FANUC AC SERVO MOTOR αi-B/αi series
FANUC AC SERVO MOTOR βi-B/βi series
FANUC LINEAR MOTOR LiS-B/LiS series
FANUC DD MOTOR DiS-B/DiS series

PARAMETER MANUAL

B-65270EN/10

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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 too many possibilities. Therefore, matters which are not especially described as possible in this manual should be regarded as impossible.

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■ General Safety Precautions

- When an abnormality such as an alarm or a hardware failure occurs, the operations described in this manual 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.
- The signals and functions described in this manual cannot be used separately for 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, so an unexpected danger may be caused. For information about the safety functions, please contact FANUC.
  Generally, the safety functions represent functions that protect the operators from machine danger.
- 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 greater care by, for example, reducing the torque limit value (No. 2060), error detection level (No. 1828 and No. 1829), or operating speed or by operating the machine in such a way that it can be stopped quickly in an emergency.

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.
Fully understand the Warnings, Cautions, and Notes before attempting to use the machine.

⚠ **WARNING**	Used when there is a danger of the user being injured or when there is a danger of both the user being injured and the equipment being damaged if the approved procedure is not observed.
⚠ **CAUTION**	Used when there is a danger of the equipment being damaged if the approved procedure is not observed.
NOTE	Notes are used to indicate supplementary information other than Warnings and Cautions.

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

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1 OVERVIEW

This manual describes servo parameters of CNC models using FANUC AC SERVO MOTOR αi-B/αi, βi-B, βi, LiS-B/LiS, and DiS-B/DiS series. The descriptions include the servo parameter start-up and adjustment procedures. The meaning of each parameter is also explained.

1.1 CNC MODELS AND APPLICABLE SERVO CONTROL SOFTWARE

CNC model name	Series of applicable servo control software	Remarks
Series 30*i*-MODEL B Series 31*i*-MODEL B Series 31*i*-MODEL B5 Series 32*i*-MODEL B Series 35*i*-MODEL B Power Motion *i*-MODEL A Digital Servo Adapter-MODEL B	Series 90G0	For SERVO HRV2,3,4 control (Note 1) For servo card A (Note 2)
	Series 90J0	For SERVO HRV2,3,4 control (Note 1) For servo card B (Note 2)
	Series 90K0	For SERVO HRV2,3,4 control (Note 1) For servo card C (Note 2)
Power Motion *i*-MODEL A Digital Servo Adapter-MODEL B	Series 90GP	For SERVO HRV2,3 control Supports pressure and position control and DSA-B (EtherCAT interface). For servo card A (Note 2)
	Series 90JP	For SERVO HRV2,3 control Supports pressure and position control and DSA-B (EtherCAT interface). For servo card B (Note 2)
Series 30*i*-MODEL A Series 31*i*-MODEL A Series 32*i*-MODEL A	Series 90D0	For SERVO HRV4 control
	Series 90E0	For SERVO HRV2,3 control
	Series 90E1	For SERVO HRV2,3 control and development series (Note 3)
Series 0*i*-MODEL F	Series 90M0	For SERVO HRV2,3 control
	Series 90M8	For SERVO HRV2,3 control and development series (Note 3)
	Series 90L0	For SERVO HRV2,3 control
	Series 90L8	For SERVO HRV2,3 control and development series (Note 3)
Series 0*i*-MODEL D Series 0*i*-Mate MODEL D	Series 90C5	For SERVO HRV2,3 control
	Series 90C8	For SERVO HRV2,3 control
	Series 90E5	For SERVO HRV2,3 control
	Series 90E8	For SERVO HRV2,3 control and development series (Note 3)
Series 0*i*-Mate MODEL D (Package 5)	Series 90H0	For SERVO HRV2,3 control

NOTE

1 SERVO HRV4 Control cannot be used with Series 35*i*-B, Power Motion *i*-A, and Digital Servo Adapter-MODEL B.

2 There are three types of servo cards for FS30*i*-B and PowerMotion*i*-A.
Servo card A Old servo card (for maintenance)
Servo card B New servo card (standard)
Servo card C New servo card (function limited version)
For information about the function limits of servo card C and other details, see Appendix O.

3 If you want to put priority on using new functions, select development series.

1.2 ABBREVIATIONS OF THE CNC MODELS COVERED BY THIS MANUAL

In this manual, the CNC model names are abbreviated as follows.

CNC model name	Abbreviations		
FANUC Series 30*i*-MODEL B	Series 30*i*-B	30*i*-B Series	30*i* Series, etc. FS30*i*, etc.
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		
Power Motion *i*-MODEL A	Power Motion *i*-A	---	
Digital Servo Adapter-MODEL B	DSA-B	---	
FANUC Series 30*i*-MODEL A	Series 30*i*-A	30*i*-A Series	
FANUC Series 31*i*-MODEL A	Series 31*i*-A		
FANUC Series 32*i*-MODEL A	Series 32*i*-A		
FANUC Series 0*i*-MODEL F	Series 0*i*-F	0*i*-F Series FS0*i*-F	0*i*-D/F Series 0*i* Series FS0*i*
FANUC Series 0*i*-MODEL D	Series 0*i*-D	0*i*-D Series FS0*i*-D	
FANUC Series 0*i* Mate-MODEL D	Series 0*i* Mate-D		

1.3 RELATED MANUALS

The following manuals are available for FANUC AC SERVO MOTOR α*i*-B, α*i*, β*i*-B, β*i* series, LINEAR MOTOR L*i*S–B and L*i*S series, and DD MOTOR D*i*S–B and D*i*S series. In the table, this manual is marked with an asterisk (*).

Table 1.3 Related manuals

Document name	Document number	Main contents	Main usage	
FANUC AC SERVO MOTOR α*i*-B series FANUC AC SERVO MOTOR α*i* series DESCRIPTIONS	B-65262EN	• Specification • Characteristics • External dimensions • Connections	• Selection of motor • Connection of motor	
FANUC AC SERVO MOTOR β*i*-B series FANUC AC SERVO MOTOR β*i* series DESCRIPTIONS	B-65302EN			
FANUC LINEAR MOTOR L*i*S series DESCRIPTIONS	B-65382EN			
FANUC SYNCHRONOUS BUILT-IN SERVO MOTOR D*i*S-B series DESCRIPTIONS	B-65492EN			
FANUC SYNCHRONOUS BUILT-IN SERVO MOTOR D*i*S series DESCRIPTIONS	B-65332EN			
FANUC SERVO AMPLIFIER α*i*-B series DESCRIPTIONS	B-65412EN	• Specifications and functions • Installation • External dimensions and maintenance area • Connections	• Selection of amplifier • Connection of amplifier	
FANUC SERVO AMPLIFIER β*i* series DESCRIPTIONS	B-65322EN			
FANUC SERVO AMPLIFIER β*i*-B series DESCRIPTIONS	B-65422EN			

Document name	Document number	Main contents	Main usage	
FANUC AC SERVO MOTOR α*i*-B/α*i* series FANUC AC SPINDLE MOTOR α*i*-B series FANUC SERVO AMPLIFIER α*i*-B series FANUC AC SERVO MOTOR β*i*-B/β*i* series FANUC AC SPINDLE MOTOR β*i*-B series FANUC SERVO AMPLIFIER β*i*-B series MAINTENANCE MANUAL	B-65515EN	• Startup procedure • Troubleshooting • Maintenance of motor	• Startup of system (hardware) • Troubleshooting • Maintenance of motor	
FANUC AC SERVO MOTOR α*i*-B/α*i* series FANUC AC SERVO MOTOR β*i*-B/β*i* series FANUC LINEAR MOTOR L*i*S series FANUC DD MOTOR D*i*S series PARAMETER MANUAL	B-65270EN	• Initial setup • Setting of parameters • Description of parameters	• Startup of system (software) • Tuning of system (parameters)	*
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	• Initial setup • Setting of parameters • Description of parameters	• Startup of system (software) • Tuning of system (parameters)	

Other manufactures' products referred to in this manual

* Windows is a registered trademark of Microsoft Corporation.

All other product names identified throughout this manual are trademarks or registered trademarks of their respective companies.

Supplementary note

In this manual, the servo parameters are explained using the following notation:

(Example)

Parameter No.	Servo parameter function name, function bit							
2021	Load inertia ratio							
	#7	#6	#5	#4	#3	#2	#1	#0
2000				PGEX			DGPR	PLC0

PLC0 (#0) The number of velocity pulses and the number of position pulses are internally:
0: Not to be multiplied by ten.
1: To be multiplied by ten.

2 SETTING PARAMETERS OF αi-B/αi/βi-B/βi SERIES SERVO MOTORS

2.1 SETTING PARAMETERS OF SERVO MOTORS

Before starting servo parameter initialization, confirm following items:

1.	CNC model	(Ex.: Series 30*i*-B)
2.	Servo motor model	(Ex.: α*i*F8/3000)
3.	Pulsecoder built into a motor	(Ex.: α*i*A1000)
4.	Is the separate position detector used?	(Ex.: Not used)
5.	Distance the machine tool moves per revolution of the motor	(Ex.: 10 mm per revolution)
6.	Machine detection unit	(Ex.: 0.001 mm)
7.	CNC command unit	(Ex.: 0.001 mm)

2.1.1 Servo Parameter Initialization Workflow

Use the procedure below to initialize the servo parameters.
For details of each setting item, see Subsection 2.1.2.

Preparation
- Turn on the power in the emergency stop state.
- Enable parameter writing.
- Display the servo setting screen. → See 2.1.2 (1).

↓

Servo parameter setting

Description of setting	Reference item
Initialization bit	→ 2.1.2 (2)
Motor ID No. setting	→ 2.1.2 (3)
AMR setting	→ 2.1.2 (4)
CMR setting	→ 2.1.2 (5)
Flexible feed gear setting	→ 2.1.2 (6)
Motor rotation direction setting	→ 2.1.2 (7)
Setting of the number of velocity pulses and the number of position pulses	→ 2.1.2 (8)
Reference counter setting	→ 2.1.2 (9)
Full-closed system setting	→ 2.1.2 (10)
Servo loop gain setting	→ 2.1.2 (11)

↓

CNC restart → 2.1.2 (12)

↓

Absolute position detector setting → 2.1.2 (13)

↓

Completion of servo parameter initialization

2.1.2 Servo Parameter Initialization Procedure

(1) Preparation

Turn on the CNC in the emergency stop state.
Enable parameter writing (PWE = 1).
Initialize servo parameters on the servo setting screen.
For the Power Motion *i*-A or another model with no display, specify a value for the number corresponding to each item on the SERVO SETTING screen. ⇒ See Fig. 2.1.2 (c).
To display the servo setting screen, follow the procedure below, using the key on the CNC.

- **0*i*-F Series**

Press the key several times until the PARAMETER SETTING SUPPORT screen appears.

Press the [(OPRT)] soft key, move the cursor to the SERVO SETTING item, and press [SELECT] to display the PARAMETER SETTING SUPPORT screen.

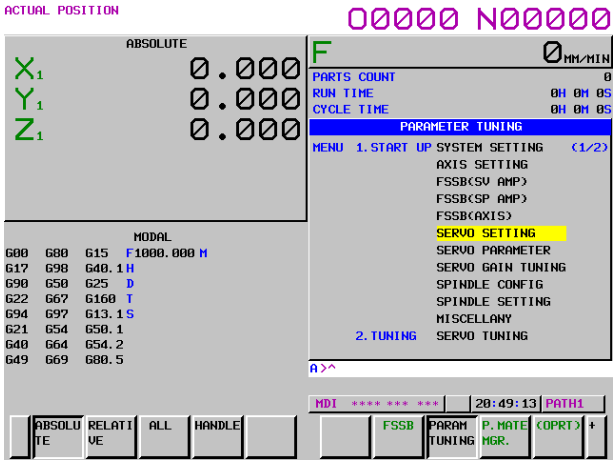
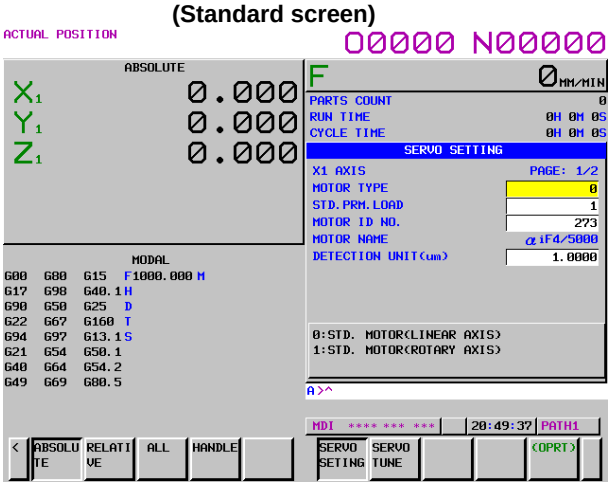


Fig. 2.1.2 (a) PARAMETER SETTING SUPPORT screen

With the 0*i* Series, two types of servo setting screens are available: the standard screen and the conventional compatible screen. Initialization can be performed by using either of the screens. For the standard screen, refer to Subsection 2.1.3, "Servo Parameter Initialization Procedure for the Series 0*i*-F/D". This subsection describes the method of setting using the **conventional compatible screen**.

(Standard screen)



(Conventional compatible screen)

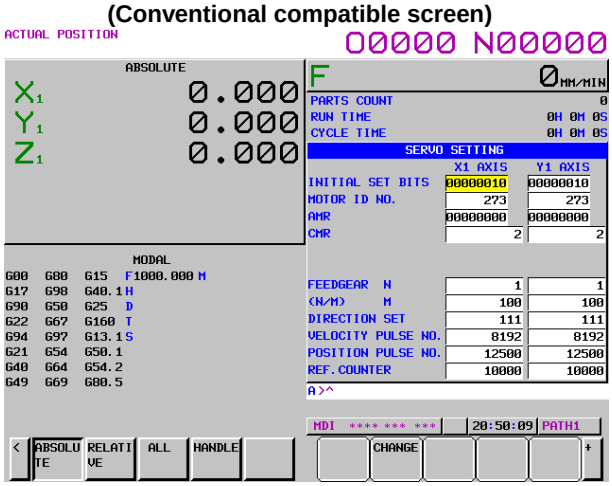


Fig. 2.1.2 (b) 0*i* Series SERVO SETTING screen

When the SERVO SETTING screen (standard screen) is displayed, the SERVO SETTING screen (conventional compatible screen) can be displayed by operating the soft keys as follows:
[(OPRT)] → [▷] → [CHANGE]

- **30*i* Series**

[SYSTEM] → [SYSTEM] → [▷] → [SV-PRM]

If the servo screen does not appear, set the following parameter as shown, and turn the CNC off and then on again.

	#7	#6	#5	#4	#3	#2	#1	#0
3111								SVS

SVS(#0) 1: Displays the servo screen.
When the following screen appears, move the cursor to the item you want to specify, and enter the value directly.

Servo setting			01000 N0000	Corresponding parameter number
		X-axis	Z-axis	
INITIAL SET BITS		00000010	00000010	No.2000
Motor ID No.		16	16	No.2020
AMR		00000000	00000000	No.2001
CMR		2	2	No.1820
CMR	N	0	0	No.1822
(N/M)	M	0	0	No.1823
Feed gear	N	1	1	No.2084
(N/M)	M	100	100	No.2085
Direction Set		111	111	No.2022
Velocity Pulse No.		8192	8192	No.2023
Position Pulse No.		12500	12500	No.2024
Ref. counter		10000	10000	No.1821

Fig. 2.1.2 (c) 30*i* Series SERVO SETTING screen

NOTE
CMR(N/M) is displayed when arbitrary command multiplier (option) is enabled.

(2) Initialization

Start initialization. **Do not power off the CNC until step (12).**

	#7	#6	#5	#4	#3	#2	#1	#0
2000							DGPR	

Reset initialization bit 1 (No. 2000) to 0.
DGPR(#1) = 0

(3) Motor ID No. setting

Specify the motor ID number.

2020	Motor ID number

Select the motor ID number of a motor to be used according to the motor model and motor specification (the middle four digits in A06B-****-B***) listed in the following tables.
The "□" mark indicates a value that varies depending on the used options.
The "-" mark indicates that automatic loading of standard parameters is not supported as of February 2019. Alternatively, this mark indicates an invalid combination.

NOTE
For linear motors and DD motors, see Chapter 3, "SETTING PARAMETERS OF LINEAR MOTOR AND DD MOTOR".

αiS/αiS-B series servo motor

Motor model	Motor specification	Motor ID No.	90G0	90J0 90K0	90GP	90JP	90D0 90E0	90E1	90M0 90M8	90C5 90E5	90C8 90E8	90H0
αiS 2/5000 (NOTE) αiS 2/5000-B	0212 2212	262 (20A)	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
		502 (40A)	-	10.0	-	04.0	-	-	06.0	-	-	-
αiS 2/6000 (NOTE) αiS 2/6000-B	0218 2218	284 (20A)	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A	02.0
		503 (40A)	-	10.0	-	04.0	-	-	06.0	-	-	-
αiS 4/5000 (NOTE) αiS 4/5000-B	0215 2215	265 (20A)	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
		504 (40A)	-	10.0	-	04.0	-	-	06.0	-	-	-
αiS 4/6000 (NOTE) αiS 4/6000-B	0210 2210	466 (20A)	03.0	01.0	02.0	01.0	28.0	04.0	02.0	D	A	02.0
		505 (40A)	-	10.0	-	04.0	-	-	06.0	-	-	-
αiS 8/4000 αiS 8/4000-B	0235 2235	285	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αiS 8/6000 αiS 8/6000-B	0232 2232	290	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A	02.0
αiS 12/4000 αiS 12/4000-B	0238 2238	288	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αiS 12/6000 αiS 12/6000-B	0230 2230	462	03.0	01.0	02.0	01.0	27.0	01.0	02.0	D	A	02.0
αiS 22/4000 αiS 22/4000-B	0265 2265	315	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αiS 22/6000 αiS 22/6000-B	0262 2262	452	03.0	01.0	02.0	01.0	Q	01.0	02.0	A	A	02.0
αiS 30/4000 αiS 30/4000-B	0268 2268	318	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αiS 40/4000 αiS 40/4000-B	0272 2272	322	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αiS 50/2000 αiS 50/2000-B	0042 2042	468	03.0	01.0	02.0	01.0	28.0	04.0	02.0	D	A	02.0
αiS 50/3000 αiS 50/3000-B	0275-B□0□ 2275-B□0□	324	03.0	01.0	02.0	01.0	B	01.0	02.0	A	A	02.0
αiS 50/3000-B αiSV 360S-B driving	2275-B□0□	541	-	10.0	-	04.0	-	-	06.0	-	-	-
αiS 50/3000 FAN αiS 50/3000 FAN-B	0275-B□1□ 2275-B□1□	325	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αiS 50/3000 FAN-B αiSV 360S-B driving	2275-B□1□	542	-	10.0	-	04.0	-	-	06.0	-	-	-
αiS 60/2000 αiS 60/2000-B	0044 2044	470	03.0	01.0	02.0	01.0	28.0	04.0	02.0	D	A	02.0
αiS 60/3000-B	2278-B□0□	456	-	06.0	-	03.0	-	-	03.0	-	-	-
αiS 60/3000-B αiSV 360S-B driving	2278-B□0□	543	-	10.0	-	04.0	-	-	06.0	-	-	-
αiS 60/3000 FAN αiS 60/3000 FAN-B	0278-B□1□ 2278-B□1□	328	03.0	01.0	02.0	01.0	28.0	04.0	02.0	D	A	02.0
αiS 60/3000 FAN-B αiSV 360S-B driving	2278-B□1□	544	-	10.0	-	04.0	-	-	06.0	-	-	-
αiS 100/2500	0285-B□0□	335	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αiS 100/2500 FAN	0285-B□1□	330	03.0	01.0	02.0	01.0	P	01.0	02.0	A	A	02.0
αiS 150/3000-B	2026	701	-	06.0	-	03.0	-	-	03.0	-	-	-
αiS 200/2500	0288-B□0□	338	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αiS 200/2500 FAN	0288-B□1□	334	03.0	01.0	02.0	01.0	P	01.0	02.0	A	A	02.0

NOTE

(20A) and (40A) indicate 20-A amplifier driving and 40-A amplifier driving, respectively.

αiS/αiS-B series servo motor (for 200-V driving, multiple windings)

Motor model	Motor specifi-cation	No. of windings	Motor ID No.	90G0	90J0 90K0	90GP	90JP	90D0 90E0	90E1	90M0 90M8	90C5 90E5	90C8 90E8	90H0
αiS 300/2000	0292	2	342	03.0	01.0	02.0	01.0	B	01.0	02.0	A	A	02.0
αiS 300/2000-B (NOTE)	2292	2	702	-	06.0	-	03.0	-	-	03.0	-	-	-
αiS 500/2000	0295	2	345	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αiS 500/2000-B (NOTE)	2295	2	703	-	06.0	-	03.0	-	-	03.0	-	-	-

NOTE
A servo amplifier (αiSV or αiPS) corresponding to the voltage information is required. For details, see Note 5 in Subsection 4.1.2.

αiF/αiF-B series servo motor (200-V driving)

Motor model	Motor specification	Motor ID No.	90G0	90J0 90K0	90GP	90JP	90D0 90E0	90E1	90M0 90M8	90C5 90E5	90C8 90E8	90H0
αiF 1/5000 (NOTE) αiF 1/5000-B	0202 2202	252 (20A)	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
		500 (40A)	-	10.0	-	04.0	-	-	06.0	-	-	-
αiF 2/5000 (NOTE) αiF 2/5000-B	0205 2205	255 (20A)	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
		501 (40A)	-	10.0	-	04.0	-	-	06.0	-	-	-
αiF 4/5000 (NOTE) αiF 4/5000-B	0223 2223	273 (40A)	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
		498 (80A)	-	10.0	-	04.0	-	-	06.0	-	-	-
αiF 8/3000 (NOTE) αiF 8/3000-B	0227 2227	277 (40A)	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
		499 (80A)	-	10.0	-	04.0	-	-	06.0	-	-	-
αiF 8/4000 αiF 8/4000-B	0228 2228	492	18.0	01.0	02.0	01.0	-	-	02.0	-	-	02.0
αiF 12/4000 αiF 12/4000-B	0243 2243	293	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αiF 22/3000 αiF 22/3000-B	0247 2247	297	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αiF 22/4000 αiF 22/4000-B	0248 2248	494	18.0	01.0	02.0	01.0	-	-	02.0	-	-	02.0
αiF 30/4000 αiF 30/4000-B	0253 2253	303	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αiF 40/3000 αiF 40/3000-B	0257-B□0□ 2257-B□0□	307	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αiF 40/3000 FAN αiF 40/3000 FAN-B	0257-B□1□ 2257-B□1□	308	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0

NOTE
(20A), (40A), and (80A) indicate 20-A amplifier driving, 40-A amplifier driving, and 80-A amplifier driving, respectively.

αiS/αiS-B series servo motor (400-V driving)

Motor model	Motor specification	Motor ID No.	90G0	90J0 90K0	90GP	90JP	90D0 90E0	90E1	90M0 90M8	90C5 90E5	90C8 90E8	90H0
αiS 2/5000HV (NOTE 1) αiS 2/5000HV-B	0213 2213	263 (10A)	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
		512 (20A)	-	10.0	-	04.0	-	-	06.0	-	-	-
αiS 2/6000HV (NOTE 1) αiS 2/6000HV-B	0219 2219	287 (10A)	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A	02.0
		513 (20A)	-	10.0	-	04.0	-	-	06.0	-	-	-
αiS 4/5000HV (NOTE 1) αiS 4/5000HV-B	0216 2216	266 (10A)	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
		514 (20A)	-	10.0	-	04.0	-	-	06.0	-	-	-
αiS 4/6000HV (NOTE 1) αiS 4/6000HV-B	0214 2214	467 (10A)	03.0	01.0	02.0	01.0	28.0	04.0	02.0	D	A	02.0
		515 (20A)	-	10.0	-	04.0	-	-	06.0	-	-	-
αiS 8/4000HV αiS 8/4000HV-B	0236 2236	286	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αiS 8/6000HV αiS 8/6000HV-B	0233 2233	292	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A	02.0
αiS 12/4000HV αiS 12/4000HV-B	0239 2239	289	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αiS 12/6000HV αiS 12/6000HV-B	0237 2237	463	03.0	01.0	02.0	01.0	27.0	01.0	02.0	D	A	02.0
αiS 22/4000HV αiS 22/4000HV-B	0266 2266	316	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αiS 22/6000HV αiS 22/6000HV-B	0263 2263	453	03.0	01.0	02.0	01.0	Q	01.0	02.0	A	A	02.0
αiS 30/4000HV αiS 30/4000HV-B	0269 2269	319	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αiS 40/4000HV αiS 40/4000HV-B	0273 2273	323	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αiS 50/2000HV αiS 50/2000HV-B	0043 2043	469	03.0	01.0	02.0	01.0	28.0	04.0	02.0	D	A	02.0
αiS 50/3000HV αiS 50/3000HV-B	0276-B□0□ 2276-B□0□	327	03.0	01.0	02.0	01.0	B	01.0	02.0	A	A	02.0
αiS 50/3000HV-B αiSV 180HVS-B driving	2276-B□0□	531	-	10.0	-	04.0	-	-	06.0	-	-	-
αiS 50/3000HV FAN αiS 50/3000HV FAN-B	0276-B□1□ 2276-B□1□	326	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αiS 50/3000HV FAN-B αiSV 180HVS-B driving	2276-B□1□	532	-	10.0	-	04.0	-	-	06.0	-	-	-
αiS 60/2000HV αiS 60/2000HV-B	0045 2045	471	03.0	01.0	02.0	01.0	28.0	04.0	02.0	D	A	02.0
αiS 60/3000HV αiS 60/3000HV-B	0279 2279-B□0□	457	-	06.0	-	03.0	-	-	03.0	-	-	-
αiS 60/3000HV-B αiSV 180HVS-B driving	2279-B□0□	533	-	10.0	-	04.0	-	-	06.0	-	-	-
αiS 60/3000HV FAN αiS 60/3000HV FAN-B	0279 2279-B□0□	329	03.0	01.0	02.0	01.0	28.0	04.0	02.0	D	A	02.0
αiS 60/3000HV FAN-B αiSV 180HVS-B driving	2279-B□1□	534	-	10.0	-	04.0	-	-	06.0	-	-	-
αiS 100/2500HV	0286-B□0□	336	03.0	01.0	02.0	01.0	B	01.0	02.0	A	A	02.0
αiS 100/2500HV FAN	0286-B□1□	331	03.0	01.0	02.0	01.0	P	01.0	02.0	A	A	02.0
αiS 150/3000HV-B	2027	704	-	06.0	-	03.0	-	-	03.0	-	-	-
αiS 200/2500HV	0289-B□0□	339	03.0	01.0	02.0	01.0	B	01.0	02.0	A	A	02.0
αiS 200/2500HV FAN	0289-B□1□	337	03.0	01.0	02.0	01.0	P	01.0	02.0	A	A	02.0
αiS 300/2000HV	0293	343	03.0	01.0	02.0	01.0	B	01.0	02.0	A	A	02.0
αiS 300/2000HV-B	2293	705	-	06.0	-	03.0	-	-	03.0	-	-	-
αiS 300/3000HV (NOTE 2) αiS 300/3000HV-B	0290 2290	344	03.0	01.0	02.0	01.0	28.0	04.0	02.0	F	A	02.0
αiS 500/2000HV	0296	346	03.0	01.0	02.0	01.0	B	01.0	02.0	A	A	02.0
αiS 500/2000HV-B	2296	706	-	06.0	-	03.0	-	-	03.0	-	-	-
αiS 500/3000HV (NOTE 2) αiS 500/3000HV-B	0297 2297	347	03.0	01.0	02.0	01.0	28.0	04.0	02.0	F	A	02.0

NOTE
1 (10A) and (20A) indicate 10-A amplifier driving and 20-A amplifier driving, respectively.
2 A servo amplifier (αiSV or αiPS) corresponding to the voltage information is required. For details, see Note 5 in Subsection 4.1.2.

αiS/αiS-B series servo motor (400-V driving, multiple windings)

Motor model	Motor specification	No. of windings	Motor ID No.	90G0	90J0 90K0	90GP	90JP	90D0 90E0	90E1	90M0 90M8	90C5 90E5	90C8 90E8	90H0
αiS 1000/2000HV	0298	2	348	03.0	01.0	02.0	01.0	B	01.0	02.0	A	A	02.0
αiS 1000/2000HV (NOTES 1 and 2) αiS 1000/2000HV-B	0098 2098	2	458	03.0	01.0	02.0	01.0	28.0	04.0	02.0	F	A	02.0
αiS 1000/3000HV (NOTES 1 and 2)	0099 2099	4	350 (PDM)	-	-	-	-	-	-	-	D	A	-
αiS 1000/3000HV-B			465	03.0	01.0	02.0	01.0	28.0	04.0	02.0	-	-	02.0
αiS 1500/3000HV-B	2097	4	707	-	06.0	-	03.0	-	-	03.0	-	-	-
αiS 2000/2000HV (NOTES 1 and 2)	0091	4	454 (PDM)	-	-	-	-	-	-	-	D	A	-
			459	03.0	01.0	02.0	01.0	28.0	04.0	02.0	-	-	02.0
αiS 2000/2000HV (NOTES 1 and 2) For spindle use	0091	4	476	12.0	01.0	02.0	01.0	33.0	10.0	02.0	F	D	02.0
αiS 3000/2000HV (NOTE)	0092	4	455 (PDM)	-	-	-	-	-	-	-	D	A	-
			460	03.0	01.0	02.0	01.0	28.0	04.0	02.0	-	-	02.0

NOTE
1 A servo amplifier (αiSV or αiPS) corresponding to the voltage information is required. For details, see Note 5 in Subsection 4.1.2.
2 The number followed by (PDM) is used as the motor number in a configuration in which a PWM distribution module (PDM) is used.

αiF/αiF-B series servo motor (400-V driving)

Motor model	Motor specification	Motor ID No.	90G0	90J0 90K0	90GP	90JP	90D0 90E0	90E1	90M0 90M8	90C5 90E5	90C8 90E8	90H0
αiF 4/5000HV αiF 4/5000HV-B	0225 2225	275 (20A)	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
		516 (40A)	-	10.0	-	04.0	-	-	06.0	-	-	-
αiF 8/3000HV αiF 8/3000HV-B	0229 2229	279 (20A)	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
		517 (40A)	-	10.0	-	04.0	-	-	06.0	-	-	-
αiF 8/4000HV αiF 8/4000HV-B	0220 2220	493	18.0	01.0	02.0	01.0	-	-	02.0	-	-	02.0
αiF 12/4000HV αiF 12/4000HV-B	0245 2245	295	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αiF 22/3000HV αiF 22/3000HV-B	0249 2249	299	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αiF 22/4000HV αiF 22/4000HV-B	0240 2240	495	18.0	01.0	02.0	01.0	-	-	02.0	-	-	02.0
αiF 30/3000HV αiF 30/3000HV-B	0255 2255	304	12.0	01.0	02.0	01.0	33.0	10.0	02.0	F	C	02.0
αiF 40/3000HV αiF 40/3000HV-B	0259-B□0□ 2259-B□0□	309	12.0	01.0	02.0	01.0	33.0	10.0	02.0	F	C	02.0
αiF 40/3000HV FAN αiF 40/3000HV FAN-B	0259-B□1□ 2259-B□1□	479	12.0	01.0	02.0	01.0	33.0	10.0	02.0	F	C	02.0

NOTE
(20A) and (40A) indicate 20-A amplifier driving and 40-A amplifier driving, respectively.

αCi series servo motor

Motor model	Motor specification	Motor ID No.	90G0	90J0 90K0	90GP	90JP	90D0 90E0	90E1	90M0 90M8	90C5 90E5	90C8 90E8	90H0
αC4/3000i	0221	271	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αC8/2000i	0226	276	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αC12/2000i	0241	291	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αC22/2000i	0246	296	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
αC30/1500i	0251	301	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0

βiS/βiS-B series servo motor

Motor model	Motor specification	Amplifier driving	Motor ID number	90G0	90J0 90K0	90GP	90JP	90D0 90E0	90E1	90M0 90M8	90C5 90E5	90C8 90E8	90H0
βiS 0.2/5000	0111	4A	260	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
βiS 0.3/5000	0112	4A	261	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
βiS 0.4/5000	0114	20A	280	03.0	01.0	02.0	01.0	A	01.0	02.0	A	A	02.0
βiS 0.4/5000-B	2114	40A	506	-	10.0	-	04.0	-	-	06.0	-	-	-
βiS 0.5/6000	0115	20A	281	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A	02.0
βiS 0.5/6000-B	2115	40A	507	-	10.0	-	04.0	-	-	06.0	-	-	-
βiS 0.5/6000-B	2015	20A	545	-	17.0	-	07.0	-	-	08.0	-	-	-
βiS 1/6000	0116	20A	282	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A	02.0
βiS 1/6000-B	2116	40A	508	-	10.0	-	04.0	-	-	06.0	-	-	-
βiS 1/6000-B	2017	20A	547	-	17.0	-	07.0	-	-	08.0	-	-	-
βiS 1.5/6000-B	2019	20A	549	-	17.0	-	07.0	-	-	08.0	-	-	-
βiS 2/4000	0061	20A	253	03.0	01.0	02.0	01.0	B	01.0	02.0	A	A	02.0
βiS 2/4000-B	2061	40A	254	03.0	01.0	02.0	01.0	B	01.0	02.0	A	A	02.0
βiS 4/4000	0063	20A	256	03.0	01.0	02.0	01.0	B	01.0	02.0	A	A	02.0
βiS 4/4000-B	2063	40A	257	03.0	01.0	02.0	01.0	B	01.0	02.0	A	A	02.0
βiS 8/3000	0075	20A	258	03.0	01.0	02.0	01.0	B	01.0	02.0	A	A	02.0
βiS 8/3000-B	2075	40A	259	03.0	01.0	02.0	01.0	B	01.0	02.0	A	A	02.0
βiS 12/2000	0077	20A	269	03.0	01.0	02.0	01.0	K	01.0	02.0	A	A	02.0
βiS 12/2000-B	2077	40A	268	03.0	01.0	02.0	01.0	P	01.0	02.0	A	A	02.0
βiS 12/3000	0078	40A	272	03.0	01.0	02.0	01.0	B	01.0	02.0	A	A	02.0
βiS 12/3000-B	2078	80A	477	12.0	01.0	02.0	01.0	33.0	10.0	02.0	F	C	02.0
βiS 22/2000	0085	40A	274	03.0	01.0	02.0	01.0	B	01.0	02.0	A	A	02.0
βiS 22/2000-B	2085	80A	478	12.0	01.0	02.0	01.0	33.0	10.0	02.0	F	C	02.0
βiS 22/3000 βiS 22/3000-B	0082 2082	80A	313	03.0	01.0	02.0	01.0	Q	01.0	02.0	A	A	02.0
βiS 22/3000-B Torque Up	2082	80A	535	-	10.0	-	04.0	-	-	06.0	-	-	-
βiS 30/2000 βiS 30/2000-B	0087 2087	80A	472	03.0	01.0	02.0	01.0	29.0	05.0	02.0	F	A	02.0
βiS 30/2000-B Torque Up	2087	80A	537	-	10.0	-	04.0	-	-	06.0	-	-	-
βiS 40/2000 βiS 40/2000-B	0089 2089	80A	474	03.0	01.0	02.0	01.0	29.0	05.0	02.0	F	A	02.0
βiS 40/2000-B Torque Up	2089	80A	539	-	10.0	-	04.0	-	-	06.0	-	-	-

βiS/βiS-B series servo motor (400-V driving)

Motor model	Motor specification	Amplifier driving	Motor ID number	90G0	90J0 90K0	90GP	90JP	90D0 90E0	90E1	90M0 90M8	90C5 90E5	90C8 90E8	90H0
βiS 0.5/6000HV-B	2016	10A	546	-	17.0	-	07.0	-	-	08.0	-	-	-
βiS 1/6000HV-B	2018	10A	548	-	17.0	-	07.0	-	-	08.0	-	-	-
βiS 1.5/6000HV-B	2020	10A	550	-	17.0	-	07.0	-	-	08.0	-	-	-
βiS 2/4000HV	0062	10A	251	03.0	01.0	02.0	01.0	J	01.0	02.0	A	A	02.0
βiS 2/4000HV-B	2062	20A	518	-	10.0	-	04.0	-	-	06.0	-	-	-
βiS 4/4000HV	0064	10A	264	03.0	01.0	02.0	01.0	J	01.0	02.0	A	A	02.0
βiS 4/4000HV -B	2064	20A	519	-	10.0	-	04.0	-	-	06.0	-	-	-
βiS 8/3000HV	0076	10A	267	03.0	01.0	02.0	01.0	J	01.0	02.0	A	A	02.0
βiS 8/3000HV -B	2076	20A	520	-	10.0	-	04.0	-	-	06.0	-	-	-
βiS 12/3000HV	0079	20A	270	03.0	01.0	02.0	01.0	J	01.0	02.0	A	A	02.0
βiS 12/3000HV -B	2079	40A	521	-	10.0	-	04.0	-	-	06.0	-	-	-
βiS 22/2000HV	0086	20A	278	03.0	01.0	02.0	01.0	J	01.0	02.0	A	A	02.0
βiS 22/2000HV -B	2086	40A	522	-	10.0	-	04.0	-	-	06.0	-	-	-
βiS 22/3000HV βiS 22/3000HV -B	0083 2083	40A	314	03.0	01.0	02.0	01.0	Q	01.0	02.0	A	A	02.0
βiS 22/3000HV –B Torque Up	2083	40A	536	-	10.0	-	04.0	-	-	06.0	-	-	-
βiS 30/2000HV βiS 30/2000HV -B	0088 2088	40A	473	03.0	01.0	02.0	01.0	29.0	05.0	02.0	F	A	02.0
βiS 30/2000HV –B Torque Up	2088	40A	538	-	10.0	-	04.0	-	-	06.0	-	-	-
βiS 40/2000HV βiS 40/2000HV -B	0090 2090	40A	475	03.0	01.0	02.0	01.0	29.0	05.0	02.0	F	A	02.0
βiS 40/2000HV βiS 40/2000HV –B Torque Up	2090	40A	540	-	10.0	-	04.0	-	-	06.0	-	-	-

βiSc/βiSc-B series servo motor

Motor model	Motor specification	Amplifier driving	Motor ID number	90G0	90J0 90K0	90GP	90JP	90D0 90E0	90E1	90M0 90M8	90C5 90E5	90C8 90E8	90H0
βiSc 2/4000	0061-B□□7	20A	306	03.0	01.0	02.0	01.0	K	01.0	02.0	A	A	02.0
βiSc 2/4000-B	2061-B□□7	40A	310	03.0	01.0	02.0	01.0	K	01.0	02.0	A	A	02.0
βiSc 4/4000	0063-B□□7	20A	311	03.0	01.0	02.0	01.0	K	01.0	02.0	A	A	02.0
βiSc 4/4000-B	2063-B□□7	40A	312	03.0	01.0	02.0	01.0	K	01.0	02.0	A	A	02.0
βiSc 8/3000	0075-B□□7	20A	283	03.0	01.0	02.0	01.0	K	01.0	02.0	A	A	02.0
βiSc 8/3000-B	2075-B□□7	40A	294	03.0	01.0	02.0	01.0	K	01.0	02.0	A	A	02.0
βiSc 12/2000	0077-B□□7	20A	298	03.0	01.0	02.0	01.0	K	05.0	02.0	A	A	02.0
βiSc 12/2000-B	2077-B□□7	40A	300	03.0	01.0	02.0	01.0	P	05.0	02.0	A	A	02.0
βiSc 12/3000	0078-B□□7	40A	496	23.0	02.0	03.0	02.0	-	-	02.0	-	F	02.0
βiSc 12/3000-B	2078-B□□7	80A	497	23.0	02.0	03.0	02.0	-	-	02.0	-	F	02.0
βiSc 22/2000	0085-B□□7	40A	481	23.0	02.0	03.0	02.0	-	-	02.0	-	F	02.0
βiSc 22/2000-B	2085-B□□7	80A	482	23.0	02.0	03.0	02.0	-	-	02.0	-	F	02.0

βiSc/βiSc-B series servo motor (400-V driving)

Motor model	Motor specification	Amplifier driving	Motor ID number	90G0	90J0 90K0	90GP	90JP	90D0 90E0	90E1	90M0 90M8	90C5 90E5	90C8 90E8	90H0
βiSc 2/4000HV	2062-B□□7	10A	523	-	10.0	-	04.0	-	-	06.0	-	-	-
		20A	524	-	10.0	-	04.0	-	-	06.0	-	-	-
βiSc 4/4000HV	2064-B□□7	10A	525	-	10.0	-	04.0	-	-	06.0	-	-	-
		20A	526	-	10.0	-	04.0	-	-	06.0	-	-	-
βiSc 8/3000HV-B	2076-B□□7	10A	527	-	10.0	-	04.0	-	-	06.0	-	-	-
		20A	528	-	10.0	-	04.0	-	-	06.0	-	-	-
βiSc 12/3000HV-B	2079-B□□7	20A	529	-	10.0	-	04.0	-	-	06.0	-	-	-
		40A	530	-	10.0	-	04.0	-	-	06.0	-	-	-

βiF/βiF-B series servo motor

Motor model	Motor specifi-cation	Ampli-fier driving	Motor ID number	90G0	90J0 90K0 90JP	90GP	90JP	90D0 90E0	90E1	90M0 90M8	90C5 90E5	90C8 90E8	90H0
βiF 4/3000	0051	20A	483	18.0	01.0	02.0	01.0	-	-	02.0	-	04.0	02.0
βiF 4/3000 -B	2051	40A	484	18.0	01.0	02.0	01.0	-	-	02.0	-	04.0	02.0
βiF 8/2000	0052	20A	485	18.0	01.0	02.0	01.0	-	-	02.0	-	04.0	02.0
βiF 8/2000 -B	2052	40A	486	18.0	01.0	02.0	01.0	-	-	02.0	-	04.0	02.0
βiF 12/2000	0053	20A	487	18.0	01.0	02.0	01.0	-	-	02.0	-	04.0	02.0
βiF 12/2000 -B	2053	40A	488	18.0	01.0	02.0	01.0	-	-	02.0	-	04.0	02.0
βiF 22/2000	0054	40A	489	18.0	01.0	02.0	01.0	-	-	02.0	-	04.0	02.0
βiF 22/2000 -B	2054	80A	490	18.0	01.0	02.0	01.0	-	-	02.0	-	04.0	02.0
βiF 30/1500 βiF 30/1500 -B	0055 2055	80A	491	18.0	01.0	02.0	01.0	-	-	02.0	-	04.0	02.0

NOTE

The response of the βi-B/βi servo motor is twice as high as the αi-B/αi servo motor when their velocity loop gains are set to the same value in the motor-specific standard parameter setting. This means that the βi-B/βi servo motor can have response that is as high as the αi-B/αi with half the velocity loop gain value.
Example: The same gain is achieved in control when the velocity loop gain of the αi-B/αi is set to 200% on the SERVO SETTING screen and when the velocity loop gain of the βi-B/βi is set to 100% on the SERVO SETTING screen.

(4) AMR setting

Set a setting value from the following table for AMR.

Motor type	AMR setting
αiS/αiF/βiS/βiF motor (except αiS2000HV and αi S3000HV)	00000000
αiS2000HV(-B), αiS3000HV(-B)	00001000

(5) CMR setting

Set a specified magnification for the amount of movement from the CNC to the servo system for CMR.

1820	CMR

CMR = Command unit / Detection unit

CMR 1/2 to 48	Setting value = CMR × 2

Usually, set CMR to 2 for parameter No. 1820, because command unit = detection unit (CMR = 1).
If the detection unit may be a special value, you can enable arbitrary command multiplier (option) and specify numerator N and denominator M of command-unit/detection unit = N/M for parameters Nos. 1822 and 1823, respectively. A value of 1 or greater must be specified for parameters Nos. 1822 and 1823.

Valid data range of CMR when arbitrary command multiply is enabled

CMR 1/9999 to 9999/1	Setting value = CMR

(6) Flexible feed gear setting

Specify the flexible feed gear (FFG).

2084	**Numerator of the FFG**
2085	**Denominator of the FFG**

This function makes it easy to specify a detection unit for the leads and gear reduction ratios of various ball screws by changing the number of position feedback pulses from the Pulsecoder or separate detector. It converts the incoming number of pulses from the position detector so that it matches the commanded number of pulses.
For linear motors, set these parameters according to the description in Section 3.1, "LINEAR MOTOR PARAMETER SETTING".
For DD motors, set these parameters according to the description in Section 3.2, "DD MOTOR PARAMETER SETTING".

(a) Flexible feed gear (semi-closed system)

Setting for the αi Pulsecoder

$$\frac{\text{FFG numerator } (\leq 32767)\ \downarrow \text{(NOTE 1)}}{\text{FFG denominator } (\leq 32767)} = \frac{\text{Necessary number of position pulses per motor revolution}}{1{,}000{,}000 \leftarrow \text{(NOTE 2)}} \text{ (as an irreducible fraction)}$$

NOTE
1. For both the FFG numerator and denominator, the maximum setting value is 32767.
2. When the αi Pulsecoder is used, the FFG is assumed to be set to 1 million pulses per motor revolution, regardless of its resolution.
3. If the calculation of the number of pulses required per motor revolution involves π, such as when a rack and pinion are used, assume π to be approximately 355/113.

Setting example

If a ball screw used for direct coupling has a lead of 5 mm/rev and a detection unit of 1 μm
The number of pulses per motor revolution (5 mm) is: 5/0.001 = 5,000 (pulses)
Because the αi Pulsecoder feeds back 1,000,000 pulses per motor turn: FFG = 5,000 / 1,000,000 = 1 / 200

Other FFG (numerator/denominator) setting examples, where the gear reduction ratio is assumed to be 1:1

Detection unit	Ball screw lead					
	6mm	8mm	10mm	12mm	16mm	20mm
1 μm	6/1000	8/1000	10/1000	12/1000	16/1000	20/1000
0.5 μm	12/1000	16/1000	20/1000	24/1000	32/1000	40/1000
0.1 μm	60/1000	80/1000	100/1000	120/1000	160/1000	200/1000

Setting example

If the gear reduction ratio between the rotary axis motor and table is 10:1 and the detection unit is 1/1,000 degrees

The table rotates through 360/10 degrees when the motor makes one turn.
The number of position pulses per motor revolution is: 360/10 / (1/1000) = 36,000 pulses

$$\frac{\text{Numerator of the FFG}}{\text{Denominator of the FFG}} = \frac{36{,}000}{1{,}000{,}000} = \frac{36}{1{,}000}$$

Setting example

If the gear reduction ratio between the rotary axis motor and table is 300:1 and the detection unit is 1/10,000 degrees

The table rotates through 360/300 degrees when the motor makes one turn.

The number of position pulses per motor revolution is: 360/300 / (1/10,000) = 12,000 pulses

$$\frac{\text{Numerator of the FFG}}{\text{Denominator of the FFG}} = \frac{12{,}000}{1{,}000{,}000} = \frac{12}{1{,}000}$$

Setting example

If a rack and pinion are used in direct coupling, the radius of the pinion is 10 mm, and the detection unit is 1 μm

The rack moves by 20π mm when the motor makes one turn.

The number of pulses per motor revolution is 20π / 0.001 ≈ (20 × 355/113) / 0.001 = 7,100,000 / 113 (pulses)

$$\frac{\text{Numerator of the FFG}}{\text{Denominator of the FFG}} = \frac{7{,}100{,}000}{1{,}000{,}000 \times 113} = \frac{71}{1{,}130}$$

(b) Flexible feed gear (full-closed system)

$$\frac{\text{FFG numerator } (\leq 32767)}{\text{FFG denominator } (\leq 32767)} = \frac{\text{Number of position pulses corresponding to a predetermined amount of travel}}{\text{Number of position pulses corresponding to a predetermined amount of travel from a separate detector}} \quad \text{(as an irreducible fraction)}$$

Setting example

To detect a distance of 1 μm using a 0.5-μm scale, set the following:

$$\frac{\text{Numerator of the FFG}}{\text{Denominator of the FFG}} = \frac{L / 1}{L / 0.5} = \frac{1}{2}$$

(L represents a constant distance.)

Other FFG (numerator/denominator) setting examples

Detection unit	Scale resolution			
	1 μm	0.5 μm	0.1 μm	0.05 μm
1 μm	1/1	1/2	1/10	1/20
0.5 μm	-	1/1	1/5	1/10
0.1 μm	-	-	1/1	1/2

NOTE

The maximum rotation speed allowable with servo control software depends on the detection unit. (See Appendix D, "VELOCITY LIMIT VALUES BY SOFTWARE".)

Select a detection unit that enables a requested maximum rotation speed to be realized.

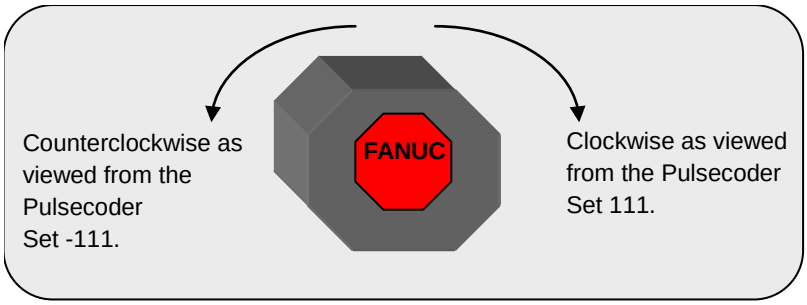
When a speed of up to 6000 revolutions is used as a live tool, in particular, use a detection unit of 2/1000 deg (IS-B setting, CMR=1/2, flexible feed gear=18/100).

(7) Motor rotation direction setting

Set the direction in which the motor is to turn when a positive value is specified as a move command.
For linear motors, set the parameter according to the description in Section 3.1, "LINEAR MOTOR PARAMETER SETTING".
For DD motors, set these parameters according to the description in Section 3.2, "DD MOTOR PARAMETER SETTING".

2022	Direction of movement

Standard setting value	Direction of movement
111	Clockwise as viewed from the Pulsecoder
–111	Counterclockwise as viewed from the Pulsecoder



(8) Specify the number of velocity pulses and the number of position pulses.

Set the number of velocity pulses and the number of position pulses according to the connected detector.
For linear motors, set the parameter according to the description in Section 3.1, "LINEAR MOTOR PARAMETER SETTING".
For DD motors, set these parameters according to the description in Section 3.2, "DD MOTOR PARAMETER SETTING".

(a) Number of velocity pulses

2023	Number of velocity pulses

Set the number of velocity pulses to 8192.

αiS/αiF/βiS/βiF motor	8192

(b) Number of position pulses

2024	Number of position pulses

(b.1) Number of position pulses (semi-closed system)

Set the number of position pulses to 12500.

Number of position pulses (αiS/αiF/βiS/βiF motor, semi-closed system)	12500

(b.2) Number of position pulses (full-closed system)

Set the number of position pulses to the number of pulses fed back from the separate detector when the motor makes one turn. (The flexible feed gear has nothing to do with the calculation of the number of position pulses.)

Number of position pulses (full-closed system)	Number of pulses fed back from the separate detector when the motor makes one turn

When using a serial rotary scale with a resolution of 1,000,000 pulses per revolution, set the value obtained using the following formula:

Number of position pulses (full-closed system) (*) 1,000,000 pulses / rev	12,500 × (motor-table gear reduction ratio)

Example 1: Serial linear scale
If the ball screw used in direct coupling has a lead of 10 mm and the separate detector used has a resolution of 0.5 μm per pulse
Number of position pulses = 10 / 0.0005 = 20,000

Example 2: Serial rotary scale
If the motor-table gear reduction ratio is 10:1,
Number of position pulses = 12,500 × (1/10) = 1,250

Example 3: Serial rotary scale
If the motor-table gear reduction ratio is indivisible by 7:1,
Number of position pulses = 12,500 × (1/7) = 1785.714286 ≈ 1786 (rounded to the nearest integer)

NOTE

1 If the calculated number of position pulses is not an integer, set the nearest integer.
Let the calculated value be P and its nearest integer be P'. Then, the position gain and feed-forward coefficient are multiplied by P/P'. If the gear reduction ratio is large and the calculated value is small, they are largely affected. If there is a problem, make a fine adjustment by specifying an appropriate value for the position gain (parameter No. 1825) and feed-forward coefficient (parameter No. 2092).

2 For the settings applicable when the separate detector is used, see Subsection 2.1.4 as well.

(b.3) If the setting for the number of position pulses is larger than 32767

If the number of position pulses exceeds 32767, set the number of position pulses with a product of two parameters, using the conversion coefficient for the number of position feedback pulses.

2185	Conversion coefficient for the number of position feedback pulses

→ See Supplementary 3 of Subsection 2.1.5.

NOTE

By setting initialization bit 0 of No. 2000 to 1, the number of velocity pulses and the number of position pulses can be internally increased by a factor of 10. Usually, however, set bit 0 of No. 2000 to 0. If the number of position pulses is beyond the setting range, use a position pulse conversion coefficient (parameter No. 2185). Only when the number of velocity pulses exceeds 32767, set bit 0 of No. 2000 to 1, set the number of velocity pulses to one-tenth of the value that was to be set originally, and also set the number of position pulses to one-tenth of the value that was to be set originally.

(9) Reference counter setting

Specify the reference counter.

1821	Reference counter capacity

The reference counter is used in returning to the reference position by the grid method.

(a) Reference counter (semi-closed system)

(Linear axis)

Count on the reference counter = Number of position pulses per motor revolution or the same number divided by an integer value

(Rotary axis)

Count on the reference counter = Number of position pulses per motor revolution/N, or the same number divided by an integer value

* When the motor-table gear reduction ratio is N/D (N and D are integers, and N/D is a fraction that is reduced to lowest terms.)

NOTE

1 If the calculation above results in a fraction, a setting can be made with a fraction. See (a)-1.

2 For the rotary axis, the formula above needs to be changed as follows.

$$\frac{\text{Number of position pulses per motor revolution}}{\text{Reference counter}} = \text{N (integer)}$$

If the result is not an integer multiple, alarm DS0405 is issued. To avoid the alarm, adjust the capacity of the reference counter so that the result of the division becomes an integer, as shown in the example below.

(Example)

When the number of position pulses per motor revolution is 120000 and parameter Nos. 1821 and 2179 are set to 100000 and 97, respectively
Since the capacity of the reference counter is represented by the ratio of the value of parameter No. 1821 to the value of parameter No. 2179, the result of the division is as follows.

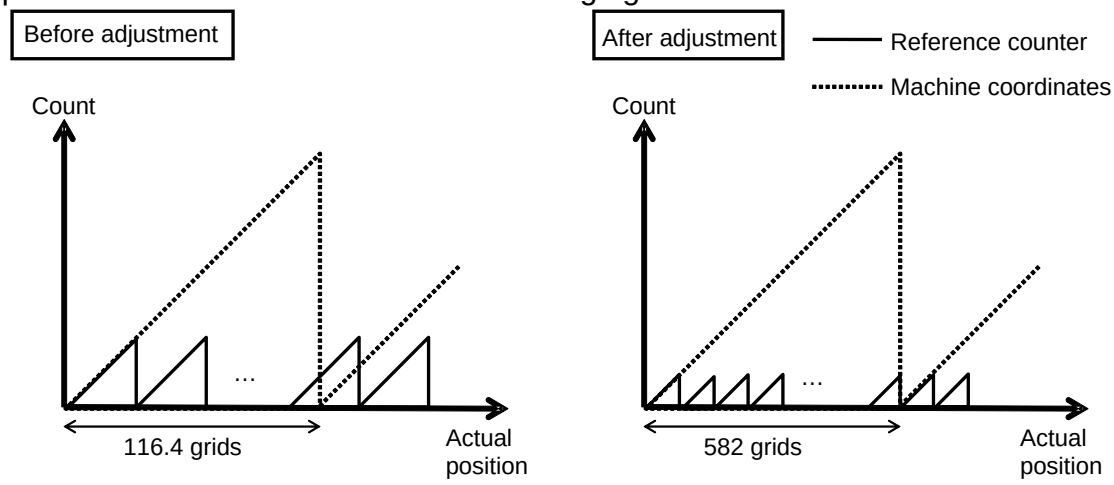
$$\frac{\text{Number of position pulses per motor revolution}}{\text{Reference counter}} = \frac{120000}{100000 / 97} = 116.4 \text{ (with a fraction)}$$

To clear the alarm, reduce the capacity of the reference counter to one-fifth (No. 1821 = 20000).
This makes the result of the division the value shown below.

$$\frac{120000}{20000 / 97} = 582 \text{ (integer)}$$

And the DS0405 alarm can be avoided.

When seen from the viewpoint of machine motion, this means that the point at which the reference counter returns to 0 (grid point) always appears in the same position relative to the table. The following figures show this.



Setting example

αi Pulsecoder and semi-closed system (1-μm detection)

Ball screw lead (mm/revolution)	Necessary number of position pulses (pulse/revolution)	Reference counter	Grid width (mm)
10	10000	10000	10
20	20000	20000	20
30	30000	30000	30

When the number of position pulses per motor revolution does not agree with the reference counter setting, the position of the zero point depends on the start point.
In such a case, set the reference counter capacity with a fraction to change the detection unit and eliminate the error in the reference counter.

Setting example

System using a detection unit of 1 μm, a ball screw lead of 20 mm/revolution, and a gear reduction ratio of 1/17
To eliminate the error of the reference counter, two methods of setting are available:
(a)-1 Method that sets a reference counter capacity with a fraction
(a)-2 Method that changes the detection unit
An example of each setting method is explained below.

(a.1) Method of specifying the reference counter capacity with a fraction

The number of position pulses per motor revolution is: 20000/17
Set the following parameter as stated below.

1821	Reference counter capacity (numerator)

[Valid range] 0 to 999999999
Set the numerator of a fraction for the reference counter capacity.

2179	Reference counter capacity (denominator)

[Valid range] 0 to 100
A value up to around 100 is assumed to be set as the denominator of the reference counter capacity. If a larger value is set, the grid width becomes too small, which makes it difficult to perform reference position return by the grid method. In addition, the processing time of the servo control software increases, which may cause a system alarm. For this reason, if a value of 101 or greater is set as the denominator, an invalid ordinary parameter alarm (detail No. 1793) is issued. (*1)
The denominator parameter is not indicated on the servo setting screen, so it must be set in the parameter screen.
In this example, set the numerator and denominator, respectively, to 20000 and 17.

(*1) 30i-B Series and 0i-F Series are not subject to any restrictions on the denominator setting (no invalid parameter alarm is issued).

NOTE
Even if a setting is made with a fraction, set “the number of position pulses per motor revolution/N” for a semi-closed loop rotary axis when the reduction ratio is N/D.
Reference counter = Number of position pulses corresponding to a single motor revolution/N, or
the same number divided by an integer value

If you want to set a value greater than 100 as the reference counter capacity (denominator), you can set the following parameter to disable invalid parameter detection.

	#7	#6	#5	#4	#3	#2	#1	#0
2299			IGNRFA					

IGNRFA(#5) The detection of an invalid parameter set for the denominator of the reference counter capacity is:
0: Performed
1: Not performed
* If this function bit is set, the power must be turned off before operation is continued.

NOTE
If an invalid parameter alarm (detail No. 1793) may be issued according to the status, setting IGNRFA = 1 may cause a system alarm. In this case, set IGNRFA to 0.

(a.2) Method of changing the detection unit

The number of position pulses per motor revolution is: 20000/17
In this case, increase all the following parameter values by a factor of 17, and set the detection unit to 1/17 μm.

Parameter modification		FS 30*i*, etc., FS0 *i*-F, 0*i*-D, etc.
FFG	× 17	Servo screen
CMR	× 17	Servo screen
Reference counter	× 17	Servo screen
In-position width	× 17	No. 1826, 27
Position error limit in traveling	× 17	No. 1828
Position error limit in the stop state	× 17	No. 1829
Conventional backlash compensation	× 17	No. 1851, 52

Since the detection unit has been changed from 1 μm to 1/17 μm, the values of all those parameters that are affected by the change in the detection unit need to be multiplied by 17.

⚠ CAUTION
Other than those shown above, there are parameters that are affected by the change in the detection unit. For details, see Appendix B.

Making these modifications eliminates the difference between the number of position pulses per motor revolution and the reference counter setting.
Number of position pulses per motor revolution = 20000
Reference counter setting = 20000

(b) Reference counter (full-closed system)

Reference counter setting =	Z-phase (reference-position) interval divided by the detection unit, or this value sub-divided by an integer value

NOTE
1 If the separate detector-table rotation ratio for the rotary axis is not an integer, it is necessary to set the reference counter capacity in such a way that points where reference counter = 0 (grid points) always appear at the same position for the table.
2 For the settings applicable when the separate detector is used, see Subsection 2.1.4 as well.

Setting example

Example 1) When the Z-phase interval is 50 mm and the detection unit is 1 μm:
Reference counter setting = 50,000/1 = 50,000

Example 2) When a rotary axis is used and the detection unit is 0.001 degrees:
Reference counter setting = 360/0.001 = 360,000

Example 3) When a linear scale is used and a single Z phase exists:
Set the reference counter to 10000, 50000, or another round number.

If the calculated value of the reference counter capacity is not an integer, the reference counter capacity can be set as a fraction as in the case of a semi-closed system. For details of parameters, see (a)-1.

NOTE

The following value can be set as a reference counter capacity:

(For linear axis)
Number of position pulses corresponding to the Z-phase interval of a separate detector (or the same number divided by an integer)

(For rotary axis)
Number of position pulses per revolution of a separate detector/N* (or the same number divided by an integer)

* When the rotation ratio between the table and separate detector is N/D. (N and D are integers, and N/D is a fraction that is reduced to lowest terms.)

(10) Full-closed system setting

For a semi-closed system, this setting is unnecessary. Go to (11).

For a full-closed system, you need the set the following function bits:

	#7	#6	#5	#4	#3	#2	#1	#0
1815							OPTx	

OPTx(#1) The separate position detector is:
0: Not to be used (semi-closed)
1: To be used (full-closed)

If you want to connect the separate detector signal in the reverse direction, set the following parameter:

	#7	#6	#5	#4	#3	#2	#1	#0
2018								RVRSE

RVRSE (#0) The signal direction of the separate detector is:
0: Not reversed.
1: Reversed.

NOTE

For a full-closed system, the use of the function for monitoring the difference in error between the semi-closed and full-closed modes is recommended. This function monitors the difference between the motor position and scale position. See Subsection 2.1.8.1, "Monitoring the difference in error between the semi-closed and full-closed modes" for details.

(11) Servo loop gain setting

Set a value other than 0 as the servo loop gain. Usually, set an initial value of 3000 (30 [sec^{-1}]) to 5000 (50 [sec^{-1}]). This initial value is adjusted later as needed.

1825	Servo loop gain

[Setting unit] 0.01 [sec^{-1}]
[Recommended value] 5000 (semi-closed)
3000 (full-closed)

NOTE
- When a servo loop gain of 0 is set, an illegal servo parameter setting alarm is issued.
- If there is a problem such as vibration occurring at the time of motor rotation after the CNC is started, perform servo tuning according to Chapter 4.

(12) CNC restart

After the CNC is turned off and on again, bit 1 of parameter No. 2000 (DGPR) is set to "1".
This completes servo parameter initialization. If an illegal servo parameter alarm occurs, go to Subsection 2.1.6.
If a servo alarm related to Pulsecoders occurs for an axis for which a servo motor or amplifier is not connected, specify the following parameter.

	#7	#6	#5	#4	#3	#2	#1	#0
2009								DMY

DMY (#0) The serial feedback dummy function is:
0: Not to be used.
1: Used
(See Appendix H.1, "SERIAL FEEDBACK DUMMY FUNCTIONS" for details on the functions.)

(13) Absolute position detector setting

When you are going to use an αi/βi Pulsecoder as an absolute Pulsecoder, use the following procedure.

Procedure
1. Set the following parameter, then turn the CNC off.

	#7	#6	#5	#4	#3	#2	#1	#0
1815			APCx					

APCx (#5) The absolute position detector is:
0: Not to be used
1: Used

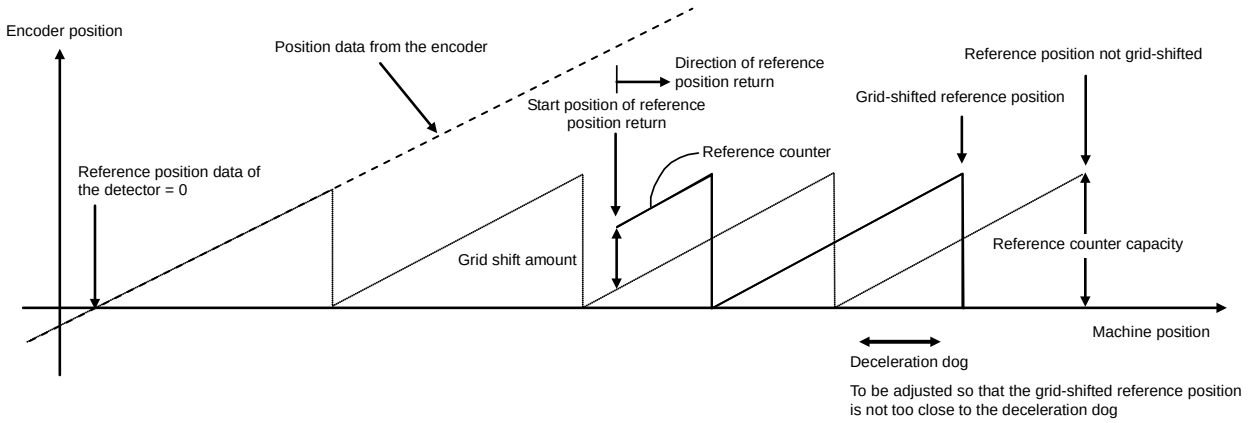
2. After making sure that the battery for the Pulsecoder is connected, turn on the CNC.
3. A request to return to the reference position is displayed.
4. Jog the servo motor to make one full turn.
5. Turn the CNC off and on again.
6. A request to return to the reference position is displayed.
7. Perform the reference position return.

NOTE

- When using a FANUC absolute Pulsecoder as an absolute position detector and making a setting so that the machine coordinate values on a rotary axis are rounded to 0° to 360°, set bit 6 of parameter No. 1815 (RON) to 0.
- If you want to use a detector with no multi-turn data for a rotary encoder supplied by third party for absolute position detection, refer to "CORRESPONDENCE OF ROTARY SCALE WITHOUT ROTARY DATA" in "FANUC Series 30*i*/31*i*/32*i*-MODEL B CONNECTION MANUAL (FUNCTION) (B-64483EN-1)" and make an appropriate setting according to the detector.
  (See also Subsection 2.1.4.1, "Setting parameters when a separate detector for the serial interface is used".)
- If the correct setting is not made, the machine coordinates are not established correctly at power-on.

(a) Reference position return when a serial type separate detector is used as an absolute-position detector

When a serial type separate detector is used as an absolute-position detector, the Z-phase position must be passed once before a reference position return is performed. Then, turn the CNC off then back on to allow reference position return.
(This description does not apply if a detector that does not require battery backup is in use.)
When reference position return is performed, adjust the deceleration dog so that the grid-shifted reference position is not too close to the deceleration dog.



2.1.3 Servo Parameter Initialization Procedure for the 0*i*-F/D

2.1.3.1 PARAMETER SETTING SUPPORT screen (SERVO SETTING)

(1) Displaying the SERVO SETTING screen and entering a value for each setting item

On the PARAMETER SETTING SUPPORT screen, select "SERVO SETTING" to display the SERVO SETTING screen.

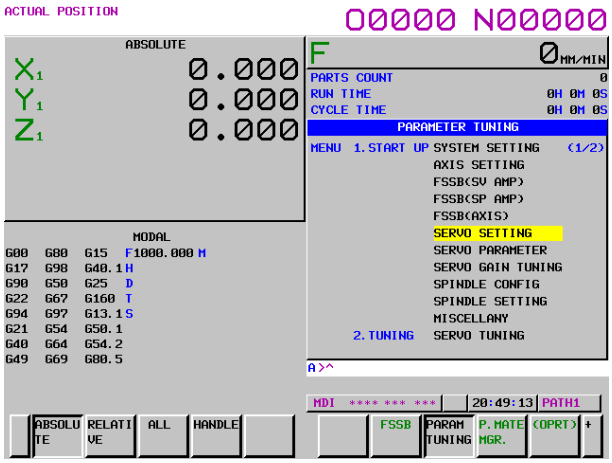


Fig. 2.1.3.1 (a) 0*i*-F PARAMETER SETTING SUPPORT screen

The SERVO SETTING screen consists of two pages. Enter physical constants including the gear ratio and ball screw lead according to the help message. For the motor number, see "(3) Motor ID No. setting" in Subsection 2.1.2.

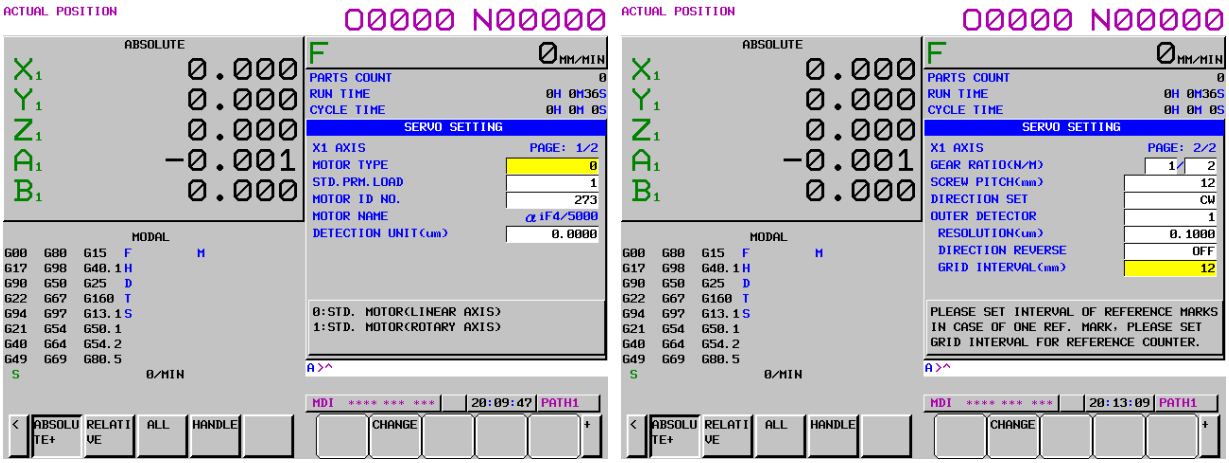


Fig. 2.1.3.1 (b) 0*i*-F PARAMETER SETTING SUPPORT screen (SERVO SETTING)

After you have entered values for all items, press the [SET] soft key. The flexible feed gear, number of position pulses, number of velocity pulses, and other values are calculated and they are automatically set for the parameters listed in the table below.

(Parameters to be set)

Parameter No.	Description
No.2000#1	Initialization bit
No.2020	Motor ID number
No.2001	AMR
No.1820	CMR
No.2084	FFG (numerator)
No.2085	FFG (denominator)
No.2274#0	Interpolation magnification

Parameter No.	Description
No.2022	Direction of movement
No.2023	Number of velocity pulses
No.2024	Number of position pulses (numerator)
No.2185	Position pulses conversion coefficient
No.1821	Reference counter (numerator)
No.2179	Reference counter (denominator)

When the setting is completed, the [SET] soft key disappears.
Then, press the [AXIS] soft key to select another axis and enter values for the axis in the same way.
After you have entered values for all axes, switch the CNC off and on again.

NOTE

When the motor number or other item is set, alarm PW0000, "PLEASE TURN OFF POWER" may be issued and the alarm screen may be displayed. In this case, you do not need to turn the power off every time the alarm is issued. Display the SERVO SETTING screen again and set the remaining items.

2.1.3.2 SERVO SETTING screen: Setting items

The following table lists the setting items on the SERVO SETTING screen and the help messages displayed when these items are selected.

Item name	Help message	Remarks
MOTOR TYPE	0: STD.MOTOR(LINEAR AXIS) 1: STD.MOTOR(ROTARY AXIS)	
STD.PRM.LOAD	0: STD.PARAMETER LOADING IS EXECUTED AFTER POWER OFF/ON 1: STD.PARAMETER LOADING IS COMPLETED	
MOTOR ID NO.	251-350:HRV2 αi, βi	
DETECTION UNIT (μm)	DETECTION UNIT IS LEAST RESOLUTION OF POSITION FEEDBACK PULSES THAT CNC USES FOR POSITION CONTROL. DETECTION UNIT IS GENERALLY COMMAND UNIT/CMR.	
GEAR RATIO (N/M)	OUTPUT AXIS (MACHINE SIDE) ROTATES N REVOLUTION WHEN INPUT AXIS (MOTOR SIDE) ROTATES M REVOLUTION.	
SCREW PITCH (mm)	BALL SCREW PITCH IS DISTANCE PER 1 REVOLUTION OF BALL SCREW.	
MOTOR DIRECTION	CW: MOTOR ROUNDS CLOCKWISE FROM A SIGHT OF PULSE CODER BY PLUS MCMD CCW: MOTOR ROUNDS COUNTERCLOCKWISE	
OUTER DETECTOR	0: NONE 3: SDU+SERIAL CIR.(X2048) 1: ONLY SDU 4: ANALOG SDU 2: SDU+SERIAL CIR.(X512)	
RESOLUTION (μm)	PLEASE SET RESOLUTION OR SIGNAL PITCH OF LINEAR SCALE.	These items are displayed when a value other than 0 is set for OUTER DETECTOR and the value indicating a standard motor (linear axis) is set for MOTOR TYPE.
DIRECTION REVERSE	ON: SIGN OF FEEDBACK PULSES FROM OUTER SCALE IS REVERSED OFF: SIGN IS NOT REVERSED	
GRID INTERVAL (mm)	PLEASE SET INTERVAL OF REFERENCE MARKS IN CASE OF ONE REF.MARK, PLEASE SET GRID INTERVAL FOR REFERENCE COUNTER.	

Item name	Help message	Remarks
COUNT (BIT, λ)	PLEASE SET BIT NUMBER(ABS) OR LINE COUNT(INC) OF OUTER ROTARY ENCODER.	These items are displayed when a value other than 0 is set for OUTER DETECTOR and the value indicating a standard motor (ROTARY AXIS) is set for MOTOR TYPE.
UNIT OF COUNT	0: PULSE/REV. 1: BIT/REV.	
DIRECTION REVERSE	ON: SIGN OF FEEDBACK PULSES FROM OUTER SCALE IS REVERSED OFF: SIGN IS NOT REVERSED	

2.1.3.3 PARAMETER SETTING SUPPORT screen (SERVO PARAMETER)

On the PARAMETER SETTING SUPPORT screen, position the cursor on "SERVO PARAMETER" and press the [(OPRT)] soft key. The [INIT] soft key appears. Execute the [INIT] soft key to set recommended values for time constant, feed-forward, backlash acceleration, and other servo parameters for all axes.

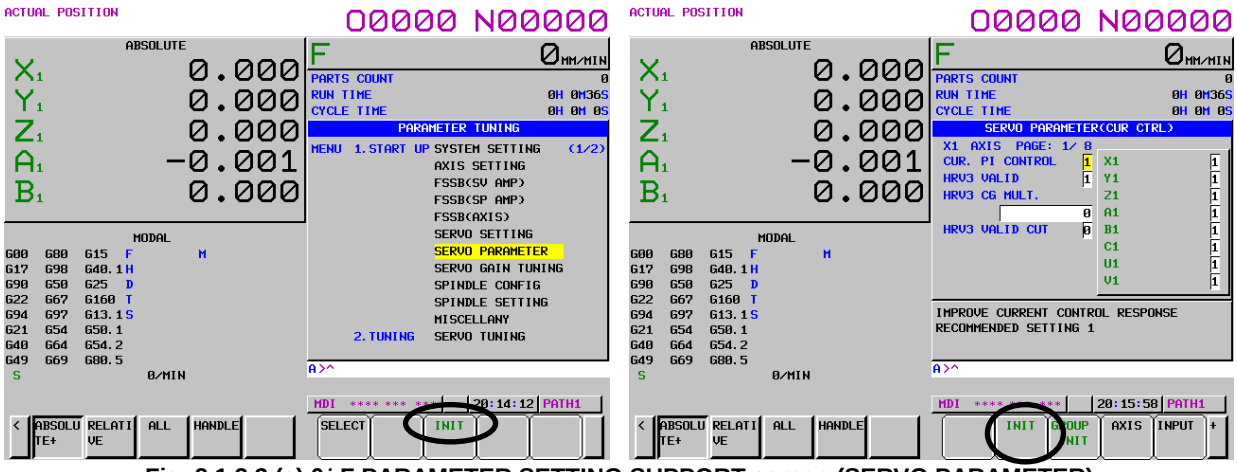


Fig. 2.1.3.3 (a) 0*i*-F PARAMETER SETTING SUPPORT screen (SERVO PARAMETER)

You can also select "SERVO PARAMETER" to display the SERVO PARAMETER screen and set recommended values for each axis.

2.1.3.4 PARAMETER SETTING SUPPORT screen (SERVO GAIN TUNING)

On the PARAMETER SETTING SUPPORT screen, select "SERVO GAIN TUNING". The SERVO GAIN TUNING screen appears.
This screen shows the value set for the velocity control gain for each axis and the automatic adjustment status. Select the [ALL_AX] soft key to start velocity gain adjustment sequentially from the axis displayed on the top row.
When the adjustment is completed, "TUN.FINISH" is displayed under TUN.STATUS.

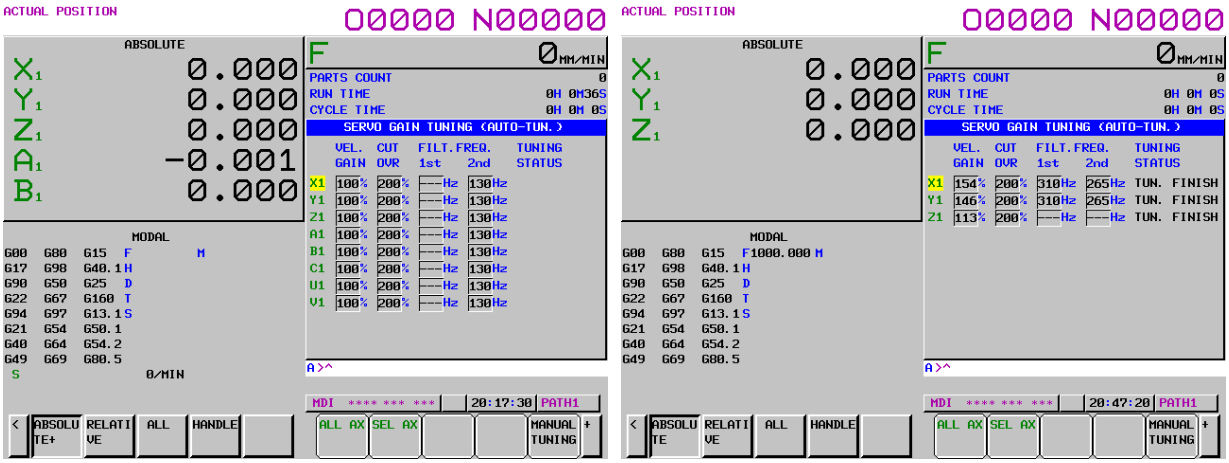


Fig. 2.1.3.4 (a) 0i-F PARAMETER SETTING SUPPORT screen (SERVO GAIN TUNING)

You can also select the [SEL_AX] soft key to perform the adjustment for one axis at a time.

2.1.4 Setting Parameters when a Specific Type of Detector is Used

2.1.4.1 Setting parameters when a separate detector for the serial interface is used

(1) Overview

This subsection describes the setting of servo parameters for using a separate detector of serial output type. Perform parameter setting as described below according to the classification (model and configuration) of the serial detector used.

(2) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	A(01) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(3) Classification of serial detectors and usable detector examples

Usable separate detectors for the serial interface are classified into five major types as shown below. Note that parameter settings vary with these types.

(a) Linear encoder

1. Serial output type

	Minimum resolution [μm]	Model	Backup
Mitutoyo	20/4096 0.05 0.1	AT555 AT353, AT553 ST753	Not required
HEIDENHAIN	0.05	LC193F, LC493F	Not required
	0.05(0.0125) *1 0.01(0.00125)*1	LC195F, LC495F	Not required
Magnescale	0.01	SR87, SR77	Not required

*1 Shown within parentheses is the minimum resolution applicable when the α*i* interface is used. It is available with the α*i* interface when the servo control software supported by the 30*i*-B Series or 0*i*-F Series is used. (See item (4) in Subsection 2.1.4.1.)

2. Analog output type + high-resolution serial output circuit

	Signal pitch [μm]	Model	Backup
Mitutoyo	20	AT402E	Not allowed
HEIDENHAIN	20 4	LS487(C), LS187(C) LF485, LF185	Not allowed
Renishaw	20 40	RG2 RG4	Not allowed

(b) Rotary encoder

3. Serial output type

	Number of counts/rev*1	Model	Backup
FANUC	2^{20} pulses	αA1000S	Required
HEIDENHAIN	2^{23} pulses 2^{27} pulses	RCN223F, RCN8390F RCN227F, RCN727F RCN827F	Not required
Mitsubishi Heavy Industries	2^{23} pulses	MPRZ + ADB20J70	Not required
Magnescale	2^{23} pulses	RU77-4096GA	Not required
Renishaw	2^{23} pulses, 2^{27} pulses	RESOLUTE	Not required

*1 The number of counts of a rotary encoder is the number of counts by the encoder itself.
In FANUC systems, this value is treated as follows:
- One million pulses/rev for 2^{20} counts/rev
- Eight million pulses/rev for 2^{23} counts/rev or more

4. Analog output type + interpolation circuit supplied by third party

	Number of counts/rev*	Model			Backup
		Signal interval (λ)	Encoder	Interpolation circuit	
HEIDENHAIN	2^{27} pulses 2^{27} pulses 2^{27} pulses 2^{26} pulses 2^{25} pulses 2^{24} pulses	32768 16384 8192 4096 2048 1024	ERA4280 ERA4280, ERA4480 ERA4480, ERA4880 ERA4880 ERM280 ERM280	EIB192F EIB392F EIB1592F	Not allowed

(*) For FANUC systems, set parameters with eight million pulses/rev.

(c) Non-binary encoder + position detection circuit for a DD motor

	Model		Backup
	Signal interval (λ)	Encoder	
FANUC	768	αiCZ 768A	Not allowed
HEIDENHAIN	12000, 20000, 40000, 52000	ERN4280	Not allowed
	6000, 10000, 14000, 20000, 26000	ERN4480	
	3000, 5000, 7000, 10000, 13000	ERN4880	

(4) Setting parameters

Set the following parameters according to the type of the detector (described in the previous item).

(1) Linear encoder

Parameter setting common to linear encoders

In addition to the conventional settings for a separate detector (bit 1 of parameter No. 1815 and FSSB), set the following parameters:

[Flexible feed gear] Parameter Nos. 2084 and 2085

$$\text{Flexible feed gear (N/M)} = \frac{\text{Minimum resolution of the detector [μm]}}{\text{Detection unit of controller [μm]}}$$

[Number of position pulses] Parameter No. 2024

$$\text{Number of position pulses} = \frac{\text{Amount of movement per motor revolution [mm]}}{\text{Minimum resolution of the detector [mm]}}$$

* If the result of the above calculation does not fall in the setting range (0 to 32767) for the number of position pulses, use "position feedback pulse conversion coefficient" to specify the number of position pulses according to the following procedure.
Number of position pulses to be set = A × B
Select B so that A is within a range between 0 and 32767. Then, set the following:
No. 2024 = A: Position pulses parameter (32767 or less)
No. 2185 = B: Position pulses conversion coefficient parameter

1. Serial output type

Example parameter settings

[System configuration]

- A linear encoder with a minimum resolution of 0.1 μm is used.
- The least input increment of the controller is 1 μm.
- The amount of movement per motor revolution is 16 mm.

[Parameter setting]

- To enable a separate detector, set bit 1 of parameter No. 1815 to 1.
- Calculate the parameters for the flexible feed gear.
  Because flexible feed gear (N/M) = 0.1 μm/1 μm = 1/10: No. 2084 = 1 and No. 2085 = 10
- Calculate the number of position pulses.
  Number of position pulses = 16 mm/0.0001 mm = 160000
  Because this result does not fall in the setting range (0 to 32767), set A and B, respectively, with the "number of position pulses" and "position pulses conversion coefficient" by assuming: 160,000 = 10,000 × 16 → A = 10,000 and B = 16
  No. 2024 = 10,000, No. 2185 = 16

When the αi interface is used

When linear encoder LC195F or LC495F manufactured by HEIDENHAIN is used with a 30*i*-B/0*i*-F Series CNC, the minimum resolution can be extended.

Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30i/31i/32i/35i-B	90G0	19.0 and subsequent editions	
Power Motion i-A	90J0	01.0 and subsequent editions	
DSA-B	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 0i-F	90M0	01.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	01.0 and subsequent editions	
	90L8	01.0 and subsequent editions	

Setting parameters

	#7	#6	#5	#4	#3	#2	#1	#0
2437				AILIN				

AILIN(#4) By using LC195F or LC495F, the minimum resolution of the scale is:
0: Not extended
1: Extended

NOTE

1 Even when this function bit is set, the resolution used for setting the number of position pulses (setting resolution), flexible feed gear, and other items is 0.05 μm/0.01 μm. If you want to use the minimum resolution of the detector as the detection unit, set AILIN to 1 and also set the flexible feed gear as listed below.

Setting resolution	Minimum resolution of the detector (*)	FFG setting to use the minimum resolution of the detector as the detection unit
0.05 μm	0.0125 μm	4/1
0.01 μm	0.00125 μm	8/1

2 If bit 4 of parameter No. 2437 is set to 1 for unsupported hardware, an invalid parameter alarm (detail No. 4374) is issued.

3 When using this function bit, set bit 0 of parameter No. 2274 to 0. If this bit is set to 1, an invalid parameter alarm (detail No. 4374) is issued.

4 When this parameter has been set, the power must be turned off before operation is continued.

2. Analog output type + high-resolution serial output circuit

Setting parameters

In addition to the common parameter settings, set the following parameters (see also NOTE below).
Check the type of the high-resolution serial conversion circuit to be coupled to the linear encoder, and then determine the setting of the following function bit.
[Function bit]

	#7	#6	#5	#4	#3	#2	#1	#0
2274								HP2048

HP2048(#0) The 2048-magnification interpolation circuit (high-resolution serial output circuit H or C) is:
0: Not to be used
1: To be used

Circuit	Specification	Interpolation magnification	HP2048
High-resolution serial output circuit	A860-0333-T501	512	0
High-resolution serial output circuit H	A860-0333-T701	2048	1
High-resolution serial output circuit C	A860-0333-T801	2048	1

NOTE

1 When high-resolution serial output circuit H is used, you would usually set setting pin SW3 inside the circuit to "Setting B".

2 If this bit is specified, the minimum resolution setting of the detector is assumed to be:

Minimum resolution = Signal pitch of encoder (λ)/512 [μm]

If the minimum resolution (signal pitch/2048 [μm]) is necessary as the detection unit, specify: Flexible feed gear = 4/1

3 When high-resolution serial output circuit H is used, and the 750 kHz input frequency needs to be supported, set the following:

- Set the setting pin SW3 to "Setting A".
- Set bit 0 (HP2048) of parameter No. 2274 to 1.
- Set the minimum resolution of the detector as:
  Encoder signal pitch/128 [μm] (Related report TMS03/16)

4 When high-resolution serial output circuit C is used, no function is available which can change an interpolation magnification according to a set-up pin. (Fixed at a magnification of 2048)

High-resolution serial output circuit C is connected to the scale with an absolute address origin.

Example parameter settings

[System configuration]

- A linear encoder with a signal pitch of 20 μm is used.
- The linear encoder is coupled with high-resolution serial output circuit H.
- The least input increment of the controller is 1 μm.
- The amount of movement per motor revolution is 16 mm.

[Parameter setting]

- To enable a separate detector, set bit 1 of parameter No. 1815 to 1.
- To use high-resolution serial output circuit H, set bit 0 of parameter No. 2274 to 1.
  Minimum resolution of the detector = 20 μm/512 = 0.0390625 μm
- Calculate the parameters for the flexible feed gear.
  Because flexible feed gear (N/M) = (20/512 μm)/1 μm=5/128
  No. 2084 = 5, No. 2085 = 128
- Calculate the number of position pulses.
  Number of position pulses = 16 mm / (20/512 μm) = 409,600
  Because this result does not fall in the setting range (0 to 32767), set A and B, respectively, with the "number of position pulses" and "position pulses conversion coefficient" by assuming: 409,600 = 25,600 × 16 → A = 25,600, B = 16
  No. 2024 = 25,600, No. 2185 = 16

(2) Rotary encoder

Parameter setting method common to rotary encoders

In addition to the settings for a separate detector (bit 1 of parameter No. 1815 and FSSB), note the following parameters:

[Flexible feed gear (FFG)] Parameter Nos. 2084 and 2085

$$\text{Flexible feed gear (N/M)} = \frac{\dfrac{\text{Amount of movement per motor revolution [deg]}}{\text{Detection unit [deg]}}}{\text{1,000,000 or 8,000,000}}$$

* Select the denominator of the FFG as appropriate for the number of counts of the detector (see the table below).

[Number of position pulses] Parameter No. 2024

Number of position pulses to be set = (12,500 or 100,000) × (Reduction ratio from motor to detector)

* Select the constant of the number of position pulses as appropriate for the number of counts of the detector (see the table below).

Number of counts of the detector	Denominator of the FFG	Constant part of the number of position pulses
2^{20} pulses or more	1,000,000	12,500
2^{23} pulses or more	8,000,000	100,000

* If the result of the above calculation does not fall in the setting range (0 to 32767) for the number of position pulses, use "position feedback pulse conversion coefficient" to specify the number of position pulses according to the following procedure.
Number of position pulses to be set = A × B
Select B so that A is within a range between 0 and 32767. Then, set the following:
No. 2024 = A: Position pulses parameter (32767 or less)
No. 2185 = B: Position pulses conversion coefficient parameter

1. Serial output type

(1) Serial output rotary encoder whose number of counts is 2^{20} pulses or more

Example parameter settings

[System configuration]

- The least input increment of the controller is 1/1000 deg.
- The amount of movement per motor revolution is 180 degrees. (Reduction ratio: 1/2)
- Table-to-separate-encoder reduction ratio = 1/1

[Parameter setting]

- To enable a separate detector, set bit 1 of parameter No. 1815 to 1.
- Calculate the parameters for the flexible feed gear.
  Because flexible feed gear (N/M) = 360 degrees/0.001 degrees/1,000,000 = 36/100
  No. 2084 = 36, No. 2085 = 100
- Calculate the number of position pulses.
  Because number of position pulses = 12500 × (1/2) = 6250
  No. 2024 = 6250

(2) Serial output rotary encoder whose number of counts is 2^{23} pulses or more
Since this type of encoder uses a high-resolution interface, it is necessary to use servo control software supporting this interface and to make the additional parameter settings shown below in addition to the common settings.

Series and edition of applicable servo control software

[Series and editions applicable to high-resolution interfaces]

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	03.0 and subsequent editions	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
DSA-B	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	J(10) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	J(10) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

[Rotary encoders using a high-resolution interface]

HEIDENHAIN: RCN223F, RCN227F, RCN727F, RCN827F
: RCNxxxxF (RCN2390F, RCN2590F, RCN5590F, RCN8390F, etc.)
: ROC4xxF (ROC425F, etc.)
: ECN223F

Setting parameters

In addition to the settings for a separate detector (bit 1 of parameter No. 1815 and FSSB), set the following parameters:

[Function bit]

Set the following function bit to 1.

	#7	#6	#5	#4	#3	#2	#1	#0
2275							RCNCLR	800PLS

800PLS (#0) A rotary encoder with eight million pulses per revolution is:
1: To be used

RCNCLR (#1) The number of revolutions is:
1: To be cleared.
This function bit is to be set in combination with the number of data mask digits, described below.

2394	Number of data mask digits

[Settings] 8 (For a rotary encoder with eight million pulses per revolution)
The value to be set in this parameter depends on the detector. At present, only the above detectors require clearing the multi-turn data.
This parameter is to be set in combination with RCNCLR, described above.

[Reference counter capacity] Parameter No. 1821

Specify the number of feedback pulses per revolution of the detector (detection unit).

* If bit 0 of parameter No. 2275 is 0, specify the number of pulses per revolution of the detector that is divided by 8 as the reference counter capacity. In this case, eight grid points occur per revolution of the detector.

NOTE

The multi-turn data of the RCN223F, 227F, 727F, or 827F is maintained while the power to the separate detector interface unit is on. The data, however, is cleared when the unit is turned off. Since the multi-turn data becomes undetermined depending on where the power is turned off, it is necessary to make a setting to clear the multi-turn data. In addition, for this reason, the RCN223F, 227F, 727F, and 827F cannot be used with a linear axis.

Example parameter settings

[System configuration]

- The rotary encoder RCN223F made by HEIDENHAIN is used.
- The least input increment of the controller is 1/10,000 deg.
- The amount of movement per motor revolution is 180 degrees. (Reduction ratio: 1/2)
- Table-to-separate-encoder reduction ratio = 1/1

[Parameter setting]

- To enable a separate detector, set bit 1 of parameter No. 1815 to 1.
- To use the RCN223F detector, set bit 0 of parameter No. 2275 to 1, bit 1 of this parameter to 1, and parameter No. 2394 to 8.
- Calculate the parameters for the flexible feed gear.
  Because flexible feed gear (N/M) = (360 degrees/0.0001 degrees) / 8,000,000 = 9/20
  No. 2084 = 9, No. 2085 = 20
- Calculate the number of position pulses.
  Number of position pulses = 100,000 × (1/2) = 50,000
  Because this result does not fall in the setting range (0 to 32767), set A and B, respectively, with the "number of position pulses" and "position pulses conversion coefficient" by assuming: 50,000 = 12,500 × 4 → A = 12,500, B = 4
  No. 2024 = 12,500, No. 2185 = 4
- Calculate the reference counter capacity.
  Reference counter capacity = 360 degrees/0.0001 degrees = 3,600,000

Speed limit

When a rotary encoder with eight million pulses per revolution is used as a separate detector, the maximum permissible speed that can be controlled may be 937 min^{-1} (7500 min^{-1} for the Series 30*i*-B).(*) (See Item (2) in Appendix D.)

(*) The above maximum speed does not include hardware limitations. For the maximum permissible speed of the detector itself, refer to the specifications of the detector.

Notes on a rotary encoder with no multi-turn data

For absolute position detectors with no multi-turn data (data to be counted by 1 for every revolution of the detector) including those listed below, if parameters are not set correctly, the machine coordinates are not established correctly at power-on.

- HEIDENHAIN : RCN223F, RCN727F and so on
- Magnescale : RU77 and so on
- Mitsubishi Heavy Industries : MPRZ series and so on
- Renishaw : RESOLUTE (rotary encoder) and so on

* Be sure to contact the detector manufacturer for the detector you use.

Set the following parameters according to the axis type you use.

1. Rotary axis (A-type)

	Parameter No.						
	1815#1	**1815#6**	**1815#0**	**1817#3**	**1868**	**2275#1**	**2394**
Semi-closed mode	0	1	0	0	0	*1	*1
Full-closed mode	1	1	0	0	0	*1	*1

2. Rotary axis (B-type)

	Parameter No.						
	1815#1	**1815#6**	**1815#0**	**1817#3**	**1868**	**2275#1**	**2394**
Semi-closed mode	0	0	*2	*2	*2	*1	*1
Full-closed mode	1	0	*2	*2	*2	*1	*1

*1) Set a value appropriate for the detector to be used. For details, see the item described above (Parameter setting) and refer to "CORRESPONDENCE OF ROTARY SCALE WITHOUT ROTARY DATA" in "FANUC Series 30*i*/31*i*/32*i*-MODEL B CONNECTION MANUAL (FUNCTION) (B-64483EN-1)".

*2) Set a value appropriate for the movable range of the rotary axis. For details, refer to "CORRESPONDENCE OF ROTARY SCALE WITHOUT ROTARY DATA" in "FANUC Series 30*i*/31*i*/32*i*-MODEL B CONNECTION MANUAL (FUNCTION) (B-64483EN-1)".

NOTE

If you want to use a detector with no multi-turn data for third party's rotary encoder on a rotary axis (A-type), set bit 6 of parameter No. 1815 (RONx) to 1.
For other cases, set this bit to 0. If the correct setting is not made, the machine coordinates are not established correctly at power-on. (See FANUC Series 30*i*/31*i*/32*i*-MODEL B CONNECTION MANUAL (FUNCTION) (B-64483EN-1).)

2 Analog output type + third party's interpolation circuit

Even when you use an interpolation circuit supplied by third party, you can configure the system using settings similar to those for the rotary encoder of the serial output type. Note, however, that when the output of the interpolation circuit is 2^{23} pulses or more per revolution, you need to make the same settings as those described in (2) for the rotary encoder of the serial output type. Since this type of encoder uses a high-resolution interface, you also need to use servo control software supporting the high-resolution interface.

Series and edition of applicable servo control software

[Series and editions applicable to high-resolution interfaces]

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	03.0 and subsequent editions	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
DSA-B	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	J(10) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	J(10) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

[Examples of rotary encoders using a high-resolution interface]

HEIDENHAIN: Rotary encoders (such as the ERA4280, ERA4480, ERA4880, and ERA280) using a HEIDENHAIN interpolation circuit such as the EIB192F whose number of counts is at least 2^{24}

(3) Non-binary encoder + high-resolution serial output circuit

Setting parameters

In addition to the settings for a separate detector (bit 1 of parameter No. 1815 and FSSB), set the following parameters:

First, check the type of the FANUC high-resolution serial output circuit to be coupled to the rotary encoder (analog type), and then determine the setting of the following function bit.

[Function bit]

	#7	#6	#5	#4	#3	#2	#1	#0
2274								HP2048

HP2048(#0) The 2048-magnification interpolation circuit (high-resolution serial output circuit H or C) is:
0: Not to be used
1: To be used

Circuit	Specification	Interpolation magnification	HP2048
High-resolution serial output circuit	A860-0333-T501	512	0
High-resolution serial output circuit H	A860-0333-T701	2048	1
High-resolution serial output circuit C	A860-0333-T801	2048	1

NOTE

1 For a configuration of a rotary encoder (analog output type) and high-resolution serial output circuit, when an input frequency of 750 kHz needs to be supported, make the following settings:
- Set the setting pin SW3 to "Setting A".
- Set bit 0 (HP2048) of parameter No. 2274 to 1.
- Set the value λ/4 for AMR conversion coefficient 1.

2 When high-resolution serial output circuit C is used, no function is available which can change an interpolation magnification according to a set-up pin. (Fixed at a magnification of 2048)
High-resolution serial output circuit C is connected to the scale with an absolute address origin.

Example parameter settings

- The non-binary encoder ERA4480 manufactured by HEIDENHAIN is used.
- Signal interval (λ) is 6000.
- The interpolation magnification of the high-resolution serial output circuit is 2048.
- The least input increment of the controller is 1/1000 deg.
- The amount of movement per motor revolution is 180 degrees. (Reduction ratio: 1/2)
- Table-to-separate-encoder reduction ratio = 1/1

[Parameter setting]

- To enable a separate detector, set bit 1 of parameter No. 1815 to 1.
- The interpolation magnification of the high-resolution serial output circuit is 2048, so set bit 0 of parameter No. 2274 to 1.
- Calculate the parameters for the flexible feed gear.
  Because flexible feed gear (N/M) = (360 degrees/0.001 degrees) / (6000 × 512) = 15/128
  No. 2084 = 15, No. 2085 = 128
- Calculate the number of position pulses.
  Number of position pulses = 6000 × 512/2 = 1,536,000
  Because this result does not fall in the setting range (0 to 32767), set A and B, respectively, with the "number of position pulses" and "position pulses conversion coefficient" by assuming: 1,536,000 = 6000 × 256 → A = 6000, B = 256
  No. 2024 = 6000, No .2185 = 256
- Calculate the reference counter capacity.
  Reference counter capacity = 360 degrees/0.001 degrees = 3,600,000

2.1.4.2 Setting parameters when an analog input separate detector interface unit is used

(1) Overview

An analog input separate detector interface unit (analog SDU) can be connected directly to an encoder having an analog output signal of 1 Vp-p. This subsection explains parameter settings to be made when this unit is connected to a separate detector.

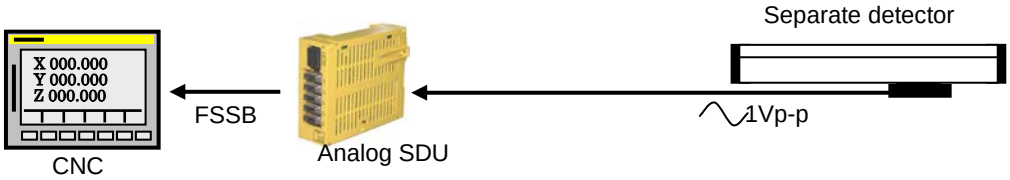


Fig. 2.1.4.2 (a) Configuration where an analog SDU is used

(2) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	03.0 and subsequent editions	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
DSA-B	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	J(10) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	J(10) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(3) Setting parameters

After performing the initialization procedure (full-closed system) described in Subsection 2.1.3, change the settings described below according to the signal pitch of the detector.

[Setting flexible feed gear]

2084	Flexible feed gear numerator

2085	Flexible feed gear denominator

Set the flexible feed gear according to the following equation.

(Equation for parameter calculation for linear encoders)

$$\text{Flexible feed gear (N/M)} = \frac{\text{Detector signal pitch [μm] / 512}}{\text{Detection unit of controller [μm]}}$$

(Equation for parameter calculation for rotary encoders)

$$\text{Flexible feed gear (N/M)} = \frac{\dfrac{\text{Amount of movement per motor revolution [deg]}}{\text{Detection unit of controller [deg]}}}{\text{Signal interval of detector } (\lambda) \times 512}$$

[Setting the number of position pulses]

2024	Number of position pulses (PPLS)

Set the number of position pulses according to the following equation:

(Equation for parameter calculation for linear encoders)

$$\text{Number of position pulses} = \frac{\text{Amount of movement per motor revolution [mm]}}{\text{Detector signal pitch [mm] / 512}}$$

(Equation for parameter calculation for rotary encoders)

Number of position pulses = Signal interval of detector (λ) × 512 × Motor-detector gear ratio

If the calculation result is greater than 32767, determine the parameter setting (PPLS) using the following position pulse conversion coefficient (PSMPYL).

2185	Position pulses conversion coefficient (PSMPYL)

This parameter is used if the calculated number of position pulses is greater than 32767.
(Parameter calculation expression)
Set this parameter so that the following equation is satisfied: Number of position pulses = PPLS × PSMPYL
(→ See Supplementary 3 in Subsection 2.1.6.)

(Example parameter settings)

[System configuration]

- The Series 30*i* is used.
- A linear encoder with a signal pitch of 20 μm is used.
- The least input increment of the controller is 1 μm.
- The amount of movement per motor revolution is 16 mm.

[Parameter setting]

- To enable a separate detector, set bit 1 of parameter No. 1815 to 1.
- Calculate the parameters for the flexible feed gear.
  Because flexible feed gear (N/M) = (20/512 μm)/1 μm = 5/128
  No. 2084 = 5, No. 2085 = 128
- Calculate the number of position pulses.
  Number of position pulses = 16 mm / (0.02 mm/512) = 409,600
  Because this result does not fall in the setting range (0 to 32767), set A and B, respectively, with the "number of position pulses" and "position pulses conversion coefficient" by assuming:
  409,600 = 25600 × 16 → A = 25600, B = 16
  No. 2024 = 25,600, No. 2185 = 16

2.1.4.3 Setting parameters when an αiCZ sensor is used

(1) Overview

The αiCZ sensors are classified into two major groups according to their application as follows:
<1> Used as a built-in detector for a DD motor (αiCZ ***A)
<2> Used as a separate detector (αiCZ ***AS)
If you want to use this sensor as the detector for a DD motor, see Section 3.2.1, "Procedure for Setting the Initial Parameters".
When the differences in resolution are considered, six types of sensors are available as indicated below.

For built-in detector (A860-2162-Txxx)	For separate detector (A860-2164-Txxx)	Signal interval	Number of pulses when set
αiCZ 512A	αiCZ 512AS	512λ/rev	500,000pulse/rev
αiCZ 768A	αiCZ 768AS	768λ/rev	750,000pulse/rev
αiCZ 1024A	αiCZ 1024AS	1024λ/rev	1,000,000pulse/rev

NOTE
When αiCZ 768A/AS is used as a built-in detector with a DD motor, the sensor can be used only for the purpose of finite rotation (within ±1 revolution).

(2) Setting parameters (<2> Used as a separate detector)

After performing the initialization procedure (full-closed system) described in Subsection 2.1.2, change the settings described below according to the signal pitch of the detector.

[Setting flexible feed gear]

2084	Flexible feed gear (numerator) (N)

2085	Flexible feed gear (denominator) (M)

Set a value listed in the following table according to the detector used.

Detector	Flexible feed gear (N/M)
αiCZ 512AS	$\frac{\text{Amount of movement per revolution of a separate detector [deg] / detection unit [deg]}}{500,000}$
αiCZ 768AS	$\frac{\text{Amount of movement per revolution of a separate detector [deg] / detection unit [deg]}}{750,000}$
αiCZ 1024AS	$\frac{\text{Amount of movement per revolution of a separate detector [deg] / detection unit [deg]}}{1,00,000}$

[Setting number of velocity pulses]

2023	Number of velocity pulses (PULCO)

Set the number of velocity pulses to 8192.

[Setting the number of position pulses]

2024	Number of position pulses (PPLS)

Set a value listed in the following table according to the detector used.

Detector	Number of position pulses
αiCZ 512AS	6250 × (reduction ratio from motor to table)
αiCZ 768AS	9375 × (reduction ratio from motor to table)
αiCZ 1024AS	12500 × (reduction ratio from motor to table)

If the calculation result is greater than 32767, determine the parameter setting (PPLS) using the following position pulse conversion coefficient (PSMPYL).

2185	Position pulses conversion coefficient (PSMPYL)

This parameter is used if the calculated number of position pulses is greater than 32767.

(Parameter calculation expression)
Set this parameter so that the following equation is satisfied: Number of position pulses = PPLS × PSMPYL (See Supplementary 3 of Subsection 2.1.6.)

[Setting reference counter capacity]

1821	Reference counter capacity

Set a value listed in the following table according to the detector used.

Detector	Reference counter capacity
αiCZ 512AS	Set the number of pulses per revolution of the detector installed separately (detection unit) or a value obtained by dividing that number by an integer.
αiCZ 768AS	Set the number of pulses per 120-degree revolution (one-third revolution) of the detector installed separately (detection unit) or a value obtained by dividing that number by an integer.
αiCZ 1024AS	Set the number of pulses per revolution of the detector installed separately (detection unit) or a value obtained by dividing that number by an integer.

(Example parameter settings)

[System configuration]
- The Series 30*i* is used.
- The detector used is the αiCZ 1024AS.
- The least input increment of the controller is 1/1000 deg.
- Gear ratio 1:1

[Parameter setting]
Flexible feed gear (N/M) = 360,000/1,000,000 = 9/25,
so parameter No. 2084 = 9, and parameter No. 2085 = 25
Number of position pulses = 12500
Reference counter capacity = 360,000

2.1.5 Setting parameters when an acceleration sensor or temperature detection circuit is used

(1) Overview

The flow indicated below is used to make a connection and setting for using an acceleration sensor (αiGS0.1-3D) or temperature detection circuit.

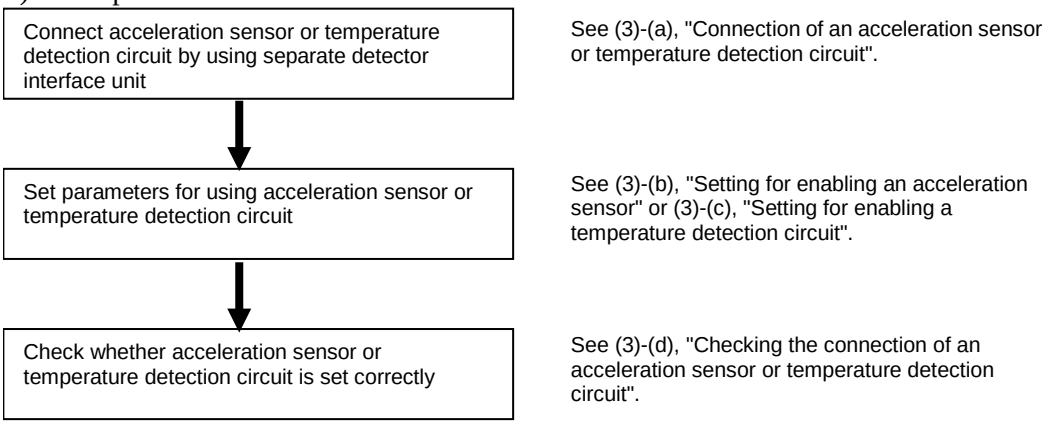


Fig. 2.1.5 (a) Setting procedure for an acceleration sensor or temperature detection circuit

(2) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90G0 90J0 90K0 90GP 90JP	09.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	P(16) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	P(16) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	 (*1)
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	 (*1)
Series 0*i*-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(*1) An acceleration sensor cannot be used with 90L0/90L8. Only temperature detection circuit is available with 90L0/90L8.

(3) Setting method

(a) Connection of an acceleration sensor or temperature detection circuit

An acceleration sensor or temperature detection circuit is connected to a separate detector interface unit (SDU). From one SDU, only one data item can be read per axis. So, when an additional acceleration sensor or temperature detection circuit is to be used in a full-closed system, one more SDU is required in addition to the SDU used for a separate position detector.

- <u>When an acceleration sensor or temperature detection circuit is to be added to an axis of a semi-closed system</u>

  Add an SDU for an acceleration sensor or temperature detection circuit.

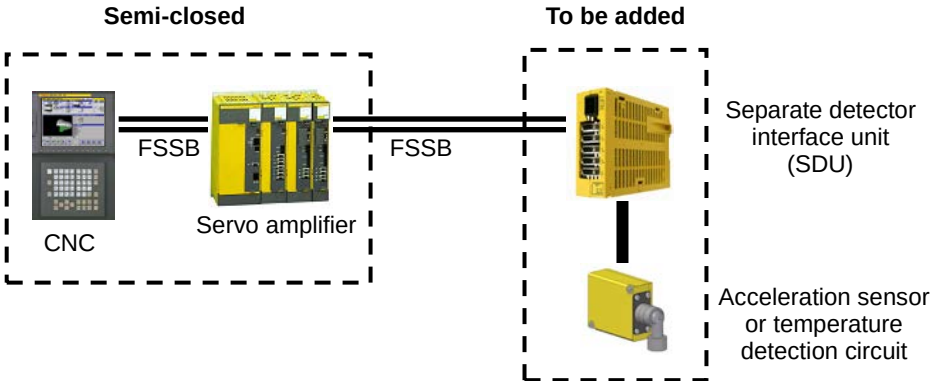


Fig. 2.1.5 (b) Configuration for a semi-closed axis

- When an acceleration sensor or temperature detection circuit is to be added to an axis of a full-closed system

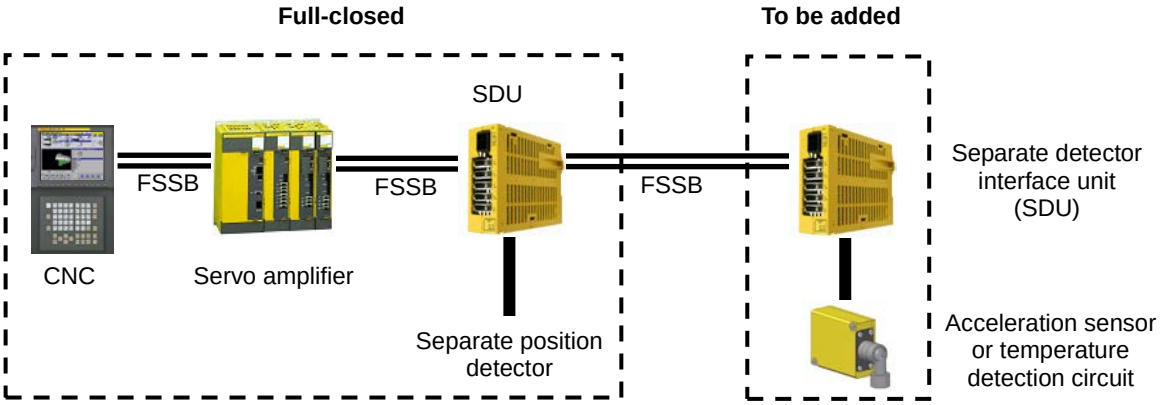


Fig. 2.1.5 (c) Configuration for a full-closed axis

NOTE

1 An SDU for an acceleration sensor or for connecting a temperature detection circuit is required.
2 No more than one odd-numbered SDU, such as the first or third unit counted from the CNC, can be used per axis. Similarly, no more than one even-numbered SDU, such as the second or fourth unit counted from the CNC, can be used per axis.
3 For the FSSB setting, refer to the CNC manual (FANUC Series 30*i*/31*i*/32*i*-MODEL B CONNECTION MANUAL (FUNCTION) B-64483EN-1).
4 When an acceleration sensor or temperature detection circuit is added to an axis of a full-closed system and the dual check safety function is used, the separate detector needs to be connected to an even-numbered SDU, such as the second or fourth unit.

(b) Setting for enabling an acceleration sensor

An acceleration sensor can detect acceleration in three directions at the same time.
The parameters to be set differ as follows according to whether or not smart machining point control (with sensor) is used:

When the function is used: Direction of acceleration feedback used for control (bit 7, 6, or 5 of parameter No. 2277)
Sign of acceleration feedback used for control (bit 4 of parameter No. 2277)

When the function is not used: Use of acceleration feedback (bit 7, 6, or 5 of parameter No. 2277)

	#7	#6	#5	#4	#3	#2	#1	#0
2277	ACC1ON	ACC2ON	ACC3ON					

ACC1ON(#7) Acceleration feedback in the first direction is:
0: Not used
1: Used

ACC2ON(#6) Acceleration feedback in the second direction is:
0: Not used
1: Used

ACC3ON(#5) Acceleration feedback in the third direction is:
0: Not used
1: Used

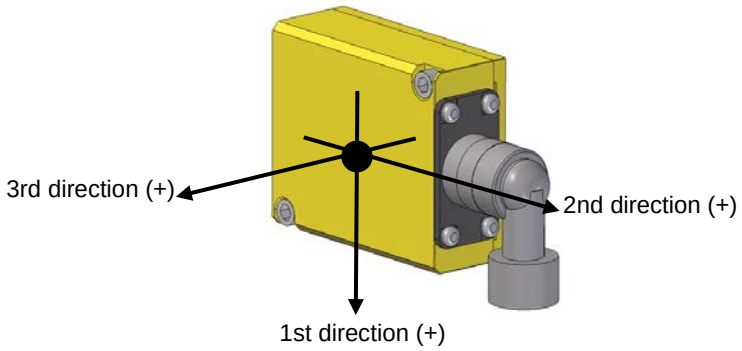


Fig. 2.1.5 (d) Directions in which an acceleration sensor detects acceleration

NOTE
1 Changing this parameter results in a power-off alarm being raised.
2 If smart machining point control (with sensor) is not used, acceleration feedback measurement is available in three directions even if any of bits 7, 6, or 5 of parameter No. 2277 is set to 1.
3 For details on smart machining point control (with sensor), see Subsection 5.4.10.
4 When the machine is accelerated in the direction of the arrow shown in Fig. 2.1.5 (d), positive acceleration is detected.

	#7	#6	#5	#4	#3	#2	#1	#0
2277				ACCNEG				

ACCNEG(#4) The sign of acceleration feedback is:
0: Not inverted.
1: Inverted.

To adjust the sign of acceleration feedback, observe position feedback (POSF) and acceleration feedback (ACC) with SERVO GUIDE during rapid traverse acceleration/deceleration.
Set the sign bit ACCNEG for acceleration feedback below so that the sign of the second-order differential of position feedback (POSF indicated by Diff2(AT) operation) equals the sign of acceleration feedback (ACC).

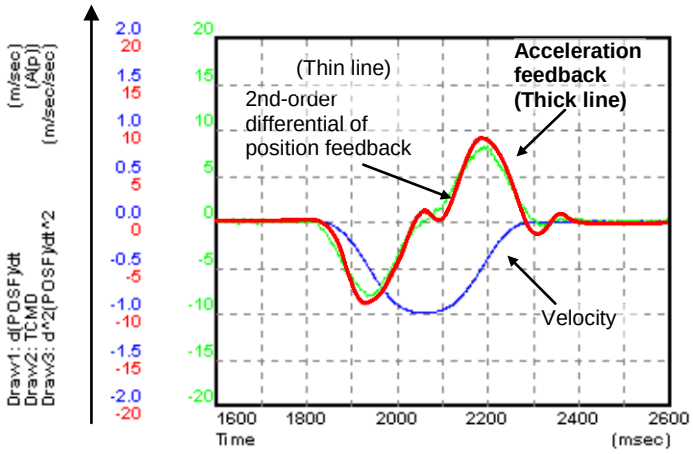


Fig. 2.1.5 (e) Acceleration feedback

When acceleration data is measured with SERVO GUIDE, the types of data are as follows:

Data type	Description	Remarks
ACC	Acceleration feedback used for smart machining point control (with sensor)	
ACC1	Acceleration feedback in the first direction	The sign cannot be inverted by setting the parameter.
ACC2	Acceleration feedback in the second direction	
ACC3	Acceleration feedback in the third direction	

NOTE
1 The observation of ACC is supported by SERVO GUIDE version 3.20 or later.
2 The observation of ACC1, ACC2, and ACC3 is supported by SERVO GUIDE version 4.00 or later.

Set the bit parameter below according to the ordinal number, counted from the CNC, of the SDU to which an acceleration sensor is connected.

	#7	#6	#5	#4	#3	#2	#1	#0
2278				PM2ACC				

PM2ACC(#4) **(Power-off parameter)**
0: Acceleration sensor data is read from an odd-numbered SDU counted from the CNC, such as the first or third unit, or no acceleration sensor is used.
1: Acceleration sensor data is read from an even-numbered SDU counted from the CNC, such as the second or fourth unit.

(c) Setting for enabling a temperature detection circuit

Set the function bits below according to the ordinal number, counted from the CNC, of the SDU to which a temperature detection circuit is connected.

	#7	#6	#5	#4	#3	#2	#1	#0
2278							PM2TP	PM1TP

PM1TP(#0) With an odd-numbered SDU such as the first or third unit, a temperature detection circuit is:
0: Not used **(Power-off parameter)**
1: Used

PM2TP(#1) With an even-numbered SDU such as the second or fourth unit, a temperature detection circuit is:
0: Not used **(Power-off parameter)**
1: Used

(d) Checking the connection of an acceleration sensor or temperature detection circuit

Check whether an acceleration sensor or temperature detection circuit is connected correctly on diagnosis screen No. 350#2/#1 or No. 351#2/#1.

	#7	#6	#5	#4	#3	#2	#1	#0
Diagnosis No. 350						PM1TMP	PM1ACC	

PM1ACC(#1) With an odd-numbered SDU such as the first or third unit, an acceleration sensor is:
0: Not connected
1: Connected

PM1TMP(#2) With an odd-numbered SDU such as the first or third unit, a temperature detection circuit is:
0: Not connected
1: Connected

	#7	#6	#5	#4	#3	#2	#1	#0
Diagnosis No. 351						PM2TMP	PM2ACC	

PM2ACC(#1) With an even-numbered SDU such as the second or fourth unit, an acceleration sensor is:
0: Not connected
1: Connected

PM2TMP(#2) With an even-numbered SDU such as the second or fourth unit, a temperature detection circuit is:
0: Not connected
1: Connected

(4) Example of setting an acceleration sensor or temperature detection circuit

An example of adding an acceleration sensor (X-axis, Y-axis, Z-axis) and temperature detection circuit (X-axis) to a system with a semi-closed axis (X-axis) and two full-closed axes (Y-axis, Z-axis) is described below.

<Connection>

CNC ⇔X-axis amplifier ⇔Y-axis amplifier ⇔Z-axis amplifier
⇔SDU (Separate detector for the Y-axis and Z-axis is connected to the first and second connectors. A temperature detection circuit for the X-axis is connected to the third connector.)
⇔SDU (Acceleration sensors for the X-, Y-, and Z-axes are connected to the first, second, and third connectors.)

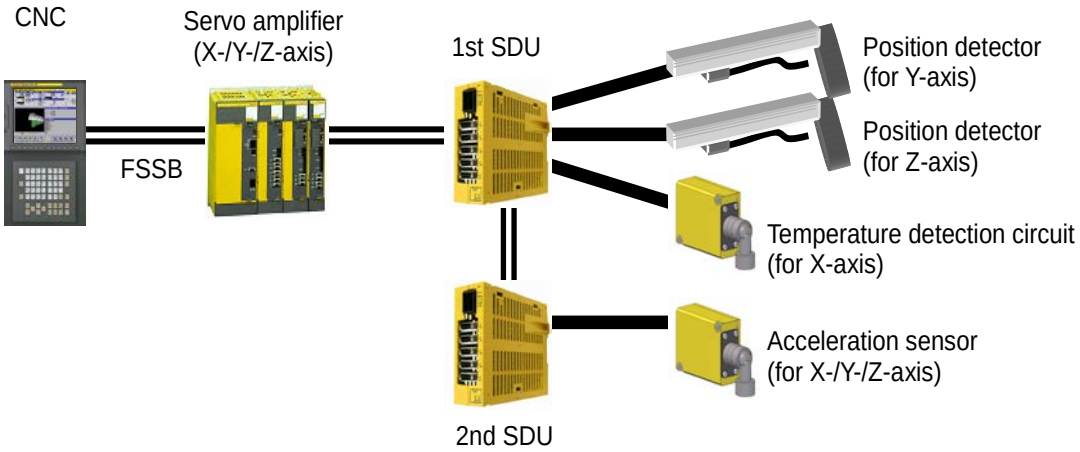


Fig. 2.1.5 (f) Example of connecting a temperature detection circuit and acceleration sensors

<Setting>

Parameter No.	Description	Setting		
		X-axis	Y-axis	Z-axis
Bit 1 of No. 1815	Enables a separate position detector.(*1)	0	1	1
Bits 7, 6, 5 of No. 2277	Enables an acceleration sensor (including the setting of direction).	100	010	001
Bit 4 of No. 2278	Sets the ordinal number of the separate detector interface unit to which an acceleration sensor is connected.(*2)	1	1	1
Bits 1, 0 of No. 2278	Sets the ordinal number of the separate detector interface unit to which a temperature detection circuit is connected.(*3)	01	00	00

*1 Bit 1 of No. 1815 =
0: Semi-closed
1: Full-closed

*2 Bit 4 of No. 2278 =
0: An acceleration sensor is used with the odd-numbered SDU.
1: An acceleration sensor is used with the even-numbered SDU.

*3 Bits 1, 0 of No. 2278 =
0,0: A temperature detection circuit is unused.
0,1: A temperature detection circuit is used with the odd-numbered SDU.
1,0: A temperature detection circuit is used with the even-numbered SDU.

(5) Alarms

Alarms related to an acceleration sensor

When an error is detected with an acceleration sensor, the following alarm is issued and the axis with which the alarm is issued is brought to a feed-hold stop:

DS0651: Acceleration sensor error

When the system software does not support the display of the alarm above, the following alarm is issued and a dynamic brake stop occurs:

SV0385: Serial data error (separate) or
SV0447: Hardware disconnection alarm (separate)

If a separate detector and acceleration sensor are used at the same time, diagnosis screen No. 350#5 can be used to identify with which detector the alarm has been issued.

	#7	#6	#5	#4	#3	#2	#1	#0
Diagnosis No. 350			ALMACC					

ALMACC(#5) 0: An alarm is issued with a separate detector.
1: An alarm is issued with an acceleration sensor.

Alarms related to a temperature detection circuit

When an error is detected with a temperature detection circuit, the following alarm is issued and a dynamic brake stop occurs:

SV0652: Temperature sensor error

When the CNC system software does not support the display of the alarm above, the following alarm is issued and a dynamic brake stop occurs:

SV0385: Serial data error (separate) or
SV0447: Hardware disconnection alarm (separate)

If a separate detector and temperature detection circuit are used at the same time, diagnosis screen No. 350#6 can be used to identify with which detector the alarm has been issued.

	#7	#6	#5	#4	#3	#2	#1	#0
Diagnosis No. 350		ALMTMP						

ALMTMP(#6) 0: An alarm is issued with a separate detector.
1: An alarm is issued with a temperature detection circuit.

Series and editions of CNC system software that support the display of alarms

CNC	CNC system software	
	Series	Edition
Series 30*i*-A	G00C,G01C,G02C	27 and subsequent editions
	G004,G014,G024	01 and subsequent editions
Series 31*i*-A5	G12,G13C	27 and subsequent editions
	G124,G134	01 and subsequent editions
Series 31*i*-A	G103,G113	15 and subsequent editions
	G104,G114	01 and subsequent editions
Series 32*i*-A	G203	15 and subsequent editions
	G204	01 and subsequent editions
Series 0*i*-MD	D4F1	01 and subsequent editions
Series 0*i*-TD	D6F1	01 and subsequent editions
Series 0*i* Mate-MD	D5F1	01 and subsequent editions
Series 0*i* Mate-TD	D7F1	01 and subsequent editions

Series 30*i*/31*i*/32*i*/35*i*-B, Power Motion *i*-A, DSA-B, and 0*i*-F all support the display of alarms.

2.1.6 Actions for Illegal Servo Parameter Alarms

(1) Overview

When a setting value is beyond an allowable range, or when an overflow occurs during internal calculation, an invalid parameter setting alarm is issued.
This section explains the procedure for identifying the location and the cause of an illegal servo parameter setting alarm.

(2) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	03.0 and subsequent editions	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
DSA-B	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(3) Illegal servo parameter setting alarms that can be displayed in parameter error detail display

This subsection describes illegal servo parameter setting alarms detected by the servo control software. For details on alarms detected by the system software, refer to the CNC CONNECTION MANUAL (FANUC Series 30*i*/31*i*/32*i*-MODEL B CONNECTION MANUAL (FUNCTION) (B-64483EN-1).
To check whether the servo control software detects an alarm, check the following:

	#7	#6	#5	#4	#3	#2	#1	#0
Diagnosis No. 203				PRM				

0: Alarm detected by the system software (See diagnosis No. 280.)
1: Alarm detected by the servo control software (See the descriptions of detailed display provided later.)

	#7	#6	#5	#4	#3	#2	#1	#0
Diagnosis No. 280		AXS		DIR	PLS	PLC		MOT

MOT(#0) 1: A value not within the specifiable range is set as the motor number in parameter No. 2020.

The table given below lists the valid motor ID numbers for each series. If a number beyond the indicated range is set, an illegal servo parameter setting alarm is issued.

Series of applicable servo control software	Motor ID No. setting range
90G0, 90J0, 90K0, 90GP, 90JP	1 to 909
90E0	1 to 550 (edition 28.0 or earlier), 1 to 909 (edition 29.0 or later)
90D0	1 to 550
90E1	1 to 550 (edition 04.0 or earlier), 1 to 909 (edition 05.0 or later)
90M0, 90L0, 90M8, 90L8	1 to 909
90C5, 90E5	1 to 550 (edition D or earlier), 1 to 909 (edition E or later)
90C8, 90E8	1 to 909
90H0	1 to 909

PLC(#2) 1: An invalid value such as a number less than or equal to 0 is set as the number of velocity feedback pulses per motor revolution in parameter No. 2023.

PLS(#3) 1: An invalid value such as a number less than or equal to 0 is set as the number of position feedback pulses per motor revolution in parameter No. 2024.

DIR(#4) 1: A correct value (111 or -111) is not set as the motor rotation direction in parameter No. 2022.

AXS(#6) 1: Parameter No. 1023 (servo axis number) is set incorrectly. A duplicate servo axis number is set, or a value exceeding the number of controlled axes of the servo card is set.

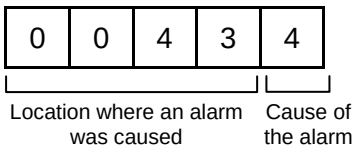
(4) Method

When an illegal servo parameter setting alarm is detected by the servo control software, analyze the cause of the alarm by following the procedure explained below.

* When more than one alarm is issued, one of the causes of these alarms is displayed. Analyze the alarms one by one.

Analyzing illegal servo parameter setting alarms in detail

Details of each alarm are displayed as No. 352 on the diagnosis screen. The displayed value consists of two to five digits as shown below:



Upper four digits: Indicate the location where the alarm was caused.

Table 2.1.6 lists the displayed numbers and corresponding parameter numbers.

* Basically, the low-order three digits of the 4-digit parameter number indicate the location where the alarm was caused. (When an alarm is due to more than one parameter, these digits and parameter numbers do not match sometimes.)
* On the diagnosis screen, 0s in high-order digits are not displayed.

Lowest digit: Indicates the cause of an alarm.

The displayed numbers and their meanings are explained below. (For bit-type parameters, it may indicate the bit location.)

2: The set parameter is invalid. The corresponding function does not operate.
3: The parameter value is beyond the setting range. Alternatively, the parameter is not set.
4 to 9: An overflow occurred during internal calculation.

Table 2.1.6 Detailed analysis of illegal servo parameter setting alarms

Alarm detail No.	Parameter No.	Cause	Action
83	2008	Parameter settings related to servo learning control are illegal. → See Supplementary 1.	Change the parameter settings so that they fall in the applicable range.
92	2009#2	A function which is not supported by the 30*i*-B/0*i*-F Series is used.	Set bit 2 of parameter No. 2009 to 0.
233	2023	When bit 0 of parameter No. 2000 is set to 1, the number of velocity pulses exceeds 13100.	Correct the number of velocity pulses so that it is within 13100. → See Supplementary 4.
234	2023	When a DD motor is used, a value smaller than 512 is set as the number of velocity pulses.	Set 512 or a greater number as the number of velocity pulses.
243	2024	When bit 0 of parameter No. 2000 is set to 1, the number of position pulses exceeds 13100.	Use the conversion coefficient for the number of position feedback pulses (parameter No. 2185) to correct the number of position pulses (parameter No. 2024) so that it is within 13100. → See Supplementary 3.
346	2034	An overflow occurred in the vibration-damping control setting.	Check whether correct values are set for the number of velocity pulses, number of position pulses, and FFG.
434 435	2043	The internal value of the velocity loop integral gain overflowed.	Decrease the value of the velocity loop integral gain parameter.
443 444 445	2044	The internal value of the velocity loop proportional gain overflowed.	Use the function (No. 2200#6) for changing the internal format of the velocity loop proportional gain. Alternatively, decrease the parameter setting. → See Supplementary 5.
474 475	2047	The internal value of the observer parameter (POA1) overflowed.	Correct the setting to (−1) × (desired absolute value) / 10.
523	2052	An attempt was made to use a velocity command or torque command according to the analog voltage input for a pulse input type DSA, but parameter No. 2052 is not set.	Set parameter No. 2052 (excess speed detection speed).
534 535	2053	The internal value of a parameter related to dead zone compensation overflowed.	Decrease the setting to the extent that the illegal servo parameter setting alarm is not caused.
544 545	2054	The internal value of a parameter related to dead zone compensation overflowed.	Decrease the setting to the extent that the illegal servo parameter setting alarm is not caused.
686 687 688	2068	The internal value of the feed-forward coefficient overflowed.	Decrease the feed-forward coefficient.
694 695 696 699	2069	The internal value of the velocity feed-forward coefficient overflowed. Alternatively, bit 5 of parameter No. 2282 is set to 1 and the number of position pulses is set to a value less than or equal to 256.	Decrease the velocity feed-forward coefficient. Alternatively, set bit 3 of parameter No. 2203 to 0. If the alarm is not canceled after the velocity feed-forward coefficient is set to 0, set bit 3 of parameter No. 2282 to 0. If the feedrate limit specified in Appendix D (3) is exceeded with bit 3 of parameter No. 2282 set to 0, determine E according to Supplementary 4 so that the number of position pulses is 256 or more, and change the related parameters.
754 755	2075	The setting for this parameter has overflowed.	This parameter is not used at present. Set 0.
764 765	2076	The setting for this parameter has overflowed.	This parameter is not used at present. Set 0.

Alarm detail No.	Parameter No.	Cause	Action
843	2084	A positive value is not set as the flexible feed gear numerator. Alternatively, the numerator of the feed gear is greater than the denominator × 16.	Set a positive value as the flexible feed gear numerator. Alternatively, correct the parameter so that the numerator of the feed gear is less than or equal to the denominator × 16. (Except for separate detectors)
853	2085	A positive value is not set as the flexible feed gear denominator.	Set a positive value as the flexible feed gear denominator.
883	2088	For an axis with a serial type separate detector, a value exceeding 100 is set as the machine velocity feedback coefficient.	For an axis with a serial type separate detector, the upper limit of the machine velocity feedback coefficient is 100. Correct the coefficient so that it does not exceed 100.
884 885 886	2088	The internal value of the machine velocity feedback coefficient overflowed.	Decrease the machine velocity feedback coefficient. Alternatively, use the vibration-damping control function that has an equivalent effect.
926 927 928	2092	The internal value of the advanced preview feed-forward coefficient overflowed.	Decrease the advanced preview feed-forward coefficient.
953	2095 2140 2395	The internally set value of the feed-forward timing adjustment coefficient is 12800 or higher.	If nano interpolation is not used, this alarm can be avoided by the following setting: No.2224#5=1
994 995 996	2099	The internal value for N pulse suppression overflowed.	Disable the N pulse suppression function. No.2003#4=0 Alternatively, decrease the parameter setting so that no overflow will occur.
1033	2103	There is a difference in retract distance under unexpected disturbance torque between the position tandem master and slave axes. (If the same-axis retract function is in use)	Set the same value.
1123	2112	Although a linear motor is used, the AMR conversion coefficient parameter is not input.	Set the AMR conversion coefficient.
1182	2118 2078 2079	The dual position feedback conversion coefficient has not been specified.	Specify the dual position feedback conversion coefficient.
1183	2118	Although an analog SDU is used, the function for monitoring the difference in error between the semi-closed and full-closed modes is disabled.	Set the level at which the difference in error between the semi-closed and full-closed modes becomes too large (parameter No. 2118). If the monitoring function cannot be enabled due to the machine configuration, enable the bit for disabling the function for monitoring the difference in error between the semi-closed and full-closed modes (bit 0 of parameter No. 2565).
1284 1285	2128	When a small value is set as the number of velocity pulses, the internal value of a parameter related to current control overflows.	Decrease the value in this parameter to the extent that the alarm is not caused.
1294 1295	2129	When a large value is set as the number of velocity pulses, the internal value of a parameter related to current control overflows.	When the value set in this parameter is resolved to the form (a) × 256 + (b), set a smaller value in (a) again.
1393	2139	The AMR offset value of a linear motor exceeds ±45.	Keep the setting of this parameter within ±45. Alternatively, set bit 0 of parameter No. 2270 to 1 to increase the setting range of the AMR offset, and then specify the parameter anywhere within ±60.

Alarm detail No.	Parameter No.	Cause	Action
1446 1447 1448	2144	Feed-forward coefficient for cutting overflowed.	Decrease the feed-forward coefficient for cutting.
1454 1455 1456 1459	2145	Velocity feed-forward coefficient for cutting overflowed.	Decrease the velocity feed-forward coefficient. Alternatively, set bit 3 of parameter No. 2203 to 0.
1493	2149	A value greater than 6 is specified in this parameter.	Only 6 or less can be specified in this parameter. Change the setting to 6 or less.
1503	2150	A value greater than or equal to 10 is set.	Set a value less than 10.
1786	2178	Bit 6 of parameter No. 2212 or bit 6 of parameter No. 2213 is set to 1, and No. 2178 is set to 0.	Set bit 6 of parameter No. 2212 or bit 6 of parameter No. 2213 to 0.
1793	2179	A negative value or a value greater than the setting of parameter No. 1821 is set. A value of 101 or greater is set.	Set a positive value less than the setting of parameter No. 1821. Set a value of 100 or less. Bit 5 of parameter No. 2299 can be set to 1 so that an invalid parameter alarm is not detected, but a system alarm may be issued when a reference position return is performed. In this case, set bit 5 of parameter No. 2299 to 0.
1853	2185	A negative value or a value greater than one-fourth of velocity pulses is set.	Set a positive value that is smaller than one-fourth of velocity pulses.
2113	2211#7	For driving a motor with four windings (when bit 7 of parameter No. 2211 is set to 1) <1> Bit 7 of parameter No. 2211 is not set to 1 for any of the four axes. <2> The motor numbers for the four axes are not the same. <3> HRV3 is set (bit 0 of No. 2013 = 1).	<1> Set bit 7 of parameter No. 2211 to 1 for all axes. <2> Use the same motor number and same standard parameters. <3> Disable HRV3.
2203	2220#0	If pole detection is enabled (bit 7 of No. 2213 = 1) and a non-binary detector is enabled (bit 0 of No. 2220 = 1), an illegal servo parameter setting alarm is issued when any of the following is set: • AMR conversion coefficient 1 ≤ 0 • AMR conversion coefficient 2 ≤ 0 • AMR conversion coefficient 2 > 512 (The settable range is 1 (2 poles) to 512 (1024 poles).)	Set the AMR conversion coefficients correctly.
2233	2223#6	This alarm is issued when parameter No. 1023 is not set to 4n + 1 (30*i*-A) or 8n + 1 (30*i*-B) for the master axis of multi-axis tandem.	For the master axis of multi-axis tandem, set 4n + 1 (30*i*-A) or 8n + 1 (30*i*-B) for parameter No. 1023.
2242	2224#5	This alarm is issued when a setting is made to ignore the invalid setting of the parameter for the feed-forward timing adjustment function (bit 5 of No. 2224 = 1) and a command for nano interpolation is issued.	Use either one.
2632	2263	When the lifting function against gravity is enabled (bit 7 of No. 2298 = 1) or the post-servo-off travel distance monitor function is enabled (bit 5 of No. 2278 = 1), the function for enabling the CNC software to post the detection unit to the servo control software is not supported and the setting of the detection unit (No. 2263) is disabled.	Take one of the following actions: 1) Set a value for parameter No. 2263. → See Supplementary 7. 2) Disable the lifting function against gravity and the post-servo-off travel distance monitor function. 3) Use CNC software that supports the function for enabling the detection unit to be posted to the servo control software.

Alarm detail No.	Parameter No.	Cause	Action
2765	2276#4,5	A setting is made to connect two analog monitor units (current input, Type-C) (bits 4 and 5 of parameter No. 2276 are both set to 1).	Eliminate the causes shown at left.
2780	1905#6 2277#5,6,7 2278#0,2,4	A setting is made to connect a detector (acceleration sensor, temperature detection circuit, or servo check interface unit) to the odd-numbered SDU unit that is not used. - No.1905#6 (30i-A Series, 0i-D Series) - No.24096 (30i-B Series)	For the odd-numbered SDU unit, check the FSSB setting (bit 6 of parameter No. 1905 and parameter No. 24096) or the detector setting (bits 0, 2, and 4 of parameter No. 2278).
2781	1905#7 2277#5,6,7 2278#1,3,4	A setting is made to connect a detector (acceleration sensor, temperature detection circuit, or servo check interface unit) to the even-numbered SDU unit that is not used. - No.1905#7 (30i-A Series, 0i-D Series) - No.24097 (30i-B Series)	For the even-numbered SDU unit, check the FSSB setting (bit 7 of parameter No. 1905 and parameter No. 24097) or the detector setting (bits 1, 3, and 4 of parameter No. 2278).
2782	1905#6 2277#5,6,7 2278#0,4	Any of the following settings is made: <1> Both an acceleration sensor and temperature detection circuit are enabled for use with the odd-numbered SDU unit. <2> Settings are made to connect the odd-numbered SDU unit, disable an acceleration sensor (bits 5, 6, 7 of No. 2277 = 0,0,0), and read acceleration data from the even-numbered SDU unit (bit 1 of No. 2278 = 1).	Check the settings of the acceleration sensor and temperature detection circuit.
2783	1905#7 2277#5,6,7 2278#1,4	Any of the following settings is made: <1> Both an acceleration sensor and temperature detection circuit are enabled for use with the even-numbered SDU unit. <2> Settings are made to connect the even-numbered SDU unit, disable an acceleration sensor (bits 5, 6, 7 of No. 2277 = 0,0,0), and read acceleration data from the even-numbered SDU unit (bit 4 of No. 2278 = 1).	Check the settings of the acceleration sensor and temperature detection circuit.
2784	1815#1 2277#5,6,7 2278#0,1,4	At the time of full-closed system setting, a detector other than a separate position detector is connected (with the odd- or even-numbered SDU unit).	Modify the setting of the detector.
2785	1815#1 2277#5,6,7 2278#0,4	At the time of full-closed system setting, a detector other than a separate position detector is connected (with the odd-numbered SDU unit).	Modify the setting of the detector.
2786	1815#1 2277#5,6,7 2278#1,4	At the time of full-closed system setting, a detector other than a separate position detector is connected (with the even-numbered SDU unit).	Modify the setting of the detector.
2787	2278#0, 1	A setting is made to connect two temperature detection circuits.	Only one temperature detection circuit can be connected. Modify the setting so that data is read from the target SDU unit.
2788	1815#1 1905#6,7 2277#7,6,5	A setting is made to connect multiple sensors to a single SDU.	Check the settings of the parameters related to sensor connection.

Alarm detail No.	Parameter No.	Cause	Action
2815	2281#5 2014#5 2292#7 2606	Any of the following functions, which cannot be used with the energy charge unit (M), is used: • Torque characteristic switching (bit 5 of No. 2014 = 1) • Interactive force compensation (bit 7 of No. 2292 = 1) Alternatively, the parameter for specifying the drive axis (No. 2606) is set incorrectly.	Disable these functions. Alternatively, set parameter No. 2606 correctly.
2843	2284#3	Any of the following settings is made: (1) Pressure and position control (bit 3 of No. 2284) is enabled for the even-numbered axis. (2) When pressure and position control is enabled for the odd-numbered axis, the even-numbered axis is not any of the following: - Multi-winding sub-axis - Torque tandem sub-axis - Dummy axis	(1) For the even-numbered axis, set bit 3 of parameter No. 2284 to 0. (2) Set the even-numbered axis to any of these axes.
3002	2300#3,#7	The αiCZ detection circuit and linear motor position detection circuit do not support overheat signal connection.	Replace the αiCZ detection circuit and linear motor position detection circuit with those circuits that support overheat signal connection. Alternatively, modify the setting so that the overheat signal is read from a DI signal. No.2300#3=0
3012	2301#2,#7	• When bit 2 of No. 2301 = 1 Hardware (PS, SV) that does not support DC link voltage information output is connected, but bit 2 of No. 2301 is set to 1. • When bit 7 of No. 2301 = 1 The CNC software does not support the torque control setting range extension function.	• When bit 2 of No. 2301 = 1 Set bit 2 of No. 2301 to 0. • When bit 7 of No. 2301 = 1 Use CNC software that supports the function. (→ See Supplementary 6.)
3553	2355	The value 4 or a smaller number is set.	Set a value of 5 or greater.
3603	2113 2360 2363 2366	The value 95 or a smaller number is set. * Parameter No. 2366 is used only when resonance elimination filter L is disabled.	Set a value of 96 or greater. Alternatively, if no resonance elimination filter is used, set all of the center frequency, band width, and dumping to 0.
3663	2366	Resonance elimination filter L is enabled and (bit 1 of parameter No. 2221 is set to 1) and the value set for parameter No. 2366 is 4 or smaller.	When using resonance elimination filter L, set 5 or a larger value for parameter No. 2366.
3722	2372	The EGB exponent setting is made.	Set 0 for the EGB exponent setting (parameter No. 2372).
4024 4025 4029	2402	The internal value of the torsion torque compensation coefficient overflowed.	Decrease the torsion torque compensation coefficient.
4224	2013#0 2014#0 2422#4 2590 2591	When servo HRV$^+$ control is enabled (bit 4 of parameter No. 2422 is set to 1), the current gain is set to 0 (parameter Nos. 2590 and 2591). Alternatively, HRV$^+$ control is enabled (bit 4 of parameter No. 2422 is set to 1) for an axis for which HRV2 control is enabled.	Disable servo HRV$^+$ control (set bit 4 of parameter No. 2422 to 0), or set the current gain.

Alarm detail No.	Parameter No.	Cause	Action
4291	2429#1	An attempt was made to use FSSB high-speed rigid tapping with either of the following functions. Bit 1 of parameter No. 2429 is set to 1. • HRV4 (No.2014#0=1) • Dual position feedback * With series 90G0/13.0 or later edition, the dual position feedback function can be used at the same time.	FSSB high-speed rigid tapping cannot be used together with these functions. Disable the function (set bit 1 of parameter No. 2429 to 0).
4374	2437#4	The linear scale supporting the αi interface cannot be used. The possible causes are: • In semi-closed mode, the αi interface is not used on the semi-closed side. Alternatively, a linear motor is not used. • In full-closed mode, the αi interface is not used on the full-closed side. • The 2048-magnification interpolation circuit (bit 0 of parameter No. 2274) is enabled.	Eliminate the causes shown at left.
4553	2455	A negative value is set.	Set a value of 0 or greater.
4563	2456	A value not within 0 to 12 is set.	Set a value within 0 to 12.
4643	2464	The set insulation resistance alarm level (parameter No. 2464) is not within the valid data range. [Valid data range] 6 to 1000, 32767 When parameter No. 2464 is set to 32767, the level is not detected.	Set a value within the valid data range for the insulation resistance alarm level (parameter No. 2464).
4793	2281#5 2479	When ECU(M) is enabled (bit 5 of parameter No. 2281 is set to 1), the power threshold value (No. 2479) is set to a negative value.	Set a positive value.
5573	2557	The value specified for parameter No. 2557 (PS control axis specification) is not within the valid data range.	Correct the value within the valid data range (between 0 and 255). For details on PS control axis setting, refer to the maintenance manual of the relevant servo amplifier.
5720 5721 5722 5723 5724 5725 5726 5727	2572	A setting for a PS control axis is made for a non-PS control axis. (No.2572)	For anything other than a PS control axis, set this parameter to 0.
5730 5731 5732 5733 5734 5735 5736 5737	2573	A setting for a PS control axis is made for a non-PS control axis. (No.2573)	For anything other than a PS control axis, set this parameter to 0.
5740	2574 2560#4	The settings of parameter No. 2574 and bit 4 of parameter No. 2560 are invalid.	Set the motor-specific standard parameters.
5953	2595	The value of parameter No. 2595 is not within the valid data range. [Valid data range] 0 to 9999	Set a value within the valid data range for parameter No. 2595.

Alarm detail No.	Parameter No.	Cause	Action
6063	2606	The interactive force compensation parameter (No. 2606) is not within the valid data range.	Set a value within the valid data range.
6114 6115 6116 6119	2611	The internal value of the velocity feed-forward coefficient for FSSB high-speed rigid tapping overflowed.	Decrease the velocity feed-forward coefficient for FSSB high-speed rigid tapping.
6713 6723 6733 6743 6753 6763 6773 6783 6793 6803 6813 6823 6833 6843 6853	2671 2672 2673 2674 2675 2676 2677 2678 2679 2680 2681 2682 2683 2684 2685	A setting for a PS control axis is made for a non-PS control axis. (No. 2671 to No. 2685)	For other axes, set this parameter to 0.
6952	2695#2 2422#4 2191 2335	When velocity loop optimization is enabled, the possible causes are as follows: • A negative value is set for parameter No. 2335. • HRV+ control is disabled (bit 4 of No. 2422 is set to 0). • The internally set value of the gain is out of the valid range.	Eliminate the causes shown at left. For details, see Subsection 5.1.6.
8213	1821	A positive value is not set in the reference counter capacity parameter.	Set a positive value in this parameter.
8254 8255 8256	1825	A position gain of 0 is set.	• Set a value other than 0.
9053	1815#1 2016#4 24096 24097	A separate interface unit is not set when the full-closed mode, analog servo adapter, or servo spindle synchronization setting is set.	Set a separate detector interface unit.
10010 10016 10019	2200#0	The internal value of the parameter related to feedback mismatch detection has overflowed.	Check whether correct values are set for the flexible feed gear, number of position pulses, and number of velocity pulses and the counting direction of separate detector data is correct. When there is no problem with them, disable "feedback mismatch detection". (No.2200#0=1)
10024 10025		An overflow occurred in internal calculation on the separate detector serial feedback extrapolation level.	When servo control software Series 90B0 is used, change the software edition to edition D(04) or a later edition. (For series other than 90B0, the software edition need not be changed.)
10033	2004	Illegal control cycle setting This error occurs if automatic modification is carried out for the control cycle.	Correct this parameter related to interrupt cycle setting.
10053	2018#0	When a linear motor is used, the scale reverse connection bit is set.	When the linear motor is used, the scale reverse connection bit cannot be used.

Alarm detail No.	Parameter No.	Cause	Action
10062	2209#4	The amplifier used does not support the HC alarm prevention function.	When you use the current amplifier continuously, set the function bit shown to the left to 0. When using the HC alarm prevention function, use an appropriate amplifier that supports the function.
10092 10093	2004 2013#0 2014#0	This alarm is issued when an invalid control cycle is set.	Change the control cycle setting to HRV2, HRV3 or HRV4. → See Supplementary 2.
		Different control cycles are set within one servo CPU.	Set the same control cycle for axes controlled by one servo CPU. → See Supplementary 2.
		When HRV4 is enabled, a detector that does not support HRV4 is used.	Replace the detector with a detector supporting HRV4. Alternatively, disable HRV4. → See Supplementary 2.
		When HRV4 is enabled, a servo amplifier that does not support HRV4 is connected.	Replace the servo amplifier with a servo amplifier supporting HRV4. Alternatively, disable HRV4. → See Supplementary 2.
10103	2004 2013#0	HRV1 is set. Alternatively, although a current control cycle of 250 μs is set, HRV3 is specified.	The 30i-A Series and 0i-D Series or later do not allow HRV1 to be set. Set HRV2, HRV3, or HRV4. Alternatively, when a current control cycle of 250 μs is set, set HRV2 or disable HRV3. → See Supplementary 2.
10113	2013#0	Current cycle mismatch alarm. This alarm is issued if the specified current cycle does not match the actual setting.	An axis for which HRV3 is specified exists on the same FSSB cable. Review the placement of the amplifier, or disable HRV3. → See Supplementary 2.
10123	2013#0	Alarm for indicating the disability of HRV3 setting. This alarm is issued when the axis supports HRV3 but the other axis of the pair does not support HRV3.	Eliminate the cause of the disability in setting the other axis. Alternatively, cancel the HRV3 setting. → See Supplementary 2.
10123	2013#0 2014#0	When HRV4 is set, this alarm is issued if any of the following conditions is met. • Servo control software not supporting HRV4 is used. • The same FSSB system includes axes with HRV4 setting and axes with HRV2 or HRV3 setting. • The limitation on the number of axes is not observed. (In HRV4 control, one axis/DSP is set.)	Eliminate the causes listed on the left. Alternatively, cancel the HRV4 setting. → See Supplementary 2.
10133	2013#0 2014#0	This alarm is issued when HRV3 or HRV4 is set, but the amplifier does not support these control types.	HRV3 or HRV4 is unusable for the axis on which the alarm was issued. → See Supplementary 2.
10202	2277#5,6,7 2278#0,2,4	The ID of the detector connected to the odd-numbered SDU unit differs from the parameter setting.	Check the detector-related parameter or the state of detector connection.
10212	2277#5,6,7 2278#1,3,4	The ID of the detector connected to the even-numbered SDU unit differs from the parameter setting.	Check the detector-related parameter or the state of detector connection.
10221	2292#6,7 2293#6	The interactive force compensation function is used, but the CNC does not support detection unit information.	Set the detection unit. → See Supplementary 7.

Supplementary 1: Details of illegal settings of servo learning control parameters

For alarm detail No. 83, details of the cause can be checked as follows. For the 30*i*-B Series and so on, set parameter No. 2115 to 0 and parameter No. 2151 to 5316. For the 30*i*-A Series and so on, set parameter No. 2115 to 0 and parameter No. 2151 to 6265. Then, check the value of information No. 353 on the diagnosis screen. Change the value to binary form. If a resulting binary bit is 1, the bit indicates the details cause as listed in the table below.
For learning control for parts cutting A and B, see the alarm details on the dedicated screen.
In addition to alarm detail No. 83, alarm detail Nos. 2206, 4442, 4452, 5162, 5172, and 5272 indicate invalid parameter alarms related to servo learning control. For details, refer to "High Precision Learning Control Operator's Manual (Angle Based Learning Control)".

Bit	Cause
B0	The band stop filter setting (No. 2512) is out of the valid range.
B1	The profile number setting (No. 2511) is out of the valid range.
B2	The command data cycle setting (Nos. 2517, 2519, 2521, 2523, and 2525) is out of the valid range.
B3	The total of the profiles (No. 2510) is out of the valid range.
B4	G05 was started during memory clear processing.
B5	The profile number (No. 2511) was 0 when the total of profiles (No. 2510) was nonzero.
B6	An automatically set value for thinning-out shift was out of the valid range because of a long command data cycle.

NOTE

If the value of information No. 353 on the Diagnosis screen is 0, a transfer error occurred when learning data was received from the PC to the servo. Set parameter No. 2151 to 6609 (30*i*-B) or 1313 (30*i*-A). You will find that B11 of information No. 353 on the Diagnosis screen is set to 1.

Supplementary 2: HRV setting

For 30*i*-A/B Series servo control software, three types of control are available: HRV2, HRV3, and HRV4. For 0*i*-D/F Series servo control software, two types of control are available: HRV2 and HRV3. Their settings are explained below.

HRV2: No. 2004 = 0X000011, No. 2013#0 = 0, No. 2014#0 = 0
HRV3: No. 2004 = 0X000011, No. 2013#0 = 1, No. 2014#0 = 0
HRV4: No. 2004 = 0X000011, No. 2013#0 = 0, No. 2014#0 = 1

When an invalid value is set in control cycle related parameters, the following alarm messages are indicated on the CNC:

Alarm detail No.	Alarm number	Message
10092 10093	456	Invalid current control cycle setting
10103	457	Invalid High-speed HRV setting
10113	458	Invalid current control cycle setting
10123	459	High-speed HRV setting not allowed
10133	468	High-speed HRV setting not allowed (amplifier)

Supplementary 3: Setting the number of position pulses

If the resolution of the separate detector is high and the number of position pulses becomes greater than 32767, take the following measure.

Use "position pulse conversion coefficient" to make settings.

Number of position pulses = A × B

Select B so that A is within 32767.

A: Number of position pulses set in the parameter (less than or equal to 32767)

B: Position pulses conversion coefficient

2024	Number of position pulses (PPLS)

2185	Position pulses conversion coefficient (PSMPYL)

(Setting example)

If the linear scale used has a minimum resolution of 0.1 μm and the distance to move per motor turn is 16 mm

Assume that A is 10000 and B is 16 because:

Number of position pulses = distance to move per motor turn (mm)/detector minimum resolution (mm) = 16 mm/0.0001 mm = 160000 (> 32767) = 10000 × 16

Set A as the "number of position pulses" and B as the "position pulses conversion coefficient".

NOTE

If the detector on the motor is an αi Pulsecoder (number of velocity pulses = 8192), select a power of 2 (2, 4, 8, ...) as the conversion coefficient wherever possible (so the position gain used within the software becomes more accurate).

Supplementary 4: Setting the number of velocity pulses

If the number of velocity pulses becomes greater than 32767, take the following measure.

(i) If the number of velocity pulses is in a range from 32,768 to 131,000

Parameter No. 30i Series, 0i-D Series, and so on	Method for changing parameters
2000#0	1
2023	(Setting target)/10
2024	(Setting target)/10

(ii) If the number of velocity pulses is larger than 131,000

Change the parameters according to the following table.

In this table, letter E satisfies:

Number of velocity pulses/10/E < 13100

Parameter No. 30i Series, 0i-D Series, and so on	Method for changing parameters
2000#0	1
2023	(Setting target) / 10 / E
2024	(Setting target) / 10 / E
2043	(Setting target) / E
2044	(Setting target) / E
2047	(Setting target) × E
2053	(Setting target) × E
2054	(Setting target) / E
2059	(Setting target) × E

NOTE
1 When a setting is made using this method, the actual speed multiplied by E is displayed on the servo screen.
2 This setting method is not available for a motor for which standard parameter No. 2574 is not set to 0.

Supplementary 5: Function for changing the internal format of the velocity loop proportional gain

An overflow may occur in the velocity loop proportional gain during internal calculation by the servo control software. This can be avoided by setting the parameter shown below.

	#7	#6	#5	#4	#3	#2	#1	#0
2200		P2EX						

P2EX (#6) 0: Uses the standard internal format for the velocity loop proportional gain.
1: Changes the internal format of the velocity loop proportional gain to prevent an overflow.

Supplementary 6: Support for the torque control setting range extension function

To use the torque control setting range extension function (bit 7 of No. 2301), CNC system software that supports the function is required. The following series and edition of CNC system software support the function:

CNC	System software	
	Series	Edition
Series 30*i*-A	G004, G014, G024	11 and subsequent editions
Series 31*i*-A5	G124, G134	11 and subsequent editions
Series 31*i*-A	G104, G114	11 and subsequent editions
Series 32*i*-A	G204	11 and subsequent editions

* For the 0*i*-D Series, there is no system software that supports the function.
* Series 30*i*/31*i*/32*i*-B/35*i*-B, Power Motion *i*-A, DSA-B, and 0*i*-F all support the function.

Supplementary 7: Setting detection unit information

If you want to use a function which uses information related to the detection unit, but the CNC system software does not support the function, you can set the detection unit for the following parameter to use the function.

2263	Detection unit setting

[Setting unit] 1 nm

Detection unit	10μm	1μm	0.1μm	0.01μm	0.001μm	0.05μm
Setting value	10000	1000	100	10	1	50

2.1.7 Notes on Using the Control Axis Detach Function

(1) Overview

Servo control software automatically identifies the type of detector connected to an axis, when the power to the CNC is turned on. When the control axis detach function is used, however, servo control software cannot identify the type of detector in a case where the power to the CNC is turned on with the detector detached from the controlled axis. (An alarm such as a communication alarm is issued.)
Such an alarm can be avoided by setting the parameter indicated below.

(2) Series and editions of applicable servo control software

[αi/βi Pulsecoder supported]

CNC	Servo control software		Remarks
	Series	Edition	
Series 30i/31i/32i/35i-B Power Motion i-A DSA-B	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30i/31i/32i-A	90E0 90E1	O(15) and subsequent editions 01.0 and subsequent editions	
Series 30i/31i-A	90D0	O(15) and subsequent editions	HRV4
Series 0i-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0i-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	
Series 0i Mate-D	90H0	02.0 and subsequent editions	

[Separate serial linear supported]

CNC	Servo control software		Remarks
	Series	Edition	
Series 30i/31i/32i/35i-B Power Motion i-A DSA-B	90J0 90JP	07.0 and subsequent editions 04.0 and subsequent editions	
Series 30i/31i/32i-A	90E1	14.0 and subsequent editions	

[Separate serial linear supported]

CNC	Servo control software		Remarks
	Series	Edition	
Series 30i/31i/32i/35i-B Power Motion i-A DSA-B	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30i/31i/32i-A	90E0 90E1	U(21) and subsequent editions 01.0 and subsequent editions	
Series 30i/31i-A	90D0	U(21) and subsequent editions	HRV4
Series 0i-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0i-D	90C5 90C8	- -	
	90E5 90E8	- -	
Series 0i Mate-D	90H0	02.0 and subsequent editions	

[Phase A/B detector supported]

CNC	Servo control software		Remarks
	Series	Edition	
Series 30i/31i/32i/35i-B Power Motion i-A DSA-B	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 0i-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	

(3) Setting parameters

If there is an axis for which the detector may be disconnected from the servo amplifier or separate detector interface unit when the power of the CNC is turned on, set one of the parameters shown below depending on the type of detector. The detector specified in the parameter is assumed to be connected without the automatic detector identification normally performed at the time of power-on.

NOTE
1 If the power is turned on with the detector disconnected, the absolute position cannot be detected.
2 When the control axis detach function is not used, set the bit parameters below to 0.
3 When the phase A/B detector or analog SDU is used as a separate detector for full-closed control, the CNC cannot be used in a way that disconnects the detector at power-on. Make sure the detector is connected before turning on the power of the CNC.

	#7	#6	#5	#4	#3	#2	#1	#0
2017					COMSRC			

COMSRC(#3) The detector on the semi-closed side is:
0: Automatically identified.
1: αi/βi Pulsecoder at all times.

NOTE
1 When this parameter is set, the power must be turned off before operation is continued.

	#7	#6	#5	#4	#3	#2	#1	#0
2277						SRLLIN	SERFIX	

SERFIX(#1) The detector on the full-closed side is:
0: Automatically identified.
1: Rotary serial interface at all times.

SRLLIN(#2) The detector on the full-closed side is:
0: Automatically identified.
1: Linear serial interface at all times.

NOTE
1 If the power is turned on with the detector disconnected, the separate detector interface unit is assumed to be a rotary-type serial interface.
2 When this parameter is set, the power must be turned off before operation is continued.
3 When SERFIX or SRLLIN is set to 1, the detector identification method is fixed with a parameter. Set either SERFIX or SRLLIN to 1.

2.1.8 Servo Error Monitoring

2.1.8.1 Monitoring the difference in error between the semi-closed and full-closed modes

(1) Overview

This function monitors the difference in detection position between the Pulsecoder and separate detector. The function is useful for checking normal operation of the separate detector and monitoring any slip between the motor and machine.
Use of this function is recommended for a full-closed configuration.

(2) Series and editions of applicable servo software

CNC	Servo software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90G0 90J0 90K0 90GP 90JP	13.0 and subsequent editions* 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	A(01) and subsequent editions* 01.0 and subsequent editions*	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i* -F	90M0 90L0 90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8 90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

* The following series and editions of servo software support the setting of the level at which the difference in error between the semi-closed and full-closed modes becomes too large in units of μm:

Series 90E0/31.0 and subsequent editions
Series 90E1/08.0 and subsequent editions
Series 90G0/13.0 and subsequent editions
Series 90GP/02.0 and subsequent editions
Series 90K0/01.0 and subsequent editions
Series 90M0/02.0 and subsequent editions
Series 90M8/02.0 and subsequent editions
Series 90J0/01.0 and subsequent editions
Series 90JP/01.0 and subsequent editions

(3) Setting parameters

To enable the function for monitoring the difference in error between the semi-closed and full-closed modes, set the following parameters:

2118	Level at which the difference in error between the semi-closed and full-closed modes is too large

[Setting value] Level at which the difference in error is too large (μm)/detection unit (μm) or level at which the difference in error is too large (μm)

[Setting unit] Detection unit or 1 μm (→ See the explanation of bit 7 of parameter No. 2420.)

If the difference between the Pulsecoder and the separate detector is greater than or equal to the value specified for the parameter, the abnormal status is assumed and alarm "EXCESS ERROR (SEMI-FULL)" is issued.
Set a value two to three times as large as the backlash. When 0 is set, detection is disabled.

	#7	#6	#5	#4	#3	#2	#1	#0
2420	SFUMSET							

SFUMSET(#7) The unit of data for the level at which the difference in error between the semi-closed and full-closed modes becomes too large (parameter No. 2118) is:

0: Detection unit
1: 1 μm

	#7	#6	#5	#4	#3	#2	#1	#0
2565								SFEROFF

SFEROFF(#0) For a machine in a full-closed configuration in which an analog input separate detector interface unit is used, the function for monitoring the difference in error between the semi-closed and full-closed modes is:

0: Enabled.
1: Disabled. (Also, set parameter No. 2118 to 0.)

NOTE

For an axis in a full-closed configuration in which an analog input separate detector interface unit is used, the function for monitoring the difference in error between the semi-closed and full-closed modes is automatically enabled. If the level at which the difference in error between the semi-closed and full-closed modes becomes too large (parameter No. 2118) is not set, invalid parameter alarm SV0417 (detail No. 1183) is issued.

When the function for monitoring the difference in error between the semi-closed and full-closed modes cannot be used for the following reasons, set parameter No. 2118 to 0 and bit 0 of No. 2565 to 1 to disable the function.

- The gear reduction ratio between the motor and separate detector greatly changes according to the machine position.
- The belt or another part between the motor and separate detector can slip.

2078	Conversion coefficient (numerator)
2079	Conversion coefficient (denominator)

[Setting value] Calculate the coefficients using the following formula:

$$\text{Conversion coefficient}\left(\frac{\text{Numerator}}{\text{Denominator}}\right)=\frac{\text{Number of position feedback pulses per motor revolution (After being multiplied by FFG)}}{1{,}000{,}000}\ \text{(as an irreducible fraction)}$$

(Example)

When αi Pulsecoder is used with a tool travel of 10 mm/motor revolution (1μm/pulse)

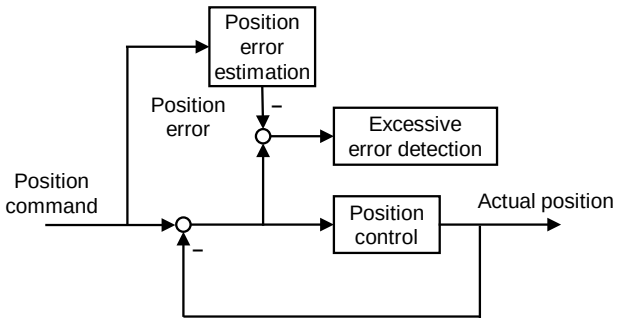
$$\text{Conversion coefficient}\left(\frac{\text{Numerator}}{\text{Denominator}}\right)=\frac{10\times 1000}{1{,}000{,}000}=\frac{1}{100}$$

2.1.8.2 Dynamic error monitoring

(1) Overview

An excessive error alarm is detected by estimating the position of the feed axis based on the specified speed, position gain, and feed-forward setting and monitoring the difference between the estimated position and actual position. This function has the effect that the alarm detection of unnecessary error is prevented when the feedrate is low. It can reduce the time it takes to detect an excessive error alarm when an error occurs.

(Configuration)



(Effect)

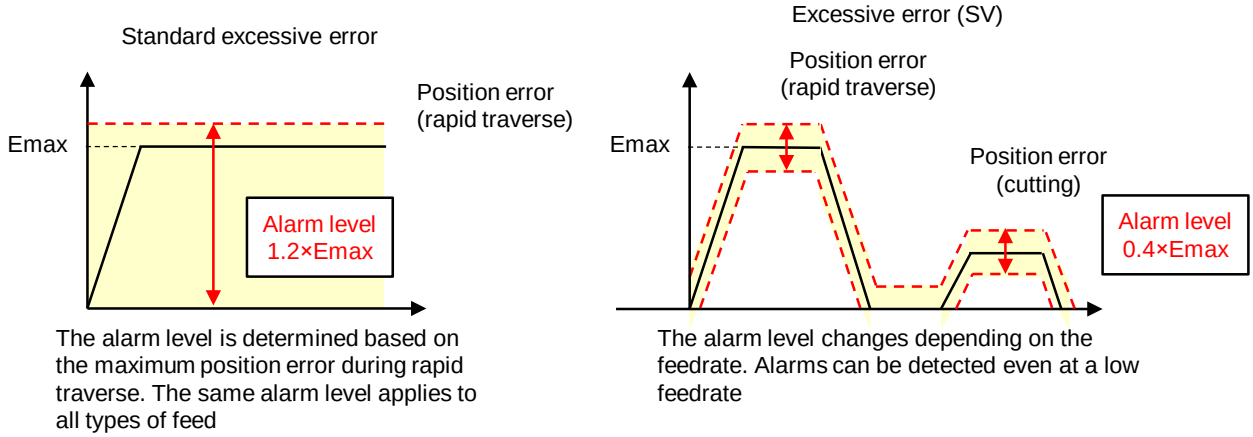


Fig. 2.1.8.2 (a) Outline of the detection of excessive error between the estimated position and actual position

(2) Series and editions of applicable servo software

[Applicable servo control software]

CNC	Servo software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90G0 90J0 90K0 90GP 90JP	04.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	28.0 and subsequent editions* 03.0 and subsequent editions*	* The dual position feedback function is supported by Series 90E0/30.0 and subsequent editions and Series 90E1/06.0 and subsequent editions.
Series 30*i*/31*i*-A	90D0	-	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	- 06.0 and subsequent editions	
	90E5 90E8	- 06.0 and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

[Applicable system software]

CNC	System software	
	Series	Edition
Series 30*i*-A	G00C,G01C,G02C	41 and subsequent editions
	G004,G014,G024	02 and subsequent editions
Series 31*i*-A5	G12C,G13C	41 and subsequent editions
	G124,G134	02 and subsequent editions
Series 31*i*-A	G103,G113	41 and subsequent editions
	G104,G114	02 and subsequent editions
Series 32*i*-A	G203	41 and subsequent editions
	G204	02 and subsequent editions
Series 0*i*-MD	D4F1	05 and subsequent editions
Series 0*i*-TD	D6F1	05 and subsequent editions
Series 0*i* Mate-MD	D5F1	05 and subsequent editions
Series 0*i* Mate-TD	D7F1	05 and subsequent editions

Series 30*i*/31*i*/32*i*/35*i*-B, 0*i*-F, and Power Motion *i*-A all support this function.

(3) Notes

- When an alarm is detected, SV0653, "EXCESS ERROR (SV)" is displayed.
- To use this function with the dual position feedback function, supporting servo software is required.

(4) Setting parameters

	#7	#6	#5	#4	#3	#2	#1	#0
2419							DYNTQL	DYNERR

DYNERR(#0) The detection of excessive error (SV) is:
0: Disabled.
1: Enabled.

DYNTQL(#1) The detection of excessive error in the torque limit mode is:
0: Enabled.
1: Disabled.

	#7	#6	#5	#4	#3	#2	#1	#0
2420				DUDYN				

DUDYN(#4) When the function for monitoring the difference in error between the semi-closed and full-closed modes and the dual position feedback function are enabled, the detection of excessive error (SV) is:
0: Disabled.
1: Enabled.

NOTE
For FS30*i*-A and FS0*i*-D, set DUDYN to 1 when enabling the function for monitoring the difference in error between the semi-closed and full-closed modes for an axis for which the dual position feedback function is enabled.

2458	Excessive error (SV) alarm detection level

[Setting unit] Detection unit (Bit 6 of No. 2428 = 0)
Physical unit (mm or deg) (Bit 6 of No. 2428 = 1)

[Valid data range] 0 to 32767

[Typical setting] Usually, set 0.2 times the position error in rapid traverse.

$$\text{Setting value} = \frac{\text{Rapid traverse rate [mm/mm]}}{60 \times \text{position gain [1/s]} \times \text{detection unit [mm]}} \times 0.2$$

For details, see item (5).

NOTE

1 When the dual position feedback function is used at the same time, since the characteristics of dual position feedback are not considered during the estimation of the position, estimation error is generated according to the time constant of dual position feedback and a mechanical torsion. For this reason, the alarm level must be increased by the amount of error.

2 If the system software does not support this function, setting bit 0 (DYNERR) of parameter No. 2419 to 1 causes invalid parameter alarm SV0417 (detail No. 4190).

3 If the function for monitoring the difference in error between the semi-closed and full-closed modes is used for an axis for which dual position feedback is used, the difference in error between the semi-closed and full-closed modes also needs to be taken into consideration for the excessive error detection level.

When any of the servo control software listed in the table below is used, the setting unit for the excessive error (SV) alarm detection level can be chosen between the detection unit and the physical unit (mm or deg).

[Servo control software supporting the use of the physical unit when setting the alarm level]

CNC	Servo control software		Remarks
	Series	Edition	
Series 30i/31i/32i/35i-B	90G0	23.0 and subsequent editions	
Power Motion i-A	90J0	01.0 and subsequent editions	
DSA-B	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 0i -F	90M0	02.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
Series 0i Mate-D	90H0	02.0 and subsequent editions	

	#7	#6	#5	#4	#3	#2	#1	#0
2428		DYUNIT						

DYUNIT (#6) Unit to be used for the dynamic excessive error level
0: Detection unit
1: Physical unit (mm or deg)

(5) Example of setting the excessive error alarm (SV) detection level

In general, the excessive error alarm level is set to 1.2 times the estimated position error in rapid traverse. For the excessive error alarm (SV), the difference between the actual position error and the position error estimated from the feedrate, position control gain, and feedforward coefficient is set as the alarm level. Therefore, to obtain an equivalent alarm level at the rapid traverse rate of 100%, set the value calculated from the following formula:

$$\text{Setting value} = \frac{\text{Rapid traverse rate [mm/min]}}{60 \times \text{position gain [1/s]} \times \text{detection unit [mm]}} \times 0.2$$

Next, the procedure for manually adjusting the alarm level is described below. Note that setting an excessively low alarm level may lead to incorrect error detection.

(1) Setting the parameter to enable the detection of excessive error (SV)

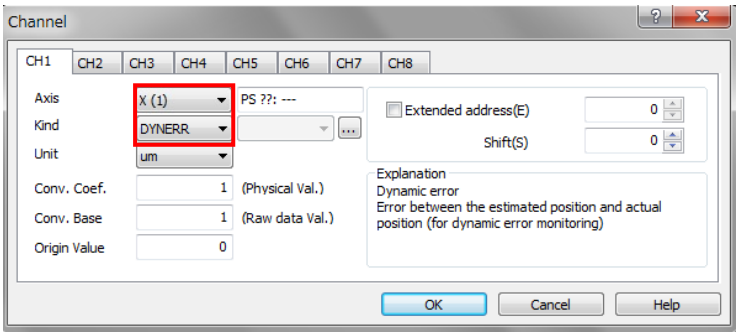
Set the following parameters by referring to "Setting parameters".
Bit 0 of No. 2419 = 1
Bit 4 of No. 2420 = 0 or 1
Bit 6 of No. 2428 = 0 or 1
No. 2458 = 30000 or so (Set a high enough alarm level to prevent incorrect error detection during adjustment.)

(2) Observing the error between the estimated position and actual position

Make the channel settings shown in the figure below, and observe the error between the estimated position and actual position using SERVO GUIDE.

For SERVO GUIDE version 11.10 or later

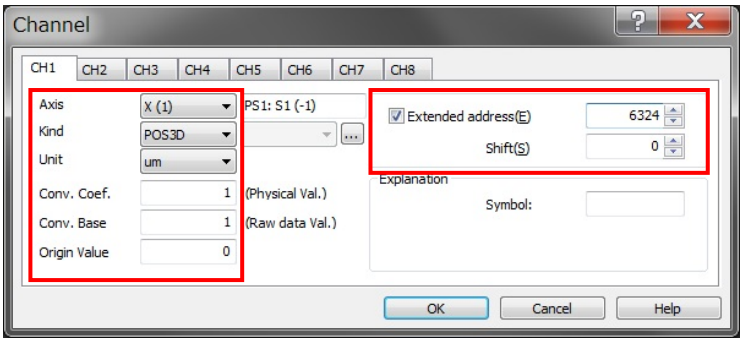
Select the axis to measure and set the data type to "DYNERR".



<Channel>
Axis: Select the axis to be measured.
Kind: DYNERR

For SERVO GUIDE versions earlier than 11.10

Set the extended address as follows:



<Channel>
Axis: Select the axis to be measured.
Kind: ERR
Unit : μm
Conv. Coef.: Detection unit (Set in μm)
Extended address: ON
Extended address value: See the table below.

[FS30*i*-B, FS0*i*-F, FS0*i* Mate-D (Package 5)]

No.1023 (n = 0, 1, 2, ...)	Servo control software 90G0/04.0 to 17.0	Servo control software Series 90G0/18.0–, 90J0, 90JP, 90L0, 90L8, 90M0, and 90M8
	Extended address	Extended address
8n+1	6068	6324
8n+2	10164	10420
8n+3	14260	14516
8n+4	18365	18612
8n+5	22452	22708
8n+6	26548	26804

[FS30*i*-A]

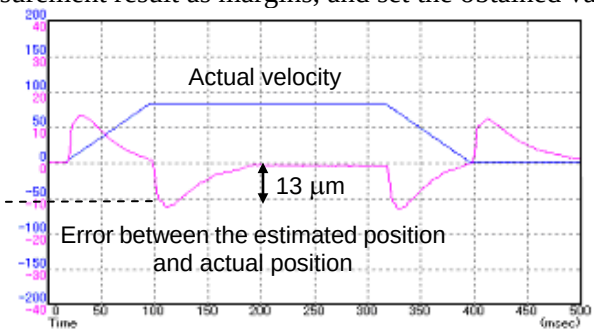
No.1023 (n = 0, 1, 2, ...)	Servo control software Series 90E0, 90E1
	Extended address
4n+1	13069
4n+2	13197
4n+3	19213
4n+4	19341

[FS0*i*-D]

No.1023 (n = 0, 1, 2, ...)	Servo control software Series 90C8	No.1023 (n = 0, 1, 2, ...)	Servo control software Series 90E8
	Extended address		Extended address
2n+1	6669	4n+1	6669
2n+2	6797	4n+2	6797
		4n+3	13325
		4n+4	13453

(3) Setting the alarm level

The figure below shows a measurement example. Note that, in this example, the actual velocity (VT display of POSF data) is measured at the same time. It can be seen that the maximum error between the estimated position and actual position is 13 μm. Add the load fluctuation and machine-dependent fluctuation to the measurement result as margins, and set the obtained value as the alarm level.



2.1.8.3 Dynamic error monitoring warning signal

(1) Overview

The excessive error alarm detection function outputs a warning signal (PMC) at a detection level different from the existing excessive error alarm detection level.
This enables an abnormal situation to be reported without stopping the machine.

(2) Applicable series and editions

CNC	Servo control software	
	Series	Edition
FANUC Series 30*i*/31*i*/32*i*/35*i* -B FANUC Power Motion *i* –A	90J0 90JP	12.0 and subsequent editions 05.0 and subsequent editions
FANUC Series 0*i*-F	90M0 90M8	07.0 and subsequent editions 07.0 and subsequent editions

CNC	System software	
	Series	Edition
FANUC Series 30*i*/31*i*/32*i*-B	G301, G311, G321, G331, G351, G401, G411, G421, G431, G501, G511	77.0 and subsequent editions
	G402, G451, G422, G481, G521	04.0 and subsequent editions
FANUC Series 0*i*-F	D4G1, D6G1	15.0 and subsequent editions

(3) Parameters

To output a warning signal, enable dynamic excessive error detection (set bit 0 of No. 2419 to 1) and then set the warning detection level (No. 2659) to 1 or more.

2659	Dynamic excessive error warning detection level

[Setting unit] Detection unit (Bit 6 of No. 2428 = 0)
Physical unit (mm or deg) (Bit 6 of No. 2428 = 1)
[Valid data range] 1 to 32767
If the warning detection level is 0 or less, no warning signal is output. For details on the setting procedure, set the alarm detection level (No. 2458) to a smaller value by referring to Subsection 2.1.8.2, "Dynamic error monitoring".

	#7	#6	#5	#4	#3	#2	#1	#0
2419								DYNERR

DYNERR (#0) Dynamic excessive error detection is:
0: Disabled.
1: Enabled.
If disabled, the existing alarm and warning signal are not output.

2458	Excessive error (SV) alarm detection level

[Setting unit] Detection unit (Bit 6 of No. 2428 = 0)
Physical unit (mm or deg) (Bit 6 of No. 2428 = 1)
[Valid data range] 0 to 32767
[Typical setting] Usually, set 0.2 times the position error in rapid traverse. When an excessive error exceeding the detection level is detected, SV0653, "EXCESS ERROR (SV)" is detected.

No.2419#0	No.2458	No.2659	Alarm output	Warning output
1	1 to 32767	0	○	
	1 to 32767	1 to 32767	○	○
	0	1 to 32767		○
0	-	-		

○: Supported

(4) PMC signal

Dynamic excessive error warning signal DYNWR1 through DYNWR8 <Fn686>

[Classification] Output signal

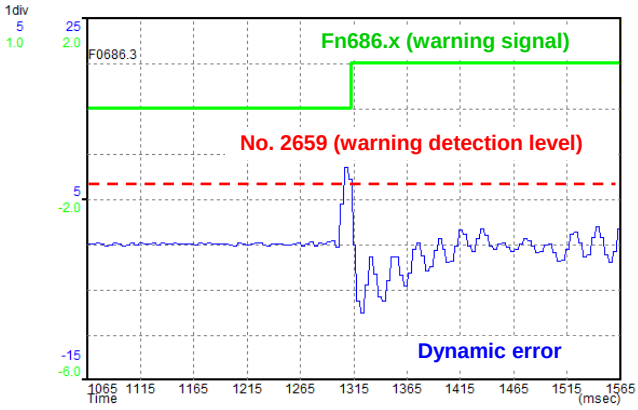
[Operation] When dynamic excessive error detection is (bit 0 of No. 2419 is 1), Fn686.x becomes "1" when the dynamic error becomes equal to or greater than the warning detection level (No. 2659). This signal returns to "0" upon reset.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
Fn686	DYNWR8	DYNWR7	DYNWR6	DYNWR5	DYNWR4	DYNWR3	DYNWR2	DYNWR1

(5) Example of operation

The following is an example of operation when the dynamic error exceeds the warning detection level. For details on how to observe the dynamic error, see item (5) in Subsection 2.1.8.2, "Dynamic error monitoring".



2.2 SETTING PARAMETERS FOR LARGE SERVO MOTORS

2.2.1 Motor Models and System Configurations

Multiple amplifiers may be used to drive a large servo motor.
The system configuration is determined according to the motor model used and CNC (Table 2.2.1 (a)).

Table 2.2.1 (a) Motor models and system configurations

Motor model	Number of amplifiers	System configuration		
		30*i*-B Series 0*i*-F Series Power Motion *i*-A, DSA-B	30*i*-A Series	0*i*-D Series
αiS 300/2000, -B αiS 500/2000, -B αiS 1000/2000HV ,-B	2	Motor with two windings*1	Torque tandem*3	Torque tandem*3
αiS 1000/3000HV, -B αiS 1500/3000HV-B αiS 2000/2000HV αiS 3000/2000HV	4	Motor with four windings*2	Motor with four windings*4	PWM distribution module (PDM*5)
αiS 18000/450HV-B	8	Motor with eight windings*6	Not supported	Not supported

*1 The motor is driven in the two-winding mode (bit 6 of parameter No. 2211 is set to 1).
*2 The motor is driven in the four-winding mode (bit 7 of parameter No. 2211 is set to 1).
*3 The tandem control option (J733) is required.
*4 To drive a motor in the four-winding mode (bit 7 of parameter No. 2211 is set to 1) with the Series 30*i*-A, the tandem control option (J733) is required.
*5 PDM stands for PWM Distribution Module. For details, refer to "PWM Distribution Module Descriptions (A-72562E-029)".
*6 The servo parameters and FSSB must be set. Refer to "FANUC AC SERVO MOTOR αiS -B series αiS 18000/450HV-B DESCRIPTIONS (A-89000-0251EN)".

2.2.2 Parameter Setting for the Four-Winding and Two-Winding Modes

(1) Overview

Set these parameters when driving a four-winding or two-winding motor for the 30*i*-A/B or 0*i*-F Series CNC. In this configuration, as many servo control axes as the number of windings are necessary.
These settings can also be used for a linear motor driven axis that uses two or four coil sliders and a linear scale.

(2) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	03.0 and subsequent editions	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
DSA-B	90K0	01.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	U(21) and subsequent editions	*1
	90E1	01.0 and subsequent editions	

*1 When driving a two-winding motor with the 30*i*-A, see Subsection 2.2.3.

The following series and editions of servo control software are applicable to the power consumption monitor for a motor with multiple windings. These are referred to as the series and editions applicable to the power consumption monitor below.

[Servo control software applicable to the power consumption monitor]

CNC	Servo control software	
	Series	Edition
Series 30*i*/31*i*/32*i*/35*i*-B	90J0	09.0 and subsequent editions
	90JP	04.0 and subsequent editions
Series 0*i*-F	90M0	05.0 and subsequent editions
	90M8	05.0 and subsequent editions

(3) Setting parameters

After you have set the standard parameters for the servo motor to be used, for all axes to be used by the motor with plural windings, set PLW4 or PLW2 according to the number of windings.

	#7	#6	#5	#4	#3	#2	#1	#0
2211	PLW4	PLW2						

PLW2 (#6) The motor with two windings is: (30*i*-B, 0*i*-F Series CNC)
0: Not used.
1: Used.

PLW4 (#7) The motor with four windings is: (30*i*-A/B, 0*i*-F Series CNC)
0: Not used.
1: Used.

2022	Direction of motor rotation (DIRCT)

* Set the same direction as the direction of motor rotation for a motor with two or four windings.

+111 When the positive direction is specified, the rotor rotates in the forward direction.

-111 When the positive direction is specified, the rotor rotates in the reverse direction.

NOTE

- Set PLW4 or PLW2 for all axes to be used by the motor with multiple windings.
- When PLW4 or PLW2 is set, the current command and feedback from the Pulsecoder are copied from the main axis to the sub-axis.
- Use one of the following combinations of servo axis numbers (parameter No. 1023) for the axis comprising the motor.

	No. 1023 combination (n=0,1,2,3,...)	
	30*i*-A	30*i*-B, 0*i*-F
When PLW2 is used	(2n+1, 2)	(8n+1, 2), (8n+3, 4), (8n+5, 6)
When PLW4 is used	(4n+1, 2, 3, 4)	(8n+1, 2, 3, 4)

- When the motor is used with the 30*i*-A Series CNC, the following restrictions apply:
  - When PLW4 is used, servo HRV3 control cannot be used.
  - The tandem control option (J733) is required.
- The motor feedback sharing bit (bit 7 of parameter No. 2018) and separate feedback sharing bit (bit 1 of parameter No. 2200) are not required.

NOTE

- In the case of a two-winding or four-winding motor, the following signals need to be input to both the main axis and sub-axis.
  - Servo off signal
  - Control axis detach signal
  - VRDY OFF invalidation signal

  The axes that configure a two-winding or four-winding motor need to be put in the same path.

	#7	#6	#5	#4	#3	#2	#1	#0
2567			**PMMW**					

PMMW(#5) Support for multiple windings by the power consumption monitor
0: Disabled.
1: Enabled.

NOTE

This bit parameter is only valid for the series and editions applicable to the power consumption monitor.
To use the power consumption monitor for a motor with multiple windings, set bit 5 of parameter No. 2567 to 1.
For details of the power consumption monitor and setting values, see Appendix J, "SETTINGS FOR THE POWER CONSUMPTION MONITOR FUNCTION" and "30*i*/31*i* /32*i* -MODEL B CONNECTION MANUAL (FUNCTION) (B64483EN-1)".

(4) Invalid parameter setting alarm

In the following cases, an invalid parameter alarm is issued. (detail No. DGN352 = 2113)

[Four windings]

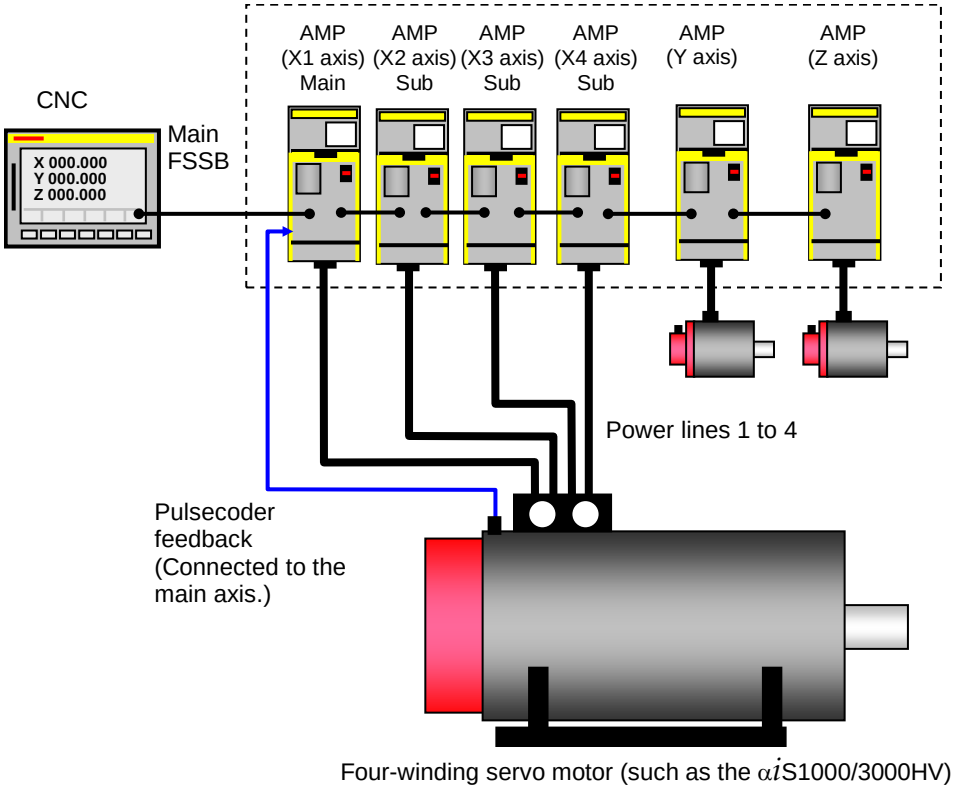
- The tandem option is not used. (No detail No. is displayed only in this case.) 30*i*-A
- Bit 7 of parameter No. 2211 is not set to 1 for all four of the axes consecutively specified for parameter No. 1023.
- The motor number is not the same for all four of the axes consecutively specified for parameter No. 1023.
- (for the Series 30*i*-A CNCs) HRV3 is used.
- HRV4 is used.

[Two windings]

- The tandem option is not used. (No detail No. is displayed only in this case.) 30*i*-A
- Bit 6 of parameter No. 2211 is not set to 1 for both axes consecutively specified for parameter No. 1023.
- The motor number is not the same for both axes consecutively specified for parameter No. 1023.
- HRV4 is used.

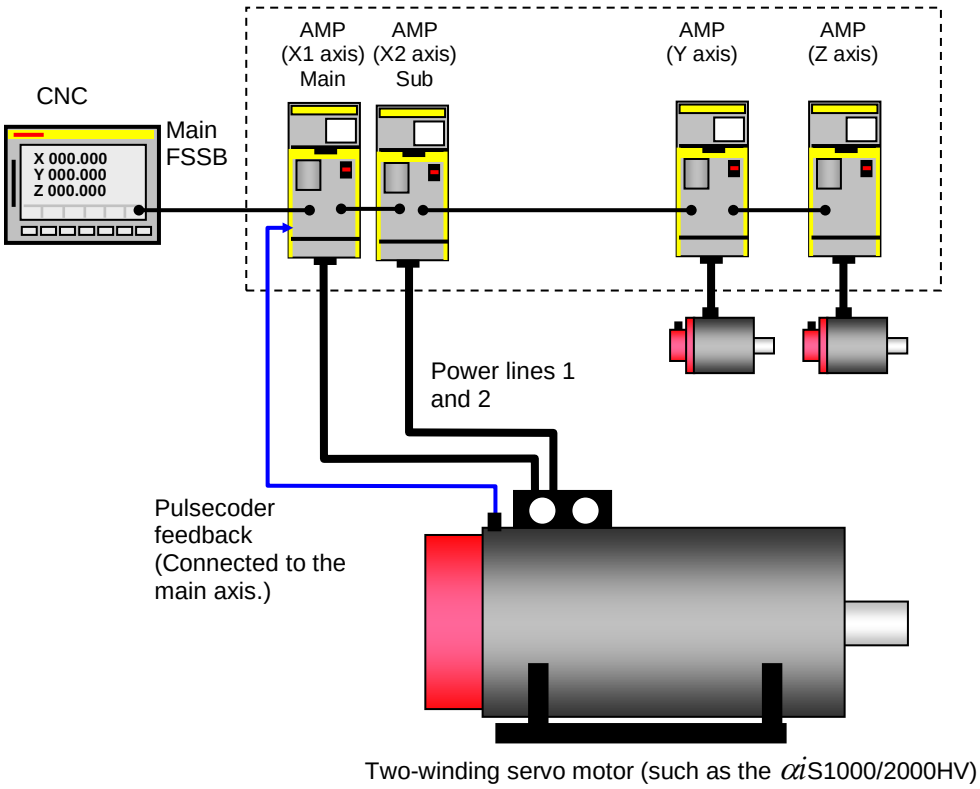
(5) Example parameter settings

- Motor with four windings



Axis name	Axis name No.1020	Second axis name No.1025	Servo axis number No.1023	Four-winding mode No.2211#7
X1	88	49	1	1
X2	88	50	2	1
X3	88	51	3	1
X4	88	52	4	1
Y	89	0	5	0
Z	90	0	6	0

- Motor with two windings



Axis name	Axis name No.1020	Second axis name No.1025	Servo axis number No.1023	Two-winding mode No.2211#6
X1	88	49	1	1
X2	88	50	2	1
Y	89	0	3	0
Z	90	0	4	0

NOTE

The second axis name (parameter No. 1025) or suffix (parameter No. 3131) must be changed for each axis used for a motor with two or four windings.
If the same axis name is used, the actual feedrate becomes lower than the specified speed.

(6) Other

- Position control is performed for the main axis. No position command is required for the sub-axis.
- In general, set the same value for each parameter for the main axis and sub-axis. In particular, be sure to set the same values for the parameters related to resonance elimination filters and current control.
- To use the control axis detach function, input the detach signal to all axes.
- You can measure frequency characteristics on SERVO GUIDE by specifying the main axis as the measurement target.

2.2.3 Setting Parameters in the Torque Tandem Configuration

(1) Overview

Set these parameters when driving a two-winding motor for the 30*i*-A, 0*i*-D Series CNC. In this configuration, two servo control axes are necessary and the torque tandem control and feedback copy functions are used.

NOTE
- Torque tandem control is an optional function.
- When a two-winding motor is used in the torque tandem configuration, two CNC axes are occupied per motor.

(2) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

NOTE
Servo HRV4 control exercises control on one axis per CPU, so this configuration cannot be used along with servo HRV4 control.

(3) Setting parameters

(1) Of the two amplifiers connected to a motor, assign one amplifier to the main axis and the other to the sub-axis used for torque tandem control, and enable torque tandem control.

	#7	#6	#5	#4	#3	#2	#1	#0
1817		TANDEM						

TANDEM(#6) 1: Enables tandem control. (Set this parameter for the main- and sub-axes.)

To make settings related to torque tandem control, see Subsection 5.10.4, "TORQUE TANDEM CONTROL FUNCTION".

(2) Make the parameter setting indicated below for the sub-axis to enable the motor feedback sharing function.
The feedback cable from the motor is connected to the amplifier on the main axis.

	#7	#6	#5	#4	#3	#2	#1	#0
2018	PFBCPY							

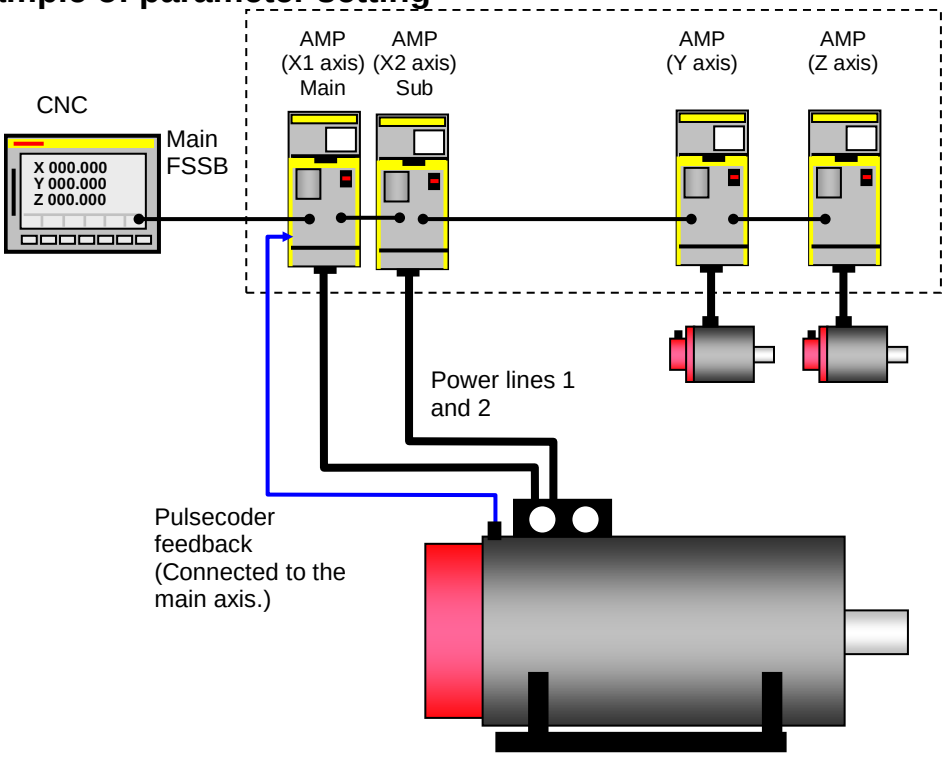
PFBCPY(#7) 1: The motor feedback signal for the main axis is shared with the sub-axis motor. (Set this parameter for the sub-axis.)

