (ORCM=0→1).
2	Acceleration/deceleration to orientation speed. Preparing for position control.
2→6	Close position loop
6	Positioning by position gain.
6→0	Completion of orientation (ORAR=0→1)

(5) Position error at orientation (Graph data: ORERR)

This is position error data (2^{24}pulses/rev) for spindle orientation. In default setting, shift value is "-10" and the resolution is "16384pulse/rev (360deg)".

5.15.9 Tuning Procedure

Tune the parameters according to the following procedure. The ability of a motor to decelerate varies with the load inertia on the motor. When tuning, mount a tool with the highest possible load inertia on the spindle. If such a tool is unavailable, allow a considerable margin in specifying an acceleration during deceleration.

(1) Parameter initialization

Initialize the parameters related to high-speed spindle orientation as listed below.

No.	Description	Initial setting
4003#0	Selecting a spindle orientation type	0
4003#3,#2	Spindle rotation direction at orientation	Select a rotation direction.
4006#1	Unit of gear ratio setting	Specify an appropriate value depending on the system configuration.
4017#7	Short-cut function when spindle orientation from stopped state is specified	Specify an appropriate value according to the use of the machine.
4018#5	Whether a speed command correction function for high-speed spindle orientation is available	1
4018#6	High-speed spindle orientation function	1
4031	Spindle orientation stop position	Specify a stop position.
4038	Spindle orientation speed upper limit	0
4042 to 4043	Velocity proportional gain on orientation	10
4050 to 4051	Velocity integral gain on orientation	10
4056 to 4059	Gear ratio	Specify an appropriate value depending on the system configuration.
4060 to 4063	Position gain on orientation	3000
4064	Percentage limit to an acceleration during deceleration	100
4075	Orientation completion signal detection level	Specify an appropriate value according to the use of the machine.
4077	Orientation stop position shift value	Specify a stop position.

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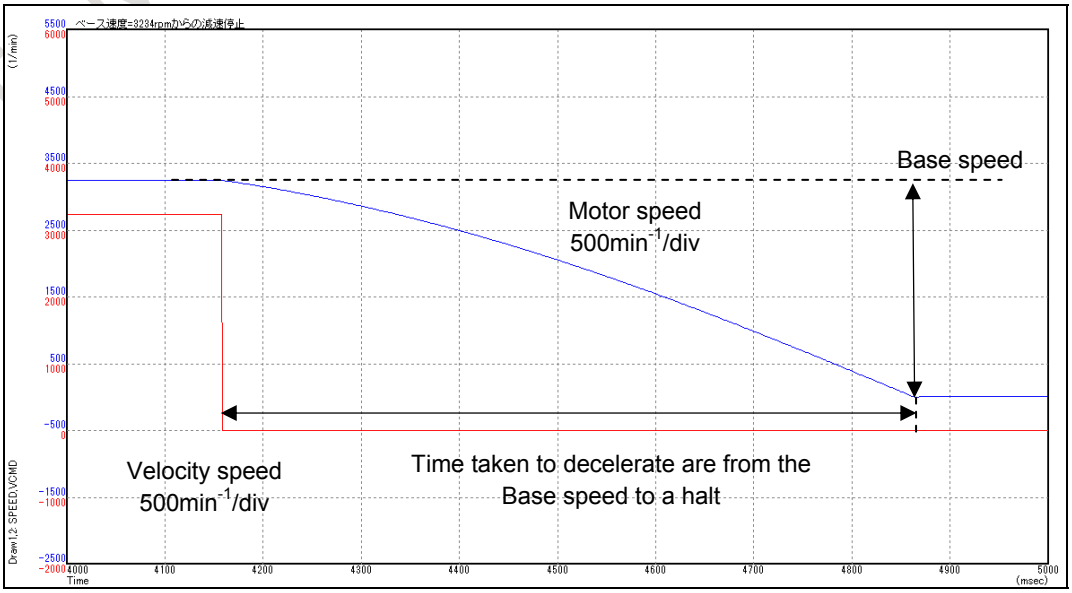
No.	Description	Initial setting
4084	Motor voltage on orientation	100
4320 to 4323	Acceleration during motor deceleration	Tune according to actual measurements.
4326,4330	Acceleration limitation start speed during deceleration	0
4328	Command multiplier for orientation	Specify an appropriate value according to the use of the machine.

NOTE
1 Spindle alarm 21 is issued if the relation (bit 0 of parameter No. 4000) between the spindle and motor rotation direction and/or the setting of the spindle sensor mounting direction (bit 4 of parameter No. 4001) is incorrect.
2 The time required for spindle orientation may get abnormally long if the gear ratio resolution (bit 1 of parameter No. 4006) setting and/or gear ratio (parameter Nos. 4056 to 4059) setting is incorrect.
3 To switch the winding of the spindle motor with speed range switching control from high-speed winding to low-speed winding during spindle orientation command-specified deceleration, set the orientation speed upper limit (parameter No. 4038) to the base speed of the low-speed winding or lower.
In the sequence enters interval C (where linear deceleration takes place with a parameter-specified time constant), the time required for spindle orientation may get abnormally long.

(2) Initial setting of the acceleration during deceleration (parameter Nos. 4320 to 4323)

Run a real machine on the velocity control mode (regular operation mode), and decelerate it from the base speed ω_B (see the following expression).
Base speed ω_B = parameter No. 4102 × parameter No. 4117/100 (if parameter No. 4038 = 0), or
= parameter No. 4038 (if parameter No. 4038 ≠ 0)
Then, measure the time the real machine takes to decelerate, set up the initial acceleration during deceleration Tc from the measured deceleration time according to the following expression (see the figure below):
Acceleration during deceleration = base speed/time taken to decelerate from the base speed to a halt/10 (in 10 min^{-1}/s)

Exsample of setting an initial accerelation during deceleration



(3) Tuning the velocity loop proportional gain (parameter Nos. 4042 and 4043) and integral gain (parameter Nos. 4050 and 4051)

Tune the velocity loop proportional/integral gain while referencing Section 4.1, "VELOCITY LOOP GAIN ADJUSTMENT" in Part I.

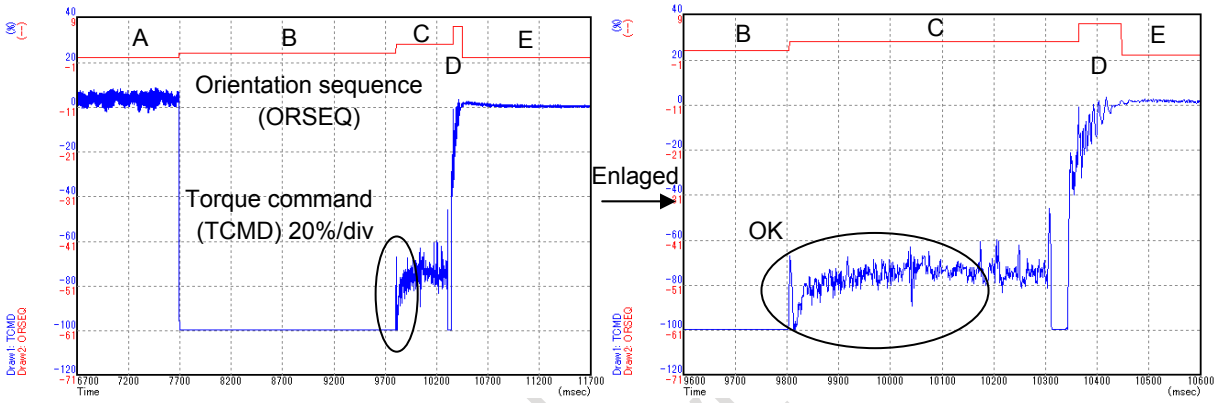
(4) Tuning the position gain

Basically, the position gain needs no adjustment. If you want to increase the setting for the position gain, do not increase it over 4000.

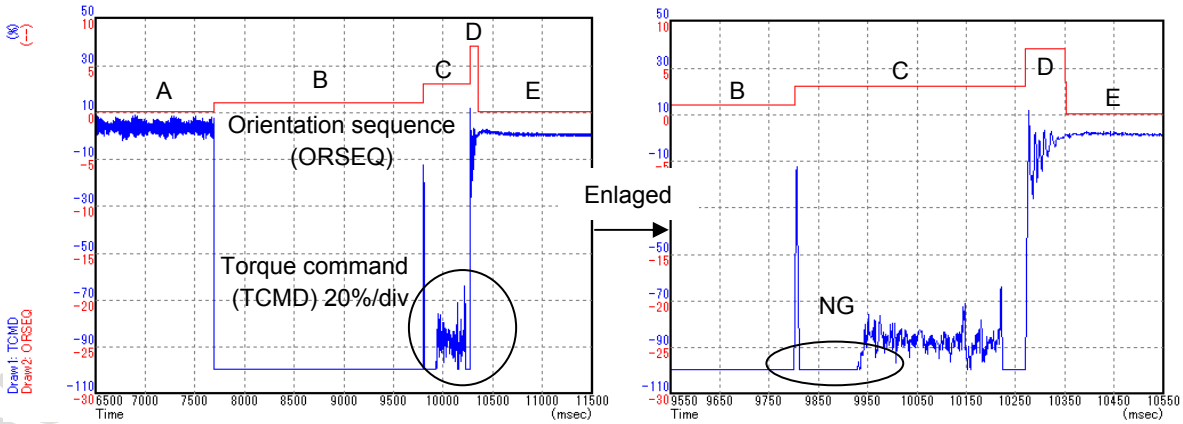
(5) Tuning the acceleration during deceleration (parameter Nos. 4320 to 4323)

Start spindle orientation when the spindle is running at the spindle maximum rotation speed, and tune the acceleration during deceleration so that the torque command will not be saturated when the motor starts linear deceleration (the beginning of interval C in the sequence). (See the following figure.)

Exsample1 of deceleration time constant adjustment (good case)



Exsample2 of deceleration time constant adjustment (bad case)

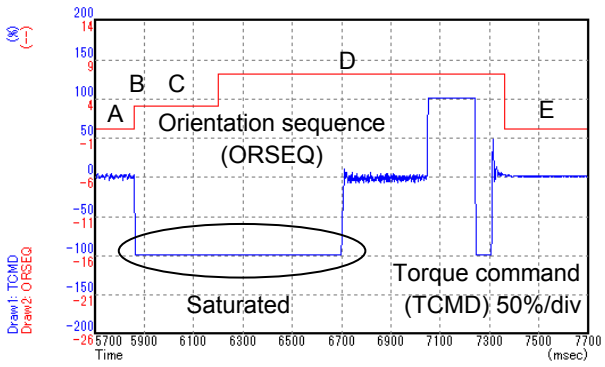


(6) Tuning the percentage limit to an acceleration during deceleration (parameter No. 4064)

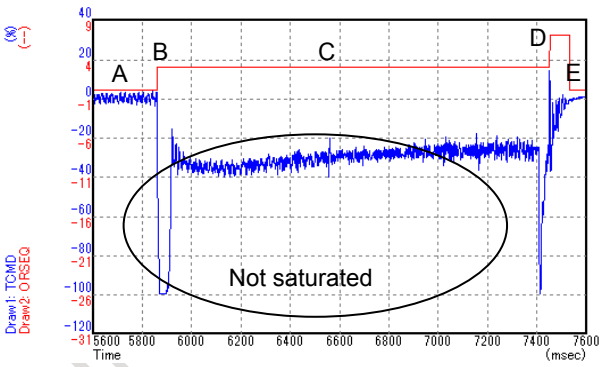
(a) Deciding whether or not to tune the percentage limit to an acceleration during deceleration

Start spindle orientation when the spindle is running at the base speed ω_B. (See the figure below.) If the torque command is saturated in sequence intervals C or D, it is necessary to tune the percentage limit to an acceleration during deceleration.
If the torque command is not saturated, stop tuning the spindle orientation.

Case in which parameter tuning is necessary



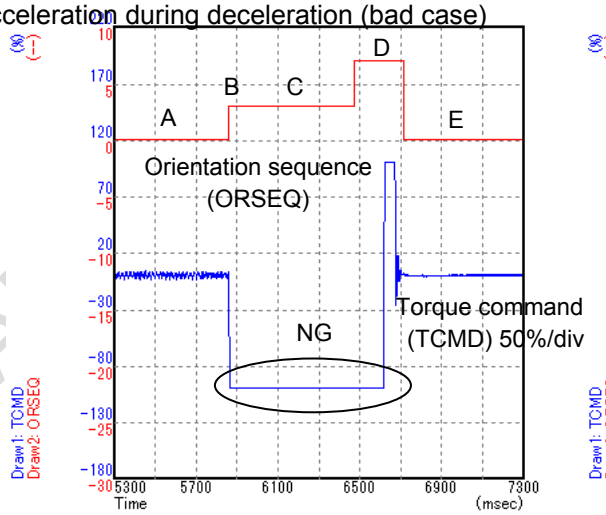
Case in which parameter tuning is unnecessary



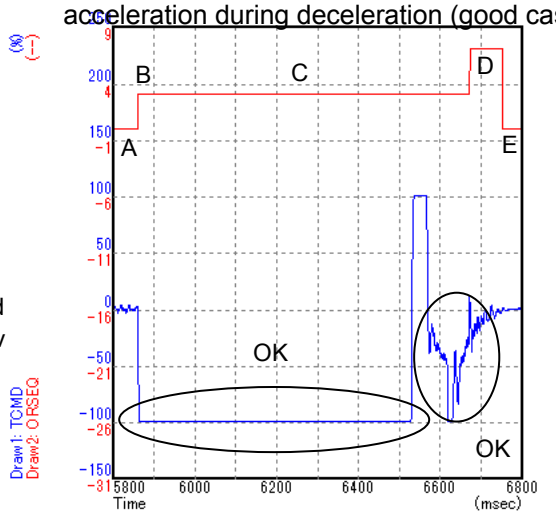
(b) Tuning the percentage limit to an acceleration during deceleration

Specify the acceleration limitation start speed during deceleration ω_{LS} (parameter Nos. 4326 and 4330) as follows:
Acceleration limitation start speed during deceleration ω_{LS} = 1.1 × base speed ω_B
Then, decrease the percentage limit to an acceleration during deceleration (parameter No. 4064) until the torque command will not be saturated at the end of sequence interval C or in sequence interval D. In this case, there is no problem even if the torque command is about to be saturated at the beginning of sequence interval C. (See the following figure.)

Example1 of the percentage limit to the acceleration during deceleration (bad case)



Example2 of the percentage limit to the acceleration during deceleration (good case)



(7) Tuning the acceleration limitation start speed during deceleration (parameter Nos. 4326 and 4330)

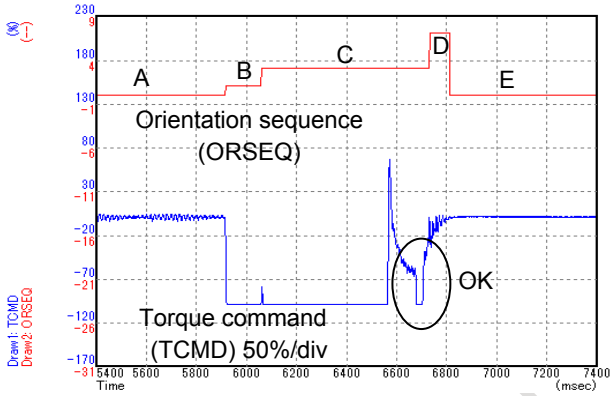
If you tuned the percentage limit to an acceleration during deceleration as explained in item (6), tune also the acceleration limitation start speed during deceleration.

(a) Deciding whether or not to tune the acceleration limitation start speed during deceleration

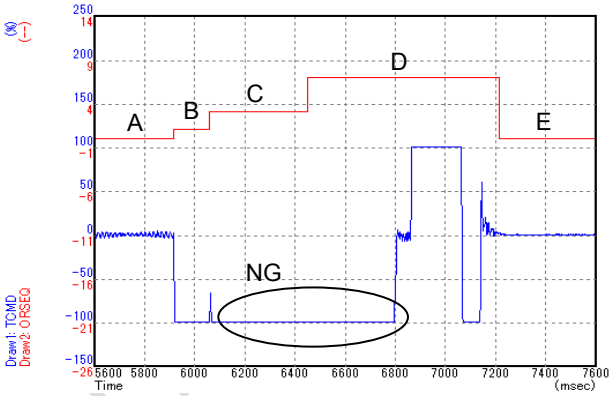
Start spindle orientation when the spindle is running at 10 min^{-1} + acceleration limitation start speed during deceleration ω_{LS}, which is an initial setting used when the percentage limit to an acceleration during deceleration is tuned. (See the following figure.) In this case, it is necessary to tune the percentage limit to an acceleration during deceleration if the torque command is saturated in sequence interval C or D.

If the torque command is not saturated, stop tuning the spindle orientation.

Case in which parameter tuning is unnecessary



Case in which parameter tuning is necessary



(b) Tuning the acceleration limitation start speed during deceleration

Increase the acceleration limitation start speed during deceleration (parameter Nos. 4326 and 4330) until the torque command will not be saturated at the end of sequence interval C or in sequence interval D even when spindle orientation is started when the spindle is running at 10 min^{-1} + acceleration limitation start speed during deceleration ω_{LS}. Similarly to item (6), there is no problem even if the torque command is about to be saturated at the beginning of sequence interval C.

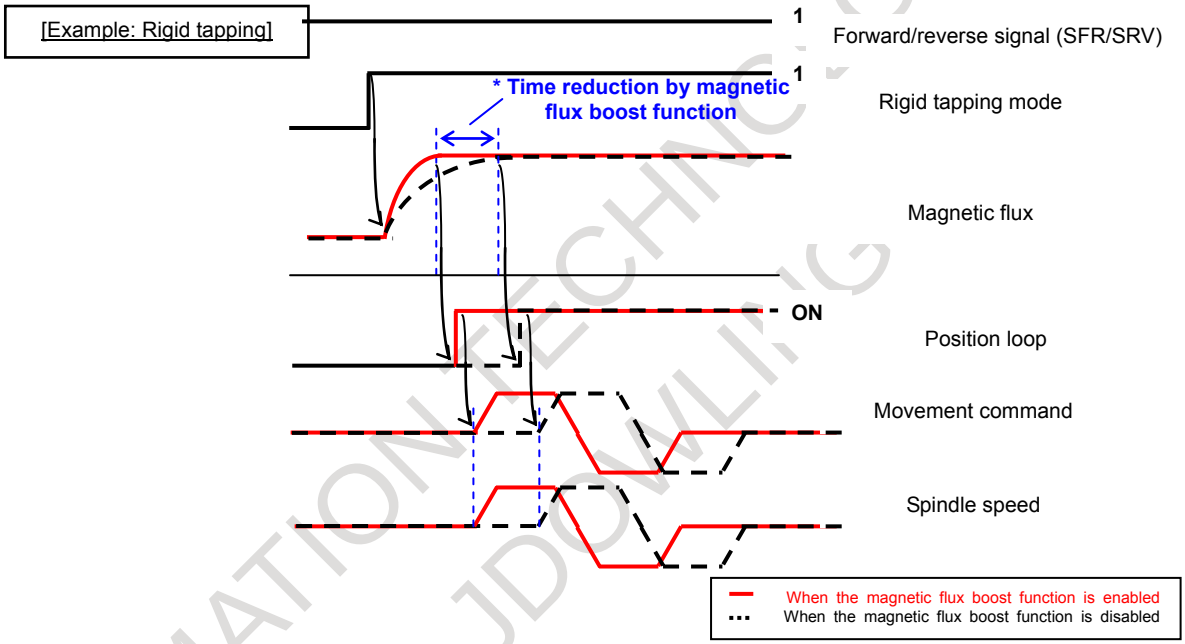
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5.16 MAGNETIC FLUX BOOST FUNCTION

5.16.1 Overview

An induction motor generates a magnetic flux by causing an excitation current to flow. Normally, when no load is applied by the speed mode, the excitation current is kept below the rated level to reduce heat generation. In this case, the magnetic flux is also reduced to below the rated level. To restore the magnetic flux to its rated value takes a certain time. Before changing to a mode in which torque responsiveness is required (rigid tapping, spindle positioning, or Cs contour control mode), the time to restore the magnetic flux to its rated value is necessary (parameter No. 4099: typically 300 to 400 ms).

The magnetic flux boost function reduces the time it takes to restore the magnetic flux to its rated value when a changed is made from the speed control mode to rigid tapping (spindle positioning or Cs contour control mode).



NOTE
1 This function cannot be used with sensorless motor.

5.16.2 Series and Editions of Applicable Spindle Software

Spindle software

Series	Edition	Usable CNC
9D80	K (11)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9D90	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	A (01)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i*-B / FS35*i*-B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

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5.16.3 List of Related Parameters

Parameter No.		Description
0*i*	30*i*	
4353 #6	4353 #6	Whether to use the magnetic flux boost function
4124	4124	Magnetic flux boost completion level/magnetic flux boost coefficient
4099	4099	Delay time for motor excitation

5.16.4 Details of Related Parameters

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4353	4353		FBTCSC						

FBTCSC : Whether to use the magnetic flux boost function
0 : Does not use the magnetic flux boost function.
1 : Use the magnetic flux boost function.

0*i*	30*i*	
4124	4124	**Magnetic flux boost completion level/magnetic flux boost coefficient**

Set the parameters for using the magnetic flux boost function.
For information about the values to be set, see Subsection 5.16.5, "Adjustment Procedure".

0*i*	30*i*	
4099	4099	**Delay time for motor excitation**

Unit of data : 1ms
Valid data range : 0 to 32767
Initial setting : 0
Set the time it takes before motor excitation becomes stable when changing to rigid tapping or Cs contour control.

NOTE
Even when you are setting this for using the magnetic flux boost function, specify an appropriate value (typically, 300 to 400 (msec)).

5.16.5 Adjustment Procedure

1 Set parameter No. 4124 (without speed range switching or for high-speed winding) and parameter No. 4155 (for low-speed winding), based on the table below. If your motor model is not indicated in the table, use the following equations to calculate the values to be set:

$$No.4124 = 24320 + MIN\left(255, \sqrt{(No.4111/100)^2 + 1} \times 0.9 \times 100\right)$$

$$No.4155 = 24320 + MIN\left(255, \sqrt{(No.4147/100)^2 + 1} \times 0.9 \times 100\right)$$ (No need to set if speed range switching is not involved)

2 If the vibration of the spindle during magnetic flux boost bothers you, try reducing the values of parameter Nos. 4124 and No.4155 in step of 10 (the lower limit is 24420).

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- **Parameter Table of Magnetic Flux Boost Coefficient and Magnetic Flux Boost Completion Level by Motor Model**

a. SPINDLE MOTOR αiI (200V)

Motor model	Applicable amplifier	Magnetic flux boost coefficient /magnetic flux boost completion level	
		No.4124 (High-speed winding)	No.4155 (Low-speed winding)
αiI 0.5/10000	αiSP2.2	24570	0
αiI 1/10000	αiSP2.2	24448	0
αiI 1.5/10000	αiSP5.5	24535	0
αiI 2/10000	αiSP5.5	24501	0
αiI 3/10000	αiSP5.5	24521	0
αiI 6/10000	αiSP11	24570	0
αiI 8/8000	αiSP11	24497	0
αiI 12/7000	αiSP15	24499	0
αiI 15/7000	αiSP22	24556	0
αiI 18/7000	αiSP22	24575	0
αiI 22/7000	αiSP26	24564	0
αiI 30/6000	αiSP45	24575	0
αiI 40/6000	αiSP45	24575	0
αiI 50/4500	αiSP55	24575	0
αiI 1.5/15000	αiSP15	24505	0
αiI 2/15000	αiSP22	24501	0
αiI 3/12000	αiSP11	24513	0
αiI 6/12000	αiSP11	24464	24570
αiI 8/10000	αiSP11	24493	24497
αiI 12/10000	αiSP15	24499	24499
αiI 15/10000	αiSP22	24515	24556
αiI 18/10000	αiSP22	24570	24575
αiI 22/10000	αiSP26	24477	24531

b. SPINDLE MOTOR αiIP (200V)

Motor model	Applicable amplifier	Magnetic flux boost coefficient /magnetic flux boost completion level	
		No.4124 (High-speed winding)	No.4155 (Low-speed winding)
αiIP 12/6000	αiSP11	24575	24575
αiIP 12/8000	αiSP11	24575	24575
αiIP 15/6000	αiSP15	24575	24575
αiIP 15/8000	αiSP15	24575	24575
αiIP 18/6000	αiSP15	24541	24575
αiIP 18/8000	αiSP15	24541	24575
αiIP 22/6000	αiSP22	24575	24575
αiIP 22/8000	αiSP22	24575	24575
αiIP 30/6000	αiSP22	24575	24575
αiIP 40/6000	αiSP26	24575	24575
αiIP 50/6000	αiSP26	24575	24575
αiIP 60/4500	αiSP30	24575	24575

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c. SPINDLE MOTOR αiIT (200V)

Motor model	Applicable amplifier	Magnetic flux boost coefficient /magnetic flux boost completion level	
		No.4124 (High-speed winding)	No.4155 (Low-speed winding)
αiIT 1.5/15000	αiSP15	24505	0
αiIT 2/15000	αiSP22	24501	0
αiIT 3/12000	αiSP11	24513	0
αiIT 6/12000	αiSP15	24509	24575
αiIT 8/12000	αiSP15	24447	24491
αiIT 8/15000	αiSP26	24450	24514
αiIT 15/10000	αiSP22	24515	24556
αiIT 15/12000	αiSP30	24566	24575
αiIT 22/10000	αiSP26	24477	24531

d. SPINDLE MOTOR αiI (400V)

Motor model	Applicable amplifier	Magnetic flux boost coefficient /magnetic flux boost completion level	
		No.4124 (High-speed winding)	No.4155 (Low-speed winding)
αiI 0.5/10000HV	αiSP5.5HV	24558	0
αiI 1/10000HV	αiSP5.5HV	24449	0
αiI 1.5/10000HV	αiSP5.5HV	24537	0
αiI 2/10000HV	αiSP5.5HV	24575	0
αiI 3/10000HV	αiSP5.5HV	24551	0
αiI 6/10000HV	αiSP11HV	24575	0
αiI 8/8000HV	αiSP11HV	24544	0
αiI 12/7000HV	αiSP15HV	24562	0
αiI 15/7000HV	αiSP30HV	24575	0
αiI 22/7000HV	αiSP30HV	24539	0
αiI 30/6000HV	αiSP45HV	24575	0
αiI 40/6000HV	αiSP45HV	24564	0
αiI 60/4500HV	αiSP75HV	24575	0
αiI 100/4000HV	αiSP75HV	24533	24553

e. SPINDLE MOTOR αiIP (400V)

Motor model	Applicable amplifier	Magnetic flux boost coefficient /magnetic flux boost completion level	
		No.4124 (High-speed winding)	No.4155 (Low-speed winding)
αiIP 15/6000HV	αiSP15HV	24575	24575
αiIP 40/6000HV	αiSP30HV	24575	24575
αiIP 50/6000HV	αiSP30HV	24541	24575

f. SPINDLE MOTOR αiIT (400V)

Motor model	Applicable amplifier	Magnetic flux boost coefficient /magnetic flux boost completion level	
		No.4124 (High-speed winding)	No.4155 (Low-speed winding)
αiIT 1.5/15000HV	αiSP15HV	24548	0
αiIT 3/12000HV	αiSP11HV	24513	0
αiIT 6/12000HV	αiSP15HV	24513	24575

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Motor model	Applicable amplifier	Magnetic flux boost coefficient /magnetic flux boost completion level	
		No.4124 (High-speed winding)	No.4155 (Low-speed winding)
αiIT 8/12000HV	αiSP15HV	24447	24510
αiIT 8/15000HV	αiSP15HV	24494	24575
αiIT15/10000HV	αiSP30HV	24544	24575
αiIT15/12000HV	αiSP30HV	24575	24575
αiIT22/10000HV	αiSP30HV	24489	24575

g. SPINDLE MOTOR βiI

Motor model	Applicable amplifier	Magnetic flux boost coefficient /magnetic flux boost completion level	
		No.4124 (High-speed winding)	No.4124 (High-speed winding)
βiI 3/10000	βiSVSPx-5.5	24575	0
βiI 6/10000	βiSVSPx-11	24528	0
βiI 8/8000	βiSVSPx-11	24575	0
βiI 8/10000	βiSVSPx-11	24575	0
βiI 12/7000	βiSVSPx-15	24575	0
βiI 12/8000	βiSVSPx-15	24575	0
βiI 15/7000	βiSVSPx-18	24575	0

h. SPINDLE MOTOR αiI_P

Motor model	Applicable amplifier	Magnetic flux boost coefficient /magnetic flux boost completion level	
		No.4124 (High-speed winding)	No.4124 (High-speed winding)
βiIP 8/6000	βiSVSPx-7.5	24575	0
βiIP 12/6000	βiSVSPx-7.5	24528	0
βiIP 12/8000	βiSVSPx-18	24575	0
βiIP 15/6000	βiSVSPx-11	24575	0
βiIP 18/6000	βiSVSPx-11	24575	0
βiIP 22/6000	βiSVSPx-15	24575	0
βiIP 30/6000	βiSVSPx-18	24575	0
βiIP 40/6000	βiSVSPx-18	24575	0

j. BUILT-IN SPINDLE MOTOR BiI (Standard type)

Motor model	Applicable amplifier	Magnetic flux boost coefficient /magnetic flux boost completion level	
		No.4124 (High-speed winding)	No.4155 (Low-speed winding)
BiI 50S/30000	αiSP2.2	24575	0
BiI 50M/25000	αiSP2.2	24551	0
BiI 50L/25000	αiSP5.5	24575	0
BiI 80S/20000	αiSP5.5	24506	24569
BiI 80M/15000	αiSP2.2	24448	0
BiI 80L/8000	αiSP5.5	24535	0
BiI 100S/12500	αiSP5.5	24551	0
BiI 112SS/20000	αiSP11	24575	24575
BiI 112S/15000	αiSP22	24487	24575

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Motor model	Applicable amplifier	Magnetic flux boost coefficient /magnetic flux boost completion level	
		No.4124 (High-speed winding)	No.4155 (Low-speed winding)
Bil 112M/15000	αiSP11	24568	0
Bil 112L/15000	αiSP30	24575	24575
Bil 112LL/15000	αiSP30	24575	24575
Bil 132M/14000	αiSP30	24575	24575
Bil 132L/14000	αiSP30	24575	24575
Bil 160S/13000	αiSP22	24575	24575
Bil 160M/13000	αiSP30	24575	24575
Bil 160L/13000	αiSP22	24575	24575
Bil 160LL/13000	αiSP30	24575	24575
Bil 170S/6000	αiSP22	24533	24575
Bil 170M/6000	αiSP26	24575	24575
Bil 180M/6000	αiSP30	24575	24575
Bil 180L/6000	αiSP30	24575	24575
Bil 180LL/8000	αiSP30	24575	24575
Bil 200S/6000	αiSP37	24575	24575
Bil 200M/6000	αiSP30	24575	24575
Bil 200L/6000	αiSP45	24575	24575
Bil 250S/6000	αiSP45	24514	24575
Bil 250M/3000	αiSP55	24575	24575

k. BUILT-IN SPINDLE MOTOR Bil (High-speed type)

Motor model	Applicable amplifier	Magnetic flux boost coefficient /magnetic flux boost completion level	
		No.4124 (High-speed winding)	No.4155 (Low-speed winding)
Bil 40S/70000	αiSP2.2	24467	0
Bil 40M/70000	αiSP11	24575	0
Bil 60SS/50000	αiSP11	24575	0
Bil 60S/50000	αiSP22	24575	24575
Bil 80S/40000	αiSP45	24575	0
Bil 100S/20000	αiSP22	24575	24575
Bil 100S/30000	αiSP30	24569	24575
Bil 100L/30000	αiSP30	24575	24575
Bil 112S/20000	αiSP30	24575	24575
Bil 112M/20000	αiSP30	24499	24575
Bil 112L/20000	αiSP30	24522	24575
Bil 112L/25000	αiSP75HV	24575	24575
Bil 160M/20000	αiSP30	24575	24575
Bil 160L/20000	αiSP30	24575	24575
Bil 160LL/20000	αiSP75HV	24575	24575
Bil 200S/10000	αiSP75HV	24575	24575

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5.17 ADJUSTING FSSB HIGH-SPEED RIGID TAPPING

5.17.1 Overview

0*i*-F series and 30*i*-B series CNC are connected to a spindle via the FSSB. This FSSB connection enables actual spindle position data to be transferred to servo software at a high speed. The FSSB high-speed rigid tapping function uses this high-speed transfer so that the servo axis follows the spindle during rigid tapping.
Since the servo axis always follows the spindle, the synchronous error does not increase even when the torque command is a little saturated on the spindle side. For this reason, the spindle motor torque can be used nearly up to the limit and the rigid tapping cycle time can be reduced while maintaining precision.
This section describes how to adjust the FSSB high-speed rigid tapping function.

NOTE
1 This function can be used with sensorless motor. (spindle sensor is necessary)

5.17.2 Procedure for Adjusting FSSB High-Speed Rigid Tapping

5.17.2.1 Initializing parameters

To use FSSB high-speed rigid tapping, first set parameters related to rigid tapping in the same way as for conventional rigid tapping. Then, set additional parameters for FSSB high-speed rigid tapping (*-marked parameters in the table below).

Parameter No. 0*i*-F / 30*i*-B	Description
2005#1	Feed-forward function bit (servo axis) Initial value: 1 * Feed-forward 100% is applied to the servo axis during FSSB high-speed rigid tapping regardless of the setting of the feed-forward coefficient. * When you use 3D rigid tapping, set "1" to this parameter for each axis.
5203#2	Feed-forward function bit (servo axis) Initial value: 0 * To apply feed-forward to the spindle, use bell-shaped acceleration/deceleration for rigid tapping (option) together. For FSSB high-speed rigid tapping, it is not necessary to set the feed-forward coefficient for the spindle according to the servo axis.
5241 to 5244	Maximum speed for rigid tapping
5261 to 5264	Acceleration/deceleration time constant for rigid tapping Initial value: 500
4065 to 4068	Spindle position gain in the servo mode Initial value: 3000
4044 to 4045	Velocity loop proportional gain for the spindle in the servo mode Initial value: Calculate the gain using the following equation: Velocity loop proportional gain = 30159/Tmax × (Jm + Jl) where Tmax: Short time rated torque within the constant torque range × 1.2 [Nm] Jm: Motor rotor inertia [kgm^2] Jl: Load inertia converted to motor shaft inertia [kgm^2]
4052 to 4053	Velocity loop integral gain for the spindle in the servo mode Initial value: Calculate the gain using the following equation: Velocity loop integral gain = 280735/Tmax × (Jm + Jl) where Tmax: Short time rated torque within the constant torque range × 1.2 [Nm] Jm: Motor rotor inertial [kgm^2] Jl: Load inertia converted to motor shaft inertial [kgm^2]

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Parameter No. 0*i*-F / 30*i*-B	Description
4085	Spindle motor voltage setting in the servo mode (for high-speed characteristics of speed range switching) Initial value: 100 When the maximum speed for rigid tapping (converted to the motor shaft speed) is higher than the base speed of the spindle motor (high-speed characteristics: Parameter No. 4100), however, calculate the voltage using the following equation and set it: Motor voltage (%) = 100 × Spindle motor base speed (parameter No. 4100) / Maximum speed for rigid tapping (converted to the motor shaft speed)
4137	Spindle motor voltage setting in the servo mode (for low-speed characteristics of speed range switching) Initial value: 100 When the maximum speed for rigid tapping (converted to the motor shaft speed) is higher than the base speed of the spindle motor (low-speed characteristics: Parameter No. 4138), however, calculate the voltage using the following equation and set it: Motor voltage (%) = 100 × Spindle motor base speed (parameter No. 4103) / Maximum speed for rigid tapping (converted to the motor shaft speed)
4016#4	Setting related to the spindle motor voltage in the servo mode Initial value: 0 Set this bit to 1 when parameter No. 4085 or No. 4137 is set to less than 100, however.
4099	Delay time for motor excitation Initial value: 300 Change this value when using the magnetic flux boost function together. (See the previous section.)
24203#0※	FSSB high-speed rigid tapping function bit (CNC) Initial value: 1
2429#1※	FSSB high-speed rigid tapping function bit (servo axis) Initial value: 1 * When you use 3D rigid tapping, set “1” to this parameter for each axis.
4549#1※	FSSB high-speed rigid tapping function bit (spindle) Initial value: 1
24204※	Spindle number of the spindle to be synchronized with the servo axis * When you use 3D rigid tapping, set “1” to this parameter for each axis.
2610※	Servo axis position gain for FSSB high-speed rigid tapping Initial value: 3000 * When you use 3D rigid tapping, set “1” to this parameter for each axis.

5.17.2.2 Parameters used for adjustment

The parameters used for adjustment are basically the same as those for conventional rigid tapping. There are the following differences in the adjustment method between conventional rigid tapping and FSSB high-speed rigid tapping:
You can set a value shorter than that for conventional rigid tapping for the acceleration/deceleration time constant.
You do not need to use the same position gain for the servo axis and spindle. For the servo axis, a position gain parameter is available, which is valid only for FSSB high-speed rigid tapping.

Parameter No. 0*i*-F / 30*i*-B	Description
5261 to 5264	Acceleration/deceleration time constant for rigid tapping
5280 to 5284	Servo axis position gain for rigid tapping (Valid when parameter No. 2610 = 0)
2610	Servo axis position gain for FSSB high-speed rigid tapping
4065 to 4068	Spindle position gain in the servo mode
4044 to 4045	Velocity loop proportional gain for the spindle in the servo mode
4052 to 4053	Velocity loop integral gain for the spindle in the servo mode

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5.17.2.3 Adjustment using the SERVO GUIDE

Adjust the parameters while observing the synchronous error, spindle speed, torque command, and other waveforms using the SERVO GUIDE. The following table lists the channels to be set for the waveforms used for adjustment.

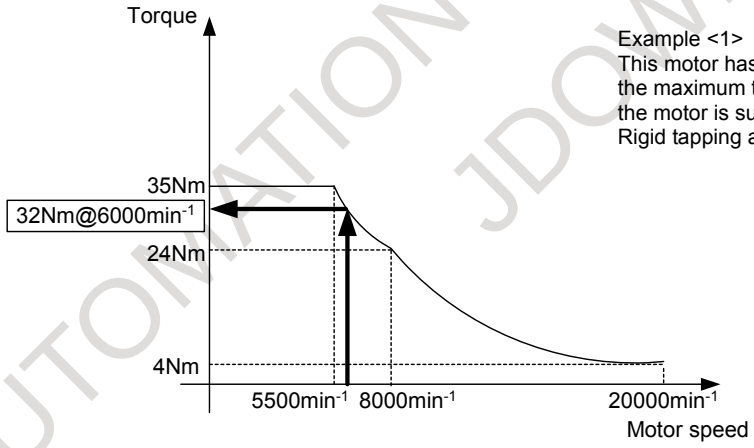
Axis	Data type	Data unit for observation
Servo axis	SYNC (Synchronous error)	[pulse]
	TCMD (Torque command)	[%]
Spindle	SPSPD (Spindle speed)	[min^{-1}]
	TCMD (Torque command)	[%]
	ERRC (Position error)	[pulse]

NOTE
The synchronous error is data calculated using the following equation:
SYNC [pulse] = PERsp [pulse] - PERsv [pulse]
SYNC [pulse]: Synchronous error (4096 pulses per spindle rotation)
PERsp [pulse]: Spindle position error
PERsv [pulse]: Servo axis position error converted for the spindle

1. Setting the maximum spindle speed for rigid tapping

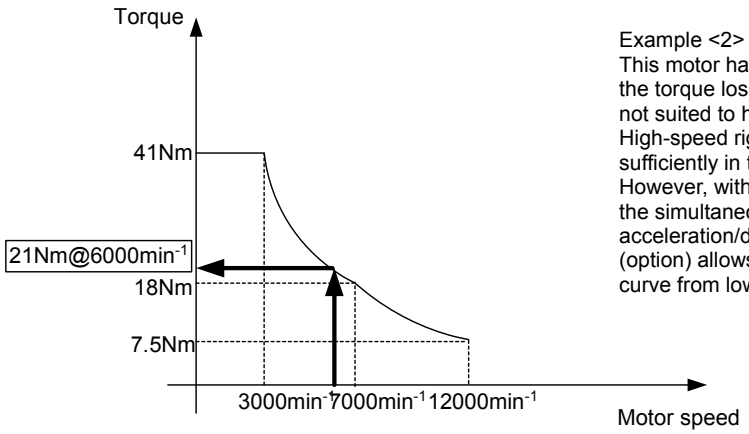
Set the maximum spindle speed for rigid tapping according to the machine specifications. Using a high-speed area unless the spindle motor torque is not reduced may be able to reduce the machining cycle time.

[Example of spindle motor speed-torque characteristics]



Example <1>
This motor has a wide constant torque area and almost the maximum torque can be used even at 6000 min^{-1}, so the motor is suited to high-speed machining.
Rigid tapping at high-speed can reduce the cycle time.

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Example <2>
This motor has a narrow constant torque area and the torque loss is large at 6000 min^{-1}, so the motor is not suited to high-speed machining.
High-speed rigid tapping cannot use the torque sufficiently in the low-speed area.
However, with a motor having these characteristics, the simultaneous use of the optimum acceleration/deceleration function for rigid tapping (option) allows the use of torque along the torque curve from low speed to high speed.

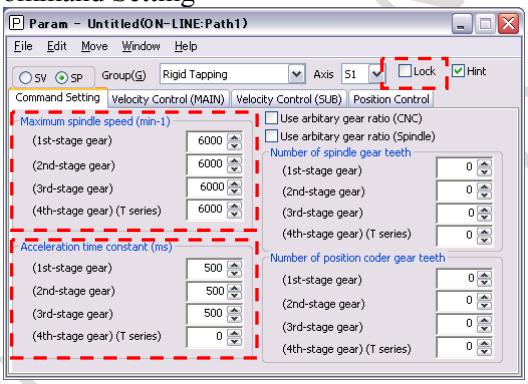
2. Preparations before the start of adjustment

2-1. Initializing parameters

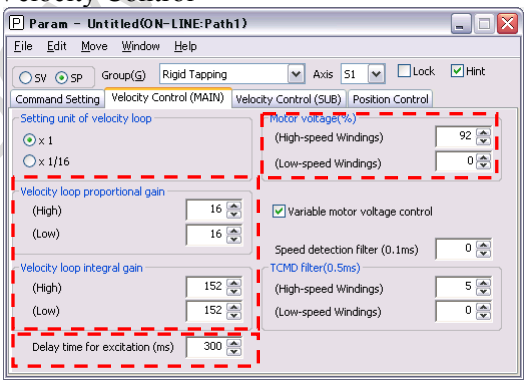
Use the parameter window of the SERVO GUIDE to initialize parameters for rigid tapping. Open the parameter window "online", select the "SP" parameter switch radio button, and select "Rigid Tapping" for Group.

Select "Command Setting", "Velocity Control", and "Position Control" for "Rigid Tapping" and enter the initial values for parameters. Before entering the values, make sure that the "Lock" check box is unchecked.
The initial value of the acceleration/deceleration time constant is determined depending on the maximum spindle speed. As a standard initial value, enter 500 to 600 ms.
When a required parameter is not found in the "Rigid Tapping" group, select "Parameter Table" for Group and enter its initial value.

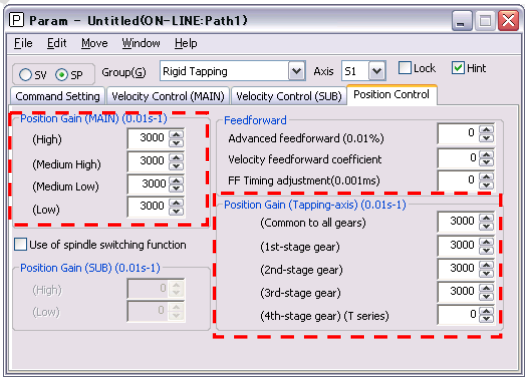
"Command Setting"



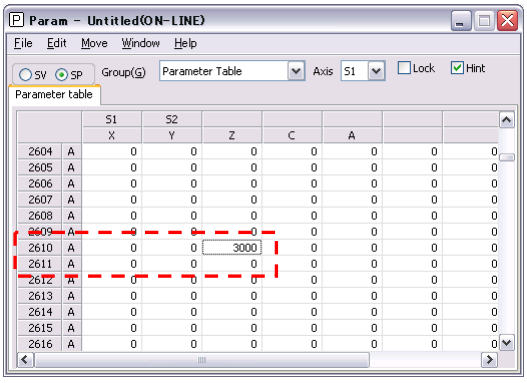
"Velocity Control"



"Position Control"



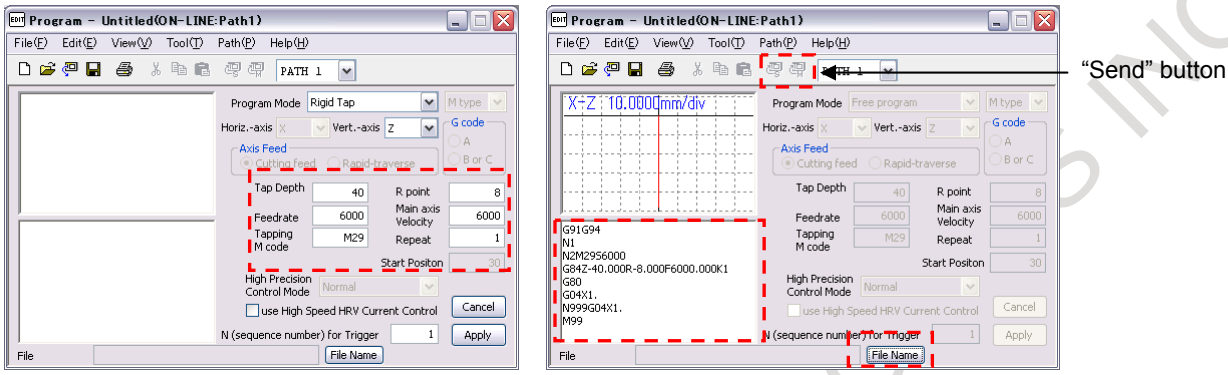
"Parameter Table"



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2-2. Creating a test program

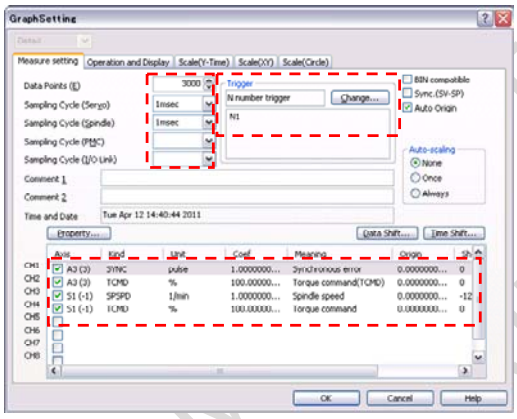
Use the program window of the SERVO GUIDE to create a test program. Select "Rigid Tap" for Program Mode and set various types of conditions. After setting conditions, click the "Apply" button. The SERVO GUIDE creates a program.



Check the program, click the "File Name" button to name the program, and click the sub and main send buttons in this order to send the program to the CNC.

2-3. Setting channels in the graph window

Open the graph window of the SERVO GUIDE and set channels for the graph. For Trigger, set the value in "N (sequence number) for Trigger" in the program window.

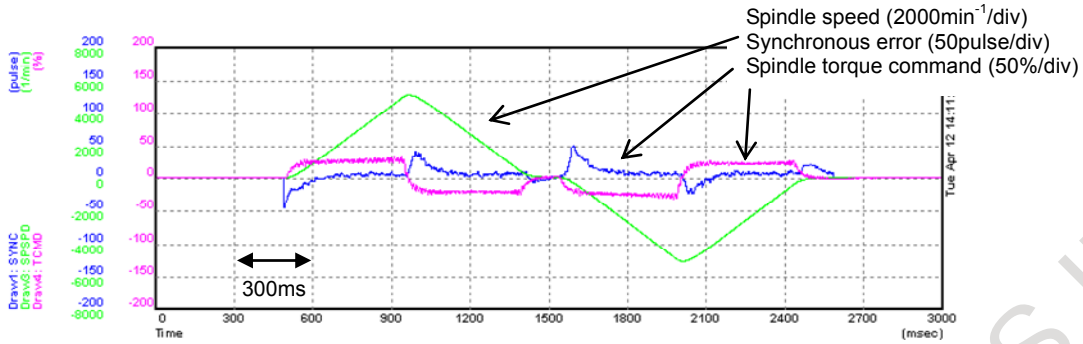


2-4. Checking the operation of the test program

Before starting data measurement, click the "origin" button in the graph window once. Press the "Start" button to place the SERVO GUIDE in the trigger wait state. Press the cycle start button on the machine. The program sent to the CNC as described above is executed and data is measured.

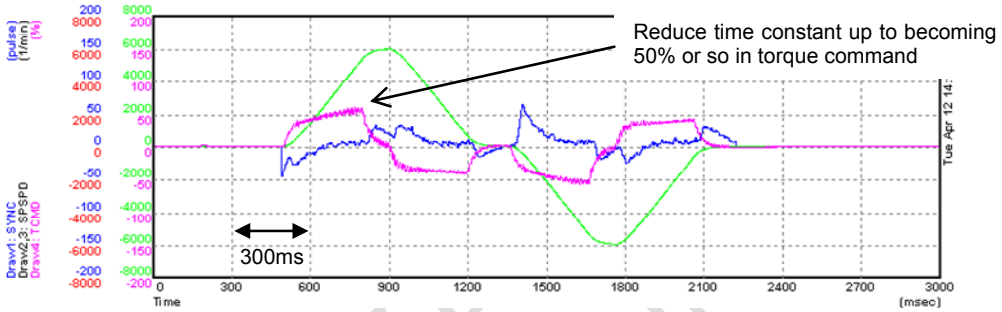
Example of rigid tapping waveforms with the initial values of the parameters (acceleration/deceleration time constant: 500 ms)

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Check the waveforms with the initial values of the parameters and decrease the value for the acceleration/deceleration time constant until the spindle torque command value indicates about 50%. Based on the settings after adjustment, adjust the velocity loop gain and position gain.

Example of waveforms after the 1st adjustment of the acceleration/deceleration time constant (The acceleration/deceleration time constant is adjusted from 500 ms to 300 ms.)



At this step, make sure that the spindle speed reaches the maximum speed for rigid tapping. If the speed does not reach the maximum, modify the test program to increase the travel distance along the Z-axis.

After setting the acceleration/deceleration time constant, check whether the spindle is operating as designed. For that purpose, check that the position error during stable rotation at the maximum speed is almost the same as the theoretical value during rigid tapping. This theoretical value is calculated as shown below.

$$Perr[pulse] = \frac{Nr[\min^{-1}]}{60} \times 4096[pulse/rev] \times \frac{1}{PG[\sec^{-1}]} \times (1 - \frac{RFF[\%]}{100})$$

$Perr[pulse]$: Position error at speed Nr

$Nr[\min^{-1}]$: Maximum speed for rigid tap

$PG[\sec^{-1}]$: Position gain for rigid tap

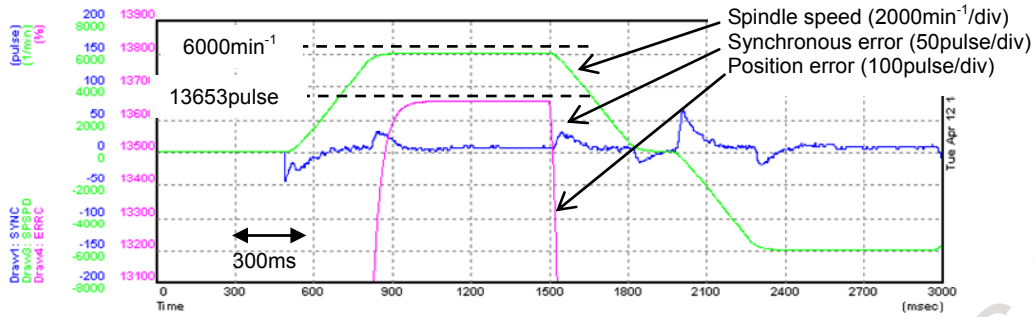
$RFF[\%]$: Feed-forward coefficient (in case of No.5203#2=1)

(Example) In this example of operation, the position error with the initial values is calculated as follows:

$$Perr[pulse] = \frac{6000}{60} \times 4096 \times \frac{1}{30} \times (1 - \frac{0}{100}) = 13653[pulse]$$

Example of checking the position error waveform (Theoretical position error value: 13653 [pulse])

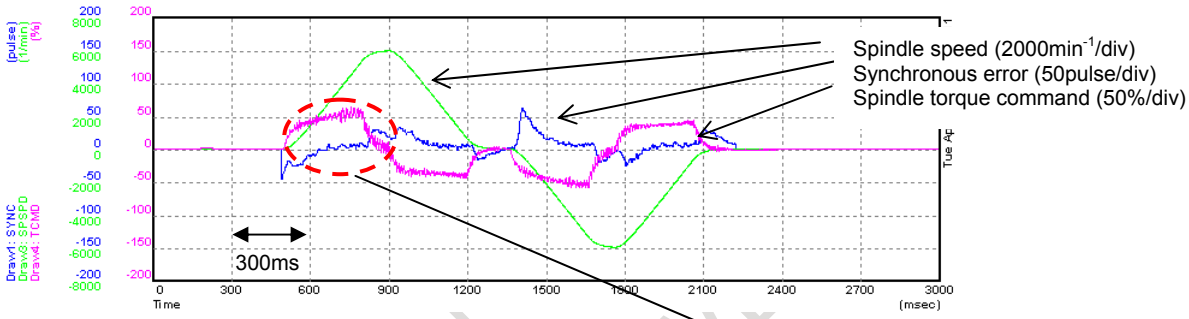
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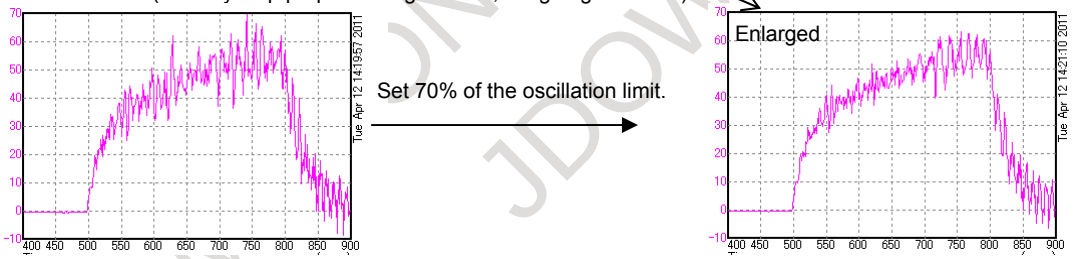
3. Adjusting the velocity loop gains

Adjust the velocity loop proportional and integral gains. On the "Velocity Control" tab of the parameter window described above, increase the proportional and integral gains in the same steps and determine the oscillation limit based on the torque command waveform, actual motor sound, vibration, and so on. As final settings, enter approximately 70% of the oscillation limit for the proportional and integral gains.

Example of waveforms after the adjustment of the velocity loop proportional and integral gains (Velocity loop proportional gain = 25, integral gain = 238)



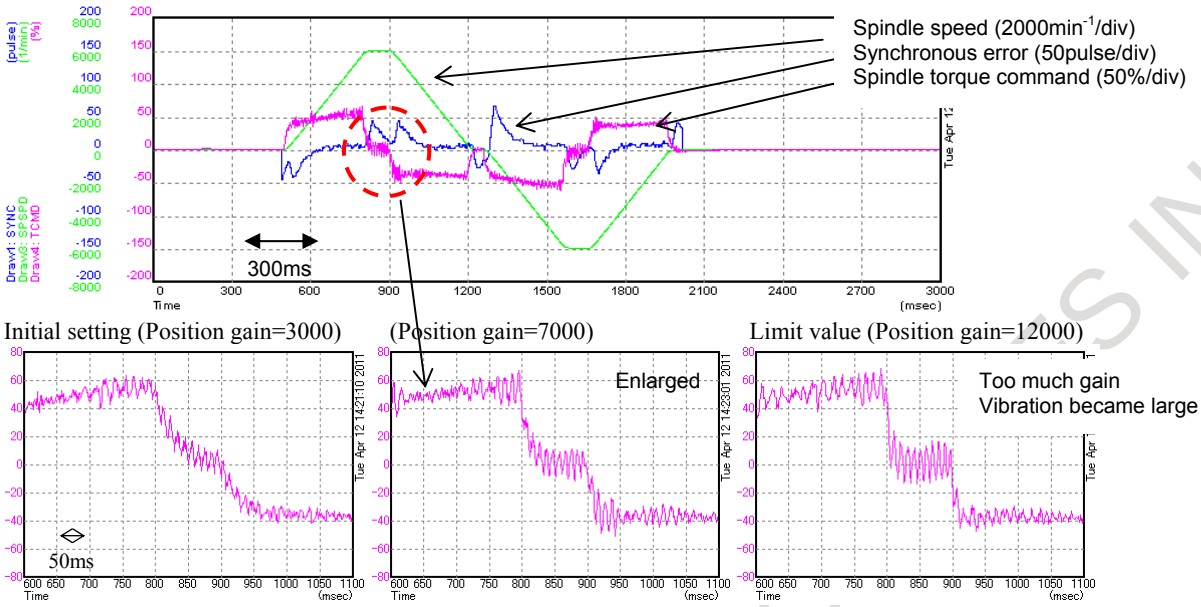
Oscillation limit (Velocity loop proportional gain = 35, integral gain = 333)



4. Adjusting the position gain

Adjust the spindle position gain. On the "Position Control" tab of the parameter window, increase the position gain in steps of about 2000. Determine the maximum allowable setting based on the torque command waveform, actual motor sound, vibration, and so on in the same way as for the adjustment of the velocity loop gains.

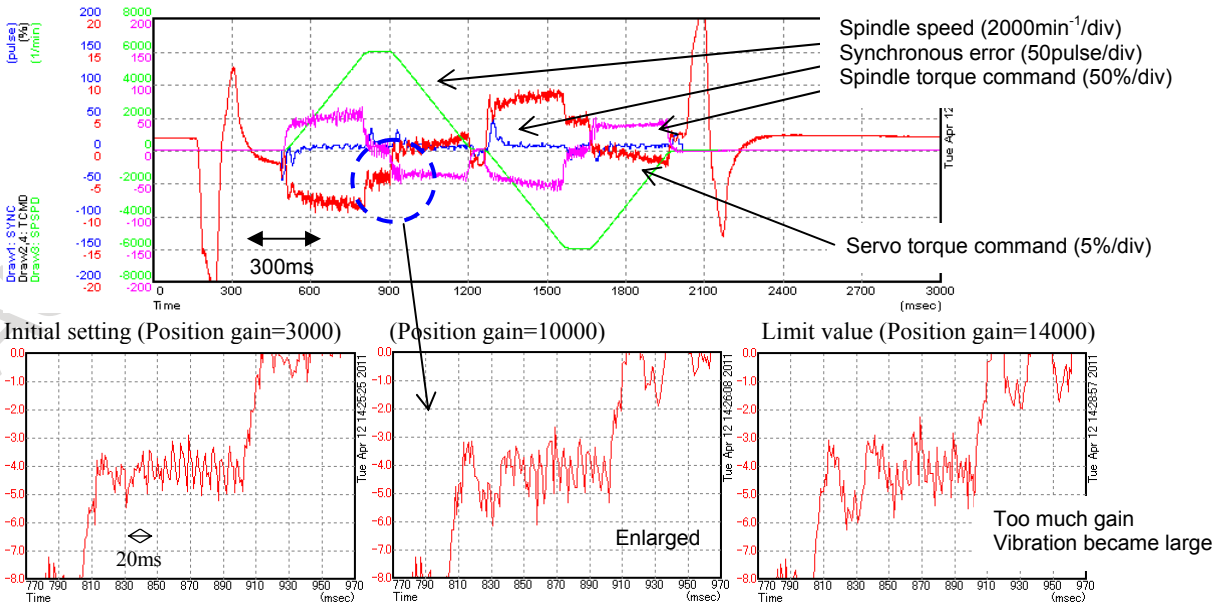
Example of waveforms after the adjustment of the spindle position gain (Spindle position gain = 7000)



Then, adjust the servo axis position gain for FSSB high-speed rigid tapping. Before this adjustment, completely adjust the servo axis velocity gains during ordinary servo adjustment.

For conventional rigid tapping, the same position gain value must be set for the spindle and servo axis to synchronize them since they are synchronized by issuing the same command to them. For FSSB high-speed rigid tapping, you can set different position gain values for the spindle and servo axis since the servo axis follows the movement of the spindle.
The servo axis position gain available for conventional rigid tapping is set using parameters Nos. 5280 to 5284. These parameters can also be used for FSSB high-speed rigid tapping. The servo axis position gain valid only for FSSB high-speed rigid tapping is available with parameter No. 2610.

Example of waveforms after the adjustment of the servo axis position gain (Servo axis position gain = 10000)



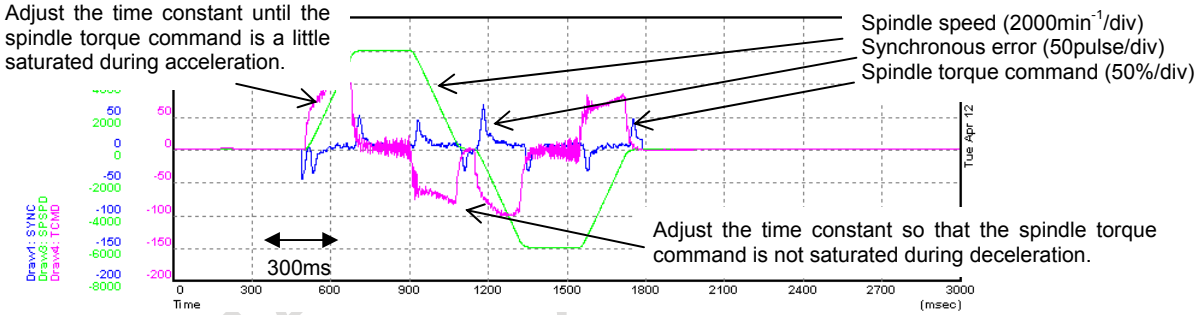
5. Adjusting the acceleration/deceleration time constant

For conventional rigid tapping, the acceleration/deceleration time constant is adjusted so that the peak value is about 80% of the maximum so as not to saturate the spindle torque command. With FSSB high-speed rigid tapping, since the servo axis follows the spindle, the spindle motor torque can be used nearly up to the limit and the acceleration/deceleration time constant can be decreased. Adjust the acceleration/deceleration time constant so that the maximum torque command during acceleration/deceleration is a little saturated at air cut. If the time constant is decreased until the deceleration torque is saturated, however, an overshoot may occur in the spindle motor near the bottom of a hole. In this case, the time constant is too small. Adjust the time constant so that an overshoot does not occur in the spindle motor speed.

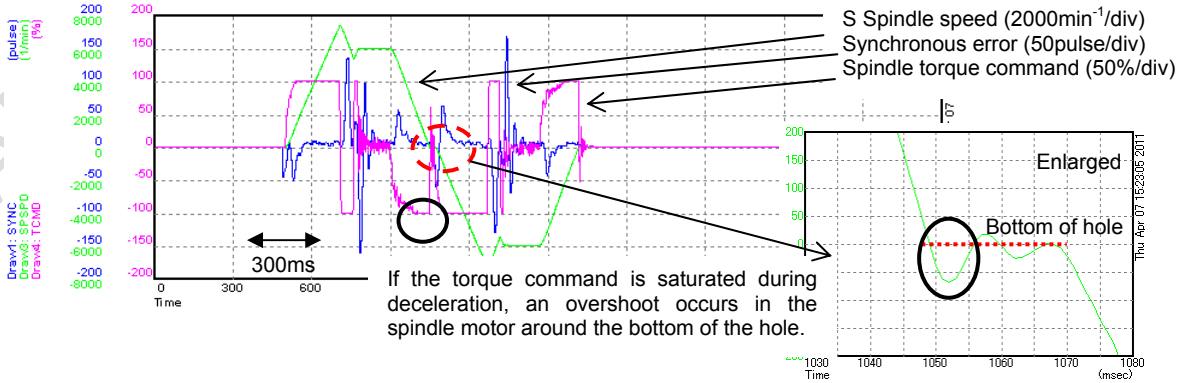
NOTE
For high-speed light-load cutting, the time constant adjusted at air cut can be used for cutting as is since the cutting load is not so large. On the other hand, for low-speed heavy-load cutting, the torque is assumed to be enough generally even when the load becomes large since the torque necessary for acceleration/deceleration becomes small at a low speed. That is, just determine the time constant with no load operation at a high speed, and it is not necessary to set the time constant additionally for low-speed large-load cutting.

Finally, conduct a test with actual cutting and check the torque command.

Example of waveforms after the 2nd adjustment of the acceleration/deceleration time constant (The acceleration/deceleration time constant is adjusted from 300 ms to 175 ms.)



Example of waveforms when the time constant is too small (The acceleration/deceleration time constant is adjusted from 300 ms to 135 ms.)



6. Checking the synchronous error

The adjustment for FSSB high-speed rigid tapping is basically completed with the above steps. When the acceleration/deceleration time constant has been adjusted, check the synchronous error between the spindle and servo axis.
As a standard, the synchronous error should be up to about 100 pulses.

5.17.2.4 Adjusting conventional rigid tapping (reference)

This subsection describes how to adjust conventional rigid tapping for reference.

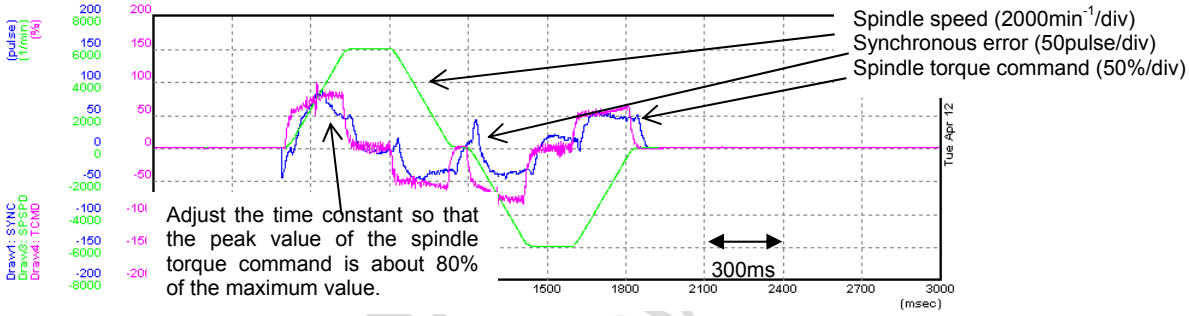
1. Setting initial values and adjusting the velocity loop gains and position gain

As the adjustment for conventional rigid tapping, set initial values and adjust the velocity loop gains and position gain after setting the values in the same way as that for FSSB high-speed rigid tapping.
However, for the servo axis position gain, set the same value as for the spindle position gain.

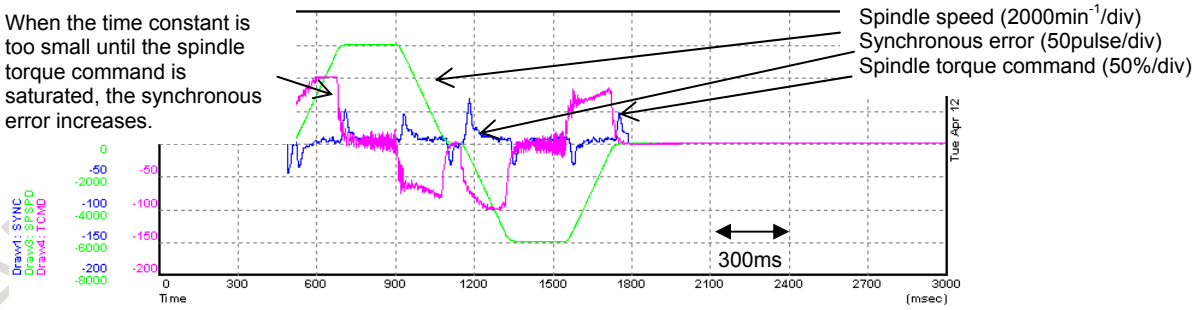
2. Adjusting the acceleration/deceleration time constant

For conventional rigid tapping, if the spindle torque command is saturated, the synchronous error increases.
Adjust the acceleration/deceleration time constant in considerarion for the torque load during actual cutting so that the spindle torque command is about 80% of the peak value during no load cutting.

Example 1 of waveforms after the adjustment of the acceleration/deceleration time constant for conventional rigid tapping (The acceleration/deceleration time constant is adjusted from 300 ms to 220 ms.)



Example 2 of waveforms after the adjustment of the acceleration/deceleration time constant for conventional rigid tapping (The acceleration/deceleration time constant is adjusted from 300 ms to 175 ms.)



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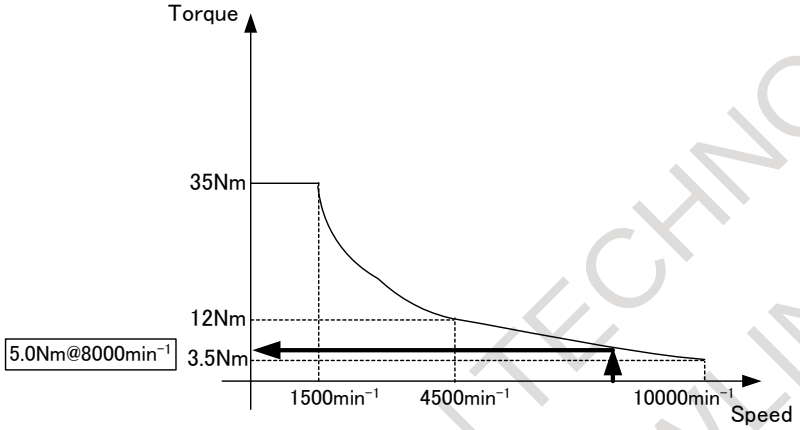
5.17.3 Using the "Optimum Rigid Tapping Acceleration/Deceleration Function" Together

The optimum rigid tapping acceleration/deceleration function can change the acceleration value for acceleration/deceleration for rigid tapping according to the torque characteristics of the spindle motor. You can use this function together to make the maximum use of the motor performance from low speed to high speed and reduce the acceleration/deceleration time.

NOTE
The optimum rigid tapping acceleration/deceleration function is an option.

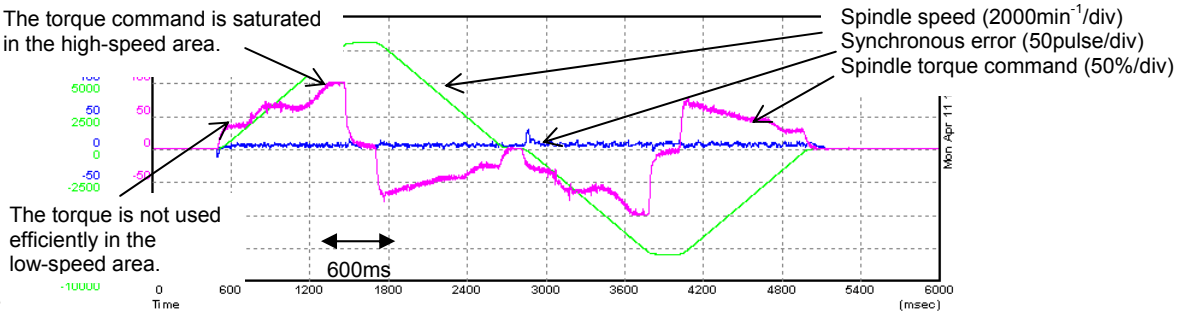
As an example, assume that a spindle motor having the following characteristics is used at a maximum speed of 8000 min^{-1}.

[Example of spindle motor speed-torque characteristics]



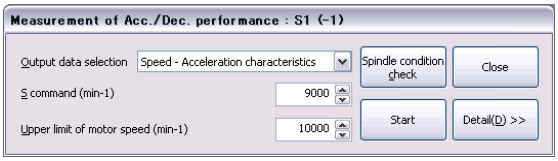
For a spindle motor having the above characteristics, the available torque is small at 8000 min^{-1}. When the motor is accelerated at a fixed acceleration from low speed to high speed, the available torque in the high-speed area is limited and the torque in the low-speed area is not used efficiently.

Example of waveforms after adjustment when the optimum rigid tapping acceleration/deceleration function is not used

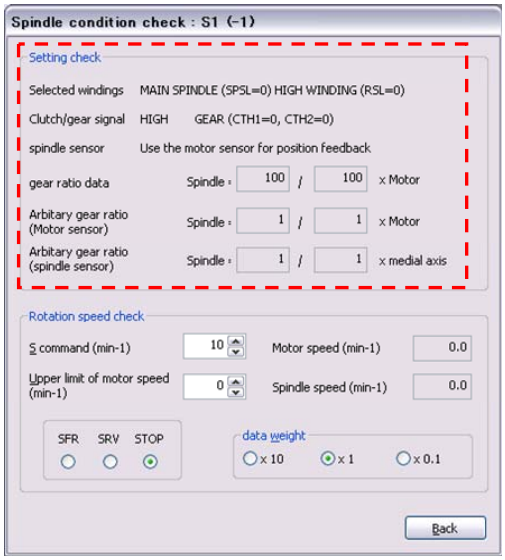


As a standard initial setting for optimum rigid tapping acceleration/deceleration, use the acceleration waveform at acceleration and deceleration measured with "Measurement of Acc./Dec. performance" of the spindle tuning function of the SERVO GUIDE.
Open the graph window of the SERVO GUIDE and select "Tool", "Spindle Tuning", and "Measurement of Acc./Dec. performance". Read the explanation and obtain spindle information. The following measurement window appears.

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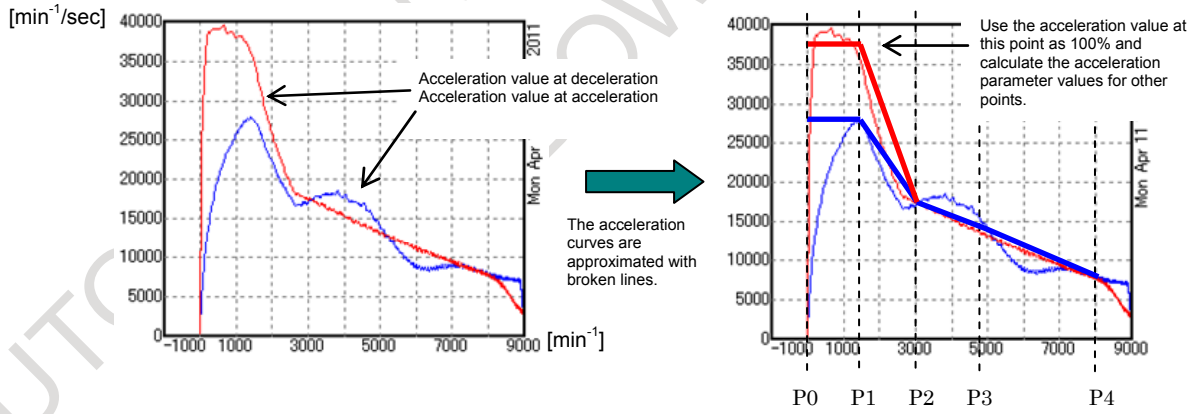


Click the "Spindle condition check" button and make sure that the current spindle status is correct.



Go back to the measurement window and enter values in the S command and Upper limit of motor speed fields. Click the "Start" button to start measurement. Enter a value greater than the maximum speed for rigid tapping in the S command field when possible.

(Example of measurement)



Estimate the initial values to be set based on the measured acceleration curves. Approximate the acceleration curves at acceleration and deceleration with broken lines using the acceleration setting points (P0 to P4). The above characteristics are shown when the motor is accelerated and decelerated always with the maximum torque in the velocity mode. The actually available acceleration is smaller than the above value. For this reason, use about 70% of the value approximated with broke lines above as the initial value of the maximum acceleration.

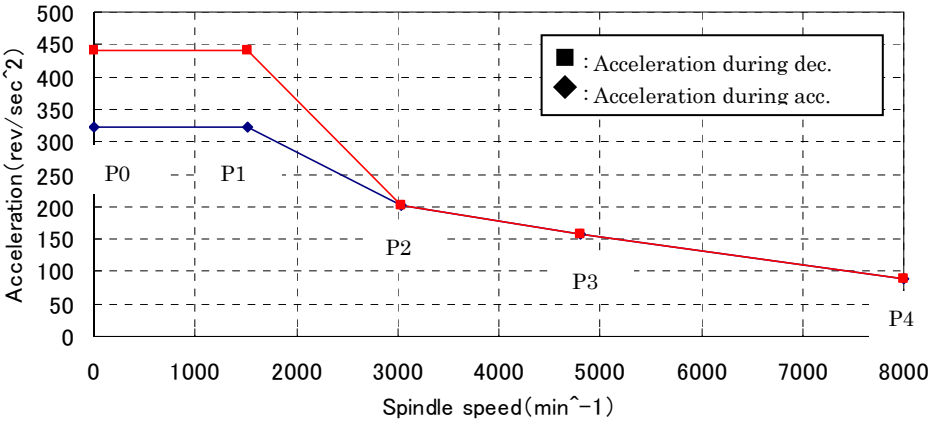
(Example of setting based on the example of measurement)
Since the maximum acceleration is measured in the 0 to 1500 min^{-1} area at deceleration, set the following value as the maximum acceleration:

$$37800(0 \sim 1500\,\mathrm{min}^{-1})[\mathrm{min}^{-1}/\mathrm{sec}] \div 60[\mathrm{sec}] \times 0.7 = 441[rev/\mathrm{sec}^2]$$

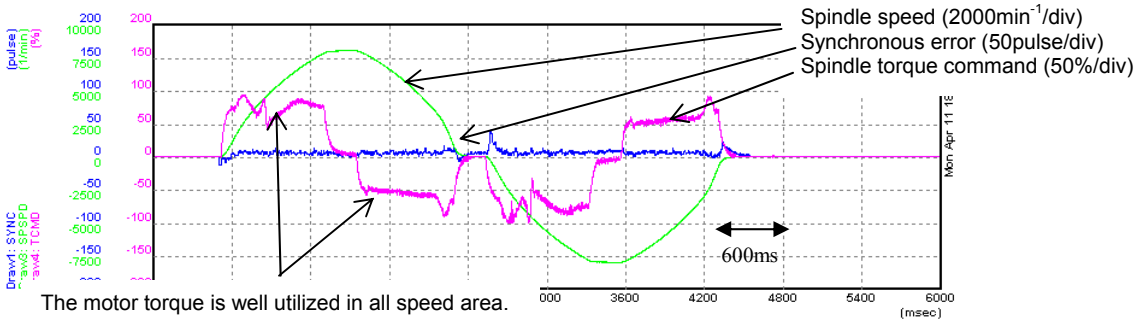
Set the other acceleration values based on the percentage of the maximum acceleration.

Example of setting initial values for parameters (for gear 1)

Gear	Maximum acceleration [rev/sec^2]	Maximum spindle speed [min^{-1}]	Acceleration setting point	Spindle speed (percentage of the maximum speed [%])	Allowable acceleration (percentage of the maximum acceleration [%])	
					Forward/reverse	
					At acceleration	At deceleration
1	No.11421=441	No.5241=8000	P0	None (0%)	No.11441=73	No.11461=100
			P1	No.11429=19	No.11442=73	No.11462=100
			P2	No.11430=38	No.11443=46	No.11463=46
			P3	No.11431=60	No.11444=36	No.11464=36
			P4	None (100%)	No.11445=20	No.11465=40



Example of operation waveforms when initial values are set

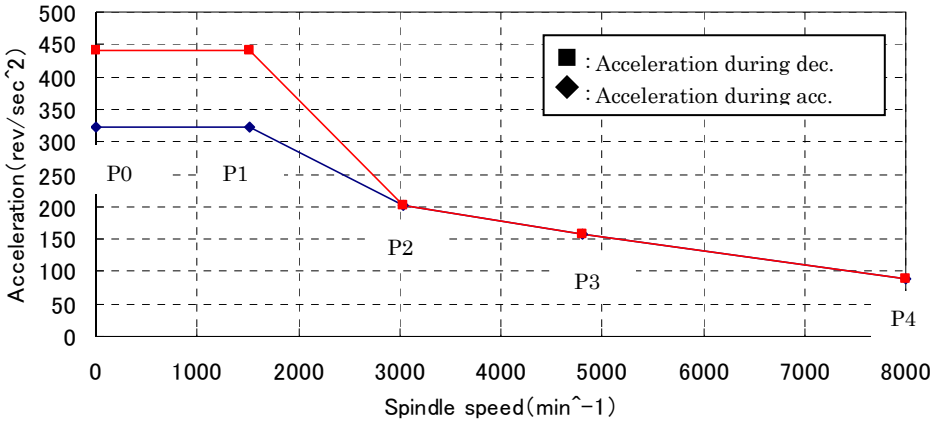


The motor torque is well utilized in all speed area.

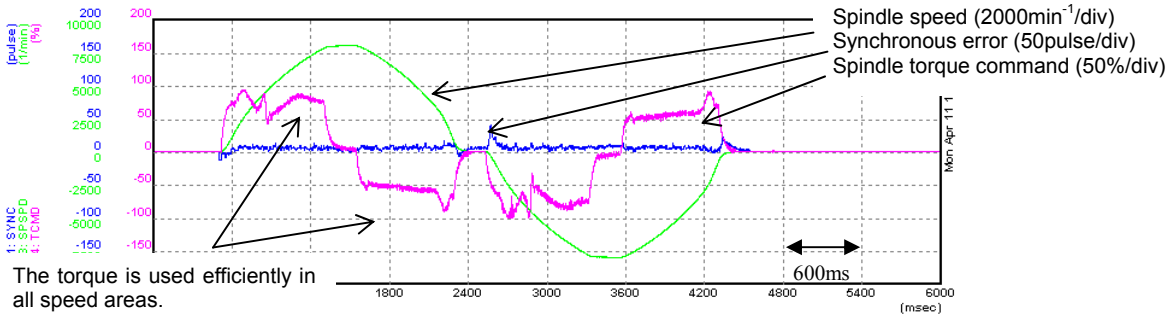
Check the operation waveforms after setting the initial values for the parameters and adjust the acceleration values so that the spindle torque command is about 100% in all speed areas.
For adjustment, use assumed rigid tapping operation at the maximum speed and sequentially set the acceleration value from the high-speed area (P4) to the low-speed area.

Example of setting parameters after the adjustment of the acceleration value (for gear 1)

Gear	Maximum acceleration [rev/sec^2]	Maximum spindle speed [min^{-1}]	Acceleration setting point	Spindle speed (percentage of the maximum speed [%])	Allowable acceleration (percentage of the maximum acceleration [%])	
					Forward/reverse	
					At acceleration	At deceleration
1	No.11421=441	No.5241=8000	P0	None (0%)	No.11441=73	No.11461=100
			P1	No.11429=19	No.11442=73	No.11462=100
			P2	No.11430=38	No.11443=52	No.11463=60
			P3	No.11431=60	No.11444=47	No.11464=55
			P4	None (100%)	No.11445=20	No.11465=40



Example of operation waveforms after the adjustment of the acceleration values



5.17.4 Using the Magnetic Flux Boost Function Together

The simultaneous use of the "magnetic flux boost function", which speeds up the startup of the magnetic flux of an induction spindle motor, may speed up the startup of the magnetic flux and reduce the cycle time.

For details of the magnetic flux boost function, see the previous section, "MAGNETIC FLUX BOOST FUNCTION".

5.18 CUTTING FEED/RAPID TRAVERSE PWM FREQUENCY SWITCHING FUNCTION IN Cs CONTOUR CONTROL

5.18.1 Overview

This section describes the "cutting feed/rapid traverse PWM frequency switching function in Cs contour control".
This function sets a PWM frequency higher than the normal PWM frequency during cutting feed in the Cs contour control mode. It also changes the current and velocity gains simultaneously when changing the PWM frequency. This function enables the application of high current control loop and velocity control loop gains during cutting feed in the Cs contour control mode to allow more precise machining.

	Rapid traverse	Cutting feed
Other than the Cs contour control mode	Normal frequency (low frequency) PWM	Normal frequency (low frequency) PWM
Cs contour control mode	Normal frequency (low frequency) PWM	High-frequency PWM

NOTE
1 This function cannot be used with sensorless motor.

5.18.2 Series and Editions of Applicable Spindle Software

(1)

Spindle software

Series	Edition	Usable CNC
9DA0	M (13)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

(2) Cautions

- This function cannot be used together with the spindle EGB function.
- This function cannot be used together with the spindle repetitive control function.
- When the "spindle control function in Cs contour control" is used, this function is disabled during the execution of the servo rotation control mode (G96.4) command.
- When the built-in synchronous spindle motor BiS series is used (when bit 6 of parameter No. 4012 is set to 1), to use this function together, the motor must be used at up to the motor base speed (parameter No. 4102). If the base speed is exceeded, normal frequency PWM is used and status error 56 is displayed.
- When high-frequency PWM is applied, heat generated from the spindle amplifier increases, so the allowable amplifier current decreases. For this reason, when high-frequency PWM is applied, there are the following limitations:
  <1> The maximum motor torque (output) is limited. (Details are described in another subsection.)
  <2> The load meter value for machining under the same condition increases. (Details are described in another subsection.)
  <3> When high-frequency PWM is applied for machining that can be made in the normal frequency (low-frequency) PWM state, a spindle amplifier current overload alarm (SP9022) may be issued.

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5.18.3 I/O Signals (CNC↔PMC)

(1) Address list of input signals (PMC→CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G306	G306							PWMSEA	
2nd-	G310	G310							PWMSEB	
3rd-	G314	G314							PWMSEC	
4th-	G318	G318							PWMSED	

(2) Details of input signals (PMC→CNC)

(a) Cutting feed/rapid traverse PWM frequency switching function in Cs contour control enable signal (PWMSEx)

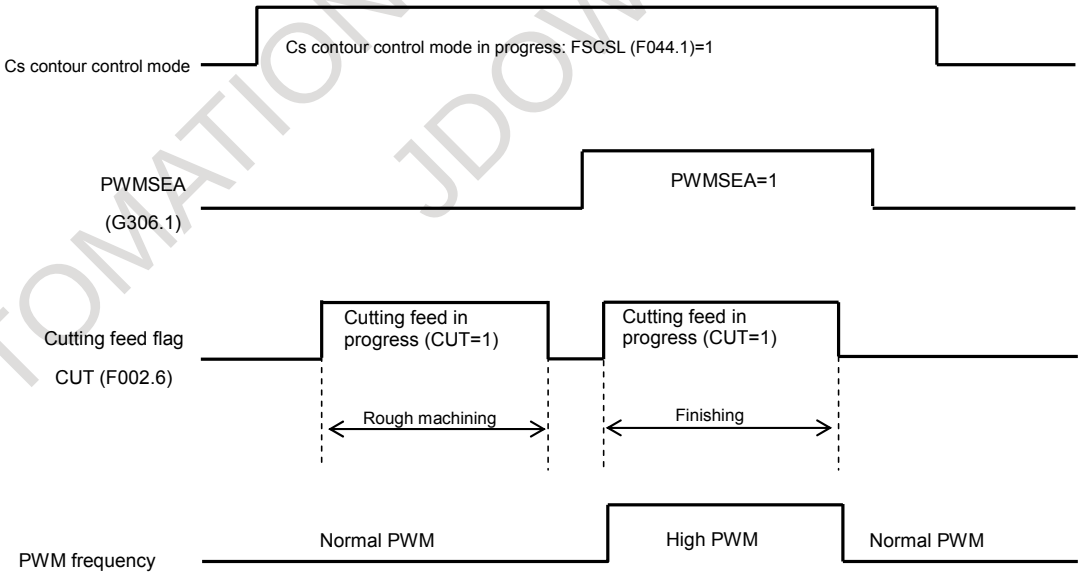
0 : Cutting feed/rapid traverse PWM frequency switching is disabled.
1 : Cutting feed/rapid traverse PWM frequency switching is enabled.

The cutting feed/rapid traverse PWM frequency switching function in Cs contour control is enabled only when bit 4 (PWMCS) of parameter No. 4012 is set to 1 (described later) and PWMSEx is set to 1.

During rapid traverse: Normal frequency PWM is applied.
During cutting feed: High-frequency PWM is applied.

When high-frequency PWM is applied, the motor output is limited. The cutting load may exceed the motor output during heavy-load cutting including rough machining. In this case, set this signal to 0 to disable the cutting feed/rapid traverse PWM frequency switching function. When high-precision machining with light load is required, for example, for finishing, set this signal to 1 to enable the cutting feed/rapid traverse PWM frequency switching function.

5.18.4 Examples of Sequences



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5.18.5 List of Related Parameters

Parameter No.		Description
0*i*	30*i*	
4012#4	4012#4	Setting of the cutting feed/rapid traverse PWM frequency switching function in Cs contour control
4012#5	4012#5	Current control cycle setting
4540#0	4540#0	Setting related to motor voltage control characteristics in Cs contour control
4619	4619	Cutting feed/rapid traverse PWM frequency switching function in Cs contour control Setting related to the current limitation (for high-speed characteristics of speed range switching)
4620	4620	Cutting feed/rapid traverse PWM frequency switching function in Cs contour control Setting related to the current limitation (for low-speed characteristics of speed range switching)
4621	4621	Cutting feed/rapid traverse PWM frequency switching function in Cs contour control Velocity loop gain override
4622	4622	Cutting feed/rapid traverse PWM frequency switching function in Cs contour control Current loop gain override

5.18.6 Details of Related Parameters

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4012	4012			CLPFRQ	PWMCS				

PWMCS The cutting feed/rapid traverse PWM frequency switching function in Cs contour control is:
0 : Not used.
1 : Used.
To use the cutting feed/rapid traverse PWM frequency switching function in Cs contour control, set this parameter to 1.
When bit 4 of parameter No. 4012 is set to 1 and input signal PWMSEx is set to 1, the cutting feed/rapid traverse PWM frequency switching function in Cs contour control is enabled.
During rapid traverse: Normal frequency PWM is applied.
During cutting feed: High-frequency PWM is applied.

CLPFRQ Current control cycle setting
0 : The normal current control cycle is used during operation with high-frequency PWM.
1 : The high-speed current control cycle is used during operation with high-frequency PWM.
To use the cutting feed/rapid traverse PWM frequency switching function in Cs contour control, set bit 4 of parameter No. 4012 to 1 and this parameter to 1.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4540	4540								EXPTCS

EXPTCS Setting related to motor voltage control characteristics in Cs contour control
To use the cutting feed/rapid traverse PWM frequency switching function in Cs contour control, set this parameter to 1.

NOTE
For a built-in synchronous spindle motor (BiS series), set this parameter to 0.

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0*i*	30*i*	
4619	4619	**Cutting feed/rapid traverse PWM frequency switching in Cs contour control: Setting related to the current limitation (for high-speed characteristics of speed range switching)**
4620	4620	**Cutting feed/rapid traverse PWM frequency switching in Cs contour control: Setting related to the current limitation (for low-speed characteristics of speed range switching)**

Standard setting: Depends on the motor model.
These parameters limit the current when high-frequency PWM is applied according to the cutting feed/rapid traverse PWM frequency switching function in Cs contour control.
These parameters are unique to the motor.

Subsection 5.18.7 describes the parameters for each model and maximum torque limitation rate when the current is limited. The tables in Subsection 5.18.7 list the values to be set for the parameters for each model. Reference the tables and set the parameters.

To fix low-speed winding when using a motor with a speed range switching function, set the value for the low-speed characteristics for the parameter for the high-speed characteristics (No. 4619).
If an error is found in the setting of these parameters, normal frequency PWM is applied for operation and status error 55 is displayed.

0*i*	30*i*	
4621	4621	**Cutting feed/rapid traverse PWM frequency switching in Cs contour control: Velocity loop gain override**

Unit of data : 1%
Valid data range : 0, 100 to 250
Standard setting : 0 (= 150%)
When high-frequency PWM is applied according to the cutting feed/rapid traverse PWM frequency switching function in Cs contour control, this override value can be applied to the velocity loop proportional gain and integral gain to increase the responsiveness of the velocity loop.
When the setting is 0, 150 (%) is assumed for operation.
When velocity loop gain override in Cs contour control (parameters Nos. 4342 and 4343) is used, both override values are applied together with the override specified for this parameter.

0*i*	30*i*	
4622	4622	**Cutting feed/rapid traverse PWM frequency switching in Cs contour control: Current loop gain override**

Unit of data : 1%
Valid data range : 0, 100 to 200
Standard setting : 0 (= 150%)
When high-frequency PWM is applied according to the cutting feed/rapid traverse PWM frequency switching function in Cs contour control, this override value can be applied to the current loop proportional gain and integral gain to increase the responsiveness of the current loop.
When the setting is 0, 150 (%) is assumed for operation.
Normally, set this parameter to 0.

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5.18.7 Current Limitation and Maximum Torque Limit

For operation with high-frequency PWM, since the allowable current value of the spindle amplifier decreases, current must be limited and the maximum motor torque decreases. The current limitation and maximum torque limitation rate when high-frequency PWM is applied differ depending on the spindle motor model. Details are given below.

(1) When an induction spindle motor is used (bit 6 of parameter No. 4012 is set to 0)

For an induction spindle motor, limit the motor voltage (maximum excitation current with no load) and torque command (torque current command).
The following tables list the value to be set for the parameter related to the current limitation (No. 4619) and maximum torque limitation rate (percentage of the maximum normal torque) when high-speed PWM is applied. Reference these tables and set each parameter.
For the values to be set for the parameters for a motor model that is not listed in any table below, contact FANUC.

(a) SPINDLE MOTOR αiI series

Motor model	High-speed winding characteristics		Low-speed winding characteristics	
	Current limitation data No.4619	Maximum torque limitation rate (%)	Current limitation data No.4619	Maximum torque limitation rate (%)
αiI 0.5/10000	25700	100	-	-
αiI 1/10000	25700	100	-	-
αiI 1.5/10000	25668	68	-	-
αiI 2/10000	25664	64	-	-
αiI 3/10000	25657	57	-	-
αiI 6/10000	25675	75	-	-
αiI 8/8000	25663	63	-	-
αiI 12/7000	25676	76	-	-
αiI 15/7000	25685	85	-	-
αiI 18/7000	25676	76	-	-
αiI 22/7000	25681	81	-	-
αiI 30/6000	25700	100	-	-
αiI 40/6000	25700	100	-	-
αiI 50/4500	25700	100	-	-
αiI 50/5000	25700	100	-	-
αiI 1/15000	19788	59	-	-
αiI 1.5/15000	25680	80	-	-
αiI 1.5/20000	25680	80	-	-
αiI 2/15000	25678	78	-	-
αiI 2/20000	25678	78	-	-
αiI 3/12000	25668	68	-	-
αiI 6/12000	22855	63	25675	75
αiI 8/10000	25665	65	25663	63
αiI 8/12000	21331	69	25675	75
αiI 12/10000	25676	76	25676	76
αiI 15/10000	25669	69	25685	85
αiI 18/10000	25674	74	25676	76
αiI 22/10000	25676	76	25682	82

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(b) SPINDLE MOTOR αiI series (Power up model)

Motor model	High-speed winding characteristics		Low-speed winding characteristics	
	Current limitation data No.4619	Maximum torque limitation rate (%)	Current limitation data No.4619	Maximum torque limitation rate (%)
αiI 6/10000	25689	89	-	-
αiI 8/8000	25670	70	-	-
αiI 12/7000	25669	69	-	-
αiI 15/7000	25668	68	-	-
αiI 18/7000	25692	92	-	-
αiI 22/7000	25692	92	-	-

(c) SPINDLE MOTOR αiIP series

Motor model	High-speed winding characteristics		Low-speed winding characteristics	
	Current limitation data No.4619	Maximum torque limitation rate (%)	Current limitation data No.4619	Maximum torque limitation rate (%)
αiIP 12/6000	25673	73	25675	75
αiIP 15/6000	25684	84	25685	85
αiIP 18/6000	25682	82	25685	85
αiIP 22/6000	25681	81	25687	87
αiIP 30/6000	25672	72	25678	78
αiIP 40/6000	25700	100	25700	100
αiIP 50/6000	25677	77	25682	82
αiIP 60/4500	25700	100	25700	100
αiIP 60/5000	25700	100	25700	100

(d) SPINDLE MOTOR αiIT series

Motor model	High-speed winding characteristics		Low-speed winding characteristics	
	Current limitation data No.4619	Maximum torque limitation rate (%)	Current limitation data No.4619	Maximum torque limitation rate (%)
αiIT 1.5/15000	25680	80	-	-
αiIT 1.5/20000	25680	80	-	-
αiIT 2/15000	25678	78	-	-
αiIT 2/20000	25678	78	-	-
αiIT 3/12000	25668	68	-	-
αiIT 6/12000	25681	81	25685	85
αiIT 8/12000	21331	69	25675	75
αiIT 8/15000	22355	72	25681	81
αiIT 15/10000	25669	69	25685	85
αiIT 15/12000	25673	73	25678	78
αiIT 15/15000	25673	73	25678	78
αiIT 22/10000	25676	76	25682	82

(e) SPINDLE MOTOR αiIL series

Motor model	High-speed winding characteristics		Low-speed winding characteristics	
	Current limitation data No.4619	Maximum torque limitation rate (%)	Current limitation data No.4619	Maximum torque limitation rate (%)
αiIL 8/20000	25676	76	25679	79
αiIL 15/15000	25679	79	25680	80
αiIL 26/15000	25679	79	25680	80

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(f) SPINDLE MOTOR αiI series (400V)

Motor model	High-speed winding characteristics		Low-speed winding characteristics	
	Current limitation data No.4619	Maximum torque limitation rate (%)	Current limitation data No.4619	Maximum torque limitation rate (%)
αiI 0.5/10000HV	25700	100	-	-
αiI 1/10000HV	25700	100	-	-
αiI 1.5/10000HV	25682	82	-	-
αiI 2/10000HV	25675	75	-	-
αiI 3/10000HV	25673	73	-	-
αiI 6/10000HV	25659	59	-	-
αiI 8/8000HV	25654	54	-	-
αiI 12/7000HV	25700	100	-	-
αiI 15/7000HV	25681	81	-	-
αiI 22/7000HV	25678	78	-	-
αiI 30/6000HV	25700	100	-	-
αiI 40/6000HV	25700	100	-	-
αiI 50/5000HV	25688	88	-	-
αiI 60/4500HV	25700	100	-	-
αiI 60/5000HV	25700	100	-	-
αiI 75/5000HV	25694	94	-	-
αiI 100/4000HV	25700	100	25700	100
αiI 100/5000HV	25700	100	25700	100

(g) SPINDLE MOTOR αiIP series (400V)

Motor model	High-speed winding characteristics		Low-speed winding characteristics	
	Current limitation data No.4619	Maximum torque limitation rate (%)	Current limitation data No.4619	Maximum torque limitation rate (%)
αiIP 15/6000HV	25666	66	25668	68
αiIP 22/6000HV	25681	81	25689	89
αiIP 40/6000HV	25700	100	25700	100
αiIP 50/6000HV	25677	77	25679	79
αiIP 60/5000HV	25700	100	25700	100

(h) SPINDLE MOTOR αiIL series (400V)

Motor model	High-speed winding characteristics		Low-speed winding characteristics	
	Current limitation data No.4619	Maximum torque limitation rate (%)	Current limitation data No.4619	Maximum torque limitation rate (%)
αiIL 8/20000HV	25665	65	25667	67
αiIL 15/15000HV	25668	68	25670	70
αiIL 26/15000HV	25668	68	25669	69

(i) SPINDLE MOTOR αiIT series (400V)

Motor model	High-speed winding characteristics		Low-speed winding characteristics	
	Current limitation data No.4619	Maximum torque limitation rate (%)	Current limitation data No.4619	Maximum torque limitation rate (%)
αiIT 1.5/15000HV	25661	61	-	-
αiIT 3/12000HV	25652	52	-	-
αiIT 6/12000HV	25658	58	25667	67
αiIT 8/12000HV	17734	48	25656	56
αiIT 8/15000HV	25671	71	25675	75
αiIT 15/10000HV	25678	78	25681	81
αiIT 15/12000HV	25700	100	25700	100
αiIT 15/15000HV	25700	100	25700	100
αiIT 22/10000HV	25677	77	25679	79

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(j) SPINDLE MOTOR BiI series (standard type)

Motor model	Drawing number	High-speed winding characteristics		Low-speed winding characteristics	
		Current limitation data No.4619	Maximum torque limitation rate (%)	Current limitation data No.4619	Maximum torque limitation rate (%)
BiI 50S/30000	A06B-1612-B170#031S	25700	100	-	-
BiI 50M/25000	A06B-1613-B170#131S	25700	100	-	-
BiI 50L/25000	A06B-1615-B120#Z31S	25684	84	-	-
BiI 80S/20000	A06B-1621-B120#Z31S	25690	90	25700	100
BiI 80M/15000	A06B-1623-B170#Z01S	25700	100	-	-
BiI 80L/8000	A06B-1625-B170#Z01S	25668	68	-	-
BiI 100S/12500	A06B-1641-B120#Z01S	25666	66	-	-
BiI 112S/15000	A06B-1672-B120#E31S	25665	65	25658	58
BiI 112L/15000	A06B-1677-B100#631S	25662	62	25659	59
BiI 132S/14000	A06B-1705-B140#B44S	25664	64	25665	65
BiI 160LL/13000	A06B-1728-B101#231S	25674	74	25666	66
BiI 170S/6000	A06B-1732-B120#131S	25670	70	25674	74
BiI 170M/6000	A06B-1733-B120#131S	25667	67	25668	68
BiI 180LL/10000	A06B-1746-B101#Q31S	25674	74	25674	74
BiI 200S/6000	A06B-1752-B120#231S	25700	100	25700	100
BiI 200M/6000	A06B-1753-B120#Z31S	25700	100	25700	100
BiI 200L/6000	A06B-1755-B120#Z31S	25700	100	25700	100
BiI 250S/6000	A06B-1772-B140#Z31S	25700	100	25700	100
BiI 250M/3000	A06B-1773-B140#Z31S	25700	100	25700	100

(k) SPINDLE MOTOR BiI series (high-speed type)

Motor model	Drawing number	High-speed winding characteristics		Low-speed winding characteristics	
		Current limitation data No.4619	Maximum torque limitation rate (%)	Current limitation data No.4619	Maximum torque limitation rate (%)
BiI 40S/70000	A06B-1601-B120#Z61S	25700	100	-	-
BiI 60S/50000	A06B-1617-B120#362S	25683	83	25684	84
BiI 112SS/20000	A06B-1661-B120#Z31S	25673	73	25674	74
BiI 112S/20000	A06B-1662-B120#Z31S	25692	92	25679	79
BiI 112S/20000	A06B-1672-B001#F31S	25665	65	25658	58
BiI 160M/20000	A06B-1723-B140#Y62S	25675	75	25676	76
BiI 160L/20000	A06B-1725-B140#Y61S	25694	94	25678	78
BiI 160LL/20000	A06B-1726-B140#W61S	25668	68	25674	74

(l) SPINDLE MOTOR BiI series (standard type M)

Motor model	Drawing number	High-speed winding characteristics		Low-speed winding characteristics	
		Current limitation data No.4619	Maximum torque limitation rate (%)	Current limitation data No.4619	Maximum torque limitation rate (%)
BiI 50M/25000 TYPE M	A06B-1613-B670#231S	25674	74	-	-
BiI 50L/30000 TYPE M	A06B-1615-B620#431S	25671	71	-	-
BiI 80M/15000 TYPE M	A06B-1623-B670#341S	25672	72	-	-
BiI 100SS/12000 TYPE M	A06B-1637-B620#501S	25667	67	-	-
BiI 170S/8000 TYPE M	A06B-1732-B620#D31S	25663	63	25666	66

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Motor model	Drawing number	High-speed winding characteristics		Low-speed winding characteristics	
		Current limitation data No.4619	Maximum torque limitation rate (%)	Current limitation data No.4619	Maximum torque limitation rate (%)
BiI 170M/8000 TYPE M	A06B-1733-B620#431S	25663	63	25664	64
BiI 200L/6000 TYPE M	A06B-1755-B620#G31S	25700	100	25698	98

(m) SPINDLE MOTOR BiI series (high-speed type M)

Motor model	Drawing number	High-speed winding characteristics		Low-speed winding characteristics	
		Current limitation data No.4619	Maximum torque limitation rate (%)	Current limitation data No.4619	Maximum torque limitation rate (%)
BiI 60S/50000 TYPE M	A06B-1617-B620#762S	25681	81	25682	82
BiI 112SS/20000 TYPE M	A06B-1661-B620#831S	25700	100	25694	94
BiI 112S/20000 TYPE M	A06B-1662-B620#231S	25692	92	25679	79

(n) SPINDLE MOTOR BiI series (standard 400V)

Motor model	Drawing number	High-speed winding characteristics		Low-speed winding characteristics	
		Current limitation data No.4619	Maximum torque limitation rate (%)	Current limitation data No.4619	Maximum torque limitation rate (%)
BiI 100S/12500	A06B-1641-B120#M01S	25661	61	-	-
BiI 112S/15000	A06B-1672-B132#731S	25659	59	25660	60
BiI 112L/15000	A06B-1675-B131#R31S	25657	57	25661	61
BiI 112LL/15000	A06B-1676-B132#D31S	25652	52	25651	51
BiI 160M/13000	A06B-1723-B120#J31S	25661	61	25656	56
BiI 160LL/13000	A06B-1726-B130#D31S	25653	53	25647	47
BiI 200L/6000	A06B-1755-B131#J31S	25700	100	25697	97
BiI 250S/4000	A06B-1772-B140#031S	25661	61	25658	58
BiI 250M/6000	A06B-1773-B140#431S	25700	100	25700	100

(o) SPINDLE MOTOR BiI series(high-speed 400V)

Motor model	Drawing number	High-speed winding characteristics		Low-speed winding characteristics	
		Current limitation data No.4619	Maximum torque limitation rate (%)	Current limitation data No.4619	Maximum torque limitation rate (%)
BiI 100S/20000	A06B-1641-B121#K61S	25650	50	-	-
BiI 112S/20000	A06B-1662-B131#Q31S	25658	58	25651	51
BiI 112M/20000	A06B-1673-B132#Q61S	25653	53	25654	54
BiI 112L/20000	A06B-1675-B131#S61S	25659	59	25654	54
BiI 112L/25000	A06B-1675-B140#X62S	25700	100	25684	84
BiI 160LL/20000	A06B-1726-B140#Y61S	25667	67	25674	74

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(2) When a built-in synchronous spindle motor is used (bit 6 of parameter No. 4012 is set to 1)

For the built-in synchronous spindle motor B*i*S series, limit the torque command (torque current command).
The following tables list the value to be set for the parameter related to the current limitation (No. 4619) and maximum torque limitation rate (percentage of the maximum normal torque) when high-speed PWM is applied. Reference these tables and set each parameter.
For the values to be set for the parameters for a motor model that is not listed in any table below, contact FANUC.

(a) SPINDLE MOTOR B*i*S series

Motor model	Drawing number	Current limitation Data No.4619	Maximum torque limitation rate (%)
B*i*S132L2/3000	A06B-1842-B14x#0P2A	90	90
B*i*S160L4/1400	A06B-1854-B14x#0P2A	86	86
B*i*S200L4/750	A06B-1874-B14x#0P2A	77	77

(b) SPINDLE MOTOR B*i*S series (400V)

Motor model	Drawing number	Current limitation Data No.4619	Maximum torque limitation rate (%)
B*i*S132L2/7000	A06B-1842-B14x#0P4C	69	69
B*i*S160L4/6000	A06B-1854-B14x#0P4C	67	67
B*i*S200L4/3000	A06B-1874-B14x#0P4C	60	60

5.18.8 Change in the Value Displayed on the Load Meter

During operation with high-frequency PWM, the value displayed on the load meter is larger as compared with the value displayed during operation with normal frequency PWM. (Since the allowable rated current decreases with high-frequency PWM, the value displayed on the load meter is relatively large for the same current.)

A standard variation in the load meter value under the same cutting condition is shown below.
Apply this function under the cutting condition so that the value displayed on the load meter during operation with high-frequency PWM does not exceed 100%.

Value displayed on the load meter with high-frequency PWM
= value displayed on the load meter with normal frequency PWM × 100/maximum torque limitation rate*
* For the maximum torque limitation rate, see the tables on the previous pages.

(Example) When the value displayed on the load meter with normal frequency PWM is 60% and the maximum torque limitation rate is 85%
Value displayed on the load meter with high-frequency PWM = 60 × 100/85 = 70.6 (%)

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5.18.9 Alarms and errors

(1) Spindle alarms

Alarm No.		Description	Reason and measure
30*i* / 0*i*	SP		
SP9022	22	SP current overload	When high-frequency PWM is applied, heat generation from the amplifier increases, so this alarm may be issued after current feed/rapid traverse PWM frequency switching functions. When this alarm is issued, review the cutting condition.
SV410	-	Excessive error when stopped	When high-frequency PWM is applied, the maximum torque is limited, so this alarm may be issued if a large load is applied when the motor stops (for example, during machining in the Cs axis stop state). When this alarm is issued, review the cutting condition and decrease the load.
SV411	-	Excessive error during movement	When high-frequency PWM is applied, the maximum torque is limited, so this alarm may be issued if the cutting load is large. When this alarm is issued, review the cutting condition.

(2) State errors

Error No. (DGN.710)	Description	Reason and measure
55	A parameter set for cutting feed/rapid traverse PWM frequency switching in Cs contour control is invalid.	Reference the tables listing current limitation data (parameters Nos. 4619 and 4620) for each motor and set the correct value.
56	The motor speed exceeds the limitation for cutting feed/rapid traverse PWM frequency switching in Cs contour control.	For the built-in synchronous spindle motor BiS series (when bit 6 of parameter No. 4012 is set to 1), PWM frequency switching can be applied when the motor base speed is not exceeded. Review the program.

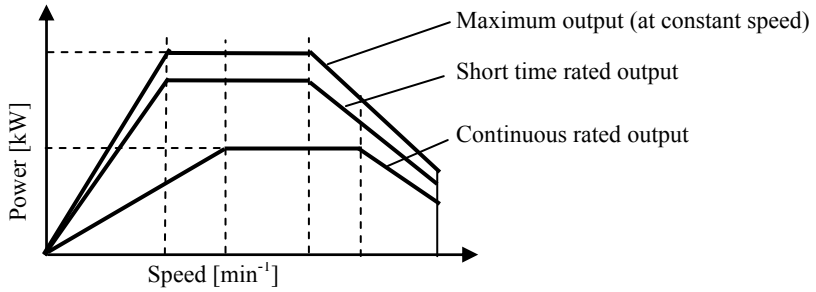
5.19 LOAD METER (NORMALIZED BY THE CONTINUOUS RATED OUTPUT)

5.19.1 Overview

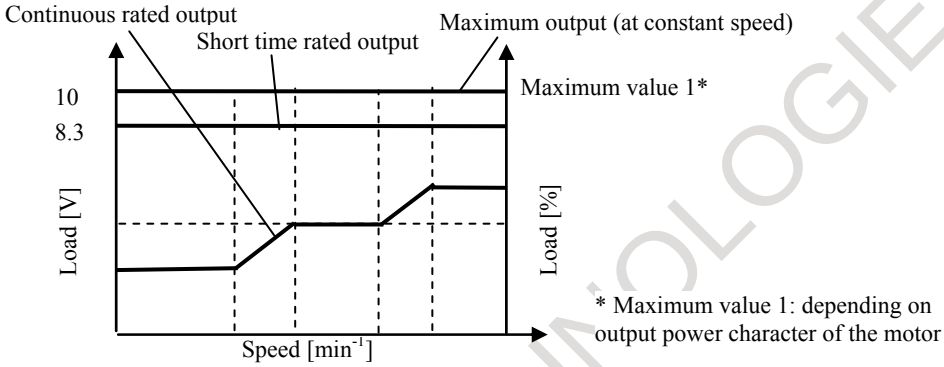
The following two types of load meters are available: Load meter normalized by the maximum output and load meter normalized by the continuous rated output. Select a type of load meter according to your purpose.

- The load meter normalized by the maximum output shows the constant load meter value for the maximum output in all speed areas and is best suited to check the margin to the maximum output. (When the motor output characteristics are as shown in (a), sample load meter indication is shown in (b).)
- On the other hand, the load meter normalized by the continuous rated output shows the constant load meter value for the continuous rated output in all speed areas and is best suited to check the continuous cutting enable conditions. (When the motor output characteristics are as shown in (a), sample load meter indication is shown in (c).)

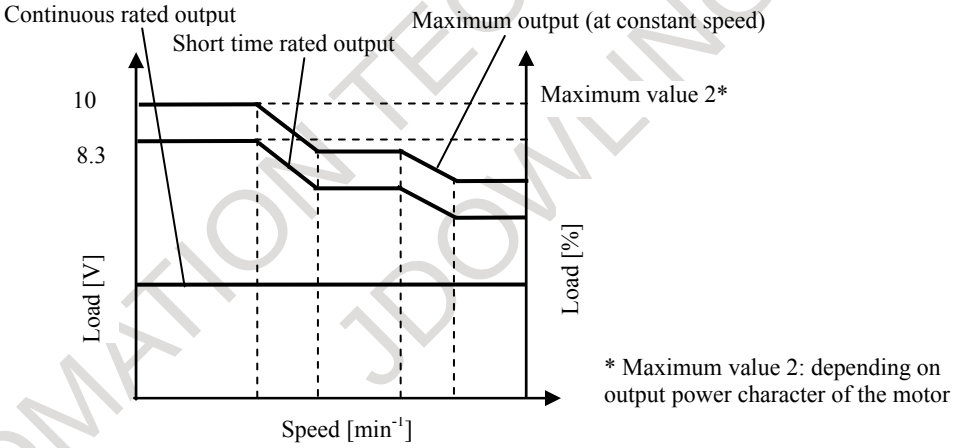
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(a) Output power character of spindle motor



(b) Load meter normalized by max. output (existing type)



(c) Load meter normalized by cont. rated output (new type)

Output characteristics and load meter types

NOTE
*1 The load meter normalized by the maximum output and the load meter normalized by the continuous rated output cannot be used simultaneously.
*2 Different types of load meters cannot be selected for the main and sub-sides of spindle switching.
*3 This function can be used with sensorless motor.

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5.19.2 Series and Editions of Applicable Spindle Software

Spindle software

Series	Edition	Usable CNC
9D8A	H (08)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i*-A
9D90	G (07)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i*-A
9DA0	I (09)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i*-B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

5.19.3 List of Related Parameters

Parameter No. (0*i*, 30*i*)				Description	Remarks
MH	ML	SH	SL		
4352#3	←	←	←	Load meter (normalized by the maximum output/continuous rated output) switch bit	
4127	4093	4274	4279	Value displayed on load meter at maximum output	The meaning of the parameter differs depending on the load meter type (normalized by the maximum output/continuous rated output).
4612	4614	4728	4730	Parameter for load meter (normalized by the continuous rated output) <1>	
4613	4615	4729	4731	Parameter for load meter (normalized by the continuous rated output) <2>	
4353#3	←	←	←	Load detection level 1/2 detection standard setting bit	
4026	←	4201	←	Load detection level 1	The meaning of the parameter differs depending on the load meter type (normalized by the maximum output/continuous rated output).
4027	←	←	←	Load detection level 2	

* MH: Parameter for the main side of spindle switching for high-speed characteristics
ML: Parameter for the main side of spindle switching for low-speed characteristics
SH: Parameter for the sub-side of spindle switching for high-speed characteristics
SL: Parameter for the sub-side of spindle switching for low-speed characteristics

5.19.4 Details of Related Parameters

	0*i*,30*i*	#7	#6	#5	#4	#3	#2	#1	#0
MAIN/SUB	4352					LMTYPE			

LMTYPE Sets a type of load meter. (For each type of load meter, see Subsection 5.19.1.)
0: Load meter normalized by the maximum output
1: Load meter normalized by the continuous rated output

	0*i*,30*i*	
MH	4127	**Value displayed on load meter at maximum output**
ML	4093	**Value displayed on load meter at maximum output**
SH	4274	**Value displayed on load meter at maximum output**
SL	4279	**Value displayed on load meter at maximum output**

Setting: Motor-specific parameter value. See the table below.

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	0*i*,30*i*	
MH	4612	**Parameter for load meter (normalized by the continuous rated output) <1>**
ML	4614	**Parameter for load meter (normalized by the continuous rated output) <1>**
SH	4728	**Parameter for load meter (normalized by the continuous rated output) <1>**
SL	4730	**Parameter for load meter (normalized by the continuous rated output) <1>**

Setting: Motor-specific parameter value. See the table below.

	0*i*,30*i*	
MH	4613	**Parameter for load meter (normalized by the continuous rated output) <2>**
ML	4615	**Parameter for load meter (normalized by the continuous rated output) <2>**
SH	4729	**Parameter for load meter (normalized by the continuous rated output) <2>**
SL	4731	**Parameter for load meter (normalized by the continuous rated output) <2>**

Setting: Motor-specific parameter value. See the table below.

Load meter parameters for α*i* series power up models

Motor model				αiI 6/10000		αiI 8/8000		αiI 12/7000	
Applicable amplifier				αi SP11		αi SP15		αi SP15	
Drawing No.				A06B-1406-Bxxx#0Pxx		A06B-1407-Bxxx#0Pxx		A06B-1408-Bxxx#0Pxx	
Low-speed winding characteristics				–		–		–	
High-speed winding characteristics				5.5/7.5/11kW		7.5/11/15		11/15/18.5	
				1500/10000min^{-1}		1500/8000		1500/7000	
FS30*i*				Load meter (Normalized by max. output)	Load meter (Normalized by cont. rated output)	Load meter (Normalized by max. output)	Load meter (Normalized by cont. rated output)	Load meter (Normalized by max. output)	Load meter (Normalized by cont. rated output)
MH	ML	SH	SL						
4127	4093	4274	4279	240(*1)	240	240(*1)	240	202(*1)	202
4352 #3	←	←	←	0(*1)	1	0(*1)	1	0(*1)	1
4612	4614	4728	4730	0(*1)	97	0(*1)	75	0(*1)	127
4613	4615	4729	4731	0(*1)	21643	0(*1)	16514	0(*1)	16774

Motor model				αiI 15/7000		αiI 18/7000		αiI 22/7000	
Applicable amplifier				αi SP22		αi SP22		αi SP26	
Drawing No.				A06B-1409-Bxxx#0Pxx		A06B-1410-Bxxx#0Pxx		A06B-1411-Bxxx#0Pxx	
Low-speed winding characteristics				–		–		–	
High-speed winding characteristics				15/18.5/25		18.5/22/30		22/26/35	
				1500/7000		1500/7000		1500/7000	
FS30*i*				Load meter (Normalized by max. output)	Load meter (Normalized by cont. rated output)	Load meter (Normalized by max. output)	Load meter (Normalized by cont. rated output)	Load meter (Normalized by max. output)	Load meter (Normalized by cont. rated output)
MH	ML	SH	SL						
4127	4093	4274	4279	200(*1)	202	195(*1)	195	191(*1)	191
4352 #3	←	←	←	0(*1)	1	0(*1)	1	0(*1)	1
4612	4614	4728	4730	0(*1)	128	0(*1)	132	0(*1)	134
4613	4615	4729	4731	0(*1)	16531	0(*1)	16778	0(*1)	16771

(*1) Standard parameter setting

NOTE
For other motor models, contact FANUC when required.

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	0i,30i	#7	#6	#5	#4	#3	#2	#1	#0
MAIN/SUB	4353					**LMTDET**			

LMTDET Selects a standard for detecting the load detection signals (LDT1A and LDT2A).
0: The load detection signals are treated, assuming the maximum output to be 100%, regardless of the type of load meter.
1: When the load meter normalized by the continuous rated output is used, the load detection signals are treated, assuming the continuous rated output to be 100%.

	0i,30i	
MAIN	4026	**Load detection level 1**
SUB	4201	**Load detection level 1**

Unit of data : 1%
Valid data range : See the table below.
Standard setting : 83

Sets the detection level of load detection signal 1 (LDT1A).
When the spindle motor output reaches the setting data (%), the status of load detection signal 1 (LDT1A) is set to 1.

LMTYPE (N4352#3)	0		1	
LDTDET (N4353#3)	0	1	0	1
Setting standard	Maximum output (= 100%)			Continuous rated output (= 100%)
Unit of data	1% (0.1% when a negative value is set for the parameter)			1%
Valid data range	-1000 to 100			0 to 32767
Standard setting	83			

0i,30i	
4027	**Load detection level 2 (No setting parameter for SUB)**

Unit of data : 1%
Valid data range : See the table below.
Standard setting : 95

Sets the detection level of load detection signal 2 (LDT2A).
When the spindle motor output reaches the setting data (%), the status of load detection signal 2 (LDT2A) is set to 1.

LMTYPE (N4352#3)	0		1	
LDTDET (N4353#3)	0	1	0	1
Setting standard	Maximum output (= 100%)			Continuous rated output (= 100%)
Unit of data	1% (0.1% when a negative value is set for the parameter)			1%
Valid data range	-1000 to 100			0 to 32767
Standard setting	95			

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NOTE
1 After changing No.4026 or No.4027, turn the power to the CNC off, then on again.
2 By default, this signal is not output in 10 seconds (set in parameter No. 4082) after the status of the speed command signal changes so that Load detection signal cannot be output by load of acceleration and deceleration. If the default time (No.4082) is not suited with the real acceleration and deceleration time, please refer to explanation of the parameter No.4082 and modify the value. If "1" is set to the parameter No.4009#4, Load detection signal is always output when load meter is beyond set level instead of the acceleration and deceleration.

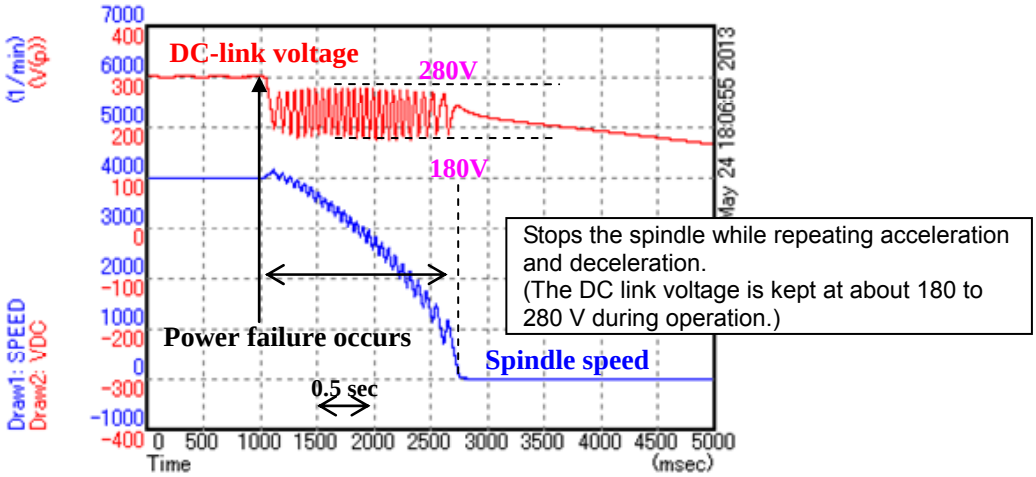
5.20 POWER FAILURE BACKUP FUNCTION

5.20.1 Overview

The power failure backup function protects the machine by monitoring the DC link voltage and controlling the power using spindle acceleration/deceleration energy if a power failure occurs. This function can be used in the following two patterns.

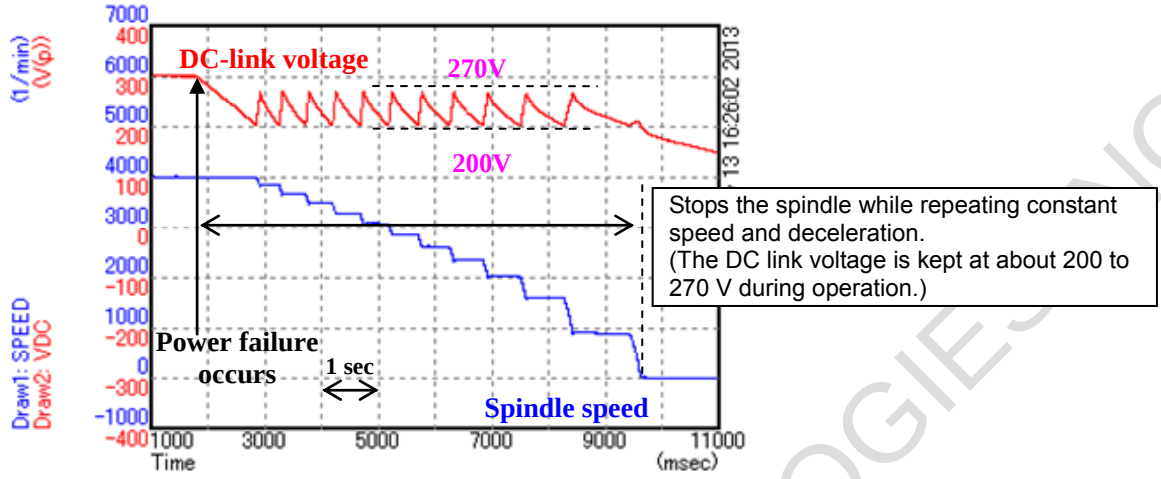
- After a power failure occurs, the function issues a command for repeating deceleration and acceleration to the spindle to consume its own rotational energy or regenerative energy returned from other axes and stops the spindle and axes as soon as possible while suppressing the increase of the DC link voltage. (Power failure backup function type-1)
- After a power failure occurs, the function issues a command for repeating deceleration and constant speed to the spindle to keep the DC link voltage as long as possible and use it, for example, for the retract of the feed axis. (Power failure backup function type-2)

Example of operation of power failure backup function type-1



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Example of operation of power failure backup function type-2



NOTE
1 This function can be used with sensorless motor.

5.20.2 Series and Editions of Applicable Spindle Software

(1) Series and editions of applicable software

Spindle software

Series	Edition	Usable CNC
9D8A	G (07)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9D90	U (21)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9D9A	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	X (24)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B
9DAA	A (01)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

(2) Notes on application

- To use this function, it is necessary to use a UPS (uninterruptible power supply) to back up the power to the CNC (24 VDC) and control power to the servo amplifiers.
  * If a failure occurs in the backup system for the control power supply, this backup function does not operate normally.

⚠ CAUTION
If a failure occurs in the backup system for the control power supply, this backup function does not work correctly, and there is a possiblity to receive the damage in the machine.

- This function can be used with spindle HRV control (for induction and synchronous motors) and the Sensor-less control (9DB0/14 or latter). However, when synchronous operation (such as spindle synchronous control or spindle tandem control) is performed using two or more spindles in the system, plese do not apply this function.

- To use this function with a motor having the speed range switching function, it is necessary to keep the MCC state even at the power failure. There are following two methods to achieve it.
  (1) Use OFF-delay release type MCC. This MCC can keep the MCC state for several seconds even at the power failure.

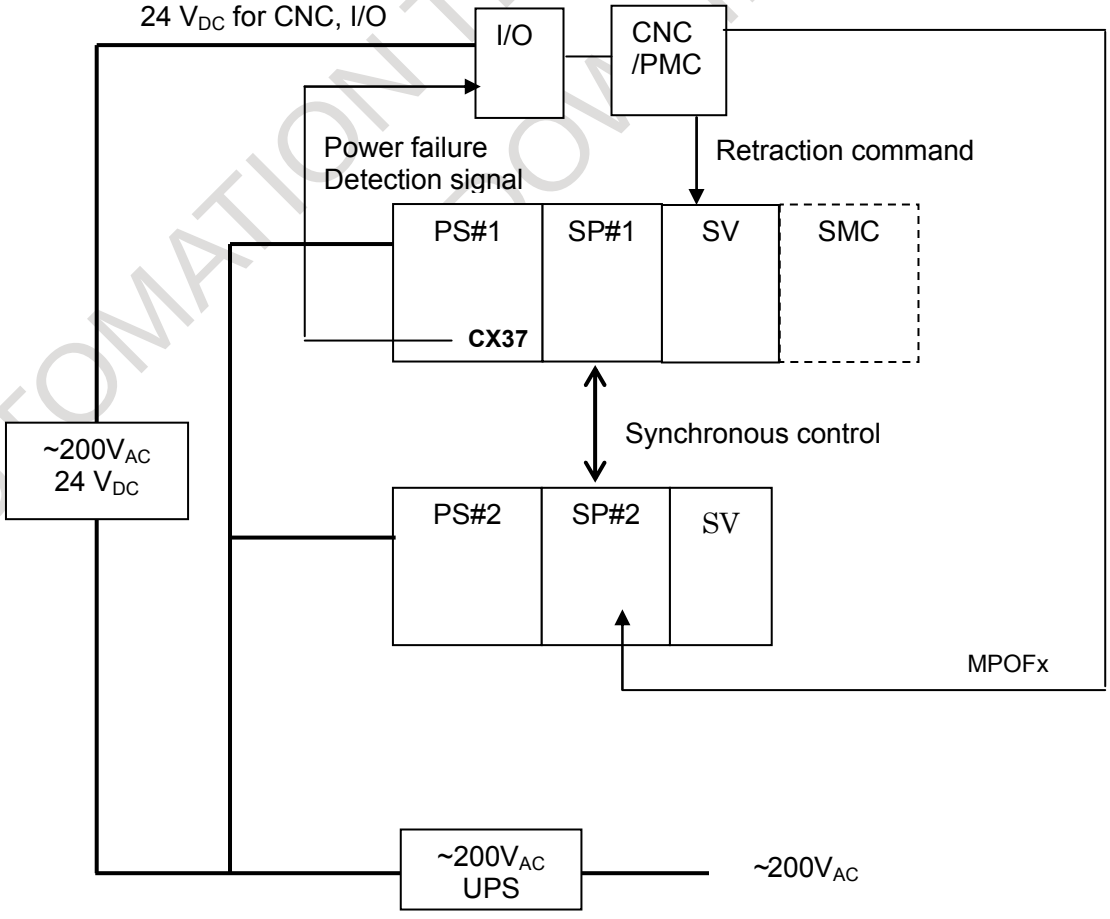
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(2) If there is a possibility that the delay time might be short, prepare MCC which is driven by 24V DC and the 24V power should be backup by UPS or Power Failure Backup Module 24(PFB-24). Please secure enough current capacity of 24V according to the MCC.
In addition, it is necessary to create a ladder program so that the status of the power line switching request signal (RSLx) and power line status signals (RCFNx/RCHPx) does not change during a power failure.

- When synchronous operation (such as spindle synchronous control or spindle tandem control) is performed using two or more spindles in the system, set this function only for one spindle.
If a power failure is detected during synchronous operation in a state in which two or more spindles are mechanically connected, it is necessary to input the motor power turn-off signal (MPOFx = 1) immediately to the spindles for which this function is not applied to shut off power.
If a power failure is detected in spindle synchronous control, cancel the spindle synchronous command from the PMC immediately. When the spindle synchronous command is canceled, this function operates.
- If a power failure occurs in the Cs contour control mode or rigid tapping mode, this function does not operate.
- To use this function with the 9DA0 series, it is necessary to use servo amplifiers for series 30*i*-B (A06B-62xx-Hxxx) as all servo amplifiers (PS/SP/SV).
- To use this function with 9D90 or 9D8A series, it is necessary to use conventional α*i* series servo amplifiers (A06B-61xx-Hxxx) and β*i* series SVSP (A06B-6164-Hxxx#H580) as all servo amplifiers (PS/SP/SV/SVSP).

5.20.3 System Configuration

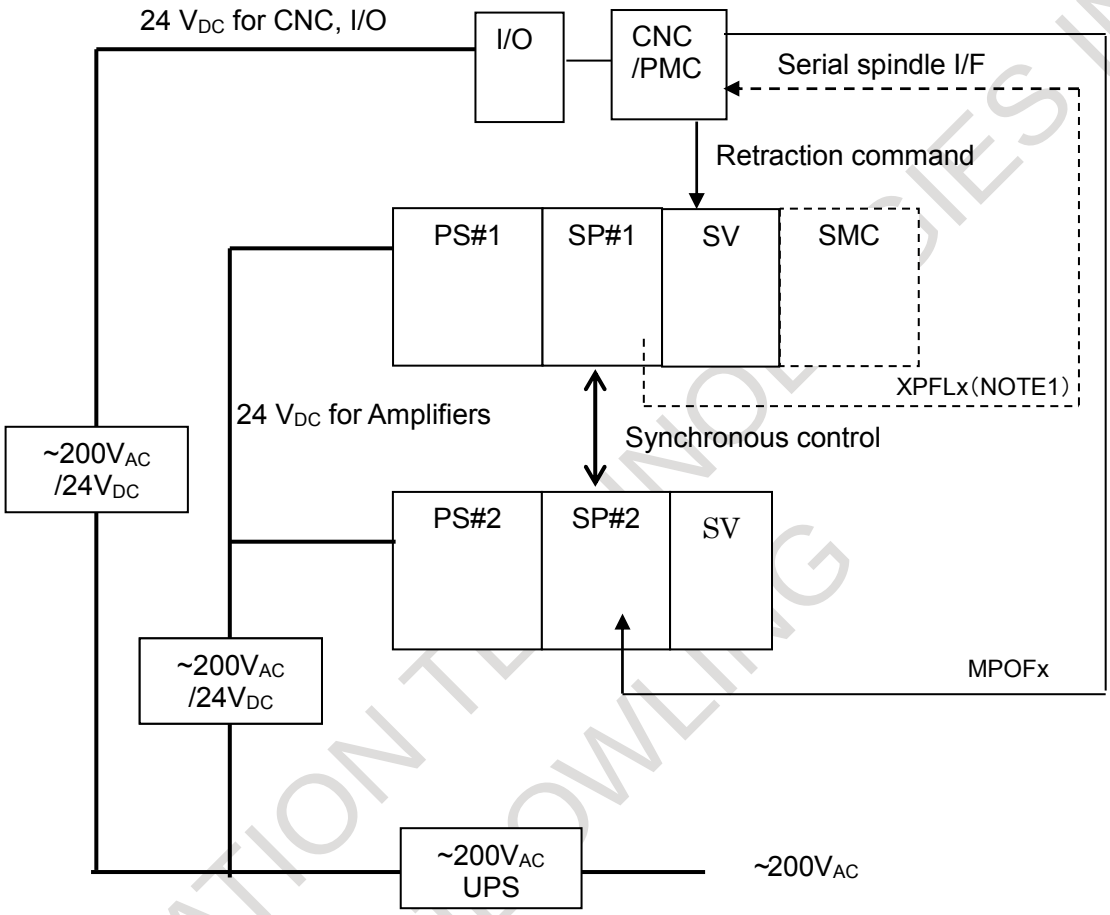
(1) In case of driving 2 spindles synchronously, using α*i* amp with UPS



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NOTE
Please refer to “FANUC SERVO AMPLIFIER α*i* series DESCRIPTION (B-65282EN)” for details of connection.

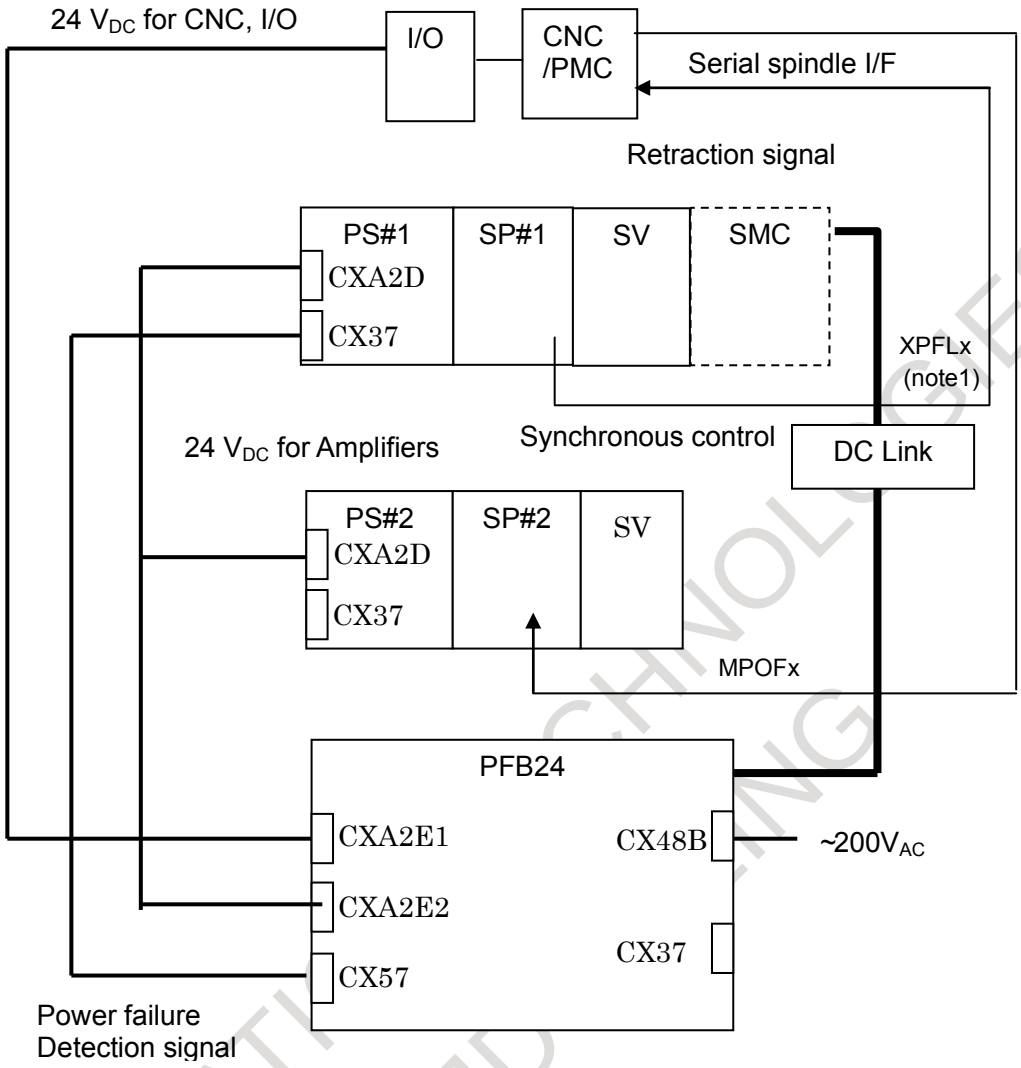
(2) In case of driving 2 spindles synchronously, using α*i*-B amp with UPS



NOTE
1. When you use α*i*-B amp (A06B-62xx-Hxxx#H600)”, DO signal for power failure detection (XPFLx) is available in ladder program directly. When this signal is used, the wiring of CX37 is unnecessary.
2. Please refer to “FANUC SERVO AMPLIFIER α*i* series DESCRIPTION (B-65412EN)” for details of connection.

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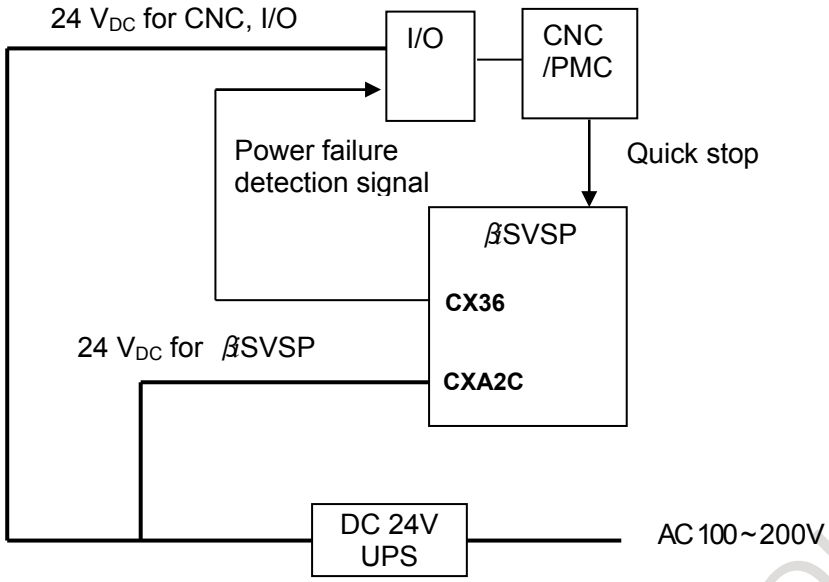
(3) In case of driving 2 spindles synchronously, using α*i*-B amp with PFB-24



NOTE
Please refer to "FANUC SERVO AMPLIFIER β*i* series DESCRIPTION (B-65322EN)" and "Power Failure Backup Module Model B B-65412JA/01-13" for details of connection.

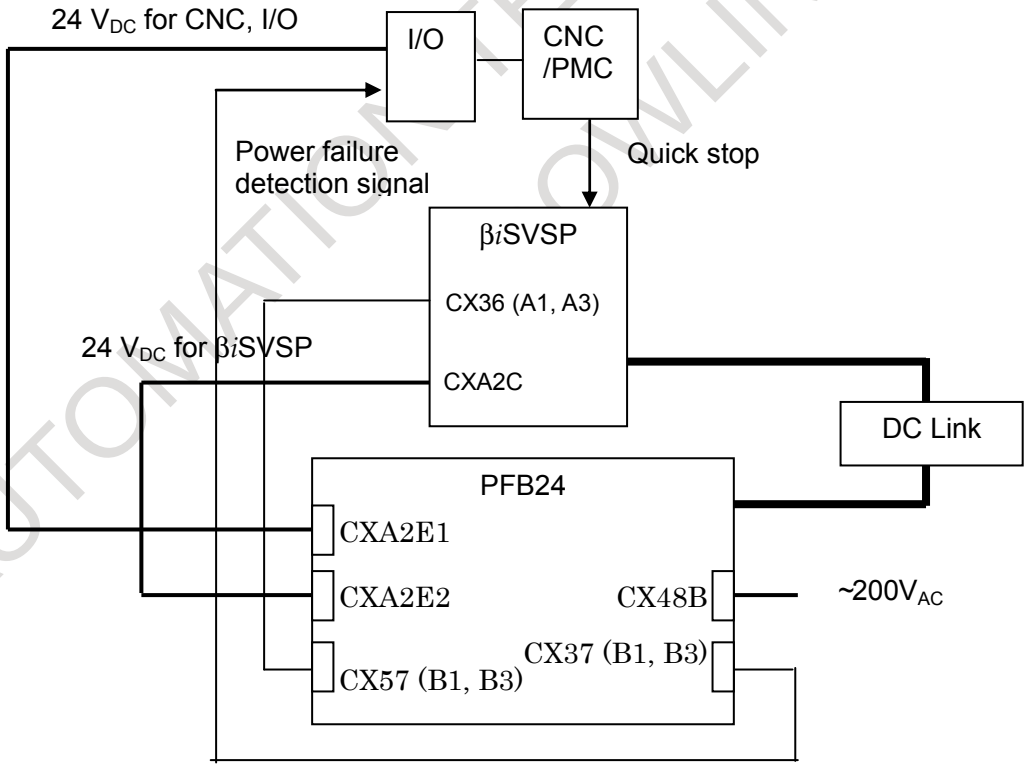
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(4) Sample system configuration of βi SVSP with UPS



NOTE
Please refer to "FANUC SERVO AMPLIFIER βi series DESCRIPTION (B-65322EN)".

(5) Sample system configuration of βi SVSP with PFB-24



NOTE
Please refer to "FANUC SERVO AMPLIFIER βi series DESCRIPTION (B-65322EN)" and "Power Failure Backup Module Model B B-65412JA/01-13" for details of connection.

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5.20.4 I/O Signals (CNC↔PMC)

(1) Input signals (PMC→CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G073	G073						MPOFA		
2nd-	G077	G077						MPOFB		

MPOFx Motor power turn-off signal

0 : Motor power turn-off not requested.

1 : Motor power turn-off being requested

When synchronous operation is performed using two or more spindles in the system, the "power failure backup function" can be applied only for one spindle.

If a power failure is detected during synchronous operation in a state in which two or more spindles are mechanically connected, it is necessary to input MPOFx = 1 immediately to the spindles for which this function is not applied to shut off power.

If a power failure is detected in spindle synchronous control, cancel the spindle synchronous command from the PMC immediately.

For power failure detection, use the PS power failure detection signal (CX37), βiSVSP power failure detection signal (CX36), or power failure detection signal for the power failure backup module (CX16_B2: *PFL). For the 30*i*-B series CNC, you can use the power failure detection signal (XPFL) output to the PMC.

NOTE
This function can not be applied to the machines in which multiple synchronous spindle motors are mechanically coupled. When MPOF is input to the motor on one side, the control of the motor becomes invalid and it is rotated by another motor. In the case of synchronous motors, do not apply this function because it is dangerous that the motor rotated by external force in uncontrolled state becomes a generator.

(2) Output signals (CNC→PMC)

	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F306				VDCABA				
2nd-	F308				VDCABB				

VDCABx Out of range signal in DC-link voltage

0 : Normal state in DC-link voltage

1 : Out of range state in DC-link voltage (Spindle software recognize it as power failure.)

When the parameter N 4396 # 5 = 1 and the DC link voltage becomes out of predetermind range, it is regarded as a power failure and this signal is output.

NOTE
It is effective in 9DAA series 15th edition / 9DB0 series 15th edition or later.

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	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F307							XPFLA	
2nd-	F309							XPFLB	

XPFLx Power failure detection signal
0 : Power failure state
1 : Normal state (power failure not detected)
The power failure state detected in the common power supply is output as a DO signal via the spindle amplifier.

5.20.5 List of Related Parameters

Parameter No.		Description
0*i*	30*i*	
4069 to 4072	4069 to 4072	Acceleration/Deceleration constant for Sensor-less control
4353#4	4353#4	Power failure backup function Function bit
4396#5	4396#5	Setting for the condition of power failure judgment (power failure judgment by DC link voltage)
4542#6	4542#6	Power failure backup function Operation setting
4510	4510	Power failure backup function Upper limit of the DC link voltage
4511	4511	Power failure backup function Lower limit of the DC link voltage
4629	4629	Allowable acceleration for acceleration at a power failure (for high-speed characteristics)
4630	4630	Allowable acceleration for acceleration at a power failure (for low-speed characteristics)

5.20.6 Details of Related Parameters

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4353	4353				PFBFEN				

PFBFEN Power failure backup function Function bit
0 : The power failure backup function is disabled.
1 : The power failure backup function is enabled.
To use this function, set this parameter to 1.
To use this function for twin-drive motors, only on the master SP, set this parameter to 1.

NOTE
This function cannot be used together with the DC-link stabilizer at a power failure (No.4540#7).

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4396	4396			VDCPF2					

VDCPF2 Setting for the condition of power failure judgement
0 : The out of range in DC-link voltage is not included in the detection condition.
If power failure state is detected in power supply, the power failure backup function will be executed.

1 : The out of range in DC-link voltage is included in the detection condition.
If power failure state is detected in power supply or the out of range in DC-link voltage is detected, the power failure backup function will be executed.

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NOTE
It is effective in 9DAA series 15th edition / 9DB0 series 15th edition or later.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4542	4542		PFBTYP						

PFBTYP Power failure backup function (Operation setting)
0 : type-1 (Acceleration is performed when the DC link voltage increases.)
The spindle stops while repeating deceleration and acceleration.
1 : type-2 (Acceleration is not performed when the DC link voltage increases.)
The spindle stops while repeating deceleration and constant speed.
When this parameter is set to 1, after the DC link voltage increases and reaches the upper limit (parameter No. 4510), acceleration is not performed and the constant speed is kept.
To use spindle energy at a power failure for retracting the feed axis, set this parameter to 1.
To apply quick stop with the full torque to the feed axis at a power failure and use the regenerative energy for the spindle or to stop the spindle as soon as possible, set this parameter to 0.

NOTE
Acceleration may be performed with type-2 when DC-link voltage monitoring is set (No.4396#5=1).

0*i*	30*i*	
4510	4510	**Power failure backup function Upper limit of the DC link voltage**

Unit of data : 1 VDC
Valid data range : 0, 550 to 700 (400-V amplifier), 250 to 325 (200-V amplifier)
Standard setting : 0 = 650 VDC (400-V amplifier), 265 VDC (200-V amplifier)
685VDC (400-V amplifier), 280 VDC (200-V amplifier) for Sensor-less control

When the DC link voltage exceeds the level set with this parameter after power failure detection, the function performs acceleration and waits for the DC link voltage to decrease. Immediately after power failure detection, the function performs acceleration even when the DC link voltage does not reach the level set with this parameter. (When bit 6 of parameter No. 4542 is set to 1, the function does not perform acceleration and keeps the speed.)
Set this parameter to 0. If you want to change the parameter, set a value within the above valid data range.

0*i*	30*i*	
4511	4511	**Power failure backup function Lower limit of the DC link voltage**

Unit of data : 1 VDC
Valid data range : 0, 450 to 650 (400-V amplifier), 200 to 300 (200-V amplifier)
Standard setting : 0 = 550 VDC (400-V amplifier), 220 VDC (200-V amplifier)
650VDC (400-V amplifier), 260 VDC (200-V amplifier) for Sensor-less controlWhen the DC link voltage decreases to the level set with this parameter after power failure detection, the function decelerates the spindle and increases the DC link voltage.
Normally, set this parameter to 0 (standard setting). If you want to change the parameter, set a value within the above valid data range.

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0*i*	30*i*	
4629	4629	**Allowable acceleration for acceleration at a power failure (for high-speed characteristics)**
4630	4630	**Allowable acceleration for acceleration at a power failure (for low-speed characteristics)** **It's impossible to use this parameter in case of Senser-less control**

Unit of data : 1 min^{-1} (10 min^{-1} when bit 2 of parameter No. 4006 is set to 1)
Valid data range : 0 to 32767
Standard setting : 0

Allowable acceleration for acceleration at a power failure
Setting unit: 1 min^{-1} (10 min^{-1} when bit 2 of parameter No. 4006 is set to 1)
Setting range: 0 to 32767
Standard setting: 0
When type-1 is specified (bit 6 of parameter No. 4542 is set to 0), set the allowable acceleration for acceleration.
When type-2 is specified (bit 6 of parameter No. 4542 is set to 1), the setting of the parameter is invalid.
When the setting is 0:
Acceleration is performed using the value of motor speed at a power failure × 1.1 as the upper limit.
When the setting is other than 0:

- Motor speed at a power failure × 1.1
- Motor speed at a power failure + setting of this parameter

Acceleration is performed using the above value, whichever is greater as the upper limit.

When it is necessary to accelerate the spindle after a power failure occurs in a state in which the spindle stops, the spindle must have been excited using the S0 command (SFR = 1 or SRV = 1) in advance.

After a power failure is detected, when quick stop is applied to the feed axis with the full torque, the DC link voltage increases due to the regenerative energy from the feed axis. By applying this function type-1, the spindle can be accelerated immediately after power failure detection to reduce the stop distance while suppressing the increase of the DC link voltage and avoiding an overvoltage alarm.
It may be dangerous to accelerate the spindle with no limit. To limit the acceleration, use this parameter.
The upper limit of the spindle speed is assumed to vary according to the type and size of the tool and workpiece that is mounted on the spindle. To use this parameter, the machine tool builder should manage the parameter.

In addition, the following upper limits are set:

- Maximum motor speed (setting of parameter No. 4020) × 1.1
- Safety speed × 0.9 when the detection of a safety speed excess alarm of the dual check safety function is enabled. This upper limit is undefined in case of Sensor-less control, because the dual check safety function can't be used in the Sensor-less control.

If a power failure occurs in the spindle orientation completion state, the setting of this parameter is invalid.

0*i*	30*i*	
4069	4069	**Acceleration/Deceleration constant for Sensor-less control (High) CTH1A=0, CTH2A=0**
4070	4070	**Acceleration/Deceleration constant for Sensor-less control (MEDIUM High) CTH1A=0, CTH2A=1**
4071	4071	**Acceleration/Deceleration constant for Sensor-less control (MEDIUM Low) CTH1A=1, CTH2A=0**

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4072	4072	**Acceleration/Deceleration constant for Sensor-less control (Low)**	**CTH1A=1, CTH2A=1**

Unit of data : 1min-1/sec
Valid data range : 0 to 32767
Standard setting : 900

When the Power failure backup function is applied to the Sensor-less control, these parameters are used at acceleration/deceleration in the power failure backup operation.

NOTE
It is effective in 9DB0 series 14th edition or later.

5.20.7 Adjustment Procedure

Basically, it is not necessary to adjust any parameter. Check the following items (adjust them when required).

1. When the motor rotates at the maximum speed, cause a power failure in the main power supply. Use the SERVO GUIDE to observe the motor speed (SPEED) and DC link voltage (VDC) while this function is operating.
2. Make sure that the DC link voltage is kept within the normal range from when a power failure occurs to when the motor stops. (200-V amplifier: About 200 to 330 V, 400-V amplifier: About 450 to 700 V)
3. If the DC link voltage is not kept within the above range, a DC link overvoltage or low voltage alarm may be issued when this function operates. Adjust the values of parameters Nos. 4510 and 4511.

5.20.8 Alarm

After the spindle stops, the DC link voltage gradually decreases and the following alarms are issued. (When the control power supply is maintained)

30*i*-A, 0*i*-D (spindle control software 9D9A or 9D8A series)

CNC alarm status:
None
When a servo amplifier is connected, a servo alarm (SV0433 or SV0607) is issued.
When a spindle amplifier for which this function is not used is connected, a spindle alarm (SP9004 or SP9051) is issued.
PS alarm display (LED):
E (Open phase in the main power supply), 4 (DC link low voltage)
SP alarm display (LED):
SP for which this function is enabled… None
SP for which this function is disabled… 04 (Open phase in the converter main power supply), 51 (Converter DC link low voltage)

30*i*-B, 0*i*-F (spindle control software 9DAA or 9DB0 series)

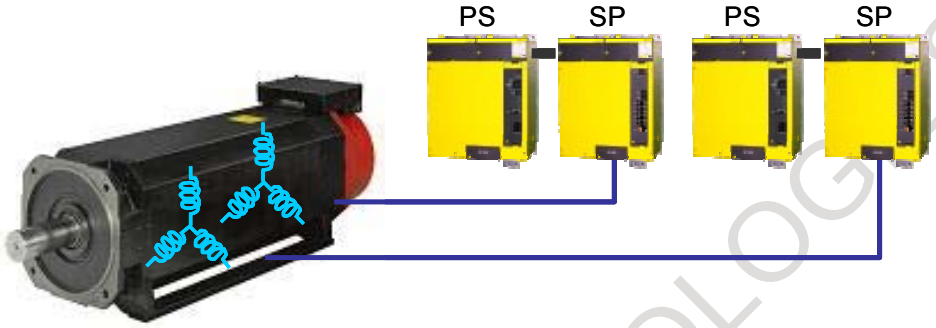
CNC alarm status:
SP9004
When a servo amplifier is connected, a servo alarm (SV0607) is issued.
PS alarm display (LED):
14 (Power failure alarm)
SP alarm display (LED):
None

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5.21 TWIN DRIVE FOR SPINDLE MOTOR

5.21.1 Overview

This section describes the twin drive to drive a spindle motor with two windings.
For the specifications of a spindle motor for which the twin drive is applied, refer to the specifications of the relevant motor.



NOTE
1 This function cannot be used with sensorless motor.

5.21.2 Series and Editions of Applicable Spindle Software

Spindle software

Series	Edition	Usable CNC
9D5A	A (01)	FS0*i* -D
9D7A	A (01)	FS30*i* / FS31*i* / FS32*i* -A
9D80	X (24)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9D90	H (08)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	K (11)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

FS0*i*-D, FS0*i* -F, FS30*i*/FS31*i*/FS32*i*-B/: Available with no option
FS30*i*/FS31*i*/FS32*i*-A: CNC software option of spindle tandem control required.

* The twin drive uses spindle tandem control within the CNC to control motors. For this reason, the spindle tandem option is required conventionally. The 30*i*-B and 0*i*-D series CNCs have been improved so that the twin drive is available without the spindle tandem option.

(1) Cautions

- The twin drive requires two α*i*SP spindle amplifiers (TYPE B) (as the master SP and slave SP) per one motor. With the 6220 and 6270 α*i*SP, both TYPE A and TYPE B are available for the twin drive. (β*i*SVSP/β*i*SVSPdoes not support this function).
- Use the same series and edition of spindle control software for the master SP and slave SP.
- The specification of an applicable amplifier is determined depending on the specification of the spindle motor. The specification and number of required common power supplies (PS) are also determined depending on the specification of the spindle motor. Use a FANUC-specified combination of these devices.
- The twin drive requires "two spindles" (master SP and slave SP) as controlled spindles for one motor. Cs contour control requires "one axis" (master SP) as a controlled axis.
- The following functions cannot be used together with the twin drive:
  - Spindle switching control

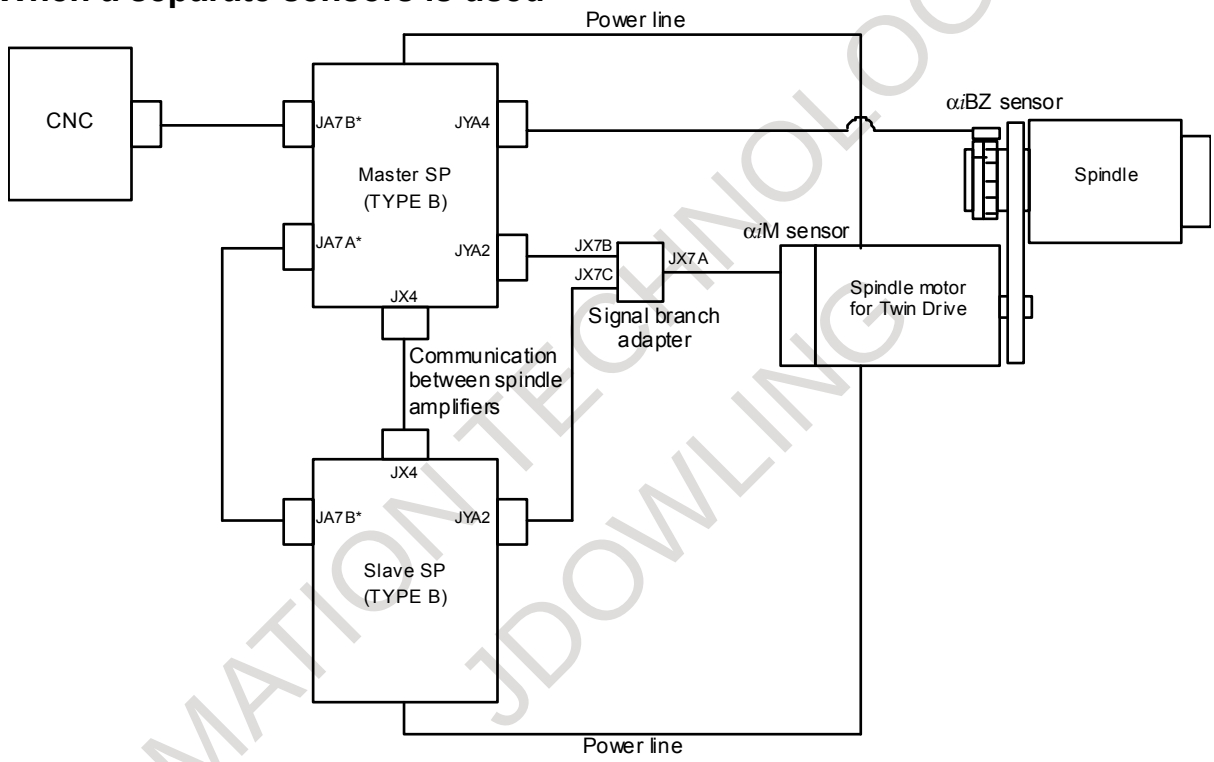
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- Position coder signal output function (connector JX4 output)
- Spindle EGB
- Spindle repetitive control
- Spindle tandem control (velocity tandem, torque tandem)
- Integrator copy function
- Synchronous spindle motor driving

- The master SP and slave SP can be assigned to any of the 1st to 4th spindles. In this manual, the following assignment is used for descriptive purposes:
  Master SP: 1st spindle
  Slave SP: 2nd spindle

5.21.3 System Configuration

(1) When a separate sensors is used

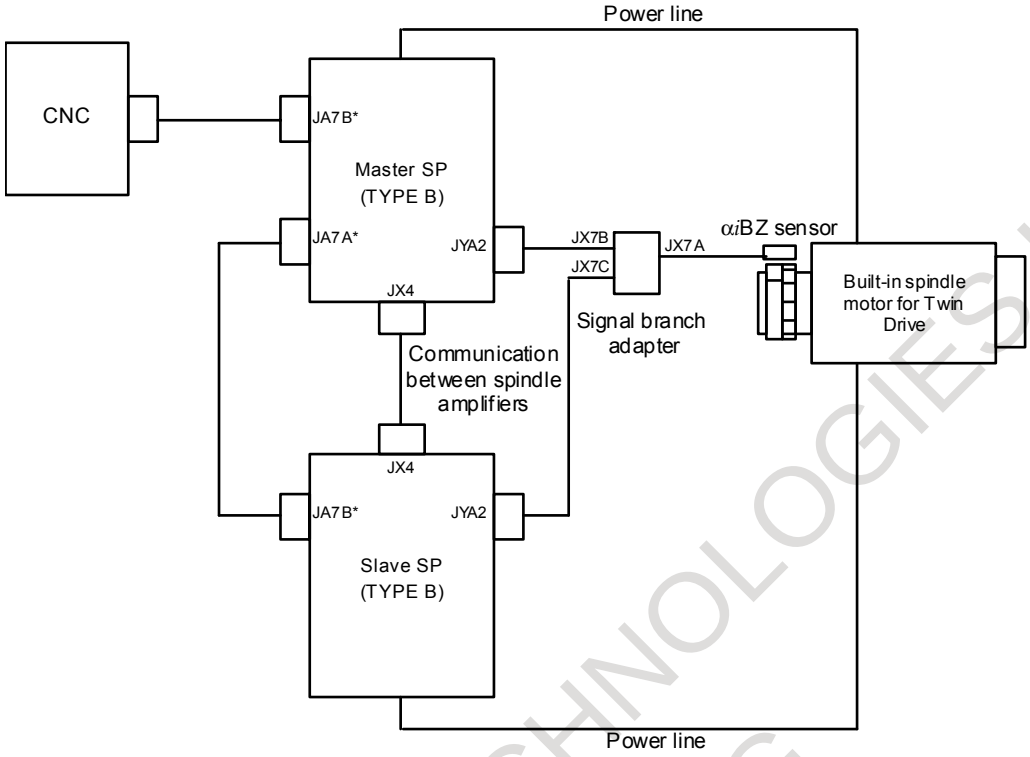


* For the FS30*i*-B series CNC (FSSB communication), use COP10A/COP10B instead of JA7A/JA7B.

NOTE
*1 Connect a motor sensor to both the master SP and slave SP by using a signal branch adapter.
*2 Connect a separate sensor to the master SP.
*3 For details of the connection of each cable, refer to FANUC SERVO AMPLIFIER α*i* series DESCRIPTIONS (B-65282EN).
*4 The number of common power supplies (PS) differs depending on the specification of the spindle motor.
*5 The emergency stop signal (connector CX4) for common power supplies (PS) must be input to each PS.

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(2) When a built-in motor is used



* For the FS30*i*-B series CNC (FSSB communication), use COP10A/COP10B instead of JA7A/JA7B.

NOTE
*1 Connect a motor sensor to both the master SP and slave SP by using a signal branch adapter.
*2 The α*i*CZ sensor (serial) cannot be used for the motor sensor.
*3 For details of the connection of each cable, refer to FANUC SERVO AMPLIFIER α*i* series DESCRIPTIONS (B-65282EN).
*4 The number of common power supplies (PS) differs depending on the specification of the spindle motor.
*5 The emergency stop signal (connector CX4) for common power supplies (PS) must be input to each PS.

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5.21.4 I/O Signals (CNC↔PMC)

NOTE
*1 During operation with the twin drive, the spindle command is issued to the master SP. The specifications of the input signals are the same as those for a normal spindle (without using the twin drive). For details of the signals used in each control mode, refer to CNC Connection Manual (Function).
*2 When the twin drive is used, it is not necessary to input PMC signals to the slave SP. The input signals required for driving the slave SP are transferred from the master SP via inter-spindle amplifier communication.
*3 When the twin drive is used, use a signal output from the master SP to determine the sequence (such as speed arrival determination and alarm detection). (No signal output from the slave SP is required.)

(1) Address list of input signals (PMC→CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G073	G073							SLVA	
2nd-	G077	G077							SLVB	

(2) Details of input signals (PMC→CNC)

(a) Tandem operation command (SLVx)

SLVA : Tandem operation command (for the 1st spindle)
SLVB : Tandem operation command (for the 2nd spindle)
0 : Makes a request to disable tandem operation.
1 : Makes a request to enable tandem operation.
These signals enable or disable tandem operation.
To use the twin drive, set these signals to 1 for both of the master and slave.

NOTE
*1 The spindle motors must be stopped before these signals are switched. The change of these signals is not accepted during rotation.
*2 These signals must be switched in the velocity control mode. The change of these signals is not accepted not in the velocity control mode.

(3) Address list of output signals (CNC→PMC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F046	F046				SLVSA				
2nd-	F050	F050				SLVSB				

(4) Details of output signals (CNC→PMC)

(a) Tandem operation state signal (SLVSx)

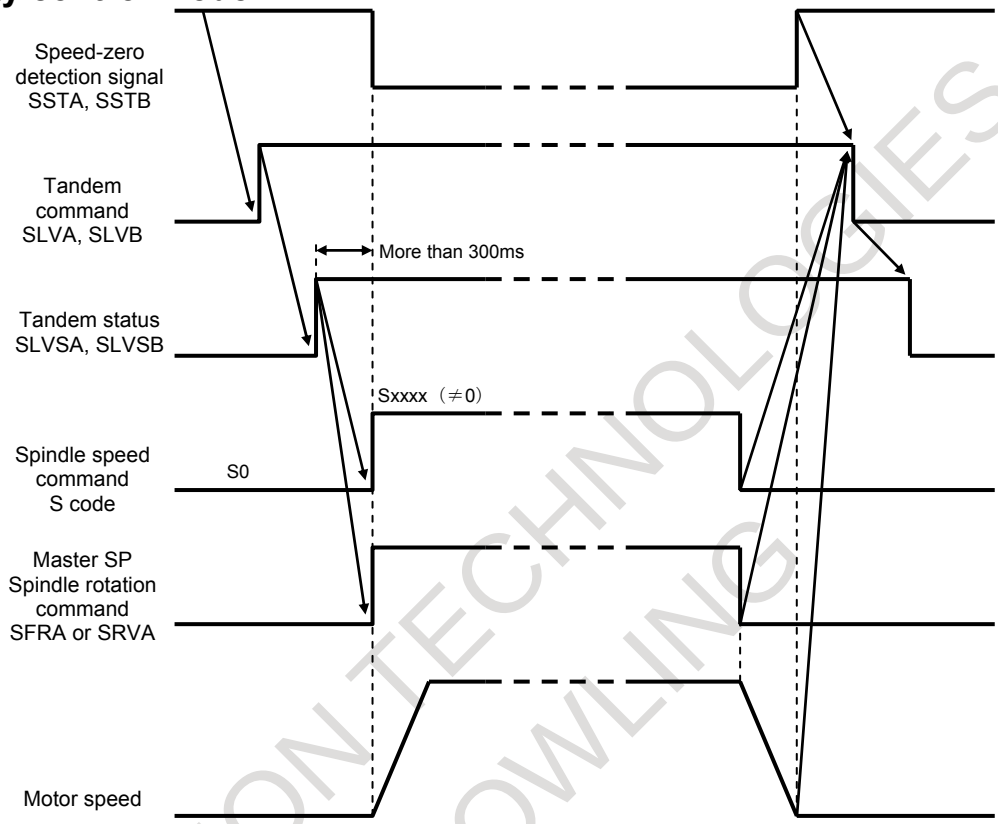
SLVSA : Tandem operation state signal (for the 1st spindle)
SLVSB : Tandem operation state signal (for the 2nd spindle)
0 : Tandem operation is disabled.
1 : Tandem operation is enabled.
After checking that these signals are set to 1 for both of the master and slave, issue a command to the master SP.

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5.21.5 Examples of Sequences

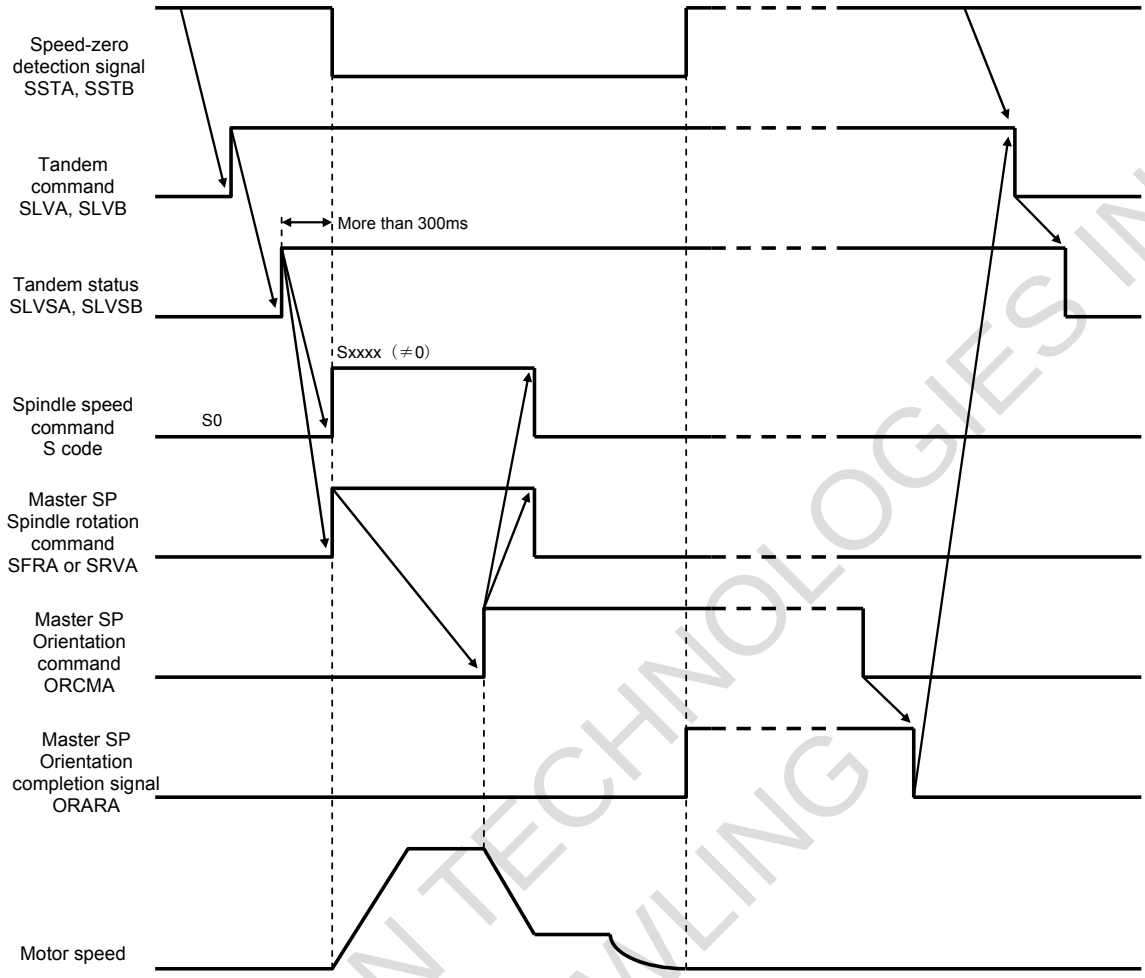
This subsection describes examples of sequences with the following assignment:
1st spindle: Master SP
2nd spindle: Slave SP

(1) Velocity control mode



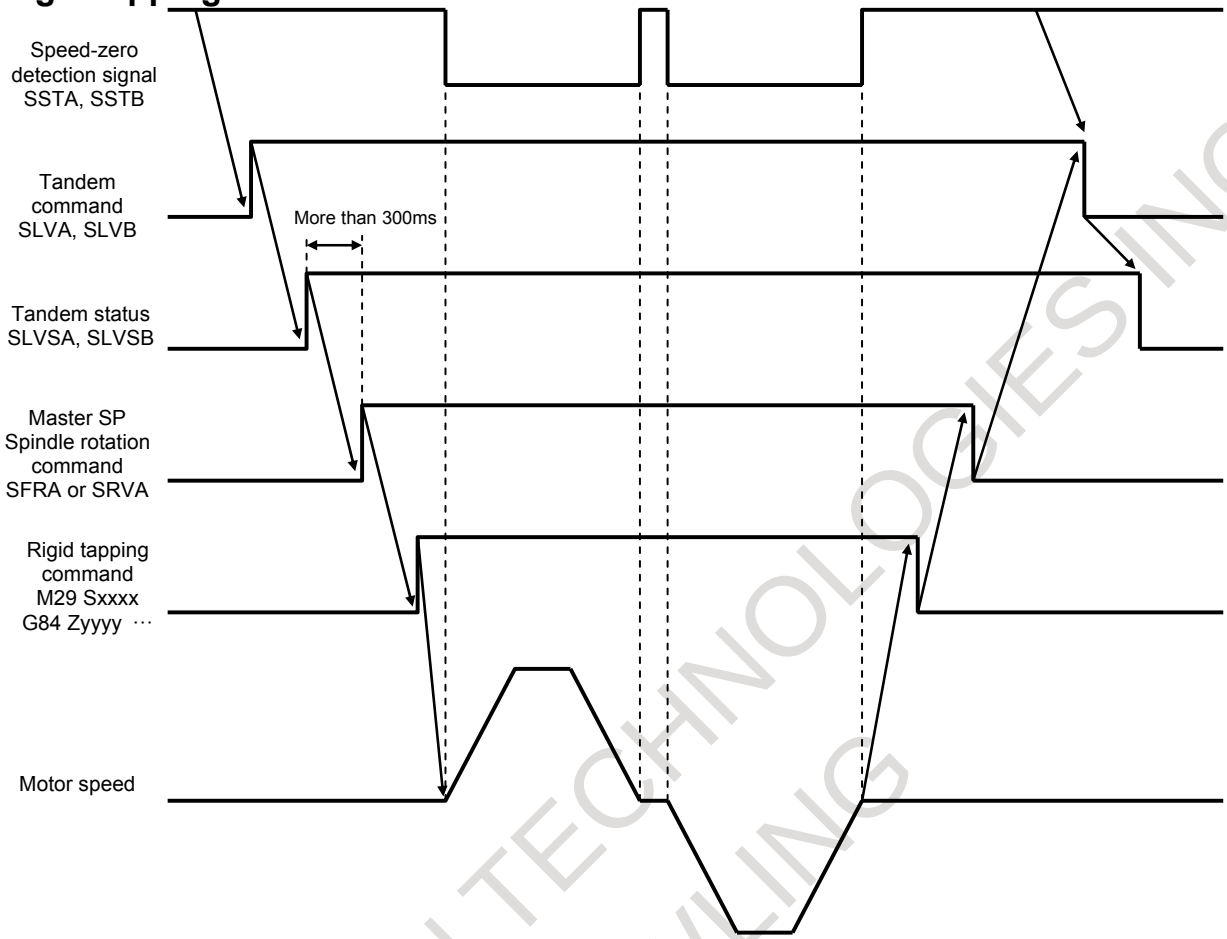
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(2) Spindle orientation



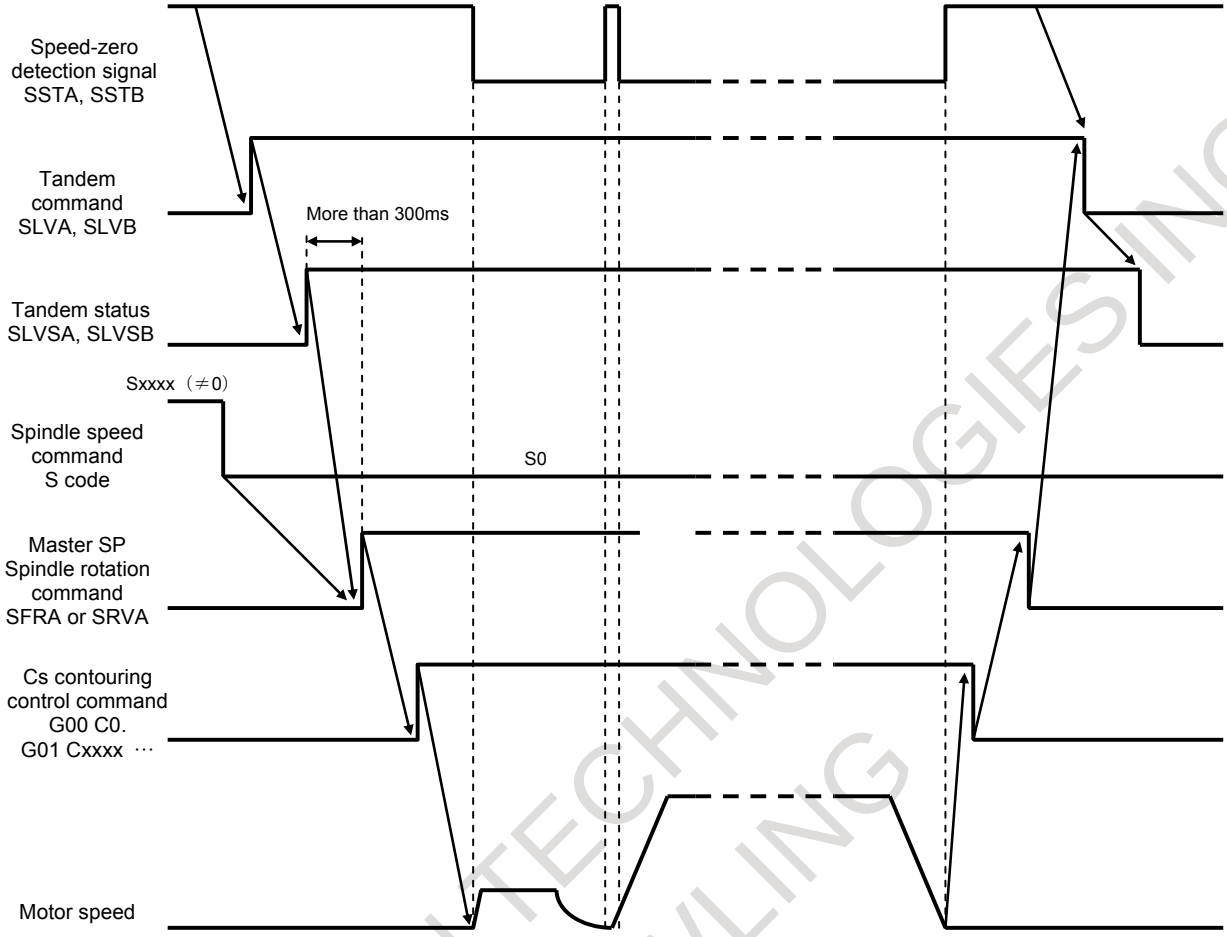
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(3) Rigid tapping



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(4) Cs contour control



5.21.6 List of Related Parameters

Parameter No.		Description
0*i*	30*i*	
4015#3	4015#3	Whether to use the spindle tandem function
4352#6	4352#6	Setting of the slave spindle for inter-spindle amplifier communication
4352#7	4352#7	Setting of the master spindle for inter-spindle amplifier communication
4398#3	4398#3	Whether to use the twin drive

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NOTE
*1 For the parameters other than listed below, set the same values for the master and slave spindles.

Parameter No.		Master SP	Slave SP	Description
0*i*	30*i*			
4352 #7,6	4352 #7,6	1, 0	0,1	Setting of inter-spindle amplifier communication
4002 #3,2,1,0	4002 #3,2,1,0	Depending on sensor	0,0,0,0	Type of spindle sensor
4134	4134	Depending on sensor	0	Motor overheat level
4657	4657	Depends on the configuration	Depends on the configuration	PS management axis
4595,4596	4595,4596	Depends on the power supply	Depends on the power supply	Common power supply loss coefficient
4771 to 4785	4771 to 4785	Depends on the power supply	Depends on the power supply	Common power supply parameter

5.21.7 Details of Related Parameters

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4009	4009						ALSP		

ALSP Motor power turn-off method when spindle alarm 24 (serial data communication error) is issued
0 : Turns the power off after the motor is decelerated and stopped.
1 : Turns the power to the motor immediately. (Set 1.)

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4015	4015					SPDTDM			

SPDTDM Whether to use the spindle tandem function (CNC software option required)
0 : The spindle tandem function is not used.
1 : The spindle tandem function is used.

NOTE
*1 When the twin drive is used with the 30*i*-B, 0*i*-D or 0*i*-F the CNC software option is not required. You can use the twin drive regardless of the setting of this bit.
*2 When the twin drive is used with the 30*i*-A, the CNC software option of spindle tandem control is required. Check that this bit is set to 1.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4352	4352	MASTER	SLAVE						

SLAVE Setting of the slave spindle for inter-spindle amplifier communication
0 : Not slave spindle
1 : Slave spindle (Set 1 for the slave SP.)

MASTER Setting of the master spindle for inter-spindle amplifier communication
0 : Not master spindle
1 : Master spindle (Set 1 for the master SP.)

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0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4398	4398					WNDTDM			

WNDTDM Whether to use the twin drive
0 : The twin drive is not used.
1 : The twin drive is used. (Set 1.)
This parameter sets whether to use the twin drive for driving one spindle motor with two SPs.

NOTE
If this bit is set to 0, the twin drive does not operate normally. Be sure to set 1.

5.21.8 Alarm and Status Error

(1) Spindle alarm

Alarm No.		Description	Measure
30*i* / 0*i*	**SP**		
SP0066	66	An error occurs in inter-spindle amplifier communication.	Check the connection of the cable (connector JX4).
SP0080	80	An alarm is issued for the other spindle amplifier for inter-spindle amplifier communication.	Remove the cause of the alarm in the other spindle amplifier.

(2) Spindle status error

Error No.	Description	Measure
38	・ A parameter related to inter-spindle amplifier communication is set incorrectly. ・ A function that cannot be used together with the twin drive is set.	Check the parameters.

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5.21.9 Parameters for Each Motor Model

Parameter No.		αiI 150/5000HV
		αiSP75HV x2 (*1) αiPS100HV x2
FS0*i*	FS30*i*	150/ 180 kW 1500 / 5000 min^{-1}
4007	4007	00000000
4008	4008	00000000
4009	4009	00000000
4010	4010	00010001
4011	4011	00001010
4012	4012	10000000
4013	4013	00001100
4019	4019	00000100
4020	4020	5000
4039	4039	0
4080	4080	10591
4083	4083	30
4100	4100	1520
4101	4101	100
4102	4102	1551
4103	4103	0
4104	4104	2500
4105	4105	0
4106	4106	4000
4107	4107	0
4108	4108	0
4109	4109	25
4110	4110	973
4111	4111	324
4112	4112	200
4113	4113	172
4114	4114	0
4115	4115	100
4116	4116	4691
4117	4117	90
4118	4118	100
4119	4119	55
4120	4120	0
4124	4124	0
4127	4127	144
4128	4128	120
4129	4129	0
4130	4130	25700
4134	4134	130
4169	4169	0
Maximum power at acceleration: 216 kW		

[Procedure for setting parameters]

(1) For both the master and slave spindles, load parameters automatically with model code 300.

(2) For both the master and slave spindles, set parameters manually as listed in the parameter table. However, set parameter No. 4134 for the slave spindle to 0.

(3) Set parameters for the twin drive functions. (See Subsections 5.21.6 and 5.21.7.)

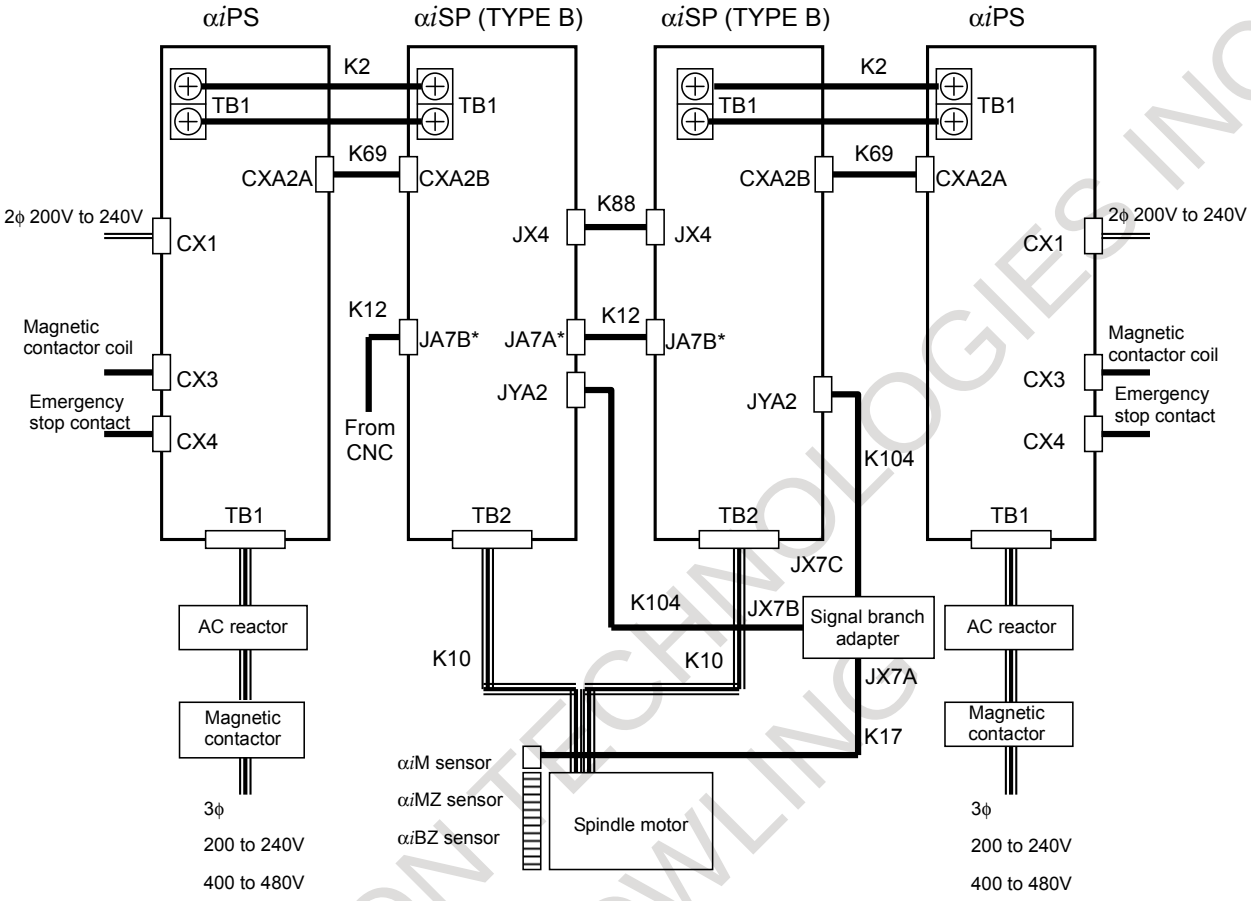
(4) Turn the power off, then on again to make sure that the spindle parameters take effect.

(*1) Note that the following αiSP75HV amplifier cannot be used for this motor:
A06B-6122-H075#Hxxx

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5.21.10 Examples of Connection

(1) When two αiPSs and two αiSPs are used in the configuration

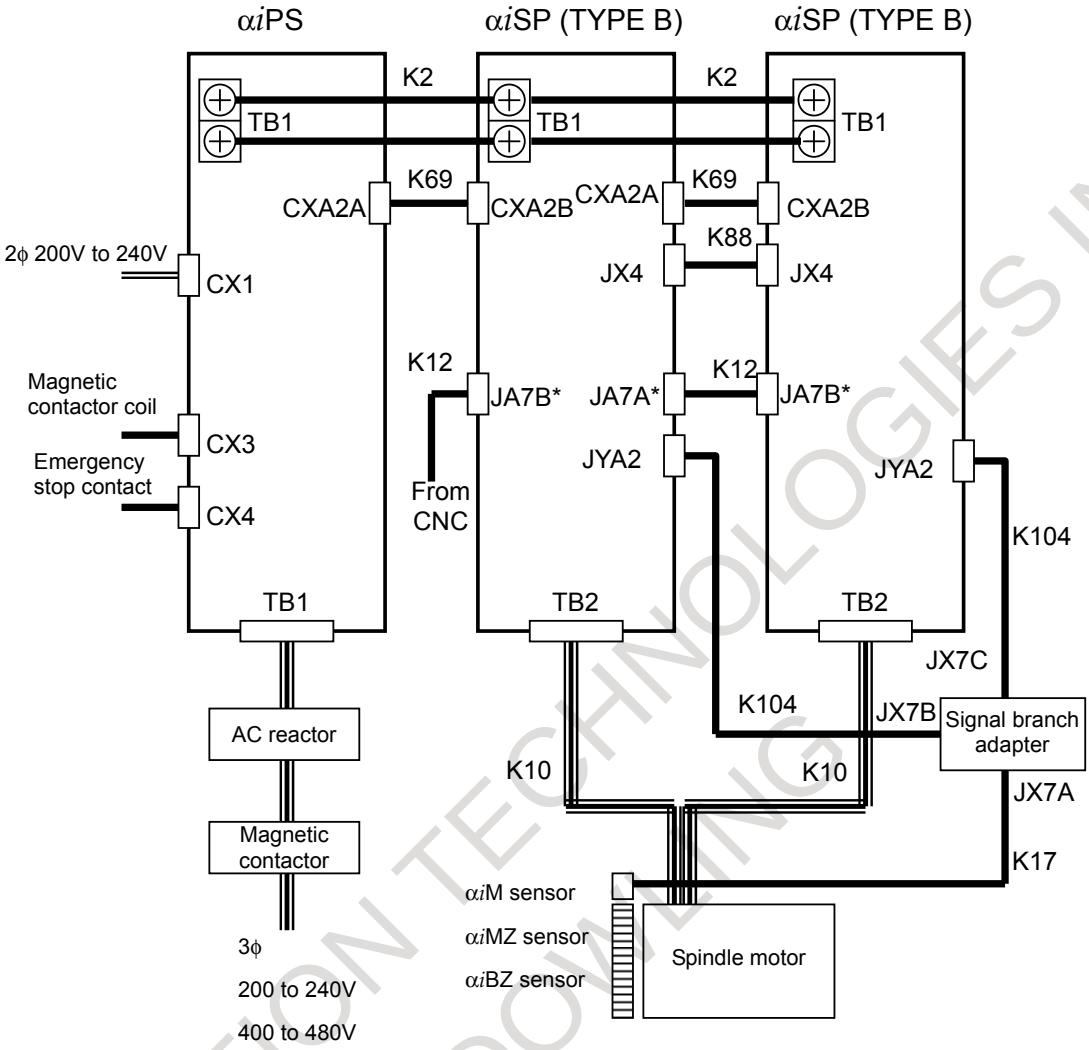


* For the FS30*i*-B series CNC (FSSB communication), use COP10A/COP10B instead of JA7A/JA7B.

NOTE
*1 For details of the connection of each cable, refer to FANUC SERVO AMPLIFIER α*i* series DESCRIPTIONS (B-65282EN).
*2 The emergency stop signal (connector CX4) for common power supplies (PS) must be input to each PS.

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(2) When one αiPS and two αiSPs are used in the configuration



* For the FS30*i*-B series CNC (FSSB communication), use COP10A/COP10B instead of JA7A/JA7B.

NOTE
For details of the connection of each cable, refer to FANUC SERVO AMPLIFIER α*i* series DESCRIPTIONS (B-65282EN).

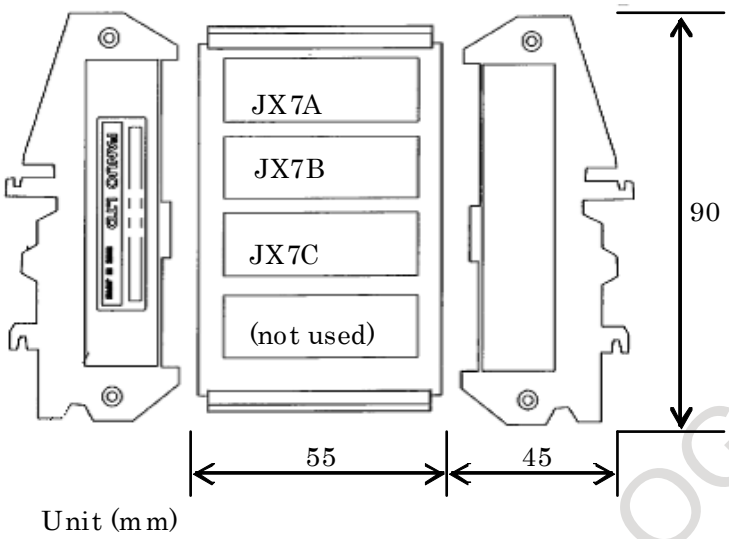
5.21.11 Signal Branch Adapter

(1) Ordering information

Name	Specification	Remarks
Signal branch adapter	A06B-6111-H405	Adapter only. Make a connection cable ready.

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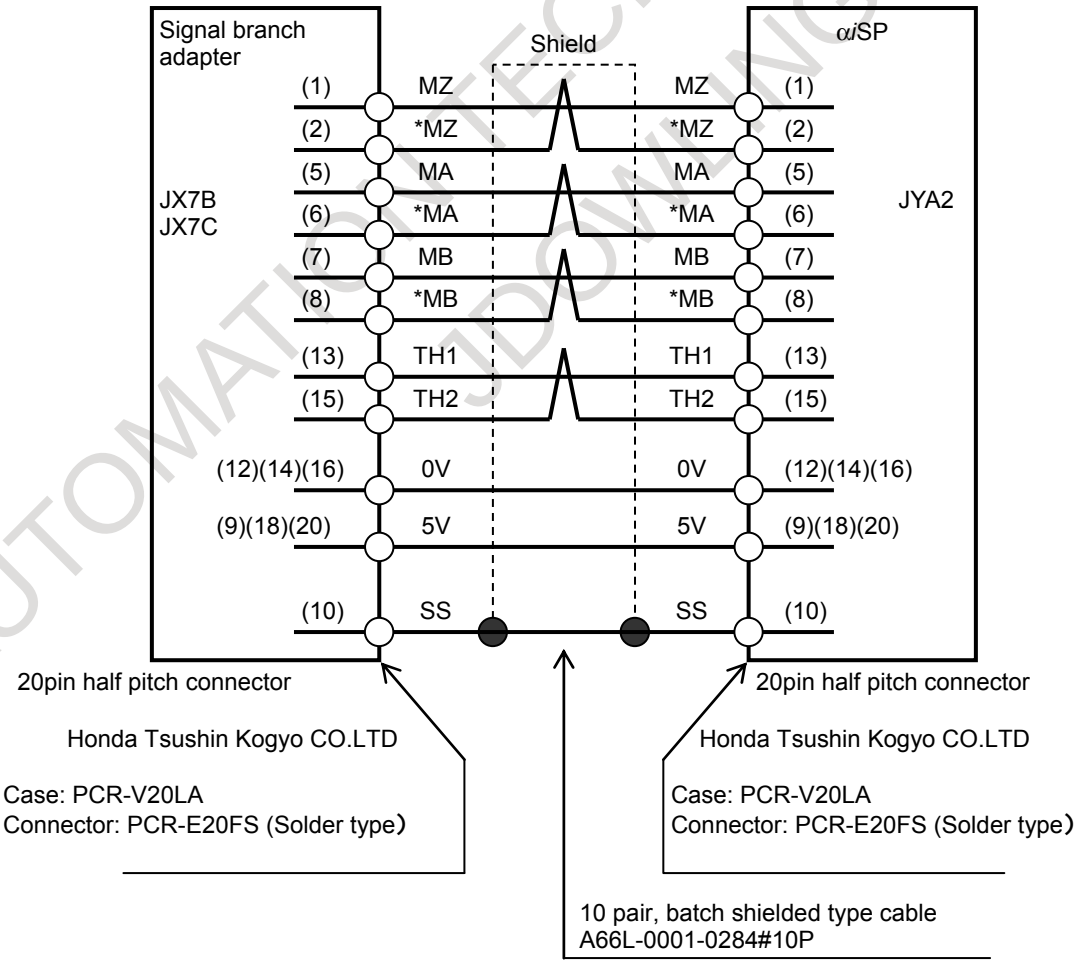
(2) External dimensions



Unit (mm)

NOTE
Attach the adapter on the DIN rail.

(3) Details of cable K104



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5.22 HOW TO USE A DISTANCE CODED SENSOR FOR A SPINDLE

5.22.1 Overview

A distance coded sensor can be used for a spindle. This section describes how to use the sensor.

NOTE
1 This function cannot be used with sensorless motor.

5.22.2 Series and Editions of Applicable Spindle Software

Spindle software

Series	Edition	Usable CNC
9D90	P (16)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	S (19)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B/ FS35*i* -B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

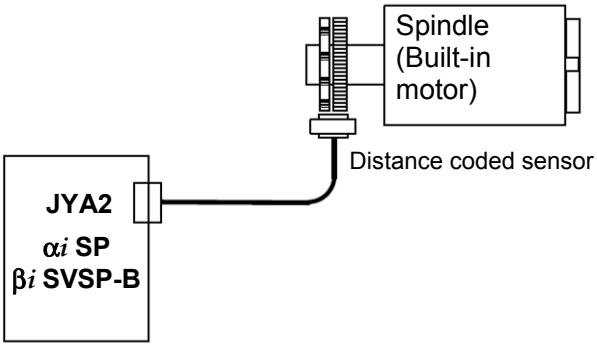
Sensors having 32768 or more slits are supported by the following series and edition or later.

Series	Edition	Usable CNC
9D90	S (19)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* –A
9DA0	V (22)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B/ FS35*i* –B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

5.22.3 System Configuration

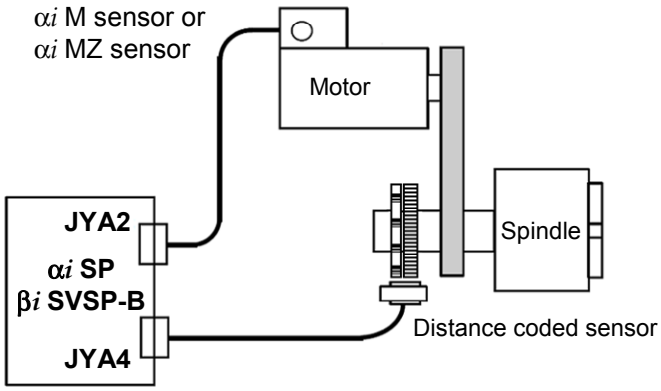
A distance coded sensor can be used in the following configurations.

(a) When a speed sensor is used for position control (built-in motor)



(b) When a separate sensor (distance coded sensor) is used for position control

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5.22.4 Related Parameters

First, set the following parameters.
(a) When a speed sensor is used for position control (built-in motor)
(b) When a separate sensor (distance coded sensor) is used for position control

Parameter No.		Description	Setting
0*i*	30*i*		
No.4002 (MAIN) No.4178 (SUB) #3,2,1,0	No.4002 (MAIN) No.4178 (SUB) #3,2,1,0	Type of position sensor	(a): Set 0,0,0,1. (b): Set 1,1,1,0.
No.4010 (MAIN) No.4186 (SUB) #2,1,0	No.4010 (MAIN) No.4186 (SUB) #2,1,0	Type of speed sensor	(a): Set 1,1,1. (b): Set bits depending on the type of speed sensor.
No.4010 (MAIN) No.4186 (SUB) #3	No.4010 (MAIN) No.4186 (SUB) #3	Order of A/B phases of the speed sensor†	0: FANUC standard phase order 1: Reverse of the FANUC standard phase order
No.4334 (MAIN) No.4335 (SUB)	No.4334 (MAIN) No.4335 (SUB)	Arbitrary number of speed sensor teeth	For (a), set the number of scale lines. When the sensor has 32768 or more scale lines, set (number of scale lines/2) × (-1).
No.4361 (MAIN)	No.4361 (MAIN)	Arbitrary number of position sensor teeth	For (b), set the number of scale lines. When the sensor has 32768 or more scale lines, set (number of scale lines/2) × (-1).
No.4394 (MAIN) No.4467 (SUB) #2	No.4394 (MAIN) No.4467 (SUB) #2	Z phase detection condition	Set 1: Z phase detection is always effective regardless of the spindle speed.

NOTE
†) For the order of A/B phases, refer to the separately issued technical report "Connection of 3rd party spindle sensor and Alpha *i* series spindle amplifier" (B-65282EN/06-27, B-65412EN/01-04).

To use a distance coded sensor, set the following parameters additionally.

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	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
MAIN	4016	4016								DCEPH
SUB	4192	4192								DCEPH

DCEPH Order of A/B phases of the distance coded sensor
0 : FANUC standard phase order
1 : Reverse of the FANUC standard phase order
Normally, make the wiring so that the order of A/B phases follows the FANUC standard phase order† and set this parameter to 0. When the order of A/B phases cannot follow the FANUC standard phase order, set this parameter to 1.
When setting this parameter to 1 for a built-in motor, set bit 3 of parameter No. 4010 to 1 (setting of motor sensor phase order).

NOTE
†) For the order of A/B phases, refer to the separately issued technical report "Connection of 3rd party spindle sensor and Alpha *i* series spindle amplifier" (B-65282EN/06-27, B-65412EN/01-04).

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
MAIN	4017	4017						RFCHK4		
SUB	4193	4193						RFCHK4		

RFCHK4 Z phase detection setting
0 : In the velocity control mode, Z phase detection is not performed.
1 : In the velocity control mode, Z phase detection is also performed.
To use a distance coded sensor, set this parameter to 1.
However, it is necessary to set this parameter to 0 during adjustment. After adjustment, set the parameter back to 1.

0*i*	30*i*	
4623	4623	**Distance coded sensor Nominal increment 1 (MAIN)**
4741	4741	**Distance coded sensor Nominal increment 1 (SUB)**

Unit of data : Number of scale lines
Valid data range : 40 to 4096
Standard setting : Number of scale lines per sensor rotation × 2/number of reference marks

Set the number of scale lines between reference marks 0 and 2 of the distance coded sensor.

Setting: Number of scale lines per sensor rotation × 2/number of reference marks

0*i*	30*i*	
4624	4624	**Distance coded sensor Nominal increment 2 (MAIN)**
4742	4742	**Distance coded sensor Nominal increment 2 (SUB)**

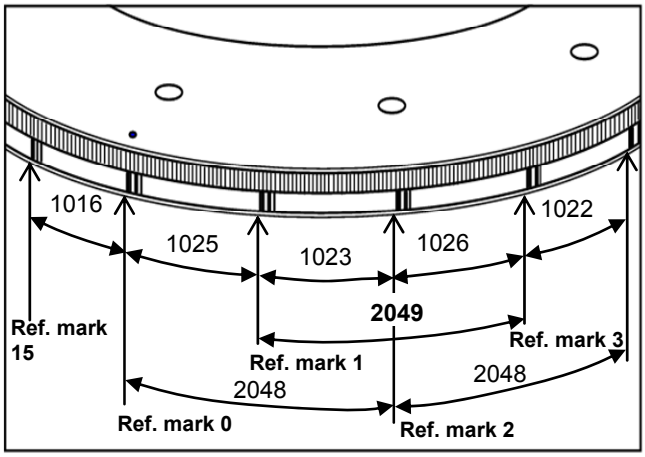
Unit of data : Number of scale lines
Valid data range : 41 to 4097

Set the number of scale lines between reference marks 1 and 3 of the distance coded sensor.

Setting: Number of scale lines per sensor rotation × 2/number of reference marks +1

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■ Example of setting nominal increments 1 and 2
In the following example, the number of sensor scale lines is 16384 and the number of reference marks is 16.
In this case, set parameter No. 4623 to 2048 and parameter No. 4624 to 2049.



0*i*	30*i*	
4625	4625	**Distance coded sensor Z phase position compensation data (MAIN)**
4743	4743	**Distance coded sensor Z phase position compensation data (SUB)**

Unit of data : 1024 = 360 degrees
Valid data range : 0 to 1023

This parameter compensates the unevenness of the position of Z phase signal output.
There is no guarantee that the Z phase signals output from the sensor are just synchronized with the A/B phase signal. The output position might have an error at maximum of ±(line interval)/2 from the ideal position. Use this parameter to eliminate the effect of the unevenness of the position of Z phase signal output on position detection accuracy and to get the correct position per rotation. If this parameter is not adjusted, the detected position might have an error of one line interval from the correct position. Be sure to adjust this parameter.

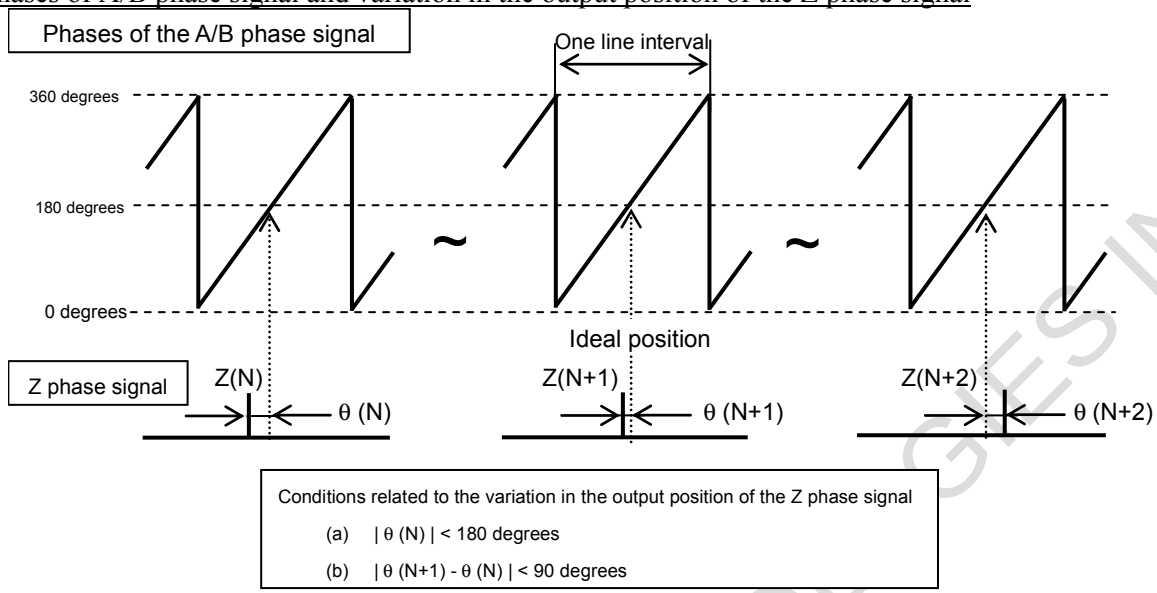
For the adjustment method, see Subsection 5.22.6.

■ Relationships among the phases of the A/B phase signal, the output position of the Z phase signal, and this parameter
The ideal output position of the Z phase signal is out of phase with the A/B phase signal by 180 degrees. The Z phase signal is not output actually at the ideal position.
To prevent the position detection accuracy from decreasing due to the deviation from the ideal position, the detection position is compensated using spindle software. To detect a position accurately, the following conditions must be satisfied:

(a) The total amount of Z phase deviation from the ideal position is under ±180 degrees.
(b) The difference between the deviations from the ideal position of adjacent Z phase signals is under ±90 degrees.

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Phases of A/B phase signal and variation in the output position of the Z phase signal



Conditions related to the variation in the output position of the Z phase signal

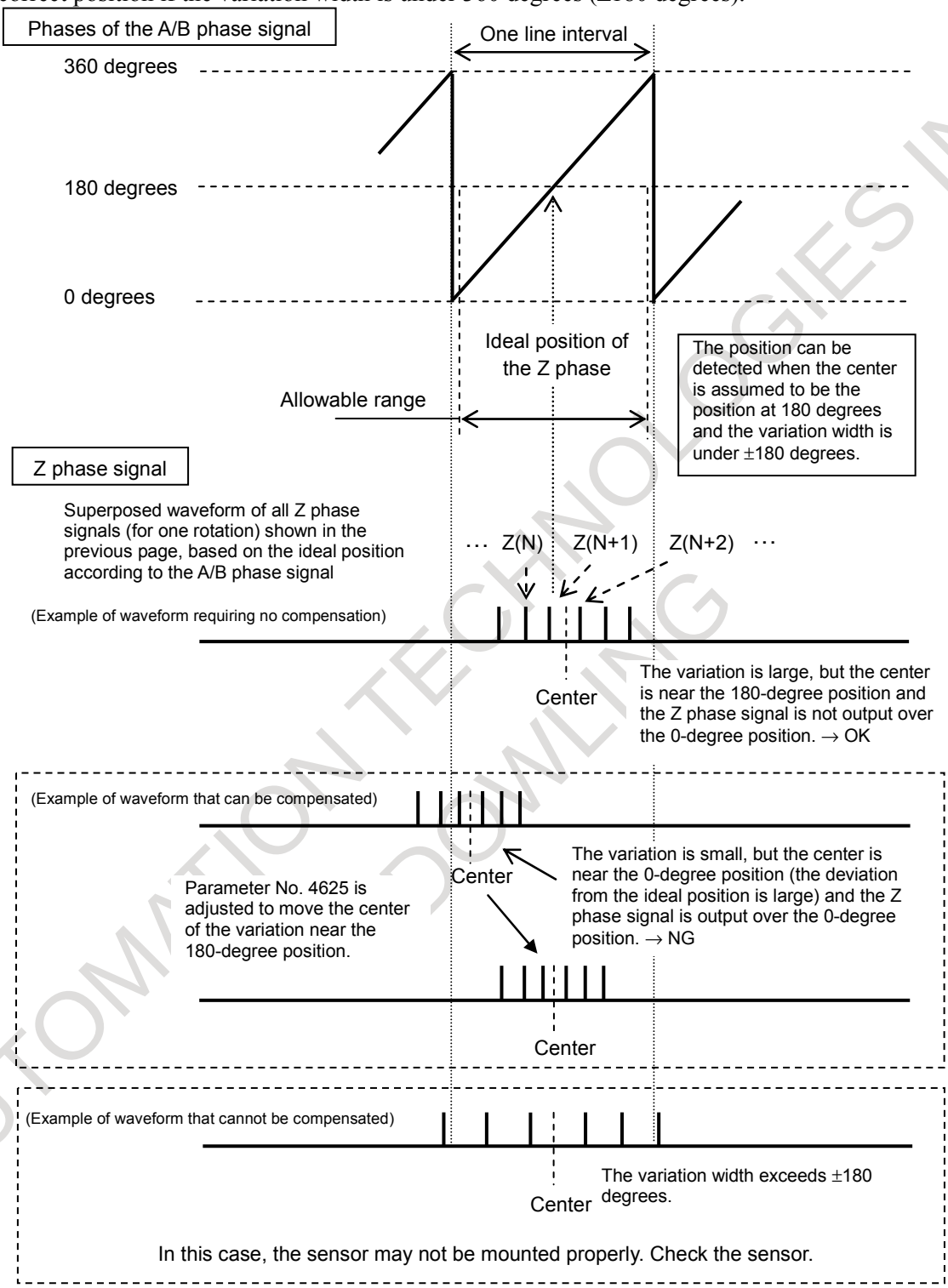
(a) | θ (N) | < 180 degrees

(b) | θ (N+1) - θ (N) | < 90 degrees

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Compensation with parameter No. 4625

Even when condition (a) above is not satisfied, parameter No. 4625 can be adjusted to detect the correct position if the variation width is under 360 degrees (±180 degrees).



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5.22.5 Applicable Sensors

The following tables list the applicable sensors and parameter settings for nominal increments 1 and 2.

ERA4000C series (Heidenhain)

Model	Sensor specifications			Parameter settings	
	Signal	Number of slits	Number of reference marks	Nominal increment 1 (No. 4623)	Nominal increment 2 (No. 4624)
ERA428xC (20 µm)	to 1 Vpp	8192	8	2048	2049
		12000	12	2000	2001
		16384	16	2048	2049
		20000	20	2000	2001
		24000	24	2000	2001
		28000	28	2000	2001
		32768	32	2048	2049
		40000	40	2000	2001
		48000	48	2000	2001
		52000	52	2000	2001
ERA448xC (40 µm)	to 1 Vpp	4096	8	1024	1025
		6000	12	1000	1001
		8192	16	1024	1025
		10000	20	1000	1001
		12000	24	1000	1001
		14000	28	1000	1001
		16384	32	1024	1025
		20000	40	1000	1001
		24000	48	1000	1001
		26000	52	1000	1001
		38000	76	1000	1001
		44000	88	1000	1001
ERA488xC (80 µm)	to 1 Vpp	3000	6	1000	1001
		4096	8	1024	1025
		5000	10	1000	1001
		7000	14	1000	1001
		8192	16	1024	1025
		10000	20	1000	1001
		12000	24	1000	1001
		13000	26	1000	1001

ROD/RON series (Heidenhain)

Model	Sensor specifications			Parameter settings	
	Signal	Number of slits	Number of reference marks	Nominal increment 1 (No. 4623)	Nominal increment 2 (No. 4624)
RON285C RON287C RON785C	to 1 Vpp	18000	36	1000	1001
RON786C	to 1 Vpp	18000	36	1000	1001
		36000	72	1000	1001
RON886C	to 1 Vpp	36000	72	1000	1001
ROD280C	to 1 Vpp	18000	36	1000	1001
ROD780C	to 1 Vpp	18000	36	1000	1001
		36000	72	1000	1001
ROD880C	to 1 Vpp	36000	72	1000	1001

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5.22.6 Checking the Z Phase Signal Interval and Adjusting the output position of the Z phase signal

To use a distance coded sensor, it is necessary to:

- Check that the Z phase signal interval is valid.
- Adjust the parameters for compensating the variation in the Z phase signal output position based on the ideal position.

This section describes the adjustment method using the diagnosis screen.

(1) Checking the Z phase signal interval

(a) Setting parameters

First, set the following parameters.

Parameter No.		Setting	Description
0*i*	30*i*		
No.4017(MAIN) No.4193(SUB) #2	No.4017(MAIN) No.4193(SUB) #2	0	The Z phase signal is not detected in the velocity control mode.
No. 4549#2	No. 4549#2	0	The EGB (FSSB type) function bit is not used. (For synchronization with the servo axis, set this bit to off for adjustment even when using EGB (FSSB type).)
No. 4532	No. 4532	13	Setting for displaying data for adjusting a distance coded sensor (1)
No.4625(MAIN) No.4743(SUB)	No.4625(MAIN) No.4743(SUB)	0	Z phase position compensation data = 0

(b) Checking diagnosis 722

Diagnosis 722 shows data used to determine whether the Z phase signal interval is valid by checking the pulses between adjacent Z phase signals.
Rotate the spindle at S10 to 30 for 10 to 20 seconds in each of the forward and reverse directions (so that the spindle rotates in each direction at least two turns). Confirm that diagnosis 722 always shows 1 when the spindle rotates at a fixed speed.
(When the rotation direction changes, diagnosis 722 shows 0 once.)

When the spindle rotates at a fixed speed, if diagnosis 722 does not always show 1, possible causes are:

- The setting of parameter No. 4623 or 4624 is incorrect.
- The phase order of the sensor A/B phases is reversed.
- The sensor is not mounted properly.

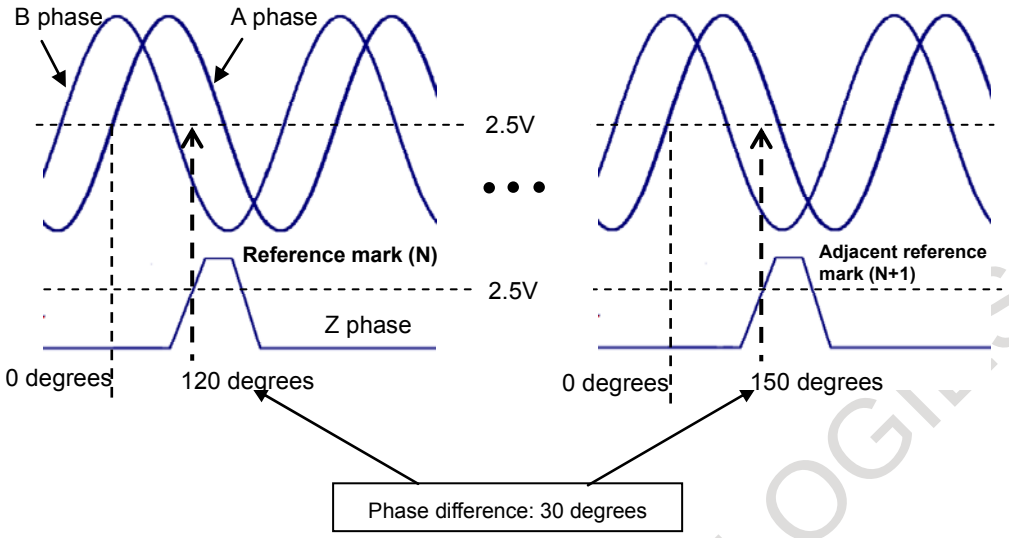
When parameters Nos. 4623 and 4624 are set correctly, set bit 0 of parameter No. 4016 to 1 and check the diagnosis as described above.

* When a motor sensor is used for position detection (built-in motor), if the phase order of the A/B phases of the sensor is incorrect, the spindle does not rotate normally.

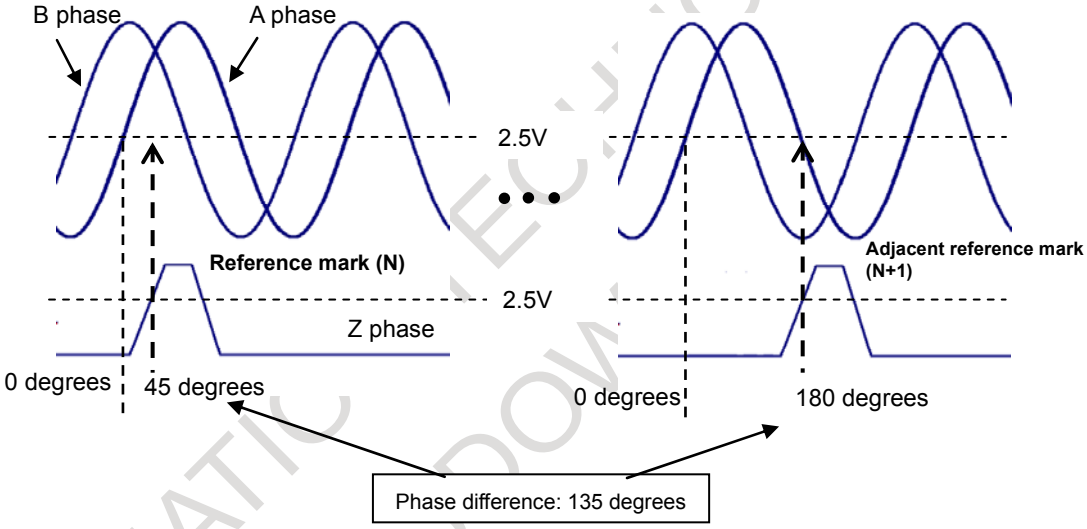
If a problem persists after bit 0 of parameter No. 4016 is set to 1, the sensor may not be mounted properly.
The phase difference based on the A/B phase between adjacent Z phase signals must be under 90 degrees. If this condition is not satisfied, the position cannot be detected correctly.
Check the sensor signals, and adjust the mounting of the sensor so that there is no problem with the relationships between the A/B phase and Z phase output positions (phases).

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[Good example]



[Bad example]



(2) Adjusting Z phase position compensation data (parameter No. 4625)

(a) Setting parameters

At the start of adjustment, set the same parameters as listed in (1) (a).

(b) Adjusting parameter No. 4625

Display data used to determine whether the setting of parameter No. 4625 is appropriate with diagnosis 720.

In the MDI mode (in which parameters can be changed), repeat forward and reverse rotations at about S300 (S300 or less also allowable when there is a mechanical limitation) for about 5 to 10 seconds each.

Repeat forward and reverse rotations several times and check whether the value displayed for diagnosis 720 becomes smaller than 256.

If the value displayed for diagnosis 720 does not become smaller than 256, change the value of parameter No. 4625 in units of 256 (256, 512, and 768) and find the setting with which the value displayed for diagnosis 720 becomes smaller than 256.

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If you cannot find any setting with which the value displayed for diagnosis 720 becomes smaller than 256, sequentially change the value of parameter No. 4625 to 128, 384, 640, and 896 and find the target setting. When you find a setting with which the value displayed for diagnosis 720 becomes smaller than 256, use the setting as the final adjustment value.

If you cannot find any setting with which the value displayed for diagnosis 720 becomes smaller than 256, adjust the value described in (3).

(3) Adjusting Z phase position compensation data (parameter No. 4625) 2

(a) Setting parameters

First, set the following parameters. (Parameter No. 4532 = 14)

Parameter No.		Setting	Description
0*i*	30*i*		
No. 4017#2	No. 4017#2	0	The Z phase signal is not detected in the velocity control mode.
No. 4549#2	No. 4549#2	0	The EGB (FSSB type) function bit is not used. (For synchronization with the servo axis, set this bit to off for adjustment even when using EGB (FSSB type).)
No. 4532	No. 4532	14	Setting for displaying data for adjusting a distance coded sensor (2)
No. 4625	No. 4625	0	Z phase position compensation data = 0

(b) Checking diagnosis 720

Display data for determination with diagnosis 720.
(This data is basically the same as that described in (2) (b). However, this data shows 0 once when the spindle rotation direction changes.)
In the same conditions as described in (2) (b), check the value displayed on the diagnosis screen during forward and reverse rotations and find the setting of parameter No. 4625 with which the value displayed for diagnosis 720 becomes smaller than 256 during rotation in both directions.

When you find a setting with which the value displayed for diagnosis 720 becomes smaller than 256, check the item as described in (3) (c) with the setting.

If you cannot find any setting with which the value displayed for diagnosis 720 becomes smaller than 256, the sensor may not be mounted properly.

(c) Checking diagnosis 722

Display the counter value indicating the number of detected Z phase position errors with diagnosis 722.
Stop the spindle. Set the following parameters and repeat forward and reverse rotations again.

- Set bit 2 of parameter No. 4017 to 1.
- Set bit 7 of parameter No. 4016 to 1. Wait at least 1 second and set bit 7 of parameter No. 4016 back to 0.

In this state, repeat forward and reverse rotations and confirm that diagnosis 722 shows 0.
When diagnosis 722 shows 0, use the setting of parameter No. 4625 as the adjustment value.

If diagnosis 722 does not show 0, return to (3) (b) and find a value with which diagnosis 720 becomes smaller than 256, then check the item as described in (3) (c).

After parameter No. 4625 has been adjusted, set bit 2 of parameter No. 4017 to 1 and adjust Cs contour control grid shift, orientation stop position shift value, and other items.

If you want to use the EGB (FSSB type) function, set bit 2 of parameter No. 4549 to 1.

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5.23 INERTIA ESTIMATION FUNCTION

5.23.1 Overview

This function estimates the load inertia of machine. Generally, the inertia of a table axis remarkably changes when various types of workpieces are mounted on it. You can use this function to optimize the acceleration/deceleration time constant and velocity gains with changes in inertia. This function starts to estimate the load inertia by the PMC signal, and the result of estimation can be found in the diagnostis screen (No, 720).

The inertia estimation has the following two methods
<1> Torque command excitation method: Apply to spindle of direct drive. <2> Speed command excitation method: Apply to spindle has speed reduction mechanism

In addition, there is a simultaneous excitation function (To run the estimation after simultaneous excitation of master and slave axis by entering the inertia estimation start signal to master axis) for the tandem axis in order to estimateinertia in spindle of the tandem drive.

NOTE
1. This function cannot be used when the motor is bound.
2. The estimation error becomes large for a machine with springs or backlash.
3. The estimation precision depends on the machine status. Sufficient examination is required before the use of this function.
4. The Inertia upper limit guideline is calculated by the following equation.

$$(\text{All Inertia [kg.m}^2\text{]}) = \times \frac{(\text{Position gain})}{100} \times (\text{Torqe at Short Time Rated Output [N.m]}) \times \frac{(4.096/\pi)^2}{100}$$

$$= \frac{(\text{Short Time Rated Output [kW]})}{(\text{Short Time Rated Output Base Speed [min}^{-1}\text{]})} \times \frac{3.072 \times 2^{12}}{\pi^3}$$

However, in the case of 9D90 series G (07) to I (09) edition and 9DA0 series I (09) to L (12) edition, inetia upper limit guideline is made to 1/10 of the above calculated value.

5. This function cannot be used with sensorless motor.

5.23.2 Series and Editions of Applicable Spindle Software

Spindle software

Series	Edition	Usable CNC
9D90	G (07)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	I (09)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B/ FS35*i* -B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

For “velocity command excitation method” and “Torque command excitation method”, it can be used from the following spindle software.

Series	Edition	Usable CNC
9D90	U (21)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	X (24)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B/ FS35*i* -B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

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5.23.3 I/O Signals (CNC↔PMC)

(1) Input signals (PMC→CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G304	G304		INESTRA						
2nd-	G308	G308		INESTRB						

INESTR x : Inertia estimation start signal
0 : Disables inertia estimation.
1 : Starts inertia estimation.
When this signal is turned on, inertial estimation starts.

NOTE
1. Keep this signal on until estimation is completed. If this signal is turned off during inertia estimation, the inertia estimation is stopped.
2. When in tandem operation, it is ignored even if this signal is input to tha slave axis. But when the independent operation of the tandem operation off will start the inertia estimation for accepting this signal.
3. In the case of the inertia estimation when in tandem operation, please this signal is input to the mastrer axis. Input to slave axis is not required because the slave axis is smultaneously excited with the master axis by the signal from the master axis to the slave axis is notified.

(2) Output signals (CNC→PMC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F307	F307						INESFNA		
2nd-	F309	F309						INESFNB		

INESFNx : Inertia estimation completion signal
0 : Inertia estimation not completed.
1 : Inertia estimation completed.
When inertial estimation is completed, this signal is turned on.

NOTE
1. After checking that this signal is turned on, turn inertia estimation start signal INESTR off.
2. The slave axis in tandem operation is accepted inertia estimation start signal INESTER to the master axis, and this signal on after estimation completion.

5.23.4 Examples of Sequences

A sample sequence is shown below.

(1) Stop the spindle (in the excitation on state) to provide S0 command and set inertia estimation start signal INESTR to 1.
When in tandem operation, the inertia estimation start signal of masuter axis INESTR to 1. Input is not required for the slave axis.

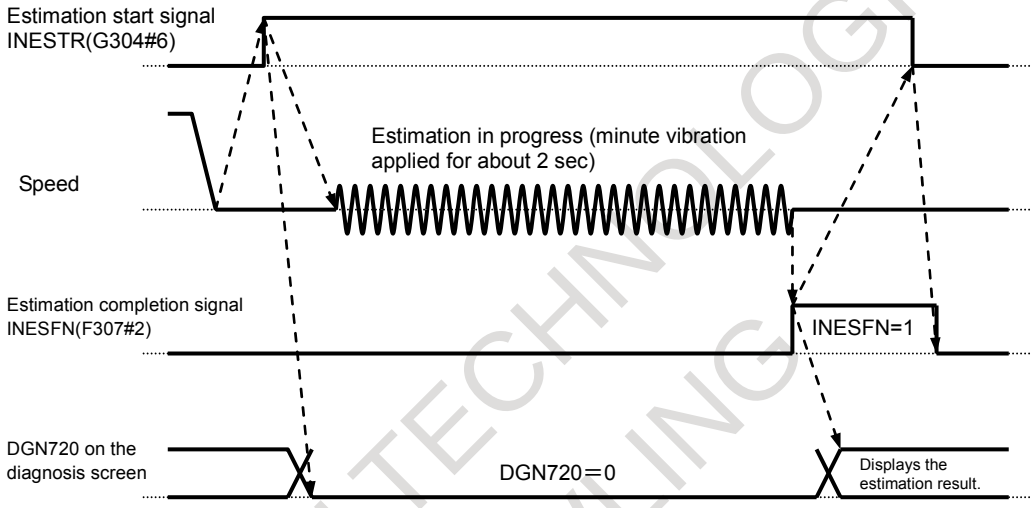
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(2) When the start signal is accepted, the estimated value on the diagnosis screen (DGN720) is cleared and micro vibration is applied to the spindle for about 2 sec.
When in tandem operation, the estimated value of the diagnosis screen (DGN720) in both the axis of the masuter and slave axis is cleared.

(3) When estimation is completed, the result is displayed on the diagnosis screen (DGN720) and estimation completion signal INESFN is set to 1.
When in tandem operation, the results is displayed in the diagnosis screen (DGN720) in both the axis of the masuter and slave axis and the inertia estimation start signal INESTR to 1.

(4) Confirm INESFN = 1, then set estimation start signal INESTR to 0.
The estimation result is kept (to be checked with DGN720) after estimation start signal INESTR is set to 0 until the signal is set to 1 again.

Sample inertia estimation sequence



5.23.5 Related Parameters

This subsection details the parameters related to the inertia estimation function.

NOTE
1. For all parameters of the following for inertia estimation, the masuter and slave axes should be the same setting in the case of tandem axis.
2. For the excitation direction of the slave axis at the time of tandem operation, it is determined by the tadem relationship parameters. Thus, this is not consider if the tandem operation is not ploblem

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4540	4540				INESFC				

INESFC The inertial estimation function is:
0 : Disabled.
1 : Enabled.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4542	4542			INEVCM					

INESFC Select of the inertial estimation mrthod:
0 : Torque command excitation method
1 : Speed command excitation method

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NOTE
This parameter (Speed command excitation method) is valid with spindle software 9D90 series U (21) edition or later and 9DA0 series X (24) edition or later and 9DB0 series A (01) edition or later.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4546	4546	INESGH	INESGL	INESFH	INESFL	INESMG			

INESMG The unit of the diagnosis screen display (DGN720) of the estimated inertia value is:
0 : Standard.
1 : 1/32 of standard.

NOTE
DGN720 may show "-3" after the completion of estimation, which indicates that the estimated value overflows. In this case, set this bit and execute estimation again.

INESFH,INESFL Determines the excitation frequency of the inertia estimation.
0,0 : Standard frequency
0,1 : Low frequency (1/2 of the standard frequency)
1,0 : High frequency (twice the standard frequency)
1,1 : - (Do not set this value.)

INESGH,INESGL Determines the excitation gain of the inertia estimation.
0,0 : Standard gain
0,1 : Low gain (1/2 of the standard gain)
1,0 : High gain (twice the standard gain)
1,1 : - (Do not set this value.)

NOTE
1 If the vibration applied during inertia estimation is too large, decrease the excitation gain and execute estimation again.
2 Error "-1" may be displayed on the diagnosis screen (No. 720), which indicates that the excitation gain is too large. In this case, decrease the excitation gain. If the error still occurs, specify the high frequency value for the excitation frequency.
3 Error "-2" may be displayed on the diagnosis screen (No. 720), which indicates that the excitation gain is too small. In this case, increase the excitation gain. If the error still occurs, specify the low frequency value for the excitation frequency.

0*i*	30*i*	
4588	4588	Inertia estimation excitation frequency

Unit of data : 1Hz
Valid data range : 0 to 200
Initial setting : 5
This parameter sets the excitation frequency for use speed command excitation method. After inertia estimation is performed by initial setteing, you confirm the result of the diagnosis screen (No.720) and adjust setting value. The detail of the diagnosis screen (No.720) wieh reference to the note of parameter No.4546.

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NOTE
This parameter is valid with spindle software 9D90 series U (21) edition or later and 9DA0 series X (24) edition or later and 9DB0 series A (01) edition or later.

0*i*	30*i*	
4589	4589	**Inertia estimation excitation gain**

Unit of data : 0.1 min^{-1}
Valid data range : 0 to 30000
Initial setting : 500
This parameter sets the excitation gain for velocity command excitation method.
After inertia estimation is performed by initial setteing, you confirm the result of the diagnosis screen (No.720) and adjust setting value. The detail of the diagnosis screen (No.720) wieh reference to the note of parameter No.4546.

NOTE
This parameter is valid with spindle software 9D90 series U (21) edition or later and 9DA0 series X (24) edition or later and 9DB0 series A (01) edition or later.

0*i*	30*i*	
4609	4609	**Inertia estimation Friction compensation**

Unit of data : TCMD (16384 equivalent to the maximum torque)
Valid data range : 0 to 8192
Standard setting : 0
This parameter eliminates the effect of friction. Set the absolute value of the torque command for rotation at about 10 min^{-1}.

NOTE
Normally, set 0 since friction is assumed to be small. When friction is small, you do not always need to set this parameter.

0*i*	30*i*	
4532	4532	**Arbitrary data output function number**

Unit of data :
Valid data range : 0 to 32767
Standard setting : 0
Set "11" to check the estimated inertia value on the diagnosis screen (No. 720).

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NOTE
1 A workpiece of which the true inertia value (J0) is known can also be measured. In this case, the ratio of the estimated inertia of another workpiece (Je) to the obtained estimated value (result of diagnosis screen No. 720) (Je0) can be used to obtain actual inertia.
J = (Je/Je0)*J0
2 If the acceleration that can be measured is exceeded, estimation is stopped and "-1" is displayed on diagnosis screen No. 720. Decrease the input gain and execute estimation again.
3 If correct calculation cannot be made since the measured acceleration is too small, "-2" is displayed on diagnosis screen No. 720. Increase the input gain and execute estimation again.
4 If the calculation result overflows, "-3" is displayed on diagnosis screen No. 720. Change the display unit to 1/32 (set bit 3 of parameter No. 4546 to 1) and execute estimation again.
5 In case of tandem operation, the sum of estimation values obtained in both axes is the inertia estimation value of machine.

5.23.6 Using the Inertia Estimation Function

This subsection describes preparations and method for using the inertial estimation function.

(1) Adding PMC ladder processing
To use the inertial estimation function, add ladder processing as described in Subsection 5.23.4, "Examples of Sequences" above.

(2) Measuring friction
Measure friction. Rotate the spindle at 10 min^{-1} and set the absolute value of the torque command value (TCMD) during rotation to parameter No. 4609 (friction compensation). When using the SERVO GUIDE for measurement, set TCMD for Data type and Conv. Coef and Conv. Base both to 1. You can read the displayed value as is.
When friction is small, you do not need to set friction.

(3) Checking the result of inertia estimation
Estimate inertia when the maximum and minimum workpieces of which the actual inertia value is known are mounted and confirm that the ratio of the estimation result displayed on the diagnosis screen and actual inertial ratio match.
In case of tandem operation, the sum of estimation values obtained in both axes is the inertia estimation value of machine.

(Estimated Jmax value)/(estimated Jmin value) ≒ (Jmax + Jm)/(Jmin + Jm)
(Estimated Jmax value): Inertia value estimated with the maximum workpiece
(Estimated Jmin value): Inertia value estimated with the minimum workpiece
Jmax: Actual inertia value of the maximum workpiece
Jmin: Actual inertia value of the minimum workpiece
Jm: Actual motor inertia value

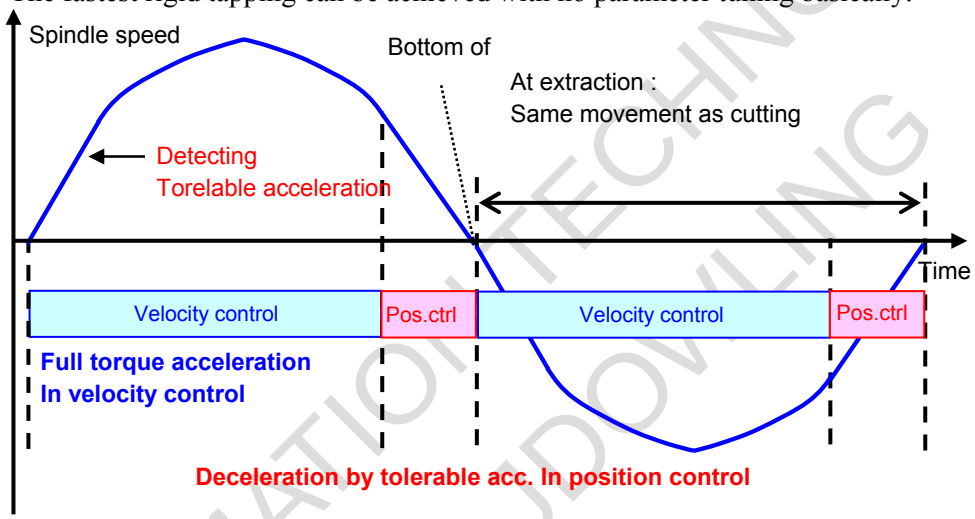
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(4) Using the inertia estimation function effectively
When a workpiece is mounted, adjust the acceleration/deceleration time constant and velocity gains, and also execute inertia estimation. Save the inertia estimation result as the initial value.
When a workpiece with different inertia is mounted, execute inertia estimation. After that, compare the inertia estimation result with the initial value and change the acceleration/deceleration time constant and velocity gains according to the ratio.
The optimum velocity gains are not always proportional to the inertial change ratio. Verify the data sufficiently in advance.
Acceleration/deceleration data are automatically changed after the inertia estimate by Smart Feed Axis Acceleration/Deceleration for Cs contour control (basic function). For details, refer to "Smart Feed Axis Acceleration/Deceleration" of the Connection Manual (Function) of each CNC.

5.24 SMART RIGID TAPPING

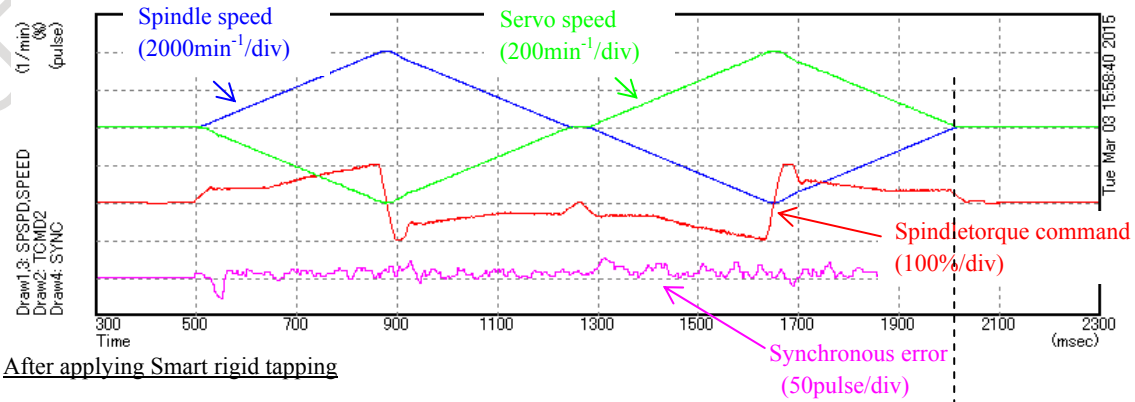
5.24.1 Overview

Smart rigid tapping is the tapping function that uses maximum spindle power in all speed range. As the servo axis follows spindle axis with using FSSB communication, the synchronous error is small.
The fastest rigid tapping can be achieved with no parameter tuning basically.

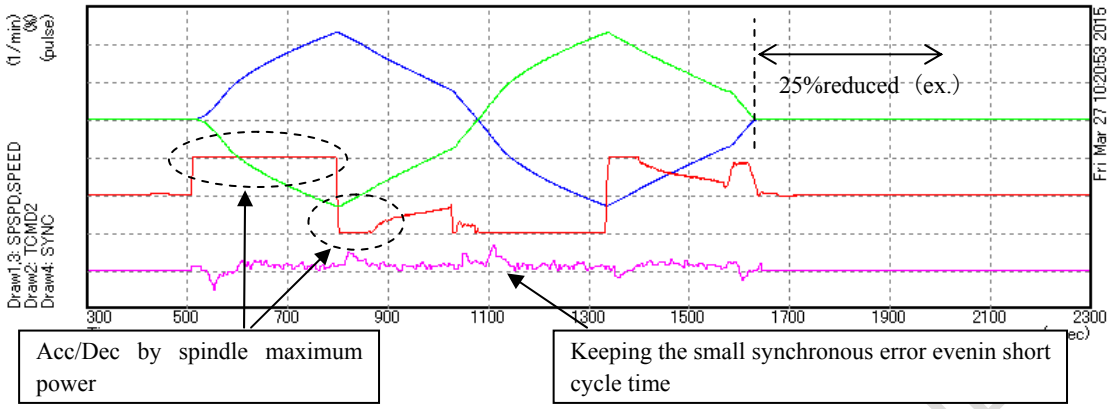


- Application example of smart rigid tapping (Pitch 1mm, Length25mm)

Before applying Smart rigid tapping



After applying Smart rigid tapping



NOTE
1 This function cannot be used with sensorless motor.

5.24.2 Series and Editions of Applicable Spindle Software

Spindle software

Series	Edition	Usable CNC
9DAA	G(07)	FS30*i* / FS31*i* / FS32*i* / FS35*i* -B, FS0*i* -F
9DB0	F(06)	FS30*i* / FS31*i* / FS32*i* / FS35*i* -B, FS0*i* -F

CNC software

Series	Edition	Usable CNC
G301/G311 G321/G331 G351	75.0	FS30*i* -B
G421/G431	75.0	FS31*i* –B5
G401/G411	75.0	FS31*i* –B
G441	13.0	FS31*i* –B(for Function for transfer line)
G501/G511	75.0	FS32*i* –B
G541	13.0	FS32*i* –B(for Function for transfer line)
G641	13.0	FS35*i* –B(for Function for transfer line)
D4G1/D6G1	13.0	FS0*i* –F

Improvement of servo motor deactivation when spindle alarm occurs during smart rigid tapping, default value change of parameter No.5214 are applied to the following system software.

CNC software

Series	Edition	Usable CNC
G301/G311 G321/G331 G351	80.0	FS30*i* -B
G421/G431	80.0	FS31*i* –B5
G401/G411	80.0	FS31*i* –B
G501/G511	80.0	FS32*i* –B
D4G1/D6G1	18.0	FS0*i* –F

Addition of parameter to change behavior of rigid tapping during dry run is applied to the following system software.

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CNC software

Series	Edition	Usable CNC
G301/G311 G321/G331 G351	81.0	FS30*i* -B
G421/G431	81.0	FS31*i* –B5
G401/G411	81.0	FS31*i* –B
G501/G511	81.0	FS32*i* –B
D4G1/D6G1	19.0	FS0*i* –F

5.24.3 System Configuration

If rigid tapping is a usable system, smart rigid tapping is available. Refer to Section I 2.3.4, "Rigid Tapping System Configuration" for rigid tapping is available.

NOTE
If you use rough TTL resolution sensor such as ai Positioncoder (4096pulse/rev) in spindle position sensor, there is a possibility that the vibration or strange sound might be detected due to the following movement of servo axis to rough feedback data. We don't recommend to use such sensors for Smart rigid tapping. Please use analog 1Vpp sensor or serial type sensor.

5.24.4 I/O Signals and Sequence

The DI/DO signals and PMC sequence for ordinal rigid tapping can be used without any chnage.
There is no special DI/DO signals and PMC sequence for Smart rigid tapping.
Regarding DI/DO signals and PMC sequence, please refer to the chapter of "Rgid tapping" in Connection manual (Function) of each CNCs.

5.24.5 Setting for FSSB high-speed rigid tapping

Set all parameters related to FSSB high-speed rigid tapping so that the servo axis follows spindle axis. The detail of setting parameters are shown in the chapter "FSSB high-speed rigid tapping" in Connection manual (Function) of each CNCs.

5.24.6 Related parameters

After setting of following parameters the settings for Smart rigid tapping will be finished in case that the settings for Normal rigid tapping has been already done. In case that the settings for Normal rigid tapping has not been done yet, please do it with referring to chapter 7 of this document or the chapter of "Rigid tapping" in Connection manual(Function) , or the chapter of "Rigid tapping" in Spindle motor parameter manual.

Parameter No. 0*i*/30*i*	Description	Setting
5206#1	Smart rigid tapping function bit	1
2423#2	Setting for the compensation of reverse operation in Smart rigid tapping	1
5214	Setting of an allowable rigid tapping synchronous error range	0
4105 4107	Time constant of magnetic flux for Magnetic flux control	Specific parameter for each motor
4661	Tolerable error value at spindle stop	0

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5.24.7 Detail of related parameters

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
5206	5206							SRT	

SRT Smart rigid tapping function bit
0: Function invalid
1: Function valid

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
2423	2423						RGDBLA		

RGDBLA Setting for the compensation of reverse operation in Smart rigid tapping
0: Compensation invalid
1: Compensation valid

0*i*	30*i*	
5214	5214	**Setting of an allowable rigid tapping synchronous error range**

Unit of data : 1/4096 revolution of spindle
Data range : 0～99999999
Standard setting : 0

The excessive error value is specified by No.5214 and No.4661 in Smart rigid tapping. The allowable rigid tapping synchronous error should be set in No.5214. If the synchronous error becomes over this value, the alarm (SP0741) will occur.
The setting value 0 is treated as 400. The standard setting value is 0, but please change it if you need.
By the way, in case that Smart rigid tapping is not used and the setting value is 0, the synchronous error check is neglected.
The setting value 0 is treated as 100 in former CNC software.

0*i*	30*i*	
4105	4105	Time constant of magnetic flux for Magnetic flux control (for high-speed output switching characteristics)
4107	4107	Time constant of magnetic flux for Magnetic flux control (for low-speed output switching characteristics)

The magnetic flux control is used to suppress the swelling of output power at acc./dec. in induction motors. These parameters are used for the function and the value is specific constant in each motor. When you use Smart rigid tapping, the setting of this parameter is necessary. If these parameters are 0 even after automatic parameter initialization, please ask FANUC of the setting value.

NOTE
When you use synchronous spindle motor (No.4012#6=1), the magnetic flux control is not necessary. Please don't set these parameters.

0*i*	30*i*	
4661	4661	**Tolerable error value at spindle stop**

Unit of data : 1/4096 revolution of spindle
Data range : 0～2048
Standard setting : 0

The tolerable error value at spindle stop should be set in No.4661. If the error at spindle stop becomes over this value, the alarm (SP9170) will occur.
The setting value 0 is treated as 1024. The standard setting value is 0.

That's all for using Smart rigid tapping basically.

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5.24.8 Setting for each machine

As Smart rigid tapping accelerates by maximum spindle power, the tuning is not necessary basically. But there may be some cases that a shock occurs in servo axis which follows spindle acc./dec. by maximum power. In such case, please use following parameters.

5.24.8.1 Related parameters

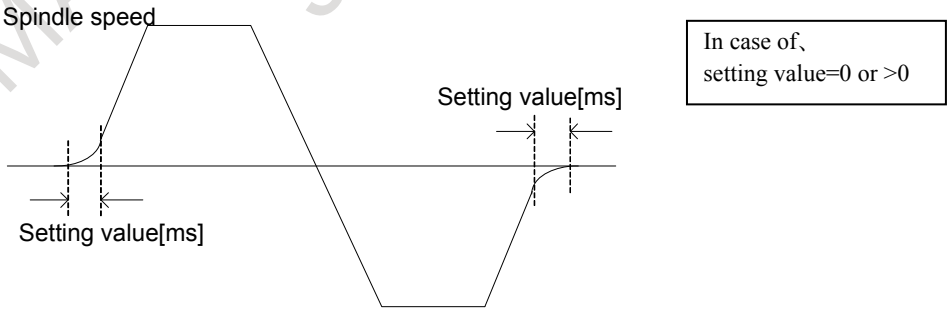
Parameter No. 0*i*/30*i*	Description	Setting
4666 4667	Bell shape acc./dec. time constant for Smart rigid tapping	0
4668 4669	Upper limit of torque command for Smart rigid tapping	0
4395#5	Improvement of deceleration for Smart rigid tapping	0
4790	Lower limit of torque command for Smart rigid tapping in position control	0
2611	Coefficient of velocity feed-forward for feed axis in Smart rigid tapping	0
2613	Compensation of reverse operation in Smart rigid tapping	0

5.24.8.2 Detail of related parameters

0*i*	30*i*		
4666	4666	Bell shape acc./dec. time constant for Smart rigid tapping	**CTH1A=0**
4667	4667	Bell shape acc./dec. time constant for Smart rigid tapping	**CTH1A=1**

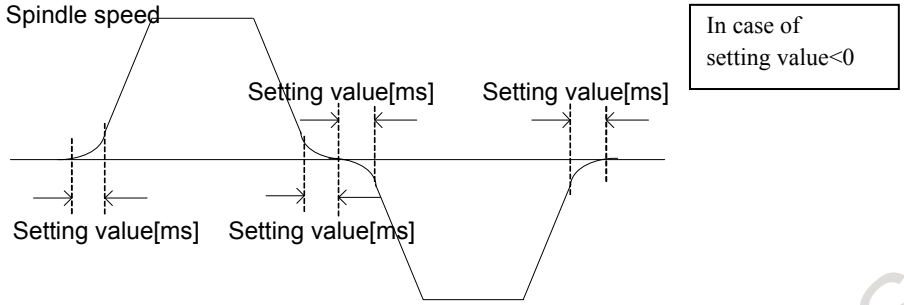
Unit of data : 1ms
Data range : -180～180
Standard setting : 0

These parameters specify the bell shape acc./dec. time constant at starting from R point or ending point to R point. If there is a shock at acceleration or at deceleration in servo or spindle axis, please tune these parameters. The setting value 0 is treated as 30 (30ms).



When the setting value is negative, the bell shape acc./dec. becomes effective also at bottom of tap.

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0*i*	30*i*		
4668	4668	Upper limit of torque command for Smart rigid tapping	**CTH1A=0**
4669	4669	Upper limit of torque command for Smart rigid tapping	**CTH1A=1**

Unit of data : 1%
Data range : 0～100
Standard setting : 0

These parameters specify the upper limit of torque command for Smart rigid tapping. If the following limits have been already applied, they are valid also in Smart rigid tapping.

- Torque limit by parameter No.4025 and DI signal TLMH,L
- Power limit by by parameter No.4028 and 4029

In such cases, it's not necessary to set these parameters. The setting value 0 is treated as 100 (100%).

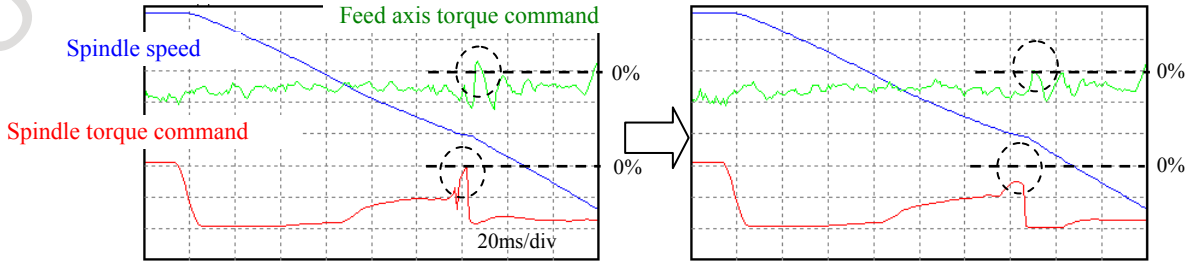
0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4395	4395		SRTDIF						

SRTDIF Improvement of deceleration for Smart rigid tapping
0: Invalid
1: Valid

These are some cases that shock sounds can be heard in the feed axis at the point where the spindle control changes from velocity control to position control during deceleration in tapping, if the torque command for spindle reverses and the torque command for feed axis reverses also as the result.

When this improvement becomes valid, the change from velocity control to positon control in spindle becomes smooth, and reverse of the spindle torque command is suppressed.

When you can't suppress shock sounds even if this improvement is applied, please use No.4790 together to set lower limit of torque command.



No.4395#5=0 No.4395#5=1

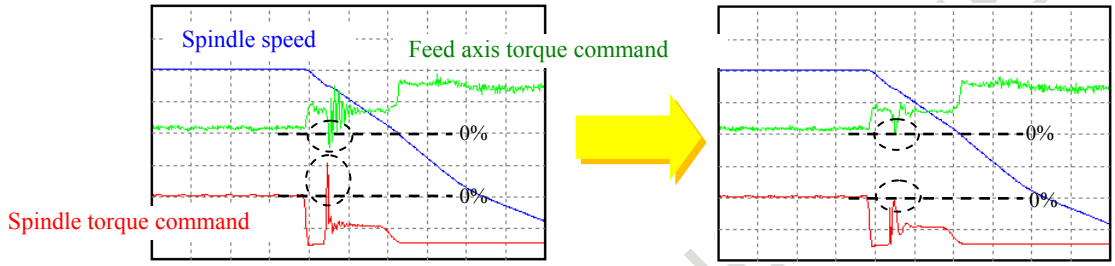
NOTE
1 This parameter is valid with 9DAA series K(11) edition or later and 9DB0 series K(11) edition or later or later.

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0i	30i	
4790	4790	Lower limit of torque command for Smart rigid tapping in position control

Unit of data : 1%
Data range : 0～25
Standard setting : 0

This parameter specifies the lower limit of torque command for spindle in position control and it clamps the torque command so that the torque command for spindle doesn't reverse in above cases. When you don't want the spindle torque command becomes under n%, please set "n" in this parameter.
If you set "0" in this parameter, the clamp of torque command is not done.



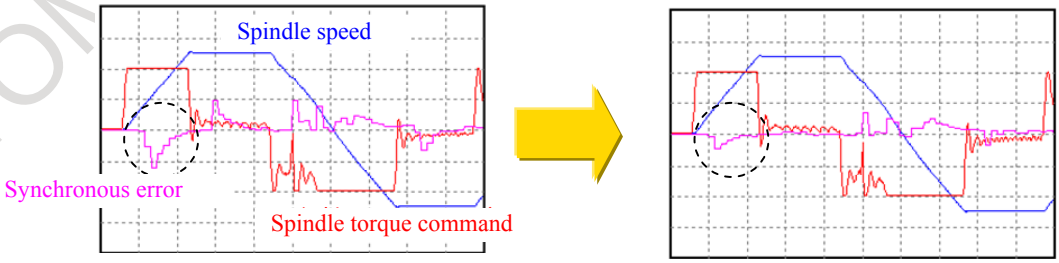
No.4790=0 No.4790=5

NOTE
1 This parameter is valid with 9DAA series J(10) edition or later and 9DB0 series J(10) edition or later or later.

0i	30i	
2611	2611	Coefficient of velocity feed-forward for feed axis in smart rigid tapping

Unit of data : 1%
Standard setting : 0

Use this parameter to improve the axis response in case that the synchronous error is large at the start point of tapping as follow figure. Please increase this value to every 100 with watching the synchronous error. There is a possibility that the torque command of servo axis might become vibrating at acc./dec. if the value is too large.



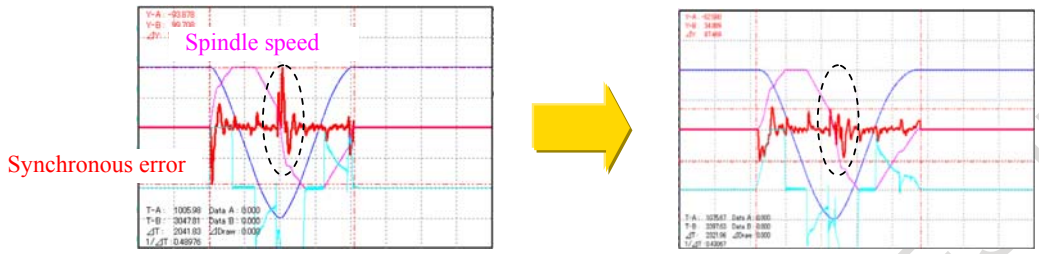
No.2611=0 No.2611=350

0i	30i	
2613	2613	Compensation of reverse operation in Smart rigid tapping

Unit of data : 0.01%
Data range : 0～10000
Standard setting : 0

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Use this parameter to improve the axis response in case that the synchronous error becomes large at the reversal point of tapping. Please increase this value to every 100 with watching the synchronous error.



No.2613=0 No.2613=700

5.24.9 Setting for Smart thermal control

As Smart rigid tapping uses maximum spindle power in tapping, there is a possibility that the motor overheat alarm (SP9001) might occur in severe duty tapping.
Smart thermal control uses the spindle motor power at the best without motor overheat. It suppresses the acc./dec. power of the motor automatically when the motor winding temperature draws to the overheat level. (Regarding the detail of Smart thermal control, please refer to section 5.25, “Smart thermal control”, in Part I)
Smart thermal control can’t be used together with the position contro l such as Normal rigid tapping or Cs contouring control, but it can be used together with Smart rigid tapping. As you can continue to do machining without the stop of the machine, the using of Smart rigid tapping and Smart thermal control together is recommended.

NOTE
1 When the power suppression is done, the time of tapping will become longer. If there is something PMC sequence that watches time, there is a possibility that the sequence might be out of timing by Smart rigid tapping.
2 With the following series and editions, smart thermal control take the overheat of amplifier into account so far. It suppresses the acc./dec. power of the motor automatically when the load of amplifier draws to the overload level.
9DAA series H(08) edition or later
9DB0 series H(08) edition or later

5.24.10 Setting for rigid tapping during dry run

Rigid tapping during dry run can be selected by bit 2 (NSD) of parameter No.5206 from Smart rigid tapping or ordinal FSSB high-speed rigid tapping. Set 1 to bit 2 (NSD) of parameter No.5206 which is described below if you make override effective during dry run.

- Bit 2 (NSD) of parameter No.5206 is 0
  Rigid tapping during dry run is Smart rigid tapping
  - Feedrate cannot be changed by manual feedrate override signal *JV0 to *JV15<Gn010, Gn011> or manual rapid traverse selection signal RT<Gn019.7>.
  - If dry run is canceled during Smart rigid tapping in dry run, feedrate is maintained until finishing tapping.
  - If dry run is switched during Smart rigid tapping, feedrate is maintained until finishing tapping.

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- Bit 2 (NSD) of parameter No.5206 is 1
  Rigid tapping during dry run is ordinal FSSB high-speed rigid tapping
  - Feedrate can be changed by manual feedrate override signal *JV0 to *JV15<Gn010, Gn011> or manual rapid traverse selection signal RT<Gn019.7>.
  - If dry run is canceled during FSSB high-speed rigid tapping in dry run, feedrate is changed from dry run feedrate to feedrate commanded in machining program.
  - If dry run is switched during Smart rigid tapping, Smart rigid tapping is continued and feedrate is maintained until finishing tapping.
  - Acc./dec. time constant setting is necessary because ordinal FSSB high-speed rigid tapping is executed during dry run. Adjustment of optimal time constant is unnecessary. Set relative long time constant such as 500[msec] to parameter No.5261 to No.5264. Refer to "7.2. Parameter list related to Normal rigid tapping" for detail.

5.24.10.1 Detail of related parameters

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
5206	5206							NSD	

NSD Rigid tapping during dry run is:
0: Smart rigid tapping (change of manual feedrate override signal *JV0 to *JV15<Gn010, Gn011> or manual rapid traverse selection signal RT<Gn019.7> is not effective.)
1: FSSB high-speed rigid tapping (Change of manual feedrate override signal *JV0 to *JV15<Gn010, Gn011> or manual rapid traverse selection signal RT<Gn019.7> is effective.)

5.24.11 Tuning of Rigid tapping

5.24.11.1 Common used parameter list

The following parameter list show the common used parameters both for Normal rigid tapping and Smart rigid tapping. In case that the tuning for Normal rigid tapping has finished, it's not necessary to change these parameters. Regarding the detail of each parameter, please refer to the chapter of "Rigid tapping" in Connection manual (Function) or the section 2.3.8 "Rigid tapping details of related para,eters" in Part I.

Parametr No. 0*i*/30*i*	Description
5210	M code of rigid tapping command
5202#0	Whether to perform orientation (reference position return) when starting rigid tapping
5221 5222 5223 5224	Teeth number of spindle side at arbitrary gear ratio (command) setting (No.5224 is used for the T series only.)
5231 5232 5233 5234	Teeth number of position coder side at arbitrary gear ratio (command) setting (No.5234 is used for the T series only.)
5241 5242 5243 5244	Spindle maximum speed at rigid tapping (No.5244 is used for the T series only.)
5200#4	Override selection at extracting
5211	Override value at extracting

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Parametr No. 0*i*/30*i*	Description
5300 5302 5304 5306	In-position width of tapping axis
5301	In-position width of spindle
4000#4	Reference position return direction on servo mode
4002#5	Whether to enable the rotation direction signal (SFR/SRV) on servo mode
4006#7	Setting of the command arbitrary gear ratio function (CMR) on rigid tapping
4017#7	Shortcut function when orientation is specified in stop state
4044 4045	Velocity loop proportional gain on servo mode (It is selected by input signal CTH1A/B.)
4052 4053	Velocity loop integral gain on servo mode (It is selected by input signal CTH1A/B.)
4056～4059	Gear ratio between spindle and motor (It is selected by input signal CTH1A or CTH2A)
4065～4068	Spindle position gain on servo mode/spindle synchronous control (It is selected by input signal CTH1A or CTH2A)
4073	Grid shift amount on servo mode
4074	Reference position return speed on servo mode
4091	Position gain change ratio at reference position return time on servo mode
4099	Delay time for stable motor excitation
4171 4173	Denominator of an arbitrary gear ratio between the motor sensor and spindle (It is selected by input signal CTH1A or CTH2A.)
4172 4174	Numerator of an arbitrary gear ratio between the motor sensor and spindle (It is selected by input signal CTH1A or CTH2A.)
4406	Acceleration/deceleration time constant for Cs contouring control/servo mode

5.24.11.2 Parameter list related to Normal rigid tapping

In case of the retraction of rigid tapping after the breakage of tool on cutting by Smart rigid tapping, Normal rigid tapping is necessary even if Smart rigid tapping. To use Normal rigid tapping, the setting of time constant parameter for acc./dec. The following list shows the tuning parameter for Normal rigid tapping. In case that the tuning for Normal rigid tapping has finished, it's not necessary to change these parameters. Regarding the detail of each parameter, please refer to the chapter of "Rigid tapping" in Connection manual (Function) or section I 2.3.8, "Details of related parameters".

Parameter No. 0*i*/30*i*	Description
5280 5281～5284	Position gain of tapping axis at rigid tapping (No. 5284 is used for the T series only.)
5261 5262 5263 5264	Acc/Dec time constant (No. 5264 is used for the T series only.)
5201#2 5271～5274	Time constant at retraction (No. 5274 is used for the T series only.)
5203#2	Feed-forward function at rigid tapping

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Parameter No. 0*i*/30*i*	Description
5310 5350 5354 5358	Allowable level of position error of tapping axis at moving
5311	Allowable level of position error of spindle at moving
5312 5352 5356 5360	Allowable level of position error of tapping axis at stop
5313	Allowable level of position error of spindle at stop
5203#5	Selection of bell shape acc./dec. for rigid tapping (CNC software option)
5365 5366 5367 5368	Bell shape acc./ dec. time constant for rigid tapping (No. 5368 is used for the T series only.)
4037	Velocity loop feed-forward coefficient
4344	Advanced preview feed-forward coefficient (This parameter sets the coefficient for rapid traverse when bit 4 of parameter No.4542 is 1.)
4542#4	Cutting feed/rapid traverse feed-forward function
4627	Advanced preview feed-forward coefficient for cutting feed (This parameter is valid when bit 4 of parameter No. 4542 is 1.)

5.24.12 Notes and Restrictions

1. You can't use Smart rigid tapping in the following conditions.
   - Using sensor-less motors as spindle motor
   - Using Spindle differential speed control

2. Smart rigid tapping becomes invalid in the following kinds of rigid tappings. In these cases, Normal rigid tapping will be executed. When you use them, please set some parameters such as time constant which are shown in "5.24.11.2.Parameter list related to Normal rigid tapping".
   - Peck rigid tapping
   - Rigid tapping by manual handling feed
   - Extraction in rigid tapping
   - Rigid tapping during tool center point control
   - Interpolation type rigid tapping
   - Rigid tapping using Spindle control by servo motor
   - Rigid tapping by analog spindle

3. In the situation that plural spindle axes are synchronized by Spindle command synchronous control mode, Smart rigid tapping becomes invalid. PS0203 alarm "PROGRAM MISS AT RIGID TAPPING" will occur.

4. Smart rigid tapping becomes invalid in the checking mode in manual handle retrace. In the mode, Normal rigid tapping will be executed.

5. As Smart rigid tapping executes acc./dec. by spindle maximum power, Acc./dec. after interpolation and Look-ahead acc./dec. before interpolation become invalid.

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6. In Smart rigid tapping over-ride signals for feed axes *FV0-*FV7<Gn012> and over-ride cancel signalOVC<Gn006.4> become invalid even if parameter OVC(No.5403#4)=1. Over-ride for extraction of rigid tapping is valid.

7. In Smart rigid tapping the backlash compensation for spindle becomes invalid. The backlash compensation for feed axis becomes valid.

8. In Smart rigid tapping the interlock and mashinelock becomes invalid. These functions become valid after the end of Smart rigid tapping.

9. In Smart rigid tapping feed hold and single block become invalid. The axes don't stop until the end of 1cycle of tapping.

10. Reset and emergency stop during Smart rigid tapping make velocity command 0 stop.

11. It's impossible to change feedrate by external deceleration during Smart rigid tapping. Feedrate at starting cutting or extraction is maintained.

12. The following functions become invalid during Smart rigid tapping
    - Active block cansel function
    - Feed stop function
    - General purpose retract
    - Tool retract and recover
    - One-digit F code feed
    - Manual handle interrupt
    - Pulse superimposed function

13. When you use 3-dimensional rigid tapping, please set 1 to D3R(No.1121#1).

14. The following settings are not supported for Smart rigid tapping axis.
    - Slave axis of superimposed control
    - Slave axis of flexible synchronization control
    - Slave axis of electronic gear box

15. When SRT(No.5206#1) is 1 and the spindle software, which doesn't support Smart rigid tapping, is used, alarm PS0564 "ILLEGAL COMMAND OF SMART RTAP " will occur at rigid tapping.

16. Alarm (SV0048) "SMART RIGID TAPPING STOP" will occur with the following alarms during Smart rigid tapping and the excitation of servo motor will be turned off. Alarm (SV0048) can be canceled with reset.
    - Alarm (SP9xxx) (when spindle motor is deactivated)
    - Alarm (SP0741) (when synchronous error range exceeds the setting value of parameter (No.5214))

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5.24.13 Alarm

Alarm No.	Description
SP0741	The synchronous error in rigid tapping is larger than the setting of No. 5214
SP9068	The reason of this alarm is in the followings. • Time constant of magnetic flux for Magbetic flux control (No.4105, No.4107) is 0. • The functions which can not be used together with Smart rigid tapping are applied. - Sensor less motor drive - Spindle differential speed control
SP9170	The spindle position error at stop exceeds the setting value in No.4661.
PS0564	The command for Smart rigid tapping is illegal. The reason of this alarm is in the followings. • The moving distance of feed axis is larger than 4096 times of screw pitch. • The used spindle software doesn't support Smart rigid tapping.
SV0048	The excitation of servo motors is turned off because smart rigid tapping is stopped. This alarm is accompanied by spindle alarm.

5.25 SMART THERMAL CONTROL

5.25.1 Overview

"Smart thermal control" is the function to make best use the output of spindle motors as far as motor overheat alarm (SP9001) and current overload alarm (SP9054) do not occur. When motor winding temperature approaches an overheat alarm level, spindle software limits the acc./dec. output of the motor automatically.
In the processing that a spindle motor repeats acceleration and deceleration frequently, continuation of the processing will be enabled with avoiding motor overheat. In addition, due to the bad cooling environment for the motor, there are some cases that heat radiation becomes not enough. In such cases also, motor overheat alarm might occur even in the processing under the continuous rated output. But you can avoid the motor overheat by applying this function.

NOTE
1 Basically this function limits the output automatically during the acc./dec. in non-cutting of velocity control mode. But as the limit of the output automatically becomes valid during Constant surface speed control also, please be careful about cutting conditions of the case.
2 When the output limitation is performed during acc./dec. , acceleration time and deceleration time will be extended. If there is a program which proceeds the sequence with monitoring time, there is a possibility that the timing of the sequence might shift by this function. Please take care of it.
3 This function can be used with sensorless motor.

5.25.2 Series and Editions of Applicable Spindle Software

Spindle software

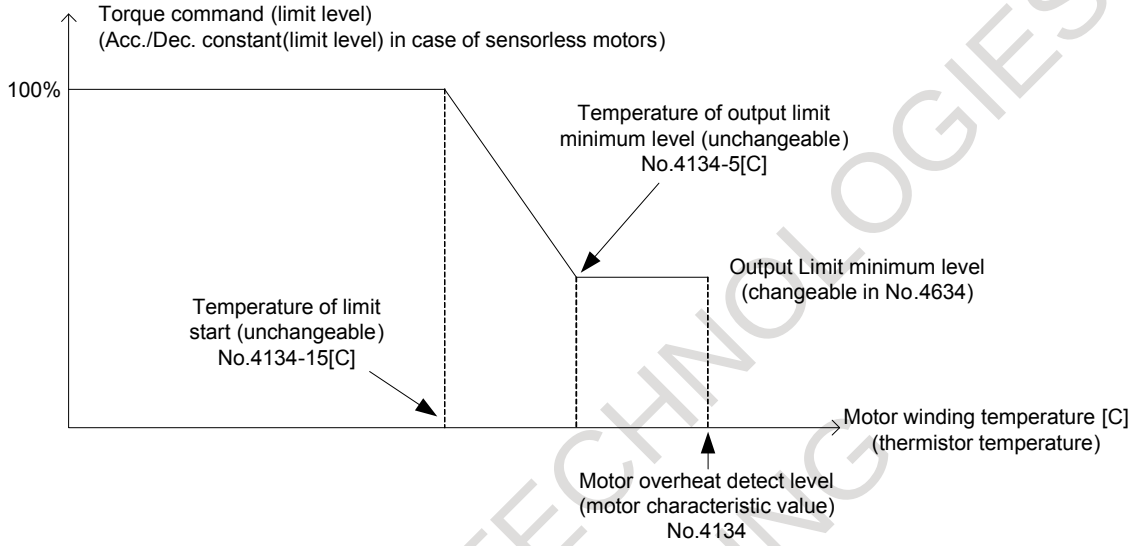
	Series	Edition	Usable CNC
αi, βi, Bi, series Induction motor /synchronous motor	9D5A	U (21)	FS0*i* -D
	9D5D	I (09)	FS0*i* -D
	9D7A	J (10)	FS30*i* / FS31*i* / FS32*i* –A
	9D8A	H (08)	FS30*i* / FS31*i* / FS32*i* –A, FS0*i* -D
	9D90	W (23)	FS30*i* / FS31*i* / FS32*i* –A, FS0*i* -D
	9DAA	A (01)	FS30*i* / FS31*i* / FS32*i* / FS35*i* -B, FS0*i* -D, FS0*i* -F
	9DB0	A (01)	FS30*i* / FS31*i* / FS32*i* / FS35*i* -B, FS0*i* -D, FS0*i* -F

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	Series	Edition	Usable CNC
βilc series sensorless motor	9DB0	M (13)	FS30*i* / FS31*i* / FS32*i* / FS35*i* -B, FS0*i* -F

5.25.3 Specification

Smart thermal control monitors motor winding temperature (thermistor temperature) and, according to the limit curve of torque command shown in the figure below, torque command will be limited.



Example:

	Overheat detect level [C]	Temperature of output limit start [C]	Temperature of output limit minimum level [C]
Motor winding temperature	110 (=No.4134)	95 (=No.4134-15)	105 (=No.4134-5)

5.25.4 I/O Signals (CNC↔PMC)

(1) Address list of output signals (CNC→PMC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F306	F306								STCSTA
2nd-	F308	F308								STCSTB
3rd-	F310	F310								STCSTC
4th-	F312	F312								STCSTD

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F048	F048						ARDSTA		
2nd-	F052	F052						ARDSTB		
3rd-	F171	F171						ARDSTC		
4th-	F269	F269						ARDSTD		

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(2) Details of output signals (CNC→PMC)

(a) Temperature state signal of Smart thermal control (STCST)

0 : Motor winding temperature doesn't reach the output limit start level.
1 : Motor winding temperature reaches the output limit start level.

This signal is used to show whether winding temperature reaches output limit start level or not. It becomes "1" when the motor winding temperature reaches the output limit start level , irrespective of actual output power limitation.

(b) Output power limitation signal of Smart thermal control (ARDST)

0 : Output power limitation is not working.
1 : Output power limitation is working.

This signal is used to show actual output power limitation state of Smart thermal control. As output power limitation does not work in position control and cutting feed even motor winding temperature reaches the temperature to limit the output power (refer to section 5.25.9), the signal becomes "0".

NOTE
This signal can be used with 9D9A/C(03), 9DAA/G(07), and 9DB0/F(06) edition or later. To use this signal, setting No.4532=21 is necessary.

5.25.5 Related Parameters

Parameter No.					Contents	Setting
Induction / Synchronous				Sensorless		
MAIN SPINDLE		SUB SPINDLE		-		
High	Low	High	Low	-		
-	-	-	-	4069 4070 4071 4072	Sensorless motor acceleration / deceleration constant	Depends on the model (0 in invalid)
4634	4635	4764	4765	4634	Output limit minimum level	Depends on the model
4127	4093	4274	4279	4127	Load meter value at maximum output	Depends on the model
4543#2	←	←	←	4543#2	Valid of invalid in Constant surface speed control	Depends on the model
4532	←	←	←	4532	Arbitrary data output function number	21

5.25.6 Details of Related Parameters

0*i*	30*i*	
4634	4634	**Smart thermal control_output limit minimum level (MAIN SPINDLE HIGH)**
4635	4635	**Smart thermal control_output limit minimum level (MAIN SPINDLE LOW)**
4764	4764	**Smart thermal control_output limit minimum level (SUB SPINDLE HIGH)**
4765	4765	**Smart thermal control_output limit minimum level (SUB SPINDLE LOW)**

Unit of data : %
Data range : 0 to 100
Standard setting : 0, the value that is calculated from the parameter for load mater value at maximum output such as No.4127
Please set (100/ the parameter for load mater value at maximum output)*100.

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When you set this value, at the temperature near the overheat detection level, the output will be limited to the continuous rated level. If overheat occurs during the processing even under the continuous rated output due to the bad cooling environment, please reduce this setting value.

(Example) When the parameter for load meter value at maximum output (MAIN SPINDLE HIGH) is "150" (No.4127=150), setting value is "67" (No.4634=(100/150)*100=67).
When setting value is "0", this function becomes invalid.

0*i*	30*i*	
4127	4127	**Load meter value at maximum output (MAIN SPINDLE HIGH)**
4093	4093	**Load meter value at maximum output (MAIN SPINDLE LOW)**
4274	4274	**Load meter value at maximum output (SUB SPINDLE HIGH)**
4279	4279	**Load meter value at maximum output (SUB SPINDLE LOW)**

Unit of data : %
Data range : 0 to 32767
Standard setting : Motor characteristic value
This value is used for calculation of Smart thermal control output limit minimum level.

For sensorless motor

0*i*	30*i*	
4069	4069	**Acceleration/deceleration constant (MAIN SPINDLE HIGH)**
4070	4070	**Acceleration/deceleration constant (MAIN SPINDLE LOW)**
4071	4071	**Acceleration/deceleration constant (SUB SPINDLE HIGH)**
4072	4072	**Acceleration/deceleration constant (SUB SPINDLE LOW)**

Unit of data : $1min^{-1}/sec$
Data range : 0 to 32767
Standard setting : 900
These parameters set an acceleration/deceleration constant calculated from the motor output torque and spindle inertia and adjust acceleration/deceleration time.
A parameter is selected by the input signals CTH1A and CTH2A. The initial setting value "900" assumes that linear acceleration/ deceleration is performed with the 30-minute rated torque at the maximum motor speed, with an inertia three times as large as the rotor inertia of the motor. It is assumed that all (βiIc series spindle motors satisfy this initial value. So, there is a margin with some motor models.
For each machine, find a load inertia, and assign the found value to the following expression to calculate an acceleration/deceleration constant for setting:

$$Tc = T/(Jm+Jl) \times (60/2\pi)$$
$$= P/N \times (60/2\pi)/(Jm+Jl) \times (60/2\pi)$$
$$= P/N/(Jm+Jl) \times (60/2\pi)^2$$

Tc $[min^{-1}/sec]$:Acceleration/deceleration constant
Jm $[kgm^2]$:Motor rotor inertia
Jl $[kgm^2]$:Load inertia in terms of motor axis
T [Nm] :30-minute tated torque
P [kW] :30-minute rated output
N $[min^{-1}]$:Motor speed

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[Rotor inertia and torque data of standard models]

Motor model	βiIc3	βiIc6	βiIc8
Rotor inertia Jm [kgm^2]	0.0078	0.0148	0.0179
15-minute rated torque at base speed T [Nm]	35.02	47.76	70.04

NOTE
1 The initial setting value satisfies a value calculated with N = maximum speed and Jl = Jm×3.
2 A maximum specifiable acceleration/deceleration constant is based on N = base speed.
3 "0"setting is not available for Smart thermal control function.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4543	4543						STCCSS		

STCCSS When cutting feed is performed by Constant surface speed control, the output power limitation by Smart thermal control is
0: valid
1: invalid
When this bit parameter is set to "0", output power limitation by Smart thermal control is valid regardless of working Constant surface speed control works. In this case, surface speed may become inconstant by Smart thermal control.
When you don't want to do the output power limitation by Smart thermal control during cutting, please set "1" in this bit parameter. By this setting, Smart thermal control becomes invalid during cutting regardless of working Constant surface speed control.

NOTE
This bit parameter can be used with 9D90/X(24), 9DAA/B(02), and 9DB0/A(01) edition or later.

0*i*	30*i*	
4532	4532	**Arbitrary data output function number**

Unit of data : --
Data range : 0 to 32767
Standard setting : To display power limiting value calculated by Smart thermal control, set "1" in this parameter.
Diagnosis No.720:
"0" is displayed when Smart thermal control be turn off (No.4634=0).
Power limiting value is display no matter motor power is limited or not, If Smart thermal control be turn on.
Diagnosis No.722:
Always "0"

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5.25.7 Diagnosis (Diagnosis Screen)

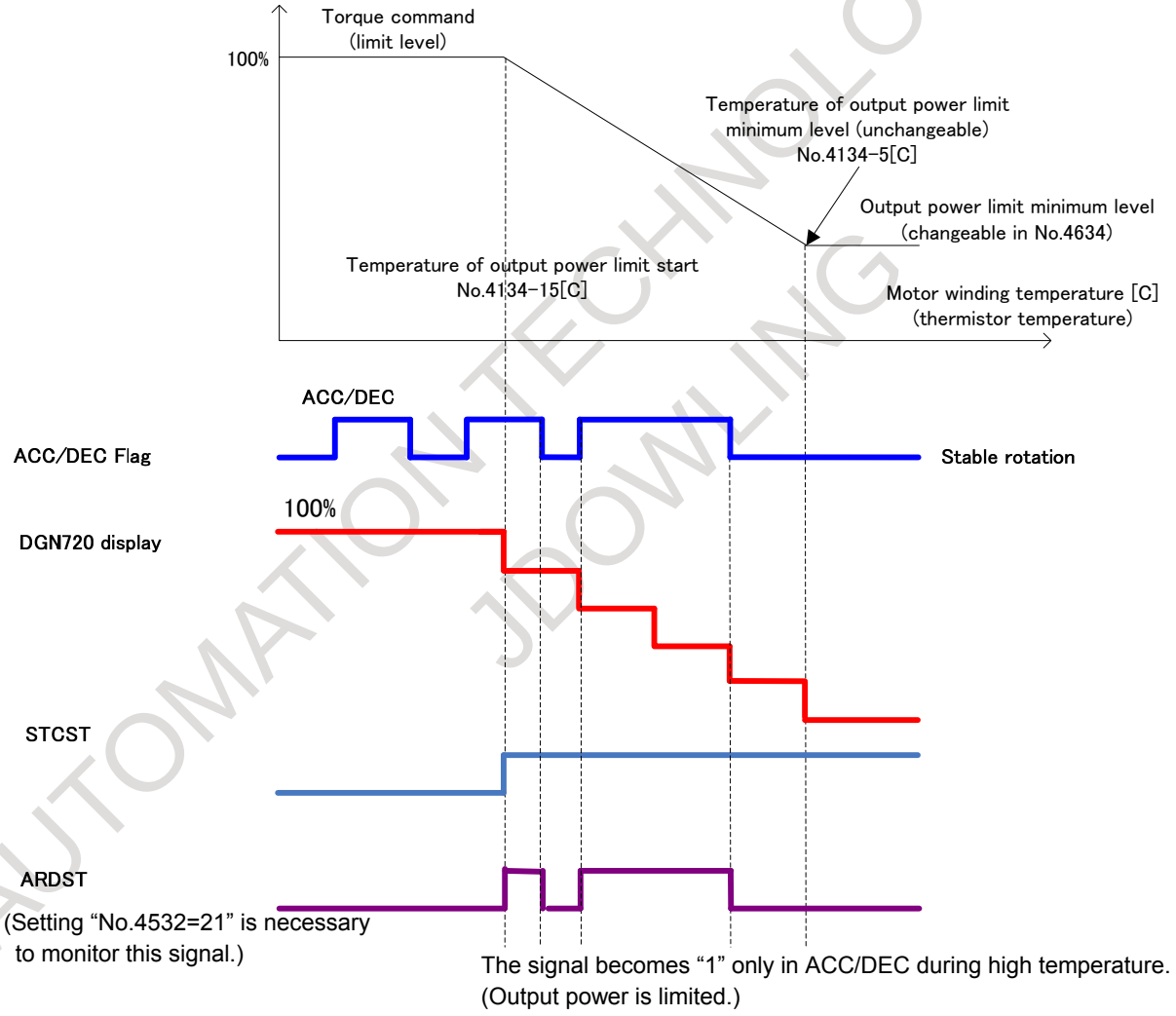
Address	Description	Unit
0720	Output power limitation ratio of Smart thermal control	%

Output power limitation ratio calculated by smart thermal control function is shown.

When the motor winding temperature is low, it shows 100(%). When the motor winding temperature goes over the temperature to limit the output power, it shows the limited value calculated by Smart thermal control. Even in case that the output power does not limit actually (refer to section 5.25.9), the limited value calculated by Smart thermal control is shown.

When Smart thermal control function is turned off (No.4634=0), it always becomes ”0”.

5.25.8 Example of signal



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5.25.9 Note

1. Basically this function works during acc./dec. in non-cutting of the velocity control mode. As the power is not limited in the following cases even if you use this function, please take care of it.
   - Constant speed in the velocity control mode
   - Rigid tapping mode (Smart thermal control is enabled during Smart rigid tapping)
   - Cs contouring control mode
   - Spindle synchronous control mode
   - Cutting mode (Example: Threading)
   - Spindle orientation till spindle axis stops after the one-rotation signal detection (The output is limited till one-rotation signal is detected.)

2. When parameter No.4543#2 is set to "0" or spindle software is not supported parameter No.4543#2, this function works during cutting by Constant surface speed control also. As this function limits the output to continuous rated level at the maximum, please take care of cutting conditions when you use this function.

5.26 COUPLING FAILURE DETECTION BETWEEN A SPINDLE AND A SPINDLE MOTOR

5.26.1 Overview

This function detects the slack and rupture of the belt, which couples a spindle with a spindle motor, using information of spindle sensor and motor sensor.
There are following two kinds of detection methods, and the both detection methods can be applied together.

- The method by monitoring motor rotation amount between neighboring one-rotation signals on a spindle
  This method outputs alarm if the number of feedback pulses from the motor sensor between neighboring one-rotation signals on a spindle becomes larger than setting value.
  Even in the system using only the external one-rotation signal without any spindle position sensor, this method is available. Because only one-rotation signal is necessary for this method.

- The method by monitoring speed deference between a spindle and a spindle motor
  This method outputs alarm if speed difference between a spindle speed and a spindle motor speed converted into spindle speed in consideration of the reduction ratio becomes larger than setting value.
  Spindle position sensor is necessary to use this function.

Method	Features
The method by monitoring motor rotation amount between neighboring one-rotation signals on a spindle	**Configuration:** Spindle position sensor is not necessary. (The device to output a one-rotaton signal is necessary.) **Merit:** Even when the spindle speed is fast, the delay of failure detection is small. **Demerit:** As this method detects failure only when one-rotation signal is detected, failure detection might be delayed when spindle speed is slow.
The method by monitoringspeed deference between a spindle and a spindle motor	**Configuration:** Spindle position sensor is necessary. **Merit:** Even when the spindle speed is slow, the delay of failure detection is small. **Demerit:** As a filter is applied for the data of speed deference, failure detection might be delayed a little when spindle speed is fast.

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NOTE
1 This function cannot be used with sensorless motor.

5.26.2 The method by monitoring motor rotation amount between neighboring one-rotation signals on a spindle

5.26.2.1 Series and Editions of Applicable Spindle Software

Spindle software

Series	Edition	Usable CNC
9D5A	U (21)	FS0*i* -D
9D5D	I (09)	FS0*i* -D
9D7A	J (10)	FS30*i* / FS31*i* / FS32*i* –A
9D8A	H (08)	FS30*i* / FS31*i* / FS32*i* –A, FS0*i* -D
9D90	V (22)	FS30*i* / FS31*i* / FS32*i* –A, FS0*i* -D
9DA0	Y (25)	FS30*i* / FS31*i* / FS32*i* / FS35*i* -B, FS0*i* -D, FS0*i* -F
9DB0	A (01)	FS30*i* / FS31*i* / FS32*i* / FS35*i* -B, FS0*i* -F

5.26.2.2 Applicable system configuration

A sensor, which outputs a one-rotation signal, is necessary to use this function. Even in the configuration using only an external one-rotation signal (proximity switch) in a spindle, this function is available. But it is not available in the axes, which use the sensor of serial output type and Distance coded encoder. When those sensors are used, please use the method by monitoring speed deference between a spindle and a spindle motor described in section 5.26.3.

5.26.2.3 Related Parameters

Parameter No. 0*i*/30*i*	Description	Setting
4005#5 4006#1	Setting for resolution of gear ratio	Motor characteristic value
4056~4059	Gear ratio between spindle and motor (It is selected by input signal CTH1A or CTH2A)	Motor characteristic value
4637 4767	Coupling failure alarm detection level (The method by monitoring motor rotation amount between neighboring one-rotation signals on a spindle)	20
4532	Arbitrary data output function number	19

5.26.2.4 Details of Related Parameters

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4005	4005			GRUNT1					
4006	4006							GRUNIT	

GRUNIT Setting 1 for resolution of gear ratio
GRUNT1 Setting 2 for resolution of gear ratio
Standard setting: 0

Set resolution of gear ratio. Unit of gear ratio parameter (No.4056~4059) is changed by these settings. The combination of parameter settings and the resolution is as follows.

(GRUNIT,GRUNT1)=(0,0):(1/100)

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(GRUNIT,GRUNT1)=(1,0):(1/1000)
(GRUNIT,GRUNT1)=(0,1):(1/10)
(GRUNIT,GRUNT1)=(1,1): There is no setting resolution

0*i*	30*i*		
4056	4056	**Gear ratio (HIGH)**	**CTH1A=0,CTH2A=0**
4057	4057	**Gear ratio (MEDIUM HIGH)**	**CTH1A=0,CTH2A=1**
4058	4058	**Gear ratio (MEDIUM LOW)**	**CTH1A=1,CTH2A=0**
4059	4059	**Gear ratio (LOW)**	**CTH1A=1,CTH2A=1**

Unit of data : (Number of motor revolution per spindle one revolution) / (setting resolution for gear ratio)
Data range : 0 to 32767
Standard setting : 100

These data are used to set the gear ratio between a spindle and a spindle motor.
Example: Assume that the motor rotates 2.5 revolution per the spindle one revolution and the setting resolution for gear ration is 1/100, please set "2.5/(1/100)=250" as the data.

0*i*	30*i*	
4637	4637	**Coupling failure alarm detection level (The method by monitoring motor rotation amount between neighboring one-rotation signals on a spindle) (MAIN SPINDLE)**
4767	4767	**Coupling failure alarm detection level (The method by monitoring motor rotation amount between neighboring one-rotation signals on a spindle) (SUB SPINDLE)**

Unit of data : 0.1rev(considering not in motor side but in spindle side)
Data range : 0, 15 to 255 (from 1.5 to 25.5rev)
Standard setting : 0
Initial setting : 20

Motor rotation amount between neighboring one-rotation signals on a spindle is monitored and Coupling failure alarm (SP9168) will be output when it becomes excessive. As the number of motor revolution is counted using the value converted in consideration of a gear ratio in spindle control software, please set the parameter value considering not in motor side but in spindle side. For example, assume that "20" is set in this parameter, the alarm will occur, the motor rotates more than the number equivalent to 2 times of spindle rotation when the spindle rotates 1 revolution.
When setting value is "0", alarm detection becomes invalid.

By the influence of the slipping of the belt, motor rotation amount between neighboring one-rotation signals on a spindle may slightly change. With setting the following parameter, the maximum motor rotation amount between neighboring one-rotation signals on a spindle can be confirmed on the diagnosis screen. After you confirm the maximum value of motor rotation in the normal operation, please set the value considering in spindle side with some margin. (See section 5.26.2.5)

0*i*	30*i*	
4532	4532	**Arbitrary data output function number**

Unit of data :
Data range : 0 to 32767
Standard setting : 19

When this parameter is set to 19, the present value and the maximum value of the motor rotation amount between neighboring one-rotation signals on a spindle can be confirmed on the diagnosis screen. Both the present value and the maximum value are shown as absolute value.

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Diagnosis No.720: The present value of motor rotation amount between neighboring one-rotation signals on a spindle to monitor SP9168 (Unit of data: 1pulse means 1/4096rev of motor)

Diagnosis No.722: The maximum value of motor rotation amount between neighboring one-rotation signals on a spindle to monitor SP9168 (Unit of data: 1pulse means 1/4096rev of motor)

After Coupling failure alarm (SP9168) occurred, the displayed value is held until alarm reset. It is cleared by the following operations.

- Gear switching or spindle switching
- Spindle alarm reset
- Turning off the power of the CNC

5.26.2.5 Setting procedure of the alarm detection level

1. After you check that the state of coupling between the spindle and the spindle motor is normal, set the following parameters.
   - Resolution setting for gear ratio (No.4006#1,No.4005#5: It depends on machine configuration)
   - Gear ratio (No.4056~4059: It depends on machine configuration)
   - Arbitrary data output function number (No.4532=19)
   - Alarm detection level (No.4637=0)

2. After you operate a machine, confirm the maximum value of motor rotation amount between neighboring one-rotation signals on a spindle in No.722 on a diagnosis screen.
   When the spindle and the motor are coupled with V belt, there is a possibility that large fluctuation of motor rotation amount between neighboring one-rotation signals on a spindle occurs by the influence of the slipping of belt in the following operations. It is recommended that you confirm the maximum value with doing the following operations to prevent miss-detection of the alarm.
   - Acceleration and deceleration with the maximum torque up to maximum spindle speed. (Forward rotation and reverse rotation)
   - Cutting with the maximum load

   As the displayed values on the diagnosis screen is cleared by gear switching or spindle switching, please confirm the displayed values before these operations.

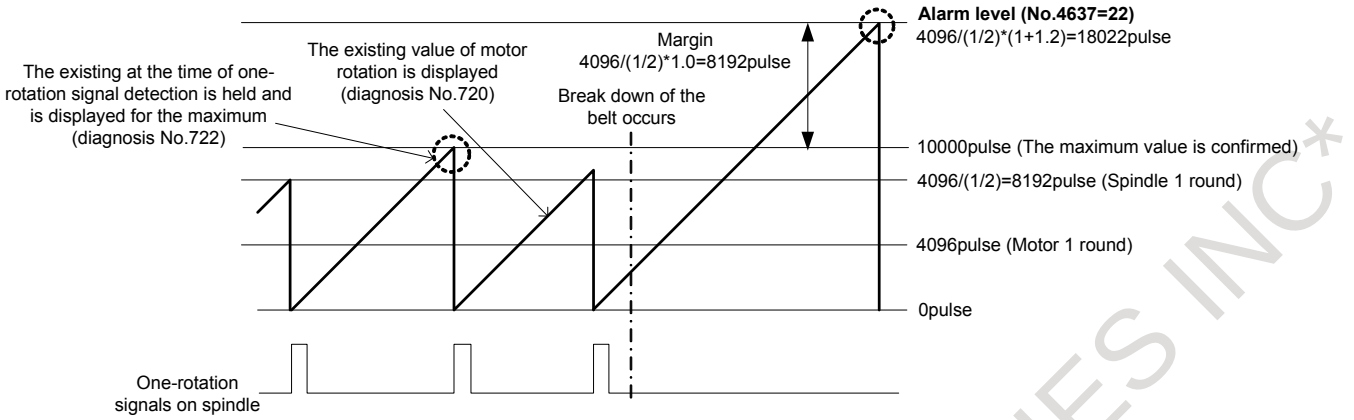
3. You calculate how much spindle rotations the maximum motor rotation amount, which is confirmed in 2 as counted in unit pulse (1pulse means 1/4096rev of motor), becomes at considering in spindle side. Please divide the maximum motor rotation amount by 4096pulse/(reduction ratio).

4. You set a value got in 3 with some margin as alarm detection level parameter (No.4637).

We show a concrete setting example as follows.

(Example) The axis that has 1:2 gear ratio between spindle and spindle motor coupled with the belt (reduction ratio 1/2)

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- When you select 1/10 as setting for resolution of gear ratio, you should set No.4005#5=1 and No.4006#1=0.
  And as the gear ratio is 1/2, you should set 20 in No.4056-4059 for the settings of gear ratio
  And please set No.4532=19 and No.4637=0 also.

- The motor rotation amount per spindle one revolution is 8192pulse (4096/(1/2)=8192), because the reduction ratio is 1/2. When the coupling between the spindle motor and the spindle are normal, the maximum value of the motor rotation should be around 8192 in diagnosis No.722. But if there is a slip of the coupling belt, the value might become larger one. Suppose that you see 10000 as maximum value in diagnosis No.722 in this example.

- The rotation amount 10000 pulses in motor side equal to 10000/8192≈1.2 revolutions considering in spindle side.

- Suppose that the margin for the alarm is spindle 1 revolutio.

- Please set the value with the margin (considering in spindle side) as alarm detection level parameter. (No.4637=(1.2+1)/(0.1rev.)=22) (equivalent to spindle 2.2 revolutions)

5.26.2.6 Alarm

Alarm No.	Description
SP9168	When the motor rotation amount per spindle one revolution becomes larger than coupling failure alarm detection level, spindle alarm SP9168 will be output. The alarm reset is possible, and the values shown on the diagnosis screen are cleared at the time of the alarm reset.

5.26.2.7 Note

- When setting value is other than “0” in alarm detection level parameter, motor rotation amount is always monitored regardless of the operating modes (Velocity control mode or Position control mode).

- In the speed zero state (SST signal =1), the alarm detection becomes invalid. The update of the value shown on the diagnosis screen is stopped, too.

- When the spindle uses Distance Coded Encoder, the alarm detection is invalid. The update of the value shown on the diagnosis screen is stopped, too.

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5.26.3 The method by monitoring speed deference between a spindle and a spindle motor.

5.26.3.1 Series and Editions of Applicable Spindle Software

Spindle software

Series	Edition	Usable CNC
9D90	V (22)	FS30*i* / FS31*i* / FS32*i* –A, FS0*i* -D
9DA0	Y (25)	FS30*i* / FS31*i* / FS32*i* / FS35*i* -B, FS0*i* -D, FS0*i* -F
9DB0	A (01)	FS30*i* / FS31*i* / FS32*i* / FS35*i* -B, FS0*i* -F

5.26.3.2 Applicable system configuration

When the spindle sensor outputs A/B phase signal, this function is available. If there is an only external one-rotation signal (proximity switch) to the spindle, this function is unavailable.

5.26.3.3 Related Parameters

Parameter No. 0*i*/30*i*	Description	Setting
4171~4174	Arbitrary gear ratio between the motor sensor and spindle (It is selected by input signal CTH1A.)	Motor characteristic value
4638	Coupling failure alarm detection level (The method by monitoring speed deference between a spindle and a spindle motor)	Refer to section 5.26.3.5
4532	Arbitrary data output function number	20

5.26.3.4 Details of Related Parameters

0*i*	30*i*		
4171	4171	**Denominator of arbitrary gear ratio between motorsensor and spindle (HIGH)**	**CTH1A=0**
4172	4172	**Numerator of arbitrary gear ratio between motorsensor and spindle (HIGH)**	**CTH1A=0**
4173	4173	**Denominator of arbitrary gear ratio between motorsensor and spindle (LOW)**	**CTH1A=1**
4174	4174	**Numerator of arbitrary gear ratio between motorsensor and spindle (LOW)**	**CTH1A=1**

Unit of data :
Data range : 0 to 32767
Standard setting : 0

It is necessary to set the arbitrary gear ratio to convert motor speed into spindle speed.
When the spindle rotates Q revolutions while the motor shaft rotates P revolutions (Regarding P and Q, there is no common divisor other than 1.), settings are:

No.4171 (No.4173 when CTH1A=1) =P
No.4172 (No.4174 when CTH1A=1) =Q

If one of these parameter is “0”, it is assumed to be “1”.
The parameter for the SUB spindle is No.4243 to No.4246

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0*i*	30*i*	
4638	4638	**Coupling failure alarm detection level (The method by monitoring speed deference between a spindle and a spindle motor)**

Unit of data : 0.1min^{-1} (considering not in motor speed but in spindle speed)
Data range : 0 to 32767 (0 to 3276.7min^{-1})
Standard setting : See section 5.26.3.5.

When speed deference between a spindle speed and a spindle motor speed converted into spindle speed by reduction ratio become larger than coupling failure alarm detection level, coupling failure alarm (SP9168) occurs. (The conversion from the spindle motor speed to the spindle speed is calculated automatically in the spindle control software.)

When setting value is "0", alarm detection is invalid.
This parameter is common in MAIN SPINDLE and SUB SPINDLE.

With setting the following parameter, you can confirm the maximum value of the speed deference between a spindle and a spindle motor. After you confirm the maximum value the normal operation, please set a value bigger than the confirmed value in this parameter. (See section 5.26.3.5.)

0*i*	30*i*	
4532	4532	**Arbitrary data output function number**

Unit of data :
Data range : 0 to 32767
Standard setting : 20

When this parameter is set to 20, the present value and the maximum value of speed deference between a spindle and a spindle motor can be confirmed on the diagnosis screen. Both the present value and the maximum value are shown as absolute value.

Diagnosis No.720: The present value of speed deference between a spindle and a spindle motor to monitor SP9168 (Unit of data: 0.1min^{-1})

Diagnosis No.722: The maximum value of speed deference between a spindle and a spindle motor to monitor SP9168 (Unit of data: 0.1min^{-1})

After Coupling failure alarm (SP9168) occurred, the displayed value is held until alarm reset. It is cleared by the following operations.

- Gear switching or spindle switching
- Spindle alarm reset
- Turning off the power of the CNC

5.26.3.5 Setting procedure of the alarm detection level

1. After you check that the state of coupling between the spindle and spindle motor is normal, set the following parameters.
   - Arbitrary gear ratio (No.4171~4174: It depends on machine configuration)
   - Arbitrary data output function number (No.4532=20)
   - Alarm detection level (No.4638=0)

2. After you operate a machine, confirm the maximum value of speed deference between the spindle and the spindle motor (in diagnosis No.722) on a diagnosis screen.
   When the spindle and the motor are coupled with V belt, there is a possibility that large fluctuation of speed deference between the spindle and the spindle motor occurs by the influence of the slipping of belt in the following operations. It is recommended that you confirm the maximum value with doing the following operations to prevent miss-detection of the alarm.

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- Acceleration and deceleration with the maximum torque up to maximum spindle speed. (Forward rotation and reverse rotation)
- Cutting with the maximum load

As the displayed values on the diagnosis screen is cleared by gear switching or spindle switching, please confirm the displayed values before these operations.

3. You set the value with some margin as alarm detection level parameter (No.4638). For example, when you see DGN No.722=100 (It means 10min^{-1} difference considering spindle speed.) and you want to gain double margin, you should set No.4638=200.

5.26.3.6 Alarm

Alarm No.	Description
SP9168	Spindle alarm SP9168 detected by the method by monitoring speed deference between a spindle and a spindle motor is common with the method by monitoring motor rotation amount between neighboring one-rotation signals on a spindle.

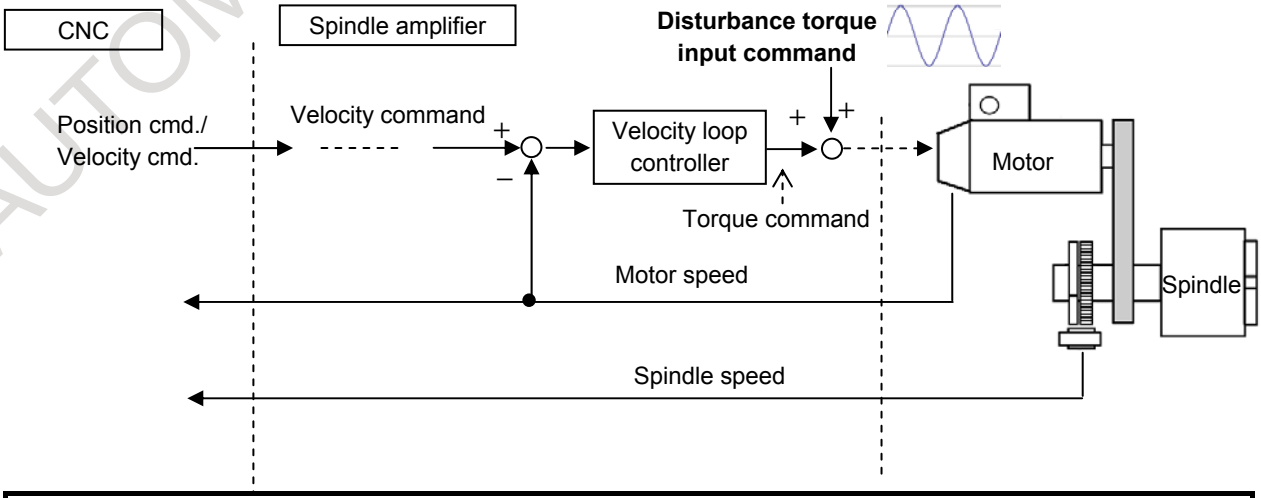
5.26.3.7 Note

- When setting value is other than "0" in alarm detection level parameter, speed deference is always monitored regardless of the operating modes (Velocity control mode or Position control mode).
- In the speed zero state (SST signal=1), the alarm detection becomes invalid. The update of the value shown on the diagnosis screen is stopped, too.
- When there is a difference between the real gear ratio and the setting gear ratio, it gives the influence in speed deference as an offset. Please take care of it.

5.27 SPINDLE OSCILLATING TORQUE INPUT FUNCTION

5.27.1 Overview

"Spindle oscillating torque input function" is the function which adds sinusoidal disturbance torque to spindle motor. It's possible to use to know the ability of response of the spindle by compulsory oscillation.



NOTE
1 This function cannot be used with sensorless motor.

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5.27.2 Series and Editions of Applicable Spindle Software

Spindle software

Series	Edition	Usable CNC
9D9A	B (02)	FS30*i* / FS31*i* / FS32*i* –A, FS0*i* -D
9DAA	E (05)	FS30*i* / FS31*i* / FS32*i* / FS35*i* -B, FS0*i* -D, FS0*i* -F
9DB0	C (03)	FS30*i* / FS31*i* / FS32*i* / FS35*i* -B, FS0*i* -F

5.27.3 I/O Signals (CNC↔PMC)

(1) Address list of input signals (PMC→CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G304	G304						ARDRQA		
2nd-	G308	G308						ARDRQB		
3rd-	G312	G312						ARDRQC		
4th-		G316						ARDRQD		

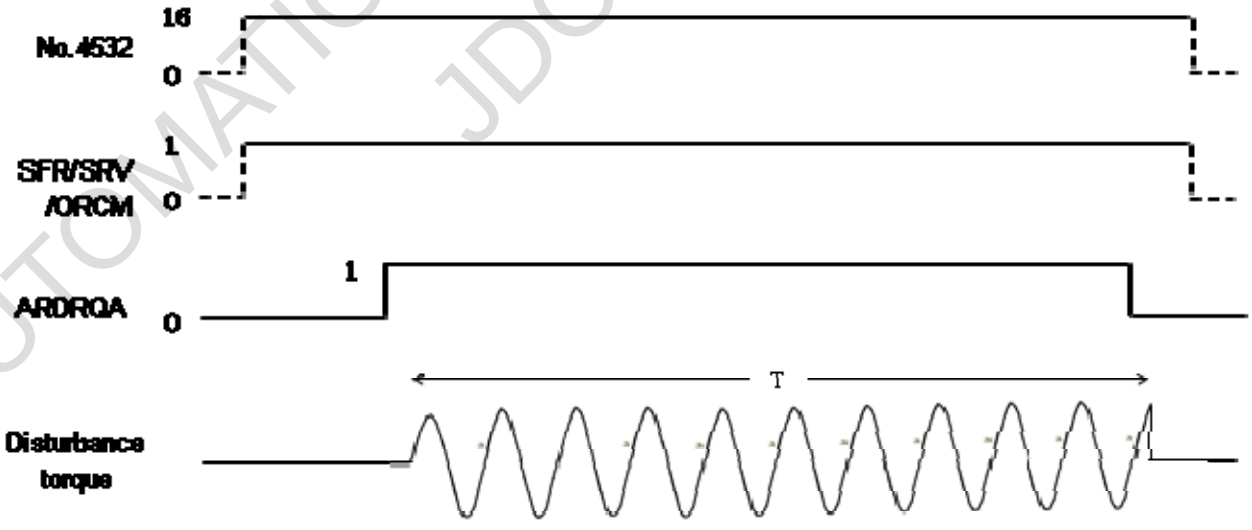
(2) Details of output signals (PMC→CNC)

(a) Request signal for arbitrary output (ARDRQ)

0 : Not on requesting arbitrary data output.
1 : On requesting arbitrary data output.

When this signal becomes "1" under setting of No.4532=16, the spindle motor starts to oscillate by this function.
When this signal return to "0", the oscillation will stop.

5.27.4 Sequence

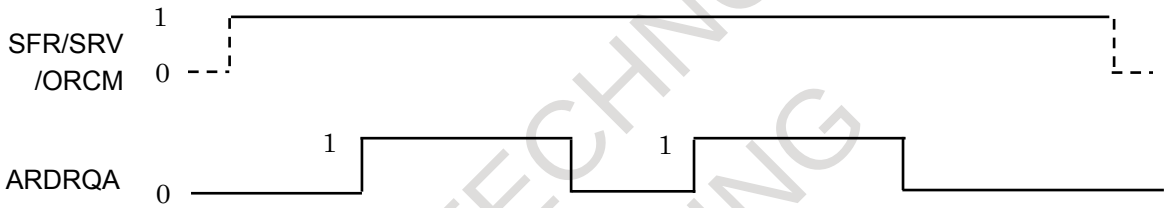


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NOTE
1 Please change ARDRQA signal to “1” after exciting the motor. If the signal is changed to “1” before finishing excitation, the state error No.62 will be shown in DGN710.
2 It’s possible to start this function regardless of driving mode or motor states(stopping or rotating).
3 Basically this function inputs sinusoidal disturbance torque one thousand times. So even in keeping ARDRQA=1, the oscillation will stop after one thousand times disturbance input. By the way, it becomes possible to oscillate infinitely during ARDRQA=1 by setting No.4413= -1.
4 The effective time T[s] in this function can be calculated by the following formula. (F[Hz] means the frequency of disturbance torque.)
(Ex.) In case of F=20Hz, T=(1/20)×1000=50s
5 Please don’t change the parameters related to spindle control during oscillation.

5.27.4.1 Supplementary explanation for sequence

1. It’s possible to turn OFF/ON repetitively during excitation.



2. This function doesn’t work if the motor excitation isn’t done.

3. If the motor excitation becomes OFF during ARDRQA=1, the alarm will not occur. (The state error will occur.) But the oscillation doesn’t restart even if the motor excitation is done again during ARDRQA=1. Please retry the sequence shown in the former page to use this function correctly.

5.27.5 Related Parameters

Prameter No. 0*i*/30*i*	Description	Setting
4532	Arbitrary data output function number	16
4410	Frequency of disturbance torque	0
4414	Amplitude of disturbance torque	0
4533	Velocity loop proportional gain at using this function	0
4534	Velocity loop integral gain at using this function	0
4395#7,#6	Disturbance input function bit	0
4412	Disturbance input function Mrasurement frequency interval	0
4415	Disturbance input function Motor speed command for measurement	0
4411	Disturbance input function Measurement end frequency	=No.4410
4413	Disturbance input function Number of measurement per onefrequency	1000

NOTE
The change of the parameters related to Spindle oscillating torque input function is reflected soon without power OFF/ON. But please don’t change them during oscillating

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5.27.6 Details of Related Parameters

0*i*	30*i*	
4532	4532	**Arbitrary data output function number**

Unit of data :
Data range : 0 to 32767
Standard setting : 16 (Spindle oscillating torque input function is invalid of No.4532=0)
When you set ”16” in this parameter and set “1” in ARDRQx signal, which is written later, the spindle software adds sinusoidal disturbance torque, which is specified by No.4410(Frequency)/No.4414(Amplitude), to torque command. And it outputs the amplitude of spindle speed in DGN720 and the amplitude of motor speed in DNG722.

0*i*	30*i*	
4410	4410	**Frequency of disturbance torque**

Unit of data : 1Hz
Data range : 0 to 100
Standard setting : 0
Set the frequency of disturbance torque you want to input.
When the setting value is “0”, the frequency becomes “10Hz”.

0*i*	30*i*	
4414	4414	**Amplitude of disturbance torque**

Unit of data : 1% (100%=Maximum torque command)
Data range : 0 to 20
Standard setting : 0
Set the amplitude of disturbance torque you want to input.
When the setting value is “0”, the frequency becomes “5%”.

0*i*	30*i*	
4533	4533	**Velocity loop proportional gain at using this function**

Data range : 0 to 32767
Standard setting : 0
It’s possible to use another velocity loop proportional gain at using this function. When the setting value in this parameter is “0”, velocity loop proportional gain for respective control mode is used at using this function also.

0*i*	30*i*	
4534	4534	**Velocity loop integral gain at using this function**

Data range : 0 to 32767
Standard setting : 0
It’s possible to use another velocity loop proportional gain at using this function. When the setting value in No.4533 is “0”, this parameter (No.4534) becomes invalid. In the case, velocity loop integral gain for respective control mode is used at using this function also.

In case of using Spindle oscillating torque input function, please set “0” to following parameters. If both No.4395#7=1 and No.4532=16 are set together, incorrect spindle parameter alarm (SP9068) will occur.

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0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4395	4395	DTQFNC	DTQTRG						

DTQFNC Disturbance input function bit
DTQTRG Disturbance input function trigger bit

0*i*	30*i*	
4412	4412	Disturbance input function Mrasurement frequency interval
4415	4415	Disturbance input function Motor speed command for measurement

Please set the same value both in No.4410 and No.4411

0*i*	30*i*	
4411	4411	Disturbance input function Measurement end frequency

0*i*	30*i*	
4413	4413	Disturbance input function Number of measurement per onefrequency

Unit of data : Once input
Data range : 0 to 32767
Standard setting : 1000
Please Set “1000” normally in No.4413. It’s possible to oscillate infinite time during ARDRQx signal =1 by setting ”-1” in this parameter. (The description of ARDRQx signal is shown later.).

5.27.7 Alarm/State Error

5.27.7.1 Alarm

Alarm No.	Description
SP9068	If both No.4395#7=1 and No.4532=16 are set together, the illegal spindle parameter alarm (SP9068) will occur. And the state error No.61 will be shown in DGN.710.

5.27.7.2 State Error

State error No.	Description
Err-62	If this function is commanded (ARDRQA=1) before motor excitation, the state error 62 will occur. The number of state error will be shown in DGN.710. The spindle motor rotates correctly even in the state error 62. After clear the above illegal situation, the state error 62 will be reset.

5.27.8 Note

When you use this function in position control mode (Cs contour control, Spindle synchronous control, Orientation, and etc.), there are some possibilities to see the following phenomenon by large position error due to disturbance torque.

- The axis position might become out of in-position.
- The excess error alarm might occur.
- The completion signal for Spindle synchronous control might become “0”. (It means Not completion state.)
- The completion signal for Orientation might become “0”. (It means Not completion state.)

In such cases, following tuning might be necessary.

- Tune the amplitude of disturbance torque (No.4414)
- Tune in-position level

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- Tune Excess error level
- Tune the completion level of Spindle synchronous control or Orientation

5.28 SMART LOAD METER

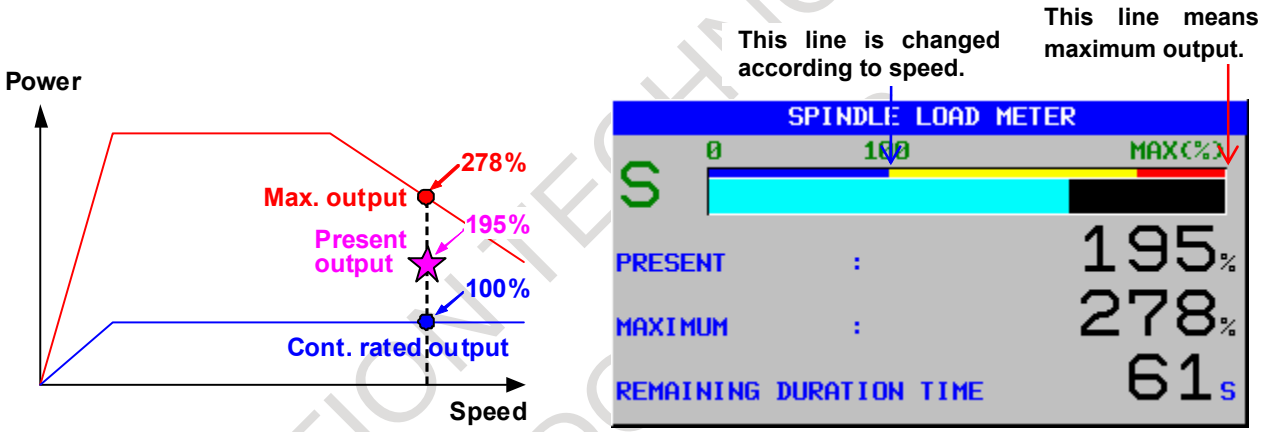
5.28.1 Outline

In Smart Load Meter, following data are shown as digital value.

- PRESENT: Present value of Load meter (Continuous rated output=100%)
- MAXIMUM: Maximum value of load in present speed (Continuous rated output =100%)
- REMAINING DURATION TIME : Duration time for cutting in present load

In Smart Load Meter bar graph, right border of blue scale (meaning continuous rated output) is changed according to present speed.
With Smart Load Meter, it becomes possible to grasp the status of load perfectly in any speed, because the ratio of present output to continuous rated output and ratio of present output to maximum output can be seen together.

(Example for output and load meter)



NOTE
1 This function can be used with sensorless motor.

5.28.2 NOTE

(1) The function bit should be set as same in all axes. It can not be set separately in each axis.
(2) When you use Speed range switching control or Spindle switching control, the function bit should be set as same in all windings or all spindle motors. It can not be set separately in each winding or spindle motor.
(3) When you use this function with the power output limitation by parameter No.4028 and No.4029 together, the PRESENT and MAXIMUM become as follows.

PRESENT : MAXIMUM (not limited by No.4028,No.4029) multiplied by [ratio of limitation by No.4028,No.4029].
MAXIMUM : No change (not limited by No.4028,No.4029)

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5.28.3 Series and Editions of Applicable Software

Spindle

Motor	Series	Edition	Usable amplifier
αi,βi,Bi series Induction / Synchronous	9DAA	D(04) edition or later	A06B-6220/6270-Hxxx#H600 : αi SP-B
	9DB0	B(02) edition or later	A06B-6222/6272-Hxxx#H610 : lever up αi SP-B A06B-6320-Hxxx :βi SVSP-B
βiIc series Sensorless	9DB0	M(13) edition or later	

CNC

Series	Edition	Usable CNC
G311, G401, G411, G421, G431 G501,G511	62.0 edition or later	FS30i / FS31i / FS32i –B
D4G1, D6G1	2.0 edition or later	FS0i –F

PMC

Series	Edition	Usable CNC
40A5	18 edition or later	FANUC Series 30i/ 31i/ 32i-MODEL B
40B2	02 edition or later	FANUC Series 0i-MODEL F

5.28.4 Parameters

5.28.4.1 Parameters for Smart Load Meter

Parameters for “Smart Load Meter” function only. Refer to Item 5.28.5 for detail.

Parameter No.					Contents	Setting
Induction / Synchronous				Sensorless		
MAIN SPINDLE		SUB SPINDLE				
High-speed	Low-speed	High-speed	Low-speed	—		
4542#7	←	←	←	4542#7	Smart Load Meter 0:Invalid, 1:Valid	1
24346	←	←	←	24346	Ratio to specify the yellow region of bar graph for Smart load meter	0

Note1) No.4542#7 should be set as same in all axes. It can not be set separately in each axis.
Note2) No.4542#7 is effective to all characteristics including MAIN HIGH, MAIN LOW,SUB HIGH, SUB LOW speed characteristic.

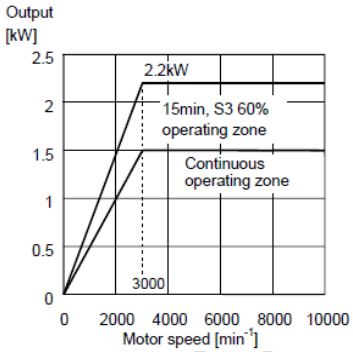
5.28.4.2 Parameters relating to Load meter (normalized by cont. rated output)

Parameters for Load meter (normalized by cont. rated output) are also needed for Smart Load Meter (however not required setting to function bit: No.4352#3=0). They are depending on motor models.
*) Refer to item 5.19 for detail of Load meter (normalized by cont. rated output.)

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Parameter No.					Contents	Setting
Induction / Synchronous				Sensorless		
MAIN SPINDLE		SUB SPINDLE				
High-speed	Low-speed	High-speed	Low-speed	—		
4352#3	←	←	←	4352#3	Switching bit for specifying load meter type (Normalized by max. output / Normalized by cont. rated output)	0
4127	4093	4274	4279	4127	Load meter value at max. output	Depending on model
4612	4614	4728	4730	4612	Parameter (1) for load meter normalized by cont. rated output	Depending on model
4613	4615	4729	4731	4613	Parameter (2) for load meter normalized by cont. rated output	Depending on model

Note1) There are some motors which don't have the parameters for Load meter (normalized by cont. rated output). The motors have the character that the ratio of short time rated output to cont. rated output is constant in all speed. In such motors, the settings for Load meter (normalized by cont. rated output) are not necessary. In the case, the right border of blue scale (meaning continuous rated output) is fixed regardless of motor speed.



Example of motor character in which the ratio of short time rated output to cont. rated output is constant.

Note2) There are some motors which don't have the parameters for Load meter (normalized by cont. rated output) in αiI/βiI series motors and BiS motors also. When you use such motors, please contact FANUC to ask the necessary parameters.

5.28.4.3 Parameters relating to estimate temperature of motor winding

The following parameters are necessary to estimate temperature of motor winding. They are depending on motor models. Please refer to the setting values shown in chapter 5.28.9.

Parameter No.					Contents	Setting
Induction / Synchronous				Sensorless		
MAIN SPINDLE		SUB SPINDLE		—		
High-speed	Low-speed	High-speed	Low-speed	—		
4134 *(H/W)	←	**4310 *(H/W)**	←	**4134 *(H/W)**	**Motor overheat level**	**Depending on model**
4398#7	←	4471#7	←	4398#7	Setting for estimation of temperature	1
4170	4168	4350	4348	4170	Heat generation coefficient for estimation temperature	Depending on model
4453	4454	4517	4518	4453	Time constant of heat generation for estimation of temperature	Depending on model

* (H/W) means higher word side in double word type parameter.
Note1) If you don't set above parameters, REMAINING DURATION TIME will not shown correctly.

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5.28.5 Detail explanation of parameters

0*i* -F	30*i*-B	#7	#6	#5	#4	#3	#2	#1	#0
4542	4542	**SLI**							

SLI Setting for spindle load meter display

0 : Ordinary load meter

1 : Smart Load Meter

Please set same value in this parameter in all axes if there are plural spindles.
(When you use Smart Load Meter in such case, all spindle software should support this function.)
When you change this parameter, please turn CNC OFF/ON. (It's not necessary to turn off amplifiers.)

0*i* -F	30*i*-B	
24346	24346	**Ratio to specify the yellow region of bar graph for Smart Load Meter**

Unit : 1 %
Setting range : 0~100
Standard value: 0

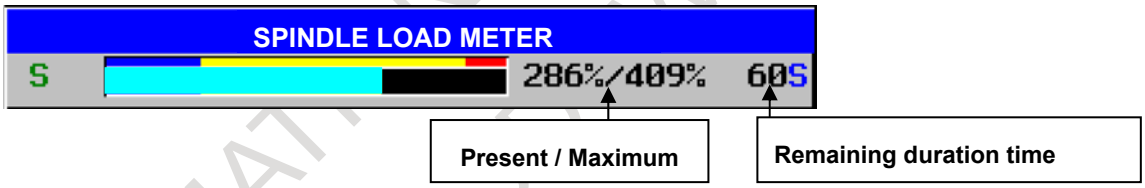
This parameter specifies the right border of yellow scale in Smart Load Meter bar graph.
If the value is over 100, it is treated as 100.
If the value under 0 is set in this parameter, it is treated as 83(=100/1.2). (In the case, the right border of yellow scale means the maximum output of short time rated output.)

5.28.6 Dtail of display data

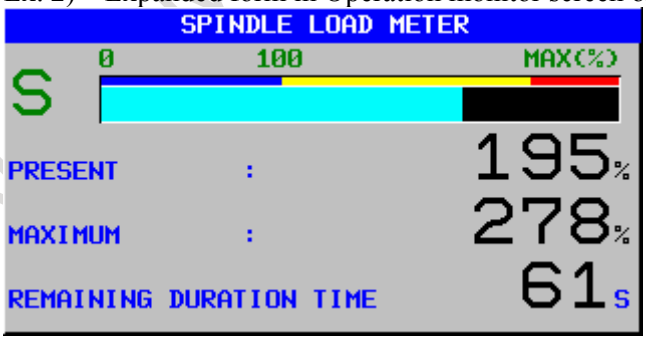
Layout of Smart Load Meter

The layout of Smart Load Meter is changed depending on the display size or the display form.

Ex. 1) Normal form in Operating monitor screen on 8.4"/10.4" display



Ex. 2) Expanded form in Operation monitor screen on 15"/19" display



<1> PRESENT value

It shows the rate (%) of present load meter to cont. rated output.

<2 > MAXIMUM value

It shows the rate (%) of maximum load to cont. rated output at the present speed.

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<3> REMAINING DURATION TIME

The remaining duration time for cutting (sec) is shown. It is calculated by motor temperature, motor current, and load value assuming continuation of present cutting condition. If it becomes 0, something alarm relating over load occurs. The value range is from 0 to 999(sec).
When the remaining duration time is over 999(sec), the display shows "***".
It is not shown on acc./dec. (in speed control mode) of the spindle. (The display shows blank.)

Alarm No.	Alarm contents
SP9001	Motor over heat detected by thermistor in motor
SP9022	Soft thermal(OVC) for amplifier
SP9029	Over load detected by load meter value in spindle software
SP9054	Soft thermal(OVC) for motor

NOTE
1. The display value might become uneven at the heavy cutting with large load fluctuation.
2. SP9031(Motor lock) and SP9002(Excessive speed deviation) is detected in a few seconds after sudden large load change. They are too short to display as remaining duration time. So they are not reflected to the calculation of remaining duration time.

The list of REMAINING DURATION TIME display based on spindle state

Spindle state	Remaining duration time
On rotating constantly in speed control mode	- The time value is shown. - But if it becomes over 1000(sec), the display shows "***".
On rotating in constant surface speed control	
On rotating in Cs contour control	
On rigid tapping (Servo mode)	
On rotating synchronous control	
On orientation	
On acc./dec. in speed control mode	The display shows blank. The value is not shown on acc./dec. in speed control mode.
On occurring spindle alarm	The display shows "0".
In excitation OFF	The display shows "***"

5.28.7 Observation of Smart Load Meter

5.28.7.1 Observation by SERVO GUIDE

It's possible to observe PRESENT, MAXIMUM, and REMAINING DURATION TIME in SERVO GUIDE. SERVO GUIDE Ver. 9.4 or subsequent editions support it.

Data name	Contents
LMDTC : PRESENT value in Smart Load Meter Unit : %	It shows the rate (%) of present load meter to cont. rated output.
LMMAX : MAXIMUM value in Smart Load Meter Unit : %	It shows the rate (%) of maximum load to cont. rated output at the present speed.
DURATM : REMAINING DURATION TIME in Smart Load Meter Unit : sec	It shows the remaining duration time for cutting assuming continuation of present cutting condition.

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5.28.7.2 Observation of diagnosis information

Observation of diagnosis information

Diagnosis No.410 : PRESENT value in Smart Load Meter
- Data type : Word spindle
- Unit of data : %
- Valid data range : 0~32767

Diagnosis No.1580 : REMAINING DURATION TIME in Smart Load Meter
- Data type : Word spindle
- Unit of data : sec
- Valid data range : -1, 0~1000
  - The value becomes "-1" on acc./dec. of spindle in speed control mode.

Diagnosis No.1581 : MAXIMUM value in Smart Load Meter
- Data type : Word spindle
- Unit of data : %
- Valid data range : 0~32767

Observation by PMC window functions

Diagnosis No	PMC window functions			
	Function code	Description	Response	R/W
410	33	Reading diagnosis data	Low-speed	R
1580	156	Reading diagnosis data	High-speed	R
1581				

Observation by FOCAS2 library

It's possible to read following data by "cnc_rdaxisdata" function in FOCAS2 library.

Data kind	type argument	Refresh cycle	Data range	Supplemetary information
PRESENT value in Smart Load Meter	0	32ms	0～32767	
Average value during 256ms of PRESENT value in Smart Load Meter	4	256ms	0～32767	
MAXIMUM value in Smart Load Meter	5	64ms	0～32767	
Average value during 256ms of MAXIMUM value in Smart Load Meter	6	256ms	0～32767	
REMAINING DURATION TIME in Smart Load Meter	7	64ms	-1, 0～1000	The output value becomes "-1", on acc. /dec. of spindle in speed control mode.

The list of REMAINING DURATION TIME data in PMC window and FOCAS2 library based on spindle state

Spindle state	Output data	Spplemenraty information
On rotating constantly in speed control mode	1~1000	On rotating constantly in speed control mode During cutting in constant surface speed control On rotating in Cs contour control On rigid tapping (Servo mode) On rotating synchronous control On orientation
During cutting in constant surface speed control		
On rotating in Cs contour control		
On rigid tapping (Servo mode)		
On rotating synchronous control		
On orientation		
On acc./dec. in speed control mode	-1	On acc./dec. in speed control mode
On occurring spindle alarm	0	On occurring spindle alarm
In excitation OFF	1000	In excitation OFF

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5.28.8 Alarms

Alarm No.	Message	Contents
SP1259	Invalid spindle load meter parameter	If "1" is set in No.4542#7, when CNC software supports this function but spindle software does not support it, this alarm occurs. And in a system which includes 2 or more spindles, when the setting value of No.4542#7 for each spindle is not same, this alarm occurs, too.
SP9068	Invalid spindle parameter	If "1" is set in No.4542#7, when spindle software supports this function but CNC software does not support it, this alarm occurs. When alarm SP9068 occurs, status error 67 will be shown in No.710 of diagnosis screen on CNC.

5.28.9 Parameters for each motor for Smart Load Meter

αiI series (200V)

Model	Drawing number	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor winding				
		N4127	N4093	N4612	N4614	N4613	N4615	N4134	N4170	N4168	N4453	N4454
αiI 0.5/10000	A06B-1401-Bxxx#xxxx	286	—	107	—	10889	—	110	784	—	2100	—
αiI 1/10000	A06B-1402-Bxxx#xxxx	176	—	0	—	0	—	110	1520	—	1900	—
αiI 1.5/10000	A06B-1403-Bxxx#xxxx	404	—	63	—	21761	—	110	1440	—	2500	—
αiI 2/10000	A06B-1404-Bxxx#xxxx	202	—	0	—	0	—	110	864	—	1200	—
αiI 3/10000	A06B-1405-Bxxx#xxxx	178	—	0	—	0	—	110	528	—	2100	—
αiI 3/12000	A06B-1425-Bxxx#00xx	178	—	0	—	0	—	110	1120	—	3000	—
αiI 6/10000	A06B-1406-Bxxx#00xx	178	—	150	—	22411	—	130	400	—	2100	—
αiI 6/12000	A06B-1426-Bxxx#00xx	164	190	127	150	12288	22157	130	1424	400	2100	2100
αiI 6/15000	A06B-1433-Bxxx#00xx	180	—	145	—	32256	—	130	528	—	2100	—
αiI 8/8000	A06B-1407-Bxxx#00xx	176	—	145	—	16513	—	130	832	—	2700	—
αiI 8/10000	A06B-1427-Bxxx#00xx	176	176	145	145	10240	16517	130	328	832	2700	2700
αiI 8/12000	A06B-1427-Bxxx#01xx	176	176	145	129	12288	19201	130	328	832	2700	2700
αiI 12/7000	A06B-1408-Bxxx#00xx	172	—	156	—	16517	—	130	704	—	2100	—
αiI 12/10000	A06B-1428-Bxxx#00xx	164	164	125	156	10240	16518	130	704	704	2100	2100
αiI 12/12000	A06B-1428-Bxxx#01xx	176	164	125	156	10380	16517	130	704	704	2100	2100
αiI 15/7000	A06B-1409-Bxxx#00xx	162	—	164	—	16530	—	130	560	—	1500	—
αiI 15/10000	A06B-1429-Bxxx#00xx	148	166	107	164	10240	16772	130	1024	560	2100	1500
αiI 15/12000	A06B-1429-Bxxx#01xx	161	148	107	164	10375	16772	130	1024	560	2100	1500
αiI 22/10000	A06B-1431-Bxxx#00xx	142	145	141	170	10240	16389	130	568	496	2300	2300
αiI 30/6000	A06B-1412-Bxxx#00xx	148	—	173	—	12549	—	130	336	—	3000	—
αiI 40/6000	A06B-1413-Bxxx#00xx	146	—	175	—	11013	—	130	544	—	2800	—
αiI 50/4500	A06B-1414-Bxxx#00xx	147	—	129	—	12551	—	130	272	—	2500	—

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αiI series power up model (200V)

Model	Drawing number	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor winding				
		N4127	N4093	N4612	N4614	N4613	N4615	N4134	N4170	N4168	N4453	N4454
αiI 2/10000	A06B-1404-Bxxx#0Pxx	300	—	73	—	27136	—	110	864	—	1200	—
αiI 6/10000	A06B-1406-Bxxx#0Pxx	240	—	97	—	21643	—	130	400	—	2100	—
αiI 6/12000	A06B-1426-Bxxx#0Pxx	240	240	107	107	12288	22157	130	1424	400	2100	2100
αiI 8/8000	A06B-1407-Bxxx#0Pxx	240	—	75	—	16514	—	130	832	—	2700	—
αiI 8/10000	A06B-1427-Bxxx#0Pxx	240	240	87	100	10240	16517	130	328	832	2700	2700
αiI 8/12000	A06B-1427-Bxxx#0Rxx	240	240	76	79	12288	19201	130	328	832	2700	2700
αiI 12/7000	A06B-1408-Bxxx#0Pxx	202	—	127	—	16774	—	130	704	—	2100	—
αiI 12/12000	A06B-1428-Bxxx#0Pxx	236	202	101	127	10379	16518	130	704	704	2100	2100
αiI 15/7000	A06B-1409-Bxxx#0Pxx	202	—	128	—	16514	—	130	850	—	2100	—
αiI 15/12000	A06B-1429-Bxxx#0Pxx	219	202	109	128	10376	16531	130	1024	560	2100	1500
αiI 18/7000	A06B-1410-Bxxx#0Pxx	195	—	132	—	16778	—	130	320	—	2100	—
αiI 22/7000	A06B-1411-Bxxx#0Pxx	191	—	134	—	16771	—	130	496	—	2300	—
αiI 30/7000	A06B-1412-Bxxx#0Pxx	193	—	142	—	12291	—	130	336	—	3000	—
αiI 40/7000	A06B-1413-Bxxx#0Pxx	183	—	144	—	14084	—	130	544	—	2800	—

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αiI-B series (200V)

Model	Drawing number	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor windin				
		MAIN HIGH			MAIN LOW			MAIN HIGH			MAIN LOW	
		4127	4612	4613	4093	4614	4615	4134	4170	4453	4168	4454
αiI 0.5/10000-B	A06B-1230-K401#S00	286	107	10889	0	0	0	110	784	2100	0	0
αiI 0.5/10000-B	A06B-1230-K401#S0P	392	78	10891	0	0	0	110	784	2100	0	0
αiI 0.5/15000-B	A06B-1230-K400#S0P	327	78	19976	0	0	0	110	784	2100	0	0
αiI 1/10000-B	A06B-1230-K402#S00	176	145	26637	0	0	0	110	1520	1900	0	0
αiI 1/10000-B	A06B-1230-K402#S0P	296	86	13837	0	0	0	110	1520	1900	0	0
αiI 1/10000-B	A06B-1230-K402#S0S	480	52	13837	0	0	0	110	1520	1900	0	0
αiI 1/15000-B	A06B-1230-K422#S00	161	135	20488	0	0	0	110	1520	1900	0	0
αiI 1/24000-B	A06B-1230-K420#S0S	550	42	16390	0	0	0	110	1008	800	0	0
αiI 1.5/10000-B	A06B-1230-K403#S0P	456	64	11168	0	0	0	110	1440	2500	0	0
αiI 1.5/10000-B	A06B-1230-K403#S0S	457	41	11170	0	0	0	110	1440	2500	0	0
αiI 1.5/20000-B	A06B-1230-K423#S00	176	48	26886	0	0	0	110	1232	600	0	0
αiI 1.5/20000-B	A06B-1230-K423#S0S	491	45	20354	0	0	0	110	1232	600	0	0
αiI 2/10000-B	A06B-1230-K404#S00	202	127	26893	0	0	0	110	864	1200	0	0
αiI 2/10000-B	A06B-1230-K404#S0P	300	73	27136	0	0	0	110	864	1200	0	0
αiI 2/10000-B	A06B-1230-K404#S0S	545	46	26893	0	0	0	110	864	850	0	0
αiI 2/12000-B	A06B-1230-K418#S0S	292	6215	12299	0	0	0	110	1008	1300	0	0
αiI2/20000-B	A06B-1230-K424#S0S	293	88	20357	0	0	0	110	1296	1200	0	0
αiI 3/10000-B	A06B-1230-K405#S00	178	144	19842	0	0	0	110	528	2100	0	0
αiI 3/10000-B	A06B-1230-K405#S0P	243	105	19842	0	0	0	110	528	2100	0	0
αiI 3/10000-B	A06B-1230-K405#S0S	357	72	19586	0	0	0	110	528	2100	0	0
αiI 3/12000-B	A06B-1230-K425#S00	178	125	32256	0	0	0	110	1120	3000	0	0
αiI 3/12000-B	A06B-1230-K425#S0S	422	61	32267	0	0	0	110	1120	3000	0	0
αiI 3/15000-B	A06B-1230-K419#S0S	327	78	20489	0	0	0	110	1696	2800	0	0
αiI 6/10000-B	A06B-1230-K406#S00	178	150	22411	0	0	0	130	400	2100	0	0
αiI 6/10000-B	A06B-1230-K406#S0P	240	107	22411	0	0	0	130	400	2100	0	0
αiI 6/10000-B	A06B-1230-K406#S0S	327	76	22155	0	0	0	130	400	2100	0	0
αiI 6/12000-B	A06B-1230-K426#S00	164	127	12288	190	150	22157	130	1424	2100	400	2100

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αiI-B series (200V)

Motor model	Drawing No. (Output spec. nameplate)	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor winding				
		MAIN HIGH			MAIN LOW			MAIN HIGH			MAIN LOW	
		4127	4612	4613	4093	4614	4615	4134	4170	4453	4168	4454
αiI 6/12000-B	A06B-1230-K426#S0P	240	107	12288	240	107	22157	130	1424	2100	400	2100
αiI 6/15000-B	A06B-1230-K433#S00	180	145	32256	0	0	0	130	528	2100	0	0
αiI 6/15000-B	A06B-1230-K433#S0S	288	89	20489	0	0	0	130	1072	2700	0	0
αiI 8/8000-B	A06B-1230-K407#S00	176	145	16513	0	0	0	130	832	2700	0	0
αiI 8/8000-B	A06B-1230-K407#S0P	240	100	16514	0	0	0	130	832	2700	0	0
αiI 8/8000-B	A06B-1230-K407#S0S	296	86	17026	0	0	0	130	832	2700	0	0
αiI 8/10000-B	A06B-1230-K427#S00	176	145	10240	176	145	16517	130	328	2700	832	2700
αiI 8/10000-B	A06B-1230-K427#S0P	240	87	10240	240	100	16517	130	328	2700	832	2700
αiI 8/12000-B	A06B-1230-K427#S01	176	145	12288	176	129	19201	130	328	2700	832	2700
αiI 8/12000-B	A06B-1230-K427#S0R	240	76	12299	240	79	19201	130	328	2700	832	2700
αiI 12/8000-B	A06B-1230-K408#S00	189	156	16522	0	0	0	130	704	2100	0	0
αiI 12/8000-B	A06B-1230-K408#S0P	202	127	16522	0	0	0	130	704	2100	0	0
αiI 12/8000-B	A06B-1230-K408#S0S	273	92	16777	0	0	0	130	704	2100	0	0
αiI 12/12000-B	A06B-1230-K428#S00	176	125	10380	164	156	16517	130	704	2100	704	2100
αiI 12/12000-B	A06B-1230-K428#S0P	240	101	10380	202	127	16518	130	704	2100	704	2100
αiI 12/12000-B	A06B-1230-K428#S0S	305	73	10379	273	94	16774	130	704	2100	704	2100
αiI 15/8000-B	A06B-1230-K409#S00	175	164	16791	0	0	0	130	560	1500	0	0
αiI 15/8000-B	A06B-1230-K409#S0P	234	128	16790	0	0	0	130	560	1500	0	0
αiI 15/8000-B	A06B-1230-K409#S0S	240	107	16791	0	0	0	130	560	1500	0	0
αiI 15/12000-B	A06B-1230-K429#S00	161	107	10375	148	164	16772	130	1024	2100	560	1500
αiI 15/12000-B	A06B-1230-K429#S0P	219	109	10376	202	128	16531	130	1024	2100	560	1500
αiI 15/12000-B	A06B-1230-K429#S0S	273	97	10376	240	107	16774	130	1024	2100	560	1500
αiI 18/8000-B	A06B-1230-K410#S00	164	179	16782	0	0	0	130	320	2100	0	0
αiI 18/8000-B	A06B-1230-K410#S0P	195	132	16782	0	0	0	130	320	2100	0	0
αiI 18/12000-B	A06B-1230-K430#S00	148	179	10370	143	179	16772	130	320	2100	320	2100
αiI 18/12000-B	A06B-1230-K430#S0P	209	129	10370	195	132	16771	130	320	2100	320	2100
αiI 22/8000-B	A06B-1230-K411#S00	149	171	16775	0	0	0	130	496	2300	0	0

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αiI-B series (200V)

Motor model	Drawing No. (Output spec. nameplate)	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor winding				
		MAIN HIGH			MAIN LOW			MAIN HIGH			MAIN LOW	
		4127	4612	4613	4093	4614	4615	4134	4170	4453	4168	4454
αiI 22/8000-B	A06B-1230-K411#S0P	191	134	16517	0	0	0	130	496	2300	0	0
αiI 22/8000-B	A06B-1230-K411#S0S	245	104	16774	0	0	0	130	496	2300	0	0
αiI 22/12000-B	A06B-1230-K431#S00	142	150	10241	155	173	16385	130	568	2300	496	2300
αiI 22/12000-B	A06B-1230-K431#S0P	193	105	10241	191	126	16385	130	568	2300	496	2300
αiI 22/12000-B	A06B-1230-K431#S0S	271	92	10241	245	99	16384	130	568	2300	496	2300
αiI 30/7000-B	A06B-1230-K412#S00	148	173	12547	0	0	0	130	336	3000	0	0
αiI 30/7000-B	A06B-1230-K412#S0P	193	142	12291	0	0	0	130	336	3000	0	0
αiI 40/7000-B	A06B-1230-K413#S00	146	175	14084	0	0	0	130	544	2800	0	0
αiI 40/7000-B	A06B-1230-K413#S0P	182	144	14084	0	0	0	130	544	2800	0	0
αiI 50/5000-B	A06B-1230-K414#S00	147	148	12560	0	0	0	130	272	2500	0	0
αiI 50/5000-B	A06B-1230-K414#S0P	173	109	12677	0	0	0	130	272	2500	0	0

αiI-B (IP65) series (200V)

Motor model	Drawing No. (Output spec. nameplate)	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor winding				
		MAIN HIGH			MAIN LOW			MAIN HIGH			MAIN LOW	
		4127	4612	4613	4093	4614	4615	4134	4170	4453	4168	4454
αiI 0.5/10000-B (IP65)	A06B-1230-K481#S00	286	107	10889	0	0	0	110	784	2100	0	0
αiI 1/8000-B (IP65)	A06B-1230-K482#S00	293	87	11024	0	0	0	110	1472	3200	0	0
αiI 1.5/8000-B (IP65)	A06B-1230-K483#S00	493	52	21776	0	0	0	110	1440	2050	0	0
αiI 2/8000-B (IP65)	A06B-1230-K484#S00	296	86	16257	0	0	0	110	928	2500	0	0
αiI 3/8000-B (IP65)	A06B-1230-K485#S00	300	85	16142	0	0	0	110	944	8500	0	0
αiI 6/8000-B (IP65)	A06B-1230-K486#S00	300	82	21776	0	0	0	130	1088	5500	0	0

αiI$_p$ series (200V)

Model	**Drawing number**	**Parameters relating to Load meter (normalized by cont. rated output)**						**Parameters relating to estimate temperature of motor winding**				
		N4127	**N4093**	**N4612**	**N4614**	**N4613**	**N4615**	**N4134**	**N4170**	**N4168**	**N4453**	**N4454**
αiI$_P$ 12/6000	A06B-1448-Bxxx#00xx	164	243	156	95	32256	12117	130	448	384	2100	2500
αiI$_P$ 15/6000	A06B-1449-Bxxx#xxxx	144	240	160	107	32277	12288	130	232	56	900	900
αiI$_P$ 15/8000	A06B-1449-B11x#01xx	162	240	144	107	32385	12288	130	232	56	900	900
αiI$_P$ 22/6000	A06B-1451-Bxxx#00xx	164	240	156	107	32512	11776	130	432	240	2300	1800
αiI$_P$ 30/6000	A06B-1452-Bxxx#00xx	148	202	173	127	24709	9991	130	480	48	5000	700
αiI$_P$ 40/6000	A06B-1453-Bxxx#00xx	143	203	179	126	24709	10056	130	336	133	3500	1700
αiI$_P$ 50/6000	A06B-1454-B2xx#00xx	172	127	156	156	13827	8553	130	443	280	2800	2800

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αiI_p series power up model (200V)

Model	Drawing number	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor winding				
		N4127	N4093	N4612	N4614	N4613	N4615	N4134	N4170	N4168	N4453	N4454
αiI_P 12/8000	A06B-1448-Bxxx#0Rxx	196	243	130	95	32391	12117	130	448	384	2100	2500
αiI_P 18/8000	A06B-1456-Bxxx#0Rxx	200	220	128	102	-32747	12544	130	592	448	1800	2000
αiI_P 15/6000	A06B-1449-Bxxx#0Pxx	192	240	108	107	32256	12288	130	232	56	900	900
αiI_P 15/8000	A06B-1449-Bxxx#0Rxx	192	216	127	225	32642	11604	130	232	56	900	900
αiI_P 22/6000	A06B-1451-Bxxx#0Pxx	202	240	127	107	32512	11776	130	432	240	2300	1800
αiI_P 22/8000	A06B-1451-Bxxx#0Rxx	240	240	127	107	32646	12114	130	432	240	2300	1800
αiI_P 40/6000	A06B-1453-Bxxx#0Pxx	169	203	150	126	24969	10051	130	336	133	3500	1700
αiI_P 50/6000	A06B-1454-Bxxx#0Pxx	202	—	57	—	20480	—	110	1296	—	1200	—

αiI_P-B series (200V)

Model	Drawing number	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor windin				
		MAIN HIGH			MAIN LOW			MAIN HIGH			MAIN LOW	
		4127	4612	4613	4093	4614	4615	4134	4170	4453	4168	4454
αi IP 12/8000-B	A06B-1230-K448#S00	178	156	32391	243	95	12117	130	448	2100	384	2500
αi IP 12/8000-B	A06B-1230-K448#S0P	196	130	32391	243	95	12117	130	448	2100	384	2500
αi IP 15/8000-B	A06B-1230-K449#S00	161	160	32641	216	255	11604	130	232	900	56	900
αi IP 15/8000-B	A06B-1230-K449#S0P	192	127	32642	216	255	11604	130	232	900	56	900
αi IP 18/8000-B	A06B-1230-K456#S00	147	175	-32761	220	105	12371	130	592	1800	448	2000
αi IP 18/8000-B	A06B-1230-K456#S0P	200	128	-32760	220	102	12544	130	592	1800	448	2000
αi IP 22/8000-B	A06B-1230-K451#S00	164	156	32518	240	107	12114	130	432	2300	240	1800
αi IP 22/8000-B	A06B-1230-K451#S0P	202	127	32518	240	107	12114	130	432	2300	240	1800
αi IP 30/6000-B	A06B-1230-K452#S00	148	173	24709	202	127	9991	130	480	5000	48	700
αi IP 30/6000-B	A06B-1230-K452#S0P	176	145	24711	202	127	9991	130	480	5000	48	700
αi IP 40/6000-B	A06B-1230-K453#S00	143	179	24709	203	126	10056	130	336	3500	133	1700
αi IP 40/6000-B	A06B-1230-K453#S0P	169	150	24969	203	126	10051	130	336	3500	133	1700
αi IP 50/6000-B	A06B-1230-K454#S00	172	156	13827	164	156	8553	130	443	2800	280	2800
αi IP 50/6000-B	A06B-1230-K454#S0P	202	127	11011	202	127	10752	130	443	2800	280	2800
αi IP 60/5000-B	A06B-1230-K455#S00	164	131	16651	195	112	10513	130	248	4500	214	2800

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αiI_T series (200V)

Model	Drawing number	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor winding				
		N4127	N4093	N4612	N4614	N4613	N4615	N4134	N4170	N4168	N4453	N4454
αiI_T 2/20000	A06B-1464-Bxxx#01xx	202	—	57	—	27136	—	110	1296	—	1200	—
αiI_T 6/12000	A06B-1466-Bxxx#00xx	164	199	78	111	12288	21645	130	1424	400	2100	2100
αiI_T 6/15000	A06B-1466-Bxxx#01xx	164	199	91	105	15360	21645	130	1424	400	2100	2100
αiI_T 8/12000	A06B-1467-Bxxx#00xx	176	176	145	129	12288	19201	130	328	832	2700	2700
αiI_T 8/15000	A06B-1477-Bxxx#01xx	240	240	86	96	15360	10752	130	2744	1328	2700	2700
αiI_T 15/15000	A06B-1479-Bxxx#02xx	234	229	95	102	8326	7568	130	1008	192	2000	1000
αiI_T 22/10000	A06B-1471-Bxxx#00xx	142	145	141	170	10240	16389	130	568	496	2300	2300

αiI_T series power up model (200V)

Model	Drawing number	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor winding				
		N4127	N4093	N4612	N4614	N4613	N4615	N4134	N4170	N4168	N4453	N4454
αiI_T 12/12000	A06B-1468-Bxxx#0Rxx	236	202	101	127	10379	16518	130	704	704	2100	2100

αiI_T-B series (200V)

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Motor model	Drawing No. (Output spec. nameplate)	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor winding				
		MAIN HIGH			MAIN LOW			MAIN HIGH			MAIN LOW	
		4127	4612	4613	4093	4614	4615	4134	4170	4453	4168	4454
αi IT 1/24000-B	A06B-1230-K460#S0S	550	42	16390	0	0	0	110	1008	800	0	0
αi IT 1.5/20000-B	A06B-1230-K463#S0S	491	45	20354	0	0	0	110	1232	600	0	0
αi IT 2/20000-B	A06B-1230-K464#S0S	327	72	20357	0	0	0	110	1296	1200	0	0
αi IT 3/12000-B	A06B-1230-K465#S00	178	125	32256	0	0	0	110	1120	3000	0	0
αi IT 3/12000-B	A06B-1230-K465#S0S	422	61	32267	0	0	0	110	1120	3000	0	0
αi IT 3/15000-B	A06B-1230-K475#S0U	327	78	20489	0	0	0	110	896	1400	0	0
αi IT 6/12000-B	A06B-1230-K466#S0P	240	107	12288	240	107	22156	130	1424	2100	400	2100
αi IT 6/15000-B	A06B-1230-K476#S0S	288	89	20489	327	70	32512	130	1072	2700	528	2100
αi IT 8/12000-B	A06B-1230-K467#S00	176	145	12299	176	129	19201	130	328	2700	832	2700
αi IT 8/12000-B	A06B-1230-K467#S0P	240	76	12299	240	79	19201	130	328	2700	832	2700
αi IT 8/12000-B	A06B-1230-K467#S0S	296	86	12299	296	86	19202	130	328	2700	832	2700
αi IT 8/15000-B	A06B-1230-K477#S0S	394	64	12421	416	55	4179	130	2744	2700	1328	2700
αi IT 12/12000-B	A06B-1230-K468#S0P	236	101	10379	202	127	16518	130	704	2100	704	2100
αi IT 12/12000-B	A06B-1230-K468#S0S	305	73	10379	273	94	16774	130	704	2100	704	2100
αi IT 15/12000-B	A06B-1230-K469#S00	161	107	10375	148	164	16772	130	1024	2100	560	1500
αi IT 15/12000-B	A06B-1230-K469#S0P	219	109	10376	202	128	16531	130	1024	2100	560	1500
αi IT 15/12000-B	A06B-1230-K469#S0S	273	97	10376	240	107	16773	130	1024	2100	560	1500
αi IT 15/15000-B	A06B-1230-K479#S00	234	95	8326	229	102	7568	130	1008	2000	192	1000
αi IT 15/15000-B	A06B-1230-K479#S0P	288	73	8326	230	86	7569	130	1008	2000	192	1000
αi IT 15/15000-B	A06B-1230-K479#S0S	342	69	8326	292	10066	9104	130	1008	2000	192	1000
αi IT 22/12000-B	A06B-1230-K471#S00	142	150	10241	155	173	16385	130	568	2300	496	2300
αi IT 22/12000-B	A06B-1230-K471#S0P	191	105	10241	191	126	16385	130	568	2300	496	2300
αi IT 22/12000-B	A06B-1230-K471#S0S	271	92	10241	245	99	16385	130	568	2300	496	2300
αi IPT 22/8000-B	A06B-1230-K472#S00	164	156	32518	240	107	12114	130	432	2300	240	1800

αiI$_L$ series (200V)

Model	Drawing number	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor winding				
		N4127	N4093	N4612	N4614	N4613	N4615	N4134	N4170	N4168	N4453	N4454
αiI$_L$ 8/20000	A06B-1497-B145#02xx	148	210	119	10588	16384	13824	130	784	368	350	240
αiI$_L$ 15/15000	A06B-1495-Bxxx#01xx	158	160	93	8586	7042	9114	130	512	109	1500	1500

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αiI_L series power up model (200V)

Model	Drawing number	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor winding				
		N4127	N4093	N4612	N4614	N4613	N4615	N4134	N4170	N4168	N4453	N4454
αiI_L 26/10000	A06B-1490-Bxxx#0Pxx	270	—	11098	—	9730	—	130	405	—	2000	—

αiI_L-B series (200V)

Motor model	Drawing No. (Output spec. nameplate)	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor winding				
		MAIN HIGH			MAIN LOW			MAIN HIGH			MAIN LOW	
		4127	4612	4613	4093	4614	4615	4134	4170	4453	4168	4454
$\alpha i I_L$ 8/20000-B	A06B-1230-K497#S0N	148	119	16384	210	10588	13824	130	784	350	368	240
$\alpha i I_L$ 15/15000-B	A06B-1230-K495#S01	158	93	7042	160	8586	9114	130	512	1500	109	1500
$\alpha i I_L$ 26/15000-B	A06B-1230-K464#S01	143	129	16770	176	97	13373	130	304	1000	352	350

αiI series (400V)

Model	Drawing number	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor winding				
		N4127	N4093	N4612	N4614	N4613	N4615	N4134	N4170	N4168	N4453	N4454
αiI 12/7000HV	A06B-1508-Bxxx#00xx	172	—	156	—	16517	—	130	704	—	2100	—
αiI 22/7000HV	A06B-1511-Bxxx#00xx	142	—	181	—	16514	—	130	496	—	2300	—
αiI 30/6000HV	A06B-1512-Bxxx#00xx	148	—	147	—	12293	—	130	336	—	3000	—
αiI 60/4500HV	A06B-1515-Bxxx#00xx	179	—	9871	—	12675	—	130	336	—	5000	—

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αiI-B series (400V)

Motor model	Drawing No. (Output spec. nameplate)	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor winding				
		MAIN HIGH			MAIN LOW			MAIN HIGH			MAIN LOW	
		4127	4612	4613	4093	4614	4615	4134	4170	4453	4168	4454
αiI 0.5/10000HV-B	A06B-1230-K501#S00	286	107	10889	0	0	0	110	752	1900	0	0
αiI 1/10000HV-B	A06B-1230-K502#S00	176	124	13581	0	0	0	110	1536	2100	0	0
αiI 1.5/10000HV-B	A06B-1230-K503#S00	404	63	21504	0	0	0	110	1664	3200	0	0
αiI 2/10000HV-B	A06B-1230-K504#S00	202	127	26637	0	0	0	110	416	1700	0	0
αiI 2/20000HV-B	A06B-1230-K524#S00	202	52	26886	0	0	0	110	1296	1200	0	0
αiI 3/10000HV-B	A06B-1230-K505#S00	178	144	19073	0	0	0	110	512	2300	0	0
αiI 6/10000HV-B	A06B-1230-K506#S00	176	156	21898	0	0	0	130	416	2900	0	0
αiI 6/10000HV-B	A06B-1230-K506#S0P	240	107	22154	0	0	0	130	1792	1500	0	0
αiI 8/8000HV-B	A06B-1230-K507#S0P	240	101	16514	0	0	0	130	832	2700	0	0
αiI 8/8000HV-B	A06B-1230-K507#S00	176	145	16513	0	0	0	130	832	2700	0	0
αiI 8/10000HV-B	A06B-1230-K527#S00	176	141	10253	176	145	16517	130	328	2700	592	2500
αiI 8/12000HV-B	A06B-1230-K527#S01	176	124	12299	176	122	19201	130	1136	774	816	612
αiI 12/8000HV-B	A06B-1230-K508#S00	185	156	16521	0	0	0	130	336	1600	0	0
αiI 12/8000HV-B	A06B-1230-K508#S0P	202	127	16521	0	0	0	130	336	1600	0	0
αiI 12/12000HV-B	A06B-1230-K528#S0P	236	107	10379	202	127	16518	130	1488	840	550	600
αiI 15/8000HV-B	A06B-1230-K509#S00	196	126	16537	0	0	0	130	312	2200	0	0
αiI 15/8000HV-B	A06B-1230-K509#S0P	272	128	16537	0	0	0	130	312	2200	0	0
αiI 15/8000HV-B	A06B-1230-K509#S0S	273	100	16537	0	0	0	130	312	2200	0	0
αiI 15/12000HV-B	A06B-1230-K529#S00	164	92	10376	153	126	16517	130	996	2100	560	1500
αiI 22/8000HV-B	A06B-1230-K511#S00	142	181	16517	0	0	0	130	496	2300	0	0
αiI 22/8000HV-B	A06B-1230-K511#S0P	191	134	16517	0	0	0	130	496	2300	0	0
αiI 22/12000HV-B	A06B-1230-K531#S00	142	134	10241	142	152	16514	130	1102	2400	530	2600
αiI 22/12000HV-B	A06B-1230-K531#S0P	193	101	10241	191	121	16771	130	1102	2400	530	2600
αiI 30/7000HV-B	A06B-1230-K512#S00	148	147	12291	0	0	0	130	336	3000	0	0
αiI 30/7000HV-B	A06B-1230-K512#S0P	196	142	12546	0	0	0	130	336	3000	0	0
αiI 40/7000HV-B	A06B-1230-K513#S00	146	175	14082	0	0	0	130	318	3700	0	0
αiI 40/7000HV-B	A06B-1230-K513#S0P	227	96	14340	0	0	0	130	318	3700	0	0
αiI 50/5000HV-B	A06B-1230-K514#S00	147	148	12559	0	0	0	130	272	2500	0	0
αiI 60/5000HV-B	A06B-1230-K515#S00	179	9871	12550	0	0	0	130	336	5000	0	0
αiI 75/5000HV-B	A06B-1230-K516#S00	151	178	13580	0	0	0	130	283	3800	0	0

JR AUTOMATION TECHNOLOGIES INC*

αiI-B series (400V)

Motor model	Drawing No. (Output spec. nameplate)	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor winding				
		MAIN HIGH			MAIN LOW			MAIN HIGH			MAIN LOW	
		4127	4612	4613	4093	4614	4615	4134	4170	4453	4168	4454
αiI 100/5000HV-B	A06B-1230-K518#S00	120	192	6938	120	169	12288	130	150	4700	275	3300
αiI 150/5000HV-B	A06B-1230-K532#S00	146	178	12298	0	0	0	130	341	2500	0	0

αiIP-B series (400V)

Model	Drawing number	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor windin				
		MAIN HIGH			MAIN LOW			MAIN HIGH			MAIN LOW	
		4127	4612	4613	4093	4614	4615	4134	4170	4453	4168	4454
αi IP 15/8000HV-B	A06B-1230-	162	160	32385	216	89	12365	130	240	470	278	1100
αi IP 22/8000HV-B	A06B-1230-	164	138	32518	240	64	12288	130	0	0	0	0
αi IP 40/6000HV-B	A06B-1230-	143	179	24453	203	126	10053	130	288	3300	74	1500
αi IP 50/6000HV-B	A06B-1230-	0	0	0	0	0	0	130	0	0	0	0
αi IP 60/5000HV-B	A06B-1230-	164	125	16395	195	92	7758	130	0	0	0	0

αiIL-B series (400V)

Model	Drawing number	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor windin				
		MAIN HIGH			MAIN LOW			MAIN HIGH			MAIN LOW	
		4127	4612	4613	4093	4614	4615	4134	4170	4453	4168	4454
αi IL 8/20000HV-B	A06B-1230-	169	92	12424	210	10603	13600	130	459	350	420	240
αi IL 15/15000HV-B	A06B-1230-	157	79	7042	160	165	8859	130	98	1500	61	1500
αi IL 26/15000HV-B	A06B-1230-	153	146	14725	176	112	11581	130	114	1000	142	350

JR AUTOMATION TECHNOLOGIES INC*
3D MODELING

αiI_T-B series (400V)

Model	Drawing number	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor windin				
		MAIN HIGH			MAIN LOW			MAIN HIGH			MAIN LOW	
		4127	4612	4613	4093	4614	4615	4134	4170	4453	4168	4454
αiIT 1.5/20000HV-B	A06B-1230-	176	48	26886	0	0	0	110	1232	600	0	0
αiIT 2/20000HV-B	A06B-1230-	202	52	26886	0	0	0	110	1296	1200	0	0
αiIT 3/12000HV-B	A06B-1230-	178	118	32523	0	0	0	110	1120	3000	0	0
αiIT 6/12000HV-B	A06B-1230-	164	80	12299	188	105	21644	130	1440	2000	400	2100
αiIT 8/12000HV-B	A06B-1230-	176	124	12299	176	122	19201	130	1136	774	816	612
αiIT 8/15000HV-B	A06B-1230-	240	86	15369	240	99	10784	130	1635	3000	794	3500
αiIT 12/12000HV-B	A06B-1230-	236	107	10379	202	127	16518	130	1488	840	550	600
αiIT 15/12000HV-B	A06B-1230-	164	92	10376	153	126	16517	130	996	2100	560	1500
αiIT 15/15000HV-B	A06B-1230-	233	86	8326	228	140	7310	130	928	3100	288	1600
αiIT 15/15000HV-B	A06B-1230-	236	62	8326	281	123	7310	130	928	3100	288	1600
αiIT 15/15000HV-B	A06B-1230-	240	51	8326	334	107	7310	130	928	3100	288	1600
αiIT 22/12000HV-B	A06B-1230-	142	134	10241	142	152	16514	130	763	1200	366	1200
αiIT 22/12000HV-B	A06B-1230-	191	101	10253	191	121	16771	130	3174	1200	2094	1200

βiI series (200V)

Model	**Drawing number**	**Parameters relating to Load meter (normalized by cont. rated output)**						**Parameters relating to estimate temperature of motor winding**				
		N4127	**N4093**	**N4612**	**N4614**	**N4613**	**N4615**	**N4134**	**N4170**	**N4168**	**N4453**	**N4454**
βiI 3/10000	A06B-1444-Bxxx#00xx	237	—	11105	—	12297	—	110	456	—	1200	—
βiI 3/12000	A06B-1444-Bxxx#02xx	237	—	11105	—	12291	—	110	456	—	1200	—
βiI 6/10000	A06B-1445-Bxxx#00xx	217	—	10858	—	12301	—	110	1120	—	3000	—
βiI 8/10000	A06B-1446-Bxxx#01xx	233	—	10856	—	12429	—	130	456	—	1800	—
βiI 8/12000	A06B-1446-Bxxx#02xx	233	—	10856	—	12422	—	130	456	—	1800	—
βiI 12/7000	A06B-1447-Bxxx#00xx	221	—	11103	—	9740	—	130	405	—	2000	—
βiI 12/8000	A06B-1447-Bxxx#01xx	221	—	11103	—	9740	—	130	405	—	2000	—
βiI 12/10000	A06B-1447-Bxxx#02xx	221	—	11103	—	9730	—	130	405	—	2000	—
βiI 15/7000	A06B-1498-Bxxx#00xx	194	—	10859	—	9482	—	130	405	—	2000	—

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βiI-B series (200V)

Model	Drawing number	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor windin				
		MAIN HIGH			MAIN LOW			MAIN HIGH			MAIN LOW	
		4127	4612	4613	4093	4614	4615	4134	4170	4453	4168	4454
βi I 3/12000-B	A06B-1230-K444#S00	237	11114	12297	0	0	0	110	456	1200	0	0
βi I 3/12000-B	A06B-1230-K444#S0P	297	11094	12291	0	0	0	110	456	1200	0	0
βi I 6/12000-B	A06B-1230-K445#S00	199	10858	12298	0	0	0	110	1120	3000	0	0
βi I 6/12000-B	A06B-1230-K445#S0P	291	10828	12298	0	0	0	110	1120	3000	0	0
βi I 8/12000-B	A06B-1230-K446#S00	213	10866	12422	0	0	0	110	456	1800	0	0
βi I 8/12000-B	A06B-1230-K446#S0P	290	10836	12423	0	0	0	110	456	1800	0	0
βi I 12/10000-B	A06B-1230-K447#S00	203	11112	9730	0	0	0	110	405	2000	0	0
βi I 12/10000-B	A06B-1230-K447#S0P	248	11106	9730	0	0	0	110	405	2000	0	0
βi I 15/8000-B	A06B-1230-K498#S00	175	10614	9476	0	0	0	130	405	2000	0	0
βi I 15/8000-B	A06B-1230-K498#S0P	208	10582	9478	0	0	0	130	405	2000	0	0

βiIp series (200V)

Model	Drawing number	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor winding				
		N4127	N4093	N4612	N4614	N4613	N4615	N4134	N4170	N4168	N4453	N4454
βiIP 18/6000	A06B-1443-Bxxx#00xx	194	—	10856	—	27648	—	130	224	—	1000	—

βiIP-B series (200V)

Model	Drawing number	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor windin				
		MAIN HIGH			MAIN LOW			MAIN HIGH			MAIN LOW	
		4127	4612	4613	4093	4614	4615	4134	4170	4453	4168	4454
βi IP 8/6000-B	A06B-1230-K457#S00	211	10575	18690	0	0	0	110	456	1800	0	0
βi IP 12/6000-B	A06B-1230-	242	13395	14080	0	0	0	110	320	1700	0	0
βi IP 15/8000-B	A06B-1230-	209	13153	#####	0	0	0	130	397	4000	0	0
βi IP 18/8000-B	A06B-1230-	176	10867	27528	0	0	0	130	224	1000	0	0
βi IP 22/8000-B	A06B-1230-	201	11136	16524	0	0	0	130	453	1800	0	0
βi IP 30/8000-B	A06B-1230-	181	11149	16775	0	0	0	130	309	1800	0	0
βi IP 40/6000-B	A06B-1230-K480#S00	158	136	18945	0	0	0	130	304	3700	0	0

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βiI_C series (200V)

Model	Drawing number	Parameters relating to Load meter (normalized by cont. rated output)			Parameters relating to estimate temperature of motor winding		
		No.4127	No.4612	No.4613	No.4134	No.4170	No.4453
βiIC 3/6000	A06B-1415-Bxxx#0009	216	10859	9493	110	677	1650
βiIC 6/6000	A06B-1416-Bxxx#0009	197	10836	12295	110	949	1900
βiIC 8/6000	A06B-1417-Bxxx#0009	212	10860	10766	110	728	1510

βiI_T-B series (200V)

Model	Drawing number	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor windin				
		MAIN HIGH			MAIN LOW			MAIN HIGH			MAIN LOW	
		4127	4612	4613	4093	4614	4615	4134	4170	4453	4168	4454
βi IT 12/10000-B	A06B-1230-	202	11112	9730	0	0	0	110	405	2000	0	0
βi IT 12/10000-B	A06B-1230-	249	11100	9730	0	0	0	110	405	2000	0	0
βi IT 15/8000-B	A06B-1230-	175	11122	9735	0	0	0	130	405	2000	0	0
βi IT 15/8000-B	A06B-1230-	208	10837	9734	0	0	0	130	405	2000	0	0

βiI-B series (400V)

Model	Drawing number	Parameters relating to Load meter (normalized by cont. rated output)						Parameters relating to estimate temperature of motor windin				
		MAIN HIGH			MAIN LOW			MAIN HIGH			MAIN LOW	
		4127	4612	4613	4093	4614	4615	4134	4170	4453	4168	4454
βi I 3/12000HV-B	A06B-1230-K544#S00	218	####	####	0	0	0	110	456	1200	0	0
βi I 3/12000HV-B	A06B-1230-K544#S0P	272	####	####	0	0	0	110	456	1200	0	0
βi I 6/12000HV-B	A06B-1230-K545#S00	199	####	####	0	0	0	110	1488	7500	0	0
βi I 6/12000HV-B	A06B-1230-K545#S0P	291	####	####	0	0	0	110	1488	7500	0	0
βi I 8/12000HV-B	A06B-1230-K546#S00	197	####	####	0	0	0	130	896	1800	0	0
βi I 8/12000HV-B	A06B-1230-K546#S0P	294	####	####	0	0	0	130	336	1500	0	0
βi I 12/10000HV-B	A06B-1230-K547#S00	202	####	9729	0	0	0	130	480	2400	0	0
βi I 12/10000HV-B	A06B-1230-K547#S0P	250	####	9729	0	0	0	130	480	2400	0	0
βi I 15/8000HV-B	A06B-1230-K598#S00	182	####	9735	0	0	0	130	288	2000	0	0
βi I 15/8000HV-B	A06B-1230-K598#S0P	199	####	9734	0	0	0	130	288	2000	0	0

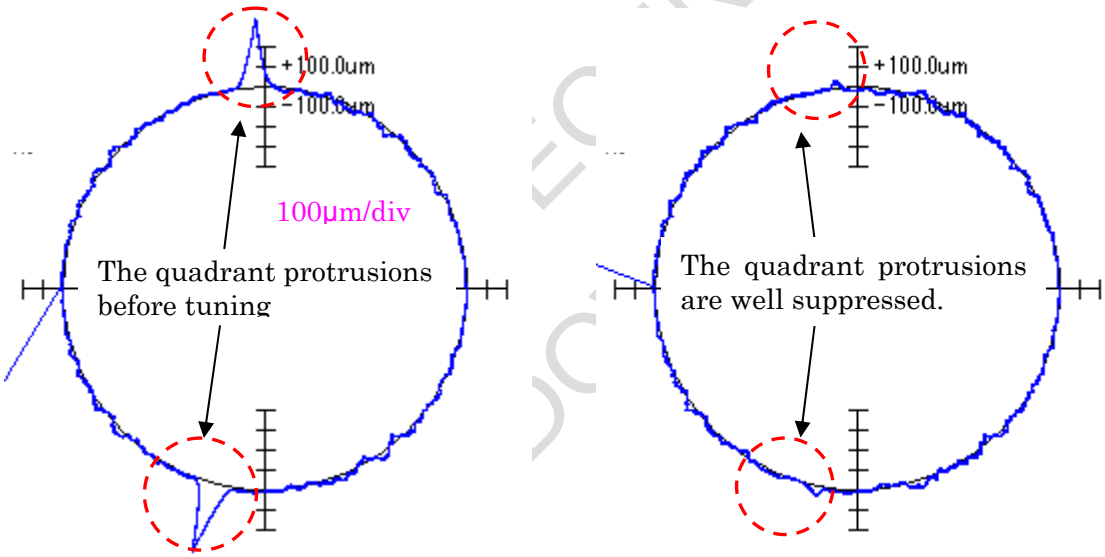
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NOTE
1 No.4352#3=0 (Disables the load meter normalized by cont. rated output), No.4398#7=1(Setting for estimation of temperature).
2 Parameter No. shown in the table are for high-speed characteristics on the main side in Spindle switching control. Parameter No. on the sub-side or for low-speed characteristics are shown in items 5.28.4.2 and 5.28.4.2
3 We will add the parameters for the motor models not listed in table step by step. If you need the missing parameters, please contact to FANUC.

5.29 Smart Backlash Compensation (Cs axis)

5.29.1 Outline

Smart backlash compensation (Cs axis) is a function that measures length of backlash between motor and machine automatically, and executes optimal backlash compensation for full-closed or dual position feedback controlled Cs axes. The function updates the backlash length using motor sensor and spindle sensor when the axis moves in reverse.
It is effective to compensate the reversal delay depending on mechanical backlash of gears or so.



(a) Smart backlash compensation OFF (b) Smart backlash compensation ON

NOTE
1 This function cannot be used with sensorless motor.

5.29.2 Series and Edition of Applicable Spindle Software

Spindle software

Series	Edition	Application
9D9A	B (02) edition or later	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DAA	E (05) edition or later	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B
9DB0	C (03) edition or later	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

5.29.3 Parameters

<1> Rerated parameter list

Parameter No. 0*i* / 30*i*	Contents
No.4543#3	Smart backlash compensation function bit
No.4644	Gain for Smart backlash compensation
No.4645	Ratio for compensation against actual backlash length
No.4646	Distance of spindle movement (Distance for update of "Based semi-full error" information)
No.4647	Judgment time of axis stop in Smart backlash compensation
No.4648	Effective time of Smart backlash compensation
No.4649	Effective time for getting "Based semi-full error"
No.4650	Compensation length of Smart backlash compensation
No.4651 to 4654 No.4171 to 4174	Arbitrary gear ratio between motor sensor and spindle

NOTE
When the backlash length changes depending on the selected gear, please change some parameters by PMC depending on selected gear signals.