To make the torque of the main axis the same as that of the sub-axis, enable the following bit:

	#7	#6	#5	#4	#3	#2	#1	#0
2008						VFBAVE		

VFBAVE (#2) 1: Enables the velocity feedback average function. (Set this parameter for the main axis).

(4) Example of parameter setting



Two-winding servo motor (such as the αiS1000/2000HV)

Axis name	Servo axis number No.1023	Tandem control No.1817#6	Motor feedback sharing No.2018#7
X1	1	1	0
X2	2	1	1
Y	3	0	0
Z	4	0	0

3 LINEAR MOTOR AND DD MOTOR PARAMETER SETTING

3.1 LINEAR MOTOR PARAMETER SETTING

3.1.1 Procedure for Setting the Initial Parameters

(1) Overview

The following describes the procedure for setting the digital servo parameters to enable the use of a FANUC linear motor.

(2) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	A(01) and subsequent editions 01.0 and subsequent editions	(*1)
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	(*1) HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	

(*1) Servo control software edition P(16) or later is required to use the linear motor position detection circuit (A860-2033-T201, -T202, -T301, -T302, A860-2034-T201, or T202).

⚠ WARNING

1 The linear motor can make an unpredictable movement, resulting in a very dangerous situation, if an error is made in linear motor assembly, power line cabling, detector installation direction setting, or basic parameter setting.

2 It is recommended to take the following actions until normal operation is confirmed:
- Lower the excessive error level so that an alarm is issued immediately when an unpredictable movement is made.
- Lower the torque limit value to disable abrupt acceleration.
- Ensure that the emergency stop switch can be pressed immediately.

(3) Linear encoders

The position and velocity of the linear motor are detected using a linear encoder. Two types of linear encoders are available: incremental type and absolute type. The parameter setting and connection vary according to the type of encoder.

To share a linear encoder in the torque tandem configuration, see Subsection 5.10.4, "TORQUE TANDEM CONTROL FUNCTION".

Incremental type

The incremental type linear encoder is connected to a servo amplifier via a position detection circuit (A860-0333-T***, A860-2033-T*** or A860-2034-T***) for linear motors manufactured by FANUC. Values to be set in parameters vary depending on the signal pitch of the linear encoder. Therefore, check the signal pitch of the encoder first.

Table 3.1.1 (a) lists examples of usable incremental linear encoders.

Table 3.1.1 (a) Examples of usable linear encoders (incremental)

Encoder manufacturer	Signal pitch (μm)	Model
HEIDENHAIN	20	LS487(C), LS187(C), LS388(C), LS688(C), LIDA483, LIDA485. LIDA487, LIDA489, etc.
	40	LB382(C), etc.
	2	LIP481R
	4	LF485, LF185, LIP581R, LIP581C, LIF481R, LIF181R, LIF181C, etc.
	0.512	LIP281
Mitutoyo	20	AT402E
Renishaw	20	RG2, TONiC, SIGNUM
	40	RG4
	2000	LM10

When an incremental type linear encoder is used, a linear motor pole detector (A860-0331-T001, -T002 or A860-2031-T001, -T002) is also needed.

Absolute type

An absolute type linear encoder is directly connected to a servo amplifier. The parameter setting varies depending on the resolution of the encoder used. First, check the resolution.
Table 3.1.1 (b) lists examples of currently usable absolute type linear encoders.

Table 3.1.1 (b) Usable linear encoders (absolute)

Encoder manufacturer	Resolution (μm)	Model
HEIDENHAIN	0.05*4	LC193F, LC493F
	0.05 (0.0125)*2*3*4 0.01 (0.00125)*2*3*4	LC195F*1, LC495F*1
	0.01, 0.005, 0.001	LIC4193F, LIC4195F, etc.
Mitutoyo	20/4096	AT555
	0.05	AT353, AT553
	0.1	ST758
Renishaw	0.001, 0.05	RESOLUTE
Magnescale	0.01, 0.05, 0.1, 0.5, 1.0	SR87, SR77
	0.005, 0.01, 0.05, 0.1, 0.5, 1.0	SR27A, SR67A, SQ47, SQ57
NEWALL	0.5, 1.0, 5, 10	SHG-AF
FAGOR	0.05, 0.1	LAF, GAF, SAF, SVAF

*1 Encoders with resolutions of 0.05 μm and 0.01 μm are available.

*2 Numerical values outside the parentheses indicate the resolution for the α interface (communication via the α interface (two-pair communication) is automatically used for a scale that does not respond to the α*i* interface (one-pair communication)).

*3 Numerical values in the parentheses indicate the resolution for the α*i* interface

*4 The α*i* interface is supported by the servo control software of the series and editions listed below.

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	19.0 and subsequent editions	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90M8	02.0 and subsequent editions	

NOTE

1 For details of the linear encoders usable with FANUC linear motors, refer to "FANUC LINEAR MOTOR L*i*S series DESCRIPTIONS (B-65482EN)".
2 For details of the linear encoders, contact the manufacturer of each linear encoder.
3 To use servo HRV4 control with a linear motor, a detector that supports servo HRV4 control is needed. See "(b) Detector" in "(4) Servo HRV4 control hardware" of Subsection 5.1.3.

(4) Parameter settings

Set the parameters according to the procedure below. Note the points below when setting the parameters.

[Cautions for using incremental linear encoders]
The following parameter setting procedure involves a parameter to be specified according to the resolution of the linear encoder. If an incremental linear encoder is to be used, convert the encoder signal pitch to the resolution for parameter calculation, using the following equation.

Resolution [μm] = Encoder signal pitch [μm] / 512

Parameter setting procedure (1)

Procedure (1) can be used to initialize the parameters (such as current gain) necessary to drive a linear motor. After initialization, parameters depending on the linear encoder resolution (or the value obtained by dividing the signal pitch of the linear encoder by the interpolation magnification of the position detection circuit) must be set. Set these parameters by following parameter setting procedure (2).

Parameters related to initialization

Incremental type, Absolute type

	#7	#6	#5	#4	#3	#2	#1	#0
2000							DGPR	PLC0

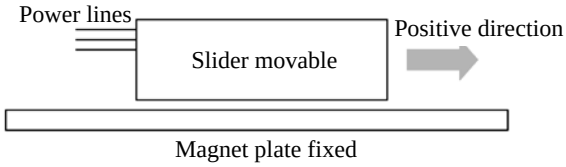
DGPR(#1) Set 0. (After initialization, this bit is set to 1 automatically.)
For PLC0 (#0), see Table 3.1.1 (e), (f).

2001	AMR

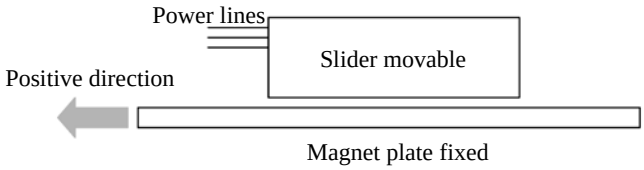
Specify 00000000.

2022	Direction of movement

(a) When the coil slider is movable:
+111 When the positive direction is specified, the slider moves in the positive direction.
-111 When the positive direction is specified, the slider moves in the reverse direction.



(b) When the magnet plate is movable:
+111 When the positive direction is specified, the magnet plate moves in the positive direction.
-111 When the positive direction is specified, the magnet plate moves in the reverse direction.



Motor ID number

Incremental type, Absolute type

2020	Motor ID number

Standard parameters are prepared for the linear motors listed below as of February 2019. The servo control software shown in Table 3.1.1 (c) is required to automatically load the standard parameters shown in Section 10.3. To automatically load the parameters, set bit 1 of parameter No. 2000 to 0, set the motor number, make the following basic settings, and restart the CNC. Upon completion of automatic loading, bit 1 of parameter No. 2000 is automatically set to 1. When the servo control software used does not support automatic loading, set the parameters with reference to the parameter list shown in this manual.

Table 3.1.1 (c) Motor ID numbers of linear motors and servo control software that can be loaded automatically

[200-V driving]

Motor model	Motor specification	Motor ID No.	90G0	90J0 90K0	90GP	90JP	90D0 90E0	90E1	90M0 90M8	90C5 90E5	90C8 90E8
L*i*S 300A1/4	0441-B200	351	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 600A1/4	0442-B200	353	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 900A1/4	0443-B200	355	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 1500B1/4	0444-B20	357	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 3000B2/2	0445-B10	360	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 3000B2/4	0445-B20	362	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 4500B2/2	0446-B10	364	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 4500B2/4	0446-B20	366	07.0	01.0	02.0	01.0	31.0	08.0	02.0	F	B
L*i*S 6000B2/2	0447-B10	368	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 6000B2/4	0447-B20	370	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 7500B2/2	0448-B10	372	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 7500B2/4	0448-B20	374	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 9000B2/2	0449-B10	376	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 9000B2/4	0449-B210	378	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 3300C1/2	0451-B10	380	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 9000C2/2	0454-B10	384	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 11000C2/2	0455-B10	388	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 11000C2/4	0455-B220	390	07.0	01.0	02.0	01.0	31.0	08.0	02.0	F	B
L*i*S 15000C2/2	0456-B10	392	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 15000C2/3	0456-B20	394	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 10000C3/2	0457-B10	396	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 17000C3/2	0459-B10	400	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 300 S1/4-B	0424-B200	402	-	10.0	-	04.0	-	-	06.0	-	-

Motor model	Motor specification	Motor ID No.	90G0	90J0 90K0	90GP	90JP	90D0 90E0	90E1	90M0 90M8	90C5 90E5	90C8 90E8
L*i*S 600 S1/4-B	0425-B200	403	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 900 S1/4-B	0427-B200	408	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 600 S2/3-B	0426-B200	404	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 1200 S2/3-B	0428-B200	409	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 1800 S2/3-B	0429-B200	410	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 3000 M2/2-B	0462-B120	651	-	06.0	-	03.0	-	-	03.0	-	-
L*i*S 3000 M2/4-B	0462-B220	669	-	17.0	-	07.0	-	-	08.0	-	-
L*i*S 4500 M2/2-B	0463-B120	652	-	06.0	-	03.0	-	-	03.0	-	-
L*i*S 4500 M2/4-B	0463-B220	670	-	17.0	-	07.0	-	-	08.0	-	-
L*i*S 6000 M2/2-B	0464-B120	653	-	06.0	-	03.0	-	-	03.0	-	-
L*i*S 6000 M2/4-B	0464-B220	671	-	17.0	-	07.0	-	-	08.0	-	-
L*i*S 7500 M2/2-B	0465-B120	654	-	06.0	-	03.0	-	-	03.0	-	-
L*i*S 7500 M2/4-B	0465-B220	672	-	17.0	-	07.0	-	-	08.0	-	-
L*i*S 9000 M2/2-B	0466-B120	655	-	06.0	-	03.0	-	-	03.0	-	-
L*i*S 11000 M2/2-B	0467-B120	656	-	06.0	-	03.0	-	-	03.0	-	-
L*i*S 4500 M3/2-B	0468-B120	673	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 4500 M3/4-B	0468-B220	691	-	17.0	-	07.0	-	-	08.0	-	-
L*i*S 7000 M3/2-B	0469-B120	674	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 7000 M3/4-B	0469-B220	692	-	17.0	-	07.0	-	-	08.0	-	-
L*i*S 9000 M3/2-B	0470-B120	675	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 9000 M3/4-B	0470-B220	693	-	17.0	-	07.0	-	-	08.0	-	-
L*i*S 11000 M3/2-B	0471-B120	676	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 11000 M3/4-B	0471-B220	694	-	17.0	-	07.0	-	-	08.0	-	-
L*i*S 14000 M3/2-B	0472-B120	677	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 16000 M3/2-B	0473-B120	678	-	10.0	-	04.0	-	-	06.0	-	-

[400-V driving]

Motor model	Motor specification	Motor ID No.	90G0	90J0 90K0	90GP	90JP	90D0 90E0	90E1	90M0 90M8	90C5 90E5	90C8 90E8
L*i*S 1500B1/4	0444-B20	358	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 3000B2/2	0445-B10	361	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 4500B2/2HV	0446-B00	363	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 4500B2/2	0446-B10	365	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 6000B2/2HV	0447-B00	367	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 6000B2/2	0447-B10	369	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 7500B2/2HV	0448-B00	371	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 7500B2/2	0448-B10	373	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 9000B2/2	0449-B10	377	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 3300C1/2	0451-B10	381	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 9000C2/2HV	0454-B00	383	07.0	01.0	02.0	01.0	31.0	08.0	02.0	F	B
L*i*S 9000C2/2	0454-B10	385	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 11000C2/2HV	0455-B00	387	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 11000C2/2	0455-B10	389	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 15000C2/3HV	0456-B00	391	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 15000C2/2	0456-B10	393	18.0	01.0	02.0	01.0	-	-	02.0	-	D
L*i*S 10000C3/2HV	0457-B00	395	03.0	01.0	02.0	01.0	29.0	05.0	02.0	F	A
L*i*S 10000C3/2	0457-B10	397	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 17000C3/2HV	0459-B00	399	03.0	01.0	02.0	01.0	28.0	04.0	02.0	D	A
L*i*S 17000C3/2	0459-B10	401	03.0	01.0	02.0	01.0	G	01.0	02.0	A	A
L*i*S 300 S1/4-B	0424-B200	405	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 600 S1/4-B	0425-B200	406	-	17.0	-	07.0	-	-	08.0	-	-
L*i*S 900 S1/4-B	0426-B200	407	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 600 S2/3-B	0427-B200	411	-	17.0	-	07.0	-	-	08.0	-	-

Motor model	Motor specification	Motor ID No.	90G0	90J0 90K0	90GP	90JP	90D0 90E0	90E1	90M0 90M8	90C5 90E5	90C8 90E8
L*i*S 1200 S2/3-B	0428-B200	412	-	17.0	-	07.0	-	-	08.0	-	-
L*i*S 1800 S2/3-B	0429-B200	413	-	17.0	-	07.0	-	-	08.0	-	-
L*i*S 3000 M2/2HV-B	0462-B020	663	-	06.0	-	03.0	-	-	03.0	-	-
L*i*S 3000 M2/2-B	0462-B120	657	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 4500 M2/2HV-B	0463-B020	664	-	06.0	-	03.0	-	-	03.0	-	-
L*i*S 4500 M2/2-B	0463-B120	658	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 6000 M2/2HV-B	0464-B020	665	-	06.0	-	03.0	-	-	03.0	-	-
L*i*S 6000 M2/2-B	0464-B120	659	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 7500 M2/2HV-B	0465-B020	666	-	06.0	-	03.0	-	-	03.0	-	-
L*i*S 7500 M2/2-B	0465-B120	660	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 9000 M2/2HV-B	0466-B020	667	-	06.0	-	03.0	-	-	03.0	-	-
L*i*S 9000 M2/2-B	0466-B120	661	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 11000 M2/2HV-B	0467-B020	668	-	06.0	-	03.0	-	-	03.0	-	-
L*i*S 11000 M2/2-B	0467-B120	662	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 4500 M3/2HV-B	0468-B020	685	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 4500 M3/2-B	0468-B120	679	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 7000 M3/2HV-B	0469-B020	686	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 7000 M3/2-B	0469-B120	680	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 9000 M3/2HV-B	0470-B020	687	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 9000 M3/2-B	0470-B120	681	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 11000 M3/2HV-B	0471-B020	688	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 11000 M3/2-B	0471-B120	682	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 14000 M3/2HV-B	0472-B020	689	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 14000 M3/2-B	0472-B120	683	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 16000 M3/2HV-B	0473-B020	690	-	10.0	-	04.0	-	-	06.0	-	-
L*i*S 16000 M3/2-B	0473-B120	684	-	10.0	-	04.0	-	-	06.0	-	-

Loading is possible with the servo control software of the series and editions listed above or subsequent editions.
After parameter initialization, check that the function bit for linear motor control is set to 1 (linear motor control is enabled).

	#7	#6	#5	#4	#3	#2	#1	#0
2010						LINEAR		

LINEAR (#2) Linear motor control is:
0: Disabled.
1: Enabled.

When using a linear motor position detection circuit

Incremental type

When a position detection circuit (-T201, -T202, -T301, or -T302) having an interpolation magnification of 2048 is used with an incremental type linear encoder, the parameter shown below must be set to maintain both the maximum feedrate and high resolution.
Set the parameter before proceeding to procedure (2).

	#7	#6	#5	#4	#3	#2	#1	#0
2274								HP2048

HP2048(#0) A 2048-time interpolation circuit (linear motor position detection circuit) is:
1: Used.
0: Not used.

NOTE

1 Setting this parameter to "enable" lets you make the basic parameter settings as explained in Procedure (2).
2 Changing this parameter results in a power-off alarm being raised.
3 When this parameter is set, the detection unit in the case of FFG=1/1 is (signal pitch/512 [μm]).
If a minimum detection unit (signal pitch/2048 [μm]) is necessary, specify: FFG = 4/1
4 If nano interpolation is applied, a resolution as high as (signal pitch/2048 [μm]) is applied as decimal-part feedback.
5 When an incremental type linear encoder is used, a linear motor pole detector is needed.
6 When it has a linear motor position detection circuit, the interpolation magnification can be changed using setting pin SW3. (The setting at the time of shipment is Setting B.)
Setting A: The interpolation magnification is 512.
Setting B: The interpolation magnification is 2048.
Setting A enables up to high-speed operation, and Setting B enables high resolution feedback acquisition.

	Setting A	Setting B
HP2048	1	1
Resolution [μm] (*1)	λ [μm]/128 (*2)	λ [μm]/512 (*2)
Maximum velocity [mm/min]	λ [μm] x 122880 (*2)	λ [μm] x 30720 (*2)

(*1)The resolution values in the table above are used for calculation of various parameters.
(*2)λ [μm] represents a linear scale signal pitch.

When using the linear scale supporting the α*i* interface

(Applicable series and editions of servo control software)

The α*i* interface is supported by the series and editions of the servo control software listed below.

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	19.0 and subsequent editions	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	

(Parameter setting method)

The minimum resolution of the scale can be extended by using the servo control software that supports the α*i* interface and setting the parameter below.

	#7	#6	#5	#4	#3	#2	#1	#0
2437				AILIN				

AILIN(#4) By using LC195F or LC495F, the minimum resolution of the scale is:
0: Not extended.
1: Extended.

NOTE

1 Even if this function bit is set, the resolution (setting resolution) used to set the number of velocity pulses, number of position pulses, flexible feed gear, and AMR conversion coefficient is 0.05 μm or 0.01 μm. If you want to use the minimum resolution of the detector as the detection unit, set AILIN to 1 and also set the flexible feed gear as listed below.

Setting resolution	Minimum resolution of the detector (*)	FFG setting to use the minimum resolution of the detector as the detection unit
0.05 μm	0.0125 μm	4/1
0.01 μm	0.00125 μm	8/1

2 If bit 4 of parameter No. 2437 is set to 1 for unsupported hardware, an invalid parameter alarm (detail number 4374) is issued.

3 When this function bit is used, set bit 0 of parameter No. 2274 to 0. If this bit is set to 1, an invalid parameter alarm (detail No. 4374) is issued.

4 If this function bit is changed, the power of the CNC needs to be turned off temporarily.

Parameter setting procedure (2)

Incremental type, Absolute type

Procedure (2) makes parameter settings that depend on the resolution of the linear encoder (hereafter simply called "the resolution"). Set the parameters according to Table 3.1.1 (e), (f).

When using an incremental type linear encoder, calculate as follows:

Resolution [μm] = Encoder signal pitch [μm] / 512

	#7	#6	#5	#4	#3	#2	#1	#0
2000								PLC0

PLC0(#0) The number of velocity pulses and the number of position pulses are:

0: Used without being modified.

1: Used after being multiplied by 10

If the number of velocity pulses is larger than 32767, set the parameter to 1.

If the number of position pulses exceeds 32767, use the following position pulse conversion coefficient.

2023	Number of velocity pulses (PULCO)

(Parameter calculation expression)

Number of velocity pulses = 3125 / 16 / (resolution [μm])

If the calculation result is greater than 32767, set PLC0 = 1, and set the parameter (PULCO) to 1/10.

2024	Number of position pulses (PPLS)

(Parameter calculation expression)

Number of position pulses = 625 / (resolution [μm])

If the calculation result is greater than 32767, determine the parameter setting (PPLS), using the following position pulse conversion coefficient (PSMPYL).

See Supplementary 4 of Subsection 2.1.6.

2185	Position pulses conversion coefficient (PSMPYL)

This parameter is used if the calculated number of position pulses is greater than 32767.
(Parameter calculation expression)

PLC0 = 0 The parameter is set so that the following equation holds: (the number of position pulses) × (position pulses conversion coefficient) = 625/resolution [m].

PLC0 = 1 The parameter is set so that the following equation holds: 10 × (the number of position pulses) × (position pulses conversion coefficient) = 625/resolution [m].

(→ See Supplementary 3 in Subsection 2.1.6.)

	#7	#6	#5	#4	#3	#2	#1	#0
2013	APTG							

APTG(#7) αpulse coder software disconnection is:
0: Not ignored.
1: Ignored.
Set this parameter to 1 when using an absolute type linear encoder.

2112	AMR conversion coefficient 1
2138	AMR conversion coefficient 2

Setting AMR conversion coefficients
Calculate the number of feedback pulses per pole-to-pole span of the linear motor, and find AMR conversion coefficients 1 and 2 expressed by the equation shown below. Determine AMR conversion coefficient 2 so that AMR conversion coefficient 1 does not exceed 32767.

Number of pulses per pole-to-pole span
= Pole-to-pole span [mm] × 1000/Resolution [μm]
= (AMR conversion coefficient 1) × $2^{(\text{AMR conversion coefficient 2})}$

Supplementary)
If AMR conversion coefficient 1 = (pole-to-pole span [mm]/ resolution [μm]) is an integer and a multiple of 1024, setting of only AMR conversion coefficient 1 is needed. In this case, the following are assumed:
AMR conversion coefficient 1 = (pole-to-pole span [mm]/resolution [μm])
AMR conversion coefficient 2 = 0
The pole-to-pole span depends on the motor model as indicated in the table below.

Table 3.1.1 (d) List of pole-to-pole spans

Classification	Pole-to-pole span (D)	Motor model
Small motors	30 mm	A1, S1, and S2 models
Medium-size and large motors	60 mm	Models other than the above

2084	Flexible feed gear numerator
2085	Flexible feed gear denominator

Use a unified detection unit for the flexible feed gear (FFG) parameters according to Tables3.1.1 (e) and 3.1.1 (f).
(Parameter calculation expression)

$$FFG = \frac{\text{Resolution}}{\text{Detection unit}}$$

Table 3.1.1 (e) Parameter setting when an incremental type linear encoder is used

[Medium-size and large motors] (pole-to-pole span: 60 mm)

Signal pitch [μm]	PLC0 (2000#0)	Number of velocity pulses / Number of position pulses, Conversion coefficient (No. 2023 / No.2024, 2185)	AMR conversion coefficient 1 or 2 (No. 2112, 2138)	FFG(No.2084/No.2085)		
				1-μm detection	0.1-μm detection	0.005-μm detection
20	0	5000 / 16000, 0	3000, 9	5/128	50/128	—
40	0	2500 / 8000, 0	1500, 9	5/64	50/64	—
2	1	5000 / 8000, 2	30000, 9	1/256	10/256	200/256
4	1	2500 / 8000, 0	15000, 9	1/128	10/128	—
40.513167	0	2468 / 7899, 0	1481, 9	301/3804	3010/3804	—

[Small motors] (pole-to-pole span: 30 mm)

Signal pitch [μm]	PLC0 (2000#0)	Number of velocity pulses / Number of position pulses, Conversion coefficient (No. 2023 / No.2024, 2185)	AMR conversion coefficient 1 or 2 (No. 2112, 2138)	FFG(No.2084/No.2085)		
				1-μm detection	0.1-μm detection	0.005-μm detection
20	0	5000 / 16000, 0	1500, 9	5/128	50/128	—
40	0	2500 / 8000, 0	750, 9	5/64	50/64	—
2	1	5000 / 8000, 2	15000, 9	1/256	10/256	200/256
4	1	2500 / 8000, 0	7500, 9	1/128	10/128	—
40.513167	0	2468 / 7899, 0	1481, 8	301/3804	3010/3804	—

Table 3.1.1 (f) Parameter setting when an absolute type linear encoder is used

[Medium-size and large motors] (pole-to-pole span: 60 mm)

Resolution [μm]	PLC0 (2000#0)	Number of velocity pulses / Number of position pulses, Conversion coefficient (No. 2023 / No.2024, 2185)	AMR conversion coefficient 1 or 2 (No. 2112, 2138)	FFG(No.2084/No.2085)		
				1-μm detection	0.1-μm detection	0.005-μm detection
0.1	0	1953 / 6250, 0	9375, 6	1/10	1/1	—
0.05	0	3906 / 12500, 0	9375, 7	1/20	1/2	—
0.01	0	19531 / 6250, 10	23438, 8	1/100	1/10	—
0.005	1	3906 / 12500, 0	23438, 9	1/200	1/20	1/1
0.001	1	19531 / 6250, 10	29297, 11	1/1000	1/100	1/5
20/4096	1	4000 / 12800, 0	24000, 9	20/4096	200/4096	4000/4096

αi interface (No.2437#4=1)

Resolution [μm]	PLC0 (2000#0)	Number of velocity pulses / Number of position pulses, Conversion coefficient (No. 2023 / No.2024, 2185)	AMR conversion coefficient 1 or 2 (No. 2112, 2138)	FFG(No.2084/No.2085)		
				1-μm detection	0.1-μm detection	0.005-μm detection
0.05 (0.0125)	0	3906 / 12500, 0	9375, 7	1/20	1/2	—
0.01 (0.00125)	0	19531 / 6250, 10	23438, 8	1/100	1/10	2/1

[Small motors] (pole-to-pole span: 30 mm)

Resolution [μm]	PLC0 (2000#0)	Number of velocity pulses / Number of position pulses, Conversion coefficient (No. 2023 / No.2024, 2185)	AMR conversion coefficient 1 or 2 (No. 2112, 2138)	FFG(No.2084/No.2085)		
				1-μm detection	0.1-μm detection	0.005-μm detection
0.1	0	1953 / 6250, 0	9375, 5	1/10	1/1	—
0.05	0	3906 / 12500, 0	9375, 6	1/20	1/2	—
0.01	0	19531 / 6250, 10	23438, 7	1/100	1/10	—
0.005	1	3906 / 12500, 0	23438, 8	1/200	1/20	1/1
0.001	1	19531 / 6250, 10	29297, 10	1/1000	1/100	1/5
20/4096	1	4000 / 12800, 0	24000, 8	20/4096	200/4096	4000/4096

αi interface (No.2437#4=1)

Resolution [μm]	PLC0 (2000#0)	Number of velocity pulses / Number of position pulses, Conversion coefficient (No. 2023 / No.2024, 2185)	AMR conversion coefficient 1 or 2 (No. 2112, 2138)	FFG(No.2084/No.2085)		
				1-μm detection	0.1-μm detection	0.005-μm detection
0.05 (0.0125)	0	3906 / 12500, 0	9375, 6	1/20	1/2	—
0.01 (0.00125)	0	19531 / 6250, 10	23438, 7	1/100	1/10	2/1

(Cautions)
If the encoder signal pitch is larger than 200 μm, various coefficients used in the servo control software may overflow to raise an alarm on invalid parameters, because the setting for the number of velocity pulses becomes very small.
In this case, change the corresponding parameter by referencing Subsection 2.1.6, "Actions for Illegal Servo Parameter Setting Alarms".

Parameter setting procedure (3)

When a linear motor is used, the linear encoder must be installed so that the Z phase of the linear encoder matches the origin of the excitation phase. Otherwise, the specified motor characteristics cannot be obtained. (For details of installation positions, refer to "FANUC LINEAR MOTOR L*i*S series DESCRIPTIONS (B-65382EN)".)

Procedure (3) describes the method of adjusting the excitation phase origin (AMR offset adjustment) when it is difficult to install a linear encoder at a specified position with a specified precision.

Setting the AMR offset

Incremental type, **Absolute type**

- When the learning control function is used,
  see "Learning Function Operator's Manual".

- When the learning control function is not used,
  set the AMR offset as follows:

2139	AMR offset

Set an excitation phase (AMR offset) for Z phase.
[Unit of data] Degrees
[Valid data range] -45 to +45 (*)

(*) Extended AMR offset setting range (-60 degrees to +60 degrees) can be specified by setting the parameter below. So, if the AMR offset value does not lie within the range of -45 degrees to +45 degrees in adjustment processing, set the bit below. (Usually, set the bit below to 0.)

	#7	#6	#5	#4	#3	#2	#1	#0
2270								AMR60

AMR60 (#0) Changes the AMR offset setting range.
0: -45 degrees to +45 degrees (standard range)
1: -60 degrees to +60 degrees (extended range)

The procedure for AMR offset adjustment is described below. The procedure varies according to whether an incremental type linear encoder or absolute type linear enable is used. Before starting to make adjustments, check the type of linear encoder used.

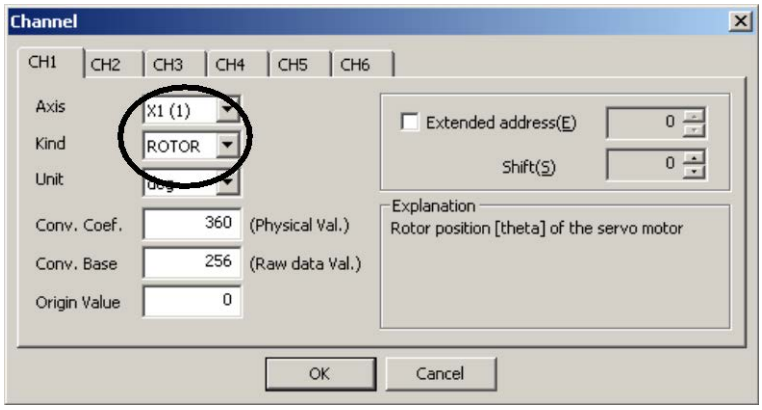
> ⚠ **CAUTION**
> Note that if an incorrect AMR offset value is input, the thrust of the motor can decrease or the motor can make an unpredictable motion.
> After setting a correct AMR offset value, never rewrite the set value manually.

Incremental type

The procedure for AMR offset adjustment when an incremental type linear encoder is used is described below. When using an absolute type linear encoder, see the item of Absolute type described later.
Make a fine adjustment to the excitation phase according to the procedure below.

Measuring the excitation phase

(1) Connect SERVO GUIDE to the CNC, and set channel data as shown below.
Select the target axis for measurement, and set the data type to "ROTOR".



* For a linear motor, a value from 0 to 360 degrees is read each time a motion is made over the distance of a pair of the N pole and S pole of the magnet (pole-to-pole span).

(2) Run the linear motor using a JOG operation for example, and observe the behavior of the excitation phase (AMR) before, at the moment, and after phase Z is captured. (See Figs. 3.1.1 (a) and (b).)
The excitation phase changes to 0 (or 360) degrees at the moment phase Z is captured. Measure the value just before it changes, and let this value be A.

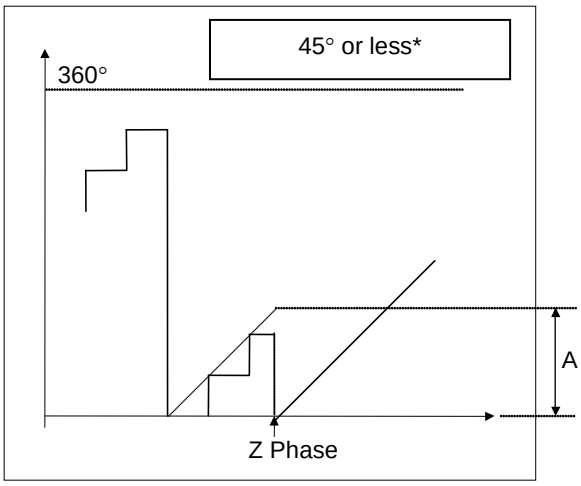


Fig. 3.1.1 (a): If the offset is set with a positive number (before AMR offset adjustment)

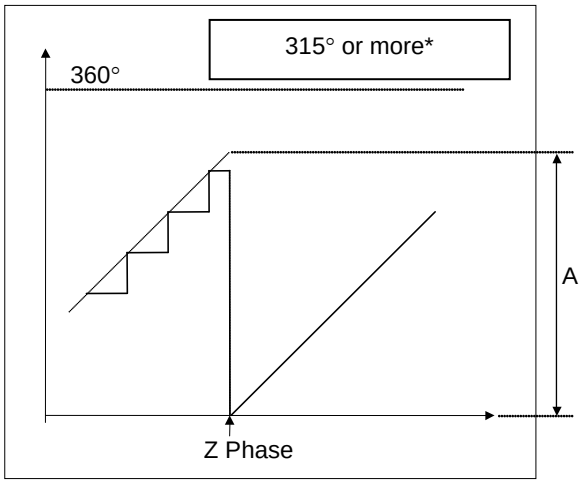


Fig. 3.1.1 (b): If the offset is set with a negative number (before AMR offset adjustment)

(*) The figures above provide examples where AMR60 = 0. When AMR60 = 1, the values should read 60° or lower and 300° or higher.

If a linear scale with absolute addressing reference marks is used, the excitation phase is determined when three reference marks are detected. Set the amount of change in the excitation phase at this time as the AMR offset value. The determination timing can be found because the resolution of activation phase data changes after the determination of the activation phase. The values before and after the determination of the activation phase depend on the scale position, but the amount of change is constant.

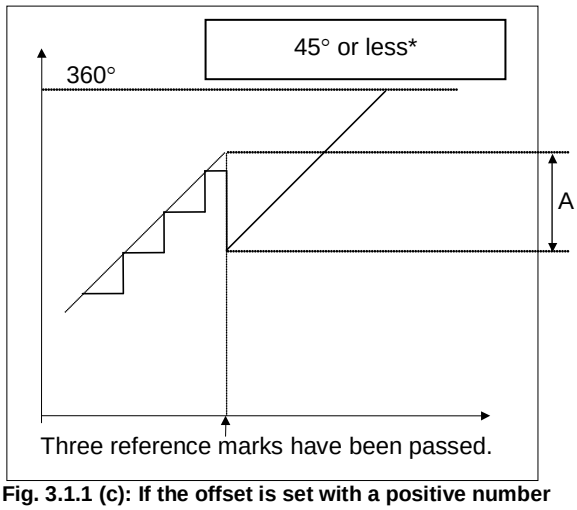


Fig. 3.1.1 (c): If the offset is set with a positive number (with absolute address reference marks, before AMR offset adjustment)

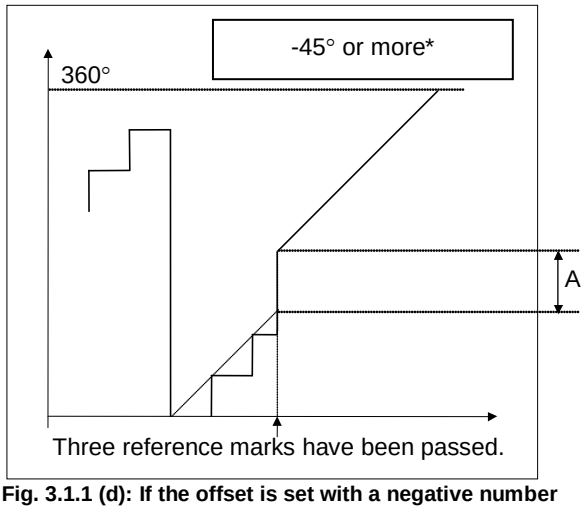


Fig. 3.1.1 (d): If the offset is set with a negative number (with absolute address reference marks, before AMR offset adjustment)

(3) Set the AMR offset parameter with A (or A - 360).

* The parameter setting range is:
-45 degrees to +45 degrees (when AMR60 = 0)
-60 degrees to +60 degrees (when AMR60 = 1)
When the value of A does not lie within the setting range, the installation position of the linear encoder needs to be readjusted.

(4) Turn the power to the CNC off, then on again.

(5) Observe the excitation phase (AMR) again according to step (2) above, and check that the excitation phase changes continuously in the phase Z rising portion.

(6) Turn the power to the CNC off, then on again. This completes parameter setting.

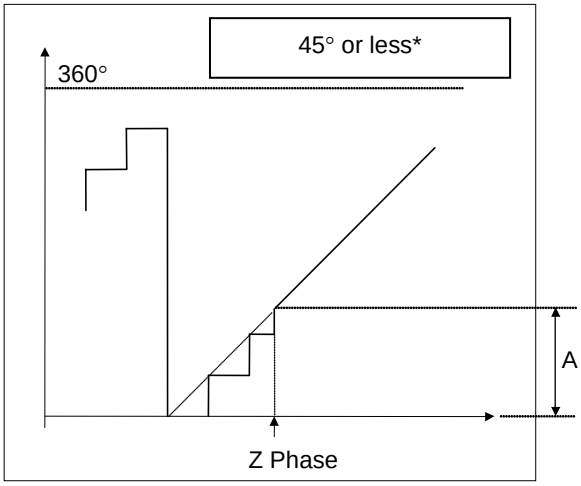


Fig. 3.1.1 (e): If the offset is set with a positive number (after AMR offset adjustment)

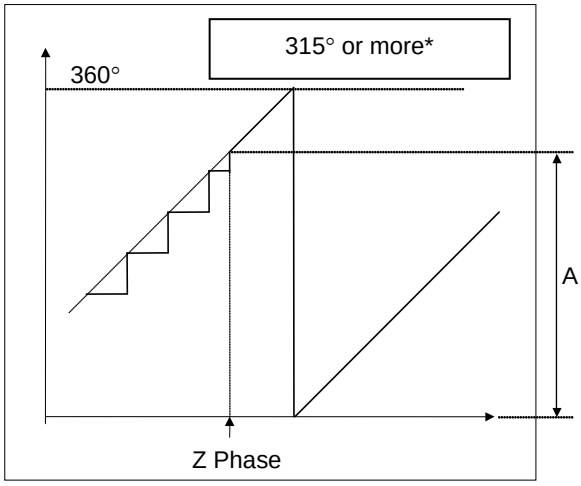


Fig. 3.1.1 (f): If the offset is set with a negative number (after AMR offset adjustment)

(*) The figures above provide examples where AMR60 = 0. When AMR60 = 1, the values should read 60° or lower and 300° or higher.

Absolute type

The procedure for AMR offset adjustment when an absolute type linear encoder is used is described below.
Make a fine adjustment to the excitation phase according to the procedure below.

> ⚠ **CAUTION**
> In this adjustment, the linear motor is driven by current from the DC power supply. The CNC does not exercise position control. For safety, move the coil slider of the linear motor to near the stroke center and make an adjustment. Activation by the DC power supply moves a medium-size or large linear motor for up to about 60 mm, and moves a small linear motor for up to about 30 mm.

(1) Turn off the power to the CNC and servo amplifier.

(2) Detach the linear motor power line from the servo amplifier, then connect the power line to the DC power supply.
Connect the + terminal of the DC power supply to phase U of the power line, and connect the - terminal of the DC power supply to phase V and phase W of the power line.

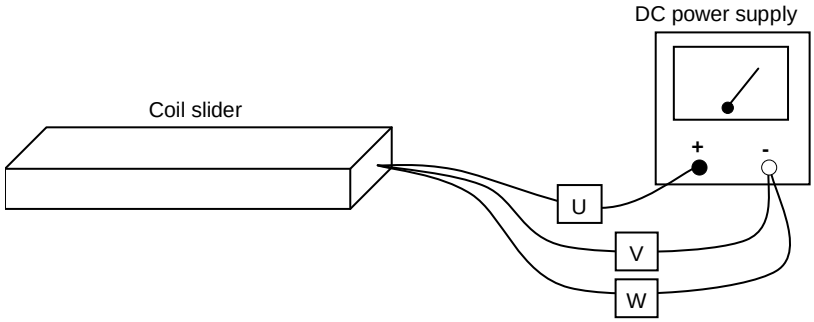


Fig. 3.1.1(g) Connection of DC power supply

(3) In the emergency stop state, turn on the power to the CNC and servo amplifier.

(4) Display phase data on the diagnosis screen (No. 762) of the CNC then turn on the DC power supply. Next, increase the current gradually (DC excitation).
When the force of the linear motor produced by current supplied from the DC power supply exceeds static friction, the linear motor starts moving, and the linear motor automatically stops at a position where activation phase = 0.
A position where excitation phase = 0 is present at intervals of 60 mm with medium-size and large linear motors, or at intervals of 30 mm with small linear motors.

* A displayed phase data value is converted to an excitation phase [degrees] according to the following expression:
Excitation phase [degrees] = Displayed phase data value x 360/256

> ⚠ **WARNING**
> If a large current flows abruptly, the motor produces a large force, resulting in a very dangerous situation. When making this adjustment, be sure to increase the current value gradually starting from current value = 0 [Ap].

(5) Read the value of phase data on the CNC screen in the state where the linear motor rests. Immediately after reading the value, turn off the DC power supply.

* Change the DC excitation start position within one pole (60 mm for the medium-sized/large type or 30 mm for the small type) then make measurements of (5) or (6). Repeat this procedure several times to determine average phase data.

(6) Based on excitation phase data measured with up to the step above, set the AMR offset parameter as described below.

Measured phase data value	AMR offset setting
0 ~ 32 (42)	-1 x (measured phase data value) x 360/256
224 (214) ~ 255 (255)	360 - (measured phase data value) x 360/256
33 (44) ~ 223 (213)	In this case, an SV0364 soft phase alarm is issued when phase Z is passed. Adjust the linear encoder installation position according to "FANUC LINEAR MOTOR L*i*S series DESCRIPTIONS (B-65382EN)". After adjustment, make an AMR offset adjustment again from step (1).

(*) A value enclosed by parentheses assumes that ARM60 is set to 1.

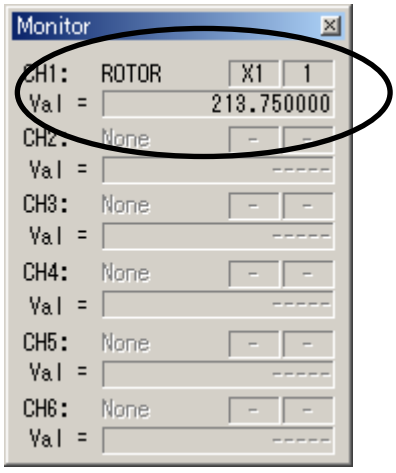
(7) Turn the CNC power off and on again.

(8) Perform steps (5) and (6) again, and check that the excitation phase data at a stop position is about 0 or 255.

(9) Turn off the power to the CNC and servo amplifier. Next, connect the power line of the linear motor to the servo amplifier. Then, turn on the power to the CNC and servo amplifier again.

(10) Decrease the torque limit and excessive error alarm level and use jog feed to check that feed operation is normal. If feed operation is normal, return the torque limit and excessive error alarm level to their original values. This completes the setting.

The excitation phase can also be observed by connecting SERVO GUIDE to the CNC and selecting "Monitor" from the "Communication" menu of the graph window.
(Set "ROTOR" as the data type in channel setting.)



Parameter setting procedure (4)

Procedure (4) explains how to set up parameters for using a linear scale with distance-coded reference marks in linear motor position detection circuit C (A860-0333-T301, -T302 or A860-2033-T301, -T302 or A860-2034-T***).

- This function is optional.
- For details of parameter setting, refer to the relevant CNC manual or specifications.

Setting procedure

(1) Enable the linear scale with distance-coded reference marks.

	#7	#6	#5	#4	#3	#2	#1	#0
1815						DCLx		

DCLx (#2) The linear scale interface with absolute address referenced marks is:
0: Not used as a position detector
1: Used as a position detector. To be set

	#7	#6	#5	#4	#3	#2	#1	#0
1818					SDCx			

SDCx (#3) The linear scale with distance-coded reference marks is:
0: Not used.
1: Used. To be set

1821	Reference counter capacity

Specify a round figure, such as 10000 or 50000, as the reference counter capacity.

1240	Coordinate of the first reference position in the machine coordinate system for each axis

Specify 0.

1883	Distance 1 from the scale mark origin to the reference position

Specify 0.

1884	Distance 2 from the scale mark origin to the reference position

Specify 0.

(2) Turn the CNC power off and on again.

(3) Follow this procedure to establish a reference position at an appropriate point.
Select the JOG mode, and set the manual reference position return signal ZRN to "1".
Set a feed axis direction selection signal (+J1, -J1, +J2, -J2,...) for an axis for which a reference position is to be established to "1" and issue the signal.
When an absolute position on the linear scale is detected, the axis stops, causing the reference position-established signal (ZRF1, ZRF2,...) to be set to "1".

If an overtravel alarm is issued in establishing a reference position, try to establish a reference position by disabling a stored stroke check.

(4) In the JOG or handle feed mode, place the machine accurately on the reference position.

(5) Using the following steps, perform the automatic setting of parameter No. 1883.

	#7	#6	#5	#4	#3	#2	#1	#0
1819						DAT		

DAT (#2) At a manual reference position return, the automatic setting of parameter No. 1883 is:
0: Not performed.
1: Performed. To be set

After setting this parameter to "1", perform a manual reference position return.
When the manual reference position return is completed, parameter No. 1883 is specified, and this parameter is automatically reset to "0".

(6) If you want to disable a stored stroke check in establishing a reference position, reset the necessary parameters to the original setting.

(7) Specify parameter No. 1240 as required.

1240	Coordinate of the first reference position in the machine coordinate system for each axis

Set the coordinate of the first reference position in the machine coordinate system.

(8) This completes the settings.

Parameter setting procedure (5)

Procedure (5) can be used to set parameters according to the cooling method used for linear motors.
Change the following parameters as listed in Table 3.1.1 (g). For self-cooling linear motors, the parameters need not be set here, because they are set up at initialization in procedure (1).

2062	OVC alarm parameter (POVC1)
2063	OVC alarm parameter (POVC2)
2065	OVC alarm parameter (POVCLMT)
2086	Current rating parameter (RTCURR)
2161	OVC magnification in stop state (OVCSTP)

⚠ CAUTION
If the correct values corresponding to the cooling method are not set for the parameters above, the expected thermal protection cannot be provided. Use care.

Table 3.1.1 (g) Setting OVC and current rating parameters by cooling method

[200-V driving]

Motor model		L*i*S 300A1/4		L*i*S 600A1/4		L*i*S 900A1/4		L*i*S 1500B1/4	
Motor specification		0441-B200		0442-B200		0443-B200		0444-B20	
Cooling method		No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		50	100	100	200	150	300	300	600
POVC1	No.2062	32720	32578	32720	32578	32721	32582	32698	32490
POVC2	No.2063	596	2380	596	2380	583	2328	873	3481
POVCLMT	No.2065	589	2357	589	2357	1326	5303	2590	10358
RTCURR	No.2086	564	1129	564	1129	847	1694	1184	2368
OVCSTP	No.2161	0	0	0	0	0	0	0	0
POVC21	No.2162	0	0	0	0	0	0	0	0
POVC22	No.2163	0	0	0	0	0	0	0	0
POVCLMT2	No.2164	0	0	0	0	0	0	0	0

Motor model		LiS 3000B2/2		LiS 3000B2/4		LiS 4500B2/2		LiS 4500B2/4	
Motor specification		0445-B10		0445-B20		0446-B10		0446-B20	
Cooling method		No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		600	1200	600	1200	900	1800	900	1800
POVC1	No.2062	32711	32539	32698	32490	32707	32526	32707	32527
POVC2	No.2063	719	2867	873	3481	758	3023	768	3018
POVCLMT	No.2065	2131	8523	2590	10358	1199	4794	1214	4787
RTCURR	No.2086	1074	2148	1184	2368	805	1611	810	1610
OVCSTP	No.2161	0	0	0	0	0	0	0	0
POVC21	No.2162	0	0	0	0	0	0	0	0
POVC22	No.2163	0	0	0	0	0	0	0	0
POVCLMT2	No.2164	0	0	0	0	0	0	0	0

Motor model		LiS 6000B2/2		LiS 6000B2/4		LiS 7500B2/2		LiS 7500B2/4	
Motor specification		0447-B10		0447-B20		0448-B10		0448-B20	
Cooling method		No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		1200	2400	1200	2400	1500	3000	1500	3000
POVC1	No.2062	32711	32539	32708	32528	32707	32524	32687	32446
POVC2	No.2063	719	2867	753	3003	765	3053	1010	4026
POVCLMT	No.2065	2131	8523	2233	8932	832	3329	799	3197
RTCURR	No.2086	1074	2148	1184	2368	671	1342	658	1316
OVCSTP	No.2161	0	0	0	140	0	0	0	0
POVC21	No.2162	0	0	0	0	0	0	0	0
POVC22	No.2163	0	0	0	0	0	0	0	0
POVCLMT2	No.2164	0	0	0	0	0	0	0	0

Motor model		LiS 9000B2/2		LiS 9000B2/4		LiS 3300C1/2		LiS 9000C2/2	
Motor specification		0449-B10		0449-B210		0451-B10		0454-B10	
Cooling method		No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		1800	3600	1800	3600	660	1320	1800	3600
POVC1	No.2062	32707	32526	32696	32482	32708	32529	32729	32612
POVC2	No.2063	758	3023	895	3570	749	2987	489	1953
POVCLMT	No.2065	1199	4794	1151	4604	1184	4738	1112	4448
RTCURR	No.2086	805	1611	789	1579	801	1602	776	1552
OVCSTP	No.2161	0	0	0	0	0	0	0	0
POVC21	No.2162	0	0	0	0	0	0	0	0
POVC22	No.2163	0	0	0	0	0	0	0	0
POVCLMT2	No.2164	0	0	0	0	0	0	0	0

Motor model		LiS 11000C2/2		LiS 11000C2/4		LiS 15000C2/2		LiS 15000C2/3	
Motor specification		0455-B10		0455-B220		0456-B10		0456-B20	
Cooling method		No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		2200	4400	2200	4400	3000	7000	3000	7000
POVC1	No.2062	32723	32589	32729	32598	32729	32558	32732	32572
POVC2	No.2063	560	2236	492	2119	483	2623	452	2455
POVCLMT	No.2065	1661	6644	1311	5246	621	3378	1340	7296
RTCURR	No.2086	948	1897	842	1685	579	1352	852	1988
OVCSTP	No.2161	0	0	0	0	0	0	0	140
POVC21	No.2162	0	0	0	0	0	0	0	0
POVC22	No.2163	0	0	0	0	0	0	0	0
POVCLMT2	No.2164	0	0	0	0	0	0	0	0

Motor model		LiS 10000C3/2		LiS 17000C3/2	
Motor specification		0457-B10		0459-B10	
Cooling method		No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		2000	4000	3400	6800
POVC1	No.2062	32722	32583	32711	32542
POVC2	No.2063	582	2314	709	2829
POVCLMT	No.2065	1719	6875	981	3925
RTCURR	No.2086	964	1929	729	1458
OVCSTP	No.2161	0	0	0	0
POVC21	No.2162	0	0	0	0
POVC22	No.2163	0	0	0	0
POVCLMT2	No.2164	0	0	0	0

Motor model		LiS 300S1/4-B		LiS 600S1/4-B		LiS 900S1/4-B		LiS 600S2/3-B	
Motor specification		0424-B200		0425-B200		0426-B200		0427-B200	
Cooling method		No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		60	120	100	240	140	360	100	240
POVC1	No.2062	32583	31927	32633	31927	32662	31788	32633	31927
POVC2	No.2063	2315	10508	1685	10508	1325	12252	1685	10508
POVCLMT	No.2065	3108	12545	2283	12545	1015	8028	2283	12545
RTCURR	No.2086	648	1390	523	1390	370	1042	556	1390
OVCSTP	No.2161	130	130	130	130	130	130	130	130
POVC21	No.2162	32750	32742	32753	32742	32755	32746	32753	32742
POVC22	No.2163	222	320	191	320	165	277	191	320
POVCLMT2	No.2164	571	2621	419	2621	186	1475	419	2621

Motor model		LiS 1200S2/3-B		LiS 1800S2/3-B		LiS 3000M2/2-B		LiS 3000M2/4-B	
Motor specification		0428-B200		0429-B200		0462-B120		0462-B220	
Cooling method		No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		180	480	260	720	480	1200	480	1200
POVC1	No.2062	32665	31927	32675	31788	32612	31608	32612	31618
POVC2	No.2063	1283	10508	1161	12252	1955	14504	1955	14376
POVCLMT	No.2065	1748	12545	892	8028	1610	9992	1610	9922
RTCURR	No.2086	486	1390	347	1042	466	1163	462	1159
OVCSTP	No.2161	130	130	130	130	130	130	130	130
POVC21	No.2162	32755	32742	32756	32746	32752	32746	32752	32746
POVC22	No.2163	162	320	152	277	206	277	206	277
POVCLMT2	No.2164	321	2621	164	1475	296	1835	296	1822

Motor model		LiS 4500M2/2-B		LiS 4500M2/4-B		LiS 6000M2/2-B		LiS 6000M2/4-B	
Motor specification		0463-B120		0463-B220		0464-B120		0464-B220	
Cooling method		No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		720	1800	720	1800	960	2400	960	2400
POVC1	No.2062	32614	32183	32614	32183	32612	31618	32613	31618
POVC2	No.2063	1931	7312	1931	7312	1955	14376	1937	14376
POVCLMT	No.2065	3580	12545	3580	12545	1610	9922	1261	7840
RTCURR	No.2086	696	1744	696	1740	466	1159	413	1030
OVCSTP	No.2161	130	130	130	130	130	130	130	130
POVC21	No.2162	32752	32725	32752	32725	32752	32746	32752	32746
POVC22	No.2163	205	542	205	539	206	277	205	277
POVCLMT2	No.2164	658	4129	658	4110	296	1822	232	1440

Motor model		LiS 7500M2/2-B		LiS 7500M2/4-B		LiS 9000M2/2-B		LiS 11000M2/2-B	
Motor specification		0465-B120		0465-B220		0466-B120		0467-B120	
Cooling method		No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		1200	3000	1200	3000	1440	3600	1680	4200
POVC1	No.2062	32613	31879	32614	31616	32614	32183	32614	31619
POVC2	No.2063	1940	11113	1926	14402	1931	7312	1924	14358
POVCLMT	No.2065	2498	12545	1960	12267	3580	12545	959	5996
RTCURR	No.2086	579	1450	515	1288	696	1740	360	901
OVCSTP	No.2161	130	130	130	130	130	130	130	130
POVC21	No.2162	32752	32740	32752	32746	32752	32725	32752	32746
POVC22	No.2163	205	352	204	277	205	539	204	277
POVCLMT2	No.2164	459	2852	360	2253	658	4110	176	1101

Motor model		LiS 4500M3/2-B		LiS 4500M3/4-B		LiS 7000M3/2-B		LiS 7000M3/4-B	
Motor specification		0468-B120		0468-B220		0469-B120		0469-B220	
Cooling method		No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		720	1800	720	1800	1080	2700	1080	2700
POVC1	No.2062	32588	31994	32587	31957	32592	31418	32593	31413
POVC2	No.2063	2255	9678	2260	10134	2195	16871	2192	16940
POVCLMT	No.2065	3251	12545	3132	12545	1784	11136	1351	8475
RTCURR	No.2086	660	1633	647	1622	492	1228	427	1071
OVCSTP	No.2161	130	130	130	130	130	130	130	130
POVC21	No.2162	32750	32731	32750	32731	32751	32746	32751	32746
POVC22	No.2163	220	467	220	459	217	277	217	277
POVCLMT2	No.2164	597	3641	575	3586	328	2045	248	1557

Motor model		LiS 9000M3/2-B		LiS 9000M3/4-B		LiS 11000M3/2-B		LiS 11000M3/4-B	
Motor specification		0470-B120		0470-B220		0471-B120		0471-B220	
Cooling method		No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		1440	3600	1440	3600	1800	4500	1800	4500
POVC1	No.2062	32592	31994	32590	31693	32579	32261	32590	32131
POVC2	No.2063	2197	9678	2231	13435	2364	6338	2231	7959
POVCLMT	No.2065	3172	12545	2444	12545	4956	12545	3818	12545
RTCURR	No.2086	654	1639	574	1436	819	2050	718	1797
OVCSTP	No.2161	130	130	130	130	130	130	130	130
POVC21	No.2162	32751	32731	32751	32740	32750	32703	32751	32721
POVC22	No.2163	217	467	219	345	224	818	219	585
POVCLMT2	No.2164	583	3641	449	2805	910	5711	701	4388

Motor model		LiS 14000M3/2-B		LiS 16000M3/2-B	
Motor specification		0472-B120		0473-B120	
Cooling method		No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		2160	5400	2520	6300
POVC1	No.2062	32617	31529	32601	31417
POVC2	No.2063	1887	15485	2083	16892
POVCLMT	No.2065	1217	8232	1824	11991
RTCURR	No.2086	406	1055	496	1274
OVCSTP	No.2161	130	130	130	130
POVC21	No.2162	32752	32746	32751	32746
POVC22	No.2163	202	277	212	277
POVCLMT2	No.2164	224	1512	335	2202

[400-V driving]

Motor model		LiS 1500B1/4		LiS 3000B2/2		LiS 4500B2/2HV		LiS 4500B2/2	
Motor specification		0444-B20		0445-B10		0446-B00		0446-B10	
Cooling method		No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		300	600	600	1200	900	1800	900	1800
POVC1	No.2062	32698	32490	32711	32539	32714	32551	32707	32526
POVC2	No.2063	873	3481	719	2867	681	2718	758	3023
POVCLMT	No.2065	2590	10358	2131	8523	1549	6194	1199	4794
RTCURR	No.2086	1184	2368	1074	2148	915	1831	805	1611
OVCSTP	No.2161	0	0	0	0	0	0	0	0
POVC21	No.2162	0	0	0	0	0	0	0	0
POVC22	No.2163	0	0	0	0	0	0	0	0
POVCLMT2	No.2164	0	0	0	0	0	0	0	0

Motor model		LiS 6000B2/2HV		LiS 6000B2/2		LiS 7500B2/2HV		LiS 7500B2/2	
Motor specification		0447-B00		0447-B10		0448-B00		0448-B10	
Cooling method		No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		1200	2400	1200	2400	1500	3000	1500	3000
POVC1	No.2062	32706	32521	32711	32539	32714	32551	32709	32532
POVC2	No.2063	774	3085	719	2867	680	2713	739	2949
POVCLMT	No.2065	688	2753	2131	8523	1075	4301	658	2631
RTCURR	No.2086	610	1221	1074	2148	763	1526	596	1193
OVCSTP	No.2161	0	0	0	0	0	0	0	0
POVC21	No.2162	0	0	0	0	0	0	0	0
POVC22	No.2163	0	0	0	0	0	0	0	0
POVCLMT2	No.2164	0	0	0	0	0	0	0	0

Motor model		LiS 9000B2/2		LiS 3300C1/2		LiS 9000C2/2HV		LiS 9000C2/2	
Motor specification		0449-B10		0451-B10		0454-B00		0454-B10	
Cooling method		No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		1800	3600	660	1320	1800	3600	1800	3600
POVC1	No.2062	32709	32533	32708	32529	32729	32614	32728	32610
POVC2	No.2063	737	2940	749	2987	489	1925	494	1972
POVCLMT	No.2065	947	3788	1184	4738	1112	4383	879	3514
RTCURR	No.2086	716	1432	801	1602	776	1540	689	1379
OVCSTP	No.2161	0	140	0	0	0	0	0	0
POVC21	No.2162	0	0	0	0	0	0	0	0
POVC22	No.2163	0	0	0	0	0	0	0	0
POVCLMT2	No.2164	0	0	0	0	0	0	0	0

Motor model		LiS 11000C2/2HV		LiS 11000C2/2		LiS 15000C2/3HV		LiS 15000C2/2	
Motor specification		0455-B00		0455-B10		0456-B00		0456-B10	
Cooling method		No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		2200	4400	2200	4400	3000	7000	3000	7000
POVC1	No.2062	32723	32589	32730	32616	32730	32563	32729	32558
POVC2	No.2063	560	2236	474	1894	471	2557	483	2623
POVCLMT	No.2065	1661	6644	1312	5250	1396	7601	621	3378
RTCURR	No.2086	948	1897	843	1686	869	2029	578	1352
OVCSTP	No.2161	0	0	0	140	0	140	0	0
POVC21	No.2162	0	0	0	0	0	0	0	0
POVC22	No.2163	0	0	0	0	0	0	0	0
POVCLMT2	No.2164	0	0	0	0	0	0	0	0

Motor model		LiS 10000C3/2HV		LiS 10000C3/2		LiS 17000C3/2HV		LiS 17000C3/2	
Motor specification		0457-B00		0457-B10		0459-B00		0459-B10	
Cooling method		No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		2000	4000	2000	4000	3400	6800	3400	6800
POVC1	No.2062	32722	32584	32720	32577	32711	32542	32711	32542
POVC2	No.2063	576	2298	597	2384	709	2829	709	2829
POVCLMT	No.2065	1707	6828	1358	5432	981	3925	981	3925
RTCURR	No.2086	961	1923	857	1715	729	1458	729	1458
OVCSTP	No.2161	0	0	0	140	0	0	0	0
POVC21	No.2162	0	0	0	0	0	0	0	0
POVC22	No.2163	0	0	0	0	0	0	0	0
POVCLMT2	No.2164	0	0	0	0	0	0	0	0

Motor model		LiS 300S1/4-B		LiS 600S1/4-B		LiS 900S1/4-B		LiS 600S2/3-B	
Motor specification		0424-B200		0425-B200		0426-B200		0427-B200	
Cooling method		No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		60	120	100	240	140	360	100	240
POVC1	No.2062	32583	31927	32633	31927	32662	31788	32633	31927
POVC2	No.2063	2315	10508	1691	10508	1325	12252	1691	10508
POVCLMT	No.2065	3108	12545	2291	12545	1015	8028	2291	12545
RTCURR	No.2086	648	1390	557	1392	370	1042	557	1392
OVCSTP	No.2161	130	130	130	130	130	130	130	130
POVC21	No.2162	32750	32742	32753	32742	32755	32746	32753	32742
POVC22	No.2163	222	320	191	321	165	277	191	321
POVCLMT2	No.2164	571	2621	421	2630	186	1475	421	2630

Motor model		LiS 1200S2/3-B		LiS 1800S2/3-B		LiS 3000M2/2HV-B		LiS 3000M2/2-B	
Motor specification		0428-B200		0429-B200		0462-B020		0462-B120	
Cooling method		No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		180	480	260	720	480	1200	480	1200
POVC1	No.2062	32663	31927	32675	31784	32614	31622	32612	31608
POVC2	No.2063	1309	10508	1166	12304	1921	14327	1955	14504
POVCLMT	No.2065	1784	12545	895	8056	1340	8375	1610	9992
RTCURR	No.2086	491	1392	348	1044	425	1064	466	1163
OVCSTP	No.2161	130	130	130	130	130	130	130	130
POVC21	No.2162	32755	32742	32756	32746	32752	32746	32752	32746
POVC22	No.2163	164	321	152	277	204	277	206	277
POVCLMT2	No.2164	328	2630	164	1480	246	1538	296	1835

Motor model		LiS 4500M2/2HV-B		LiS 4500M2/2-B		LiS 6000M2/2HV-B		LiS 6000M2/2-B	
Motor specification		0463-B020		0463-B120		0464-B020		0464-B120	
Cooling method		No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		720	1800	720	1800	960	2400	960	2400
POVC1	No.2062	32617	32052	32614	32183	32612	31603	32612	31618
POVC2	No.2063	1893	8946	1931	7312	1947	14563	1955	14376
POVCLMT	No.2065	2938	12545	3580	12545	1340	8375	1272	7840
RTCURR	No.2086	630	1599	696	1744	425	1064	415	1030
OVCSTP	No.2161	130	130	130	130	130	130	130	130
POVC21	No.2162	32752	32733	32752	32725	32752	32746	32752	32746
POVC22	No.2163	203	441	205	542	205	277	206	277
POVCLMT2	No.2164	540	3468	658	4129	246	1538	234	1440

Motor model		LiS 7500M2/2HV-B		LiS 7500M2/2-B		LiS 9000M2/2HV-B		LiS 9000M2/2-B	
Motor specification		0465-B020		0465-B120		0466-B020		0466-B120	
Cooling method		No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		1200	3000	1200	3000	1440	3600	1440	3600
POVC1	No.2062	32615	31666	32613	31616	32612	32052	32614	32004
POVC2	No.2063	1911	13772	1940	14402	1949	8946	1931	9555
POVCLMT	No.2065	2062	12545	1974	12267	3023	12545	2829	12545
RTCURR	No.2086	528	1335	513	1288	639	1599	618	1547
OVCSTP	No.2161	130	130	130	130	130	130	130	130
POVC21	No.2162	32752	32745	32752	32746	32752	32733	32752	32735
POVC22	No.2163	204	292	205	277	205	441	205	408
POVCLMT2	No.2164	379	2418	363	2253	555	3468	520	3247

Motor model		LiS 11000M2/2HV-B		LiS 11000M2/2-B		LiS 4500M3/2HV-B		LiS 4500M3/2-B	
Motor specification		0467-B020		0467-B120		0468-B020		0468-B120	
Cooling method		No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		1680	4200	1680	4200	720	1800	720	1800
POVC1	No.2062	32609	32261	32614	32228	32586	31963	32588	31994
POVC2	No.2063	1990	6338	1924	6744	2275	10061	2255	9678
POVCLMT	No.2065	4194	12545	3838	12545	3172	12545	3251	12545
RTCURR	No.2086	753	1867	720	1802	648	1622	660	1633
OVCSTP	No.2161	130	130	130	130	130	130	130	130
POVC21	No.2162	32751	32717	32752	32721	32750	32731	32750	32731
POVC22	No.2163	208	638	204	585	220	467	220	467
POVCLMT2	No.2164	770	4732	705	4405	583	3641	597	3641

Motor model		LiS 7000M3/2HV-B		LiS 7000M3/2-B		LiS 9000M3/2HV-B		LiS 9000M3/2-B	
Motor specification		0469-B020		0469-B120		0470-B020		0470-B120	
Cooling method		No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		1080	2700	1080	2700	1440	3600	1440	3600
POVC1	No.2062	32590	31425	32592	31418	32591	31963	32592	31744
POVC2	No.2063	2228	16791	2195	16871	2216	10061	2197	12799
POVCLMT	No.2065	1748	10720	1410	8799	3093	12545	2506	12545
RTCURR	No.2086	486	1204	437	1091	648	1613	581	1457
OVCSTP	No.2161	130	130	130	130	130	130	130	130
POVC21	No.2162	32751	32746	32751	32746	32751	32732	32751	32740
POVC22	No.2163	218	277	217	277	218	451	217	355
POVCLMT2	No.2164	321	1969	259	1616	568	3532	460	2877

Motor model		LiS 11000M3/2HV-B		LiS 11000M3/2-B		LiS 14000M3/2HV-B		LiS 14000M3/2-B	
Motor specification		0471-B020		0471-B120		0472-B020		0472-B120	
Cooling method		No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		1800	4500	1800	4500	2160	5400	2160	5400
POVC1	No.2062	32583	32261	32593	32161	32613	31519	32617	31529
POVC2	No.2063	2315	6338	2191	7586	1937	15618	1887	15485
POVCLMT	No.2065	4857	12545	3915	12545	1206	8007	1217	8232
RTCURR	No.2086	811	2015	728	1822	404	1041	406	1055
OVCSTP	No.2161	130	130	130	130	130	130	130	130
POVC21	No.2162	32750	32706	32751	32720	32752	32746	32752	32746
POVC22	No.2163	222	779	217	605	205	277	202	277
POVCLMT2	No.2164	892	5508	719	4513	222	1471	224	1512

Motor model		LiS 16000M3/2HV-B		LiS 16000M3/2-B	
Motor specification		0473-B020		0473-B120	
Cooling method		No cooling	Water cooling	No cooling	Water cooling
Continuous force [N]		2520	6300	2520	6300
POVC1	No.2062	32599	31416	32601	31417
POVC2	No.2063	2110	16896	2083	16892
POVCLMT	No.2065	1784	11584	1824	11991
RTCURR	No.2086	491	1252	496	1274
OVCSTP	No.2161	130	130	130	130
POVC21	No.2162	32751	32746	32751	32746
POVC22	No.2163	213	277	212	277
POVCLMT2	No.2164	328	2128	335	2202

[Conventional linear motors]

Motor model		1500A/4			3000B/2			3000B/4		
Motor specification		0410			0411			0411-B811		
Cooling method		No cooling	Air cooling	Water cooling	No cooling	Air cooling	Water cooling	No cooling	Air cooling	Water cooling
Continuous force [N]		300	360	600	600	720	1200	600	720	1200
POVC1	No.2062	32698	32667	32490	32698	32667	32490	32698	32667	32490
POVC2	No.2063	873	1257	3481	873	1257	3481	873	1257	3481
POVCLMT	No.2065	2590	3729	10358	2590	3729	10358	2590	3729	10358
RTCURR	No.2086	1184	1421	2369	1184	1421	2369	1184	1421	2368
OVCSTP	No.2161	0	0	0	0	0	0	0	0	0
POVC21	No.2162	0	0	0	0	0	0	0	0	0
POVC22	No.2163	0	0	0	0	0	0	0	0	0
POVCLMT2	No.2164	0	0	0	0	0	0	0	0	0

Motor model		6000B/2			6000B/4 (160-A driving)			9000B/2 (160-A driving)		
Motor specification		0412			0412-B811			0413		
Cooling method		No cooling	Air cooling	Water cooling	No cooling	Air cooling	Water cooling	No cooling	Air cooling	Water cooling
Continuous force [N]		1200	1440	2400	1200	1440	2400	1800	2160	3600
POVC1	No.2062	32698	32667	32490	32706	32679	32520	32729	32711	32611
POVC2	No.2063	873	1257	3481	777	1118	3098	491	707	1962
POVCLMT	No.2065	2590	3729	10358	2304	3317	9215	1457	2098	5827
RTCURR	No.2086	1184	1421	2369	1117	1340	2234	888	1065	1776
OVCSTP	No.2161	0	0	0	0	0	0	0	0	0
POVC21	No.2162	0	0	0	0	0	0	0	0	0
POVC22	No.2163	0	0	0	0	0	0	0	0	0
POVCLMT2	No.2164	0	0	0	0	0	0	0	0	0

Motor model		9000B/4 (360-A driving)			15000C/2 (360-A driving)			15000C/3		
Motor specification		0413-B811			0414			0414-B811		
Cooling method		No cooling	Air cooling	Water cooling	No cooling	Air cooling	Water cooling	No cooling	Air cooling	Water cooling
Continuous force [N]		1800	2160	3600	3000	3600	7000	3000	3600	7000
POVC1	No.2062	32737	32723	32644	32751	32744	32677	32732	32716	32572
POVC2	No.2063	388	559	1551	209	301	1139	452	651	2455
POVCLMT	No.2065	1151	1657	4604	621	894	3378	1340	1930	7296
RTCURR	No.2086	789	947	1579	579	695	1352	852	1022	1988
OVCSTP	No.2161	0	0	0	0	0	0	0	0	0
POVC21	No.2162	0	0	0	0	0	0	0	0	0
POVC22	No.2163	0	0	0	0	0	0	0	0	0
POVCLMT2	No.2164	0	0	0	0	0	0	0	0	0

(5) Illegal servo parameter setting alarms when linear motors are used

The following illegal servo parameter setting alarms have been added to linear motors.

Table 3.1.1 (h) Parameter error alarm detail numbers during use of the linear motor

Illegal servo parameter setting alarm Detail number	Description
10043	Separate detectors cannot be used for linear motors. Full-closed loop setting results in an alarm being issued.
1123	If no AMR conversion coefficient is set, an alarm is issued. Even when the linear encoder is not relocated after the motor is replaced, the AMR conversion coefficients must be re-set, because initialization accompanying motor replacement causes the AMR coefficients to be erased.
1393	The valid setting range of the AMR offset is from: -45 (degrees) and +45 (degrees) : (AMR60 = 0) -60 (degrees) and +60 (degrees) : (AMR60 = 1) If a value outside of this range is specified in the parameter, an invalid-parameter alarm is issued.

⚠ **CAUTION**

When an AMR conversion coefficient is not set, an alarm is issued. If it is set, but incorrect, no alarm is issued. In this case, the linear motor fails to drive correctly immediately after it passes phase Z. It may move within one pole-to-pole span (60 mm or 30 mm) in the worst case.

(6) Notes on using high-speed HRV current control or the cutting /rapid velocity loop gain switching function

In general, a higher velocity loop gain (load inertia ratio) is set for a linear motor than for a rotary motor. So, if high-speed HRV current control and the cutting/rapid velocity loop gain switching function are used at the same time to achieve an even higher velocity loop gain, an overflow can occur in the internal value of the velocity load proportional (PK2V: parameter No. 2044). (The parameter error detail number is 443).

In this case, set the parameter indicated below. Whether an overflow occurs or not can be checked using Fig. 3.1.1 (h).

	#7	#6	#5	#4	#3	#2	#1	#0
2200		P2EX						

P2EX(#6) The velocity loop proportional gain (PK2V) format is:

0: Standard format.

1: Converted format. To be set.

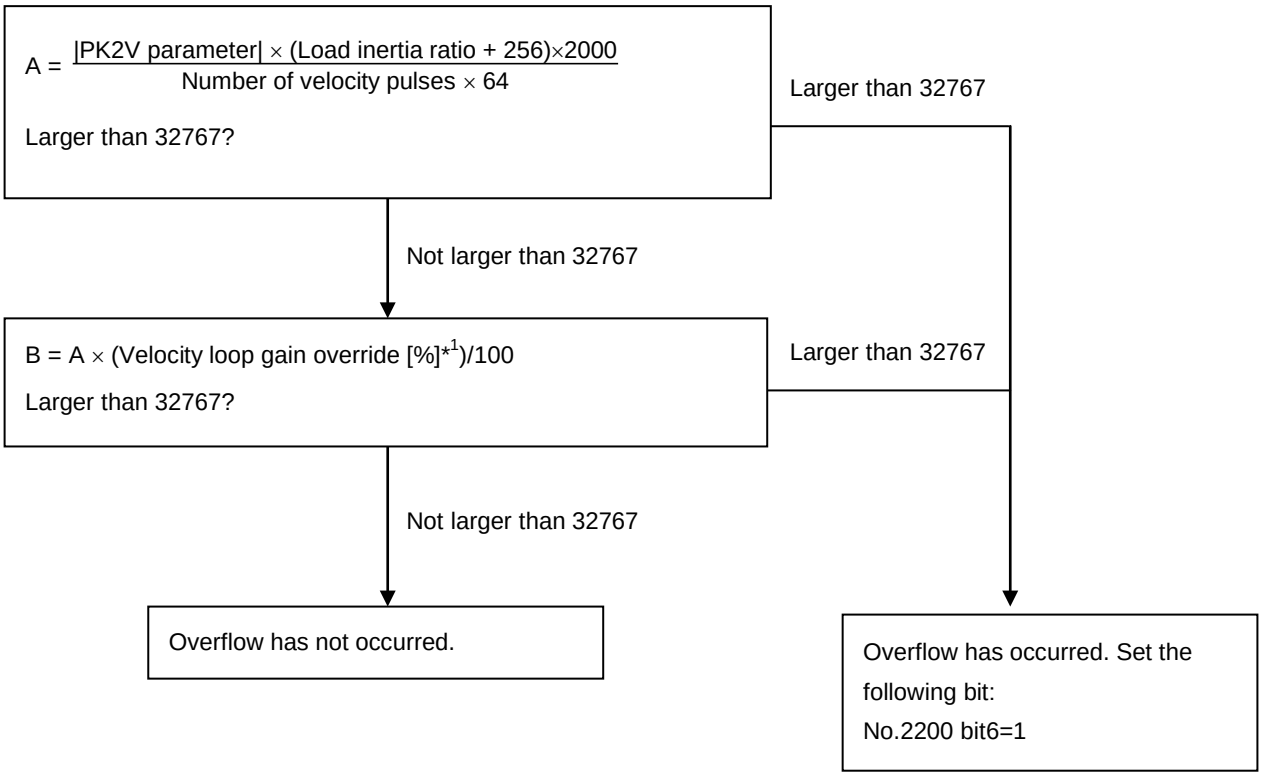


Fig. 3.1.1 (h) PK2V overflow check

NOTE

*1 In the flowchart above, the velocity loop gain override is:

Velocity gain magnification (No. 2335)	(when high-speed HRV current control is enabled)
Velocity gain override (No. 2107)	(when the cutting/rapid velocity loop gain switching function is enabled)

3.1.2 Smoothing Compensation for Linear Motor

(1) Overview

Smoothing compensation for linear motors improves the smoothness in feed of a linear motor by producing a sinusoidal compensation torque with a cycle of 1/2, 1/4, or 1/6 of the pole-to-pole span produced by servo control software and by applying such a torque to the current command. Compensation torque can be generated for each motor by setting gain and phase for each component.

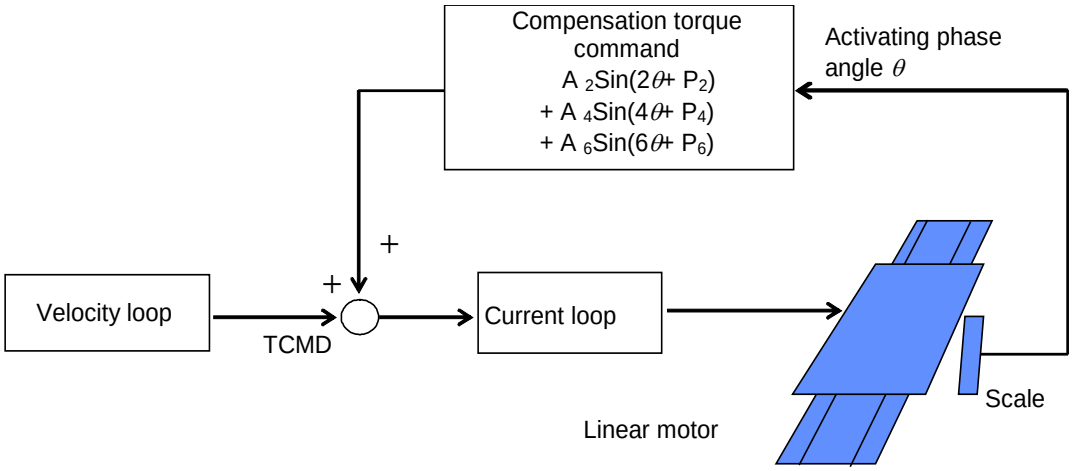


Fig. 3.1.2 (a) Diagram showing smoothing compensation

(2) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0	03.0 and subsequent editions	
	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	

(3) Setting parameters

Setting of the smoothing compensation in the positive direction

2130	Smoothing compensation performed twice per pole pair	
	Correction gain (high-order 8 bits)	Correction phase (low-order 8 bits)

2131	Smoothing compensation performed four times per pole pair	
	Correction gain (high-order 8 bits)	Correction phase (low-order 8 bits)

2132	Smoothing compensation performed six times per pole pair	
	Correction gain (high-order 8 bits)	Correction phase (low-order 8 bits)

Setting of the smoothing compensation in the negative direction

If the correction gain of the following parameters is set to a non-zero value, it is possible to set a value in the negative direction that is different from the value in the positive direction. To set the same value between the negative direction and the positive direction, set the correction gain of the following parameters to 0.

2369	Smoothing compensation performed twice per pole pair (negative direction)	
	Correction gain (high-order 8 bits)	Correction phase (low-order 8 bits)

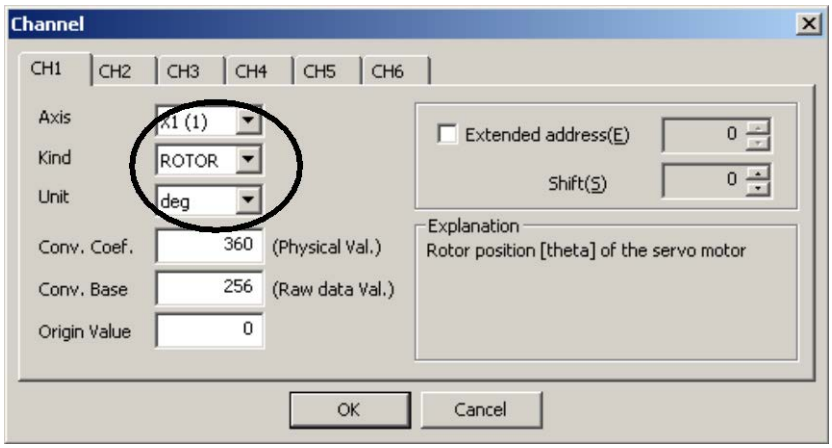
2370	Smoothing compensation performed four times per pole pair (negative direction)	
	Correction gain (high-order 8 bits)	Correction phase (low-order 8 bits)

2371	Smoothing compensation performed six times per pole pair (negative direction)	
	Correction gain (high-order 8 bits)	Correction phase (low-order 8 bits)

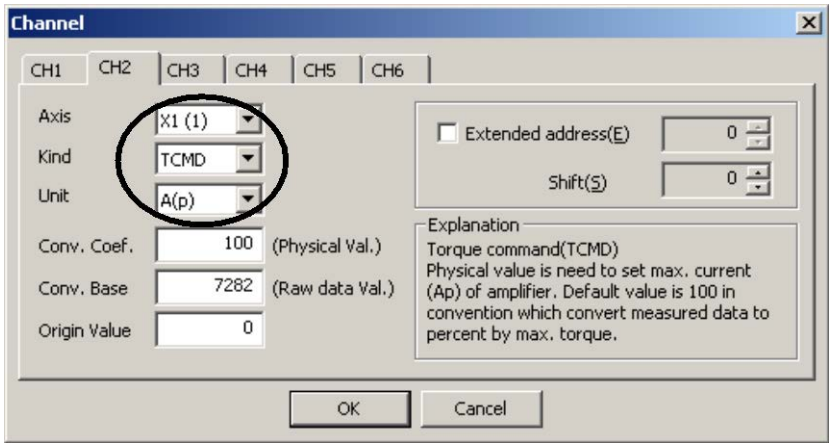
The above compensation parameters must be determined for each motor assembled.
In principle, variations in torque command that is generated when the motor is fed at a low speed depends on the position. The application of smoothing compensation cancels this position-dependent characteristic, allowing the motor to move smoothly.

By using SERVO GUIDE, these parameters can be determined easily. Follow the procedure below to measure the excitation phase and torque command, which are required to determine the compensation parameters.

(1) Set channels as follows:
Channel 1: Excitation phase
Select the target axis for measurement, and set the data type to "ROTOR".



Channel 2: Torque command
Select the target axis for measurement, and set "TCMD" as the data type.
As the conversion coefficient, set the maximum current of the amplifier used for the target axis.

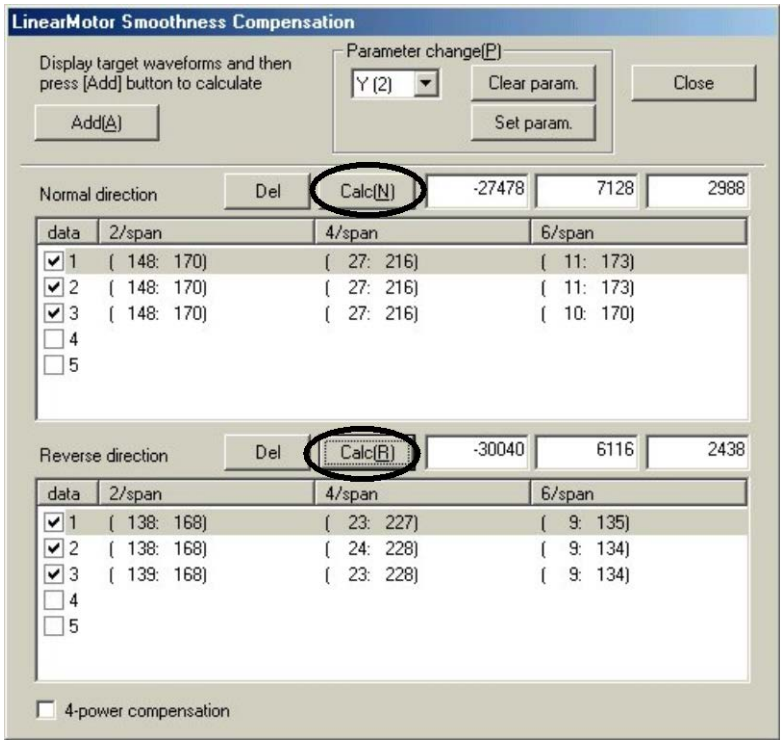


(2) Create a program that performs back and forth motion at a feedrate of F1200 (mm/min).
If the distance of movement is shorter than the pole-to-pole span, it is impossible to automatically calculate smoothing compensation parameters. Therefore, it is recommended that the distance of movement be at least 200 mm for large linear motors or at least 100 mm for small linear motors.
For the number of measurement points, provide enough time to obtain data during one back and forth motion of the motor. (About 15000 to 20000 points in 1-ms sampling)

(3) Check that the torque command does not fluctuate before starting measurement. If it fluctuates, lower the velocity gain to such an extent that hunting does not occur to reduce the fluctuation.

(4) From the "Tools" menu, select "Smoothness compensation calc.".
(The shortcut is [Ctrl] + [L].)

(5) Pressing the [ADD] button in the displayed dialog box analyzes waveform data and registers compensation parameter candidates.



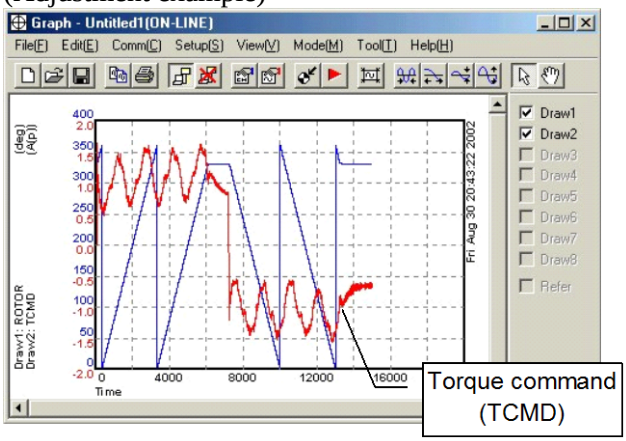
(6) The compensation parameters slightly vary depending on the measurement conditions. So, repeatedly take data measurements and press the [Add] button several times in a similar manner while keeping the dialog box open. (Up to five candidates can be registered.)
If the displayed values include an extremely different value, uncheck the corresponding check box on the leftmost side of the list so that the value is not taken into account in the final compensation calculation.

(7) Press the [Calc] button for each of the forward and backward directions. Then, smoothing compensation parameters are displayed.

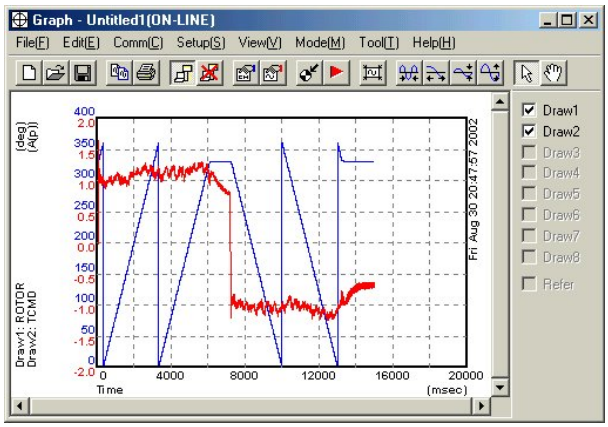
(8) When the target axis for parameter transfer is selected in "Parameter change", and the [Set param.] button is pressed, the presented parameters are set in the CNC.

(9) Measure TCMD again to confirm the effect of smoothing compensation.

(Adjustment example)



Before smoothing compensation adjustment



After smoothing compensation adjustment

3.2 DD MOTOR PARAMETER SETTING

3.2.1 Procedure for Setting the Initial Parameters

(1) Overview

The following describes the procedure for setting the digital servo parameters to enable the use of a FANUC DD motor.
To drive a DD motor, the optional pole detection function is required.

(2) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	A(01) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	

(3) CAUTION

⚠ WARNING

1 A DD motor can make an unpredictable movement or vibration if the basic parameters for pole detection and so forth are not set correctly.
2 Take the following actions until the motor is confirmed to operate normally:
- Lower the excessive error level so that an alarm is issued immediately when an unpredictable movement is made.
- Lower the torque limit value to disable abrupt acceleration.
- Ensure that the emergency stop switch can be pressed immediately.

(4) Rotary encoder

A rotary encoder is used to detect the position and speed of a DD motor.
Table 3.2.1 (a) lists examples of usable rotary encoders.

Table 3.2.1 (a) Examples of usable rotary encoders

Rotary encoder	Number of pulses for parameter setting(*1)	Remarks
αiCZ 512A(*5)	500,000 p/rev	Manufactured by FANUC
αiCZ 768A(*2, *5)	750,000 p/rev	Manufactured by FANUC
αiCZ 1024A(*5)	1,000,000 p/rev	Manufactured by FANUC
RCN223F, RCN723F, RCN727F(*3)	8,000,000 p/rev	Manufactured by HEIDENHAIN
Analog encoder (binary type) and DD motor position detection circuit(*4)	1,000,000 p/rev (λ=4096) 2,000,000 p/rev (λ=8192) 4,000,000 p/rev (λ=16384) 8,000,000 p/rev (λ=32768)	λ: Number of sine waves per detector revolution
Analog encoder (non-binary type) + DD motor position detection circuit (*2) (*4)	λ × 512 p/rev	λ: Number of sine waves per detector revolution

(*1) Number of pulses for parameter setting, which differs from the actual resolution.

(*2) The servo control software of the Series 90D0 and 90E0/J(10) and subsequent editions is required to use the αiCZ 768A analog encoder (non-binary type) and the DD motor position detection circuit as a rotary encoder for the DD motor in the 30i-A Series.
The servo control software of the Series 90D0 and 90E0/P(16) and subsequent editions is required to use the DD motor position detection circuit (A860-2033-T601) in the 30i-A Series.

(*3) The servo control software of the Series 90D0 and 90E0/J(10) and subsequent editions is required to use the RCN727F as a rotary encoder for the DD motor in the 30i-A Series.

(*4) Analog encoder (binary type): Encoder that outputs an analog signal (sine wave, 1Vp-p) and represents number λ per revolution as a binary number (power of 2)
Analog encoder (non-binary type): Encoder that outputs an analog signal (sine wave, 1Vp-p) and represents number λ per revolution as a non-binary number (which is not a power of 2)

(*5) When you set Bit 0 of parameter No. 2294 to 1 to display the αiCZ sensor amplitude and offset information on the diagnosis screen of the CNC, reset this bit to 0 after confirming that the sensor outputs the correct signal.

NOTE

1 For details of rotary encoders usable with DD motors, refer to "FANUC SYNCHRONOUS BUILT-IN SERVO MOTOR DiS series DESCRIPTIONS (B-65332EN)".
2 For detailed specifications of a rotary encoder supplied by a vendor other than FANUC, contact the manufacturer of the rotary encoder.
3 Keep the following in mind when the DD motor is combined with the structure including the analog encoder (non-binary type) and the DD motor position detection circuit.
  1 Absolute setting is disabled.
  2 The movable range is within 1 detector revolution. (Use assuming infinite revolution is disabled.)
  Each time the power to the CNC is turned on, pole position detection must be performed.

3.2.1.1 Parameter Setting Procedure (1) (Initialization)

In parameter setting procedure (1), parameters for the current gain, etc. required to drive the DD motor are initialized. After setting DGPR to 0, set the motor ID number. For the connection and setting method for the overheat signal (thermostat signal), see Section 3.3, "DETECTION OF AN OVERHEAT ALARM BY SERVO CONTROL SOFTWARE WHEN A LINEAR MOTOR AND A DD MOTOR ARE USED".

(1) Setting the standard parameters

	#7	#6	#5	#4	#3	#2	#1	#0
2000							DGPR	

DGPR(#1) Set 0. (Upon completion of automatic loading, this parameter is automatically set to 1.)

2020	Motor ID number

Table 3.2.1.1 (a) indicates the DD motors for which the standard parameters are available as of February 2019. The servo control software shown in Table 3.2.1.1 (a) is required to automatically load the standard parameters described in Section 10.4. To perform automatic loading, set bit 1 of parameter No. 2000 to 0, set the motor ID number, make the following basic settings, and restart the CNC. Upon completion of automatic loading, bit 1 of parameter No. 2000 is automatically set to 1. When the servo control software used does not support automatic loading, set the parameters manually with reference to the parameter list shown in this manual. The parameters to be loaded automatically are those for non-cooling. For liquid cooling, set the OVC parameters manually with reference to Subsection 3.2.1.3 after detecting the magnetic pole.

Table 3.2.1.1 (a) Motor ID numbers of DD motors and servo control software that can be loaded automatically [200-V driving]

Motor model	Motor specification	Motor ID No.	90G0	90J0 90K0	90GP	90JP	90D0 90E0	90E1	90M0 90M8	90C5 90E5	90C8 90E8
DiS 400/250	0485-B20	419	05.0	01.0	02.0	01.0	30.0	07.0	02.0	F	B
DiS 22/600	0482-B10	421	03.0	01.0	02.0	01.0	P	01.0	02.0	A	A
DiS 85/400	0483-B20	423	03.0	01.0	02.0	01.0	N	01.0	02.0	A	A
DiS 110/300	0484-B10	425	03.0	01.0	02.0	01.0	N	01.0	02.0	A	A
DiS 260/300	0484-B30	427	03.0	01.0	02.0	01.0	N	01.0	02.0	A	A
DiS 260/600	0484-B31	429	03.0	01.0	02.0	01.0	P	01.0	02.0	A	A
DiS 370/300	0484-B40	431	03.0	01.0	02.0	01.0	N	01.0	02.0	A	A
DiS 800/250	0485-B40	433	05.0	01.0	02.0	01.0	30.0	07.0	02.0	F	B
DiS 1200/250	0485-B50	435	03.0	01.0	02.0	01.0	P	01.0	02.0	A	A
DiS 1500/200	0486-B30	437	03.0	01.0	02.0	01.0	N	01.0	02.0	A	A
DiS 2100/150	0487-B30	439	03.0	01.0	02.0	01.0	N	01.0	02.0	A	A
DiS 3000/150	0487-B40	441	03.0	01.0	02.0	01.0	N	01.0	02.0	A	A
DiS 85/1000	0483-B22	443	03.0	01.0	02.0	01.0	P	01.0	02.0	A	A
DiS 110/1000	0484-B12	445	03.0	01.0	02.0	01.0	P	01.0	02.0	A	A
DiS 260/1000	0484-B32	447	03.0	01.0	02.0	01.0	P	01.0	02.0	A	A
DiS 22/1500	0482-B12	449	03.0	01.0	02.0	01.0	Q	01.0	02.0	A	A
DiS 15/1000	0492-B100	551	05.0	01.0	02.0	01.0	30.0	07.0	02.0	F	B
DiS 60/400	0493-B200	553	05.0	01.0	02.0	01.0	30.0	07.0	02.0	F	B
DiS 70/300	0494-B100	555	05.0	01.0	02.0	01.0	30.0	07.0	02.0	F	B
DiS 150/300	0494-B300	557	05.0	01.0	02.0	01.0	30.0	07.0	02.0	F	B
DiS 200/300	0494-B400	559	05.0	01.0	02.0	01.0	30.0	07.0	02.0	F	B
DiS 250/250	0495-B200	561	05.0	01.0	02.0	01.0	30.0	07.0	02.0	F	B
DiS 500/250	0495-B400	563	05.0	01.0	02.0	01.0	30.0	07.0	02.0	F	B
DiS 1000/200	0496-B300	565	12.0	01.0	02.0	01.0	33.0	10.0	02.0	F	C
DiS 1500/100	0497-B300	567	12.0	01.0	02.0	01.0	33.0	10.0	02.0	F	C
DiS 2000/100	0497-B400	569	12.0	01.0	02.0	01.0	33.0	10.0	02.0	F	C
DiS 2000/150	0497-B490	571	12.0	01.0	02.0	01.0	33.0	10.0	02.0	F	C

Motor model	Motor specification	Motor ID No.	90G0	90J0 90K0	90GP	90JP	90D0 90E0	90E1	90M0 90M8	90C5 90E5	90C8 90E8
DiS 120/600	0493-B400	575	-	10.0	-	04.0	-	-	06.0	-	-
DiS 60/2000	0493-B220	577	19.0	01.0	02.0	01.0	-	-	02.0	-	-
DiS 70/1500	0494-B120	579	19.0	01.0	02.0	01.0	-	-	02.0	-	-
DiS 150/1500	0494-B320	581	19.0	01.0	02.0	01.0	-	-	02.0	-	-
DiS 500/1000	0495-B420	583	19.0	01.0	02.0	01.0	-	-	02.0	-	-
DiS 500/1200	0495-B421	585	-	10.0	-	04.0	-	-	06.0	-	-
DiS 1000/1000-385	0499-B420	587	-	10.0	-	04.0	-	-	06.0	-	-
DiS 1000/1000	0496-B320	589	-	10.0	-	04.0	-	-	06.0	-	-
DiS 15/1000-B	2392-B100	593	-	10.0	-	04.0	-	-	06.0	-	-
DiS 60/400-B	2393-B200	595	-	10.0	-	04.0	-	-	06.0	-	-
DiS 60/2000-B	2393-B220	597	-	10.0	-	04.0	-	-	06.0	-	-
DiS 120/600-B	2393-B400	599	-	10.0	-	04.0	-	-	06.0	-	-
DiS 70/300-B	2394-B100	601	-	10.0	-	04.0	-	-	06.0	-	-
DiS 70/1500-B	2394-B120	603	-	10.0	-	04.0	-	-	06.0	-	-
DiS 150/300-B	2394-B300	605	-	10.0	-	04.0	-	-	06.0	-	-
DiS 150/1500-B	2394-B320	607	-	10.0	-	04.0	-	-	06.0	-	-
DiS 500/250-B	2395-B400	614	-	10.0	-	04.0	-	-	06.0	-	-
DiS 500/1200-B	2395-B421	616	-	10.0	-	04.0	-	-	06.0	-	-
DiS 1000/1000-385-B	2399-B420	619	-	10.0	-	04.0	-	-	06.0	-	-
DiS 1000/200-B	2396-B300	621	-	10.0	-	04.0	-	-	06.0	-	-
DiS 1000/1000-B	2396-B320	623	-	10.0	-	04.0	-	-	06.0	-	-

[400-V driving]

Motor model	Motor specification	Motor ID No.	90G0	90J0 90K0	90GP	90JP	90D0 90E0	90E1	90M0 90M8	90C5 90E5	90C8 90E8
DiS 400/250	0485-B20	420	05.0	01.0	02.0	01.0	30.0	07.0	02.0	F	B
DiS 22/600	0482-B10	422	03.0	01.0	02.0	01.0	P	01.0	02.0	A	A
DiS 85/400	0483-B20	424	03.0	01.0	02.0	01.0	N	01.0	02.0	A	A
DiS 110/300	0484-B10	426	03.0	01.0	02.0	01.0	N	01.0	02.0	A	A
DiS 260/300	0484-B30	428	03.0	01.0	02.0	01.0	N	01.0	02.0	A	A
DiS 260/600	0484-B31	430	03.0	01.0	02.0	01.0	P	01.0	02.0	A	A
DiS 370/300	0484-B40	432	03.0	01.0	02.0	01.0	N	01.0	02.0	A	A
DiS 800/250	0485-B40	434	05.0	01.0	02.0	01.0	30.0	07.0	02.0	F	B
DiS 1200/250	0485-B50	436	03.0	01.0	02.0	01.0	P	01.0	02.0	A	A
DiS 1500/200	0486-B30	438	03.0	01.0	02.0	01.0	N	01.0	02.0	A	A
DiS 2100/150	0487-B30	440	03.0	01.0	02.0	01.0	N	01.0	02.0	A	A
DiS 3000/150	0487-B40	442	03.0	01.0	02.0	01.0	N	01.0	02.0	A	A
DiS 15/1000	0492-B100	552	05.0	01.0	02.0	01.0	30.0	07.0	02.0	F	B
DiS 60/400	0493-B200	554	05.0	01.0	02.0	01.0	30.0	07.0	02.0	F	B
DiS 70/300	0494-B100	556	05.0	01.0	02.0	01.0	30.0	07.0	02.0	F	B
DiS 150/300	0494-B300	558	05.0	01.0	02.0	01.0	30.0	07.0	02.0	F	B
DiS 200/300	0494-B400	560	05.0	01.0	02.0	01.0	30.0	07.0	02.0	F	B
DiS 250/250	0495-B200	562	05.0	01.0	02.0	01.0	30.0	07.0	02.0	F	B
DiS 500/250	0495-B400	564	05.0	01.0	02.0	01.0	30.0	07.0	02.0	F	B
DiS 1000/200	0496-B300	566	05.0	01.0	02.0	01.0	30.0	07.0	02.0	F	B
DiS 1500/100	0497-B300	568	12.0	01.0	02.0	01.0	33.0	10.0	02.0	F	C
DiS 2000/100	0497-B400	570	12.0	01.0	02.0	01.0	33.0	10.0	02.0	F	C
DiS 2000/150	0497-B490	572	05.0	01.0	02.0	01.0	30.0	07.0	02.0	F	B
DiS 5000/50	0488-B400	573	12.0	01.0	02.0	01.0	33.0	10.0	02.0	F	C
DiS 200/150	0494-B450	574	-	06.0	-	03.0	-	-	03.0	-	-
DiS 120/600	0493-B400	576	-	10.0	-	04.0	-	-	06.0	-	-
DiS 60/2000	0493-B220	578	19.0	01.0	02.0	01.0	-	-	02.0	-	-
DiS 70/1500	0494-B120	580	19.0	01.0	02.0	01.0	-	-	02.0	-	-

Motor model	Motor specification	Motor ID No.	90G0	90J0 90K0	90GP	90JP	90D0 90E0	90E1	90M0 90M8	90C5 90E5	90C8 90E8
DiS 150/1500	0494-B320	582	19.0	01.0	02.0	01.0	-	-	02.0	-	-
DiS 500/1000	0495-B420	584	19.0	01.0	02.0	01.0	-	-	02.0	-	-
DiS 500/1200	0495-B421	586	-	10.0	-	04.0	-	-	06.0	-	-
DiS 1000/1000-385	0499-B420	588	-	10.0	-	04.0	-	-	06.0	-	-
DiS 1000/1000	0496-B320	590	-	10.0	-	04.0	-	-	06.0	-	-
DiS 5000/500	0488-B430	591	-	10.0	-	04.0	-	-	06.0	-	-
DiS 500/150	0495-B450	592	-	10.0	-	04.0	-	-	06.0	-	-
DiS 15/1000-B	2392-B100	594	-	10.0	-	04.0	-	-	06.0	-	-
DiS 60/400-B	2393-B200	596	-	10.0	-	04.0	-	-	06.0	-	-
DiS 60/2000-B	2393-B220	598	-	10.0	-	04.0	-	-	06.0	-	-
DiS 120/600-B	2393-B400	600	-	10.0	-	04.0	-	-	06.0	-	-
DiS 70/300-B	2394-B100	602	-	10.0	-	04.0	-	-	06.0	-	-
DiS 70/1500-B	2394-B120	604	-	10.0	-	04.0	-	-	06.0	-	-
DiS 150/300-B	2394-B300	606	-	10.0	-	04.0	-	-	06.0	-	-
DiS 150/1500-B	2394-B320	608	-	10.0	-	04.0	-	-	06.0	-	-
DiS 500/250-B	2395-B400	615	-	10.0	-	04.0	-	-	06.0	-	-
DiS 500/1200-B	2395-B421	617	-	10.0	-	04.0	-	-	06.0	-	-
DiS 500/150-B	2395-B450	618	-	10.0	-	04.0	-	-	06.0	-	-
DiS 1000/1000-385-B	2399-B420	620	-	10.0	-	04.0	-	-	06.0	-	-
DiS 1000/200-B	2396-B300	622	-	10.0	-	04.0	-	-	06.0	-	-
DiS 1000/1000-B	2396-B320	624	-	10.0	-	04.0	-	-	06.0	-	-
DiS 5000/500-B	2388-B430	632	-	10.0	-	04.0	-	-	06.0	-	-

Automatic loading is possible with the servo control software of the series and edition listed above or subsequent editions.
After the parameters are loaded automatically, make sure that the function bit for DD motor control is enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
2300						DD		

DD(#2) DD motor control is:
0: Disabled.
1: Enabled.

(2) Setting the rotation direction

2022	Movement direction

+111 When the positive direction of the table matches the positive direction of the rotary encoder, specification of the positive direction turns the table in the positive direction.
-111 When the positive direction of the table matches the positive direction of the rotary encoder, specification of the positive direction turns the table in the reverse direction.

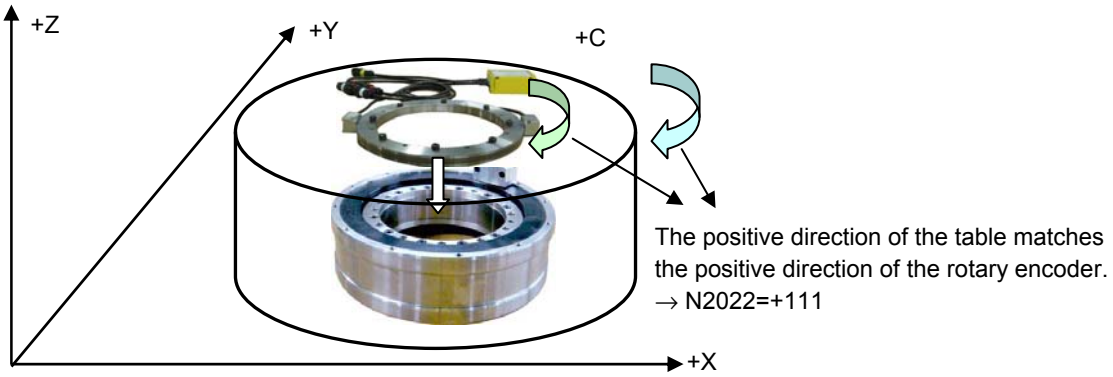


Fig. 3.2.1.1 (a) Relationship between the table and the rotary encoder

(3) Setting of parameters related to feedback

The necessary parameters are set depending on the type of the rotary encoder to be used.

	#7	#6	#5	#4	#3	#2	#1	#0
2000								PLC0

PLC0(#0) The number of velocity pulses and the number of position pulses are:
0: Used without being modified.
1: Used after being multiplied by 10
If the number of velocity pulses is larger than 32767, set the parameter to 1.

2023	Number of velocity pulses (PULCO)
2024	Number of position pulses (PPLS)
2185	Position pulses conversion coefficient (PSMPYL)

This parameter is used if the calculated number of position pulses is greater than 32767.
When this parameter is set to 0, PSMPYL = 1 is assumed for processing.

(Parameter calculation expression)
When PLC0 = 0
→ Set this parameter so that the following equation is satisfied: Number of position pulses = PPLS x PSMPYL
When PLC0=1
→ Set so that Number of position pulses = 10 x PPLS x PSMPYL

Table 3.2.1.1 (b) Setting the number of velocity pulses and number of position pulses

Rotary encoder	PLC0 (No.2000#0)	PULCO (No.2023)	PPLS (No.2024)	PSMPYL (No.2185)
αiCZ 512A	0	4096	6250	0
αiCZ 768A	0	6144	9375	0
αiCZ 1024A	0	8192	12500	0
RCN223F, RCN723F, RCN727F, RCN8390F	1	6554	10000	0
Analog encoder (binary type) + DD linear motor position detection circuit	(*1)			
Analog encoder (non-binary type) + DD motor position detection circuit	(*2)			

(*1) When an analog encoder (binary type) and DD motor position detection circuit are used together, the number of velocity pulses and the number of position pulses are calculated according to the following expressions:

Number of velocity pulses = 2 × λ
Number of position pulses = 3125 x λ/1024
(λ: Number of sine waves per detector revolution)

(*2) When an analog encoder (non-binary type) and DD motor position detection circuit are used together, the number of velocity pulses and the number of position pulses are calculated according to the following expressions:

Number of velocity pulses = 2 × λ
Number of position pulses = 32 x λ/5
(λ: Number of sine waves per detector revolution)

2084	Flexible feed gear numerator
2085	Flexible feed gear denominator

(Parameter calculation expression)

$$FFG = \frac{No.2084}{No.2085} = \frac{\text{Number of pulses per motor revolution (detection unit)}}{\text{Number of pulses per rotary encoder revolution}}$$

For the number of pulses per rotary encoder revolution, see Table 3.2.1 (a).

1821	Reference counter capacity

Set the number of pulses per motor revolution (detection unit) or the same number divided by an integer.
With the αiCZ 768A, however, set the number of pulses per one-third of one motor revolution (detection unit) or the same number divided by an integer.

	#7	#6	#5	#4	#3	#2	#1	#0
2275							RCNCLR	800PLS

800PLS (#0) A rotary encoder with eight million pulses per revolution is:
0: Not to be used
1: To be used. (When using the RCN223F, 723F, or 727F, set the bit to 1.)

RCNCLR (#1) The number of revolutions is:
0: Not to be cleared.
1: To be cleared. (When using the RCN223F, 723F, or 727F, set the bit to 1.)
This function bit is to be set in combination with the number of data mask digits, described below.

2394	Number of data mask digits (DMASK)

[Settings] 8 (To use the RCN223F, 723F, or 727F)

This parameter need not be set for an αiCZ sensor. Set this parameter along with RCNCLR above.

Setting of an AMR conversion coefficient

	#7	#6	#5	#4	#3	#2	#1	#0
2001	0	AMR6	AMR5	AMR4	AMR3	AMR2	AMR1	AMR0

Set the value that matches the type of rotary encoder used according to Table 3.2.1.1 (c).

Table 3.2.1.1 (c) Setting AMR

Rotary encoder	AMR6-AMR0
αiCZ 512A	Set the number of motor poles/2 in binary.
αiCZ 768A	Set the number of motor poles/2 in binary.
αiCZ 1024A	Set the number of motor poles/2 in binary.
RCN223F, RCN723F, RCN727F, RCN8390F	Set the number of motor poles/2 in binary.
Analog encoder (binary type) + DD motor position detection circuit	Set the number of motor poles/2 in binary.
Analog encoder (non-binary type) + DD motor position detection circuit	Set 0.

NOTE

- In PARAMETER MANUAL B-65270EN/07 or earlier, parameter No. 2001 was set to the number of poles when some rotary encoders were used. Although the number of motor poles may be set as before except for high speed models, this version of PARAMETER MANUAL or later recommends that parameter No. 2001 be set to the number of motor poles divided by two for consistency of the setting. If the number of motor poles divided by two is set when the following two conditions are satisfied, smoothing compensation may not function correctly. In this case, use the conventional setting (set the number of motor poles).
  - The αiCZ 512A is used.
  - The servo control software 90G0/03.0 to 17.0 is used.

  The settings of parameter No. 2001 and parameter No. 2138 need to be changed together. (Only one of these parameters cannot be set to a conventional value.)
- When using the following rotary encoders with the conventional setting (the number of poles set to parameter No. 2001), set each value to the AMR conversion coefficient 1 (parameter No. 2112) and AMR conversion coefficient 2 (parameter No. 2138) as follows.

  αiCZ 512A No.2112 = 0, No.2138 = 0
  RCN223F, RCN723F, RCN727F No.2112 = 0, No.2138 = -4

	#7	#6	#5	#4	#3	#2	#1	#0
2220								DECAMR

Set the value that matches the type of the rotary encoder used, according to Table 3.2.1.1 (d).

Table 3.2.1.1 (d) Setting DECAMR

Rotary encoder	DECAMR
αiCZ 512A	Set 0.
αiCZ 768A	Set 1.
αiCZ 1024A	Set 0.
RCN223F, RCN723F, RCN727F, RCN8390F	Set 0.
Analog encoder (binary type) + DD motor position detection circuit	Set 0.
Analog encoder (non-binary type) + DD motor position detection circuit	Set 1.

2112	AMR conversion coefficient 1 (AMRDL)
2138	AMR conversion coefficient 2 (AMR2)

Set the value that matches the type of the rotary encoder used, according to Table 3.2.1.1 (e).

Table 3.2.1.1 (e) Setting AMRDL and AMR2

Rotary encoder	AMR conversion coefficient 1 (AMRDL : No.2112)	AMR conversion coefficient 2 (AMR2 : No.2138)
αiCZ 512A	Set 0.	Set 1. (*1)
αiCZ 768A	Set 768.	Set the number of motor poles/2.
αiCZ 1024A	Set 0.	Set 0.

Rotary encoder	AMR conversion coefficient 1 (AMRDL : No.2112)	AMR conversion coefficient 2 (AMR2 : No.2138)
RCN223F, RCN723F, RCN727F, RCN8390F	Set 0.	Set -3. (*1)
Analog encoder (binary type) + DD motor position detection circuit	Set 0.	0 (4096 λ/revolution) (*2) -1 (8192 λ/revolution) -2 (16384 λ/ revolution)
Analog encoder (non-binary type) + DD motor position detection circuit	Set λ. (*3)(*4)	Set the number of motor poles/2.

(*1) When you set parameter No. 2001 to the number of poles, refer to NOTE on parameter No. 2001 on the previous page.

(*2) Set AMR conversion coefficient 2 using 4096 λ as reference (0). For example, AMR conversion coefficient 2 is set to 1 in the case of 2048 λ or -1 in the case of 8192 λ.

(*3) When λ exceeds 32767, find an AMR conversion coefficient 1 value less than 32767 by dividing AMR conversion coefficient 1 and AMR conversion coefficient 2 by a common divisor and set the parameter to that value.

(*4) If "support for the input frequency 750 kHz" is specified when an analog encoder (non-binary type) and DD motor position detection circuit are used together (SW3 = A and bit 0 of parameter No. 2274 = 1), set the value λ/4 as AMR conversion coefficient 1.

Setting for using a configuration containing only an analog encoder (non-binary type) and a DD motor position detection circuit

	#7	#6	#5	#4	#3	#2	#1	#0
2010						LINEAR		

When using an analog encoder (non-binary type) and DD motor position detection circuit together, set LINEAR to 1.

Setting for using a configuration containing only an analog encoder (binary type) and DD motor position detection circuit or
an analog encoder (non-binary type) and a DD motor position detection circuit

	#7	#6	#5	#4	#3	#2	#1	#0
2274		DD2048						HP2048

HP2048(#0) A 2048-time interpolation circuit (DD motor position detection circuit) is:
0: Not to be used
1: To be used.

DD2048(#6) In the D*i*S motor, bit HP2048 is:
0: Disabled.
1: Enabled.
* Supported in 90E0, D0/21.0 and subsequent editions and 90G0/03.0 and subsequent editions.
Generally, set bits 0 and 6 of parameter No. 2274 to 1.

(4) Examples of setting parameters for each rotary encoder type

Tables 3.2.1.1 (f), (g), (h), (i), (j), (k) and (l) provide summarized examples of parameter setting according to the type of rotary encoder. Set parameters according to the types of a rotary encoder and DD motor used.
For the number of poles of each motor model, see Table 3.2.1.1 (m).

Table 3.2.1.1 (f) αiCZ 512A

Symbol name	Parameter number	Parameter setting	
		Detection unit 1/1000deg	Detection unit 1/10000deg
AMRDL	2112	0	0
AMR2	2138 (*1)	1	1
PLC0	2000#0	0	0
AMR	2001	Number of poles/2 (binary)	Number of poles/2 (binary)
PULCO	2023	4096	4096
PPLS	2024	6250	6250
REFCOUNT	1821	360000	3600000
FFG	2084	36	36
FFG	2085	50	5
PSMPYL	2185	0	0
DECAMR	2220#0	0	0
800PLS#0	2275#0	0	0
800PLS#1	2275#1	0	0

(*1) When parameter No. 2001 is set to the number or motor poles, set parameter No. 2138 to 0.

Table 3.2.1.1 (g) αiCZ 768A

Symbol name	Parameter number	Parameter setting	
		Detection unit 1/1000deg	Detection unit 1/10000deg
AMRDL	2112	768	768
AMR2	2138	Number of poles/2	Number of poles/2
PLC0	2000#0	0	0
AMR	2001	Number of poles/2 (binary)	Number of poles/2 (binary)
PULCO	2023	6144	6144
PPLS	2024	9375	9375
REFCOUNT	1821	120000	1200000
FFG	2084	36	360
FFG	2085	75	75
PSMPYL	2185	0	0
DECAMR	2220#0	1	1
800PLS#0	2275#0	0	0
800PLS#1	2275#1	0	0

Table 3.2.1.1 (h) αiCZ 1024A

Symbol name	Parameter number	Parameter setting	
		Detection unit 1/1000deg	Detection unit 1/10000deg
AMRDL	2112	0	0
AMR2	2138	0	0
PLC0	2000#0	0	0
AMR	2001	Number of poles/2 (binary)	Number of poles/2 (binary)
PULCO	2023	8192	8192
PPLS	2024	12500	12500
REFCOUNT	1821	360000	3600000
FFG	2084	36	36
FFG	2085	100	10
PSMPYL	2185	0	0
DECAMR	2220#0	0	0
800PLS#0	2275#0	0	0
800PLS#1	2275#1	0	0

Table 3.2.1.1 (i) RCN223F, RCN723F, RCN727F, RCN8390F

Symbol name	Parameter number	Parameter setting	
		Detection unit 1/1000deg	Detection unit 1/10000deg
AMRDL	2112	0	0
AMR2	2138(*1)	-3	-3
PLC0	2000#0	1	1
AMR	2001	Number of poles/2 (binary)	Number of poles/2 (binary)
PULCO	2023	6554	6554
PPLS	2024	10000	10000
REFCOUNT	1821	360000	3600000
FFG	2084	9	9
FFG	2085	200	20
PSMPYL	2185	0	0
DECAMR	2220#0	0	0
800PLS#0	2275#0	1	1
800PLS#1	2275#1	1	1
DMASK	2394	8	8

(*1) When parameter No. 2001 is set to the number of motor poles, set parameter No. 2138 to -4.

Table 3.2.1.1 (j) Analog encoder (binary type) and DD motor position detection circuit (1)

Symbol name	Parameter number	Parameter setting			
		4096 λ/revolution		8192 λ/revolution	
		Detection unit 1/1000deg	Detection unit 1/10000deg	Detection unit 1/1000deg	Detection unit 1/10000deg
AMRDL	2112	0	0	0	0
AMR2	2138	0	0	-1	-1
PLC0	2000#0	0	0	0	0
AMR	2001	Number of poles/2 (binary)	Number of poles/2 (binary)	Number of poles/2 (binary)	Number of poles/2 (binary)
PULCO	2023	8192	8192	16384	16384
PPLS	2024	12500	12500	25000	25000
REFCOUNT	1821	360000	3600000	180000	1800000
FFG	2084	9	90	9	90
FFG	2085	25	25	50	50
PSMPYL	2185	0	0	0	0
DECAMR	2220#0	0	0	0	0
800PLS#0	2275#0	0	0	0	0
LINEAR	2010#2	0	0	0	0
HP2048	2274#0	1	1	1	1
DD2048	2274#6	1	1	1	1

Table 3.2.1.1 (k) Analog encoder (binary type) and DD motor position detection circuit (2)

Symbol name	Parameter number	Parameter setting			
		16384 λ/revolution		32768 λ/revolution	
		Detection unit 1/1000deg	Detection unit 1/10000deg	Detection unit 1/1000deg	Detection unit 1/10000deg
AMRDL	2112	0	0	0	0
AMR2	2138	-2	-2	-3	-3
PLC0	2000#0	1	1	1	1
AMR	2001	Number of poles/2 (binary)	Number of poles/2 (binary)	Number of poles/2 (binary)	Number of poles/2 (binary)
PULCO	2023	3277	3277	6554	6554
PPLS	2024	5000	5000	10000	10000
REFCOUNT	1821	90000	900000	360000	3600000
FFG	2084	9	90	9	90
FFG	2085	100	100	200	200
PSMPYL	2185	0	0	0	0
DECAMR	2220#0	0	0	0	0
800PLS#0	2275#0	0	0	1	1
LINEAR	2010#2	0	0	0	0
HP2048	2274#0	1	1	1	1
DD2048	2274#6	1	1	1	1

Table 3.2.1.1 (l) Analog encoder (non-binary type) and DD motor position detection circuit

Symbol name	Parameter number	Parameter setting	
		Detection unit 1/1000deg	Detection unit 1/10000deg
AMRDL	2112	λ	λ
AMR2	2138	Number of poles/2	Number of poles/2
PLC0	2000#0	0	0
AMR	2001	00000000	00000000
PULCO	2023	2λ	2λ
PPLS	2024	32λ/5	32λ/5
REFCOUNT	1821	360000	3600000
FFG	2084	Reduction of $\frac{360000}{\lambda \times 512}$	Reduction of $\frac{3600000}{\lambda \times 512}$
FFG	2085		
PSMPYL	2185	0	0
DECAMR	2220#0	1	1
LINEAR	2010#2	1	1
HP2048	2274#0	1	1
DD2048	2274#6	1	1

Table 3.2.1.1 (m) Number of poles and number of pole pairs of each motor model

Motor model	Motor specification	Number of poles	Number of pole pairs (number of poles/2)
D*i*S 15/1000	0492-B100	16	8 (00001000)
D*i*S 15/1000-B	2392-B100		
D*i*S 22/600	0482-B10	24	12 (00001100)
D*i*S 22/1500	0482-B12		
D*i*S 60/400	0493-B200		
D*i*S 60/2000	0493-B220		
D*i*S 120/600	0493-B400		
D*i*S 60/400-B	2393-B200		
D*i*S 60/2000-B	2393-B220		
D*i*S 70/300	0494-B100	32	16 (00010000)
D*i*S 70/1500	0494-B120		
D*i*S 85/400	0483-B20		
D*i*S 85/1000	0483-B22		
D*i*S 150/300	0494-B300		
D*i*S 150/1500	0494-B320		
D*i*S 200/300	0494-B400		
D*i*S 200/150	0494-B450		
D*i*S 70/300-B	2394-B100		
D*i*S 70/1500-B	2394-B120		
D*i*S 150/300-B	2394-B300		
D*i*S 150/1500-B	2394-B320		
D*i*S 110/300	0484-B10	40	20 (00010100)
D*i*S 110/1000	0484-B12		
D*i*S 260/300	0484-B30		
D*i*S 260/600	0484-B31		
D*i*S 260/1000	0484-B32		
D*i*S 370/300	0484-B40		
D*i*S 250/250	0495-B200	48	24 (00011000)
D*i*S 500/250	0495-B400		
D*i*S 500/1000	0495-B420		
D*i*S 500/1200	0495-B421		
D*i*S 500/250-B	2395-B400		
D*i*S 500/1200-B	2395-B421		
D*i*S 400/250	0485-B20	56	28 (00011100)
D*i*S 800/250	0485-B40		
D*i*S 1200/250	0485-B50		
D*i*S 1000/1000-385	0499-B420		
D*i*S 1000/1000-385-B	2399-B420		
D*i*S 1000/200	0496-B300	64	32 (00100000)
D*i*S 1000/1000	0496-B320		
D*i*S 1000/200-B	2396-B300		
D*i*S 1000/1000-B	2396-B320		
D*i*S 1500/200	0486-B30	72	36 (00100100)
D*i*S 1500/100	0497-B300	88	44 (00101100)
D*i*S 2000/100	0497-B400		
D*i*S 2000/150	0497-B490		
D*i*S 2100/150	0487-B30		
D*i*S 3000/150	0487-B40		
D*i*S 5000/50	0488-B400	128	64 (01000000)

3.2.1.2 Parameter setting procedure 2 (pole position detection) (optional function)

To drive a DD motor, the optional pole detection function is required. This subsection describes the pole position detection function.

(1) Overview

The pole position detection function detects the pole position of a motor to be driven when the relationship between the pole position of the motor and the phase of the detector is unknown.

⚠ WARNING

1 If the correct pole position cannot be detected in some detection conditions, the motor can make an unpredictable movement. To avoid this dangerous situation, the following conditions must be satisfied until completion of detection:
<1> The torque limit parameter (parameter No. 2060) must be set to 150% of the continuous current or less.
<2> The setting of excessive error at stop time must be 100 μm or 0.1 deg or less. Moreover, the setting of excessive error at move time must be 120% of the logical positional deviation or less.
<3> While pole detection is in progress and a subsequent move operation is specified, the protection doors must be closed.
If these conditions are not satisfied and pole detection operation is not terminated normally, the motor can make an unpredictable movement with the maximum torque until the NC detects an excessive error alarm.
For safety, create the following sequence with the PMC by using the pole detection state signal:
<1> When the protection doors are open, pole detection is not started.
<2> If a protection door is opened during pole detection (Fn158 = 1), a reset is made.
<3> When pole detection is incomplete (Fn159 = 0), no command is issued to relevant axes.
<4> When pole detection is incomplete (Fn159 = 0), the brake for the vertical axis is not released. (For brake operation, monitor not only the SA signal but also the pole detection completion signal (Fn159).)
In general, this function cannot be applied to the following motors and conditions:
<1> Linear motor
<2> Axis for which the control axis detach function (detach function) is used (See Item (8) in this section.)
<3> When the joint rigidity between the motor and detector is low
<4> State where the axes are locked completely

2 After replacing the detector, set the AMR offset (parameter No. 2139) to 0 to perform pole detection again.

⚠ CAUTION

1 When each of two axes for which tandem control or feed axis synchronous control is made has a detector (encoder), perform pole detection one by one by setting 0 to the AMR offset (parameter No. 2139) for the axis for which no pole detection is made. For tandem control, turn off the servo alarm 2-axis simultaneous monitor function during detection (bit 0 of parameter No. 2007 is set to 0).

2 When using the motor feedback sharing function (No. 2018#7) under tandem control, perform pole detection one by one by setting the other axis to the servo-off state when performing pole detection for an axis.

3 For a detector to be applied, note the following:
   1) Use an absolute detector whenever possible.
   2) If the use of an incremental detector is unavoidable, an incremental detector with a one-rotation signal is recommended.

Detection method

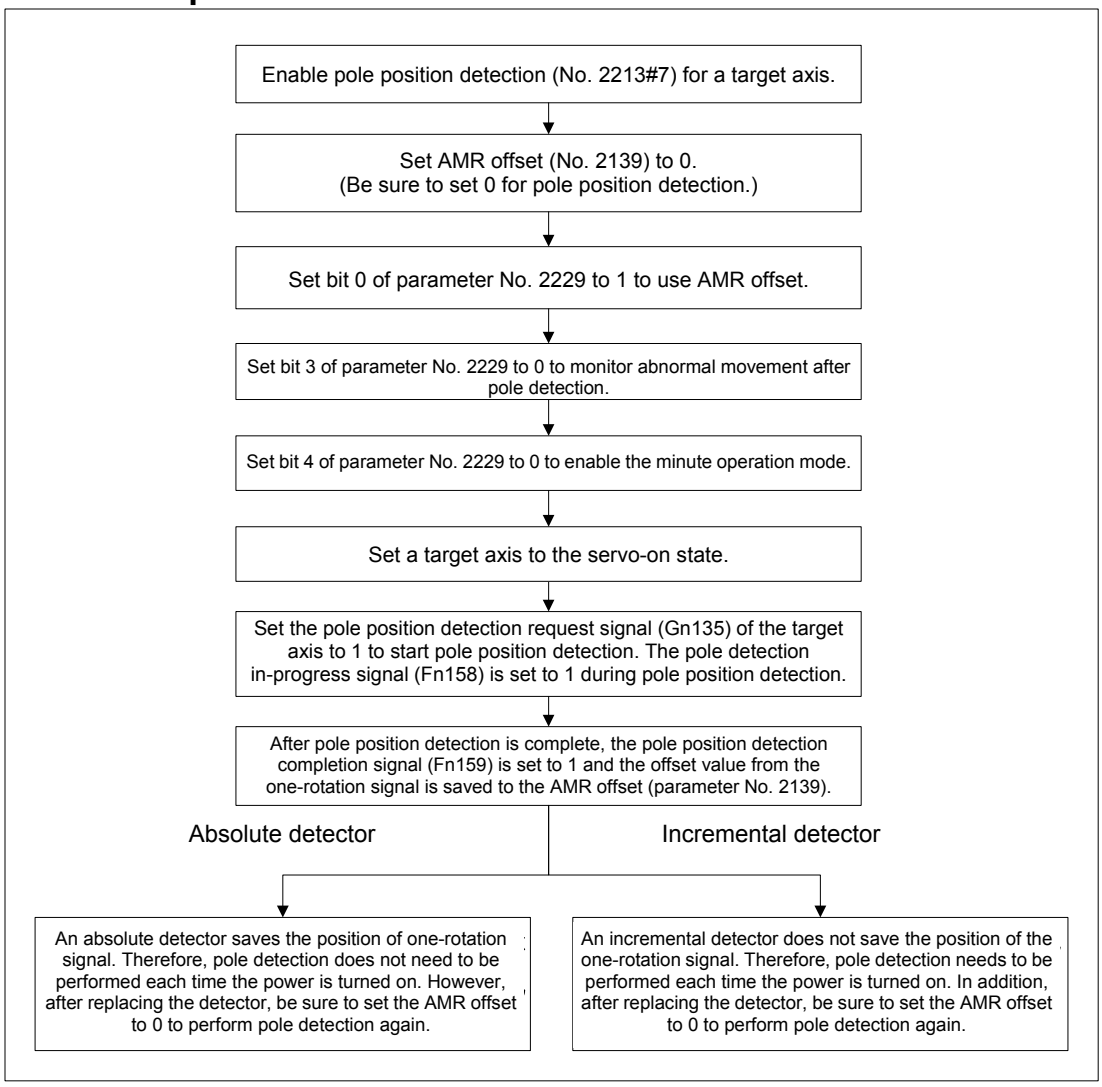
DC current method — This method detects the pole position by applying current at any two positions. The motor may rotate by an electric angle of up to 180 degrees during detection. The detection time is about 5 seconds. This method is used only for the detection during initial startup of the motor. (90G0/19.0, 90J0/1.0, 90K0/1.0, 90GP/02.0, 90JP/1.0, 90E1/13.0 and subsequent editions)

Minute operation method — This method detects the pole position by applying a continuous current multiple times. The motor may rotate by a mechanical angle of up to 5 degrees during detection. The detection time is about 2 seconds. This method is used for detection at times other than initial startup of the motor.

(2) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0	03.0 and subsequent editions	
	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	J(10) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	J(10) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	

(3) Pole detection procedure



Remarks

- Enable the parameter (No. 2213#7) for a target axis. Pole detection is performed only for an enabled axis. For a disabled axis, the pole detection request signal (Gn135) is ignored.
- Set the servo-on state. Note that releasing the brake before the pole detection completion signal (Fn159) is set to 1 causes the tool to drop vertically.
- Do not perform a pole detection operation in the servo-off state. Moreover, do not set the servo-off state during pole detection operation.
- When the pole detection request signal (Gn135) is set to 1, pole detection is started, and the pole detection in-progress signal (Fn158) is set to 1.
- Once a pole detection operation is started, the detection operation is continued even when the pole detection request signal is set to 0.
- Motor operation during pole detection is not under control of the CNC. During this period, the CNC performs a follow-up operation.
- If pole detection is terminated abnormally due to a mechanical cause, detection error alarm SV0454 is issued.
- Detection error alarm SV0454 cannot be released by a reset. Turn off the power then turn on the power again.
- When a reset is made during pole detection, the pole detection is stopped. To restart pole detection, set the pole detection request signal (Gn135) to 0 then set the same signal to 1 again.

- Once a pole detection operation is completed, no additional pole detection operation can be performed until the power is turned off except using the control axis detachment.
- Set bit 0 of parameter No. 2229 to 1. When pole detection is completed and the motor one-rotation signal is received, the result of detection is saved in parameter No. 2139. When an absolute detector is used, pole detection does not need to be performed each time the power is turned on.
- In the MDI, MEM, or EDIT mode, the result of detection is reflected on the screen immediately. In the REF or JOG mode, the result of detection is reflected on the screen when the reset key is pressed or the mode is switched to the MDI mode.
- To restart pole detection, temporarily set parameter No. 2139 to 0 and turn the power off and back on again.

NOTE
- When an absolute detector is used and the parameter (No. 2229#0) is set to 1, the pole detection completion signal (Fn159) is set to 1 immediately after power-on if the parameter (No. 2139) is not set to 0.
- Create logic for confirming the pole detection completion signal (Fn159) before specifying a move command immediately after power-on.
- If an alarm such as a count error alarm is issued for a detector fault, the pole detection completion signal (Fn159) is returned to 0. In this case, perform another pole detection operation.

(4) Parameters for pole position detection function

When this parameter has been modified, the power to the CNC must be turned off before operation is continued.

	#7	#6	#5	#4	#3	#2	#1	#0
2213	OCM							

OCM(#7) 0: The pole position detection function is disabled.
1: The pole position detection function is enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
2229				FORME	WATRA			ABSEN

ABSEN(#0) 0: AMR offset (No. 2139) is not used.
1: AMR offset (No. 2139) is used.
Set 1.
When an absolute detector is used, the result of detection is saved to the AMR offset (parameter No. 2139). Therefore, pole detection does not need to be performed when the power is turned on the second and subsequent times.
If an incremental detector is used, the result of detection is saved to the AMR offset (No. 2139) when the one-rotation signal is detected. In this case, pole detection needs to be performed each time the power is turned on. After the one-rotation signal is detected, however, the value saved to the AMR offset (No. 2139) is used, so that the influence of pole detection variation can be eliminated.

WATRA(#3) 0: After pole detection, an abnormal movement is monitored.
1: After pole detection, no abnormal movement is monitored.
If a detection error occurs, protection against an abnormal operation is provided. Operation is monitored until a command after detection is issued. If an abnormal operation is detected, detection error alarm SV0454 is issued.
Generally, set this bit to 0.

FORME(#4) 0: Automatic selection mode.
1: Minute operation mode
Set 1.

	#7	#6	#5	#4	#3	#2	#1	#0
2009			PDDDM					

PDDDM(#5) 0: Pole detection using the minute operation method
1: Pole detection using the DC current method
Set 1.
If the AMR offset (No. 2139) is set to 0, the position is detected using the DC current method. Also, the torque limit is reduced to the rated current (No. 2086) until the one rotation signal passes.
(90G0/19.0, 90J0/1.0, 90K0/1.0, 90GP/02.0, 90JP/1.0, 90E1/13.0 and subsequent editions)

> ⚠ **CAUTION**
> The motor may rotate by an electric angle of up to 180 degrees during detection.

2139	AMR offset

[Unit of data] Degrees
[Valid data range] 1~360
[Initial setting] 0
When bit 0 (ABSEN) of parameter No. 2229 is set to 1, the result of detection is saved to this parameter upon completion of detection.
Only when detection is performed again, manually set this parameter to 0 then turn the power off and back on again.

> ⚠ **WARNING**
> After pole determination, never rewrite the value of this parameter manually.

2182	Current A for pole detection

[Unit of data] 7282 is the maximum amplifier current value.
[Valid data range 0~7282
[Standard setting] 0
Set a current value for pole detection. If this parameter is set to 0, pole detection is performed according to the value of the rated current parameter (No. 2086). If the friction of the machine is large and the pole detection error alarm SV0454 is issued during detection, increase current A for pole detection. The maximum value of this parameter is limited by the torque limit (No. 2060).

2198	Number of repetitions

[Unit of data] Number
[Valid data range] -1~30
[Standard setting] 0
When the minute operation method is selected (bit 4 of parameter No. 2229 is set to 1 and bit 5 of parameter No. 2009 is set to 0), pole detection is repeated the set number of times plus 1, and the average value of the detection results is displayed in the AMR offset.
When the DC current method is selected (bit 4 of parameter No. 2229 is set to 1 and bit 5 of parameter No. 2009 is set to 1), pole detection is performed using the DC current method, regardless of whether the AMR offset (No. 2139) is 0 or not, if a negative value is set for this parameter.
(90G0/19.0, 90J0/1.0, 90K0/1.0, 90GP/02.0, 90JP/1.0, 90E1/13.0 and subsequent editions)

2199	Allowable electric angle

[Unit of data] deg (electric angle)

[Valid data range] 0~45

[Standard setting] 0 (10 degrees internally)

When the DC current method is selected (bit 4 of parameter No. 2229 is set to 1 and bit 5 of parameter No. 2009 is set to 1), this parameter sets the allowable range of detection accuracy. 0 internally means a range from -10 degrees to +10 degrees. If detection accuracy is outside of the allowable range, detection error alarm SV0454 is issued.

(90G0/19.0, 90J0/1.0, 90K0/1.0, 90GP/02.0, 90JP/1.0, 90E1/13.0 and subsequent editions)

2268	Allowable travel distance magnification (MFMPMD)

[Unit of data] % unit

[Valid data range] -1000~1000

[Standard setting] 0 (100% internally)

In the case of a positive value

Set the allowable travel distance for the minute operation method. The allowable travel distance is 100% at the mechanical angle of 5 degrees. If the allowable travel distance is exceeded, the detection current is automatically reduced. If the allowable travel distance is exceeded even when the detection current is reduced, detection error alarm SV0454 is issued. In that case, set this parameter to 100% or larger (200 or so).

In the case of a negative value

Change the velocity judgment level (detection sensitivity) for movement and stoppage in the minute operation method or DC current method. Set a value smaller than 100% (absolute value smaller than 100) to increase the detection sensitivity or 100% or larger (absolute value greater than or equal to 100) to decrease the detection sensitivity. If the velocity feedback noise is high, decrease the detection sensitivity (to -200 to -500). If the allowable travel distance is exceeded with large inertia and a detection error alarm is issued, increase the detection sensitivity (to -10 to -20).

(5) Signals for pole position detection function

Pole detection request signal RPREQ1~RPREQ8

[Classification] Input signal

[Function] Requests pole detection. This signal is available for each controlled axis, and the suffix at the end of each signal name indicates a controlled axis number.

[Operation] Pole detection is started by setting this signal to 1. Once a pole detection operation is started, the operation is continued even when this signal is set to 0.

Pole detection in-progress signal RPDET1~RPDET8

[Classification] Output signal

[Function] Posts that pole detection is being performed. This signal is available for each controlled axis, and the suffix at the end of each signal name indicates a controlled axis number.

[Output condition] This signal is set to 1 in the following case:

- When pole detection is being performed

This signal is set to 0 in one of the following cases:

- When pole detection is completed
- When pole detection is terminated abnormally
- When pole detection is stopped by a reset

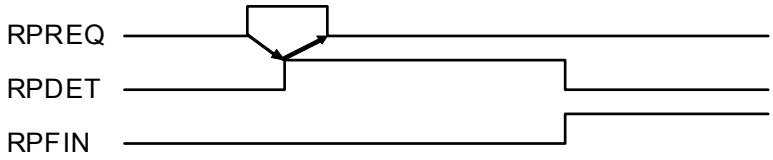
Pole detection completion signal
RPFIN1~RPFIN8

[Classification] Output signal

[Function] Posts that pole detection is completed. This signal is available for each controlled axis, and the suffix at the end of each signal name indicates a controlled axis number.

[Output condition] This signal is set to 1 in the following case:

- When pole detection is completed after pole detection is started by setting the pole detection request signal to 1



NOTE

1 If an absolute detector is used, this signal remains set to 1 even when the power is turned off then back on after completion of pole detection performed by setting the parameter (No. 2229#0) to 1. When the power is turned off then back on after setting the parameter (No. 2139) to 0, this signal is set to 0.

2 If an incremental detector is used, the pole detection completion signal is set to 0 when the power is turned off.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
Gn135	RPREQ8	RPREQ7	RPREQ6	RPREQ5	RPREQ4	RPREQ3	RPREQ2	RPREQ1

	#7	#6	#5	#4	#3	#2	#1	#0
Fn158	RPDET8	RPDET7	RPDET6	RPDET5	RPDET4	RPDET3	RPDET2	RPDET1
Fn159	RPFIN8	RPFIN7	RPFIN6	RPFIN5	RPFIN4	RPFIN3	RPFIN2	RPFIN1

(6) Detection error alarm

If detection error alarm SV0454 is issued, details of the cause of the alarm can be checked using diagnosis screen No. 352.
(90G0/19.0, 90J0/1.0, 90K0/1.0, 90GP/02.0, 90JP/1.0, 90E1/13.0 and subsequent editions)

Table 3.2.1.2 (a) Alarm detail numbers

Details No.	Cause of the alarm	Presumed cause
1	In the minute operation method, the velocity feedback does not fall below the stop judgment level.	The velocity feedback noise is high. Take anti-noise measures or decrease the detection sensitivity (negative value in No. 2268).
2	In the minute operation method, the motor rotates significantly even if the detection current is reduced.	Dynamic friction is small. Increase the detection sensitivity (negative value in No. 2268).
3	In the minute operation method, the velocity feedback does not exceed the judgment level even if the detection current is increased.	The motor is locked. If inertia is large, increase the detection sensitivity (negative value in No. 2268).
5	The polarity of torque does not match the direction of motor acceleration.	Improper power line connection
6	In the DC current method, the velocity feedback does not fall below the stop judgment level.	The velocity feedback noise is high. Take anti-noise measures or decrease the detection sensitivity (negative value in No. 2268).

Details No.	Cause of the alarm	Presumed cause
7	In the DC current method, the motor is rotating in the reverse direction.	Improper power line connection
8	In the DC current method, the travel amount of the motor is outside of the allowable range.	An invalid value is set as the number of poles or in some other parameter, the motor is locked, or friction is large.

(7) Action for trouble for pole position detection function

Table 3.2.1.2 (b) Action against trouble for pole detection

Symptom	State	Detection request (Gn135)	During detection (Fn158)	Detection completion (Fn159)	Cause	Action
[Before detection completion]						
Detection is not started.	The motor does not operate at all.	OFF	OFF	OFF	The pole detection request signal is turned off.	Turn on the pole detection request signal.
		ON	OFF	OFF	The pole position detection function is disabled.	Check bit 7 of No. 2213 or the option.
					Servo-off	Set the servo-on state.
Detection is not completed	The motor operates slightly, but detection is not completed and no alarm occurs.	ON	ON	OFF	The detector resolution is low: 100 million/rev or lower	Set the stop speed decision value (No. 2268) to a value from -200 to -500.
					Velocity feedback noise	Take action for noise protection.
					The friction is very small, so that activation causes a vibration to disable stop decision initiation.	Decrease detection current A (No. 2182) to find an optimal value.
	The motor does not operate at all, detection is not completed, and no alarm occurs.				The index table indexing function is enabled.	Disable the index table indexing function (set bit 0 of parameter No. 5501 to 1).
	During detection, an abnormally large motion is made and detection is not completed.				The resolution of the detector is too fine.	Set the stop speed decision value (No. 2268) to a value from -10 to -20.
Excessive error at stop time	During detection, the excessive error alarm at stop time is issued.	ON	ON → OFF	OFF	The friction is small.	Increase the setting of excessive error at stop time or set detection current A (No. 2182) to the rated current or lower.

Symptom	State	Detection request (Gn135)	During detection (Fn158)	Detection completion (Fn159)	Cause	Action
Detection error alarm (SV0454)	The pole detection error alarm is issued.	ON	ON → OFF	OFF	The friction is large.	Set detection current A (No. 2182) to the rated current or higher.
					The current gain is small.	Set a proper current gain.
[After detection completion]						
Vibration		—	OFF	ON	The phase order of the power line does not match the direction of the detector.	Change the phase order of the power line.
					The detector is not set correctly.	Set the detector correctly.
					The number of poles is not set correctly.	Set the number of poles correctly.
					The velocity gain is high.	Adjust the velocity gain to a proper value.
Excessive error at stop time or excessive error at move time	An unpredictable movement is made, or no movement is made in response to an issued command, so that an excessive error alarm is issued.	—	OFF	ON	The phase order of the power line does not match the direction of the detector.	Change the phase order of the power line.
					The detector is not set correctly.	Set the detector correctly.
					The number of poles is not set correctly.	Set the number of poles correctly.
					DD motor position detection circuit C with a referenced mark	Use the 90D0, 90E0/10 or later
The AMR offset does not change.	After detection completion, the result of detection is not written to the AMR offset.	—	OFF	ON	No.2229#0=0	Set bit 0 of No. 2229 to 1.
					The mode is not the MDI mode.	The display is updated in the MDI mode.
					Incremental detector, αiCZ sensor	The motor needs to make one or more revolutions.
Detection error alarm (SV0454)	After detection completion, the pole detection error alarm is issued.	—	OFF	ON → OFF	The velocity mode is used for operation.	Set bit 3 of parameter No. 2229 to 1 to avoid detection error.

Symptom	State	Detection request (Gn135)	During detection (Fn158)	Detection completion (Fn159)	Cause	Action
[After restart]						
No motion	The AMR offset is not 0, but no movement is made in response to an issued command.	—	—	—	Incremental detector	Pole detection needs to be performed each time a start-up operation is performed.
					Detector alarm	Pole detection needs to be performed again.
Detection result variation	The value of the AMR offset varies in each detection operation.	—	—	—	The friction is large.	Set detection current A (No. 2182) to the rated current or higher.
					The phase order of the power line does not match the direction of the detector.	Change the phase order of the power line.
					The detector is not set correctly.	Set the detector correctly.
					The number of poles is not set correctly.	Set the number of poles correctly.

(8) Detection of the pole detection request alarm

No torque occurs on an axis on which pole detection is not completed (servo-off state). For this reason, conventionally, the customer's ladder needs to monitor the pole detection completion signal (Fn159) to determine whether to release the brake of an axis or to specify a move command for an axis.

The servo control software and CNC software indicated below execute the following processing when pole detection is not completed [pole position detection function enabled (bit 7 of No. 2213=1) and the pole detection completion signal is off (Fn159=0)]:

1) The interlock state is set. Interlock is applied to each axis. "INTER/START LOCK ON" on the diagnosis screen No. 0000 displays 1.
2) The servo ready signal SA is turned off for all axes.
3) Alarm DS0650 is displayed (cleared by a reset).

Safety is thus ensured even if the user's ladder processing is not performed.

[Series and editions of applicable servo control software]

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0	03.0 and subsequent editions	
	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	M(13) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	M(13) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	

[Series and editions of applicable system software]

CNC	System software	
	Series	Edition
Series 30*i*-A	G00C,G01C,G02C	27 and subsequent editions
	G004,G014,G024	01 and subsequent editions
Series 31*i*-A5	G12C,G13C	27 and subsequent editions
	G124,G134	01 and subsequent editions
Series 31*i*-A	G103,G113	04 and subsequent editions
	G104,G114	01 and subsequent editions
Series 32*i*-A	G203	04 and subsequent editions
	G204	01 and subsequent editions
Series 0*i*-MD	D4F1	01 and subsequent editions
Series 0*i*-TD	D6F1	01 and subsequent editions
Series 0*i* Mate-MD	D5F1	01 and subsequent editions
Series 0*i* Mate-TD	D7F1	01 and subsequent editions

For the series 30*i*/31*i*/32*i*/35*i*-B, Power Motion *i*-A, and 0*i*-F Series, all series and editions support this function.

The alarm number and message are indicated below.

No.	Message	Description
DS0650	POLE DETECTION REQUEST	With an absolute detection axis (bit 5 of No. 1815=1), pole detection is not completed (Fn159=0). With a non-absolute detection axis (bit 5 of No. 1815=0), pole detection is completed once then the state is changed to the pole detection incomplete state (Fn159=0).

With the parameters below, the operation to be performed when pole detection is not completed can be changed.

	#7	#6	#5	#4	#3	#2	#1	#0
1809							PAO	SAN

[Input type] Parameter input
[Data type] Bit path

SAN (#0) When the pole position detection function is used, the pole position detection function is enabled (bit 7 of No. 2213=1), and pole detection is not completed (Fn159=0) with an axis, the servo ready signal SA <Fn000.6> of the path to which the axis belongs and the servo ready signals SA8 to SA1 <Fn186.7 to Fn186.0> for all axes that belong to the path are:

0: Not set to 0.
1: Set to 0.

> ⚠ **CAUTION**
> When applying pole position detection function to a gravity axis, basically release the brake after confirming pole detection completion (Fn159=1) and the servo ready signal. When releasing the brake by checking the servo ready signal alone for an avoidable reason, set this parameter to 1.

PAO(#1) When the pole position detection function is used, pole position detection function is enabled (bit 7 of No. 2213=1), and pole detection is not completed (Fn159=0) with an axis:

0: Alarm DS0650 (POLE DETECTION REQUEST) is issued.
1: Alarm DS0650 (POLE DETECTION REQUEST) is not issued.

NOTE

1 The issue condition of alarm DS0650 varies, depending on whether the axis in question is an absolute detection axis, as described below.
   - The alarm is issued with an absolute detection axis (bit 5 of No. 1815=1) when pole detection is not completed (Fn159=0).
   - The alarm is issued with a non-absolute detection axis (bit 5 of No. 1815=0) when pole detection is completed once then the state is changed to the pole detection incomplete state (Fn159=0).

2 If this alarm is issued, detect the pole position again. After a pole position is detected again, this alarm is cleared by a reset.

(9) Using the pole position detection function and control axis detach function (detach function) together

When the pole position detection function is used with an axis of a DD motor, motor switching using the control axis detach function is conventionally impossible. However, the servo control software and CNC software of the series and editions indicated below enable the pole position detection function and control axis detach function to be used at the same time.

[Series and editions of applicable servo control software]

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	M(13) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	M(13) and subsequent editions	HRV4
Series 0*i*-F	90M0 90M8	02.0 and subsequent editions 02.0 and subsequent editions	
Series 0*i*-D	90C5 90C8 90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions	

[Series and editions of applicable system software]

CNC	System software	
	Series	Edition
Series 30*i*-A	G00C,G01C,G02C	27 and subsequent editions
	G004,G014,G024	01 and subsequent editions
Series 31*i*-A5	G12C,G13C	27 and subsequent editions
	G124,G134	01 and subsequent editions
Series 31*i*-A	G103,G113	04 and subsequent editions
	G104,G114	01 and subsequent editions
Series 32*i*-A	G203	04 and subsequent editions
	G204	01 and subsequent editions
Series 0*i*-MD	D4F1	01 and subsequent editions
Series 0*i*-TD	D6F1	01 and subsequent editions

For the series 30*i*/31*i*/32*i*/35*i*-B, Power Motion *i*-A, and 0*i*-F Series, all series and editions support this function.

> ⚠ **CAUTION**
> 1 When switching is made by using the detach function among those motors that need the pole position detection function, the motors and detectors need to be of the same type.
> 2 The control axis detach function is supported only by a combination of the CNC software and servo control software indicated above. When CNC software and servo control software not listed above are used, the pole position detection function and control axis detach function cannot be used at the same time.

When the control axis detach function is used, the relationship of the Z phase of the detector with the pole position of the motor may vary. So, pole detection needs to be performed again or the AMR offset (No. 2139) needs to be rewritten to a proper value. To perform pole detection again and rewrite the AMR offset, however, the conventional specification requires that the power to the CNC be turned off then back on. With the servo control software and CNC software listed above, the power to the CNC need not be turned off then back on to perform pole detection again and rewrite the AMR offset.

When detaching a control axis to which pole detection is applied, use the procedure below.

- Start detaching a control axis (detach) with Gn124 or bit 7 of parameter No. 12.
  (Pole detection completion signal Fn159=0)
- Rewrite the AMR offset (No. 2139) to a proper value manually or by using G10(*1)
- Release the detachment of the control axis.
- Pole detection request alarm DS0650 is issued(*2).
- If an absolute detector is used and the AMR offset value is something other than 0, the alarm can be canceled by a reset to enable operation (pole detection completion signal Fn159=1).
- If an absolute detector is used and the AMR offset value is 0, the alarm can be canceled by a reset after executing pole detection to enable operation (pole detection completion signal Fn159=0 changed to Fn159=1 after pole detection completion).
- If an incremental detector is used, the alarm can be canceled after pole detection to enable operation (pole detection completion signal Fn159=0 changed to Fn159=1 after pole detection completion).

*1 : By setting bit 0 of No. 1809 to 1, the servo ready signal SA can be turned off when pole detection is not completed.
*2 : By setting bit 1 of No. 1809 to 1, alarm display can be disabled even when pole detection is not completed.

If the AMR offset is rewritten at a time other than during control axis detach operation, a power-off request is issued. When performing pole detection with an absolute detector after cancellation of control axis detach operation, set the AMR offset value to 0.

3.2.1.3 Parameter setting procedure 3 (OVC alarm parameters)

This subsection can be used to set parameters according to the cooling method used for synchronous built-in servo motors.
In the case of no cooling, the parameters are set by initialization according to Subsection 3.2.1.1, so that the parameters need not be modified.
In the case of liquid cooling only, modify the parameters according to Table 3.2.1 (a) and Table 3.2.1 (b).

2062	First OVC alarm parameter (POVC1)
2063	First OVC alarm parameter (POVC2)
2065	First OVC alarm parameter (POVCLMT)
2086	Current rating parameter (RTCURR)
2161	OVC magnification in stop state (OVCSTP)
2162	Second OVC alarm parameter (POVC21)
2163	Second OVC alarm parameter (POVC22)
2164	Second OVC alarm parameter (POVCLMT2)
2574	Third OVC alarm parameter (POVC31)
2576	Third OVC alarm parameter (POVC32)
2580	Third OVC alarm parameter (POVC33)

	#7	#6	#5	#4	#3	#2	#1	#0
2560				POVC3				

POVC(#4) The OVC for the rotor in the DD motor is:
0: Disabled.
1: Enabled.

> ⚠ **CAUTION**
> If the correct values corresponding to the cooling method are not set for the parameters above, the expected thermal protection cannot be provided. Use care.

Table 3.2.1.3 (a) Setting OVC and current rating parameters by cooling method [200-V driving]

Motor model		DiS 400/250		DiS 22/600		DiS 85/400		DiS 110/300		DiS 260/300	
Motor specification		0485-B20		0482-B10		0483-B20		0484-B10		0484-B30	
Cooling method		No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling
Continuous torque [Nm]		65	140	6	10	17	35	25	45	55	105
POVC1	No.2062	32743	32646	32689	32523	32683	32427	32682	32427	32682	32427
POVC2	No.2063	308	1528	988	3069	1069	4258	1069	4260	1069	4260
POVCLMT	No.2065	903	4290	2826	8170	3172	12689	3173	12694	3173	12694
RTCURR	No.2086	753	1641	1237	2104	1310	2621	1310	2621	1310	2621
OVCSTP	No.2161	120	120	0	0	0	0	0	0	0	0
POVC21	No.2162	0	0	0	0	0	0	0	0	0	0
POVC22	No.2163	0	0	0	0	0	0	0	0	0	0
POVCLMT2	No.2164	0	0	0	0	0	0	0	0	0	0

Motor model		DiS 260/600		DiS 370/300		DiS 800/250		DiS 1200/250		DiS 1500/200	
Motor specification		0484-B31		0484-B40		0485-B40		0485-B50		0486-B30	
Cooling method		No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling
Continuous torque [Nm]		55	105	75	150	160	320	240	480	300	600
POVC1	No.2062	32679	32360	32705	32518	32713	32529	32677	32352	32682	32427
POVC2	No.2063	1111	5100	782	3121	690	2989	1113	5196	1069	4259
POVCLMT	No.2065	1710	6848	2322	9287	1200	4801	1940	7743	3173	12692
RTCURR	No.2086	963	1926	1121	2242	868	1737	1028	2033	1310	2621
OVCSTP	No.2161	0	102	0	0	0	107	0	107	0	162
POVC21	No.2162	0	0	0	0	0	0	0	0	0	0
POVC22	No.2163	0	0	0	0	0	0	0	0	0	0
POVCLMT2	No.2164	0	0	0	0	0	0	0	0	0	0

Motor model		DiS 2100/150		DiS 3000/150		DiS 85/1000		DiS 110/1000		DiS 260/1000	
Motor specification		0487-B30		0487-B40		0483-B22		0484-B12		0484-B32	
Cooling method		No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling
Continuous torque [Nm]		375	750	500	1000	-	40	-	53	-	95
POVC1	No.2062	32682	32427	32682	32427	-	32346	-	32434	-	32580
POVC2	No.2063	1069	4259	1069	4259	-	5276	-	4174	-	2354
POVCLMT	No.2065	3173	12693	3173	12693	-	15735	-	12437	-	6423
RTCURR	No.2086	1310	2621	1310	2621	-	2919	-	2595	-	1865
OVCSTP	No.2161	0	162	0	162	-	0	-	0	-	0
POVC21	No.2162	0	0	0	0	-	0	-	0	-	0
POVC22	No.2163	0	0	0	0	-	0	-	0	-	0
POVCLMT2	No.2164	0	0	0	0	-	0	-	0	-	0

Motor model		DiS 22/1500		DiS 15/1000		DiS 60/400		DiS 70/300		DiS 150/300	
Motor specification		0482-B12		0492-B100		0493-B200		0494-B100		0494-B300	
Cooling method		No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling
Continuous torque [Nm]		-	9	8.7	16	24	65	35	75	73	170
POVC1	No.2062	-	32439	32675	32401	32675	32275	32684	32449	32714	32391
POVC2	No.2063	-	4109	1160	4589	1160	6169	1056	3986	679	4717
POVCLMT	No.2065	-	10559	3300	11603	1856	8321	2178	7432	1419	8580
RTCURR	No.2086	-	2576	1440	2700	845	2294	1005	2159	944	2201
OVCSTP	No.2161	-	0	0	125	0	127	0	120	0	120
POVC21	No.2162	-	0	0	32601	0	32581	0	32629	0	32599
POVC22	No.2163	-	0	0	2091	0	2337	0	1735	0	2118
POVCLMT2	No.2164	-	0	0	8308	0	5958	0	5321	0	6143

Motor model		DiS 200/300		DiS 250/250		DiS 500/250		DiS 1000/200		DiS 1500/100	
Motor specification		0494-B400		0495-B200		0495-B400		0496-B300		0497-B300	
Cooling method		No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling
Continuous torque [Nm]		98	240	120	225	210	520	470	840	750	1400
POVC1	No.2062	32721	32368	32707	32487	32723	32454 (32465)	32677	32344 (32465)	32682	32384 (32453)
POVC2	No.2063	590	5004	761	3513	567	3923 (3783)	1135	5300 (3782)	1078	4796 (3942)
POVCLMT	No.2065	1237	9014	2196	9212	1646	10144 (9830)	3231	13083 (9827)	3076	12041 (10187)
RTCURR	No.2086	881	2201	1175	2201	1062	2606 (2259)	1421	2606 (2259)	1390	2606 (2259)
OVCSTP	No.2161	0	123	0	110	0	110	0	110	0	112
POVC21	No.2162	0	32594	0	32623	0	32596 (32600)	0	32686 (32700)	0	32686 (32700)
POVC22	No.2163	0	2172	0	1813	0	2156 (2103)	0	1027 (852)	0	1024 (853)
POVCLMT2	No.2164	0	6454	0	6595	0	7263 (7038)	0	9367 (7036)	0	8621 (7294)

* When 2-axis amplifier αiSV80/160 or αiSV160/160 is used, set the values enclosed in parentheses.

Motor model		DiS 2000/100		DiS 2000/150		DiS 60/2000		DiS 70/1500		DiS 150/1500	
Motor specification		0497-B400		0497-B490		0493-B220		0494-B120		0494-B320	
Cooling method		No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling
Continuous torque [Nm]		940	2080	920	2200	-	60	-	70	-	170
POVC1	No.2062	32709	32366 (32465)	32707	32369	-	32517	-	32467	-	32438
POVC2	No.2063	740	5019 (3782)	763	4992	-	3235	-	3761	-	4128
POVCLMT	No.2065	2136	12508 (9827)	1739	9838	-	4529	-	5409	-	5864
RTCURR	No.2086	1176	2606 (2259)	1045	2492	-	2293	-	2506	-	2610
OVCSTP	No.2161	0	110	0	110	-	106	-	106	-	0
POVC21	No.2162	0	32713 (32705)	0	32705	-	32633	-	32678	-	32643
POVC22	No.2163	0	687 (789)	0	792	-	1683	-	1130	-	1558
POVCLMT2	No.2164	0	8955 (7036)	0	7044	-	1389	-	1024	-	515

* When 2-axis amplifier αiSV80/160 or αiSV160/160 is used, set the values enclosed in parentheses.

Motor model		DiS 500/1000		DiS 120/600		DiS 500/1200		DiS 1000/1000-385		DiS 1000/1000	
Motor specification		0495-B420		0493-B400		0495-B421		0499-B420		0496-B320	
Cooling method		No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling
Continuous torque [Nm]		-	450	-	118	-	550	-	1000	-	960
POVC1	No.2062	-	32567	-	32485	-	32423	-	32294	-	32464
POVC2	No.2063	-	2517	-	3533	-	4309	-	5920	-	3800
POVCLMT	No.2065	-	3427	-	5207	-	10998	-	9941	-	9867
RTCURR	No.2086	-	1995	-	2236	-	3249	-	3089	-	3115
OVCSTP	No.2161	-	0	-	117	-	122	-	115	-	115
POVC21	No.2162	-	32630	-	32713	-	32659	-	32686	-	32674
POVC22	No.2163	-	1719	-	687	-	1362	-	1025	-	1175
POVCLMT2	No.2164	-	323	-	6001	-	588	-	284	-	343

Motor model		DiS15/1000-B		DiS60/400-B		DiS60/2000-B		DiS70/300-B		DiS70/1500-B	
Motor specification		2392-B100		2393-B200		2393-B220		2394-B100		2394-B120	
Cooling method		No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling
Continuous torque [Nm]		8.7	16	24	65	-	60	35	75	-	70
POVC1	No.2062	32675	32401	32675	32275	-	32517	32684	32449	-	32467
POVC2	No.2063	1160	4589	1160	6169	-	3235	1056	3986	-	3761
POVCLMT	No.2065	3300	11603	1856	8321	-	4529	2178	7432	-	5409
RTCURR	No.2086	1440	2700	845	2294	-	2293	1005	2159	-	2506
OVCSTP	No.2161	0	125	0	127	-	106	0	120	-	106
POVC21	No.2162	0	32601	0	32581	-	32633	0	32629	-	32678
POVC22	No.2163	0	2091	0	2337	-	1683	0	1735	-	1130
POVCLMT2	No.2164	0	8308	0	5958	-	1389	0	5321	-	1024

Motor model		DiS150/300-B			DiS 500/250-B			DiS 1000/200-B		
Motor specification		2394-B300			2395-B400			A06B-2393-B300		
Cooling method		No cooling	Oil cooling	Water cooling	No cooling	Oil cooling	Water cooling	No cooling	Oil cooling	Oil cooling
Continuous torque [Nm]		73	170	185	210	550	550	470	840	840
POVC1	No.2062	32714	32391	32389	32723	32454	32463	32677	32344	32344
POVC2	No.2063	679	4717	4738	567	3923	3808	1135	5300	5300
POVCLMT	No.2065	1419	8580	8611	1646	10144	9885	3231	13083	13083
RTCURR	No.2086	944	2201	2433	1062	2606	2606	1421	2606	2606
OVCSTP	No.2161	0	120	120	0	110	110	0	110	110
POVC21	No.2162	0	32599	32598	0	32596	32559	0	32686	32686
POVC22	No.2163	0	2118	2122	0	2156	2112	0	1027	1027
POVCLMT2	No.2164	0	6143	6165	0	7263	7077	0	9367	9367

Motor model		DiS150/1500-B			DiS 500/1200-B			DiS 1000/1000-385-B		
Motor specification		2394-B320			2395-B421			2399-B420		
Cooling method		No cooling	Oil cooling	Water cooling	No cooling	Oil cooling	Water cooling	No cooling	Oil cooling	Oil cooling
Continuous torque [Nm]		-	170	170	-	550	550	-	1000	1000
POVC1	No.2062	-	32438	32355	-	32423	32423	-	32294	32187
POVC2	No.2063	-	4128	5158	-	4309	4309	-	5920	7262
POVCLMT	No.2065	-	5864	7077	-	10998	10998	-	9941	11667
RTCURR	No.2086	-	2610	2610	-	3249	3249	-	3089	3346
OVCSTP	No.2161	-	0	105	-	122	122	-	115	125
POVC21	No.2162	-	32643	32659	-	32659	32659	-	32686	32659
POVC22	No.2163	-	1558	1362	-	1362	1362	-	1025	1362
POVCLMT2	No.2164	-	515	681	-	588	588	-	284	235
POVC31	No.2574	-	0	1800	-	0	0	-	0	1200
POVC32	No.2576	-	0	-1000	-	0	0	-	0	-5627
POVC33	No.2580	-	0	2039	-	0	0	-	0	1752
POVC3	No.2560#4	-	0	1	-	0	0	-	0	1

Motor model		DiS 1000/1000-B		
Motor specification		2396-B320		
Cooling method		No cooling	Oil cooling	Water cooling
Continuous torque [Nm]		-	960	1020
POVC1	No.2062	-	32464	32232
POVC2	No.2063	-	3800	6698
POVCLMT	No.2065	-	9867	10960
RTCURR	No.2086	-	3115	3269
OVCSTP	No.2161	-	115	121
POVC21	No.2162	-	32674	32659
POVC22	No.2163	-	1175	1362
POVCLMT2	No.2164	-	343	331
POVC31	No.2574	-	0	1175
POVC32	No.2576	-	0	-4858
POVC33	No.2580	-	0	1900
POVC3	No.2560#4	-	0	1

Table 3.2.1.3 (b) Setting OVC and current rating parameters by cooling method [400-V driving]

Motor model		DiS 400/250		DiS 22/600		DiS 85/400		DiS 110/300		DiS 260/300	
Motor specification		0485-B20		0482-B10		0483-B20		0484-B10		0484-B30	
Cooling method		No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling
Continuous torque [Nm]		65	140	6	10	17	35	25	45	55	105
POVC1	No.2062	32743	32646	32689	32523	32683	32427	32682	32427	32682	32427
POVC2	No.2063	308	1528	988	3069	1069	4258	1069	4260	1069	4260
POVCLMT	No.2065	903	4290	2826	8170	3172	12689	3173	12694	3173	12694
RTCURR	No.2086	753	1641	1237	2104	1310	2621	1310	2621	1310	2621
OVCSTP	No.2161	120	120	0	0	0	0	0	0	0	0
POVC21	No.2162	0	0	0	0	0	0	0	0	0	0
POVC22	No.2163	0	0	0	0	0	0	0	0	0	0
POVCLMT2	No.2164	0	0	0	0	0	0	0	0	0	0

Motor model		DiS 260/600		DiS 370/300		DiS 800/250		DiS 1200/250		DiS 1500/200	
Motor specification		0484-B31		0484-B40		0485-B40		0485-B50		0486-B30	
Cooling method		No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling
Continuous torque [Nm]		55	105	75	150	160	320	240	480	300	600
POVC1	No.2062	32679	32360	32705	32518	32713	32529	32678	32352	32700	32498
POVC2	No.2063	1111	5095	782	3121	690	2989	1130	5196	845	3369
POVCLMT	No.2065	1351	5406	2322	9287	948	3793	1529	6118	2507	10029
RTCURR	No.2086	856	1712	1121	2242	772	1544	914	1807	1165	2330
OVCSTP	No.2161	0	0	0	0	0	0	0	0	0	109
POVC21	No.2162	0	0	0	0	0	0	0	0	0	0
POVC22	No.2163	0	0	0	0	0	0	0	0	0	0
POVCLMT2	No.2164	0	0	0	0	0	0	0	0	0	0

Motor model		DiS 2100/150		DiS 3000/150		DiS 15/1000		DiS 60/400		DiS 70/300	
Motor specification		0487-B30		0487-B40		0492-B100		0493-B200		0494-B100	
Cooling method		No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling
Continuous torque [Nm]		420	840	600	1200	8.7	15	24	60	35	73
POVC1	No.2062	32682	32427	32682	32427	32675	32401	32675	32275	32684	32449
POVC2	No.2063	1069	4259	1069	4259	1160	4589	1160	6169	1056	3986
POVCLMT	No.2065	3173	12693	3173	12693	3300	11603	1856	8321	2178	7432
RTCURR	No.2086	1310	2621	1310	2621	1440	2595	845	2108	1005	2108
OVCSTP	No.2161	0	122	0	122	0	125	0	127	0	120
POVC21	No.2162	0	0	0	0	0	32601	0	32581	0	32629
POVC22	No.2163	0	0	0	0	0	2091	0	2337	0	1735
POVCLMT2	No.2164	0	0	0	0	0	8308	0	5958	0	5321

Motor model		DiS 150/300		DiS 200/300		DiS 250/250		DiS 500/250		DiS 1000/200	
Motor specification		0494-B300		0494-B400		0495-B200		0495-B400		0496-B300	
Cooling method		No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling
Continuous torque [Nm]		73	160	98	230	120	215	210	520	470	1000
POVC1	No.2062	32714	32391	32721	32368	32707	32487	32723	32454	32677	32286
POVC2	No.2063	679	4717	590	5004	761	3513	567	3923	1135	6024
POVCLMT	No.2065	1419	8580	1237	9014	2196	9212	1301	8015	2553	11469
RTCURR	No.2086	944	2108	881	2108	1175	2109	944	2317	1266	2760
OVCSTP	No.2161	0	120	0	123	0	110	0	110	0	110
POVC21	No.2162	0	32599	0	32594	0	32623	0	32596	0	32686
POVC22	No.2163	0	2118	0	2172	0	1813	0	2156	0	1029
POVCLMT2	No.2164	0	6143	0	6454	0	6595	0	5738	0	8212

Motor model		DiS 1500/100		DiS 2000/100		DiS 2000/150		DiS 5000/50		DiS 200/150	
Motor specification		0497-B300		0497-B400		0497-B490		0488-B400		0494-B450	
Cooling method		No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling
Continuous torque [Nm]		750	1500	940	2200	920	2200	2000	4500	98	260
POVC1	No.2062	32682	32384	32709	32366	32707	32369	32731	32559	32721	32368
POVC2	No.2063	1078	4796	740	5019	763	4992	459	2617	590	5004
POVCLMT	No.2065	2430	9514	1688	9883	1739	9838	1337	7076	1237	9014
RTCURR	No.2086	1235	2445	1045	2497	1045	2492	916	2097	880	2386
OVCSTP	No.2161	0	112	0	110	0	110	0	110	0	123
POVC21	No.2162	0	32686	0	32713	0	32705	0	32722	0	32594
POVC22	No.2163	0	1024	0	687	0	792	0	569	0	2172
POVCLMT2	No.2164	0	6812	0	7076	0	7044	0	5066	0	6454

Motor model		DiS 60/2000		DiS 70/1500		DiS 150/1500		DiS 500/1000	
Motor specification		0493-B220		0494-B120		0494-B320		0495-B420	
Cooling method		No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling
Continuous torque [Nm]		-	60	-	70	-	170	-	450
POVC1	No.2062	-	32517	-	32467	-	32438	-	32567
POVC2	No.2063	-	3235	-	3761	-	4128	-	2517
POVCLMT	No.2065	-	4529	-	5409	-	4633	-	3427
RTCURR	No.2086	-	2293	-	2506	-	2320	-	1995
OVCSTP	No.2161	-	106	-	106	-	0	-	0
POVC21	No.2162	-	32633	-	32678	-	32643	-	32630
POVC22	No.2163	-	1683	-	1130	-	1558	-	1719
POVCLMT2	No.2164	-	1389	-	455	-	181	-	116

Motor model		DiS 120/600		DiS 500/1200		DiS 1000/1000-385		DiS 1000/1000		DiS 5000/500	
Motor specification		0493-B400		0495-B421		0499-B420		0496-B320		0488-B430	
Cooling method		No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling	No cooling	Liquid cooling
Continuous torque [Nm]		-	118	-	550	-	1000	-	1000	-	4500
POVC1	No.2062	-	32485	-	32423	-	32294	-	32464	-	32561
POVC2	No.2063	-	3533	-	4309	-	5920	-	3800	-	2583
POVCLMT	No.2065	-	5207	-	10998	-	9941	-	9867	-	6993
RTCURR	No.2086	-	2236	-	3249	-	3089	-	3115	-	2591
OVCSTP	No.2161	-	117	-	122	-	115	-	115	-	119
POVC21	No.2162	-	32713	-	32659	-	32686	-	32674	-	32674
POVC22	No.2163	-	687	-	1362	-	1025	-	1175	-	1175
POVCLMT2	No.2164	-	5669	-	588	-	284	-	343	-	224

Motor model		DiS 500/150	
Motor specification		0495-B450	
Cooling method		**No cooling**	**Liquid cooling**
Continuous torque [Nm]		210	550
	No.2013	00001000	00000100
	No.2014	00101000	00100100
TCMD LIMIT	No.2060	6099	7082
POVC1	No.2062	32705	32559
POVC2	No.2063	791	2617
POVCLMT	No.2065	1599	7077
RTCURR	No.2086	1048	2606
OVCSTP	No.2161	0	4683
POVC21	No.2162	0	105
POVC22	No.2163	0	0
POVCLMT2	No.2164	0	0

Motor model		DiS 15/1000-B		DiS 60/400-B		DiS 60/2000-B		DiS 70/300-B		DiS 70/1500-B	
Motor specification		2392-B100		2393-B200		2393-B220		2394-B100		2394-B120	
Cooling method		**No cooling**	**Liquid cooling**	**No cooling**	**Liquid cooling**	**No cooling**	**Liquid cooling**	**No cooling**	**Liquid cooling**	**No cooling**	**Liquid cooling**
Continuous torque [Nm]		8.7	15	24	60	-	60	35	73	-	70
POVC1	No.2062	32675	32401	32675	32275	-	32517	32684	32449	-	32467
POVC2	No.2063	1160	4589	1160	6169	-	3235	1056	3986	-	3761
POVCLMT	No.2065	3300	11603	1856	8321	-	4529	2178	7432	-	5409
RTCURR	No.2086	1440	2595	845	2108	-	2293	1005	2108	-	2506
OVCSTP	No.2161	0	125	0	127	-	106	0	120	-	106
POVC21	No.2162	0	32601	0	32581	-	32633	0	32629	-	32678
POVC22	No.2163	0	2091	0	2337	-	1683	0	1735	-	1130
POVCLMT2	No.2164	0	8308	0	5958	-	1389	0	5321	-	455

Motor model		DiS 500/1200-B		DiS 1000/200-B	
Motor specification		2395-B421		2396-B300	
Cooling method		**No cooling**	**Liquid cooling**	**No cooling**	**Liquid cooling**
Continuous torque [Nm]		-	550	470	1000
POVC1	No.2062	-	32423	32677	32286
POVC2	No.2063	-	4309	1135	6024
POVCLMT	No.2065	-	10998	2553	11469
RTCURR	No.2086	-	3249	1266	2760
OVCSTP	No.2161	-	122	0	110
POVC21	No.2162	-	32659	0	32686
POVC22	No.2163	-	1362	0	1029
POVCLMT2	No.2164	-	588	0	8212

Motor model		DiS 150/300-B			DiS 500/250-B			DiS 500/150-B		
Motor specification		2394-B300			2395-B400			2395-B450		
Cooling method		No cooling	Oil cooling	Water cooling	No cooling	Oil cooling	Water cooling	No cooling	Oil cooling	Oil cooling
Continuous torque [Nm]		73	160	185	210	550	610	210	550	550
POVC1	No.2062	32714	32391	32389	32723	32454	32367	32705	32559	32463
POVC2	No.2063	679	4717	4738	567	3923	5015	791	2617	3808
POVCLMT	No.2065	1419	8580	8611	1301	8015	9875	1599	7077	9885
RTCURR	No.2086	944	2108	2433	944	2317	2605	1048	2606	2606
OVCSTP	No.2161	0	120	120	0	110	110	0	105	105
POVC21	No.2162	0	32599	32598	0	32596	32567	0	0	32553
POVC22	No.2163	0	2118	2122	0	2156	2516	0	0	2693
POVCLMT2	No.2164	0	6143	6165	0	5738	7070	0	0	7077

Motor model		DiS150/1500-B			DiS 1000/1000-385-B			DiS 1000/1000-B		
Motor specification		2394-B320			2399-B420			2396-B320		
Cooling method		No cooling	Oil cooling	Water cooling	No cooling	Oil cooling	Water cooling	No cooling	Oil cooling	Oil cooling
Continuous torque [Nm]		-	170	185	-	1000	1090	-	960	1020
POVC1	No.2062	-	32438	32240	-	32294	32187	-	32464	32232
POVC2	No.2063	-	4128	6605	-	5920	7262	-	3800	6698
POVCLMT	No.2065	-	4633	6824	-	9941	11667	-	9867	10960
RTCURR	No.2086	-	2320	2440	-	3089	3346	-	3115	3269
OVCSTP	No.2161	-	0	116	-	115	125	-	115	121
POVC21	No.2162	-	32643	32659	-	32686	32659	-	32674	32659
POVC22	No.2163	-	1558	1362	-	1025	1362	-	1175	1362
POVCLMT2	No.2164	-	181	538	-	284	235	-	343	331
POVC31	No.2574	-	0	1800	-	0	1200	-	0	1175
POVC32	No.2576	-	0	-1000	-	0	-5627	-	0	-4858
POVC33	No.2580	-	0	1812	-	0	1752	-	0	1900
POVC3	No.2560#4	-	0	1	-	0	1	-	0	1

3.2.2 Smoothing Compensation for DD Motor

(1) Overview

Smoothing compensation is a function to improve the feed smoothness of a DD motor by applying a sine wave compensation torque per pole pair to the torque command. Compensation torque can be generated for each motor by setting gain and phase for each component. The value to be set for a parameter for compensation is automatically calculated using SERVO GUIDE.

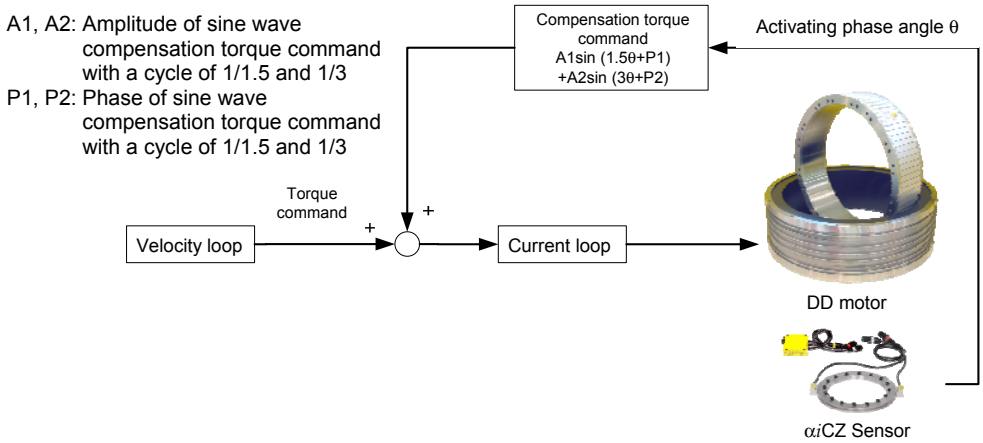


Fig. 3.2.2 (a) Diagram showing smoothing compensation

NOTE

This function is supported only in the configurations described below (as of February 2019).

[Smoothing compensation for D*i*S motor]

- Encoder that uses 8,000,000 pulses/rev. or less for parameter setting
  Example) αiCZ512A or αiCZ1024A and RCN223F or RCN727F manufactured by HEIDENHAIN
- Analog encoder (binary type, non-binary type) and DD motor position detection circuit

[Smoothing compensation for D*i*S-B motors]

- Binary type rotary encoder
  Example) αiCZ512A, αiCZ1024A
- Third-party rotary encoder that supports the FANUC serial interface (such as the RCN manufactured by HEIDENHAIN)
- Analog encoder (binary type) and DD motor position detection circuit

(2) Applicable series and editions of software

(2.1) Smoothing compensation for D*i*S motor

[Applicable series and editions of servo software]

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	L(12) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	L(12) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	

[Applicable series and editions of SERVO GUIDE]
3.20 and subsequent editions

(2.2) Smoothing compensation for D*i*S-B motors

[Applicable series and editions of servo software]

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90J0 90JP	15.0 and subsequent editions 07.0 and subsequent editions	
Series 0*i*-F	90M0, 90M8	08.0 and subsequent editions	

[Applicable series and editions of SERVO GUIDE]
10.70 and subsequent editions

(3) Setting parameters

(3.1) Smoothing compensation for D*i*S motor

	#7	#6	#5	#4	#3	#2	#1	#0
2300						DD		

DD(#2) DD motor control is:
0: Disabled.
1: Enabled. (Smoothing compensation for D*i*S motor is also enabled.)

The following parameters can be automatically adjusted using SERVO GUIDE. For how to adjust them, see the next section.

Setting of the smoothing compensation in the positive direction

2377	Smoothing compensation performed 1.5 times per pole pair
2380	Smoothing compensation performed three times per pole pair

Setting of the smoothing compensation in the negative direction

If the correction gain of the following parameters is set to a non-zero value, it is possible to set a value in the negative direction that is different from the value in the positive direction. To set the same value between the negative direction and the positive direction, set the correction gain of the following parameters to 0.

2378	Smoothing compensation performed 1.5 times per pole pair (negative direction)
2381	Smoothing compensation performed three times per pole pair (negative direction)

Correction gain (high-order 8 bits) Correction phase (low-order 8 bits)

[Valid data range] Correction gain (high-order 8 bits): 0 to 255 (Unit: Torque command)
Correction phase (low-order 8 bits): 0 to 255 (Unit: 360°/256)

The optimal value varies from one motor to another. So, compensation parameters need to be determined for each assembled motor. A torque command variation generated when the motor is fed at low speed is dependent on the position. The application of smoothing compensation cancels this position-dependent characteristic, allowing the motor to move smoothly.

(3.2) Smoothing compensation for D*i*S-B motors

Use smoothing compensation for D*i*S-B motors for the motors shown in the following table.

Standard model

Model name	Specification number of the order	Remarks
D*i*S 80/400HV-B	A06B-2323-B111	-
D*i*S 180/800-B	A06B-2323-B330	-
D*i*S 300/300-B	A06B-2331-B230	-
D*i*S 300/300HV-B	A06B-2331-B221	-
D*i*S 600/600-B	A06B-2331-B440	-

High-speed model

Model name	Specification number of the order	Remarks
D*i*S 80/3000-B	A06B-2323-B140	Liquid cooling, for HRV3 only
D*i*S 180/3000HV-B	A06B-2323-B341	Liquid cooling, for HRV3 only
D*i*S 600/1500-B	A06B-2331-B450	Liquid cooling, for HRV3 only

Enable the following function bits.

	#7	#6	#5	#4	#3	#2	#1	#0
2563			DDRBSM					

DDRBSM (#5)Smoothing compensation for D*i*S-B motors
0: Disabled.
1: Enabled.

NOTE

Use smoothing compensation for D*i*S motors for the D*i*S-B motors shown in the following table as for the D*i*S motor. To use smoothing compensation for D*i*S motors, set bit 5 of parameter No. 2563 to 0.

Model name	Specification number of the order
D*i*S 15/1000-B	A06B-2392-B100
D*i*S 60/400-B	A06B-2393-B200
D*i*S 70/300-B	A06B-2394-B100
D*i*S 150/300-B	A06B-2394-B300
D*i*S 500/150-B	A06B-2395-B450
D*i*S 500/250-B	A06B-2395-B400
D*i*S 1000/200-B	A06B-2396-B300
D*i*S 60/2000-B	A06B-2393-B220
D*i*S 70/1500-B	A06B-2394-B120
D*i*S 150/1500-B	A06B-2394-B320
D*i*S 500/1200-B	A06B-2395-B421
D*i*S 1000/1000-385-B	A06B-2399-B420
D*i*S 1000/1000-B	A06B-2396-B320

2584	Number of times smoothing compensation for DiS-B is performed per motor revolution

Set a value suitable for the model of the motor used according to the following table.

Standard model

Model name	Value to be set for parameter No. 2584
D*i*S 80/400HV-B	24
D*i*S 180/800-B	24
D*i*S 300/300-B	36
D*i*S 300/300HV-B	36
D*i*S 600/600-B	36

High-speed model

Model name	Value to be set for parameter No. 2584
D*i*S 80/3000-B	24
D*i*S 180/3000HV-B	24
D*i*S 600/1500-B	36
D*i*S 80/3000-B	24
D*i*S 180/3000HV-B	24

The following parameters can be automatically adjusted using SERVO GUIDE. For how to adjust them, see the next section.
The following parameters are shared with smoothing compensation for linear motors. When bit 5 of parameter No. 2563 is set to 1, smoothing compensation for D*i*S-B is enabled.

No.2130	Smoothing compensation for DiS-B (x1)

No.2131	Smoothing compensation for DiS-B (x2)

No.2132	Smoothing compensation for DiS-B (x3)

Setting of the smoothing compensation in the negative direction

If the correction gain of the following parameters is set to a non-zero value, it is possible to set a value in the negative direction that is different from the value in the positive direction. To set the same value between the negative direction and the positive direction, set the correction gain of the following parameters to 0.

No.2369	Smoothing compensation for DiS-B (x1) (negative direction)

No.2370	Smoothing compensation for DiS-B (x2) (negative direction)

No.2371	Smoothing compensation for DiS-B (x3) (negative direction)

Correction gain (high-order 8 bits) Correction phase (low-order 8 bits)

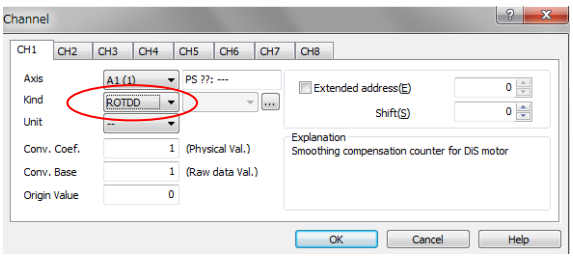
[Valid data range] Correction gain (high-order 8 bits): 0 to 255 (Unit: Torque command)
Correction phase (low-order 8 bits): 0 to 255 (Unit: 360°/256)

The optimal value varies from one motor to another. So, compensation parameters need to be determined for each assembled motor. A torque command variation generated when the motor is fed at low speed is dependent on the position. The application of smoothing compensation cancels this position-dependent characteristic, allowing the motor to move smoothly.

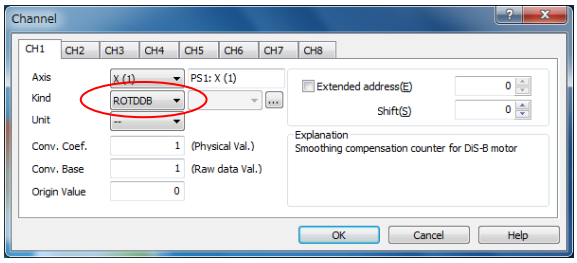
By using SERVO GUIDE, these parameters can be determined easily. Follow the procedure below to measure the activating phase and torque command, which are required to determine the compensation parameters.

(4) Tuning procedure using SERVO GUIDE

(1) Set channels.
Channel 1: Counter for smoothing compensation for D*i*S or D*i*S-B motors
Select the target axis for measurement, and set "ROTDD" (smoothing compensation for D*i*S motors) or "ROTDDB" (smoothing compensation for D*i*S-B motors) as the data type.



ROTDD (smoothing compensation for D*i*S motors)



ROTDDB (smoothing compensation for D*i*S-B motors)

Fig. 3.2.2 (b) Selection of counter for smoothing compensation

Channel 2: Torque command
Select the target axis for measurement, and set "TCMD" as the data type.
As the conversion coefficient, set the maximum current of the amplifier used for the target axis.

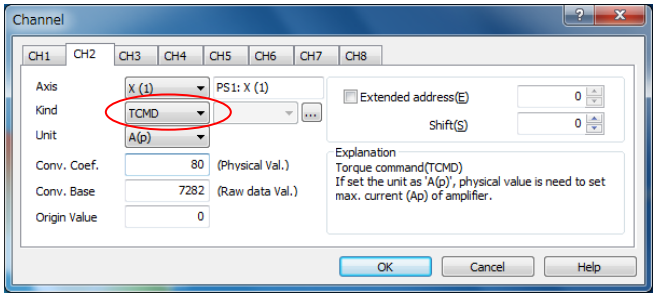


Fig. 3.2.2 (c) Selection of torque command

(2) With this setting, make bidirectional movements by about ± (1440/setting value of parameter No. 2584) deg at about F (10800/setting value of parameter No. 2584) deg/min for data measurement. At the time of data measurement, ensure that all the following smoothing compensation values are set to 0.

Smoothing compensation for D*i*S motor :No.2377, No.2378, No.2380, No.2381
Smoothing compensation for linear or D*i*S-B motors : No.2130, No.2131, No.2132, No.2369, No.2370, No.2371

When making measurements, lower the velocity gain to such an extent that hunting does not occur.

(3) From the "Tools" menu, select "Smoothness compensation".

(4) Pressing the [ADD] button on the displayed dialog box analyzes waveform data and registers compensation parameter candidates.

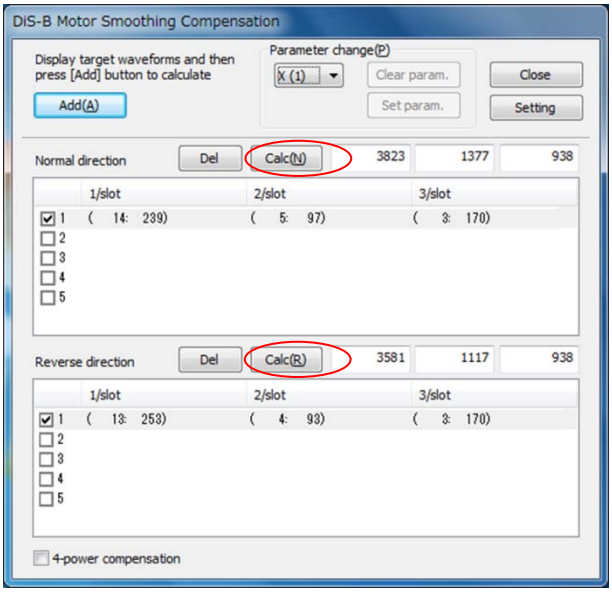


Fig. 3.2.2 (d) Compensation parameter calculation screen

(5) The compensation parameters slightly vary depending on the measurement conditions. So, repeatedly take data measurements and press the [Add] button several times in a similar manner while keeping the dialog box open. (Up to five candidates can be registered.)
If the displayed values include an extremely different value, uncheck the corresponding check box on the leftmost side of the list so that the value is not taken into account in the final compensation calculation.

(6) Finally, press the [Calc] button for each of the forward and backward directions. Then, smoothing compensation parameters are displayed.

(7) By pressing the [Set param] button, the smoothing compensation parameters are set to the CNC.

(8) Measure TCMD again to confirm the effect of smoothing compensation.

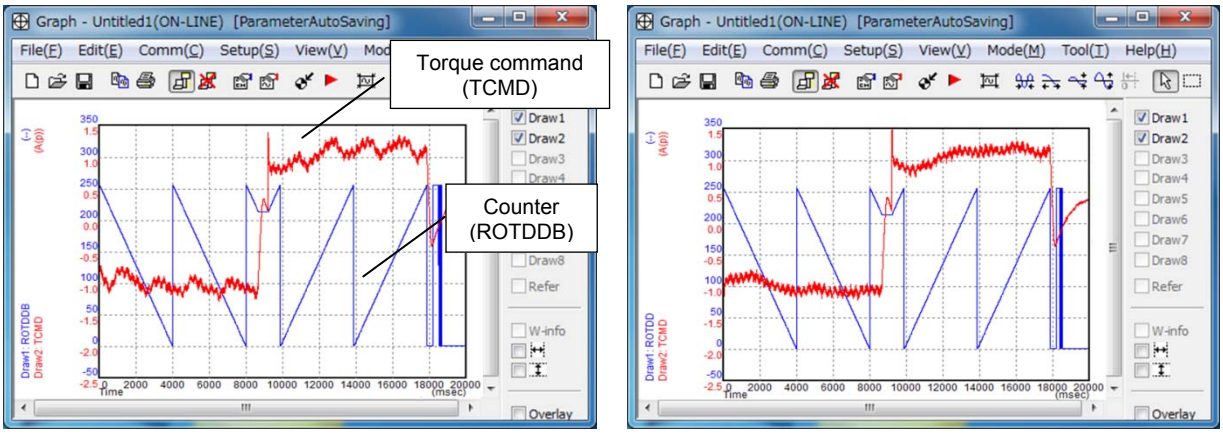


Fig. 3.2.2 (e) Confirming the effect of smoothing compensation (before compensation (left) and after compensation (right))

3.3 DETECTION OF AN OVERHEAT ALARM BY SERVO CONTROL SOFTWARE WHEN A LINEAR MOTOR AND A DD MOTOR ARE USED

(1) Overview

When a linear motor or DD motor is used, the overheat signal (thermostat signal) of the motor can be connected in one of three ways:

Configuration 1: Connected to the PMC signal
Configuration 2: Connected to the α*i*CZ detection circuit (A860-2162-T***)
Connected to the linear motor or the DD motor position detection circuit (A860-2033-T***)
Configuration 3: Connected to the temperature detection circuit (A860-2091-T301)

For details on the hardware components, refer to the following specifications.
FANUC SYNCHRONOUS BUILT-IN SERVO MOTOR D*i*S series DESCRIPTIONS (B-65332EN)
FANUC LINEAR MOTOR L*i*S series DESCRIPTIONS (B-65382EN)

This section describes these methods of connection and settings.

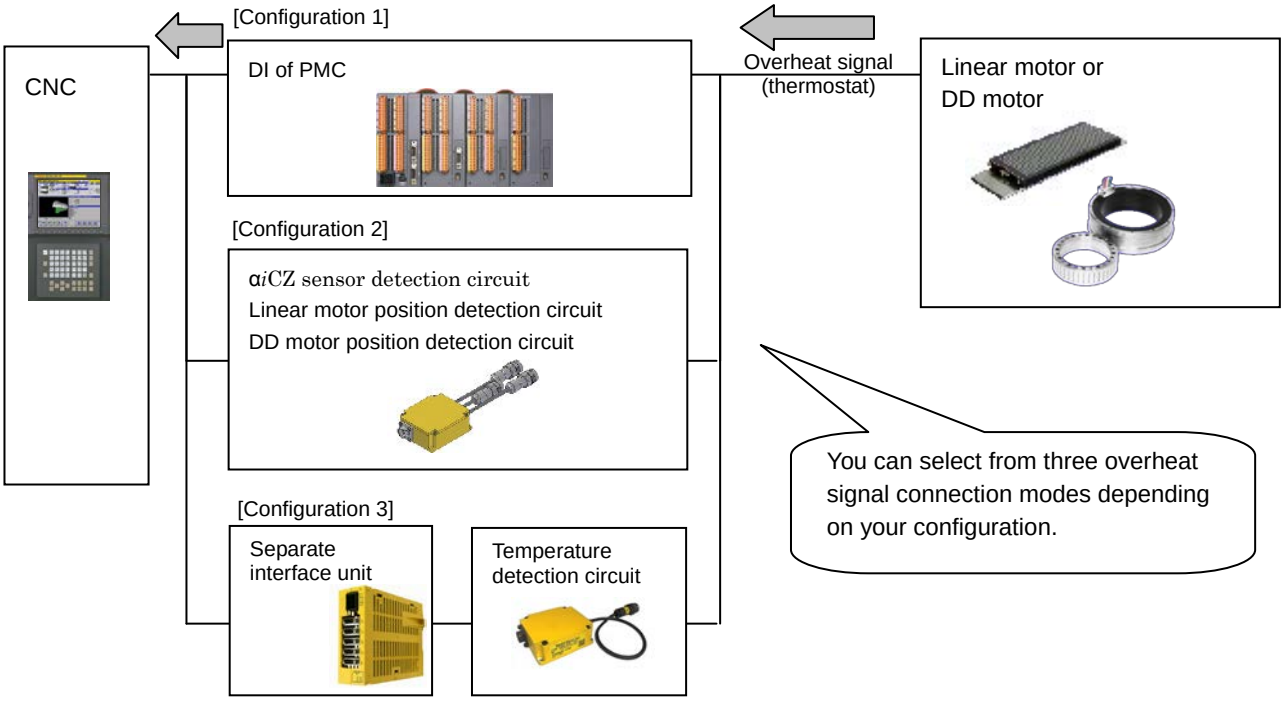


Fig. 3.3 (a) Overheat signal connection configuration

> ⚠ **CAUTION**
> When using a linear motor or DD motor, be sure to monitor the overheat signal by using any of the methods mentioned above for proper protection against motor overheating.

> **NOTE**
> The linear motor or DD motor position detection circuit (A860-2034-T***) supports the PTC thermistor as the source of the overheat signal, in addition to the thermostat. For details, refer to technical reports (B-65382/05-03 and B-65332/03-03).

(2) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	03.0 and subsequent editions	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	(*1)(*2)
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	(*1)(*2) HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	

(*1) Configuration 1 is supported in 90E0 and 90D0/J(10) and subsequent editions.
(*2) Configurations 2 and 3 are supported in 90E0 and 90D0/O(15) and subsequent editions.

(3) Setting parameters

	#7	#6	#5	#4	#3	#2	#1	#0
2300	CKLNOH				THRMO			

THRMO(#3) When bit 7 of parameter No. 2300 is 1, an overheat alarm is:
- 0: Obtained from a DI signal via the PMC. (Configuration 1)
- 1: Obtained from the α*i*CZ detection circuit, linear or DD motor position detection circuit, or temperature detection circuit. (Configurations 2 and 3)
- * When this parameter has been set, the power must be turned off before operation is continued.

CLKNOH(#7) The overheat alarm of a linear or DD motor is:
- 1: Obtained from the DI signal via the PMC, the α*i*CZ detection circuit, the position detection circuit, or the temperature detection circuit
- * When this parameter has been set, the power must be turned off before operation is continued.

Set these parameters according to the overheat signal connection mode (configuration) as indicated in the table below.

CKLNOH	THRMO	Description
1	0	Detects an overheat alarm with a DI signal via the PMC. (Configuration 1)
1	1	Detects an overheat alarm via the α*i*CZ detection circuit or linear motor or DD motor position detection circuit. (Configuration 2)
		Detects an overheat alarm via the temperature detection circuit. (Configuration 3)(*1)

(*1) Before an overheat alarm can be detected via the temperature detection circuit (configuration 3), the temperature detection circuit must be set (with a parameter such as No. 2278). (See Subsection 2.1.5.)

NOTE

If bits 3 and 7 of No. 2300 are both set to 1 (to enable overheat alarm detection with the built-in temperature detection circuit) when an α*i*CZ sensor of old type (A860-2142-Txxx) not supporting the temperature detection circuit is used, an illegal parameter setting alarm (detail number 3002) is issued.

⚠ **CAUTION**

1 This function bit is automatically set during automatic loading of the standard parameters. However, if the setting differs from the configuration, set it manually.

2 In a CNC that cannot use interface Gn326 of the PMC, if this function bit is set to 1, a servo alarm SV0430 (motor overheat) is issued. If this occurs, set the function bit to 0.

(4) Signals (only in configuration 1)

When using configuration 1, connect the overheat signal from the motor to the following PMC signal with ladder circuitry:

Overheat state signals via the PMC: SVDI61 to SVDI68<Gn326>

	#7	#6	#5	#4	#3	#2	#1	#0
Gn326	SVDI68	SVDI67	SVDI66	SVDI65	SVDI64	SVDI63	SVDI62	SVDI61

[Classification] Input signal

[Function] Thermostat signals are input via the PMC. An independent signal is provided for each axis, and the last digit of each name indicates the number of a controlled axis.

[Status] 0: A signal for issuing an overheat alarm or detecting an overheat is not connected.
1: No overheat alarm is issued.

(5) Connection and usage

(1) Parameter setting

Set parameter No. 2300 according to the overheat signal connection mode.

By default, bit 7 (CKLNOH) of No.2300=1 and bit 3 (THRMO) of No.2300=0 are set for a linear motor and DD motor (to obtain the overheat signal via the PMC). If the setting of a parameter does not match the actual overheat signal connection, the motor overheat alarm SV0430 is issued.

(2) Overheat signal connection

Connect the overheat signal to a proper point according to each configuration. When configuration 1 (connection via the PMC) is used, a ladder program for connecting the overheat signal (external signal) to the G signal needs to be created.

(3) Checking of an overheat alarm on the diagnosis screen

An overheat alarm via the pulse coder can be distinguished from an overheat alarm via the PMC DI signal based on diagnosis data

[Alarm details displayed on the diagnosis screen]

Alarm	Diagnosis No. 200 #7(OVL)	Diagnosis No. 201 #7(ALD)	Diagnosis No. 201 #4(EXP)
Overheat alarm via Pulsecoder	1	1	0
Overheat alarm via PMC DI signal	1	1	1

4 SERVO PARAMETER TUNING

This chapter describes servo parameter tuning. A servo tuning tool known as "SERVO GUIDE" is available to help you perform parameter tuning smoothly. See Chapter 8 for a summary of SERVO GUIDE.

4.1 SERVO TUNING SCREEN AND DIAGNOSIS INFORMATION

4.1.1 Servo Tuning Screen

Display the servo tuning screen, and check the position error, actual current, and actual speed on the screen. Using the keys on the CNC, enter values according to the procedure explained below.

SYSTEM → [SYSTEM] → [▷] → [SV-PRM] → [SV-TUN]

If the servo setting/tuning screen does not appear, set the following parameter.

	#7	#6	#5	#4	#3	#2	#1	#0
3111								SVS

SVS(#0) 1: Displays the servo screen.

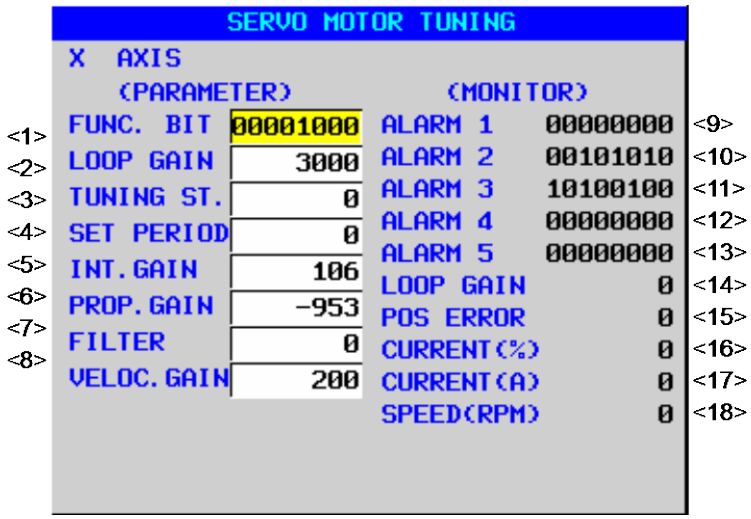


Fig. 4.1.1 (a) Tuning screen

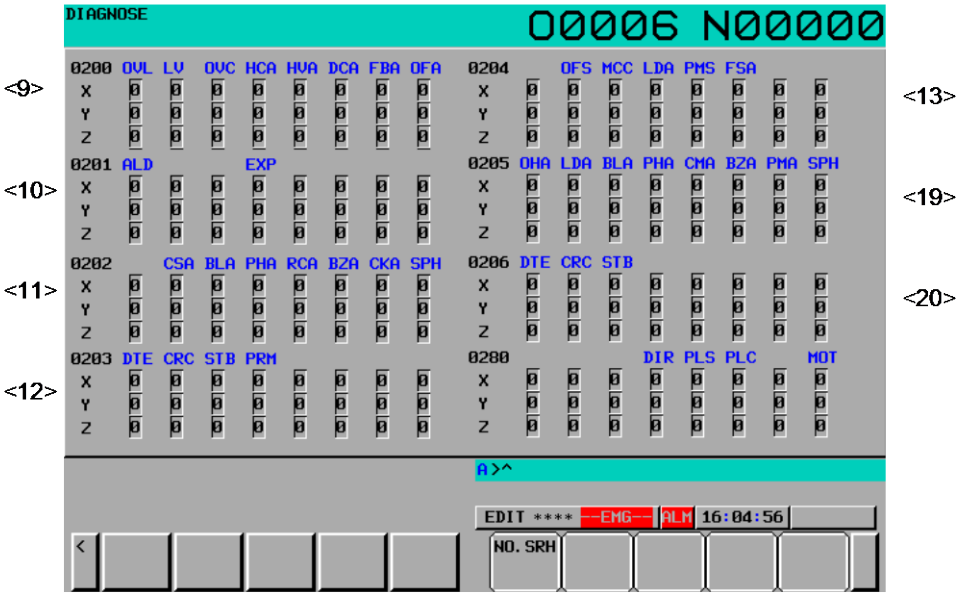


Fig. 4.1.1 (b) Diagnosis screen

The items on the servo tuning screen correspond to the following parameter numbers:

Table 4.1.1 (a) Correspondence between the servo tuning screen and diagnosis screen, and parameters

Servo tuning screen	Parameter number/Diagnosis number
(1) Function bit (2) Loop gain	No. 2003 No. 1825
(3) Tuning start bit (4) Setting period	Not used at present Not used at present
(5) Velocity loop integral gain (6) Velocity loop proportional gain (7) TCMD filter	No. 2043 No. 2044 No. 2067
(8) Velocity loop gain	Related to No. 2021
	The relationship with the load inertia ratio (LDINT= No.2021) is as follows: Velocity gain = (1 + LDINT/256) x 100 [%]
(9) Alarm 1 diagnosis (10) Alarm 2 (11) Alarm 3 (12) Alarm 4 (13) Alarm 5 (19) Alarm 7 (20) Alarm 8	Diagnosis No. 200 201 202 203 204 205 206
(14) Loop gain or actual loop gain	The actual servo loop gain is displayed.
(15) Position error diagnosis	Diagnosis No. 300
	Position error =(feedrate) [mm/min] / (least input increment x 60 x loop gain x 0.01) [mm]
(16) Actual current [%] (17) Actual current [Ap] (18) Actual speed [min^{-1}] or [mm/min]	Indicates the percentage [%] of the current value to the continuous rated current. Indicates the current value (peak value). Indicates the actual speed or feedrate.

4.1.2 Diagnosis Information List

The table below provides a list of servo-related data items displayed on the diagnosis screen.

Table 4.1.2 (a) Diagnosis number list

Diagnosis No. (DGN)	Unit of data	Data description	Remarks
280	-	Invalid parameter details (CNC)	See Subsection 2.1.6
300	Detection unit	Positional deviation	
308	°C	Servo motor temperature	(Note 1)
309	°C	Pulse coder temperature	
350	-	Servo state flag 1	(Note 2)
351	-	Servo state flag 2	(Note 3)
352	-	Invalid parameter details (SV)	See Subsection 2.1.6
353	-	Tuning data #1	
354	-	Tuning data #2 Acceleration data	See Subsection 4.1.4
355	Number of times	Separately installed in serial Communication alarm neglect counter	
356	Number of times	Built-in pulse coder Feedback extrapolation counter	
357	Number of times	Separately installed in serial Feedback extrapolation counter	
358	-	V-READY OFF information	
359	Number of times	Built-in pulse coder Communication alarm neglect counter	
360	Detection unit	Command pulse accumulation (NC)	
361	Detection unit	Compensation pulse (NC)	
362	Detection unit	Command pulse accumulation (SV)	
363	Detection unit	Feedback accumulation (SV)	
550	Detection unit	Dual position Error on the full-closed side	
551	Detection unit	Dual position Error on the semi-closed side	
552	Detection unit	Dual position Error on the semi-/full-closed side	
553	Detection unit	Dual position Compensation value	
700	-	Servo state flag 3	(Note 4)
750	%	OVC data	Alarm with 100%
752	V	Voltage information	(Note 5)(Note 6)
760	I_{max}[Ap]/6554	R phase current value	I_{max}=Maximum amplifier current
761	I_{max}[Ap]/8027	Effective current value	I_{max}=Maximum amplifier current
762	360[deg]/256	Excitation phase data	

Note 1: When a linear motor or synchronous built-in servo motor is used and temperature information (thermistor signal) is connected to a temperature detection circuit, α*i*CZ detection circuit, linear motor position detection circuit, or synchronous built-in servo motor position detection circuit, the temperature of the motor can be displayed on diagnosis No. 308.
See the following subsection or section:
2.1.5 Setting Parameters When an Acceleration Sensor or Temperature Detection Circuit Is Used

Note 2: Diagnosis No. 350 displays the following state signals:

	#7	#6	#5	#4	#3	#2	#1	#0
Diagnosis No.350		ALMTMP	ALMACC	A_PHAL	PM1CHK	PM1TMP	PM1ACC	PM1POS

PM1POS(#0) 1: A position detector is connected to an odd-numbered unit such as the first SDU unit, and the third SDU unit.
PM1ACC(#1) 1: An acceleration sensor is connected to an odd-numbered unit such as the first SDU unit, and the third SDU unit.
PM1TMP(#2) 1: A temperature detection circuit is connected to an odd-numbered unit such as the first SDU unit, and the third SDU unit.
PM1CHK(#3) 1: A servo check interface unit is connected to an odd-numbered unit such as the first SDU unit, and the third SDU unit.
A_PHAL(#4) 1: An error has occurred in the EEPROM of the αi pulse coder. (This is not an alarm.)
ALMACC(#5) 1: An alarm is issued from an acceleration sensor.
ALMTMP(#6) 1: An alarm is issued from a temperature detection circuit.

Note 3: Diagnosis No. 351 displays the following state signals:

	#7	#6	#5	#4	#3	#2	#1	#0
Diagnosis No. 351					PM2CHK	PM2TMP	PM2ACC	PM2POS

PM2POS(#0) 1: A position detector is connected to an even-numbered unit such as the second SDU unit, and the fourth SDU unit.
PM2ACC(#1) 1: An acceleration sensor is connected to an even-numbered unit such as the second SDU unit, and the fourth SDU unit.
PM2TMP(#2) 1: A temperature detection circuit is connected to an even-numbered unit such as the second SDU unit, and the fourth SDU unit.
PM2CHK(#3) 1: A servo check interface unit is connected to an even-numbered unit such as the second SDU unit, and the fourth SDU unit.

Note 4: Diagnosis No. 700 displays the following state signals:

	#7	#6	#5	#4	#3	#2	#1	#0
Diagnosis No. 700	L2048	O2048	1VPP	FSFMB	PSFMB	DCLNK	HRV3OK	HRV3ON

HRV3ON(#0) 1: The high-speed HRV current control mode is ON (HRV3, HRV4).
HRV3OK(#1) 1: The configured hardware enables high-speed HRV current control and PDM to be used.
DCLNK(#2) 1: DC link voltage information can be used.
PSFMB(#3) 1: On the semi-closed side, a high resolution rotary scale (such as RCN727) is connected.
FSFMB(#4) 1: On the full-closed side, a high resolution rotary scale (such as RCN727) is connected.
1VPP(#5) 1: A detector is connected via an analog SDU unit.
O2048(#6) 1: The detector on the full-closed side enables 2048-magnification interpolation setting.
L2048(#7) 1: The detector on the semi-closed side enables 2048-magnification interpolation circuitry. (Linear motor)

Note 5: To use diagnosis data about voltage information, the following software and hardware are required:

CNC system software

CNC	System software	
	Series	Edition
Series 30*i*-A	G00C,G01C,G02C G004,G014,G024	27 and subsequent editions 01 and subsequent editions
Series 31*i*-A5	G12C, G13C G124, G134	27 and subsequent editions 01 and subsequent editions
Series 31*i*-A	G103, G113 G104, G114	07 and subsequent editions 01 and subsequent editions
Series 32*i*-A	G203 G204	07 and subsequent editions 01 and subsequent editions
Series 0*i*-MD	D4F1	01 and subsequent editions
Series 0*i*-TD	D6F1	01 and subsequent editions
Series 0*i* Mate-MD	D5F1	01 and subsequent editions
Series 0*i* Mate-TD	D7F1	01 and subsequent editions

For the Series 30*i*/31*i*/32*i*/35*i*-B, Power Motion *i*-A, DSA-B, and Series 0*i*-F, all series and editions support the use of diagnosis data about voltage information.

Servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90G0 90J0 90K0 90GP 90JP	01.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	O(15) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	O(15) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

Hardware

Hardware		Specification	Remarks
Power supply	α*i* PS	All α*i* PS-B models and the following α*i* PS models A06B-6140-Hxxx (for 200 V) A06B-6150-Hxxx (for 400 V)	
Servo amplifier	α*i* SV	All α*i* SV-B models and the following α*i* SV models A06B-6117-Hxxx (for 200 V) A06B-6127-Hxxx (for 400 V)	
	β*i* SV	All β*i* SV-B models and the following β*i* SV models A06B-6130-Hxxx A06B-6131-Hxxx	
	β*i* SVSP	All β*i* SVSP-B models and the following β*i* SVSP models A06B-6164-Hxxx#H580 A06B-6167-Hxxx#H560	

Note 6: The unit of data and the valid data range displayed in the voltage information in diagnosis No. 752 differ depending on the system used.

Diagnosis No.	Description	Displayed value		Remarks
		FS30*i*-A,0*i*-D	FS30*i*-B, PM*i* -A, DSA-B, 0*i*-F, 0*i* Mate-D(Pkg5)	
No.752	DC link voltage information	Unit of data: Vrms Valid data range: 0 to 452 (200-V amplifier) 0 to 905 (400-V amplifier)	Unit of data: V Valid data range: 0~1023	(*1)

(*1) For example, when the power supply voltage is 200 Vrms, the value displayed on the diagnosis screen is 200 (FS30*i*-A and 0*i*-D) or 283 (FS30*i*-B).

4.1.3 Actual Current Peak Hold Display

(1) Overview

The servo tuning screen displays an actual current value (Ap) and a ratio (%) to the rated current value. However, if current abruptly changes during acceleration, for example, its value cannot be checked. By setting the parameter indicated below, a peak current value is displayed for about 3 seconds, so that a maximum current value during acceleration can be read.

(2) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	A(01) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(3) Setting parameters

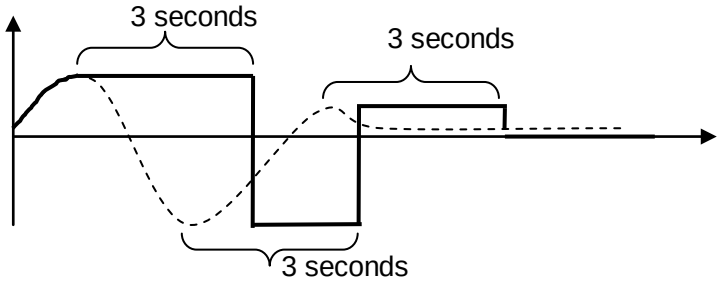
	#7	#6	#5	#4	#3	#2	#1	#0
2201		CPEEKH						

PK2VDN (#6) 0: A current value is displayed as usual.
1: The display of a peak current value is held.

NOTE

When reading an actual current by using an application that uses SERVO GUIDE or the FOCAS library or an application that uses the PMC window, note that this function displays a waveform different from an actual momentary current waveform.

Actual momentary current: Dashed line Observed current: Solid line



4.1.4 Acceleration Monitor

(1) Overview

Acceleration feedback can be observed on diagnosis screen No. 354 with the acceleration monitor.

(2) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	03.0 and subsequent editions	
Power Motion *i*-A DSA-B	90J0 90GP 90JP	01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	P(16) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	P(16) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	

(3) Setting parameters

By setting bit 0 of No. 2290 to 1 after setting an acceleration sensor (Subsection 2.1.5), acceleration feedback can be displayed on diagnosis screen No. 354.
By setting bit 1 of No. 2290 to 1, a peak acceleration rate can be held (for 1 second). By setting bit 2 of No. 2290 to 1, the remaining acceleration data after a stop can be observed.

	#7	#6	#5	#4	#3	#2	#1	#0
2290						ACCMON	ACCHLD	ACCOUT

ACCOUT(#0) To the diagnosis screen (No. 354), acceleration data output is:
0: Not performed.
1: Performed.

ACCHLD(#1) A peak acceleration rate is:
0: Not held.
1: Held (for 1 second).

ACCMON(#2) 0: Acceleration data at all times
1: Remaining acceleration data after a stop (The acceleration data is cleared to 0 during movement and for 16 ms after a stop.)

Diagnosis No.354	Acceleration feedback

[Display unit] mm/s^2

4.2 ACTIONS FOR ALARMS

If a servo alarm is issued, the related alarm number is displayed on the CNC alarm screen. Based on this information, check the cause of the servo alarm and take appropriate action.

(1) Alarms related to the amplifier and motor

Number	Message	Description
SV0010	SV OVERHEAT	Amplifier internal overheat → See Supplementary 1.
SV0011	SV MOTOR OVER CURRENT(SOFT)	The digital servo control software detected an abnormal specified value. Possible causes include an unconnected power cable, cable disconnection (open phase), and short-circuit. → See Supplementary 2.
SV0012	SV DRIVE OFF CIRCUIT FAILURE	The two drive off inputs are not in the same status or a drive off circuit error occurred. → See Supplementary 2.
SV0013	SV CPU BUS FAILURE	An error was found in CPU bus data in the amplifier. → See Supplementary 2.
SV0014	SV CPU WATCH DOG	An error occurred in CPU operation in the amplifier. → See Supplementary 2.
SV0015	SV LOW VOLT DRIVER	The driver power supply voltage has dropped in the amplifier. → See Supplementary 2. Possible causes include improper insertion of the control PC board and amplifier failure.
SV0016	SV CURRENT DETECT ERROR	An error was found in motor current detection data in the amplifier. Possible causes include improper insertion of the control PC board and amplifier failure. → See Supplementary 2.
SV0017	SV INTERNAL SERIAL BUS FAILURE	An error occurred in serial bus communication in the amplifier. Possible causes include improper insertion of the control PC board and amplifier failure. → See Supplementary 2.
SV0018	SV ROM DATA FAILURE	An error was found in ROM data in the amplifier. → See Supplementary 2.

Number	Message	Description
SV0019	SV MOTOR OVER CURRENT (GND FAULT)	A ground fault occurred in the motor, power cable, or amplifier. → See Supplementary 2.
SV0020	PS GROUND FAULT	A ground fault occurred in the motor, power cable, or amplifier. → See Supplementary 2.
SV0021	PS OVERCURRENT 2	Overcurrent on input circuit section. → See Supplementary 2.
SV0022	PS OVERCURRENT 3	Overcurrent on input circuit section. → See Supplementary 2.
SV0023	PS OVERCURRENT 4	Overcurrent on input circuit section. → See Supplementary 2.
SV0024	PS SOFT THERMAL	A load higher than the rating was applied. → See Supplementary 2.
SV0025	PS OVER VOLT. DC LINK 2	The DC link voltage is too high. → See Supplementary 2.
SV0026	PS OVER VOLT. DC LINK 3	The DC link voltage is too high. → See Supplementary 2.
SV0027	PS OVER VOLT. DC LINK 4	The DC link voltage is too high. → See Supplementary 2.
SV0028	PC LOW VOLT. DC LINK 2	The DC link voltage has dropped. → See Supplementary 2.
SV0029	PC LOW VOLT. DC LINK 3	The DC link voltage has dropped. → See Supplementary 2.
SV0030	PC LOW VOLT. DC LINK 4	The DC link voltage has dropped. → See Supplementary 2.
SV0031	PS ILLEAGAL PARAMETER	An invalid value is set for a PS control parameter. For details, refer to the relevant servo amplifier descriptions such as B-65412EN.
SV0032	PS CONTROL AXIS ERROR 1	An invalid value is set for parameter No. 2557. Set parameter APS (No.11549#0) to 1 and execute automatic setting.
SV0033	PS CONTROL AXIS ERROR 2	An invalid value is set for parameter No. 2557. Set parameter APS (No.11549#0) to 1 and execute automatic setting.
SV0034	PS HARDWARE ERROR	A PS hardware error was detected. → See Supplementary 2.
SV0035	SV NO FAILURE	No failure occurs in the servo amplifier. → See Supplementary 2.
SV0036	PHASE OPEN	A power line or the like has an open phase. → See Supplementary 2.
SV0037	FAILURE OF SV (OPEN)	An open failure occurred in the output of the servo amplifier. → See Supplementary 2.
SV0038	SV FAILURE OF CURRENT CTL.	A failure occurred in the current detection circuit in the servo amplifier. → See Supplementary 2.
SV0039	FAILURE OF SV (SHORT)	A short-circuit occurred in the output of the servo amplifier. → See Supplementary 2.
SV0040	PS SUB MODULE ERROR 1	Failure of PS SUB MODULE, PS or cable. Replace PS SUB MODULE, PS or cable. → See Supplementary 2.
SV0041	PS SUB MODULE ERROR 2	Failure of PS SUB MODULE, PS or cable. Replace PS SUB MODULE, PS or cable. → See Supplementary 2.
SV0042	PS SUB MODULE ERROR 3	Failure of PS SUB MODULE, PS or cable. Replace PS SUB MODULE, PS or cable. → See Supplementary 2.
SV0043	PS SUB MODULE ERROR 4	Failure of PS SUB MODULE, PS or cable. Replace PS SUB MODULE, PS or cable. → See Supplementary 2.

Number	Message	Description
SV0044	MISMATCHED FUNCTION CODE	CNC, SV, SP or PS software has been updated. Turn the power off, then restart.
SV0430	SV MOTOR OVERHEAT	Overheat → See Supplementary 1.
SV0431	PS OVERLOAD	Overheat → See Supplementary 2.
SV0432	PS LOW VOLT. CONTROL	The control power supply voltage has dropped. → See Supplementary 2.
SV0433	PS LOW VOLT. DC LINK	The DC link voltage has dropped. → See Supplementary 2.
SV0434	SV LOW VOLT CONTROL	The control power supply voltage has dropped. → See Supplementary 2.
SV0435	SV LOT VOLT. DC LINK	The DC link voltage has dropped. → See Supplementary 2.
SV0436	SOFTTHERMAL(OVC)	The digital servo control software detected a soft thermal (OVC). → See Supplementary 3.
SV0437	PS OVERCURRENT	Overcurrent on input circuit section. → See Supplementary 2.
SV0438	SV ABNORMAL CURRENT	Motor overcurrent → See Supplementary 4.
SV0439	PS OVER VOTL. DC LINK	The DC link voltage is too high. → See Supplementary 2.
SV0440	PS EXCESS-REGENERATION2	Excessive regenerative discharge → See Supplementary 2.
SV0442	PS PRE-CHARGE FAILURE	The spare charge circuit for the DC link is abnormal. → See Supplementary 2.
SV0443	PS INTERNAL FAN FAILURE	Internal cooling fan failure. → See Supplementary 2.
SV0444	SV INTERNAL FAN FAILURE	Internal cooling fan failure. → See Supplementary 2.
SV0449	SV IPM ALARM	The IPM (Intelligent Power Module) detected an alarm. → See Supplementary 2.
SV0600	SV DC LINK OVER CURRENT	DC link overcurrent. → See Supplementary 2.
SV0601	SV EXTERNAL FAN FAILURE	Radiator cooling fan failure. → See Supplementary 2.
SV0602	SV RADIATOR OVERHEAT	Overheat → See Supplementary 2.
SV0603	INV. IPM ALARM(OH)	The IPM (Intelligent Power Module) detected an overheat alarm. → See Supplementary 2.
SV0604	AMP COMMUNICATION ERROR	The communication between Servo Amplifier (SV) and Common Power Supply (PS) is in error. → See Supplementary 2.
SV0605	PS EXCESS-REGENERATION1	The motor regenerative power is too much. → See Supplementary 2.
SV0606	PS EXTERNAL FAN FAILURE	External radiator cooling fan failure. → See Supplementary 2.
SV0607	PS IMPROPER INPUT POWER	An abnormality was found with the input power supply. → See Supplementary 2.
SV0654	DB RELAY FAILURE	A failure occurs in the dynamic brake relay of the servo amplifier. Replace the amplifier. → See Supplementary 2.

Supplementary 1: Overheat alarms

If an overheat alarm occurs after long continuous operation, the alarm can be determined to have been caused by a temperature rise in the motor or amplifier. Stop operation for a while. If the alarm still occurs after the power is kept off for about 10 minutes, the hardware may be defective.
If the alarm occurs intermittently, increase the time constant, or increase the programmed stop time period to suppress temperature rise.
Motor and Pulsecoder temperature information is displayed on the diagnosis screen.

	Diagnosis No.
Motor temperature (C)	No.308
Pulsecoder temperature (C)	No.309

Supplementary 2: Hardware alarms

For action to be taken, refer to manuals including the maintenance manual on the servo amplifier.
Maintenance manual of α*i* series: B-65285EN
Maintenance manual of β*i* series: B-65325EN

Supplementary 3: OVC alarms

When an OVC alarm occurs, check that standard values are set for the following parameters. When the parameters are correct, take action to ease the operating conditions, including increasing the time constant or programmed stop time period.

Parameter No.	Details
2062	Overload protection coefficient (POVC1)
2063	Overload protection coefficient (POVC2)
2065	Soft thermal coefficient (POVCLMT)
2161	OVC magnification at a stop (OVCSTP)
2162	Overload protection coefficient 2 (POVC21)
2163	Overload protection coefficient 2 (POVC22)
2164	Overload protection coefficient 2 (POVCLMT2)
2574	Overload protection coefficient 2 (VELOVC)

OVC data is displayed on the diagnosis screen. (An OVC alarm occurs when OVC data is set to 100%.)

	Diagnosis No.
OVC data (%)	No.750

Supplementary 4: Overcurrent alarms

This type of alarm is issued when an extremely large current flows through the main circuit.
When an overcurrent alarm is always issued after emergency stop is released or at the time of moderate acc./dec., the cause of the alarm is determined to be an amplifier failure, cable connection error, line disconnection, or a parameter setting error. First, check that standard values are set for the following servo parameters. If these parameter settings are correct, check the amplifier and cable status by referring to the maintenance manual on the servo amplifier.

Parameter No.	Details
2004	HRV setting
2040	Current loop gain (PK1)
2041	Current loop gain (PK2)
2013#1-4	-
2014#1-4	-

If an overcurrent alarm is issued only when a strong acc./dec. is performed, the operating conditions may be too abrupt. Increase the acc./dec. time constant, and see whether the alarm is issued.

⚠ CAUTION

1 If an overcurrent alarm is detected, and the LED indication in the amplifier remains set to "-", the overcurrent alarm may have been detected by the servo control software. The cause may be one of the following:
   - The contact of the power line is poor, or the power line is disconnected or broken.
   - The AMR conversion coefficient or AMR offset is not set correctly.

2 If the emergency stop state is released without connecting the motor power line in a test such as a test for machine start-up, an overcurrent alarm (software) may be issued. In such a case, the alarm can be avoided temporarily by setting the bit parameter indicated below to 1. However, be sure to return the bit parameter to 0 before starting normal operation after the completion of the test.
   To ignore the overcurrent alarm (software), set bit 0 of No2207

(2) Alarms related to the Pulsecoder and separate serial Pulsecoder

Number	Message	Description
SV0360	ABNORMAL CHECKSUM(INT)	The checksum alarm occurred on the built–in Pulsecoder. See Supplementary 1.
SV0361	ABNORMAL PHASE DATA(INT)	The phase data abnormal alarm occurred on the built–in Pulsecoder.
SV0362	ABNORMAL REV. DATA(INT)	The revolution count error alarm occurred on the built-in Pulsecoder.
SV0363	ABNORMAL CLOCK(INT)	The clock alarm occurred on the built–in Pulsecoder.
SV0364	SOFT PHASE ALARM(INT)	A digital servo control software detected an abnormality on the built in Pulsecoder. → See Supplementary 2.
SV0365	BROKEN LED(INT)	An LED in the built-in Pulsecoder is abnormal.
SV0366	PULSE MISS(INT)	A pulse error occurred on the built–in Pulsecoder. → See Supplementary 2.
SV0367	COUNT MISS(INT)	A count error occurred on the built–in Pulsecoder. → See Supplementary 2.
SV0368	SERIAL DATA ERROR(INT)	The communications data could not be received from the built–in Pulsecoder. → See Supplementary 3.
SV0369	DATA TRANS. ERROR(INT)	A CRC error or stop bit error occurred in the communications data from the built–in Pulsecoder. → See Supplementary 3.
SV0380	BROKEN LED(EXT)	Separate detector error
SV0381	ABNORMAL PHASE (EXT)	An abnormal alarm in the phase data occurred on the separate detector.
SV0382	COUNT MISS(EXT)	A count error occurred on the separate detector. → See Supplementary 2.
SV0383	PULSE MISS(EXT)	A pulse error occurred on the separate detector. → See Supplementary 2.
SV0384	SOFT PHASE ALARM(EXT)	The digital servo control software detected abnormal data on the separate detector. → See Supplementary 2.
SV0385	SERIAL DATA ERROR (EXT) SERIAL DATA ERROR(EXT)	The communications data could not be received from the separate detector. → See Supplementary 3.

Number	Message	Description
SV0386	DATA TRANS. ERROR (EXT) DATA TRANS. ERROR(EXT)	A CRC error or stop bit error occurred in the communications data from the separate detector. → See Supplementary 3.
SV0387	ABNORMAL ENCODER(EXT)	An abnormality occurred on a separate detector. For details, contact the manufacturer of the detector.
SV0445	SOFT DISCONNECT ALARM	The digital servo control software detected a disconnected Pulsecoder. → See Supplementary 4.
SV0447	HARD DISCONNECT(EXT)	The hardware detected a disconnected separate detector. This alarm may be issued when a separate phase A/B scale is used. Check whether the phase A/B detector is connected properly.
SV0453	SPC SOFT DISCONNECT ALARM	Software disconnection alarm of the αPulsecoder. Turn off the power to the CNC, then remove and insert the Pulsecoder cable. If this alarm is issued again, replace the Pulsecoder. → See Supplementary 5.
DS0306	APC ALARM: BATTERY VOLTAGE 0	The battery voltage of the absolute position detector has dropped to a level at which data can no longer be held. Or, the power was supplied to the Pulsecoder for the first time. The battery or cable may be defective. Replace the battery with the machine turned on. → See Supplementary 6.
DS0307	APC ALARM: BATTERY LOW 1	The battery voltage of the absolute position detector has dropped to a level at which a replacement is required. Replace the battery with the machine turned on. → See Supplementary 6.
DS0308	APC ALARM: BATTERY LOW2	The battery voltage of the absolute position detector dropped to a level at which a replacement was required in the past (including during power off). Replace the battery with the machine turned on. → See Supplementary 6.

NOTE

For alarms with no action number indicated, the detector may be defective. Replace the detector.

Supplementary 1: Alarm that may occur due to a failure in the Pulsecoder or separate serial detector

The Pulsecoder or separate serial detector may be defective. Replace the detector.

Supplementary 2: Alarms that may occur due to noise

When an alarm occurs intermittently or occurs after emergency stop is released, there is a high possibility that the alarm is caused by noise. Take thorough noise-prevention measures. If the alarm still occurs continuously after the measures are taken, replace the detector.

Supplementary 3: Alarms that may occur due to a serial communication failure

Serial communication is not performed correctly. Check whether cable connection is correct and whether there is a line disconnection. This alarm may also be caused by noise. Take noise-prevention measures. If the alarm always occurs after power is turned on, the Pulsecoder, the control board of the amplifier, or the separate detector interface unit may be defective.

Supplementary 4: Alarm that may occur due to software disconnection

This alarm occurs when the change in the position feedback pulses obtained from the separate detector is relatively small for the change in velocity feedback pulses obtained from the built-in Pulsecoder. This alarm does not occur in a semi-closed system configuration. If this alarm occurs, check whether the separate detector outputs position feedback pulses correctly. If the detector outputs pulses correctly, only the motor rotates in the reverse direction at the start of machine operation because there is a large backlash between the motor position and scale position. In this case, you can increase the alarm level to a value equivalent to the backlash to avoid this alarm during normal operation.

Checking position feedback pulses

<1> Set the types of data on the channel setting screen of SERVO GUIDE.
CH1: ABS (Integral value of position feedback of the detector built into the motor)
CH2: POSF (Integral value of position feedback of the separate detector)

<2> In the Operation and Display dialog box, specify Synchro in Operation, CH1 in Input 1, and CH2 in Input 2.

<3> Acquire data and display the difference between the semi-closed and full-closed modes (Input 2 - Input 1) in the graph window.

<4> Check the graph data.

- If the difference between the semi-closed and full-closed modes becomes larger during reverse rotation, perform servo tuning to decrease the difference. Alternatively, set a value a little larger than the difference between the semi-closed and full-closed modes for parameter No. 2064 to avoid the alarm.
- If the difference is too large at times other than during reverse rotation, check whether the parameters for the separate detector are set properly.

Related parameters

	#7	#6	#5	#4	#3	#2	#1	#0
2003							TGAL	

TGAL(#1) 1: The level for detecting the software disconnection alarm is set by parameter.
When bit 1 of parameter No. 2003 is set to 0, the alarm is detected by 1/32rev.
When bit 1 of parameter No. 2003 is set to 1, the alarm is detected by the value set for parameter No. 2064/32 rev.

2064	Software disconnection alarm level

Standard setting value 4: Alarm occurs when motor turns 1/8 of a turn.
Increase this value.

Supplementary 5: Software disconnection alarm of the αPulsecoder

This alarm occurs when the absolute position data sent from the built-in Pulsecoder cannot be synchronized with the phase data. Remove the Pulsecoder cable with the NC power switched off and wait for about 10 minutes, then connect the cable again. If this alarm occurs again, replace the Pulsecoder.

When an absolute type linear encoder is used with a linear motor or when a synchronous built-in servo motor is used, this alarm must be ignored because the detector does not have phase data. Set the following bit.

	#7	#6	#5	#4	#3	#2	#1	#0
2013	APTG							

APTG(#7) 1: Ignores α Pulsecoder software disconnection.

Supplementary 6: Battery-related alarms

Check the connection and voltage of the battery. If the voltage drops, replace the battery. After absolute position detection is enabled, when the power to the CNC is turned on for the first time, the alarm may occur. In this case, turn the power to the CNC off then on again.

(3) Illegal servo parameter setting alarm

Number	Message	Description
SV0417	ILL DGTL SERVO PARAMETER	A digital servo parameter setting is incorrect. Investigate the cause of the alarm according to the instructions described in Subsection 2.1.6, "Actions for Illegal Servo Parameter Setting Alarms".

(4) Other alarms

Number	Message	Description
SV0407	EXCESS ERROR	The difference in the amount of positional deviation for the synchronization axis exceeded the setting value (No.8314). (during synchronization control only) For details, refer to Subsection 1.6.6, "Synchronization Error Check" in the CNC Connection Manual (Function).
SV0409	DETECT ABNORMAL TORQUE	An abnormal load was detected on the servo motor, or during Cs axis or spindle positioning. The alarm can be canceled by RESET. This alarm occurs when a load exceeding the alarm level is detected. The alarm may also occur when the estimated disturbance is not tuned properly. In this case, tune the estimated disturbance again according to the instructions described in Section 5.9, "UNEXPECTED DISTURBANCE TORQUE DETECTION".
SV0410	EXCESS ERROR (STOP)	The amount of positional deviation during stopping exceeded the parameter No. 1829 setting value. Check the following points: Check that the motor is not locked and whether the detector is connected properly. If this alarm occurs during a gradual stop, the time constant may be too small or gain tuning may be insufficient. * Setting a large value for parameter No. 1829 may damage the machine.
SV0411	EXCESS ERROR (MOVING)	The amount of positional deviation during moving exceeded the parameter No. 1828 setting value. Check the following points: ・ Whether the motor is locked or not. ・ The detector is connected properly. ・ The time constant and parameter No. 1828 value are not too small. ・ Gain tuning has been done properly. * Setting a large value for parameter No. 1828 may damage the machine. Carefully set the value.
SV0413	LSI OVERFLOW	The specified feedrate exceeded the limit. (See Appendix D). Decrease the feedrate.
SV0415	MOTION VALUE OVERFLOW	The specified feedrate exceeded the limit. (See Appendix D). Decrease the feedrate.
SV0420	SYNC TORQUE EXCESS	In feed axis synchronization control, for synchronization, the difference value of torque between a master and slave axes exceeded the parameter No. 2031 setting value. This alarm occurs for a master axis.
SV0421	EXCESS ERROR(SEMI-FULL)	The difference in feedback between the built-in Pulsecoder and separate detector exceeded the value set for parameter No. 2118. See Subsection 2.1.8.1, "Monitoring the difference in error between the semi-closed and full-closed modes".
SV0422	EXCESS VELOCITY IN TORQUE	In torque control, the commanded permissible velocity was exceeded.
SV0423	EXCESS ERROR IN TORQUE	In torque control, the total permissible move value specified as a parameter was exceeded.

Number	Message	Description
SV0441	ABNORMAL CURRENT OFFSET	The digital servo control software detected an abnormality in the motor current detection circuit. The current offset (equivalent to the current value in the emergency stop state) of the current detector became abnormally large. If the alarm occurs again after the power is turned on and off, the current detector may be abnormal. Replace the amplifier.
SV0448	UNMATCHED FEEDBACK ALARM	The sign of the feedback signal from the separate detector is opposite to that from the feedback signal from the built-in Pulsecoder. See Supplementary 1.
SV0454	ILLEGAL ROTOR POS DETECT	The magnetic pole detection function terminated abnormally. The magnetic pole could not be detected because the motor did not run. See "(7) Action for trouble for pole position detection function" in Subsection 3.2.1.2, "Parameter setting procedure 2 (pole position detection)".
SV0456	ILLEGAL CURRENT LOOP	An attempt was made to set a current loop that could not be set. See "Supplementary 2: HRV setting" in Subsection 2.1.6, "Actions for Illegal Servo Parameter Setting Alarms".
SV0458	CURRENT LOOP ERROR	The specified current loop differs from the actual current loop. See "Supplementary 2: HRV setting" in Subsection 2.1.6, "Actions for Illegal Servo Parameter Setting Alarms".
SV0459	HI HRV SETTING ERROR	For two axes whose servo axis numbers (parameter No. 1023) are consecutively odd and even numbers, HIGH SPEED HRV control is possible for one axis and impossible for the other. See "Supplementary 2: HRV setting" in Subsection 2.1.6, "Actions for Illegal Servo Parameter Setting Alarms".
SV0465	READ ID DATA FAILED	A read of the ID information for the amplifier has failed at power-on. The FB cable may be connected to the JX5 pin incorrectly. Check the connection and turn the power off then on again. If this alarm still occurs after that, replace the amplifier.
SV0466	MOTOR/AMP. COMBINATION	The maximum current of an amplifier is different to that of a motor. Probable causes are: ・ The FSSB setting is incorrect. ・ Servo parameters have not been initialized. ・ The parameter No. 2165 setting is incorrect
SV0468	HI HRV SETTING ERROR (AMP)	The setting for applying HIGH SPEED HRV control was configured for an amplifier for which HIGH SPEED HRV control could not be used. See "Supplementary 2: HRV setting" in Subsection 2.1.6, "Actions for Illegal Servo Parameter Setting Alarms".
SV0646	ABNORMAL ANALOG SIGNAL (EXT)	An error occurred in the analog 1Vp-p output of the separate detector. The cable, separate detector, or separate detector interface unit may have failed.
SV0649	MOTOR OVER SPEED	The permissible motor speed was exceeded.
SV0652	TEMP. ERROR	Communication between the separate detector interface unit and temperature sensor was disconnected. The cable may be disconnected or the temperature sensor may be defective.
SV0653	EXCESS ERROR (SV)	The difference between the estimated position error and actual position error exceeded the parameter No. 2458. See Subsection 2.1.8.2, "Dynamic error monitoring".

Supplementary 1: Feedback mismatch

This alarm occurs when the move directions for the position detector and velocity detector are opposite to each other. Check the rotation direction of the separate detector. If the direction is opposite to the direction in which the motor turns, take the following action:

- Phase A/B detector: Switch A and XA connection. Alternatively, set the following parameter to 1 to reverse the signal direction for the separate detector.
- Serial detector: Set the following parameter to 1 to reverse the signal direction for the separate detector.

	#7	#6	#5	#4	#3	#2	#1	#0
2018								RVRSE

RVRSE(#0) The signal direction of the separate detector is:
0: Not reversed.
1: Reversed.

When there is a large torsion or backlash between the motor and separate detector, this alarm may occur when an abrupt acceleration/deceleration is performed. In this case, set the following parameter to 1 to change the detection level.

	#7	#6	#5	#4	#3	#2	#1	#0
2201							RNLV	

RNLV(#1) Change of the feedback mismatch alarm detection level
0: To be detected at 600 min^{-1} or more
1: To be detected at 1000 min^{-1} or more

4.3 TUNING PARAMETERS FOR HIGH-SPEED AND HIGH-PRECISION MACHINING

4.3.1 Overview and Tuning Procedure

(1) Overview

For higher positioning precision, higher cutting surface quality, and higher precision in the machined surface and machining profile in machine tools, the tuning of the servo control system (servo tuning) are required. This subsection explains the servo tuning procedure. Servo tuning can also be made more easily by using SERVO GUIDE, which is an integrated tuning tool for servo spindles.

(2) Tuning procedure

Perform servo tuning according to the procedure described in Fig. 4.3.1 (a).

	Description	Items to Tune (related functions and parameters)
Initialization of Parameters Related to Servo Tuning **⇒ Subsection 4.3.2**	Set recommended values in related parameters to make tuning easier.	Setting of initial parameters
Tuning to Improve the Servo Stiffness **⇒ Subsection 4.3.3**	Increase each control loop gain to enhance the response speed.	Tuning of the current control loop (HRV control and HRV$^+$ control) Tuning of the velocity control loop gain and resonance elimination filter (velocity gain and resonance elimination filter) Tuning of the position control loop gain (position gain)
Tuning to Improve Contouring Accuracy **⇒ Subsection 4.3.4**	Improve contouring accuracy during contour control, by tuning the acceleration/deceleration parameters for quadrant protrusion compensation (backlash acceleration) and AI contour control.	Tuning by using an arc figure (quadrant protrusion compensation) Tuning by using a square with rounded corners (velocity feedforward and deceleration function by acceleration in circular interpolation) Tuning by using a square figure (velocity control by speed difference among axes at corners)
Tuning of Rapid Traverse Acceleration/Deceleration **⇒ Subsection 4.3.5**	Reduce the positioning time by optimizing the acceleration/deceleration time constant.	Tuning of the rapid traverse acceleration/deceleration time constant

Fig. 4.3.1 (a) Servo tuning procedure

4.3.2 Initialization of Parameters Related to Servo Tuning

Set the initial values (recommended values) in the related parameters according to Table 4.3.2 (a) and Table 4.3.2 (b).

Table 4.3.2 (a) List of the initial values (recommended values) of the parameters related to servo tuning 1

Parameter No.	Setting value	Description
■ Initial values of the parameters related to servo stiffness		
1825	5000 (semi-closed) 3000 (full-closed)	Servo loop gain (position gain)
2004 (*1)	00000011	Enables HRV2 control.
2003 #3	1	Enables velocity loop PI control.
2006 #4	1	Enables 1-ms velocity feedback acquisition.
2013 #0	1	Enables HRV3 control.
2016 #3	1	Enables variable proportional gain in the stop state
2017 #7	1	Enables velocity loop high cycle management
2021	256 (α*i* series) 0 (α*i* series)	Load inertia ratio (velocity loop gain)
2067	0	Torque command filter
2107	150	Velocity loop gain magnification at cutting
2119	2 (1 μm detection) 20 (0.1 μm detection)	Variable proportional gain function in the stop state: judgment level for stop state (detection unit)
2178	3000 (semi-closed) 3000 (full-closed)	Servo loop gain (position gain) (at rapid traverse)
2202 #1	1	Enables cutting/rapid velocity loop gain switching.
2213 #6	1	Enables cutting/rapid position gain switching.
2283 #0	1	Enables high-speed HRV current control in cutting feed.
2334	150	Current gain magnification for high-speed HRV current control
2335	200	Velocity gain magnification for high-speed HRV current control

Table 4.3.2 (b) List of the initial values (recommended values) of the parameters related to servo tuning 2

Parameter No.	Setting value	Description
■ Initial values of the parameters related to contour error reduction or cycle time reduction		
1602#3	1	Type of acceleration/deceleration after cutting feed interpolation in acceleration/deceleration mode before interpolation
1602#6	1	Type of acceleration/deceleration after cutting feed interpolation in acceleration/deceleration mode before interpolation
1604#0	1	AI contour control from the start of automatic operation
1610#0	1	Type of acceleration/deceleration after cutting feed interpolation
1610#1	1	Type of acceleration/deceleration after cutting feed interpolation
1660	2000	Maximum allowable acceleration for acceleration/deceleration before interpolation (mm/s^2)
1732	100	Lower limit velocity for deceleration by acceleration in circular interpolation
1735	600	Permissible acceleration in deceleration by acceleration in circular interpolation
1737	600	Allowable acceleration for the deceleration by acceleration in AI advanced preview control/AI contour control
1738	100	Lower limit velocity for the deceleration by acceleration in AI advanced preview control/AI contour control
1769	16	Acceleration/deceleration time constant after interpolation in acceleration/deceleration mode before interpolation (ms)
1772	32	Acceleration change time in bell-shaped acceleration/deceleration before interpolation (ms)

Parameter No.	Setting value	Description
1783	300	Allowable speed difference in determining velocity based on the speed difference at corners
1800#3	1	Enables rapid traverse feedforward.
2005 #1	1	Enables feedforward.
2069	100	Velocity feedforward coefficient for rapid traverse
2092	9800	Rapid traverse feedforward coefficient
2144	10000	Cutting feedforward coefficient
2145	100	Velocity feedforward coefficient for cutting feed
2214#4	1	Enables cutting/rapid feedforward switching.
2415#1	1	Enables the default value for feedforward timing tuning.

4.3.3 Tuning to Improve the Servo Stiffness

(1) Overview

Servo control consists of three control loops: position control, velocity control, and current control.

- Position control — Control loop that causes the actual position to follow the position command
- Velocity control — Control loop that causes the servo motor velocity to follow the velocity command
- Current control — Control loop that causes the actual torque of the servo motor to follow the torque command

In order to increase the follow-up performance for position commands and reduce the contour error, it is indispensable to improve the response speed of velocity control and current control. Since each control loop is affected by the inner control loop, servo tuning needs to be performed for the current control loop, velocity control loop, and position control loop in this order.

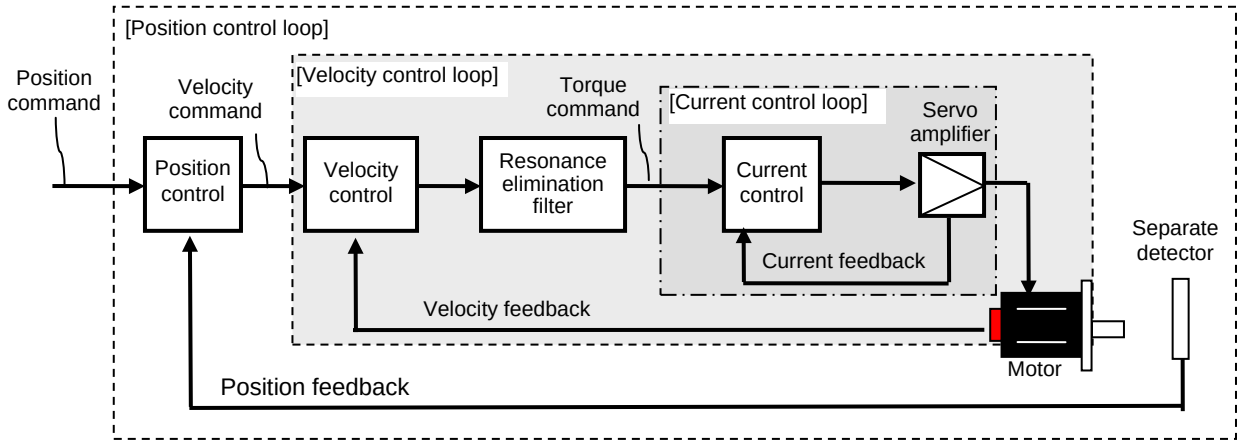
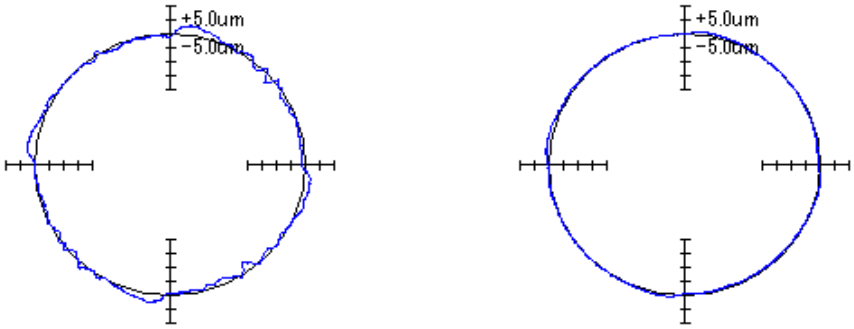


Fig. 4.3.3 (a) Block diagram of the servo control system (example of a full-closed system)

Fig. 4.3.3 (b) shows examples of arc accuracy before and after gain tuning. These examples demonstrate that appropriately tuning the current, velocity, and position control loops increases servo stiffness and that proper contouring accuracy can be obtained without using quadrant protrusion compensation (to be described later) or other compensation functions.



(i) Before servo adjustment (ii) After servo adjustment

Fig. 4.3.3 (b) Examples of servo tuning results for an arc figure

(2) Tuning of the current control loop

For the tuning of the current control loop, select servo HRV control.
According to the CNC and selection criterion shown in Table 4.3.3 (a), select servo HRV control and set the parameters.

Table 4.3.3 (a) Servo HRV selection and parameter settings

CNC	Selection criterion	Servo HRV control (*1)	Parameter setting			
			N2013 #0	N2014 #0	N2422 #4	N2300 #0
FS30*i*-B FS0*i*-F (*2)	Standard	HRV3	1	0	0	0
	Machine tool requiring high-speed, high-precision machining	HRV3+	1	0	1	0
	Ultra-high precision machine tool	HRV4+	0	1	1	0
FS30*i*-A FS0*i*-D (*2)	Standard	HRV3	1	0	0	0
	Ultra-high precision machine tool	HRV4	0	1	0	1

NOTE
1 For details of servo HRV control, see Section 5.1, "SERVO HRV CONTROL".
2 For FS0*i*-D/F, HRV4 control and HRV4+ control are not available.

(3) Tuning of the velocity control loop

To increase servo stiffness, the velocity control loop gain (hereinafter the velocity gain) needs to be set to a high value. However, an excessively high velocity gain may induce vibration due to machine resonance or some other cause. Tune it so that as high a velocity gain as possible can be obtained while avoiding vibration by using a resonance elimination filter.

Fig. 4.3.3 (c) shows the tuning procedure.

	Description
Preparation for tuning	Perform tuning under the conditions in which oscillation is most likely to occur (the load on the motor generally becomes minimal).
⇓	
Tuning of the velocity gain and resonance elimination filter ⇒ 4.3.3 (3.1)	Decide on the optimal velocity gain by using one of the following methods: Method using Tuning Navigator of SERVO GUIDE Method using the frequency response
⇓	
Check of the tuning results ⇒ 4.3.3 (3.2)	· Operate the machine in full stroke and check that vibration and other problems do not occur. · Perform the acceleration/deceleration operation under the conditions in which the response speed becomes lowest (the load on the motor generally becomes maximum) and check that vibration and other problems do not occur.

Fig.4.3.3 (c) Velocity gain tuning procedure

(3.1) Tuning of the velocity gain and resonance elimination filter

Decide on the optimal velocity gain by using one of the following methods:

(A) Method using Tuning Navigator of SERVO GUIDE

(B) Method using the frequency response

(A) Method using Tuning Navigator

By using Tuning Navigator of SERVO GUIDE, the velocity gain and resonance elimination filter can be tuned easily. To start Tuning Navigator of SERVO GUIDE, click the [Navigator] button in the main bar of SERVO GUIDE. (See Fig. 4.3.3 (d).)

To tune the velocity gain and resonance elimination filter, the functions of (A.1), (A.2), and (A.3) in Fig. 4.3.3 (d) are used. Use them sequentially, starting with (A.1).

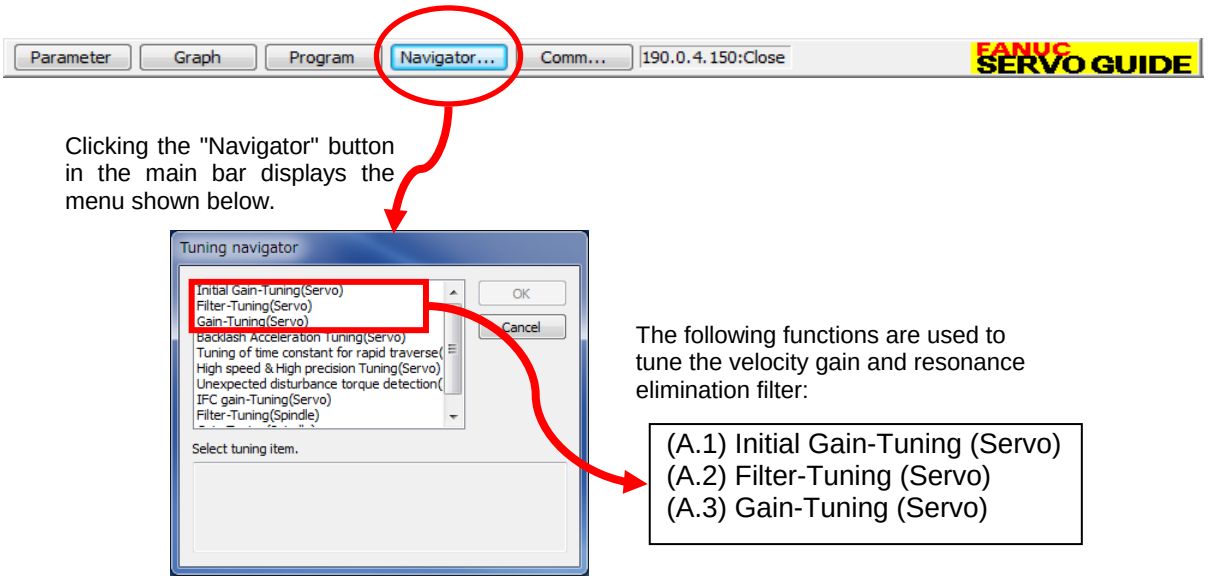
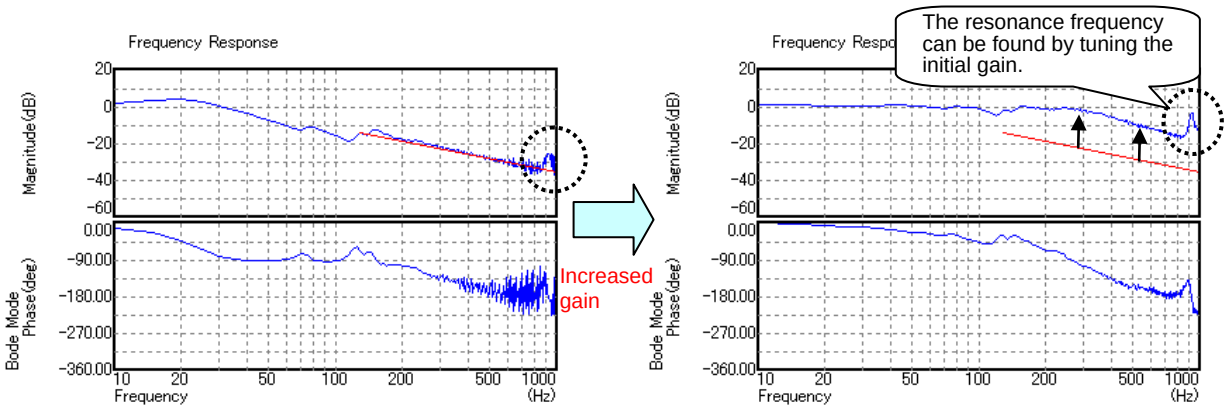


Fig. 4.3.3 (d) Starting Tuning Navigator of SERVO GUIDE

(A.1) Initial Gain-Tuning (Servo)

First, execute "Initial Gain-Tuning (Servo)" from Tuning Navigator to determine the initial value of the velocity gain that has a sufficient margin against the vibration limit.
Tuning Navigator displays the frequency response (bode plot) of the velocity control loop, as shown in Fig. 4.3.3 (e).

By tuning the initial value of the velocity gain, it is possible to find the exact resonance frequency using "Filter-Tuning (Servo)" described next. The final velocity gain is determined using "Gain-Tuning (Servo)."

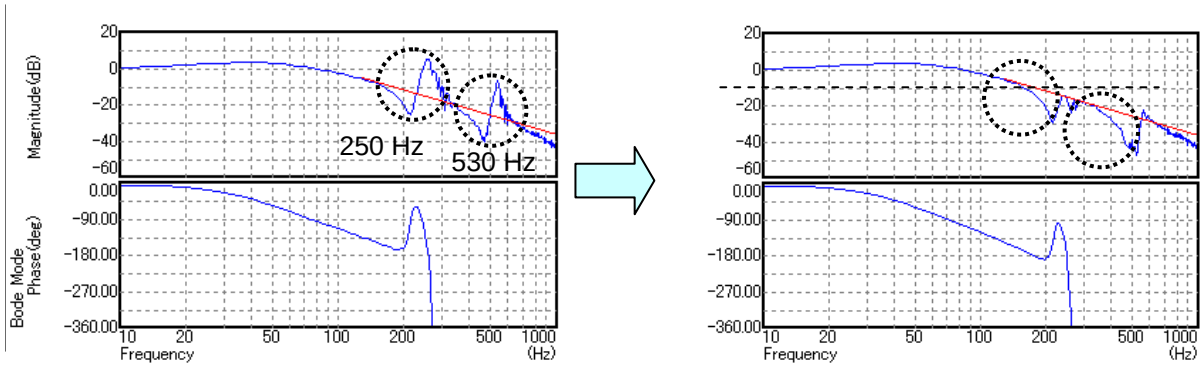


(i) Before velocity gain tuning **(ii) After velocity gain tuning**

Fig. 4.3.3 (e) Frequency response before and after execution of "Initial Gain-Tuning (Servo)" (example)

(A.2) Filter-Tuning (Servo)

Next, select "Filter-Tuning (Servo)" from Tuning Navigator and tune the resonance elimination filter to suppress machine resonance. Fig. 4.3.3 (f) shows an example of tuning for a machine having two resonance frequencies (250 Hz and 530 Hz).
By applying the resonance elimination filter, you can find that the gain at the resonance frequency is reduced.



(i) Before filter-tuning **(ii) After filter-tuning**

Fig. 4.3.3 (f) Frequency response before and after execution of "Filter-Tuning (Servo)" (example)

(A.3) Gain-Tuning (Servo)

The tuning in (A.1) and (A.2) eliminates the effect of machine resonance, making it possible to set a high velocity loop gain. Lastly, select "Gain-Tuning (Servo)" from Tuning Navigator and decide on the final velocity loop gain.

This completes the automatic tuning of the velocity gain and resonance elimination filter using Tuning Navigator.

(B) Method using the frequency response

This section describes the method of measuring the frequency response using SERVO GUIDE and tuning the velocity control loop based on its gain characteristic and phase characteristic. The frequency response has a "closed loop characteristic" and "open loop characteristic". Tune while observing the measurements of these two characteristics according to the procedure below.

1 Measure the frequency response and have the closed loop characteristic and open loop characteristic displayed.
2 If a machine resonance point is present, tune the velocity gain or resonance elimination filter according to the frequency.
3 Increase the velocity gain while observing the frequency response.

Fig. 4.3.3 (g) shows the flow of the tuning process.

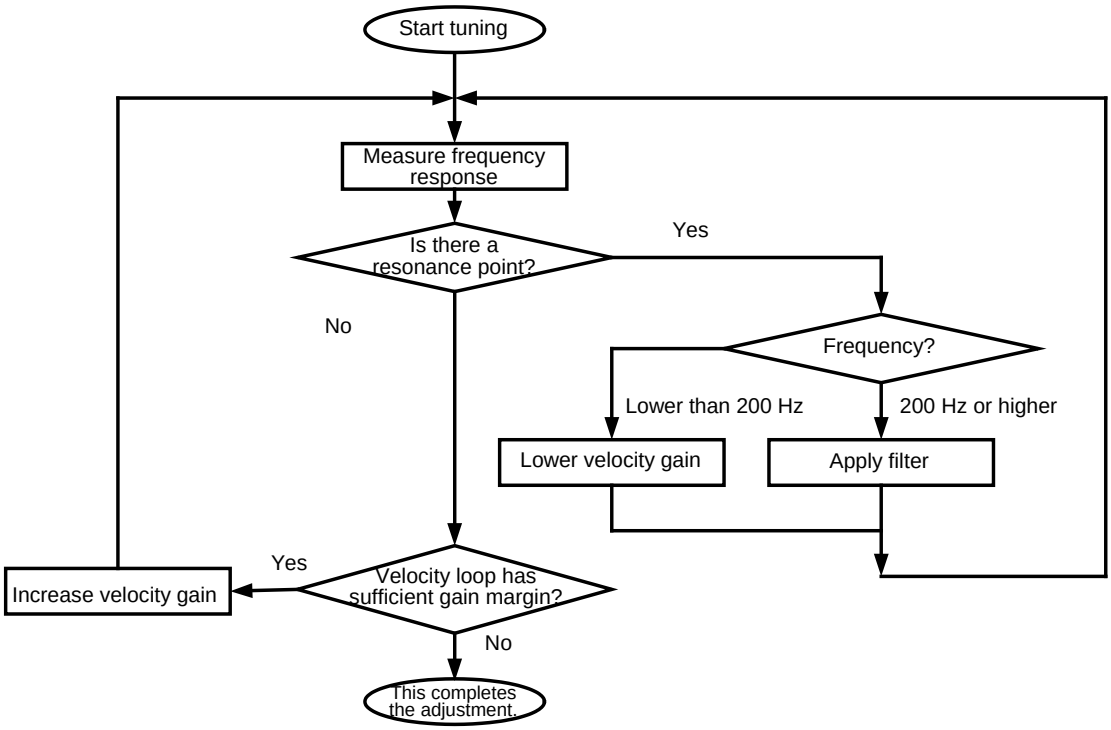
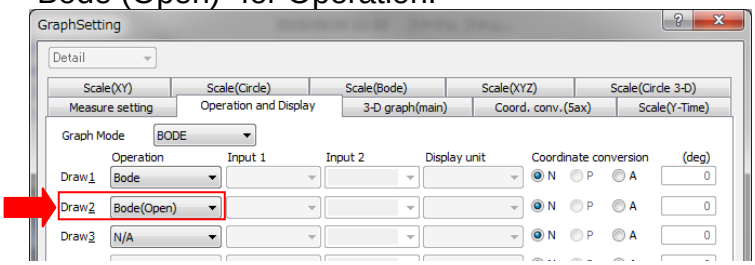


Fig. 4.3.3 (g) (B) Flow of gain tuning using the frequency response

NOTE

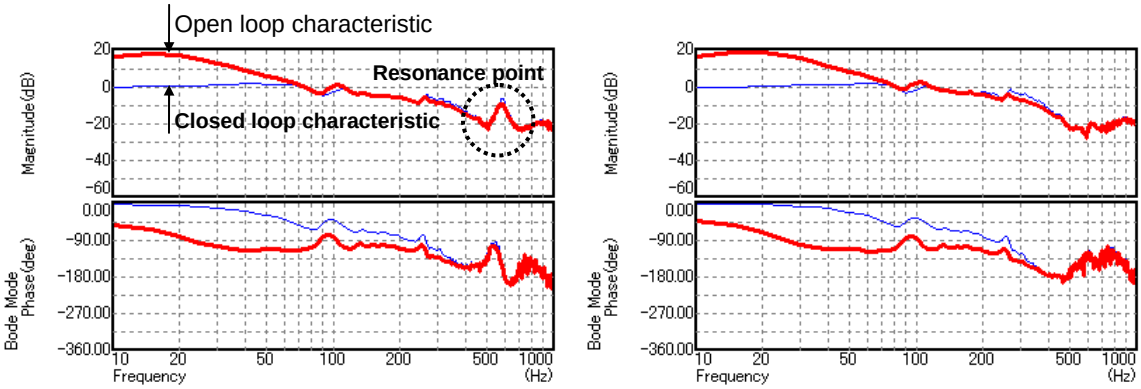
1 By default, SERVO GUIDE displays the closed loop characteristic as the frequency response. The open loop frequency response can be displayed by choosing [Setup(S)] - [Operation and Display] from the menu and then selecting "Bode (Open)" for Operation.



2 A more accurate frequency response measurement can be done by using "high precision measurement mode" when measuring the frequency response. For details, see Chapter 8, "SERVO TUNING TOOL SERVO GUIDE".

(B.1) Judgment of whether a resonance point is present and application of the resonance elimination filter

If there is a maximum point (resonance point) in the gain characteristic of the frequency response and vibration or noise occurs at that frequency (resonance frequency), it is likely that there is resonance-induced vibration. In this case, tune according to the resonance frequency, as shown in Table 4.3.3 (b).



(i) Before filter tuning **(ii) After filter tuning**

Fig. 4.3.3 (h) Example of frequency response measurement (before and after filter tuning)

Table 4.3.3 (b) Resonance frequency and tuning method

Resonance frequency	Tuning method	Reference filter setting	
Below 200 Hz	Lower the velocity gain (NOTE 1).	-	
200~400 Hz	Apply the resonance elimination filter (NOTE 2).	Attenuation bandwidth: Damping coefficient:	60~100 Hz 0~50 %
400~1000 Hz		Attenuation bandwidth: Damping coefficient:	100~200 Hz 0~10 %
Above 1000 Hz		Attenuation bandwidth: Damping coefficient:	300~600 Hz 0~10 %

Table 4.3.3 (c) Parameters for the resonance elimination filter

	Attenuation center frequency [Hz]	Attenuation bandwidth [Hz]	Damping [%]
Resonance elimination filter 1	No.2113	No.2177	No.2359
Resonance elimination filter 2	No.2360	No.2361	No.2362
Resonance elimination filter 3	No.2363	No.2364	No.2365
Resonance elimination filter 4	No.2366	No.2367	No.2368

NOTE

1 If the vibration frequency is as low as 200 Hz, the application of the resonance elimination filter is not recommended for the reasons mentioned below. Tune by lowering the velocity gain.
- The vibration is caused by an excessive velocity gain.
- The resonance frequency is close to the control bandwidth, and the application of the filter may reduce the control bandwidth.

2 For details of the resonance elimination filter function, see Subsection 5.4.4.

(B.2) Judgment of whether the velocity gain has sufficient margin

When the following three criteria are all met, you can judge that there is a margin for the velocity gain value and increase the velocity gain.

(1) In the open loop characteristic, the gain is -6 dB or less when the phase delay is 180 degrees (gain margin).

(2) In the open loop characteristic, the phase delay is -150 degrees or more when the gain is 0 dB (phase margin).

(3) In the closed loop characteristic, the gain is +5 dB or less in all frequency domains.

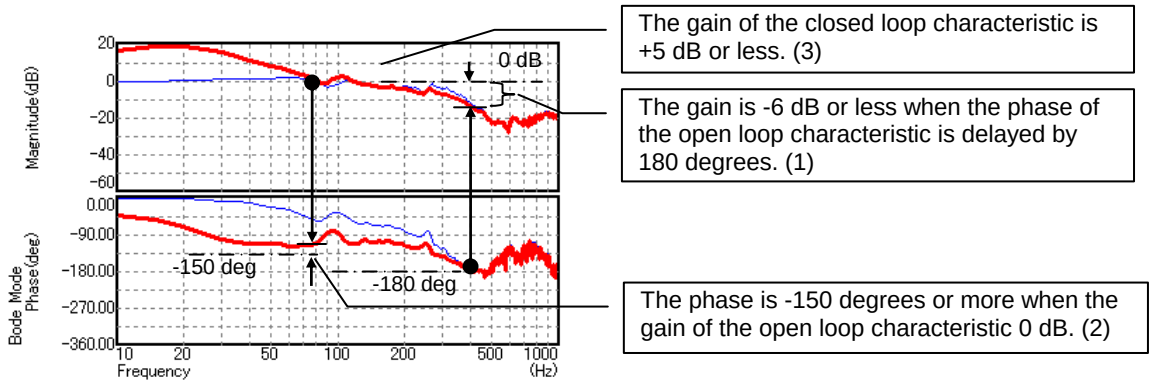


Fig. 4.3.3 (i) Judgment criteria for the velocity gain margin and example of frequency response measurement

(B)-3 Check of the tuning results

Check that vibration, noise, and other problems do not occur, as a result of the gain tuning made in the preceding steps. The major items to be checked are as follows.

- Have the machine perform a reciprocating motion in full stroke at the maximum cutting feedrate, and check that vibration and noise do not occur.
- Have the machine perform a reciprocating motion in small steps in manual handle feed, and check that vibration and noise do not occur.
- Have the machine operate at the maximum cutting feedrate with the maximum load on it, and check that vibration and noise do not occur.

The check is complete if vibration and noise do not occur.

If vibration or noise is detected, identify the vibration frequency and fine-tune the velocity gain and resonance elimination filter.

1. Identify the vibration frequency by using SERVO GUIDE. (For the method, see the next section.)
2. Tune the velocity gain or apply the resonance elimination filter according to the vibration frequency, as instructed in "Table 4.3.3 (b) Resonance frequency and tuning method".

Identification of the vibration frequency

The vibration frequency that appears in the torque command (TCMD) can be identified using the procedure below.

1. In the channel setting of SERVO GUIDE, set the following:
   Sampling Cycle (Servo): 125 µsec
   Kind: TCMD
   Measure the TCMD data during vibration, and display the result in "XTYT mode".
2. Tune the horizontal axis scale so that the number of vibrations is 1 to 100 (NOTE), select "FOURIER mode" (Ctrl-F) as the display mode, and then display the result. This shows the frequency analysis result for the waveform displayed in "XTYT mode".
3. If you check the "W-info" check box in the lower right of the graph window and place the cursor over the peak vibration in the graph, the vibration frequency is displayed in the Freq field.

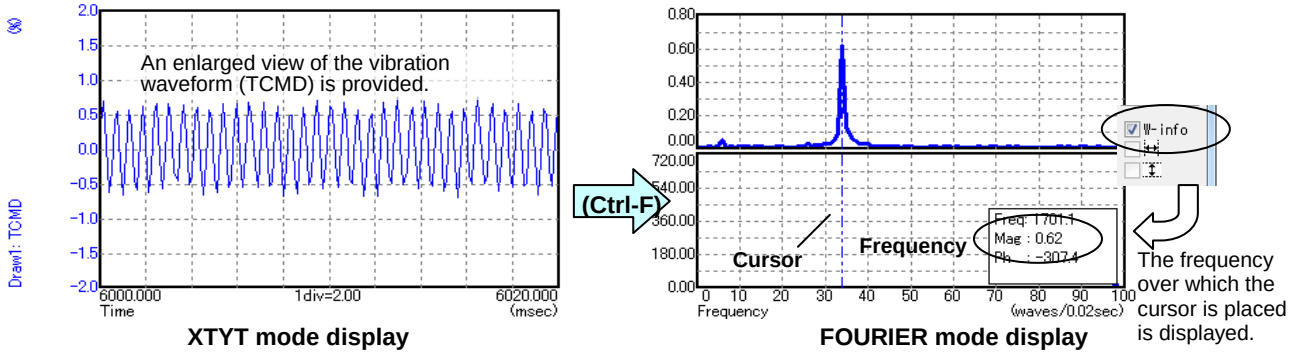


Fig. 4.3.3 (j) Example of identification of the vibration frequency

> **NOTE**
> In FOURIER mode, the number of vibrations for the time range displayed in XTYT mode is displayed along the horizontal axis and vibration components from 1 to 100 can be analyzed. When the number of vibration components is less than 1 or more than 100, enlarge or reduce the horizontal axis in XTYT mode so that the number of vibrations falls within the range of 1 to 100, and then display the vibration components in FOURIER mode.

(4) Tuning of the position control loop

To improve the contouring accuracy, the position control loop gain (hereinafter, the position gain) needs to be set to a high value. However, an excessively high position gain may induce vibration of a low frequency (10 to 30 Hz). Tune so that as high a position gain can be obtained without causing vibration.

Fig. 4.3.3 (k) shows the tuning procedure.

	Description
Preparation for tuning	Tune under the conditions in which the response speed becomes lowest (the load on the motor generally becomes maximum).
⇓	
Tuning of the position gain ⇒ 4.3.3 (4.1)	Determine the optimal position gain by using one of the following methods: (A) Tuning method based on the velocity loop bandwidth (B) Tuning method based on the vibration state in a reciprocating motion (C) Tuning method based on the vibration state in a circular motion

Fig. 4.3.3 (k) Position gain tuning procedure

(4.1) Position gain tuning

(A) Tuning method based on the velocity loop bandwidth

In the case of semi-closed control, the response bandwidth of the position loop is generally about a fifth of that of the velocity loop. By using this, the reference position gain can be determined by using the procedure below.

1) Using SERVO GUIDE, obtain the frequency response (closed loop characteristic) of the velocity loop.
2) Determine the band frequency of the velocity loop. (The band frequency is the frequency at which the phase delay is 90 degrees in the closed loop characteristic.)
3) Find the reference position gain value using the equation below.

$$\text{Set position gain } [0.01/s] \leq \frac{2\pi}{5} \cdot f_v \cdot 100$$

(f_v: Band frequency of the velocity loop)

4) As the position gain, set a value that is 80% of the maximum value calculated in the preceding step.

5) Perform the reciprocating motion described in the following item (B), and make sure that none of the problems mentioned in Table 4.3.3 (c) or low-frequency vibration occur.
If no problems (including vibration) occur, use the position gain determined above. If a problem does occur, lower the position gain and set a value that is about 80% of the oscillation limit.

In the example of Fig. 4.3.3 (l), the band frequency of the velocity loop is 65 Hz. Therefore, the position gain value can be calculated using the equation above.

Set position gain $[0.01/s] \leq \frac{2\pi}{5} \cdot 65 \cdot 100 = 8168$

The position gain is found to be 6500, which is about 80% of the maximum value.

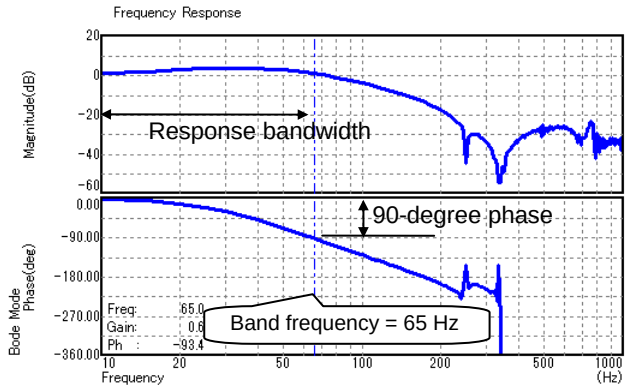


Fig. 4.3.3 (l) Determining the position gain based on the velocity loop bandwidth

(B) Tuning method based on the vibration state in a reciprocating motion

Perform rapid traverse and cutting feed at the maximum cutting feedrate, and observe the velocity and torque command waveform (TCMD) at acceleration/deceleration, as shown in Fig. 4.3.3 (m). If any of the problems mentioned in Table 4.3.3 (d) does not occur or low-frequency vibration of 10 to 30 Hz (hunting) does not occur in the torque command (TCMD) waveform at a constant feedrate, increase the position gain. If vibration occurs, set a value that is about 80% of the oscillation limit.

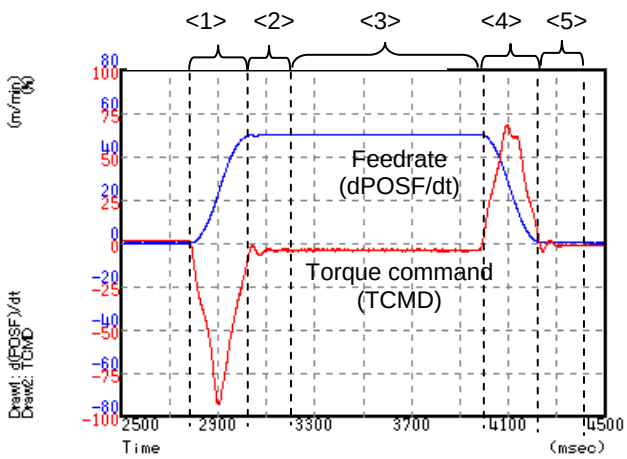


Fig. 4.3.3 (m) Rapid traverse acceleration/deceleration measurement for position gain tuning

Table 4.3.3 (d) Major problems for acceleration/deceleration and actions

Legend	Operation	Problem	Action
<1>, <4>	During acceleration or deceleration	There is vibration or noise.	Lower the position gain.
		The torque command has reached the maximum value.	Increase acceleration/deceleration time constant T1 (linear part).
<2>, <5>	After acceleration or deceleration	There is overshoot or vibration.	Lower the position gain.
		The torque command has reached the maximum value.	Increase acceleration/deceleration time constant T2 (bell-shaped part).
<3>	Constant feedrate	There is vibration (uneven feedrate).	Lower the position gain.

NOTE

The servo delay at a constant feedrate is expressed by the following equation:

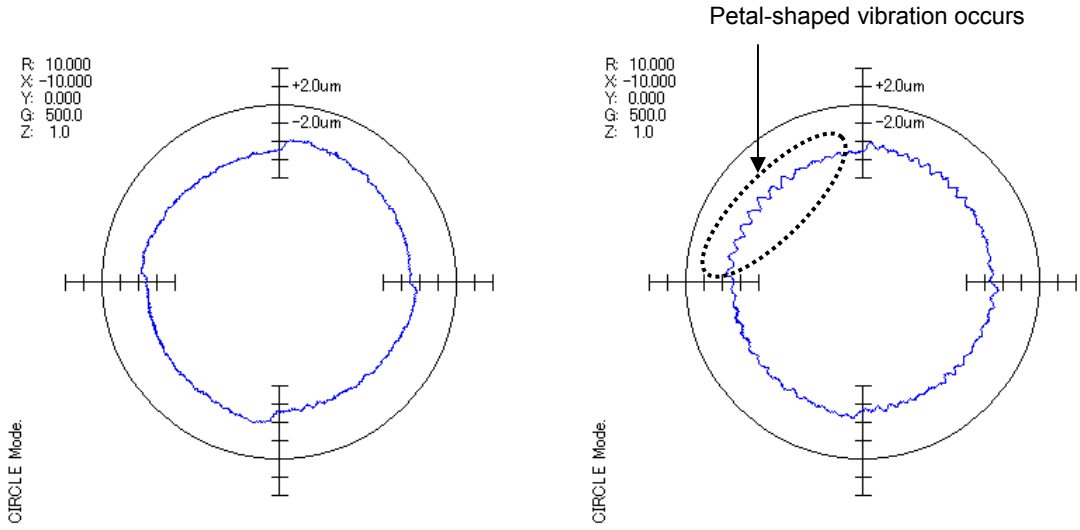
$$\text{Position error} = \frac{\text{Feedrate (mm/s)}}{\text{Minimum detection unit (mm)} \times \text{Position gain}} \times (1 - \alpha)$$

(α: Feedforward coefficient ($0 \leq \alpha \leq 1$))

If feedforward is not used or a value other than 1 (equivalent to 100%) is set as the feedforward coefficient, and if the position gain value differs between the axes for which interpolation is performed, interpolation error occurs (e.g., an arc figure becomes elliptical). In such a case, set the same position gain value for each axis for which interpolation is performed.

(C) Tuning method based on the vibration state in a circular motion

Perform a high-acceleration circular motion (circular motion with a small radius and a high velocity; e.g., R10 F4000), and display the result in the CONTOUR mode of SERVO GUIDE. As you increase the position gain, petal-shaped vibration occurs in the waveform. Set a value that is about 80% of the position gain (limit value) observed when the vibration occurred.



(i) Before position gain tuning **(ii) Position gain limit value**

Fig. 4.3.3 (n) Tuning of the position gain using a circular motion

4.3.4 Tuning to Improve Contouring Accuracy

(1) Overview

Improving contouring accuracy requires the following tuning procedures in addition to tuning feedback control to increase servo stiffness.

- Feedforward control
  Compensates the necessary velocity and torque commands to reduce position and velocity errors.
- Quadrant protrusion compensation (backlash acceleration)
  Reduces position errors caused by a delay when motor rotation is reversed.
- Acceleration/deceleration control
  Reduces changes in velocity (acceleration) and acceleration (jerk) to reduce contour errors such as shaking and corner error of the machining point.

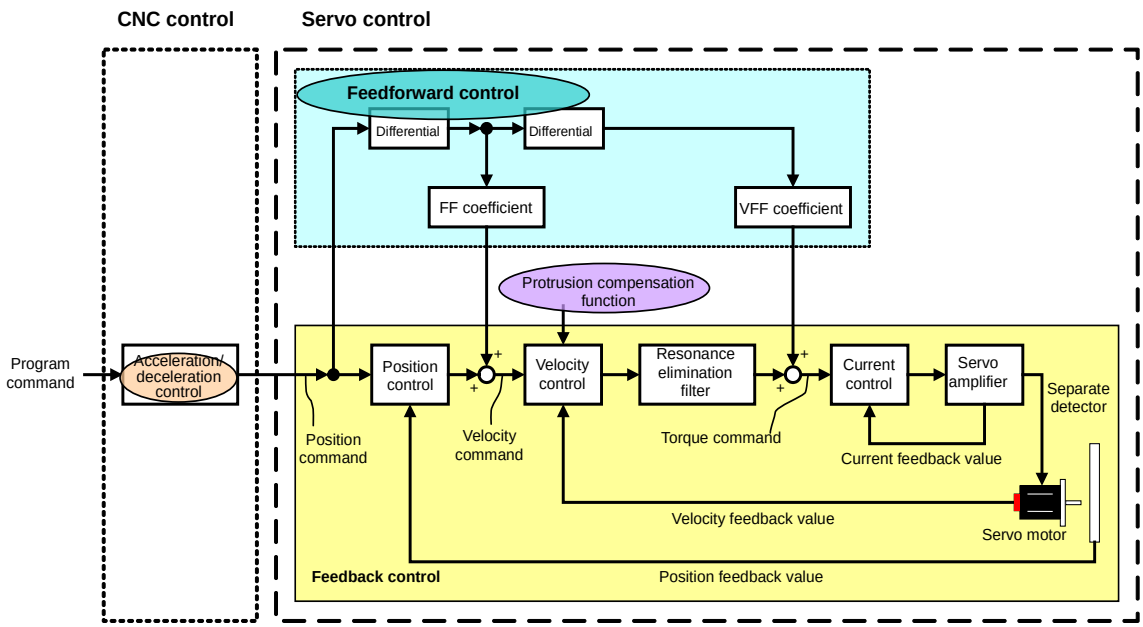


Fig. 4.3.4 (a) Block diagram for functions related to contouring accuracy

Calculate the feedforward coefficient as follows: Tune the acceleration/deceleration parameters for quadrant protrusion compensation and AI contour control by using the following test figures:

- Arc figure Tuning of the quadrant protrusion compensation (backlash acceleration)
- Square figure Tuning of velocity control by the speed difference among axes at corners
- Square figure with rounded corners Tuning of deceleration by acceleration in circular interpolation

(2) Tuning of feedforward

Feedforward is a function to reduce error, i.e., the difference between the command value and feedback value, by adding the differential value of the command value. There are two types of feedforward: feedforward for position loop and feedforward for velocity loop.

- Feedforward for velocity loop: The necessary velocity command value obtained by the first-order differential of the position command value is added to the velocity command to reduce the position error.
- Feedforward for velocity loop: The acceleration command value obtained by the second-order of the position command value is added to the torque command value to reduce the velocity error.

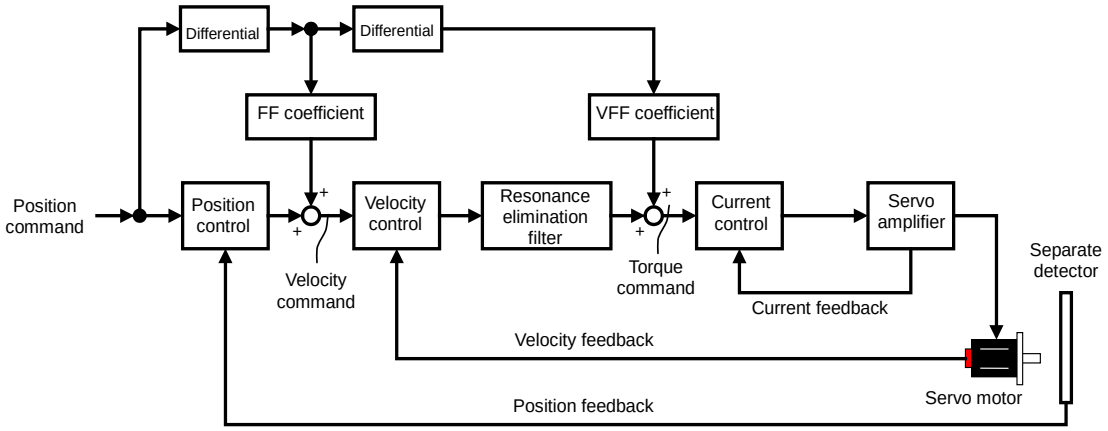


Fig. 4.3.4 (b) Block diagram for feedforward control

(2.1) Feedforward (for position loop)

The velocity command value is obtained by multiplying the difference between the position command value and the position feedback value (position error) by the position gain, so a position error occurs when a motor is turned. This feedforward can reduce the position error by compensating for the velocity command necessary for the specified velocity being used as the feedforward parameter.

For cutting, specify 100% to eliminate the position error, and for rapid traverse, specify 98% to reduce overshoot.

Table 4.3.4 (a) Recommended feedforward coefficient

Parameter No.	Description	Recommended value
2092	Rapid traverse feedforward coefficient	9800 (*1)
2144	Cutting feedforward coefficient	10000

(*1) The recommended value is 98%, but if you want to reduce the position error during rapid traverse, you may set a value of 98% to 100% while taking the overshoot amount into consideration.

(2.2) Feedforward (for velocity loop)

When the specified acceleration value is large, contour error may occur as the response of the velocity control loop is delayed. Velocity feedforward can reduce contour error caused by the delay of the velocity control loop, by compensating for the torque command value with the torque necessary for the specified acceleration being used as the feedforward parameter.

Check the load inertia of the machine, and then set the value calculated by the following equation in the velocity feedforward coefficient parameter. If the load inertia of the machine is unknown, specify the initial setting, or 100%.

$$\text{(Velocity feedforward coefficient)} = 100 \times \frac{\text{Rotor inertia of motor + Load inertia}}{\text{Rotor inertia of motor}}$$

Table 4.3.4 (b) Recommended feedforward coefficient

Parameter No.	Description	Initial setting
2069	Velocity feedforward coefficient for rapid traverse	100
2145	Velocity feedforward coefficient for cutting feed	100

(3) Tuning by using an arc figure

Error that occurs when one quadrant switches to another during a circular motion (the direction of axis movement is reversed) is called a quadrant protrusion.

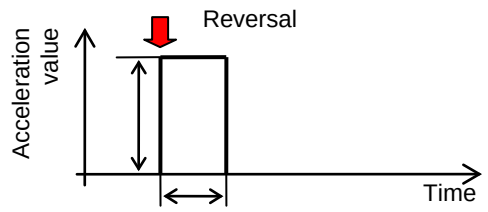
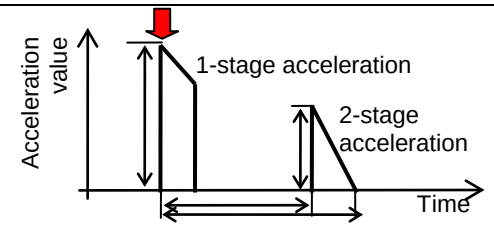
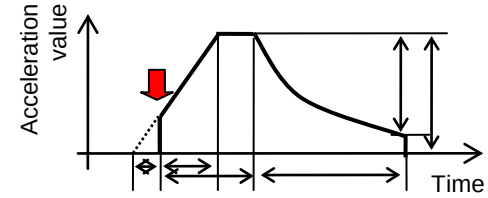
A quadrant protrusion is caused by an axis reversal delay (insufficient response speed) and can be improved by the tuning described below.

- Increase the velocity gain (increase the response speed of the axis). → For information about this tuning, see (3) in Subsection 4.3.3.
- Perform quadrant protrusion compensation.

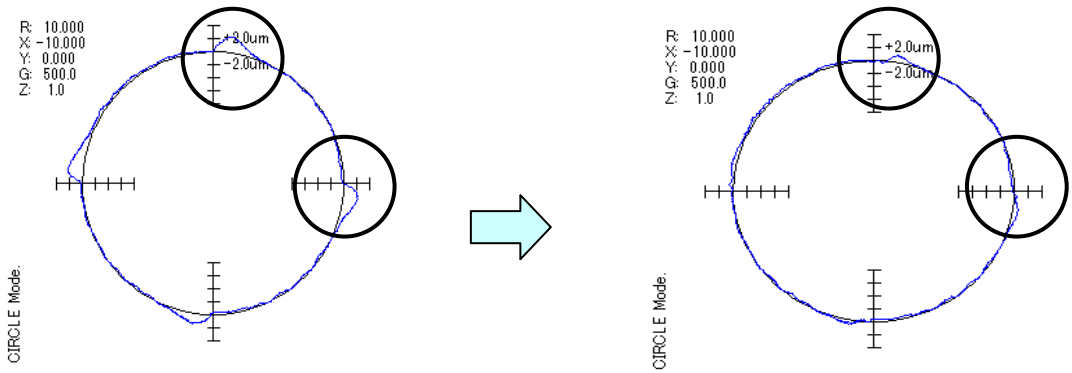
Quadrant protrusion compensation compensates the reversal torque in terms of feedforward to reduce quadrant protrusions. Based on the difference in the compensation torque pattern (acceleration value), there are three functions as shown in Table 4.3.4 (c).

The pattern of error generation due to a quadrant protrusion depends on the mechanical characteristics. Select the appropriate quadrant protrusion compensation function based on the error pattern. For details of the functions, see Section 5.5 and Appendix M.

Table 4.3.4 (c) Quadrant protrusion compensation functions and compensation patterns

Function	Compensation torque pattern	Details
Backlash acceleration		Subsection 5.5.4
Two-stage backlash acceleration		Subsection 5.5.5
SERVO GUIDE quadrant protrusion tuning (automatic tuning by Tuning Navigator)		Appendix M SERVO GUIDE Help

* The arrow shown in the compensation torque pattern column in the above table represents the tuning parameter.



(i) When quadrant protrusion compensation is disabled **(ii) When quadrant protrusion compensation is enabled**

Fig. 4.3.4 (d) Example of the effect of quadrant protrusion compensation

(4) Tuning by using a square figure

In this item, tune the following parameters through the motion of a square figure.

- Tuning of the allowable speed difference in determining velocity based on the speed difference at corners
- Time constant of Acc./Dec. before interpolation

(4.1) Preparation for tuning

For the tuning, prepare a motion program for a square figure with 20 mm on a side shown in Fig. 4.3.4 (e). This program can be created easily by using the Program window of SERVO GUIDE.

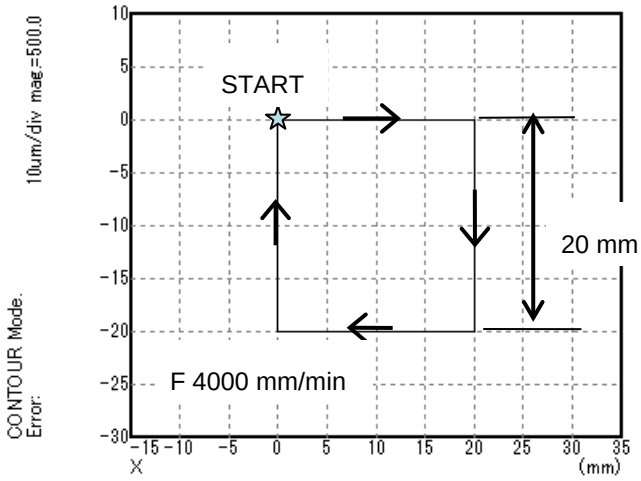


Fig. 4.3.4 (e) Example of a square figure

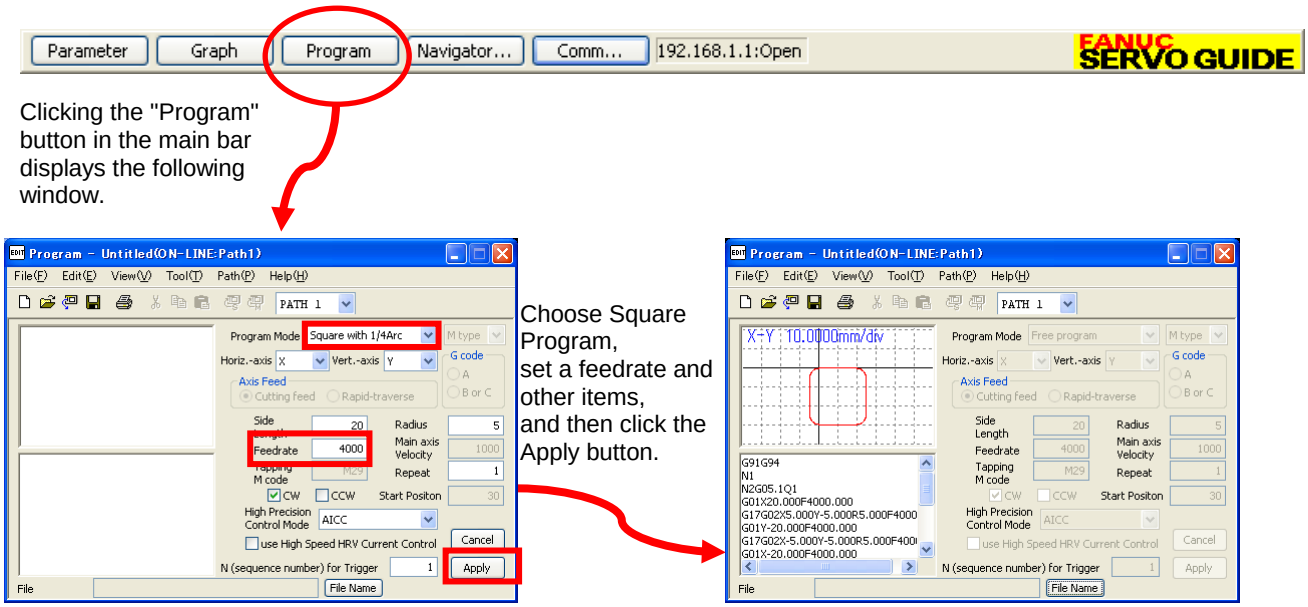


Fig. 4.3.4 (f) Creating a test program using the Program window (square)

(4.2) Tuning of velocity control by speed difference among axes at corners

In a square figure, position error (overshoot) occurs at corners (corners of the square figure) because the velocity of each axis significantly changes. This position error can be reduced by applying velocity control by speed difference among axes at corners and reducing the velocity at corners.

At corners, velocity is reduced by the allowable acceleration (No. 1660) and bell-shaped time constant (No. 1772) of acceleration/deceleration before interpolation. To reduce contour error at corners, reduce acceleration and jerk at corners. Note, however, that reducing the allowable acceleration or increasing the time constant improves accuracy, whereas the cycle time becomes longer.

(A) Tuning of the allowable speed difference at corners (Reduce the allowable speed difference at corners of No. 1783.)
(B) Tuning of acceleration/deceleration before interpolation (Reduce the allowable maximum acceleration of No. 1660 and increase the bell-shaped time constant of No. 1772.)

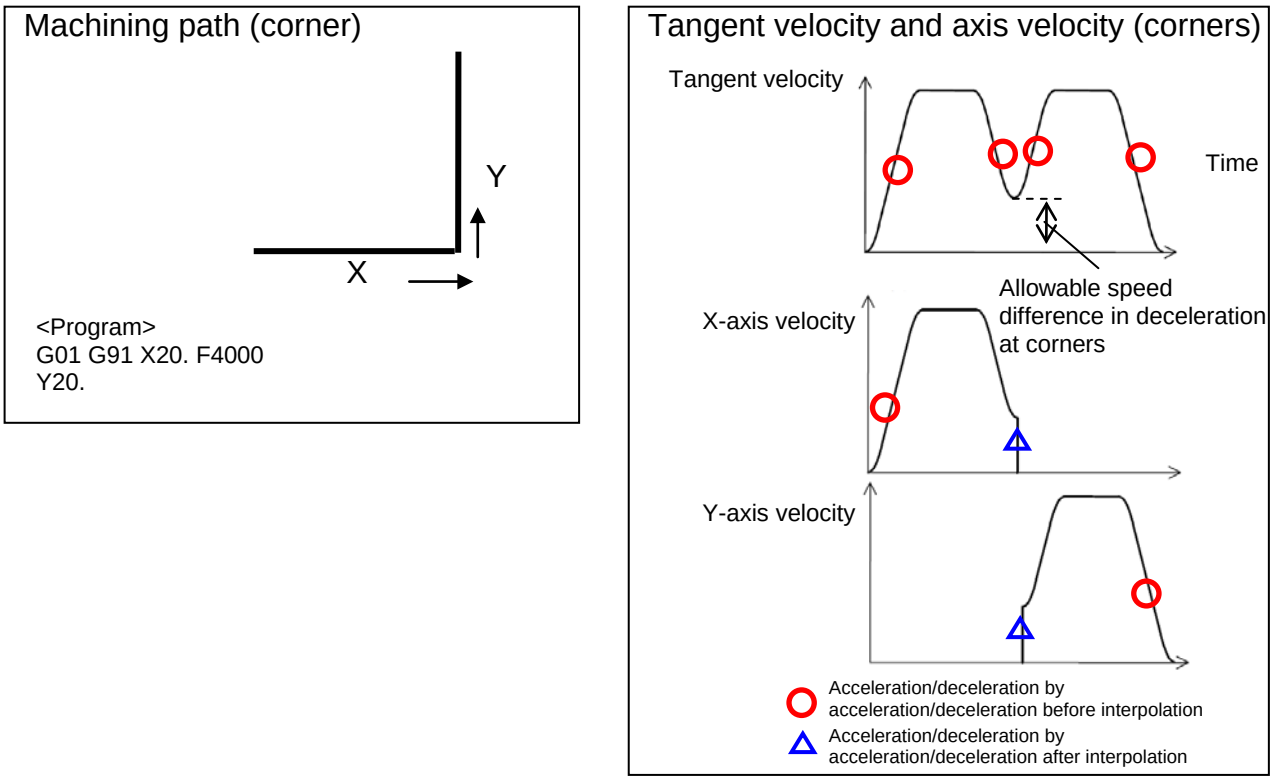


Fig. 4.3.4 (g) Machining path and acceleration/deceleration at corners

As shown in the figure below, the acceleration/deceleration applied before the command is distributed to each axis is referred to as acceleration/deceleration before interpolation, and the acceleration/deceleration distributed to each axis is referred to as acceleration/deceleration after interpolation.

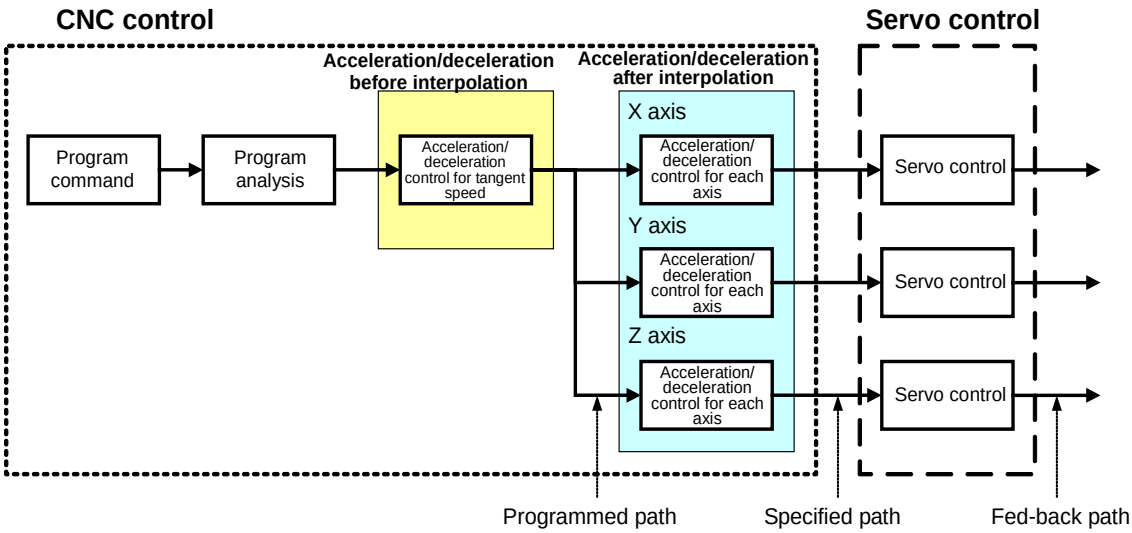


Fig. 4.3.4 (h) Acceleration/deceleration before interpolation and acceleration/deceleration after interpolation

(A) Tuning of the allowable speed difference at corners

In order to reduce contour error at corners, it is effective to reduce the cutting feedrate at corners by using the following parameter.

Table 4.3.4 (d) Parameter for the allowable speed difference in determining velocity based on the speed difference at corners

Parameter No.	Description
1783	Allowable speed difference in determining velocity based on the speed difference at corners

[Parameter window main screen] **[Acceleration/deceleration + AI contour control I (AI contour control I is used)]**

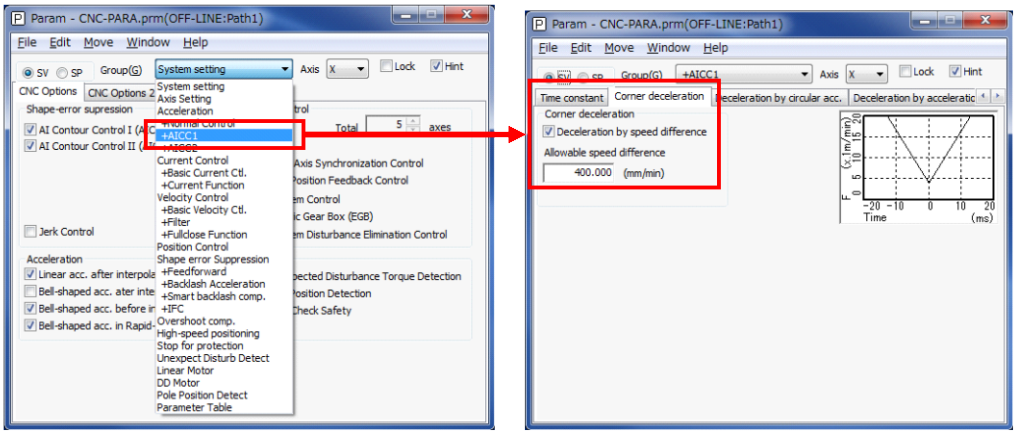
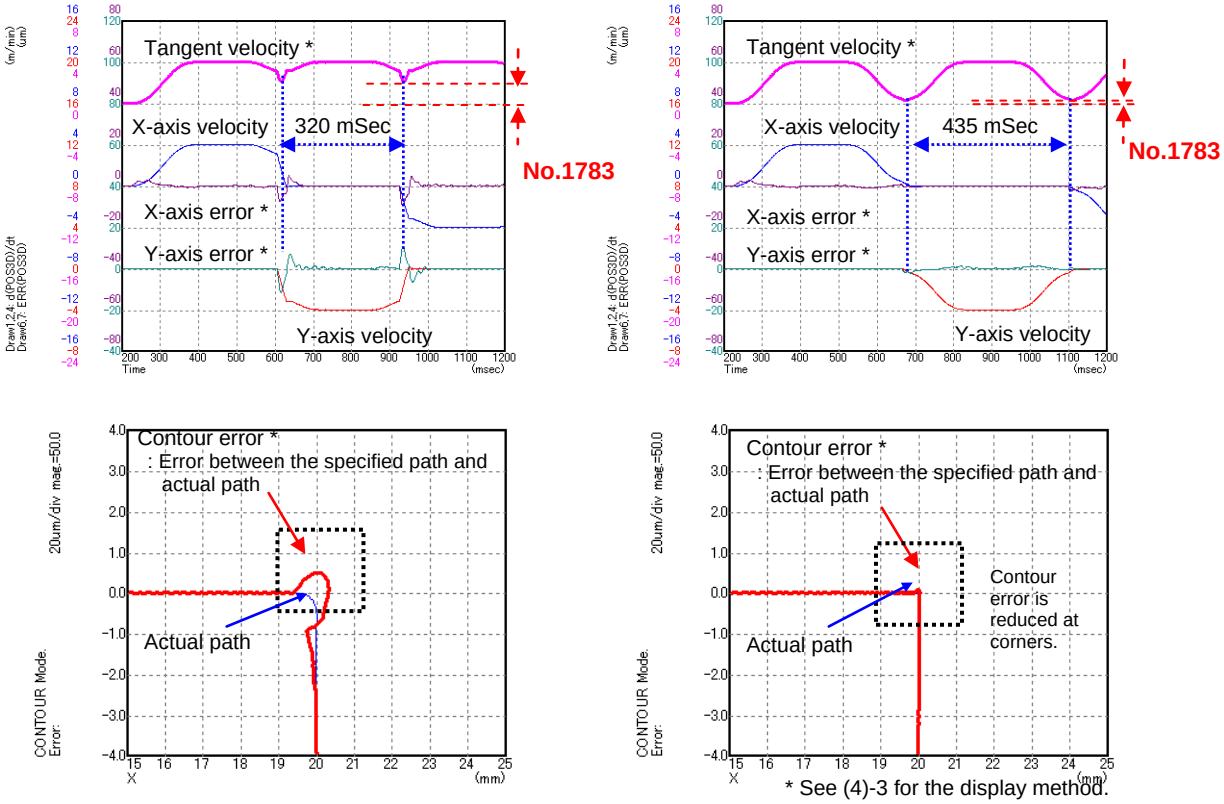


Fig. 4.3.4 (i) SERVO GUIDE screen for setting the allowable speed difference at corners

Fig. 4.3.4 (j) shows motions obtained when the allowable speed difference at corners is changed. Reducing the allowable speed difference reduces velocity at corners and decreases contour error, whereas the cycle time becomes longer. It is necessary to maintain balance between contouring accuracy and cycle time when tuning.



(i) Before tuning of the allowable speed difference at corners **(ii) After tuning of the allowable speed difference at corners**

Fig. 4.3.4 (j) Reduction in contour error by tuning of the allowable speed difference at corners

(B) Tuning of acceleration/deceleration before interpolation

Acceleration/deceleration before interpolation allows acceleration of the tangent velocity to be tuned using the following parameters.

Table 4.3.4 (e) Parameters for acceleration/deceleration before interpolation

Parameter No.	Description
1660	Allowable maximum acceleration for each axis by acceleration/deceleration before interpolation
1772	Acceleration change time in bell-shaped acceleration/deceleration before interpolation

[Parameter window main screen] **[Acceleration/deceleration + AI contour control 1 (AI contour control I is used)]**

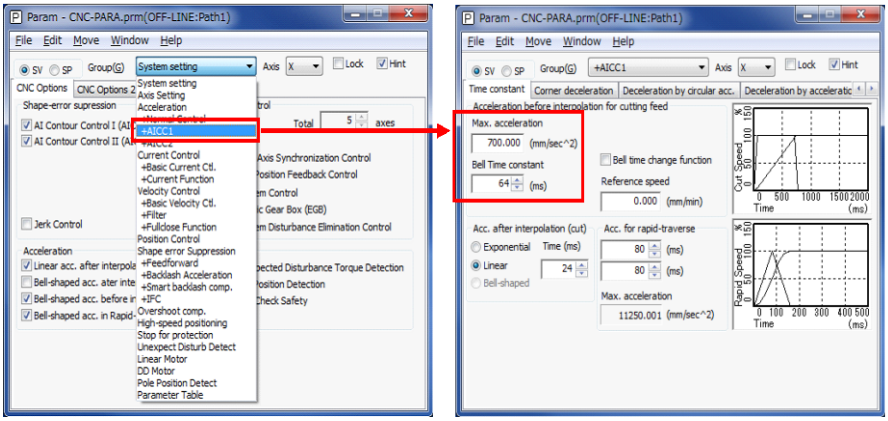
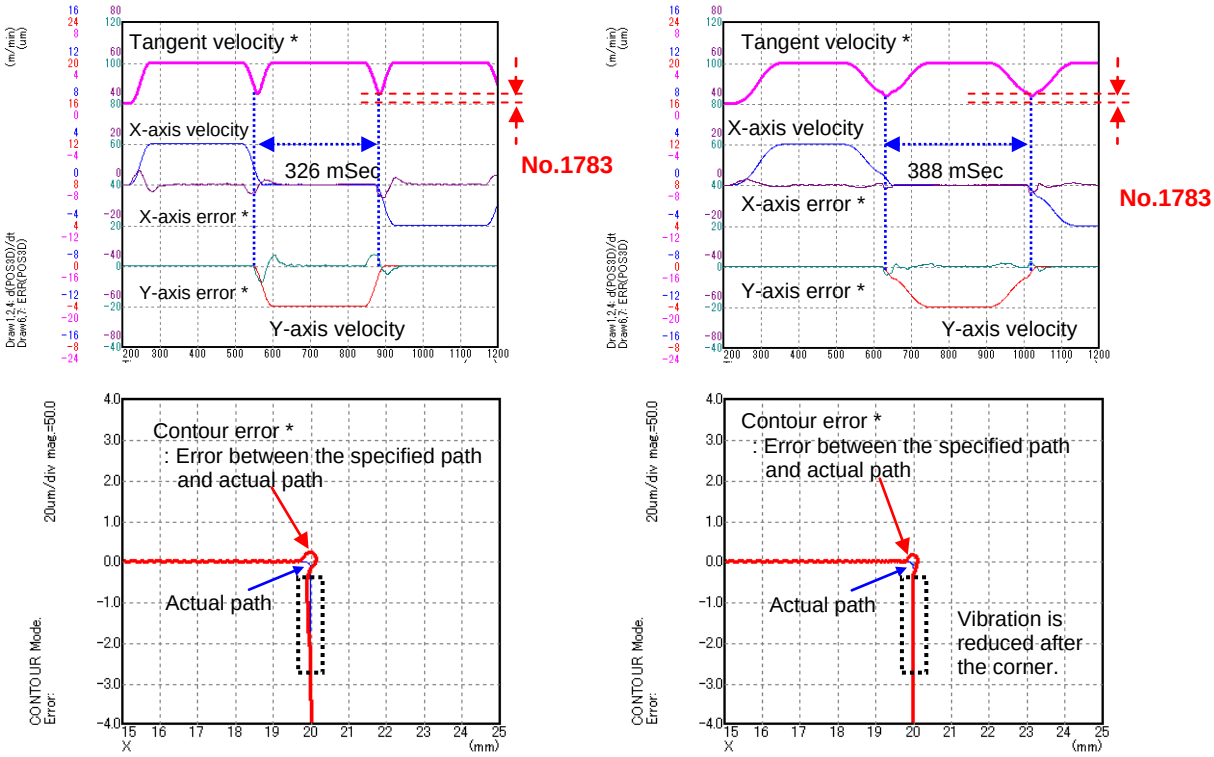


Fig. 4.3.4 (k) SERVO GUIDE setting screen for cutting feed acceleration/deceleration before interpolation

Fig. 4.3.4 (l) shows motions obtained when the maximum allowable acceleration of acceleration/deceleration before interpolation is changed. Reducing the maximum allowable acceleration reduces acceleration at corners and decreases contour error, whereas the cycle time becomes longer. It is necessary to maintain balance between contouring accuracy and cycle time when tuning.



* See (4)-3 for the display method.

(i) Before tuning of acceleration/deceleration before interpolation **(ii) After tuning of acceleration/deceleration before interpolation**

Fig. 4.3.4 (l) Reduction in contour error by tuning of acceleration/deceleration before interpolation

(4.3) Display method

To display the tangent velocity, position error, and contour error, select the following in Operation and Display:

Table 4.3.4 (f) Data to display

Graph mode	Data to display	Operation
YT	Tangent velocity	Tangent
YT	Position error	ERR
XY	Contour error	PathErr2D

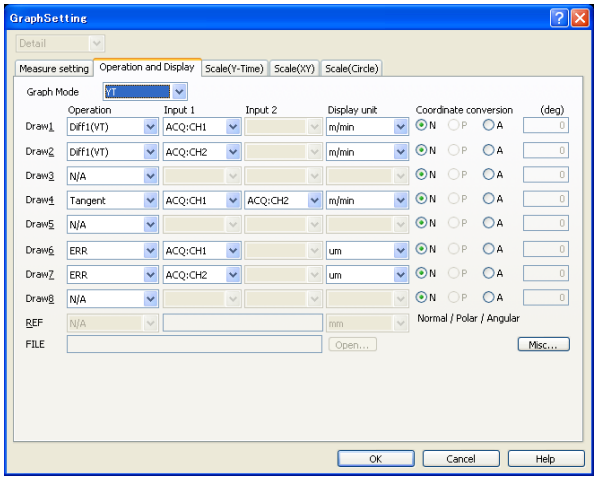


Fig. 4.3.4 (m) Example of display in YT mode

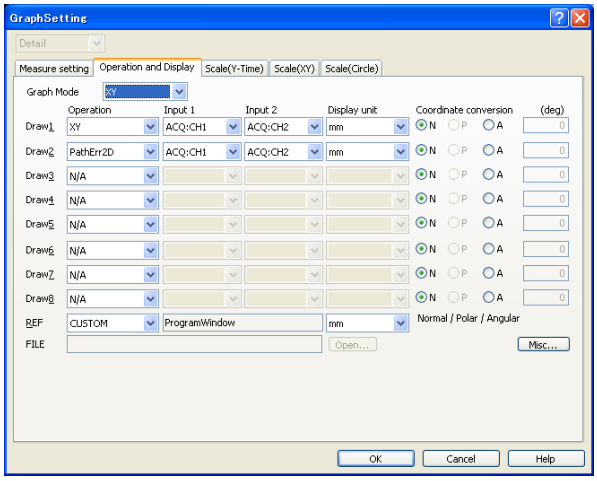


Fig. 4.3.4 (n) Example of display in XY mode

(5) Tuning by using a square with rounded corners

In this item, tune the following parameters through the motion of a square figure with rounded corners.

- Tuning of deceleration by acceleration in circular interpolation

(5.1) Preparation for tuning

For the tuning, prepare a motion program for a square figure with 1/4 arcs of a 5-mm radius shown in Fig. 4.3.4 (o). This program can be created easily by using the Program window of SERVO GUIDE. (See Fig. 4.3.4 (p).)

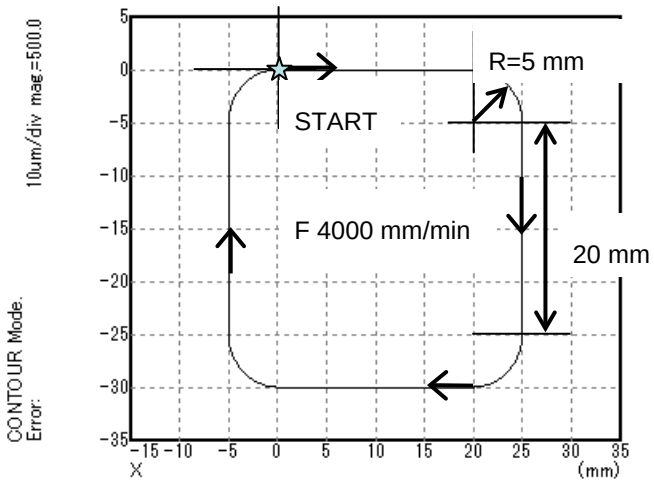


Fig. 4.3.4 (o) Example of a square figure with rounded corners

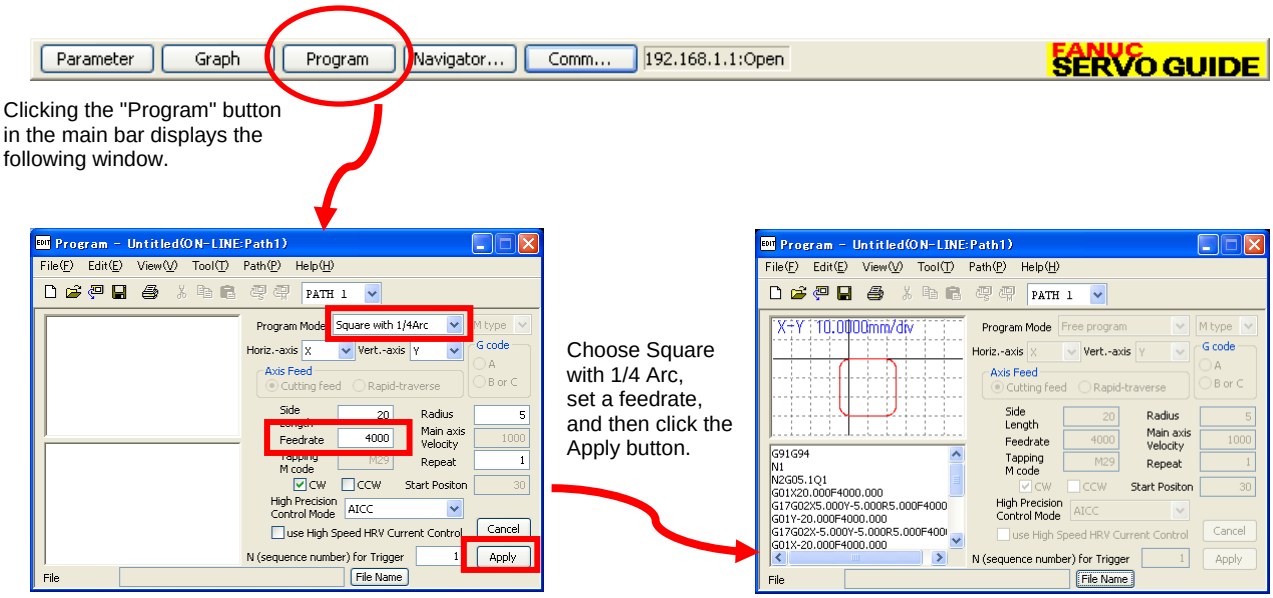


Fig. 4.3.4 (p) Creating a test program using the Program window (square with rounded corners)

(5.2) Tuning of deceleration by acceleration in circular interpolation

In a square figure with rounded corners, position error occurs at a part where a line and an arc are connected and acceleration significantly changes. Limiting acceleration for the arc is effective for reducing the position error. The acceleration of a circular motion can be calculated by the following equation using the feedrate (F[mm/min]) and radius (R[mm]). Calculate the acceleration limit value based on the radius of the arc and the velocity to be limited.

$$\text{Acceleration of circular motion}\,[\text{mm/s}^2] = \frac{(\text{F[mm/min]}/60)^2}{\text{R[mm]}}$$

For example, if you have a motion program in which the arc radius is set to 5 mm and the feedrate is set to 4000 mm/min and you want to reduce the velocity for the arc down to 1500 mm/min, set $(1500 / 60)^2 / 5 = 125$ mm/s^2 as the allowable acceleration (No. 1735). If the arc radius is very small, set the lower-limit velocity (No. 1732) to prevent the velocity from becoming too low.

Parameter No.	Description
1735	Allowable acceleration of each axis for deceleration by acceleration in circular interpolation
1732	Lower limit velocity for deceleration by acceleration in circular interpolation

When using the Parameter window of SERVO GUIDE, you can enter these values as shown in Fig. 4.3.4 (q).

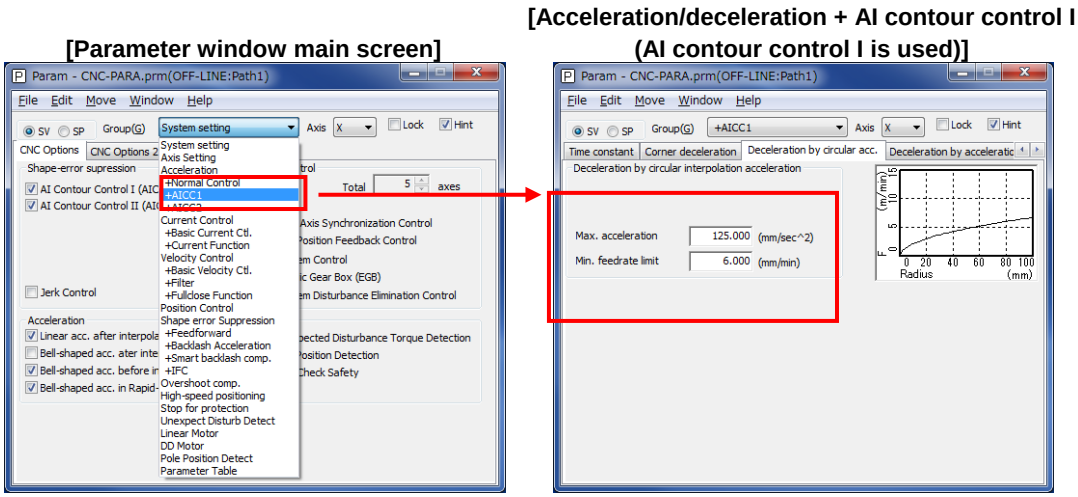
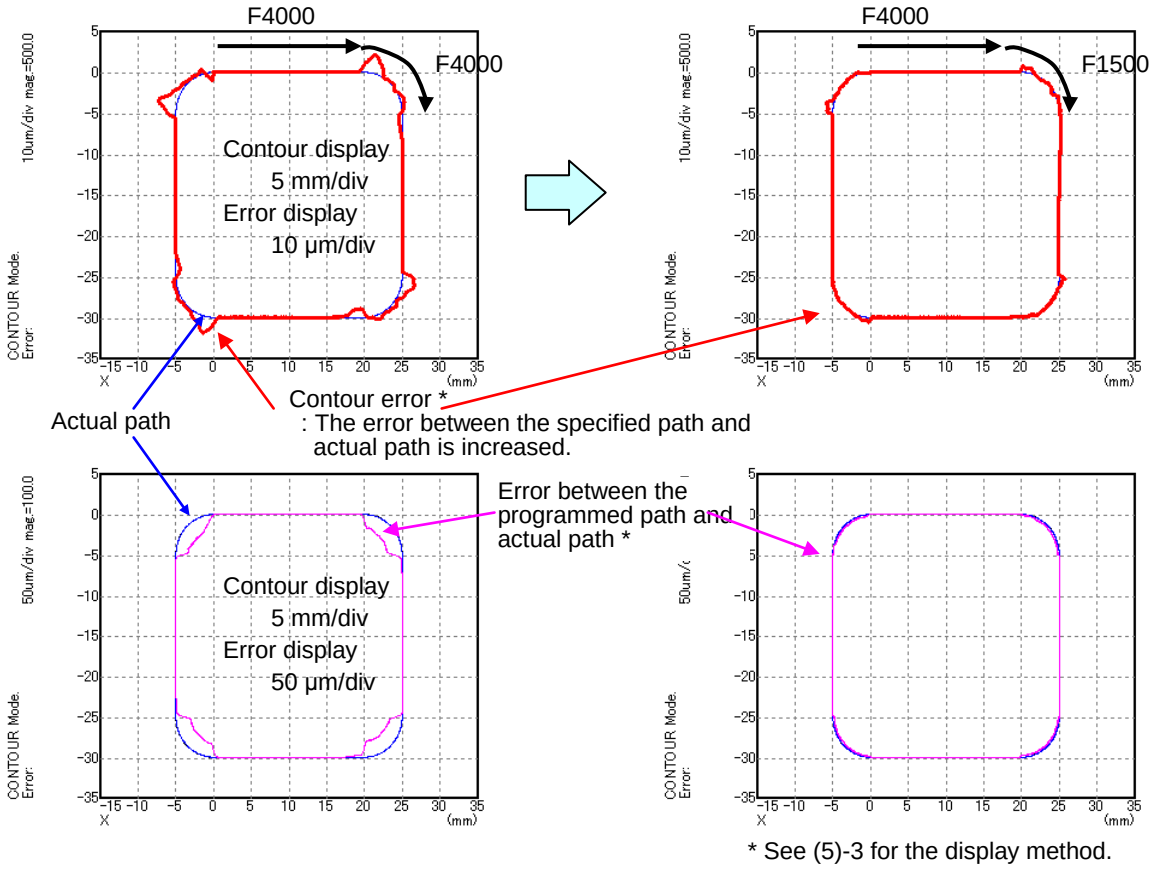


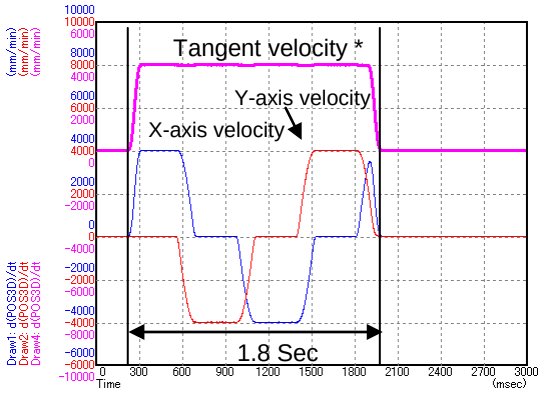
Fig. 4.3.4 (q) Allowable acceleration setting screen of SERVO GUIDE

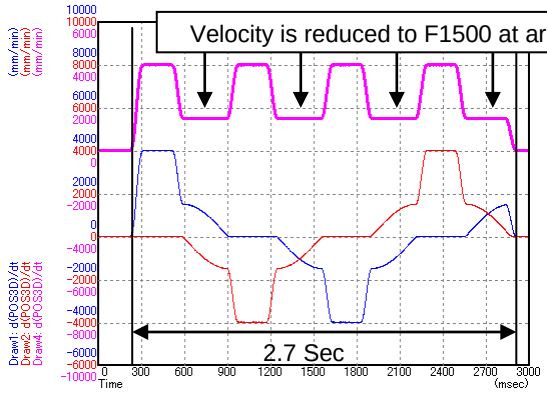
Figures 4.3.4 (r) and 4.3.4 (s) show the effects of velocity control by acceleration/deceleration in circular interpolation. It can be seen that setting the allowable acceleration reduces the feedrate at the arc to F1500, thereby resulting in reduced contour error. Since this has the side effect of an increased cycle time, you need to maintain balance between contouring accuracy and cycle time when tuning.



(i) Velocity is not reduced at arc **(ii) Velocity is reduced to F1500 at arc**

Fig. 4.3.4 (r) Contour error reduction at an arc by limiting acceleration





* See (5)-3 for the display method.

(i) Velocity is not reduced at arc **(ii) Velocity is reduced to F1500 at arc**

Fig. 4.3.4 (s) Change in the feedrate at an arc when the allowable acceleration is changed

To reduce acceleration resulting from a change in the machine tool movement direction in a minute line segment program or some other program excluding circular interpolation, set the following parameters to the allowable acceleration determined above by circular interpolation as well.

Parameter No.	Description
1737	Allowable acceleration of each axis for deceleration by acceleration in AI contour control
1738	Lower-limit velocity for deceleration by acceleration in AI contour control

(5.3) Display method

To display the tangent velocity, position error, and contour error, and error between the programmed path and actual path, select the following in Operation and Display:

Table 4.3.4 (g) Data to display

Graph mode	Data to display	Operation
YT	Tangent velocity	Tangent
YT	Position error	ERR
XY	Contour error	PathErr2D
XY	Error between the programmed path and actual path	Contour

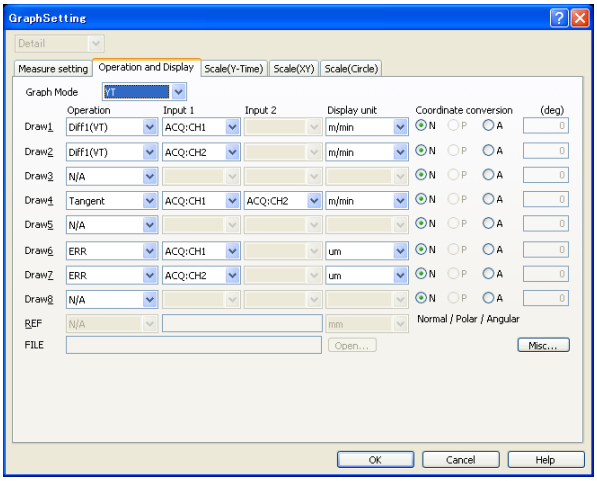
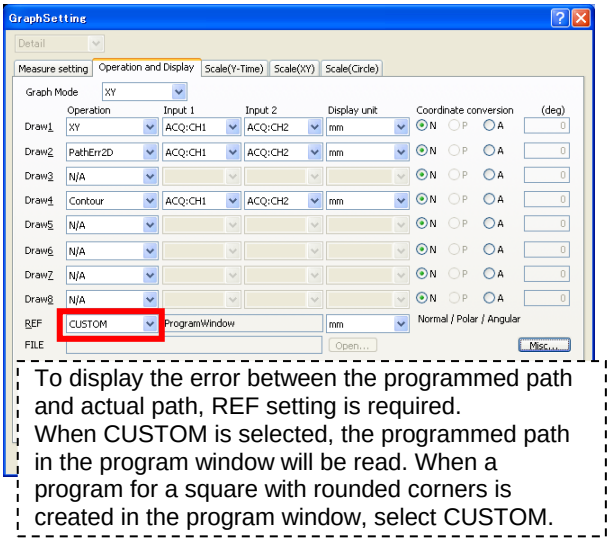


Fig. 4.3.4 (t) Example of display in YT mode



To display the error between the programmed path and actual path, REF setting is required.
When CUSTOM is selected, the programmed path in the program window will be read. When a program for a square with rounded corners is created in the program window, select CUSTOM.

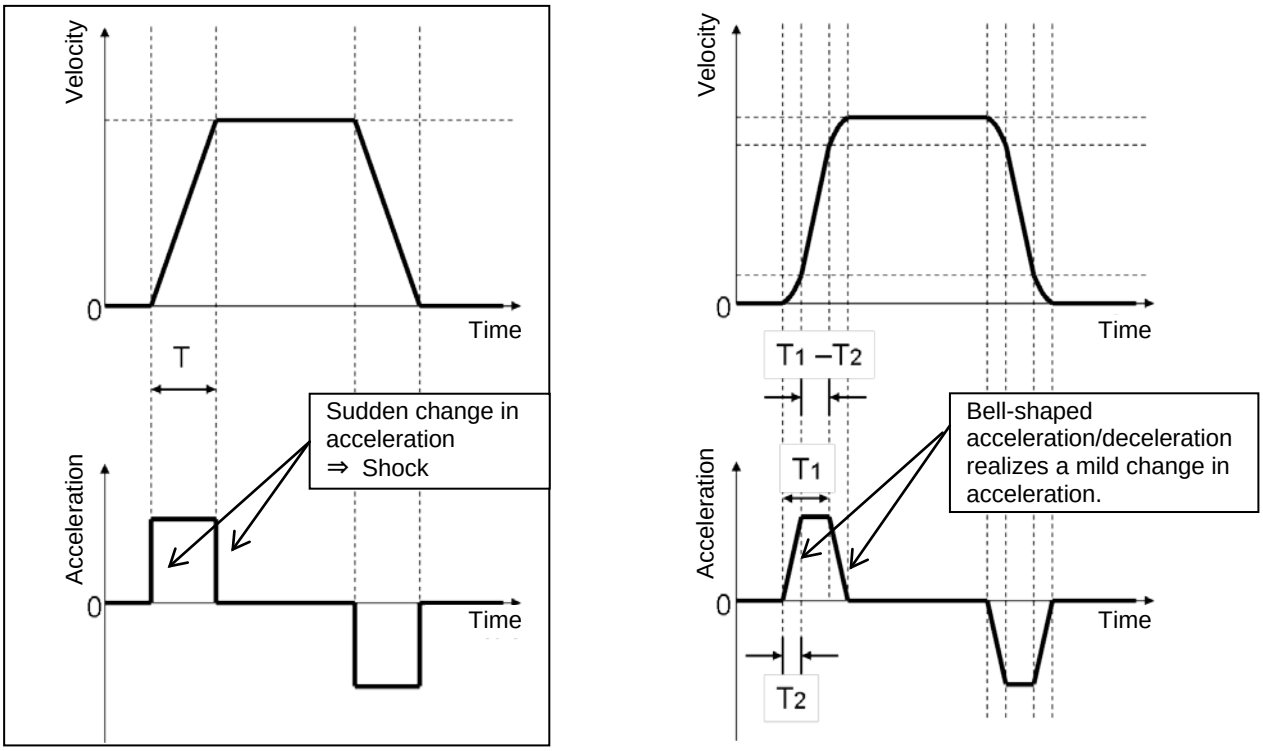
Fig. 4.3.4 (u) Example of display in XY mode

4.3.5 Tuning of Rapid Traverse Acceleration/Deceleration

(1) Overview

In this section, optimize the acceleration/deceleration time constant in order to reduce the positioning time during rapid traverse.

During rapid traverse by linear acceleration/deceleration, a mechanical shock is generated as a sudden change in acceleration occurs at the start and end of acceleration, as shown in Fig. 4.3.5 (a) (i). Applying bell-shaped acceleration/deceleration realizes a mild change in acceleration, as shown in Fig. 4.3.5 (a) (ii), thus reducing the shock.



(i) Linear acceleration/deceleration during rapid traverse

(ii) Bell-shaped acceleration/deceleration during rapid traverse (T1 ≥ T2)

Fig. 4.3.5 (a) Rapid traverse acceleration/deceleration methods and time constants

(2) Method of Tuning the acceleration/deceleration time constants using a reciprocating motion during rapid traverse

Tune acceleration/deceleration time constants T1 (linear part) and T2 (bell-shaped part) for rapid traverse.

Parameter No.	Description
1620	Bell-shaped rapid traverse acceleration/deceleration time constant for each axis (T1)
1621	Bell-shaped rapid traverse acceleration/deceleration time constant for each axis (T2)

[Parameter window main screen] **[Acceleration/deceleration + normal control]**

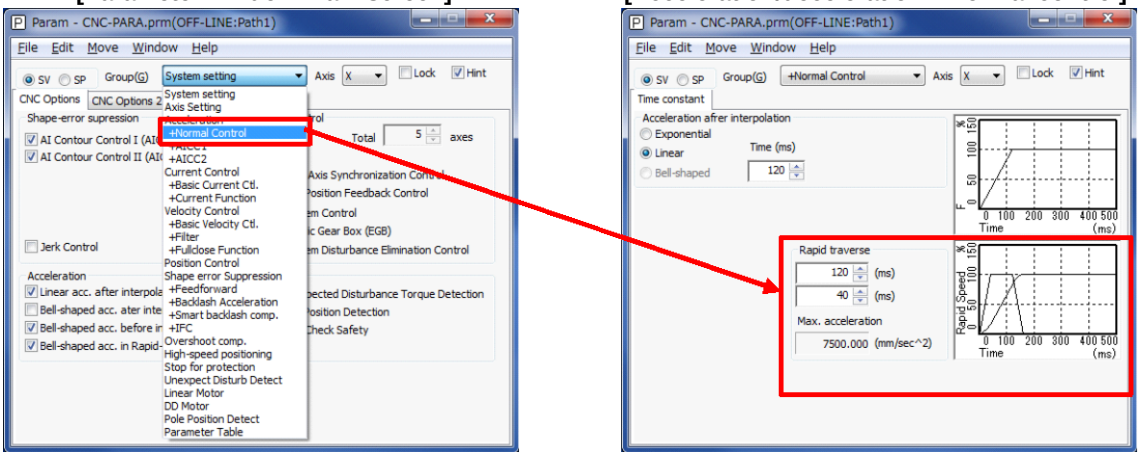


Fig. 4.3.5 (b) SERVO GUIDE screen for setting the rapid traverse acceleration/deceleration time constants

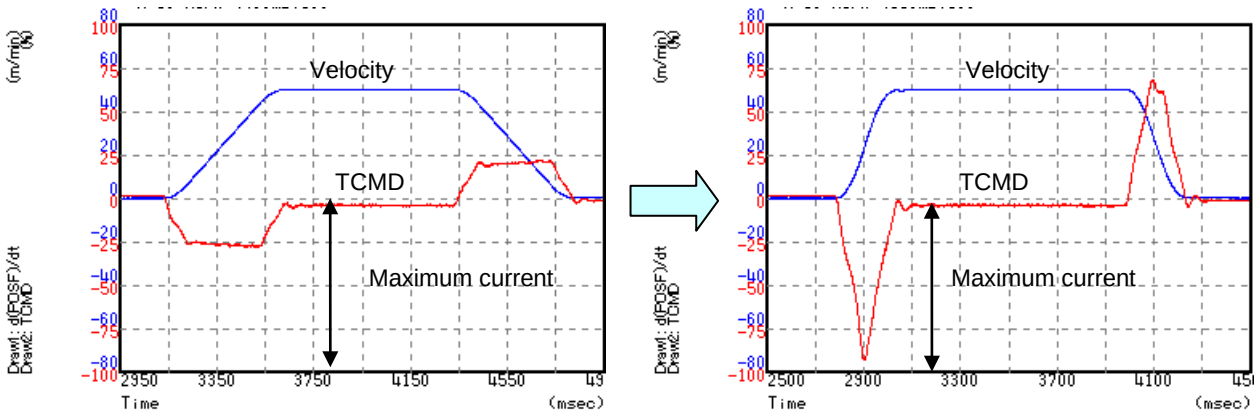
T1 and T2 are determined by the characteristics of the motor and machine and generally set in the ranges shown below.

(Maximum velocity [m/s]) / (Time constant T1 [s]) ≤ Maximum acceleration [m/s^2]

(Maximum velocity [m/s]) / (Time constant T1 [s] × Time constant T2 [s]) ≤ Allowable jerk

The maximum acceleration is determined by the maximum torque and load inertia, and the allowable jerk is determined by the allowable shock of the machine.

Measure the position error (ERR) and torque command (TCMD) by using SERVO GUIDE. When the waveform is not disturbed abnormally and overshoot or other problem does not occur at the end of acceleration/deceleration or upon completion of positioning, reduce the time constants. Note that T1 must be greater than or equal to T2. In cases where the mechanical shock is great, making the time constant for the bell-shaped part, T2, larger is effective for easing the shock. Fig. 4.3.5 (c) shows the results of tuning the rapid traverse time constants.



(i) Before tuning of the rapid traverse acceleration/deceleration time constants **(ii) After tuning of the rapid traverse acceleration/deceleration time constants**

Fig. 4.3.5 (c) Example of tuning of rapid traverse acceleration/deceleration

4.3.6 High-speed Positioning Tuning Procedure

(1) Overview

This subsection describes the servo tuning procedure for high-speed positioning required with a punch press and PC board drilling machine.

(2) Tuning procedure

Tune high-speed positioning while observing the position error (ERR) and torque command (TCMD) by using SERVO GUIDE. Set the waveform display range as follows.

ERR:

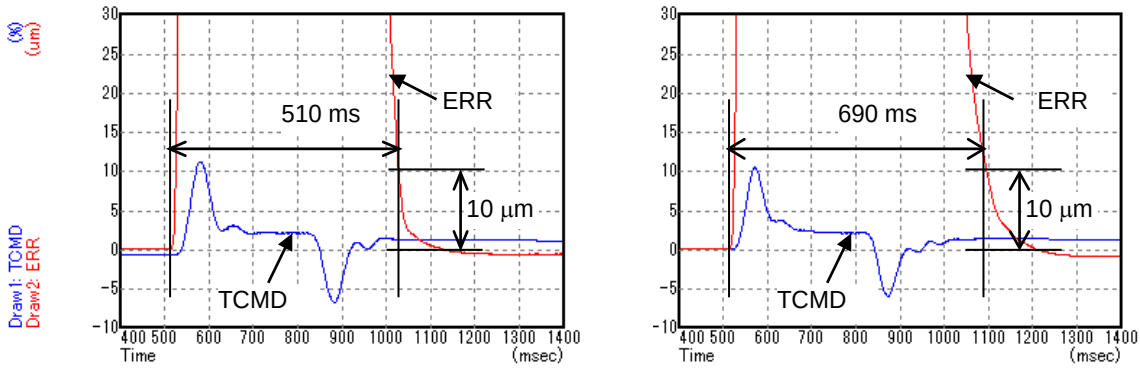
The graph is enlarged so that the completion of positioning can be judged. In the example below, the in-position width (position error for judging the completion of positioning) is assumed to be 10 μm.

TCMD:

If a tuning is performed to reduce the positioning time, the torque command may reach the maximum value. The graph is displayed so that it can be checked that the torque is below the maximum value.

<1> Velocity loop I-P function setting

In general, the PI function reduces start-up time for a command, but requires a longer setting time, so the PI function is not suitable for high-speed positioning. On the other hand, the I-P function reduces the setting time as compared with the PI function, so the positioning time can be reduced (Fig. 4.3.6 (a)). Use the I-P function for velocity loop control to tune high-speed positioning.

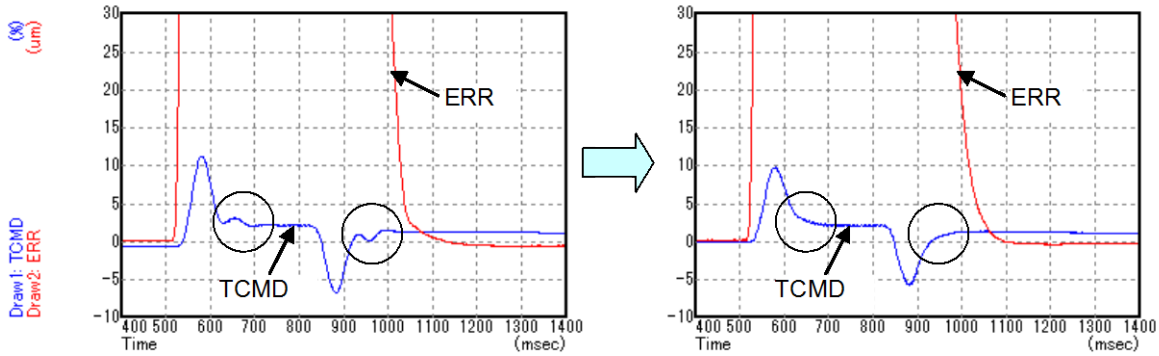


(i) Velocity loop I-P control **(ii) Velocity loop PI control**

Fig. 4.3.6 (a) Setting times according to velocity loop I-P/PI controls

<2> Velocity loop gain tuning

Set the highest possible velocity loop gain while setting the resonance elimination filter when required according to the instructions described in Subsection 4.3.3, "tuning to Improve the Servo Stiffness". A high velocity loop gain reduces the fluctuation of the TCMD waveform as shown in Fig. 4.3.6 (b) and allows stable positioning.

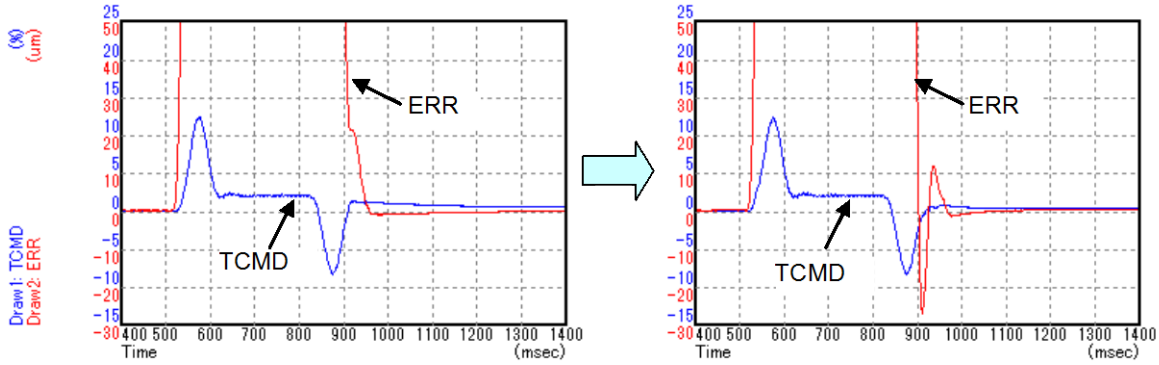


(i) Before velocity loop gain tuning **(ii) After velocity loop gain tuning**

Fig. 4.3.6 (b) Example of the velocity loop gain tuning

<3> Application of the position gain switch function

Set a switch speed of 15 min^{-1} (1500 as the CNC parameter value) with the position gain switch function (see Subsection 5.7.1). When this function is enabled, a change in ERR waveform is observed as shown in Fig. 4.3.6 (c).



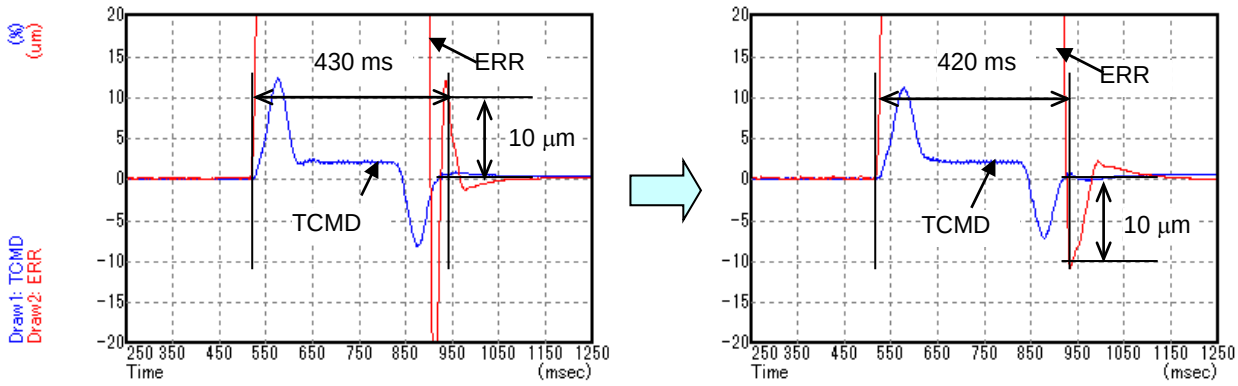
(i) Position gain switch function: Disabled **(ii) Position gain switch function: Enabled**

Fig. 4.3.6 (c) Application of the position gain switch function

<4> Position gain tuning

Setting a high value for the position gain allows the position error to be eliminated more quickly during positioning, potentially leading to a shorter positioning time. While viewing the ERR waveform as shown in Fig. 4.3.6 (d), tune the position gain so that the overshoot value lies within the requested precision. After setting the position gain, perform rapid traverse for a long distance to check that vibration does not occur. If vibration occurs, lower the position gain. The "positioning function at optimal acceleration" enables the position gain to be changed according to travel distance. A small overshoot can also be suppressed by the tuning in step <5> below.

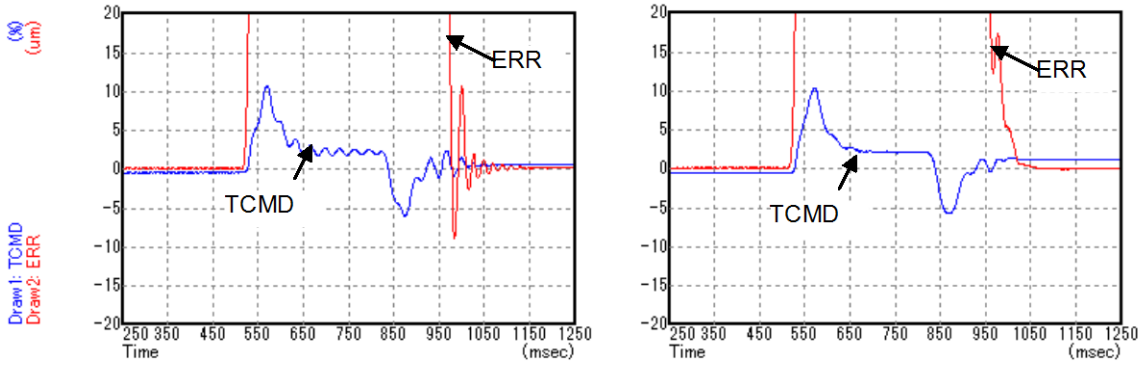
In this example, the positioning time before the tuning (Figure 4.3.6 (a) (ii)), which is 690 ms, is reduced to 420 ms after the tuning (Fig. 4.3.6 (d) (ii)).



(i) Excessively high position gain **(ii) Adequate position gain**

Fig. 4.3.6 (d) Position gain tuning

<5> A fine tuning can be made for PK1V (velocity loop integral gain) so that neither overshoot nor undershoot occurs as shown in Fig. 4.3.6 (e). If the PK1V setting is too small, a large undershoot occurs.

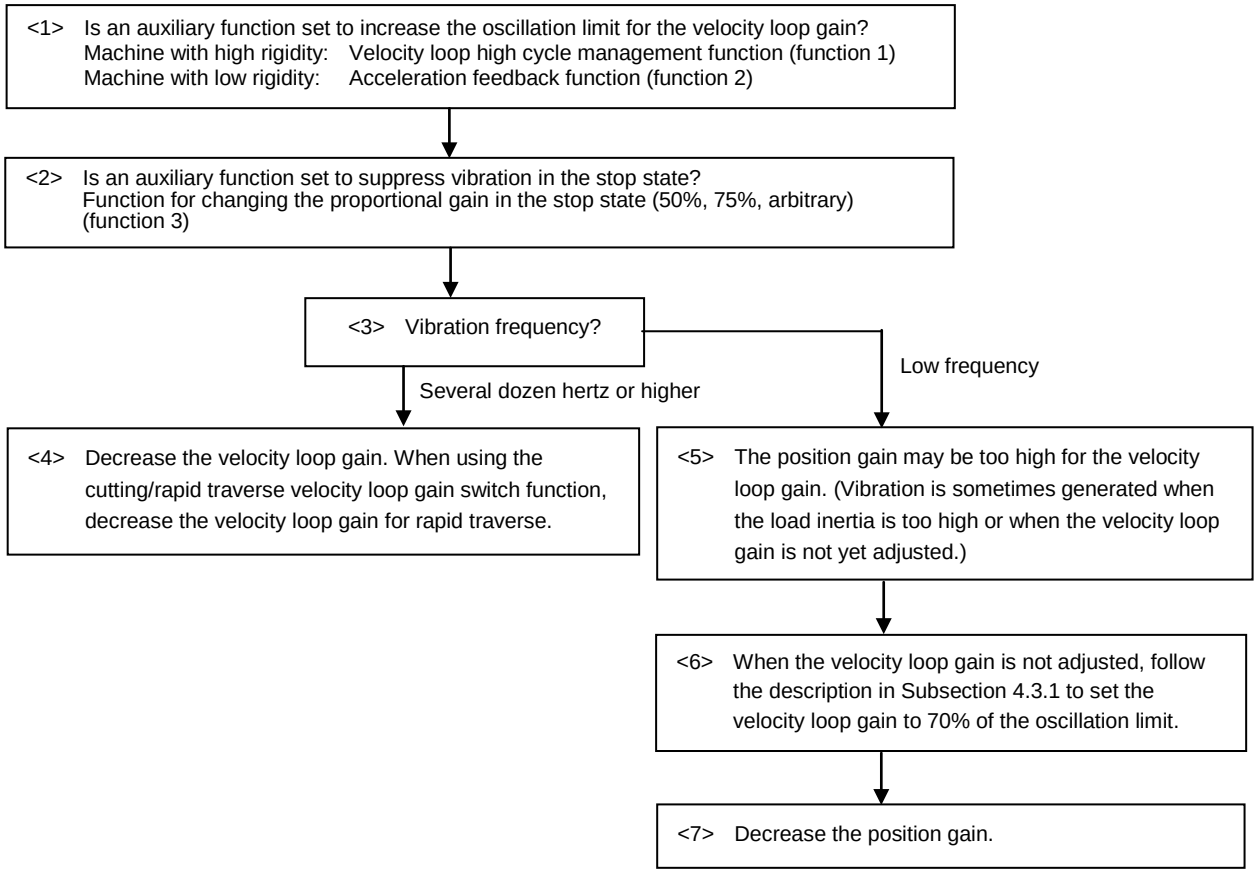


(i) Excessively large PK1V value **(ii) Adequate PK1V value**

Fig. 4.3.6 (e) PK1V tuning

4.3.7 Vibration in the Stop State

Vibration generated only in the stop state is caused by the decreased load inertia in a backlash. Tune the auxiliary functions for suppressing stop-time vibration. Vibration may also be generated only in the stop state when the position gain is too large.



(Reference: Parameter numbers)
For details, see Chapter 5, “SERVO FUNCTION DETAILS.”

1: Velocity loop high cycle management

	#7	#6	#5	#4	#3	#2	#1	#0
2017	**PK2V25**							

PK2V25(#7) 1: Enables velocity loop high cycle management

2: Acceleration feedback

2066	**Acceleration feedback gain**

3: Variable proportional gain in the stop state

	#7	#6	#5	#4	#3	#2	#1	#0
2016					PK2VDN			

PK2VDN(#3) 1: Enables variable proportional gain in the stop state: 75%

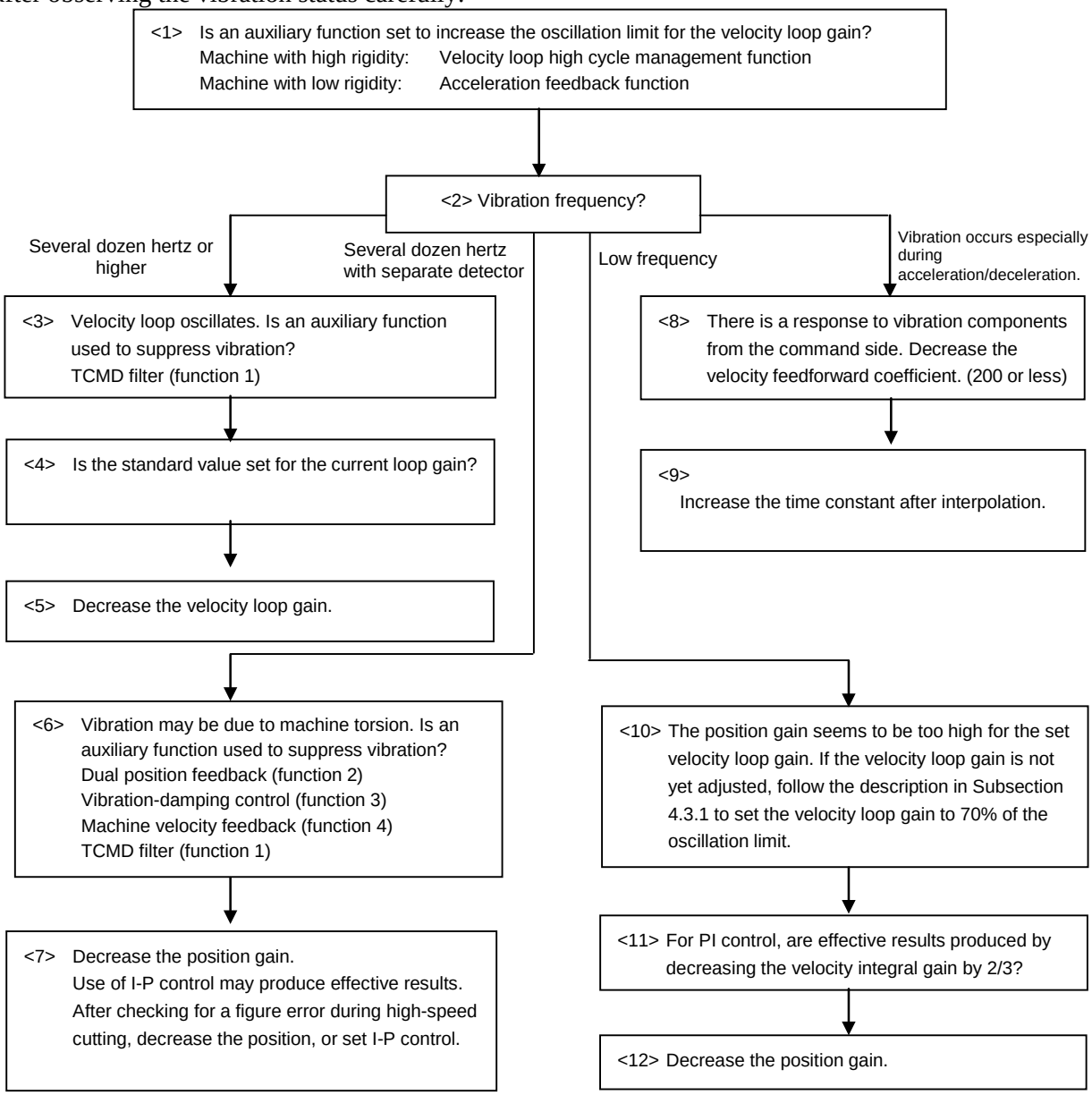
	#7	#6	#5	#4	#3	#2	#1	#0
2207					PK2D50			

PK2D50(#3) 1: Decreases the proportional gain in the stop state to 50%.

2119	Stop decision level
2324	Variable proportional gain in the stop state: Arbitrary magnification in the stop state (during cutting feed only)

4.3.8 Vibration during Travel

Vibration is generated during travel by various causes. So, the most appropriate method must be selected after observing the vibration status carefully.



(Reference: Parameter numbers)
For details, see Chapter 5, “SERVO FUNCTION DETAILS.”

1: TCMD filter

2067	TCMD filter coefficient

2: Dual position feedback function

	#7	#6	#5	#4	#3	#2	#1	#0
2019	DPFB							

DPFB(#7) 1: Dual position feedback maximum amplitude

2078	Dual position feedback function: conversion coefficient (numerator)
2079	Dual position feedback function: conversion coefficient (denominator)
2080	Dual position feedback: primary delay time constant

3: Vibration-damping control

2033	Vibration-damping control: number of position feedback pulses
2034	Vibration-damping control gain

4: Velocity feedback

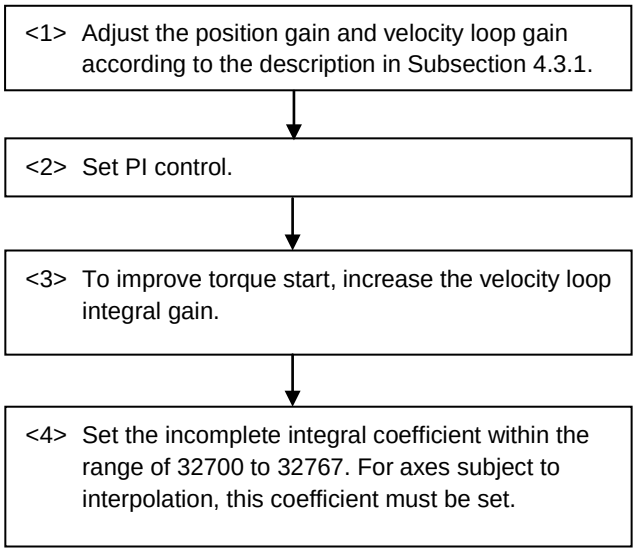
	#7	#6	#5	#4	#3	#2	#1	#0
2012							MSFE	

MSFE(#1) 1: Enables machine velocity feedback.

2088	Machine velocity feedback gain

4.3.9 Stick Slip

When the time from the detection of a position error until the compensation torque is output is too long, a stick slip occurs during low-speed feed. Improve the gain or tune the incomplete integral.

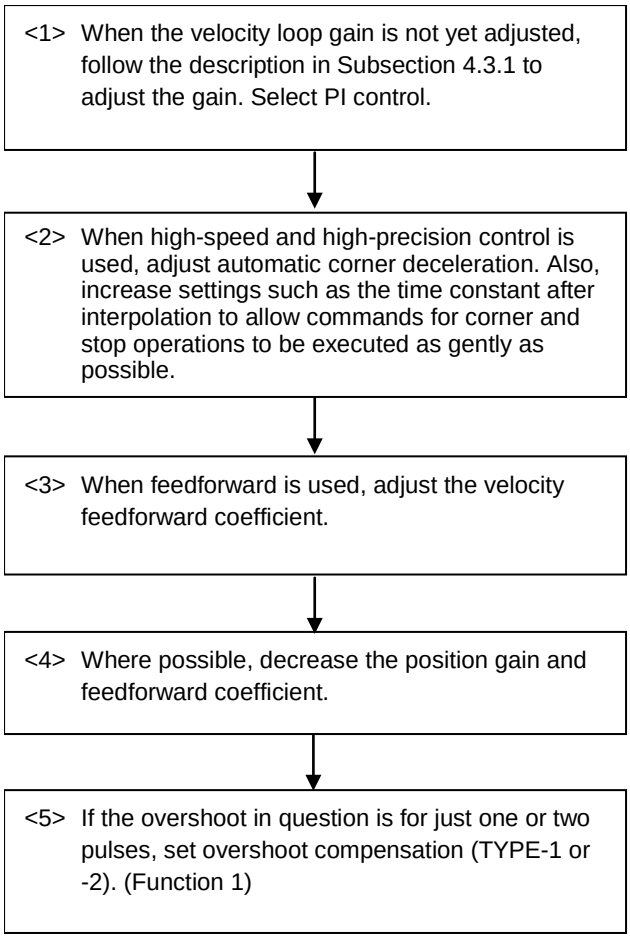


(Reference: Parameter numbers)
For details, see Chapter 5, “SERVO FUNCTION DETAILS.”

2045	Incomplete integral gain

4.3.10 Overshoot

When the machine is operated at high speed or with a detection unit of 0.1 μm or less, the problem of overshooting may arises. Select the most appropriate preventive method depending on the cause of the overshoot.



(Reference: Parameter numbers)
For details, see Chapter 5, “SERVO FUNCTION DETAILS.”

1: Overshoot compensation

	#7	#6	#5	#4	#3	#2	#1	#0
2003		OVSC						

OVSC(#6) 1: Enables overshoot compensation.

2077	Overshoot prevention counter
2045	Incomplete integral coefficient

	#7	#6	#5	#4	#3	#2	#1	#0
2202					OVS1			

OVS1(#3) 1: Enables overshoot compensation TYPE-2.

5 SERVO FUNCTION DETAILS

5.1 SERVO HRV CONTROL

(1) Overview

Servo HRV (High Response Vector) control is high-speed, fast-response control. Servo HRV control includes servo HRV2 control, servo HRV3 control, servo HRV3$^+$ control, servo HRV4 control, and servo HRV4$^+$ control. Servo HRV control can exercise current control, which is the innermost servo control loop, at high speed to allow higher speed and higher precision.

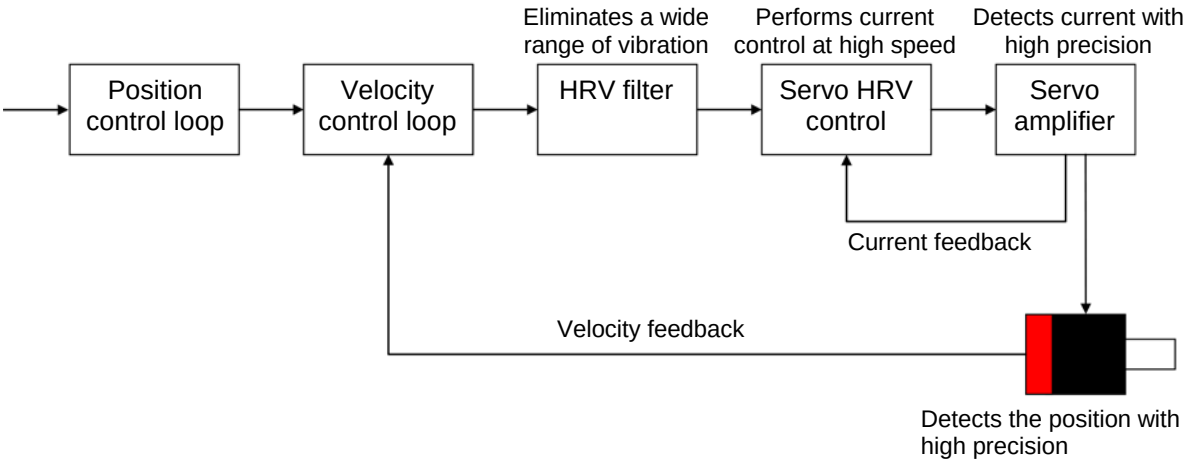


Fig. 5.1 (a) Servo HRV control

(2) Series and editions of applicable servo control software

	30*i*–B Series	0*i*–F Series	30*i*–A Series		0*i*–D Series
	Series 90G0 Series 90J0 Series 90K0 NOTE 1)	Series 90M0 Series 90L0 Series 90M8 Series 90L8	Series 90D0 (NOTE 1, 2)	Series 90E0 Series 90E1	Series 90C5 Series 90E5 Series 90C8 Series 90E8
(Servo HRV1 control)	×	×	×	×	×
Servo HRV2 control	○	○	○	○	○
Servo HRV3 control	●	●	○	●	●
Servo HRV3$^+$ control	●	●	○	●	×
Servo HRV4 control	○	×	●	×	×
Servo HRV4$^+$ control	○	×	●	×	×

○, ●: Supported (● is recommended.)
×: Not supported

NOTE
1 Series 32*i*-A, Series 35*i* –B, Power Motion *i*-A, and DSA-B do not support servo HRV4 control.
2 When using servo HRV4 control with a 30*i*-A Series CNC, use series 90D0 J(10) or later edition.
3 For 30*i*-A Series, apply the same servo HRV control to all axes.
4 In 30*i*-B Series, the same HRV control needs to be applied for each FSSB line.

(3) Features of servo HRV control

Table 5.1 (a) Features of each servo HRV control system

	HRV	HRV$^+$
HRV2	**Servo HRV2 control** ・ Exercises basic motor current control. ・ Eliminates a wide range of vibration with HRV filters.	
HRV3	**Servo HRV3 control** In addition to the features of servo HRV2 control, ・ Exercises high-speed HRV current control. ・ Best suited to machine tools that require high speed and high precision.	**Servo HRV3$^+$ control** In addition to the features of servo HRV3 control, ・ Optimizes the control method and current loop gain to make the response of the current loop much faster.
HRV4	**Servo HRV4 control** In addition to the features of servo HRV3 control, ・ Makes the response of the current loop even faster. ・ Best suited to machine tools for ultra-high precision machining.	**Servo HRV4$^+$ control** In addition to the features of servo HRV4 control, ・ Optimizes the control method and current loop gain to make the response of the current loop much faster.

Table 5.1 (b) Types of servo HRV control valid during cutting feed and rapid traverse

Setting	Cutting feed (in the high-speed HRV current control mode)		Rapid traverse
	HRV$^+$ enabled (bit 4 of No.2422 = 1)	HRV$^+$ disabled (bit 4 of No. 2422 = 0)	
HRV3 (bit 0 of No. 2013 = 1)	Servo HRV3$^+$ control	Servo HRV3 control	Servo HRV2 control
HRV4 (bit 0 of No. 2014 = 1)	Servo HRV4$^+$ control	Servo HRV4 control	Servo HRV3 control

5.1.1 Servo HRV2 control

(1) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	A(01) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(2) Setting parameters

<1> Set bit 1 of parameter No. 2000 to 0.
<2> Set a motor number for HRV2 control.
<3> Turn the power to the CNC off, then on again.
<4> The standard parameters for servo HRV2 control are automatically loaded.

NOTE

1 For details of the initial settings of the servo parameters, see the following subsections:
   αiS/αiF/βiS/βiF : 2.1.2
   LiS series : 3.1.1
   DiS series : 3.2.1
2 Available servo axis numbers (parameter No. 1023) vary with the setting of servo HRV control. For details, see the following table.

Table5.1.1 (a) Available servo axis numbers

CNC	30*i*-B Series			0*i*-F Series			30*i*-A Series				0*i*-D Series		
Series of servo control software	90G0, 90J0, 90K0			90M0, 90M8			90D0		90E0, 90E1		90C5, 90C8	90E5, 90E8	
No.1023	HRV2	HRV3	HRV4	HRV2	HRV3	HRV4	HRV2,3	HRV4	HRV2	HRV3	HRV2,3	HRV2	HRV3
8n+1	○	○	○	○	○	×	○	○	○	○	○	○	○
8n+2	○	○	×	○	○	×	○	×	○	○	○	○	○
8n+3	○	○	×	○	○	×	○	○	○	○	○	○	○
8n+4	○	○	×	○	○	×	○	×	○	×	○	○	×
8n+5	○	×	×	○	○	×	○	○	○	○	○	○	○
8n+6	○	×	×	○	×	×	○	×	○	○	○	○	○
8n+7	×	×	×	×	×	×	○	○	○	○	○	○	○
8n+8	×	×	×	×	×	×	○	×	○	×	○	○	×

○: Available, ×: Not available * n = 0, 1, 2, ...

5.1.2 Servo HRV3 control

(1) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	A(01) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	01.0 and subsequent editions	

(2) Setting parameters

<1> See Subsection 5.1.1, and make settings for servo HRV2 control.

<2> Set servo HRV3 control. (For each axis)

	#7	#6	#5	#4	#3	#2	#1	#0
2013								HR3

HR3(#0) Servo HRV3 control is:
0: Not to be used.
1: Used.

NOTE
1 Available servo axis numbers (parameter No. 1023) vary with the setting of servo HRV control. For details, see the table in Subsection 5.1.1, "Servo HRV2 Control".
2 When a 5-axis servo CPU is used in Series 0*i*-F, the maximum number of full-closed axes is 3.

<3> Set the cutting/rapid velocity loop gain switching function.

	#7	#6	#5	#4	#3	#2	#1	#0
2202							VGCCR	

VGCCR (#1) The cutting/rapid velocity loop gain switching function is:
0: Not to be used.
1: Used.

<4> Set the current loop gain magnification.

2334	In high-speed HRV current control mode: Current loop gain magnification

[Unit of data] %
[Valid data range] 100 to 150
[Recommended value] 150
This parameter is valid only for cutting feed in the high-speed HRV current control mode.

<5> Set the velocity loop gain magnification.

2335	In high-speed HRV current control mode: Velocity loop gain magnification

[Unit of data] %
[Valid data range] 100 to 800 (A value of 0 indicates the default value (100%).)
This parameter is valid only for cutting feed in the high-speed HRV current control mode.

2107	Velocity loop gain magnification for cutting (cutting/rapid velocity loop gain switching)

[Unit of data] %
[Valid data range] 100 to 800 (A value of 0 indicates the default value (100%).)
This parameter is valid only for cutting feed when the high-speed HRV current control mode is not set.

<6> Set the high-speed HRV current control mode.
Set the following bit, which automatically sets the high-speed HRV current control mode during cutting feed:

	#7	#6	#5	#4	#3	#2	#1	#0
2283								NOG54

NOG54(#0) Servo HRV3 control is enabled when:
0: Both G5.4Q1 and G01 are specified.
1: G01 is specified (the specification of G5.4Q1 is not required).

<7> This completes parameter setting.

NOTE
The velocity loop gain is changed as listed below according to whether the high-speed HRV current control mode is set or not.

Table 5.1.2 Velocity loop gain for cutting feed and rapid traverse

High-speed HRV current control mode	Feed	Velocity loop gain [%]
Set (G5.4Q1 - 5.4Q0)	Rapid traverse	(1 + No. 2021 / 256) × **100**
	Cutting feed	(1 + No. 2021 / 256) × **No. 2335** (In high-speed HRV current control: Velocity loop gain magnification)
Not set	Rapid traverse	(1 + No. 2021 / 256) × **100**
	Cutting feed	(1 + No. 2021 / 256) × **No. 2107** (Cutting/rapid switching: Velocity loop gain magnification)

(3) Limitation on servo HRV3 control

(a) Servo motor output torque

There is no limitation on the output torque.

(b) Rated current

The rated current during use of HRV3 may be reduced as compared with HRV2. For details, refer to "Environmental conditions - derating" in FANUC SERVO AMPLIFIER α*i* series DESCRIPTIONS.

5.1.3 Servo HRV4 control

(1) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*-B	90G0 90J0 90K0	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	J(10) and subsequent editions	HRV4

(2) Setting parameters

<1> See Subsection 5.1.1, and make settings for servo HRV2 control.

<2> Set servo HRV4 control. (For each axis)

	#7	#6	#5	#4	#3	#2	#1	#0
2014								HR4

HR4(#0) Servo HRV4 control is:
0: Not to be used.
1: Used.

NOTE

1 When the high-speed HRV current control mode is set by the G5.4Q1 command, servo HRV3 control or servo HRV4 control, whichever is set in a parameter, is enabled. Therefore, both the servo HRV3 control enable bit and the servo HRV4 control enable bit cannot be set to 1 at the same time. (If both bits are set to 1, alarm SV0456, "ILLEGAL CURRENT LOOP" is issued.)

2 Available servo axis numbers (parameter No. 1023) vary with the setting of servo HRV control. For details, see the table in Subsection 5.1.1, "Servo HRV2 Control".

3 When servo HRV4 control is set, servo HRV3 control is used during rapid traverse or cutting feed for which high-speed HRV current control is disabled.

4 Servo HRV4 control and the following functions are not available simultaneously:
- Synchronous axes automatic compensation
- Tandem disturbance elimination control
- Torque tandem control
- Axis synchronous torque difference alarm
- Driving of a motor with plural windings
- Electronic gear box (EGB)
- Servo/spindle synchronous control (FSSB method)
- Pressure and position control

<3> Enable extended HRV. (For each axis)

	#7	#6	#5	#4	#3	#2	#1	#0
2300								HRVEN

HRVEN(#0) Extended HRV is:
0: Not to be used.
1: Used.

<4> Set the cutting/rapid velocity loop gain switching function.

	#7	#6	#5	#4	#3	#2	#1	#0
2202							VGCCR	

VGCCR (#1) The cutting/rapid velocity loop gain switching function is:
0: Not to be used.
1: Used.

<5> Set the current loop gain magnification.

2334	In high-speed HRV current control mode: Current loop gain magnification

[Unit of data] %
[Valid data range] 100 to 150
[Recommended value] 150
This parameter is valid only for cutting feed in the high-speed HRV current control mode.

<6> Set the velocity loop gain magnification.

2335	In high-speed HRV current control mode: Velocity loop gain magnification

[Unit of data] %
[Valid data range] 100 to 800 (A value of 0 indicates the default value (100%).)
This parameter is valid only during cutting feed when the high-speed HRV current control mode is enabled.

2107	Velocity loop gain magnification (cutting/rapid velocity loop gain switching)

[Unit of data] %
[Valid data range] 100 to 800 (A value of 0 indicates the default value (100%).)
This parameter is valid only for cutting feed when the high-speed HRV current control mode is not set.

<7> This completes parameter setting. To actually enter the high-speed HRV current control mode, G codes must be programmed. (See Subsection 5.1.5, “High-Speed HRV Current Control Mode” for details.)

NOTE
The velocity loop gain is changed as listed below according to whether the high-speed HRV current control mode is set or not.

Table 5.1.3 (a) Velocity loop gain for cutting feed and rapid traverse

High-speed HRV current control mode	Feed	Velocity loop gain [%]
Set (G5.4Q1 - 5.4Q0)	Rapid traverse	(1 + No. 2021 / 256) × **100**
	Cutting feed	(1 + No. 2021 / 256) × **No. 2335** (In high-speed HRV current control: Velocity loop gain magnification)
Not set	Rapid traverse	(1 + No. 2021 / 256) × **100**
	Cutting feed	(1 + No. 2021 / 256) × **No. 2107** (Cutting/rapid switching: Velocity loop gain magnification)

(3) Limitation on servo HRV4 control

(a) Servo motor output torque

During cutting operation in servo HRV control, the torque command is automatically limited to 70% of the maximum current value of the servo amplifier. As a result, the torque command is easily saturated. Therefore, when determining the acceleration/deceleration time constant in cutting feed, consider the cutting load and the above limitation. Normally, the high-speed HRV current control mode is used for light cutting for finish machining, so the limitation of the torque command to 70% of the maximum current value of the servo amplifier is not regarded as critical.

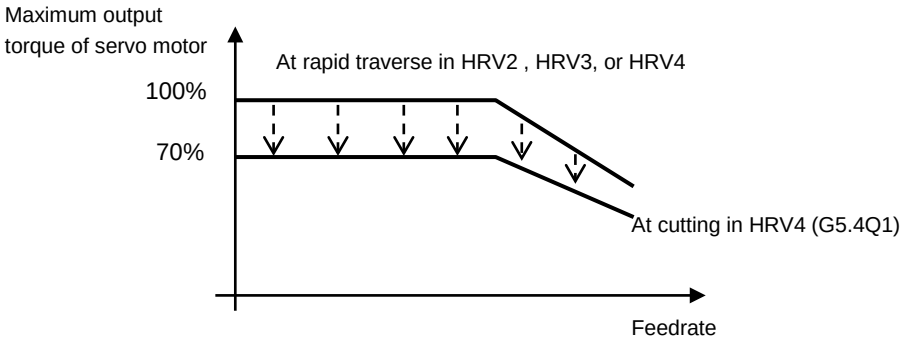


Fig. 5.1.3 (a) Limitation on torque during servo HRV4 control

(b) Rated current

The rated current during use of HRV4 may be reduced as compared with HRV2. For details, refer to "Environmental conditions - derating" in FANUC SERVO AMPLIFIER α*i* series DESCRIPTIONS.

(4) Servo HRV4 control hardware

(a) Servo amplifiers

A servo amplifier supporting servo HRV4 control must be specified.

(b) Detector

To use servo HRV4 control, a detector supporting high-speed communication needs to be used as a detector on the semi-closed loop side.

The table below indicates examples of detectors that support high-speed communication. If a setting is made to enable servo HRV4 control when a detector not supporting high-speed communication is connected, alarm SV0456 "ILLEGAL CURRENT LOOP" is issued.

Table 5.1.3 (b) Sample configuration of a detector usable with HRV4

Manufacturer	Configuration or model
FANUC	α*i* Pulsecoder, β*i* Pulsecoder
FANUC	α*i*CZ sensor (512A, 768A, 1024A)
FANUC	Linear motor position detection circuit + incremental scale supplied by a third party (1 Vpp output)
FANUC	DD motor position detection circuit + incremental scale supplied by a third party (1 Vpp output)
HEIDENHAIN	RCN827F, RCN727F, RCN227F, RCN223F, ECN223F RCN8590F, RCN8390F, RCN5590F, RCN5390F, RCN2590F, RCN2390F LC493F, LC193F LC495F, LC195F
MITUTOYO	AT553, AT555, ST753
Magnescale	RU77, RS97, SR77, SR87
NEWALL	SHG-AF
Renishaw	RESOLUTE
FAGOR	LAF, GAF, SAF, SVAF, HAF-D, SAF-D

* The table above indicates the configurations and models whose support for high-speed communication is confirmed as of February 2019. For details, contact the manufacturer of the detector.

5.1.4 Servo Card and Number of Servo Controlled Axes

(1) 30*i*-B Series

The servo card has one or two optical connectors depending on the number of FSSB systems, so the number of connectable amplifiers and separate detector interface units are changed accordingly.

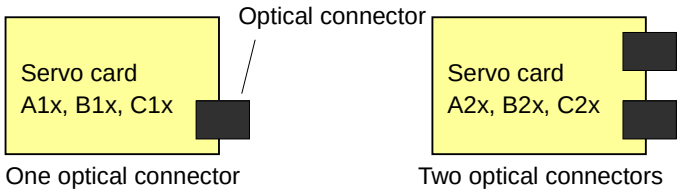


Table 5.1.4 (a) Maximum number of amplifier axes and separate detector interface units that can be connected to one FSSB optical connector

	Amplifier (α*i*SV+α*i*SP)	Separate detector interface unit (basic module)
Servo HRV2 control	28 axes	4 units
Servo HRV3 control	13 axes	2 units
Servo HRV4 control	6 axes	1 unit

Table 5.1.4 (b) Maximum number of amplifier axes that can be connected to the servo card

Servo card	Number of FSSB systems	Maximum number of amplifier axes		
		HRV2	HRV3	HRV4
Servo card A11, B11, C11	1	6 axes	4 axes	1 axis
Servo card A12, B12, C12	1	12 axes	8 axes	2 axes
Servo card A13, B13, C13	1	18 axes	12 axes	3 axes
Servo card A24, B24, C24	2	24 axes	16 axes	4 axes
Servo card A26, B26	2	32 axes	24 axes	6 axes

(2) 30*i*-A Series

The servo card has one or two optical connectors depending on the number of FSSB systems, so the number of connectable amplifiers and separate detector interface units are changed accordingly.

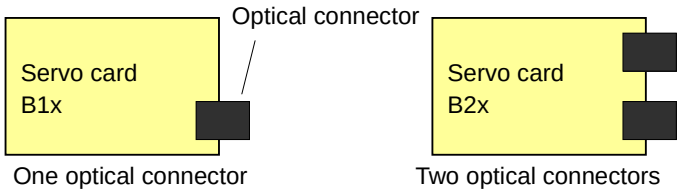


Table 5.1.4 (c) Maximum number of amplifier axes and separate detector interface units that can be connected to one FSSB optical connector

	Amplifier	Separate detector interface unit
Servo HRV2 control	16 axes	2 units
Servo HRV3 control	10 axes	2 units
Servo HRV4 control	4 axes	1 unit

Table 5.1.4 (d) Maximum number of amplifier axes that can be connected to the servo card

Servo card	Number of FSSB systems	Maximum number of amplifier axes		
		HRV2	HRV3	HRV4
Servo card B11	1	4 axes	3 axes	1 axis
Servo card B12	1	8 axes	6 axes	2 axes
Servo card B13	1	12 axes	9 axes	3 axes
Servo card B24	2	16 axes	12 axes	4 axes
Servo card B26	2	24 axes	18 axes	6 axes

* The servo control software for servo HRV2 and HRV3 control is 90E0 and 90E1 Series.
* The servo control software for servo HRV4 control is 90D0 Series.

NOTE
For the maximum number of controlled axes of the CNC, refer to Section 7.1, "CONNECTION TO THE SERVO AMPLIFIERS" in Series 30*i*-A CONNECTION MANUAL (HARDWARE) (B-63943EN).

(3) Series 0*i*-F

Only one FSSB system is available.
For basic unit A, the main board has an FSSB optical connector.
For basic unit G, the servo card has an FSSB optical connector.

Table5.1.4 (e) Maximum number of amplifier axes and separate detector interface units that can be connected to one FSSB optical connector

	Amplifier	Separate detector interface unit
Servo HRV2 control	12 axes	2 units
Servo HRV3 control	10 axes	2 units

Table5.1.4 (f) Maximum number of amplifier axes that can be connected to the servo card

Main board or servo card	Number of FSSB systems	Maximum number of amplifier axes	
		HRV2	HRV3
Main board (basic unit A)	1	12 axes	10 axes
Servo card (basic unit G)			

NOTE
For the maximum number of controlled axes of the CNC, refer to Section 6.2, "CONNECTION TO THE AMPLIFIERS" in Series 0*i*-F CONNECTION MANUAL (HARDWARE) (B-64603EN).

(4) Series 0*i*-D/0*i* Mate-D

For basic unit A, the servo card has an FSSB optical connector.
For basic unit C, the main board has an FSSB optical connector.

Table5.1.4 (g) Maximum number of amplifier axes and separate detector interface units that can be connected to one FSSB optical connector

	Amplifier	Separate detector interface unit (basic module)
Servo HRV2 control	9 axes	2 units
Servo HRV3 control	9 axes	2 units

Table5.1.4 (h) Maximum number of amplifier axes that can be connected to each servo card or main board

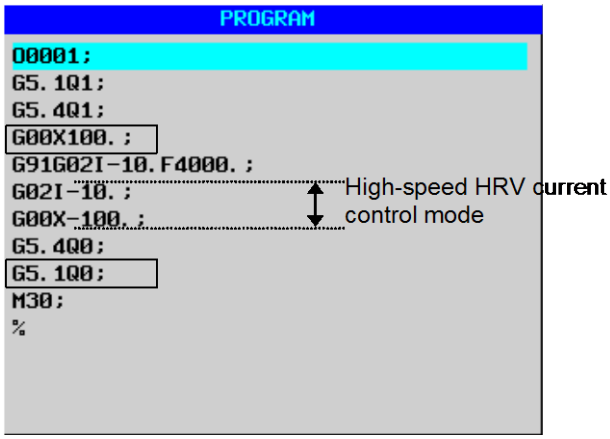
Servo card	Number of FSSB systems	Maximum number of amplifier axes	
		HRV2	HRV3
Servo card A1	1	2 axes	2 axes
Servo card A2		4 axes	4 axes
Servo card A3		6 axes	6 axes
Servo card A4		8 axes	8 axes
Servo card B2		8 axes	6 axes
Servo card B3		9 axes	9 axes
Main board (basic unit C)		5 axes	5 axes

* The servo control software corresponding to servo cards A1 to A4 is 90C5 and 90C8 Series.
* The servo control software corresponding to servo cards B2 and B3 is 90E5 and 90E8 Series.

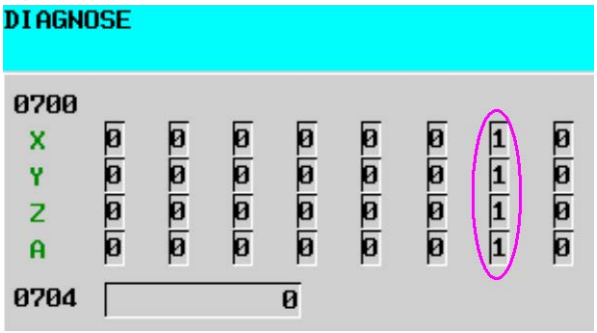
5.1.5 High-speed HRV current control mode

(1) Starting the high-speed HRV current control mode

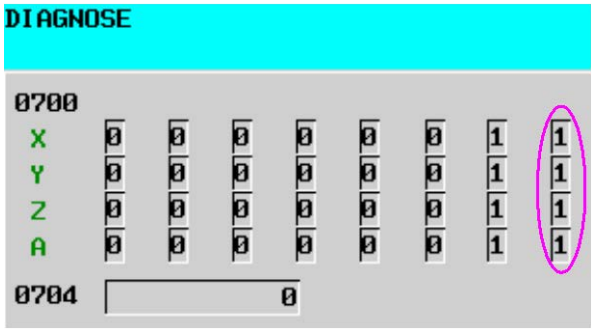
The high-speed HRV current control mode is turned on and off by using a G code (G5.4). The high-speed HRV current control mode is set for cutting commands specified between G5.4Q1 and G5.4Q0.



(2) Checking the high-speed HRV current control mode



Diagnosis No. 700 is used to check the status of the high-speed HRV current control mode in servo HRV3 control and servo HRV4 control. After setting servo HRV3 or HRV4 control and turning the power off then back on, check that bit 1 (HOK) of diagnosis No. 700 is set. When servo HRV3 or HRV4 control can be used, HOK is set to 1.



When HOK is set to 1, specifying G5.4Q1 sets bit 0 (HON) of diagnosis No.700 to 1 during the cutting feed command. When bit 0 (NOG54) of parameter No. 2283 is set to 1, the bit (HON) is set to 1 regardless of whether G5.4Q1 is specified.
When HON is set to 1, the current gain magnification for high-speed HRV current control is applied.

	#7	#6	#5	#4	#3	#2	#1	#0
Diagnosis No.700							**HOK**	**HON**

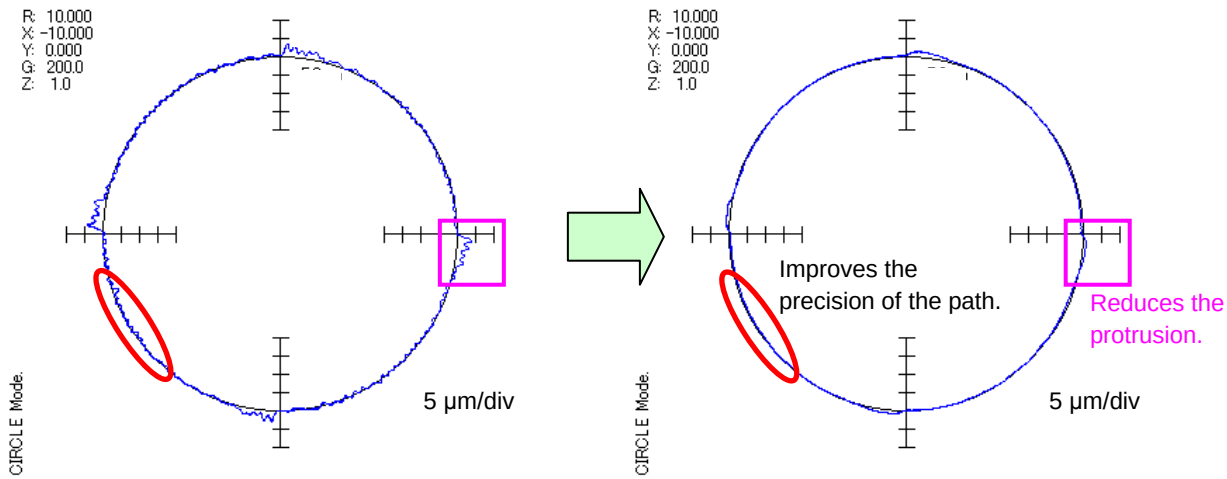
HOK(#1) The high-speed HRV current control mode can:
0: Not be used.
1: Be used.

HON(#0) The current cutting feed is:
0: Not in the high-speed HRV current control mode.
1: In the high-speed HRV current control mode.

5.1.6 Servo HRV$^+$ control

(1) Overview

Servo HRV$^+$ control makes the response of a current control loop faster. It enables a higher velocity control loop gain and improves the cutting surface quality.
In the following example, servo HRV$^+$ control improves the precision of the motor end path.



(i) Servo HRV control **(ii) Servo HRV$^+$ control**

Fig. 5.1.6 (a) Example of the motor end path

If the response limit of a velocity control loop is determined by the characteristics of the machine, however, a higher velocity control loop gain may not be able to be achieved even by making the response of the current control loop faster with servo HRV$^+$ control.

(2) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90J0	02.0 and subsequent editions	
Power Motion *i*-A	90K0	02.0 and subsequent editions	
DSA-B	90JP	02.0 and subsequent editions	
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	

* With the Power Motion *i* -A, 35*i* -B, DSA-B, and Series 0*i*-F, servo HRV4$^+$ control cannot be used.
* For linear motors, the following series and editions of servo control software are applicable.

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90J0	04.0 and subsequent editions	
Power Motion *i*-A	90K0	04.0 and subsequent editions	
DSA-B	90J3	05.0 and subsequent editions	
	90JP	02.0 and subsequent editions	
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	

(3) Setting parameters

<1> See Subsections 5.1.2 and 5.1.3 and set HRV3 or HRV4.
<2> Enable servo HRV$^+$ control (for each axis).

	#7	#6	#5	#4	#3	#2	#1	#0
2422				HRVPLS				

HRVPLS (#4) Servo HRV$^+$ control is:
0: Disabled.
1: Enabled.

When bit 4 of parameter No. 2422 is set to 1, servo HRV$^+$ control is enabled in the high-speed HRV current control mode enable state.

NOTE

1 To enable servo HRV$^+$ control, servo HRV3 or HRV4 control must be set.
If servo HRV2 control is set, setting the function bit (bit 4 of parameter No. 2422) to 1 causes alarm SV0417, "ILL DGTL SERVO PARAMETER" (diagnosis No. 0352 = 4224) to be issued.

2 When the current gains for servo HRV$^+$ control (parameters Nos. 2590 and 2591) are set to 0, enabling servo HRV$^+$ control (setting bit 4 of parameter No. 2422 to 1) causes alarm SV0417, "ILL DGTL SERVO PARAMETER" (diagnosis No. 0352 = 4224) to be issued.
The current gains for servo HRV$^+$ control are determined as standard parameters for each motor. For some servo motors, the gains are determined to be 0. In this case, servo HRV$^+$ control is not applicable.

3 To apply servo HRV$^+$ control, setting bit 7 of parameter No. 2004 to 1 is recommended. This setting makes the response of the current loop faster.

<3> Set the cutting/rapid velocity loop gain switching function.

	#7	#6	#5	#4	#3	#2	#1	#0
2202							VGCCR	

VGCCR (#1) The cutting/rapid velocity loop gain switching function is:
0: Not to be used.
1: Used.

<4> Tune the filters.
When servo HRV$^+$ control is applied, making the response of the current control loop faster may cause vibration at high frequency (around 1 kHz). In this case, eliminate the vibration using HRV filters. For HRV$^+$ control, it is important to adjust filters, so the following low pass filter (secondary) is added in addition to the conventional resonance elimination filters. For details of the filter adjustment, see Section 5.4.

2643	Low pass filter for servo HRV$^+$ control: Cut-off frequency

[Unit of data] Hz
[Valid data range] 500 to 1000
[Recommended value] Set two-thirds of the frequency of the vibration to be suppressed at the beginning and decrease the cut-off frequency until the vibration at high frequency is suppressed.

NOTE
This filter is enabled only during the execution of servo HRV$^+$ control and does not affect servo HRV control.

Setting the following function bit to 1 can disable the default torque command filter (*) used during the execution of servo HRV$^+$ control. Set the bit if you want to make the response even faster when no vibration is caused by applying servo HRV$^+$ control.
* A torque command filter with a cut-off frequency of 500 Hz is enabled by default so that servo HRV$^+$ control does not make the response too fast.