<2> Details of parameters

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4543	4543					**SBLFNC**			

SBLFNC: Smart backlash compensation function bit
0 : Function invalid
1 : Function valid
When this function bit is set, Smart backlash compensation in full-closed and dual position feedback controlled Cs axis.
It's impossible to use this function under the following conditions.
・ Axes controlled as semi-closed (No.4002#3~0=0001 : Position control is done by motor sensor.)
・ Axes controlled in IS-D as command unit
・ Axes controlled in Spindle electronic gear box
・ Sub-side axes in Spindle switching control

0*i*	30*i*	
4644	4644	**Gain for Smart backlash compensation**

Unit of data : %
Data range : 0~10000
Initial setting : 100
This parameter is used as the gain for Smart backlash compensation. When the function is valid, the following compensation is given to velocity command.
(The distance to the target edge of backlash) * No.4644 / 100 * Position gain.
The optimum value of this parameter varies depending on the mechanical character and position gain. Please tune it starting from 100 as initial setting value.

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0*i*	30*i*	
4645	4645	**Ratio for compensation against actual backlash length**

Unit of data : 0.1%
Data range : 0~10000
Initial setting : 0 (It is equal to 900, which means 90%.)

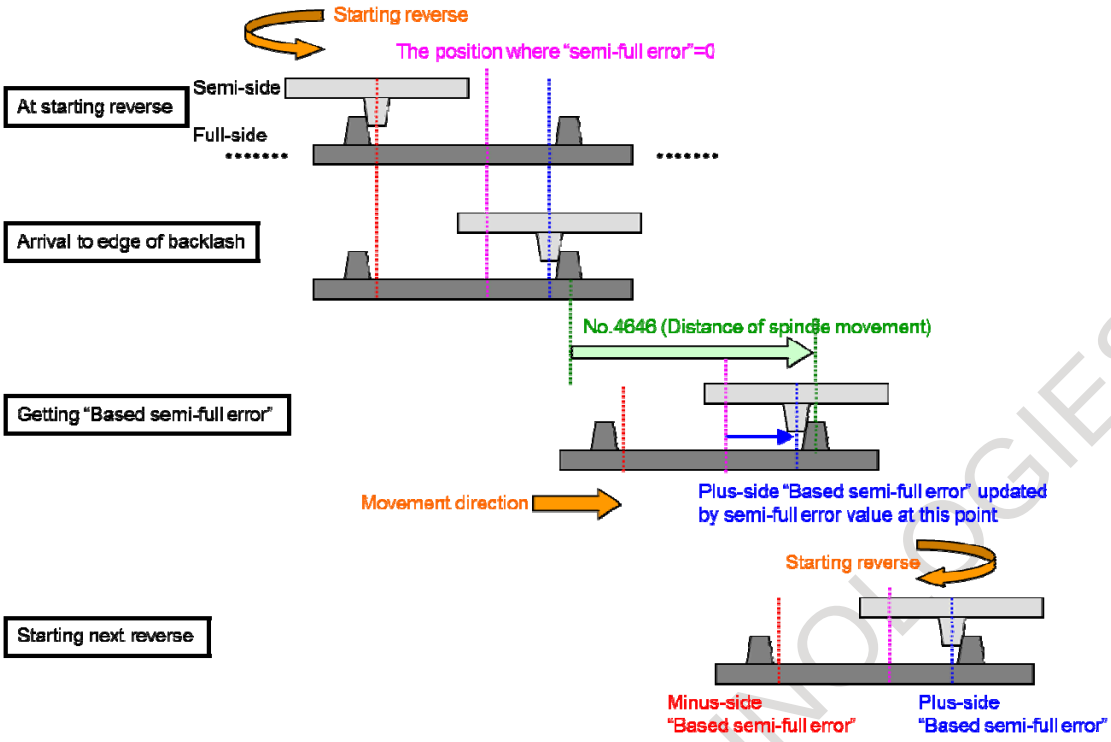
The compensation will finish after the motor moves following distance from compensation start point.
(The distance to the edge of backlash at reversal start) * No.4645 / 1000
Please set 0 (It is equal to 900.) as initial value. And if you see a dent in circle by over-compensation, please change it to smaller value. On the contrary, if you seen the lack of compensation, please change it to larger value. Please refer to [Supplementation 1] in Page 6 about the calculation way of compensation command applying "Ratio for compensation against actual backlash length"

0*i*	30*i*	
4646	4646	**Distance of spindle movement (Distance for update of "Based semi-full error" information)**

Unit of data : 0.001deg
Data range : 0~32767
Initial setting : 500

In Smart backlash compensation, the semi-full error, which is the difference between the error counter for semi-closed loop side and the error counter for full-closed side, at the edge of mechanical backlash is memorized and used for control as "Based semi-full error".
In this parameter, please set moving distance of spindle from the reverse point to the point where the information of "Based semi-full error" is gotten. Theoretically this parameter should become small value, because the spindle starts to move after the motor reaches to the edge of backlash. But the spindle might move minutely during the motor moves to the edge of backlash, and the minute moving distance is counted as the distance of spindle movement. Therefore we recommend you to set slightly larger value than expected backlash length. However if the value is too large, the next reverse point might come before the spindle reaches the setting distance. Then the smaller value than the distance to next reversal point should be set in this parameter. (See below figure)
Please set 500 as initial value and tune it according to the machine or cutting condition.

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0*i*	30*i*	
4647	4647	**Judgment time of axis stop in Smart backlash compensation**

Unit of data : 1ms
Data range : 0~32767
Initial setting : 0 (It is equal to 200.)

Smart backlash compensation finishes after the spindle axis stops for the specified time by this parameter.
If the axis stops after very small reverse which is less than the distance of Smart backlash compensation, the compensation will be given continuously. To avoid such situation, this parameter is used for management of compensation time.
We recommend you to set 200 or so as initial value.

0*i*	30*i*	
4648	4648	**Effective time of Smart backlash compensation**

Unit of data : 1ms
Data range : 0~32767
Initial setting : 500

This parameter specifies the time from start of Smart backlash compensation to finish.
Smart backlash compensation starts at the reversal point and it finishes after the movement of (Backlash length)*(Ratio of compensation) (No.4645). In addition to it, the finish time is specified by this parameter.
We recommend you to set 500ms or so as initial value, and tune it according to reversal speed.

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0*i*	30*i*	
4649	4649	**Effective time for getting "Based semi-full error"**

Unit of data : 1ms
Data range : 0~32767
Initial setting : 0 (It is equal to 10000.)
The getting "Based semi-full error" procedure will be terminated forcedly if it takes the time over this parameter value after starting of getting "Based semi-full error" information. If it is terminated, "Based semi-full error" is not updated.
We recommend you to set 0 (10000ms) as initial value.

0*i*	30*i*	
4650	4650	**Compensation length of Smart backlash compensation**

Unit of data : 0.001deg
Data range : 0~3000
Initial setting : 0
When you can't set the exact values in the parameters for arbitrary gear ratio, the spindle software can't measure the backlash length automatically as the semi-full error changes at the rotating. Even in such axes, it becomes possible to use Smart backlash compensation by setting the backlash length, which measures in other way, in this parameter.
(On the contrary, when you can set the exact values in the parameters for arbitrary gear ratio, 0 should be set in this parameter.)
When something value except 0 is set in this parameter, the value is used as the backlash length. In the case, the automatic measurement of backlash length is not done, and the command for reversal compensation is calculated by this parameter (fixed value).
Please refer to "Tuning example" about the way to measure the backlash length.

<3> Related parameters

0*i*	30*i*	
4171	4171	**The denominator of Arbitrary gear ratio between motor sensor and spindle (HIGH)**
4172	4172	**The numerator of Arbitrary gear ratio between motor sensor and spindle (HIGH)**
4651	4651	**The denominator of Arbitrary gear ratio between motor sensor and spindle (MEDIUM HIGH)**
4652	4652	**The numerator of Arbitrary gear ratio between motor sensor and spindle (MEDIUM HIGH)**
4653	4653	**The denominator of Arbitrary gear ratio between motor sensor and spindle (MEDIUM LOW)**
4654	4654	**The numerator of Arbitrary gear ratio between motor sensor and spindle (MEDIUM LOW)**
4173	4173	**The denominator of Arbitrary gear ratio between motor sensor and spindle (LOW)**
4174	4174	**The numerator of Arbitrary gear ratio between motor sensor and spindle (LOW)**

Unit of data : 0.001deg
Data range : 0~32767
Initial setting : 0
These parameters are set as conversion coefficients (numerator, denominator) for using arbitrary gear ratio function (DMR function) when a motor sensor (αiM or αiMZ sensor) is used as spindle position feedback signal by multiplying a gear ratio.
When the spindle rotates Q times while the motor shaft rotates P times (there is no common divisor other than 1 for P and Q), settings are:
No.4171(No.4173 when CTH1A=1) = P
No.4172(No.4174 when CTH1A=1) = Q

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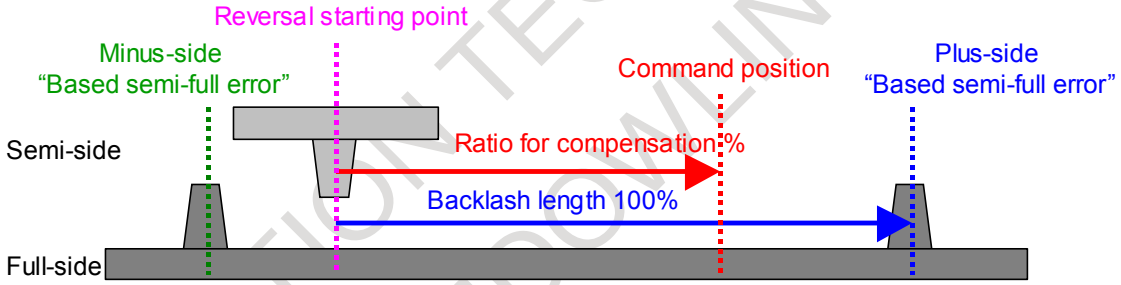
In Smart backlash compensation, the semi-full error is calculated by these parameters. When you can't set the exact values in these parameters, the spindle software can't measure the backlash length automatically as the semi-full error changes at the rotating. In such case, you should set the backlash length in No.4650 (Compensation length of Smart backlash compensation).

NOTE
For details of this parameter, refer to Section 1.3.2, "PARAMETERS RELATED TO DETECTORS" in Part I.

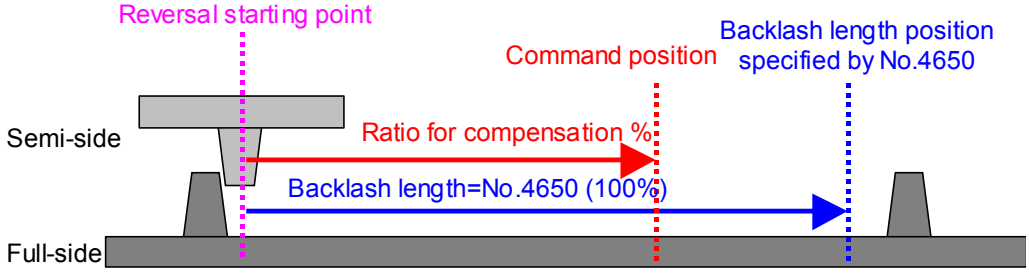
<4> Additional explanation: Ratio for compensation against actual backlash length and the command

Smart backlash compensation accelerates the motor to the other backlash edge at reverse. The following figure shows the concept of the command calculation. The command calculation way changes depending on whether the arbitrary gear ratio is set exactly or not. (No.4650=0 or ≠0).

(1) In case that the arbitrary gear ratio is set exactly (No.4650=0)
The difference between the position at reversal starting point and "Based semi-full error" which is measured automatically treated as the backlash length, and the compensation command is calculated from the backlash length multiplied by "Ratio for compensation against actual backlash length"(No.4645). The following compensation continues till the motor reaches the command position, and it ends after the motor reaches the command position. Remaining distance to the command position * Gain for Smart backlash compensation(No.4644) /100 * Position gain



(2) In case that the arbitrary gear ratio is NOT set exactly (No.4650≠0)
As the semi-full error is calculated by arbitrary gear ratio, it becomes impossible to measure the backlash length when the arbitrary gear ratio is not exact value. In such case, the command position is calculated from the setting value of No.4650 (Compensation length of Smart backlash compensation). When something value except 0 is set in No.4650, the value is treated as the backlash length. And the command position is calculated from the value multiplied by "Ratio for compensation against actual backlash length"(No.4645). The following compensation continues till the motor reaches the command position, and it ends after the motor reaches the command position.
Remaining distance to the command position * Gain for Smart backlash compensation(No.4644) /100 * Position gain



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5.29.4 parameter adjustment procedure

5.29.4.1 Initial parameter settings

Please set following initial parameters for Smart backlash compensation.

Parameter No. (30*i*, 0*i*)	Contents
No.4543#3	· Smart backlash compensation function bit Set 1 to activate Smart backlash compensation
No.4644	· Gain for Smart backlash compensation Set 100 as initial value. Tune it later according to the machine or machining condition.
No.4645	· Ratio for compensation against actual backlash length Set 0(900) as initial value. Tune it later according to the machine or machining condition.
No.4646	· Distance of spindle movement (Distance for update of "Based semi-full error" information) Set 500 as initial value.
No.4647	· Judgment time of axis stop in Smart backlash compensation Set 0(200) as initial value
No.4648	· Effective time of Smart backlash compensation Set 500 as initial value.
No.4649	· Effective time for getting "Based semi-full error" Set 0(10000) as initial value.
No.4650	· Compensation length of Smart backlash compensation Set 0 when you can set exact value in arbitrary gear ratio. If you can't set it, set the value which is measured by following way.
No.4171~4174 No.4651~4654	· Arbitrary gear ratio between motor sensor and spindle Set the value according to the machine configuration as the arbitrary gear ratio is used to calculate semi-full error.

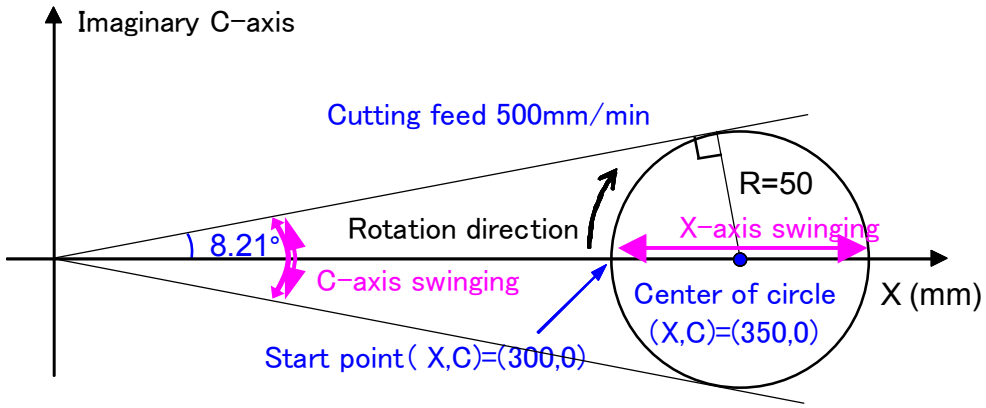
5.29.4.2 Tuning example

The tuning way is different depending on whether the arbitrary gear ratio (No.4171~4174,No.4651~No.4654) is exact or not.

<1> In case that the arbitrary gear ratio is exact value

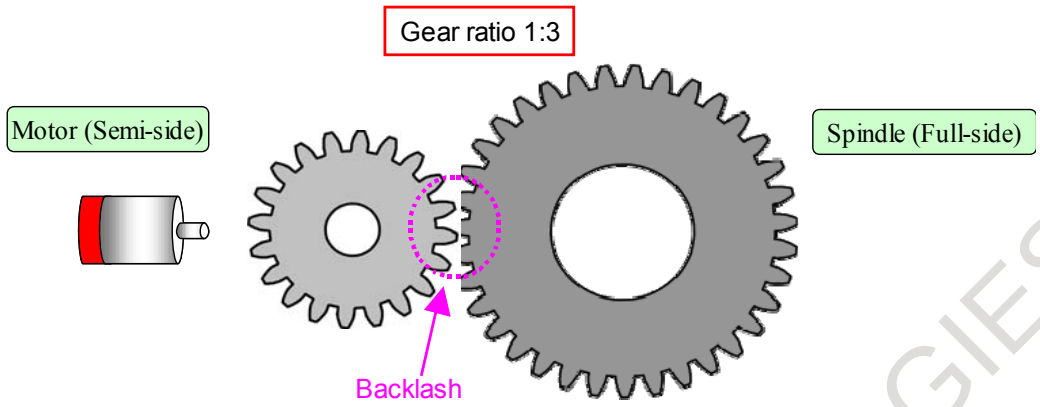
(1) The tuning example of spindle Smart backlash compensation under the following circle and machine condition is show.

[Circle condition]



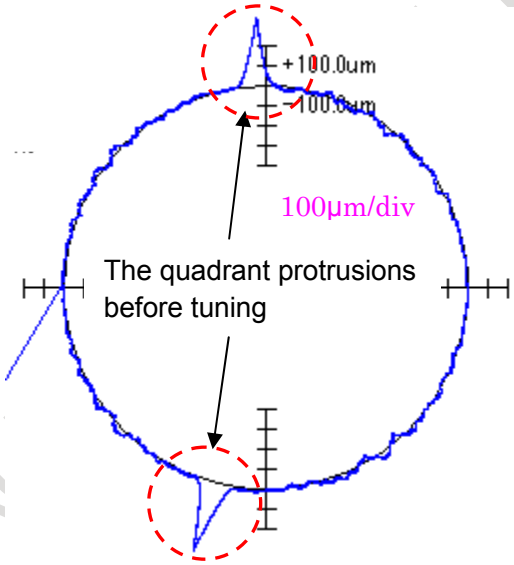
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[Machine condition]
The target machine has the following gear ratio.

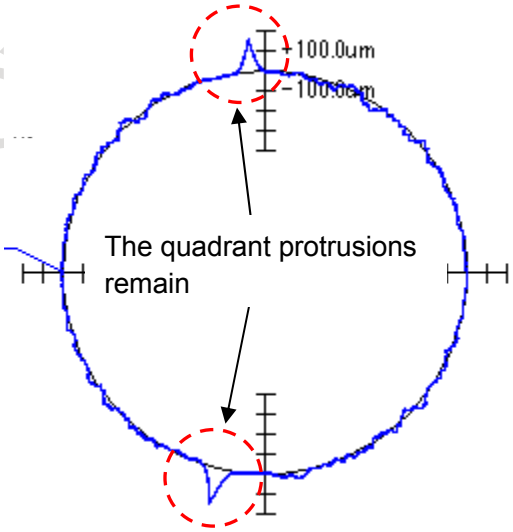


(2) Set initial parameters according to "4. Initial parameter settings". The arbitrary gear ratio should be No.4171=3、No.4172=1 in this example. The figures (a) and (b) in next page shows the effect of Smart backlash compensation. (a) shows the result before tuning. And (b) shows the result after setting initial parameters. When only initial settings can't eliminate the quadrant protrusions enough, please try to tune some parameters.

(3) To reduce the quadrant protrusions, "Gain for Smart backlash compensation" (No.4644) and "Ratio for compensation against actual backlash length"(No.4645) should be tuned. Here we try to increase both parameters to reduce the quadrant protrusions. The figure(c) shows the result of circle after set No.4644=1200 and No.4645=100.
If these parameters are too much, dents may occur due to the over compensation like figure(d).

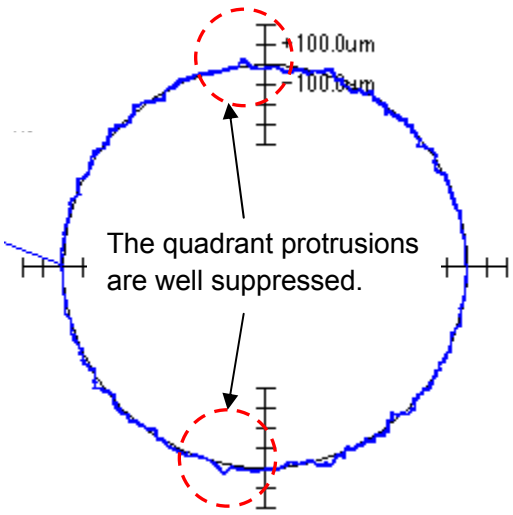


(b) The circle before tuning
Smart backlash compensation OFF

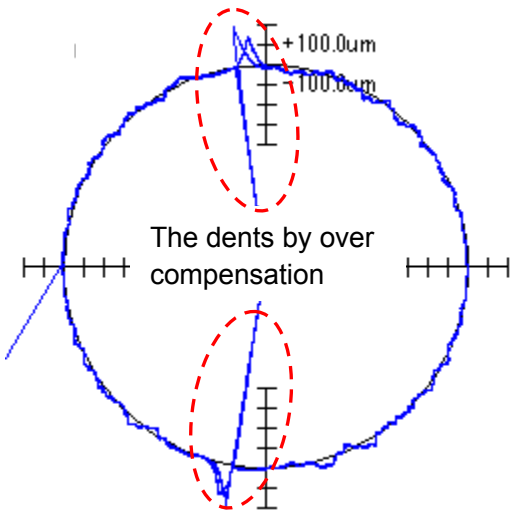


(b) The circle after setting initial parameters
No.4644=100, No.4645=90%

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(c) The circle after tuning
No.4644=1200, No.4645=100%.



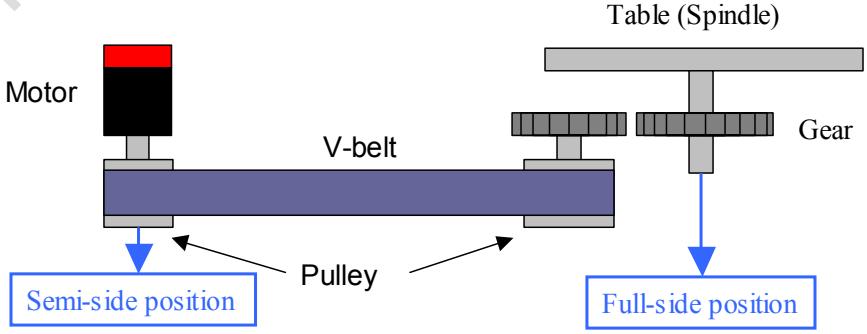
(d) The circle with over compensation
No.4644=3200, No.4645=100%.

<2> In case that the arbitrary gear ratio is NOT exact value

There are some cases that we can't set exact value in the arbitrary gear ratio, because the connection between the motor and the spindle uses V-belt (with pulley) or the gear ratio is irreducible to 1 word / 1word. When the arbitrary gear ratio is not exact value, the semi-full error changes in motor rotation and it becomes impossible to measure the backlash length automatically. In such case, please measure the backlash length manually by the following way and set the value in No.4650. Then "Based semi-full error" will not update automatically, and the fixed backlash length specified by No.4650 is always used.

Note) The exa mple that the arbitrary gear ratio is NOT exact value

Suppose following axis which has a V-belt and gears as a reduction between a motor and a spindle. The total reduction ratio is determined by pulley ratio and gear ratio. For example, if the total gear ratio is 1003 : 92337(mutually prime number), we can't set the parameters for the arbitrary gear ratio (No.4171~4174,No.4651~No.4654) as exact value, because the data range is from 0 to 32767. In such case, as it's impossible to measure the backlash length automatically, we use Smart backlash compensation with using No.4650 (Compensation length of Smart backlash compensation).
There are possibilities that above situation occurs in the cases that the many gears are used in the connection between the motor and the spindle.

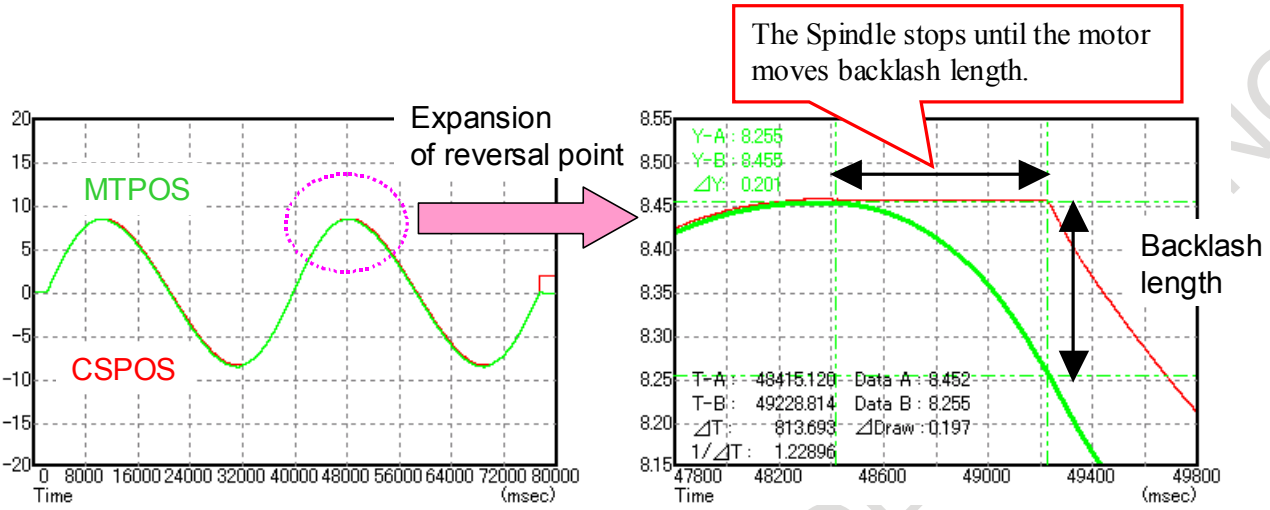


(1) Measurement of backlash length

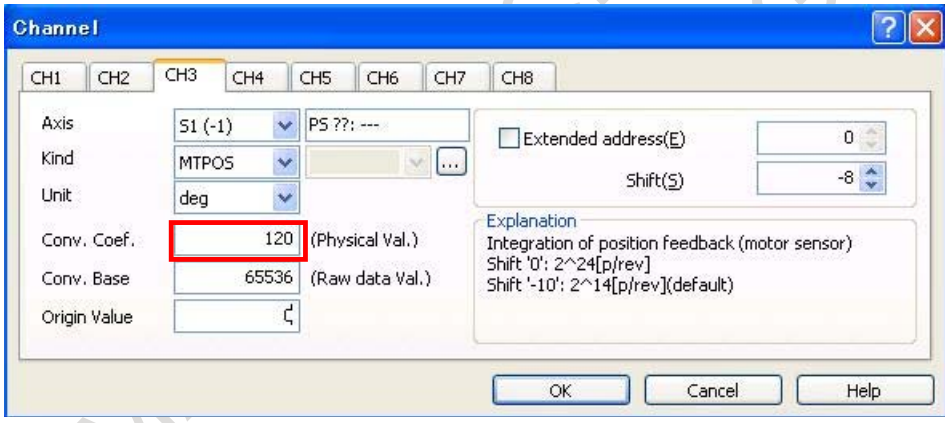
Measure motor position(MTPOS) and spindle position(CSPOS) during circle movement by SERVO GUIDE without Smart backlash compensation (No.4543#3=0). The spindle doesn't move until the motor reaches the backlash edge in other side in the reversal movement. So the distance of motor movement shows the backlash length during the spindle stop in the reversal movement.

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In the following example, as the measurement result of backlash length is 0.201degree, No.4650(Compensation length of Smart backlash compensation) should be “201”.



† The conversion of MTPOS to CSPOS unit
It becomes easy to compare by converting motor position to spindle position unit. To do it, please change “Conversion coefficient” of MTPOS. In this example, “Conversion coefficient” of MTPOS is 360deg/3=120deg, because the gear ratio is 1:3.



(2) Tuning of quadrant protrusion
Set initial parameters for Smart backlash compensation. Tune mainly “Gain for Smart backlash compensation” (No.4644) and ”Ratio for compensation against actual backlash length”(No.4645) to reduce quadrant protrusions such as “5.1 In case that the arbitrary gear ratio is exact value”.

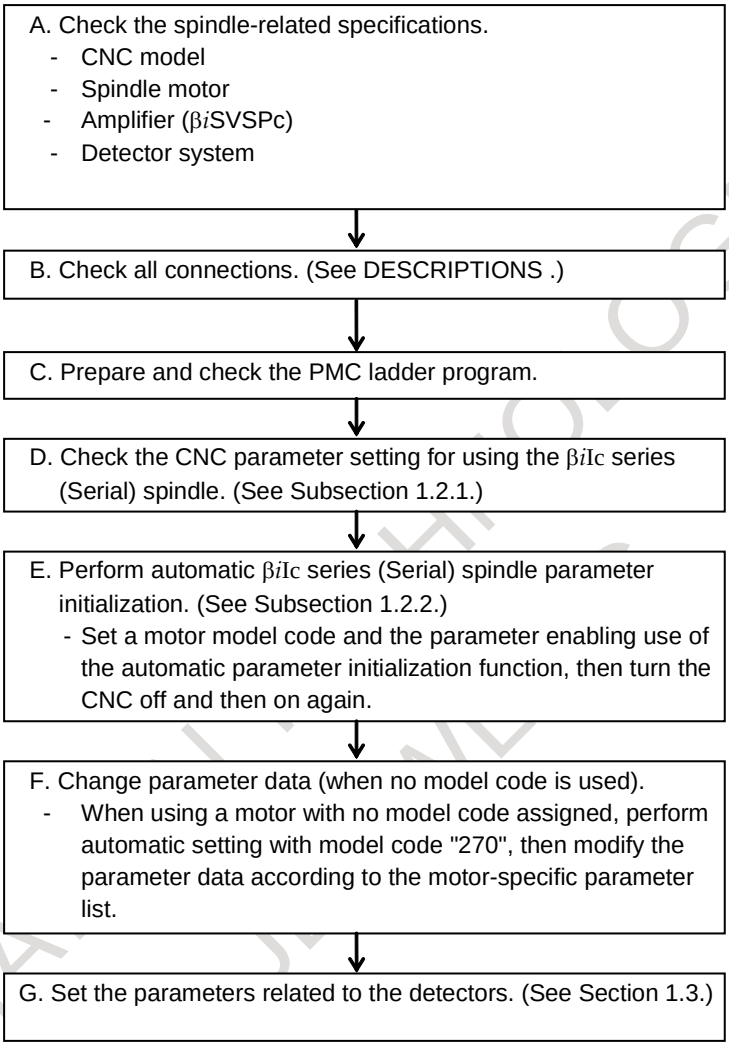
II. FANUC SPINDLE MOTOR βiIc series

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1 START-UP

1.1 START-UP PROCEDURE



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1.2 SPINDLE SERIAL INTERFACE (OPTIONAL FUNCTION)

1.2.1 Parameters Related to Spindle Serial Output

For this subsection, see Subsection 1.2.1, “Parameters Related to Spindle Serial Output”, in Part I.

1.2.2 Spindle Parameter Initialization

(1) Parameter list

Parameter No.	Description
4019#7	Function for automatically initializing spindle parameters
4133	Spindle motor model code

(2) Procedure for spindle parameter initialization

Perform spindle parameter initialization by following the procedure below.

<1> Set the model code for the desired motor for automatic parameter initialization.

Parameter No.	Description
4133	Model code

NOTE

*1 For the spindle motor βiIc, which has no model code, set the model code to automatically set the parameter, and then input data manually according to the motor parameter table.

For Series βiSVSPc: 270
For Series βiSVSP-B: 299

*2 In Series βiSVSPc and Series βiSVSP-B, the following parameter settings are different.

For Series βiSVSPc: No.4000#7 to 0
For Series βiSVSP-B: No.4000#7 to 1

<2> Set the relevant parameter to enable automatic spindle parameter initialization.

Parameter No.	Description
4019#7	1

NOTE

This bit is reset to its original value after automatic parameter initialization.

<3> Turn the CNC off, then on again. Then, the spindle parameters specified with a model code are automatically initialized.

1.2.3 Diagnosis (Diagnosis Screen)

For this subsection, see Subsection 1.2.4, “Diagnosis (Diagnosis Screen)”, in Part I.

1.2.4 Alarm

For this subsection, see Subsection 1.2.5, “Alarm”, in Part I.

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1.3 PARAMETERS RELATED TO DETECTORS

The spindle detectors applicable to the βiIc series spindle motor are shown below.

Spindle sensor
αi position coder
αiBZ sensor

1.3.1 List of Parameters for Detectors

Parameter No.	Description
3720	Number of pulses of the position coder
4000 #0	Direction of spindle and spindle motor rotation
4001 #4	Spindle sensor mounting direction
4002#3,2,1,0	Spindle sensor type setting
4003#7,6,5,4	Sets the number of spindle sensor gear teeth. (Set to 0,0,0,0.)
4006 #1	Gear ratio increment system
4007 #5	Whether to detect disconnection of feedback signals
4007 #6	Whether to detect alarms related to position feedback signals
4016 #6	Whether to detect alarms related to threading feedback
4016 #7	Setting of the function of detecting the one-rotation signal again each time position control mode is set.
4056 to 4059	Spindle-to-motor gear ratio data (This data is selected by spindle control input signals CTH1A and CTH2A.)
4098	Maximum speed for position feedback signal detection
4361	Sets arbitrary number of spindle sensor gear teeth. (When the number of spindle sensor gear teeth cannot be set with bits 7, 6, 5, and 4 of parameter No. 4003)

1.3.2 Details of Parameters for Detectors

For this subsection, see Subsection 1.3.2, “Details of Parameters for Detectors”, in Part I.

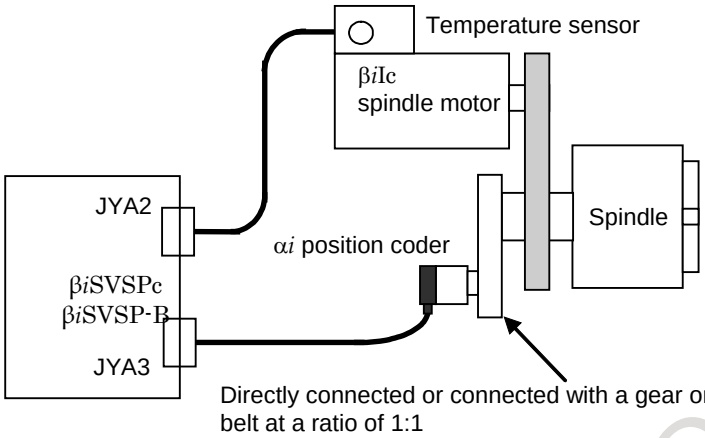
1.3.3 Typical Detector Configurations

This subsection describes the detector configurations for the spindles to which the βiIc series spindle motor is applicable and the procedure for setting parameters for the detector configurations.
Since the hardware of the detection circuit is set according to the parameter setting in the βiIc series spindle motor, a broken wire alarm or the like may be indicated incorrectly during setting of the parameter related to detectors.
To initialize the hardware, after setting the parameters related to detectors, turn the power to the amplifier off once.

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(1) When the αi position coder is used

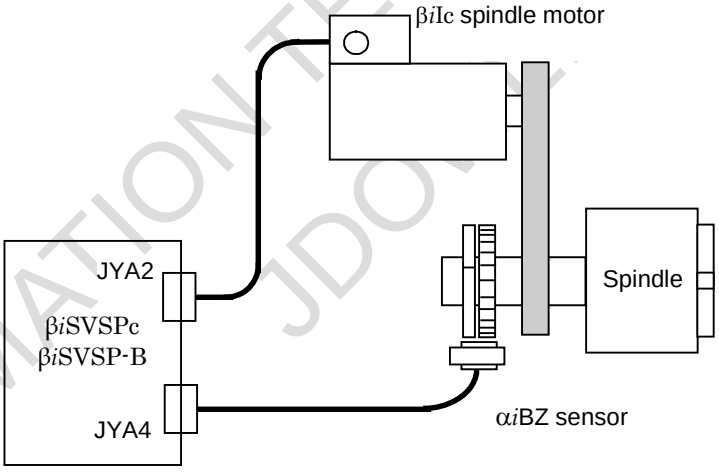
[Sample system configuration]



Parameter No.	Settings	Description
4000 #0	Depends on the configuration.	Rotation directions of the spindle and motor
4001 #4	Depends on the configuration.	Spindle sensor mounting direction
4002 #3,2,1,0	0,0,1,0	Uses the αi position coder as the spindle sensor.
4003 #7,6,5,4	0,0,0,0	Sets the number of spindle sensor gear teeth.
4056 to 4059	Depends on the configuration.	Gear ratio between the spindle and motor

(2) When the separate type αiBZ sensor is used

[Sample system configuration]



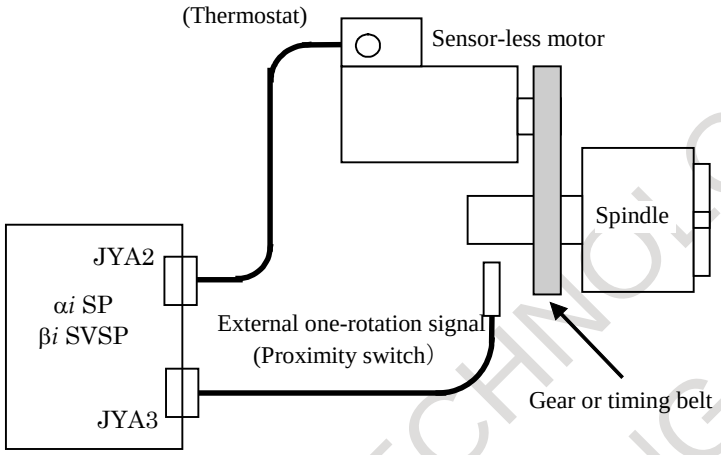
Parameter No.	Settings	Description
4000 #0	Depends on the configuration.	Rotation directions of the spindle and motor
4001 #4	Depends on the configuration.	Spindle sensor mounting direction
4002 #3,2,1,0	0,0,1,1	Use of the αiBZ sensor as the spindle sensor.
4003 #7,6,5,4	Depends on the detector.	Sets the number of spindle sensor gear teeth.
4056 to 4059	Depends on the configuration.	Gear ratio between the spindle and motor
4361	Depends on the detector.	(When setting by #7,6,5,4 is impossible) Setting of the arbitrary number of spindle sensor gear teeth

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1.3.4 Detection of speed by proximity switch when a sensor-less motor is driven

In sensor-less control, when a proximity switch is used for the spindle, speed of the spindle is calculated by the pulse signal output from the proximity switch. The calculated spindle speed is displayed in the spindle monitor screen on NC. At using this function, speed zero status signal (SST) and speed arrival signal (SAR) are output by monitoring both the speed detected by the proximity switch and the estimated speed. This function can be used only in a configuration that uses a proximity switch with sensor-less control and does not use a spindle sensor.

[Sample system configuration]



Parameter No.	Settings	Description
4000 #0	Depends on the configuration.	Direction of rotation of spindle and motor
4002 #3,2,1,0	0,0,0,1	Use motor sensor as position feed buck.
4004 #2	1	Use external one-rotation signal
4004 #3	Depends on the detector.	Setting for type of external one-rotation signal
4010 #2,1,0	Depends on the detector.	Setting for type of motor sensor
4011 #2,1,0	Depends on the detector.	Setting for the number of teeth of motor sensor
4056~4059	Depends on the configuration.	Gear ratio between spindle and motor
4334	Depends on the configuration.	The number of pulses detected in one rotation of spindle

【Related parameter】

30*i*,0*i*	#7	#6	#5	#4	#3	#2	#1	#0
4004					RFTYP	EXTRF		

RFTYP, EXTRF External one-rotation signal settings

This parameter sets the type of an external one-rotation signal (proximity) switch to be attached to the spindle (to be connected to connector JYA3).

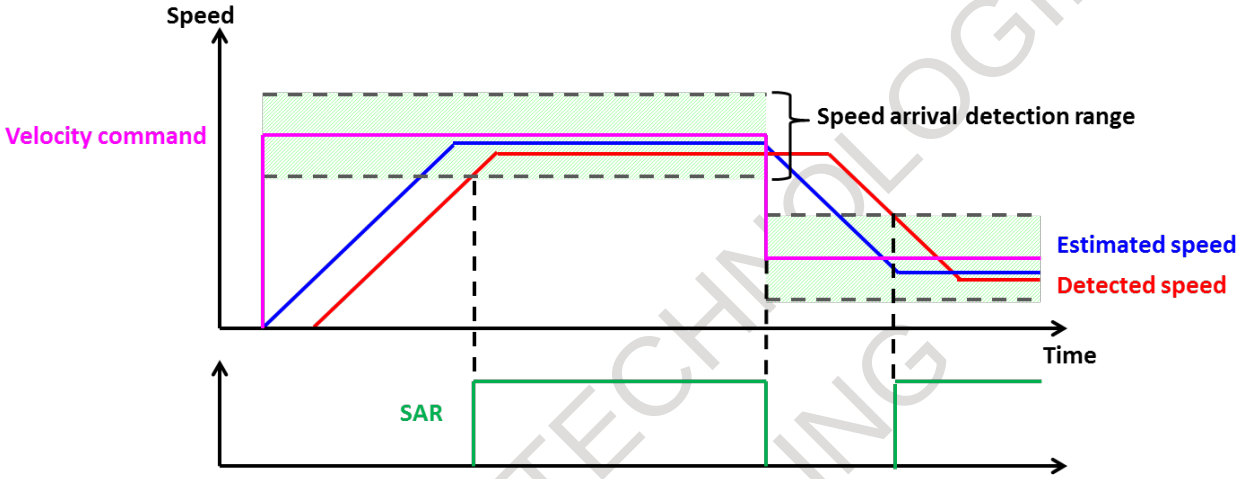
RFTYP	EXTRF	External one-rotation signal (proximity switch)
0	0	None
0	1	Detects the leading edge.
1	1	Detects the trailing edge.

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	30*i*,0*i*
4022	Speed arrival detection level

Unit of data: 0.1%
Valid data range: 0~1000
Initial setting: 150

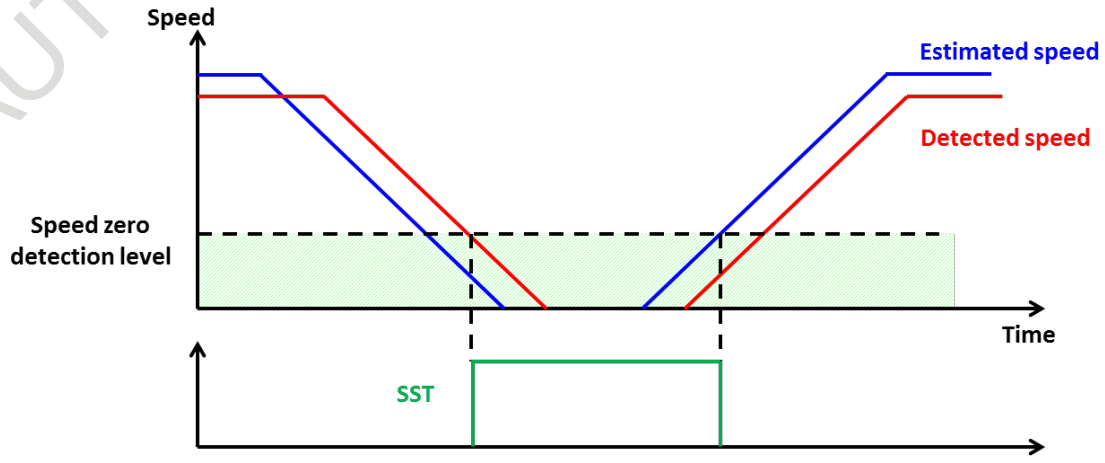
This parameter sets a speed arrival signal (SAR) detection range.
When both the estimated speed and the detected speed by proximity switch reach within +-(setting data/10)% of the velocity command, the state of the speed arrival signal (SAR) becomes “1”.
However, when No.4399#3=1, speed arrival detection is performed only with the estimated speed.



	30*i*,0*i*
4024	Speed zero detection level

Unit of data: 0.01%
Valid data range: 0~10000
Initial setting: 75

This parameter sets a speed zero signal (SST) detection range.
When both the estimated speed and the detected speed by proximity switch become less than (setting data/10)% of the maximum speed, the state of the speed zero signal (SST) becomes “1”.



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30*i*,0*i*	
4122	Filter time constant for speed detection by proximity switch

Unit of data: 1ms
Valid data range:10~10000
Initial setting: 200 (When 0 is set, speed detection becomes invalid)
Unlike a general spindle sensor, the pulse signal of the proximity switch is output only about once or twice in one rotation of the spindle. Therefore, since the resolution of proximity swtich is too coarse to use as speed data, it is necessary to calculate the speed by averaging. In this function, the pulses output from the proximity switch are counted, averaged by a filter, and speed is calculated. Set the filter time constant to this parameter. Increasing the filter time constant improves the resolution of detection speed, but the detection delay against the actual speed increases. On the contrary, if the filter time constant is decreased, the detection delay against the actual speed becomes small, but the resolution decreases. It is recommended to set 200 as the initial value. If 0 is set, speed detection by the proximity switch is not performed.

30*i*,0*i*	
4334	Number of pulses of the proximity switch generated every one rotation of the spindle

Unit of data: 1pulse
Valid data range: 1~6
Standard value: Set the value according to the proxiimty switch
Set the number of pulses of the proximity switch generated every one rotation of the spindle.

30*i*,0*i*	
4086	Warning level for detecting failure of the proximity switch / Gear ratio parameter setting error alarm detection level

Unit of data: 1rpm
Valid data range: 1~32767
Initial setting: 2000 (0 is equal to 500)
In order to detect that the proximity switch has failed and no pulse is output, if the difference between the detected speed by the proximity switch and estimated speed exceeds a set value for more than 2 seconds, warning 35 is output. It is recommended to set 2000 as the initial value. (This value seems to be large. However, since there is a possibility that the error may increase during acceleration / detection, high load, etc., this value is recommended to prevent mis-detection of warning.) When 0 is set, 500 is used as the detection level.At using the spindle sensor with sensor-less control, this parameter is the detection level for outputting the alarm of mis-setting in gear ratio parameter.

30*i*,0*i*	#7	#6	#5	#4	#3	#2	#1	#0
4399					SLZSAR			

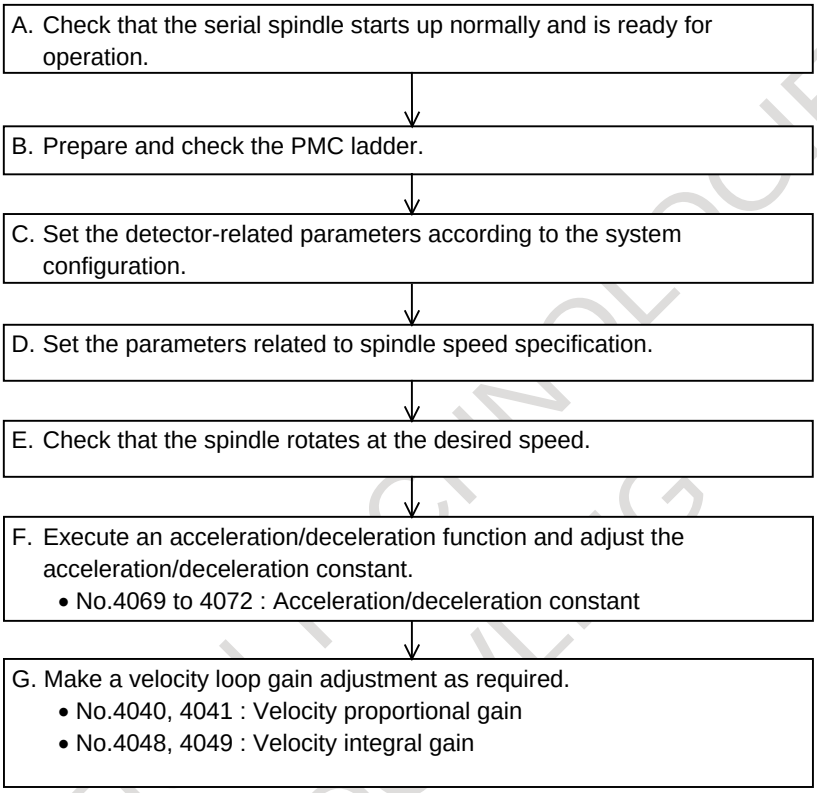
SLZSAR Setting for the speed arrival detection
In sensor-less control with speed detection by proximity switch, when this parameter is 0, speed arrival detection is performed using both estimated speed and detected speed. When this parameter is 1, speed arrival detection is performed using only the estimated speed.

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2 EXPLANATION OF OPERATION MODES

2.1 VELOCITY CONTROL MODE

2.1.1 Start-up Procedure



2.1.2 Overview

The velocity control mode is a function for exercising velocity control to rotate the spindle motor according to a velocity command from the CNC.

NOTE
On a CNC screen (such as the spindle monitor screen and the adjustment screen), the velocity control mode is indicated as “NORMAL OPERATION MODE”.

2.1.3 System Configuration

For system configurations, see Subsection 1.3.3, “Typical Detector Configurations”, in Part II.

2.1.4 List of I/O Signals (CNC↔PMC)

This Subsection provides a list of the I/O signals related to the velocity control mode only. For details of signal, refer to the Connection Manual (Function) of CNC.

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"FANUC Series 0*i*-MODEL D CONNECTION MANUAL (FUNCTION) : B-64303EN-1/
Refer to Section 10.6, "SPINDLE SPEED CONTROL."

For details on common input/output signals, see Chapter 3, "I/O SIGNALS (CNC↔PMC)", in Part I.

(1)Input signals (PMC→CNC)

		#7	#6	#5	#4	#3	#2	#1	#0
	G028						GR2	GR1	
	G029		*SSTP	SOR	SAR				
	G030	SOV7	SOV6	SOV5	SOV4	SOV3	SOV2	SOV1	SOV0
	G032	R08I	R07I	R06I	R05I	R04I	R03I	R02I	R01I
	G033	SIND	SSIN	SGN		R12I	R11I	R10I	R09I
Common signals	G070	MRDYA		SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
	G071							*ESPA	
	G072				OVRA				

(2) Output signals (CNC→PMC)

		#7	#6	#5	#4	#3	#2	#1	#0
	F001				ENB				
	F007						SF		
	F022	S07	S06	S05	S04	S03	S02	S01	S00
	F023	S15	S14	S13	S12	S11	S10	S09	S08
	F024	S23	S22	S21	S20	S19	S18	S17	S16
	F025	S31	S30	S29	S28	S27	S26	S25	S24
	F036	R08O	R07O	R06O	R05O	R04O	R03O	R02O	R01O
	F037					R12O	R11O	R10O	R09O
Common signals	F045		TLMA		LDT1A	SARA	SDTA	SSTA	

2.1.5 List of Related Parameters

Parameter No.	Description
3705#0	Sets SF signal output and the S code for an S command.
3705#4	Sets SF signal output and the S code for an S command.
3706#7,6	Spindle speed command polarity (valid when input signal SSIN = 0)
3709#0	Number of sampling operations at spindle speed calculation time
3740	Time until the spindle speed arrival signal is checked
3741	Maximum spindle speed for gear 1
3742	Maximum spindle speed for gear 2
3743	Maximum spindle speed for gear 3
3744	Maximum spindle speed for gear 4
3772	Maximum allowable spindle speed
3031	Allowable number of S code characters
3720	Number of position coder pulses
3721	Number of gear teeth on the position coder side on velocity control (for feed per revolution, threading, etc.)
3722	Number of gear teeth on the spindle side on velocity control (for feed per revolution, threading, etc.)
4006#5	Sets an analog override range.
4009#4	Whether to output the load detection signal (LDT1) during acceleration/deceleration

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Parameter No.	Description
4009#6	Analog override type
4019#7	Automatic spindle parameter setting function
4020	Maximum motor speed
4040 4041	Velocity loop proportional gain on the velocity control mode (A parameter is selected by the PMC input signal CTH1A.)
4048 4049	Velocity loop integral gain on the velocity control mode (A parameter is selected by the PMC input signal CTH1A.)
4056 to 4059	Spindle and motor gear ratio data (A parameter is selected by the PMC input signals CTH1A and CTH2A.)
4069 to 4072	Acceleration/deceleration constant (A parameter is selected by the PMC input signals CTH1A and CTH2A.)
4081	Delay time until the motor power is turned off
4082	Sets an acceleration/deceleration time.
4083	Motor voltage on the velocity control mode
4399#2	Whether the motor rotation operation is quitted with emergency stop

NOTE
1 For the detector-related parameters, see Section 1.3, “PARAMETERS RELATED TO DETECTORS”, in Part II.
2 For velocity loop proportional/integral gain adjustment, see Section 4.1, “VELOCITY LOOP GAIN ADJUSTMENT”, in Part II.

2.1.6 Details of Related Parameters

This subsection details the serial spindle parameters (in the four thousands) among the parameters related to the velocity control mode. For details of other parameters, refer to the parameter manual of each CNC.

	#7	#6	#5	#4	#3	#2	#1	#0
4006			ALGOVR					

ALGOVR Sets a spindle analog override range.
0 : 0 to 100% (initial setting value)
1 : 0 to 120%

	#7	#6	#5	#4	#3	#2	#1	#0
4009		OVRTYP		LDTOUT				

LDTOUT Whether to output the load detection signal (LDT1A) during acceleration/deceleration
0 : Not output during acceleration/deceleration. (initial setting value)
1 : Output (at all times) during acceleration/deceleration if the parameter-set level is exceeded.

OVRTYP Analog override type
0 : Override of linear function type (initial setting value)
1 : Override of quadratic function type

	#7	#6	#5	#4	#3	#2	#1	#0
4019	PRLOAD							

PRLOAD Automatic parameter setting function
0 : Does not perform automatic parameter setting. (initial setting value)
1 : Performs automatic parameter setting.

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After setting a desired motor model code in parameter No. 4133 and setting this bit to 1, turn off the power to the CNC, then turn on the power to the CNC again. The parameters (No. 4000 to No. 4175) for the βiIc series spindle corresponding to the model code are automatically initialized. Upon completion of automatic setting, this bit is automatically set to "0".

4020	**Maximum motor speed**

Unit of data : $1min^{-1}$
Valid data range : 0 to 32767
Initial setting : Depends on the motor model.
This parameter sets a maximum spindle motor speed.

> ⚠ **WARNING**
> The spindle motor may rotate at the maximum spindle motor speed specified by this parameter. Therefore, this parameter must not be set to a value greater than the maximum rotation speed indicated by the specification of the spindle motor.

4040	**Velocity loop proportional gain on velocity control mode (HIGH)**	**CTH1A=0**
4041	**Velocity loop proportional gain on velocity control mode (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : Depends on the motor model.
This data is used to set the velocity loop proportional gain on velocity control mode.
When the input signal CTH1A = 0, (HIGH) is selected. When the input signal CTH1A = 1, (LOW) is selected.

4048	**Velocity integral gain on velocity control mode (HIGH)**	**CTH1A=0**
4049	**Velocity integral gain on velocity control mode (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : Depends on the motor model.
This data is used to set the velocity loop integral gain on velocity control mode.
When the input signal CTH1A = 0, (HIGH) is selected. When the input signal CTH1A = 1, (LOW) is selected.

4056	**Gear ratio (HIGH)**	**CTH1A=0, CTH2A=0**
4057	**Gear ratio (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4058	**Gear ratio (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4059	**Gear ratio (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : (Motor rotation for one rotation of spindle) / 100
(When parameter No. 4006 #1 (GRUNIT) is 1, motor rotation / 1000)
Valid data range : 0 to 32767
Initial setting : 100
These data are used to set the gear ratio between spindle and spindle motor.
Example :
When the spindle rotates once, set "250" as the data when the motor rotates 2.5 times.

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NOTE
1 A parameter is selected by the input signals CTH1A and CTH2A. Ensure that the gear or clutch state corresponds to the input signals CTH1A and CTH2A. When the signals are not input correctly, the overcurrent alarm (spindle alarm 12) can be issued.
2 When using a position coder, be sure to set this parameter. If this parameter is not set correctly, the velocity error excess alarm (spindle alarm 02), motor binding alarm (spindle alarm 31), or gear ratio parameter setting error alarm (spindle alarm 35) may be detected.
3 When an improper value is set in this parameter, an unexpected operation can occur. For example, the spindle can continue rotating without stopping at the time of orientation. So, be sure to set a proper gear ratio.

4069	**Acceleration/deceleration constant (HIGH)**	**CTH1A=0, CTH2A=0**
4070	**Acceleration/deceleration constant (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4071	**Acceleration/deceleration constant (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4072	**Acceleration/deceleration constant (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : $1min^{-1}$ / sec
Valid data range : 0 to 32767
Initial setting : 900

These parameters set an acceleration/deceleration constant calculated from the motor output torque and spindle inertia and adjust acceleration/deceleration time.
A parameter is selected by the input signals CTH1A and CTH2A. The initial setting value "900" assumes that linear acceleration/ deceleration is performed with the 30-minute rated torque at the maximum motor speed, with an inertia three times as large as the rotor inertia of the motor. It is assumed that all (βiIc series spindle motors satisfy this initial value. So, there is a margin with some motor models.
For each machine, find a load inertia, and assign the found value to the following expression to calculate an acceleration/deceleration constant for setting:

$$Tc = T/(Jm+Jl) \times (60/2\pi)$$
$$= P/N \times (60/2\pi) /(Jm+Jl) \times (60/2\pi)$$
$$= P/N/(Jm+Jl) \times (60/2\pi)^2$$

Tc [min^{-1}/sec] : Acceleration/deceleration constant
Jm [kgm^2] : Motor rotor inertia
Jl [kgm^2] : Load inertia in terms of motor axis
T [Nm] : 30-minute rated torque
P [kW] : 30-minute rated output
N [min^{-1}] : Motor speed

[Rotor inertia and torque data of standard models]

Motor model	βiIc3	βiIc6	βiIc8
Rotor inertia Jm [kgm^2]	0.0078	0.0148	0.0179
15-minute rated torque at base speed T [Nm]	35.02	47.76	70.04

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NOTE
1 The initial setting value satisfies a value calculated with N = maximum speed and Jl = Jm×3.
2 A maximum specifiable acceleration/deceleration constant is based on N = base speed.

4081 **Delay time until the motor power is turned off**

Unit of data : 10ms
Valid data range : 0 to 1000
Initial setting : 20(200ms)

If SFRA = 0 or SRVA = 0 is specified, this parameter sets a period of time from the stop of the motor (detection of the speed zero detection signal SSTA = 1) until the power to the motor is turned off.

NOTE
When a small value is set in this parameter, the motor can coast after the power to the motor is turned off.

4082 **Setting of acceleration/deceleration time**

Unit of data : 1sec
Valid data range : 0 to 255
Initial setting : 10

This parameter sets a period of time in which alarm detection is disabled by assuming that the spindle motor is being accelerated or decelerated even if the velocity error exceeds the velocity error excess alarm (spindle alarm 02) level after start of acceleration/deceleration on the velocity control mode.
In the velocity control mode, a step-by-step speed command is specified. So, the spindle motor cannot follow up the command immediately after start of acceleration/deceleration, and the velocity error exceeds the velocity error excess alarm level. This parameter is used to prevent the velocity error excess alarm (spindle alarm 02) from being detected incorrectly immediately after start of acceleration/deceleration.

NOTE
With a machine tool such as a lathe that has a large load inertia, the acceleration/deceleration time becomes longer. In such a case, set the value corresponding to the acceleration/deceleration time of the machine in this parameter.

4083 **Motor voltage setting on velocity control mode**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 60

This parameter is used to set a motor voltage on velocity control mode. Usually, this parameter need not be adjusted. Use the initial setting

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30*i*-B	#7	#6	#5	#4	#3	#2	#1	#0
4399						**SOSALW**		

SOSALW : When the motor rotation operation is quitted with emergency stop
0 : motor decelerates with full torque (without time constant)
1 : motor decelerates with time constant
We've been able to use the deceleration without any time constant at emergency stop in sensor-less motor control. This time, we added the specification of the deceleration with time constant same as normal motor (with sensor) control.
It becomes possible to use the deceleration with time constant when you set following parameter. The time constant for sensor-less motor control is specified by No.4069

NOTE
This parameter is available for 9DAA series M(13) edition or later and 9DB0 series M(13) edition or later.

2.1.7 Troubleshooting

If the spindle motor does not operate normally, take an action by referencing the items listed below according to the state of trouble.
For an action to be taken when an alarm is issued, refer to the maintenance manual.

	State of trouble
(i)	When the motor does not rotate
(ii)	When the motor does not rotate at a specified speed
(iii)	When the motor vibrates and makes an abnormal sound when rotating
(iv)	When an overshoot or hunting occurs
(v)	When the cutting capability is degraded
(vi)	When the acceleration/deceleration time is long

(i) When the motor does not rotate

(1) Check the connections. (Refer to Descriptions (B-65372EN).)
  (a) Motor power line phase order
  (b) Connection of the position coder signal cable (shielding, grounding)

(2) Check the parameter settings.
  (a) Parameter data for each motor model
  (b) Detector-related parameter data (Refer to Section 1.3, "PARAMETERS RELATED TO DETECTORS", in Part II)
  (c) Setting of a maximum motor speed

Parameter No.	Description
4020	Maximum motor speed

  (d) Parameters related to spindle speed specification
  Refer to Subsection 2.1.5, "Related Parameters", in Part II.

(3) Check the input signals.
  (a) Input signals for spindle control (PMC→CNC)

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		#7	#6	#5	#4	#3	#2	#1	#0
1st-	G070	MRDYA		SFRA	SRVA				
2nd-	G074	MRDYB		SFRB	SRVB				
1st-	G071							*ESPA	
2nd-	G075							*ESPB	

(ii) When the motor does not rotate at a specified speed

(1) Check the connections. (Refer to Descriptions (B-65372EN).)
  (a) Motor power line connection
  (b) Connection of the position coder signal cable (shielding, grounding)

(2) Check the parameter settings.
  (a) Parameter data for each motor model
  (b) Detector-related parameter data (Refer to Section 1.3, "PARAMETERS RELATED TO DETECTORS", in Part II)
  (c) Setting of a maximum motor speed

Parameter No.	Description
4020	Maximum motor speed

  (d) Parameters related to spindle speed specification
  For Series 0*i*-D
  Refer to "FANUC Series 0*i*-MODEL-D CONNECTION MANUAL (FUNCTION): B-64303EN-1, Section 10.6, "SPINDLE SPEED CONTROL." "

(iii) When the motor vibrates and makes an abnormal sound when rotating

(1) Check the connections. (Refer to Descriptions (B-65372EN).)
  (a) Connection of the position coder signal cable (shielding, grounding)

(2) Check the parameter settings.
  The velocity loop gain may be too large. Adjust the following parameters:

Parameter No.	Description	Setting data
4040	Velocity proportional gain (HIGH)	Decrease the setting values.
4041	Velocity proportional gain (LOW)	
4048	Velocity integral gain (HIGH)	
4049	Velocity integral gain (LOW)	

(3) Make a comparison with the case of motor coasting.
  If vibration and sound produced when the motor coasts are extremely smaller than those produced when the motor is driven, the control circuit is faulty. If sound produced remains unchanged, the motor or the machine may be faulty. If the overheat signal cable from the motor is disconnected during motor rotation, an alarm is issued, and the motor coasts. Before performing the coasting of the motor, consult with the machine tool builder for confirmation. Depending on the sequence, the brake may be applied.

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(iv) When an overshoot or hunting occurs

(1) Check the parameter settings.

(a) The velocity loop gain may be too large. Adjust the following parameters:

Parameter No.	Description	Setting data
4040	Velocity proportional gain(HIGH)	Decrease the setting values.
4041	Velocity proportional gain(LOW)	
4048	Velocity integral gain (HIGH)	
4049	Velocity integral gain (LOW)	

(b) The acceleration/deceleration constant may be too large. Adjust the following parameters:

Parameter No.	Description	Setting data
4069	Acceleration/deceleration constant (HIGH)	Decrease the setting values.
4070	Acceleration/deceleration constant (MEDIUM HIGH)	
4071	Acceleration/deceleration constant (MEDIUM LOW)	
4072	Acceleration/deceleration constant (LOW)	

(v) When the cutting capability is degraded

(1) Check the parameter settings.

(a) Parameter data for each motor model

(2) Check the input signals.

(a) Torque limitation command (TLMHA)

		#7	#6	#5	#4	#3	#2	#1	#0
1st-	G070							TLMHA	
2nd-	G074							TLMHB	

(3) Check the machine.

(a) Belt tension, and so forth

(vi) When the acceleration/deceleration time is long

(1) Check the parameter settings.

(a) Parameter data for each motor model

(b) The acceleration/deceleration constant may be too small. Adjust the following parameters:

Parameter No.	Description	Setting data
4069	Acceleration/deceleration constant (HIGH)	Increase the setting values.
4070	Acceleration/deceleration constant (MEDIUM HIGH)	
4071	Acceleration/deceleration constant (MEDIUM LOW)	
4072	Acceleration/deceleration constant (LOW)	

(c) Regenerative power limitation (Check if the same value as in the parameter table for each motor model is set.)

Parameter No.	Description
4080	Regenerative power limitation

(2) Check the input signals.

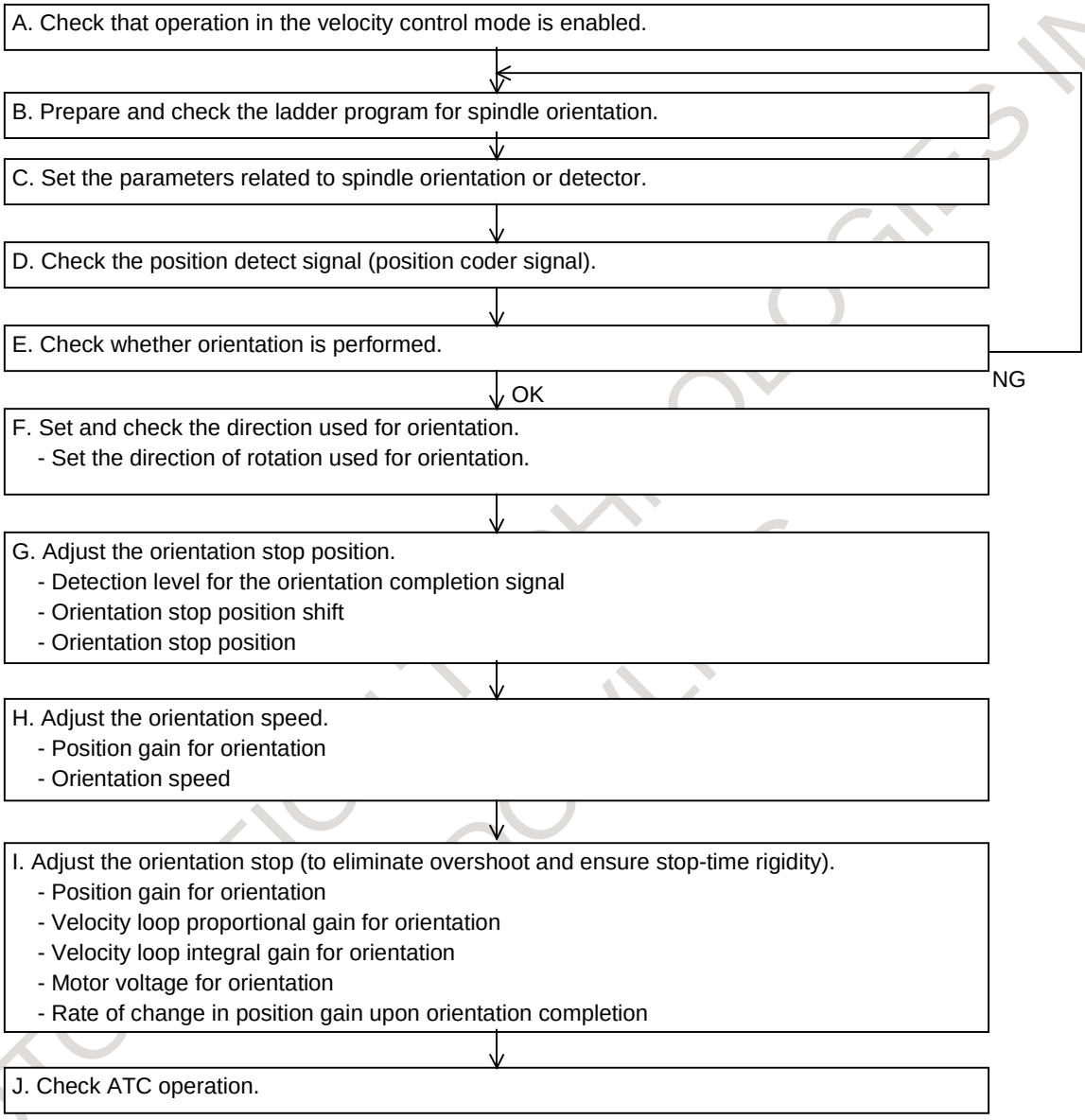
(a) Torque limitation commands (TLMH)

		#7	#6	#5	#4	#3	#2	#1	#0
1st-	G070							TLMHA	
2nd-	G074							TLMHB	

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2.2 POSITION CODER METHOD SPINDLE ORIENTATION (OPTIONAL FUNCTION)

2.2.1 Start-up Procedure



2.2.2 Overview

For this subsection, see Subsection 5.4.1, “Overview”, in Part I.

2.2.3 Feature

For this subsection, see Subsection 2.2.4, “ Feature”, in Part I.

2.2.4 System Configuration

The position coder method orientation function is available in all configurations shown in Subsection 1.3.3, "Typical Detector Configurations", in Part II.

2.2.5 Stop Position Specification Method

For this subsection, see Subsection 2.2.7, “Stop Position Specification Method “, in Part I.

2.2.6 I/O Signals (CNC↔PMC)

(1) Address list of Input signals (PMC→CNC)

	#7	#6	#5	#4	#3	#2	#1	#0
G070		ORCMA			CTH1A	CTH2A		
G072						NRROA	ROTAA	INDXA
G078	SHA07	SHA06	SHA05	SHA04	SHA03	SHA02	SHA01	SHA00
G079					SHA11	SHA10	SHA09	SHA08

(2) Details of input signals (PMC→CNC)

With the βiIc series, the signals indicated in the item above are valid. For details of each signal, see Subsection 2.2.8(2), “Details of input signals (PMC→CNC)”, in Part I.

(3) Address list of output signals (CNC→PMC)

	#7	#6	#5	#4	#3	#2	#1	#0
F045	ORARA							

(4) Details of output signals (CNC→PMC)

With the βiIc series, the signals indicated in the item above are valid. For details of each signal, see Subsection 2.2.8(4), “Details of output signals (CNC→PMC)”, in Part I.

2.2.7 Examples of Sequences

For this subsection, see Subsection 2.2.9, “ Examples of Sequences “, in Part I.

2.2.8 Related Parameters

Parameter No.	Description
4015 #0	Specifies whether to use the spindle orientation function. (The CNC software option is required.)
3729#0	Specifies whether to use the spindle orientation function with the stop position external setting type.
4003#3,#2	Direction of rotation in spindle orientation (Set to 0, 0 or 0, 1.)
4005#0	Setting of the velocity feedback method (Set to 1.)
4017#7	Shortcut function when orientation is specified in stop state
4031	Stop position for position coder method orientation (This parameter is disabled when spindle orientation with an externally set stop position or an externally set incremental command is used.)
4038	Spindle orientation speed
4042 4043	Velocity proportional gain on orientation (A parameter is selected by the CTH1A input signal.)
4050 4051	Velocity integral gain on orientation (A parameter is selected by the CTH1A input signal.)

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Parameter No.	Description
4056 to 4059	Spindle-to-motor gear ratio (A parameter is selected by the CTH1A and CTH2A input signals.)
4060 to 4063	Position gain for orientation (A parameter is selected by the CTH1A and CTH2A input signals.)
4064	Acceleration limitation ratio at deceleration time (Set to 100.)
4075	Detection level for the spindle orientation completion signal
4077	Spindle orientation stop position shift
4084	Motor voltage for spindle orientation
4320 to 4323	Acceleration at orientation deceleration time (A parameter is selected by the CTH1A and CTH2A input signals.)

NOTE
1 For the parameters related to detectors, see Section 1.3, “PARAMETERS RELATED TO DETECTORS” in the Part II.
2 For velocity loop proportional/integral gain adjustment, see Section 4.1, “VELOCITY LOOP GAIN ADJUSTMENT”, in Part II.

2.2.9 Details of Related Parameters

	#7	#6	#5	#4	#3	#2	#1	#0
4003					DIRCT2	DIRCT1		

DIRCT2, DIRCT1 Setting of rotation direction at spindle orientation

DIRCT2	DIRCT1	Rotation direction at spindle orientation
0	0	By rotation direction immediately before (It is CCW at the power on.)
0	1	By rotation direction immediately before (It is CW at the power on.)

	#7	#6	#5	#4	#3	#2	#1	#0
4005								VCTLPC

VCTLPC Sets the velocity feedback method.
0 : Exercises velocity control with an estimated velocity only.
1 : Uses a velocity calculated from the position coder signal to exercise velocity control.
Set to 1.

	#7	#6	#5	#4	#3	#2	#1	#0
4017	NRROEN							

NRROEN Specifies whether to use the shortcut function when orientation is specified in the stop state.
0 : Does not use the function.
1 : Uses the function.
When this bit is set to 1, short cut operation is performed when the following conditions are satisfied:
- Bit 7 of parameter No. 4016 (RFCHK3) is set to 0.
- Zero speed detection output signal SSTA is set to 1.
- Shortcut command input signal NRROA is set to 1.

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4031	**Position coder method orientation stop position**

Unit of data : 1 pulse (360 degrees /4096)
Valid data range : 0 to 4096
Initial setting : 0

This data is used to set the stop position of position coder method spindle orientation. It can be set at every 360 degrees/4096.
When stop position external command type orientation and incremental command external type orientation are set, this parameter becomes invalid.
Stop position command (SHA11-SHA00) of input signal instructed becomes valid.

4038	**Spindle orientation speed**

Unit of data : $1min^{-1}$
Valid data range : 0 to 32767
Initial setting : 0

This parameter sets the orientation speed at the end of the spindle.
When this data is set to 0, 200 min^{-1} is set.

4042	**Velocity loop proportional gain on orientation (HIGH) CTH1A=0**
4043	**Velocity loop proportional gain on orientation (LOW) CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : Depends on the motor model.

This parameter sets the velocity loop proportional gain for spindle orientation.
When the CTH1A input signal is set to 0, proportional gain for the HIGH gear is selected.
When the CTH1A input signal is set to 1, proportional gain for the LOW gear is selected.

4050	**Velocity loop integral gain on orientation (HIGH)CTH1A=0**
4051	**Velocity loop integral gain on orientation (LOW)CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : Depends on the motor model.

This parameter sets the velocity loop integral gain for spindle orientation.
When the CTH1A input signal is set to 0, integral gain for the HIGH gear is selected.
When the CTH1A input signal is set to 1, integral gain for the LOW gear is selected.

4056	**Gear ratio (HIGH)**	**CTH1A=0, CTH2A=0**
4057	**Gear ratio (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4058	**Gear ratio (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4059	**Gear ratio (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : (Motor rotation for one rotation of spindle) / 100
(When parameter No. 4006 #1 (GRUNIT) is 1, motor rotation / 1000)
Valid data range : 0 to 32767
Initial setting : 100

These parameters set the gear ratio of the spindle motor relative to the spindle.
When the motor rotates 2.5 times, for every rotation of the spindle, for example, set 250 in the parameter.

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NOTE
1 A parameter is selected by the input signals CTH1A and CTH2A. Ensure that the gear or clutch state corresponds to the input signals CTH1A and CTH2A. When the signals are not input correctly, the overcurrent alarm (spindle alarm 12) can be issued.
2 When using a position coder, be sure to set this parameter. If this parameter is not set correctly, the velocity error excess alarm (spindle alarm 02), motor binding alarm (spindle alarm 31), or gear ratio parameter setting error alarm (spindle alarm 35) may be detected.
3 When an improper value is set in this parameter, an unexpected operation can occur. For example, the spindle can continue rotating without stopping at the time of orientation. So, be sure to set a proper gear ratio.

4060	**Position gain on orientation (HIGH)**	**CTH1A=0, CTH2A=0**
4061	**Position gain on orientation (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4062	**Position gain on orientation (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4063	**Position gain on orientation (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : $0.01sec^{-1}$
Valid data range : 0 to 32767
Initial setting : 1000
These parameters set the position gain for orientation.
A parameter is selected by the CTH1A and CTH2A input signals.

4064 **Acceleration limitation ratio at deceleration time**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 100
Set to 100.

4075 **Orientation completion signal detection level (limits of in-position)**

Unit of data : ± 1 pulse unit (360degrees/4096)
Valid data range : 0 to 100
Initial setting : 10
This data is used to set the detecting level of orientation completion signal (ORARA).
When the spindle position is located within the setting data on orientation completion, the bit of orientation completion signal (ORARA) in the spindle control signals is set to “1”.
When the orientation command (ORCMA) is turned off (= 0), the orientation completion signal (ORARA) is set to “0”.

4077 **Orientation stop position shift value**

Unit of data : ± 1 pulse unit (360degrees/4096)
Valid data range : -4095 to 4095
Initial setting : 0
In the position coder method orientation, set this data to shift stop position.
Spindle is shift No. of setting pulse in CCW direction, and stops by data (+).

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4084	**Motor voltage setting on orientation**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 60
This parameter sets the motor voltage for orientation.
Usually, set 60.

4320	**Acceleration at orientation deceleration time (HIGH) CTH1A=0, CTH2A=0**
4321	**Acceleration at orientation deceleration time (MEDIUM HIGH) CTH1A=0, CTH2A=1**
4322	**Acceleration at orientation deceleration time (MEDIUM LOW) CTH1A=1, CTH2A=0**
4323	**Acceleration at orientation deceleration time (LOW) CTH1A=1, CTH2A=1**

Unit of data : 10min^{-1}/sec
Valid data range : 0 to 6400
Standard setting : 0
These parameters set a motor acceleration value at deceleration time in orientation. When 0 is set, an acceleration value of 520 min^{-1}/sec (corresponding to setting = 52 or equivalent to the standard setting for the βiIc series spindle) is set.

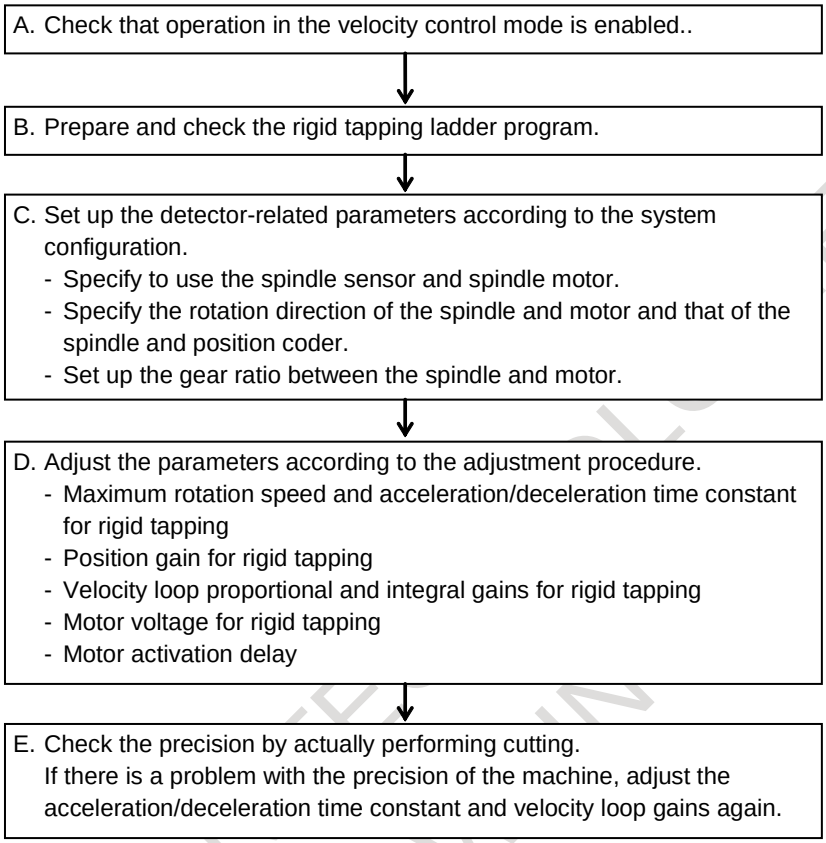
2.2.10 Adjusting the Orientation Stop Position Shift Parameter

For this subsection, see Subsection 2.2.14, “Adjusting the Orientation Stop Position Shift Parameter”, in Part I.

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2.3 RIGID TAPPING (OPTIONAL FUNCTION)

2.3.1 Start-up Procedure



2.3.2 Overview

For this subsection, see Subsection 2.3.2, “Overview”, in Part I.

2.3.3 FSSB High-speed Rigid Tapping

It is possible to reduce synchronous error and shorten cycle time by using”FSSB High-speed Rigid Tapping”. When you use βiSVSP-B, you can apply” FSSB High-speed Rigid Tapping”.
For details of “FSSB High-speed Rigid Tapping”, see section 5.17 in Part I “ADJUSTING FSSB HIGH-SPEED RIGID TAPPING”.

Series and edition of applicable spindle software

Series	Edition	CNC
9DB0	A （01）	FS30*i* -B / FS31*i*-B / FS32*i*-B / FS35*i*-B, FS0*i* -F

2.3.4 System Configuration

Rigid tapping is available in all configurations shown in Subsection 1.3.3, "Typical Detector Configurations", in Part III.

2.3.5 List of I/O Signals (CNC↔PMC)

This subsection provides a list of the I/O signals related to rigid tapping only. For details of each signal, refer to the Connection Manual (Function) of each CNC.

"FANUC Series 0*i*-MODEL D CONNECTION MANUAL (FUNCTION) : B-64303EN-1
Refer to Section 10.13, "RIGID TAPPING."

For details on common input/output signals, see Chapter 3, "I/O SIGNALS (CNC↔PMC)", in Part I.

(1) Input signals (PMC→CNC)

	#7	#6	#5	#4	#3	#2	#1	#0
G028						GR2	GR1	
G061								RGTAP

Common signals

	#7	#6	#5	#4	#3	#2	#1	#0
G070			SFRA	SRVA	CTH1A	CTH2A		

(2) Output signals (CNC→PMC)

	#7	#6	#5	#4	#3	#2	#1	#0
F076					RTAP			

2.3.6 Sequence

For the sequence of rigid tapping, see Section 10.13, "Rigid Tapping" in the FANUC Series 0*i*-MODEL D Connection Manual (Function) (B-64303EN-1).

2.3.7 Related Parameters

Parameter No.	Description
5210	M code of rigid tapping command
5202#0	Whether to perform orientation (reference position return) when starting rigid tapping
3720	Number of pulse of the position coder
5280 5281 to 5284	Position gain of tapping axis at rigid tapping
5241 5242 5243 5244	Spindle maximum speed at rigid tapping
5261 5262 5263 5264	Acc./Dec. time constant
5200#4	Override selection at extracting
5211	Override value at extracting
5201#2 5271 to 5274	Time constant at extracting
5300	In-position width of tapping axis
5301	In-position width of spindle
5310	Allowable level of position error of tapping axis at moving
5311	Allowable level of position error of spindle at moving
5312	Allowable level of position error of tapping axis at stop

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Parameter No.	Description
5313	Allowable level of position error of spindle at stop
5321 5322 to 5324	Backlash of spindle
4000#4	Reference position return direction on servo mode
4002#5	Whether to enable the rotation direction signal (SFR/SRV) on servo mode
4005#0	Setting of the velocity feedback method (Set to 1.)
4044 4045	Velocity loop proportional gain on servo mode/spindle synchronous control (It is selected by input signal CTH1A/B.)
4052 4053	Velocity loop integral gain on servo mode/spindle synchronous control (It is selected by input signal CTH1A/B.)
4056 to 4059	Gear ratio between spindle and motor (It is selected by input signal CTH1A or CTH2A)
4065 to 4068	Spindle position gain on servo mode/spindle synchronous control (It is selected by input signal CTH1A or CTH2A)
4073	Grid shift amount on servo mode
4074	Reference position return speed on servo mode
4091	Position gain change ratio at reference position return time on servo mode
4085	Motor voltage on servo mode/spindle synchronous control
4099	Delay time for stable motor excitation

NOTE
1 For the parameters related to detectors, see Section 1.3, “PARAMETERS RELATED TO DETECTORS” in the Part III.
2 For velocity loop proportional/integral gain adjustment, see Section 4.1, “VELOCITY LOOP GAIN ADJUSTMENT”, in Part III.

2.3.8 Details of Related Parameters

This subsection details the serial spindle parameters (in the four thousands) among the parameters related to rigid tapping. For details of other parameters, refer to the parameter manual of each CNC.

	#7	#6	#5	#4	#3	#2	#1	#0
4000				RETSV				

RETSV Reference position return direction on servo mode (rigid tapping/spindle positioning)
0 : The spindle performs a reference position return operation in the CCW(counterclockwise) direction.
1 : The spindle performs a reference position return operation in the CW(clockwise) direction.

	#7	#6	#5	#4	#3	#2	#1	#0
4002			SVMDRT					

SVMDRT Whether to enable the rotation direction signal (SFR/SRV) function on servo mode (rigid tapping/spindle positioning)
0 : Enables the rotation direction function.
If a move command from the CNC is positive (+),
(a) The spindle rotates in the CCW direction when the input signal SFR (bit 5 of G70) = 1.
(b) The spindle rotates in the CW direction when the input signal SRV (bit 4 of G70) = 1.
1 : Disables the rotation direction function.

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If a move command from the CNC is positive (+), the spindle rotates in the CCW direction when the input signal SFR = 1 or SRV = 1.

	#7	#6	#5	#4	#3	#2	#1	#0
4005								VCTLPC

VCTLPC Sets the velocity feedback method.
0 : Exercises velocity control with an estimated velocity only.
1 : Uses a velocity calculated from the position coder signal to exercise velocity control.
Set to 1.

4044	Velocity loop proportional gain on servo mode/spindle synchronous control (HIGH)CTH1A=0
4045	Velocity loop proportional gain on servo mode/spindle synchronous control (LOW)CTH1A=1

Unit of data :
Valid data range : 0 to 32767
Initial setting : Depends on the motor model.
These parameters set a velocity loop proportional gain on servo mode (rigid tapping/spindle positioning) or spindle synchronous control.
When the input signal CTH1A = 0, (HIGH) is selected. When the input signal CTH1A = 1, (LOW) is selected.

4052	Velocity loop integral gain on servo mode/spindle synchronous control (HIGH)	CTH1A=0
4053	Velocity loop integral gain on servo mode/spindle synchronous control (LOW)	CTH1A=1

Unit of data :
Valid data range : 0 to 32767
Initial setting : Depends on the motor model.
These parameters set a velocity loop integral gain on servo mode (rigid tapping/spindle positioning) or spindle synchronous control.
When the input signal CTH1A = 0, (HIGH) is selected. When the input signal CTH1A = 1, (LOW) is selected.

NOTE
For velocity loop gain setting on spindle synchronous control and servo mode, the common parameters are used.

4056	Gear ratio (HIGH)	CTH1A=0, CTH2A=0
4057	Gear ratio (MEDIUM HIGH)	CTH1A=0, CTH2A=1
4058	Gear ratio (MEDIUM LOW)	CTH1A=1, CTH2A=0
4059	Gear ratio (LOW)	CTH1A=1, CTH2A=1

Unit of data : (Motor rotation for one rotation of spindle) / 100
(When parameter No. 4006 #1 (GRUNIT) is 1, motor rotation / 1000)
Valid data range : 0 to 32767
Initial setting : 100
These parameters set the gear ratio of the spindle motor relative to the spindle.
When the motor rotates 2.5 times, for every rotation of the spindle, for example, set 250 in the parameter.

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NOTE
1 A parameter is selected by the input signals CTH1A and CTH2A. Ensure that the gear or clutch state corresponds to the input signals CTH1A and CTH2A. When the signals are not input correctly, the overcurrent alarm (spindle alarm 12) can be issued.
2 When using a position coder, be sure to set this parameter. If this parameter is not set correctly, the velocity error excess alarm (spindle alarm 02), motor binding alarm (spindle alarm 31), or gear ratio parameter setting error alarm (spindle alarm 35) may be detected.

4065	**Spindle position gain on servo mode/spindle synchronous control (HIGH)CTH1A=0, CTH2A=0**
4066	**Spindle position gain on servo mode/spindle synchronous control (MEDIUM HIGH)CTH1A=0, CTH2A=1**
4067	**Spindle position gain on servo mode/spindle synchronous control (MEDIUM LOW)CTH1A=1, CTH2A=0**
4068	**Spindle position gain on servo mode/spindle synchronous control (LOW)CTH1A=1, CTH2A=1**

Unit of data : $0.01sec^{-1}$
Valid data range : 0 to 32767
Initial setting : 1000

These parameters set a position gain on servo mode (rigid tapping/spindle positioning) or spindle synchronous control.
A parameter is selected according to the input signals CTH1A and CTH2A.

NOTE
For velocity loop gain setting on spindle synchronous control and servo mode, the common parameters are used.

4073	**Grid shift amount on servo mode**

Unit of data : 1 pulse (=360 degrees /4096)
Valid data range : 0 to 4095
Initial setting : 0

This parameter is used to shift the reference position on servo mode (rigid tapping/spindle positioning).
The reference position of the spindle is shifted in the CCW direction by the specified number of pulses.

4074	**Reference position return speed on servo mode**

Unit of data : $1min^{-1}$
Valid data range : 0 to 32767
Initial setting : 0

To perform a reference position return operation, set a reference position return speed in this parameter.

4085	**Motor voltage on servo mode/spindle synchronous control**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 60

These parameters set a motor voltage on rigid tapping.
Usually, set 60.

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4091 **Position gain change ratio at reference position return time on servo mode**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 100

This parameter sets a position gain change ratio at reference position return time on servo mode (rigid tapping, spindle positioning, and so forth).

NOTE
An overshoot can occur at reference position return time for a cause such as an excessively high reference position return speed and an excessively large spindle inertia. In this case, an overshoot can be avoided by setting a small value in this parameter.

4099 **Delay time for stable motor excitation**

Unit of data : 1ms
Valid data range : 0 to 32767
Initial setting : 0

This parameter sets a period of time required until motor excitation becomes stable on rigid tapping.

NOTE
In switching from the velocity control mode to rigid tapping mode, the stop time excessive error alarm can be issued intermittently. This is because the excitation state of the spindle motor changes abruptly, and therefore a transient state occurs in the motor, thus moving the motor shaft slightly.
In such a case, set this parameter. In general, set a value from about 300 to 400 (300 to 400 msec).

2.3.9 Parameter Setting Procedure

(1) Gear ratio between the spindle and the motor

The loop gain constant parameter is not used in the βiIc series (Serial) spindle system.
"Gear ratio between the spindle and the motor" parameter should be set instead of it.
Each parameter is selected according to the gear selection signal (CTH1A/B, CTH2A/B).

[1st. sp]

Gear signal		Parameter No.
CTH1A	CTH2A	
0	0	4056(S1)
0	1	4057(S1)
1	0	4058(S1)
1	1	4059(S1)

[2nd. sp]

Gear signal		Parameter No.
CTH1B	CTH2B	
0	0	4056(S2)
0	1	4057(S2)
1	0	4058(S2)
1	1	4059(S2)

(2) Position gain

In rigid tapping, the tapping axis and spindle are controlled to be synchronized. So, the position gains of the tapping axis and spindle must be set to the same value.

The position gain parameter of the tapping axis in the rigid tapping is selected as follows according to the gear selection signal.

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Standard machining [M series]: GR3O, GR2O, GR1O
Turning [T series] and machining [M series] with surface speed constant option: GR2, GR1
Second spindle of turning: GR21, GR21 (Multi-spindle control option is needed)

Gear signal		Parameter No.
GRs1*	GRs2*	
		5280(*1)
0	0	5281
1	0	5282
0	1	5283
1	1	5284

*First spindle: GR1, GR2 / Second spindle: GR21, GR22

NOTE
*1 When this parameter is “0”, each gear parameter becomes valid.
When this parameter is not “0”, each gear parameter becomes invalid, and this parameter is always used.

The position gain parameter of the spindle in the rigid tapping is selected as follows according to the gear selection signal (CTH1A/B, CTH2A/B).

[1st. sp]

Gear signal		Parameter No.
CTH1A	CTH2A	
0	0	4065 (S1)
0	1	4066 (S1)
1	0	4067 (S1)
1	1	4068 (S1)

[2nd. sp]

Gear signal		Parameter No.
CTH1B	CTH2B	
0	0	4065 (S2)
0	1	4066 (S2)
1	0	4067 (S2)
1	1	4068 (S2)

⚠ **CAUTION**
Take care to input the gear selection signal GR1, GR2, GR21, GR22, GR1O, GR2O, GR3O and CTH1A/B, CTH2A/B according to the real gear state in order to get the same position gain of the tapping axis and that of the spindle, because GR1, GR2, GR21, GR22, GR1O, GR2O, GR3O and CTH1A/B, CTH2A/B are inputted independently.

(3) Acceleration/deceleration time constant

(1) Each parameter can be set for each gear and is selected according to the gear selection signal.
By setting the following parameter, the different time constant between the cutting in and cutting out (extracting) becomes available.

5201 #2

0 : The same time constant between cutting in and out.
(No. 5261 to 5264)
1 : The different time constant between cutting in and out.
Cutting in : No. 5261 to 5264
Cutting out: No. 5271 to 5274

Second spindle of turning: GR21, GR21 (Multi-spindle control option is needed)

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Gear signal		Time constant (Cutting in) Parameter No.	Time constant (Cutting out) Parameter No.	Spindle max. speed at rigid tapping Parameter No.	
GRs1*	GRs2*			T	M
0	0	5261	5271	5241	5241
1	0	5262	5272	5242	5242
0	1	5263	5273	5243	5243
1	1	5264 (*1)	5274 (*1)	5244 (*1)	—

*First spindle: GR1, GR2 / Second spindle: GR21, GR22

(2) The override at extracting.

5200 #4

0 : The override at extracting is not valid.
1 : The override at extracting is valid. (Set override value at No. 5211)

2.3.10 Adjustment Procedure

(1) Parameters used for adjustment

The table below lists and describes the parameters used for adjusting rigid tapping.

Parameter No.	Description
5241 to 5244	Maximum spindle speed on rigid tapping (Depends on the GR signal.)
5261 to 5264	Acceleration/deceleration time constant on rigid tapping (Depends on the GR signal.)
5280 to 5284	Position gain of tapping axis on rigid tapping (5280 is for all gears. 5281 to 5284 depend on the GR signal.)
4065 to 4068	Spindle position gain on rigid tapping (depends on CTH1 and CTH2 signals)
4044 to 4045	Velocity proportional gain on rigid tapping (depends on CTH1A signal)
4052 to 4053	Velocity integral gain on rigid tapping (depends on CTH1A signal)
4085	Motor voltage on rigid tapping (Set to 60.)
4099	Delay time for motor excitation (Specify a value around 300 to 400.)

(2) Spindle data used for adjustment

For this item, see Item 2.3.10-(3), “Spindle data used for adjustment”, in Part I.

(3) Adjustment procedure

For this item, see Item 2.3.10-(4), “Adjustment procedure”, in Part I.

2.3.11 Diagnosis (Diagnosis Screen)

For this subsection, see Subsection 2.3.11, “Diagnosis (Diagnosis Screen)”, in Part I.

2.3.12 Alarm

For this subsection, see Subsection 2.3.12, “Alarm”, in Part I.

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2.4 SPECIFICATIONS COMMON TO ALL OPERATION MODES

2.4.1 Overview

This section describes the I/O signals (CNC↔PMC), parameters, diagnosis signals, and alarms common to all operation modes.

2.4.2 List of I/O Signals (CNC↔PMC)

This Subsection provides a list of the I/O signals related to spindle speed control only. For details of each signal, refer to the "FANUC Series 0*i*-MODEL D CONNECTION MANUAL (FUNCTION) : B-64303EN-1/02 Refer to Section 10.6, "SPINDLE SPEED CONTROL."

For details on common input/output signals, see Chapter 3, "I/O SIGNALS (CNC↔PMC)", in Part I.

(1) Input signals (PMC→CNC)

	#7	#6	#5	#4	#3	#2	#1	#0
G028						GR2	GR1	
G029		*SSTP	SOR	SAR				
G030	SOV7	SOV6	SOV5	SOV4	SOV3	SOV2	SOV1	SOV0
G032	R08I	R07I	R06I	R05I	R04I	R03I	R02I	R01I
G033	SIND	SSIN	SGN		R12I	R11I	R10I	R09I

Common signals

	#7	#6	#5	#4	#3	#2	#1	#0
G070	MRDYA		SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA (*1)
G071							*ESPA	ARSTA
G073						MPOFA		

(2) Output signals (CNC→PMC)

	#7	#6	#5	#4	#3	#2	#1	#0
F001				ENB				
F007						SF		
F022	S07	S06	S05	S04	S03	S02	S01	S00
F023	S15	S14	S13	S12	S11	S10	S09	S08
F024	S23	S22	S21	S20	S19	S18	S17	S16
F025	S31	S30	S29	S28	S27	S26	S25	S24
F036	R08O	R07O	R06O	R05O	R04O	R03O	R02O	R01O
F037					R12O	R11O	R10O	R09O

Common signals

	#7	#6	#5	#4	#3	#2	#1	#0
F045		TLMA		LDT1A	SARA	SDTA	SSTA	ALMA
F047								PC1DTA

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2.4.3 List of Parameters

This subsection describes those parameters that are common to all operation modes by dividing them into several types.

NOTE
For the detector-related parameters, see Section 1.3, “PARAMETERS RELATED TO DETECTORS”, in Part III.

(1) List of parameters specific to spindle motor driving

This item provides a list of the motor parameters specific to spindle motor driving. Usually, the settings of these parameters need not be changed. Use the values indicated on a parameter table for each motor model without modification.

Parameter No.	Description
4008#3	Presence or absence of measures against a belt slip
4011#3	Sets the number of motor polarities.
4011#4	Sets a maximum output for acceleration/deceleration.
4011#7	Sets the number of motor polarities.
4012#2,1,0	Sets a PWM carrier frequency.
4013#6 to 2	Sets current dead-band data.
4020	Maximum motor speed
4080	High-speed area regenerative power limit/regenerative power limit
4083	Motor voltage on velocity control motor
4100	Base speed for motor output specification
4101	Torque limitation value for motor output specification
4102	Excitation voltage saturation speed with no load
4103	Compensation data for resistance
4104	Current loop proportional gain
4105	Current loop integral gain
4106	D-axis current loop gain
4107	Q-axis current loop gain
4108	Q-axis current deviation limitation coefficient
4109	Filter time constant in voltage command saturation processing
4110	Current conversion constant
4111	Secondary current coefficient
4112	Voltage command saturation decision level/PWM command clamp value
4113	Slip constant
4115	PWM command clamp value at deceleration time
4116	Motor leakage constraint
4117	Voltage compensation coefficient for a high-speed area in steady state/motor voltage coefficient in steady state
4118	Voltage compensation coefficient for a high-speed area at deceleration time/motor voltage coefficient at deceleration time
4119	Time constant for excitation current change at deceleration time/time constant for excitation current change
4120	Dead-band compensation data
4127	Load meter indication value at maximum output time
4128	Compensation coefficient between the specification and true base/maximum torque curve compensation coefficient
4130	Current loop proportional gain velocity coefficient/current phase delay compensation constant
4131	Dead-band compensation hysteresis
4133	Motor model code

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Parameter No.	Description
4134	Motor overheat level (2 words)
4138	Primary frequency clamp velocity1
4139	Primary frequency clamp slip frequency 1
4140	Primary frequency clamp velocity 2
4141	Primary frequency clamp slip frequency 2
4142	Belt slip state detection coefficient 1
4143	Belt slip state detection coefficient 2

(2) List of parameters related to alarm detection

This item provides a list of the parameters related to alarm detection conditions.

Parameter No.	Description
4009#2	Motor power turn-off method when spindle alarm 24 (serial data transfer error) is issued
4086	Gear ratio parameter setting error alarm (spindle alarm 35) detection level
4088	Velocity error excess detection level when the motor is bound
4089	Velocity error excess detection level when the motor is rotating
4090	Overload detection level
4123	Short-time overload detection period

(3) Other parameters

This item provides a list of the parameters common to all operation modes except the parameters listed in Items (1) and (2) above.

Parameter No.	Description
3720	Number of position coder pulses
4001#0	Whether to use the MRDY signal (machine ready signal)
4002#4	SM pin output data selection
4005#0	Setting of the velocity feedback method
4006#1	Gear ratio increment system
4006#2	Sets the unit of speed.
4009#4	Whether to output the load detection signal (LDT1A) during acceleration/deceleration
4019#7	Automatic parameter setting function
4020	Maximum motor speed
4022	Speed arrival detection level
4023	Speed detection level
4024	Speed zero detection level
4025	Torque limitation value.
4026	Load detection level 1
4056	Gear ratio (High)
4057	Gear ratio (Medium High)
4058	Gear ratio (Medium Low)
4059	Gear ratio (Low)
4078	Gear switch timer
4095	Speedometer output voltage adjustment value
4121	Torque change time constant (torque command filter time constant)

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2.4.4 Details of parameters

This subsection details the serial spindle parameters (in the four thousands) among the parameters common to all operation modes. For details of other parameters, refer to the Connection Manual (Function) of each CNC.

(1) List of parameters specific to spindle motor driving

Usually, the settings of the motor parameters specific to spindle motor driving need not be changed. Their details are omitted.

(2) List of parameters related to alarm detection

This item details the parameters related to alarm detection conditions.

	#7	#6	#5	#4	#3	#2	#1	#0
4009						ALSP		

ALSP Motor power turn-off method when spindle alarm 24 (serial data transfer error) is issued
0 : Turns off the power after the motor is decelerated and stopped.
1 : Turns off the power to the motor immediately.
Set this parameter to 1 to turn off the power to the motor immediately when any spindle alarm is issued

4086 **Gear ratio parameter setting error alarm (spindle alarm 35) detection level**

Unit of data : $1min^{-1}$
Valid data range : 0 to 32767
Initial setting : 0 (equivalent to 500 min^{-1})
This parameter sets the detection level of the gear ratio parameter setting error alarm (spindle alarm 35).
When the difference between the motor speed calculated from the position coder feedback and gear ratio parameters (No. 4056 to No. 4059) and the estimated motor speed calculated with control software becomes equal to or greater than the setting, the gear ratio parameter setting error alarm (spindle alarm 35) is issued.
When the initial setting (0) is used, the setting of 500 min^{-1} is assumed.

4088 **Velocity error excess detection level when the motor is bound**

Unit of data : 0.01%
Valid data range : 0 to 10000
Initial setting : 75
This parameter sets a velocity error excess (spindle alarm 31) detection level when the motor is bound.
If a velocity error equal to or greater than [maximum motor speed (No. 4020) × setting data (%)] occurs when the motor is bound, for example, the motor binding alarm (spindle alarm 31) is issued.

4089 **Velocity error excess detection level when the motor is rotating**

Unit of data : 0.1%
Valid data range : 0 to 1000
Initial setting : 200
This parameter sets a velocity error excess detection level when the motor is rotating.
If a velocity error equal to or greater than [maximum motor speed (No. 4020) × setting data (%)] occurs, the velocity error excess alarm (spindle alarm 02) is issued.

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4090	Overload detection level

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 90

This parameter sets a condition for detecting the short-time overload alarm (spindle alarm 29).
If the state where a load equal to or greater than setting data (%) (maximum motor output = 100%) is imposed on the spindle motor lasts for a specified period (set in No. 4123) or more, the short-time overload alarm (spindle alarm 29) is issued.

4123	Short-time overload detection period

Unit of data : 1sec
Valid data range : 0 to 500
Initial setting : 30

This parameter sets the timing for detecting the short-time overload alarm (spindle alarm 29).
If the state where a load equal to or greater than the specified value (set in parameter No. 4090) is imposed on the spindle motor lasts for at least the period specified in this parameter, the short-time overload alarm (spindle alarm 29) is issued.

(3) Other parameters

This item details the parameters common to all operation modes except the parameters listed in Items (1) and (2) above.

	#7	#6	#5	#4	#3	#2	#1	#0
4001								MRDY1

MRDY1 Whether to use the MRDYA signal (machine ready signal)
0 : Does not uses the MRDYA signal (MRDYA = 1 at all times).
1 : Uses the MRDYA signal.

	#7	#6	#5	#4	#3	#2	#1	#0
4002				SMORLM				

SMORLM SM pin output data selection
0 : Speedometer data
1 : Load meter data

	#7	#6	#5	#4	#3	#2	#1	#0
4005								VCTLPC

VCTLPC Sets the velocity feedback method.
0 : Exercises velocity control with an estimated velocity only.
1 : Uses a velocity calculated from the position coder signal to exercise velocity control.
The feedback signal from a position coder attached to a spindle on a 1:1 basis is converted to motor speed data for velocity control. Set this bit to 1 when performing orientation, rigid tapping, or spindle synchronous control.
By setting this bit to 1 even in ordinary velocity control, the response characteristics and stability of velocity control can be improved.

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NOTE
1 The feature may not be fully utilized, depending on the connection ratio between the spindle and spindle motor or between the spindle and position coder, the rigidity of the connection, the precision of position coder attachment, and so forth.
2 When this bit is set to 1 with a spindle that has a gear switch mechanism, the torque limitation command signal (TLMLA) must be input at the start of gear switching. For details, see Chapter 3, "I/O SIGNALS (CNC↔PMC)", in Part II.

	#7	#6	#5	#4	#3	#2	#1	#0
4006						SPDUNT	GRUNIT	

GRUNIT Sets a gear ratio setting resolution:
0 : 1/100 unit
1 : 1/1000 unit
Select a gear ratio data setting resolution from the following:
(a) Resolution based on motor speed increased by a factor of 100 relative to one spindle rotation
(b) Resolution based on motor speed increased by a factor of 1000 relative to one spindle rotation
Depending on the setting of this parameter, the increment system of the parameters indicated in the table below changes.

Parameter No.		Description
3056 to 3059	4056 to 4059	Spindle-to-motor gear ratio data

NOTE
Usually, use the 1/100 unit (setting "0").

SPDUNT Sets the unit of speed.
Set to 0.

	#7	#6	#5	#4	#3	#2	#1	#0
4009				LDTOUT				

LDTOUT Whether to output the load detection signal (LDT1A) during acceleration/deceleration
0 : Does not output the load detection signals during acceleration/ deceleration (standard setting value).
1 : Outputs the load detection signals during acceleration/ deceleration (at all times) when the parameter-set level is exceeded.

	#7	#6	#5	#4	#3	#2	#1	#0
4019	PRLOAD					SSTTRQ		

SSTTRQ Whether to perform torque clamping when the speed is zero
0 : Performs clamping.
1 : Does not perform clamping.

NOTE
Usually, set this parameter to 1 not to perform clamping.

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PRLOAD Automatic parameter setting function
0 : Does not perform automatic parameter setting (standard setting value).
1 : Performs automatic parameter setting.
After setting a desired motor model code in parameter No. 4133 and setting this bit to 1, turn off the power to the CNC, then turn on the power to the CNC again. The parameters (No. 4000 to No. 4175) for the αC*i* series spindle corresponding to the model code are automatically initialized. Upon completion of automatic setting, this bit is automatically set to 0.

4020 **Maximum motor speed**

Unit of data : $1min^{-1}$
Valid data range : 0 to 32767
Initial setting : Depends on the motor model.
This parameter sets a maximum spindle motor speed.

4022 **Speed arrival detection signal**

Unit of data : 0.1%
Valid data range : 0 to 1000
Initial setting : 150
This parameter sets a speed arrival signal (SARA) detection range.
When the motor speed (estimated value) reaches within ±(setting data/10)% of a specified speed, the speed arrival signal (SARA) is set to 1.

4023 **Speed detection level**

Unit of data : 0.1%
Valid data range : 0 to 1000
Initial setting : 30
This parameter sets a speed detection signal (SDTA) detection range.
When the motor speed (estimated value) is (setting data/10)% of a maximum speed or less, the speed detection signal (SDTA) is set to 1.

4024 **Speed zero detection level**

Unit of data : 0.01%
Valid data range : 0 to 10000
Initial setting : 75
This parameter sets a speed zero detection signal (SSTA) detection range.
When the motor speed (estimated value) is (setting data/100)% of a maximum speed or less, the speed zero detection signal (SSTA) is set to 1.

4025 **Torque limitation value.**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 50
This parameter sets a torque limitation value to be applied when the torque limitation command HIGH (TLMHA) is specified.
The data indicates limitation values when the maximum torque is 100%.

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Torque limitation command HIGH (TLMHA)	Description
0	No torque limitation is imposed.
1	The torque is limited to the value set in this parameter.

4026 **Load detection level 1**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 83

This parameter sets a load detection signal 1 (LDT1A) detection range.
When the output of the spindle motor is (setting data)% of the maximum output or more, load detection signal 1 (LDT1A) is set to 1.

NOTE
By default, these signals are not output in 10 seconds (set in parameter No. 4082) after the status of the speed command signal changes so that Load detection signals can not be output by load of acceleration and deceleration. If the default time (No.4082) is not suited with the real acceleration and deceleration time, please refer to explanation of the parameter No.4082 and modify the value.

4056	**Gear ratio (HIGH)**	**CTH1A=0, CTH2A=0**
4057	**Gear ratio (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4058	**Gear ratio (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4059	**Gear ratio (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : (Motor rotation for one rotation of spindle) / 100
(When parameter No. 4006 #1 (GRUNIT) is 1, motor rotation / 1000)
Valid data range : 0 to 32767
Initial setting : 100

These data are used to set the gear ratio between spindle and spindle motor.
Example :
When the spindle rotates once, set “250” as the data when the motor rotates 2.5 times.

NOTE
1 A parameter is selected by the input signals CTH1A and CTH2A. Ensure that the gear or clutch state corresponds to the input signals CTH1A and CTH2A. When the signals are not input correctly, the overcurrent alarm (spindle alarm 12) can be issued.
2 When using a position coder, be sure to set this parameter. If this parameter is not set correctly, the velocity error excess alarm (spindle alarm 02), motor binding alarm (spindle alarm 31), or gear ratio parameter setting error alarm (spindle alarm 35) may be detected.
3 When an improper value is set in this parameter, an unexpected operation can occur. For example, the spindle can continue rotating without stopping at the time of orientation. So, be sure to set a proper gear ratio.

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4078 **Gear switch timer**

Unit of data : 1sec
Valid data range : 0 to 500
Initial setting : 0

For a spindle that has a gear switch mechanism, this parameter sets a period of time from the start of a gear switch sequence (input of the TLML signal) until the gear shifter is actually started. For details, see Chapter 3, "I/O SIGNALS (CNC↔PMC)", in Part II.
For a spindle that has no gear switch mechanism, set this parameter to 0.

4095 **Speedometer output voltage adjustment value**

Unit of data : 0.1%
Valid data range : -1000 to +100(-100% to +10%)
Initial setting : 0

Set this parameter when making a fine adjustment of speedometer terminal output voltage.
Positive (+) data increases the output voltage.

NOTE
Usually, this parameter need not be adjusted.

4121 **Torque command filter time constant**

Unit of data : 0.5msec
Valid data range : 0 to 32767
Initial setting : 5

Basically, use the standard setting value 5 (time constant of 2.5 ms).

2.4.5 Diagnosis (Diagnosis Screen)

For this subsection, see Subsection 2.5.5, "Diagnosis (Diagnosis Screen)", in Part I.

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3 I/O SIGNALS (CNC↔PMC)

This chapter explains the functions of the signals directly input from the PMC to spindle (βiSVSPc/βiSVSP-B) via the CNC and the signals directly output from the spindle to PMC. For other spindle-related I/O signals, refer to the Connection Manual (Function) of the relevant CNC.

3.1 INPUT SIGNALS (PMC→CNC→SP)

This section explains the functions of the signals directly input from the PMC to spindle via the CNC. For other spindle-related input signals, refer to "SPINDLE FUNCTION" of the Connection Manual (Function) of the relevant CNC.

3.1.1 List of Input Signals

	#7	#6	#5	#4	#3	#2	#1	#0
G070	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
G071			INTGA				*ESPA	ARSTA
G072			INCMDA	OVRA		NRROA	ROTAA	INDXA
G073						MPOFA		

3.1.2 Explanation of Input Signals

For information about the signals listed in Subsection 3.1.1, "List of Input Signals", in Part III, see Subsection 3.1.2, "Explanation of Input Signals", in Part I.
Those signals that are not listed in Subsection 3.1.1, "List of Input Signals", in Part III are not used with the βiIc series spindle.
This subsection describes only those signals that have different specifications for use with the βiIc spindle.

Symbol	Name	Description
TLMLA, B	Torque limitation command LOW	Switches to a speed control method that uses speed estimation during gear switching. 0: - 1: Performs speed control using only speed estimation. (However, there is the delay set by the gear switching timer [No.4078].)

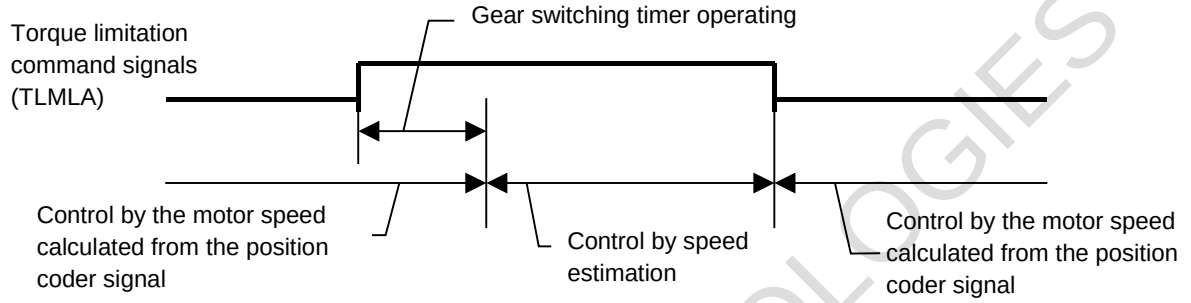
3.1.3 Details of Input Signals

For information about the signals listed in Subsection 3.1.1, "List of Input Signals", in Part III, see Subsection 3.1.3, "Details of input signals", in Part I.
Those signals that are not listed in Subsection 3.1.1, "List of Input Signals", in Part III are not used with the βiIc series spindle.
This subsection describes only those signals that have different specifications for use with the βiIc spindle.

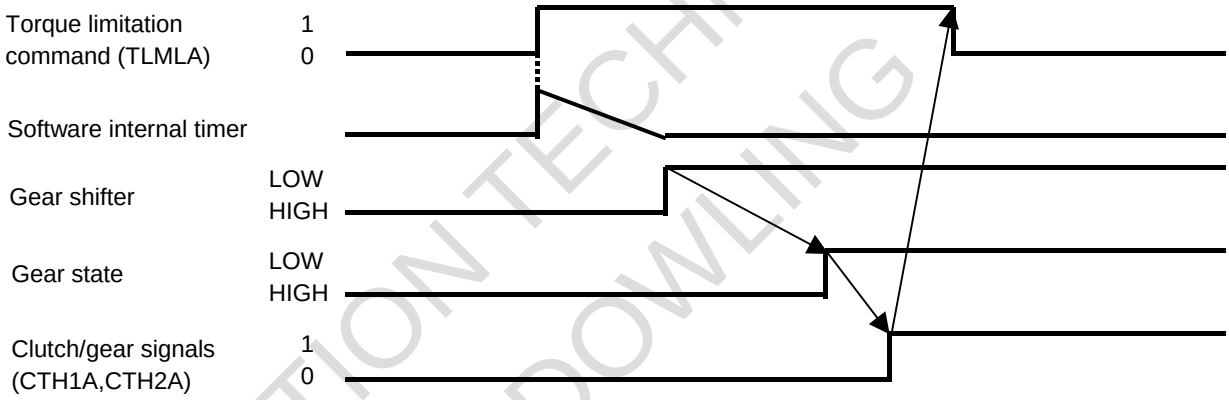
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(a) Torque limitation command signals (TLMLA)

If gear switching is performed with the setting (No.4005#0="1") that uses motor speed calculated from the position coder signal to perform speed control, the state of machine gear may not match the state of the gear ratio parameter. This can cause an alarm to occur due to speed control using incorrect speed data. Therefore, switch to a control method that uses the speed estimation during gear switching by inputting the torque limitation command signal (TLMLA) upon start of gear switching so that gear switching is performed smoothly. In addition, set the time from when a gear switching sequence starts to when the gear shifter actually operates for parameter No.4078 (gear switching timer). (See below.)



(Example of a recommended sequence)



3.2 OUTPUT SIGNALS (SP→CNC→PMC)

This section explains the functions of the signals directly output from the spindle to PMC via the CNC. For other spindle-related output signals, refer to the Connection Manual (Function) of the relevant CNC.

3.2.1 List of Output Signals

	#7	#6	#5	#4	#3	#2	#1	#0
F045	ORARA	TLMA		LDT1A	SARA	SDTA	SSTA	ALMA
F047							INCSTA	PC1DTA

3.2.2 Explanation of Output Signals

For information about the signals listed in Subsection 3.2.1, "List of Output Signals", in Part III, see Subsection 3.2.2, "Explanation of Output Signals", in Part I.
Those signals that are not listed in Subsection 3.2.1, "List of Output Signals", in Part III are not used with the βiIc series spindle.

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3.2.3 Details of Output Signals

For information about the signals listed in Subsection 3.2.1, “List of Output Signals”, in Part III, see Subsection 3.2.3, “Details of Output Signals”, in Part I.
Those signals that are not listed in Subsection 3.2.1, “List of Output Signals”, in Part III are not used with the βiIc series spindle.

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4 ADJUSTMENT

4.1 VELOCITY LOOP GAIN ADJUSTMENT

4.1.1 Overview

Optimum adjustment of the velocity loop gain increases the position loop gain, therefore significantly enhancing disturbance suppression performance, positioning speed and accuracy. So, the adjustment of the velocity loop gain is very important in servo adjustments, and it should be performed first. This section explains the parameters for velocity loop gain adjustment and the adjustment procedure.
To check the waveform of a torque command, position error, or so on, use the servo guide (see Appendix F).

4.1.2 Parameters

There are four operation modes in spindle control: velocity control mode, orientation, servo mode (rigid tapping and spindle positioning), and spindle synchronous control. There are parameters corresponding to each operation mode and to the clutch/gear signals (CTH1A and CTH2A). The following shows the parameters for each operation mode.

(1) Velocity control mode

4040	**Velocity loop proportional gain on velocity control mode (HIGH) CTH1A=0**
4041	**Velocity loop proportional gain on velocity control mode (LOW) CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : Depends on the motor model.

4048	**Velocity loop integral gain on velocity control mode (HIGH) CTH1A=0**
4049	**Velocity loop integral gain on velocity control mode (LOW) CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : Depends on the motor model.

(2) Orientation

4042	**Velocity loop proportional gain on orientation (HIGH) CTH1A=0**
4043	**Velocity loop proportional gain on orientation (LOW) CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : Depends on the motor model.

4050	**Velocity loop integral gain on orientation (HIGH) CTH1A=0**
4051	**Velocity loop integral gain on orientation (LOW) CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : Depends on the motor model.

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(3) Servo mode (Rigid tapping and spindle positioning)

4044	**Velocity loop proportional gain on servo mode (HIGH) CTH1A=0**
4045	**Velocity loop proportional gain on servo mode (LOW) CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : Depends on the motor model.

4052	**Velocity loop integral gain on servo mode (HIGH) CTH1A=0**
4053	**Velocity loop integral gain on servo mode (LOW)CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : Depends on the motor model.

(4) Spindle synchronous control

4044	**Velocity loop proportional gain on spindle synchronous control (HIGH) CTH1A=0**
4045	**Velocity loop proportional gain on spindle synchronous control (LOW) CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : Depends on the motor model.

4052	**Velocity loop integral gain on spindle synchronous control (HIGH) CTH1A=0**
4053	**Velocity loop integral gain on spindle synchronous control (LOW) CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : Depends on the motor model.

NOTE
For the velocity loop gain on spindle synchronous control and on the servo mode, common parameters are used.

4.1.3 Adjustment Procedure

(1) Start of each operation mode

In preparation for the adjustment, settings must be made so that a stable operation takes place in each mode without overshoot or oscillation.
See Chapter 2, “EXPLANATION OF OPERATION MODES”, temporarily set parameters (acceleration/deceleration time constant, position gain, and so on) to make operations stable in each operation mode, and confirm operations

NOTE
When the rigidity of the spindle is low, the initial setting of the velocity loop gain may be so high that oscillation can occur. In such a case, decrease the velocity loop gain.

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(2) Adjustment

Before adjusting the velocity loop gain, check the operation mode and the clutch/gear signals and then change the corresponding parameters. Follow the steps below to adjust the parameters:

The velocity loop proportional gain and integral gain are parameters to be set according to the load inertia. Set the value according to the following equation.

$$[\text{Proportional/integral gain considering load inertia}] = (\frac{\text{JL}\,[\text{kgm}^2]}{\text{Jm}\,[\text{kgm}^2]} + 1) \times [\text{Initial value of proportional/integral gain}]$$

JL [kgm^2] : Spindle load inertia (converted for the motor shaft)
Jm [kgm^2] : Rotor inertia of spindle motor

Example) For the βiIc3/6000

The motor rotor inertia Jm is 0.0078 kgm^2.
The initial value of the proportional gain is 24.
The initial value of the integral gain is 607.
If the spindle inertia Jl is 0.0250kgm^2:
The proportional gain considering load inertia is (No.4040 to No.4045) = (0.0250/0.0078+1)×24 = 101.
The integral gain considering load inertia is (No.4048 to No.4053) = (0.0250/0.0078+1)×607 = 2553.

Motor model	Rotor inertia Jm (kgm^2)	Initial value of proportional gain	Initial value of integral gain
βiIc3/6000	0.0078	24	607
βiIc6/6000	0.0148	34	844
βiIc8/6000	0.0179	28	696

If vibration as described below occurs when a value calculated by the above expression is set because, for example, the rigidity of the spindle is low, then set a smaller value (equal to or less than 70% of the calculated value) by providing a margin.
- The vibration sound of spindle occurs.
- Vibration of a torque command becomes large.
- Vibration caused by position error at a stop becomes large.

4.1.4 Additional Information (Position Gain Adjustment)

Although the limit value of the position gain is determined basically depending on the velocity loop characteristics, the setting standards may vary depending on the operation mode. See Chapter 2, “EXPLANATION OF OPERATION MODES”, and make adjustments accordingly.

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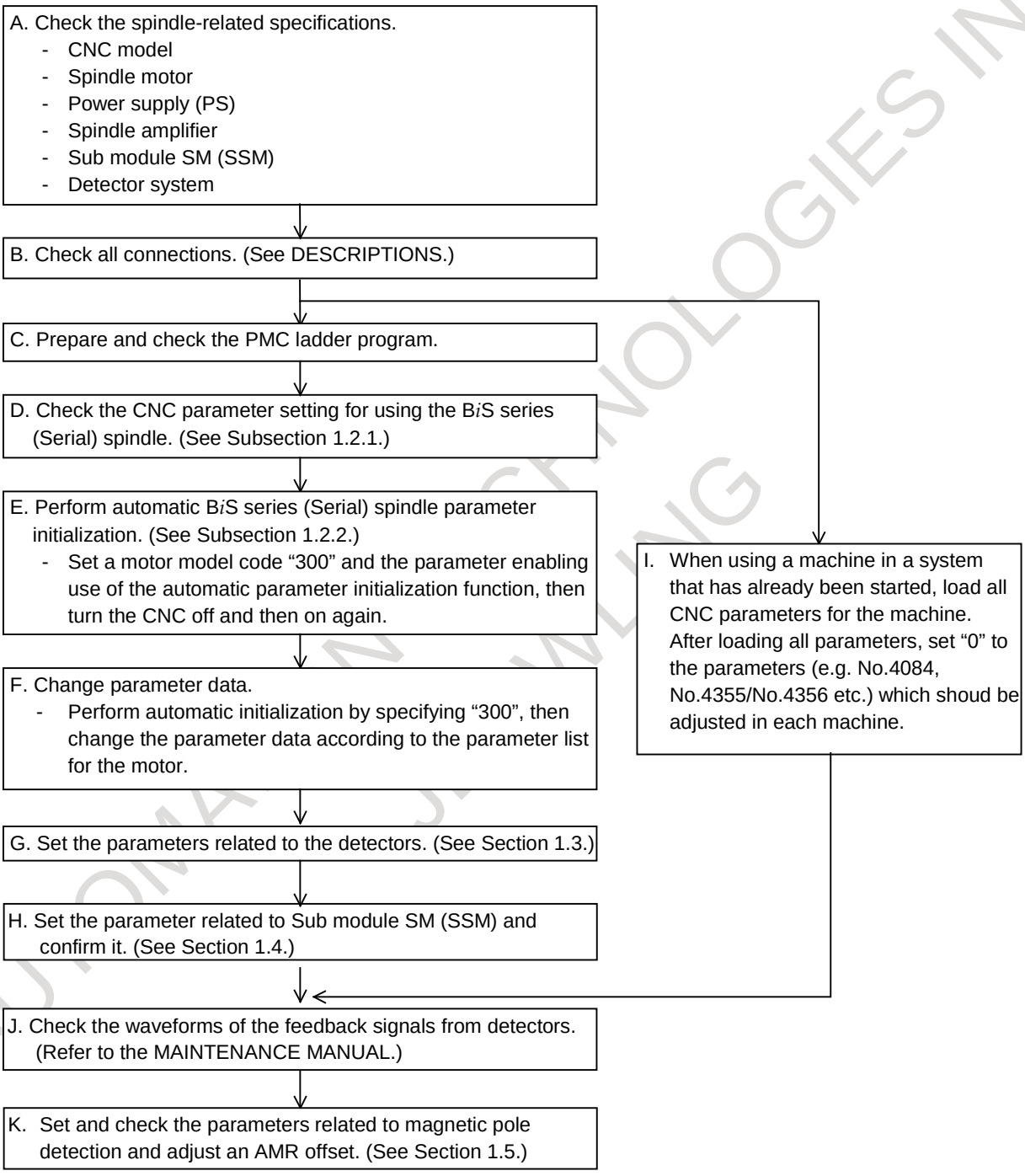
III. FANUC BUILT-IN SPINDLE MOTOR
B*i*S series

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1 START-UP

1.1 START-UP PROCEDURE



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1.2 SPINDLE SERIAL INTERFACE (OPTIONAL FUNCTION)

1.2.1 Parameters Related to Spindle Serial Output

For this subsection, see Subsection 1.2.1, “Parameters Related to Spindle Serial Output”, in Part I.

1.2.2 Automatic Spindle Parameter Initialization

(1) Parameter list

Parameter No.		Description
0*i*	30*i*	
4019#7	4019#7	Function for automatically initializing spindle parameters
4133	4133	Spindle motor model code

(2) Procedure for automatic spindle parameter initialization

Perform spindle parameter initialization by following the procedure below.

<1> Set model code “300”.

Parameter No.		Description
0*i*	30*i*	
4133	4133	Model code

<2> Set the relevant parameter to enable automatic spindle parameter initialization.

Parameter No.		Description
0*i*	30*i*	
4019#7	4019#7	1

NOTE
This bit is reset to its original value after automatic parameter initialization.

<3> Turn off then turn on again the power to the CNC. The spindle parameter data common to each model is automatically initialized.
<4> Input parameters manually according to the model-by-model parameter list.
<5> Set detector-related parameters according to the detector configuration.

1.2.3 Automatic Setting of the Parameter for Specifying the PS Management Axis

For this subsection, see Subsection 1.2.3, "Automatic Setting of the Parameter for Specifying the PS Management Axis", in Part I.

1.2.4 Diagnosis (Diagnosis Screen)

For this subsection, see Subsection 1.2.4, “Diagnosis (Diagnosis Screen)”, in Part I.

1.2.5 Alarm

For this subsection, see Subsection 1.2.5, “Alarm”, in Part I.

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1.3 PARAMETERS RELATED TO DETECTORS

NOTE
1 Note that the specifications of parameters related to detectors for the α*i* series spindle amplifiers differ from those of parameters for the α series spindle amplifiers.
2 The sensor used with the B*i*S series spindle is an α*i*BZ sensor or α*i*CZ sensor (analog or serial). In the case of the α*i*CZ sensor (serial), however, use spindle software 9D80 series H (08) edition, 9D90 series A (01) edition, 9DA0 series (01) edition, or 9DB0 series A (01) edition or later.

1.3.1 List of Parameters for Detectors

For this subsection, see Subsection 1.3.1, "List of Parameters for Detectors", in Part I.

1.3.2 Details of Parameters for Detectors

For this subsection, see Subsection 1.3.2, "Details of Parameters for Detectors", in Part I.

1.3.3 Series and Editions of Applicable Spindle Software

- When the α*i*BZ sensor or α*i*CZ (analog) sensor is used
  9D53 series A (01) edition or later
  9D70 series A (01) edition or later
  9D80 series B (02) edition or later
  9D90 series A (01) edition or later
  9DA0 series A (01) edition or later
  9DB0 series A (01) edition or later

- When the α*i*CZ (serial) sensor is used
  9D80 series H (08) edition or later
  9D90 series A (01) edition or later
  9DA0 series A (01) edition or later
  9DB0 series A (01) edition or later

1.3.4 Typical Detector Configurations

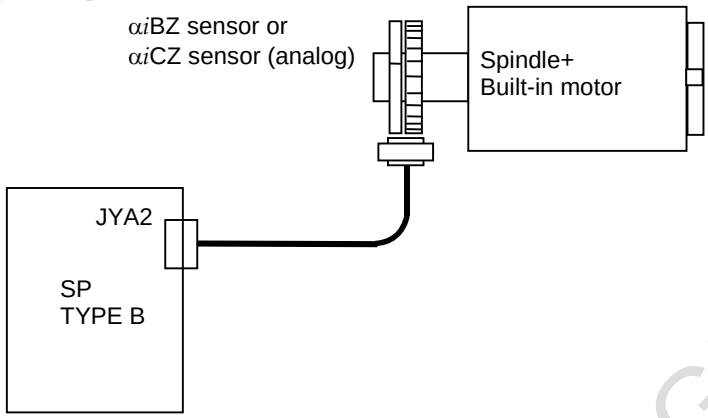
This subsection describes the detector configuration of the B*i*S series spindle and the parameter setting procedure applicable to the detector configuration.
With the B*i*S series spindle, the detector circuitry hardware is set according to the parameter setting. For this reason, an alarm such as a disconnection alarm may be output while parameters related to detectors are being set.
To initialize the hardware, after setting the parameters related to detectors, turn the power to the amplifier off once.

NOTE
In the sample system configurations below, spindle amplifier (SP) TYPE B is used, assuming that the sub module SM is connected. (For the spindle amplifier (A06B-62xx-Hxxx) for 30*i*-B series, TYPE B is not differentiated.)

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(1) When the α*i*BZ or α*i*CZ sensor (analog) is used

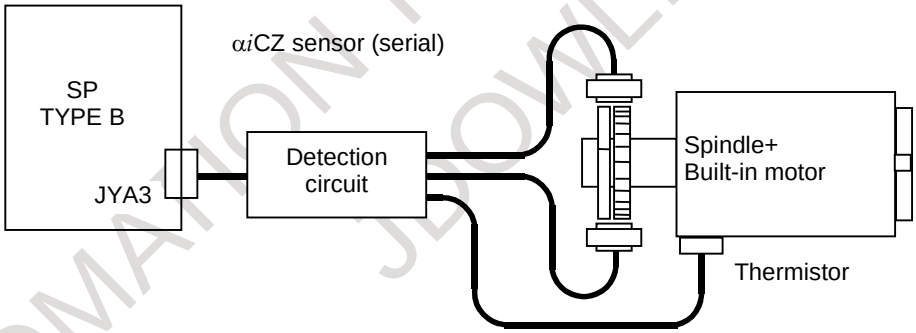
[Sample system configuration]



Parameter	Settings	Description
4000 #0	0	Rotation directions of the spindle and motor
4002 #3,2,1,0	0,0,0,1	Uses the motor sensor for position feedback.
4010 #2,1,0	0,0,1	Uses the α*i*BZ or α*i*CZ sensor (analog) as the motor sensor.
4011 #2,1,0	Depends on the detector.	Sets the number of motor sensor gear teeth.
4056 to 4059	100 or 1000	Gear ratio between the spindle and motor 1 : 1

(2) When the α*i*CZ sensor (serial) is used

[Sample system configuration]



Parameter	Settings	Description
4000 #0	0	Rotation directions of the spindle and motor
4002 #3,2,1,0	0,0,0,1	Uses the motor sensor for position feedback.
4007 #5	0	Feedback signal disconnection detection is enabled.
4007 #6	0	Alarms related to position feedback signals are enabled.
4010 #2,1,0	0,1,1	Uses the α*i*CZ sensor (serial) as the motor sensor.
4011 #2,1,0	Depends on the detector.	Sets the number of motor sensor gear teeth. (For 512λ/rev)
4016 #5	1	Alarms related to position feedback signals are enabled.
4016 #6	1	Alarms related to threading position feedback signals are enabled.
4056 to 4059	100 or 1000	Gear ratio between the spindle and motor 1 : 1
4334	Depends on the detector.	Sets the number of motor sensor gear teeth. (For 768λ/rev、1024λ/rev)

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NOTE
When using the α*i*CZ sensor (serial), use spindle software of the following series and editions:
- 9D80/08 edition or later
- 9D90/01 edition or later
- 9DA0/01 edition or later
- 9DB0/01 edition or later

1.4 SUB MODULE SM

1.4.1 Overview

The sub module SM (SSM) protects the amplifier and motor against an overvoltage caused by the motor counter electromotive voltage of the B*i*S series spindle (synchronous built-in spindle motor), for example, when a spindle alarm is issued.

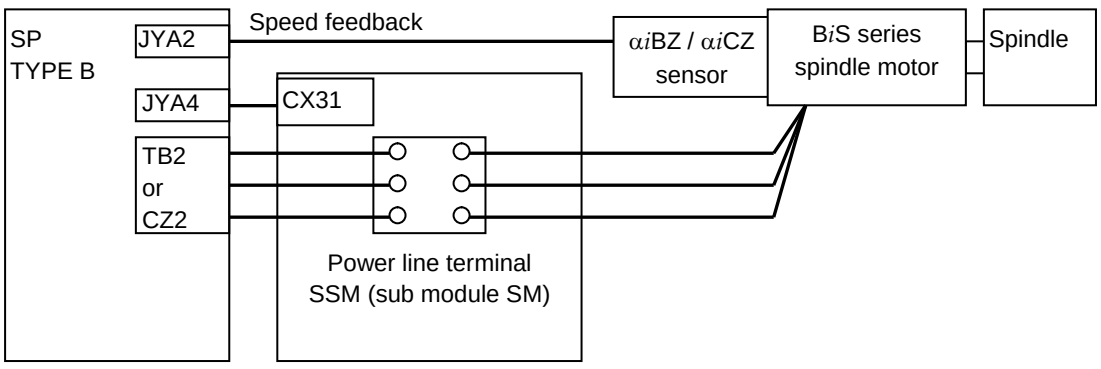
⚠ CAUTION
1 This section provides information important to safe use of the B*i*S series spindle (synchronous built-in spindle motor). Be sure to read this section.
2 To use the B*i*S series spindle motor safely, be sure to connect the SSM.
3 Specify the parameter related to the SSM (bit 5 of parameter No. 4008 to 1) and confirm that the SSM operates securely (see Subsection 1.4.7).

1.4.2 Series and Editions of Applicable Spindle Software

9D53 series B (02) edition or later
9D70 series A (01) edition or later
9D80 series B (02) edition or later
9D90 series A (01) edition or later
9DA0 series A (01) edition or later
9DB0 series A (01) edition or later

1.4.3 Configuration

The following figure shows the connection of the sub module SM.
For the specifications of the sub module SM and connection details, refer to "FANUC SERVO AMPLIFIER α*i* series DESCRIPTIONS (B-65282EN)".



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NOTE
To use the sub module SM, spindle amplifier (SP) TYPE B is required. (For the spindle amplifier (A06B-62xx-Hxxx) for 30*i*-B series, TYPE B is not differentiated.)

1.4.4 Related Parameters

⚠ CAUTION
This subsection describes the parameters related to the sub module SM (SSM). To use the SSM safely, specify the following parameter related to the SSM and confirm that the SSM operates securely (see Subsection 1.4.7).

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4008	4008			SSMUSE					

SSMUSE This parameter sets whether to use the sub module SM (SSM).
0 : Does not use the sub module SM.
1 : Uses the sub module SM.
To use the synchronous built-in spindle motor safely, connect the SSM securely and set this bit to "1".

1.4.5 Stop Processing When a Sub Module SM Error Occurs

⚠ CAUTION
1 This subsection describes stop processing to be performed when a sub module SM (SSM) error occurs.
2 If an SSM error occurs during the motor is rotating, the function for protecting the amplifier against a spindle alarm does not operate normally. Ensure that when an SSM error occurs, the motor is stopped according to the descriptions of this subsection.

(a) Output signals (CNC→PMC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F048	F048					SSMBRKA			
2nd-	F052	F052					SSMBRKB			

Symbol	Name	Description
SSMBRKA, SSMBRKB	Sub module SM (SSM) error state signal	Output when a sub module SM (SSM) error is detected. 0: Normal state 1: The sub module SM (SSM) is abnormal.

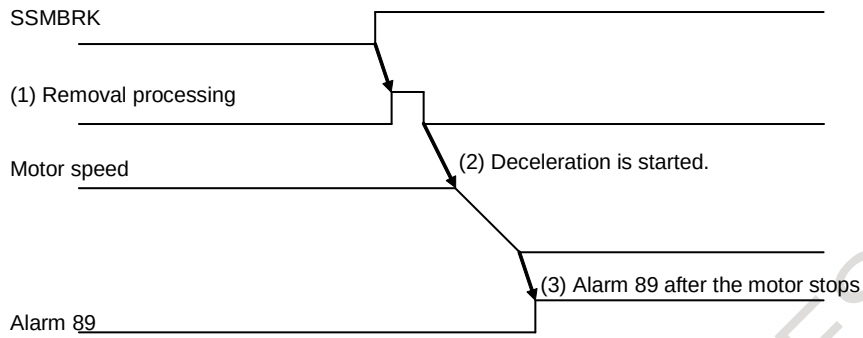
(b) Stop processing

When an SSM error is detected during motor is rotating, the SSM error signal SSMBRK is set to 1, and the spindle amplifier (SP) has state error 36 turned on. At this time, decelerate and stop the motor safely by following the procedure below:

(1) When the SSM error occurs, please move the spindle axis with tool away from the work piece. This operation is to prevent the deceleration of the spindle motor from having a mechanical impact on the spindles.
(2) Then, decelerate and stop the target spindle.
(3) When the motor is decelerated and the speed becomes zero (SST = 1), spindle alarm 89 is issued.

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(Timing chart)



1.4.6 Alarm and Status Error

There are two ways of cases that the abnormality of the SSM is detected and becomes the alarm 89 at following

- When emergency stop is canceled, and the abnormality of the SSM is detected by self test before MCC is turned on.
- When after the abnormality of the SSM (status error No.36) was detected during motor drive outside, a motor is stopped by command.

(a) Spindle alarm

Alarm No.		LED display	Description	Measure
0*i*	**30*i***	**Spindle amplifier**		
9089	SP9089	89	The SSM is abnormal. (1) The spindle amplifier (SP) does not support the SSM. (2) No SSM is installed or connected. (3) The interface signal between the spindle amplifier (SP) and SSM is disconnected. (4) The SSM is faulty.	Alarm 89 cannot be reset. Turn the power off, then check whether the SP supports the SSM and whether the SSM and SP are connected properly. If the SSM is faulty, replace the SSM.

(b) Status error

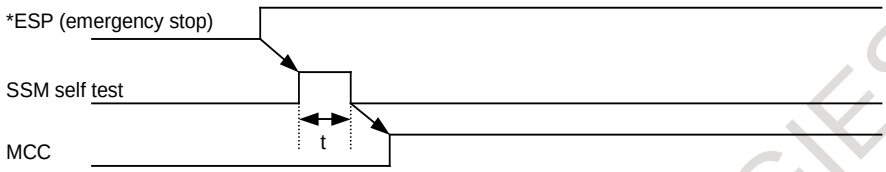
Status error No.	Description	Measure
36	The SSM is abnormal. (1) The interface signal between the spindle amplifier (SP) and SSM is disconnected. (2) The SSM is faulty.	Error 36 cannot be reset. For PMC processing to be performed when error 36 is issued, see Subsection 1.4.5, “Stop Processing When a Sub Module SM Error Occurs”, in Part III.

1.4.7 Caution

> ⚠ **CAUTION**
> This subsection provides notes on using the B*i*S series spindle safely. Fully understand the instructions described in this subsection before using the B*i*S series spindle.

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(1) When MCC is turned on, spindle amplifier performs the self test of the SSM and checks the normal operation of the SSM (a power line is shunted normally). Alarm 89 is output if SSM could not operate normally. To check that the SSM operates normally, off and on the emergency stop signal at least once a day. An SSM self test is conducted on the rising edge of the emergency stop signal *ESP. The execution time (corresponding to "t" in the figure below) of the self test is about 450 ms (with 9D53 series H (08) edition or later, 9D70 series G (07) edition or later, 9D80 series B (02) edition or later; 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later, and 9DB0 series A (01) edition or later about 250 ms with any edition earlier than the above).



MCC: The MCC is connected between the power supply and common power supply (PS), and the MCC switch signal line is connected to the CX3 of the common power supply (PS). The MCC is turned on/off by the emergency stop signal *ESP (G071#1).

(2) By conducting the test described below at least once after SSM installation, check that the SSM self test function operates normally. If this test is not conducted, the function for protecting the SSM amplifier and motor can be lost, resulting in damage to the amplifier or motor, for example, when a power failure occurs.

Step 1. Turn off the power to the machine.
Step 2. To prevent the power to the motor from being turned on during testing, detach the CX3 connector on the common power supply (PS) connected to the SSM and also detach the CX31 connector on the sub module SM.
Step 3. Turn on the power to the machine.
Step 4. After the CNC starts up and the indication of "--" on the spindle amplifier (SP) is turned on, set the emergency stop signal (*ESP) to 1.
Step 5. The self test function is operating normally if spindle alarm 89 is issued at emergency stop cancellation time. If the alarm is not issued, the cable, parameter, or spindle amplifier (SP) is abnormal.
Step 6. Turn off the power to the machine. Be sure to reinstall the CX3 and CX31 connectors.

(3) If a spindle alarm is issued and the spindle amplifier (SP) detects the input of the motor power turn-off signal (MPOF), the SSM is activated and the motor is decelerated to a stop. This deceleration differs from ordinary deceleration in that it is dynamic brake operation caused by short-circuits between motor pins by the SSM, however. If the SSM is faulty at this time, the spindle amplifier (SP) can be damaged.

(4) After the SSM is activated, the spindle amplifier (SP) ignores any alarm reset unless the speed zero state (speed zero signal SST = 1) continues for at least 5 sec (with 9D53 series G (07) edition or later, 9D70 series F (06) edition or later, or 9D80 series B (02) edition or later; for at least 120 sec with any edition earlier than the above). For resetting of the alarm, the speed zero state (SST = 1) needs to be set.

(5) After the SSM is activated, the SP ignores any alarm reset during the period described in item (4). When the SSM is active, reset the alarm after the period has elapsed. If the alarm is reset in the state where a command is input, the motor can abruptly start rotation. So, specify such a sequence that all commands are cleared when an alarm is issued or MPOF is input, and the cleared commands are specified again upon completion of alarm resetting.

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(6) If the motor power turn-off signal MPOF is input, the SSM is activated. So, a deceleration to a stop (dynamic brake operation, which differs from ordinary deceleration) occurs instead of a free-run stop.

(7) When the SSM is faulty, inputting the motor power turn-off signal MPOF may damage the spindle amplifier (SP). So, ensure that MPOF is not input in a high-speed area where the SSM is needed.

(8) Do not insert a switch element such as an electromagnetic contactor in the power line between the spindle amplifier (SP) and synchronous built-in spindle motor. If the power line is broken during rotation, the amplifier or motor can be damaged.

1.5 POLE POSITION DETECTION

1.5.1 Overview

To control the synchronous built-in spindle motor, information about the pole position (phase) of the rotor is needed. Operation for detecting the pole position (phase) of the rotor is referred to as pole position detection. Immediately after the power is turned on or if pole position information is lost for a cause such as an alarm, pole position detection needs to be performed before the motor can be driven.
There are the following three methods in pole position detection.

- Minute moving method (usable with 9D53 series I edition or later, 9D70 series H edition or later, 9D80 series B edition or later, 9D90 series A edition or later, and 9DA0 series A edition or later)
- Minute moving method + stop method (usable with 9D53 series C edition or later, 9D70 series B edition or later, 9D80 series B edition or later, 9D90 series A edition or later, 9DA0 series A edition or later, and 9DB0 series A edition later)
- DC current method

By setting the phase difference between the pole position (phase) of the rotor and the one-rotation signal generation position beforehand in a parameter, control can be exercised using a parameter-set offset value and one-rotation signal position as reference data after one-rotation signal detection (AMR offset function).

⚠ WARNING

1 For the B*i*S series spindle motor, if pole position detection and other basic parameter settings are inappropriate, the correct pole position cannot be detected, and the motor may move unpredictably or the maximum motor speed may be exceeded.
2 To avoid danger due to the above symptom, performing the following action is recommended until normal spindle motor operation is confirmed:
<1> Specify a value smaller than or equal to 10% of the specified maximum motor speed for the maximum motor speed parameter (No. 4020).
<2> Specify a low torque limitation value to limit the torque (for example, specify 10% for the torque limitation parameter (No. 4025) and set torque limitation command signal TLMHA to 1) so that the motor is not accelerated suddenly.
<3> Be sure to close the protection door during pole position detection and subsequent command input.
If these conditions are not satisfied and the correct pole position cannot be detected, the motor may move unpredictably with the maximum torque until the SP detects an overspeed alarm.

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⚠ WARNING

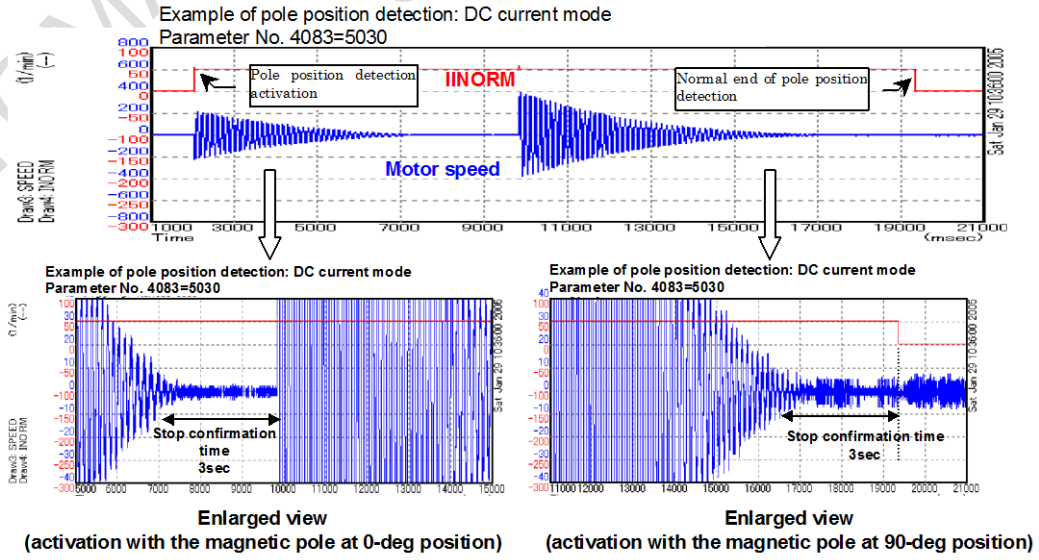
3 Use the pole detection state signals to create the following sequence with the PMC:
<1> When the protection door is open, starting pole position detection is prohibited.
<2> If the protection door is opened during pole position detection (from the start of detection until pole position detection signal EPFIX is set to 1), pole position detection is stopped.
<3> In the pole position undetected state (when EPFIX is set to 0), no command is input.

1.5.2 Pole Position Detection Operation

(1) DC current method

In the DC current method, pole position detection is performed while the motor is vibrating to a large extent.
When the motor is locked, pole position detection is disabled.
Operation in the DC current method is as follows:
<1> A direct current is flowed in 0 deg electric angle.
<2> Check that the motor is stopped. The motor is assumed to be stopped when a stop confirmation time (specified using the lower two digits of parameter No. 4083) has elapsed after the motor speed becomes 5 min^{-1} or below.
<3> After checking that the motor is stopped, a direct current is flowed in 90 deg electric angle.
<4> Check that the motor is stopped.
<5> After checking that the motor is stopped, the spindle alarm 65 is issued if the phase difference of the rotor between the cases where direct current activation is performed at the electric angle 0 deg and at the electric angle 90 deg is not within the range 80 to 100 deg.
The maximum travel distance from the start to end of pole position detection is the electric angle 270 deg.

During the machine startup or maintenance (for example, replacement of motor sensors), use of this method is recommended. In this method, an incorrect power line phase order or the like can be detected as Alarm 65.



Enlarged view
(activation with the magnetic pole at 0-deg position)

Enlarged view
(activation with the magnetic pole at 90-deg position)

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(2) Minute moving method

Usable with 9D53 series I edition or later, 9D70 series H edition or later, 9D80 series B edition or later, 9D90 series A edition or later, 9DA0 series A edition or later, and 9DB0 series A edition or later.

In the minute moving method, pole position detection is performed while the motor is being moved minutely. When the motor is locked, pole position detection is disabled in principle (spindle alarm 65 is issued).

Normally, use of this method is recommended.

During the machine startup or maintenance (for example, replacement of motor sensors), however, use of the DC current method where an incorrect power line phase order or the like can be detected as an alarm is recommended.

(3) Minute moving method + stop method (auto select)

Usable with 9D53 series I edition or later, 9D70 series H edition or later, 9D80 series B edition or later, 9D90 series A edition or later, 9DA0 series A edition or later, and 9DB0 series A edition or later.

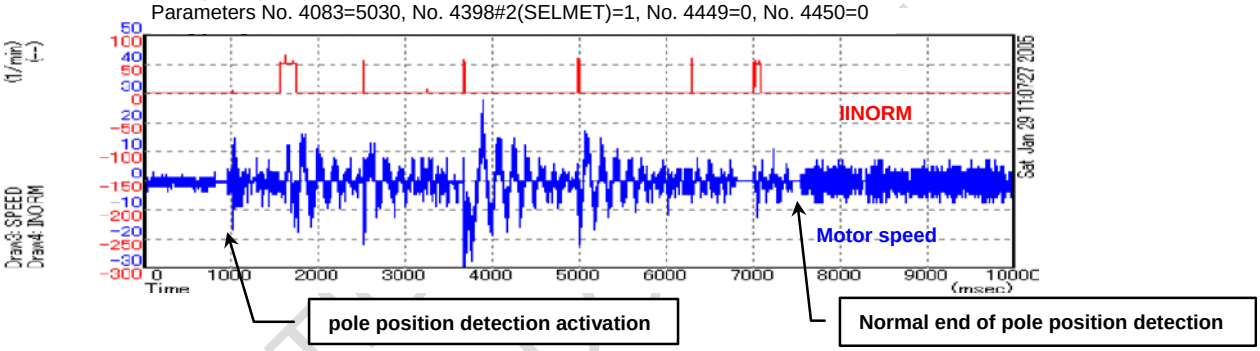
In auto select, the spindle amplifier (SP) automatically switches the following two methods for pole position detection.

Minute moving method: Pole position detection is performed while the motor is moving minutely.

Stop method: Even when the motor is locked, pole position detection is enabled.

In auto select mode, pole position detection is started by the minute moving method, and if the motor is judged as being in the locked state, the method is switched to the stop method and pole position detection is performed.

Example of pole position detection: Auto select mode
Parameters No. 4083=5030, No. 4398#2(SELMET)=1, No. 4449=0, No. 4450=0



NOTE

Since auto select involves the stop method, pole position detection is possible even in the motor locked state. To apply the stop method, however, the following conditions must be satisfied.

- The saliency of the motor is sufficiently large. (Lq-Ld>1mH)
- At about 70% of the maximum current, a magnetic saturation of 5% or more is generated (the torque constant decreases by 5% or more.)

If either of the above conditions is not satisfied, the precision of detection may be degraded or the pole position may be unable to be detected. Therefore, when using auto select, never fail to check that the stop method can operate normally in advance.

When the minute moving method or auto select is used, the velocity feedback may exceed the value set in parameter No. 4450 (velocity feedback threshold) due to noise and a symptom such as the following may occur: Pole position detection is not started or is not completed. In this case, follow the steps below:

<1> First, check the noise level of the velocity feedback.

<2> When the noise level of the velocity feedback is 5.5 min^{-1} or less, set the lower two digits (velocity feedback threshold) of parameter No. 4450 to the standard setting (0: 11 min^{-1}).

<3> When the noise level of the velocity feedback exceeds 5.5 min^{-1}, first reduce the noise by suppressing it. If the noise cannot be reduced to the allowable level by any means, set the lower two digits (velocity feedback threshold) of parameter No. 4450 to about double the noise level.

1.5.3 AMR Offset Function

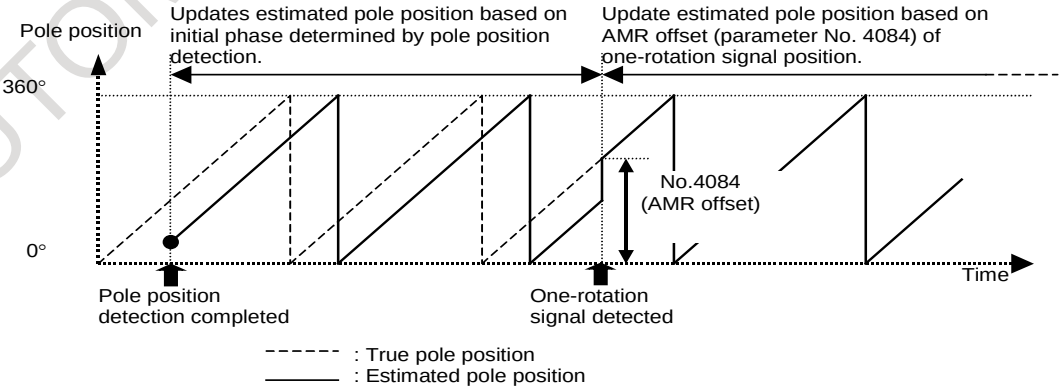
The spindle amplifier controls the motor based on the initial pole position estimated by pole position detection. So, a large error between the estimated and true pole position may affect the motor so that the acceleration/deceleration time during forward rotation differs from that during reverse rotation (torque characteristics during forward rotation differ from those during reverse rotation) or another symptom occurs.
The AMR offset function minimizes the error between these pole positions.
Reading this subsection and using the AMR offset function are recommended.

⚠ WARNING
1. The AMR offset is a parameter indicating the phase relationships between the motor magnetic pole position and motor sensor. After the phase relationships are changed due to a cause such as the replacement of the motor sensor or the loading of parameters of another machine, the AMR offset must be adjusted again.
2. If an inappropriate value is set for the AMR offset parameter, after the execution of the AMR offset, the motor may not recognize the correct magnetic pole position, may move unpredictably, and may rotate at a speed higher than the specified speed.

NOTE
This function can be used with 9D53 series C (03) edition or later, 9D70 series B (02) edition or later, 9D80 series B (02) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later, and 9DB0 series A (01) edition or later.

(1) AMR offset function operation

When the AMR offset function is enabled, the spindle amplifier determines the estimated pole position as follows:



<1> After the power is turned on, pole position detection is performed.
"The precision of the estimated pole position" is "the precision of pole position detection." So, the width of the error between the estimated and true pole positions is determined depending on the precision of pole position detection.

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<2> When a rotation command is input, the motor rotates and the estimated pole position is updated using the feedback data of the motor sensor based on the initial pole position determined in step <1>. So, the error of the initial value determined in step <1> is the error of the estimated pole position with no change.

<3> When the AMR offset function is enabled (when bit 6 of parameter No. 4008 is 0 and the value of parameter No. 4084 is the adjustment value and is not 0), the following processing compensates the displacement of the detected pole position above.
When the motor rotates and the one-rotation signal is detected, the estimated pole position is forcibly replaced with AMR offset data (parameter No. 4084). AMR offset processing is executed only when the one-rotation signal is detected for the first time after pole position detection.

(2) Setting of the AMR offset parameters

Set the parameters according to the procedure below.

<1> Set bit 6 (NEGREF) of parameter No. 4008 to 0 and set parameter No. 4084 (AMR offset) to 0.

<2> After performing pole position detection, rotate the motor at about 100 min^{-1} and check the pole position when the one-rotation signal is detected. When the one-rotation signal is detected, data changes from "0" to "the pole position when the one-rotation signal is detected."

(*) Checking the pole position when the one-rotation signal is detected

- On the diagnosis screen :
  Set parameter No. 4532 to 2. The pole position is displayed on diagnosis screen No. 720 (1st spindle). This function may be unavailable depending on the spindle software edition. For details, see Subsection 1.5.5(2), "Parameters related to AMR offset".

<3> The checked pole position contains the detection error. Check the pole position as described in step <2> several times and find the average.

<4> Turn motor excitation off, then set the average found in step <3> in parameter No. 4084.

> ⚠ **WARNING**
> If an inappropriate value is set for the AMR offset (parameter No. 4084), after the execution of the AMR offset, the motor may move unpredictably. So, observe the following rules strictly when setting the parameter:
> - Set the parameter in the emergency stop signal input state.
> - Confirm that the setting is the same as the average found in step <3>.

<5> Turn the power off, then on again and perform pole position detection. Accelerate and decelerate the motor with the forward and reverse rotation commands at about 100 min^{-1}, and check whether the motor rotates normally.

<6> By using the SERVO GUIDE, measure the torque command, actual speed, and the torque command in a constant rotation when acceleration/deceleration operation is performed with the forward (SFR) and reverse (SRV) commands at the maximum speed.

<7> Compare the torque command and actual speed during forward rotation with those during reverse rotation to check whether the AMR offset setting is appropriate. When the acceleration time, deceleration time, and torque command amplitude during forward rotation are almost the same as those during reverse rotation, the AMR offset data setting (parameter No. 4084) is appropriate.

<8> If they are not almost the same, the AMR offset data setting (parameter No. 4084) is inappropriate. In this case, adjust the value of parameter No. 4085 (parameter for checking and fine-adjusting the AMR offset) so that they are almost the same.

<9> After the completion of adjustment, set the following values in parameters Nos. 4084 and 4085:
No.4084 (new) = No.4084 (old) + No.4085 (old)
No.4085 (new) = 0

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> ⚠ **WARNING**
> Observe the following rules strictly when setting the parameters for the same reasons as described in WARNING in step <4>:
> - Set the parameters in the emergency stop signal input state.
> - Confirm that the settings are the same as the values in step <9>.

<10> Turn the power off.

1.5.4 I/O Signals (CNC↔PMC)

(1) Address list of Input signals (PMC→CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G070	G070	MRDYA		SFRA	SRVA				
2nd-	G074	G074	MRDYB		SFRB	SRVB				
1st-	G071	G071							*ESPA	
2nd-	G075	G075							*ESPB	
1st-	G073	G073	EPFSTRA					MPOFA		
2nd-	G077	G077	EPFSTRB					MPOFB		

(2) Details of input signals (PMC→CNC)

This item provides a list of the input signals related to pole position detection only. Also see Section 3.1, "INPUT SIGNALS (PMC→CNC→SP)," in Part IV.

(a) Machine ready signal (MRDYA)

Set this signal to "1" before starting pole position detection.

(b) Forward rotation command signal (SFRA) and reverse rotation command signal (SRVA)

(1) When bit 7 (EPFSIG) of parameter No. 4007 is set to 0:
One of these signals starts pole position detection operation.
Input one of the signals. The velocity command is ignored while the pole position undetected state (EPFIX = 0). However, as soon as EPFIX is set to 1 (the pole position detection completed), the velocity command is accepted to start rotation. Therefore, clear the velocity command during the pole position detection, and input it after the pole position detection is completed.

(2) When bit 7 (EPFSIG) of parameter No. 4007 is set to 1:
When this setting is made, these signals operate not as signals for starting pole position detection, but as those for simply turning excitation on. Before starting pole position detection operation (EPFSTR = 1), input either signal of SFR and SRV.

(c) Emergency stop signal (*ESPA)

Set this signal to "1" before starting pole position detection.

(d) Pole position detection operation start signal (EPFSTRA)

(1) When bit 7 (EPFSIG) of parameter No. 4007 is set to 0:
This signal is disabled. Always set this signal to "0."

(2) When bit 7 (EPFSIG) of parameter No. 4007 is set to 1:
To make the operator concerned with pole position detection operation, this signal can be used together with EPFIX (pole position detection state signal). While this signal is input, the spindle software ignores a command and displays error 30 (on the spindle amplifier (SP)). So, when EPFIX is set to 1, turn this signal off.

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(e) Motor power turn-off signal (MPOFA)

Do not input this signal during pole position detection operation. The motor is not excited and the magnetic pole position cannot be detected.

(3) Address list of output signals (CNC→PMC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F048	F048	EPFIXA							
2nd-	F052	F052	EPFIXB							

(4) Details of output signals (CNC→PMC)

(a) Pole position detection state signal (EPFIXA)

This signal indicates the state of pole position detection.

0 : Pole position undetected
In this state, pole position detection operation is started by a start signal.

1 : Pole position detection completed
This signal is reset to 0 if a spindle alarm indicating the loss of the pole position due to trouble such as a motor sensor disconnection is issued.

If this signal state is indicated using a lamp on the operator's panel, the operator can recognize the pole position detection state.

If any of the following spindle alarms is issued, the spindle amplifier (SP) loses the pole position and turns off the pole position detection state signal (EPFIX = 0).

Spindle alarm Nos. : 01, 24, 25, 26, 31, 37, 65, 73, 90, 91, 92, 132, 133, 134, 139, 140, 141, 142

1.5.5 Related Parameters

(1) Parameters related to pole position detection

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4007	4007	EPFSIG							

EPFSIG Selects a pole position detection start signal.
0 : Uses SFR or SRV as a pole position detection start signal.
1 : Uses EPFSTR as a pole position detection start signal.
Set this parameter to select a desired start signal.

0*i*	30*i*	
4083	4083	Current ratio/motor stop confirmation time in pole position detection operation

The upper two digits (thousands and hundreds) indicate a current ratio in pole position detection, and the lower two digits (tens and ones) indicate a motor stop confirmation time.

Current ratio in pole position detection (upper two digits)
Unit of data : 1%
Valid data range : 0 to 99
Initial setting : Depends on the motor model.
Set the magnitude of a current command value in pole position detection operation as a ratio to the maximum current value.
This parameter is valid in the minute moving method or DC current method.

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Motor stop confirmation time (lower two digits)
Unit of data : 0.1sec
Valid data range : 0 to 99
Initial setting : Depends on the motor model.
Set a period of time for confirming the stop of the motor in DC current method.

NOTE
If pole detection position precision is insufficient for a cause such as friction, the motor output torque may decrease. In such a case, this parameter needs to be adjusted.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4398	4398						SELMET		

SELMET Selects a pole position detection method.
0 : Performs pole position detection in the DC current method.
1 : Performs pole position detection in the minute moving method + stop method (auto select), or in the minute moving method.

Normally, set 1 (auto select or minute moving method).

NOTE
This parameter is valid with 9D53 series C (03) edition or later, 9D70 series B (02) edition or later, 9D80 series B (02) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later, and 9DB0 series A (01) edition or later.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4399	4399		MINUTE		PPSFIL				

MINUTE Selects a pole position detection method.
0 : Minute moving method + stop method (auto select)
1 : Minute moving method

Usually, set this parameter to 1 (minute moving method) to use the function.

NOTE
This parameter is valid with 9D53 series I (09) edition or later, 9D70 series H (08) edition or later, 9D80 series B (02) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later, and 9DB0 series A (01) edition or later.

PPSFIL select velocity feedback for minute moving method of pole position detection
=0: without filter (default)
=1: with filter

For minute moving method of pole position detection of synchronous spindle motor, position detection may not finish when velocity feedback is disturbed by noise impact. In this case, filter velocity feedback
with setting No.4399#4 to "1" may finish position detection.
But if noise is very strong, the detected pole position may not exact, please reduce noise before apply this function.

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NOTE
This parameter is valid with 9D9A series E (05) edition or later, 9DAA series J (10) edition or later, and 9DB0 series J (10) edition or later.

0*i*	30*i*	
4449	4449	**Direction detection current(Current value B)/polarity determination current(Current value C)**

The upper three digits (ten thousands, thousands, and hundreds) indicate a direction detection current, and the lower two digits (tens and ones) indicate a polarity determination current.

Direction detection current (upper three digits)
Unit of data : 1%
Valid data range : 0 to 320
Initial setting : 0
Set a current for pole position direction detection in pole position detection operation. When 0 is set, 100% is set.
This parameter is valid in the stop method.

Polarity determination current (lower two digits)
Unit of data : 1%
Valid data range : 0 to 99
Initial setting : 0
Set a detection current for determining the polarity of the pole position as a ratio to the maximum current value. When 0 is set, 70% is set internally.
This parameter is valid in the stop method.

NOTE
This parameter is valid with 9D53 series C (03) edition or later, 9D70 series B (02) edition or later, 9D80 series B (02) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later, and 9DB0 series A (01) edition or later.

0*i*	30*i*	
4450	4450	**Travel distance allowance magnification/velocity feedback threshold**

The upper three digits (ten thousands, thousands, and hundreds) indicate a travel distance allowance magnification, and the lower two digits (tens and ones) indicate a velocity feedback threshold.

Travel distance allowance magnification (upper three digits)
Unit of data : 1%
Valid data range : 0 to 200
Initial setting : 0
Set a travel distance allowance magnification. Set a ratio relative to a machine angle of 5 deg assumed to be 100%. When 0 is set, 100% (machine angle of 5 deg) is set internally.
This parameter is valid in the minute moving method.

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Velocity feedback threshold (lower two digits)
Unit of data : 1%
Valid data range : 0 to 99
Initial setting : 0

Set a velocity feedback threshold for determining the stop of the motor, assuming 100% = 110 min^{-1}. When 0 is set, 10% (11 min^{-1}) is set internally.
This parameter is valid in the minute moving method.

NOTE
This parameter is valid with 9D53 series C (03) edition or later, 9D70 series B (02) edition or later, 9D80 series B (02) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later, and 9DB0 series A (01) edition or later.

(2) Parameters related to AMR offset

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4008	4008		NEGREF						

NEGREF Sets whether to use a one-rotation signal of the motor sensor as reference pole position data.
0 : Uses the one-rotation signal position of the motor sensor as reference pole position data.
1 : Does not use the one-rotation signal position of the motor sensor as reference pole position data.

When this parameter is set to "1," the spindle amplifier operates based on the initial pole position detected by pole position detection operation regardless of the one-rotation signal position of the motor sensor.
Usually, set this parameter to 0 (uses the AMR offset function) to use the spindle amplifier.

0*i*	30*i*	
4084	4084	AMR offset

Unit of data : 1 pulse (8192 pulses = electric angle 360 deg)
Valid data range : 0, 1 to 8192
Initial setting : 0

Set an AMR offset.
This parameter is valid when bit 6 (NEGREF) of parameter No. 4008 is set to 0. Set an adjustment value to this parameter. When this parameter is set to 0, the AMR offset function is disabled. When setting 0 pulse as an AMR offset, set 8192.
See Subsection 1.5.3, "AMR Offset Function", in Part IV, and adjust this parameter for each motor.

⚠ CAUTION
1 This parameter needs to be adjusted for individual motors. If parameters for another machine are loaded, clear and adjust this parameter after loading the parameters.
2 This parameter indicates the phase relationships between the motor and motor sensor. After the phase relationships are changed due to a cause such as the replacement of the motor sensor, adjust the AMR offset again.

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NOTE
1 This parameter is valid with 9D53 series C (03) edition or later, 9D70 series B (02) edition or later, 9D80 series B (02) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later, and 9DB0 series A (01) edition or later.
2 When the spindle software edition is earlier than the editions above, set this parameter to 0.

0*i*	30*i*	
4085	4085	**AMR offset adjustment value**

Unit of data : 1 pulse (8192 pulses = electric angle 360 deg)
Valid data range : -300 to +300 (electric angle: -13.2deg to +13.2deg)
Initial setting : 0

This parameter is used to adjust the AMR offset. The pole position can be shifted by the specified number of pulses.
After execution of the AMR offset, check the torque command and actual speed during forward rotation/backward rotation at the same speed, and adjust this value so that the same acceleration time and deceleration time are achieved by the same torque command and that the torque commands during constant rotation are almost the same.

⚠ CAUTION
1 After the adjustment with this parameter, change the following parameters in the emergency stop state:
2 Add the adjusted value of parameter No. 4085 to the setting of parameter No. 4084, and set the obtained value for parameter No. 4084 as the new AMR offset value.
3 After setting parameter No. 4084 again, set parameter No. 4085 to "0".
4 Turn the power off, then on again.

NOTE
1 This parameter is valid with 9D53 series C (03) edition or later, 9D70 series B (02) edition or later, 9D80 series B (02) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later, and 9DB0 series A (01) edition or later.
2 When the spindle software edition is earlier than the editions above, set this parameter to 0.

0*i*	30*i*	
4532	4532	**Arbitrary data output function number**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0

Set this parameter to 2 when an AMR offset candidate value is to be checked on the diagnosis screen of the CNC. An AMR offset candidate value (pole position corresponding to a one-rotation signal position counted relative to the pole detection position) can be checked with the following numbers on the diagnosis screen of the CNC:

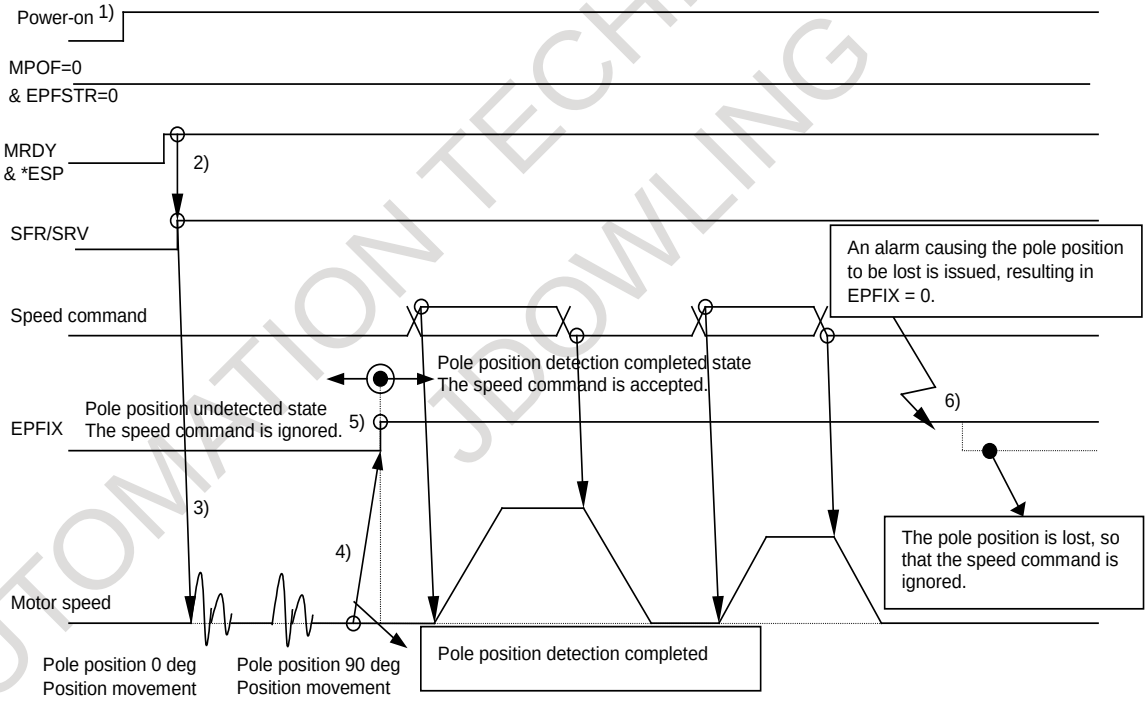
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	Diagnosis No. (0*i*-D)	Diagnosis No. (30*i*)
1st spindle	720	720
2nd spindle	721	720
3rd spindle	740	720
4th spindle	741	720

NOTE
1 When this function is used, the following combinations of spindle software and CNC software must be used:
For spindle software 9D70 series E edition or later and 9D80 series B edition or later
FS30*i* /300*i* /300*i*s-A : G002/G012/G022 series F (6.0) edition or later
FS31*i* /310*i* /310*i*s-A5 : G121/G131 series F (6.0) edition or later
FS31*i* /310*i* /310*i*s-A : G101/G111 series F (6.0) edition or later
FS32*i* /320*i* /320*i*s-A : G201 series F (6.0) edition or later

1.5.6 Sequence

(1) When SFR or SRV is used as a start signal (Parameter No.4007#7:EPFSIG=0)



When SFR or SRV is input in the pole position undetected state (EPFIX = 0), pole position detection starts, ignoring the speed command. The speed command is enabled after pole position detection is completed (EPFIX = 1). Do not input MPOF (motor power turn-off signal) and EPFSTR (pole position detection operation start signal).

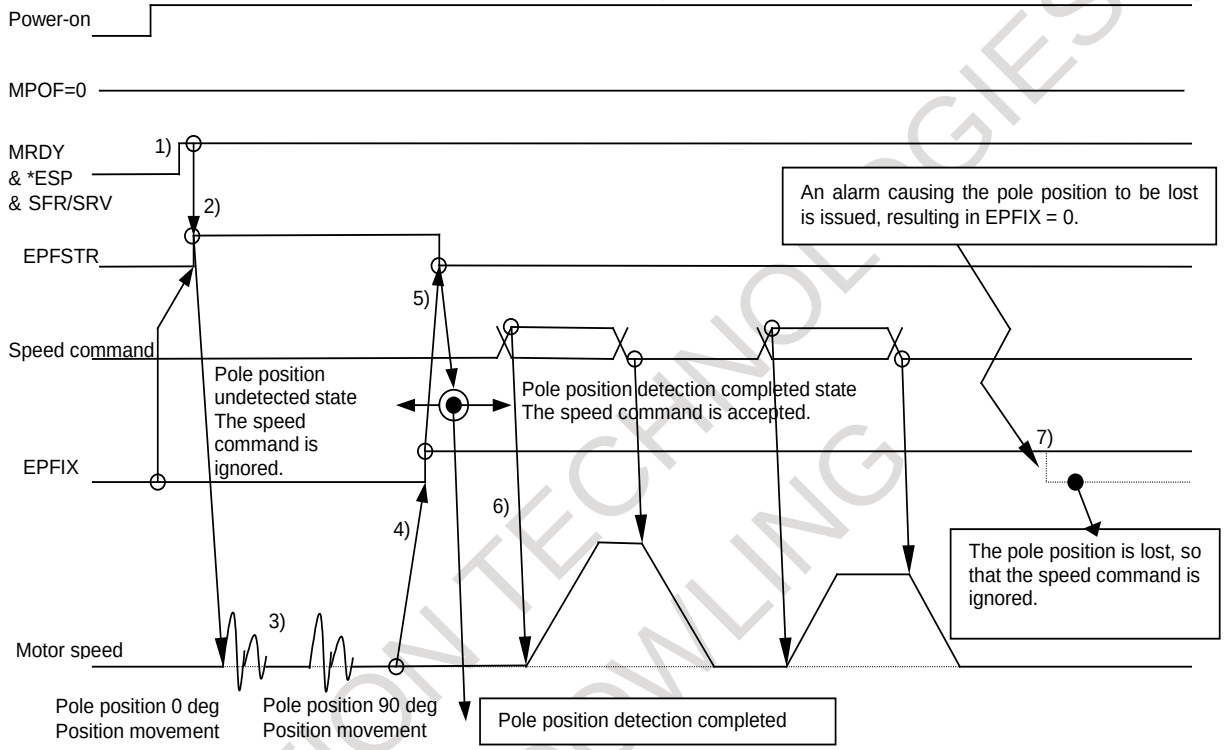
(1) After turning on the power, the operator is to make a preparation to activate the motor.
(2) Upon completion of preparation, set SFR (or SRV) to 1.
(3) In the pole position undetected state (EPFIX = 0), magnetic pole detection automatically starts.
(4) When pole position detection operation is started, the motor moves to the pole position 0 deg position then moves to and stops at the pole position 90 deg position (machine angle 90 deg/pole-pair), determining the pole position. (DC current method)

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(5) When the pole position is determined, the motor enters the pole position detection completed state (EPFIXA = 1), which allows the motor to drive. If a command is kept input during pole position detection, the motor starts rotating at the same time the pole position is determined. The operator may feel that this motion is unpredictable. So, provide interlock so that rotation and other commands cannot be input in the pole position undetected state (EPFIX = 0).

(6) If a spindle alarm that causes the pole position to be lost is issued, the pole position undetected state (EPFIX = 0) is set. When specifying the next rotation command, start all over again from the beginning of the sequence.

(2) When EPFSTR is used as a start signal (Parameter No.4007#7:EPFSIG=1)



It is assumed that the pole position determination state signal EPFIX and the pole position determination operation start signal EPFSTR correspond to a lamp and button on the operator's panel. Do not input MPOF (motor power turn-off signal) during pole position detection operation.

(1) The operator recognizes EPFIX = 0 (the lamp turned off on the operator's panel) then makes a preparation for pole position detection operation.

(2) Upon completion of preparation, set EPFSTR = 1 (turn on the button on the operator's panel) to start pole position determination operation.

(3) The motor moves to the pole position 0 deg position then moves to and stops at the pole position 90 deg position (machine angle 90 deg/pole-pair), determining the pole position.

(4) Upon pole position determination, EPFIX = 1 is set (the lamp on the operator's panel is turned on).

(5) The operator recognizes the completion of pole position detection operation and set EPFSTR to 0 (turns the button on the operator's panel off).

(6) When EPFSTR is set to 0, the speed command can be accepted. Confirm that the spindle amplifier is in the pole position detection completed state (EPFIX = 1) and EPFSTR is set to 0 before inputting a rotation or move command.

(7) If a spindle alarm that causes the pole position to be lost is issued, EPFIX = 0 is set (the lamp on the operator's panel is turned off). In this case, start all over again from the beginning of the sequence.

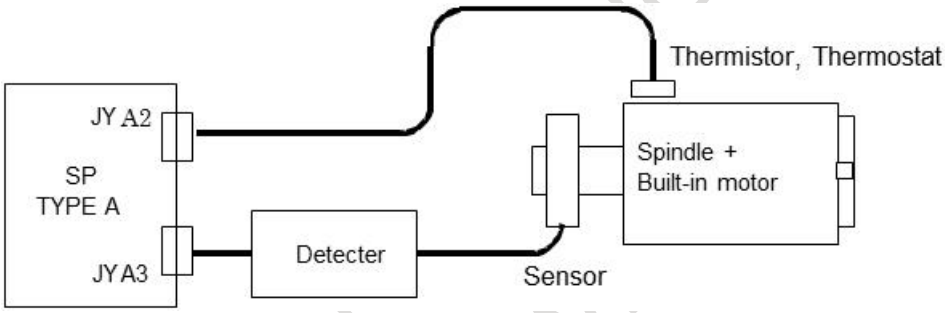
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1.5.7 To omit pole position detection for synchronous spindle motor after power on

When the following sensor (position of one-rotation signal fixed after power-on) are used for synchronous spindle motor and AMR offset parameters are set (No.4008#6=0 & No.4084≠0), to omit pole position detection is possible. In this case pole position fixed automatically and position detection signal (F048#07 : EPFIX) is set to 1. Please confirm this signal before rotation command is input.
But pole position detection is necessary before AMR offset parameters are set.

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RCN2390F
RCN2590F
RCN5390F
RCN5590F
RCN8390F
RCN8590F

Applicable System configuration and parameters setting



Parameter	Setting	Contents
4008#6	0	Uses the AMR offset function (Case of =1, not used)
4084	Tuning value	AMR offset
4002 #3,2,1,0	0,0,0,1	Uses the motor sensor for position feedback
4010 #2,1,0	0,1,1	Serial sensor
4011 #2,1,0	0,0,0	Gear teeth number of the motor sensor
4056~4059	100	Gear ratio between the spindle and motor 1: 1
4334	8192	Arbitrary number of motor sensor teeth
4547#5	1	Gets the temperature data from JYA2
4548#0	1	Absolute sensor

NOTE
This parameter is valid with 9D9A series E (05) edition or later, 9DAA series J (10) edition or later, and 9DB0 series J (10) edition or later.

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1.5.8 Causes of Spindle Alarm 65

If pole position detection fails, spindle alarm 65 is issued. This alarm may be issued for the causes listed below. If spindle alarm 65 is issued, check the following:

(1) Any of the following parameters is set incorrectly:
No.4011#2,#1,#0,No.4334 (Number of teeth of the motor sensor)
No.4011#7,#3,No.4368 (Number of motor poles)
(2) The activation current ratio in pole position detection is small so that friction impedes movement.
If spindle alarm 65 is issued for this cause, increase the value of the upper three digits (activation current ratio) of parameter No. 4083.
(3) The motor stop confirmation time (lower two digits of parameter No. 4083) is too short.
The motor vibrates when it stops. So, if the set value is too small, an incorrect magnetic pole position is recognized. A sufficiently long time is needed to confirm the stop of the motor.
(4) Motor feedback signal counting is performed incorrectly for a cause such as noise.
(5) The motor is mechanically held and cannot move.
(6) The motor power line is not connected. (Alternatively, the magnetic contactor is off if it is installed between the spindle amplifier and motor.)
(7) The motor power line phase order does not match the motor feedback signal connection phase order.

1.5.9 Cautions

> ⚠ **CAUTION**
> This subsection provides notes on magnetic pole detection. For safety, carefully follow the notes described in this subsection.

(1) After the power is turned on or an alarm that causes the pole position to be lost is issued, pole position detection needs to be performed.
(2) In both the DC current method and the minute moving method, pole position detection is performed while the motor moves. For this reason, pole position detection is disabled in the motor locked state. So, perform pole position detection when the motor can move.
(3) If the precision of pole position detection is poor, the motor output torque is small.
(4) If pole position detection is not completed, all input rotation and move commands are ignored. However, those commands become valid upon completion of pole position detection. So, if an input command is left uncleared in the pole position undetected state, the motor abruptly rotates upon completion of pole position detection, resulting in a dangerous situation. Prepare such a sequence that commands are input after the pole position determination state signal (F048#7 (EPFIXA)) set to 1 is confirmed.

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2 EXPLANATION OF OPERATION MODES

2.1 VELOCITY CONTROL MODE

2.1.1 Start-up Procedure

For this subsection, see Subsection 2.1.1, “Start-up Procedure”, in Part I.

2.1.2 Overview

For this subsection, see Subsection 2.1.2, “Overview”, in Part I.

2.1.3 System Configuration

The velocity control mode is applicable to all detector configurations. For system configurations, see Subsection 1.3.4, “Typical Detector Configurations”, in Part III.

2.1.4 List of I/O Signals (CNC↔PMC)

For this subsection, see Subsection 2.1.4, “List of I/O Signals (CNC↔PMC)”, in Part I.

2.1.5 Related Parameters

Parameter No.		Description
0*i*	30*i*	
3705#0	3705#0	Sets SF signal output and the S code for an S command.
3705#2	3705#2	Gear switch method (M series only)
3705#4	3705#4	Sets SF signal output and the S code for an S command (T series only).
3705#5	3705#5	Sets SF signal output when constant surface speed control is exercised and an S code is specified (M series only).
3705#6	3705#6	Sets SF signal output (M series only).
3706#4	3706#4	Spindle gear selection method (M series only)
3706#7,6	3706#7,6	Spindle speed command polarity (valid when input signal SSIN = 0)
3709#0	3709#0	Number of sampling operations at spindle speed calculation time
3735	3735	Minimum clamp speed of the spindle motor (M series only)
3736	3736	Maximum clamp speed of the spindle motor (M series only)
3740	3740	Time until the spindle speed arrival signal is checked
3741	3741	Maximum spindle speed for gear 1
3742	3742	Maximum spindle speed for gear 2
3743	3743	Maximum spindle speed for gear 3
3744	3744	Maximum spindle speed for gear 4 (T series only)
3751	3751	Spindle motor speed at the switch point between gear 1 and gear 2 (M series only)
3752	3752	Spindle motor speed at the switch point between gear 2 and gear 3 (M series only)
3772	3772	Maximum allowable spindle speed
3031	3031	Allowable number of S code characters
3720	3720	Number of position coder pulses
3721	3721	Number of gear teeth on the position coder side on velocity control (for feed per revolution, threading, etc.)
3722	3722	Number of gear teeth on the spindle side on velocity control (for feed per revolution, threading, etc.)

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Parameter No.		Description
0*i*	30*i*	
4006#5	4006#5	Sets an analog override range.
4009#4	4009#4	Whether to output the load detection signals (LDT1, LDT2) during acceleration/deceleration
4009#6	4009#6	Analog override type
4012#6	4012#6	Sets whether to drive the synchronous built-in spindle motor. (Set “1”.)
4012#7	4012#7	Sets the spindle HRV function. (Set “1”.)
4019#7	4019#7	Automatic spindle parameter setting function
4352#1	4352#1	Sets the peak hold function for load meter output.
4020	4020	Maximum motor speed
4022	4022	Speed arrival detection level
4023	4023	Speed detection level
4024	4024	Speed zero detection level
4025	4025	Torque limitation value.
4026	4026	Load detection level 1
4027	4027	Load detection level 2
4030	4030	Soft start/stop setting time
4040 4041	4040 4041	Velocity loop proportional gain on the velocity control mode (A parameter is selected by the PMC input signal CTH1A.)
4048 4049	4048 4049	Velocity loop integral gain on the velocity control mode (A parameter is selected by the PMC input signal CTH1A.)
4056 to 4059	4056 to 4059	Spindle and motor gear ratio data (A parameter is selected by the PMC input signals CTH1A and CTH2A.)
4081	4081	Delay time until the motor power is turned off
4082	4082	Sets an acceleration/deceleration time.
4508	4508	Rate of change in acceleration at soft start/stop.
4519	4519	Bell-shaped acceleration/deceleration time constant for soft start/stop

NOTE
1 For the detector-related parameters, see Section 1.3, “PARAMETERS RELATED TO DETECTORS”, in Part III.
2 For velocity loop proportional/integral gain adjustment, see Section 4.1, “VELOCITY LOOP GAIN ADJUSTMENT”, in Part III.