	#7	#6	#5	#4	#3	#2	#1	#0
2566		TFILOF						

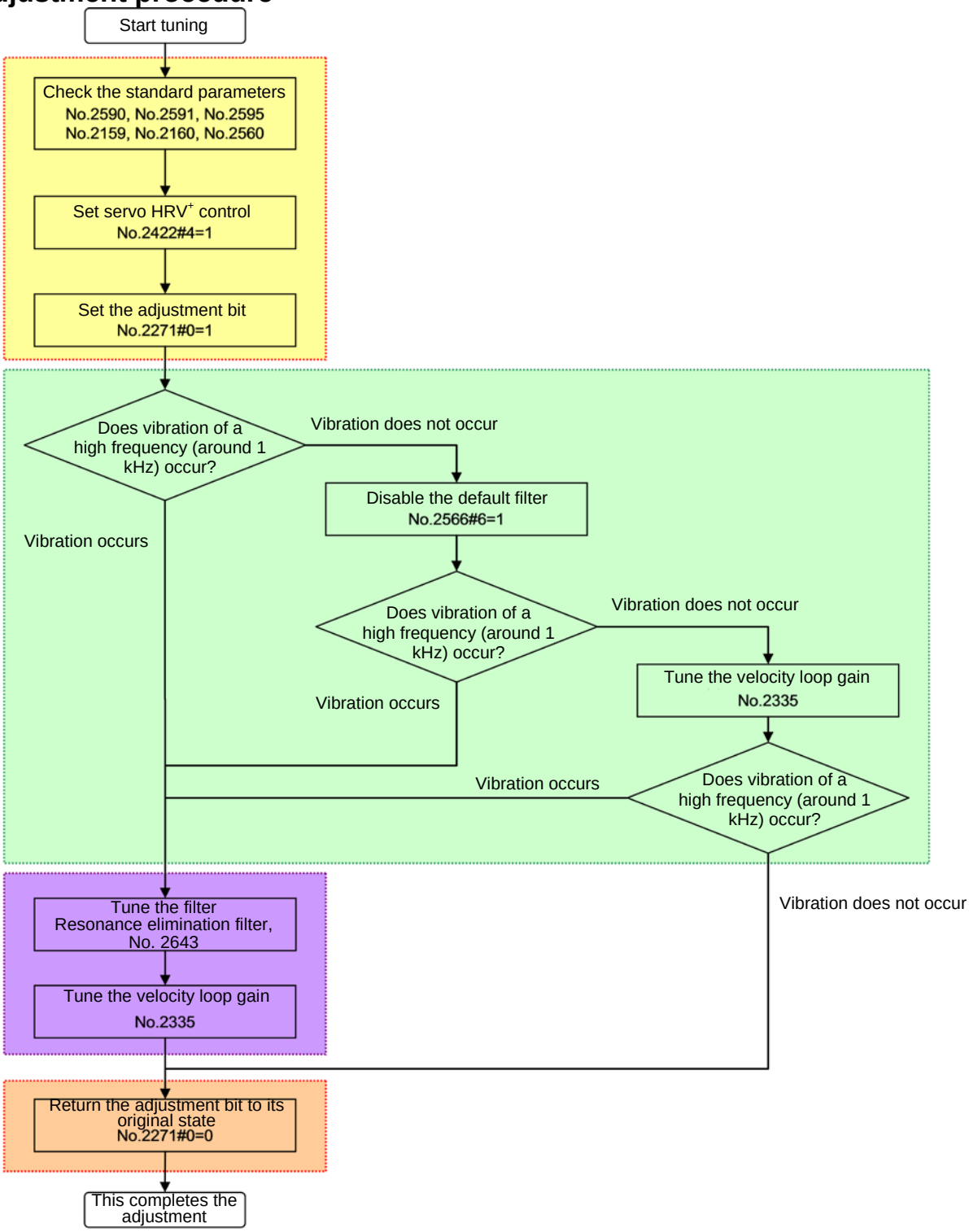
TFILOF (#6) The filter used by default during the execution of servo HRV$^+$ control is:
0: Enabled.
1: Disabled.

<5> Set the velocity loop gain magnification.

2335	In high-speed HRV current control mode: Velocity loop gain magnification

[Unit of data] %
[Valid data range] 100 to 800 (A value of 0 indicates the default value (100%).)
This parameter is valid only during cutting feed when the high-speed HRV current control mode is enabled.

(4) Adjustment procedure

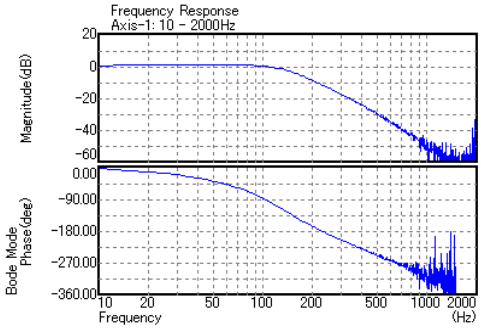


(5) Examples of adjustment

(a) The response of the velocity control loop becomes faster.

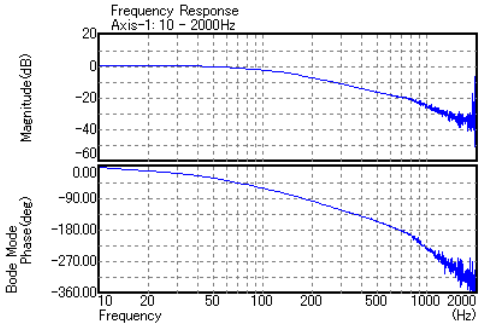
・ No vibration occurs by applying servo HRV$^+$ control.

Servo HRV control



Velocity control loop gain = 300%

Servo HRV$^+$ control

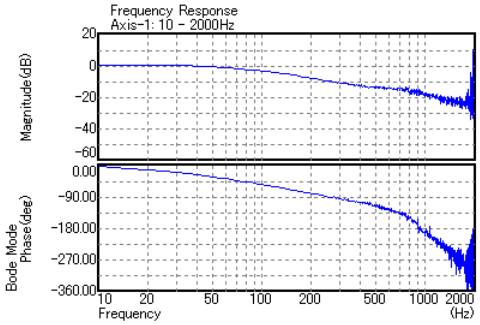


Velocity control loop gain = 300%

・ Filter tuning

When the velocity control loop gain is increased to 800%, vibration occurs at high frequency (1330 Hz), so the low pass filter is applied (parameter No. 2643 = 900 (= 1330 x 2/3)).

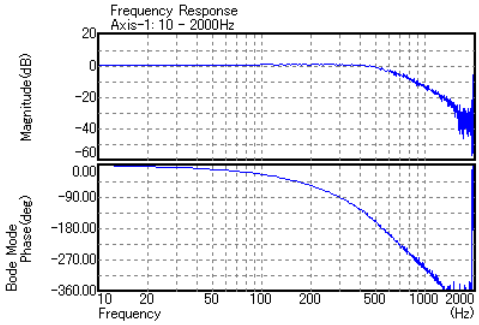
Servo HRV$^+$ control



Velocity control loop gain = 300%

Bit 6 of No. 2566 is set to 1 to disable the filter.

Servo HRV$^+$ control



Velocity control loop gain = 800%

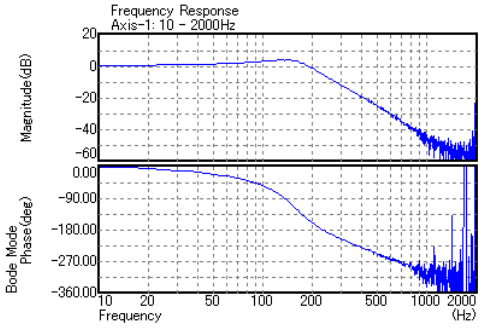
No. 2643 is set to 900 to enable the 900 Hz low pass filter.

・ Velocity control loop gain tuning

The velocity control loop gain is tuned.

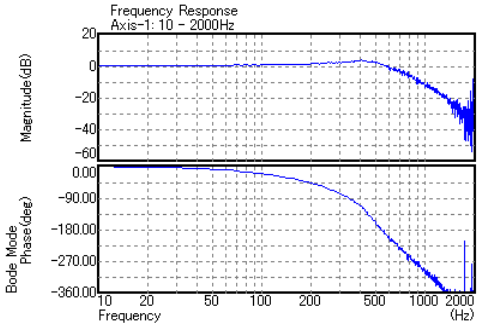
⇒ The response of the velocity control loop becomes faster.

Servo HRV control



Velocity control loop gain = 500%

Servo HRV$^+$ control

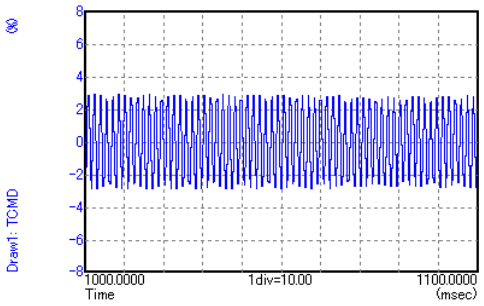


Velocity control loop gain = 1000%

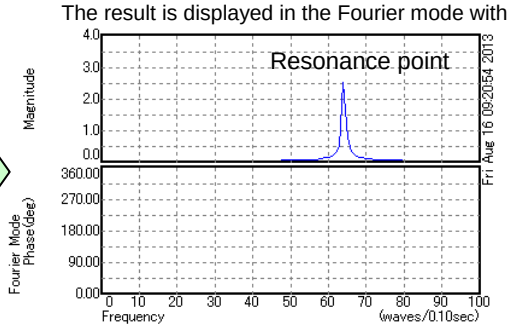
(b) The response of the velocity control loop does not become faster.

- When servo HRV+ control is applied, vibration occurs at high frequency (620 Hz).

TCMD is measured with a sampling cycle of 125 μsec.

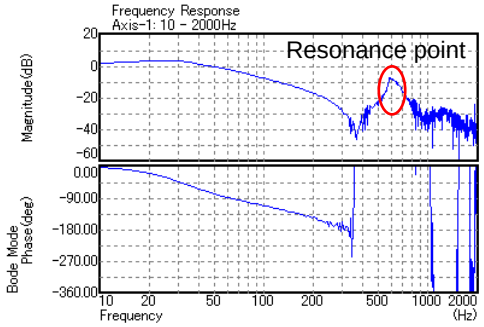


The result is displayed in the Fourier mode with Ctrl + F.



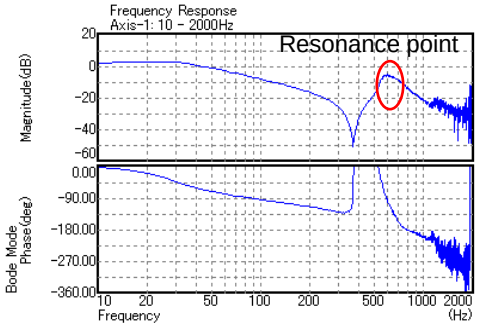
- Filter tuning
  The velocity control loop gain is a little decreased and the frequency response is measured.
  A notch filter is applied at the resonance point to suppress the vibration.

Servo HRV control



Velocity control loop gain = 300%

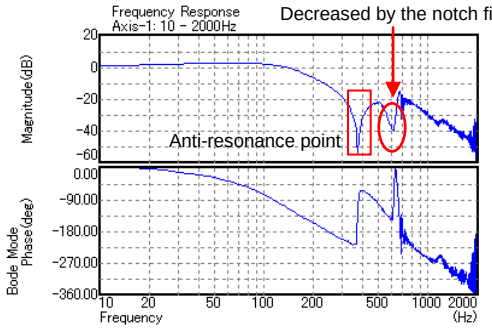
Servo HRV+ control



Velocity control loop gain = 300%

- Velocity control loop gain tuning
  The velocity control loop gain is tuned.
  ⇒ The response of the velocity control loop does not change due to the anti-resonance point.

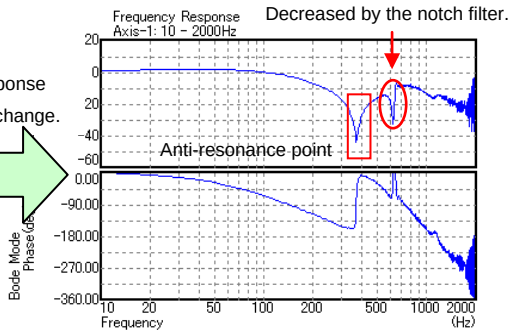
Servo HRV control



Velocity control loop gain = 800%

The response does not change.

Servo HRV+ control



Velocity control loop gain = 800%

5.1.7 Servo HRV+ Control (Velocity Loop Optimization)

(1) Overview

This function increases the integral gain of velocity loop in a range where stability is not lost so as to improve the response to disturbances. As the integral gain increases, the effect of reduction of position errors and quadrant protrusions caused by cutting resistance increases.

(2) Applicable series and editions

[Series and editions of applicable servo control software]

CNC	Servo control software		Remarks
	Series	Edition	
FANUC Series 30*i*/31*i* /32*i* -B Power Motion *i*-A DSA-B	90J0 90JP	12.0 and subsequent editions 06.0 and subsequent editions	
FANUC Series 0*i*-F	90M0 90M8	07.0 and subsequent editions 07.0 and subsequent editions	

[Series and editions of applicable system software]
See Appendix P.

(3) Setting parameters

	#7	#6	#5	#4	#3	#2	#1	#0
2695						VGPLS		

VGPLS (#2) Servo HRV+ control (velocity loop optimization) is:
0: Disabled.
1: Enabled.

2191	Total inertia of drive system

[Unit of data] %
[Setting value] (Total inertia of drive system including motor)/(motor inertia) × 100

To enable velocity loop optimization, set bit 2 of parameter No. 2695 to 1 and parameter No. 2191 to a value other than 0.

NOTE

- With velocity loop optimization enabled, the velocity loop integral gain multiplication during cutting feed in high-speed HRV current control is optimized.
- When velocity loop optimization is enabled (bit 2 of parameter No. 2695 is set to 1, and parameter No. 2191 is set to a value other than 0) by any of the following settings, an invalid parameter alarm (detail No. 6952) is issued.
  - A negative value is specified for No. 2335.
  - HRV+ control is disabled (bit 4 of No. 2422 is set to 0).
  - The following conditions are not satisfied:

$$\frac{1}{16} < \frac{\text{No. 2191 [\%]}}{\text{Velocity gain [\%]}} < 8, \quad \text{Velocity gain} = \frac{\text{No. 2021} + 256}{256} \times 100$$

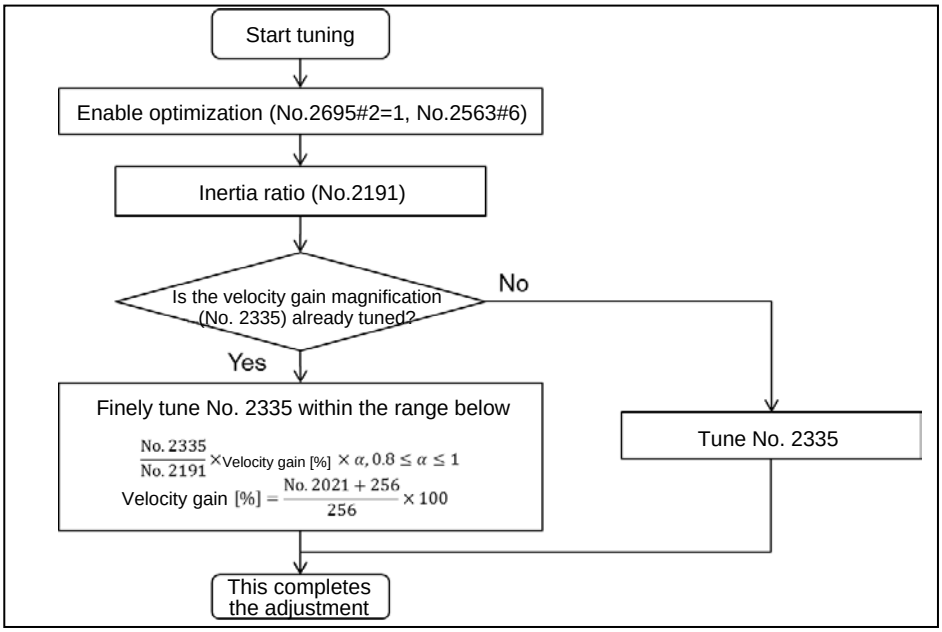
For β*i* / β*i*-B Series and synchronous built-in servo motors, enable the following parameter:

	#7	#6	#5	#4	#3	#2	#1	#0
2563		DDBCNV						

DDBCNV (#6) For β*i* / β*i*-B Series and synchronous built-in servo motors, servo HRV+ control (velocity loop optimization) is:
0: Not used.
1: Used.

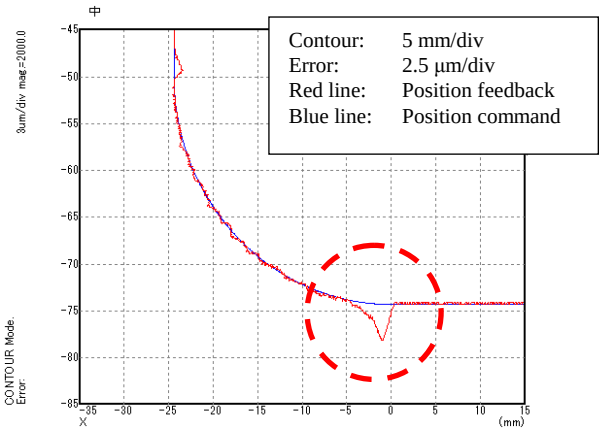
(4) Adjustment procedure

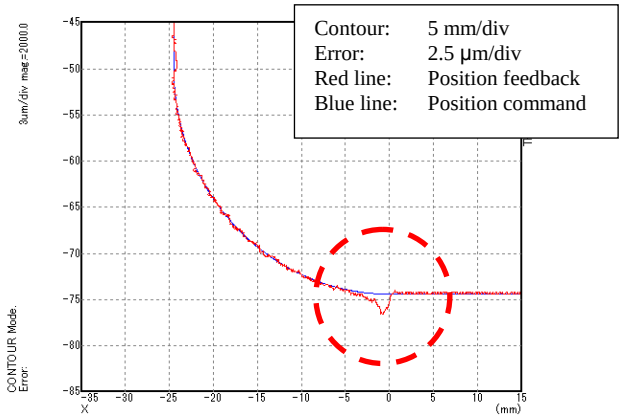
The adjustment procedure for servo HRV+ control (velocity loop optimization) is as follows:



(5) Application example

When a square with rounded corners is operated at F4000 mm/min, the waveform is as follows:





5.2 CUTTING/RAPID SWITCHING

(1) Overview

The suitability of cutting feed (machining operation) and that of rapid traverse (positioning operation with high acceleration and maximum speed) generally depend on the control gains.

	Cutting feed	Rapid traverse
Higher gains	Good for high precision	Possible hunting
Lower gains	Insufficient precision	Good for stability

Fig. 5.2 (a) shows some functions that can switch parameters between cutting feed and rapid traverse. These features lead to both the higher response and the higher stability of the servo system.

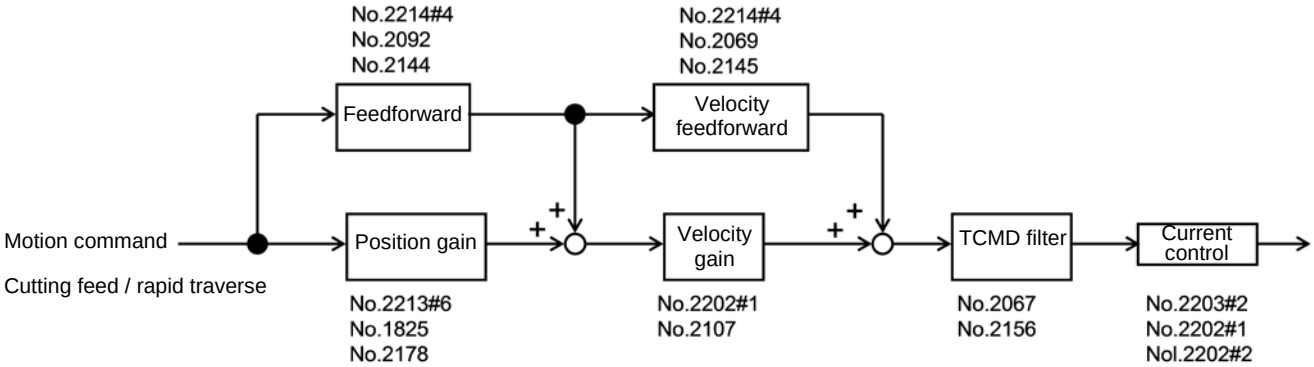


Fig. 5.2 (a) Functions that can switch parameters between cutting feed and rapid traverse

(2) Series and editions of applicable servo software

CNC	Servo software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	03.0 and subsequent editions	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	01.0 and subsequent editions	

(3.1) Velocity gain switching

Oscillation is more apt to occur in the velocity loop when torque is saturated at the end of acceleration of rapid traverse. Some high-frequency oscillations may easily happen at a high feedrate in some machines. It is quite effective to switch the control gains between cutting and rapid traverse for such cases.
If the cutting/rapid velocity loop gain is set, the overridden value is used for cutting feed gain but the previous gain is used for rapid traverse. The usual range of override is between 150 and 200%.

Cutting/rapid velocity loop gain switching function	Mode	Velocity loop gain [%]
No. 2202#1=0 (disabled)	Always	(1 + No. 2021 / 256) × 100
No. 2202#1=1 (enabled)	Rapid traverse	(1 + No. 2021 / 256) × 100
	Cutting feed	(1 + No. 2021 / 256) × No. 2107

	#7	#6	#5	#4	#3	#2	#1	#0
2202							VGCCR	

0: Disables cutting/rapid velocity loop gain switching.
1: Enables cutting/rapid velocity loop gain switching.

2107	Velocity loop gain magnification for cutting (%)

[Valid data range] 100 to 800% (A value of 0 indicates the default value (100%).)

(3.2) Feedforward switching

Cutting/rapid feedforward switching	Mode	Position feedforward coefficient	Velocity feedforward coefficient
No. 2214#4=0 (disabled)	Always	No.2092	No.2069
No. 2214#4=1 (enabled)	Rapid traverse	No.2092	No.2069
	Cutting feed	No.2144	No.2145

	#7	#6	#5	#4	#3	#2	#1	#0
1800					FFR			

FFR(#3) During rapid traverse, feedforward is:
0: Disabled.
1: Enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
2005							FEED	

FEED (#1) 1: Feedforward is enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
2214				FFCHG				

0: Cutting/rapid feedforward switching is disabled.
1: Cutting/rapid feedforward switching is enabled.

2145	Velocity feedforward coefficient for cutting feed
2144	Advanced preview feedforward coefficient for cutting
2069	Velocity feedforward coefficient for rapid traverse
2092	Advanced preview feedforward coefficient for rapid traverse

(3.3) TCMD filter switching

The torque command filter works better than the resonance elimination filter when high-frequency oscillation happens only in rapid traverse. But an unsuitable use of the torque command filter reduces the stability limit of the velocity gain due to a delay by the filter. It is effective to use the torque command filter only for rapid traverse in such cases.

Cutting feed/rapid traverse switching torque command filter	Mode	TCMD filter coefficient
No. 2156=0 (disabled)	Always	No.2067
No. 2156≠0 (enabled)	Rapid traverse	No.2156
	Cutting feed	No.2067

2067	TCMD filter coefficient
2156	Torque command filter coefficient for rapid traverse

(3.4) Switching of current loop 1/2 PI control

With the cutting/rapid velocity loop gain switching function enabled, current loop 1/2 PI control is disabled during rapid traverse. Set the bit for "always enabling current loop 1/2 PI control" for both cutting feed and rapid traverse.

1/2PI (No.2203#2)	Cutting/rapid switching velocity gain (bit 1 of No. 2202)	Always-on 1/2PI (No.2202#2)	Mode	1/2PI
0	0/1	0/1	Rapid traverse	Disabled
			Cutting feed	
1	0	0/1	Rapid traverse	Enabled
			Cutting feed	
	1	0	Rapid traverse	Disabled
			Cutting feed	Enabled
		1	Rapid traverse	Enabled
			Cutting feed	

	#7	#6	#5	#4	#3	#2	#1	#0
2203						CRPI		

0: Disables current loop 1/2 PI control.
1: Enables current loop 1/2 PI control.

	#7	#6	#5	#4	#3	#2	#1	#0
2202							VGCCR	

0: Disables cutting/rapid velocity loop gain switching.
1: Enables cutting/rapid velocity loop gain switching.

- When the cutting/rapid velocity loop gain switching function is used:

	#7	#6	#5	#4	#3	#2	#1	#0
2202						PIAL		

1: Always enables current loop 1/2 PI control.

(3.5) Position gain switching

It is possible to switch position gains between cutting feed and rapid traverse.

Cutting/rapid position loop gain		Position loop gain parameters
No.2213#6=0 (disabled)	Always	No.1825
No.2213#6=1 (enabled)	Rapid traverse	No.2178
	Cutting feed	No.1825

NOTE

A mechanical shock may occur in the following cases:

- In switching the modes when having a position error under a setting of large in-position width.
- In having the large difference in position gains between cutting feed and rapid traverse.

Use a smaller in-position width or decrease the difference between the cutting position and rapid traverse position loop gains to avoid such a shock.

	#7	#6	#5	#4	#3	#2	#1	#0
2213		PGCCR2						

Cutting/rapid position loop gain switching is:

0: Disabled.

1: Enabled.

1825	Position loop gain for cutting
2178	Position loop gain for rapid traverse

[Valid data range] 0 to 32767

[Unit of data] 0.01 /sec.

5.3 VIBRATION SUPPRESSION IN THE STOP STATE

5.3.1 Velocity Loop High Cycle Management

(1) Overview

This function speeds up the calculation of the proportional term in the velocity controller, leading to higher precision with higher servo response.

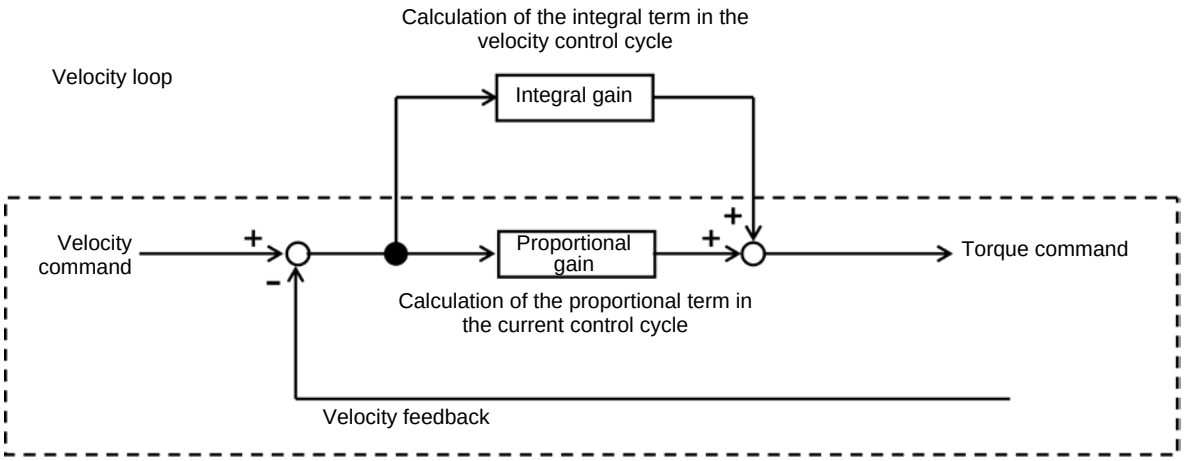


Fig. 5.3.1 (a) Velocity loop high cycle management function

> ⚠ **CAUTION**
> This function may amplify some mechanical oscillation with lower frequencies depending on the machinery.

(2) Series and editions of applicable servo software

CNC	Servo software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	03.0 and subsequent editions	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
DSA-B	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	01.0 and subsequent editions	

(3) Setting parameters

	#7	#6	#5	#4	#3	#2	#1	#0
2017	PK2V25							

PK2V25 (#7) 1: Velocity loop high cycle management is used.

(4) Restrictions

NOTE

1 Observer is disabled when using this function. Use the resonance elimination filter and TCMD filter to avoid high-frequency oscillations.

2 The normalization of machine speed feedback is disabled when using this function.
Use the vibration damping control function similar to the machine speed feedback function, when a higher velocity gain does not resolve hunting.

3 There are some restrictions as shown in the table below when using this function.

Unavailable function
Non-linear control
Acceleration feedback
N pulses suppression function

Function with restricted usage
Machine speed feedback; normalization not performed
Observer used for unexpected disturbance torque detection

5.3.2 Acceleration Feedback

(1) Overview

Fig. 5.3.2 (a) shows a block diagram of the velocity loop. Acceleration feedback compensates the torque command with the multiplication of the acceleration feedback gain by the acceleration derived from velocity feedback. This function is effective for stabilization of servo systems when there are some oscillations with frequencies of 50 to 150 Hz due to spring-like couplings between the motor and the machinery.

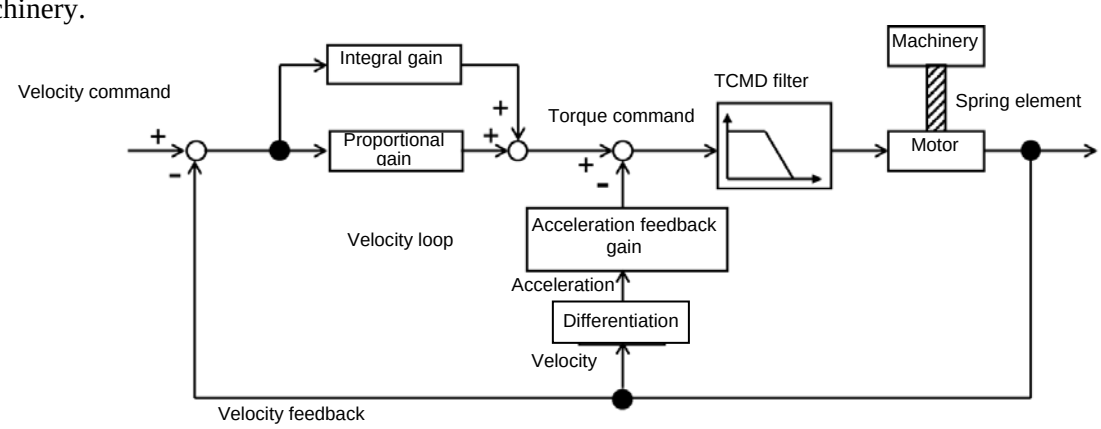


Fig. 5.3.2 (a) Acceleration feedback function

NOTE

This function is disabled when using velocity loop high cycle management (see Subsection 5.3.1).

(2) Series and editions of applicable servo software

CNC	Servo software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	A(01) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0 90M8	02.0 and subsequent editions 02.0 and subsequent editions	
Series 0*i*-D	90C5 90C8 90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	01.0 and subsequent editions	

(3) Setting parameters

2066	Acceleration feedback gain

[Valid data range] -32768 to 0 (Setting 0 disables this function.)
[Recommendation] -20 to -10

> ⚠ **CAUTION**
> Abnormal sound and oscillation may happen during add./dec. with too high of an acceleration feedback gain.
> Reduce the gain to solve such a problem.

(4) Comparison with the velocity loop high cycle management function

	Acceleration feedback function	Velocity loop high cycle management
Control method	Performs acceleration feedback at high speed.	Performs calculation for velocity loop integral terms only at high speed.
Adjustment method	No.2066 = -10 ~ -20	No.2017#7=1
Effect	Stabilizes the servo control system when low-frequency resonance occurs.	Allows higher gains to be set.

5.3.3 Variable Proportional Gain in the Stop State

(1) Overview

This function stabilizes the servo system in the stop state using the lower proportional gain only in the stop state as illustrated in Fig. 5.3.3 (a). It is useful to realize both higher response and higher stability as the usual proportional gain is used during operation. This function decreases the proportional gain of the velocity controller to the specified multiplication when the absolute value of the position error goes into the range of the stop judgment level.

If oscillation of the machinery happens in the stop state even using this function, the velocity loop proportional gain is too high.
Decrease the velocity loop proportional gain.

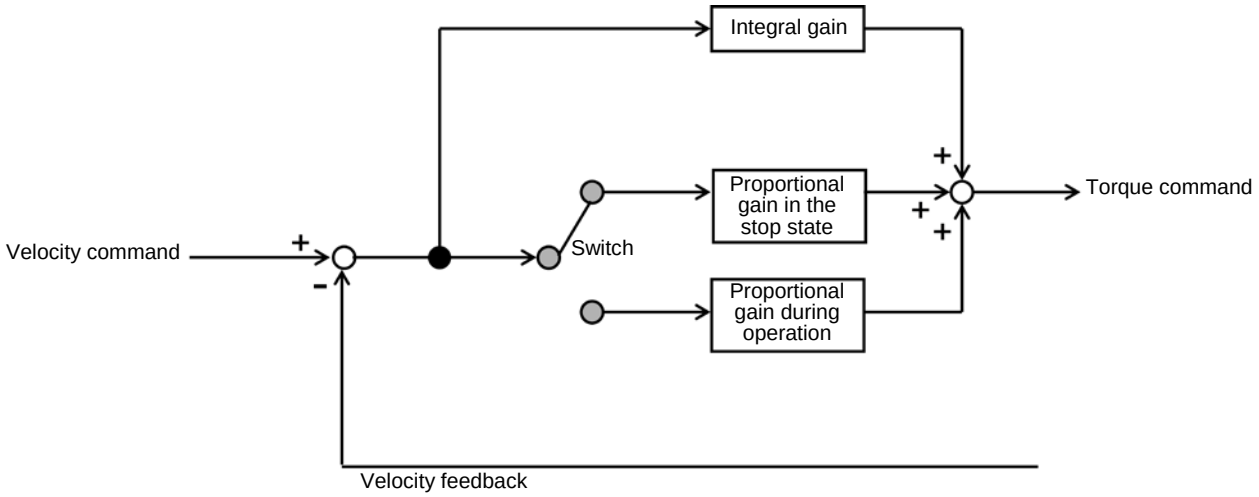


Fig. 5.3.3 (a) Variable proportional gain in the stop state

NOTE
If oscillation of the machinery happens in the stop state even using the variable proportional gain in the stop state, the velocity loop proportional gain is too high. Decrease the velocity gain.

(2) Series and editions of applicable servo software

CNC	Servo software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	03.0 and subsequent editions	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
	90GP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	01.0 and subsequent editions	

(3) Setting parameters

	#7	#6	#5	#4	#3	#2	#1	#0
2016					PK2VDN			

PK2VDN (#3) 1: Variable proportional gain in the stop state is used.

Arbitrary magnification setting	Multiplication selection setting	Applied proportional gain	
		Cutting feed	Rapid traverse
No.2324 = 0	No.2207#3 = 0	0.75	
	No.2207#3 = 1	0.5	
No.2324 = α	No.2207#3 = 0	× (α/100)	0.75
	No.2207#3 = 1	× (α/100)	0.5

	#7	#6	#5	#4	#3	#2	#1	#0
2207					PK2D50			

PK2D50(#3) When bit 3 of parameter No. 2016 is set to 1, the velocity loop proportional gain in the stop state is:
0: 75%
1: 50%

2324	Arbitrary multiplication of the proportional gain in the stop state during cutting feed

[Unit of data] %
[Recommended value] 25 to 100

2119	Variable proportional gain in the stop state: stop judgment level

[Unit of data] Detection unit
[Recommendation] 2 to 10 (Detection unit: 1 μm)
20 to 100 (Detection unit: 0.1 μm)

5.3.4 Current Loop 1/2 PI Control

(1) Overview

It is effective to realize the highest possible velocity gain for improvement of servo performance in high-speed machining, high-precision machining, high-speed positioning, ultrahigh-precision positioning and so on.
Higher response of current control is required to realize the higher velocity gain.
Current loop 1/2 PI control leads to higher response of the current loop.

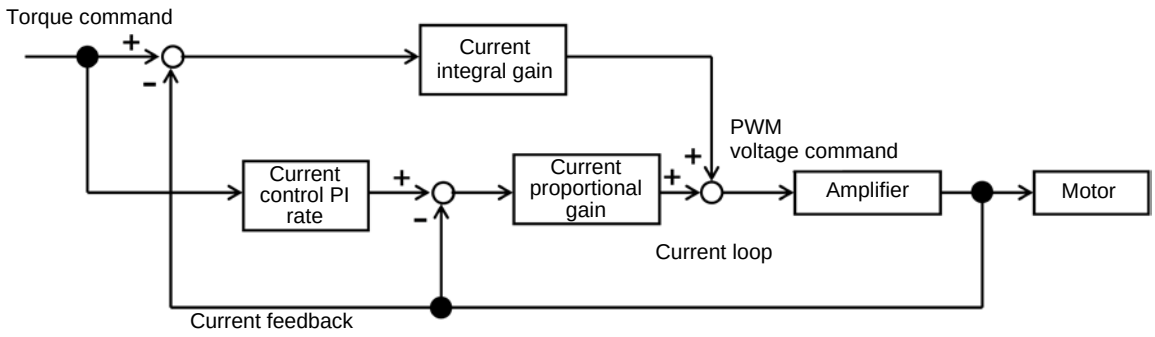


Fig. 5.3.4 (a) Block diagram of current loop 1/2 PI control

> ⚠ **CAUTION**
> Disable this function when the sound with the motor excitation and the vibration in the stop state are louder.

(2) Series and editions of applicable servo software

CNC	Servo software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	03.0 and subsequent editions	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
	90GP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	01.0 and subsequent editions	

(3) Setting parameters

To enable this function, set bit 2 of parameter No. 2203 to 1.

	#7	#6	#5	#4	#3	#2	#1	#0
2203						CRPI		

CRPI(#2) 1: Current loop 1/2 PI control is enabled.

If you want to use cutting/rapid velocity loop gain switching together, also set the following function bits to 1.

	#7	#6	#5	#4	#3	#2	#1	#0
2202							VGCCR	

VGCCR(#1) 1: Cutting feed/rapid traverse velocity loop gain switching

	#7	#6	#5	#4	#3	#2	#1	#0
2202						PIAL		

PIAL(#2) 1: When this function is used with cutting feed/rapid traverse velocity loop gain switching, current loop 1/2 PI control is enabled both during cutting feed and rapid traverse.

2323	Current control PI rate

[Valid data range] 0 to 4096

[Unit of data] A value of 4096 indicates 100% (complete PI control). When a value of 0 is set, the default value (2048) is internally applied.

[Recommended value] Normally, set 0.

NOTE

The parameter No. 2323 should usually be set to 0. We strongly recommend that you use servo HRV^{+} current control to realize the higher response, not the parameter or the PI rate.

5.4 MACHINE RESONANCE ELIMINATION

5.4.1 Selecting a Resonance Elimination Function

The frequency band where the resonance elimination functions produce elimination effects varies from one function to another. Check the resonance frequency in question with SERVO GUIDE or a vibrometer then select a resonance elimination function according to the frequency.
The figure below shows the classified functions and their effective resonance frequency bands.

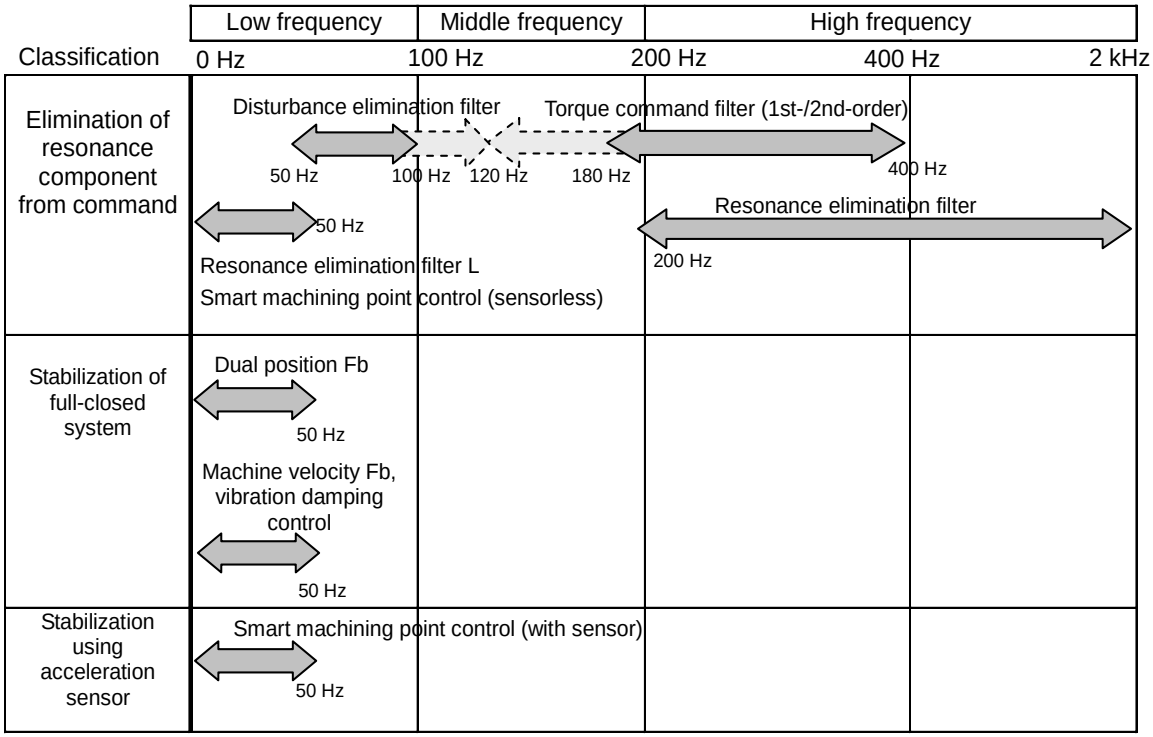


Fig. 5.4.1 (a) Resonance elimination functions and frequency bands

* The figure above shows guideline frequencies.
* For vibration at 100 Hz to 180 Hz, a disturbance elimination filter or torque command filter may be useful. Vibration can also be reduced by applying servo HRV$^+$ control or current loop 1/2 PI control or by fine-tuning the velocity loop gain.
* The observer function for suppressing high-frequency vibration described in previous parameter manuals is not currently recommended since there is a problem with a combination of the function and velocity feedforward and other functions. To suppress high-frequency vibration, the torque command filter (1st, 2nd order) and resonance elimination filters are recommended.
* The resonance elimination functions for use at low frequencies have the following features:

Table 5.4.1 (a) Features of resonance elimination functions

Function	Feature
Resonance elimination filter L	Parameter setting is easy, and a large resonance elimination effect can be expected. However, precision degradation (such as overshoot) is unavoidable, so this function is not suitable for applications that require high precision. The precision and elimination effect need to be balanced by using an exclusion rate.
Smart machining point control (sensor-less)	Parameter setting is easy, and a large resonance elimination effect can be expected. In some cases, an acceleration sensor is required at adjustment.
Disturbance elimination filter	This function compensates a torque command, so that precision is less affected. However, the maximum torque may decrease.

Function	Feature
Dual position Fb, machine velocity Fb, vibration damping control	These functions are specifically for a full-closed system and reduce vibration (instability) caused by a twist between the motor and scale. The order of effect is: Dual position Fb > Machine velocity Fb = Vibration damping control.
Smart machining point control (with sensor)	This function has a limited influence on precision and produces a high elimination effect. An acceleration loop may oscillate depending on the gain setting. An acceleration sensor needs to be installed.

5.4.2 Torque Command Filter (1st order) (Middle-Frequency Resonance Elimination Filter)

(1) Overview

The torque command filter (1st order) applies a 1st order low-pass filter to the torque command. This function eliminates resonance in machines that resonate at a few hundred Hz or higher.

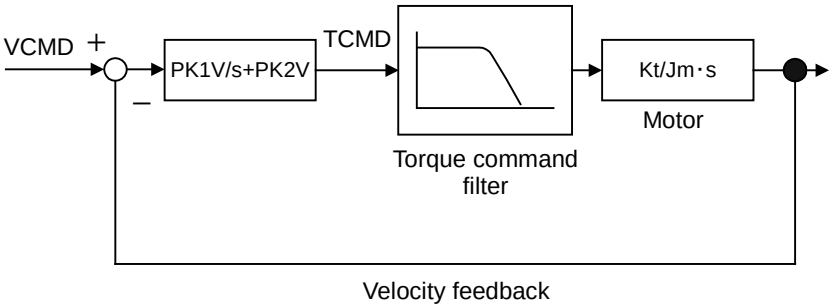


Fig. 5.4.2 (a) Configuration of velocity loop including torque command filter

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	A(01) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0 90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8 90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	01.0 and subsequent editions	

(3) Setting parameters

2067	Torque command filter (FILTER)

[Recommended value] 1166 (200 Hz) to 2327 (90 Hz)

When changing the torque command filter setting, see Table 5.4.2 (a).

As the cut-off frequency, select the parameter value corresponding to a half of the vibration frequency from the table below.

(Example)

In the case of 200-Hz vibration, select a cutoff frequency of 100 Hz for the torque command filter, and set FILTER = 2185.

> ⚠ **CAUTION**
> Do not specify 2400 or a greater value. Such a high value may increase the vibration.

Table5.4.2 (a) Parameter setting value of torque command filter

Cutoff frequency (Hz)	Setting value of parameter	Cutoff frequency (Hz)	Setting value of parameter
90	2327	170	1408
95	2255	180	1322
100	2185	190	1241
110	2052	200	1166
120	1927	220	1028
130	1810	240	907
140	1700	260	800
150	1596	280	705
160	1499	300	622

(4) Cutting feed/rapid traverse switching torque command filter

With this function, the torque command filter coefficient can be switched between rapid traverse and cutting feed to improve contouring accuracy during cutting and increase the maximum feedrate and maximum acceleration during rapid traverse at the same time. For details on cutting/rapid switching, see Section 5.2.

2156	Torque command filter coefficient for rapid traverse

[Valid data range] 1166 (200 Hz) to 2327 (90 Hz)

According to the setting of parameter No. 2156, the torque command filter changes as listed in the following table.

Cutting feed/rapid traverse switching torque command filter		Torque command filter
No. 2156=0 (disabled)	Always	No.2067
No. 2156≠0 (enabled)	Stop state, rapid traverse, jog feed	**No.2156**
	Cutting feed	No.2067

5.4.3 Torque Command Filter (2nd order) (High-Frequency Resonance Elimination Filter)

(1) Overview

The torque command filter (2nd order) function applies the 2nd order low-pass filter for the torque command. The secondary low-pass filter has higher resonance elimination effects than the primary low-pass filter. The secondary low-pass filter is effective particularly when multiple resonance points are present at a high frequency of 1 kHz or more.

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	03.0 and subsequent editions	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
DSA-B	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	01.0 and subsequent editions	

(3) Setting parameters

The torque command filter (2nd order) uses the same parameters as the resonance elimination filter function in Subsection 5.4.4.

2113, 2360, 2363, 2366	RE filters 1 to 4: Attenuation center frequencies

[Valid data range] 500 to 1000 (HRV1, HRV2), 500 to 2000 (HRV3), 500 to 4000 (HRV4)
[Unit of data] Hz
Set the cut-off frequency. The cutoff frequency needs to be less than or equal to half the resonance frequency to be eliminated. For example, when the resonance frequency is 1 kHz, the cutoff frequency needs to be 500 Hz or less.

2177, 2361, 2364, 2367	RE filters 1 to 4: Attenuation bandwidth

Set 0.

2359, 2362, 2365, 2368	RE filters 1 to 4: Damping

[Standard setting] 70
[Unit of data] %

5.4.4 Resonance Elimination Filter (High-Frequency Resonance Elimination Filter)

(1) Overview

The resonance elimination filters remove high-frequency resonance. With this function, high frequency resonance can be removed to set a higher velocity loop gain.

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	A(01) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	01.0 and subsequent editions	

The following series and editions of servo control software are applicable for resonance elimination filter 5 (only for semi-closed control).

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90J0 90K0 90JP	02.0 and subsequent editions 02.0 and subsequent editions 02.0 and subsequent editions	
Series 0*i*-F	90M0 90L0 90M8 90L8	01.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions	

For the following series and editions of servo control software, the valid setting range of the center frequency has been expanded. They are referred to as series and editions that support expanded frequencies.

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90J0 90K0 90JP	04.0 and subsequent editions 04.0 and subsequent editions 02.0 and subsequent editions	
Series 0*i*-F	90M0 90L0 90M8 90L8	01.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions	

(3) Control block diagram

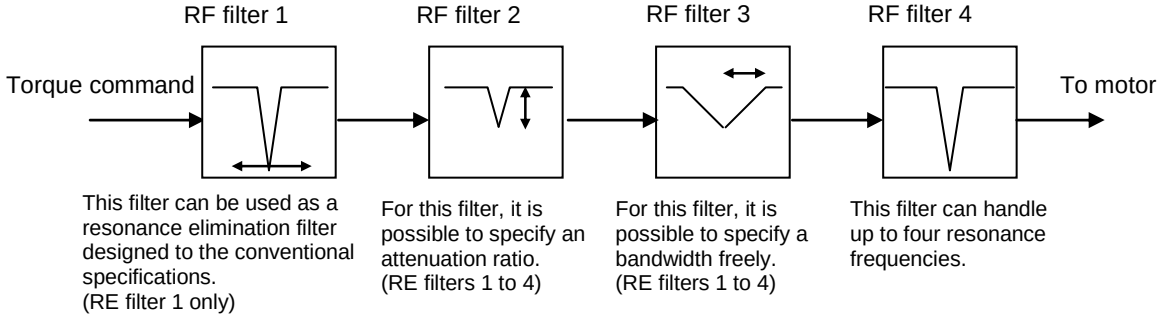


Fig. 5.4.4 (a) Overview of a resonance elimination filter

(4) Note

⚠ CAUTION

1 If the frequency of a resonance elimination filter is set to a low frequency around 100 Hz, the control system can become unstable, resulting in a large vibration. See the example of adjustment.

2 Resonance elimination filters are enabled when a value other than 0 is set for the center frequency, attenuation bandwidth, or damping parameter. If you do not want to use the resonance elimination filters, be sure to set all three of the parameters (attenuation center frequency, attenuation bandwidth, and damping) to 0. In addition, modify the parameters in the emergency stop state.

(5) Setting parameters

<1> Setting for resonance elimination filters 2 to 5

The resonance elimination filter has a function for cutting signals of a particular frequency band. Three parameters are used for this filter. They specify the center frequency of a range to be cut, a bandwidth to be cut, and damping separately.

2360	Resonance elimination filter 2: attenuation center frequency

[Valid data range] 96 to 1000 (HRV1, HRV2), 96 to 2000 (HRV3), 96 to 4000 (HRV4)
96 to 1750 (HRV1, HRV2), 96 to 3500 (HRV3), 96 to 7000 (HRV4) (Series and editions that support expanded frequencies)
[Unit of data] Hz

2361	Resonance elimination filter 2: attenuation bandwidth

[Valid data range] 0 to attenuation center frequency (independent of the damping setting)
[Unit of data] Hz

2362	Resonance elimination filter 2: damping

[Valid data range] 0 to 100 (Maximum attenuation when set to 0)
[Unit of data] %

Resonance elimination filters 3, 4, and 5 have the same specification as resonance elimination filter 2.

2363	Resonance elimination filter 3: attenuation center frequency
2364	Resonance elimination filter 3: attenuation bandwidth
2365	Resonance elimination filter 3: damping
2366	Resonance elimination filter 4: Attenuation center frequency

2367	Resonance elimination filter 4: Attenuation bandwidth
2368	Resonance elimination filter 4: Damping
2640	Resonance elimination filter 5: Attenuation center frequency
2641	Resonance elimination filter 5: Attenuation bandwidth
2642	Resonance elimination filter 5: Damping

* Resonance elimination filter 5 is available only when semi-closed control is applied with the applicable series and editions.

	#7	#6	#5	#4	#3	#2	#1	#0
2221		QNOTCH					LNOTCH	

LNOTCH(#1) 0: Resonance elimination filter 4 is used.
1: Resonance elimination filter L is used.

QNOTCH(#6) Resonance elimination filter 4 has (90G0/17.0 and subsequent editions):
0: The standard specification.
1: The extended frequency specification.

Table5.4.4 (a) Extension of the setting range of the attenuation center frequency of resonance elimination filter 4

	HRV1, HRV2	HRV3	HRV4
Setting range of attenuation center frequency No. 2366 (No.2221#6=0)	96~1000	96~2000	96~4000
Setting range of attenuation center frequency No. 2366 (No.2221#6=1)	96~2000	96~4000	96~4000

<2> Setting for resonance elimination filter 1
Only resonance elimination filter 1 has the conventional specification if the damping is 0 and the improved specification if the damping is not 0.

2113	Resonance elimination filter 1: Attenuation center frequency

[Valid data range] 96 to 1000 (HRV1, HRV2), 96 to 2000 (HRV3), 96 to 4000 (HRV4)
96 to 1750 (HRV1, HRV2), 96 to 3500 (HRV3), 96 to 7000 (HRV4) (Series and editions that support expanded frequencies)
[Unit of data] Hz

2177	Resonance elimination filter 1: attenuation bandwidth

[Valid data range] 0 to attenuation center frequency
[Unit of data] Hz

2359	Resonance elimination filter 1: damping

[Valid data range] 0 to 100 (Maximum attenuation when set to be 0. For resonance elimination filter 1.)
[Unit of data] %

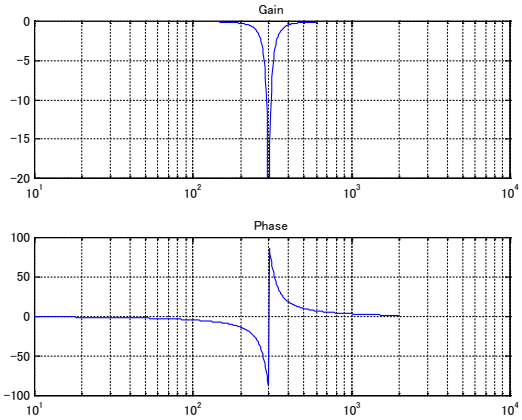
NOTE
In Series 30*i*-A and Series 0*i*-D, when the damping for resonance elimination filter 1 is set to 0, the specification compatible with the conventional (FS16*i*-B or earlier) elimination filters is used, so the center frequency can be set to 250 to 992 Hz and the attenuation bandwidth can be set to 20, 30, or 40 Hz.

[Parameters for resonance elimination filters]

	Attenuation center frequency [Hz]	Attenuation bandwidth	Damping
Resonance elimination filter 1	No.2113	No.2177	No.2359
Resonance elimination filter 2	No.2360	No.2361	No.2362
Resonance elimination filter 3	No.2363	No.2364	No.2365
Resonance elimination filter 4	No.2366	No.2367	No.2368

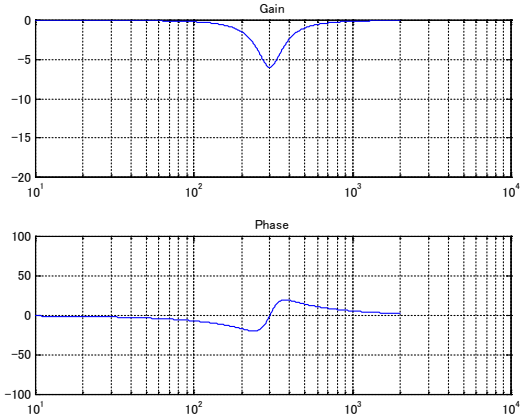
(6) Example of filter characteristics

<a> Conventional resonance elimination filter



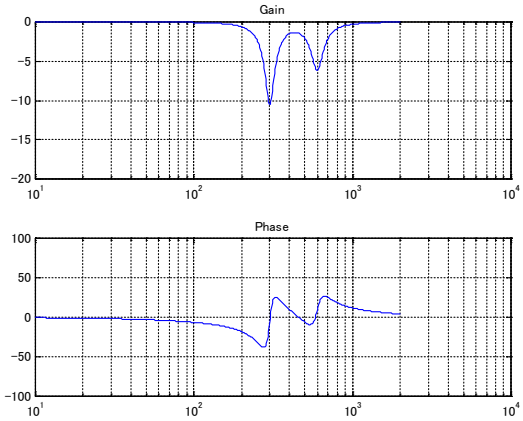
Center frequency = 300 Hz
Bandwidth = 30 Hz
Damping = 0

<b> Improved resonance elimination filter (with damping)



Center frequency = 300 Hz
Bandwidth = 100 Hz
Damping = 50%

<c> Improved resonance elimination filter (with two stages of damping)



(First filter)
Center frequency = 300 Hz
Bandwidth = 50 Hz
Damping = 30%
(Second filter)
Center frequency = 600 Hz
Bandwidth = 100 Hz
Damping = 50%

(7) Example of adjustment

1 Measure frequency characteristics with SERVO GUIDE and display the open loop transfer function (figure below).

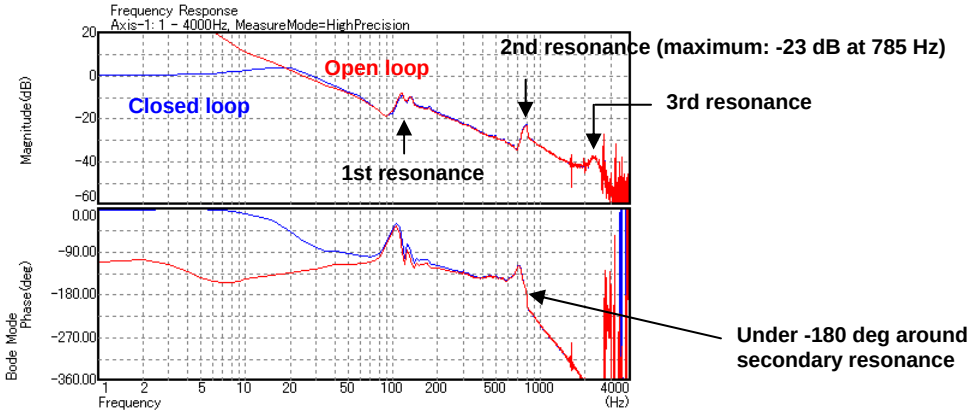


Fig. 5.4.4 (b) Configuration of a velocity loop containing a torque command filter

2 There are three main resonances. In this example, they are called the 1st, 2nd and 3rd resonances from the lowest frequency.

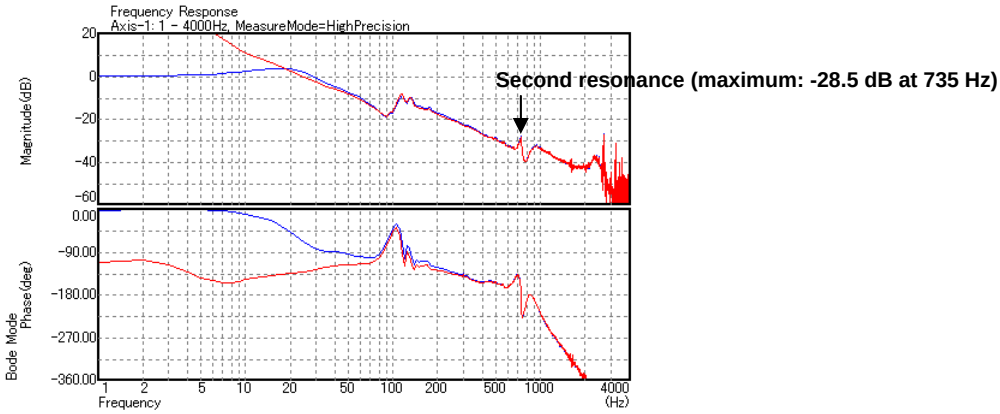
3 Check the frequency at which the phase of the control system is under -180 deg. In this example, you can see the frequency is just around the secondary resonance frequency. Since the gain must be set to up to 0 dB at a frequency at which the phase is under -180 deg, the peak of the gain at the 2nd resonance prevents an increase in the velocity gain. Handle the 2nd resonance with resonance elimination filters.

4 At the 1st resonance frequency, the phase is not under -135 deg: the phase margin is over 45 deg. Because the gain is to be increased, resonance elimination filters are not used for the 1st resonance.

5 The 3rd resonance is not adjusted in this example.

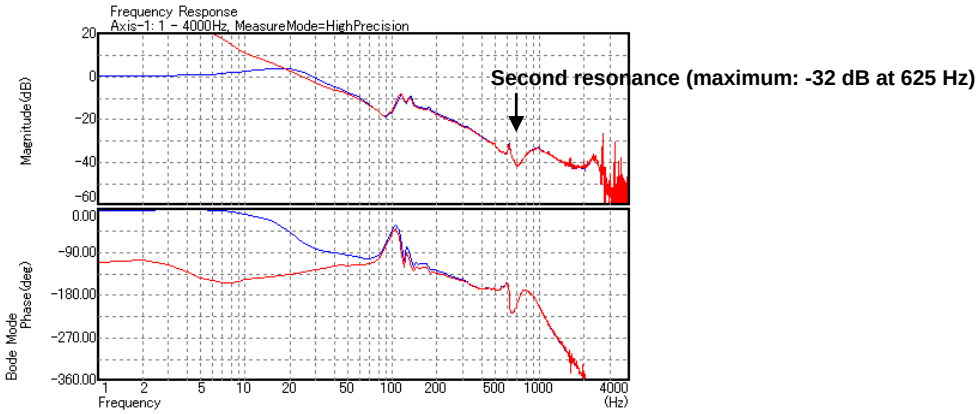
6 Examine the values of the resonance elimination filters to be applied for the secondary resonance.
- 6.1 You can see that the center frequency is around 785 Hz, so use this value as the attenuation center frequency.
- 6.2 When the resonance is around 685 to 815 Hz, the gain is large. Set the attenuation bandwidth to 130 Hz (= 815 - 685).
- 6.3 For the second resonance, the gain is large by about 10 dB. To apply a -10 dB filter, it is necessary to use a value of $10^{-10/20}$ = 0.25 times. Set the damping to 25%.

7 Set the above parameters and measure frequency characteristics with SERVO GUIDE again.



8 The gain at the second resonance changes from -23 dB to -28.5 dB, that is, it can be decreased by about -6 dB (50%). The resonance cannot be partially decreased, however, because the bandwidth is too narrow. Fine-adjust each parameter, in particular, the bandwidth.

9 As the result of fine-adjustment, the gain at the second resonance is decreased to -32 dB (by -9 dB = 65% of the resonance before adjustment).



10 The above example shows the setting of resonance elimination filters for a certain machine. To apply the filters to your machine, setting filters slightly on the strong side (wide bandwidth and small attenuation factor) is recommended taking individual differences between machines and the influence of aging on the machine into consideration.

5.4.5 Disturbance Elimination Filter (Low-Frequency Resonance Elimination Filter)

(1) Overview

The disturbance elimination filter estimates disturbance by comparing a torque command with the actual velocity, and feeding the estimated disturbance back to the torque command to suppress the effect of the disturbance. In particular, this function is useful for vibrations of 50 Hz to 100 Hz.

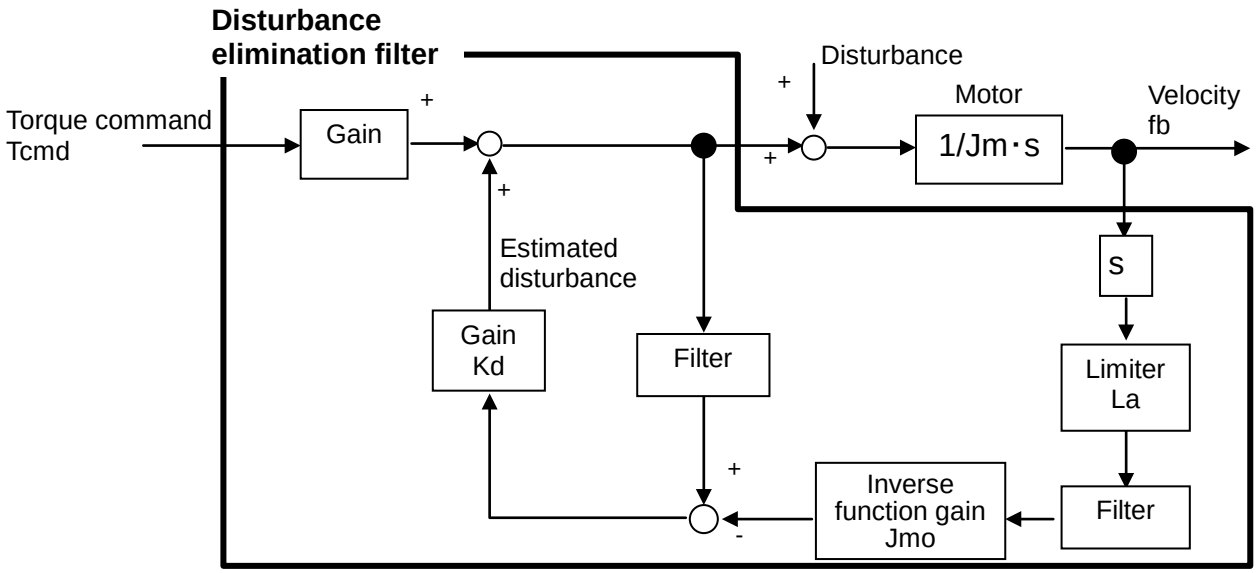


Fig. 5.4.5 (a) Configuration of disturbance elimination filter

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90G0 90J0 90K0 90GP 90JP	09.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	A(01) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0 90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8 90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	01.0 and subsequent editions	

(3) Setting parameters

	#7	#6	#5	#4	#3	#2	#1	#0
2223								DISOBS

DISOBS(#0) The disturbance elimination filter is:
0: Disabled.
1: Enabled.

2318	Disturbance elimination filter gain (Kd)

[Valid data range] 101 to 500
[Recommended value] 500

> **NOTE**
> If a gain of 0 to 100 is set, the disturbance elimination filter function does not operate.

2319	Inertia ratio (Rj) (%)

[Valid data range] 0 to 32767
[Recommended value] 100
Set inertia ratio (= machine inertia/motor inertia) in %.
100% is usually set.

2320	Inverse function gain (Jmo)

[Valid data range] 100 to 2000
[Initial setting] 100 (Increase the setting step by step.)
Set an inverse function gain as a conversion coefficient for acceleration-to-TCMD conversion. This parameter needs to be adjusted. As a guideline, set a value not greater than the value obtained by the following expressions:
Linear motor (The detection unit of the scale is assumed to be p μm.)

$$Jmo=466048 \cdot p \cdot Jm/Kt/Imax$$

Rotary motor

$$Jmo=1396264 \cdot Jm/Kt/Imax$$

Jm: Weight [kg] or inertia [kgm^2]
kt: Torque constant [N/Ap] or [Nm/Ap]
Imax: Maximum amplifier current [Ap]

> **NOTE**
> If an excessively large gain value is set, an abnormal sound and vibration can occur.

2321	Filter time constant (Tp)

・ When HRV1, HRV2, or HRV3 is used:

[Valid data range] 0 to 4096

[Recommended value] 3700 (equivalent to T = 10 ms). * Usually, this value does not need to be changed.

Set a filter time constant for determining an estimated disturbance velocity by using the following expression:

Tp = 4096 × exp (-t/T)

T: Setting time constant [sec], t = 0.001 [sec]

・ When HRV4 is used:

[Valid data range] 0 to 4096

[Recommended value] 3994 (equivalent to T = 10 ms). * Usually, this value does not need to be changed.

Set a filter time constant for determining an estimated disturbance velocity by using the following expression:

Tp = 4096 × exp (-t/T)

T: Setting time constant [sec], t = 0.00025 [sec]

2322	Acceleration feedback limit (La)

[Valid data range] 0 to 7282

[Recommended value] 1000

Set a limiter for a feedback torque calculated from acceleration. This parameter suppresses excessive motion at the time of adjustment.

The value 7282 represents a maximum amplifier current. When a 160-A amplifier is used, for example, the value 1000 is equivalent to 22 A.

NOTE

In a case where a value close to the torque limit may be used, the torque is limited if the acceleration feedback limit is not increased.

(4) Procedure

(1) Make an adjustment according to the procedure below. First, disable functions that only operate in the stop state such as "variable proportional gain in the stop state".
Use frequency characteristics measurement by SERVO GUIDE to determine the resonance frequency and adjust the disturbance elimination filter.

(2) Enable the disturbance elimination filter, set the disturbance elimination filter gain to 100 (not functioning), then measure the frequency characteristics.
With SERVO GUIDE, observe the response waveform obtained during the above measurement, and set the input amplitude (to about 500) to allow the waveform to be observed and machine sound to be heard. A sinusoidal torque command is used, so that the command does not generate a torque in one direction. The command is to be executed away from the machine stroke limits.

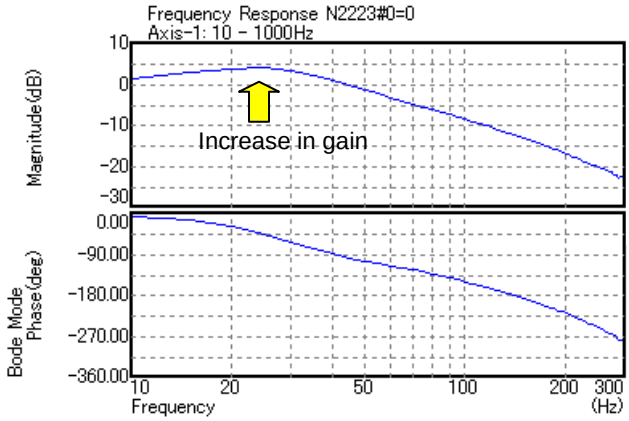


Fig. 5.4.5 (b) Measurement example using SERVO GUIDE (before adjustment)

(3) Set the disturbance elimination filter gain to 500 and check the frequency characteristics with SERVO GUIDE while increasing the gain for inverse model starting with 100 in steps of 100. Adjust the value so that the gain swell part is small.

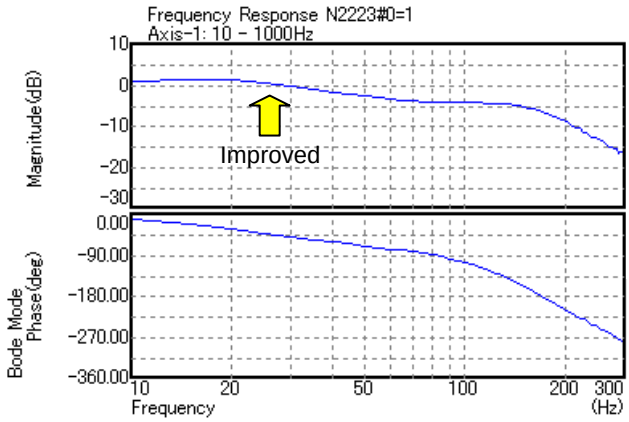


Fig. 5.4.5 (c) Measurement example using SERVO GUIDE (after adjustment)

(4) Note that the velocity loop gain of higher frequencies is increased and violent vibration may be caused just by enabling the disturbance elimination filter function. If a vibration occurs, increase the inverse function gain gradually, and check the vibration of the torque command. If the vibration becomes greater, decrease the inverse function gain. If the vibration cannot be reduced by increasing or decreasing the inverse function gain, change the filter time constant by ±50 to eliminate the vibration.

(5) If the frequency of vibration is higher than 100 Hz, use another machine resonance elimination function such as the Resonance elimination filter or Torque command filter.

5.4.6 Resonance Elimination Filter L (Low-Frequency Resonance Elimination Filter)

(1) Overview

Resonance elimination filter L eliminates low-frequency vibration by applying a filter designed to eliminate low-frequency components from a feed-forward command/velocity command.
This function reduces low-frequency vibration but can degrade contouring accuracy in high-speed feed. Check the accuracy before using this function.

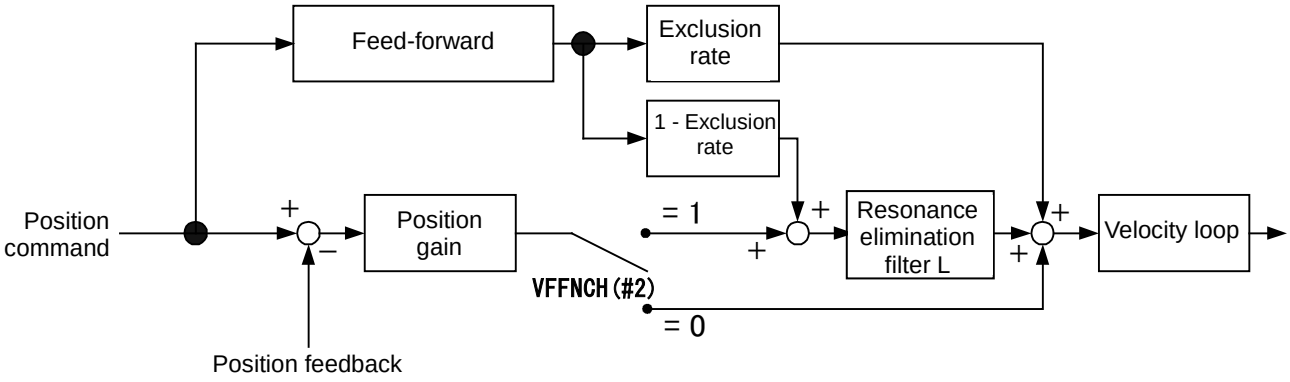


Fig. 5.4.6 (a) Configuration of a position loop including resonance elimination filter L

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	P(16) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	P(16) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	01.0 and subsequent editions	

(3) Setting parameters

For resonance elimination filter L, the parameter for the fourth resonance elimination filter is used. So, resonance elimination filter 4 cannot be used.
To use resonance elimination filter L, enable the function bit (LNOTCH) below.

	#7	#6	#5	#4	#3	#2	#1	#0
2221						VFFNCH	LNOTCH	

LNOTCH(#1)
0: Resonance elimination filter 4 is used.
1: Resonance elimination filter L is used.

VFFNCH(#2) Resonance elimination filter L is applied to:
0: Only the feed-forward part of the velocity command (Default)
1: Entire velocity command

> **NOTE**
> - To enhance the elimination effect, set VFFNCH to 1.
> - When this parameter is set, the power must be turned off before operation is continued.

Set the following filter parameters:

2366	Resonance elimination filter L/resonance elimination filter 4 attenuation center frequency

[Valid data range] 5 to 50
[Unit of data] Hz

2367	Resonance elimination filter L/resonance elimination filter 4 attenuation bandwidth

[Valid data range] 5 to 20
[Unit of data] Hz

2368	Resonance elimination filter L/resonance elimination filter 4 damping

[Valid data range] 0 to 100 (Maximum attenuation when set to 0)
[Unit of data] %

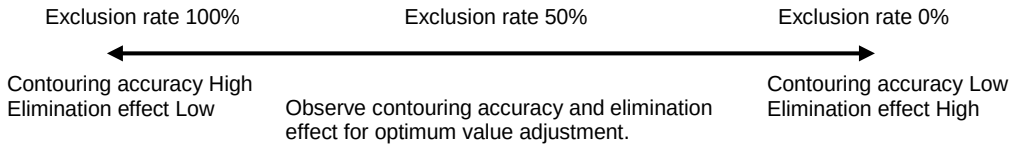
> **NOTE**
> To stop the use of this function, be sure to set all parameters above to 0 then restart the CNC.

> **NOTE**
> When 4 or less is specified as the attenuation center frequency, an illegal parameter setting alarm (detail number 3663 or 3603) is issued. Set 5 or greater.

2356	Resonance elimination filter L/feed-forward filter exclusion rate

[Valid data range] 0 to 100
[Unit of data] %

When resonance elimination filter L is applied to the feed-forward part, contouring accuracy can degrade. So, this function is used to balance contouring accuracy and the effect of resonance elimination.
When 100% is set, this filter is not applied to the feed-forward part.
When 50% is set, this filter is applied to a half of the feed-forward part.



Example of effect

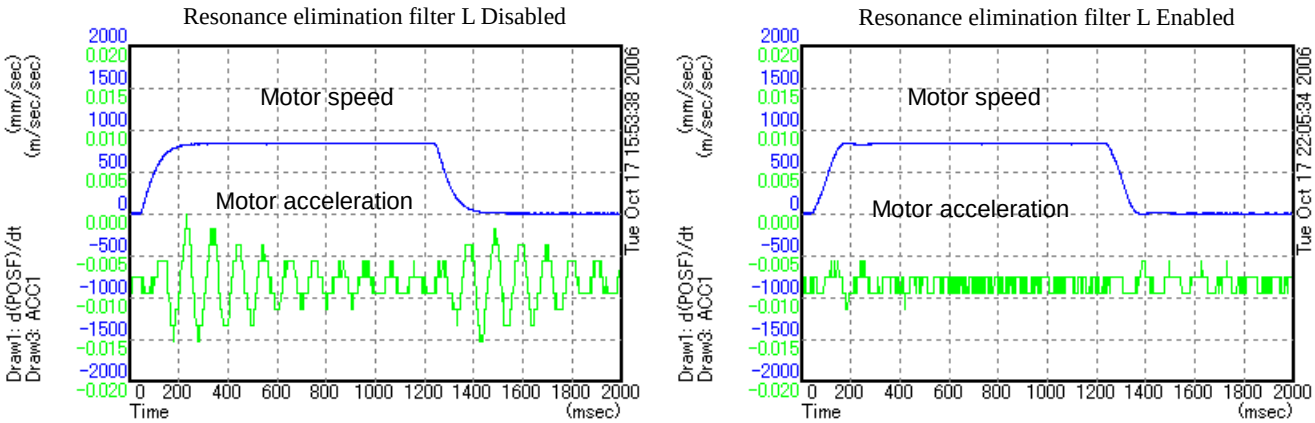


Fig. 5.4.6 (b) Effects of resonance elimination filter L

5.4.7 Vibration-damping control

(1) Overview

In a closed-loop system, the Pulsecoder on the motor is used for velocity control and a separate detector is used for position control.

During acceleration/deceleration, the connection between the motor and machine is distorted and causes the speed of the machine to slightly differ from the actual motor speed, making it difficult to properly control the machine (reduce vibration on the machine) in some cases.

The vibration damping control function feeds the difference between the speeds on the motor and machine (speed transfer error) back to the torque command, to reduce vibration on the machine.

This function has the effect of machine velocity feedback, but is superior to machine velocity feedback in that it does not have the restrictions of the machine velocity feedback function.

(2) Control method

The following figure shows the block diagram for vibration damping control:

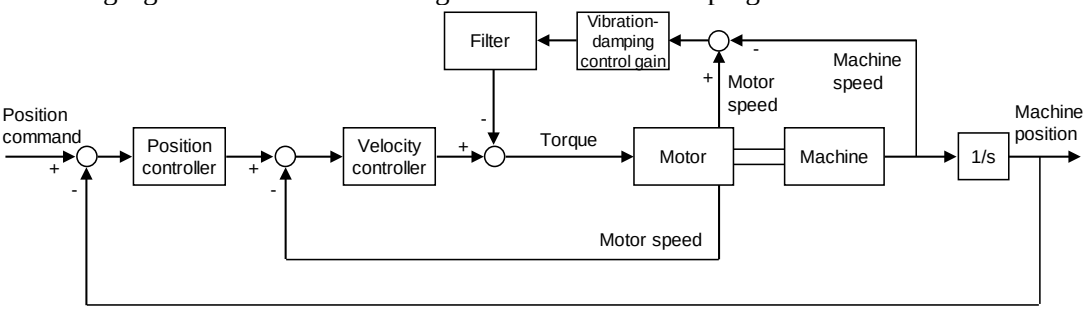


Fig. 5.4.7 (a) Block diagram for vibration damping control

(3) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90G0 90J0 90K0 90GP 90JP	15.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	A(01) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	01.0 and subsequent editions	

The following series and editions have an additional function to change the vibration damping control gain according to each gain in cutting/rapid gain switching. The table below shows applicable series and editions of cutting/rapid gain switching:

[Servo control software that supports cutting/rapid gain switching]

CNC	Servo control software		Remarks
	Series	Edition	
FANUC Series 30*i*/31*i*/32*i*-B Power Motion *i*-A DSA-B	90J0 90JP	10.0 and subsequent editions 04.0 and subsequent editions	
FANUC Series 0*i*-F	90M0 90M8	07.0 and subsequent editions 07.0 and subsequent editions	

[System software that supports cutting/rapid gain switching]
See Appendix P.

(4) Setting parameters

2033	Number of position feedback pulses for vibration damping control conversion coefficient

[Valid data range] -32767 to 32767

When 0 is set, this function is disabled.
If a negative value is specified, it is internally read as 10 times the specified value. (Settings -1000 and 10000 specify the same value.)

Set a value as follows according to the type of separate detector to be used.

[A/B phase separate detector]

Set value = Number of feedback pulses per motor revolution, received from the separate detector/8

(Example)

With a 5 mm/rev ball screw, 0.5 μm/pulse separate detector, and a detection unit of 1 μm, FFG = 1/2 Then,
Set value = 10,000 × 1/8 = 1250

[Serial separate detector]

Set value = Travel distance per motor revolution [detection unit]/8

(Example 2)

With the condition of example 1,
Set value = 5000/8 = 625

[Analog SDU]

Set value = (Travel distance per motor revolution [mm]) / (detector signal pitch [mm]) × 512 / 8

(Example 3)

When travel distance per motor revolution = 10 [mm], and detector signal pitch = 20 [μm]
Set value = 10 / 0.020 × 512 / 8 = 32000

NOTE

1 If the above expression is indivisible, set the nearest integer.
2 For 30*i*-B Series and Power Motion *i*-A, it is not necessary to set parameter No. 2033 because automatic calculation is performed based on the parameter for the number of position pulses.

2034	Vibration-damping control gain

[Valid data range] -32767 to 32767
[Recommended value] About 500

This is the feedback gain for vibration damping control.
Adjust the value in increments of about 100, observing the actual vibration.
An excessively large gain will amplify the vibration.
If setting a positive value amplifies the vibration, try setting a negative value.

	#7	#6	#5	#4	#3	#2	#1	#0
2694								VDOVR

VDOVR(#0) Vibration-damping control gain is:
0: Multiplied by velocity gain override (No. 2107).
1: Not multiplied by velocity gain override (No. 2107).

This function bit is valid only for the series and editions that support cutting/rapid gain switching (see (3)).
The maximum vibration-damping control gain changes depending on the velocity gain. When cutting/rapid velocity gain switching is used, the vibration suppression effect can be improved by enabling this function bit.

5.4.8 Dual Position Feedback (Option)

(1) Overview

A machine with large backlash or low-frequency resonance may cause vibrations under full-closed control even if it works steadily under semi-closed control. This function stabilizes the operation of such a machine. This function is optional.

(2) Control types

The following block diagram shows the general method of dual position feedback control:

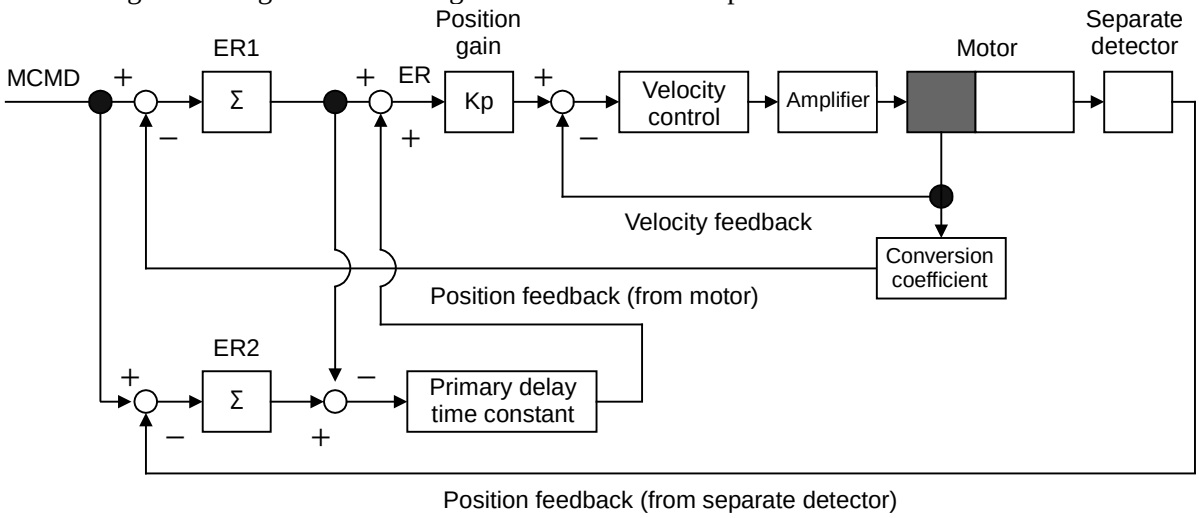


Fig.5.4.8 (a) Block diagram of dual position feedback control

As shown in Fig. 5.4.8 (a), error counter ER1 in the semi-closed loop system and error counter ER2 in the closed loop system are used. The primary delay transfer function is represented by the following equation:

Primary delay time constant = $(1 + \tau s)^{1}$

The actual error, ER, depends on the time constant τ, as described below:

(1) When time constant τ is 0 ..... $(1 + \tau s)^{-1} = 1$

ER = ER1 + (ER2 - ER1) = ER2 (error counter of the full-closed loop system)

(2) When time constant τ is ∞ ..... $(1 + \tau s)^{-1} = 0$

ER = ER1 (error counter of the semi-closed loop system)

This shows that control can be changed according to the primary delay time constant. The semi-closed loop system applies control at the transitional stage and the full-closed loop system applies control in positioning.

This method allows vibrations during traveling to be controlled as in the semi-closed loop system.

(3) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	A(01) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0 90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8 90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	01.0 and subsequent editions	

(4) Setting parameters

	#7	#6	#5	#4	#3	#2	#1	#0
2019	DPFB							

DPFB (#7) 1: Dual position feedback maximum amplitude

2049 **Maximum dual position feedback amplitude**

[Setting value] Maximum amplitude (μm)/(minimum detection unit for full-closed mode × 64)
This parameter should normally be set to 0.

[Unit of data] Minimum detection unit for full-closed mode (μm/p) × 64
If setting = 0, compensation is not clamped.
If the parameter is specified, and a position error larger than the specified value occurs during semi-closed and full-closed modes, compensation is clamped.
So set the parameter with a value two times the sum of the backlash and pitch error compensation amounts.
If it is impossible to find the sum, set the parameter to 0.

2078 **Dual position feedback function: conversion coefficient (numerator)**

2079 **Dual position feedback function: conversion coefficient (denominator)**

[Setting value] Reduce the following fraction and use the resulting irreducible fraction.

$$\text{Conversion coefficient}\left(\frac{\text{Numerator}}{\text{Denominator}}\right)=\frac{\text{Travel distance per motor revolution (detection unit)}}{1{,}000{,}000}=\text{(as irreducible fraction)}$$

(Example)

When the α*i* Pulsecoder is used with a detection unit of 1 μm and a tool travel distance of 10 mm/motor revolution
As the detection unit, 10 mm is equivalent to 10000 pulses.

$$\text{Conversion coefficient}\left(\frac{\text{Numerator}}{\text{Denominator}}\right)=\frac{10{,}000}{1{,}000{,}000}=\frac{1}{100}$$

2080 **Dual position feedback primary delay time constant**

[Setting value] Set to a value in the range of 10 to 300 msec or so.

[Unit of data] msec
Normally, set a value of around 100 msec as the initial value. If hunting occurs during acceleration/deceleration, increase the value in 50-msec steps. If a stable status is observed, decrease the value in 20-msec steps.
When 0 msec is set, the same axis movement as that in full-closed mode is performed.
When 32767 msec is set, the same axis movement as that in semi-closed mode is performed.
For a system that requires simultaneous control of two axes, use the same value for both axes.

2081 **Dual position feedback zero-point amplitude**

[Setting value] Zero width (μm)/minimum detection unit for full-closed mode

[Unit of data] Minimum detection unit for full-closed mode (μm/p)
Positioning is performed so that the difference in the position between full-closed mode and semi-closed mode does not exceed the pulse width that corresponds to the parameter-set value.
First set the parameter to 0. If there is still fluctuation, increase the parameter value.
If this is applied to an axis with a large backlash, a large position error may remain.
For details, see Art. (6) in this section.

2118	Dual position feedback function: alarm detection level of Semi-Full error

[Setting value] Level on which the difference in error is too large (μm)/minimum detection unit (μm/p) for full-closed mode

[Unit of data] Minimum detection unit for full-closed mode (μm/p)

If the difference between the Pulsecoder and the separate detector is greater than or equal to the number of pulses that corresponds to the value specified by the parameter, an alarm is issued.

Set a value two to three times as large as the backlash. When 0 is set, detection is disabled.

NOTE

Semi-full error monitoring is also useful for monitoring for problems such as missing feedback pulses of a separate detector. Semi-full error monitoring is to be performed on a machine for which dual position feedback is not required for stabilization, semi-full error monitoring can be used by not only making an ordinary full-closed loop setting but also setting a conversion coefficient for dual position feedback and the parameter for the monitoring level of the difference in error between the semi-closed and full-closed modes. (No option setting and function bit setting need to be made.) See Subsection 2.1.8.1, “Semi-full error monitoring” for details.

	#7	#6	#5	#4	#3	#2	#1	#0
2010			HBBL	HBPE				

HBBL (#5) The backlash compensation is added to the error count of:
0: The semi-closed loop. (Standard setting)
1: The closed loop.

HBPE (#4) The pitch error compensation is added to the error count of:
0: The closed loop. (Standard setting)
1: The semi-closed loop.

	#7	#6	#5	#4	#3	#2	#1	#0
2206				HBSF				

HBFS (#4) The backlash compensation amount and pitch error compensation amount are:
0: Added after selection according to conventional parameter No. 2010.
1: Added to the closed loop side and semi-closed loop side at the same time.

When this parameter is set to 1, the settings of No. 2010 are ignored.

* In the 30*i*-B Series, when the dual position feedback function is enabled, pitch error compensation amounts are added to both the closed loop side and the semi-closed side regardless of the bit setting. The backlash compensation amount is the same as before.

No.2010#4	No.2206#4	Counter to which pitch error compensation amount is added	
		30*i*-A, 0*i*-D Series	30*i*-B Series
0	0	Full-closed side	Closed loop side and semi-closed loop side
1	0	Semi-closed side	Closed loop side and semi-closed loop side
0	1	Closed loop side and semi-closed loop side	Closed loop side and semi-closed loop side
1	1	Closed loop side and semi-closed loop side	Closed loop side and semi-closed loop side

> **NOTE**
> If a setting is made to perform semi-full error monitoring for an axis placed in a simple full-closed loop, the specification for adding backlash compensation and pitch error compensation is the same as in the case of using dual position feedback. In this case, it is recommended to set the above so as to "Add a backlash compensation and pitch error compensation to the closed loop side and semi-closed loop side at the same time".

(5) Use with smooth backlash compensation

A smooth backlash compensation value can be added onto the semi-closed side by setting the parameter indicated below to 1 when dual position feedback is used with smooth backlash compensation.

[Applicable servo control software]

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0 90J0 90K0	21.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	Q(17) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	Q(17) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	

[Applicable system software]

CNC model	System software	
	Series	Edition
Series 30*i*/31*i*/32*i*/35*i*-B	All series	All editions
Series 30*i*-A	G00C, G01C, G02C G004, G014, G024	27.0 and subsequent editions 01.0 and subsequent editions
Series 31*i*-A5	G12C, G13C G124, G134	27.0 and subsequent editions 01.0 and subsequent editions
Series 31*i*-A	G103, G113 G104, G114	12.0 and subsequent editions 01.0 and subsequent editions
Series 32*i*-A	G203 G204	12.0 and subsequent editions 01.0 and subsequent editions
Series 0*i*-MD	D4F1	01.0 and subsequent editions
Series 0*i*-TD	D6F1	01.0 and subsequent editions
Series 0*i* Mate-MD	D5F1	01.0 and subsequent editions
Series 0*i* Mate-TD	D7F1	01.0 and subsequent editions

	#7	#6	#5	#4	#3	#2	#1	#0
11601(FS30*i*)		**SBN**						

SBN (#6) When both of smooth backlash compensation and dual position feedback are enabled, a smooth backlash compensation value is:

0: Dependent on the settings of bit 4 of No. 2206 and bit 5 of No. 2010.

1: Used for compensation on the semi-closed side.

(6) Zero-width setting for a machine with a large backlash or twist

If dual position feedback is used for an axis where a machine backlash of about 1/10 of a revolution in terms of the motor shaft exists, the machine may stop with a position error remaining, which is greater than the dual position feedback zero-width parameter value. (In some cases, there may be ten or more pulses left.) To solve this problem, make the following settings:

	#7	#6	#5	#4	#3	#2	#1	#0
2202				DUAL0W				

DUAL0W (#4) The zero-width determination is performed with:

0: Semi-full error only.

1: Both of the position error on the full-closed side and semi-full error. ← Set this value.

5.4.9 Machine Speed Feedback Gain

(1) Overview

The full-closed system performs velocity control with a pulsecoder installed on the motor and performs position control with a scale installed on the machine. When there is a large difference between the motor speed and machine speed due to distortion or shakiness between the motor and the machine, it is difficult to maintain high position gain.

This function allows adding the speed of the machine itself to the speed control in a full-closed system, making the position control stable.

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	A(01) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	01.0 and subsequent editions	

(3) Control block diagram

Fig. 5.4.9 (a) is a control block diagram

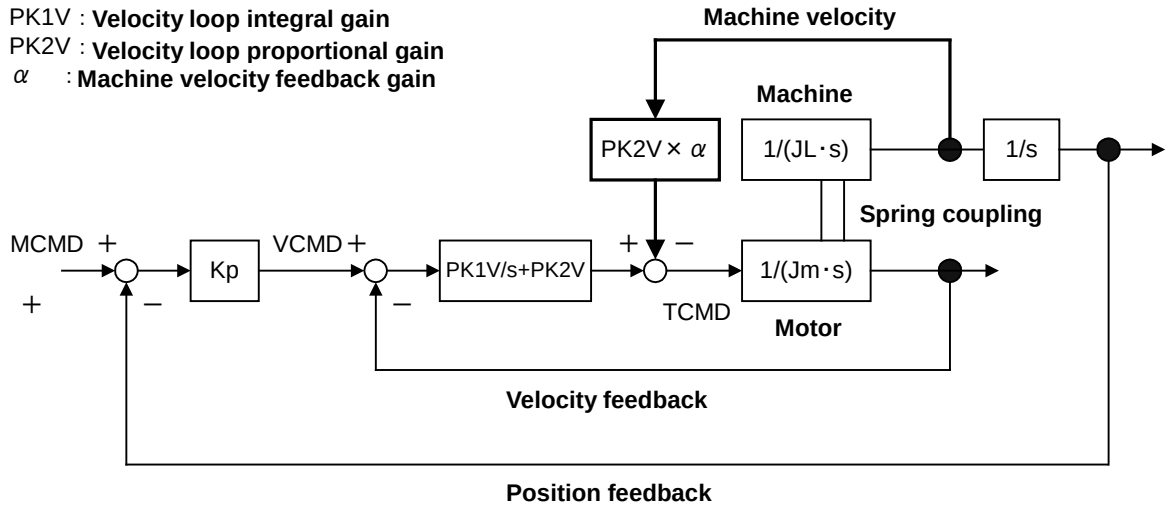


Fig. 5.4.9 (a) Position loop block diagram that includes machine speed feedback

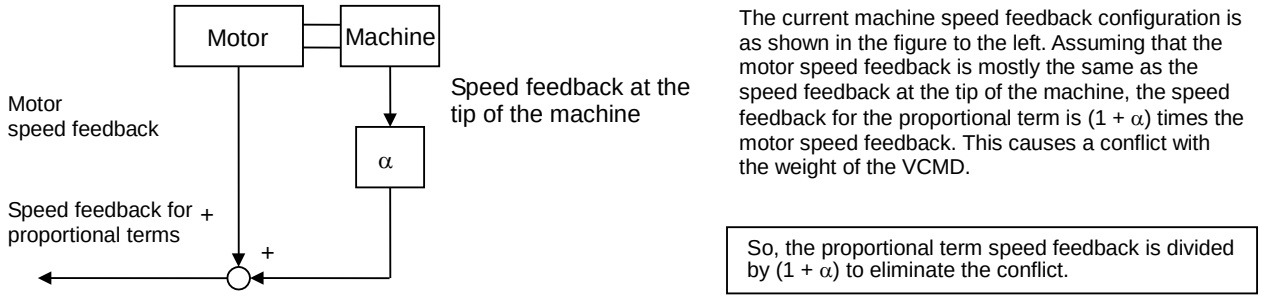
As shown in Fig. 5.4.9 (a), this function corrects the torque command by multiplying the machine speed by machine velocity feedback gain, α, as shown by the bold line.
When α = 1, the torque command is corrected equally by the motor speed and the machine speed.

(4) Adding the normalization function

(a) Overview

If an arc is drawn with the machine speed feedback function enabled, the arc may be elongated in the direction parallel to the axis to which the machine speed feedback function is applied. To solve this problem, machine speed feedback was improved.

(b) Explanation



* The normalization function cannot be used when velocity loop high cycle management is used.

(5) Setting parameters

	#7	#6	#5	#4	#3	#2	#1	#0
2012							MSFE	

MSFE (#1) 1: Enables machine speed feedback.

2088	Machine speed feedback gain (MCNFB)

☆ When a serial output type separate detector is used or when the flexible feed gear (parameters Nos. 2084 and 2085, parameter Nos. 1977 and 1978) is set to 1/1 (Setting range: 1 to 100 or 1 to 100)
(Typical setting)

When normalization is not used:	MCNFB=30~100
When normalization is used:	MCNFB=-30~-100

☆ For anything other than flexible feed gear (No. 2084, 2085) = 1/1 (Setting range: 101 to 10000 or -101 to -10000)
(Typical setting)

When normalization is not used:	MCNFB=3000~10000
When normalization is used:	MCNFB=-3000~-10000

☆ When 30*i*-B Series is used (valid data range: 1 to 100 (in units of 1%) or 101 to 10000 (in units of 0.01%))
For 30*i*-B Series, normalization is always enabled.
(Typical setting)

When the increment system is 0.01%:	MCNFB=3000~10000
When the increment system is 1%:	MCNFB=30~100

(6) Note

If the machine has a resonance frequency greater than 200 Hz, using this function may result in a resonance being amplified, thus leading to abnormal vibration or sound. In this case, use resonance elimination filters to avoid resonance.

5.4.10 Smart Machining Point Control (with Sensor)

(1) Overview

Smart machining point control (with sensor) suppresses residual vibration using the feedback from an acceleration sensor attached to the machining point.

NOTE
Smart machining point control (with sensor) uses an acceleration sensor. For the setting of an acceleration sensor, see Subsection 2.1.5.4.

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90GP 90JP	09.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	P(16) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	P(16) and subsequent editions	HRV4
Series 0*i*-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i*-F	90M0 90M8	03.0 and subsequent editions 03.0 and subsequent editions	

(3) Setting parameters

(a) Setting smart machining point control (with sensor)

(Function bit setting)

To use smart machining point control (with sensor), enable the following function bit:

	#7	#6	#5	#4	#3	#2	#1	#0
2288	MPCEF							

MPCEF(#7) Smart machining point control (with sensor) is:
0: Disabled.
1: Enabled.

(Band-pass filter setting)

When gain is tuned for smart machining point control (with sensor), components other than a vibration suppression target frequency may cause vibration making it impossible to set a high gain value. To extract a vibration suppression target frequency component only, be sure to set the vibration suppression target frequency component in the following parameter:

2355	Machining point control: center frequency of band-pass filter

[Unit of data] Hz
[Valid data range] 5 to 200

> **NOTE**
> If 4 or a smaller number is set, an illegal parameter setting alarm (detail number 3553) is issued.
> Set 5 or a greater number.

This function requires detection unit information. If the CNC software does not support this function, set the following parameter.

2263	Detection unit setting

[Unit of data] 1 nm

Detection unit	10 μm	1 μm	0.1 μm	0.01 μm	0.001 μm	0.05 μm
Setting value	10000	1000	100	10	1	50

(b) Tuning smart machining point control (with sensor)

The following three parameters are available for tuning smart machining point control (with sensor). By tuning these parameters, vibration after specified acceleration/deceleration can be suppressed.

- Gain = 1
- Timing adjustment parameter
- Gain = 2

(Tuning of machining point control gain 1)
Tune machining point control gain 1 so that the acceleration rate (enclosed by the dashed line in the Fig. 5.4.10 (a)) after acceleration/deceleration based on the specified acceleration decreases. Tune machining point control gain 1, starting with a small value (about 50).

2266	Machining point control gain 1 (MPCK1)

[Valid data range] -32767 to 32767

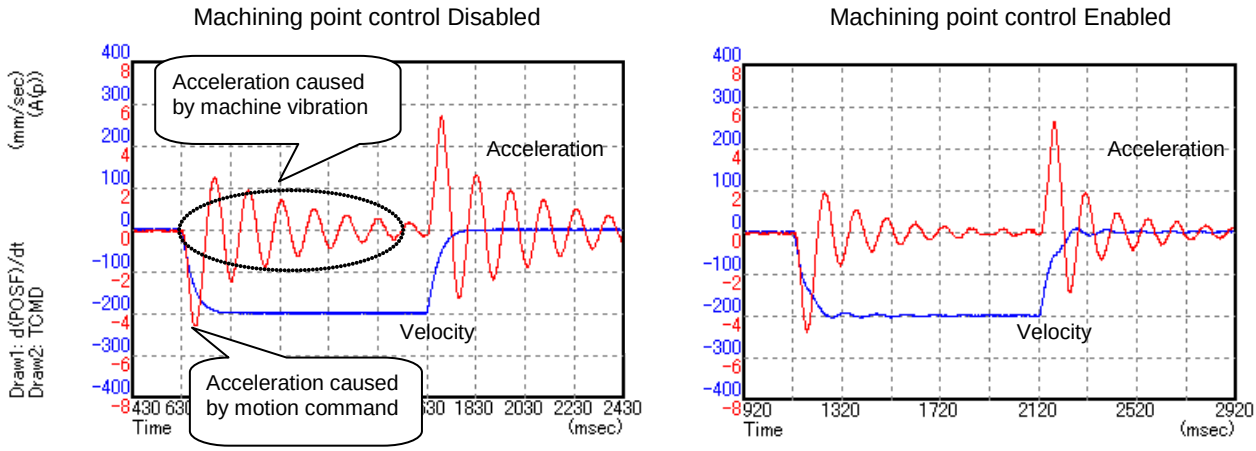


Fig. 5.4.10 (a) Adjustment of machining point control gain 1

(Tuning of the timing adjustment parameter)
Tune the machining point control timing adjustment parameter so that the acceleration rates (enclosed by the dashed lines in the Fig. 5.4.10 (a)) after acceleration/deceleration based on the specified acceleration decrease.
This timing adjustment is implemented with a low-pass filter applied to feedback. Set the parameter so that the cut-off frequency of the filter is around the frequency of vibration.

After the setting of the timing adjustment parameter is modified, gain 1 needs to be tuned again. To obtain an optimum vibration suppression effect, tune the timing adjustment parameter and gain 1 repeatedly.

Machining point control Enabled
(after tuning gain 1 and the timing adjustment parameter)

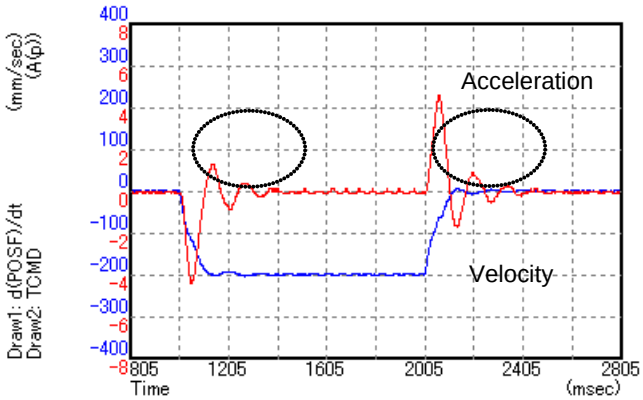


Fig. 5.4.10 (b) Adjustment of machining point control gain 1 and timing adjustment parameter

2096	Machining point control timing adjustment parameter (MPCTIM)

[Valid data range] 0 to 4095

[Recommended value] The setting of the parameter corresponds to the cut-off frequency of the low-pass filter.
Set the parameter so that the cut-off frequency is around the frequency of vibration.

Table 5.4.10 (a) Cut-off frequency and Parameter setting value

Cut-off frequency [Hz]	Parameter setting	Cut-off frequency [Hz]	Parameter setting
5	3969	17.5	3669
7.5	3907	20	3612
10	3847	25	3501
12.5	3787	30	3392
15	3728	40	3186

NOTE
When the parameter is set to 0, the cut-off frequency of the filter is 40 Hz.

(Tuning of machining point control gain 2)
By tuning machining point control gain 2, vibration may be suppressed further.
While checking the effect of vibration suppression, tune machining point control gain 1 and machining point control gain 2 repeatedly. Tune machining point control gain 2, starting with a small value of about 10.

2265	Machining point control gain 2 (MPCK2)

[Valid data range] -32767 to 32767

5.4.11 Smart Machining Point Control (Sensor-less)

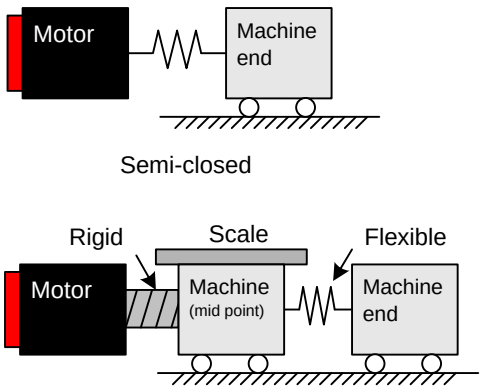
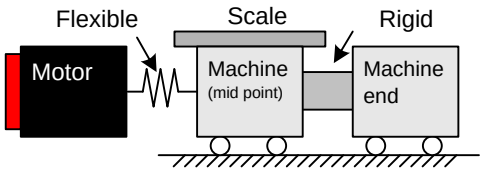
(1) Overview

Smart machining point control (sensor-less) is a function to suppress low-frequency vibration at the machining point. Use either of the following filters appropriately according to the vibrating position of the machine:

1 Filter for the semi-closed system
2 Filter for the full-closed system

(2) Which filter you should use

Name	Filter for the semi-closed system	Filter for the full-closed system
Target	Axis that has a spring factor between positioning sensor* and machining point. * Pulsecoder (if semi-closed axis) or separated scale (if full-closed axis)	Axis that has a spring factor between motor and scale. (Only for full-closed axes)

Name	Filter for the semi-closed system	Filter for the full-closed system
Target (figure)	 When machine end vibrates at full-closed axis	 When scale vibrates at full-closed axis
Overview	The filter swings the motor so that the machining point does not vibrate.	The filter is provided with a controller in consideration of the transfer delay from motor to scale.
Remarks	The function needs an acceleration sensor for tuning.	

* If the cause of the vibration cannot be identified in the full-closed axis, install an acceleration sensor at a machining point, acquire and compare the acceleration waveforms of motor, scale, and acceleration sensor, and identify the one whose behavior differs from the others.

(2) Applicable series and editions

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90J0	06.0 and subsequent editions	
Series 0*i*-F	90M0 90M8	04.0 and subsequent editions 04.0 and subsequent editions	

For the following series and editions, the following improvements have been made for the filter for the full-closed system for smart machining point control (sensor-less):

- Improving the vibration damping effect
- Expanding the upper-limit frequency (100 Hz → 200 Hz)

The improved series and editions are as follows:

[Series and editions of improved servo control software]

CNC	Servo control software		Remarks
	Series	Edition	
FANUC Series 30*i*/31*i*/32*i*-B Power Motion *i*-A DSA-B	90J0 90JP	12.0 and subsequent editions 06.0 and subsequent editions	
FANUC Series 0*i*-F	90M0 90M8	07.0 and subsequent editions 07.0 and subsequent editions	

[Series and editions of improved system software]

See Appendix P.

(3) Setting parameters

(3.1) Filter for the semi-closed system

	#7	#6	#5	#4	#3	#2	#1	#0
2564							MCFILT	

MCFILT(#1) The filter for the semi-closed system is:

0: Disabled.
1: Enabled.

2638	Damping frequency

[Unit of data] 0.1 Hz
[Valid data range] 5.0 to 200.0 Hz (A value outside the valid data range is clamped to the upper or lower limit.)
[Setting value] Set the vibration frequency.
[When 0 is set] This function is disabled.
[Note] This function moves the motor at high speed to prevent the machining point from swinging. Note that setting an excessively small value for the damping frequency gives a large shock to the machine. In this case, increase the time constant, use a bell-shaped time constant, or make another setting concurrently to reduce the shock.

2639	Damping factor

[Unit of data] %
[Valid data range] 0% to 1000% (A value outside the valid data range is clamped to the upper or lower limit.)
[Setting value] 10% to 20% is recommended. Adjust the value to reduce the vibration.
[When 0 is set] 0%

(3.2) Filter for the full-closed system

	#7	#6	#5	#4	#3	#2	#1	#0
2570				FFFILT				

FFFILT(#4)The filter for the full-closed system is:

0: Disabled.
1: Enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
2571					PLFILT			

PLFILT(#3)The FB filter for the full-closed system is:

0: Disabled.
1: Enabled.

At the beginning of adjustment, enable only the FF filter and check the vibration suppression effect.

For a machine having high-frequency vibration, enabling the FB filter may make the feedback system unstable. In this case, decrease the FB bandwidth magnification described later or only use the FF filter.

2647	Damping frequency

[Unit of data]0.1 Hz
[Valid data range] 10.0 to 100.0 Hz (A value outside the valid data range is clamped to the upper or lower limit.)
10.0 to 200.0 Hz (HRV2 and HRV3), 20.0 to 200.0 Hz (HRV4) (for improved series and editions)
[Setting value] Set the vibration frequency.
[When 0 is set] This function is disabled.

2648	Damping factor

[Unit of data] %

[Valid data range] 5% to 70% (A value outside the valid data range is clamped to the upper or lower limit.)

[When 0 is set] 25%

[Adjustment method] First, set the initial value (25%) and check the resonance elimination characteristics of the filter. When a smaller value is set, the vibration is suppressed, but positional deviation like an acceleration waveform occurs, which degrades the precision of the path. Set the largest value possible within the valid data range with which the vibration suppression effect is allowable. Since the precision of the path also depends the bandwidth magnification set in parameter No. 2649, trial-and-error adjustment is required for the damping factor and bandwidth magnification.

2649	FF bandwidth magnification (two high-order digits)/FB bandwidth magnification (two low-order digits)

FF bandwidth magnification (two high-order digits)

[Unit of data] 0.1 times

[Valid data range] 1.0 to 5.0 times (A value outside the valid data range is clamped to the upper or lower limit.)

[When 0 is set] 2.5 times

[Adjustment method] First, set the initial value (2.5 times) and check the resonance elimination performance of the filter. Increasing the bandwidth magnification can improve positional deviation like an acceleration waveform and avoid degrading the circular precision, but can easily generate vibration having a frequency higher than the damping frequency. When there is another vibration mode near the frequency for suppressing vibration, determine the method with trade-off with the high-frequency vibration. To improve circular precision, the FF timing adjustment parameter (parameter No. 2095) can also be used.

FB bandwidth magnification (two low-order digits)

[Unit of data] 0.1 times

[Valid data range] 1.0 to 5.0 times (A value outside the valid data range is clamped to the upper or lower limit.)

[When 0 is set] 2.5 times

Set 1.0 time.

1825	Servo loop gain for each axis

[Unit of data] 0.01/s

Inserting an adequate feedback filter may increase the limit of the servo loop gain. When the FB filter for the full-closed system is enabled (bit 3 of parameter No. 2571 is set to 1), tuning the servo loop gain again is recommended.

2095	Feedforward timing adjustment coefficient

[Unit of data] 1/4096 msec

If an arc figure becomes worse after the FF filter for the full-closed system has been tuned, use this parameter to tune the arc figure.

	#7	#6	#5	#4	#3	#2	#1	#0
2695			VFFFILT					

VFFFILT(#5) The vibration damping effect of the FF filter for the full-closed system is:
0: Not improved.
1: Improved.
This function is only valid for improved series and editions.
When setting the FF filter for the full-closed system (bit 4 of No. 2570), set bit 5 of No. 2695 at the same time. Filtering is also applied to velocity feedforward, increasing the vibration damping effect. If the FF filter for full-closed systems has already been tuned, you may need to finely tune the filter parameters (Nos. 2627 to 2629).

This function cannot be used with the following options:
- When the high-speed cycle machining option is enabled
- When high-speed binary operation option is enabled

(3.3) Recommended values

Table 5.4.11 (a) Recommended values for the filter for semi-closed systems for smart machining point control (sensor-less)

Parameter No.	Recommended value	Description
No.2564#1	1	Filter for the semi-closed system enabled
No.2638 [0.1 Hz]	Vibration frequency × 10	Damping frequency
No.2639	10*	Damping factor

* When a higher vibration damping effect is required, tune the damping factor.
* Enable feedforward.

Table 5.4.11 (b) Recommended values for the filter for the full-closed system for smart machining point control (sensor-less)

Parameter No.	Recommended value	Description
No.2570#4	1	FF filter for the full-closed system enabled
No.2571#3	1	FB filter for the full-closed system enabled
No.2647 [0.1 Hz]	Vibration frequency × 10	Damping frequency
No.2648	30*	Damping factor
No.2649	2510	Bandwidth

* When a higher vibration damping effect is required, tune the damping factor.

(4) Tuning

(4.1) Filter for the semi-closed system

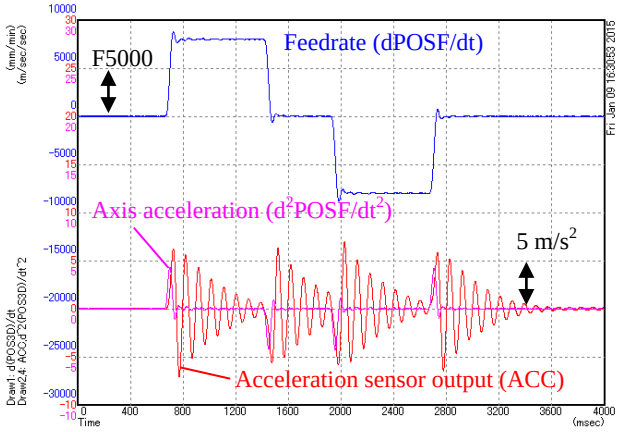
1. Checking where vibration occurs

This function predicts how the machining point vibrates and operates the motor so that the machining point does not vibrate. This function is useful when the machining point vibrates significantly even after positioning is complete. Check that only the machining point vibrates significantly.

Install a FANUC acceleration sensor to the machining point, set the FSSB, and set the acceleration sensor. For the setting of an acceleration sensor, see Subsection 2.1.5.4.

Load the SERVO GUIDE data and check the POSF (axis position) and ACC (acceleration sensor). Allow the axis to reciprocate. For tuning, use the following program, for example:

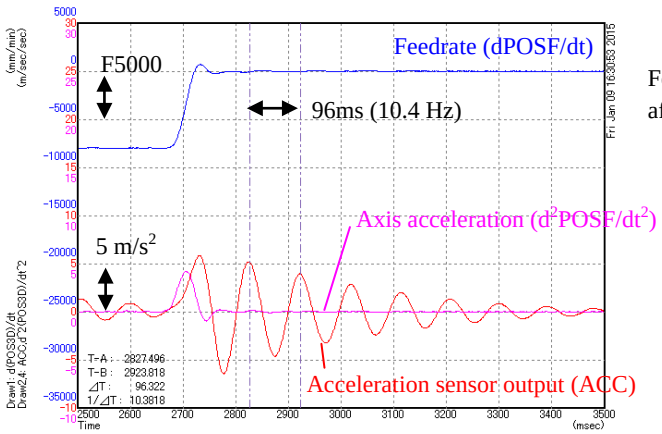
```
G90;
G01X100.0F8000.0;
G01X0.0;
```



The vibration of the acceleration sensor is large in relation to the acceleration of the axis, meaning that there is a component that easily causes vibration on the machine side from the positioning sensor.

2. Tuning the damping frequency

Check the waveform of the acceleration sensor to identify the frequency at which vibration occurs.



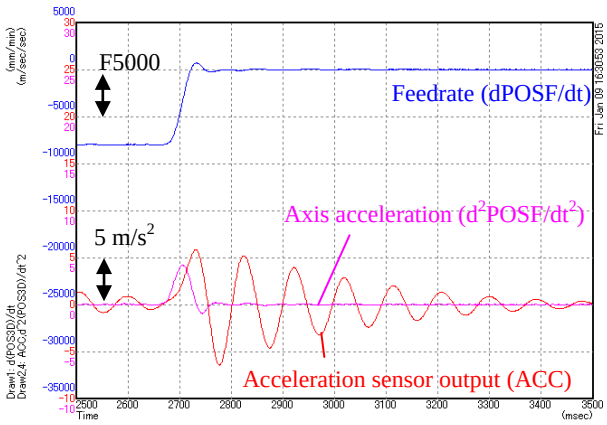
For this machine, the vibration of the acceleration sensor after acceleration/deceleration is around 96 ms (10.4 Hz).

Enable the function and set the damping frequency.

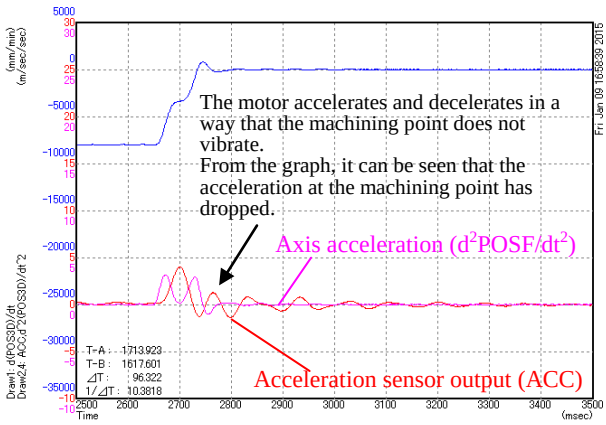
No. 2564#1 = 1 (Enable the machining point resonance elimination filter.)

No. 2638 = 104 (Damping frequency: 10.4 Hz)

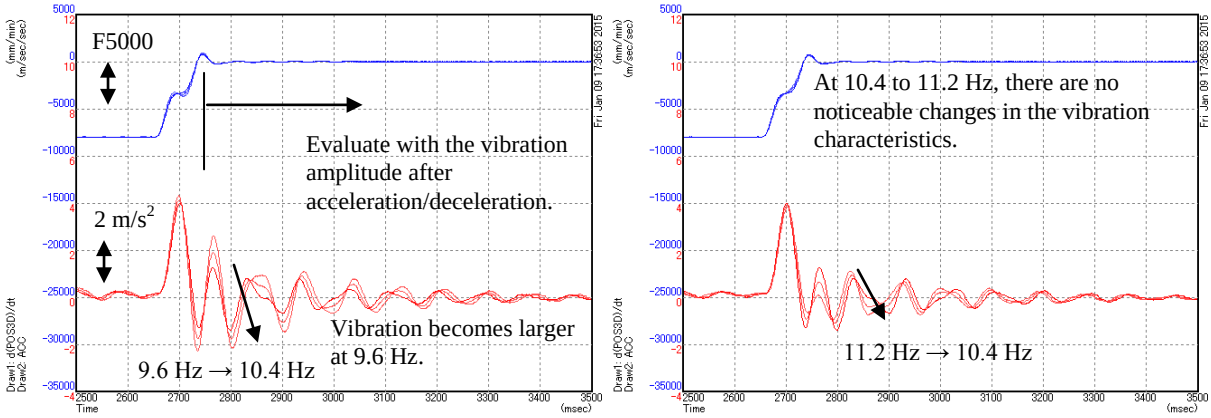
Function OFF



Function ON



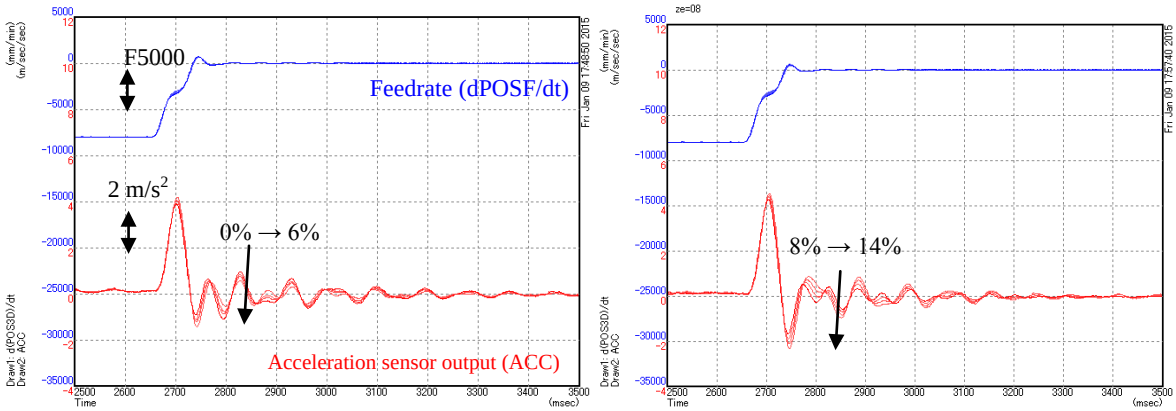
Finely tune the damping frequency. In this example, the frequency is increased and decreased in increments of 0.4 Hz. Evaluate vibration around the time when the acceleration/deceleration ends.



Because the optimal frequency is around 10.8 Hz, set the damping frequency to 10.8 Hz.

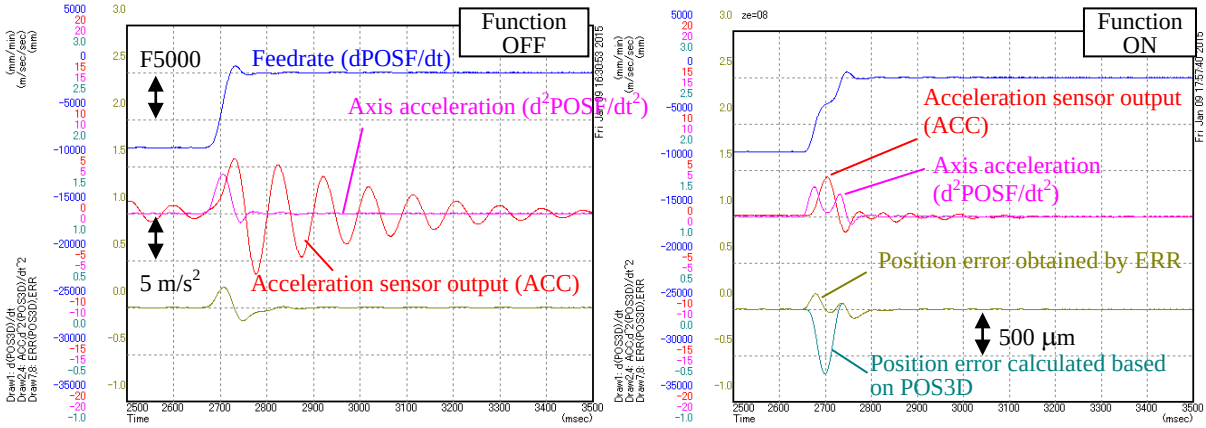
3. Tuning the damping factor

Increase the damping factor from 0 to identify the point where vibration is smallest. In this example, the damping factor is increased in increments of 2%.



Vibration is smallest when the damping factor is around 8%.

The final tuning results are as follows:



* This function causes the motor to vibrate so that the machining point stops vibrating. Therefore, the motor does not move as programmed. When this function is used, the following position errors have different waveforms:

(1) Position error displayed by loading SERVO GUIDE data and specifying ERR

(2) Position error displayed by loading SERVO GUIDE data, specifying POS3D, and selecting ERR in the Operation graph mode

More specifically,

(1) indicates a deviation from the path obtained when the motor is vibrated for vibration damping, and

(2) indicates a deviation from the programmed movement.

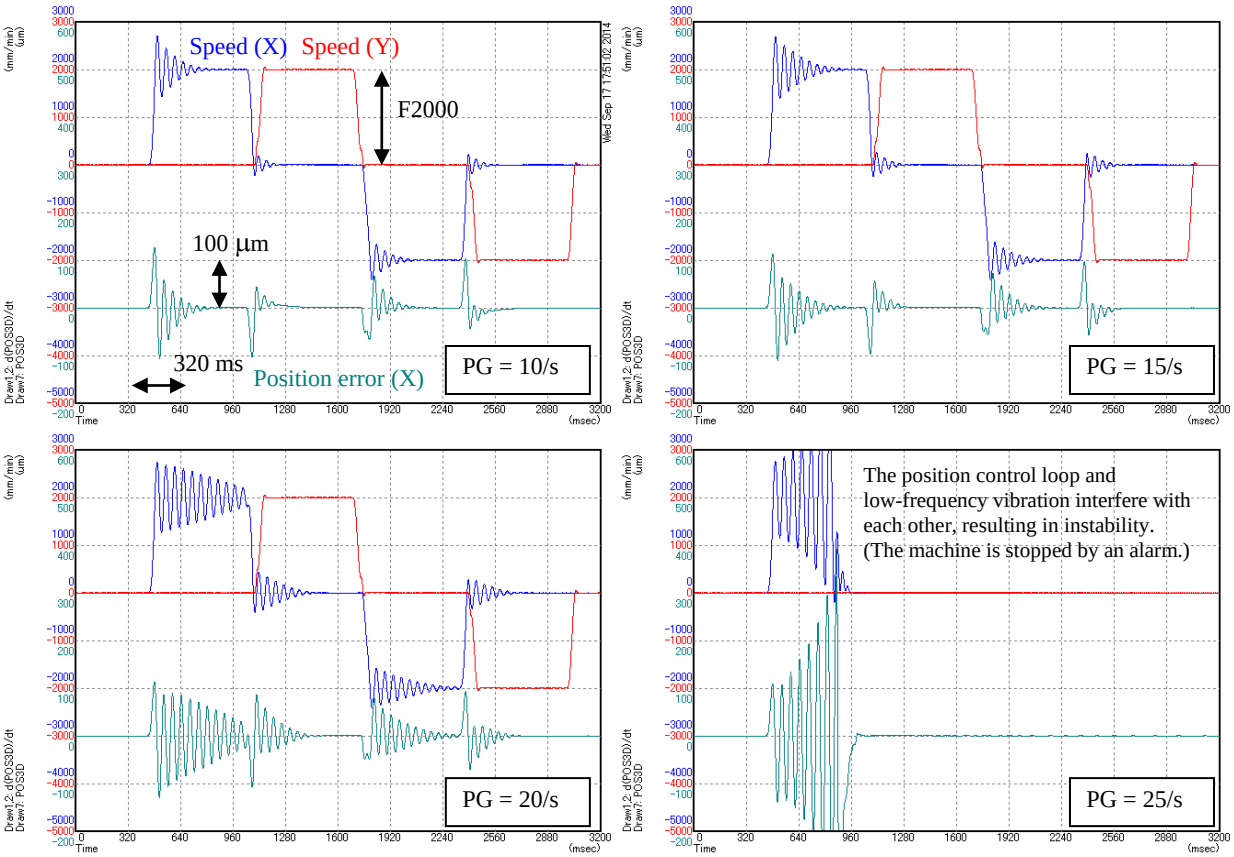
(4.2) Filter for the full-closed system

1. Preparation

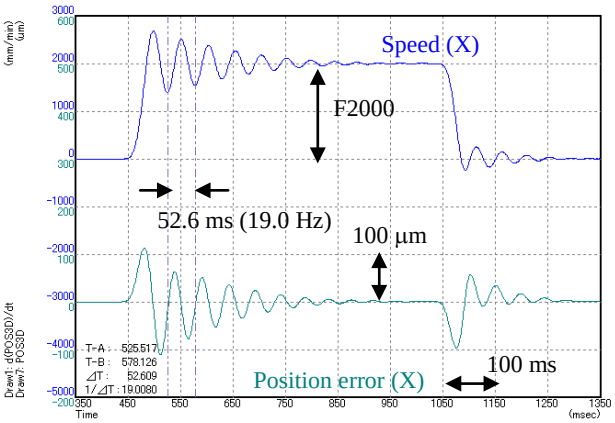
This function suppresses low-frequency vibration caused by acceleration/deceleration. Prepare a program that allows rapid acceleration/deceleration. In this example, the following rectangular motion is used for tuning. Before tuning this function, tune the velocity gain.

```
G91;
G01X20.0F2000.0;
G01Y20.0;
G01X-20.0
G01Y-20.0;
```

For axes having low-frequency resonance, if the position gain is increased, the control system becomes unstable due to vibration caused by low-frequency resonance.



In this example, the settings before tuning in the example with PG = 15/s are used. From the figure, it can be seen that vibration of 19 Hz occurs.

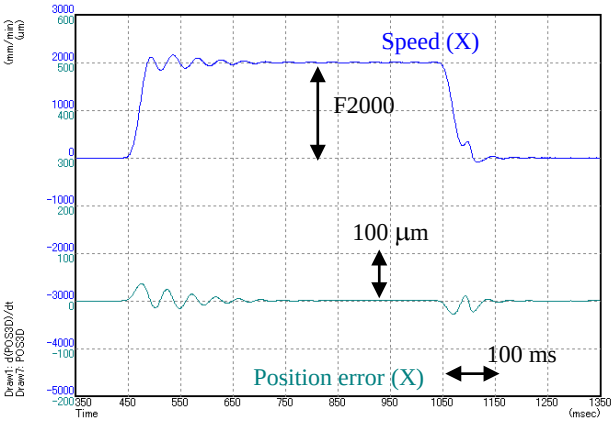


2. Enabling the FF filter

Enable the FF filter and set the frequency to 19 Hz.

No.2570#4 = 1 (Enable the FF filter.)

No. 2647 = 190 (Vibration frequency = 19.0 Hz)

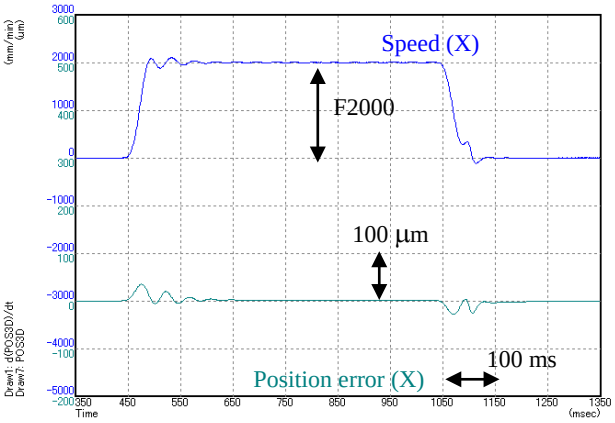


3. Enabling the FB filter

Vibration can be reduced by enabling the FF filter, so enable the FB filter. The FB filter changes the feedback characteristics. If the axis has only the intended vibration, this filter works in the direction the system becomes stable, but if a vibration mode having a higher order than the intended vibration exists, the system may become unstable. Therefore, decrease the position gain before enabling the FB filter.

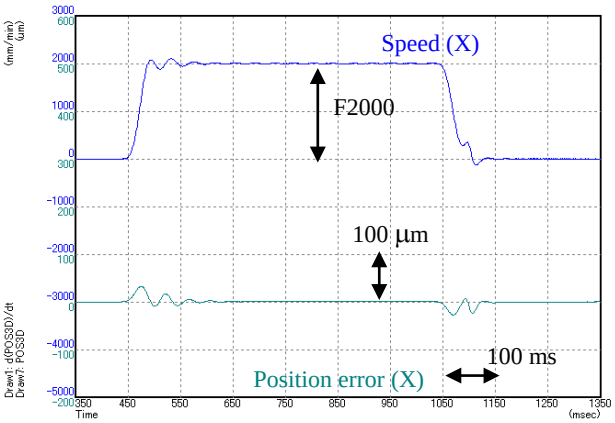
No.1825 = 1000 (PG = 10/s)

No. 2571#3 = 1 (Enable the FB filter.)



Now that you have confirmed that the control system is stable, return the position gain to its original value. At this time, change the gain gradually.

No.1825 = 1500 (PG = 15/s)



If, after the FB filter is enabled, the system becomes unstable with the position gain at which the system was stable when the FB filter was disabled, tune the damping factor and bandwidth magnification as described on the next page before enabling the FB filter.

If the system becomes unstable even when the FB filter is enabled after the damping factor and bandwidth magnification are tuned, it is probably not possible to apply the FB filter to that axis, most likely because there are multiple machine resonances of close frequencies. In such a case, enable the FF filter only.

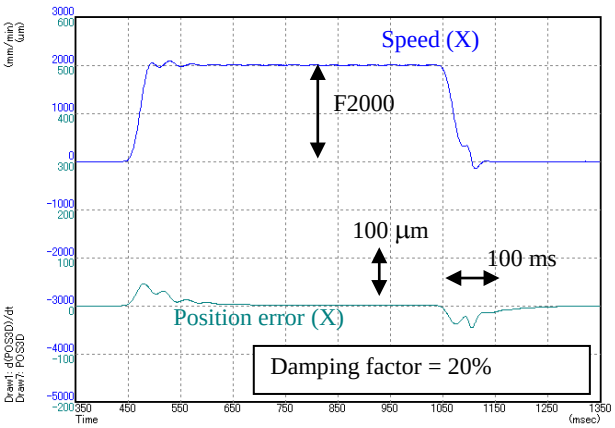
4. Tuning the damping factor and bandwidth magnification

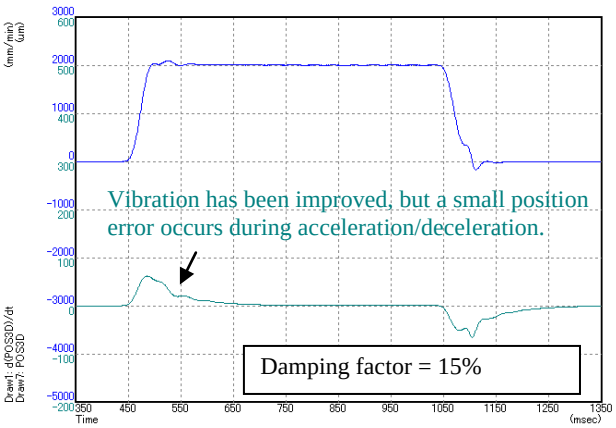
Tune the damping factor (No. 2648) and bandwidth magnification (upper two digits and lower two digits of No. 2649) to improve vibration. Because vibration remains, decrease the damping factor from the default value, or 25%. Set the default value for the bandwidth magnification.

No. 2648 = 20 (Damping factor = 20%) (Left figure)

No. 2648 = 15 (Damping factor = 15%) (Right figure)

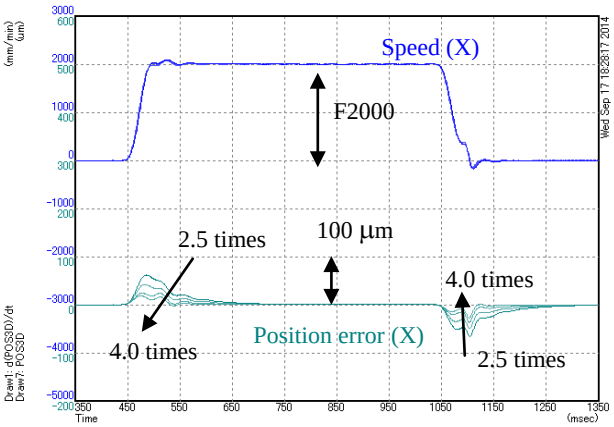
No. 2649 = 2525 (FF bandwidth magnification = FB bandwidth magnification = 2.5 times)





Tune the bandwidth magnification to improve the position error. Improve the position error, focusing on the fact that during acceleration/deceleration, the position error occurs only in the direction of travel.

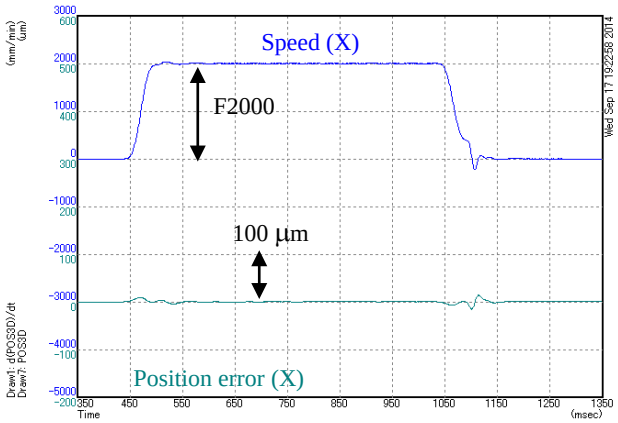
No. 2649 = 2525, 3030, 3535, and 4040 (The bandwidth magnification changes from 2.5 times to 4.0 times.)



This section gives only a brief description of how to tune the damping factor and bandwidth magnification. To find the most appropriate value, you need to tune the damping factor and bandwidth magnification by trial and error.

5. Position gain tuning

You have now completed filter tuning. Next, increase the position gain. In this example, the position gain can be increased stably to 100/s.

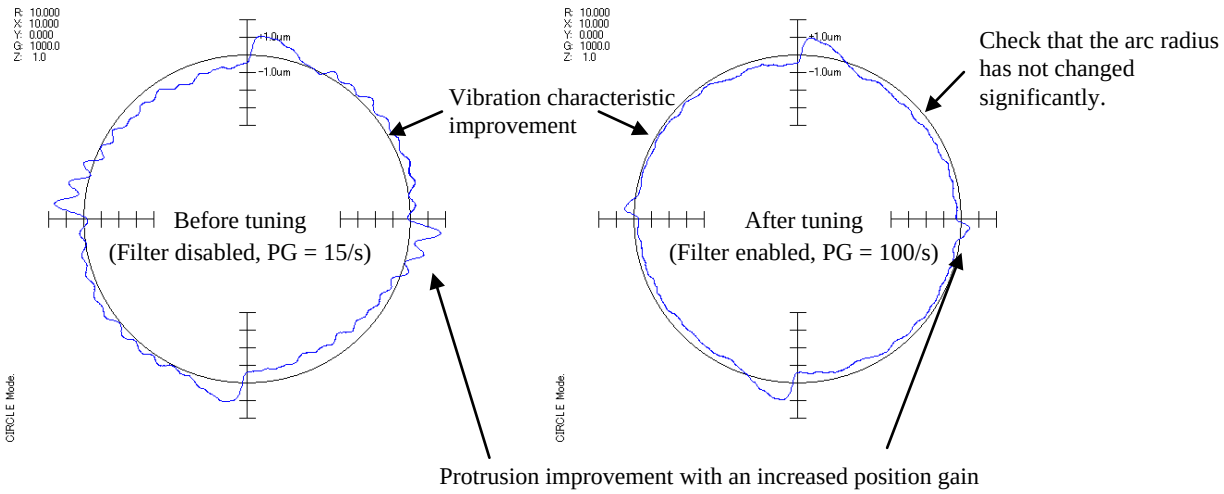


⚠CAUTION

Decreasing the function bit of the FB filter (bit 3 of parameter No. 2571) decreases the stability limit of the position control loop.
Do not set the function bit of the FB filter to 0 with the position gain increased.

6. Arc accuracy

Check the arc accuracy to check that the arc radius with this function enabled is almost the same as that with this function disabled. If the arc radius has changed, tune the arc radius with the feedforward timing adjustment parameter No. 2095.



(5) Note

The filter for the semi-closed system is effective when the system software operates in the mode called nano interpolation.

With the 30*i*-B and 0*i* -F, normal cutting and rapid traverse are operated in the nano interpolation mode.

With the following system software, PMC axis control operates in the nano interpolation mode.

CNC	System software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i* -B		71.0 and subsequent editions	
Series 0*i*-F		09.0 and subsequent editions	

5.5 CONTOUR ERROR SUPPRESSION FUNCTION

5.5.1 Feedforward

(1) Two causes of contour error

There are two main causes generating contour errors:

1 Error caused due to delay in the servo control system
2 Error in the position command contained by acc./dec. after interpolation

In a circular motion with 2-axis interpolation, there is a relationship between a decrease of the radius and the delay in the servo system:

$$\Delta R1[\mathrm{mm}] = \frac{(F[\mathrm{mm/sec}])^2}{2 \times (PG[\mathrm{sec}^{-1}])^2 \times R[\mathrm{mm}]}$$

F: Feedrate before interpolation, *PG*: Position gain, *R*: Arc radius

Given that the feedrate is 1000 mm/min = 16.66 mm/sec, the position gain is 30 sec^{-1} and the radius is 100 mm, the decrease of the radius is $16.66^2/(2 \times 30^2 \times 100)$ mm = 1.54 μm.

When using linear acc./dec. after interpolation, the decrease of a radius is given as follows:

$$\Delta R2[\mathrm{mm}] = \frac{1}{24}\left(\frac{T_c[\mathrm{sec}] \times F[\mathrm{mm/sec}]}{R[\mathrm{mm}]}\right)^2$$

F: Feedrate before interpolation, *Tc*: Time constant of acc./dec. after interpolation, *R*: Arc radius

Given that the feedrate is 30000 mm/min = 500 mm/sec, the time constant of acc./dec. after interpolation is 32 msec = 0.032 sec and the arc radius is 100 mm, the decrease of the radius is $(1/24) \times (0.032 \times 500/100)^2$ mm = 1.06 μm.

To sum up the discussion, the total decrease of a radius in a circular motion is given as the sum of the two: ΔR = ΔR1 + ΔR2.
Fig. 5.5.1 (a) is an illustration of the contour error in a circular motion.

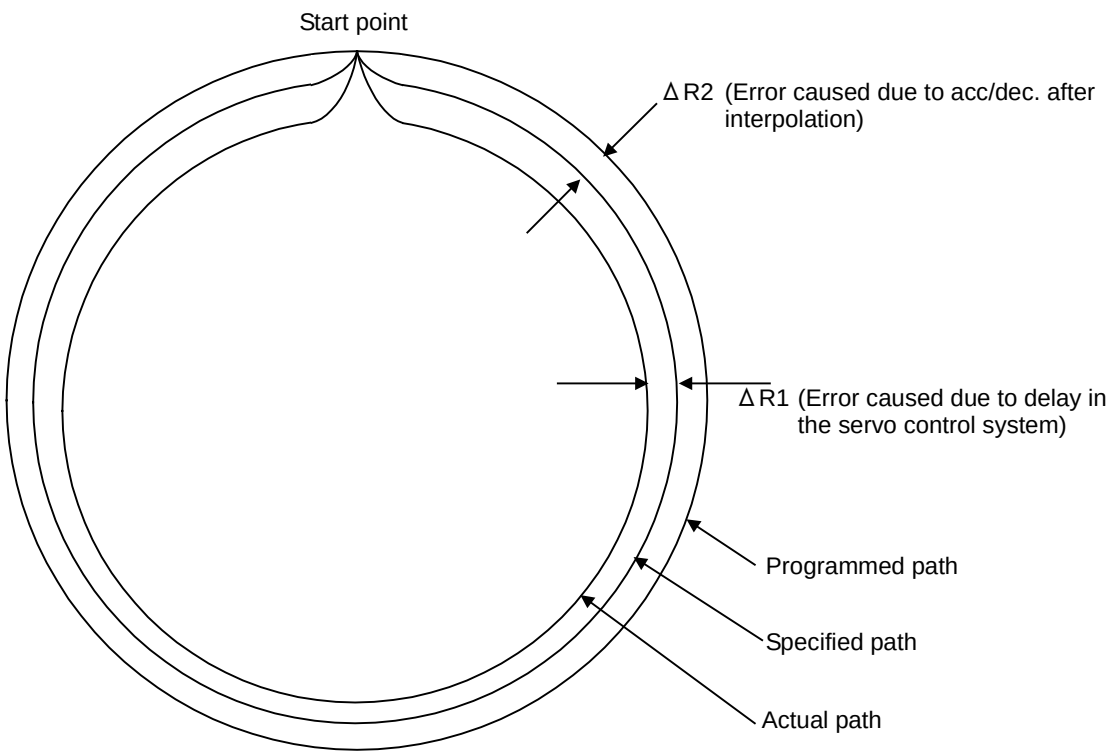


Fig. 5.5.1 (a) Contour error in a circular motion

(2) Overview

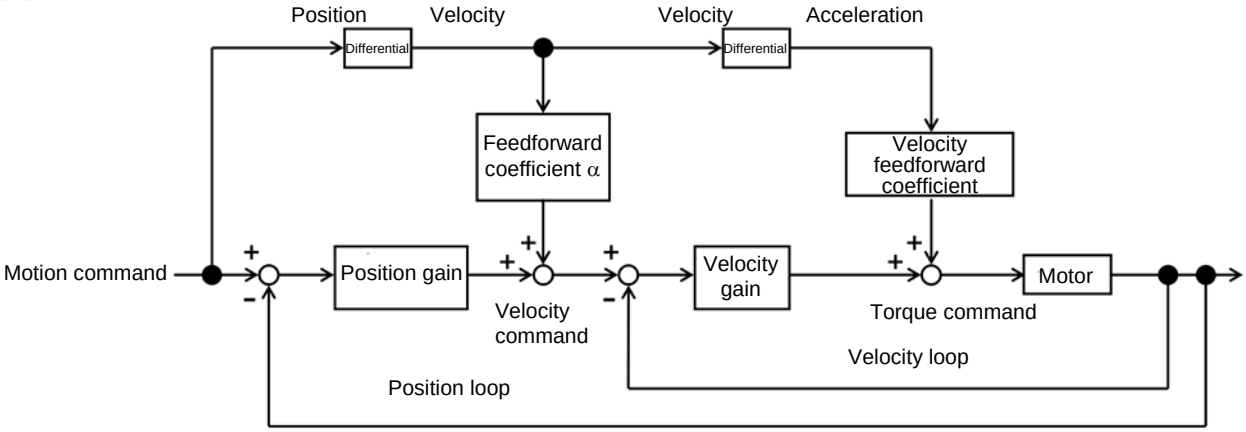


Fig. 5.5.1 (b) Feedforward control

It is useful to use the Feedforward Function to eliminate the contour error due to delay in the servo system. Fig. 5.5.1 (b) shows a block diagram of the servo control system with feedforward control. The (position) feedforward compensates the velocity command and the velocity feedforward compensates the torque command to improve the command following performance, reducing the contour error. When using the feedforward in the position loop, the decrease of a radius is given as follows:

$$\Delta R1'[\mathrm{mm}] = \frac{(F[\mathrm{mm/sec}])^2}{2\times\left(PG[\mathrm{sec}^{-1}]\right)^2\times R[\mathrm{mm}]}\left(1-\alpha^2\right)$$

α: Feedforward coefficient (0 ≤α≤ 1))

ΔR1', the decrease of the radius due to delay in the servo system, is clearly 0 for α= 1.

(3) Series and editions of applicable servo software

CNC	Servo software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	03.0 and subsequent editions	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
DSA-B	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	01.0 and subsequent editions	

(4) Parameters

	#7	#6	#5	#4	#3	#2	#1	#0
2003					PIEN			

PIEN(#3) 1: PI control is used for the velocity loop.

	#7	#6	#5	#4	#3	#2	#1	#0
2005							FEED	

FEED(#1) 1: Feedforward is enabled during cutting feed.

	#7	#6	#5	#4	#3	#2	#1	#0
1800					FFR			

FFR(#3) During rapid traverse, feedforward is:
0: Disabled.
1: Enabled.

NOTE
It is useful to use the feedforward in rapid traverse for reduction of the cycle time. But a mechanical shock may happen during acc./dec. In this case, tune parameters relevant to acc./dec. - acc./dec. time constant and acceleration, not the feedforward coefficient.

2092	Advanced preview feedforward coefficient (ADFF1)

[Unit of data] 0.01%
[Recommended value] 9800 to 10000 (98% to 100%. For example, 98.5% when 9850 is set)

2069	Velocity feedforward coefficient (VFFLT)

[Unit of data] %
[Recommended value] 50 to 200

(5) Using the electronic gear box (EGB) at the same time

To use the EGB at the same time, set the following function bit.

	#7	#6	#5	#4	#3	#2	#1	#0
2011							FFAL	

FFAL(#1) Feedforward control is:
1: Always enabled regardless of the mode.

The following feedforward coefficient is applied.

2068	Feedforward coefficient (FALPH)

FALPH = α × 100 or α × 10000

FALPH ≤ 100: In units of 1%
FALPH > 100: In units of 0.01%
[Recommended value] 100 or 10000

5.5.2 Cutting/Rapid Feedforward Switching

(1) Overview

This function is for switching two feedforward coefficients between cutting feed and rapid traverse. When nearing 100% of the feedforward coefficient, overshoot may occur during acceleration/deceleration in rapid traverse even though the contour error can be reduced. In this case, you can reduce the overshoot by using either a longer acceleration/deceleration time constant or a smaller feedforward coefficient.

(2) Series and edition of applicable servo control software

CNC	Servo software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	A(01) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0 90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8 90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	01.0 and subsequent editions	

(3) Setting parameters

The following three function bits can be set to select feedforward control appropriate for cutting feed or rapid traverse as listed in Table 5.5.2 (a).

	#7	#6	#5	#4	#3	#2	#1	#0
2005							FEED	

FEED (#1) 1: Feedforward is enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
1800					FFR			

FFR(#3) 1: Feedforward control during rapid traverse is enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
2214				FFCHG				

FFCHG (#4) 1: Cutting/rapid feedforward switching is enabled.

Table 5.5.2 (a) Cutting/rapid feedforward switching

Cutting/rapid feedforward switching		Position feedforward	Velocity feedforward
No. 2214#4=0 (disabled)	Always	No.2092	No.2069
No. 2214#4=1 (enabled)	Rapid traverse		
	Cutting feed	No.2144	No.2145

2145	Velocity feedforward coefficient for cutting feed
2144	Advanced preview feedforward coefficient for cutting
2069	Velocity feedforward coefficient for rapid traverse
2092	Advanced preview feedforward coefficient for rapid traverse

5.5.3 Feedforward timing adjustment coefficient

(1) Overview

All the axes involved in interpolation must basically have a common feedforward coefficient. But, the behavior of each axis is not always similar even if a common feedforward coefficient is used as each axis has its own mechanical characteristics. For example, the actual path of a circular motion may be an oval.
The Feedforward Timing Adjustment Function improves the circularity since the position error of each axis should be close by shifting the timing of the actual application of feedforward control. This function improves the following performance only for the motion with higher acceleration and it does not affect linear motion parallel with a specified axis because this function does not change the feedforward coefficient itself.

The radius should increase in a high-speed circular motion when delaying the feedforward timing. On the other hand, the radius should decrease when advancing it. The relationship between the variation of a radius and the feedforward timing is given as follows:

$$\Delta R[\mathrm{mm}] = \frac{\tau[\mathrm{sec}] \times (F[\mathrm{mm/sec}])^2}{PG[\mathrm{sec}^{-1}] \times R[\mathrm{mm}]}$$

τ: Feedforward timing

Given that the feedrate before interpolation is 4000 mm/min = 66.66 mm/sec, the position gain is 40 sec^{-1}, the arc radius is 10 mm and the delay of the timing by 1 msec = 0.001 sec, the result is an increase in the radius by $\Delta R = 0.001 \times 66.66^2/(40 \times 10)$ mm = 11 μm.

(2) Series and editions of applicable servo software

CNC	Servo software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0	03.0 and subsequent editions	
	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
	90GP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	01.0 and subsequent editions	

(3) Setting parameters

2095	Feedforward timing adjustment coefficient

[Unit of data] 2^{-12} msec

[Valid data range] -4096 to +4096

[Recommended value] Specifying +4096 causes the feedforward timing to advance by 1 msec, and specifying -4096 causes the feedforward timing to be delayed by 1 msec.
If you want to decrease the arc radius during high-speed cutting, increase the value by about 300 at each step.
If you want to increase the arc radius during high-speed cutting, decrease the value by about 300 at each step.

NOTE
(Actual feedforward timing) = (parameter No. 2095) + (the default timing)

(4) Compatibility with former CNC models

Table 5.5.3 (a) describes how to set parameter No. 2095 to realize equal timing of feedforward when replacing the CNC.

Table5.5.3 (a) Setting of parameter No. 2095 when the CNC model is changed

CNC model		No.2415#1	Setting of parameter No. 2095
From	To		
FS16*i* -B	FS30*i*-A, FS0*i*-D	0	No. 2095 (new setting) = No. 2095 (old setting) + A(*1)
		1	No. 2095 (new setting) = No. 2095 (old setting)
FS16*i*-B	FS30*i*-B	0/1	No. 2095 (new setting) = No. 2095 (old setting)
FS30*i*-A	FS30*i*-B	0	No. 2095 (new setting) = No. 2095 (old setting) - A(*1)
		1	No. 2095 (new setting) = No. 2095 (old setting)

(*1) The symbol A means the default feedforward timing.
The value of A differs depending on the used controller. See the actual value of A listed in Table 5.5.3 (b) below when setting parameter No. 2095.

Table 5.5.3 (b) Default feedforward timing value

Current control	Default feedforward timing value A
HRV2 control	3900
HRV3 control	3900
HRV4 control	3792
HRV4 control and any of the following functions used ・ High-speed processing ・ AI contour control II ・ High-speed cycle machining	-240

Bit 1 of parameter No. 2415 listed in Table 5.5.3 (a) is used to make the default feedforward timing value compatible with the FS16*i*-B Series on the 30*i*-A Series, 0*i*-D Series, and 0*i*-F Series. (The setting is not required for the 30*i*-B Series.)

	#7	#6	#5	#4	#3	#2	#1	#0
2415							IAHDON	

IAHDON(#1) The default value of the feedforward timing adjustment parameter is:
0: 0.
1: Compatible with the FS16*i*-B Series.

5.5.4 Backlash Acceleration

(1) Overview

The delay at a reversal tends to result in a spike (a quadrant protrusion) if the machinery has the characteristic of stick motion, which is actually contour error by mechanical backlash and static friction. Backlash acceleration eliminates the protrusion.

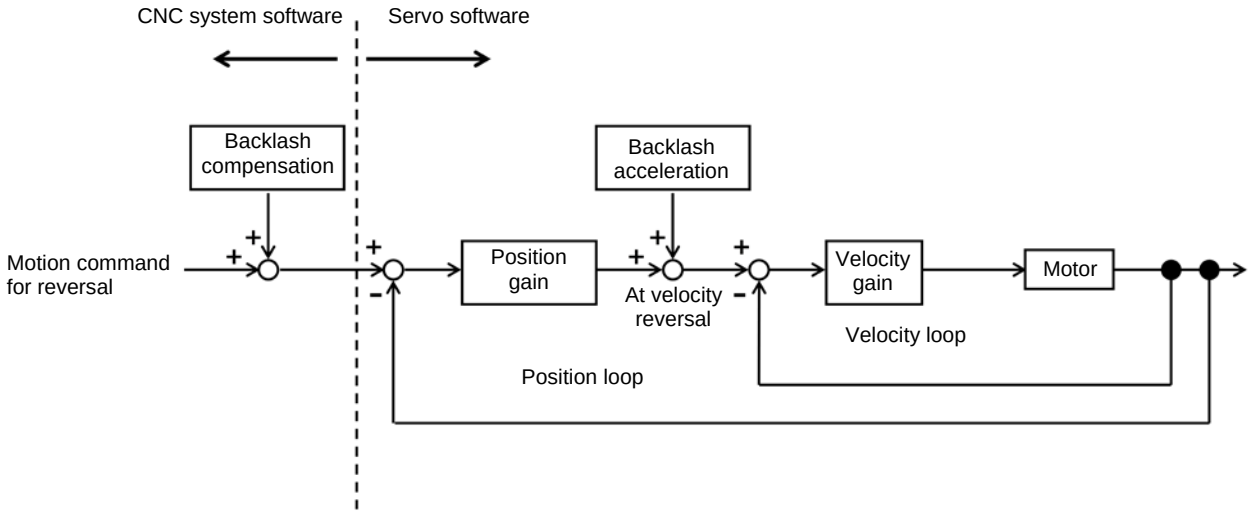


Fig. 5.5.4 (a) Compensation of the velocity command by backlash acceleration

Table5.5.4 (a) Functions to reduce contour error at reversal

	Backlash compensation	Backlash acceleration	Two-stage backlash acceleration(*1)
Purpose	Compensation of mechanical backlash of the machinery	Compensation of delay at reversal	Suitable compensation of delay at reversal according to the operating conditions
Compensation target	Motion command	Velocity command	Velocity command
Controlled by	CNC system(*2)	Servo software	Servo software
When the adjustment is good	Resolves the rattle	Reduces the protrusion.	Reduces the protrusion.
When the adjustment is insufficient	The rattle remains.	The protrusion remains.	The protrusion remains.
If the adjustment is too much	Overcutting occurs.(*3)	Overcutting occurs.(*3)	Overcutting occurs.(*3)

(*1) For details, see Subsection 5.5.5.

(*2) For details of backlash compensation, refer to the relevant CNC connection manual (such as B-64483EN-1).

(*3) If overcutting occurs and it is difficult to suppress the contour error at reversal, smart backlash compensation is useful for preventing overcutting. To suppress the contour error for a specific operation, servo learning control is also effective.

(2) Series and editions of applicable servo software

CNC	Servo software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	A(01) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	01.0 and subsequent editions	

NOTE

Backlash acceleration starts at

- the reverse of direction of motion command when advanced preview feedforward is enabled.
- the output backlash compensation when advanced preview feedforward is disabled.

Set a positive value in parameter No.1851, which is the backlash compensation, to use backlash acceleration in the modes where advanced preview feedforward is disabled. When backlash compensation is unnecessary because of fully closed loop, set a positive value in parameter No. 1851, and set bit 0 of parameter No. 2006 to 1 in order not to reflect backlash compensation in the position.

Advanced preview feedforward is disabled in the modes below:

- Manual operation (manual continuous feed, handle feed)
- G28 (reference position return in a low-speed sequence)
- G31 (skip)
- Flexible synchronization control in which a PMC-controlled axis is used as the master axis and the inter-path flexible synchronization mode selection signal OVLN <Gn531.4> is set to 0
- Superimposed control in which the AI contour control enable signal OVLN <Gn531.4> is set to 0

(3) Parameters for easy adjustment

(3.1) Basic function

	#7	#6	#5	#4	#3	#2	#1	#0
2003			BLEN					

BLEN(#5) 1: Backlash acceleration is enabled.

2048	Backlash acceleration amount

[Unit of data] Internal velocity command unit
[Recommended value] 20 to 600
[Description] Offset added to the velocity command just after reversal

2071	Time during which backlash acceleration is enabled

[Unit of data] 2 msec
[Recommended value] 20 to 100 (equivalent to 40 to 200 msec)
[Description] Duration in which the acceleration is added to the velocity command (If there is a long protrusion, increase the setting by 10 at each step)

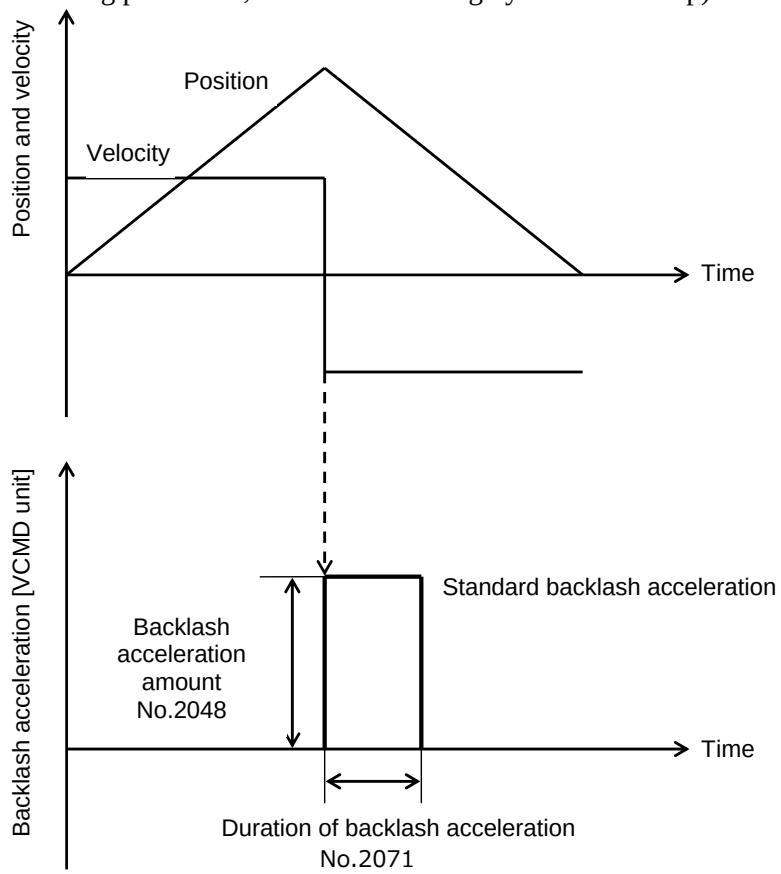


Fig. 5.5.4 (b) Standard backlash acceleration operation

(3.2) Backlash acceleration override

The machinery behaves as shown in Table 5.5.4 (b) as standard backlash acceleration does not depend on feedrate or acceleration. Use the override for backlash acceleration to specify suitable backlash acceleration according to feedrate and acceleration when the size and shape of protrusion depends on operation feedrate.

Table5.5.4 (b) Behavioral difference depending on conditions of backlash acceleration adjustment

	Adjustment for a low-speed motion	Adjustment for a high-speed motion
Behavior at low speed	Adequate	The acceleration amount is too large (overcutting occurs).
Behavior at high speed	The acceleration amount is insufficient (the protrusion remains).	Adequate

The override to backlash acceleration works in a circular motion as follows. In other words, acceleration is specified by the square of feedrate.

$$v_{net} = v_{set}\left(1 + \frac{F^2}{R} \times \frac{OVR}{16 \times 1000 \times \text{Detection unit [}\mu\text{m]}}\right)$$

- v_{net} [VCMD unit]: Effective backlash acceleration
- v_{set} [VCMD unit]: Backlash acceleration parameter setting (No. 2048)
- *OVR*: Override parameter setting (No. 2114)
- *F*[mm/sec]: Feedrate before interpolation along an arc (feedrate in the tangent direction)
- *R* [mm]: Arc radius

2114	Acceleration amount override

[Valid data range] 0 to 32767
[Recommendation] See the details described in Item (5).

> **NOTE**
> For a specific method for adjusting backlash acceleration override, see Item (5).

2338	Limit of acceleration amount

[Valid data range] 0 to 32767 (A value of 0 means no limit.)
[Recommendation] See the details described in Item (5).

The backlash acceleration changes according to the feedrate as shown in Fig. 5.5.4 (c) in the following example:

- Detection unit of 0.1 μm
- Arc having a radius of 10 mm
- Parameter No. 2048 (acceleration amount setting) = 46
- Parameter No. 2114 (override) = 23
- Parameter No. 2338 (limit) = 500

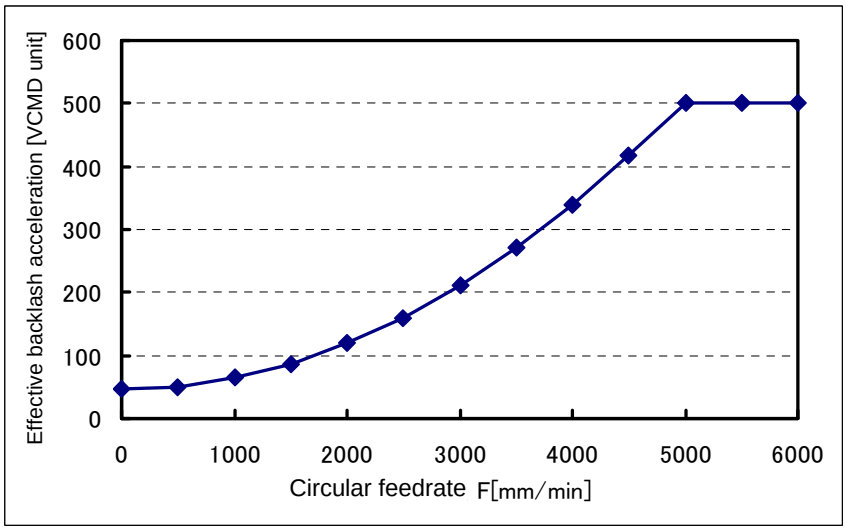


Fig. 5.5.4 (c) Example of changes in the acceleration amount according to override

(3.3) Direction-based backlash acceleration

Asymmetrical protrusions may happen on a circle shown in Fig. 5.5.4 (d). Different backlash acceleration settings are available for each side for each axis. Table 5.5.4 (c) shows how to use direction-based parameters.

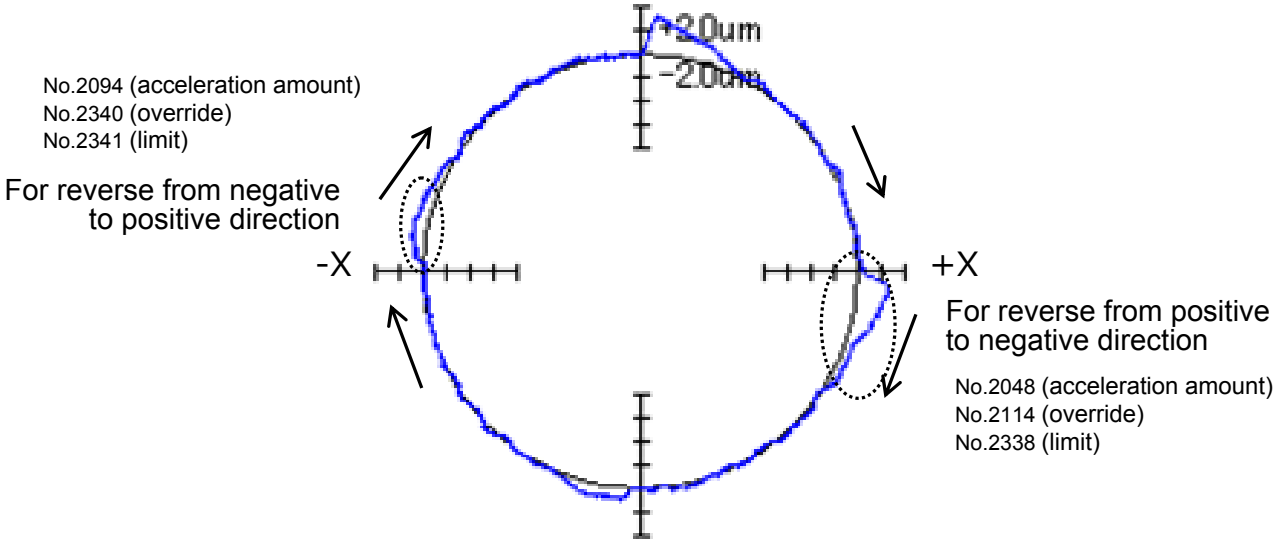


Fig. 5.5.4 (d) Parameter setting for asymmetric protrusions

Table 5.5.4 (c) How to use direction-based parameters

Direction-specific setting	Reverse direction	Backlash acceleration amount	Acceleration amount override	Limit of acceleration amount
Not made	Common	No.2048	No.2114	No.2338
Made (No. 2094 ≠ 0)	From + to -			
	From - to +	No.2094	No.2340	No.2341

2094	Backlash acceleration amount (for reverse from negative to positive direction)

[Recommended value] 20 to 600

2340	Acceleration amount override (for reverse from negative to positive direction)

[Valid data range] 0 to 32767

2341	Limit of acceleration amount (for reverse from negative to positive direction)

[Valid data range] 0 to 32767 (A value of 0 means no limit.)

(3.4) Backlash acceleration stop

In the adjustment of backlash acceleration, from the viewpoint of machining precision, it is effective to determine the acceleration based on the accuracy at low-feedrate reversal and limit the acceleration at high-feedrate reversal. Backlash acceleration stop prevents overcutting with less accelerating distance by forcibly stopping addition of backlash acceleration as shown in Fig. 5.5.4 (e) even in the effective duration of backlash acceleration at high-speed reversal.

The difference between the backlash acceleration stop and the limit of acceleration is illustrated in Fig. 5.5.4 (e).

- The limit of acceleration specifies the upper limit of “the offset to the velocity command".
- Acceleration stop specifies the upper limit of “the motion in position”.

Therefore, backlash acceleration stop can securely prevent overcutting because it specifies "distance" to the end of acceleration.

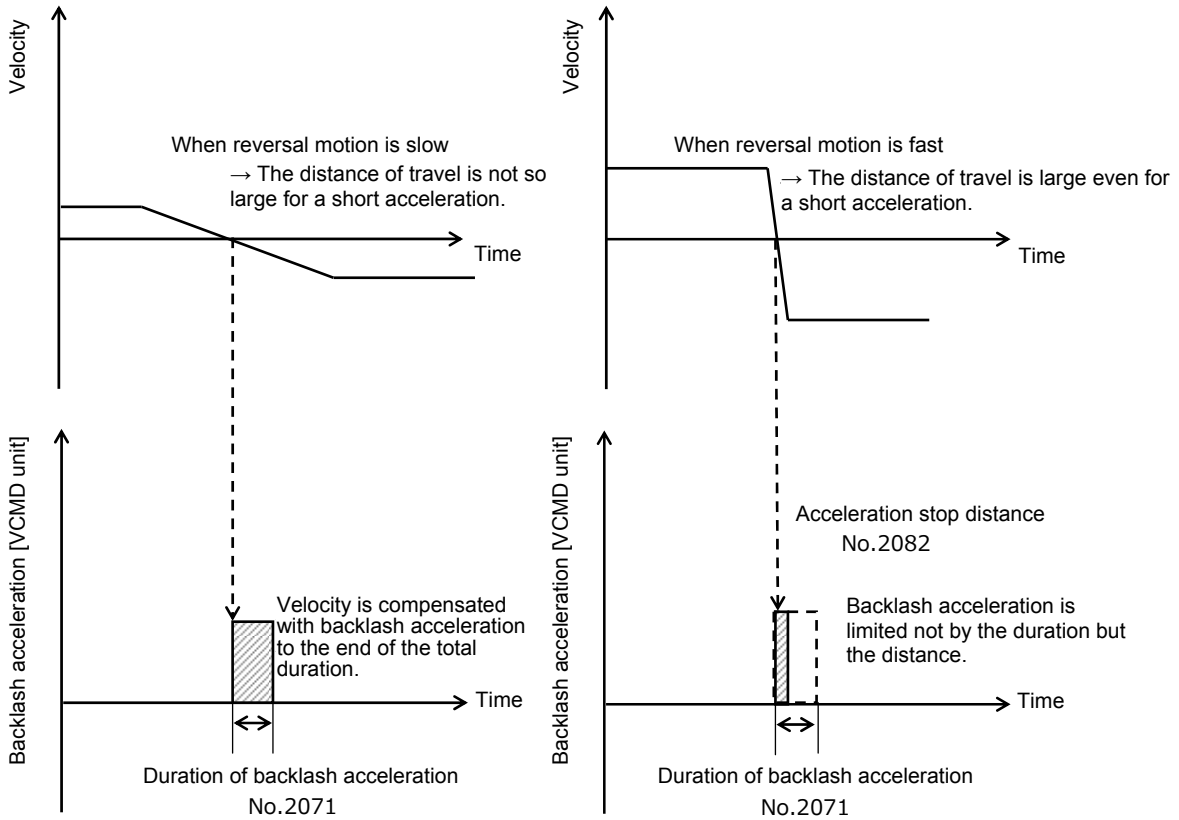


Fig. 5.5.4 (e) Operation of backlash acceleration stop
(The override increases acceleration at high-speed reversal.)

	#7	#6	#5	#4	#3	#2	#1	#0
2009	BLST							

BLST(#7) 1: Backlash acceleration stop is enabled.

2082	Backlash acceleration stop distance

[Valid data range] 0 to 32767 (A value of 0 disables backlash acceleration itself.)
[Recommended value] 2 to 5 (detection unit of 1 μm), 20 to 50 (detection unit of 0.1 μm)
[Description] Specify the distance by which backlash acceleration ends. Parameter No. 2082 is used to force the backlash acceleration to stop regardless of the setting of parameter No. 2071 (time during which backlash acceleration is enabled).

(4) Disabling backlash acceleration selectively

(4.1) Disabling backlash acceleration during non-cutting feed (such as handle feed)

The following function bit can be set to disable backlash acceleration during rapid traverse, handle feed, and other non-cutting feed operations.

	#7	#6	#5	#4	#3	#2	#1	#0
2223	BLCUT2							

BLCUT2(#7) 1: Backlash acceleration is enabled only during cutting feed.

NOTE
1 Backlash acceleration is disabled in rapid traverse. Backlash acceleration is disabled during handle feed since handle feed is in the rapid traverse mode.
2 This function bit can be applied regardless of the setting of feedforward control during rapid traverse (bit 3 of parameter No. 1800).

(4.2) Disabling backlash acceleration after a stop

The backlash acceleration can be disabled when the axis keeps stopping over the duration specified the parameter.

	#7	#6	#5	#4	#3	#2	#1	#0
2283	BLSTP2							

BLSTP2(#7) 1: Backlash acceleration is disabled after a stop.

2073	Stop state judgment parameter

[Valid data range] 1 to 32767
[Setting method] Stop determination time = (parameter setting) × Ts
Ts = 4 ms (Series 30*i*), 8 ms (Series 0*i*)
[Recommended value] 5

NOTE
This parameter is also used by static friction compensation. Disabling backlash acceleration after a stop requires enabling static friction compensation (setting bit 7 of parameter No. 2005) to 1.

(5) Adjustment of acceleration override

(5.1) Description

Fig. 5.5.4 (f) illustrates the adjustment procedure. The settings of both override and acceleration can be obtained using the gradient and intercept of the straight line connecting the two points, A and B, shown in STEP 1 in Fig. 5.5.4 (f). Then, as shown in STEP 2 in Fig. 5.5.4 (f), decide the limit of the acceleration at point C. Use the following expressions to calculate these values:

$$No.2114(\text{override}) = \frac{v_B - v_A}{a_B v_A - a_A v_B} \times 16 \times 1000 \times \text{Detection unit [μm]}$$

$$No.2048(\text{acceleration amount setting}) = \frac{a_B v_A - a_A v_B}{a_B - a_A}$$

$$No.2338(\text{limit}) = v_c$$

v: Acceleration amount obtained by adjustment [VCMD unit], $a=F^2/R$: Circular acceleration [mm/sec^2]

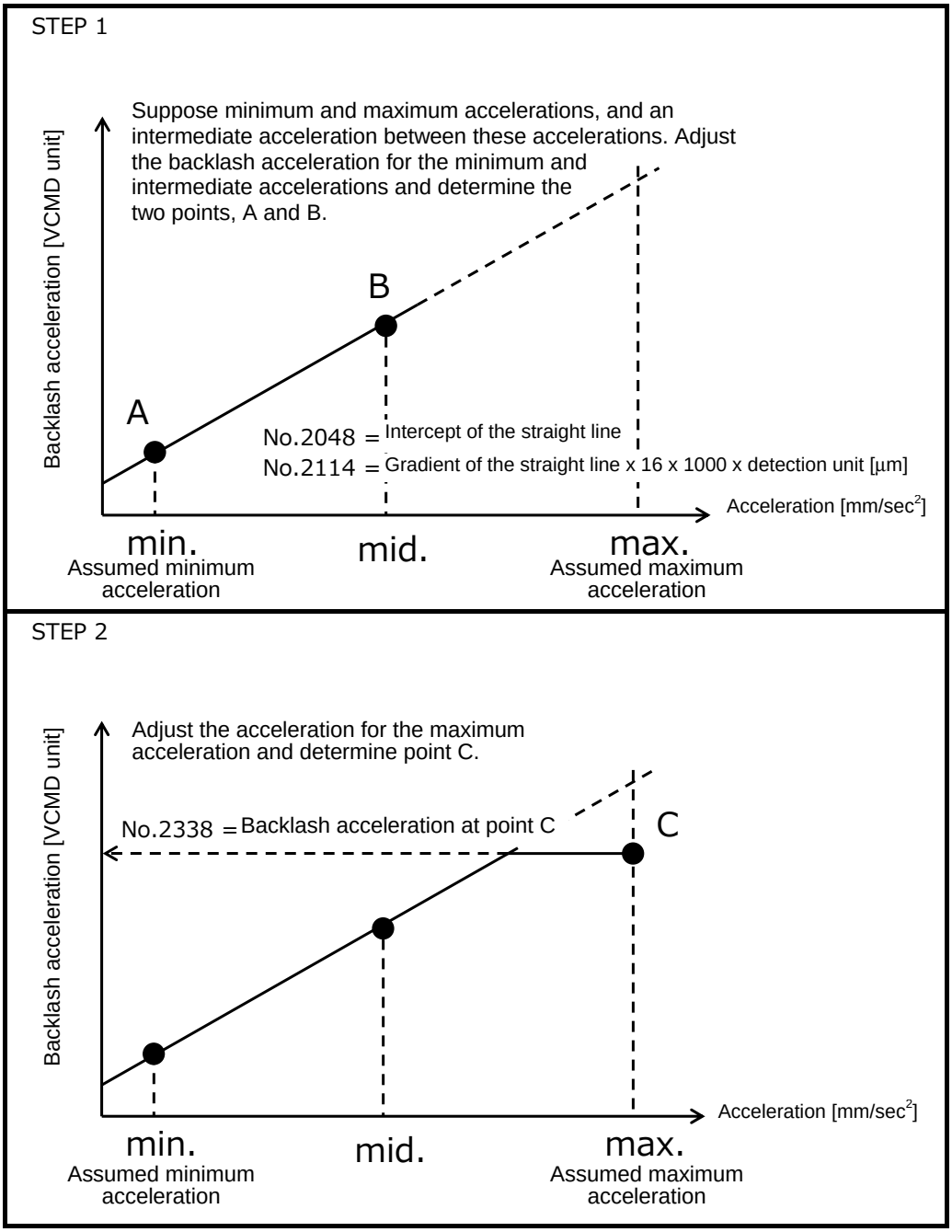


Fig.5.5.4 (f) Adjustment of backlash acceleration override

(5.2) Example of calculation for override adjustment

Table 5.5.4 (d) summarizes an example of dataset of backlash acceleration adjustment under the three conditions A, B and C.

Table 5.5.4 (d) Results of measurement for backlash acceleration override adjustment

Condition	Feedrate [mm/min]	Acceleration [mm/sec^2]	Backlash acceleration amount
A	500	6.9	50
B	3000	250	200
C	5000	694	500

Arc radius R = 10 mm, detection unit of 1 μm, acceleration = (velocity [mm/sec])2/radius [mm]

The parameters can be calculated in the way described in the previous sub-Item (5.1).

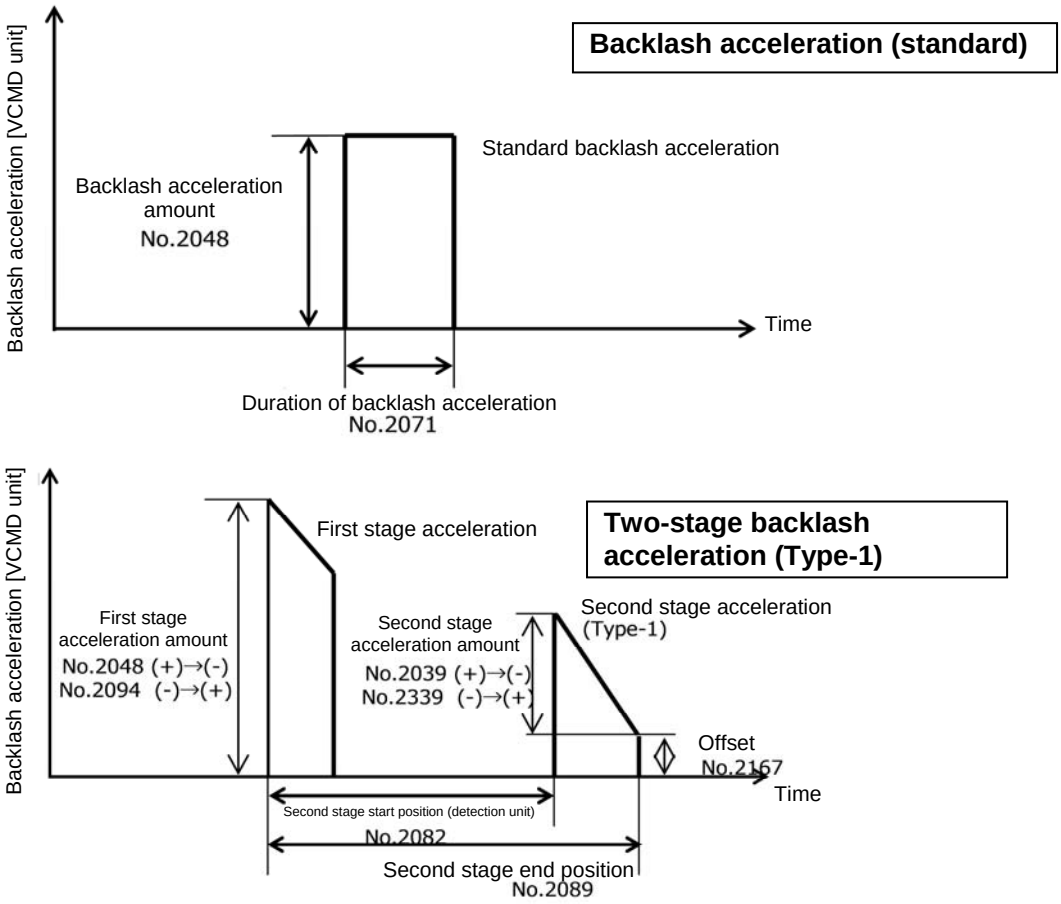
$$No.2114(\text{ override }) = \frac{v_B - v_A}{a_B v_A - a_A v_B} \times 16 \times 1000 \times \text{Detection unit [μm]}$$
$$= \frac{200-50}{250 \cdot 50 - 6.9 \cdot 200} \times 16 \times 1000 \times 1 = \frac{150}{11120} \times 16000 = 216$$
$$No.2048(\text{acceleration amount setting}) = \frac{a_B v_A - a_A v_B}{a_B - a_A} = \frac{250 \cdot 50 - 6.9 \cdot 200}{250 - 6.9} = \frac{11120}{243.1} = 46$$
$$No.2338(\text{ limit }) = v_c = 500$$

5.5.5 Two-stage Backlash Acceleration

(1) Overview

When the machinery performs a reversal motion, the following two types of friction act: mechanical friction and motor friction. These two types of friction are separately handled and acceleration is compensated for as illustrated in Fig. 5.5.5 (a) with two-stage backlash acceleration. A sawtooth waveform can be given with Two-stage Backlash Acceleration Function while the compensation waveform is rectangular for standard backlash acceleration.

- The first stage acceleration removes the motor friction at reversal. Compensation is possible according to the motor speed and load variation.
- The second stage acceleration removes the mechanical friction at reversal.



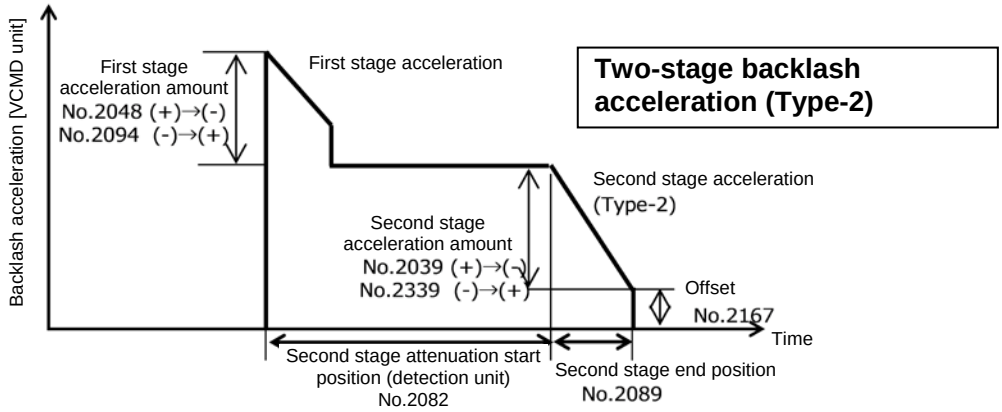


Fig. 5.5.5 (a) Acceleration patterns and parameters for backlash acceleration

Table5.5.5 (a) Comparison of backlash acceleration functions

	Standard backlash acceleration	Two-stage backlash acceleration (Type-1)	Two-stage backlash acceleration (Type-2)
Effect	Compensation of delay at reversal	Compensation for both motor friction and machine friction	
Operation	Adds the offset to the velocity command only at reversal.	Separates the first and second stage accelerations.	Starts the first and second stage accelerations at the start of reversal.
To be used	For general protrusions	When motor friction is significant	When mechanical friction is significant

NOTE

Two-stage backlash acceleration cannot be used with backlash acceleration stop. For the second stage acceleration, however, an acceleration duration can be specified for parameter No. 2146.

(2) Series and editions of applicable servo software

CNC	Servo software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	03.0 and subsequent editions	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
DSA-B	90K0	01.0 and subsequent editions	
	90GP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	
	90E0	E(05) and subsequent editions	Second stage acceleration Type-2
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
	90D0	E(05) and subsequent editions	Second stage acceleration Type-2
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	01.0 and subsequent editions	

(3) Setting parameters

(3.1) Basic setting

	#7	#6	#5	#4	#3	#2	#1	#0
2003			BLEN					

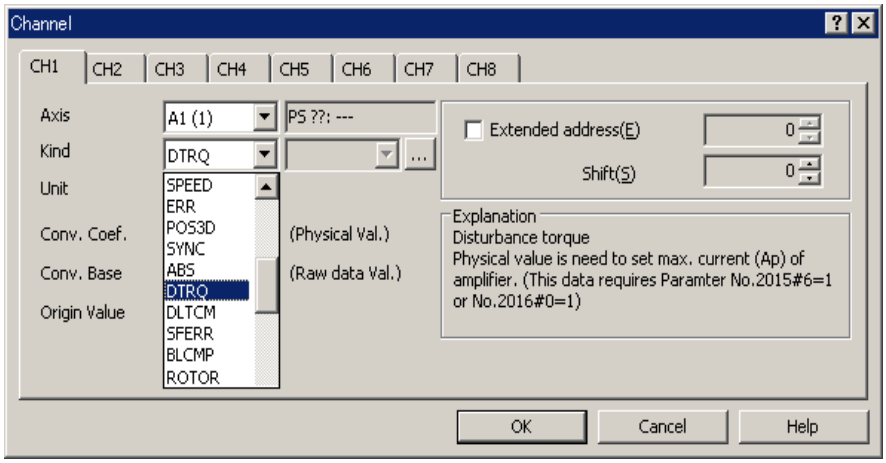
BLEN(#5) 1: Backlash acceleration is enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
2015		BLAT						

BLAT(#6) 1: Two-stage backlash acceleration is enabled.

(3.2) Estimation of the friction torque using the observer

Two-stage backlash acceleration estimates the friction torque using the observer circuit. The function calculates the first stage acceleration based on the friction torque. Adjust observer parameter POA1 properly to obtain an adequate acceleration. Optimize the value of POA1 observing some estimated disturbance DTRQ on SERVO GUIDE in acc./dec motion.



NOTE

This adjustment is similar to that of the observer for unexpected disturbance torque detection function. Readjustment of the observer is unnecessary when unexpected disturbance torque detection has already been adjusted.

2047	Observer parameter (POA1)

[Setting value] Adjusted value (Make an adjustment according to steps <5> and <6> in (3) in Subsection 5.9.1.)

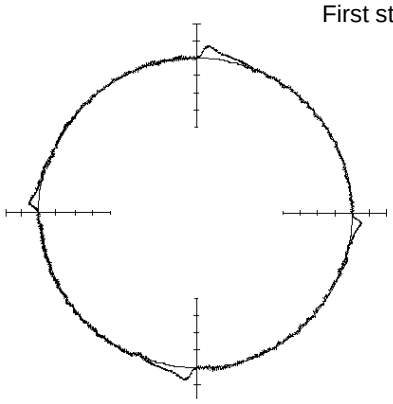
2087	Torque offset parameter

[Unit of data] TCMD unit (A value of 7282 is equivalent to the maximum current of the amplifier.)

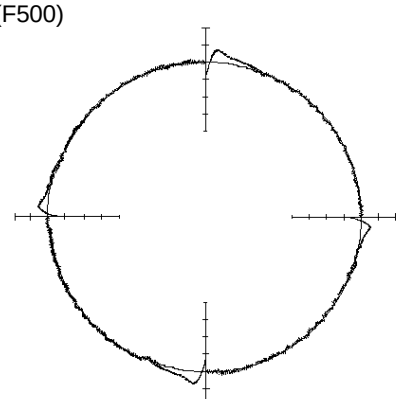
[Setting value] Adjusted value (If the center of an estimated disturbance value does not become zero on an axis such as the gravity axis, make an adjustment according to step <6> in (3) in Subsection 5.9.1.)

(3.3) First stage acceleration

First stage acceleration (F500)



When the first stage acceleration is adequate
(Protrusions caused by mechanical friction remain, but the second stage acceleration can be adjusted for them.)



When the first stage acceleration is too large
(Overcutting occurs due to excessive acceleration when the motor reverses.)

Fig. 5.5.5 (b) Adjusting the first stage acceleration

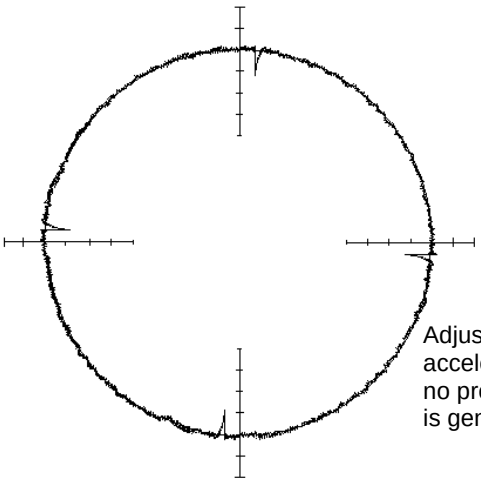
2048	First stage backlash acceleration amount (from positive to negative direction) (%)

[Unit of data]
[Valid data range] -100% to +100% (100% means an acceleration amount equivalent to the friction torque. A value of -100 disables the first stage acceleration.)
[Recommended value] 50 (Usually, optimum values range from 20% to 70%.)

2094	First stage backlash acceleration amount (from negative to positive direction) (%)

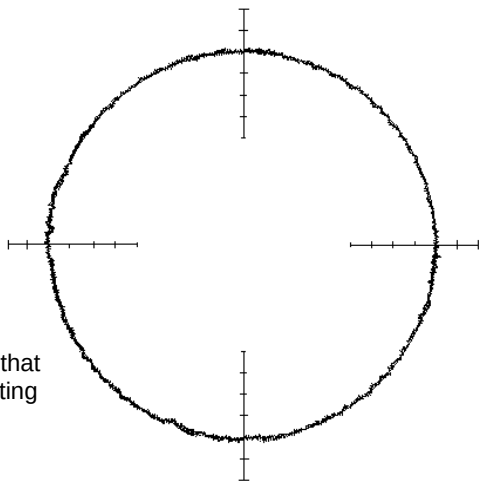
[Unit of data]
[Valid data range] -100% to +100% (100% means an acceleration amount equivalent to the friction torque. A value of -100 disables the first stage acceleration.)
[Recommendation] 0 (Setting is usually not required. Set a value when asymmetrical protrusions happen depending on the mechanical characteristics.)

(3.4) Second stage acceleration: Acceleration



Second stage acceleration (too large)

Adjust the second stage acceleration amount so that no protrusion or overcutting is generated.



Second stage acceleration (adequate)

Fig. 5.5.5 (c) Adjusting the second stage acceleration amount

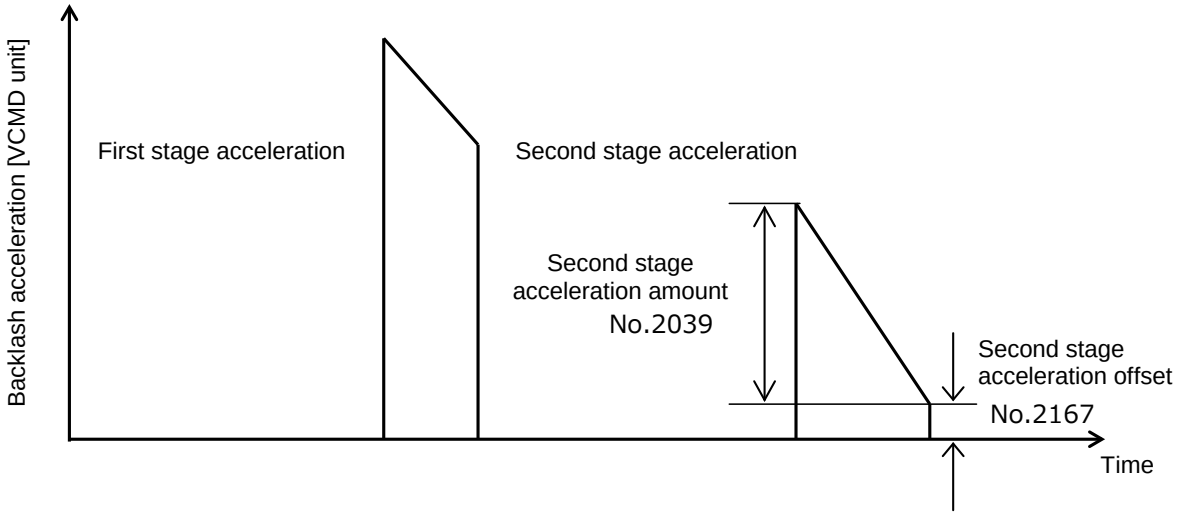


Fig. 5.5.5 (d) Parameters related to the second stage acceleration amount

2039	Second stage acceleration amount for two-stage backlash acceleration

[Unit of data] VCMD unit
[Recommended value] 0 to 600 (Setting of 0 disables the second stage acceleration)

2167	Second stage offset for two-stage backlash acceleration

[Recommendation] 0 (Setting is usually not required.)

(3.5) Second stage acceleration: Selecting Type-1 or Type-2 and specifying the start and end positions

	#7	#6	#5	#4	#3	#2	#1	#0
2271			2NDTMG					

2NDTMG(#5) The second stage acceleration for two-stage backlash acceleration is of:
0: Type-1
1: Type-2

For Type-1

2082	Second stage acceleration start position (Type-1)

[Unit of data] Detection unit
[Valid data range] -32768 to 32767 (A value of 0 is equivalent to an internal value of 100.)
[Recommended value] 1 to 10 (Detection unit: 1 μm)
1 to 100 (Detection unit: 0.1 μm)

2089	Second stage acceleration end position (Type-1)

[Unit of data] In units of 0.1
[Valid data range] 0 to 10279 (multiplication by 0 to 1027.9)
[Recommended value] 0 (Normally, set 0.)
[Description] When a value greater than 0 is set for parameter No. 2089: End position = 0.1 × value of parameter No. 2089 × start position
When a value of 0 is set for parameter No. 2089: The internal value is determined according to the value of parameter No. 2082.

- When a value greater than 0 is set for parameter No. 2082: End position = 2 × start position
- When a value smaller than 0 is set for parameter No. 2082: End position = 3 × start position

2146	Maximum second stage backlash acceleration duration

[Unit of data] msec
[Recommended value] 50

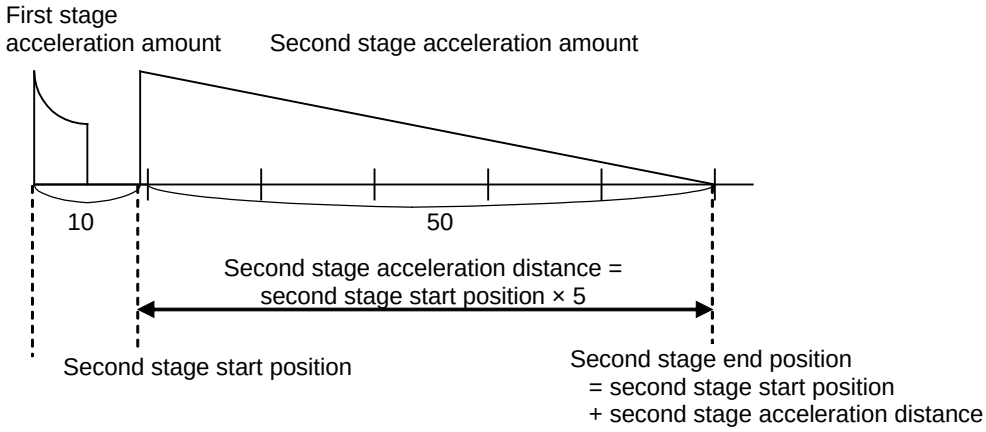


Fig.5.5.5 (e) Second stage acceleration Type-1 (second stage acceleration start position = 10 [detection unit], end position = 50 (magnification of 5))

For Type-2

2082	Second stage acceleration attenuation start position (Type-2)

[Unit of data] Detection unit
[Valid data range] 0 to 32767 (A value of 0 is equivalent to an internal value of 100.)
[Recommended value] 1 to 10 (Detection unit: 1 μm)
1 to 100 (Detection unit: 0.1 μm)

2089	Second stage acceleration end position (Type-2)

[Unit of data] Detection unit
[Recommended value] 20 to 30 (detection unit of 1 μm), 200 to 300 (detection unit of 0.1 μm)

2146	Maximum second stage backlash acceleration duration

[Unit of data] msec
[Recommended value] 50

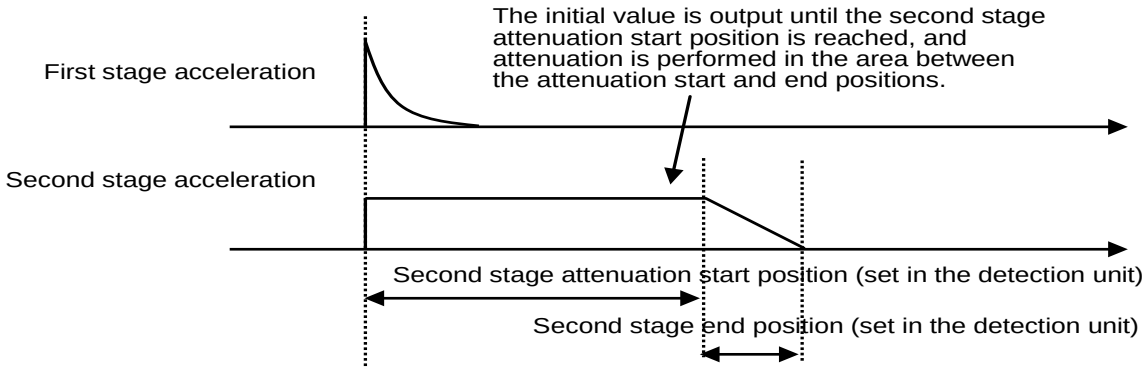
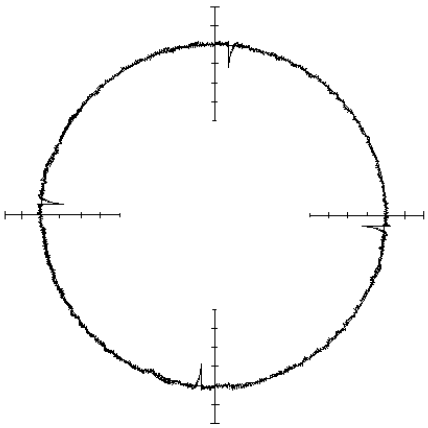
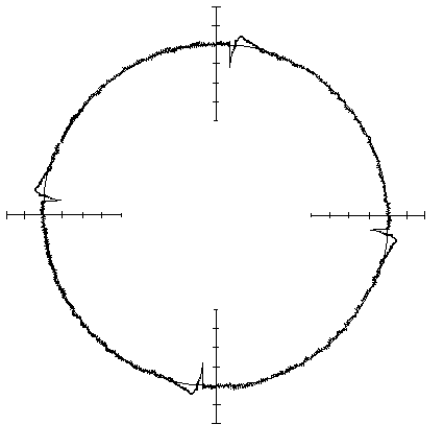


Fig. 5.5.5 (f) Second stage acceleration Type-2 (second stage acceleration start position = 10 [detection unit], end position = 50 [detection unit])

Start adjustment with setting second stage acceleration = 500 (recommendation).
Adjust the acceleration start and end positions while checking the second stage acceleration timing.