2.1.6 Details of Related Parameters

This subsection details the serial spindle parameters (in the four thousands) among the parameters related to the velocity control mode. For details of other parameters, refer to “SPINDLE SPEED CONTROL” of the Connection Manual (Function) of each CNC.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4006	4006			ALGOVR					

ALGOVR Sets a spindle analog override range.
0 : 0 to 100% (initial setting value)
1 : 0 to 120%

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4008	4008			SSMUSE					

SSMUSE Sets whether to use the sub module SM (SSM).
0 : Does not use the sub module SM.
1 : Uses the sub module SM.

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NOTE
To use the B*i*S series spindle motor safely, be sure to connect the SSM and set SSMUSE to “1”.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4009	4009		OVRTYP		LDTOUT				

LDTOUT Whether to output the load detection signals (LDT1 and LDT2) during acceleration/deceleration
0 : Not output during acceleration/deceleration. (initial setting value)
1 : Output (at all times) during acceleration/deceleration if the parameter-set level is exceeded.

OVRTYP Analog override type
0 : Override of linear function type (initial setting value)
1 : Override of quadratic function type

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4012	4012	SPHRV	SYSP						

SYSP Sets whether to drive the synchronous built-in spindle motor.
0 : Enables inductive spindle motor driving. (initial setting value)
1 : Enables synchronous built-in spindle motor driving.
Set to “1”.

SPHRV Sets the spindle HRV control function.
0 : Disables spindle HRV control.
1 : Enables spindle HRV control. (initial setting value)
Set to “1”.

NOTE
When driving the B*i*S series spindle (synchronous built-in spindle motor), be sure to set both of the SYSP and SPHRV bits to 1.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4019	4019	PRLOAD							

PRLOAD Automatic parameter setting function
0 : Does not perform automatic parameter setting. (initial setting value)
1 : Performs automatic parameter setting.
After setting a desired motor model code in parameter No. 4133 and setting this bit to 1, turn off the power to the CNC, then turn on the power to the CNC again. The parameters (No. 4000 to No. 4175) for the α*i* series spindle corresponding to the model code are automatically initialized. Upon completion of automatic setting, this bit is automatically set to 0.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4352	4352							PKHALW	

PKHALW Sets the peak hold function for load meter output.
0 : Does not use the peak hold function. (initial setting value)
1 : Uses the peak hold function.

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0*i*	30*i*	
4020	4020	**Maximum motor speed**

Unit of data : $1min^{-1}$
Valid data range : 0 to 32767
Initial setting : Depends on the motor model.
This parameter sets a maximum spindle motor speed.

> ⚠ **WARNING**
> The spindle motor may rotate at the maximum spindle motor speed specified by this parameter. Therefore, this parameter must not be set to a value greater than the maximum rotation speed indicated by the specification of the spindle motor.

0*i*	30*i*	
4022	4022	**Speed arrival detection level**

Unit of data : 0.1%
Valid data range : 0 to 1000
Initial setting : 150
This parameter sets a speed arrival signal (SARA) detection range.
When the motor speed reaches within ±(setting data/10)% of a specified speed, the speed arrival signal (SARA) is set to 1.

0*i*	30*i*	
4023	4023	**Speed detection level**

Unit of data : 0.1%
Valid data range : 0 to 1000
Initial setting : 30
This parameter sets a speed detection signal (SDTA) detection range.
When the motor speed is (setting data/10)% of a maximum speed or less, the speed detection signal (SDTA) is set to 1.

0*i*	30*i*	
4024	4024	**Speed zero detection level**

Unit of data : 0.01%
Valid data range : 0 to 10000
Initial setting : 75
This parameter sets a speed zero detection signal (SSTA) detection range.
When the motor speed is (setting data/100)% of a maximum speed or less, the speed zero detection signal (SSTA) is set to 1.

> **NOTE**
> If a calculated speed zero detection level exceeds 200 min^{-1}, the speed zero detection level is clamped to 200 min^{-1}. (9D53 series B (02) edition or later, 9D70 series A (01) edition or later, 9D80 series B (02) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later, and 9DB0 series A (01) edition or later)

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0*i*	30*i*	
4025	4025	**Torque limitation value.**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 50

This parameter sets a torque limitation value to be applied when the torque limitation command HIGH (TLMHA) or the torque limitation command LOW (TLMLA) is specified.
The data indicates limitation values when the maximum torque is 100%.

Torque limitation command LOW (TLMLA)	Torque limitation command HIGH (TLMHA)	Description
0	0	No torque limitation is imposed.
0	1	The torque is limited to the value set in this parameter.
1	0	The torque is limited to a half of the value set in this parameter.
1	1	

0*i*	30*i*	
4026	4026	**Load detection level 1**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 83

This parameter sets a load detection signal 1 (LDT1A) detection range.
When the output of the spindle motor is (setting data)% of the maximum output or more, load detection signal 1 (LDT1A) is set to 1.

0*i*	30*i*	
4027	4027	**Load detection level 2**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 95

This parameter sets a load detection signal 2 (LDT2A) detection range.
When the output of the spindle motor is (setting data)% of the maximum output or more, load detection signal 2 (LDT2A) is set to 1.

NOTE
By default, this signal is not output in 10 seconds (set in parameter No. 4082) after the status of the speed command signal changes so that Load detection signal cannot be output by load of acceleration and deceleration. If the default time (No.4082) is not suited with the real acceleration and deceleration time, please refer to explanation of the parameter No.4082 and modify the value.
If “1” is set to the parameter No.4009#4, Load detection signal is always output when load meter is beyond set level instead of the acceleration and deceleration.

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0*i*	30*i*	
4030	4030	**Soft start/stop setting time**

Unit of data : $1min^{-1}$/sec
Valid data range : 0 to 32767
Initial setting : 0
This parameter sets an acceleration value (speed change rate) when the soft start/stop function is enabled (when the soft start/stop signal SOCNA = 1).

NOTE
When 0 is set, the soft start/stop function is disabled.

0*i*	30*i*		
4040	4040	**Velocity loop proportional gain on velocity control mode (HIGH)**	**CTH1A=0**
4041	4041	**Velocity loop proportional gain on velocity control mode (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10
This data is used to set the velocity loop proportional gain on velocity control mode.
When the input signal CTH1A = 0, (HIGH) is selected. When the input signal CTH1A = 1, (LOW) is selected.

0*i*	30*i*		
4048	4048	**Velocity loop integral gain on velocity control mode (HIGH)**	**CTH1A=0**
4049	4049	**Velocity loop integral gain on velocity control mode (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10
This data is used to set the velocity loop integral gain on velocity control mode.
When the input signal CTH1A = 0, (HIGH) is selected. When the input signal CTH1A = 1, (LOW) is selected.

0*i*	30*i*		
4056	4056	**Gear ratio (HIGH)**	**CTH1A=0, CTH2A=0**
4057	4057	**Gear ratio (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4058	4058	**Gear ratio (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4059	4059	**Gear ratio (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : (Motor rotation for one rotation of spindle) / 100
(When parameter No. 4006 #1 (GRUNIT) is 1, motor rotation / 1000)
Valid data range : 0 to 32767
Initial setting : 100
These data are used to set the gear ratio between spindle and spindle motor.
Usually, set 100.

NOTE
When an improper value is set in these parameters, an unexpected operation can occur. For example, the spindle can continue rotating without stopping at the time of orientation. So, be sure to set a proper gear ratio.

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0*i*	30*i*	
4081	4081	**Delay time until the motor power is turned off**

Unit of data : 10ms
Valid data range : 0 to 1000
Initial setting : 20(200ms)

This parameter sets a period of time from the stop of the motor (detection of the speed zero detection signal SSTA set to 1) until the power to the motor is turned off if the SFR/SRV signal is off.

NOTE
When a small value is set in this parameter, the motor can coast after the power to the motor is turned off.

0*i*	30*i*	
4082	4082	**Setting of acceleration/deceleration time**

Unit of data : 1sec
Valid data range : 0 to 255
Initial setting : 10

This parameter sets a period of time in which alarm detection is disabled by assuming that the spindle motor is being accelerated or decelerated even if the velocity error exceeds the velocity error excess alarm (spindle alarm 02) level after start of acceleration/deceleration on the velocity control mode.
In the velocity control mode, a step-by-step speed command is specified. So, the spindle motor cannot follow up the command immediately after start of acceleration/deceleration, and the velocity error exceeds the velocity error excess alarm level. This parameter is used to prevent the velocity error excess alarm (spindle alarm 02) from being detected incorrectly immediately after start of acceleration/deceleration.

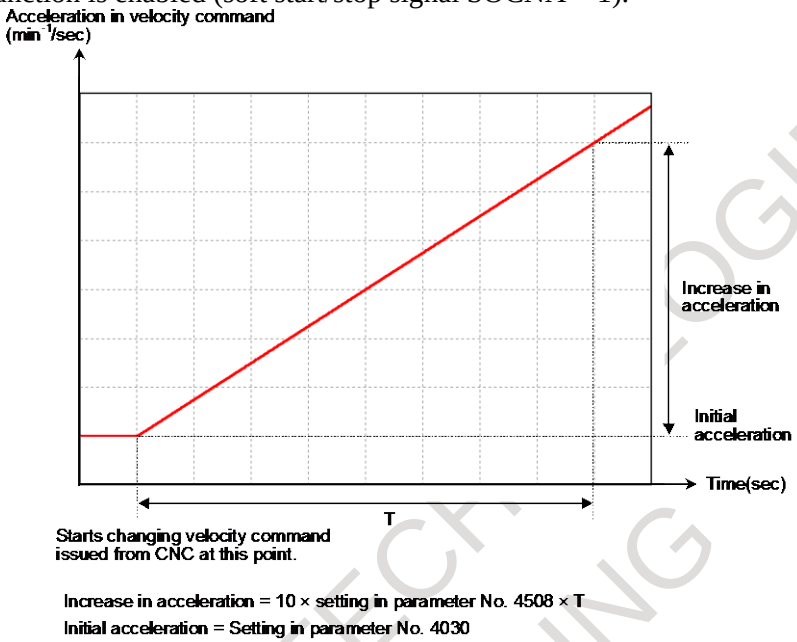
NOTE
With a machine tool such as a lathe that has a large load inertia, the acceleration/deceleration time becomes longer. In such a case, set the value corresponding to the acceleration/deceleration time of the machine in this parameter.

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0*i*	30*i*	
4508	4508	**Rate of change in acceleration at soft start/stop**

Unit of data : $10min^{-1}/sec^{2}$
Valid data range : 0 to 32767
Initial setting : 0

This parameter sets the jerk (the rate of change in acceleration) when the soft start/stop function is enabled (soft start/stop signal SOCNA = 1).



NOTE
1 This parameter is valid with 9D53 series B (02) edition or later, 9D70 series A (01) edition or later, 9D80 series B (02) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later, and 9DB0 series A (01) edition or later.
2 If 0 is set, a liner type velocity command is observed when the soft start/stop function is enabled.

0*i*	30*i*	
4519	4519	**Bell-shaped acceleration/deceleration time constant for soft start/stop**

Unit of data : 1msec
Valid data range : 0 to 512
Initial setting : 0

This parameter sets the bell-shaped acceleration/deceleration time constant when the soft start/stop function is used (parameter No. 4030≠0, SOCN = 1).

This parameter can be set to enable bell-shaped acceleration/deceleration for soft start/stop.

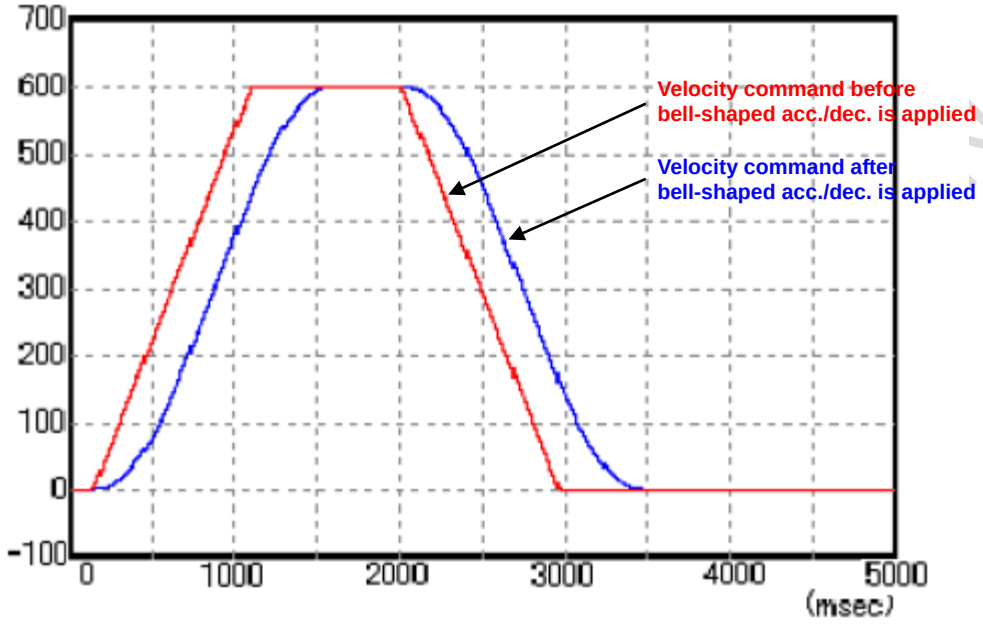
This parameter is useful for reducing a shock at the start or end of acceleration/deceleration in the velocity control mode.

If a specified value exceeds the valid data range, the value is clamped to 512.

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■Application example

No.4030=600(min-1/sec)、No.4519=512



NOTE
*1 This parameter is valid with 9D53 series G (07) edition or later, 9D70 series F (06) edition or later, 9D80 series A (01) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later and 9DB0 series A (01) edition or later.
2 If 0 is set, a liner type velocity command is observed when the soft start/stop function is enabled.

2.1.7 Troubleshooting

For this subsection, see Subsection 2.1.7, “Troubleshooting”, in Part I.

2.2 POSITION CODER METHOD SPINDLE ORIENTATION (OPTIMUM ORIENTATION) (OPTIONAL FUNCTION)

2.2.1 Start-up Procedure

For this subsection, see Subsection 2.2.1, “Start-up Procedure”, in Part I.

2.2.2 Overview

For this subsection, see Subsection 2.2.2, “Overview”, in Part I.

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⚠ CAUTION

*1 When driving the B*i*S series spindle (synchronous built-in spindle motor), **parameter No.4084** is used for AMR offset function. (The parameter isn't the motor voltage for spindle orientation)
Be sure that if an inappropriate value is set for the AMR offset, the motor may move unpredictably.

*2 For an explanation of AMR offset function, see Subsection 1.5.3, "AMR Offset Function", in Part III.

2.2.3 Transition from Conventional Method Orientation to Optimum Orientation

For this subsection, see Subsection 2.2.3, "Transition from Conventional Method Orientation to Optimum Orientation", in Part I.

2.2.4 Feature

For this subsection, see Subsection 2.2.4, "Feature", in Part I.

2.2.5 Block Diagram

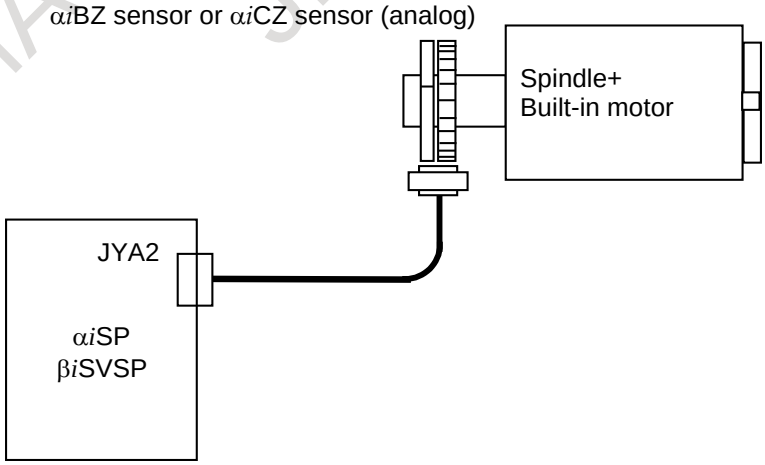
For this subsection, see Subsection 2.2.5, "Block Diagram", in Part I.

2.2.6 System Configuration

The system configurations that enable the use of the position coder method orientation function are shown below.

(1) When the α*i*BZ sensor or α*i*CZ (analog) sensor is used

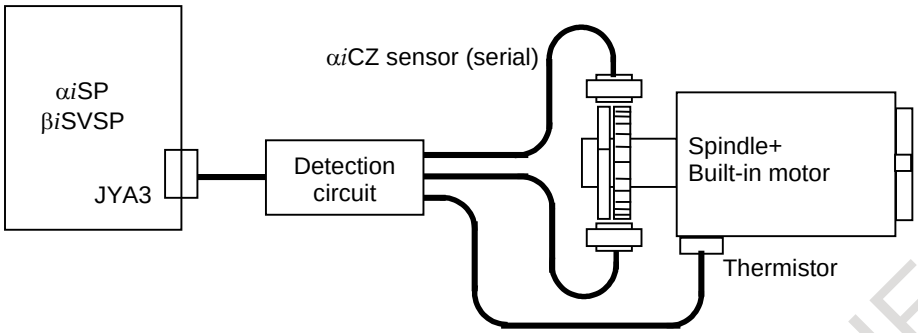
[Sample system configuration]



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(2) When the α*i*CZ (serial) sensor is used

[Sample system configuration]



2.2.7 Stop Position Specification Method

For this subsection, see Subsection 2.2.7, “Stop Position Specification Method”, in Part I.

2.2.8 I/O Signals (CNC↔PMC)

For this subsection, see Subsection 2.2.8, “I/O Signals (CNC↔PMC)“, in Part I.

2.2.9 Examples of Sequences

For this subsection, see Subsection 2.2.9, “Examples of Sequences”, in Part I.

2.2.10 Explanation of Operation

For this subsection, see Subsection 2.2.10, “Explanation of Operation”, in Part I.

2.2.11 Related Parameters

For this subsection, see Subsection 2.2.11, “Related Parameters”, in Part I.

2.2.12 Details of Related Parameters

For this subsection, see Subsection 2.2.12, “Details of Related Parameters”, in Part I.

2.2.13 Tuning Procedure

For this subsection, see Subsection 2.2.13, “Tuning Procedure”, in Part I.

2.2.14 Adjusting the Orientation Stop Position Shift Parameter

For this subsection, see Subsection 2.2.14, “Adjusting the Orientation Stop Position Shift Parameter”, in Part I.

2.2.15 Supplementary Descriptions

For this subsection, see Subsection 2.2.15, “Supplementary Descriptions”, in Part I.

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2.3 RIGID TAPPING (OPTIONAL FUNCTION)

2.3.1 Start-up Procedure

For this subsection, see Subsection 2.3.1, “Start-up Procedure”, in Part I.

2.3.2 Overview

For this subsection, see Subsection 2.3.2, “Overview”, in Part I.

2.3.3 FSSB High-speed Rigid Tapping

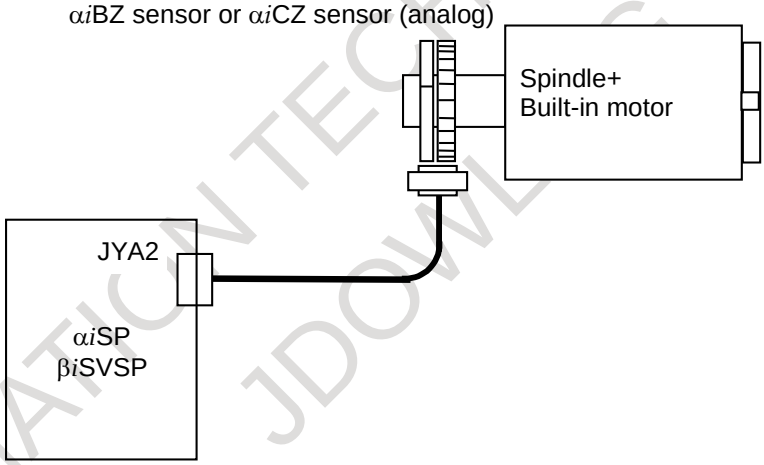
For this subsection, see Subsection 2.3.3, “FSSB High-speed Rigid Tapping”, in Part I.

2.3.4 System Configuration

The system configurations that enable the use of rigid tapping are shown below.

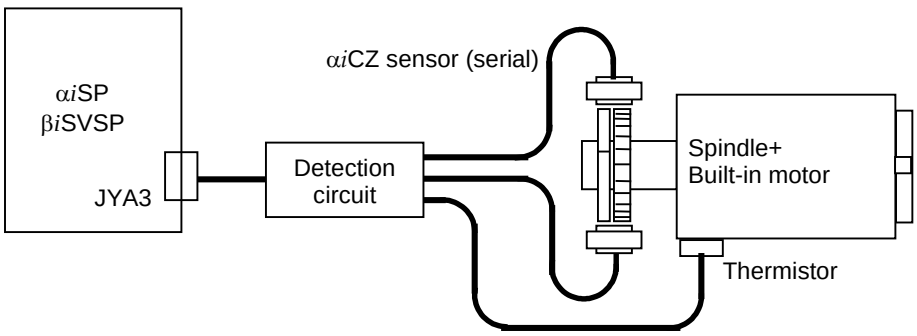
(1) When the α*i*BZ sensor or α*i*CZ sensor (analog) is used

[Sample system configuration]



(2) When the α*i*CZ sensor (serial) is used

[Sample system configuration]



2.3.5 List of I/O Signals (CNC↔PMC)

For this subsection, see Subsection 2.3.5, “List of I/O Signals (CNC↔PMC)”, in Part I.

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2.3.6 Sequence

For a rigid tapping sequence, refer to “RIGID TAPPING” of the Connection Manual (Function) of each CNC.

2.3.7 Related Parameters

Parameter No.		Description
0*i*	**30*i***	
5210	5210	M code of rigid tapping command
5202#0 (M series only)	5202#0	Whether to perform orientation (reference position return) when starting rigid tapping
3720	3720	Number of pulse of the position coder
5221 5222 5223 5224	5221 5222 5223 5224	Teeth number of spindle side at arbitrary gear ratio (command) setting (No. 5224 is used for the T series only.)
5231 5232 5233 5234	5231 5232 5233 5234	Teeth number of position coder side at arbitrary gear ratio (command) setting (No. 5234 is used for the T series only.)
5280 5281 to 5284	5280 5281 to 5284	Position gain of tapping axis at rigid tapping (No. 5284 is used for the T series only.)
5241 5242 5243 5244	5241 5242 5243 5244	Spindle maximum speed at rigid tapping (No. 5244 is used for the T series only.)
5261 5262 5263 5264	5261 5262 5263 5264	Acc./Dec. time constant (No. 5264 is used for the T series only.)
5200#4	5200#4	Override selection at extracting
5211	5211	Override value at extracting
5201#2 5271 to 5274	5201#2 5271 to 5274	Time constant at extracting (No. 5274 is used for the T series only.)
5203#2	5203#2	Feed-forward function at rigid tapping
5300	5300	In-position width of tapping axis
5301	5301	In-position width of spindle
5310	5310	Allowable level of position error of tapping axis at moving
5311	5311	Allowable level of position error of spindle at moving
5312	5312	Allowable level of position error of tapping axis at stop
5313	5313	Allowable level of position error of spindle at stop
5321 5322 to 5324	5321 5322 to 5324	Backlash of spindle (No. 5324 is used for the T series only.)
5365 5366 5367 5368	5365 5366 5367 5368	Bell-shaped acceleration/deceleration time constant on rigid tapping (No. 5368 is used for the T series only.)
4000#4	4000#4	Reference position return direction on servo mode
4002#5	4002#5	Whether to enable the rotation direction signal (SFR/SRV) on servo mode
4006#7	4006#7	Setting of the command arbitrary gear ratio function (CMR) on rigid tapping
4017#7	4017#7	Shortcut function when orientation is specified in the stop state
4037	4037	Velocity loop feed-forward coefficient
4044 4045	4044 4045	Velocity loop proportional gain on servo mode/spindle synchronous control (It is selected by input signal CTH1A/B.)

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Parameter No.		Description
0*i*	**30*i***	
4052 4053	4052 4053	Velocity loop integral gain on servo mode/spindle synchronous control (It is selected by input signal CTH1A/B.)
4056 to 4059	4056 to 4059	Gear ratio between spindle and motor (It is selected by input signal CTH1A or CTH2A)
4065 to 4068	4065 to 4068	Spindle position gain on servo mode/spindle synchronous control (It is selected by input signal CTH1A or CTH2A)
4073	4073	Grid shift amount on servo mode
4074	4074	Reference position return speed on Cs contouring control/servo mode
4091	4091	Position gain change ratio at reference position return time on servo mode
4344	4344	Advanced preview feed-forward coefficient
4406	4406	Acceleration/deceleration time constant for reference position return on Cs contouring control mode/servo mode
4542#4	4542#4	Cutting feed/rapid traverse feed-forward function
4549#1	4549#1	Setting of FSSB high-speed rigid tapping
4627 (*)	4627 (*)	Advanced preview feed-forward coefficient for cutting feed * This parameter is valid when bit 4 of parameter No. 4542 is 1.

NOTE
1 For the parameters related to detectors, see Section 1.3, “PARAMETERS RELATED TO DETECTORS” in the Part I.
2 For velocity loop proportional/integral gain adjustment, see Section 4.1, “VELOCITY LOOP GAIN ADJUSTMENT”, in Part I.

2.3.8 Details of Related Parameters

This subsection details the serial spindle parameters (in the four thousands) among the parameters related to rigid tapping. For details of other parameters, refer to “RIGID TAPPING” of the Connection Manual (Function) of each CNC.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4000	4000				**RETSV**				

RETSV Reference position return direction on servo mode (rigid tapping/spindle positioning)
0 : The spindle performs a reference position return operation in the CCW(counterclockwise) direction.
1 : The spindle performs a reference position return operation in the CW(clockwise) direction.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4002	4002			**SVMDRT**					

SVMDRT Whether to enable the rotation direction signal (SFR/SRV) function on servo mode (rigid tapping/spindle positioning)
0 : Enables the rotation direction function.
If a move command from the CNC is positive (+),
(a) The spindle rotates in the CCW direction when the input signal SFR (bit 5 of G70) = 1.
(b) The spindle rotates in the CW direction when the input signal SRV (bit 4 of G70) = 1.

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1 : Disables the rotation direction function.
If a move command from the CNC is positive (+), the spindle rotates in the CCW direction when the input signal SFR = 1 or SRV = 1.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4006	4006	**RGTCMR**							

RGTCMR Sets the command arbitrary gear ratio function (CMR) on rigid tapping.
0 : Disables the command arbitrary gear ratio function.
1 : Enables the specified arbitrary gear ratio function.
Set this parameter to 1 when rigid tapping is performed using a signal from the sensor built-into the motor as a position feedback signal and the gear ratio between the motor and spindle is other than 1:1.
When using the command arbitrary gear ratio function (CMR function), set the following as well:

- Enabling an arbitrary gear ratio between the spindle and position coder (bit 1 of No. 5200 = 1)
- Parameters for the number of gear teeth on the spindle side (No. 5221 to No. 5224)
- Parameters for the number of gear teeth on the position coder side (No. 5231 to No. 5234)

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4017	4017	**NRROEN**							

NRROEN Shortcut function when orientation is specified in the stop state
0 : Does not use the function.
1 : Uses the function.
When the set value is "1", shortcut is performed if the following conditions are satisfied.
i) Bit 7 (RFCHK3) of parameter No. 4016 = 0
ii) Zero speed detection output signal SST = 1
iii) Shortcut command input signal NRROA = 1

0*i*	30*i*	
4037	4037	**Velocity loop feed-forward coefficient**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0
This parameter sets a velocity loop feed-forward coefficient for using feed-forward control. Set the result of calculation of the following expression:

$$\text{Setting} = 214466 \times \frac{[\text{spindle inertia} + \text{rotor inertia}](\text{kg}\cdot\text{m}^2)}{\text{Maximum motor torque (N}\cdot\text{m)}}$$

0*i*	30*i*		
4044	4044	**Velocity loop proportional gain on servo mode/spindle synchronous control (HIGH)**	**CTH1A=0**
4045	4045	**Velocity loop proportional gain on servo mode/spindle synchronous control(LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10
These parameters set a velocity loop proportional gain on servo mode (rigid tapping/spindle positioning) or spindle synchronous control.
When the input signal CTH1A = 0, (HIGH) is selected. When the input signal CTH1A = 1, (LOW) is selected.

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0*i*	30*i*		
4052	4052	**Velocity loop integral gain on servo mode/spindle synchronous control (HIGH)**	**CTH1A=0**
4053	4053	**Velocity loop integral gain on servo mode/spindle synchronous control (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10

These parameters set a velocity loop integral gain on servo mode (rigid tapping/spindle positioning) or spindle synchronous control.
When the input signal CTH1A = 0, (HIGH) is selected. When the input signal CTH1A = 1, (LOW) is selected.

0*i*	30*i*		
4056	4056	**Gear ratio (HIGH)**	**CTH1A=0, CTH2A=0**
4057	4057	**Gear ratio (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4058	4058	**Gear ratio (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4059	4059	**Gear ratio (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : (Motor rotation for one rotation of spindle) / 100
(When parameter No. 4006 #1 (GRUNIT) is 1, motor rotation / 1000)
Valid data range : 0 to 32767
Initial setting : 100

These data are used to set the gear ratio between spindle and spindle motor. Usually, set 100.

NOTE
When an improper value is set in these parameters, an unexpected operation can occur. For example, the spindle can continue rotating without stopping at the time of orientation. So, be sure to set a proper gear ratio.

0*i*	30*i*	
4065	4065	**Spindle position gain on servo mode/spindle synchronous control (HIGH)CTH1A=0, CTH2A=0**
4066	4066	**Spindle position gain on servo mode/spindle synchronous control (MEDIUM HIGH)CTH1A=0, CTH2A=1**
4067	4067	**Spindle position gain on servo mode/spindle synchronous control (MEDIUM LOW)CTH1A=1, CTH2A=0**
4068	4068	**Spindle position gain on servo mode/spindle synchronous control (LOW)CTH1A=1, CTH2A=1**

Unit of data : $0.01sec^{-1}$
Valid data range : 0 to 32767
Initial setting : 1000

These parameters set a position gain on servo mode (rigid tapping/spindle positioning) or spindle synchronous control. A parameter is selected according to the input signals CTH1A and CTH2A.

0*i*	30*i*	
4073	4073	**Grid shift amount on servo mode**

Unit of data : 1 pulse unit (360 degrees/4096)
Valid data range : 0 to 4095
Initial setting : 0

This parameter is used to shift the reference position on servo mode (rigid tapping/spindle positioning).
The reference position of the spindle is shifted in the CCW direction by the specified number of pulses.

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0*i*	30*i*	
4074	4074	**Reference position return speed on Cs contouring control/servo mode**

Unit of data : $1min^{-1}$
Valid data range : 0 to 32767
Initial setting : 0

- When 0 is set
  The orientation speed is the reference position return speed in servo mode (rigid tapping/spindle positioning).
- When a value other than 0 is set
  The value set in this parameter is used as a reference position return speed on servo mode (rigid tapping/spindle positioning).

0*i*	30*i*	
4091	4091	**Position gain change ratio at reference position return time on servo mode**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 100

This parameter sets a position gain change ratio at reference position return time on servo mode (rigid tapping, spindle positioning, and so forth).

NOTE
An overshoot can occur at reference position return time for a cause such as an excessively high reference position return speed and an excessively large spindle inertia. In this case, an overshoot can be avoided by setting a small value in this parameter.

0*i*	30*i*	
4344	4344	**Advanced preview feed-forward coefficient**

Unit of data : 0.01%
Valid data range : 0 to 10000
Initial setting : 0

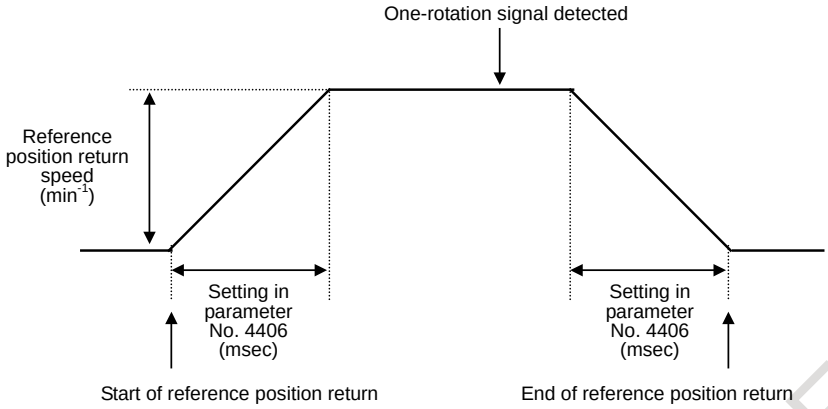
This parameter sets a feed-forward coefficient for using feed-forward control. Set the same value as for the servo axis simultaneously subjected to interpolation.

0*i*	30*i*	
4406	4406	**Acceleration/deceleration time constant for reference position return on Cs contouring control/servo mode**

Unit of data : 1msec
Valid data range : 0 to 32767
Initial setting : 0

This parameter sets a reference position return acceleration for Cs contouring control or servo mode (rigid tapping/spindle positioning). Use of this parameter can reduce the shock due to acceleration/deceleration during return to the reference position. The spindle speed command during return to the reference position is then given as follows:

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NOTE
1 When 0 is set in this parameter, a velocity command is assumed as follows.
- Before detecting the one-rotation signal: Reference position return speed (step-type velocity command)
- After detecting the one-rotation signal:
  Distance to the reference position × Position gain

2 This parameter is enabled when soft start/stop signal SOCNA is 1.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4542	4542				FFCHG				

FFCHG Cutting feed /rapid traverse feed-forward function
0: Disabled
1: Enabled

NOTE
1 This parameter is valid with 9D8A series C (03) edition or later, 9D90 series R (18) edition or later, 9DA0 series U (21) edition or later, and 9DB0 series A (01) edition or later.
2 When this parameter is set to 1, set bit 3 of FFR parameter No. 1800 to 1 (feed-forward control in rapid traverse is enabled).

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4549	4549							FHRSP	

FHRSP Setting of FSSB high-speed rigid tapping
0 : FSSB high-speed rigid tapping is disabled.
1 : FSSB high-speed rigid tapping is enabled.
When FSSB high-speed rigid tapping is used, the CNC and the servo axis must also be set. For details of the settings, refer to the Connection Manual (Function) of each CNC or see Subsection 5.17.2, "Procedure for Adjusting FSSB High-Speed Rigid Tapping", in Part I.

0*i*	30*i*	
4627	4627	**Advanced preview feed-forward coefficient for cutting feed**

Unit of data : 0.01%
Valid data range : 0 to 10000
Initial setting : 0
This parameter sets an advanced preview feed-forward coefficient for cutting feed. Set the same value as for the servo axis simultaneously subjected to interpolation.

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NOTE
1 This parameter is valid with 9D8A series C (03) edition or later, 9D90 series R (18) edition or later, 9DA0 series U (21) edition or later, and 9DB0 series A (01) edition or later.
2 When the cutting feed /rapid traverse feed-forward function is enabled (bit 4 of parameter No. 4542 = 1), this function is enabled.

2.3.9 Parameter Setting Procedure

For this subsection, see Subsection 2.3.9, "Parameter Setting Procedure", in Part I.

2.3.10 Adjustment Procedure

(1) Parameters used for adjustment

The table below lists and describes the parameters used for adjusting rigid tapping.

Parameter No.	Description
5241 to 5244	Maximum spindle speed on rigid tapping (Depends on the GR signal. No. 5244 is for the T series only.)
5261 to 5264	Acceleration/deceleration time constant on rigid tapping (Depends on the GR signal. No. 5264 is for the T series only.)
5280 to 5284	Position gain of tapping axis on rigid tapping (No. 5280 is for all gears. Nos. 5281 to 5284 depend on the GR signal. No. 5284 is for T series only.)
4065 to 4068	Spindle position gain on rigid tapping (depends on CTH1A and CTH2A signals)
4044 to 4045	Velocity loop proportional gain on rigid tapping (depends on CTH1A signal)
4052 to 4053	Velocity loop integral gain on rigid tapping (depends on CTH1A signal)

(2) Initialization

Before adjustment, initialize the parameters related to rigid tapping with a spindle motor.

Parameter No. (FS0*i*,30*i*)	Initial setting
5241 to 5244	Set the maximum spindle speed on rigid tapping.
5261 to 5264	Set them with either of the methods <1> and <2> below. <1> Method to set parameters from the spindle acceleration time In velocity control mode, measure the acceleration time [ms] required to achieve the maximum spindle speed on rigid tapping (Nos. 5241 to 5244), and set the value equal to the acceleration time multiplied by 1.5 to 2. <2> Method to set the acceleration/deceleration constant from an expression $tr[\mathrm{ms}] = \frac{Jm[\mathrm{kgm}^2] + JL[\mathrm{kgm}^2]}{T\max(Nr)[\mathrm{Nm}]} \times \frac{2\pi}{60} \times Nr[\mathrm{min}^{-1}] \times Gear \times 1000 \times 1.2$ *tr* [ms] : Acceleration/deceleration time constant on rigid tapping (Nos. 5261 to 5264) *Nr* [min^{-1}] : Maximum spindle speed on rigid tapping (Nos. 5241 to 5244) *Gear* : Gear ratio data between spindle and motor (motor speed per one spindle rotation) *Tmax(Nr)* [Nm] : Maximum torque of the spindle motor at *Nr* *Jm* [kgm^2] : Rotor inertia of the spindle motor *JL* [kgm^2] : Spindle load inertia (converted for the motor shaft)
5280 to 5284	3000
4065 to 4068	3000
4044 to 4045	10
4052 to 4053	10

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(3) Spindle data used for adjustment

Adjust the parameters while observing the motor speed, torque command, velocity error, synchronous error, and other waveform by using SERVO GUIDE. The table below lists spindle check board settings for observing the waveform.

Symbols in SERVO GUIDE	Output signals
VERR	Velocity deviation
TCMD	Torque command
SYNC	Synchronization error (Converted for spindle,4096 pulses/rev)
SPEED	Motor speed

NOTE
When observing a synchronous error, set the following parameter:
Bit 7 of parameter No. 3700 = 1: Uses the synchronous error output (maintenance function).

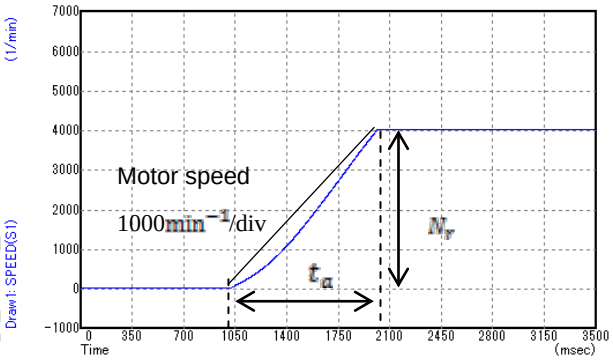
(4) Adjustment procedure

(4)-1 Specifying an acceleration/deceleration time constant (1): Specifying a provisional value

Before optimizing the acceleration/deceleration time constant, adjust the gain to improve the response. Following (a) or (b) below, specify a provisional acceleration/deceleration time constant according to the target maximum speed.

(a) Specifying a provisional time constant according to the velocity waveform in actual acceleration/deceleration

Observe the motor velocity waveform (velocity control mode) in acceleration up to the maximum rigid tapping speed. Specify such a provisional time constant that the inclination (acceleration) during rigid tapping acceleration becomes about a half of the inclination of a tangent to the motor velocity waveform near the location of maximum speed. See the sample waveform shown below.



Nr: Maximum rigid tapping speed (No. 5241 to 5244) 4000 min^{-1} in this example
ta: Time of acceleration by the maximum torque at *Nr*
About 900 ms in this example
tr: Rigid tapping acceleration/deceleration time constant (No. 5261 to 5264) 1800 ms, which is two times *ta*, in this example

In this example, the maximum rigid tapping speed *Nr* is set to 4000 min^{-1}. To determine the acceleration/deceleration time constant, the motor velocity waveform in acceleration up to 4000 min^{-1} is observed. If the acceleration is performed with the maximum motor torque at 4000 min^{-1}, the acceleration time *ta* needed to attain 4000 min^{-1} is about 400 ms, as shown above. This is the minimum value of acceleration/deceleration time constant *tr*, which can be specified without consideration of cutting load. A time constant that can be specified in consideration of cutting load is usually about 1.2 to 1.5 times this value. As a provisional value for gain adjustment, approximately double (800 ms) is specified here.

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(b) Specifying a value calculated from the relationship between the maximum torque and spindle inertia

Specify an acceleration/deceleration time constant calculated from the following expression:

$$tr[\mathrm{ms}] = \frac{Jm[\mathrm{kgm}^2] + JL[\mathrm{kgm}^2]}{T\max(Nr)[\mathrm{Nm}]} \times \frac{2\pi}{60} \times Nr[\mathrm{min}^{-1}] \times GR \times 1000 \times 2$$

tr[ms] : Acceleration/deceleration time constant on rigid tapping (No. 5261 to 5264)
Nr[min^{-1}] : Maximum spindle speed on rigid tapping (No. 5241 to 5244)
GR : Spindle-motor gear ratio (Motor rotation per spindle rotation)
Tmax(Nr) [Nm]: Maximum torque of spindle motor at *Nr*
Jm[kgm^2] : Rotor inertia of spindle motor
JL[kgm^2] : Spindle load inertia(converted for the motor shaft)

(4)-2 Specifying a position gain

Specify an initial value of about 2000(20 sec^{-1}) to 3000(30 sec^{-1}), then adjust the value as needed. Basically, specify identical values for the spindle and tapping axis.
After specifying the position gain, check whether the spindle is operating as designed. For that purpose, check that the position error (value displayed on the CNC screen) during stable rotation at the maximum speed is almost the same as the theoretical value. This theoretical value is calculated as shown below. If the theoretical value is substantially different, re-check the parameters related to position gain, gear ratio, and detector.

$$Perr(Nr)[pulse] = \frac{Nr[\mathrm{min}^{-1}]}{60} \times 4096[pulse/rev] \times \frac{1}{PG[\mathrm{sec}^{-1}]}$$

Perr(Nr) [pulse] : Position error in stable rotation at *Nr*
Nr [min^{-1}] : Maximum speed on rigid tapping
PG [sec^{-1}] : Position gain on rigid tapping

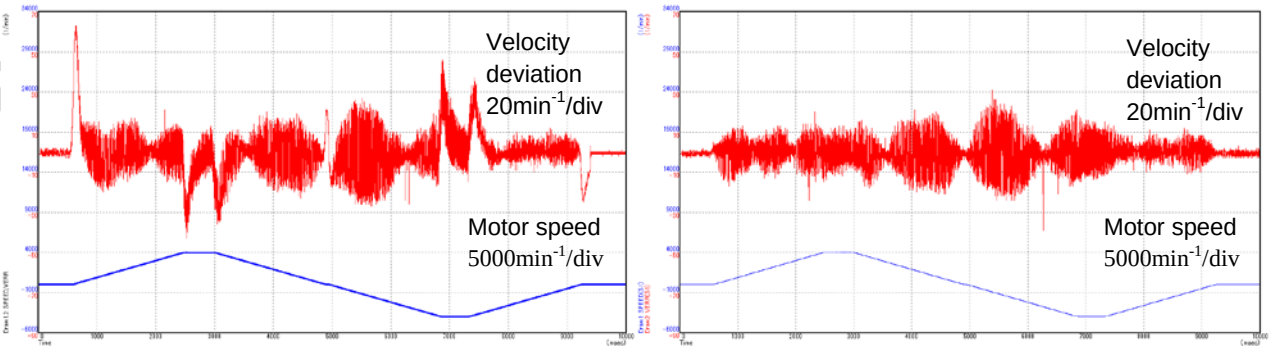
If the gear ratio is 1:1 at *Nr*=4000 min^{-1} and *PG*=3000 (30 sec^{-1}), the position error in stable rigid tapping at *Nr* is calculated as follows:

$$Perr(Nr) = \frac{4000}{60} \times 4096 \times \frac{1}{30} = 9102[pulse]$$

(4)-3 Specifying a velocity loop gain

Refer to Section 4.1, “VELOCITY LOOP GAIN ADJUSTMENT”, in Part I for details of the velocity loop proportional/integral gain. Adjust the velocity loop proportional/integral gain so that the velocity error decreases.
During the adjustment, observe the velocity error and motor speed. Sample waveforms before and after the adjustment are shown below:

(a) Waveform before adjustment(No.4044=10,No.4052=10） (b)Waveform（N0.4044=93,No.4052=864)

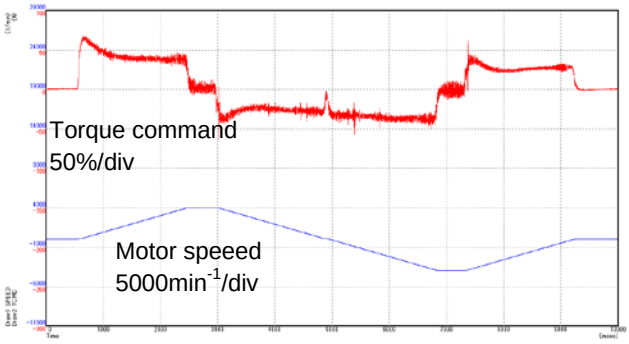


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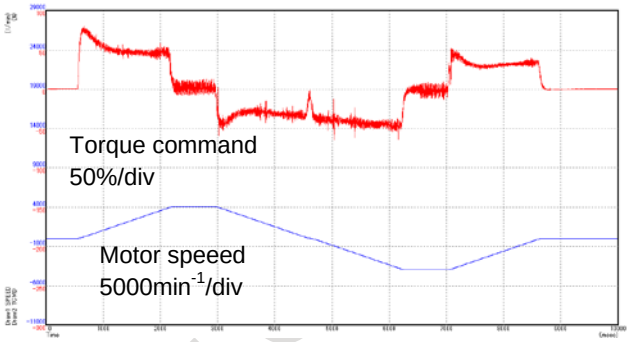
(4)-4 Specifying an acceleration/deceleration time constant (2) : Specifying an optimum value

Observing the torque command and motor speed, make a final adjustment of the time constant. Adjust the time constant in consideration of the actual cutting load, so that the peak torque at air cut becomes about 70% to 80% of the maximum value. Sample waveforms before and after the adjustment are shown below:

(a) Waveform before adiustment(N0.5261=1900)



(b) Waveform after adjustment(No.5261=1600)



(4)-5Checking the synchronous error

The spindle adjustment ends when the adjustments described in above procedures are completed. After the spindle adjustment, check the synchronous error between the spindle and servo axis, which will be an index of rigid tapping precision.

The synchronous error is a difference between the spindle position error and the servo axis position error converted for the spindle.

$SYNCER[\text{pulse}] = PERsp[\text{pulse}] - PERsv[\text{pulse}]$

SYNCER [pulse]:Synchronous error (4096 pulses per spindle rotation)
PERsp [pulse]:Spindle position error
PERsv [pulse]:Servo axis position error converted for the spindle

(4)-6Making adjustments for FSSB high-speed rigid tapping

In conventional method rigid tapping, if the spindle torque at acceleration/deceleration is saturated, the synchronous error becomes worse extremely. The acceleration/deceleration time constant must therefore be adjusted to a value with an adequate margin with respect to the spindle torque of 100%.

In contrast, FSSB high-speed rigid tapping is a method by which the servo follows up the spindle, so it is possible to prevent the synchronous error from becoming worse even when the spindle torque is saturated to some degree. The cycle time can be shorter than ever before by adjusting the acceleration/deceleration time constant so that a torque command for tapping at the maximum possible load can be used as closely as possible to 100%.

If FSSB high-speed rigid tapping is used when the torque is saturated extremely, the synchronous error does not become much worse. However, an overshoot may occur at a hole bottom. Ensure that no overshoot occurs, and then adjust the acceleration/deceleration time constant. In addition, when the optimum rigid tapping acceleration/deceleration function (option) is also used, the spindle torque can always be used up to the limit according to the tapping speed, so the effect of FSSB high-speed rigid tapping is further enhanced.

For details of the adjustments, see Section 5.17, "ADJUSTING FSSB HIGH-SPEED RIGID TAPPING", in Part I.

2.3.11 Diagnosis (Diagnosis Screen)

For this subsection, see Subsection 2.3.11, “Diagnosis (Diagnosis Screen)”, in Part I.

2.3.12 Alarm

For this subsection, see Subsection 2.3.12, “Alarm”, in Part I.

2.4 Cs CONTOURING CONTROL (OPTIONAL FUNCTION)

2.4.1 Start-up Procedure

For this subsection, see Subsection 2.4.1, “Start-up Procedure”, in Part I.

2.4.2 Overview

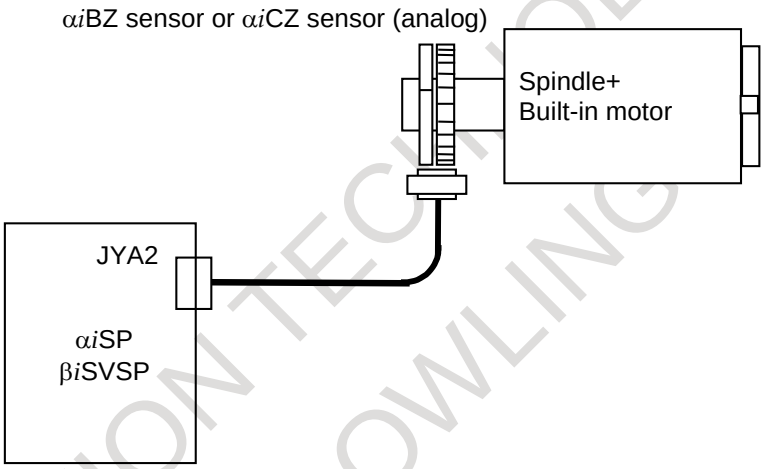
For this subsection, see Subsection 2.4.2, “Overview”, in Part I.

2.4.3 System Configuration

The system configurations that enable the use of the Cs contouring control function are shown below.

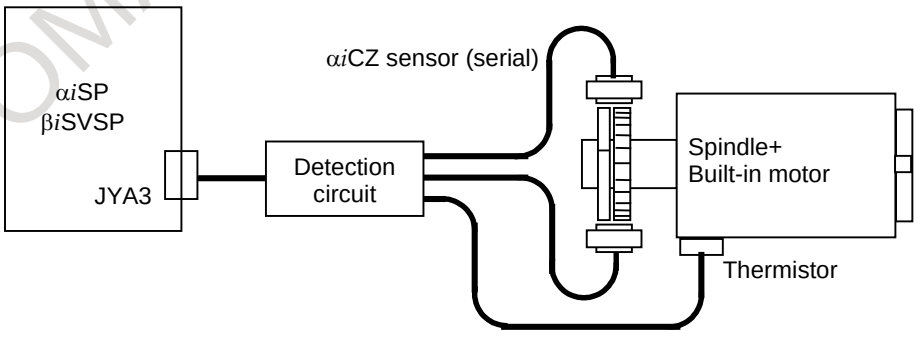
(1) When the α*i*BZ sensor or α*i*CZ (analog) sensor is used

[Sample system configuration]



(2) When the α*i*CZ (serial) sensor is used

[Sample system configuration]



NOTE

In a configuration in which the α*i*CZ sensor (serial) is used as the motor sensor, if Cs contouring control is to be performed immediately after the power is turned on, use spindle software 9D80 series H (08) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later, and 9DB0 series A (01) edition or later.

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2.4.4 List of I/O Signals (CNC↔PMC)

For this subsection, see Subsection 2.4.4, “List of I/O Signals (CNC↔PMC)”, in Part I.

2.4.5 Examples of Sequences

For this subsection, see Subsection 2.4.5, “Examples of Sequences”, in Part I.

2.4.6 Velocity Loop Gains Override Function on Cs Contouring Control Mode

For this subsection, see Subsection 2.4.6, “Velocity Loop Gains Override Function on Cs Contouring Control Mode”, in Part I.

2.4.7 Cutting Feed/Rapid Traverse PWM Frequency Switching Function in Cs Contour Control

For this subsection, see Subsection 2.4.7, “Cutting Feed/Rapid Traverse PWM Frequency Switching Function in Cs Contour Control”, in Part I.

2.4.8 Related Parameters

Parameter No.		Description
0*i*	**30*i***	
1005#0	1005#0	Whether to use the reference position return function
1006#0	1006#0	Sets a linear axis/rotation axis. (Set “1”.)
3700#1	3700#1	Specifies whether to enable the reference position return function for the first G00 command received after switching to Cs contouring control.
3712#2	3712#2	Sets the Cs axis coordinate establishment function.
1013 #3,2,1,0	1013 #3,2,1,0	Increment system (Usually, set and use IS-B.)
1020	1020	Program axis name
1022	1022	Sets an axis of the basic coordinate system. (Set “0”.)
1023	1023	Servo axis number (Set “-1”.)
1260	1260	Movement per rotation of rotation axis (Set “360.0”.)
1420	1420	Rapid traverse rate
1620	1620	Linear acceleration/deceleration time constant for rapid feed
1820	1820	Command multiplication (Usually, set “2” [= CMR 1].)
1826	1826	In-position width
1828	1828	Position error limit during movement
1829	1829	Position error limit when stopped
3900 3910 3920 3930 3940	3900 3910 3920 3930 3940	Servo axis number subject to interpolation with the Cs contouring control axis
3901 to 3904 3911 to 3914 3921 to 3924 3931 to 3934 3941 to 3944	3901 to 3904 3911 to 3914 3921 to 3924 3931 to 3934 3941 to 3944	Position gain of a servo axis subject to interpolation with the Cs contouring control axis
4000#1	4000#1	Spindle rotation direction for a positive motion command on Cs contouring control mode

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Parameter No.		Description
0*i*	30*i*	
4000#3	4000#3	Direction of reference position return when the system enters Cs contouring control mode
4002#4	4002#4	Whether to use the rotation direction signal (SFR/SRV) function on Cs contouring control
4016#3	4016#3	Sets the smoothing function in feed-forward control.
4021	4021	Maximum spindle speed on Cs contouring control mode
4037	4037	Velocity loop feed-forward coefficient
4046 4047	4046 4047	Velocity loop proportional gain on Cs contouring control mode (A parameter is selected by the CTH1A input signal sent from the PMC.)
4054 4055	4054 4055	Velocity loop integral gain on Cs contouring control mode (A parameter is selected by the CTH1A input signal sent from the PMC.)
4056 to 4059	4056 to 4059	Spindle-to-motor gear ratio (A parameter is selected by the CTH1A and CTH2A input signals sent from the PMC.)
4069 to 4072	4069 to 4072	Position gain for axes subject to Cs contouring control (A parameter is selected by the CTH1A input signal sent from the PMC.)
4074	4074	Feedrate for reference position return on Cs contouring control mode or servo mode
4092	4092	Rate of change in the position gain when reference position return is performed on Cs contouring control mode
4094	4094	Disturbance torque compensating constant (acceleration feedback gain)
4131	4131	Velocity detection filter time constant (on Cs contouring control)
4135	4135	Grid shift on Cs contouring control mode
4162 4163	4162 4163	Velocity loop integral gain for cutting feed on Cs contouring control (A parameter is selected by the PMC input signal CTH1A.)
4342 4343	4342 4343	Velocity loop gain override in Cs contouring control. (These parameters are selected by the input signal CTH1A of PMC.)
4344	4344	Advanced preview feed-forward coefficient
4353#5	4353#5	Sets the Cs axis position data transfer function.
4406	4406	Acceleration/deceleration time constant for reference position return on Cs contouring control mode/servo mode
4540#0	4540#0	Setting related to motor voltage control characteristics on Cs contouring control
4542#4	4542#4	Cutting feed /rapid traverse feed-forward function
4598	4598	Variable proportional gain function in the stop state for Cs control: magnification in the stop state
4599	4599	Variable proportional gain function in the stop state for Cs control: judgment level for the stop state
4627 (*)	4627(*)	Advanced preview feed-forward coefficient for cutting feed * Valid when bit 4 of parameter No. 4542 is set to 1.

NOTE
1 For the detector-related parameters, see Section 1.3, “PARAMETERS RELATED TO DETECTORS”, in Part III.
2 For velocity loop proportional/integral gain adjustment, see Section 4.1, “VELOCITY LOOP GAIN ADJUSTMENT”, in Part III.

2.4.9 Details of Related Parameters

This subsection details the serial spindle parameters (in the four thousands) among the parameters related to Cs contouring control. For details of other parameters, refer to “Cs CONTOUR CONTROL” of the Connection Manual (Function) of each CNC.

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0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4000	4000					RETRN		ROTA2	

ROTA2 Indicates the spindle direction by the move command (+). (Only effective on Cs contouring control)

0 : When the value of a move command from the CNC is positive (+), the spindle rotates in the CCW direction.

1 : When the value of a move command from the CNC is positive (+), the spindle rotates in the CW direction.

Change the setting of this parameter when changing the rotation direction of the spindle on Cs contouring control.

RETRN Indicates the reference position return direction on Cs contouring control.

0 : Returns the spindle from the CCW direction to the reference position (counterclockwise direction).

1 : Returns the spindle from the CW direction to the reference position (clockwise direction).

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4002	4002				CSDRCT				

CSDRCT Whether to use the rotation direction signal (SFR/SRV) on Cs contouring control

0 : Rotation direction function enabled

(1) When bit 1 (ROTA2) of No. 4000 = 0, and the value of a move command from the CNC is positive (+)

(a) The spindle rotates counterclockwise when input signal SFR(G70#5) is set to 1.

(b) Tithe spindle rotates clockwise when input signal SRV(G70#4) is set to 1.

(2) When bit 1 (ROTA2) of No. 4000 = 1, and the value of a move command from the CNC is positive (+)

(a) The spindle rotates clockwise when input signal SFR(G70#5) is set to 1.

(b) The spindle rotates counterclockwise when input signal SRV(G70#4) is set to 1.

1 : Rotation direction function disabled

The rotation direction function of the SFR/SRV signal is disabled. Only the function for enabling spindle motor excitation is available.

(1) When bit 1 (ROTA2) of parameter No. 4000 is set to 0

When the value of a move command from the CNC is positive (+), and SFR/SRV = 1, the spindle rotates in the CCW direction.

(2) When bit 1 (ROTA2) of parameter No. 4000 is set to 1

When the value of a move command from the CNC is positive (+), and SFR/SRV = 1, the spindle rotates in the CW direction.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4005	4005								CS360M

CS360M Sets the detection unit for Cs contouring control.

0 : 0.001°

1 : 0.0001°

Set 0 usually. When a α*i*CZ sensor (analog, serial) is used as the position detector and the setting unit IS-C is used, set 1.

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0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4016	4016					FFSMTH			

FFSMTH Specifies whether to use the smoothing function under feed-forward control.
0 : Does not use the smoothing function.
1 : Uses the smoothing function.
This bit specifies whether to use the smoothing function under feed-forward control on Cs contouring control mode.

0*i*	30*i*	
4021	4021	**Maximum speed on Cs contouring control mode**

Unit of data : $1min^{-1}$
Valid data range : 0 to 32767
Initial setting : 100
This parameter specifies the maximum speed of a spindle operating on Cs contouring control mode.
When 0 is specified as the parameter for the feedrate for reference position return on Cs contouring control mode (parameter No. 4074), reference position return is performed at the speed specified as the maximum speed in this parameter.

0*i*	30*i*	
4037	4037	**Velocity loop feed-forward coefficient**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0
Set a velocity loop feed-forward coefficient when feed-forward control is executed on Cs contouring control. Use the following expression to determine a value to be set:

$$\text{Setting} = 214466 \times \frac{[\text{spindle inertia + rotor inertia}](kg \cdot m^2)}{\text{Maximum motor torque } (N \cdot m)}$$

0*i*	30*i*		
4046	4046	**Velocity loop proportional gain on Cs contouring control (HIGH)**	**CTH1A=0**
4047	4047	**Velocity loop proportional gain on Cs contouring control (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 30
These parameters specify the proportional gains of the velocity loop on Cs contouring control mode.
When the input signal CTH1A = 0, (HIGH) is selected. When the input signal CTH1A = 1, (LOW) is selected.

0*i*	30*i*		
4054	4054	**Velocity loop integral gain on Cs contouring control (HIGH)**	**CTH1A=0**
4055	4055	**Velocity loop integral gain on Cs contouring control (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 50
These parameters specify the integral gains of the velocity loop for Cs contouring control mode.
When the input signal CTH1A = 0, (HIGH) is selected. When the input signal CTH1A = 1, (LOW) is selected.

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0*i*	30*i*		
4056	4056	**Gear ratio (HIGH)**	**CTH1A=0, CTH2A=0**
4057	4057	**Gear ratio (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4058	4058	**Gear ratio (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4059	4059	**Gear ratio (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : (Motor rotation for one rotation of spindle) / 100
(When parameter No. 4006 #1 (GRUNIT) is 1, motor rotation / 1000)
Valid data range : 0 to 32767
Initial setting : 100

These parameters set the gear ratio of the spindle motor to the spindle.
Usually, set 100.

NOTE
When an improper value is set in these parameters, an unexpected operation can occur. For example, the spindle does not stop but keeps rotating at the time of orientation. So, be sure to set a proper gear ratio.

0*i*	30*i*		
4069	4069	**Position gain on Cs contouring control (HIGH)**	**CTH1A=0, CTH2A=0**
4070	4070	**Position gain on Cs contouring control (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4071	4071	**Position gain on Cs contouring control (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4072	4072	**Position gain on Cs contouring control (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : $0.01sec^{-1}$
Valid data range : 0 to 32767
Initial setting : 3000

These parameters specify the position gains used on Cs contouring control mode.
A parameter is selected by the input signals CTH1A and CTH2A.

0*i*	30*i*	
4074	4074	**Speed for return to reference position on Cs contouring control mode/servo mode**

Unit of data : $1min^{-1}$
Valid data range : 0 to 32767
Initial setting : 0

- When 0 is set
  The value set in No. 4021 (maximum spindle speed) is used as a reference position return speed on Cs contouring control.
- When a value other than 0 is set
  The value set in this parameter is used as a reference position return speed on Cs contouring control.

NOTE
An overshoot can occur at reference position return time for a cause such as an excessively high reference position return speed by setting the parameter No. 4021 (maximum spindle speed on Cs contouring control mode). In this case, set this parameter.

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0*i*	30*i*	
4092	4092	**The reduction rate of position loop gain in returning to the reference position on Cs contouring mode**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 100
This parameter specifies a rate of change in the position gain used for reference position return on Cs contouring control mode.

NOTE
An overshoot can occur at reference position return time for a cause such as an excessively high reference position return speed and an excessively large spindle inertia. In this case, an overshoot can be avoided by setting a small value in this parameter.

0*i*	30*i*	
4094	4094	**The constant of the torque disturbance compensating (Acceleration feedback gain)**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0
This parameter specifies the constant for compensating for a disturbance torque on Cs contouring control mode.

NOTE
By setting this parameter, stability in cutting can be improved.
In this parameter, set a value from 500 to 2000.
Do not set a value exceeding 4000.

0*i*	30*i*	
4131	4131	**Velocity detection filter time constant (on Cs contouring control)**

Unit of data : 0.1ms
Valid data range : 0 to 10000
Initial setting : 0
This parameter sets a filter time constant for the velocity feedback signal on Cs contouring control. Usually, set 0.

0*i*	30*i*	
4135	4135	**Grid shift amount on Cs contouring control**

Unit of data : 1 pulse unit (=0.001°) (0.0001° when bit 0 (CS360M) of parameter No. 4005 is set to 1)
Valid data range : -360000 to +360000
(When parameter No. 4005 #0 (CS360M) is 1, -3,600,000 to +3,600,000)
Initial setting : 0
Use this parameter to shift the machine reference position on Cs contouring control.
The machine reference position of the spindle shifts by the set number of pulses in the CCW direction.

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0*i*	30*i*		
4162	4162	**Velocity loop integral gain for cutting feed on Cs contouring control(HIGH)**	**CTH1A=0**
4163	4163	**Velocity loop integral gain for cutting feed on Cs contouring control(LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0

These parameters set a velocity loop integral gain for cutting feed (G01, G02, G03) on Cs contouring control.
When the input signal CTH1A = 0, (HIGH) is selected. When the input signal CTH1A = 1, (LOW) is selected.

NOTE
When 0 is set in these parameters, the values set in No. 4054 and No. 4055 (velocity loop integral gain on Cs contouring control) are valid.

0*i*	30*i*		
4342	4342	**Velocity loop gain override in Cs contouring control (HIGH)**	**CTH1A=0**
4343	4343	**Velocity loop gain override in Cs contouring control (LOW)**	**CTH1A=1**

Unit of data : 1%
Valid data range : 0 to 3000
Initial setting : 0

These parameters specify override of velocity loop proportional gain and integral gain for Cs contouring control mode.
If the set value is "0", it is treated as "100".

NOTE
This parameter is valid with
9D53 series J (10) edition or later
9D70 series I (09) edition or later
9D80 series C (03) edition or later.

0*i*	30*i*	
4344	4344	**Advanced preview feed-forward coefficient**

Unit of data : 0.01%
Valid data range : 0 to 10000
Initial setting : 0

This parameter sets a feed-forward coefficient for exercising feed-forward control when Cs contouring control is used.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4353	4353			**CSPTRE**					

CSPTRE Sets the Cs axis position data transfer function.
0 : Disables the Cs axis position data transfer function.
1 : Enables the Cs axis position data transfer function.
Set this parameter to 1 when using the Cs axis coordinate establishment function.

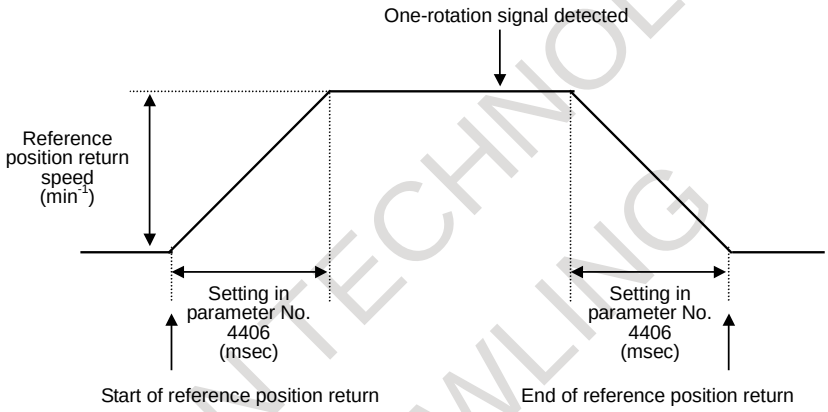
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NOTE
This parameter is valid with
9D53 series B (02) edition or later
9D70 series A (01) edition or later
9D80 series B (02) edition or later.

0*i*	30*i*	
4406	4406	**Acceleration/deceleration time constant for Cs contouring control/servo mode**

Unit of data : 1msec
Valid data range : 0 to 32767
Initial setting : 0

This parameter set the reference position return acceleration for Cs contouring control or servo mode (rigid tapping/spindle positioning). Use of this parameter can reduce the shock due to acceleration/deceleration during return to the reference position. The spindle speed command during return to the reference position is then given as follows:



NOTE
1 When 0 is set in this parameter, a velocity command is assumed as follows.
- Before detecting the one-rotation signal: Reference position return speed (step-type velocity command)
- After detecting the one-rotation signal:
  Distance to the reference position × Position gain

2 This parameter is enabled when soft start/stop signal SOCNA is 1.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4540	4540								**EXPTCS**

EXPTCS Setting related to the motor voltage control characteristics on Cs contouring control
Set this bit to 1 when setting a value less than 100 as the motor voltage on Cs contouring control (No. 4086)
Bit 4 of parameter No. 4016 is valid for all of Cs contouring control, rigid tapping (servo mode), and spindle synchronous control. Use this parameter to set each mode independently.
This parameter is valid only when bit 4 of parameter No. 4016 is set to 0.

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0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4542	4542				FFCHG				

FFCHG Cutting feed/rapid traverse feed-forward function
0: Disabled
1: Enabled

NOTE
1 This parameter is valid with 9D8A series C (03) edition or later, 9D90 series R (18) edition or later, 9DA0 series U (21) edition or later, and 9DB0 series A (01) edition or later.
2 When this parameter is set to 1, set bit 3 of FFR parameter No. 1800 to 1 (feed-forward control in rapid traverse is enabled).

0*i*	30*i*	
4598	4598	**Variable proportional gain function in the stop state for Cs control: magnification in the stop state**

Unit of data : 1%
Valid data range : 0 to 100 (0 means that the function is disabled.)
After a stop is checked in the Cs contouring control state, the variable proportional gain function in the stop state for Cs control suppresses vibration in the stop state by decreasing the velocity loop proportional gain to the level specified with the relevant parameter. In this parameter, set a magnification of the gain to be applied in the stop state. The function is enabled when a value other than 0 is set in this parameter.

0*i*	30*i*	
4599	4599	**Variable proportional gain function in the stop state for Cs control: judgment level for the stop state**

Unit of data : Detection unit (0.001° (when bit 0 of parameter No. 4005 = 0), 0.0001° (when bit 0 of parameter No. 4005 = 1))
Valid data range : 0 to 32767
Initial setting : 0
This parameter is used for stop state judgment in the Cs control state. After a move command for the Cs axis has become 0 and the time five times the reciprocal of the set position gain has elapsed, the spindle is regarded as being stopped when the position error becomes lower than or equal to the level set in this parameter.
Setting example) In parameter No. 4599, set a value larger than the absolute value of the position error of vibration in the stop state, and in parameter No. 4598, adjust a magnification in the stop state in a range of 25% to 90%.

0*i*	30*i*	
4627	4627	**Advanced preview feed-forward coefficient for cutting feed**

Unit of data : 0.01%
Valid data range : 0 to 10000
Initial setting : 0
This parameter sets an advanced preview feed-forward coefficient for cutting feed. Set the same value as for the servo axis simultaneously subjected to interpolation.

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NOTE
1 This parameter is valid with 9D8A series C (03) edition or later, 9D90 series R (18) edition or later, 9DA0 series U (21) edition or later, and 9DB0 series A (01) edition or later.
2 When the cutting feed/rapid traverse feed-forward function is enabled (bit 4 of parameter No. 4542 = 1), this function is enabled.

2.4.10 Adjusting Cs Contouring Control

For this subsection, see Subsection 2.4.10, "Adjusting CS Contour Control", in Part I.

2.4.11 Divided Backlash Compensation Output in Non-Cutting Mode for Cs Contour Control

For this subsection, see Subsection 2.4.11, “Divided Backlash Compensation Output in Non-Cutting Mode for Cs Contour Control”, in Part I.

2.4.12 Diagnosis (Diagnosis Screen)

For this subsection, see Subsection 2.4.12, “Diagnosis (Diagnosis Screen)”, in Part I.

2.4.13 Alarm

For this subsection, see Subsection 2.4.13, “Alarm”, in Part I.

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2.5 SPINDLE SYNCHRONOUS CONTROL (OPTIONAL FUNCTION)

2.5.1 Start-up Procedure

For this subsection, see Subsection 2.5.1, “Start-up Procedure”, in Part I.

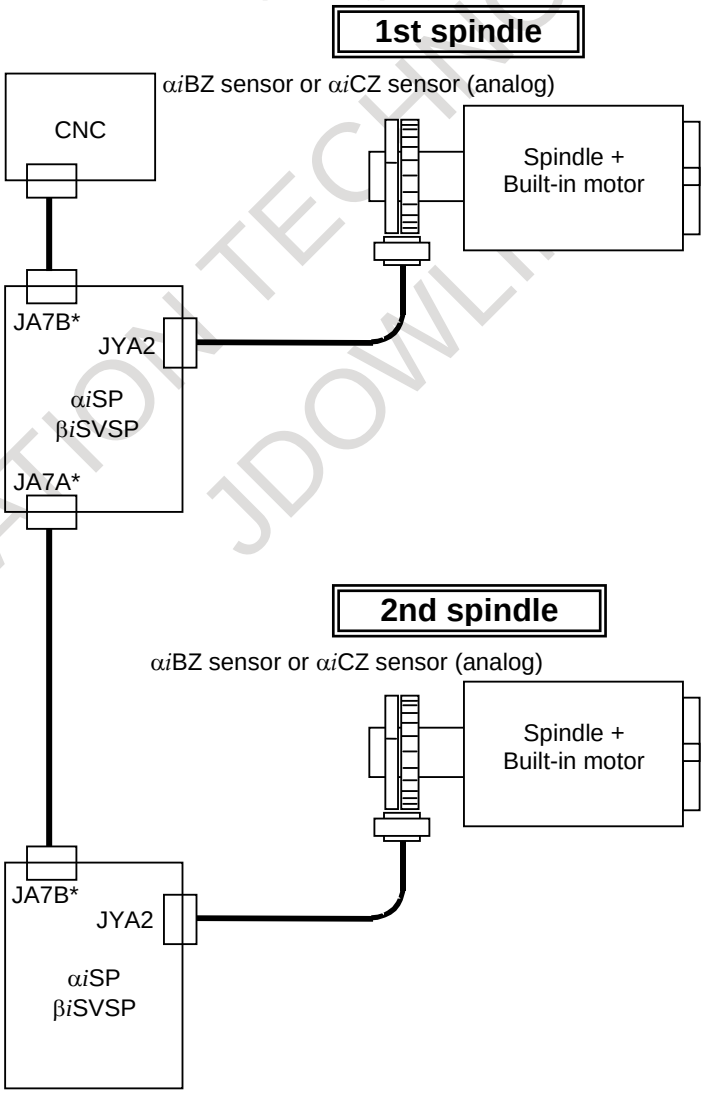
2.5.2 Overview

For this subsection, see Subsection 2.5.2, “Overview”, in Part I.

2.5.3 System Configuration

The system configurations that enable the use of the spindle synchronous control function are shown below.

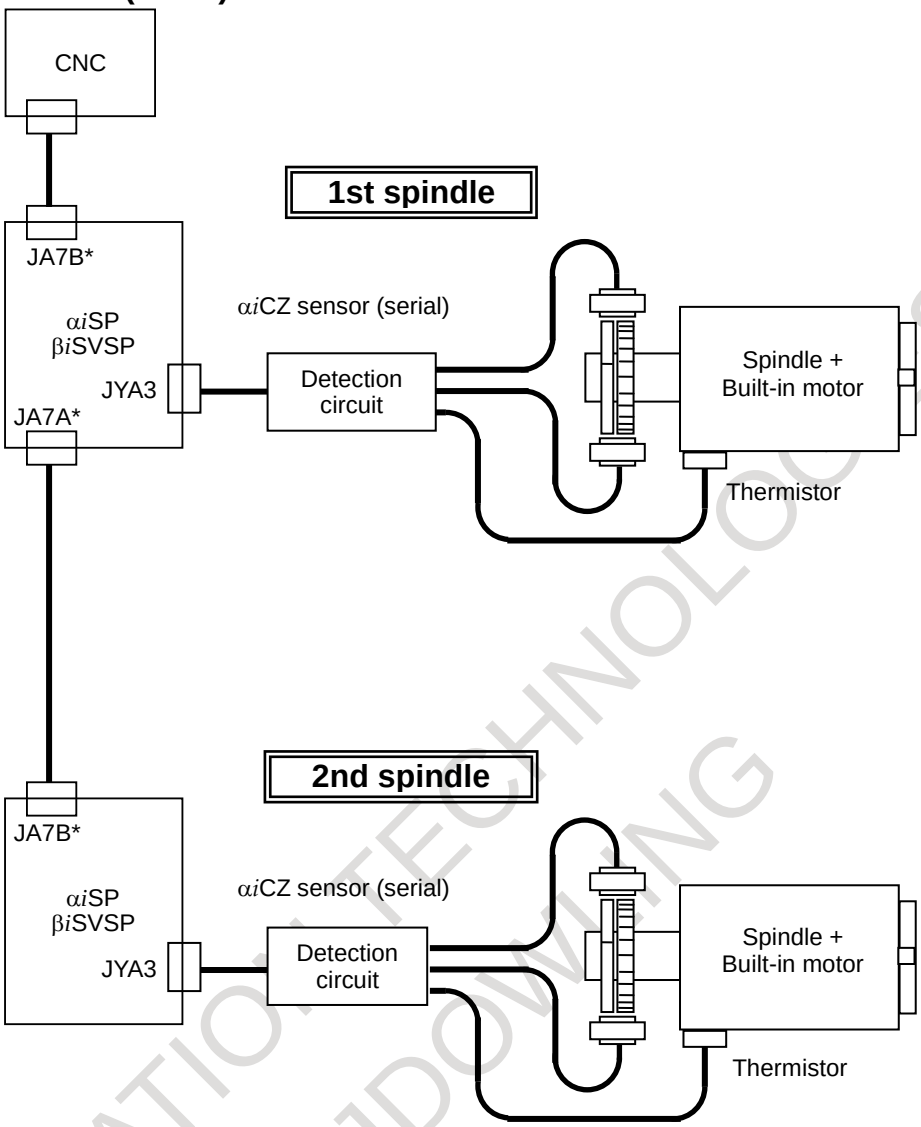
(1) When the α*i*BZ sensor or α*i*CZ (analog) sensor is used



* For the FS30*i*-B series CNC (FSSB communication), use COP10A/COP10B instead of JA7A/JA7B.

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(2) When the α*i*CZ (serial) sensor is used



* For the FS30*i*-B series CNC (FSSB communication), use COP10A/COP10B instead of JA7A/JA7B.

2.5.4 Explanation of Operation

For this subsection, see Subsection 2.5.4, “Explanation of Operation”, in Part I.

2.5.5 I/O Signals (CNC↔PMC)

For this subsection, see Subsection 2.5.5, “I/O Signals (CNC↔PMC)”, in Part I.

2.5.6 Examples of Sequences

For this subsection, see Subsection 2.5.6, “Examples of Sequences”, in Part I.

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2.5.7 Related Parameters

Parameter No.		Description
0*i*	30*i*	
4801#0	4801#0	Direction of rotation of each spindle motor while spindle synchronous control is applied
4810	4810	Error pulse difference between the two spindles for which to output the spindle phase synchronous control completion signal
4811	4811	Error pulse difference between the two spindles for which to output the phase synchronous error monitor signal (SYCAL)
4001#1	4001#1	Lower limit setting of the acceleration for polygon machining with two spindles
4002#6	4002#6	Whether to enable the rotation direction signal (SFR/SRV) function on spindle synchronous control
4006#1	4006#1	Gear ratio increment system
4006#3	4006#3	Setting for disabling automatic one-rotation signal detection at spindle synchronous control mode switching time
4032	4032	Acceleration used for spindle synchronous control (The same value must be set for both the 1st and 2nd spindles.)
4033	4033	Spindle synchronous speed arrival level
4034	4034	Shift amount for spindle phase synchronous control
4035	4035	Compensation data for spindle phase synchronization
4044 4045	4044 4045	Velocity loop proportional gain for spindle synchronous control (A parameter is selected by the CTH1A PMC input signal.)
4052 4053	4052 4053	Velocity loop integral gain for spindle synchronous control (A parameter is selected by the CTH1A PMC input signal.)
4056 to 4059	4056 to 4059	Spindle-to-motor gear ratio data (A parameter is selected by the CTH1A and CTH2A PMC input signals.)
4065 to 4068	4065 to 4068	Position gain for spindle synchronous control (The same value must be specified for both the 1st and 2nd spindles.) (A parameter is selected by the CTH1A and CTH2A PMC input signals.)
4336	4336	Magnetic flux switching point used for calculating an acceleration/deceleration time constant used for spindle synchronous control (The same value must be specified for both the 1st and 2nd spindles.)
4340	4340	Bell-shaped acceleration/deceleration time constant for spindle synchronous control (The same value must be specified for both the first and second spindles.)
4346	4346	Incomplete integration coefficient
4515	4515	Excessive speed deviation alarm detection level on spindle synchronous control
4516	4516	Excessive positional deviation alarm detection level on spindle synchronous control
4550 4551	4550 4551	Whether to enable the rotation direction signal (SFR/SRV) function on spindle synchronous control
4552 4553	4552 4553	Velocity loop proportional gain on spindle synchronous control (A parameter is selected by the PMC input signal CTH1A .)
4554 to 4557	4554 to 4557	Position gain on spindle synchronous control (The same value must be specified for both the 1st and 2nd spindles.) (A parameter is selected by the PMC input signals CTH1A and CTH2A.)

NOTE
1 For the detector-related parameters, see Section 1.3, “PARAMETERS RELATED TO DETECTORS”, in Part III.
2 For velocity loop proportional/integral gain adjustment, see Section 4.1, “VELOCITY LOOP GAIN ADJUSTMENT”, in Part III.

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2.5.8 Spindle Parameters for Rigid Tapping and Spindle Synchronous Control

Of the spindle parameters for rigid tapping (servo mode) and spindle synchronous control, the velocity loop gains and position gains can be set individually. The settings to be used exclusively for spindle synchronous control can be made in parameters Nos. 4550 to 4557; when the parameters are not 0, these parameters are valid for spindle synchronous control, and when the parameters are 0, the common parameters are valid as usual.

Related Parameters

	Rigid tapping	Spindle synchronous control	Condition
Velocity loop proportional gain (HIGH) CTH1A=0	No.4044	No.4044	No.4550＝0
		No.4550	No.4550≠0
Velocity loop proportional gain (LOW) CTH1A=1	No.4045	No.4045	No.4551＝0
		No.4551	No.4551≠0
Velocity loop integral gain (HIGH) CTH1A=0	No.4052	No.4052	No.4552＝0
		No.4552	No.4552≠0
Velocity loop integral gain (LOW) CTH1A=1	No.4053	No.4053	No.4553＝0
		No.4553	No.4553≠0
Position gain (HIGH) CTH1A=0, CTH2A=0	No.4065	No.4065	No.4554＝0
		No.4554	No.4554≠0
Position gain (MEDIUM HIGH) CTH1A=0, CTH2A=1	No.4066	No.4066	No.4555＝0
		No.4555	No.4555≠0
Position gain (MEDIUM LOW) CTH1A=1, CTH2A=0	No.4067	No.4067	No.4556＝0
		No.4556	No.4556≠0
Position gain (LOW) CTH1A=1, CTH2A=1	No.4068	No.4068	No.4557＝0
		No.4557	No.4557≠0

2.5.9 Details of Related Parameters

This subsection details the serial spindle parameters (in the four thousands) among the parameters related to spindle synchronous control. For details of other parameters, refer to “SPINDLE SYNCHRONOUS CONTROL” of the Connection Manual (Function) of each CNC.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4001	4001							POLYM	

POLYM The lower limit setting of the acceleration (parameter No. 4032) for polygon machining with two spindles is:

0 : Normal setting
For FS30*i*: 916
For FS0*i*-D: 229

1 : Extended setting
For FS30*i*: 1
For FS0*i*-D: 1

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NOTE
1 This parameter is valid with 9D5A series D (04) edition or later, 9D53 series R (18) edition or later, 9D70 series R (18) edition or later, 9D80 series N (14) edition or later, 9D90 series B (02) edition or later, 9DA0 series A (01) edition or later, and 9DB0 series A (01) edition or later.
2 Use this bit only when spindle software of any of the above series and editions is applied to both spindle amplifiers for polygon machining with two spindles. Do not set this bit to 1 if the software is not applied.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4002	4002		SYCDRT						

SYCDRT Whether to enable the rotation direction signal (SFR/SRV) function on spindle synchronous control
0 : Enables the rotation direction function.
If a move command from the CNC is positive (+),
(a) The spindle rotates in the CCW (counterclockwise) direction when the input signal SFR (bit 5 of G70) = 1.
(b) The spindle rotates in the CW (clockwise) direction when the input signal SRV (bit 4 of G70) = 1.
1 : Disables the rotation direction function.
If a move command from the CNC is positive (+), the spindle rotates in the CCW (counterclockwise) direction when the input signal SFR = 1 or SRV = 1.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4006	4006					SYCREF		GRUNIT	

GRUNIT Sets a gear ratio setting resolution:
0 : 1/100 unit
1 : 1/1000 unit
Select a gear ratio data setting resolution from the following:
(a) Resolution based on motor speed increased by a factor of 100 relative to one spindle rotation
(b) Resolution based on motor speed increased by a factor of 1000 relative to one spindle rotation
Depending on the setting of this parameter, the increment system of the parameters indicated in the table below changes.

Parameter No.		Description
0*i*	30*i*	
4056 to 4059	4056 to 4059	Spindle-to-motor gear ratio data

NOTE
1 Usually, use the 1/100 unit (setting “0”).
2 When the 1/100 unit is set as the gear ratio setting resolution (with the bit set to 0), a steady-state synchronous error may be indicated due to the fraction of the gear ratio.
In such a case, the synchronous error can be improved when the 1/1000 unit is set as the gear ratio setting resolution (with the bit set to 1).

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SYCREF Setting for function performing automatic detection of the one-rotation signal on spindle synchronous control

0 : Automatic detection of the one-rotation signal carried out

1 : Automatic detection of the one-rotation signal not carried out. (When spindle phase synchronization is not carried out)

When the mode is switched to spindle synchronous control mode after power-on, the two spindles automatically perform a one-rotation signal detection operation. So, the spindles automatically make two to three turns even if such turns are not intended.

This operation is required because the one-rotation signal must be detected to enable spindle phase synchronous control.

If the two spindles are mechanically connected to disable each spindle from performing a one-rotation signal detection operation, or if spindle phase synchronous control is not exercised, the operation above can be disabled by setting this bit to 1.

When this parameter is set to "1", check that the one-rotation signal has been detected for both spindles (output signal PC1DTA = 1) before applying the spindle phase synchronous control signal (SPPHS).

If the one-rotation signal is not detected, specify a speed of several ten min^{-1} or higher in spindle synchronous control mode, and wait until the one-rotation signal is detected. (See sequence example (4).)

0*i*	30*i*	
4032	4032	**Acceleration at spindle synchronous control**

Unit of data : $1min^{-1}$/sec
Valid data range : 0 to 32767
Initial setting : 0

This parameter sets an acceleration value for linear acceleration/deceleration when the synchronous speed command for spindle synchronous control is changed.

NOTE
1 Set exactly the same data for 1st spindle and 2nd spindle. When different data is set, synchronization between the two spindles is not guaranteed.
2 When this parameter is set to 0, motor doesn't accelerate/decelerate, so, be sure to set proper value in this parameter.

0*i*	30*i*	
4033	4033	**Spindle synchronous speed arrival level**

Unit of data : $1min^{-1}$/sec
Valid data range : 0 to 32767
Initial setting : 10

For the synchronous speed command at spindle synchronous control, if the error of the respective spindle motor speeds are within the setting level, the spindle synchronous control complete signal (FSPSY) becomes "1".

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0*i*	30*i*	
4034	4034	**Shift amount at spindle phase synchronous control**

Unit of data : 1 pulse unit (360 degrees/4096)
Valid data range : 0 to 4095
Initial setting : 0
Sets the shift amount from the reference position (one-rotation signal) at spindle phase synchronous control.

0*i*	30*i*	
4035	4035	**Spindle phase synchronous compensation data**

Unit of data : 1 pulse/2msec
Valid data range : 0 to 4095
Initial setting : 10
This parameter reduces speed fluctuations when aligning phase of spindles in spindle phase synchronous control.
When this parameter is “0”, since the phase alignment amount is only issued once, the position error quickly becomes large, and there are large speed changes on phase alignment.
It is possible to perform smooth phase alignments through issuing separate commands for phase alignment amounts for the number of 2 msec pulses set in this parameter.

0*i*	30*i*		
4044	4044	**Velocity loop proportional gain on spindle synchronous control (HIGH)**	**CTH1A=0**
4045	4045	**Velocity loop proportional gain on spindle synchronous control (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10
This sets velocity loop proportional gain on spindle synchronous control.
It is selected HIGH when CTH1A=0 of input signal, and It is selected LOW when CTH1A=1 of input signal.

0*i*	30*i*		
4052	4052	**Velocity loop integral gain on spindle synchronous control (HIGH)**	**CTH1A=0**
4053	4053	**Velocity loop integral gain on spindle synchronous control (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10
This sets velocity loop integral gain on spindle synchronous control. It is selected HIGH when CTH1A=0 of input signal, and It is selected LOW when CTH1A=1 of input signal.

0*i*	30*i*		
4056	4056	**Gear ratio (HIGH)**	**CTH1A=0, CTH2A=0**
4057	4057	**Gear ratio (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4058	4058	**Gear ratio (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4059	4059	**Gear ratio (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : (Motor rotation for one rotation of spindle) / 100
(When parameter No. 4006 #1 (GRUNIT) is 1, motor rotation / 1000)
Valid data range : 0 to 32767
Initial setting : 100

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These parameters set the gear ratio of the spindle motor to the spindle.
Usually, set 100.

NOTE
When an improper value is set in these parameters, an unexpected operation can occur. For example, the spindle does not stop but keeps rotating at the time of orientation. So, be sure to set a proper gear ratio.

0*i*	30*i*	
4065	4065	**Position gain on spindle synchronous control (HIGH) CTH1A=0, CTH2A=0**
4066	4066	**Position gain on spindle synchronous control (MEDIUM HIGH) CTH1A=0, CTH2A=1**
4067	4067	**Position gain on spindle synchronous control (MEDIUM LOW) CTH1A=1, CTH2A=0**
4068	4068	**Position gain on spindle synchronous control (LOW) CTH1A=1, CTH2A=1**

Unit of data : $0.01sec^{-1}$
Valid data range : 0 to 32767
Initial setting : 1000
This sets position gain in spindle synchronous control. It is selected by CTH1A or CTH2A of input signal.

0*i*	30*i*	
4336	4336	**Acceleration switch point on spindle synchronous control**

Unit of data $1min^{-1}$
Valid data range : 0 to 32767
Initial setting : 0
The acceleration for spindle synchronous control changes according to the speed set in this parameter as follows:

- Area where the spindle speed does not exceed the speed set in this parameter
  The acceleration for spindle synchronous control is constant (as set in parameter No. 4032).
- Area where the spindle speed exceeds the speed set in this parameter
  The acceleration for spindle synchronous control decreases in inverse proportion to the speed.

NOTE
1 Set the same data for the first spindle and second spindle. If different data is set, synchronization between the two spindles is not guaranteed.
2 When this parameter is set to 0, linear acceleration/deceleration (constant acceleration) is performed.

0*i*	30*i*	
4340	4340	**Bell-shaped acceleration/deceleration time constant for spindle synchronous control**

Unit of data : 1msec
Valid data range : 0 to 512
Initial setting : 0
This parameter sets a bell-shaped acceleration/deceleration time constant for spindle synchronous control.

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This parameter is applied to the move command after "Acceleration at spindle synchronous control" (parameter No. 4032) is applied.
When this parameter is set, the spindle synchronous speed control completion signal (FSPSY), output when the synchronous speed is first reached after the spindle synchronous control mode is entered, is delayed by the set time.

NOTE
Set the same data for the first spindle and second spindle. If different data is set, synchronization between the two spindles is not guaranteed.

0*i*	30*i*	
4346	4346	**Incomplete integration coefficient**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0
Set this parameter to use incomplete integration for velocity loop integration control.

NOTE
Usually, this parameter need not be adjusted.

0*i*	30*i*	
4515	4515	**Excessive speed deviation alarm detection level on spindle synchronous control**

Unit of data : 1min^{-1}
Valid data range : 0 to 32767
Initial setting : 0
This parameter sets a level for detecting the excessive speed deviation alarm under spindle synchronous control.
If the positional deviation (position error) or the difference between the speed command for the spindle end calculated from the position gain and the actual spindle speed exceeds the value set in this parameter in the spindle synchronous control mode, the excessive speed deviation alarm under spindle synchronous control (spindle alarm C8) is detected. When this parameter is set to 0, alarm detection is disabled.

If the speed integration control signal (INTG) is used, the speed deviation increases for a cause such as acceleration/deceleration and cutting load. The spindle speed deviation that causes torque command saturation is indicated below. Set an alarm level by using a calculated value as a guideline. (During spindle synchronous control, ensure that torque command saturation does not take place.)

Spindle speed deviation $[\text{min}^{-1}] = 1024 \times A / P \times B / G$

where

No.4006#1	No.4009#0	A	B
0	0	1	100
0	1	16	100
1	0	1	1000
1	1	16	1000

P: Velocity loop proportional gain on spindle synchronous control(No.4044, 4045)
G: Gear ratio (No.4056 to 4059)

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NOTE
This parameter is valid with 9D53 series E (05) edition or later, 9D70 series D (04) edition or later, and 9D80 series B (02) edition or later.

0*i*	30*i*	
4516	4516	**Excessive positional deviation alarm detection level on spindle synchronous control**

Unit of data : 100 pulses (weight of 4096 pulses/rev)
Valid data range : 0 to 32767
Initial setting : 0

This parameter sets a level for detecting the excessive positional deviation alarm under spindle synchronous control.
If the positional deviation (position error) exceeds the value set in this parameter in the spindle synchronous control mode, the excessive positional deviation alarm under spindle synchronous control (spindle alarm C9) is detected. When this parameter is set to 0, alarm detection is disabled.

As an alarm level, set a value greater than the positional deviation (position error) equivalent to the spindle speed specified in the spindle synchronous control mode. The positional deviation equivalent to the spindle speed can be calculated from the following expression:

Positional deviation [pulse] =
Spindle speed [min^{-1}] / 60 × 4096 × 100 / PG
where
PG: Position gain on spindle synchronous control (No.4065 to 4068)

NOTE
This parameter is valid with 9D53 series E (05) edition or later, 9D70 series D (04) edition or later, and 9D80 series B (02) edition or later.

0*i*	30*i*		
4550	4550	**Velocity loop proportional gain on spindle synchronous control (HIGH)**	**CTH1A=0**
4551	4551	**Velocity loop proportional gain on spindle synchronous control (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10

These parameters set a velocity loop proportional gain on spindle synchronous control. (HIGH) is selected when the input signal CTH1A is 0, and (LOW) is selected when the input signal CTH1A is 1.

NOTE
1 These parameters are valid with 9D70 series O (15) edition or later, 9D80 series K (11) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later, and 9DB0 series A (01) edition or later.
2 When parameters Nos. 4550 and 4551 are set to 0, the values set in parameters Nos. 4044 and 4045 are valid.

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0*i*	30*i*		
4552	4552	**Velocity loop integral gain on spindle synchronous control (HIGH)**	**CTH1A=0**
4553	4553	**Velocity loop integral gain on spindle synchronous control (LOW)**	**CTH1A=1**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 10

These parameters set a velocity loop integral gain on spindle synchronous control. (HIGH) is selected when the input signal CTH1A is 0, and (LOW) is selected when the input signal CTH1A is 1.

NOTE
1 These parameters are valid with 9D70 series O (15) edition or later, 9D80 series K (11) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later, and 9DB0 series A (01) edition or later.
2 When parameters Nos. 4552 and 4553 are set to 0, the values set in parameters Nos. 4052 and 4053 are valid.

0*i*	30*i*		
4554	4554	**Position gain on spindle synchronous control (HIGH)**	**CTH1A=0、CTH2A=0**
4555	4555	**Position gain on spindle synchronous control (MEDIUM HIGH)**	**CTH1A=0、CTH2A=1**
4556	4556	**Position gain on spindle synchronous control (MEDIUM LOW)**	**CTH1A=1、CTH2A=0**
4557	4557	**Position gain on spindle synchronous control (LOW)**	**CTH1A=1、CTH2A=1**

Unit of data : $0.01sec^{-1}$
Valid data range : 0 to 32767
Initial setting : 1000

These parameters set a position gain on spindle synchronous control.
They are selected by the input signals CTH1A and CTH2A.

NOTE
1 These parameters are valid with 9D70 series O (15) edition or later, 9D80 series K (11) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later, and 9DB0 series A (01) edition or later.
2 When parameters Nos. 4554, 4555, 4556 and 4557 are set to 0, the values set in parameters Nos. 4056, 4057, 4058 and 4059 are valid.

2.5.10 Number of Error Pulses in Spindle Synchronous Control

For this subsection, see Subsection 2.5.10, “Number of Error Pulses in Spindle Synchronous Control”, in Part I.

2.5.11 Specifying a Shift Amount for Spindle Phase Synchronous Control

For this subsection, see Subsection 2.5.11, “Specifying a Shift Amount for Spindle Phase Synchronous Control”, in Part I.

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2.5.12 Diagnosis (Diagnosis Screen)

For this subsection, see Subsection 2.5.12, “Diagnosis (Diagnosis Screen)”, in Part I.

2.5.13 Alarm

For this subsection, see Subsection 2.5.13, “Alarm”, in Part I.

2.6 SPECIFICATIONS COMMON TO ALL OPERATION MODES

2.6.1 Overview

For this subsection, see Subsection 2.6.1, “Overview”, in Part I.

2.6.2 List of I/O Signals (CNC↔PMC)

This subsection provides a list of the I/O signals related to spindle speed control only. For details of each signal, refer to “SPINDLE SPEED CONTROL” of the Connection Manual (Function) of each CNC.

For details of the I/O signals common to the CNCs, see Chapter 3, “I/O SIGNALS (CNC↔PMC)”, in Part III.

(1) Input signals (PMC→CNC)

(a) Series 0*i*

		#7	#6	#5	#4	#3	#2	#1	#0
Common to all axes	G027				*SSTP2 (*1)	*SSTP1 (*1)		SWS2 (*1)	SWS1 (*1)
Common to all axes	G028						GR2	GR1	
Common to all axes	G029		*SSTP	SOR	SAR				
Common to all axes	G030	SOV7	SOV6	SOV5	SOV4	SOV3	SOV2	SOV1	SOV0
1st-	G032	R08I	R07I	R06I	R05I	R04I	R03I	R02I	R01I
2nd-	G034	R08I2	R07I2	R06I2	R05I2	R04I2	R03I2	R02I2	R01I2
1st-	G033	SIND	SSIN	SGN		R12I	R11I	R10I	R09I
2nd-	G035	SIND2	SSIN2	SGN2		R12I2	R11I2	R10I2	R09I2

NOTE
*1 These signals are valid in multi-spindle control.

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(b) Series 30*i*

		#7	#6	#5	#4	#3	#2	#1	#0
Common to all axes	G027				*SSTP2 (*1)	*SSTP1 (*1)		SWS2 (*1)	SWS1 (*1)
Common to all axes	G028						GR2	GR1	
Common to all axes	G029		*SSTP	SOR	SAR				
Common to all axes	G030	SOV7	SOV6	SOV5	SOV4	SOV3	SOV2	SOV1	SOV0
1st-	G032	R08I	R07I	R06I	R05I	R04I	R03I	R02I	R01I
2nd-	G034	R08I2	R07I2	R06I2	R05I2	R04I2	R03I2	R02I2	R01I2
1st-	G033	SIND	SSIN	SGN		R12I	R11I	R10I	R09I
2nd-	G035	SIND2	SSIN2	SGN2		R12I2	R11I2	R10I2	R09I2

NOTE
*1 These signals are valid in multi-spindle control.

(c) Common to CNCs

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G070	G070	MRDYA		SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
2nd-	G074	G074	MRDYB		SFRB	SRVB	CTH1B	CTH2B	TLMHB	TLMLB
1st-	G071	G071							*ESPA	ARSTA
2nd-	G075	G075							*ESPB	ARSTB
1st-	G073	G073	EPFSTRA			DSCNA		MPOFA		
2nd-	G077	G077	EPFSTRB			DSCNB		MPOFB		

(2) Output signals (CNC→PMC)

(a) Series 0*i*

	#7	#6	#5	#4	#3	#2	#1	#0
F001				ENB				
F007						SF		
F022	S07	S06	S05	S04	S03	S02	S01	S00
F023	S15	S14	S13	S12	S11	S10	S09	S08
F024	S23	S22	S21	S20	S19	S18	S17	S16
F025	S31	S30	S29	S28	S27	S26	S25	S24
F034						GR3O (*1)	GR2O (*1)	GR1O (*1)
F036	R08O	R07O	R06O	R05O	R04O	R03O	R02O	R01O
F037					R12O	R11O	R10O	R09O

NOTE
*1 These signals are valid with the M series only.

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(b) Series 30*i*

	#7	#6	#5	#4	#3	#2	#1	#0
F001				ENB				
F007						SF		
F022	S07	S06	S05	S04	S03	S02	S01	S00
F023	S15	S14	S13	S12	S11	S10	S09	S08
F024	S23	S22	S21	S20	S19	S18	S17	S16
F025	S31	S30	S29	S28	S27	S26	S25	S24
F034						GR3O (*1)	GR2O (*1)	GR1O (*1)
F036	R08O	R07O	R06O	R05O	R04O	R03O	R02O	R01O
F037					R12O	R11O	R10O	R09O

NOTE
*1 These signals are valid with the M series only.

(c) Common to CNCs

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F045	F045		TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	ALMA
2nd-	F049	F049		TLMB	LDT2B	LDT1B	SARB	SDTB	SSTB	ALMB
1st-	F047	F047				EXOFA				PC1DTA
2nd-	F051	F051				EXOFB				PC1DTB
1st-	F048	F048	EPFIXA				SSMBRKA			
2nd-	F052	F052	EPFIXB				SSMBRKB			

2.6.3 Parameters

This subsection describes those parameters that are common to all operation modes by dividing them into several types.

NOTE
For the detector-related parameters, see Section 1.3, “PARAMETERS RELATED TO DETECTORS”, in Part III.

(1) List of parameters specific to synchronous built-in spindle motor driving

This item provides a list of the motor parameters specific to synchronous built-in spindle motor driving. Usually, the settings of these parameters need not be changed. Use the values indicated on a parameter table for each motor model without modification.

Parameter No.		Description
0*i*	30*i*	
4006#4	4006#4	Sets the d-phase current command.
4008#3	4008#3	Sets the current command.
4008#4	4008#4	Sets the method of output control.
4009#5	4009#5	Sets base speed (for B*i*S160L4/6000)
4011#3	4011#3	Sets the number of motor poles.
4011#4	4011#4	Sets a maximum output for acceleration/deceleration.
4011#7	4011#7	Sets the number of motor poles.
4012#2,1,0	4012#2,1,0	Sets a PWM carrier frequency.
4012#6	4012#6	Sets whether to drive the synchronous built-in spindle motor.

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Parameter No.		Description
0*i*	30*i*	
4012#7	4012#7	Sets the spindle HRV function.
4013#6 to 2	4013#6 to 2	Sets current dead-band data.
4020	4020	Maximum motor speed
4080	4080	Limits regenerative power.
4083	4083	Current step selection/activation current ratio/stop confirmation time in magnetic pole detection
4084	4084	AMR offset
4085	4085	AMR offset fine adjustment
4086	4086	Inductance ratio
4100	4100	Base speed for motor output specification
4101	4101	Torque limitation value for motor output specification
4102	4102	Base speed at maximum load
4103	4103	Magnetic flux reduction start speed / Current pattern switching speed
4104	4104	Current loop proportional gain
4106	4106	Current loop integral gain
4108	4108	Current loop integral gain zero speed
4109	4109	Filter time constant in voltage command saturation processing
4110	4110	Current conversion constant
4111	4111	Maximum current coefficient
4112	4112	Voltage command saturation decision level/PWM command clamp value
4113	4113	Current coefficient for magnetic flux reduction
4115	4115	PWM command clamp value at deceleration time
4116	4116	Counter electromotive voltage compensation coefficient
4117	4117	Interference voltage compensation coefficient
4119	4119	Interference voltage compensation
4120	4120	Dead-band rectangular wave component zero voltage/dead-band data
4127	4127	Load meter indication value at maximum output time
4130	4130	Current phase delay compensation constant
4133	4133	Motor model code
4134	4134	Motor overheat level (2 words)
4362	4362	Load meter compensation 1
4363	4363	Load meter compensation 2
4364	4364	Load meter compensation 3

(2) List of parameters related to alarm detection

This item provides a list of the parameters related to alarm detection conditions.

Parameter No.		Description
0*i*	30*i*	
4009#2	4009#2	Motor power turn-off method when spindle alarm 24 (serial data transfer error) is issued
4087	4087	Overspeed level
4088	4088	Velocity error excess detection level when the motor is bound
4089	4089	Velocity error excess detection level when the motor is rotating
4090	4090	Overload detection level
4123	4123	Short-time overload detection period
4399#5	4399#5	Whether to detect magnetic pole position count miss alarm (spindle alarm 91)
4463	4463	Unexpected rotation detection level (spindle Alarm 90)
4464	4464	Velocity command-dependent over speed (spindle alarm 92) detection offset level
4465	4465	Excessive speed deviation level 2
4466	4466	Excessive speed deviation detection time 2

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Parameter No.		Description
0*i*	**30*i***	
4527	4527	Temperature difference between warning level and alarm level

(3) Other parameters

This item provides a list of the parameters common to all operation modes except the parameters listed in Items (1) and (2) above.

Parameter No.		Description
0*i*	**30*i***	
3720	3720	Number of position coder pulses
4001#0	4001#0	Whether to use the MRDY signal (machine ready signal)
4006#1	4006#1	Gear ratio increment system
4009#0	4009#0	Velocity loop gain increment system
4009#4	4009#4	Whether to output the load detection signals (LDT1, LDT2) during acceleration/deceleration
4012#6	4012#6	Sets whether to drive the synchronous built-in spindle motor.
4012#7	4012#7	Sets the spindle HRV function.
4019#2	4019#2	Whether to perform torque clamping when the speed is zero
4019#7	4019#7	Automatic parameter setting function
4352#1	4352#1	Sets the peak hold function for load meter output.
4395#3	4395#3	Sets parameter transfer from the CNC to spindle software.
4020	4020	Maximum motor speed
4022	4022	Speed arrival detection signal
4023	4023	Speed detection level
4024	4024	Speed zero detection level
4025	4025	Torque limitation value.
4026	4026	Load detection level 1
4027	4027	Load detection level 2
4056	4056	Gear ratio (High)
4057	4057	Gear ratio (Medium High)
4058	4058	Gear ratio (Medium Low)
4059	4059	Gear ratio (Low)
4095	4095	Speedometer output voltage adjustment value
4096	4096	Load meter output voltage adjustment value
4122	4122	Speed detection filter time constant
4170	4170	Monitor constant of winding temperature (Heat coefficient)
4345	4345	Detection level of the spindle motor speed command
4346	4346	Incomplete integral coefficient
4351	4351	Current detection offset compensation

2.6.4 Details of Parameters

This subsection details the serial spindle parameters (in the four thousands) among the parameters common to all operation modes. For details of other parameters, refer to “SPINDLE SPEED CONTROL” of the Connection Manual (Function) of each CNC.

(1) List of parameters specific to spindle motor driving

Usually, the settings of the motor parameters specific to synchronous built-in spindle motor driving need not be changed. Their details are omitted.

(2) List of parameters related to alarm detection

This item details the parameters related to alarm detection conditions.

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0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4009	4009						ALSP		

ALSP Motor power turn-off method when spindle alarm 24 (serial data transfer error) is issued
0 : Turns off the power after the motor is decelerated and stopped.
1 : Turns off the power to the motor immediately.
Set this parameter to 1 to turn off the power to the motor immediately when any spindle alarm is issued

0*i*	30*i*	
4087	4087	**Overspeed level**

Unit of data : 1%
Valid data range : 0 to 115
Initial setting : 115
This parameter sets an overspeed level.
When the speed exceeds [maximum motor speed (No. 4020) × setting data (%)], the overspeed alarm (spindle alarm 07) is issued.

> ⚠ **WARNING**
> Make sure this parameter is set to the initial setting value. Do not change the value.

0*i*	30*i*	
4088	4088	**Velocity error excess detection level when the motor is bound**

Unit of data : 0.01%
Valid data range : 0 to 10000
Initial setting : 75
This parameter sets a velocity error excess (spindle alarm 31) detection level when the motor is bound.
If a velocity error equal to or greater than [maximum motor speed (No. 4020) × setting data (%)] occurs when the motor is bound, for example, the motor binding alarm (spindle alarm 31) is issued.

0*i*	30*i*	
4089	4089	**Velocity error excess detection level when the motor is rotating**

Unit of data : 0.1%
Valid data range : 0 to 1000
Initial setting : 200
This parameter sets a velocity error excess detection level when the motor is rotating.
If a velocity error equal to or greater than [maximum motor speed (No. 4020) × setting data (%)] occurs, the velocity error excess alarm (spindle alarm 02) is issued.

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0*i*	30*i*	
4090	4090	**Overload detection level**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 90

This parameter sets a condition for detecting the short-time overload alarm (spindle alarm 29).
If the state where a load equal to or greater than setting data (%) (maximum motor output [load meter full scale] = 100%) is imposed on the spindle motor lasts for a specified period (set in No. 4123) or more, the short-time overload alarm (spindle alarm 29) is issued.

0*i*	30*i*	
4123	4123	**Short-time overload detection period**

Unit of data : 1sec
Valid data range : 0 to 500
Initial setting : 30

This parameter sets the timing for detecting the short-time overload alarm (spindle alarm 29).
If the state where a load equal to or greater than the specified value (set in parameter No. 4090) is imposed on the spindle motor lasts for at least the period specified in this parameter, the short-time overload alarm (spindle alarm 29) is issued.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4399	4399			NCHAMR					

NCHAMR Determines whether to detect “pole position count miss alarm (spindle alarm 91)”.
0: Detect alarm 91.
1: Does not detect alarm 91.

When the one-rotation signal is detected, this function monitors the difference between the initial magnetic pole position estimated by magnetic pole detection and AMR offset (parameter No. 4084). If the parameter-set threshold is exceeded, alarm 91 is detected.
If spindle alarm 91 must be invalidated temporarily for adjustment and other purposes, set this parameter to "-1 (alarm 91 is invalid)".

NOTE
1 When the α*i*CZ sensor (serial) is used, this function cannot be used.
2 This function is valid after executing AMR offset. Therefore, following parameters are needed to be set.
No.4008#6 = “0 (AMR offset is valid)”
No.4084 = “An adjustment value”
3 The magnetic pole undetected state (EPFIX: F048#7) is reset to 0 if spindle alarm 91 is issued.
4 This parameter is valid with
9D53 series I (09) edition or later
9D70 series H (08) edition or later
9D80 series B (02) edition or later
9D90 series A (01) edition or later
9DA0 series A (01) edition or later
9DB0 series A (01) edition or later.

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0*i*	30*i*	
4463	4463	**Unexpected rotation detection level**

Unit of data : 0.1rev
Valid data range : -1, 0 to 500
Initial setting : 0

This parameter specifies the unexpected rotation detection level (Alarm 90 level).
When the sign of unexpected rotation is once detected, spindle amplifier (SP) begins to sum the velocity error. When the motor rotates normally, Sp subtracts the velocity error from the summation. If the parameter-set threshold is exceeded, alarm 90 is detected.
When “0” is set, 1.0rev is set internally.
If spindle alarm 90 must be invalidated temporarily for adjustment and other purposes, set this parameter to "-1 (alarm 90 is invalid)".

NOTE
*1 The magnetic pole undetected state (EPFIX: F048#7) is reset to 0 if spindle alarm 90 is issued.
*2 This parameter is valid with
9D53 series I (09) edition or later
9D70 series H (08) edition or later
9D80 series B (02) edition or later
9D90 series A (01) edition or later
9DA0 series A (01) edition or later
9DB0 series A (01) edition or later.

0*i*	30*i*	
4464	4464	**Velocity command-dependent over speed detection offset level**

Unit of data : 0.1%
Valid data range : -1, 0 to 500
Initial setting : 0

This parameter sets the offset speed level for detecting the over speed (spindle alarm 92) according to the velocity command.
When the spindle motor reaches the velocity command plus the maximum motor speed (No. 4020) × setting data% the velocity command-dependent over speed alarm (spindle alarm 92) is issued. This detection level is automatically updated if the velocity command increases or changes to 0 or if control mode (such as speed mode or orientation mode) changes.
If the setting is "0", the offset level is 15%.
If spindle alarm 92 must be invalidated temporarily for adjustment and other purposes, set this parameter to "-1 (alarm 92 is invalid)".

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NOTE
*1 The magnetic pole undetected state (EPFIX: F048#7) is reset to 0 if spindle alarm 92 is issued.
*2 This parameter is valid with
9D53 series I (09) edition or later
9D70 series H (08) edition or later
9D80 series B (02) edition or later
9D90 series A (01) edition or later
9DA0 series A (01) edition or later
9DB0 series A (01) edition or later.

0*i*	30*i*	
4465	4465	**Excessive speed deviation level 2**

Unit of data : If the setting is positive, 1 min^{-1}
(When bit 2 (SPDUNT) of parameter No. 4006 is 1, 10 min^{-1})
If the setting is negative: 0.1%
Valid data range : -1000 to 32767
Initial setting : 0

This parameter sets the alarm level for excessive speed deviation alarms (spindle alarms 02 and 31) in units of 1 min^{-1} (motor speed) or as a ratio to the motor velocity command. Depending on the setting of this parameter, the alarm level (min^{-1}) for the excessive speed deviation alarms is as follows:
- If the setting is positive: Setting of parameter No. 4465 (min^{-1})
- If the setting is negative: |Velocity command × Setting of parameter No. 4465/1000| (min^{-1})
If the setting is "0", this parameter is excluded from the excessive speed deviation alarm detection conditions.

NOTE
This parameter is valid with
9D53 series J (10) edition or later
9D70 series I (09) edition or later
9D80 series C (03) edition or later
9D90 series A (01) edition or later
9DA0 series A (01) edition or later
9DB0 series A (01) edition or later.

0*i*	30*i*	
4466	4466	**Excessive speed deviation detection time 2**

Unit of data : 0.1sec
Valid data range : 0 to 1000
Initial setting : 0

This parameter sets the period from the time the motor speed deviation exceeds the alarm level of the excessive speed deviation alarm set in parameter No. 4465 until an excessive speed deviation alarm (spindle alarm 02 or 31) is issued.
If the motor speed deviation goes below the alarm level within the period of time set in this parameter, the period of time is reset.

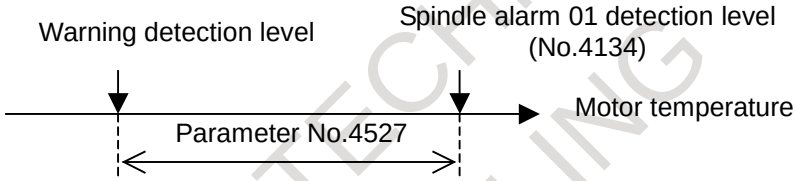
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NOTE
This parameter is valid with
9D53 series J (10) edition or later
9D70 series I (09) edition or later
9D80 series C (03) edition or later
9D90 series A (01) edition or later
9DA0 series A (01) edition or later
9DB0 series A (01) edition or later.

0*i*	30*i*	
4527	4527	**Temperature difference between warning level and alarm level**

Unit of data : 1K
Valid data range : 0 to 50
Initial setting : 0

This parameter sets the difference between motor overheat alarm detection temperature and the warning detection temperature. If the parameter setting is 0, the spindle motor overheat warning function is disabled.
While the motor temperature exceeds the warning detection temperature, the motor overheat warning (warning number 01) is issued.



(3) Other parameters

This item details the parameters common to all operation modes except the parameters listed in Items (1) and (2) above.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4001	4001								**MRDY1**

MRDY1 Whether to use the MRDYA signal (machine ready signal)
0 : Does not uses the MRDYA signal (MRDYA = 1 at all times).
1 : Uses the MRDYA signal.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4006	4006							**GRUNIT**	

GRUNIT Sets a gear ratio setting resolution:
0 : 1/100 unit
1 : 1/1000 unit

Select a gear ratio data setting resolution from the following:
(a) Resolution based on motor speed increased by a factor of 100 relative to one spindle rotation
(b) Resolution based on motor speed increased by a factor of 1000 relative to one spindle rotation
Depending on the setting of this parameter, the increment system of the parameters indicated in the table below changes.

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Parameter No.		Description
0*i*-D	30*i*	
4056 to 4059	4056 to 4059	Spindle-to-motor gear ratio data

NOTE
Usually, use the 1/100 unit (setting “0”).

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4009	4009				LDTOUT				VLPGAN

VLPGAN Velocity control loop gain increment system
0 : Uses ordinary setting.
1 : Divides ordinary setting data by 16 for processing.

NOTE
Usually, set this parameter to 0.

LDTOUT Whether to output the load detection signals (LDT1, LDT2) during acceleration/deceleration
0 : Does not output the load detection signals during acceleration/ deceleration (initial setting value).
1 : Outputs the load detection signals during acceleration/ deceleration (at all times) when the parameter-set level is exceeded.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4012	4012	SPHRV	SYSP						

SYSP Sets whether to drive the synchronous built-in spindle motor.
0 : Enables inductive spindle motor driving. (initial setting value)
1 : Enables synchronous built-in spindle motor driving.
Set this parameter to 1.

SPHRV Sets the spindle HRV control function.
0 : Disables spindle HRV control.
1 : Enables spindle HRV control. (initial setting value)
Set this parameter to 1.

NOTE
When driving the B*i*S series spindle (synchronous built-in spindle motor), be sure to set both of the SYSP and SPHRV bits to 1.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4019	4019	PRLOAD					SSTTRQ		

SSTTRQ Whether to perform torque clamping when the speed is zero
0 : Performs clamping.
1 : Does not perform clamping.

NOTE
Usually, set this parameter to 1 not to perform clamping.

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PRLOAD Automatic parameter setting function

0 : Does not perform automatic parameter setting (initial setting value).

1 : Performs automatic parameter setting.

After setting a desired motor model code in parameter No. 4133 and setting this bit to 1, turn off the power to the CNC, then turn on the power to the CNC again. The parameters (No. 4000 to No. 4175) for the αi series spindle corresponding to the model code are automatically initialized. Upon completion of automatic setting, this bit is automatically set to 0.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4352	4352							PKHALW	

PKHALW Sets the peak hold function for load meter output.

0 : Does not use the peak hold function. (initial setting value)

1 : Uses the peak hold function.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4395	4395					PRIMED			

PRIMED Sets parameter transfer from the CNC to spindle software.

0 : Regards parameters as valid one second after they are transferred from the CNC. (initial setting value)

1 : Regards parameters as valid as soon as they are transferred from the CNC.

NOTE

This parameter is valid with 9D53 series B (02) edition or later, 9D70 series A (01) edition or later, 9D80 series B (02) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later, and 9DB0 series A (01) edition or later.

0*i*	30*i*	
4020	4020	Maximum motor speed

Unit of data : $1min^{-1}$

Valid data range : 0 to 32767

Initial setting : Depends on the motor model.

This parameter sets a maximum spindle motor speed.

0*i*	30*i*	
4022	4022	Speed arrival detection level

Unit of data : 0.1%

Valid data range : 0 to 1000

Initial setting : 150

This parameter sets a speed arrival signal (SARA) detection range.

When the motor speed reaches within ±(setting data/10)% of a specified speed, the speed arrival signal (SARA) is set to 1.

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0*i*	30*i*	
4023	4023	**Speed detection level**

Unit of data : 0.1%
Valid data range : 0 to 1000
Initial setting : 30

This parameter sets a speed detection signal (SDTA) detection range.
When the motor speed is (setting data/10)% of a maximum speed or less, the speed detection signal (SDTA) is set to 1.

0*i*	30*i*	
4024	4024	**Speed zero detection level**

Unit of data : 0.01%
Valid data range : 0 to 10000
Initial setting : 75

This parameter sets a speed zero detection signal (SSTA) detection range.
When the motor speed is (setting data/100)% of a maximum speed or less, the speed zero detection signal (SSTA) is set to 1.

NOTE
If the calculated speed zero detection level exceeds 200 min^{-1}, it is clamped at 200 min^{-1}. (9D53 series B (02) edition or later, 9D70 series A (01) edition or later, 9D80 series B (02) edition or later, 9D90 series A (01) edition or later, 9DA0 series A (01) edition or later, and 9DB0 series A (01) edition or later)

0*i*	30*i*	
4025	4025	**Torque limitation value.**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 50

This parameter sets a torque limitation value to be applied when the torque limitation command HIGH (TLMHA) or the torque limitation command LOW (TLMLA) is specified.
The data indicates limitation values when the maximum torque is 100%.

Torque limitation command LOW (TLMLA)	Torque limitation command HIGH (TLMHA)	Description
0	0	No torque limitation is imposed.
0	1	The torque is limited to the value set in this parameter.
1	0	The torque is limited to a half of the value set in this parameter.
1	1	

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0*i*	30*i*	
4026	4026	**Load detection level 1**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 83

This parameter sets a load detection signal 1 (LDT1A) detection range. When the output of the spindle motor is (setting data)% of the maximum output or more, load detection signal 1 (LDT1A) is set to 1.

0*i*	30*i*	
4027	4027	**Load detection level 2**

Unit of data : 1%
Valid data range : 0 to 100
Initial setting : 95

This parameter sets a load detection signal 2 (LDT2A) detection range. When the output of the spindle motor is (setting data)% of the maximum output or more, load detection signal 2 (LDT2A) is set to 1.

NOTE
By default, this signal is not output in 10 seconds (set in parameter No. 4082) after the status of the speed command signal changes so that Load detection signal cannot be output by load of acceleration and deceleration. If the default time (No.4082) is not suited with the real acceleration and deceleration time, please refer to explanation of the parameter No.4082 and modify the value.
If "1" is set to the parameter No.4009#4, Load detection signal is always output when load meter is beyond set level instead of the acceleration and deceleration.

0*i*	30*i*		
4056	4056	**Gear ratio (HIGH)**	**CTH1A=0, CTH2A=0**
4057	4057	**Gear ratio (MEDIUM HIGH)**	**CTH1A=0, CTH2A=1**
4058	4058	**Gear ratio (MEDIUM LOW)**	**CTH1A=1, CTH2A=0**
4059	4059	**Gear ratio (LOW)**	**CTH1A=1, CTH2A=1**

Unit of data : (Motor rotation for one rotation of spindle) / 100
(When parameter No. 4006 #1 (GRUNIT) is 1, motor rotation / 1000)
Valid data range : 0 to 32767
Initial setting : 100

These data are used to set the gear ratio between spindle and spindle motor.
Example :
When the spindle rotates once, set "250" as the data when the motor rotates 2.5 times.
A parameter is selected with the CTH1A and CTH2A input signals.
Set the gear or clutch status to correspond to the clutch/gear signal (CTH1A, CTH2A) in input signals.

NOTE
When an improper value is set in these parameters, an unexpected operation can occur. For example, the spindle can continue rotating without stopping at the time of orientation. So, be sure to set a proper gear ratio.

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0*i*	30*i*	
4095	4095	**Speedometer output voltage adjustment value**

Unit of data : 0.1%
Valid data range : -1000 to +100(-100% to +10%)
Initial setting : 0
Set this parameter when making a fine adjustment of speedometer output voltage.
Positive (+) data increases the output voltage.

NOTE
Usually, this parameter need not be adjusted.

0*i*	30*i*	
4096	4096	**Load meter output voltage adjustment value**

Unit of data : 0.1%
Valid data range : -1000 to +100(-100% to +10%)
Initial setting : 0
Set this parameter when making a fine adjustment of load meter output voltage.
Positive (+) data increases the output voltage.

NOTE
Usually, this parameter need not be adjusted.

0*i*	30*i*	
4122	4122	**Speed detection filter time constant**

Unit of data : 0.1ms
Valid data range : 0 to 10000
Initial setting : 0
This parameter sets a time constant for a filter to be applied to the velocity feedback signal.

NOTE
Usually, this parameter need not be adjusted.

0*i*	30*i*	
4345	4345	**Specified detection level of the spindle motor speed**

Unit of data : 1 min^{-1}
Valid data range : 0 to 32767
Initial setting : 0
This parameter sets the detection level of the spindle motor speed detection function. If the specified spindle motor speed is greater than the set value, the level of the speed specification detection signal output from the spindle amplifier to the CNC becomes 1.
If the set value is 0, the level of the speed specification detection signal is always 0.

0*i*	30*i*	
4346	4346	**Incomplete integral coefficient**

Unit of data :
Valid data range : 0 to 32767
Initial setting : 0
Set this parameter to use incomplete integral function for velocity loop integral control.

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NOTE
Usually, this parameter need not be adjusted.

0*i*	30*i*	
4351	4351	**Current detection offset compensation**

Unit of data :
Valid data range : 0 to ±32767
Initial setting : 0

NOTE
Usually, this parameter need not be adjusted.

2.6.5 Diagnosis (Diagnosis Screen)

For this subsection, see Subsection 2.6.5, “Diagnosis (Diagnosis Screen)”, in Part I.

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3 I/O SIGNALS (CNC↔PMC)

This chapter explains the functions of the signals directly input from the PMC to spindle amplifier (SP) via the CNC and the signals directly output from the spindle amplifier (SP) to PMC. For other spindle-related I/O signals, refer to "SPINDLE SPEED FUNCTION" of the Connection Manual (Function) of the relevant CNC.

⚠ WARNING

1 Operation of each signal described in this chapter is not guaranteed if an alarm is issued or if a hardware failure or abnormal operation occurs.
2 A signal described in this chapter can be used as a safety function only when it is described that "the signal can be used as a safety function".

⚠ CAUTION

Each signal described in this chapter is disabled and its operation is not guaranteed after power-on until the parameters have been transferred from the CNC to the spindle amplifier. After checking spindle operation ready signal SRSRDY and other signals (refer to the Connection Manual for the relevant CNC) to see the ready status, use the signals described in this chapter.

3.1 INPUT SIGNALS (PMC→CNC→SP)

This chapter explains the functions of the signals directly input from the PMC to spindle amplifier (SP) via the CNC and the address for signals of the first spindle or second spindle.

"FANUC Series 0*i*-MODEL D CONNECTION MANUAL (FUNCTION) : B-64303EN-1
Refer to Chapter 10, "SPINDLE SPEED FUNCTION."

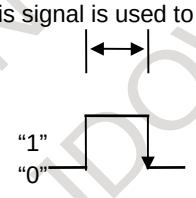
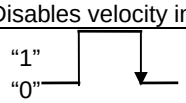
3.1.1 List of Input Signals

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G070	G070	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
2nd-	G074	G074	MRDYB	ORCMB	SFRB	SRVB	CTH1B	CTH2B	TLMHB	TLMLB
1st-	G071	G071			INTGA	SOCNA			*ESPA	ARSTA
2nd-	G075	G075			INTGB	SOCNB			*ESPB	ARSTB
1st-	G072	G072			INCMDA	OVRA		NRROA	ROTAA	INDXA
2nd-	G076	G076			INCMDB	OVRB		NRROB	ROTAB	INDXB
1st-	G073	G073	EPFSTRA			DSCNA	SORSLA	MPOFA	SLVA	
2nd-	G077	G077	EPFSTRB			DSCNB	SORSLB	MPOFB	SLVB	

3.1.2 Explanation of Input Signals

The signals whose names are not listed in Subsection 3.1.1, "List of Input Signals", in Part III are not supported by the B*i*S series spindle.

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Symbol	Name	Description
TLMLA, B	Torque limitation command LOW	These signals limit the output torque of the spindle motor. The limit value is set in spindle parameter No. 4025. TLML TLMH 0 0 : Torque not limited 0 1 : Limited to the parameter-set value 1 0 : Limited to about half of the parameter-set value 1 1 : Limited to about half of the parameter-set value
TLMHA, B	Torque limitation command HIGH	
CTH1A, B CHT2A, B	Clutch/gear signal	These signals set the conditions listed below according to the clutch or gear status. The signals can also be used for selecting spindle control parameters. The names such as HIGH GEAR are given for convenience, and the correspondence to the actual gears is free. CTH1 CTH2 0 0 : HIGH GEAR 0 1 : MEDIUM HIGH GEAR 1 0 : MEDIUM LOW GEAR 1 1 : LOW GEAR
SRVA, B	Reverse rotation command	These signals set the rotation direction of the spindle motor when viewed from the shaft side. SRV SFR 0 0 : Stopped 0 1 : Forward rotation (CCW: Counterclockwise direction) 1 0 : Reverse rotation (CW: Clockwise direction) 1 1 : Stopped
SFRA, B	Forward rotation command	
ORCMA, B	Spindle orientation command	This signal is used to perform spindle orientation control. 0: Turns off the spindle orientation command. 1: Performs spindle orientation control.
MRDYA, B	Machine ready signal	0: Motor excitation is off. 1: Ready for operation
ARSTA, B	Spindle alarm reset signal	This signal is used to reset spindle alarms.  An alarm is reset when the signal status changes from "1" to "0".
*ESPA, B	Emergency stop signal	0: Emergency stop 1: Normal operation
SOCNA, B	Soft start/stop signal	0: Disables the soft start/stop function. 1: Enables the soft start/stop function.
INTGA, B	Velocity integral control signal	0: Enables velocity integral control. 1: Disables velocity integral control.
INDXA, B	Orientation stop position change command	 This signal is used in orientation with the stop position set external setting type. When the status of this signal changes from "1" to "0", new position stop data is input, and a movement to the new position then a stop take place.
ROTAA, B	Rotation direction command at orientation stop position change	This signal is used in orientation with the stop position set external setting type. 0: CCW (counterclockwise) 1: CW (clockwise)
NRROA, B	Shortcut command at orientation stop position change	This signal is used in orientation with the stop position set external setting type. 0: The rotation direction depends on the ROTA signal setting. 1: Shortcut control (within ±180°)

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Symbol	Name	Description
OVRA, B	Analog override command	0: Disables analog override. 1: Enables analog override.
INCMDA, B	Incremental command	1: Incremental command spindle orientation 0: Ordinary orientation
MPOFA, B	Motor power turn-off signal	1: Turns off the motor power.
SORSLA, B	Synchronous orientation request command	This signal requests a synchronous orientation operation. 0: Cancels synchronous orientation. 1: Requests synchronous orientation.
DSCNA, B	Disconnection detection disable signal	This signal is used to detach the feedback cable between the amplifier and motor. This signal is disabled in the excitation ON state. 0: Enables disconnection and overheat detection. 1: Disables disconnection and overheat detection.
EPFSTRA, B	Magnetic pole detection operation start signal	Signal for starting magnetic pole detection operation 0: Cancels magnetic pole detection operation. 1: Requests magnetic pole detection operation.
SLVA, B	Tandem operation command	0: Disables tandem operation. 1: Enables tandem operation.

3.1.3 Details of Input Signals

(a) Torque limitation command signals (TLMLA, TLMHA)

For details of these signals, see Subsection 3.1.2, “Explanation of Input Signals”, in Part I.

(b) Clutch/gear signals (CTH1A, CTH2A)

For details of these signals, see Subsection 3.1.2, “Explanation of Input Signals”, in Part I.

(c) Forward rotation command signal (SFRA) and reverse rotation command signal (SRVA)

For details of these signals, see Subsection 3.1.2, “Explanation of Input Signals”, in Part I.
For these signals, see also Section 1.5, “MAGNETIC POLE DETECTION”, in Part III.

(d) Spindle orientation command (ORCMA)

For details of this signal, see Subsection 3.1.2, “Explanation of Input Signals”, in Part I.

(e) Machine ready signal (MRDYA)

For details of this signal, see Subsection 3.1.2, “Explanation of Input Signals”, in Part I.
For this signal, see also Section 1.5, “MAGNETIC POLE DETECTION”, in Part III.

(f) Spindle alarm reset signal (ARSTA)

For details of this signal, see Subsection 3.1.2, “Explanation of Input Signals”, in Part I.

(g) Emergency stop signal (*ESPA)

For details of this signal, see Subsection 3.1.2, “Explanation of Input Signals”, in Part I.
For this signal, see also Section 1.5, “MAGNETIC POLE DETECTION”, in Part III.

(h) Soft start/stop signal (SOCNA)

For details of this signal, see Subsection 3.1.2, “Explanation of Input Signals”, in Part I.

(i) Velocity integral control signal (INTGA)

For details of this signal, see Subsection 3.1.2, “Explanation of Input Signals”, in Part I.

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(j) Orientation stop position change command (INDXA), rotation direction command at orientation stop position change (ROTAA), shortcut command at orientation stop position change (NRROA), and incremental command (INCMDA)

For details of these signals, see Section 2.2, "POSITION CODER METHOD SPINDLE ORIENTATION", in Part I and Section 5.3, "INCREMENTAL COMMAND TYPE SPINDLE ORIENTATION", in Part I.

(k) Spindle analog override command (OVRA)

For details of this signal, see Subsection 3.1.2, "Explanation of Input Signals", in Part I.

(l) Motor power turn-off signal (MPOFA)

NOTE
Some specifications of this signal differ from those with an inductive spindle motor.

For details of this signal, see Subsection 3.1.2, "Explanation of Input Signals", in Part I.
Some specifications of this signal differ from those with an inductive spindle motor, so carefully set this signal for the sub module SM and magnetic pole detection. See Sections 1.4, "SUB MODULE SM," and 1.5, "MAGNETIC POLE DETECTION," in Part III.

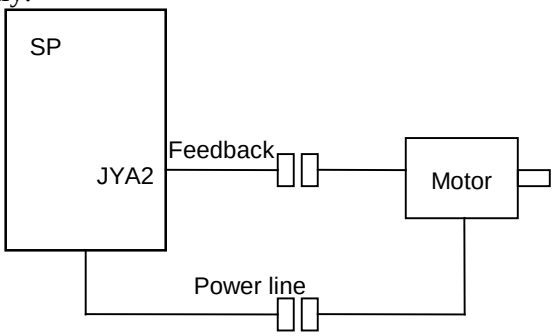
(m) Synchronous orientation request command (SORSLA)

For details of this signal, see Section 5.5, "SPINDLE ORIENTATION DURING SPINDLE SYNCHRONIZATION CONTROL", in Part I.

(n) Disconnection detection disable signal (DSCNA)

NOTE
1 When the dual check safety function is enabled, this signal is disabled. In the FS30*i* series MODEL B CNC, however, this signal can be used in combination with the safety stop/temporary stop signal. For details, refer to the explanation of the dual check safety in the Connection Manual (B-64483EN-2)".
2 When the α*i*CZ sensor (serial) is used, this function cannot be used.
3 The specifications of this signal partly differ from the specifications for the inductive spindle motor. This signal is disabled in the excitation ON state.

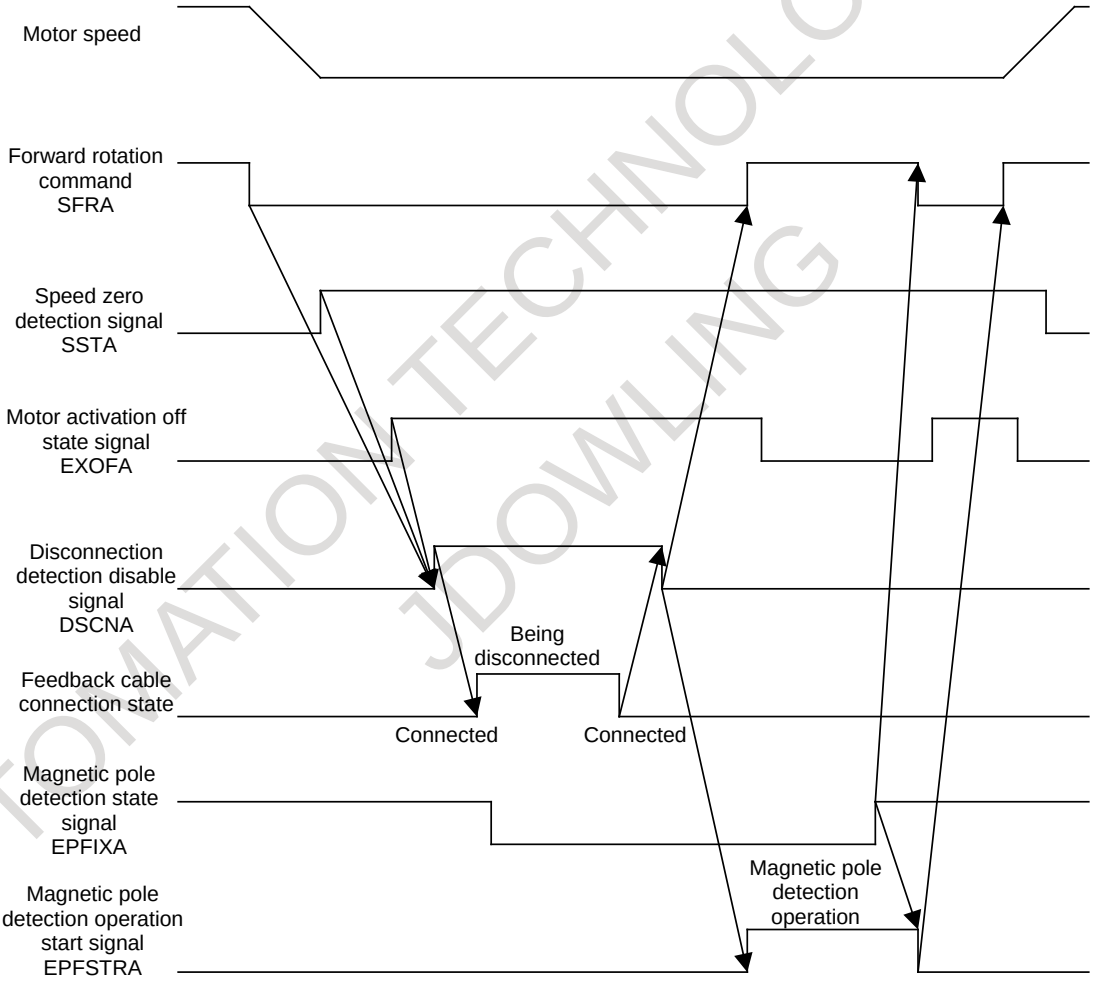
(1) This signal is used when the connection between the spindle amplifier and spindle motor needs to be disconnected temporarily.



(2) When this signal is used to detach the feedback signal, motor overheat and the issuance of a feedback signal disconnection alarm can be prevented.

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(3) A motor excitation OFF state confirmation signal (EXOFA) is provided to confirm that the motor is not excited before the connected power line is detached.
(4) Before setting this signal to 1 and disconnecting the feedback signals and power line, set all the SFRA, SRVA, ORCMA, MRDYA, and *ESPA commands to 0, and confirm that the motor excitation OFF state confirmation signal (EXOFA) has been set to 1. After completing re-connection, reset this signal to 0.
(5) With the synchronous built-in spindle motor, the motor sensor disconnection alarm (spindle alarm 73) is issued during activation even if this signal is set to 1.
(6) With the synchronous built-in spindle motor, the motor sensor feedback is monitored for a disconnection even while this signal is set to 1. When a disconnection is detected, the magnetic pole position undetected state (EPFIXA = 0) is set. So, while this signal is set to 1 (not during activation, however,), the motor sensor disconnection alarm (spindle alarm 73) is not detected even if the motor sensor feedback disconnection state is detected. In this case, however, the magnetic pole position undetected state is set.
(7) Sample sequence (for the synchronous built-in spindle motor)



(o) Magnetic pole detection operation start signal (EPFSTRA)

For details of this signal, see Section 1.5, “MAGNETIC POLE DETECTION”, in Part III.

(p) Tandem operation command (SLVA)

For details of this signal, see Section 5.10, "SPEED TANDEM CONTROL FUNCTION", in Part I.

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3.2 OUTPUT SIGNALS (SP→CNC→PMC)

This section explains the functions of the signals directly output from the spindle amplifier (SP) to PMC via the CNC.

3.2.1 List of Output Signals

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F045	F045	ORARA	TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	ALMA
2nd-	F049	F049	ORARB	TLMB	LDT2B	LDT1B	SARB	SDTB	SSTB	ALMB
1st-	F046	F046				SLVSA				
2nd-	F050	F050				SLVSB				
1st-	F047	F047				EXOFA	SORENA		INCSTA	PC1DTA
2nd-	F051	F051				EXOFB	SORENB		INCSTB	PC1DTB
1st-	F048	F048	EPFIXA			CSPENA	SSMBRKA			
2nd-	F052	F052	EPFIXB			CSPENB	SSMBRKB			

3.2.2 Explanation of Output Signals

The signals whose names are not listed in Subsection 3.2.1, “List of Output Signals”, in Part III are not supported by the B*i*S series spindle.

Symbol	Name	Description
ALMA, B	Alarm signal	This signal is output when a spindle alarm is issued. 0: Normal state 1: Alarm state
SSTA, B	Zero speed detection signal	This signal is output when the actual rotation speed of the spindle motor has decreased to the zero speed detection level or lower. 0: Rotating 1: Zero speed state
SDTA, B	Speed detection signal	This signal is output when the actual rotation speed of the spindle motor has decreased to a predetermined rotation speed or lower. 0: Above predetermined speed 1: Predetermined speed or lower
SARA, B	Speed arrival signal	This signal is output when the actual rotation speed of the spindle motor has achieved a predetermined range for a speed command. 0: Speed not achieved 1: Speed achieved
LDT1A, B	Load detection signal 1	These signals are output when load at a set load detection level or higher is detected. Different levels can be set for LDT1A and LDT2A. 0: Lower than the set load 1: Set load or higher
LDT2A, B	Load detection signal 2	
TLMA, B	Torque limitation in-progress signal	This signal is output when the torque is being limited by the TLMLA or TLMHA signal. 0: Torque not being limited 1: Torque being limited
ORARA, B	Orientation completion signal	This signal is output when the spindle stops in the neighborhood of a predetermined position after an orientation command is input. 0: Orientation not completed 1: Orientation completed

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Symbol	Name	Description
PC1DTA, B	Position coder one-rotation signal detection state signal	This signal is used to confirm whether the position coder one-rotation signal is detected or not. 0: Position coder one-rotation signal not detected 1: Position coder one-rotation signal detected
INCSTA, B	Incremental orientation signal	This signal is used to confirm whether incremental spindle orientation is being performed or not. 0: Incremental spindle orientation is not in progress. 1: Incremental spindle orientation is in progress.
SORENA, B	Synchronous orientation enable signal	This signal is used to confirm whether synchronous orientation is enabled or not. 0: Disables synchronous orientation. 1: Enables synchronous orientation.
EXOFA, B	Motor excitation off state signal	This signal is used to confirm whether motor excitation is off. 0: Motor excitation is in progress. 1: Motor excitation is off.
SSMBRKA, B	Sub module SM (SSM) error state signal	This signal is used to check the error state of the sub module SM (SSM). 0: The SSM is normal. 1: The SSM is abnormal.
CSPENA, B	Cs reference position establishment state signal	This signal is used to indicate whether Cs axis coordinate establishment processing is possible. 0: Coordinate establishment processing is impossible (with a reference position not established). 1: Coordinate establishment processing is possible (with a reference position established).
EPFIXA, B	Magnetic pole detection state signal	This signal is used to check whether magnetic pole detection is completed or not. 0: Magnetic pole detection is not completed. 1: Magnetic pole detection is completed.
SLVSA, B	Tandem operation state signal	This signal is used with the spindle tandem function. 0: Tandem operation is not in progress. 1: Tandem operation is in progress.

3.2.3 Details of Output Signals

(a) Spindle alarm signal (ALMA)

For details of this signal, see Subsection 3.2.2, “Explanation of Output Signals”, in Part I.

(b) Zero speed detection signal (SSTA)

For details of this signal, see Subsection 3.2.2, “Explanation of Output Signals”, in Part I.

> ⚠ **CAUTION**
> 1 If a motor feedback signal disconnection alarm (spindle alarm 73) is issued, the status of this signal is undefined.
> 2 When bit 5 of parameter No. 4007 is set to "1", the detection operation of the feedback signal disconnection alarm is not performed.
> Set the parameter to "0" when not required, to enable alarm detection.

(c) Speed detection signal (SDTA)

For details of this signal, see Subsection 3.2.2, “Explanation of Output Signals”, in Part I.

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> ⚠ **CAUTION**
> 1 If a motor feedback signal disconnection alarm (spindle alarm 73) is issued, the status of this signal is undefined.
> 2 When bit 5 of parameter No. 4007 is set to "1", the detection operation of the feedback signal disconnection alarm is not performed.
> Set the parameter to "0" when not required, to enable alarm detection.

(d) Speed arrival signal (SARA)

For details of this signal, see Subsection 3.2.2, “Explanation of Output Signals”, in Part I.

(e) Load detection signals (LDT1A, LDT2A)

For details of these signals, see Subsection 3.2.2, “Explanation of Output Signals”, in Part I.

(f) Torque limitation in-progress signal (TLMA)

For details of this signal, see Subsection 3.2.2, “Explanation of Output Signals”, in Part I.

(g) Orientation completion signal (ORARA)

For details of this signal, see Section 2.2, “POSITION CODER METHOD SPINDLE ORIENTATION”, in Part I.

(h) Position coder one-rotation signal detection state signal (PC1DTA)

For details of this signal, see Subsection 3.2.2, “Explanation of Output Signals”, in Part I.

(i) Incremental orientation signal (INCSTA)

For details of this signal, see Section 5.3, “INCRMENTAL COMMAND TYPE SPINDLE ORIENTATION”, in Part I.

(j) Synchronous orientation enable signal (SORENA)

For details of this signal, see Section 5.5, “SPINDLE ORIENTATION DURING SPINDLE SYNCHRONIZATION CONTROL”, in Part I.

(k) Motor excitation off state signal (EXOFA)

For details of this signal, see Subsection 3.1.3(p), “Disconnection detection disable signal (DSCNA)”, in Part I.

(l) Sub module SM (SSM) error state signal (SSMBRKA)

For details of this signal, see Section 1.4, “SUB MODULE SM”, in Part III.

(m) Cs reference position establishment state signal (CSPENA)

For details of this signal, see Subsection 3.2.2, “Explanation of Output Signals”, in Part I.

(n) Magnetic pole detection state signal (EPFIXA)

For details of this signal, see Section 1.5, “MAGNETIC POLE DETECTION”, in Part III.

(o) Tandem operation state signal (SLVSA)

For details of this signal, see Section 5.10, "SPEED TANDEM CONTROL FUNCTION", in Part I.

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4 ADJUSTMENT

4.1 VELOCITY LOOP GAIN ADJUSTMENT

4.1.1 Overview

For this subsection, see Subsection 4.1.1, “Overview”, in Part I.

4.1.2 Parameters

For this subsection, see Subsection 4.1.2, “Parameters”, in Part I.

4.1.3 Adjustment Procedure

For this subsection, see Subsection 4.1.3, “Adjustment Procedure”, in Part I.

4.1.4 Additional Information (Position Gain Adjustment)

For this subsection, see Subsection 4.1.4, “Additional Information (Position Gain Adjustment)”, in Part I.

4.2 MACHINE RESONANCE ELIMINATION

4.2.1 TCMD Filter

For this subsection, see Subsection 4.2.1, “TCMD Filter”, in Part I.

4.2.2 Resonance Elimination Filter

For this subsection, see Subsection 4.2.2, “Resonance Elimination Filter”, in Part I.

※When the resonance elimination filter disable signal is used, the following spindle and CNC software products must be used.

Spindle software

Series	Edition	Usable CNC
9D53	L (12) edition or later	
9D70	L (12) edition or later	
9D80	H (08) edition or later	
9D90	A (01) edition or later	
9DA0	A (01) edition or later	
9DB0	A (01) edition or later	

CNC software (Resonance elimination filter disable signal supported)

Series	Edition	Usable CNC
G002/G012/ G022/G032	W (23) edition or later	FANUC Series 30*i* /300*i* /300*i*s-A
G003/G013/ G023/G033	F (06) edition or later	
G121/G131	W (23) edition or later	FANUC Series 31*i* /310*i* /310*i*s-A5

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Series	Edition	Usable CNC
G123/G133	F (06) edition or later	
G101/G111	W (23) edition or later	FANUC Series 31*i* /310*i* /310*i*s-A
G103/G133	F (06) edition or later	
G201	W (23) edition or later	FANUC Series 32*i* /320*i* /320*i*s-A
G203	F (06) edition or later	

* For the series 30*i*-B, 0*i*-F and 0*i*-D, the first edition and later support the signal.

4.2.3 Adaptive Resonance Elimination Filter

For this subsection, see Subsection 4.2.3, "Adaptive Resonance Elimination Filter", in Part I.

4.3 AMPLITUDE RATIO/PHASE DIFFERENCE COMPENSATION FUNCTION

For this section, see Subsection 4.3, “AMPLITUDE RATIO/PHASE DIFFERENCE COMPENSATION FUNCTION”, in Part I.

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5 FUNCTION DESCRIPTIONS

Support /Not support of the function in the B*i*S series spindle (synchronous spindle motor) is shown in the list.

	Function	Support/Not support	Reference
1	Speed range switching control	×	III-5.1
2	Spindle switching control	×	III-5.2
3	Incremental command type spindle orientation	○	III-5.3
4	Conventional method orientation	○	III-5.4
5	Spindle orientation during spindle synchronization control	○	III-5.5
6	Unexpected disturbance torque detection function	○	III-5.6
7	Spindle EGB	○	III-5.7
8	Differential spindle speed control	×	III-5.8
9	Dual position feedback function	×	III-5.9
10	Velocity tandem control function	○	III-5.10
11	Tandem disturbance elimination control	○	III-5.11
12	Torque tandem control function	×	III-5.12
13	Magnetic sensor method spindle orientation	×	III-5.13
14	Spindle backlash acceleration function	○	III-5.14
15	High-speed spindle orientation	○	III-5.15
16	Magnetic flux boost function	×	III-5.16
17	Adjusting FSSB High-speed rigid tapping	○	III-5.17
18	Cutting feed/rapid traverse PWM frequency switching function in Cs contour control	○	III-5.18
19	Load meter (Normalized by the continuous rated output)	○	III-5.19
20	Power failure backup function	○	III-5.20
21	Twin drive for spindle motor	○	III-5.21
22	How to use a distance coded sensor for a spindle	○	III-5.22
23	Inertia estimation function	○	III-5.23
24	Smart rigid tapping	○	III-5.24
25	Smart thermal control	○	III-5.25
26	Coupling failure detection between a spindle and a spindle motor	×	III-5.26
27	Spindle oscillating torque input function	○	III-5.27
28	Smart load meter	○	III-5.28
29	Smart backlash compensation (Cs axis)	×	III-5.29

5.1 SPEED RANGE SWITCHING CONTROL (OPTIONAL FUNCTION)

The B*i*S series spindle (synchronous built-in spindle motor) does not support this function.

5.2 SPINDLE SWITCHING CONTROL

The B*i*S series spindle (synchronous built-in spindle motor) does not support this function.

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5.3 INCRMENTAL COMMAND TYPE SPINDLE ORIENTATION (SPINDLE ROTATION SPEED CONTROL)

5.3.1 Overview

For this subsection, see Subsection 5.3.1, “Overview”, in Part I.

5.3.2 Series and Editions of Applicable Spindle Software

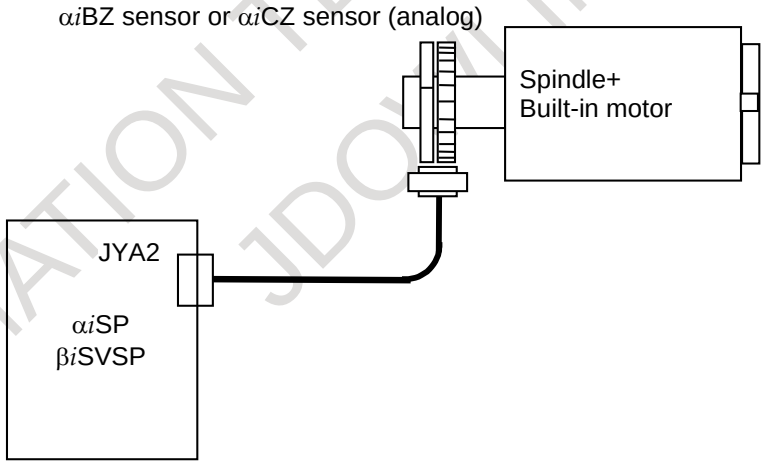
Spindle software

Series	Edition	Usable CNC
9D53	A (01)	FS0*i* -D
9D70	A (01)	FS30*i* / FS31*i* / FS32*i* -A
9D80	B (02)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9D90	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	A (01)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B

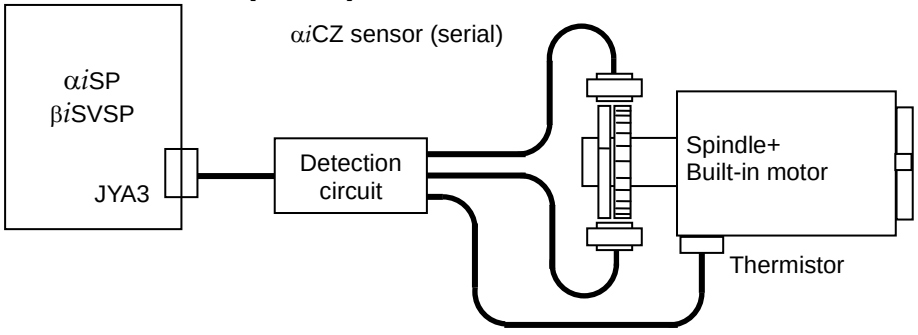
5.3.3 System Configuration

The incremental command type spindle orientation function can be used in the following system configuration.

(1) When the α*i*BZ sensor or α*i*CZ sensor (analog) is used



(2) When the α*i*CZ sensor (serial) is used



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5.3.4 I/O Signals (CNC↔PMC)

(1) Address list of input signals (PMC→CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G070	G070		ORCMA			CTH1A	CTH2A		
2nd-	G074	G074		ORCMB			CTH1B	CTH2B		
1st-	G072	G072			INCMDA			NRROA	ROTAA	INDXA
2nd-	G076	G076			INCMDB			NRROB	ROTAB	INDXB
1st-	G078	G078	SHA07	SHA06	SHA05	SHA04	SHA03	SHA02	SHA01	SHA00
2nd-	G080	G080	SHB07	SHB06	SHB05	SHB04	SHB03	SHB02	SHB01	SHB00
1st-	G079	G079					SHA11	SHA10	SHA09	SHA08
2nd-	G081	G081					SHB11	SHB10	SHB09	SHB08

(2) Details of input signals (PMC→CNC)

For this item, see Subsection 5.3.4(2), “Details of input signals (PMC→CNC)”, in Part I.

(3) Address list of output signals (CNC→PMC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F045	F045	ORARA							
2nd-	F049	F049	ORARB							
1st-	F047	F047							INCSTA	
2nd-	F051	F051							INCSTB	

(4) Details of output signals (CNC→PMC)

For this item, see Subsection 5.3.4(4), “Details of output signals (CNC→PMC)”, in Part I.

5.3.5 Examples of Sequences

For this subsection, see Subsection 5.3.5, “Examples of Sequences”, in Part I.

5.3.6 List of Related Parameters

Parameter No.		Description
0*i*	30*i*	
4015 #0	4015 #0	Whether the spindle orientation function is available (The CNC software option is required.)
3729 #0	3729 #0	Whether the stop position external setting-type spindle orientation function is available
4328	4328	Command multiplier for incremental command external setting data

NOTE

This subsection describes only the parameters specific to incremental command type spindle orientation. See Section 2.2, “POSITION CODER METHOD SPINDLE ORIENTATION” in Part I, for parameters related to other types of spindle orientation.

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5.3.7 Details of Related Parameters

For this subsection, see Subsection 5.3.7, “Details of Related Parameters”, in Part I.

5.4 CONVENTIONAL METHOD ORIENTATION (OPTIONAL FUNCTION)

5.4.1 Overview

For this subsection, see Subsection 5.4.1, “Overview”, in Part I.

NOTE
1 For the B*i*S series spindle (synchronous built-in spindle motor),
Parameter No. 4084
is used for the AMR offset function (not for the motor voltage on orientation).
If an inappropriate value is set for the AMR offset, the motor may move unpredictably.
2 For AMR offset function, see Subsection 1.5.3, “AMR Offset Function”, in Part III.

5.4.2 Series and Editions of Applicable Spindle Software

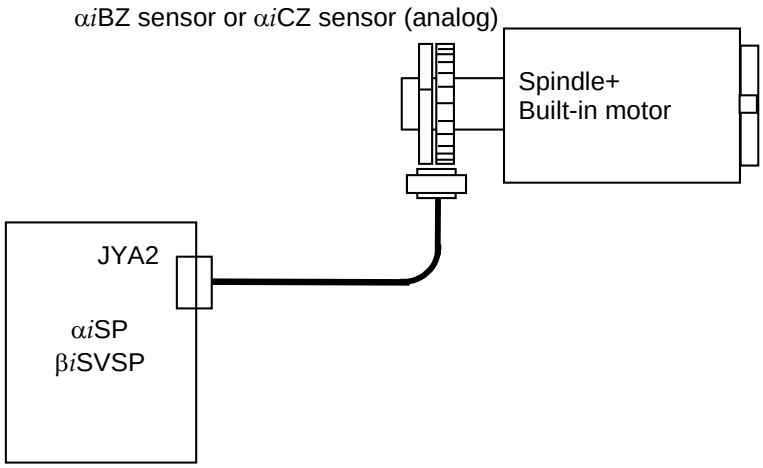
Spindle software

Series	Edition	Usable CNC
9D53	A (01)	FS0*i* -D
9D70	A (01)	FS30*i* / FS31*i* / FS32*i* -A
9D80	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9D90	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	A (01)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B

5.4.3 System Configuration

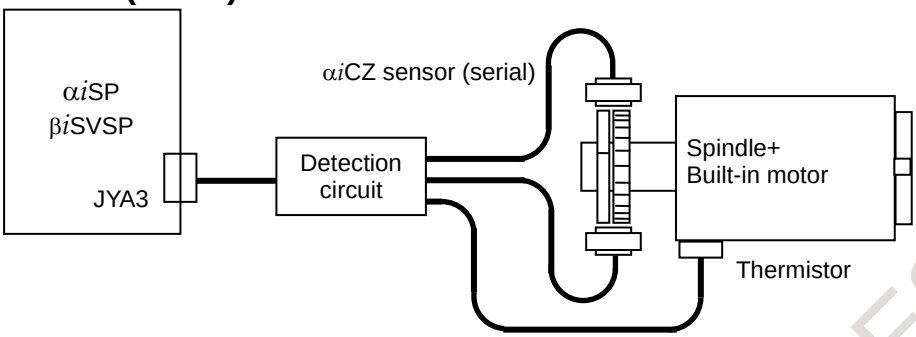
Explained below is a system configuration in which the conventional method orientation function is usable.

(1) When the α*i*BZ sensor or α*i*CZ (analog) sensor is used



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(2) When the α*i*CZ (serial) sensor is used



5.4.4 I/O Signals (CNC↔PMC)

For this subsection, see Section 2.2, “POSITION CODER METHOD SPINDLE ORIENTATION”, and Section 5.3, “INCREMENTAL COMMAND TYPE SPINDLE ORIENTATION” , in Part I.

5.4.5 Sequence

For this subsection, see Subsection 5.4.5, “Sequence”, in Part I.

5.4.6 List of Related Parameters

For this subsection, see Subsection 5.4.6, “List of Related Parameters”, in Part I.

5.4.7 Details of Related Parameters

For this subsection, see Subsection 5.4.7, “Details of Related Parameters”, in Part I.

5.4.8 Adjusting the Orientation Stop Position Shift Parameter

For this subsection, see Subsection 5.4.8, “Adjusting the Orientation Stop Position Shift Parameter”, in Part I.

5.4.9 Calculating the Position Gain for Orientation

For this subsection, see Subsection 5.4.9, “Calculating the Position Gain for Orientation”, in Part I.

5.4.10 Calculating the Orientation Time

For this subsection, see Subsection 5.4.10, “Calculating the Orientation Time”, in Part I.

5.5 SPINDLE ORIENTATION DURING SPINDLE SYNCHRONOUS CONTROL

5.5.1 Overview

For this subsection, see Subsection 5.5.1, “Overview”, in Part I.

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5.5.2 Series and Editions of Applicable Spindle Software

Spindle software

Series	Edition	Usable CNC
9D53	B (02)	FS0*i* -D
9D70	A (01)	FS30*i* / FS31*i* / FS32*i* -A
9D80	B (02)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9D90	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	A (01)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B

5.5.3 Specification

For this subsection, see Subsection 5.5.3, “Specification”, in Part I.

5.5.4 I/O Signals (CNC↔PMC)

(1) Address list of input signals (PMC→CNC)

(a) For path 1

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
	G038	G038					SPPHS	SPSYC		
1st-	G072	G072							ROTAA	
2nd-	G076	G076							ROTAB	
1st-	G073	G073					SORSLA			
2nd-	G077	G077					SORSLB			
1st-	G078	G078	SHA07	SHA06	SHA05	SHA04	SHA03	SHA02	SHA01	SHA00
2nd-	G080	G080	SHB07	SHB06	SHB05	SHB04	SHB03	SHB02	SHB01	SHB00
1st-	G079	G079					SHA11	SHA10	SHA09	SHA08
2nd-	G081	G081					SHB11	SHB10	SHB09	SHB08

(b) For path 2

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
	G1038	G1038					SPPHS	SPSYC		
1st-	G1072	G1072							ROTAA	
2nd-	G1076	G1076							ROTAB	
1st-	G1073	G1073					SORSLA			
2nd-	G1077	G1077					SORSLB			
1st-	G1078	G1078	SHA07	SHA06	SHA05	SHA04	SHA03	SHA02	SHA01	SHA00
2nd-	G1080	G1080	SHB07	SHB06	SHB05	SHB04	SHB03	SHB02	SHB01	SHB00
1st-	G1079	G1079					SHA11	SHA10	SHA09	SHA08
2nd-	G1081	G1081					SHB11	SHB10	SHB09	SHB08

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(2) Details of input signals (PMC→CNC)

(a) Spindle synchronous control command (SPSYC)

(b) Spindle phase synchronous control command or synchronous orientation command (SPPHS)

(c) Synchronous orientation request command (SORSLA)

(d) Synchronous orientation external stop position command (SHA11 to SHA00)

(e) Rotation direction command for synchronous (ROTAA)

For the input signals SPSYC, SPPHS, SORSLA, SHA11 to SHA00, and ROTAA, see Subsection 5.5.4(2), "Details of input signals (PMC→CNC)", in Part I.

(3) Address list of output signals (CNC→PMC)

(a) For path 1

0*i*-D	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
F044	F044				SYCAL	FSPPH	FSPSY		
1st- F047	F047					SORENA			
2nd- F051	F051					SORENB			

(b) For path 2

0*i*-D	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
F1044	F1044				SYCAL	FSPPH	FSPSY		
1st- F1047	F1047					SORENA			
2nd- F1051	F1051					SORENB			

(4) Details of output signals (CNC→PMC)

(a) Synchronous orientation permission signal (SORENA)

(b) Spindle speed synchronous control completion signal (FSPSY)

(c) Spindle phase synchronous control completion signal or synchronous orientation completion signal (FSPPH)

(d) Phase synchronous error monitor signal (SYCAL)

For the output signals SORENA, FSPSY, FSPPH, and SYCAL, see Subsection 5.5.4 (4), "Details of output signals (CNC→PMC)", in Part I.

5.5.5 Sequence

For this subsection, see Subsection 5.5.5, "Sequence", in Part I.

5.5.6 List of Related Parameters

Parameter No.		Description
0*i*	30*i*	
4801#0	4801#0	Direction in which each of spindles rotates under spindle synchronous control
4810	4810	That error pulse difference between two spindles on which the spindle phase synchronous completion signal is output
4811	4811	That error pulse difference between two spindles on which the spindle phase synchronous error monitor signal is output
3729#0	3729#0	Whether the stop position external setting-type spindle orientation function is available
4006#3	4006#3	Setting for disabling automatic detection of a one-rotation signal when the spindle synchronous control mode is switched
4014#6	4014#6	Whether the synchronous orientation function is available

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Parameter No.		Description
0*i*	30*i*	
4032	4032	Acceleration at spindle synchronous control (It is necessary to specify the same value for the first and second spindles.)
4033	4033	Spindle synchronous speed arrival level
4034	4034	Shift amount at spindle phase synchronous control
4035	4035	Spindle phase synchronous compensation data
4044 4045	4044 4045	Velocity proportional gain on spindle synchronous control (This parameter is selected with the input signal CTH1A.)
4052 4053	4052 4053	Velocity integral gain on spindle synchronous control (This parameter is selected with the input signal CTH1A.)
4056 to 4059	4056 to 4059	Gear ratio data between spindle and motor (These parameters are selected with the input signals CTH1A and CTH2A.)
4065 to 4068	4065 to 4068	Position gain on spindle synchronous control (It is necessary to specify the same value for the first and second spindles.) (These parameters are selected with the input signals CTH1A and CTH2A.)
4075	4075	Orientation completion signal detection level
4336	4336	Acceleration switching point for spindle synchronous control (It is necessary to specify the same value for the first and second spindles.)
4340	4340	Bell-shaped acceleration/deceleration time constant for spindle synchronous control (It is necessary to specify the same value for the first and second spindles.)
4369	4369	Synchronous orientation deceleration coefficient

NOTE
1 See Section 1.3, “PARAMETERS RELATED TO DETECTORS”, in Part III for parameters related to detectors.
2 See Section 4.1, “VELOCITY LOOP GAIN ADJUSTMENT”, in Part III for velocity loop proportional/integral gain tuning.
3 See “Function Description: Spindle Synchronous Control” for parameters related to the spindle synchronous control function.

5.5.7 Details of Related Parameters

For this subsection, see Subsection 5.5.7, “Details of Related Parameters”, in Part I.

5.6 UNEXPECTED DISTURBANCE TORQUE DETECTION FUNCTION (OPTIONAL FUNCTION)

5.6.1 Overview

For this subsection, see Subsection 5.6.1, “Overview”, in Part I.

5.6.2 Series and Editions of Applicable Spindle Software

Spindle software

Series	Edition	Remark
9D53	E (05)	FS0*i* -D
9D70	D (04)	FS30*i* / FS31*i* / FS32*i* -A
9D80	B (02)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9D90	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	A (01)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B

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5.6.3 I/O Signals (CNC↔PMC)

(1) Address list of output signals (CNC→PMC)

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
F090	F090					ABTSP3	ABTSP2	ABTSP1	
F091	F091				ABTSP4				

(2) Details of output signals (CNC→PMC)

(a) First-spindle unexpected disturbance torque detection signals (ABTSP1 and AQSP1)

(b) Second-spindle unexpected disturbance torque detection signals (ABTSP2 and AQSP2)

(c) Third-spindle unexpected disturbance torque detection signals (ABTSP3 and AQSP3)

(d) Fourth-spindle unexpected disturbance torque detection signals (ABTSP4 and AQSP4)

These signals are output when the estimated load torques on the respective spindles become higher than or equal to the set level.

Refer to “Unexpected Disturbance Torque Detection Function” of an applicable CNC Connection Manual (Function) for details.

5.6.4 List of Related Parameters

Parameter No.		Description
0*i*	30*i*	
4015 #1	4015 #1	Whether the unexpected disturbance torque detection function is available (The CNC software option is required.)
4248	4248	Torque constant for spindle load torque monitoring
4249	4249	Observer gain 1 for spindle load torque monitoring
4250	4250	Observer gain 2 for spindle load torque monitoring
4341	4341	Unexpected disturbance torque detection level

5.6.5 Details of Related Parameters

For this subsection, see Subsection 5.6.5, “Details of Related Parameters”, in Part I.

5.6.6 Parameter Tuning Procedure

For this subsection, see Subsection 5.6.6, “Parameter Tuning Procedure”, in Part I.

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5.7 SPINDLE EGB (SPINDLE ELECTRONIC GEAR BOX) (OPTIONAL FUNCTION)

5.7.1 Overview

The spindle EGB function is intended to use one of spindles in a pair as a tool axis (master axis) and the other as a workpiece axis (slave axis) and cause the slave axis to rotate in synchronization with the master axis at a specified synchronous ratio. Refer to "Spindle Electronic Gear Box" of an applicable CNC Connection Manual (Function) for details of this function.

NOTE
1 Using this function requires the CNC software option.
2 Using this function requires SP TYPE B for both the master and slave axes for the A06B-61xx-Hxxx amplifier.
3 For the master and slave axes, use the spindle software of the same series and edition.
4 This function cannot be used together with the spindle fine Acc./Dec. (FAD) function.
5 This function cannot be used together with the spindle tandem control function.
6 This function cannot be used with the FANUC Series 32*i*.
7 There are no limitations on the assignment of the master and slave axes.
For descriptive purposes, this specification assumes:
Master spindle amplifier: First spindle
Slave spindle amplifier: Second spindle

5.7.2 Series and Editions of Applicable Spindle Software

Spindle software

Series	Edition	Remark
9D80	B (02)	FS30*i* / FS31*i* / FS32*i* -A
9D90	A (01)	FS30*i* / FS31*i* / FS32*i* -A
9DA0	B (02)	FS0*i*-F, FS30*i* / FS31*i* / FS32*i* -B
9DB0	A (01)	FS0*i*-F, FS30*i* / FS31*i* / FS32*i* -B

NOTE
When using the α*i*CZ sensor (serial) as the motor or spindle sensor, use 9D80 series H (08) edition.

CNC software

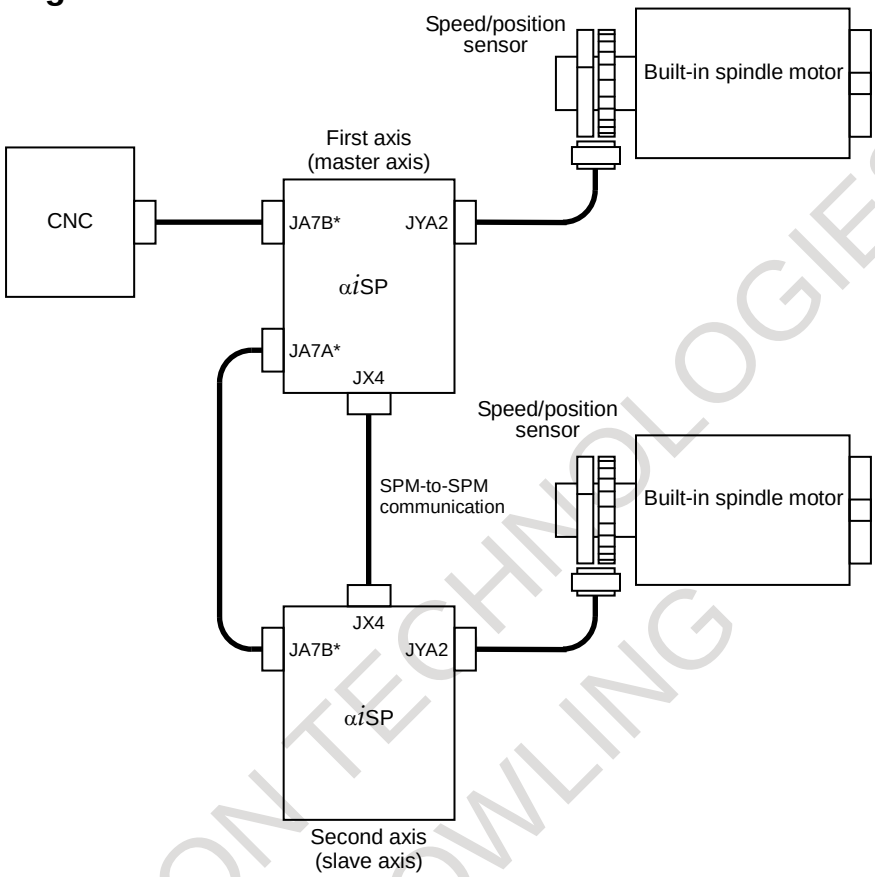
Series	Edition	Remark
G003/G013/ G023/G033/ G00C/G01C G02C/G03C	28 edition or later	FANUC Series 30*i*/300*i* /300*i*s-A
G004/G014 G024/G034	01 edition or later	
G123/G133 G12C/G13C	28 edition or later	FANUC Series 31*i*/310*i* /310*i*s-A5
G124/G134	01 edition or later	
G103/G113	28 edition or later	FANUC Series 31*i*/310*i* /310*i*s-A
G104/G114	01 edition or later	

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5.7.3 System Configuration

The spindle EGB function is usable in the following system configuration.

(1) System configuration with built-in motors



* For the FS30*i*-B series CNC (FSSB communication), use COP10A/COP10B instead of JA7A/JA7B.

NOTE
When using the α*i*CZ sensor (serial) as the motor sensor, connect the feedback cable to JYA3.

Parameter settings related to detectors

Parameter	Setting	Description
4000#0	0	The spindle and motor rotates in the same direction.
4002#3,#2,#1,#0	0,0,0,1	The motor sensor is used for position feedback.
4003#7,#6,#5,#4	0,0,0,0	It is unnecessary to specify the number of the spindle sensor teeth.
4010#2,#1,#0	0,0,1	α*i*MZ/α*i*BZ/α*i*CZ sensor (analog)
	0,1,1	α*i*CZ sensor (serial)
4011#2,#1,#0 or 4334	Depending on the sensor.	Setting for the number of motor sensor (speed sensor) teeth
4056 to 4059	100 or 1000	The spindle-to-motor gear ratio is 1:1. (The settings for these parameters vary depending on the gear ratio increment system specified in bit 1 or parameter No. 4006.)
4386 (*)	Depending on the sensor.	Setting for the number of master-axis motor sensor (speed sensor) teeth

(*) This parameter is valid only for the slave axis (second spindle).

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5.7.4 Block Diagram

For this subsection, see Subsection 5.7.4, “Block Diagram”, in Part I.

5.7.5 I/O Signals (CNC↔PMC)

This subsection lists only the input/output signals related to the spindle EGB. Refer to “Spindle Electronic Gear Box” of an applicable CNC Connection Manual (Function) for details of each signal.

(1) Input signals (PMC→CNC)

30*i*	#7	#6	#5	#4	#3	#2	#1	#0
G066				RTRCT				

(2) Output signals (CNC→PMC)

30*i*	#7	#6	#5	#4	#3	#2	#1	#0
F065		SYNMOD		RTRCTF				

5.7.6 Examples of Sequences

Refer to “Spindle Electronic Gear Box” of an applicable CNC Connection Manual (Function) for spindle EGB sequences.

5.7.7 List of Related Parameters

Parameter No.	Description
7700#0	Setting for releasing the synchronous mode at a reset
7700#2	Direction for helical compensation
7709	Axis number for helical gear axial feed axis
7710	Spindle EGB slave axis number
7772	The number of pulses the position sensor generates at each rotation of the tool axis (master axis) (Specify 360,000 for the IS-B.)
7773	The number of pulses the position sensor generates at each rotation of the workpiece axis (slave axis) (Specify 360,000 for the IS-B.)
7778	Acceleration for workpiece axis acceleration/deceleration
8005#4	Setting for the type of the PMC axis control constant-speed command function
8007#2	Setting for the velocity command for PMC axis control
8028	30*i*: Time for calculating the acceleration and deceleration for the velocity command for PMC axis control
8032	Feedrate for calculating the acceleration rate for the velocity command for PMC axis control
8040	Number of pulses the position sensor generates at each rotation of the spindle on a PMC-controlled axis (Specify 360,000 for the IS-B.)
4016#3	Setting for the feed-forward smoothing function
4352#4	Feed-forward setting
4352#6	Inter-SPM communication slave axis setting
4352#7	Inter-SPM communication master axis setting
4036	Feed forward coefficient
4037	Velocity loop feed forward coefficient
4046 4047	Velocity proportional gain on Cs contouring control (This parameter is selected with the PMC input signal CTH1A.)

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Parameter No.	Description
4054 4055	Velocity integral gain on Cs contouring control (This parameter is selected with the PMC input signal CTH1A.)
4069 to 4072	Position gain on Cs contouring control (This parameter is selected with the PMC input signal CTH1A.)
4386	Number of master-axis spindle sensor teeth
4387	Synchronous ratio numerator
4388	Synchronous ratio denominator
4498	Denominator of the master-axis motor sensor-to-spindle arbitrary gear ratio
4499	Numerator of the master-axis motor sensor-to-spindle arbitrary gear ratio
4396#2	Setting for on-off switching of the EGB command in the Cs contouring control mode
4548#6	Setting for 100% of feed forward for the EGB command
4616	Speed for changing slave axis acceleration in EGB automatic phase matching

NOTE
1 See Section 1.3, “PARAMETERS RELATED TO DETECTORS” in Part III for parameters related to detectors.
2 See Section 4.1, “VELOCITY LOOP GAIN ADJUSTMENT”, in Part IV for velocity loop proportional/integral gain tuning.

5.7.8 Details of Related Parameters

For this subsection, see Subsection 5.7.8, “Details of Related Parameters”, in Part I.

5.7.9 Diagnosis Signal Related to Spindle EGB

Address 30*i*	Description	Unit
0716	Synchronous error between master and slave axes. (Weight is slave side)	Pulse

5.7.10 Status Errors Related to Spindle EGB

Error No.	Description	Measure
33	Invalid hardware configuration	Check the model of the CNC in use.
34	An attempt was made to enable both the spindle EGB and FAD functions.	To use the spindle EGB function, disable the spindle FAD function.

5.7.11 Alarms

For this subsection, see Subsection 5.8.11, “Alarms”, in Part I.

5.8 DIFFERENTIAL SPINDLE SPEED CONTROL

The B*i*S series spindle (synchronous built-in spindle motor) does not support this function.

5.9 DUAL POSITION FEEDBACK FUNCTION

The B*i*S series spindle (synchronous built-in spindle motor) does not support this function.

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5.10 VELOCITY TANDEM CONTROL FUNCTION (OPTIONAL FUNCTION)

5.10.1 Overview

For this subsection, see Subsection 5.10.1, “Overview”, in Part I.
For the B*i*S series spindle (synchronous built-in spindle motor), only speed tandem control is applicable and torque tandem control cannot be used.

5.10.2 Series and Editions of Applicable Spindle Software

Spindle software

Series	Edition	Usable CNC
9D90	B (02)	FS30*i*-A / FS31*i*-A
9DA0	F (06)	FS0*i*-F, FS30*i*-B / FS31*i*-B
9DB0	A (01)	FS0*i*-F, FS30*i*-B / FS31*i*-B

NOTE
When using the α*i*CZ sensor (serial), 9D90 series G (07) edition or later or 9DA0 series I (09) edition or later is required.

5.10.3 System Configuration

For this subsection, see Subsection 5.10.3, “System Configuration”, in Part I.
The B*i*S series spindle is not applicable to "Sample configuration 2: System where the table axis is driven by two motors".

5.10.4 I/O Signals (CNC↔PMC)

For this subsection, see Subsection 5.10.4, “I/O Signals (CNC↔PMC)”, in Part I.

5.10.5 Examples of Sequences

For this subsection, see Subsection 5.10.5, “Examples of Sequences”, in Part I.

NOTE
For the B*i*S series spindle (synchronous built-in spindle motor), keep the following in mind when creating a sequence.
1 In the synchronous spindle motor, magnetic pole detection needs to be performed after power-on (or after occurrence of an alarm reporting a loss of the magnetic pole detection state). At this time, disconnect both axes mechanically to free the motor of each axis and then perform magnetic pole detection.
2 Before entering the tandem operation command SLVx=1, make sure that both axes are in the magnetic pole detection completion state (EPFIXA=1&EPFIXB=1). If the magnetic pole detection incompletion state is detected, set SLVx = 0.

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5.10.6 Parameters

For this subsection, see Subsection 5.10.6, “Parameters”, in Part I.

5.10.7 Block Diagram for the Speed Tandem Operation

For this subsection, see Subsection 5.10.7, "Block Diagram for the Speed Tandem Operation", in Part I.

5.10.8 Alarm and Status Error

For this subsection, see Subsection 5.10.8, “Alarm and Status Error”, in Part I.

5.10.9 Additional Information

For this subsection, see Subsection 5.10.9, “Additional Information”, in Part I.

5.11 TANDEM RESONANCE ELIMINATION (OPTIONAL FUNCTION)

5.11.1 Overview

For this subsection, see Subsection 5.11.1, “Overview”, in Part I.

5.11.2 Series and Editions of Applicable Spindle Software

Spindle software

Series	Edition	Usable CNC
9D90	B (02)	FS30*i*-A / FS31*i*-A
9DA0	F (06)	FS0*i*-F, FS30*i*-B / FS31*i*-B
9DB0	A (01)	FS0*i*-F, FS30*i*-B / FS31*i*-B

5.11.3 System Configuration

For this subsection, see Subsection 5.11.3, “System Configuration”, in Part I.

5.11.4 I/O Signals (CNC↔PMC)

For this subsection, see Subsection 5.11.4, “I/O Signals (CNC↔PMC)”, in Part I.

5.11.5 Examples of Sequences

For this subsection, see Subsection 5.11.5, “Examples of Sequences”, in Part I.

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NOTE

For the B*i*S series spindle (synchronous built-in spindle motor), keep the following in mind when creating a sequence.

1 In the synchronous spindle motor, magnetic pole detection needs to be performed after power-on (or after occurrence of an alarm reporting a loss of the magnetic pole detection state). At this time, disconnect both axes mechanically to free the motor of each axis and then perform magnetic pole detection.
2 Before entering the tandem operation command SLVx=1, make sure that both axes are in the magnetic pole detection completion state (EPFIXA=1&EPFIXB=1). If the magnetic pole detection incompletion state is detected, set SLVx = 0.

5.11.6 Parameters

For this subsection, see Subsection 5.11.6, “Parameters”, in Part I.

5.11.7 Block Diagram

For this subsection, see Subsection 5.11.7, “Block Diagram”, in Part I.

5.11.8 Adjustment

For this subsection, see Subsection 5.11.8, "Adjustment", Part I.

5.12 TORQUE TANDEM CONTROL FUNCTION (OPTIONAL FUNCTION)

The B*i*S series spindle (synchronous built-in spindle motor) does not support this function.

5.13 MAGNETIC SENSOR METHOD SPINDLE ORIENTATION (OPTIONAL FUNCTION)

The B*i*S series spindle (synchronous built-in spindle motor) does not support this function.

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5.14 SPINDLE BACKLASH ACCELERATION FUNCTION

5.14.1 Overview

For this subsection, see Subsection 5.14.1, “Overview”, in Part I.

5.14.2 Series and Editions of Applicable Spindle Software

Spindle software

Series	Edition	Usable CNC
9D53	G (07)	FS0*i* -D
9D70	F (06)	FS30*i* / FS31*i* / FS32*i* -A
9D80	B (02)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9D90	A (01)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* -A
9DA0	A (01)	FS0*i* -D, FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B
9DB0	A (01)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* -B

5.14.3 Block Diagram

For this subsection, see Subsection 5.14.3, “Block Diagram”, in Part I.

5.14.4 Parameters

For this subsection, see Subsection 5.14.4, “Parameters”, in Part I.

5.14.5 Example of Adjustment

For this subsection, see Subsection 5.14.5, “Example of Adjustment”, in Part I.

5.15 HIGH-SPEED SPINDLE ORIENTATION (OPTIONAL FUNCTION)

5.15.1 Overview

For this subsection, see Subsection 5.15.1, “Overview”, in Part I.

NOTE

1 When driving the B*i*S series spindle (synchronous built-in spindle motor),
parameter No.4084
is used for AMR offset function. (The parameter isn’t the motor voltage for spindle orientation)
Be sure that if an inappropriate value is set for the AMR offset, the motor may move unpredictably.

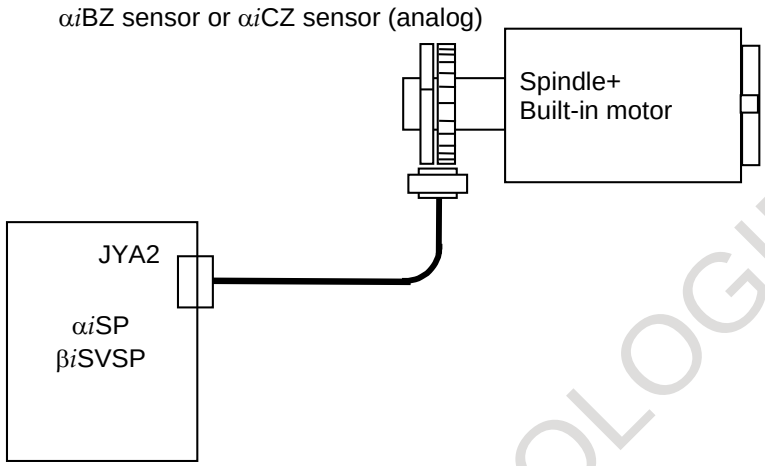
2 For AMR offset function, see Subsection 1.5.3, “AMR Offset Function”, in Part III.

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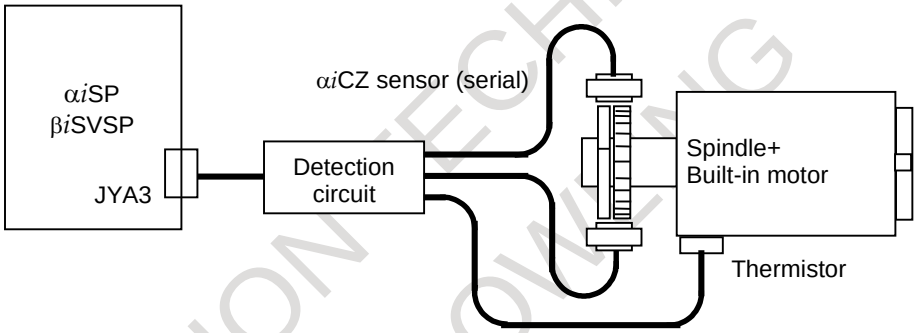
5.15.2 System Configuration

The system configurations that enable the use of the high-speed orientation function are shown below.

(1) When the α*i*BZ sensor or α*i*CZ sensor (analog) is used



(2) When the α*i*CZ sensor (serial) is used



5.15.3 I/O Signals (CNC↔PMC)

For this subsection, see Sections 2.2, “POSITION CODER METHOD SPINDLE ORIENTATION”, and 5.3, “INCREMENTAL COMMAND TYPE SPINDLE ORIENTATION (SPINDLE ROTATION SPEED CONTROL)” in Part I.

5.15.4 Sequence

For this subsection, see Subsection 5.15.5, “Sequence”, in Part I.

5.15.5 List of Related Parameters

For this subsection, see Subsection 5.15.6, “List of Related Parameters”, in Part I.

5.15.6 Details of Related Parameters

For this subsection, see Subsection 5.15.7, “Details of Related Parameters”, in Part I.

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5.15.7 Spindle Data Used in Tuning

For this subsection, see Subsection 5.15.8, “Spindle Data Used in Tuning”, in Part I.

5.15.8 Tuning Procedure

For this subsection, see Subsection 5.15.9, “Tuning Procedure”, in Part I.

5.16 MAGNETIC FLUX BOOST FUNCTION

The B*i*S series spindle (synchronous built-in spindle motor) does not support this function.

5.17 ADJUSTING FSSB HIGH-SPEED RIGID TAPPING

5.17.1 Overview

For this subsection, see Subsection 5.17.1, “Overview”, in Part I.

5.17.2 Procedure for Adjusting FSSB High-Speed Rigid Tapping

For this subsection, see Subsection 5.17.2, “Procedure for Adjusting FSSB High-Speed Rigid Tapping”, in Part I.

5.17.2.1 Initializing parameters

For this subsection, see Subsection 5.17.2.1, “Initializing parameters”, in PART I

5.17.2.2 Parameters used for adjustment

For this subsection, see Subsection 5.17.2.2, “Parameters used for adjustment”, in PART I

5.17.2.3 Adjustment using the SERVO GUIDE

For this subsection, see Subsection 5.17.2.3, “Adjustment using the SERVO GUIDE”, in PART I

5.17.2.4 Adjusting conventional rigid tapping (reference)

For this subsection, see Subsection 5.17.2.4, “Adjusting conventional rigid tapping (reference)”, in PART I

5.17.3 Using the "Optimum Rigid Tapping Acceleration/Deceleration Function" Together

For this subsection, see Subsection 5.17.3, “Using the "Optimum Rigid Tapping Acceleration/Deceleration Function" Together”, in Part I.

5.17.4 Using the Magnetic Flux Boost Function Together

For the B*i*S spindle motors, this function is not used.

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5.18 CUTTING FEED/RAPID TRAVERSE PWM FREQUENCY SWITCHING FUNCTION IN Cs CONTOUR CONTROL

5.18.1 Overview

For this subsection, see Subsection 5.18.1, “Overview”, in Part I.

5.18.2 Series and Editions of Applicable Spindle Software

For this subsection, see Subsection 5.18.2, “Series and Editions of Applicable Spindle Software”, in Part I.

5.18.3 I/O Signals (CNC↔PMC)

For this subsection, see Subsection 5.18.3, “I/O Signals (CNC↔PMC)”, in Part I.

5.18.4 Examples of Sequences

For this subsection, see Subsection 5.18.4, “Examples of Sequences”, in Part I.

5.18.5 List of Related Parameters

For this subsection, see Subsection 5.18.5, “List of Related Parameters”, in Part I.

5.18.6 Details of Related Parameters

For this subsection, see Subsection 5.18.6, “Details of Related Parameters”, in Part I.

5.18.7 Current Limitation and Maximum Torque Limit

For this subsection, see Subsection 5.18.7, “Current Limitation and Maximum Torque Limit”, in Part I.

5.18.8 Change in the Value Displayed on the Load Meter

For this subsection, see Subsection 5.18.8, “Change in the Value Displayed on the Load Meter”, in Part I.

5.18.9 Alarms and errors

For this subsection, see Subsection 5.18.9, “Alarms and errors”, in Part I.

5.19 LOAD METER (NORMALIZED BY THE CONTINUOUS RATED OUTPUT)

5.19.1 Overview

For this subsection, see Subsection 5.19.1, “Overview”, in Part I.

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5.19.2 Series and Editions of Applicable Spindle Software

For this subsection, see Subsection 5.19.2, “Series and Editions of Applicable Spindle Software”, in Part I.

5.19.3 List of Related Parameters

For this subsection, see Subsection 5.19.3, “List of Related Parameters”, in Part I.

5.19.4 Details of Related Parameters

For this subsection, see Subsection 5.19.4, “Details of Related Parameters”, in Part I.

5.20 POWER FAILURE BACKUP FUNCTION

5.20.1 Overview

For this subsection, see Subsection 5.20.1, “Overview”, in Part I.

5.20.2 Series and Editions of Applicable Spindle Software

For this subsection, see Subsection 5.20.2, “Series and Editions of Applicable Spindle Software”, in Part I.

5.20.3 System Configuration

For this subsection, see Subsection 5.20.3, “System Configuration”, in Part I.

5.20.4 I/O Signals (CNC↔PMC)

For this subsection, see Subsection 5.20.4, “I/O Signals (CNC↔PMC)”, in Part I.

5.20.5 List of Related Parameters

For this subsection, see Subsection 5.20.5, “List of Related Parameters”, in Part I.

5.20.6 Details of Related Parameters

For this subsection, see Subsection 5.20.6, “Details of Related Parameters”, in Part I.

5.20.7 Adjustment Procedure

For this subsection, see Subsection 5.20.7, “Adjustment Procedure”, in Part I.

5.20.8 Alarm

For this subsection, see Subsection 5.20.8, “Alarm”, in Part I.

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5.21 TWIN DRIVE FOR SPINDLE MOTOR

5.21.1 Overview

For this subsection, see Subsection 5.21.1, “Overview”, in Part I.

5.21.2 Series and Editions of Applicable Spindle Software

For this subsection, see Subsection 5.21.2, “Series and Editions of Applicable Spindle Software”, in Part I.

5.21.3 System Configuration

For this subsection, see Subsection 5.21.3, “System Configuration”, in Part I.

5.21.4 I/O Signals (CNC↔PMC)

For this subsection, see Subsection 5.21.4, “I/O Signals (CNC↔PMC)”, in Part I.

5.21.5 Examples of Sequences

For this subsection, see Subsection 5.21.5, “Examples of Sequences”, in Part I.

5.21.6 List of Related Parameters

For this subsection, see Subsection 5.21.6, “List of Related Parameters”, in Part I.

5.21.7 Details of Related Parameters

For this subsection, see Subsection 5.21.7, “Details of Related Parameters”, in Part I.

5.21.8 Alarm and status error

For this subsection, see Subsection 5.21.8, “Alarm and status error”, in Part I.

5.21.9 Parameters for Each Motor Model

For this subsection, see Subsection 5.21.9, “Parameters for Each Motor Model”, in Part I.

5.21.10 Examples of Connection

For this subsection, see Subsection 5.21.10, “Examples of Connection”, in Part I.

5.21.11 Signal Branch Adapter

For this subsection, see Subsection 5.21.11, “Signal Branch Adapter”, in Part I.

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5.22 HOW TO USE A DISTANCE CODED SENSOR FOR A SPINDLE

5.22.1 Overview

For this subsection, see Subsection 5.22.1, “Overview”, in Part I.

5.22.2 Series and Editions of Applicable Spindle Software

For this subsection, see Subsection 5.22.2, “Series and Editions of Applicable Spindle Software”, in Part I.

5.22.3 System Configuration

For this subsection, see Subsection 5.22.3, “System Configuration”, in Part I.

5.22.4 Related Parameters

For this subsection, see Subsection 5.22.4, “Related Parameters”, in Part I.

5.22.5 Applicable Sensors

For this subsection, see Subsection 5.22.5, “Applicable Sensors”, in Part I.

5.22.6 Checking the Z Phase Signal Interval and Adjusting the output position of the Z phase signal

For this subsection, see Subsection 5.22.6, “Checking the Z Phase Signal Interval and Adjusting the output position of the Z phase signal”, in Part I.

5.23 INERTIA ESTIMATION FUNCTION

5.23.1 Overview

For this subsection, see Subsection 5.23.1, “Overview”, in Part I.

5.23.2 Series and Editions of Applicable Spindle Software

For this subsection, see Subsection 5.23.2, “Series and Editions of Applicable Spindle Software”, in Part I.

5.23.3 I/O Signals (CNC↔PMC)

For this subsection, see Subsection 5.23.3, “I/O Signals (CNC↔PMC)”, in Part I.

5.23.4 Examples of Sequences

For this subsection, see Subsection 5.23.4, “Examples of Sequences”, in Part I.

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5.23.5 Related Parameters

For this subsection, see Subsection 5.23.5, “Related Parameters”, in Part I.

5.23.6 Using the Inertia Estimation Function

For this subsection, see Subsection 5.23.6, “Using the Inertia Estimation Function”, in Part I.

5.24 SMART RIGID TAPPING

5.24.1 Overview

For this subsection, see Subsection 5.24.1, “Overview”, in Part I.

5.24.2 Series and Editions of Applicable Spindle Software

For this subsection, see Subsection 5.24.2, “Series and Editions of Applicable Spindle Software”, in Part I.

5.24.3 System Configuration

For this subsection, see Subsection 5.24.3, “System Configuration”, in Part I.

5.24.4 I/O Signals and Sequence

For this subsection, see Subsection 5.24.4, “I/O Signals and Sequence”, in Part I.

5.24.5 Setting for FSSB high-speed rigid tapping

For this subsection, see Subsection 5.24.5, “Setting for FSSB high-speed rigid tapping”, in Part I.

5.24.6 Related Parameters

For this subsection, see Subsection 5.24.6, “Related Parameters”, in Part I.

5.24.7 Details of Related Parameters

For this subsection, see Subsection 5.24.7, “Details of Related Parameters”, in Part I.

5.24.8 Setting for each machine

For this subsection, see Subsection 5.24.8, “Setting for each machine”, in Part I.

5.24.9 Setting for Smart thermal control

For this subsection, see Subsection 5.24.9, “Setting for Smart thermal control”, in Part I.

5.24.10 Setting for rigid tapping during dry run

For this subsection, see Subsection 5.24.10, “Setting for rigid tapping during dry run”, in Part I.

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5.24.11 Tuning of Rigid tapping

For this subsection, see Subsection 5.24.11, “Tuning of Rigid tapping”, in Part I.

5.24.12 Notes and Restrictions

For this subsection, see Subsection 5.24.12, “Notes and Restrictions”, in Part I.

5.24.13 Alarm

For this subsection, see Subsection 5.24.13, “Alarm”, in Part I.

5.25 SMART THERMAL CONTROL

5.25.1 Overview

For this subsection, see Subsection 5.25.1, “Overview”, in Part I.

5.25.2 Series and Editions of Applicable Spindle Software

For this subsection, see Subsection 5.25.2, “Series and Editions of Applicable Spindle Software”, in Part I.

5.25.3 Specification

For this subsection, see Subsection 5.25.3, “Specification”, in Part I.

5.25.4 I/O Signals (CNC↔PMC)

For this subsection, see Subsection 5.25.4, “I/O Signals (CNC↔PMC)”, in Part I.

5.25.5 Related Parameters

For this subsection, see Subsection 5.25.5, “Related parameters”, in Part I.

5.25.6 Details of Related Parameters

For this subsection, see Subsection 5.25.6, “Details of Related Parameters”, in Part I.

5.25.7 Diagnosis (Diagnosis Screen)

For this subsection, see Subsection 5.25.7, “Diagnosis (Diagnosis Screen)”, in Part I.

5.25.8 Example of signal

For this subsection, see Subsection 5.25.8, “Example of signal”, in Part I.

5.25.9 Note

For this subsection, see Subsection 5.25.9, “Note”, in Part I.

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5.26 COUPLING FAILURE DETECTION BETWEEN A SPINDLE AND A SPINDLE MOTOR

The B*i*S series spindle (synchronous built-in spindle motor) does not support this function.

5.27 SPINDLE OSCILLATING TORQUE INPUT FUNCTION

5.27.1 Overview

For this subsection, see Subsection 5.27.1, “Overview”, in Part I.

5.27.2 Series and Editions of Applicable Spindle Software

For this subsection, see Subsection 5.27.2, “Series and Editions of Applicable Spindle Software”, in Part I.

5.27.3 I/O Signals (CNC↔PMC)

For this subsection, see Subsection 5.27.3, “I/O Signals (CNC↔PMC)”, in Part I.

5.27.4 Sequence

For this subsection, see Subsection 5.27.4, “Sequence”, in Part I.

5.27.5 Related Parameters

For this subsection, see Subsection 5.27.5, “Related Parameters”, in Part I.

5.27.6 Details of Related Parameters

For this subsection, see Subsection 5.27.6, “Details of Related Parameters”, in Part I.

5.27.7 Alarm/State Error

For this subsection, see Subsection 5.27.7, “Alarm/State Error”, in Part I.

5.27.8 Note

For this subsection, see Subsection 5.27.8, “Note”, in Part I.

5.28 SMART LOAD METER

5.28.1 Outline

For this subsection, see Subsection 5.28.1, “Outline”, in Part I.

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5.28.2 Note

For this subsection, see Subsection 5.28.2, “Note”, in Part I.

5.28.3 Series and Editions of Applicable Spindle Software

For this subsection, see Subsection 5.28.3, “Series and Editions of Applicable Spindle Software”, in Part I.

5.28.4 Parameters

For this subsection, see Subsection 5.28.4, “Parameters”, in Part I.

5.28.5 Detail explanation of parameters

For this subsection, see Subsection 5.28.5, “Detail explanation of parameters”, in Part I.

5.28.6 Detail of display data

For this subsection, see Subsection 5.28.6, “Detail of display data”, in Part I.

5.28.7 Observation of Smart load meter

For this subsection, see Subsection 5.28.7, “Observation of Smart load meter”, in Part I.

5.28.8 Alarms

For this subsection, see Subsection 5.28.8, “Alarms”, in Part I.

5.28.9 Parameters for each motor for Smart load meter

For this subsection, see Subsection 5.28.9, “Parameters for each motor for Smart load meter”, in Part I.

5.29 SMART BACKLASH COMPENSATION (Cs axis)

The B*i*S series spindle (synchronous built-in spindle motor) does not support this function.

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APPENDIX

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A SPINDLE PARAMETER TABLE

A.1 αi SERIES SPINDLE PARAMETER TABLE

αi series spindle parameters are classified into the following types:

A : Parameters related to the setup of detectors

B : Parameters related to the setup of various functions (operating modes)

C : Unique parameters for the drive of spindle motors (Set the parameter data according to the parameter list for each motor model.)

D : Parameters related to the setting of alarm detection conditions

E : Parameters related to the setting of a power consumption monitor, refer to the following specifications or an applicable CNC CONNECTION MANUAL (FUNCTION) for details.

・"FANUC Series 30*i*-A/31*i*-A5/31*i*-A/32*i*-A Power Consumption Monitor Specification": A-92345.

・"FANUC Series 30*i*-B/31*i*-B5/31*i*-B/32*i*-B/35*i*-B Power Consumption Monitor Specification": A-94362.

・"FANUC Series 0*i*/0*i* Mate-MODEL D Power Consumption Monitor Specification": A-93067.

・"FANUC Series 0*i*-MODEL F Connection Manual (Function)": B-64603JA-1.

F: Parameters for the common power supply (see "FANUC SERVO AMPLIFIER α*i* series 30*i*-B series CNC DESCRIPTIONS" (B-65412EN/01).)

・" FANUC SERVO AMPLIFIER α*i*-B series DESCRIPTIONS": B-65412JA.

・" FANUC SERVO AMPLIFIER β*i*-B series DESCRIPTIONS": B-65422JA.

MH, ML, SH, and SL in the table represent the following:

MH: Parameter for speed range switch high-speed characteristics on the main side of spindle switching (for standard motors)

ML: Parameter for speed range switch low-speed characteristics on the main side of spindle switching

SH: Parameter for speed range switch high-speed characteristics on the sub-side of spindle switching

SL: Parameter for speed range switch low-speed characteristics on the sub-side of spindle switching

Internal data No. F-xxx	0*i*	30*i*	bit	Standard initial setting data	Contents	Application				Classifi-cation	Reference item
						MH	ML	SH	SL		
0H	4000	4000	#0	0	Rotation direction relationship between the spindle and motor	○	○			A	I-1.3.2
			#1	0	Spindle rotation direction when a positive (+) move command is specified on Cs contouring control	○	○			B	I-2.4.9
			#3	0	Return direction for the reference position on Cs contouring control mode	○	○			B	I-2.4.9
			#4	0	Return direction for the reference position on servo mode	○	○			B	I-2.3.7
			#5	0	Whether to use the differential spindle speed control function	○	○			B	I-5.8.8
			#6	0	Direction for differential spindle speed control	○	○			B	I-5.8.8
0L	4001	4001	#0	1	Whether to use MRDY (machine ready) signal	○	○			B	I-2.6.4
			#3	0	Mounting direction of the magnetic sensor	○	○			B	I-5.11.6
			#4	0	Mounting direction of the spindle sensor	○	○			A	I-1.3.2
1H	4002	4002	#0	0	Spindle sensor type	○	○			A	I-1.3.2
			#1	0	Spindle sensor type	○	○			A	I-1.3.2
			#2	0	Spindle sensor type	○	○			A	I-1.3.2
			#3	0	Spindle sensor type	○	○			A	I-1.3.2
			#4	0	Whether to use the rotation direction signal (SFR/SRV) function on Cs contouring control	○	○			B	I-2.4.9
			#5	0	Whether to use the rotation direction signal (SFR/SRV) function on servo mode	○	○			B	I-2.3.7
			#6	0	Whether to use the rotation direction signal (SFR/SRV) function on spindle synchronous control	○	○			B	I-2.5.8

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Internal data No. F-xxx	0*i*	30*i*	bit	Standard initial setting data	Contents	Application				Classifi-cation	Reference item
						MH	ML	SH	SL		
			#7	0	Whether to use the CMR (servo mode Cs contouring) function in servo mode	○	○			B	
1L	4003	4003	#0	0	Spindle orientation method	○	○			B	I-2.2.12
			#2	0	Rotation direction during spindle orientation	○	○			B	I-2.2.12
			#3	0	Rotation direction during spindle orientation	○	○			B	I-2.2.12
			#4	0	Teeth number setting of spindle sensor	○	○			A	I-1.3.2
			#5	0	Teeth number setting of spindle sensor	○	○			A	I-1.3.2
			#6	0	Teeth number setting of spindle sensor	○	○			A	I-1.3.2
			#7	0	Teeth number setting of spindle sensor	○	○			A	I-1.3.2
2H	4004	4004	#2	0	Setting of external one-rotation signal	○	○			A	I-1.3.2
			#3	0	Setting of external one-rotation signal	○	○			A	I-1.3.2
2L	4005	4005	#0	0	Command resolution for Cs contouring control	○	○			B	I-2.4.9
			#2	0	Setting of backlash cmpensation	○	○	○	○	B	I-5.14.4
			#5	0	Increment system of gear ratio 1	○	○				I-5.26.2
3H	4006	4006	#1	0	Increment system of gear ratio 2	○	○			A	I-1.3.2
			#2	Depends on the model	Increment system of spindle speed	○	○			C	I-2.6.4
			#3	0	Automatic detection of one-rotation signal during spindle synchronous control	○	○			B	I-2.5.8
			#5	0	Setting of analog override range	○	○			B	I-2.1.6
			#7	0	Whether to use the command arbitrary gear ratio (CMR) function on rigid tapping	○	○			B	I-2.3.7
3L	4007	4007	#5	0	Whether to detect a feedback signal disconnection	○	○			A	I-1.3.2
			#6	0	Whether to detect the alarms (spindle alarms 41, 42, 47, 81, 82, 83, 85, 86, and 87) related to the position feedback signal (when non-Cs contouring control mode is set)	○	○			A	I-1.3.2
4H	4008	4008	#0	0	Reserved	○				C	
			#1	0	Reserved		○			C	
			#2	0	Reserved	○	○			C	
			#4	Depends on the model	Setting of output limitation method	○	○			C	I-2.6.4
4L	4009	4009	#0	0	Increment system of velocity loop gain	○	○			B	I-2.6.4
			#2	0	Motor power turn-off method when spindle alarm 24 (serial data transfer error) is issued	○	○			D	I-2.6.4
			#4	0	Whether to output the load detection signals (LDT1, LDT2) during acceleration/deceleration	○	○			B	I-2.1.6
			#6	0	Analog override type	○	○			B	I-2.1.6
5H	4010	4010	#0	Depends on the model	Motor sensor type	○	○			A	I-1.3.2
			#1	Depends on the model	Motor sensor type	○	○			A	I-1.3.2
			#2	Depends on the model	Motor sensor type	○	○			A	I-1.3.2
5L	4011	4011	#0	Depends on the model	Teeth number setting of motor sensor	○	○			A	I-1.3.2
			#1	Depends on the model	Teeth number setting of motor sensor	○	○			A	I-1.3.2
			#2	Depends on the model	Teeth number setting of motor sensor	○	○			A	I-1.3.2
			#3	Depends on the model	Number of motor poles	○	○			C	I-2.6.4
			#4	Depends on the model	Setting of maximum output during acceleration/deceleration	○	○			C	I-2.6.4

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Internal data No. F-xxx	0*i*	30*i*	bit	Standard initial setting data	Contents	Application				Classifi-cation	Reference item
						MH	ML	SH	SL		
			#7	Depends on the model	Number of motor poles	○	○			C	I-2.6.4
6H	4012	4012	#0	Depends on the model	Setting of PWM carrier frequency	○	○			C	I-2.6.4
			#1	Depends on the model	Setting of PWM carrier frequency	○	○			C	I-2.6.4
			#2	Depends on the model	Setting of PWM carrier frequency	○	○			C	I-2.6.4
			#4	0	Setting of the cutting feed/rapid traverse PWM frequency switching function in Cs contouring control	○	○			B	I-5.18.6
			#5	0	Current control cycle setting	○	○			B	I-5.18.6
			#7	1	Setting of spindle HRV function	○	○	○	○	C	I-2.6.4
6L	4013	4013	#2	Depends on the model	Current dead-band data	○	○			C	I-2.6.4
			#3	Depends on the model	Current dead-band data	○	○			C	I-2.6.4
			#4	Depends on the model	Current dead-band data	○	○			C	I-2.6.4
			#5	Depends on the model	Current dead-band data	○	○			C	I-2.6.4
			#6	Depends on the model	Current dead-band data	○	○			C	I-2.6.4
			#7	Depends on the model	Setting of a PWM carrier frequency for low-speed characteristics area		○			C	I-2.6.4
7H	4014	4014	#0	0	Whether to use the spindle switch function	○	○	○	○	B	I-5.2.9
			#2	0	Whether to check both spindle switch main and sub magnetic contactor contacts	○	○	○	○	B	I-5.2.9
			#3	0	Whether to check both magnetic contactor contacts for high-speed /low-speed characteristics in speed range switching	○	○	○	○	B	I-5.1.7
			#6	0	Whether to use the orientation function on spindle synchronous control	○	○			B	I-5.5.6
			#7	0	Setting of dual position feedback	○	○			B	I-5.9.4
7L	4015	4015	#0	0	Whether to use the spindle orientation function	○	○	○	○	B	I-2.2.12
			#1	0	Whether to use the unexpected disturbance torque detection function	○	○	○	○	B	I-5.6.5
			#2	0	Whether to use the speed range switching function	○	○	○	○	B	I-5.1.7
			#3	0	Whether to use the spindle tandem function	○	○	○	○	B	I-5.10.6
8H	4016	4016	#0	0	Order of A/B phases of the distance coded sensor	○	○			A	I-5.23.4
			#3	0	Setting of the smoothing function in feed-forward control	○	○			B	I-2.4.9 I-5.7.7
			#4	0	Setting related to the motor voltage control characteristics on Cs contouring control or servo mode	○	○			B	I-2.3.7 I-2.4.9
			#5	0	Whether to detect the alarms (spindle alarms 81, 82, 85, 86) related to position feedback (on Cs contouring control mode)	○	○			A	I-1.3.2
			#6	0	Whether to detect the alarm (spindle alarms 46) related to feedback of the position detection signal for threading	○	○			A	I-1.3.2
			#7	0	Function for newly detecting the one-rotation signal before entering position control mode	○	○			A	I-1.3.2
8L	4017	4017	#0	0	This parameter sets speed integration operation when differential spindle speed control is exercised.	○	○			B	I-5.8.8
			#2	0	Z phase detection setting	○	○			A	I-5.23.4
			#7	0	Setting of shortcut orientation from stop state in position coder method spindle orientation	○	○			B	I-2.2.12
9H	4018	4018	#3	0	Type of position coder method orientation	○	○			B	I-2.2.12

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Internal data No. F-xxx	0*i*	30*i*	bit	Standard initial setting data	Contents	Application				Classifi-cation	Reference item
						MH	ML	SH	SL		
			#4	0	Optimum orientation: Setting of velocity feedforward (CTH1A=0)	○	○			B	I-2.2.12
			#5	0	Optimum orientation: Setting of velocity feedforward (CTH1A=1) High-speed orientation: Velocity command compensation function	○	○			B	I-2.2.12 I-5.4.7
			#6	0	Type of position coder method orientation	○	○			B	I-2.2.12
9L	4019	4019	#2	1	Whether to use torque clamp at zero speed	○	○			B	I-2.6.4
			#4	0	Setting of the function for switching from high-speed characteristics to low-speed characteristics with the speed detection signal SDT = 1 at speed range switching	○	○			B	I-5.1.7
			#6	1	Presence or absence of the compensation of the spindle acceleration command	○	○			B	I-2.2.12
			#7	0	Automatic parameter setting function	○	○			B	I-1.2.2 I-2.6.4
10	4020	4020		Depends on the model	Maximum motor speed	○	○			C	I-2.6.4
11	4021	4021		100	Maximum speed on Cs contouring control mode	○	○			B	I-2.4.9
12	4022	4022		150	Speed arrival detection level (SAR)	○	○			B	I-2.6.4
13	4023	4023		30	Speed detection level (SDT)	○	○			B	I-2.6.4
14	4024	4024		75	Zero speed detection level (SST)	○	○			B	I-2.6.4
15	4025	4025		50	Limited torque (TLMH, TLML)	○	○			B	I-2.6.4
16	4026	4026		83	Load detection level 1 (LDT1)	○	○			B	I-2.6.4
17	4027	4027		95	Load detection level 2 (LDT2)	○	○	○	○	B	I-2.6.4
18	4028	4028		0	Limited output pattern	○	○			B	I-2.1.6
19	4029	4029		100	Output limit	○	○			B	I-2.1.6
20	4030	4030		0	Soft start/stop time (SOCN)	○	○	○	○	B	I-2.1.6
21	4031	4031		0	Stop position of position coder method orientation	○	○			B	I-2.2.12
22	4032	4032		0	Acceleration on spindle synchronous control	○	○			B	I-2.5.8
23	4033	4033		10	Spindle synchronous speed arrival level	○	○			B	I-2.5.8
24	4034	4034		0	Shift during synchronous control of spindle phase	○	○			B	I-2.5.8
25	4035	4035		10	Compensation data for spindle phase synchronous control	○	○			B	I-2.5.8
26	4036	4036		0	Feed-forward coefficient	○	○			B	I-2.4.9 I-5.7.8
27	4037	4037		0	Feed-forward coefficient of velocity loop	○				B	I-2.4.9 I-5.7.8
28	4038	4038		0	Optimum orientation: Orientation speed upper limit Conventional method orientation, High-speed orientation: Spindle orientation speed upper limit	○	○			B	I-2.2.12 I-5.4.7
29	4039	4039		Depends on the model	Slip compensation gain	○				C	I-2.6.4
30	4040	4040		10	Velocity loop proportional gain on velocity control mode (High)	○	○			B	I-2.1.6
31	4041	4041		10	Velocity loop proportional gain on velocity control mode (Low)	○	○			B	I-2.1.6
32	4042	4042		10	Velocity loop proportional gain on orientation (High)	○	○			B	I-2.2.12
33	4043	4043		10	Velocity loop proportional gain on orientation (Low)	○	○			B	I-2.2.12
34	4044	4044		10	Velocity loop proportional gain on servo mode/spindle synchronous control (High)	○	○			B	I-2.3.7 I-2.5.8
35	4045	4045		10	Velocity loop proportional gain on servo mode/spindle synchronous control (Low)	○	○			B	I-2.3.7 I-2.5.8
36	4046	4046		30	Velocity loop proportional gain on Cs contouring control (High)	○	○			B	I-2.4.9
37	4047	4047		30	Velocity loop proportional gain on Cs contouring control (Low)	○	○			B	I-2.4.9
38	4048	4048		10	Velocity loop integral gain on velocity control mode (High)	○	○			B	I-2.1.6
39	4049	4049		10	Velocity loop integral gain on velocity control mode (Low)	○	○			B	I-2.1.6
40	4050	4050		10	Velocity loop integral gain on orientation (High)	○	○			B	I-2.2.12
41	4051	4051		10	Velocity loop integral gain on orientation (Low)	○	○			B	I-2.2.12
42	4052	4052		10	Velocity loop integral gain on servo mode/spindle synchronous control (High)	○	○			B	I-2.3.7 I-2.5.8
43	4053	4053		10	Velocity loop integral gain on servo mode/spindle synchronous control (Low)	○	○			B	I-2.3.7 I-2.5.8
44	4054	4054		50	Velocity loop integral gain on Cs contouring control (High)	○	○			B	I-2.4.9

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Internal data No. F-xxx	0*i*	30*i*	bit	Standard initial setting data	Contents	Application				Classifi-cation	Reference item
						MH	ML	SH	SL		
45	4055	4055		50	Velocity loop integral gain on Cs contouring control (Low)	○	○			B	I-2.4.9
46	4056	4056		100	Gear ratio (High)	○	○			A	I-1.3.2
47	4057	4057		100	Gear ratio (Medium High)	○	○			A	I-1.3.2
48	4058	4058		100	Gear ratio (Medium Low)	○	○			A	I-1.3.2
49	4059	4059		100	Gear ratio (Low)	○	○			A	I-1.3.2
50	4060	4060		1000	Position gain on orientation (High)	○	○			B	I-2.2.12
51	4061	4061		1000	Position gain on orientation (Medium High)	○	○			B	I-2.2.12
52	4062	4062		1000	Position gain on orientation (Medium Low)	○	○			B	I-2.2.12
53	4063	4063		1000	Position gain on orientation (Low)	○	○			B	I-2.2.12
54	4064	4064		100	Normal orientation: Rate of change in the position gain upon completion of spindle orientation High-speed orientation: Percentage limit to an acceleration during deceleration Optimum orientation: Position feedforward coefficient	○	○			B	I-2.2.12 I-5.4.7
55	4065	4065		1000	Position gain on servo mode/spindle synchronous control (High)	○	○			B	I-2.3.7 I-2.5.8
56	4066	4066		1000	Position gain on servo mode/spindle synchronous control (Medium High)	○	○			B	I-2.3.7 I-2.5.8
57	4067	4067		1000	Position gain on servo mode/spindle synchronous control (Medium Low)	○	○			B	I-2.3.7 I-2.5.8
58	4068	4068		1000	Position gain on servo mode/spindle synchronous control (Low)	○	○			B	I-2.3.7 I-2.5.8
59	4069	4069		3000	Position gain on Cs contouring control (High)	○	○			B	I-2.4.9
60	4070	4070		3000	Position gain on Cs contouring control (Medium High)	○	○			B	I-2.4.9
61	4071	4071		3000	Position gain on Cs contouring control (Medium Low)	○	○			B	I-2.4.9
62	4072	4072		3000	Position gain on Cs contouring control (Low)	○	○			B	I-2.4.9
63	4073	4073		0	Grid shift on servo mode	○	○			B	I-2.3.7
64	4074	4074		0	Reference position return speed on Cs contouring control/servo mode	○	○	○	○	B	I-2.3.7 I-2.4.9
65	4075	4075		10	Detection level for orientation completion signal (ORAR)	○	○			B	I-2.2.12
66	4076	4076		33	Ordinary orientation: Motor speed limit value on orientation High-speed orientation: Reserved Optimum orientation: Bell-shaped acceleration / Delay time for acceleration detection	○	○			B	I-2.2.12
67	4077	4077		0	Orientation stop position shift	○	○			B	I-2.2.12
68	4078	4078		200	MS signal constant	○	○			B	I-5.11.6
69	4079	4079		0	MS signal gain adjustment	○	○			B	I-5.11.6
70	4080	4080		Depends on the model	Regenerative power limit for high-speed zone/regenerative power limit	○				C	I-2.6.4
71	4081	4081		20	Delay time until motor power is cut off	○	○			B	I-2.1.6
72	4082	4082		10	Setting of acceleration/deceleration time	○	○			B	I-2.1.6
73	4083	4083		Depends on the model	Motor voltage on velocity control mode	○				C	I-2.1.6
74	4084	4084		Depends on the model	Motor voltage on orientation	○	○			C	I-2.2.12 I-5.4.7
75	4085	4085		Depends on the model	Motor voltage on servo mode/spindle synchronous control mode	○				C	I-2.3.7 I-2.5.8
76	4086	4086		100	Motor voltage on Cs contouring control	○	○			C	I-2.4.9
77	4087	4087		115	Overspeed level	○	○	○	○	D	I-2.6.4
78	4088	4088		75	Level for detecting excess velocity error when motor is restrained	○	○	○	○	D	I-2.6.4
79	4089	4089		200	Level for detecting excess velocity error when motor rotates	○	○	○	○	D	I-2.6.4
80	4090	4090		90	Overload detection level	○	○	○	○	D	I-2.6.4
81	4091	4091		100	Rate of change in position gain during reference position return on servo mode	○	○			B	I-2.3.7
82	4092	4092		100	Rate of change in position gain during reference position return on Cs contouring control	○	○			B	I-2.4.9

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						MH	ML	SH	SL		
83	4093	4093		Depends on the model	Value displayed on load meter at maximum output		○			C	App. B
84	4094	4094		0	Disturbance torque compensation constant (acceleration feedback gain)	○	○			B	I-2.4.9
85	4095	4095		0	Adjusted output voltage of speedometer	○	○	○	○	B	I-2.6.4
86	4096	4096		0	Adjusted output voltage of load meter	○	○	○	○	B	I-2.6.4
87	4097	4097		0	Feedback gain of spindle speed	○	○			B	I-2.4.9
88	4098	4098		0	Maximum speed for position feedback signal detection	○	○	○	○	A	I-1.3.2
89	4099	4099		0	Delay time for motor excitation	○	○	○	○	B	I-2.3.7 I-2.4.9
90	4100	4100		Depends on the model	Base speed of motor output specifications	○				C	I-2.6.4
91	4101	4101		Depends on the model	Output limit for motor output specifications	○				C	I-2.6.4
92	4102	4102		Depends on the model	Excitation voltage saturation speed at no-load	○				C	I-2.6.4
93	4103	4103		Depends on the model	Base speed limit ratio	○				C	I-2.6.4
94	4104	4104		Depends on the model	Current loop proportional gain	○				C	I-2.6.4
95	4105	4105		Depends on the model	Magnetic flux time constant for magnetic flux control	○				C	I-5.24.7
96	4106	4106		Depends on the model	Current loop integral gain	○				C	I-2.6.4
97	4107	4107		Depends on the model	Magnetic flux time constant for magnetic flux control		○			C	I-5.24.7
98	4108	4108		Depends on the model	Velocity at which the current loop integral gain is zero	○				C	I-2.6.4
99	4109	4109		Depends on the model	Filter time constant for processing saturation related to the voltage command	○				C	I-2.6.4
100	4110	4110		Depends on the model	Current conversion constant	○				C	I-2.6.4
101	4111	4111		Depends on the model	Secondary current coefficient	○				C	I-2.6.4
102	4112	4112		Depends on the model	Criterion level for saturation related to the voltage command/PWM command clamp value	○				C	I-2.6.4
103	4113	4113		Depends on the model	Slip constant	○				C	I-2.6.4
104	4114	4114		Depends on the model	Slip compensation coefficient for a high-speed zone/slip compensation coefficient at deceleration	○				C	I-2.6.4
105	4115	4115		Depends on the model	PWM command clamp value at deceleration	○				C	I-2.6.4
106	4116	4116		Depends on the model	Motor leakage constant	○				C	I-2.6.4
107	4117	4117		Depends on the model	Regular-time voltage compensation coefficient for high-speed zone/regular-time motor voltage coefficient	○				C	I-2.6.4
108	4118	4118		Depends on the model	Acceleration-time voltage compensation coefficient for high-speed zone/acceleration-time motor voltage coefficient	○				C	I-2.6.4

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						MH	ML	SH	SL		
109	4119	4119		Depends on the model	Deceleration-time excitation current change time constant/excitation current change time constant	○				C	I-2.6.4
110	4120	4120		Depends on the model	Dead-band rectangular wave component zero voltage/dead-band data	○	○	○	○	C	I-2.6.4
111	4121	4121		5	Time constant for changing the torque (TCMD filter time constant)	○				B	I-4.2.1
112	4122	4122		0	Time constant for velocity detecting filter	○	○			B	I-2.6.4
113	4123	4123		30	Short-time overload detection time	○	○	○	○	D	I-2.6.4
114	4124	4124		0	Magnetic flux boost completion level/magnetic flux boost coefficient	○				B	I-5.16.4
117	4127	4127		Depends on the model	Value displayed on load meter at maximum output	○				C	I-2.6.4
118	4128	4128		Depends on the model	Compensation coefficient between the specification and true base/maximum torque curve compensation coefficient	○				C	I-2.6.4
119	4129	4129		Depends on the model	Secondary current coefficient for rigid tapping	○				C	I-2.6.4
120	4130	4130		Depends on the model	Current loop proportional gain speed coefficient/current phase delay compensation coefficient	○				C	I-2.6.4
121	4131	4131		0	Time constant for velocity detecting filter (on Cs contouring control)	○	○			B	I-2.4.9
123	4133	4133		Depends on the model	Motor model code	○	○			C	I-1.1.2 I-2.6.4
124 125	4134	4134		Depends on the model	Motor overheat detect level (2-word)	○	○			C	I-2.6.4
126 127	4135	4135		0	Grid shift during Cs contouring control mode l (2-word)	○	○			B	I-2.4.9
128	4136	4136		Depends on the model	Motor voltage on velocity control mode		○			C	App. B
129	4137	4137		Depends on the model	Motor voltage on servo mode/spindle synchronous control mode		○			C	App. B
130	4138	4138		Depends on the model	Base speed of motor output specifications		○			C	App. B
131	4139	4139		Depends on the model	Output limit for motor output specifications		○			C	App. B
132	4140	4140		Depends on the model	Excitation voltage saturation speed at no-load		○			C	App. B
133	4141	4141		Depends on the model	Base speed limit ratio		○			C	App. B
134	4142	4142		Depends on the model	Current loop proportional gain		○			C	App. B
135	4143	4143		Depends on the model	Current loop integral gain		○			C	App. B
136	4144	4144		Depends on the model	Velocity at which the current loop integral gain is zero		○			C	App. B
137	4145	4145		Depends on the model	Filter time constant for processing saturation related to the voltage command		○			C	App. B
138	4146	4146		Depends on the model	Current conversion constant		○			C	App. B

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						MH	ML	SH	SL		
139	4147	4147		Depends on the model	Secondary current coefficient		○			C	App. B
140	4148	4148		Depends on the model	Criterion level for saturation related to the voltage command/PWM command clamp value		○			C	App. B
141	4149	4149		Depends on the model	Slip constant		○			C	App. B
142	4150	4150		Depends on the model	Slip compensation coefficient for a high-speed zone/slip compensation coefficient at deceleration		○			C	App. B
143	4151	4151		Depends on the model	PWM command clamp value at deceleration		○			C	App. B
144	4152	4152		Depends on the model	Motor leakage constant		○			C	App. B
145	4153	4153		Depends on the model	Regular-time voltage compensation coefficient for high-speed zone/regular-time motor voltage coefficient		○			C	App. B
146	4154	4154		Depends on the model	Acceleration-time voltage compensation coefficient for high-speed zone/acceleration-time motor voltage coefficient		○			C	App. B
147	4155	4155		0	Magnetic flux boost completion level/magnetic flux boost coefficient		○			B	App. B
148	4156	4156		Depends on the model	Slip compensation gain		○			C	App. B
149	4157	4157		5	Time constant for changing the torque (TCMD filter time constant)		○			B	App. B
150	4158	4158		Depends on the model	Compensation coefficient between the specification and true base/maximum torque curve compensation coefficient		○			C	App. B
151	4159	4159		Depends on the model	Secondary current coefficient for rigid tapping		○			C	App. B
152	4160	4160		0	Hysteresis of speed detection level	○	○	○	○	B	I-5.1.7
153	4161	4161		Depends on the model	Current loop proportional gain speed coefficient/current phase delay compensation coefficient		○			C	App. B
154	4162	4162		0	Integral gain of velocity loop during cutting feed on Cs contouring control mode (High)	○	○			B	I-2.4.9
155	4163	4163		0	Integral gain of velocity loop during cutting feed on Cs contouring control mode (Low)	○	○			B	I-2.4.9
157	4165	4165		Depends on the model	Deceleration-time excitation current change time constant/excitation current change time constant		○			C	App. B
158	4166	4166		Depends on the model	Regenerative power limit for high-speed zone/regenerative power limit		○			C	App. B
160	4168	4168		0	Monitor constant of winding temperature(Heat coefficient)		○			D	App. B
161	4169	4169		Depends on the model	Temperature monitoring time constant	○	○			C	I-2.6.4
162	4170	4170		0	Monitor constant of winding temperature(Heat coefficient)	○				D	I-2.6.4
163	4171	4171		0	Denominator of arbitrary gear ratio between motor sensor and spindle (High)	○	○			A	I-1.3.2
164	4172	4172		0	Numerator of arbitrary gear ratio between motor sensor and spindle (High)	○	○			A	I-1.3.2
165	4173	4173		0	Denominator of arbitrary gear ratio between motor sensor and spindle (Low)	○	○			A	I-1.3.2
166	4174	4174		0	Numerator of arbitrary gear ratio between motor sensor and spindle (Low)	○	○			A	I-1.3.2
168H	4176	4176	#0	0	Rotation direction relationship between the spindle and motor			○	○	A	App. B
			#4	0	Return direction for the reference position on servo mode			○	○	B	App. B
168L	4177	4177	#0	1	Whether to use MRDY (machine ready) signal			○	○	B	App. B

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Internal data No. F-xxx	0*i*	30*i*	bit	Standard initial setting data	Contents	Application				Classifi-cation	Reference item
						MH	ML	SH	SL		
			#3	0	Mounting direction of the magnetic sensor			○	○	B	App. B
			#4	0	Mounting direction of the spindle sensor			○	○	A	App. B
169H	4178	4178	#0	0	Spindle sensor type			○	○	A	App. B
			#1	0	Spindle sensor type			○	○	A	App. B
			#2	0	Spindle sensor type			○	○	A	App. B
			#3	0	Spindle sensor type			○	○	A	App. B
			#5	0	Whether to use the rotation direction signal (SFR/SRV) function on servo mode			○	○	B	App. B
169L	4179	4179	#0	0	Spindle orientation method			○	○	B	App. B
			#2	0	Rotation direction during spindle orientation			○	○	B	App. B
			#3	0	Rotation direction during spindle orientation			○	○	B	App. B
			#4	0	Teeth number setting of spindle sensor			○	○	A	App. B
			#5	0	Teeth number setting of spindle sensor			○	○	A	App. B
			#6	0	Teeth number setting of spindle sensor			○	○	A	App. B
			#7	0	Teeth number setting of spindle sensor			○	○	A	App. B
170H	4180	4180	#2	0	Setting of external one-rotation signal			○	○	A	App. B
			#3	0	Setting of external one-rotation signal			○	○	A	App. B
171H	4182	4182	#1	0	Increment system of gear ratio			○	○	A	App. B
			#2	Depends on the model	Increment system of spindle speed			○	○	C	App. B
			#5	0	Setting of analog override range			○	○	B	App. B
			#7	0	Whether to use the command arbitrary gear ratio (CMR) function on rigid tapping			○	○	B	App. B
171L	4183	4183	#5	0	Whether to detect a feedback signal disconnection			○	○	A	App. B
			#6	0	Whether to detect the alarms (spindle alarms 41, 42, 47, 81, 82, 83, 85, 86, and 87) related to the position feedback signal (when Cs contouring control mode is not set)			○	○	A	App. B
172H	4184	4184	#0	0	Reserved			○		C	
			#1	0	Reserved				○	C	
			#2	0	Reserved			○	○	C	
			#4	Depends on the model	Setting of output limitation method			○	○	C	App. B
172L	4185	4185	#0	0	Increment system of velocity loop gain			○	○	B	App. B
			#2	0	Motor power turn-off method when spindle alarm 24 (serial data transfer error) is issued			○	○	D	App. B
			#4	0	Whether to output the load detection signals (LDT1, LDT2) during acceleration/deceleration			○	○	B	App. B
			#6	0	Analog override type			○	○	B	App. B
173H	4186	4186	#0	Depends on the model	Motor sensor type			○	○	A	App. B
			#1	Depends on the model	Motor sensor type			○	○	A	App. B
			#2	Depends on the model	Motor sensor type			○	○	A	App. B
173L	4187	4187	#0	Depends on the model	Teeth number setting of motor sensor			○	○	A	App. B
			#1	Depends on the model	Teeth number setting of motor sensor			○	○	A	App. B
			#2	Depends on the model	Teeth number setting of motor sensor			○	○	A	App. B
			#3	Depends on the model	Number of motor poles			○	○	C	App. B
			#4	Depends on the model	Setting of maximum output during acceleration/deceleration			○	○	C	App. B

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						MH	ML	SH	SL		
			#7	Depends on the model	Number of motor poles			○	○	C	App. B
174H	4188	4188	#0	Depends on the model	Setting of PWM carrier frequency			○	○	C	App. B
			#1	Depends on the model	Setting of PWM carrier frequency			○	○	C	App. B
			#2	Depends on the model	Setting of PWM carrier frequency			○	○	C	App. B
174L	4189	4189	#2	Depends on the model	Current dead-band data			○	○	C	App. B
			#3	Depends on the model	Current dead-band data			○	○	C	App. B
			#4	Depends on the model	Current dead-band data			○	○	C	App. B
			#5	Depends on the model	Current dead-band data			○	○	C	App. B
			#6	Depends on the model	Current dead-band data			○	○	C	App. B
			#7	Depends on the model	Setting of a PWM carrier frequency for low-speed characteristics area				○	C	App. B
176L	4191	4191	#0	0	Whether to use the spindle orientation function					B	
			#1	0	Whether to use the spindle load detection function					B	
			#2	0	Whether to use the output switching function					B	
			#3	0	Whether to use the spindle tandem function					B	
176H	4192	4192	#3	0	Setting of the smoothing function in feed-forward control			○	○	B	App. B
			#4	0	Setting related to control characteristics on servo mode			○	○	B	App. B
			#6	0	Whether to detect the alarm (spindle alarms 46) related to feedback of the position detection signal for threading			○	○	A	App. B
			#7	0	Function for newly detecting the one-rotation signal before entering position control mode			○	○	A	App. B
176L	4193	4193	#7	0	Setting of shortcut orientation from stop state in position coder method spindle orientation			○	○	B	App. B
177H	4194	4194	#3	0	Type of position coder method orientation			○	○	B	App. B
			#4	0	Optimum orientation: Setting of velocity feedforward (CTH1A=0)			○	○	B	App. B
			#5	0	Optimum orientation: Setting of velocity feedforward (CTH1A=1) High-speed orientation: Velocity command compensation function			○	○	B	App. B
			#6	0	Type of position coder method orientation			○	○	B	App. B
177L	4195	4195	#2	1	Whether to use torque clamp at zero speed			○	○	B	App. B
			#4	0	Setting of the function for switching from high-speed characteristics to low-speed characteristics with the speed detection signal SDT = 1 at speed range switching			○	○	B	App. B
			#6	1	Presence or absence of the compensation of the spindle acceleration command			○	○	B	App. B
			#7	0	Automatic parameter setting function (0*i*-D/30*i*)			○	○	B	App. B
178	4196	4196		Depends on the model	Maximum motor speed			○	○	C	App. B
179	4197	4197		150	Speed arrival detection level (SAR)			○	○	B	App. B
180	4198	4198		30	Speed detection level (SDT)			○	○	B	App. B
181	4199	4199		75	Zero speed detection level (SST)			○	○	B	App. B
182	4200	4200		50	Limited torque (TLMH, TLML)			○	○	B	App. B
183	4201	4201		83	Load detection level 1 (LDT1)			○	○	B	App. B

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						MH	ML	SH	SL		
184	4202	4202		0	Limited output pattern			○	○	B	App. B
185	4203	4203		100	Output limit			○	○	B	App. B
186	4204	4204		0	Stop position of position coder method orientation			○	○	B	App. B
187	4205	4205		0	Optimum orientation: Orientation speed upper limit Conventional method orientation, High-speed orientation: Spindle orientation speed			○	○	B	App. B
188	4206	4206		10	Velocity loop proportional gain on velocity control mode (High)			○	○	B	App. B
189	4207	4207		10	Velocity loop proportional gain on velocity control mode (Low)			○	○	B	App. B
190	4208	4208		10	Velocity loop proportional gain on orientation (High)			○	○	B	App. B
191	4209	4209		10	Velocity loop proportional gain on orientation (Low)			○	○	B	App. B
192	4210	4210		10	Velocity loop proportional gain on servo mode (High)			○	○	B	App. B
193	4211	4211		10	Velocity loop proportional gain on servo mode (Low)			○	○	B	App. B
194	4212	4212		10	Velocity loop integral gain on velocity control mode (common to High and Low)			○	○	B	App. B
195	4213	4213		10	Velocity loop integral gain on orientation (common to High and Low)			○	○	B	App. B
196	4214	4214		10	Velocity loop integral gain on servo mode (common to High and Low)			○	○	B	App. B
197	4215	4215		0	Primary delay time constant in dual position feedback [in Cs contour control]	○	○			B	I-5.9.5
198	4216	4216		100	Gear ratio (High)			○	○	A	App. B
199	4217	4217		100	Gear ratio (Low)			○	○	A	App. B
200	4218	4218		1000	Position gain on orientation (High)			○	○	B	App. B
201	4219	4219		1000	Position gain on orientation (Low)			○	○	B	App. B
202	4220	4220		100	Ordinary orientation: Rate of change in position gain upon completion of orientation High-speed orientation: Percentage limit to an acceleration during deceleration Optimum orientation: Position feedforward coefficient			○	○	B	App. B
203	4221	4221		1000	Position gain on servo mode (High)			○	○	B	App. B
204	4222	4222		1000	Position gain on servo mode (Low)			○	○	B	App. B
205	4223	4223		0	Grid shift on servo mode			○	○	B	App. B
206	4224	4224		0	Maximum amplitude in dual position feedback [in Cs contour control]	○	○			B	I-5.9.5
207	4225	4225		0	Dual position feedback zero width [in Cs contour control]	○	○			B	I-5.9.5
208	4226	4226		10	Detection level for orientation completion signal (ORAR)			○	○	B	App. B
209	4227	4227		33	Ordinary orientation: Motor speed limit value on orientation High-speed orientation: Reserved Optimum orientation: Bell-shaped acceleration / Delay time for acceleration detection			○	○	B	App. B
210	4228	4228		0	Orientation stop position shift			○	○	B	App. B
211	4229	4229		200	MS signal constant			○	○	B	App. B
212	4230	4230		0	MS signal gain adjustment			○	○	B	App. B
213	4231	4231		Depends on the model	Regenerative power limit for high-speed zone/regenerative power limit			○		C	App. B
214	4232	4232		20	Delay time until motor power is cut off			○	○	B	App. B
215	4233	4233		10	Setting of acceleration/deceleration time			○	○	B	App. B
216	4234	4234		0	Spindle load monitor observer gain 1			○	○	B	App. B
217	4235	4235		0	Spindle load monitor observer gain 2			○	○	B	App. B
218	4236	4236		Depends on the model	Motor voltage on velocity control mode			○		C	App. B
219	4237	4237		Depends on the model	Motor voltage on orientation			○	○	C	App. B
220	4238	4238		Depends on the model	Motor voltage on servo mode			○		C	App. B
221	4239	4239		100	Rate of change in position gain during reference position return on servo mode			○	○	B	App. B

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						MH	ML	SH	SL		
222	4240	4240		0	Feed-forward coefficient			○	○	B	App. B
223	4241	4241		0	Feed-forward coefficient of velocity loop			○		B	App. B
225	4243	4243		0	Denominator of arbitrary gear ratio between motor sensor and spindle (High)			○	○	A	App. B
226	4244	4244		0	Numerator of arbitrary gear ratio between motor sensor and spindle (High)			○	○	A	App. B
227	4245	4245		0	Denominator of arbitrary gear ratio between motor sensor and spindle (Low)			○	○	A	App. B
228	4246	4246		0	Numerator of arbitrary gear ratio between motor sensor and spindle (Low)			○	○	A	App. B
230	4248	4248		0	Spindle load monitor torque constant	○				B	I-5.6.5
231	4249	4249		0	Spindle load monitor observer gain 1	○	○			B	I-5.6.5
232	4250	4250		0	Spindle load monitor observer gain 2	○	○			B	I-5.6.5
236	4254	4254		Depends on the model	Slip compensation gain			○		C	App. B
237	4255	4255		Depends on the model	Slip compensation gain				○	C	App. B
238	4256	4256		Depends on the model	Base speed of motor output specifications			○		C	App. B
239	4257	4257		Depends on the model	Output limit for motor output specifications			○		C	App. B
240	4258	4258		Depends on the model	Excitation voltage saturation speed at no-load			○		C	App. B
241	4259	4259		Depends on the model	Base speed limit ratio			○		C	App. B
242	4260	4260		Depends on the model	Current loop proportional gain			○		C	App. B
243	4261	4261		Depends on the model	Current loop integral gain			○		C	App. B
244	4262	4262		Depends on the model	Velocity at which the current loop integral gain is zero			○		C	App. B
245	4263	4263		Depends on the model	Filter time constant for processing saturation related to the voltage command			○		C	App. B
246	4264	4264		Depends on the model	Current conversion constant			○		C	App. B
247	4265	4265		Depends on the model	Secondary current coefficient			○		C	App. B
248	4266	4266		Depends on the model	Criterion level for saturation related to the voltage command/PWM command clamp value			○		C	App. B
249	4267	4267		Depends on the model	Slip constant			○		C	App. B
250	4268	4268		Depends on the model	Slip compensation coefficient for a high-speed zone/slip compensation coefficient at deceleration			○		C	App. B
251	4269	4269		Depends on the model	PWM command clamp value at deceleration			○		C	App. B
252	4270	4270		Depends on the model	Motor leakage constant			○		C	App. B
253	4271	4271		Depends on the model	Regular-time voltage compensation coefficient for high-speed zone/regular-time motor voltage coefficient			○		C	App. B

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						MH	ML	SH	SL		
254	4272	4272		Depends on the model	Acceleration-time voltage compensation coefficient for high-speed zone/acceleration-time motor voltage coefficient			○		C	App. B
255	4273	4273		5	Time constant for changing the torque (TCMD filter time constant)			○		B	App. B
256	4274	4274		Depends on the model	Value displayed on load meter at maximum output			○		C	App. B
257	4275	4275		Depends on the model	Compensation coefficient between the specification and true base/maximum torque curve compensation coefficient			○		C	App. B
258	4276	4276		Depends on the model	Secondary current coefficient for rigid tapping			○		C	App. B
259	4277	4277		Depends on the model	Current loop proportional gain speed coefficient/current phase delay compensation coefficient			○		C	App. B
260	4278	4278		0	Time constant for velocity detecting filter			○	○	B	App. B
261	4279	4279		Depends on the model	Value displayed on load meter at maximum output				○	C	App. B
262	4280	4280		Depends on the model	Deceleration-time excitation current change time constant/excitation current change time constant			○		C	App. B
263	4281	4281		0	Spindle load monitor torque constant		○			B	App. B
264	4282	4282		0	Spindle load monitor torque constant			○		B	App. B
265	4283	4283		0	Spindle load monitor torque constant				○	B	App. B
266	4284	4284		Depends on the model	Motor voltage on velocity control mode				○	C	App. B
267	4285	4285		Depends on the model	Motor voltage on servo mode				○	C	App. B
268	4286	4286		Depends on the model	Base speed of motor output specifications				○	C	App. B
269	4287	4287		Depends on the model	Output limit for motor output specifications				○	C	App. B
270	4288	4288		Depends on the model	Excitation voltage saturation speed at no-load				○	C	App. B
271	4289	4289		Depends on the model	Base speed limit ratio				○	C	App. B
272	4290	4290		Depends on the model	Current loop proportional gain				○	C	App. B
273	4291	4291		Depends on the model	Current loop integral gain				○	C	App. B
274	4292	4292		Depends on the model	Velocity at which the current loop integral gain is zero				○	C	App. B
275	4293	4293		Depends on the model	Filter time constant for processing saturation related to the voltage command				○	C	App. B
276	4294	4294		Depends on the model	Current conversion constant				○	C	App. B
277	4295	4295		Depends on the model	Secondary current coefficient				○	C	App. B
278	4296	4296		Depends on the model	Criterion level for saturation related to the voltage command/PWM command clamp value				○	C	App. B

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						MH	ML	SH	SL		
279	4297	4297		Depends on the model	Slip constant				○	C	App. B
280	4298	4298		Depends on the model	Slip compensation coefficient for a high-speed zone/slip compensation coefficient at deceleration				○	C	App. B
281	4299	4299		Depends on the model	PWM command clamp value at deceleration				○	C	App. B
282	4300	4300		Depends on the model	Motor leakage constant				○	C	App. B
283	4301	4301		Depends on the model	Regular-time voltage compensation coefficient for high-speed zone/regular-time motor voltage coefficient				○	C	App. B
284	4302	4302		Depends on the model	Acceleration-time voltage compensation coefficient for high-speed zone/acceleration-time motor voltage coefficient				○	C	App. B
285	4303	4303		5	Time constant for changing the torque (TCMD filter time constant)				○	B	App. B
286	4304	4304		Depends on the model	Compensation coefficient between the specification and true base/maximum torque curve compensation coefficient				○	C	App. B
287	4305	4305		Depends on the model	Secondary current coefficient for rigid tapping				○	C	App. B
288	4306	4306		Depends on the model	Current loop proportional gain speed coefficient/current phase delay compensation coefficient				○	C	App. B
289	4307	4307		Depends on the model	Regenerative power limit for high-speed zone/regenerative power limit				○	C	App. B
290	4308	4308		Depends on the model	Deceleration-time excitation current change time constant/excitation current change time constant				○	C	App. B
291	4309	4309		Depends on the model	Motor model code			○	○	C	App. B
292 293	4310	4310		Depends on the model	Motor overheat detect level (2-word)			○	○	C	App. B
304	4320	4320		0	Optimum orientation: Spindle acceleration command (High)	○	○			B	I-2.2.12
					High-speed orientation: Motor acceleration at deceleration time (High)	○	○				I-5.4.7
305	4321	4321		0	Optimum orientation: Spindle acceleration command (Low)	○	○			B	I-2.2.12
					High-speed orientation: Motor acceleration at deceleration time (Medium High)	○	○				I-5.4.7
306	4322	4322		0	Optimum orientation: Spindle acceleration command (High)			○	○	B	App. B
					High-speed orientation: Motor acceleration at deceleration time (Medium Low)	○	○				I-5.4.7
307	4323	4323		0	Optimum orientation: Spindle acceleration command (Low)			○	○	B	App. B
					High-speed orientation: Motor acceleration at deceleration time (Low)	○	○				I-5.4.7
308	4324	4324		0	Optimum orientation: One-rotation signal detection speed	○	○			B	I-2.2.12
					High-speed orientation: Motor acceleration at deceleration time (High)			○	○		App. B
309	4325	4325		0	Optimum orientation: One-rotation signal detection speed			○	○	B	App. B
					High-speed orientation: Motor acceleration at deceleration time (Low)			○	○		App. B
310	4326	4326		0	Optimum orientation: Time constant for overshoot compensation/Limit ratio for acceleration command (High)	○	○			B	I-2.2.12
					High-speed orientation: Acceleration limitation start speed at deceleration time (High)	○	○				I-5.4.7

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						MH	ML	SH	SL		
311	4327	4327		0	Optimum orientation: Time constant for overshoot compensation/Limit ratio for acceleration command (Low)	○	○			B	I-2.2.12
					High-speed orientation: Acceleration limitation start speed at deceleration time (High)			○	○		App. B
312	4328	4328		0	Command multiplication for spindle orientation by position coder	○	○			B	I-5.3.6
313	4329	4329		0	Command multiplication for spindle orientation by position coder			○	○	B	App. B
314	4330	4330		0	Optimum orientation: Time constant for overshoot compensation/Limit ratio for acceleration command (High)			○	○	B	App. B
					High-speed orientation: Acceleration limitation start speed at deceleration time (Low)	○	○				I-5.4.7
315	4331	4331		0	Optimum orientation: Time constant for overshoot compensation/Limit ratio for acceleration command (Low)			○	○	B	App. B
					High-speed orientation: Acceleration limitation start speed at deceleration time (Low)			○	○		App. B
316	4332	4332		0	Magnetic flux boost completion level/magnetic flux boost coefficient			○		B	App. B
317	4333	4333		0	Magnetic flux boost completion level/magnetic flux boost coefficient				○	B	App. B
318	4334	4334		0	Number of motor sensor arbitrary teeth	○	○			A	I-1.3.2
319	4335	4335		0	Number of motor sensor arbitrary teeth			○	○	A	App. B
320	4336	4336		0	Switching point used for an acceleration/deceleration time constant used for spindle synchronous control	○	○	○	○	B	I-2.5.8
324	4340	4340		0	Bell-shaped acceleration/deceleration time constant during spindle synchronous control	○	○	○	○	B	I-2.5.8
325	4341	4341		0	Unexpected disturbance torque detection level	○	○	○	○	B	I-5.6.5
326	4342	4342		0	Velocity loop gains override function on Cs contouring control mode (HIGH)	○	○			B	I-2.4.9
327	4343	4343		0	Velocity loop gains override function on Cs contouring control mode (LOW)	○	○			B	I-2.4.9
329	4345	4345		0	Spindle motor speed specification detection level	○	○	○	○	B	I-2.6.4
330	4346	4346		0	Incomplete integration factor	○	○	○	○	B	I-2.5.8 I-2.6.4
331	4347	4347		0	Master-slave speed difference state signal output setting	○	○			B	I-5.10.6
332	4348	4348		0	Monitor constant of winding temperature(Heat coefficient)				○	D	App. B
333	4349	4349		Depends on the model	Temperature monitoring time constant			○	○	C	App. B
334	4350	4350		0	Monitor constant of winding temperature(Heat coefficient)			○		D	App. B
335	4351	4351		0	Current detection offset compensation	○	○	○	○	B	I-2.6.4
336H	4352	4352	#1	0	Setting of the peak hold function for load meter output	○	○			B	I-2.1.6
			#3	0	Load meter (normalized by the maximum output/continuous rated output) switch bit	○	○	○	○	B	I-5.19.4
			#4	0	Setting of whether to enable/disable feed forward at all times	○	○			B	I-5.7.8
			#6	0	Inter-spindle amplifier communication slave axis setting	○	○			B	I-5.7.8 I-5.10.6
			#7	0	Inter-spindle amplifier communication master axis setting	○	○			B	I-5.7.8 I-5.10.6
336L	4353	4353	#0	0	Improvement of backlash acceleration for low-speed reverse operation	○	○			B	I-5.14.4
			#1	0	Velocity feedback signal setting in torque tandem operation	○	○			B	I-5.10.6
			#2	0	Relationship of master/slave motor rotation directions in torque tandem operation	○	○			B	I-5.10.6
			#3	0	Load detection level 1/2 detection standard setting bit	○	○	○	○	B	I-5.19.4
			#4	0	Power failure backup function Function bit	○	○			B	I-5.20.6
			#5	0	Setting of the Cs axis position data transfer function	○	○			B	I-2.4.9
			#6	0	Whether to use the magnetic flux boost function	○	○			B	I-5.16.4
337	4354	4354		0	Excessive semi-closed loop/closed loop position error alarm detection level [in Cs contour control]	○	○			B	I-5.9.5
338	4355	4355		0	Motor sensor signal amplitude ratio compensation	○	○			A	I-1.3.2 I-4.3

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						MH	ML	SH	SL		
339	4356	4356		0	Motor sensor signal phase difference compensation	○	○			A	I-1.3.2 I-4.3
340	4357	4357		0	Spindle sensor signal amplitude ratio compensation	○	○			A	I-1.3.2 I-4.3
341	4358	4358		0	Spindle sensor signal phase difference compensation	○	○			A	I-1.3.2 I-4.3
343	4360	4360		0	Preload value	○	○			B	I-5.10.6
344	4361	4361		0	Number of spindle sensor arbitrary teeth	○	○			A	I-1.3.2
345	4362	4362		0	Load meter compensation 1	○				C	I-2.6.4
346	4363	4363		0	Load meter compensation 2	○				C	I-2.6.4
347	4364	4364		0	Load meter compensation 3	○				C	I-2.6.4
348	4365	4365		0	Load meter compensation 1		○			C	App. B
349	4366	4366		0	Load meter compensation 2		○			C	App. B
350	4367	4367		0	Load meter compensation 3		○			C	App. B
352	4369	4369		0	Spindle synchronous orientation deceleration coefficient	○	○			B	I-5.5.6
353	4370	4370		0	Filter time constant for spindle acceleration detection	○	○			B	I-2.2.12
354	4371	4371		-1	Reserved						
355	4372	4372		0	Spindle speed limit for safety 1	○	○			D	
356H	4373	4373	#1	0	Setting of the peak hold function for load meter output			○	○	B	App. B
356L	4374	4374	#6	0	Whether to use the magnetic flux boost function			○	○	B	App. B
358	4376	4376		0	Load meter compensation 1			○		C	App. B
359	4377	4377		0	Load meter compensation 2			○		C	App. B
360	4378	4378		0	Load meter compensation 3			○		C	App. B
361	4379	4379		0	Load meter compensation 1				○	C	App. B
362	4380	4380		0	Load meter compensation 2				○	C	App. B
363	4381	4381		0	Load meter compensation 3				○	C	App. B
365	4383	4383		0	Filter time constant for spindle acceleration detection			○	○	B	App. B
368	4386	4386		0	Spindle EGB : master side detector pulse count	○	○			B	I-5.7.8
369	4387	4387		0	Spindle EGB : synchronous ratio numerator	○	○			B	I-5.7.8
370	4388	4388		0	Spindle EGB : synchronous ratio denominator	○	○			B	I-5.7.8
373	4391	4391		0	Resonance elimination filter 1 : attenuation center frequency	○	○			B	I-4.2.3
374	4392	4392		0	Resonance elimination filter 1 : attenuation bandwidth	○	○			B	I-4.2.3
375	4393	4393		0	Resonance elimination filter 1 : damping	○	○			B	I-4.2.3
376H	4394	4394	#2	0	Setting of the detection lower limit of the one-rotation signal	○	○			A	I-1.3.3
			#5	0	Whether to detect the alarm related to spindle sensor polarity erroneous setting	○	○			A	I-1.3.2
376L	4395	4395	#3	0	Setting of parameter transfer from the CNC to spindle software	○	○	○	○	B	I-2.6.4
			#6	0	Triggering of the disturbance input function (vibration application function)	○	○			B	I-5.27.6
			#7	0	Setting of the disturbance input function (vibration application function)	○	○			B	I-5.27.6
378H	4398	4398	#3	0	Whether to use the twin drive function	○	○			B	I-5.13.6
			#4	0	Whether to use the velocity tandem function	○	○			B	I-5.10.6
			#5	0	Whether to use the velocity integrator copy function	○	○			B	I-5.10.6
			#6	0	Whether to detect a speed polarity error (spindle alarm d0) in tandem operation	○	○			B	I-5.13.6
378L	4399	4399	#1	0	Stop method used on detection of a safety speed excess alarm (30*i*)	○	○			D	
			#2	0	Setting of the emergency stop operation of the soft start/stop function	○	○			B	I-2.1.6
380H	4402	4402	#0	0	Whether to enable the backlash avveleration function	○	○			B	I-5.14.4
			#1	0	Setting of the feed-forward coefficient when the backlash acceleration function is enabled	○	○			B	I-5.14.4
			#3	0	Whether to use the torque tandem function (for 30*i*-B)	○	○			B	I-5.10.6
383	4406	4406		0	Acceleration/deceleration time constant at return to the reference position in Cs contouring control/servo mode	○	○			B	I-2.3.8 I-2.4.7
387	4410	4410		0	Frequency of disturbance torque	○	○	○	○	B	I-5.27.6
388	4411	4411		0	Disturbance input function : measurement end frequency	○	○	○	○	B	I-5.27.6
389	4412	4412		0	Disturbance input function : measurement frequency interval	○	○	○	○	B	I-5.27.6

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390	4413	4413		0	Disturbance input function : number of measurements per frequency	○	○	○	○	B	I-5.27.6
391	4414	4414		0	Amplitude of disturbance torque	○	○	○	○	B	I-5.27.6
392	4415	4415		0	Disturbance input function : motor speed command for measurement	○	○	○	○	B	I-5.27.6
393	4416	4416		0	Resonance elimination filter 2 : attenuation center frequency	○	○			B	I-4.2.2
394	4417	4417		0	Resonance elimination filter 2 : attenuation bandwidth	○	○			B	I-4.2.2
395	4418	4418		0	Resonance elimination filter 2 : damping	○	○			B	I-4.2.2
396	4419	4419		0	Resonance elimination filter 3 : attenuation center frequency	○	○			B	I-4.2.2
397	4420	4420		0	Resonance elimination filter 3 : attenuation bandwidth	○	○			B	I-4.2.2
398	4421	4421		0	Resonance elimination filter 3 : damping	○	○			B	I-4.2.2
399	4422	4422		0	Resonance elimination filter 4 : attenuation center frequency	○	○			B	I-4.2.2
400	4423	4423		0	Resonance elimination filter 4 : attenuation bandwidth	○	○			B	I-4.2.2
401	4424	4424		0	Resonance elimination filter 4 : damping	○	○			B	I-4.2.2
414	4437	4437		-1	Reserved						
415	4438	4438		0	Spindle speed limit for safety 2	○	○			D	
416	4439	4439		-1	Reserved						
417	4440	4440		0	Spindle speed limit for safety 3	○	○			D	
418	4441	4441		-1	Reserved						
419	4442	4442		0	Spindle speed limit for safety 4	○	○			D	
420	4443	4443		0	Feed-forward coefficient of velocity loop		○			B	App. B
424	4447	4447		-1	Reserved						
425	4448	4448		0	Criterion level for spindle stop (30*i*)	○	○	○	○	D	
432	4455	4455		0	Backlash acceleration: Acceleration-dependent compensation	○	○			B	I-5.14.4
433	4456	4456		0	Backlash acceleration: Stop timing	○	○			B	I-5.14.4
434	4457	4457		0	Backlash acceleration: Acceleration-independent compensation	○	○			B	I-5.14.4
435	4458	4458		0	Backlash acceleration: Spindle stop check time	○	○			B	I-5.14.4
441	4464	4464		0	Velocity command-dependent over speed 2 (spindle alarm 92) detection offset level 2	○	○	○	○	D	I-2.6.4
442	4465	4465		0	Excessive speed deviation level2	○	○	○	○	D	I-2.6.4
443	4466	4466		0	Excessive speed deviation detection time 2	○	○	○	○	D	I-2.6.4
444H	4467	4467	#2	0	Setting of the detection lower limit of the one-rotation signal			○	○	A	App. B
			#5	0	Whether to detect the alarm related to spindle sensor polarity erroneous setting			○	○	A	App. B
444L	4468	4468	#6	0	Triggering of the disturbance input function (vibration application function)			○	○	B	App. B
			#7	0	Setting of the disturbance input function (vibration application function)			○	○	B	App. B
446L	4472	4472	#1	0	Stop method used on detection of a safety speed excess alarm (30*i*)			○	○	D	
			#2	0	Setting of the emergency stop operation of the soft start/stop function			○	○	B	App. B
453	4481	4481		0	Feed-forward timing adjustment coefficient			○	○	B	App. B
458	4486	4486		0	Feed-forward coefficient of velocity loop				○	B	App. B
470	4498	4498		0	Spindle EGB master side : denominator of arbitrary gear ratio between motor sensor and spindle	○	○			B	I-5.7.8
471	4499	4499		0	Spindle EGB master side : numerator of arbitrary gear ratio between motor sensor and spindle	○	○			B	I-5.7.8
472	4500	4500		0	Denominator of arbitrary gear ratio between spindle sensor and spindle (High)	○	○			A	I-1.3.2
473	4501	4501		0	Numerator of arbitrary gear ratio between spindle sensor and spindle (High)	○	○			A	I-1.3.2
474	4502	4502		0	Denominator of arbitrary gear ratio between spindle sensor and spindle (Low)	○	○			A	I-1.3.2
475	4503	4503		0	Numerator of arbitrary gear ratio between spindle sensor and spindle (Low)	○	○			A	I-1.3.2
480	4508	4508		0	Rate of change in acceleration at soft start/stop	○	○	○	○	B	I-2.1.6
482	4510	4510		0	Power failure backup function Upper limit of the DC link voltage	○	○				I-5.20.6

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Internal data No. F-xxx	0*i*	30*i*	bit	Standard initial setting data	Contents	Application				Classifi-cation	Reference item
						MH	ML	SH	SL		
483	4511	4511		0	Power failure backup function Lower limit of the DC link voltage	○	○				I-5.20.6
487	4515	4515		0	Excessive speed deviation alarm detection level on spindle synchronous control	○	○			D	I-2.5.8
488	4516	4516		0	Excessive positional deviation alarm detection level on spindle synchronous control	○	○			D	I-2.5.8
491	4519	4519		0	Bell-shaped acceleration/deceleration time constant for soft start/stop	○	○	○	○	B	I-2.1.6
492	4520	4520		0	Primary delay time constant in dual position feedback [in servo mode]	○	○			B	I-5.9.5
493	4521	4521		0	Maximum amplitude in dual position feedback [in servo mode]	○	○			B	I-5.9.5
494	4522	4522		0	Dual position feedback zero width [in servo mode]	○	○			B	I-5.9.5
495	4523	4523		0	Excessive semi-closed loop/closed loop position error alarm detection level [in servo mode]	○	○			B	I-5.9.5
499	4527	4527		0	Temperature difference between warning level and alarm level	○	○	○	○	D	I-2.6.4
504	4532	4532		0	Arbitrary data output function number	○	○	○	○	B	
512H	4540	4540	#0	0	Setting related to the motor voltage control characteristics on Cs contouring control	○	○			B	I-5.18.6
			#2	0	Setting of preload function operation at a power failure	○	○			B	I-5.21.7
			#4	0	Whether the inertial estimation function is enabled or disabled	○	○	○	○	B	I-5.24.5
			#7	0	Setting of the the DC-link stabilizer at a spindle power failure	○	○			B	I-5.21.7
512L	4541	4541	#0		Presence or absence of power consumption calculation	○	○	○	○	E	
			#1		Setting of the output unit of accumulated power consumption	○	○	○	○	E	
			#2		Setting of the output unit of accumulated power consumption	○	○	○	○	E	
			#3	0	Scaling function for the slave axis preload during velocity tandem control	○	○			B	I-5.10.6
			#4	0	Scaling function for the slave axis velocity command during velocity tandem control	○	○			B	I-5.10.6
			#5	0	Tandem command SLV acceptance condition setting	○	○			B	I-5.10.6
			#6	0	Master/slave motor rotation direction relationship for the multi-axis integrator copy	○	○			B	I-5.10.6
513H	4542	4542	#4	0	Cutting/rapid feed-forward function selection bit	○	○	○	○	B	I-2.4.9
			#5		Select of the inertial estimation mrthod	○	○	○	○	B	I-5.23.5
			#6	0	Power failure backup function Operation setting	○	○			B	I-5.20.6
			#7	0	Setting of smart load meter display	○	○	○	○	B	I-5.28.5
513L	4543	4543	#2	0	Smart thermal control: Setting of operation during cutting in constant surface speed control	○	○	○	○	B	I-5.25.6
			#3	0	Smart backlash compensation function	○	○			B	I-5.29.3
515H	4546	4546	#3	0	Unit of the diagnosis screen display (DGN720) of the estimated inertia value	○	○	○	○	B	I-5.24.5
			#4	0	Setting 0 of the input frequency of the inertia estimation signals	○	○	○	○	B	I-5.24.5
			#5	0	Setting 1 of the input frequency of the inertia estimation signals	○	○	○	○	B	I-5.24.5
			#6	0	Setting 0 of the input gain of the inertia estimation signals	○	○	○	○	B	I-5.24.5
			#7	0	Setting 1 of the input gain of the inertia estimation signals	○	○	○	○	B	I-5.24.5
516H	4548	4548	#6	0	Setting of the feed-forward coefficient for the EGB move command	○	○			B	I-5.7.8
517	4550	4550		0	Velocity loop proportional gain on spindle synchronous control (High)	○	○			B	I-2.5.9
518	4551	4551		0	Velocity loop proportional gain on spindle synchronous control (Low)	○	○			B	I-2.5.9
519	4552	4552		0	Velocity loop integral gain on spindle synchronous control (High)	○	○			B	I-2.5.9
520	4553	4553		0	Velocity loop integral gain on spindle synchronous control Low)	○	○			B	I-2.5.9
521	4554	4554		0	Position gain on spindle synchronous control (High)	○	○			B	I-2.5.9
522	4555	4555		0	Position gain on spindle synchronous control (Medium High)	○	○			B	I-2.5.9
523	4556	4556		0	Position gain on spindle synchronous control (Medium Low)	○	○			B	I-2.5.9
524	4557	4557		0	Position gain on spindle synchronous control (Low)	○	○			B	I-2.5.9
525	4558	4558		0	Motor voltage for spindle synchronous control (for high-speed characteristics)	○				B	I-2.5.9

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Internal data No. F-xxx	0*i*	30*i*	bit	Standard initial setting data	Contents	Application				Classifi-cation	Reference item
						MH	ML	SH	SL		
526	4559	4559		0	Motor voltage for spindle synchronous control (for low-speed characteristics)		○			B	I-2.5.9
555	4588	4588		0	Inertia estimation: Excitationinput frequency	○	○	○	○	B	I-5.23.5
556	4589	4589		0	Inertia estimation: Excitationinput gain	○	○	○	○	B	I-5.23.5
557	4590	4590		0	Orientation speed restriction rate 1/orientation speed restriction rate 2 (HIGH)	○	○			B	I-2.2.12
558	4591	4591		0	Orientation speed restriction rate 1/orientation speed restriction rate 2 (LOW)	○	○			B	I-2.2.12
560	4593	4593			Spindle amplifier loss coefficient 1	○	○	○	○		
561	4594	4594			Spindle amplifier loss coefficient 2	○	○	○	○		
562	4595	4595			Common power supply loss coefficient 1	○	○	○	○		
563	4596	4596			Common power supply loss coefficient 2	○	○	○	○		
564	4597	4597			Setting for the multi-axis integrator copy	○	○			B	I-5.10.6
573	4606	4606			Preload time constant	○	○			B	I-5.10.6
574	4607	4607		0	Motor voltage after completion of optimum orientation	○	○			B	I-2.2.12
576	4609	4609		0	Inertia estimation Friction compensation	○	○	○	○	B	I-5.24.5
579	4612	4612		0	Parameter for load meter (normalized by the continuous rated output) <1>	○				B	I-5.19.4
580	4613	4613		0	Parameter for load meter (normalized by the continuous rated output) <2>	○				B	I-5.19.4
581	4614	4614		0	Parameter for load meter (normalized by the continuous rated output) <1>		○			B	I-5.19.4
582	4615	4615		0	Parameter for load meter (normalized by the continuous rated output) <2>		○			B	I-5.19.4
583	4616	4616		0	Speed for changing slave axis acceleration in EGB automatic phase matching	○	○			B	I-5.7.8
586	4619	4619		Depends on the model	Cutting feed/rapid traverse PWM frequency switching in Cs contour control Setting related to the current limitation (for high-speed characteristics of speed range switching)	○				B	I-5.18.6
587	4620	4620		Depends on the model	Cutting feed/rapid traverse PWM frequency switching in Cs contour control Setting related to the current limitation (for low-speed characteristics of speed range switching)		○			B	I-5.18.6
588	4621	4621		Depends on the model	Cutting feed/rapid traverse PWM frequency switching in Cs contour control Velocity loop gain override	○	○			B	I-5.18.6
589	4622	4622		1	Cutting feed/rapid traverse PWM frequency switching in Cs contour control Current loop gain override	○	○			B	I-5.18.6
590	4623	4623		Depends on the sensor	Distance coded sensor Nominal increment 1	○	○			A	I-5.23.4
591	4624	4624		Depends on the sensor	Distance coded sensor Nominal increment 2	○	○			A	I-5.23.4
592	4625	4625		0	Distance coded sensor Z phase position compensation data	○	○			A	I-5.23.4
593	4626	4626		0	Output limitation value		○			B	I-2.1.6
594	4627	4627		0	Advanced preview feed-forward coefficient for cutting feed	○	○	○	○	B	I-2.4.9
596	4629	4629		0	Allowable acceleration for acceleration at a power failure (for high-speed characteristics)	○					I-5.20.6
597	4630	4630		0	Allowable acceleration for acceleration at a power failure (for low-speed characteristics)		○				I-5.20.6
601	4634	4634		Depends on the model	Smart thermal control: Output lower limit	○				B	I-5.25.6
602	4635	4635		Depends on the model	Smart thermal control: Output lower limit		○			B	I-5.25.6
604	4637	4637		0	Alarm detection level of conection error (monitoring amount of motor rotation during the spindle one rotation ssignal)	○	○			B	I-5.26.2
605	4638	4638		0	Alarm detection level of conection error (monitoring amount of spindle-motor speed difference)	○	○			B	I-5.26.3
608	4641	4641		0	Backlash acceleration: Calculation time of acceleration	○	○			B	I-5.14.4
609	4642	4642		0	Backlash acceleration: Stop timing (motor travel distance)	○	○			B	I-5.14.4

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Internal data No. F-xxx	0*i*	30*i*	bit	Standard initial setting data	Contents	Application				Classifi-cation	Reference item
						MH	ML	SH	SL		
611	4644	4644		100	Gain for Smart backlash compensation	○	○			B	I-5.29.3
612	4645	4645		0	Ratio for compensation against actual backlash length	○	○			B	I-5.29.3
613	4646	4646		500	Distance of spindle movement (Distance for update of “Based semi-full error” information)	○	○			B	I-5.29.3
614	4647	4647		0	Judgment time of axis stop in Smart backlash compensation	○	○			B	I-5.29.3
615	4648	4648		500	Effective time of Smart backlash compensation	○	○			B	I-5.29.3
616	4649	4649		0	Effective time for getting “Based semi-full error”	○	○			B	I-5.29.3
617	4650	4650		0	Compensation length of Smart backlash compensation	○	○			B	I-5.29.3
628	4661	4661		0	Tolerable error value at spindle stop	○	○	○	○	B	I-5.24.7
633	4666	4666		0	Smart rigid tapping: Bell-shaped acceleration/deceleration time constant	○				B	I-5.24.8
634	4667	4667		0	Smart rigid tapping: Bell-shaped acceleration/deceleration time constant		○			B	I-5.24.8
635	4668	4668		0	Smart rigid tapping: Upper limit of torque command	○				B	I-5.24.8
636	4669	4669		0	Smart rigid tapping: Upper limit of torque command		○			B	I-5.24.8
638H		4672		0	Common power supply parameter (Bits 07-00) [FS30*i*-B]					F	
638L		4673		0	Common power supply parameter (Bits 07-00) [FS30*i*-B]					F	
682	4720	4720		0	Orientation speed restriction rate 1/orientation speed restriction rate 2 (HIGH)			○	○	B	App. B
683	4721	4721		0	Orientation speed restriction rate 1/orientation speed restriction rate 2 (LOW)			○	○	B	App. B
690	4728	4728		0	Parameter for load meter (normalized by the continuous rated output) <1>			○		B	App. B
691	4729	4729		0	Parameter for load meter (normalized by the continuous rated output) <2>			○		B	App. B
692	4730	4730		0	Parameter for load meter (normalized by the continuous rated output) <1>				○	B	App. B
693	4731	4731		0	Parameter for load meter (normalized by the continuous rated output) <2>				○	B	App. B
694	4732	4732		0	Output limitation value				○	B	App. B
699	4737	4737		0	Motor voltage after completion of optimum orientation			○	○	B	App. B
726	4764	4764		Depends on the model	Smart thermal control: Output lower limit			○		B	I-5.25.6
727	4765	4765		Depends on the model	Smart thermal control: Output lower limit				○	B	I-5.25.6
729	4767	4767		0	Alarm detection level of conection error (monitoring amount of motor rotation during the spindle one rotation ssignal)			○	○	B	I-5.26.2
733 to 745		4771 to 4783		0	Common power supply parameters [FS30*i*-B]					F	
746		4784		0	Common power supply parameter [FS30*i*-B]: Power failure detection level 1/power failure detection time 1)					F	
747		4785		0	Common power supply parameter [FS30*i*-B]: Power failure detection level 2/power failure detection time 2)					F	

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A.2 B*i*S SERIES SPINDLE PARAMETER TABLE

Spindle parameters are classified into the following types:

A : Parameters related to the setup of detectors

B : Parameters related to the setup of various functions (operating modes)

C : Unique parameters for the drive of spindle motors (Set the parameter data according to the parameter list for each motor model.)

D : Parameters related to the setting of alarm detection conditions

E : Parameters related to the setting of a power consumption monitor, refer to the following specifications or an applicable CNC CONNECTION MANUAL (FUNCTION) for details.

・" FANUC Series 30*i*-A/31*i*-A5/31*i*-A/32*i*-A Power Consumption Monitor Specification": A-92737.

・"FANUC Series FANUC Series 30*i*-B/31*i*-B5/31*i*-B/32*i*-B/35*i*-B Power Consumption Monitor Specification": A-94362.

・"FANUC Series 0*i*/0*i* Mate-MODEL D Power Consumption Monitor Specification": A-93067.

・"FANUC Series 0*i*-MODEL F Connection Manual (Function)": B-64603JA-1.

F: Parameters for the common power supply (see "FANUC SERVO AMPLIFIER α*i* series 30*i*-B series CNC DESCRIPTIONS" (B-65412EN/01).)

・" FANUC SERVO AMPLIFIER α*i*-B series DESCRIPTIONS": B-65412JA.

・" FANUC SERVO AMPLIFIER β*i*-B series DESCRIPTIONS": B-65422JA

Internal data No. F-xxx	0*i*	30*i*	bit	Standard initial setting data	Contents	Classifi-cation	Reference item
0H	4000	4000	#0	0	Rotation direction relationship between the spindle and motor	A	III-1.3.2
			#1	0	Spindle rotation direction when a positive (+) move command is specified on Cs contouring control	B	III-2.4.9
			#3	0	Return direction for the reference position on Cs contouring control mode	B	III-2.4.9
			#4	0	Return direction for the reference position on servo mode	B	III-2.3.8
0L	4001	4001	#0	1	Whether to use MRDY (machine ready) signal	B	III-2.6.4
			#4	0	Spindle sensor attachment direction	A	III-1.3.2
1H	4002	4002	#0	0	Spindle sensor type	A	III-1.3.2
			#1	0	Spindle sensor type	A	III-1.3.2
			#2	0	Spindle sensor type	A	III-1.3.2
			#3	0	Spindle sensor type	A	III-1.3.2
			#4	0	Whether to use the rotation direction signal (SFR/SRV) function on Cs contouring control	B	III-2.4.9
			#5	0	Whether to use the rotation direction signal (SFR/SRV) function on servo mode	B	III-2.3.8
			#6	0	Whether to use the rotation direction signal (SFR/SRV) function on spindle synchronous control	B	III-2.5.9
			#7	0	Whether to use the CMR (servo mode Cs contouring) function in servo mode	B	
1L	4003	4003	#0	0	Spindle orientation method	B	III-2.2.12
			#2	0	Rotation direction during spindle orientation	B	III-2.2.12
			#3	0	Rotation direction during spindle orientation	B	III-2.2.12
			#4	0	Teeth number setting of spindle sensor	A	III-1.3.2
			#5	0	Teeth number setting of spindle sensor	A	III-1.3.2
			#6	0	Teeth number setting of spindle sensor	A	III-1.3.2
			#7	0	Teeth number setting of spindle sensor	A	III-1.3.2
2L	4005	4005	#0	0	Command resolution for Cs contouring control	B	III-2.4.9
			#5	0	Increment system of gear ratio 1		I-5.26.2
3H	4006	4006	#1	0	Increment system of gear ratio 2	A	III-1.3.2
			#3	0	Automatic detection of one-rotation signal during spindle synchronous control	B	III-2.5.9
			#4	0	Sets the D-phase current command.	C	III-2.6.3

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Internal data No. F-xxx	0*i*	30*i*	bit	Standard initial setting data	Contents	Classifi -cation	Reference item
			#5	0	Setting of analog override range	B	III-2.1.6
			#7	0	Whether to use the command arbitrary gear ratio (CMR) function on rigid tapping	B	III-2.3.8
3L	4007	4007	#5	0	Whether to detect a feedback signal disconnection	A	III-1.3.2
			#6	0	Whether to detect the alarms (spindle alarms 41, 42, 47, 81, 82, 83, 85, 86, and 87) related to the position feedback signal (when non-Cs contouring control mode is set)	A	III-1.3.2
			#7	0	Magnetic pole detection start signal selection	B	III -1.5.4
4H	4008	4008	#0	0	Reserved	C	
			#1	0	Reserved	C	
			#2	0	Reserved	C	
			#3	0	Sets the current command.	C	III-2.6.3
			#4	Depends on the model	Setting of output limitation method	C	III-2.6.3
			#5	0	Whether to use the SSM	B	III -1.4.4
			#6	0	Reference magnetic pole position selection (Whether to use the AMR offset function)	B	III -1.5.3 III-1.5.5
4L	4009	4009	#0	0	Increment system of velocity loop gain	B	III-2.6.4
			#2	0	Motor power turn-off method when spindle alarm 24 (serial data transfer error) is issued	D	III-2.6.4
			#4	0	Whether to output the load detection signals (LDT1, LDT2) during acceleration/deceleration	B	III-2.1.6
			#5	Depends on the model	Setting related to magnetic flux reduction speed	C	III-2.6.3
			#6	0	Analog override type	B	III-2.1.6
5H	4010	4010	#0	Depends on the model	Motor sensor type	A	III-1.3.2
			#1	Depends on the model	Motor sensor type	A	III-1.3.2
			#2	Depends on the model	Motor sensor type	A	III-1.3.2
5L	4011	4011	#0	Depends on the model	Teeth number setting of motor sensor	A	III-1.3.2
			#1	Depends on the model	Teeth number setting of motor sensor	A	III-1.3.2
			#2	Depends on the model	Teeth number setting of motor sensor	A	III-1.3.2
			#3	Depends on the model	Number of motor poles	C	III-2.6.3
			#4	Depends on the model	Setting of maximum output during acceleration/deceleration	C	III-2.6.3
			#7	Depends on the model	Number of motor poles	C	III-2.6.3
6H	4012	4012	#0	Depends on the model	Setting of PWM carrier frequency	C	III-2.6.3
			#1	Depends on the model	Setting of PWM carrier frequency	C	III-2.6.3
			#2	Depends on the model	Setting of PWM carrier frequency	C	III-2.6.3
			#4	0	Setting of the cutting feed/rapid traverse PWM frequency switching function in Cs contouring control	B	III-5.17.6
			#5	0	Current control cycle setting	B	III-5.17.6
			#6	1	Setting of the synchronous built-in spindle motor	C	III-2.6.3
			#7	1	Setting of spindle HRV function	C	III-2.6.3
6L	4013	4013	#2	Depends on the model	Current dead-band data	C	III-2.6.3
			#3	Depends on the model	Current dead-band data	C	III-2.6.3
			#4	Depends on the model	Current dead-band data	C	III-2.6.3
			#5	Depends on the model	Current dead-band data	C	III-2.6.3

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Internal data No. F-xxx	0*i*	30*i*	bit	Standard initial setting data	Contents	Classifi -cation	Reference item
			#6	Depends on the model	Current dead-band data	C	III-2.6.3
7H	4014	4014	#6	0	Whether to use the orientation function on spindle synchronous control	B	III-5.5.6
7L	4015	4015	#0	0	Whether to use the spindle orientation function	B	III-2.2.12
			#1	0	Whether to use the unexpected disturbance torque detection function	B	III-5.6.5
8H	4016	4016	#0	0	Order of A/B phases of the distance coded sensor	A	III-5.21.4
			#3	0	Setting of the smoothing function in feed-forward control	B	III-2.4.9 III-5.7.7
			#5	0	Whether to detect the alarms (spindle alarms 81, 82, 85, 86) related to position feedback (on Cs contouring control mode)	A	III-1.3.2
			#6	0	Whether to detect the alarm (spindle alarms 46) related to feedback of the position detection signal for threading	A	III-1.3.2
			#7	0	Function for newly detecting the one-rotation signal before entering position control mode	A	III-1.3.2
8L	4017	4017	#2	0	Z phase detection setting	A	III-5.21.4
			#7	0	Setting of shortcut orientation from stop state in position coder method spindle orientation	B	III-2.2.12
9H	4018	4018	#3	0	Type of position coder method orientation	B	III-2.2.12
			#4	0	Optimum orientation: Setting of velocity feedforward (CTH1A=0)	B	III-2.2.12
			#5	0	Optimum orientation: Setting of velocity feedforward (CTH1A=1) High-speed orientation: Velocity command compensation function	B	III-2.2.12 III-5.14.7
			#6	0	Type of position coder method orientation	B	III-2.2.12
9L	4019	4019	#2	1	Whether to use torque clamp at zero speed	B	III-2.6.4
			#7	0	Automatic parameter setting function (0*i*-D/30*i*)	B	III-1.1.2 III-2.6.4
10	4020	4020		Depends on the model	Maximum motor speed	C	III-1.4.4 III-2.6.3
11	4021	4021		100	Maximum speed on Cs contouring control mode	B	III-2.4.9
12	4022	4022		150	Speed arrival detection level (SAR)	B	III-2.6.4
13	4023	4023		30	Speed detection level (SDT)	B	III-2.6.4
14	4024	4024		75	Zero speed detection level (SST)	B	III-2.6.4
15	4025	4025		50	Limited torque (TLMH, TLML)	B	III-2.6.4
16	4026	4026		83	Load detection level 1 (LDT1)	B	III-2.6.4
17	4027	4027		95	Load detection level 2 (LDT2)	B	III-2.6.4
20	4030	4030		0	Soft start/stop time (SOCN)	B	III-2.1.6
21	4031	4031		0	Stop position of position coder method orientation	B	III-2.2.12
22	4032	4032		0	Acceleration for spindle synchronous control	B	III-2.5.9
23	4033	4033		10	Spindle synchronous speed arrival level	B	III-2.5.9
24	4034	4034		0	Shift during synchronous control of spindle phase	B	III-2.5.9
25	4035	4035		10	Compensation data for spindle phase synchronous control	B	III-2.5.9
26	4036	4036		0	Feed-forward coefficient	B	III-2.4.9 III-5.8.8
27	4037	4037		0	Feed-forward coefficient of velocity loop	B	III-2.4.9 III-5.6.4 III-5.8.8
28	4038	4038		0	Optimum orientation: Orientation speed upper limit Conventional method orientation, High-speed orientation: Spindle orientation speed	B	III-2.2.12
29	4039	4039		0	Reserved	C	
30	4040	4040		10	Velocity loop proportional gain on velocity control mode (High)	B	III-2.1.6
31	4041	4041		10	Velocity loop proportional gain on velocity control mode (Low)	B	III-2.1.6
32	4042	4042		10	Velocity loop proportional gain on orientation (High)	B	III-2.2.12
33	4043	4043		10	Velocity loop proportional gain on orientation (Low)	B	III-2.2.12
34	4044	4044		10	Velocity loop proportional gain on servo mode/spindle synchronous control (High)	B	III-2.3.8 III-2.5.9
35	4045	4045		10	Velocity loop proportional gain on servo mode/spindle synchronous control (Low)	B	III-2.3.8 III-2.5.9
36	4046	4046		30	Velocity loop proportional gain on Cs contouring control (High)	B	III-2.4.9
37	4047	4047		30	Velocity loop proportional gain on Cs contouring control (Low)	B	III-2.4.9

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38	4048	4048		10	Velocity loop integral gain on velocity control mode (High)	B	III-2.1.6
39	4049	4049		10	Velocity loop integral gain on velocity control mode (Low)	B	III-2.1.6
40	4050	4050		10	Velocity loop integral gain on orientation (High)	B	III-2.2.12
41	4051	4051		10	Velocity loop integral gain on orientation (Low)	B	III-2.2.12
42	4052	4052		10	Velocity loop integral gain on servo mode/spindle synchronous control (High)	B	III-2.3.8 III-2.5.9
43	4053	4053		10	Velocity loop integral gain on servo mode/spindle synchronous control (Low)	B	III-2.3.8 III-2.5.9
44	4054	4054		50	Velocity loop integral gain on Cs contouring control (High)	B	III-2.4.9
45	4055	4055		50	Velocity loop integral gain on Cs contouring control (Low)	B	III-2.4.9
46	4056	4056		100	Gear ratio (High)	A	III-1.3.2
47	4057	4057		100	Gear ratio (Medium High)	A	III-1.3.2
48	4058	4058		100	Gear ratio (Medium Low)	A	III-1.3.2
49	4059	4059		100	Gear ratio (Low)	A	III-1.3.2
50	4060	4060		1000	Position gain on orientation (High)	B	III-2.2.12
51	4061	4061		1000	Position gain on orientation (Medium High)	B	III-2.2.12
52	4062	4062		1000	Position gain on orientation (Medium Low)	B	III-2.2.12
53	4063	4063		1000	Position gain on orientation (Low)	B	III-2.2.12
54	4064	4064		100	Ordinary orientation: Rate of change in position gain upon completion of orientation High-speed orientation: Rate of change in position gain upon completion of orientation Optimum orientation: Position feedforward coefficient	B	III-2.2.12 III-5.4.7
55	4065	4065		1000	Position gain on servo mode/spindle synchronous control (High)	B	III-2.3.8 III-2.5.9
56	4066	4066		1000	Position gain on servo mode/spindle synchronous control (Medium High)	B	III-2.3.8 III-2.5.9
57	4067	4067		1000	Position gain on servo mode/spindle synchronous control (Medium Low)	B	III-2.3.8 III-2.5.9
58	4068	4068		1000	Position gain on servo mode/spindle synchronous control (Low)	B	III-2.3.8 III-2.5.9
59	4069	4069		3000	Position gain on Cs contouring control (High)	B	III-2.4.9
60	4070	4070		3000	Position gain on Cs contouring control (Medium High)	B	III-2.4.9
61	4071	4071		3000	Position gain on Cs contouring control (Medium Low)	B	III-2.4.9
62	4072	4072		3000	Position gain on Cs contouring control (Low)	B	III-2.4.9
63	4073	4073		0	Grid shift on servo mode	B	III-2.3.8
64	4074	4074		0	Reference position return speed on Cs contouring control/servo mode	B	III-2.3.8 III-2.4.9
65	4075	4075		10	Detection level for orientation completion signal (ORAR)	B	III-2.2.12
66	4076	4076		33	Ordinary orientation: Motor speed limit value on orientation High-speed orientation: Reserved Optimum orientation: Bell-shaped acceleration / Delay time for acceleration detection	B	III-2.2.12
67	4077	4077		0	Orientation stop position shift	B	III-2.2.12
70	4080	4080		Depends on the model	Regenerative power limit	C	III-2.6.3
71	4081	4081		20	Delay time until motor power is cut off	B	III-2.1.6
72	4082	4082		10	Setting of acceleration/deceleration time	B	III-2.1.6
73	4083	4083		0	Current ratio/motor stop confirmation time in magnetic pole detection operation	C	III-1.5.5 III-2.6.3
74	4084	4084		0	AMR offset	C	III-1.5.3 III-1.5.5 III-2.6.3
75	4085	4085		0	AMR offset fine adjustment	C	III-1.5.3 III-1.5.5 III-2.6.3
76	4086	4086		Depends on the model	Inductance ratio	C	III-2.6.3
77	4087	4087		115	Overspeed level	D	III-2.6.4
78	4088	4088		75	Level for detecting excess velocity error when motor is restrained	D	III-2.6.4
79	4089	4089		200	Level for detecting excess velocity error when motor rotates	D	III-2.6.4

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80	4090	4090		90	Overload detection level	D	III-2.6.4
81	4091	4091		100	Rate of change in position gain during reference position return on servo mode	B	III-2.3.8
82	4092	4092		100	Rate of change in position gain during reference position return on Cs contouring control	B	III-2.4.9
84	4094	4094		0	Disturbance torque compensation constant (acceleration feedback gain)	B	III-2.4.9
85	4095	4095		0	Adjusted output voltage of speedometer	B	III-2.6.4
86	4096	4096		0	Adjusted output voltage of load meter	B	III-2.6.4
88	4098	4098		0	Maximum speed for position feedback signal detection	A	III-1.3.2
89	4099	4099		0	Delay time for motor excitation	B	III-2.3.8 III-2.4.9
90	4100	4100		Depends on the model	Base speed of motor output specifications	C	III-2.6.3
91	4101	4101		Depends on the model	Output limit for motor output specifications	C	III-2.6.3
92	4102	4102		Depends on the model	Base speed at maximum load	C	III-2.6.3
93	4103	4103		Depends on the model	Magnetic flux reduction start speed / Current pattern switching speed	C	III-2.6.3
94	4104	4104		Depends on the model	Current loop proportional gain	C	III-2.6.3
95	4105	4105		0	Reserved	C	
96	4106	4106		Depends on the model	Current loop integral gain	C	III-2.6.3
97	4107	4107		0	Reserved	C	
98	4108	4108		Depends on the model	elocity at which the current loop integral gain is zero	C	III-2.6.3
99	4109	4109		0	Reserved	C	III-2.6.3
100	4110	4110		Depends on the model	Current conversion constant	C	III-2.6.3
101	4111	4111		Depends on the model	Maximum current constant	C	III-2.6.3
102	4112	4112		Depends on the model	PWM command clamp value	C	III-2.6.3
103	4113	4113		Depends on the model	Current constant for magnetic flux reduction	C	III-2.6.3
104	4114	4114		0	Reserved	C	
105	4115	4115		Depends on the model	PWM command clamp value at deceleration	C	III-2.6.3
106	4116	4116		Depends on the model	Counter electromotive voltage compensation constant for magnetic flux reduction speed at maximum load	C	III-2.6.3
107	4117	4117		Depends on the model	Interference voltage compensation constant for magnetic flux reduction speed at maximum load	C	III-2.6.3
108	4118	4118		0	Reserved	C	
109	4119	4119		Depends on the model	Interference voltage compensation	C	III-2.6.3
110	4120	4120		Depends on the model	Dead-band rectangular wave component zero voltage/dead-band data	C	III-2.6.3
111	4121	4121		5	Time constant for changing the torque (TCMD filter time constant)	B	III-4.2.1
112	4122	4122		0	Time constant for velocity detecting filter	B	III-2.6.4
113	4123	4123		30	Short-time overload detection time	D	III-2.6.4
114	4124	4124		0	Reserved	C	
117	4127	4127		Depends on the model	Value displayed on load meter at maximum output	C	III-2.6.3
118	4128	4128		0	Reserved	C	
119	4129	4129		0	Reserved	C	
120	4130	4130		Depends on the model	Current phase delay compensation coefficient	C	III-2.6.3
121	4131	4131		0	Time constant for velocity detecting filter (on Cs contouring control)	B	III-2.4.9
123	4133	4133		Depends on the model	Motor model code	C	III-1.2.2 III-2.6.3

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Internal data No. F-xxx	0*i*	30*i*	bit	Standard initial setting data	Contents	Classifi -cation	Reference item
124 125	4134	4134		Depends on the model	Motor overheat detect level (2-word)	C	III-2.6.3
126 127	4135	4135		0	Grid shift during Cs contouring control mode I (2-word)	B	III-2.4.9
154	4162	4162		0	Integral gain of velocity loop during cutting feed on Cs contouring control mode (High)	B	III-2.4.9
155	4163	4163		0	Integral gain of velocity loop during cutting feed on Cs contouring control mode (Low)	B	III-2.4.9
161	4169	4169		Depends on the model	Temperature monitoring time constant	C	III-2.6.4
162	4170	4170		0	Monitor constant of winding temperature(Heat coefficient)	D	III-2.6.4
163	4171	4171		0	Denominator of arbitrary gear ratio between motor sensor and spindle (High)	A	III-1.3.2
164	4172	4172		0	Numerator of arbitrary gear ratio between motor sensor and spindle (High)	A	III-1.3.2
165	4173	4173		0	Denominator of arbitrary gear ratio between motor sensor and spindle (Low)	A	III-1.3.2
166	4174	4174		0	Numerator of arbitrary gear ratio between motor sensor and spindle (Low)	A	III-1.3.2
230	4248	4248		0	Spindle load monitor torque constant	B	III-5.6.5
231	4249	4249		0	Spindle load monitor observer gain 1	B	III-5.6.5
232	4250	4250		0	Spindle load monitor observer gain 2	B	III-5.6.5
304	4320	4320		0	Optimum orientation: Spindle acceleration command (High) High-speed orientation: Motor acceleration at deceleration time (High)	B	III-2.2.12 III-5.15.7
305	4321	4321		0	Optimum orientation: Spindle acceleration command (Low) High-speed orientation: Motor acceleration at deceleration time (Medium High)	B	III-2.2.12 III-5.15.7
306	4322	4322		0	High-speed orientation: Motor acceleration at deceleration time (Medium Low)	B	III-5.15.7
307	4323	4323		0	High-speed orientation: Motor acceleration at deceleration time (Low)	B	III-5.15.7
308	4324	4324		0	Optimum orientation: One-rotation signal detection speed	B	III-2.2.12
310	4326	4326		0	Optimum orientation: Time constant for overshoot compensation/Limit ratio for acceleration command (High) High-speed orientation: Acceleration limitation start speed at deceleration time (High)	B	III-2.2.12 III-5.15.7
311	4327	4327		0	Optimum orientation: Time constant for overshoot compensation/Limit ratio for acceleration command (Low)	B	III-2.2.12
312	4328	4328		0	Command multiplication for spindle orientation by position coder	B	III-5.3.6
314	4330	4330		0	High-speed orientation: Acceleration limitation start speed at deceleration time (Low)	B	III-5.15.7
318	4334	4334		0	Number of motor sensor arbitrary teeth	A	III-1.3.2
320	4336	4336		0	Switching point used for an acceleration/deceleration time constant used for spindle synchronous control	B	III-2.5.9
324	4340	4340		0	Bell-shaped acceleration/deceleration time constant during spindle synchronous control	B	III-2.5.9
325	4341	4341		0	Unexpected disturbance torque detection level	B	III-5.6.5
326	4342	4342		0	Velocity loop gains override function on Cs contouring control mode (HIGH)	B	III-2.4.9
327	4343	4343		0	Velocity loop gains override function on Cs contouring control mode (LOW)	B	III-2.4.9
328	4344	4344		0	Advanced preview feed-forward coefficient	B	III-2.3.8
329	4345	4345		0	Spindle motor speed specification detection level	B	III-2.6.4
330	4346	4346		0	Incomplete integration factor	B	III-2.5.9 III-2.6.4
335	4351	4351		0	Current detection offset compensation	B	III-2.6.4
336H	4352	4352	#1	0	Setting of the peak hold function for load meter output	B	III-2.1.6
			#3	0	Load meter (normalized by the maximum output/continuous rated output) switch bit	B	III-5.18.4
			#4	0	Setting of whether to enable/disable feed forward at all times	B	III-5.7.8
			#6	0	Inter-spindle amplifier communication slave axis setting	B	III-5.7.8
			#7	0	Inter-spindle amplifier communication master axis setting	B	III-5.7.8
336L	4353	4353	#0	0	Improvement of backlash acceleration for low-speed reverse operation	B	I-5.14.4

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			#3		Load detection level 1/2 detection standard setting bit	B	III-5.18.4
			#4	0	Power failure backup function Function bit	B	III-5.19.6
			#5	0	Setting of the Cs axis position data transfer function	B	III-2.4.9
338	4355	4355		0	Motor sensor signal amplitude ratio compensation	A	III-1.3.2 III-4.3
339	4356	4356		0	Motor sensor signal phase difference compensation	A	III-1.3.2 III-4.3
345	4362	4362		0	Load meter compensation 1	C	III-2.6.3
346	4363	4363		0	Load meter compensation 2	C	III-2.6.3
347	4364	4364		0	Load meter compensation 3	C	III-2.6.3
352	4369	4369		0	Spindle synchronous orientation deceleration coefficient	B	III-5.5.6
353	4370	4370		0	Filter time constant for spindle acceleration detection	B	III-2.2.12
354	4371	4371		-1	Reserved		
355	4372	4372		0	Spindle speed limit for safety 1	D	
368	4386	4386		0	Spindle EGB: master side detector pulse count	B	III-5.7.8
369	4387	4387		0	Spindle EGB: synchronous ratio numerator	B	III-5.7.8
370	4388	4388		0	Spindle EGB: synchronous ratio denominator	B	III-5.7.8
373	4391	4391		0	Resonance elimination filter 1: attenuation center frequency	B	III-4.2.2
374	4392	4392		0	Resonance elimination filter 1: attenuation bandwidth	B	III-4.2.2
375	4393	4393		0	Resonance elimination filter 1: damping	B	III-4.2.2
376H	4394	4394	#2	0	Setting of the detection lower limit of the one-rotation signal	A	III-1.3.2
			#5	0	Whether to detect the alarm related to spindle sensor polarity erroneous setting	A	III-1.3.2
376L	4395	4395	#3	0	Setting of parameter transfer from the CNC to spindle software	B	III-2.6.4
			#6	0	Triggering of the disturbance input function (vibration application function)	B	III-4.2.3
			#7	0	Setting of the disturbance input function (vibration application function)	B	III-4.2.3
378H	4398	4398	#2	0	Selects a magnetic pole detection mode 1	C	III-1.5.5
378L	4399	4399	#2	0	Specifies whether to enable the soft start/stop function when emergency stop operation is performed	B	III-2.1.6
			#5	0	Determines whether to detect pole position count miss alarm (Alarm 91)	D	III-2.6.4
			#6	0	Selects a pole position detection mode	C	III-1.5.5
380H	4402	4402	#0	0	Setting of backlash acceleration function	B	I-5.14.4
			#1	0	Setting of the feed-forward coefficient when the backlash acceleration function is enabled.	B	I-5.14.4
383	4406	4406		0	Acceleration/deceleration time constant at return to the reference position in Cs contouring control/servo mode	B	III-2.3.7 III-2.4.9
387	4410	4410		0	Frequency of disturbance torque command	B	I-5.27.6
388	4411	4411		0	Disturbance input function: measurement end frequency	B	I-5.27.6
389	4412	4412		0	Disturbance input function: measurement frequency interval	B	I-5.27.6
390	4413	4413		0	Disturbance input function: number of measurements per frequency	B	I-5.27.6
391	4414	4414		0	Amplitude of disturbance torque command	B	I-5.27.6
392	4415	4415		0	Disturbance input function: motor speed command for measurement	B	III-4.2.3
393	4416	4416		0	Resonance elimination filter 2: attenuation center frequency	B	III-4.2.2
394	4417	4417		0	Resonance elimination filter 2: attenuation bandwidth	B	III-4.2.2
395	4418	4418		0	Resonance elimination filter 2: damping	B	III-4.2.2
396	4419	4419		0	Resonance elimination filter 3: attenuation center frequency	B	III-4.2.2
397	4420	4420		0	Resonance elimination filter 3: attenuation bandwidth	B	III-4.2.2
398	4421	4421		0	Resonance elimination filter 3: damping	B	III-4.2.2
399	4422	4422		0	Resonance elimination filter 4: attenuation center frequency	B	III-4.2.2
400	4423	4423		0	Resonance elimination filter 4: attenuation bandwidth	B	III-4.2.2
401	4424	4424		0	Resonance elimination filter 4: damping	B	III-4.2.2
414	4437	4437		-1	Reserved		
415	4438	4438		0	Spindle speed limit for safety 2	D	
416	4439	4439		-1	Reserved		
417	4440	4440		0	Spindle speed limit for safety 3		
418	4441	4441		-1	Reserved		

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419	4442	4442		0	Spindle speed limit for safety 4	D	
424	4447	4447		-1	Reserved		
425	4448	4448		0	Criterion level for spindle stop (30*i*)	D	
426	4449	4449		0	Direction detection current/polarity determination current	C	III-1.5.5
427	4450	4450		0	Travel distance allowance magnification/velocity feedback threshold	C	III-1.5.5
428	4451	4451		0	Reserved		
432	4455	4455		0	Backlash acceleration: Acceleration-dependent compensation	B	I-5.14.4
433	4456	4456		0	Backlash acceleration: Stop timing (spindle travel distance)	B	I-5.14.4
434	4457	4457		0	Backlash acceleration: Acceleration-independent compensation	B	I-5.14.4
435	4458	4458		0	Backlash acceleration: Spindle stop check time	B	I-5.14.4
440	4463	4463		0	Unexpected rotation detection level (Alarm 90 detection level)	D	III-2.6.4
441	4464	4464		0	Velocity command-dependent over speed (spindle alarm 92) detection offset level	D	III-2.6.4
442	4465	4465		0	Excessive speed deviation level2	D	III -2.6.4
443	4466	4466		0	Excessive speed deviation detection time 2	D	III -2.6.4
470	4498	4498		0	Spindle EGB master side: denominator of arbitrary gear ratio between motor sensor and spindle	B	III-5.7.8
471	4499	4499		0	Spindle EGB master side: numerator of arbitrary gear ratio between motor sensor and spindle	B	III-5.7.8
480	4508	4508		0	Rate of change in acceleration at soft start/stop	B	III-2.1.6
482	4510	4510		0	Power failure backup function Upper limit of the DC link voltage	B	III-5.19.6
483	4511	4511		0	Power failure backup function Lower limit of the DC link voltage	B	III-5.19.6
487	4515	4515		0	Excessive speed deviation alarm detection level on spindle synchronous control	D	III-2.5.9
488	4516	4516		0	Excessive positional deviation alarm detection level on spindle synchronous control	D	III-2.5.9
491	4519	4519		0	Bell-shaped acceleration/deceleration time constant for soft start/stop	B	III-2.1.6
499	4527	4527		0	Temperature difference between warning level and alarm level	D	III-2.6.4
504	4532	4532		0	Arbitrary data output function number	B	III-1.5.5
512H	4540	4540	#0	0	Setting related to the motor voltage control characteristics on Cs contouring control	B	III-5.17.6
			#2	0	Setting of the the DC-link stabilizer at a spindle power failure	B	III-5.20.7
			#7	0	Setting of preload function operation at a power failure	B	III-5.20.7
512L	4541	4541	#0	0	Presence or absence of power consumption calculation	E	
			#1	0	Setting of the output unit of accumulated power consumption	E	
			#2	0	Setting of the output unit of accumulated power consumption	E	
513H	4542	4542	#4	0	Cutting/rapid feed-forward function selection bit	B	III -2.4.9
			#5	0	Select of inertial estimation mrthod	B	I-5.23.5
			#6	0	Power failure backup function Operation setting	B	III-5.19.6
			#7	0	Setteing of smart load meter display	B	I-5.28.5
513L	4543	4543	#2	0	Smart thermal control: Setting of operation during cutting in constant surface speed control	B	I-5.25.6
			#3	0	Smart backlash compensation function	B	I-5.29.3
516H	4548	4548	#4	0	Setting of power failure determination by DC link voltage monitoring	B	III-5.20.7
			#5	0	Setting of torque limitation during DC-link stabilizing operation at a power failure	B	III-5.20.7
			#6	0	Setting of the feed-forward coefficient for the EGB move command	B	III -5.7.8
517	4550	4550		0	Velocity loop proportional gain on spindle synchronous control (High)	B	III -2.5.9
518	4551	4551		0	Velocity loop proportional gain on spindle synchronous control (Low)	B	III -2.5.9
519	4552	4552		0	Velocity loop integral gain on spindle synchronous control (High)	B	III -2.5.9
520	4553	4553		0	Velocity loop integral gain on spindle synchronous control Low)	B	III -2.5.9
521	4554	4554		0	Position gain on spindle synchronous control (High)	B	III -2.5.9
522	4555	4555		0	Position gain on spindle synchronous control (Medium High)	B	III -2.5.9
523	4556	4556		0	Position gain on spindle synchronous control (Medium Low)	B	III -2.5.9
524	4557	4557		0	Position gain on spindle synchronous control (Low)	B	III -2.5.9
555	4588	4588		0	Inertia estimation: Excitationinput frequency	B	I-5.23.5
556	4589	4589		0	Inertia estimation: Excitationinput gain	B	I-5.23.5
557	4590	4590		0	Orientation speed restriction rate 1/orientation speed restriction rate 2 (HIGH)	B	I-2.2.12

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558	4591	4591		0	Orientation speed restriction rate 1/orientation speed restriction rate 2 (LOW)	B	I-2.2.12
560	4593	4593		0	Spindle amplifier loss coefficient 1	E	
561	4594	4594		0	Spindle amplifier loss coefficient 2	E	
562	4595	4595		0	Common power supply loss coefficient 1	E	
563	4596	4596		0	Common power supply loss coefficient 2	E	
579	4612	4612		0	Parameter for load meter (normalized by the continuous rated output) <1>	B	III-5.18.4
580	4613	4613		0	Parameter for load meter (normalized by the continuous rated output) <2>	B	III-5.18.4
586	4619	4619		Depends on the model	Cutting feed/rapid traverse PWM frequency switching in Cs contour control Setting related to the current limitation (for high-speed characteristics of speed range switching)	B	III-5.17.6
587	4620	4620		Depends on the model	Cutting feed/rapid traverse PWM frequency switching in Cs contour control Setting related to the current limitation (for low-speed characteristics of speed range switching)	B	III-5.17.6
588	4621	4621		0	Cutting feed/rapid traverse PWM frequency switching in Cs contour control Velocity loop gain override	B	III-5.17.6
589	4622	4622		0	Cutting feed/rapid traverse PWM frequency switching in Cs contour control Current loop gain override	B	III-5.17.6
590	4623	4623		0	Distance coded sensor Nominal increment 1	A	III-5.21.4
591	4624	4624		0	Distance coded sensor Nominal increment 2	A	III-5.21.4
592	4625	4625		0	Distance coded sensor Z phase position compensation data	A	III-5.21.4
594	4627	4627		0	Advanced preview feed-forward coefficient for cutting feed	B	III -2.4.9
596	4629	4629		0	Allowable acceleration for acceleration at a power failure (for high-speed characteristics)	B	III-5.19.6
597	4630	4630		0	Allowable acceleration for acceleration at a power failure (for low-speed characteristics)	B	III-5.19.6
601	4634	4634		Depends on the model	Smart thermal control: Output lower limit	B	I-5.25.6
602	4635	4635		Depends on the model	Smart thermal control: Output lower limit	B	I-5.25.6
604	4637	4637		0	Alarm detection level of conection error (monitoring amount of motor rotation during the spindle one rotation ssignal)	B	I-5.26.2
605	4638	4638		0	Detection level of conection error alarm (monitoring amount of spindle-motor speed difference)	B	I-5.26.3
608	4641	4641		0	Backlash acceleration: Acceleration compute time	B	I-5.14.4
609	4642	4642		0	Backlash acceleration: Stop timing (motor travel distance)	B	I-5.14.4
611	4644	4644		100	Gain for Smart backlash compensation	B	I-5.29.3
612	4645	4645		0	Ratio for compensation against actual backlash length	B	I-5.29.3
613	4646	4646		500	Distance of spindle movement (Distance for update of “Based semi-full error” information)	B	I-5.29.3
614	4647	4647		0	Judgment time of axis stop in Smart backlash compensation	B	I-5.29.3
615	4648	4648		500	Effective time of Smart backlash compensation	B	I-5.29.3
616	4649	4649		0	Effective time for getting “Based semi-full error”	B	I-5.29.3
617	4650	4650		0	Compensation length of Smart backlash compensation	B	I-5.29.3
628	4661	4661		0	Tolerable error value at spindle stop	B	I-5.24.7
633	4666	4666		0	Smart rigid tapping: Bell-shaped acceleration/deceleration time constant	B	I-5.24.8
634	4667	4667		0	Smart rigid tapping: Bell-shaped acceleration/deceleration time constant	B	I-5.24.8
635	4668	4668		0	Smart rigid tapping: Upper limit of torque command	B	I-5.24.8
636	4669	4669		0	Smart rigid tapping: Upper limit of torque command	B	I-5.24.8
638H		4672		0	Common power supply parameter (Bits 07-00) [FS30*i*-B]	F	
638L		4673		0	Common power supply parameter (Bits 07-00) [FS30*i*-B]	F	
726	4764	4764		Depends on the model	Smart thermal control: Output lower limit	B	I-5.25.6
727	4765	4765		Depends on the model	Smart thermal control: Output lower limit	B	I-5.25.6

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Internal data No. F-xxx	0*i*	30*i*	bit	Standard initial setting data	Contents	Classifi-cation	Reference item
729	4767	4767		0	Alarm detection level of conection error (monitoring amount of motor rotation during the spindle one rotation ssignal)	B	I-5.26.2
733 to 745		4771 to 4783		0	Common power supply parameters [FS30*i*-B]	F	
746		4784		0	Common power supply parameter [FS30*i*-B]: Power failure detection level 1/power failure detection time 1)	F	
747		4785		0	Common power supply parameter [FS30*i*-B]: Power failure detection level 2/power failure detection time 2)	F	

A.3 βiIc SERIES SPINDLE PARAMETER TABLE

βiIc series spindle parameters are classified into the following types:

A : Parameters related to the setup of detectors
B : Parameters related to the setup of various functions (operating modes)
C : Unique parameters for the drive of spindle motors (Set the parameter data according to the parameter list for each motor model.)
D : Parameters related to the setting of alarm detection conditions

Internal data No. F-xxx	0*i* Mate-TD	bit	Standard initial setting data	Contents	Classi fi-cation	Reference item
0H	4000	#0	0	Rotation direction relationship between the spindle and motor	A	II-1.3.2
		#4	0	Return direction for the reference position on servo mode	B	II-2.3.7
0L	4001	#0	1	Whether to use MRDY (machine ready) signal	B	II-2.5.4
		#4	0	Spindle sensor (position coder) attachment direction	A	II-1.3.2
1H	4002	#0	0	Spindle sensor type	A	II-1.3.2
		#1	0	Spindle sensor type	A	II-1.3.2
		#2	0	Spindle sensor type	A	II-1.3.2
		#3	0	Spindle sensor type	A	II-1.3.2
		#4	0	SM pin output data selection	B	II-2.5.4
		#5	0	Whether to use the rotation direction signal (SFR/SRV) function on servo mode	B	II-2.3.7
1L	4003	#2	0	Rotation direction during spindle orientation	B	II-2.2.9
		#3	0	Rotation direction during spindle orientation	B	II-2.2.9
		#4	0	Teeth number setting of spindle sensor	A	II-1.3.2
		#5	0	Teeth number setting of spindle sensor	A	II-1.3.2
		#6	0	Teeth number setting of spindle sensor	A	II-1.3.2
		#7	0	Teeth number setting of spindle sensor	A	II-1.3.2
2L	4005	#0	0	Setting of the velocity feedback method	A	II-1.3.2
3H	4006	#1	0	Increment system of gear ratio	A	II-1.3.2
		#2	0	Increment system of spindle speed	C	II-2.5.4
		#5	0	Setting of analog override range	B	II-2.1.6
3L	4007	#5	0	Whether to detect a feedback signal disconnection	A	II-1.3.2
		#6	0	Whether to detect the alarms (spindle alarms 41, 42, and 47) related to the position feedback signal (when non-Cs contouring control mode is set)	A	II-1.3.2
	4008	#3	0	Presence or absence of measures against a belt slip	C	II-2.4.3
4L	4009	#2	0	Motor power turn-off method when spindle alarm 24 (serial data transfer error) is issued	D	II-2.5.4
		#4	0	Whether to output the load detection signals (LDT1) during acceleration/deceleration	B	II-2.1.6
		#6	0	Analog override type	B	II-2.1.6
5L	4011	#3	1	Number of motor poles	C	II-2.5.3
		#4	Depends on the model	Setting of maximum output during acceleration/deceleration	C	II-2.5.3

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Internal data No. F-xxx	0*i* Mate-TD	bit	Standard initial setting data	Contents	Classi fi-cati on	Referenc e item
		#7	0	Number of motor poles	C	II-2.5.3
6H	4012	#0	0	Setting of PWM carrier frequency	C	II-2.5.3
		#1	0	Setting of PWM carrier frequency	C	II-2.5.3
		#2	0	Setting of PWM carrier frequency	C	II-2.5.3
6L	4013	#2	Depends on the model	Current dead-band data	C	II-2.5.3
		#3	Depends on the model	Current dead-band data	C	II-2.5.3
		#4	Depends on the model	Current dead-band data	C	II-2.5.3
		#5	Depends on the model	Current dead-band data	C	II-2.5.3
		#6	Depends on the model	Current dead-band data	C	II-2.5.3
7L	4015	#0	0	Whether to use the spindle orientation function	B	II-2.2.8
8H	4016	#6	0	Whether to detect the alarm (spindle alarms 46) related to feedback of the position detection signal for threading	A	II-1.3.2
		#7	0	Function for newly detecting the one-rotation signal before entering position control mode	A	II-1.3.2
8L	4017	#7	0	Setting of shortcut orientation from stop state in position coder method spindle orientation	B	II-2.2.9
9L	4019	#2	1	Whether to use torque clamp at zero speed	B	II-2.5.4
		#7	0	Automatic parameter setting function (0*i*-D/30*i*)	B	II-2.1.6
10	4020		Depends on the model	Maximum motor speed	C	II-2.1.6
12	4022		150	Speed arrival detection level (SAR)	B	II-2.5.4
13	4023		30	Speed detection level (SDT)	B	II-2.5.4
14	4024		75	Zero speed detection level (SST)	B	II-2.5.4
15	4025		50	Limited torque (TLMH)	B	II-2.5.4
16	4026		83	Load detection level 1 (LDT1)	B	II-2.5.4
21	4031		0	Stop position of position coder method orientation	B	II-2.2.9
28	4038		0	Spindle orientation speed	B	II-2.2.9
30	4040		Depends on the model	Velocity loop proportional gain on velocity control mode (High)	B	II-2.1.6
31	4041		Depends on the model	Velocity loop proportional gain on velocity control mode (Low)	B	II-2.1.6
32	4042		Depends on the model	Velocity loop proportional gain on orientation (High)	B	II-2.2.9
33	4043		Depends on the model	Velocity loop proportional gain on orientation (Low)	B	II-2.2.9
34	4044		Depends on the model	Velocity loop proportional gain on servo mode/spindle synchronous control (High)	B	II-2.3.7 II-2.4.8
35	4045		Depends on the model	Velocity loop proportional gain on servo mode/spindle synchronous control (Low)	B	II-2.3.7 II-2.4.8
38	4048		Depends on the model	Velocity loop integral gain on velocity control mode (High)	B	II-2.1.6
39	4049		Depends on the model	Velocity loop integral gain on velocity control mode (Low)	B	II-2.1.6
40	4050		Depends on the model	Velocity loop integral gain on orientation (High)	B	II-2.2.9
41	4051		Depends on the model	Velocity loop integral gain on orientation (Low)	B	II-2.2.9
42	4052		Depends on the model	Velocity loop integral gain on servo mode/spindle synchronous control (High)	B	II-2.3.7 II-2.4.8
43	4053		Depends on the model	Velocity loop integral gain on servo mode/spindle synchronous control (Low)	B	II-2.3.7 II-2.4.8
46	4056		100	Gear ratio (High)	A	II-1.3.2
47	4057		100	Gear ratio (Medium High)	A	II-1.3.2
48	4058		100	Gear ratio (Medium Low)	A	II-1.3.2
49	4059		100	Gear ratio (Low)	A	II-1.3.2
50	4060		1000	Position gain on orientation (High)	B	II-2.2.9

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Internal data No. F-xxx	0*i* Mate-TD	bit	Standard initial setting data	Contents	Classi fi-cati on	Referenc e item
51	4061		1000	Position gain on orientation (Medium High)	B	II-2.2.9
52	4062		1000	Position gain on orientation (Medium Low)	B	II-2.2.9
53	4063		1000	Position gain on orientation (Low)	B	II-2.2.9
54	4064		100	Acceleration limitation ratio at deceleration time	B	II-2.2.9
55	4065		1000	Position gain on servo mode (High)	B	II-2.3.7 II-2.4.8
56	4066		1000	Position gain on servo mode (Medium High)	B	II-2.3.7 II-2.4.8
57	4067		1000	Position gain on servo mode (Medium Low)	B	II-2.3.7 II-2.4.8
58	4068		1000	Position gain on servo mode (Low)	B	II-2.3.7 II-2.4.8
59	4069		900	Acceleration/deceleration constant (High)	B	II-2.1.6
60	4070		900	Acceleration/deceleration constant (Medium High)	B	II-2.1.6
61	4071		900	Acceleration/deceleration constant (Medium Low)	B	II-2.1.6
62	4072		900	Acceleration/deceleration constant (Low)	B	II-2.1.6
63	4073		0	Grid shift on servo mode	B	II-2.3.7
64	4074		0	Reference position return speed on servo mode	B	II-2.3.7
65	4075		10	Detection level for orientation completion signal	B	II-2.2.9
67	4077		0	Orientation stop position shift	B	II-2.2.9
68	4078		0	Gear switch timer	B	II-2.5.4
70	4080		Depends on the model	Regenerative power limit for high-speed zone/regenerative power limit	B	II-2.5.3
71	4081		20	Delay time until motor power is cut off	B	II-2.1.6
72	4082		10	Setting of acceleration/deceleration time	B	II-2.1.6
73	4083		60	Motor voltage on velocity control mode	C	II-2.1.6
74	4084		60	Motor voltage on orientation	C	II-2.2.9
75	4085		60	Motor voltage on servo mode	C	II-2.3.7 II-2.4.8
76	4086		0	Gear ratio parameter setting error alarm (spindle alarm 35) detection level	D	II-2.5.4
78	4088		75	Level for detecting excess velocity error when motor is restrained	D	II-2.5.4
79	4089		200	Level for detecting excess velocity error when motor rotates	D	II-2.5.4
80	4090		90	Overload detection level	D	II-2.5.4
81	4091		100	Rate of change in position gain during reference position return on servo mode	B	II-2.3.7
85	4095		0	Speedometer pin output voltage adjustment value	B	II-2.5.4
88	4098		0	Maximum speed for position coder signal detection	A	II-1.3.2
89	4099		0	Delay time for motor excitation	B	II-2.3.7
90	4100		Depends on the model	Base speed of motor output specifications	C	II-2.5.3
91	4101		Depends on the model	Output limit for motor output specifications	C	II-2.5.3
92	4102		Depends on the model	Excitation voltage saturation speed at no-load	C	II-2.5.3
93	4103		Depends on the model	Compensation data for resistance	C	II-2.5.3
94	4104		Depends on the model	Current loop proportional gain	C	II-2.5.3
95	4105		Depends on the model	Current loop integral gain	C	II-2.5.3
96	4106		Depends on the model	D-axis current loop gain	C	II-2.5.3
97	4107		Depends on the model	Q-axis current loop gain	C	II-2.5.3
98	4108		Depends on the model	Q-axis current deviation limitation coefficient	C	II-2.5.3
99	4109		Depends on the model	Filter time constant for processing saturation related to the voltage command	C	II-2.5.3
100	4110		Depends on the model	Current conversion constant	C	II-2.5.3

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Internal data No. F-xxx	0*i* Mate-TD	bit	Standard initial setting data	Contents	Classification	Reference item
101	4111		Depends on the model	Secondary current coefficient	C	II-2.5.3
102	4112		Depends on the model	Criterion level for saturation related to the voltage command/PWM command clamp value	C	II-2.5.3
103	4113		Depends on the model	Slip constant	C	II-2.5.3
105	4115		Depends on the model	PWM command clamp value at deceleration	C	II-2.5.3
106	4116		Depends on the model	Motor leakage constant	C	II-2.5.3
107	4117		Depends on the model	Regular-time voltage compensation coefficient for high-speed zone/regular-time motor voltage coefficient	C	II-2.5.3
108	4118		Depends on the model	Acceleration-time voltage compensation coefficient for high-speed zone/acceleration-time motor voltage coefficient	C	II-2.5.3
109	4119		Depends on the model	Deceleration-time excitation current change time constant/excitation current change time constant	C	II-2.5.3
110	4120		Depends on the model	Dead-band compensation data	C	II-2.5.3
111	4121		5	Time constant for changing the torque (TCMD filter time constant)	B	II-2.5.4
113	4123		30	Short-time overload detection time	D	II-2.5.4
117	4127		Depends on the model	Value displayed on load meter at maximum output	C	II-2.5.3
118	4128		Depends on the model	Compensation coefficient between the specification and true base/maximum torque curve compensation coefficient	C	II-2.5.3
120	4130		Depends on the model	Current loop proportional gain speed coefficient/current phase delay compensation coefficient	C	II-2.5.3
121	4131		Depends on the model	Dead-band compensation hysteresis	B	II-2.5.3
123	4133		Depends on the model	Motor model code	C	II-2.5.3
124 125	4134		Depends on the model	Motor overheat detect level (2-word)	C	II-2.5.3
130	4138		Depends on the model	Primary frequency clamp speed 1	C	V-2.5.3
131	4139		Depends on the model	Primary frequency clamp slip frequency 1	C	V-2.5.3
132	4140		Depends on the model	Primary frequency clamp speed 2	C	V-2.5.3
133	4141		Depends on the model	Primary frequency clamp slip frequency 2	C	V-2.5.3
134	4142		Depends on the model	Belt slip state detection coefficient 1	C	V-2.5.3
135	4143		Depends on the model	Belt slip state detection coefficient 2	C	V-2.5.3
152	4160		0	Hysteresis of speed detection level	B	I-5.1.7
304	4320		0	Acceleration at orientation deceleration time (High)	B	II-2.2.9
305	4321		0	Acceleration at orientation deceleration time (Medium High)	B	II-2.2.9
306	4322		0	Acceleration at orientation deceleration time (Medium Low)	B	II-2.2.9
307	4323		0	Acceleration at orientation deceleration time (Low)	B	II-2.2.9
312	4328		0	Command multiplication for spindle orientation by position coder	B	I-5.3.6
345	4362		Depends on the model	Load meter compensation 1	C	V-2.5.3
346	4363		Depends on the model	Load meter compensation 2	C	V-2.5.3
347	4364		Depends on the model	Load meter compensation 3	C	V-2.5.3

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B LIST OF SPINDLE PARAMETER NUMBERS

The following shows corresponding of the parameter numbers of parameters for speed range switch high-speed/low-speed characteristics on the main side/sub-side of spindle switching.

MH, ML, SH, and SL in the table represent the following:

- MH: Parameter for speed range switch high-speed characteristics on the main side of spindle switching (for standard motors)
- ML: Parameter for speed range switch low-speed characteristics on the main side of spindle switching
- SH: Parameter for speed range switch high-speed characteristics on the sub-side of spindle switching
- SL: Parameter for speed range switch low-speed characteristics on the sub-side of spindle switching

0*i*				30*i*				Contents
MH	ML	SH	SL	MH	ML	SH	SL	
4000	←	4176	←	4000	←	4176	←	Bit parameter
4001	←	4177	←	4001	←	4177	←	Bit parameter
4002	←	4178	←	4002	←	4178	←	Bit parameter
4003	←	4179	←	4003	←	4179	←	Bit parameter
4004	←	4180	←	4004	←	4180	←	Bit parameter
4005	←	4181	←	4005	←	4181	←	Bit parameter
4006	←	4182	←	4006	←	4182	←	Bit parameter
4007	←	4183	←	4007	←	4183	←	Bit parameter
4008	←	4184	←	4008	←	4184	←	Bit parameter
4009	←	4185	←	4009	←	4185	←	Bit parameter
4010	←	4186	←	4010	←	4186	←	Bit parameter
4011	←	4187	←	4011	←	4187	←	Bit parameter
4012	←	4188	←	4012	←	4188	←	Bit parameter
4013	←	4189	←	4013	←	4189	←	Bit parameter
4014	←	←	←	4014	←	←	←	Bit parameter
4015	←	←	←	4015	←	←	←	Bit parameter
4016	←	4192	←	4016	←	4192	←	Bit parameter
4017	←	4193	←	4017	←	4193	←	Bit parameter
4018	←	4194	←	4018	←	4194	←	Bit parameter
4019	←	4195	←	4019	←	4195	←	Bit parameter
4020	←	4196	←	4020	←	4196	←	Maximum motor speed
4021	←	None	None	4021	←	None	None	Maximum speed on Cs contouring control mode
4022	←	4197	←	4022	←	4197	←	Speed arrival detection level
4023	←	4198	←	4023	←	4198	←	Speed detection level
4024	←	4199	←	4024	←	4199	←	Zero speed detection level
4025	←	4200	←	4025	←	4200	←	Limited torque
4026	←	4201	←	4026	←	4201	←	Load detection level 1
4027	←	←	←	4027	←	←	←	Load detection level 2
4028	←	4202	←	4028	←	4202	←	Limited output pattern
4029	4626	4203	4732	4029	4626	4203	4732	Output limit
4030	←	←	←	4030	←	←	←	Soft start/stop time
4031	←	4204	←	4031	←	4204	←	Stop position of position coder method orientation
4032	←	None	None	4032	←	None	None	Acceleration on spindle synchronous control
4033	←	None	None	4033	←	None	None	Spindle synchronous speed arrival level
4034	←	None	None	4034	←	None	None	Shift during synchronous control of spindle phase
4035	←	None	None	4035	←	None	None	Compensation data for spindle phase synchronous control
4036	←	4240	←	4036	←	4240	←	Feed-forward coefficient
4037	4443	4241	4486	4037	4443	4241	4486	Feed-forward coefficient of velocity loop

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0*i*				30*i*				Contents
MH	ML	SH	SL	MH	ML	SH	SL	
4038	←	4205	←	4038	←	4205	←	Optimum orientation: Upper limit of orientation speed Conventional method/high-speed orientation: Spindle orientation speed
4039	4156	4254	4255	4039	4156	4254	4255	Slip compensation gain
4040	←	4206	←	4040	←	4206	←	Velocity loop proportional gain on velocity control mode (High)
4041	←	4207	←	4041	←	4207	←	Velocity loop proportional gain on velocity control mode (Low)
4042	←	4208	←	4042	←	4208	←	Velocity loop proportional gain on orientation (High)
4043	←	4209	←	4043	←	4209	←	Velocity loop proportional gain on orientation (Low)
4044	←	4210	←	4044	←	4210	←	Velocity loop proportional gain on servo mode/spindle synchronous control (High)
4045	←	4211	←	4045	←	4211	←	Velocity loop proportional gain on servo mode/spindle synchronous control (Low)
4046	←	None	None	4046	←	None	None	Velocity loop proportional gain on Cs contouring control (High)
4047	←	None	None	4047	←	None	None	Velocity loop proportional gain on Cs contouring control (Low)
4048	←	4212	←	4048	←	4212	←	Velocity loop integral gain on velocity control mode (High)
4049	←	↑	↑	4049	←	↑	↑	Velocity loop integral gain on velocity control mode (Low)
4050	←	4213	←	4050	←	4213	←	Velocity loop integral gain on orientation (High)
4051	←	↑	↑	4051	←	↑	↑	Velocity loop integral gain on orientation (Low)
4052	←	4214	←	4052	←	4214	←	Velocity loop integral gain on servo mode/spindle synchronous control (High)
4053	←	↑	↑	4053	←	↑	↑	Velocity loop integral gain on servo mode/spindle synchronous control (Low)
4054	←	None	None	4054	←	None	None	Velocity loop integral gain on Cs contouring control (High)
4055	←	None	None	4055	←	None	None	Velocity loop integral gain on Cs contouring control (Low)
4056	←	4216	←	4056	←	4216	←	Gear ratio (High)
4057	←	↑	↑	4057	←	↑	↑	Gear ratio (Medium High)
4058	←	↓	↓	4058	←	↓	↓	Gear ratio (Medium Low)
4059	←	4217	←	4059	←	4217	←	Gear ratio (Low)
4060	←	4218	←	4060	←	4218	←	Position gain on orientation (High)
4061	←	↑	↑	4061	←	↑	↑	Position gain on orientation (Medium High)
4062	←	↓	↓	4062	←	↓	↓	Position gain on orientation (Medium Low)
4063	←	4219	←	4063	←	4219	←	Position gain on orientation (Low)
4064	←	4220	←	4064	←	4220	←	Conventional method orientation: Rate of change in position gain upon completion of orientation High-speed orientation: Percentage limit to an acceleration during deceleration Optimum orientation: Position feedforward coefficient
4065	←	4221	←	4065	←	4221	←	Position gain on servo mode/spindle synchronous control (High)
4066	←	↑	↑	4066	←	↑	↑	Position gain on servo mode/spindle synchronous control (Medium High)
4067	←	↓	↓	4067	←	↓	↓	Position gain on servo mode/spindle synchronous control (Medium Low)
4068	←	4222	←	4068	←	4222	←	Position gain on servo mode/spindle synchronous control (Low)
4069	←	None	None	4069	←	None	None	Position gain on Cs contouring control (High)
4070	←	None	None	4070	←	None	None	Position gain on Cs contouring control (Medium High)
4071	←	None	None	4071	←	None	None	Position gain on Cs contouring control (Medium Low)
4072	←	None	None	4072	←	None	None	Position gain on Cs contouring control (Low)
4073	←	4223	←	4073	←	4223	←	Grid shift on servo mode
4074	←	←	←	4074	←	←	←	Reference position return speed on Cs contouring control/servo mode
4075	←	4226	←	4075	←	4226	←	Detection level for orientation completion signal
4076	←	4227	←	4076	←	4227	←	Conventional method orientation: Motor speed limit ratio for orientation High-speed orientation: Reserved Optimum orientation: Delay time for acceleration detection/bell-shaped acceleration/deceleration time constant
4077	←	4228	←	4077	←	4228	←	Orientation stop position shift
4078	←	4229	←	4078	←	4229	←	MS signal constant
4079	←	4230	←	4079	←	4230	←	MS signal gain adjustment

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0*i*				30*i*				Contents
MH	ML	SH	SL	MH	ML	SH	SL	
4080	4166	4231	4307	4080	4166	4231	4307	Regenerative power limit for high-speed zone/regenerative power limit
4081	←	4232	←	4081	←	4232	←	Delay time until motor power is cut off
4082	←	4233	←	4082	←	4233	←	Setting of acceleration/deceleration time
4083	4136	4236	4284	4083	4136	4236	4284	Motor voltage on velocity control mode
4084	←	4237	←	4084	←	4237	←	Motor voltage on orientation
4085	4137	4238	4285	4085	4137	4238	4285	Motor voltage on servo mode/spindle synchronous control mode
4086	←	None	None	4086	←	None	None	Motor voltage on Cs contouring control
4087	←	←	←	4087	←	←	←	Overspeed level
4088	←	←	←	4088	←	←	←	Level for detecting excess velocity deviation when motor is restrained
4089	←	←	←	4089	←	←	←	Level for detecting excess velocity deviation when motor rotates
4090	←	←	←	4090	←	←	←	Overload detection level
4091	←	4239	←	4091	←	4239	←	Rate of change in position gain during reference position return on servo mode
4092	←	None	None	4092	←	None	None	Rate of change in position gain during reference position return on Cs contouring control
4094	←	None	None	4094	←	None	None	Disturbance torque compensation constant (acceleration feedback gain)
4095	←	←	←	4095	←	←	←	Adjusted output voltage of speedometer
4096	←	←	←	4096	←	←	←	Adjusted output voltage of load meter
4097	←	None	None	4097	←	None	None	Feedback gain of spindle speed
4098	←	←	←	4098	←	←	←	Maximum speed for position feedback signal detection
4099	←	←	←	4099	←	←	←	Delay time for motor excitation
4100	4138	4256	4286	4100	4138	4256	4286	Base speed of motor output specifications
4101	4139	4257	4287	4101	4139	4257	4287	Output limit for motor output specifications
4102	4140	4258	4288	4102	4140	4258	4288	Excitation voltage saturation speed at no-load
4103	4141	4259	4289	4103	4141	4259	4289	Base speed limit ratio
4104	4142	4260	4290	4104	4142	4260	4290	Current loop proportional gain
4105	4107	4733	4734	4105	4107	4733	4734	Magnetic flux time constant for magnetic flux control
4106	4143	4261	4291	4106	4143	4261	4291	Current loop integral gain
4108	4144	4262	4292	4108	4144	4262	4292	Velocity at which the current loop integral gain is zero
4109	4145	4263	4293	4109	4145	4263	4293	Filter time constant for processing saturation related to the voltage command
4110	4146	4264	4294	4110	4146	4264	4294	Current conversion constant
4111	4147	4265	4295	4111	4147	4265	4295	Secondary current coefficient
4112	4148	4266	4296	4112	4148	4266	4296	Criterion level for saturation related to the voltage command/PWM command clamp value
4113	4149	4267	4297	4113	4149	4267	4297	Slip constant
4114	4150	4268	4298	4114	4150	4268	4298	Slip compensation coefficient for a high-speed zone/slip compensation coefficient at deceleration
4115	4151	4269	4299	4115	4151	4269	4299	PWM command clamp value at deceleration
4116	4152	4270	4300	4116	4152	4270	4300	Motor leakage constant
4117	4153	4271	4301	4117	4153	4271	4301	Regular-time voltage compensation coefficient for high-speed zone/regular-time motor voltage coefficient
4118	4154	4272	4302	4118	4154	4272	4302	Acceleration-time voltage compensation coefficient for high-speed zone/acceleration-time motor voltage coefficient
4119	4165	4280	4308	4119	4165	4280	4308	Deceleration-time excitation current change time constant/excitation current change time constant
4120	←	←	←	4120	←	←	←	Dead-band rectangular wave component zero voltage/dead-band data
4121	4157	4273	4303	4121	4157	4273	4303	Time constant for changing the torque (TCMD filter time constant)
4122	←	4278	←	4122	←	4278	←	Time constant for velocity detecting filter
4123	←	←	←	4123	←	←	←	Short-time overload detection time
4124	4155	4332	4333	4124	4155	4332	4333	Magnetic flux boost completion level/magnetic flux boost coefficient
4127	4093	4274	4279	4127	4093	4274	4279	Value displayed on load meter at maximum output
4128	4158	4275	4304	4128	4158	4275	4304	Compensation coefficient between the specification and true base/maximum torque curve compensation coefficient
4129	4159	4276	4305	4129	4159	4276	4305	Secondary current coefficient for rigid tapping
4130	4161	4277	4306	4130	4161	4277	4306	Current loop proportional gain speed coefficient/current phase delay compensation coefficient
4131	←	None	None	4131	←	None	None	Time constant for velocity detecting filter (on Cs contouring control)
4133	←	4309	←	4133	←	4309	←	Motor model code
4134	←	4310	←	4134	←	4310	←	Motor overheat detect level (2-word)

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0*i*				30*i*				Contents
MH	ML	SH	SL	MH	ML	SH	SL	
4135	←	None	None	4135	←	None	None	Grid shift during Cs contouring control mode I (2-word)
4160	←	←	←	4160	←	←	←	Hysteresis of speed detection level
4162	←	None	None	4162	←	None	None	Integral gain of velocity loop during cutting feed on Cs contouring control mode (High)
4163	←	None	None	4163	←	None	None	Integral gain of velocity loop during cutting feed on Cs contouring control mode (Low)
4169	←	4349	←	4169	←	4349	←	Temperature monitoring time constant
4170	4168	4350	4348	4170	4168	4350	4348	Monitor constant of winding temperature(Heat coefficient)
4171	←	4243	←	4171	←	4243	←	Denominator of arbitrary gear ratio between motor sensor and spindle (High)
4172	←	4244	←	4172	←	4244	←	Numerator of arbitrary gear ratio between motor sensor and spindle (High)
4173	←	4245	←	4173	←	4245	←	Denominator of arbitrary gear ratio between motor sensor and spindle (Low)
4174	←	4246	←	4174	←	4246	←	Numerator of arbitrary gear ratio between motor sensor and spindle (Low)
4215	←	None	None	4215	←	None	None	Primary delay time constant in dual position feedback [in Cs contour control]
4224	←	None	None	4224	←	None	None	Maximum amplitude in dual position feedback [in Cs contour control]
4225	←	None	None	4225	←	None	None	Dual position feedback zero width [in Cs contour control]
4248	4281	4282	4283	4248	4281	4282	4283	Spindle load monitor torque constant
4249	←	4234	←	4249	←	4234	←	Spindle load monitor observer gain 1
4250	←	4235	←	4250	←	4235	←	Spindle load monitor observer gain 2
4320	←	4322	←	4320	←	4322	←	Optimum orientation: Spindle acceleration command (High)
4321	←	4323	←	4321	←	4323	←	Optimum orientation: Spindle acceleration command (Low)
4324	←	4325	←	4324	←	4325	←	Optimum orientation: one-rotation signal detection speed
4320	←	4324	←	4320	←	4324	←	High-speed orientation: Motor acceleration at deceleration time (High)
4321	←	↑	↑	4321	←	↑	↑	High-speed orientation: Motor acceleration at deceleration time (Medium High)
4322	←	↓	↓	4322	←	↓	↓	High-speed orientation: Motor acceleration at deceleration time (Medium Low)
4323	←	4325	←	4323	←	4325	←	High-speed orientation: Motor acceleration at deceleration time (Low)
4326	←	4330	←	4326	←	4330	←	Optimum orientation: Time constant for overshoot compensation/Limit ratio for spindle acceleration command (High)
4327	←	4331	←	4327	←	4331	←	Optimum orientation: Time constant for overshoot compensation/Limit ratio for spindle acceleration command (Low)
4326	←	4327	←	4326	←	4327	←	High-speed orientation: Acceleration limitation start speed at deceleration time (High)
4328	←	4329	←	4328	←	4329	←	Command multiplication for spindle orientation by position coder
4330	←	4331	←	4330	←	4331	←	High-speed orientation: Acceleration limitation start speed at deceleration time (Low)
4334	←	4335	←	4334	←	4335	←	Number of motor sensor arbitrary teeth
4336	←	None	None	4336	←	None	None	Switching point used for an acceleration/deceleration time constant used for spindle synchronous control
4340	←	None	None	4340	←	None	None	Bell-shaped acceleration/deceleration time constant during spindle synchronous control
4341	←	←	←	4341	←	←	←	Unexpected disturbance torque detection level
4342	←	None	None	4342	←	None	None	Velocity loop gain override in Cs contouring control (High)
4343	←	None	None	4343	←	None	None	Velocity loop gain override in Cs contouring control (Low)
4344	←	←	←	4344	←	←	←	Advanced preview feed-forward coefficient
4345	←	←	←	4345	←	←	←	Spindle motor speed command detection level
4346	←	←	←	4346	←	←	←	Incomplete integration factor
4347	←	None	None	4347	←	None	None	Master-slave speed difference state signal output setting
4351	←	←	←	4351	←	←	←	Current detection offset compensation
4352	←	4373	←	4352	←	4373	←	Bit parameter
4353	←	4374	←	4353	←	4374	←	Bit parameter

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0*i*				30*i*				Contents
MH	ML	SH	SL	MH	ML	SH	SL	
4354	←	None	None	4354	←	None	None	Excessive semi-closed loop/closed loop position error alarm detection level [in Cs contour control]
4355	←	None	None	4355	←	None	None	Motor sensor signal amplitude ratio compensation
4356	←	None	None	4356	←	None	None	Motor sensor signal phase difference compensation
4357	←	None	None	4357	←	None	None	Spindle sensor signal amplitude ratio compensation
4358	←	None	None	4358	←	None	None	Spindle sensor signal phase difference compensation
4360	←	None	None	4360	←	None	None	Preload value
4361	←	None	None	4361	←	None	None	Number of spindle sensor arbitrary teeth
4362	4365	4376	4379	4362	4365	4376	4379	Load meter compensation 1
4363	4366	4377	4380	4363	4366	4377	4380	Load meter compensation 2
4364	4367	4378	4381	4364	4367	4378	4381	Load meter compensation 3
4369	←	None	None	4369	←	None	None	Spindle synchronous orientation deceleration coefficient
4370	←	4383	←	4370	←	4383	←	Filter time constant for spindle acceleration detection
4372	←	None	None	4372	←	None	None	Spindle speed limit for safety 1
4384	←	None	None	4384	←	None	None	Spindle EGB : Maximum acceleration/deceleration value in automatic phase matching
4385	←	None	None	4385	←	None	None	Spindle EGB : time constant for free-running phase matching
4386	←	None	None	4386	←	None	None	Spindle EGB : master side detector pulse count
4387	←	None	None	4387	←	None	None	Spindle EGB : synchronous ratio numerator
4388	←	None	None	4388	←	None	None	Spindle EGB : synchronous ratio denominator
4391	←	None	None	4391	←	None	None	Resonance elimination filter 1 : attenuation center frequency
4392	←	None	None	4392	←	None	None	Resonance elimination filter 1 : attenuation bandwidth
4393	←	None	None	4393	←	None	None	Resonance elimination filter 1 : damping
4394	←	4467	←	4394	←	4467	←	Bit parameter
4395	←	4468	←	4395	←	4468	←	Bit parameter
4396	←	4469	←	4396	←	4469	←	Bit parameter
4397	←	4470	←	4397	←	4470	←	Bit parameter
4398	←	4471	←	4398	←	4471	←	Bit parameter
4399	←	4472	←	4399	←	4472	←	Bit parameter
4400	←	4473	←	4400	←	4473	←	Bit parameter
4401	←	4474	←	4401	←	4474	←	Bit parameter
4402	←	4475	←	4402	←	4475	←	Bit parameter
4403	←	4476	←	4403	←	4476	←	Bit parameter
4406	←	None	None	4406	←	None	None	Acceleration/deceleration time constant at return to the reference position in Cs contouring control/servo mode
4409	←	4481	←	4409	←	4481	←	Feed-forward Timing Adjustment coefficient
4410	←	←	←	4410	←	←	←	Disturbance input function : measurement start frequency
4411	←	←	←	4411	←	←	←	Disturbance input function : measurement end frequency
4412	←	←	←	4412	←	←	←	Disturbance input function : measurement frequency interval
4413	←	←	←	4413	←	←	←	Disturbance input function : number of measurements per frequency
4414	←	←	←	4414	←	←	←	Disturbance input function : disturbance torque command amplitude
4415	←	←	←	4415	←	←	←	Disturbance input function : motor speed command for measurement
4416	←	None	None	4416	←	None	None	Resonance elimination filter 2 : attenuation center frequency
4417	←	None	None	4417	←	None	None	Resonance elimination filter 2 : attenuation bandwidth
4418	←	None	None	4418	←	None	None	Resonance elimination filter 2 : damping
4419	←	None	None	4419	←	None	None	Resonance elimination filter 3 : attenuation center frequency
4420	←	None	None	4420	←	None	None	Resonance elimination filter 3 : attenuation bandwidth
4421	←	None	None	4421	←	None	None	Resonance elimination filter 3 : damping
4422	←	None	None	4422	←	None	None	Resonance elimination filter 4 : attenuation center frequency
4423	←	None	None	4423	←	None	None	Resonance elimination filter 4 : attenuation bandwidth
4424	←	None	None	4424	←	None	None	Resonance elimination filter 4 : damping
4438	←	None	None	4438	←	None	None	Spindle speed limit for safety 2
4440	←	None	None	4440	←	None	None	Spindle speed limit for safety 3
4442	←	None	None	4442	←	None	None	Spindle speed limit for safety 4
4448	←	None	None	4448	←	None	None	Criterion level for spindle stop
4455	←	None	None	4455	←	None	None	Backlash acceleration: Acceleration-dependent compensation
4456	←	None	None	4456	←	None	None	Backlash acceleration: Stop timing (spindle travel distance)
4457	←	None	None	4457	←	None	None	Backlash acceleration: Acceleration-independent compensation
4458	←	None	None	4458	←	None	None	Backlash acceleration: Spindle stop check time

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0*i*				30*i*				Contents
MH	ML	SH	SL	MH	ML	SH	SL	
4464	←	←	←	4464	←	←	←	Velocity command-dependent over speed detection offset level
4465	←	←	←	4465	←	←	←	Excessive speed deviation level 2
4466	←	←	←	4466	←	←	←	Excessive speed deviation detection time 2
4498	←	None	None	4498	←	None	None	Spindle EGB master side : denominator of arbitrary gear ratio between motor sensor and spindle
4499	←	None	None	4499	←	None	None	Spindle EGB master side : numerator of arbitrary gear ratio between motor sensor and spindle
4500	←	None	None	4500	←	None	None	Denominator of arbitrary gear ratio between spindle sensor and spindle (High)
4501	←	None	None	4501	←	None	None	Numerator of arbitrary gear ratio between spindle sensor and spindle (High)
4502	←	None	None	4502	←	None	None	Denominator of arbitrary gear ratio between spindle sensor and spindle (Low)
4503	←	None	None	4503	←	None	None	Numerator of arbitrary gear ratio between spindle sensor and spindle (Low)
4508	←	←	←	4508	←	←	←	Rate of change in acceleration at soft start/stop
4510	←	←	←	4510	←	←	←	Power failure backup function Upper limit of the DC link voltage
4511	←	←	←	4511	←	←	←	Power failure backup function Lower limit of the DC link voltage
4519	←	←	←	4519	←	←	←	Bell-shaped acceleration/deceleration time constant for soft start/stop
4520	←	None	None	4520	←	None	None	Primary delay time constant in dual position feedback [in servo mode]
4521	←	None	None	4521	←	None	None	Maximum amplitude in dual position feedback [in servo mode]
4522	←	None	None	4522	←	None	None	Dual position feedback zero width [in servo mode]
4523	←	None	None	4523	←	None	None	Excessive semi-closed loop/closed loop position error alarm detection level [in servo mode]
4527	←	←	←	4527	←	←	←	Temperature difference between warning level and alarm level
4542	←	4672	←	4542	←	4672	←	Common power supply parameter
4550	←	None	None	4550	←	None	None	Velocity loop proportional gain on spindle synchronous control (High)
4551	←	None	None	4551	←	None	None	Velocity loop proportional gain on spindle synchronous control (Low)
4552	←	None	None	4552	←	None	None	Velocity loop integral gain on spindle synchronous control (High)
4553	←	None	None	4553	←	None	None	Velocity loop integral gain on spindle synchronous control Low)
4554	←	None	None	4554	←	None	None	Position gain on spindle synchronous control (High)
4555	←	None	None	4555	←	None	None	Position gain on spindle synchronous control (Medium High)
4556	←	None	None	4556	←	None	None	Position gain on spindle synchronous control (Medium Low)
4557	←	None	None	4557	←	None	None	Position gain on spindle synchronous control (Low)
4558	←	None	None	4558	←	None	None	Motor voltage on spindle synchronous control (High)
4559	←	None	None	4559	←	None	None	Motor voltage on spindle synchronous control (Low)
4588	←	←	←	4588	←	←	←	Inertia estimation: Excitationinput frequency
4589	←	←	←	4589	←	←	←	Inertia estimation: Excitationinput gain
4590	←	4720	←	4590	←	4720	←	Orientation speed restriction rate 1/orientation speed restriction rate 2 (HIGH)
4591	←	4721	←	4591	←	4721	←	Orientation speed restriction rate 1/orientation speed restriction rate 2 (LOW)
4593	←	←	←	4593	←	←	←	Spindle amplifier loss coefficient 1
4594	←	←	←	4594	←	←	←	Spindle amplifier loss coefficient 2
4595	←	←	←	4595	←	←	←	Common power supply loss coefficient 1
4596	←	←	←	4596	←	←	←	Common power supply loss coefficient 2
4597	←	None	None	4597	←	None	None	Setting for the multi-axis integrator copy
4606	←	None	None	4606	←	None	None	Preload time constant
4607	←	4737	←	4607	←	4737	←	Motor voltage after completion of optimum orientation
4612	4614	4728	4730	4612	4614	4728	4730	Parameter for load meter (normalized by the continuous rated output) <1>
4613	4615	4729	4731	4613	4615	4729	4731	Parameter for load meter (normalized by the continuous rated output) <2>
-	-	-	-	4616	←	None	None	Speed for changing slave axis acceleration in EGB automatic phase matching
4619	4620	None	None	4619	4620	None	None	Cutting feed/rapid traverse PWM frequency switching in Cs contour control Setting related to the current limitation
4621	←	None	None	4621	←	None	None	Cutting feed/rapid traverse PWM frequency switching in Cs contour control Velocity loop gain override
4622	←	None	None	4622	←	None	None	Cutting feed/rapid traverse PWM frequency switching in Cs contour control Current loop gain override
4623	←	None	None	4623	←	None	None	Distance coded sensor Nominal increment 1
4624	←	None	None	4624	←	None	None	Distance coded sensor Nominal increment 2
4625	←	None	None	4625	←	None	None	Distance coded sensor Z phase position compensation data

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0*i*				30*i*				Contents
MH	ML	SH	SL	MH	ML	SH	SL	
4627	←	←	←	4627	←	←	←	Advanced preview feed-forward coefficient for cutting feed
4629	4630	None	None	4629	4630	None	None	Allowable acceleration for acceleration at a power failure
4634	4635	4764	4765	4634	4635	4764	4765	Smart thermal control: Output lower limit
4637	←	4767	←	4637	←	4767	←	Alarm detection level of conection error (monitoring amount of motor rotation during the spindle one rotation ssignal)
4638	←	←	←	4638	←	←	←	Alarm detection level of conection error (monitoring amount of spindle-motor speed difference)
4641	←	None	None	4641	←	None	None	Backlash acceleration: Calculation time of acceleration
4642	←	None	None	4642	←	None	None	Backlash acceleration: Stop timing (motor travel distance)
4644	←	None	None	4644	←	None	None	Gain for Smart backlash compensation
4645	←	None	None	4645	←	None	None	Ratio for compensation against actual backlash length
4646	←	None	None	4646	←	None	None	Distance of spindle movement (Distance for update of “Based semi-full error” information)
4647	←	None	None	4647	←	None	None	Judgment time of axis stop in Smart backlash compensation
4648	←	None	None	4648	←	None	None	Effective time of Smart backlash compensation
4649	←	None	None	4649	←	None	None	Effective time for getting “Based semi-full error”
4650	←	None	None	4650	←	None	None	Compensation length of Smart backlash compensation
4661	←	←	←	4661	←	←	←	Tolerable error value at spindle stop
4666	4667	None	None	4666	4667	None	None	Smart rigid tapping: Bell-shaped acceleration/deceleration time constant
4668	4669	None	None	4668	4669	None	None	Backlash acceleration: acceleration compute time

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C PARAMETER TABLE FOR EACH MOTOR MODEL

Unless otherwise annotated, the following spindle amplifiers are applicable to motors for 200 V and 400 V.

Amplifiers for 200 V

Conventional spindle amplifier	(A06B-611x-...)
Level-up spindle amplifier	(A06B-614x-...)
Spindle amplifier for 30*i*-B	(A06B-622x-...)

Amplifiers for 400 V

Conventional spindle amplifier	(A06B-612x-...)
Level-up spindle amplifier	(A06B-615x-...)
Spindle amplifier for 30*i*-B	(A06B-627x-...)

JR AUTOMATION TECHNOLOGIES INC*
JDOWLING

C.1 SPINDLE MOTOR α*i*I series

Motor model	α*i* I 0.5/10000	α*i* I 1/10000	α*i* I 1.5/10000	α*i* I 2/10000	α*i* I 3/10000	α*i* I 6/10000	α*i* I 8/8000	α*i* I 12/7000
Applicable amplifier	α*i* SP2.2	α*i* SP2.2	α*i* SP5.5	α*i* SP5.5	α*i* SP5.5	α*i* SP11	α*i* SP11	α*i* SP15
Model code	301	302	304	306	308	310	312	314
Applicable software series and edition	9D50/F	9D50/D	9D50/D	9D50/D	9D50/D	9D50/F	9D50/D	9D50/D
Low-speed winding characteristics	–	–	–	–	–	–	–	–
High-speed winding characteristics	0.55/1.1kW 3000/10000min^{-1}	1.5/2.2kW 3000/10000min^{-1}	1.1/3.7kW 1500/10000min^{-1}	2.2/3.7kW 1500/10000min^{-1}	3.7/5.5kW 1500/10000min^{-1}	5.5/7.5kW 1500/10000min^{-1}	7.5/11kW 1500/8000min^{-1}	11/15kW 1500/7000min^{-1}
FS30*i* FS0*i*								
4007	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4008	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4009	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4010	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4011	00011000	00011001	00011001	00011001	00011001	00011010	00011010	00011010
4012	10000010	10000010	10000010	10000010	10000010	10000010	10000010	10000010
4013	00001100	00001100	00001100	00001100	00001100	00001100	00001100	00001100
4019	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100
4020	10000	10000	10000	10000	10000	10000	8000	7000
4023								
4039	0	0	0	0	0	0	0	0
4040								
4041								
4048								
4049								
4080	90	83 80(*1)	85 65(*1)	77 70(*1)	60 65(*1)	66	75	70
4083	30	30	30	30	30	30	30	30
4093	0	0	0	0	0	0	0	0
4100	3400	3100	1650	1550	1600	1550	1600	1500
4101	100	100	100	100	100	96	100	100
4102	6500	3557	2767	2567	1967	2630	1656	1500
4103	46 0(*1)	87 0(*1)	60 0(*1)	68 0(*1)	75 0(*1)	60	0	0
4104	3000	6000	6000	6000	7000	6000	8000	7000
4105	46	45	58	80	89	154	121	307
4106	7500	6000	6000	6000	7000	6000	8000	7000
4107								
4108	0	0	0	0	0	0	0	0
4109	25	25	25	25	25	25	25	25
4110	1571	690	563	474	475	754	503	595
4111	260	102	217	175	200	260	170	173
4112	200	200	200	200	19400	200	200	200
4113	2077	2100	1635	1192	1077	620	790	311
4114	23040	17920	0	0	0	20480	19200	23040
4115	100	100	100	100	100	100	100	100
4116	13760	10018	9598	9300	7950	8803	8118	5000
4117	90	90	90	90	28250	90	90	90
4118	100	100	100	100	110	100	100	100
4119	5	5	5	8	5	15	12	31
4120	0	0	0	0	0	0	0	0
4124	24570	24448	24535	24501	24521	24570	24497	24499
4127	240	176	404	202	178	164	176	164
4128	120	0	115	90	0	109	117	0
4129	0	0	0	0	0	0	0	0
4130	25700	25700	25700	25700	25700	25700	25700	25700
4134	110	110	110	110	110	130	130	130
4136	0	0	0	0	0	0	0	0
4138	0	0	0	0	0	0	0	0
4139	0	0	0	0	0	0	0	0
4140	0	0	0	0	0	0	0	0
4141	0	0	0	0	0	0	0	0
4142	0	0	0	0	0	0	0	0
4143	0	0	0	0	0	0	0	0
4144	0	0	0	0	0	0	0	0
4145	0	0	0	0	0	0	0	0
4146	0	0	0	0	0	0	0	0
4147	0	0	0	0	0	0	0	0
4148	0	0	0	0	0	0	0	0
4149	0	0	0	0	0	0	0	0
4150	0	0	0	0	0	0	0	0
4151	0	0	0	0	0	0	0	0
4152	0	0	0	0	0	0	0	0
4153	0	0	0	0	0	0	0	0
4154	0	0	0	0	0	0	0	0
4155	0	0	0	0	0	0	0	0
4156	0	0	0	0	0	0	0	0
4158	0	0	0	0	0	0	0	0
4159	0	0	0	0	0	0	0	0
4161	0	0	0	0	0	0	0	0
4165	0	0	0	0	0	0	0	0
4166	0	0	0	0	0	0	0	0
4169	0	0	0	0	0	0	0	0
Maximum output during acceleration (for PS selection)	1.32kW 2.60kW(*1)	2.64kW 2.87kW(*1)	4.44kW 6.7kW(*1)	4.44kW 6.4kW(*1)	6.6kW 7.9kW(*1)	9.0kW	13.2kW	18.0kW
Motor model (old name)	α0.5/10000*i*	α1/10000*i*	α1.5/10000*i*	α2/10000*i*	α3/10000*i*	α6/10000*i*	α8/8000*i*	α12/7000*i*
Applicable amplifier (old name)	SPM-2.2*i*	SPM-2.2*i*	SPM-5.5*i*	SPM-5.5*i*	SPM-5.5*i*	SPM-11*i*	SPM-11*i*	SPM-15*i*

(*1)This setting makes the maximum output during acceleration greater and the acceleration time reduced.

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Motor model	αi I 15/7000	αi I 18/7000	αi I 22/7000	αi I 30/6000	αi I 40/6000	αi I 50/4500	αi I 50/5000	αi I 1/15000
Applicable amplifier	αi SP22	αi SP22	αi SP26	αi SP45	αi SP45	αi SP55	αi SP55	αi SP5.5
Model code	316	318	320	322	323	324	–	303
Applicable software series and edition	9D50/D	9D50/F	9D50/D	9D50/E	9D50/E	9D50/F	–	–
Low-speed winding characteristics	–	–	–	–	–	–	–	–
High-speed winding characteristics	15/18.5kW 1500/7000min^{-1}	18.5/22kW 1500/7000min^{-1}	22/26kW 1500/7000min^{-1}	30/37kW 1150/6000min^{-1}	37/45kW 1500/6000min^{-1}	45/55kW 1150/4500min^{-1}	45/55kW 1150/5000min^{-1}	1.5/2.2kW 3000/15000min^{-1}
FS30*i* FS0*i*								
4007	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4008	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4009	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4010	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000001
4011	00011010	00011010	00011010	00011010	00011010	00011010	00011010	00011001
4012	10000010	10000010	10000010	10000010	10000000	10000000	10000000	10000010
4013	01010000	01010000	01010000	00011000	00011000	00011000	00011000	00001100
4019	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100
4020	7000	7000	7000	6000	6000	4500	5000	15000
4023								
4039	0	0	0	0	0	0	0	0
4040								
4041								
4048								
4049								
4080	20555	11615	80	77	80	80	80	85 80(*1)
4083	30	30	30	30	30	30	30	30
4093	0	0	0	0	0	0	0	0
4100	1500	1520	1500	1387	1740	1200	1200	3100
4101	95	100	95	100	100	85	85	93
4102	1710	1813	1756	1387	1740	1201	1201	8015
4103	0	84	0	0	0	89	89	70 0(*1)
4104	5500	3000	4500	6000	3000	3000	3000	2000
4105	314	310	329	505	503	562	562	51
4106	5500	10000	4500	6000	3000	4500	4500	7000
4107								
4108	0	0	0	0	0	0	0	0
4109	25	25	25	25	25	25	25	25
4110	794	943	924	1145	970	1260	1260	343
4111	243	333	252	286	286	320	320	102
4112	200	200	200	200	200	200	200	200
4113	304	308	290	189	190	170	170	1870
4114	23040	0	0	20480	23040	23040	23040	0
4115	100	100	100	100	100	100	100	100
4116	5177	3600	5564	6071	6128	5800	5800	9669
4117	90	90	29530	90	90	90	90	90
4118	100	100	110	100	100	100	100	100
4119	31	31	29	51	48	56	56	5
4120	0	0	0	0	0	0	0	0
4124	24556	24575	24564	24575	24575	24575	24575	24448
4127	148	143	142	148	146	146	146	176
4128	105	0	105	0	0	114	114	80
4129	0	0	0	0	0	0	0	0
4130	25700	25700	25700	25700	25700	25700	25700	25700
4134	130	130	130	130	130	130	130	110
4136	0	0	0	0	0	0	0	0
4138	0	0	0	0	0	0	0	0
4139	0	0	0	0	0	0	0	0
4140	0	0	0	0	0	0	0	0
4141	0	0	0	0	0	0	0	0
4142	0	0	0	0	0	0	0	0
4143	0	0	0	0	0	0	0	0
4144	0	0	0	0	0	0	0	0
4145	0	0	0	0	0	0	0	0
4146	0	0	0	0	0	0	0	0
4147	0	0	0	0	0	0	0	0
4148	0	0	0	0	0	0	0	0
4149	0	0	0	0	0	0	0	0
4150	0	0	0	0	0	0	0	0
4151	0	0	0	0	0	0	0	0
4152	0	0	0	0	0	0	0	0
4153	0	0	0	0	0	0	0	0
4154	0	0	0	0	0	0	0	0
4155	0	0	0	0	0	0	0	0
4156	0	0	0	0	0	0	0	0
4158	0	0	0	0	0	0	0	0
4159	0	0	0	0	0	0	0	0
4161	0	0	0	0	0	0	0	0
4165	0	0	0	0	0	0	0	0
4166	0	0	0	0	0	0	0	0
4169	0	0	0	0	0	0	0	0
Maximum output during acceleration (for PS selection)	22.2kW	26.4kW	31.2kW	44.4kW	54.0kW	66.0KW	66.0kW	5.6kW 7.0kW(*1)
Motor model (old name)	α15/7000*i*	α18/7000*i*	α22/7000*i*	α30/6000*i*	α40/6000*i*	α50/4500*i*	–	α1/15000*i*
Applicable amplifier (old name)	SPM-22*i*	SPM-22*i*	SPM-26*i*	SPM-45*i*	SPM-45*i*	SPM-55*i*	–	SPM-5.5*i*

(*1)This setting makes the maximum output during acceleration greater and the acceleration time reduced.

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Motor model	αiI 1.5/15000	αiI 1.5/20000	αiI 2/15000	αiI 2/20000	αiI 3/12000	αiI 6/12000	αiI 6/12000(*4)
Applicable amplifier	αi SP15	αi SP15	αi SP22	αi SP22	αi SP11	αi SP11	αi SP11
Model code	305	–	307	–	309	401	–
Applicable software series and edition	9D50/I	–	9D50/D	–	9D50/F	9D50/D	–
Low-speed winding characteristics	–	–	–	–	–	5.5/7.5kW 1500/12000min^{-1}	5.5/7.5kW 1500/12000min^{-1}
High-speed winding characteristics	1.5/2.2kW 3000/15000min^{-1}	1.5/2.2kW 3000/20000min^{-1}	2.2/3.7kW 3000/15000min^{-1}	2.2/3.7kW 3000/20000min^{-1}	3.7/5.5kW 1500/12000min^{-1}	5.5/7.5kW 4000/12000min^{-1}	–
FS30*i* FS0*i*							
4007	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4008	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4009	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4010	00000000	00000001	00000000	00000001	00000000	00000000	00000000
4011	00011001	00011001	00011001	00011001	00011001	00011010	00011010
4012	10000010	10000010	10000010	10000010	10000010	10000010	10000010
4013	00001100	00001100	01010000	01010000	00001100	00001100	00001100
4019	00000100	00000100	00000100	00000100	00000100	00000100	00000100
4020	15000	20000	15000	20000	12000	12000	12000
4023						333(*2)	
4039	0	0	0	0	0	0	0
4040							6(*3)
4041						6(*3)	
4048							6(*3)
4049						6(*3)	
4080	14165	14165	12122	19290	16720	82 78(*1)	66
4083	10	10	10	10	30	20	30
4093	0	0	0	0	0	164	0
4100	3250	3250	3200	3200	1500	4000	1550
4101	33	33	45	45	87	81	96
4102	7145	7145	6432	6432	3015	4561	2630
4103	75	75	92	92	82	69 0(*1)	60
4104	2300	2300	3000	3000	3200	4000	6000
4105	43	43	53	53	106	147	154
4106	8700	8700	3000	3000	7500	4000	6000
4107						154	
4108	0	0	0	0	0	0	0
4109	25	25	25	25	25	25	25
4110	629	629	588	588	559	431	754
4111	180	180	175	175	190	125	260
4112	200	200	200	200	200	200	200
4113	2227	2227	1800	1800	900	650	620
4114	0	0	0	0	19200	20480	20480
4115	90	90	100	80	100	100	100
4116	10289	10289	16564	16564	7376	8986	8803
4117	90	90	90	90	90	90	90
4118	100	100	100	100	100	100	100
4119	5	5	2	2	9	15	15
4120	0	0	0	0	0	0	0
4124	24505	24505	24501	24501	24513	24464	24570
4127	176	176	202	202	178	164	164
4128	73	73	85	85	0	95	109
4129	0	0	0	0	0	0	0
4130	25700	25700	25700	25700	25700	25700	25700
4134	110	110	110	110	110	130	130
4136	0	0	0	0	0	30	0
4138	0	0	0	0	0	1550	0
4139	0	0	0	0	0	96	0
4140	0	0	0	0	0	2630	0
4141	0	0	0	0	0	60	0
4142	0	0	0	0	0	6000	0
4143	0	0	0	0	0	6000	0
4144	0	0	0	0	0	0	0
4145	0	0	0	0	0	25	0
4146	0	0	0	0	0	754	0
4147	0	0	0	0	0	260	0
4148	0	0	0	0	0	200	0
4149	0	0	0	0	0	620	0
4150	0	0	0	0	0	20480	0
4151	0	0	0	0	0	100	0
4152	0	0	0	0	0	8803	0
4153	0	0	0	0	0	90	0
4154	0	0	0	0	0	100	0
4155	0	0	0	0	0	24570	0
4156	0	0	0	0	0	0	0
4158	0	0	0	0	0	109	0
4159	0	0	0	0	0	0	0
4161	0	0	0	0	0	25700	0
4165	0	0	0	0	0	15	0
4166	0	0	0	0	0	66	0
4169	0	0	0	0	0	0	0
Maximum output during acceleration (for PS selection)	13.0kW	13kW	20.0kW	20kW	13.0kW	9.0kW 14.0kW(*1)	9.0kW
Motor model (old name)	α1.5/15000*i*	–	α2/15000*i*	–	α3/12000*i*	α6/12000*i*	α6/12000*i*
Applicable amplifier (old name)	SPM-15*i*	–	SPM-22*i*	–	SPM-11*i*	SPM-11*i*	SPM-11*i*

(*1)This setting makes the maximum output during acceleration greater and the acceleration time reduced.
(*2)When using the SDT signal, manually change the parameters that were automatically set.
(*3) Set this value as the initial value of the velocity loop gain for low-speed characteristics of speed range switching.
(*4) This setting is used when only a low-speed winding is connected without the output range being switched in the output range switching motor.

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Motor model	αi I 8/10000	αi I 8/10000(*4)	αi I 8/12000	αi I 12/10000	αi I 12/10000(*4)	αi I 15/10000	αi I 15/10000(*4)
Applicable amplifier	αi SP11	αi SP11	αi SP15	αi SP15	αi SP15	αi SP22	αi SP22
Model code	402	–	–	403	–	404	–
Applicable software series and edition	9D50/F	–	–	9D50/F	–	9D50/F	–
Low-speed winding characteristics	7.5/11kW 1500/10000min^{-1}	7.5/11kW 1500/10000min^{-1}	7.5/11kW 1500/12000min^{-1}	11/15kW 1500/10000min^{-1}	11/15kW 1500/10000min^{-1}	15/18.5kW 1500/10000min^{-1}	15/18.5kW 1500/10000min^{-1}
High-speed winding characteristics	7.5/11kW 4000/10000min^{-1}	–	7.5/11kW 4000/12000min^{-1}	11/15kW 4000/10000min^{-1}	–	15/18.5kW 4000/10000min^{-1}	–
FS30*i* FS0*i*							
4007	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4008	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4009	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4010	00000000	00000000	00000001	00000000	00000000	00000000	00000000
4011	00011010	00011010	00011010	00011010	00011010	00011010	00011010
4012	10000010	10000010	10000010	10000010	10000010	10000010	10000010
4013	00001100	00001100	00001100	00001100	00001100	01010000	01010000
4019	00000100	00000100	00000100	00000100	00000100	00000100	00000100
4020	10000	10000	12000	10000	10000	10000	10000
4023	400(*2)		333(*2)	400(*2)		400(*2)	
4039	0	0	0	0	0	0	0
4040		6(*3)					
4041	6(*3)		6(*3)				
4048		6(*3)					
4049	6(*3)		6(*3)				
4080	12880	14168	70	75	70	80	20555
4083	30	30	30	30	30	30	30
4093	176	0	176	164	0	148	0
4100	3538	1600	3580	3900	1500	4000	1500
4101	100	100	100	80	100	62	95
4102	3538	1656	3580	3593	1500	3482	1710
4103	0	0	0	90	0	75	70
4104	2200	6000	2300	1800	7000	1700	5500
4105	199	121	97	341	307	347	314
4106	8000	18000	2300	6500	7000	5500	5500
4107	121		88	307		314	
4108	0	0	0	0	0	0	0
4109	25	25	25	25	25	25	25
4110	503	503	421	595	595	575	794
4111	165	170	100	173	173	193	243
4112	200	200	200	200	200	200	200
4113	480	790	980	280	311	275	304
4114	0	19200	0	0	23040	23040	23040
4115	100	100	100	100	100	100	100
4116	5734	8118	11031	5280	5000	5126	5177
4117	100	90	90	90	90	90	90
4118	100	100	100	100	100	90	100
4119	20	12	522	34	31	35	31
4120	0	0	0	0	0	0	0
4124	24493	24497	24447	24499	24499	24515	24556
4127	176	176	176	164	164	148	148
4128	0	117	0	0	0	0	105
4129	0	0	0	0	0	0	0
4130	25700	25700	25700	25700	25700	25700	25700
4134	130	130	130	130	130	130	130
4136	30	0	30	30	0	30	0
4138	1600	0	1500	1500	0	1500	0
4139	100	0	89	100	0	95	0
4140	1656	0	1642	1500	0	1710	0
4141	0	0	77	0	0	70	0
4142	6000	0	5000	7000	0	5500	0
4143	18000	0	5000	7000	0	5500	0
4144	0	0	0	0	0	0	0
4145	25	0	25	25	0	25	0
4146	503	0	566	595	0	794	0
4147	170	0	162	173	0	243	0
4148	200	0	200	200	0	200	0
4149	790	0	1090	311	0	304	0
4150	19200	0	19200	23040	0	23040	0
4151	100	0	100	100	0	100	0
4152	8118	0	8000	5000	0	5177	0
4153	90	0	90	90	0	90	0
4154	100	0	100	100	0	100	0
4155	24497	0	24491	24499	0	24556	0
4156	0	0	0	0	0	0	0
4158	117	0	0	0	0	105	0
4159	0	0	0	0	0	0	0
4161	25700	0	25700	25700	0	25700	0
4165	12	0	521	31	0	31	0
4166	14168	0	49	70	0	20555	0
4169	0	0	0	0	0	0	0
Maximum output during acceleration (for PS selection)	13.2kW	13.2kW	13.2kW	18.0kW	18.0kW	22.2kW	22.2kW
Motor model (old name)	α8/10000*i*	α8/10000*i*	–	α12/10000*i*	α12/10000*i*	α15/10000*i*	α15/10000*i*
Applicable amplifier (old name)	SPM-11*i*	SPM-11*i*	–	SPM-15*i*	SPM-15*i*	SPM-22*i*	SPM-22*i*

(*2)When using the SDT signal, manually change the parameters that were automatically set.
(*3) Set this value as the initial value of the velocity loop gain for low-speed characteristics of speed range switching.
(*4) This setting is used when only a low-speed winding is connected without the output range being switched in the output range switching motor.

JR AUTOMATION TECHNOLOGIES, INC*

Motor model	αi I 18/10000	αi I 18/10000(*4)	αi I 22/10000	αi I 22/10000(*4)
Applicable amplifier	αi SP22	αi SP22	αi SP26	αi SP26
Model code	405	–	406	–
Applicable software series and edition	9D50/F	–	9D50/E	–
Low-speed winding characteristics	18.5/22kW 1500/10000min^{-1}	18.5/22kW 1500/10000min^{-1}	22/26kW 1500/10000min^{-1}	22/26kW 1500/10000min^{-1}
High-speed winding characteristics	18.5/22kW 4000/10000min^{-1}	–	22/26kW 4000/10000min^{-1}	–
FS30*i* FS0*i*				
4007	00000000	00000000	00000000	00000000
4008	00000000	00000000	00000000	00000000
4009	00000000	00000000	00000000	00000000
4010	00000000	00000000	00000000	00000000
4011	00011010	00011010	00011010	00011010
4012	10000010	10000010	10000010	10000010
4013	01010000	01010000	01010000	01010000
4019	00000100	00000100	00000100	00000100
4020	10000	10000	10000	10000
4023	400(*2)		400(*2)	
4039	0	0	0	0
4040				
4041				
4048				
4049				
4080	80	11615	75	56
4083	30	30	30	30
4093	143	0	142	0
4100	4100	1520	4000	1440
4101	100	100	83	96
4102	4582	1813	3504	1709
4103	89	84	0	96
4104	1300	3000	2800	5000
4105	299	310	360	318
4106	5000	10000	2800	5000
4107	310		318	
4108	0	0	0	0
4109	25	25	25	25
4110	754	943	603	823
4111	260	333	143	213
4112	200	200	200	200
4113	319	308	265	300
4114	0	0	24320	19200
4115	100	100	100	100
4116	4100	3600	5523	5593
4117	90	90	90	90
4118	100	100	100	100
4119	30	31	36	341
4120	0	0	0	0
4124	24570	24575	24477	24531
4127	143	143	142	142
4128	102	0	0	0
4129	0	0	0	0
4130	25700	25700	25700	25700
4134	130	130	130	130
4136	30	0	30	0
4138	1520	0	1440	0
4139	100	0	96	0
4140	1813	0	1709	0
4141	84	0	96	0
4142	3000	0	5000	0
4143	10000	0	5000	0
4144	0	0	0	0
4145	25	0	25	0
4146	943	0	823	0
4147	333	0	213	0
4148	200	0	200	0
4149	308	0	300	0
4150	0	0	19200	0
4151	100	0	100	0
4152	3600	0	5593	0
4153	90	0	90	0
4154	100	0	100	0
4155	24575	0	24531	0
4156	0	0	0	0
4158	0	0	0	0
4159	0	0	0	0
4161	25700	0	25700	0
4165	31	0	341	0
4166	11615	0	56	0
4169	0	0	0	0
Maximum output during acceleration (for PS selection)	26.4kW	26.4kW	31.2kW	31.2kW
Motor model (old name)	α18/10000*i*	α18/10000*i*	α22/10000*i*	α22/10000*i*
Applicable amplifier (old name)	SPM-22*i*	SPM-22*i*	SPM-26*i*	SPM-26*i*

(*2)When using the SDT signal, manually change the parameters that were automatically set.
(*4) This setting is used when only a low-speed winding is connected without the output range being switched in the output range switching motor.