When the start and end positions are adequate
Overcutting occurs due to the slightly large second stage acceleration to check the second stage acceleration timing, but the second stage acceleration can be decreased to prevent overcutting.



When the start and end positions are inadequate
Protrusions are not removed with the second stage acceleration since the second stage acceleration duration is too short.

Fig. 5.5.5 (g) Adjusting the start and end positions of the second stage backlash acceleration

NOTE Compatibility between the FS30*i*-A and FS30*i*-B when using HRV4.

The actual backlash acceleration depends on whether the controller is FS30*i*-A and FS30*i*-B, when HRV4 control and two-stage backlash acceleration are used together even when using the same parameter settings. Some conversions of parameters are required as follows when necessary to apply the parameters adjusted with FS30*i*-A to the FS30*i*-B:

- To use two-stage backlash acceleration Type-1: Multiply the value of parameter No. 2082 by 1/4.
- To use two-stage backlash acceleration Type-2: Multiply the values of parameter Nos. 2082 and 2089 by 1/4.

(3.6) Second stage acceleration: Override

$$v_{net} = v_{set}\left(1 + \frac{F^2}{R} \times \frac{OVR}{2^n \times 1000 \times \text{Detection unit [μm]}}\right), \quad n = \begin{cases} 5 & (No.2018\#2 = 0) \\ 1 & (No.2018\#2 = 1) \end{cases}$$

- v_{net} [VCMD unit]: Effective backlash acceleration
- v_{set} [VCMD unit]: Backlash acceleration parameter setting (No. 2039)
- OVR: Override set for parameter No. 2114
- F [mm/sec]: Feedrate before interpolation along an arc
- R [mm]: Arc radius

	#7	#6	#5	#4	#3	#2	#1	#0
2018						**OVR8**		

OVR8(#2) The format of the second stage acceleration override is based on:
0: 4096
1: 256 ← Usual setting

2114	Second stage acceleration amount override

[Valid data range] 0 to 32767

2338	Limit value of the second stage acceleration amount for two-stage backlash acceleration

[Valid data range] 0 to 32767 (A value of 0 means no limit.)

2167	Second stage offset for two-stage backlash acceleration

[Recommendation] 0 (Setting is usually not required.)

NOTE
The second stage override is also effective for the second stage offset.

Calculate the override for the second stage using adjustment results in the three conditions with different accelerations A (minimum acceleration), B (intermediate) and C (maximum). This procedure is similar to that for the first stage acceleration.

Suffixes: A (minimum acceleration), B (intermediate acceleration), C (maximum acceleration)

$$No.2114(\text{override}) = \frac{v_B - v_A}{a_B v_A - a_A v_B} \times 1000 \times \text{Detection unit [μm]} \times 2^n, \quad n = \begin{cases} 5 & (No.2018\#2 = 0) \\ 1 & (No.2018\#2 = 1) \end{cases}$$

$$No.2039(\text{acceleration amount setting}) = \frac{a_B v_A - a_A v_B}{a_B - a_A}$$

v: Acceleration amount obtained by adjustment [VCMD unit], $a = F^2/R$: Circular acceleration [mm/sec^2]

$$No.2338(\text{limit}) = v_c$$

Table 5.5.5 (b) summarizes an example of dataset of backlash acceleration adjustment under the three conditions, A, B and C.

Table 5.5.5 (b) Results of measurement for second stage backlash acceleration override adjustment

Condition	Feedrate [mm/min]	Acceleration [mm/sec^2]	Backlash acceleration amount
A	500	6.9	40
B	3000	250	100
C	6000	1000	260

Arc radius R = 10 mm, detection unit of 1 μm, acceleration = (velocity [mm/sec]) 2/radius [mm], bit 2 of parameter No. 2018 = 1

The parameter values can be calculated as follows.

$$No.2114(\text{override}) = \frac{v_B - v_A}{a_B v_A - a_A v_B} \times 1000 \times \text{Detection unit [μm]} \times 2^n$$

$$= \frac{100 - 40}{250 \cdot 40 - 6.9 \cdot 100} \times 1000 \times 1 \times 2^1 = \frac{60}{9310} \times 2000 = 13$$

$$No.2039(\text{acceleration amount setting}) = \frac{a_B v_A - a_A v_B}{a_B - a_A} = \frac{250 \cdot 40 - 6.9 \cdot 100}{250 - 6.9} = \frac{9310}{243.1} = 38$$

$$No.2338(\text{limit}) = v_c = 260$$

(3.7) Second stage acceleration: Direction-based setting

[Parameters for direction-based setting]

Direction-based setting	Reverse direction	Second stage acceleration amount	Acceleration amount override	Limit of acceleration amount
Not made	Common	No.2039	No.2114	No.2338
Made (No. 2339 ≠ 0)	From + to -			
	From - to +	No.2339	No.2340	No.2341

2339	Second stage acceleration amount from negative to positive direction for two-stage backlash acceleration

[Recommended value] 100

2340	Second stage acceleration amount override from negative to positive direction

[Valid data range] 0 to 32767

2341	Limit of second stage acceleration amount from negative to positive direction

[Valid data range] 0 to 32767

5.5.6 Backlash acceleration base pulse

(1) Overview

For example, a CAM program for a gradual tapering may result in a tiny traversal command even though there is no actual reversal command in the program. Backlash acceleration may damage the surface of the workpiece if unintended backlash acceleration occurs at reversal. Backlash acceleration base pulse prevents such over-compensation by canceling backlash accretion until the reversal command over a threshold called base pulse comes into the velocity loop. (Fig. 5.5.6 (a))

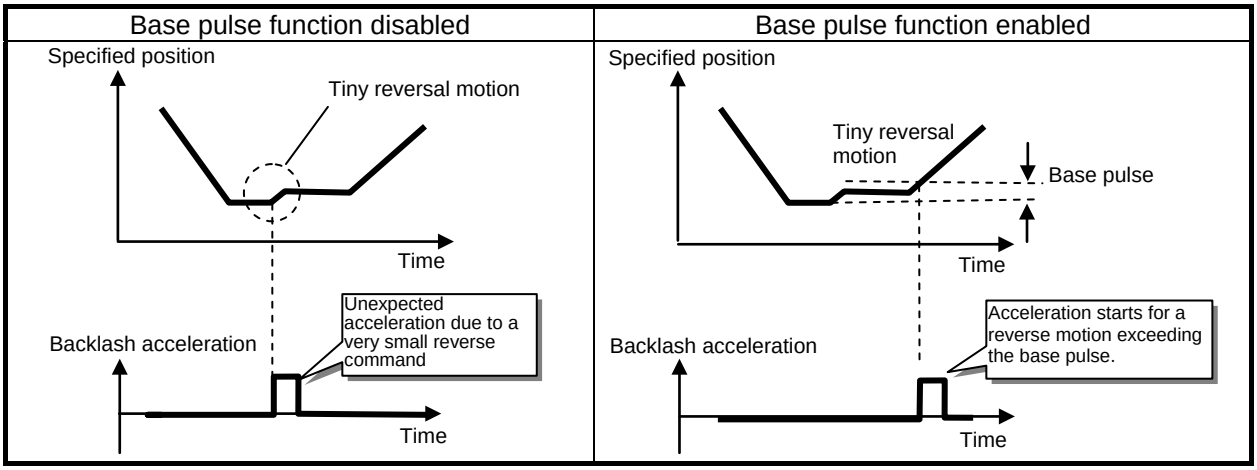


Fig. 5.5.6 (a) Backlash base pulse and its operation for a tiny reversal motion

(2) Series and editions of applicable servo software

CNC	Servo software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP 90JP	13.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	L(12) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	01.0 and subsequent editions	

(3) Parameters

The base pulse function works with a non-zero setting of the following base pulse parameters. Note that the parameter to be set depends on whether two-stage backlash acceleration is enabled or disabled.

[When two-stage backlash acceleration is disabled (bit 6 of parameter No. 2015 is set to 0)]

2089	Backlash acceleration base pulse

[Unit of data] Detection unit
[Description] Threshold for a very small reverse command

[When two-stage backlash acceleration is enabled (bit 6 of parameter No. 2015 is set to 1)]

2349	Two-stage backlash acceleration base pulse

[Unit of data] Detection unit
[Description] Threshold for a very small reverse command

NOTE
The contouring accuracy may be negatively affected during the usual reversal motions since the start of backlash acceleration is delayed if a large value is used for the base pulse.

Table 5.5.6 (a) summarizes the two-stage backlash acceleration settings and its corresponding parameters.

Table 5.5.6 (a) How to use base pulse parameters

Two-stage backlash acceleration	Effective base pulse	Remarks
Disabled	No. 2089	
Enabled	No. 2349	The value of parameter No. 2089 is used as the second stage acceleration end position.

5.5.7 Acceleration Monitor for Backlash Acceleration

(1) Overview

Backlash acceleration override adjusts the backlash acceleration according to the acceleration at reversal. However, it may overcompensate for the backlash acceleration in the following cases in which the acceleration rapidly changes before and after reversal.

1 The acceleration rapidly changes before and after reversal in a right-angled motion, while the acceleration is almost the same before and after reversal along a feed axis in a circular motion. When backlash acceleration adjusted for a circular motion is applied to a right-angled motion, backlash acceleration may cause excessive compensation, resulting in overcutting.

2 If the travel distance after the position reverses is very short (very small up-and-down motion), the motion command itself may specify zero during backlash acceleration and backlash acceleration may cause excessive acceleration, resulting in overcutting.

Acceleration monitor for backlash acceleration provides the following two functions to prevent "backlash acceleration due to the change in acceleration at reversal" caused by backlash acceleration and obtain a good machined surface:

"Backlash acceleration amount override by acceleration monitor" (Fig. 5.5.7 (a))
"Backlash acceleration stop by detection of a very small reverse motion" (Fig. 5.5.7 (b))

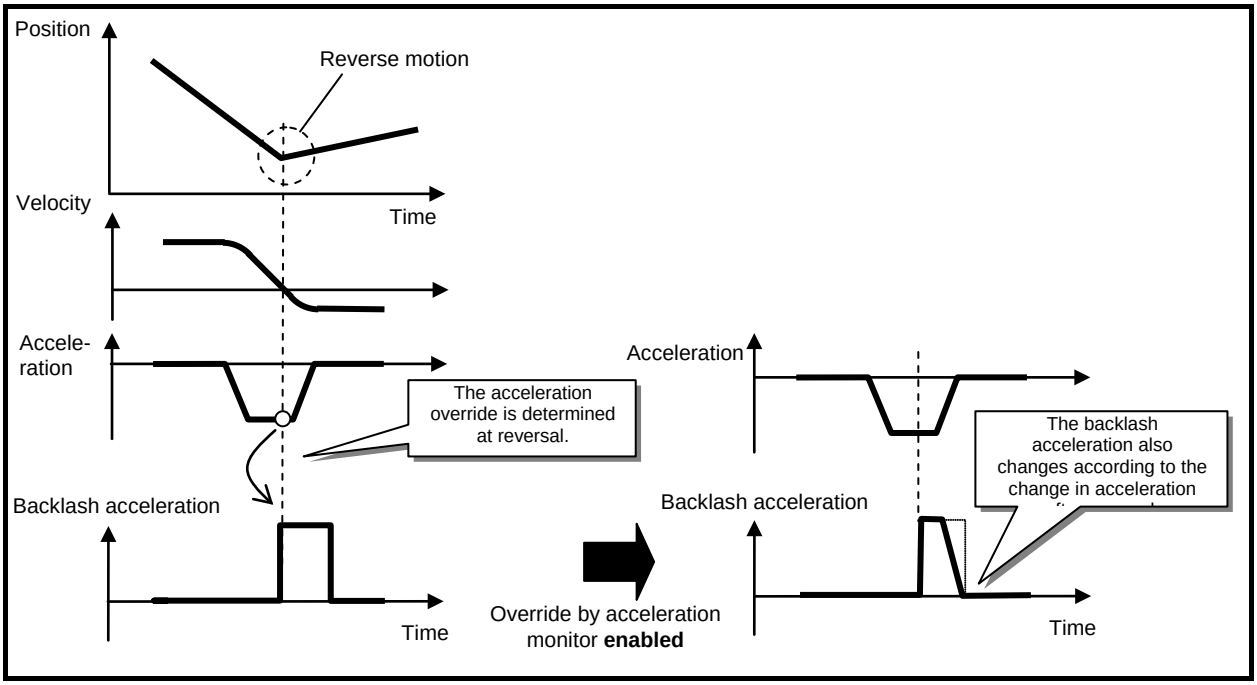


Fig. 5.5.7 (a) Backlash acceleration override by acceleration monitor

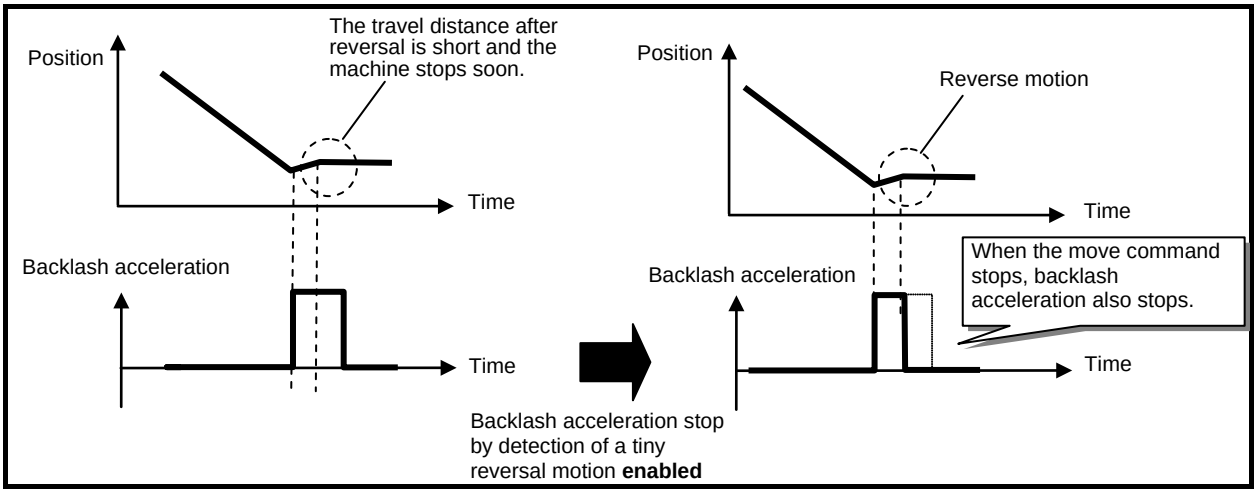


Fig. 5.5.7 (b) Backlash acceleration stop by detection of a tiny reversal motion

(2) Series and editions of applicable servo software

CNC	Servo software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP 90JP	12.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	33.0 and subsequent editions 10.0 and subsequent editions	
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i* Mate-D	90H0	01.0 and subsequent editions	

For the following series and editions, it is possible to increase an insufficient compensation amount to an optimal value as well as reducing excessive compensation due to changes in acceleration before and after reversal, which is done by the conventional acceleration monitor function. These series and editions are referred to as the series and editions that support the improved acceleration monitor.

[Series and editions of servo control software that supports the improved acceleration monitor]

CNC	Servo control software		Remarks
	Series	Edition	
FANUC Series 30*i*/31*i*/32*i*-B Power Motion *i*-A DSA-B	90J0 90JP	10.0 and subsequent editions 04.0 and subsequent editions	
FANUC Series 0*i*-F	90M0 90M8	07.0 and subsequent editions 07.0 and subsequent editions	

[Series and editions of system software that supports the improved acceleration monitor]
See Appendix P.

(3) Parameters

(3.1) Backlash acceleration override by acceleration monitor

	#7	#6	#5	#4	#3	#2	#1	#0
2423	BLOVRF							

BLOVRF(#7) Acceleration monitor is:

1 : Enabled.

0 : Disabled.

Use of acceleration monitor (bit 7 of parameter No. 2423 = 1) is recommended.

	#7	#6	#5	#4	#3	#2	#1	#0
2296	BLOV2							

BLOV2(#7) Backlash acceleration override by acceleration monitor is:

1 : Enabled.

0 : Disabled.

> **NOTE**
> Also set bit 7 (BLOVRF) of parameter No. 2423 to 1 to enable the function.
> This function is applied when advanced preview feedforward is enabled. The function is disabled during operations in which advanced preview feedforward is off, including manual feed, PMC axis control, and EGB (electronic gear box).

	#7	#6	#5	#4	#3	#2	#1	#0
2694		BLAFTA						

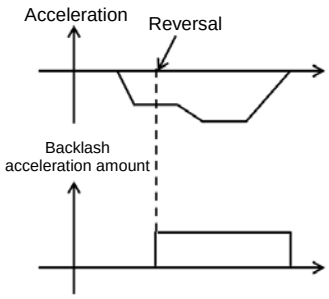
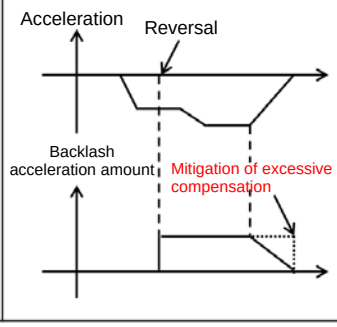
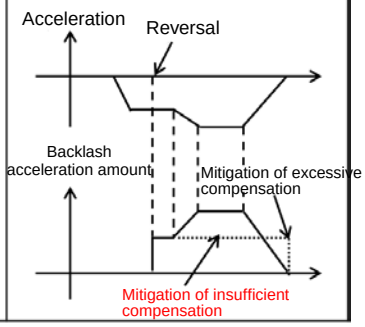
BLAFTA(#6) Backlash acceleration override is calculated:

0: Based on acceleration around reversal (conventional compatibility).

1: Based on acceleration after reversal.

> **NOTE**
> This function is valid only for series and editions that support the improved acceleration monitor.
> To use this function, set BLAFTA to 1 and then set backlash acceleration override. When this function is used, backlash acceleration override by the conventional acceleration monitor is invalid. (Bit 7 of No. 2296 is ignored.)
> This function is also valid with two-stage backlash acceleration (Type-1 and Type-2) and protrusion compensation for Tuning Navigator.

Example of operation

Acceleration monitor for backlash acceleration (No.2423#7, No.2296#7)	Disabled	Enabled	Disabled/ Enabled
Improved acceleration monitor for backlash acceleration (No.2694#6)	Disabled	Disabled	Enabled
Overview of operation			

(3.2) Backlash acceleration stop by detection of a tiny reversal motion

	#7	#6	#5	#4	#3	#2	#1	#0
2423	BLOVRF							

BLOVRF(#7) Acceleration monitor is:
1 : Enabled.
0 : Disabled.

	#7	#6	#5	#4	#3	#2	#1	#0
2296		BLSTP2						

BLSTP2(#6) Backlash acceleration stop by detection of a tiny reversal motion is:
1 : Enabled.
0 : Disabled.

2184	Acceleration monitor time

[Unit of data] msec
[Recommended value] Around the value of the time constant of acc./dec. after interpolation (parameter No. 1769)
[Default value] 8 (When a value smaller than 8 is set for parameter No. 2184, 8 msec is internally used.)
[Recommended value] 100

NOTE
Also set bit 7 (BLOVRF) of parameter No. 2423 to 1 to enable the function.
This function is applied when advanced preview feedforward is enabled. The function is disabled during operations in which advanced preview feedforward is off, including manual feed, PMC axis control, and EGB (electronic gear box).

5.5.8 Smart Backlash Compensation (Semi-Closed)

(1) Overview

Smart backlash compensation (semi-closed) compensates for lost motion caused due to elastic deformation of a feed axis using an internal model of a ball screw drive system as shown in Fig. 5.5.8 (a). This function dynamically changes the position compensation according to the load and also changes the compensation timing according to the feedrate, preventing overcutting and improving the precision of motion of the machining point. The function is effective to improve the precision of machines for which it is difficult to realize higher gains for the control loop.

In the example shown in Fig. 5.5.8 (b), while standard backlash compensation generates overcutting as a result, smart backlash compensation (semi-closed) eliminates backlash and overcutting at the same time.

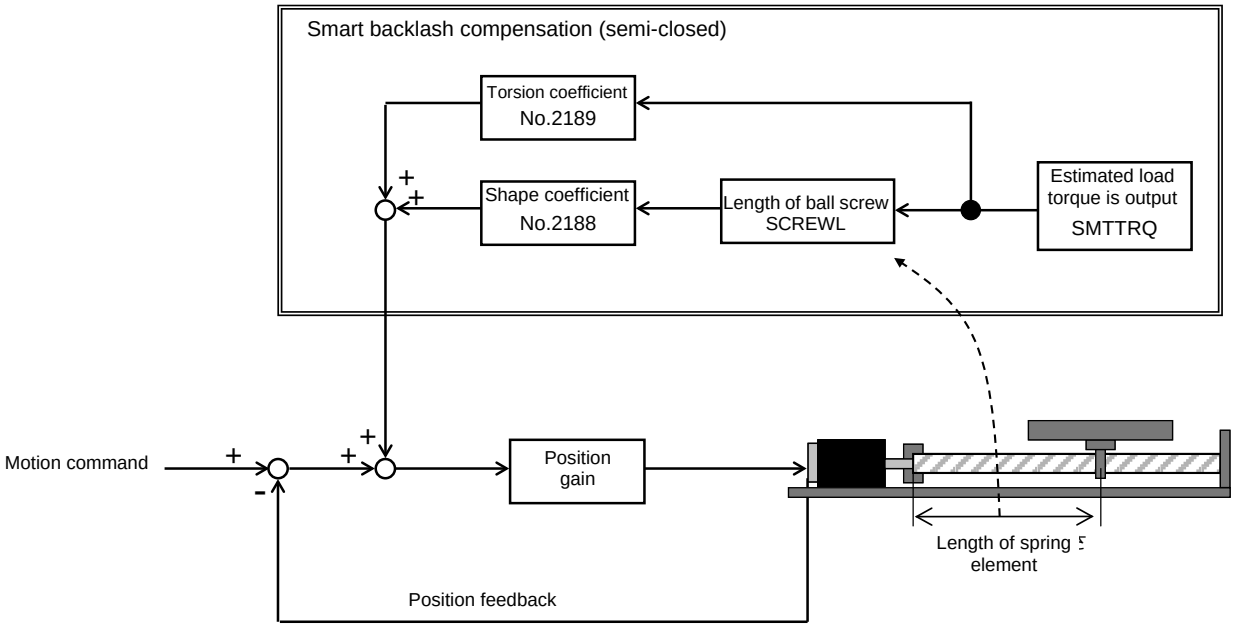


Fig. 5.5.8 (a) Smart backlash compensation (semi-closed)

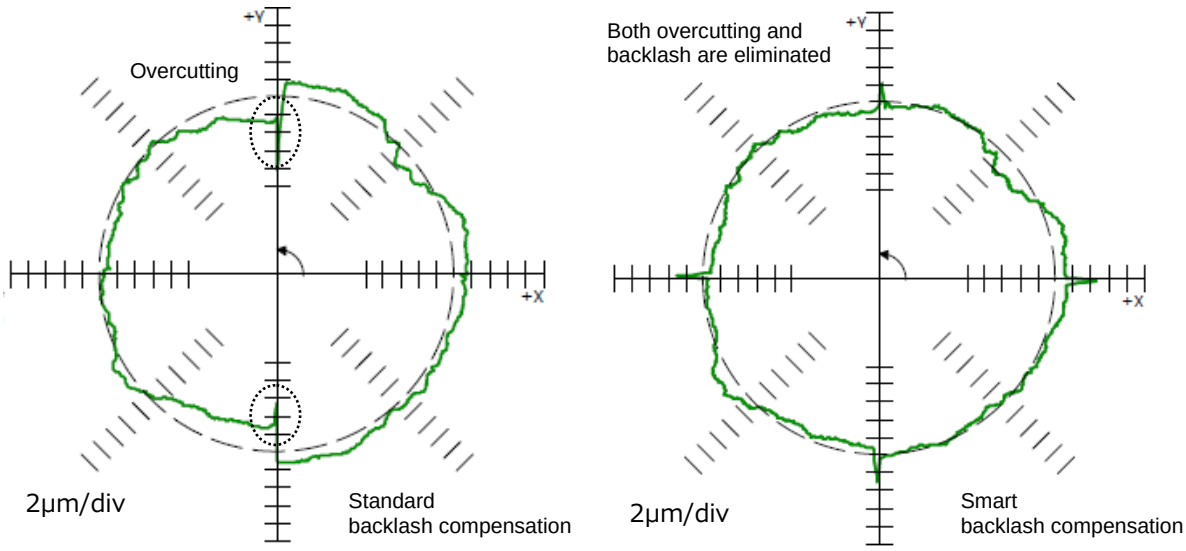


Fig. 5.5.8 (b) Sample effect of smart backlash compensation (semi-closed) (double ball-bar measurement)
(It is also necessary to adjust backlash acceleration additionally for protrusions)

NOTE

Effects of this function cannot directly be checked by observing feedback data with SERVO GUIDE. Be sure to prepare a measuring instrument for measuring the precision of the machining point path. Major measuring instruments are:

- Double ball-bar measurement system (DBB: Renishaw QC20-W, etc.)
- Two-dimensional grid encoder (KGM: Heidenhain KGM 181, etc.)

In this document, a Renishaw double ball-bar measurement (DBB) system is used for tuning as an example.

NOTE: Inch-system detection units not supported.

- Smart backlash compensation (semi-closed) does not support any inch-system detection unit. Use the function with a metric detection unit.
- NC programs can be used in the inch-system mode.

(2) Series and editions of applicable servo software

CNC	Servo software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*	90G0	25.0 and subsequent editions	
	90J0	01.0 and subsequent editions	
	90J0	10.0 and subsequent editions	*1
	90K0	01.0 and subsequent editions	
	90GP	01.0 and subsequent editions	
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90M0	06.0 and subsequent editions	*1
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90M8	06.0 and subsequent editions	*1
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C8	06.0 and subsequent editions	
	90E8	06.0 and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

*1 These series and editions of servo control software support the function for fixing the compensation value with parameter No. 2660. Hereinafter, they are referred to as the series and editions that support the function for fixing the compensation value.

CNC	System software	
	Series	Edition
Series 30*i*/31*i*/32*i*-B	G301, G311, G321, G331, G401, G411 G421, G431, G501, G511	51.0 and subsequent editions
Series 0*i*-F	All series	First and subsequent editions
Series 0*i*-MD/TD	D4F1, D6F1	30.0 and subsequent editions
Series 0*i* Mate- MD/TD	D5F1, D7F1	30.0 and subsequent editions

CNC	SERVO GUIDE edition	Remarks
30*i*-B Series, 0*i* Series	9.10 and subsequent editions	Use is recommended.

Table 5.5.8 (a) Backlash compensation functions

	Standard backlash compensation	Smooth backlash compensation	Smart backlash compensation (semi-closed)
Feature	Fixed compensation	Compensation according to the position	Dynamic compensation according to the position, operation, and load conditions
Controlled by	CNC system	CNC system	Servo software

(3) Parameters

(3.1) Parameters for initialization

2105	Product of the torque constant and maximum current

[Default value] Standard parameter automatically loaded

2061	Rotary motor inertia/linear motor mass

[Unit of data] Rotary motor: 1/(rad/s^2), linear motor: 1/(m/s^2)
[Default value] Standard parameter automatically loaded

$$\text{Rotary motor}: \frac{\sqrt{2} \times \text{motor inertia } [\text{kgm}^2]}{\text{torque constant [Nm/Arms]} \times \text{maximum amplifier current [Ap]}} \times 2^{23}$$

$$\text{Linear motor}: \frac{1}{2\pi} \times \frac{\sqrt{2} \times \text{motor mass [kg]}}{\text{thrust constant [Nm/Arms]} \times \text{maximum amplifier current [Ap]}} \times 2^{23}$$

(3.2) Parameters set in advance according to the machine configuration

2087	Torque offset for vertical axis

[Unit of data] TCMD unit
[Valid data range] -7282 to +7282
[Default value] 0
[Recommended value] Observed TCMD value of the vertical axis in the excited mode

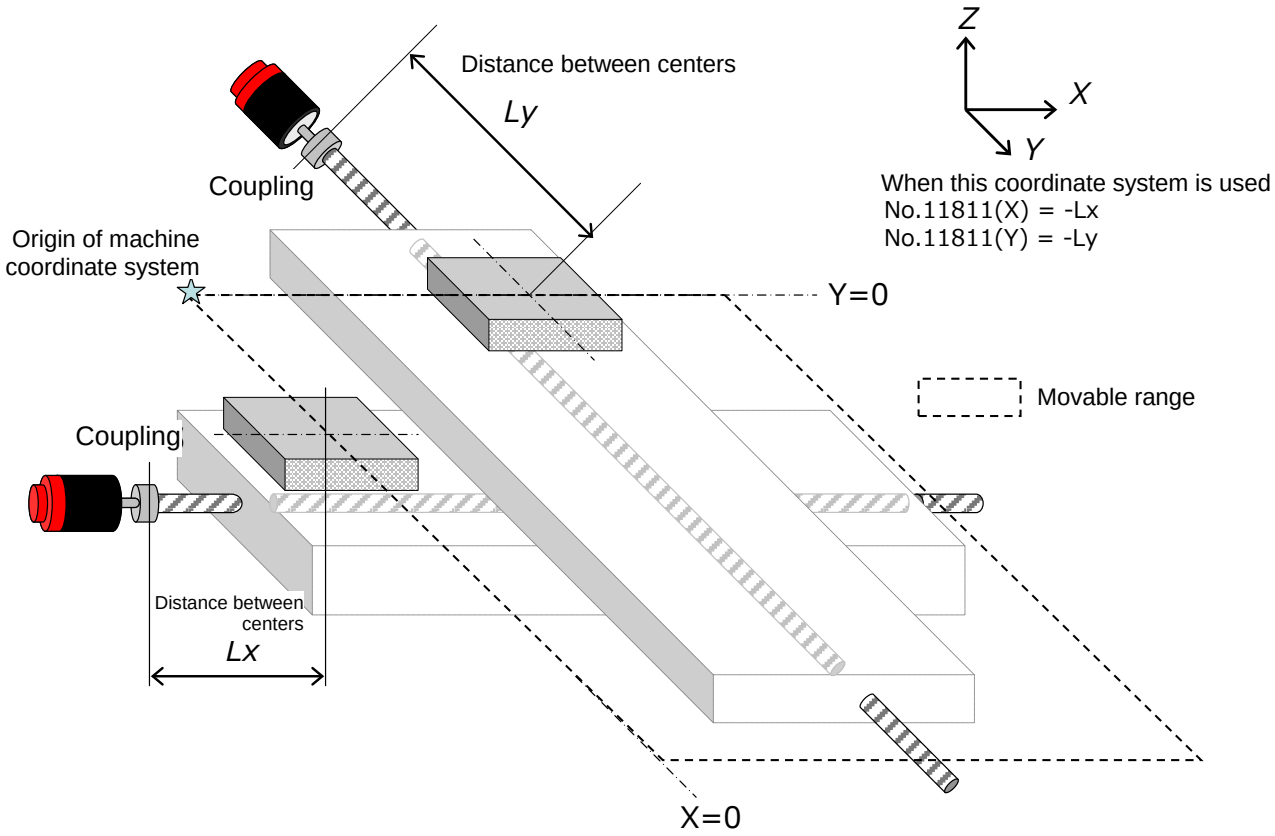
> **NOTE**
> There is no adjustment especially for smart backlash compensation. When the torque offset for vertical axis has already been adjusted, you do not need to readjust it.

2191	Total inertia of drive system

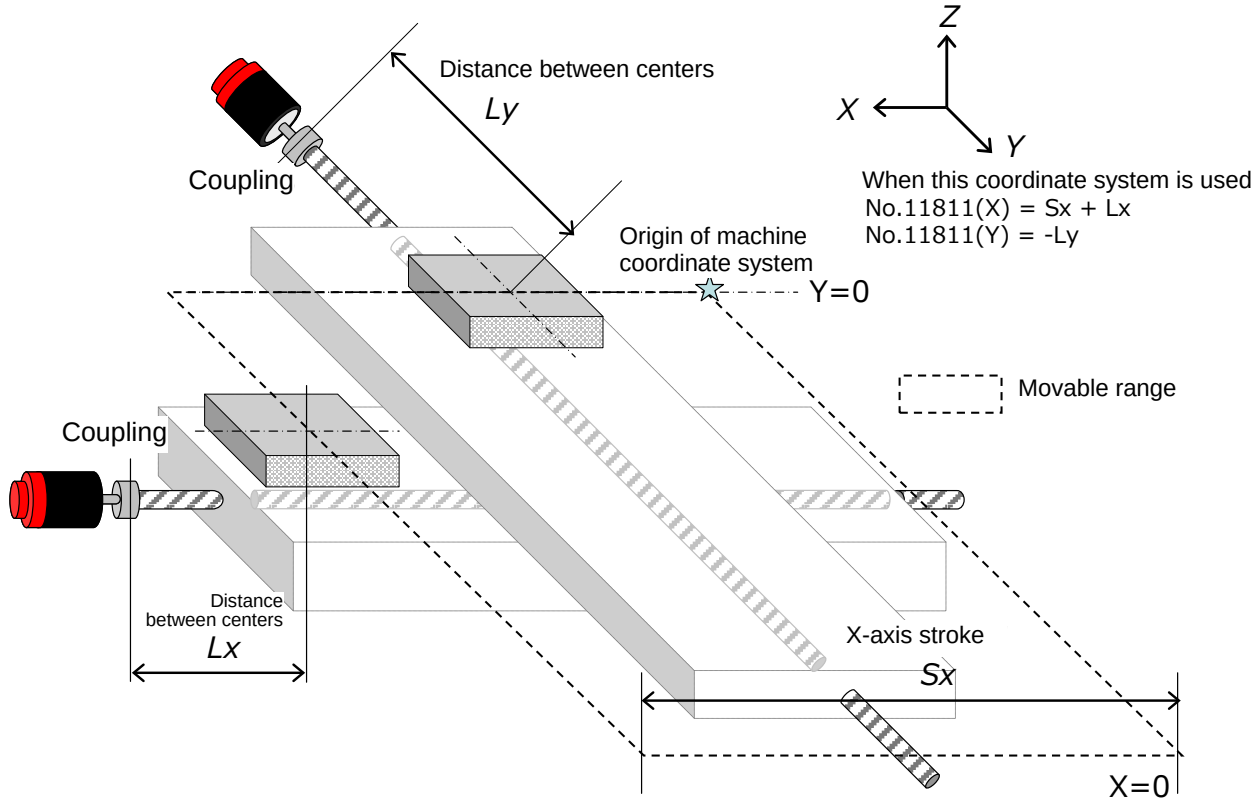
[Unit of data] %
[Valid data range] 0 to 32767
[Default value] 0
[Setting method] Parameter No. 2191 = 100 x (total inertia of drive system including motor)/(motor inertia)
[Recommended value] 100 to 500
[Remarks] If a negative value is set, an invalid parameter alarm (detail No. 1913) is issued. When a value of 0 is set, the acceleration torque is not considered.

11811	Machine coordinate of ball screw-motor coupling

[Unit of data] mm, inch
[Valid data range] -32767 to 32767
[Default value] 0
[Description] Due to the machine structure, the coupling is normally outside the coordinate system that the CNC manages. "Machine coordinate" above means the length of the ball screw in the machinery design. Set this parameter including a sign according to Fig. 5.5.8 (d).



Example: When the motor is located at a negative machine coordinate



Example: When the motor is located at a positive machine coordinate

Fig. 5.5.8 (c) Setting parameter No. 11811

(3.3) Parameters to be set for dual position feedback control

	#7	#6	#5	#4	#3	#2	#1	#0
2206				HBSF				

HBSF(#4) When dual position feedback is used, a compensation value of smart backlash compensation (semi-closed) is added to the error counter:
0: Selected with bit 5 of parameter No. 2010.
1: Of both semi-closed and full-closed sides.

	#7	#6	#5	#4	#3	#2	#1	#0
2010			HBBL					

HBBL(#5) When dual position feedback is used, a compensation value of smart backlash compensation (semi-closed) is added to the error counter:
0: Semi-closed side
1: Full-closed side

(3.4) Tuning parameters

	#7	#6	#5	#4	#3	#2	#1	#0
2216								SMTBKL

SMTBKL(#0) Smart backlash compensation (for semi-closed system) is:
0: Disabled.
1: Enabled.

2188	Shape coefficient for smart backlash compensation (semi-closed)

[Unit of data] 100 mm
[Valid data range] -32768 to 32767
[Default value] 0
[Setting limit value] At least one-tenth of the setting of parameter No. 2105 (Too small of a value may cause vibration.)
When a value of 0 is set, the length dependency is assumed to be 0 for processing.
When the setting of this parameter is large, backlash is considered to strongly depend on the position.

> **NOTE**
> For a rotary axis, position dependency with the shape coefficient cannot be compensated for (compensation is not required).

2189	Torsion coefficient for smart backlash compensation (semi-closed)

[Unit of data] Internal unit (see the parameter window of SERVO GUIDE.)
[Valid data range] 0 to 32767
[Default value] 0
[Recommended value] 1000 to about 5000
A large setting may cause vibration.
For a motor alone with no load, when a value of 1000 is set, the compensation amount is about 1 um.

2190	Compensation limit for smart backlash compensation (semi-closed)

[Unit of data] 0.01 μm (linear axis), 0.01 mdeg (rotary axis)
[Valid data range] 0 to 32767
[Default value] 0
The compensation for smart backlash compensation (semi-closed) is clamped to (0.01 × parameter No. 2190 setting) [μm].

1851	Conventional backlash compensation

[Unit of data] Detection unit
[Valid data range] 0 to 32767
[Recommended value] 0
[Description] Normally, setting is not required. Use this parameter when stick motion (rattling) in addition to lost motion (ball screw elastic deformation) is significant.

2660	Fixed estimated load torque

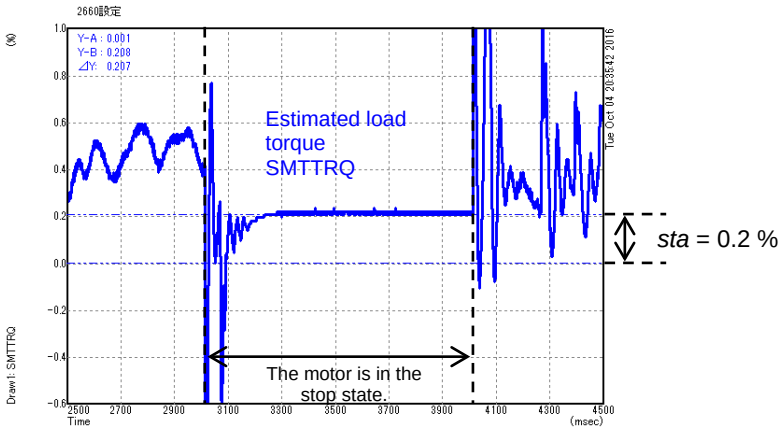
[Valid data range] -32768 to 32767
[Unit of data] TCMD
[Default value] 0
[Description] While cutting feed is stopped or during rapid traverse, the compensation value can be fixed to reduce unstable servo motor operation in the stop state.

NOTE
This function is only valid for series and editions that support the function for fixing the compensation value.
The specifications where parameter No. 2660, the parameter for fixing the estimated load torque, is set to 0 are the same as those of the conventional software.

[Setting procedure]
1) Set parameter No. 2660 to 0 and measure the estimated torque value while the motor is in the stop state *sta* [%].
2) Set the No. 2660 by using the calculation formula below:
No. 2660 = *sta* [%] × 7282 / 100

Setting procedure applied when using the SERVO GUIDE

1) Set bit 0 of parameter No. 2216 to 1 and set the compensation coefficients (Nos. 2188 and 2189) and No. 2660 to 0.
2) Operate the servo motor in the normal direction and then stop it.
3) Measure the estimated load torque in the stop state sta [%] as shown in the figure below.



4) Derive No. 2660 from the equation below:
No. 2660 = 0.2 [%] × 7282 / 100 = 14.56 → 15

Setting procedure applied when not using the SERVO GUIDE

1) Set bit 0 of parameter No. 2216 to 1 and set the compensation coefficients (Nos. 2188 and 2189) and No. 2660 to 0.
2) Operate the servo motor in the normal direction and then stop it.
3) Measure the actual current value while the motor is in the stop state on the Servo setting screen.
4) Calculate the estimated load torque *sta* [%] by using the formula below:

$$\text{Load torque in the stop state } sta\ [\%] = \frac{\text{Continuous current [Arms]} \times \text{Actual current [\%]}}{\text{Maximum amplifier current [Ap]}} \times \sqrt{2}$$

5) Based on the obtained *sta* [%], calculate No. 2660 by using the equation given in "(3) Setting parameters".

(4) Tuning

Step 1: Initial setting

At first, set the parameters listed in Table 5.5.8 (b) before actual tuning. With SERVO GUIDE, it is easy to set these parameters in the parameter window as shown in Fig. 5.5.8 (d).

Table 5.5.8 (b) Setting parameters

Parameter	Setting value	Meaning
No.2061	Standard setting for each motor	Motor inertia
No.2191	Inertia in machine design	Total inertia of drive system including motor
No.11811	Coordinate in machine design	Position of ball screw-motor coupling
No.1851	0	Disables standard backlash compensation.
No.2048	0	Disables backlash acceleration.
No.2189	0	Shape coefficient for smart backlash compensation
No.2190	0	Torsion coefficient for smart backlash compensation
No.2216#0	1 (Enables the function.)	Function bit for smart backlash compensation

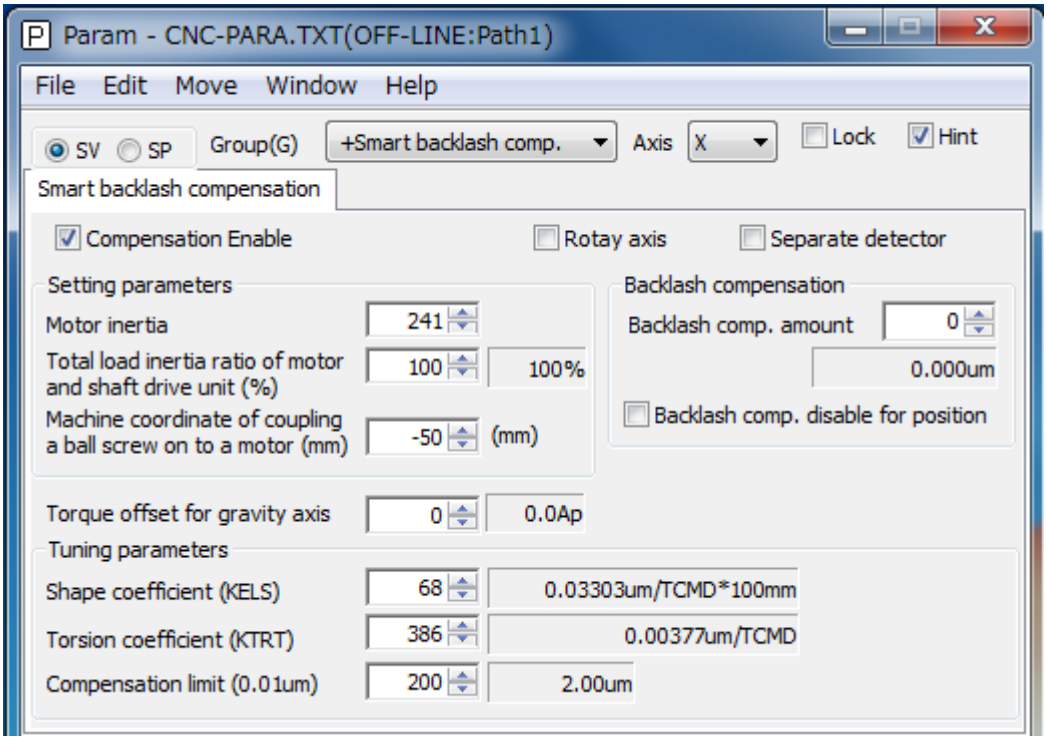


Fig. 5.5.8 (d) Parameter window for smart backlash compensation (semi-closed)

Step 2: Double ball-bar measurement

Perform double ball-bar measurement for the 2-axis circular interpolation motion without any backlash compensation. Measure two kinds of data SCREWL and SMTTRQ on SERVO GUIDE at the same time. Fig. 5.5.8 (e) shows a sample dataset of measurement waveforms. It is advisable to perform double ball-bar and SERVO GUIDE measurements at multiple coordinates to check how much backlash depends on the position.

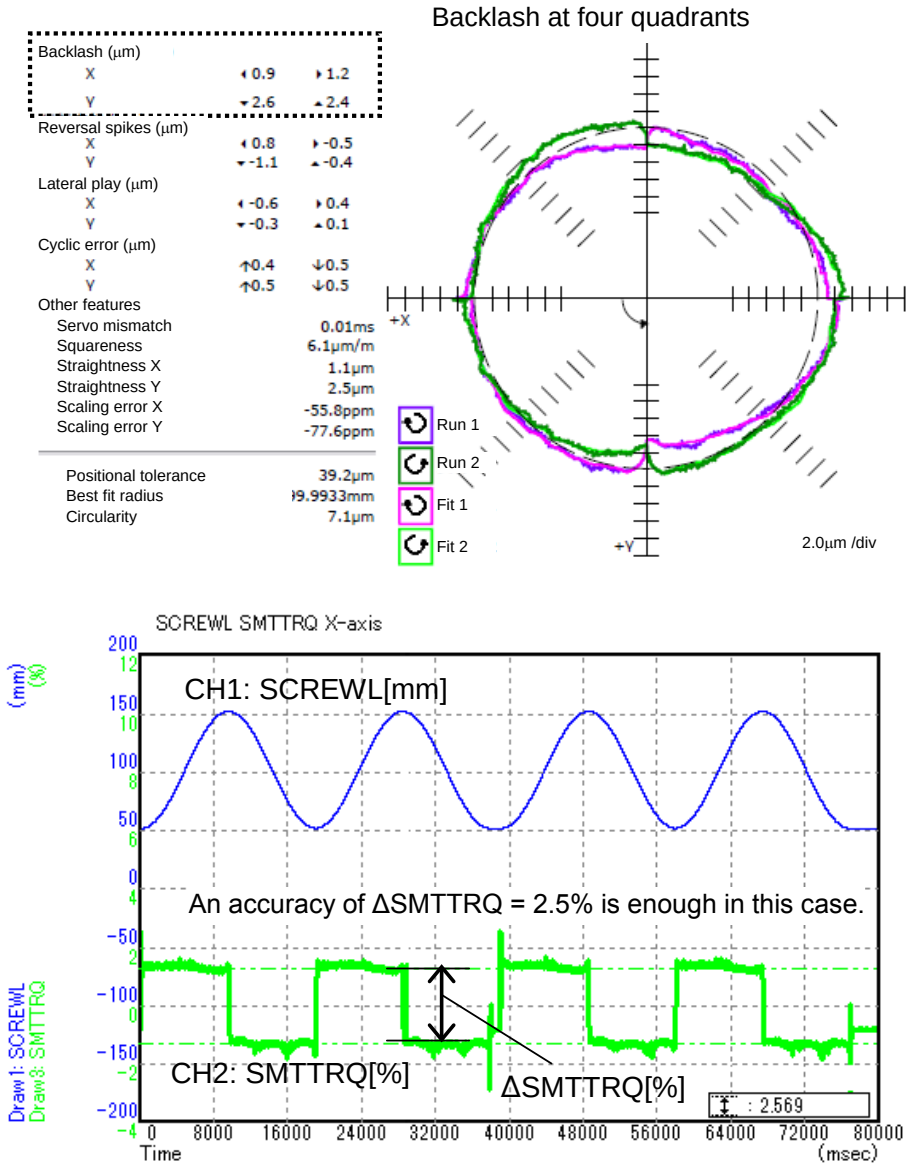


Fig. 5.5.8 (e) Measurement of circular motions with double ball-bar (Renishaw QC-20W) and SERVO GUIDE

Reference: How to specify coordinates for double ball-bar measurements

Fig. 5.5.8 (f) shows an example of machinery. It is expected that backlash depends on the table position especially along the Y-axis. On the other hand, it can be assumed that backlash along the X-axis does not depend on the position. Generally speaking, selecting a coordinate on the diagonal line as shown in Fig.5.5.8 (f, right) is efficient even in this case.

For example, double ball-bar measurements for the two circles A and C would show the position dependency along the Y-axis. Backlash is large for C further away from the motor because the spring element is longer. If backlash along the X-axis is almost the same for circles A and C, the use of the measurement results for circle C is reasonable from the viewpoint of machining accuracy.

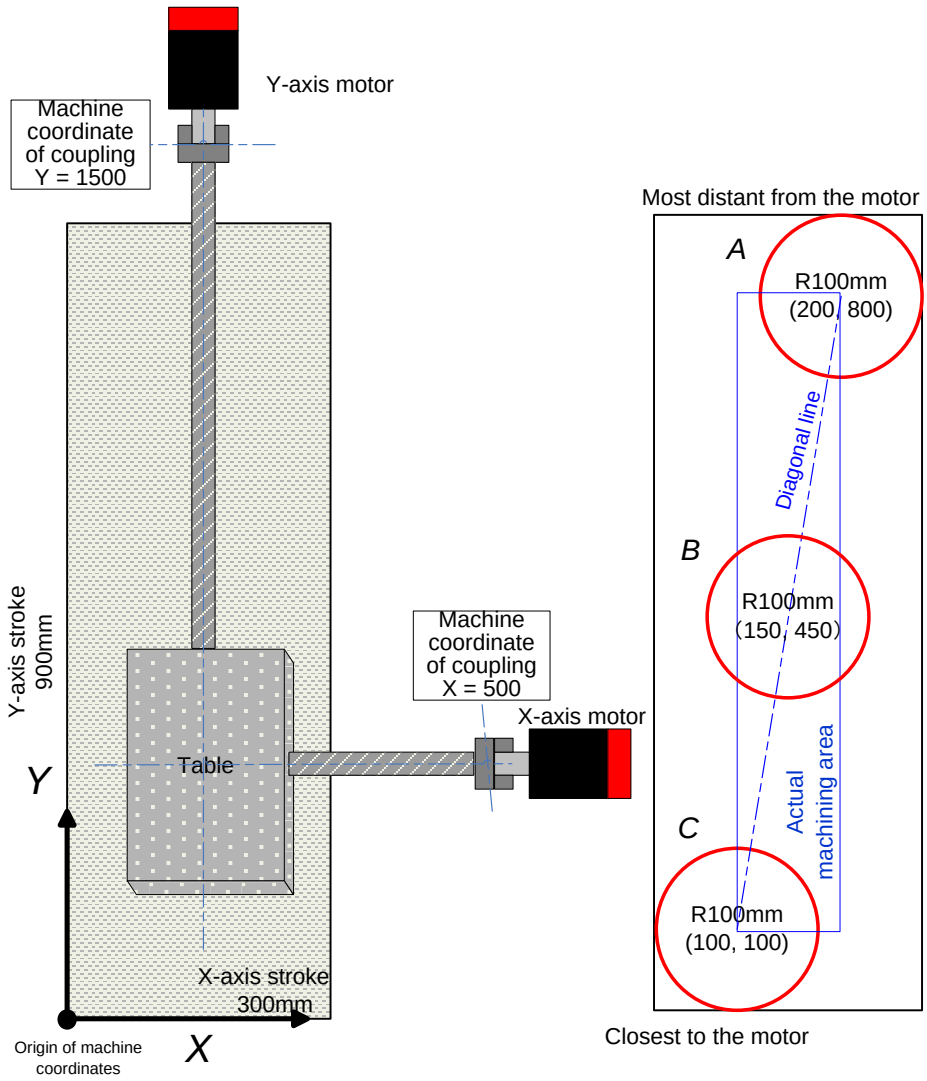


Fig. 5.5.8 (f) Example of machinery having a long and narrow stroke

NOTE

For a rotary axis, another method is used for measuring backlash. When backlash is assumed to be independent of the position, it is enough to select one center point and perform double ball-bar measurement. Use this method as simple tuning.

Step 3: Parameter calculation using SERVO GUIDE

In the graph window, you can calculate parameters for smart backlash compensation (semi-closed). In the window shown in Fig. 5.5.8 (g), enter values while checking the illustration indicating the position relationship of the ball screw. For a rotary axis, read the unit of the backlash length μm as mdeg (0.001 deg) and enter values.

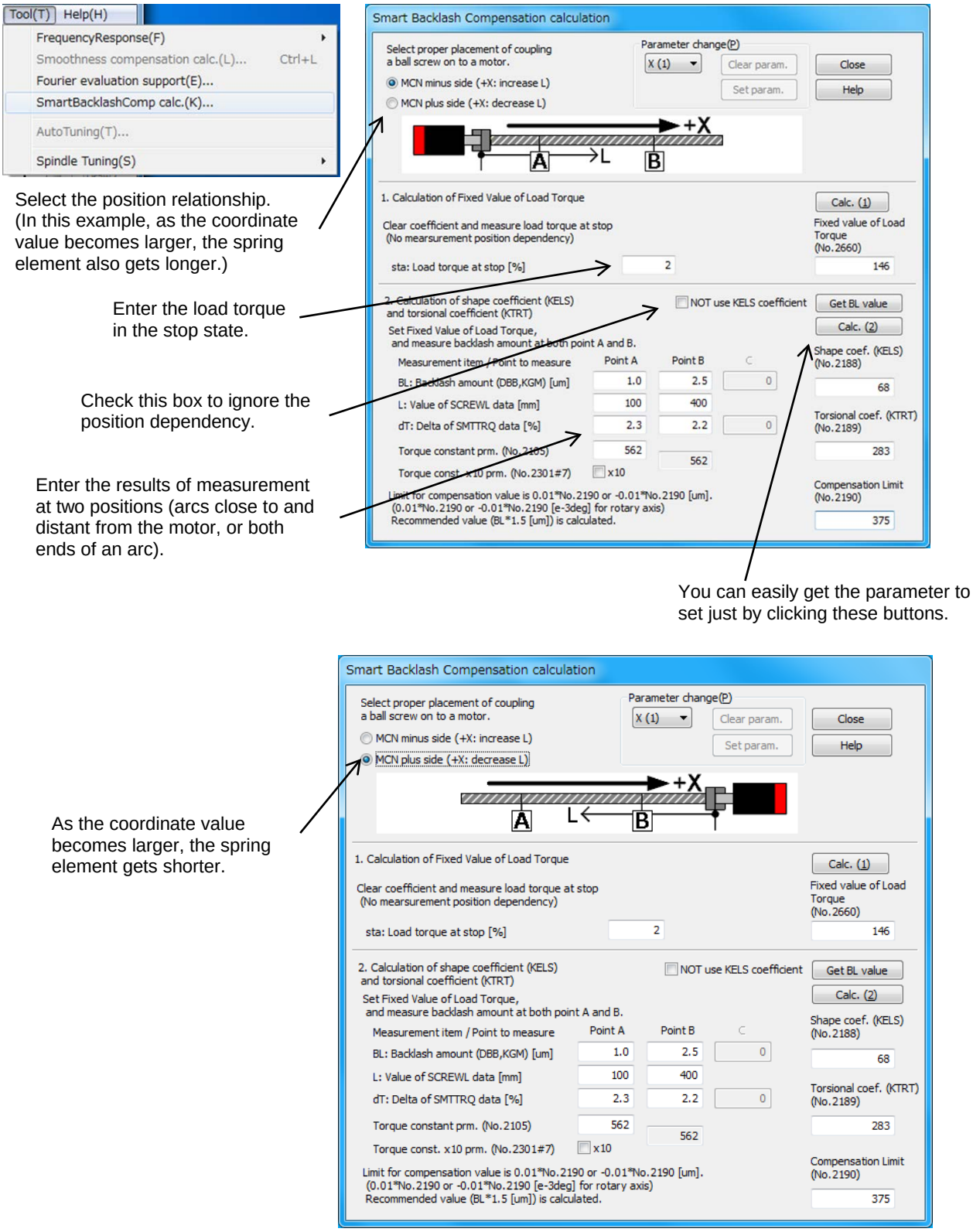


Fig. 5.5.8 (g) SERVO GUIDE tuning support function for smart backlash compensation (semi-closed)

NOTE

The torsion coefficient can be calculated with backlash values measured at one position. If backlash values differ between the ends of a circle, select either of the following methods for tuning:

- Uses the intermediate backlash values between the values at both ends.
- Uses the larger values and uses the smaller backlash value as the compensation value limit (parameter No. 2190).

NOTE: When SERVO GUIDE supporting the tuning support functions is unavailable

Calculate the parameters using the following expressions.

$$\mathrm{No.2188} = \mathrm{No.2105} \times \left| \frac{1}{\mathrm{SCREWL}_A - \mathrm{SCREWL}_B[\mathrm{mm}]} \left(\frac{\mathrm{BL}_A[\mu\mathrm{m}]}{\Delta\mathrm{SMTTRQ}_A[\%]} - \frac{\mathrm{BL}_B[\mu\mathrm{m}]}{\Delta\mathrm{SMTTRQ}_B[\%]} \right) \right|^{-1} \times \frac{2\sqrt{2}}{10^4}$$

$$\mathrm{No.2189} = 1000\sqrt{2} \times \frac{\mathrm{BL}[\mu\mathrm{m\ or\ mdeg}]}{\Delta\mathrm{SMTTRQ}[\%]}$$ (BL: BackLash)

Suffixes A and B indicate measurement positions. Substitute spring element length SCREWL in units of mm, backlash BL in units of μm (mdeg for a rotary axis), and change of torque at reversal ΔSMTTRQ in units of %.
For a rotary axis, assume the value of parameter No. 2188 to be 0 and calculate the value only for parameter No. 2189.

Example 1

Assume that the following measurement results are obtained for a certain linear axis. In this case, the value of parameter No. 2188 can be calculated as follows.

	Point A	Point B
No.2105	562 (α*i* S 8/4000)	
SCREWL	100 mm	400 mm
BL	1 μm (left)	2.5 μm (right)
ΔSMTTRQ	2.3%	2.2%

$$\mathrm{No.2188} = 562 \times \left| \frac{1}{100-400} \left(\frac{1}{2.3} - \frac{2.5}{2.2} \right) \right|^{-1} \times \frac{2\sqrt{2}}{10^4} = 68$$

(The smaller the value is, the stronger the position dependency is.)

Example 2

Assume that the following measurement results are obtained for a certain rotary axis. In this case, the value of parameter No. 2188 can be calculated as follows.

	Center of the stroke
BL	0.24 mdeg (intermediate value between two values)
ΔSMTTRQ	2.7%

$$\mathrm{No.2189} = 1000\sqrt{2} \times \frac{0.24}{2.7} = 126$$

Step 4: Tuning of protrusions

After completion of tuning smart backlash compensation, tune the backlash acceleration. Smart backlash compensation (semi-closed) is useful to eliminate backlash and align circular arc curves. However, this function cannot eliminate protrusions. After smart backlash compensation has been tuned, protrusions clearly remain, which makes the tuning of backlash acceleration easy. Fig. 5.5.8 (h) shows an example of tuning.

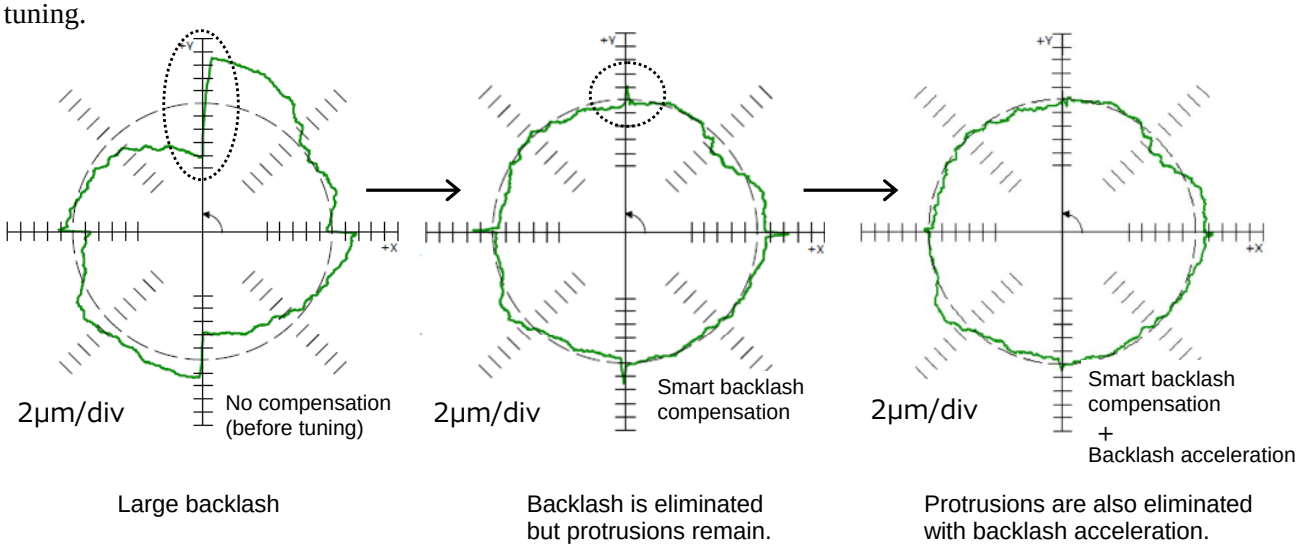


Fig. 5.5.8 (h) Effects of tuning including backlash acceleration

Tips on tuning

Table 5.5.8 (c) lists possible problems with smart backlash compensation (semi-closed) and their solutions. Use them as reference when tuning.

Table5.5.8 (c) Tips on tuning smart backlash compensation (semi-closed)

Problem	Related parameter(s)	Solution
The compensation value is too large and overcutting occurs.(*1)	No.2188, 2189 No.2190	Decrease the shape and torsion coefficients. Set the compensation value limit.
Backlash always occurs regardless of the load torque.	No.1851	Tune standard backlash compensation.
The arc figure is largely deformed.	No.2087	Check the torque offset again.
Double ball-bar measurement is disabled.	No.2188, 2189 No.2190	Set the shape coefficient to 0, a slightly larger torsion coefficient, and the backlash amount to the compensation value limit.(*2)

(*1) You can measure SMTBKL using SERVO GUIDE to check how the compensation value is output.
(*2) This method cannot really be called tuning, but the compensation value limit can be expected to prevent overcutting.

5.5.9 Smart Backlash Compensation (Full-Closed)

(1) Overview

Smart backlash compensation (full-closed) automatically measures the length of backlash between the motor and machine and executes compensation optimum for protrusions for a machine for which full-closed or dual position feedback control is performed. This function improves circularity (or decreases errors) for a machine with large torsion or rattling. The function updates the length of backlash based on position information from the motor sensor (Pulsecoder) and machine sensor (such as a linear scale) every time movement along an axis is made. A control block diagram of this function (Fig. 5.5.9 (a)) and an example of compensating protrusions with this function (Fig. 5.5.9 (b)) are shown below.

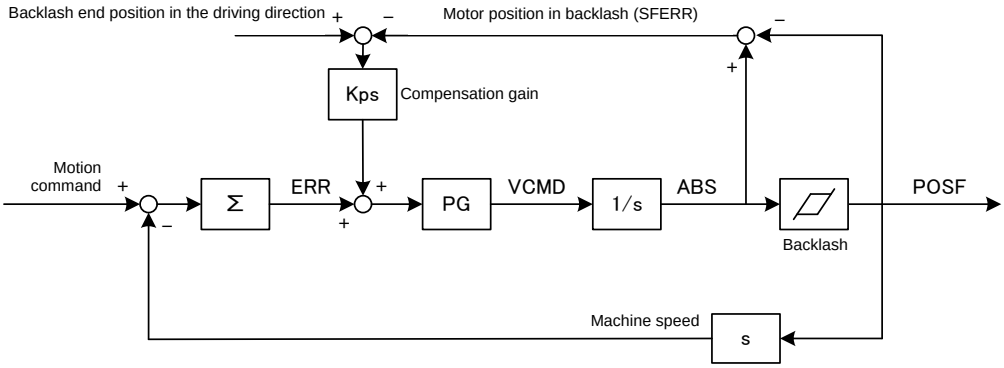


Fig. 5.5.9 (a) Block diagram of smart backlash compensation (full-closed)

Smart backlash compensation (full-closed) feeds back the Semi-Full error (SFERR), which indicates the motor position within backlash, at velocity reversal and reduces the time during which the motor moves within backlash to eliminate protrusions.

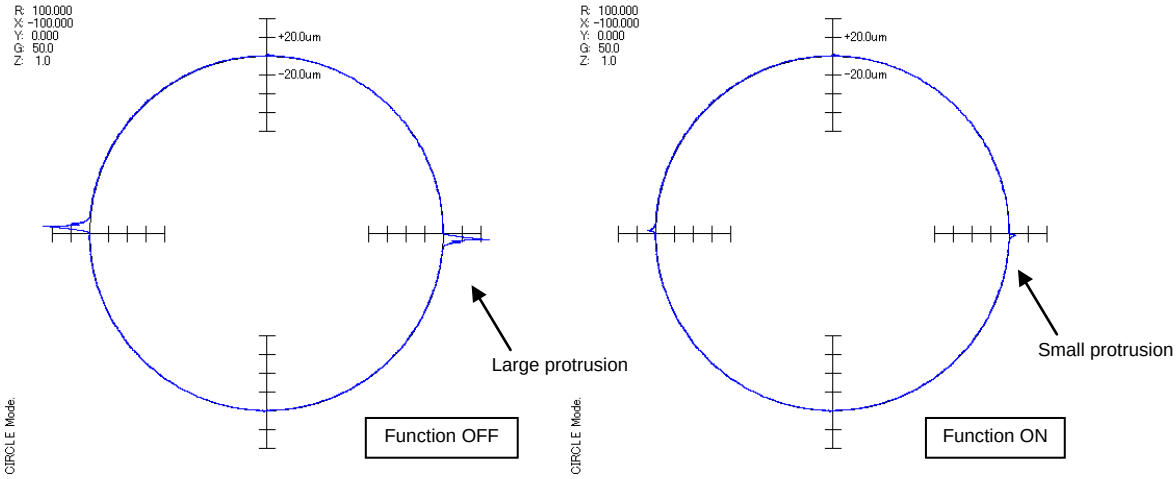


Fig. 5.5.9 (b) Example of applying smart backlash compensation (full-closed)

(2) Series and editions of applicable servo software

CNC	Servo software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90J0	02.0 and subsequent editions	
Power Motion *i*-A	90K0	02.0 and subsequent editions	
Series 0*i*-F	90M0	03.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	03.0 and subsequent editions	
	90L8	01.0 and subsequent editions	

(3) Notes

This function cannot be applied to a semi-closed control axis.
The function cannot be applied to an axis with mechanical slips between the motor and full-closed sensor.
The function is disabled in some modes including reference position return and manual feed.

(4) Setting parameters

(4.1) Parameters for smart backlash compensation (full-closed)

Set bit 2 of parameter No. 2567 (function bit for smart backlash compensation (full-closed)) to 1 (enabled).
For a dual position feedback control axis (bit 7 of parameter No. 2019), set bit 4 of parameter No. 2567 (automatic backlash compensation for the semi-closed side for a dual position feedback machine) to 1 (enabled). When backlash compensation according to the setting of parameter No. 1851 is applied to the dual position feedback axis, set 0 or a very small value for parameter No. 1851.

	#7	#6	#5	#4	#3	#2	#1	#0
2567				SBFSPOS		SBF		

SBF (#2) Smart backlash compensation (for a full-closed system) is:
0: Disabled.
1: Enabled.

Smart backlash compensation (full-closed) automatically measures the length of backlash between the motor and machine and executes optimal compensation for protrusions.

SBFSPOS (#4) Semi-closed loop automatic backlash compensation for dual position feedback is:
0: Disabled.
1: Enabled.
Enable smart backlash compensation (full-closed) (set bit 2 of parameter No. 2567 to 1).
Set the backlash compensation value (parameter No. 1851) to 0 or a very small value.

In parameter No. 2619, set the gain, compensation length ratio, and time during which acceleration is enabled for smart backlash compensation (full-closed).
Carefully set parameter No. 2619 since each of the digit places of the setting have a different meaning.

2619	Time during which acceleration is enabled / compensation length ratio / gain for smart backlash compensation (full-closed)

[Gain for smart backlash compensation (full-closed)]

[Unit] 0.1 times
[Valid data range] 1 to 99 (last two digits of a decimal number)
[Default value] 0

Set the gain of smart backlash compensation (full-closed) in units of 0.1. Until the motor reaches the backlash end in the driving direction, the following Vcmd compensation is applied: Remaining distance to backlash end × 0.1 × setting of parameter No. 2619 (last two digits) × PG

[Compensation length ratio for smart backlash compensation (full-closed)]

[Unit] %
[Valid data range] 0, 100 to 9900 (thousands and hundreds places of a decimal number)
[Default value] 90%*
[Recommended value] 0 or 90 to 99

Generally, set 0 (90%). If overcutting occurs, it may be able to be eliminated by decreasing the gain or compensation length ratio.
If compensation is insufficient, it may be able to become sufficient by increasing the gain or compensation length ratio.
* For the following series and editions, the default compensation length ratio is 100%:
Series 90J0 editions 02.0 to 06.0
Series 90K0 editions 02.0 to 04.0

[Time during which acceleration is enabled for smart backlash compensation (full-closed)]

[Valid data range] 0, 10000, 20000 (ten-thousands place of a decimal number)
Set a value listed in the following table. First, set 0.

Setting	Time during which acceleration is enabled
0	3 × time constant*
10000	5 × time constant
20000	7 × time constant

* The time constant is the reciprocal of (gain for smart backlash compensation (full-closed) × position gain).

(4.2) Related parameters

Smart backlash compensation (full-closed) uses the "Semi-Full error" calculated by the dual position feedback (Subsection 5.4.8) or Semi-Full error monitoring (Subsection 2.1.8) for compensation. Enable either function. Set the following parameters.

	#7	#6	#5	#4	#3	#2	#1	#0
2019	DPFB							

DPFB (#7) 1: Dual position feedback maximum amplitude

2078	Dual position feedback conversion coefficient (numerator)

2079	Dual position feedback conversion coefficient (denominator)

[Setting value] Reduce the following fraction and set the result.

$$\frac{\text{Conversion coefficient (numerator)}}{\text{Conversion coefficient (denominator)}} = \frac{\text{Travel distance per motor revolution [detection unit]}}{1{,}000{,}000}$$

(Example)

When the detection unit is 1 μm and the travel distance per motor revolution is 10 mm (= 10000 μm)

$$\frac{\text{Conversion coefficient (numerator)}}{\text{Conversion coefficient (denominator)}} = \frac{10000\ \text{[detection unit]}}{1{,}000{,}000} = \frac{1}{100}$$

2118	Excessive Semi-Full error level for dual position feedback

[Setting value] Level on which the difference in error is too large (μm)/minimum detection unit (μm/p) for full-closed mode

[Unit of data] Minimum detection unit (μm/p) for full-closed mode

(4.3) Examples

[Example 1 (full-closed axis)]

Full-closed control Bit 1 of parameter No. 1815 = 1
Not dual position feedback controlled Bit 7 of parameter No. 2019 = 0
Enable smart backlash compensation (full-closed) Bit 2 of parameter No. 2567 = 1
Automatic backlash compensation for the semi-closed side for a dual position feedback machine disabled
Bit 4 of parameter No. 2567 = 0
Gain for smart backlash compensation (full-closed): 3.0 × PG Parameter No. 2619 = 30
Compensation length ratio for smart backlash compensation (full-closed): 100%
Time during which acceleration is enabled for smart backlash compensation (full-closed): 3τ

For a full-closed axis for which dual position feedback is not applied, enable the Semi-Full error monitor function. Set the Semi-Full error monitor function according to the machine. In this example, the travel distance per revolution is 10 mm and the detection unit is 0.1 μm for the machine.

Excessive Semi-Full error level: 200 μm No. 2118 = 2000 [detection unit]
Dual position feedback conversion coefficient
A travel distance per motor revolution of 10 mm is equivalent to 100,000 [detection unit].
The dual position feedback conversion coefficient is 100,000/1,000,000 = 1/10.
No. 2078 = 1
No. 2079 = 10

[Example 2 (dual position feedback axis)]
Full-closed control Bit 1 of parameter No. 1815 = 1
Dual position feedback controlled Bit 7 of parameter No. 2019 = 1
Enable smart backlash compensation (full-closed) Bit 2 of parameter No. 2567 = 1
Automatic backlash compensation for the semi-closed side for a dual position feedback machine enabled
Bit 4 of parameter No. 2567 = 1
Gain for smart backlash compensation (full-closed): 2.5 × PG Parameter No. 2619 = 19625
Compensation length ratio for smart backlash compensation (full-closed): 96%
Time during which acceleration is enabled for smart backlash compensation (full-closed): 5τ
Backlash compensation: 0 No. 1851 = 0

(5) Tuning

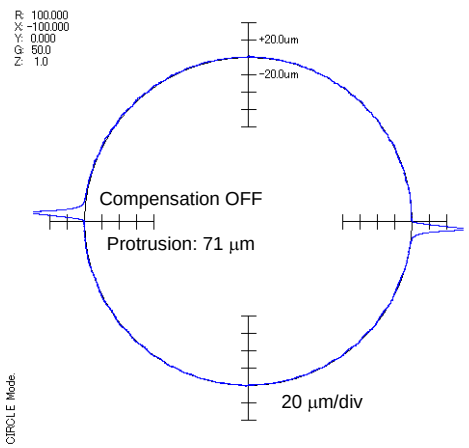
Start tuning from tune 1 for a dual position feedback axis (for which bit 7 of parameter No. 2019 is set to 1) or from tune 2 for a full-closed axis (for which bit 7 of parameter No. 2019 is set to 0).
Before performing this tuning, complete tuning of the position gain.

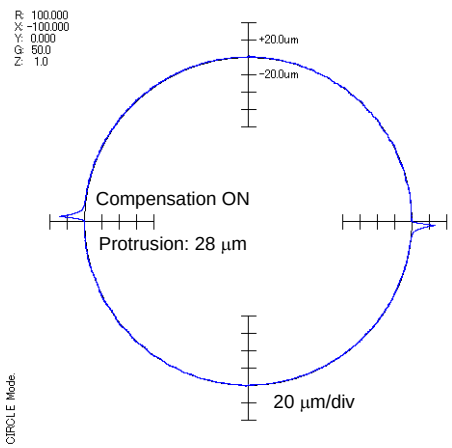
Tune 1 (for dual position feedback axes only)

For a dual position feedback axis, it is advisable to use a subfunction of smart backlash compensation (full-closed) "automatic backlash compensation for the semi-closed side for a dual position feedback machine". Set the parameters as follows:

- Backlash compensation value No. 1851 = 0 or 1
- Smart backlash compensation (full-closed) Bit 2 of parameter No. 2567 = 1
- Automatic backlash compensation for the semi-closed side for a dual position feedback machine Bit 4 of parameter No. 2567 = 1
- Gain and other items for smart backlash compensation No. 2619 = 0

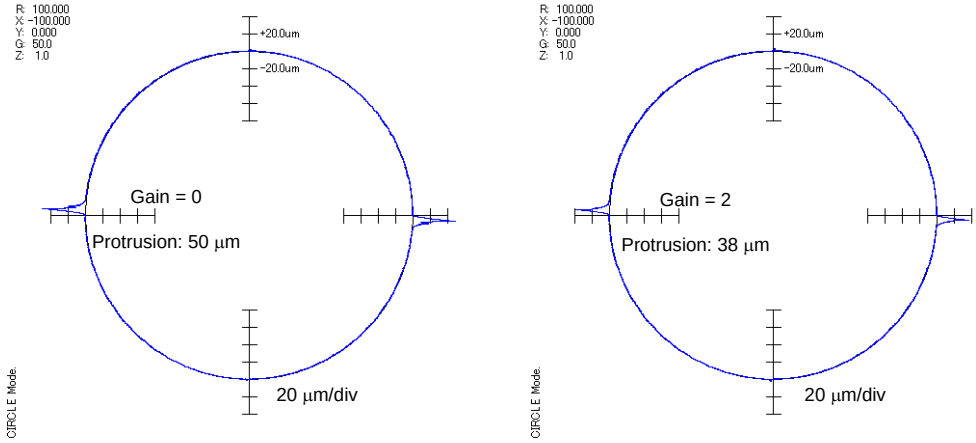
Evaluate automatic backlash compensation for the semi-closed side for a dual position feedback machine (using bit 4 of parameter No. 2567) with a circular motion. Confirm that when this function is enabled, protrusions are reduced.





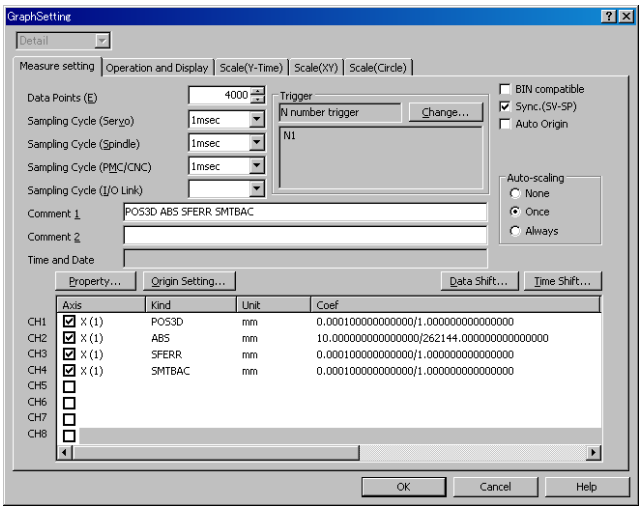
Tune 2 (tune 2 and subsequent steps are common to dual position feedback and full-closed axes)

Enable smart backlash compensation (full-closed) and set the gain to 2 (parameter No. 2619 to 2). Compare the resultant circle with that when the gain is set to 0 (data for full-closed setting is used hereafter, so the size of protrusions differs from that for compensation OFF in tune 1).



To check the time series data, set up SERVO GUIDE.

■ Setting channels (for SERVO GUIDE 9.20 or later and servo software 90J0 and 90K0 04.0 or later)



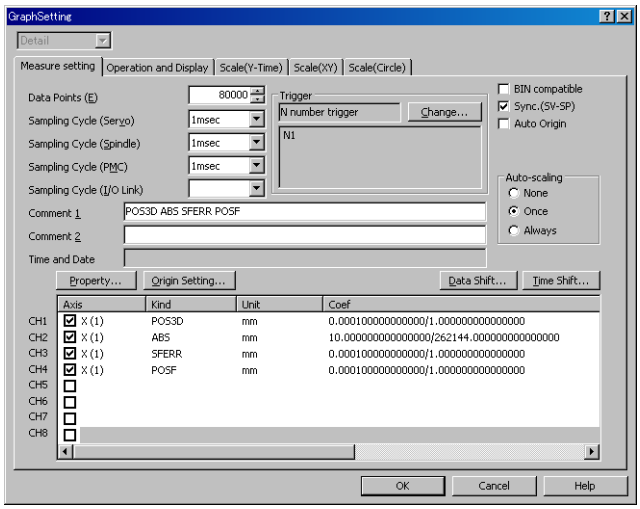
CH1: POS3D (for checking POSF and ERR)

CH2: ABS

CH3: SFERR (motor position in backlash)

CH4: SMTBAC

■ Setting channels (for SERVO GUIDE 9.10 or earlier or servo software 90J0 or 90K0 03.0 or earlier)

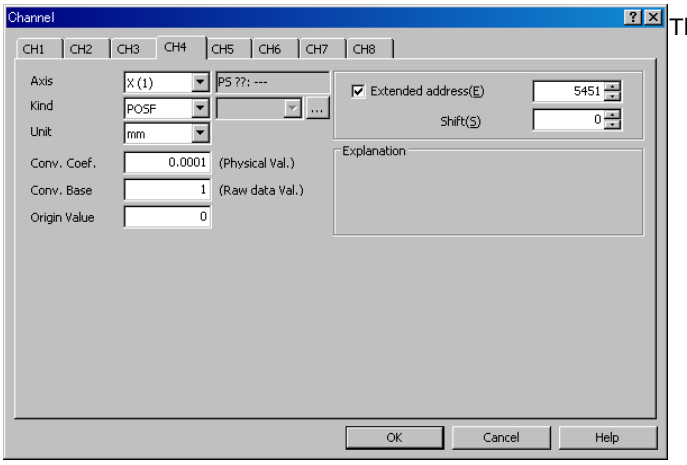


CH1: POS3D (for checking POSF and ERR)

CH2: ABS

CH3: SFERR (motor position in backlash)

CH4: Compensation value



The settings for CH4 are:

Kind: POSF

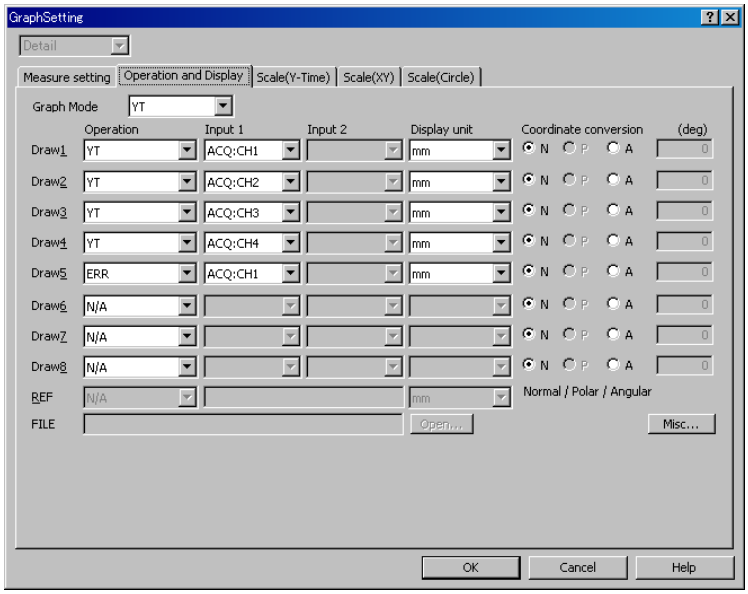
Conv. Coef., Conv. Base: Same as for POSF

Extended address: 1355 + 4096 × mod (parameter No. 1023 = 8)

* mod(x, y) is the remainder after division of x/y.

* The extended address is subject to change without notice.

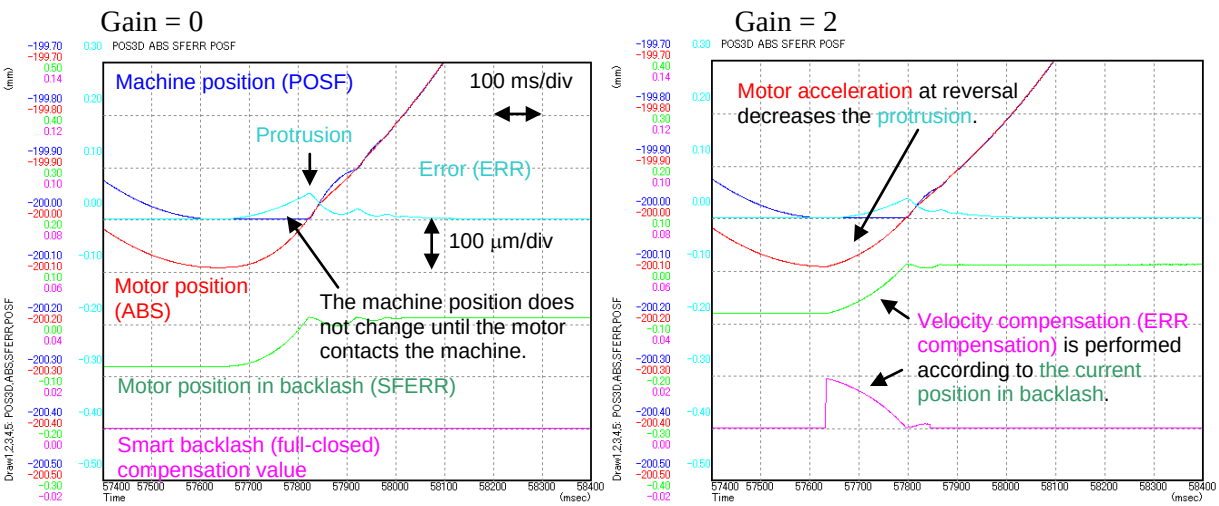
■ Setting display



Display POSF and ERR from POS3D.

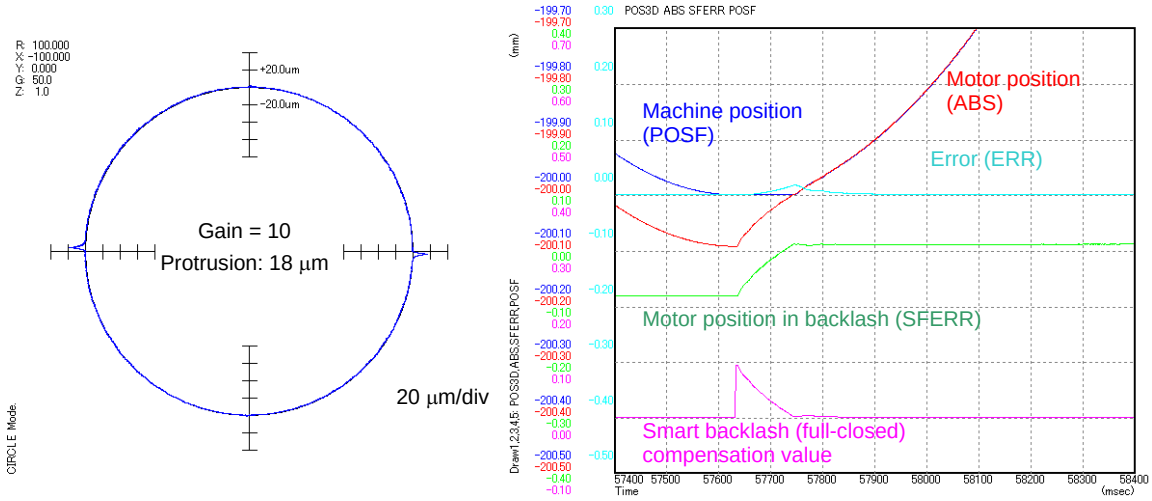
Display YT for each of other channels.

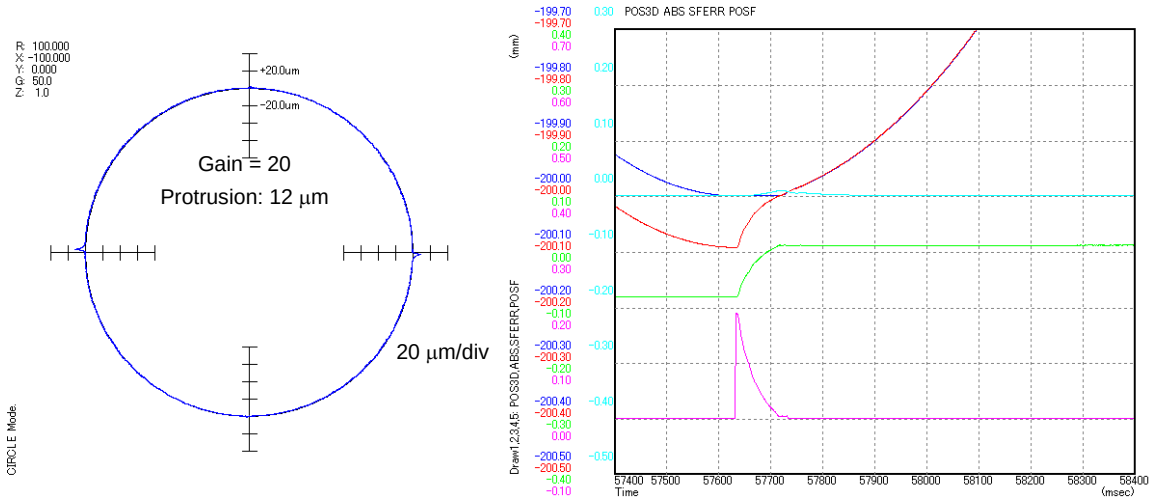
The comparison between time series data when the gain is set to 0 and 2 is shown below.

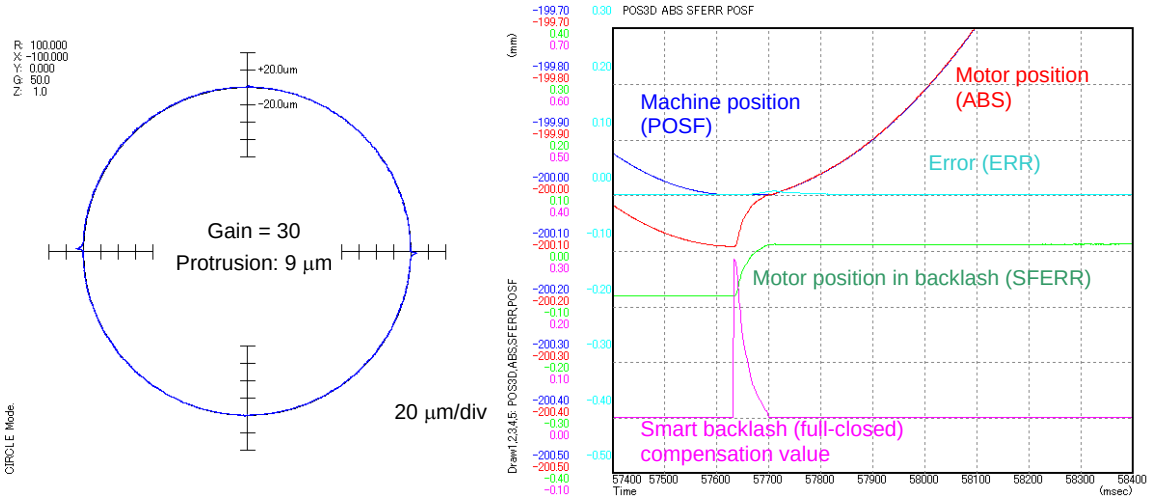


Tune 3

While checking the circular motion and time series data near the velocity reversal, gradually increase the gain.

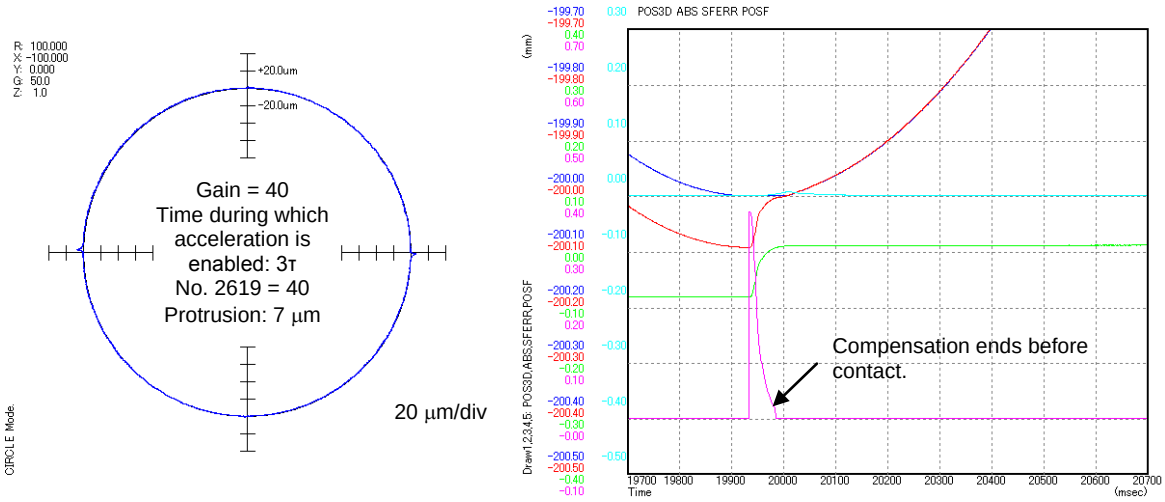


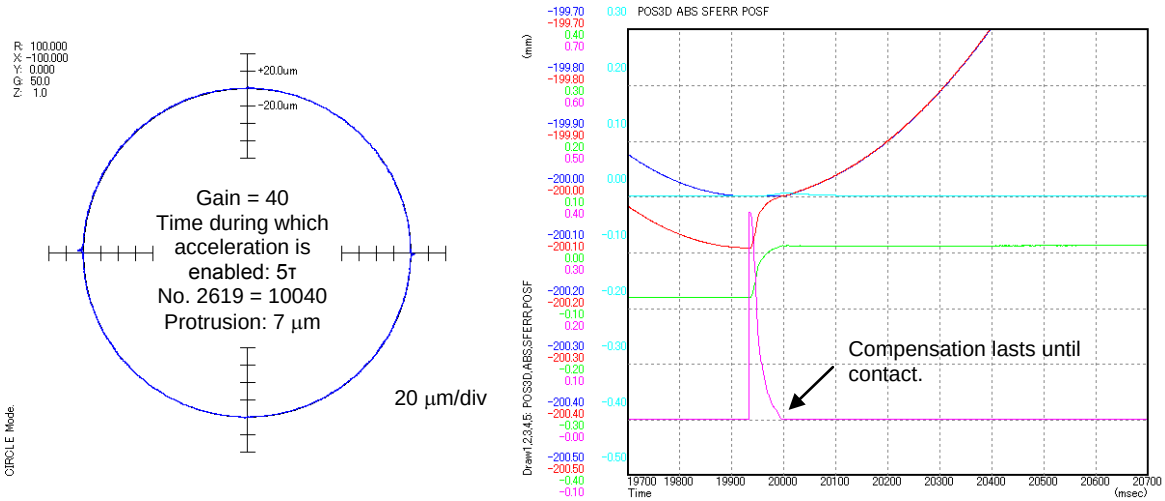


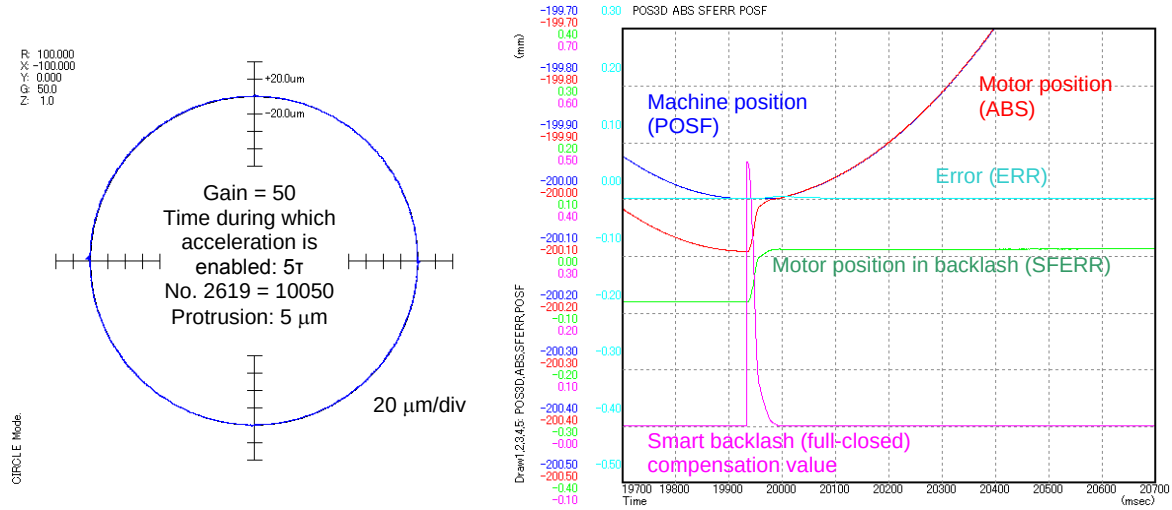


Tune 4

As the gain is increased, the time constant becomes shorter and compensation may end before the motor contacts the machine in the driving direction. In this case, increase the time during which acceleration is enabled (ten-thousands place of parameter No. 2619).

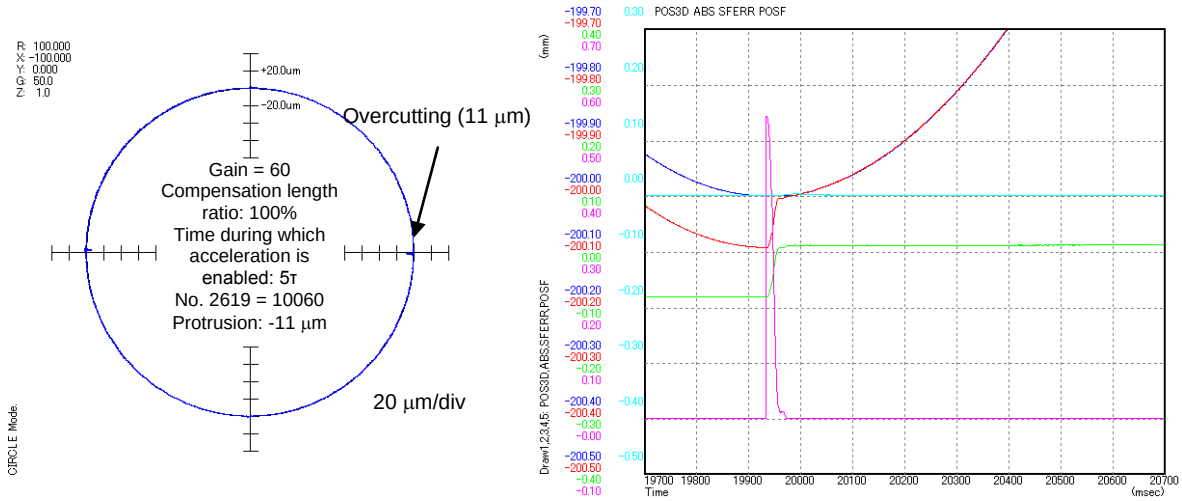


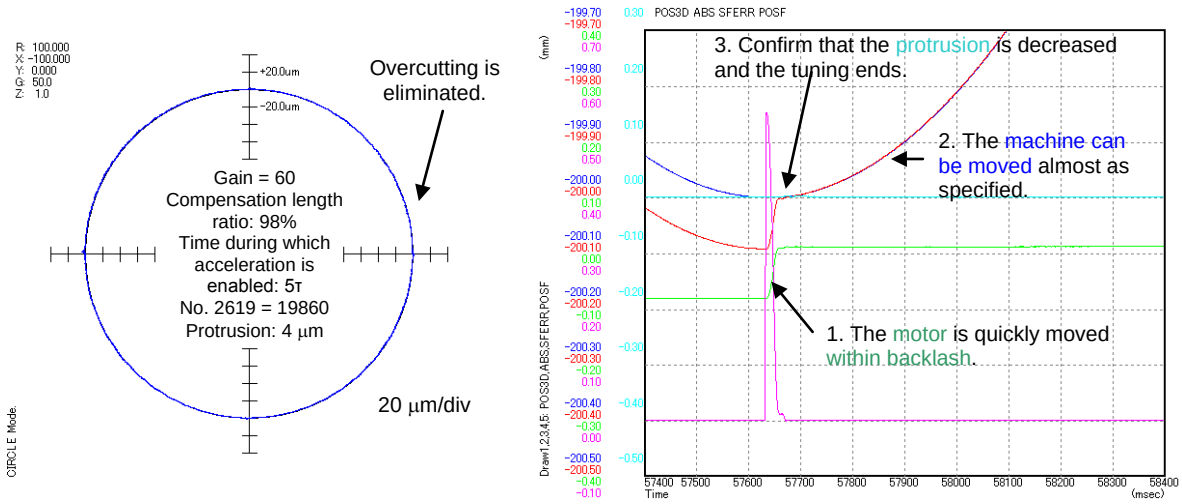




Tune 5

Gain that is too high may generate overcutting. Decrease the gain or compensation length ratio (thousands and hundreds places of parameter No. 2619).





When the sign of the velocity command changes, if the gain increases so that the motor can move within the backlash quickly and the protrusion due to backlash is removed enough, the tuning of this function is complete.

(6) Displaying the backlash amount between the motor and the scale on the diagnosis screen

You can display the measured backlash value on the diagnosis screen (No. 769) when smart backlash compensation (full-closed) is enabled (1 is set to Bit 2 of parameter No. 2567).

[Applicable servo software]

CNC	Servo software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90J0	09.0 and subsequent editions	
Series 0*i*-F	90M0	05.0 and subsequent editions	
	90M8	05.0 and subsequent editions	

Diagnosis 769	Measured backlash value

[Unit] Detection unit
[Range] 0 to 32767

* If you want to only diagnose and display the measured backlash value without performing smart backlash compensation (full-closed), set parameter No. 2619 to 0.
* Measurement of the backlash amount starts after you turn on the CNC and the motor moves in both the positive and negative directions. The diagnosis screen displays 0 until the measurement starts.
* The backlash amount is calculated from the positions of the moving motor and the separate detector.

5.5.10 Static Friction Compensation

(1) Overview

When a machine in the stop state is activated, the increase in speed may be delayed due to static friction. Backlash acceleration (see Subsections 5.5.4 to 5.5.7) performs compensation when the motor rotation is **reversed**. This function reduces the delay at the time of start-up by compensating the velocity command **when the motor starts from the stop state in the same direction as before**.

Table 5.5.10 (a) Difference between the backlash acceleration function and static friction compensation function

Function	Compensation timing
Backlash acceleration	When the motor rotation is reversed (from the plus direction to the minus direction or from the minus direction to the plus direction)
Static friction compensation	When the motor starts from the stop state in the same direction as before (from the plus direction to the plus direction or from the minus direction to the minus direction)

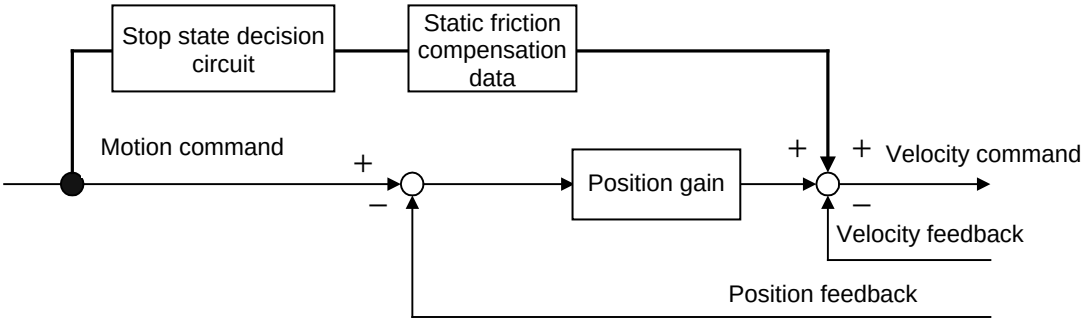


Fig. 5.5.10 (a) Configuration of static friction compensation

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	03.0 and subsequent editions	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(3) Setting parameters

<1> Enable this function.

The processing of the backlash acceleration is used for static friction compensation. Therefore, the following settings are necessary.

	#7	#6	#5	#4	#3	#2	#1	#0
2003			BLEN					

BLEN(#5) Backlash acceleration is:
0: Disabled.
1: Enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
2005	SFCM							

SFCM(#7) Static friction compensation is:
0: Disabled.
1: Enabled.

<2> Set adjustment parameters.

2071	Time during which static friction compensation is enabled (in 2-ms units)

[Valid data range] 0 to 32767
[Recommended value] 10

2072	Static friction compensation amount

[Valid data range] 0 to 32767
[Recommended value] 100
Offset for the velocity command that is to be added at the start of travel from a stopped state

2073	Stop state judgment parameter

[Valid data range] 1 to 32767
[Setting method] Stop determination time = (parameter setting) × Ts
Ts = 4 ms (Series 30*i*), 8 ms (Series 0*i*)
If the machine starts moving after stopping for the time set for this parameter or longer, this compensation function is enabled.

NOTE
1 If a small value is set for the stop state judgment parameter, feed at a low feedrate is regarded by mistake as stop state, and compensation may not be performed correctly. In such a case, increase the setting of this parameter.
2 When static friction compensation is enabled, be sure to set a nonzero positive value for the stop state judgment parameter.

	#7	#6	#5	#4	#3	#2	#1	#0
2009	BLST							

BLST(#7) 1: The function used to release static friction compensation is enabled.

2097	Parameter for stopping static friction compensation

[Valid data range] 0 to 32767
[Recommended value] 5
Parameter related to the distance the tool travels until the end of static friction compensation. Determine the setting by looking at the actual shape.

<3> Set the following parameter to switch the static friction compensation amount depending on the direction of movement.

2347	Static friction compensation (negative direction)

[Valid data range] 0 to 32767
[Recommended value] 100
Speed command offset applied when a movement is started from a stop in the minus (-) direction.

No. 2347	Applied static friction compensation value		Remarks
	Movement in positive direction	Movement in negative direction	
0	No. 2072	No. 2072	Disables direction-by-direction static friction compensation.
Non-zero value	No .2072	No. 2347	Enables direction-by-direction static friction compensation.

5.5.11 Torsion Preview Control

(1) Overview

For relatively large machines having torsion, torsion occurs between the motor and the machine end during acceleration and deceleration. In machines of this type, positional deviation is caused by torsion during acceleration and deceleration.
Torsion preview control compensates the speed command by estimating the amount of torsion from the position command. This reduces the amount of positional deviation during acceleration and deceleration.

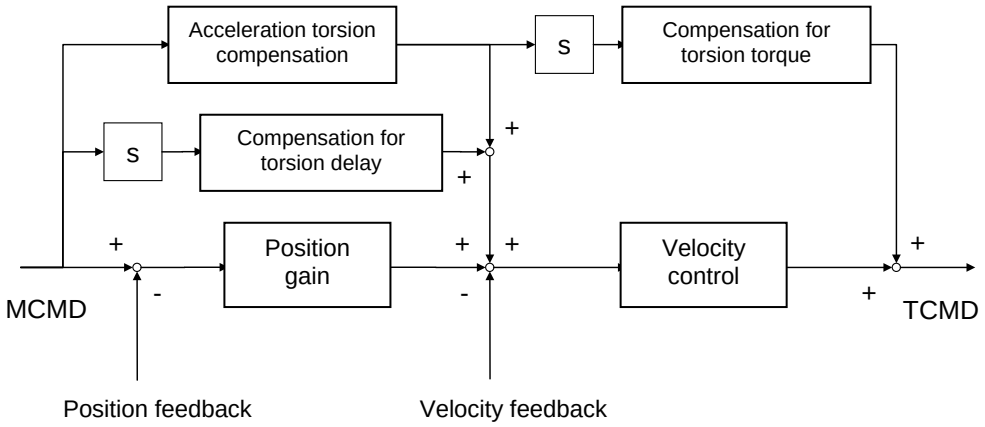


Fig. 5.5.11 (a) Torsion preview control structure

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP 90JP	09.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	M(13) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	M(13) and subsequent editions	HRV4

(3) Notes

- This function is applied when advanced preview feedforward is enabled. It is disabled for manual feed, PMC axis control, etc.
- Because this function requires the user to observe the machine operation at the time of adjustment, a separate detector is needed.
- Adjusting the acceleration/deceleration time constant at the same time is effective to ensure smooth acceleration change. (Example: Bell-shaped acc./dec. before interpolation plus linear-shaped acc./dec. after interpolation).

(4) Setting parameters

<1> Setting feedforward

Torsion preview control uses feedforward processing. Therefore, the following settings are necessary.

	#7	#6	#5	#4	#3	#2	#1	#0
2005							FEED	

FEED(#1) Feed-forward is:
0: Not used.
1: Used.

When also enabling torsion preview control in rapid traverse, set FFR to 1.

	#7	#6	#5	#4	#3	#2	#1	#0
1800					FFR			

FFR(#3) Feedforward control during rapid traverse is:
0: Disabled.
1: Enabled.

Since the compensation value is determined by measuring the error during the adjustment, set the feedforward coefficient to 100% (setting value of 10000).

2092	Advanced preview feedforward coefficient (ADFF1)
2144	Position advanced preview feedforward coefficient for cutting

<2> Operation measurement and time constant setting

To make adjustments, measure the actual speed (differential of POSF) and position error (ERR) using SERVO GUIDE.

When operating the machine at a feedrate of about F10 m/min, check that the following waveform is observed:

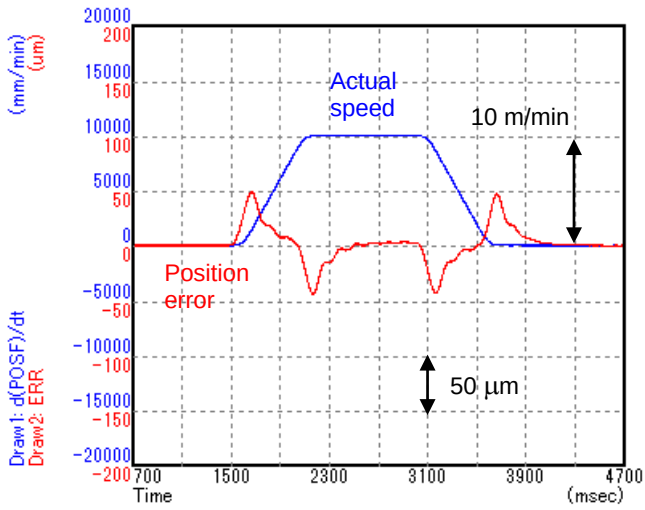


Fig. 5.5.11 (b) Position error and actual speed

In torsion preview control, speed compensation and torque compensation are performed based on the specified acceleration. To prevent shock or vibration due to a large change in acceleration, adjust the acceleration/deceleration parameters for bell-shaped acceleration/deceleration before interpolation and acceleration/deceleration after interpolation (rapid traverse bell-shaped acceleration/deceleration in the case of rapid traverse) in advance. Examples of acceleration settings for a large machine (whose resonance frequency is about 10 Hz) are shown below.

- Time constant of acc./dec. before interpolation: 333 mm/s^2
- Bell-shaped time constant of acc./dec. before interpolation: 200 ms
- Time constant of acc./dec. after interpolation: 100 ms

The use of bell-shaped acceleration/deceleration and acceleration/deceleration after interpolation reduces the change in acceleration, enabling smooth speed compensation and torque compensation. Set the acceleration/deceleration time constants so that significant vibration does not occur in the machine at the time of acceleration/deceleration.

<3> Setting the acceleration

In torsion preview control, three acceleration areas can be specified, and compensation coefficients can be set separately for these areas.

In a machine having the spring characteristic assumed by torsion preview control, the acceleration, torsion amount, and position error are almost proportional to one another. Normally, therefore, it is sufficient to set two kinds of acceleration: one is the acceleration set for acceleration/deceleration before interpolation and the other is about one-half or three-quarters of that acceleration.

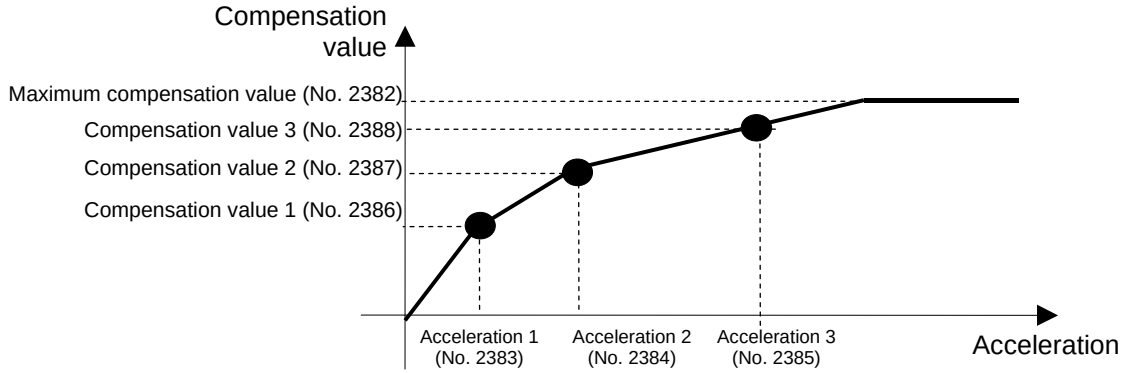


Fig. 5.5.11 (c) Compensation curve of acceleration torsion compensation

2383	**Torsion preview control: acceleration 1**
2384	**Torsion preview control: acceleration 2**
2385	**Torsion preview control: acceleration 3**

[Unit] D × 1000 [mm/s^2] unit (D: detection unit (mm))
[Setting value] 0 to 32767

NOTE
- Set acceleration values so that acceleration 1 is smaller than acceleration 2, and acceleration 2 is smaller than acceleration 3. If acceleration 1 is greater than acceleration 2, the setting of acceleration 2 is ignored.
- If the acceleration is set to 0, the setting is ignored.

<4> Setting the acceleration torsion compensation value

The acceleration torsion compensation value is used to compensate the amount of torsion generated at a constant acceleration. Measure the amount of torsion (position error) generated at a constant acceleration while changing the acceleration setting for acceleration/deceleration before interpolation, and set it for the acceleration torsion compensation value and deceleration torsion compensation value parameters.

2386	Torsion preview control: Acceleration torsion compensation value 1 (positive direction)

[Unit] Detection unit
[Setting value] 0 to 32767
Set the torsion amount generated at acceleration 1.
When 0 is set, compensation is disabled.

2387	Torsion preview control: Acceleration torsion compensation value 2 (positive direction)

[Unit] Detection unit
[Setting value] 0 to 32767
Set the torsion amount generated at acceleration 2.
When this parameter is set to 0, the K1 setting is applied.

2388	Torsion preview control: Acceleration torsion compensation value 3 (positive direction)

[Unit] Detection unit
[Setting value] 0 to 32767
Set the torsion amount generated at acceleration 3.
When this parameter is set to 0, the K2 setting of acceleration 2 is applied.
The compensation values are corrected automatically so that the following is satisfied: K1 ≤ K2 ≤ K3. (See Fig. 5.5.11 (e).)

2391	Torsion preview control: Acceleration torsion compensation value 1 (negative direction)

[Unit] Detection unit
[Setting value] 0 to 32767
Set the amount of torsion generated at acceleration 1 (when the acceleration is a negative value).

2392	Torsion preview control: Acceleration torsion compensation value 2 (negative direction)

[Unit] Detection unit
[Setting value] 0 to 32767
Set the amount of torsion generated at acceleration 2 (when the acceleration is a negative value).

2393	Torsion preview control: Acceleration torsion compensation value 3 (negative direction)

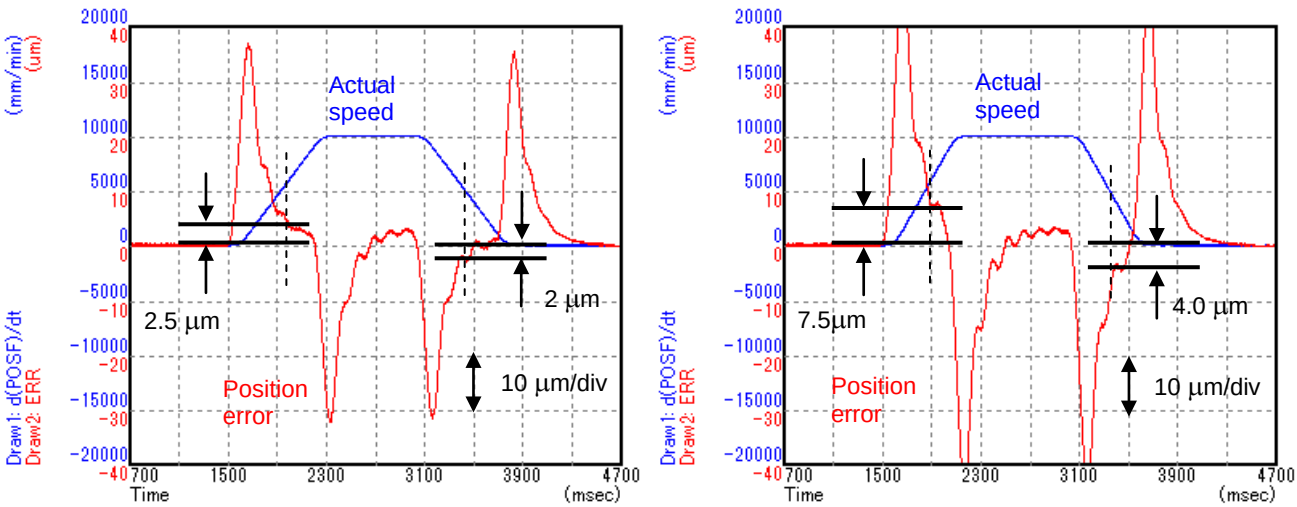
[Unit] Detection unit
[Setting value] 0 to 32767
Set the amount of torsion generated at acceleration 3 (when the acceleration is a negative value).
When this parameter is set to 0, the settings up to acceleration 2 are applied.

NOTE
When none of the three accelerations are used, set the parameter of the unused accelerations to 0.

Fig. 5.5.11 (d) shows examples of measuring the amount of torsion.

- The acceleration of acceleration/deceleration before interpolation is 333.3 mm/s^2. Set this value for acceleration 2.
- For acceleration 1, set 250 mm/s^2, which is smaller than that of acceleration/deceleration before interpolation.
- Acceleration 3 is not used.
- The detection unit is 0.1 μm.
- As a result of the position error waveform measurement, the acceleration setting and acceleration torsion compensation value are determined as shown below.

	Acceleration setting		**Acceleration torsion compensation value (positive direction)**		**Acceleration torsion compensation value (negative direction)**	
	Parameter	Setting value	Parameter	Setting value	Parameter	Setting value
Acceleration 1	No. 2383	2500	No. 2386	25	No. 2391	20
Acceleration 2	No. 2384	3333	No. 2387	75	No. 2392	40
Acceleration 3	No. 2385	0	No. 2388	0	No. 2393	0

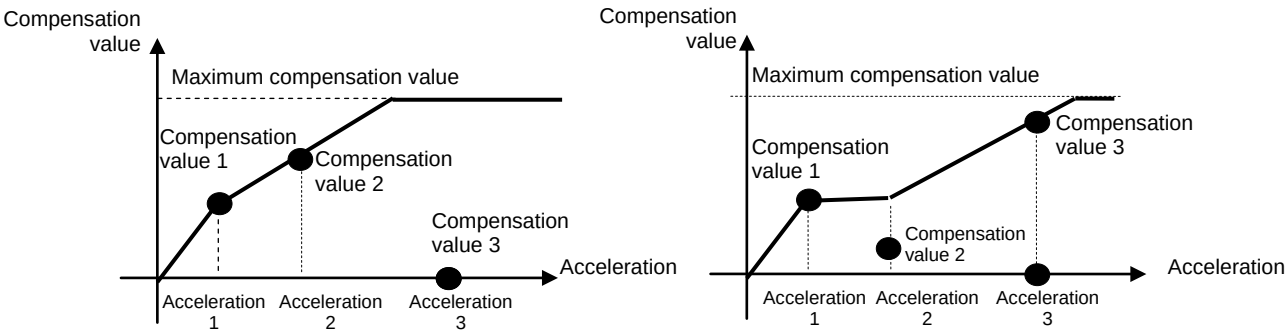


Example of position error measurement at acceleration 1

Example of position error measurement at acceleration 2

Fig. 5.5.11 (d) Determining the acceleration torsion compensation value

The compensation value parameters are automatically corrected to establish the following relationship: compensation value 1 ≤ compensation value 2 ≤ compensation value 3 (Figure 5.5.11 (e)).



When acceleration torsion compensation value 2 = 0

When compensation value 1 > acceleration torsion compensation value 2

Fig. 5.5.11 (e) Automatic correction of the compensation curve

<5> Setting the maximum compensation value (enabling torsion preview control)

2382	Torsion preview control: Maximum compensation value

[Unit] Detection unit
[Setting value] 0 to 1000
[Recommended value] Value about 1.2 to 2 times as large as the maximum position error

Set the maximum value of the compensation value to be added to the velocity command in the detection unit. By setting the parameter to a value greater than 0, torsion preview control is enabled.

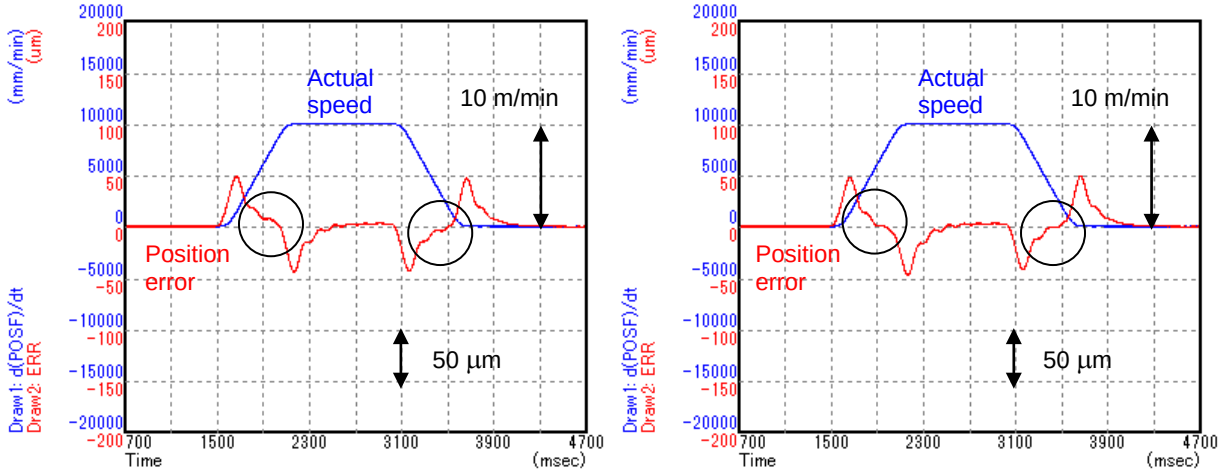


Fig. 5.5.11 (f) Effect of acceleration torsion compensation

<6> Setting the torsion delay compensation value

The torsion amount generated at the start of acc./dec. due to delay in velocity control cannot be corrected with just the acceleration torsion compensation value; therefore a position error remains. Adjust the torsion delay compensation coefficient while observing the waveform plotted at the time of acc./dec.

2389	Torsion preview control: Torsion delay compensation coefficient

If the delay at the start of acceleration is different from that at the start of deceleration, set a value other than 0 for the following parameter.

2396	Torsion preview control: Torsion delay compensation coefficient (at deceleration)

NOTE

When parameter No. 2396 is set to 0, the value set for parameter No. 2389 is used as the torsion delay compensation value for both acceleration and deceleration.

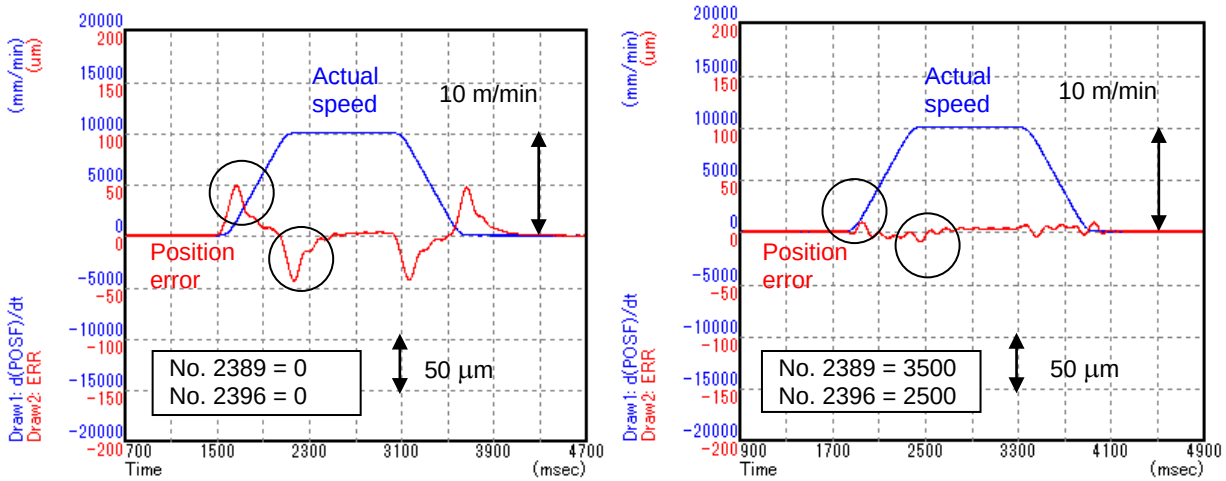


Fig. 5.5.11 (g) Example of effect of compensation for torsion delay

<7> Setting the torsion torque compensation coefficient

Torsion torque compensation is set when an adequate velocity loop gain cannot be obtained and acceleration torsion compensation does not work efficiently. The delay in velocity control can be compensated by adding the differential of the compensation value to TCMD.

2402	Torsion preview control: Torsion torque compensation coefficient

[Unit] %

[Setting value] 0 to 1000

Compensation coefficient used when the compensation value of VCMD is differentiated to compensate TCMD. When 100% is set as the compensation coefficient for TCMD, the acceleration amount of the motor itself is indicated.

5.5.12 Overshoot Compensation

(1) Overview

When the motor attempts to stop, it may not be able to stop at the originally specified position and may overshoot, depending on the relationship between the torque command and the moving friction. The overshoot compensation function suppresses overshoot when the motor stops.

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	03.0 and subsequent editions*	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

* When overshoot compensation Type2 is used in the 30*i*-B Series, 90G0/15.0 and subsequent editions are required.

(3) Setting parameters

	#7	#6	#5	#4	#3	#2	#1	#0
2003		OVSC						

OVSC(#6) Overshoot compensation is:
0: Disabled.
1: Enabled.

2045	Velocity loop incomplete integral gain (PK3V)

[Valid data range] 0 to 32767
[Recommended value] Approximately 25000 to 32000

NOTE

When overshoot compensation is not used (bit 6 of parameter No. 2003 = 0), basically set PK3V to 0.
If incomplete integration is used when bit 6 of parameter No. 2003 = 0, the positional deviation does not become 0 in the stop state or the cutting precision degrades.

2077	Overshoot compensation counter (OSCTP)

[Valid data range] 0 to 32767
[Unit of data] ms
[Recommended value] 20
Set an incomplete integral time.
If the motor overshoots, increase the value in steps of 10. If the motor does not overshoot but is prone to become unsteady when it stops, decrease the value in steps of 10.
When OSCTP is set to 0, an operation equivalent to the normal overshoot compensation is performed.

For overshoot compensation, incomplete integration is performed only when the position error is 0. A machine using a 0.1-μm detection unit, however, has a very short period in which the position error is 0, resulting in a very short time for incomplete integration.
In that case, you can set a range of position error for judging whether to perform overshoot compensation by setting the following parameter.

2101	Overshoot compensation valid level

[Valid data range] 0 to 32767
[Unit of data] Detection unit
[Recommended value] About 1 μm
To specify the valid region for overshoot compensation as shown below, set Δ to the overshoot compensation valid level.

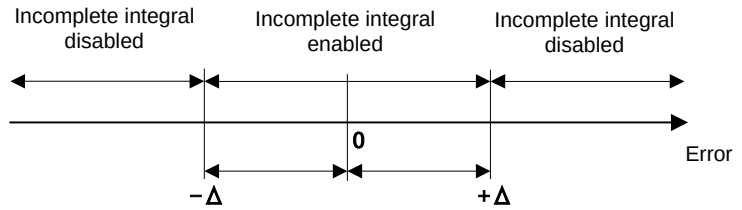


Fig. 5.5.12 (a) Relationship between error and overshoot compensation

(4) Function details

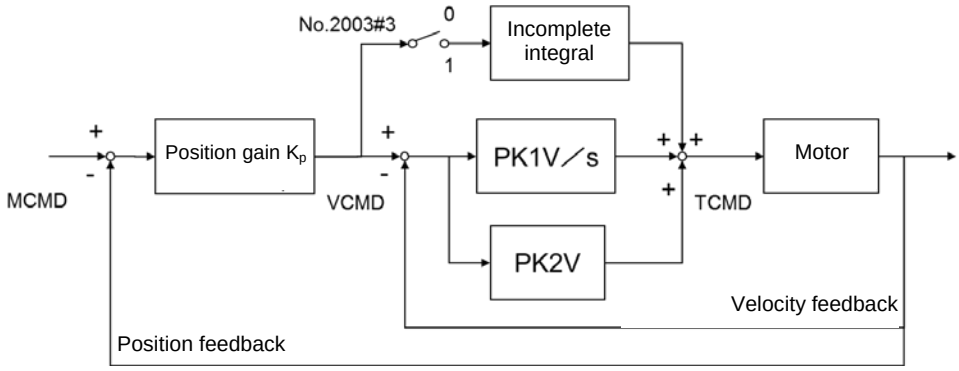


Fig. 5.5.12 (b) Servo system configuration

First, 1–pulse motion command (MCMD) is issued from the NC. Initially, because the Position Feedback and Velocity Feedback are "0", the motion command 1–pulse multiplied position gain K_p value is generated as the velocity command (VCMD). Because the motor will not move immediately due to internal friction and other factors, the value of the integrator is accumulated according to the VCMD. When the value of this integrator creates a torque command (TCMD), large enough to overcome the friction in the machine system, the motor will move and VCMD will become "0" as the value of MCMD and the Position Feedback becomes equal. Since the Velocity Feedback becomes 1 only when the motor moves and returns to 0 the rest of the time, the torque command is maintained. The above situation is shown in Fig. 5.5.12 (c).

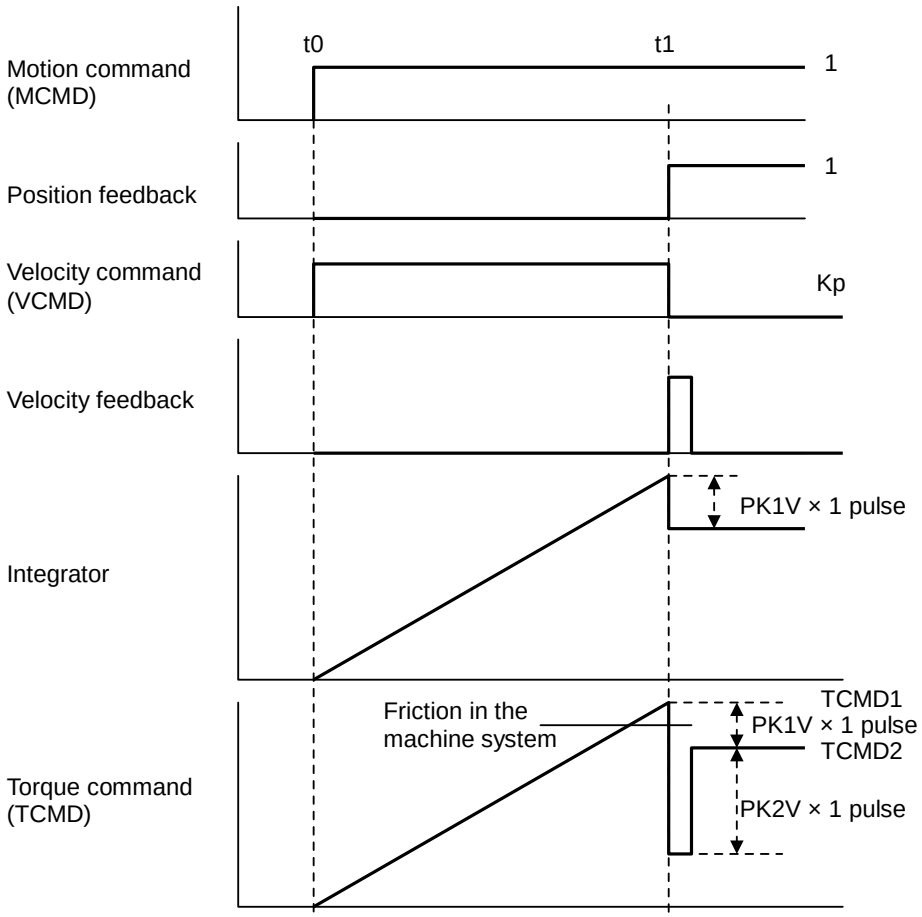


Fig. 5.5.12 (c) Response to 1 pulse movement commands

In Fig. 5.5.12 (c) above, the torque (TCMD1) when movement has started becomes greater than the machine static friction level. The motor will move 1 pulse, and finally stops at the TCMD2 level.
Because the moving frictional power of the machine is smaller than the maximum rest frictional power, if the final torque TCMD2 in Fig. 5.5.12 (c) is smaller than the moving friction level, the motor will stop at the place where it has moved 1 pulse (Fig. 5.5.12 (d)). When the TCMD2 is greater than the moving friction level the motor cannot stop and overshoot will occur (Fig. 5.5.12 (e)).
The overshoot compensation function prevents the occurrence of this phenomenon.

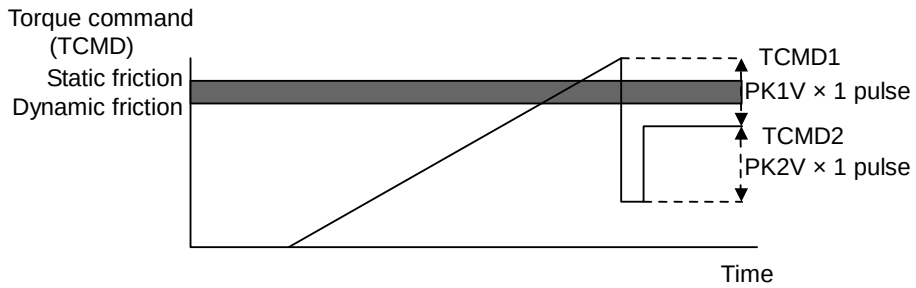


Fig. 5.5.12 (d) Torque commands (when there is no overshoot)

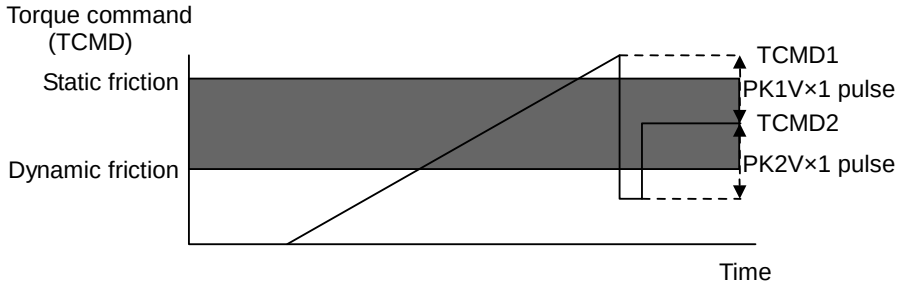


Fig. 5.5.12 (e) Torque commands (during overshoot)

From Figure 5.5.12 (d), the conditions under which overshoot does not occur are as follows:
When
TCMD1 > static friction > dynamic friction > TCMD2…… <1>
and there is a relationship such that
TCMD1 > static friction > TCMD2 > dynamic friction…… <2>
regarding static and dynamic friction like that of Fig. 5.5.12 (e), perform compensation so that <2> becomes <1>.
The torque command status at that time is shown in Fig. 5.5.12 (f).

(Example)	When PK3V = 32000	Time constant approx. 42 msec
	When PK3V = 30000	Time constant approx. 11 msec
	When PK3V = 25000	Time constant approx. 4 msec

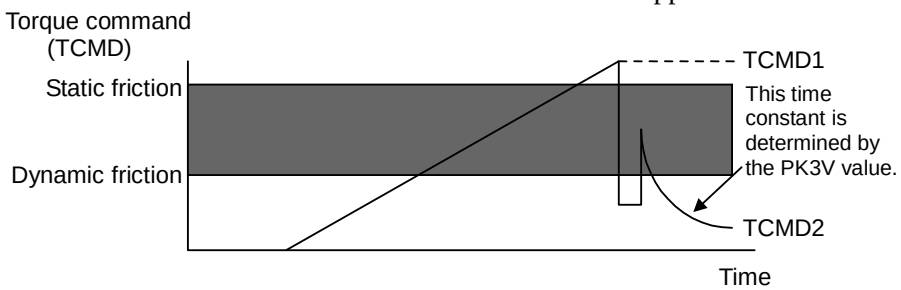


Fig. 5.5.12 (f) Torque command (when overshoot compensation is used)

If overshoot compensation is used, it is possible to prevent overshoot so that the relationship between machine static and dynamic friction and TCMD2 satisfies <1>. However, since torque TCMD2 in the stopped state becomes 0, unsteadiness may occur at ±1 pulse due to insufficient servo rigidity. Such unsteadiness can be prevented by setting the overshoot compensation counter (number of incomplete integrals) (Fig. 5.5.12 (g)).

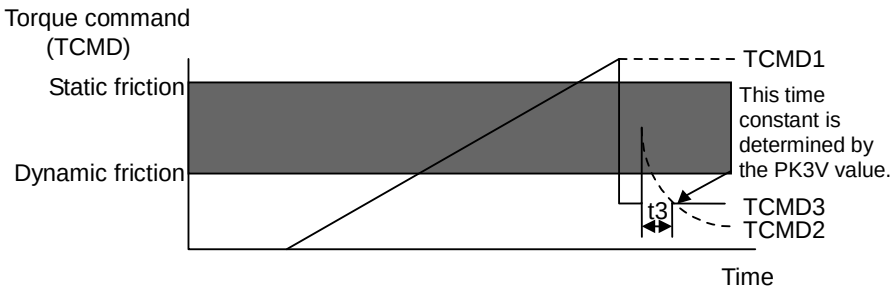


Fig. 5.5.12 (g) Torque command (using overshoot compensation counter)

In this case, the final torque command is TCMD3. If you set PK3V (parameter No. 2045) and OSCTP (parameter No. 2077) so that this value is below the moving friction level, a sufficient torque is maintained in the stopped state, thus preventing overshoot from occurring when the motor stops and reducing unsteadiness.

(5) Overshoot compensation type 2

(a) Overview

If the normal overshoot compensation function is used in a machine whose detection unit is 0.1 μm or so, minute vibrations may occur when the motor stops even if the overshoot compensation counter (parameter No. 2077) is set. This is caused by the repeated occurrence of the following phenomena:

- While the machine is in the stopped state, the position error falls within the compensation valid level, and the integrator is rewritten. Subsequently, the motor is pushed back by a machine element such as a machine spring element, causing the position error to exceed the compensation valid level.
- While the position error is beyond the threshold, a torque command is output to decrease the position error, then it decreases to below the threshold again.

In such a case, minute vibrations can be suppressed by setting the following parameter to enable compensation only once after the termination of a move command.

(b) Setting parameters

	#7	#6	#5	#4	#3	#2	#1	#0
2202					OVS1			

OVS1 (#3) Overshoot compensation is:
0: Always enabled.
1: Enabled only once after the termination of a move command.

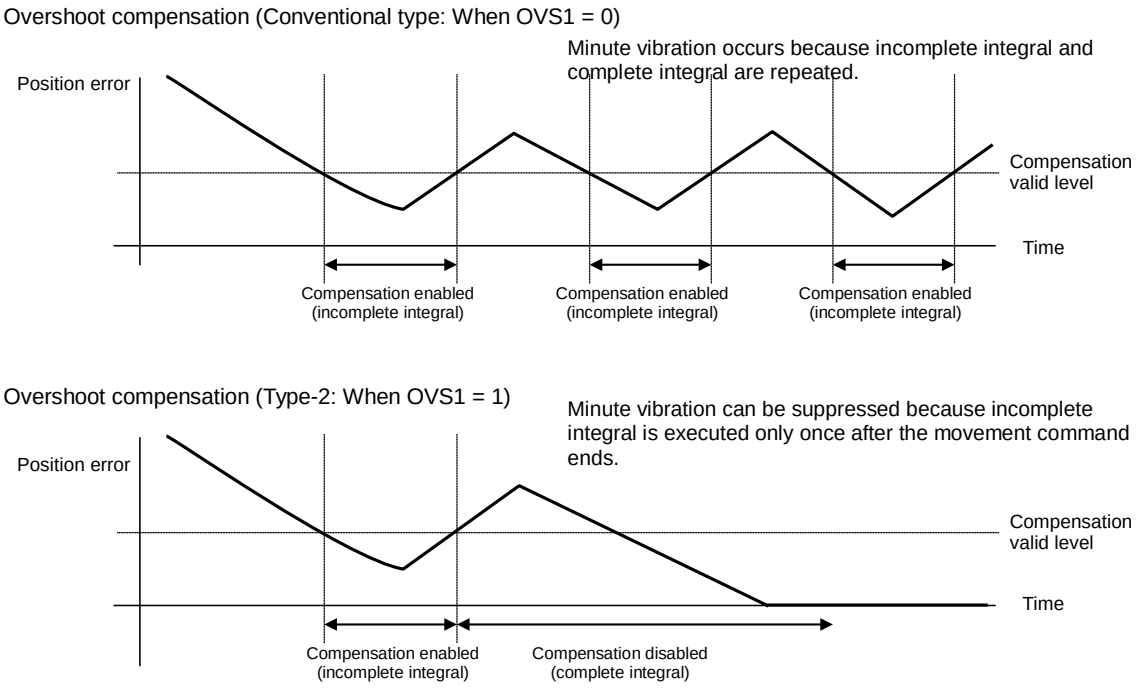


Fig. 5.5.12 (h) Overshoot compensation type 2

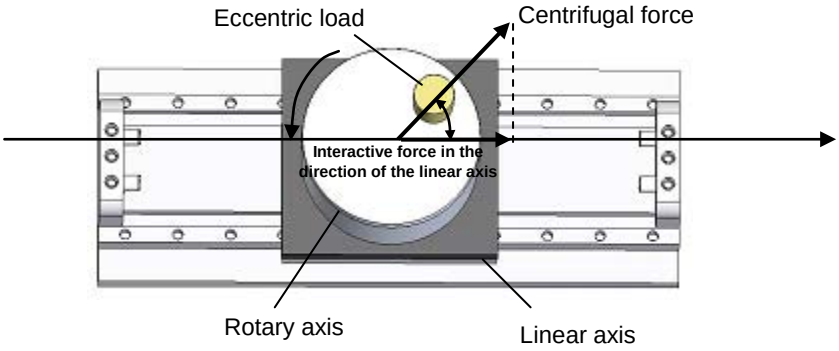
5.5.13 Interactive Force Compensation

(1) Overview

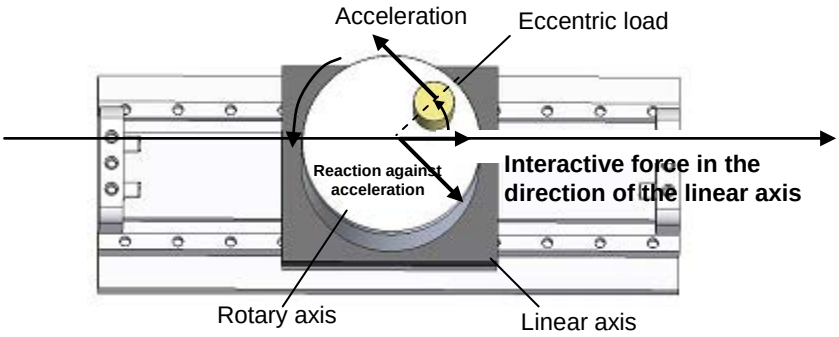
If a rotary axis with an eccentric load is located on a linear axis, an interactive force such as a centrifugal force or reaction force due to acceleration/deceleration is applied to the linear axis when a motion is made on the rotary axis. Similarly, an interactive force is applied to the rotary axis due to acceleration/deceleration on the linear axis.

The interactive force compensation function achieves more accurate position control by compensating the interactive forces in servo control software and canceling their influences. This function is useful for enabling machine tools such as 5-axis machine tools to perform higher-speed and higher-precision machining.

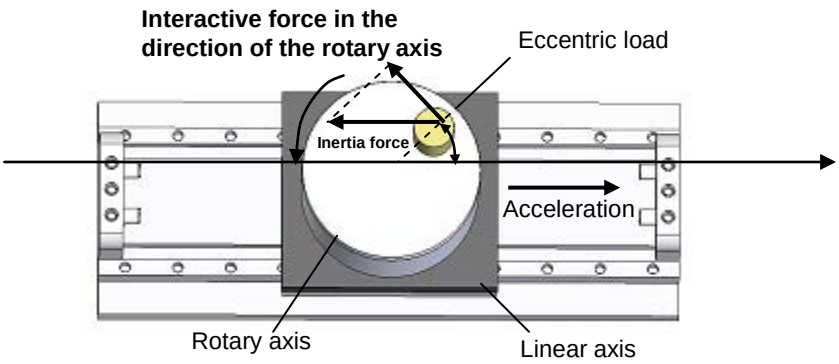
- When a constant-speed rotation is made on a rotary axis



- When acceleration is performed on a rotary axis



- When acceleration is performed on a linear axis



(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP 90JP	16.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	P(16) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	P(16) and subsequent editions	HRV4

To use interactive force compensation, the system software below is needed.

CNC	System software	
	Series	Edition
Series 30*i*-A	G00C, G01C, G02C	27 and subsequent editions
	G004, G014, G024	01 and subsequent editions
Series 31*i*-A5	G12C, G13C	27 and subsequent editions
	G124, G134	01 and subsequent editions
Series 31*i*-A	G103, G113	06 and subsequent editions
	G104, G114	01 and subsequent editions
Series 32*i*-A	G203	06 and subsequent editions
	G204	01 and subsequent editions

For the series 30*i*/31*i*/32*i*/35*i*-B and Power Motion *i*-A, all series and editions support this function.

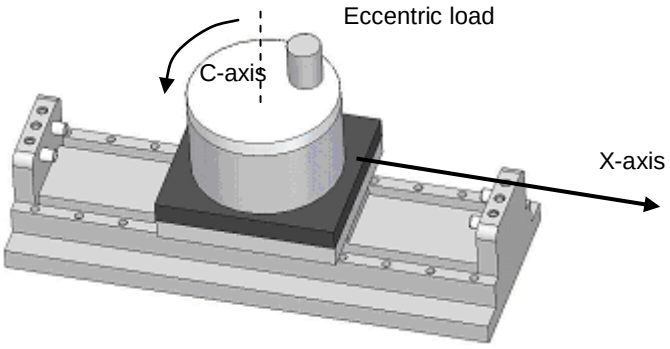
(3) Using interactive force compensation

(a) Target axis configuration

Interactive force compensation basically assumes the two axis configurations described below.

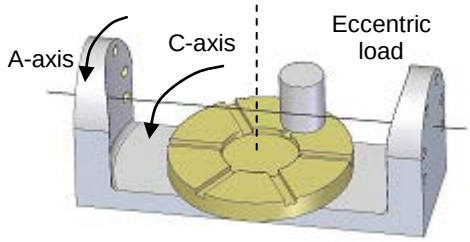
■ Configuration 1: Rotary table (C-axis) on a linear axis (X-axis)

Configuration in which a rotary axis with an eccentric load is located on a linear axis and the center axis of the rotary axis is normal to the linear axis (When the two axes are parallel with each other, no interactive force occurs.)



■ Configuration 2: Rotary table (C-axis) on a rotary axis (A-axis)

Configuration in which the center axis of a rotary axis with an eccentric load is normal to the center axis of a rotary axis on which the rotary axis with an eccentric load is located



(b) Axis naming in interactive force compensation

With interactive force compensation, an axis that produces an interactive force when a movement is made on the axis is called a **moving axis**, and an axis affected by such an interactive force (an axis to which interactive force compensation is applied) is called a **compensated axis**.
In configuration 1, for example, suppose that an interactive force acts on the rotary axis due to acceleration operation on the linear axis. In such a case, the linear axis is referred to as the moving axis, and the rotary axis is referred to as the compensated axis.
Conversely, suppose that an interactive force acts on the linear axis due to rotation on the rotary axis. In such a case, the rotary axis is referred to as the moving axis, and the linear axis is referred to as the compensated axis.

(c) Axis configuration

For one compensated axis, up to two moving axes can be specified (interactive force applied from two axes onto one axis can be compensated for simultaneously). Of two specifiable moving axes, the first one is referred to as the first moving axis, and the second one is referred to as the second moving axis.
Bidirectional compensation is applicable between two axes.
An axis to which torque tandem control or synchronous control is applied can also be set as a moving axis or compensated axis.

When a servo axis number (No. 1023) is represented in the following format, set servo axis numbers so that n for a moving axis matches n for the corresponding compensated axis. In other words, choose the value to be set for parameter No. 1023 from a group of values having the same value of n in the figure below.

FS30*i*-B (Series 90G0, 90J0, or 90K0) or
FS0*i*-F (Series 90M0, 90M8, 90L0, or 90L8): Servo axis number = 16n + k
(where n is an integer, and k = 1, 2, 3, 4, 5, 6, 9, 10, 11, 12, 13, 14)

No.1023(n=1)=1,2,3,4,5,6, 9,10,11,12,13,14	No.1023(n=1)=17,18,19,20, 21,22,25,26,27,28,29,30	33,…

FS30*i*-A (Series 90E0 or 90E1): Servo axis number = 8n + k
(where n is an integer, and k = 1, 2, 3, 4, 5, 6, 7, 8)

No.1023(n=1)=1,2,3,4,5, 6,7,8	No.1023(n=2)=9,10,11,12, 13,14,15,16	17,…

FS30*i*-A (Series 90D0): Servo axis number = 4n + k
(where n is an integer, and k = 1, 2, 3, 4)

No.1023(n=1) =1.2.3.4	No.1023(n=2) =5.6.7.8	9,…

(d) Notes

- To apply interactive force compensation, **feedforward must be enabled (bit 1 of parameter No. 2005 = 1)**. While feedforward is disabled for a moving axis, interactive force is disabled.
- When no direct connection is made between a moving axis and compensated axis, interactive force compensation cannot be applied.

(4) Setting parameters

The function of each parameter is described below.

* For an example of parameter setting, see "(5) Example of parameter setting".

* A compensation value for interactive force compensation is calculated on the compensated axis side. So, parameters for setting a compensation gain, angle data offset value, and so forth are to be set on the compensated axis side.

	#7	#6	#5	#4	#3	#2	#1	#0
2292(FS30*i*)	MOVAXS	MV1IFC	MV1ID2	MV1ID1	MV1ID0	IFC1ON	C1TYP1	C1TYP0

Moving axis specification

MOVAXS(#7) Specifies whether the axis is a moving axis used with the interactive force compensation function. **(Power-off parameter)**

0: The axis is not a moving axis.
1: The axis is a moving axis.

For an axis used for interactive force compensation as a moving axis (axis that affects another axis), set this bit parameter to 1.

Compensated axis specification

MV1IFC(#6) Sets calculation of interactive force from the first moving axis. **(Power-off parameter)**

0: Disables calculation of interactive force from the first moving axis.
1: Enables calculation of interactive force from the first moving axis.

When this bit parameter is set to 1, interactive force from the first moving axis is calculated. (However, when position feedforward for the first moving axis is disabled, the calculated value of interactive force is 0.)
This bit parameter specifies interactive force calculation alone. To actually enable interactive force compensation, IFC1ON (bit 2 of No. 2292) needs to be set as well.

Compensated axis specification

MV1ID2, MV1ID1, MV1ID0(#5, 4, 3) Specifies servo axis number of the first moving axis. **(30*i*-A Series specific)**

This bit parameter is specific to the 30*i*-A Series. In the 30*i*-B Series and Power Motion *i*-A, the servo axis numbers of the first moving axis and second moving axis are specified by parameter No. 2606.
For calculation of interactive force from the first moving axis (bit 6 of No. 2292 = 1), a servo axis number needs to be specified for the first moving axis.
Set these bit parameters to the values below according to the desired servo axis number.

MV1ID2	MV1ID1	MV1ID0	Servo axis number for moving axis (Series 90E0, 90E1)
0	0	0	8n + 1
0	0	1	8n + 2
0	1	0	8n + 3
0	1	1	8n + 4
1	0	0	8n + 5

MV1ID2	MV1ID1	MV1ID0	Servo axis number for moving axis (Series 90E0, 90E1)
1	0	1	8n + 6
1	1	0	8n + 7
1	1	1	8n + 8

* n = 0, 1, 2, ...

NOTE
It is not possible to arbitrarily select the moving axis and compensated axis to which interactive force compensation is applied. See (c) Axis configuration in (3) as mentioned above.

Compensated axis specification

IFC1ON(#2) Turns on/off compensation for interactive force from the first moving axis.
0: Does not compensate for interactive force from the first moving axis.
1: Compensates for interactive force from the first moving axis.

By setting this bit parameter to 1, compensation for interactive force from the first moving axis is enabled. (However, bit 6 (MV1IFC) of No. 2292 must be set to 1.)

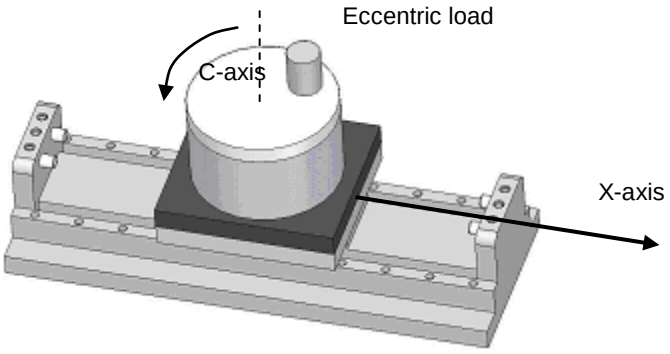
Compensated axis specification

C1TYP1, C1TYP0(#1, 0)

Sets a compensation type (for the first moving axis).
Set the compensation type according to the axis configuration and axis type to which interactive force compensation is applied. An example of axis configuration is provided below.

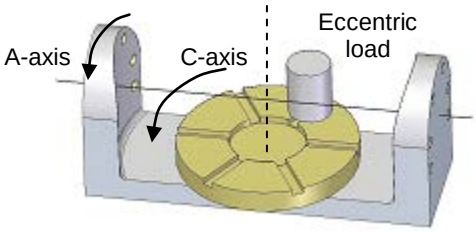
Axis configuration	C1TYP1	C1TYP0	Compensation type
Interactive force from linear axis to rotary axis	0	0	Type L
Interactive force from rotary axis to linear axis	0	1	Type R

■ Configuration 1: Rotary axis (C-axis) on a linear axis (X-axis)



When the C-axis is a compensated axis → Type L (Bits 1, 0 of No. 2292 = 0, 0)
When the X-axis is a compensated axis → Type R (Bits 1, 0 of No. 2292 = 0, 1)

■ Configuration 2: Rotary axis (C-axis) on a rotary axis (A-axis)



When the C-axis is a compensated axis → Type L (Bits 1, 0 of No. 2292 = 0, 0)
When the A-axis is a compensated axis → Type R (Bits 1, 0 of No. 2292 = 0, 1)

	#7	#6	#5	#4	#3	#2	#1	#0
2293(FS30*i*)		MV2IFC	MV2ID2	MV2ID1	MV2ID0	IFC2ON	C2TYP1	C2TYP0

Compensated axis specification

MV2IFC(#6) Sets calculation of interactive force from the second moving axis.
(Power-off parameter)
0: Disables calculation of interactive force from the second moving axis.
1: Enables calculation of interactive force from the second moving axis.

Compensated axis specification

MV2ID2, MV2ID1, MV2ID0(#5, 4, 3)
Specifies servo axis number of the second moving axis. **(30*i*-A Series specific)**
This bit parameter is specific to the 30*i*-A Series. In the 30*i*-B Series and Power Motion *i*-A, the servo axis numbers of the first moving axis and second moving axis are specified by parameter No. 2606.

MV2ID2	MV2ID1	MV2ID0	Servo axis number for moving axis (Series 90E0, 90E1)
0	0	0	8n + 1
0	0	1	8n + 2
0	1	0	8n + 3
0	1	1	8n + 4
1	0	0	8n + 5
1	0	1	8n + 6
1	1	0	8n + 7
1	1	1	8n + 8

* n = 0, 1, 2, ...

Compensated axis specification

IFC2ON(#2) Turns on/off compensation for interactive force from the second moving axis.
0: Does not compensate for interactive force from the second moving axis.
1: Compensates for interactive force from the second moving axis.

Compensated axis specification

C2TYP1, C2TYP0(#1, 0) Sets a compensation type (for the second moving axis).

Axis configuration	C2TYP1	C2TYP0	Compensation type
Interactive force from linear axis to rotary axis	0	0	Type L
Interactive force from rotary axis to linear axis	0	1	Type R

Compensated axis specification

This parameter is specific to the 30*i*-B Series. In the 30*i*-A Series, the servo axis numbers of the first moving axis and second moving axis are specified by bits 3, 4, and 5 of parameter No. 2292 and bits 3, 4, and 5 of parameter No. 2293, respectively.

2606(FS30*i*-B)	Axis number of second moving axis	Axis number of first moving axis

[Valid data range] 1 to 9999

[Setting value] Set the axis number (1 to 99) of the second moving axis 2 × 100 + the axis number (1 to 99) of the first moving axis.

When the interactive force from the first moving axis and second moving axis is calculated (bit 6 of parameter No. 2292 = 1 and bit 6 of parameter No. 2293 = 1), the target moving axes (axes having influences) need to be specified.
Set this parameter according to the axis numbers (parameter No. 1023) of the moving axes.
When the moving axis is a tandem axis, make settings according to the axis number of the master axis.

NOTE

It is not possible to arbitrarily select the moving axis and compensated axis to which interactive force compensation is applied. The moving axis and compensated axis need to be selected from among axes having the same value "n" in the axis number (parameter No. 1023) represented in the following form.

Axis number = 16n + k (where n is an integer, and k = 1 to 6 or 9 to 14)

If the value "n" of the moving axis is different from that of the compensated axis, change the settings of axis numbers so that they coincide with each other.

Compensated axis specification

2478(FS30*i*)	Interactive force compensation: Compensation gain (for the first moving axis)

2480(FS30*i*)	Interactive force compensation: Compensation gain (for the second moving axis)

[Valid data range] 0 to 32767

Set a coefficient (gain) for interactive force compensation.
The optimum value varies according to the weight of an eccentric load and the distance from the rotation center. So, set a proper value according to "(6) Parameter adjustment methods".

Compensated axis specification

2479(FS30*i*)	Interactive force compensation: Angle data offset (for the first moving axis)

2481(FS30*i*)	Interactive force compensation: Angle data offset (for the second moving axis)

[Unit of data] 360/4096 deg

[Valid data range] 0 to 4096

Set angle data that can be read when an eccentric load is placed at the reference position of the rotary axis. The parameter setting varies, depending on the compensation type as follows:

Compensation type L → An offset relative to the angle data of the compensated axis is set with the compensated axis.
Compensation type R → An offset relative to the angle data of the moving axis is set with the compensated axis.

Rotary axis specification

2455(FS30*i*)	Integer part of the number of pulses per revolution (α)

[Valid data range] 0 to 32767

Rotary axis specification

2456(FS30*i*)	Exponent part of the number of pulses per revolution (β)

[Valid data range] 0 to 12

From the number of feedback pulses per revolution on a rotary axis, find the values of the integers (α and β) that satisfy the expression below then set the above parameters to the found values.

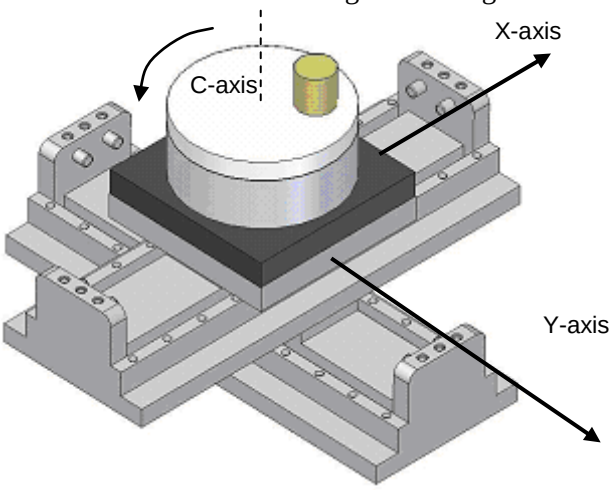
Number of pulses per revolution on a rotary axis = $\alpha \times 2^{\beta}$ (where, $1 \leq \alpha \leq 32767$, $0 \leq \beta \leq 12$)

An example of parameter setting is provided below using a detector indicated below for a synchronous built-in servo motor.

Detector	No. 2455	No. 2456	Remarks
α*i*CZ 512A	8192	7	Manufactured by FANUC
α*i*CZ 768A	12288	7	Manufactured by FANUC
α*i*CZ 1024S	16384	7	Manufactured by FANUC
RCN223F	16384	10	Manufactured by HEIDENHAIN

(5) Example of parameter setting

To apply interactive force compensation, an axis (moving axis) that produces an interactive force by movement on the axis and an axis (compensated axis) that is affected by the interactive force need to be set, and the relationship between the two axes needs to be set properly according to the machine configuration. This example explains the parameters for axis setting.
As an example, imagine a machine with the following axis configuration:



- Assume it has a configuration where the X-axis (linear axis) is placed on the Y-axis (linear axis), the C-axis (rotary axis) is placed on the X-axis, and an eccentric load is mounted on the C-axis.
- Suppose that a synchronous built-in servo motor is used for the C-axis and that the detector α*i*CZ1024A is used.
- Suppose also that the servo axis numbers (No. 1023) and detection units indicated below are used for the axes. (Use of servo control software Series 90J0 is assumed.)

Axis	No. 1023	Detection unit	Remarks
X-axis	1	1 μm	Linear axis
Y-axis	2	1 μm	Linear axis
C-axis	6	0.001 deg	Rotary axis

- Suppose that the X-axis and Y-axis cross each other at right angles and that no interactive force occurs between the X-axis and Y-axis.
- This example simultaneously compensates for an interactive force that is produced by rotation on the C-axis and acts on the X-axis and Y-axis and also compensates for an interactive force that is produced by acceleration on the X-axis and Y-axis and acts on the C-axis.

Compensated axis: X-axis Compensated axis: Y-axis	Interactive force ←	First moving axis: C-axis Second moving axis: -	Movement on rotary axis
Compensated axis: C-axis	Interactive force ←	First moving axis: X-axis Second moving axis: Y-axis	Movement on linear axes

(Parameter setting)

No.	Description	Setting			
		X-axis	Y-axis	C-axis	
No. 2292#7	Moving axis specification	1	1	1	*1
No. 2455	Integer part of the number of pulses per revolution	0	0	16384	*2
No. 2456	Exponent part of the number of pulses per revolution	0	0	7	
No. 2292#6	Calculation of interactive force from the first moving axis	1	1	1	*3
No. 2606	Servo axis number specification for the first moving axis	6	6	201	
No. 2292#2	Enabling compensation for interactive force from the first moving axis	1	1	1	
No. 2292#1, 0	Type of compensation for interactive force from the first moving axis	01	01	00	
No. 2478	Compensation gain for interactive force from the first moving axis	Adjusted value	Adjusted value	Adjusted value	
No. 2479	Angle data offset for the first moving axis	Adjusted value	Adjusted value	Adjusted value	
No. 2293#6	Calculation of interactive force from the second moving axis	0	0	1	
No. 2606	Servo axis number specification for the second moving axis	6	6	201	
No. 2293#2	Enabling compensation for interactive force from the second moving axis	-	-	1	*3
No. 2293#1, 0	Type of compensation for interactive force from the second moving axis	-	-	00	
No. 2480	Compensation gain for interactive force from the second moving axis	-	-	Adjusted value	
No. 2481	Angle data offset for the second moving axis	-	-	Adjusted value	

*1) All axes are moving axes. So, set bit 7 of No. 2292 to 1 for all axes.

*2) The X-axis and Y-axis are linear axes. So, set 0 as the number of pulses per revolution. The C-axis is a rotary axis, so the number of pulses per revolution needs to be set. When using α*i*CZ 1024A, set No. 2455 to 16384, and set No. 2456 to 7.

*3) Considering the C-axis as the first moving axis for the X-axis and Y-axis, and the X-axis as the first moving axis for the C-axis, set the first moving axis for the X-axis, Y-axis, and C-axis. In addition, considering the Y-axis as the second moving axis for the C-axis, set the second moving axis for the C-axis.
While the servo axis numbers of the first moving axis and the second moving axis are specified by parameter No. 2606 in the 30*i*-B Series and Power Motion *i*-A, the servo axis numbers of the first moving axis and the second moving axis are specified by bits 5, 4, and 3 of parameter No. 2292 and bits 5, 4, and 3 of parameter No. 2293, respectively, in the 30*i*-A Series.

Example of setting the servo axis numbers of the first moving axis and second moving axis in 30*i*-A Series

Axis	No. 2292#5, 4, 3 Servo axis number specification for the first moving axis	No. 2293#5, 4, 3 Servo axis number specification for the second moving axis
X-axis	101	-
Y-axis	101	-
C-axis	000	001

*4) The linear axes (X-axis and Y-axis) are affected by an interactive force from the rotary axis (C-axis). So, set type R for the X-axis and Y-axis.
The rotary axis (C-axis) is affected by an interactive force from the linear axes (X-axis and Y-axis). So, set type L for the C-axis.

(6) Parameter adjustment methods

For interactive force compensation, two parameters, one for angle data offset and the other for compensation gain, need to be adjusted. The method of adjustment is described below.

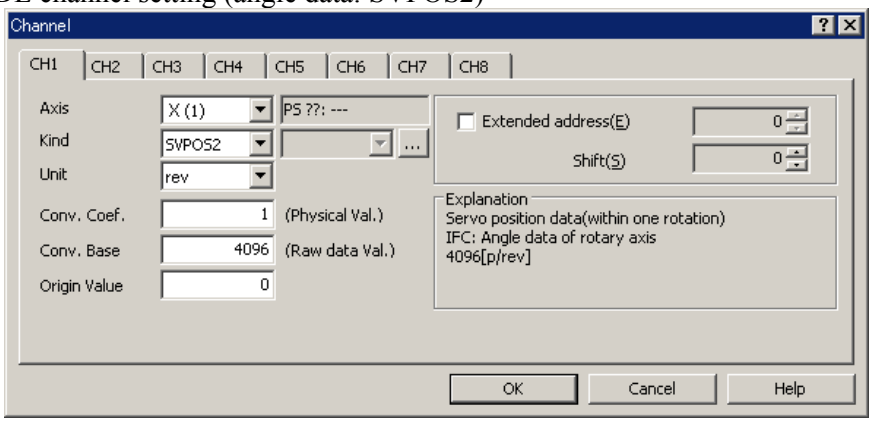
NOTE
To use interactive force compensation, various parameters need to be set. Before starting parameter adjustment, **set bit 2 of No. 2292 to 0 and set bit 2 of No. 2293 to 0 (to disable interactive force compensation).** If these bit parameters are set to 0, interactive force compensation is not actually enabled but calculated compensation data can be observed. Disable compensation at the initial stage of adjustment.

(a) Checking the angle data of a rotary axis

When a rotary axis is to be set as a compensated axis or moving axis, measure the angle data for the rotary axis (SVPOS2) with SERVO GUIDE. Check that the number of pulses per revolution (No. 2455 and No. 2456) is set correctly and the angle data is calculated correctly. For all rotary axes that are used for interactive force compensation, check that phase data is output correctly using the method described below.

■ Check method
Observe the change in angle data by making a movement on a rotary axis by a certain amount. If the number of pulses per revolution is set correctly, the angle data changes by 4096 when a movement is made on the rotary axis by 360°. Check whether the actual amount of movement matches the change in phase data.
For example, check that when a movement of 90° is made on a rotary axis, the change in phase data is 1024 (= 4096 × 90/360).
If the actual amount of movement does not match the change in phase data, recheck the settings of No. 2455 and No. 2456.

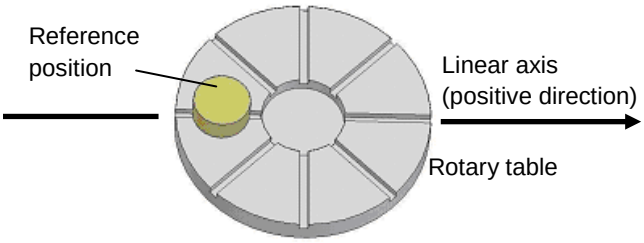
■ SERVO GUIDE channel setting (angle data: SVPOS2)



Axis: Select a target rotary axis.
Kind: Select SVPOS2.
Unit: Select rev.
Conv. Coef: Set 1. (Set 360 when change is observed with 360°/rev.)
Conv. Base: Set 4096.
Origin Value: Set 0.

(b) Setting angle data (No. 2479 and No. 2481)

Move the eccentric load on a rotary axis to the reference position shown below and observe the value of phase data. Set the angle data parameter (No. 2479 or No. 2481) to the observed value.



If the eccentric load cannot be moved to the reference position, find a value by estimation from the angle data at a position to which the eccentric load can be moved. For example, if phase data of 2000 is observed when the eccentric load is moved to a position of 90° away from the reference position, the value to be set as angle data is:

$$2000 - 4096 \times 90/360 = 976$$

(If the result of calculation is a negative value, add 4096 to the result to make a value from 0 to 4095.)
If the accurate position of the eccentric load is unknown, set an approximate position with the method above then make a fine adjustment according to "(c) Adjusting compensation gain" below.

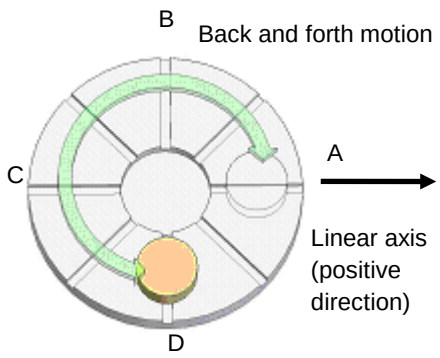
(c) Adjusting compensation gain (No. 2478 and No. 2480)

The example described below uses a rotary table as a moving axis and uses a linear axis as a compensated axis in configuration 1, and uses a waveform produced by making reciprocating motions in the directions of the arrows. It is supposed that each reciprocating motion is made by 270° through the reference position.

NOTE

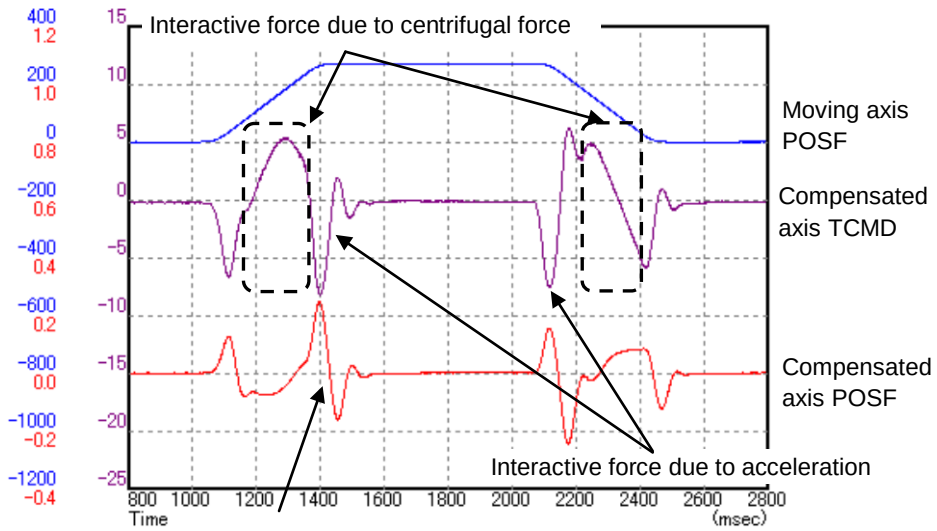
The magnitude of interactive force varies depending on the position (angle) of an eccentric load on the rotary table. Depending on the position of an eccentric load, no interactive force is produced. So, when making a compensation gain adjustment, check it by making movements across the entire movable range on the rotary axis.

- If acceleration/deceleration is performed on the linear axis in the following figure, no interactive force is produced on the rotary axis at positions A and C.
- At positions A and C, acceleration/deceleration performed on the rotary axis produces no interactive force on the linear axis. However, interactive force due to centrifugal force is produced.
- At positions B and D, interactive force due to the centrifugal force of the rotary axis is not produced on the linear axis. However, acceleration/deceleration performed on the rotary axis produces interactive force.



<1> Checking the influence of interactive force

While making no movement on the compensated axis to which interactive force compensation is applied, make a movement on the moving axis. At this time, observe the waveform of the torque command (TCMD) and position feedback (POSF) on the compensated axis with SERVO GUIDE.



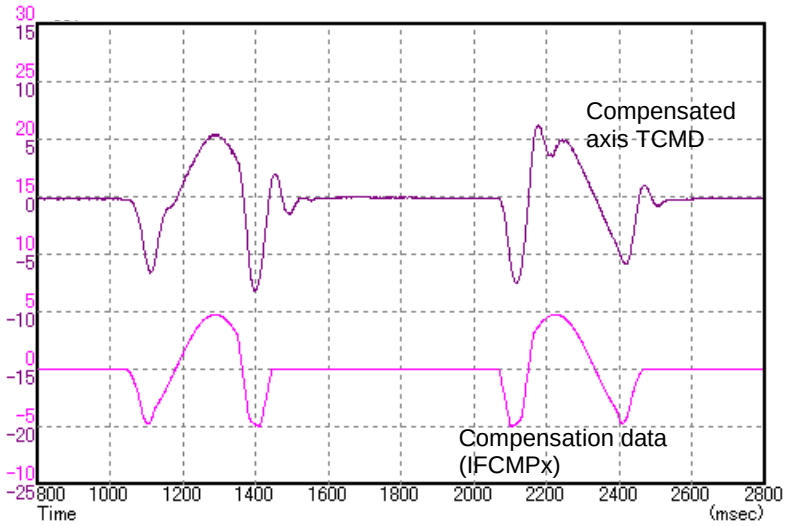
The position of the compensated axis varies as the moving axis moves.

<2> Checking interactive force compensation data

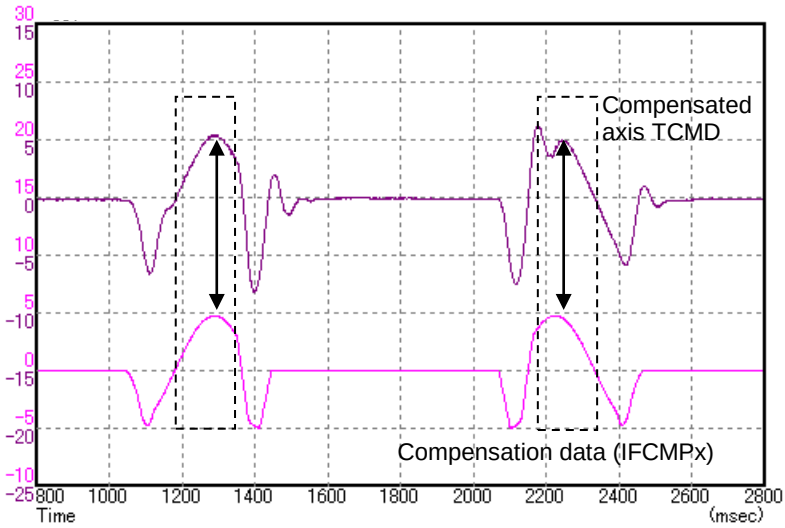
When interactive force compensation is disabled (bit 2 of No. 2292 = 0, bit 2 of No. 2293 = 0), adjust the compensation gain (No. 2478, No. 2480).

A torque command change occurring on the compensated axis according to a movement on the moving axis is considered to be a torque produced to cancel the influence of interactive force. Accordingly, the torque command waveform observed at this time is about equal to the interactive force. So, observe the torque command and interactive force compensation data on the compensation axis present when a movement is made on the moving axis (IFCMP1 for the first moving axis/IFCMP2 for the second moving axis), and adjust the compensation gain so that the torque command approximately matches the compensation data.

See the next item for the setting of SERVO GUIDE for observing interactive force compensation data.



If the accurate position of the eccentric load cannot be identified in angle data adjustment of item (b), gain adjustment alone may not produce a waveform match. Make a fine adjustment of the angle data offset (No. 2479, No. 2481).

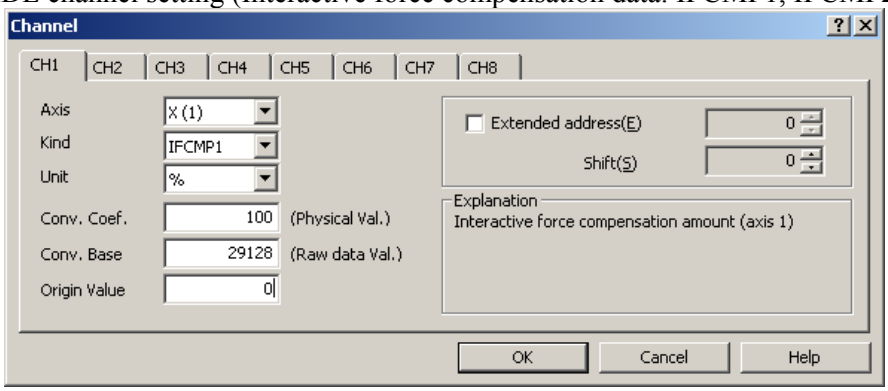


The angle data offset is properly adjusted because the time when the maximum interactive force due to centrifugal force is produced matches.

NOTE

- **Be sure to enable feedforward.**
- When the motor rotation direction of a compensated axis (No. 2022) is set to -111 (CW direction), the polarity of compensation data is opposite to that of the torque command. So, make an adjustment so that IFCMPx is TCMD inverted upside down.

■ SERVO GUIDE channel setting (Interactive force compensation data: IFCMP1, IFCMP2)

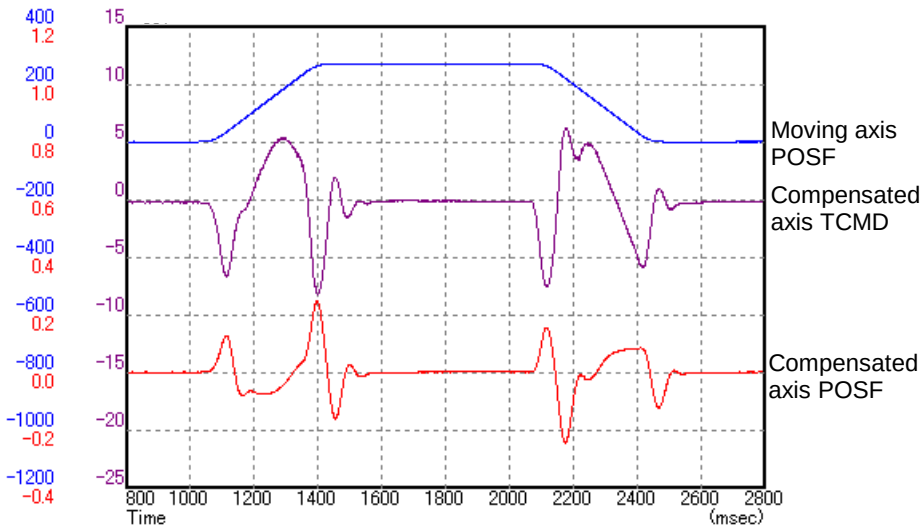


Axis: Select a target compensated axis.
Kind: Select IFCMP1 or IFCMP2.
Unit: Select %.
Conv. Coef: Set 100.
Conv. Base: Set 29128.
Origin Value: Set 0.

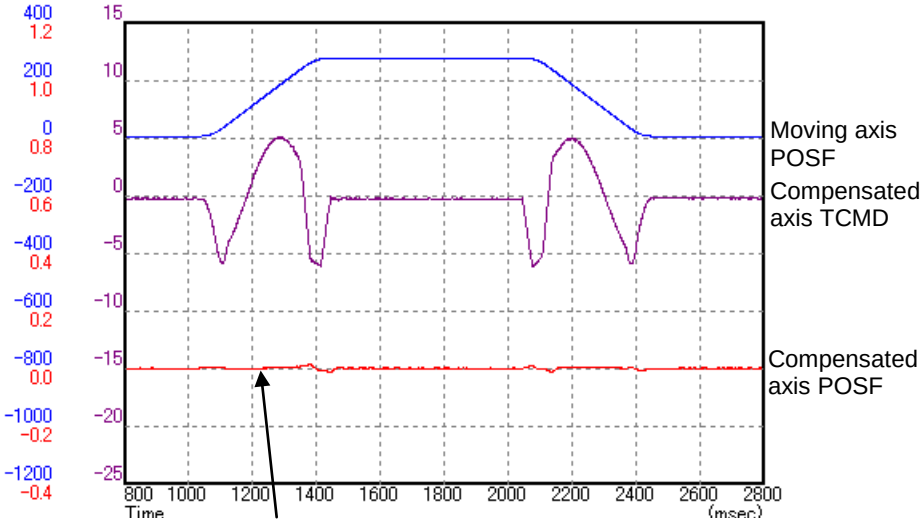
<3> Checking the effect of interactive force compensation

After adjusting the compensation gain parameter, enable interactive force compensation (First moving axis: Bit 2 of No. 2292 = 1, Second moving axis: Bit 2 of No. 2293 = 1) then observe the waveform of position feedback (POSF) on the compensated axis.
Check that when a movement is made on the moving axis, the change in position feedback is reduced.
Make a fine adjustment of the compensation gain parameter so that the change in position feedback is minimized.

■ Without compensation (Bit 2 of No. 2292 = 0)



■ With compensation (Bit 2 of No. 2292 = 1)



Positional variation of the compensated axis is improved.

5.6 FUNCTION FOR REDUCING EFFECTS OF VARIATIONS IN MACHINE CHARACTERISTICS

5.6.1 Inertia Estimation

(1) Overview

This function estimates the inertia of the machine. Since various workpieces are attached to the rotary axis and linear axis that drive the workpiece, the inertia varies. In such a case, the estimation of the inertia enables the PMC to set the time constant of acc./dec. or the velocity gain that are appropriate for the inertia that varies. Estimation is started by the PMC signal and the results are indicated on the diagnosis screen (No. 764). There are two estimation methods shown below.

Torque application method: This method is applied to a direct driving axis that uses a linear motor or DD motor.
Use this method when the machine-specific frequency is 200 Hz or higher.

Velocity application method: This method is applied to a ball screw driving axis that uses a rotary motor with an axis or a linear motor or DD motor with a reducer.
Use this method when the machine-specific frequency is below 200 Hz.

(2) Series and edition of applicable servo control software

[Applicable servo software]

CNC	Servo software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP 90JP	09.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	28.0 and subsequent editions* 03.0 and subsequent editions*	
Series 30*i*/31*i*-A	90D0	-	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	E(05) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	E(05) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	01.0 and subsequent editions	

*) Support for the velocity application method (bit 3 of parameter No. 2418) is as follows:
Series 90E0 33.0 and subsequent editions
Series 90E1 08.0 and subsequent editions

Support for detection sensitivity improvement (bit 2 of parameter No. 2418) and tandem control is as follows:
Series 90E0 30.0 and subsequent editions
Series 90E1 04.0 and subsequent editions

[Applicable system software]

CNC	System software	
	Series	Edition
Series 30*i*-A	G00C, G01C, G02C	27 and subsequent editions
	G004, G014, G024	01 and subsequent editions
Series 31*i*-A5	G12C, G13C	27 and subsequent editions
	G124, G134	01 and subsequent editions
Series 31*i*-A	G103, G113	13 and subsequent editions
	G104, G114	01 and subsequent editions
Series 32*i*-A	G203	13 and subsequent editions
	G204	01 and subsequent editions
Series 0*i*-MD	D4F1	01 and subsequent editions
Series 0*i*-TD	D6F1	01 and subsequent editions
Series 0*i* Mate-MD	D5F1	01 and subsequent editions
Series 0*i* Mate-TD	D7F1	01 and subsequent editions

For the Series 30*i*/31*i*/32*i*/35*i*-B, Power Motion *i*-A, and Series 0*i*-F, all series and editions support this function.

(3) Notes

- This function estimates inertia by adding a small vibration to a motor. Therefore, this function cannot be applied to a motor that is locked.
- Estimation error becomes large in the case of machines with a spring or backlash, or tandem control or feed axis synchronous control with low rigidity.
- The disturbance elimination filter does not operate during estimation of inertia.
- Since the estimated precision depends on the machine status, sufficiently verify it.
- If inertia estimation is not used (bit 2 of parameter No. 2419 is 0), set the vibration frequency (parameter No. 2025) and vibration gain (parameter No. 2026) to 0.
- During the inertia estimation, the error may become excessive when the motor stops, especially in the case of the velocity application method. Therefore, raise the alarm detection level during the estimation.

(4) Parameter

	#7	#6	#5	#4	#3	#2	#1	#0
2419	INESGH	INESGL	INESFH	INESFL	INESMG	INESFC		

INESFC (#2) Inertia estimation is:
0: Disabled.
1: Enabled.

INESMG (#3) The weight on diagnosis screen (No. 764) indication is:
0: The standard output value.
1: The standard output value divided by 32.
If error "-3" is indicated on the diagnosis screen (No. 764) upon completion of estimation, an overflow occurred in the estimation results. In this case, enable this bit and perform estimation again.

INESFL (#4) The vibration frequency for inertia estimation is:
0: The standard value. (50 Hz)
1: The low frequency. (25 Hz)

INESFH (#5) The vibration frequency for inertia estimation is:
0: The standard value. (50 Hz)
1: The high frequency. (100 Hz)

INESGL (#6) The vibration gain for inertia estimation is:

0: The standard value. (Rated current)

1: Half the standard value. (Rated current/2)

If an excessive error alarm (SV410) at stop time occurs during estimation of inertia, increase the setting (parameter No. 1829) of the excessive error at stop time or enable this bit and perform estimation again.

If error "-1" is indicated on the diagnosis screen (No. 764) upon completion of estimation, the vibration gain is too large. In this case, also enable this bit and perform estimation again. If the error persists, set the vibration frequency to the low frequency (bit 4 of parameter No. 2419 is 1).

INESGH (#7) The vibration gain for inertia estimation is:

0: The standard value. (Rated current)

1: Double the standard value. (Rated current × 2)

If error "-2" is indicated on the diagnosis screen (No. 764) upon completion of estimation, enable this bit and perform estimation again. If the error persists, set the vibration frequency to the high frequency (bit 5 of parameter No. 2419 is 1) or divide the detectable minimum deceleration by 32 (bit 2 of parameter No. 2418 is 1).

	#7	#6	#5	#4	#3	#2	#1	#0
2418					INEVCM	INESHS		

INESHS (#2) The minimum detectable acceleration for inertia estimation is set to be:

0: The normal value.

1: The normal value divided by 32 (detection sensitivity improvement).

If error "-2" is indicated on the diagnosis screen upon completion of inertia estimation, enable this bit.

INEVCM (#3) Inertia estimation uses:

0: The torque application method.

1: The velocity application method.

The torque application method is used for a direct driving axis that uses a linear motor or DD motor. The velocity application method is used for a ball screw driving axis that uses a rotary motor with an axis.

The above two bit parameters require the corresponding servo software. See "(2) Series and editions of applicable servo software" above.

Settings to prevent errors (Torque application method)

Parameter	No. 2419				No. 2418
Bit	INESGH #7	INESGL #6	INESFH #5	INESFL #4	INESHS #2
Vibration frequency: Standard (50 Hz)	-	-	0	0	-
Low frequency (25 Hz): Measure against error "-1"	-	-	0	1	-
High frequency (100 Hz): Measure against error "-2"	-	-	1	0	-
Vibration gain: Standard	0	0	-	-	-
Half the rated current: Measure against error "-1"	0	1	-	-	-
Double the rated current: Measure against error "-2"	1	0	-	-	-
Minimum acceleration divided by 32: Measure against error "-2"	-	-	-	-	1

Settings to prevent errors (Velocity application method)

Parameter	No. 2025	No. 2026	No. 2418
Bit			INESHS #2
Vibration frequency: as a guide	5	-	-
Low frequency: Measure against error "-1"	3	-	-
High frequency: Measure against error "-2"	10	-	-
Vibration gain: as a guide	-	5000	-
Low velocity: Measure against error "-1"	-	2500	-
High velocity: Measure against error "-2"	-	10000	-
Minimum acceleration divided by 32: Measure against error "-2"			1

2025 **Vibration frequency**

[Unit of data] Hz
[Valid data range] 0 to 200
[Standard setting] 5

Set the vibration frequency for the velocity application method. This parameter is not affected by the settings of bits 4 and 5 of parameter No. 2419. This parameter requires the corresponding servo control software. See "(2) Series and editions of applicable servo control software" above. When inertia estimation is not used, set this parameter to 0.

2026 **Vibration gain**

[Unit of data] 0.1 min^{-1} (rotary motor), 5 mm/min (linear motor)
[Valid data range] 0 to 30000
[Standard setting] 5000

Set the vibration gain for the velocity application method. This parameter is not affected by the settings of bits 6 and 7 of parameter No. 2419. This parameter requires the corresponding servo software. See "(2) Series and editions of applicable servo software" above. When inertia estimation is not used, set this parameter to 0.

2086 **Rated current value**

[Unit of data] The maximum current of an amplifier is equivalent to 6554.
[Valid data range] 0 to 6554

The vibration gain used for the torque application method is calculated using this parameter and bits 7 and 6 of parameter No. 2419. This value is set according to the motor specification. If the value is 0, error "-2" is indicated on the diagnosis screen (No. 764).

2345 **Friction compensation**

[Unit of data] TCMD (The maximum current of an amplifier is equivalent to 7282.)
[Valid data range] 0 to 7282

This compensation eliminates effects of friction. This parameter sets the absolute value of a torque command value (TCMD) during operation at 10 min^{-1} (rotary motor) or 10 mm/s (linear motor).

If the average current during estimation is less than the value of this parameter, error "-2" is indicated on the diagnosis screen (No. 764). In this case, increase the vibration gain.

NOTE
- In a multi-winding driving motor, tandem control, and feed axis synchronous control, set all the above parameters on the sub-axis to the same values as in the main axis.
- This parameter is also used as the dynamic friction compensation value in the stopped state when you use the unexpected disturbance torque detection function.

	#7	#6	#5	#4	#3	#2	#1	#0
2438							INESSFC	

INESSFC (#1) When inertia is estimated, friction compensation is:
0: Taken into consideration. (default)
1: Not taken into consideration.
Even if friction compensation is set for parameter No. 2345, it is not used in inertia estimation. (90J0 / 7.0 and subsequent editions)
NOTE) Series 90K0 does not support this parameter.

(5) PMC signal

The start and end of inertia estimation is controlled by PMC signal Gn390. For 2.5 seconds after the start of estimation, the motor vibrates slightly. Completion of the estimation is reported by PMC signal Fn371. At the same time, the estimation results are indicated on the diagnosis screen (No. 764). Unless a reset signal is input, the estimation results on the diagnosis screen (No. 764) are maintained until the next time the estimation starts. The results can be used by the PMC program. In a multi-winding driving motor or tandem control, turn on only Gn390 for the main axis and check the obtained results from the main axis. On the other hand, in feed axis synchronous control, turn on Gn390 for the main axis and the sub-axis at the same time to obtain the sum of the results from the axes as the inertia of the machine. A reset signal interrupts the estimation and clears the estimation results on the diagnosis screen (No. 764) as well.

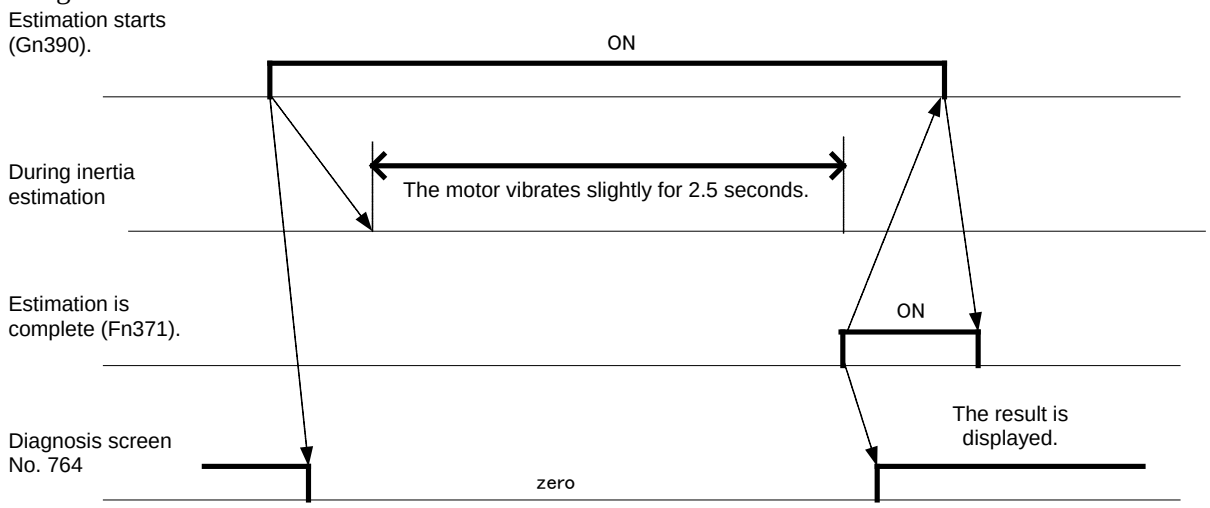
Inertia estimation start DI signal
Gn390.0 to Gn390.7 (axis type)

[Classification] Input signal
[Function] Starts and ends inertia estimation.
[Operation] Enabling or disabling this signal starts or ends inertia estimation.

Inertia estimation start DO signal
Fn371.0 to Fn371.7 (axis type)

[Classification] Output signal
[Function] Reports the completion of inertia estimation.
[Operation] When inertia estimation is completed, this signal turns on.

Timing chart



Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
Gn390	**INIDRQ8**	**INIDRQ7**	**INIDRQ6**	**INIDRQ5**	**INIDRQ4**	**INIDRQ3**	**INIDRQ2**	**INIDRQ1**

	#7	#6	#5	#4	#3	#2	#1	#0
Fn371	**INIDFN8**	**INIDFN7**	**INIDFN6**	**INIDFN5**	**INIDFN4**	**INIDFN3**	**INIDFN2**	**INIDFN1**

(6) Indication of the diagnosis screen

The estimation results are indicated on the diagnosis screen (No. 764). The inertia can be calculated by the following equation based on the values.

Rotary motor

$$Jm = \frac{DGN764 \times (Kt/\sqrt{2}) \times Imax \times P}{6.4557 \times 10^{12}}$$

Inertia Jm [kgm^2], torque constant Kt [Nm/Arms], amplifier maximum current Imax [Ap]

NOTE) For motor constants such as inertia Jm and torque constant Kt, refer to the specification of the motor.

NOTE) When the minimum detectable acceleration is multiplied by 1/32 (bit 2 of parameter No. 2418 is set to 1), the result of the above calculation Jm is multiplied by 0.5.

Resolution of built-in detectors: P [pulse]

α*i*CZ512A	P = 2^{19}
α*i*CZ768A	P = 786432
α*i* Pulsecoder, α*i*CZ1024A	P = 2^{20} (See the following example.)
RCN223, RCN723, RCN727, or other detector whose resolution is 2^{23} or higher	P = 2^{23}
Binary encoder or non-binary encoder + High-resolution detection circuit	P = (Number λ of sine waves per rotation of detector) × 512

NOTE) For the full-closed system, the resolution of the built-in detector needs to be used as P.

Example) In α*i*S8/4000, if Kt = 0.72 [Nm/Arms], Imax = 80 [Ap], P = 2^{20} [pulse], and the estimation result DGN764 = 176, then inertia Jm = 0.00116 [kgm^2].

Linear motor

$$M = \frac{DGN764 \times (Kf / \sqrt{2}) \times Imax}{8.2196 \times 10^6 \times A}$$

Weight of object to be moved M [kg], thrust constant Kf [N/Arms], amplifier maximum current Imax [Ap], resolution of detector A [μm]

NOTE) When the minimum detectable acceleration is multiplied by 1/32 (bit 2 of parameter No. 2418 is set to 1), the result of the above calculation M is multiplied by 0.5.

Linear incremental detector + High-resolution detection circuit	A = Signal pitch [μm]/512 (See the following example.)
Linear absolute detector	A = Resolution [μm]

Example) In L*i*S600A1/4, if Kf = 41.1 [N/Arms], Imax = 40 [Ap], A = 20 [μm]/512, and the estimation result DGN764 = 1358, then weight of object to be moved M = 4.9 [kg].

The value of inertia to be estimated by this function should satisfy the following expression.

Rotary motor

$$2^5 \le \frac{Jm \times 6.4557 \times 10^{12}}{(Kt / \sqrt{2}) \times Imax \times P} \le 2^{20}$$

If the stall current is assumed to be Is [Arms]:

$$\frac{0.81 \times Kt \times Is \times P}{\pi \times 10^6 \times 2^{14}} \le Jm \le \frac{0.81 \times Kt \times Is \times P \times 2^2}{\pi^2 \times 10^8}$$

When the detection sensitivity improvement (bit 2 of parameter No. 2418) is enabled:

$$\frac{Kt \times Is \times P}{\pi^2 \times 10^6 \times 2^{13}} \le Jm \le \frac{Kt \times Is \times P \times 2^7}{\pi^2 \times 10^7}$$

Linear motor

$$2^5 \le \frac{M \times 8.2196 \times 10^6 \times A}{(Kf / \sqrt{2}) \times Imax} \le 2^{20}$$

If the continuous current is assumed to be Ic [Arms]:

$$\frac{0.81 \times Kf \times Ic}{A \times 2^{14}} \le M \le \frac{0.81 \times Kf \times Ic}{25\pi \times A}$$

When the detection sensitivity improvement (bit 2 of parameter No. 2418) is enabled:

$$\frac{Kf \times Ic}{\pi \times A \times 2^{13}} \le M \le \frac{Kf \times Ic \times 2^7}{\pi \times A \times 10}$$

NOTE) For stall current Is and continuous current Ic, refer to the specifications of the motor.

Error indication and measures

- If an error is indicated, first check whether the conditions of the above expression are satisfied. When the conditions are satisfied, take the following actions.
- If the acceleration is too large to calculate a correct inertia, error "-1" is displayed on diagnosis screen No. 764. In this case, halve the vibration gain (bit 6 of parameter No. 2419 = 1 or parameter No. 2026 = set value/2) and perform estimation again. If the error persists, set the vibration frequency to a low frequency (bit 4 of parameter No. 2419 = 1 or parameter No. 2025 = set value/2).

- If the acceleration is too small to calculate a correct inertia, error "-2" is displayed on diagnosis screen No. 764. In this case, double the standard value of the vibration gain (bit 7 of parameter No. 2419 = 1 or parameter No. 2026 = set value × 2) and perform estimation again. If the error persists, set the vibration frequency to a high frequency (bit 5 of parameter No. 2419 = 1 or parameter No. 2025 = set value × 2) or divide the minimum detectable acceleration by 32 (bit 2 of parameter No. 2418 = 1).
- If an overflow occurs in the calculation results, error "-3" is displayed on diagnosis screen No. 764. In this case, divide the standard value of the indication of the diagnosis screen by 32 (bit 3 of parameter 2419 = 1) and perform estimation again.

(7) How to use

The following describes the preparation and method for applying inertia estimation.

1) Creation of a PMC ladder
   Create a PMC ladder with reference to (5) above to start the inertia estimation function. In a multi-winding driving motor or tandem control, input only the inertia estimation start DI signal of the main axis. On the other hand, in feed axis synchronous control, input the inertia estimation start DI signals of the main axis and sub-axis at the same time.
2) Measurement of friction
   Measure the friction. Set the absolute value of the torque command value (TCMD) during operation at 10 min^{-1} (rotary motor) or 10 mm/s (linear motor) to parameter No. 2345. In measurement with the servo guide, if the data type is TCMD and both the conversion coefficient and conversion reference are 1, the displayed value can be read as is. In a machine with small friction, the setting is optional.
3) Confirmation of inertia estimation results
   Estimate the inertia when the largest workpiece and smallest workpiece whose actual inertia values are known are attached. Confirm that the estimation result indicated on the diagnosis screen matches the actual inertia. If an error (-1, -2, or -3) is indicated on the diagnosis screen upon completion of estimation, see "(6) Error indication and measures" above.
4) Method for changing the acc./dec. time constant and the velocity gain
   Attach a workpiece whose inertia value is known and adjust the acc./dec. time constant and the velocity gain. Then, estimate the inertia and record the estimation result on the diagnosis screen as the initial value. When workpieces with different inertias are attached, estimate the inertia, compare the estimation result with the initial value, and change the acc./dec. time constant and the velocity gain based on the ratio between them. However, since the velocity gain is not proportional to the change rate of the inertia, give detailed consideration in advance.

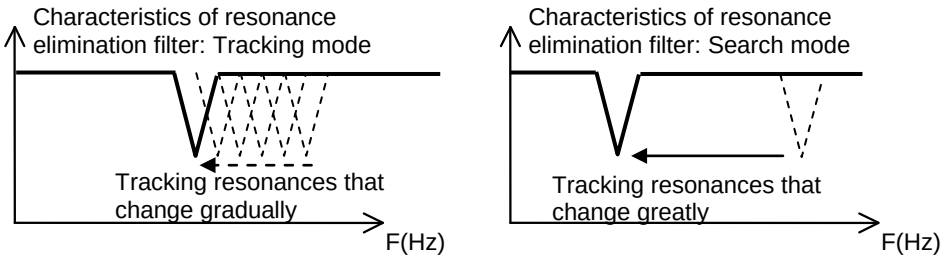
5.6.2 Adaptive Resonance Elimination Filter

(1) Overview

An adaptive resonance elimination filter detects changes in the resonance frequency as described below and changes the filter characteristics based on the changes.

- Changes in the resonance frequency depending on the machine position
- Changes in the resonance frequency depending on individual differences of machines
- Changes in the resonance frequency over time
- Changes in the resonance frequency depending on the rigidity of a workpiece

1) Follow-up mode and search mode
   The follow-up mode is used for follow-up in a narrow bandwidth and the search mode is used for follow-up in a wide bandwidth.
   The follow-up mode is applied when the resonance frequency gradually changes according to the machine position.
   The search mode is applied when the resonance frequency greatly changes such as when the workpiece is attached or detached.



2) Application method
In the follow-up mode, follow-up is performed generally during axis feed operation. PMC signal Gn322 enables follow-up even in a stop state.
In the search mode, PMC signal Gn324 starts or stops follow-up regardless of whether axis feed operation is in progress or the stop state is entered.

3) Automatic update of parameters
The center frequency of a resonance elimination filter in the follow-up result is lost when the NC power is turned off. The center frequency can be recorded in the parameter (No. 2113) by enabling the automatic update of parameters (bit 1 of parameter No. 2290 = 1).
Changes in the center frequency during follow-up can be checked at any time on diagnosis screen No. 763.

(2) Series and editions of applicable servo software

CNC	Servo software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	09.0 and subsequent editions	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	S(19) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	S(19) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	01.0 and subsequent editions	

The automatic update of parameters requires the following NC software.

CNC	System software	
	Series	Edition
Series 30*i*-A	G00C, G01C, G02C	27 and subsequent editions
	G004, G014, G024	01 and subsequent editions
Series 31*i*-A5	G12C, G13C	27 and subsequent editions
	G124, G134	01 and subsequent editions
Series 31*i*-A	G103, G113	13 and subsequent editions
	G104, G114	01 and subsequent editions
Series 32*i*-A	G203	13 and subsequent editions
	G204	01 and subsequent editions
Series 0*i*-MD	D4F1	01 and subsequent editions
Series 0*i*-TD	D6F1	01 and subsequent editions
Series 0*i* Mate-MD	D5F1	01 and subsequent editions
Series 0*i* Mate-TD	D7F1	01 and subsequent editions

For the Series 30*i*/31*i*/32*i*/35*i*-B, Power Motion *i*-A, and Series 0*i*-F, all series and editions support this function.

(3) Notes

- This function is valid only for resonance elimination filter 1 (parameters Nos. 2113, 2177, and 2359).
- This function is enabled after releasing an emergency stop.
- To measure frequency characteristics with SERVO GUIDE (including the tuning navigator), turn off the adaptive resonance elimination filter.

(4) Setting parameters

	#7	#6	#5	#4	#3	#2	#1	#0
2270					ACREF			

ACREF(#3) The adaptive resonance elimination filter is:
0: Disabled.
1: Enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
2290			FRFPWE	FRFDES	FRFATE			

FRFATE(#3) Execution condition 1 in the follow-up mode of the adaptive resonance elimination filter:
0: During axis feed operation (handle, rapid traverse, cutting feed).
1: Only during rapid traverse (other than stop/cutting feed).

FRFDES(#4) Execution condition 2 in the follow-up mode of the adaptive resonance elimination filter:
0: Executed depending on FRFATE (#3) and PMC signal Gn322.
1: Executed depending on only PMC signal Gn322.

No. 2290#4	No. 2290#3	Execution condition in the follow-up mode
0	0	Executed when Gn322.x = 1 or during axis feed.
0	1	Executed when Gn322.x = 1 or during rapid traverse.
1	-	Executed only when Gn322.x = 1.

NOTE
To use only the search mode without using the follow-up mode, set bit 4 (FRFDES) to 1 and Gn322.x to 0.

FRFPWE(#5) The parameter for the center frequency of the adaptive resonance elimination filter (No. 2113) is:
0: Not automatically updated.
1: Automatically updated.
The follow-up result is lost when the power is turned off. If this bit is set to be enabled, the follow-up result is stored in parameter No. 2113 of the center frequency.
In the follow-up mode, the center frequency is rewritten in the stop state when a change in the resonance frequency is detected. In the search mode, when a change in the resonance frequency is detected, the completion signal of the PMC signal Fn370 is turned on. In addition, when the search mode is stopped by PMC signal Gn324, the center frequency is rewritten.

	#7	#6	#5	#4	#3	#2	#1	#0
2291						FRFEBW		

FRFEBW(#2) The maximum frequency that can be followed by the adaptive resonance elimination filter in HRV3 or HRV4 control is:
0: 1.3 kHz (standard).
1: 2.0 kHz (extended).
* The maximum frequency of HRV2 control is 1.0 kHz and cannot be extended.
* For an extended frequency, the maximum of the detection time in the search mode is changed from 2 seconds to 3 seconds.
* This setting can be used by the servo software 90G0/15 and subsequent editions

2113 **Resonance elimination filter 1: Center frequency**

[Unit] Hz
[Valid data range] 100 to 1 kHz (HRV2), 100 Hz to 2 kHz (HRV3), 100 Hz to 4 kHz (HRV4)
The follow-up range is 100 Hz to 990 Hz (HRV2) and 100 Hz to 1270 Hz (HRV3 and HRV4). When the adaptive resonance elimination filter is enabled (No. 2270#3 = 1), the center frequency needs fall within this range. The adaptive resonance elimination filter follows up the resonance frequency with the bandwidth set in the follow-up range (parameter No. 2351), centered on the set frequency. If this parameter is rewritten, the follow-up result is lost and this parameter is reset to the set value.

2177 **Resonance elimination filter 1: Bandwidth**

[Unit] Hz
[Valid data range] 10 to center frequency
The bandwidth can be set to a value in a range from 10 Hz to the center frequency (parameter No. 2113).

2359 **Resonance elimination filter 1: Attenuation ratio**

[Unit] %
[Valid data range] 0 to 100%

2350 **Adaptive resonance elimination filter: Allowable acceleration**

[Unit] Amount of distribution pulse change per 8 ms
[Valid data range] 0 to 10
[Standard setting] 0 (A value of 0 means an internal value of 2.)
Set the allowable acceleration of a command in the follow-up mode. If the specified acceleration is large, TCMD vibration may occur. Follow-up is not performed unless the command becomes the allowable acceleration or less in order to prevent a follow-up error from occurring in this case.

2351	Adaptive resonance elimination filter: Follow-up bandwidth

[Unit] Hz
[Valid data range] 40 to 500 (A setting of 39 or less means an internal value of 40.)
[Standard setting] 0 (A value of 0 means an internal value of 40.)
Set the follow-up range of the center frequency in the follow-up mode. If this parameter is set to 0, follow-up is performed in the range of ±40 Hz centered on the value of parameter No. 2113. The follow-up range is 100 Hz to 1.0 kHz (HRV2) and 100 Hz to 1.3 kHz (HRV3 and HRV4). However, when the maximum frequency is extended (bit 2 of parameter No. 2291 is 1) in 90G0/15 or subsequent editions, the follow-up range is 100 Hz to 2.0 kHz (HRV3 and HRV4).

2352	Adaptive resonance elimination filter: Detection level

[Unit] A value of 7282 in TCMD units corresponds to the maximum amplifier current.
[Valid data range] 0 to 7282
[Recommended value] 0 (A value of 0 means an internal value of 16.)

NOTE
If the detection level is too small, accurate detection may be prevented by noise. Before application, check if appropriate follow-up is performed using an actual machine.

2353	Adaptive resonance elimination filter: Wait time for setting

[Unit] TCMD
[Valid data range] 0 to 32767
[Recommended value] 0 (A value of 0 means an internal value of 25.)
Set the setting time in the follow-up mode. If the acc./dec. time constant is small, TCMD vibration may occur upon completion of a move command. It is necessary to set the time until follow-up starts after the move command becomes the allowable acceleration or less so as not to receive the vibration. If TCMD vibration by acceleration/deceleration is large, the setting needs to be larger.

2459	Adaptive resonance elimination filter: Search bandwidth

[Unit] Hz
[Valid data range] 40 to 890 Hz (A setting of 39 or less means an internal value of 40.)
[Standard setting] 0 (A value of 0 means an internal value of 890.)
Set the search range of the resonance frequency in the search mode.
A search is made in the range indicated by the center frequency ± the search range. A setting of 0 means a search range of ±890 Hz. The searchable range is 100 Hz to 1.0 kHz (HRV2) and 100 Hz to 1.3 kHz (HRV3 and HRV4). However, when the maximum frequency is extended (bit 2 of parameter No. 2291 is 1) in 90G0/15 or subsequent editions, the follow-up range is 100 Hz to 2.0 kHz (HRV3 and HRV4).

(5) PMC signal

Follow-up mode and search mode

Follow-up mode: Follows up the resonance frequency that moves in the range indicated by the center frequency (parameter No. 2113) ± the follow-up range (parameter No. 2351). The follow-up mode is used when the width of variations in the resonance frequency is small (within ±40 Hz) and the velocity of variations is high. (The detection time is approximately 0.4 seconds.)

Search mode: Follows up the resonance frequency in the range indicated by the center frequency (parameter No. 2113) ± the search range (parameter No. 2459). The search mode is used when the resonance frequency varies greatly due to attachment or detachment of the workpiece, for example. (The detection time is approximately 2 to 3 seconds.)

Follow-up start DI signal of the adaptive resonance elimination filter Gn322.0 to Gn322.7 (axis type)

[Classification] Input signal

[Function] Starts and stops the follow-up mode.

[Operation] Although the follow-up mode is used during axis feed, follow-up is performed even in the stop state if this signal is enabled.

Search start DI signal of the adaptive resonance elimination filter Gn324.0 to Fn324.7 (axis type)

[Classification] Input signal

[Function] Starts and stops the search mode.

[Operation] Follow-up in the search mode is performed if this signal is enabled.

Search completion DO signal of the adaptive resonance elimination filter Fn370.0 to Fn370.7 (axis type)

[Classification] Output signal

[Function] Reports the completion of the search mode.

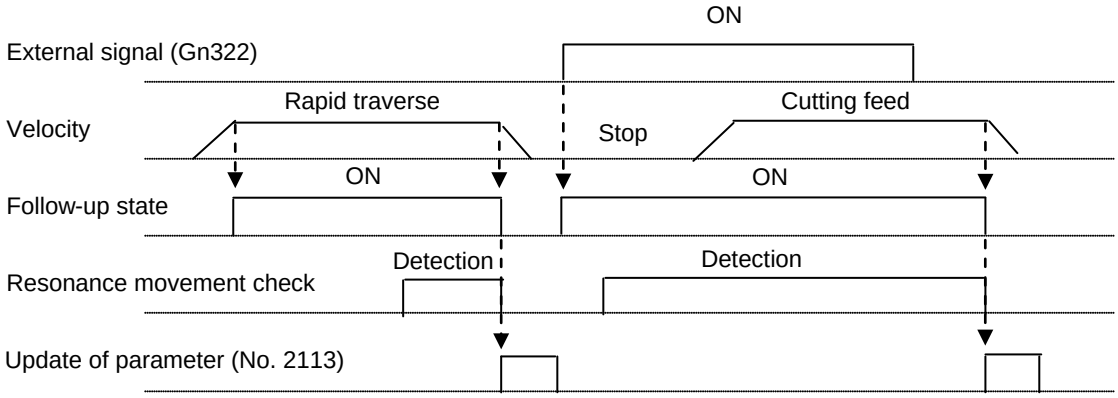
[Operation] This signal is turned on when the resonance frequency is detected in the search mode.

NOTE

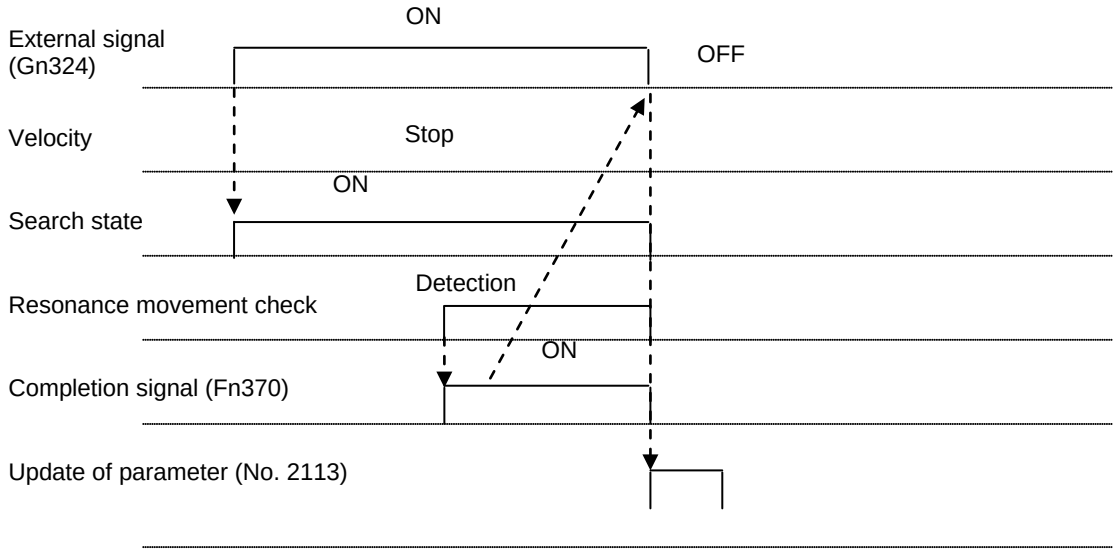
The timing at which Gn322 or Gn324 is turned off depends on the mechanical and machining conditions. However, Gn322 or Gn324 usually needs to be turned off when detection completion signal Fn370 is turned on or before actual machining is performed.

Timing chart

Follow-up mode (No. 2270#3 = 1, No. 2290#5 = 1, #4 = 0, #3 = 1)



Search mode (No. 2270#3 = 1, No. 2290#5 = 1, #4 = 0, #3 = 0)



Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
Gn322	FRFRQS8	FRFRQS7	FRFRQS6	FRFRQS5	FRFRQS4	FRFRQS3	FRFRQS2	FRFRQS1

	#7	#6	#5	#4	#3	#2	#1	#0
Gn324	FRFSMD8	FRFSMD7	FRFSMD6	FRFSMD5	FRFSMD4	FRFSMD3	FRFSMD2	FRFSMD1

	#7	#6	#5	#4	#3	#2	#1	#0
Fn370	FRFDET8	FRFDET7	FRFDET6	FRFDET5	FRFDET4	FRFDET3	FRFDET2	FRFDET1

5.7 HIGH-SPEED POSITIONING

High-speed positioning is used in the following cases:

<1> To perform point-to-point movement quickly, where the composite track of two or more simultaneous axes can be ignored such as in a punch press, for example.

<2> To speed up positioning in rapid traverse while errors in the shape during cutting must be minimized (reduction of cycle time)

In case <1>, position gain switching and low-speed integral are effective (⇒ See Subsection 4.3.6, "High-Speed Positioning Adjustment Procedure").

In case <2>, rapid traverse feedforward is effective. For information about feedforward, see Subsections 5.5.1 to 5.5.3.

5.7.1 Position Gain Switching

(1) Overview

An increase in the position gain is an effective means of reducing the positioning time when the machine is about to stop. An excessively high position gain decreases the tracking ability of the velocity loop, making the position loop unstable. This results in hunting or overshoot. A position gain adjusted in high-speed response mode produces a margin in the position gain when the machine is about to stop. Increase the position gain in low-speed mode so that both the characteristics in high-speed response mode and a short positioning time are achieved.

NOTE

When this function is used, the error amount in constant-speed feed and the actual position gain indication on the CNC do not match the logical values.

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	03.0 and subsequent editions	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(3) Setting parameters

<1> This parameter specifies whether to enable position gain switching as follows:

	#7	#6	#5	#4	#3	#2	#1	#0
2015								PGTW

PGTW(#0) Position gain switching is:
0: Disabled.
1: Enabled.

<2> This parameter specifies whether to set the velocity at which position gain switching is to occur, as follows:

2028	Limit speed for enabling position gain switching

The position gain is doubled with a speed lower than or equal to the speed specified above.

[Unit of data] 0.01 min^{-1} for a rotary motor
0.01 mm/min for a linear motor

[Valid data range] 0 to 32767

[Recommended value] 1500 to 5000

NOTE
You can increase the effective velocity to ten times by magnifying the high-speed positioning velocity increment system (⇒ (5) in Subsection 5.7.1).

Fig. 5.7.1 (a) shows the relationships between the positional deviation and velocity command.

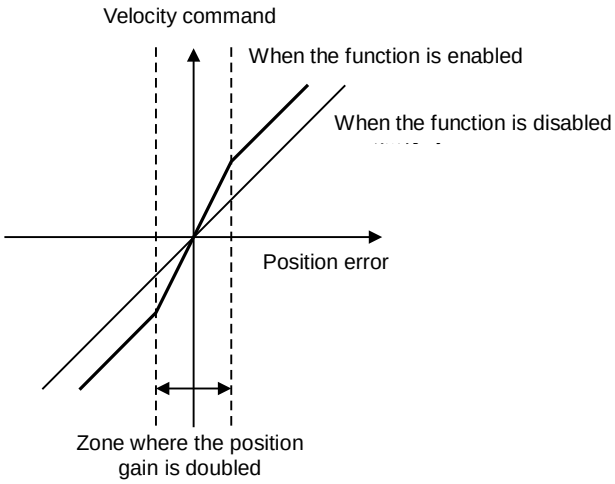


Fig. 5.7.1 (a) Position gain switching

(4) When feedforward is used at the same time (position gain switching function type 2)

When using position gain switching together with feedforward, make the setting below.

(a) Overview

When conventional position gain switching is used in conjunction with feedforward, it can cause an overshoot at a relative low feedforward coefficient, sometimes resulting in difficulty in adjustment, because the feedforward term-based effect is also doubled. Position gain switch type 2 has been improved to make position gain switching independent of the feedforward function.

(b) Setting parameters

In addition to the parameter of the position gain switching function described earlier, set the following parameter.

	#7	#6	#5	#4	#3	#2	#1	#0
2204			PGTW2					

PGTWN2 (#5) Specifies whether to double the feedforward-based effect at position gain switching as follows:
0: Double
1: Do not double

> **NOTE**
> This function is invalid when the VCMD interface is in use. (When the VCMD interface is in use, set PGTWN2 = 0.)

(5) High-speed positioning velocity increment system magnification

(a) Overview

This function increases the velocity increment system for the effective velocity parameter of high-speed positioning (position gain switching and low-speed integral) to ten times.

(b) Setting parameters

Using the following parameter can change the increment system for the effective velocity.

	#7	#6	#5	#4	#3	#2	#1	#0
2204							HSTP10	

HSTP10 (#1) Specifies the effective velocity increment system for the high-speed positioning (position gain switching and low-speed integral) as follows:
0: 0.01 min^{-1} (rotary motor), 0.01 mm/min (linear motor)
1: 0.1 min^{-1} (rotary motor), 0.1 mm/min (linear motor)

> **NOTE**
> The value set for this function applies to the increment system of both position gain switching and low-speed integral.

5.7.2 Low-speed Integral

(1) Overview

To ensure that the motor responds quickly, a small time constant must be set so that a command enabling quick startup is issued. If the time constant is too small, vibration or hunting occurs because of the delayed response of the velocity loop integrator, preventing further reduction of the time constant. With the low-speed integral function, velocity loop integrator calculation is performed in low-speed mode only. This function ensures quick response and high stability while maintaining the positioning characteristics in the low-speed and stop states.

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	03.0 and subsequent editions	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(3) Setting parameters

<1> Specify whether to enable low-speed integral.

	#7	#6	#5	#4	#3	#2	#1	#0
2015							SSG1	

SSG1(#1) Low-speed integral is:
0: Disabled.
1: Enabled.

<2> Specify whether to enable integration at acc./dec. time.

2029	Limit speed for disabling low-speed integral at acceleration

The integral gain is invalidated during acceleration at a speed higher than or equal to the specified speed.

[Unit of data] 0.01 min^{-1} for a rotary motor
0.01 mm/min for a linear motor
[Valid data range] 0 to 32767
[Recommended value] 1000

2030	Limit speed for enabling low-speed integral at deceleration

The integral gain is validated during deceleration at a speed lower than or equal to the specified speed.

[Unit of data] 0.01 min^{-1} for a rotary motor
0.01 mm/min for a linear motor
[Valid data range] 0 to 32767
[Recommended value] 1500

REFERENCE

You can increase the effective velocity to ten times by magnifying the high-speed positioning velocity increment system (bit 1 of parameter No. 2204) (⇒ (5) in Subsection 5.7.1).

This function can specify whether to enable the velocity loop integration term for two velocity values, the first for acceleration and the second for deceleration. It works as shown in Fig. 5.7.2 (a).

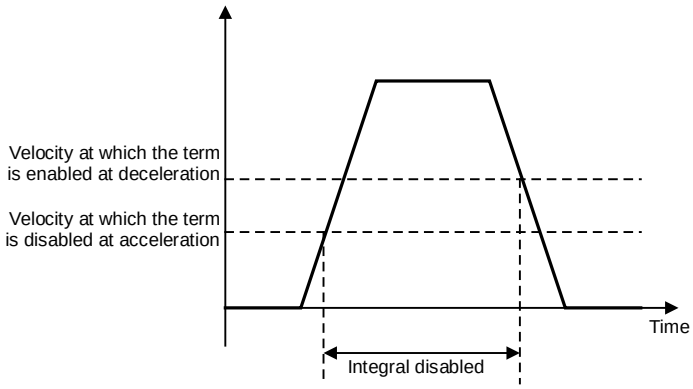


Fig. 5.7.2 (a) Integration invalid range at low-speed integral

5.8 CONTROL STOP FUNCTIONS

5.8.1 Brake Control

(1) Overview

This function prevents the tool from dropping vertically when a servo alarm or emergency stop occurs. The function prevents the motor from being immediately deactivated, instead keeping the motor activated for the period specified in the corresponding parameter, until the mechanical brake is fully applied.

(2) Hardware configuration

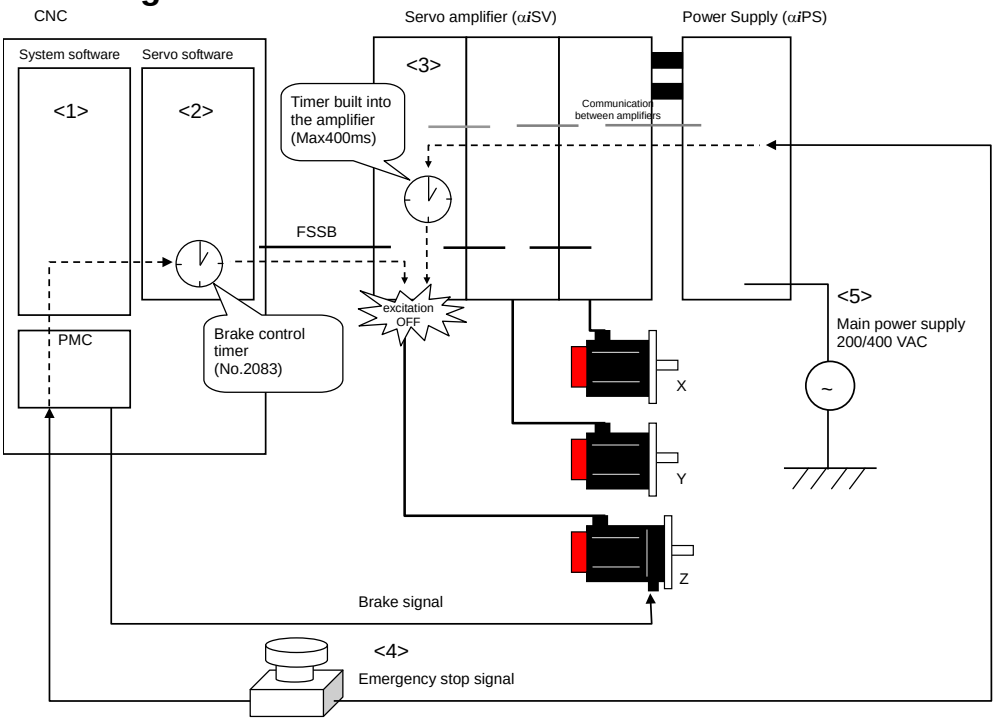


Fig. 5.8.1 (a) Example of configuration

The numbers of the following descriptions correspond to those in the figure:

<1> Applicable system software: All

<2> Applicable servo control software: All

<3> Servo amplifier:

- For the servo amplifiers for the αiSV-B and βiSVSP-B including 2-axis and 3-axis amplifiers, the brake control can be set for each axis.
- For servo amplifiers other than those for the αiSV-B and βiSVSP-B, the use of **a 1-axis servo amplifier** is recommended since the brake control cannot be set for each axis when you want to use the control for a 2-axis or 3-axis amplifier.

For an axis to which the brake control is not applied, any servo amplifier can be used.

NOTE

- If you want to use the brake control function with a 2-axis or 3-axis amplifier other than that for the α*i*SV-B and β*i*SVSP-B, specify the brake control parameters for all axes on the multiaxis amplifier including the target axis. In this case, however, if an alarm is issued for any of the axes connected to the multiaxis amplifier, the brake control function does not operate effectively.
- For the Series 30*i*-A and 0*i*-D, if you want to use the brake control, quick stop, or lifting function against gravity at emergency stop with a multiaxis amplifier for which a dummy axis is set, be sure to connect a dummy connector.

<4> Emergency stop signal

With the α*i* series, a timer for the emergency stop signal is built into the α*i*SV. While motor excitation is kept by brake control, the timer in the α*i*SV is used to extend the excitation time that lasts until the emergency stop signal operates.

Motor deexcitation can be delayed by the α*i*SV for 50 ms, 100 ms, 200 ms, and 400 ms. To delay motor deexcitation by brake control for 400 ms or more, insert a timer in the contact signal of the emergency stop signal and +24 V, and delay the emergency stop signal to be input to the α*i*PS, as has been done up until now. (For α*i*SV timer setting, see Item (3) "Setting parameters" below.)

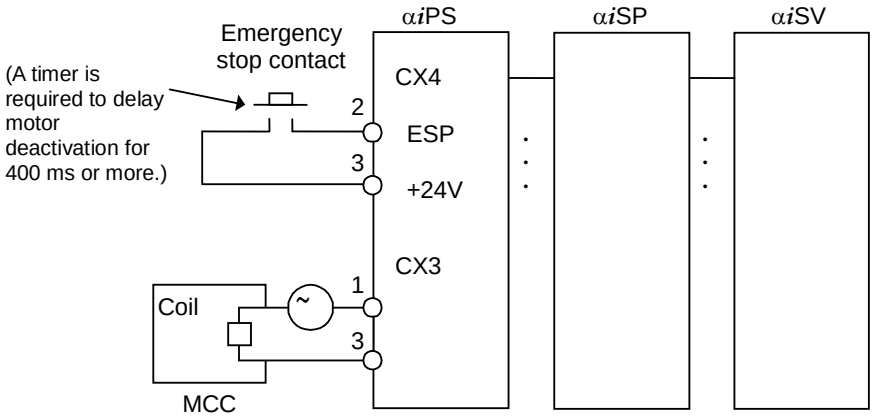


Fig. 5.8.1 (b) α*i* series amplifier

<5> 200/400 VAC

If the 200 VAC or 400 VAC supply to the servo amplifier is cut, the brake control will not work.

To cause the brake control to work effectively even in a power failure, apply the power failure machine protection.

(3) Setting parameters

<1> Brake control function enable/disable bit

	#7	#6	#5	#4	#3	#2	#1	#0
2005		BRKC						

BRKC (#6) The brake control is:

0: Disabled.

1: Enabled.

<2> Excitation delay

2083	Brake control timer

[Unit of data] msec

[Valid data range] 0 to 16000

(Example) To specify an excitation delay of 200 ms, set the brake control timer usually with 200 (appropriately).

Also set the timer connected to the emergency stop contact with the same value as set for the parameter.

<3> Setting the emergency stop timer built into the α*i*SV

	#7	#6	#5	#4	#3	#2	#1	#0
2210		ESPTM1	ESPTM0					

ESPTM1 (#6), ESPTM0 (#5)

Set a period of time from the input of the emergency stop signal into the α*i*PS until emergency stop operation is actually performed in the servo amplifier (α*i*SV).

ESPTM1	ESPTM0	Delay time
0	0	50 ms (default)
0	1	100 ms
1	0	200 ms
1	1	400 ms

Set a longer time than the setting of the brake control timer (parameter No. 2083) to parameter No. 2210.

NOTE

For those axes that are connected to a multiaxis amplifier other than that for the α*i*SV-B and β*i*SVSP-B, the parameters above need to be set in the same way.

(4) Details

Suppose that there is a machine having horizontal and vertical axes of motion. If a servo alarm(NOTE 1) occurs on an axis, the READY signal is turned off for the amplifiers for all axes. If the emergency stop button is pressed, the READY signal is also turned off for the amplifiers for all axes. When the READY signal is turned off for an amplifier, the force to support the tool is lost, so the mechanical brake functions to prevent the tool from dropping vertically.

Since it takes time until the mechanical brake actually functions and force is generated, the tool may drop vertically, causing the workpiece or tool to be damaged.

The brake control delays the timing to turn the READY signal for the amplifiers off to prevent the tool from dropping by making the servo motor support the tool until the mechanical brake functions.

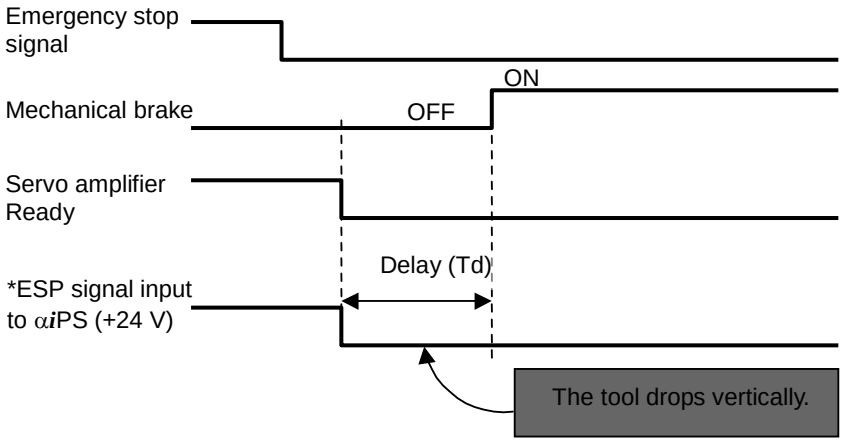


Fig. 5.8.1 (c) When the brake control function is not used

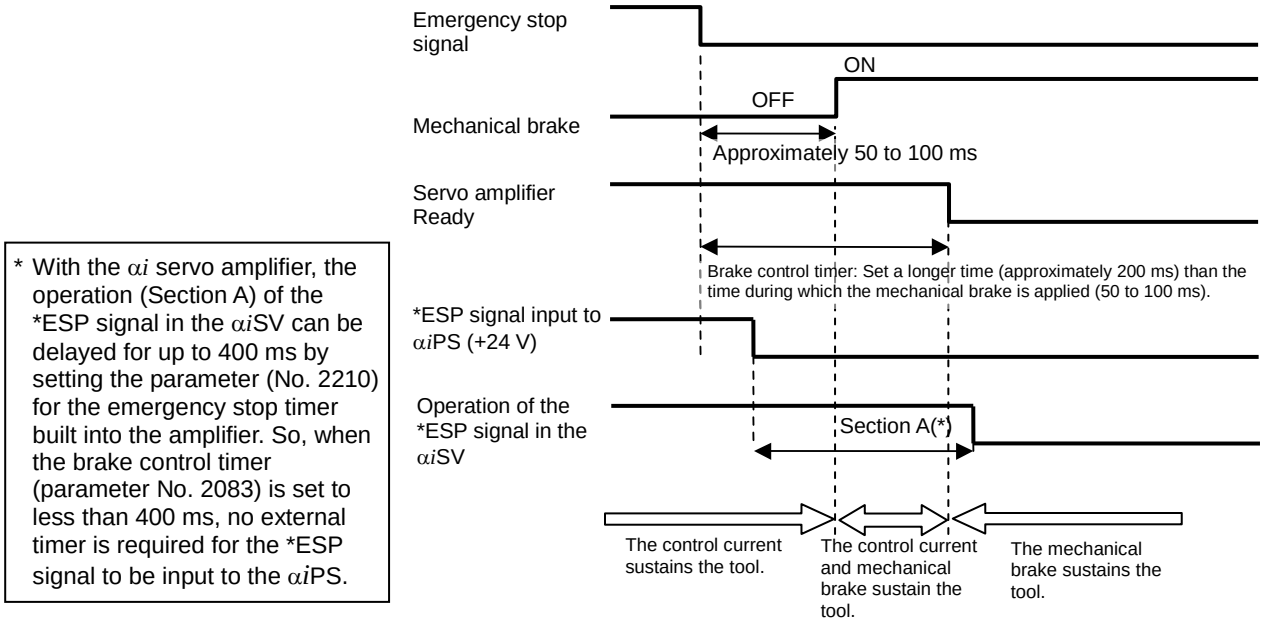


Fig. 5.8.1 (d) When the brake control function is used

NOTE

1 The servo alarm mentioned in the above description refers to a servo alarm detected by the software (OVC alarm, motor overheat alarm, software disconnection alarm, etc.), an alarm detected by the servo amplifier, or a servo alarm detected by the CNC (excessive error).
If a servo alarm occurs on the axis using this function, no brake control is performed on the axis (except for a motor overheat alarm).

2 For brake control, use the SA signal (F0.6, which is common to all axes).

5.8.2 Torque Limit Setting during Brake Control

(1) Overview

This function can be used to limit the torque during brake control. This function is useful in avoiding a large torque.

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	A(01) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(3) Setting parameters

	#7	#6	#5	#4	#3	#2	#1	#0
2273	DBTLIM							

DBTLIM (#7) Torque limit setting during brake control is:
0: Disabled.
1: Enabled.

2375	Torque limit magnification during brake control

[Unit of data] % (The maximum torque is assumed to be 100%.)
[Valid data range] 30 to 100 (Default: 70%)

> ⚠ **CAUTION**
> If too small of a value is specified for the torque limit, the stop distance becomes longer, which may cause the tool to collide with the machine or workpiece. Carefully specify the parameter value.

> **NOTE**
> - When a value of 0 or less is specified for the torque limit magnification during brake control, 70% is applied. When a value of 100 or greater is specified, 100% (maximum torque) is applied.
> - This function cannot be used together with the quick stop function at emergency stop.

The following functions are also provided to reduce the motor stop distance and prevent the tool from colliding with the machine or workpiece if a disconnection, overheat, or OVC alarm occurs in the separate detector or at emergency stop.

5.8.3 Quick Stop Type 1 at Emergency Stop

(1) Overview

This function reduces the stop distance by resetting the velocity command for a servo motor to 0 at a position where an emergency stop signal is detected for the servo motor. To further reduce the stop distance required for the motor to stop, use quick stop type 2 at emergency stop described in Subsection 5.8.4.

NOTE

- For the Series 30*i*-A and 0*i*-D, if you want to use the brake control, quick stop, or lifting function against gravity at emergency stop with a multiaxis amplifier for which a dummy axis is set, be sure to connect a dummy connector.

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0	03.0 and subsequent editions	
	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(3) Setting parameters

	#7	#6	#5	#4	#3	#2	#1	#0
2017								DBST

DBST (#0) The quick stop type 1 at emergency stop is:
0: Disabled.
1: Enabled.

When using the quick stop function at emergency stop, make the brake control settings described in Subsection 5.8.1 for all the axes to which this function is applied.

NOTE

When only the brake control is set, a gradual stop occurs with the torque limit set by the torque limit setting function during brake control.
When the quick stop function at emergency stop is enabled, a gradual stop occurs with the torque limit set to 100%, so that the stop distance is reduced.

(4) Timing diagram

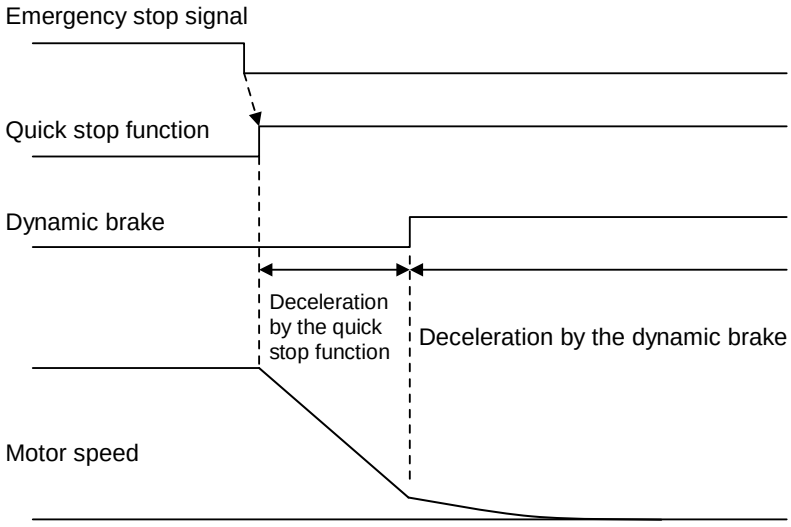


Fig. 5.8.3 (a) Timing diagram of quick stop

(5) Connection of amplifier

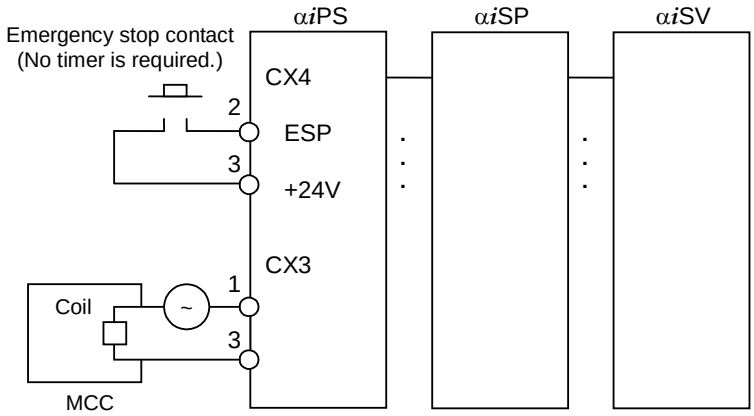


Fig. 5.8.3 (b) αi series amplifier

5.8.4 Quick Stop Type 2 at Emergency Stop

(1) Overview

This function returns a servo motor to a position where an emergency stop signal is detected for the servo motor and stops the motor, thereby assuring a shorter stop distance than with quick stop type 1 at emergency stop.

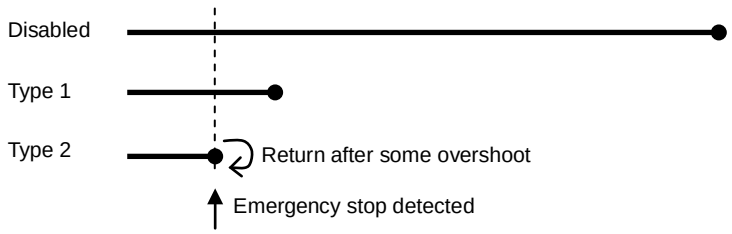


Fig. 5.8.4 (a) Diagram for comparing stop distances

> **NOTE**
> - For the Series 30*i*-A and 0*i*-D, if you want to use the brake control, quick stop, or lifting function against gravity at emergency stop with a multiaxis amplifier for which a dummy axis is set, be sure to connect a dummy connector.

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0	03.0 and subsequent editions	
	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(3) Setting parameters

To use this function, it is necessary to set the following parameter in addition to the brake control settings described in Subsection 5.8.1.

	#7	#6	#5	#4	#3	#2	#1	#0
2204	DBS2							

DBS2(#7) The quick stop type 2 at emergency stop is:
0: Disabled.
1: Enabled.

NOTE
1 Like type 1, type 2 requires that the brake control parameter be set.
2 The method of connecting the amplifier for type 2 is the same as for type 1.
3 If both type 1 and type 2 function bits are set, type 2 function is assumed.

5.8.5 Lifting against Gravity at Emergency Stop

NOTE
- For the Series 30*i*-A and 0*i*-D, if you want to use the brake control, quick stop, or lifting function against gravity at emergency stop with a multiaxis amplifier for which a dummy axis is set, be sure to connect a dummy connector.

5.8.5.1 Lifting against gravity at emergency stop

(1) Overview

This function is intended to lift and stop the vertical axis (Z-axis) of a vertical machining center when the machine comes to an emergency stop or power failure (for details of how the tool is prevented from dropping vertically at a power failure, refer to the description about power failure detection in the relevant servo amplifier descriptions).

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0	03.0 and subsequent editions	
	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(3) Setting parameters

To use this function, it is necessary to make the brake control settings described in Subsection 5.8.1 and enable quick stop type 2 at emergency stop (quick stop type 1 at emergency stop (bit 0 of No. 2017) is not needed).

2373	Distance to lift

This parameter is for determining the distance to lift upon an emergency stop. The larger the value, the larger the lift distance becomes.

[Unit of data] Detection unit or 1 μm (⇒ See Subsection 5.8.5.3.)

[Valid data range] -32767 to 32767
[Recommended value] Approximately 500 (detection unit of 1 μm)
Approximately 5000 (detection unit of 0.1 μm)

NOTE
1 If the brake is in use, it starts working while the vertical axis is being lifted. This means that the distance through which the axis is actually lifted differs from the setting.
2 Whether the parameter values is positive or negative matches whether the machine coordinate value is positive or negative.
3 Using this function causes the load to stop after moving it to one side of the machine. So, it should be used for the vertical axis (Z-axis) of a vertical machining center in which an axis retracts in a fixed single direction at an emergency stop.

2374	Lifting time

This parameter determines the lifting time as measured from the time of an emergency stop. The distortion easing function is executed after the lifting time has elapsed. This function is intended to decrease the amount of machine elastic strain that can increase when a vertical axis is lifted when the machine is about to apply the brake. Executing this function can reduce the shock that may occur when the axis drops because the servo amplifier stops energizing. The initial value of the function is a quarter of the distance to lift. (See the following figure.)

[Unit of data] ms
[Valid data range] Specify an integer multiple of 4 (Series 30*i*) or of 8 (Series 0*i*) between 8 and 32767.
[Recommended value] Approximately 16 to 24 ms

NOTE
1 To use the lifting function against gravity at emergency stop, specify 4 ms or longer (Series 30*i*) or 8 ms or longer (Series 0*i*) as the lifting time.
2 If the distortion easing function is not used, specify a time longer than or equal to the one set for the brake control timer as the lifting time.

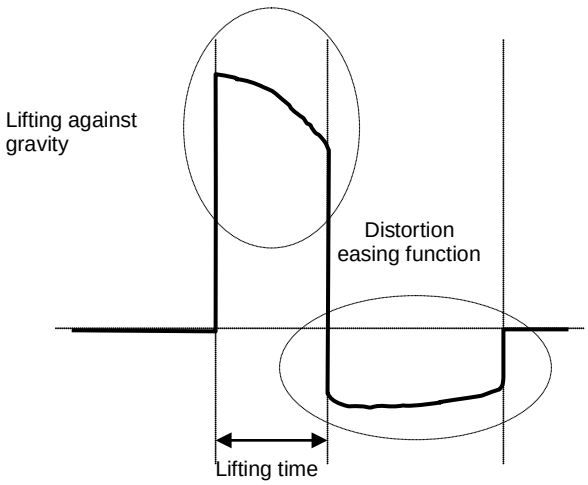


Fig. 5.8.5.1 (a) Velocity command

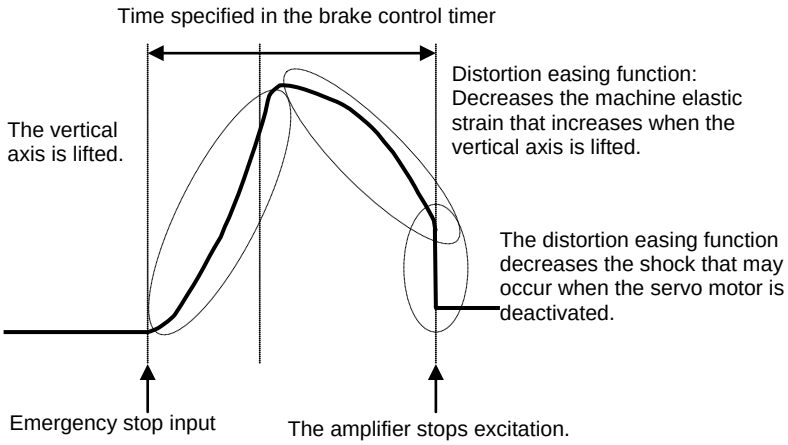


Fig. 5.8.5.1 (b) Motor position waveform

> **NOTE**
> If the vertical axis (Z-axis) is connected to a multiaxis amplifier other than a servo amplifier for the αiSV-B and βiSVSP-B, it is necessary to enable the brake control for all the axes connected to the amplifier. In this case, the largest of the values specified for the axes is assumed to be the delay time.

(4) Example of using the parameter

The following example shows the effect of using the lifting function against gravity at emergency stop for the vertical axis (Z-axis). In this example, the distance to lift is 500 μm, and the lifting time is 16 ms. The vertical axis of the graph is graduated 2 μm/div.

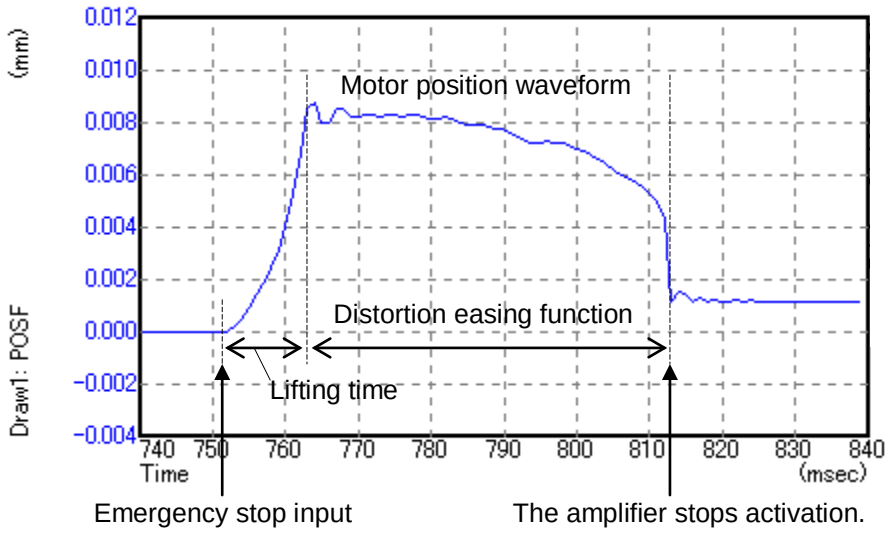


Fig. 5.8.5.1 (c) Motor position waveform

As seen from the graph, the motor is lifted through a large distance after an emergency stop signal is input. The distortion easing function decreased the machine elastic strain and kept the motor from falling when the amplifier stopped energizing. The position where the motor finally rested is higher than the position where the motor was before the emergency stop signal was input.

NOTE
1 In this example, positive coordinates of the machine coordinate system correspond to the direction in which the axis is lifted.
2 Variation occurs in the position where the Z-axis stops depending on the direction in which the Z-axis is moving before an emergency stop. When tuning the parameter, it is necessary to take into account both the position where the motor rests before the axis is moved up and the position where the motor rests after the axis is moved down.

5.8.5.2 Switching the distance to lift based on the DI signal

(1) Overview

With the lifting function against gravity at emergency stop, switching between two types of parameters for specifying a distance to lift is enabled based on the DI signal of the PMC. By setting either parameter to 0, lift operation can be temporarily disabled.

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	P(16) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	P(16) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(3) Switching signal

Signal for switching the distance to lift for the lifting function against gravity at emergency stop

	#7	#6	#5	#4	#3	#2	#1	#0
Gn323	SWDBS8	SWDBS7	SWDBS6	SWDBS5	SWDBS4	SWDBS3	SWDBS2	SWDBS1

[Classification] Input signal

[Function] This signal is used to switch the distance to lift when the lifting against gravity at emergency stop is enabled. A number suffixed at the end of the signal represents the number of each controlled axis.

[Operation] The distance to lift for the lifting function against gravity at emergency is as follows:
SWDBSx = 0: Value set for parameter No. 2373
SWDBSx = 1: Value set for parameter No. 2173

NOTE
1 The distance to lift depends on the state of SWDBSx present when the emergency stop command is input. (If this signal is changed during lift operation after the emergency stop command is input, the change does not become effective until the lift operation is completed and the excitation is turned off.)
2 Among the parameters related to the lifting against gravity at emergency stop, the parameters other than those related to the distance to lift are common, regardless of the state of SWDBSx.

(4) Setting parameters

To use this function, set the following parameters in addition to the settings of the lifting against gravity at emergency stop described in Subsection 5.8.5.1.

2373	Distance to lift (when SWDBSx = 0)

This parameter is for determining the distance to lift upon an emergency stop. The larger the value, the larger the lift distance becomes.

[Unit of data] Detection unit or 1 μm (⇒ See Subsection 4.11.3.3.)
[Valid data range] -32767 to 32767
[Recommended value] Approximately 500 or -500 (detection unit of 1 μm)
Approximately 5000 or -5000 (detection unit of 0.1 μm)

This parameter is effective only when the signal (SWDBSx) for switching the distance to lift for the lifting function against gravity at emergency stop is set to 0. To disable lift operation when (SWDBSx) = 0, set this parameter to 0.

2173	Distance to lift (when SWDBSx = 1)

This parameter is for determining the distance to lift upon an emergency stop. The larger the value, the larger the lift distance becomes.

[Unit of data] Detection unit or 1 μm (⇒ See Subsection 4.11.3.3.)
[Valid data range] -32767 to 32767
[Recommended value] Approximately 500 or -500 (detection unit of 1 μm)
Approximately 5000 or -5000 (detection unit of 0.1 μm)

This parameter is effective only when the signal (SWDBSx) for switching the distance to lift for the lifting function against gravity at emergency stop is set to 1.

NOTE
1 When a brake is used, brake application starts during lift operation, so that the set value does not match the actual lift distance.
2 The parameter polarity matches the polarity of the machine coordinate system.
3 Use this function only when lift operation does not cause a mechanical interference.

5.8.5.3 Method of setting a distance to lift in μm

(1) Overview

When the servo control software below is used for the lifting against gravity at emergency stop, the parameter for specifying a distance to lift can be set in μm, independently of the detection unit. With this function, a large distance to lift can be used even if a small detection unit is used.

(2) Series and edition of applicable servo control software

[Applicable servo control software]

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0	03.0 and subsequent editions	
	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	P(16) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	P(16) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

[Applicable system software]

CNC	System software	
	Series	Edition
Series 30*i*-A	G00C, G01C, G02C	27 and subsequent editions
	G004, G014, G024	01 and subsequent editions
Series 31*i*-A5	G12C, G13C	27 and subsequent editions
	G124, G134	01 and subsequent editions
Series 31*i*-A	G103, G113	06 and subsequent editions
	G104, G114	01 and subsequent editions
Series 32*i*-A	G203	06 and subsequent editions
	G204	01 and subsequent editions
Series 0*i*-MD	D4F1	01 and subsequent editions
Series 0*i*-TD	D6F1	01 and subsequent editions
Series 0*i* Mate-MD	D5F1	01 and subsequent editions
Series 0*i* Mate-TD	D7F1	01 and subsequent editions

For the series 30*i*/31*i*/32*i*/35*i*-B and Power Motion *i*-A, all series and editions support this function.

(3) Setting parameters

To use this function, set the following parameter in addition to the settings of the lifting against gravity at emergency stop described in Subsection 5.8.5.1.

	#7	#6	#5	#4	#3	#2	#1	#0
2298	DUNIT							

DUNIT(#7) The unit for the setting value of the parameter for specifying a distance to lift for the lifting against gravity at emergency stop is:
0: Detection unit.
1: μm.

NOTE
1 When this function is enabled, the parameter (No. 2373 or No. 2173) for specifying a distance to lift for the lifting against gravity at emergency stop can be set in μm, independently of the detection unit.
2 When this parameter has been set, the power must be turned off before operation is continued.
3 If this function is used with a CNC that does not support the function for sending the detection unit to servo control software, an illegal parameter setting alarm (detail number 2982) is issued.

5.8.5.4 Superimposition specified for lifting against gravity at power failure

(1) Overview

This function superimposes the parameter values set for the vertical axis onto a move command to prevent a workpiece from being damaged at power failure in a vertical machining center. Using this function in combination with the feed hold function allows the vertical axis to escape upward if a power failure occurs during machining.

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	25.0 and subsequent editions	
Power Motion *i*-A	90J0	02.0 and subsequent editions	
	90K0	02.0 and subsequent editions	
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(3) Setting parameters

To use this function, set the following parameters in addition to the brake control settings described in Subsection 5.8.1.

	#7	#6	#5	#4	#3	#2	#1	#0
2571								PWSTBK

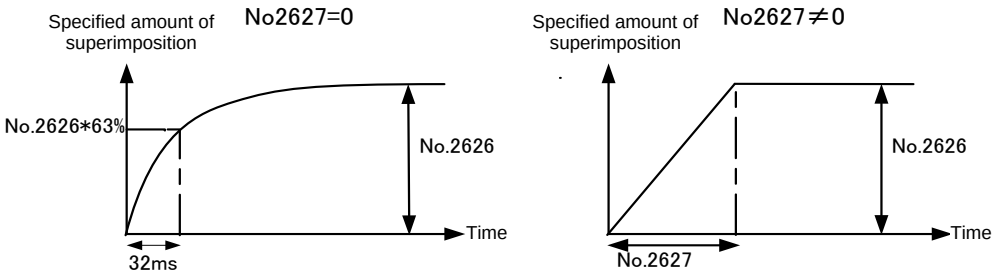
PWSTBK (#0) Command superimposition for lifting against gravity at power failure is:
0: Disabled.
1: Enabled. (to be set for the vertical axis)

2626	Amount of superimposition specified for lifting against gravity at power failure

[Unit of data] μm
[Valid data range] -32768 to 32767
[Setting value] The sign indicates the direction of the machine coordinate value.
If + is set, the specified amount is superimposed in the plus direction of the machine coordinate value.
If - is set, the specified amount is superimposed in the minus direction of the machine coordinate value.

2627	Superimposition for lifting against gravity at power failure time constant

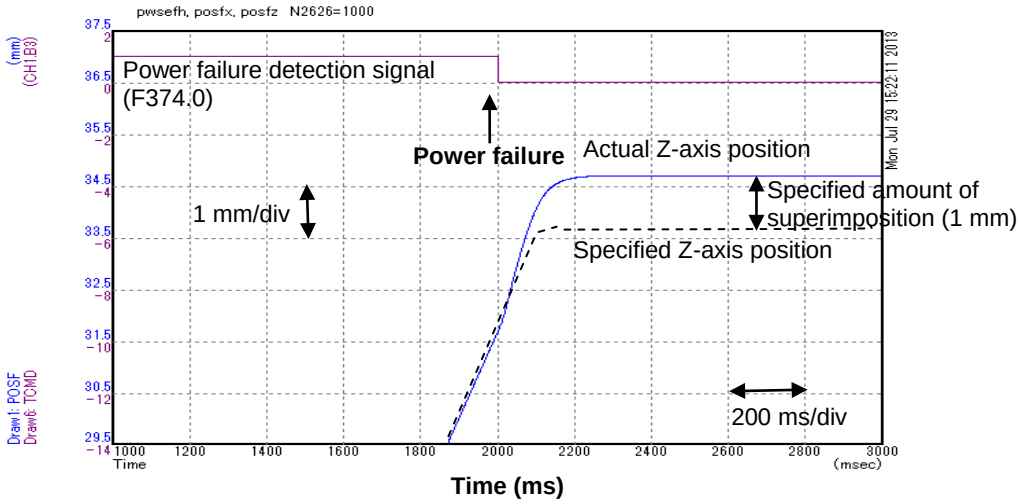
[Unit of data] ms
[Valid data range] 0 to 32767
[Setting value] 0 The time constant for lifting is exponential. The time constant is 32 ms (fixed).
Other than 0 The time constant for lifting is linear. The time constant is the value set for parameter No. 2627.



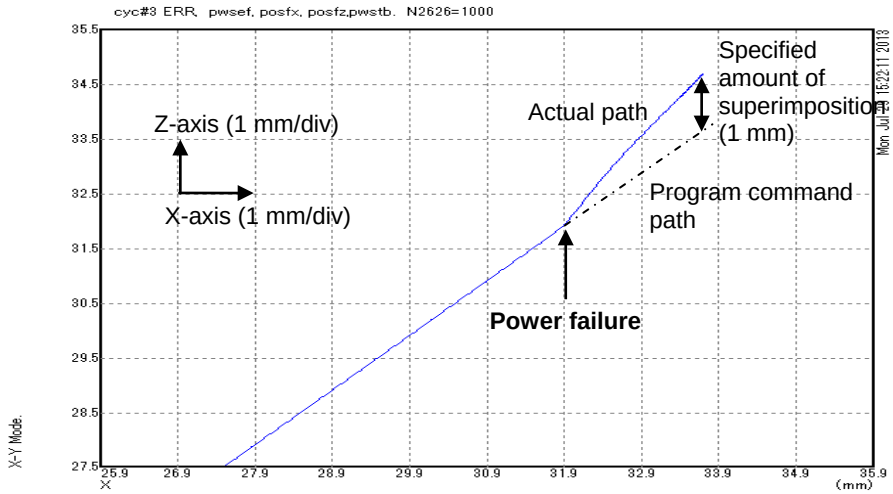
(4) Application example

The following figure shows waveforms that may be generated if a power failure occurs when the tool moves at a feedrate of 1414 mm/min in the 45-degree direction on the X-Z plane. If a power failure occurs, the Z-axis is pulled up by the specified amount of superimposition relative to the specified path and then stopped.

■ Z position-time waveform



■ XZ path



5.8.6 Quick Stop for Hardware Disconnection of Separate Detector

(1) Overview

This function reduces the stop distance by resetting the velocity command for a servo motor to 0 when the separate detector for the servo motor encounters a hardware disconnection condition. It also causes the other axes to stop sooner than they would when a usual alarm occurs.

NOTE

- For the Series 30*i*-A and 0*i*-D, if you want to use the brake control, quick stop, or lifting function against gravity at emergency stop with a multiaxis amplifier for which a dummy axis is set, be sure to connect a dummy connector.

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0	03.0 and subsequent editions	
	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(3) Setting parameters

To use this function, set the following parameters in addition to the brake control settings described in Subsection 5.8.1.

	#7	#6	#5	#4	#3	#2	#1	#0
2205				HDIS	HD2O			

HD2O (#3) The quick stop function for hardware disconnection of separate detector is:
0: Not applied to axes under synchronous control.
1: Applied to axes under synchronous control.

HDIS (#4) The quick stop function for hardware disconnection of separate detector is:
0: Disabled.
1: Enabled.
* For the FS30*i*-B, Power Motion *i*-A, and FS0*i*-F, when bit 4 of parameter No. 2205 or bit 5 of parameter No. 2282 is set, the quick stop function for separate detector alarms is enabled.

Setting	Alarms to which the quick stop function applies	
	FS30*i*-A, FS0*i*-D	FS30*i*-B, Power Motion *i*-A, FS0*i*-F
No. 2205#4 = 1	Hardware disconnection of the phase A/B detector	Hardware disconnection of the phase A/B detector or separate serial detector alarm
No. 2282#5 = 1	Separate serial detector alarm	

NOTE

1 When applying this function to axes under feed axis synchronization control, follow the steps below:
   1) Change the servo axis setting (No. 1023) of the two axes under feed axis synchronization to set an odd-numbered axis as the master axis and an even-numbered axis ((master axis number) + 1) as the slave axis.
   2) Set HD2O (bit 3) to 1 for both axes under synchronous control.
2 This function is implemented using part of the unexpected disturbance torque detection option. Therefore, to use this function, the unexpected disturbance torque detection option is required.
3 Usually, when a separate detector disconnection alarm occurs for an axis, the other axes are brought to an emergency stop as well. If an unexpected disturbance torque detection group is set up, however, only the axes in the same group as the axis for which an alarm condition has occurred are brought to an emergency stop.
4 If the value (No. 1880) specified as an interval between the detection of an unexpected disturbance torque and the occurrence of an emergency stop is small, it may impossible to ensure sufficient stop time. The value should be at least greater than or equal to the one specified in the brake control timer parameter (there is no problem with a setting value of 0, because it means 200 ms).

5.8.7 Quick Stop for Separate Serial Detector Alarms

(1) Overview

This function reduces the stop distance by setting the velocity command for the servo motor to 0 when the separate serial detector is placed in an alarm state indicated below. With this function, motion on the axes other than the axis with which any of the alarms below is issued is also stopped quicker than in the case of an ordinary alarm.

Alarm number	Description
SV0380	BROKEN LED (EXT)
SV0381	ABNORMAL PHASE (EXT)
SV0382	COUNT MISS (EXT)
SV0383	PULSE MISS (EXT)
SV0384	SOFT PHASE ALARM (EXT)
SV0385	SERIAL DATA ERROR (EXT)
SV0386	DATA TRANS. ERROR (EXT)
SV0387	ABNORMAL ENCODER (EXT)

NOTE

- For the Series 30*i*-A and 0*i*-D, if you want to use the brake control, quick stop, or lifting function against gravity at emergency stop with a multiaxis amplifier for which a dummy axis is set, be sure to connect a dummy connector.

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	03.0 and subsequent editions	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	L(12) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	L(12) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(3) Setting parameters

To use this function, set the following parameters in addition to the brake control settings described in Subsection 5.8.1.

	#7	#6	#5	#4	#3	#2	#1	#0
2282			FSAQS					

FSAQS(#5) The quick stop function for separate serial detector alarms is:
0: Disabled.
1: Enabled.

* For the FS30*i*-B, Power Motion *i*-A, and FS0*i*-F, when bit 4 of parameter No. 2205 or bit 5 of parameter No. 2282 is set, the quick stop function for separate detector alarms is enabled.

Setting	Alarms to which the quick stop function applies	
	FS30*i*-A, 0*i*-D	FS30*i*-B, Power Motion *i*-A, FS0*i*-F
No. 2205#4 = 1	Hardware disconnection of the phase A/B detector	Hardware disconnection of the phase A/B detector or separate serial detector alarm
No. 2282#5 = 1	Separate serial detector alarm	

	#7	#6	#5	#4	#3	#2	#1	#0
2205					HD2O			

HD2O(#3) When a separate serial detector alarm is issued, two-axis simultaneous stop is:
0: Disabled.
1: Enabled.

* This parameter can be used with either the quick stop function for hardware disconnection of separate detector (bit 4 of No. 2205 = 1) or the quick stop function for separate serial detector alarms (bit 5 of No. 2282 = 1).

5.8.8 Quick Stop at OVL and OVC Alarms

(1) Overview

This function reduces the stop distance for a servo motor when an OVL (motor overheat or amplifier overheat) or OVC alarm condition is detected for the servo motor. It also causes the other axes to stop sooner than they would when a usual alarm occurs.

NOTE

- For the Series 30*i*-A and 0*i*-D, if you want to use the brake control, quick stop, or lifting function against gravity at emergency stop with a multiaxis amplifier for which a dummy axis is set, be sure to connect a dummy connector.

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0	03.0 and subsequent editions	
	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(3) Setting parameters

To use this function, set the following parameters in addition to the brake control settings described in Subsection 5.8.1.

	#7	#6	#5	#4	#3	#2	#1	#0
2212	OVQK							

OVQK(#7) Specifies whether to enable the quick stop function at the OVC and OVL alarms as follows:

0: Disabled.

1: Enabled.

NOTE

The operation of this function is performed by using part of the unexpected disturbance torque detection option. Therefore, to use this function, the unexpected disturbance torque detection option described in Section 5.9 is required.

5.9 UNEXPECTED DISTURBANCE TORQUE DETECTION FUNCTION (OPTION)

5.9.1 Unexpected Disturbance Torque Detection Function

(1) Overview

When a tool collides with the machine or workpiece, or when a tool is faulty or damaged, a load torque greater than that experienced during normal feed is imposed. This function monitors the load torque to the motor at servo high-speed sampling intervals. If it detects an abnormal torque, it brings the axis to an emergency stop by issuing an alarm, or reverses the motor by an appropriate amount. In addition, the function enables the PMC to be used to switch the speed at warning occurrence or load fluctuation.

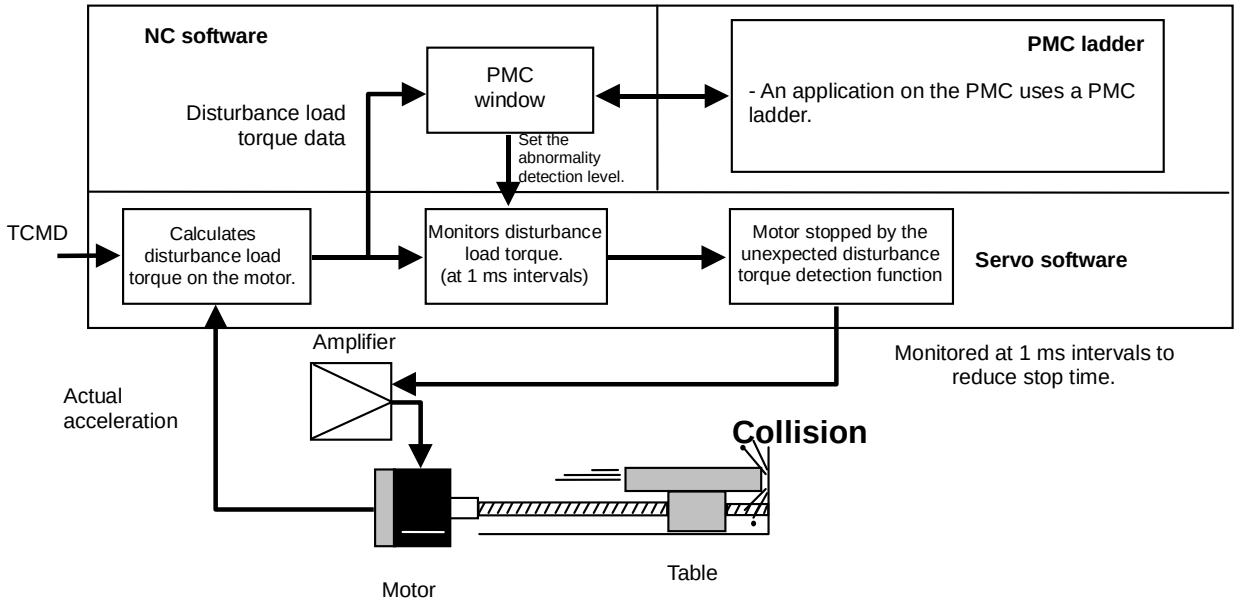


Fig. 5.9.1 (a) Overview of unexpected disturbance torque detection

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0	03.0 and subsequent editions	
	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(3) Parameter adjustment procedure

<1> Enable the unexpected disturbance torque detection function.

	#7	#6	#5	#4	#3	#2	#1	#0
2016								ABNT

ABNT(#0) The unexpected disturbance torque detection function is:
0: Disabled.
1: Enabled.

Moreover, **be sure to set 1** to the following parameters as well.

	#7	#6	#5	#4	#3	#2	#1	#0
2200						IQOB		

IQOB(#2) In disturbance estimation, the impact of control voltage saturation is:
0: Not taken into consideration.
1: Eliminated.

<2> Set up the parameters related to the observer.

2050	Observer gain
2051	Observer gain

Table 5.9.1 (a) Setting value of observer gain

	HRV1, HRV2, HRV3	HRV4
No. 2050	Change 956 (standard setting value) to 3559.	Change 264 (standard setting value) to 1420.
No. 2051	Change 510 (standard setting value) to 3329.	Change 35 (standard setting value) to 332.

NOTE
When using this function together with the observer, do not modify the standard setting of the parameter above.
Observer: No. 2003#2

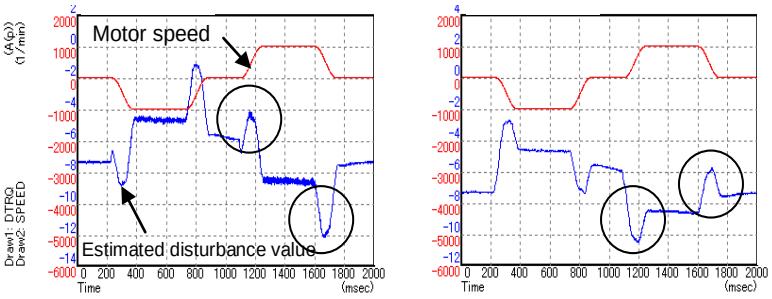
<3> Make adjustments on the **POA1** observer parameter.

2047	Observer parameter (POA1)

NOTE
When a negative value is set for POA1,
it is assumed to be |POA1| × 10.

Make the servo motor perform linear back and forth operation at a speed equal to about 50% of the rapid traverse rate, and observe the motor speed (SPEED) and the estimated disturbance value (DTRQ). The waveform observed before the adjustment shows one of the following features:

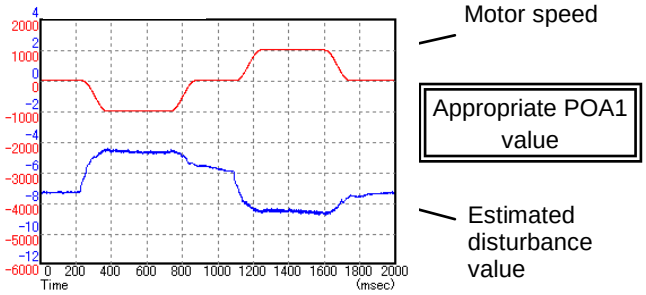
Example of measurement: 1000 min^{-1} (when using a rotary motor)



Insufficient POA1 value
Overshoot or undershoot on the estimated disturbance value

Excessive POA1 value
Overshoot or undershoot on the estimated disturbance value (in the direction opposite to the overshoot or undershoot caused by an insufficient POA1 value)

Adjust the value of the observer parameter (POA1) so that neither an overshoot nor an undershoot will be observed on the estimated disturbance value at acc./dec. (see the figure below).
(A clear waveform as shown below may not be obtained in some machines. In such machines, find the POA1 parameter value that can minimize the overshoot and undershoot while watching the estimated disturbance waveform at acc./dec.)



NOTE

The POA1 parameter is internally related to the load inertia ratio parameter ("velocity gain" on the servo screen) in the software. When the load inertia ratio parameter is changed, the POA1 parameter must also be changed. So, first determine the load inertia ratio (velocity gain) when adjusting the servo.
If you must change the load inertia ratio (velocity gain) after the POA1 parameter is determined, re-set the POA1 parameter using the following expression.

New POA1 =

$$\text{POA1 initially determined} \times \frac{\text{Load inertia ratio value set after adjustment} + 256}{\text{Load inertia ratio value set before adjustment} + 256}$$

Load inertia ratio: No. 2021

The velocity gain magnification (in cutting or high-speed HRV current control) does not affect the setting of POA1.

(Details)

The observer estimates a disturbance torque by subtracting the torque required for acc./dec. from the entire torque. The torque required for acc./dec. is calculated using a motor model. The POA1 parameter corresponds to the inertia of the motor model. If the parameter value differs from the actual value, it is impossible to estimate a correct disturbance torque. To detect an unexpected disturbance torque correctly, therefore, you must adjust the value of this parameter.

Under normal conditions, an estimated disturbance value is supposed to be related only to frictional torque (for the horizontal axis), and proportional to the velocity Therefore, a program, like the one used for adjustment, that merely repeats simple acc./dec. is supposed to generate a trapezoidal estimated disturbance torque waveform like a velocity waveform.

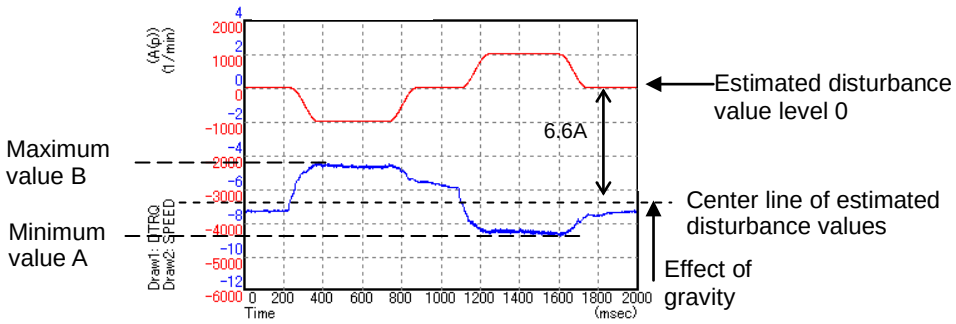
<4> For the vertical axis, adjust the torque offset. (This is unnecessary for the horizontal axis.)
For the vertical axis, the estimated disturbance value is not centered at level 0. Torque offset adjustment is done to center the estimated disturbance value at level 0.

2087	Torque offset parameter

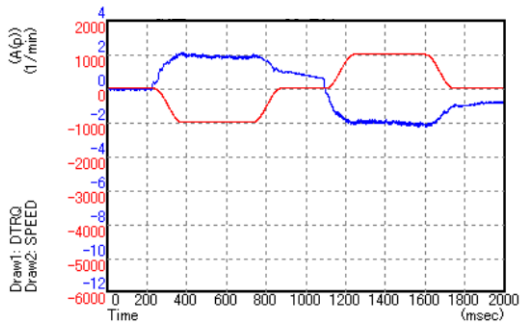
[Unit of data] TCMD (7282 with the maximum current value of the amplifier)
[Valid data range] -7282 to 7282

(Example of torque offset setting)
Estimated disturbance values for constant-velocity movements in the + direction and - direction are read. In the figure below, minimum value A (signed) is read in a movement in the + direction, and maximum value B (signed) is read in a movement in the - direction. A torque offset parameter setting is given using the following expressions:

$$\text{Torque offset} = \frac{A[Ap] + B[Ap]}{\text{Maximum current value of the amplifier [Ap]}} \times 3641$$



If the minimum value A is -8.6 Ap and maximum value B is -4.5 Ap in the above chart (the amplifier used is rated at 80 Ap maximum),
the torque offset parameter = -[(-8.6)+(-4.5)] / 80 × 3641 = 596.
The following chart applies when the parameter is set to 596.



When the torque offset parameter is set, **set** the following parameter to **1**.

	#7	#6	#5	#4	#3	#2	#1	#0
2215							TCPCLR	

TCPCLR(#1) The function for setting a value for canceling the torque offset at an emergency stop in the velocity loop integrator is:
0: Disabled.
1: Enabled.

NOTE
When using the torque offset canceling function (bit 1 of parameter No. 2215), do not use the function for adding a preload with a time constant (bit 4 of parameter No. 2417).

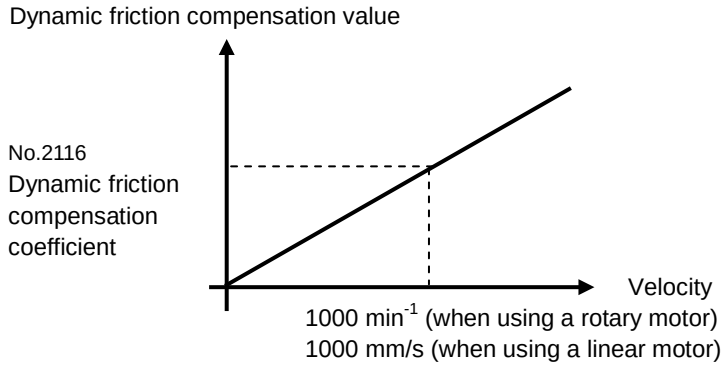
<5> Compensate for dynamic friction.
(i) Method of canceling a dynamic friction in proportion to velocity
Measure an estimated disturbance value at a constant velocity. Then, by assuming this measured value as a dynamic friction, set the proportional coefficient for a velocity and dynamic friction compensation value.

2116	Dynamic friction compensation coefficient

[Unit of data] See the equation below.
[Valid data range] -264 to 264
[Measurement velocity] Rotary motor: 1000 min^{-1}, Linear motor: 1000 mm/s
Measure an estimated disturbance value at a measurement velocity, then set the results of calculations made according to the table below.

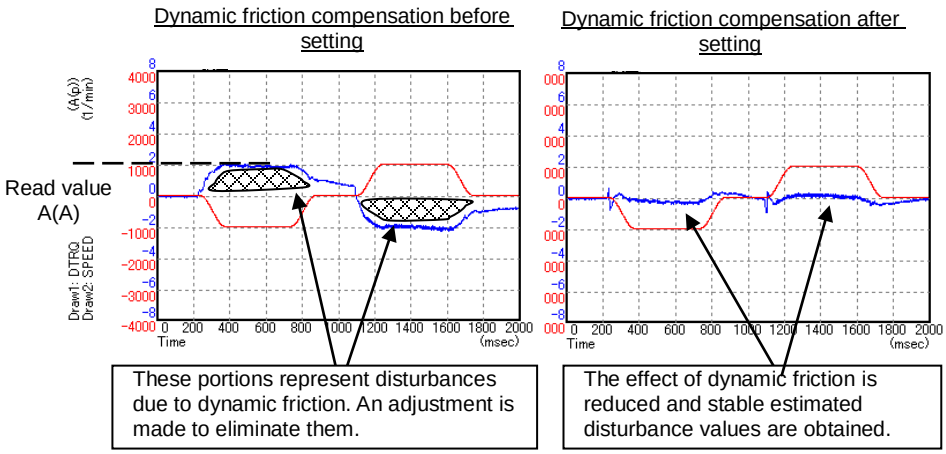
$$\text{Dynamic friction compensation coefficient} = -\frac{\text{Estimated disturbance value [Ap]}}{\text{Maximum current value of the amplifier [Ap]}} \times 440$$

NOTE
If the measurement velocity is too high, lower the measurement velocity, and measure the estimated disturbance value. By proportional calculation, obtain the estimated disturbance value at the above measurement velocity.



Set a compensation value at a measurement velocity, and correct the value proportional to the velocity as a dynamic friction.

(Example of setting for a rotary motor)
Suppose that the estimated disturbance value at 1000 min^{-1} is 1 Ap when the maximum amplifier current value is 40 Ap.
Dynamic friction compensation coefficient = 1/40 × 440 = 11

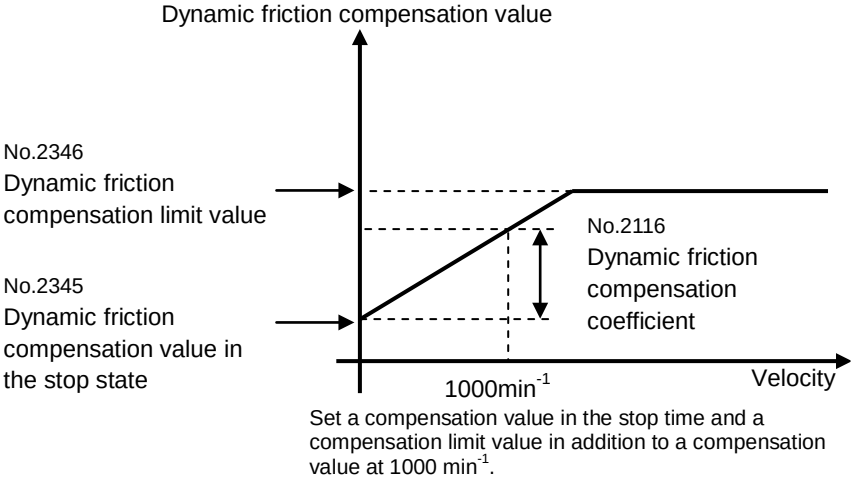


If the resolution of the dynamic friction compensation coefficient (parameter No. 2116) is insufficient, set the following function bit to 1. The dynamic friction compensation coefficient will be calculated by multiplying the value when the function bit is 0 by 1/128.

	#7	#6	#5	#4	#3	#2	#1	#0
2286	SLOPQ5							

SLOPQ5(#7) During dynamic friction compensation by the unexpected disturbance torque detection function, the dynamic friction compensation coefficient (parameter No. 2116) is:
0: As usual.
1: Multiplied by 1/128 (high-precision mode).

(ii) Method of setting a dynamic friction as "portion proportional to velocity + constant portion" and imposing a limit
If the compensation value for stop time to low-velocity movement is insufficient in adjustment of (i), set a dynamic friction compensation value in the stop state. If the compensation value for high-speed movement is excessive, a limit is imposed on the compensation value.



2345	Dynamic friction compensation value in the stop state

[Unit of data] TCMD (7282 when the estimated disturbance value is equivalent to the maximum current value of the amplifier)
[Valid data range] 0 to 7282
[Measurement velocity] 10 min^{-1} (rotary motor), 10 mm/s (linear motor)

2346	Dynamic friction compensation limit value

[Unit of data] TCMD (7282 when the estimated disturbance value is equivalent to the maximum current value of the amplifier)
[Valid data range] 0 to 7282
[Measurement velocity] Maximum feedrate

(Method of setting)

First, measure an estimated disturbance value when a movement is made at a maximum feedrate on the axis, then set "dynamic friction compensation limit value" to the results of the calculations made according to the table below.

$$\text{Dynamic friction compensation limit value} = -\frac{\text{Estimated disturbance value [Ap]}}{\text{Maximum current value of the amplifier [Ap]}} \times 7282$$

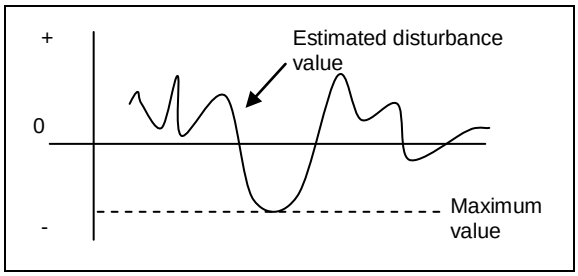
Next, measure an estimated disturbance value when a movement is made on the axis at the measurement velocity (10 min^{-1} or 10 mm/s) for "dynamic friction compensation value in the stop state", then set "dynamic friction compensation value in the stop state" to the results of the calculations made according the table below.

$$\text{Dynamic friction compensation value in the stop state} = -\frac{\text{Estimated disturbance value [Ap]}}{\text{Maximum current value of the amplifier [Ap]}} \times 7282$$

Finally, measure an estimated disturbance value when a movement is made on the axis at the measurement velocity (1000 min^{-1} or 1000 mm/s) for "dynamic friction compensation coefficient", then set "dynamic friction compensation coefficient" to the results of the calculations made according the table below.

$$\text{Dynamic friction compensation value in the stop state} = -\frac{\text{Estimated disturbance value [Ap]}}{\text{Maximum current value of the amplifier [Ap]}} \times 440$$

<6> Set an unexpected disturbance torque detection alarm level.
Perform several different operations (sample machining program, simultaneous all-axis rapid traverse acc./dec., etc.), observe the estimated disturbance values, and measure the absolute maximum value. Then, set up an alarm level.



2104	Unexpected disturbance torque detection alarm level

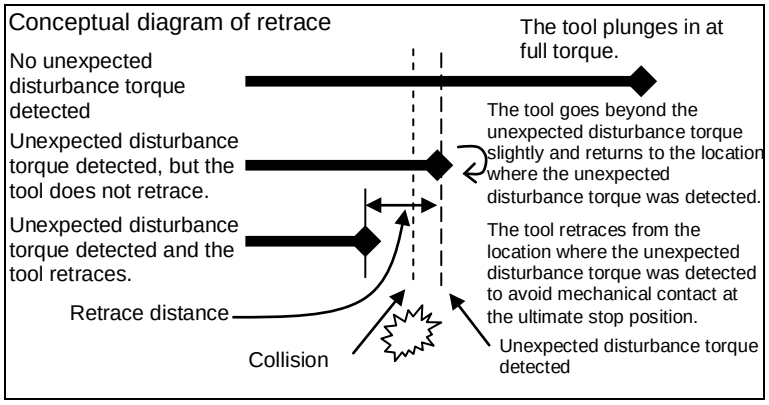
[Unit of data] TCMD
[Valid data range] 0 to 32767 (The setting value equivalent to the maximum motor torque is 7282.)

Alarm level conversion uses the following expression.

$$\text{Alarm level} = \frac{\text{Maximum estimated disturbance value[Ap]}}{\text{Maximum current value of the amplifier}} \times 7282 + 500 \text{ to } 1000 \text{ (approximate value)}$$

NOTE
1 Add some margin (usually about 500 to 1000) to the alarm level to be set.
2 If the "unexpected disturbance torque detection alarm level" parameter is 32767, no unexpected disturbance torque alarm detection is performed.

<7> Set a distance to be retraced at unexpected disturbance torque detection.
If the retrace amount parameter is 0, the motor stops at the point where an unexpected disturbance torque was detected. To quickly retract the tool from the location of collision, set the retrace distance parameter.



2103	Retrace distance

[Unit of data] Detection unit
[Setting value] Approximately 3 mm

NOTE
When the tool is moving faster or slower than the velocity listed below, the tool will not go back even if this parameter is set. It stops at the location where an unexpected disturbance torque was detected.
Let the value set for the retrace distance parameter be A:
Minimum retract velocity = A × detection unit (μm) × 60/512 [mm/min]

Ex.) When detection unit = 1 μm, and retract amount setting = 3000,
Minimum retract velocity = 3000 × 1 × 60/512 = 352 [mm/min]

[2-axis simultaneous retract function at detection of an unexpected disturbance torque]
Normally, retraction at detection of an unexpected disturbance torque is performed only for the axis for which the unexpected disturbance torque is detected. By making the following setting for both the master and slave axes, you can have the other axis retracted if an unexpected disturbance torque is detected for one position tandem axis.

	#7	#6	#5	#4	#3	#2	#1	#0
2271						RETR2		

RETR2(#2) With the unexpected disturbance torque detection function, 2-axis simultaneous retraction is:
0: Not performed.
1: Performed.

In the parameter for the distance to retract, specify the same value for both the master and slave axes. If an unexpected disturbance torque is detected on one of the axes, both axes are retracted.

NOTE
1 This function can be applied only when position tandem control is used on the same DSP. Do not use this function for any axis that has not been set for position tandem.
2 If different values are specified for the master and slave axes, an invalid parameter alarm (detail No. 1033) is issued.

[Ignoring retraction at detection of an unexpected disturbance torque during cutting]
If you want to use different retrace distances for rapid traverse and cutting feed, you can have retraction ignored when an unexpected disturbance torque alarm is detected during cutting by making the settings described below.
This function allows you to use retraction differently as follows.
During rapid traverse: The retraction is performed to enable the tool to retract from the collision point quickly.
During cutting feed: The retraction is not performed in order to prevent the interference of the tool and workpiece by retraction from damaging the work surface.

Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	25.0 and subsequent editions	
Power Motion *i*-A	90J0	03.0 and subsequent editions	
	90K0	03.0 and subsequent editions	
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C8	G(07) and subsequent editions	
	90E8	G(07) and subsequent editions	

To use this function, set the following bit.

	#7	#6	#5	#4	#3	#2	#1	#0
2275	UNDCN							

UNDCN (#7) In the event of an unexpected disturbance torque detection alarm, the retrace distance during cutting is:
0: No. 2103.
1: 0. (The tool is not retracted and stops at the point where the unexpected disturbance torque alarm is detected.)

	Distance of retraction upon the unexpected disturbance torque alarm	
	Cutting feed	Rapid traverse
N2275#7 = 0	No. 2103	No. 2103
N2275#7 = 1	0	No. 2103

<8> Set the alarm level, and check that the alarm is not detected incorrectly during normal operation.
If the unexpected disturbance torque detection function works incorrectly, increase the alarm level.

<9> This completes the adjustment.

5.9.2 Cutting/Rapid Traverse Unexpected Disturbance Torque Detection Function

(1) Overview

This function makes it possible to switch the alarm level for unexpected disturbance torque detection between cutting and rapid traverse. When switching from cutting feed to rapid traverse, the change in the alarm level can be delayed using a timer.

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	A(01) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0 90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8 90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

The cutting/rapid traverse switching timer can be applied to the following servo control software.

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90J0	04.0 and subsequent editions	
Series 0*i*-F	90M0 90L0 90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C8 90E8	E(05) and subsequent editions E(05) and subsequent editions	

(3) Setting parameters

	#7	#6	#5	#4	#3	#2	#1	#0
2200					ABG0			

ABG0(#3) The cutting/rapid unexpected disturbance torque detection switching function is:
0: Disabled.
1: Enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
2215	ABT2							

ABT2(#7) When rapid traverse feedforward is enabled (bit 3 of parameter No. 1800 is set to 1), the cutting/rapid traverse unexpected disturbance torque detection function is:
0: Disabled.
1: Enabled.

NOTE
To use the cutting/rapid traverse unexpected disturbance torque detection function, set the two parameters mentioned above.

2104	Unexpected disturbance torque detection threshold for cutting

[Valid data range] 0 to 32767 (The setting value equivalent to the maximum motor torque is 7282.)

2142	Unexpected disturbance torque detection threshold for rapid traverse

[Valid data range] 0 to 32767 (The setting value equivalent to the maximum motor torque is 7282.)

Table 5.9.2 (a) Cutting/rapid traverse unexpected disturbance torque detection function

Cutting/rapid traverse unexpected disturbance torque detection function	Unexpected disturbance torque detection alarm level	
	Cutting	Rapid traverse
Disabled	No. 2104	No. 2104
Enabled	No. 2104	No. 2142

NOTE
1 When the alarm level for cutting is 0 or 32767, unexpected disturbance torque is not detected during cutting.
2 When the alarm level for rapid traverse is 0 or 32767, unexpected disturbance torque is not detected during rapid traverse.
3 When both parameters are 0 or 32767, unexpected disturbance torque is not detected at any time.

	#7	#6	#5	#4	#3	#2	#1	#0
2428				CRTIM				

CRTIM(#4) In the cutting/rapid traverse unexpected disturbance torque detection function, the alarm level timer switching for switching from cutting feed to rapid traverse is:
0: Disabled.
1: Enabled.

2358	Unexpected disturbance torque detection cutting/rapid traverse switching timer

[Unit of data] ms
[Valid data range] 0 to 32767
When a switch is made from cutting feed to rapid traverse, the alarm level for cutting feed remains applicable for the time set for parameter No. 2358. Upon switching from rapid traverse to cutting feed, the timer is inactive and the alarm level is switched at the same time the mode is changed.

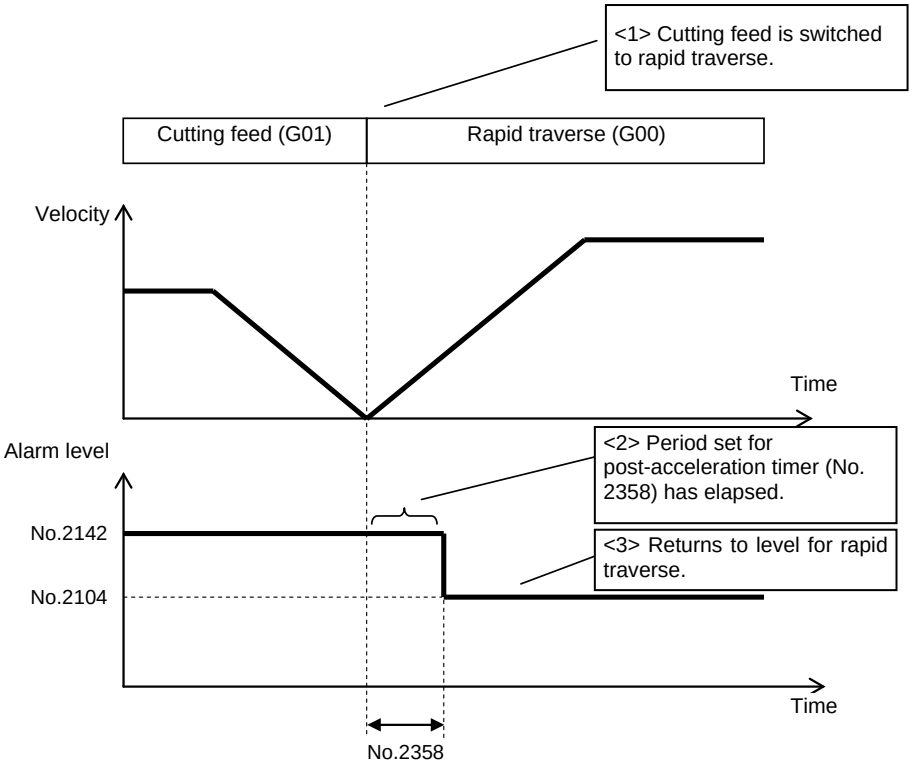


Fig. 5.9.2 (a) Timer switching in cutting/rapid traverse unexpected disturbance torque detection

NOTE

The cutting/rapid traverse switching timer (Subsection 5.9.2) uses the same parameter that is used by the post-acceleration timer (Subsection 5.9.3) for the unexpected disturbance torque detection function depending on acceleration. If a switch is made from cutting feed to rapid traverse when these two functions are used and the alarm level for high acceleration is applied (the post-acceleration timer is in operation), the alarm level for rapid traverse is applied after the post-acceleration timer expires.

5.9.3 Unexpected Disturbance Torque Detection Switching Function Depending on Acc.

(1) Overview

This function lets you switch the alarm level for unexpected disturbance torque detection at the time of acceleration or deceleration when the estimated disturbance value tends to fluctuate. The use of this function makes it possible to prevent the incorrect detection of an unexpected disturbance torque during acceleration or deceleration. Also, by setting a timer to return to the original level, the impact of remaining vibration after acceleration or deceleration can be avoided.

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	P(16) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	P(16) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(3) Notes

- To use this function, set a value other than 0 for the acceleration threshold (parameter No. 2342) and the alarm level for high acceleration (parameter No. 2343).
- This function can be used together with the cutting/rapid unexpected disturbance torque detection switching function.

(4) Setting parameters

2342 **Acceleration threshold in unexpected disturbance torque detection**

[Unit of data] Detection unit

[Setting value] Let α [mm/s^2] be an acceleration rate and let P [mm/pulse] be a detection unit. Then, the value to be set for the parameter can be found with the following expression:

$$\text{Setting value} = \frac{\alpha \times 16}{P \times 10^6}$$

[Valid data range] 0 to 32767

When 0 is set for this parameter, acceleration-based alarm level switching is disabled.

2343 **Alarm level for high acceleration in unexpected disturbance torque detection**

[Unit of data] TCMD (7282 with the maximum current value of the amplifier)

[Valid data range] 0 to 32767

When the absolute value of a specified acceleration rate is greater than or equal to the setting of No. 2342, the setting of No. 2343 is applied as an unexpected disturbance torque detection alarm level.

When 0 is set for this parameter, acceleration-based alarm level switching is disabled.

2358	Post-acceleration timer in unexpected disturbance torque detection

[Unit of data] ms
[Valid data range] 0 to 32767

Even after the specified acceleration falls below a certain level (parameter No. 2342), the alarm level set for parameter No. 2343 is maintained for the time set for parameter No. 2358.

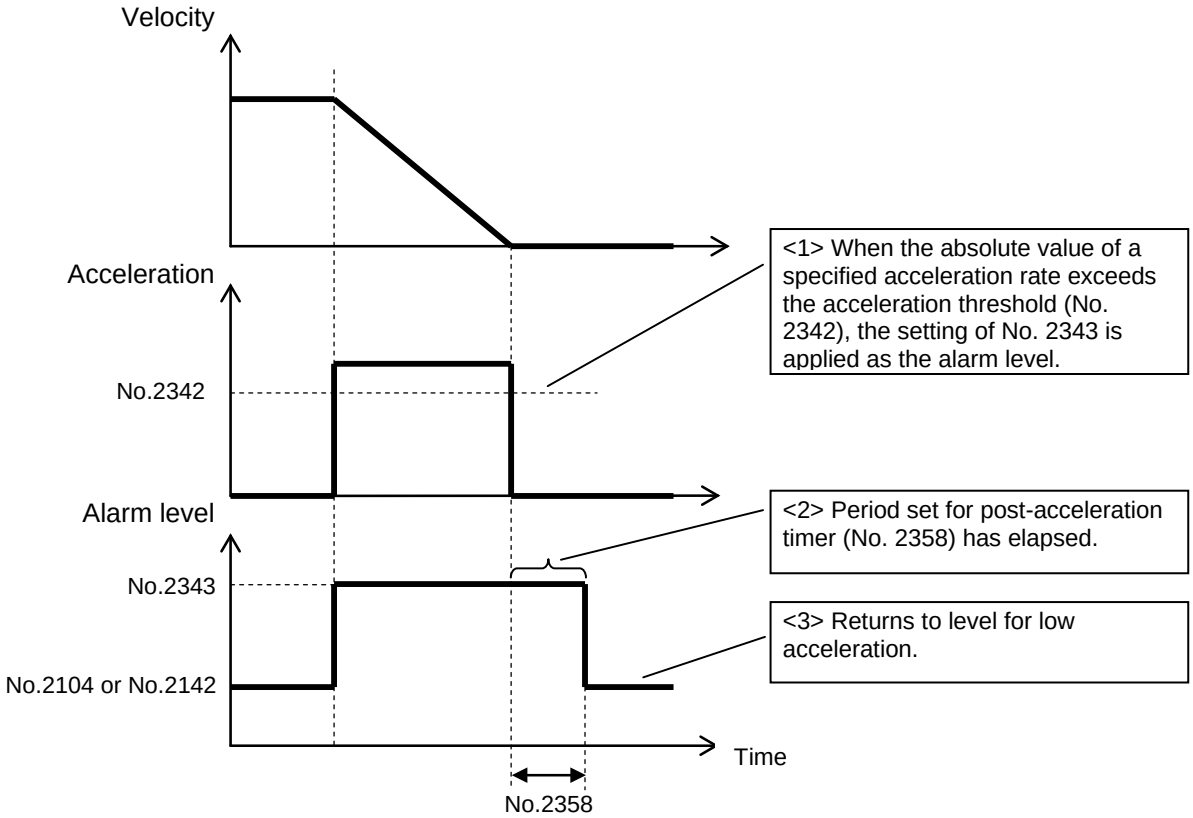


Fig. 5.9.3 (a) Acceleration-based alarm level switching

NOTE

The cutting/rapid traverse switching timer (Subsection 5.9.2) uses the same parameter that is used by the post-acceleration timer (Subsection 5.9.3) for the unexpected disturbance torque detection function depending on acceleration. If a switch is made from cutting feed to rapid traverse when these two functions are used and the alarm level for high acceleration is applied (the post-acceleration timer is in operation), the alarm level for rapid traverse is applied after the post-acceleration timer expires.

5.10 MULTIPLE-MOTOR DRIVING (TANDEM DRIVING) (OPTION)

(1) Overview

If a single motor is not capable of producing sufficient torque to drive a large table or if you want to reduce the backlash between gears, multiple motors can be used to produce movement along one axis.
Also, a large servo motor (motor with plural windings) may be driven by multiple amplifiers.
For multiple-motor driving, the following three tandem control methods are available according to the control method for the slave or sub axis (position control, velocity control, or torque control). (In this section, to make a distinction between feed axis synchronization control and torque tandem control, the terms master and slave axes are used for the former, while main and sub axes are used for the latter.)

- Position tandem control
  Feed axis synchronization control (feed axis synchronization control option (J843) for the Series 30*i*) is necessary. When odd and even numbers are specified for servo axis arrangement (parameter No. 1023) in this order, in particular, the control applied is called "position tandem control". In this status, the master and slave axes are enabled to perform various types of operation in a coordinated way. For example, the tandem disturbance elimination control option (S660), which suppresses interference between two axes, is available.
  In general, position tandem control is used for multiple-motor driving.
  NOTE) With the 30*i*-B or later, the feed axis synchronization control option includes the tandem control option (J733).

  Position tandem control is also available for driving linear motors connected in series, motors with two windings (α*i*S300/2000,-B, α*i*S500/2000,-B, and α*i*S1000/2000HV,-B), and motors with four windings (α*i*S1000/3000HV, α*i*S1500/3000HV-B, α*i*S2000/2000HV, and α*i*S3000/2000HV).
  In addition, position tandem control is available for performing tandem control for motors with multiple windings.

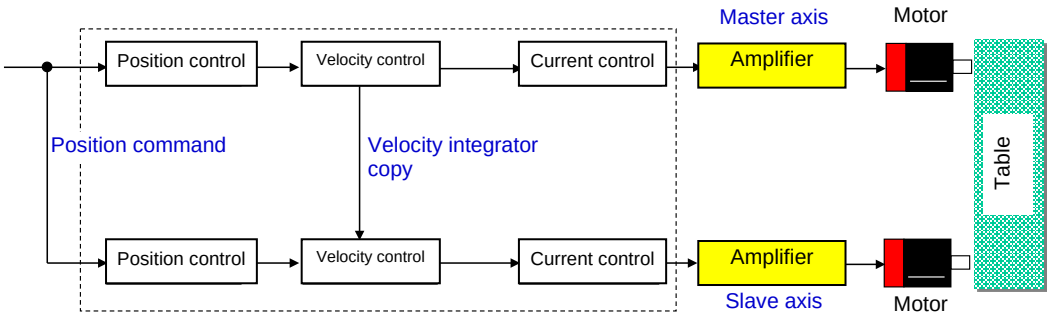


Fig. 5.10 (a) Block diagram of position tandem control

- Torque tandem control
  The tandem control option is necessary. (The feed axis synchronization control option is necessary for the Series 30*i*-B.)
  Since the former torque tandem control can be replaced with the position tandem control + velocity loop integrator copy function by using the feed axis synchronization control, it is recommended to replace it. The position tandem control + velocity loop integrator copy function can control the position and velocity, so it can control the sub-motor more stably as compared with torque tandem control.

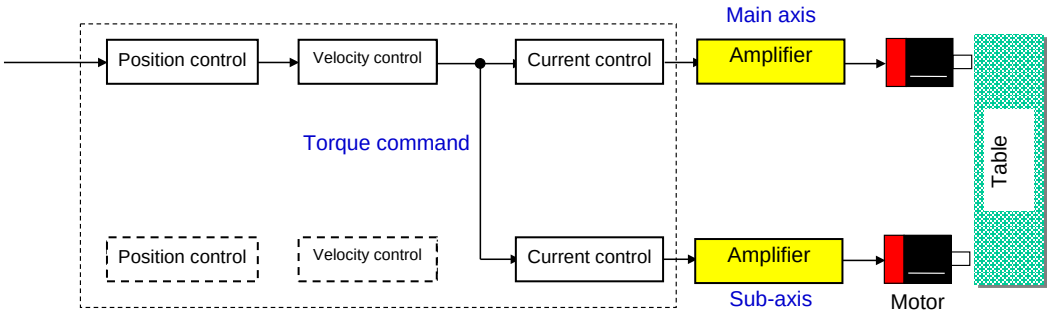


Fig. 5.10 (b) Block diagram of torque tandem control

- Velocity Tandem Control
  The tandem control option is necessary. (The feed axis synchronization control option is necessary for the Series 30*i*-B.)
  The velocity tandem control + velocity loop integrator copy function can control the velocity, so it can control the motors more stably as compared with torque tandem control. Velocity tandem control can be replaced with position tandem control + velocity loop integrator copy function to control the sub-motor more stably than velocity tandem control.

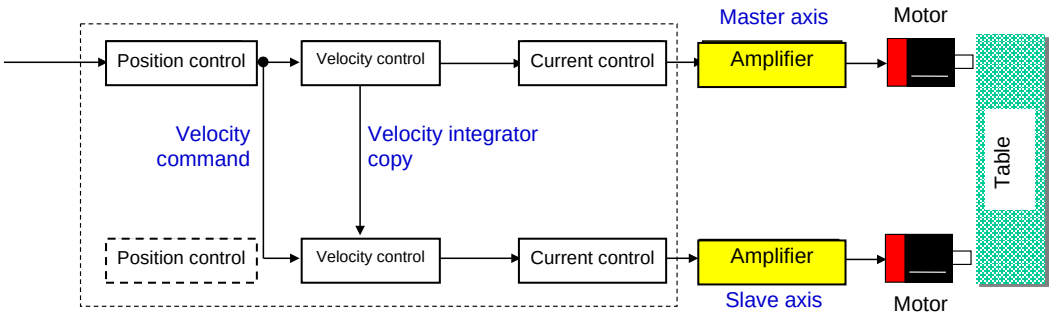


Fig. 5.10 (c) Block diagram of velocity tandem control

The three types of tandem control described above are generally used for two axes. By using the multiaxis tandem function, these types of tandem control can also be used for four and eight axes. For details, see Subsection 5.10.2, "Multiaxis Tandem".

(2) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	03.0 and subsequent editions	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
	90GP	01.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	

NOTE
This function cannot be used with the servo HRV4 control.

(3) Servo control software functions and their corresponding tandem control methods

Function name	Position tandem	Torque tandem	Velocity tandem	Remarks
Feed axis synchronization control	Supported	-	-	Option
Velocity loop integrator copy	Supported	-	Supported	Suppresses interference between axes. Can be turned off and on using Gn321.
Preload	Supported	Supported	Supported	Suppresses the backlash. With a time constant.
Servo alarm two-axis monitoring	Supported	Supported	Supported	Prevents damage to the machine.
Tandem disturbance elimination control function	Supported	-	Supported	Option
Synchronous axes automatic compensation	Supported	-	-	
Torque difference alarm	Supported	-	-	Prevents damage to the machine.
Separate detector feedback sharing	Supported	-	Supported	One scale
Driving a motor with four windings	Supported (Note 1)	-	-	Set automatically.
Driving a motor with two windings	Supported (Note 1)	-	-	Set manually.
Tandem control	-	Supported	Supported	Option
Damping compensation	-	Supported	-	
Tandem speed difference alarm	-	Supported	-	Prevents damage to the machine.
Velocity feedback average function	-	Supported	Supported	
Motor feedback sharing	-	Supported (Note 2)	-	Motor with two windings

NOTE
1 With the 30*i*-B, this method is available without the feed axis synchronization control option.
2 With the 30*i*-A or earlier, drive the motor using torque tandem control + motor feedback sharing function.

(4) Using the velocity loop integrator copy function and preload function together

The motor for each axis produces almost the same torque as that produced when positioning is performed for the single axis, so double the torque can be obtained with two motors. (Load sharing mode).
If interference between axes is caused by driving multiple axes, the velocity loop integrator copy function is useful.

If you want to suppress the backlash between gears of the reducer or the like for each axis, enable the integrator copy function and use the preload function together. The backlash between gears can be reduced by adding a preload torque to the master and slave motors in opposite directions to produce tension. (Anti-backlash mode)

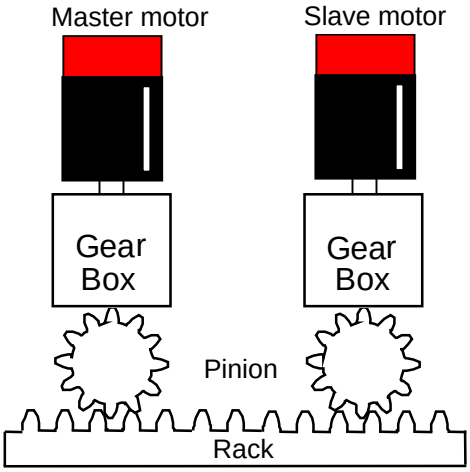


Fig. 5.10 (d) Example of driving multiple axes (1)

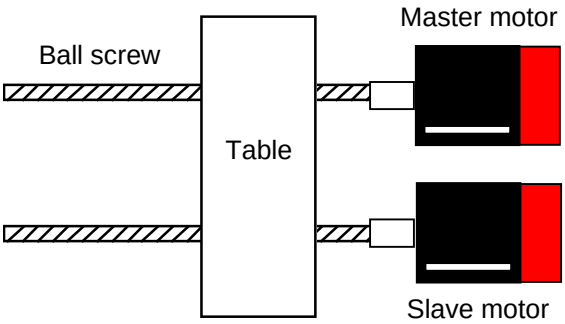


Fig. 5.10 (e) Example of driving multiple axes (2)

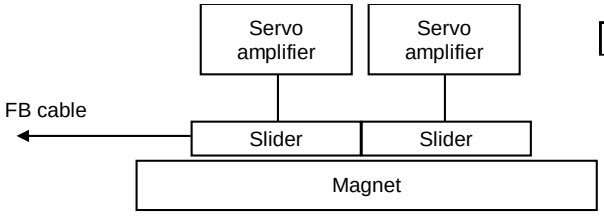


Fig. 5.10 (f) Example of tandem control (linear motor connected)

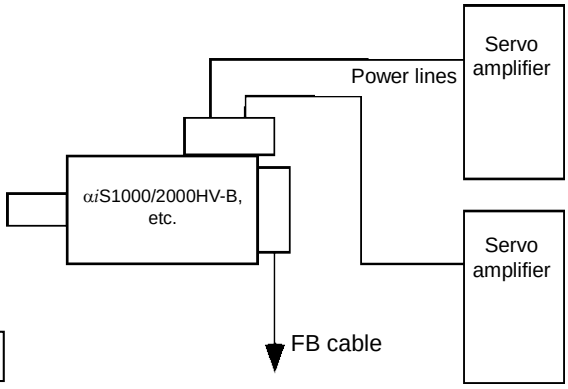


Fig. 5.10 (g) Example of tandem control (motor with two windings)

(5) Using a motor with multiple windings and EGB (electric gear box)

It is possible to use one of the sub-axes of a motor with two or four windings as a dummy axis of the EGB and read the position data of the EGB master axis. The same applies for the EGB (FSSB method). When position tandem control or torque tandem control is used for two-motor driving, the EGB cannot be used.

Example of parameter setting (motor with four windings)

Axis No.	Arrangement No. 1023	Motor with four windings No. 2211#7	Separate detector No. 1815#1	EGB No. 2011#0	Remarks
1	1 (L)	1	Note 1	1	1st axis of the motor with four windings
2	2 (M)	1	1	1	2nd axis of the motor with four windings and EGB dummy axis
3	3 (J)	1	0	0	3rd axis of the motor with four windings
4	4 (K)	1	0	0	4th axis of the motor with four windings

Example of parameter setting (motor with four windings): FSSB method

Axis No.	Arrangement No. 1023	Motor with four windings No. 2211#7	Separate detector No. 1815#1	FSSB method No. 2429#2	EGB No. 2011#0	Remarks
1	1 (L)	1	Note 1	0	1	1st axis of the motor with four windings
2	2 (M)	1	1	1	1	2nd axis of the motor with four windings and EGB dummy axis
3	3 (J)	1	0	0	0	3rd axis of the motor with four windings
4	4 (K)	1	0	0	0	4th axis of the motor with four windings

Example of parameter setting (motor with two windings)

Axis No.	Arrangement No. 1023	Motor with two windings No. 2211#6	Separate detector No. 1815#1	EGB No. 2011#0	Remarks
1	1 (L) Note 2	1	Note 1	1	1st axis of the motor with two windings
2	2 (M) Note 2	1	1	1	2nd axis of the motor with two windings and EGB dummy axis

Example of parameter setting (motor with two windings): FSSB method

Axis No.	Arrangement No. 1023	Motor with two windings No. 2211#6	Separate detector No. 1815#1	FSSB method No. 2429#2	EGB No. 2011#0	Remarks
1	1 (L) Note 2	1	Note 1	0	1	1st axis of the motor with two windings
2	2 (M) Note 2	1	0	1	1	2nd axis of the motor with two windings and EGB dummy axis

NOTE

1 Set the parameter for specifying whether to use a separate detector for the master axis of a motor with four or two windings as required. With the 30*i*-B, this method is available without the feed axis synchronization control option.

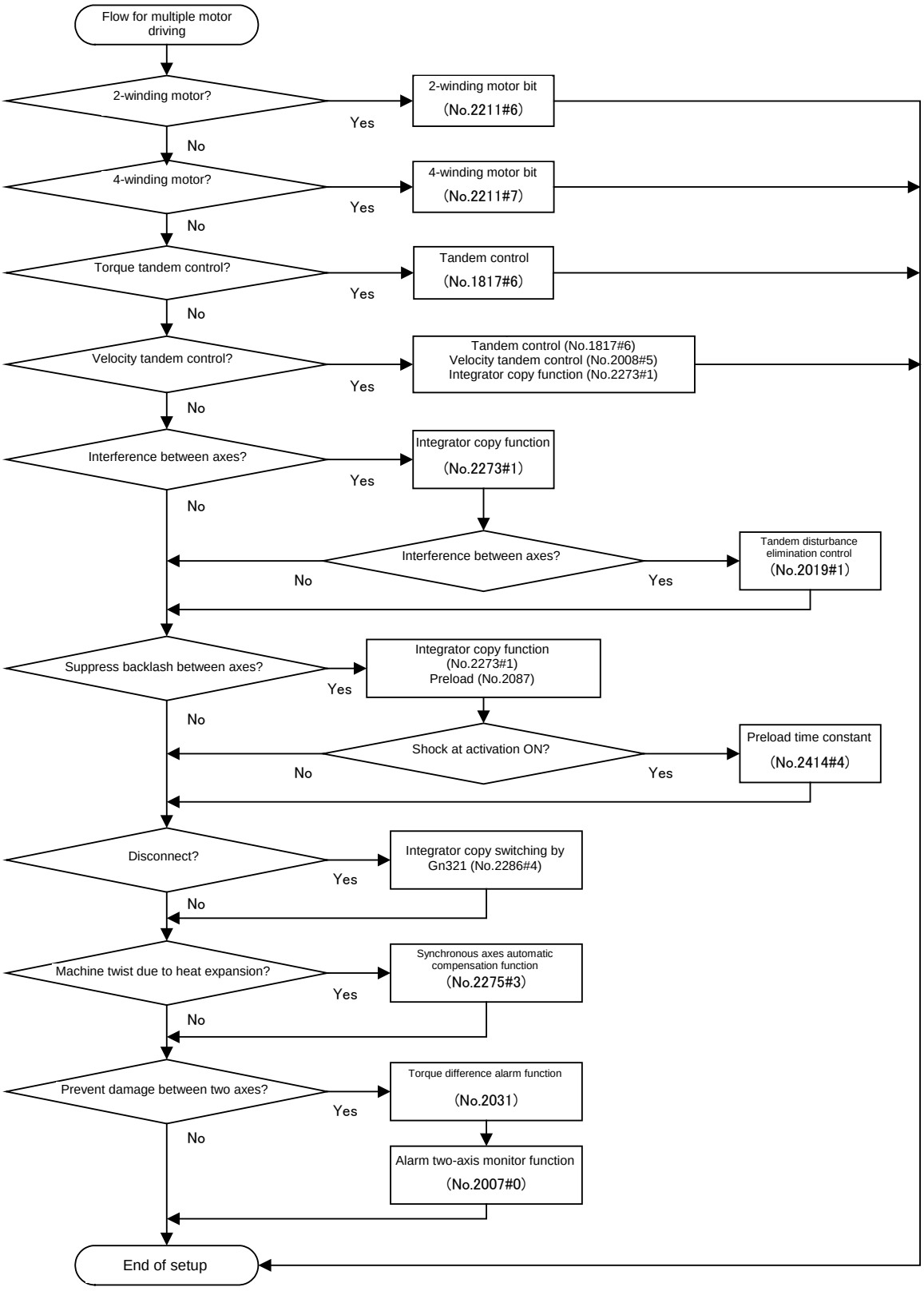
2 By using two consecutive odd-numbered and even-numbered axes set for parameter No. 1023, it is possible to drive a motor with two windings.

(NOTE) The following table lists the series and editions of applicable servo control software.

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	13.0 and subsequent editions	FSSB method
Power Motion *i*-A	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
	90GP	01.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	-	
	90E1	03.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	-	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90M8	02.0 and subsequent editions	

(6) Function selection flow for multiple motor driving

The following figure shows a function selection flow for multiple motor driving.



5.10.1 Position Tandem

5.10.1.1 Velocity loop integrator copy

(1) Overview

If the velocity loop integrator gets unbalanced between the master and slave during feed axis synchronization control or velocity tandem control, the axes may get twisted, leading to an OVC alarm.
In this case, this function copies the velocity loop integrator from the master axis to the slave axis, thereby preventing integrator imbalance between the master and slave.
When used with the preload, the backlash can be suppressed by adding a preload torque in opposite directions, in the same way as when the preload is used in a conventional torque tandem configuration.

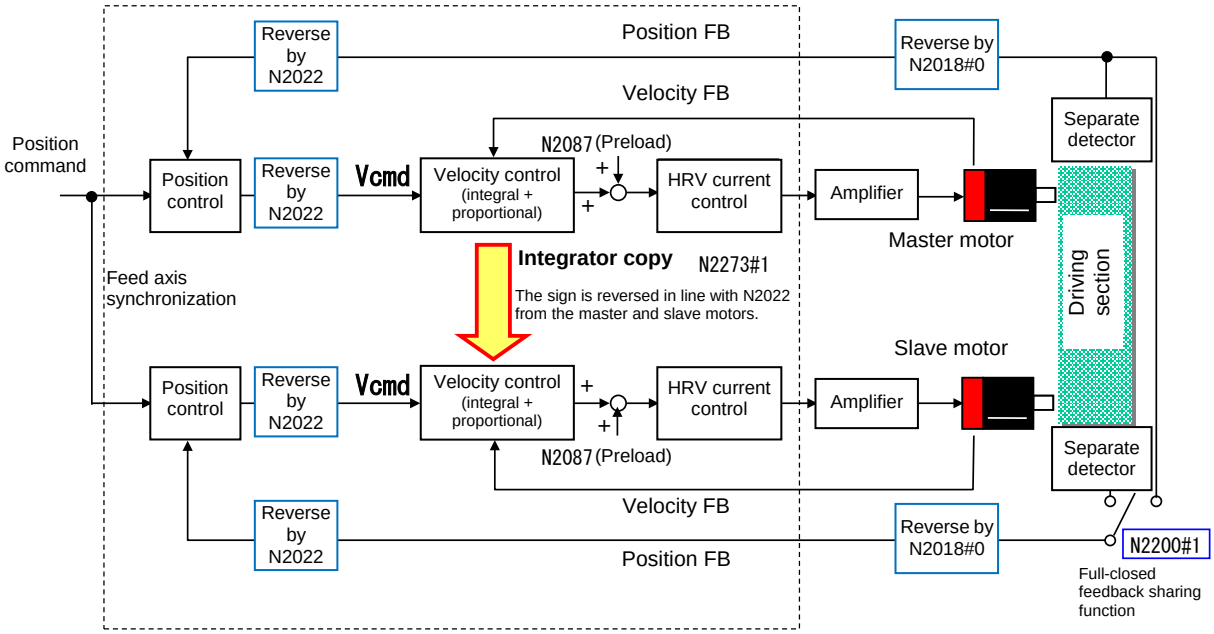


Fig. 5.10.1.1 (a) Block diagram of the velocity loop integrator copy function

(2) Series and editions of applicable servo control software

(Integrator copy)

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	A(01) and subsequent editions 01.0 and subsequent editions	
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	

(Dynamic switching between whether to enable or disable the integrator copy function)

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	Y(25) and subsequent editions 01.0 and subsequent editions	
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	

(3) Setting parameters

	#7	#6	#5	#4	#3	#2	#1	#0
2273							WSVCP	

WSVCP(#1) 1: The velocity loop integrator of the master axis is copied to the slave axis.
(Set this parameter for the master and slave axes.)

NOTE

1 When this function is used, servo axis arrangement (parameter No. 1023) needs to be set as follows.
Master axis: Axis for which an odd number is set for parameter No. 1023
Slave axis: Axis for which the master axis number + 1 (even number) is set for parameter No. 1023
2 This function can be used for feed axis synchronization control or velocity tandem control.
3 This function can be used together with the preload.
4 It is impossible to specify functions related to the velocity loop integrator (such as the incomplete integral or low-speed integral function) separately for the master axis and slave axis.
5 When this function is used with servo HRV4 control or for a motor with multiple windings, see Subsection 5.10.2, "Multiaxis Tandem".

(4) Dynamic switching between whether to enable or disable the integrator copy function

If you want to enable the integrator copy function only when two axes are coupled mechanically, you can use external signal Gn321 (coupling signal) to turn the velocity loop integrator copy function off and on. You may not want to operate the velocity loop integrator copy function. For example, for axes along which the workpiece is chucked from both sides, when the workpiece is not chucked, you can set external signal Gn321 to 1 to turn the integrator copy function off.

	#7	#6	#5	#4	#3	#2	#1	#0
2286				WCCNCK				

WCCNCK(#4) 1: When external signal Gn321 is set to 0, the velocity loop integrator is copied to the slave axis.
0: The velocity loop integrator is always copied to the slave axis regardless of whether external signal Gn321 is set to 0 or 1.
(Set this parameter for the slave axis.)

	#7	#6	#5	#4	#3	#2	#1	#0
Gn321	SVDI18	SVDI17	SVDI16	SVDI15	SVDI14	SVDI13	SVDI12	SVDI11

SVDI1x 1: Uncoupled state
0: Coupled state
(Input this signal for the master and slave axes.)
The bit position represents the relevant NC axis number. For example, bit 0 represents the first NC axis.

5.10.1.2 Preload

(1) Overview

This function can apply torques of opposite directions to the master axis (master motor) and slave axis (slave motor) by applying an offset (preload) torque to the torque command to maintain tension at all times. This function can reduce the backlash between the master and slave axes, caused by the tandem connection of two motors through gears. However, this function does not reduce the backlash between the ball screw and table, which is a feature of the machine system.
For example, set preload +Pre for the master axis and preload -Pre for the slave axis. Then, torques are produced as shown in Fig. 5.10.1.2 (a) below.
If a torque is required during acc./dec., a torque of the same direction is produced with the two motors. (Load sharing mode)
Preload torques produce tension between the two axes when no torque is required (e.g., during stop state). (Anti-backlash mode)
The average driving torque for the master and slave motors when this function is used is the value obtained by averaging the driving torques of each motor, which is represented with a dotted line in Fig. 5.10.1.2 (b) below.

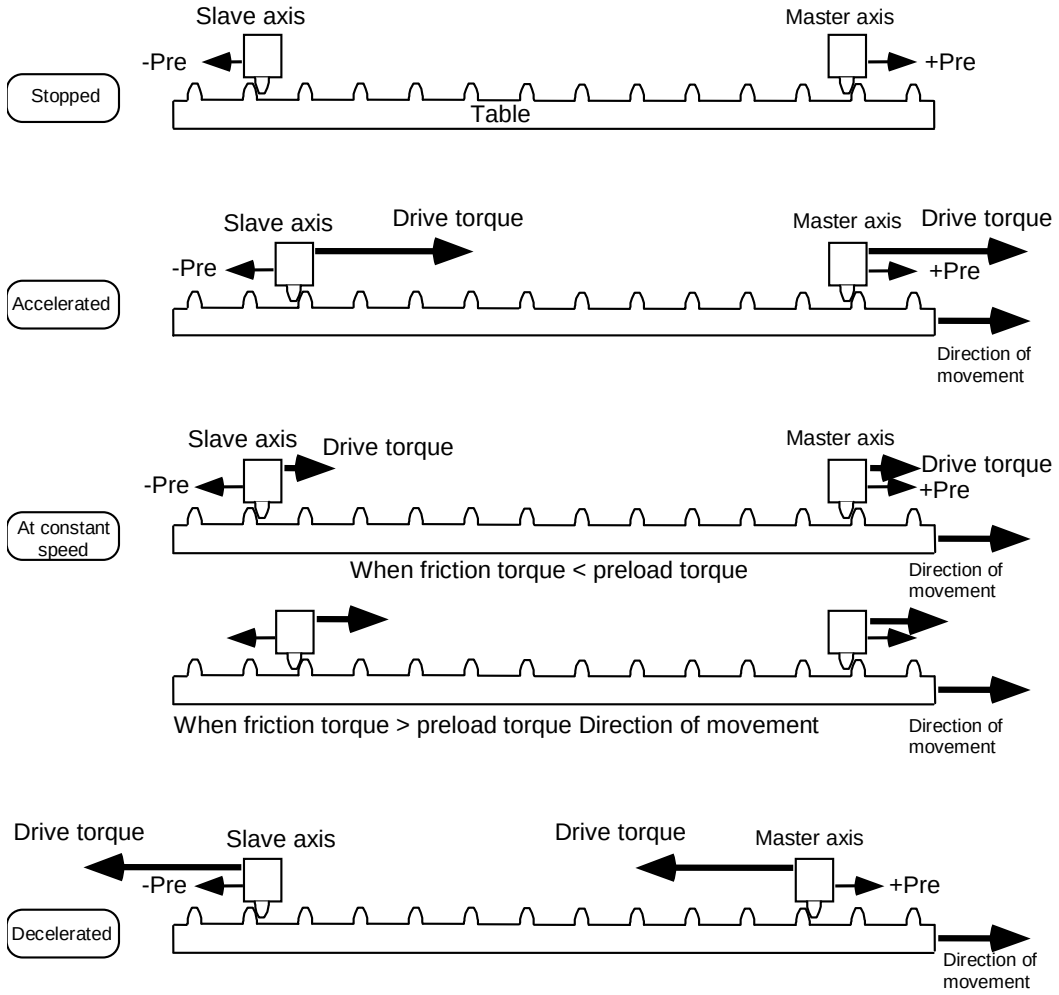


Fig. 5.10.1.2 (a) Changes of torque during movement

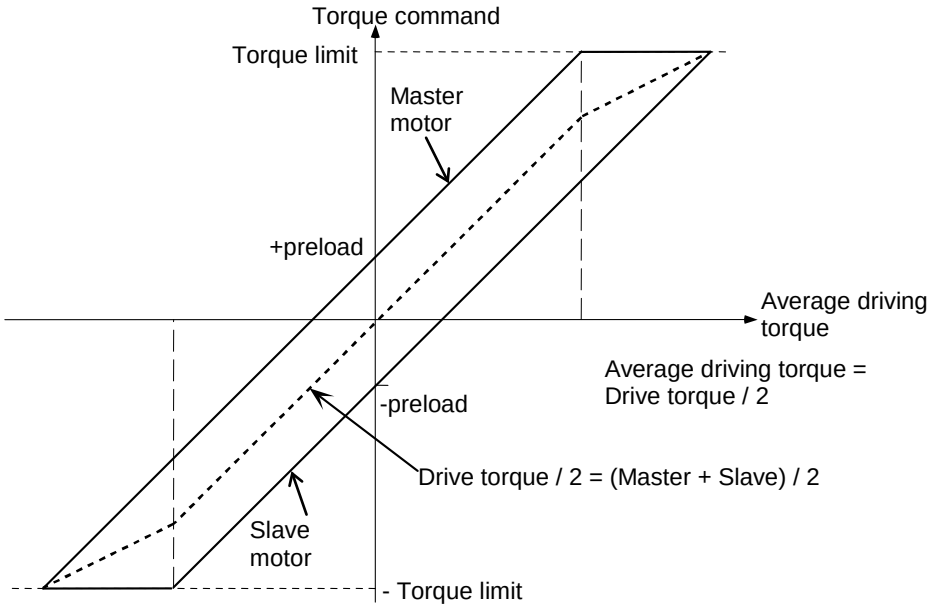


Fig. 5.10.1.2 (b) Relationships between the average driving torque and torque command for each motor

2087	Preload value (PRLOAD)

[Unit] TCMD (The value 7282 represents the maximum amplifier current.)
Set this parameter for both the master and slave axes.

> **NOTE**
> Set a value that is as small as possible but greater than the static friction torque.
> A set preload torque is applied to each motor at all times. So, set a value that does not exceed the rated torque of each motor. As a guideline, specify a value equal to one-third of the rated torque.
> As shown in Fig. 5.10.1.1 (a) in Subsection 5.10.1.1, a preload torque is added in any case. So, set the preload torque directions as follows:
> - When the rotation directions of the master axis and slave axis are the same: Different signs
> - When the rotation directions of the master axis and slave axis are different: Same sign

Example of setting)

For the α*i*S8/4000 (Servo amplifier α*i* SV 80)
When a preload torque of 5 Nm is to be added, the torque constant is 0.72 Nm/Arms according to the descriptions of the servo motor. So, the peak value is 0.509 Nm/Ap.
The torque is converted to a current value as follows:

5/0.509 = 9.82 Ap

The amplifier limit is 80 Ap, so that the value to be set is:

9.82/80 × 7282 = 894

So, set 894 for the master axis, and -894 for the slave axis (when the directions of rotation of the two motors are the same).
When movement of the table is stopped, check whether there is tension in the system. If not, increase this value gradually.

> ⚠ **WARNING**
> For torque tandem control, when two motors are not connected, always set a preload value of 0. The sub-axis motor may rotate at extremely high speed, which is very dangerous. (⇒ See Subsection 5.10.4.4 "Tandem speed difference alarm function".)

(2) Preload with a time constant

With the conventional preload, since a torque offset is always added to the torque command, a stepwise torque is produced at the moment of activation, which may cause a shock.

When this function is enabled, a torque offset can be applied exponentially. A time constant is determined based on the position gain. For example, when the position loop gain is Pg = 30 [s^{-1}], the preload function starts with a time constant of 33.3 ms. In addition, a function bit can be set to increase the time constant by four times.

The time constant is also applied when activation is turned off or when the parameter value is changed.

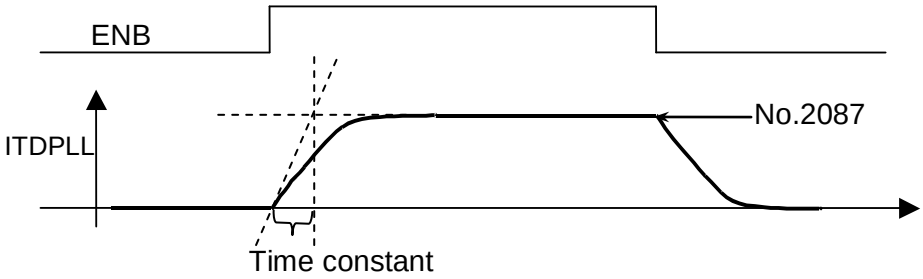


Fig. 5.10.1.2 (c) Preload value with a time constant

(2.1) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	Y(25) and subsequent editions 01.0 and subsequent editions	
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	- -	
	90E5 90E8	- -	

(2.2) Parameter

	#7	#6	#5	#4	#3	#2	#1	#0
2417				TIMCAL		TIMPR2		

TIMCAL(#4) Preload time constant calculation is:
1: Performed.
0: Not performed. (Conventional specification)

> **NOTE**
> When using the torque offset canceling function (bit 1 of parameter No. 2215) for the unexpected disturbance torque detection function, do not use this function.

TIMPR2(#2) The exponential time constant of the preload function is:
1: Four times the reciprocal number of the position loop gain.
0: Reciprocal number of the position loop gain.

5.10.1.3 Functions for preventing damage between two axes

(1) Overview

In a position tandem or torque tandem configuration, motors are mechanically coupled. To prevent mechanical damage, the following functions are available:

(1) Function which monitors the torque between the master and slave axes and prevents a large torque from being applied (excessive torque difference alarm)

(2) Function which turns the activation for the other axis off immediately when an error occurs in one of the axes (servo alarm two-axis monitoring)

(2) Series and editions of applicable servo control software

(Excessive torque difference alarm, servo alarm two-axis monitoring)

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	A(01) and subsequent editions 01.0 and subsequent editions	
Series 0*i*-F	90M0 90M8	02.0 and subsequent editions 02.0 and subsequent editions	
Series 0*i*-D	90C5 90C8 90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions	

(Latch open time setting for servo alarm two-axis monitoring)

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90GP 90JP	25.0 and subsequent editions 03.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-F	90M0 90M8	02.0 and subsequent editions 02.0 and subsequent editions	

(3) Details

(1) Excessive torque difference alarm

2031	Excessive torque difference alarm threshold

[Unit] TCMD (The value 7282 represents the maximum amplifier current.) (Set this parameter for the master axis.)

[Valid data range] 0 to 32767 (When a value of 0 is set, this alarm is not detected.)

(2) Servo alarm two-axis monitoring

If an alarm occurs in either of two axis motors used to operate a machine in concert as in position tandem control or torque tandem control, it is necessary to stop the other axis motor immediately so as to prevent the machine from being twisted. This function monitors two axes controlled by the same DSP simultaneously for servo alarms. If an alarm occurs in either of the two axes, the function can promptly turn the activation for the other axis off.
This function is not confined to tandem axes. When consecutive (odd and even) servo axis numbers are assigned, the function can be applied and available for feed axis synchronization control and so on.

	#7	#6	#5	#4	#3	#2	#1	#0
2007							IGNVRO	ESP2AX

ESP2AX (#0) 1: Servo alarm two-axis monitoring is enabled. (Set this parameter for the master axis (to which an odd number is assigned by parameter No. 1023.))

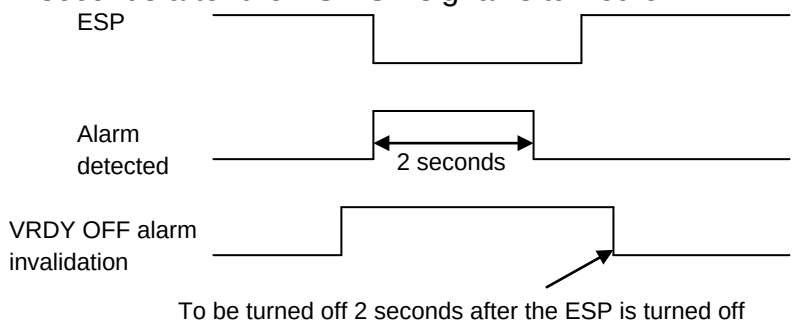
IGNVRO (#1) 1: An alarm condition is released 2 seconds after the servo alarm two-axis monitor function holds the alarm condition. (Set this parameter for the master axis to which an odd number is assigned by parameter No. 1023.)

Some systems have a configuration in which the ESP line of the PS is cut off with an interlocked machine door, independently of the emergency stop button, for safety purposes. In these systems, the amplifier is turned off with an emergency stop not in effect, and therefore, a "V ready off alarm" occurs. This alarm is avoided by using the "VRDY OFF alarm invalidation signal".
However, in the past, it was impossible to use "PS cut-off based on the VRDY OFF alarm invalidation signal" along with the "servo alarm two-axis monitoring". This is because the "servo alarm two-axis monitoring" holds an alarm condition in the servo control software and will not activate a motor when the ESP line is connected after that.

To avoid this problem, a function has been added which clears information about an alarm condition in the servo control software 2 seconds after the alarm is detected. This function enables the simultaneous use of the "servo alarm two-axis monitoring" and "PS cut-off based on the VRDY OFF alarm invalidation signal".

NOTE

It is necessary to release the VRDY OFF alarm invalidation signal 2 seconds after the PS ESP signal is turned off.



- Normally, the alarm latch is opened two seconds after an alarm is detected, as shown in the figure above. This time can be reduced using a parameter.

2622	Latch open time setting for alarm two-axis monitoring (ms)

[Unit] ms (Set this parameter for the master axis.)
[Valid data range] 50 to 2000 (When 0 is set, No. 2622 is assumed to be 2000 ms.)

5.10.1.4 Tandem disturbance elimination control (option)

(1) Overview

This function suppresses vibration caused by interference between the master axis and slave axis in position tandem (feed axis synchronization) control.

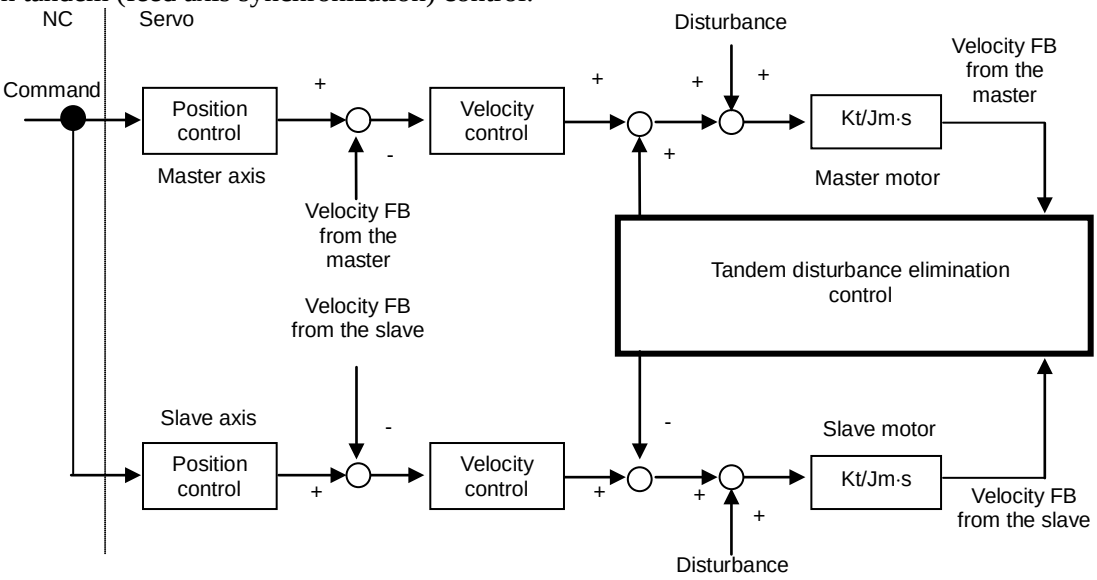


Fig. 5.10.1.4 (a) Block diagram of tandem disturbance elimination control

(2) Series and editions of applicable servo control software

(Tandem disturbance elimination control)

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0	09.0 and subsequent editions	
	90J0	01.0 and subsequent editions	
	90GP	01.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	

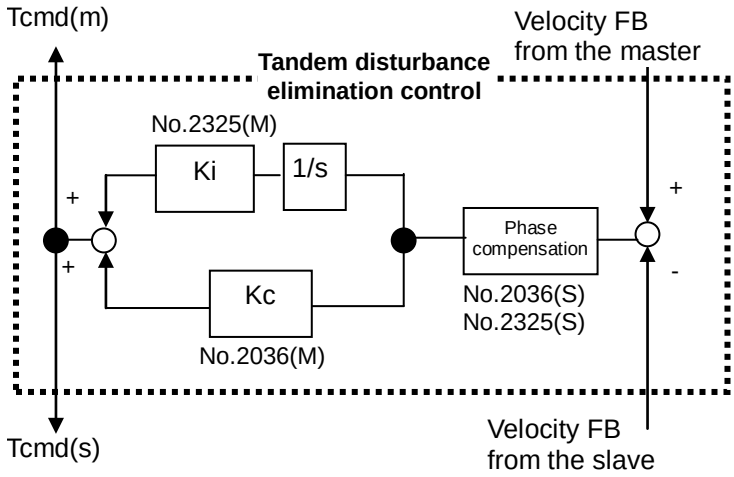
(Dynamic switching between whether to enable or disable the tandem disturbance elimination control)

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0	09.0 and subsequent editions	
	90J0	01.0 and subsequent editions	
	90GP	01.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	J(10) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	

(3) Notes

- To use this function, the feed axis synchronization control option and tandem disturbance elimination control option are required.
- This function can only be used for two-axis feed axis synchronization control. It cannot be used for more than two axes.
- When this function is used, servo axis arrangement (parameter No. 1023) needs to be set as follows.
  Master axis: Axis for which an odd number is set for parameter No. 1023
  Slave axis: Axis for which the master axis number + 1 (even number) is set for parameter No. 1023
- This function cannot be used with the servo HRV4 control.

(4) Setting parameters



	#7	#6	#5	#4	#3	#2	#1	#0
2019							TANDMP	

TANDMP (#1) Tandem disturbance elimination control is: (Set this parameter for the master axis only.)
0: Not used.
1: Used.

	#7	#6	#5	#4	#3	#2	#1	#0
2008						VFBAVE		

VFBAVE (#2) The velocity feedback average function is: (Set this parameter for the master axis only.)
0: Not used.
1: Used.
Usually, set this parameter to 0.
The velocity feedback average function has an effect equivalent to that of tandem disturbance elimination control for machines that have a certain rigidity. In general, this function is not used with tandem disturbance elimination control. When using this function with tandem disturbance elimination control, set integral gain Ki and proportional gain Kc to 0.

2036	Proportional gain Kc

[Valid data range] 0 to 32767 (0 < Kc < 0.5) (Set this parameter for the master axis only.)
[Recommended value] 0
This parameter is generally not used, but it is used for machines with a large friction. This parameter has the same function as damping compensation gain Kc of the tandem control function. (See Subsection 5.10.4.1.)

2036	Phase compensation coefficient α

[Valid data range] 51 to 512 (0.1 < α < 1) (Set this parameter for the slave axis only.)
[Recommended value] 0 (512 internally)
This parameter has the same function as damping compensation of the tandem control function. When 512 is specified, the advance amount is 0 degree. (See Subsection 5.10.4.1.)

2325	Integral gain Ki

[Valid data range] 0 to 4000 (Set this parameter for the master axis only.)
This parameter compensates for a machine spring element. Set a large value when the rigidity is high. Set a small value for a motor with a greater torque constant.

2325	Phase compensation coefficient 2T/t

[Valid data range] 0 to 32767 (Set this parameter for the slave axis only.)
[Recommended value] 0 (40 internally)
This parameter is used with coefficient α to compensate the compensation delay. When the resonance frequency is 100 Hz or more, set α= 100 and 2T/t = 6.

2333	Incomplete integral time constant

[Valid data range] 0 to 32767 (Set this parameter for the master axis only.)
[Recommended value] 0 (30887 internally)
As integral gain Ki increases, vibration in the low frequency area (10 Hz or less) may occur. In such a case, set the incomplete integral time constant to decrease the time constant. Set a parameter value listed below.

Table 5.10.1.4 (a) Setting in the incomplete integral time constant parameter (when HRV2 or HRV3 is used)

Time constant (sec)	Parameter setting
0.1	30887
0.05	29307
0.02	25810

(5) Dynamic switching between whether to enable or disable the tandem disturbance elimination control

If you want to enable the tandem disturbance elimination control function only when two axes are coupled mechanically, you can use external signal Gn321 (uncoupling flag) to turn the tandem disturbance elimination control and velocity feedback average functions off and on.
You may not want to operate the tandem disturbance elimination control and velocity feedback average functions. For example, for axes along which the workpiece is chucked from both sides, when the workpiece is not chucked, you can set external signal Gn321 to 1 to turn the tandem disturbance elimination control and velocity feedback average functions off.

	#7	#6	#5	#4	#3	#2	#1	#0
2007						SUBDEP		

SUBDEP (#2) The slave axis separation function (set for the master axis) is:
0: Not used. (The tandem disturbance elimination control function is always enabled regardless of whether G321 is set to 0 or 1.)
1: Used. (When G321 is set to 1, the tandem disturbance elimination control function is turned off.)

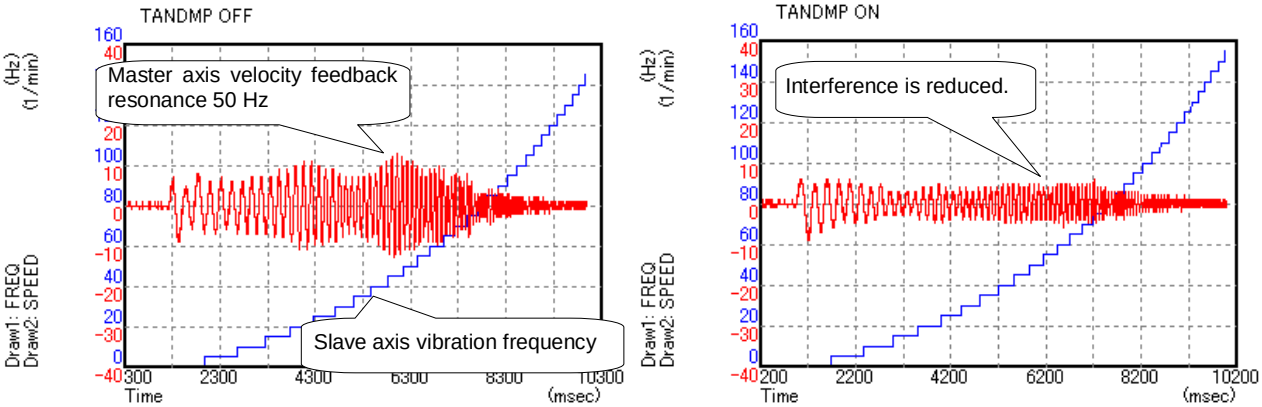
	#7	#6	#5	#4	#3	#2	#1	#0
Gn321	SVDI18	SVDI17	SVDI16	SVDI15	SVDI14	SVDI13	SVDI12	SVDI11

SVDI1x 1: Uncoupled state
0: Coupled state
(Input this signal for the master and slave axes.)
The bit position represents the relevant NC axis number. For example, bit 0 represents the first NC axis.

(6) Tuning method

- Check the torque commands for the master axis and slave axis and velocity feedback vibration by using a Servo Guide. (See Item (7).)
- If the vibration phase is shifted by 180 degrees, the cause of resonance is assumed to be inter-axis interference.
- Enable tandem disturbance elimination control, and tune integral gain Ki.
- Increase the value of integral gain Ki gradually from 0, and observe the vibration. Ki has an optimal value. When the value of Ki is increased excessively, vibration becomes stronger.
- When the velocity loop gain is changed, the frequency of vibration changes. So, tune Ki to minimize vibration.
- If the frequency of vibration exceeds 100 Hz, the effect of tandem disturbance elimination control decreases. In such a case, set phase compensation coefficients α and 2T/t or increase the current loop gain with the current 1/2 PI control.

Effect of tandem disturbance elimination control



*** Velocity feedback and vibration frequency when the slave axis is vibrated**

(7) Method for checking the resonance frequency

With this check, use the disturbance input function for the slave axis, measure the velocity feedback for the master axis, check for interference between the axes, and check and tune the effect of tandem disturbance elimination control.

The following explains how to use the disturbance input function and how to make settings for data measurement.

(a) Setting parameters related to disturbance input

Parameters related to the disturbance input function are set for the slave axis.

(About the disturbance input function)
The disturbance input function applies vibration to an axis by inputting a sine wave disturbance to the torque command. In the tuning of tandem disturbance elimination control, this function is used for the slave axis to observe the interference status between the axes when vibration is applied to the slave axis.

Parameters related to the disturbance input function are set for the slave axis.

	#7	#6	#5	#4	#3	#2	#1	#0
2270	DSTIN	DSTTAN	DSTWAV					

DSTIN(#7) Disturbance input
0: Stop
1: Start (Disturbance input starts on the rising edge from 0 to 1.)
DSTTAN(#6) Set 0.
DSTWAV(#5) Set 0.

2326	Disturbance input gain

[Setting value] 500
* Set the amplitude of the applied vibration (torque). (Value 7282 is equivalent to the maximum current of the amplifier.)
First, set about 500 to apply vibration to the machine so that a small sound is generated. If it is not possible to observe the vibration status, increase the parameter value gradually.

2327	Disturbance input function: Start frequency (Hz)

[Setting value] 0
* If 0 is set, the default (10 Hz) is assumed to be the vibration start frequency.

2328	Disturbance input end frequency

[Setting value] 0
* If 0 is set, the default (200 Hz) is assumed to be the vibration end frequency.

2329	Number of disturbance input measurement points

[Setting value] 0
* If 0 is set, the default (3) is assumed as the number of disturbance input measurement points.

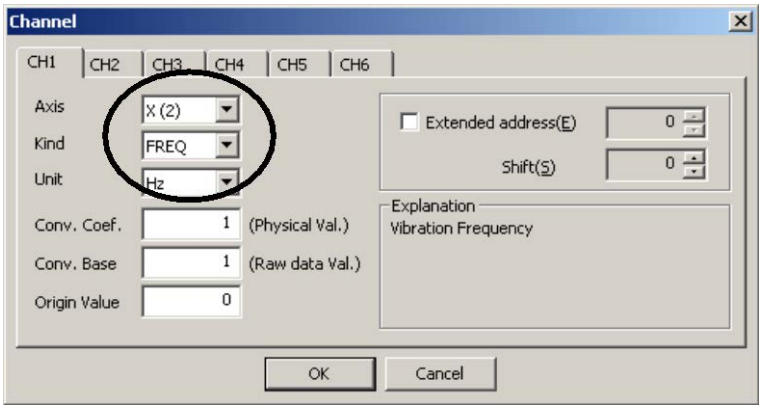
[Cautions]
- Disable the functions that operate only in the stop state, such as the variable proportional gain function in the stop state and the overshoot compensation function.
- When characteristics at the time of cutting are measured, cutting/rapid switching functions should be treated carefully.
- Decrease the position gain to about 1000.

(b) Channel setting with SERVO GUIDE

With SERVO GUIDE, make settings for data acquisition.
Two types of data including disturbance frequency data (the slave axis) and velocity feedback data (the master axis) are acquired at the same time.

From the graph window menu of SERVO GUIDE, select [Setting] then [Channel].

Channel 1: Disturbance frequency
- Specify the slave axis as the axis, and set the data type to "FREQ". (The other items are automatically set when FREQ is selected.)



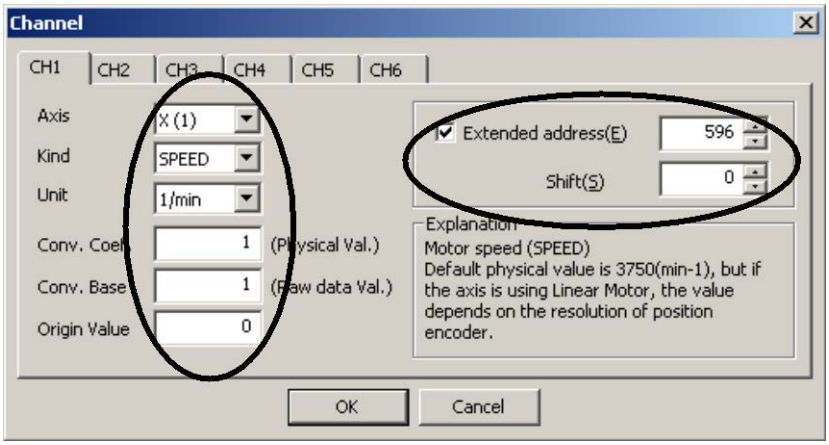
Channel 2: Master axis velocity feedback

- Specify the master axis as the axis, and set the data type to "SPEED".
- Set the conversion coefficient to 1, and set the conversion base data to 1.
- Check the check box of the extended address, and set an address as listed in the table below. (The setting varies depending on the value set for parameter No. 1023.)

Set the shift amount to 0 for Series 90Ex and 90Cx or to -5 for Series 90Gx, 90Jx and 90Mx.

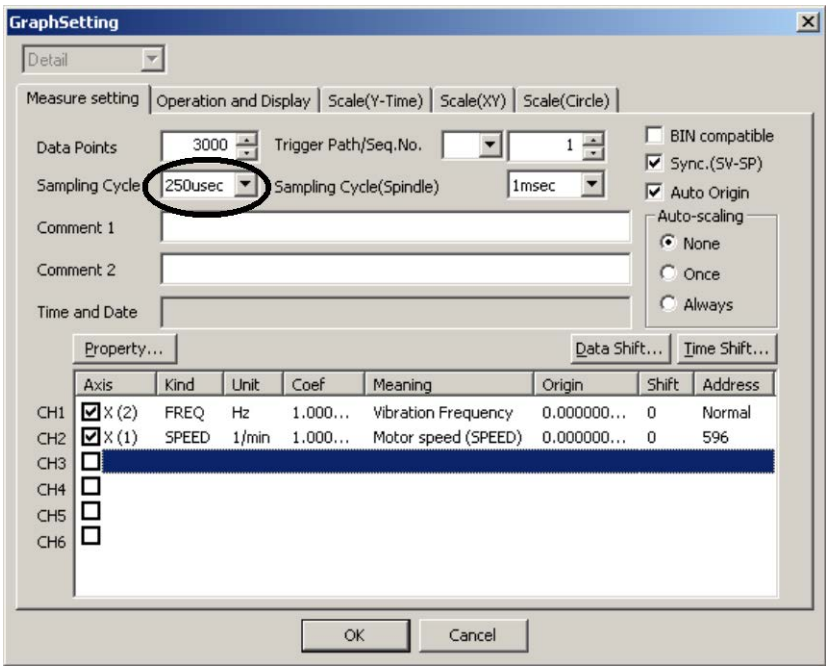
No. 1023 (n: 0, 1, 2,..)	4n + 1	4n + 2	4n + 3	4n + 4
Series 90C5, 90C8	596	724	-	-
Series 90E0, 90E1, 90E5, 90E8	596	724	6740	6868

No. 1023 (n: 0, 1, 2,..)	8n + 1	8n + 2	8n + 3	8n + 4	8n + 5	8n + 6
Series 90G0, 90J0, 90GP, 90JP	6144	10240	14336	18432	22528	26624



(c) Setting for sampling

Set the sampling cycle to 250 μs.



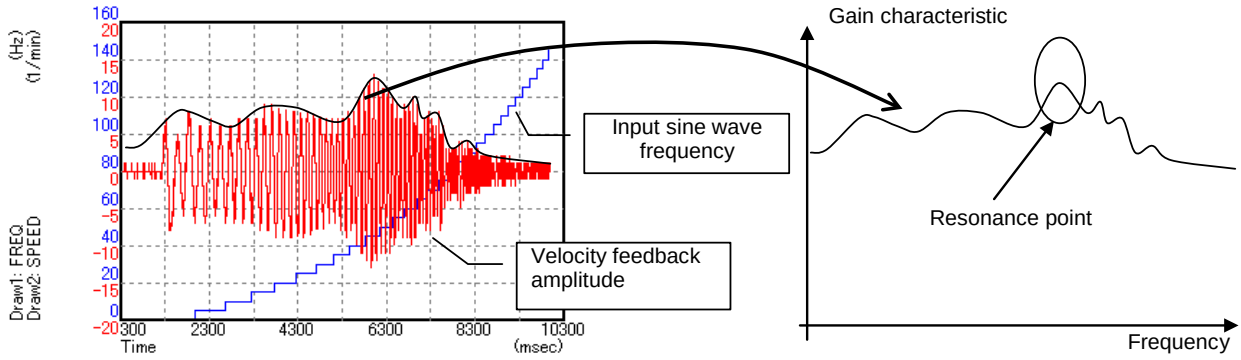
(d) Usage

When the rising edge of the disturbance input bit (No. 2270#7) (**DSTIN**) is detected, application of vibration is started. Vibration is automatically stopped after a sine sweep is performed from the start frequency to the end frequency. The operation is stopped by a reset or an emergency stop. After the emergency stop is released, disturbance input is resumed starting with the start frequency by setting the function bit off then on again.

[Example of setting]

No. 2326 = 50 → Gain = 500
No. 2327 = 0 → Start frequency = 10 Hz
No. 2328 = 0 → End frequency = 200 Hz
No. 2329 = 0 → Number of measurement points = 3

By using SERVO GUIDE, obtain data, and display the frequency (ch1) and velocity feedback (ch2) in the XY-YT mode.



As shown in the above waveform, the envelope of the velocity feedback indicates the gain characteristic at each frequency, and a swell in the waveform shows a resonance point.

Tune the tandem disturbance elimination control parameters so that the degree of the gain swell at the resonance point is reduced.

5.10.1.5 Synchronous axes automatic compensation

(1) Overview

With synchronized axes having a long stroke, a machine twist occurs due to the absolute precision of the scale and thermal expansion of the machine. In such a case, the master motor and slave motor of the synchronized axes pull against each other, and if a large current flows for the pull, an overheat problem or OVC alarm occurs.

The fundamental cause of this is a measurement position error. Pitch error compensation can compensate for the scale error but cannot compensate for thermal expansion due to change in temperature.

The synchronous axes automatic compensation function is useful for such cases. The function monitors a torque error between the master and slave and corrects the position on the slave side slowly to reduce the torque error.

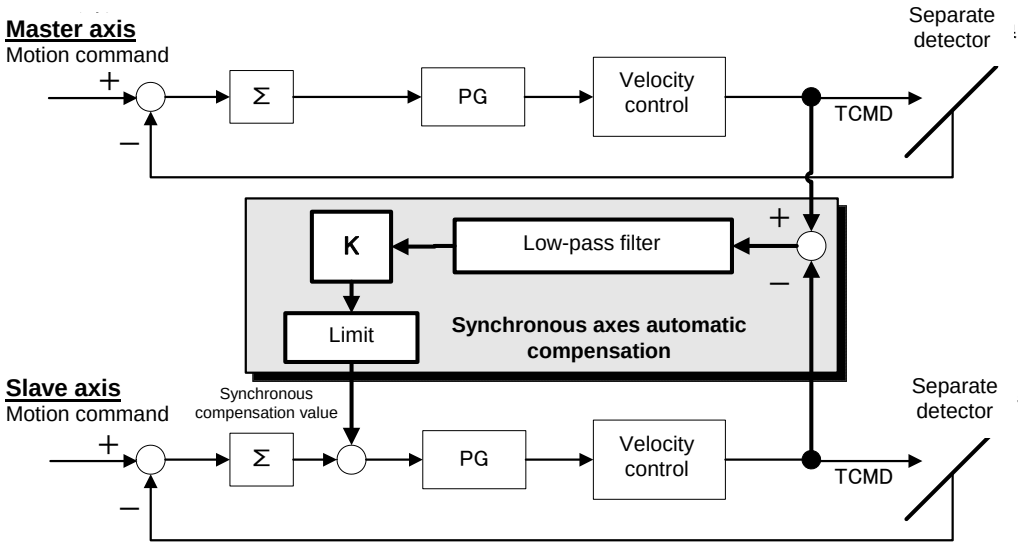


Fig. 5.10.1.5 (a) Configuration of the synchronous axes automatic compensation

(2) Series and editions of applicable servo control software

(Synchronous axes automatic compensation)

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	N(14) and subsequent editions 01.0 and subsequent editions	
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	

(Supporting the coupling signal and preset function)

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	30.0 and subsequent editions 05.0 and subsequent editions	
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	

(Supporting the compensation amount hold function)

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	U(21) and subsequent editions 01.0 and subsequent editions	
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	

NOTE
This function cannot be used with the servo HRV4 control.

(3) Setting parameters

- The following parameters are all set for the slave axis (the axis for which an even number is set for parameter No. 1023) only.

	#7	#6	#5	#4	#3	#2	#1	#0
2275					ASYN			

ASYN (#3) Synchronous axes automatic compensation is:
0: Not used.
1: Used.

	#7	#6	#5	#4	#3	#2	#1	#0
2221	ASYCS							

ASYCS(#7) The use of the coupling signal for the synchronous axes automatic compensation is: (Power-off parameter)
0: Disabled.
1: Enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
2289								SYNDI

SYNDI(#0) The function for holding the compensation amount in synchronous axes automatic compensation is:
0: Not used.
1: Used.

The function for holding the compensation amount in synchronous axes automatic compensation temporarily stops the update of the compensation amount according to DI signal Gn325. When Gn325 is set to 1, this function stops the update of the compensation amount.

2121	Synchronous axes automatic compensation: Preset

[Unit] Detection unit

[Setting value] 0 to 5000

* Use this parameter to input the initial compensation amount.
* If an excessive large value is input, the machine may move by a large extent at power-on. Set a smaller value.
* If the power is turned off while the synchronous axes automatic compensation function is being used, the compensation amount is reset to 0. After power-on, the servo control software reads the value of parameter No. 2121, which sets the value as the compensation amount of the synchronous axes automatic compensation. The setting is valid only when bit 7 of parameter No. 2221 is set to 1.
* Before the value of parameter No. 2121 is rewritten from the PMC, make sure that movement along all axes stops.

2403	Synchronous axes automatic compensation coefficient (K)

[Unit] Detection unit/TCMD × 4096 (TCMD: 7282 with the maximum current value of the amplifier)

[Setting value] -32767 to 32767

From the relationship between the current value generated in the stopped state when this function is disabled and the position error between the synchronized axes, determine the coefficient (K) according to the following expression:

K = position error/current value (in TCMD) × 4096 <1>

On the servo tuning screen, the current value is indicated in amperes or as the percentage to the rated current value. So, use expression <2> or <3> for calculation.

K = position error/{current value (%) × Ir × 7282/6554} × 4096 <2>

Ir: Rated current in parameter No. 2086

K = position error/{current value (A)/Amax × 7282} × 4096 <3>

Amax: Maximum current value of the amplifier

Measure the current value when the pulling phenomenon is observed at the release of emergency stop. The position error between the synchronized axes is obtained from the difference in position error between the master axis and slave axis at the time of emergency stop. Normally, the position error of the master axis at the time of emergency stop is 0, so you need to check the position error of the slave axis only.

Example) Suppose that the position error of the slave at the time of emergency stop is 200, the current value at the release of emergency stop is 60% (the percentage to the rating), and 1437 is set for parameter No. 2086 (rated current value):

Settings = 200 / { 1437 × 60/100 × 7282/6554 } × 4096 = 855

2404	Synchronous axes automatic compensation: Maximum compensation

[Unit] Detection unit

[Setting value] 0 to 5000

Set the synchronous axes automatic compensation to the maximum compensation amount.

2405	Synchronous axes automatic compensation: Filter time constant

[Unit] sec
[Setting value] 0 to 10
[Recommended value] 0 (When a value of 0 is set, 1 second is assumed.)
Set the position compensation to the time constant for reflecting the twist. As a larger time constant is set, compensation to release the twist is performed more slowly.

NOTE
1 This function reduces the difference in torque between the master and slave axes by adding compensation pulses to the slave axis. In the steady state, position error equivalent to the compensation amount is accumulated in the slave axis.
2 When this function is used, servo axis arrangement (parameter No. 1023) needs to be set as follows.
Master axis: Axis for which an odd number is set for parameter No. 1023
Slave axis: Axis for which the master axis number + 1 (even number) is set for parameter No. 1023

Set the following parameter for the odd-numbered axis side (the master axis) only:

2404	Synchronous axes automatic compensation: Dead-band width

[Unit] %. 100% is equivalent to the rated current.
[Setting value] 0 to 800
If the difference in torque between the master axis and slave axis is within the dead-band width, the synchronous axes automatic compensation amount becomes 0.

(4) Signal

- **SVDI1n: Coupling signal**

	#7	#6	#5	#4	#3	#2	#1	#0
Gn321	SVDI18	SVDI17	SVDI16	SVDI15	SVDI14	SVDI13	SVDI12	SVDI11

[Classification] Input signal
[Function] This signal is used to disable the functions acting between synchronous axes when the mechanical coupling of the synchronous axes normally driven in the coupled state is temporarily released.
This signal also is available for the tandem disturbance elimination control, velocity feedback averaging, and velocity loop integrator copying.
[Operation] 0: Coupled state (The functions for synchronization control are turned on.)
1: Uncoupled state (The functions for synchronization control are turned off.)

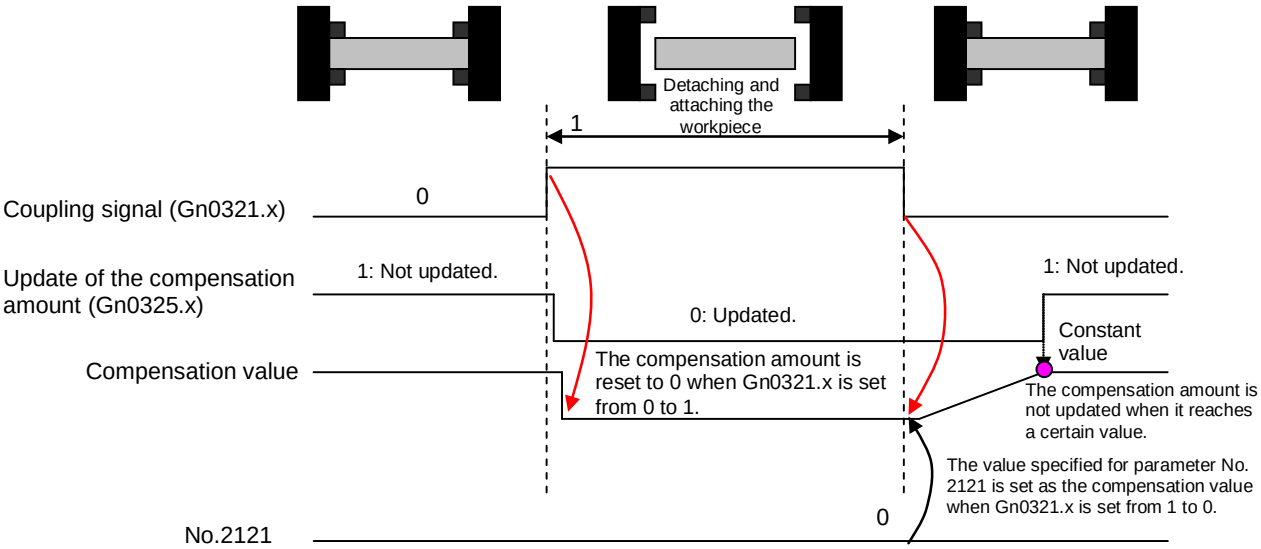
- **SVDI5n: Signal for holding the compensation amount in synchronous axes automatic compensation**

	#7	#6	#5	#4	#3	#2	#1	#0
Gn325	SVDI58	SVDI57	SVDI56	SVDI55	SVDI54	SVDI53	SVDI52	SVDI51

[Classification] Input signal
[Function] This signal is used to request the stop of the update of the synchronization compensation amount.
[Operation] When the function for holding the synchronization compensation amount (bit 0 of parameter No. 2289) is used, setting this signal to "1" stops the update of the synchronization compensation amount.

(4.1) Timing chart

Operation performed when the workpiece is attached and detached (resetting the synchronization compensation amount to 0) * Enabled only when bit 7 of parameter No. 2221 is set to 1.



(5) Application example

The figure below shows how synchronous axes automatic compensation works effectively.

When the master axis and slave axis, which are synchronized axes coupled mechanically, indicate different positions as position B, the master axis and slave axes pull against each other, and their torque command (TCMD) waveforms increase in opposite directions.

Use of this function allows the position of the slave axis to move slowly to a position that is balanced with the master axis position, so the problem of axes pulling against each other does not occur.

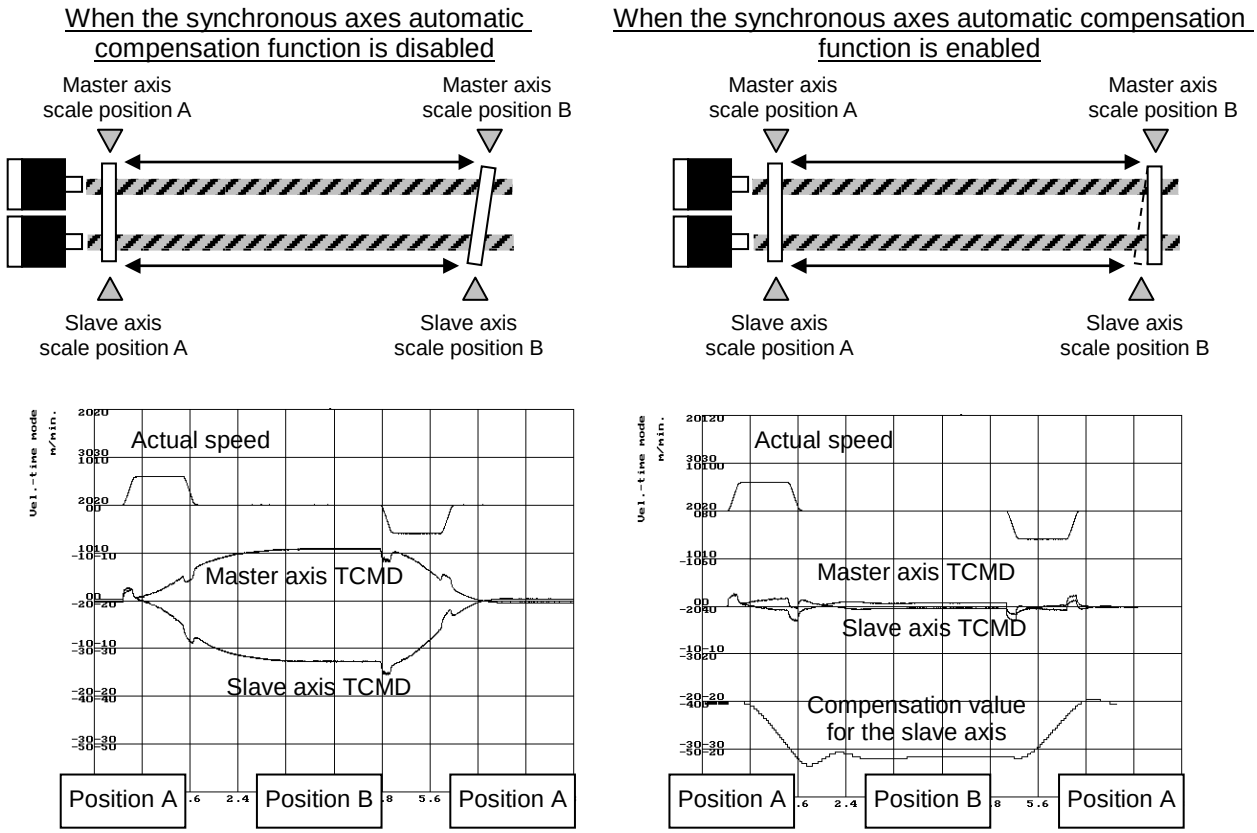


Fig. 5.10.1.5 (b)

5.10.1.6 Functions for sharing a separate detector

When using a serial cable or in other cases where a feedback cable cannot be divided into two, separate feedback can be shared by both the main axis and sub-axis, by employing one of the two methods below.

(1) Method for setting the FSSB
(2) Method for sharing the separate feedback

Basically, use (1) Method for setting the FSSB. (2) Method for sharing the separate feedback is intended for backward compatibility.

(1) Method for setting the FSSB

The parameters to be set differ according to the CNC. So, see one of the following items:

(1.1) 30*i*-A Series CNC or 0*i*-D, 0*i* Mate-D (Package5)
(1.2) 30*i*-B Series CNC or 0*i*-F

(1.1) 30*i*-A Series CNC or 0*i*-D, 0*i* Mate-D (Package5)

	#7	#6	#5	#4	#3	#2	#1	#0
14476			SSC					

SSC (#5) One connector on the separate detector interface unit is:
0: Not shared between multiple axes.
1: Shared between multiple axes.

	#7	#6	#5	#4	#3	#2	#1	#0
1902								FMD

FMD The FSSB setting is made in:
1: Manual setting mode (manual setting 2 mode).
0: Automatic setting mode.

	#7	#6	#5	#4	#3	#2	#1	#0
1905	PM2	PM1				PM4	PM3	

PM1(#6) The first separate detector interface unit is:
1: Used.
0: Not used.

PM2(#7) The second separate detector interface unit is:
1: Used.
0: Not used.

PM3(#1) The third separate detector interface unit is:
1: Used.
0: Not used.

PM4(#2) The fourth separate detector interface unit is:
1: Used.
0: Not used.

1936 (FS30*i*-A)	Connector number for the first separate detector interface unit (0 to 7)
1937 (FS30*i*-A)	Connector number for the second separate detector interface unit (0 to 7)
1938 (FS30*i*-A)	Connector number for the third separate detector interface unit (0 to 7)

1939 (FS30*i*-A)	Connector number for the fourth separate detector interface unit (0 to 7)
14376 (FS30*i*-A) to 14383 (FS30*i*-A)	ATR value corresponding to connector number i on the first separate detector interface unit (No. 1023 – 1)
14384 (FS30*i*-A) to 14391 (FS30*i*-A)	ATR value corresponding to connector number i on the second separate detector interface unit (No. 1023 – 1)
14392 (FS30*i*-A) to 14399 (FS30*i*-A)	ATR value corresponding to connector number i on the third separate detector interface unit (No. 1023 – 1)
14400 (FS30*i*-A) to 14407 (FS30*i*-A)	ATR value corresponding to connector number i on the fourth separate detector interface unit (No. 1023 – 1)

<Setting method>

<1> Set bit 0 of parameter No. 1902 to 1 and bit 5 of parameter No. 14476 to 1.

<2> Set the same connector numbers for the axes sharing the separate detector. (No. 24096, No. 24097, No. 24098, No. 24099)

<3> Set the value of (value of parameter No. 1023 for the axis referencing the connector + 1000) for the ATR value corresponding to the separate detector interface connector number (parameters Nos. 24104 to 24135).
Only one axis can be set for the parameter at a time. So, when multiple axes reference a connector, set the parameter as many times as the number of reference axes. For details, see the example of setting.

<Example of setting>
[Configuration]
SDU (First unit)
First connector - Separate detector
Second connector - Blank
Third connector - Blank
Fourth connector - Blank

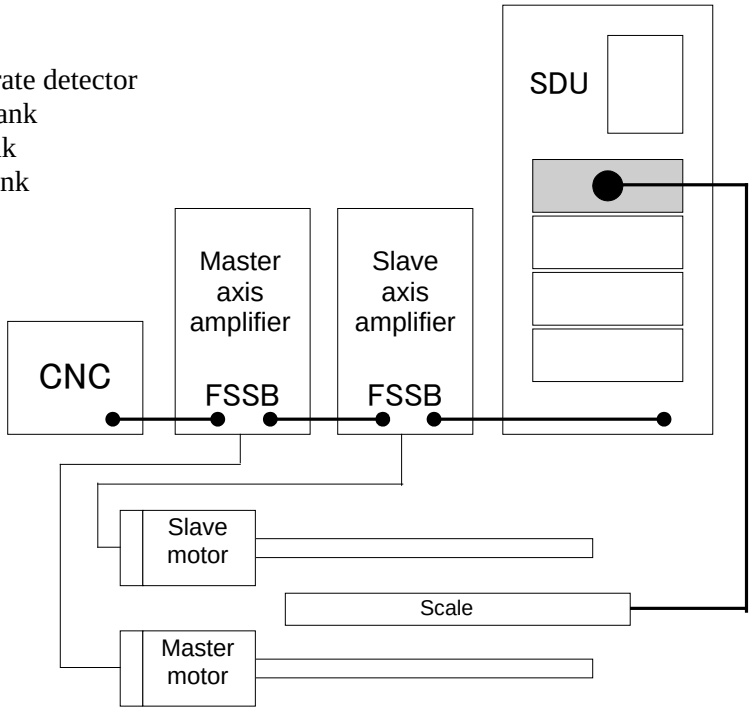


Fig. 5.10.1.6 (a) Example of SDU connection

[Setting]
No. 1902#0 = 1, No. 1905#6 = 1, No. 14476#5 = 1
Set 0 for parameter No. 1936 for each axis referencing the separate detector.
Set the value set for parameter No. 1023 for the first axis referencing the separate detector - 1 for parameter No. 14376.
Set the value set for parameter No. 1023 for the second axis referencing the separate detector – 1 for parameter No. 14377.
No. 14378 to No. 1483 = 32

(1.2) 30*i*-B Series CNC or 0*i*-F

	#7	#6	#5	#4	#3	#2	#1	#0
14476			SSC					

SSC (#5) One connector on the separate detector interface unit is:
0: Not shared between multiple axes.
1: Shared between multiple axes.

	#7	#6	#5	#4	#3	#2	#1	#0
1902								FMD

FMD The FSSB setting is made in:
1: Manual setting mode (manual setting 2 mode).
0: Automatic setting mode.

24096 (FS30*i*-B)	Connector number for the first or ninth separate detector interface unit (1 to 8)
24097 (FS30*i*-B)	Connector number for the second or tenth separate detector interface unit (1 to 8)
24098 (FS30*i*-B)	Connector number for the third or eleventh separate detector interface unit (1 to 8)
24099 (FS30*i*-B)	Connector number for the fourth or twelfth separate detector interface unit (1 to 8)
24100 (FS30*i*-B)	Connector number for the fifth separate detector interface unit (1 to 8)
24101 (FS30*i*-B)	Connector number for the sixth separate detector interface unit (1 to 8)
24102 (FS30*i*-B)	Connector number for the seventh separate detector interface unit (1 to 8)
24103 (FS30*i*-B)	Connector number for the eighth separate detector interface unit (1 to 8)

First FSSB line

24104 (FS30*i*-B) to 24111 (FS30*i*-B)	ATR value corresponding to connector number i on the first separate detector interface unit (No. 1023 + 1000)
24112 (FS30*i*-B) to 24119 (FS30*i*-B)	ATR value corresponding to connector number i on the second separate detector interface unit (No. 1023 + 1000)
24120 (FS30*i*-B) to 24127 (FS30*i*-B)	ATR value corresponding to connector number i on the third separate detector interface unit (No. 1023 + 1000)
24128 (FS30*i*-B) to 24135 (FS30*i*-B)	ATR value corresponding to connector number i on the fourth separate detector interface unit (No. 1023 + 1000)

Second FSSB line

24136 (FS30*i*-B) to 24143 (FS30*i*-B)	**ATR value corresponding to connector number i on the fifth separate detector interface unit (No. 1023 + 1000)**
24144 (FS30*i*-B) to 24151 (FS30*i*-B)	**ATR value corresponding to connector number i on the sixth separate detector interface unit (No. 1023 + 1000)**
24152 (FS30*i*-B) to 24159 (FS30*i*-B)	**ATR value corresponding to connector number i on the seventh separate detector interface unit (No. 1023 + 1000)**
24160 (FS30*i*-B) to 24167 (FS30*i*-B)	**ATR value corresponding to connector number i on the eighth separate detector interface unit (No. 1023 + 1000)**

Third FSSB line

24168 (FS30*i*-B) to 24175 (FS30*i*-B)	**ATR value corresponding to connector number i on the ninth separate detector interface unit (No. 1023 + 1000)**
24176 (FS30*i*-B) to 24183 (FS30*i*-B)	**ATR value corresponding to connector number i on the tenth separate detector interface unit (No. 1023 + 1000)**
24184 (FS30*i*-B) to 24191 (FS30*i*-B)	**ATR value corresponding to connector number i on the eleventh separate detector interface unit (No. 1023 + 1000)**
24192 (FS30*i*-B) to 24199 (FS30*i*-B)	**ATR value corresponding to connector number i on the twelfth separate detector interface unit (No. 1023 + 1000)**

<Setting method>

<1> Set bit 0 of parameter No. 1902 to 1 and bit 5 of parameter No. 14476 to 1.

<2> Set the same connector numbers for the axes sharing the separate detector. (No. 24096, No. 24097, No. 24098, No. 24099)

<3> Set the value of (value of parameter No. 1023 for the axis referencing the connector + 1000) for the ATR value corresponding to the separate detector interface connector number (parameters Nos. 24104 to 24135).

Only one axis can be set for the parameter at a time. So, when multiple axes reference a connector, set the parameter as many times as the number of reference axes. For details, see the example of setting.

<Example of setting>
[Configuration]
SDU (First unit)
First connector - Separate detector
Second connector - Blank
Third connector - Blank
Fourth connector - Blank

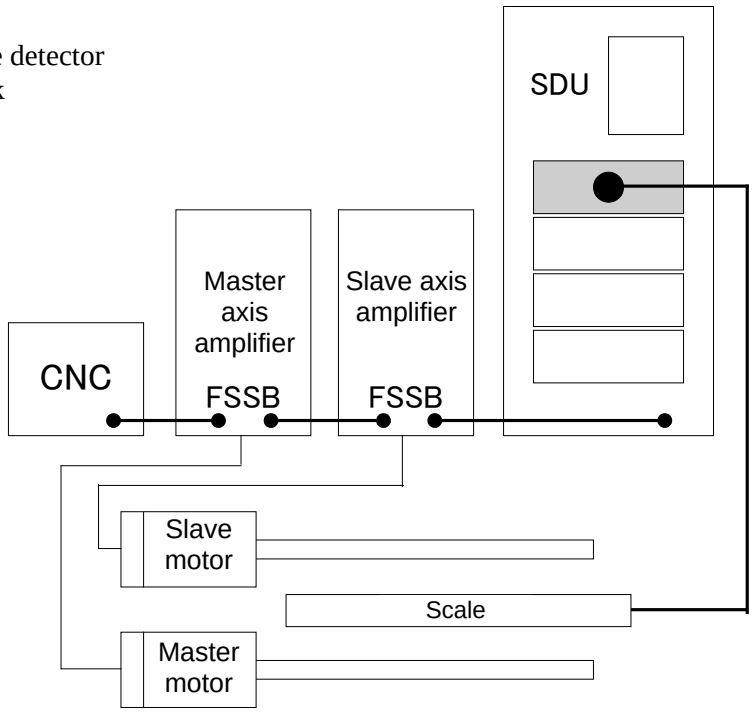


Fig. 5.10.1.6 (b) Example of SDU connection

[Setting]
No. 1902#0 = 1, No. 14476#5 = 1
Set 1 for parameter No. 24096 for each axis referencing the separate detector.
Set the value set for parameter No. 1023 for the first axis referencing the separate detector + 1000 for parameter No. 24104.
Set the value set for parameter No. 1023 for the second axis referencing the separate detector + 1000 for parameter No. 24105.
Parameter Nos. 24106 and after =1000

(2) Method for sharing the separate feedback

	#7	#6	#5	#4	#3	#2	#1	#0
2200							FULLCP	

FULLCP(#1) 1: A separate position feedback is shared by the master and slave axes.
(To be set for the slave axis only)

NOTE
1 The master axis and slave axis have consecutive numbers set for parameter No. 1023, the former being an odd number and the latter being an even number.
2 This function cannot be used with dual check safety (DCS). For an axis for which to use this function, disable DCS (set bit 6 of parameter No. 1904 to 1).

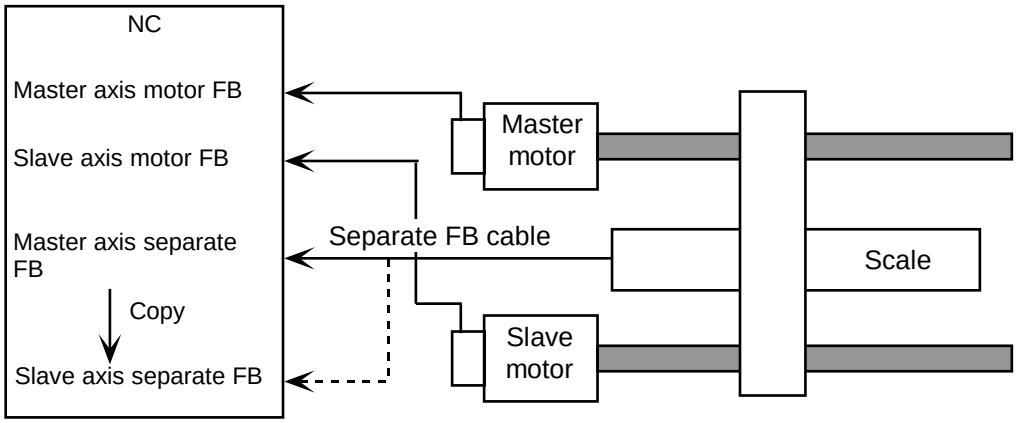


Fig. 5.10.1.6 (c) Separate feedback sharing

<Setting method>
<1> Set bit 1 of parameter No. 2200 to 1 for the slave axis.
<2> Set bit 1 of parameter No. 1815 to 1 and make FSSB setting related to the separate detector for both the master and slave axes. Set the number of the connector to which the separate detector is actually connected for the master axis and the number of an unused connector to which no detector is connected for the slave axis.

5.10.2 Multiaxis Tandem

(1) Overview

The following methods are available for controlling one axis with two motors: feed axis synchronization control (position tandem control) and torque tandem control. Feed axis synchronization control gives the same command to the master axis and multiple slave axes to control the position. The positions of the master and slave axes are controlled separately. On the other hand, in torque tandem control, the position is controlled only for the main axis*1. Only the torque is controlled for the sub*1 axes.

When two or more motors are used for controlling an axis, the multiaxis tandem function is used together with feed axis synchronization control and torque tandem control as shown in the examples below.

*1) When feed axis synchronization control and torque tandem control are used together, to make a distinction between them, the terms master and slave axes are used for the former, while main and sub axes are used for the latter.

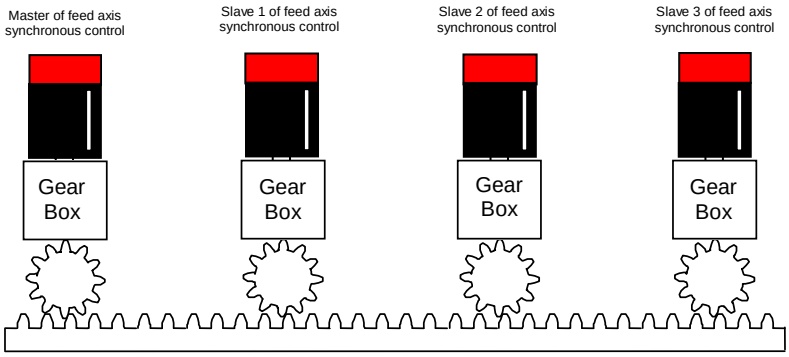


Fig. 5.10.2 (a) Example of four-axis control (feed axis synchronization control for four axes)

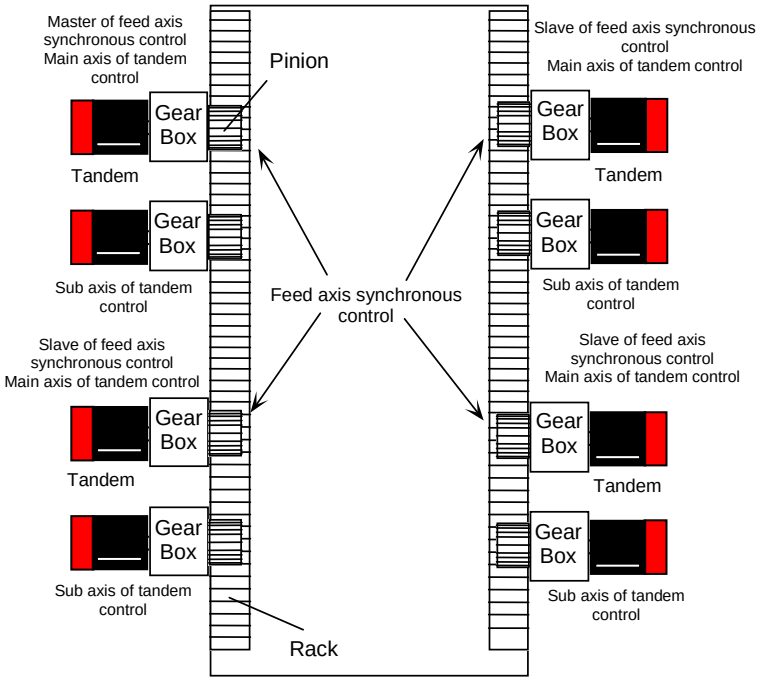


Fig. 5.10.2 (b) Example of eight-axis control
(tandem control for four axes and synchronization control for four axes)

The multiaxis tandem function can also be used for large motors driven by two amplifiers (two-winding motors: α*i*S300/2000, α*i*S500/2000, and α*i*S1000/2000HV) and those driven by four amplifiers (four-winding motors: α*i*S2000/2000HV and α*i*S3000/2000HV) together with feed axis synchronization control.

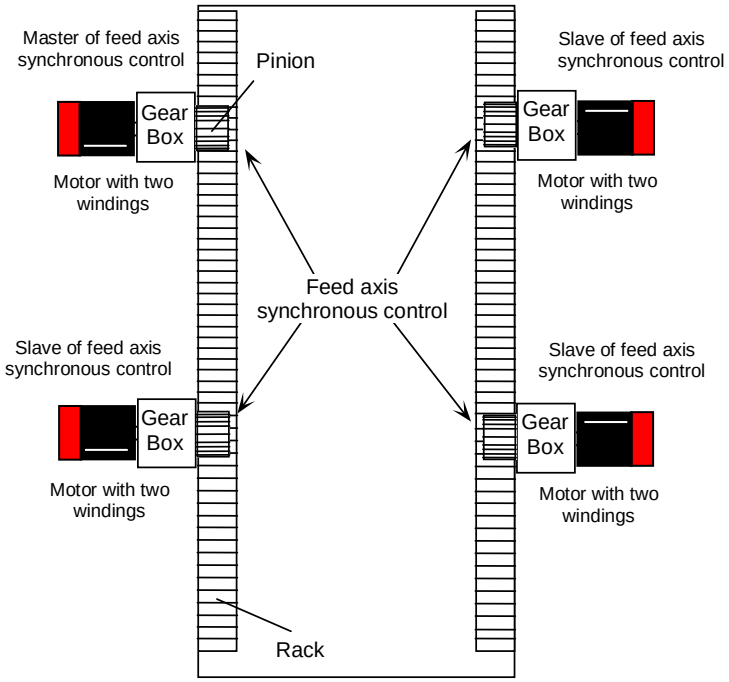


Fig. 5.10.2 (c) Example of using eight NC axes
(four motors with two windings and feed axis synchronization control for four axes)

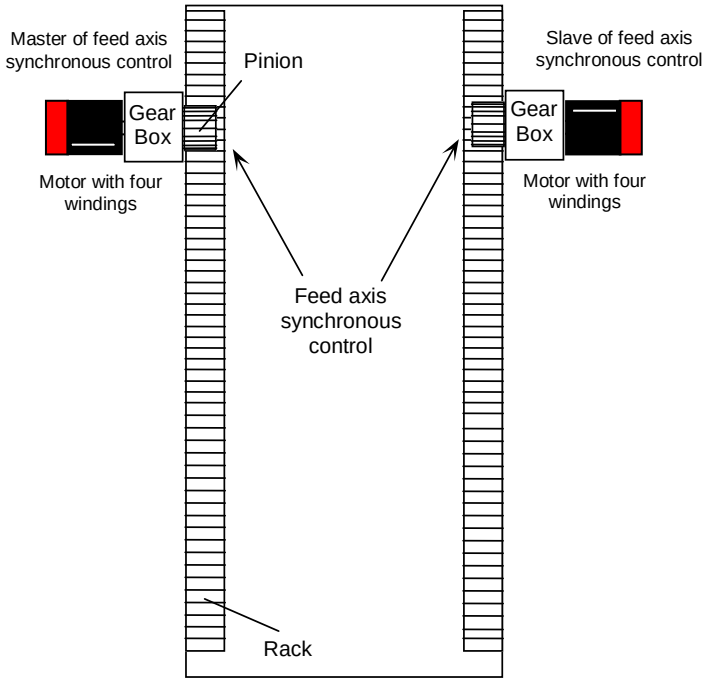


Fig. 5.10.2 (d) Example of using eight NC axes
(two motors with four windings and feed axis synchronization control for two axes)

The multiaxis tandem function enables the velocity loop integrator of the master axis to be copied to two or more slave axes.

When two motors are driven in synchronization, if the rigidity between synchronous axes is high, interference occurs due to a slight difference in the stop position, which may generate torque offset. (An OVC alarm may occur at worst.) In such circumstances, interference between the axes can be suppressed by copying the velocity loop integrator of the master axis to that of the slave axis.
A similar problem might occur when a four-axis motor is driven in synchronization or when two pairs of two axes in tandem control are driven in synchronization. To avoid this problem, a function has been added which copies the velocity loop integrator of one of the four axes to the velocity loop integrators of the other axes. (This function is an extension of the conventional velocity loop integrator copy function for two axes that is available for up to four axes.)