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C.2 SPINDLE MOTOR αiI series (Power up model)

Motor model	αiI 6/10000	αiI 8/8000	αiI 12/7000	αiI 15/7000	αiI 18/7000	αiI 22/7000
Applicable amplifier	αi SP11	αi SP15	αi SP15	αi SP22	αi SP22	αi SP26
Model code	363	364	365	366	367	368
Applicable software series and edition	9D8A/B 9DA0/P	9D8A/B 9DA0/P	9D8A/B 9DA0/P	9D8A/B 9DA0/P	9D8A/B 9DA0/P	9D8A/B 9DA0/P
Low-speed winding characteristics	–	–	–	–	–	–
High-speed winding characteristics	5.5/7.5/11kW 1500/10000min^{-1}	7.5/11/15kW 1500/8000min^{-1}	11/15/18.5kW 1500/7000min^{-1}	15/18.5/25kW 1500/7000min^{-1}	18.5/22/30kW 1500/7000min^{-1}	22/26/35kW 1500/7000min^{-1}
FS30*i* FS0*i*						
4007	00000000	00000000	00000000	00000000	00000000	00000000
4008	00010000	00010000	00010000	00010000	00010000	00010000
4009	00000000	00000000	00000000	00000000	00000000	00000000
4010	00000000	00000000	00000000	00000000	00000000	00000000
4011	00001010	00001010	00001010	00001010	00001010	00001010
4012	10000111	10000010	10000010	10000010	10000111	10000111
4013	00001100	00001100	00001100	00001100	00001100	00001100
4019	00000100	00000100	00000100	00000100	00000100	00000100
4020	10000	8000	7000	7000	7000	7000
4023						
4039	0	0	0	0	0	0
4040						
4041						
4048						
4049						
4080	16710	20565	16735	24410	18005	15460
4083	30	30	30	30	30	30
4093	0	0	0	0	0	0
4100	1570	1600	1550	1500	1700	1550
4101	100	94	100	100	100	100
4102	2016	1656	1922	1710	1909	1756
4103	0	0	0	0	0	0
4104	3000	6000	3000	5500	1600	1500
4105	138	121	324	314	310	329
4106	6000	20000	10000	5500	5000	5000
4107	0	0	0	0	0	0
4108	0	0	0	0	0	0
4109	25	25	25	25	25	25
4110	603	754	905	794	943	924
4111	261	265	337	305	418	353
4112	200	200	200	200	200	200
4113	690	790	295	304	308	290
4114	0	19200	0	23040	0	23040
4115	100	100	100	100	100	100
4116	6500	8118	5279	5177	4500	5000
4117	90	90	90	90	90	90
4118	100	100	100	100	100	100
4119	527	12	32	31	31	29
4120	0	0	0	0	0	0
4124	24571	24574	24575	24575	24575	24575
4127	240	240	202	200	195	191
4128	6505	117	0	105	0	0
4129	0	0	0	0	0	0
4130	25700	25700	25700	25700	25700	25700
4134	130	130	130	130	130	130
4136	0	0	0	0	0	0
4138	0	0	0	0	0	0
4139	0	0	0	0	0	0
4140	0	0	0	0	0	0
4141	0	0	0	0	0	0
4142	0	0	0	0	0	0
4143	0	0	0	0	0	0
4144	0	0	0	0	0	0
4145	0	0	0	0	0	0
4146	0	0	0	0	0	0
4147	0	0	0	0	0	0
4148	0	0	0	0	0	0
4149	0	0	0	0	0	0
4150	0	0	0	0	0	0
4151	0	0	0	0	0	0
4152	0	0	0	0	0	0
4153	0	0	0	0	0	0
4154	0	0	0	0	0	0
4155	0	0	0	0	0	0
4156	0	0	0	0	0	0
4158	0	0	0	0	0	0
4159	0	0	0	0	0	0
4161	0	0	0	0	0	0
4165	0	0	0	0	0	0
4166	0	0	0	0	0	0
4169	0	0	0	0	0	0
4362	0	-26424	0	0	0	0
4363	0	-24351	0	0	0	0
4364	0	-30320	0	0	0	0
4365	0	0	0	0	0	0
4366	0	0	0	0	0	0
4367	0	0	0	0	0	0
4400	00000001 (*6)	0	0	0	00000001 (*6)	00000001 (*6)
4612	97	75	127	128	132	134
4613	21643	16514	16774	16531	16778	16771
4614	0	0	0	0	0	0
4615	0	0	0	0	0	0
Maximum output during acceleration (for PS selection)	13.2kW	18.0kW	22.2kW	30.0kW	36.0kW	42.0kW

(*6) Change parameters manually according to the table after load parameters automatically with the model code.

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Motor model	αiI 0.5/15000	αiI 2/10000	αiI 6/12000	αiI 6/12000(*4)	αiI 8/10000	αiI 8/10000(*4)
Applicable amplifier	αiSP 2.2	αiSP 11	αiSP 11	αiSP 11	αiSP 15	αiSP 15
Model code	372	373	421	–	422	–
Applicable softw are series and edition	9D8A/I 9DAA/A	9D8A/I 9DAA/A	9D8A/I 9DAA/A	–	9D8A/I 9DAA/A	–
Low -speed w inding characteristics	–	–	5.5/7.5/11 kW 1500/12000min^{-1}	5.5/7.5/11 kW 1500/12000min^{-1}	7.5/11/15 kW 1500/10000min^{-1}	7.5/11/15 kW 1500/10000min^{-1}
High-speed w inding characteristics	0.55/1.1/1.5 kW 3000/15000min^{-1}	2.2/3.7/5.5 kW 1500/10000min^{-1}	5.5/7.5/11 kW 4000/12000min^{-1}	–	7.5/11/15 kW 4000/10000min^{-1}	–
FS30*i* FS0*i*						
4007	00000000	00000000	00000000	00000000	00000000	00000000
4008	00010000	00010000	00010000	00010000	00010000	00010000
4009	00000000	00000000	00000000	00000000	00000000	00000000
4010	00000001	00000000	00000000	00000000	00000001	00000001
4011	00001000	00001001	00001010	00001010	00001010	00001010
4012	10000010	10000010	10000111	10000111	10000010	10000010
4013	00001100	00001100	00001100	00001100	00001100	00001100
4019	00000100	00000100	00000100	00000100	00000100	00000100
4020	15000	10000	12000	12000	10000	10000
4023			333 (*2)		400 (*2)	
4039	0	0	0	0	0	0
4040	2 (*3)	3 (*3)				
4041						
4048	6 (*3)	13 (*3)				
4049						
4080	20570	20575	75	12870	12877	17749
4083	30	30	30	30	30	30
4093			240	0	240	0
4100	3300	1550	4400	1570	4006	1600
4101	100	85	100	100	82	94
4102	8226	2567	4838	2016	4006	1656
4103	0	0	0	0	0	0
4104	2000	4500	1200	3000	2050	6000
4105	46	96	119	138	160	121
4106	6000	15000	2500	6000	7600	20000
4107	0	0	138	0	121	0
4108	0	0	0	0	0	0
4109	25	25	25	25	25	25
4110	1508	949	479	603	854	754
4111	346	298	198	261	305	265
4112	200	200	200	200	200	200
4113	2078	992	800	690	598	790
4114	0	0	17920	0	0	19200
4115	100	100	100	100	100	100
4116	13770	9300	6500	6500	5734	8118
4117	90	90	90	90	100	90
4118	100	100	100	100	100	100
4119	5	10	15	527	16	12
4120	0	0	0	0	0	0
4124	24575	24575	24519	24571	24575	24574
4127	327	300	240	240	240	240
4128	110	107	105	6505	0	117
4129	0	0	0	0	0	0
4130	25700	25700	25700	25700	25700	25700
4134	110	110	130	130	130	130
4136	0	0	30	0	30	0
4138	0	0	1570	0	1600	0
4139	0	0	100	0	94	0
4140	0	0	2016	0	1656	0
4141	0	0	0	0	0	0
4142	0	0	3000	0	6000	0
4143	0	0	6000	0	20000	0
4144	0	0	0	0	0	0
4145	0	0	25	0	25	0
4146	0	0	603	0	754	0
4147	0	0	261	0	265	0
4148	0	0	200	0	200	0
4149	0	0	690	0	790	0
4150	0	0	0	0	19200	0
4151	0	0	100	0	100	0
4152	0	0	6500	0	8118	0
4153	0	0	90	0	90	0
4154	0	0	100	0	100	0
4155	0	0	24571	0	24574	0
4156	0	0	0	0	0	0
4158	0	0	6505	0	117	0
4159	0	0	0	0	0	0
4161	0	0	25700	0	25700	0
4165	0	0	527	0	12	0
4166	0	0	12870	0	17749	0
4169	0	0	0	0	0	0
4362	0	-24176	0	0	0	0
4363	0	-24176	0	0	0	0
4364	0	-32268	0	0	0	0
4365	0	0	0	0	0	0
4366	0	0	0	0	0	0
4367	0	0	0	0	0	0
4400	0	0	00010001(*6)	00000001(*6)	0	0
4612	0	73	107	0	87	0
4613	0	27136	12288	0	10240	0
4614	0	0	107	0	100	0
4615	0	0	22157	0	16517	0
Maximum output during acceleration (for PS selection)	1.8kW	6.6kW	13.2kW	13.2kW	18kW	18kW

(*2)When using the SDT signal, manually change the parameters that were automatically set.
(*3) Set this value as the initial value of the velocity loop gain for low-speed characteristics of speed range switching.
(*4) This setting is used when only a low-speed winding is connected without the output range being switched in the output range switching motor.
(*6) Change parameters manually according to the table after load parameters automatically with the model code.

JR AUTOMATION TECHNOLOGIES INC* SDOWLING

Motor model	αi I 8/12000	αi I 8/12000(*4)	αi I 12/12000	αi I 12/12000(*4)	αi I 15/12000	αi I 15/12000(*4)
Applicable amplifier	αi SP 15	αi SP 15	αi SP 15	αi SP 15	αi SP 22	αi SP 22
Model code	423	–	424	–	425	-
Applicable softw are series and edition	9D8A/I 9DAA/A	–	9D8A/I 9DAA/A	–	9D8A/I 9DAA/A	–
Low -speed w inding characteristics	7.5/11/15 kW 1500/12000min^{-1}	7.5/11/15 kW 1500/12000min^{-1}	11/15/18.5 kW 1500/12000min^{-1}	11/15/18.5 kW 1500/12000min^{-1}	15/18.5/25 kW 1500/12000min^{-1}	15/18.5/25 kW 1500/12000min^{-1}
High-speed w inding characteristics	7.5/11/15 kW 4000/12000min^{-1}	–	11/15/18.5 kW 4000/12000min^{-1}	–	15/18.5/25 kW 4000/12000min^{-1}	–
FS30*i* FS0*i*						
4007	00000000	00000000	00000000	00000000	00000000	00000000
4008	00010000	00010000	00010000	00010000	00010000	00010000
4009	00000000	00000000	00000000	00000000	00000000	00000000
4010	00000001	00000001	00000000	00000000	00000001	00000001
4011	00001010	00001010	00001010	00001010	00001010	00001010
4012	10000010	10000010	10000010	10000010	10000010	10000010
4013	00001100	00001100	00001100	00001100	00001100	00001100
4019	00000100	00000100	00000100	00000100	00000100	00000100
4020	12000	12000	12000	12000	12000	12000
4023	333 (*2)		333 (*2)		333 (*2)	
4039	0	0	0	0	0	0
4040					17 (*3)	7 (*3)
4041					7 (*3)	
4048					81 (*3)	32 (*3)
4049					32 (*3)	
4080	15186	15693	75	16735	15445	17498
4083	30	30	30	30	30	30
4093	240	0	202	0	200	0
4100	3580	1505	3800	1550	4200	1500
4101	71	74	80	100	85	100
4102	3580	1642	3593	1922	3482	1710
4103	0	0	0	0	0	0
4104	4000	8000	1800	3000	1700	5500
4105	97	88	341	324	347	314
4106	14000	24000	6000	10000	5500	5500
4107	88	0	324	0	314	0
4108	0	0	0	0	0	0
4109	25	25	25	25	25	25
4110	421	566	595	905	575	794
4111	157	229	223	337	212	305
4112	200	200	200	200	200	200
4113	980	1090	280	295	275	304
4114	22528	21760	0	0	23040	23040
4115	100	100	100	100	100	100
4116	11031	8000	5280	5279	5126	5177
4117	90	90	90	90	29530	90
4118	100	100	100	100	100	100
4119	522	521	34	32	35	31
4120	0	0	0	0	0	0
4124	24487	24544	24539	24575	24530	24575
4127	240	240	202	202	200	200
4128	0	0	0	0	0	105
4129	0	0	0	0	0	0
4130	25700	25700	25700	25700	25700	25700
4134	130	130	130	130	130	130
4136	30	0	30	0	30	0
4138	1505	0	1550	0	1500	0
4139	74	0	100	0	100	0
4140	1642	0	1922	0	1710	0
4141	0	0	0	0	0	0
4142	8000	0	3000	0	5500	0
4143	24000	0	10000	0	5500	0
4144	0	0	0	0	0	0
4145	25	0	25	0	25	0
4146	566	0	905	0	794	0
4147	229	0	337	0	305	0
4148	200	0	200	0	200	0
4149	1090	0	295	0	304	0
4150	21760	0	0	0	23040	0
4151	100	0	100	0	100	0
4152	8000	0	5279	0	5177	0
4153	90	0	90	0	90	0
4154	100	0	100	0	100	0
4155	24544	0	24575	0	24575	0
4156	0	0	0	0	0	0
4158	0	0	0	0	105	0
4159	0	0	0	0	0	0
4161	25700	0	25700	0	25700	0
4165	521	0	32	0	31	0
4166	15693	0	16735	0	17498	0
4169	0	0	0	0	0	0
4362	0	0	-24076	0	-24326	0
4363	0	0	-24076	0	-26124	0
4364	0	0	-32168	0	-32168	0
4365	0	0	0	0	0	0
4366	0	0	0	0	0	0
4367	0	0	0	0	0	0
4400		0	0	0	0	0
4612	76	0	101	0	109	0
4613	12288	0	10379	0	10376	0
4614	79	0	127	0	128	0
4615	19201	0	16518	0	16531	0
Maximum output during acceleration (for PS selection)	18kW	18kW	22.2kW	22.2kW	30kW	30kW

(*2)When using the SDT signal, manually change the parameters that were automatically set.
(*3) Set this value as the initial value of the velocity loop gain for low-speed characteristics of speed range switching.
(*4) This setting is used when only a low-speed winding is connected without the output range being switched in the output range switching motor.

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Motor model	αi I 18/12000	αi I 18/12000(*4)	αi I 22/12000	αi I 22/12000(*4)	αi I 30/7000	αi I 40/7000
Applicable amplifier	αi SP 22	αi SP 22	αi SP 26	αi SP 26	αi SP 37	αi SP 45
Model code	426	–	427	–	374	375
Applicable softw are series and edition	9D8A/I 9DAA/A	–	9D8A/I 9DAA/A	–	9D8A/I 9DAA/A	9D8A/I 9DAA/A
Low -speed w inding characteristics	18.5/22/30 kW 1500/12000min^{-1}	18.5/22/30 kW 1500/12000min^{-1}	22/26/35 kW 1500/12000min^{-1}	22/26/35 kW 1500/12000min^{-1}	–	–
High-speed w inding characteristics	18.5/22/30 kW 4000/12000min^{-1}	–	22/26/35 kW 4000/12000min^{-1}	–	30/37/45 kW 1150/7000min^{-1}	37/45/55 kW 1150/7000min^{-1}
FS30*i* FS0*i*						
4007	00000000	00000000	00000000	00000000	00000000	00000000
4008	00010000	00010000	00010000	00010000	00010000	00010000
4009	00000000	00000000	00000000	00000000	00000000	00000000
4010	00000001	00000001	00000000	00000000	00010000	00010000
4011	00001010	00001010	00001010	00001010	00001010	00001010
4012	10000111	10000111	10000111	10000111	10000000	10000000
4013	00001100	00001100	00001100	00001100	00001100	00001100
4019	00000100	00000100	00000100	00000100	00000100	00000100
4020	12000	12000	12000	12000	7000	7000
4023	333 (*2)		333 (*2)			
4039	0	0	0	0	0	0
4040	18 (*3)	7(*3)				
4041	7 (*3)					
4048	86 (*3)	32 (*3)				
4049	32 (*3)					
4080	15439	15714	80	16735	16734	16208
4083	30	30	30	30	30	30
4093	195	0	191	0		
4100	4050	1700	4000	1520	1260	1230
4101	98	100	78	94	100	100
4102	4582	1909	3504	1709	1886	1611
4103	0	0	0	0	0	0
4104	900	1600	1400	2200	2500	3000
4105	299	310	360	318	516	461
4106	2200	5000	1400	4600	4000	4000
4107	310	0	318	0	0	0
4108	0	0	0	0	0	0
4109	25	25	25	25	25	25
4110	754	943	604	823	1341	771
4111	330	418	218	312	524	312
4112	200	200	200	200	200	200
4113	319	308	265	300	185	207
4114	0	0	0	19200	0	0
4115	100	100	100	100	100	100
4116	4100	4500	5523	5593	4526	4614
4117	90	90	90	90	90	90
4118	100	100	100	100	100	100
4119	30	31	36	32	52	46
4120	0	0	0	0	0	0
4124	24575	24575	24535	24575	24575	24575
4127	195	195	191	191	180	178
4128	0	0	0	108	90	0
4129	0	0	0	0	0	0
4130	25700	25700	25700	25700	25700	25700
4134	130	130	130	130	130	130
4136	30	0	30	0	0	0
4138	1700	0	1520	0	0	0
4139	100	0	94	0	0	0
4140	1909	0	1709	0	0	0
4141	0	0	0	0	0	0
4142	1600	0	2200	0	0	0
4143	5000	0	4600	0	0	0
4144	0	0	0	0	0	0
4145	25	0	25	0	0	0
4146	943	0	823	0	0	0
4147	418	0	312	0	0	0
4148	200	0	200	0	0	0
4149	308	0	300	0	0	0
4150	0	0	19200	0	0	0
4151	100	0	100	0	0	0
4152	4500	0	5593	0	0	0
4153	90	0	90	0	0	0
4154	100	0	100	0	0	0
4155	24575	0	24575	0	0	0
4156	0	0	0	0	0	0
4158	0	0	108	0	0	0
4159	0	0	0	0	0	0
4161	25700	0	25700	0	0	0
4165	31	0	32	0	0	0
4166	15714	0	16735	0	0	0
4169	0	0	0	0	0	0
4362	0	0	0	0	-24476	-24516
4363	0	0	0	0	-28472	-28477
4364	0	0	0	0	-28372	31020
4365	-26324	0	0	0	0	0
4366	-24176	0	0	0	0	0
4367	-32168	0	0	0	0	0
4400	00010001(*6)	00000001(*6)	00010001(*6)	00000001(*6)	0	0
4612	129	0	105	0	142	8334
4613	10370	0	10241	0	12291	14087
4614	132	0	126	0	0	0
4615	16771	0	16385	0	0	0
Maximum output during acceleration (for PS selection)	36kW	36kW	42kW	42kW	54kW	66kW

(*2)When using the SDT signal, manually change the parameters that were automatically set.
(*3) Set this value as the initial value of the velocity loop gain for low-speed characteristics of speed range switching.
(*4) This setting is used when only a low-speed winding is connected without the output range being switched in the output range switching motor.
(*6) Change parameters manually according to the table after load parameters automatically with the model code.

JR AUTOMATION TECHNOLOGIES INC*
SUBDOWLING

C.3 SPINDLE MOTOR αiIP series

Motor model	αiIP 12/6000	αiIP 12/8000	αiIP 15/6000	αiIP 15/8000	αiIP 18/6000	αiIP 18/8000	αiIP 22/6000	αiIP 22/8000
Applicable amplifier	αiSP11	αiSP11	αiSP15	αiSP15	αiSP15	αiSP15	αiSP22	αiSP22
Model code	407	–	408	–	409	–	410	–
Applicable software series and edition	9D50/F	–	9D50/F	–	9D50/F	–	9D50/F	–
Low-speed winding characteristics	3.7/7.5kW 500/1500min^{-1}	3.7/7.5kW 500/1500min^{-1}	5/9kW 500/1500min^{-1}	5/9kW 500/1500min^{-1}	6/11kW 500/1500min^{-1}	6/11kW 500/1500min^{-1}	7.5/15kW 500/1500min^{-1}	7.5/15kW 500/1500min^{-1}
High-speed winding characteristics	5.5/7.5kW 750/6000min^{-1}	5.5/7.5kW 750/8000min^{-1}	7.5/9kW 750/6000min^{-1}	7.5/9kW 750/8000min^{-1}	9/11kW 750/6000min^{-1}	9/11kW 750/8000min^{-1}	11/15kW 750/6000min^{-1}	11/15kW 750/8000min^{-1}
FS30*i* FS0*i*								
4007	00000000	←	00000000	←	00000000	←	00000000	←
4008	00000000	←	00000000	←	00000000	←	00000000	←
4009	00000000	←	00000000	←	00000000	←	00000000	←
4010	00000000	←	00000000	←	00000000	←	00000000	←
4011	00011010	←	00011010	←	00011010	←	00011010	←
4012	10000010	←	10000010	←	10000010	←	10000010	←
4013	00001100	←	00001100	←	00001100	←	01010000	←
4019	00000100	←	00000100	←	00000100	←	00000100	←
4020	6000	8000	6000	8000	6000	8000	6000	8000
4023	125(*2)	94(*2)	125(*2)	94(*2)	125(*2)	94(*2)	125(*2)	94(*2)
4039	0	←	0	←	0	←	0	←
4040								
4041								
4048								
4049								
4080	11610	←	16730	←	75	←	18000	←
4083	30	←	30	←	30	←	30	←
4093	243	←	216	←	220	←	240	←
4100	750	←	750	←	740	←	800	←
4101	100	←	90	←	100	←	100	←
4102	1488	←	1431	←	1261	←	1342	←
4103	75	←	65	←	70	←	65	←
4104	4000	←	3800	←	5500	←	5500	←
4105	398	←	354	←	318	←	318	←
4106	10000	←	11000	←	17000	←	5500	←
4107	354		341		303		292	
4108	0	←	0	←	0	←	0	←
4109	25	←	25	←	25	←	25	←
4110	815	←	1043	←	754	←	914	←
4111	297	←	326	←	225	←	300	←
4112	200	←	200	←	200	←	200	←
4113	240	←	270	←	300	←	300	←
4114	23040	←	23040	←	0	←	23040	←
4115	100	←	100	←	100	←	100	←
4116	5307	←	5171	←	5671	←	6196	←
4117	90	←	90	←	90	←	90	←
4118	100	←	100	←	100	←	100	←
4119	40	←	35	←	32	←	301	←
4120	0	←	0	←	0	←	0	←
4124	24575	←	24575	←	24541	←	24575	←
4127	164	←	144	←	147	←	164	←
4128	105	←	105	←	105	←	110	←
4129	0	←	0	←	0	←	0	←
4130	25700	←	25700	←	25700	←	25700	←
4134	130	←	130	←	130	←	130	←
4136	30	←	30	←	30	←	30	←
4138	530	←	560	←	500	←	530	←
4139	90	←	100	←	90	←	100	←
4140	887	←	1143	←	755	←	930	←
4141	0	←	80	←	60	←	0	←
4142	6500	←	5000	←	8000	←	6500	←
4143	15000	←	13000	←	23000	←	15000	←
4144	0	←	0	←	0	←	0	←
4145	25	←	25	←	25	←	25	←
4146	1494	←	2514	←	1489	←	1886	←
4147	565	←	816	←	476	←	617	←
4148	200	←	200	←	200	←	200	←
4149	270	←	280	←	315	←	327	←
4150	23040	←	23040	←	0	←	20480	←
4151	100	←	100	←	100	←	100	←
4152	5268	←	5170	←	5660	←	4813	←
4153	90	←	90	←	90	←	90	←
4154	100	←	100	←	115	←	110	←
4155	24575	←	24575	←	24575	←	24575	←
4156	0	←	0	←	0	←	0	←
4158	110	←	105	←	0	←	90	←
4159	0	←	0	←	0	←	0	←
4161	25700	←	25700	←	25700	←	25700	←
4165	15	←	34	←	10	←	20	←
4166	70	←	70	←	77	←	75	←
4169	0	←	0	←	0	←	0	←
Maximum output during acceleration (for PS selection)	12.3kW	12.3kW	13.5kW	13.5kW	15.1kW	15.1kW	20.0kW	20.0kW
Motor model (old name)	α12/6000*i*P	α12/8000*i*P	α15/6000*i*P	α15/8000*i*P	α18/6000*i*P	α18/8000*i*P	α22/6000*i*P	α22/8000*i*P
Applicable amplifier (old name)	SPM-11*i*	SPM-11*i*	SPM-15*i*	SPM-15*i*	SPM-15*i*	SPM-15*i*	SPM-22*i*	SPM-22*i*

(*2)When using the SDT signal, manually change the parameters that were automatically set.

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Motor model	αiIP 30/6000	αiIP 40/6000	αiIP 50/6000	αiIP 60/4500	αiIP 60/5000
Applicable amplifier	αiSP22	αiSP26	αiSP26	αiSP30	αiSP30
Model code	411	412	413	414	—
Applicable software series and edition	9D50/E	9D50/F	9D50/E	9D50/F	—
Low-speed winding characteristics	11/18.5kW 400/1500min^{-1}	13/22kW 400/1500min^{-1}	22/30kW 575/1500min^{-1}	18.5/30kW 400/1500min^{-1}	18.5/30kW 400/1500min^{-1}
High-speed winding characteristics	15/18.5kW 575/6000min^{-1}	18.5/22kW 575/6000min^{-1}	22/30kW 1200/6000min^{-1}	22/30kW 750/4500min^{-1}	22/30kW 750/5000min^{-1}
FS30*i* FS0*i*					
4007	00000000	00000000	00000000	00000000	00000000
4008	00000000	00000000	00000000	00000000	00000000
4009	00000000	00000000	00000000	00000000	00000000
4010	00000000	00000000	00000000	00000000	00000000
4011	00011010	00011010	00011010	00011010	00011010
4012	10000010	10000000	10000010	10000000	10000000
4013	01010000	01010000	01010000	01010000	01010000
4019	00000100	00000100	00000100	00000100	00000100
4020	6000	6000	6000	4500	5000
4023	96(*2)	96(*2)	200(*2)	167(*2)	167(*2)
4039	0	0	0	0	0
4040					
4041					
4048					
4049					
4080	19280	65	75	75	75
4083	30	30	30	30	30
4093	202	203	164	195	195
4100	590	590	1107	750	750
4101	100	100	100	84	84
4102	889	835	1107	861	861
4103	85	80	0	80	80
4104	10000	3500	8000	5000	5000
4105	482	562	531	487	487
4106	10000	6500	8000	9000	9000
4107	579	477	490	490	490
4108	0	0	0	0	0
4109	25	25	25	25	25
4110	750	1052	686	1018	1018
4111	267	312	175	280	280
4112	150	200	200	200	200
4113	198	170	180	196	196
4114	21760	0	25600	0	0
4115	100	100	100	100	100
4116	6050	4500	6150	5050	5050
4117	90	90	90	90	90
4118	100	100	100	100	100
4119	48	56	53	49	49
4120	0	0	0	0	0
4124	24575	24575	24501	24575	24575
4127	148	143	164	164	164
4128	105	85	100	0	0
4129	0	0	0	0	0
4130	25700	25700	25700	25700	25700
4134	130	130	130	130	130
4136	30	30	30	30	30
4138	400	430	608	420	420
4139	100	100	100	85	85
4140	684	713	608	497	497
4141	0	56	0	0	0
4142	13000	5000	21000	8000	8000
4143	13000	7000	21000	12000	12000
4144	0	0	0	0	0
4145	25	25	25	25	25
4146	2011	2155	1131	1764	1764
4147	733	655	317	510	510
4148	200	200	200	200	200
4149	165	200	195	195	195
4150	0	0	23040	0	0
4151	100	100	100	100	100
4152	6008	5200	6191	5045	5045
4153	28250	90	90	90	90
4154	100	100	100	100	100
4155	24575	24575	24575	24575	24575
4156	0	0	0	0	0
4158	90	0	110	0	0
4159	0	0	0	0	0
4161	25700	25700	25700	25700	25700
4165	58	48	49	20	20
4166	50	17232	65	45	45
4169	0	0	0	0	0
Maximum output during acceleration (for PS selection)	25.0kW	29.0kW	35.4kW	36kW	36.0kW
Motor model (old name)	α30/6000*i*P	α40/6000*i*P	α50/6000*i*P	α60/4500*i*P	—
Applicable amplifier (old name)	SPM-22*i*	SPM-26*i*	SPM-26*i*	SPM-30*i*	—

(*2)When using the SDT signal, manually change the parameters that were automatically set.

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C.4 SPINDLE MOTOR αiIP series (Power up model)

Motor model	αi IP 18/6000	αi IP 18/6000(*4)	αi IP 22/6000	αi IP 22/6000(*4)	αi IP 50/6000	αi IP 50/6000(*4)
Applicable amplifier	αi SP15	αi SP15	αi SP22	αi SP22	αi SP26	αi SP26
Model code	429	–	430	–	431	–
Applicable softw are series and edition	9D8A/I 9DAA/A	–	9D8A/I 9DAA/A	–	9D8A/I 9DAA/A	–
Low -speed w inding characteristics	6/11kW 500/1500min-1	6/11kW 500/1500min-1	7.5/15kW 500/1500min-1	7.5/15kW 500/1500min-1	22/30/37kW 575/1500min-1	22/30/37kW 575/1500min-1
High-speed w inding characteristics	9/11/15kW 750/6000min-1	–	11/15/18.5kW 750/6000min-1	–	22/30/37kW 1200/6000min-1	–
FS30i FS0i						
4007	00000000	00000000	00000000	00000000	00000000	00000000
4008	00010000	00010000	00010000	00010000	00010000	00010000
4009	00000000	00000000	00000000	00000000	00000000	00000000
4010	00000000	00000000	00000000	00000000	00000001	00000001
4011	00001010	00001010	00001010	00001010	00001010	00001010
4012	10000111	10000111	10000111	10000111	10000111	10000111
4013	00001100	00001100	01010000	01010000	00001100	00001100
4019	00000100	00000100	00000100	00000100	00000100	00000100
4020	6000	6000	6000	6000	6000	6000
4023	125(*2)	125(*2)	125(*2)	125(*2)	200(*2)	200(*2)
4039	0	0	0	0	0	0
4040	7 (*3)	6 (*3)	7 (*3)	6 (*3)	13 (*3)	6 (*3)
4041	6 (*3)		6 (*3)		6 (*3)	
4048	32 (*3)	29 (*3)	32 (*3)	26 (*3)	59 (*3)	28 (*3)
4049	29 (*3)		26 (*3)		28 (*3)	
4080	25153	15425	21062	75	16738	95
4083	30	30	30	30	30	30
4093	300		240		202	
4100	1261	755	800	530	1230	630
4101	100	88	100	100	100	100
4102	1261	755	1342	930	1491	881
4103	0	0	0	0	0	0
4104	3200	8000	2500	6500	4000	6000
4105	318	303	318	292	464	438
4106	7000	23000	2500	15000	6500	10000
4107	303	0	292	0	438	0
4108	0	0	0	0	0	0
4109	25	25	25	25	25	25
4110	755	1489	914	1886	924	1508
4111	311	650	387	617	326	609
4112	200	200	200	200	200	200
4113	300	315	300	327	206	218
4114	0	0	23040	20480	0	0
4115	100	100	100	100	100	100
4116	5671	5660	6196	4813	6156	5000
4117	90	90	90	90	90	90
4118	90	115	100	110	100	100
4119	32	10	301	20	46	44
4120	0		0		0	
4124	24575	24575	24575	24575	24575	24575
4127	200	300	202	240	202	202
4128	0	0	0	90	0	85
4129	0	0	0	0	0	0
4130	25700	25700	25700	25700	25700	25700
4134	130	130	130	130	130	130
4136	30	0	30	0	30	0
4138	755	0	530	0	630	0
4139	88	0	100	0	100	0
4140	755	0	930	0	881	0
4141	0	0	0	0	0	0
4142	8000	0	6500	0	6000	0
4143	23000	0	15000	0	10000	0
4144	0	0	0	0	0	0
4145	25	0	25	0	25	0
4146	1489	0	1886	0	1508	0
4147	650	0	617	0	609	0
4148	200	0	200	0	200	0
4149	315	0	327	0	218	0
4150	0	0	20480	0	0	0
4151	100	0	100	0	100	0
4152	5660	0	4813	0	5000	0
4153	90	0	90	0	90	0
4154	115	0	110	0	100	0
4155	24575	0	24575	0	24575	0
4156	0	0	0	0	0	0
4158	0	0	90	0	85	0
4159	0	0	0	0	0	0
4161	25700	0	25700	0	25700	0
4165	10	0	20	0	44	0
4166	15425	0	75	0	95	0
4169	0	0	0	0	0	0
4362	0	0	0	0	-24516	0
4363	0	0	0	0	-28472	0
4364	0	0	0	0	-24276	0
4365	0	0	0	0	-26595	0
4366	0	0	0	0	28732	0
4367	0	0	0	0	26694	0
4400	00000001(*6)	0	00000001(*6)	0	00010001(*6)	00000001(*6)
4612	128	0	127	0	127	0
4613	-32768	0	32512	0	11011	0
4614	105	0	107	0	127	0
4615	12288	0	11776	0	10752	0
Maximum output during acceleration (for PS selection)	18kW	18kW	22.2kW	22.2kW	44.4kW	44.4kW

(*2)When using the SDT signal, manually change the parameters that were automatically set.
(*3) Set this value as the initial value of the velocity loop gain for low-speed characteristics of speed range switching.
(*4) This setting is used when only a low-speed winding is connected without the output range being switched in the output range switching motor.
(*6) Change parameters manually according to the table after load parameters automatically with the model code.

JR AUTOMATION TECHNOLOGIES INC*

C.5 SPINDLE MOTOR α*i*IT series

Motor model	α*i* IT 1.5/15000	α*i* IT 1.5/20000	α*i* IT 2/15000	α*i* IT 2/20000	α*i* IT 3/12000	α*i* IT 6/12000	α*i* IT 6/12000(*4)
Applicable amplifier	α*i* SP15	α*i* SP15	α*i* SP22	α*i* SP22	α*i* SP11	α*i* SP15	α*i* SP15
Model code	–	–	–	–	–	–	–
Applicable software series and edition	–	–	–	–	–	–	–
Low-speed winding characteristics	–	–	–	–	–	5.5/7.5kW 1500/12000min^{-1}	5.5/7.5kW 1500/12000min^{-1}
High-speed winding characteristics	1.5/2.2kW 3000/15000min^{-1}	1.5/2.2kW 3000/20000min^{-1}	2.2/3.7kW 3000/15000min^{-1}	2.2/3.7kW 3000/20000min^{-1}	3.7/5.5kW 1500/12000min^{-1}	5.5/7.5kW 4000/12000min^{-1}	–
FS30*i* FS0*i*							
4007	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4008	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4009	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4010	00000001	00000001	00000001	00000001	00000001	00000001	00000001
4011	00011001	00011001	00011001	00011001	00011001	00011010	00011010
4012	10000010	10000010	10000010	10000010	10000010	10000010	10000010
4013	00001100	00001100	01010000	01010000	00001100	00001100	00001100
4019	00000100	00000100	00000100	00000100	00000100	00000100	00000100
4020	15000	20000	15000	20000	12000	12000	12000
4023						333(*2)	
4039	0	0	0	0	0	0	0
4040							
4041						6(*3)	
4048							
4049						6(*3)	
4080	14165	14165	12122	19290	16720	81	58
4083	10	10	10	10	30	30	30
4093	0	0	0	0	0	164	0
4100	3250	3250	3200	3200	1500	4200	1500
4101	33	33	45	45	87	50	71
4102	7145	7145	6432	6432	3015	4561	2630
4103	75	75	92	92	82	70	70
4104	2300	2300	3000	3000	3200	3000	5500
4105	43	43	53	53	106	147	154
4106	8700	8700	3000	3000	7500	3000	5500
4107							
4108	0	0	0	0	0	0	0
4109	25	25	25	25	25	25	25
4110	629	629	588	588	559	646	1131
4111	180	180	175	175	190	185	353
4112	200	200	200	200	200	200	200
4113	2227	2227	1800	1800	900	650	620
4114	0	0	0	0	19200	20480	20480
4115	90	90	100	80	100	100	100
4116	10289	10289	16564	16564	7376	10783	8803
4117	90	90	90	90	90	90	90
4118	100	100	100	100	100	100	100
4119	5	5	2	2	9	15	527
4120	0	0	0	0	0	0	0
4124	24505	24505	24501	24501	24513	24509	24575
4127	176	176	202	202	178	164	164
4128	73	73	85	85	0	95	105
4129	0	0	0	0	0	0	0
4130	25700	25700	25700	25700	25700	25700	25700
4134	110	110	110	110	110	130	130
4136	0	0	0	0	0	30	0
4138	0	0	0	0	0	1500	0
4139	0	0	0	0	0	71	0
4140	0	0	0	0	0	2630	0
4141	0	0	0	0	0	70	0
4142	0	0	0	0	0	5500	0
4143	0	0	0	0	0	5500	0
4144	0	0	0	0	0	0	0
4145	0	0	0	0	0	25	0
4146	0	0	0	0	0	1131	0
4147	0	0	0	0	0	353	0
4148	0	0	0	0	0	200	0
4149	0	0	0	0	0	620	0
4150	0	0	0	0	0	20480	0
4151	0	0	0	0	0	100	0
4152	0	0	0	0	0	8803	0
4153	0	0	0	0	0	90	0
4154	0	0	0	0	0	100	0
4155	0	0	0	0	0	24575	0
4156	0	0	0	0	0	0	0
4158	0	0	0	0	0	105	0
4159	0	0	0	0	0	0	0
4161	0	0	0	0	0	25700	0
4165	0	0	0	0	0	527	0
4166	0	0	0	0	0	58	0
4169	0	0	0	0	0	0	0
Maximum output during acceleration (for PS selection)	13.0kW	13kW	20kW	20kW	13kW	13kW	13kW
Motor model (old name)	α1.5/15000*i*T	–	α2/15000*i*T	–	α3/12000*i*T	α6/12000*i*T	α6/12000*i*T
Applicable amplifier (old name)	SPM-15*i*	–	SPM-22*i*	–	SPM-11*i*	SPM-15*i*	SPM-15*i*

(*2)When using the SDT signal, manually change the parameters that were automatically set.
(*3) Set this value as the initial value of the velocity loop gain for low-speed characteristics of speed range switching.
(*4) This setting is used when only a low-speed winding is connected without the output range being switched in the output range switching motor.

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Motor model	αi IT 8/12000	αi IT 8/12000(*4)	αi IT 8/15000	αi IT 8/15000(*4)	αi IT 15/10000	αi IT 15/10000(*4)	αi IT 15/12000	αi IT 15/12000(*4)
Applicable amplifier	αi SP15	αi SP15	αi SP26	αi SP26	αi SP22	αi SP22	αi SP30	αi SP30
Model code	–	–	–	–	–	–	–	–
Applicable softw are series and edition	–	–	–	–	–	–	–	–
Low -speed w inding characteristics	7.5/11kW 1500/12000min-1	7.5/11kW 1500/12000min-1	7.5/11/15kW 1500/4000min-1	7.5/11/15kW 1500/4000min-1	15/18.5kW 1500/10000min-1	15/18.5kW 1500/10000min-1	15/18.5/22kW 1400/4000min-1	15/18.5/22kW 1400/4000min-1
High-speed w inding characteristics	7.5/11kW 4000/12000min-1	–	7.5/11/15kW 4000/15000min-1	–	15/18.5kW 4000/10000min-1	–	15/18.5/22kW 5000/12000min-1	–
FS30i FS0i								
4007	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4008	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4009	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4010	00000001	00000001	00000001	00000001	00000001	00000001	00000001	00000001
4011	00011010	00011010	00011010	00011010	00011010	00011010	00011010	00011010
4012	10000010	10000010	10000010	10000010	10000010	10000010	10000010	10000010
4013	00001100	00001100	01010000	01010000	01010000	01010000	01010000	01010000
4019	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100
4020	12000	12000	15000	4000	10000	10000	12000	4000
4023	333(*2)		267(*2)		400(*2)		292(*2)	
4039	0	0	0	0	0	0	0	0
4040								
4041	6(*3)		4(*3)					
4048								
4049	6(*3)		4(*3)					
4080	70	49	18774	95	80	20555	85	65
4083	30	30	30	30	30	30	30	30
4093	176	0	240	0	148	0	176	0
4100	3580	1500	4040	1570	4000	1500	4500	1450
4101	100	89	84	90	62	95	65	70
4102	3580	1642	5161	2592	3482	1710	5392	1783
4103	0	77	0	0	75	70	82	93
4104	2300	5000	2700	5000	1700	5500	3500	7000
4105	97	88	95	91	347	314	251	251
4106	2300	5000	9200	16000	5500	5500	3500	7000
4107	88		91		314		251	
4108	0	0	0	0	0	0	0	0
4109	25	25	25	25	25	25	25	25
4110	421	566	503	754	575	794	887	2155
4111	100	162	105	192	193	243	255	650
4112	200	200	200	200	200	200	200	200
4113	980	1090	1000	1050	275	304	380	380
4114	0	19200	28160	0	23040	23040	0	0
4115	100	100	100	100	100	100	100	100
4116	11031	8000	10984	11083	5126	5177	9314	2000
4117	90	90	90	90	90	90	90	90
4118	100	100	90	100	90	100	90	90
4119	522	521	10	15	35	31	25	25
4120	0	0	0	0	0	0	0	0
4124	24447	24491	24450	24514	24515	24556	24566	24575
4127	176	176	240	240	148	148	176	176
4128	0	0	0	110	0	105	0	0
4129	0	0	0	0	0	0	0	0
4130	25700	25700	25700	25700	25700	25700	25700	25700
4134	130	130	130	130	130	130	130	130
4136	30	0	30	0	30	0	30	0
4138	1500	0	1570	0	1500	0	1450	0
4139	89	0	90	0	95	0	70	0
4140	1642	0	2592	0	1710	0	1783	0
4141	77	0	0	0	70	0	93	0
4142	5000	0	5000	0	5500	0	7000	0
4143	5000	0	16000	0	5500	0	7000	0
4144	0	0	0	0	0	0	0	0
4145	25	0	25	0	25	0	25	0
4146	566	0	754	0	794	0	2155	0
4147	162	0	192	0	243	0	650	0
4148	200	0	200	0	200	0	200	0
4149	1090	0	1050	0	304	0	380	0
4150	19200	0	0	0	23040	0	0	0
4151	100	0	100	0	100	0	100	0
4152	8000	0	11083	0	5177	0	2000	0
4153	90	0	90	0	90	0	90	0
4154	100	0	100	0	100	0	90	0
4155	24491	0	24514	0	24556	0	24575	0
4156	0	0	0	0	0	0	0	0
4158	0	0	110	0	105	0	0	0
4159	0	0	0	0	0	0	0	0
4161	25700	0	25700	0	25700	0	25700	0
4165	521	0	15	0	31	0	25	0
4166	49	0	95	0	20555	0	65	0
4169	0	0	0	0	0	0	0	0
Maximum output during acceleration (for PS selection)	13.2kW	13.2kW	28kW	28kW	22.2kW	22.2kW	38kW	38kW
Motor model (old name)	α8/12000iT	α8/12000iT	α8/15000iT	α8/15000iT	α15/10000iT	α15/10000iT	α15/12000iT	α15/12000iT
Applicable amplifier (old name)	SPM-15i	SPM-15i	SPM-26i	SPM-26i	SPM-22i	SPM-22i	SPM-30i	SPM-30i

(*2)When using the SDT signal, manually change the parameters that were automatically set.
(*3) Set this value as the initial value of the velocity loop gain for low-speed characteristics of speed range switching.
(*4) This setting is used when only a low-speed winding is connected without the output range being switched in the output range switching motor.

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Motor model	αi IT 15/15000	αi IT 22/10000	αi IT 22/10000(*4)
Applicable amplifier	αi SP30	αi SP26	αi SP26
Model code	–	–	–
Applicable softw are series and edition	–	–	–
Low -speed w inding characteristics	15/18.5/22kW 1400/4000min-1	22/26kW 1500/10000min-1	22/26kW 1500/10000min-1
High-speed w inding characteristics	15/18.5/22kW 5000/15000min-1	22/26kW 4000/10000min-1	–
FS30*i* FS0*i*			
4007	00000000	00000000	00000000
4008	00000000	00000000	00000000
4009	00000000	00000000	00000000
4010	00000001	00000001	00000001
4011	00011010	00011010	00011010
4012	10000010	10000010	10000010
4013	01010000	01010000	01010000
4019	00000100	00000100	00000100
4020	15000	10000	10000
4023	233(*2)	400(*2)	
4039	0	0	0
4040			
4041	4(*3)		
4048			
4049	4(*3)		
4080	10583	75	56
4083	30	30	30
4093	176	142	0
4100	4500	4000	1440
4101	65	83	96
4102	5392	3504	1709
4103	82	0	96
4104	3500	2800	5000
4105	251	360	318
4106	3500	2800	5000
4107	251	318	
4108	0	0	0
4109	25	25	25
4110	887	603	823
4111	255	143	213
4112	200	200	200
4113	380	265	300
4114	0	24320	19200
4115	100	100	100
4116	9314	5523	5593
4117	90	90	90
4118	90	100	100
4119	25	36	341
4120	0	0	0
4124	24566	24477	24531
4127	176	142	142
4128	0	0	0
4129	0	0	0
4130	25700	25700	25700
4134	130	130	130
4136	30	30	0
4138	1450	1440	0
4139	70	96	0
4140	1783	1709	0
4141	93	96	0
4142	7000	5000	0
4143	7000	5000	0
4144	0	0	0
4145	25	25	0
4146	2155	823	0
4147	650	213	0
4148	200	200	0
4149	380	300	0
4150	0	19200	0
4151	100	100	0
4152	2000	5593	0
4153	90	90	0
4154	90	100	0
4155	24575	24531	0
4156	0	0	0
4158	0	0	0
4159	0	0	0
4161	25700	25700	0
4165	25	341	0
4166	65	56	0
4169	0	0	0
Maximum output during acceleration (for PS selection)	38kW	31.2kW	31.2kW
Motor model (old name)	α15/15000*i* T	α22/10000*i* T	α22/10000*i* T
Applicable amplifier (old name)	SPM-30*i*	SPM-26*i*	SPM-26*i*

(*2)When using the SDT signal, manually change the parameters that were automatically set.
(*3) Set this value as the initial value of the velocity loop gain for low-speed characteristics of speed range switching.
(*4) This setting is used when only a low-speed winding is connected without the output range being switched in the output range switching motor.

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C.6 SPINDLE MOTOR αiIT series (Power up model)

Motor model	αi IT 6/12000	αi IT 6/12000(*4)	αi IT 8/12000	αi IT 8/12000(*4)	αi IT 12/12000	αi IT 12/12000(*4)
Applicable amplifier	αi SP 11	αi SP 11	αi SP 15	αi SP 15	αi SP 15	αi SP 15
Model code	–	–	–	–	–	–
Applicable softw are series and edition	–	–	–	–	–	–
Low -speed w inding characteristics	5.5/7.5/11 kW 1500/12000 min-1	5.5/7.5/11 kW 1500/12000 min-1	7.5/11/15 kW 1500/12000 min-1	7.5/11/15 kW 1500/12000 min-1	11/15/18.5 kW 1500/12000min-1	11/15/18.5 kW 1500/12000min-1
High-speed w inding characteristics	5.5/7.5/11 kW 4000/12000 min-1	–	7.5/11/15 kW 4000/12000 min-1	–	11/15/18.5 kW 4000/12000min-1	–
FS30i FS0i						
4007	00000000	00000000	00000000	00000000	00000000	00000000
4008	00010000	00010000	00010000	00010000	00010000	00010000
4009	00000000	00000000	00000000	00000000	00000000	00000000
4010	00000001	00000001	00000001	00000001	00000000	00000000
4011	00001010	00001010	00001010	00001010	00001010	00001010
4012	10000111	10000111	10000010	10000010	10000010	10000010
4013	00001100	00001100	00001100	00001100	00001100	00001100
4019	00000100	00000100	00000100	00000100	00000100	00000100
4020	12000	12000	12000	12000	12000	12000
4023	333 (*2)		333 (*2)		333 (*2)	
4039	0	0	0	0	0	0
4040						
4041						
4048						
4049						
4080	75	12870	15186	15693	75	16735
4083	30	30	30	30	30	30
4093	240	0	240	0	202	0
4100	4400	1570	3580	1505	3800	1550
4101	100	100	71	74	80	100
4102	4838	2016	3580	1642	3593	1922
4103	0	0	0	0	0	0
4104	1200	3000	4000	8000	1800	3000
4105	119	138	97	88	341	324
4106	2500	6000	14000	24000	6000	10000
4107	138	0	88	0	324	0
4108	0	0	0	0	0	0
4109	25	25	25	25	25	25
4110	479	905	421	566	595	905
4111	198	261	157	229	223	337
4112	200	200	200	200	200	200
4113	800	690	980	1090	280	295
4114	17920	0	22528	21760	0	0
4115	100	100	100	100	100	100
4116	6500	6500	11031	8000	5280	5279
4117	90	90	90	90	90	90
4118	100	100	100	100	100	100
4119	15	527	522	521	34	32
4120	0	0	0	0	0	0
4124	24519	24571	24487	24544	24539	24575
4127	240	240	240	240	202	202
4128	105	6505	0	0	0	0
4129	0	0	0	0	0	0
4130	25700	25700	25700	25700	25700	25700
4134	130	130	130	130	130	130
4136	30	0	30	0	30	0
4138	1570	0	1505	0	1550	0
4139	100	0	74	0	100	0
4140	2016	0	1642	0	1922	0
4141	0	0	0	0	0	0
4142	3000	0	8000	0	3000	0
4143	6000	0	24000	0	10000	0
4144	0	0	0	0	0	0
4145	25	0	25	0	25	0
4146	905	0	566	0	905	0
4147	261	0	229	0	337	0
4148	200	0	200	0	200	0
4149	690	0	1090	0	295	0
4150	0	0	21760	0	0	0
4151	100	0	100	0	100	0
4152	6500	0	8000	0	5279	0
4153	90	0	90	0	90	0
4154	100	0	100	0	100	0
4155	24571	0	24544	0	24575	0
4156	0	0	0	0	0	0
4158	6505	0	0	0	0	0
4159	0	0	0	0	0	0
4161	25700	0	25700	0	25700	0
4165	527	0	521	0	32	0
4166	12870	0	15693	0	16735	0
4169	0	0	0	0	0	0
4362	0	0	0	0	0	0
4363	0	0	0	0	0	0
4364	0	0	0	0	0	0
4365	0	0	0	0	0	0
4366	0	0	0	0	0	0
4367	0	0	0	0	0	0
4400	00010001(*6)	00000001(*6)	0	0	0	0
4612	0	0	0	0	0	0
4613	0	0	0	0	0	0
4614	0	0	0	0	0	0
4615	0	0	0	0	0	0
Maximum output during acceleration (for PS selection)	13.2kW	13.2kW	18kW	18kW	22.2kW	22.2kW

(*2)When using the SDT signal, manually change the parameters that were automatically set.
(*4) This setting is used when only a low-speed winding is connected without the output range being switched in the output range switching motor.
(*6) Change parameters manually according to the table after load parameters automatically with the model code.

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Motor model	αi IT 15/10000	αi IT 15/10000(*4)	αi IT 22/10000	αi IT 22/10000(*4)
Applicable amplifier	αi SP 22	αi SP 22	αi SP 26	αi SP 26
Model code	–	–	–	–
Applicable softw are series and edition	–	–	–	–
Low -speed w inding characteristics	15/18.5/25 kW 1500/10000 min^{-1}	15/18.5/25 kW 1500/10000 min^{-1}	22/26/35 kW 1500/10000 min^{-1}	22/26/35 kW 1500/10000 min^{-1}
High-speed w inding characteristics	15/18.5/25 kW 4000/10000 min^{-1}	–	22/26/35 kW 4000/10000 min^{-1}	–
FS30*i* FS0*i*				
4007	00000000	00000000	00000000	00000000
4008	00010000	00010000	00010000	00010000
4009	00000000	00000000	00000000	00000000
4010	00000001	00000001	00000001	00000001
4011	00001010	00001010	00001010	00001010
4012	10000010	10000010	10000111	10000111
4013	00001100	00001100	00001100	00001100
4019	00000100	00000100	00000100	00000100
4020	10000	10000	10000	10000
4023	400 (*2)		400 (*2)	
4039	0	0	0	0
4040	17 (*3)	7 (*3)	19 (*3)	7 (*3)
4041	7 (*3)		7 (*3)	
4048	81 (*3)	32 (*3)	90 (*3)	34 (*3)
4049	32 (*3)		34 (*3)	
4080	15445	19290	80	16735
4083	30	30	30	30
4093	200	0	191	0
4100	4200	1500	4000	1520
4101	85	100	78	94
4102	3482	1710	3504	1709
4103	0	0	0	0
4104	1700	5500	1400	2200
4105	347	314	360	318
4106	5500	5500	1400	4600
4107	314	0	318	0
4108	0	0	0	0
4109	25	25	25	25
4110	575	794	604	823
4111	212	305	218	312
4112	200	200	200	200
4113	275	304	265	300
4114	23040	23040	0	19200
4115	100	100	100	100
4116	5126	5177	5523	5593
4117	29530	90	90	90
4118	100	100	100	100
4119	35	31	36	32
4120	0	0	0	0
4124	24530	24575	24535	24575
4127	200	200	191	191
4128	0	105	0	108
4129	0	0	0	0
4130	25700	25700	25700	25700
4134	130	130	130	130
4136	30	0	30	0
4138	1500	0	1520	0
4139	100	0	94	0
4140	1710	0	1709	0
4141	0	0	0	0
4142	5500	0	2200	0
4143	5500	0	4600	0
4144	0	0	0	0
4145	25	0	25	0
4146	794	0	823	0
4147	305	0	312	0
4148	200	0	200	0
4149	304	0	300	0
4150	23040	0	19200	0
4151	100	0	100	0
4152	5177	0	5593	0
4153	90	0	90	0
4154	100	0	100	0
4155	24575	0	24575	0
4156	0	0	0	0
4158	105	0	108	0
4159	0	0	0	0
4161	25700	0	25700	0
4165	31	0	32	0
4166	19290	0	16735	0
4169	0	0	0	0
4362	0	0	0	0
4363	0	0	0	0
4364	0	0	0	0
4365	0	0	0	0
4366	0	0	0	0
4367	0	0	0	0
4400	0	0	00010001 (*6)	00000001(*6)
4612	0	0	0	0
4613	0	0	0	0
4614	0	0	0	0
4615	0	0	0	0
Maximum output during acceleration (for PS selection)	30kW	30kW	42kW	42kW

(*2)When using the SDT signal, manually change the parameters that were automatically set.
(*3) Set this value as the initial value of the velocity loop gain for low-speed characteristics of speed range switching.
(*4) This setting is used when only a low-speed winding is connected without the output range being switched in the output range switching motor
(*6) Change parameters manually according to the table after load parameters automatically with the model code.

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C.7 SPINDLE MOTOR αiIL series

Motor model	αiIL 8/20000	αiIL 15/15000	αiIL 26/15000
Applicable amplifier	αi SP30	αi SP30	αi SP30
Model code	–	–	–
Applicable software series and edition	–	–	–
Low-speed winding characteristics	11/15kW 1150/4000min-1	18.5/22kW 1400/4000min-1	15/22kW 600/2000min-1
High-speed winding characteristics	15/18.5kW 5000/20000min-1	18.5/22kW 6000/15000min-1	26/30kW 2500/15000min-1
FS30i FS0i			
4007	00000000	00000000	00000000
4008	00000000	00000000	00000000
4009	00000000	00000000	00000000
4010	00000001	00000001	00000001
4011	00011001	00011001	00011001
4012	10000010	10000010	10000010
4013	01010000	01010000	01010000
4019	00000100	00000100	00000100
4020	20000	15000	15000
4023	200(*2)	267(*2)	120(*2)
4039	0	0	0
4040			
4041	3(*3)	4(*3)	5(*3)
4048			
4049	3(*3)	4(*3)	5(*3)
4080	11856	12115	12875
4083	20	30	30
4093	164	143	176
4100	5070	6000	2470
4101	69	52	70
4102	6960	6153	2580
4103	0	89	97
4104	2100	1800	2100
4105	95	318	298
4106	3900	2800	4600
4107	83	318	227
4108	0	0	0
4109	25	25	25
4110	805	1207	1207
4111	217	343	344
4112	200	200	200
4113	1005	300	320
4114	0	0	0
4115	100	100	100
4116	9613	7537	4716
4117	90	90	90
4118	100	90	100
4119	778	32	286
4120	0	0	0
4124	24535	24575	24575
4127	148	143	138
4128	0	0	0
4129	0	0	0
4130	25700	25700	25700
4134	130	130	130
4136	30	30	30
4138	1350	1470	700
4139	75	79	67
4140	2605	2573	873
4141	0	0	0
4142	5600	4000	7000
4143	7000	6000	12000
4144	0	0	0
4145	25	25	25
4146	1724	2011	2321
4147	504	585	685
4148	200	200	200
4149	1145	300	420
4150	0	0	19200
4151	100	100	100
4152	10911	7536	4711
4153	90	90	90
4154	110	100	120
4155	24575	24575	24575
4156	0	0	0
4158	110	107	105
4159	0	0	0
4161	25700	25700	25700
4165	8	32	23
4166	12893	75	60
4169	0	0	0
Maximum output during acceleration (for PS selection)	41kW	41kW	43kW
Motor model (old name)	α8/20000iL	α15/15000iL	α26/15000iL
Applicable amplifier (old name)	SPM-30i	SPM-30i	SPM-30i

(*2)When using the SDT signal, manually change the parameters that were automatically set.
(*3) Set this value as the initial value of the velocity loop gain for low-speed characteristics of speed range switching.

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C.8 SPINDLE MOTOR αiI series (driven by βiSVSP)

Motor model	αiI 0.5/10000	αiI 0.5/10000	αiI 0.5/10000	αiI 0.5/10000	αiI 1/10000	αiI 1/10000	αiI 1/10000	αiI 1/10000
Applicable amplifier	βiSVSPx-7.5	βiSVSPx-11	βiSVSPx-15	βiSVSPx-18	βiSVSPx-7.5	βiSVSPx-11	βiSVSPx-15	βiSVSPx-18
Model code	(301)	(301)	(301)	(301)	(302)	(302)	(302)	(302)
Applicable software series and edition	9D80/A	9D80/A	9D80/A	9D80/A	9D80/A	9D80/A	9D80/A	9D80/A
Low-speed winding characteristics	–	–	–	–	–	–	–	–
High-speed winding characteristics	0.55/1.1kW 3000/10000min^{-1}	0.55/1.1kW 3000/10000min^{-1}	0.55/1.1kW 3000/10000min^{-1}	0.55/1.1kW 3000/10000min^{-1}	1.5/2.2kW 3000/10000min^{-1}	1.5/2.2kW 3000/10000min^{-1}	1.5/2.2kW 3000/10000min^{-1}	1.5/2.2kW 3000/10000min^{-1}
FS30*i* FS0*i*								
4007	00000000	←	←	←	00000000	←	←	←
4008	00000000	←	←	←	00000000	←	←	←
4009	00000000	←	←	←	00000000	←	←	←
4010	00000000	←	←	←	00000000	←	←	←
4011	00011000	←	←	←	00011001	←	←	←
4012	10000010	←	←	←	10000010	←	←	←
4013	00001100	←	←	←	00001100	←	←	←
4019	00000100	←	←	←	00000100	←	←	←
4020	10000	←	←	←	10000	←	←	←
4023								
4039	0	←	←	←	0	←	←	←
4040								
4041								
4048								
4049								
4080	90	←	←	←	83 80(*1)	←	←	←
4083	30	←	←	←	30	←	←	←
4093	0	←	←	←	0	←	←	←
4100	3400	←	←	←	3100	←	←	←
4101	100	←	←	←	100	←	←	←
4102	6500	←	←	←	3557	←	←	←
4103	46 0(*1)	←	←	←	87 0(*1)	←	←	←
4104	3000	←	←	←	6000	←	←	←
4105	46	←	←	←	45	←	←	←
4106	7500	←	←	←	6000	←	←	←
4107	0	←	←	←	0	←	←	←
4108	0	←	←	←	0	←	←	←
4109	25	←	←	←	25	←	←	←
4110	2513 (*6)	3142 (*6)	4713 (*6)	6283 (*6)	1104 (*6)	1380 (*6)	2070 (*6)	2760 (*6)
4111	260	←	←	←	102	←	←	←
4112	200	←	←	←	200	←	←	←
4113	2077	←	←	←	2100	←	←	←
4114	23040	←	←	←	17920	←	←	←
4115	100	←	←	←	100	←	←	←
4116	13760	←	←	←	10018	←	←	←
4117	90	←	←	←	90	←	←	←
4118	100	←	←	←	100	←	←	←
4119	5	←	←	←	5	←	←	←
4120	0	←	←	←	0	←	←	←
4124	24570	←	←	←	24448	←	←	←
4127	240	←	←	←	176	←	←	←
4128	120	←	←	←	0	←	←	←
4129	0	←	←	←	0	←	←	←
4130	25700	←	←	←	25700	←	←	←
4134	110	←	←	←	110	←	←	←
4136	0	←	←	←	0	←	←	←
4138	0	←	←	←	0	←	←	←
4139	0	←	←	←	0	←	←	←
4140	0	←	←	←	0	←	←	←
4141	0	←	←	←	0	←	←	←
4142	0	←	←	←	0	←	←	←
4143	0	←	←	←	0	←	←	←
4144	0	←	←	←	0	←	←	←
4145	0	←	←	←	0	←	←	←
4146	0	←	←	←	0	←	←	←
4147	0	←	←	←	0	←	←	←
4148	0	←	←	←	0	←	←	←
4149	0	←	←	←	0	←	←	←
4150	0	←	←	←	0	←	←	←
4151	0	←	←	←	0	←	←	←
4152	0	←	←	←	0	←	←	←
4153	0	←	←	←	0	←	←	←
4154	0	←	←	←	0	←	←	←
4155	0	←	←	←	0	←	←	←
4156	0	←	←	←	0	←	←	←
4158	0	←	←	←	0	←	←	←
4159	0	←	←	←	0	←	←	←
4161	0	←	←	←	0	←	←	←
4165	0	←	←	←	0	←	←	←
4166	0	←	←	←	0	←	←	←
4169	0	←	←	←	0	←	←	←
4400								
Maximum output during acceleration (for PS selection)	1.32kW 2.60kW(*1)	1.32kW 2.60kW(*1)	1.32kW 2.60kW(*1)	1.32kW 2.60kW(*1)	2.64kW 2.87kW(*1)	2.64kW 2.87kW(*1)	2.64kW 2.87kW(*1)	2.64kW 2.87kW(*1)

(*1)This setting makes the maximum output during acceleration greater and the acceleration time reduced.
(*6) Change parameters manually according to the table after load parameters automatically with the model code.

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Motor model	αi I 1.5/10000	αi I 1.5/10000	αi I 1.5/10000	αi I 1.5/10000	αi I 2/10000	αi I 2/10000	αi I 2/10000	αi I 2/10000
Applicable amplifier	βi SVSPx-7.5	βi SVSPx-11	βi SVSPx-15	βi SVSPx-18	βi SVSPx-7.5	βi SVSPx-11	βi SVSPx-15	βi SVSPx-18
Model code	(304)	(304)	(304)	(304)	(306)	(306)	(306)	(306)
Applicable software series and edition	9D80/A	9D80/A	9D80/A	9D80/A	9D80/A	9D80/A	9D80/A	9D80/A
Low-speed winding characteristics	–	–	–	–	–	–	–	–
High-speed winding characteristics	1.1/3.7kW 1500/10000min^{-1}	1.1/3.7kW 1500/10000min^{-1}	1.1/3.7kW 1500/10000min^{-1}	1.1/3.7kW 1500/10000min^{-1}	2.2/3.7kW 1500/10000min^{-1}	2.2/3.7kW 1500/10000min^{-1}	2.2/3.7kW 1500/10000min^{-1}	2.2/3.7kW 1500/10000min^{-1}
FS30*i* FS0*i*								
4007	00000000	←	←	←	00000000	←	←	←
4008	00000000	←	←	←	00000000	←	←	←
4009	00000000	←	←	←	00000000	←	←	←
4010	00000000	←	←	←	00000000	←	←	←
4011	00011001	←	←	←	00011001	←	←	←
4012	10000010	←	←	←	10000010	←	←	←
4013	00001100	←	←	←	00001100	←	←	←
4019	00000100	←	←	←	00000100	←	←	←
4020	10000	←	←	←	10000	←	←	←
4023								
4039	0	←	←	←	0	←	←	←
4040								
4041								
4048								
4049								
4080	85 65(*1)	←	←	←	77 70(*1)	←	←	←
4083	30	←	←	←	30	←	←	←
4093	0	←	←	←	0	←	←	←
4100	1650	←	←	←	1550	←	←	←
4101	100	←	←	←	100	←	←	←
4102	2767	←	←	←	2567	←	←	←
4103	60 0(*1)	←	←	←	68 0(*1)	←	←	←
4104	6000	←	←	←	6000	←	←	←
4105	58	←	←	←	80	←	←	←
4106	6000	←	←	←	6000	←	←	←
4107	0	←	←	←	0	←	←	←
4108	0	←	←	←	0	←	←	←
4109	25	←	←	←	25	←	←	←
4110	900 (*6)	1126 (*6)	1689 (*6)	2250 (*6)	758 (*6)	948 (*6)	1422 (*6)	1895 (*6)
4111	217	←	←	←	175	←	←	←
4112	200	←	←	←	200	←	←	←
4113	1635	←	←	←	1192	←	←	←
4114	0	←	←	←	0	←	←	←
4115	100	←	←	←	100	←	←	←
4116	9598	←	←	←	9300	←	←	←
4117	90	←	←	←	90	←	←	←
4118	100	←	←	←	100	←	←	←
4119	5	←	←	←	8	←	←	←
4120	0	←	←	←	0	←	←	←
4124	24535	←	←	←	24501	←	←	←
4127	404	←	←	←	202	←	←	←
4128	115	←	←	←	90	←	←	←
4129	0	←	←	←	0	←	←	←
4130	25700	←	←	←	25700	←	←	←
4134	110	←	←	←	110	←	←	←
4136	0	←	←	←	0	←	←	←
4138	0	←	←	←	0	←	←	←
4139	0	←	←	←	0	←	←	←
4140	0	←	←	←	0	←	←	←
4141	0	←	←	←	0	←	←	←
4142	0	←	←	←	0	←	←	←
4143	0	←	←	←	0	←	←	←
4144	0	←	←	←	0	←	←	←
4145	0	←	←	←	0	←	←	←
4146	0	←	←	←	0	←	←	←
4147	0	←	←	←	0	←	←	←
4148	0	←	←	←	0	←	←	←
4149	0	←	←	←	0	←	←	←
4150	0	←	←	←	0	←	←	←
4151	0	←	←	←	0	←	←	←
4152	0	←	←	←	0	←	←	←
4153	0	←	←	←	0	←	←	←
4154	0	←	←	←	0	←	←	←
4155	0	←	←	←	0	←	←	←
4156	0	←	←	←	0	←	←	←
4158	0	←	←	←	0	←	←	←
4159	0	←	←	←	0	←	←	←
4161	0	←	←	←	0	←	←	←
4165	0	←	←	←	0	←	←	←
4166	0	←	←	←	0	←	←	←
4169	0	←	←	←	0	←	←	←
4400								
Maximum output during acceleration (for PS selection)	4.44kW 6.7kW(*1)	4.44kW 6.7kW(*1)	4.44kW 6.7kW(*1)	4.44kW 6.7kW(*1)	4.44kW 6.4kW(*1)	4.44kW 6.4kW(*1)	4.44kW 6.4kW(*1)	4.44kW 6.4kW(*1)

(*1)This setting makes the maximum output during acceleration greater and the acceleration time reduced.
(*6) Change parameters manually according to the table after load parameters automatically with the model code.

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Motor model	αi I 3/10000	αi I 3/10000	αi I 3/10000	αi I 3/10000	αi I 6/10000	αi I 6/10000	αi I 6/10000
Applicable amplifier	βi SVSPx-7.5	βi SVSPx-11	βi SVSPx-15	βi SVSPx-18	βi SVSPx-11	βi SVSPx-15	βi SVSPx-18
Model code	(308)	(308)	(308)	(308)	363	(363)	(363)
Applicable software series and edition	9D80/A	9D80/A	9D80/A	9D80/A	9D8A/D	9D8A/D	9D8A/D
Low-speed winding characteristics	–	–	–	–	–	–	–
High-speed winding characteristics	3.7/5.5kW 1500/10000min^{-1}	3.7/5.5kW 1500/10000min^{-1}	3.7/5.5kW 1500/10000min^{-1}	3.7/5.5kW 1500/10000min^{-1}	5.5/7.5/11kW 1500/10000min^{-1}	5.5/7.5/11kW 1500/10000min^{-1}	5.5/7.5/11kW 1500/10000min^{-1}
FS30*i* FS0*i*							
4007	00000000	←	←	←	00000000	←	←
4008	00000000	←	←	←	00010000	←	←
4009	00000000	←	←	←	00000000	←	←
4010	00000000	←	←	←	00000000	←	←
4011	00011001	←	←	←	00001010	←	←
4012	10000010	←	←	←	10000111	←	←
4013	00001100	←	←	←	00001100	←	←
4019	00000100	←	←	←	00000100	←	←
4020	10000	←	←	←	10000	←	←
4023							
4039	0	←	←	←	0	←	←
4040							
4041							
4048							
4049							
4080	60 65(*1)	←	←	←	16710	←	←
4083	30	←	←	←	30	←	←
4093	0	←	←	←	0	←	←
4100	1600	←	←	←	1570	←	←
4101	100	←	←	←	100	←	←
4102	1967	←	←	←	2016	←	←
4103	75 0(*1)	←	←	←	0	←	←
4104	7000	←	←	←	3000	←	←
4105	89	←	←	←	138	←	←
4106	7000	←	←	←	6000	←	←
4107	0	←	←	←	0	←	←
4108	0	←	←	←	0	←	←
4109	25	←	←	←	25	←	←
4110	760 (*6)	950 (*6)	1425 (*6)	1900 (*6)	603	905 (*6)	1206 (*6)
4111	200	←	←	←	261	←	←
4112	19400	←	←	←	200	←	←
4113	1077	←	←	←	690	←	←
4114	0	←	←	←	0	←	←
4115	100	←	←	←	100	←	←
4116	7950	←	←	←	6500	←	←
4117	28250	←	←	←	90	←	←
4118	110	←	←	←	100	←	←
4119	5	←	←	←	527	←	←
4120	0	←	←	←	0	←	←
4124	24521	←	←	←	24571	←	←
4127	178	←	←	←	240	←	←
4128	0	←	←	←	6505	←	←
4129	0	←	←	←	0	←	←
4130	25700	←	←	←	25700	←	←
4134	110	←	←	←	130	←	←
4136	0	←	←	←	0	←	←
4138	0	←	←	←	0	←	←
4139	0	←	←	←	0	←	←
4140	0	←	←	←	0	←	←
4141	0	←	←	←	0	←	←
4142	0	←	←	←	0	←	←
4143	0	←	←	←	0	←	←
4144	0	←	←	←	0	←	←
4145	0	←	←	←	0	←	←
4146	0	←	←	←	0	←	←
4147	0	←	←	←	0	←	←
4148	0	←	←	←	0	←	←
4149	0	←	←	←	0	←	←
4150	0	←	←	←	0	←	←
4151	0	←	←	←	0	←	←
4152	0	←	←	←	0	←	←
4153	0	←	←	←	0	←	←
4154	0	←	←	←	0	←	←
4155	0	←	←	←	0	←	←
4156	0	←	←	←	0	←	←
4158	0	←	←	←	0	←	←
4159	0	←	←	←	0	←	←
4161	0	←	←	←	0	←	←
4165	0	←	←	←	0	←	←
4166	0	←	←	←	0	←	←
4169	0	←	←	←	0	←	←
4400					00000001(*6)	←	←
Maximum output during acceleration (for PS selection)	6.6kW 7.9kW(*1)	6.6kW 7.9kW(*1)	6.6kW 7.9kW(*1)	6.6kW 7.9kW(*1)	13.2kW	13.2kW	13.2kW

(*1)This setting makes the maximum output during acceleration greater and the acceleration time reduced.
(*6) Change parameters manually according to the table after load parameters automatically with the model code.

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Motor model	αi I 8/8000	αi I 8/8000	αi I 12/7000	αi I 1/15000	αi I 1/15000	αi I 1/15000	αi I 1/15000
Applicable amplifier	βi SVSPx-15	βi SVSPx-18	βi SVSPx-18	βi SVSPx-7.5	βi SVSPx-11	βi SVSPx-15	βi SVSPx-18
Model code	364	(364)	369	(303)	(303)	(303)	(303)
Applicable software series and edition	9D8A/B	9D8A/B	9D8A/B	9D8A/B	9D8A/B	9D8A/B	9D8A/B
Low-speed winding characteristics	–	–	–	–	–	–	–
High-speed winding characteristics	7.5/11/15kW 1500/8000min^{-1}	7.5/11/15kW 1500/8000min^{-1}	11/15/18.5kW 1500/7000min^{-1}	1.5/2.2kW 3000/15000min^{-1}	1.5/2.2kW 3000/15000min^{-1}	1.5/2.2kW 3000/15000min^{-1}	1.5/2.2kW 3000/15000min^{-1}
FS30*i* FS0*i*							
4007	00000000	←	00000000	00000000	←	←	←
4008	00000000	←	00010000	00000000	←	←	←
4009	00010000	←	00000000	00000000	←	←	←
4010	00000000	←	00000000	00000001	←	←	←
4011	00001010	←	00001010	00011001	←	←	←
4012	10000010	←	10000010	10000010	←	←	←
4013	00001100	←	00001100	00001100	←	←	←
4019	00000100	←	00000100	00000100	←	←	←
4020	8000	←	7000	15000	←	←	←
4023							
4039	0	←	0	0	←	←	←
4040							
4041							
4048							
4049							
4080	20565	←	16735	85 80(*1)	←	←	←
4083	30	←	30	30	←	←	←
4093	0	←	0	0	←	←	←
4100	1600	←	1550	3100	←	←	←
4101	94	←	100	93	←	←	←
4102	1656	←	1922	8015	←	←	←
4103	0	←	0	70 0(*1)	←	←	←
4104	6000	←	3000	2000	←	←	←
4105	121	←	324	51	←	←	←
4106	20000	←	10000	7000	←	←	←
4107	0	←	0	0	←	←	←
4108	0	←	0	0	←	←	←
4109	25	←	25	25	←	←	←
4110	754	1006 (*6)	1207	548 (*6)	686 (*6)	1029 (*6)	1370 (*6)
4111	265	←	337	102	←	←	←
4112	200	←	200	200	←	←	←
4113	790	←	295	1870	←	←	←
4114	19200	←	0	0	←	←	←
4115	100	←	100	100	←	←	←
4116	8118	←	5279	9669	←	←	←
4117	90	←	90	90	←	←	←
4118	100	←	100	100	←	←	←
4119	12	←	32	5	←	←	←
4120	0	←	0	0	←	←	←
4124	24574	←	24575	24448	←	←	←
4127	240	←	202	176	←	←	←
4128	117	←	0	80	←	←	←
4129	0	←	0	0	←	←	←
4130	25700	←	25700	25700	←	←	←
4134	130	←	130	110	←	←	←
4136	0	←	0	0	←	←	←
4138	0	←	0	0	←	←	←
4139	0	←	0	0	←	←	←
4140	0	←	0	0	←	←	←
4141	0	←	0	0	←	←	←
4142	0	←	0	0	←	←	←
4143	0	←	0	0	←	←	←
4144	0	←	0	0	←	←	←
4145	0	←	0	0	←	←	←
4146	0	←	0	0	←	←	←
4147	0	←	0	0	←	←	←
4148	0	←	0	0	←	←	←
4149	0	←	0	0	←	←	←
4150	0	←	0	0	←	←	←
4151	0	←	0	0	←	←	←
4152	0	←	0	0	←	←	←
4153	0	←	0	0	←	←	←
4154	0	←	0	0	←	←	←
4155	0	←	0	0	←	←	←
4156	0	←	0	0	←	←	←
4158	0	←	0	0	←	←	←
4159	0	←	0	0	←	←	←
4161	0	←	0	0	←	←	←
4165	0	←	0	0	←	←	←
4166	0	←	0	0	←	←	←
4169	0	←	0	0	←	←	←
4400							
Maximum output during acceleration (for PS selection)	18.0kW	18.0kW	22.2kW	5.6kW 7.0kW(*1)	5.6kW 7.0kW(*1)	5.6kW 7.0kW(*1)	5.6kW 7.0kW(*1)

(*1)This setting makes the maximum output during acceleration greater and the acceleration time reduced.
(*6) Change parameters manually according to the table after load parameters automatically with the model code.

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Motor model	αi I 1.5/20000	αi I 1.5/20000	αi I 2/20000	αi I 3/12000	αi I 3/12000	αi I 3/12000
Applicable amplifier	βi SVSPx-15	βi SVSPx-18	βi SVSPx-18	βi SVSPx-11	βi SVSPx-15	βi SVSPx-18
Model code	(305)	(305)	(307)	309	(309)	(309)
Applicable software series and edition	9D80/A	9D80/A	9D80/A	9D80/A	9D80/A	9D80/A
Low-speed winding characteristics	–	–	–	–	–	–
High-speed winding characteristics	1.5/2.2kW 3000/20000min^{-1}	1.5/2.2kW 3000/20000min^{-1}	2.2/3.7kW 3000/20000min^{-1}	3.7/5.5kW 1500/12000min^{-1}	3.7/5.5kW 1500/12000min^{-1}	3.7/5.5kW 1500/12000min^{-1}
FS30*i* FS0*i*						
4007	00000000	←	00000000	00000000	←	←
4008	00000000	←	00000000	00000000	←	←
4009	00000000	←	00000000	00000000	←	←
4010	00000001(*6)	←	00000001(*6)	00000000	←	←
4011	00011001	←	00011001	00011001	←	←
4012	10000010	←	10000010	10000010	←	←
4013	00001100	←	01010000	00001100	←	←
4019	00000100	←	00000100	00000100	←	←
4020	20000(*6)	←	20000 (*6)	12000	←	←
4023						
4039	0	←	0	0	←	←
4040						
4041						
4048						
4049						
4080	14165	←	19290 (*6)	16720	←	←
4083	10	←	10	30	←	←
4093	0	←	0	0	←	←
4100	3250	←	3200	1500	←	←
4101	33	←	45	87	←	←
4102	7145	←	6432	3015	←	←
4103	75	←	92	82	←	←
4104	2300	←	3000	3200	←	←
4105	43	←	53	106	←	←
4106	8700	←	3000	7500	←	←
4107	0	←	0	0	←	←
4108	0	←	0	0	←	←
4109	25	←	25	25	←	←
4110	629	838 (*6)	588	559	838 (*6)	1118 (*6)
4111	180	←	175	190	←	←
4112	200	←	200	200	←	←
4113	2227	←	1800	900	←	←
4114	0	←	0	19200	←	←
4115	90	←	80(*6)	100	←	←
4116	10289	←	16564	7376	←	←
4117	90	←	90	90	←	←
4118	100	←	100	100	←	←
4119	5	←	2	9	←	←
4120	0	←	0	0	←	←
4124	24505	←	24501	24513	←	←
4127	176	←	202	178	←	←
4128	73	←	85	0	←	←
4129	0	←	0	0	←	←
4130	25700	←	25700	25700	←	←
4134	110	←	110	110	←	←
4136	0	←	0	0	←	←
4138	0	←	0	0	←	←
4139	0	←	0	0	←	←
4140	0	←	0	0	←	←
4141	0	←	0	0	←	←
4142	0	←	0	0	←	←
4143	0	←	0	0	←	←
4144	0	←	0	0	←	←
4145	0	←	0	0	←	←
4146	0	←	0	0	←	←
4147	0	←	0	0	←	←
4148	0	←	0	0	←	←
4149	0	←	0	0	←	←
4150	0	←	0	0	←	←
4151	0	←	0	0	←	←
4152	0	←	0	0	←	←
4153	0	←	0	0	←	←
4154	0	←	0	0	←	←
4155	0	←	0	0	←	←
4156	0	←	0	0	←	←
4158	0	←	0	0	←	←
4159	0	←	0	0	←	←
4161	0	←	0	0	←	←
4165	0	←	0	0	←	←
4166	0	←	0	0	←	←
4169	0	←	0	0	←	←
4400						
Maximum output during acceleration (for PS selection)	13.0kW	13.0kW	20.0kW	13.0kW	13.0kW	13.0kW

(*6) Change parameters manually according to the table after load parameters automatically with the model code.

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C.9 SPINDLE MOTOR αiI series (Power up model driven by βiSVSP)

Motor model	αiI 0.5/15000	αiI 0.5/15000	αiI 0.5/15000	αiI 0.5/15000	αiI 2/10000	αiI 2/10000	αiI 2/10000
Applicable amplifier	βiSVSP-7.5	βiSVSP-11	βiSVSP-15	βiSVSP-18	βiSVSP-11	βiSVSP-15	βiSVSP-18
Model code	(372)	(372)	(372)	(372)	(373)	(373)	(373)
Applicable software series and edition	9D8A/I 9DAA/A	9D8A/I 9DAA/A	9D8A/I 9DAA/A	9D8A/I 9DAA/A	9D8A/I 9DAA/A	9D8A/I 9DAA/A	9D8A/I 9DAA/A
Low-speed winding characteristics	–	–	–	–	–	–	–
High-speed winding characteristics	0.55/1.1/1.5 kW 3000/15000 min^{-1}	0.55/1.1/1.5 kW 3000/15000 min^{-1}	0.55/1.1/1.5 kW 3000/15000 min^{-1}	0.55/1.1/1.5 kW 3000/15000 min^{-1}	2.2/3.7/5.5 kW 1500/10000 min^{-1}	2.2/3.7/5.5 kW 1500/10000 min^{-1}	2.2/3.7/5.5 kW 1500/10000 min^{-1}
FS30*i* FS0*i*							
4007	00000000	←	←	←	00000000	←	←
4008	00010000	←	←	←	00010000	←	←
4009	00000000	←	←	←	00000000	←	←
4010	00000001	←	←	←	00000000	←	←
4011	00001000	←	←	←	00001001	←	←
4012	10000010	←	←	←	10000010	←	←
4013	00001100	←	←	←	00001100	←	←
4019	00000100	←	←	←	00000100	←	←
4020	15000	←	←	←	10000	←	←
4023							
4039	0	←	←	←	0	←	←
4040	2 (*3)	←	←	←	3 (*3)	←	←
4041							
4048	6 (*3)	←	←	←	13(*3)	←	←
4049							
4080	20570	←	←	←	20575	←	←
4083	30	←	←	←	30	←	←
4093							
4100	3300	←	←	←	1550	←	←
4101	100	←	←	←	85	←	←
4102	8226	←	←	←	2567	←	←
4103	0	←	←	←	0	←	←
4104	2000	←	←	←	4500	←	←
4105	46	←	←	←	96	←	←
4106	6000	←	←	←	15000	←	←
4107	0	←	←	←	0	←	←
4108	0	←	←	←	0	←	←
4109	25	←	←	←	25	←	←
4110	2413(*6)	3016(*6)	4524(*6)	6032(*6)	949	1424(*6)	1898(*6)
4111	346	←	←	←	298	←	←
4112	200	←	←	←	200	←	←
4113	2078	←	←	←	992	←	←
4114	0	←	←	←	0	←	←
4115	100	←	←	←	100	←	←
4116	13770	←	←	←	9300	←	←
4117	90	←	←	←	90	←	←
4118	100	←	←	←	100	←	←
4119	5	←	←	←	10	←	←
4120	0	←	←	←	0	←	←
4124	24575	←	←	←	24575	←	←
4127	327	←	←	←	300	←	←
4128	110	←	←	←	107	←	←
4129	0	←	←	←	0	←	←
4130	25700	←	←	←	25700	←	←
4134	110	←	←	←	110	←	←
4136	0	←	←	←	0	←	←
4138	0	←	←	←	0	←	←
4139	0	←	←	←	0	←	←
4140	0	←	←	←	0	←	←
4141	0	←	←	←	0	←	←
4142	0	←	←	←	0	←	←
4143	0	←	←	←	0	←	←
4144	0	←	←	←	0	←	←
4145	0	←	←	←	0	←	←
4146	0	←	←	←	0	←	←
4147	0	←	←	←	0	←	←
4148	0	←	←	←	0	←	←
4149	0	←	←	←	0	←	←
4150	0	←	←	←	0	←	←
4151	0	←	←	←	0	←	←
4152	0	←	←	←	0	←	←
4153	0	←	←	←	0	←	←
4154	0	←	←	←	0	←	←
4155	0	←	←	←	0	←	←
4156	0	←	←	←	0	←	←
4158	0	←	←	←	0	←	←
4159	0	←	←	←	0	←	←
4161	0	←	←	←	0	←	←
4165	0	←	←	←	0	←	←
4166	0	←	←	←	0	←	←
4169	0	←	←	←	0	←	←
4400							
Maximum output during acceleration (for PS selection)	1.8kW	1.8kW	1.8kW	1.8kW	6.6kW	6.6kW	6.6kW

(*3) Set this value as the initial value of the velocity loop gain for low-speed characteristics of speed range switching.
(*6) Change parameters manually according to the table after load parameters automatically with the model code.

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Motor model	αi I 6/12000	αi I 6/12000	αi I 6/12000	αi I 6/12000(*4)	αi I 6/12000(*4)	αi I 6/12000(*4)
Applicable amplifier	βi SVSP-11	βi SVSP-15	βi SVSP-18	βi SVSP-11	βi SVSP-15	βi SVSP-18
Model code	(421)	(421)	(421)	–	–	–
Applicable software series and edition	9D8A/I 9DAA/A	9D8A/I 9DAA/A	9D8A/I 9DAA/A	–	–	–
Low-speed winding characteristics	5.5/7.5/11 kW 1500/12000 min-1	5.5/7.5/11 kW 1500/12000 min^{-1}	5.5/7.5/11 kW 1500/12000 min^{-1}	5.5/7.5/11 kW 1500/12000 min^{-1}	5.5/7.5/11 kW 1500/12000 min^{-1}	5.5/7.5/11 kW 1500/12000 min^{-1}
High-speed winding characteristics	5.5/7.5/11 kW 4000/12000 min-1	5.5/7.5/11 kW 4000/12000 min^{-1}	5.5/7.5/11 kW 4000/12000 min^{-1}	–	–	–
FS30*i* FS0*i*						
4007	00000000	←	←	00000000	←	←
4008	00010000	←	←	00010000	←	←
4009	00000000	←	←	00000000	←	←
4010	00000000	←	←	00000000	←	←
4011	00001010	←	←	00001010	←	←
4012	10000111	←	←	10000111	←	←
4013	00001100	←	←	00001100	←	←
4019	00000100	←	←	00000100	←	←
4020	12000	←	←	12000	←	←
4023	333 (*2)	←	←			
4039	0	←	←	0	←	←
4040						
4041						
4048						
4049						
4080	75	←	←	12870	←	←
4083	30	←	←	30	←	←
4093	240	←	←	0	←	←
4100	4400	←	←	1570	←	←
4101	100	←	←	100	←	←
4102	4838	←	←	2016	←	←
4103	0	←	←	0	←	←
4104	1200	←	←	3000	←	←
4105	119	←	←	138	←	←
4106	2500	←	←	6000	←	←
4107	138	←	←	0	←	←
4108	0	←	←	0	←	←
4109	25	←	←	25	←	←
4110	479	719(*6)	958(*6)	603	905	1206
4111	198	←	←	261	←	←
4112	200	←	←	200	←	←
4113	800	←	←	690	←	←
4114	17920	←	←	0	←	←
4115	100	←	←	100	←	←
4116	6500	←	←	6500	←	←
4117	90	←	←	90	←	←
4118	100	←	←	100	←	←
4119	15	←	←	527	←	←
4120	0	←	←	0	←	←
4124	24519	←	←	24571	←	←
4127	240	←	←	240	←	←
4128	105	←	←	6505	←	←
4129	0	←	←	0	←	←
4130	25700	←	←	25700	←	←
4134	130	←	←	130	←	←
4136	30	←	←	0	←	←
4138	1570	←	←	0	←	←
4139	100	←	←	0	←	←
4140	2016	←	←	0	←	←
4141	0	←	←	0	←	←
4142	3000	←	←	0	←	←
4143	6000	←	←	0	←	←
4144	0	←	←	0	←	←
4145	25	←	←	0	←	←
4146	603	905(*6)	1206(*6)	0	←	←
4147	261	←	←	0	←	←
4148	200	←	←	0	←	←
4149	690	←	←	0	←	←
4150	0	←	←	0	←	←
4151	100	←	←	0	←	←
4152	6500	←	←	0	←	←
4153	90	←	←	0	←	←
4154	100	←	←	0	←	←
4155	24571	←	←	0	←	←
4156	0	←	←	0	←	←
4158	6505	←	←	0	←	←
4159	0	←	←	0	←	←
4161	25700	←	←	0	←	←
4165	527	←	←	0	←	←
4166	12870	←	←	0	←	←
4169	0	←	←	0	←	←
4400	00010001(*6)	←	←	00000001(*6)	←	←
Maximum output during acceleration (for PS selection)	13.2kW	13.2kW	13.2kW	13.2kW	13.2kW	13.2kW

(*2)When using the SDT signal, manually change the parameters that were automatically set.

(*4) This setting is used when only a low-speed winding is connected without the output range being switched in the output range switching motor.

(*6) Change parameters manually according to the table after load parameters automatically with the model code.

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Motor model	αi I 8/10000	αi I 8/10000	αi I 8/10000(*4)	αi I 8/10000(*4)	αi I 8/12000	αi I 8/12000	αi I 8/12000(*4)	αi I 8/12000(*4)
Applicable amplifier	βi SVSP-15	βi SVSP-18	βi SVSP-15	βi SVSP-18	βi SVSP-15	βi SVSP-18	βi SVSP-15	βi SVSP-18
Model code	(422)	(422)	–	–	(423)	(423)	–	–
Applicable software series and edition	9D8A/I 9DAA/A	9D8A/I 9DAA/A	–	–	9D8A/I 9DAA/A	9D8A/I 9DAA/A	–	–
Low-speed winding characteristics	7.5/11/15 kW 1500/10000 min^{-1}	7.5/11/15 kW 1500/10000 min^{-1}	7.5/11/15 kW 1500/10000 min^{-1}	7.5/11/15 kW 1500/10000 min^{-1}	7.5/11/15 kW 1500/12000 min^{-1}	7.5/11/15 kW 1500/12000 min^{-1}	7.5/11/15 kW 1500/12000 min^{-1}	7.5/11/15 kW 1500/12000 min^{-1}
High-speed winding characteristics	7.5/11/15 kW 4000/10000 min^{-1}	7.5/11/15 kW 4000/10000 min^{-1}	–	–	7.5/11/15 kW 4000/12000 min^{-1}	7.5/11/15 kW 4000/12000 min^{-1}	–	–
FS30*i* FS0*i*								
4007	00000000	←	00000000	←	00000000	←	00000000	←
4008	00010000	←	00010000	←	00010000	←	00010000	←
4009	00000000	←	00000000	←	00000000	←	00000000	←
4010	00000001	←	00000001	←	00000001	←	00000001	←
4011	00001010	←	00001010	←	00001010	←	00001010	←
4012	10000010	←	10000010	←	10000010	←	10000010	←
4013	00001100	←	00001100	←	00001100	←	00001100	←
4019	00000100	←	00000100	←	00000100	←	00000100	←
4020	10000	←	10000	←	12000	←	12000	←
4023	400 (*2)	←			333 (*2)	←		
4039	0	←	0	←	0	←	0	←
4040								
4041								
4048								
4049								
4080	12877	←	17749	←	15186	←	15693	←
4083	30	←	30	←	30	←	30	←
4093	240	←	0	←	240	←	0	←
4100	4006	←	1600	←	3580	←	1505	←
4101	82	←	94	←	71	←	74	←
4102	4006	←	1656	←	3580	←	1642	←
4103	0	←	0	←	0	←	0	←
4104	2050	←	6000	←	4000	←	8000	←
4105	160	←	121	←	97	←	88	←
4106	7600	←	20000	←	14000	←	24000	←
4107	121	←	0	←	88	←	0	←
4108	0	←	0	←	0	←	0	←
4109	25	←	25	←	25	←	25	←
4110	854	1139(*6)	754	1005	421	561(*6)	566	755
4111	305	←	265	←	157	←	229	←
4112	200	←	200	←	200	←	200	←
4113	598	←	790	←	980	←	1090	←
4114	0	←	19200	←	22528	←	21760	←
4115	100	←	100	←	100	←	100	←
4116	5734	←	8118	←	11031	←	8000	←
4117	100	←	90	←	90	←	90	←
4118	100	←	100	←	100	←	100	←
4119	16	←	12	←	522	←	521	←
4120	0	←	0	←	0	←	0	←
4124	24575	←	24574	←	24487	←	24544	←
4127	240	←	240	←	240	←	240	←
4128	0	←	117	←	0	←	0	←
4129	0	←	0	←	0	←	0	←
4130	25700	←	25700	←	25700	←	25700	←
4134	130	←	130	←	130	←	130	←
4136	30	←	0	←	30	←	0	←
4138	1600	←	0	←	1505	←	0	←
4139	94	←	0	←	74	←	0	←
4140	1656	←	0	←	1642	←	0	←
4141	0	←	0	←	0	←	0	←
4142	6000	←	0	←	8000	←	0	←
4143	20000	←	0	←	24000	←	0	←
4144	0	←	0	←	0	←	0	←
4145	25	←	0	←	25	←	0	←
4146	754	1005(*6)	0	←	566	755(*6)	0	←
4147	265	←	0	←	229	←	0	←
4148	200	←	0	←	200	←	0	←
4149	790	←	0	←	1090	←	0	←
4150	19200	←	0	←	21760	←	0	←
4151	100	←	0	←	100	←	0	←
4152	8118	←	0	←	8000	←	0	←
4153	90	←	0	←	90	←	0	←
4154	100	←	0	←	100	←	0	←
4155	24574	←	0	←	24544	←	0	←
4156	0	←	0	←	0	←	0	←
4158	117	←	0	←	0	←	0	←
4159	0	←	0	←	0	←	0	←
4161	25700	←	0	←	25700	←	0	←
4165	12	←	0	←	521	←	0	←
4166	17749	←	0	←	15693	←	0	←
4169	0	←	0	←	0	←	0	←
4400								
Maximum output during acceleration (for PS selection)	18kW	18kW	18kW	18kW	18kW	18kW	18kW	18kW

(*2)When using the SDT signal, manually change the parameters that were automatically set.

(*4) This setting is used when only a low-speed winding is connected without the output range being switched in the output range switching motor.

(*6) Change parameters manually according to the table after load parameters automatically with the model code.

JR AUTOMATION TECHNOLOGIES, INC*

Motor model	αi I 12/12000	αi I 12/12000	αi I 12/12000(*4)	αi I 12/12000(*4)
Applicable amplifier	βi SVSP-15	βi SVSP-18	βi SVSP-15	βi SVSP-18
Model code	(424)	(424)	–	–
Applicable software series and edition	9D8A/I 9DAA/A	9D8A/I 9DAA/A	–	–
Low-speed winding characteristics	11/15/18.5 kW 1500/12000 min^{-1}	11/15/18.5 kW 1500/12000 min^{-1}	11/15/18.5 kW 1500/12000 min^{-1}	11/15/18.5 kW 1500/12000 min^{-1}
High-speed winding characteristics	11/15/18.5 kW 4000/12000 min^{-1}	11/15/18.5 kW 4000/12000 min^{-1}	–	–
FS30*i* FS0*i*				
4007	00000000	←	00000000	←
4008	00010000	←	00010000	←
4009	00000000	←	00000000	←
4010	00000000	←	00000000	←
4011	00001010	←	00001010	←
4012	10000010	←	10000010	←
4013	00001100	←	00001100	←
4019	00000100	←	00000100	←
4020	12000	←	12000	←
4023	333 (*2)	←		
4039	0	←	0	←
4040				
4041				
4048				
4049				
4080	75	←	16735	←
4083	30	←	30	←
4093	202	←	0	←
4100	3800	←	1550	←
4101	80	←	100	←
4102	3593	←	1922	←
4103	0	←	0	←
4104	1800	←	3000	←
4105	341	←	324	←
4106	6000	←	10000	←
4107	324	←	0	←
4108	0	←	0	←
4109	25	←	25	←
4110	595	793(*6)	905	1207
4111	223	←	337	←
4112	200	←	200	←
4113	280	←	295	←
4114	0	←	0	←
4115	100	←	100	←
4116	5280	←	5279	←
4117	90	←	90	←
4118	100	←	100	←
4119	34	←	32	←
4120	0	←	0	←
4124	24539	←	24575	←
4127	202	←	202	←
4128	0	←	0	←
4129	0	←	0	←
4130	25700	←	25700	←
4134	130	←	130	←
4136	30	←	0	←
4138	1550	←	0	←
4139	100	←	0	←
4140	1922	←	0	←
4141	0	←	0	←
4142	3000	←	0	←
4143	10000	←	0	←
4144	0	←	0	←
4145	25	←	0	←
4146	905	1207(*6)	0	←
4147	337	←	0	←
4148	200	←	0	←
4149	295	←	0	←
4150	0	←	0	←
4151	100	←	0	←
4152	5279	←	0	←
4153	90	←	0	←
4154	100	←	0	←
4155	24575	←	0	←
4156	0	←	0	←
4158	0	←	0	←
4159	0	←	0	←
4161	25700	←	0	←
4165	32	←	0	←
4166	16735	←	0	←
4169	0	←	0	←
4400				
Maximum output during acceleration (for PS selection)	22.2kW	22.2kW	22.2kW	22.2kW

(*2)When using the SDT signal, manually change the parameters that were automatically set.
(*4) This setting is used when only a low-speed winding is connected without the output range being switched in the output range switching motor.
(*6) Change parameters manually according to the table after load parameters automatically with the model code.

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C.10 SPINDLE MOTOR αiIP series (Power up model driven by βiSVSP)

Motor model	αi IP 18/6000	αi IP 18/6000	αi IP 18/6000(*4)	αi IP 18/6000(*4)
Applicable amplifier	βi SVSP-15	βi SVSP-18	βi SVSP-15	βi SVSP-18
Model code	(429)	(429)	–	–
Applicable software series and edition	9D8A/I 9DAA/A	9D8A/I 9DAA/A	–	–
Low-speed winding characteristics	6/11kW 500/1500min-1	6/11kW 500/1500min-1	6/11kW 500/1500min-1	6/11kW 500/1500min-1
High-speed winding characteristics	9/11/15kW 750/6000min-1	9/11/15kW 750/6000min-1	–	–
FS30i FS0i				
4007	00000000	←	00000000	←
4008	00010000	←	00010000	←
4009	00000000	←	00000000	←
4010	00000000	←	00000000	←
4011	00001010	←	00001010	←
4012	10000111	←	10000111	←
4013	00001100	←	00001100	←
4019	00000100	←	00000100	←
4020	6000	←	6000	←
4023	125(*2)	←	125(*2)	←
4039	0	←	0	←
4040	7 (*3)	←	6 (*3)	←
4041	6 (*3)	←		
4048	32 (*3)	←	29 (*3)	←
4049	29 (*3)	←		
4080	25153	←	15425	←
4083	30	←	30	←
4093	300	←	0	←
4100	1261	←	755	←
4101	100	←	88	←
4102	1261	←	755	←
4103	0	←	0	←
4104	3200	←	8000	←
4105	318	←	303	
4106	7000	←	23000	←
4107	303	←	0	
4108	0	←	0	←
4109	25	←	25	←
4110	755	1007(*6)	1489	1981(*6)
4111	311	←	650	←
4112	200	←	200	←
4113	300	←	315	←
4114	0	←	0	←
4115	100	←	100	←
4116	5671	←	5660	←
4117	90	←	90	←
4118	90	←	115	←
4119	32	←	10	←
4120	0	←		
4124	24575	←	24575	←
4127	200	←	300	←
4128	0	←	0	←
4129	0	←	0	←
4130	25700	←	25700	←
4134	130	←	130	←
4136	30	←	0	←
4138	755	←	0	←
4139	88	←	0	←
4140	755	←	0	←
4141	0	←	0	←
4142	8000	←	0	←
4143	23000	←	0	←
4144	0	←	0	←
4145	25	←	0	←
4146	1489	1985(*6)	0	←
4147	650	←	0	←
4148	200	←	0	←
4149	315	←	0	←
4150	0	←	0	←
4151	100	←	0	←
4152	5660	←	0	←
4153	90	←	0	←
4154	115	←	0	←
4155	24575	←	0	←
4156	0	←	0	←
4158	0	←	0	←
4159	0	←	0	←
4161	25700	←	0	←
4165	10	←	0	←
4166	15425	←	0	←
4169	0	←	0	←
4400	00000001(*6)	←		
Maximum output during acceleration (for PS selection)	18kW	18kW	18kW	18kW

(*2)When using the SDT signal, manually change the parameters that were automatically set.
(*3) Set this value as the initial value of the velocity loop gain for low-speed characteristics of speed range switching.
(*4) This setting is used when only a low-speed winding is connected without the output range being switched in the output range switching motor.
(*6) Change parameters manually according to the table after load parameters automatically with the model code.

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C.11 SPINDLE MOTOR αiIT series (Power up model driven by βiSVSP)

Motor model	αi IT 6/12000	αi IT 6/12000	αi IT 6/12000	αi IT 6/12000(*4)	αi IT 6/12000(*4)	αi IT 6/12000(*4)
Applicable amplifier	βi SVSP-11	βi SVSP-15	βi SVSP-18	βi SVSP-11	βi SVSP-15	βi SVSP-18
Model code	–	–	–	–	–	–
Applicable software series and edition	–	–	–	–	–	–
Low-speed winding characteristics	5.5/7.5/11 kW 1500/12000 min^{-1}	5.5/7.5/11 kW 1500/12000 min^{-1}	5.5/7.5/11 kW 1500/12000 min^{-1}	5.5/7.5/11 kW 1500/12000 min^{-1}	5.5/7.5/11 kW 1500/12000 min^{-1}	5.5/7.5/11 kW 1500/12000 min^{-1}
High-speed winding characteristics	5.5/7.5/11 kW 4000/12000 min^{-1}	5.5/7.5/11 kW 4000/12000 min^{-1}	5.5/7.5/11 kW 4000/12000 min^{-1}	–	–	–
FS30*i* FS0*i*						
4007	00000000	←	←	00000000	←	←
4008	00010000	←	←	00010000	←	←
4009	00000000	←	←	00000000	←	←
4010	00000001	←	←	00000001	←	←
4011	00001010	←	←	00001010	←	←
4012	10000111	←	←	10000111	←	←
4013	00001100	←	←	00001100	←	←
4019	00000100	←	←	00000100	←	←
4020	12000	←	←	12000	←	←
4023	333 (*2)	←	←			
4039	0	←	←	0	←	←
4040						
4041						
4048						
4049						
4080	75	←	←	12870	←	←
4083	30	←	←	30	←	←
4093	240	←	←	0	←	←
4100	4400	←	←	1570	←	←
4101	100	←	←	100	←	←
4102	4838	←	←	2016	←	←
4103	0	←	←	0	←	←
4104	1200	←	←	3000	←	←
4105	119	←	←	138	←	←
4106	2500	←	←	6000	←	←
4107	138	←	←	0	←	←
4108	0	←	←	0	←	←
4109	25	←	←	25	←	←
4110	479	719	958	905	1358	1810
4111	198	←	←	261	←	←
4112	200	←	←	200	←	←
4113	800	←	←	690	←	←
4114	17920	←	←	0	←	←
4115	100	←	←	100	←	←
4116	6500	←	←	6500	←	←
4117	90	←	←	90	←	←
4118	100	←	←	100	←	←
4119	15	←	←	527	←	←
4120	0	←	←	0	←	←
4124	24519	←	←	24571	←	←
4127	240	←	←	240	←	←
4128	105	←	←	6505	←	←
4129	0	←	←	0	←	←
4130	25700	←	←	25700	←	←
4134	130	←	←	130	←	←
4136	30	←	←	0	←	←
4138	1570	←	←	0	←	←
4139	100	←	←	0	←	←
4140	2016	←	←	0	←	←
4141	0	←	←	0	←	←
4142	3000	←	←	0	←	←
4143	6000	←	←	0	←	←
4144	0	←	←	0	←	←
4145	25	←	←	0	←	←
4146	905	1358	1810	0	←	←
4147	261	←	←	0	←	←
4148	200	←	←	0	←	←
4149	690	←	←	0	←	←
4150	0	←	←	0	←	←
4151	100	←	←	0	←	←
4152	6500	←	←	0	←	←
4153	90	←	←	0	←	←
4154	100	←	←	0	←	←
4155	24571	←	←	0	←	←
4156	0	←	←	0	←	←
4158	6505	←	←	0	←	←
4159	0	←	←	0	←	←
4161	25700	←	←	0	←	←
4165	527	←	←	0	←	←
4166	12870	←	←	0	←	←
4169	0	←	←	0	←	←
4400	00010001(*6)	←	←	00000001(*6)	←	←
Maximum output during acceleration (for PS selection)	13.2kW	13.2kW	13.2kW	13.2kW	13.2kW	13.2kW

(*2)When using the SDT signal, manually change the parameters that were automatically set.
(*4) This setting is used when only a low-speed winding is connected without the output range being switched in the output range switching motor.
(*6) Change parameters manually according to the table after load parameters automatically with the model code.

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Motor model	αi IT 8/12000	αi IT 8/12000	αi IT 8/12000(*4)	αi IT 8/12000(*4)	αi IT 12/12000	αi IT 12/12000	αi IT 12/12000(*4)	αi IT 12/12000(*4)
Applicable amplifier	βi SVSP-15	βi SVSP-18	βi SVSP-15	βi SVSP-18	βi SVSP-15	βi SVSP-18	βi SVSP-15	βi SVSP-18
Model code	–	–	–	–	–	–	–	–
Applicable software series and edition	–	–	–	–	–	–	–	–
Low-speed winding characteristics	7.5/11/15 kW 1500/12000 min^{-1}	7.5/11/15 kW 1500/12000 min^{-1}	7.5/11/15 kW 1500/12000 min^{-1}	7.5/11/15 kW 1500/12000 min^{-1}	11/15/18.5 kW 1500/12000min^{-1}	11/15/18.5 kW 1500/12000min^{-1}	11/15/18.5 kW 1500/12000min^{-1}	11/15/18.5 kW 1500/12000min^{-1}
High-speed winding characteristics	7.5/11/15 kW 4000/12000 min^{-1}	7.5/11/15 kW 4000/12000 min^{-1}	–	–	11/15/18.5 kW 4000/12000min^{-1}	11/15/18.5 kW 4000/12000min^{-1}	–	–
FS30*i* FS0*i*								
4007	00000000	←	00000000	←	00000000	←	00000000	←
4008	00010000	←	00010000	←	00010000	←	00010000	←
4009	00000000	←	00000000	←	00000000	←	00000000	←
4010	00000001	←	00000001	←	00000000	←	00000000	←
4011	00001010	←	00001010	←	00001010	←	00001010	←
4012	10000010	←	10000010	←	10000010	←	10000010	←
4013	00001100	←	00001100	←	00001100	←	00001100	←
4019	00000100	←	00000100	←	00000100	←	00000100	←
4020	12000	←	12000	←	12000	←	12000	←
4023	333 (*2)	←			333 (*2)	←		
4039	0	←	0	←	0	←	0	←
4040								
4041								
4048								
4049								
4080	15186	←	15693	←	75	←	16735	←
4083	30	←	30	←	30	←	30	←
4093	240	←	0	←	202	←	0	←
4100	3580	←	1505	←	3800	←	1550	←
4101	71	←	74	←	80	←	100	←
4102	3580	←	1642	←	3593	←	1922	←
4103	0	←	0	←	0	←	0	←
4104	4000	←	8000	←	1800	←	3000	←
4105	97	←	88	←	341	←	324	←
4106	14000	←	24000	←	6000	←	10000	←
4107	88	←	0	←	324	←	0	←
4108	0	←	0	←	0	←	0	←
4109	25	←	25	←	25	←	25	←
4110	421	561	566	755	595	793	905	1207
4111	157	←	229	←	223	←	337	←
4112	200	←	200	←	200	←	200	←
4113	980	←	1090	←	280	←	295	←
4114	22528	←	21760	←	0	←	0	←
4115	100	←	100	←	100	←	100	←
4116	11031	←	8000	←	5280	←	5279	←
4117	90	←	90	←	90	←	90	←
4118	100	←	100	←	100	←	100	←
4119	522	←	521	←	34	←	32	←
4120	0	←	0	←	0	←	0	←
4124	24487	←	24544	←	24539	←	24575	←
4127	240	←	240	←	202	←	202	←
4128	0	←	0	←	0	←	0	←
4129	0	←	0	←	0	←	0	←
4130	25700	←	25700	←	25700	←	25700	←
4134	130	←	130	←	130	←	130	←
4136	30	←	0	←	30	←	0	←
4138	1505	←	0	←	1550	←	0	←
4139	74	←	0	←	100	←	0	←
4140	1642	←	0	←	1922	←	0	←
4141	0	←	0	←	0	←	0	←
4142	8000	←	0	←	3000	←	0	←
4143	24000	←	0	←	10000	←	0	←
4144	0	←	0	←	0	←	0	←
4145	25	←	0	←	25	←	0	←
4146	566	755	0	←	905	1207	0	←
4147	229	←	0	←	337	←	0	←
4148	200	←	0	←	200	←	0	←
4149	1090	←	0	←	295	←	0	←
4150	21760	←	0	←	0	←	0	←
4151	100	←	0	←	100	←	0	←
4152	8000	←	0	←	5279	←	0	←
4153	90	←	0	←	90	←	0	←
4154	100	←	0	←	100	←	0	←
4155	24544	←	0	←	24575	←	0	←
4156	0	←	0	←	0	←	0	←
4158	0	←	0	←	0	←	0	←
4159	0	←	0	←	0	←	0	←
4161	25700	←	0	←	25700	←	0	←
4165	521	←	0	←	32	←	0	←
4166	15693	←	0	←	16735	←	0	←
4169	0	←	0	←	0	←	0	←
4400								
Maximum output during acceleration (for PS selection)	18kW	18kW	18kW	18kW	22.2kW	22.2kW	22.2kW	22.2kW

(*2)When using the SDT signal, manually change the parameters that were automatically set.

(*4) This setting is used when only a low-speed winding is connected without the output range being switched in the output range switching motor.

JR AUTOMATION TECHNOLOGIES INC*

C.12 SPINDLE MOTOR α*i*I series (400V)

Motor model	α*i* I 0.5/10000HV	α*i* I 1/10000HV	α*i* I 1.5/10000HV	α*i* I 2/10000HV	α*i* I 3/10000HV	α*i* I 6/10000HV	α*i* I 8/8000HV	α*i* I 12/7000HV
Applicable amplifier	α*i* SP5.5HV	α*i* SP5.5HV	α*i* SP5.5HV	α*i* SP5.5HV	α*i* SP5.5HV	α*i* SP11HV	α*i* SP11HV	α*i* SP15HV
Model code	311	313	315	317	319	321	325	326
Applicable software series and edition	9D50/F	9D50/F	9D50/F	9D50/F	9D50/F	9D50/F	9D50/F	9D50/F
Low-speed winding characteristics	–	–	–	–	–	–	–	–
High-speed winding characteristics	0.55/1.1kW 3000/10000min^{-1}	1.5/2.2kW 3000/10000min^{-1}	1.1/3.7kW 1500/10000min^{-1}	2.2/3.7kW 1500/10000min^{-1}	3.7/5.5kW 1500/10000min^{-1}	5.5/7.5kW 1500/10000min^{-1}	7.5/11kW 1500/8000min^{-1}	11/15kW 1500/7000min^{-1}
FS30*i* FS0*i*								
4007	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4008	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4009	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4010	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4011	00011000	00011001	00011001	00011001	00011001	00011010	00011010	00011010
4012	10000010	10000010	10000010	10000010	10000010	10000010	10000010	10000000
4013	00001100	00001100	00001100	00001100	00001100	00001100	00001100	00001100
4019	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100
4020	10000	10000	10000	10000	10000	10000	8000	7000
4023								
4039	0	0	0	0	0	0	0	0
4040								
4041								
4048								
4049								
4080	85	20565 20570(*1)	14173 14170(*1)	80 65(*1)	85 75(*1)	85 65(*1)	70	88 85(*1)
4083	30	30	30	30	30	30	30	30
4093	0	0	0	0	0	0	0	0
4100	3250	2600	1610	1500	1400	1500	1800	1550
4101	100	85	100	100	100	100	100	100
4102	6503	3600	2745	4421	2288	3000	2323	1754
4103	45 0 (*1)	83 0 (*1)	65 0 (*1)	50 0 (*1)	61 0 (*1)	58 0 (*1)	85 0(*1)	88 0(*1)
4104	4500	6000	5000	5000	7000	5000	7000	2000
4105	46	43	40	102	109	109	132	347
4106	4500	6000	12000	5000	7000	5000	7000	4500
4107	0	0	0	0	0	0	0	0
4108	0	0	0	0	0	0	0	0
4109	25	25	25	25	25	25	25	25
4110	3143	1423	1109	1397	1077	754	629	1077
4111	245	103	220	318	237	272	229	250
4112	200	200	200	200	200	200	200	200
4113	2058	2200	2400	935	873	878	723	275
4114	23040	14080	17920	110	20480	23040	23040	0
4115	100	100	100	100	100	100	100	100
4116	13641	17300	10218	10519	9908	9016	8734	5800
4117	90	90	90	90	90	90	90	90
4118	100	100	100	100	100	100	100	100
4119	5	4	4	10	11	11	13	35
4120	0	0	0	0	0	0	0	0
4124	24558	24449	24537	24575	24551	24575	24544	24562
4127	240	176	404	202	178	164	176	164
4128	120	75	107	90	90	0	0	108
4129	0	0	0	0	0	0	0	0
4130	25700	25700	25700	25700	25700	25700	25700	25700
4134	110	110	110	110	110	130	130	130
4136	0	0	0	0	0	0	0	0
4138	0	0	0	0	0	0	0	0
4139	0	0	0	0	0	0	0	0
4140	0	0	0	0	0	0	0	0
4141	0	0	0	0	0	0	0	0
4142	0	0	0	0	0	0	0	0
4143	0	0	0	0	0	0	0	0
4144	0	0	0	0	0	0	0	0
4145	0	0	0	0	0	0	0	0
4146	0	0	0	0	0	0	0	0
4147	0	0	0	0	0	0	0	0
4148	0	0	0	0	0	0	0	0
4149	0	0	0	0	0	0	0	0
4150	0	0	0	0	0	0	0	0
4151	0	0	0	0	0	0	0	0
4152	0	0	0	0	0	0	0	0
4153	0	0	0	0	0	0	0	0
4154	0	0	0	0	0	0	0	0
4155	0	0	0	0	0	0	0	0
4156	0	0	0	0	0	0	0	0
4158	0	0	0	0	0	0	0	0
4159	0	0	0	0	0	0	0	0
4161	0	0	0	0	0	0	0	0
4165	0	0	0	0	0	0	0	0
4166	0	0	0	0	0	0	0	0
4169	0	0	0	0	0	0	0	0
Maximum output during acceleration (for PS selection)	1.32kW 2.59kW(*1)	2.64kW 3.0kW(*1)	4.44kW 6.3kW(*1)	4.44kW 7.5kW(*1)	6.6kW 8.9kW(*1)	9.0kW 15.4kW(*1)	13.2kW 15.8kW(*1)	18.0kW 20.3kW(*1)
Motor model (old name)	α0.5/10000HV*i*	α1/10000HV*i*	α1.5/10000HV*i*	α2/10000HV*i*	α3/10000HV*i*	α6/10000HV*i*	α8/8000HV*i*	α12/7000HV*i*
Applicable amplifier (old name)	SPM-5.5HV*i*	SPM-5.5HV*i*	SPM-5.5HV*i*	SPM-5.5HV*i*	SPM-5.5HV*i*	SPM-11HV*i*	SPM-11HV*i*	SPM-15HV*i*

(*1)This setting makes the maximum output during acceleration greater and the acceleration time reduced.

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Motor model	αi I 15/7000HV	αi I 15/7000HV	αi I 22/7000HV	αi I 30/6000HV	αi I 40/6000HV	αi I 50/5000HV	αi I 60/4500HV	αi I 60/5000HV
Applicable amplifier	αi SP30HV	αi SP22HV	αi SP30HV	αi SP45HV	αi SP45HV	αi SP45HV(*5)	αi SP75HV	αi SP75HV
Model code	327	–	328	329	330	376	–	331
Applicable software series and edition	9D50/F	9D50/F	9D50/F	9D50/F	9D8A/I 9DAA/A	9D8A/I 9DAA/A	–	9D8A/I 9DAA/A
Low-speed winding characteristics	–	–	–	–	–	–	–	–
High-speed winding characteristics	15/18.5kW 1500/7000min^{-1}	15/18.5kW 1500/7000min^{-1}	22/26kW 1500/7000min^{-1}	30/37kW 1150/6000min^{-1}	37/45 kW 1500/6000 min^{-1}	45/55kW 1150/5000min^{-1}	60/75 kW 1150/4500 min^{-1}	60/75kW 1150/5000min^{-1}
FS30*i* FS0*i*								
4007	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4008	00000000	00000000	00000000	00000000	00010000	00010000	00000000	00000000
4009	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4010	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4011	00011010	00011010	00011010	00011010	00001010	00001010	00011010	00011010
4012	10000010	10000010	10000010	10000000	10000000	10000000	10000000	10000000
4013	01010000	01010000	01010000	01010000	01010000	00001100	00011000	00011000
4019	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100
4020	7000	7000	7000	6000	6000	5000	4500	5000
4023								
4039	0	0	0	0	0	0	0	0
4040								
4041								
4048								
4049								
4080	65	65	75	98	82	18000	90	90
4083	30	30	30	30	30	30	30	30
4093	0	0	0	0	0	0	0	0
4100	1500	1500	1595	1230	1600	1150	1130	1130
4101	73	73	100	85	100	85	100	100
4102	1972	1972	1595	1617	1940	1175	1491	1491
4103	65	65	0	55	0	0	85	85
4104	4500	4500	5000	2500	2500	4000	3500	3500
4105	341	341	294	597	546	492	495	495
4106	4500	4500	5000	4000	2800	6000	7000	7000
4107	0	0	0	0	0	0	0	0
4108	0	0	0	0	0	0	0	0
4109	25	25	25	25	25	25	25	25
4110	1499	999	838	1257	718	678	1174	1174
4111	425	425	223	455	252	274	345	345
4112	200	200	200	200	200	200	200	200
4113	280	280	325	160	175	194	193	193
4114	23040	23040	20480	0	0	0	0	0
4115	100	100	100	100	100	100	100	100
4116	5153	5153	5572	5056	6212	5045	5042	5042
4117	90	90	90	90	90	90	90	90
4118	100	100	100	100	100	100	100	100
4119	34	34	29	60	54	49	49	49
4120	0	0	0	0	0	0	0	0
4124	24575	24575	24539	24575	24564	24575	24575	24575
4127	148	148	142	148	146	147	150	150
4128	0	0	0	110	115	0	0	0
4129	0	0	0	0	0	0	0	0
4130	25700	25700	25700	25700	25700	25700	25700	25700
4134	130	130	130	130	130	130	130	130
4136	0	0	0	0	0	0	0	0
4138	0	0	0	0	0	0	0	0
4139	0	0	0	0	0	0	0	0
4140	0	0	0	0	0	0	0	0
4141	0	0	0	0	0	0	0	0
4142	0	0	0	0	0	0	0	0
4143	0	0	0	0	0	0	0	0
4144	0	0	0	0	0	0	0	0
4145	0	0	0	0	0	0	0	0
4146	0	0	0	0	0	0	0	0
4147	0	0	0	0	0	0	0	0
4148	0	0	0	0	0	0	0	0
4149	0	0	0	0	0	0	0	0
4150	0	0	0	0	0	0	0	0
4151	0	0	0	0	0	0	0	0
4152	0	0	0	0	0	0	0	0
4153	0	0	0	0	0	0	0	0
4154	0	0	0	0	0	0	0	0
4155	0	0	0	0	0	0	0	0
4156	0	0	0	0	0	0	0	0
4158	0	0	0	0	0	0	0	0
4159	0	0	0	0	0	0	0	0
4161	0	0	0	0	0	0	0	0
4165	0	0	0	0	0	0	0	0
4166	0	0	0	0	0	0	0	0
4169	0	0	0	0	0	0	0	0
Maximum output during acceleration (for PS selection)	22.2kW	22.2kW	31.2kW	44.4kW	54kW	66kW	90kW	90kW
Motor model (old name)	α15/7000HV*i*	α15/7000HV*i*	α22/7000HV*i*	α30/6000HV*i*	α40/6000HV*i*	–	α60/4500HV*i*	–
Applicable amplifier (old name)	SPM-30HV*i*	–	SPM-30HV*i*	SPM-45HV*i*	SPM-45HV*i*	–	SPM-75HV*i*	–

(*5) Spindle amplifiers indicated by A06B-612x-... are not applicable.

JR AUTOMATION TECHNOLOGIES, INC*

Motor model	αi I 75/5000HV	αi I 100/4000HV	αi I 100/4000HV(*4)	αi I 100/5000HV
Applicable amplifier	αi SP75HV(*5)	αi SP75HV	αi SP75HV	αi SP100HV(*5)
Model code	377	415	–	428
Applicable software series and edition	9D8A/I 9DAA/A	9D50/F	–	9D8A/I 9DAA/A
Low-speed winding characteristics	–	100kW 1000/3000min^{-1}	100kW 1000/3000min^{-1}	100kW 1000/5000min^{-1}
High-speed winding characteristics	75/90kW 1050/5000min^{-1}	100kW 2000/4000min^{-1}	–	100kW 3000/5000min^{-1}
FS30*i* FS0*i*				
4007	00000000	00000000	00000000	00000000
4008	00010000	00000000	00000000	00010000
4009	00000000	00000000	00000000	00000000
4010	00010001	00000001	00000001	00010001
4011	00001010	00011010	00011010	00001010
4012	10000000	10000000	10000000	10000000
4013	00001100	00011000	00011000	00001100
4019	00000100	00000100	00000100	00000100
4020	5000	4000	3000	5000
4023		500(*2)		600(*2)
4039	0	0	0	0
4040				
4041				
4048				
4049				
4080	20560	80	72	85
4083	30	30	30	30
4093	0	120	0	120
4100	1100	2007	835	3050
4101	100	100	100	90
4102	1254	2007	835	3210
4103	0	0	0	0
4104	2500	2500	6000	1400
4105	531	516	444	555
4106	4000	3000	7500	2300
4107	0	444	0	555
4108	0	0	0	0
4109	25	25	25	25
4110	887	754	823	1131
4111	292	215	239	379
4112	200	200	200	200
4113	180	185	215	172
4114	0	0	0	0
4115	100	100	100	100
4116	4794	6516	6532	4691
4117	90	105	105	90
4118	100	105	105	100
4119	53	39	20	55
4120	0	0	0	0
4124	24575	24533	24553	24575
4127	144	120	120	120
4128	110	0	0	0
4129	0	0	0	0
4130	25700	25700	25700	25700
4134	130	140	140	130
4136	0	30	0	30
4138	0	835	0	1020
4139	0	100	0	79
4140	0	835	0	1042
4141	0	0	0	0
4142	0	6000	0	4000
4143	0	7500	0	7000
4144	0	0	0	0
4145	0	25	0	25
4146	0	823	0	993
4147	0	239	0	352
4148	0	200	0	200
4149	0	215	0	172
4150	0	0	0	0
4151	0	100	0	100
4152	0	6532	0	4691
4153	0	105	0	90
4154	0	105	0	100
4155	0	24553	0	24575
4156	0	0	0	0
4158	0	0	0	0
4159	0	0	0	0
4161	0	25700	0	25700
4165	0	20	0	55
4166	0	72	0	16730
4169	0	0	0	0
Maximum output during acceleration (for PS selection)	108kW	117kW	117kW	120kW
Motor model (old name)	–	α100/4000HV*i*	α100/4000HV*i*	–
Applicable amplifier (old name)	–	SPM-75HV*i*	SPM-75HV*i*	–

(*2)When using the SDT signal, manually change the parameters that were automatically set.
(*4) This setting is used when only a low-speed winding is connected without the output range being switched in the output range switching motor.

JR AUTOMATION TECHNOLOGIES INC*
JDOWLING

C.13 SPINDLE MOTOR αiIP series (400V)

Motor model	αiIP 15/6000HV	αiIP 22/6000HV	αiIP 22/6000HV	αiIP 40/6000HV	αiIP 50/6000HV	αiIP 60/5000HV
Applicable amplifier	αi SP15HV	αi SP30HV	αi SP22HV	αi SP30HV	αi SP30HV	αi SP30HV
Model code	416	417	–	418	419	420
Applicable software series and edition	9D8A/I 9DAA/A	9D8A/I 9DAA/A	–	9D50/F,9D70/A	9D8A/I 9DAA/A	9D8A/I 9DAA/A
Low-speed winding characteristics	5/9kW 500/1500min-1	7.5/15kW 500/1500min-1	7.5/15kW 500/1500min-1	13/22kW 400/1500min-1	22/30kW 575/1500min-1	18.5/30kW 400/1500min-1
High-speed winding characteristics	7.5/9kW 750/6000min-1	11/15kW 750/6000min-1	11/15kW 750/6000min-1	18.5/22kW 575/6000min-1	22/30kW 1200/6000min-1	22/30kW 750/5000min-1
FS30i FS0i						
4007	00000000	00000000	00000000	00000000	00000000	00000000
4008	00000000	00010000	00010000	00000000	00000000	00000000
4009	00000000	00000000	00000000	00000000	00000000	00000000
4010	00000000	00000000	00000000	00000000	00000000	00000000
4011	00011010	00001010	00001010	00011010	00011010	00001010
4012	10000010	10000010	10000010	10000000	10000010	10000000
4013	00001100	01010000	01010000	01010000	01010000	01010000
4019	00000100	00000100	00000100	00000100	00000100	00000100
4020	6000	6000	6000	6000	6000	5000
4023	125	125(*2)	125(*2)	96(*2)	167	150(*2)
4039	0	0	0	0	0	0
4040						
4041						
4048						
4049						
4080	95	75	75	73	80	80
4083	30	30	30	30	30	30
4093	216	240	240	203	164	195
4100	760	760	760	600	1120	863
4101	90	88	88	100	100	100
4102	1460	1240	1240	889	1356	863
4103	60	0	0	75	85	0
4104	5000	5000	5000	6400	6000	6000
4105	367	286	286	531	475	495
4106	12000	15000	15000	6400	16000	14000
4107	289	288	288	516	508	492
4108	0	0	0	0	0	0
4109	25	25	25	25	25	25
4110	1384	1355	903	1098	838	764
4111	330	382	382	304	225	229
4112	200	200	200	200	200	200
4113	260	334	334	180	201	193
4114	0	20480	20480	20480	0	0
4115	100	100	100	100	100	100
4116	4600	4500	4500	6043	6202	5045
4117	90	90	90	90	90	90
4118	100	90	90	90	100	100
4119	37	29	29	53	48	49
4120	0	0	0	0	0	0
4124	24575	24575	24575	24575	24541	24544
4127	144	164	164	143	164	164
4128	103	105	105	115	104	0
4129	0	0	0	0	0	0
4130	25700	25700	25700	25700	25700	25700
4134	130	130	130	130	130	130
4136	30	30	30	30	30	30
4138	530	500	500	430	699	500
4139	75	60	60	100	95	100
4140	726	717	717	661	699	500
4141	75	0	0	60	95	0
4142	10000	8500	8500	8600	10000	11000
4143	28000	19000	19000	8600	24000	22000
4144	0	0	0	0	0	0
4145	25	25	25	25	25	25
4146	1934	2357	1571	2514	1374	1331
4147	465	620	620	726	395	424
4148	200	200	200	200	200	200
4149	330	332	332	185	188	194
4150	0	23040	23040	23040	0	0
4151	100	100	100	100	100	100
4152	5167	5542	5542	6040	6203	5045
4153	90	90	90	90	90	90
4154	100	90	90	90	100	100
4155	24575	24575	24575	24575	24575	24575
4156	0	0	0	0	0	0
4158	0	0	0	0	120	0
4159	0	0	0	0	0	0
4161	25700	25700	25700	25700	25700	25700
4165	29	29	29	52	51	49
4166	80	85	85	65	63	70
4169	0	0	0	0	0	0
Maximum output during acceleration (for PS selection)	13.5kW	20kW	20kW	29.0kW	35.4kW	36.0kW
Motor model (old name)	α15/6000HViP	α22/6000HViP	α22/6000HViP	α40/6000HViP	α50/6000HViP	–
Applicable amplifier (old name)	SPM-15HVi	SPM-30HVi	–	SPM-30HVi	SPM-30HVi	–

(*2)When using the SDT signal, manually change the parameters that were automatically set.

JR AUTOMATION TECHNOLOGIES INC*

C.14 SPINDLE MOTOR αiIT series (400V)

Motor model	αi IT 1.5/15000HV	αi IT 3/12000HV	αi IT 6/12000HV	αi IT 6/12000HV(*4)	αi IT 8/12000HV	αi IT 8/12000HV(*4)	αi IT 8/15000HV	αi IT 8/15000HV(*4)
Applicable amplifier	αi SP15HV	αi SP11HV	αi SP15HV	αi SP15HV	αi SP15HV	αi SP15HV	αi SP30HV	αi SP30HV
Model code	–	–	–	–	–	–	–	–
Applicable software series and edition	–	–	–	–	–	–	–	–
Low-speed winding characteristics	–	–	5.5/7.5kW 1500/12000min^{-1}	5.5/7.5kW 1500/12000min^{-1}	7.5/11kW 1500/12000min^{-1}	7.5/11kW 1500/12000min^{-1}	7.5/11/15kW 1500/4000min^{-1}	7.5/11/15kW 1500/4000min^{-1}
High-speed winding characteristics	1.5/2.2kW 3000/15000min^{-1}	3.7/5.5kW 1500/12000min^{-1}	5.5/7.5kW 4000/12000min^{-1}	–	7.5/11kW 4000/12000min^{-1}	–	7.5/11/15kW 4000/15000min^{-1}	–
FS30*i* FS0*i*								
4007	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4008	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4009	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4010	00000001	00000001	00000001	00000001	00000001	00000001	00000001	00000001
4011	00011001	00011001	00011010	00011010	00011010	00011010	00011010	00011010
4012	10000010	10000010	10000010	10000010	10000010	10000010	10000010	10000010
4013	00001100	00001100	00001100	00001100	00001100	00001100	01010000	01010000
4019	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100
4020	15000	12000	12000	12000	12000	12000	15000	4000
4023			333(*2)		333(*2)		267(*2)	
4039	0	0	0	0	0	0	0	0
4040						6(*3)		4(*3)
4041					6(*3)		4(*3)	
4048						6(*3)		4(*3)
4049					6(*3)		4(*3)	
4080	9045	90	96	19807	9050	14938	98	92
4083	10	30	30	30	30	30	30	30
4093	0	0	164	0	176	0	240	0
4100	3500	1550	4030	1570	3750	1550	4000	1630
4101	33	82	51	67	85	84	81	93
4102	7257	2864	4526	2475	3798	1957	5660	2913
4103	80	90	67	68	89	74	86	85
4104	3500	4000	2700	4600	3800	7000	3000	5500
4105	48	112	127	131	101	95	101	87
4106	3500	14000	7000	12000	10000	18000	3000	5500
4107	0	0	131	0	95	0	87	0
4108	0	0	0	0	0	0	0	0
4109	25	25	25	25	25	25	25	25
4110	1005	559	862	1508	569	838	646	984
4111	233	190	190	360	100	186	166	282
4112	200	200	200	200	200	200	200	200
4113	2000	850	750	730	950	1000	950	1100
4114	0	0	19200	19200	0	0	0	0
4115	100	100	100	100	100	100	100	100
4116	9815	7377	8202	8202	8736	8737	8703	8708
4117	90	90	90	90	90	90	90	90
4118	100	110	90	100	90	90	90	90
4119	5	11	13	13	10	266	266	9
4120	0	0	0	0	0	0	0	0
4124	24548	24513	24513	24575	24447	24510	24494	24575
4127	176	178	164	164	176	176	240	240
4128	90	0	105	113	0	0	105	106
4129	0	0	0	0	0	0	0	0
4130	25700	25700	25700	25700	25700	25700	25700	25700
4134	110	110	130	130	130	130	130	130
4136	0	0	30	0	30	0	30	0
4138	0	0	1570	0	1550	0	1630	0
4139	0	0	67	0	84	0	93	0
4140	0	0	2475	0	1957	0	2913	0
4141	0	0	68	0	74	0	85	0
4142	0	0	4600	0	7000	0	5500	0
4143	0	0	12000	0	18000	0	5500	0
4144	0	0	0	0	0	0	0	0
4145	0	0	25	0	25	0	25	0
4146	0	0	1508	0	838	0	984	0
4147	0	0	360	0	186	0	282	0
4148	0	0	200	0	200	0	200	0
4149	0	0	730	0	1000	0	1100	0
4150	0	0	19200	0	0	0	0	0
4151	0	0	100	0	100	0	100	0
4152	0	0	8202	0	8737	0	8708	0
4153	0	0	90	0	90	0	90	0
4154	0	0	100	0	90	0	90	0
4155	0	0	24575	0	24510	0	24575	0
4156	0	0	0	0	0	0	0	0
4158	0	0	113	0	0	0	106	0
4159	0	0	0	0	0	0	0	0
4161	0	0	25700	0	25700	0	25700	0
4165	0	0	13	0	266	0	9	0
4166	0	0	19807	0	14938	0	92	0
4169	0	0	0	0	0	0	0	0
Maximum output during acceleration (for PS selection)	13kW	13kW	13kW	13kW	13.2kW	13.2kW	28kW	28kW
Motor model (old name)	α1.5/15000HV*i* T	α3/12000HV*i* T	α6/12000HV*i* T	α6/12000HV*i* T	α8/12000HV*i* T	α8/12000HV*i* T	α8/15000HV*i* T	α8/15000HV*i* T
Applicable amplifier (old name)	SPM-15HV*i*	SPM-11HV*i*	SPM-15HV*i*	SPM-15HV*i*	SPM-15HV*i*	SPM-15HV*i*	SPM-30HV*i*	SPM-30HV*i*

(*2)When using the SDT signal, manually change the parameters that were automatically set.
(*3) Set this value as the initial value of the velocity loop gain for low-speed characteristics of speed range switching.

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Motor model	αi IT 15/10000HV	αi IT 15/10000HV(*4)	αi IT 15/12000HV	αi IT 15/12000HV(*4)	αi IT 15/15000HV	αi IT 22/10000HV	αi IT 22/10000HV(*4)
Applicable amplifier	αi SP30HV	αi SP30HV	αi SP30HV	αi SP30HV	αi SP30HV	αi SP30HV	αi SP30HV
Model code	–	–	–	–	–	–	–
Applicable software series and edition	–	–	–	–	–	–	–
Low-speed winding characteristics	15/18.5kW 1500/10000min-1	15/18.5kW 1500/10000min-1	15/18.5/22kW 1400/4000min-1	15/18.5/22kW 1400/4000min-1	15/18.5/22kW 1400/4000min-1	22/26kW 1500/10000min-1	22/26kW 1500/10000min-1
High-speed winding characteristics	15/18.5kW 4000/10000min-1	–	15/18.5/22kW 5000/12000min-1	–	15/18.5/22kW 5000/15000min-1	22/26kW 4000/10000min-1	–
FS30i FS0i							
4007	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4008	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4009	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4010	00000001	00000001	00000001	00000001	00000001	00000001	00000001
4011	00011010	00011010	00011010	00011010	00011010	00011010	00011010
4012	10000010	10000010	10000000	10000000	10000000	10000010	10000010
4013	01010000	01010000	01010000	01010000	01010000	01010000	01010000
4019	00000100	00000100	00000100	00000100	00000100	00000100	00000100
4020	10000	10000	12000	4000	15000	10000	10000
4023	400(*2)		292(*2)		233(*2)	400(*2)	
4039	0	0	0	0	0	0	0
4040							
4041					6(*3)		
4048							
4049					6(*3)		
4080	80	65	67	11354	19270	83	18517
4083	30	30	30	30	30	30	30
4093	148	0	176	0	176	142	0
4100	4000	1500	4600	1500	4600	3630	1500
4101	53	73	59	96	59	74	84
4102	3464	1972	4937	2494	4937	3318	1669
4103	70	65	94	0	94	93	82
4104	2800	4500	1800	3600	1800	2100	4000
4105	341	341	239	217	239	360	347
4106	2800	4500	3000	5500	3000	6300	12000
4107	341	0	217	0	217	347	0
4108	0	0	0	0	0	0	0
4109	25	25	25	25	25	25	25
4110	857	1499	870	1331	870	666	984
4111	229	425	295	470	295	160	270
4112	200	200	120	200	120	200	200
4113	280	280	400	440	400	265	275
4114	0	23040	0	0	0	0	0
4115	100	100	100	100	100	100	100
4116	5184	5153	9570	9567	9570	5000	4991
4117	90	90	90	90	90	90	90
4118	100	100	90	90	90	90	90
4119	34	34	1048	22	1048	50	70
4120	0	0	0	0	0	0	0
4124	24544	24575	24575	24575	24575	24489	24575
4127	148	148	176	176	176	142	142
4128	0	0	0	0	0	98	103
4129	0	0	0	0	0	0	0
4130	25700	25700	25700	25700	25700	25700	25700
4134	130	130	130	130	130	130	130
4136	30	0	30	0	30	30	0
4138	1500	0	1500	0	1500	1500	0
4139	73	0	96	0	96	84	0
4140	1972	0	2494	0	2494	1669	0
4141	65	0	0	0	0	82	0
4142	4500	0	3600	0	3600	4000	0
4143	4500	0	5500	0	5500	12000	0
4144	0	0	0	0	0	0	0
4145	25	0	25	0	25	25	0
4146	1499	0	1331	0	1331	984	0
4147	425	0	470	0	470	270	0
4148	200	0	200	0	200	200	0
4149	280	0	440	0	440	275	0
4150	23040	0	0	0	0	0	0
4151	100	0	100	0	100	100	0
4152	5153	0	9567	0	9567	4991	0
4153	90	0	90	0	90	90	0
4154	100	0	90	0	90	90	0
4155	24575	0	24575	0	24575	24575	0
4156	0	0	0	0	0	0	0
4158	0	0	0	0	0	103	0
4159	0	0	0	0	0	0	0
4161	25700	0	25700	0	25700	25700	0
4165	34	0	22	0	22	70	0
4166	65	0	11354	0	11354	18517	0
4169	0	0	0	0	0	0	0
Maximum output during acceleration (for PS selection)	22.2kW	22.2kW	38kW	38kW	38kW	31.2kW	31.2kW
Motor model (old name)	α15/10000HVi T	α15/10000HVi T	α15/12000HVi T	α15/12000HVi T	α15/15000HVi T	α22/10000HVi T	α22/10000HVi T
Applicable amplifier (old name)	SPM-30HVi	SPM-30HVi	SPM-30HVi	SPM-30HVi	SPM-30HVi	SPM-30HVi	SPM-30HVi

(*2)When using the SDT signal, manually change the parameters that were automatically set.
(*3) Set this value as the initial value of the velocity loop gain for low-speed characteristics of speed range switching.

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C.15 SPINDLE MOTOR αiIL series (400V)

Motor model	αi IL 8/20000HV	αi IL 15/15000HV	αi IL 26/15000HV
Applicable amplifier	αi SP45HV	αi SP45HV	αi SP45HV
Model code	–	–	–
Applicable software series and edition	–	–	–
Low-speed winding characteristics	11/15kW 1150/4000min-1	18.5/22kW 1400/4000min-1	15/22kW 700/2000min-1
High-speed winding characteristics	15/18.5kW 5000/20000min-1	18.5/22kW 6000/15000min-1	26/30kW 2000/15000min-1
FS30i FS0i			
4007	00000000	00000000	00000000
4008	00000000	00000000	00000000
4009	00000000	00000000	00000000
4010	00000001	00000001	00000001
4011	00011001	00011001	00011001
4012	10000010	10000010	10000010
4013	01010000	01010000	01010000
4019	00000100	00000100	00000100
4020	20000	15000	15000
4023	200(*2)	267(*2)	100
4039	0	0	0
4040			
4041	3(*3)	5(*3)	7(*3)
4048			
4049	3(*3)	5(*3)	7(*3)
4080	95	19792	14165
4083	30	30	30
4093	164	143	176
4100	5050	5500	2030
4101	53	44	79
4102	6274	5335	2633
4103	0	94	95
4104	3400	2300	3500
4105	105	298	245
4106	5000	2600	5500
4107	84	251	212
4108	0	0	0
4109	25	25	25
4110	862	1437	1508
4111	255	456	475
4112	200	200	200
4113	907	320	390
4114	0	0	0
4115	100	90	100
4116	9345	8423	4525
4117	90	90	90
4118	90	90	90
4119	523	30	24
4120	0	0	0
4124	24566	24575	24575
4127	148	143	138
4128	112	95	98
4129	0	0	0
4130	25700	25700	25700
4134	130	130	130
4136	30	30	30
4138	1320	1480	810
4139	88	92	77
4140	3163	2777	1248
4141	0	0	0
4142	7000	4800	6500
4143	10000	5200	12000
4144	0	0	0
4145	25	25	25
4146	1207	2011	2011
4147	375	632	639
4148	200	200	200
4149	1140	380	450
4150	0	0	0
4151	100	100	100
4152	12110	9785	4525
4153	90	90	85
4154	90	90	85
4155	24575	24575	24575
4156	0	0	0
4158	123	0	0
4159	0	0	0
4161	25700	25700	25700
4165	8	10	21
4166	95	14180	60
4169	0	0	0
Maximum output during acceleration (for PS selection)	48kW	48kW	50kW
Motor model (old name)	α8/20000HVi L	α15/15000HVi L	–
Applicable amplifier (old name)	SPM-45HVi	SPM-45HVi	–

(*2)When using the SDT signal, manually change the parameters that were automatically set.

(*3) Set this value as the initial value of the velocity loop gain for low-speed characteristics of speed range switching.

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C.16 SPINDLE MOTOR βiI series

Motor model	βiI 3/10000	βiI 3/10000	βiI 3/10000	βiI 3/10000	βiI 3/10000	βiI 6/10000	βiI 6/10000	βiI 6/10000
Applicable amplifier	βiI SVSPx-5.5 TYPE A	βiI SVSPx-7.5 TYPE D	βiI SVSPx-11 TYPE A,D	βiI SVSPx-15 TYPE A,D	βiI SVSPx-18	βiI SVSPx-11 TYPE A,D	βiI SVSPx-15 TYPE A,D	βiI SVSPx-18
Model code	332	336	337	338	371	333	339	359
Applicable softw are series and edition	9D50/I	9D50/Q	9D50/Q	9D50/Q	9D8A/D	9D50/I	9D50/Q	9D8A/A
Continuous rated characteristics	3.7kW 2000/10000min^{-1}	3.7kW 2000/10000min^{-1}	3.7kW 2000/10000min^{-1}	3.7kW 2000/10000min^{-1}	–	5.5kW 2000/10000min^{-1}	5.5kW 2000/10000min^{-1}	5.5kW 2000/10000min^{-1}
15-min. rated characteristics	5.5kW 1500/10000min^{-1}	5.5kW 1500/10000min^{-1}	5.5kW 1500/10000min^{-1}	5.5kW 1500/10000min^{-1}	3.7/5.5kW 1500/10000min^{-1}	7.5kW 1500/10000min^{-1}	7.5kW 1500/10000min^{-1}	7.5kW 1500/10000min^{-1}
FS30*i* FS0*i*								
4007	00000000	←	←	←	←	00000000	←	←
4008	00000000	←	←	←	←	00000000	←	←
4009	00000000	←	←	←	←	00000000	←	←
4010	00010000	←	←	←	←	00010000	←	←
4011	00011001	←	←	←	←	00011001	←	←
4012	10000000	←	←	←	←	10000000	←	←
4013	00001100	←	←	←	←	00001100	←	←
4019	00000100	←	←	←	←	00000100	←	←
4020	10000	←	←	←	←	10000	←	←
4023								
4039	0	←	←	←	0	0	←	←
4040								
4041								
4048								
4049								
4080	13412	←	←	←	←	14170	←	←
4083	30	←	←	←	←	30	←	←
4093	0	←	←	←	←	0	←	←
4100	1700	←	←	←	←	1550	←	←
4101	90	←	←	←	←	90	←	←
4102	2154	←	←	←	←	2621	←	←
4103	72	←	←	←	←	58	←	←
4104	2500	←	←	←	←	2000	←	←
4105	112	←	←	←	←	119	←	←
4106	6600	←	←	←	←	5500	←	←
4107	0	←	←	←	←	0	←	←
4108	0	←	←	←	←	0	←	←
4109	25	←	←	←	←	25	←	←
4110	718	1149	1436	2154	2872	520	780	1040
4111	318	←	←	←	←	208	←	←
4112	200	←	←	←	←	200	←	←
4113	850	←	←	←	←	800	←	←
4114	21760	←	←	←	←	0	←	←
4115	100	←	←	←	←	100	←	←
4116	7978	←	←	←	←	7395	←	←
4117	90	←	←	←	←	90	←	←
4118	100	←	←	←	←	100	←	←
4119	11	←	←	←	←	12	←	←
4120	0	←	←	←	←	0	←	←
4124	24575	←	←	←	←	24527	←	←
4127	164	←	←	←	←	150	←	←
4128	120	←	←	←	←	115	←	←
4129	0	←	←	←	←	0	←	←
4130	25700	←	←	←	←	25700	←	←
4134	110	←	←	←	←	110	←	←
4136	0	←	←	←	←	0	←	←
4138	0	←	←	←	←	0	←	←
4139	0	←	←	←	←	0	←	←
4140	0	←	←	←	←	0	←	←
4141	0	←	←	←	←	0	←	←
4142	0	←	←	←	←	0	←	←
4143	0	←	←	←	←	0	←	←
4144	0	←	←	←	←	0	←	←
4145	0	←	←	←	←	0	←	←
4146	0	←	←	←	←	0	←	←
4147	0	←	←	←	←	0	←	←
4148	0	←	←	←	←	0	←	←
4149	0	←	←	←	←	0	←	←
4150	0	←	←	←	←	0	←	←
4151	0	←	←	←	←	0	←	←
4152	0	←	←	←	←	0	←	←
4153	0	←	←	←	←	0	←	←
4154	0	←	←	←	←	0	←	←
4155	0	←	←	←	←	0	←	←
4156	0	←	←	←	←	0	←	←
4158	0	←	←	←	←	0	←	←
4159	0	←	←	←	←	0	←	←
4161	0	←	←	←	←	0	←	←
4165	0	←	←	←	←	0	←	←
4166	0	←	←	←	←	0	←	←
4169	0	←	←	←	←	0	←	←
Maximum output during acceleration	6.1kW	6.1kW	6.1kW	6.1kW	6.1kW	8.3kW	8.3kW	8.3kW
Motor model (old name)	β3/10000*i*	β3/10000*i*	β3/10000*i*	β3/10000*i*	–	β6/10000*i*	β6/10000*i*	β6/10000*i*
Applicable amplifier (old name)	SVPMx-5.5*i*	-	SVPMx-11*i*	SVPMx-15*i*	–	SVPMx-11*i*	SVPMx-15*i*	–

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Motor model	βi I 8/8000	βi I 8/8000	βi I 8/8000	βi I 8/10000	βi I 8/10000	βi I 8/10000	βi I 12/7000	βi I 12/7000
Applicable amplifier	βi SVSPx-11 TYPE A,D	βi SVSPx-15 TYPE A,D	βi SVSPx-18	βi SVSPx-11 TYPE A,D	βi SVSPx-15 TYPE A,D	βi SVSPx-18	βi SVSPx-15 TYPE A,D	βi SVSPx-18
Model code	334	340	-	341	342	360	335	-
Applicable softw are series and edition	9D50/I	9D50/Q	-	9D50/Q	9D50/Q	9D8A/A	9D50/I	-
Continuous rated characteristics	7.5kW 2000/8000min^{-1}	7.5kW 2000/8000min^{-1}	7.5kW 2000/8000min^{-1}	7.5kW 2000/10000min^{-1}	7.5kW 2000/10000min^{-1}	7.5kW 2000/10000min^{-1}	11kW 2000/7000min^{-1}	11kW 2000/7000min^{-1}
15-min. rated characteristics	11kW 1500/8000min^{-1}	11kW 1500/8000min^{-1}	11kW 1500/8000min^{-1}	11kW 1500/10000min^{-1}	11kW 1500/10000min^{-1}	11kW 1500/10000min^{-1}	15kW 1500/7000min^{-1}	15kW 1500/7000min^{-1}
FS30*i* FS0*i*								
4007	00000000	←	←	←	←	←	00000000	←
4008	00000000	←	←	←	←	←	00000000	←
4009	00000000	←	←	←	←	←	00000000	←
4010	00010000	←	←	←	←	←	00010000	←
4011	00011010	←	←	←	←	←	00011010	←
4012	10000000	←	←	←	←	←	10000000	←
4013	00001100	←	←	←	←	←	00001100	←
4019	00000100	←	←	←	←	←	00000100	←
4020	8000	←	←	10000	←	←	7000	←
4023								
4039	0	←	←	←	←	←	0	←
4040								
4041								
4048								
4049								
4080	75	←	←	←	←	←	60	←
4083	30	←	←	←	←	←	30	←
4093	0	←	←	←	←	←	0	←
4100	1500	←	←	←	←	←	1550	←
4101	95	←	←	←	←	←	82	←
4102	2602	←	←	←	←	←	1844	←
4103	64	←	←	←	←	←	80	←
4104	2000	←	←	←	←	←	3000	←
4105	191	←	←	←	←	←	135	←
4106	6000	←	←	←	←	←	8000	←
4107	0	←	←	←	←	←	0	←
4108	0	←	←	←	←	←	0	←
4109	25	←	←	←	←	←	25	←
4110	887	1331	1774	887	1331	1774	1031	1375
4111	381	←	←	←	←	←	355	←
4112	200	←	←	←	←	←	200	←
4113	500	←	←	←	←	←	705	←
4114	0	←	←	←	←	←	23040	←
4115	100	←	←	←	←	←	100	←
4116	8000	←	←	←	←	←	6300	←
4117	90	←	←	←	←	←	90	←
4118	100	←	←	←	←	←	100	←
4119	19	←	←	←	←	←	14	←
4120	0	←	←	←	←	←	0	←
4124	24575	←	←	←	←	←	24575	←
4127	161	←	←	←	←	←	150	←
4128	78	←	←	←	←	←	95	←
4129	0	←	←	←	←	←	0	←
4130	25700	←	←	←	←	←	25700	←
4134	110	←	←	←	←	←	110	←
4136	0	←	←	←	←	←	0	←
4138	0	←	←	←	←	←	0	←
4139	0	←	←	←	←	←	0	←
4140	0	←	←	←	←	←	0	←
4141	0	←	←	←	←	←	0	←
4142	0	←	←	←	←	←	0	←
4143	0	←	←	←	←	←	0	←
4144	0	←	←	←	←	←	0	←
4145	0	←	←	←	←	←	0	←
4146	0	←	←	←	←	←	0	←
4147	0	←	←	←	←	←	0	←
4148	0	←	←	←	←	←	0	←
4149	0	←	←	←	←	←	0	←
4150	0	←	←	←	←	←	0	←
4151	0	←	←	←	←	←	0	←
4152	0	←	←	←	←	←	0	←
4153	0	←	←	←	←	←	0	←
4154	0	←	←	←	←	←	0	←
4155	0	←	←	←	←	←	0	←
4156	0	←	←	←	←	←	0	←
4158	0	←	←	←	←	←	0	←
4159	0	←	←	←	←	←	0	←
4161	0	←	←	←	←	←	0	←
4165	0	←	←	←	←	←	0	←
4166	0	←	←	←	←	←	0	←
4169	0	←	←	←	←	←	0	←
Maximum output during acceleration	12.1kW	12.1kW	12.1kW	12.1kW	12.1kW	12.1kW	16.5kW	16.5kW
Motor model (old name)	β8/8000*i*	β8/8000*i*	β8/8000*i*	β8/10000*i*	β8/10000*i*	β8/10000*i*	β12/7000*i*	β12/7000*i*
Applicable amplifier (old name)	SVPMx-11*i*	SVPMx-15*i*	–	SVPMx-11*i*	SVPMx-15*i*	SVPMx-15*i*	SVPMx-15*i*	–

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Motor model	βi I 12/8000	βi I 12/8000	βi I 15/7000
Applicable amplifier	βi SVSPx-15 TYPE A,D	βi SVSPx-18	βi SVSPx-18
Model code	343	361	362
Applicable software series and edition	9D50/Q	9D8A/A	9D8A/A
Continuous rated characteristics	11kW	11kW	15kW
	2000/8000min^{-1}	2000/8000min^{-1}	2000/7000min^{-1}
15-min. rated characteristics	15kW	15kW	18.5kW
	1500/8000min^{-1}	1500/8000min^{-1}	1500/7000min^{-1}
FS30*i* FS0*i*			
4007	00000000	←	00000000
4008	00000000	←	00000000
4009	00000000	←	00000000
4010	00010000	←	00010000
4011	00011010	←	00011010
4012	10000000	←	10000000
4013	00001100	←	00001100
4019	00000100	←	00000100
4020	8000	←	7000
4023			
4039	0	←	0
4040			
4041			
4048			
4049			
4080	60	←	15445
4083	30	←	30
4093	0	←	0
4100	1550	←	1550
4101	82	←	81
4102	1844	←	1610
4103	80	←	0
4104	3000	←	2500
4105	135	←	320
4106	8000	←	5000
4107	0	←	0
4108	0	←	0
4109	25	←	25
4110	1031	1375	1426
4111	355	←	389
4112	200	←	200
4113	705	←	298
4114	23040	←	0
4115	100	←	100
4116	6300	←	4344
4117	90	←	90
4118	100	←	100
4119	14	←	32
4120	0	←	0
4124	24575	←	24575
4127	150	←	136
4128	95	←	0
4129	0	←	0
4130	25700	←	25700
4134	110	←	130
4136	0	←	0
4138	0	←	0
4139	0	←	0
4140	0	←	0
4141	0	←	0
4142	0	←	0
4143	0	←	0
4144	0	←	0
4145	0	←	0
4146	0	←	0
4147	0	←	0
4148	0	←	0
4149	0	←	0
4150	0	←	0
4151	0	←	0
4152	0	←	0
4153	0	←	0
4154	0	←	0
4155	0	←	0
4156	0	←	0
4158	0	←	0
4159	0	←	0
4161	0	←	0
4165	0	←	0
4166	0	←	0
4169	0	←	0
Maximum output during acceleration	16.5kW	16.5kW	
Motor model (old name)	β12/8000*i*	β12/8000*i*	–
Applicable amplifier (old name)	SVPMx-15*i*	–	–

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C.17 SPINDLE MOTOR βiIP series

Motor model	βi IP 8/6000	βi IP 12/6000	βi IP 12/6000	βi IP 12/6000	βi IP 12/6000	βi IP 15/6000	βi IP 15/6000	βi IP 15/6000
Applicable amplifier	βi SVSPx-7.5 TYPE D	βi SVSPx-7.5	βi SVSPx-11	βi SVSPx-15	βi SVSPx-18	βi SVSPx-11 TYPE D	βi SVSPx-15 TYPE A,D	βi SVSPx-18
Model code	–	347	348	349	370	350	351	354
Applicable softw are series and edition	–	9D8A/D	9D8A/D	9D8A/D	9D8A/D	9D50/U	9D50/Q	9D8A/A
Continuous rated characteristics	3.7kW 1000/6000min-1	–	–	–	–	7.5kW 1200/6000min-1	7.5kW 1200/6000min-1	7.5kW 1200/6000min-1
15-min. rated characteristics	5.5kW 750/6000min-1	5.5/7.5kW 750/6000min-1	5.5/7.5kW 750/6000min-1	5.5/7.5kW 750/6000min-1	5.5/7.5kW 750/6000min-1	9kW 750/6000min-1	9kW 750/6000min-1	9kW 750/6000min-1
FS30i FS0i								
4007	00000000	00000000	←	←	←	00000000	←	←
4008	00010000	00010000	←	←	←	00010000	←	←
4009	00000000	00000000	←	←	←	00000000	←	←
4010	00010000	00010000	←	←	←	00010000	←	←
4011	00001010	00001010	←	←	←	00001010	←	←
4012	10000000	10000000	←	←	←	10000000	←	←
4013	00001100	00001100	←	←	←	00001100	←	←
4019	00000100	00000100	←	←	←	00000100	←	←
4020	6000	6000	←	←	←	6000	←	←
4023								
4039	0	0	←	←	←	0	←	←
4040								
4041								
4048								
4049								
4080	16474	18000	←	←	←	20575	←	←
4083	30	30	←	←	←	30	←	←
4093	0	0	←	←	←	0	←	←
4100	800	800	←	←	←	750	←	←
4101	65	78	←	←	←	79	←	←
4102	1345	1059	←	←	←	1566	←	←
4103	0	0	←	←	←	0	←	←
4104	4500	5000	←	←	←	2000	←	←
4105	131	122	←	←	←	419	←	←
4106	7500	11000	←	←	←	7000	←	←
4107	0	0	←	←	←	0	←	←
4108	0	0	←	←	←	0	←	←
4109	25	25	←	←	←	25	←	←
4110	1106	927	1159	1738	2318	943	1414	1886
4111	503	403	←	←	←	503	←	←
4112	200	200	←	←	←	200	←	←
4113	730	780	←	←	←	228	←	←
4114	23552	20480	←	←	←	0	←	←
4115	100	100	←	←	←	100	←	←
4116	6255	6000	←	←	←	5307	←	←
4117	90	90	←	←	←	90	←	←
4118	100	100	←	←	←	100	←	←
4119	13	12	←	←	←	42	←	←
4120	0	0	←	←	←	0	←	←
4124	24575	24575	←	←	←	24575	←	←
4127	164	150	←	←	←	132	←	←
4128	110	0	←	←	←	90	←	←
4129	0	0	←	←	←	0	←	←
4130	25700	25700	←	←	←	25700	←	←
4134	110	110	←	←	←	130	←	←
4136	0	0	←	←	←	0	←	←
4138	0	0	←	←	←	0	←	←
4139	0	0	←	←	←	0	←	←
4140	0	0	←	←	←	0	←	←
4141	0	0	←	←	←	0	←	←
4142	0	0	←	←	←	0	←	←
4143	0	0	←	←	←	0	←	←
4144	0	0	←	←	←	0	←	←
4145	0	0	←	←	←	0	←	←
4146	0	0	←	←	←	0	←	←
4147	0	0	←	←	←	0	←	←
4148	0	0	←	←	←	0	←	←
4149	0	0	←	←	←	0	←	←
4150	0	0	←	←	←	0	←	←
4151	0	0	←	←	←	0	←	←
4152	0	0	←	←	←	0	←	←
4153	0	0	←	←	←	0	←	←
4154	0	0	←	←	←	0	←	←
4155	0	0	←	←	←	0	←	←
4156	0	0	←	←	←	0	←	←
4158	0	0	←	←	←	0	←	←
4159	0	0	←	←	←	0	←	←
4161	0	0	←	←	←	0	←	←
4165	0	0	←	←	←	0	←	←
4166	0	0	←	←	←	0	←	←
4169	0	0	←	←	←	0	←	←
Maximum output during acceleration	6.1kW	8.3kW	8.3kW	8.3kW	8.3kW	9.9kW	9.9kW	9.9kW
Motor model (old name)	–	–	–	–	–	–	–	–
Applicable amplifier (old name)	–	–	–	–	–	–	–	–

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Motor model	βi IP 18/6000	βi IP 18/6000	βi IP 18/6000	βi IP 22/6000	βi IP 22/6000	βi IP 30/6000
Applicable amplifier	βi SVSPx-11 TYPE D	βi SVSPx-15 TYPE A,D	βi SVSPx-18	βi SVSPx-15 TYPE A,D	βi SVSPx-18	βi SVSPx-18
Model code	353	352	355	356	357	358
Applicable software series and edition	9D50/U	9D50/Q	9D8A/A	9D5A/N, 9D8A/A	9D8A/A	9D8A/A
Continuous rated characteristics	9kW 1000/6000min^{-1}	9kW 1000/6000min^{-1}	9kW 1000/6000min^{-1}	11kW 1000/6000min^{-1}	11kW 1000/6000min^{-1}	15kW 1000/6000min^{-1}
15-min. rated characteristics	11kW 750/6000min^{-1}	11kW 750/6000min^{-1}	11kW 750/6000min^{-1}	15kW 750/6000min^{-1}	15kW 750/6000min^{-1}	18.5kW 750/6000min^{-1}
FS30*i* FS0*i*						
4007	00000000	←	←	00000000	←	00000000
4008	00010000	←	←	00010000	←	00010000
4009	00000000	←	←	00000000	←	00000000
4010	00010000	←	←	00010000	←	00010000
4011	00001010	←	←	00001010	←	00001010
4012	10000000	←	←	10000000	←	10000000
4013	00001100	←	←	00001100	←	00001100
4019	00000100	←	←	00000100	←	00000100
4020	6000	←	←	6000	←	6000
4023						
4039	0	←	←	0	←	0
4040						
4041						
4048						
4049						
4080	21845	←	←	19275	←	16730
4083	30	←	←	30	←	30
4093	0	←	←	0	←	0
4100	750	←	←	770	←	750
4101	79	←	←	100	←	100
4102	1191	←	←	953	←	1007
4103	0	←	←	0	←	0
4104	3000	←	←	4000	←	3500
4105	356	←	←	318	←	318
4106	7000	←	←	9000	←	8000
4107	0	←	←	0	←	0
4108	0	←	←	0	←	0
4109	25	←	←	25	←	25
4110	793	1190	1586	1077	1436	1143
4111	410	←	←	333	←	334
4112	200	←	←	200	←	200
4113	268	←	←	300	←	300
4114	0	←	←	20480	←	0
4115	100	←	←	100	←	100
4116	4194	←	←	4408	←	4298
4117	90	←	←	90	←	90
4118	100	←	←	100	←	100
4119	36	←	←	32	←	32
4120	0	←	←	0	←	0
4124	24575	←	←	24575	←	24575
4127	134	←	←	150	←	136
4128	105	←	←	103	←	0
4129	0	←	←	0	←	0
4130	25700	←	←	25700	←	25700
4134	130	←	←	130	←	130
4136	0	←	←	0	←	0
4138	0	←	←	0	←	0
4139	0	←	←	0	←	0
4140	0	←	←	0	←	0
4141	0	←	←	0	←	0
4142	0	←	←	0	←	0
4143	0	←	←	0	←	0
4144	0	←	←	0	←	0
4145	0	←	←	0	←	0
4146	0	←	←	0	←	0
4147	0	←	←	0	←	0
4148	0	←	←	0	←	0
4149	0	←	←	0	←	0
4150	0	←	←	0	←	0
4151	0	←	←	0	←	0
4152	0	←	←	0	←	0
4153	0	←	←	0	←	0
4154	0	←	←	0	←	0
4155	0	←	←	0	←	0
4156	0	←	←	0	←	0
4158	0	←	←	0	←	0
4159	0	←	←	0	←	0
4161	0	←	←	0	←	0
4165	0	←	←	0	←	0
4166	0	←	←	0	←	0
4169	0	←	←	0	←	0
Maximum output during acceleration	12.1kW	12.1kW	12.1kW	16.5kW	9.9kW	–
Motor model (old name)	–	–	–	–	–	–
Applicable amplifier (old name)	–	–	–	–	–	–

JR AUTOMATION TECHNOLOGIE GMBH JROWLING*

C.18 SPINDLE MOTOR βiIc series

Motor model	βiIc3/6000	βiIc3/6000	βiIc6/6000	βiIc6/6000	βiIc8/6000	βiIc8/6000
Applicable amplifier	βiSVSPc-7.5	βiSVSP-7.5-B	βiSVSPc-7.5L	βiSVSP-7.5-B	βiSVSPc-11	βiSVSP-11-B
Model code	271	271	272	272	273	273
Applicable softw are series and edition	9D60/G	9DB0/B	9D60/G	9DB0/B	9D60/G	9DB0/B
Continuous rated characteristics	3.7kW 2000/6000min^{-1}	3.7kW 2000/6000min^{-1}	5.5kW 2000/6000min^{-1}	5.5kW 2000/6000min^{-1}	7.5kW 2000/6000min^{-1}	7.5kW 2000/6000min^{-1}
15-min. rated characteristics	5.5kW 1500/6000min^{-1}	5.5kW 1500/6000min^{-1}	7.5kW 1500/6000min^{-1}	7.5kW 1500/6000min^{-1}	11kW 1500/6000min^{-1}	11kW 1500/6000min^{-1}
FS30*i* FS0*i*						
4000	00000000	10000000	00000000	10000000	00000000	10000000
4001	00000001	00000001	00000001	00000001	00000001	00000001
4002	00000010(*1)	00000010(*1)	00000010(*1)	00000010(*1)	00000010(*1)	00000010(*1)
4003	00000000	00000000	00000000	00000000	00000000	00000000
4005	00000001	00000001	00000001	00000001	00000001	00000001
4006	00000000	00000000	00000000	00000000	00000000	00000000
4007	00000000	00000000	00000000	00000000	00000000	00000000
4008	00001000	00001000	00001000	00001000	00001000	00001000
4011	00001000	00001000	00001000	00001000	00001000	00001000
4012	00000000	00000000	00000000	00000000	00000000	00000000
4013	00001100	00001100	00001100	00001100	00001100	00001100
4019	00000000	00000000	00000000	00000000	00000000	00000000
4020	6000	6000	6000	6000	6000	6000
4040~4045	24(*2)	24(*2)	34(*2)	34(*2)	28(*2)	28(*2)
4048~4053	607(*2)	607(*2)	844(*2)	844(*2)	696(*2)	696(*2)
4080	75	75	75	75	80	80
4083	60	60	60	60	60	60
4084	60	60	60	60	60	60
4085	60	60	60	60	60	60
4100	1600	1600	1607	1607	1450	1450
4101	90	90	65	65	90	90
4102	1800	1800	1607	1607	1799	1799
4103	53	53	53	53	36	36
4104	400	400	300	300	400	400
4105	25	25	25	25	25	25
4106	100	100	100	100	100	100
4107	0	0	0	0	0	0
4108	200	200	200	200	200	200
4109	25	25	25	25	25	25
4110	929	929	623	623	580	580
4111	250	250	276	276	250	250
4112	200	200	200	200	200	200
4113	1000	1000	897	897	680	680
4114	0	0	0	0	0	0
4115	100	100	100	100	100	100
4116	8500	8500	7393	7393	8001	8001
4117	29530	29530	120	120	32090	32090
4118	120	120	120	120	100	100
4119	10	10	21	21	12	12
4120	15	15	15	15	15	15
4124	0	0	0	0	0	0
4127	164	164	150	150	161	161
4128	0	0	90	90	90	90
4129	0	0	0	0	0	0
4130	100	100	100	100	100	100
4131	12900	12900	12900	12900	12900	12900
4134	110	110	110	110	110	110
4138	1500	1500	1700	1700	4350	4350
4139	150	150	150	150	450	450
4140	5600	5600	6000	6000	5800	5800
4141	680	680	650	650	600	600
4142	0	0	0	0	0	0
4143	0	0	0	0	0	0
4362	-28572	-28572	-30645	-30645	-32693	-32693
4363	-30495	-30495	30820	30820	-26424	-26424
4364	28972	28972	31020	31020	26924	26924

(*1) This setting is applied to when the position coder is attached to the spindle. When using the αiBZ sensor, set bits 3, 2, 1, 0 of parameter No. 4002 to 0, 0, 1, 1, respectively, and set bits 7, 6, 5, 4 of parameter No. 4003 or parameter No. 4361 depending on the number of sensor teeth.