Form 1. One of four axes under feed axis synchronization control is set as the master axis and the integrator of the master axis is copied to the other three axes. (See Fig. 5.10.2 (a))

Form 2. The integrator is copied between main axes in tandem control for four pairs of tandem control axes. (See Fig. 5.10.2 (b))

Form 3. There are four motors with two windings. One of the motors with two windings occupies two axes. The torque is copied between the axes. Feed axis synchronization control is used for the four motors with two windings and the integrator is copied between the axes. (See Fig. 5.10.2 (c))

Form 4. There are two motors with four windings. One of the motors with four windings occupies four axes. The torque is copied among the axes. Feed axis synchronization control is used for the two motors with four windings and the integrator is copied between the axes. (See Fig. 5.10.2 (d))
The same applies when four linear motors are used instead of a motor with four windings.

Form 5. The integrator is copied between two HRV4 axes.

The multiaxis tandem function can be used together with the simultaneous monitor function to monitor three or more axes simultaneously, and in that case all axis movements can be stopped immediately if a servo alarm occurs or at emergency stop. With this function, the conventional quick stop and lifting functions against gravity can be made available for tandem control for three or more axes.

(2) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	03.0 and subsequent editions	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
	90GP	01.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	U(21) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	-	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	

(3) Setting parameters

* In this manual, the DSP axis number, which is determined by parameter No. 1023, may be used to refer to the setting for the sake of convenience.

DSP axis No.	Setting value of servo axis arrangement (No. 1023)		
	30*i*-A (Series 90Ex)	30*i*-A (Series 90Dx)	30*i*-B, 0*i*-F
1	4n + 1	2n + 1	8n + 1
2	4n + 2	2n + 2	8n + 2
3	4n + 3		8n + 3
4	4n + 4		8n + 4
5			8n + 5
6			8n + 6

The parameter settings related to multiaxis tandem are described below.

(a) Setting for copying the integrator for four axes

	#7	#6	#5	#4	#3	#2	#1	#0
2223		SLTMAS	SLTAN					

SLTAN (#5) 1: The multiaxis tandem function is enabled.
(Set this parameter for all of the master and slave axes.)
* When this parameter is changed, it is necessary to turn the power to the CNC off.
* When this parameter is set to 1, the simultaneous monitor function and integrator copy function are enabled for three or more axes.
The axis whose DSP axis number is 1 is the master axis for the integrator copy function.
If you want to use the conventional integrator copy function for two axes, set this bit to 0.

It is necessary to set SLTAN = 1 for all axes in the configuration when:
・ The integrator copy function is used for three or more axes.

SLTMAS (#6) 0: Slave axis of multiaxis tandem
1: Master axis of multiaxis tandem
* When this parameter is changed, it is necessary to turn the power to the CNC off.
* Set 1 only for the master axis of multiaxis tandem. Only the axis whose DSP axis number is 1 can be set as the master axis of multiaxis tandem. If any axis other than the one whose DSP axis number is 1 is set as the master axis, an illegal parameter setting alarm (detail number 2233) is issued.

	#7	#6	#5	#4	#3	#2	#1	#0
2273							WSVCP	

WSCCP (#1) 1: The velocity loop integrator of the master axis is copied to the slave axis.
(Set 1 for all of the master and slave axes sharing the velocity loop integrator.)
* When bit 5 (SLTAN) of parameter No. 2223 is set to 1, the velocity loop integrator copy function is enabled for three or more axes.
* When bit 5 (SLTAN) of parameter No. 2223 is set to 0, the velocity loop integrator is copied between two axes.
* For the sub-axis of torque tandem, set 0.

	#7	#6	#5	#4	#3	#2	#1	#0
2211	PLW4	PLW2						

PLW4 (#7) 1: A motor with four windings is enabled.
(Set this parameter for all of the main and sub axes.)
* When this parameter is changed, it is necessary to turn the power to the CNC off.

PLW2 (#6) 1: A motor with two windings is enabled.
(Set this parameter for the main and sub axes.)
* When this parameter is changed, it is necessary to turn the power to the CNC off.

For details of parameter setting for a motor with multiple windings, see Subsection 2.2.2, "Parameter Setting for the Four-Winding and Two-Winding Modes".

(b) Setting for simultaneously monitoring the servo alarm on four axes

	#7	#6	#5	#4	#3	#2	#1	#0
2007								ESP2AX

ESP2AX (#0) 1: The servo alarm multiaxis monitoring is enabled.
* When bit 5 (SLTAN) of parameter No. 2223 is set to 1, the multiaxis monitor function is enabled for three or more axes.
* When bit 5 (SLTAN) of parameter No. 2223 is set to 0, the multiaxis monitor function is enabled for two axes.

(c) Setting for applying a preload for more than two axes

	#7	#6	#5	#4	#3	#2	#1	#0
2417				TIMCAL		TIMPR2		

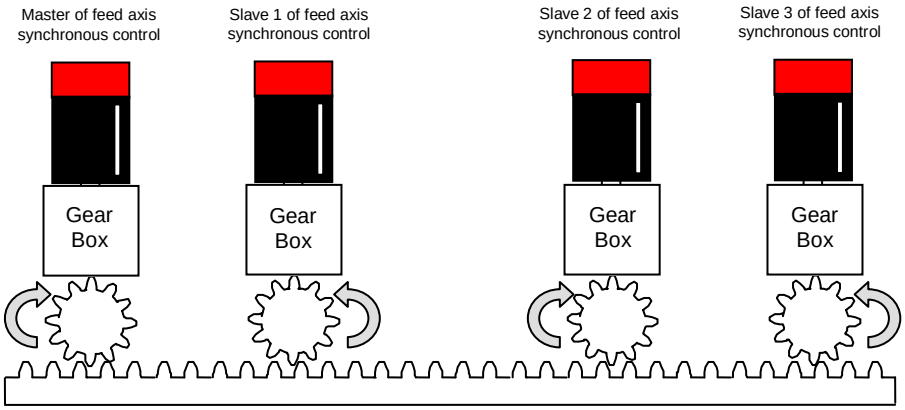
TIMCAL(#4) Preload time constant calculation is:
0: Not performed. The time constant is 0. (Conventional specification)
1: Performed.
* This function reduces a mechanical shock because a preload multiplied by a time constant is applied at the activation of the motor. For the time constant, see the description of TIMPR2 below.

TIMPR2(#2) The exponential time constant of the preload function is:
0: Reciprocal number of the position loop gain (1/s).
1: Four times the reciprocal number of the position loop gain (1/s).

2087	Preload value (PRLOAD)

The backlash between axes can be reduced by adding a torque offset to the master and slave axes of tandem in opposite directions.
If you want to a preload value for more than two axes, set preload values so that the total value is 0.
For details of the preload, see Subsection 5.10.1.2 "Preload".

[Example of setting 1] Four axes are used. Tension is produced between two axes, and between pairs of axes.

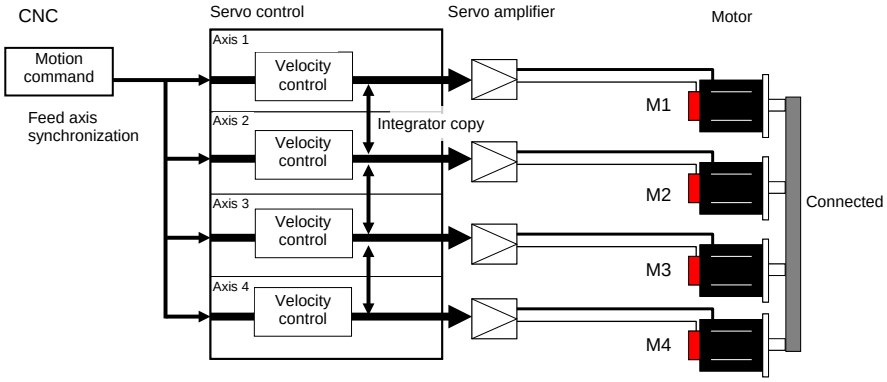


Axis No.	Axis arrangement No. 1023	Multiaxis tandem No. 2223#5	Multiaxis tandem: Master No. 2223#6	Integrator copy No. 2273#1	Preload No. 2087	Remarks
1	1	1	1	1	+600	Master of feed axis synchronization
2	2	1	0	1	-300	Slave of axis 1
3	3	1	0	1	+300	Slave of axis 1
4	4	1	0	1	-600	Slave of axis 1

(4) Example of parameter setting

(4.1) Driving four axes with feed axis synchronization control and using the integrator copy function for the four axes (Form <1>)

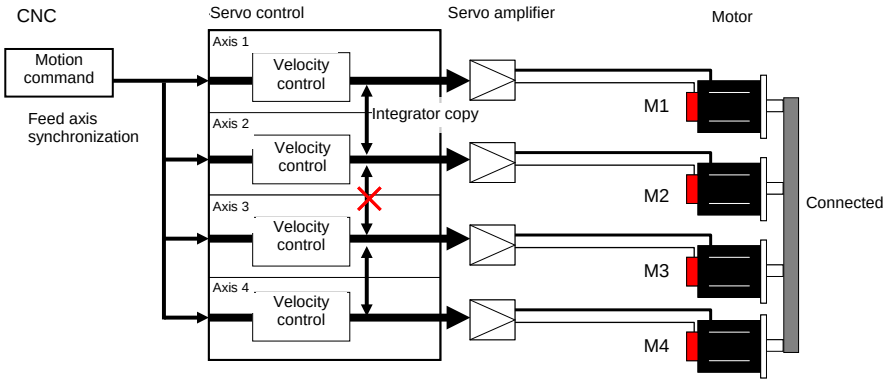
- Set feed axis synchronization control for axes 1 to 4.
- To use the alarm multiaxis monitor function for axes 1 to 4, set bit 5 of parameter No. 2223 (multiaxis tandem) to 1 and bit 0 of parameter No. 2007 (multiaxis monitor) to 1.



Axis	Axis arrangement No.1023	Tandem No.1817#6	Multiaxis tandem No. 2223#5	Multiaxis tandem: Master No.2223#6	Integrator copy No.2273#1	Multiaxis monitor No.2007#0	Remarks
Axis 1	1	0	1	1	1	1	Master of feed axis synchronization
Axis 2	2	0	1	0	1	1	Slave 1 of feed axis synchronization
Axis 3	3	0	1	0	1	1	Slave 2 of feed axis synchronization
Axis 4	4	0	1	0	1	1	Slave 3 of feed axis synchronization

(4.2) Driving four axes with feed axis synchronization control and copying the integrator between axes 1 and 2 and that between axes 3 and 4 (Form <1>)

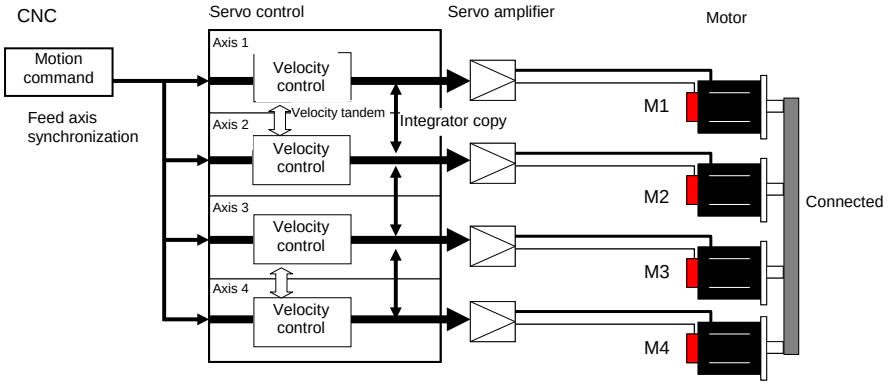
- Set feed axis synchronization control for axes 1 to 4.
- Set bit 1 of parameter No. 2273 to 0 for axis 3 so that the integrator of axis 1 is not copied to axis 3.
- To use the emergency stop multiaxis monitor function for axes 1 to 4, set bit 0 of parameter No. 2007 to 1 and bit 5 of parameter No. 2223 to 1 for axes 1 and 3.



Axis	Axis arrangement No.1023	Tandem No.1817#6	Multiaxis tandem No. 2223#5	Multiaxis tandem: Master No.2223#6	Integrator copy No.2273#1	Multiaxis monitor No.2007#0	Remarks
Axis 1	1	0	1	1	1	1	Master of feed axis synchronization
Axis 2	2	0	0	0	1	1	Slave 1 of feed axis synchronization
Axis 3	3	0	1	0	0	1	Slave 2 of feed axis synchronization
Axis 4	4	0	0	0	1	1	Slave 3 of feed axis synchronization

(4.3) Driving two axes with feed axis synchronization control, setting tandem control (velocity tandem) for the two axes under feed axis synchronization control, and copying the integrator between the axes under feed axis synchronization control (Form <2>)

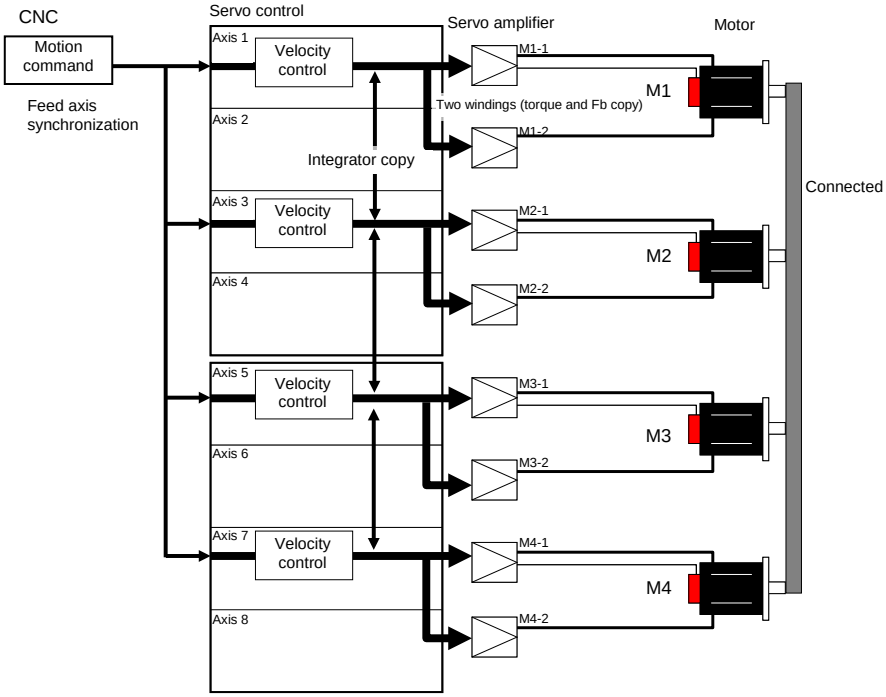
- Tandem control (velocity tandem) is set for axes 1 and 3, and axes 2 and 4.
- Set feed axis synchronization control for axes 1 and 2.



Axis	Axis arrangement No.1023	Tandem No.1817#6	Velocity tandem No.2008#5	Multiaxis tandem No. 2223#5	Multiaxis tandem: Master No.2223#6	Integrator copy No.2273#1	Remarks
Axis 1	1	1	1	1	1	1	Master of feed axis synchronization
Axis 2	2	1	0	1	0	1	Tandem sub of axis 1
Axis 3	3	1	1	1	0	1	Slave of feed axis synchronization
Axis 4	4	1	0	1	0	1	Tandem sub of axis 3

(4.4) Driving four motors with two windings, with feed axis synchronization control, and using the integrator copy function for the axes under feed axis synchronization control (Form <3>)

- Set feed axis synchronization control for axes 1, 3, 5, and 7.
- The integrator of axis 1 is copied to axes 3, 5, and 7.
- Each motor with two windings corresponds to axes 1 and 2, axes 3 and 4, axes 5 and 6, or axes 7 and 8.



Example of setting with the 30*i*-B and 0*i*-F

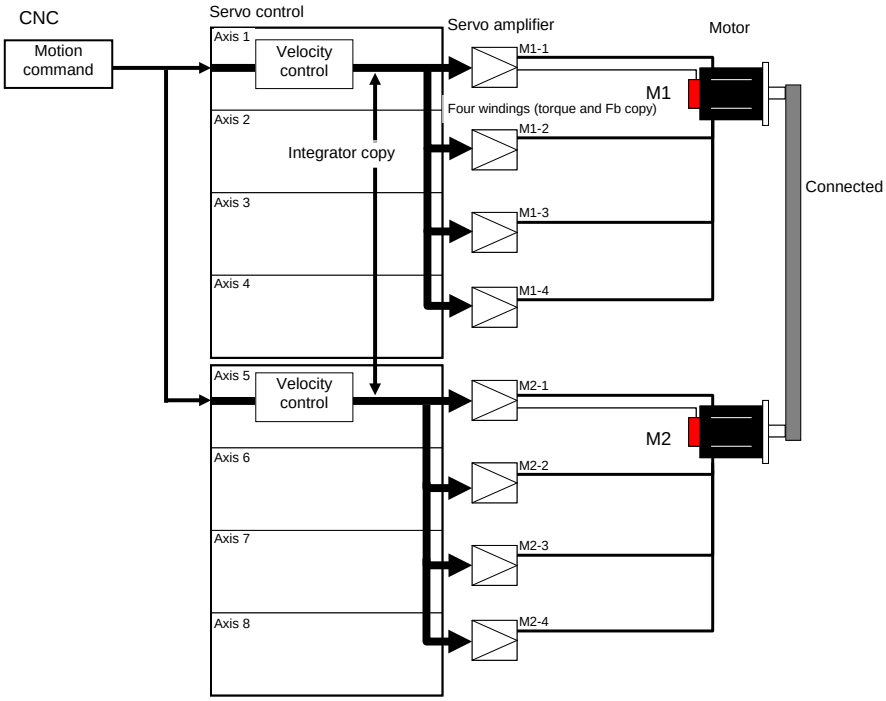
Axis	Axis arrangement No.1023	Motor with two windings No.2211#6	Multiaxis tandem No.2223#5	Multiaxis tandem: Master No.2223#6	Integrator copy No.2273#1	Remarks
Axis 1	1	1	1	1	1	Master of feed axis synchronization
Axis 3	3	1	1	0	1	Slave 1 of feed axis synchronization
Axis 5	9	1	1	0	1	Slave 2 of feed axis synchronization
Axis 7	11	1	1	0	1	Slave 3 of feed axis synchronization
Axis 2	2	1	1	0	0	Tandem sub of master axis
Axis 4	4	1	1	0	0	Tandem sub of slave 1
Axis 6	10	1	1	0	0	Tandem sub of slave 2
Axis 8	12	1	1	0	0	Tandem sub of slave 3

Example of setting with the 30*i*-A

Axis	Axis arrangement No.1023	Tandem No.1817#6	FB sharing No.2018#7	Multiaxis tandem No.2223#5	Multiaxis tandem: Master No.2223#6	Integrator copy No.2273#1	Remarks
Axis 1	1	1	0	1	1	1	Master of feed axis synchronization
Axis 3	3	1	0	1	0	1	Slave 1 of feed axis synchronization
Axis 5	5	1	0	1	0	1	Slave 2 of feed axis synchronization
Axis 7	7	1	0	1	0	1	Slave 3 of feed axis synchronization
Axis 2	2	1	1	1	0	0	Tandem sub of master axis
Axis 4	4	1	1	1	0	0	Tandem sub of slave 1
Axis 6	6	1	1	1	0	0	Tandem sub of slave 2
Axis 8	8	1	1	1	0	0	Tandem sub of slave 3

(4.5) Driving two motors with four windings, with feed axis synchronization control, and using the integrator copy function for the axes under feed axis synchronization control (Form <4>)

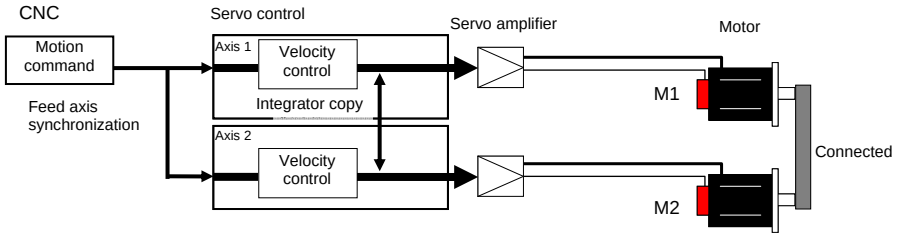
- Set feed axis synchronization control for axes 1 and 5.
- The integrator of axis 1 is copied to axis 5.
- The four-winding motor function is used to copy the position feedback and torque command from axis 1 to axes 2 to 4 and from axis 5 to axes 6 to 8. For each sub-axis, you do not have to share motor feedback (bit 7 of parameter No. 2018).
- In this case, use axis names different from those assigned to axes 1 and 2 for axes other than axes 1 and 5, master and slave axes of synchronization (axes 2 to 4 and 6 to 8). If the same axis name is used, the actual feedrate becomes lower than the specified speed. In this case, use the extended axis name function (set bit 0 of parameter No. 1000 to 1 and set parameter No. 1025 to axis name 2) to set a different axis name.



Axis	Axis arrangement No.1023 (30*i*B)	(30*i*A)	Tandem No.1817#6	Motor with four windings No.2211#7	Multiaxis tandem No.2223#5	Multiaxis tandem: Master No.2223#6	Integrator copy No.2273#1	Remarks
Axis 1	1	1	0	1	1	1	1	Master of feed axis synchronization
Axis 2	2	2	0	1	1	0	0	Tandem sub of axis 1
Axis 3	3	3	0	1	1	0	0	Tandem sub of axis 1
Axis 4	4	4	0	1	1	0	0	Tandem sub of axis 1
Axis 5	9	5	0	1	1	0	1	Slave of feed axis synchronization
Axis 6	10	6	0	1	1	0	0	Tandem sub of axis 2
Axis 7	11	7	0	1	1	0	0	Tandem sub of axis 2
Axis 8	12	8	0	1	1	0	0	Tandem sub of axis 2

(4.6) Driving two motors with feed axis synchronization control and copying the integrator between two HRV4 axes (Form <5>)

- Set feed axis synchronization control for axes 1 and 2.



Example of setting with the 30*i*-B

Axis	Arrangement No.1023	Tandem No.1817#6	Multiaxis tandem No.2223#5	Multiaxis tandem: Master No.2223#6	Integrator copy No.2273#1	HRV4 No.2014#0	Remarks
Axis 1	1	0	1	1	1	1	Master of feed axis synchronization
Axis 2	9	0	1	0	1	1	Slave of feed axis synchronization

5.10.3 Turning On and Off the Functions Related to Synchronization and Tandem Control by Using a PMC Signal

(1) Overview

PMC signal G321 (coupling flag) can be used to turn the following functions on and off dynamically:

- Integrator copy — See the Item (4) of Subsection 5.10.1.1.
- Tandem disturbance elimination — See the Item (5) of Subsection 5.10.1.4.
- Synchronous automatic compensation — See the Item (4) of Subsection 5.10.1.5.
- Velocity feedback average function — See Subsection 5.10.4.2.

> **NOTE**
> For the function details and the supported editions, see the sections describing each function.

(2) Signal

- **SVDI1n: Coupling signal**

	#7	#6	#5	#4	#3	#2	#1	#0
Gn321	SVDI18	SVDI17	SVDI16	SVDI15	SVDI14	SVDI13	SVDI12	SVDI11

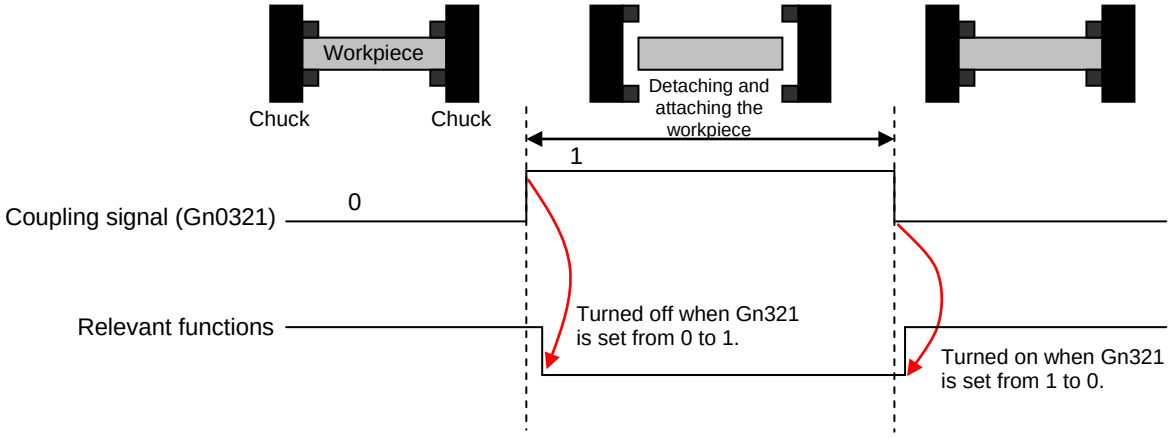
[Classification] Input signal

[Function] This signal is used to disable the functions acting between synchronous axes when the mechanical coupling of the synchronous axes normally driven in the coupled state is temporarily released.
This signal is available for velocity loop integrator copy, tandem disturbance elimination control, synchronous axes automatic compensation, and velocity feedback averaging.

[Operation] 0: Coupled state (The functions are turned on.)
1: Uncoupled state (The functions are turned off.)

(3) Example of using this signal

When the workpiece is detached, set G0321.x to 1 to turn off the functions.



5.10.4 Torque Tandem Control

(1) Overview

By copying the torque command from the main motor to the sub-motor, this function makes it possible to obtain twice as large a torque as the torque obtained when driven by a single motor (Load sharing mode). In this mode, position control is exercised only over the main motor, and the sub-motor only generates a torque.

By applying a preload torque to produce tension between the main motor and sub-motor, the backlash between gears can be reduced.

(Anti-backlash mode)

Tandem control can also be used with motor feedback sharing to drive linear motors connected in series and motors with multiple windings (α*i*S300/2000,-B, α*i*S500/2000,-B, α*i*S1000/2000HV,-B, α*i*S1000/3000HV,-B, α*i*S1500/3000HV-B, α*i*S2000/2000HV, and α*i*S3000/2000HV). For details, see Section 2.2.

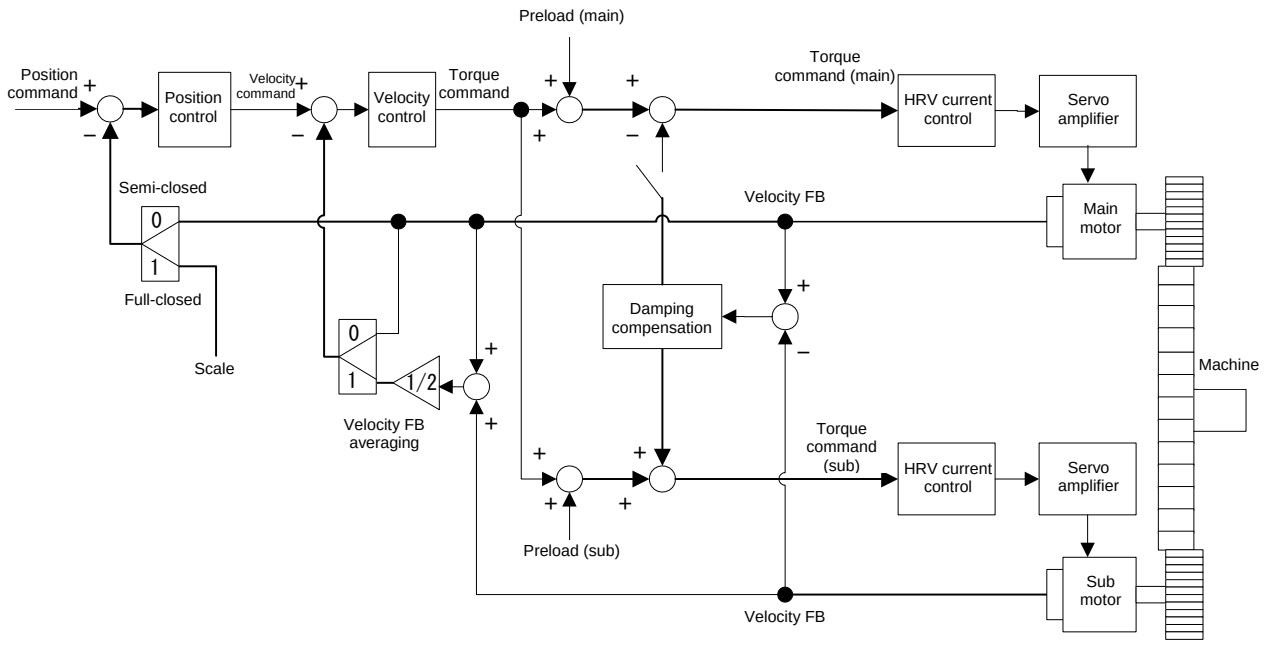


Fig. 5.10.4 (a) Block diagram of torque tandem control (usual case)

> ⚠ **WARNING**
> When torque tandem control is used, position control and velocity control are not exercised on the sub-motor side. Use care.
> When two motors are not connected with each other, applying a force to the main motor side is very dangerous, because the sub-motor may make an extremely high-speed rotation.

(2) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	A(01) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0 90M8	02.0 and subsequent editions 02.0 and subsequent editions	
Series 0*i*-D	90C5 90C8 90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions	

NOTE
This function cannot be used with the servo HRV4 control.

(3) Start-up procedure

To start tandem control, follow the procedure below.

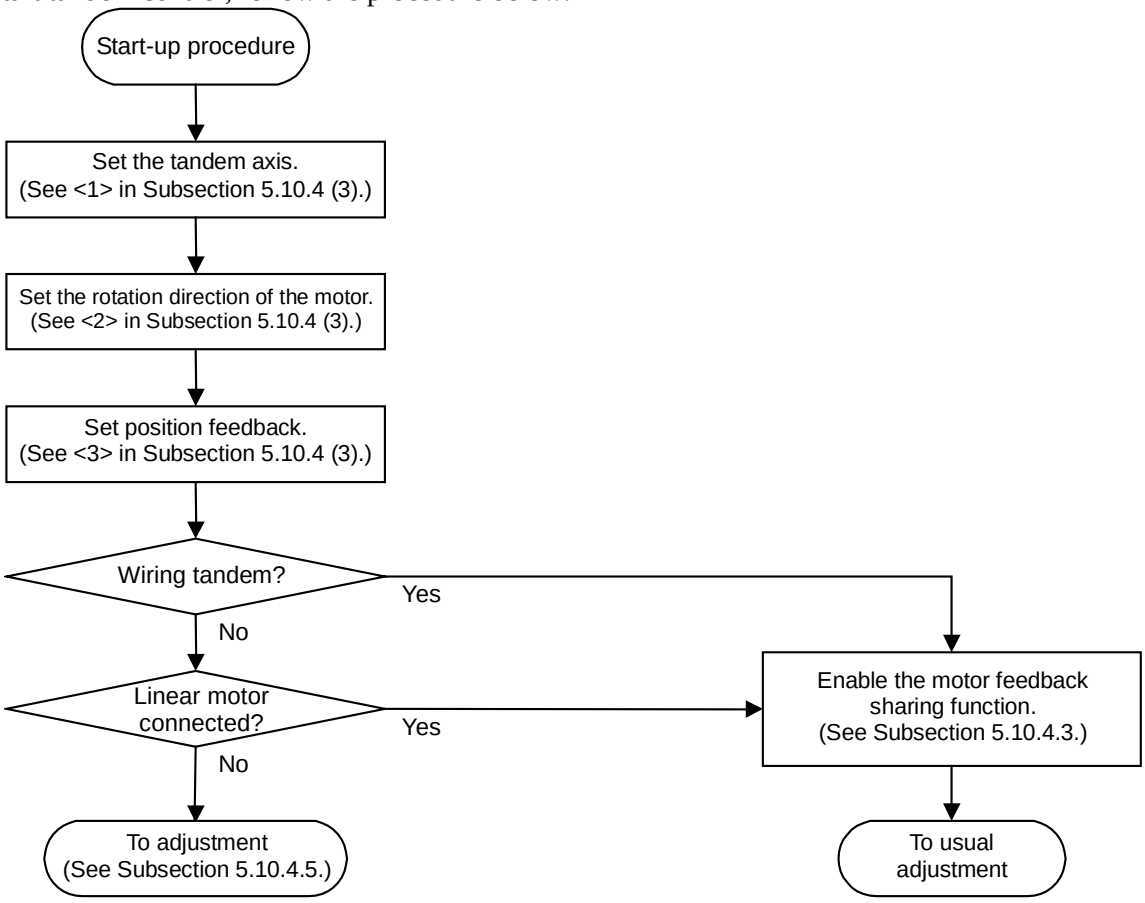


Fig. 5.10.4 (b) Start-up procedure flowchart

<1> Tandem axis setting

Tandem control is an optional function. (When the NC is not the Series 30*i*-B, the "tandem control" option is necessary. With the Series 30*i*-B, the "feed axis synchronization control" option is necessary.)

Refer to the Parameter Manual of the CNC for details.

	#7	#6	#5	#4	#3	#2	#1	#0
1817		TANDEM						

TANDEM(#6) 1: Enables tandem control. (Set this parameter for the main- and sub-axes.)

1023	Servo axis arrangement

This parameter specifies servo axis arrangement.
Set an odd number for the main axis and set an even number ((main axis) + 1) for the sub-axis.
For example, if 3 is set for the main axis, set 4 for the sub-axis.

Example of tandem axis setting
(★ indicates a tandem axis.)
Number of controlled axes = 6

	Axis No.	Axis name	Servo axis arrangement No. 1023	Tandem No. 1817#6	Position display No. 3115#0	Remarks
★	1	X	1	1	0	CNC axis (main axis)
★	2	Y	3	1	0	CNC axis (main axis)
	3	Z	5	0	0	CNC axis
★	4	A	2	1	1	Tandem control sub-axis (sub-X-axis)
★	5	B	4	1	1	Tandem control sub-axis (sub-Y-axis)
	6	C	6	0	0	PMC axis

<2> Direction of motor rotation

2022	Direction of motor rotation (DIRCT)

Main axis: With a forward direction specified, 111 specifies that the main axis motor rotates counterclockwise as viewed from the motor shaft side, while -111 specifies the opposite direction.

Sub-axis: To cause the sub-axis motor to rotate in the same direction as the main axis, specify the same value for both the sub-axis and the main axis because of their mechanical structure.
To cause the sub-axis motor to reverse, specify a value whose sign is opposite to that of the normal direction. For winding tandem, be sure to specify values with the same sign.

<3> Position feedback setting

Specify position feedback for both the main axis and the sub-axis. (See Subsection 5.10.4.5 for a specific example.)

* Assume position feedback shown in Fig. 5.10.4.5 (a) for both the main axis and the sub-axis.

☐ Semi-closed or full-closed loop setting	No. 1815#1
☐ CMR setting	No. 1820
☐ Setting the reference counter capacity	No. 1821
☐ Setting the high-resolution Pulsecoder	No. 2000#0
☐ Setting the number of velocity pulses	No. 2023
☐ Setting the number of position pulses	No. 2024
☐ Flexible feed gear (numerator) setting	No. 2084
☐ Flexible feed gear (denominator) setting	No. 2085

(4) Descriptions of servo parameters for adjustment

The load inertia ratio to be specified for axes subjected to tandem control differs from that for ordinary axes.

2021	Load inertia ratio (LDINT)

[Standard setting] (Load inertia/motor inertia) × 256

(NOTE) In typical tandem control, the total load inertia of the machine is borne by two motors. So, calculate the load inertia for the above formula as follows:

(Load inertia) = (Total load inertia of machine)/2

Example of setting The example shown in Fig. 5.10 (a) is used. Assume that the inertia of each section applied to the motor shaft as follows:

- Inertias of the reducers of the main- and sub-axes: J_{1m}, J_{1s}
- Inertias of the pinions of the main- and sub-axes: J_{2m}, J_{2s}
- Inertia of the rack: J_3

(Total load inertia of the machine) = $J_{1m} + J_{2m} + J_3 + J_{1s} + J_{2s}$

When the total load inertia of the machine is double that of the motor inertia, for example, set the following:

When typical tandem control is used:

(Load inertia ratio) = (2/2) × 256 = 256

Note that, in some cases, vibration may occur with the load inertia ratio calculated by the above formula because of the machine structure, thus making it necessary to set a lower value.

○ Notes on stable tandem control operation

To ensure stable tandem control operation, the machine must be capable of performing back-feed. "Back-feed" means the feasibility that the axis can be driven not only from the motor side, but also from the machine side. In this description, when the sub-axis can be moved from the main axis and the main axis can be moved from the sub-axis through the connected transmission feature, it is assumed that the axis can also be driven from the machine and back-feed is enabled. If back-feed is disabled, operation becomes unstable and it is necessary to adjust the machine.

To make this check in the case of the example shown in Figs. 5.10 (a) and (b), turn the main motor with the power line for the sub-motor disconnected, and check that the main motor can be turned with one-third or less of the rated torque of the motor (See (2) in Subsection 5.10.4.5). If the sub-motor cannot be turned due to a mechanical cause, the axis cannot be moved from the machine. In this case, a higher torque than necessary is produced on the main motor.

5.10.4.1 Damping compensation

To enable more stable tandem control, a torque offset can be applied to the sub-axis, or to both the main- and sub-axes to eliminate a difference in speed, if any, between the main- and sub-axes.
This function is particularly useful for controlling the vibration (with a frequency of several Hz to 30 or 40 Hz) that may occur in a machine system with low spring rigidity.

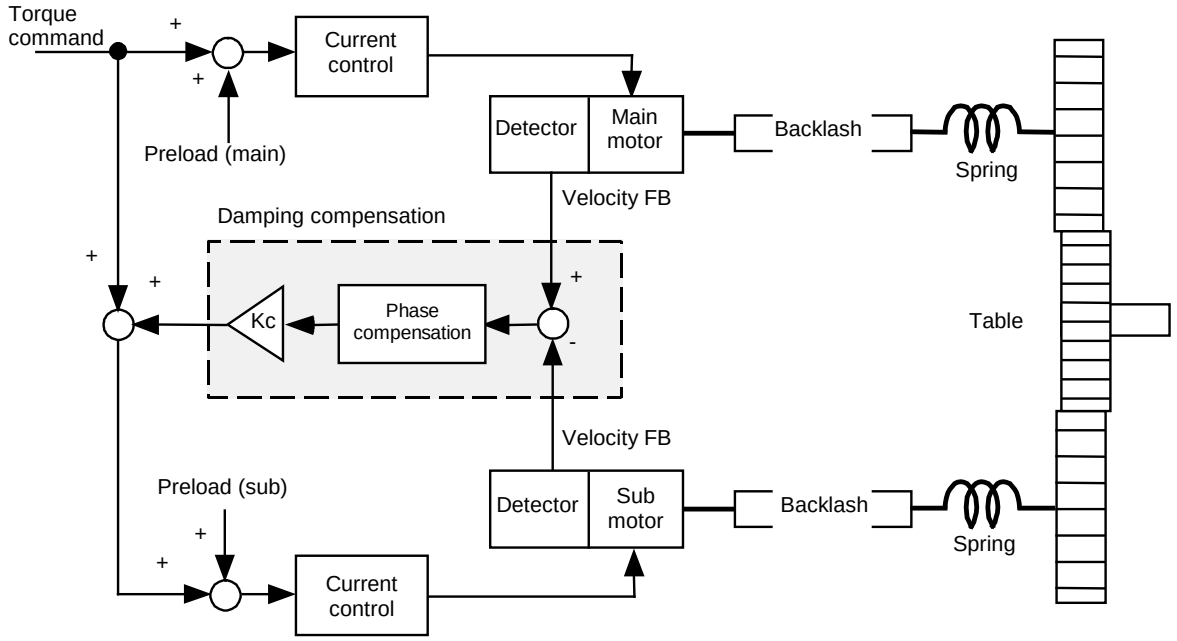


Fig. 5.10.4.1 (a) Damping compensation

	#7	#6	#5	#4	#3	#2	#1	#0
2008	LAXDMP							

LAXDMP(#7) Damping compensation is: (Set this parameter for the main axis only.)
1: Enabled for the main axis and sub-axis.
0: Enabled for the main axis only.

Usually, set LAXDMP to 0.

2036	Damping compensation gain Kc (ABPGL)

[Valid data range] 0 to 16384 (Set this parameter for the main axis only.)
[Setting method] Kc × 32768 (0 ≤ Kc ≤ 0.5)

A function bit is not supported for the damping compensation function; the damping compensation function is enabled at all times.
When 0 is set for this parameter, the damping compensation function is ineffective.

2036	Damping compensation phase coefficient α (ABPHL)

[Valid data range] 51 to 512 (Set this parameter for the sub-axis only.)
[Setting method] α × 512 (0.1 ≤ α ≤ 1.0)
When this parameter is set to 0, this setting is internally handled as 512 (α = 1).
When α = 1, phase compensation is not performed. Instead, the set value is output to Kc as is.

(Adjustment example) The speeds of the motors are checked using the SERVO GUIDE (when the motors rotate in the same direction).
This function may be useful when the oscillation frequencies (several Hz to 30 or 40 Hz) are the same, and the phases are opposite as shown below.

NOTE
1 When the directions of rotation of the main motor and sub-motor are different, the phase relationship is reversed.
2 When the phase difference is not 180°, the phase coefficient α must be adjusted.
Start with 512, then decrease the value gradually.

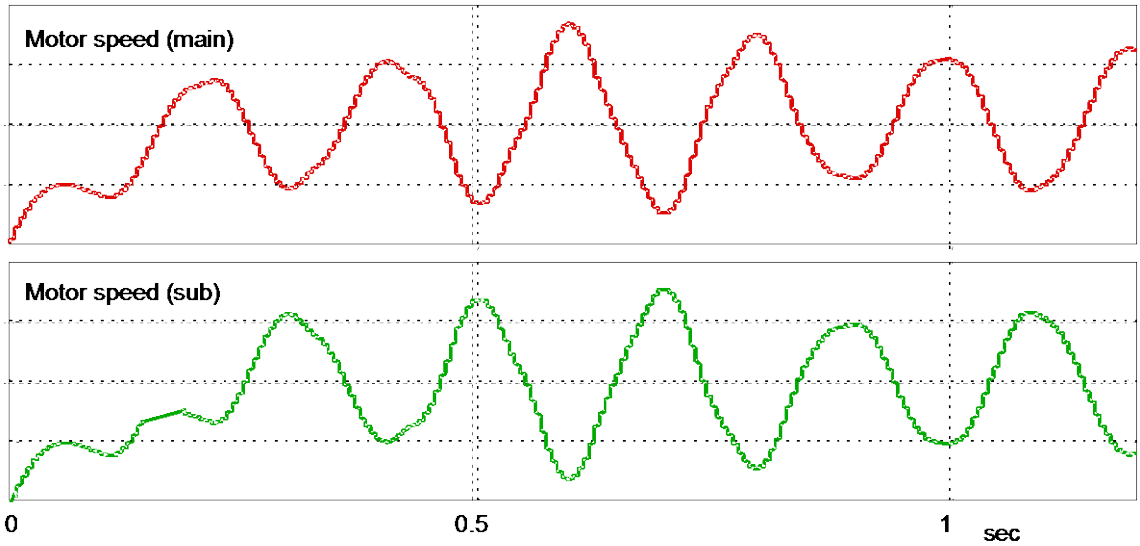


Fig. 5.10.4.1 (b) Motor speed vibration

- **Tuning procedure for damping compensation**

1 When the dual-position feedback is used, set a time constant (parameter No. 2080) of 200 and adjust the setting to ensure stable axis movement.
2 Set 0 or 512 as the phase coefficient α.
[Sub-axis No. 2036]
If 512 is set, the value may have to be reduced when the vibration phase difference between the motors is anything other than 180°.
3 Set a damping gain of 3277.
[Main axis No. 2036]
To reduce the vibration, this value must be tuned.
Be careful not to increase this value excessively. Otherwise, high-frequency vibration will occur.
When tuning this parameter, apply the maximum axis load.
4 Repeat steps 1 through 3 until smooth movement is achieved.

NOTE
To observe the motor speeds along the main axis and sub-axis using SERVO GUIDE, select ABS (absolute position detected by the detector built into the motor) on the Channel dialog and Diff1(VT) on the Operation and Display page, and display a graph. When POSF (position feedback) is selected, the motor position is assumed in the semi-closed mode and the machine position is assumed in the full-closed mode.

5.10.4.2 Velocity feedback average function

In tandem control, velocity control is not exercised on the sub-axis motor. For this reason, the sub-axis may vibrate and become unstable due to backlash in the gears, for example, in a machine with a large backlash. In such a case, the machine can be made stable by exercising velocity control on the sub-axis as well. This function is referred to as the velocity feedback average function.
PMC signal Gn321 can be set to 1 to turn the velocity feedback average function off during NC program operation. For details, see Subsection 5.10.3, "Turning On and Off the Functions Related to Synchronization and Tandem Control by Using a PMC Signal".

	#7	#6	#5	#4	#3	#2	#1	#0
2008						VFBAVE		

VFBAVE(#2) 1: Enables the velocity feedback average function.
Usually, set this bit to 1. (Set this parameter for the main axis only.)

	#7	#6	#5	#4	#3	#2	#1	#0
2297				VAVNEG				

VAVNEG(#4) 1: The velocity feedback average function is disabled for high cycle proportional elements.
(Set this parameter for the main axis only.)

5.10.4.3 Motor feedback sharing

This function allows the velocity and position feedback of the main axis to be shared by the sub-axis. Set the function when using a two-winding motor or two connected linear motors in a 30*i*-A Series CNC.

	#7	#6	#5	#4	#3	#2	#1	#0
2018	PFBCPY							

PFBCPY(#7) 1: The motor feedback signal for the main axis is shared with the sub-axis motor.
(Set this parameter for the sub-axis only.)

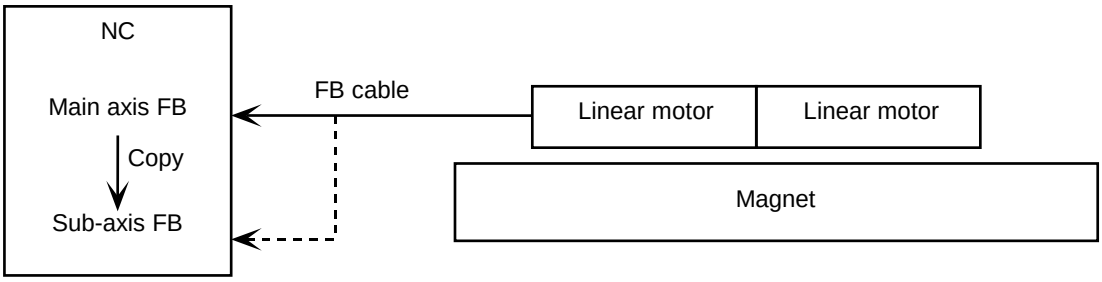


Fig. 5.10.4.3 (a) Motor feedback sharing

NOTE
If bit 7 of parameter No. 2018 is set to 1 in a full-closed loop system, the data of a separate detector is also copied from the main axis to the sub-axis.

5.10.4.4 Tandem speed difference alarm function

(1) Overview

Torque tandem control is a method of control for driving a rigidly connected machine by using two motors. The speed of the sub-axis side is not controlled. This means that if the mechanical connection is canceled and a force is applied to the main axis side, the sub-axis can rotate at an unnecessarily high speed. This function monitors the speed difference between the main axis and sub-axis, and when the parameter-set threshold is exceeded, "SV0641 SPEED DIFFERENCE ALARM" is detected.

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	03.0 and subsequent editions	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
	90GP	01.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	L(12) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	L(12) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	

The following table lists the series and editions of CNC system software that support the message display of "SV0641 SPEED DIFFERENCE ALARM". Note that if NC software that does not support the message display of alarm SV0641 is used, the message "SV0448 UNMATCHED FEEDBACK ALARM" is displayed when this alarm is issued.

CNC	CNC system software	
	Series	Edition
Series 30*i*-A	G00C, G01C, G02C	27 and subsequent editions
	G004, G014, G024	01 and subsequent editions
Series 31*i*-A5	G12C, G13C	27 and subsequent editions
	G124, G134	01 and subsequent editions
Series 31*i*-A	G103, G113	04 and subsequent editions
	G104, G114	01 and subsequent editions
Series 32*i*-A	G203	04 and subsequent editions
	G204	01 and subsequent editions
Series 0*i*-MD	G4F1	01 and subsequent editions
Series 0*i*-TD	D6F1	01 and subsequent editions
Series 0*i* Mate-MD	G5F1	01 and subsequent editions
Series 0*i* Mate-TD	D7F1	01 and subsequent editions

For the Series 30*i*/31*i*/32*i*/35*i*-B, Power Motion *i*-A, and Series 0*i*-F, all series and editions support this function.

(3) Setting parameters

Set threshold parameters only with the sub-axis of tandem control.

2357	Tandem speed difference alarm threshold

[Valid data range] 0 to 2000

[Unit of data] min^{-1} (10 mm/min when a linear motor is used)

When 0 is set for this parameter, the threshold for the tandem speed difference alarm function is set to 1000 by default.

While the tandem speed difference alarm function is enabled by default, it can be disabled by setting the parameter below.

For safety reasons, the use of an appropriate alarm level is recommended.

	#7	#6	#5	#4	#3	#2	#1	#0
2007				VLDALM				

VLDALM (#4) The tandem speed difference alarm function is:

0: Used. (The tandem speed difference alarm function is enabled by default.)

1: Not used.

5.10.4.5 Example of torque tandem setting

(1) Examples of parameter setting

This section gives examples of parameter setting.

Semi-closed loop system using a least command increment of 1/1000 deg, a detection unit of 1/1000 deg, and a rotary axis with a gear reduction ratio of 1/984

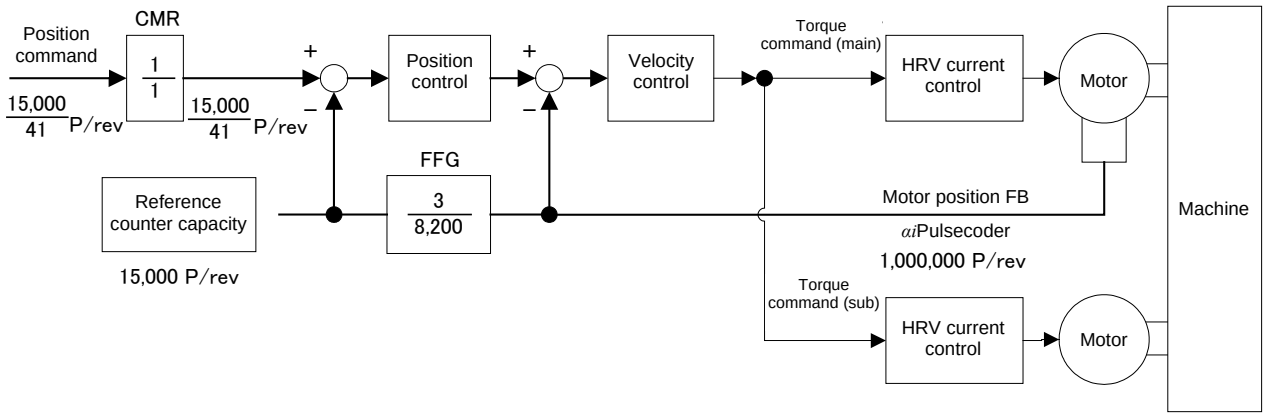


Fig. 5.10.4.5 (a) Example of torque tandem setting

		Main	Sub
・ Tandem axis	No. 1817#6	1	1
・ Semi-closed	No. 1815#1	0	0
・ CMR	No. 1820	2	2
・ Reference counter capacity	No. 1821	15000	15000
・ Reference counter capacity (denominator)	No. 2179	41	41
・ High-resolution Pulsecoder	No. 2000#0	0	0
・ Number of velocity pulses	No. 2023	8192	8192
・ Number of position pulses	No. 2024	12500	12500
・ Flexible feed gear	No. 2084	3	3
・ Flexible feed gear	No. 2085	8200	8200

NOTE

$$\text{FFG} = \frac{360000/984}{1000000} = \frac{36}{98400} = \frac{3}{8200} \qquad \text{Reference counter capacity} = \frac{360000}{984} = \frac{15000}{41}$$

(2) Back-feed confirmation method

"Back-feed" means the feasibility that the axis can be driven not only from the motor side but also from the machine table side. In this description, when the sub-axis can be moved from the main axis and the main axis can be moved from the sub-axis through the connected transmission feature, it is assumed that the axis can also be driven from the machine and back-feed is enabled.

(a) Check whether back-feed is possible when the machine is connected and the power line is removed.
If back-feed is impossible, unstable control will result, and machine tuning such as gear box tuning will be necessary.
(1) Performing a check manually
First, turn the shaft of the main motor manually to check that the sub-motor turns. Next, turn the shaft of the sub-motor manually to check that the main motor turns. If these checks are successful, back-feed is possible.
(2) Performing a check using NC commands
After checking (b) and (c) below, remove the sub-motor power line. Then, enter a plus (+) command or minus (-) command to rotate the main motor. Check that the main motor can be turned with one-third or less of its rated torque. When this check is successful, back-feed is possible.
When inertia is low and the motor shaft can be turned manually, whether or not back-feed is possible can be determined using method <1>. If inertia is large or the machine has a complex configuration, whether or not back-feed is possible cannot be determined by turning the shaft manually. In this case, use method <2>.

(b) With the machine connected, activate the motors. At this time, release the emergency stop state after reducing the torque limit by a factor of about 10.
Check the motor current on the servo tuning screen. If the current increases gradually, the directions of rotation of the main- and sub-motors may not be set correctly.

(c) Check the operation by entering a plus (+) command and minus (-) command.
If the error persists due to friction load, increase the torque limit gradually.

(d) If the operation is normal, return the torque limit to its original value, and then set a preload value.

(3) Tuning items

If vibration occurs:

- Check the position feedback setting (<3> in Subsection 5.10.4 (3)).
- Check TCMD, ABS(VT display), and POSF(VT display) with SERVO GUIDE.

(a) A higher gear reduction ratio tends to produce more backlash, such that unstable operation will result from the sub-axis running between backlashes.
→ Enable the velocity feedback average function (set bit 2 of parameter No. 2008 (main axis) to 1).

(b) The main axis and sub-axis vibrate at the same frequency (several Hz to 30 or 40 Hz) as a result of the spring rigidity being low.
(The twist rigidity is proportional to the second power of the gear reduction ratio, so the frequency is probably a lower resonant frequency.)
→ Enable damping compensation (set parameter No. 2036 (main axis) to a value other than 0).
(See the tuning procedure described in Subsection 5.10.4.1.)

(c) The operation of a full-closed-loop system is unstable.
→ Check the position feedback setting (<3> in Subsection 5.10.4 (3)).
If the parameters are set correctly, place the system in semi-closed loop mode, then tune the system to achieve stable operation.
Then, return the system to full-closed loop mode. If the operation is still unstable, consider the use of the dual position feedback function.

(d) In the stop state, no tension is established between the main axis and sub-axis.
→ Set a preload value of 0, and check the torque in the stop state.
Then, set parameter No. 2087 to a preload value greater than the stop-state torque.

(e) Position-dependent vibration occurs.
→ Change the feedrate to determine whether the vibration frequency is constant or proportional to the feedrate.
If the vibration frequency is proportional to the feedrate, position-dependent vibration is occurring. Check position-related items such as the number of gear teeth.

5.10.5 Velocity Tandem Control

This function is optional. (When the NC is not the Series 30*i*-B, the "tandem control" option is necessary. With the Series 30*i*-B, the "feed axis synchronization control" option is necessary.)

With torque tandem control, the position and velocity of the slave side tend to be unstable because they are not controlled. They can be stabilized by using one of the following configurations.
(1) Position tandem control + velocity loop integrator copy function (See Subsection 5.10.1.1)
(2) Velocity tandem control + velocity loop integrator copy function (this subsection)

The configuration of (1) is recommended as it enables the position of the slave axis to be controlled.
This subsection describes the parameters related to the configuration of (2) that has conventionally been used. To enable velocity tandem control, enable tandem control for the master and slave axes. (Set bit 6 of parameter No. 1817 to 1.) Note that the preload function can also be used in both the configurations of (1) and (2).

	#7	#6	#5	#4	#3	#2	#1	#0
2008			VCMDTM				TANDEM	

VCMDTM(#5) 1: Velocity command tandem control is enabled.
(Set this parameter for the master axis.)

	#7	#6	#5	#4	#3	#2	#1	#0
2273							WSVCP	

WSVCP (#1) 1: The velocity loop integrator of the master axis is copied to the slave axis.
(Set this parameter to 1 for axes sharing a velocity loop integrator.)

2087	Preload value (PRLOAD)

Set this parameter for both the master and slave axes.

5.11 TORQUE CONTROL

(1) Overview

The torque control function is part of PMC axis control that isolates an axis from the control by the CNC and controls the axis using PMC signals.
To control the torque through PMC axis control, specify 11h. During the torque control, the servo motor outputs the torque specified by the PMC.
For details of PMC axis control, refer to the section on "PMC axis control" in the CONNECTION MANUAL (FUNCTION) of the CNC in use.

(2) Control method

Two types of torque control are supported: type 1 and type 2. Generally, use type 2. The two types are explained below.

(i) Torque control type 1
The motor produces a torque according to a torque command specified by the PMC. A servo alarm SV0422, "EXCESS VELOCITY IN TORQUE" is issued if the speed of the motor exceeds the maximum feed rate specified by the PMC.

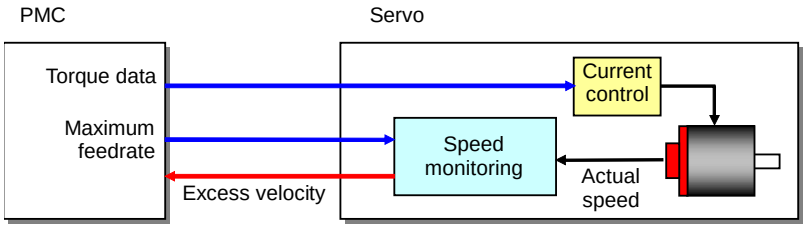


Fig. 5.11 (a) Torque control type 1

(ii) Torque control type 2
The motor produces a torque according to a torque command specified by the PMC.
When the motor is loaded, it produces a torque according to a torque command. When it is not loaded, it rotates at a constant speed (maximum feed rate).

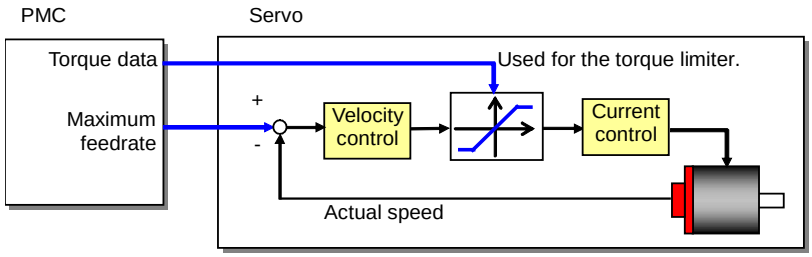


Fig. 5.11 (b) Torque control type 2

* Basically, torque control type 2 performs speed control to cause the limiter to operate on a command from the speed controller according to a torque command specified by the PMC. This causes the motor to produce a torque that matches the torque command when it is loaded and to rotate at a constant speed (maximum command feed rate under torque control) when it is not loaded.

(3) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	A(01) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
CNC	**Servo control software**		**Remarks**
	Series	**Edition**	
Series 0*i*-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(4) Setting parameters

This manual describes servo-related parameters only.

> **NOTE**
> For details about the setting of the torque control function for each CNC, refer to "PMC Axis Control" in the respective CNC Connection Manual (Function).

	#7	#6	#5	#4	#3	#2	#1	#0
2007	FRCAXS							

FRCAXS (#7) Torque control is:
0: Not performed.
1: Performed. ← To be set

	#7	#6	#5	#4	#3	#2	#1	#0
2203				FRCAX2				

FRCAX2 (#4) Torque control type
0: Type 1
1: Type 2 ← Type 2 is usually used.

	#7	#6	#5	#4	#3	#2	#1	#0
2003					PIEN			

PIEN (#3) The velocity control method to be used is:
0: I-P control.
1: PI control. ← To be set

2105	Torque constant

This parameter is used to specify a motor-specific torque constant.
The units are as follows: 0.00001 N·m/(torque command) for a rotary motor
0.001 N·m/(torque command) for a linear motor

NOTE

1 When the initial parameter setting function (Section 2.1) is used, a motor-specific value is set automatically.
2 When torque control is set, the following functions are disabled:
  - Velocity loop high cycle management
  - Acceleration feedback
3 To use torque control type 2, disable the variable proportional gain in the stop state.
4 Torque tandem control and torque control cannot be used simultaneously.
5 In the case of a motor with multiple windings, the torques of all the windings can be controlled just by exerting torque control on the master axis.
6 In the case of multiaxis tandem control, a torque control command needs to be input for both the master and slave axes.

5.12 USING A SERVO MOTOR FOR SPINDLE CONTROL

(1) Overview

The spindle control by a servo motor can be used to perform spindle functions including the spindle rotation command and rigid tapping by means of a servo motor. This section explains the speed arrival signal, and zero-speed detecting signal, and load meter display when a servo motor is used as a spindle.
For details of the spindle control by a servo motor, refer to the "CONNECTION MANUAL (FUNCTION)" for the relevant CNC.

5.12.1 Speed Arrival Signal and Zero-Speed Detecting Signal

(1) Overview

When the spindle control function by a servo motor is used, the speed arrival signal (SVSAR) and zero-speed detecting signal (SVSST) are available in the same way as for a spindle motor.

(2) Series and edition of applicable servo control software

・ Support for the speed arrival signal and zero-speed detecting signal

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	03.0 and subsequent editions	
	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	T(20) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	T(20) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	-	
	90C8	D(04) and subsequent editions	
	90E5	-	
	90E8	D(04) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

・ Support for the speed arrival signal in low speed mode

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	20.0 and subsequent editions	
	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	33.0 and subsequent editions	
	90E1	08.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	-	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	-	
	90C8	D(04) and subsequent editions	
	90E5	-	
	90E8	D(04) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

To use the speed arrival signal (SVSAR) and zero-speed detecting signal (SVSST), the following series and edition of system software are necessary.

CNC	System software	
	Series	Edition
Series 30*i*-A	G00C, G01C, G02C	30 and subsequent editions
	G004, G014, G024	01 and subsequent editions
Series 31*i*-A5	G12C, G13C	30 and subsequent editions
	G124, G134	01 and subsequent editions
Series 31*i*-A	G103, G113	30 and subsequent editions
	G104, G114	01 and subsequent editions
Series 32*i*-A	G203	30 and subsequent editions
	G204	01 and subsequent editions
Series 0*i*-MD	D4F1	25 and subsequent editions
Series 0*i*-TD	D6F1	25 and subsequent editions
Series 0*i* Mate-MD	-	-
Series 0*i* Mate-TD	D7F1	25 and subsequent editions

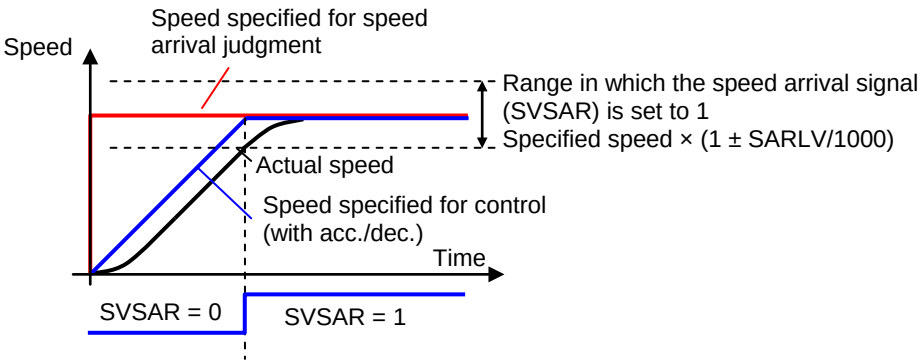
For the Series 30*i*/31*i*/32*i*/35*i*-B and Series 0*i*-F, all series and editions support this function.

(4) Setting parameters

・ Detection of the speed arrival signal

2482	Detection level of speed arrival (SARTLV)

[Valid data range] 0 to 1000
[Unit of data] 0.1%
[Standard setting] 0 (A value of 0 means 15% internally.)
The detection level of speed arrival means the ratio to the specified speed. When the difference between the specified speed and actual speed becomes lower than (specified speed × detection level of speed arrival (parameter No. 2482)), it is assumed that the specified speed is reached and the speed arrival signal SVSARn is set to 1.



・ Support for the speed arrival signal in low speed mode
An offset speed can be set so that the detection level of speed arrival becomes too low in low speed mode. This allows the stable detection of the speed arrival signal. A hysteresis speed can also be set to prevent the fluctuation of the speed arrival signal.

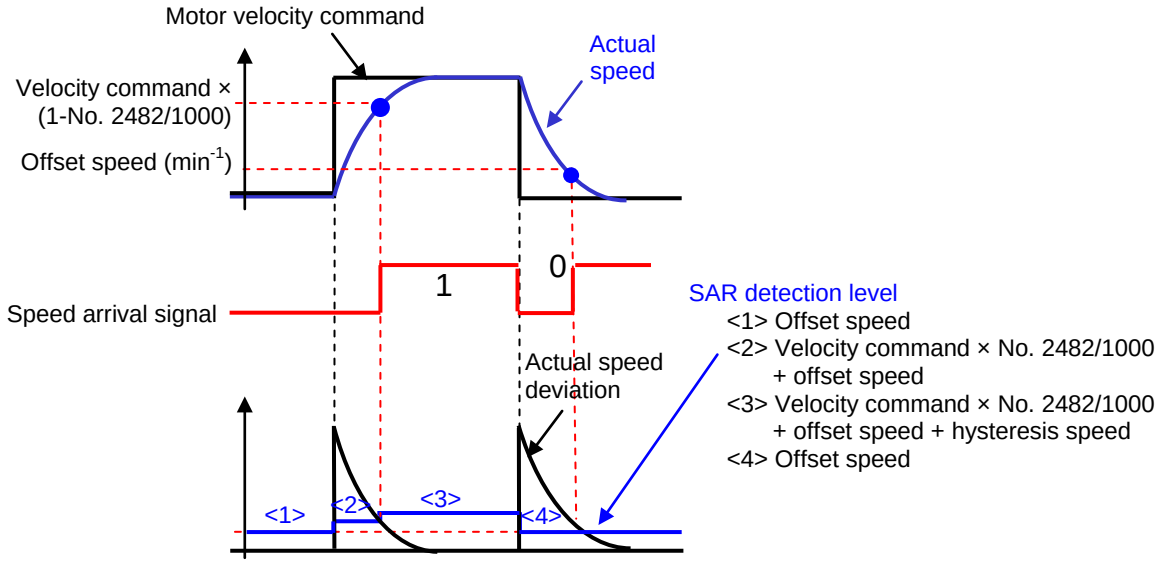
	#7	#6	#5	#4	#3	#2	#1	#0
2422(FS30*i*)							SVSAR1	SVSAR2

SVSAR1 Coefficient for the detection level of speed arrival 1
SVSAR2 Coefficient for the detection level of speed arrival 2

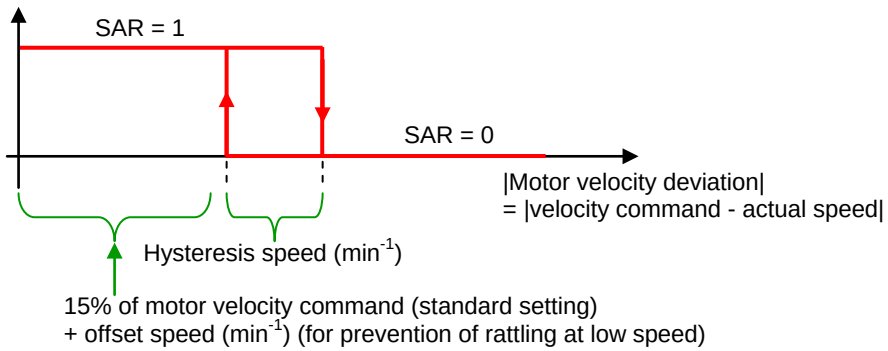
Relationships between the offset speed and hysteresis speed

SVSAR1	SVSAR2	Offset speed	Hysteresis speed	Remarks
0	0	50 min^{-1}	20 min^{-1}	Recommended (αi, βi motor)
0	1	10 min^{-1}	5 min^{-1}	
1	0	5 min^{-1}	2 min^{-1}	Recommended (DiS motor)
1	1	2 min^{-1}	1 min^{-1}	

■ Operation of the speed arrival signal (details)



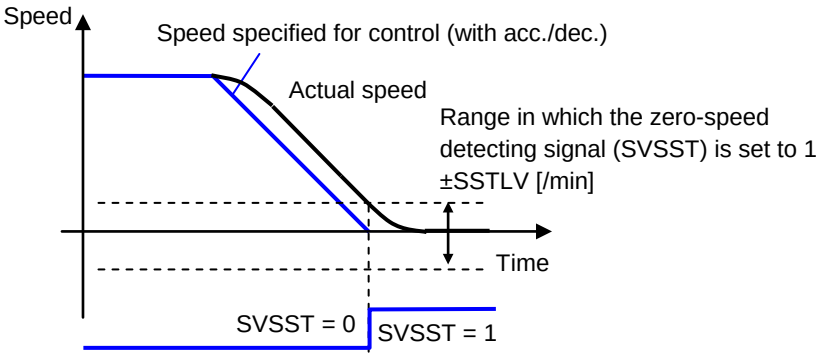
A hysteresis speed is set to prevent the fluctuation of the spindle arrival signal.



・ Detection of the zero-speed detecting signal

2483	Detection level of speed zero (SSTLV)

[Valid data range] 0 to 10000
[Unit of data] min^{-1}
[Standard setting] 0 (A value of 0 means 45 min^{-1} internally.)
The detection level of speed zero means the speed (min^{-1}) at which the motor is determined to have stopped. When the actual speed becomes lower than the detection level of speed zero, it is assumed that the motor has stopped and the zero-speed detecting signal SVSSTn is set to 1.



(5) Signal

Speed arrival signal SVSAR1 to SVSAR8<Fn377>

[Classification] Output signal

[Function] This signal indicates that the actual speed of the servo motor has reached the range specified in advance for the speed specified in spindle control by the servo motor.

[Output cond.] ･This signal is set to "1" when the specified speed is reached.
･This signal is set to "0" when the specified speed is not reached.

Zero-speed detecting signal SVSST1 to SVSST8<Fn376>

[Classification] Output signal

[Function] This signal indicates that the speed of the servo motor in spindle control by a servo motor is lower than or equal to the detection level of speed zero.

[Output cond.] ･This signal is set to "1" when the actual speed becomes lower than or equal to the detection level of speed zero.
･This signal is set to "0" when the actual speed is higher than the detection level of speed zero.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
Fn376	SVSST8	SVSST7	SVSST6	SVSST5	SVSST4	SVSST3	SVSST2	SVSST1

	#7	#6	#5	#4	#3	#2	#1	#0
Fn377	SVSAR8	SVSAR7	SVSAR6	SVSAR5	SVSAR4	SVSAR3	SVSAR2	SVSAR1

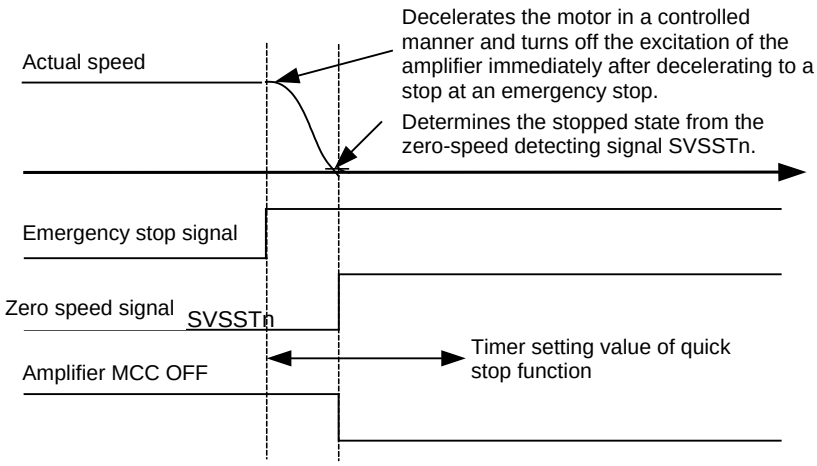
* In the emergency stop state, speed arrival signal SVSARn is set to 0. This signal is set to 0 when the servo control software detects an emergency stop. When an emergency stop is applied during rotation or the DB stops after an alarm occurs, SVSARn is set to 0 even in the speed arrival state.
* When the servo off signal is input, speed arrival signal SVSARn is also set to 0.
* Zero-speed detecting signal SVSSTn is a status signal, which is always monitored. So, the signal status changes according to the actual motor speed. (Emergency stop, alarm, servo-off, and other conditions do not affect this signal.)
* If an alarm occurs in the detector built into the motor, such as when the feedback cable is broken, however, feedback data becomes unpredictable, and the output of the signal may be invalid.

> ⚠ **CAUTION**
> These two signals cannot be used as a function (safety function) for protecting operators from danger due to machine operation.

5.12.2 Control Stop Judgment in the Quick Stop Function at Emergency Stop

(1) Overview

When a large servo motor is used for a spindle, it may take more than a few seconds until the motor stops even by deceleration with the maximum torque since the inertia is large. Applying the quick stop at emergency stop to such an axis can reduce the time it takes for the motor to stop. This function allows the motor excitation to be turned off when the zero-speed detecting signal (SVSSTn) is output, without the need to create a ladder program.



(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0 90J0 90K0	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	Y(25) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	Y(25) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	- -	
	90E5 90E8	- -	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

To use the zero-speed detecting signal (SVSST), the following series and edition of system software are necessary.

CNC	System software	
	Series	Edition
Series 30*i*-A	G00C, G01C, G02C	30 and subsequent editions
	G004, G014, G024	01 and subsequent editions
Series 31*i*-A5	G12C, G13C	30 and subsequent editions
	G124, G134	01 and subsequent editions
Series 31*i*-A	G103, G113	30 and subsequent editions
	G104, G114	01 and subsequent editions
Series 32*i*-A	G203	30 and subsequent editions
	G204	01 and subsequent editions
Series 0*i*-MD	D4F1	25 and subsequent editions
Series 0*i*-TD	D6F1	25 and subsequent editions
Series 0*i* Mate-MD	-	-
Series 0*i* Mate-TD	D7F1	25 and subsequent editions

For the Series 30*i*/31*i*/32*i*/35*i*-B and Series 0*i*-F, all series and editions support this function.

(3) Parameters

To enable this function, set SSTMCC to 1.

	#7	#6	#5	#4	#3	#2	#1	#0
2294				SSTMCC				

SSTMCC(#4) When the quick stop at emergency stop is enabled and the zero-speed detecting signal (SVSSTn) is set to 1, the excitation of the amplifier is:
0: Not cut off.
1: Cut off.

2483	Detection level of speed zero (SSTLV)

[Valid data range] 0 to 10000
[Unit of data] min^{-1}
[Standard setting] 0 (A value of 0 means 45 min^{-1} internally.)
The detection level of speed zero means the speed (min^{-1}) at which the motor is determined to have stopped. When the actual speed becomes lower than the detection level of speed zero, it is assumed that the motor has stopped and the zero-speed detecting signal SVSSTn is set to 1.

To set at least several seconds for the timer for the emergency stop signal for the quick stop at emergency stop, it is necessary to set a longer period not only for the brake control timer, but also for the emergency stop signal of the α*i*PS. For the emergency stop timer of the α*i*PS, up to 400 ms can be set. To set a longer value, prepare an external timer.
(For details, see Section 5.8, "CONTROL STOP FUNCTIONS".)

2083	Brake control timer

[Unit of data] ms
[Valid data range] 0 to 32000 ms

	#7	#6	#5	#4	#3	#2	#1	#0
2210		ESPTM1	ESPTM0					

Emergency stop timer built into the amplifier

ESPTM1	ESPTM0	Delay time
0	0	50 ms (Default value)
0	1	100 ms
1	0	200 ms
1	1	400 ms

5.12.3 Load Meter Display

(1) Overview

In the same way as when a spindle motor is used, the motor output can be displayed in POWER (%) on the servo tuning screen of the NC using the rated current as the reference value (100%) in the constant motor torque area or the actual output to the continuous rated output as the reference value (100%) in the constant output area.

This function is set with the motor standard parameter values. You do not need to change the values. However, when torque characteristic switching is enabled (setting bit 5 of parameter No. 2014 to 1), the display on the servo tuning screen is changed from CURRENT (%) to POWER (%).

For details of the load meter display of servo motor, refer to the "Operator's Manual (Common to Lathe System/Machining Center System)" for the relevant CNC.

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0 90J0 90K0	09.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	- 04.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	-	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8	D(04) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	D(04) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

5.12.4 Smart Load Meter (Servo Motor Axis)

(1) Overview

This function displays the maximum possible machining time at the current output on the diagnosis screen.

(2) Applicable series and editions

[Series and editions of applicable servo control software]

CNC	Servo control software		Remarks
	Series	Edition	
FANUC Series 30*i*/31*i*/32*i*-B Power Motion *i*-A DSA-B	90J0 90JP	10.0 and subsequent editions 04.0 and subsequent editions	
FANUC Series 0*i*-F	90M0 90M8	06.0 and subsequent editions 06.0 and subsequent editions	

[Series and editions of applicable system software]
See Appendix P.

(3) Setting parameters

To apply the smart load meter to an axis for which a servo motor is used, set the following parameter.

	#7	#6	#5	#4	#3	#2	#1	#0
2694				SMTLM				

SMTLM (#0) Smart load meter (servo axis) is:
0: Disabled.
1: Enabled.

2582	Motor heat time constant

[Unit] s
[Valid data range] 1 to 7500 s (A value other than "0" that falls outside this range, if specified, is clamped.)
[When 0 is set] 1800 s (30 min)
Set the heat time constant specified in the specification of the motor.

2086	Rated current parameter

[Unit] The maximum current value of an amplifier is equivalent to 6554.
[Valid data range] 0 to 6554
Set a standard value for each motor model.

(4) Diagnosis

The time for which machining at the current output can be continued is displayed on diagnosis screen No. 770.

Diagnosis 770	Maximum possible machining time

[Unit] s
[Valid data range] 0 to 1800
Diagnosis 770 displays the estimated time remaining until an OVC (software thermal) or OH (overheat) alarm is issued at the current output. For 1800 seconds or greater, "1800 seconds" is displayed.
In a configuration that uses a thermostat without temperature information, the remaining time for OH alarm is not calculated.
* Configurations that use a thermostat without temperature information are as follows.
- β*i*Sc series servo motor
- Linear motor to which a thermistor for temperature indication is not connected, or synchronous built-in servo motor

5.13 COMPENSATION FOR REVERSE OPERATION IN HIGH-SPEED FSSB RIGID TAPPING

(1) Overview

When the FSSB high-speed rigid tapping function is used, a synchronization error may be generated due to delay of reverse operation of the servo motor at the start of tapping and at the hole bottom. Compensation for reverse operation in FSSB high-speed rigid tapping can be used to decrease synchronization errors at the start of tapping and at the hole bottom. This compensation can also be used for smart rigid tapping.

* For the settings of FSSB high-speed rigid tapping, refer to the "CONNECTION MANUAL (FUNCTION)" for each CNC.
* For details of FSSB high-speed rigid tapping and smart rigid tapping, refer to the "SPINDLE MOTOR Parameter Manual" (B-65280EN).

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	12.0 and subsequent editions	
	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	

(3) Setting parameters

To use compensation for reverse operation in FSSB high-speed rigid tapping, set the following parameters.

	#7	#6	#5	#4	#3	#2	#1	#0
2423						RGDBLA		

RGDBLA (#2) Compensation for reverse operation and at the start of FSSB high-speed rigid tapping is:
0: Disabled.
1: Enabled.

2613	Compensation amount for reverse operation in FSSB high-speed rigid tapping

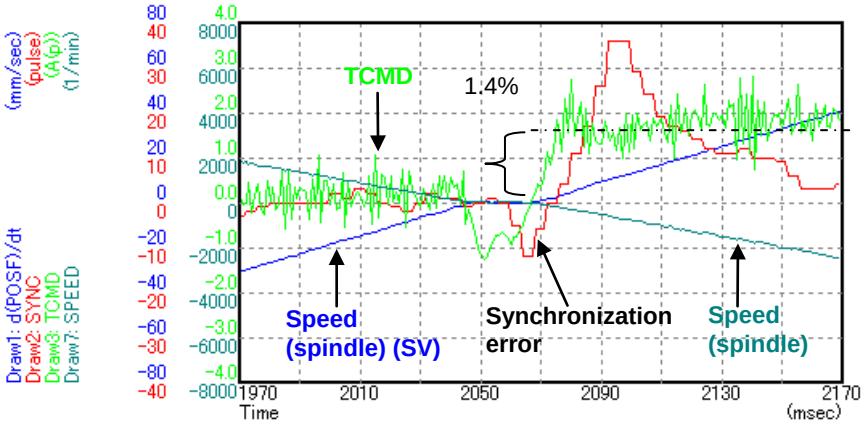
[Unit of data] 0.01% (A value of 10000 is equivalent to the maximum current of the amplifier.)
Set the compensation amount for reverse operation in the FSSB high-speed rigid tapping mode.

(4) Notes

When compensation for reverse operation and at the start is enabled (bit 2 of parameter No. 2423 is set to 1), the backlash acceleration and static friction compensation are disabled.

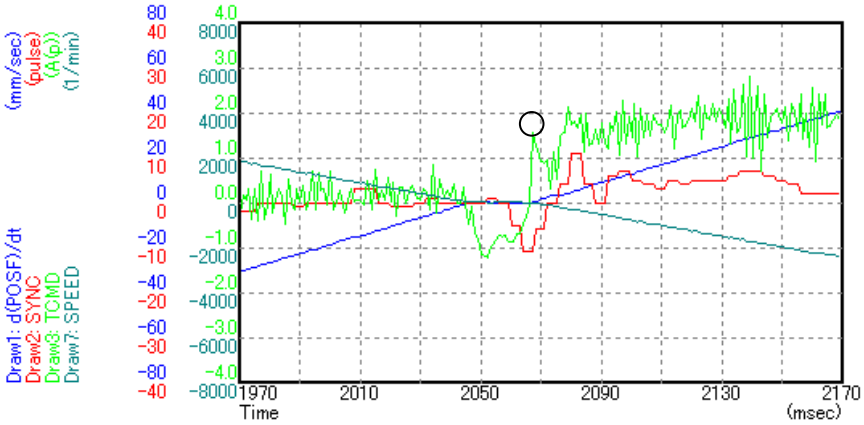
(5) Standard compensation amount

Observe the TCMD (torque command) waveform during reverse operation (at the hole bottom) and use the difference between TCMD immediately before reverse operation and TCMD immediately after reverse operation as the standard compensation amount.



Compensation for reverse operation: OFF

TCMD (after reverse operation − immediately before reverse operation) = 1.4%



Compensation for reverse operation: ON

Set parameter No. 2613 to 140.

TCMD rises at reverse operation (section indicated with ○) earlier and synchronization error is decreased.

5.14 FUNCTION FOR OBTAINING CURRENT OFFSETS AT EMERGENCY STOP

(1) Overview

The CNC automatically performs an offset adjustment (zero point adjustment) for the current sensor when the power is turned on. This function readjusts the current offset at every emergency stop. In cases where a small revolution error (four components per motor revolution) occurs due to the current offset after many hours of operation following the power-on of the CNC, the problem can be resolved by using this function.

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	A(01) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0 90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8 90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(3) Setting parameters

Set the following parameter to obtain current offsets at emergency stop again.

	#7	#6	#5	#4	#3	#2	#1	#0
2201								CROFS

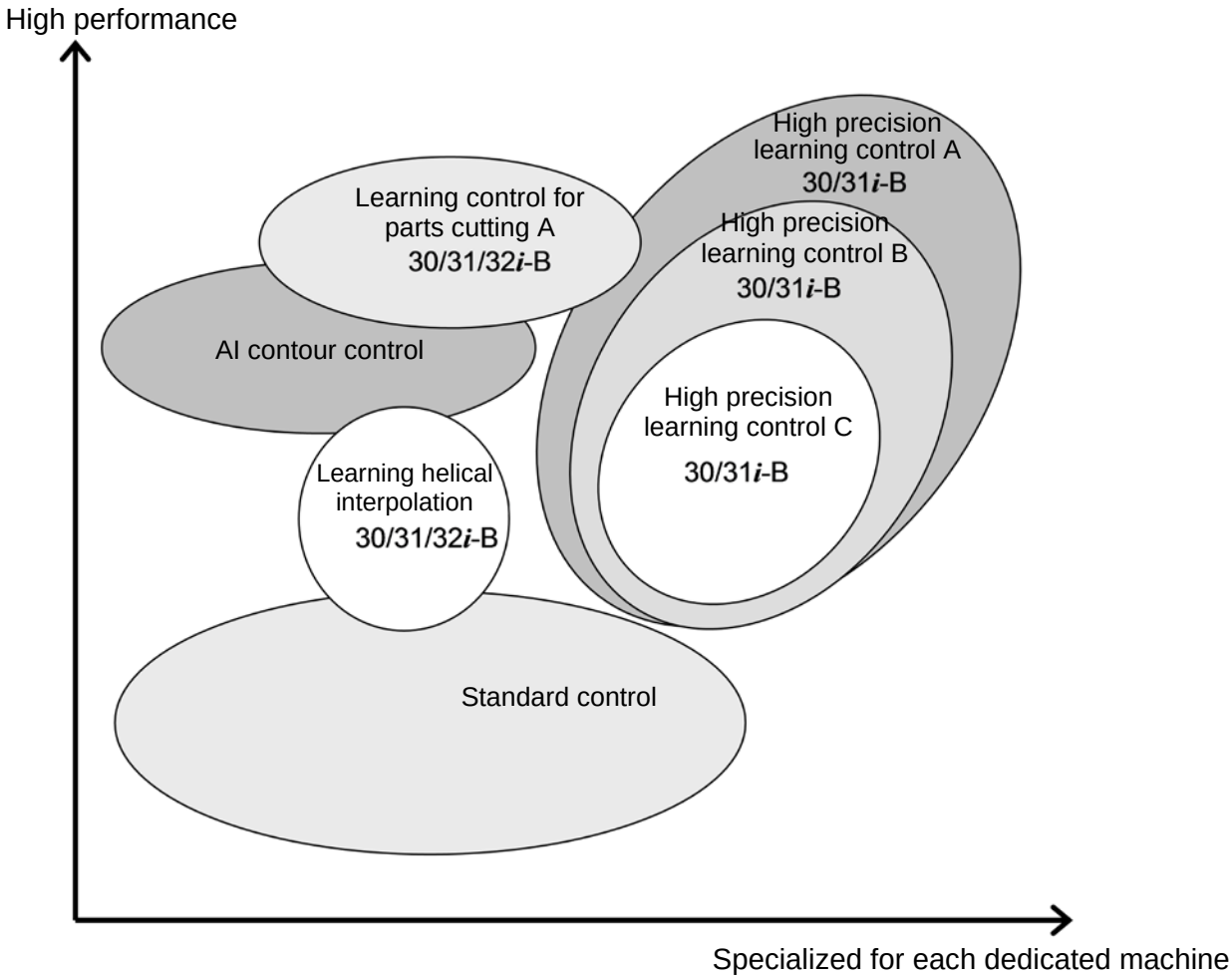
CROFS (#0) Function for obtaining current offsets at emergency stop is:

0: Disabled.

1: Enabled.

6 SERVO LEARNING CONTROL (OPTIONAL FUNCTIONS)

(1) Overview



Learning control improves the performance of following of "periodic commands that are executed in a predetermined pattern." It decreases position error as machining progresses from the first period to the second, from the second period to the third, and so on. Learning control can also eliminate the effect on periodic disturbance. It can be used for dedicated machine tools that perform machining in a repetitive pattern, such as cam and crank-pin grinding machines and gear cutting machines.

(2) Learning control methods

Control method	Program	Shape	Required memory	Change in the specified speed	Application
Angle based	Operation using normal NC statements	Shape that allows "one period" to be defined	Fewer	The permissible range for speed change is wide.	Cam grinding Gear cutting
Time based	Cycle/binary program operation Operation using normal NC statements	Free shape	Tends to increase	A change from the specified value is not permitted.	Parts cutting

Angle based learning control is based on the periodic shape. Time based learning control is based on the periodic time. Angle based learning control supports a wider range of application. While time based learning control enables learning control using free shapes, the NC program tends to become complicated and a change of machining feedrate is not accepted. Angle based learning control makes the program simple and supports a wide permissible range for speed change. It cannot be applied if the central angle cannot be defined for the shape. Angle based learning control is easier to use for many dedicated machine tool applications, except for those that handle complex shapes such as parts cutting.

(3) Option selection policy

While high precision learning control A supports all the functions, you do not always need all of them. Select the functions that are required for the application. High precision learning control is for dedicated machine tools, and parts cutting learning control and learning helical interpolation are for general machining centers. With parts cutting learning control, learning data can be saved in external media, such as USB memory, and reused repeatedly, making learning unnecessary.

Application / Option	Gear cutting Jig grinding Plane grinding	Gear grinding	Cam grinding Piston lathing Lens cutting	Parts cutting	Drilling
High precision learning C	Optimal	Adequate		Possible	Possible
High precision learning B	Adequate	Optimal	Adequate	Possible	Possible
High precision learning A	Possible	Possible	Optimal	Possible	Possible
Parts cutting learning				Optimal	Adequate
Learning helical					Optimal

(4) Details of learning control

Option name (Model B)	Former option name (Model A)	Learning method	Document title	Specification
High precision learning control A (A02B-032x-J706)NOTE	Preview repetitive control	Angle	Servo Learning Control 90G3/90J3 Series High Precision Learning Control Operator's Manual (Angle Based Learning Control)	A-63639-204
High precision learning control B (A02B-032x-J705)	Learning control	Time	Servo Learning Control 90G3/90J3 Series High Precision Learning Control Operator's Manual (Time Based Learning Control)	A-63639-200
		Spindle	FANUC AC SPINDLE MOTOR α*i* Series Spindle Learning Control Operator's Manual	A-63639-132
High precision learning control C (A02B-032x-R692)	Compact learning control	Angle only	Servo Learning Control 90G3/90J3 Series High Precision Learning Control Operator's Manual (Angle Based Learning Control)	A-63639-204
Learning control for parts cutting A (A02B-032x-R510)	Parts cutting learning control	Time only	Servo Learning Control 90G3/90J3 Series Learning Control A for Parts Cutting Operator's Manual	A-63639-201

NOTE
30*i*-B: 0323, 31*i*-B5: 0326, 31*i*-B: 0327, 32*i*-B: 0328

7 PRESSURE AND POSITION CONTROL (OPTIONAL FUNCTION)

(1) Overview

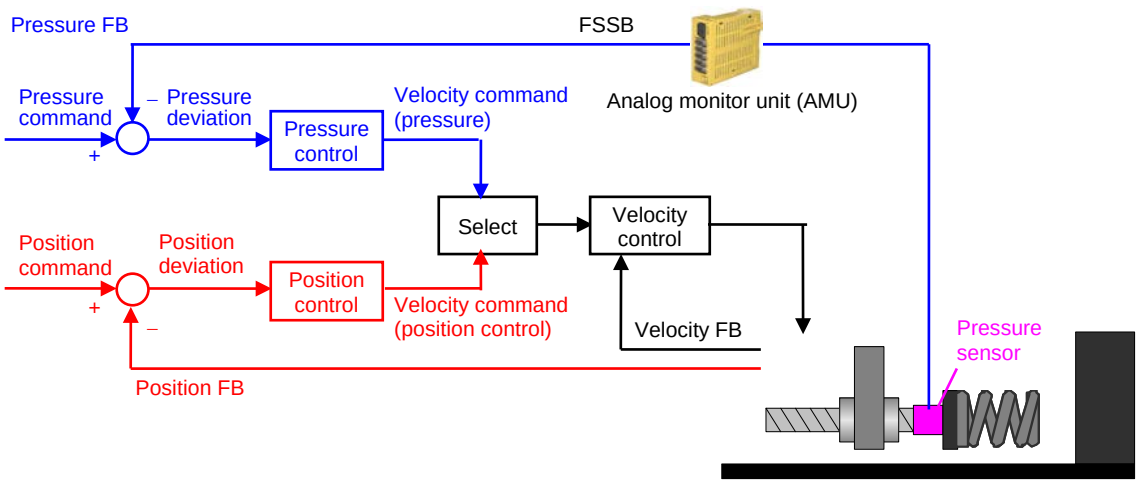
Pressure and position control is a function that makes it possible to command a pressure and position simultaneously in an NC program and that realizes press operation, servo die cushion operation, etc. as the servo control software switches between:

- Pressure control, which controls the pressure on the pressure sensor as commanded
- Position control, which is the normal motor operation

Switching between position control and pressure control enables operations, including:

- Approaching the pressed object* through position control
- Applying pressure to the pressed object* through pressure control
- Ending pressure control and returning to the initial position

* In this manual, the following names are used:
Pressure control axis: Axis for exercising pressure control via pressure and position control.
Pressed object: Object to be pressed by contacting the pressure control axis. Pressure control is not exercised for the pressed object.

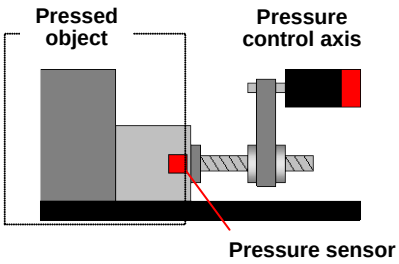
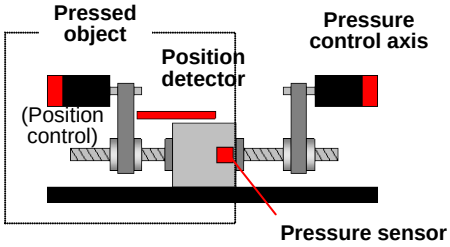


Pressure and position control block diagram

Basically, the control law is switched as shown in the table below.

Control law	Condition	Operation
Position control	The pressure control axis is separated from the pressed object. No pressure is generated.	The pressure control axis is moved or positioned according to the position command.
Pressure control	The position is commanded so that the pressure control axis overlaps the pressed object. Pressure is generated.	The pressure control axis is moved so that the pressure between the pressure control axis and pressed object approaches the specified pressure. When the pressed object moves, the pressure control axis moves along the movement of the pressed object. The position command is ignored.

Pressure and position control supports two operations as follows. There are differences in the hardware to be prepared and parameter settings.

Operation name	Operation A	Operation B
Overview	The pressure control axis approaches the stopped pressed object and applies pressure.	The pressed object approaches the pressure control axis that is stopped, retracting or performing another operation and applies pressure.
Conceptual diagram		
Application	Press axis	Servo die cushion axis
Differences in hardware	—	Separate detector Separate detector interface unit (for reading the velocity information of the pressed object)
To be used	Use pressure initial value parameter No. 2254. The control law used until contact is made is position control.	Use the function that feeds forward the velocity of the pressed object to the pressure control axis. The pressure response immediately after contact is improved.

⚠WARNING

1 If the wiring or setting of the pressure sensor, the direction of pressure control, the direction of the detector, or other basic settings are wrong, pressure and position control may cause an unexpected motion, which is very dangerous. Before making sure that it operates normally, you should:
- Sufficiently lower the excess error level.
- Sufficiently lower the torque limit value.
- Make the emergency stop switch readily available.
- Set 1 in bit 2 (PRSCHK) of parameter No. 2284 and check using position control at startup.

(2) Specifications

Starting pressure and position control requires making various settings. Refer to the following documents.

FANUC Power Motion *i*-MODEL A Pressure and Position Control B-64573EN-1/01-02
Setting and Tuning Manual for Pressure and Position Control Function A-81017-063EN/03

(3) Required hardware and software

(3.1) CNC

Power Motion *i*-A

(3.2) CNC software series and editions

88H0 Series Edition 04 and subsequent editions

(3.3) Applicable servo control software series and editions

CNC	Servo control software		Remarks
	Series	Edition	
Power Motion *i*-A	90GP 90JP	02.0 and subsequent editions 01.0 and subsequent editions	

(3.4) Analog monitor unit (AMU)

A02B-0334-C231

* Note that the wiring between the AMU and pressure sensor should be as short as possible, and should not be located parallel to power lines to prevent noise.

(3.5) Optional functions

Using pressure and position control requires the following options.

Multi-axis high response	A02B-0334-R396
Pressure and position control	A02B-0334-R400

(4) Notes

This function cannot be used together with the functions below.
If this function is set with any of these functions, an invalid parameter alarm is issued (the detail number is in parentheses).

- Adaptive resonance elimination filter (2703)
- Smart machining point control (with sensor) (2887)
- Torsion preview control (3823)
- SERVO HRV4 Control

(5) Setting parameters

When starting the function or adjusting the parameters, refer to the specifications mentioned in (2).

(5.1) Setting axis numbers

In addition to the ordinary position control loop, pressure and position control requires two successive servo axes (odd-numbered axis No. 1023 = 2n + 1 and even-numbered axis No. 1023 = 2n + 2) to perform the pressure control loop calculation.

Name	Odd-numbered axis (main axis)	Even-numbered axis (sub-axis)
No. 1023	2n + 1 (n = 0, 1, 2, 4, 5, 6, 8...)	2n + 2 (n = 0, 1, 2, 4, 5, 6, 8...)
Overview	Pressure and position control axis	One of the following: ・ Dummy axis ・ Multi-winding sub-axis ・ Torque tandem sub-axis
Operation A	Setting of the pressure and position control axis Setting for pressure sensor reading	Setting of the dummy, multi-winding, or torque tandem sub-axis
Operation B	—	Setting for reading the pressed object velocity in addition to operation A

Set the parameters so that the main axis and sub-axis for pressure and position control meet the conditions mentioned in the table above.

1023	Servo axis number for each axis

The NC needs to be rebooted if this parameter is changed.

If the pressure and position control axis is a multi-winding motor, set the multi-winding motor. For details, see Subsection 2.2.2.

	#7	#6	#5	#4	#3	#2	#1	#0
2211	PLW4	PLW2						

PLW4 (#7) 4-winding motor
0: No
1: Yes

PLW2 (#7) 2-winding motor
0: No
1: Yes

The NC needs to be rebooted if any of these parameters is changed.

NOTE
When pressure and position control is exerted using a multi-winding motor, the pressed object velocity cannot be read if the function bit of the motor feedback sharing (bit 7 of parameter No. 2018) or the function bit of the full-closed loop feedback sharing (bit 1 of parameter No. 2200) is set. Be sure to set 0 for bit 7 of parameter No. 2018 and bit 1 of parameter No. 2200.

When torque tandem driving or velocity tandem driving is used for the pressure and position control axis, specify tandem settings. For details, see Section 5.10.

When the pressure and position control axis is not a multi-winding motor and torque tandem driving is not used, set the sub-axis as a dummy axis.

	#7	#6	#5	#4	#3	#2	#1	#0
2009								DMY

DMY (#0) The feedback dummy is:
0: Not used.
1: Used.

The NC needs to be rebooted if this parameter is changed.

(5.2) Parameters related to the pressure sensor and analog monitor unit

Before setting pressure and position control, determine the maximum pressure detection value, which is calculated by subtracting the margin from the maximum value of the pressure sensor. The maximum pressure detection value is the value of the maximum pressure to be used by the servo control software. Set the maximum pressure detection value so that it satisfies the following equation.

Maximum pressure to be detected by the detector ≥ Maximum pressure detection value × 1.1

Next, set conversion coefficients for the NC software and servo control software, respectively.

2630	Pressure feedback conversion coefficient

Set (maximum pressure detection value [Pa] × Is [mA] × 32767) / (Ps [Pa] × 25 [mA]), where
Ps: Amount of change in the input pressure of the pressure sensor
Is: Amount of change in the output current of the pressure sensor

8697	Pressure conversion coefficient

[Valid data range] 0 to 32767
Determine the pressure specification unit, and set "maximum pressure detection value / pressure specification unit."

2631	Pressure feedback offset

This parameter is to cancel the offset of the pressure sensor.

	#7	#6	#5	#4	#3	#2	#1	#0
2276			PM2AMI	PM1AMI				

PM2AMI (#5) In the second, fourth, and other even-numbered Type-C modules, the analog monitor unit is:
0: Disabled.
1: Enabled.

PM1AMI (#4) In the first, third, and other odd-numbered Type-C modules, the analog monitor unit is:
0: Disabled.
1: Enabled.

The NC needs to be rebooted if any of these parameters is changed.

(5.3) Basic parameters for pressure and position control

	#7	#6	#5	#4	#3	#2	#1	#0
2284					PRSCTL	PRSCHK		

PRSCTL (#3) Pressure and position control is:
0: Disabled.
1: Enabled.

Set this parameter for the main axis of pressure and position control. The NC needs to be rebooted if this parameter is changed.

PRSCHK (#2) Pressure and position control is:
0: Exercised
1: Not exercised

If this bit is enabled (1), the control law is fixed to position control and the pressure control state does not occur, regardless of the result of pressure and position control. This bit is used for confirmation at startup.

	#7	#6	#5	#4	#3	#2	#1	#0
2285					PRSREV			

PRSREV (#3) The direction of pressure control is:
0: Not reversed.
1: Reversed.

Set this parameter appropriately by referring to the specifications mentioned in (2). The wrong setting leads to an unexpected motion. The NC needs to be rebooted if this parameter is changed.

(5.4) Parameters related to pressure and position control alarms

2255	Maximum pressure feedback value

[Valid data range] 0 to 10000
[Unit of data] 0.01%

This parameter is to issue an alarm if an excessive pressure is applied.
If this parameter is not set when pressure and position control is enabled, an invalid parameter alarm (detail No. 2553) is issued.

2256	Preload upper limit value

2257	Preload lower limit value

[Valid data range] 0 to 10000
[Unit of data] 0.01%

These parameters are to check that the pressure is within the specified range when pressure and position control starts.

(5.5) Pressure and position control gain

2246	Pressure control proportional gain

[Valid data range] 0 to 32767
[Initial value] 10
Increase the value gradually, starting with 10. Increasing the gain improves the pressure control response.
The reference value is about 70% of the stability limit.

2247	Pressure control integral gain

[Valid data range] 0 to 32767
[Initial value] 0
Adjust this value after the pressure control proportional gain (No. 2246).
The reference value is about 70% of the value at which low frequency oscillation occurs as the pressure response.

(5.6) Function to accelerate the switch to pressure control in pressure and position control

2254	Pressure specification initial value

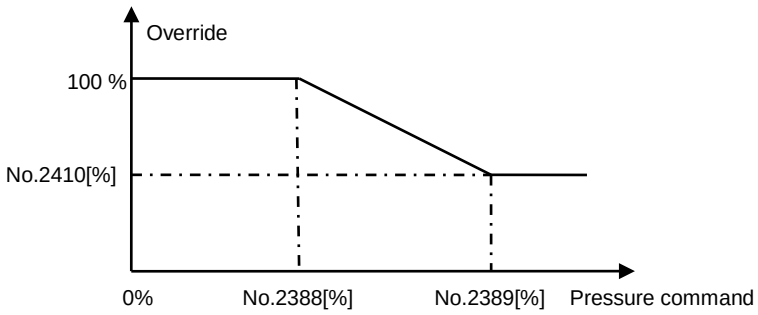
[Valid data range] −10000 to 10000
[Unit of data] 0.01%
If this parameter is set, the specified pressure is fixed to the value set in this parameter until the pressure value exceeds the specified pressure and position control is exerted during that period.
Set this parameter when using operation A.

2249	Pressure specification time constant

[Valid data range] 0 to 500
[Unit of data] ms
This parameter is valid when the pressure specification initial value (No. 2254) is used.
If this parameter is set to 0 when parameter No. 2254 is set, the specified pressure returns to the pressure specified in the program as soon as the pressure exceeds the pressure specification initial value for the first time.
If this parameter is set when parameter No. 2254 is set, the specified pressure gradually approaches the pressure specified in the program at the time constant specified in this parameter as soon as the pressure exceeds the pressure specification initial value for the first time.

(5.7) Gain switch function (pressure command dependent) in pressure and position control

The gain switch function (pressure command dependent) is to prevent the pressure control loop from becoming unstable when the pressure rises. Depending on the pressure command, it applies override to the pressure control gain (proportional and integral) as shown in the figure below.



	#7	#6	#5	#4	#3	#2	#1	#0
2286					PRGCHG			

PRGCHG (#3) Gain switching for pressure and position control is:

0: Disabled.
1: Enabled.

2410	Pressure command dependent override

[Valid data range] 1 to 100
[Unit of data] %

This is the pressure gain override shown in the figure above. This function is disabled when the value is 0.

2388	Pressure command threshold (lower)

2389	Pressure command threshold (upper)

[Valid data range] 0 to 10000
[Unit of data] 0.01%

These are the pressure command thresholds shown in the figure above.
Make sure that parameter No. 2388 is smaller than parameter No. 2389. If parameter No. 2388 is greater than or equal to parameter No. 2389, the function is disabled.

(5.8) Simultaneous switch function in pressure and position control

This function is to activate multiple pressure and position control axes and execute tandem driving for one of the axes. If the function is used improperly, the control law does not switch to pressure control, possibly resulting in damage to the machine or other problems. When using this function, refer to the specifications mentioned in (5).

	#7	#6	#5	#4	#3	#2	#1	#0
2284								PRSCHG

PRSCHG (#3) The simultaneous switch function is:

0: Disabled.
1: Enabled.

The NC needs to be rebooted if this parameter is changed.

2232	Number of simultaneously switched axes

[Valid data range] 0 to 18

Of all the pressure and position control axes for which the simultaneous switch function (bit 0 of parameter No. 2284) is set, if the "number of axes deemed eligible for the shift to pressure control" exceeds the value set in this parameter, simultaneous switching is executed for all the simultaneously switched axes.
Set the same value for all the simultaneously switched axes. If 0 is set, this function is disabled.

> ⚠ **CAUTION**
> If the simultaneous switch function is used improperly, the control law does not switch to pressure and position control, possibly resulting in damage to the machine or other problems. Read "Setting and Tuning Manual for Pressure and Position Control Function" mentioned in (2) in advance to understand how to use it.

8 SERVO TUNING TOOL SERVO GUIDE

(1) Overview

Servo tuning tool "SERVO GUIDE" is an integrated tuning tool for servo and spindle axes that runs on a PC. This tool can be connected to the CNC to observe the operation of servo and spindle axes with waveforms. The automatic tuning feature called "Tuning Navigator" extensively supports you to enable servo tuning with simple operations.

[Order specification of the package for new purchase]
A08B-9010-J900 (for single users)
A08B-9010-J910 (for 10 users)
A08B-9010-J920 (for 20 users)
A08B-9010-J930 (for site licenses)

[Order specification of the package for update]
A08B-9010-J919 (Supplied on one CD-ROM disk)

This software can be used to update a previous version of software previously licensed, regardless of the number of computers, so that the updated software can be used under the same licensing conditions as before.

To install SERVO GUIDE supplied on the CD for update, a previous version of SERVO GUIDE must have been installed on your PC.

[Order specification of the package for the 3-D View Function]
A08B-9010-J904 (Supplied on one CD-ROM disk and one hardware key)

NOTE
3-D View Function (option) comes with a CD for update (A08B-9010-J919).

(2) Operating environment

■ Applicable SERVO GUIDE editions

CNC	SERVO GUIDE Edition	Remarks
Series 30*i*/31*i*/32*i*/35*i*-B	7.30 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	3.00 and subsequent editions	
Series 0*i*-F	10.10 and subsequent editions	
Series 0*i*-D	6.00 and subsequent editions	
Power Motion *i*-A	8.00 and subsequent editions	

■ Necessary hardware and software configuration

Operating this software requires the hardware and software configuration below.

Necessary hardware and software configuration

Item	Description
Computer	IBM PC/AT COMPATIBLE, or CNC display unit with PC functions (PANEL *i*)
OS	Microsoft Windows 7/8/10 (32-bit, 64-bit) (Note 1, 2) Multiple language support: Japanese, English, Chinese versions (Simplified, Traditional)
CPU	Windows 10: Pentium III 1 GHz or higher recommended Windows 8: Pentium III 1 GHz or higher recommended Windows 7: Pentium III 1 GHz or higher recommended

Item	Description
Memory	Windows 10: 512 MB or more (1 GB or more recommended) Windows 8: 512 MB or more (1 GB or more recommended) Windows 7: 512 MB or more (1 GB or more recommended)
Hard-disk space	50 MB or more (Note 3) (100 MB for installation)
Display resolution	SVGA (800*600) or higher (Note 4) (XGA (1,024*768) or higher is recommended) (Note 5)
Other	Ethernet port (LAN) (in case of Ethernet connection) A pointing device such as a mouse is required. For browsing online help, Internet Explorer 4.01 or later is required.

* Windows is a trademark of Microsoft Corporation in the United States.
* Other company and product names are either registered trademarks or trademarks of each company.

NOTE
When opening multiple screens, allocate as much memory as possible.

(Note 1) Windows 95/98/Me/NT4.0/2000/XP/Vista are not supported.
(Note 2) If 3-D View Function (option) is to be used, OpenGL1.4 or later is required. A USB port is required to attach an OpenGL-compliant graphics card and a hardware key.
(Note 3) In addition, the space for storing measurement data is required.
(Note 4) Although SVGA also can be used, when two or more windows are opened simultaneously, it becomes hard to see due to overlapping windows.
(Note 5) When using the 3-D View Function (option), 2-D and 3-D graphs cannot be viewed simultaneously unless XGA or higher is used.

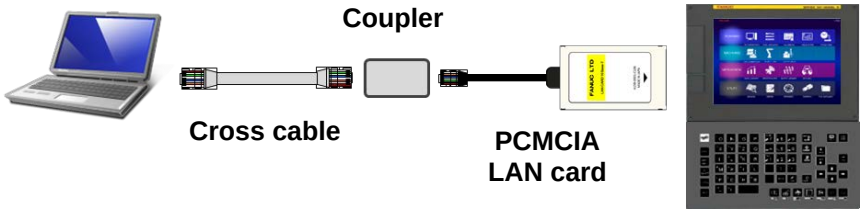
Apart from the above, the hardware configuration below may be required.

Other hardware configuration

Item	Description
PCMCIA LAN card	Used for an Ethernet connection. (Note 1) Use the FANUC-designated one (A02B-0281-K710).
Coupler	Used for an Ethernet connection. (Note 1) It is commercially available, and can be obtained from a PC shop, etc.
Ethernet cable (cross)	Used for an Ethernet connection. (Note 1) It is commercially available, and can be obtained from a PC shop, etc.
Ethernet cable (straight)	Used for an Ethernet connection. (Note 1) It is commercially available, and can be obtained from a PC shop, etc.
Hub	Used for an Ethernet connection. (Note 1) It is commercially available, and can be obtained from a PC shop, etc.
HSSB board	Required for an HSSB connection. (Note 1) Use a genuine FANUC HSSB board. Note that the Panel *i* has an HSSB function.
Printer	Required to print acquired waveforms.

[Ethernet connection (when not using a hub)]

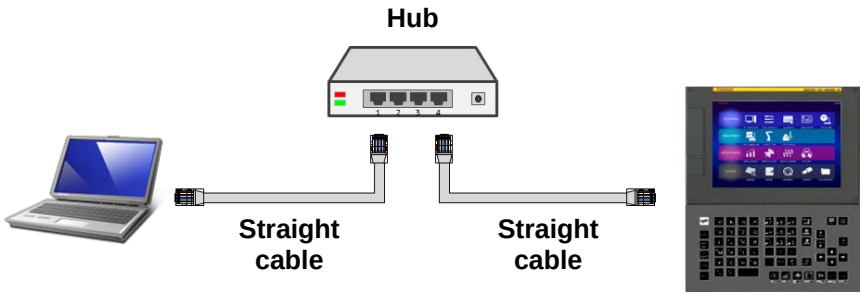
The FANUC-supplied PCMCIA-LAN card comes with a dedicated connector on the card side and a 1.5-m straight cable with an RJ45 male connector on the PC side. The PC and the CNC are connected directly as shown below.

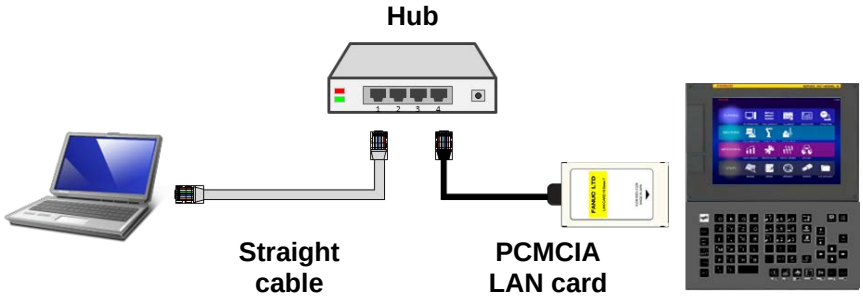


(The cross type cable and coupler are commercially available from any personal computer store.)

[Ethernet connection (when using a hub)]

When the PC and the CNC are connected via a hub, they are connected as shown in the figure below. In this case, the coupler becomes unnecessary, but a straight type cable must be prepared.





* If using the built-in Ethernet port, do not use a PCMCIA-LAN card but the RJ45 female connector on the CNC.

[HSSB connection]

When HSSB is used, the CNC and the PC are connected using an optical cable as shown in the figure below. In this case, no special connection must be added to use SERVO GUIDE.

* Also, when a CNC display unit with a PC function is used, no special connection is required.

■ Related software series / edition list

The operation of SERVO GUIDE is guaranteed with the combinations below.

(a) System software

CNC models and series / edition of system software

CNC	System software	
	Series	Edition
Series 30*i*-B	G301,G311,G321,G331	01 and subsequent editions
Series 31*i*-B5	G421,G431	01 and subsequent editions
Series 31*i*-B	G401,G411	01 and subsequent editions
Series 32*i*-B	G501	01 and subsequent editions
Series 35*i* -B	G601,G611	01 and subsequent editions
Series 30*i*-A	G004,G014,G024	01 and subsequent editions
	G003,G013,G023	01 and subsequent editions
	G002,G012,G022	01 and subsequent editions
	G00C,G01C,G02C	01 and subsequent editions
	G00A,G01A,G02A	01 and subsequent editions
	G001,G011,G021	23 and subsequent editions
Series 31*i*-A5	G124,G134	01 and subsequent editions
	G123,G133	01 and subsequent editions
	G121,G131	01 and subsequent editions
	G12C,G13C	01 and subsequent editions
Series 31*i*-A	G104,G114	01 and subsequent editions
	G103,G113	01 and subsequent editions
	G101,G111	01 and subsequent editions
Series 32*i*-A	G201,G203,G204	01 and subsequent editions
Series 0*i*-MF	D4G1	01 and subsequent editions
Series 0*i*-TF	D6G1	01 and subsequent editions
Series 0*i*-MD	D4F1	01 and subsequent editions
Series 0*i*-TD	D6F1	01 and subsequent editions
Series 0*i* Mate-MD	D5F1	01 and subsequent editions
Series 0*i* Mate-TD	D7F1	01 and subsequent editions
Power Motion *i*-A	88H0	01 and subsequent editions

* For system software series/editions supporting I/O Link β*i*, refer to the function correspondence table in an appendix in "FANUC SERVO GUIDE OPERATOR'S MANUAL (B-65404EN)" or online help.

(b) FOCAS1/2-related software

CNC models and series / edition of FOCAS1/2-related software

FOCAS1/2-related software	CNC models	Specification	Series / Edition
Control software for embedded Ethernet function	Series 30*i*/31*i*/32*i*/35*i*-B. Power Motion *i*-A	A02B-0323-J571#658M	658M/01 and subsequent editions
	Series 30*i*/31*i*/32*i*-A	A02B-0303-J571#656E	656E/06 and subsequent editions
	Series 0*i*-D	A02B-0319-J571#656E	658E/01 and subsequent editions 658E/02 and subsequent editions (support stand-alone type)
Software for Ethernet communication management	Series 30*i*/31*i*/32*i*-A	A02B-0303-J572#656F	656F/07 and subsequent editions
	Series 0*i*-D	A02B-0319-J572#658F	658F/01 and subsequent editions
Software for 15" LCD control (if using a 15" LCD)	Series 30*i*/31*i*/32*i*-A	A02B-0207-J595#60VB	60VB/1.3 and subsequent editions
			60VB/1.7 and subsequent editions (supports I/O Link β*i*)
		A02B-0207-J903#60VF	60VF1.0 and subsequent editions (supports I/O Link β*i*)
Windows CE.NET customized OS	Series 30*i*/31*i*/32*i*-A (When personal computer function option with Windows CE is used)	A02B-0207-J594	1.2 and subsequent editions
Windows CE.NET FOCAS2/HSSB library		A02B-0207-J808	1.5 and subsequent editions
			1.7 and subsequent editions (supports I/O Link β*i*)
		A02B-0207-J875	1.0 and subsequent editions
Windows CE.NET standard application/ library		A02B-0207-J809	1.2 and subsequent editions

* For software series/editions related to FOCAS1/2 supporting I/O Link β*i*, refer to the function correspondence table in an appendix in "FANUC SERVO GUIDE OPERATOR'S MANUAL (B-65404EN)" or online help on SERVO GUIDE.

(c) Servo software

CNC models and series / edition of servo software

CNC	Servo software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0	03.0 and subsequent editions	
	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	C(03) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	C(03) and subsequent editions	HRV4
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	

* For system software series/editions supporting each function of Tuning Navigator, refer to the function correspondence table in an appendix in "FANUC SERVO GUIDE OPERATOR'S MANUAL (B-65404EN)" or Help page.

(3) Outline of software specifications

Servo tuning tool, "SERVO GUIDE" consists of four software functions including three types of window, which are the Parameter Window, the Graph Window, and the Program Window, and a tuning support wizard called Tuning Navigator.
The following outlines the specifications of these software functions.

(a) Parameter Window

- Parameters on the CNC are read and can be changed on the personal computer.
- Servo and spindle parameters are classified and displayed for each function.
- Automatic acceleration/deceleration functions for high speed and high-precision are supported.
- CNC parameters can be changed on the personal computer.

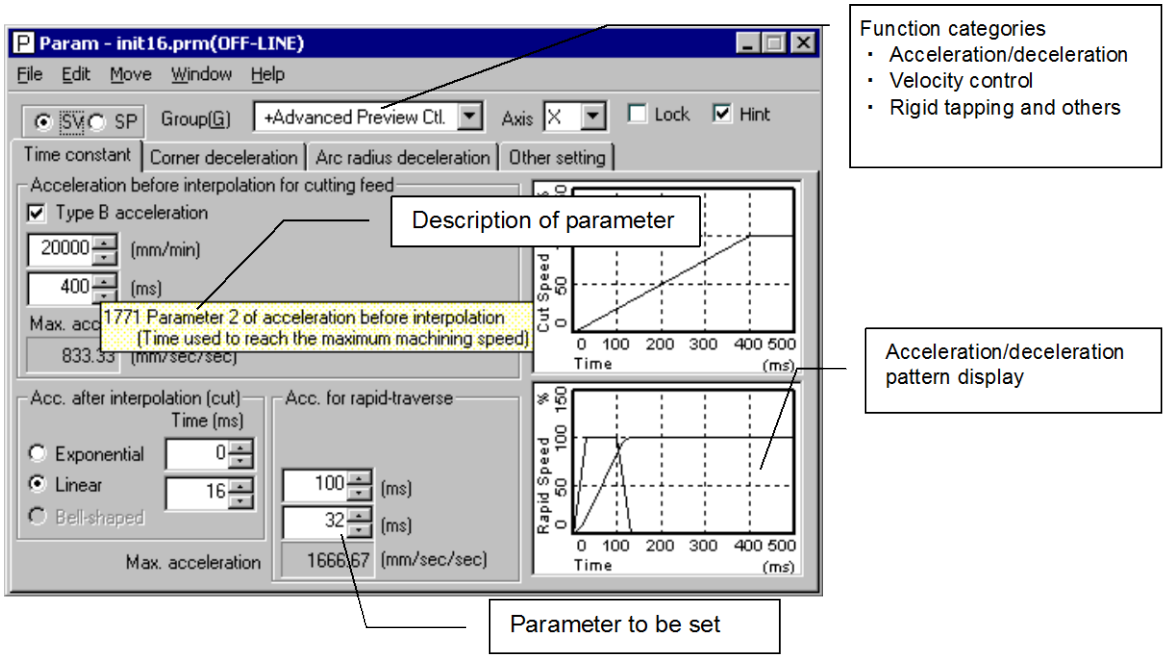
Details of function groups that can be set in the Parameter Window

[Servo]

Group	Description
System setting	CNC options related to servo systems are extracted and displayed.
Servo axis setting	Use of a separate detector, rotary motor/linear motor/synchronous built-in servo motor (DD motor), CMR, flexible feed gear, setting of AMR, setting of acceleration sensor, etc.
Acceleration/ deceleration	Time constant of Acc./Dec. before interpolation and time constant of Acc./Dec. after interpolation, speed difference in automatic corner deceleration, setting for arc radius-based feed rate clamp, setting for acceleration-based deceleration, jerk control (Normal control, advanced preview control, AI advanced preview control, AI contour control, AI nano contour control, high precision contour control, AI high precision contour control, AI nano high precision contour control, AI contour control I and II)
Current control	HRV, HRV2, HRV3, and HRV4 control, and setting of current gain
Velocity control	Velocity loop gain setting, setting of the function of vibration suppression in the stop state, setting of filters for eliminating machine resonance, vibration damping control, setting of dual position feedback, and setting of the full-closed loop function, etc.
Position control	Position gain
Contour error suppression	Feed-forward, backlash acceleration, interactive force compensation, and fine Acc./Dec. (16*i* series only)
Improvement in overshoot	Setting of overshoot compensation function
High-speed positioning function	Setting of position gain switching function, etc.
Stop	Setting of brake control, quick stop, and lifting function against gravity, etc.
Unexpected disturbance torque detection	Adjustment of estimated disturbance value, alarm detection level
FSSB high-speed rigid tapping	Setting of FSSB high-speed rigid tapping (servo axis side)
Linear motor	Setting of feedback, setting of AMR, and setting of smoothing compensation
DD motor	Setting of feedback, setting of AMR, and setting of smoothing compensation
Tandem control axes	Setting of tandem control axes
Pole position detection	Setting of pole position detection functions

[Spindle]

Group	Description
System setting	CNC options related to spindle systems are extracted and displayed.
Spindle system configuration	Motor end sensor (main and sub) setting, spindle end sensor (main and sub) setting, gear ratio (main and sub)
Normal mode velocity control	Velocity loop gain setting, and setting of filters (main and sub) for eliminating vibration, resonance elimination filter
Orientation	Stop position setting, velocity control setting (main and sub), position control setting (main and sub), acceleration setting (optimum orientation, high-speed orientation), resonance elimination filters
Rigid tapping	Command setting, velocity control setting (main and sub), position control setting, fine Acc./Dec. (16*i* series only), FSSB high-speed rigid tapping, Optimum torque acceleration/deceleration for rigid tapping
Cs contour control	Command setting, velocity control setting, position control setting, fine Acc./Dec. (16*i* series only), resonance elimination filters
Spindle synchronous control	Velocity control setting, position control setting, resonance elimination filters
Synchronous spindle	Pole position detection, setting of AMR, current pattern, alarm detection level



Parameter Window (example)

(b) Graph Window

・ Data measurement display function
- Horizontal axis time mode
  Normal mode, first order differential mode, second order differential mode, third order differential mode (YT mode)
  Feed smoothness measurement mode (DXDY mode)
  Tangent speed display mode (XTVT mode)
  Synchronous error measurement mode (Synchro mode)
- XY mode
  (Polar coordinates conversion and angular axis conversion also available)
- Arc path error zoom mode (Circle mode)
- Contour path error zoom mode (Contour mode)
- Frequency spectrum analysis mode (Fourier mode)
- Velocity loop and position loop frequency response mode (Bode mode)

For servo and spindle axes, data measurement is possible. (Data of both servo and spindle axes can also be measured at the same time.)

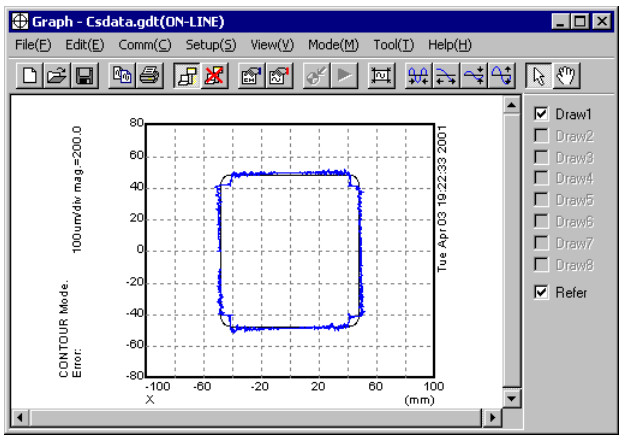
	Maximum number of channels that can be measured simultaneously
Total	Eight channels
Per two servo axes	Four channels (*)
Per spindle	Four channels (*)
PMC	Up to 16 PMC signals can be measured simultaneously on one channel. (*)
I/O Link β*i*	Two channels (*)

* Up to four channels can be measured for servo axes that have successive numbers set in parameter No. 1023, 2n-1, 2n (n: Non-negative integer).
* Up to four channels can be measured for an α*i* spindle axis connected to the FSSB. (Up to two channels can be measured for a conventional spindle axis.)
* With the Series 0*i*-D, up to eight PMC signals can be measured simultaneously.
* Only one I/O Link β*i* axis can be measured at a time.
* Different I/O Link β*i* axes cannot be measured simultaneously.
* An I/O Link β*i* axis and other CNC axes cannot be measured simultaneously.

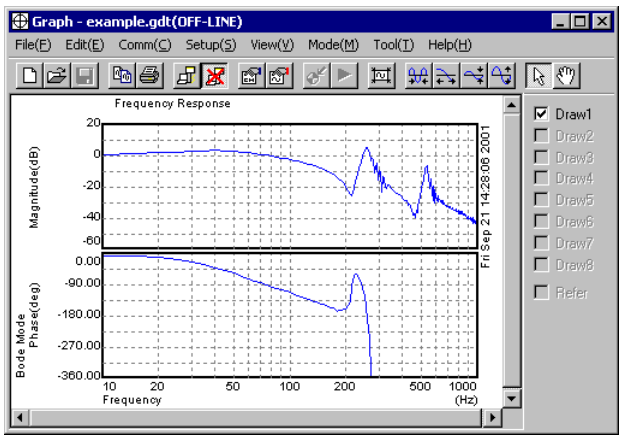
Display data can be printed out.

* Bit map data can be read via the clipboard.

The highest-speed sampling period equals the current control period or 62.5 μs, whichever longer. (Servo axis only)



Example of contour error measurement in Cs contour axis control



Example of velocity loop frequency response

- Velocity loop frequency response measurement (high-precision measurement mode)
  "High-precision measurement mode" can be used to measure the frequency domain above 1 kHz more accurately with frequency response measurement mode in the graph window.
  For example, this can be used for tuning to be done when making the velocity gain higher by applying servo HRV+ control.

NOTE

If frequency response measurement is conducted in high-precision mode, axis excitation is performed for a longer time than in the normal measurement mode (SingleSweep) to improve the measurement precision in the high frequency domain (about three to four times longer).

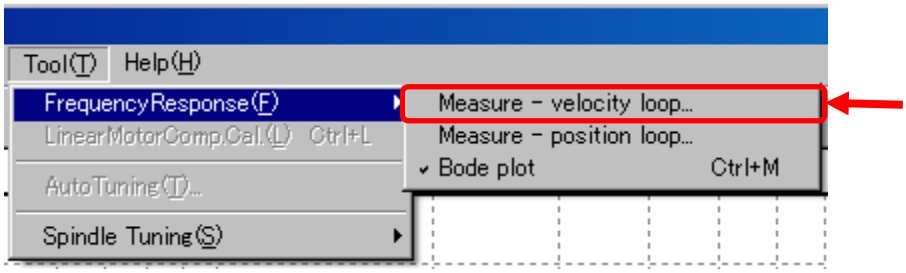
(1) Series and editions of applicable software

SERVO GUIDE	9.20 edition and subsequent editions
Servo control software for the 30*i*-B	90J0/03.0 and subsequent editions, 90K0/03.0 and subsequent editions, and 90J3/03.0 and subsequent editions

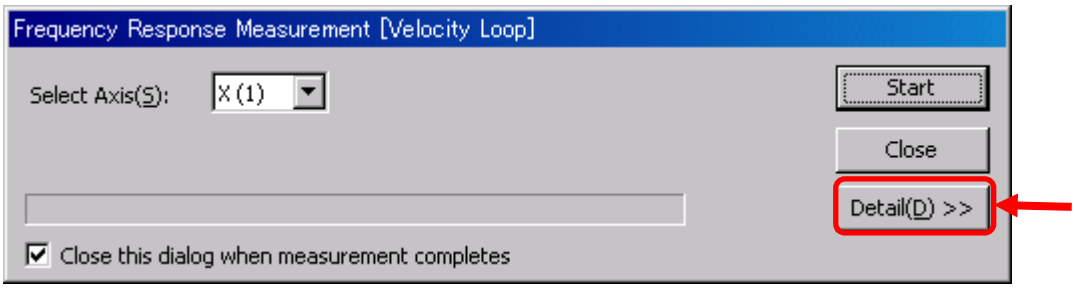
(2) Procedure

The operating procedure is as described below.

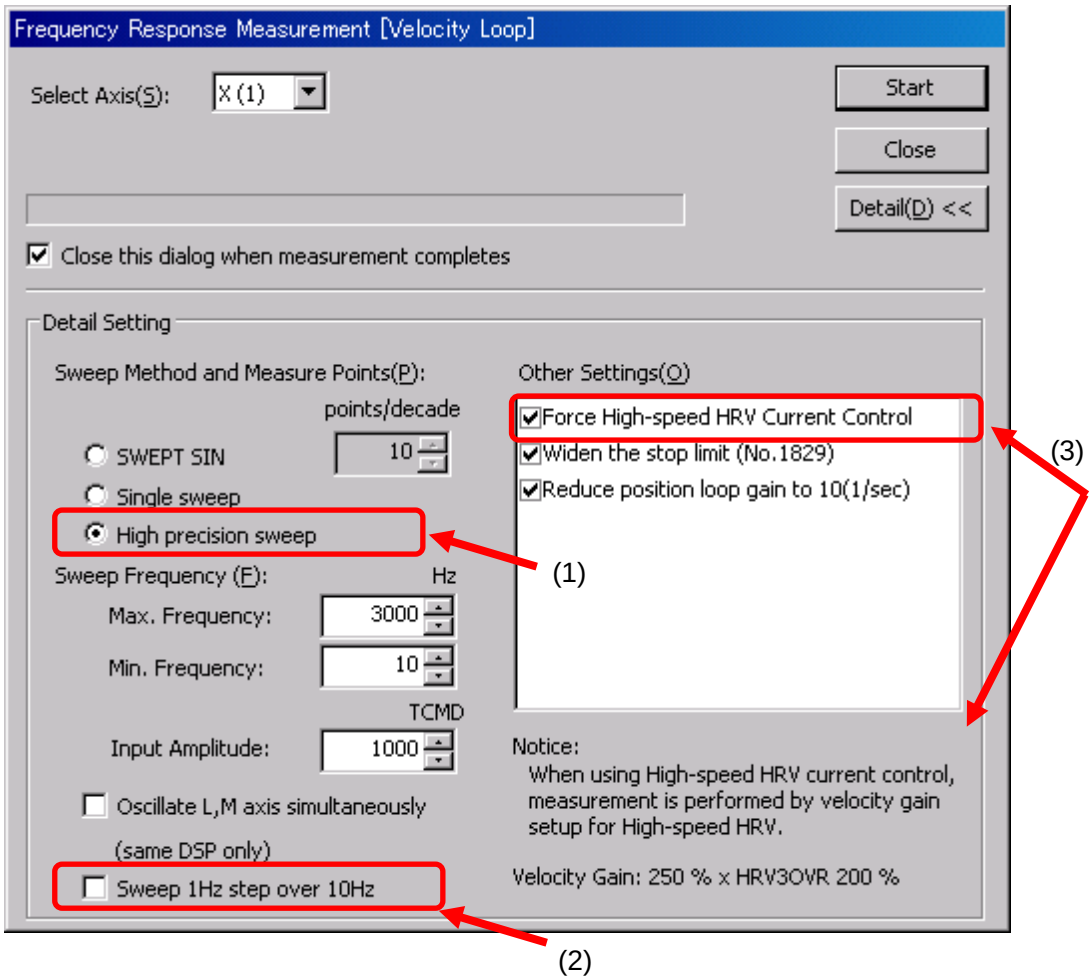
a) From [Frequency Response] in the [Tool] menu in the graph window, select [Measure – velocity loop] to display the frequency response measurement dialog.



b) Select the axis to be measured, and press the [Detail] button.



c) From sweep method in detail setting, select "High precision sweep."
(This can be selected only if the servo control software supports the high-precision measurement mode.)



Changes to [Detail setting] are as described below.

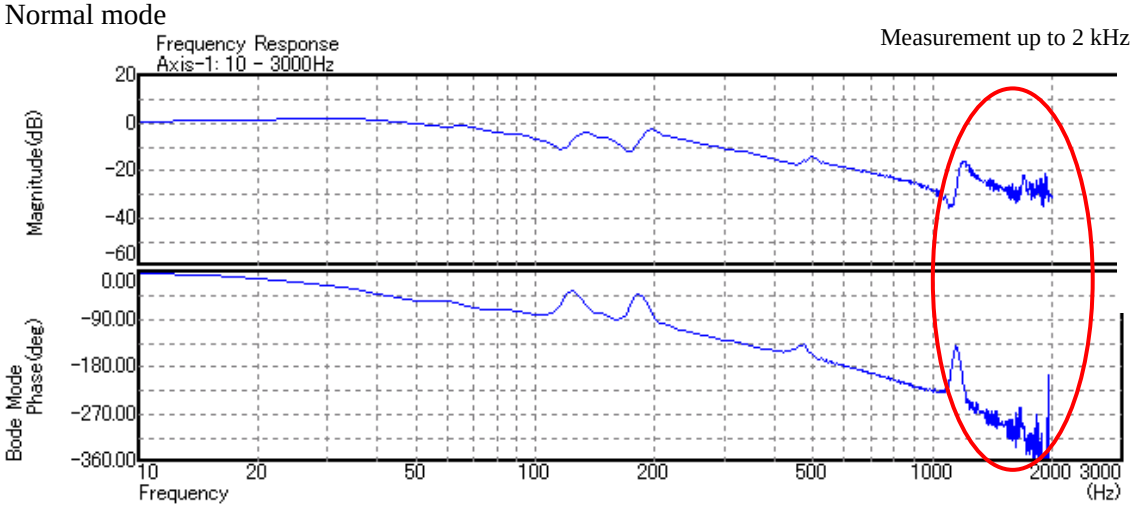
Item	Description	
Sweep Method	SWEPT SIN: Measurement mode for previous models (9096 series) Single sweep: Normal measurement mode High precision sweep: High-precision measurement mode	(1)
Sweep Frequency	Set the maximum and minimum measurement frequencies. For 1 to 10 Hz, excitation is performed for every 1 Hz; and for 10 Hz or higher, for every 5 Hz. The servo control software supporting the high-precision mode can perform excitation for every 1 Hz even for 10 Hz or higher. Note that this makes the measurement time much longer. (This setting can be used together with the normal measurement mode.)	(2)
Other settings	If HRV3 or HRV4 control is used, frequency response can be measured by forcing the high-speed HRV current control to be enabled (measurement with bit 0 of parameter No. 2271 being 1).	(3)

d) Press the [Start] button, and frequency response measurement is performed in high-precision mode.

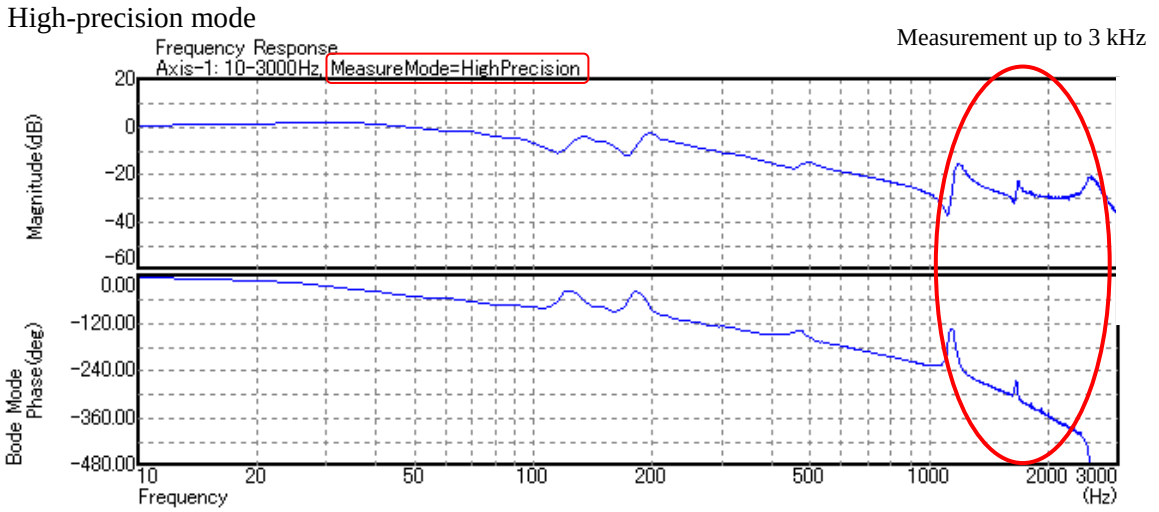
NOTE
If frequency response is measured in high-precision mode, the character string "HighPrecision" is inserted into comment 2. This is used to distinguish the measurement from the normal measurement. Do not change or delete it.

(3) Measurement example

Normal mode

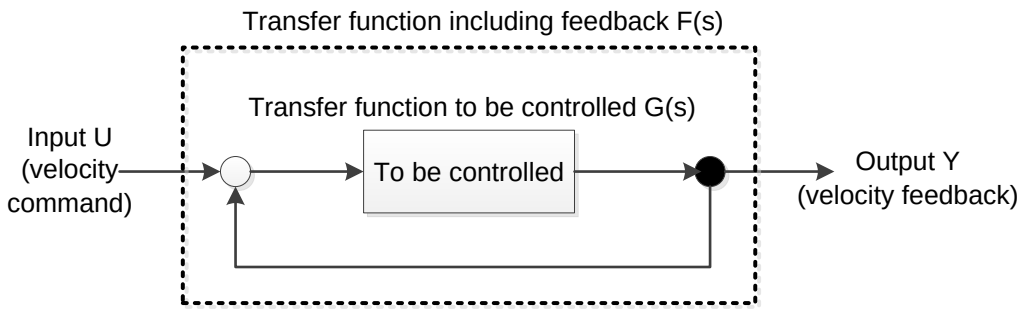


High-precision mode



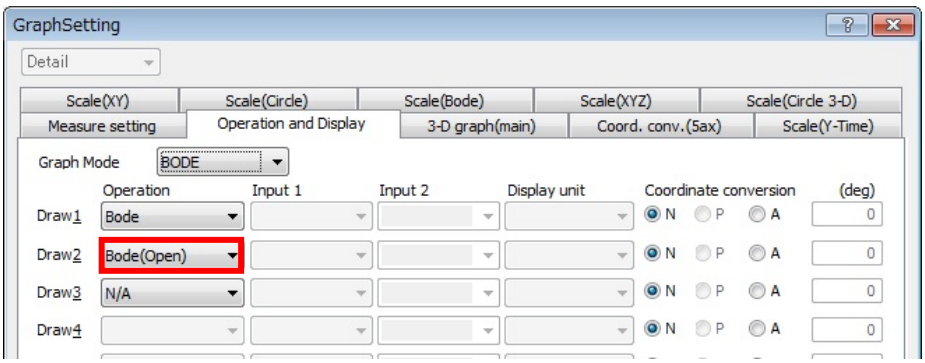
Measurement precision improved
in the domain of 1 kHz or higher

- Velocity loop frequency response measurement (open loop)
  By default, the frequency response of the closed loop is displayed, but the frequency response of the open loop can be displayed. The frequency response of the open loop indicates the transfer characteristics of controlled objects, whereas the frequency response of the closed loop indicates the transfer characteristics containing feedback.

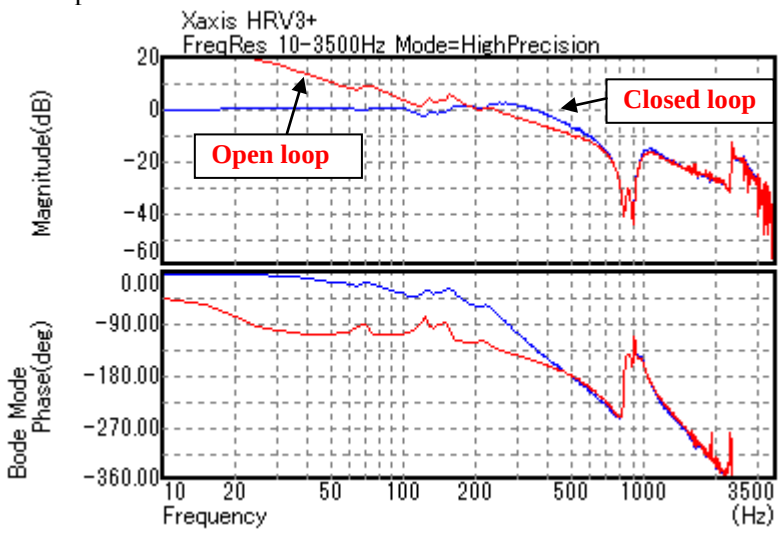


(1) Series and editions of applicable software
SERVO GUIDE 8.30 edition and subsequent editions

(2) Procedure
To display the frequency response of the open loop, select the [Setup(S)] menu-[Operation and Display], and then select "Bode(Open)" from operation.

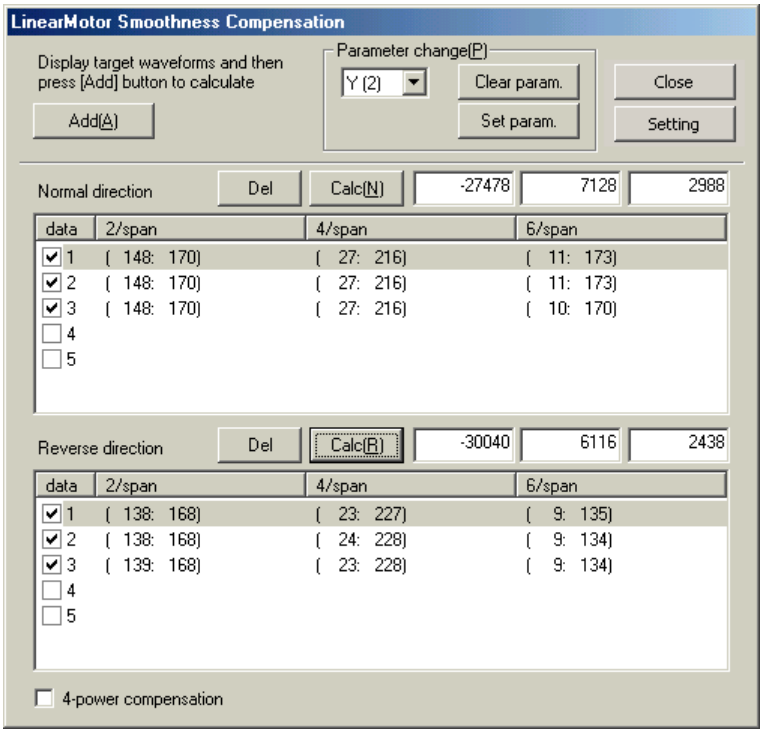


(3) Measurement example

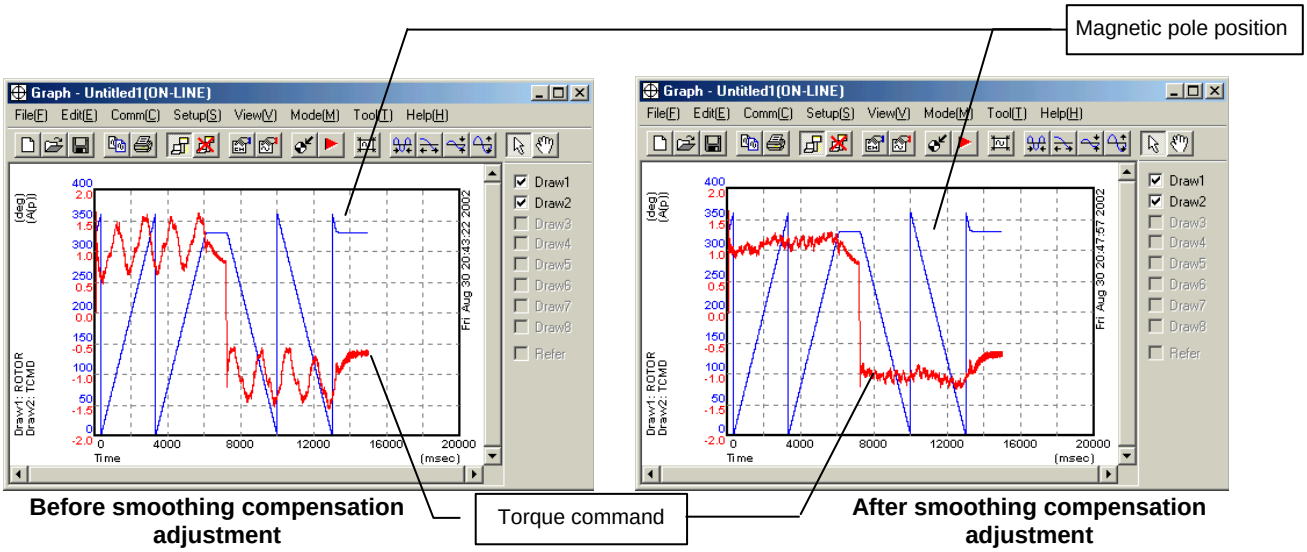


- Smoothness compensation setting support functions
  With this function, parameters of the smoothing compensation function, which improves the smoothness of linear motor feed or synchronous built-in servo motor feed, can be determined easily.

(Screen example)



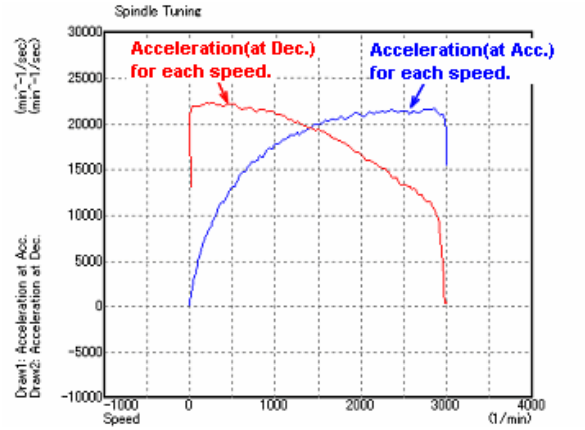
(Adjustment example)



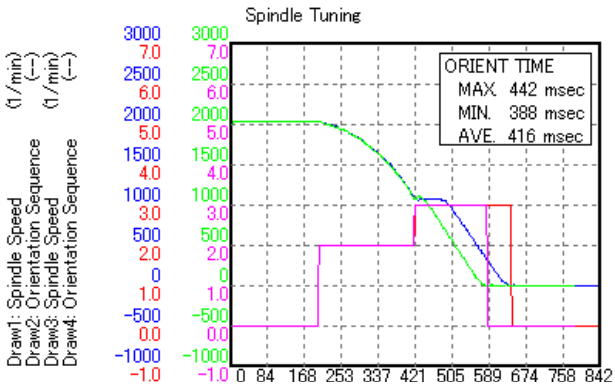
・ Spindle tuning functions

These functions support the automatic acquisition of data during the acceleration/deceleration of the spindle, data during orientation, and data for frequency response.

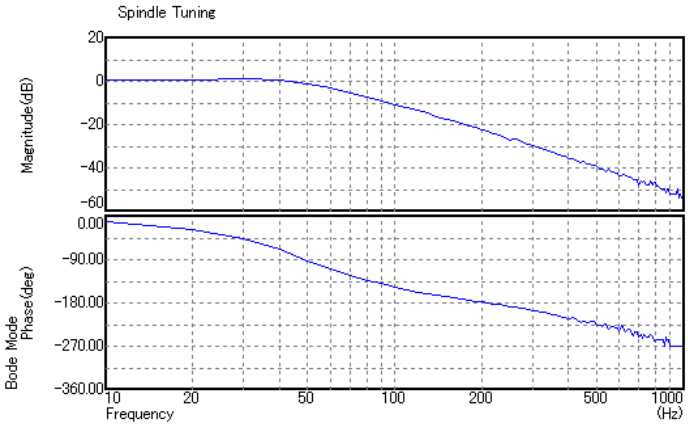
(Acquired data examples)



Measurement of acceleration/deceleration performance (Speed − Acceleration characteristics)

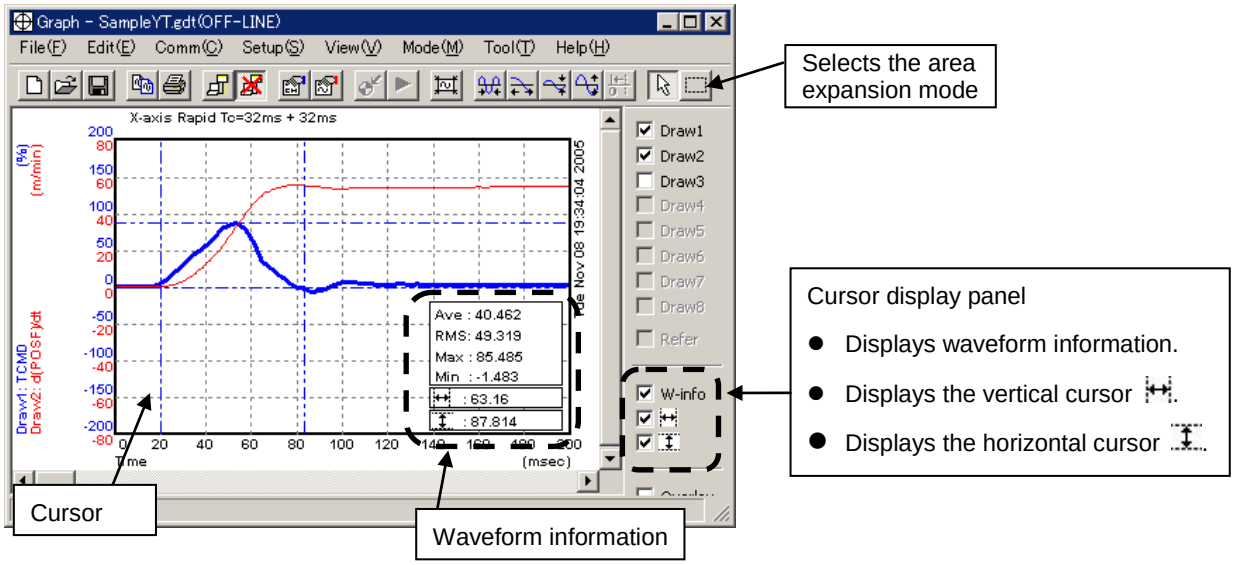


Measurement of orientation (Orientation time)



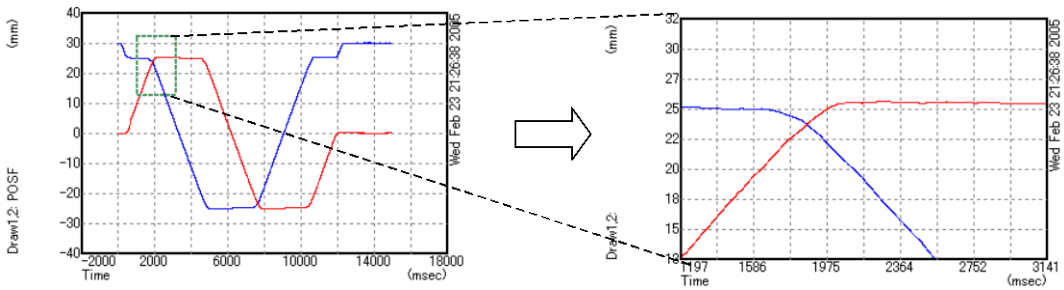
Frequency response measurement

- Cursor function



By using the horizontal and vertical cursors, a waveform measurement can be made.
The type of possible measurement depends on the display mode as described below:

- YT mode: Inter-cursor differential measurement (time measurement)
  Measurements of a maximum value (Max), minimum value (Min), average (Ave), and root-mean-square (RMS) value in an inter-cursor area
- XY mode: Inter-cursor differential measurement
- Fourier mode: Frequency, magnitude, phase
- Bode mode: Frequency, gain, phase
- Area expansion function
  In the area expansion mode, a rectangular area can be selected by dragging the left mouse button within the graph display area. By left-clicking in the selected area, the selected area can be enlarged.

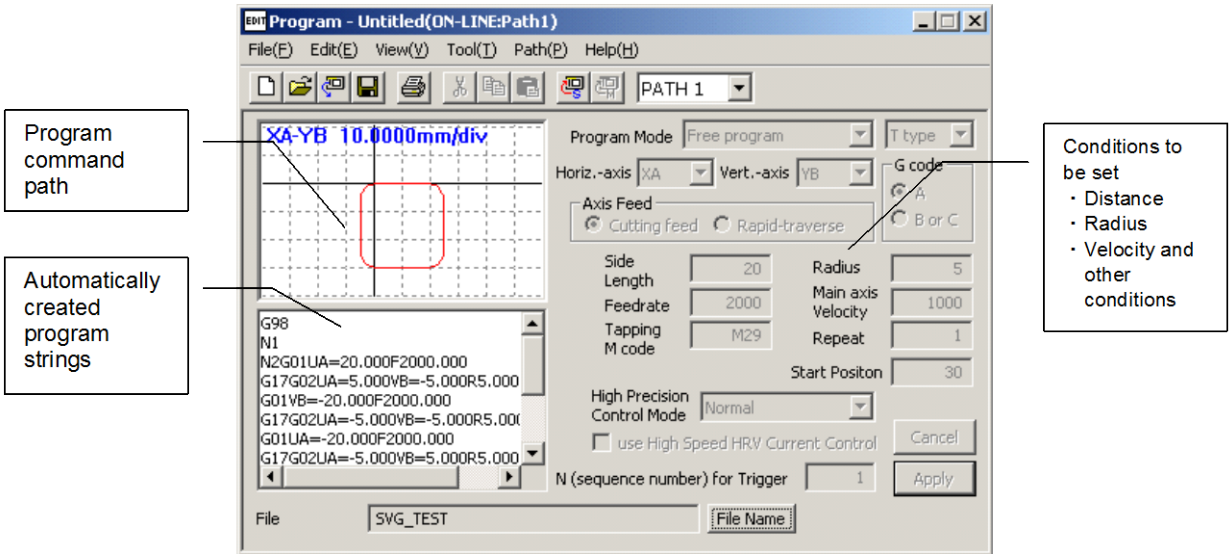


Left-click in a selected rectangular area

(c) Program Window

- Test program creation support function
  - Linear acceleration/deceleration for one axis
  - Arc
  - Square
  - Square with rounded corners
  - Rigid tapping
  - Cs contour
- Display of test program path
- Sending a test program to CNC memory and executing it
  (The operator needs to press the start button.)
- Selecting a program in CNC memory and executing it
  (The operator needs to press the start button.)
- Printing of a created program

* The multipath system is supported by Version 3.00 and subsequent editions.



Program Window (example)

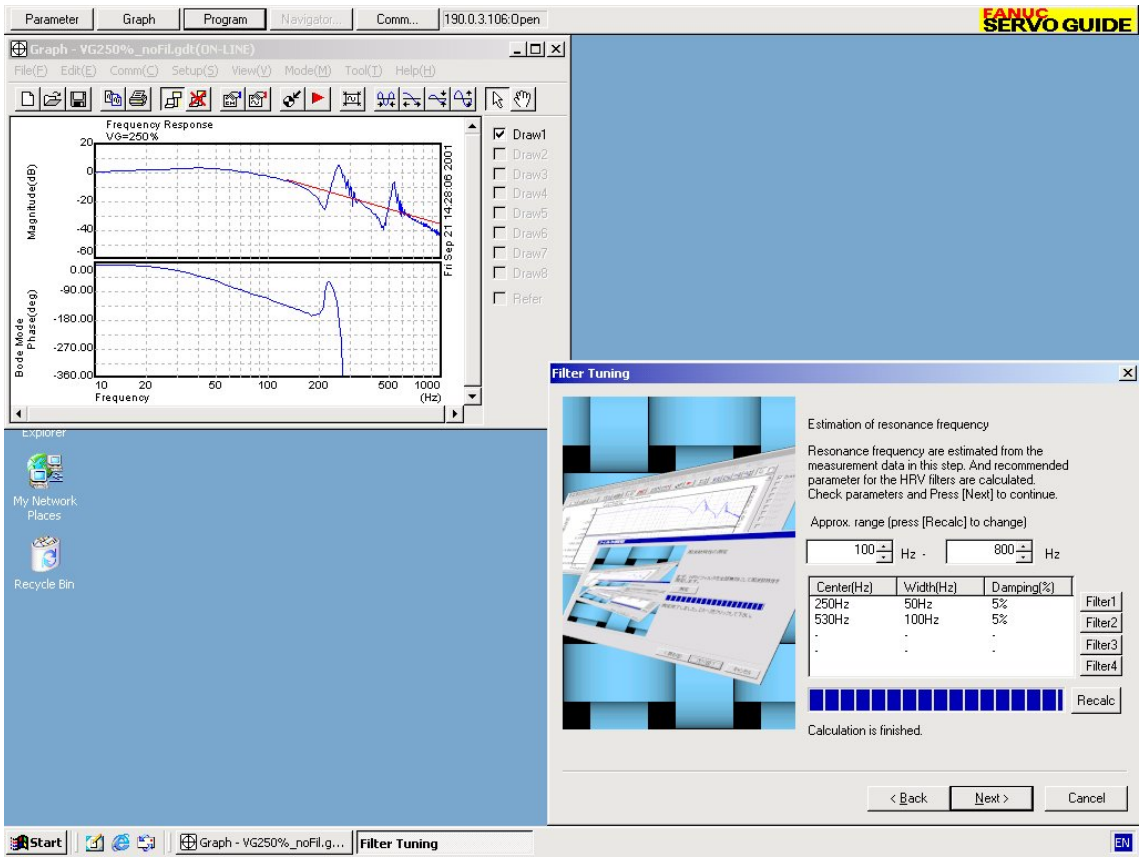
(d) Tuning Navigator

- Automatic tuning functions (servo tuning support functions)
  - Automatic tuning of velocity loop gain and filters
  - Support of high-speed and high-precision function setting
  - Automatic tuning of time constant during rapid traverse
  - Automatic tuning of quadrant protrusion compensation
  - Tuning support of unexpected disturbance torque detection function
  - Tuning support of interactive force compensation function
  - Automatic tuning of spindle filters

NOTE
Some functions cannot be used depending on the version of SERVO GUIDE and the series and editions of the CNC and servo software.

[Automatic tuning of velocity loop gain and filters]

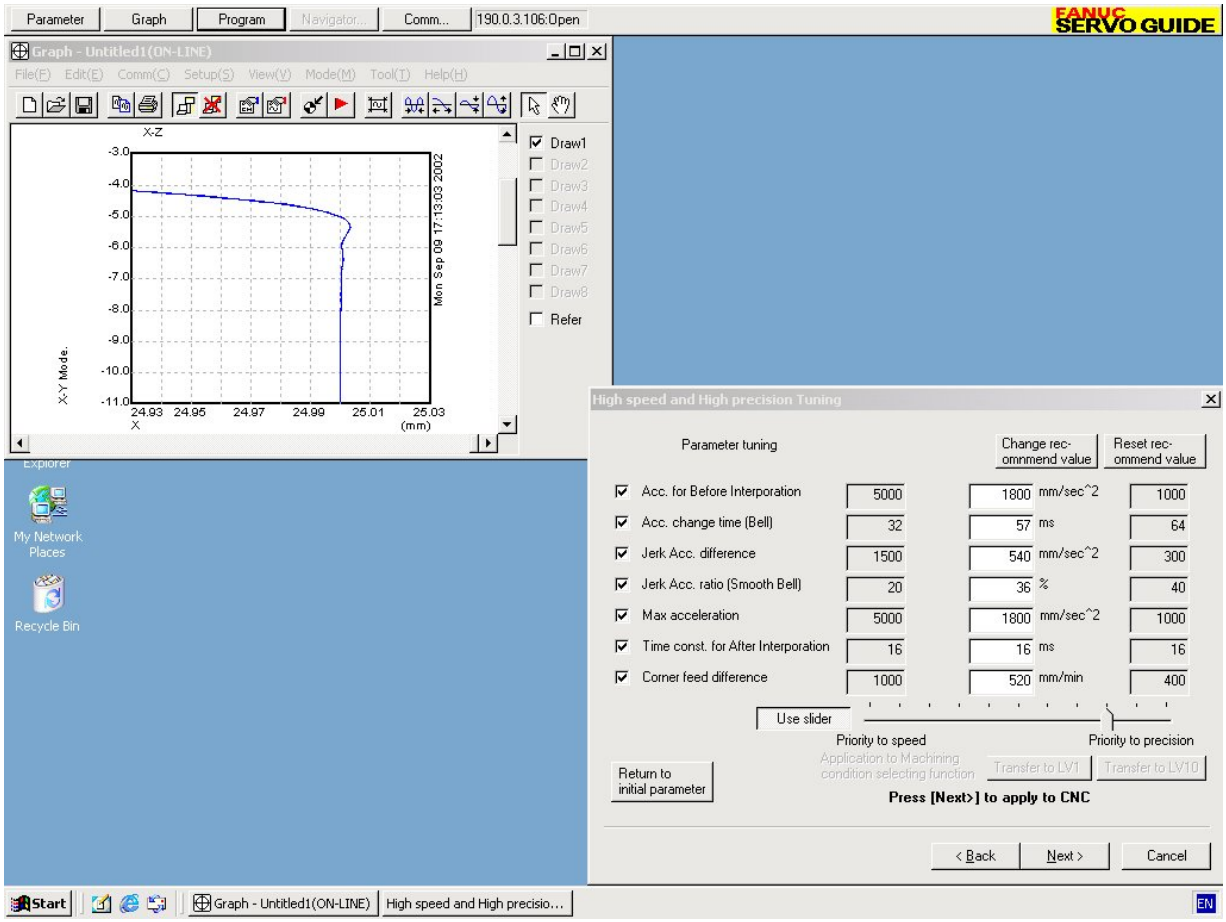
By measuring the frequency response of velocity control loop with moving axis, and the parameters of the velocity loop gain and resonance elimination filters are determined automatically. It is also possible to fine-tune the indicated parameter values and check the effect of the fine-tuning.



Filter adjustment (example)

[Support of high-speed and high-precision function setting]

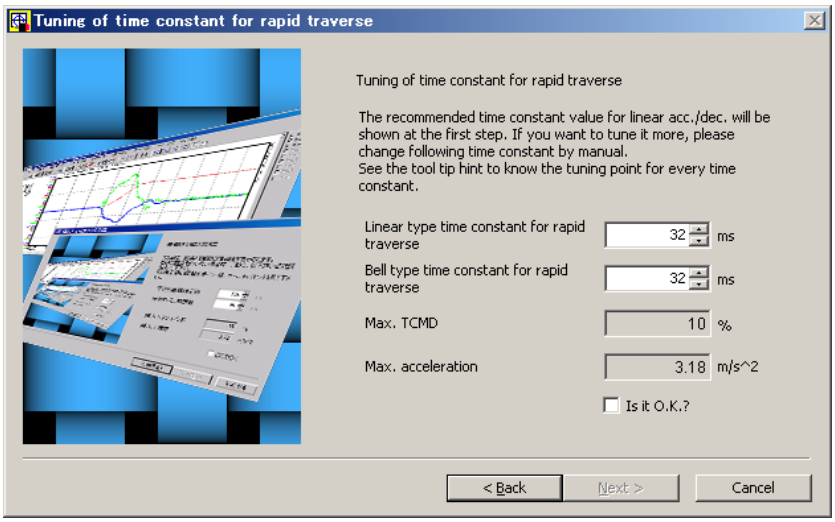
In a program of a square with rounded corners, the high-speed and high-precision function parameters are tuned while overshoots are checked. There are tuning parameters for the high-speed and high-precision function. FANUC provides recommended parameter sets (for speed priority and precision priority), and an intermediate value between recommended parameter values can be selected easily just by using a slider.



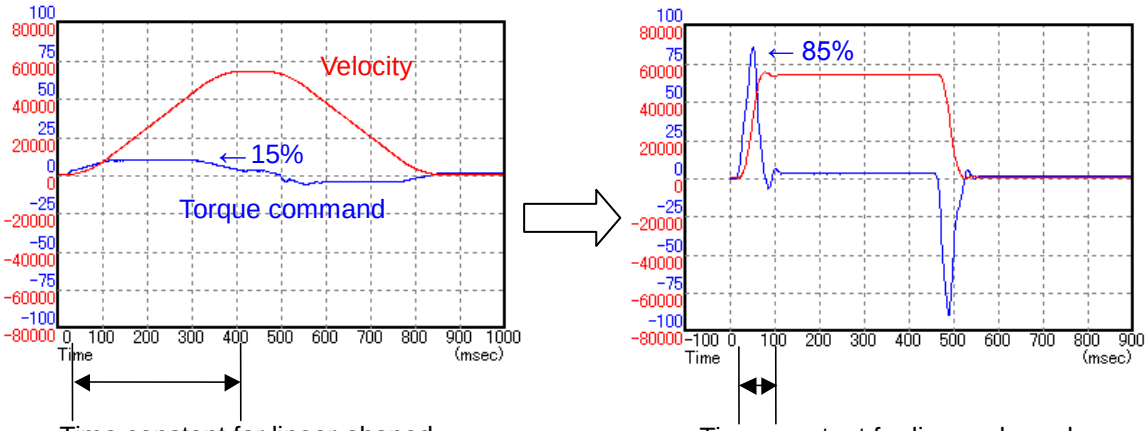
Tuning of the high-speed and high-precision function (example)

[Automatic tuning for time constant at rapid traverse] (Version 4.00 and subsequent editions)

By measuring the velocity and torque while moving the axis at rapid traverse, the rapid traverse time constant is determined automatically. With this function, a rapid traverse time constant can be determined quickly and easily.



Example of tuning



Time constant for linear-shaped acceleration/deceleration: 300 ms
Time constant for bell-shaped acceleration/deceleration: 96 ms

Time constant for linear-shaped acceleration/deceleration: 32 ms
Time constant for bell-shaped acceleration/deceleration: 32 ms

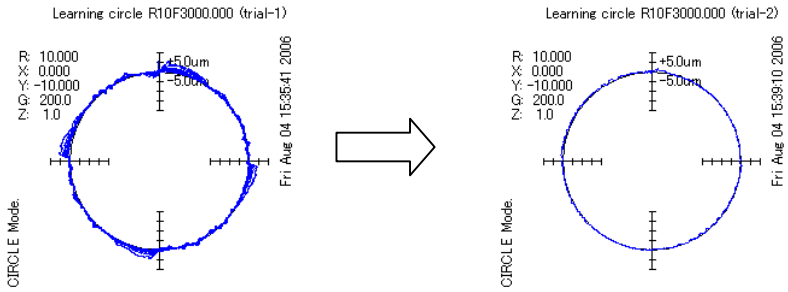
[Automatic tuning of quadrant protrusion compensation] (Version 4.00 and subsequent editions)

By making several circular motions, this function automatically determines the parameters for the quadrant protrusion compensation function for Tuning Navigator. With this function, quadrant protrusion tuning on an arc can be performed quickly and easily.

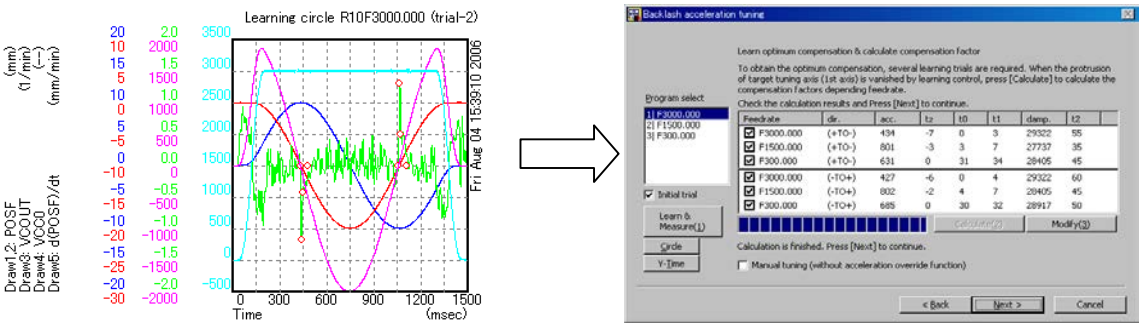
For details, see Appendix M, "QUADRANT PROTRUSION TUNING USING SERVO GUIDE."

Example of tuning

<1> Make circular motions until the quadrant protrusion becomes sufficiently small to let the function learn the optimum compensation.

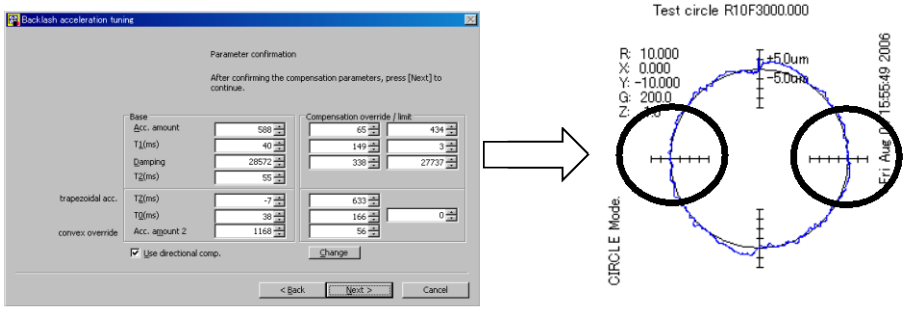


<2> Let the function calculate the compensation based on the result of learning.



<3> Perform steps <1> and <2> at three different feedrates.

<4> Make a circular motion based on the finally determined parameters and check the effect after the application of these parameters.
(Apply the compensation parameters to the horizontal axis.)

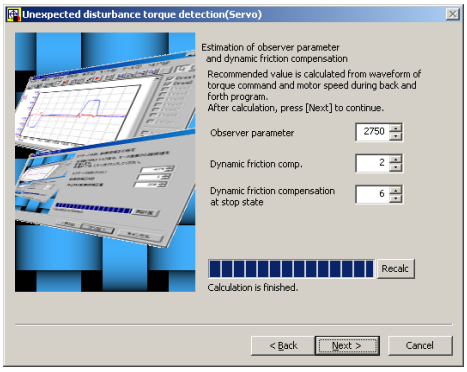


[Tuning support of unexpected disturbance torque detection function] (Version 6.20 and subsequent editions)

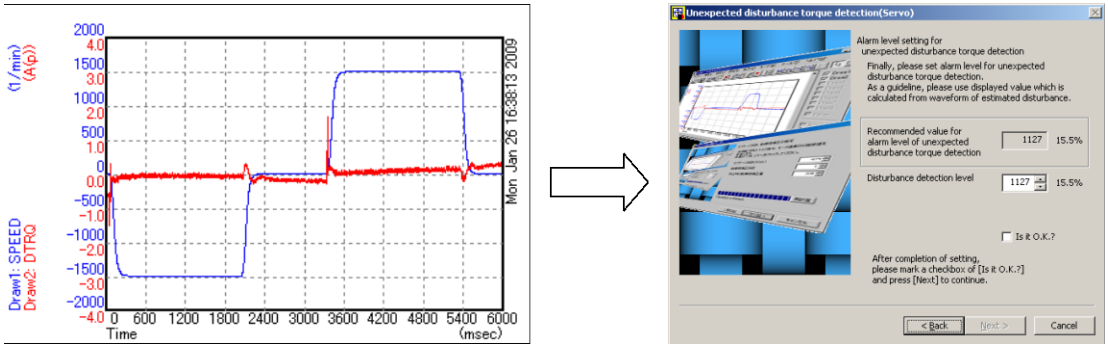
The unexpected disturbance torque detection function monitors the load torque applied to the motor, and if an unexpected disturbance torque is detected, it issues an alarm, and brings the axis to an emergency stop. Tuning Navigator can automatically determine the parameters of the unexpected disturbance torque detection function by estimating the disturbance during back-and-forth acceleration/deceleration operation.

Example of tuning

<1> Let the function automatically calculate the recommended values of the observer gain (POA1), dynamic friction compensation coefficient, and dynamic friction compensation in the stopped state.



<2> Perform back-and-forth acceleration/deceleration operation based on the recommended values and let the function automatically calculate the unexpected disturbance torque detection alarm level.

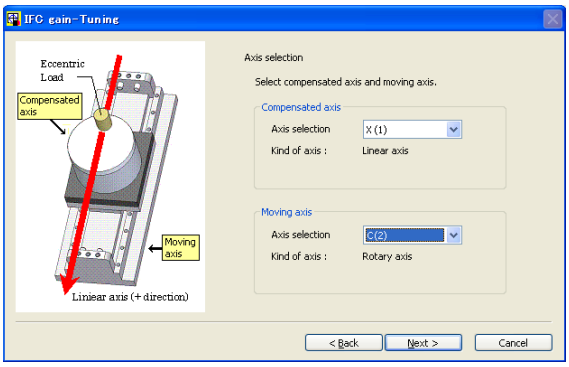


[Tuning support of interactive force compensation function] (Version 6.20 and subsequent editions)

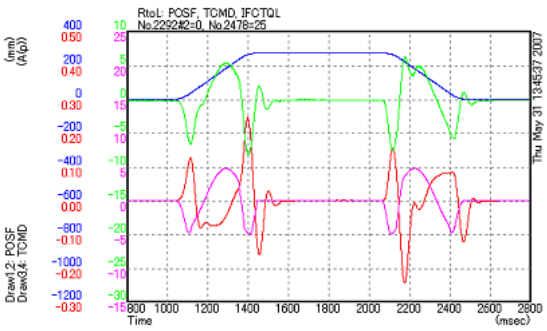
The interactive force compensation function suppresses the effect of the interactive force generated when the rotary axis with eccentric load is moved. Tuning Navigator can automatically determine the parameters of the interactive force compensation function by performing round trip operation on the moving axis and estimating the interactive force acting between the two axes, the compensated and moving axes.

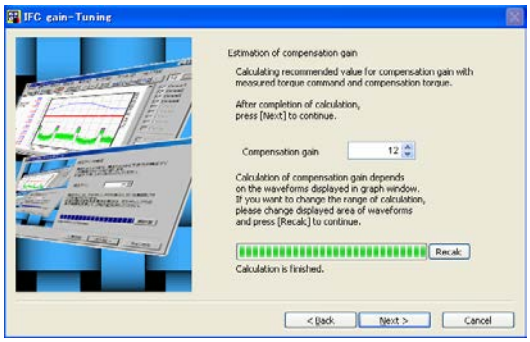
Example of tuning

<1> Select compensated and moving axes.

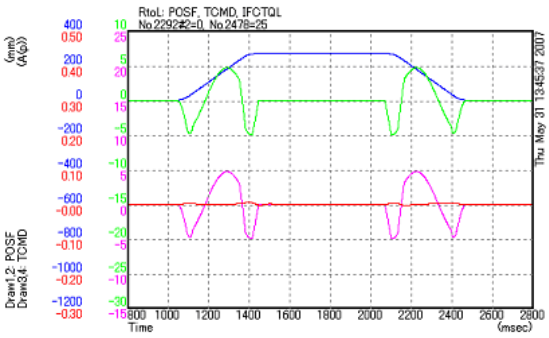


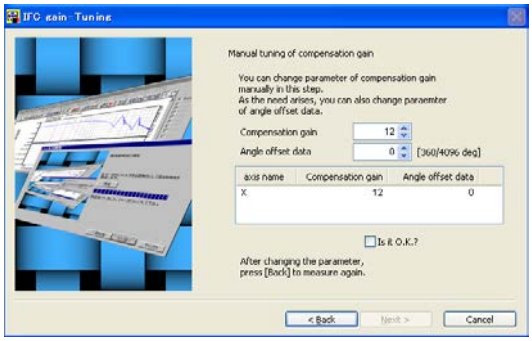
<2> Perform round trip operation on the moving axis and let the function automatically calculate the recommended compensation gain.





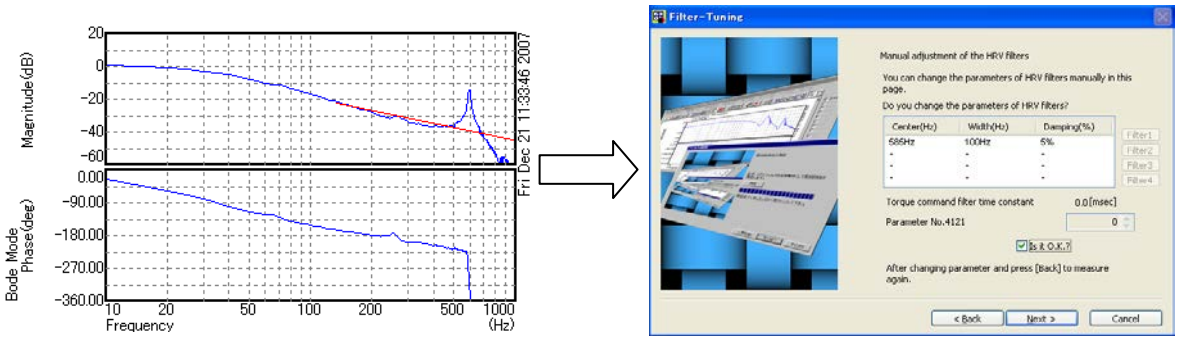
<3> Perform round trip operation based on the recommended gain and determine the optimum compensation gain.





[Automatic tuning of spindle filters] (Version 6.00 and subsequent editions)

This function calculates an ideal frequency response with no resonance based on the frequency characteristics of the velocity loop measured in the velocity control mode, finds the resonation point in comparison with this ideal response, and automatically calculates an optimum filter value.



(4) Outline of the tuning procedure

<1> Set required parameters in the Parameter Window.
<2> Create, send, and execute test programs in the Program Window.
<3> Measure data in the Graph Window.
<4> Repeat steps <1> to <3> while checking graph data for the optimal tuning.

For details on using SERVO GUIDE, refer to "FANUC SERVO GUIDE OPERATOR'S MANUAL (B-65404EN)" or online help after installing the software.

9 DETAILS OF PARAMETERS

This chapter gives details of servo parameters.
For parameters for which no specification method is described, do not change the values automatically set up during servo parameter initialization.

★: Do not change.

	#7	#6	#5	#4	#3	#2	#1	#0
1815			APCx				OPTx	

OPTx (#1) A separate detector is:
0: Not used.
1: Used.

Reference item	Subsection 2.1.2

APCx (#5) An absolute detector is:
0: Not used.
1: Used.

Reference item	Subsection 2.1.2

	#7	#6	#5	#4	#3	#2	#1	#0
1817		TANDEM						

TANDEM (#6) Tandem control (optional function) is:
0: Disabled.
1: Enabled.
Specify this parameter for both the main axis and sub-axis

Reference item	Subsections 2.2.3 and 5.10.4

	#7	#6	#5	#4	#3	#2	#1	#0
2000				PGEX			DGPR	PLC0

PLC0 (#0) The number of velocity pulses and the number of position pulses are internally:
0: Not multiplied by ten.
1: Multiplied by ten.

Reference item	Subsection 2.1.2

DGPR (#1) When power is switched on, the motor-specific standard servo parameter is:
0: Specified.
1: Not specified.

Reference item	Subsection 2.1.2

PGEX (#4) The position gain range is:
0: Not expanded.
1: Expanded by eight times.

	#7	#6	#5	#4	#3	#2	#1	#0
2001	0	AMR6	AMR5	AMR4	AMR3	AMR2	AMR1	AMR0

AMR0 to 6 (#0 to 6) Specify the AMR value according to the Pulsecoder model for the motor.

AMR							
6	5	4	3	2	1	0	
0	0	0	1	0	0	0	16-pole servo motors αiS2000/2000HV, αiS3000/2000HV
0	0	0	0	0	0	0	Other than 16-pole servo motors (8-pole servo motors)

Reference item	Subsections 2.2.4, 3.1.1, and 3.2.1.1

	#7	#6	#5	#4	#3	#2	#1	#0
2002					PFSE			

PFSE (#3) A separate detector is:
0: Not used.
1: Used.
In the 30*i* Series and 0*i* Series, setting bit 1 (OPT) of parameter No. 1815 to 1 automatically specifies this parameter.

	#7	#6	#5	#4	#3	#2	#1	#0
2003	VOFS	OVSC	BLEN	NPSP	PIEN	OBEN	TGAL	

TGAL (#1) The software disconnection alarm detection level is:
0: Standard setting (detected by 1/32rev).
1: Set by a parameter (detected by the value set for parameter No. 2064/32rev).

OBEN (#2) The velocity control observer is:
0: Not used.
1: Used.

PIEN (#3) The velocity control method to be used is:
0: I-P
1: PI

NPSP (#4) The N pulse suppression function is:
0: Not used.
1: Used.

BLEN (#5) Backlash acceleration is:
0: Not used.
1: Used.

Reference item	Subsections 5.5.4 to 5.5.7

OVSC (#6) Overshoot compensation is:
0: Not used.
1: Used.

Reference item	Subsection 5.5.12

VOFS (#7) The VCMD offset is:
0: Not used.
1: Used.

	#7	#6	#5	#4	#3	#2	#1	#0
2004					TRW1	TRW0	TIB0	TIA0

TIA0 (#0), TIB0 (#1), TRW0 (#2), TRW1 (#3) The setting of these bits varies according to the HRV control method.

TRW1	TRW0	TIB0	TIA0	
0	0	1	1	For HRV2, HRV3, HRV4 control

	#7	#6	#5	#4	#3	#2	#1	#0
2005	SFCM	BRKC					FEED	

FEED(#1) Feed-forward is:
0: Not used.
1: Used.

Reference item	Subsections 5.5.1 and 5.5.2

BRKC (#6) The brake control is:
0: Not used.
1: Used.

Reference item	Subsection 5.8.1

SFCM (#7) Static friction compensation is:
0: Not used.
1: Used.

Reference item	Subsection 5.5.10

	#7	#6	#5	#4	#3	#2	#1	#0
2006				ACCF		PKVE		FCBL

FCBL (#0) During full-closed feedback,
the backlash compensation pulse is:
0: Applied to the position.
1: Not applied to the position.

Reference item	Subsections 5.5.4 to 5.5.7

PKVE (#2) Variable speed-dependent current loop gain is:
0: Not used.
1: Used. ★: Do not change.

ACCF (#4) Specifies the amount of velocity feedback data to be used as follows:
0: Velocity feedback for the latest 2 ms.
1: Velocity feedback for the latest 1 ms.

	#7	#6	#5	#4	#3	#2	#1	#0
2007	FRCAXS			VLDALM		SUBDEP	IGNVRO	ESP2AX

ESP2AX (#0) Servo alarm 2-axis simultaneous monitoring is:
0: Not used.
1: Used.

Reference item	Subsections 5.10.1.3 and 5.10.2

IGNVRO (#1) An alarm condition is:
0: Not released two seconds after the servo alarm 2-axes simultaneous monitoring function holds the alarm condition.
1: Released two seconds after the servo alarm 2-axes simultaneous monitoring function holds the alarm condition.

Reference item	Subsection 5.10.1.3

SUBDEP (#2) Separation of the slave axis (set for the master axis) is:
0: Not used.
1: Used.

Reference item	Subsection 5.10.1.4

VLDALM (#4) The tandem speed difference alarm function is:
0: Used.
1: Not used.

Reference item	Subsection 5.10.4.4

FRCAXS (#7) The torque control function is:
0: Not used.
1: Used.

Reference item	Section 5.11

	#7	#6	#5	#4	#3	#2	#1	#0
2008	LAXDMP	PFBSWC	VCMDTM	SPPCHG	SPPRLD	VFBAVE	TNDM	

TNDM (#1) This bit is automatically set to 1 when bit 6 (tandem axis) of parameter No. 1817 is set to 1.
This bit cannot be set directly.

VFBAVE (#2) 1: Enables the velocity feedback average function.
(Usually, set this bit to 1. Set this parameter for the main axis only.)

Reference item	Subsections 5.10.1.4 and 5.10.4.2

SPPRLD (#3) 0: Disables the full-preload function.
1: Enables the full-preload function. (Set this parameter for the main axis only.)

SPPCHG (#4) The motor output torque polarities are as follows:
0: Outputs only the positive polarity to the main axis, and outputs only the negative polarity to the sub-axis.
1: Outputs only the negative polarity to the main axis, and outputs only the positive polarity to the sub-axis.
(Set this parameter for the main axis only.)

VCMDTM (#5) 1: Enables velocity command tandem control.
(Set this parameter for the main axis only.)

Reference item	Subsection 5.10.2

PFBSWC (#6) 1: Switches position feedback according to the direction of a torque command.
(Set this parameter for the main axis only.)

LAXDMP (#7) 0: Enables damping compensation for the sub-axis only.
1: Enables damping compensation with both the main axis and sub-axis.
Usually, set this bit to 1. (Set this parameter for the main axis only.)

Reference item	Subsection 5.10.4.1

	#7	#6	#5	#4	#3	#2	#1	#0
2009	BLST	BLCU		ANALOG				DMY

DMY (#0) Dummy serial feedback is:
0: Not used.
1: Used.

Reference item	Appendix H.1

ANALOG (#4) The analog servo interface is:
0: Not used.
1: Used.

Reference item	Appendix A

BLCU (#6) Backlash acceleration is:
0: Not enabled during cutting.
1: Enabled only during cutting.

Reference item	Subsections 5.5.4 to 5.5.7

BLST (#7) The backlash acceleration stop function is:
0: Not used.
1: Used.

Reference item	Subsections 5.5.4 to 5.5.7

	#7	#6	#5	#4	#3	#2	#1	#0
2010	POLE		HBBL	HBPE	BLTE	LINEAR		

LINEAR (#2) Linear motor control is:
0: Not performed.
1: Performed.
This bit is set automatically when the parameters of the linear motor are initialized. Check that this bit is set before the linear motor is driven.
When using a set of a non-binary detector and DD motor position detection circuit, set LINEAR to 1.

Reference item	Subsections 3.1.1 and 3.2.2

BLTE (#3) The function to multiply the backlash acceleration amount by 10 is:
0: Disabled.
1: Enabled.

HBPE (#4) When the dual position feedback function is used, a pitch error compensation is added to the error counter of:
0: Full-closed loop. ← Standard setting
1: Semi-closed loop.
* In the 30*i*-B Series, when dual position feedback is enabled, pitch error compensation is added to the error counters of both the full- and semi-closed loop systems regardless of whether this bit is set to 0 or 1. A backlash compensation value is added as usual, however.

Reference item	Subsection 5.4.8

HBBL (#5) When the dual position feedback function is used, a backlash compensation value is added to the error counter of:
0: Semi-closed loop. ←Standard setting
1: Full-closed loop.

Reference item	Subsection 5.4.8

POLE (#7) The punch/laser switching function is:
0: Not used.
1: Used.

	#7	#6	#5	#4	#3	#2	#1	#0
2011	TMPABS		RCCL				FFAL	EGB

EGB (#0) The EGB is:
0: Not used.
1: Used.

FFAL (#1) Feed-forward control is:
1: Enabled in all modes.

Reference item	Subsection 5.5.1

RCCL (#5) The actual variable current torque limit is:
0: Not used.
1: Used. ★: Do not change.

TMPABS (#7) Temporary absolute coordination setting is:
0: Not used.
1: Used.

	#7	#6	#5	#4	#3	#2	#1	#0
2012	STNG		VCM2	VCM1			MSFE	

MSFE (#1) The machine speed feedback is:
0: Not used.
1: Used.

Reference item	Subsections 4.3.5 and 5.4.9

VCM1 (#4) Switches the VCMD waveform signal conversion on the check board.
VCM2 (#5) Switches the VCMD waveform conversion value according to the following list:
For rotary type motor

VCM2	VCM1	Motor rotation speed/5 V
0	0	0.9155 min^{-1}
0	1	14 min^{-1}
1	0	234 min^{-1}
1	1	3,750 min^{-1}

For linear motor (P in the table below represents a scale signal pitch [μm].)

VCM2	VCM1	Motor rotation speed/5 V
0	0	0.00375 × P m/min
0	1	0.06 × P m/min
1	0	0.96 × P m/min
1	1	15.36 × P m/min

Reference item	Appendix F

STNG (#7) In velocity command mode, a software disconnection alarm is:
0: Detected.
1: Ignored.

	#7	#6	#5	#4	#3	#2	#1	#0
2013	APTG							HR3

HR3 (#0) HRV3 current control is:
0: Not used.
1: Used.

Reference item	Subsection 5.1.2

APTG (#7) The αPulsecoder software disconnection monitor is:
0: Not ignored.
1: Ignored.

Reference item	Section 4.2

	#7	#6	#5	#4	#3	#2	#1	#0
2014			SPF					HR4

HR4 (#0) HRV4 current control is:
0: Not used.
1: Used.

Reference item	Subsection 5.1.3

SPF (#5) The servo motor torque characteristic is used for:
0: Feed axis control.
1: Spindle control.
* When spindle control is selected, the current value (%) on the servo tuning screen is displayed in the load meter mode.

	#7	#6	#5	#4	#3	#2	#1	#0
2015	BZNG	BLAT	TDOUT				SSG1	PGTW

PGTW (#0) The position gain switching function is:
0: Not used.
1: Used.

Reference item	Subsection 5.7.1

SSG1 (#1) Low-speed integral is:
0: Not used.
1: Used.

Reference item	Subsection 5.7.2

TDOUT (#5) Switches the check board output data as follows:
0 : TCMD
1: Estimated load torque

Reference item	Appendix F

BLAT (#6) Two-stage backlash acceleration is:
0: Not used.
1: Used.

Reference item	Subsection 5.5.5

BZNG (#7) When a separate detector is used, the battery alarm for the built-in Pulsecoder is:
0: Ignored.
1: Not ignored.

	#7	#6	#5	#4	#3	#2	#1	#0
2016					PK2VDN			ABNT

ABNT (#0) The unexpected disturbance torque detection function (option) is:
0: Not used.
1: Used.

Reference item	Subsection 5.9.1

PK2VDN (#3) The variable proportional gain in the stop state is:
0: Not used.
1: Used.

Reference item	Subsection 5.3.3

	#7	#6	#5	#4	#3	#2	#1	#0
2017	PK2V25		RISCFF	HTNG	COMSRC			DBST

DBST (#0) The quick stop type 1 at emergency stop is:
0: Not used.
1: Used.

Reference item	Subsection 5.8.3

COMSRC(#3) The detector on the semi-closed side is:
0: Automatically identified.
1: α*i*/β*i* Pulsecoder at all times.

Reference item	Subsection 2.1.7

HTNG (#4) In velocity command mode, the hardware disconnection alarm of a separate detector is:
0: Detected.
1: Ignored.

RISCFF (#5) 0: Feed-forward response characteristics remain unchanged when RISC is used.
1: Feed-forward response characteristics are improved when RISC is used.

Reference item	Appendix G.2

PK2V25 (#7) Velocity loop high cycle management is:
0: Not used.
1: Used.

Reference item	Subsection 5.3.1

	#7	#6	#5	#4	#3	#2	#1	#0
2018	PFBCPY					OVR8	MOVOBS	RVRSE

RVRSE(#0) The signal direction of the separate detector is:
0: Not reversed.
1: Reversed.

Reference item	Subsection 2.1.2 and Section 4.2

MOVOBS (#1) The disable function for observer in the stop state is:
0: Not used.
1: Used.

OVR8 (#2) The stage-2 acceleration amount override format is on the basis of:
0: 4096.
1: 256.

Reference item	Subsection 5.5.5

PFBCPY (#7) 1: The motor feedback signal for the main axis is shared by the sub-axis.

(Set this parameter for the sub-axis only.)

Reference item	Subsections 2.2.3 and 5.10.4.3

	#7	#6	#5	#4	#3	#2	#1	#0
2019	DPFB						TANDMP	

TANDMP (#1) Tandem disturbance elimination control (optional function) is:
0: Not used.
1: Used.

Reference item	Subsection 5.10.1.4 and 5.10.4.3

DPFB (#7) The dual position feedback (optional function) is:
0: Not used.
1: Used.

Reference item	Subsection 5.4.8

	#7	#6	#5	#4	#3	#2	#1	#0
2200		P2EX	RISCMC		ABG0	IQOB	FULLCP	OVSP

OVSP (#0) A feedback mismatch alarm is:
0: Detected.
1: Not detected.

FULLCP (#2) 1: A separate position feedback is shared by the master and slave axes. (Set this parameter for the sub-axis only.)

Reference item	Subsection 5.10.1.6

IQOB (#2) 1: Eliminates the effect of voltage saturation on unexpected disturbance torque detection.

Reference item	Subsection 5.9.1

ABG0 (#3) 1: When an unexpected disturbance torque is detected, a threshold is set separately for cutting/rapid traverse.

Reference item	Subsection 5.9.2

RISCMC (#5) When a RISC processor is used:
0: The response to a positioning command is the same as before.
1: The response to a positioning command is improved.

Reference item	Appendix G.2

P2EX(#6) The velocity loop proportional gain (PK2V) format is:
0: Standard format.
1: Converted format.

Reference item	Supplementary in Subsection 2.1.6, Subsection 5, 3.1.1(7)

	#7	#6	#5	#4	#3	#2	#1	#0
2201		CPEE					RNLV	CROFS

CROFS (#0) The function for obtaining current offsets upon an emergency stop is:
0: Not used.
1: Used.

Reference item	Section 5.14

RNLV (#1) Specifies the detection level for the feedback mismatch alarm as follows:
0: 600 min^{-1}
1: 1,000 min^{-1}

CPEE (#6) The actual current display peak hold function is:
0: Not used.
1: Used.

Reference item	Subsection 4.1.3

	#7	#6	#5	#4	#3	#2	#1	#0
2202				DUAL0W	OVS1	PIAL	VGCCR	

VGCCR (#1) The cutting/rapid velocity loop gain switching function is:
0: Not used.
1: Used.

Reference item	Section 5.2 and Subsection 5.3.4

PIAL (#2) When rapid traverse is selected by the cutting/rapid velocity loop gain switching function, the 1/2 PI control is:
0: Automatically disabled.
1: Always enabled.

Reference item	Subsection 5.3.4

OVS1 (#3) 1: Overshoot compensation is valid only once after the termination of a move command.

Reference item	Subsection 5.5.12

DUAL0W (#4) For zero-width judgment:
0: Semi-full error only is used.
1: Both a position error and semi-full error are used.

Reference item	Subsection 5.4.8

	#7	#6	#5	#4	#3	#2	#1	#0
2203			TCMD4X	FRCAX2	VFFINE	CRPI		

CRPI (#2) The current loop 1/2 PI control is:
0: Not used.
1: Used.

Reference item	Subsection 5.3.4

VFFINE (#3) The precision of the velocity feed-forward coefficient is:
0: As usual.
1: Improved by a factor of 16.
With the improvement of the precision, an overflow may occur with one-sixteenth the current setting. If an overflow occurs, return the setting to 0.

FRCAX2 (#4) Torque control type 2 is:
0: Not performed.
1: Performed.

Reference item	Section 5.11

TCMD4X (#5) The check board output voltage of the TCMD signal is:
0: Ordinary (default).
1: Multiplied by 4.

Reference item	Appendix F

	#7	#6	#5	#4	#3	#2	#1	#0
2204	DBS2		PGTWN2				HSTP10	

HSTP10(#1) The valid speed increment system for the high-speed positioning function is:
0: 0.01 mm^{-1} (rotary motor), 0.01 mm/min (linear motor).
1: 0.1 mm^{-1} (rotary motor), 0.1 mm/min (linear motor).

Reference item	Subsection 5.7.1

PGTWN2 (#5) The position gain switching type 2 is:
0: Not used.
1: Used.

Reference item	Subsection 5.7.1

DBS2 (#7) The quick stop function type 2 at emergency stop is:
0: Not used.
1: Used.

Reference item	Subsection 5.8.4

	#7	#6	#5	#4	#3	#2	#1	#0
2205				HDIS	HD2O	FULDMY		

FULDMY (#2) The dummy separate detector is:
0: Not used.
1: Used.

Reference item	Appendix H.1

HD2O (#3) The quick stop function for hardware disconnection of a separate detector is:
0: Not applied to axes under synchronous control.
1: Applied to axes under synchronous control.

Reference item	Subsections 5.8.6 and 5.8.7

HDIS (#4) The quick stop function for hardware disconnection of a separate detector is:

0: Disabled.
1: Enabled.
* For the 30*i*-B Series and Power Motion *i*-A, when bit 4 of parameter No. 2205 or bit 5 of parameter No. 2282 is set, the quick stop function for separate detector alarms is enabled.