(*2) Since these values are the standard values for the motor alone, they need to be changed as shown below depending on the load state of an actual machine. Setting = (machine load inertia/motor inertia + 1) * standard value of motor alone

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C.19 SPINDLE MOTOR αiI-B series

Motor model	αiI 0.5/10000-B	αiI 0.5/10000-B	αiI 0.5/10000-B	αiI 0.5/10000-B	αiI 0.5/10000-B	αiI 0.5/10000-B	αiI 0.5/10000-B	αiI 0.5/10000-B
Applicable amplifier	αi SP 2.2-B	βi SVSP 7.5-B	βi SVSP 11-B αi SP 11-B	βi SVSP 15-B αi SP 15-B	αi SP 2.2-B	βi SVSP 7.5-B	βi SVSP 11-B αi SP 11-B	βi SVSP 15-B αi SP 15-B
Output specification nameplate	A06B-1230-K401#S00	A06B-1230-K401#S00	A06B-1230-K401#S00	A06B-1230-K401#S00	A06B-1230-K401#S0P	A06B-1230-K401#S0P	A06B-1230-K401#S0P	A06B-1230-K401#S0P
Model code	5000	6000	7000	8000	5001	6001	7001	8001
Parameter ID	2954	–	–	–	2810	–	–	–
Applicable software series and edition	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0*i*-D,FS30*i*								
4007	00000000	←	←	←	00000000	←	←	←
4008	00000000	←	←	←	00010000	←	←	←
4009	00000000	←	←	←	00000000	←	←	←
4010	00000000	←	←	←	00000000	←	←	←
4011	00011000	←	←	←	00001000	←	←	←
4012	10000010	←	←	←	10000010	←	←	←
4013	00001100	←	←	←	00001100	←	←	←
4019	00000100	←	←	←	00000100	←	←	←
4400	00000000	←	←	←	00000000	←	←	←
4020	10000	←	←	←	10000	←	←	←
4023(*1)	30	←	←	←	30	←	←	←
4039	0	←	←	←	0	←	←	←
4040(*2)	2	←	←	←	1	←	←	←
4041(*2)	10	←	←	←	10	←	←	←
4048(*2)	8	←	←	←	6	←	←	←
4049(*2)	10	←	←	←	10	←	←	←
4080	90	←	←	←	20560	←	←	←
4083	30	←	←	←	30	←	←	←
4093	0	←	←	←	0	←	←	←
4100	3400	←	←	←	3400	←	←	←
4101	100	←	←	←	100	←	←	←
4102	6500	←	←	←	6500	←	←	←
4103	46	←	←	←	0	←	←	←
4104	3000	←	←	←	3000	←	←	←
4105	46	←	←	←	46	←	←	←
4106	7500	←	←	←	7500	←	←	←
4107	0	←	←	←	0	←	←	←
4108	0	←	←	←	0	←	←	←
4109	25	←	←	←	25	←	←	←
4110	1571	2514	3142	4713	1571	2514	3142	4713
4111	260	←	←	←	361	←	←	←
4112	200	←	←	←	200	←	←	←
4113	2077	←	←	←	2077	←	←	←
4114	23040	←	←	←	24320	←	←	←
4115	100	←	←	←	100	←	←	←
4116	13760	←	←	←	13760	←	←	←
4117	90	←	←	←	90	←	←	←
4118	100	←	←	←	100	←	←	←
4119	5	←	←	←	5	←	←	←
4120	0	←	←	←	0	←	←	←
4124	24570	←	←	←	24575	←	←	←
4127	240	←	←	←	240	←	←	←
4128	120	←	←	←	105	←	←	←
4129	0	←	←	←	0	←	←	←
4130	25700	←	←	←	25700	←	←	←
4134	110	←	←	←	110	←	←	←
4136	30	←	←	←	30	←	←	←
4138	0	←	←	←	0	←	←	←
4139	0	←	←	←	0	←	←	←
4140	0	←	←	←	0	←	←	←
4141	0	←	←	←	0	←	←	←
4142	0	←	←	←	0	←	←	←
4143	0	←	←	←	0	←	←	←
4144	0	←	←	←	0	←	←	←
4145	0	←	←	←	0	←	←	←
4146	0	←	←	←	0	←	←	←
4147	0	←	←	←	0	←	←	←
4148	0	←	←	←	0	←	←	←
4149	0	←	←	←	0	←	←	←
4150	0	←	←	←	0	←	←	←
4151	0	←	←	←	0	←	←	←
4152	0	←	←	←	0	←	←	←
4153	0	←	←	←	0	←	←	←
4154	0	←	←	←	0	←	←	←
4155	0	←	←	←	0	←	←	←
4156	0	←	←	←	0	←	←	←
4158	0	←	←	←	0	←	←	←
4159	0	←	←	←	0	←	←	←
4161	0	←	←	←	0	←	←	←
4165	0	←	←	←	0	←	←	←
4166	0	←	←	←	0	←	←	←
4169	0	←	←	←	0	←	←	←
4362	0	←	←	←	0	←	←	←
4363	0	←	←	←	0	←	←	←
4364	0	←	←	←	0	←	←	←
4365	0	←	←	←	0	←	←	←
4366	0	←	←	←	0	←	←	←
4367	0	←	←	←	0	←	←	←
4612	107	←	←	←	78	←	←	←
4613	10889	←	←	←	10891	←	←	←
4614	0	←	←	←	0	←	←	←
4615	0	←	←	←	0	←	←	←
Maximum output during acceleration (for PS selection)	1.32	1.32	1.32	1.32	1.8	1.8	1.8	1.8

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

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Motor model	αiI 0.5/15000-B	αiI 0.5/15000-B	αiI 0.5/15000-B	αiI 0.5/15000-B	αiI 1/10000-B	αiI 1/10000-B	αiI 1/10000-B	αiI 1/10000-B
Applicable amplifier	αi SP 2.2-B	βi SVSP 7.5-B	βi SVSP 11-B αi SP 11-B	βi SVSP 15-B αi SP 15-B	αi SP 2.2-B	βi SVSP 7.5-B	βi SVSP 11-B αi SP 11-B	βi SVSP 15-B αi SP 15-B
Output specification nameplate	A06B-1230-K400#S0P	A06B-1230-K400#S0P	A06B-1230-K400#S0P	A06B-1230-K400#S0P	A06B-1230-K402#S00	A06B-1230-K402#S00	A06B-1230-K402#S00	A06B-1230-K402#S00
Model code	5002	6002	7002	8002	5003	6003	7003	8003
Parameter ID	2828	–	–	–	2979	–	–	–
Applicable software series and edition	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0*i*-D,FS30*i*								
4007	00000000	←	←	←	00000000	←	←	←
4008	00010000	←	←	←	00000000	←	←	←
4009	00000000	←	←	←	00000000	←	←	←
4010	00000000	←	←	←	00000000	←	←	←
4011	00001000	←	←	←	00011001	←	←	←
4012	10000010	←	←	←	10000010	←	←	←
4013	00001100	←	←	←	00001100	←	←	←
4019	00000100	←	←	←	00000100	←	←	←
4400	00000000	←	←	←	00000000	←	←	←
4020	15000	←	←	←	10000	←	←	←
4023(*1)	30	←	←	←	30	←	←	←
4039	0	←	←	←	0	←	←	←
4040(*2)	1	←	←	←	5	←	←	←
4041(*2)	10	←	←	←	10	←	←	←
4048(*2)	6	←	←	←	25	←	←	←
4049(*2)	10	←	←	←	10	←	←	←
4080	20570	←	←	←	83	←	←	←
4083	30	←	←	←	30	←	←	←
4093	0	←	←	←	0	←	←	←
4100	3300	←	←	←	3100	←	←	←
4101	100	←	←	←	100	←	←	←
4102	8226	←	←	←	3557	←	←	←
4103	0	←	←	←	87	←	←	←
4104	2000	←	←	←	6000	←	←	←
4105	46	←	←	←	45	←	←	←
4106	6000	←	←	←	6000	←	←	←
4107	0	←	←	←	0	←	←	←
4108	0	←	←	←	0	←	←	←
4109	25	←	←	←	25	←	←	←
4110	1508	2413	3016	4524	690	1104	1380	2070
4111	346	←	←	←	102	←	←	←
4112	200	←	←	←	200	←	←	←
4113	2078	←	←	←	2100	←	←	←
4114	0	←	←	←	17920	←	←	←
4115	100	←	←	←	100	←	←	←
4116	13770	←	←	←	10018	←	←	←
4117	90	←	←	←	90	←	←	←
4118	100	←	←	←	100	←	←	←
4119	5	←	←	←	5	←	←	←
4120	0	←	←	←	0	←	←	←
4124	24575	←	←	←	24448	←	←	←
4127	327	←	←	←	176	←	←	←
4128	110	←	←	←	0	←	←	←
4129	0	←	←	←	0	←	←	←
4130	25700	←	←	←	25700	←	←	←
4134	110	←	←	←	110	←	←	←
4136	30	←	←	←	30	←	←	←
4138	0	←	←	←	0	←	←	←
4139	0	←	←	←	0	←	←	←
4140	0	←	←	←	0	←	←	←
4141	0	←	←	←	0	←	←	←
4142	0	←	←	←	0	←	←	←
4143	0	←	←	←	0	←	←	←
4144	0	←	←	←	0	←	←	←
4145	0	←	←	←	0	←	←	←
4146	0	←	←	←	0	←	←	←
4147	0	←	←	←	0	←	←	←
4148	0	←	←	←	0	←	←	←
4149	0	←	←	←	0	←	←	←
4150	0	←	←	←	0	←	←	←
4151	0	←	←	←	0	←	←	←
4152	0	←	←	←	0	←	←	←
4153	0	←	←	←	0	←	←	←
4154	0	←	←	←	0	←	←	←
4155	0	←	←	←	0	←	←	←
4156	0	←	←	←	0	←	←	←
4158	0	←	←	←	0	←	←	←
4159	0	←	←	←	0	←	←	←
4161	0	←	←	←	0	←	←	←
4165	0	←	←	←	0	←	←	←
4166	0	←	←	←	0	←	←	←
4169	0	←	←	←	0	←	←	←
4362	0	←	←	←	0	←	←	←
4363	0	←	←	←	0	←	←	←
4364	0	←	←	←	0	←	←	←
4365	0	←	←	←	0	←	←	←
4366	0	←	←	←	0	←	←	←
4367	0	←	←	←	0	←	←	←
4612	78	←	←	←	145	←	←	←
4613	19976	←	←	←	26637	←	←	←
4614	0	←	←	←	0	←	←	←
4615	0	←	←	←	0	←	←	←
Maximum output during acceleration (for PS selection)	1.8	1.8	1.8	1.8	2.64	2.64	2.64	2.64

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

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Motor model	αi I 1/10000-B	αi I 1/10000-B	αi I 1/10000-B	αi I 1/10000-B	αi I 1/10000-B	αi I 1/10000-B	αi I 1/10000-B	αi I 1/10000-B
Applicable amplifier	αi SP 2.2-B	βi SVSP 7.5-B	βi SVSP 11-B αi SP 11-B	βi SVSP 15-B αi SP 15-B	αi SP 5.5-B	βi SVSP 7.5-B	βi SVSP 11-B αi SP 11-B	βi SVSP 15-B αi SP 15-B
Output specification nameplate	A06B-1230-K402#S0P	A06B-1230-K402#S0P	A06B-1230-K402#S0P	A06B-1230-K402#S0P	A06B-1230-K402#S0S	A06B-1230-K402#S0S	A06B-1230-K402#S0S	A06B-1230-K402#S0S
Model code	5004	6004	7004	8004	5005	6005	7005	8005
Parameter ID	2911	–	–	–	2676	–	–	–
Applicable software series and edition	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0*i*-D,FS30*i*								
4007	00000000	←	←	←	00000000	←	←	←
4008	00010000	←	←	←	00010000	←	←	←
4009	00000000	←	←	←	00000000	←	←	←
4010	00000000	←	←	←	00000000	←	←	←
4011	00001001	←	←	←	00001001	←	←	←
4012	10000010	←	←	←	10000010	←	←	←
4013	00001100	←	←	←	00001100	←	←	←
4019	00000100	←	←	←	00000100	←	←	←
4400	00000000	←	←	←	00000000	←	←	←
4020	10000	←	←	←	10000	←	←	←
4023(*1)	30	←	←	←	30	←	←	←
4039	0	←	←	←	0	←	←	←
4040(*2)	3	←	←	←	2	←	←	←
4041(*2)	10	←	←	←	10	←	←	←
4048(*2)	15	←	←	←	9	←	←	←
4049(*2)	10	←	←	←	10	←	←	←
4080	7770	←	←	←	1887	←	←	←
4083	30	←	←	←	30	←	←	←
4093	0	←	←	←	0	←	←	←
4100	3100	←	←	←	3310	←	←	←
4101	100	←	←	←	100	←	←	←
4102	3557	←	←	←	3566	←	←	←
4103	0	←	←	←	0	←	←	←
4104	4300	←	←	←	5750	←	←	←
4105	45	←	←	←	45	←	←	←
4106	15000	←	←	←	9500	←	←	←
4107	0	←	←	←	0	←	←	←
4108	0	←	←	←	0	←	←	←
4109	25	←	←	←	25	←	←	←
4110	690	1104	1380	2070	692	1107	1384	2076
4111	164	←	←	←	286	←	←	←
4112	200	←	←	←	200	←	←	←
4113	2100	←	←	←	2100	←	←	←
4114	23040	←	←	←	0	←	←	←
4115	100	←	←	←	100	←	←	←
4116	10018	←	←	←	6296	←	←	←
4117	90	←	←	←	90	←	←	←
4118	100	←	←	←	100	←	←	←
4119	5	←	←	←	5	←	←	←
4120	0	←	←	←	0	←	←	←
4124	24492	←	←	←	24575	←	←	←
4127	296	←	←	←	480	←	←	←
4128	0	←	←	←	0	←	←	←
4129	0	←	←	←	0	←	←	←
4130	25700	←	←	←	25700	←	←	←
4134	110	←	←	←	110	←	←	←
4136	30	←	←	←	30	←	←	←
4138	0	←	←	←	0	←	←	←
4139	0	←	←	←	0	←	←	←
4140	0	←	←	←	0	←	←	←
4141	0	←	←	←	0	←	←	←
4142	0	←	←	←	0	←	←	←
4143	0	←	←	←	0	←	←	←
4144	0	←	←	←	0	←	←	←
4145	0	←	←	←	0	←	←	←
4146	0	←	←	←	0	←	←	←
4147	0	←	←	←	0	←	←	←
4148	0	←	←	←	0	←	←	←
4149	0	←	←	←	0	←	←	←
4150	0	←	←	←	0	←	←	←
4151	0	←	←	←	0	←	←	←
4152	0	←	←	←	0	←	←	←
4153	0	←	←	←	0	←	←	←
4154	0	←	←	←	0	←	←	←
4155	0	←	←	←	0	←	←	←
4156	0	←	←	←	0	←	←	←
4158	0	←	←	←	0	←	←	←
4159	0	←	←	←	0	←	←	←
4161	0	←	←	←	0	←	←	←
4165	0	←	←	←	0	←	←	←
4166	0	←	←	←	0	←	←	←
4169	0	←	←	←	0	←	←	←
4362	-26474	←	←	←	-26524	←	←	←
4363	-24276	←	←	←	-28372	←	←	←
4364	-24076	←	←	←	31220	←	←	←
4365	0	←	←	←	0	←	←	←
4366	0	←	←	←	0	←	←	←
4367	0	←	←	←	0	←	←	←
4612	86	←	←	←	52	←	←	←
4613	13837	←	←	←	13837	←	←	←
4614	0	←	←	←	0	←	←	←
4615	0	←	←	←	0	←	←	←
Maximum output during acceleration (for PS selection)	4.44	4.44	4.44	4.44	7.2	7.2	7.2	7.2

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

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Motor model	αi I1/15000-B	αi I1/15000-B	αi I1/15000-B	αi I1/15000-B	αi I1/24000-B	αi I1.5/10000-B	αi I1.5/10000-B	αi I1.5/10000-B	αi I1.5/10000-B
Applicable amplifier	αi SP 5.5-B	βi SVSP 7.5-B	βi SVSP 11-B αi SP 11-B	βi SVSP 15-B αi SP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 5.5-B	βi SVSP 7.5-B	βi SVSP 11-B αi SP 11-B	βi SVSP 15-B αi SP 15-B
Output specification nameplate	A06B-1230-K422#S00	A06B-1230-K422#S00	A06B-1230-K422#S00	A06B-1230-K422#S00	A06B-1230-K420#S0S	A06B-1230-K403#S0P	A06B-1230-K403#S0P	A06B-1230-K403#S0P	A06B-1230-K403#S0P
Model code	5006	6006	7006	8006	5007	5008	6008	7008	8008
Parameter ID	2632	–	–	–	2711	2355	–	–	–
Applicable software series and edition	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0*i*-D,FS30*i*									
4007	00000000	←	←	←	00000000	00000000	←	←	←
4008	00000000	←	←	←	00000000	00010000	←	←	←
4009	00000000	←	←	←	00000000	00000000	←	←	←
4010	00000001	←	←	←	00000001	00000000	←	←	←
4011	00011001	←	←	←	00011001	00001001	←	←	←
4012	10000010	←	←	←	10000010	10000010	←	←	←
4013	00001100	←	←	←	00001100	00001100	←	←	←
4019	00000100	←	←	←	00000100	00000100	←	←	←
4400	00000000	←	←	←	00000000	00000000	←	←	←
4020	15000	←	←	←	24000	10000	←	←	←
4023(*1)	30	←	←	←	30	30	←	←	←
4039	0	←	←	←	0	0	←	←	←
4040(*2)	5	←	←	←	2	3	←	←	←
4041(*2)	10	←	←	←	10	10	←	←	←
4048(*2)	25	←	←	←	10	14	←	←	←
4049(*2)	10	←	←	←	10	10	←	←	←
4080	85	←	←	←	15447	14174	←	←	←
4083	30	←	←	←	10	30	←	←	←
4093	0	←	←	←	0	0	←	←	←
4100	3100	←	←	←	6100	3200	←	←	←
4101	93	←	←	←	99	75	←	←	←
4102	8015	←	←	←	11558	3708	←	←	←
4103	70	←	←	←	66	0	←	←	←
4104	2000	←	←	←	1300	4500	←	←	←
4105	51	←	←	←	48	58	←	←	←
4106	7000	←	←	←	2800	9500	←	←	←
4107	0	←	←	←	0	0	←	←	←
4108	0	←	←	←	0	0	←	←	←
4109	25	←	←	←	25	25	←	←	←
4110	343	549	686	1029	915	754	1206	1508	2262
4111	102	←	←	←	299	325	←	←	←
4112	200	←	←	←	200	200	←	←	←
4113	1870	←	←	←	1978	1635	←	←	←
4114	0	←	←	←	0	0	←	←	←
4115	100	←	←	←	90	100	←	←	←
4116	9669	←	←	←	10318	9598	←	←	←
4117	90	←	←	←	90	90	←	←	←
4118	100	←	←	←	28260	100	←	←	←
4119	5	←	←	←	5	5	←	←	←
4120	0	←	←	←	0	0	←	←	←
4124	24448	←	←	←	24575	24575	←	←	←
4127	176	←	←	←	600	300	←	←	←
4128	80	←	←	←	0	0	←	←	←
4129	0	←	←	←	0	0	←	←	←
4130	25700	←	←	←	25700	25700	←	←	←
4134	110	←	←	←	110	110	←	←	←
4136	30	←	←	←	30	30	←	←	←
4138	0	←	←	←	0	0	←	←	←
4139	0	←	←	←	0	0	←	←	←
4140	0	←	←	←	0	0	←	←	←
4141	0	←	←	←	0	0	←	←	←
4142	0	←	←	←	0	0	←	←	←
4143	0	←	←	←	0	0	←	←	←
4144	0	←	←	←	0	0	←	←	←
4145	0	←	←	←	0	0	←	←	←
4146	0	←	←	←	0	0	←	←	←
4147	0	←	←	←	0	0	←	←	←
4148	0	←	←	←	0	0	←	←	←
4149	0	←	←	←	0	0	←	←	←
4150	0	←	←	←	0	0	←	←	←
4151	0	←	←	←	0	0	←	←	←
4152	0	←	←	←	0	0	←	←	←
4153	0	←	←	←	0	0	←	←	←
4154	0	←	←	←	0	0	←	←	←
4155	0	←	←	←	0	0	←	←	←
4156	0	←	←	←	0	0	←	←	←
4158	0	←	←	←	0	0	←	←	←
4159	0	←	←	←	0	0	←	←	←
4161	0	←	←	←	0	0	←	←	←
4165	0	←	←	←	0	0	←	←	←
4166	0	←	←	←	0	0	←	←	←
4169	0	←	←	←	0	0	←	←	←
4362	0	←	←	←	0	-24276	←	←	←
4363	0	←	←	←	0	-26224	←	←	←
4364	0	←	←	←	0	-30220	←	←	←
4365	0	←	←	←	0	0	←	←	←
4366	0	←	←	←	0	0	←	←	←
4367	0	←	←	←	0	0	←	←	←
4612	135	←	←	←	42	64	←	←	←
4613	20488	←	←	←	16390	11168	←	←	←
4614	0	←	←	←	0	0	←	←	←
4615	0	←	←	←	0	0	←	←	←
Maximum output during acceleration (for PS selection)	5.6	5.6	5.6	5.6	22	6.6	6.6	6.6	6.6

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

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Motor model	αi I 1.5/10000-B	αi I 1.5/10000-B	αi I 1.5/10000-B	αi I 1.5/10000-B	αi I 1.5/20000-B	αi I 1.5/20000-B	αi I 1.5/20000-B	αi I 2/10000-B	αi I 2/10000-B	αi I 2/10000-B	αi I 2/10000-B
Applicable amplifier	βi SVSP 7.5-B	βi SVSP 11-B αi SP 11-B	βi SVSP 15-B αi SP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B	βi SVSP 18-B αi SP 22-B	αi SP 5.5-B	βi SVSP 7.5-B	βi SVSP 11-B αi SP 11-B	βi SVSP 15-B αi SP 15-B
Output specification nameplate	A06B-1230-K403#S0S	A06B-1230-K403#S0S	A06B-1230-K403#S0S	A06B-1230-K403#S0S	A06B-1230-K423#S00	A06B-1230-K423#S00	A06B-1230-K423#S0S	A06B-1230-K404#S00	A06B-1230-K404#S00	A06B-1230-K404#S00	A06B-1230-K404#S00
Model code	5009	6009	7009	8009	5010	6010	5011	5012	6012	7012	8012
Parameter ID	2472	–	–	–	2359	–	2270	2310	–	–	–
Applicable software series and edition	9DAA/N 9DB0/N	9DAA/N 9DB0/N	9DAA/N 9DB0/N	9DAA/N 9DB0/N	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0*i*-D,FS30*i*											
4007	00000000	←	←	←	00000000	←	00000000	00000000	←	←	←
4008	00010000	←	←	←	00000000	←	00000000	00000000	←	←	←
4009	00000000	←	←	←	00000000	←	00000000	00000000	←	←	←
4010	00000000	←	←	←	00000001	←	00000001	00000000	←	←	←
4011	00001001	←	←	←	00011001	←	00011001	00011001	←	←	←
4012	10000010	←	←	←	10000010	←	10000010	10000010	←	←	←
4013	00001100	←	←	←	00001100	←	00001100	00001100	←	←	←
4019	00000100	←	←	←	00000100	←	00000100	00000100	←	←	←
4400	00000000	←	←	←	00000000	←	00000000	00000000	←	←	←
4020	10000	←	←	←	20000	←	20000	10000	←	←	←
4023(*1)	30	←	←	←	30	←	30	30	←	←	←
4039	0	←	←	←	0	←	0	0	←	←	←
4040(*2)	2	←	←	←	3	←	2	4	←	←	←
4041(*2)	10	←	←	←	10	←	10	10	←	←	←
4048(*2)	11	←	←	←	15	←	9	19	←	←	←
4049(*2)	10	←	←	←	10	←	10	10	←	←	←
4080	15962	←	←	←	14165	←	5981	77	←	←	←
4083	30	←	←	←	10	←	10	30	←	←	←
4093	0	←	←	←	0	←	0	0	←	←	←
4100	3350	←	←	←	3250	←	3300	1550	←	←	←
4101	66	←	←	←	33	←	87	100	←	←	←
4102	3708	←	←	←	7145	←	7145	2567	←	←	←
4103	0	←	←	←	75	←	70	68	←	←	←
4104	4500	←	←	←	2300	←	3000	6000	←	←	←
4105	58	←	←	←	43	←	43	80	←	←	←
4106	9500	←	←	←	8700	←	3000	6000	←	←	←
4107	0	←	←	←	0	←	0	0	←	←	←
4108	0	←	←	←	0	←	0	0	←	←	←
4109	25	←	←	←	25	←	25	25	←	←	←
4110	1207	1509	2263	3018	629	839	838	474	758	948	1422
4111	490	←	←	←	180	←	260	175	←	←	←
4112	200	←	←	←	200	←	200	200	←	←	←
4113	1635	←	←	←	2227	←	2227	1192	←	←	←
4114	0	←	←	←	0	←	0	0	←	←	←
4115	100	←	←	←	90	←	90	100	←	←	←
4116	9598	←	←	←	10289	←	10289	9300	←	←	←
4117	90	←	←	←	90	←	90	90	←	←	←
4118	100	←	←	←	100	←	100	100	←	←	←
4119	5	←	←	←	5	←	1	8	←	←	←
4120	0	←	←	←	0	←	0	0	←	←	←
4124	24575	←	←	←	24505	←	24570	24501	←	←	←
4127	409	←	←	←	176	←	490	202	←	←	←
4128	0	←	←	←	73	←	102	90	←	←	←
4129	0	←	←	←	0	←	0	0	←	←	←
4130	25700	←	←	←	25700	←	25700	25700	←	←	←
4134	110	←	←	←	110	←	110	110	←	←	←
4136	30	←	←	←	30	←	30	30	←	←	←
4138	0	←	←	←	0	←	0	0	←	←	←
4139	0	←	←	←	0	←	0	0	←	←	←
4140	0	←	←	←	0	←	0	0	←	←	←
4141	0	←	←	←	0	←	0	0	←	←	←
4142	0	←	←	←	0	←	0	0	←	←	←
4143	0	←	←	←	0	←	0	0	←	←	←
4144	0	←	←	←	0	←	0	0	←	←	←
4145	0	←	←	←	0	←	0	0	←	←	←
4146	0	←	←	←	0	←	0	0	←	←	←
4147	0	←	←	←	0	←	0	0	←	←	←
4148	0	←	←	←	0	←	0	0	←	←	←
4149	0	←	←	←	0	←	0	0	←	←	←
4150	0	←	←	←	0	←	0	0	←	←	←
4151	0	←	←	←	0	←	0	0	←	←	←
4152	0	←	←	←	0	←	0	0	←	←	←
4153	0	←	←	←	0	←	0	0	←	←	←
4154	0	←	←	←	0	←	0	0	←	←	←
4155	0	←	←	←	0	←	0	0	←	←	←
4156	0	←	←	←	0	←	0	0	←	←	←
4158	0	←	←	←	0	←	0	0	←	←	←
4159	0	←	←	←	0	←	0	0	←	←	←
4161	0	←	←	←	0	←	0	0	←	←	←
4165	0	←	←	←	0	←	0	0	←	←	←
4166	0	←	←	←	0	←	0	0	←	←	←
4169	0	←	←	←	0	←	0	0	←	←	←
4362	-24351	←	←	←	0	←	-23826	0	←	←	←
4363	-28372	←	←	←	0	←	-27772	0	←	←	←
4364	-26224	←	←	←	0	←	-31768	0	←	←	←
4365	0	←	←	←	0	←	0	0	←	←	←
4366	0	←	←	←	0	←	0	0	←	←	←
4367	0	←	←	←	0	←	0	0	←	←	←
4612	41	←	←	←	48	←	45	127	←	←	←
4613	11170	←	←	←	26886	←	20354	26893	←	←	←
4614	0	←	←	←	0	←	0	0	←	←	←
4615	0	←	←	←	0	←	0	0	←	←	←
Maximum output during acceleration (for PS selection)	9	9	9	9	13	13	22	4.44	4.44	4.44	4.44

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

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Motor model	αi I2/10000-B	αi I2/10000-B	αi I2/10000-B	αi I2/10000-B	αi I2/12000-B	αi I2/20000-B	αi I3/10000-B	αi I3/10000-B	αi I3/10000-B	αi I3/10000-B
Applicable amplifier	βi SVSP 7.5-B	βi SVSP 11-B αi SP 11-B	βi SVSP 15-B αi SP 15-B	βi SVSP 18-B αi SP 22-B	βi SVSP 18-B αi SP 22-B	βi SVSP 18-B αi SP 22-B	αi SP 5.5-B	βi SVSP 7.5-B	βi SVSP 11-B αi SP 11-B	βi SVSP 15-B αi SP 15-B
Output specification nameplate	A06B-1230-K404#S0P	A06B-1230-K404#S0P	A06B-1230-K404#S0P	A06B-1230-K404#S0P	A06B-1230-K418#S0S	A06B-1230-K424#S0S	A06B-1230-K405#S00	A06B-1230-K405#S00	A06B-1230-K405#S00	A06B-1230-K405#S00
Model code	5013	6013	7013	8013	5112	5015	5016	6016	7016	8016
Parameter ID	2631	–	–	–	2514	2447	2145	–	–	–
Applicable software series and edition	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/P 9DB0/P	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0*i*-D,FS30*i*										
4007	00000000	←	←	←	00000000	00000000	00000000	←	←	←
4008	00010000	←	←	←	00000000	00000000	00010000	←	←	←
4009	00000000	←	←	←	00000000	00000000	00000000	←	←	←
4010	00000000	←	←	←	00000001	00000001	00000000	←	←	←
4011	00001001	←	←	←	00011001	00011001	00011001	←	←	←
4012	10000010	←	←	←	10000010	10000000	10000010	←	←	←
4013	00001100	←	←	←	00001100	00001100	00001100	←	←	←
4019	00000100	←	←	←	00000100	00000100	00000100	←	←	←
4400	00000000	←	←	←	00000000	00000000	00000000	←	←	←
4020	10000	←	←	←	12000	20000	10000	←	←	←
4023(*1)	30	←	←	←	30	30	30	←	←	←
4039	0	←	←	←	0	0	0	←	←	←
4040(*2)	3	←	←	←	2	3	5	←	←	←
4041(*2)	10	←	←	←	10	10	10	←	←	←
4048(*2)	13	←	←	←	11	15	25	←	←	←
4049(*2)	10	←	←	←	10	10	10	←	←	←
4080	20575	←	←	←	20575	92	60	←	←	←
4083	30	←	←	←	30	10	30	←	←	←
4093	0	←	←	←	0	0	0	←	←	←
4100	1550	←	←	←	3100	3100	1600	←	←	←
4101	85	←	←	←	61	100	100	←	←	←
4102	2567	←	←	←	4911	6432	1967	←	←	←
4103	0	←	←	←	80	92	75	←	←	←
4104	4500	←	←	←	2550	1700	7000	←	←	←
4105	96	←	←	←	83	53	89	←	←	←
4106	15000	←	←	←	10500	2500	7000	←	←	←
4107	0	←	←	←	0	0	0	←	←	←
4108	0	←	←	←	0	0	0	←	←	←
4109	25	←	←	←	25	25	25	←	←	←
4110	759	949	1423	1898	1044	588	475	760	950	1425
4111	298	←	←	←	331	175	200	←	←	←
4112	200	←	←	←	200	200	19400	←	←	←
4113	992	←	←	←	1150	1800	1077	←	←	←
4114	0	←	←	←	0	0	0	←	←	←
4115	100	←	←	←	100	80	100	←	←	←
4116	9300	←	←	←	10677	16564	7950	←	←	←
4117	90	←	←	←	90	90	28250	←	←	←
4118	100	←	←	←	90	100	110	←	←	←
4119	10	←	←	←	2	2	5	←	←	←
4120	0	←	←	←	0	0	0	←	←	←
4124	24575	←	←	←	24575	24501	24521	←	←	←
4127	300	←	←	←	292	292	178	←	←	←
4128	107	←	←	←	0	0	0	←	←	←
4129	0	←	←	←	0	0	0	←	←	←
4130	25700	←	←	←	25700	25700	25700	←	←	←
4134	110	←	←	←	110	110	110	←	←	←
4136	30	←	←	←	30	30	30	←	←	←
4138	0	←	←	←	0	0	0	←	←	←
4139	0	←	←	←	0	0	0	←	←	←
4140	0	←	←	←	0	0	0	←	←	←
4141	0	←	←	←	0	0	0	←	←	←
4142	0	←	←	←	0	0	0	←	←	←
4143	0	←	←	←	0	0	0	←	←	←
4144	0	←	←	←	0	0	0	←	←	←
4145	0	←	←	←	0	0	0	←	←	←
4146	0	←	←	←	0	0	0	←	←	←
4147	0	←	←	←	0	0	0	←	←	←
4148	0	←	←	←	0	0	0	←	←	←
4149	0	←	←	←	0	0	0	←	←	←
4150	0	←	←	←	0	0	0	←	←	←
4151	0	←	←	←	0	0	0	←	←	←
4152	0	←	←	←	0	0	0	←	←	←
4153	0	←	←	←	0	0	0	←	←	←
4154	0	←	←	←	0	0	0	←	←	←
4155	0	←	←	←	0	0	0	←	←	←
4156	0	←	←	←	0	0	0	←	←	←
4158	0	←	←	←	0	0	0	←	←	←
4159	0	←	←	←	0	0	0	←	←	←
4161	0	←	←	←	0	0	0	←	←	←
4165	0	←	←	←	0	0	0	←	←	←
4166	0	←	←	←	0	0	0	←	←	←
4169	0	←	←	←	0	0	0	←	←	←
4362	-24176	←	←	←	0	-23826	0	←	←	←
4363	-24176	←	←	←	0	-29845	0	←	←	←
4364	-32268	←	←	←	0	31720	0	←	←	←
4365	0	←	←	←	0	0	0	←	←	←
4366	0	←	←	←	0	0	0	←	←	←
4367	0	←	←	←	0	0	0	←	←	←
4612	73	←	←	←	6215	88	144	←	←	←
4613	27136	←	←	←	12299	20357	19842	←	←	←
4614	0	←	←	←	0	0	0	←	←	←
4615	0	←	←	←	0	0	0	←	←	←
Maximum output during acceleration (for PS selection)	6.6	6.6	6.6	6.6	20	20	6.6	6.6	6.6	6.6

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

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Motor model	αi I 2/10000-B(*3)	αi I 2/10000-B(*3)	αi I 2/10000-B(*3)
Applicable amplifier	αi SP 11-B βi SVSP 11-B	βi SVSP 15-B αi SP 15-B	βi SVSP 18-B αi SP 22-B
Output specification nameplate	A06B-1230-K404#S0S	A06B-1230-K404#S0S	A06B-1230-K404#S0S
Model code	5014	6014	7014
Parameter ID	2872	–	–
Applicable software series and edition	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/O 9DB0/O
FS0*i*-D,FS30*i*			
4007	00000000	←	←
4008	00010000	←	←
4009	00000000	←	←
4010	00000000	←	←
4011	00001001	←	←
4012	10000111	←	←
4013	00001100	←	←
4019	00000100	←	←
4400	00000001	←	←
4020	10000	←	←
4023(*1)	30	←	←
4039	0	←	←
4040(*2)	2	←	←
4041(*2)	10	←	←
4048(*2)	7	←	←
4049(*2)	10	←	←
4080	15711	←	←
4083	30	←	←
4093	0	←	←
4100	1650	←	←
4101	98	←	←
4102	2567	←	←
4103	0	←	←
4104	2400	←	←
4105	96	←	←
4106	6800	←	←
4107	0	←	←
4108	0	←	←
4109	25	←	←
4110	949	1424	1898
4111	396	←	←
4112	200	←	←
4113	992	←	←
4114	0	←	←
4115	100	←	←
4116	9300	←	←
4117	90	←	←
4118	100	←	←
4119	10	←	←
4120	0	←	←
4124	24575	←	←
4127	545	←	←
4128	113	←	←
4129	0	←	←
4130	25700	←	←
4134	110	←	←
4136	30	←	←
4138	0	←	←
4139	0	←	←
4140	0	←	←
4141	0	←	←
4142	0	←	←
4143	0	←	←
4144	0	←	←
4145	0	←	←
4146	0	←	←
4147	0	←	←
4148	0	←	←
4149	0	←	←
4150	0	←	←
4151	0	←	←
4152	0	←	←
4153	0	←	←
4154	0	←	←
4155	0	←	←
4156	0	←	←
4158	0	←	←
4159	0	←	←
4161	0	←	←
4165	0	←	←
4166	0	←	←
4169	0	←	←
4362	-24526	←	←
4363	-28272	←	←
4364	31220	←	←
4365	0	←	←
4366	0	←	←
4367	0	←	←
4612	46	←	←
4613	26893	←	←
4614	0	←	←
4615	0	←	←
Maximum output during acceleration (for PS selection)	12	12	12

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

(*3)For this motor model, it is necessary to set the OVC alarm detection level for motor protection.
Manually change the following parameters to estimate temperature of motor winding that were automatically set.

Parameter No.	Contents	Setting
4134	Overload current alarm detection level *(H/W) Motor overheat level *(L/W)	11010158
4398#7	Setting for estimation of temperature	1
4170	Heat generation coefficient for estimation temperature	864
4453	Time constant of heat generation for estimation of temperature	850

*(H/W) means higher word side in double word type parameter.
*(L/W) means lower word side in double word type parameter.

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*JDOWLING

Motor model	αi I3/10000-B	αi I3/10000-B	αi I3/10000-B	αi I3/10000-B	αi I3/10000-B	αi I3/10000-B	αi I3/10000-B	αi I3/12000-B	αi I3/12000-B	αi I3/12000-B
Applicable amplifier	βi SVSP 7.5-B	βi SVSP 11-B αi SP 11-B	βi SVSP 15-B αi SP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 11-B βi SVSP 11-B	βi SVSP 15-B αi SP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 11-B βi SVSP 11-B	βi SVSP 15-B αi SP 15-B	βi SVSP 18-B αi SP 22-B
Output specification nameplate	A06B-1230-K405#S0P	A06B-1230-K405#S0P	A06B-1230-K405#S0P	A06B-1230-K405#S0P	A06B-1230-K405#S0S	A06B-1230-K405#S0S	A06B-1230-K405#S0S	A06B-1230-K425#S00	A06B-1230-K425#S00	A06B-1230-K425#S00
Model code	5017	6017	7017	8017	5018	6018	7018	5019	6019	7019
Parameter ID	2275	–	–	–	2692	–	–	2319	–	–
Applicable software series and edition	9DAA/N 9DB0/N	9DAA/N 9DB0/N	9DAA/N 9DB0/N	9DAA/N 9DB0/N	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0*i*-D,FS30*i*										
4007	00000000	←	←	←	00000000	←	←	00000000	←	←
4008	00010000	←	←	←	00000000	←	←	00000000	←	←
4009	00000000	←	←	←	00000000	←	←	00000000	←	←
4010	00000000	←	←	←	00000000	←	←	00000000	←	←
4011	00001001	←	←	←	00011001	←	←	00011001	←	←
4012	10000010	←	←	←	10000010	←	←	10000010	←	←
4013	00001100	←	←	←	00001100	←	←	00001100	←	←
4019	00000100	←	←	←	00000100	←	←	00000100	←	←
4400	00000000	←	←	←	00000000	←	←	00000000	←	←
4020	10000	←	←	←	10000	←	←	12000	←	←
4023(*1)	30	←	←	←	30	←	←	30	←	←
4039	0	←	←	←	0	←	←	0	←	←
4040(*2)	4	←	←	←	3	←	←	5	←	←
4041(*2)	10	←	←	←	10	←	←	10	←	←
4048(*2)	18	←	←	←	12	←	←	25	←	←
4049(*2)	10	←	←	←	10	←	←	10	←	←
4080	15445	←	←	←	12895	←	←	16720	←	←
4083	30	←	←	←	30	←	←	30	←	←
4093	0	←	←	←	0	←	←	0	←	←
4100	1600	←	←	←	1700	←	←	1500	←	←
4101	100	←	←	←	100	←	←	87	←	←
4102	1967	←	←	←	1967	←	←	3015	←	←
4103	0	←	←	←	0	←	←	82	←	←
4104	6000	←	←	←	6500	←	←	3200	←	←
4105	89	←	←	←	89	←	←	106	←	←
4106	13000	←	←	←	17000	←	←	7500	←	←
4107	0	←	←	←	0	←	←	0	←	←
4108	0	←	←	←	0	←	←	0	←	←
4109	25	←	←	←	25	←	←	25	←	←
4110	759	949	1423	1898	949	1424	1898	559	839	1118
4111	258	←	←	←	377	←	←	190	←	←
4112	19400	←	←	←	19400	←	←	200	←	←
4113	1077	←	←	←	1077	←	←	900	←	←
4114	0	←	←	←	0	←	←	19200	←	←
4115	100	←	←	←	80	←	←	100	←	←
4116	7950	←	←	←	7950	←	←	7376	←	←
4117	28250	←	←	←	28250	←	←	90	←	←
4118	110	←	←	←	110	←	←	100	←	←
4119	5	←	←	←	5	←	←	9	←	←
4120	0	←	←	←	0	←	←	0	←	←
4124	24569	←	←	←	24575	←	←	24513	←	←
4127	243	←	←	←	357	←	←	178	←	←
4128	0	←	←	←	0	←	←	0	←	←
4129	0	←	←	←	0	←	←	0	←	←
4130	25700	←	←	←	25700	←	←	25700	←	←
4134	110	←	←	←	110	←	←	110	←	←
4136	30	←	←	←	30	←	←	30	←	←
4138	0	←	←	←	0	←	←	0	←	←
4139	0	←	←	←	0	←	←	0	←	←
4140	0	←	←	←	0	←	←	0	←	←
4141	0	←	←	←	0	←	←	0	←	←
4142	0	←	←	←	0	←	←	0	←	←
4143	0	←	←	←	0	←	←	0	←	←
4144	0	←	←	←	0	←	←	0	←	←
4145	0	←	←	←	0	←	←	0	←	←
4146	0	←	←	←	0	←	←	0	←	←
4147	0	←	←	←	0	←	←	0	←	←
4148	0	←	←	←	0	←	←	0	←	←
4149	0	←	←	←	0	←	←	0	←	←
4150	0	←	←	←	0	←	←	0	←	←
4151	0	←	←	←	0	←	←	0	←	←
4152	0	←	←	←	0	←	←	0	←	←
4153	0	←	←	←	0	←	←	0	←	←
4154	0	←	←	←	0	←	←	0	←	←
4155	0	←	←	←	0	←	←	0	←	←
4156	0	←	←	←	0	←	←	0	←	←
4158	0	←	←	←	0	←	←	0	←	←
4159	0	←	←	←	0	←	←	0	←	←
4161	0	←	←	←	0	←	←	0	←	←
4165	0	←	←	←	0	←	←	0	←	←
4166	0	←	←	←	0	←	←	0	←	←
4169	0	←	←	←	0	←	←	0	←	←
4362	0	←	←	←	0	←	←	0	←	←
4363	0	←	←	←	0	←	←	0	←	←
4364	0	←	←	←	0	←	←	0	←	←
4365	0	←	←	←	0	←	←	0	←	←
4366	0	←	←	←	0	←	←	0	←	←
4367	0	←	←	←	0	←	←	0	←	←
4612	105	←	←	←	72	←	←	125	←	←
4613	19842	←	←	←	19586	←	←	32256	←	←
4614	0	←	←	←	0	←	←	0	←	←
4615	0	←	←	←	0	←	←	0	←	←
Maximum output during acceleration (for PS selection)	9	9	9	9	13.2	13.2	13.2	12	12	12

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

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Motor model	αi I3/12000-B	αi I3/15000-B	αi I6/10000-B	αi I6/10000-B	αi I6/10000-B	αi I6/10000-B	αi I6/10000-B	αi I6/10000-B	αi I6/10000-B	αi I6/10000-B
Applicable amplifier	βi SVSP 18-B αi SP 22-B	αi SP 22-B	αi SP 11-B βi SVSP 11-B	βi SVSP 15-B αi SP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 11-B βi SVSP 11-B	βi SVSP 15-B αi SP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B
Output specification nameplate	A06B-1230-K425#S0S	A06B-1230-K419#S0S	A06B-1230-K406#S00	A06B-1230-K406#S00	A06B-1230-K406#S00	A06B-1230-K406#S0P	A06B-1230-K406#S0P	A06B-1230-K406#S0P	A06B-1230-K406#S0S	A06B-1230-K406#S0S
Model code	5020	5021	5022	6022	7022	5023	6023	7023	5024	6024
Parameter ID	2268	2030	2314	–	–	2124	–	–	2700	–
Applicable software series and edition	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/O 9DB0/O
FS0*i*-D,FS30*i*										
4007	00000000	00000000	00000000	←	←	00000000	←	←	00000000	←
4008	00000000	00000000	00000000	←	←	00010000	←	←	00010000	←
4009	00000000	00000000	00000000	←	←	00000000	←	←	00000000	←
4010	00000000	00000001	00000000	←	←	00000000	←	←	00000000	←
4011	00011001	00001001	00011010	←	←	00001010	←	←	00001010	←
4012	10000000	10000010	10000010	←	←	10000111	←	←	10000111	←
4013	00001100	00001100	00001100	←	←	00001100	←	←	00001100	←
4019	00000100	00000100	00000100	←	←	00000100	←	←	00000100	←
4400	00000000	00000000	00000000	←	←	00000001	←	←	00000001	←
4020	12000	15000	10000	←	←	10000	←	←	10000	←
4023(*1)	30	30	30	←	←	30	←	←	30	←
4039	0	0	0	←	←	0	←	←	0	←
4040(*2)	2	4	5	←	←	3	←	←	3	←
4041(*2)	10	10	10	←	←	10	←	←	10	←
4048(*2)	10	18	22	←	←	15	←	←	11	←
4049(*2)	10	10	10	←	←	10	←	←	10	←
4080	20570	7700	66	←	←	16710	←	←	16191	←
4083	30	30	30	←	←	30	←	←	30	←
4093	0	0	0	←	←	0	←	←	0	←
4100	1600	3150	1550	←	←	1570	←	←	1600	←
4101	100	100	96	←	←	100	←	←	97	←
4102	3015	4725	2630	←	←	2016	←	←	2016	←
4103	4939	0	60	←	←	0	←	←	0	←
4104	1700	2000	6000	←	←	3000	←	←	3000	←
4105	106	106	154	←	←	138	←	←	138	←
4106	4000	7000	6000	←	←	6000	←	←	6000	←
4107	0	0	0	←	←	0	←	←	0	←
4108	0	0	0	←	←	0	←	←	0	←
4109	25	25	25	←	←	25	←	←	25	←
4110	1117	614	754	1131	1508	603	905	1206	905	1207
4111	399	229	260	←	←	261	←	←	358	←
4112	200	200	200	←	←	200	←	←	200	←
4113	900	904	620	←	←	690	←	←	690	←
4114	19200	0	20480	←	←	0	←	←	0	←
4115	80	100	100	←	←	100	←	←	90	←
4116	7376	7375	8803	←	←	6500	←	←	6500	←
4117	90	90	90	←	←	90	←	←	90	←
4118	90	100	100	←	←	100	←	←	100	←
4119	9	10	15	←	←	527	←	←	527	←
4120	0	0	0	←	←	0	←	←	0	←
4124	24575	24544	24570	←	←	24571	←	←	24575	←
4127	421	327	164	←	←	240	←	←	327	←
4128	110	0	109	←	←	6505	←	←	115	←
4129	0	0	0	←	←	0	←	←	0	←
4130	25700	25700	25700	←	←	25700	←	←	25700	←
4134	110	110	130	←	←	130	←	←	130	←
4136	30	30	30	←	←	30	←	←	30	←
4138	0	0	0	←	←	0	←	←	0	←
4139	0	0	0	←	←	0	←	←	0	←
4140	0	0	0	←	←	0	←	←	0	←
4141	0	0	0	←	←	0	←	←	0	←
4142	0	0	0	←	←	0	←	←	0	←
4143	0	0	0	←	←	0	←	←	0	←
4144	0	0	0	←	←	0	←	←	0	←
4145	0	0	0	←	←	0	←	←	0	←
4146	0	0	0	←	←	0	←	←	0	←
4147	0	0	0	←	←	0	←	←	0	←
4148	0	0	0	←	←	0	←	←	0	←
4149	0	0	0	←	←	0	←	←	0	←
4150	0	0	0	←	←	0	←	←	0	←
4151	0	0	0	←	←	0	←	←	0	←
4152	0	0	0	←	←	0	←	←	0	←
4153	0	0	0	←	←	0	←	←	0	←
4154	0	0	0	←	←	0	←	←	0	←
4155	0	0	0	←	←	0	←	←	0	←
4156	0	0	0	←	←	0	←	←	0	←
4158	0	0	0	←	←	0	←	←	0	←
4159	0	0	0	←	←	0	←	←	0	←
4161	0	0	0	←	←	0	←	←	0	←
4165	0	0	0	←	←	0	←	←	0	←
4166	0	0	0	←	←	0	←	←	0	←
4169	0	0	0	←	←	0	←	←	0	←
4362	-24176	0	0	←	←	0	←	←	-24301	←
4363	-30245	0	0	←	←	0	←	←	-26324	←
4364	-30120	0	0	←	←	0	←	←	31230	←
4365	0	0	0	←	←	0	←	←	0	←
4366	0	0	0	←	←	0	←	←	0	←
4367	0	0	0	←	←	0	←	←	0	←
4612	61	78	150	←	←	107	←	←	76	←
4613	32267	20489	22411	←	←	22411	←	←	22155	←
4614	0	0	0	←	←	0	←	←	0	←
4615	0	0	0	←	←	0	←	←	0	←
Maximum output during acceleration (for PS selection)	22	18	9	9	9	13.2	13.2	13.2	18	18

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

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Motor model	αi I 6/12000-B	αi I 6/12000-B	αi I 6/12000-B	αi I 6/12000-B	αi I 6/12000-B	αi I 6/12000-B	αi I 6/15000-B	αi I 6/15000-B	αi I 6/15000-B	αi I 6/15000-B
Applicable amplifier	αi SP 11-B βi SVSP 11-B	βi SVSP 15-B αi SP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 11-B βi SVSP 11-B	βi SVSP 15-B αi SP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 11-B βi SVSP 11-B	βi SVSP 15-B αi SP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 22-B
Output specification nameplate	A06B-1230-K426#S00	A06B-1230-K426#S00	A06B-1230-K426#S00	A06B-1230-K426#S0P	A06B-1230-K426#S0P	A06B-1230-K426#S0P	A06B-1230-K433#S00	A06B-1230-K433#S00	A06B-1230-K433#S00	A06B-1230-K433#S0S
Model code	5200	6200	7200	5201	6201	7201	5025	6025	7025	5026
Parameter ID	2138	–	–	2989	–	–	2235	–	–	2125
Applicable software series and edition	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0*i*-D,FS30*i*										
4007	00000000	←	←	00000000	←	←	00000000	←	←	00000000
4008	00000000	←	←	00010000	←	←	00010000	←	←	00000000
4009	00000000	←	←	00000000	←	←	00000000	←	←	00000000
4010	00000000	←	←	00000000	←	←	00010001	←	←	00000001
4011	00011010	←	←	00001010	←	←	00011010	←	←	00011010
4012	10000000	←	←	10000111	←	←	10000000	←	←	10000010
4013	00001100	←	←	00001100	←	←	00001100	←	←	00001100
4019	00000100	←	←	00000100	←	←	00000100	←	←	00000100
4400	00000000	←	←	00010001	←	←	00000000	←	←	00000000
4020	12000	←	←	12000	←	←	15000	←	←	15000
4023(*1)	333	←	←	333	←	←	30	←	←	30
4039	0	←	←	0	←	←	0	←	←	0
4040(*2)	13	←	←	9	←	←	4	←	←	4
4041(*2)	5	←	←	3	←	←	10	←	←	10
4048(*2)	58	←	←	40	←	←	16	←	←	18
4049(*2)	22	←	←	15	←	←	10	←	←	10
4080	82	←	←	75	←	←	10332	←	←	10325
4083	20	←	←	30	←	←	30	←	←	30
4093	164	←	←	240	←	←	0	←	←	0
4100	4000	←	←	4400	←	←	1570	←	←	3100
4101	81	←	←	100	←	←	93	←	←	100
4102	4561	←	←	4838	←	←	2885	←	←	4853
4103	69	←	←	0	←	←	88	←	←	0
4104	4000	←	←	1200	←	←	2300	←	←	2600
4105	147	←	←	119	←	←	143	←	←	137
4106	4000	←	←	2500	←	←	4400	←	←	6000
4107	154	←	←	138	←	←	0	←	←	0
4108	0	←	←	0	←	←	0	←	←	0
4109	25	←	←	25	←	←	25	←	←	25
4110	431	647	862	479	719	958	586	879	1172	702
4111	125	←	←	198	←	←	240	←	←	275
4112	200	←	←	200	←	←	200	←	←	200
4113	650	←	←	800	←	←	670	←	←	700
4114	20480	←	←	17920	←	←	0	←	←	0
4115	100	←	←	100	←	←	100	←	←	100
4116	8986	←	←	6500	←	←	7647	←	←	7157
4117	90	←	←	90	←	←	28250	←	←	90
4118	100	←	←	100	←	←	100	←	←	100
4119	15	←	←	15	←	←	29	←	←	29
4120	0	←	←	0	←	←	0	←	←	0
4124	24464	←	←	24519	←	←	24554	←	←	24575
4127	164	←	←	240	←	←	164	←	←	288
4128	95	←	←	105	←	←	110	←	←	110
4129	0	←	←	0	←	←	0	←	←	0
4130	25700	←	←	25700	←	←	25700	←	←	25700
4134	130	←	←	130	←	←	130	←	←	130
4136	30	←	←	30	←	←	0	←	←	0
4138	1550	←	←	1570	←	←	0	←	←	0
4139	96	←	←	100	←	←	0	←	←	0
4140	2630	←	←	2016	←	←	0	←	←	0
4141	60	←	←	0	←	←	0	←	←	0
4142	6000	←	←	3000	←	←	0	←	←	0
4143	6000	←	←	6000	←	←	0	←	←	0
4144	0	←	←	0	←	←	0	←	←	0
4145	25	←	←	25	←	←	0	←	←	0
4146	754	1131	1508	603	905	1206	0	←	←	0
4147	260	←	←	261	←	←	0	←	←	0
4148	200	←	←	200	←	←	0	←	←	0
4149	620	←	←	690	←	←	0	←	←	0
4150	20480	←	←	0	←	←	0	←	←	0
4151	100	←	←	100	←	←	0	←	←	0
4152	8803	←	←	6500	←	←	0	←	←	0
4153	90	←	←	90	←	←	0	←	←	0
4154	100	←	←	100	←	←	0	←	←	0
4155	24570	←	←	24571	←	←	0	←	←	0
4156	0	←	←	0	←	←	0	←	←	0
4158	109	←	←	6505	←	←	0	←	←	0
4159	0	←	←	0	←	←	0	←	←	0
4161	25700	←	←	25700	←	←	0	←	←	0
4165	15	←	←	527	←	←	0	←	←	0
4166	66	←	←	12870	←	←	0	←	←	0
4169	0	←	←	0	←	←	0	←	←	0
4362	0	←	←	0	←	←	0	←	←	0
4363	0	←	←	0	←	←	0	←	←	0
4364	0	←	←	0	←	←	0	←	←	0
4365	0	←	←	0	←	←	0	←	←	0
4366	0	←	←	0	←	←	0	←	←	0
4367	0	←	←	0	←	←	0	←	←	0
4612	127	←	←	107	←	←	145	←	←	89
4613	12288	←	←	12288	←	←	32256	←	←	20489
4614	150	←	←	107	←	←	0	←	←	0
4615	22157	←	←	22157	←	←	0	←	←	0
Maximum output during acceleration (for PS selection)	9	9	9	13.2	13.2	13.2	12	12	12	30

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

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Motor model	αi I8/8000-B	αi I8/8000-B	αi I8/8000-B	αi I8/8000-B	αi I8/8000-B	αi I8/8000-B	αi I8/8000-B	αi I8/10000-B	αi I8/10000-B	αi I8/10000-B
Applicable amplifier	αi SP 11-B βi SVSP 11-B	βi SVSP 15-B αi SP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 11-B βi SVSP 11-B	βi SVSP 15-B αi SP 15-B	βi SVSP 18-B αi SP 22-B
Output specification nameplate	A06B-1230-K407#S00	A06B-1230-K407#S00	A06B-1230-K407#S00	A06B-1230-K407#S0P	A06B-1230-K407#S0P	A06B-1230-K407#S0S	A06B-1230-K407#S0S	A06B-1230-K427#S00	A06B-1230-K427#S00	A06B-1230-K427#S00
Model code	5027	6027	7027	5028	6028	5029	6029	5202	6202	7202
Parameter ID	2294	–	–	2993	–	2330	–	2705	–	–
Applicable software series and edition	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0*i*-D,FS30*i*										
4007	00000000	←	←	00000000	←	00000000	←	00000000	←	←
4008	00000000	←	←	00010000	←	00000000	←	00000000	←	←
4009	00000000	←	←	00000000	←	00000000	←	00000000	←	←
4010	00000000	←	←	00000000	←	00000000	←	00000000	←	←
4011	00011010	←	←	00001010	←	00011010	←	00011010	←	←
4012	10000010	←	←	10000010	←	10000010	←	10000010	←	←
4013	00001100	←	←	00001100	←	00001100	←	00001100	←	←
4019	00000100	←	←	00000100	←	00000100	←	00000100	←	←
4400	00000000	←	←	00000000	←	00000000	←	00000000	←	←
4020	8000	←	←	8000	←	8000	←	10000	←	←
4023(*1)	30	←	←	30	←	30	←	400	←	←
4039	0	←	←	0	←	0	←	0	←	←
4040(*2)	5	←	←	4	←	4	←	13	←	←
4041(*2)	10	←	←	10	←	10	←	5	←	←
4048(*2)	23	←	←	17	←	16	←	61	←	←
4049(*2)	10	←	←	10	←	10	←	23	←	←
4080	75	←	←	20565	←	16720	←	12880	←	←
4083	30	←	←	30	←	30	←	30	←	←
4093	0	←	←	0	←	0	←	176	←	←
4100	1600	←	←	1600	←	1656	←	3538	←	←
4101	100	←	←	94	←	100	←	100	←	←
4102	1656	←	←	1656	←	1656	←	3538	←	←
4103	0	←	←	0	←	0	←	0	←	←
4104	8000	←	←	6000	←	5500	←	2200	←	←
4105	121	←	←	121	←	121	←	199	←	←
4106	8000	←	←	20000	←	18000	←	8000	←	←
4107	0	←	←	0	←	0	←	121	←	←
4108	0	←	←	0	←	0	←	0	←	←
4109	25	←	←	25	←	25	←	25	←	←
4110	503	755	1006	754	1005	755	1007	503	755	1006
4111	170	←	←	265	←	285	←	165	←	←
4112	200	←	←	200	←	200	←	200	←	←
4113	790	←	←	790	←	790	←	480	←	←
4114	19200	←	←	19200	←	0	←	0	←	←
4115	100	←	←	100	←	100	←	100	←	←
4116	8118	←	←	8118	←	6118	←	5734	←	←
4117	90	←	←	90	←	90	←	100	←	←
4118	100	←	←	100	←	100	←	100	←	←
4119	12	←	←	12	←	12	←	20	←	←
4120	0	←	←	0	←	0	←	0	←	←
4124	24497	←	←	24574	←	24575	←	24493	←	←
4127	176	←	←	240	←	296	←	176	←	←
4128	117	←	←	117	←	0	←	0	←	←
4129	0	←	←	0	←	0	←	0	←	←
4130	25700	←	←	25700	←	25700	←	25700	←	←
4134	130	←	←	130	←	130	←	130	←	←
4136	30	←	←	30	←	30	←	30	←	←
4138	0	←	←	0	←	0	←	1600	←	←
4139	0	←	←	0	←	0	←	100	←	←
4140	0	←	←	0	←	0	←	1656	←	←
4141	0	←	←	0	←	0	←	0	←	←
4142	0	←	←	0	←	0	←	6000	←	←
4143	0	←	←	0	←	0	←	18000	←	←
4144	0	←	←	0	←	0	←	0	←	←
4145	0	←	←	0	←	0	←	25	←	←
4146	0	←	←	0	←	0	←	503	755	1006
4147	0	←	←	0	←	0	←	170	←	←
4148	0	←	←	0	←	0	←	200	←	←
4149	0	←	←	0	←	0	←	790	←	←
4150	0	←	←	0	←	0	←	19200	←	←
4151	0	←	←	0	←	0	←	100	←	←
4152	0	←	←	0	←	0	←	8118	←	←
4153	0	←	←	0	←	0	←	90	←	←
4154	0	←	←	0	←	0	←	100	←	←
4155	0	←	←	0	←	0	←	24497	←	←
4156	0	←	←	0	←	0	←	0	←	←
4158	0	←	←	0	←	0	←	117	←	←
4159	0	←	←	0	←	0	←	0	←	←
4161	0	←	←	0	←	0	←	25700	←	←
4165	0	←	←	0	←	0	←	12	←	←
4166	0	←	←	0	←	0	←	14168	←	←
4169	0	←	←	0	←	0	←	0	←	←
4362	0	←	←	-26424	←	-24501	←	0	←	←
4363	0	←	←	-24351	←	-28372	←	0	←	←
4364	0	←	←	-30320	←	-32368	←	0	←	←
4365	0	←	←	0	←	0	←	0	←	←
4366	0	←	←	0	←	0	←	0	←	←
4367	0	←	←	0	←	0	←	0	←	←
4612	145	←	←	100	←	86	←	145	←	←
4613	16513	←	←	16514	←	17026	←	10240	←	←
4614	0	←	←	0	←	0	←	145	←	←
4615	0	←	←	0	←	0	←	16517	←	←
Maximum output during acceleration (for PS selection)	13.2	13.2	13.2	18	18	22.2	22.2	13.2	13.2	13.2

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

JR AUTOMATION TECHNOLOGIES INC*

Motor model	αi I 8/10000-B	αi I 8/10000-B	αi I 8/12000-B	αi I 8/12000-B	αi I 8/12000-B	αi I 8/12000-B	αi I 12/8000-B	αi I 12/8000-B	αi I 12/8000-B	αi I 12/8000-B	αi I 12/8000-B
Applicable amplifier	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 22-B
Output specification nameplate	A06B-1230-K427#S0P	A06B-1230-K427#S0P	A06B-1230-K427#S01	A06B-1230-K427#S01	A06B-1230-K427#S0R	A06B-1230-K427#S0R	A06B-1230-K408#S00	A06B-1230-K408#S00	A06B-1230-K408#S0P	A06B-1230-K408#S0P	A06B-1230-K408#S0S
Model code	5203	6203	5204	6204	5205	6205	5030	6030	5031	6031	5032
Parameter ID	2741	–	2239	–	2215	–	2491	–	2704	–	2085
Applicable software series and edition	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0*i*-D,FS30*i*											
4007	00000000	←	00000000	←	00000000	←	00000000	←	00000000	←	00000000
4008	00010000	←	00000000	←	00010000	←	00000000	←	00010000	←	00010000
4009	00000000	←	00000000	←	00000000	←	00000000	←	00000000	←	00000000
4010	00000000	←	00000001	←	00000001	←	00000000	←	00000000	←	00010000
4011	00001010	←	00011010	←	00001010	←	00011010	←	00001010	←	00001010
4012	10000010	←	10000010	←	10000010	←	10000010	←	10000010	←	10000010
4013	00001100	←	00001100	←	00001100	←	00001100	←	00001100	←	00001100
4019	00000100	←	00000100	←	00000100	←	00000100	←	00000100	←	00000100
4400	00000000	←	00000000	←	00000000	←	00000000	←	00000000	←	00000000
4020	10000	←	12000	←	12000	←	8000	←	8000	←	8000
4023(*1)	400	←	333	←	333	←	30	←	30	←	30
4039	0	←	0	←	0	←	0	←	0	←	0
4040(*2)	10	←	13	←	10	←	9	←	7	←	5
4041(*2)	4	←	5	←	4	←	10	←	10	←	10
4048(*2)	45	←	61	←	45	←	43	←	35	←	40
4049(*2)	17	←	23	←	17	←	10	←	10	←	10
4080	12877	←	70	←	15186	←	70	←	16735	←	15201
4083	30	←	30	←	30	←	30	←	30	←	30
4093	240	←	176	←	240	←	0	←	0	←	0
4100	4006	←	3580	←	3580	←	1500	←	1550	←	1570
4101	82	←	100	←	71	←	100	←	100	←	98
4102	4006	←	3580	←	3580	←	1500	←	1922	←	1922
4103	0	←	0	←	0	←	0	←	0	←	0
4104	2050	←	2300	←	4000	←	7000	←	3000	←	4450
4105	160	←	97	←	97	←	307	←	324	←	323
4106	7600	←	2300	←	14000	←	7000	←	10000	←	6000
4107	121	←	88	←	88	←	0	←	0	←	0
4108	0	←	0	←	0	←	0	←	0	←	0
4109	25	←	25	←	25	←	25	←	25	←	25
4110	854	1139	421	561	421	561	595	793	905	1207	1207
4111	305	←	100	←	157	←	173	←	337	←	490
4112	200	←	200	←	200	←	200	←	200	←	200
4113	598	←	980	←	980	←	311	←	295	←	295
4114	0	←	0	←	22528	←	23040	←	0	←	24320
4115	100	←	100	←	100	←	100	←	100	←	100
4116	5734	←	11031	←	11031	←	5000	←	5279	←	5279
4117	100	←	90	←	90	←	90	←	90	←	90
4118	100	←	100	←	100	←	100	←	100	←	100
4119	16	←	522	←	522	←	31	←	32	←	32
4120	0	←	0	←	0	←	0	←	0	←	0
4124	24575	←	24447	←	24487	←	24499	←	24575	←	24575
4127	240	←	176	←	240	←	164	←	202	←	273
4128	0	←	0	←	0	←	0	←	0	←	0
4129	0	←	0	←	0	←	0	←	0	←	0
4130	25700	←	25700	←	25700	←	25700	←	25700	←	25700
4134	130	←	130	←	130	←	130	←	130	←	130
4136	30	←	30	←	30	←	30	←	30	←	30
4138	1600	←	1500	←	1505	←	0	←	0	←	0
4139	94	←	89	←	74	←	0	←	0	←	0
4140	1656	←	1642	←	1642	←	0	←	0	←	0
4141	0	←	77	←	0	←	0	←	0	←	0
4142	6000	←	5000	←	8000	←	0	←	0	←	0
4143	20000	←	5000	←	24000	←	0	←	0	←	0
4144	0	←	0	←	0	←	0	←	0	←	0
4145	25	←	25	←	25	←	0	←	0	←	0
4146	754	1005	566	755	566	755	0	←	0	←	0
4147	265	←	162	←	229	←	0	←	0	←	0
4148	200	←	200	←	200	←	0	←	0	←	0
4149	790	←	1090	←	1090	←	0	←	0	←	0
4150	19200	←	19200	←	21760	←	0	←	0	←	0
4151	100	←	100	←	100	←	0	←	0	←	0
4152	8118	←	8000	←	8000	←	0	←	0	←	0
4153	90	←	90	←	90	←	0	←	0	←	0
4154	100	←	100	←	100	←	0	←	0	←	0
4155	24574	←	24491	←	24544	←	0	←	0	←	0
4156	0	←	0	←	0	←	0	←	0	←	0
4158	117	←	0	←	0	←	0	←	0	←	0
4159	0	←	0	←	0	←	0	←	0	←	0
4161	25700	←	25700	←	25700	←	0	←	0	←	0
4165	12	←	521	←	521	←	0	←	0	←	0
4166	17749	←	49	←	15693	←	0	←	0	←	0
4169	0	←	0	←	0	←	0	←	0	←	0
4362	0	←	0	←	0	←	0	←	0	←	-24426
4363	0	←	0	←	0	←	0	←	0	←	-28447
4364	0	←	0	←	0	←	0	←	0	←	-24276
4365	0	←	0	←	0	←	0	←	0	←	0
4366	0	←	0	←	0	←	0	←	0	←	0
4367	0	←	0	←	0	←	0	←	0	←	0
4612	87	←	145	←	76	←	156	←	127	←	92
4613	10240	←	12288	←	12299	←	16522	←	16522	←	16777
4614	100	←	129	←	79	←	0	←	0	←	0
4615	16517	←	19201	←	19201	←	0	←	0	←	0
Maximum output during acceleration (for PS selection)	18	18	13.2	13.2	18	18	18	18	22.2	22.2	30

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

JR AUTOMATION TECHNOLOGIES, INC*
DOWNING

Motor model	αi I 12/12000-B	αi I 12/12000-B	αi I 12/12000-B	αi I 12/12000-B	αi I 12/12000-B	αi I 15/8000-B	αi I 15/8000-B	αi I 15/8000-B	αi I 15/12000-B	αi I 15/12000-B	αi I 15/12000-B
Applicable amplifier	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 22-B	βi SVSP 18-B αi SP 22-B	αi SP 22-B	αi SP 22-B	βi SVSP 18-B αi SP 22-B	αi SP 22-B	αi SP 22-B
Output specification nameplate	A06B-1230-K428#S00	A06B-1230-K428#S00	A06B-1230-K428#S0P	A06B-1230-K428#S0P	A06B-1230-K428#S0S	A06B-1230-K409#S00	A06B-1230-K409#S0P	A06B-1230-K409#S0S	A06B-1230-K429#S00	A06B-1230-K429#S0P	A06B-1230-K429#S0S
Model code	5206	6206	5207	6207	5208	5033	5034	5035	5209	5210	5211
Parameter ID	2937	–	2246	–	2478	2202	2048	2585	2886	2323	2771
Applicable software series and edition	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/O 9DB0/O	**9DAA/O** **9DB0/O**	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0*i*-D,FS30*i*											
4007	00000000	←	00000000	←	00000100	00000000	00000000	00000000	00000000	00000000	00000000
4008	00000000	←	00010000	←	00000000	00000000	00010000	00010000	00000000	00010000	00000000
4009	00000000	←	00000000	←	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4010	00000000	←	00000000	←	00010000	00000000	00000000	00000000	00000000	00000000	00000000
4011	00011010	←	00001010	←	00011010	00011010	00001010	00001010	00011010	00001010	00011010
4012	10000010	←	10000010	←	10000010	10000010	10000010	10000000	10000010	10000010	10000000
4013	00001100	←	00001100	←	00001100	00001100	00001100	00001100	00001100	00001100	00001100
4019	00000100	←	00000100	←	00000100	00000100	00000100	00000100	00000100	00000100	00000100
4400	00000000	←	00000000	←	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4020	12000	←	12000	←	12000	8000	8000	8000	12000	12000	12000
4023(*1)	333	←	333	←	333	30	30	30	333	333	333
4039	0	←	0	←	0	0	0	0	0	0	0
4040(*2)	25	←	20	←	13	10	7	6	26	19	14
4041(*2)	9	←	7	←	6	10	10	10	10	7	6
4048(*2)	114	←	93	←	61	45	33	28	119	88	67
4049(*2)	42	←	35	←	26	10	10	10	45	33	28
4080	75	←	75	←	12883	20555	24410	16989	80	15445	5205
4083	30	←	30	←	30	30	30	30	30	30	30
4093	164	←	202	←	273	0	0	0	148	200	240
4100	3900	←	3800	←	4100	1500	1500	1625	4000	4200	4570
4101	80	←	80	←	87	95	100	100	62	85	100
4102	3593	←	3593	←	3593	1710	1710	1625	3482	3482	4570
4103	90	←	0	←	0	0	0	0	75	0	80
4104	1800	←	1800	←	1800	5500	5500	1800	1700	1700	700
4105	341	←	341	←	307	314	314	314	347	347	398
4106	6500	←	6000	←	6000	5500	5500	4400	5500	5500	2000
4107	307	←	324	←	307	0	0	0	314	314	314
4108	0	←	0	←	0	0	0	0	0	0	0
4109	25	←	25	←	25	25	25	25	25	25	25
4110	595	793	595	793	794	794	794	754	575	575	754
4111	173	←	223	←	311	243	305	333	193	212	320
4112	200	←	200	←	200	200	200	200	200	200	200
4113	280	←	280	←	311	304	304	304	275	275	240
4114	0	←	0	←	0	23040	23040	24320	23040	23040	0
4115	100	←	100	←	100	100	100	100	100	100	100
4116	5280	←	5280	←	5280	5177	5177	5177	5126	5126	5126
4117	90	←	90	←	100	90	90	90	90	29530	90
4118	100	←	100	←	28772	100	100	100	90	100	100
4119	34	←	34	←	31	31	31	31	35	35	35
4120	0	←	0	←	0	0	0	0	0	0	0
4124	24499	←	24539	←	24575	24556	24575	24575	24515	24530	24575
4127	164	←	202	←	305	148	200	240	148	200	264
4128	0	←	0	←	0	105	105	0	0	0	0
4129	0	←	0	←	0	0	0	0	0	0	0
4130	25700	←	25700	←	25700	25700	25700	25700	25700	25700	25700
4134	130	←	130	←	130	130	130	130	130	130	130
4136	30	←	30	←	30	30	30	30	30	30	30
4138	1500	←	1550	←	1600	0	0	0	1500	1500	1625
4139	100	←	100	←	100	0	0	0	95	100	100
4140	1500	←	1922	←	1922	0	0	0	1710	1710	1625
4141	0	←	0	←	0	0	0	0	70	0	0
4142	7000	←	3000	←	3000	0	0	0	5500	5500	1800
4143	7000	←	10000	←	10000	0	0	0	5500	5500	4400
4144	0	←	0	←	0	0	0	0	0	0	0
4145	25	←	25	←	25	0	0	0	25	25	25
4146	595	793	905	1207	1207	0	0	0	794	794	754
4147	173	←	337	←	486	0	0	0	243	305	333
4148	200	←	200	←	200	0	0	0	200	200	200
4149	311	←	295	←	311	0	0	0	304	304	304
4150	23040	←	0	←	0	0	0	0	23040	23040	24320
4151	100	←	100	←	100	0	0	0	100	100	100
4152	5000	←	5279	←	5015	0	0	0	5177	5177	5177
4153	90	←	90	←	90	0	0	0	90	90	90
4154	100	←	100	←	100	0	0	0	100	100	100
4155	24499	←	24575	←	24575	0	0	0	24556	24575	24575
4156	0	←	0	←	0	0	0	0	0	0	0
4158	0	←	0	←	0	0	0	0	105	105	0
4159	0	←	0	←	0	0	0	0	0	0	0
4161	25700	←	25700	←	25700	0	0	0	25700	25700	25700
4165	31	←	32	←	31	0	0	0	31	31	31
4166	70	←	16735	←	15450	0	0	0	20555	17498	16725
4169	0	←	0	←	0	0	0	0	0	0	0
4362	0	←	0	←	-24426	0	0	0	0	-24326	0
4363	0	←	0	←	-28172	0	0	0	0	-26124	0
4364	0	←	0	←	-30120	0	0	0	0	-32168	0
4365	0	←	0	←	-26424	0	0	0	0	0	-24276
4366	0	←	0	←	-26174	0	0	0	0	0	-28172
4367	0	←	0	←	-32168	0	0	0	0	0	-30120
4612	125	←	101	←	73	164	128	107	107	109	97
4613	10380	←	10380	←	10379	16791	16790	16791	10375	10376	10376
4614	156	←	127	←	94	0	0	0	164	128	107
4615	16517	←	16518	←	16774	0	0	0	16772	16531	16774
Maximum output during acceleration (for PS selection)	18	18	22.2	22.2	33.6	22.2	30	36	22.2	30	36

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

JR AUTOMATION TECHNOLOGIES, INC*

Motor model	αiI 18/8000-B	αiI 18/8000-B	αiI 18/12000-B	αiI 18/12000-B	αiI 22/8000-B	αiI 22/8000-B	αiI 22/8000-B	αiI 22/12000-B	αiI 22/12000-B	αiI 22/12000-B	αiI 30/7000-B
Applicable amplifier	αi SP 22-B	αi SP 22-B	αi SP 22-B	αi SP 22-B	αi SP 26-B	αi SP 26-B	αi SP 30-B	αi SP 26-B	αi SP 26-B	αi SP 30-B	αi SP 37-B
Output specification nameplate	A06B-1230-K410#S00	A06B-1230-K410#S0P	A06B-1230-K430#S00	A06B-1230-K430#S0P	A06B-1230-K411#S00	A06B-1230-K411#S0P	A06B-1230-K411#S0S	A06B-1230-K431#S00	A06B-1230-K431#S0P	A06B-1230-K431#S0S	A06B-1230-K412#S00
Model code	5036	5037	5212	5213	5039	5040	5041	5214	5215	5216	5042
Parameter ID	2231	2453	2360	2576	2379	2240	2788	2033	2173	2082	2005
Applicable software series and edition	9DAA/M 9DB0/M	9DAA/O 9DB0/O	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/O 9DB0/O	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/O 9DB0/O
FS0*i*-D,FS30*i*											
4007	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4008	00000000	00010000	00000000	00010000	00000000	00010000	00010000	00000000	00010000	00010000	00000000
4009	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4010	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4011	00011010	00001010	00011010	00001010	00011010	00001010	00001010	00011010	00001010	00001010	00011010
4012	10000010	10000111	10000010	10000111	10000010	10000111	10000010	10000010	10000111	10000010	10000010
4013	00001100	00001100	00001100	00001100	00001100	00001100	00001100	00001100	00001100	00001100	00001100
4019	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100
4400	00000000	00000001	00000000	00010001	00000000	00000001	00000000	00000000	00010001	00000000	00000000
4020	8000	8000	12000	12000	8000	8000	8000	12000	12000	12000	7000
4023(*1)	30	30	333	333	30	30	30	333	333	333	30
4039	0	0	0	0	0	0	0	0	0	0	0
4040(*2)	9	7	25	18	10	7	6	26	19	14	12
4041(*2)	10	10	9	7	10	10	10	10	7	6	10
4048(*2)	44	32	117	86	45	34	26	121	90	65	56
4049(*2)	10	10	44	32	10	10	10	45	34	26	10
4080	11615	18005	80	15439	80	15460	19295	75	80	80	77
4083	30	30	30	30	30	30	30	30	30	30	30
4093	0	0	143	195	0	0	0	142	191	245	0
4100	1520	1700	4100	4050	1500	1550	1500	4000	4000	4050	1387
4101	100	100	100	98	95	100	100	83	78	94	100
4102	1813	1909	4582	4582	1756	1756	1756	3504	3504	4348	1387
4103	84	0	89	0	0	0	0	0	0	0	0
4104	3000	1600	1300	900	4500	1500	3800	2800	1400	1700	6000
4105	310	310	299	299	329	329	329	360	360	357	505
4106	10000	5000	5000	2200	4500	5000	9500	2800	1400	4400	6000
4107	0	0	310	310	0	0	0	318	318	339	0
4108	0	0	0	0	0	0	0	0	0	0	0
4109	25	25	25	25	25	25	25	25	25	25	25
4110	943	943	754	754	924	924	1231	603	604	1006	1018
4111	333	418	260	330	252	353	427	143	218	335	286
4112	200	200	200	200	200	200	200	200	200	200	200
4113	308	308	319	319	290	290	290	265	265	255	189
4114	0	0	0	0	0	23040	0	24320	0	0	20480
4115	100	100	100	100	100	100	100	100	100	100	100
4116	3600	4500	4100	4100	5564	5000	5564	5523	5523	3438	6071
4117	90	90	90	90	29530	90	90	90	90	90	90
4118	100	100	100	100	110	100	100	100	100	100	100
4119	31	31	30	30	29	29	33	36	36	37	51
4120	0	0	0	0	0	0	0	0	0	0	0
4124	24575	24575	24570	24575	24564	24575	24575	24477	24535	24575	24575
4127	143	195	143	195	142	191	245	142	191	262	148
4128	0	0	102	0	105	0	0	0	0	0	0
4129	0	0	0	0	0	0	0	0	0	0	0
4130	25700	25700	25700	25700	25700	25700	25700	25700	25700	25700	25700
4134	130	130	130	130	130	130	130	130	130	130	130
4136	30	30	30	30	30	30	30	30	30	30	30
4138	0	0	1520	1700	0	0	0	1440	1520	1550	0
4139	0	0	100	100	0	0	0	96	94	95	0
4140	0	0	1813	1909	0	0	0	1709	1709	1725	0
4141	0	0	84	0	0	0	0	96	0	0	0
4142	0	0	3000	1600	0	0	0	5000	2200	4700	0
4143	0	0	10000	5000	0	0	0	5000	4600	9000	0
4144	0	0	0	0	0	0	0	0	0	0	0
4145	0	0	25	25	0	0	0	25	25	25	0
4146	0	0	943	943	0	0	0	823	823	1077	0
4147	0	0	333	418	0	0	0	213	312	371	0
4148	0	0	200	200	0	0	0	200	200	200	0
4149	0	0	308	308	0	0	0	300	300	285	0
4150	0	0	0	0	0	0	0	19200	19200	0	0
4151	0	0	100	100	0	0	0	100	100	100	0
4152	0	0	3600	4500	0	0	0	5593	5593	3696	0
4153	0	0	90	90	0	0	0	90	90	90	0
4154	0	0	100	100	0	0	0	100	100	100	0
4155	0	0	24575	24575	0	0	0	24531	24575	24575	0
4156	0	0	0	0	0	0	0	0	0	0	0
4158	0	0	0	0	0	0	0	0	108	0	0
4159	0	0	0	0	0	0	0	0	0	0	0
4161	0	0	25700	25700	0	0	0	25700	25700	25700	0
4165	0	0	31	31	0	0	0	341	32	34	0
4166	0	0	11615	15714	0	0	0	56	16735	16735	0
4169	0	0	0	0	0	0	0	0	0	0	0
4362	0	0	0	0	0	0	-28522	0	0	0	0
4363	0	0	0	0	0	0	-30520	0	0	0	0
4364	0	0	0	0	0	0	-24276	0	0	0	0
4365	0	0	0	-26324	0	0	0	0	0	-24501	0
4366	0	0	0	-24176	0	0	0	0	0	-30420	0
4367	0	0	0	-32168	0	0	0	0	0	31320	0
4612	179	132	179	129	171	134	104	150	105	92	173
4613	16782	16782	10370	10370	16775	16517	16774	10241	10241	10241	12547
4614	0	0	179	132	0	0	0	173	126	99	0
4615	0	0	16772	16771	0	0	0	16385	16385	16384	0
Maximum output during acceleration (for PS selection)	26.4	36	26.4	36	31.2	42	54	31.2	42	57.6	44.4

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

JR AUTOMATION TECHNOLOGY, INC*

Motor model	αiI 30/7000-B	αiI 40/7000-B	αiI 40/7000-B	αiI 50/5000-B	αiI 50/5000-B
Applicable amplifier	αi SP 37-B	αi SP 45-B	αi SP 45-B	αi SP 55-B	αi SP 55-B
Output specification nameplate	A06B-1230-K412#S0P	A06B-1230-K413#S00	A06B-1230-K413#S0P	A06B-1230-K414#S00	A06B-1230-K414#S0P
Model code	5043	5044	5045	5046	5047
Parameter ID	2051	2093	2798	2831	2864
Applicable software series and edition	9DAA/O 9DB0/O	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/O 9DB0/O
FS0*i*-D,FS30*i*					
4007	00000000	00000000	00000000	00000000	00000000
4008	00010000	00000000	00010000	00000000	00010000
4009	00000000	00000000	00000000	00000000	00000000
4010	00010000	00000000	00010000	00000000	00000000
4011	00001010	00011010	00001010	00011010	00001010
4012	10000000	10000000	10000000	10000000	10000000
4013	00001100	00001100	00001100	00001100	00001100
4019	00000100	00000100	00000100	00000100	00000100
4400	00000000	00000000	00000000	00000000	00000000
4020	7000	7000	7000	5000	5000
4023(*1)	30	30	30	30	30
4039	0	0	0	0	0
4040(*2)	10	12	10	13	11
4041(*2)	10	10	10	10	10
4048(*2)	46	56	45	63	53
4049(*2)	10	10	10	10	10
4080	16734	80	16208	80	21840
4083	30	30	30	30	30
4093	0	0	0	0	0
4100	1260	1740	1230	1200	1185
4101	100	100	100	85	74
4102	1886	1740	1611	1201	1201
4103	0	0	0	89	0
4104	2500	3000	3000	3000	3400
4105	516	503	461	562	439
4106	4000	3000	4000	4500	5400
4107	0	0	0	0	0
4108	0	0	0	0	0
4109	25	25	25	25	25
4110	1341	970	771	1260	1260
4111	524	286	312	320	443
4112	200	200	200	200	200
4113	185	190	207	170	218
4114	0	23040	0	23040	23552
4115	100	100	100	100	100
4116	4526	6128	4614	5800	5500
4117	90	90	90	90	90
4118	100	100	100	100	100
4119	52	48	46	56	56
4120	0	0	0	0	0
4124	24575	24575	24575	24575	24575
4127	180	146	178	146	173
4128	90	0	0	114	108
4129	0	0	0	0	0
4130	25700	25700	25700	25700	25700
4134	130	130	130	130	130
4136	30	30	30	30	30
4138	0	0	0	0	0
4139	0	0	0	0	0
4140	0	0	0	0	0
4141	0	0	0	0	0
4142	0	0	0	0	0
4143	0	0	0	0	0
4144	0	0	0	0	0
4145	0	0	0	0	0
4146	0	0	0	0	0
4147	0	0	0	0	0
4148	0	0	0	0	0
4149	0	0	0	0	0
4150	0	0	0	0	0
4151	0	0	0	0	0
4152	0	0	0	0	0
4153	0	0	0	0	0
4154	0	0	0	0	0
4155	0	0	0	0	0
4156	0	0	0	0	0
4158	0	0	0	0	0
4159	0	0	0	0	0
4161	0	0	0	0	0
4165	0	0	0	0	0
4166	0	0	0	0	0
4169	0	0	0	0	0
4362	-24476	0	-24516	0	-24526
4363	-28472	0	-28447	0	-28522
4364	-28372	0	31020	0	-24376
4365	0	0	0	0	0
4366	0	0	0	0	0
4367	0	0	0	0	0
4612	142	175	144	148	109
4613	12291	14084	14084	12560	12677
4614	0	0	0	0	0
4615	0	0	0	0	0
Maximum output during acceleration (for PS selection)	54	54	66	66	78

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

JR AUTOMATION TECHNOLOGIES INC*
JIDOWLING

C.20 SPINDLE MOTOR αiI-B series(400V)

Motor model	αiI 0.5/10000HV-B	αiI 0.5/10000HV-B	αiI 1/10000HV-B	αiI 1/10000HV-B	αiI 1.5/10000HV-B	αiI 1.5/10000HV-B	αiI 2/10000HV-B	αiI 2/10000HV-B	αiI 2/20000HV-B
Applicable amplifier	αi SP 5.5HV-B βi SVSP 11HV-B	βi SVSP 15HV-B αi SP 15HV-B	αi SP 5.5HV-B βi SVSP 11HV-B	βi SVSP 15HV-B αi SP 15HV-B	αi SP 5.5HV-B βi SVSP 11HV-B	βi SVSP 15HV-B αi SP 15HV-B	αi SP 5.5HV-B βi SVSP 11HV-B	βi SVSP 15HV-B αi SP 15HV-B	αi SP 30HV-B
Output specification nameplate	A06B-1230-K501#S00	A06B-1230-K501#S00	A06B-1230-K502#S00	A06B-1230-K502#S00	A06B-1230-K503#S00	A06B-1230-K503#S00	A06B-1230-K504#S00	A06B-1230-K504#S00	A06B-1230-K524#S00
Model code	5048	6048	5049	6049	5050	6050	5051	6051	5052
Parameter ID	2714	–	2040	–	2092	–	2353	–	2204
Applicable software series and edition	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0*i*-D,FS30*i*									
4007	00000000	←	00000000	←	00000000	←	00000000	←	00000000
4008	00000000	←	00000000	←	00000000	←	00000000	←	00000000
4009	00000000	←	00000000	←	00000000	←	00000000	←	00000000
4010	00000000	←	00000000	←	00000000	←	00000000	←	00000001
4011	00011000	←	00011001	←	00011001	←	00011001	←	00011001
4012	10000010	←	10000010	←	10000010	←	10000010	←	10000010
4013	00001100	←	00001100	←	00001100	←	00001100	←	00001100
4019	00000100	←	00000100	←	00000100	←	00000100	←	00000100
4400	00000000	←	00000000	←	00000000	←	00000000	←	00000000
4020	10000	←	10000	←	10000	←	10000	←	20000
4023(*1)	30	←	30	←	30	←	30	←	30
4039	0	←	0	←	0	←	0	←	0
4040(*2)	2	←	5	←	2	←	4	←	3
4041(*2)	10	←	10	←	10	←	10	←	10
4048(*2)	8	←	25	←	11	←	19	←	16
4049(*2)	10	←	10	←	10	←	10	←	10
4080	85	←	20565	←	14173	←	80	←	11605
4083	30	←	30	←	30	←	30	←	10
4093	0	←	0	←	0	←	0	←	0
4100	3250	←	2600	←	1610	←	1500	←	3400
4101	100	←	85	←	100	←	100	←	41
4102	6503	←	3600	←	2745	←	4421	←	6612
4103	45	←	83	←	65	←	50	←	92
4104	4500	←	6000	←	5000	←	5000	←	2700
4105	46	←	43	←	40	←	102	←	56
4106	4500	←	6000	←	12000	←	5000	←	4500
4107	0	←	0	←	0	←	0	←	0
4108	0	←	0	←	0	←	0	←	0
4109	25	←	25	←	25	←	25	←	25
4110	3143	6286	1423	2846	1109	2218	1397	2794	1052
4111	245	←	103	←	220	←	318	←	235
4112	200	←	200	←	200	←	200	←	200
4113	2058	←	2200	←	2400	←	935	←	1700
4114	23040	←	14080	←	17920	←	110	←	0
4115	100	←	100	←	100	←	100	←	100
4116	13641	←	17300	←	10218	←	10519	←	11131
4117	90	←	90	←	90	←	90	←	90
4118	100	←	100	←	100	←	100	←	100
4119	5	←	4	←	4	←	10	←	5
4120	0	←	0	←	0	←	0	←	0
4124	24558	←	24449	←	24537	←	24575	←	24549
4127	240	←	176	←	404	←	202	←	202
4128	120	←	75	←	107	←	90	←	88
4129	0	←	0	←	0	←	0	←	0
4130	25700	←	25700	←	25700	←	25700	←	25700
4134	110	←	110	←	110	←	110	←	110
4136	30	←	30	←	30	←	30	←	30
4138	0	←	0	←	0	←	0	←	0
4139	0	←	0	←	0	←	0	←	0
4140	0	←	0	←	0	←	0	←	0
4141	0	←	0	←	0	←	0	←	0
4142	0	←	0	←	0	←	0	←	0
4143	0	←	0	←	0	←	0	←	0
4144	0	←	0	←	0	←	0	←	0
4145	0	←	0	←	0	←	0	←	0
4146	0	←	0	←	0	←	0	←	0
4147	0	←	0	←	0	←	0	←	0
4148	0	←	0	←	0	←	0	←	0
4149	0	←	0	←	0	←	0	←	0
4150	0	←	0	←	0	←	0	←	0
4151	0	←	0	←	0	←	0	←	0
4152	0	←	0	←	0	←	0	←	0
4153	0	←	0	←	0	←	0	←	0
4154	0	←	0	←	0	←	0	←	0
4155	0	←	0	←	0	←	0	←	0
4156	0	←	0	←	0	←	0	←	0
4158	0	←	0	←	0	←	0	←	0
4159	0	←	0	←	0	←	0	←	0
4161	0	←	0	←	0	←	0	←	0
4165	0	←	0	←	0	←	0	←	0
4166	0	←	0	←	0	←	0	←	0
4169	0	←	0	←	0	←	0	←	0
4362	0	←	0	←	0	←	0	←	0
4363	0	←	0	←	0	←	0	←	0
4364	0	←	0	←	0	←	0	←	0
4365	0	←	0	←	0	←	0	←	0
4366	0	←	0	←	0	←	0	←	0
4367	0	←	0	←	0	←	0	←	0
4612	107	←	124	←	63	←	127	←	52
4613	10889	←	13581	←	21504	←	26637	←	26886
4614	0	←	0	←	0	←	0	←	0
4615	0	←	0	←	0	←	0	←	0
Maximum output during acceleration (for PS selection)	1.32	1.32	2.64	2.64	4.44	4.44	4.44	4.44	20

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

JR AUTOMATION TECHNOLOGY, INC*

Motor model	αiI 3/10000HV-B	αiI 3/10000HV-B	αiI 6/10000HV-B	αiI 6/10000HV-B	αiI 6/10000HV-B	αiI 6/10000HV-B	αiI 8/8000HV-B	αiI 8/8000HV-B	αiI 8/8000HV-B	αiI 8/10000HV-B	αiI 8/10000HV-B
Applicable amplifier	αi SP 5.5HV-B βi SVSP 11HV-B	βi SVSP 15HV-B αi SP 15HV-B	αi SP 11HV-B βi SVSP 11HV-B	βi SVSP 15HV-B αi SP 15HV-B	αi SP 11HV-B βi SVSP 11HV-B	βi SVSP 15HV-B αi SP 15HV-B	αi SP 15HV-B αi SP 15HV-B	αi SP 11HV-B βi SVSP 11HV-B	βi SVSP 15HV-B αi SP 15HV-B	αi SP 11HV-B βi SVSP 11HV-B	βi SVSP 15HV-B αi SP 15HV-B
Output specification nameplate	A06B-1230-K505#S00	A06B-1230-K505#S00	A06B-1230-K506#S00	A06B-1230-K506#S00	A06B-1230-K506#S0P	A06B-1230-K506#S0P	A06B-1230-K507#S0P	A06B-1230-K507#S00	A06B-1230-K507#S00	A06B-1230-K527#S00	A06B-1230-K527#S00
Model code	5053	6053	5054	6054	5055	6055	5056	5057	6057	5217	6217
Parameter ID	2037	–	2938	–	2159	–	2276	2813	–	2735	–
Applicable software series and edition	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/P 9DB0/P	9DAA/P 9DB0/P	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0*i*-D,FS30*i*											
4007	00000000	←	00000000	←	00000100	←	00000000	00000000	←	00000000	←
4008	00000000	←	00000000	←	00000000	←	00000000	00000000	←	00000000	←
4009	00000000	←	00000000	←	00000000	←	00000000	00000000	←	00000000	←
4010	00000000	←	00000000	←	00000000	←	00000000	00000000	←	00000000	←
4011	00011001	←	00011010	←	00011010	←	00011010	00011010	←	00011010	←
4012	10000010	←	10000010	←	10000000	←	10000010	10000010	←	10000010	←
4013	00001100	←	00001100	←	00001100	←	00001100	00001100	←	00001100	←
4019	00000100	←	00000100	←	00000100	←	00000100	00000100	←	00000100	←
4400	00000000	←	00000000	←	00000000	←	00000000	00000000	←	00000000	←
4020	10000	←	10000	←	10000	←	8000	8000	←	10000	←
4023(*1)	30	←	30	←	30	←	30	30	←	400	←
4039	0	←	0	←	0	←	0	0	←	0	←
4040(*2)	5	←	5	←	3	←	4	5	←	13	←
4041(*2)	10	←	10	←	10	←	10	10	←	5	←
4048(*2)	25	←	22	←	15	←	17	23	←	61	←
4049(*2)	10	←	10	←	10	←	10	10	←	23	←
4080	85	←	85	←	73	←	14180	70	←	90	←
4083	30	←	30	←	30	←	30	30	←	30	←
4093	0	←	0	←	0	←	0	0	←	176	←
4100	1400	←	1500	←	1650	←	1750	1800	←	4000	←
4101	100	←	100	←	100	←	95	100	←	97	←
4102	2288	←	3000	←	2236	←	2323	2323	←	4524	←
4103	61	←	58	←	0	←	0	85	←	90	←
4104	7000	←	5000	←	2300	←	7000	7000	←	2000	←
4105	109	←	109	←	109	←	132	132	←	140	←
4106	7000	←	5000	←	4600	←	7000	7000	←	7000	←
4107	0	←	0	←	0	←	0	0	←	132	←
4108	0	←	0	←	0	←	0	0	←	0	←
4109	25	←	25	←	25	←	25	25	←	25	←
4110	1077	2154	754	1508	539	1078	1257	629	1258	471	942
4111	237	←	272	←	229	←	344	229	←	150	←
4112	200	←	200	←	200	←	200	200	←	200	←
4113	873	←	878	←	880	←	723	723	←	680	←
4114	20480	←	23040	←	22528	←	0	23040	←	0	←
4115	100	←	100	←	100	←	100	100	←	100	←
4116	9908	←	9016	←	9016	←	8734	8734	←	6321	←
4117	90	←	90	←	90	←	90	90	←	90	←
4118	100	←	100	←	100	←	100	100	←	100	←
4119	11	←	11	←	11	←	13	13	←	14	←
4120	0	←	0	←	0	←	0	0	←	0	←
4124	24551	←	24575	←	24545	←	24575	24544	←	24482	←
4127	178	←	164	←	240	←	240	176	←	176	←
4128	90	←	0	←	0	←	0	0	←	0	←
4129	0	←	0	←	0	←	0	0	←	0	←
4130	25700	←	25700	←	25700	←	25700	25700	←	25700	←
4134	110	←	130	←	130	←	130	130	←	130	←
4136	30	←	30	←	30	←	0	30	←	30	←
4138	0	←	0	←	0	←	0	0	←	1800	←
4139	0	←	0	←	0	←	0	0	←	100	←
4140	0	←	0	←	0	←	0	0	←	2323	←
4141	0	←	0	←	0	←	0	0	←	85	←
4142	0	←	0	←	0	←	0	0	←	5000	←
4143	0	←	0	←	0	←	0	0	←	14000	←
4144	0	←	0	←	0	←	0	0	←	0	←
4145	0	←	0	←	0	←	0	0	←	25	←
4146	0	←	0	←	0	←	0	0	←	629	1258
4147	0	←	0	←	0	←	0	0	←	229	←
4148	0	←	0	←	0	←	0	0	←	200	←
4149	0	←	0	←	0	←	0	0	←	723	←
4150	0	←	0	←	0	←	0	0	←	23040	←
4151	0	←	0	←	0	←	0	0	←	100	←
4152	0	←	0	←	0	←	0	0	←	8734	←
4153	0	←	0	←	0	←	0	0	←	90	←
4154	0	←	0	←	0	←	0	0	←	100	←
4155	0	←	0	←	0	←	0	0	←	24544	←
4156	0	←	0	←	0	←	0	0	←	0	←
4158	0	←	0	←	0	←	0	0	←	0	←
4159	0	←	0	←	0	←	0	0	←	0	←
4161	0	←	0	←	0	←	0	0	←	25700	←
4165	0	←	0	←	0	←	0	0	←	13	←
4166	0	←	0	←	0	←	0	0	←	20568	←
4169	0	←	0	←	0	←	0	0	←	0	←
4362	0	←	0	←	-24501	←	-26399	0	←	0	←
4363	0	←	0	←	-26474	←	-28347	0	←	0	←
4364	0	←	0	←	-24351	←	31145	0	←	0	←
4365	0	←	0	←	0	←	0	0	←	0	←
4366	0	←	0	←	0	←	0	0	←	0	←
4367	0	←	0	←	0	←	0	0	←	0	←
4612	144	←	156	←	107	←	101	145	←	141	←
4613	19073	←	21898	←	22154	←	16514	16513	←	10253	←
4614	0	←	0	←	0	←	0	0	←	145	←
4615	0	←	0	←	0	←	0	0	←	16517	←
Maximum output during acceleration (for PS selection)	6.66	6.66	9	9	13.2	13.2	18	13.2	13.2	13.2	13.2

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

JR AUTOMATION TECHNOLOGIES, INC*

Motor model	αiI8/12000HV-B	αiI12/8000HV-B	αiI12/8000HV-B	αiI12/12000HV-B	αiI15/8000HV-B	αiI15/8000HV-B	αiI15/8000HV-B	αiI15/12000HV-B	αiI22/8000HV-B	αiI22/8000HV-B	αiI22/12000HV-B
Applicable amplifier	αi SP 15HV-B βi SVSP 15HV-B	αi SP 15HV-B βi SVSP 15HV-B	αi SP 15HV-B βi SVSP 15HV-B	αi SP 15HV-B βi SVSP 15HV-B	αi SP 22HV-B	αi SP 22HV-B	αi SP 30HV-B	αi SP 22HV-B	αi SP 30HV-B	αi SP 30HV-B	αi SP 30HV-B
Output specification nameplate	A06B-1230-K527#S01	A06B-1230-K508#S00	A06B-1230-K508#S0P	A06B-1230-K528#S0P	A06B-1230-K509#S00	A06B-1230-K509#S0P	A06B-1230-K509#S0S	A06B-1230-K529#S00	A06B-1230-K511#S00	A06B-1230-K511#S0P	A06B-1230-K531#S00
Model code	5218	5058	5059	5219	5060	5061	5062	5220	5063	5064	5221
Parameter ID	2603	2484	2836	2290	2842	2908	2916	2400	2117	2127	2586
Applicable software series and edition	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/P 9DB0/P	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/O 9DB0/O	9DAA/N 9DB0/N	9DAA/O 9DB0/O	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0*i*-D,FS30*i*											
4007	00000000	00000000	00000100	00000100	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4008	00000000	00000000	00000000	00000000	00000000	00010000	00010000	00000000	00000000	00010000	00000000
4009	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4010	00000001	00000000	00000000	00010001	00000000	00000000	00000000	00000001	00000000	00000000	00000000
4011	00011010	00011010	00001010	00011010	00011010	00001010	00001010	00011010	00011010	00001010	00011010
4012	10000010	10000000	10000010	10000010	10000010	10000111	10000010	10000010	10000010	10000010	10000010
4013	00001100	00001100	00001100	00001100	00001100	00001100	00001100	00001100	00001100	00001100	00001100
4019	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100
4400	00000000	00000000	00000000	00000000	00000000	00000001	00000000	00000000	00000000	00000000	00000000
4020	12000	8000	8000	12000	8000	8000	8000	12000	8000	8000	12000
4023(*1)	333	30	30	333	30	30	30	333	30	30	333
4039	0	0	0	0	0	0	0	0	0	0	0
4040(*2)	13	9	7	20	10	7	6	26	10	7	26
4041(*2)	5	10	10	7	10	10	10	10	10	10	10
4048(*2)	61	43	35	93	45	33	26	119	45	34	121
4049(*2)	23	10	10	35	10	10	10	45	10	10	45
4080	9050	88	79	88	65	21840	21840	80	75	23125	83
4083	30	30	30	30	30	30	30	30	30	30	30
4093	176	0	0	202	0	0	0	148	0	0	142
4100	3750	1550	1493	4032	1500	1550	1530	4000	1595	1520	3630
4101	85	100	100	84	73	100	94	53	100	100	74
4102	3798	1754	1913	3253	1972	1972	1972	3464	1595	1794	3318
4103	89	88	0	95	65	0	0	70	0	0	93
4104	3800	2000	4000	900	4500	1700	3300	2800	5000	4000	2100
4105	101	347	363	381	341	341	341	341	294	318	360
4106	10000	4500	11000	2300	4500	3800	10000	2800	5000	15000	6300
4107	95	0	0	379	0	0	0	341	0	0	347
4108	0	0	0	0	0	0	0	0	0	0	0
4109	25	25	25	25	25	25	25	25	25	25	25
4110	569	1077	1207	754	999	999	1499	571	838	870	666
4111	100	250	329	190	425	450	554	229	223	295	160
4112	200	200	200	200	200	200	200	200	200	200	200
4113	950	275	263	250	280	280	280	280	325	300	265
4114	0	0	0	0	23040	21760	21760	0	20480	0	0
4115	100	100	100	100	100	100	100	100	100	100	100
4116	8736	5800	4345	4701	5153	5153	5153	5184	5572	4295	5000
4117	90	90	23130	90	90	90	90	90	90	90	90
4118	90	100	100	19300	100	100	100	100	100	100	90
4119	10	35	36	38	34	34	34	34	29	32	50
4120	0	0	0	0	0	0	0	0	0	0	0
4124	24447	24562	24575	24513	24575	24575	24575	24544	24539	24575	24489
4127	176	164	202	202	148	200	240	148	142	191	142
4128	0	108	90	0	0	105	0	0	0	102	98
4129	0	0	0	0	0	0	0	0	0	0	0
4130	25700	25700	25700	25700	25700	25700	25700	25700	25700	25700	25700
4134	130	130	130	130	130	130	130	130	130	130	130
4136	30	30	30	30	30	30	30	30	30	30	30
4138	1550	0	0	1550	0	0	0	1500	0	0	1500
4139	84	0	0	100	0	0	0	73	0	0	84
4140	1957	0	0	1615	0	0	0	1972	0	0	1669
4141	74	0	0	88	0	0	0	65	0	0	82
4142	7000	0	0	3000	0	0	0	4500	0	0	4000
4143	18000	0	0	9000	0	0	0	4500	0	0	12000
4144	0	0	0	0	0	0	0	0	0	0	0
4145	25	0	0	25	0	0	0	25	0	0	25
4146	838	0	0	1160	0	0	0	999	0	0	984
4147	186	0	0	315	0	0	0	425	0	0	270
4148	200	0	0	200	0	0	0	200	0	0	200
4149	1000	0	0	252	0	0	0	280	0	0	275
4150	0	0	0	0	0	0	0	23040	0	0	0
4151	100	0	0	100	0	0	0	100	0	0	100
4152	8737	0	0	4463	0	0	0	5153	0	0	4991
4153	90	0	0	90	0	0	0	90	0	0	90
4154	90	0	0	100	0	0	0	100	0	0	90
4155	24510	0	0	24575	0	0	0	24575	0	0	24575
4156	0	0	0	0	0	0	0	0	0	0	0
4158	0	0	0	0	0	0	0	0	0	0	103
4159	0	0	0	0	0	0	0	0	0	0	0
4161	25700	0	0	25700	0	0	0	25700	0	0	25700
4165	266	0	0	38	0	0	0	34	0	0	70
4166	14938	0	0	61	0	0	0	65	0	0	18517
4169	0	0	0	0	0	0	0	0	0	0	0
4362	0	0	-24501	0	0	0	0	0	0	-24501	0
4363	0	0	-30605	0	0	0	0	0	0	-26424	0
4364	0	0	-24376	0	0	0	0	0	0	31120	0
4365	0	0	0	0	0	0	0	0	0	0	0
4366	0	0	0	0	0	0	0	0	0	0	0
4367	0	0	0	0	0	0	0	0	0	0	0
4612	124	156	127	107	126	128	100	92	181	134	134
4613	12299	16521	16521	10379	16537	16537	16537	10376	16517	16517	10241
4614	122	0	0	127	0	0	0	126	0	0	152
4615	19201	0	0	16518	0	0	0	16517	0	0	16514
Maximum output during acceleration (for PS selection)	13.2	18	22.2	22.2	22.2	30	36	22.2	31.2	42	31.2

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

JR AUTOMATION TECHNOLOGIES, INC*
DOWLING

Motor model	αiI22/12000HV-B	αiI30/7000HV-B	αiI30/7000HV-B	αiI40/7000HV-B	αiI40/7000HV-B	αiI50/5000HV-B	αiI60/5000HV-B	αiI75/5000HV-B	αiI100/5000HV-B	αiI150/5000HV-B
Applicable amplifier	αi SP 30HV-B	αi SP 45HV-B	αi SP 45HV-B	αi SP 45HV-B	αi SP 75HV-B	αi SP 45HV-B	αi SP 75HV-B	αi SP 75HV-B	αi SP 100HV-B	αi SP 75HV-B × 2
Output specification nameplate	A06B-1230-K531#S0P	A06B-1230-K512#S00	A06B-1230-K512#S0P	A06B-1230-K513#S00	A06B-1230-K513#S0P	A06B-1230-K514#S00	A06B-1230-K515#S00	A06B-1230-K516#S00	A06B-1230-K518#S00	A06B-1230-K532#S00
Model code	5222	5065	5066	5067	5068	5069	5070	5071	5223	5072
Parameter ID	2076	2888	2266	2673	2967	2090	2957	2187	2688	2800
Applicable software series and edition	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/P 9DB0/P	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0*i* -D,FS30*i*										
4007	00000000	00000000	00000100	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4008	00010000	00000000	00000000	00010000	00010000	00010000	00000000	00010000	00010000	00000000
4009	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4010	00000000	00000000	00000000	00000000	00010000	00000000	00000000	00010001	00010001	00010001
4011	00001010	00011010	00001010	00001010	00001010	00001010	00011010	00001010	00001010	00001010
4012	10000010	10000000	10000010	10000000	10000000	10000000	10000000	10000000	10000000	10000000
4013	00001100	00001100	00001100	00001100	00001100	00001100	00001100	00001100	00001100	00001100
4019	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100
4400	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4020	12000	7000	7000	7000	7000	5000	5000	5000	5000	5000
4023(*1)	333	30	30	30	30	30	30	30	600	30
4039	0	0	0	0	0	0	0	0	0	0
4040(*2)	19	12	10	12	8	14	10	12	39	11
4041(*2)	7	10	10	10	10	10	10	10	13	10
4048(*2)	90	56	46	56	36	63	46	57	180	50
4049(*2)	34	10	10	10	10	10	10	10	60	10
4080	19280	98	70	82	20560	18000	90	20560	85	10591
4083	30	30	30	30	30	30	30	30	30	30
4093	191	0	0	0	0	0	0	0	120	0
4100	4000	1230	1190	1600	1170	1150	1130	1100	3050	1520
4101	75	85	100	100	100	85	100	100	90	100
4102	3318	1617	1617	1940	1940	1175	1491	1254	3210	1551
4103	0	55	0	0	0	0	85	0	0	0
4104	2500	2500	5100	2500	2500	4000	3500	2500	1400	2500
4105	360	597	564	546	544	492	495	531	555	554
4106	5000	4000	11500	2800	5000	6000	7000	4000	2300	4000
4107	347	0	0	0	0	0	0	0	555	0
4108	0	0	0	0	0	0	0	0	0	0
4109	25	25	25	25	25	25	25	25	25	25
4110	666	1257	1257	718	1437	678	1174	887	1131	973
4111	236	455	469	252	478	274	345	292	379	324
4112	200	200	200	200	200	200	200	200	200	200
4113	265	160	169	175	175	194	193	180	172	172
4114	20480	0	23040	0	0	0	0	0	0	0
4115	100	100	100	100	100	100	100	100	100	100
4116	5000	5056	5056	6212	6800	5045	5042	4794	4691	4691
4117	90	90	90	90	90	90	90	90	90	90
4118	100	100	100	100	100	100	100	100	100	100
4119	50	60	56	54	54	49	49	53	55	55
4120	0	0	0	0	0	0	0	0	0	0
4124	24550	24575	24575	24564	24575	24575	24575	24575	24575	24575
4127	191	148	180	146	227	147	150	144	120	144
4128	110	110	0	115	103	0	0	110	0	120
4129	0	0	0	0	0	0	0	0	0	0
4130	25700	25700	25700	25700	25700	25700	25700	25700	25700	25700
4134	130	130	130	130	130	130	130	130	130	130
4136	30	30	30	30	30	30	30	30	30	30
4138	1550	0	0	0	0	0	0	0	1020	0
4139	90	0	0	0	0	0	0	0	79	0
4140	1669	0	0	0	0	0	0	0	1042	0
4141	0	0	0	0	0	0	0	0	0	0
4142	4000	0	0	0	0	0	0	0	4000	0
4143	12000	0	0	0	0	0	0	0	7000	0
4144	0	0	0	0	0	0	0	0	0	0
4145	25	0	0	0	0	0	0	0	25	0
4146	984	0	0	0	0	0	0	0	993	0
4147	365	0	0	0	0	0	0	0	352	0
4148	200	0	0	0	0	0	0	0	200	0
4149	275	0	0	0	0	0	0	0	172	0
4150	24320	0	0	0	0	0	0	0	0	0
4151	100	0	0	0	0	0	0	0	100	0
4152	4991	0	0	0	0	0	0	0	4691	0
4153	90	0	0	0	0	0	0	0	90	0
4154	28260	0	0	0	0	0	0	0	100	0
4155	24575	0	0	0	0	0	0	0	24575	0
4156	0	0	0	0	0	0	0	0	0	0
4158	110	0	0	0	0	0	0	0	0	0
4159	0	0	0	0	0	0	0	0	0	0
4161	25700	0	0	0	0	0	0	0	25700	0
4165	35	0	0	0	0	0	0	0	55	0
4166	19280	0	0	0	0	0	0	0	16730	0
4169	0	0	0	0	0	0	0	0	0	0
4362	-26424	0	-24526	0	0	0	0	0	0	0
4363	-26324	0	-30570	0	0	0	0	0	0	0
4364	-26274	0	-24276	0	0	0	0	0	0	0
4365	-26349	0	0	0	0	0	0	0	0	0
4366	-32443	0	0	0	0	0	0	0	0	0
4367	-26274	0	0	0	0	0	0	0	0	0
4612	101	147	142	175	96	148	9871	178	192	178
4613	10241	12291	12546	14082	14340	12559	12550	13580	6938	12298
4614	121	0	0	0	0	0	0	0	169	0
4615	16771	0	0	0	0	0	0	0	12288	0
Maximum output during acceleration (for PS selection)	42	44.4	54	54	84	66	90	108	120	216

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

JR AUTOMATION TECHNOLOGY, INC*

C.21 SPINDLE MOTOR αiI-B series(IP65)

Motor model	αi I 0.5/10000-B(IP65)	αi I 0.5/10000-B(IP65)	αi I 0.5/10000-B(IP65)	αi I 0.5/10000-B(IP65)	αi I 1/8000-B(IP65)	αi I 1/8000-B(IP65)	αi I 1/8000-B(IP65)	αi I 1/8000-B(IP65)
Applicable amplifier	αi SP 2.2-B	βi SVSP 7.5-B	βi SVSP 11-B αi SP 11-B	βi SVSP 15-B αi SP 15-B	αi SP 2.2-B	βi SVSP 7.5-B	βi SVSP 11-B αi SP 11-B	βi SVSP 15-B αi SP 15-B
Output specification nameplate	A06B-1230-K481#S00	A06B-1230-K481#S00	A06B-1230-K481#S00	A06B-1230-K481#S00	A06B-1230-K482#S00	A06B-1230-K482#S00	A06B-1230-K482#S00	A06B-1230-K482#S00
Model code	5113	6113	7113	8113	5114	6114	7114	8114
Parameter ID	2819	–	–	–	2211	–	–	–
Applicable software series and edition	9DAA/P 9DB0/P	9DAA/P 9DB0/P	9DAA/P 9DB0/P	9DAA/P 9DB0/P	9DAA/P 9DB0/P	9DAA/P 9DB0/P	9DAA/P 9DB0/P	9DAA/P 9DB0/P
FS0i-D,FS30i								
4007	00000000	←	←	←	00000000	←	←	←
4008	00000000	←	←	←	00000000	←	←	←
4009	00000000	←	←	←	00000000	←	←	←
4010	00000001	←	←	←	00000001	←	←	←
4011	00011000	←	←	←	00011001	←	←	←
4012	10000010	←	←	←	10000010	←	←	←
4013	00001100	←	←	←	00001100	←	←	←
4019	00000100	←	←	←	00000100	←	←	←
4400	00000000	←	←	←	00000000	←	←	←
4020	10000	←	←	←	8000	←	←	←
4023(*1)	30	←	←	←	30	←	←	←
4039	0	←	←	←	0	←	←	←
4040(*2)	2	←	←	←	5	←	←	←
4041(*2)	10	←	←	←	10	←	←	←
4048(*2)	8	←	←	←	25	←	←	←
4049(*2)	10	←	←	←	10	←	←	←
4080	90	←	←	←	83	←	←	←
4083	30	←	←	←	30	←	←	←
4093	0	←	←	←	0	←	←	←
4100	3400	←	←	←	3100	←	←	←
4101	100	←	←	←	100	←	←	←
4102	6500	←	←	←	3557	←	←	←
4103	46	←	←	←	87	←	←	←
4104	3000	←	←	←	6000	←	←	←
4105	46	←	←	←	45	←	←	←
4106	7500	←	←	←	6000	←	←	←
4107	0	←	←	←	0	←	←	←
4108	0	←	←	←	0	←	←	←
4109	25	←	←	←	25	←	←	←
4110	1571	2514	3142	4713	690	1104	1380	2070
4111	260	←	←	←	102	←	←	←
4112	200	←	←	←	200	←	←	←
4113	2077	←	←	←	2100	←	←	←
4114	23040	←	←	←	17920	←	←	←
4115	100	←	←	←	100	←	←	←
4116	13760	←	←	←	10018	←	←	←
4117	90	←	←	←	90	←	←	←
4118	100	←	←	←	100	←	←	←
4119	5	←	←	←	5	←	←	←
4120	0	←	←	←	0	←	←	←
4124	24570	←	←	←	24448	←	←	←
4127	240	←	←	←	293	←	←	←
4128	120	←	←	←	0	←	←	←
4129	0	←	←	←	0	←	←	←
4130	25700	←	←	←	25700	←	←	←
4134	110	←	←	←	110	←	←	←
4136	30	←	←	←	30	←	←	←
4138	0	←	←	←	0	←	←	←
4139	0	←	←	←	0	←	←	←
4140	0	←	←	←	0	←	←	←
4141	0	←	←	←	0	←	←	←
4142	0	←	←	←	0	←	←	←
4143	0	←	←	←	0	←	←	←
4144	0	←	←	←	0	←	←	←
4145	0	←	←	←	0	←	←	←
4146	0	←	←	←	0	←	←	←
4147	0	←	←	←	0	←	←	←
4148	0	←	←	←	0	←	←	←
4149	0	←	←	←	0	←	←	←
4150	0	←	←	←	0	←	←	←
4151	0	←	←	←	0	←	←	←
4152	0	←	←	←	0	←	←	←
4153	0	←	←	←	0	←	←	←
4154	0	←	←	←	0	←	←	←
4155	0	←	←	←	0	←	←	←
4156	0	←	←	←	0	←	←	←
4158	0	←	←	←	0	←	←	←
4159	0	←	←	←	0	←	←	←
4161	0	←	←	←	0	←	←	←
4165	0	←	←	←	0	←	←	←
4166	0	←	←	←	0	←	←	←
4169	0	←	←	←	0	←	←	←
4362	0	←	←	←	0	←	←	←
4363	0	←	←	←	0	←	←	←
4364	0	←	←	←	0	←	←	←
4365	0	←	←	←	0	←	←	←
4366	0	←	←	←	0	←	←	←
4367	0	←	←	←	0	←	←	←
4612	107	←	←	←	87	←	←	←
4613	10889	←	←	←	11024	←	←	←
4614	0	←	←	←	0	←	←	←
4615	0	←	←	←	0	←	←	←
Maximum output during acceleration (for PS selection)	1.32	1.32	1.32	1.32	2.64	2.64	2.64	2.64

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

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Motor model	αi I 1.5/8000-B(IP65)	αi I 1.5/8000-B(IP65)	αi I 1.5/8000-B(IP65)	αi I 1.5/8000-B(IP65)	αi I 2/8000-B(IP65)	αi I 2/8000-B(IP65)	αi I 2/8000-B(IP65)	αi I 2/8000-B(IP65)
Applicable amplifier	αi SP 5.5-B	βi SVSP 7.5-B	βi SVSP 11-B αi SP 11-B	βi SVSP 15-B αi SP 15-B	αi SP 5.5-B	βi SVSP 7.5-B	βi SVSP 11-B αi SP 11-B	βi SVSP 15-B αi SP 15-B
Output specification nameplate	A06B-1230-K483#S00	A06B-1230-K483#S00	A06B-1230-K483#S00	A06B-1230-K483#S00	A06B-1230-K484#S00	A06B-1230-K484#S00	A06B-1230-K484#S00	A06B-1230-K484#S00
Model code	5115	6115	7115	8115	5116	6116	7116	8116
Parameter ID	2496	–	–	–	2161	–	–	–
Applicable software series and edition	9DAA/P 9DB0/P	9DAA/P 9DB0/P	9DAA/P 9DB0/P	9DAA/P 9DB0/P	9DAA/P 9DB0/P	9DAA/P 9DB0/P	9DAA/P 9DB0/P	9DAA/P 9DB0/P
FS0*i*-D,FS30*i*								
4007	00000000	←	←	←	00000000	←	←	←
4008	00000000	←	←	←	00000000	←	←	←
4009	00000000	←	←	←	00000000	←	←	←
4010	00000001	←	←	←	00000001	←	←	←
4011	00011001	←	←	←	00011001	←	←	←
4012	10000010	←	←	←	10000010	←	←	←
4013	00001100	←	←	←	00001100	←	←	←
4019	00000100	←	←	←	00000100	←	←	←
4400	00000000	←	←	←	00000000	←	←	←
4020	8000	←	←	←	8000	←	←	←
4023(*1)	30	←	←	←	30	←	←	←
4039	0	←	←	←	0	←	←	←
4040(*2)	2	←	←	←	4	←	←	←
4041(*2)	10	←	←	←	10	←	←	←
4048(*2)	11	←	←	←	19	←	←	←
4049(*2)	10	←	←	←	10	←	←	←
4080	85	←	←	←	77	←	←	←
4083	30	←	←	←	30	←	←	←
4093	0	←	←	←	0	←	←	←
4100	1650	←	←	←	1550	←	←	←
4101	100	←	←	←	100	←	←	←
4102	2767	←	←	←	2567	←	←	←
4103	60	←	←	←	68	←	←	←
4104	6000	←	←	←	6000	←	←	←
4105	58	←	←	←	80	←	←	←
4106	6000	←	←	←	6000	←	←	←
4107	0	←	←	←	0	←	←	←
4108	0	←	←	←	0	←	←	←
4109	25	←	←	←	25	←	←	←
4110	563	901	1126	1689	474	758	948	1422
4111	217	←	←	←	175	←	←	←
4112	200	←	←	←	200	←	←	←
4113	1635	←	←	←	1192	←	←	←
4114	0	←	←	←	0	←	←	←
4115	100	←	←	←	100	←	←	←
4116	9598	←	←	←	9300	←	←	←
4117	90	←	←	←	90	←	←	←
4118	100	←	←	←	100	←	←	←
4119	5	←	←	←	8	←	←	←
4120	0	←	←	←	0	←	←	←
4124	24535	←	←	←	24501	←	←	←
4127	493	←	←	←	296	←	←	←
4128	115	←	←	←	90	←	←	←
4129	0	←	←	←	0	←	←	←
4130	25700	←	←	←	25700	←	←	←
4134	110	←	←	←	110	←	←	←
4136	30	←	←	←	30	←	←	←
4138	0	←	←	←	0	←	←	←
4139	0	←	←	←	0	←	←	←
4140	0	←	←	←	0	←	←	←
4141	0	←	←	←	0	←	←	←
4142	0	←	←	←	0	←	←	←
4143	0	←	←	←	0	←	←	←
4144	0	←	←	←	0	←	←	←
4145	0	←	←	←	0	←	←	←
4146	0	←	←	←	0	←	←	←
4147	0	←	←	←	0	←	←	←
4148	0	←	←	←	0	←	←	←
4149	0	←	←	←	0	←	←	←
4150	0	←	←	←	0	←	←	←
4151	0	←	←	←	0	←	←	←
4152	0	←	←	←	0	←	←	←
4153	0	←	←	←	0	←	←	←
4154	0	←	←	←	0	←	←	←
4155	0	←	←	←	0	←	←	←
4156	0	←	←	←	0	←	←	←
4158	0	←	←	←	0	←	←	←
4159	0	←	←	←	0	←	←	←
4161	0	←	←	←	0	←	←	←
4165	0	←	←	←	0	←	←	←
4166	0	←	←	←	0	←	←	←
4169	0	←	←	←	0	←	←	←
4362	0	←	←	←	0	←	←	←
4363	0	←	←	←	0	←	←	←
4364	0	←	←	←	0	←	←	←
4365	0	←	←	←	0	←	←	←
4366	0	←	←	←	0	←	←	←
4367	0	←	←	←	0	←	←	←
4612	52	←	←	←	86	←	←	←
4613	21776	←	←	←	16257	←	←	←
4614	0	←	←	←	0	←	←	←
4615	0	←	←	←	0	←	←	←
Maximum output during acceleration (for PS selection)	4.44	4.44	4.44	4.44	4.44	4.44	4.44	4.44

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

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Motor model	αiI 3/8000-B(IP65)	αiI 3/8000-B(IP65)	αiI 3/8000-B(IP65)	αiI 3/8000-B(IP65)	αiI 6/8000-B(IP65)	αiI 6/8000-B(IP65)	αiI 6/8000-B(IP65)
Applicable amplifier	αiSP 5.5-B	βiSVSP 7.5-B	βiSVSP 11-B αiSP 11-B	βiSVSP 15-B αiSP 15-B	αiSP 11-B βiSVSP 11-B	βiSVSP 15-B αiSP 15-B	βiSVSP 18-B αiSP 22-B
Output specification nameplate	A06B-1230-K485#S00	A06B-1230-K485#S00	A06B-1230-K485#S00	A06B-1230-K485#S00	A06B-1230-K486#S00	A06B-1230-K486#S00	A06B-1230-K486#S00
Model code	5117	6117	7117	8117	5118	6118	7118
Parameter ID	2109	–	–	–	2191	–	–
Applicable software series and edition	9DAA/P 9DB0/P	9DAA/P 9DB0/P	9DAA/P 9DB0/P	9DAA/P 9DB0/P	9DAA/P 9DB0/P	9DAA/P 9DB0/P	9DAA/P 9DB0/P
FS0*i*-D,FS30*i*							
4007	00000000	←	←	←	00000000	←	←
4008	00000000	←	←	←	00000000	←	←
4009	00000000	←	←	←	00000000	←	←
4010	00000001	←	←	←	00000001	←	←
4011	00011001	←	←	←	00011010	←	←
4012	10000010	←	←	←	10000010	←	←
4013	00001100	←	←	←	00001100	←	←
4019	00000100	←	←	←	00000100	←	←
4400	00000000	←	←	←	00000000	←	←
4020	8000	←	←	←	8000	←	←
4023(*1)	30	←	←	←	30	←	←
4039	0	←	←	←	0	←	←
4040(*2)	5	←	←	←	5	←	←
4041(*2)	10	←	←	←	10	←	←
4048(*2)	25	←	←	←	22	←	←
4049(*2)	10	←	←	←	10	←	←
4080	60	←	←	←	66	←	←
4083	30	←	←	←	30	←	←
4093	0	←	←	←	0	←	←
4100	1600	←	←	←	1550	←	←
4101	100	←	←	←	96	←	←
4102	1967	←	←	←	2630	←	←
4103	75	←	←	←	60	←	←
4104	7000	←	←	←	6000	←	←
4105	89	←	←	←	154	←	←
4106	7000	←	←	←	6000	←	←
4107	0	←	←	←	0	←	←
4108	0	←	←	←	0	←	←
4109	25	←	←	←	25	←	←
4110	475	760	950	1425	754	1131	1508
4111	200	←	←	←	260	←	←
4112	19400	←	←	←	200	←	←
4113	1077	←	←	←	620	←	←
4114	0	←	←	←	20480	←	←
4115	100	←	←	←	100	←	←
4116	7950	←	←	←	8803	←	←
4117	28250	←	←	←	90	←	←
4118	110	←	←	←	100	←	←
4119	5	←	←	←	15	←	←
4120	0	←	←	←	0	←	←
4124	24521	←	←	←	24571	←	←
4127	300	←	←	←	300	←	←
4128	0	←	←	←	109	←	←
4129	0	←	←	←	0	←	←
4130	25700	←	←	←	25700	←	←
4134	110	←	←	←	130	←	←
4136	30	←	←	←	30	←	←
4138	0	←	←	←	0	←	←
4139	0	←	←	←	0	←	←
4140	0	←	←	←	0	←	←
4141	0	←	←	←	0	←	←
4142	0	←	←	←	0	←	←
4143	0	←	←	←	0	←	←
4144	0	←	←	←	0	←	←
4145	0	←	←	←	0	←	←
4146	0	←	←	←	0	←	←
4147	0	←	←	←	0	←	←
4148	0	←	←	←	0	←	←
4149	0	←	←	←	0	←	←
4150	0	←	←	←	0	←	←
4151	0	←	←	←	0	←	←
4152	0	←	←	←	0	←	←
4153	0	←	←	←	0	←	←
4154	0	←	←	←	0	←	←
4155	0	←	←	←	0	←	←
4156	0	←	←	←	0	←	←
4158	0	←	←	←	0	←	←
4159	0	←	←	←	0	←	←
4161	0	←	←	←	0	←	←
4165	0	←	←	←	0	←	←
4166	0	←	←	←	0	←	←
4169	0	←	←	←	0	←	←
4362	0	←	←	←	0	←	←
4363	0	←	←	←	0	←	←
4364	0	←	←	←	0	←	←
4365	0	←	←	←	0	←	←
4366	0	←	←	←	0	←	←
4367	0	←	←	←	0	←	←
4612	85	←	←	←	82	←	←
4613	16142	←	←	←	21776	←	←
4614	0	←	←	←	0	←	←
4615	0	←	←	←	0	←	←
Maximum output during acceleration (for PS selection)	6.6	6.6	6.6	6.6	9	9	9

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

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C.22 SPINDLE MOTOR αiIP-B series

Motor model	αi IP 12/8000-B	αi IP 12/8000-B	αi IP 12/8000-B	αi IP 12/8000-B	αi IP 12/8000-B	αi IP 12/8000-B	αi IP 15/8000-B	αi IP 15/8000-B	αi IP 15/8000-B	αi IP 15/8000-B
Applicable amplifier	αi SP 11-B βi SVSP 11-B	βi SVSP 15-B αi SP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 11-B βi SVSP 11-B	βi SVSP 15-B αi SP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B
Output specification nameplate	A06B-1230-K448#S00	A06B-1230-K448#S00	A06B-1230-K448#S00	A06B-1230-K448#S0P	A06B-1230-K448#S0P	A06B-1230-K448#S0P	A06B-1230-K449#S00	A06B-1230-K449#S00	A06B-1230-K449#S0P	A06B-1230-K449#S0P
Model code	5224	6224	7224	5225	6225	7225	5226	6226	5227	6227
Parameter ID	2041	–	–	2910	–	–	2903	–	2295	–
Applicable software series and edition	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0*i*-D,FS30*i*										
4007	00000000	←	←	00000000	←	←	00000000	←	00000000	←
4008	00000000	←	←	00010000	←	←	00000000	←	00010000	←
4009	00000000	←	←	00000000	←	←	00000000	←	00000000	←
4010	00000000	←	←	00010000	←	←	00000000	←	00000000	←
4011	00011010	←	←	00011010	←	←	00011010	←	00001010	←
4012	10000010	←	←	10000000	←	←	10000010	←	10000010	←
4013	00001100	←	←	00001100	←	←	00001100	←	00001100	←
4019	00000100	←	←	00000100	←	←	00000100	←	00000100	←
4400	00000000	←	←	00000000	←	←	00000000	←	00000000	←
4020	8000	←	←	8000	←	←	8000	←	8000	←
4023(*1)	94	←	←	94	←	←	94	←	94	←
4039	0	←	←	0	←	←	0	←	0	←
4040(*2)	9	←	←	8	←	←	10	←	7	←
4041(*2)	6	←	←	6	←	←	7	←	7	←
4048(*2)	43	←	←	36	←	←	46	←	34	←
4049(*2)	29	←	←	29	←	←	31	←	31	←
4080	11610	←	←	60	←	←	16730	←	18778	←
4083	30	←	←	30	←	←	30	←	30	←
4093	243	←	←	243	←	←	216	←	216	←
4100	750	←	←	792	←	←	750	←	850	←
4101	100	←	←	100	←	←	90	←	95	←
4102	1488	←	←	1488	←	←	1431	←	1431	←
4103	75	←	←	0	←	←	65	←	0	←
4104	4000	←	←	2600	←	←	3800	←	4200	←
4105	398	←	←	397	←	←	354	←	353	←
4106	10000	←	←	4500	←	←	11000	←	12500	←
4107	354	←	←	354	←	←	341	←	340	←
4108	0	←	←	0	←	←	0	←	0	←
4109	25	←	←	25	←	←	25	←	25	←
4110	815	1223	1630	815	1223	1630	1043	1391	1043	1391
4111	297	←	←	348	←	←	326	←	412	←
4112	200	←	←	200	←	←	200	←	200	←
4113	240	←	←	240	←	←	270	←	270	←
4114	23040	←	←	23040	←	←	23040	←	0	←
4115	100	←	←	100	←	←	100	←	100	←
4116	5307	←	←	5307	←	←	5171	←	5171	←
4117	90	←	←	90	←	←	90	←	90	←
4118	100	←	←	100	←	←	100	←	100	←
4119	40	←	←	40	←	←	35	←	35	←
4120	0	←	←	0	←	←	0	←	0	←
4124	24575	←	←	24575	←	←	24575	←	24575	←
4127	164	←	←	196	←	←	144	←	192	←
4128	105	←	←	105	←	←	105	←	107	←
4129	0	←	←	0	←	←	0	←	0	←
4130	25700	←	←	25700	←	←	25700	←	25700	←
4134	130	←	←	130	←	←	130	←	130	←
4136	30	←	←	30	←	←	30	←	30	←
4138	530	←	←	530	←	←	560	←	560	←
4139	90	←	←	90	←	←	100	←	100	←
4140	887	←	←	887	←	←	1143	←	1143	←
4141	0	←	←	0	←	←	80	←	80	←
4142	6500	←	←	3700	←	←	5000	←	5000	←
4143	15000	←	←	8000	←	←	13000	←	13000	←
4144	0	←	←	0	←	←	0	←	0	←
4145	25	←	←	25	←	←	25	←	25	←
4146	1494	2241	2988	1494	2241	2988	2514	3352	2514	3352
4147	565	←	←	565	←	←	816	←	816	←
4148	200	←	←	200	←	←	200	←	200	←
4149	270	←	←	270	←	←	280	←	280	←
4150	23040	←	←	23040	←	←	23040	←	23040	←
4151	100	←	←	100	←	←	100	←	100	←
4152	5268	←	←	5268	←	←	5170	←	5170	←
4153	90	←	←	90	←	←	90	←	90	←
4154	100	←	←	100	←	←	100	←	100	←
4155	24575	←	←	24575	←	←	24575	←	24575	←
4156	0	←	←	0	←	←	0	←	0	←
4158	110	←	←	110	←	←	0	←	105	←
4159	0	←	←	0	←	←	0	←	0	←
4161	25700	←	←	25700	←	←	25700	←	25700	←
4165	15	←	←	35	←	←	10	←	34	←
4166	70	←	←	62	←	←	70	←	70	←
4169	0	←	←	0	←	←	0	←	0	←
4362	0	←	←	-24476	←	←	0	←	-24351	←
4363	0	←	←	31110	←	←	0	←	-30420	←
4364	0	←	←	27024	←	←	0	←	-26174	←
4365	0	←	←	0	←	←	0	←	0	←
4366	0	←	←	0	←	←	0	←	0	←
4367	0	←	←	0	←	←	0	←	0	←
4612	156	←	←	130	←	←	160	←	127	←
4613	32391	←	←	32391	←	←	32641	←	32642	←
4614	95	←	←	95	←	←	255	←	255	←
4615	12117	←	←	12117	←	←	11604	←	11604	←
Maximum output during acceleration (for PS selection)	9	9	9	10.8	10.8	10.8	10.8	10.8	14.4	14.4

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

JR AUTOMATION TECHNOLOGIES INC*

Motor model	αi IP18/8000-B	αi IP18/8000-B	αi IP18/8000-B	αi IP18/8000-B	αi IP22/8000-B	αi IP22/8000-B	αi IP30/6000-B	αi IP30/6000-B	αi IP40/6000-B	αi IP40/6000-B
Applicable amplifier	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 22-B	αi SP 22-B	αi SP 22-B	αi SP 22-B	αi SP 26-B	αi SP 26-B
Output specification nameplate	A06B-1230-K456#S00	A06B-1230-K456#S00	A06B-1230-K456#S0P	A06B-1230-K456#S0P	A06B-1230-K451#S00	A06B-1230-K451#S0P	A06B-1230-K452#S00	A06B-1230-K452#S0P	A06B-1230-K453#S00	A06B-1230-K453#S0P
Model code	5228	6228	5229	6229	5230	5231	5232	5233	5234	5235
Parameter ID	2808	–	2530	–	2975	2065	2551	2455	2255	2488
Applicable software series and edition	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0*i*-D,FS30*i*										
4007	00000000	←	00000000	←	00000000	00000000	00000000	00000000	00000000	00000100
4008	00000000	←	00010000	←	00000000	00010000	00000000	00000000	00000000	00000000
4009	00000000	←	00000000	←	00000000	00000000	00000000	00000000	00000000	00000000
4010	00000000	←	00000000	←	00000000	00000000	00000000	00000000	00000000	00010000
4011	00011010	←	00001010	←	00011010	00001010	00011010	00011010	00011010	00011010
4012	10000010	←	10000111	←	10000010	10000111	10000010	10000000	10000000	10000010
4013	00001100	←	00001100	←	00001100	00001100	00001100	00001100	00001100	00001100
4019	00000100	←	00000100	←	00000100	00000100	00000100	00000100	00000100	00000100
4400	00000000	←	00000001	←	00000000	00000001	00000000	00000000	00000000	00000000
4020	8000	←	8000	←	8000	8000	6000	6000	6000	6000
4023(*1)	94	←	94	←	94	94	96	96	96	96
4039	0	←	0	←	0	0	0	0	0	0
4040(*2)	9	←	7	←	8	7	12	10	10	7
4041(*2)	6	←	6	←	6	6	8	8	7	9
4048(*2)	44	←	32	←	39	32	56	47	47	40
4049(*2)	29	←	29	←	26	26	39	39	33	39
4080	75	←	25153	←	18000	21062	19280	70	65	38
4083	30	←	30	←	30	30	30	30	30	30
4093	220	←	220	←	240	240	202	202	203	203
4100	740	←	1261	1681	800	800	590	575	590	675
4101	100	←	100	←	100	100	100	100	100	99
4102	1261	←	1261	←	1342	1342	889	889	835	835
4103	70	←	0	←	65	0	85	56	80	0
4104	5500	←	3200	←	5500	2500	10000	4200	3500	3500
4105	318	←	318	←	318	318	482	483	562	475
4106	17000	←	7000	←	5500	2500	10000	7500	6500	6500
4107	303	←	292	←	292	292	579	580	477	478
4108	0	←	0	←	0	0	0	0	0	0
4109	25	←	25	←	25	25	25	25	25	25
4110	754	1005	755	1007	914	914	750	750	1052	1052
4111	225	←	311	←	300	387	267	320	312	363
4112	200	←	200	←	200	200	150	200	200	200
4113	300	←	300	←	300	300	198	198	170	199
4114	0	←	0	←	23040	23040	21760	0	0	0
4115	100	←	100	←	100	100	100	100	100	100
4116	5671	←	5671	←	6196	6196	6050	6050	4500	3600
4117	90	←	90	←	90	90	90	90	90	24154
4118	100	←	90	←	100	100	100	100	100	100
4119	32	←	32	←	301	301	48	48	56	48
4120	0	←	0	←	0	0	0	0	0	0
4124	24541	←	24575	←	24575	24575	24575	24575	24575	24575
4127	147	←	200	←	164	202	148	176	143	169
4128	105	←	0	←	110	0	105	0	85	110
4129	0	←	0	←	0	0	0	0	0	0
4130	25700	←	25700	←	25700	25700	25700	25700	25700	25700
4134	130	←	130	←	130	130	130	130	130	130
4136	30	←	30	←	30	30	30	30	30	30
4138	500	←	500	←	530	530	400	400	430	430
4139	90	←	90	←	100	100	100	100	100	100
4140	755	←	755	←	930	930	684	684	713	713
4141	60	←	60	←	0	0	0	0	56	73
4142	8000	←	8000	←	6500	6500	13000	4700	5000	5000
4143	23000	←	23000	←	15000	15000	13000	7800	7000	7000
4144	0	←	0	←	0	0	0	0	0	0
4145	25	←	25	←	25	25	25	25	25	25
4146	1489	1985	1489	1985	1886	1886	2011	2011	2155	2155
4147	476	←	476	←	617	617	733	733	655	655
4148	200	←	200	←	200	200	200	200	200	200
4149	315	←	315	←	327	327	165	165	200	200
4150	0	←	0	←	20480	20480	0	0	0	0
4151	100	←	100	←	100	100	100	100	100	100
4152	5660	←	5660	←	4813	4813	6008	6008	5200	5200
4153	90	←	90	←	90	90	28250	28250	90	90
4154	115	←	115	←	110	110	100	100	100	100
4155	24575	←	24575	←	24575	24575	24575	24575	24575	24575
4156	0	←	0	←	0	0	0	0	0	0
4158	0	←	0	←	90	90	90	90	0	0
4159	0	←	0	←	0	0	0	0	0	0
4161	25700	←	25700	←	25700	25700	25700	25700	25700	25700
4165	10	←	10	←	20	20	58	58	48	48
4166	77	←	77	←	75	75	50	50	17232	65
4169	0	←	0	←	0	0	0	0	0	0
4362	0	←	0	←	0	0	0	0	0	0
4363	0	←	0	←	0	0	0	0	0	0
4364	0	←	0	←	0	0	0	0	0	0
4365	0	←	0	←	0	0	0	0	0	0
4366	0	←	0	←	0	0	0	0	0	0
4367	0	←	0	←	0	0	0	0	0	0
4612	175	←	128	←	156	127	173	145	179	150
4613	-32761	←	-32760	←	32518	32518	24709	24711	24709	24969
4614	105	←	102	←	107	107	127	127	126	126
4615	12371	←	12544	←	12114	12114	9991	9991	10056	10051
Maximum output during acceleration (for PS selection)	13.2	13.2	18	18	18	22.2	22.2	26.4	26.4	31.2

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

JR AUTOMATION TECHNOLOGIES, INC*

Motor model	αi I$_P$50/6000-B	αi I$_P$50/6000-B	αi I$_P$60/5000-B
Applicable amplifier	αi SP 26-B	αi SP 26-B	αi SP 30-B
Output specification nameplate	A06B-1230-K454#S00	A06B-1230-K454#S0P	A06B-1230-K455#S00
Model code	5236	5237	5238
Parameter ID	2722	2612	2753
Applicable software series and edition	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0*i*-D,FS30*i*			
4007	00000000	00000000	00000000
4008	00000000	00010000	00000000
4009	00000000	00000000	00000000
4010	00000000	00000000	00000000
4011	00011010	00001010	00011010
4012	10000010	10000111	10000000
4013	00001100	00001100	00001100
4019	00000100	00000100	00000100
4400	00000000	00010001	00000000
4020	6000	6000	5000
4023(*1)	200	200	150
4039	0	0	0
4040(*2)	19	13	16
4041(*2)	9	6	9
4048(*2)	87	59	75
4049(*2)	42	28	40
4080	75	16738	75
4083	30	30	30
4093	164	202	195
4100	1107	1230	750
4101	100	100	84
4102	1107	1491	861
4103	0	0	80
4104	8000	4000	5000
4105	531	464	487
4106	8000	6500	9000
4107	490	438	490
4108	0	0	0
4109	25	25	25
4110	686	924	1018
4111	175	326	280
4112	200	200	200
4113	180	206	196
4114	25600	0	0
4115	100	100	100
4116	6150	6156	5050
4117	90	90	90
4118	100	100	100
4119	53	46	49
4120	0	0	0
4124	24501	24575	24575
4127	164	202	164
4128	100	0	0
4129	0	0	0
4130	25700	25700	25700
4134	130	130	130
4136	30	30	30
4138	608	630	420
4139	100	100	85
4140	608	881	497
4141	0	0	0
4142	21000	6000	8000
4143	21000	10000	12000
4144	0	0	0
4145	25	25	25
4146	1131	1508	1764
4147	317	609	510
4148	200	200	200
4149	195	218	195
4150	23040	0	0
4151	100	100	100
4152	6191	5000	5045
4153	90	90	90
4154	100	100	100
4155	24575	24575	24575
4156	0	0	0
4158	110	85	0
4159	0	0	0
4161	25700	25700	25700
4165	49	44	20
4166	65	95	45
4169	0	0	0
4362	0	-24516	0
4363	0	-28472	0
4364	0	-24276	0
4365	0	-26595	0
4366	0	28732	0
4367	0	26694	0
4612	156	127	131
4613	13827	11011	16651
4614	156	127	112
4615	8553	10752	10513
Maximum output during acceleration (for PS selection)	36	44.4	36

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

JR AUTOMATION TECHNOLOGIES INC*
JDOWLING

C.23 SPINDLE MOTOR αiIP-B series(400V)

Motor model	αi IP 15/8000HV-B	αi IP 22/8000HV-B	αi IP 40/6000HV-B	αi IP 50/6000HV-B	αi IP 60/5000HV-B
Applicable amplifier	αi SP 15HV-B βi SVSP 15HV-B	αi SP 22HV-B	αi SP 30HV-B	αi SP 30HV-B	αi SP 30HV-B
Output specification nameplate	A06B-1230-K549#S00	A06B-1230-K551#S00	A06B-1230-K553#S00	A06B-1230-K554#S00	A06B-1230-K555#S00
Model code	5239	5240	5241	5242	5243
Parameter ID	2657	2548	2729	2591	2387
Applicable software series and edition	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0i-D,FS30i					
4007	00000000	00000000	00000000	00000000	00000000
4008	00000000	00010000	00000000	00000000	00000000
4009	00000000	00000000	00000000	00000000	00000000
4010	00000000	00000000	00000000	00000000	00000000
4011	00011010	00001010	00011010	00011010	00001010
4012	10000010	10000010	10000000	10000010	10000000
4013	00001100	00001100	00001100	00001100	00001100
4019	00000100	00000100	00000100	00000100	00000100
4400	00000000	00000000	00000000	00000000	00000000
4020	8000	8000	6000	6000	5000
4023(*1)	94	94	96	200	150
4039	0	0	0	0	0
4040(*2)	10	8	10	19	16
4041(*2)	7	6	7	9	9
4048(*2)	46	39	47	87	75
4049(*2)	31	26	33	42	40
4080	95	75	73	80	80
4083	30	30	30	30	30
4093	216	240	203	164	195
4100	760	760	600	1120	863
4101	90	88	100	100	100
4102	1460	1240	889	1356	863
4103	60	0	75	85	0
4104	5000	5000	6400	6000	6000
4105	368	286	530	475	495
4106	12000	15000	6400	16000	14000
4107	289	288	516	508	492
4108	0	0	0	0	0
4109	25	25	25	25	25
4110	1384	903	1098	838	764
4111	330	382	304	225	229
4112	200	200	200	200	200
4113	260	334	180	201	193
4114	0	20480	20480	0	0
4115	100	100	100	100	100
4116	4600	4500	6043	6202	5045
4117	90	90	90	90	90
4118	100	90	90	100	100
4119	37	29	53	48	49
4120	0	0	0	0	0
4124	24575	24575	24575	24541	24544
4127	144	164	143	164	164
4128	103	105	115	104	0
4129	0	0	0	0	0
4130	25700	25700	25700	25700	25700
4134	130	130	130	130	130
4136	30	30	30	30	30
4138	530	500	430	699	500
4139	75	60	100	95	100
4140	726	717	661	699	500
4141	75	0	60	95	0
4142	10000	8500	8600	10000	11000
4143	28000	19000	8600	24000	22000
4144	0	0	0	0	0
4145	25	25	25	25	25
4146	1934	1571	2514	1374	1331
4147	465	620	726	395	424
4148	200	200	200	200	200
4149	330	332	185	188	194
4150	0	23040	23040	0	0
4151	100	100	100	100	100
4152	5167	5542	6040	6203	5045
4153	90	90	90	90	90
4154	100	90	90	100	100
4155	24575	24575	24575	24575	24575
4156	0	0	0	0	0
4158	0	0	0	120	0
4159	0	0	0	0	0
4161	25700	25700	25700	25700	25700
4165	29	29	52	51	49
4166	80	85	65	63	70
4169	0	0	0	0	0
4362	0	0	0	0	0
4363	0	0	0	0	0
4364	0	0	0	0	0
4365	0	0	0	0	0
4366	0	0	0	0	0
4367	0	0	0	0	0
4612	160	138	179	0	125
4613	32385	32518	24453	0	16395
4614	89	64	126	0	92
4615	12365	12288	10053	0	7758
Maximum output during acceleration (for PS selection)	13.5	18	29	36.4	36

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

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C.24 SPINDLE MOTOR αiIT-B series

Motor model	αi IT 1/24000-B	αi IT 1.5/20000-B	αi IT 2/20000-B	αi IT 3/12000-B	αi IT 3/12000-B	αi IT 3/12000-B	αi IT 3/12000-B	αi IT 3/15000-B
Applicable amplifier	βi SVSP 18-B αi SP 22-B	βi SVSP 18-B αi SP 22-B	αi SP 22-B	αi SP 11-B βi SVSP 11-B	βi SVSP 15-B αi SP 15-B	βi SVSP 18-B αi SP 22-B	βi SVSP 18-B αi SP 22-B	αi SP 22-B
Output specification nameplate	A06B-1230-K460#S0S	A06B-1230-K463#S0S	A06B-1230-K464#S0S	A06B-1230-K465#S00	A06B-1230-K465#S00	A06B-1230-K465#S00	A06B-1230-K465#S0S	A06B-1230-K475#S0U
Model code	5073	5074	5075	5076	6076	7076	5077	5078
Parameter ID	2593	2638	2762	2545	–	–	2556	2069
Applicable software series and edition	9DAA/M 9DB0/M	9DAA/O 9DB0/O	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0i-D,FS30i								
4007	00000000	00000000	00000000	00000000	←	←	00000000	00000100
4008	00000000	00000000	00000000	00000000	←	←	00000000	00000000
4009	00000000	00000000	00000000	00000000	←	←	00000000	00000000
4010	00000001	00000001	00000001	00000001	←	←	00000001	00010001
4011	00011001	00011001	00011001	00011001	←	←	00011001	00001001
4012	10000010	10000010	10000010	10000010	←	←	10000000	10000010
4013	00001100	00001100	00001100	00001100	←	←	00001100	00001100
4019	00000100	00000100	00000100	00000100	←	←	00000100	00000100
4400	00000000	00000000	00000000	00000000	←	←	00000000	00000000
4020	24000	20000	20000	12000	←	←	12000	15000
4023(*1)	30	30	30	30	←	←	30	30
4039	0	0	0	0	←	←	0	0
4040(*2)	2	2	3	5	←	←	2	4
4041(*2)	10	10	10	10	←	←	10	10
4048(*2)	10	9	13	25	←	←	10	18
4049(*2)	10	10	10	10	←	←	10	10
4080	15447	5981	24410	16720	←	←	20570	12870
4083	10	10	10	30	←	←	30	30
4093	0	0	0	0	←	←	0	0
4100	6100	3300	3200	1500	←	←	1600	3150
4101	99	87	100	87	←	←	100	100
4102	11558	7145	6432	3015	←	←	3015	4725
4103	66	70	75	82	←	←	4939	0
4104	1300	3000	2700	3200	←	←	1700	2000
4105	49	43	53	106	←	←	106	103
4106	2800	3000	5300	7500	←	←	4000	7000
4107	0	0	0	0	←	←	0	0
4108	0	0	0	0	←	←	0	0
4109	25	25	25	25	←	←	25	25
4110	915	838	588	559	839	1118	1117	614
4111	299	260	222	190	←	←	399	229
4112	200	200	200	200	←	←	200	200
4113	1978	2227	1800	900	←	←	900	904
4114	0	0	0	19200	←	←	19200	0
4115	90	90	80	100	←	←	80	100
4116	10318	10289	16564	7376	←	←	7376	7375
4117	90	90	90	90	←	←	90	90
4118	28260	100	100	100	←	←	90	100
4119	5	1	2	9	←	←	9	10
4120	0	0	0	0	←	←	0	0
4124	24575	24570	24539	24513	←	←	24575	24544
4127	600	490	357	178	←	←	421	327
4128	0	102	105	0	←	←	110	0
4129	0	0	0	0	←	←	0	0
4130	25700	25700	25700	25700	←	←	25700	25700
4134	110	110	110	110	←	←	110	110
4136	30	30	30	30	←	←	30	30
4138	0	0	0	0	←	←	0	0
4139	0	0	0	0	←	←	0	0
4140	0	0	0	0	←	←	0	0
4141	0	0	0	0	←	←	0	0
4142	0	0	0	0	←	←	0	0
4143	0	0	0	0	←	←	0	0
4144	0	0	0	0	←	←	0	0
4145	0	0	0	0	←	←	0	0
4146	0	0	0	0	←	←	0	0
4147	0	0	0	0	←	←	0	0
4148	0	0	0	0	←	←	0	0
4149	0	0	0	0	←	←	0	0
4150	0	0	0	0	←	←	0	0
4151	0	0	0	0	←	←	0	0
4152	0	0	0	0	←	←	0	0
4153	0	0	0	0	←	←	0	0
4154	0	0	0	0	←	←	0	0
4155	0	0	0	0	←	←	0	0
4156	0	0	0	0	←	←	0	0
4158	0	0	0	0	←	←	0	0
4159	0	0	0	0	←	←	0	0
4161	0	0	0	0	←	←	0	0
4165	0	0	0	0	←	←	0	0
4166	0	0	0	0	←	←	0	0
4169	0	0	0	0	←	←	0	0
4362	0	-23826	-23826	0	←	←	-24176	0
4363	0	-27772	-27797	0	←	←	-30245	0
4364	0	-31768	31720	0	←	←	-30120	0
4365	0	0	0	0	←	←	0	0
4366	0	0	0	0	←	←	0	0
4367	0	0	0	0	←	←	0	0
4612	42	45	72	125	←	←	61	78
4613	16390	20354	20357	32256	←	←	32267	20489
4614	0	0	0	0	←	←	0	0
4615	0	0	0	0	←	←	0	0
Maximum output during acceleration (for PS selection)	22	22	26	13	13	13	22	18

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

JR AUTOMATION TECHNOLOGIES INC*

Motor model	αi IT 6/12000-B	αi IT 6/12000-B	αi IT 6/12000-B	αi IT 6/15000-B	αi IT 8/12000-B	αi IT 8/12000-B	αi IT 8/12000-B	αi IT 8/12000-B	αi IT 8/12000-B	αi IT 8/15000-B
Applicable amplifier	αi SP 11-B βi SVSP 11-B	βi SVSP 15-B αi SP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 22-B	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B	βi SVSP 18-B αi SP 22-B	αi SP 30-B
Output specification nameplate	A06B-1230-K466#S0P	A06B-1230-K466#S0P	A06B-1230-K466#S0P	A06B-1230-K476#S0S	A06B-1230-K467#S00	A06B-1230-K467#S00	A06B-1230-K467#S0P	A06B-1230-K467#S0P	A06B-1230-K467#S0S	A06B-1230-K477#S0S
Model code	5244	6244	7244	5245	5246	6246	5247	6247	5248	5249
Parameter ID	2893	–	–	2575	2982	–	2600	–	2931	2786
Applicable software series and edition	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0*i*-D,FS30*i*										
4007	00000000	←	←	00000000	00000000	←	00000000	←	00000000	00000000
4008	00010000	←	←	00000000	00000000	←	00010000	←	00000000	00000000
4009	00000000	←	←	00000000	00000000	←	00000000	←	00000000	00000000
4010	00000001	←	←	00000001	00000001	←	00000001	←	00000001	00000001
4011	00001010	←	←	00011010	00011010	←	00001010	←	00011010	00011010
4012	10000111	←	←	10000010	10000010	←	10000010	←	10000010	10000010
4013	00001100	←	←	00001100	00001100	←	00001100	←	00001100	00001100
4019	00000100	←	←	00000100	00000100	←	00000100	←	00000100	00000100
4400	00010001	←	←	00000000	00000000	←	00000000	←	00000000	00000000
4020	12000	←	←	15000	12000	←	12000	←	12000	15000
4023(*1)	333	←	←	200	333	←	333	←	333	267
4039	0	←	←	0	0	←	0	←	0	0
4040(*2)	9	←	←	4	13	←	10	←	8	4
4041(*2)	3	←	←	2	5	←	4	←	3	2
4048(*2)	40	←	←	18	61	←	45	←	36	18
4049(*2)	15	←	←	9	23	←	17	←	14	9
4080	75	←	←	10325	70	←	15186	←	75	15962
4083	30	←	←	30	30	←	30	←	30	30
4093	240	←	←	327	176	←	240	←	296	416
4100	4400	←	←	3100	3580	←	3580	←	4614	4200
4101	100	←	←	100	100	←	71	←	100	90
4102	4838	←	←	4853	3580	←	3580	←	4614	5161
4103	0	←	←	0	0	←	0	←	0	90
4104	1200	←	←	2600	2300	←	4000	←	3300	2700
4105	119	←	←	137	97	←	97	←	83	78
4106	2500	←	←	6000	2300	←	14000	←	10000	9200
4107	138	←	←	143	88	←	88	←	88	75
4108	0	←	←	0	0	←	0	←	0	0
4109	25	←	←	25	25	←	25	←	25	25
4110	479	719	958	702	421	561	421	561	603	669
4111	198	←	←	275	100	←	157	←	148	208
4112	200	←	←	200	200	←	200	←	200	200
4113	800	←	←	700	980	←	980	←	1150	1232
4114	17920	←	←	0	0	←	22528	←	17920	28160
4115	100	←	←	100	100	←	100	←	100	100
4116	6500	←	←	7157	11031	←	11031	←	10000	10984
4117	90	←	←	90	90	←	90	←	90	90
4118	100	←	←	100	100	←	100	←	100	100
4119	15	←	←	29	522	←	522	←	522	3
4120	0	←	←	0	0	←	0	←	0	0
4124	24519	←	←	24575	24447	←	24487	←	24480	24527
4127	240	←	←	288	176	←	240	←	296	360
4128	105	←	←	0	0	←	0	←	0	105
4129	0	←	←	0	0	←	0	←	0	0
4130	25700	←	←	25700	25700	←	25700	←	25700	25700
4134	130	←	←	130	130	←	130	←	130	130
4136	30	←	←	30	30	←	30	←	30	30
4138	1570	←	←	1600	1500	←	1505	←	1642	1700
4139	100	←	←	90	89	←	74	←	100	90
4140	2016	←	←	2885	1642	←	1642	←	1642	2592
4141	0	←	←	0	77	←	0	←	0	0
4142	3000	←	←	4500	5000	←	8000	←	8000	5000
4143	6000	←	←	9000	5000	←	24000	←	20000	16000
4144	0	←	←	0	0	←	0	←	0	0
4145	25	←	←	25	25	←	25	←	25	25
4146	603	905	1206	1172	566	755	566	755	754	1003
4147	261	←	←	479	162	←	229	←	220	335
4148	200	←	←	200	200	←	200	←	200	200
4149	690	←	←	670	1090	←	1090	←	1090	1277
4150	0	←	←	0	19200	←	21760	←	21760	0
4151	100	←	←	100	100	←	100	←	100	100
4152	6500	←	←	7647	8000	←	8000	←	8000	11083
4153	90	←	←	90	90	←	90	←	90	90
4154	100	←	←	95	100	←	100	←	100	100
4155	24571	←	←	24575	24491	←	24544	←	24537	24575
4156	0	←	←	0	0	←	0	←	0	0
4158	6505	←	←	0	0	←	0	←	0	103
4159	0	←	←	0	0	←	0	←	0	0
4161	25700	←	←	25700	25700	←	25700	←	25700	25700
4165	527	←	←	14	521	←	521	←	9	7
4166	12870	←	←	21855	49	←	15693	←	19285	83
4169	0	←	←	0	0	←	0	←	0	0
4362	0	←	←	0	0	←	0	←	-24176	-24076
4363	0	←	←	0	0	←	0	←	-24176	-26024
4364	0	←	←	0	0	←	0	←	-30120	-25874
4365	0	←	←	-24476	0	←	0	←	0	-24501
4366	0	←	←	-28522	0	←	0	←	0	-28572
4367	0	←	←	-24076	0	←	0	←	0	-30520
4612	107	←	←	89	145	←	76	←	86	64
4613	12288	←	←	20489	12299	←	12299	←	12299	12421
4614	107	←	←	70	129	←	79	←	86	55
4615	22156	←	←	32512	19201	←	19201	←	19202	4179
Maximum output during acceleration (for PS selection)	13.2	13.2	13.2	33	13.2	13.2	18	18	22	48

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

JR AUTOMATION TECHNOLOGIES, INC*

Motor model	αi IT 12/12000-B	αi IT 12/12000-B	αi IT 12/12000-B	αi IT 15/12000-B	αi IT 15/12000-B	αi IT 15/12000-B	αi IT 15/15000-B	αi IT 15/15000-B	αi IT 15/15000-B	αi IT 22/12000-B
Applicable amplifier	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 22-B	βi SVSP 18-B αi SP 22-B	αi SP 22-B	αi SP 22-B	αi SP 30-B	αi SP 30-B	αi SP 30-B	αi SP 26-B
Output specification nameplate	A06B-1230-K468#S0P	A06B-1230-K468#S0P	A06B-1230-K468#S0S	A06B-1230-K469#S00	A06B-1230-K469#S0P	A06B-1230-K469#S0S	A06B-1230-K479#S00	A06B-1230-K479#S0P	A06B-1230-K479#S0S	A06B-1230-K471#S00
Model code	5250	6250	5251	5252	5253	5254	5255	5256	5257	5258
Parameter ID	2059	–	2392	2948	2386	2791	2761	2857	2998	2854
Applicable software series and edition	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0*i*-D,FS30*i*										
4007	00000000	←	00000100	00000000	00000000	00000100	00000000	00000100	00000100	00000000
4008	00010000	←	00000000	00000000	00010000	00000000	00000000	00000000	00000000	00000000
4009	00000000	←	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4010	00000001	←	00010001	00000001	00000001	00010001	00000001	00010001	00010001	00000001
4011	00001010	←	00011010	00011010	00001010	00011010	00011010	00011010	00011010	00011010
4012	10000010	←	10000010	10000010	10000010	10000000	10000010	10000010	10000010	10000010
4013	00001100	←	00001100	00001100	00001100	00001100	00001100	00001100	00001100	00001100
4019	00000100	←	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100
4400	00000000	←	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4020	12000	←	12000	12000	12000	12000	15000	15000	15000	12000
4023(*1)	333	←	333	333	333	283	233	233	267	333
4039	0	←	0	0	0	0	0	0	0	0
4040(*2)	20	←	13	26	19	14	12	10	10	26
4041(*2)	7	←	6	10	7	6	5	4	3	10
4048(*2)	93	←	61	119	88	67	58	45	44	121
4049(*2)	35	←	26	45	32	28	21	18	13	45
4080	75	←	12883	80	15445	70	10583	15956	13396	75
4083	30	←	30	30	30	30	30	30	30	30
4093	202	←	273	148	200	240	176	208	240	142
4100	3800	←	4100	4000	4200	4570	4500	5100	5100	4000
4101	80	←	87	62	85	100	65	59	80	83
4102	3593	←	3593	3482	3482	4570	5392	5392	5392	3504
4103	0	←	0	75	0	80	82	78	83	0
4104	1800	←	1800	1700	1700	700	3500	2700	2700	2800
4105	341	←	307	347	347	398	251	251	251	360
4106	6000	←	6000	5500	5500	2000	3500	7700	7700	2800
4107	324	←	307	314	314	314	252	252	252	318
4108	0	←	0	0	0	0	0	0	0	0
4109	25	←	25	25	25	25	25	25	25	25
4110	595	793	794	575	575	754	887	887	887	603
4111	223	←	311	193	212	320	255	300	300	143
4112	200	←	200	200	200	200	200	200	200	200
4113	280	←	311	275	275	240	380	380	380	265
4114	0	←	0	23040	23040	0	0	0	0	24320
4115	100	←	100	100	100	100	100	100	100	100
4116	5280	←	5280	5126	5126	5126	9314	9314	9314	5523
4117	90	←	100	90	29530	90	90	21850	23898	90
4118	100	←	28772	90	100	100	90	28250	26202	100
4119	34	←	31	35	35	35	25	25	25	36
4120	0	←	0	0	0	0	0	0	0	0
4124	24539	←	24575	24515	24530	24575	24566	24575	24575	24477
4127	202	←	305	148	200	264	176	208	296	142
4128	0	←	0	0	0	0	0	105	114	0
4129	0	←	0	0	0	0	0	0	0	0
4130	25700	←	25700	25700	25700	25700	25700	25700	25700	25700
4134	130	←	130	130	130	130	130	130	130	130
4136	30	←	30	30	30	30	30	30	30	30
4138	1550	←	1600	1500	1500	1625	1450	1450	1300	1440
4139	100	←	100	95	100	100	70	70	93	96
4140	1922	←	1922	1710	1710	1625	1783	1783	1783	1709
4141	0	←	0	70	0	0	93	0	0	96
4142	3000	←	3000	5500	5500	1800	7000	7400	7400	5000
4143	10000	←	10000	5500	5500	4400	7000	14800	17900	5000
4144	0	←	0	0	0	0	0	0	0	0
4145	25	←	25	25	25	25	25	25	25	25
4146	905	1207	1207	794	794	754	2155	2155	2155	823
4147	337	←	486	243	305	333	650	761	761	213
4148	200	←	200	200	200	200	200	200	200	200
4149	295	←	311	304	304	304	380	380	380	300
4150	0	←	0	23040	23040	24320	0	0	0	19200
4151	100	←	100	100	100	100	100	100	100	100
4152	5279	←	5015	5177	5177	5177	2000	7955	7955	5593
4153	90	←	90	90	90	90	90	26970	28250	90
4154	100	←	100	100	100	100	90	90	28270	100
4155	24575	←	24575	24556	24575	24575	24575	24575	24575	24531
4156	0	←	0	0	0	0	0	0	0	0
4158	0	←	0	105	105	0	0	0	0	0
4159	0	←	0	0	0	0	0	0	0	0
4161	25700	←	25700	25700	25700	25700	25700	25700	25700	25700
4165	32	←	31	31	31	31	25	25	25	341
4166	16735	←	15450	20555	17498	53	65	17488	17494	56
4169	0	←	0	0	0	0	0	0	0	0
4362	0	←	-24426	0	-24326	0	0	0	0	0
4363	0	←	-28172	0	-26124	0	0	0	0	0
4364	0	←	-30120	0	-32168	0	0	0	0	0
4365	0	←	-26424	0	0	-24276	0	0	0	0
4366	0	←	-26174	0	0	-28172	0	0	0	0
4367	0	←	-32168	0	0	-30120	0	0	0	0
4612	101	←	73	107	109	97	95	73	69	150
4613	10379	←	10379	10375	10376	10376	8326	8326	8326	10241
4614	127	←	94	164	128	107	102	86	10066	173
4615	16518	←	16774	16772	16531	16773	7568	7569	9104	16385
Maximum output during acceleration (for PS selection)	22.2	22.2	33.6	22.2	30	39.6	38	50	50	31.2

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

JR AUTOMATION TECHNOLOGIES, INC*

Motor model	αi IT 22/12000-B	αi IT 22/12000-B	αi IPT 22/8000-B
Applicable amplifier	αi SP 26-B	αi SP 30-B	αi SP 22-B
Output specification nameplate	A06B-1230-K471#S0P	A06B-1230-K471#S0S	A06B-1230-K472#S00
Model code	5259	5260	5261
Parameter ID	2440	2553	2740
Applicable software series and edition	9DAA/M 9DB0/M	9DAA/O 9DB0/O	9DAA/M 9DB0/M
FS0i-D,FS30i			
4007	00000000	00000000	00000000
4008	00010000	00010000	00000000
4009	00000000	00000000	00000000
4010	00000001	00000001	00000001
4011	00001010	00001010	00011010
4012	10000111	10000010	10000010
4013	00001100	00001100	00001100
4019	00000100	00000100	00000100
4400	00010001	00000000	00000000
4020	12000	12000	8000
4023(*1)	333	333	94
4039	0	0	0
4040(*2)	19	14	8
4041(*2)	7	6	6
4048(*2)	90	65	38
4049(*2)	34	26	26
4080	80	80	18000
4083	30	30	30
4093	191	245	240
4100	4000	4050	800
4101	78	94	100
4102	3504	4348	1342
4103	0	0	65
4104	1400	1700	5500
4105	360	357	318
4106	1400	4400	5500
4107	318	339	292
4108	0	0	0
4109	25	25	25
4110	604	1006	914
4111	218	335	300
4112	200	200	200
4113	265	255	300
4114	0	0	23040
4115	100	100	100
4116	5523	3438	6196
4117	90	90	90
4118	100	100	100
4119	36	37	301
4120	0	0	0
4124	24535	24575	24575
4127	191	262	164
4128	0	0	110
4129	0	0	0
4130	25700	25700	25700
4134	130	130	130
4136	30	30	30
4138	1520	1550	530
4139	94	95	100
4140	1709	1725	930
4141	0	0	0
4142	2200	4700	6500
4143	4600	9000	15000
4144	0	0	0
4145	25	25	25
4146	823	1077	1886
4147	312	371	617
4148	200	200	200
4149	300	285	327
4150	19200	0	20480
4151	100	100	100
4152	5593	3696	4813
4153	90	90	90
4154	100	100	110
4155	24575	24575	24575
4156	0	0	0
4158	108	0	90
4159	0	0	0
4161	25700	25700	25700
4165	32	34	20
4166	16735	19290	75
4169	0	0	0
4362	0	0	0
4363	0	0	0
4364	0	0	0
4365	0	-24501	0
4366	0	-30420	0
4367	0	31320	0
4612	105	92	156
4613	10241	10241	32518
4614	126	99	107
4615	16385	16385	12114
Maximum output during acceleration (for PS selection)	42	57.6	20

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

JR AUTOMATION TECHNOLOGIES INC*
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C.25 SPINDLE MOTOR αiIT-B series(400V)

Motor model	αi IT 1.5/20000HV-B	αi IT 2/20000HV-B	αi IT 3/12000HV-B	αi IT 6/12000HV-B	αi IT 8/12000HV-B	αi IT 8/15000HV-B	αi IT 12/12000HV-B	αi IT 15/12000HV-B	αi IT 15/15000HV-B
Applicable amplifier	αi SP 15HV-B βi SVSP 15HV-B	αi SP 30HV-B	αi SP 11HV-B βi SVSP 11HV-B	αi SP 15HV-B βi SVSP 15HV-B	αi SP 15HV-B βi SVSP 15HV-B	αi SP 30HV-B	αi SP 15HV-B βi SVSP 15HV-B	αi SP 22HV-B	αi SP 30HV-B
Output specification nameplate	A06B-1230-K563#S00	A06B-1230-K564#S00	A06B-1230-K565#S00	A06B-1230-K566#S00	A06B-1230-K567#S00	A06B-1230-K577#S00	A06B-1230-K568#S0P	A06B-1230-K569#S00	A06B-1230-K579#S00
Model code	5079	5080	5081	5262	5263	5264	5265	5266	5267
Parameter ID	2121	2968	2990	2900	2409	2852	2506	2992	2308
Applicable software series and edition	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/M 9DB0/M	9DAA/O 9DB0/O	9DAA/M 9DB0/M	9DAA/N 9DB0/N	9DAA/O 9DB0/O
FS0*i* -D,FS30*i*									
4007	00000000	00000000	00000000	00000000	00000000	00000000	00000100	00000000	00000000
4008	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4009	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4010	00000001	00000001	00000001	00000001	00000001	00000001	00010001	00000001	00000001
4011	00011001	00011001	00011001	00011010	00011010	00011010	00011010	00011010	00011010
4012	10000010	10000010	10000010	10000010	10000010	10000010	10000010	10000010	10000000
4013	00001100	00001100	00001100	00001100	00001100	00001100	00001100	00001100	00001100
4019	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100
4400	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4020	20000	20000	12000	12000	12000	15000	12000	12000	15000
4023(*1)	30	30	30	333	333	267	333	333	233
4039	0	0	0	0	0	0	0	0	0
4040(*2)	3	3	5	7	13	7	20	26	10
4041(*2)	10	10	10	3	5	4	7	10	5
4048(*2)	15	16	25	30	61	32	93	119	46
4049(*2)	10	10	10	15	23	17	35	45	21
4080	9045	11605	90	96	9050	98	88	80	19270
4083	10	10	30	30	30	30	30	30	30
4093	0	0	0	164	176	240	202	148	176
4100	3500	3400	1550	4030	3750	4000	4032	4000	4600
4101	33	41	82	51	85	81	84	53	59
4102	7257	6612	2864	4526	3798	5660	3253	3464	4937
4103	80	92	90	67	89	86	95	70	94
4104	3500	2700	4000	2700	3800	3000	900	2800	1800
4105	48	56	112	127	101	101	381	341	239
4106	3500	4500	14000	7000	10000	3000	2300	2800	3000
4107	0	0	0	131	95	87	379	341	217
4108	0	0	0	0	0	0	0	0	0
4109	25	25	25	25	25	25	25	25	25
4110	1005	1052	559	862	569	646	754	571	870
4111	233	235	190	190	100	166	190	229	295
4112	200	200	200	200	200	200	200	200	120
4113	2000	1700	850	750	950	950	250	280	400
4114	0	0	0	19200	0	0	0	0	0
4115	100	100	100	100	100	100	100	100	100
4116	9815	11131	7377	8202	8736	8703	4701	5184	9570
4117	90	90	90	90	90	90	90	90	90
4118	100	100	110	90	90	90	19300	100	90
4119	5	5	11	13	10	266	38	34	1048
4120	0	0	0	0	0	0	0	0	0
4124	24548	24549	24513	24513	24447	24494	24513	24544	24575
4127	176	202	178	164	176	240	202	148	176
4128	90	88	0	105	0	105	0	0	0
4129	0	0	0	0	0	0	0	0	0
4130	25700	25700	25700	25700	25700	25700	25700	25700	25700
4134	110	110	110	130	130	130	130	130	130
4136	30	30	30	30	30	30	30	30	30
4138	0	0	0	1570	1550	1630	1550	1500	1500
4139	0	0	0	67	84	93	100	73	96
4140	0	0	0	2475	1957	2913	1615	1972	2494
4141	0	0	0	68	74	85	88	65	0
4142	0	0	0	4600	7000	5500	3000	4500	3600
4143	0	0	0	12000	18000	5500	9000	4500	5500
4144	0	0	0	0	0	0	0	0	0
4145	0	0	0	25	25	25	25	25	25
4146	0	0	0	1508	838	984	1160	999	1331
4147	0	0	0	360	186	282	315	425	470
4148	0	0	0	200	200	200	200	200	200
4149	0	0	0	730	1000	1100	252	280	440
4150	0	0	0	19200	0	0	0	23040	0
4151	0	0	0	100	100	100	100	100	100
4152	0	0	0	8202	8737	8708	4463	5153	9567
4153	0	0	0	90	90	90	90	90	90
4154	0	0	0	100	90	90	100	100	90
4155	0	0	0	24575	24510	24575	24575	24575	24575
4156	0	0	0	0	0	0	0	0	0
4158	0	0	0	113	0	106	0	0	0
4159	0	0	0	0	0	0	0	0	0
4161	0	0	0	25700	25700	25700	25700	25700	25700
4165	0	0	0	13	266	9	38	34	22
4166	0	0	0	19807	14938	92	61	65	11354
4169	0	0	0	0	0	0	0	0	0
4362	0	0	0	0	0	0	0	0	0
4363	0	0	0	0	0	0	0	0	0
4364	0	0	0	0	0	0	0	0	0
4365	0	0	0	0	0	0	0	0	0
4366	0	0	0	0	0	0	0	0	0
4367	0	0	0	0	0	0	0	0	0
4612	48	52	118	80	124	86	107	92	86
4613	26886	26886	32523	12299	12299	15369	10379	10376	8326
4614	0	0	0	105	122	99	127	126	140
4615	0	0	0	21644	19201	10784	16518	16517	7310
Maximum output during acceleration (for PS selection)	13	20	13	13	13.2	28	22.2	22.2	38

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

JR AUTOMATION TECHNOLOGY, INC*

Motor model	αi IP 15/15000HV-B	αi IP 15/15000HV-B	αi IP 22/12000HV-B	αi IP 22/12000HV-B
Applicable amplifier	αi SP 30HV-B	αi SP 45HV-B	αi SP 30HV-B	αi SP 30HV-B
Output specification nameplate	A06B-1230-K579#S0P	A06B-1230-K579#S0S	A06B-1230-K571#S00	A06B-1230-K571#S0P
Model code	5268	5269	5270	5271
Parameter ID	2344	2354	2571	2080
Applicable software series and edition	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/O 9DB0/O
FS0*i*-D,FS30*i*				
4007	00000000	00000100	00000000	00000000
4008	00000000	00000000	00000000	00010000
4009	00000000	00000000	00000000	00000000
4010	00000001	00010001	00000001	00000001
4011	00011010	00011010	00011010	00001010
4012	10000111	10000010	10000010	10000010
4013	00001100	00001100	00001100	00001100
4019	00000100	00000100	00000100	00000100
4400	00010001	00000000	00000000	00000000
4020	15000	15000	12000	12000
4023(*1)	233	233	333	333
4039	0	0	0	0
4040(*2)	8	6	26	19
4041(*2)	4	3	10	7
4048(*2)	36	27	121	90
4049(*2)	18	14	45	34
4080	18005	20572	83	19280
4083	30	30	30	30
4093	208	240	142	191
4100	4600	5100	3630	4000
4101	50	48	74	75
4102	4279	4279	3318	3318
4103	0	0	93	0
4104	2000	4000	2100	2500
4105	239	239	360	360
4106	3400	9000	6300	5000
4107	222	222	347	347
4108	0	0	0	0
4109	25	25	25	25
4110	755	1006	666	666
4111	310	370	160	236
4112	200	200	200	200
4113	400	400	265	265
4114	0	0	0	20480
4115	100	100	100	100
4116	9570	9570	5000	5000
4117	90	26458	90	90
4118	100	28260	90	100
4119	24	24	50	50
4120	0	0	0	0
4124	24575	24575	24489	24550
4127	208	240	142	191
4128	95	0	98	110
4129	0	0	0	0
4130	25700	25700	25750	25700
4134	130	130	130	130
4136	30	30	30	30
4138	1480	1480	1500	1550
4139	100	100	84	90
4140	2232	2232	1669	1669
4141	0	0	82	0
4142	4000	7500	4000	4000
4143	6500	15000	12000	12000
4144	0	0	0	0
4145	25	25	25	25
4146	1191	1588	984	984
4147	463	527	270	365
4148	200	200	200	200
4149	430	430	275	275
4150	0	0	0	24320
4151	100	100	100	100
4152	9567	7967	4991	4991
4153	90	90	90	90
4154	90	100	90	28260
4155	24575	24575	24575	24575
4156	0	0	0	0
4158	103	0	103	110
4159	0	0	0	0
4161	25700	25700	25700	25700
4165	22	22	70	35
4166	12895	18778	18517	19280
4169	0	0	0	0
4362	0	0	0	-26424
4363	0	0	0	-26324
4364	0	0	0	-26274
4365	0	-24526	0	-26349
4366	0	-28522	0	-32443
4367	0	-24326	0	-26274
4612	62	51	134	101
4613	8326	8326	10241	10253
4614	123	107	152	121
4615	7310	7310	16514	16771
Maximum output during acceleration (for PS selection)	50	58	31.2	42

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

JR AUTOMATION TECHNOLOGIES INC*
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C.26 SPINDLE MOTOR αiIL-B series

Motor model	αi IL 8/20000-B	αi IL 15/15000-B	αi IL 26/15000-B
Applicable amplifier	αi SP 30-B	αi SP 30-B	αi SP 30-B
Output specification nameplate	A06B-1230-K497#S0N	A06B-1230-K495#S01	A06B-1230-K494#S01
Model code	5272	5273	5274
Parameter ID	2669	2476	2540
Applicable software series and edition	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0i-D,FS30i			
4007	00000000	00000000	00000000
4008	00000000	00000000	00000000
4009	00000000	00000000	00000000
4010	00000001	00000001	00000001
4011	00011001	00011001	00011001
4012	10000010	10000010	10000010
4013	00001100	00001100	00001100
4019	00000100	00000100	00000100
4400	00000000	00000000	00000000
4020	20000	15000	15000
4023(*1)	200	267	120
4039	0	0	0
4040(*2)	12	24	12
4041(*2)	5	6	4
4048(*2)	56	109	56
4049(*2)	23	26	19
4080	11856	12115	12875
4083	20	30	30
4093	164	143	176
4100	5070	6000	2470
4101	69	52	70
4102	6960	6153	2580
4103	0	89	97
4104	2100	1800	2100
4105	95	318	298
4106	3900	2800	4600
4107	83	318	227
4108	0	0	0
4109	25	25	25
4110	805	1207	1207
4111	217	343	344
4112	200	200	200
4113	1005	300	320
4114	0	0	0
4115	100	100	100
4116	9613	7537	4716
4117	90	90	90
4118	100	90	100
4119	778	32	286
4120	0	0	0
4124	24535	24575	24575
4127	148	143	138
4128	0	0	0
4129	0	0	0
4130	25700	25700	25700
4134	130	130	130
4136	30	30	30
4138	1350	1470	700
4139	75	79	67
4140	2605	2573	873
4141	0	0	0
4142	5600	4000	7000
4143	7000	6000	12000
4144	0	0	0
4145	25	25	25
4146	1724	2011	2321
4147	504	585	685
4148	200	200	200
4149	1145	300	420
4150	0	0	19200
4151	100	100	100
4152	10911	7536	4711
4153	90	90	90
4154	110	100	120
4155	24575	24575	24575
4156	0	0	0
4158	110	107	105
4159	0	0	0
4161	25700	25700	25700
4165	8	32	23
4166	12893	75	60
4169	0	0	0
4362	0	0	0
4363	0	0	0
4364	0	0	0
4365	0	0	0
4366	0	0	0
4367	0	0	0
4612	119	93	129
4613	16384	7042	16770
4614	10588	8586	97
4615	13824	9114	13373
Maximum output during acceleration (for PS selection)	41	41	43

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

JR AUTOMATION TECHNOLOGIES INC*
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C.27 SPINDLE MOTOR αiIL-B series(400V)

Motor model	αi IL 8/20000HV-B	αi IL 15/15000HV-B	αi IL 26/15000HV-B
Applicable amplifier	αi SP 45HV-B	αi SP 45HV-B	αi SP 45HV-B
Output specification nameplate	A06B-1230-K597#S0N	A06B-1230-K595#S01	A06B-1230-K594#S01
Model code	5275	5276	5277
Parameter ID	2019	2666	2541
Applicable software series and edition	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0*i*-D,FS30*i*			
4007	00000000	00000000	00000000
4008	00000000	00000000	00000000
4009	00000000	00000000	00000000
4010	00000001	00000001	00000001
4011	00011001	00011001	00011001
4012	10000010	10000010	10000010
4013	00001100	00001100	00001100
4019	00000100	00000100	00000100
4400	00000000	00000000	00000000
4020	20000	15000	15000
4023(*1)	200	267	100
4039	0	0	0
4040(*2)	5	8	12
4041(*2)	3	5	7
4048(*2)	24	38	55
4049(*2)	13	21	33
4080	95	19792	14165
4083	30	30	30
4093	164	143	176
4100	5050	5500	2030
4101	53	44	79
4102	6274	5335	2633
4103	0	94	95
4104	3400	2300	3500
4105	105	298	245
4106	5000	2600	5500
4107	84	251	212
4108	0	0	0
4109	25	25	25
4110	862	1437	1508
4111	255	456	475
4112	200	200	200
4113	907	320	390
4114	0	0	0
4115	100	90	100
4116	9345	8423	4525
4117	90	90	90
4118	90	90	90
4119	523	30	24
4120	0	0	0
4124	24566	24575	24575
4127	148	143	138
4128	112	95	98
4129	0	0	0
4130	25700	25700	25700
4134	130	130	130
4136	30	30	30
4138	1320	1480	810
4139	88	92	77
4140	3163	2777	1248
4141	0	0	0
4142	7000	4800	6500
4143	10000	5200	12000
4144	0	0	0
4145	25	25	25
4146	1207	2011	2011
4147	375	632	639
4148	200	200	200
4149	1140	380	450
4150	0	0	0
4151	100	100	100
4152	12110	9785	4525
4153	90	90	85
4154	90	90	85
4155	24575	24575	24575
4156	0	0	0
4158	123	0	0
4159	0	0	0
4161	25700	25700	25700
4165	8	10	21
4166	95	14180	60
4169	0	0	0
4362	0	0	0
4363	0	0	0
4364	0	0	0
4365	0	0	0
4366	0	0	0
4367	0	0	0
4612	92	79	146
4613	12424	7042	14725
4614	10603	165	112
4615	13600	8859	11581
Maximum output during acceleration (for PS selection)	48	48	50

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

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C.28 SPINDLE MOTOR βiI-B series

Motor model	βiI 3/12000-B	βiI 3/12000-B	βiI 3/12000-B	βiI 3/12000-B	βiI 3/12000-B	βiI 3/12000-B	βiI 3/12000-B	βiI 3/12000-B	βiI 6/12000-B	βiI 6/12000-B	βiI 6/12000-B
Applicable amplifier	αiSP 5.5-B	βiSVSP 7.5-B	βiSVSP 11-B αiSP 11-B	βiSVSP 15-B αiSP 15-B	βiSVSP 7.5-B	βiSVSP 11-B αiSP 11-B	βiSVSP 15-B αiSP 15-B	βiSVSP 18-B αiSP 22-B	αiSP 11-B βiSVSP 11-B	βiSVSP 15-B αiSP 15-B	βiSVSP 18-B αiSP 22-B
Output specification nameplate	A06B-1230-K444#S00	A06B-1230-K444#S00	A06B-1230-K444#S00	A06B-1230-K444#S00	A06B-1230-K444#S0P	A06B-1230-K444#S0P	A06B-1230-K444#S0P	A06B-1230-K444#S0P	A06B-1230-K445#S00	A06B-1230-K445#S00	A06B-1230-K445#S00
Model code	5082	6082	7082	8082	5083	6083	7083	8083	5084	6084	7084
Parameter ID	2060	–	–	–	2450	–	–	–	2261	–	–
Applicable software series and edition	9DAA/N 9DB0/N	9DAA/N 9DB0/N	9DAA/N 9DB0/N	9DAA/N 9DB0/N	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0*i*-D,FS30*i*											
4007	00000000	←	←	←	00000000	←	←	←	00000000	←	←
4008	00000000	←	←	←	00010000	←	←	←	00000000	←	←
4009	00000000	←	←	←	00000000	←	←	←	00000000	←	←
4010	00000000	←	←	←	00000000	←	←	←	00010000	←	←
4011	00011001	←	←	←	00001001	←	←	←	00011001	←	←
4012	10000000	←	←	←	10000010	←	←	←	10000000	←	←
4013	00001100	←	←	←	00001100	←	←	←	00001100	←	←
4019	00000100	←	←	←	00000100	←	←	←	00000100	←	←
4400	00000000	←	←	←	00000000	←	←	←	00000000	←	←
4020	12000	←	←	←	12000	←	←	←	12000	←	←
4023(*1)	30	←	←	←	30	←	←	←	30	←	←
4039	0	←	←	←	0	←	←	←	0	←	←
4040(*2)	3	←	←	←	2	←	←	←	4	←	←
4041(*2)	10	←	←	←	10	←	←	←	10	←	←
4048(*2)	14	←	←	←	10	←	←	←	20	←	←
4049(*2)	10	←	←	←	10	←	←	←	10	←	←
4080	13412	←	←	←	13408	←	←	←	14170	←	←
4083	30	←	←	←	30	←	←	←	30	←	←
4093	0	←	←	←	0	←	←	←	0	←	←
4100	1700	←	←	←	1830	←	←	←	1550	←	←
4101	90	←	←	←	100	←	←	←	90	←	←
4102	2154	←	←	←	2154	←	←	←	2621	←	←
4103	72	←	←	←	0	←	←	←	58	←	←
4104	2500	←	←	←	2500	←	←	←	2000	←	←
4105	112	←	←	←	95	←	←	←	119	←	←
4106	6600	←	←	←	6600	←	←	←	5500	←	←
4107	0	←	←	←	0	←	←	←	0	←	←
4108	0	←	←	←	0	←	←	←	0	←	←
4109	25	←	←	←	25	←	←	←	25	←	←
4110	718	1149	1436	2154	1149	1436	2154	2873	520	780	1040
4111	318	←	←	←	417	←	←	←	208	←	←
4112	200	←	←	←	200	←	←	←	200	←	←
4113	850	←	←	←	1007	←	←	←	800	←	←
4114	21760	←	←	←	20480	←	←	←	0	←	←
4115	100	←	←	←	100	←	←	←	100	←	←
4116	7978	←	←	←	7978	←	←	←	7395	←	←
4117	90	←	←	←	90	←	←	←	90	←	←
4118	100	←	←	←	100	←	←	←	100	←	←
4119	11	←	←	←	9	←	←	←	12	←	←
4120	0	←	←	←	0	←	←	←	0	←	←
4124	24575	←	←	←	24575	←	←	←	24527	←	←
4127	164	←	←	←	223	←	←	←	150	←	←
4128	120	←	←	←	125	←	←	←	115	←	←
4129	0	←	←	←	0	←	←	←	0	←	←
4130	25700	←	←	←	25700	←	←	←	25700	←	←
4134	110	←	←	←	110	←	←	←	110	←	←
4136	0	←	←	←	0	←	←	←	0	←	←
4138	0	←	←	←	0	←	←	←	0	←	←
4139	0	←	←	←	0	←	←	←	0	←	←
4140	0	←	←	←	0	←	←	←	0	←	←
4141	0	←	←	←	0	←	←	←	0	←	←
4142	0	←	←	←	0	←	←	←	0	←	←
4143	0	←	←	←	0	←	←	←	0	←	←
4144	0	←	←	←	0	←	←	←	0	←	←
4145	0	←	←	←	0	←	←	←	0	←	←
4146	0	←	←	←	0	←	←	←	0	←	←
4147	0	←	←	←	0	←	←	←	0	←	←
4148	0	←	←	←	0	←	←	←	0	←	←
4149	0	←	←	←	0	←	←	←	0	←	←
4150	0	←	←	←	0	←	←	←	0	←	←
4151	0	←	←	←	0	←	←	←	0	←	←
4152	0	←	←	←	0	←	←	←	0	←	←
4153	0	←	←	←	0	←	←	←	0	←	←
4154	0	←	←	←	0	←	←	←	0	←	←
4155	0	←	←	←	0	←	←	←	0	←	←
4156	0	←	←	←	0	←	←	←	0	←	←
4158	0	←	←	←	0	←	←	←	0	←	←
4159	0	←	←	←	0	←	←	←	0	←	←
4161	0	←	←	←	0	←	←	←	0	←	←
4165	0	←	←	←	0	←	←	←	0	←	←
4166	0	←	←	←	0	←	←	←	0	←	←
4169	0	←	←	←	0	←	←	←	0	←	←
4362	0	←	←	←	0	←	←	←	0	←	←
4363	0	←	←	←	0	←	←	←	0	←	←
4364	0	←	←	←	0	←	←	←	0	←	←
4365	0	←	←	←	0	←	←	←	0	←	←
4366	0	←	←	←	0	←	←	←	0	←	←
4367	0	←	←	←	0	←	←	←	0	←	←
4612	11114	←	←	←	11094	←	←	←	10858	←	←
4613	12297	←	←	←	12291	←	←	←	12298	←	←
4614	0	←	←	←	0	←	←	←	0	←	←
4615	0	←	←	←	0	←	←	←	0	←	←
Maximum output during acceleration (for PS selection)	6.1	6.1	6.1	6.1	8.3	8.3	8.3	8.3	8.3	8.3	8.3

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

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Motor model	βi I 6/12000-B	βi I 6/12000-B	βi I 8/12000-B	βi I 8/12000-B	βi I 8/12000-B	βi I 8/12000-B	βi I 8/12000-B	βi I 12/10000-B	βi I 12/10000-B	βi I 12/10000-B	βi I 12/10000-B
Applicable amplifier	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 11-B βi SVSP 11-B	βi SVSP 15-B αi SP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B
Output specification nameplate	A06B-1230-K445#S0P	A06B-1230-K445#S0P	A06B-1230-K446#S00	A06B-1230-K446#S00	A06B-1230-K446#S00	A06B-1230-K446#S0P	A06B-1230-K446#S0P	A06B-1230-K447#S00	A06B-1230-K447#S00	A06B-1230-K447#S0P	A06B-1230-K447#S0P
Model code	5085	6085	5086	6086	7086	5087	6087	5088	6088	5089	6089
Parameter ID	2851	–	2132	–	–	2818	–	2936	–	2419	–
Applicable software series and edition	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0*i*-D,FS30*i*											
4007	00000000	←	00000000	←	←	00000000	←	00000000	←	00000100	←
4008	00010000	←	00000000	←	←	00000000	←	00000000	←	00000000	←
4009	00000000	←	00000000	←	←	00000000	←	00000000	←	00000000	←
4010	00000000	←	00010000	←	←	00000000	←	00010000	←	00010000	←
4011	00001001	←	00011010	←	←	00011010	←	00011010	←	00011010	←
4012	10000010	←	10000000	←	←	10000010	←	10000010	←	10000010	←
4013	00001100	←	00001100	←	←	00001100	←	00001100	←	00001100	←
4019	00000100	←	00000100	←	←	00000100	←	00000100	←	00000100	←
4400	00000000	←	00000000	←	←	00000000	←	00000000	←	00000000	←
4020	12000	←	12000	←	←	12000	←	10000	←	10000	←
4023(*1)	30	←	30	←	←	30	←	30	←	30	←
4039	0	←	0	←	←	0	←	0	←	0	←
4040(*2)	5	←	4	←	←	3	←	4	←	3	←
4041(*2)	10	←	10	←	←	10	←	10	←	10	←
4048(*2)	20	←	16	←	←	12	←	9	←	15	←
4049(*2)	10	←	10	←	←	10	←	10	←	10	←
4080	15957	←	75	←	←	16220	←	12895	←	19513	←
4083	30	←	30	←	←	30	←	30	←	30	←
4093	0	←	0	←	←	0	←	0	←	0	←
4100	1600	←	1500	←	←	1680	←	1550	←	1550	←
4101	87	←	95	←	←	95	←	82	←	89	←
4102	2621	←	2602	←	←	2602	←	1844	←	1844	←
4103	0	←	64	←	←	0	←	80	←	0	←
4104	4550	←	2000	←	←	4300	←	3500	←	3500	←
4105	119	←	191	←	←	134	←	135	←	135	←
4106	7000	←	6000	←	←	10000	←	10000	←	10000	←
4107	0	←	0	←	←	0	←	0	←	0	←
4108	0	←	0	←	←	0	←	0	←	0	←
4109	25	←	25	←	←	25	←	25	←	25	←
4110	780	1040	887	1331	1774	1331	1775	1031	1375	1031	1375
4111	301	←	381	←	←	532	←	355	←	414	←
4112	200	←	200	←	←	200	←	200	←	200	←
4113	800	←	500	←	←	714	←	705	←	705	←
4114	32000	←	0	←	←	21760	←	23040	←	0	←
4115	100	←	100	←	←	90	←	100	←	100	←
4116	8874	←	8000	←	←	8000	←	6300	←	6300	←
4117	90	←	90	←	←	23130	←	90	←	28762	←
4118	100	←	100	←	←	100	←	100	←	100	←
4119	12	←	19	←	←	13	←	14	←	14	←
4120	0	←	0	←	←	0	←	0	←	0	←
4124	24575	←	24575	←	←	24575	←	24575	←	24575	←
4127	220	←	161	←	←	220	←	150	←	185	←
4128	103	←	78	←	←	110	←	95	←	0	←
4129	0	←	0	←	←	0	←	0	←	0	←
4130	25700	←	25700	←	←	25700	←	25700	←	25700	←
4134	110	←	110	←	←	110	←	110	←	110	←
4136	0	←	0	←	←	0	←	0	←	0	←
4138	0	←	0	←	←	0	←	0	←	0	←
4139	0	←	0	←	←	0	←	0	←	0	←
4140	0	←	0	←	←	0	←	0	←	0	←
4141	0	←	0	←	←	0	←	0	←	0	←
4142	0	←	0	←	←	0	←	0	←	0	←
4143	0	←	0	←	←	0	←	0	←	0	←
4144	0	←	0	←	←	0	←	0	←	0	←
4145	0	←	0	←	←	0	←	0	←	0	←
4146	0	←	0	←	←	0	←	0	←	0	←
4147	0	←	0	←	←	0	←	0	←	0	←
4148	0	←	0	←	←	0	←	0	←	0	←
4149	0	←	0	←	←	0	←	0	←	0	←
4150	0	←	0	←	←	0	←	0	←	0	←
4151	0	←	0	←	←	0	←	0	←	0	←
4152	0	←	0	←	←	0	←	0	←	0	←
4153	0	←	0	←	←	0	←	0	←	0	←
4154	0	←	0	←	←	0	←	0	←	0	←
4155	0	←	0	←	←	0	←	0	←	0	←
4156	0	←	0	←	←	0	←	0	←	0	←
4158	0	←	0	←	←	0	←	0	←	0	←
4159	0	←	0	←	←	0	←	0	←	0	←
4161	0	←	0	←	←	0	←	0	←	0	←
4165	0	←	0	←	←	0	←	0	←	0	←
4166	0	←	0	←	←	0	←	0	←	0	←
4169	0	←	0	←	←	0	←	0	←	0	←
4362	-24276	←	0	←	←	-24426	←	0	←	-24451	←
4363	-28272	←	0	←	←	-24076	←	0	←	30870	←
4364	-30120	←	0	←	←	13038	←	0	←	-28472	←
4365	0	←	0	←	←	0	←	0	←	0	←
4366	0	←	0	←	←	0	←	0	←	0	←
4367	0	←	0	←	←	0	←	0	←	0	←
4612	10828	←	10866	←	←	10836	←	11112	←	11106	←
4613	12298	←	12422	←	←	12423	←	9730	←	9730	←
4614	0	←	0	←	←	0	←	0	←	0	←
4615	0	←	0	←	←	0	←	0	←	0	←
Maximum output during acceleration (for PS selection)	12.1	12.1	12.1	12.1	12.1	16.5	16.5	16.5	16.5	20.4	20.4

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

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Motor model	βi I 15/8000-B	βi I 15/8000-B
Applicable amplifier	βi SVSP 18-B αi SP 22-B	αi SP 22-B
Output specification nameplate	A06B-1230-K498#S00	A06B-1230-K498#S0P
Model code	5090	5091
Parameter ID	2495	2015
Applicable software series and edition	9DAA/O 9DB0/O	9DAA/M 9DB0/M
FS0*i*-D,FS30*i*		
4007	00000000	00000000
4008	00000000	00000000
4009	00000000	00000000
4010	00010000	00000000
4011	00011010	00011010
4012	10000000	10000010
4013	00001100	00001100
4019	00000100	00000100
4400	00000000	00000000
4020	8000	8000
4023(*1)	30	30
4039	0	0
4040(*2)	3	5
4041(*2)	10	10
4048(*2)	12	21
4049(*2)	10	10
4080	15445	15455
4083	30	30
4093	0	0
4100	1550	1550
4101	81	70
4102	1610	1610
4103	0	0
4104	2500	4500
4105	320	321
4106	5000	11500
4107	0	0
4108	0	0
4109	25	25
4110	1426	1426
4111	389	577
4112	200	200
4113	298	298
4114	0	0
4115	100	100
4116	4344	4344
4117	90	90
4118	100	90
4119	32	32
4120	0	0
4124	24575	24575
4127	136	161
4128	0	0
4129	0	0
4130	25700	25700
4134	130	130
4136	0	0
4138	0	0
4139	0	0
4140	0	0
4141	0	0
4142	0	0
4143	0	0
4144	0	0
4145	0	0
4146	0	0
4147	0	0
4148	0	0
4149	0	0
4150	0	0
4151	0	0
4152	0	0
4153	0	0
4154	0	0
4155	0	0
4156	0	0
4158	0	0
4159	0	0
4161	0	0
4165	0	0
4166	0	0
4169	0	0
4362	0	-24451
4363	0	-30545
4364	0	-24326
4365	0	0
4366	0	0
4367	0	0
4612	10614	10582
4613	9476	9478
4614	0	0
4615	0	0
Maximum output during acceleration (for PS selection)	20.4	24.2

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

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C.29 SPINDLE MOTOR βiI-B series(400V)

Motor model	βiI 3/12000HV-B	βiI 3/12000HV-B	βiI 3/12000HV-B	βiI 3/12000HV-B	βiI 6/12000HV-B	βiI 6/12000HV-B	βiI 6/12000HV-B	βiI 8/12000HV-B	βiI 8/12000HV-B	βiI 8/12000HV-B
Applicable amplifier	αiSP 5.5HV-B βiSVSP 11HV-B	βiSVSP 15HV-B αiSP 15HV-B	αiSP 11HV-B βiSVSP 11HV-B	βiSVSP 15HV-B αiSP 15HV-B	αiSP 11HV-B βiSVSP 11HV-B	βiSVSP 15HV-B αiSP 15HV-B	αiSP 15HV-B βiSVSP 15HV-B	αiSP 11HV-B βiSVSP 11HV-B	βiSVSP 15HV-B αiSP 15HV-B	αiSP 15HV-B βiSVSP 15HV-B
Output specification nameplate	A06B-1230-K544#S00	A06B-1230-K544#S00	A06B-1230-K544#S0P	A06B-1230-K544#S0P	A06B-1230-K545#S00	A06B-1230-K545#S00	A06B-1230-K545#S0P	A06B-1230-K546#S00	A06B-1230-K546#S00	A06B-1230-K546#S0P
Model code	5092	6092	5093	6093	5094	6094	5095	5096	6096	5097
Parameter ID	2859	–	2424	–	2271	–	2617	2042	–	2180
Applicable software series and edition	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/O 9DB0/O
FS0*i*-D,FS30*i*										
4007	00000000	←	00000000	←	00000000	←	00000000	00000000	←	00000000
4008	00010000	←	00010000	←	00010000	←	00010000	00010000	←	00010000
4009	00000000	←	00000000	←	00000000	←	00000000	00000000	←	00000000
4010	00000000	←	00000000	←	00000000	←	00000000	00000000	←	00000000
4011	00001001	←	00001001	←	00001001	←	00001001	00001010	←	00001010
4012	10000010	←	10000010	←	10000010	←	10000010	10000010	←	10000010
4013	00001100	←	00001100	←	00001100	←	00001100	00001100	←	00001100
4019	00000100	←	00000100	←	00000100	←	00000100	00000100	←	00000100
4400	00000000	←	00000000	←	00000000	←	00000000	00000000	←	00000000
4020	12000	←	12000	←	12000	←	12000	12000	←	12000
4023(*1)	30	←	30	←	30	←	30	30	←	30
4039	0	←	0	←	0	←	0	0	←	0
4040(*2)	3	←	2	←	4	←	3	4	←	3
4041(*2)	10	←	10	←	10	←	10	10	←	10
4048(*2)	14	←	10	←	18	←	12	16	←	12
4049(*2)	10	←	10	←	10	←	10	10	←	10
4080	14180	←	14180	←	15450	←	17242	13914	←	14163
4083	30	←	30	←	30	←	30	30	←	30
4093	0	←	0	←	0	←	0	0	←	0
4100	1590	←	1650	←	1550	←	1580	1600	←	1650
4101	57	←	76	←	0	←	93	100	←	82
4102	1922	←	1924	←	2712	←	2712	1893	←	1999
4103	0	←	0	←	0	←	0	0	←	0
4104	8000	←	8000	←	4100	←	4100	7500	←	7000
4105	95	←	95	←	107	←	107	107	←	107
4106	18000	←	18000	←	14000	←	14000	15500	←	13500
4107	0	←	0	←	0	←	0	0	←	0
4108	0	←	0	←	0	←	0	0	←	0
4109	25	←	25	←	25	←	25	25	←	25
4110	1078	2156	1077	2154	460	920	920	603	1206	1371
4111	328	←	328	←	153	←	236	223	←	443
4112	200	←	200	←	200	←	200	200	←	200
4113	1000	←	1000	←	895	←	895	890	←	870
4114	0	←	0	←	0	←	0	0	←	0
4115	100	←	100	←	100	←	100	100	←	100
4116	7982	←	7982	←	7398	←	7398	6919	←	5700
4117	90	←	90	←	90	←	90	90	←	90
4118	100	←	100	←	100	←	100	100	←	100
4119	10	←	10	←	11	←	11	11	←	11
4120	0	←	0	←	0	←	0	0	←	0
4124	24575	←	24575	←	24484	←	24550	24539	←	24575
4127	164	←	223	←	150	←	220	161	←	220
4128	105	←	107	←	107	←	111	106	←	103
4129	0	←	0	←	0	←	0	0	←	0
4130	25700	←	25700	←	25700	←	25700	25700	←	25700
4134	110	←	110	←	110	←	110	130	←	130
4136	0	←	0	←	30	←	30	30	←	30
4138	0	←	0	←	0	←	0	0	←	0
4139	0	←	0	←	0	←	0	0	←	0
4140	0	←	0	←	0	←	0	0	←	0
4141	0	←	0	←	0	←	0	0	←	0
4142	0	←	0	←	0	←	0	0	←	0
4143	0	←	0	←	0	←	0	0	←	0
4144	0	←	0	←	0	←	0	0	←	0
4145	0	←	0	←	0	←	0	0	←	0
4146	0	←	0	←	0	←	0	0	←	0
4147	0	←	0	←	0	←	0	0	←	0
4148	0	←	0	←	0	←	0	0	←	0
4149	0	←	0	←	0	←	0	0	←	0
4150	0	←	0	←	0	←	0	0	←	0
4151	0	←	0	←	0	←	0	0	←	0
4152	0	←	0	←	0	←	0	0	←	0
4153	0	←	0	←	0	←	0	0	←	0
4154	0	←	0	←	0	←	0	0	←	0
4155	0	←	0	←	0	←	0	0	←	0
4156	0	←	0	←	0	←	0	0	←	0
4158	0	←	0	←	0	←	0	0	←	0
4159	0	←	0	←	0	←	0	0	←	0
4161	0	←	0	←	0	←	0	0	←	0
4165	0	←	0	←	0	←	0	0	←	0
4166	0	←	0	←	0	←	0	0	←	0
4169	0	←	0	←	0	←	0	0	←	0
4362	-24526	←	-24426	←	-24326	←	-24326	-24176	←	-24401
4363	-30220	←	-32543	←	-26324	←	-26324	-30220	←	-28222
4364	31320	←	-30320	←	31345	←	23153	25176	←	25176
4365	0	←	0	←	0	←	0	0	←	0
4366	0	←	0	←	0	←	0	0	←	0
4367	0	←	0	←	0	←	0	0	←	0
4612	11075	←	11057	←	10881	←	10834	11127	←	11079
4613	12547	←	12547	←	12296	←	12298	12422	←	12935
4614	0	←	0	←	0	←	0	0	←	0
4615	0	←	0	←	0	←	0	0	←	0
Maximum output during acceleration (for PS selection)	6.1	6.1	8.3	8.3	8.3	8.3	12.1	12.1	12.1	16.5

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

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Motor model	βi I 12/10000HV-B	βi I 12/10000HV-B	βi I15/8000HV-B	βi I15/8000HV-B
Applicable amplifier	αi SP 15HV-B βi SVSP 15HV-B	βi SVSP 18HV-B αi SP 22HV-B	βi SVSP 18HV-B αi SP 22HV-B	αi SP 22HV-B
Output specification nameplate	A06B-1230-K547#S00	A06B-1230-K547#S0P	A06B-1230-K598#S00	A06B-1230-K598#S0P
Model code	5098	5099	5100	5101
Parameter ID	2528	2925	2278	2227
Applicable software series and edition	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/N 9DB0/N	9DAA/N 9DB0/N
FS0*i*-D,FS30*i*				
4007	00000000	00000000	00000000	00000000
4008	00010000	00010000	00000000	00000000
4009	00000000	00000000	00000000	00000000
4010	00000000	00000000	00000000	00000000
4011	00001010	00001010	00001010	00001010
4012	10000010	10000010	10000010	10000010
4013	00001100	00001100	00001100	00001100
4019	00000100	00000100	00000100	00000100
4400	00000000	00000000	00000000	00000000
4020	10000	10000	8000	8000
4023(*1)	30	30	30	30
4039	0	0	0	0
4040(*2)	4	3	8	7
4041(*2)	10	10	10	10
4048(*2)	18	15	38	32
4049(*2)	10	10	10	10
4080	13412	13156	13412	15204
4083	30	30	30	30
4093	0	0	0	0
4100	1583	1578	1558	1570
4101	85	80	78	77
4102	1716	1712	1791	1791
4103	0	0	0	0
4104	7000	7000	4600	4600
4105	129	129	343	343
4106	14500	14500	12500	12500
4107	0	0	0	0
4108	0	0	0	0
4109	25	25	25	25
4110	1375	1371	1508	1508
4111	360	453	490	602
4112	200	200	200	200
4113	741	741	278	278
4114	20480	20480	20480	20480
4115	100	100	100	100
4116	6500	6500	4344	4344
4117	90	90	90	73
4118	100	100	100	100
4119	13	13	34	34
4120	0	0	0	0
4124	24575	24575	24575	24575
4127	150	185	136	161
4128	110	105	0	110
4129	0	0	0	0
4130	25700	25700	25700	25700
4134	130	130	130	130
4136	30	30	30	30
4138	0	0	0	0
4139	0	0	0	0
4140	0	0	0	0
4141	0	0	0	0
4142	0	0	0	0
4143	0	0	0	0
4144	0	0	0	0
4145	0	0	0	0
4146	0	0	0	0
4147	0	0	0	0
4148	0	0	0	0
4149	0	0	0	0
4150	0	0	0	0
4151	0	0	0	0
4152	0	0	0	0
4153	0	0	0	0
4154	0	0	0	0
4155	0	0	0	0
4156	0	0	0	0
4158	0	0	0	0
4159	0	0	0	0
4161	0	0	0	0
4165	0	0	0	0
4166	0	0	0	0
4169	0	0	0	0
4362	-24326	-24476	-24401	-24476
4363	-28322	-32593	-28472	-26449
4364	12788	-28372	-32368	-24276
4365	0	0	0	0
4366	0	0	0	0
4367	0	0	0	0
4612	11116	11090	11118	11099
4613	9729	9729	9735	9734
4614	0	0	0	0
4615	0	0	0	0
Maximum output during acceleration (for PS selection)	16.5	20.4	20.4	24.2

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

JR AUTOMATION TECHNOLOGIES INC*
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C.30 SPINDLE MOTOR βiIP-B series

Motor model	βi IP 8/6000-B	βi IP 8/6000-B	βi IP 8/6000-B	βi IP 8/6000-B	βi IP 12/6000-B	βi IP 12/6000-B	βi IP 12/6000-B	βi IP 12/6000-B
Applicable amplifier	βi SVSP 7.5-B	βi SVSP 11-B αi SP 11-B	βi SVSP 15-B αi SP 15-B	βi SVSP 18-B αi SP 22-B	βi SVSP 7.5-B	βi SVSP 11-B αi SP 11-B	βi SVSP 15-B αi SP 15-B	βi SVSP 18-B αi SP 22-B
Output specification nameplate	A06B-1230-K457#S00	A06B-1230-K457#S00	A06B-1230-K457#S00	A06B-1230-K457#S00	A06B-1230-K458#S00	A06B-1230-K458#S00	A06B-1230-K458#S00	A06B-1230-K458#S00
Model code	5119	6119	7119	8119	5102	6102	7102	8102
Parameter ID	2374	–	–	–	2466	–	–	–
Applicable software series and edition	9DAA/P 9DB0/P	9DAA/P 9DB0/P	9DAA/P 9DB0/P	9DAA/P 9DB0/P	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M
FS0*i*-D,FS30*i*								
4007	00000000	←	←	←	00000000	←	←	←
4008	00010000	←	←	←	00010000	←	←	←
4009	00000000	←	←	←	00000000	←	←	←
4010	00010000	←	←	←	00010000	←	←	←
4011	00001010	←	←	←	00001010	←	←	←
4012	10000000	←	←	←	10000000	←	←	←
4013	00001100	←	←	←	00001100	←	←	←
4019	00000100	←	←	←	00000100	←	←	←
4400	00000000	←	←	←	00000000	←	←	←
4020	6000	←	←	←	6000	←	←	←
4023(*1)	30	←	←	←	30	←	←	←
4039	0	←	←	←	0	←	←	←
4040(*2)	4	←	←	←	4	←	←	←
4041(*2)	10	←	←	←	10	←	←	←
4048(*2)	16	←	←	←	18	←	←	←
4049(*2)	10	←	←	←	10	←	←	←
4080	16474	←	←	←	18000	←	←	←
4083	30	←	←	←	30	←	←	←
4093	0	←	←	←	0	←	←	←
4100	800	←	←	←	800	←	←	←
4101	65	←	←	←	78	←	←	←
4102	1345	←	←	←	1059	←	←	←
4103	0	←	←	←	0	←	←	←
4104	4500	←	←	←	5000	←	←	←
4105	131	←	←	←	122	←	←	←
4106	7500	←	←	←	11000	←	←	←
4107	0	←	←	←	0	←	←	←
4108	0	←	←	←	0	←	←	←
4109	25	←	←	←	25	←	←	←
4110	1106	1383	2074	2765	927	1159	1738	2318
4111	503	←	←	←	403	←	←	←
4112	200	←	←	←	200	←	←	←
4113	730	←	←	←	780	←	←	←
4114	23552	←	←	←	20480	←	←	←
4115	100	←	←	←	100	←	←	←
4116	6255	←	←	←	6000	←	←	←
4117	90	←	←	←	90	←	←	←
4118	100	←	←	←	100	←	←	←
4119	13	←	←	←	12	←	←	←
4120	0	←	←	←	0	←	←	←
4124	24575	←	←	←	24575	←	←	←
4127	164	←	←	←	150	←	←	←
4128	110	←	←	←	0	←	←	←
4129	0	←	←	←	0	←	←	←
4130	25700	←	←	←	25700	←	←	←
4134	110	←	←	←	110	←	←	←
4136	30	←	←	←	30	←	←	←
4138	0	←	←	←	0	←	←	←
4139	0	←	←	←	0	←	←	←
4140	0	←	←	←	0	←	←	←
4141	0	←	←	←	0	←	←	←
4142	0	←	←	←	0	←	←	←
4143	0	←	←	←	0	←	←	←
4144	0	←	←	←	0	←	←	←
4145	0	←	←	←	0	←	←	←
4146	0	←	←	←	0	←	←	←
4147	0	←	←	←	0	←	←	←
4148	0	←	←	←	0	←	←	←
4149	0	←	←	←	0	←	←	←
4150	0	←	←	←	0	←	←	←
4151	0	←	←	←	0	←	←	←
4152	0	←	←	←	0	←	←	←
4153	0	←	←	←	0	←	←	←
4154	0	←	←	←	0	←	←	←
4155	0	←	←	←	0	←	←	←
4156	0	←	←	←	0	←	←	←
4158	0	←	←	←	0	←	←	←
4159	0	←	←	←	0	←	←	←
4161	0	←	←	←	0	←	←	←
4165	0	←	←	←	0	←	←	←
4166	0	←	←	←	0	←	←	←
4169	0	←	←	←	0	←	←	←
4362	0	←	←	←	0	←	←	←
4363	0	←	←	←	0	←	←	←
4364	0	←	←	←	0	←	←	←
4365	0	←	←	←	0	←	←	←
4366	0	←	←	←	0	←	←	←
4367	0	←	←	←	0	←	←	←
4612	10575	←	←	←	13395	←	←	←
4613	18690	←	←	←	14080	←	←	←
4614	0	←	←	←	0	←	←	←
4615	0	←	←	←	0	←	←	←
Maximum output during acceleration (for PS selection)	6.1	6.1	6.1	6.1	8.3	8.3	8.3	8.3

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

JR AUTOMATION TECHNOLOGIES INC*

Motor model	βi I P 15/8000-B	βi I P 15/8000-B	βi I P 15/8000-B	βi I P18/8000-B	βi I P18/8000-B	βi I P18/8000-B	βi I P22/8000-B	βi I P22/8000-B	βi I P30/8000-B	βi I P 40/6000-B
Applicable amplifier	βi SVSP 11-B αi SP 11-B	βi SVSP 15-B αi SP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 11-B βi SVSP 11-B	βi SVSP 15-B αi SP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B	βi SVSP 18-B αi SP 22-B	βi SVSP 18-B αi SP 22-B
Output specification nameplate	A06B-1230-K442#S00	A06B-1230-K442#S00	A06B-1230-K442#S00	A06B-1230-K443#S00	A06B-1230-K443#S00	A06B-1230-K443#S00	A06B-1230-K459#S00	A06B-1230-K459#S00	A06B-1230-K499#S00	A06B-1230-K480#S00
Model code	5103	6103	7103	5104	6104	7104	5105	6105	5106	5107
Parameter ID	2220	–	–	2434	–	–	2538	–	2871	2690
Applicable software series and edition	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/N 9DB0/N
FS0*i*-D,FS30*i*										
4007	00000000	←	←	00000000	←	←	00000000	←	00000000	00000000
4008	00010000	←	←	00010000	←	←	00010000	←	00010000	00010000
4009	00000000	←	←	00000000	←	←	00000000	←	00000000	00000000
4010	00010000	←	←	00010000	←	←	00010000	←	00010000	00010000
4011	00001010	←	←	00001010	←	←	00001010	←	00001010	00001010
4012	10000000	←	←	10000000	←	←	10000000	←	10000000	10000000
4013	00001100	←	←	00001100	←	←	00001100	←	00001100	00001100
4019	00000100	←	←	00000100	←	←	00000100	←	00000100	00000100
4400	00000000	←	←	00000000	←	←	00000000	←	00000000	00000000
4020	8000	←	←	8000	←	←	8000	←	8000	6000
4023(*1)	30	←	←	30	←	←	30	←	30	30
4039	0	←	←	0	←	←	0	←	0	0
4040(*2)	8	←	←	9	←	←	8	←	10	15
4041(*2)	10	←	←	10	←	←	10	←	10	10
4048(*2)	39	←	←	41	←	←	35	←	10	69
4049(*2)	10	←	←	10	←	←	10	←	10	10
4080	20575	←	←	21845	←	←	19275	←	16730	16228
4083	30	←	←	30	←	←	30	←	30	30
4093	0	←	←	0	←	←	0	←	0	0
4100	750	←	←	750	←	←	770	←	750	670
4101	79	←	←	79	←	←	100	←	100	72
4102	1566	←	←	1191	←	←	953	←	1007	775
4103	0	←	←	0	←	←	0	←	0	0
4104	2000	←	←	3000	←	←	4000	←	3500	6500
4105	418	←	←	356	←	←	318	←	318	494
4106	7000	←	←	7000	←	←	9000	←	8000	7500
4107	0	←	←	0	←	←	0	←	0	0
4108	0	←	←	0	←	←	0	←	0	0
4109	25	←	←	25	←	←	25	←	25	25
4110	943	1415	1886	793	1190	1586	1077	1436	1143	849
4111	503	←	←	410	←	←	333	←	334	299
4112	200	←	←	200	←	←	200	←	200	200
4113	228	←	←	268	←	←	300	←	300	193
4114	0	←	←	0	←	←	20480	←	0	0
4115	100	←	←	100	←	←	100	←	100	100
4116	5307	←	←	4194	←	←	4408	←	4298	4983
4117	90	←	←	90	←	←	90	←	90	90
4118	100	←	←	100	←	←	100	←	100	100
4119	42	←	←	36	←	←	32	←	32	49
4120	0	←	←	0	←	←	0	←	0	0
4124	24575	←	←	24575	←	←	24575	←	24575	24575
4127	132	←	←	134	←	←	150	←	136	136
4128	90	←	←	105	←	←	103	←	0	108
4129	0	←	←	0	←	←	0	←	0	0
4130	25700	←	←	25700	←	←	25700	←	25700	25700
4134	130	←	←	130	←	←	130	←	130	130
4136	30	←	←	0	←	←	30	←	30	30
4138	0	←	←	0	←	←	0	←	0	0
4139	0	←	←	0	←	←	0	←	0	0
4140	0	←	←	0	←	←	0	←	0	0
4141	0	←	←	0	←	←	0	←	0	0
4142	0	←	←	0	←	←	0	←	0	0
4143	0	←	←	0	←	←	0	←	0	0
4144	0	←	←	0	←	←	0	←	0	0
4145	0	←	←	0	←	←	0	←	0	0
4146	0	←	←	0	←	←	0	←	0	0
4147	0	←	←	0	←	←	0	←	0	0
4148	0	←	←	0	←	←	0	←	0	0
4149	0	←	←	0	←	←	0	←	0	0
4150	0	←	←	0	←	←	0	←	0	0
4151	0	←	←	0	←	←	0	←	0	0
4152	0	←	←	0	←	←	0	←	0	0
4153	0	←	←	0	←	←	0	←	0	0
4154	0	←	←	0	←	←	0	←	0	0
4155	0	←	←	0	←	←	0	←	0	0
4156	0	←	←	0	←	←	0	←	0	0
4158	0	←	←	0	←	←	0	←	0	0
4159	0	←	←	0	←	←	0	←	0	0
4161	0	←	←	0	←	←	0	←	0	0
4165	0	←	←	0	←	←	0	←	0	0
4166	0	←	←	0	←	←	0	←	0	0
4169	0	←	←	0	←	←	0	←	0	0
4362	0	←	←	0	←	←	0	←	0	-24526
4363	0	←	←	0	←	←	0	←	0	-28572
4364	0	←	←	0	←	←	0	←	0	-30420
4365	0	←	←	0	←	←	0	←	0	0
4366	0	←	←	0	←	←	0	←	0	0
4367	0	←	←	0	←	←	0	←	0	0
4612	13153	←	←	10867	←	←	11136	←	11149	136
4613	-30047	←	←	27528	←	←	16524	←	16775	18945
4614	0	←	←	0	←	←	0	←	0	0
4615	0	←	←	0	←	←	0	←	0	0
Maximum output during acceleration (for PS selection)	9.9	9.9	9.9	12.1	12.1	12.1	16.5	16.5	20.4	20.35

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

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C.31 SPINDLE MOTOR βiIT-B series

Motor model	βi IT 12/10000-B	βi IT 12/10000-B	βi IT12/10000-B	βi IT12/10000-B	βi IT 15/8000-B	βi IT 15/8000-B
Applicable amplifier	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B	αi SP 15-B βi SVSP 15-B	βi SVSP 18-B αi SP 22-B	βi SVSP 18-B αi SP 22-B	αi SP 22-B
Output specification nameplate	A06B-1230-K490#S00	A06B-1230-K490#S00	A06B-1230-K490#S0P	A06B-1230-K490#S0P	A06B-1230-K491#S00	A06B-1230-K491#S0P
Model code	5108	6108	5109	6109	5110	5111
Parameter ID	2744	–	2515	–	2420	2649
Applicable software series and edition	9DAA/M 9DB0/M	9DAA/M 9DB0/M	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/O 9DB0/O	9DAA/O 9DB0/O
FS0*i*-D,FS30*i*						
4007	00000000	←	00000100	←	00000000	00000000
4008	00000000	←	00000000	←	00000000	00000000
4009	00000000	←	00000000	←	00000000	00000000
4010	00010001	←	00010001	←	00010001	00000001
4011	00011010	←	00011010	←	00011010	00011010
4012	10000010	←	10000010	←	10000000	10000010
4013	00001100	←	00001100	←	00001100	00001100
4019	00000100	←	00000100	←	00000100	00000100
4400	00000000	←	00000000	←	00000000	00000000
4020	10000	←	10000	←	8000	8000
4023(*1)	30	←	30	←	30	30
4039	0	←	0	←	0	0
4040(*2)	4	←	3	←	8	7
4041(*2)	10	←	10	←	10	10
4048(*2)	18	←	15	←	38	32
4049(*2)	10	←	10	←	10	10
4080	12895	←	19513	←	15445	15455
4083	30	←	30	←	30	30
4093	0	←	0	←	0	0
4100	1550	←	1550	←	1550	1550
4101	82	←	89	←	81	70
4102	1844	←	1844	←	1610	1610
4103	80	←	0	←	0	0
4104	3500	←	3500	←	2500	4500
4105	135	←	135	←	321	321
4106	10000	←	10000	←	5000	11500
4107	0	←	0	←	0	0
4108	0	←	0	←	0	0
4109	25	←	25	←	25	25
4110	1031	1375	1031	1375	1426	1426
4111	355	←	414	←	389	577
4112	200	←	200	←	200	200
4113	705	←	705	←	298	298
4114	23040	←	0	←	0	0
4115	100	←	100	←	100	100
4116	6300	←	6300	←	4344	4344
4117	90	←	28762	←	90	90
4118	100	←	100	←	100	90
4119	14	←	14	←	32	32
4120	0	←	0	←	0	0
4124	24575	←	24575	←	24575	24575
4127	150	←	185	←	136	161
4128	95	←	0	←	0	0
4129	0	←	0	←	0	0
4130	25700	←	25700	←	25700	25700
4134	110	←	110	←	130	130
4136	30	←	30	←	30	30
4138	0	←	0	←	0	0
4139	0	←	0	←	0	0
4140	0	←	0	←	0	0
4141	0	←	0	←	0	0
4142	0	←	0	←	0	0
4143	0	←	0	←	0	0
4144	0	←	0	←	0	0
4145	0	←	0	←	0	0
4146	0	←	0	←	0	0
4147	0	←	0	←	0	0
4148	0	←	0	←	0	0
4149	0	←	0	←	0	0
4150	0	←	0	←	0	0
4151	0	←	0	←	0	0
4152	0	←	0	←	0	0
4153	0	←	0	←	0	0
4154	0	←	0	←	0	0
4155	0	←	0	←	0	0
4156	0	←	0	←	0	0
4158	0	←	0	←	0	0
4159	0	←	0	←	0	0
4161	0	←	0	←	0	0
4165	0	←	0	←	0	0
4166	0	←	0	←	0	0
4169	0	←	0	←	0	0
4362	0	←	-24451	←	0	-24451
4363	0	←	30870	←	0	-30545
4364	0	←	-28472	←	0	-24326
4365	0	←	0	←	0	0
4366	0	←	0	←	0	0
4367	0	←	0	←	0	0
4612	11112	←	11100	←	11122	10837
4613	9730	←	9730	←	9735	9734
4614	0	←	0	←	0	0
4615	0	←	0	←	0	0
Maximum output during acceleration (for PS selection)	16.5	16.5	20.4	20.4	20.4	24.2

(*1)When using the SDT signal, manually change the parameter No.4023 that were automatically set.
(*2)Manually change the velocity loop gain (No.4040, 4041, 4048, 4049) that were automatically set.

JR AUTOMATION TECHNOLOGIES INC*
DOWLING

D LISTS OF ALARMS/STATE ERRORS

D.1 LIST OF SPINDLE ALARMS

This section provides a list of spindle alarms. For details of the alarms and actions to be taken, refer to Part II, "TROUBLESHOOTING", in "FANUC SERVO MOTOR α*i* series MAINTENANCE MANUAL (B-65285EN)".
When two rows are present in the [LED display] field, the upper row indicates SP, PS, and SVSP for specification drawing numbers A06B-61xx-... and the lower row indicates SP, PS, and SVSP for specification drawing numbers A06B-62xx-...

Alarm No.		LED display		Description
0*i*	30*i*	SP	PS	
SP12xx	SP12xx	A		Program ROM error
SP12xx	SP12xx	A1		Program ROM error
SP12xx	SP12xx	A2		Program ROM error
SP9001	SP9001	01		Motor overheat
SP9002	SP9002	02		Excessive velocity error
SP9003	SP9003	03		DC link fuse blown
SP9004	SP9004	04	E	Open phase in the PS main power supply
			14	
SP9006	SP9006	06		Temperature sensor disconnected
SP9007	SP9007	07		Over speed
SP9009	SP9009	09		Main circuit overload/IPM overheat
SP9010	SP9010	10		Low power supply input voltage
SP9011	SP9011	11	7	PS: DC link overvoltage
			07	
SP9012	SP9012	12		DC link overcurrent/IPM alarm
SP12xx	SP12xx	13		CPU internal data memory error
SP9014	SP9014	14		Amplifier ID not registered
SP9015	SP9015	15		Speed range switching/spindle switching alarm
SP9016	SP9016	16		RAM error
SP9017	SP9017	17		Amplifier ID data error
SP12xx	SP12xx	18		Program sum check error
SP12xx	SP12xx	19		Excessive offset of the phase U current detection circuit
SP12xx	SP12xx	20		Excessive offset of the phase V current detection circuit
SP9021	SP9021	21		Position sensor polarity setting incorrect
SP9022	SP9022	22		Spindle amplifier current overload
SP12xx	SP12xx	24		Serial communication error
SP9027	SP9027	27		Position coder disconnected
SP9029	SP9029	29		Short-time overload
SP9030	SP9030	30	1	Overcurrent in the PS input circuit
			01	
SP9031	SP9031	31		Motor lock alarm
SP9032	SP9032	32		Serial communication LSI RAM error
SP9033	SP9033	33	5	PS: DC link recharge failure
			05	
SP9034	SP9034	34		Parameter data out of the specifiable range
SP9035	SP9035	35		Gear ratio parameter error
SP9036	SP9036	36		Error counter overflow
SP9037	SP9037	37		Speed detector parameter error
SP9041	SP9041	41		Position coder one-rotation signal detection error

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Alarm No.		LED display		Description
0*i*	30*i*	SP	PS	
SP9042	SP9042	42		Position coder one-rotation signal not detected
SP9043	SP9043	43		Position coder signal for differential speed mode disconnected
SP9046	SP9046	46		Position sensor one-rotation signal detection error during thread cutting
SP9047	SP9047	47		Position coder signal error
SP9049	SP9049	49		Overflow of converted motor speed for differential spindle speed control
SP9050	SP9050	50		Excessive speed command calculation value during spindle synchronous control
SP9051	SP9051	51	4	PS: DC link low voltage
			04	
SP9052	SP9052	52		ITP signal error I
SP9053	SP9053	53		ITP signal error II
SP9054	SP9054	54		Current overload alarm
SP9055	SP9055	55		Abnormal switching status of power leads
SP9056	SP9056	56		Internal cooling fan stopped
SP9057	SP9057	57	H	PS: excessive deceleration power
			16	
SP9058	SP9058	58	3	PS: main circuit overload
			03	
SP9059	SP9059	59	2	PS: cooling fan stopped
			02	
SP9061	SP9061	61		Excessive semi-closed loop/closed loop position error alarm
SP9065	SP9065	65		Abnormal travel distance in magnetic pole determination operation
SP9066	SP9066	66		Communication alarm between spindle amplifiers
SP9067	SP9067	67		Reference position return command in the EGB mode
SP9069	SP9069	69		Safety speed exceeded
SP9070	SP9070	70		Abnormal axis data
SP9071	SP9071	71		Abnormal safety parameter
SP9072	SP9072	72		Motor speed mismatch
SP9073	SP9073	73		Motor sensor disconnected
SP9074	SP9074	74		CPU test alarm
SP9075	SP9075	75		CRC test alarm
SP9076	SP9076	76		Safety function not executed
SP9077	SP9077	77		Axis number mismatch
SP9078	SP9078	78		Safety parameter mismatch
SP9079	SP9079	79		Abnormal initial test operation
SP9080	SP9080	80		Destination amplifier error in inter-spindle amplifier communication
SP9081	SP9081	81		Motor sensor one-rotation signal detection error
SP9082	SP9082	82		Motor sensor one-rotation signal not detected
SP9083	SP9083	83		Motor sensor signal error
SP9084	SP9084	84		Spindle sensor disconnected
SP9085	SP9085	85		Spindle sensor one-rotation signal detection error
SP9086	SP9086	86		Spindle sensor one-rotation signal not detected
SP9087	SP9087	87		Spindle sensor signal error
SP9088	SP9088	88		Cooling fan stopped of the radiator
SP9089	SP9089	89		Sub module SM (SSM) error
SP9090	SP9090	90		Unexpected rotation alarm
SP9091	SP9091	91		Pole position count miss alarm
SP9092	SP9092	92		Velocity command-dependent overspeed alarm
SP9110	SP9110	b0		Communication error between amplifier modules

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Alarm No.		LED display		Description
0*i*	30*i*	SP	PS	
SP9111	SP9111	b1	6	PS: control power supply low voltage
			06	
SP9112	SP9112	b2	8	PS: excessive regenerative power
			08	
SP9113	SP9113	b3	A	PS: cooling fan stopped of the radiator
			10	
SP9114	SP9114	b4		Specification of PS management axis error 1
SP9115	SP9115	b5		Specification of PS management axis error 2
SP9120	SP9120	C0		Communication data alarm
SP9121	SP9121	C1		Communication data alarm
SP9122	SP9122	C2		Communication data alarm
SP9123	SP9123	C3		Spindle switch circuit error
SP9124	SP9124	C4		Invalid velocity command during learning control
SP9125	SP9125	C5		Invalid dynamic characteristics compensation order during learning control
SP9126	SP9126	C6		Spindle speed exceeded
SP9128	SP9128	C8		Excessive speed deviation alarm on spindle synchronous control
SP9129	SP9129	C9		Excessive positional deviation alarm on spindle synchronous control
SP9130	SP9130	d0		Speed polarity error in torque tandem operation
SP9131	SP9131	d1		Spindle Tuning function alarm
SP9132	SP9132	d2		Serial data error
SP9133	SP9133	d3		Data transfer error
SP9134	SP9134	d4		Soft phase alarm
SP9135	SP9135	d5		Safety speed zero monitoring error
SP9136	SP9136	d6		Safety speed zero monitoring mismatch
SP9137	SP9137	d7		Device communication error
SP9139	SP9139	d9		Pulse error alarm
SP9140	SP9140	E0		Count error alarm
SP9141	SP9141	E1		Serial sensor one-rotation signal not detected
SP9142	SP9142	E2		Serial sensor abnormal
SP9143	SP9143	E3		Cs axis high-speed switching function command abnormal
SP9144	SP9144	E4		Current detection circuit abnormal
SP9145	SP9145	E5		Driver voltage low
SP9146	SP9146	E6		SP inside overheat
SP9147	SP9147	E7		SP ground fault
SP9148	SP9148	E8		Axis number not set
SP9153	SP9153	F3		SP normal
SP9154	SP9154	F4		Phase-to-phase open
SP9155	SP9155	F5		SP abnormal（OPEN）
SP9156	SP9156	F6		Current control bad
SP9157	SP9157	F7		SP abnormal (SHORT)
SP9160	SP9160	G0		SP thermistor wire break
SP9161	SP9161	G1		Motor power line short-circuited
SP9167	SP9167	G7		Spindle control sequence error
SP9168	SP9168	G8		Connection error between SP and motor
SP9169	SP9169	G9		Drive off circuit failure (STO)
SP9170	SP9170	H0		Excess error at spindle stop (Smart rigid tapping)
SP9171	SP9171	H1		Cooling fan stopped of the motor
SP9200	SP9200		09	PS ground fault
SP9201	SP9201		11	Common power supply (PS) error
SP9202	SP9202		12	Common power supply (PS) error
SP9203	SP9203		13	Common power supply (PS) error

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Alarm No.		LED display		Description
0*i*	30*i*	SP	PS	
SP9204	SP9204		15	PS soft thermal
SP9205	SP9205		17	Common power supply (PS) error
SP9206	SP9206		18	Common power supply (PS) error
SP9207	SP9207		19	Common power supply (PS) error
SP9208	SP9208		20	Common power supply (PS) error
SP9209	SP9209		21	Common power supply (PS) error
SP9210	SP9210		22	Common power supply (PS) error
SP9211	SP9211		23	Invalid PS parameter
SP9212	SP9212		24	PS hardware error
SP9213	SP9213		25	PS external input device error
SP9214	SP9214		26	PS PFBM-R error
SP9215	SP9215		27	PS PFBM-C error
SP9216	SP9216		28	PS submodule error
		UU		FSSB master port wire break
		LL		FSSB slave port wire break

D.2 LIST OF SPINDLE STATE ERRORS

When a parameter is set incorrectly or a sequence is incorrect, the error LED (yellow) on the indicator of the spindle amplifier (SP) is turned on, and an error code is displayed. The error is also displayed on the diagnosis screen of the CNC.

Diagnostic number	Description
FS0*i* / FS30*i*	
710	State error number

When the spindle motor malfunctions, check the error code and take action according to the table below.

Indication	Description of error state	Action
01	Although neither *ESP (emergency stop signal; there are two types of signals including the input signal and common power supply (PS) contact signal) nor MRDY (machine ready signal) is input, SFR (forward rotation signal)/SRV (reverse rotation signal)/ORCM (orientation command) is input.	Check the *ESP and MRDY sequence. For MRDY, pay attention to the parameter setting regarding the use of the MRDY signal (bit 0 of parameter No. 4001).
03	Although a parameter setting (bits 3,2,1,0 of No. 4002 = 0,0,0,0) is made to use no position sensor (to exercise no position control), the Cs contouring control command is input. In this case, the motor is not excited.	Check the parameter setting.
04	Although a parameter setting (bits 3,2,1,0 of No. 4002 = 0,0,0,0) is made to use no position sensor (to exercise no position control), a command for servo mode (such as rigid tapping and spindle positioning) or spindle synchronous control is input. In this case, the motor is not excited.	Check the parameter setting.
05	Although the option parameter of the orientation function is not set, the ORCM (orientation command) is input.	Check the parameter setting of the orientation function.

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Indication	Description of error state	Action
06	Although the option parameter of the speed range switching control function is not set, the low-speed characteristics winding is selected. (RCH=1)	Check the parameter setting of the speed range switching control function and also check the power line state check signal (RCH).
07	Although the Cs contour control command is specified, SFR(clockwise command) / SRV(counterclockwise command) is not input.	Check the sequence.
08	Although the servo mode (rigid tapping, spindle positioning, etc.) is specified, SFR(clockwise command) / SRV(counterclockwise command) is not input.	Check the sequence.
09	Although spindle synchronous control mode is specified, SFR(clockwise command) / SRV(counterclockwise command) is not input.	Check the sequence.
10	Although Cs contour control mode is set, another mode (servo mode, spindle synchronous control, or orientation) is specified.	During execution of the Cs contour control command, do not specify another mode. Before entering another mode, cancel the Cs contour control command.
11	Although servo mode (rigid tapping, or spindle positioning, etc.) is set, another mode (Cs contour control, spindle synchronous control, or orientation) is specified.	During execution of the servo mode command, do not specify another mode. Before entering another mode, cancel the servo mode.
12	Although spindle synchronous control is being performed, another mode (Cs contour control, servo mode, or orientation) is specified.	During execution of the spindle synchronous control command, do not specify another mode. Before entering another mode, cancel the spindle synchronous control command.
13	Although the orientation command is being executed, another mode (Cs contour control, servo mode, or spindle synchronous control) is specified.	During execution of the orientation command, do not specify another mode. Before entering another mode, cancel the orientation command.
14	The SFR(clockwise command) and SRV(counterclockwise command) signals are both input at the same time.	Input the SFR(clockwise command) or SRV(counterclockwise command)signal.
16	Although a parameter setting (bit 5 of parameter No. 4000 = 0) is made to use no differential spindle speed control function, DEFMD (differential speed mode command) is input.	Check the parameter setting and differential speed mode command.
17	Setting of the speed detector parameter (bits 2, 1, and 0 of parameter No. 4011) is invalid. The corresponding speed detector is not present.	Check the parameter setting.
18	Although a parameter setting (bits 3,2,1,0 of No. 4002 = 0,0,0,0) is made to use no position sensor (to exercise no position control), position coder method orientation is specified.	Check the parameter setting and input signal.
19	Although the magnetic sensor method orientation command is specified, another mode (Cs contouring control, servo mode, or spindle synchronous control) is specified.	During the execution of the orientation command, do not specify another mode. Before changing the mode to another mode, cancel the orientation command.
21	A tandem operation command was input when spindle synchronous control is enabled.	Input a tandem operation command after canceling spindle synchronous control.
22	Spindle synchronous control was specified when tandem operation is enabled.	Specify spindle synchronous control after canceling torque tandem operation.
23	A tandem operation command is input even if the option is not specified.	Torque tandem control requires the CNC software option. Check the option.
24	For successive indexing in position coder method orientation, an incremental operation (INCMD = 1) is first performed, then an absolute position command (INCMD = 0) is input.	Check INCMD (incremental command). When specifying the absolute position command successively, be sure to perform absolute position command orientation first.

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Indication	Description of error state	Action
26	Parameter settings are made to use both spindle switching and three stage speed range switching control.	Check the parameter settings and input signals.
29	Parameter settings for using the shortest time orientation function (bit 6 of No. 4018 = 0, No. 4320 to No. 4323 ≠ 0) are made.	The shortest time orientation function is unusable with the αi series spindle amplifier. Using optimum orientation function is recommended.
30	The magnetic pole undetected state is set, but a command is input.	In the magnetic pole undetected state (EPFIXA = 0), the motor cannot be driven even if a command is input. Input a command in the magnetic pole detection completed state (EPFIXA = 1). While EPFSTR = 1 is set, a command is ignored even in the magnetic pole detection completed state, and this error is indicated. Upon completion of magnetic pole detection, set EPFSTR = 0.
31	The hardware configuration disables the use of the spindle FAD function. In this case, the motor is not excited.	Check the model of the CNC.
32	Although S0 is not specified for the speed mode, the parameter setting is made to enable the disturbance input function (bit 7 of parameter No. 4395 = 1).	Specify S0 for the speed mode before enabling the disturbance input function (setting bit 7 of parameter No. 4395 to 1).
33	The hardware configuration disables the use of the spindle EGB function. In this case, the motor is not excited.	Check the model of the CNC.
34	Both the spindle FAD function and spindle EGB function are enabled. In this case, the motor is not excited.	The two functions cannot be used at the same time. Enable one of the two functions at a time.
35	ID information of the spindle amplifier cannot be obtained.	Replace the spindle amplifier with one for which correct ID information is written.
36	The sub module SM (SSM) is abnormal. *1) Disconnection of the interface signal between the spindle amplifier and SSM *2) SSM failure	For action to be taken for this error, see Section 1.4, “SUB MODULE SM”, in Part IV.
37	The current loop setting (parameter No. 4012) is changed.	Check the setting of parameter No. 4012, and turn the power off, then on again.
38	Parameters related to inter-spindle amplifier communication are not set correctly, or functions that cannot be used together with the torque tandem function are set.	Check the parameters.
39	DSCN (disconnection detection disable signal) is input in the state where SFR (forward rotation command), SRV (reverse rotation command), or ORCM (orientation command) is input.	Check the sequence. Do not input DSCN (disconnection detection disable signal) while a command for motor activation is input.
43	A setting unavailable with the αiCZ sensor (serial) is made. (*1)	Check the parameters.
44	The spindle amplifier does not support the control frequency setting.	Check the setting of parameter No. 4012.
45	The setting does not correspond to the maximum output control setting for cutting.	This is a state error related to the function that performs output control for cutting. The function cannot be used for the system in which this state error occurs. Set bit 6 of parameter No. 4011 to 0, and disable the function.

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Indication	Description of error state	Action
46	CNC system software does not support spindle synchronous control using the nano directive.	CNC system software does not support the nano directive. Check the series and edition of CNC system software.
48	A setting is made to use both the integral copy via NC and the spindle EGB.	Do not use the spindle EGB when the integral copy via NC is enabled.
49	The sine wave filter relationship is not set correctly.	This cannot be used with the following functions. Conventional control bit 7 of parameter No. 4012 = 0, synchronous motor driving bit 6 of parameter No. 4012 = 1, spindle switching bit 0 of parameter No. 4014 = 1, Low-speed winding selection, position coder signal output function
50	Sine wave filter function error	After changing the sine wave filter function bit 6 of parameter No. 4540, and turn the power of the CNC off, then on again.
51	The position coder parameters for the βiIc spindle motor are not set correctly.	Check bit 1 of parameter No. 4002 and parameters Nos. 4140, 4141, 4138 and 4139.
54	FSSB high-speed rigid tapping and the servo EGB (FSSB method) cannot be used at the same time.	Either disable FSSB high-speed rigid tapping (bit 1 of parameter No. 4549 = 0) or disable the servo EGB (FSSB method) (bit 2 of parameter No. 4549 = 0).
55	The current limitation value setting for the PWM cycle switching function is incorrect.	The maximum current determined by the current limitation value exceeds the maximum current for the amplifier. Check the parameters (Nos. 4619 /4620) settings.
56	The speed is too high when the PWM cycle switching function is used.	The base speed for the synchronous spindle motor is exceeded. Check the use conditions.
57	The parameter is not set correctly when optimum orientation and reference position return on servo mode are used.	Set a value other than 0 to the parameter (No. 4074) for the reference position return speed on serve mode.
58	The parameter settings unavailable with safety speed monitoring by the spindle speed are made.	Check the settings of bits 3 to 0 of parameter No. 4002.
59	The setting is incorrect when the minimum setting unit 360/32768deg is used for the spindle orientation stop position.	・CNC system software does not support the minimum setting unit 360/32768deg for the spindle orientation stop position. Check the series and edition of CNC system software. ・This cannot be used together with the orientation function during spindle synchronous control (bit 6 of parameter No. 4014 =1).
60	The sequence in which spindle phase synchronous control is used is incorrect.	Check the sequence related to phase alignment for spindle phase synchronous control. When the setting is made not to automatically detect the one-rotation signal (bit 3 of parameter No. 4006 = 1), this error occurs if the spindle phase synchronization command is entered with the one-rotation signal not detected. Check this point.
63	The DC-link stabilizer at a power failure is not supported.	Spindle control software does not support the DC-link stabilizer at a power failure. Check the series and edition of spindle control software.
64	The sequence is incorrect in the servo EGB (FSSB method).	In the setting where both the serve EGB (FSSB method) and the arbitrary gear ratio function are used, do not perform gear switching for the serve EGB.

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NOTE

1 If state error 43 is displayed, check the following items. The items to be checked differ depending on the spindle software series and edition.

Series 9D80/E(05), F(06): Items <1> to <12>
Series 9D80/G(07): Items <1> to <9>, <12>, and <13>
Series 9D80/H(08): Items <1> to <9>, <13>, and <14>
Series 9D90/A(01): Items <1> to <9>, <13>, and <14>
Series 9DA0/A(01): Items <1> to <9>, <13>, and <14>
Series 9DB0/A(01): Items <1> to <9>, <13>

<1> The setting is made so that the α*i*CZ sensor (serial) is used as both of the motor and spindle sensors. (No.4010#2,1,0=0,1,0 and No.4002#3,2,1,0=0,1,1,0)
<2> Spindle HRV control is not set. (No.4012#7=0)
<3> The use of the differential spindle speed control function is set. (No.4000#5=1)
<4> The use of the spindle switching control function is set. (No.4014#0=1)
<5> The setting is made so that alarms related to position feedback are not detected. (No.4007#6=1 or No.4016#5=0)
<6> The setting is made so that feedback signal disconnection is not detected. (No.4007#5=1)
<7> The setting is made so that alarms related to threading position detection signal feedback are not detected. (No.4016#6=0)
<8> The use of an external one-rotation signal is set. (No.4004#2=1)
<9> The use of a position coder is set. (No.4002#3,2,1,0=0,0,1,0)
<10> The setting is made so that the synchronous built-in spindle motor is driven. (No.4012#6=1)
<11> The use of inter-spindle amplifier communication is set. (No.4352#7=1 or No.4352#6=1)
<12> The use of the dual check safety function is set.
<13> The use of the spindle tandem function is set. (No.4015#3=1)
<14> The use of the twin-drive function is set. (No.4398#3=1)
<15> The use of the α*i*CZ sensor (serial) as the motor sensor is set and the dual check safety function is enabled (CNC software or spindle amplifier is not support this configuration.).

D.3 ALARMS RELATED TO INCORRECTLY SET SPINDLE PARAMETERS / CONTROL SEQUENSE (SP9034, SP9068, SP9167)

Alarms related to incorrectly set spindle parameters / control sequence (SP9034, SP9068, SP9167) are caused by several factors. This section describes how to identify the cause of an alarm.

1. Location of illegal parameter range alarms (SP9034)

Illegal parameter range alarms (SP9034) help you check incorrectly set parameter numbers on the diagnosis screen of the CNC. Check the valid range of the relevant parameter and set a value within the range.

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Diagnosis No. FS0*i* / FS30*i*	Description
720	Internal data number of parameter*

NOTE
* The internal data number of a parameter is not the parameter number displayed to the CNC. See Appendix A, "SPINDLE PARAMETER TABLE", in the Spindle Parameter Manual.

2. List of causes of incorrect spindle parameter alarms (SP9068), spindle control sequence alarm (SP9167)

Incorrect spindle parameter alarms (SP9068) and spindle control sequence alarms (SP91767) occur in conjunction with spindle state errors. The spindle state error number identifies the cause of the alarm.

The spindle state error number can be checked on the diagnosis screen of the CNC.

Diagnosis No. FS0*i* / FS30*i*	Description
710	State error number

State error number	Description	Cause and action
52	Setting unit IS-D: incorrectly set function	In the setting unit IS-D (bits 1, 0 of parameter No. 4005 = 1, 0), the following functions cannot be used. ・ Spindle orientation ・ Servo mode control such as rigid tapping ・ Spindle synchronous control ・ Learning control ・ Spindle tandem control ・ Synchronous spindle motor control or non-spindle HRV control (bits 7, 6 of parameter No. 4012 ≠ 1, 0) ・ Inter-spindle amplifier communication (bits 7, 6 of parameter No. 4352 ≠ 0, 0) ・ Spindle backlash acceleration (bit 0 of parameter No. 4402 = 1) ・ Cs contouring control by customer's board While the setting unit IS-D is being used, an SP9068 alarm occurs if the above functions are used. Check the parameter settings and the ladder.
54	FSSB communication: incorrectly set function	When FSSB communication is used, the following two functions cannot be used together. An SP9068 alarm occurs if both functions are enabled. ・ FSSB high-speed rigid tapping (bit 1 of parameter No. 4549 = 1) ・ EGB function (FSSB method) (bit 2 of parameter No. 4549 =1) Check the parameter setting.
57	Optimum orientation & reference position return on servo mode: incorrectly set	A value other than 0 must be set to the reference position return speed (No. 4074) to return to the reference position on servo mode in the setting where optimum orientation is used. When No. 4074 = 0, an SP9068 alarm occurs. Check the parameter setting.

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State error number	Description	Cause and action
58	Dual check safety: incorrectly set safety speed monitoring	In the dual check safety function, the safety speed monitoring function using the spindle speed exists. Under the following spindle sensor conditions, the safety speed monitoring function cannot be used. ・ No spindle sensor (Bits 3, 2, 1, 0 of parameter No. 4002 = 0, 0, 0, 0) ・ αi position coder is used (Bits 3, 2, 1, 0 of parameter No. 4002 = 0, 0, 1, 0) Use an appropriate spindle sensor, or adjust the parameter settings.
59	Minimum setting unit 1/32768rev for spindle orientation stop position: incorrectly set function	When a setting is made to improve resolution for specifying the spindle orientation stop position (bit 0 of parameter No. 4542 = 1), an SP9068 alarm occurs in the following states: ・ CNC software does not support resolution improvement. Check the series and edition of CNC software. A setting is made to use the orientation function during spindle synchronous control (bit 6 of parameter No. 4014 =1). This cannot be used together with this function. Check the parameter setting.
60	The sequence for using spindle phase synchronous control is not correct.	Check the sequence for phase matching of spindle synchronous control. When bit 3 of parameter No. 4006 is set to 1 (to not detect the one-rotation signal automatically), if the spindle phase synchronous command is entered in a state where the one-rotation signal is not detected, this error occurs. Check this point.
61	Spindle oscillating torque input function cannot be used.	Disturbance input function and spindle oscillating torque input function cannot be used together. (No.4395#7=1 & No.4352=16)
62	The sequence for using spindle oscillating torque input function is not correct.	Although the details of output signal is inputted (G304#2=1), SFR(clockwise command) / SRV(counterclockwise command) is not input.
63	Spindle DC-link stabilizer during power failure is not supported.	The spindle control software does not support spindle DC-link stabilizer during power failure. Check the series and edition of the spindle control software.
64	The sequence is not correct in the servo EGB (FSSB) method.	Do not change the gear during servo EGB with the setting to use the servo EGB (FSSB method) and the arbitrary gear ratio function together.
66	The setting of PWM cycle switching function for synchronous motor is incorrect.	When the synchronous motor is used (No.4012#6=1), the parameter setting of PWM cycle switching function is failure (No.4639≠0 & No.4129=0)
67	The smart load meter cannot be used.	The CNC system software does not support the smart load meter. Check the series and edition of the CNC system software.
68	The setting for the terminating resistance for third-party analog sensors is not correct.	The setting for the terminating resistance for third-party analog sensors is enabled under the setting to use FANUC analog sensors. Check the settings for the sensor (bits 3 to 0 of No. 4002, bits 2 to 0 of No. 4010) and the settings for the terminating resistance for third-party analog sensors (bits 7 and 6 of No. 4004).
69	The smart rigid tapping cannot be used.	・ Constant parameters for magnetic flux control (No. 4105 and No. 4107) are not input. ・ The sensor-less motor drive and the smart rigid tapping cannot be used together. ・ The spindle differential speed control and the smart rigid tapping cannot be used together.

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State error number	Description	Cause and action
70	The setting for third-party temperature sensors is not correct.	Third-party temperature sensor KTY-84 and the setting for using Pt1000 are enabled at the same time. Check the settings for the third-party temperature sensor (bit 4 of No. 4397 and No. 4587).
74	The setting for temperature sensors or thermostat is not correct.	The following function that is used thermostat signal cannot be used together. ・ Motor overheat detection by thermostat (No.4134=0). ・ Dual overheat detection function (No.4017#6=1). ・ Failure of motor fan detection (No.4016#1=1) ・ The sine wave filter is used with SSM (No.4540#6=1 & No.4008#5=1)
75	Servo/Spindle synchronous control (FSSB type) cannot be used.	Used re-acquisition of one-rotation signal position function with arbitrary gear ratio in Servo/Spindle synchronous control (FSSB type) together (No.4679#2=1 & No.4004#1=1).

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E TABLE OF I/O SIGNALS RELATED TO SPINDLE CONTROL

E.1 αi SERIES SPINDLE

E.1.1 Input Signals (PMC→CNC)

(1)Series 0*i*-D

		#7	#6	#5	#4	#3	#2	#1	#0
	G026							PC4SLC	PC3SLC
	G027	CON		*SSTP3 (*1)	*SSTP2 (*1)	*SSTP1 (*1)	SWS3 (*1)	SWS2 (*1)	SWS1 (*1)
	G028	PC2SLC	SPSTPA	*SCPFA	*SUCPFA		GR12	GR11	
	G029		*SSTP	SOR	SAR	GR32	GR31	GR22	GR21
	G030	SOV7	SOV6	SOV5	SOV4	SOV3	SOV2	SOV1	SOV0
	G031	PKESS2	PKESS1						
Common to all axes	G038					SPPHS	SPSYC	SBRT	
	G061		RGTSP3 (*1)	RGTSP2 (*1)	RGTSP1 (*1)				RGTAP
Common to all axes	G064		ESRSYC						
	G122	PKESS2	PKESS1						
	G264						ESSYC3	ESSYC2	ESSYC1
	G265						PKESE3	PKESE2	PKESE1
	G274		CSFI3	CSFI2	CSFI1		CONS3	CONS2	CONS1
	G288						SPSYC3	SPSYC2	SPSYC1
	G289						SPPHS3	SPPHS2	SPPHS1
	G351						SSEGB3	SSEGB2	SSEGB1
	G400						*SUCPFC	*SUCPFB	
	G401						*SCPFC	*SCPFB	
	G402						SPSTPC	SPSTPB	
	G521		SRVON7	SRVON6	SRVON5	SRVON4	SRVON3	SRVON2	SRVON1
	G523		SVRVS7	SVRVS6	SVRVS5	SVRVS4	SVRVS3	SVRVS2	SVRVS1
	G533				SSRS		SSR3	SSR2	SSR1
	G536	SPSP							

1st-	G030	SOV7	SOV6	SOV5	SOV4	SOV3	SOV2	SOV1	SOV0
2nd-	G376	SOV27	SOV26	SOV25	SOV24	SOV23	SOV22	SOV21	SOV20
3rd-	G377	SOV37	SOV36	SOV35	SOV34	SOV33	SOV32	SOV31	SOV30

1st-	G032	R08I	R07I	R06I	R05I	R04I	R03I	R02I	R01I
2nd-	G034	R08I2	R07I2	R06I2	R05I2	R04I2	R03I2	R02I2	R01I2
3rd-	G036	R08I3	R07I3	R06I3	R05I3	R04I3	R03I3	R02I3	R01I3

1st-	G033	SIND	SSIN	SGN		R12I	R11I	R10I	R09I
2nd-	G035	SIND2	SSIN2	SGN2		R12I2	R11I2	R10I2	R09I2
3rd-	G037	SIND3	SSIN3	SGN3		R12I3	R11I3	R10I3	R09I3

1st-	G078	SH07A	SH06A	SH05A	SH04A	SH03A	SH02A	SH01A	SH00A
1st-	G079					SH11A	SH10A	SH09A	SH08A

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2nd-	G080	SH07B	SH06B	SH05B	SH04B	SH03B	SH02B	SH01B	SH00B
2nd-	G081					SH11B	SH10B	SH09B	SH08B
3rd-	G208	SH07C	SH06C	SH05C	SH04C	SH03C	SH02C	SH01C	SH00C
3rd-	G209					SH11C	SH10C	SH09C	SH08C

NOTE
*1 These signals are valid in multi-spindle control.

(2) Series 30*i*

		#7	#6	#5	#4	#3	#2	#1	#0
	G021	SVR08I	SVR07I	SVR06I	SVR05I	SVR04I	SVR03I	SVR02I	SVR01I
	G022	SVSP		SVGN	DFSYC	SVR12I	SVR11I	SVR10I	SVR09I
	G026		*SSTP4 (*1)			SWS4 (*1)		PC4SLC	PC3SLC
	G027	CON		*SSTP3 (*1)	*SSTP2 (*1)	*SSTP1 (*1)	SWS3 (*1)	SWS2 (*1)	SWS1 (*1)
	G028	PC2SLC	SPSTPA	*SCPFA	*SUCPFA		GR12	GR11	
	G029		*SSTP	SOR	SAR	GR32	GR31	GR22	GR21
	G030	SOV7	SOV6	SOV5	SOV4	SOV3	SOV2	SOV1	SOV0
	G031	PKESS2	PKESS1	GR42	GR41				
Common to all axes	G038					SPPHS	SPSYC	SBRT	
	G061	RGTSP4 (*1)	RGTSP3 (*1)	RGTSP2 (*1)	RGTSP1 (*1)		SYSS		RGTAP
Common to all axes	G064		ESRSYC						
	G122	PKESS2	PKESS1						
	G264					ESSYC4	ESSYC3	ESSYC2	ESSYC1
	G265					PKESE4	PKESE3	PKESE2	PKESE1
	G274	CSFI4	CSFI3	CSFI2	CSFI1	CONS4	CONS3	CONS2	CONS1
	G288					SPSYC4	SPSYC3	SPSYC2	SPSYC1
	G289					SPPHS4	SPPHS3	SPPHS2	SPPHS1
	G351					SSEGB4	SSEGB3	SSEGB2	SSEGB1
	G400					*SUCPFD	*SUCPFC	*SUCPFB	
	G401					*SCPFD	*SCPFC	*SCPFB	
	G402					SPSTPD	SPSTPC	SPSTPB	
	G521	SRVON8	SRVON7	SRVON6	SRVON5	SRVON4	SRVON3	SRVON2	SRVON1
	G523	SVRVS8	SVRVS7	SVRVS6	SVRVS5	SVRVS4	SVRVS3	SVRVS2	SVRVS1
	G533				SSRS	SSR4	SSR3	SSR2	SSR1
	G536	SPSP							

1st-	G030	SOV7	SOV6	SOV5	SOV4	SOV3	SOV2	SOV1	SOV0
2nd-	G376	SOV27	SOV26	SOV25	SOV24	SOV23	SOV22	SOV21	SOV20
3rd-	G377	SOV37	SOV36	SOV35	SOV34	SOV33	SOV32	SOV31	SOV30
4th-	G378	SOV47	SOV46	SOV45	SOV44	SOV43	SOV42	SOV41	SOV40

1st-	G032	R08I	R07I	R06I	R05I	R04I	R03I	R02I	R01I
2nd-	G034	R08I2	R07I2	R06I2	R05I2	R04I2	R03I2	R02I2	R01I2
3rd-	G036	R08I3	R07I3	R06I3	R05I3	R04I3	R03I3	R02I3	R01I3
4th-	G272	R08I4	R07I4	R06I4	R05I4	R04I4	R03I4	R02I4	R01I4

1st-	G033	SIND	SSIN	SGN		R12I	R11I	R10I	R09I
2nd-	G035	SIND2	SSIN2	SGN2		R12I2	R11I2	R10I2	R09I2
3rd-	G037	SIND3	SSIN3	SGN3		R12I3	R11I3	R10I3	R09I3
4th-	G273	SIND4	SSIN4	SGN4		R12I4	R11I4	R10I4	R09I4

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1st-	G078	SH07A	SH06A	SH05A	SH04A	SH03A	SH02A	SH01A	SH00A
1st-	G079					SH11A	SH10A	SH09A	SH08A
2nd-	G080	SH07B	SH06B	SH05B	SH04B	SH03B	SH02B	SH01B	SH00B
2nd-	G081					SH11B	SH10B	SH09B	SH08B
3rd-	G208	SH07C	SH06C	SH05C	SH04C	SH03C	SH02C	SH01C	SH00C
3rd-	G209					SH11C	SH10C	SH09C	SH08C
4th-	G270	SH07D	SH06D	SH05D	SH04D	SH03D	SH02D	SH01D	SH00D
4th-	G271					SH11D	SH10D	SH09D	SH08D

NOTE
*1 These signals are valid in multi-spindle control.

(3) Common to CNCs

	0*i*-D	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G070	G070	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
2nd-	G074	G074	MRDYB	ORCMB	SFRB	SRVB	CTH1B	CTH2B	TLMHB	TLMLB
3rd-	G204	G204	MRDYC	ORCMC	SFRC	SRVC	CTH1C	CTH2C	TLMHC	TLMLC
4th-		G266	MRDYD	ORCMD	SFRD	SRVD	CTH1D	CTH2D	TLMHD	TLMLD
1st-	G071	G071	RCHA	RSLA	INTGA	SOCNA	MCFNA	SPSLA	*ESPA	ARSTA
2nd-	G075	G075	RCHB	RSLB	INTGB	SOCNB	MCFNB	SPSLB	*ESPB	ARSTB
3rd-	G205	G205	RCHC	RSLC	INTGC	SOCNC	MCFNC	SPSLC	*ESPC	ARSTC
4th-		G267	RCHD	RSLD	INTGD	SOCND	MCFND	SPSLD	*ESPD	ARSTD
1st-	G072	G072	RCHHGA	MFNHGA	INCMDA	OVRA	DEFMDA	NRROA	ROTAA	INDXA
2nd-	G076	G076	RCHHGB	MFNHGB	INCMDB	OVRB	DEFMDB	NRROB	ROTAB	INDXB
3rd-	G206	G206	RCHHGC	MFNHGC	INCMDC	OVRC	DEFMDC	NRROC	ROTAC	INDXC
4th-		G268	RCHHGD	MFNHGD	INCMDD	OVRD	DEFMDD	NRROD	ROTAD	INDXD
1st-	G073	G073				DSCNA	SORSLA	MPOFA	SLVA	
2nd-	G077	G077				DSCNB	SORSLB	MPOFB	SLVB	
3rd-	G207	G207				DSCNC	SORSLC	MPOFC	SLVC	
4th-		G269				DSCND	SORSLD	MPOFD	SLVD	
1st-	G304	G304	FRFSMA	INESTRA						
2nd-	G308	G308	FRFSMB	INESTRB						
3rd-	G312	G312	FRFSMC	INESTRC						
4th-		G316	FRFSMD	INESTRD						
1st-	G305	G305					HF4A	HF3A	HF2A	HF1A
2nd-	G309	G309					HF4B	HF3B	HF2B	HF1B
3rd-	G313	G313					HF4C	HF3C	HF2C	HF1C
4th-		G317					HF4D	HF3D	HF2D	HF1D
1st-	G306	G306						TDFCANA	PWMSEA	
2nd-	G310	G310						TDFCANB	PWMSEB	
3rd-	G314	G314						TDFCANC	PWMSEC	
4th-		G318						TDFCAND	PWMSED	

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E.1.2 Output Signals (CNC→PMC)

(1)Series 0*i*-D

		#7	#6	#5	#4	#3	#2	#1	#0
Common to all axes	F001				ENB				
Common to all axes	F002						CSS		
Common to all axes	F007						SF		
Common to all axes	F022	S07	S06	S05	S04	S03	S02	S01	S00
Common to all axes	F023	S15	S14	S13	S12	S11	S10	S09	S08
Common to all axes	F024	S23	S22	S21	S20	S19	S18	S17	S16
Common to all axes	F025	S31	S30	S29	S28	S27	S26	S25	S24
	F034	SRSRDY	SRSP1R	SRSP2R	SRSP3R		GR3O (*1)	GR2O (*1)	GR1O (*1)
	F035								SPAL
	F038					ENB3	ENB2	SUCLPA	SCLPA
	F039							ENB4	MSPOSA
	F043						SYCAL3	SYCAL2	SYCAL1
Common to all axes	F044				SYCAL	FSPPH	FSPSY	FSCSL	
Common to all axes	F065						RSMAX	RGSPM (*1)	RGSPP (*1)
Common to all axes	F076					RTAP			
Common to all axes	F094		ZP7	ZP6	ZP5	ZP4	ZP3	ZP2	ZP1
Common to all axes	F160	MSP07	MSP06	MSP05	MSP04	MSP03	MSP02	MSP01	MSP00
Common to all axes	F161	MSP15	MSP14	MSP13	MSP12	MSP11	MSP10	MSP09	MSP08
Common to all axes	F264	SPWRN8	SPWRN7	SPWRN6	SPWRN5	SPWRN4	SPWRN3	SPWRN2	SPWRN1
Common to all axes	F265								SPWRN9
	F274		CSFO3	CSFO2	CSFO1		FCSS3	FCSS2	FCSS1
	F288						FSPSY3	FSPSY2	FSPSY1
	F289						FSPPH3	FSPPH2	FSPPH1
	F351						SSEGBM3	SSEGBM2	SSEGBM1
	F400						SUCLPC	SUCLPB	
	F401						SCLPC	SCLPB	
	F402						MSPOSC	MSPOSB	
	F521		SVREV7	SVREV6	SVREV5	SVREV4	SVREV3	SVREV2	SVREV1
	F522		SPP7	SPP6	SPP5	SPP4	SPP3	SPP2	SPP1

1st-	F036	R08O	R07O	R06O	R05O	R04O	R03O	R02O	R01O
1st-	F037					R12O	R11O	R10O	R09O
2nd-	F200	R08O2	R07O2	R06O2	R05O2	R04O2	R03O2	R02O2	R01O2
2nd-	F201					R12O2	R11O2	R10O2	R09O2
3rd-	F204	R08O3	R07O3	R06O3	R05O3	R04O3	R03O3	R02O3	R01O3
3rd-	F205					R12O3	R11O3	R10O3	R09O3

1st-	F040	AR07	AR06	AR05	AR04	AR03	AR02	AR01	AR00
1st-	F041	AR15	AR14	AR13	AR12	AR11	AR10	AR09	AR08
2nd-	F202	AR072	AR062	AR052	AR042	AR032	AR022	AR012	AR002

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2nd-	F203	AR152	AR142	AR132	AR122	AR112	AR102	AR092	AR082
3rd-	F206	AR073	AR063	AR053	AR043	AR033	AR023	AR013	AR003
3rd-	F207	AR153	AR143	AR133	AR123	AR113	AR103	AR093	AR083

NOTE
*1 These signals are valid with the M series only.

(2) Series 30*i*

		#7	#6	#5	#4	#3	#2	#1	#0
Common to all axes	F001				ENB				
Common to all axes	F002						CSS		
Common to all axes	F007						SF		
Common to all axes	F022	S07	S06	S05	S04	S03	S02	S01	S00
Common to all axes	F023	S15	S14	S13	S12	S11	S10	S09	S08
Common to all axes	F024	S23	S22	S21	S20	S19	S18	S17	S16
Common to all axes	F025	S31	S30	S29	S28	S27	S26	S25	S24
	F034	SRSRDY	SRSP1R	SRSP2R	SRSP3R	SRSP4R	GR3O (*1)	GR2O (*1)	GR1O (*1)
	F035								SPAL
	F038					ENB3	ENB2	SUCLPA	SCLPA
	F039							ENB4	MSPOSA
	F043					SYCAL4	SYCAL3	SYCAL2	SYCAL1
Common to all axes	F044				SYCAL	FSPPH	FSPSY	FSCSL	
Common to all axes	F065						RSMAX	RGSPM (*1)	RGSPP (*1)
Common to all axes	F076					RTAP			
	F090	SVSPM	SVAR	SYSSM	SYAR				
Common to all axes	F094	ZP8	ZP7	ZP6	ZP5	ZP4	ZP3	ZP2	ZP1
Common to all axes	F160	MSP07	MSP06	MSP05	MSP04	MSP03	MSP02	MSP01	MSP00
Common to all axes	F161	MSP15	MSP14	MSP13	MSP12	MSP11	MSP10	MSP09	MSP08
Common to all axes	F264	SPWRN8	SPWRN7	SPWRN6	SPWRN5	SPWRN4	SPWRN3	SPWRN2	SPWRN1
Common to all axes	F265								SPWRN9
	F274	CSFO4	CSFO3	CSFO2	CSFO1	FCSS4	FCSS3	FCSS2	FCSS1
	F288					FSPSY4	FSPSY3	FSPSY2	FSPSY1
	F289					FSPPH4	FSPPH3	FSPPH2	FSPPH1
	F351					SSEGBM4	SSEGBM3	SSEGBM2	SSEGBM1
	F376	SVSST8	SVSST7	SVSST6	SVSST5	SVSST4	SVSST3	SVSST2	SVSST1
	F377	SVSAR8	SVSAR7	SVSAR6	SVSAR5	SVSAR4	SVSAR3	SVSAR2	SVSAR1
	F400					SUCLPD	SUCLPC	SUCLPB	
	F401					SCLPD	SCLPC	SCLPB	
	F402					MSPOSD	MSPOSC	MSPOSB	
	F521	SVREV8	SVREV7	SVREV6	SVREV5	SVREV4	SVREV3	SVREV2	SVREV1
	F522	SPP8	SPP7	SPP6	SPP5	SPP4	SPP3	SPP2	SPP1

1st-	F036	R08O	R07O	R06O	R05O	R04O	R03O	R02O	R01O
1st-	F037					R12O	R11O	R10O	R09O

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2nd-	F200	R08O2	R07O2	R06O2	R05O2	R04O2	R03O2	R02O2	R01O2
2nd-	F201					R12O2	R11O2	R10O2	R09O2
3rd-	F204	R08O3	R07O3	R06O3	R05O3	R04O3	R03O3	R02O3	R01O3
3rd-	F205					R12O3	R11O3	R10O3	R09O3
4th-	F270	R08O4	R07O4	R06O4	R05O4	R04O4	R03O4	R02O4	R01O4
4th-	F271					R12O4	R11O4	R10O4	R09O4

1st-	F040	AR07	AR06	AR05	AR04	AR03	AR02	AR01	AR00
1st-	F041	AR15	AR14	AR13	AR12	AR11	AR10	AR09	AR08
2nd-	F202	AR072	AR062	AR052	AR042	AR032	AR022	AR012	AR002
2nd-	F203	AR152	AR142	AR132	AR122	AR112	AR102	AR092	AR082
3rd-	F206	AR073	AR063	AR053	AR043	AR033	AR023	AR013	AR003
3rd-	F207	AR153	AR143	AR133	AR123	AR113	AR103	AR093	AR083
4th-	F272	AR074	AR064	AR054	AR044	AR034	AR024	AR014	AR004
4th-	F273	AR154	AR144	AR134	AR124	AR114	AR104	AR094	AR084

NOTE
*1 These signals are valid with the M series only.

(3) Common to CNCs

	0*i*-D	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F045	F045	ORARA	TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	ALMA
2nd-	F049	F049	ORARB	TLMB	LDT2B	LDT1B	SARB	SDTB	SSTB	ALMB
3rd-	F168	F168	ORARC	TLMC	LDT2C	LDT1C	SARC	SDTC	SSTC	ALMC
4th-		F266	ORARD	TLMD	LDT2D	LDT1D	SARD	SDTD	SSTD	ALMD

1st-	F046	F046				SLVSA	RCFNA	RCHPA	CFINA	CHPA
2nd-	F050	F050				SLVSB	RCFNB	RCHPB	CFINB	CHPB
3rd-	F169	F169				SLVSC	RCFNC	RCHPC	CFINC	CHPC
4th-		F267				SLVSD	RCFND	RCHPD	CFIND	CHPD

1st-	F047	F047				EXOFA	SORENA		INCSTA	PC1DTA
2nd-	F051	F051				EXOFB	SORENB		INCSTB	PC1DTB
3rd-	F170	F170				EXOFC	SORENC		INCSTC	PC1DTC
4th-		F268				EXOFD	SOREND		INCSTD	PC1DTD

1st-	F048	F048				CSPENA				
2nd-	F052	F052				CSPENB				
3rd-	F171	F171				CSPENC				
4th-		F269				CSPEND				

1st-	F307	F307						INESFNA	XPFLA	FRDTEA
2nd-	F309	F309						INESFNB	XPFLB	FRDTEB
3rd-	F311	F311						INESFNC	XPFLC	FRDTEC
4th-		F313						INESFND	XPFLD	FRDTED

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E.2 βiIc SERIES SPINDLE

E.2.1 Input Signals (PMC→CNC)

(1) Series 0*i*-D

See (1) in 1.1.

(2) Series 30*i*

See (2) in 1.1.

(3) Common to CNCs

	0*i*-D	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G070	G070	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA (*1)
2nd-	G074	G074	MRDYB	ORCMB	SFRB	SRVB	CTH1B	CTH2B	TLMHB	TLMLB (*1)
1st-	G071	G071			INTGA				*ESPA	ARSTA
2nd-	G075	G075			INTGB				*ESPB	ARSTB
1st-	G072	G072			INCMDA	OVRA		NRROA	ROTAA	INDXA
2nd-	G076	G076			INCMDB	OVRB		NRROB	ROTAB	INDXB
1st-	G073	G073						MPOFA		
2nd-	G077	G077						MPOFB		

NOTE
*1 For the βiIc series, the signal functions are different from those of the αi series. For details, see Chapter 3, "I/O SIGNALS (CNC↔PMC)", in Part III.

E.2.2 Output Signals (CNC→PMC)

(1) Series 0*i*–D

See (1) in 1.2.

(2) Series 30*i*

See (2) in 1.2.

(3) Common to CNCs

	0*i*-D	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F045	F045	ORARA	TLMA		LDT1A	SARA	SDTA	SSTA	ALMA
2nd-	F049	F049	ORARB	TLMB		LDT1B	SARB	SDTB	SSTB	ALMB
1st-	F047	F047							INCSTA	PC1DTA
2nd-	F051	F051							INCSTB	PC1DTB

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E.3 BiS SERIES SPINDLE

E.3.1 Input Signals (PMC→CNC)

(1) Series 0*i*–D

See (1) in 1.1.

(2) Series 30*i*

See (2) in 1.1.

(3) Common to CNCs

	0*i*-D	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G070	G070	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
2nd-	G074	G074	MRDYB	ORCMB	SFRB	SRVB	CTH1B	CTH2B	TLMHB	TLMLB
3rd-	G204	G204	MRDYC	ORCMC	SFRC	SRVC	CTH1C	CTH2C	TLMHC	TLMLC
4th-		G266	MRDYD	ORCMD	SFRD	SRVD	CTH1D	CTH2D	TLMHD	TLMLD
1st-	G071	G071			INTGA	SOCNA			*ESPA	ARSTA
2nd-	G075	G075			INTGB	SOCNB			*ESPB	ARSTB
3rd-	G205	G205			INTGC	SOCNC			*ESPC	ARSTC
4th-		G267			INTGD	SOCND			*ESPD	ARSTD
1st-	G072	G072			INCMDA	OVRA	DEFMDA	NRROA	ROTAA	INDXA
2nd-	G076	G076			INCMDB	OVRB	DEFMDB	NRROB	ROTAB	INDXB
3rd-	G206	G206			INCMDC	OVRC	DEFMDC	NRROC	ROTAC	INDXC
4th-		G268			INCMDD	OVRD	DEFMDD	NRROD	ROTAD	INDXD
1st-	G073	G073	EPFSTRA			DSCNA	SORSLA	MPOFA		
2nd-	G077	G077	EPFSTRB			DSCNB	SORSLB	MPOFB		
3rd-	G207	G207	EPFSTRC			DSCNC	SORSLC	MPOFC		
4th-		G269	EPFSTRD			DSCND	SORSLD	MPOFD		
1st-	G304	G304	FRFSMA	INESTRA	LRDTCLA					
2nd-	G308	G308	FRFSMB	INESTRB	LRDTCLB					
3rd-	G312	G312	FRFSMC	INESTRC	LRDTCLC					
4th-	G316	G316	FRFSMD	INESTRD	LRDTCLD					
1st-	G305	G305					HF4A	HF3A	HF2A	HF1A
2nd-	G309	G309					HF4B	HF3B	HF2B	HF1B
3rd-	G313	G313					HF4C	HF3C	HF2C	HF1C
4th-	G317	G317					HF4D	HF3D	HF2D	HF1D
1st-	G306	G306						TDFCANA	PWMSEA	
2nd-	G310	G310						TDFCANB	PWMSEB	
3rd-	G314	G314						TDFCANC	PWMSEC	
4th-	G318	G318						TDFCAND	PWMSED	

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E.3.2 Output Signals (CNC→PMC)

(1) Series 0*i*–D

See (1) in 1.2.

(2) Series 30*i*

See (2) in 1.2.

(3) Common to CNCs

	0*i*-D	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	F045	F045	ORARA	TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	ALMA
2nd-	F049	F049	ORARB	TLMB	LDT2B	LDT1B	SARB	SDTB	SSTB	ALMB
3rd-	F168	F168	ORARC	TLMC	LDT2C	LDT1C	SARC	SDTC	SSTC	ALMC
4th-		F266	ORARD	TLMD	LDT2D	LDT1D	SARD	SDTD	SSTD	ALMD
1st-	F047	F047				EXOFA	SORENA		INCSTA	PC1DTA
2nd-	F051	F051				EXOFB	SORENB		INCSTB	PC1DTB
3rd-	F170	F170				EXOFC	SORENC		INCSTC	PC1DTC
4th-		F268				EXOFD	SOREND		INCSTD	PC1DTD
1st-	F048	F048	EPFIXA			CSPENA	SSMBRKA			
2nd-	F052	F052	EPFIXB			CSPENB	SSMBRKB			
3rd-	F171	F171	EPFIXC			CSPENC	SSMBRKC			
4th-		F269	EPFIXD			CSPEND	SSMBRKD			
1st-	F306	F306			LDCLFNA					
2nd-	F308	F308			LDCLFNB					
3rd-	F310	F310			LDCLFNC					
4th-		F312			LDCLFND					
1st-	F307	F307						INESFNA	XPFLA	FRDTEA
2nd-	F309	F309						INESFNB	XPFLB	FRDTEB
3rd-	F311	F311						INESFNC	XPFLC	FRDTEC
4th-		F313						INESFND	XPFLD	FRDTED

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F OBSERVING DATA USING THE SERVO GUIDE

Using the servo adjustment tool, SERVO GUIDE, enables you to observe internal data for the spindle. This Appendix F describes the spindle data that can be observed using the SERVO GUIDE. It also presents examples of observed data. Refer to FANUC SERVO GUIDE OPERATOR'S MANUAL (B-65404EN) online help for detailed explanations about how to use the SERVO GUIDE.

F.1 SERIES AND EDITIONS OF APPLICABLE SPINDLE SOFTWARE

9D50 series B (02) edition or later
9D53 series A (01) edition or later
9D70 series A (01) edition or later
9D80 series A (01) edition or later
9D90 series A (01) edition or later
9DA0 series A (01) edition or later

F.2 SPINDLE DATA THAT CAN BE OBSERVED USING THE SERVO GUIDE

F.2.1 Data List

The following table lists the spindle data that can be observed using the SERVO GUIDE.

Data type	Description	Description
SPEED	Motor speed	
INORM	Motor current amplitude	
IRMS	Motor current (RMS value)	9D80 series 20 edition or later *6
IPEAK	Motor current (amplitude value)	9D80 series 20 edition or later *6
TCMD	Torque command	
TCMD2	Torque command 2	9D8A series 03 edition or later *7
VCMD	Motor speed command	
VERR	Speed deviation	
MCMD	Move command for an individual communication cycle	
ERR	Position error	9D50 series 11 edition or later *1
ERRC	Position error (CNC)	
SYNC	Synchronous error	9D50 series 11 edition or later *1
ORERR	Position error at orientation	
ORSEQ	Orientation sequence data	
PCPOS	Cumulative position feedback value	
CSPOS	Cumulative position feedback value	
CSPOS2	Cumulative position feedback value	9D80 series 20 edition or later *6
POS3D	Cumulative position feedback value for 3D display	9D80 series 20 edition or later *5
WMDAT	Move command for an individual position loop	

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Data type	Description	Description
ERR2	Position error 2	
ERR2C	Position error 2 (CNC)	9D50 series 11 edition or later *1
SPCMD	Speed command data from the CNC	
SPSPD	Spindle speed	9D50 series 11 edition or later *1
SPCT1	Spindle control signal 1	
SPCT2	Spindle control signal 2	
SPCT3	Spindle control signal 3	9D50 series 11 edition or later *1
SPCT4	Spindle control signal 4	9DAA series 10 edition or later
SPST1	Spindle status signal 1	
SPST2	Spindle status signal 2	
SPST3	Spindle status signal 3	9DAA series 10 edition or later
SFLG1	Spindle flag 1	9D50 series 11 edition or later *1
SPPOS	Spindle position data	9D50 series 12 edition or later *2
LMDAT	Load meter data	9D50 series 11 edition or later *1
DTRQ	Spindle load torque (unexpected disturbance torque detection function)	9D50 series 11 edition or later *1
FREQ	Frequency of a disturbance torque command (disturbance input function)	9D50 series 11 edition or later *1
GAIN	Gain (disturbance input function)	9D50 series 11 edition or later *1
MTTMP	Motor winding temperature	9D50 series 11 edition or later *1
MFBDF	Feedback differential data on the motor side (for amplitude ratio/phase difference compensation adjustment)	9D50 series 11 edition or later *1
SFBDF	Feedback differential data on the spindle side (for amplitude ratio/phase difference compensation adjustment)	9D50 series 11 edition or later *1
PA1	A/D value of motor sensor phase A	9D50 series 11 edition or later *1
PB1	A/D value of motor sensor phase B	9D50 series 11 edition or later *1
PA2	A/D value of spindle sensor phase A	9D50 series 11 edition or later *1
PB2	A/D value of spindle sensor phase B	9D50 series 11 edition or later *1
VDC	DC link voltage	9D50 series 11 edition or later *1
SFERR	Semi-closed loop/closed loop difference (Dual position feedback function)	9D50 series 11 edition or later *1
SMERR	Positional deviation on the semi-closed loop side (Dual position feedback function)	9D50 series 11 edition or later *1
SPACC	Spindle acceleration data	9D50 series 20 edition or later *4
EMPTR	Spindle power consumption	9DAA series 17 edition or later *9
AOVCLV	Level of amplifier OVC	9DAA series 10 edition or later
MOVCLV	Level of motor OVC	9DAA series 10 edition or later

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NOTE

*1 Valid with 9D53 series 03 edition or later, valid with 9D70 series 02 edition or later, valid with 9D80 series 01 edition or later, valid with 9D90 series 01 edition or later, and valid with 9DA0 series 01 edition or later

*2 Valid with 9D53 series 04 edition or later, valid with 9D70 series 03 edition or later, valid with 9D80 series 01 edition or later, valid with 9D90 series 01 edition or later, and valid with 9DA0 series 01 edition or later

*3 To observe data marked with *1 and *2, Servo Guide Ver. 3.0 or later is needed.

*4 Valid with 9D70 series 10 edition or later, valid with 9D80 series 04 edition or later, valid with 9D90 series 01 edition or later, and valid with 9DA0 series 01 edition or later. To observe data, Servo Guide Ver. 4.10 or later is needed.

*5 Valid with 9D90 series 07 edition or later, and valid with 9DA0 series 09 edition or later. To observe data, Servo Guide Ver. 7.00 or later is needed.

*6 Valid with 9D90 series 07 edition or later, and valid with 9DA0 series 01 edition or later. To observe data, Servo Guide Ver. 7.20 or later is needed.

*7 Valid with 9D90 series 11 edition or later, and valid with 9DA0 series 14 edition or later. To observe data, Servo Guide Ver. 8.10 or later is needed.

*8 Valid with 9DAA series 10 edition or later, and valid with 9DB0 series 10 edition or later. To observe data, Servo Guide Ver. 10.50 or later is needed.

*9 Valid with 9DAA series 17 edition or later, and valid with 9DB0 series 17 edition or later. To observe data, Servo Guide Ver. 11.30 or later, or SERVO VIEWER Ver. 3.40 or later is needed.

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F.2.2 About the Spindle Speed Control and Spindle Status Signals

As stated in the previous item, the SERVO GUIDE can be used to observe the PMC signals (spindle speed control signals 1, 2, 3 and 4 and spindle status signals 1, 2 and 3) used by the spindle.
Listed below is the data configuration for spindle speed control signals 1, 2, 3 amd 4 and spindle status signals 1, 2 and 3. Refer to Chapter 3, "I/O SIGNALS (CNC↔PMC)", in each part for explanations about each signal.

(a) Spindle speed control signal 1 (SPCT1)

#15	#14	#13	#12	#11	#10	#9	#8
RCH	RSL	INTG	SOCN	MCFN	SPSL	*ESP	ARST
#7	#6	#5	#4	#3	#2	#1	#0
MRDY	ORCM	SFR	SRV	CTH1	CTH2	TLMH	TLML

(b) Spindle speed control signal 2 (SPCT2)

#15	#14	#13	#12	#11	#10	#9	#8
			DSCN	SORSL	MPOF	SLV	
#7	#6	#5	#4	#3	#2	#1	#0
RCHHG	MFNHG	INCMD	OVR	DEFMD	NRRO	ROTA	INDX

(c) Spindle speed control signal 3 (SPCT3)

#15	#14	#13	#12	#11	#10	#9	#8
				HF4	HF3	HF2	HF1
#7	#6	#5	#4	#3	#2	#1	#0
FRFSM	INESTR				ARDRQ		

(d) Spindle speed control signal 4 (SPCT4)

#15	#14	#13	#12	#11	#10	#9	#8
#7	#6	#5	#4	#3	#2	#1	#0
					TDFCAN	PWMSE	

(e) Spindle status signal 1 (SPST1)

#15	#14	#13	#12	#11	#10	#9	#8
			SLVS	RCFN	RCHP	CFIN	CHP
#7	#6	#5	#4	#3	#2	#1	#0
ORAR	TLM	LDT2	LDT1	SAR	SDT	SST	ALM

(f) Spindle status signal 2 (SPST2)

#15	#14	#13	#12	#11	#10	#9	#8
			CSPEN		ARDST		
#7	#6	#5	#4	#3	#2	#1	#0
			EXOF	SOREN	MSOVR	INCST	PC1DT

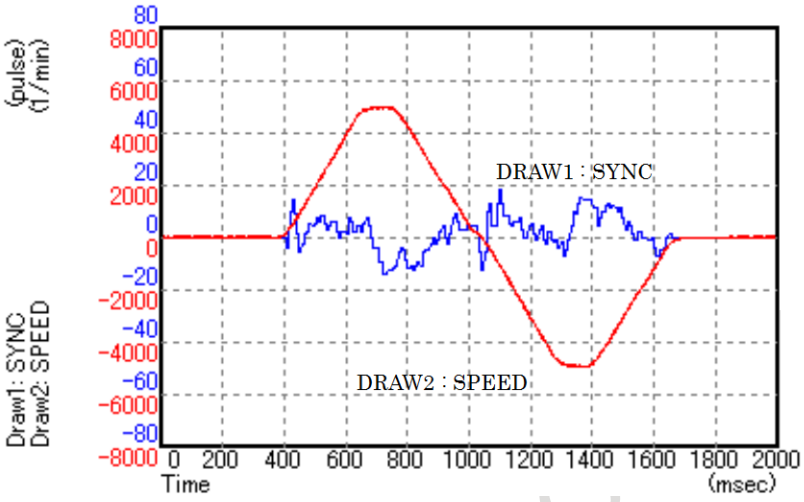
(g) Spindle status signal 3 (SPST3)

#15	#14	#13	#12	#11	#10	#9	#8
					INESFN	XPFL	FRDTE
#7	#6	#5	#4	#3	#2	#1	#0
							STCST

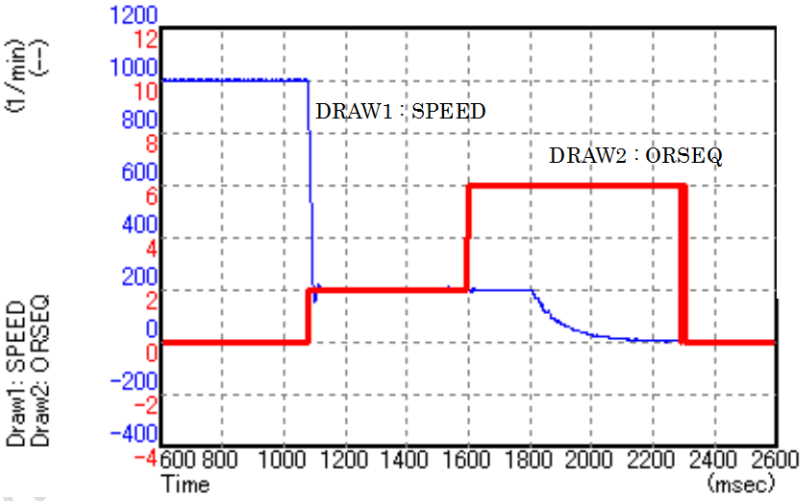
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F.3 EXAMPLE OF OBSERVING DATA

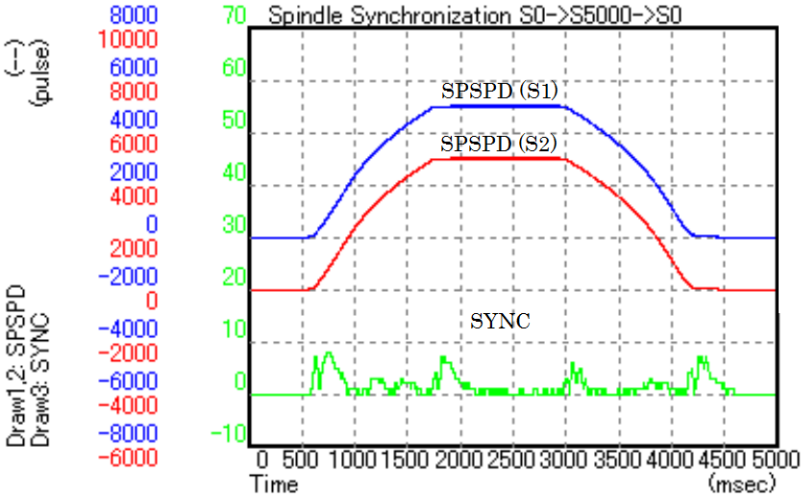
(1) Synchronous error (SYNC) and motor speed (SPEED) in rigid tapping



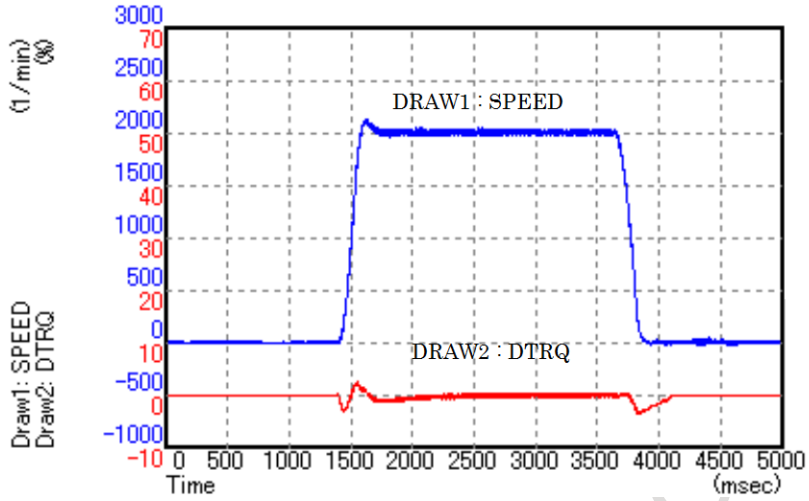
(2) Motor speed (SPEED) and orientation sequence (ORSEQ) in orientation



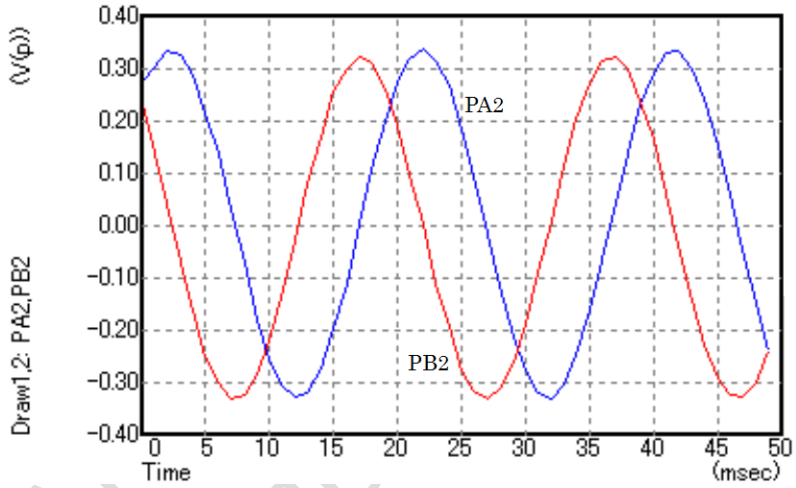
(3) Spindle speeds (SPSPD) and synchronous error (SYNC) in spindle synchronous control



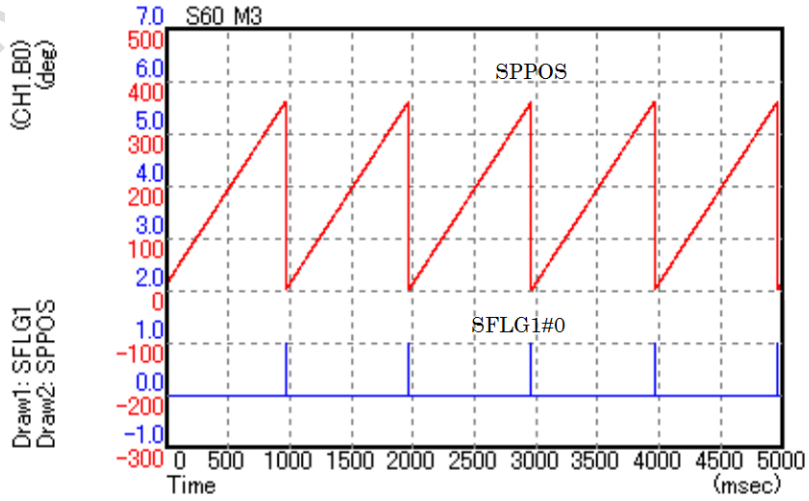
(4) Motor speed (SPEED) and estimated load torque (DTRQ) data



(5) Phase A/B feedback signal of α*i*BZ sensor (PA2/PB2)



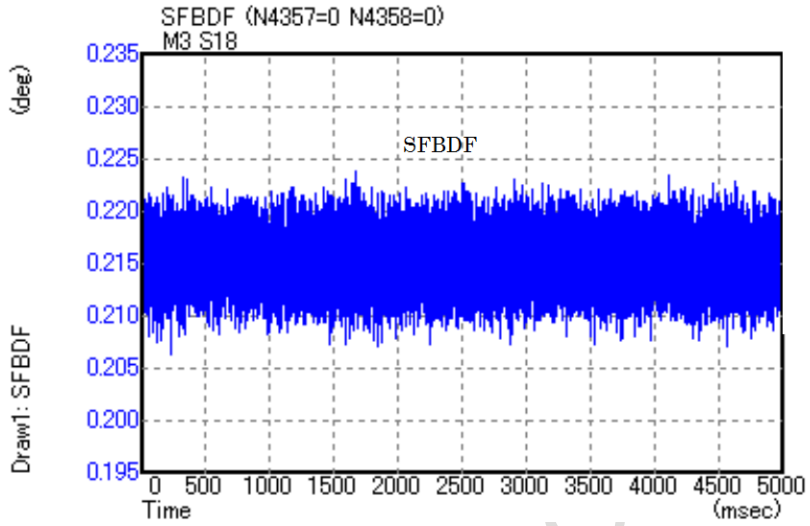
(6) Spindle position data (SPPOS) and one-rotation signal (SFLG1_BIT0)



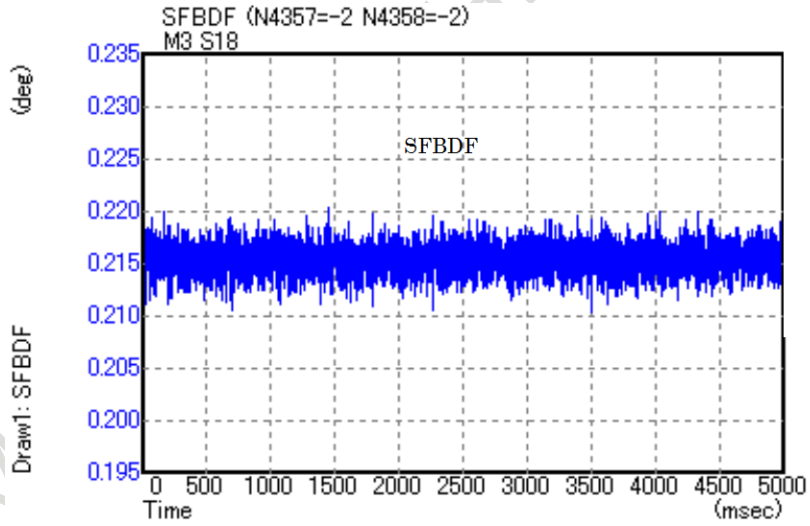
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(7) Adjustment of amplitude ratio/phase difference compensation data (SFBDF: Spindle feedback difference data)

(a) Before adjustment (No.4357=0, No.4358=0)



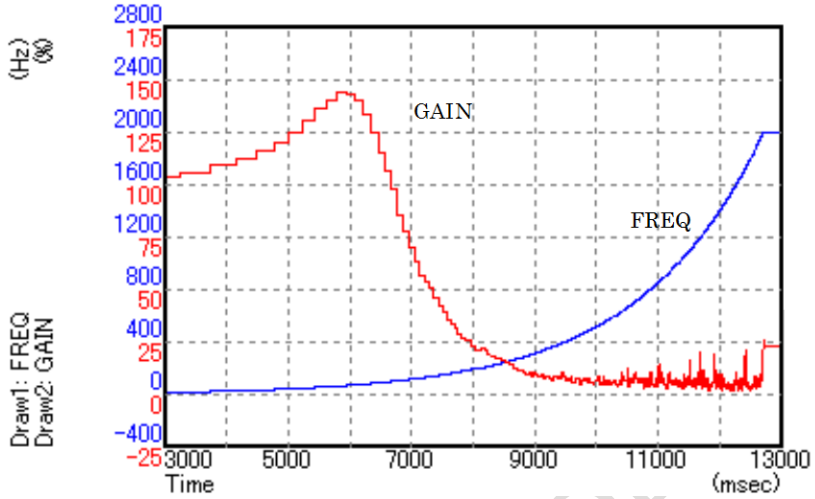
(b) After adjustment (No.4357=-2, No.4358=-2)



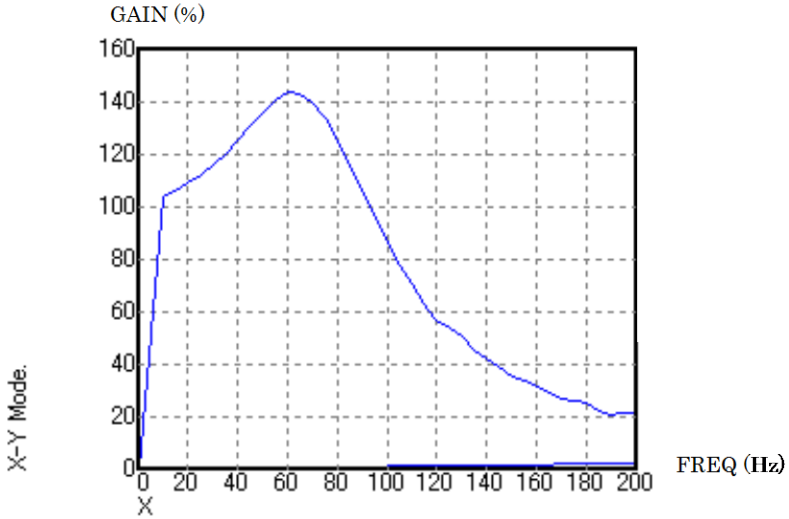
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(8) Measurement of frequency characteristics using the disturbance input function (DRAW1FREQ: Frequency in the disturbance torque command, DRAW2 GAIN)

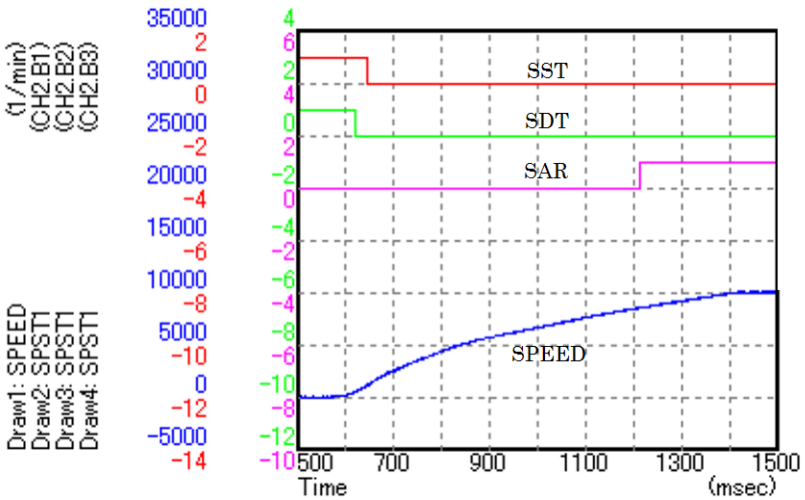
(a) XTYT display



(b) X-Y display



(9) Observation of spindle status signals



G PARAMETER SPECIFICATION DIFFERENCES BETWEEN THE α*i* SERIES AND β*i*Ic SERIES

This appendix describes the parameter specification differences between the α*i* series and β*i*Ic series. The specifications of some parameters differ between the α*i* series and β*i*Ic series. For example, some identical parameter numbers do not specify the same functions. Take care at the time of the parameter setting.

G.1 PARAMETERS WITH DIFFERENT MEANINGS

0*i*-D	Contents	
	α*i* series	β*i*Ic series
4000#1	Spindle rotation direction when a positive (+) move command is specified on Cs contouring control	Unused (Set to 0.)
4000#3	Return direction for the reference position on Cs contouring control mode	Unused (Set to 0.)
4002#4	Whether to use the rotation direction signal (SFR/SRV) function on Cs contouring control	SM pin output data selection
4002#7	Whether to use the CMR (servo mode Cs contouring) function on servo mode	Unused (Set to 0.)
4003#3	Rotation direction during spindle orientation	Unused (Set to 0.)
4004#2	Setting of external one-rotation signal	Unused (Set to 0.)
4004#3	Setting of external one-rotation signal	Unused (Set to 0.)
4005#0	Command resolution for Cs contouring control	Setting of the velocity feedback method
4009#0	Increment system of velocity loop gain	Unused (Set to 0.)
4010#0	Motor sensor type	Unused (Set to 0.)
4010#1	Motor sensor type	Unused (Set to 0.)
4010#2	Motor sensor type	Unused (Set to 0.)
4011#0	Teeth number setting of motor sensor	Unused (Set to 0.)
4011#1	Teeth number setting of motor sensor	Unused (Set to 0.)
4011#2	Teeth number setting of motor sensor	Unused (Set to 0.)
4012#7	Setting of spindle HRV function	Unused (Set to 0.)
4013#7	Setting of a PWM carrier for low-speed characteristics area	Unused (Set to 0.)
4014#0	Whether to use the spindle switch function	Unused (Set to 0.)
4014#2	Whether to check both spindle switch main and sub magnetic contactor contacts	Unused (Set to 0.)
4014#3	Whether to check both magnetic contactor contacts for high-speed characteristics/low-speed characteristics in speed range switching	Unused (Set to 0.)
4014#6	Whether to use the orientation function on spindle synchronous control	Unused (Set to 0.)
4016#4	Setting related to control characteristics on Cs contouring control/servo mode	Unused (Set to 0.)
4016#5	Whether to detect the alarms (SPM alarms 82, 83, 85, 86) related to position feedback (in Cs contouring control mode)	Unused (Set to 0.)
4018#3	Optimum orientation function	Unused (Set to 0.)
4018#5	Whether to use the velocity command compensation function during high-speed orientation	Unused (Set to 0.)
4018#6	High-speed orientation function	Unused (Set to 0.)
4019#4	Setting of the function for switching from high-speed characteristics to low-speed characteristics with the speed detection signal SDT = 1 at speed range switching	Unused (Set to 0.)
4021	Maximum speed on Cs contouring control mode	Unused (Set to 0.)
4027	Load detection level 2	Unused (Set to 0.)
4028	Limited output pattern	Unused (Set to 0.)

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0*i*-D	Contents	
	α*i* series	**β*i*Ic series**
4029	Output limit	Unused (Set to 0.)
4030	Soft start/stop time	Unused (Set to 0.)
4038	Spindle orientation speed (*1)	Spindle orientation speed (*1)
4039	Slip compensation gain	Unused (Set to 0.)
4046	Velocity loop proportional gain on Cs contouring control (High)	Unused (Set to 0.)
4047	Velocity loop proportional gain on Cs contouring control (Low)	Unused (Set to 0.)
4054	Velocity loop integral gain on Cs contouring control (High)	Unused (Set to 0.)
4055	Velocity loop integral gain on Cs contouring control (Low)	Unused (Set to 0.)
4064	Rate of change in position gain upon completion of orientation / Acceleration limitation ratio at deceleration time	Acceleration limitation ratio at deceleration time
4069	Position gain on Cs contouring control (High)	Acceleration/deceleration constant (High)
4070	Position gain on Cs contouring control (Medium High)	Acceleration/deceleration constant (Medium High)
4071	Position gain on Cs contouring control (Medium Low)	Acceleration/deceleration constant (Medium Low)
4072	Position gain on Cs contouring control (Low)	Acceleration/deceleration constant (Low)
4076	Motor speed limit value on orientation	Unused (Set to 0.)
4078	Reserved (Set to 200.)	Gear switch timer
4086	Motor voltage on Cs contouring control	Gear ratio parameter setting error alarm (SPM alarm 35) detection level
4087	Overspeed level	Unused (Set to 0.)
4092	Rate of change in position gain during reference position return on Cs contouring control	Unused (Set to 0.)
4093	Value displayed on load meter at maximum output	Unused (Set to 0.)
4094	Disturbance torque compensation constant (acceleration feedback gain)	Unused (Set to 0.)
4096	Adjusted output voltage of load meter	Unused (Set to 0.)
4097	Feedback gain of spindle speed	Unused (Set to 0.)
4103	Base speed limit ratio	Compensation data for resistance
4104	Current loop proportional gain (*1)	Current loop proportional gain (*1)
4105	Unused (Set to 0.)	Current loop integral gain
4106	Current loop integral gain	D-axis current loop gain
4107	Unused (Set to 0.)	Q-axis current loop gain
4108	Velocity at which the current loop integral gain is zero	Q-axis current deviation limitation coefficient
4114	Slip compensation coefficient for a high-speed zone/slip compensation coefficient at deceleration	Unused (Set to 0.)
4120	Dead-band rectangular wave component zero voltage/dead-band data	Dead-band compensation data
4129	Secondary current coefficient for rigid tapping	Unused (Set to 0.)
4131	Time constant for velocity detecting filter (on Cs contouring control)	Dead-band compensation hysteresis
4135	Grid shift during Cs contouring control mode I (2-word)	Unused (Set to 0.)
4320	Motor acceleration at deceleration time (High)	Acceleration at orientation deceleration time (High)
4321	Motor acceleration at deceleration time (Medium High)	Acceleration at orientation deceleration time (Medium High)
4322	Motor acceleration at deceleration time (Medium Low)	Acceleration at orientation deceleration time (Medium Low)
4323	Motor acceleration at deceleration time (Low)	Acceleration at orientation deceleration time (Low)

NOTE
*1 The name is identical, but the specification differs partly.

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H PARAMETER SPECIFICATION DIFFERENCES BETWEEN THE α*i* SERIES AND B*i*S SERIES

This appendix describes the parameter specification differences between the α*i* series and B*i*S series. The specifications of some parameters differ between the α*i* series and B*i*S series. For example, some identical parameter numbers do not specify the same functions. Take care at the time of the parameter setting.

H.1 PARAMETERS WITH DIFFERENT MEANINGS

NOTE
The parameters marked with (*1) have the same name but their specifications partly differ from each other.

0*i*-D	30*i*	Contents	
		α*i* series	B*i*S series
4006#4	4006#4	Reserved	Sets the d-phase current command.
4007#5	4007#5	Whether to detect a feedback signal disconnection (*1)	Whether to detect a feedback signal disconnection (*1)
4007#7	4007#7	Reserved	Magnetic pole detection start signal selection
4008#3	4008#3	Reserved	Sets the current command.
4008#5	4008#5	Reserved	Setting for using the sub module SM
4008#6	4008#6	Reserved	Reference magnetic pole position selection
4009#5	4009#5	Reserved	Setting related to magnetic flux reduction speed
4012#6	4012#6	Unused (Set to 0.)	Setting of whether to drive the synchronous built-in spindle motor
4012#7	4012#7	Setting of spindle HRV function	Setting of spindle HRV function
4013#7	4013#7	Setting of a PWM carrier frequency for low-speed characteristics area	Unused (Set to 0.)
4014#0	4014#0	Whether to use the spindle switch function	Unused (Set to 0.)
4014#2	4014#2	Whether to check both spindle switch main and sub magnetic contactor contacts	Unused (Set to 0.)
4014#3	4014#3	Whether to check both magnetic contactor contacts for high-speed /low-speed characteristics in speed range switching	Unused (Set to 0.)
4015#2	4015#2	Whether to use the speed range switching function	Unused (Set to 0.)
4015#3	4015#3	Whether to use the spindle tandem function	Unused (Set to 0.)
4016#4	4016#4	Setting related to control characteristics on Cs contouring control/servo mode	Unused (Set to 0.)
4017#0	4017#0	This parameter sets speed integration operation when differential spindle speed control is exercised.	Unused (Set to 0.)
4019#4	4019#4	Setting of the function for switching from high-speed characteristics to low-speed characteristics with the speed detection signal SDT = 1 at speed range switching	Unused (Set to 0.)
4024	4024	Zero speed detection level (SST) (*1)	Zero speed detection level (SST) (*1)
4039	4039	Slip compensation gain	Unused (Set to 0.)
4080	4080	Regenerative power limit for high-speed zone/regenerative power limit	Regenerative power limit
4083	4083	Motor voltage on velocity control mode	Current ratio/motor stop confirmation time in magnetic pole detection operation
4084	4084	Motor voltage on orientation	AMR offset
4085	4085	Motor voltage on servo mode/spindle synchronous control mode	AMR offset fine adjustment
4086	4086	Motor voltage on Cs contouring control	Inductance ratio
4097	4097	Feedback gain of spindle speed	Unused (Set to 0.)
4102	4102	Excitation voltage saturation speed at no-load	Base speed

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0*i*-D	30*i*	Contents	
		α*i* series	**B*i*S series**
4103	4103	Base speed limit ratio	Magnetic flux reduction speed at maximum load
4109	4109	Filter time constant for processing saturation related to the voltage command	Unused (Set to 0.)
4111	4111	Secondary current coefficient	Maximum current constant
4113	4113	Slip constant	Current constant for magnetic flux reduction
4114	4114	Slip compensation coefficient for a high-speed zone/slip compensation coefficient at deceleration	Unused (Set to 0.)
4116	4116	Motor leakage constant	Counter electromotive voltage compensation constant for magnetic flux reduction speed at maximum load
4117	4117	Regular-time voltage compensation coefficient for high-speed zone/regular-time motor voltage coefficient	Interference voltage compensation constant for magnetic flux reduction speed at maximum load
4118	4118	Acceleration-time voltage compensation coefficient for high-speed zone/acceleration-time motor voltage coefficient	Unused (Set to 0.)
4119	4119	Deceleration-time excitation current change time constant/excitation current change time constant	Interference voltage compensation
4128	4128	Compensation coefficient between the specification and true base/maximum torque curve compensation coefficient	Unused (Set to 0.)
4129	4129	Secondary current coefficient for rigid tapping	Unused (Set to 0.)
4130	4130	Current loop proportional gain speed coefficient/current phase delay compensation coefficient	Current phase delay compensation coefficient
4136	4136	Motor voltage on velocity control mode	Unused (Set to 0.)
4137	4137	Motor voltage on servo mode/spindle synchronous control mode	Unused (Set to 0.)
4138	4138	Base speed of motor output specifications	Unused (Set to 0.)
4139	4139	Output limit for motor output specifications	Unused (Set to 0.)
4140	4140	Excitation voltage saturation speed at no-load	Unused (Set to 0.)
4141	4141	Base speed limit ratio	Unused (Set to 0.)
4142	4142	Current loop proportional gain	Unused (Set to 0.)
4143	4143	Current loop integral gain	Unused (Set to 0.)
4144	4144	Velocity at which the current loop integral gain is zero	Unused (Set to 0.)
4145	4145	Filter time constant for processing saturation related to the voltage command	Unused (Set to 0.)
4146	4146	Current conversion constant	Unused (Set to 0.)
4147	4147	Secondary current coefficient	Unused (Set to 0.)
4148	4148	Criterion level for saturation related to the voltage command/PWM command clamp value	Unused (Set to 0.)
4149	4149	Slip constant	Unused (Set to 0.)
4150	4150	Slip compensation coefficient for a high-speed zone/slip compensation coefficient at deceleration	Unused (Set to 0.)
4151	4151	PWM command clamp value at deceleration	Unused (Set to 0.)
4152	4152	Motor leakage constant	Unused (Set to 0.)
4153	4153	Regular-time voltage compensation coefficient for high-speed zone/regular-time motor voltage coefficient	Unused (Set to 0.)
4154	4154	Acceleration-time voltage compensation coefficient for high-speed zone/acceleration-time motor voltage coefficient	Unused (Set to 0.)
4156	4156	Slip compensation gain	Unused (Set to 0.)
4157	4157	Time constant for changing the torque (TCMD filter time constant)	Unused (Set to 0.)
4158	4158	Compensation coefficient between the specification and true base/maximum torque curve compensation coefficient	Unused (Set to 0.)
4159	4159	Secondary current coefficient for rigid tapping	Unused (Set to 0.)
4161	4161	Current loop proportional gain speed coefficient/current phase delay compensation coefficient	Unused (Set to 0.)
4163	4163	Integral gain of velocity loop during cutting feed on Cs contouring control mode (Low)	Unused (Set to 0.)
4165	4165	Deceleration-time excitation current change time constant/excitation current change time constant	Unused (Set to 0.)
4166	4166	Regenerative power limit for high-speed zone/regenerative power limit	Unused (Set to 0.)
4176#0	4176#0	Rotation direction relationship between the spindle and motor	Unused (Set to 0.)

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0*i*-D	30*i*	Contents	
		α*i* series	**B*i*S series**
4176#4	4176#4	Return direction for the reference position on servo mode	Unused (Set to 0.)
4177#0	4177#0	Whether to use MRDY (machine ready) signal	Unused (Set to 0.)
4177#3	4177#3	Mounting direction of the magnetic sensor	Unused (Set to 0.)
4177#4	4177#4	Mounting direction of the spindle sensor	Unused (Set to 0.)
4178#0	4178#0	Spindle sensor type	Unused (Set to 0.)
4178#1	4178#1	Spindle sensor type	Unused (Set to 0.)
4178#2	4178#2	Spindle sensor type	Unused (Set to 0.)
4178#3	4178#3	Spindle sensor type	Unused (Set to 0.)
4178#5	4178#5	Whether to use the rotation direction signal (SFR/SRV) function on servo mode	Unused (Set to 0.)
4179#0	4179#0	Spindle orientation method	Unused (Set to 0.)
4179#2	4179#2	Rotation direction during spindle orientation	Unused (Set to 0.)
4179#3	4179#3	Rotation direction during spindle orientation	Unused (Set to 0.)
4179#4	4179#4	Teeth number setting of spindle sensor	Unused (Set to 0.)
4179#5	4179#5	Teeth number setting of spindle sensor	Unused (Set to 0.)
4179#6	4179#6	Teeth number setting of spindle sensor	Unused (Set to 0.)
4179#7	4179#7	Teeth number setting of spindle sensor	Unused (Set to 0.)
4180#2	4180#2	Setting of external one-rotation signal	Unused (Set to 0.)
4180#3	4180#3	Setting of external one-rotation signal	Unused (Set to 0.)
4182#1	4182#1	Increment system of gear ratio	Unused (Set to 0.)
4182#2	4182#2	Increment system of spindle speed	Unused (Set to 0.)
4182#5	4182#5	Setting of analog override range	Unused (Set to 0.)
4182#7	4182#7	Whether to use the command arbitrary gear ratio (CMR) function on rigid tapping	Unused (Set to 0.)
4183#5	4183#5	Whether to detect a feedback signal disconnection	Unused (Set to 0.)
4183#6	4183#6	Whether to detect the alarms (spindle alarms 41, 42, 47, 81, 82, 83, 85, 86, and 87) related to the position feedback signal (when Cs contouring control mode is not set)	Unused (Set to 0.)
4184#4	4184#4	Setting of output limitation method	Unused (Set to 0.)
4185#0	4185#0	Increment system of velocity loop gain	Unused (Set to 0.)
4185#2	4185#2	Motor power turn-off method when spindle alarm 24 (serial data transfer error) is issued	Unused (Set to 0.)
4185#4	4185#4	Whether to output the load detection signals (LDT1, LDT2) during acceleration/deceleration	Unused (Set to 0.)
4185#6	4185#6	Analog override type	Unused (Set to 0.)
4186#0	4186#0	Motor sensor type	Unused (Set to 0.)
4186#1	4186#1	Motor sensor type	Unused (Set to 0.)
4186#2	4186#2	Motor sensor type	Unused (Set to 0.)
4187#0	4187#0	Teeth number setting of motor sensor	Unused (Set to 0.)
4187#1	4187#1	Teeth number setting of motor sensor	Unused (Set to 0.)
4187#2	4187#2	Teeth number setting of motor sensor	Unused (Set to 0.)
4187#3	4187#3	Number of motor poles	Unused (Set to 0.)
4187#4	4187#4	Setting of maximum output during acceleration/deceleration	Unused (Set to 0.)
4187#7	4187#7	Number of motor poles	Unused (Set to 0.)
4188#0	4188#0	Setting of PWM carrier frequency	Unused (Set to 0.)
4188#1	4188#1	Setting of PWM carrier frequency	Unused (Set to 0.)
4188#2	4188#2	Setting of PWM carrier frequency	Unused (Set to 0.)
4189#2	4189#2	Current dead-band data	Unused (Set to 0.)
4189#3	4189#3	Current dead-band data	Unused (Set to 0.)
4189#4	4189#4	Current dead-band data	Unused (Set to 0.)
4189#5	4189#5	Current dead-band data	Unused (Set to 0.)
4189#6	4189#6	Current dead-band data	Unused (Set to 0.)
4189#7	4189#7	Setting of a PWM carrier frequency for low-speed characteristics area	Unused (Set to 0.)
4192#3	4192#3	Setting of the smoothing function in feed-forward control	Unused (Set to 0.)
4192#4	4192#4	Setting related to control characteristics on servo mode	Unused (Set to 0.)

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0*i*-D	30*i*	Contents	
		α*i* series	**B*i*S series**
4192#6	4192#6	Whether to detect the alarm (spindle alarms 46) related to feedback of the position detection signal for threading	Unused (Set to 0.)
4192#7	4192#7	Function for newly detecting the one-rotation signal before entering position control mode	Unused (Set to 0.)
4193#0	4193#0	This parameter sets speed integration operation when differential spindle speed control is exercised.	Unused (Set to 0.)
4193#7	4193#7	Setting of shortcut orientation from stop state in position coder method spindle orientation	Unused (Set to 0.)
4194#5	4194#5	Whether to use the velocity command compensation function during high-speed orientation	Unused (Set to 0.)
4194#6	4194#6	High-speed orientation function	Unused (Set to 0.)
4195#2	4195#2	Whether to use torque clamp at zero speed	Unused (Set to 0.)
4195#4	4195#4	Setting of the function for switching from high-speed characteristics to low-speed characteristics with the speed detection signal SDT = 1 at speed range switching	Unused (Set to 0.)
4195#7	4195#7	Automatic parameter setting function (16*i* /30*i*)	Unused (Set to 0.)
4196	4196	Maximum motor speed	Unused (Set to 0.)
4197	4197	Speed arrival detection level (SAR)	Unused (Set to 0.)
4198	4198	Speed detection level (SDT)	Unused (Set to 0.)
4199	4199	Zero speed detection level (SST)	Unused (Set to 0.)
4200	4200	Limited torque (TLMH, TLML)	Unused (Set to 0.)
4201	4201	Load detection level 1 (LDT1)	Unused (Set to 0.)
4202	4202	Limited output pattern	Unused (Set to 0.)
4203	4203	Output limit	Unused (Set to 0.)
4204	4204	Stop position of position coder method orientation	Unused (Set to 0.)
4205	4205	Spindle orientation speed	Unused (Set to 0.)
4206	4206	Velocity loop proportional gain on velocity control mode (High)	Unused (Set to 0.)
4207	4207	Velocity loop proportional gain on velocity control mode (Low)	Unused (Set to 0.)
4208	4208	Velocity loop proportional gain on orientation (High)	Unused (Set to 0.)
4209	4209	Velocity loop proportional gain on orientation (Low)	Unused (Set to 0.)
4210	4210	Velocity loop proportional gain on servo mode (High)	Unused (Set to 0.)
4211	4211	Velocity loop proportional gain on servo mode (Low)	Unused (Set to 0.)
4212	4212	Velocity loop integral gain on velocity control mode (common to High and Low)	Unused (Set to 0.)
4213	4213	Velocity loop integral gain on orientation (common to High and Low)	Unused (Set to 0.)
4214	4214	Velocity loop integral gain on servo mode (common to High and Low)	Unused (Set to 0.)
4216	4216	Gear ratio (High)	Unused (Set to 0.)
4217	4217	Gear ratio (Low)	Unused (Set to 0.)
4218	4218	Position gain on orientation (High)	Unused (Set to 0.)
4219	4219	Position gain on orientation (Low)	Unused (Set to 0.)
4220	4220	Ordinary orientation: Rate of change in position gain upon completion of orientation High-speed orientation: Rate of change in position gain upon completion of orientation	Unused (Set to 0.)
4221	4221	Position gain on servo mode (High)	Unused (Set to 0.)
4222	4222	Position gain on servo mode (Low)	Unused (Set to 0.)
4223	4223	Grid shift on servo mode	Unused (Set to 0.)
4226	4226	Detection level for orientation completion signal (ORAR)	Unused (Set to 0.)
4227	4227	Ordinary orientation: Motor speed limit value on orientation High-speed orientation: Reserved	Unused (Set to 0.)
4228	4228	Orientation stop position shift	Unused (Set to 0.)
4229	4229	MS signal constant	Unused (Set to 0.)
4230	4230	MS signal gain adjustment	Unused (Set to 0.)
4231	4231	Regenerative power limit for high-speed zone/regenerative power limit	Unused (Set to 0.)

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0*i*-D	30*i*	Contents	
		α*i* series	**B*i*S series**
4232	4232	Delay time until motor power is cut off	Unused (Set to 0.)
4233	4233	Setting of acceleration/deceleration time	Unused (Set to 0.)
4234	4234	Spindle load monitor observer gain 1	Unused (Set to 0.)
4235	4235	Spindle load monitor observer gain 2	Unused (Set to 0.)
4236	4236	Motor voltage on velocity control mode	Unused (Set to 0.)
4237	4237	Motor voltage on orientation	Unused (Set to 0.)
4238	4238	Motor voltage on servo mode	Unused (Set to 0.)
4239	4239	Rate of change in position gain during reference position return on servo mode	Unused (Set to 0.)
4240	4240	Feed-forward coefficient	Unused (Set to 0.)
4241	4241	Feed-forward coefficient of velocity loop	Unused (Set to 0.)
4243	4243	Denominator of arbitrary gear ratio between motor sensor and spindle (High)	Unused (Set to 0.)
4244	4244	Numerator of arbitrary gear ratio between motor sensor and spindle (High)	Unused (Set to 0.)
4245	4245	Denominator of arbitrary gear ratio between motor sensor and spindle (Low)	Unused (Set to 0.)
4246	4246	Numerator of arbitrary gear ratio between motor sensor and spindle (Low)	Unused (Set to 0.)
4254	4254	Slip compensation gain	Unused (Set to 0.)
4255	4255	Slip compensation gain	Unused (Set to 0.)
4256	4256	Base speed of motor output specifications	Unused (Set to 0.)
4257	4257	Output limit for motor output specifications	Unused (Set to 0.)
4258	4258	Excitation voltage saturation speed at no-load	Unused (Set to 0.)
4259	4259	Base speed limit ratio	Unused (Set to 0.)
4260	4260	Current loop proportional gain	Unused (Set to 0.)
4261	4261	Current loop integral gain	Unused (Set to 0.)
4262	4262	Velocity at which the current loop integral gain is zero	Unused (Set to 0.)
4263	4263	Filter time constant for processing saturation related to the voltage command	Unused (Set to 0.)
4264	4264	Current conversion constant	Unused (Set to 0.)
4265	4265	Secondary current coefficient	Unused (Set to 0.)
4266	4266	Criterion level for saturation related to the voltage command/PWM command clamp value	Unused (Set to 0.)
4267	4267	Slip constant	Unused (Set to 0.)
4268	4268	Slip compensation coefficient for a high-speed zone/slip compensation coefficient at deceleration	Unused (Set to 0.)
4269	4269	PWM command clamp value at deceleration	Unused (Set to 0.)
4270	4270	Motor leakage constant	Unused (Set to 0.)
4271	4271	Regular-time voltage compensation coefficient for high-speed zone/regular-time motor voltage coefficient	Unused (Set to 0.)
4272	4272	Acceleration-time voltage compensation coefficient for high-speed zone/acceleration-time motor voltage coefficient	Unused (Set to 0.)
4273	4273	Time constant for changing the torque (TCMD filter time constant)	Unused (Set to 0.)
4274	4274	Value displayed on load meter at maximum output	Unused (Set to 0.)
4275	4275	Compensation coefficient between the specification and true base/maximum torque curve compensation coefficient	Unused (Set to 0.)
4276	4276	Secondary current coefficient for rigid tapping	Unused (Set to 0.)
4277	4277	Current loop proportional gain speed coefficient/current phase delay compensation coefficient	Unused (Set to 0.)
4278	4278	Time constant for velocity detecting filter	Unused (Set to 0.)
4279	4279	Value displayed on load meter at maximum output	Unused (Set to 0.)
4280	4280	Deceleration-time excitation current change time constant/excitation current change time constant	Unused (Set to 0.)
4281	4281	Spindle load monitor torque constant	Unused (Set to 0.)
4282	4282	Spindle load monitor torque constant	Unused (Set to 0.)
4283	4283	Spindle load monitor torque constant	Unused (Set to 0.)
4284	4284	Motor voltage on velocity control mode	Unused (Set to 0.)
4285	4285	Motor voltage on servo mode	Unused (Set to 0.)
4286	4286	Base speed of motor output specifications	Unused (Set to 0.)

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0*i*-D	30*i*	Contents	
		α*i* series	**B*i*S series**
4287	4287	Output limit for motor output specifications	Unused (Set to 0.)
4288	4288	Excitation voltage saturation speed at no-load	Unused (Set to 0.)
4289	4289	Base speed limit ratio	Unused (Set to 0.)
4290	4290	Current loop proportional gain	Unused (Set to 0.)
4291	4291	Current loop integral gain	Unused (Set to 0.)
4292	4292	Velocity at which the current loop integral gain is zero	Unused (Set to 0.)
4293	4293	Filter time constant for processing saturation related to the voltage command	Unused (Set to 0.)
4294	4294	Current conversion constant	Unused (Set to 0.)
4295	4295	Secondary current coefficient	Unused (Set to 0.)
4296	4296	Criterion level for saturation related to the voltage command/PWM command clamp value	Unused (Set to 0.)
4297	4297	Slip constant	Unused (Set to 0.)
4298	4298	Slip compensation coefficient for a high-speed zone/slip compensation coefficient at deceleration	Unused (Set to 0.)
4299	4299	PWM command clamp value at deceleration	Unused (Set to 0.)
4300	4300	Motor leakage constant	Unused (Set to 0.)
4301	4301	Regular-time voltage compensation coefficient for high-speed zone/regular-time motor voltage coefficient	Unused (Set to 0.)
4302	4302	Acceleration-time voltage compensation coefficient for high-speed zone/acceleration-time motor voltage coefficient	Unused (Set to 0.)
4303	4303	Time constant for changing the torque (TCMD filter time constant)	Unused (Set to 0.)
4304	4304	Compensation coefficient between the specification and true base/maximum torque curve compensation coefficient	Unused (Set to 0.)
4305	4305	Secondary current coefficient for rigid tapping	Unused (Set to 0.)
4306	4306	Current loop proportional gain speed coefficient/current phase delay compensation coefficient	Unused (Set to 0.)
4307	4307	Regenerative power limit for high-speed zone/regenerative power limit	Unused (Set to 0.)
4308	4308	Deceleration-time excitation current change time constant/excitation current change time constant	Unused (Set to 0.)
4309	4309	Motor model code	Unused (Set to 0.)
4310	4310	Motor overheat detect level (2-word)	Unused (Set to 0.)
4324	4324	Motor acceleration at deceleration time (High)	Unused (Set to 0.)
4325	4325	Motor acceleration at deceleration time (Low)	Unused (Set to 0.)
4327	4327	Acceleration limitation start speed at deceleration time (High)	Unused (Set to 0.)
4329	4329	Command multiplication for spindle orientation by position coder	Unused (Set to 0.)
4331	4331	Acceleration limitation start speed at deceleration time (Low)	Unused (Set to 0.)
4335	4335	Number of motor sensor arbitrary teeth	Unused (Set to 0.)
4347	4347	Master-slave speed difference state signal output setting	Unused (Set to 0.)
4349	4349	Temperature monitoring time constant	Unused (Set to 0.)
4353#1	4353#1	Velocity feedback signal setting in torque tandem operation	Unused (Set to 0.)
4353#2	4353#2	Relationship of master/slave motor rotation directions in torque tandem operation	Unused (Set to 0.)
4360	4360	Preload value	Unused (Set to 0.)
4365	4365	Load meter compensation 1	Unused (Set to 0.)
4366	4366	Load meter compensation 2	Unused (Set to 0.)
4367	4367	Load meter compensation 3	Unused (Set to 0.)
4373#1	4373#1	Setting of the peak hold function for load meter output	Unused (Set to 0.)
4376	4376	Load meter compensation 1	Unused (Set to 0.)
4377	4377	Load meter compensation 2	Unused (Set to 0.)
4378	4378	Load meter compensation 3	Unused (Set to 0.)
4379	4379	Load meter compensation 1	Unused (Set to 0.)
4380	4380	Load meter compensation 2	Unused (Set to 0.)
4381	4381	Load meter compensation 3	Unused (Set to 0.)

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0*i*-D	30*i*	Contents	
		α*i* series	**B*i*S series**
4398#2	4398#2	Unused (Set to 0.)	Magnetic pole detection mode selection 1
4398#3	4398#3	Whether to use the twin drive function	Unused (Set to 0.)
4398#6	4398#6	Whether to detect a speed polarity error (spindle alarm d0) in torque tandem operation	Unused (Set to 0.)
4399#5	4399#5	Unused (Set to 0.)	Neglect “Pole position count miss alarm (spindle alarm 91)”
4399#6	4399#6	Unused (Set to 0.)	Magnetic pole detection mode selection 2
4443	4443	Feed-forward coefficient of velocity loop	Unused (Set to 0.)
4463	4463	Unused (Set to 0.)	Unexpected rotation detection level (spindle alarm 90)
4467#2	4467#2	Setting of the detection lower limit of the one-rotation signal	Unused (Set to 0.)
4467#3	4467#3	Setting of the fine acceleration/deceleration (FAD) function	Unused (Set to 0.)
4467#4	4467#4	Acceleration/deceleration type of fine acceleration/deceleration (FAD)	Unused (Set to 0.)
4467#5	4467#5	Whether to detect the alarm related to spindle sensor polarity erroneous setting	Unused (Set to 0.)
4468#6	4468#6	Triggering of the disturbance input function (vibration application function)	Unused (Set to 0.)
4468#7	4468#7	Setting of the disturbance input function (vibration application function)	Unused (Set to 0.)
4481	4481	Feed-forward timing adjustment coefficient	Unused (Set to 0.)
4486	4486	Feed-forward coefficient of velocity loop	Unused (Set to 0.)
4520	4520	Primary delay time constant in dual position feedback [in servo mode]	Unused (Set to 0.)
4521	4521	Maximum amplitude in dual position feedback [in servo mode]	Unused (Set to 0.)
4522	4522	Dual position feedback zero width [in servo mode]	Unused (Set to 0.)
4523	4523	Excessive semi-closed loop/closed loop position error alarm detection level [in servo mode]	Unused (Set to 0.)

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ADDITIONAL INFORMATION

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Revision of Spindle Software (9DAA/19(S), 9DB0/19(S))

1. Type of applied documents

Name	FANUC AC SPINDLE MOTOR αi series, FANUC AC SPINDLE MOTOR βi series, FANUC BUILT-IN SPINDLE MOTOR Bi series PARAMETER MANUAL
Spec. No./Ver.	B-65280EN/11

2. Summary of Change

Group	Name / Outline	New, Add Correct, Del	Applicable Date
Basic Function			
Optional Function			
Unit			
Maintenance Parts			
Notice			
Correction			
Another	- Revision of spindle software 9DAA/19(S) - Revision of spindle software 9DB0/19(S)	Add	2019.10

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				TITLE: Revision of Spindle software (9DAA/19(S), 9DB0/19(S))	
01	19.10.30	G.Li	Newly designed	DRAW. No. B-65280EN/11-01	CUST.
Ed.	Date	Design.		FANUC CORPORATION	SHEET 1/3

Revision of Spindle Software (9DAA/19(S), 9DB0/19(S))

1. Outline

Spindle software series were revised as follows.

2. Software series, edition and applied spindle amplifier

Software edition	Spindle amplifier specification		Notes
9DAA edition 19(S)	αiSP-B	A06B-6220-Hxxx#H600 A06B-6270-Hxxx#H600	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-D, 0*i*-F Induction / Synchronous spindle motor
	αiSVP	A06B-6230-Hxxx#H600 A06B-6280-Hxxx#H600	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-F Induction / Synchronous spindle motor
9DB0 edition 19(S)	Level-up αiSP-B	A06B-6222-Hxxx#H610 A06B-6272-Hxxx#H610	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-F Induction / Synchronous spindle motor
	Level-up αiSVP-B	A06B-6232-Hxxx#H610 A06B-6282-Hxxx#H610	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-F Induction / Synchronous spindle motor
	βiSVSP-B	A06B-6320-Hxxx A06B-6321-Hxxx A06B-6330-Hxxx A06B-6331-Hxxx	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-F Induction / Synchronous spindle motor

3. Contents of modification

	Contents	9DAA/19	9DB0/19
(1)	We changed deceleration control of Smart rigid tapping.	*	*

* : Revised item - : Not supported

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				TITLE: Revision of Spindle software (9DAA/19(S), 9DB0/19(S))	
01	19.10.30	G.Li	Newly designed	DRAW. No. B-65280EN/11-01	CUST.
Ed.	Date	Design.		FANUC CORPORATION	SHEET 2/3

4. Details of modification

Change of deceleration control of Smart rigid tapping

In deceleration of Smart rigid tapping, the control is switched from velocity control to position control.
When Smart rigid tapping works in conventional control method, there are possibilities that spindle motor might not follow a deceleration command of velocity control under some conditions of operation or motor characteristics. In the case, the deceleration in position control might receive the influence. (By the influence, serial spindle alarm (SP9170) rarely occurs.)
Switching method from velocity control to position control has been changed from this revision. By the new control method, the influence in deceleration of positon control is suppressed.

In this revision, the new control method becomes valid as default. We think that the new control method does not give a bad influence to the machine which alarm does not occur now.
For the machine in which you want to use the conventional control method by all means, it is prepared a parameter to return to the conventional control method.

Parameter

	#7	#6	#5	#4	#3	#2	#1	#0
4679							**SRTDF2**	

SRTDF2 Switching method of deceleration control in Smart rigid tapping,
0: New control method (Default setting)
1: Conventional control method

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				TITLE	Revision of Spindle software (9DAA/19(S), 9DB0/19(S))
01	19.10.30	G.Li	Newly designed	DRAW. No. B-65280EN/11-01	CUST.
Ed.	Date	Design.		**FANUC CORPORATION**	SHEET 3/3

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FANUC AC SPINDLE MOTOR αi series,
FANUC AC SPINDLE MOTOR βi series,
FANUC BUILT-IN SPINDLE MOTOR Bi series

Correction of Parameter manual (Parameter related to detectors)

1.Type of applied technical documents

Name	FANUC AC SPINDLE MOTOR αi series, FANUC AC SPINDLE MOTOR βi series, FANUC BUILT-IN SPINDLE MOTOR Bi series PARAMETER MANUAL
Spec.No./Ed.	B-65280EN/11

2.Summary of Change

Group	Name/Outline	New, Add, Correct, Delete	Applicable Date
Basic	We added the feature to apply the thread cutting to a spindle system with proximity switch. So we added the explanation related to thread cutting in a part of "I.1.3 PARAMETERS RELATED TO DETECTORS"	Add	2020.03
Optional Function			
Unit			
Maintenance Parts			
Notice			
Correction			
Another			

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Ed.	Date	Design	Description
01	20.03.20	Takahashi	Newly designed

Date	20.04.16	Desig.	Takahashi	Check	Takahashi	Apprv.	Tsutsumi

Title	FANUC AC SPINDLE MOTOR αi series, FANUC AC SPINDLE MOTOR βi series, FANUC BUILT-IN SPINDLE MOTOR Bi series Correction of Parameter manual (Parameter related to detectors)
Draw	B-65280EN/11-002

FANUC CORPORATION Sheet. 1/4

Applying the thread cutting to a spindle system with proximity switch

We added the feature to apply the thread cutting to a spindle system with proximity switch. The thread cutting is useable by the following setting.

N4004(#3,2)=(-,1)、N4016#7=0、N4402#5=1

The spindle orientation must be executed to detect the one-rotation signal before start of the thread cutting. The status signal F047#0(PC1DTA) becomes “1” after completion of detecting one-rotation signal. The thread cutting must be started after confirming that this signal is “1”.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4004	4004					RFTYPE	EXTRF		

EXTRF, RFTYPE External one-rotation signal setting

These parameters are set to specify the type of an external one-rotation signal (proximity) switch to be attached to the spindle (to be connected to connector JYA3).

RFTYPE	EXTRF	External one-rotation signal (proximity switch)
0	0	None
0	1	Detects the leading edge.
1	1	Detects the trailing edge.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4016	4016	RFCHK3							

RFCHK3 Setting of the function to detect the one-rotation signal every time when position control mode becomes valid.

0 : The one-rotation signal is not detected every time when the operating mode changes.
Once the one-rotation signal is detected, it is not detected again until the power turns off.

1 : The one-rotation signal is detected every time when the operating mode changes.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4402	4402			PRSWTHC					

PRSWTHC Setting for applying thread cutting to the spindle system when the proximity switch is used

0 : not apply

1 : apply

In line with the above change, we add the following contents in “I 1.3 PARAMETERS RELATED TO DETECTOS”.

<1> Add the description of N4402#5 in “1.3.1 List of Parameters for Detectors”.

<2> Add the description of N4402#5 in“1.3.2 Details of Parameters for Detectors”.

<3> Add the description of N4016#7, and N4402#5 in “(8) When the external one-rotation signal (proximity switch) is used”, in“1.3.3 Typical Detector Configuration”.

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1.3.1 List of Parameters for Detectors

The description of N4402#5 is added to "1.3.1 List of Parameters for Detectors".

Parameter No.		Description
0*i*	30*i*	
4394#2	4394#2	Condition of Z phase signal detection†
4402#5	4402#5	Setting for applying the thread cutting to the spindle system with using the proximity switch. <1>
4500 4502	4500 4502	Denominator of arbitrary gear ratio between spindle sensor and spindle (This data is selected by spindle control input signal CTH1A.)

1.3.2 Details of Parameters for Detectors

The description of N4402#5 is added to "1.3.2 Details of Parameters for Detectors".

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4402	4402			PRSWTHC					

PRSWTHC Setting for applying thread cutting to the spindle system when the proximity switch is used
0 : not apply
1 : apply

NOTE

*1 This parameter is valid in 9D90 series T (20) edition or later, 9DA0 series T (20) edition or later, and 9DB0 series T (20) edition or later.

*2 When you use this parameter, it is necessary to set the following parameters also.
N4004#3,2=x,1: External one-rotation signal setting
N4016#7=0: Once the one-rotation signal is detected, it is not detected again until the power turns off.

*3 It is necessary to execute the spindle orientation before start of thread cutting to detect 1 rotation signal. F047#0(PC1DTA) becomes "1" after completion of detecting one-rotation signal. The thread cutting must be started after confirmation of this signal.

*4 To detect the one-rotation signal securely, use the fixed orientation direction to only one direction (by bits 3 and 2 of parameter No. 4003)

*5 To detect the one-rotation signal securely, set the spindle orientation speed to a value between 50 and 100 min^{-1} according to the specification of applicable speed in the external one-rotation signal (proximity switch) (by parameter No. 4038 or No.4324).

*6 A sequence for detecting the one-rotation signal is started after the spindle speed is reached to the specified orientation speed.

*7 Specify the denominator/numerator parameters (No. 4171 to 4174) as an arbitrary gear ratio between the motor sensor and spindle.

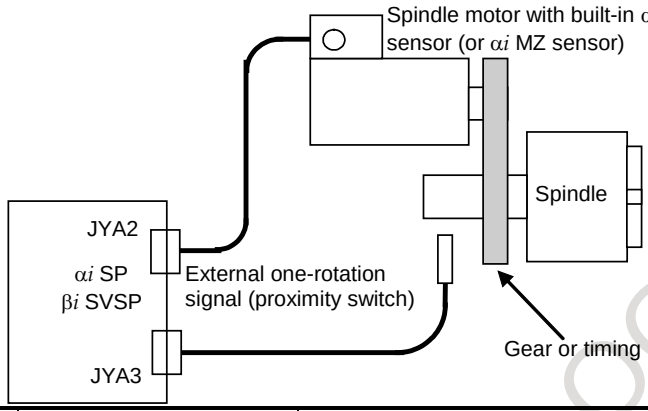
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1.3.3 Typical Detector Configurations

The descriptions of N4016#7 and N4402#5 are added to "(8) When the external one-rotation signal (proximity switch) is used", in "1.3.3 Typical Detector Configuration".

(8) When the external one-rotation signal (proximity switch) is used

[Sample system configuration]



Parameter No.	Settings	Description
4000 #0	Depends on the configuration.	Rotation directions of the spindle and motor
4002 #3,2,1,0	0,0,0,1	Uses the motor sensor for position feedback.
4004 #2	1	Uses the external one-rotation signal.
4004 #3	Depends on the detector.	Sets the external one-rotation signal type.
4010 #2,1,0	Depends on the detector.	Sets the type of motor sensor.
4011 #2,1,0	Depends on the detector.	Sets the number of motor sensor gear teeth.
4016#7	Depends on the configuration.	Setting of the function to detecting the one-rotation signal every time when position control mode becomes valid <3>
4056 to 4059	Depends on the configuration.	Gear ratio between the spindle and motor
4171 to 4174	Depends on the configuration.	Arbitrary gear ratio between the motor sensor and spindle
4402#5	Depends on the configuration.	Setting for applying thread cutting to the spindle system when the proximity switch is used
4003#3,2 4000#4 4000#3	Prepared by CCW (counter clockwise direction) or CW (clockwise dorection)	Setting of rotation direction at spindle orientation Reference position return direction on servo mode (rigid tapping/spindle positioning) Reference position return direction on Cs contouring control To detect the one-rotation signal securely, prepare setting of the rotatory direction.
4324 or 4038 (selected by the orientation method) 4074	50 to 100[min^{-1}]	4324:One-rotation signal detection speed (Optimum orientation) 4038:Spindle orientation speed (Conventional method orientation and High-speed spindle orientation) Reference position return speed on Cs contouring control/servo mode To detect the one-rotation signal securely, prepare setting of detection speed

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Ed.	Date	Design	Description
01	20.03.20	Takahashi	Newly designed

Date	20.04.16	Desig.	Takahashi	Check	Takahashi	Apprv.	Tsutsumi

Title	FANUC AC SPINDLE MOTOR αi series, FANUC AC SPINDLE MOTOR βi series, FANUC BUILT-IN SPINDLE MOTOR Bi series Correction of Parameter manual (Parameter related to detectors)
Draw	B-65280EN/11-002
FANUC CORPORATION	Sheet. 4/4

Revision of Spindle Software (9DAA/20(T), 9DB0/20(T))

1.Type of applied technical documents

Name	FANUC AC SPINDLE MOTOR αi series, FANUC AC SPINDLE MOTOR βi series, FANUC BUILT-IN SPINDLE MOTOR Bi series PARAMETER MANUAL
Spec.No./Ed.	B-65280EN/11

2.Summary of Change

Group	Name/Outline	New, Add, Correct, Delete	Applicable Date
Basic			
Optional Function			
Unit			
Maintenance Parts			
Notice			
Correction			
Another	- Revision of spindle software 9DAA/20(T) - Revision of spindle software 9DB0/20(T)	Add	2020.03

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								Title	Revision of Spindle software (9DAA/20(T), 9DB0/20(T))
								Draw	B-65280EN/11-003
01	20.03.27	Yoshikawa	Newly designed						
Ed.	Date	Design	Description					FANUC CORPORATION	Sheet. 1/2
Date	20.04.15	Desig.	Yoshikawa	Check	Yoshikawa	Apprv.	Tsutsumi		

Revision of Spindle Software (9DAA/20(T), 9DB0/20(T))

1 Outline

Spindle software series were revised as follows.

2 Software series, edition and applied spindle amplifier

Software edition	Spindle amplifier specification		Notes
9DAA edition 20(T)	αiSP-B	A06B-6220-Hxxx#H600 A06B-6270-Hxxx#H600	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-D, 0*i*-F Induction / Synchronous spindle motor
	αiSVP-B	A06B-6230-Hxxx#H600 A06B-6280-Hxxx#H600	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-F Induction / Synchronous spindle motor
9DB0 edition 20(T)	Level-up αiSP-B	A06B-6222-Hxxx#H610 A06B-6272-Hxxx#H610	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-F Induction / Synchronous spindle motor
	Level-up αiSVP-B	A06B-6232-Hxxx#H610 A06B-6282-Hxxx#H610	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-F Induction / Synchronous spindle motor
	βiSVSP-B	A06B-6320-Hxxx A06B-6321-Hxxx A06B-6330-Hxxx A06B-6331-Hxxx	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-F Induction / Synchronous spindle motor

3 Contents of modification

	Contents	9DAA/20	9DB0/20
(1)	Thread cutting with a proximity switch is supported in case that the spindle motor is connected with spindle by gears or timing belt (there is no slip between spindle motor and spindle). (Please refer to technical report (B-65280EN/11-02) for detail.)	*	*
(2)	We found a problem that thread cutting using the distance coded sensor as spindle sensor had not worked correctly. It is fixed.	*	*

* : Revised item - : Not supported

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Ed.	Date	Design	Description
01	20.03.27	Yoshikawa	Newly designed

Date	20.04.15	Desig.	Yoshikawa	Check	Yoshikawa	Apprv.	Tsutsumi

Title	Revision of Spindle software (9DAA/20(T), 9DB0/20(T))		
Draw	B-65280EN/11-003		
FANUC CORPORATION		Sheet.	2/2

Revision of Spindle Software (9DAA/21(U), 9DB0/21(U))

1.Type of applied technical documents

Name	FANUC AC SPINDLE MOTOR αi series, FANUC AC SPINDLE MOTOR βi series, FANUC BUILT-IN SPINDLE MOTOR Bi series PARAMETER MANUAL
Spec.No./Ed.	B-65280EN/11

2.Summary of Change

Group	Name/Outline	New, Add, Correct, Delete	Applicable Date
Basic			
Optional Function			
Unit			
Maintenance Parts			
Notice			
Correction			
Another	- Revision of spindle software 9DAA/21(U) - Revision of spindle software 9DB0/21(U)	Add	2020.09

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Ed.	Date	Design	Description
Date	20.09.11	Desig. Tajima	Check Tajima Apprv. Tsutsumi

Title	Revision of Spindle software (9DAA/21(U), 9DB0/21(U))
Draw	B-65280EN/11-004
FANUC CORPORATION	Sheet. 1/2

Revision of Spindle Software (9DAA/21(U), 9DB0/21(U))

1 Outline

Spindle software series were revised as follows.

2 Software series, edition and applied spindle amplifier

Software edition	Spindle amplifier specification		Notes
9DAA edition 21(U)	αiSP-B	A06B-6220-Hxxx#H600 A06B-6270-Hxxx#H600	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-D, 0*i*-F Induction / Synchronous spindle motor
	αiSVP-B	A06B-6230-Hxxx#H600 A06B-6280-Hxxx#H600	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-F Induction / Synchronous spindle motor
9DB0 edition 21(U)	Level-up αiSP-B	A06B-6222-Hxxx#H610 A06B-6272-Hxxx#H610	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-F Induction / Synchronous spindle motor
	Level-up αiSVP-B	A06B-6232-Hxxx#H610 A06B-6282-Hxxx#H610	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-F Induction / Synchronous spindle motor
	βiSVSP-B	A06B-6320-Hxxx A06B-6321-Hxxx A06B-6330-Hxxx A06B-6331-Hxxx	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-F Induction / Synchronous spindle motor

3 Contents of modification

	Contents	9DAA/21	9DB0/21
(1)	The smoothing compensation calculation of SERVO GUIDE was supported. (Please refer to technical report of SERVO GUIDE for detail later.)	-	*
(2)	Disconnection detection disable signal in the sensorless motor drive was supported. (Please refer to technical report (B-65280EN/11-005) for detail.)	-	*

* : Revised item - : Not supported

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Ed.	Date	Design	Description
Date	20.09.11	Desig. Tajima	Check Tajima Apprv. Tsutsumi

Title	Revision of Spindle software (9DAA/21(U), 9DB0/21(U))
Draw	B-65280EN/11-004
FANUC CORPORATION	Sheet. 2/2

FANUC AC SPINDLE MOTOR αi series,
FANUC AC SPINDLE MOTOR βi series,
FANUC BUILT-IN SPINDLE MOTOR Bi series

Correction of Parameter manual (I/O signal in sensorless motor drive)

1.Type of applied technical documents

Name	FANUC AC SPINDLE MOTOR αi series, FANUC AC SPINDLE MOTOR βi series, FANUC BUILT-IN SPINDLE MOTOR Bi series PARAMETER MANUAL
Spec.No./Ed.	B-65280EN/11

2.Summary of Change

Group	Name/Outline	New, Add, Correct, Delete	Applicable Date
Basic	"Disconnection detection disable signal" became available in sensorless motor drive. So we added the explanation related to I/O signal in a part of "II.3 I/O SIGNALS (CNC↔PMC)"	Add	2020.09
Optional Function			
Unit			
Maintenance Parts			
Notice			
Correction			
Another			

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Ed.	Date	Design	Description
Date	20.09.11	Desig. Tajima	Check Apprv. Tsutsumi

Title	FANUC AC SPINDLE MOTOR αi series, FANUC AC SPINDLE MOTOR βi series, FANUC BUILT-IN SPINDLE MOTOR Bi series Correction of Parameter manual (I/O signal in sensorless motor drive)
Draw	B-65280EN/11-005
FANUC CORPORATION	Sheet. 1/2

3.1.1 List of Input Signals

Disconnection detection disable signal (G073#4 DSCNA) is added to the list of “3.1.1 List of input signals”.

	#7	#6	#5	#4	#3	#2	#1	#0
G070	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
G071			INTGA				*ESPA	ARSTA
G072			INCMDA	OVRA		NRROA	ROTAA	INDXA
G073				DSCNA		MPOFA		

3.2.1 List of Output Signals

Motor excitation off state signal (F047#4 EXOFA) is added to the list of “3.2.1 List of output signals”.

	#7	#6	#5	#4	#3	#2	#1	#0
F045	ORARA	TLMA		LDT1A	SARA	SDTA	SSTA	ALMA
F047				EXOFA			INCSTA	PC1DTA

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Ed.	Date	Design	Description
Date	20.09.11	Desig. Tajima	Check Apprv. Tsutsumi

Title	FANUC AC SPINDLE MOTOR αi series, FANUC AC SPINDLE MOTOR βi series, FANUC BUILT-IN SPINDLE MOTOR Bi series Correction of Parameter manual (I/O signal in sensorless motor drive)
Draw	B-65280EN/11-005
FANUC CORPORATION	Sheet. 2/2

FANUC AC SPINDLE MOTOR αi series,
FANUC AC SPINDLE MOTOR βi series,
FANUC BUILT-IN SPINDLE MOTOR Bi series
Spindle speed variation function Specifications

1. Type of applied technical documents

Name	FANUC AC SPINDLE MOTOR αi series, FANUC AC SPINDLE MOTOR βi series, FANUC BUILT-IN SPINDLE MOTOR Bi series PARAMETER MANUAL
Spec.No./Ed.	B-65280EN/11

2. Summary of Change

Group	Name/Outline	New, Add, Correct, Delete	Applicable Date
Basic	Spindle speed variation function is added.	Add	2021.04
Optional Function			
Unit			
Maintenance Parts			
Notice			
Correction			
Another			

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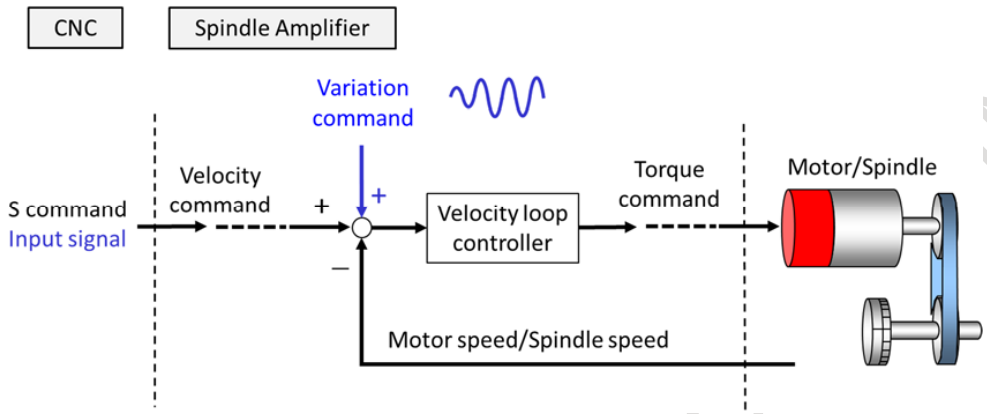
Spindle speed variation function Specifications

1 Overview ····· 3
2 Applicable Spindle Amplifier and Spindle Software ····· 3
3 I/O Signals and Sequence ····· 4
3.1 Address List of Input Signals (PMC→CNC) ····· 4
3.2 Sequence ····· 4
4 Detail of Related Parameters ····· 5
5 Using the Function ····· 6
6 Note ····· 7

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1 Overview

This function which suppresses the growth of regenerative chatter vibration by periodically acceleration and deceleration for spindle rotation speed. This is helpful in suppressing chatter by long overhung tools and long shaft workpieces in turning.



NOTE
1. This function is intended to suppress only regenerated chatter vibration. Chatter vibration during cutting can be caused by various factors, so not all chatter vibration can be eliminated by this function.
2. When the spindle speed variation is applyed, the load and temparuture of spindle motor may inctrases by acceleration and deceleration. Please select speed variation condition within the range of motor specifications.

2 Applicable Spindle Amplifier and Spindle Software

Software edition	Spindle amplifier specification		Notes
9DAA edition 21(U) or later	α*i*SP-B	A06B-6220-Hxxx#H600 A06B-6270-Hxxx#H600	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-F Induction / Synchronous spindle motor
	α*i*SVP-B	A06B-6230-Hxxx#H600 A06B-6280-Hxxx#H600	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-F Induction / Synchronous spindle motor
9DB0 edition 21(U) or later	Level-up α*i*SP-B	A06B-6222-Hxxx#H610 A06B-6272-Hxxx#H610	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-F Induction / Synchronous spindle motor
	Level-up α*i*SVP-B	A06B-6232-Hxxx#H610 A06B-6282-Hxxx#H610	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-F Induction / Synchronous spindle motor
	β*i*SVSP-B	A06B-6320-Hxxx A06B-6321-Hxxx A06B-6330-Hxxx A06B-6331-Hxxx	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-F Induction / Synchronous spindle motor

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3 I/O Signals and Sequence

3.1 Address List of Input Signals (PMC→CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st-	G304	G304						ARDRQA		
2nd-	G308	G308						ARDRQB		
3rd-	G312	G312						ARDRQC		
4th-	G316	G316						ARDRQD		

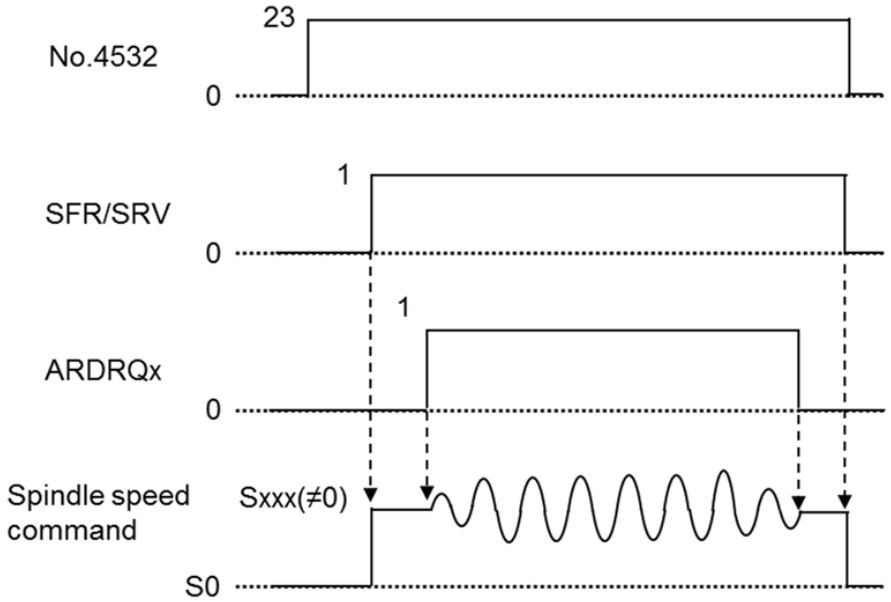
ARDRQx : Operation signal of the spindle speed variation function

0 : Disables spindle speed variation operation

1 : Enables spindle speed variation operation

The meaning of this signal changes depending on the parameter setting No.4532. When No.4532=23 or 24, the spindle speed variation operation is switched.

3.2 Sequence



NOTE

1. This function is effective only in the velocity control mode and the spindle rotation signal is ON (SFR or SRV=1).
2. It cannot be used to position control mode (Cs contouring control, Orientation, Rigid tapping) and sensorless motor control.
3. It cannot be used to spindle synchronous operation (Spindle synchronous control, Spindle EGB function, Tandem control function).

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4 Detail of Related Parameters

0*i*	30*i*	
4532	4532	**Function number**

Unit of data :
Data range : 0 to 32767
Standard setting : 23 or 24

When you set "23" or "24" in this parameter and set "1" in ARDRQx signal, which is written later, the spindle software adds speed variation, which is specified by No.4533(Amplitude ratio)/No.4534(Frequency ratio) to velocity command.
When "23" is set for this parameter, a sinusoidal wave variation command is applied.
When "24" is set for this parameter, a triangular wave variation command is applied.

0*i*	30*i*	
4533	4533	**Amplitude ratio of variation speed**

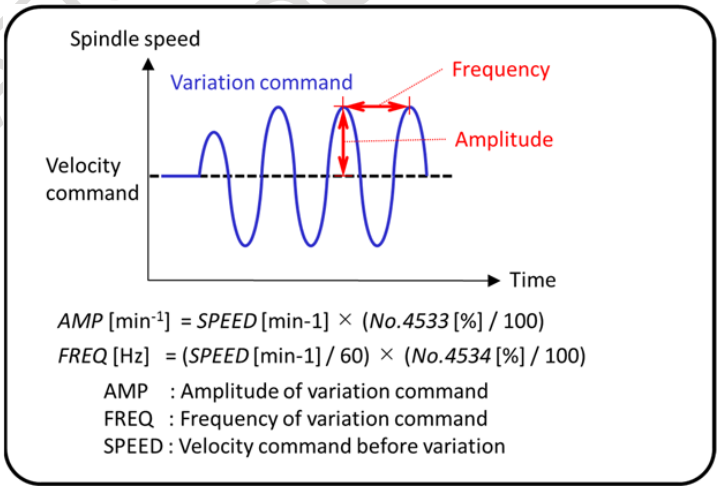
Unit of data : 1%
Data range : 0 to 50
Standard setting : 0

Set the amplitude ratio of variation speed you want input.
When the setting value is less than 0, the amplitude ratio becomes 10%.
02 If a specified value exceeds the valid data range, the value is clamped to 50%.

0*i*	30*i*	
4534	4534	**Frequency ratio of variation speed**

Unit of data : 1%
Data range : 0 to 50
Standard setting : 0

Set the frequency ratio of variation speed you want input.
When the setting value is less than 0, the frequency ratio becomes 10%.
02 If a specified value exceeds the valid data range, the value is clamped to 50%.



AMP [min^{-1}] = *SPEED* [min-1] × (*No.4533* [%] / 100)
FREQ [Hz] = (*SPEED* [min-1] / 60) × (*No.4534* [%] / 100)

AMP : Amplitude of variation command
FREQ : Frequency of variation command
SPEED : Velocity command before variation

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5 Using the Function

(1) Adding PMC ladder program
Add ladder program as described in Subsection 3.1 "Sequence" above.

(2) Using spindle speed variation function
Enable the spindle speed variation function during the cutting block to which you want to apply chatter vibration suppression.

(3) Adjusting parameter
The amplitude ratio of variation of variation speed (No.4533) and frequency ratio of variation speed (No.4534) can be change according within the specifications of the machine and tool. If you are not satisfied with the chatter suppression effect, increase the amplitude rate/frequency rate of parameter settings.
Basically, the higher frequency/amplitude value would be the better effect to suppress vibration, but would increase the risk of over load of motor and/or mechanical shock.

02

Relationship between each parameters and chatter suppression effect

Parameters	Guideline for adjustment
No.4532 Function number 23: sinusoidal wave variation 24: triangular wave variation	● The triangular wave is more effective for suppression than the sinusoidal wave ● The triangular wave causes a greater mechanical shock during acceleration/deceleration than the sinusoidal wave ● Normally, the triangular wave is used. However if you are concerned about mechanical shock, the sinusoidal wave would be used.
No.4533 Amplitude ratio of variation Adjust between 0 to 50(%)	● The higher amplitude ratio is used, the more effective for suppression can be got. ● However, too high value might lead to following concerns. - The motor load increases. - The surface quality of workpiece is impaired. ● Normally, this parameter is set to 0 (means 10%). If the chatter vibration cannot be suppressed, you would increase it.
No.4534 Frequency ratio of variation Adjust between 0 to 50(%)	● The higher frequency ratio is used, the more effective for suppression can be got. ● However, this parameter gives a minor effect for suppression compared to the amplitude ratio of variation. ● Normally, this parameter is set to 0(means 10%). If the chatter vibration cannot be suppressed, you would change (increase) the amplitude rate of variation, and confirm the effect.

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6 Note

- During speed variation, the output limit pattern (No.4028 and No.4029) during acceleration/deceleration is applied.
- According to the machine specifications and machining conditions, such as below, the spindle acceleration/deceleration torque may be saturated.
  - The spindle speed command is high
  - The variation command ratio is high
  - The spindle inertia is large or the cutting torque is large.

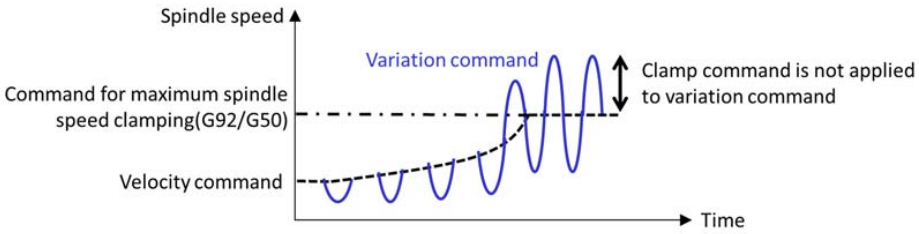
  In these case, the spindle motor may not be able to follow up the speed vibration command.
- If the spindle motor cannot follow up the speed vibration command, not only the effect to suppress vibration would be reduced, but also the following phenomena would occur.
  - The velocity error excess alarm (spindle alarm 02) is issued.
  - The speed arrival signal (SARA) is occurred intermittently.

  In these case, decrease the variation ratio setting values (No.4533, No.4534)
- If this function is used with "Spindle speed fluctuation detection" option, the overheat alarm (OH704) may issue because the spindle speed variation is detected as spindle speed fluctuation.
  Please disable the alarm during spindle speed variation temporarily or enlarge alarm level (No.4912, No.4913) to avoid this alarm. For details of "Spindle speed fluctuation detection", please refer to the Connection Manual (Function) of each CNC.

(02) ● If this function is used with "Servo Learning Oscillation", the following phenomena may occur.
  - The desired chip shredding effect cannot be obtained.
  - The surface roughness becomes worse by large feed rate fluctuation.

  Therefore, we do not recommend using this function together. You can limit the activation by considering the activation status signal SLOST <Fn732.2> of the Servo Learning Oscillation in ladder program.

(02) ● The command for maximum spindle speed clamping (M series:G92 S_;/T series:G50 S_;) is not applied to the spindle speed variation command by this function. Therefore, spindle speed would exceed the clamp value intermittently during constant surface speed control. If there is a problem, please disable this function or specify the clamp value that takes the amplitude of variation speed into consideration.



【Version history】

Ed	Date	Description
01	2021.04.15	The first edition registration
02	2021.08.26	- Added about the relationship between each parameters and chatter suppression - Added about the combined use with Servo Learning Oscillation - Added about operation when command for maximum spindle speed clamping

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Revision of Spindle Software
(9DAA/22(V), 9DB0/23(W))

1.Type of applied technical documents

Name	FANUC AC SPINDLE MOTOR α*i* series, FANUC AC SPINDLE MOTOR β*i* series, FANUC BUILT-IN SPINDLE MOTOR B*i* series PARAMETER MANUAL
Spec.No./Ed.	B-65280EN/11

2.Summary of Change

Group	Name/Outline	New, Add, Correct, Delete	Applicable Date
Basic			
Optional Function			
Unit			
Maintenance Parts			
Notice			
Correction			
Another	- Revision of spindle software 9DAA/22(V) - Revision of spindle software 9DB0/23(W)	Add	2021.10

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Revision of Spindle Software(9DAA/22(V), 9DB0/23(W))

1. Outline

Spindle software series were revised as follows.

2. Software series, edition and applied spindle amplifier

Software edition	Spindle amplifier specification		Notes
9DAA edition 20(T)	α*i*SP-B	A06B-6220-Hxxx#H600 A06B-6270-Hxxx#H600	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-D, 0*i*-F Induction / Synchronous spindle motor
	α*i*SVP-B	A06B-6230-Hxxx#H600 A06B-6280-Hxxx#H600	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-F Induction / Synchronous spindle motor
9DB0 edition 20(T)	Level-up α*i*SP-B	A06B-6222-Hxxx#H610 A06B-6272-Hxxx#H610	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-F Induction / Synchronous spindle motor
	Level-up α*i*SVP-B	A06B-6232-Hxxx#H610 A06B-6282-Hxxx#H610	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-F Induction / Synchronous spindle motor
	β*i*SVSP-B	A06B-6320-Hxxx A06B-6321-Hxxx A06B-6330-Hxxx A06B-6331-Hxxx	30*i*/31*i*/32*i*-B, 35*i*-B, 0*i*-F Induction / Synchronous spindle motor

3. Contents of modification

	Contents	9DAA/22	9DB0/23
(1)	The scope of application of the thread cutting function has been expanded. (Please refer to technical report (B-65280EN/11-008) for detail.)	*	*
(2)	Tuning support of spindle learning control is added. (Please refer to technical report (B-65404EN/02-027) for detail.)	-	*

【Version history】

Ed	Date	Description
01	2021.10.22	The first edition registration

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FANUC AC SPINDLE MOTOR α*i* series,
FANUC AC SPINDLE MOTOR β*i* series,
FANUC BUILT-IN SPINDLE MOTOR B*i* series
Expanded application range of thread cutting function

1.Type of applied technical documents

Name	FANUC AC SPINDLE MOTOR α*i* series, FANUC AC SPINDLE MOTOR β*i* series, FANUC BUILT-IN SPINDLE MOTOR B*i* series PARAMETER MANUAL
Spec.No./Ed.	B-65280EN/11

2.Summary of Change

Group	Name/Outline	New, Add, Correct, Delete	Applicable Date
Basic	Expanded application range of thread cutting function	Add	2021.10
Optional Function			
Unit			
Maintenance Parts			
Notice			
Correction			
Another			

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Expanded application range of thread cutting function

1. Outline

This manual describes the settings for the thread cutting with using the reference counter based on the established zero position by the orientation etc.

By using this function, it becomes possible to do the thread cutting even in the below systems.
(1) The system that the proximity switch is mounted on the spindle end
(2) The system that the gear ratio between spindle and spindle sensor is not 1:1

NOTE

In the above configuration (2), there is a following restriction if the proximity switch is not mounted on the spindle end.

- There is a possibility that Multiple zero position are established by the orientation etc. Therefore, it cannot be applied to re-threading basically.

*By all means, if re-threading is needed, try to the following contents.
After you measure the starting point of thread cutting and set the compensation for the start position, please execute thread cutting.

2. Applicable spindle software

The applicable spindle softwares are as follows.

Series	Edition	Applicable CNC
9DAA	22(V)	FS0*i* -D, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B
9DB0	23(W)	FS0*i* -F, FS30*i* / FS31*i* / FS32*i* / FS35*i* -B

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3. System configuration

This manual assumes that thread cutting is applied to the spindle in the following system configuration.

(1) Configuration that the proximity switch is mounted at the spindle end

In case of using proximity switch, the spindle should be combined with the motor by gear or timing belt so that the spindle position is not lost by belt slip.

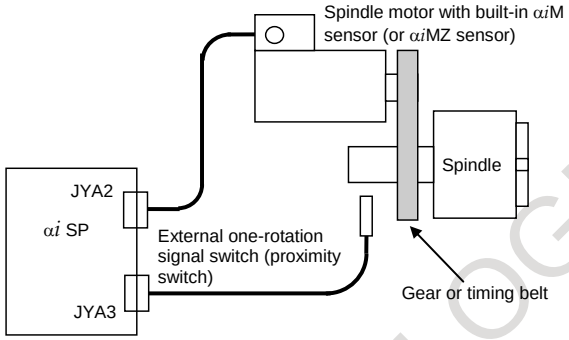


Fig. 1 Configuration that the proximity switch is mounted at the spindle end

NOTE

*1 To detect the one-rotation signal exactly, fix the orientation direction to one direction (by setting of bits 3 and 2 of parameter No. 4003)

*2 Specify the type of an external one-rotation signal (proximity switch) (by setting of bits 3 and 2 of parameter No. 4004).

*3 To detect the one-rotation signalexactly, set the spindle orientation speed to a value between 50 and 100 min^{-1} according to the specification of the external one-rotation signal (proximity switch) (by setting of parameter No. 4038 or No.4324).

*4 A sequence for detecting the one-rotation signal is started after the spindle speed reaches the specified orientation speed.

*5 Specify the numerator/denominator parameters (No. 4171 to 4174) as an arbitrary gear ratio between the motor sensor and the spindle.

(2) Configuration that the gear ratio between the spindle and spindle sensor is not 1:1

The spindle sensor should be combined with the spindle by gear or timing belt so that the spindle position is not lost by belt slip.

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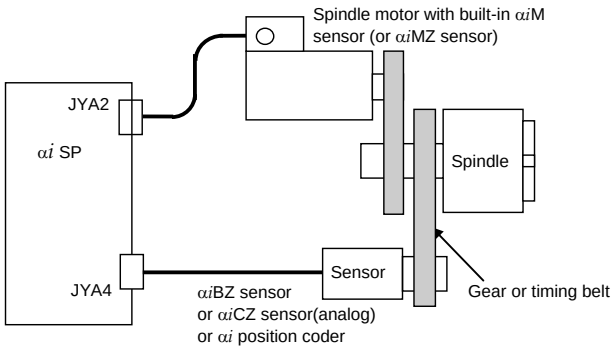


Fig. 2 Configuration that the gear ratio between the spindle and spindle sensor is not 1:1

NOTE

*1 Specify the numerator/denominator parameters (No. 4500 to 4503) as an arbitrary gear ratio between the spindle sensor and the spindle.

*2 Thread cutting is applicable even in this configuration by using the following parameter settings.
No.4402#5=1 and No.4016#7=0

*3 In this case, the orientation is performed at first and the reference counter of the spindle must be established. Thread cutting will be executed by using this reference counter.

*4 After the one-rotation signal is detected by the orientation, PC1DTA(F047.0) is turned on. Start thread cutting after the confirmation that this signal is "1".

*5 But in this configuration, there is a possibility that the multiple zero-point of reference counter are generated in case of power off/on or the cause of sensor alarm etc. In the situation, it is necessary to shift the cutting start point.

*6 If you want to get rid of the above restriction, mount the proximity switch on the spindle end like the configuration as below.

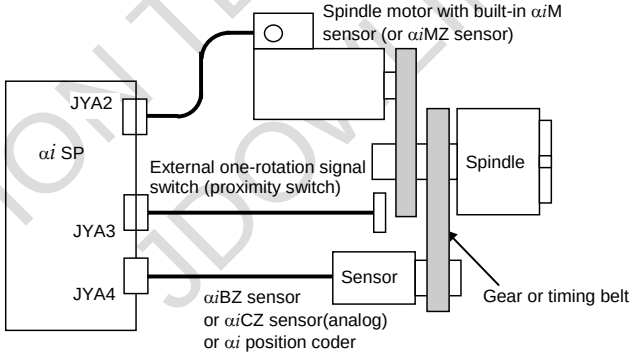


Fig. 3 Configuration that the gear ratio between the spindle and spindle sensor is not 1:1 (In case of using the proximity switch)

NOTE

*1 In this case, the proximity switch is used as the one-rotation signal for the feedback of spindle end.

*2 The feedback signal (connected to JYA4) is converted to the equivalent value on spindle end by No.4500-No.4503.

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4. PMC signal

(1) Address list of input signals (PMC → CNC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st SP	G070	G070		**ORCMA**						
2nd SP	G070	G070		**ORCMB**						

(2) Details of input signals (PMC → CNC)

(a) Orientation command (ORCMA)

The orientation must be executed in order to establish the reference counter.

The detected one-rotation signal position by the orientation is the zero-point of reference counter of thread cutting process.

(3) Address list of output signals (CNC→PMC)

	0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
1st SP	F045	F045	**ORARA**							
2nd SP	F049	F049	**ORARB**							
1st SP	F047	F047								**PC1DTA**
2nd SP	F051	F051								**PC1DTB**

(4) Details of output signals (CNC → PMC)

(a) Spindle orientation completion signal (ORARA)

This signal becomes “1” when the spindle stops in the neighborhood of a predetermined position (±1deg, for example) after an orientation command is input.

(b) Position coder one-rotation signal detection state signal (PC1DTA)

- This signal becomes “1” when the one-rotation signal is detected.
- When the thread cutting with using the reference counter executes, the orientation must be performed at first after power on to establish the reference counter.
- When this function is used, N4016#7 should be set to “0”. It means that the state of one rotation signal detection is kept even after mode change.
- This signal will be cleared to “0” if spindle alarm related to sensor occurs.

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5. Parameters

The following parameters are related to use the external one-rotation signal (proximity switch).

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4003	4003					DIRCT2	DIRCT1		

DIRCT2, DIRCT1 Setting of rotation direction at spindle orientation

DIRCT2	DIRCT1	Rotation direction at spindle orientation
0	0	Determined by rotation direction at the last minute (It is CCW just after power on.)
0	1	Determined by rotation direction at the last minute (It is CW just after power on.)
1	0	CCW direction looking from shaft of motor
1	1	CW direction looking from shaft of motor

NOTE
At using the external one-rotation signal (proximity switch), fix the orientation direction to CCW or CW for stable detection of the one-rotation signal.
(by settings of Bits 3, 2 of No. 4003 = 1, 0 or 1, 1)

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4004	4004					RFTYPE	EXTRF		

EXTRF, RFTYPE External one-rotation signal setting
This parameter specifies the type of an external one-rotation signal (proximity switch) attached to the spindle end (It is connected to connector JYA3.).

RFTYPE	EXTRF	External one-rotation signal (proximity switch)
0	0	None
0	1	Spindle software detects the rising edge.
1	1	Spindle software detects the falling edge.

0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4016	4016	RFCHK3							

RFCHK3 Setting of the function that the one-rotation signal is detected each time after position control mode becomes on

0 : The one-rotation signal is not detected each time even after the operating mode changes. Once the one-rotation signal is detected, it is not detected again until the power off.
1 : The one-rotation signal is detected each time after the operating mode changes.

NOTE
If thread cutting is applied to the system configuration (1) or (2) described in item 3 (fig.1,2,3), this bit must be 0.

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0*i*	30*i*	
4038	4038	**Spindle orientation speed**

Unit of data : $1min^{-1}$ ($10min^{-1}$ when bit 2 of parameter No.4006(SPDUNT) is 1)

Valid data range : 0 to 32767

Initial setting value : 0

This parameter specifies the orientation speed of the spindle.

When 0 is set to this parameter, the orientation speed is determined according to the position gain and the motor speed limit ratio for orientation.

NOTE

At using the external one-rotation signal (proximity switch), set the value from 50 to 100 min^{-1} as orientation speed according to the specification of the external one-rotation signal (proximity switch) for stable detection of the one-rotation signal.

However, if there is no problem in the accuracy of stop position even at high speed orientation, you can use the higher value than $100min^{-1}$.

0*i*-D	30*i*		
4171	4171	**Denominator of an arbitrary gear ratio between the motor sensor and spindle (HIGH)**	**CTH1A=0**
4172	4172	**Numerator of an arbitrary gear ratio between the motor sensor and spindle (HIGH)**	**CTH1A=0**
4173	4173	**Denominator of an arbitrary gear ratio between the motor sensor and spindle (LOW)**	**CTH1A=1**
4174	4174	**Numerator of an arbitrary gear ratio between the motor sensor and spindle (LOW)**	**CTH1A=1**

Unit of data :

Valid data range : 0 to 32767

Initial setting value : 0

These parameters specify the conversion coefficients (numerator, denominator) for using arbitrary gear ratio function (DMR function). They are used as multiplier to a motor sensor (αiM sensor or αiMZ sensor) feedback signal to produce a spindle position feedback signal.

When the spindle rotates Q times while the motor shaft rotates P times (there is no common divisor other than 1 for P and Q), the settings should be:

No. 4171 (No. 4173 when CTH1A = 1) = P

No. 4172 (No. 4174 when CTH1A = 1) = Q

When 0 is set in any of these parameters, the setting is assumed as 1.

NOTE

In case of using an external one-rotation signal (proximity switch), use the detection arbitrary gear ratio function (DMR function) by setting an arbitrary gear ratio between the motor sensor and spindle with these parameters.

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0*i*	30*i*	#7	#6	#5	#4	#3	#2	#1	#0
4402	4402			**PRSWTHC**					

PRSWTHC The function for applying of thread cutting of using the reference counter based on the established zero position by the orientation etc.

0 : is not used
1 : is used

NOTE
If thread cutting is applied to the system configuration (1) or (2) described in item 3 (fig.1,2,3), this bit must be 1.

0*i*-D	30*i*		
4500	4500	**Denominator of arbitrary gear ratio between the spindle sensor and spindle (HIGH)**	**CTH1A=0**
4501	4501	**Numerator of arbitrary gear ratio between the spindle sensor and spindle (HIGH)**	**CTH1A=0**
4502	4502	**Denominator of arbitrary gear ratio between the spindle sensor and spindle (LOW)**	**CTH1A=1**
4503	4503	**Numerator of arbitrary gear ratio between the spindle sensor and spindle (LOW)**	**CTH1A=1**

Unit of data :

Valid data range : 0 to 32767

Initial setting value : 0

These parameters specify the conversion coefficients (numerator, denominator) for using the detection arbitrary gear ratio function (DMR function) by multiplying a spindle sensor (αi position coder, α position coder S, separate αiBZ sensor, or separate αiCZ sensor (analog)) feedback signal by a gear ratio to produce a spindle position feedback signal. When the spindle rotates Q times while the motor shaft rotates P times (there is no common divisor other than 1 for P and Q), setting should be:

No. 4500 (No. 4502 when CTH1A = 1) = P
No. 4501 (No. 4503 when CTH1A = 1) = Q

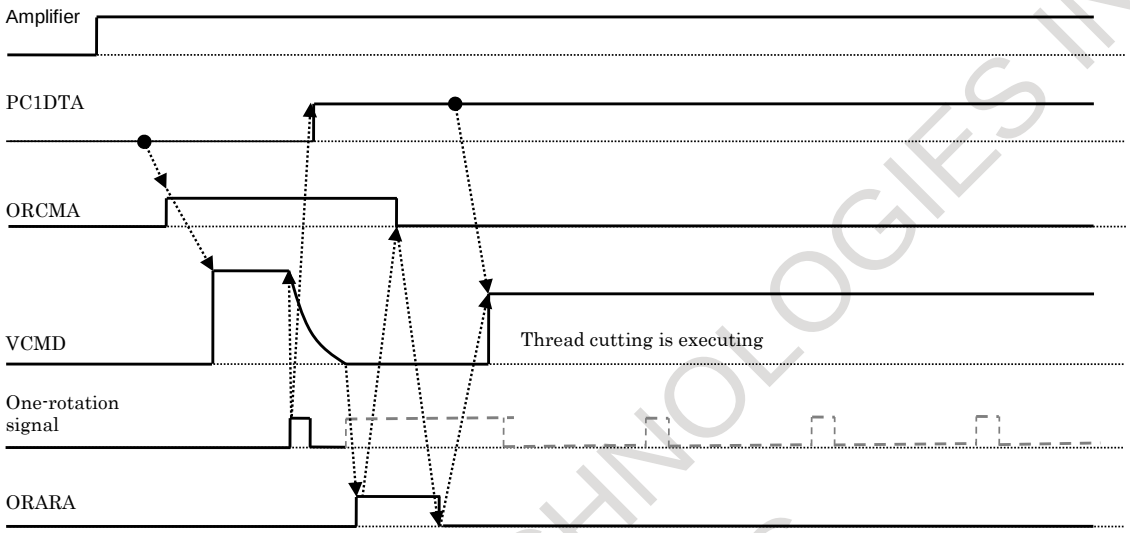
When one of these parameters is set to 0, it is assumed as 1.

NOTE
*1 In case of the system configuration (2) described in item 3 (fig.2,3), set a gear ratio between the spindle sensor and spindle with these parameters. The feedback data of the spindle sensor is converted to the equivalent value on spindle end.
*2 When this parameter is used in the configuration having no external one-rotation signal (proximity switch), set the following parameters.
No.4007#6=1: Alarms related to positional feedback signals (in non-Cs mode) are not detected
No.4016#5=0: Alarms related to positional feedback signals (in Cs mode) are not detected.
*3 If the αiCZ sensor (serial) is used, this parameter is invalid.

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6. Sequence

The following sequence should be needed to execute the thread cutting of using reference counter that zero-point is established by orientation etc.



(1) After turning on the power of amplifier, the state of PC1DTA is 0 (one-rotation signal has not detected yet.).

(2) Spindle orientation should be executed to detect the one-rotation signal.

(3) Turn on the orientation command ORCMA.

(4) The spindle stops at the orientation position after detecting the reference signal (PC1DET becomes on), and ORARA becomes "1".

(5) After confirming of ORARA=1, cancel the orientation command ORCMA.

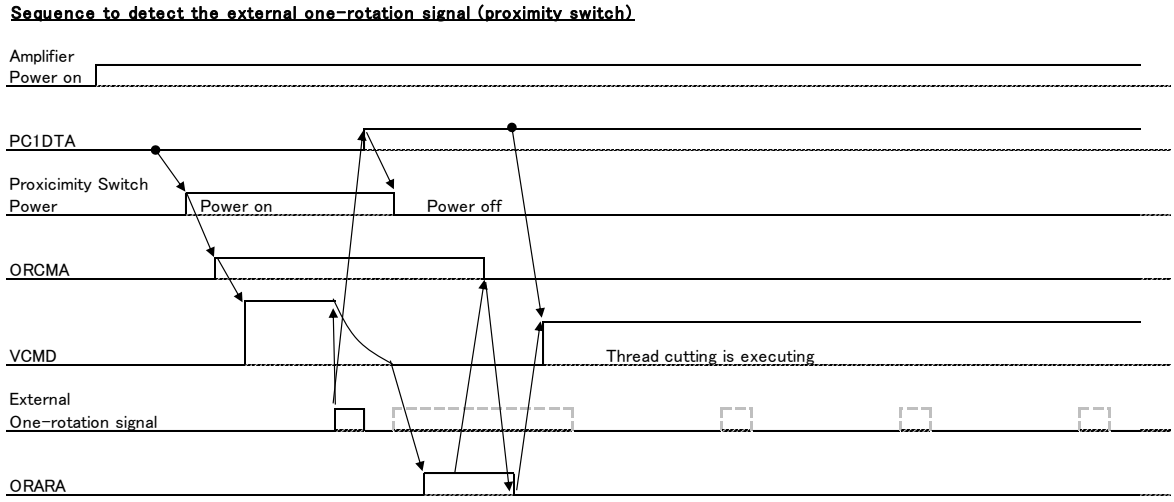
(6) After this, the spindle control software uses the reference counter based on the position of one-rotation signal.

(7) After confirming of PC1DTA=1, thread cutting should be executed.

NOTE
When thread cutting is executed, the spindle control software regards the one-rotation signal is detected each time after the reference counter position crosses the zero-position.

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The following sequence should be needed to execute the thread cutting in the system of applying power ON/OFF of a proximity switch.



(1) After turning on the power of amplifier, the state of PC1DTA is 0 (one-rotation signal has not detected yet.).

(2) Spindle orientation should be executed to detect the reference signal.

(3) At first, turn on the power for proximity switch.

(4) Wait to stable state of the power for proximity switch.

(5) Turn on the orientation command ORCMA.

(6) The spindle stops at the orientation position after detecting the reference signal (PC1DET becomes on). After this, turn off the orientation command.

(7) Turn off the power for proximity switch after confirmation of PC1DET=1.

(8) After this, the spindle control software uses the detected reference position in the above sequence.

(9) After confirmation of PC1DTA=1, thread cutting should be executed.

NOTE

When thread cutting is executed, the spindle control software regards the reference signal is detected each time after the spindle crosses the reference position.

【Version history】

Ed	Date	Description
01	2021.10.22	The first edition registration

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REVISION RECORD

Edition	Date	Contents
11	Dec., 2019	- Addition of a parameter table for each model (-B series) - Applied to sensorless control
10	Dec., 2016	- Applied to Series 0*i*-F - Addition of β*i*SVSP-B series - Addition of New functions - Integration of part I and II in former edition
09	Feb., 2014	- Addition of the FSSB high-speed rigid tapping function - Addition of the load meter normalized by the continuous rated output - Addition of the power failure backup function - Addition of the twin drive for a spindle motor - Addition of the cutting feed/rapid traverse PWM frequency switching function in Cs contour control - Supporting a distance coded sensor - Addition of the inertia estimation function - Addition of a parameter table for each model - Deletion of descriptions about Series 16*i*/Series 15*i* - Deletion of descriptions about SPINDLE MOTOR αCi series
08	Jun., 2011	- Applied to Series 30*i*-B - Addition of SPINDLE MOTOR β*i*Ic series - Addition of speed tandem control
07	Jul., 2008	- Addition of optimum orientation - Addition of α*i*CZ sensor (serial)
06	Jul., 2006	- Change of the motor model name - Addition of spindle backlash acceleration function
05	Apr., 2005	- Applied to Series 30*i* - Addition of BUILT-IN SPINDLE MOTOR B*i*s series
04	Oct., 2003	- Addition of AC SPINDLE MOTOR β*i* series
03	Apr., 2003	- Change of the motor model name - Addition of the spindle speed differential control function
02	Oct., 2002	Total revision - Addition of AC SPINDLE MOTOR αC*i* series - Addition of Appendixes C, D, F, and G
01	Jun., 2001	

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