Setting	Alarms to which the quick stop function applies	
	FS30*i*-A,0*i*-D	FS30*i*-B, Power Motion *i*-A
No.2205#4=1	Hardware disconnection of the phase A/B detector	Hardware disconnection of the phase A/B detector or separate serial detector alarm
No.2282#5=1	Separate serial detector alarm	

Reference item	Subsection 5.8.6

	#7	#6	#5	#4	#3	#2	#1	#0
2206				HBSF				

HBSF (#4) The backlash compensation value and pitch error compensation value are added:

0: Selectively according to conventional parameter No. 2010.
1: Simultaneously for the full-closed and semi-closed sides.

If this parameter is set to 1 (enabled), the settings of bits 5 and 4 of parameter No. 2010 are ignored.

* In the 30*i*-B Series, when dual position feedback is enabled, pitch error compensation is added to the error counters of both the full- and semi-closed loop systems regardless of whether this bit is set to 0 or 1. A backlash compensation value is added as usual, however.

Reference item	Subsection 5.4.8

	#7	#6	#5	#4	#3	#2	#1	#0
2207					PK2D50			NEGSHC

NEGSHC (#0) Overcurrent alarm (software) is:

0: Not ignored.
1: Ignored.

> ⚠ **CAUTION**
> If the emergency stop state is released without connecting the power line in a test such as a test for machine start-up, the overcurrent alarm detected by the servo control software may be issued. In such a case, the alarm can be avoided temporarily by setting this bit parameter to 1.
> However, be sure to return the bit parameter to 0 before starting up in the normal operation state after completion of a test.

Reference item	Section 4.2

PK2D50 (#3) The variable proportional gain in the stop state is:

0: 75% lower.
1: 50% lower.

Reference item	Subsection 5.3.3

	#7	#6	#5	#4	#3	#2	#1	#0
2208	TQMNT							

TQMNT (#7) Fine torque sensing data is:
0: Estimated disturbance value
1 : TCMD
For details of fine torque sensing data, refer to the description of the window function in a PMC programming manual (including B-64513EN).

	#7	#6	#5	#4	#3	#2	#1	#0
2209				HCNGL				

HCNGL (#4) 0: The overcurrent alarm avoidance based on amplifier hardware is disabled.
1: The overcurrent alarm avoidance based on amplifier hardware is enabled.

NOTE
- If an abnormal level of current that causes the overcurrent alarm to be issued is detected momentarily, processing is performed to suppress the level of current without issuing the alarm.
- Even if this function is used, the overcurrent alarm is issued in the following cases:
  - When a complete short circuit occurs, or
  - When the processing above for suppressing the level of current is continuously performed.

	#7	#6	#5	#4	#3	#2	#1	#0
2210		ESPTM1	ESPTM0			PK12S2		

PK12S2 (#2) The current gain internally 4 times function is:
0: Not used.
1: Used.

ESPTM0(#5) Set the timer built into the αi amplifier to delay emergency stop.
ESPTM1(#6)

ESPTM1	ESPTM0	Delay time
0	0	50 ms (default)
0	1	100 ms
1	0	200 ms
1	1	400 ms

Reference item	Section 5.8

	#7	#6	#5	#4	#3	#2	#1	#0
2211	PLW4	PLW2					PHCP	

PHCP (#1) The phase lag compensation during deceleration is:
0: Not used.
1: Used.

PLW2 (#6) A motor with two windings is:
0: Not used.
1: Used.
PLW4 (#7) A motor with four windings is:
0: Not used.
1: Used.

Reference item	Subsections 2.2.2 and 5.10.2

	#7	#6	#5	#4	#3	#2	#1	#0
2212	OVQK							

OVQK(#7) Specifies whether to enable the quick stop function upon the OVC and OVL alarms as follows:
0: Not used.
1: Used.

Reference item	Subsection 5.8.8

	#7	#6	#5	#4	#3	#2	#1	#0
2213	OCM				PK1VDN			

PK1VDN (#3) The variable integral gain in the stop state is:
0: Disabled.
1: Enabled.
The variable integral gain in the stop state is used when decreasing not only the proportional gain, but also the integral gain, which can suppress the vibration in the stopped state more efficiently.

OCM (#7) Pole position detection (optional function) is:
0: Disabled.
1: Enabled.

Reference item	Subsection 3.2.1.2

	#7	#6	#5	#4	#3	#2	#1	#0
2214				FFCHG				

FFCHG (#4) The cutting/rapid feed-forward switching function is:
0: Not used.
1: Used.

Reference item	Section 5.2 and Subsection 5.5.2

	#7	#6	#5	#4	#3	#2	#1	#0
2215	ABT2						TCPCLR	PK1D50

PK1D50 (# 0) The magnification in the stopped state for the variable integral gain in the stop state is:
0 : 75%
1 : 50%

TCPCLR (#1) The function for setting a value for canceling the torque offset at an emergency stop in the velocity loop integrator is:
0: Disabled.
1: Enabled.

Reference item	Subsections 5.9.1 and 5.10.1.2

ABT2 (#7) The cutting/rapid unexpected disturbance torque detection function type 2 is:
0: Disabled.
1: Enabled.

Reference item	Subsection 5.9.2

	#7	#6	#5	#4	#3	#2	#1	#0
2216								SMTBKL

SMTBKL (# 0) Smart backlash compensation (semi-closed) is:
0: Disabled.
1: Enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
2220			P16					DECAMR

DECAMR(#0) A non-binary detector is:
0: Not used.
1: Used.

Reference item	Subsection 3.2.1.1

P16(#5) 16-pole servo motor is:
0: Not used.
1: Used.

Reference item	Subsection 2.2.4

	#7	#6	#5	#4	#3	#2	#1	#0
2221	ASYCS	QNOTCH	AMREX			VFFNCH	LNOTCH	

LNOTCH(#1)
0: Uses resonance elimination filter 4.
1: Uses resonance elimination filter L.

Reference item	Subsections 5.4.3 and 5.4.4

VFFNCH(#2) Resonance elimination filter L is applied to:
0: Feed-forward part only of the velocity command.
1: Entire velocity command.

Reference item	Subsection 5.4.4

AMREX(#5) AMR conversion coefficient 1 (parameter No. 2112) is set to:
0: The usual value.
1: One-sixteenth the usual value.

QNOTCH(#6) The specification of resonance elimination filter 4 is:
0: Standard specification.
1: Frequency extended specification.

Extended valid data range of the attenuation center frequency of resonance elimination filter 4

	HRV1, HRV2	HRV3	HRV4
Setting range of attenuation center frequency No. 2366 (No. 2221#6 = 0)	96–1,000	96–2,000	96–4,000
Setting range of attenuation center frequency No. 2366 (No. 2221#6 = 1)	96–2,000	96–4,000	96–4,000

Reference item	Subsection 5.4.3

(Power-off parameter)

ASYCS(#7) The coupling signal for the synchronous axes automatic compensation is:
0: Disabled.
1: Enabled.

Reference item	Subsection 5.10.1.5

	#7	#6	#5	#4	#3	#2	#1	#0
2223	BLCUT2	SLTMAS	SLTAN					DISOBS

DISOBS (#0) The disturbance elimination filter is:
0: Not used.
1: Used.

Reference item	Subsection 5.4.5

SLTAN (#5) Multi-axis tandem is:
0: Not used.
1: Used.

Reference item	Section 10.2

SLTMAS (#6) In a multiaxis tandem system, this axis is used as the:
0: Slave axis.
1: Master axis.

Reference item	Subsection 5.10.2

BLCUT2 (#7) Backlash acceleration is:
0: Enabled for both cutting feed and rapid traverse.
1: Enabled only for cutting feed.

Reference item	Subsections 5.5.4 and 5.5.5

	#7	#6	#5	#4	#3	#2	#1	#0
2225						TSA05	TCMD05	

TCMD05 (#1) The check board output voltage of the TCMD signal is:
0: Ordinary (default).
1: Halved.

Reference item	Appendix F

TSA05 (#2) The check board output voltage of the SPEED signal is:
0: Ordinary (default).
1: Halved (7,500 min^{-1}/5 V).

Reference item	Appendix F

	#7	#6	#5	#4	#3	#2	#1	#0
2228					ELSAL			

ELSAL(#3) In pole detection, the motor saliency is:
0 : Lq>Ld
1 : Lq<Ld

	#7	#6	#5	#4	#3	#2	#1	#0
2229				FORME	WATRA			ABSEN

ABSEN(#0) In pole detection, the AMR offset is:
0: Not used.
1: Used.

Reference item	Subsection 3.2.1.2

WATRA(#3) After pole detection, abnormal operation is:
0: Monitored.
1: Not monitored.

Reference item	Subsection 3.2.1.2

FORME(#4) The operation mode for pole detection is:
0: Automatic selection mode.
1: Minute operation mode.

Reference item	Subsection 3.2.1.2

	#7	#6	#5	#4	#3	#2	#1	#0
2270	DSTIN	DSTTAN	DSTWAV		ACREF			AMR60

AMR60 (#0) The valid setting range of the AMR offset is from:
0: −45 degrees to +45 degrees.
1: −60 degrees to +60 degrees.

Reference item	Subsection 3.1.1

ACREF (#0) The adaptive resonance elimination filter is:
0: Disabled.
1: Enabled.

Reference item	Subsection 3.1.1

DSTWAV (#5) The input waveform of disturbance input is:
0: Sine wave. (Usually, select sine wave.)
1: Square wave.

Reference item	Subsection 5.10.1.4

DSTTAN (#6) Disturbance is:
0: Input for one axis only.
1: Input for both the L and M axes.
(To be set only for the L-axis side of synchronous axes or tandem axes).

Reference item	Subsection 5.10.1.4

DSTIN (#7) The disturbance input function is:
0: Not used.
1: Used.

Reference item	Subsection 5.10.1.4

	#7	#6	#5	#4	#3	#2	#1	#0
2271			2NDTMG			RETR2		

RETR2 (#2) When an unexpected disturbance torque is detected, the simultaneous two-axis retract function is:
0: Not used.
1: Used.

Reference item	Subsection 5.9.1

2NDTMG (#5) The second stage acceleration type 2 for two-stage backlash acceleration is:
0: Not used.
1: Used.

Reference item	Subsection 5.5.5

	#7	#6	#5	#4	#3	#2	#1	#0
2273	DBTLIM	EGBFFG	EGBEX	POA1NG			WSVCPY	

WSVCPY (#1) The velocity loop integrator of the master axis is:
0: Not copied to the slave axis.
1: Copied to the slave axis.

Reference item	Section 5.10

POA1NG (#4) In the calculation of the observer coefficient (POA1), the load inertia ratio (LDINT) is:
0: Considered.
1: Not considered.

EGBEX (#5) The EGB automatic phase matching function is:
0: In the normal mode (deceleration not performed between the master and detector).
1: In the extended mode (deceleration performed between the master and detector).

EGBFFG(#6) FFG is:
0: Not considered in the EGB ratio.
1: Considered in the EGB ratio.

DBTLIM (#7) Torque limit setting during brake control is:
0: Disabled.
1: Enabled.

Reference item	Subsection 5.8.2

	#7	#6	#5	#4	#3	#2	#1	#0
2274		DD2048						HP2048

HP2048 (#0) A 2048-time interpolation circuit (position detection circuit H or C) is:
0: Not used.
1: Used.

DD2048(#0) In the D*i*S motor, bit HP2048 is:
0: Disabled.
1: Enabled.

(Interpolation magnification to be assumed for setting parameters)

No.2274#6 (DD2048)	No.2274#0 (HP2048)	Interpolation magnification when a position detection circuit is used	
		D*i*S motor	L*i*S motor
0	0	×2,048	×2,048
0	1		×512
1	1	×512	

Reference item	Subsections 2.1.4.1, 3.1.1, and 3.2.1

	#7	#6	#5	#4	#3	#2	#1	#0
2275	UNDCN				ASYN		RCNCLR	800PLS

800PLS (#0) When the RCN723 or RCN223 is used, the reference counter setting is made in reference to:
0: 1/8 turn of the detector.
1: 1 turn of the detector.

Reference item	Subsection 2.1.4.1

RCNCLR (#1) The multi-turn data is:
0: Not cleared.
1: Cleared.
(To use the RCN223 or RCN723, set it to 1.)

Reference item	Subsection 2.1.4.1
Related parameter	No.2394

ASYN (#3) Synchronous axes automatic compensation is:
0: Not used.
1: Used.

Reference item	Subsection 5.10.1.5

UNDCN (#7) In the event of an unexpected disturbance torque detection alarm, the retrace distance during cutting is:
0: No. 2103.
1: 0 (The tool is not retracted and stops at the point where the unexpected disturbance torque alarm is detected).

Reference item	Subsection 5.9.1

	#7	#6	#5	#4	#3	#2	#1	#0
2277	ACC1ON	ACC2ON	ACC3ON	ACCNEG				

ACCNEG(#4) The sign of acceleration feedback is:
0: Not inverted.
1: Inverted.

Reference item	Subsection 2.1.4.4

ACC3ON(#5) Acceleration feedback in the third direction is:
0: Disabled.
1: Enabled.

Reference item	Subsection 2.1.4.4

ACC2ON(#6) Acceleration feedback in the second direction is:
0: Disabled.
1: Enabled.

Reference item	Subsection 2.1.4.4

ACC1ON(#7) Acceleration feedback in the first direction is:
0: Disabled.
1: Enabled.

Reference item	Subsection 2.1.4.4

	#7	#6	#5	#4	#3	#2	#1	#0
2278				PM2ACC	PM2SCB	PM1SCB	PM2TP	PM1TP

PM1TP(#0) With an odd-numbered separate detector interface unit, such as the first and third, the temperature detection circuit is:
0: Not used.
1: Used.

Reference item	Subsection 2.1.4.4

PM2TP(#1) With an even-numbered separate detector interface unit, such as the second and fourth, the temperature detection circuit is:
0: Not used.
1: Used.

Reference item	Subsection 2.1.4.4

PM1SCB(#2) An odd-numbered servo check interface unit, such as the first and third, is:
0: Not used.
1: Used.

Reference item	Appendix F

PM2SCB(#3) An even-numbered servo check interface unit, such as the second and fourth, is:
0: Not used.
1: Used.

Reference item	Appendix F

PM2ACC(#4) Acceleration sensor data is:

0: Taken from an odd-numbered separate detector interface unit, such as the first and third as counted from the CNC, or no acceleration sensor is used.

1: Taken from an even-numbered separate detector interface unit, such as the second and fourth as counted from the CNC.

Reference item	Subsection 2.1.4.4

	#7	#6	#5	#4	#3	#2	#1	#0
2279								DMCON

DMCON(#0) In emergency stop cancellation with the dummy enabled,

0: The ready signal is not output.

1: The ready signal is output.

Reference item	Appendix H.2

	#7	#6	#5	#4	#3	#2	#1	#0
2281						RDPRR	RDPMU2	RDPMU1

RDPMU1(#0) Internal unit for power consumption monitoring

RDPMU2(#1) Internal unit for power consumption monitoring

Maximum motor output	RDPMU2	RDPMU1
300 kW –	0	0
30 kW – 300 kW	0	1
3 kW – 30 kW	1	0
– 3 kW	1	1

RDPRR(#2) The type of regeneration used for a servo amplifier for power consumption monitoring is:

0: Electric power regeneration.

1: Resistance regeneration.

	#7	#6	#5	#4	#3	#2	#1	#0
2282			FSAQS					

FSAQS(#5) The quick stop function for separate serial detector alarms is:

0: Disabled.

1: Enabled.

* For the 30*i*-B Series and Power Motion *i*-A, when bit 4 of parameter No. 2205 or bit 5 of parameter No. 2282 is set, the quick stop function for separate detector alarms is enabled.

Setting	Alarms to which the quick stop function applies	
	FS30*i*-A,0*i*-D	FS30*i*-B, Power Motion *i*-A
No.2205#4=1	Hardware disconnection of the phase A/B detector	Hardware disconnection of the phase A/B detector or separate serial detector alarm
No.2282#5=1	Separate serial detector alarm	

Reference item	Subsection 5.8.7

	#7	#6	#5	#4	#3	#2	#1	#0
2283	BLSTP2							NOG54

NOG54(#0) High-speed HRV current control mode (servo HRV3 control) is:

0: Used only when both G5.4Q1 and G01 are specified.

1: Used when G01 is specified. (G5.4Q1 is not monitored.)

NOTE

This function can be used when servo HRV3 control is used.
This function cannot be used when servo HRV4 control is used.

Reference item	Subsection 5.1.3

BLSTP2(#7) The function for disabling backlash acceleration after a stop is:
0: Not used.
1: Used.

	#7	#6	#5	#4	#3	#2	#1	#0
2285		TRQCPY			PRSREV			

PRSREV (#3) The direction of pressure control is:
0: Not reversed.
1: Reversed.

Reference item	Chapter 7

TRQCPY(#6) As the current command for the sub-axis, the current command for the main axis is:
0: Not used.
1: Used.

	#7	#6	#5	#4	#3	#2	#1	#0
2286	SLOPQ5			WCCNCK				

WCCNCK(#4) 0: When external signal Gn321 is set to 0, the velocity loop integrator is copied to the slave axis.
1: The velocity loop integrator is always copied to the slave axis regardless of whether external signal Gn321 is set to 0 or 1.
(Set this parameter for the slave axis.)

SLOPQ5(#7) During dynamic friction compensation by the unexpected disturbance torque detection function, the dynamic friction compensation coefficient (parameter No. 2116) is:
0: The same as always.
1: Multiplied by 1/128 (high-precision mode).

Reference item	Subsection 5.10.1.1 and Section 5.9

	#7	#6	#5	#4	#3	#2	#1	#0
2288	MPCEF							

MPCEF(#7) Smart point machining control (with sensor) is:
0: Disabled.
1: Enabled.

Reference item	Subsection 5.4.10

	#7	#6	#5	#4	#3	#2	#1	#0
2289								SYNDI

SYNDI(#0) The function for holding the compensation amount in synchronous axes automatic compensation is:
0: Not used.
1: Used.

Reference item	Subsection 5.10.1.5

	#7	#6	#5	#4	#3	#2	#1	#0
2290			FRFPWE	FRFDES	FRFATE	ACCMON	ACCHLD	ACCOUT

ACCOUT(#0) The acceleration data output to the diagnosis screen (No. 354) is:
0: Not performed.
1: Performed.

Reference item	Subsection 4.1.4

ACCHLD(#1) An output peak acceleration rate is:
0: Not held.
1: Held (for one second).

Reference item	Subsection 4.1.4

ACCMON(#2) 0: Acceleration data output at all times
1: The remaining acceleration data after a stop is output. (The acceleration data is cleared to 0 during movement and for 16 ms after a stop.)

Reference item	Subsection 4.1.4

FRFATE(#3) Execution condition 1 in the follow-up mode of the adaptive resonance elimination filter:
FRFDES(#4) Execution condition 2 in the follow-up mode of the adaptive resonance elimination filter:

No.2290#4	No.2290#3	Execution condition in the follow-up mode
0	0	Executed when G322.x = 1 or during axis movement.
0	1	Executed when G322.x = 1 or during rapid traverse.
1	—	Executed only when G322.x = 1.

Reference item	Subsection 5.6.2

FRFPWE(#5) The parameter for the center frequency of the adaptive resonance elimination filter (No. 2113) is:
0: Not automatically updated.
1: Automatically updated.

Reference item	Subsection 5.6.2

	#7	#6	#5	#4	#3	#2	#1	#0
2291						FRFEBW		

FRFEBW(#2) The maximum frequency that can be followed by the adaptive resonance elimination filter in HRV3 or HRV4 control is:
0: 1.3 kHz (standard).
1: 2.0 kHz (extended).

Reference item	Subsection 5.6.2

	#7	#6	#5	#4	#3	#2	#1	#0
2292	MOVAXS	MV1IFC	MV1ID2	MV1ID1	MV1ID0	IFC1ON	C1TYP1	C1TYP0

C1TYP0, 1(#0, 1) Sets a compensation type (for the first moving axis).

Reference item	Subsection 5.5.13

IFC1ON(#2) Turns on/off the compensation for interactive force from the first moving axis.
0: Does not compensate for interactive force from the first moving axis.
1: Compensates for interactive force from the first moving axis.

Reference item	Subsection 5.5.13

MV1ID0 to 2(#3, 4, 5) Servo axis number specification for the first moving axis

NOTE
In the 30*i*-B Series and Power Motion *i*-A, the servo axis numbers of the first moving axis and second moving axis are specified by parameter No. 2606.

Reference item	Subsection 5.5.13

MV1IFC(#6) Sets calculation of interactive force from the first moving axis.
0: Disables calculation of interactive force from the first moving axis.
1: Enables calculation of interactive force from the first moving axis.

Reference item	Subsection 5.5.13

MOVAXS(#7) Specifies whether the axis is a moving axis used for interactive force compensation.
0: The axis is not a moving axis.
1: The axis is a moving axis.

Reference item	Subsection 5.5.13

	#7	#6	#5	#4	#3	#2	#1	#0
2293		MV2IFC	MV2ID2	MV2ID1	MV2ID0	IFC2ON	C2TYP1	C2TYP0

C2TYP0, 1(#0, 1) Sets a compensation type (for the second moving axis).

Reference item	Subsection 5.5.13

IFC2ON(#2) Turns on/off the compensation for interactive force from the second moving axis.
0: Does not compensate for interactive force from the second moving axis.
1: Compensates for interactive force from the second moving axis.

Reference item	Subsection 5.5.13

MV2ID0 to 2(#3, 4, 5) Specifies servo axis number for the second moving axis

NOTE
In the 30*i*-B Series and Power Motion *i*-A, the servo axis numbers of the first moving axis and second moving axis are specified by parameter No. 2606.

Reference item	Subsection 5.5.13

MV2IFC(#6) Sets calculation of interactive force from the second moving axis.
0: Disables calculation of interactive force from the second moving axis.
1: Enables calculation of interactive force from the second moving axis.

Reference item	Subsection 5.5.13

	#7	#6	#5	#4	#3	#2	#1	#0
2294				SSTMCC	PK2VDR			

PK2VDR(#3) The arbitrary magnification in the stop state is applied:
0: Only during cutting feed.
1: Also in rapid traverse.
The arbitrary magnification in the stop state for the variable proportional gain in the stop state is also applied in rapid traverse.

NOTE
This parameter is available with series 90G0 edition 03.0 or later (30*i*-B Series, Power Motion *i*-A, DSA-B).

SSTMCC(#4) When the quick stop function at emergency stop is enabled and the zero-speed detecting signal (SVSSTn) is set to 1, the excitation of the amplifier is:
0: Not cut off.
1: Cut off.

Reference item	Subsection 5.12.2

	#7	#6	#5	#4	#3	#2	#1	#0
2297				VAVNEG				

VAVNEG(#4) For high cycle proportional elements, the velocity feedback average function is: (Set this parameter for the main axis only.)
0: Enabled.
1: Disabled.

Reference item	Subsection 5.10.4.2

	#7	#6	#5	#4	#3	#2	#1	#0
2298	DUNIT							

DUNIT(#7) When the lifting function against gravity at emergency stop is used, the function that enables the parameter for specifying a distance to lift to be set in 1 μm independently of the detection unit is:

0: Not used.
1: Used.

Reference item	Subsection 5.8.5.3

	#7	#6	#5	#4	#3	#2	#1	#0
2299			IGNRFA					

IGNRFA(#5) The detection of an invalid parameter set for the denominator of the reference counter capacity is:

0: Performed.
1: Not performed.

NOTE
If an invalid parameter alarm (detail No. 1793) may be issued according to the status, setting IGNRFA = 1 may cause a system alarm. In this case, set IGNRFA to 0.

	#7	#6	#5	#4	#3	#2	#1	#0
2300	CKLNOH				THRMO	DD		HRVEN

HRVEN(#0) The extended HRV function is:

0: Not used.
1: Used.

NOTE
Set this function when using servo HRV4 control.

Reference item	Subsection 5.1.3

DD (#2) DD motor control is:

0: Not performed.
1: Performed.

This bit is set automatically when the parameters of the DD motor are initialized. Check that this bit is set before the DD motor is driven.

Reference item	Subsection 3.2.1.1

THRMO(#3) When bit 7 of No. 2300 is set to 1, the overheat alarm of a motor is:

0: Obtained from a DI signal via the PMC.
1: Obtained from the α*i*CZ detection circuit, linear motor position detection circuit, or temperature detection circuit.

Reference item	Section 3.3

CKLNOH (#7) The overheat alarm of a motor is:

0: Obtained from the pulse coder (for an α*i*/β*i* motor).
1: Obtained from a DI signal via the PMC, or from the α*i*CZ detection circuit, linear motor position detection circuit, or temperature detection circuit.

Reference item	Section 3.3

	#7	#6	#5	#4	#3	#2	#1	#0
2301	TQCT10							

TQCT10(#7) The torque control setting range extension is:

0: Disabled. (The setting of the torque constant parameter is used without modification.)

1: Enabled. (The setting of the torque constant parameter is increased by a factor of 10 for use in the NC.)

	#7	#6	#5	#4	#3	#2	#1	#0
2414	*			NEGPTD	LCSYN	BUFRST		CMPLC

(#0) For tuning the relevant parameter for quadrant protrusion compensation for Tuning Navigator

(#1) For tuning the relevant parameter for quadrant protrusion compensation for Tuning Navigator

(#2) For tuning the relevant parameter for quadrant protrusion compensation for Tuning Navigator

(#3) For tuning the relevant parameter for quadrant protrusion compensation for Tuning Navigator

(#4) For tuning the relevant parameter for quadrant protrusion compensation for Tuning Navigator

(#5) For tuning the relevant parameter for quadrant protrusion compensation for Tuning Navigator

(#6) For tuning the relevant parameter for quadrant protrusion compensation for Tuning Navigator

* These parameters are used by Tuning Navigator during tuning. After tuning, they are set to 0.

	#7	#6	#5	#4	#3	#2	#1	#0
2415	*	*	LBLACC	*	*	*	IAHDON	

IAHDON(#1) The default value of the feed-forward timing adjustment parameter is:

0: 0.

1: Compatible with that of the 16*i* Series.

* By setting IAHDON to 1 and parameter No. 2095 to 0, the feed-forward timing becomes compatible with that of the 16*i* Series. For the 30*i*-B Series, the feed-forward timing is fixed to that compatible with the Series 16*i* regardless of whether bit 1 of parameter No. 2415 is set to 0 or 1. (No.2415#1=1)

Reference item	Subsection 5.5.3

(#2) Attenuation type setting for quadrant protrusion compensation for Tuning Navigator (Normally 0: Exponential)

(#3) Acceleration amount override setting for quadrant protrusion compensation for Tuning Navigator (Normally 1)

(#4) Filter setting for quadrant protrusion compensation for Tuning Navigator (Normally 0)

LBLACC (#5) Quadrant protrusion compensation for Tuning Navigator is:

0: Disabled.

1: Enabled.

(#6) Acceleration amount override setting for quadrant protrusion compensation for Tuning Navigator (Normally 1)

(#7) Acceleration amount override setting for quadrant protrusion compensation for Tuning Navigator (1 or 0)

Reference item	Appendix M

	#7	#6	#5	#4	#3	#2	#1	#0
2417	*	*		TIMCAL		TIMPR2		

TIMCAL(#4) Preload time constant calculation is:
0: Not performed. (Conventional specification)
1: Performed.

TIMPR2(#2) The exponential time constant of the preload function is:
0: The reciprocal of the position loop gain.
1: Four times the reciprocal of the position loop gain.

Reference item	Subsection 5.10.1.2

	#7	#6	#5	#4	#3	#2	#1	#0
2418					INEVCM	INESHS		

INESHS (#2) The minimum detectable acceleration for inertia estimation is set to be:
0: The normal value.
1: 1/32.

INEVCM(#3) Oscillation for inertia estimation is input by:
0: Torque command
1: Velocity command

Reference item	Subsection 5.6.1

	#7	#6	#5	#4	#3	#2	#1	#0
2419	INESGH	INESGL	INESFH	INESFL	INESMG	INESFC	DYNTQL	DYNERR

DYNERR(#0) The detection of excessive error between the estimated position and actual position is:
0: Disabled.
1: Enabled.

DYNTQL(#1) The detection of excessive error between the estimated position and actual position in the torque limit mode is:
0: Disabled.
1: Enabled.

Reference item	Subsection 2.1.8.2

INESFC(#2) Inertia estimation is:
0: Disabled.
1: Enabled.

INESMG(#3) The weight of the diagnosis screen display (No. 764) of the estimated inertia value is:
0: Standard.
1: 1/32 of standard.

INESFL(#4) Oscillation frequency for inertia estimation
INESFH(#5) Oscillation frequency for inertia estimation

Amount of the oscillation current command	INESFH	INESFL
Standard frequency (50 Hz)	0	0
Low frequency (25 Hz)	0	1
High frequency (100 Hz)	1	0

INESGL(#6) Amount of the oscillation current command for inertia estimation
INESGH(#7) Amount of the oscillation current command for inertia estimation

Amount of the oscillation current command	INESGH	INESGL
Rated current	0	0
1/2 of the rated current	0	1
Double the rated current	1	0

Reference item	Subsection 5.6.1

	#7	#6	#5	#4	#3	#2	#1	#0
2420	SFUMSET	ATPKVF		DUDYN				

DUDYN(#4) When the dual position feedback function is enabled, the detection of excessive error between the estimated position and actual position is:
0: Disabled.
1: Enabled.
* For the 30*i*-B Series, this function bit is not used because the dual position feedback function can be used by default.

Reference item	Subsection 2.1.8.2

ATPKVF(#6) On the PARAMETER SETTING SUPPORT screen (0*i*-D Series), the servo gain has:
0: Not been tuned.
1: Been tuned.

SFUMSET (#7) The unit of data for the level on which the difference in error between the semi-closed and full-closed modes becomes too large (parameter No. 2118) is:
0: Detection unit.
1: 1 μm.
* Use this parameter when the detection unit is too small to set the necessary value within the valid data range for parameter No. 2118.

Reference item	Subsection 2.1.8.1

	#7	#6	#5	#4	#3	#2	#1	#0
2422				HRVPLS			SVSAR2	SVSAR1

SVSAR1(#0) Coefficient for the detection level of speed arrival 1
SVSAR2(#1) Coefficient for the detection level of speed arrival 2

SVSAR1	SVSAR2	Offset speed	Hysteresis speed	Remarks
0	0	50/min	20/min	Recommended (α*i*, β*i* motor)
0	1	10/min	5/min	
1	0	5/min	2/min	Recommended (D*i*S motor)
1	1	2/min	1/min	

Reference item	Subsection 5.12.1

HRVPLS(#4) Servo HRV+ control is:
0: Disabled.
1: Enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
2423					RGDFRC	RGDBLA	DBCOFF	

DBCOFF(#1) Dead-band compensation for the amplifier is:
0: Always enabled.
1: Disabled in the stopped state.

When this parameter is used, the system determines the stopped state when both of the conditions below are satisfied, and set dead-band compensation to 0:

- The move command from the CNC is 0.
- The absolute value of the position error becomes lower than or equal to the setting of parameter No. 2193.

NOTE
This parameter is used with Series 90G0/08.0 and subsequent editions (30*i*-B Series, Power Motion *i*-A, DSA-B) or Series 90E1/08.0 and subsequent editions (30*i*-A Series).

RGDBLA(#2) Compensation for reverse operation and at the start of FSSB high-speed rigid tapping is enabled:
0: Disabled.
1: Enabled.

RGDFRC(#3) Compensation for reverse operation and at the start of FSSB high-speed rigid tapping is enabled:
0: Only for reverse operation.
1: For reverse operation and at the start of rigid tapping.

Reference item	Section 5.13

	#7	#6	#5	#4	#3	#2	#1	#0
2428		DYUNIT						

DYUNIT (#6) Setting unit of dynamic error excessive level is:
0: Detection unit.
1: Physical unit (mm or deg).

Reference item	Subsection 2.1.8.2

	#7	#6	#5	#4	#3	#2	#1	#0
2429						FSBSYN	FSBTAP	SVZENB

SVZENB(#0) Leakage detection for the servo amplifier is:
0: Disabled.
1: Enabled.
* This parameter can be used with α*i* SV-B.

FSBTAP(#1) FSSB high-speed rigid tapping is:
0: Disabled.
1: Enabled.

FSBSYN(#2) Servo control for the EGB (FSSB method) is:
0: Disabled.
1: Enabled.

NOTE
1 To use the EGB (FSSB method), set 1.
2 For an axis (EGB dummy axis) for which bit 2 (FSBSYN) of parameter No. 2429 is set to 1, the following functions cannot be used together:
- FSSB high-speed rigid tapping (bit 1 of No. 2429)
- Servo-spindle synchronization control (bit 4 of No. 2016)
- SERVO HRV4 Control (bit 0 of No. 2014)

3 When this parameter is set, the power must be turned off before operation is continued.

Reference item	Connection manual (function) for each CNC "Electronic Gear Box (FSSB type)"

	#7	#6	#5	#4	#3	#2	#1	#0
2436							STO	

STO (#1) The safety torque-off function by the servo amplifier is:
0: Disabled.
1: Enabled.
* This parameter can be used with α*i* SV-B and β*i* SVSP-B.

	#7	#6	#5	#4	#3	#2	#1	#0
2437				AILIN				

AILIN(#4) By using LC195F or LC495F, the minimum resolution of the scale is:
0: Not extended.
1: Extended.

Reference item	Subsection 2.1.4.1

	#7	#6	#5	#4	#3	#2	#1	#0
2560			HPLSCS		VOLTF2	PK12S4P	PK12S2P	VOLTFL

PK12S2P(#1) The current control loop gain for servo HRV+ control is:
0: Not quadrupled.
1: Quadrupled.

PK12S4P(#2) The current control loop gain for servo HRV+ control is:
0: Not multiplied by 16.
1: Multiplied by 16.

VOLTF2(#3) The filter dedicated to servo HRV4+ control in the current control loop is:
0: Disabled.
1: Enabled.

#5, #0 These parameters are motor-specific.

Reference item	Subsection 5.1.6

	#7	#6	#5	#4	#3	#2	#1	#0
2563		DDBCNV						

DDBCNV (#6) In the servo motor β*i*/β*i*-B Series and DD motor, SERVO HRV + control (velocity loop optimization) is:
0: Not used.
1: Used.

* Except for β*i*S0.2/5000, β*i*S0.3/5000, β*i*S0.4/5000(-B), β*i*S0.5/6000(-B), and β*i*S1/6000(-B). When using these motors, set bit 6 of parameter No. 2563 to 0.

Reference item	Subsection 5.1.7

	#7	#6	#5	#4	#3	#2	#1	#0
2565								SFEROFF

SFEROFF(#0) In a full-closed configuration in which an analog SDU is used, the Semi-Full error monitor is:
0: Enabled.
1: Disabled.

Reference item	Subsection 2.1.8.1

	#7	#6	#5	#4	#3	#2	#1	#0
2567				SBFSPOS		SBF		

SBF (#2) Smart backlash compensation (for full-closed system) is:
0: Disabled.
1: Enabled.

SBFSPOS (#4) Semi-closed loop automatic backlash compensation for dual position feedback is:
0: Disabled.
1: Enabled.

Reference item	Subsection 5.5.9

	#7	#6	#5	#4	#3	#2	#1	#0
2571								PWSTBK

PWSTBK (#0) Command superimposition for lifting against gravity at power failure is:
0: Disabled.
1: Enabled. (to be set for the vertical axis)

Reference item	Subsection 5.8.5.4

	#7	#6	#5	#4	#3	#2	#1	#0
2694		BLAFTA						VDOVR

VDOVR(#0) The vibration-damping control gain is:
0: Not multiplied by the velocity gain override (parameter No. 2107).
1: Multiplied by the velocity gain override (parameter No. 2107).

BLAFTA(#6) Backlash acceleration override is:
0: Calculated using the acceleration near reversal (backward compatible).
1: Calculated using the acceleration after reversal (new function).

* This is also enabled for two-stage backlash acceleration (Type-1 or Type-2) and quadrant protrusion adjustment for Tuning Navigator.

Reference item	Subsections 5.4.7 and 5.5.7

	#7	#6	#5	#4	#3	#2	#1	#0
2695			VFFFILT			VGPLS		

VGPLS (#2) Servo HRV+ control (velocity loop optimization) is:
0: Disabled.
1: Enabled.

VFFFILT(#5) Improvement of the vibration suppression effect in the FF filter for full-closed loop is:
0: Disabled.
1: Enabled.
When setting the FF filter for full-closed loop (bit 4 of parameter No. 2570), set bit 5 of parameter No. 2695 as well. The velocity feedforward is also filtered and the vibration suppression effect is increased. If the FF filter for full-closed loop is already adjusted, you may have to fine-tune the filter parameters (parameter Nos. 2627 to 2629).

This function cannot be used with the following options:
- High-speed cycle machining option
- High-speed binary operation option

Reference item	Subsections 5.1.7 and 5.4.11

	#7	#6	#5	#4	#3	#2	#1	#0
3111								SVS

SVS(#0) 1: The SERVO SETTING screen is displayed.

Reference item	Subsections 2.1.2 and 4.1.1

☆: Parameters set up automatically at initialization
★: Parameters that can be kept atthe automatically set values

Parameter number	Details	
1821	Reference counter capacity	→ 2.1.2
1825	Position loop gain (position gain)	→ 4.1.1
1851	Backlash compensation value	→ 5.5.4, 5.5.5
2020	Motor ID number Motor ID number that can be specified	→ 2.1.2 Initial setting
2021	Load inertia ratio (LDINT) $\frac{\text{Load inertia}}{\text{Rotor inertia}} \times 256$ Multiply velocity loop gain parameters PK1V and PK2V by (1 + LDINT/256).	Adjust for individual machines separately.
2022 2023 2024	Rotation direction of the motor Number of velocity pulses Number of position pulses	→ 2.1.2 Initial setting
2025 2026	Inertial estimation: Oscillation frequency Inertial estimation: Oscillation gain	→ 5.6.1
2028	Velocity enabling position gain switching	→ 5.7.1
2029 2030	Acceleration-time velocity enabling integral function for low speed Deceleration-time velocity enabling integral function for low speed	→ 5.7.2
2031	Excessive torque difference alarm threshold	→ 5.10.1.3
2033 2034	Number of position feedback pulses Vibration damping control gain	→ 5.4.7
2036	Tandem control/damping compensation gain (main axis) Tandem control/damping compensation phase coefficient (sub-axis)	→ 5.10.1.4, 5.10.4.1
2039	Second stage acceleration amount for two-stage backlash acceleration	→ 5.5.5
2040 2041 2042	Current loop gain (PK1) Current loop gain (PK2) Current loop gain (PK3)	★ Motorspecific
2043 2044	Velocity loop integral gain (PK1V) Velocity loop proportional gain (PK2V)	☆ Motorspecific Adjust for individual machines separately.
2045	Velocity loop incomplete integral gain (PK3V)	☆ Motorspecific → 4.3.7
2046	Velocity loop gain (PK4V)	★ Motorspecific
2047	Observer parameter (POA1) This parameter is adjusted when the unexpected disturbance torque detection and two-stage backlash are used. NOTE: If the velocity gain (load inertia ratio) is changed, this parameter must be readjusted. When a negative value is set for POA1, it is assumed to be |POA1| × 10.	☆ Motorspecific → 5.5.5, 5.9.1
2048	Backlash acceleration amount	☆→ 5.5.4, 5.5.5
2049	Maximum dual position feedback amplitude	☆→ 5.4.8
2050 2051	Observer gain (POK1) Observer gain (POK2) When only the unexpected disturbance torque detection is used, these parameters must be changed.	☆ Motorspecific
2052	Excess speed alarm detection speed	★
2053 2054 2055	Current dead-band compensation (PPMAX) Current dead-band compensation (PDDP) The standard setting for α*i* motors is 1894. Current dead-band compensation (PHYST)	★ Motorspecific

☆: Parameters set up automatically at initialization
★: Parameters that can be kept atthe automatically set values

Parameter number	Details	
2056 2057 2058	Variable current loop gain during deceleration (EMFCMP) Phase D current at high-speed (PVPA) Phase D current limit (PALPH)	★ Motorspecific
2060	Torque limit The value 7282 represents the maximum current value of the amplifier. The default represents the maximum current of the motor.	★ Motorspecific
2061	Motor inertia (INERTIA)	★ Motorspecific
2062 2063	First OVC alarm parameter (POVC1) First OVC alarm parameter (POVC2)	★ Motorspecific
2064	Software disconnection alarm level	★ Motorspecific → 3.2
2065	First OVC alarm parameter (POVCLMT)	★ Motorspecific
2066	Acceleration feedback gain	☆→ 4.3.4
2067	Torque command filter	☆→ 4.3.5, 5.2, 5.4.2
2068 2069	Feed-forward coefficient Velocity feedforward coefficient	☆→ 5.5.1, 5.5.2
2070	Backlash acceleration timing	☆
2071	Time during which backlash acceleration is effective, Static friction compensation count	☆→ 5.5.4
2072 2073	Static friction compensation amount Stop state judgment parameter	☆→ 5.5.6
2074	Variable current loop gain depending on current	★ Motorspecific
2075	Not in use at present.	☆
2076	Not in use at present.	☆
2077	Overshoot compensation counter	☆→ 4.3.7
2078 2079 2080 2081	Dual position feedback: Conversion coefficient (numerator) Dual position feedback: Conversion coefficient (denominator) Dual position feedback: Constant of first-order lag Dual position feedback: Zero zone	☆→ 5.4.8
2082	Backlash acceleration stop amount (when two-stage backlash acceleration is disabled) Second stage acceleration start position (when two-stage backlash acceleration Type-1 is enabled) Second stage acceleration attenuation start position (when two-stage backlash acceleration Type-2 is enabled)	☆→ 5.5.4 ☆→ 5.5.5
2083	Brake control timer (msec)	☆→ 5.8.1
2084 2085	Flexible feed gear (numerator) Flexible feed gear (denominator)	→ 2.1.1 Initial setting
2086	Rated current parameter	★ Motorspecific
2087	Torque offset Tandem control/Preload value	☆→ 5.5.5, 5.9.1, ☆→ 5.10.1.2
2088	Machine speed feedback gain	☆→ 4.3.5, 5.4.9
2089	Backlash acceleration base pulse (when two-stage backlash acceleration is disabled) Second stage acceleration end position (when two-stage backlash acceleration is enabled)	☆→ 5.5.6 ☆→ 5.5.5
2091	Nonlinear control parameter	☆
2092	Advanced preview feed-forward coefficient	☆→ 5.5.1
2094	Backlash acceleration amount in the negative direction	☆→ 5.5.4
2095	Feedforward timing adjustment coefficient	☆→ 5.5.3
2096	Machining point control: Timing adjustment parameter (MPCTIM)	→ 5.4.10

☆: Parameters set up automatically at initialization
★: Parameters that can be kept atthe automatically set values

Parameter number	Details	
2097	Static friction compensation stop parameter	☆→ 5.5.6
2098	Current phase lead compensation coefficient	★ Motorspecific
2099	N pulses suppression function	
2101	Overshoot compensation valid level	☆→ 5.5.12
2102	Final clamp value for the actual-current limit	★Motor-specific
2103	Track back amount applied when an unexpected disturbance torque is detected	☆→ 5.9.1
2104	Unexpected disturbance torque detection alarm level (cutting when switching is used)	☆→ 5.9.1
2105	Torque constant	☆→ 5.11
2107	Velocity loop gain magnification for cutting	☆→ 5.2
2110	Magnetic saturation compensation	★ Motorspecific
2111	Torque limit at deceleration	★ Motorspecific
2112	Linear motor AMR conversion coefficient 1	☆→ 3.2.1.1
2113	Resonance elimination filter 1: attenuation center frequency	☆→ 5.4.4, 5.6.2
2114	Acceleration amount override for backlash acceleration Second stage acceleration amount override for two-stage backlash acceleration	→ 5.5.4 → 5.5.5
2115	For internal data output: Under normal circumstances 0 must be set.	
2116	Dynamic friction compensation value for the unexpected disturbance torque detection function	→ 5.9.1
2118	Dual position feedback Semi-closed/full-closed error overestimation level	→ 5.4.8
2119	Stop level for variable proportional gain in the stop state	→ 5.3.3
2121	Synchronous axes automatic compensation: Preset	→ 5.10.1.5
2122	Not used	
2126	Tandem control/position feedback switching time constant	
2127	Non-interference control coefficient (NINTCT)	★ Motorspecific
2128	Coefficient for magnetic flux weaken compensation (MFWKCE)	★ Motorspecific
2129	Coefficient for magnetic flux weaken compensation (MFWKBL)	★ Motorspecific
2130 2131 2132	Smoothing compensation performed twice per pole pair Smoothing compensation performed four times per pole pair Smoothing compensation performed six times per pole pair	☆→ 3.1.2
2133	Coefficient for phase lag compensation during deceleration (PHDLY1)	★ Motorspecific
2134	Coefficient for phase lag compensation during deceleration (PHDLY2)	★Motor-specific
2137	First stage acceleration amount override for two-stage backlash acceleration	
2138 2139	Linear motor AMR conversion coefficient 2 Linear motor AMR offset	→ 3.2.1.1
2142	Unexpected disturbance torque detection alarm level in rapid traverse	→ 5.9.2
2144 2145	Position feed-forward coefficient for cutting Velocity feed-forward coefficient for cutting	→ 5.2, 5.5.2, 5.5.11
2146	Stage-2 backlash acceleration end timer	→ 5.5.5
2148	Deceleration decision level (HRV control) Usually to be kept at 0.	Usually adjustment is not needed.
2149	Exponent part of PK1V	→ 2.1.6
2150	Exponent part of PK2V	→ 2.1.6
2151 2152 2153	For internal data output: Under normal circumstances 0 must be set. For internal data output: Under normal circumstances 0 must be set. For internal data output: Under normal circumstances 0 must be set.	

☆: Parameters set up automatically at initialization
★: Parameters that can be kept atthe automatically set values

Parameter number	Details	
2156	Torque command filter (at rapid traverse)	→ 5.2, 5.4.2
2159 2160	Improved current-dependent current gain variable 1 (CGMAX) Improved current-dependent current gain variable 2 (CGMPY)	★ Motorspecific
2161	OVC magnification at a stop (OVCSTP)	★ Motorspecific
2162 2163 2164	Second OVC alarm parameter (POVC21) Second OVC alarm parameter (POVC22) Second OVC alarm parameter (POVCLMT2)	★ Motorspecific
2165	Maximum amplifier current	★ Motorspecific
2167	Second stage acceleration amount offset for two-stage backlash acceleration	→ 5.5.5
2173	Distance to lift for the lifting function against gravity at emergency stop	→ 5.8.5.2
2177	Resonance elimination filter 1: attenuation bandwidth	→ 5.4.4 5.6.2
2179	Reference counter capacity (denominator)	→ 2.1.2
2182	Current A for pole detection (DTCCRT_A)	→ 3.2.1.2
2183	Stop level for variable integral gain in the stop state	
2185	Position pulses conversion coefficient	→ 2.1, 2.1.6, 2.1.2 Initial setting
2188	Shape coefficient for smart backlash compensation (semi-closed)	→ 5.5.8
2189	Torsion coefficient for smart backlash compensation (semi-closed)	→ 5.5.8
2190	Compensation limit for smart backlash compensation (semi-closed)	→ 5.5.8
2191	Total inertia of drive system	→ 5.5.8
2193	Stop level (Dead-band compensation: Disabled in the stopped state)	
2198 2199	Current B for pole detection (DTCCRT_B) Current C for pole detection (DTCCRT_C)	
2263	Detection unit setting	→ 2.1.9
2265 2266	Machining point control: gain 2 (MPCK2) Machining point control: gain 1 (MPCK1)	→ 5.4.10
2268	Allowable travel distance magnification/stop speed decision value (MFMPMD)	→ 3.2.1.2
2315	Servo check interface unit output signal setting	→ Appendix F
2318 2319 2320 2321 2322	Disturbance elimination filter: gain Disturbance elimination filter: inertia ratio Disturbance elimination filter: inverse function gain Disturbance elimination filter: time constant Disturbance elimination filter: acceleration feedback limit	→ 5.4.5
2323	Variable current PI rate	→ 5.3.4
2324	Variable proportional gain in the stop state: arbitrary magnification at a stop (for cutting only)	→ 4.3.4, 5.3.3
2325	Tandem disturbance elimination control function/integral gain (main axis) Tandem disturbance elimination control function/phase coefficient (sub-axis)	→ 5.10.1.4
2326 2327 2328 2329	Disturbance input gain Disturbance input: start frequency Disturbance input: end frequency Number of disturbance input measurement points	→ 5.10.1.4
2333	Tandem disturbance elimination control function /incomplete integral time constant (main axis)	→ 5.10.1.4
2334 2335	Current loop gain magnification in high-speed HRV current control mode Velocity loop gain magnification in the high-speed HRV current control mode	→ 5.1.2, 5.1.3, C.2

☆: Parameters set up automatically at initialization
★: Parameters that can be kept atthe automatically set values

Parameter number	Details	
2338	Backlash acceleration function: acceleration amount limit value Limit value of the second stage acceleration amount for two-stage backlash acceleration	→ 5.5.4 → 5.5.5
2339	Second stage acceleration amount for two-stage backlash acceleration (negative direction)	→ 5.5.5
2340	Backlash acceleration function: acceleration amount override (negative direction) Two-stage backlash acceleration function: second stage acceleration amount override (negative direction)	→ 5.5.4 → 5.5.5
2341	Backlash acceleration function: acceleration amount limit value (negative direction) Two-stage backlash acceleration function: second stage acceleration amount limit value (negative direction)	→ 5.5.4 → 5.5.5
2342 2343	Unexpected disturbance torque detection: Acceleration threshold Unexpected disturbance torque detection: Alarm level for high acceleration	→ 5.9.3
2344	Variable integral gain in the stop state: Arbitrary magnification in the stop state	
2345 2346	Disturbance estimation: dynamic friction compensation value in the stop state Disturbance estimation: dynamic friction compensation limit value	→ 5.9.1
2350	Adaptive resonance elimination filter: Allowable acceleration	→ 5.6.2
2351	Adaptive resonance elimination filter: Follow-up bandwidth	→ 5.6.2
2352	Adaptive resonance elimination filter: Detective level	→ 5.6.2
2353	Adaptive resonance elimination filter: Wait time for setting	→ 5.6.2
2355	Machining point control: Center frequency of band-pass filter	→ 5.4.10
2357	Tandem speed difference alarm threshold	→ 5.10.4.4
2356	Resonance elimination filter L: Feed-forward filter exclusion rate	→ 5.4.6
2358	Unexpected disturbance torque detection: Post-acceleration timer	→ 5.9.3
2359	Resonance elimination filter 1: damping	→ 5.4.3, 5.4.4, 5.6.2
2360 2361 2362	Resonance elimination filter 2: attenuation center frequency Resonance elimination filter 2: attenuation bandwidth Resonance elimination filter 2: damping	→ 5.4.3, 5.4.4
2363 2364 2365	Resonance elimination filter 3: attenuation center frequency Resonance elimination filter 3: Attenuation bandwidth Resonance elimination filter 3: Damping	→ 5.4.3, 5.4.4
2366 2367 2368	Resonance elimination filter 4 / Resonance elimination filter L: attenuation center frequency Resonance elimination filter 4 / Resonance elimination filter L: attenuation bandwidth Resonance elimination filter 4 / Resonance elimination filter L: damping	→ 5.4.3, 5.4.4, 5.4.6,
2369 2370 2371	Smoothing compensation performed twice per pole pair (negative direction) Smoothing compensation performed four times per pole pair (negative direction) Smoothing compensation performed six times per pole pair (negative direction)	→ 3.1.2
2372	Serial EGB exponent setting * For the 30*i*-B, no exponent setting is required.	
2373 2374	Distance to lift for the lifting function against gravity at emergency stop Lifting function against gravity at emergency stop: Lifting time	→ 5.8.5.1, 5.8.5.2

☆: Parameters set up automatically at initialization
★: Parameters that can be kept atthe automatically set values

Parameter number	Details	
2377 2378	Smoothing compensation performed 1.5 times per pole pair Smoothing compensation performed 1.5 times per pole pair (negative direction)	→ 3.2.2
2380 2381	Smoothing compensation performed three times per pole pair Smoothing compensation performed three times per pole pair (negative direction)	→ 3.2.2
2382	Torsion preview control: maximum compensation value (LSTCM)	→ 5.5.11
2383 2384 2385	Torsion preview control: acceleration 1 (LSTAC1) Torsion preview control: acceleration 2 (LSTAC2) Torsion preview control: acceleration 3 (LSTAC3)	→ 5.5.11
2386 2387 2388	Torsion preview control: Acceleration torsion compensation value K1 (LSTK1) Torsion preview control: Acceleration torsion compensation value K2 (LSTK2) Torsion preview control: Acceleration torsion compensation value K3 (LSTK3)	→ 5.5.11
2389	Torsion preview control: torsion delay compensation value KD (LSTKD)	→ 5.5.11
2391 2392 2393	Torsion preview control: Acceleration torsion compensation value K1N (LSTK1N) Torsion preview control: Acceleration torsion compensation value K2N (LSTK2N) Torsion preview control: Acceleration torsion compensation value K3N (LSTK3N)	→ 5.5.11
2394	Number of data mask digits	→ 2.1.4.1, 3.2.1.1
2396	Torsion preview control: Torsion delay compensation value KDN (LSTKDN)	→ 5.5.11
2402	Torsion preview control: torsion torque compensation coefficient (LSTKT)	→ 5.5.11
2403	Synchronous axes automatic compensation coefficient (K)	→ 5.10.1.5
2404	Synchronous axes automatic compensation: Maximum compensation (sub axis) Synchronous axes automatic compensation: Dead-band width (main axis)	→ 5.10.1.5
2405	Synchronous axes automatic compensation: Filter coefficient	→ 5.10.1.5
2446–2453	Parameters for tuning for quadrant protrusion compensation for Tuning Navigator	→ Appendix M
2455 2456	Integer part of the number of pulses per revolution Exponent part of the number of pulses per revolution	→ 5.5.13
2458	Detection of excessive error between the estimated position and actual position: Detection level	→ 2.1.8.2
2459	Adaptive resonance elimination filter: Search bandwidth	→ 5.6.2
2463	Power consumption monitoring: Loss coefficient C (Power Supply)	→ Appendix J
2464	Warning level of insulation resistance	→ 2.1.6
2468 2469	Power consumption monitoring: Coil resistance Power consumption monitoring: Loss coefficient A (Servo Amplifier)	→ Appendix J
2470–2475	Parameters for tuning for quadrant protrusion compensation for Tuning Navigator	→ Appendix M

☆: Parameters set up automatically at initialization
★: Parameters that can be kept atthe automatically set values

Parameter number	Details	
2478 2479 2480 2481	Interactive Force Compensation: Compensation gain (for the first moving axis) Interactive Force Compensation: Angle data offset (for the first moving axis) Interactive Force Compensation: Compensation gain (for the second moving axis) Interactive Force Compensation: Angle data offset (for the second moving axis)	→ 5.5.13
2482 2483	Detection level of speed arrival Detection level of speed zero	→ 5.12.1
2486–2489	Parameters for tuning for quadrant protrusion compensation for Tuning Navigator	
2490	Power consumption monitoring: Loss coefficient B (Servo Amplifier)	→ Appendix J
2491	Power consumption monitoring: Loss coefficient D (Power Supply)	→ Appendix J
2494–2505	Parameters for tuning for quadrant protrusion compensation for Tuning Navigator	→ Appendix M
2506–2509	Parameters for tuning for quadrant protrusion compensation for Tuning Navigator	→ Appendix M
2574	Second OVC alarm parameter (VELOVC)	★ Motorspecific
2590 2591	Current loop integral gain for HRV$^+$ control (PK1PLS) Current loop proportional gain for HRV$^+$ control (PK2PLS)	★ Motorspecific
2595	Current loop gain for HRV4$^+$ control (HRV4PLS)	★ Motorspecific
2606	Interactive force compensation: First moving axis number, second moving axis number	→ 5.5.13
2613	Compensation amount for reverse operation in FSSB high-speed rigid tapping	→ 5.13
2619	Time during which acceleration is enabled/compensation length ratio/gain for smart backlash compensation (full-closed)	→ 5.5.9
2626	Amount of superimposition specified for lifting against gravity at power failure	→ 5.8.5.4
2627	Superimposition for lifting against gravity at power failure time constant	→ 5.8.5.4
2638 2639 2647 2648 2649	Smart machining point control (sensorless) damping frequency Smart machining point control (sensorless) damping factor Smart machining point control (sensorless) damping frequency Smart machining point control (sensorless) damping factor Smart machining point control (sensorless) bandwidth magnification	→ 5.4.11
2660	Estimated fixed load for smart backlash (semi-closed)	→ 5.5.8
2669	Excessive dynamic error warning detection level	→ 2.1.8.3

10 PARAMETER LIST

* With the Series 30*i*-B, Power Motion *i*-A, or DSA-B, to use a 400-V driving motor, servo control software of 90G0/06.0 or later is required.

This parameter list is valid as of the end of February 2019.

When *1 to *9 is added in "Remarks" for a motor, a servo amplifier and power supply having the specification numbers listed below, and/or servo control software of the listed series and edition or later are required.

(*1)

Servo amplifiers and power supply

Hardware		Specification	Remarks
Power supply	α*i* PS	All α*i* PS-B models and the following α*i* PS models A06B-6140-Hxxx (for 200 V) A06B-6150-Hxxx (for 400 V)	
Servo amplifier	α*i* SV	All α*i* SV-B models and the following α*i* SV models A06B-6117-Hxxx (for 200 V) A06B-6127-Hxxx (for 400 V)	
	β*i* SV	All β*i* SV-B models and the following β*i* SV models A06B-6130-Hxxx A06B-6131-Hxxx	
	β*i* SVSP	All β*i* SVSP-B models and the following β*i* SVSP models A06B-6164-Hxxx#H580 A06B-6167-Hxxx#H560	

Series and editions of servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	Q(17) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	Q(17) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D Series 0*i* Mate-D	90C5 90C8	01.0 and subsequent editions 01.0 and subsequent editions	
	90E5 90E8	01.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(*2)
Series and editions of servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90G0 90J0 90K0 90GP 90JP	01.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	N(14) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	N(14) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D Series 0*i* Mate-D	90C5 90C8	01.0 and subsequent editions 01.0 and subsequent editions	
	90E5 90E8	01.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(*3)
Series and editions of servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90G0 90J0 90K0 90GP 90JP	10.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	28.0 and subsequent editions 04.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	—	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D Series 0*i* Mate-D	90C5 90C8	— 06.0 and subsequent editions	
	90E5 90E8	— 06.0 and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(*4)
Series and editions of servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90G0 90J0 90K0 90GP 90JP	09.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	30.0 and subsequent editions 04.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	—	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D Series 0*i* Mate-D	90C5 90C8	04.0 and subsequent editions 01.0 and subsequent editions	
	90E5 90E8	04.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(*5)
Series and editions of servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90G0 90J0 90K0 90GP 90JP	01.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	N(14) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	N(14) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D Series 0*i* Mate-D	90C5 90C8	01.0 and subsequent editions 01.0 and subsequent editions	
	90E5 90E8	01.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(*6)
Series and editions of servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90G0 90J0 90K0 90GP 90JP	19.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	— —	
Series 30*i*/31*i*-A	90D0	—	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D Series 0*i* Mate-D	90C5 90C8	— —	
	90E5 90E8	— —	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(*7)
Series and editions of servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90G0 90J0 90K0 90GP 90JP	09.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	33.0 and subsequent editions 08.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	—	HRV4
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D Series 0*i* Mate-D	90C5 90C8	— 04.0 and subsequent editions	
	90E5 90E8	— 04.0 and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(*8)
Series and editions of servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90J0 90JP	10.0 and subsequent editions 04.0 and subsequent editions	
Series 0*i*-F	90M0	06.0 and subsequent editions	
	90M8	06.0 and subsequent editions	

(*9)
Series and editions of servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90J0 90JP	17.0 and subsequent editions 07.0 and subsequent editions	
Series 0*i*-F	90M0	08.0 and subsequent editions	
	90M8	08.0 and subsequent editions	

10.1 STANDARD PARAMETERS FOR THE α*i*-B/α*i* SERIES SERVO MOTORS

Series 90G0, 90J0, 90K0, 90GP, and 90JP (for Series 30*i*/31*i*/32*i*/35*i*-B, Power Motion *i*-A, DSA-B)
Series 90E0 and 90E1 (for Series 30*i*/31*i*/32*i*-A)
Series 90D0 (for Series 30*i*/31*i*-A)
Series 90M0, 90L0, 90M8, and 90L8 (for Series 0*i*-F)
Series 90C5 and 90C8 (for Series 0*i*-D)
Series 90E5 and 90E8 (for Series 0*i*-D)
Series 90H0 (for Series 0*i* Mate-D)

* If a motor specification is also indicated, the same parameter is used for both the conventional motor and the "-B" motor.

10.1.1 αiS-B/αiS Series

	Motor model	αiS2 5000,-B	αiS2 5000,-B 40A	αiS2 6000,-B	αiS2 6000,-B 40A	αiS4 5000,-B	αiS4 5000,-B 40A	αiS4 6000,-B	αiS4 6000,-B 40A	αiS8 4000,-B	αiS8 6000,-B	αiS12 4000,-B
	Motor specification	0212,2212	0212,2212	0218,2218	0218,2218	0215,2215	0215,2215	0210,2210	0210,2210	0235,2235	0232,2232	0238,2238
	Motor ID No.	262	502	284	503	265	504	466	505	285	290	288
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00000000	00001110	00000000	00001110	00000000	00001110	00000000	00001110	00000000	00000000	00000000
2014		00000000	00001110	00000000	00001110	00000000	00001110	00000000	00001110	00000000	00000000	00000000
2210		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2211		00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010
2300		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2560		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2040	CUR GAIN I	530	1060	552	1104	420	840	395	790	550	460	570
2041	CUR GAIN P	-2543	-5086	-2288	-4576	-1748	-3496	-1606	-3212	-3449	-1760	-3358
2042	CUR GAIN 3	-1251	-1251	-1252	-1252	-1276	-1276	-1277	-1277	-1307	-1305	-1319
2043	VEL GAIN I	39	20	48	24	64	32	76	38	33	53	52
2044	VEL GAIN P	-350	-175	-429	-215	-574	-287	-678	-339	-294	-478	-466
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	10853	21706	-884	-1769	-661	-1322	5601	11202	-1289	-794	-815
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	7000	0	7500	7500	7000	7000	7500	7500	5600	7500	5600
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	0	0	0	0	0	0	0	0	0
2057	D-PHASE CUR	-10250	-10245	-13062	-13060	-8974	-9480	-13326	-13319	-7685	-16398	-5898
2058	D-PHASE CUR	-2000	-1000	-1000	-730	-3641	-2000	-2500	-1500	-2000	-1000	-3000
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	7282	3641	7282	3641	7282	3641	7282	3641	7282	7282	7282
2061	INERTIA	284	142	348	174	465	0	569	0	239	387	378
2062	POVC1	32528	32172	32415	32409	32289	32293	32310	32321	32609	32520	32534
2063	POVC2	3005	7444	4413	4489	5994	5935	5728	5584	1993	3101	2923
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	POVCLMT	8936	4280	13146	3236	17889	4472	17091	4273	5920	9224	8692
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	20480	0	20480	0	12288	4096	16384	0	0	8192	0
2086	RATED CURRENT	1540	770	1868	934	2824	1412	2585	1292	1253	2075	1518
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	117	234	96	192	127	254	104	208	562	346	696
2110	MGSTCM	32	1344	1555	806	8	1545	3092	1576	519	1284	521
2111	TQLIM IN DEC.	8995	8995	11550	11550	10295	10295	8208	8208	7268	10255	6174
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	1137	1137	1137	1137	646	646	660	660	2106	801	1592
2128	MFWKCE	1000	2000	3000	6000	1667	3334	3000	6000	4000	1000	2000
2129	MFWKBL	3851	3851	4112	4113	3847	3847	4365	4363	2580	5388	2575
2133	PHDLY1	7690	7690	7690	7690	7690	7690	7690	7690	5150	10250	6174
2134	PHDLY2	12840	6440	7740	3900	12840	6440	12830	6430	8990	12830	8990
2159	CGMAX	4369	10537	2320	5158	2824	6417	2313	5140	4368	3339	5141
2160	CGMPY	2660	1330	5170	2585	7780	3890	5210	2605	2660	2660	2630
2161	OVCSTP	0	0	0	0	0	0	0	0	0	0	0
2162	POVC21	32766	32766	32766	32766	32762	32762	32763	32763	32767	32765	32766
2163	POVC22	20	28	30	27	77	77	58	62	13	38	19
2164	POVCLMT2	3776	2097	5554	1165	12702	3172	9912	2680	2501	6857	3672
2165	MAX CURRENT	25	45	25	45	25	45	25	45	85	85	85
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	5300	8796	4200	7061	2990	5520	3350	6086	7191	2020	6500
2591	PK2PLS	-9450	-15683	-8400	-15260	-5740	-10194	-5800	-10537	-12400	-4900	-12200
2595	HRV4PLS	1429	1429	1539	1539	1633	1633	1635	1635	1742	1948	1942
Remarks			*8		*8		*8		*8			

	Motor model	αiS12 6000,-B	αiS22 4000,-B	αiS22 6000,-B	αiS30 4000,-B	αiS40 4000,-B	αiS50 2000,-B	αiS50 3000,-B	αiS50 3000 Fan,-B	αiS50 3000-B □iSV 360S-B	□iS50 3000FAN-B □iSV 360S-B	αiS60 2000,-B
	Motor specification	0230,2230	0265,2265	0262,2262	0268,2268	0272,2272	0042,2042	0275,2275	0275,2275	2275	2275	0044,2044
	Motor ID No.	462	315	452	318	322	468	324	325	541	542	470
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2014		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2210		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2211		00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010
2300		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2560		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2040	CUR GAIN I	471	581	605	799	712	1539	547	547	547	547	1358
2041	CUR GAIN P	-2249	-3844	-2393	-4447	-4138	-7321	-3423	-3423	-3423	-3423	-6767
2042	CUR GAIN 3	-1321	-1337	-1335	-1317	-1341	-1344	-1345	-1345	-1345	-1345	-1344
2043	VEL GAIN I	43	69	102	82	92	90	69	69	69	69	103
2044	VEL GAIN P	-387	-616	-914	-733	-827	-802	-622	-622	-622	-622	-925
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	-980	6163	4150	5175	4589	4731	6099	6099	6099	6099	4103
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	7500	5600	7500	5400	4800	2800	4200	4200	4200	4200	2700
2053	DB-CMP PPMAX	21	21	21	21	21	31979	31979	31979	31979	31979	31979
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	3	3	3	3	3	3
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	0	0	0	0	0	0	0	0	0
2057	D-PHASE CUR	-12808	-7687	-12039	-6412	-5645	-3867	-5638	-5638	-5638	-5638	-3097
2058	D-PHASE CUR	-1800	-2000	-2000	-2300	-3000	-3393	-1000	-1000	-1000	-1000	-2995
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	7282	7282	7282	7282	7282	7282	7282	7282	7282	7282	7282
2061	INERTIA	314	499	741	594	670	649	504	504	504	504	764
2062	POVC1	32688	32515	32515	32515	32515	32515	32558	32348	32558	32348	32515
2063	POVC2	998	3166	3166	3166	3166	3166	2627	5245	2627	5245	3166
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	POVCLMT	2960	9418	9418	9418	9418	9418	7810	15639	7810	15639	9418
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	12288	4096	4096	4096	4096	8192	4096	4096	4096	4096	0
2086	RATED CURRENT	1181	1627	1977	1836	2073	1856	1439	2037	1439	2037	2018
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	837	1216	819	1470	1701	2569	3312	3312	3312	3312	2942
2110	MGSTCM	528	519	1288	775	776	1032	519	519	519	519	1544
2111	TQLIM IN DEC.	10260	6224	12830	6450	5682	4954	6174	6174	6174	6174	3151
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	1146	2041	1000	1871	1853	2825	2046	2046	2046	2046	5498
2128	MFWKCE	667	2500	1000	4000	4000	4601	6500	6500	6500	6500	4004
2129	MFWKBL	3850	2580	3854	2574	2063	1296	2063	2063	2063	2063	1302
2133	PHDLY1	7690	5150	7690	5150	5150	2570	5150	5150	5150	5150	4146
2134	PHDLY2	8990	8990	8990	8990	8988	12814	8990	8990	8990	8990	12821
2159	CGMAX	4364	4113	3598	3594	2570	3854	3597	3597	3597	3597	5653
2160	CGMPY	2660	2640	2630	2630	2560	2640	2650	2650	2650	2650	2620
2161	OVCSTP	0	128	128	128	128	128	0	0	0	0	128
2162	POVC21	32764	32766	32765	32765	32765	32764	32754	32739	32754	32739	32761
2163	POVC22	45	28	44	37	38	51	174	365	174	365	81
2164	POVCLMT2	1721	5177	7743	6687	6846	6831	3300	6608	3300	6608	8124
2165	MAX CURRENT	165	165	165	165	165	165	365	365	365	365	165
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	23	23	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	0	0	0	0	0	0	0	3641	3641	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	3113	7700	4550	8200	7900	12600	12500	12500	12500	12500	11800
2591	PK2PLS	-7143	-12000	-7700	-11600	-11600	-20500	-19900	-19900	-19900	-19900	-18700
2595	HRV4PLS	1740	1842	1642	1738	1746	1744	1630	1630	1630	1630	1645
Remarks										*8	*8	

	Motor model	αiS60 3000,-B	αiS60 3000 Fan,-B	αiS60 3000-B αiSV 360S-B	αiS60 3000FAN-B αiSV 360S-B	αiS100 2500	αiS100 2500 Fan	αiS150 3000	αiS200 2500	αiS200 2500 Fan	αiS300 2000	αiS300 2000
	Motor specification	0278,2278	0278,2278	2278	2278	0285	0285	2026	0288	0288	0292	2292
	Motor ID No.	456	328	543	544	335	330	701	338	334	342	702
PRM NO	SERVO PRM.										Amp*2	
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2014		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2210		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2211		00001010	00001010	00001010	00001010	00001010	00001010	00011010	00001010	00001010	00001010	00011010
2300		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2560		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2040	CUR GAIN I	1191	1191	1191	1191	1020	1020	1432	1834	1834	1659	1659
2041	CUR GAIN P	-6320	-6320	-6320	-6320	-7093	-7093	-7278	-7805	-7805	-8045	-8045
2042	CUR GAIN 3	-1347	-1347	-1347	-1347	-1359	-1359	-1354	-1360	-1360	-1354	-1354
2043	VEL GAIN I	69	69	69	69	91	91	135	115	115	114	114
2044	VEL GAIN P	-617	-617	-617	-617	-819	-819	-1212	-1026	-1026	-1025	-1025
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	6152	6152	6152	6152	4632	4632	3130	3699	3699	3709	3709
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	4200	4000	4200	4000	3500	3500	3300	3100	3100	2800	2800
2053	DB-CMP PPMAX	31979	31979	31979	31979	21	21	21	21	21	21	21
2054	DB-CMP PDDP	3	3	3	3	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	0	0	0	0	0	0	0	0	0
2057	D-PHASE CUR	-4619	-4619	-4619	-4619	-4368	-4368	-3596	-3090	-3090	-3081	-4114
2058	D-PHASE CUR	-2000	-2000	-2000	-2000	-1359	-1359	-2500	-2700	-2700	-700	-2500
2059	PPBAS	0	0	0	0	-500	-500	-500	-500	-500	-500	-500
2060	TCMD LIMIT	7282	7282	7282	7282	7282	7282	7282	7282	7282	7282	7282
2061	INERTIA	500	500	500	500	664	664	894	832	832	831	831
2062	POVC1	32590	32388	32590	32388	32310	32309	32327	32309	32309	32391	32391
2063	POVC2	2230	4744	2230	4744	5728	5734	5515	5734	5734	4714	4714
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	POVCLMT	6624	14138	6624	14138	15662	27346	26492	27346	27346	23263	23263
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	8192	8192	8192	8192	20480	20480	12288	12288	12288	12288	12288
2086	RATED CURRENT	1326	1937	1326	1937	1960	2848	2652	2712	3013	2386	2386
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	4411	4411	4411	4411	4589	4589	5411	5973	5973	10871	10871
2110	MGSTCM	519	519	519	519	776	776	783	1290	1290	1296	783
2111	TQLIM IN DEC.	5220	5220	5220	5220	3787	3787	3257	0	0	0	2800
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	2852	2852	2852	2852	3520	3520	3817	3518	3518	3817	3817
2128	MFWKCE	5000	5000	5000	5000	6500	6500	1500	4000	4000	7000	1500
2129	MFWKBL	1300	1300	1300	1300	1297	1297	1300	1298	1298	1301	1300
2133	PHDLY1	5150	5150	5150	5150	2570	2570	2572	3092	3092	2574	2572
2134	PHDLY2	8990	8990	8990	8990	8970	8970	7696	12826	12826	12814	7702
2159	CGMAX	6676	6676	6676	6676	0	0	0	4366	4366	0	0
2160	CGMPY	2630	2630	2630	2630	0	0	0	7780	7780	0	0
2161	OVCSTP	0	0	0	0	106	140	140	140	140	140	140
2162	POVC21	32767	32742	32767	32742	32750	32745	32750	32745	32745	32738	32738
2163	POVC22	15	327	15	327	223	292	225	292	292	375	375
2164	POVCLMT2	2799	5973	2799	5973	6581	13952	11193	13952	13952	13952	13952
2165	MAX CURRENT	365	365	365	365	365	365	365	365	365	365	365
2302	TQLIM AT STOP	0	0	23	23	0	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	0	0	21	0	0	0	21
2310	DCIDBS	0	0	0	0	0	0	1648	0	0	0	1648
2316	LIMLIM	0	0	3641	3641	0	0	0	0	0	0	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	10600	10600	10600	10600	0	0	0	9100	9100	0	0
2591	PK2PLS	-18500	-18500	-18500	-18500	0	0	0	-19000	-19000	0	0
2595	HRV4PLS	1631	1631	1631	1631	0	0	0	1327	1327	0	0
Remarks				*8	*8							

	Motor model	□iS 500 2000	□iS 500 2000									
	Motor specification	0295	2295									
	Motor ID No.	345	703									
PRM NO	SERVO PRM.	Amp*2										
2003		00001000	00001000									
2004		00000011	00000011									
2005		00000000	00000000									
2006		00000000	00000000									
2007		00000000	00000000									
2008		00000000	00000000									
2009		00000000	00000000									
2010		00000000	00000000									
2011		00000000	00000000									
2012		00000000	00000000									
2013		00000000	00000000									
2014		00000000	00000000									
2210		00000000	00000000									
2211		00001010	00001010									
2300		00000000	00000000									
2301		00000000	00000000									
2560		00000000	00000000									
2040	CUR GAIN I	2660	2660									
2041	CUR GAIN P	-10235	-10235									
2042	CUR GAIN 3	-1355	-1355									
2043	VEL GAIN I	134	134									
2044	VEL GAIN P	-1199	-1199									
2045	VEL GAIN 3	0	0									
2046	VEL GAIN 4	-8235	-8235									
2047	OBSERVER POA1	3164	3164									
2048	BLACC CMP	0	0									
2049	DPFMX	0	0									
2050	OBSERVER POK1	956	956									
2051	OBSERVER POK2	510	510									
2052	OVER SPEED	2400	2400									
2053	DB-CMP PPMAX	21	21									
2054	DB-CMP PDDP	1894	1894									
2055	DB-CMP PHYST	319	319									
2056	EMFCMP	0	0									
2057	D-PHASE CUR	-2068	-2322									
2058	D-PHASE CUR	-2600	-3000									
2059	PPBAS	-500	-500									
2060	TCMD LIMIT	7282	7282									
2061	INERTIA	972	972									
2062	POVC1	32309	32309									
2063	POVC2	5734	5734									
2064	TGALMLV	4	4									
2065	POVCLMT	27346	27346									
2066	ACC FB GAIN	0	0									
2067	TCMD FILTER	0	0									
2074	AALPH	12288	12288									
2086	RATED CURRENT	2980	2980									
2090	ROBSTL	0	0									
2099	ONEPSL	400	400									
2100	INPA1	0	0									
2101	INPA2	0	0									
2102	DBLIM	0	0									
2103	ABVOF	0	0									
2104	ABTSH	0	0									
2105	TORQUE CONST.	15096	15096									
2110	MGSTCM	1296	1297									
2111	TQLIM IN DEC.	0	2976									
2112	AMRDML	0	0									
2113	HRV FILT	0	0									
2127	NINTCT	4175	4175									
2128	MFWKCE	4000	2700									
2129	MFWKBL	1041	781									
2133	PHDLY1	2069	2069									
2134	PHDLY2	8981	6419									
2159	CGMAX	0	0									
2160	CGMPY	0	0									
2161	OVCSTP	140	140									
2162	POVC21	32745	32745									
2163	POVC22	292	292									
2164	POVCLMT2	13952	13952									
2165	MAX CURRENT	365	365									
2302	TQLIM AT STOP	0	0									
2304	ACCBSLM	0	0									
2305	ACDCEBD	0	0									
2310	DCIDBS	0	1442									
2316	LIMLIM	0	0									
2574	VELOVC	0	0									
2576	DDOVC	0	0									
2590	PK1PLS	0	0									
2591	PK2PLS	0	0									
2595	HRV4PLS	0	0									
Remarks												

10.1.2 αiS-B/αiS Series HV

	Motor model	αiS2 5000HV,-B	αiS2 5000HV,-B 20A	αiS2 6000HV,-B	αiS2 6000HV,-B 20A	αiS4 5000HV,-B	αiS4 5000HV,-B 20A	αiS4 6000HV,-B	αiS4 6000HV,-B 20A	αiS8 4000HV,-B	αiS8 6000HV,-B	αiS12 4000HV,-B
	Motor specification	0213,2213	0213,2213	0219,2219	0219,2219	0216,2216	0216,2216	0214,2214	0214,2214	0236,2236	0233,2233	0239,2239
	Motor ID No.	263	512	287	513	266	514	467	515	286	292	289
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00000000	00001110	00000000	00001110	00000000	00001110	00000000	00001110	00000000	00000000	00000000
2014		00000000	00001110	00000000	00001110	00000000	00001110	00000000	00001110	00000000	00000000	00000000
2210		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2211		00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010
2300		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2560		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2040	CUR GAIN I	400	800	497	994	425	850	432	864	694	381	783
2041	CUR GAIN P	-2312	-4624	-2371	-4742	-1641	-3282	-1673	-3346	-3858	-1749	-4294
2042	CUR GAIN 3	-1251	-1251	-1249	-1249	-1266	-1266	-1266	-1266	-1318	-1305	-1333
2043	VEL GAIN I	39	20	48	24	64	32	77	39	34	53	52
2044	VEL GAIN P	-351	-176	-429	-215	-574	-287	-688	-344	-306	-478	-470
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	-1081	-2162	-884	-1769	-661	-1322	5516	11032	-1240	-794	-808
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	7000	7000	7500	7500	7000	7000	7500	7500	5600	7500	5600
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	0	0	0	0	0	0	0	0	0
2057	D-PHASE CUR	-10252	-10246	-13062	-13060	-10262	-10251	-13326	-13319	-7685	-16398	-5898
2058	D-PHASE CUR	-1600	-800	-1200	-600	-3300	-1650	-2500	-1250	-2000	-1000	-3000
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	7282	3641	7282	3641	7282	3641	7282	3641	7282	7282	7282
2061	INERTIA	285	142	348	174	465	465	569	284	248	387	381
2062	POVC1	32532	32515	32416	32361	32289	31283	32288	31760	32596	32548	32530
2063	POVC2	2953	3164	4405	5087	5994	18563	5995	13253	2153	2755	2976
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	POVCLMT	8782	2196	13123	3286	17889	7504	17893	6343	6396	8192	8848
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	16384	0	20480	0	8192	0	16384	0	8192	8192	8192
2086	RATED CURRENT	1526	763	1866	933	2824	1412	2586	1293	1302	2075	1532
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	117	234	96	192	127	254	104	208	541	346	690
2110	MGSTCM	40	1360	1555	806	40	1360	3092	1576	519	1284	521
2111	TQLIM IN DEC.	10260	10260	11550	11550	10260	10260	8208	8208	7268	10255	6159
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	4548	4548	2302	2302	1293	1293	1368	1368	5103	1600	4904
2128	MFWKCE	1250	2500	2200	4400	3000	6000	3000	6000	4500	1400	2000
2129	MFWKBL	3847	3847	4112	4112	5122	5122	4365	4365	2580	5390	2575
2133	PHDLY1	7690	7685	7690	7685	7685	7682	7690	7690	5150	10260	6174
2134	PHDLY2	12850	6450	7740	3870	12850	6425	12830	6430	8990	12835	8990
2159	CGMAX	3605	8501	5397	13621	2312	5137	2055	4367	6680	7715	6168
2160	CGMPY	5200	2600	5210	2605	6500	3378	2650	1325	2560	5182	2625
2161	OVCSTP	0	0	0	0	0	0	0	0	0	0	0
2162	POVC21	32766	32766	32766	32766	32762	32765	32763	32766	32767	32765	32766
2163	POVC22	20	29	30	28	77	32	63	22	14	38	20
2164	POVCLMT2	3711	1156	5544	1729	12702	3949	10651	2680	2702	6857	3738
2165	MAX CURRENT	10	25	10	25	10	25	10	25	45	45	45
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	4820	7624	4300	6801	2650	4892	3350	6234	8000	2200	7250
2591	PK2PLS	-9000	-15429	-8500	-13444	-6220	-11300	-5900	-10892	-14700	-5000	-12700
2595	HRV4PLS	1635	1930	1635	1635	1641	1634	1634	1634	1737	1550	1636
Remarks			*8		*8		*8		*8			

	Motor model	αiS12 6000HV,-B	αiS22 4000HV,-B	αiS22 6000HV,-B	αiS30 4000HV,-B	αiS40 4000HV,-B	αiS50 2000HV,-B	αiS50 3000HV,-B	αiS50 3000HV Fan,-B	αiS50 3000HV-B αiSV 180HVS-B	αiS50 3000HVFAN-B αiSV 180HVS-B	αiS60 3000HV-B αiSV 180HVS-B
	Motor specification	0237,2237	0266,2266	0263,2263	0269,2269	0273,2273	0043,2043	0276,2276	0276,2276	2276	2276	2279
	Motor ID No.	463	316	453	319	323	469	327	326	531	532	533
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2014		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2210		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2211		00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010
2300		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2560		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2040	CUR GAIN I	471	709	605	816	860	1539	705	705	705	705	1131
2041	CUR GAIN P	-2249	-4008	-2393	-4681	-4938	-7321	-4855	-4855	-4855	-4855	-5966
2042	CUR GAIN 3	-1321	-1345	-1335	-1348	-1350	-1344	-1348	-1348	-1348	-1348	-1345
2043	VEL GAIN I	43	76	102	82	93	90	70	70	70	70	69
2044	VEL GAIN P	-387	-685	-914	-738	-831	-802	-628	-628	-628	-628	-617
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	-980	5538	4150	5143	4569	4731	6039	6039	6039	6039	6152
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	7500	5600	7500	5400	4800	2800	4200	4200	4200	4200	4200
2053	DB-CMP PPMAX	21	21	21	21	21	31979	31979	31979	31979	31979	31979
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	3	3	3	3	3	3
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	0	0	0	0	0	0	0	0	0
2057	D-PHASE CUR	-12808	-7683	-12039	-6412	-5648	-3867	-5638	-5638	-5638	-5638	-4620
2058	D-PHASE CUR	-1800	-1000	-2000	-2300	-3000	-3393	-1000	-1000	-1000	-1000	-2000
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	7282	7282	7282	7282	7282	7282	7282	7282	7282	7282	7282
2061	INERTIA	314	555	741	598	673	649	509	509	509	509	500
2062	POVC1	32688	32501	32501	32501	32501	32501	32554	32371	32554	32371	32590
2063	POVC2	998	3332	3332	3332	3332	3332	2680	4967	2680	4967	2230
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	POVCLMT	2960	9912	9912	9912	9912	9912	7968	14807	7968	14807	6625
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	12288	8192	4096	4096	4096	8192	0	0	0	0	4096
2086	RATED CURRENT	1181	1810	1977	1847	2083	1856	1454	2057	1454	2057	1326
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	837	1093	819	1460	1693	2569	3279	3279	3279	3279	4411
2110	MGSTCM	528	513	1288	775	769	1032	519	519	519	519	519
2111	TQLIM IN DEC.	10260	6194	12830	6430	5682	4954	6174	6174	6174	6174	5220
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	2292	4264	2000	5117	5230	5651	4861	4861	4861	4861	5393
2128	MFWKCE	667	2000	1000	3000	4000	4601	2500	2500	2500	2500	3000
2129	MFWKBL	3850	3092	3854	2574	2063	1296	2068	2068	2068	2068	1300
2133	PHDLY1	7690	5150	7690	5150	5150	2570	5150	5150	5150	5150	5150
2134	PHDLY2	8990	8990	8990	8990	8988	12814	8990	8990	8990	8990	8990
2159	CGMAX	5143	3080	4882	9507	4114	4627	4875	4875	4875	4875	4103
2160	CGMPY	2630	2660	2620	2610	2630	2620	2640	2640	2640	2640	2650
2161	OVCSTP	0	0	0	0	0	0	0	0	0	0	0
2162	POVC21	32764	32766	32765	32766	32765	32764	32754	32738	32754	32738	32767
2163	POVC22	45	28	34	30	38	48	178	373	178	373	15
2164	POVCLMT2	1721	5218	6222	5432	6908	6829	3366	6736	3366	6736	2799
2165	MAX CURRENT	85	85	85	85	85	85	185	185	185	185	185
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	23	23	23
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	0	0	0	0	0	0	0	3641	3641	3641
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	3646	6000	4200	7800	7900	12100	7100	7100	7100	7100	13000
2591	PK2PLS	-6008	-11500	-6800	-13000	-13500	-20200	-13000	-13000	-13000	-13000	-24500
2595	HRV4PLS	1942	1746	1940	1534	1742	1743	1827	1827	1827	1827	921
Remarks									*8	*8	*8	

	Motor model	αiS60 3000HVFAN-B αiSV 180HVS-B	αiS60 2000HV,-B	αiS60 3000HV,-B	αiS60 3000HV Fan,-B	αiS100 2500HV	αiS100 2500HV Fan	αiS150 3000HV-B	αiS200 2500HV	αiS200 2500HV Fan	αiS300 2000HV	αiS300 2000HV-B
	Motor specification	2279	0045,2045	0279,2279	0279,2279	0286	0286	2027	0289	0289	0293	2293
	Motor ID No.	534	471	457	329	336	331	704	339	337	343	705
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	01000011	00000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2011		00000000	00000000	00000000	00000000	00100000	00100000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2014		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2210		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2211		00001010	00001010	00001010	00001010	00000000	00000000	00011010	00001010	00001010	00001010	00011010
2300		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2560		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2040	CUR GAIN I	1131	1358	1131	1131	1790	1790	1406	2080	2080	1327	1327
2041	CUR GAIN P	-5966	-6767	-5966	-5966	-5915	-5915	-6997	-8139	-8139	-7279	-7279
2042	CUR GAIN 3	-1345	-1344	-1345	-1345	-1359	-1359	-1356	-1359	-1359	-1356	-1356
2043	VEL GAIN I	69	103	69	69	91	91	135	115	115	114	114
2044	VEL GAIN P	-617	-925	-617	-617	-819	-819	-1212	-1026	-1026	-1025	-1025
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	6152	4103	6152	6152	4636	4636	3130	3699	3699	3703	3703
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	4000	2700	4200	4000	3500	3500	3300	3100	3100	2800	2800
2053	DB-CMP PPMAX	31979	31979	31979	31979	21	21	21	21	21	21	21
2054	DB-CMP PDDP	3	3	3	3	1894	1894	1894	1894	1894	3787	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	0	0	0	0	0	0	0	0	0
2057	D-PHASE CUR	-4620	-3097	-4620	-4620	-3846	-3846	-4366	-3088	-3088	-3846	-4114
2058	D-PHASE CUR	-2000	-2995	-2000	-2000	-900	-900	-2800	-3000	-3000	-900	-2500
2059	PPBAS	0	0	0	0	-500	-500	-500	-500	-500	-500	-500
2060	TCMD LIMIT	7282	7282	7282	7282	7282	7282	7282	7282	7282	7282	7282
2061	INERTIA	500	764	500	500	664	664	894	832	832	831	831
2062	POVC1	32388	32501	32590	32388	32474	32309	32327	32309	32309	32391	32391
2063	POVC2	4745	3332	2230	4745	3672	5734	5515	5734	5734	4714	4714
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	POVCLMT	14140	9912	6625	14140	15982	27346	26492	27346	27346	23263	23263
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	4096	0	4096	4096	12288	12288	12288	12288	12288	12288	12288
2086	RATED CURRENT	1937	2018	1326	1937	2033	2848	2652	2712	3013	2483	2483
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	10000	10000	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	4411	2942	4411	4411	4423	4423	5411	5973	5973	10871	10871
2110	MGSTCM	519	1544	519	519	1291	1291	783	1291	1291	1296	783
2111	TQLIM IN DEC.	5220	3151	5220	5220	0	0	3247	3428	3428	0	2800
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	5393	5498	5393	5393	6952	6952	3817	6729	6729	7634	7634
2128	MFWKCE	3000	4004	3000	3000	2000	2000	1500	4000	4000	5000	1500
2129	MFWKBL	1300	1302	1300	1300	1549	1549	1300	1551	1551	1298	1300
2133	PHDLY1	5150	4146	5150	5150	0	0	2572	2575	2575	2574	2572
2134	PHDLY2	8990	12821	8990	8990	0	0	8984	8984	8984	12814	7702
2159	CGMAX	4103	5140	4103	4103	0	0	0	0	0	0	0
2160	CGMPY	2650	2620	2650	2650	0	0	0	0	0	0	0
2161	OVCSTP	0	0	0	0	140	140	140	140	140	140	140
2162	POVC21	32742	32764	32767	32742	32759	32745	32750	32745	32745	32738	32738
2163	POVC22	327	51	15	327	112	292	225	292	292	375	375
2164	POVCLMT2	5974	7077	2799	5974	6752	13952	11193	13952	13952	13952	13952
2165	MAX CURRENT	185	85	185	185	185	185	185	185	185	365	365
2302	TQLIM AT STOP	23	0	0	0	0	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	0	0	21	0	0	0	21
2310	DCIDBS	0	0	0	0	0	0	2100	0	0	0	1648
2316	LIMLIM	3641	0	0	0	0	0	0	0	0	0	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	13000	12800	13000	13000	0	0	0	0	0	0	0
2591	PK2PLS	-24500	-20650	-24500	-24500	0	0	0	0	0	0	0
2595	HRV4PLS	921	1238	921	921	0	0	0	0	0	0	0
	Remarks	*8									*1,*2,*3	

	Motor model	αiS300 3000HV,-B	αiS500 2000HV	αiS500 2000HV-B	αiS500 3000HV,-B	αiS1000 2000HV,-B	αiS1000 2000HV	αiS1000 3000HV,-B	αiS1000 3000HV,-B	αiS1500 3000HV-B	αiS2000 2000HV	αiS2000 2000HV
	Motor specification	0290, 2290	0296	2296	0297,2297	0098,2098	0298	0099,2099	0099,2099	2097	0091	0091
	Motor ID No.	344	346	706	347	458	348	350	465	707	454	459
PRM NO	SERVO PRM.					Amp*4	Amp*2	Amp*4(PDM)	Amp*4		Amp*4(PDM)	Amp*4
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		00000011	01000011	00000011	00000011	01000011	01000011	00000011	00000011	01000011	01000011	01000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00001000	00000000	00000000	00001000	00001000	00000000	00001000	00001000	00000000	00000000	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00100000	00100000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00000000	00000000	00000000	00000000	00000000	00000000	00000001	00000000	00000000	00000001	00000000
2014		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2210		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2211		00011010	00001010	00001010	00011010	00011010	00001010	00011010	10011010	00011010	00011110	10011110
2300		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2301		00000000	00000000	00000000	00000000	00000000	00000000	10000000	10000000	10000000	11000000	11000000
2560		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2040	CUR GAIN I	821	2255	2255	1344	1260	840	960	960	692	643	643
2041	CUR GAIN P	-5450	-10049	-10049	-7296	-8010	-5329	-6554	-6554	-4892	-3600	-3600
2042	CUR GAIN 3	-1355	-1356	-1356	-1357	-1362	-1361	-1362	-1362	-907	-1358	-1358
2043	VEL GAIN I	91	134	134	111	263	234	191	191	205	502	502
2044	VEL GAIN P	-819	-1199	-1199	-996	-2357	-2096	-1708	-1708	-1840	-4500	-4500
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	4633	3164	3164	3811	1610	1811	2221	2221	2062	843	843
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	3900	2400	2400	4200	2600	2600	3800	3800	3300	2400	2400
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	3787	1894	1894	3787	3787	1894	1894	3788	3787	3787
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	0	0	0	0	0	0	0	0	0
2057	D-PHASE CUR	-5646	-2070	-2322	-3600	-2320	-2320	-4620	-4620	-3597	-3363	-3363
2058	D-PHASE CUR	-1800	-2700	-3000	-2900	-2500	-2500	-2500	-2500	-3000	-3200	-3200
2059	PPBAS	-500	-500	-500	-500	-500	-500	-500	-500	-500	-500	-500
2060	TCMD LIMIT	7282	7282	7282	7282	7282	7282	7282	7282	7282	7282	7282
2061	INERTIA	672	972	972	807	1736	1699	1385	1385	1529	3648	3648
2062	POVC1	32380	32309	32309	32380	32309	32309	32488	32488	32380	32309	32309
2063	POVC2	4850	5734	5734	4850	5734	5734	3503	3503	4850	5734	5734
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	POVCLMT	12155	27346	27346	12155	27346	27346	18280	18280	12155	27346	27346
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	12288	12288	12288	12288	12288	12288	12288	12288	12288	12288	12288
2086	RATED CURRENT	2000	2980	2980	2482	2960	2834	2599	2599	2402	2893	2893
2090	ROBSTL	0	0	0	0	0	0	0	0	0	2800	2800
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	13494	15096	15096	18125	27963	28573	3807	3807	5622	5957	5957
2110	MGSTCM	523	1293	1297	521	785	1296	1040	1040	787	784	784
2111	TQLIM IN DEC.	2960	0	2976	2953	2300	3172	3242	3242	3233	2022	2022
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	7720	8341	8341	8021	11851	8637	9876	9876	8345	3449	3449
2128	MFWKCE	4300	4500	2700	2500	4500	6000	4500	4500	3000	3000	3000
2129	MFWKBL	1556	788	781	1041	1038	1047	1556	1556	1554	1291	1291
2133	PHDLY1	3100	2324	2069	3093	2570	2580	2580	2580	2570	2060	2060
2134	PHDLY2	6422	8984	6419	6418	12810	8985	6418	6418	6415	12820	12820
2159	CGMAX	0	0	0	0	0	0	0	0	0	0	0
2160	CGMPY	0	0	0	0	0	0	0	0	0	0	0
2161	OVCSTP	140	140	140	140	140	140	140	140	140	140	140
2162	POVC21	32700	32745	32745	32700	32745	32745	32721	32721	32700	32745	32745
2163	POVC22	853	292	292	853	292	292	589	589	853	292	292
2164	POVCLMT2	10644	13952	13952	10644	13952	13952	13952	13952	10644	13952	13952
2165	MAX CURRENT	545	365	365	545	365	365	0	365	545	0	365
2302	TQLIM AT STOP	20	0	0	20	0	0	0	0	20	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	2720	2720
2305	ACDCEBD	29	0	0	32	22	0	29	29	28	4112	4112
2310	DCIDBS	1700	0	1442	1400	1112	0	1648	1648	1648	1236	1236
2316	LIMLIM	5394	0	0	5394	0	0	0	0	5394	0	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	0	0	0	0	0	0	0	0	0	0	0
2591	PK2PLS	0	0	0	0	0	0	0	0	0	0	0
2595	HRV4PLS	0	0	0	0	0	0	0	0	0	0	0
Remarks			*1,*2,*3			*1,*2,*3	*1,*2,*3	*1,*2,*3	*1,*2		*1,*2	*1,*2,*3,*4

	Motor model	αiS2000 2000HV spindle	αiS3000 2000HV	αiS3000 2000HV								
	Motor specification	0091	0092	0092								
	Motor ID No.	476	455	460								
PRM NO	SERVO PRM.	Amp*4	Amp*4(PDM)	Amp*4								
2003		00001000	00001000	00001000								
2004		01000011	01000011	01000011								
2005		00000000	00000000	00000000								
2006		00001000	00000000	00000000								
2007		00100000	00100000	00100000								
2008		00000000	00000000	00000000								
2009		00000000	00000000	00000000								
2010		00000000	00000000	00000000								
2011		00000000	00000000	00000000								
2012		00000000	00000000	00000000								
2013		00000000	00000001	00000000								
2014		00100000	00000000	00000000								
2210		00000000	00000000	00000000								
2211		10011110	00011010	10011010								
2300		00000000	00000000	00000000								
2301		11000000	11000000	11000000								
2560		00000000	00000000	00000000								
2040	CUR GAIN I	643	772	772								
2041	CUR GAIN P	-3600	-3819	-3819								
2042	CUR GAIN 3	-1358	-1357	-1357								
2043	VEL GAIN I	502	652	652								
2044	VEL GAIN P	-4500	-5836	-5836								
2045	VEL GAIN 3	0	0	0								
2046	VEL GAIN 4	-8235	-8235	-8235								
2047	OBSERVER POA1	843	650	650								
2048	BLACC CMP	0	0	0								
2049	DPFMX	0	0	0								
2050	OBSERVER POK1	956	956	956								
2051	OBSERVER POK2	510	510	510								
2052	OVER SPEED	2400	2800	2800								
2053	DB-CMP PPMAX	21	21	21								
2054	DB-CMP PDDP	3787	3787	3787								
2055	DB-CMP PHYST	319	319	319								
2056	EMFCMP	0	0	0								
2057	D-PHASE CUR	-3363	-2088	-2088								
2058	D-PHASE CUR	-3200	-5000	-5000								
2059	PPBAS	-500	-500	-500								
2060	TCMD LIMIT	5097	7282	7282								
2061	INERTIA	3648	4984	4984								
2062	POVC1	32309	32322	32322								
2063	POVC2	5734	5579	5579								
2064	TGALMLV	4	4	4								
2065	POVCLMT	27346	26742	26742								
2066	ACC FB GAIN	0	0	0								
2067	TCMD FILTER	0	0	0								
2074	AALPH	12288	12288	12288								
2086	RATED CURRENT	2893	3187	3187								
2090	ROBSTL	2800	0	0								
2099	ONEPSL	400	400	400								
2100	INPA1	2000	0	0								
2101	INPA2	0	0	0								
2102	DBLIM	0	0	0								
2103	ABVOF	0	0	0								
2104	ABTSH	0	0	0								
2105	TORQUE CONST.	5957	8472	8472								
2110	MGSTCM	784	267	267								
2111	TQLIM IN DEC.	2720	2218	2218								
2112	AMRDML	0	0	0								
2113	HRV FILT	0	0	0								
2127	NINTCT	3449	3029	3029								
2128	MFWKCE	3000	2700	2700								
2129	MFWKBL	1291	777	777								
2133	PHDLY1	2060	2068	2068								
2134	PHDLY2	12820	6410	6410								
2159	CGMAX	0	0	0								
2160	CGMPY	0	0	0								
2161	OVCSTP	140	140	140								
2162	POVC21	32745	32756	32756								
2163	POVC22	292	151	151								
2164	POVCLMT2	13952	13949	13949								
2165	MAX CURRENT	365	0	365								
2302	TQLIM AT STOP	0	0	0								
2304	ACCBSLM	2720	0	0								
2305	ACDCEBD	4112	22	22								
2310	DCIDBS	1236	1112	1112								
2316	LIMLIM	0	0	0								
2574	VELOVC	0	0	0								
2576	DDOVC	0	0	0								
2590	PK1PLS	0	0	0								
2591	PK2PLS	0	0	0								
2595	HRV4PLS	0	0	0								
Remarks		*1,*2	*1,*2									

10.1.3 αiF-B/αiF Series

	Motor model	αiF1 5000,-B	αiF1 5000,-B 40A	αiF2 5000,-B	αiF2 5000,-B 40A	αiF4 5000,-B	αiF4 5000,-B 80A	αiF8 3000,-B	αiF8 3000,-B 80A	αiF8 4000,-B	αiF12 4000,-B	αiF22 3000,-B
	Motor specification	0202,2202	0202,2202	0205,2205	0205,2205	0223,2223	0223,2223	0227,2227	0227,2227	0228,2228	0243,2243	0247,2247
	Motor ID No.	252	500	255	501	273	498	277	499	492	293	297
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2011		00000000	00000000	00000000	00000000	00100000	00100000	00100000	00100000	00000000	00100000	00100000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00000000	00001110	00000000	00001110	00000000	00001110	00000000	00001110	00000000	00000000	00000000
2014		00000000	00001110	00000000	00001110	00000000	00001110	00000000	00001110	00000000	00000000	00000000
2210		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2211		00001010	00001010	00001010	00001010	00000010	00000010	00000000	00000000	00001010	00000000	00000000
2300		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2560		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2040	CUR GAIN I	620	1240	760	1520	993	1986	787	1574	526	1701	1750
2041	CUR GAIN P	-3034	-6068	-3743	-7486	-4260	-8520	-4184	-8368	-3270	-6391	-6000
2042	CUR GAIN 3	-1256	-1256	-1283	-1283	-1311	-1311	-1325	-1325	-1322	-1315	-1345
2043	VEL GAIN I	66	33	76	38	106	53	113	57	90	192	198
2044	VEL GAIN P	-594	-297	-680	-340	-953	-477	-1009	-505	-807	-1721	-1775
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	6384	12768	5578	11156	3980	7960	3760	7520	4704	2204	2137
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	7000	7000	7000	0	6000	6000	4200	4200	5600	4800	3600
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	-5130	-5130	-10	-10	-6430	-6430	0	0	0	0	0
2057	D-PHASE CUR	0	0	-12298	-12293	-10510	-10503	-6420	-6410	-10007	-8199	-5136
2058	D-PHASE CUR	0	0	-1275	-637	-2575	-1287	-2000	-1000	-1593	-747	-2800
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	7282	3641	7282	3641	8010	4005	8010	4005	7282	7282	7282
2061	INERTIA	482	241	551	0	773	386	818	409	654	1395	1439
2062	POVC1	32613	32601	32497	32456	32446	32246	32383	32407	32522	32520	32520
2063	POVC2	1933	2084	3390	3896	4029	4029	4807	4508	3078	3101	3101
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	POVCLMT	5739	1435	10085	2521	11998	2999	14327	3582	9154	9224	9224
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	20480	0	12288	0	8192	0	8192	0	12288	8192	12288
2086	RATED CURRENT	1234	617	1636	818	1784	892	1950	975	1588	2085	2131
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	15000	7500	15000	7500	0	15000	15000
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	72	144	109	218	201	402	369	738	461	517	929
2110	MGSTCM	32	1344	32	1344	1553	802	776	272	1300	32	1291
2111	TQLIM IN DEC.	10260	10260	10280	10280	7712	7712	3870	3870	6500	5191	0
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	1188	1188	1276	1276	1443	1443	2103	2103	1631	2388	3272
2128	MFWKCE	1667	3334	2000	4000	1401	2802	3500	7000	3139	2000	4500
2129	MFWKBL	3858	3858	3862	3862	3335	3335	1815	1815	3089	2568	1301
2133	PHDLY1	7690	7690	7693	7693	7712	7712	0	0	5141	7701	0
2134	PHDLY2	12840	6440	12840	6440	8992	4384	0	0	8981	5141	0
2159	CGMAX	3596	8475	3084	6939	4114	9772	4370	10540	4374	4367	4881
2160	CGMPY	5215	2608	10335	5168	5200	2600	5210	2605	5200	2640	5200
2161	OVCSTP	0	0	0	0	0	0	0	0	0	0	0
2162	POVC21	32767	32767	32766	32766	32766	32766	32765	32766	32765	32765	32765
2163	POVC22	13	11	23	23	27	27	33	23	40	38	40
2164	POVCLMT2	2425	606	4261	1065	5069	1267	6053	1513	5746	6924	7229
2165	MAX CURRENT	25	45	25	45	45	85	45	85	85	85	85
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	1817
2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	4850	8554	5150	9083	6800	11152	9000	14760	7200	9700	14000
2591	PK2PLS	-9000	-15429	-8500	-14992	-7800	-13104	-11000	-18260	-10500	-12200	-15500
2595	HRV4PLS	1635	1635	1531	1531	1528	1528	1532	1532	1939	1944	1239
Remarks			*8		*8					*1		

	Motor model	αiF22 4000,-B	αiF30 4000,-B	αiF40 3000,-B	αiF40 3000 Fan,-B							
	Motor specification	0248,2248	0253,2253	0257,2257	0257,2257							
	Motor ID No.	494	303	307	308							
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000							
2004		00000011	00000011	00000011	00000011							
2005		00000000	00000000	00000000	00000000							
2006		00000000	00000000	00000000	00000000							
2007		00000000	00000000	00000000	00000000							
2008		00000000	00000000	00000000	00000000							
2009		00000000	00000000	00000000	00000000							
2010		00000000	00000000	00000000	00000000							
2011		00000000	00000000	00100000	00100000							
2012		00000000	00000000	00000000	00000000							
2013		00000000	00000000	00000000	00000000							
2014		00000000	00000000	00000000	00000000							
2210		00000000	00000000	00000000	00000000							
2211		00001010	00001010	00001010	00001010							
2300		00000000	00000000	00000000	00000000							
2301		00000000	00000000	00000000	00000000							
2560		00000000	00000000	00000000	00000000							
2040	CUR GAIN I	1214	768	1500	1500							
2041	CUR GAIN P	-5208	-4492	-8224	-8224							
2042	CUR GAIN 3	-1343	-1347	-1348	-1348							
2043	VEL GAIN I	170	230	191	191							
2044	VEL GAIN P	-1523	-2057	-1712	-1712							
2045	VEL GAIN 3	0	0	0	0							
2046	VEL GAIN 4	-8235	-8235	-8235	-8235							
2047	OBSERVER POA1	2492	1845	2216	2216							
2048	BLACC CMP	0	0	0	0							
2049	DPFMX	0	0	0	0							
2050	OBSERVER POK1	956	956	956	956							
2051	OBSERVER POK2	510	510	510	510							
2052	OVER SPEED	4800	4800	4200	4200							
2053	DB-CMP PPMAX	21	21	21	21							
2054	DB-CMP PDDP	1894	1894	1894	1894							
2055	DB-CMP PHYST	319	319	319	319							
2056	EMFCMP	0	-20500	0	0							
2057	D-PHASE CUR	-7696	-7697	-2570	-2570							
2058	D-PHASE CUR	-2574	-2512	-2000	-2000							
2059	PPBAS	0	0	0	0							
2060	TCMD LIMIT	7282	7282	7282	7282							
2061	INERTIA	1234	1667	1388	1388							
2062	POVC1	32487	32515	32515	32431							
2063	POVC2	3517	3166	3166	4212							
2064	TGALMLV	4	4	4	4							
2065	POVCLMT	9418	9418	9418	12545							
2066	ACC FB GAIN	0	0	0	0							
2067	TCMD FILTER	0	0	0	0							
2074	AALPH	8192	4096	0	0							
2086	RATED CURRENT	1827	2306	1957	2593							
2090	ROBSTL	0	0	0	0							
2099	ONEPSL	400	400	400	400							
2100	INPA1	0	0	0	0							
2101	INPA2	0	0	0	0							
2102	DBLIM	0	0	12000	12000							
2103	ABVOF	0	0	0	0							
2104	ABTSH	0	0	0	0							
2105	TORQUE CONST.	1083	1170	1839	1839							
2110	MGSTCM	1547	1815	1291	1291							
2111	TQLIM IN DEC.	5495	0	5220	5140							
2112	AMRDML	0	0	0	0							
2113	HRV FILT	0	0	0	0							
2127	NINTCT	2226	1688	3041	3041							
2128	MFWKCE	5518	2500	6000	2000							
2129	MFWKBL	2326	2829	1560	1553							
2133	PHDLY1	5141	5140	2590	3085							
2134	PHDLY2	8981	8995	8990	8990							
2159	CGMAX	5141	2829	3856	3856							
2160	CGMPY	5200	5210	5210	5210							
2161	OVCSTP	128	128	128	128							
2162	POVC21	32762	32764	32764	32717							
2163	POVC22	75	48	46	637							
2164	POVCLMT2	7898	8124	8124	10815							
2165	MAX CURRENT	165	165	165	165							
2302	TQLIM AT STOP	0	0	0	0							
2304	ACCBSLM	0	0	0	0							
2305	ACDCEBD	0	0	0	0							
2310	DCIDBS	0	0	0	0							
2316	LIMLIM	0	0	0	0							
2574	VELOVC	0	0	0	0							
2576	DDOVC	0	0	0	0							
2590	PK1PLS	9000	7800	13200	13200							
2591	PK2PLS	-13000	-11800	-21500	-21500							
2595	HRV4PLS	1734	1636	1642	1642							
Remarks												

10.1.4 αiF-B/αiF Series HV

	Motor model	αiF4 5000HV,-B	αiF4 5000HV,-B 40A	αiF8 3000HV,-B	αiF8 3000HV,-B 40A	αiF8 4000HV,-B	αiF12 4000HV,-B	αiF22 3000HV,-B	αiF22 4000HV,-B	αiF30 4000HV,-B	αiF40 3000HV,-B	αiF40 3000HV Fan,-B
	Motor specification	0225,2225	0225,2225	0229,2229	0229,2229	0220,2220	0245,2245	0249,2249	0240,2240	0255,2255	0259,2259	0259,2259
	Motor ID No.	275	516	279	517	493	295	299	495	304	309	479
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2011		00000000	00000000	00000000	00000000	00000000	00100000	00100000	00000000	00100000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00000000	00001110	00000000	00001110	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2014		00000000	00001110	00000000	00001110	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2210		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2211		00001010	00001010	00001010	00001010	00001010	00000000	00000000	00001010	00001010	00011010	00011010
2300		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2560		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2040	CUR GAIN I	570	1140	1222	2444	526	1200	1919	1214	785	1441	1441
2041	CUR GAIN P	-3578	-7156	-5890	-11780	-3270	-6059	-9132	-5208	-4179	-7513	-7513
2042	CUR GAIN 3	-1309	-1309	-1322	-1322	-1322	-1339	-1346	-1343	-1347	-1350	-1350
2043	VEL GAIN I	113	57	113	57	90	193	197	170	225	188	188
2044	VEL GAIN P	-1009	-505	-1008	-504	-807	-1727	-1765	-1523	-2016	-1684	-1684
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	3762	7524	3764	7528	4704	2197	2150	2492	-1882	2253	2253
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	6000	6000	3900	3900	5600	4800	3600	4800	4800	3600	3600
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	0	0	0	0	0	0	0	0	0
2057	D-PHASE CUR	-11788	-11782	-6159	-6151	-10007	-8203	-5136	-7696	-7697	-5137	-5137
2058	D-PHASE CUR	-1734	-867	-1261	-630	-1593	-1178	-2824	-2574	-2512	-2027	-2027
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	7282	3641	8010	4005	7282	7282	7282	7282	7282	7282	7282
2061	INERTIA	818	409	817	408	654	1400	1430	1234	1634	1387	1387
2062	POVC1	32433	32433	32433	32433	32522	32548	32548	32487	32501	32501	32501
2063	POVC2	4184	4188	4184	4188	3078	2755	2755	3517	3332	3332	3332
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	POVCLMT	12461	3113	12461	3110	9154	8192	8192	9418	9912	9912	9912
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	12288	0	12288	0	12288	12288	8192	8192	12288	8192	8192
2086	RATED CURRENT	1888	944	1948	974	1588	2092	2118	1827	2259	1876	2607
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	15000	15000	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	190	380	369	738	461	516	934	1083	2215	1869	1869
2110	MGSTCM	1553	802	782	284	1300	774	787	1547	1815	1044	1044
2111	TQLIM IN DEC.	10300	10300	0	0	6500	5191	0	5495	0	4241	4241
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	2573	2573	4191	4191	1631	4787	6547	2226	3354	6538	6538
2128	MFWKCE	1001	2002	6000	12000	3139	4000	6000	5518	3000	6147	6147
2129	MFWKBL	2568	2568	1810	1810	3089	2320	1808	2326	2833	1809	1809
2133	PHDLY1	8220	8220	5150	5150	5141	7701	0	5141	5150	3594	3594
2134	PHDLY2	8990	6430	8990	6430	8981	5141	0	8981	8990	6414	6414
2159	CGMAX	4369	7449	4371	11039	4375	4627	3601	4114	3343	4626	4626
2160	CGMPY	5210	2610	5210	2610	5200	2630	5210	5210	5210	5200	5200
2161	OVCSTP	0	0	0	0	0	0	0	0	0	0	0
2162	POVC21	32766	32766	32765	32765	32765	32765	32765	32762	32763	32762	32763
2163	POVC22	31	25	33	38	40	39	40	75	58	78	58
2164	POVCLMT2	5676	1416	6042	1511	5746	6969	7142	7898	9912	8288	9912
2165	MAX CURRENT	25	45	25	45	45	45	45	85	85	85	85
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	0	0	0	0	0	36	36
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	5200	8450	9500	16500	7200	10700	12000	9200	7000	13000	13000
2591	PK2PLS	-9000	-15500	-14000	-25000	-11000	-15500	-14000	-14000	-12000	-24000	-24000
2595	HRV4PLS	1422	1638	1324	1629	1839	1442	1436	1735	1839	1540	1540
Remarks			*8		*8						*2	*2

10.1.5 αC*i* Series

	Motor model	αC4 3000i	αC8 2000i	αC12 2000i	αC22 2000i	αC30 1500i						
	Motor specification	0221	0226	0241	0246	0251						
	Motor ID No.	271	276	291	296	301						
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000						
2004		00000011	00000011	00000011	00000011	00000011						
2005		00000000	00000000	00000000	00000000	00000000						
2006		00000000	00000000	00000000	00000000	00000000						
2007		00000000	00000000	00000000	00000000	00000000						
2008		00000000	00000000	00000000	00000000	00000000						
2009		00000000	00000000	00000000	00000000	00000000						
2010		00000000	00000000	00000000	00000000	00000000						
2011		00000000	00000000	00100000	00000000	00000000						
2012		00000000	00000000	00000000	00000000	00000000						
2013		00000000	00000000	00000000	00000000	00000000						
2014		00000000	00000000	00000000	00000000	00000000						
2210		00000000	00000000	00000000	00000000	00000000						
2211		00001010	00001010	00000010	00001010	00001010						
2300		00000000	00000000	00000000	00000000	00000000						
2301		00000000	00000000	00000000	00000000	00000000						
2560		00000000	00000000	00000000	00000000	00000000						
2040	CUR GAIN I	1240	1276	1875	2320	2238						
2041	CUR GAIN P	-6415	-6288	-9137	-10593	-13330						
2042	CUR GAIN 3	-1309	-1326	-1339	-1347	-1347						
2043	VEL GAIN I	115	150	280	271	166						
2044	VEL GAIN P	-1034	-1342	-2504	-2426	-1486						
2045	VEL GAIN 3	0	0	0	0	0						
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235						
2047	OBSERVER POA1	3670	2827	1516	1565	2553						
2048	BLACC CMP	0	0	0	0	0						
2049	DPFMX	0	0	0	0	0						
2050	OBSERVER POK1	956	956	956	956	956						
2051	OBSERVER POK2	510	510	510	510	510						
2052	OVER SPEED	4200	2800	2800	2400	2100						
2053	DB-CMP PPMAX	21	21	21	21	21						
2054	DB-CMP PDDP	1894	1894	1894	1894	1894						
2055	DB-CMP PHYST	319	319	319	319	319						
2056	EMFCMP	0	0	0	0	0						
2057	D-PHASE CUR	-5915	-3854	-1804	-2597	-1545						
2058	D-PHASE CUR	-1500	-1236	-2500	-1942	-1300						
2059	PPBAS	0	0	0	0	0						
2060	TCMD LIMIT	7282	7282	7282	8010	7282						
2061	INERTIA	838	1088	2030	1966	1205						
2062	POVC1	32406	32289	32289	32114	32520						
2063	POVC2	4529	5994	5994	8171	3101						
2064	TGALMLV	4	4	4	4	4						
2065	POVCLMT	13493	17889	17889	24454	9224						
2066	ACC FB GAIN	0	0	0	0	0						
2067	TCMD FILTER	0	0	0	0	0						
2074	AALPH	12288	8192	8192	4096	8192						
2086	RATED CURRENT	1892	2593	3020	2911	1655						
2090	ROBSTL	0	0	0	0	0						
2099	ONEPSL	400	400	400	400	400						
2100	INPA1	0	0	0	0	0						
2101	INPA2	0	0	0	0	0						
2102	DBLIM	0	0	15000	0	0						
2103	ABVOF	0	0	0	0	0						
2104	ABTSH	0	0	0	0	0						
2105	TORQUE CONST.	190	277	350	680	1630						
2110	MGSTCM	1289	1552	0	1548	2059						
2111	TQLIM IN DEC.	3900	3880	2168	2600	2148						
2112	AMRDML	0	0	0	0	0						
2113	HRV FILT	0	0	0	0	0						
2127	NINTCT	2544	2380	4150	3695	6680						
2128	MFWKCE	5000	4500	12000	4000	14000						
2129	MFWKBL	1812	1550	1044	1046	539						
2133	PHDLY1	3855	3860	5150	2070	1054						
2134	PHDLY2	8995	8990	8990	9000	9000						
2159	CGMAX	0	0	0	0	0						
2160	CGMPY	0	0	0	0	0						
2161	OVCSTP	0	0	0	0	0						
2162	POVC21	32766	32763	32761	32761	32766						
2163	POVC22	31	63	91	83	23						
2164	POVCLMT2	5701	10709	14518	13493	4361						
2165	MAX CURRENT	25	25	25	45	85						
2302	TQLIM AT STOP	0	0	0	0	0						
2304	ACCBSLM	0	0	0	0	0						
2305	ACDCEBD	0	0	0	0	0						
2310	DCIDBS	0	0	0	0	0						
2316	LIMLIM	0	0	0	0	0						
2574	VELOVC	0	0	0	0	0						
2576	DDOVC	0	0	0	0	0						
2590	PK1PLS	0	0	0	0	0						
2591	PK2PLS	0	0	0	0	0						
2595	HRV4PLS	0	0	0	0	0						
	Remarks											

10.2 STANDARD PARAMETERS FOR THE β*i*-B/β*i* SERIES SERVO MOTORS

Series 90G0, 90J0, 90K0, 90GP, and 90JP (for Series 30*i*/31*i*/32*i*/35*i*-B, Power Motion *i*-A, DSA-B)
Series 90E0 and 90E1 (for Series 30*i*/31*i*/32*i*-A)
Series 90D0 (for Series 30*i*/31*i*-A)
Series 90M0, 90L0, 90M8, and 90L8 (for Series 0*i*-F)
Series 90C5 and 90C8 (for Series 0*i*-D)
Series 90E5 and 90E8 (for Series 0*i*-D)
Series 90H0 (for Series 0*i* Mate-D)

* If a motor specification is also indicated, the same parameter is used for both the conventional motor and the "-B" motor.

10.2.1 βiS-B/βiS Series

	Motor model	βiS0.2 5000	βiS0.3 5000	βiS0.4 5000,-B	βiS0.4 5000,-B 40A	βiS0.5 6000,-B	βiS0.5 6000,-B 40A	βiS0.5 6000-B	βiS1 6000,-B	βiS1 6000,-B 40A	βiS1 6000-B	βiS1.5 6000-B
	Motor specification	0111	0112	0114,2114	0114,2114	0115,2115	0115,2115	2015	0116,2116	0116,2116	2017	2019
	Motor ID No.	260	261	280	506	281	507	545	282	508	547	549
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		00000011	00000011	00000011	00000011	00000011	00000011	10000011	00000011	00000011	10000011	10000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00000000	00000000	00000000	00001110	00000000	00001110	00000000	00000000	00001110	00000000	00000000
2014		00000000	00000000	00000000	00001110	00000000	00001110	00000000	00000000	00001110	00000000	00000000
2210		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2211		00000010	00000010	00000010	00000010	00001010	00001010	00000010	00001010	00001010	00000010	00000010
2300		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2301		00000000	00000000	00000000	00000000	00000000	00000000	01000010	00000000	00000000	01000010	01000010
2560		00000000	00000000	00000000	00000000	00000000	00000000	00100000	00000000	00000000	00100000	00100000
2561		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2562		00000000	00000000	00000000	00000000	00000000	00000000	00000100	00000000	00000000	00000100	00000100
2563		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2040	CUR GAIN I	123	210	100	200	138	276	335	312	624	640	540
2041	CUR GAIN P	-510	-970	-430	-860	-673	-1346	-1130	-1360	-2720	-2400	-1760
2042	CUR GAIN 3	-1069	-1146	-2463	-2463	-1205	-1205	-1195	-1203	-1203	-1219	-1295
2043	VEL GAIN I	4	4	7	3	7	4	10	6	3	9	14
2044	VEL GAIN P	-36	-33	-61	-30	-59	-30	-89	-53	-26	-81	-122
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	-10638	-11550	-6249	-12498	-6462	-12924	-4286	-7176	-14353	-4708	-3117
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	7000	7000	7000	0	7500	0	7500	7500	7500	7500	7500
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	-12850	-12850	-12850	-12850	0	-12850	-12850	0	0
2057	D-PHASE CUR	0	0	0	0	0	0	-7681	-15114	-15109	-12805	-12806
2058	D-PHASE CUR	0	0	0	0	0	0	-250	-1200	-600	-1500	-1300
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	7282	7282	5826	2913	7282	3641	6554	7282	3641	6554	7282
2061	INERTIA	29	27	49	0	48	0	72	43	0	65	99
2062	POVC1	32725	32725	32640	32547	32674	32673	32671	32695	32695	32685	32630
2063	POVC2	533	533	1603	2764	1178	1193	1218	915	916	1031	1724
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	POVCLMT	3163	3163	4759	1190	3497	874	2801	2714	678	2387	4809
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	20480	20480	20480	0	20480	0	0	20480	0	0	0
2086	RATED CURRENT	1929	1929	1605	802	1376	688	1379	1212	606	1273	1807
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	7	14	22	44	42	84	41	89	178	84	82
2110	MGSTCM	1	1	30	1340	25	1330	262	1556	808	276	266
2111	TQLIM IN DEC.	7710	7700	10290	10290	10290	10290	0	10290	10290	0	0
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	379	852	400	400	504	504	538	881	881	1017	1162
2128	MFWKCE	0	3000	0	0	0	0	512	1500	3000	3072	1024
2129	MFWKBL	0	3880	0	0	0	0	3865	5135	5135	3855	3865
2133	PHDLY1	7700	7695	7690	7690	7690	7690	10241	15400	15400	5123	8968
2134	PHDLY2	12825	12840	12820	6420	12820	6420	6405	12840	6440	15380	14090
2159	CGMAX	0	0	0	0	0	0	5151	0	0	6689	4387
2160	CGMPY	0	0	0	0	0	0	5210	0	0	2660	10340
2161	OVCSTP	0	0	0	0	0	0	110	0	0	110	110
2162	POVC21	0	0	32766	32765	32767	32767	32763	32767	32767	32763	32763
2163	POVC22	0	0	22	37	16	16	68	12	12	68	68
2164	POVCLMT2	0	0	4104	1026	3015	754	2169	2340	585	1849	3724
2165	MAX CURRENT	4	4	25	45	25	45	25	25	45	25	25
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	0	0	0	0	0	0	1500	0	0	2600	1750
2591	PK2PLS	0	0	0	0	0	0	-2600	0	0	-4750	-2915
2595	HRV4PLS	0	0	0	0	0	0	1828	0	0	2138	1215
Remarks					*8		*8	*9		*8	*9	*9

	Motor model	βiS2 4000,-B	βiS2 4000,-B 40A	βiS2 4000,-B FS0i	βiS2 4000,-B FS0i,40A	βiS4 4000,-B	βiS4 4000,-B 40A	βiS4 4000,-B FS0i	βiS4 4000,-B FS0i,40A	βiS8 3000,-B	βiS8 3000,-B 40A	βiS8 3000,-B FS0i
	Motor specification	0061-Bxx3 2061-Bxx3	0061-Bxx3 2061-Bxx3	0061-Bxx7 2061-Bxx7	0061-Bxx7 2061-Bxx7	0063-Bxx3 2063-Bxx3	0063-Bxx3 2063-Bxx3	0063-Bxx7 2063-Bxx7	0063-Bxx7 2063-Bxx7	0075-Bxx3 2075-Bxx3	0075-Bxx3 2075-Bxx3	0075-Bxx7 2075-Bxx7
	Motor ID No.	253	254	306	310	256	257	311	312	258	259	283
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00000100	00010000	00000100	00010000	00000000	00001110	00000000	00001110	00000000	00001110	00000000
2014		00000100	00010000	00000100	00010000	00000000	00001110	00000000	00001110	00000000	00001110	00000000
2210		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2211		00001110	00001110	00001110	00001110	00001110	00001110	00001110	00001110	00001110	00001110	00001110
2300		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2560		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2561		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2562		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2563		01000000	01000000	01000000	01000000	01000000	01000000	01000000	01000000	01000000	01000000	01000000
2040	CUR GAIN I	360	720	360	720	400	800	400	800	650	1160	650
2041	CUR GAIN P	-1920	-3840	-1920	-3840	-1920	-3840	-1920	-3840	-3831	-5600	-3831
2042	CUR GAIN 3	-1237	-1237	-1237	-1237	-1253	-1253	-1253	-1253	-1299	-1299	-1299
2043	VEL GAIN I	78	39	78	39	112	56	112	56	164	82	164
2044	VEL GAIN P	-698	-349	-698	-349	-1008	-504	-1008	-504	-1476	-738	-1476
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	-1089	-2178	-1089	-2178	-753	-1506	-753	-1506	5143	-1029	5143
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	5600	5600	5600	5600	5600	5600	5600	5600	4200	4200	4200
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	0	0	0	0	0	0	-2570	0	-2570
2057	D-PHASE CUR	-10250	-10245	-10250	-10245	-7694	-7687	-7694	-7687	-5140	-5131	-5140
2058	D-PHASE CUR	-1000	-500	-1000	-500	-2800	-1400	-2800	-1400	-3200	-1600	-3200
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	6554	3277	6554	3277	7282	3641	7282	3641	7282	3641	7282
2061	INERTIA	283	141	283	141	408	204	408	204	598	299	598
2062	POVC1	32531	32531	32652	32739	32289	32289	32532	32709	32289	32289	32381
2063	POVC2	2963	2963	1455	364	5988	5988	2945	738	5994	5994	4835
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	POVCLMT	8811	2203	4317	1079	17873	4468	8758	2189	17889	4472	14410
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	16384	0	16384	0	20480	0	20480	0	16384	0	16384
2086	RATED CURRENT	1529	764	1529	764	2178	1089	2178	1089	2780	1390	2780
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	119	238	119	238	146	292	146	292	226	452	226
2110	MGSTCM	1048	815	1048	815	780	532	780	532	1807	1045	1807
2111	TQLIM IN DEC.	11600	11600	11600	11600	7790	7790	7790	7790	7930	7930	7930
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	1172	1172	1172	1172	796	796	796	796	1442	1442	1442
2128	MFWKCE	2500	5000	2500	5000	3000	6000	3000	6000	3500	7000	3500
2129	MFWKBL	3358	3358	3358	3358	3392	3392	3392	3392	1298	1298	1298
2133	PHDLY1	7192	7192	7192	7192	8992	8992	8992	8992	3858	3858	3858
2134	PHDLY2	8990	8990	8990	8990	12864	9024	12864	9024	8990	8990	8990
2159	CGMAX	4626	11815	4626	11815	2569	4369	2569	4369	2571	4630	2571
2160	CGMPY	2650	2607	2650	2607	5210	2620	5210	2620	2650	2610	2650
2161	OVCSTP	0	0	120	120	0	0	120	120	0	0	0
2162	POVC21	32766	32766	32757	32765	32765	32765	32745	32762	32762	32762	32764
2163	POVC22	20	20	140	34	42	42	294	70	74	74	51
2164	POVCLMT2	3723	931	2665	666	7551	1888	5407	1352	12305	3076	8896
2165	MAX CURRENT	25	45	25	45	25	45	25	45	25	45	25
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	4770	8300	4770	8300	3470	7400	3470	7400	6400	11400	6400
2591	PK2PLS	-8800	-15200	-8800	-15200	-6500	-12000	-6500	-12000	-9800	-16600	-9800
2595	HRV4PLS	1637	1333	1637	1333	1634	1533	1634	1533	1730	1429	1730
Remarks												

	Motor model	βiS8 3000,-B FS0i,40A	βiS12 2000,-B	βiS12 2000,-B 40A	βiS12 2000,-B FS0i	βiS12 2000,-B FS0i,40A	βiS12 3000,-B	βiS12 3000,-B (80A)	βiS22 1500 FS0i	βiS22 1500 FS0i,40A	βiS22 2000,-B	βiS22 2000,-B (80A)
	Motor specification	0075-Bxx7 2075-Bxx7	0077-Bxx3 2077-Bxx3	0077-Bxx3 2077-Bxx3	0077-Bxx7 2077-Bxx7	0077-Bxx7 2077-Bxx7	0078,2078	0078,2078	0084-Bxx6	0084-Bxx6	0085,2085	0085,2085
	Motor ID No.	294	269	268	298	300	272	477	302	305	274	478
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00001110	00000000	00001110	00000000	00001110	00000000	00001110	00000000	00001110	00000000	00001110
2014		00001110	00000000	00001110	00000000	00001110	00000000	00001110	00000000	00001110	00000000	00001110
2210		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2211		00001110	00001110	00001110	00001110	00001110	00001110	00001110	00001110	00001110	00001110	00001110
2300		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2560		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2561		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2562		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2563		01000000	01000000	01000000	01000000	01000000	01000000	01000000	01000000	01000000	01000000	01000000
2040	CUR GAIN I	1160	547	1094	547	1094	402	804	2171	4342	1184	2368
2041	CUR GAIN P	-5600	-3289	-6578	-3289	-6578	-2217	-4434	-8178	-16356	-6800	-13600
2042	CUR GAIN 3	-1299	-1305	-1305	-1305	-1305	-1304	-1304	-1329	-1329	-1331	-1331
2043	VEL GAIN I	82	230	115	230	115	170	85	280	140	242	121
2044	VEL GAIN P	-738	-2054	-1027	-2054	-1027	-1530	-765	-2507	-1254	-2172	-1086
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	-1029	3695	7390	3695	7390	4960	9920	3027	6054	3496	6992
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	4200	2800	2800	2800	2800	4200	4200	1800	1800	2800	2800
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	0	0	0	0	0	0	0	-5130	-5130
2057	D-PHASE CUR	-5131	-3884	-3862	-3884	-3862	-5140	-5130	-2110	-2079	-3612	-3598
2058	D-PHASE CUR	-1600	-4350	-2175	-4350	-2175	-3500	-1750	-4691	-2342	-3000	-1500
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	3641	7282	3641	7282	3641	7282	3641	7282	3641	7282	3641
2061	INERTIA	299	833	416	834	416	620	310	1016	508	880	440
2062	POVC1	32671	32284	32646	32323	32646	32205	31932	32319	32655	32106	31744
2063	POVC2	1214	6045	1525	5566	1525	7041	10454	5617	1411	8275	12801
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	POVCLMT	3603	18045	4511	16603	4511	21044	5230	16756	4189	24770	6422
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	0	8192	0	8192	0	16384	0	8192	0	16384	0
2086	RATED CURRENT	1390	3126	1563	3126	1563	2363	1181	3012	1506	2618	1309
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	452	315	630	315	630	418	836	597	1194	692	1384
2110	MGSTCM	1045	1	1282	1	1282	1814	812	1025	514	0	1280
2111	TQLIM IN DEC.	7930	3940	3940	3940	3940	7930	7930	2248	2248	2866	2866
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	1442	1350	1350	1350	1350	1194	1194	3290	3290	2459	2459
2128	MFWKCE	7000	4000	8000	4000	8000	3000	6000	5500	11000	5000	10000
2129	MFWKBL	1298	280	280	280	280	2056	2056	1032	1032	562	562
2133	PHDLY1	3858	3614	3614	3614	3614	5138	5138	2580	2580	3350	3350
2134	PHDLY2	8990	8980	4372	8980	4372	8990	4382	8990	4382	8979	4371
2159	CGMAX	4630	2825	4886	2825	4886	3344	7193	0	0	3597	6170
2160	CGMPY	2610	2660	2610	2660	2610	5200	2610	0	0	2630	1320
2161	OVCSTP	0	0	0	0	0	0	0	0	0	0	0
2162	POVC21	32767	32760	32766	32763	32767	32764	32766	32763	32767	32763	32766
2163	POVC22	12	99	21	60	15	51	31	60	14	64	31
2164	POVCLMT2	2224	15559	3890	10250	2785	8891	2752	10345	2586	10913	3379
2165	MAX CURRENT	45	25	45	25	45	45	85	25	45	45	85
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	11400	5280	11000	5280	11000	5200	8800	0	0	10500	19800
2591	PK2PLS	-16600	-8300	-19000	-8300	-19000	-8500	-16300	0	0	-18600	-25500
2595	HRV4PLS	1429	1732	1328	1732	1328	1632	1441	0	0	1331	1134
Remarks												

	Motor model	βiS22 3000,-B	βiS22 3000-B Torque Up	βiS30 2000,-B	βiS30 2000-B Torque Up	βiS40 2000,-B	βiS40 2000-B Torque Up					
	Motor specification	0082,2082	2082	0087,2087	2087	0089,2089	2089					
	Motor ID No.	313	535	472	537	474	539					
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000					
2004		00000011	00000011	00000011	00000011	00000011	00000011					
2005		00000000	00000000	00000000	00000000	00000000	00000000					
2006		00000000	00000000	00000000	00000000	00000000	00000000					
2007		00000000	00000000	00000000	00000000	00000000	00000000					
2008		00000000	00000000	00000000	00000000	00000000	00000000					
2009		00000000	00000000	00000000	00000000	00000000	00000000					
2010		00000000	00000000	00000000	00000000	00000000	00000000					
2011		00000000	00000000	00000000	00000000	00000000	00000000					
2012		00000000	00000000	00000000	00000000	00000000	00000000					
2013		00001000	00000000	00000010	00000000	00000010	00000000					
2014		00001000	00000000	00000010	00000000	00000010	00000000					
2210		00000000	00000000	00000000	00000000	00000000	00000000					
2211		00001110	00001010	00001010	00001010	00001010	00001010					
2300		00000000	00000000	00000000	00000000	00000000	00000000					
2301		00000000	00000000	00000000	00000000	00000000	00000000					
2560		00000000	00000000	00000000	00000000	00000000	00000000					
2561		00000000	00000000	00000000	00000000	00000000	00000000					
2562		00000000	00000000	00000000	00000000	00000000	00000000					
2563		01000000	01000000	01000000	01000000	01000000	01000000					
2040	CUR GAIN I	1157	1157	1650	1650	1624	1624					
2041	CUR GAIN P	-5102	-5102	-6565	-6565	-7197	-7197					
2042	CUR GAIN 3	-1332	-1332	-2681	-2681	-1341	-1341					
2043	VEL GAIN I	198	198	214	214	208	208					
2044	VEL GAIN P	-1766	-1766	-1912	-1912	-1870	-1870					
2045	VEL GAIN 3	0	0	0	0	0	0					
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235					
2047	OBSERVER POA1	4297	4297	3971	3971	4057	4057					
2048	BLACC CMP	0	0	0	0	0	0					
2049	DPFMX	0	0	0	0	0	0					
2050	OBSERVER POK1	956	956	956	956	956	956					
2051	OBSERVER POK2	510	510	510	510	510	510					
2052	OVER SPEED	4200	4200	2800	2800	2600	2600					
2053	DB-CMP PPMAX	21	21	21	21	21	21					
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894					
2055	DB-CMP PHYST	319	319	319	319	319	319					
2056	EMFCMP	0	0	0	0	0	0					
2057	D-PHASE CUR	-6174	-6174	-4647	-4647	-3881	-3881					
2058	D-PHASE CUR	-2843	-2843	-3115	-3115	-3732	-3732					
2059	PPBAS	0	0	0	0	0	0					
2060	TCMD LIMIT	5462	7282	6554	7282	6554	7282					
2061	INERTIA	716	716	775	775	758	758					
2062	POVC1	32520	32520	32413	32413	32413	32413					
2063	POVC2	3097	3097	4431	4431	4431	4431					
2064	TGALMLV	4	4	4	4	4	4					
2065	POVCLMT	9212	9212	13201	13201	13201	13201					
2066	ACC FB GAIN	0	0	0	0	0	0					
2067	TCMD FILTER	0	0	0	0	0	0					
2074	AALPH	12288	12288	8192	8192	8192	8192					
2086	RATED CURRENT	2121	2121	2154	2154	2154	2154					
2090	ROBSTL	0	0	0	0	0	0					
2099	ONEPSL	400	400	400	400	400	400					
2100	INPA1	0	0	0	0	0	0					
2101	INPA2	0	0	0	0	0	0					
2102	DBLIM	0	0	0	0	0	0					
2103	ABVOF	0	0	0	0	0	0					
2104	ABTSH	0	0	0	0	0	0					
2105	TORQUE CONST.	848	848	1127	1127	1503	1503					
2110	MGSTCM	1289	1289	1546	1546	263	263					
2111	TQLIM IN DEC.	7268	5016	4255	4054	3065	2815					
2112	AMRDML	0	0	0	0	0	0					
2113	HRV FILT	0	0	0	0	0	0					
2127	NINTCT	1967	1967	2095	2095	2712	2712					
2128	MFWKCE	6000	6000	3066	3066	3354	3354					
2129	MFWKBL	2315	2315	1548	1548	1038	1038					
2133	PHDLY1	5647	5647	4110	4110	2567	2567					
2134	PHDLY2	12820	12820	12814	12814	8967	8967					
2159	CGMAX	6422	6422	5138	5138	5652	5652					
2160	CGMPY	2610	2610	2620	2620	2620	2620					
2161	OVCSTP	0	0	0	0	0	0					
2162	POVC21	32765	32765	32765	32765	32765	32765					
2163	POVC22	40	40	34	34	36	36					
2164	POVCLMT2	7166	7166	7387	7387	7713	7713					
2165	MAX CURRENT	85	85	85	85	85	85					
2302	TQLIM AT STOP	0	0	0	0	0	0					
2304	ACCBSLM	0	0	0	0	0	0					
2305	ACDCEBD	0	0	0	0	0	0					
2310	DCIDBS	0	0	0	0	823	823					
2316	LIMLIM	0	0	0	0	0	0					
2574	VELOVC	0	0	0	0	0	0					
2576	DDOVC	0	0	0	0	0	0					
2590	PK1PLS	7650	7650	13100	13100	12100	12100					
2591	PK2PLS	-13760	-13760	-18500	-18500	-18500	-18500					
2595	HRV4PLS	1643	1643	1541	1541	1441	1441					
Remarks			*8		*8		*8					

10.2.2 βiS-B/βiS Series HV

	Motor model	βiS0.5 6000HV-B	βiS1 6000HV-B	βiS1.5 6000HV-B	βiS2 4000HV,-B	βiS2 4000HV,-B 20A	βiS4 4000HV,-B	βiS4 4000HV,-B 20A	βiS8 3000HV,-B	βiS8 3000HV,-B 20A	βiS12 3000HV,-B	βiS12 3000HV,-B 40A
	Motor specification	2016	2018	2020	0062,2062	0062,2062	0064,2064	0064,2064	0076,2076	0076,2076	0079,2079	0079,2079
	Motor ID No.	546	548	550	251	518	264	519	267	520	270	521
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		10000011	10000011	10000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00000000	00000000	00000000	00000100	00001110	00000000	00001110	00000000	00001110	00000000	00001110
2014		00000000	00000000	00000000	00000100	00001110	00000000	00001110	00000000	00001110	00000000	00001110
2210		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2211		00000010	00000010	00000010	00001110	00001110	00001110	00001110	00001110	00001110	00001110	00001110
2300		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2301		01000010	01000010	01000010	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2560		00100000	00100000	00100000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2561		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2562		00000100	00000100	00000100	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2563		00000000	00000000	00000000	01000000	01000000	01000000	01000000	01000000	01000000	01000000	01000000
2040	CUR GAIN I	330	725	485	348	696	331	662	605	1210	427	854
2041	CUR GAIN P	-1115	-2400	-1550	-1676	-3352	-1560	-3120	-3028	-6056	-2301	-4602
2042	CUR GAIN 3	-1175	-1202	-1230	-1232	-1232	-1246	-1246	-1300	-1300	-1302	-1302
2043	VEL GAIN I	10	9	14	78	39	112	56	166	83	170	85
2044	VEL GAIN P	-89	-80	-125	-700	-350	-1010	-505	-1482	-741	-1524	-762
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	-4286	-4722	-3034	-1085	-2170	-751	-1502	5118	10236	4978	9956
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	7500	7500	7500	5600	5600	5600	5600	4200	4200	4200	4200
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	0	0	0	0	0	0	0	0	0
2057	D-PHASE CUR	-7681	-12805	-12806	-10250	-10245	-7694	-7687	-5140	-5130	-5140	-5130
2058	D-PHASE CUR	-250	-1500	-1300	-1000	-500	-2800	-1400	-3200	-1600	-3500	-1750
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	6554	6554	7282	6554	3277	7282	3641	7282	3641	7282	3641
2061	INERTIA	72	65	101	283	141	409	204	601	300	618	309
2062	POVC1	32671	32685	32630	32538	32451	32299	32172	32301	32301	32435	32435
2063	POVC2	1218	1031	1724	2879	3960	5865	7444	5842	5838	4164	4163
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	POVCLMT	2801	2387	4809	8560	2071	17504	4280	17435	4356	12399	3100
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	0	0	0	20480	0	20480	0	20480	0	20480	0
2086	RATED CURRENT	1379	1273	1807	1507	753	2155	1077	2793	1396	2356	1178
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	41	84	80	119	238	146	292	225	450	420	840
2110	MGSTCM	262	276	266	1048	560	780	1360	1807	798	1814	812
2111	TQLIM IN DEC.	0	0	0	11600	11600	7790	7790	7930	7930	7930	7930
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	1012	1966	1154	2345	2345	1592	1592	2885	2885	2388	2388
2128	MFWKCE	512	3072	1024	1000	2000	500	1000	1000	2000	3000	6000
2129	MFWKBL	3865	3855	3865	3358	3358	3339	3339	1298	1298	2056	2056
2133	PHDLY1	10241	5123	8968	7192	7192	8972	8972	3848	3848	5138	5138
2134	PHDLY2	6405	15380	14090	8990	4382	12816	6416	8990	6430	6430	6430
2159	CGMAX	7210	6437	2839	4881	12073	3342	7713	3341	4374	2318	4114
2160	CGMPY	7780	5220	7780	2650	1325	3840	2086	2650	2610	2660	2610
2161	OVCSTP	110	110	110	0	0	0	0	0	0	0	0
2162	POVC21	32763	32763	32763	32766	32766	32765	32766	32762	32762	32764	32764
2163	POVC22	68	68	68	19	22	41	22	75	75	50	50
2164	POVCLMT2	2169	1849	3724	3617	875	7395	1808	12424	3096	8836	2221
2165	MAX CURRENT	10	10	10	10	25	10	25	10	25	25	45
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	1400	2790	1950	4750	7883	3200	5486	6900	10300	5600	8400
2591	PK2PLS	-2300	-4800	-3100	-10200	-16514	-6300	-10952	-11193	-18000	-8800	-15000
2595	HRV4PLS	1825	1520	1723	1532	1532	1930	1930	1320	1527	1731	1737
Remarks		*9	*9	*9		*8		*8		*8		*8

	Motor model	βiS22 2000HV,-B	βiS22 2000HV,-B 40A	βiS22 3000HV,-B	βiS22 3000HV-B Torque Up	βiS30 2000HV,-B	βiS30 2000HV-B Torque Up	βiS40 2000HV,-B	βiS40 2000HV-B Torque Up			
	Motor specification	0086,2086	0086,2086	0083,2083	2083	0088,2088	2088	0090,2090	2090			
	Motor ID No.	278	522	314	536	473	538	475	540			
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000			
2004		00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011			
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2013		00000000	00001110	00001000	00000000	00000010	00000000	00000010	00000000			
2014		00000000	00001110	00001000	00000000	00000010	00000000	00000010	00000000			
2210		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2211		00001110	00001110	00001110	00001010	00001010	00001010	00001010	00001010			
2300		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2560		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2561		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2562		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2563		01000000	01000000	01000000	01000000	01000000	01000000	01000000	01000000			
2040	CUR GAIN I	1446	2892	1146	1146	1650	1650	1624	1624			
2041	CUR GAIN P	-5822	-11644	-5267	-5267	-6565	-6565	-7197	-7197			
2042	CUR GAIN 3	-1332	-1332	-1332	-1332	-2681	-2681	-1341	-1341			
2043	VEL GAIN I	244	122	192	192	214	214	208	208			
2044	VEL GAIN P	-2182	-1091	-1722	-1722	-1912	-1912	-1870	-1870			
2045	VEL GAIN 3	0	0	0	0	0	0	0	0			
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235			
2047	OBSERVER POA1	3478	6956	4406	4406	3971	3971	4057	4057			
2048	BLACC CMP	0	0	0	0	0	0	0	0			
2049	DPFMX	0	0	0	0	0	0	0	0			
2050	OBSERVER POK1	956	956	956	956	956	956	956	956			
2051	OBSERVER POK2	510	510	510	510	510	510	510	510			
2052	OVER SPEED	2700	2700	4200	4200	2800	2800	2600	2600			
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21			
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894			
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319			
2056	EMFCMP	0	0	0	0	0	0	0	0			
2057	D-PHASE CUR	-3612	-3598	-6174	-6174	-4647	-4647	-3881	-3881			
2058	D-PHASE CUR	-3000	-1500	-2843	-2843	-3115	-3115	-3732	-3732			
2059	PPBAS	0	0	0	0	0	0	0	0			
2060	TCMD LIMIT	7282	3641	5462	7282	6554	7282	6554	7282			
2061	INERTIA	884	442	698	698	777	777	758	758			
2062	POVC1	32433	32433	32548	32548	32413	32413	32413	32413			
2063	POVC2	4185	4188	2755	2755	4431	4431	4431	4431			
2064	TGALMLV	4	4	4	4	4	4	4	4			
2065	POVCLMT	12462	3112	8192	8192	13201	13201	13201	13201			
2066	ACC FB GAIN	0	0	0	0	0	0	0	0			
2067	TCMD FILTER	0	0	0	0	0	0	0	0			
2074	AALPH	8192	0	8192	8192	8192	8192	8192	8192			
2086	RATED CURRENT	2611	1305	2069	2069	2154	2154	2154	2154			
2090	ROBSTL	0	0	0	0	0	0	0	0			
2099	ONEPSL	400	400	400	400	400	400	400	400			
2100	INPA1	0	0	0	0	0	0	0	0			
2101	INPA2	0	0	0	0	0	0	0	0			
2102	DBLIM	0	0	0	0	0	0	0	0			
2103	ABVOF	0	0	0	0	0	0	0	0			
2104	ABTSH	0	0	0	0	0	0	0	0			
2105	TORQUE CONST.	689	1378	869	869	1127	1127	1503	1503			
2110	MGSTCM	0	1307	1289	1289	1546	1546	263	263			
2111	TQLIM IN DEC.	2866	2866	7268	5016	4255	4054	3065	2815			
2112	AMRDML	0	0	0	0	0	0	0	0			
2113	HRV FILT	0	0	0	0	0	0	0	0			
2127	NINTCT	5149	5149	3894	3894	2095	2095	2712	2712			
2128	MFWKCE	3000	6000	6000	6000	3066	3066	3354	3354			
2129	MFWKBL	562	562	2315	2315	1548	1548	1038	1038			
2133	PHDLY1	3352	3352	5647	5647	4110	4110	2567	2567			
2134	PHDLY2	8989	6429	12820	12820	12814	12814	8967	8967			
2159	CGMAX	3856	7709	6425	6425	5141	5141	4112	4112			
2160	CGMPY	2630	2610	2610	2610	2620	2620	2630	2630			
2161	OVCSTP	0	0	0	0	0	0	0	0			
2162	POVC21	32763	32763	32765	32765	32765	32765	32765	32765			
2163	POVC22	64	63	38	38	34	34	36	36			
2164	POVCLMT2	10854	2711	6815	6815	7387	7387	7713	7713			
2165	MAX CURRENT	25	45	45	45	45	45	45	45			
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0			
2304	ACCBSLM	0	0	0	0	0	0	0	0			
2305	ACDCEBD	0	0	0	0	0	0	0	0			
2310	DCIDBS	0	0	0	0	0	0	1646	1646			
2316	LIMLIM	0	0	0	0	0	0	0	0			
2574	VELOVC	0	0	0	0	0	0	0	0			
2576	DDOVC	0	0	0	0	0	0	0	0			
2590	PK1PLS	11400	20200	8300	8300	12900	12900	12200	12200			
2591	PK2PLS	-19200	-31900	-14600	-14600	-18800	-18800	-18700	-18700			
2595	HRV4PLS	1124	1433	1539	1539	1540	1540	1435	1435			
Remarks			*8		*8		*8		*8			

10.2.3 βiSc-B/βiSc Series

	Motor model	βiSc2 4000,-B	βiSc2 4000,-B 40A	βiSc4 4000,-B	βiSc4 4000,-B 40A	βiSc8 3000,-B	βiSc8 3000,-B 40A	βiSc12 2000,-B	βiSc12 2000,-B 40A	βiSc12 3000,-B	βiSc12 3000,-B 80A	βiSc22 2000,-B
	Motor specification	0061-Bxx7 2061-Bxx7	0061-Bxx7 2061-Bxx7	0063-Bxx7 2063-Bxx7	0063-Bxx7 2063-Bxx7	0075-Bxx7 2075-Bxx7	0075-Bxx7 2075-Bxx7	0077-Bxx7 2077-Bxx7	0077-Bxx7 2077-Bxx7	0078-Bxx7 2078-Bxx7	0078,2078	0085-Bxx7 2085-Bxx7
	Motor ID No.	306	310	311	312	283	294	298	300	496	497	481
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00000100	00010000	00000000	00001110	00000000	00001110	00000000	00001110	00000000	00001110	00000000
2014		00000100	00010000	00000000	00001110	00000000	00001110	00000000	00001110	00000000	00001110	00000000
2210		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2211		00001110	00001110	00001110	00001110	00001110	00001110	00001110	00001110	00001110	00001110	00001110
2300		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2560		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2561		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2562		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2563		01000000	01000000	01000000	01000000	01000000	01000000	01000000	01000000	01000000	01000000	01000000
2040	CUR GAIN I	360	720	400	800	650	1160	547	1094	402	804	1184
2041	CUR GAIN P	-1920	-3840	-1920	-3840	-3831	-5600	-3289	-6578	-2217	-4434	-6800
2042	CUR GAIN 3	-1237	-1237	-1253	-1253	-1299	-1299	-1305	-1305	-1304	-1304	-1331
2043	VEL GAIN I	78	39	112	56	164	82	230	115	170	85	242
2044	VEL GAIN P	-698	-349	-1008	-504	-1476	-738	-2054	-1027	-1530	-765	-2172
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	-1089	-2178	-753	-1506	5143	-1029	3695	7390	4960	9920	3496
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	5600	5600	5600	5600	4200	4200	2800	2800	4200	4200	2800
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	0	0	-2570	0	0	0	0	0	-5130
2057	D-PHASE CUR	-10250	-10245	-7694	-7687	-5140	-5131	-3884	-3862	-5140	-5130	-3612
2058	D-PHASE CUR	-1000	-500	-2800	-1400	-3200	-1600	-4350	-2175	-3500	-1750	-3000
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	6554	3277	7282	3641	7282	3641	7282	3641	7282	3641	7282
2061	INERTIA	283	141	408	204	598	299	834	416	620	310	880
2062	POVC1	32652	32739	32532	32709	32381	32671	32323	32646	32492	32492	32431
2063	POVC2	1455	364	2945	738	4835	1214	5566	1525	3445	3445	4207
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	POVCLMT	4317	1079	8758	2189	14410	3603	16603	4511	10250	2562	12528
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	16384	0	20480	0	16384	0	8192	0	16384	0	16384
2086	RATED CURRENT	1529	764	2178	1089	2780	1390	3126	1563	2363	1181	2618
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	119	238	146	292	226	452	315	630	418	836	692
2110	MGSTCM	1048	815	780	532	1807	1045	1	1282	1814	812	0
2111	TQLIM IN DEC.	11600	11600	7790	7790	7930	7930	3940	3940	7930	7930	2866
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	1172	1172	796	796	1442	1442	1350	1350	1194	1194	2459
2128	MFWKCE	2500	5000	3000	6000	3500	7000	4000	8000	3000	6000	5000
2129	MFWKBL	3358	3358	3392	3392	1298	1298	280	280	2056	2056	562
2133	PHDLY1	7192	7192	8992	8992	3858	3858	3614	3614	5138	5138	3350
2134	PHDLY2	8990	8990	12864	9024	8990	8990	8980	4372	8990	4382	8979
2159	CGMAX	4626	11815	2569	4369	2571	4630	2825	4886	3344	7193	3597
2160	CGMPY	2650	2607	5210	2620	2650	2610	2660	2610	5200	2610	2630
2161	OVCSTP	120	120	120	120	0	0	0	0	0	0	0
2162	POVC21	32757	32765	32745	32762	32764	32767	32763	32767	32765	32765	32764
2163	POVC22	140	34	294	70	51	12	60	15	35	35	44
2164	POVCLMT2	2665	666	5407	1352	8896	2224	10250	2785	6328	1582	7787
2165	MAX CURRENT	25	45	25	45	25	45	25	45	45	85	45
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	4770	8300	3470	7400	6400	11400	5280	11000	5200	8800	10500
2591	PK2PLS	-8800	-15200	-6500	-12000	-9800	-16600	-8300	-19000	-8500	-16300	-18600
2595	HRV4PLS	1637	1333	1634	1533	1730	1429	1732	1328	1632	1441	1331
	Remarks											

	Motor model	βiSc22 2000, -B 80A										
	Motor specification	0085-Bxx7 2085-Bxx7										
	Motor ID No.	482										
PRM NO	SERVO PRM.											
2003		00001000										
2004		00000011										
2005		00000000										
2006		00000000										
2007		00000000										
2008		00000000										
2009		00000000										
2010		00000000										
2011		00000000										
2012		00000000										
2013		00001110										
2014		00001110										
2210		00000000										
2211		00001110										
2300		00000000										
2301		00000000										
2560		00000000										
2561		00000000										
2562		00000000										
2563		01000000										
2040	CUR GAIN I	2368										
2041	CUR GAIN P	-13600										
2042	CUR GAIN 3	-1331										
2043	VEL GAIN I	121										
2044	VEL GAIN P	-1086										
2045	VEL GAIN 3	0										
2046	VEL GAIN 4	-8235										
2047	OBSERVER POA1	6992										
2048	BLACC CMP	0										
2049	DPFMX	0										
2050	OBSERVER POK1	956										
2051	OBSERVER POK2	510										
2052	OVER SPEED	2800										
2053	DB-CMP PPMAX	21										
2054	DB-CMP PDDP	1894										
2055	DB-CMP PHYST	319										
2056	EMFCMP	-5130										
2057	D-PHASE CUR	-3598										
2058	D-PHASE CUR	-1500										
2059	PPBAS	0										
2060	TCMD LIMIT	3641										
2061	INERTIA	440										
2062	POVC1	32431										
2063	POVC2	4207										
2064	TGALMLV	4										
2065	POVCLMT	3132										
2066	ACC FB GAIN	0										
2067	TCMD FILTER	0										
2074	AALPH	0										
2086	RATED CURRENT	1309										
2090	ROBSTL	0										
2099	ONEPSL	400										
2100	INPA1	0										
2101	INPA2	0										
2102	DBLIM	0										
2103	ABVOF	0										
2104	ABTSH	0										
2105	TORQUE CONST.	1384										
2110	MGSTCM	1280										
2111	TQLIM IN DEC.	2866										
2112	AMRDML	0										
2113	HRV FILT	0										
2127	NINTCT	2459										
2128	MFWKCE	10000										
2129	MFWKBL	562										
2133	PHDLY1	3350										
2134	PHDLY2	4371										
2159	CGMAX	6170										
2160	CGMPY	1320										
2161	OVCSTP	0										
2162	POVC21	32764										
2163	POVC22	44										
2164	POVCLMT2	1947										
2165	MAX CURRENT	85										
2302	TQLIM AT STOP	0										
2304	ACCBSLM	0										
2305	ACDCEBD	0										
2310	DCIDBS	0										
2316	LIMLIM	0										
2574	VELOVC	0										
2576	DDOVC	0										
2590	PK1PLS	19800										
2591	PK2PLS	-25500										
2595	HRV4PLS	1134										
Remarks												

10.2.4 βiSc-B/βiSc Series HV

	Motor model	βiSc2 4000HV	βiSc2 4000HV 20A	βiSc4 4000HV	βiSc4 4000HV 20A	βiSc8 3000HV-B	βiSc8 3000HV-B 20A	βiSc12 3000HV-B	βiSc12 3000HV-B 40A			
	Motor specification	2062-Bxx7	2062-Bxx7	2064-Bxx7	2064-Bxx7	2076-Bxx7	2076-Bxx7	2079-Bxx7	2079-Bxx7			
	Motor ID No.	523	524	525	526	527	528	529	530			
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000			
2004		00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011			
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2013		00000100	00001110	00000000	00001110	00000000	00001110	00000000	00001110			
2014		00000100	00001110	00000000	00001110	00000000	00001110	00000000	00001110			
2210		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2211		00001110	00001110	00001110	00001110	00001110	00001110	00001110	00001110			
2300		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2560		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2561		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2562		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000			
2563		01000000	01000000	01000000	01000000	01000000	01000000	01000000	01000000			
2040	CUR GAIN I	348	696	331	662	605	1210	427	854			
2041	CUR GAIN P	-1676	-3352	-1560	-3120	-3028	-6056	-2301	-4602			
2042	CUR GAIN 3	-1232	-1232	-1246	-1246	-1300	-1300	-1302	-1302			
2043	VEL GAIN I	78	39	112	56	166	83	170	85			
2044	VEL GAIN P	-700	-350	-1010	-505	-1482	-741	-1524	-762			
2045	VEL GAIN 3	0	0	0	0	0	0	0	0			
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235			
2047	OBSERVER POA1	-1085	-2170	-751	-1502	5118	10236	4978	9956			
2048	BLACC CMP	0	0	0	0	0	0	0	0			
2049	DPFMX	0	0	0	0	0	0	0	0			
2050	OBSERVER POK1	956	956	956	956	956	956	956	956			
2051	OBSERVER POK2	510	510	510	510	510	510	510	510			
2052	OVER SPEED	5600	5600	5600	5600	4200	4200	4200	4200			
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21			
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894			
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319			
2056	EMFCMP	0	0	0	0	0	0	0	0			
2057	D-PHASE CUR	-10250	-10245	-7694	-7687	-5140	-5130	-5140	-5130			
2058	D-PHASE CUR	-1000	-500	-2800	-1400	-3200	-1600	-3500	-1750			
2059	PPBAS	0	0	0	0	0	0	0	0			
2060	TCMD LIMIT	6554	3277	7282	3641	7282	3641	7282	3641			
2061	INERTIA	283	141	409	204	0	300	0	309			
2062	POVC1	32653	32653	32515	32515	32381	32671	32492	32703			
2063	POVC2	1441	1441	3161	3161	4838	1213	3450	813			
2064	TGALMLV	4	4	4	4	4	4	4	4			
2065	POVCLMT	4060	1015	8389	2097	14406	3601	10245	2423			
2066	ACC FB GAIN	0	0	0	0	0	0	0	0			
2067	TCMD FILTER	0	0	0	0	0	0	0	0			
2074	AALPH	20480	0	20480	0	20480	0	20480	0			
2086	RATED CURRENT	1507	753	2155	1077	2793	1396	2356	1178			
2090	ROBSTL	0	0	0	0	0	0	0	0			
2099	ONEPSL	400	400	400	400	400	400	400	400			
2100	INPA1	0	0	0	0	0	0	0	0			
2101	INPA2	0	0	0	0	0	0	0	0			
2102	DBLIM	0	0	0	0	0	0	0	0			
2103	ABVOF	0	0	0	0	0	0	0	0			
2104	ABTSH	0	0	0	0	0	0	0	0			
2105	TORQUE CONST.	119	238	146	292	225	450	420	840			
2110	MGSTCM	1048	560	780	1360	1807	798	1814	812			
2111	TQLIM IN DEC.	11600	11600	7790	7790	7930	7930	7930	7930			
2112	AMRDML	0	0	0	0	0	0	0	0			
2113	HRV FILT	0	0	0	0	0	0	0	0			
2127	NINTCT	2345	2345	1592	1592	2885	2885	2388	2388			
2128	MFWKCE	1000	2000	500	1000	1000	2000	3000	6000			
2129	MFWKBL	3358	3358	3339	3339	1298	1298	2056	2056			
2133	PHDLY1	7192	7192	8972	8972	3848	3848	5138	5138			
2134	PHDLY2	8990	4382	12816	6416	8990	6430	6430	6430			
2159	CGMAX	4881	12073	3342	7713	3341	7710	2318	5153			
2160	CGMPY	2650	1325	3840	2086	2650	1325	2660	1330			
2161	OVCSTP	0	0	0	0	0	0	0	0			
2162	POVC21	32747	32747	32747	32747	32764	32764	32764	32764			
2163	POVC22	266	266	268	268	50	50	50	50			
2164	POVCLMT2	2538	635	5245	1311	9720	2430	6913	1635			
2165	MAX CURRENT	10	25	10	25	10	25	25	45			
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0			
2304	ACCBSLM	0	0	0	0	0	0	0	0			
2305	ACDCEBD	0	0	0	0	0	0	0	0			
2310	DCIDBS	0	0	0	0	0	0	0	0			
2316	LIMLIM	0	0	0	0	0	0	0	0			
2574	VELOVC	0	0	0	0	0	0	0	0			
2576	DDOVC	0	0	0	0	0	0	0	0			
2590	PK1PLS	4750	7883	3200	5486	6900	11995	5600	9600			
2591	PK2PLS	-10200	-16514	-6300	-10952	-11193	-19459	-8800	-15987			
2595	HRV4PLS	1532	1532	1930	1930	1320	1320	1731	1731			
Remarks		*8	*8	*8	*8	*8	*8	*8	*8			

10.2.5 βiF-B/βiF Series

	Motor model	βiF4 3000,-B	βiF4 3000,-B 40A	βiF8 2000,-B	βiF8 2000,-B 40A	βiF12 2000,-B	βiF12 2000,-B 40A	βiF22 2000,-B	βiF22 2000,-B 80A	βiF30 1500,-B		
	Motor specification	0051,2051	0051,2051	0052,2052	0052,2052	0053,2053	0053,2053	0054,2054	0054,2054	0055,2055		
	Motor ID No.	483	484	485	486	487	488	489	490	491		
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000		
2004		00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011		
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000		
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000		
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000		
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000		
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000		
2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000		
2011		00000000	00000000	00000000	00000000	00100000	00100000	00000000	00000000	00000000		
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000		
2013		00000000	00001110	00000000	00001110	00000000	00001110	00000000	00001110	00000000		
2014		00000000	00001110	00000000	00001110	00000000	00001110	00000000	00001110	00000000		
2210		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000		
2211		00001010	00001010	00001010	00001010	00000010	00000010	00001010	00001010	00001010		
2300		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000		
2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000		
2560		00000000	00000000	00000000	00000000	00000000	00000010	00000000	00000010	00000010		
2040	CUR GAIN I	1240	2480	1276	2552	1875	3750	2320	4640	2238		
2041	CUR GAIN P	-6415	-12830	-6288	-12576	-9137	-18274	-10593	-21186	-13330		
2042	CUR GAIN 3	-1309	-1309	-1326	-1326	-1339	-1339	-1347	-1347	-1347		
2043	VEL GAIN I	231	115	300	150	559	280	542	271	332		
2044	VEL GAIN P	-2068	-1034	-2685	-1342	-5008	-2504	-4851	-2426	-2973		
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0		
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235		
2047	OBSERVER POA1	3670	7339	2827	5654	1516	3031	1565	3129	2553		
2048	BLACC CMP	0	0	0	0	0	0	0	0	0		
2049	DPFMX	0	0	0	0	0	0	0	0	0		
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956		
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510		
2052	OVER SPEED	4200	4200	2800	2800	2800	2800	2400	2400	2100		
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21		
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894		
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319		
2056	EMFCMP	0	0	0	0	0	0	0	0	0		
2057	D-PHASE CUR	-5915	-5901	-3854	-3847	-1804	-1798	-2597	-2578	-1545		
2058	D-PHASE CUR	-1500	-750	-1236	-618	-2500	-1250	-1942	-971	-1300		
2059	PPBAS	0	0	0	0	0	0	0	0	0		
2060	TCMD LIMIT	7282	3641	7282	3641	7282	3641	7282	3641	7282		
2061	INERTIA	838	419	1088	544	2030	1015	1966	983	1205		
2062	POVC1	32546	32537	32297	32297	31979	31986	32105	32105	32589		
2063	POVC2	2781	2888	5890	5890	9861	9769	8282	8282	2239		
2064	TGALMLV	4	4	4	4	4	4	4	4	4		
2065	POVCLMT	7442	1860	14063	3516	20702	5175	18179	4545	5986		
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0		
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0		
2074	AALPH	12288	0	8192	0	8192	0	4096	0	8192		
2086	RATED CURRENT	1655	827	2269	1134	2825	1412	2646	1323	1490		
2090	ROBSTL	0	0	0	0	0	0	0	0	0		
2099	ONEPSL	400	400	400	400	400	400	400	400	400		
2100	INPA1	0	0	0	0	0	0	0	0	0		
2101	INPA2	0	0	0	0	0	0	0	0	0		
2102	DBLIM	0	0	0	0	15000	7500	0	0	0		
2103	ABVOF	0	0	0	0	0	0	0	0	0		
2104	ABTSH	0	0	0	0	0	0	0	0	0		
2105	TORQUE CONST.	190	380	277	554	350	700	680	1360	1630		
2110	MGSTCM	1289	530	1552	800	0	1280	1548	792	2059		
2111	TQLIM IN DEC.	3900	3900	3880	3880	2168	2168	2600	2600	2148		
2112	AMRDML	0	0	0	0	0	0	0	0	0		
2113	HRV FILT	0	0	0	0	0	0	0	0	0		
2127	NINTCT	2544	2544	2380	2380	4150	4150	3695	3695	6680		
2128	MFWKCE	5000	10000	4500	9000	12000	24000	4000	8000	14000		
2129	MFWKBL	1812	1812	1550	1550	1044	1044	1046	1046	539		
2133	PHDLY1	3855	3855	3860	3860	5150	5150	2070	2070	1054		
2134	PHDLY2	8995	4387	8990	4382	8990	4382	9000	4392	9000		
2159	CGMAX	6935	11542	2828	10278	3343	7205	2828	2322	4372		
2160	CGMPY	7760	2610	6500	4656	5210	2610	5210	5200	2650		
2161	OVCSTP	0	0	0	0	0	0	0	0	0		
2162	POVC21	32755	32755	32756	32756	32756	32756	32756	32756	32755		
2163	POVC22	157	158	153	151	151	150	148	147	157		
2164	POVCLMT2	3708	927	7007	1752	10315	2579	9058	2265	2982		
2165	MAX CURRENT	25	45	25	45	25	45	45	85	85		
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0		
2304	ACCBSLM	0	0	0	0	0	0	0	0	0		
2305	ACDCEBD	0	0	0	0	0	0	0	0	0		
2310	DCIDBS	0	0	0	0	0	0	0	0	0		
2316	LIMLIM	0	0	0	0	0	0	0	0	0		
2574	VELOVC	0	0	0	0	0	0	0	0	0		
2576	DDOVC	0	0	0	0	0	0	0	0	0		
2590	PK1PLS	10500	18200	10250	17540	18000	7500	16000	6750	6875		
2591	PK2PLS	-15000	-25800	-15500	-25800	-22000	-9750	-25500	-9500	-9250		
2595	HRV4PLS	1228	1221	1629	1123	1424	1014	1222	1833	1228		
	Remarks											

10.3 STANDARD PARAMETERS FOR LINEAR MOTORS

Series 90G0, 90J0, 90K0, 90GP, and 90JP (for Series 30*i*/31*i*/32*i*/35*i*-B, Power Motion *i*-A, DSA-B)
Series 90E0 and 90E1 (for Series 30*i*/31*i*/32*i*-A)
Series 90D0 (for Series 30*i*/31*i*-A)
Series 90M0, 90L0, 90M8, and 90L8 (for Series 0*i*-F)
Series 90C5 and 90C8 (for Series 0*i*-D)
Series 90E5 and 90E8 (for Series 0*i*-D)
Series 90H0 (for Series 0*i* Mate-D)

10.3.1 Linear Motor L*i*S-B and L*i*S Series [200V]

	Motor model	LiS300 A1/4 (200V)	LiS600 A1/4 (200V)	LiS900 A1/4 (200V)	LiS1500 B1/4 (200V)	LiS3000 B2/2 (200V)	LiS3000 B2/4 (200V)	LiS4500 B2/2 (200V)	LiS4500 B2/4 (200V)	LiS6000 B2/2 (200V)	LiS6000 B2/4 (200V)	LiS7500 B2/2 (200V)
	Motor specification	0441-B200	0442-B200	0443-B200	0444-B210	0445-B110	0445-B210	0446-B110	0446-B210	0447-B110	0447-B210	0448-B110
	Motor ID No.	351	353	355	357	360	362	364	366	368	370	372
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2014		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2210		00000000	00000000	00000000	00000000	00000100	00000100	00000100	00000000	00000100	00000000	00000100
2211		00000000	00000000	00000000	00000000	00000000	00000000	00001000	00001000	00000000	00000000	00001000
2300		10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000
2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2560		00000000	00000000	00000000	00000000	00000000	00000011	00100011	00000011	00000000	00000000	00101011
2561		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2562		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2563		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2040	CUR GAIN I	1968	1868	1594	1512	961	324	2834	4394	961	1401	848
2041	CUR GAIN P	-7138	-6536	-6162	-11488	-5781	-4472	-10862	-21486	-5255	-10722	-5532
2042	CUR GAIN 3	-2618	-2618	-2618	-2647	-2667	-2660	-2696	-2689	-2660	-2660	-2696
2043	VEL GAIN I	16	9	13	19	14	16	10	10	13	15	8
2044	VEL GAIN P	-217	-122	-179	-260	-194	-214	-131	-131	-169	-202	-103
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	-8755	-9339	-6367	-4371	-5866	-5321	-8705	-8705	-6746	-5642	-11014
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	0	0	0	0	0	0	0	0	0	0	0
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	-6400	-6400	-6400	0	0	0	0	0	0	0	-7936
2057	D-PHASE CUR	0	0	0	0	0	0	0	0	0	0	0
2058	D-PHASE CUR	0	0	0	0	0	0	0	0	0	0	0
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	5826	6554	7282	7282	7282	7282	5462	5462	7282	7282	4551
2061	INERTIA	2136	2003	2937	5630	4195	4625	2827	2827	3648	4625	2234
2062	POVC1	32720	32720	32721	32698	32711	32698	32707	32707	32711	32708	32707
2063	POVC2	596	596	583	873	719	873	758	768	719	753	765
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	POVCLMT	589	589	1326	2590	2131	2590	1199	1214	2131	2233	832
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	-24576	-8192	28672	0	0	0	20480	0	0	0	-24576
2086	RATED CURRENT	564	564	847	1184	1074	1184	805	810	1074	1184	671
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	68	137	137	227	502	455	1005	1005	1005	911	2010
2110	MGSTCM	793	792	786	0	0	0	0	0	0	0	0
2111	DETQLM	0	0	0	0	0	0	0	0	0	0	0
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	0	0	0	0	0	0	0	0	0	0	0
2128	MFWKCE	0	0	0	0	0	0	0	0	0	0	0
2129	MFWKBL	0	0	0	0	0	0	0	0	0	0	0
2133	PHDLY1	0	0	0	0	0	0	0	0	0	0	0
2134	PHDLY2	0	0	0	0	0	0	0	0	0	0	0
2159	CGMAX	17453	15916	8216	6168	0	5395	13365	8473	0	0	11023
2160	CGMPY	2620	2620	2650	5215	0	2660	7680	2560	0	0	2625
2161	OVCSTP	0	0	0	0	0	0	0	0	0	0	0
2162	POVC21	0	0	0	0	0	0	0	0	0	0	0
2163	POVC22	0	0	0	0	0	0	0	0	0	0	0
2164	POVCLMT2	0	0	0	0	0	0	0	0	0	0	0
2165	MAX CURRENT	25	45	45	45	45	85	85	165	85	165	165
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	15200	12200	9100	24444	0	6850	2125	10375	0	0	8700
2591	PK2PLS	-16500	-16000	-13500	-29000	0	-8250	-15750	-14300	0	0	-18200
2595	HRV4PLS	1228	1432	1429	1117	0	2039	0	1533	0	0	0
When water cooling is used, modify the following parameters from the values listed above to those listed below.												
2062	POVC1	32578	32578	32582	32490	32539	32490	32526	32527	32539	32528	32524
2063	POVC2	2380	2380	2328	3481	2867	3481	3023	3018	2867	3003	3053
2065	POVCLMT	2357	2357	5303	10358	8523	10358	4794	4787	8523	8932	3329
2086	RATED CURRENT	1129	1129	1694	2368	2148	2368	1611	1610	2148	2368	1342
2161	OVCSTP	-	-	-	-	-	-	-	-	-	140	-

	Motor model	LiS7500 B2/4 (200V)	LiS9000 B2/2 (200V)	LiS9000 B2/4 (200V)	LiS3300 C1/2 (200V)	LiS9000 C2/2 (200V)	LiS11000 C2/2 (200V)	LiS11000 C2/4 (200V)	LiS15000 C2/2 (200V)	LiS15000 C2/3 (200V)	LiS10000 C3/2 (200V)	LiS17000 C3/2 (200V)
	Motor specification	0448-B210	0449-B110	0449-B210	0451-B110	0454-B110	0455-B110	0455-B210	0456-B110	0456-B210	0457-B110	0459-B110
	Motor ID No.	374	376	378	380	384	388	390	392	394	396	400
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00000000	00001000
2004		00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00001000	00000110	00001010	00000000	00000000	00000000	00000000	00001010	00000000	00000000	00000000
2014		00001000	00000110	00001010	00000000	00000000	00000000	00000000	00001010	00000000	00000000	00000000
2210		00000100	00000100	00000100	00000100	00000100	00000100	00000000	00000100	00000100	00000100	00000100
2211		00001000	00000000	00000000	00001000	00001000	00001000	00001000	00000000	00000000	00001000	00001000
2300		10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000
2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2560		00000000	00000000	00000000	00000011	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2561		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2562		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2563		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2040	CUR GAIN I	946	1240	1483	1346	587	431	3736	1704	478	158	2182
2041	CUR GAIN P	-6400	-7877	-7099	-6448	-3839	-3377	-18246	-13440	-3379	-1761	-8540
2042	CUR GAIN 3	-1331	-2660	-2660	-2695	-2696	-2695	-2693	-2663	-2657	-2695	-2696
2043	VEL GAIN I	8	12	10	9	8	10	9	7	10	10	7
2044	VEL GAIN P	-101	-158	-141	-126	-110	-136	-121	-87	-128	-141	-99
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	-11240	-7199	-8099	-9048	-10377	-8363	-9409	-13022	-8861	-8077	-11497
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	0	0	0	0	0	0	0	0	0	0	0
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	-7680	0	0	0	0	0	0	0	0	0	0
2057	D-PHASE CUR	0	0	0	0	0	0	0	0	0	0	0
2058	D-PHASE CUR	0	0	0	0	0	0	0	0	0	0	0
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	4046	5917	4855	5462	6372	7282	6877	4855	7282	7282	6887
2061	INERTIA	2189	3101	3038	2720	2372	2942	2616	1890	2777	3047	2140
2062	POVC1	32687	32707	32696	32708	32729	32723	32729	32729	32732	32722	32711
2063	POVC2	1010	758	895	749	489	560	492	483	452	582	709
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	POVCLMT	799	1199	1151	1184	1112	1661	1311	621	1340	1719	981
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	20480	0	0	0	-16384	-24576	0	0	0	-24576	20480
2086	RATED CURRENT	658	805	789	801	776	948	842	579	852	964	729
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	2051	2010	2051	741	2087	2087	2348	4656	3168	1865	4197
2110	MGSTCM	0	0	0	0	0	0	0	0	0	0	0
2111	DETQLM	0	0	0	0	0	0	0	0	0	0	0
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	0	0	0	0	0	0	0	0	0	0	0
2128	MFWKCE	0	0	0	0	0	0	0	0	0	0	0
2129	MFWKBL	0	0	0	0	0	0	0	0	0	0	0
2133	PHDLY1	0	0	0	0	0	0	0	0	0	0	0
2134	PHDLY2	0	0	0	0	0	0	0	0	0	0	0
2159	CGMAX	0	0	0	6929	0	0	0	0	0	0	0
2160	CGMPY	0	0	0	2560	0	0	0	0	0	0	0
2161	OVCSTP	0	0	0	0	0	0	0	0	0	0	0
2162	POVC21	0	0	0	0	0	0	0	0	0	0	0
2163	POVC22	0	0	0	0	0	0	0	0	0	0	0
2164	POVCLMT2	0	0	0	0	0	0	0	0	0	0	0
2165	MAX CURRENT	365	165	365	85	165	165	365	365	365	165	365
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	0	0	0	14175	0	0	0	0	0	0	0
2591	PK2PLS	0	0	0	-20125	0	0	0	0	0	0	0
2595	HRV4PLS	0	0	0	1223	0	0	0	0	0	0	0

When water cooling is used, modify the following parameters from the values listed above to those listed below.

2062	POVC1	32446	32526	32482	32529	32612	32589	32598	32558	32572	32583	32542
2063	POVC2	4026	3023	3570	2987	1953	2236	2119	2623	2455	2314	2829
2065	POVCLMT	3197	4794	4604	4738	4448	6644	5246	3378	7296	6875	3925
2086	RATED CURRENT	1316	1611	1579	1602	1552	1897	1685	1352	1988	1929	1458
2161	OVCSTP	-	-	-	-	-	-	-	-	140	-	-

	Motor model	LiS3000 M2/2-B (200V)	LiS3000 M2/4-B (200V)	LiS4500 M2/2-B (200V)	LiS4500 M2/4-B (200V)	LiS4500 M3/2-B (200V)	LiS4500 M3/4-B (200V)	LiS6000 M2/2-B (200V)	LiS6000 M2/4-B (200V)	LiS7000 M3/2-B (200V)	LiS7000 M3/4-B (200V)	LiS7500 M2/2-B (200V)
	Motor specification	0462-B120	0462-B220	0463-B120	0463-B220	0468-B120	0468-B220	0464-B120	0464-B220	0469-B120	0469-B220	0465-B120
	Motor ID No.	651	669	652	670	673	691	653	671	674	692	654
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		00000011	10000011	00000011	10000011	10000011	10000011	00000011	10000011	10000011	10000011	00000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000100	00000101	00000100	00000101	00000101	00000101	00000100	00000101	00000101	00000101	00000100
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00001100	00001100	00000010	00000010	00000110	00000110	00001100	00001110	00001100	00001110	00001000
2014		00001100	00001100	00000010	00000010	00000110	00000110	00001100	00001110	00001100	00001110	00001000
2210		00000100	00000000	00000100	00000000	00000100	00000000	00000100	00000000	00000100	00000000	00000100
2211		00000000	00000000	00001000	00000000	00000000	00000000	00001000	00000000	00000000	00000000	00000000
2300		10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000
2301		00000000	01000110	01000110	01000110	01000110	01000110	01000110	01000110	01000110	01000110	01000110
2560		00100011	00101010	00100010	00101010	00100010	00100010	00100010	00101010	00100010	00100000	00100010
2561		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2562		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2563		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2040	CUR GAIN I	1585	8000	572	7400	3750	8000	654	9200	3500	5000	347
2041	CUR GAIN P	-7101	-27500	-4201	-24000	-12250	-26800	-2868	-32000	-12250	-19000	-1683
2042	CUR GAIN 3	-2706	-2702	-2709	-2702	-2705	-2703	-2710	-2702	-2705	-2705	-2710
2043	VEL GAIN I	8	6	8	8	7	7	5	5	5	5	5
2044	VEL GAIN P	-109	-80	-111	-114	-99	-96	-72	-65	-71	-61	-71
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	-10418	-14232	-10245	-9986	-11488	-11813	-15725	-17519	-16059	-18639	-16131
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	0	0	0	0	0	0	0	0	0	0	0
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	-12032	0	0	0	0	0	0	0	0
2057	D-PHASE CUR	0	0	0	0	0	0	0	0	0	0	0
2058	D-PHASE CUR	0	0	0	0	0	0	0	0	0	0	0
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	4551	4551	6827	6827	6035	5917	4551	4046	4528	3944	5689
2061	INERTIA	2362	1729	2402	2464	2142	2083	1565	1405	1532	1320	1526
2062	POVC1	32612	32612	32614	32614	32588	32587	32612	32613	32592	32593	32613
2063	POVC2	1955	1955	1931	1931	2255	2260	1955	1937	2195	2192	1940
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	POVCLMT	1610	1610	3580	3580	3251	3132	1610	1261	1784	1351	2498
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	0	0	-20480	0	0	0	0	0	0	0	0
2086	RATED CURRENT	466	462	696	696	660	647	466	413	492	427	579
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	931	901	931	907	1020	1049	1862	2075	2057	2388	1862
2110	MGSTCM	0	1054	1557	1554	1292	1292	1048	1072	1054	1061	1304
2111	DETQLM	0	0	0	0	0	0	0	0	0	0	0
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	0	0	0	0	0	0	0	0	0	0	0
2128	MFWKCE	0	2000	0	2000	1200	8000	0	2000	2000	2500	0
2129	MFWKBL	0	3078	0	3078	1542	3079	0	3078	1557	3086	0
2133	PHDLY1	0	0	0	0	0	0	0	0	0	0	0
2134	PHDLY2	0	0	0	0	0	0	0	0	0	0	0
2159	CGMAX	7453	11307	6682	5914	7453	7196	11307	14650	12589	-26954	7456
2160	CGMPY	5121	2622	2650	2654	2640	2640	2622	2616	2625	2595	2638
2161	OVCSTP	130	130	130	130	130	130	130	130	130	130	130
2162	POVC21	32752	32752	32752	32752	32750	32750	32752	32752	32751	32751	32752
2163	POVC22	206	206	205	205	220	220	206	205	217	217	205
2164	POVCLMT2	296	296	658	658	597	575	296	232	328	248	459
2165	MAX CURRENT	85	165	85	165	85	165	165	365	165	365	165
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	6335	7500	4500	6250	4925	7600	3500	6900	5450	7500	3500
2591	PK2PLS	-23625	-11500	-13000	-10150	-13950	-11825	-13400	-12100	-17775	-22000	-12600
2595	HRV4PLS	0	1111	1718	1521	1819	1012	1313	1111	1616	808	1213

When water cooling is used, modify the following parameters from the values listed above to those listed below.

2062	POVC1	31608	31618	32183	32183	31994	31957	31618	31618	31418	31413	31879
2063	POVC2	14504	14376	7312	7312	9678	10134	14376	14376	16871	16940	11113
2065	POVCLMT	9992	9922	12545	12545	12545	12545	9922	7840	11136	8475	12545
2086	RATED CURRENT	1163	1159	1744	1740	1633	1622	1159	1030	1228	1071	1450
2161	OVCSTP	130	130	130	130	130	130	130	130	130	130	130
2162	POVC21	32746	32746	32725	32725	32731	32731	32746	32746	32746	32746	32740
2163	POVC22	277	277	542	539	467	459	277	277	277	277	352
2164	POVCLMT2	1835	1822	4129	4110	3641	3586	1822	1440	2045	1557	2852

	Motor model	LiS7500 M2/4-B (200V)	LiS9000 M2/2-B (200V)	LiS9000 M3/2-B (200V)	LiS9000 M3/4-B (200V)	LiS11000 M2/2-B (200V)	LiS11000 M3/2-B (200V)	LiS11000 M3/4-B (200V)	LiS14000 M3/2-B (200V)	LiS16000 M3/2-B (200V)	LiS300 S1/4-B (200V)	LiS600 S1/4-B (200V)
	Motor specification	0465-B220	0466-B120	0470-B120	0470-B220	0467-B120	0471-B120	0471-B220	0472-B120	0473-B120	0424-B200	0425-B200
	Motor ID No.	672	655	675	693	656	676	694	677	678	402	403
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		10000011	00000011	10000011	10000011	00000011	10000011	10000011	10000011	10000011	10000011	10000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000101	00000100	00000101	00000101	00000100	00000101	00000101	00000101	00000101	00000101	00000101
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00001010	00000010	00000110	00001000	00010000	00000000	00000100	00001110	00001010	00000110	00000110
2014		00001010	00000010	00000110	00001000	00010000	00000000	00000100	00001110	00001010	00000110	00000110
2210		00000000	00000100	00000100	00000100	00000100	00000100	00000000	00000100	00000100	00000000	00000000
2211		00000000	00001000	00000000	00000000	00001000	00000000	00000000	00000000	00000000	00000000	00000000
2300		10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000
2301		01000110	01000110	01000110	01000110	01000110	01000110	01000110	01000110	01000110	01000110	01000110
2560		00101010	00100010	00101010	00100010	00100010	00101010	00101010	00101010	00101010	00100000	00100000
2561		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2562		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2563		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2040	CUR GAIN I	9200	302	4250	2500	278	4250	8800	3075	3600	2800	2800
2041	CUR GAIN P	-28000	-1335	-12750	-8600	-4542	-12750	-31600	-11000	-11800	-17000	-18300
2042	CUR GAIN 3	-2702	-2710	-2705	-2703	-2710	-2706	-2704	-2705	-2705	-2685	-2685
2043	VEL GAIN I	6	8	7	6	4	9	7	4	5	7	6
2044	VEL GAIN P	-79	-106	-91	-79	-55	-114	-99	-60	-70	-93	-78
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	-14351	-10731	-12506	-14339	-20836	-9964	-11452	-19024	-16377	-12217	-14527
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	0	0	0	0	0	0	0	0	0	0	0
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	0	0	0	0	0	0	0	0	0
2057	D-PHASE CUR	0	0	0	0	0	0	0	0	0	0	0
2058	D-PHASE CUR	0	0	0	0	0	0	0	0	0	0	0
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	5057	6829	6035	5259	3540	7282	6574	4025	4697	5826	5826
2061	INERTIA	1715	2293	1968	1716	1181	2470	2149	1294	1503	2014	1694
2062	POVC1	32614	32614	32592	32590	32614	32579	32590	32617	32601	32583	32633
2063	POVC2	1926	1931	2197	2231	1924	2364	2231	1887	2083	2315	1685
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	POVCLMT	1960	3580	3172	2444	959	4956	3818	1217	1824	3108	2283
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	0	0	0	0	0	0	0	0	0	0	0
2086	RATED CURRENT	515	696	654	574	360	819	718	406	496	648	523
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	2095	1862	2085	2390	4191	2056	2363	4651	4616	87	175
2110	MGSTCM	1048	1560	1310	1298	792	1549	1549	1082	1048	1298	1298
2111	DETQLM	0	0	0	0	0	0	0	0	0	0	0
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	0	0	0	0	0	0	0	0	0	0	0
2128	MFWKCE	8000	0	2000	8000	0	1000	4000	3000	5000	1000	1000
2129	MFWKBL	3072	0	1546	3076	0	1540	3078	1544	1537	3087	3854
2133	PHDLY1	0	0	0	0	0	0	0	0	0	0	0
2134	PHDLY2	0	0	0	0	0	0	0	0	0	0	0
2159	CGMAX	10023	6682	8222	7716	19020	6425	5659	21315	15928	14654	14396
2160	CGMPY	2630	2654	2642	2632	2608	2660	2650	2615	2624	2625	2625
2161	OVCSTP	130	130	130	130	130	130	130	130	130	130	130
2162	POVC21	32752	32752	32751	32751	32752	32750	32751	32752	32751	32750	32753
2163	POVC22	204	205	217	219	204	224	219	202	212	222	191
2164	POVCLMT2	360	658	583	449	176	910	701	224	335	571	419
2165	MAX CURRENT	365	165	165	365	365	165	365	365	365	25	45
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	8500	4850	5350	9800	3450	6375	8500	3425	5250	11000	14000
2591	PK2PLS	-12300	-13100	-14275	-14250	-17600	-14050	-14200	-10825	-15800	-24000	-29000
2595	HRV4PLS	1213	1818	1213	1110	1010	1010	1114	2020	1919	1835	1629

When water cooling is used, modify the following parameters from the values listed above to those listed below.

2062	POVC1	31616	32183	31994	31693	31619	32261	32131	31529	31417	31927	31927
2063	POVC2	14402	7312	9678	13435	14358	6338	7959	15485	16892	10508	10508
2065	POVCLMT	12267	12545	12545	12545	5996	12545	12545	8232	11991	12545	12545
2086	RATED CURRENT	1288	1740	1639	1436	901	2050	1797	1055	1274	1390	1390
2161	OVCSTP	130	130	130	130	130	130	130	130	130	130	130
2162	POVC21	32746	32725	32731	32740	32746	32703	32721	32746	32746	32742	32742
2163	POVC22	277	539	467	345	277	818	585	277	277	320	320
2164	POVCLMT2	2253	4110	3641	2805	1101	5711	4388	1512	2202	2621	2621

	Motor model	LiS600 S2/3-B (200V)	LiS900 S1/4-B (200V)	LiS1200 S2/3-B (200V)	LiS1800 S2/3-B (200V)							
	Motor specification	0427-B200	0426-B200	0428-B200	0429-B200							
	Motor ID No.	408	404	409	410							
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000							
2004		10000011	10000011	10000011	10000011							
2005		00000000	00000000	00000000	00000000							
2006		00000000	00000000	00000000	00000000							
2007		00000000	00000000	00000000	00000000							
2008		00000000	00000000	00000000	00000000							
2009		00000000	00000000	00000000	00000000							
2010		00000101	00000101	00000101	00000101							
2011		00000000	00000000	00000000	00000000							
2012		00000000	00000000	00000000	00000000							
2013		00000110	00001100	00000110	00001100							
2014		00000110	00001100	00000110	00001100							
2210		00000000	00000000	00000000	00000000							
2211		00000000	00000000	00000000	00000000							
2300		10000000	10000000	10000000	10000000							
2301		01000110	01000110	01000110	01000110							
2560		00000011	00000001	00100011	00100010							
2561		00000000	00000000	00000000	00000000							
2562		00000000	00000000	00000000	00000000							
2563		00000000	00000000	00000000	00000000							
2040	CUR GAIN I	4900	2600	5800	8200							
2041	CUR GAIN P	-28000	-15000	-26500	-31000							
2042	CUR GAIN 3	-2689	-2686	-2689	-2691							
2043	VEL GAIN I	6	4	5	4							
2044	VEL GAIN P	-77	-56	-68	-49							
2045	VEL GAIN 3	0	0	0	0							
2046	VEL GAIN 4	-8235	-8235	-8235	-8235							
2047	OBSERVER POA1	-14839	-20368	-16797	-23130							
2048	BLACC CMP	0	0	0	0							
2049	DPFMX	0	0	0	0							
2050	OBSERVER POK1	956	956	956	956							
2051	OBSERVER POK2	510	510	510	510							
2052	OVER SPEED	0	0	0	0							
2053	DB-CMP PPMAX	21	21	21	21							
2054	DB-CMP PDDP	1894	1894	1894	1894							
2055	DB-CMP PHYST	319	319	319	319							
2056	EMFCMP	0	0	0	0							
2057	D-PHASE CUR	0	0	0	0							
2058	D-PHASE CUR	0	0	0	0							
2059	PPBAS	0	0	0	0							
2060	TCMD LIMIT	5826	4369	5826	4369							
2061	INERTIA	1658	1208	1465	1064							
2062	POVC1	32633	32662	32665	32675							
2063	POVC2	1685	1325	1283	1161							
2064	TGALMLV	4	4	4	4							
2065	POVCLMT	2283	1015	1748	892							
2066	ACC FB GAIN	0	0	0	0							
2067	TCMD FILTER	0	0	0	0							
2074	AALPH	0	0	0	0							
2086	RATED CURRENT	556	370	486	347							
2090	ROBSTL	0	0	0	0							
2099	ONEPSL	400	400	400	400							
2100	INPA1	0	0	0	0							
2101	INPA2	0	0	0	0							
2102	DBLIM	0	0	0	0							
2103	ABVOF	0	0	0	0							
2104	ABTSH	0	0	0	0							
2105	TORQUE CONST.	174	349	352	689							
2110	MGSTCM	1036	1044	1288	1044							
2111	DETQLM	0	0	0	0							
2112	AMRDML	0	0	0	0							
2113	HRV FILT	0	0	0	0							
2127	NINTCT	0	0	0	0							
2128	MFWKCE	2000	2000	2500	3000							
2129	MFWKBL	1557	3086	1560	1557							
2133	PHDLY1	0	0	0	0							
2134	PHDLY2	0	0	0	0							
2159	CGMAX	17210	-25676	15682	32120							
2160	CGMPY	2620	2602	2620	2604							
2161	OVCSTP	130	130	130	130							
2162	POVC21	32753	32755	32755	32756							
2163	POVC22	191	165	162	152							
2164	POVCLMT2	419	186	321	164							
2165	MAX CURRENT	25	85	45	85							
2302	TQLIM AT STOP	0	0	0	0							
2304	ACCBSLM	0	0	0	0							
2305	ACDCEBD	0	0	0	0							
2310	DCIDBS	0	0	0	0							
2316	LIMLIM	0	0	0	0							
2574	VELOVC	0	0	0	0							
2576	DDOVC	0	0	0	0							
2590	PK1PLS	4100	11300	7175	8000							
2591	PK2PLS	-9750	-26100	-12875	-12750							
2595	HRV4PLS	1422	1432	1118	1123							

When water cooling is used, modify the following parameters from the values listed above to those listed below.

2062	POVC1	31927	31788	31927	31788							
2063	POVC2	10508	12252	10508	12252							
2065	POVCLMT	12545	8028	12545	8028							
2086	RATED CURRENT	1390	1042	1390	1042							
2161	OVCSTP	130	130	130	130							
2162	POVC21	32742	32746	32742	32746							
2163	POVC22	320	277	320	277							
2164	POVCLMT2	2621	1475	2621	1475							

10.3.2 Linear Motor L*i*S-B and L*i*S Series [400V]

	Motor model	LiS1500 B1/4 (400V)	LiS3000 B2/2 (400V)	LiS4500 B2/2HV (400V)	LiS4500 B2/2 (400V)	LiS6000 B2/2HV (400V)	LiS6000 B2/2 (400V)	LiS7500 B2/2HV (400V)	LiS7500 B2/2 (400V)	LiS9000 B2/2 (400V)	LiS3300 C1/2 (400V)	LiS9000 C2/2HV (400V)
	Motor specification	0444-B210	0445-B110	0446-B010	0446-B110	0447-B010	0447-B110	0448-B010	0448-B110	0449-B110	0451-B110	0454-B010
	Motor ID No.	358	361	363	365	367	369	371	373	377	381	383
PRM NO	SERVO PRM.											
2003		00001000	00000000	00001000	00001000	00000000	00001000	00001000	00001000	00000000	00001000	00001000
2004		00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00000000	00000000	00000000	00000000	00000110	00000000	00000000	00001000	00000010	00000000	00000000
2014		00000000	00000000	00000000	00000000	00000110	00000000	00000000	00001000	00000010	00000000	00000000
2210		00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000000
2211		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2300		10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000
2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2560		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000011	00000000
2561		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2562		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2563		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2040	CUR GAIN I	409	602	2590	802	1469	766	1742	1123	834	636	1453
2041	CUR GAIN P	-2068	-3127	-6505	-4726	-9936	-4195	-6205	-6625	-4701	-3246	-13899
2042	CUR GAIN 3	-2689	-1330	-2697	-2696	-1330	-2696	-2697	-2696	-1330	-2695	-1321
2043	VEL GAIN I	19	14	11	10	7	13	9	7	9	9	8
2044	VEL GAIN P	-260	-194	-149	-131	-96	-169	-117	-92	-128	-126	-108
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	-4371	-5866	-7658	-8705	-11870	-6746	-9690	-12391	-8929	-9048	-10496
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	0	0	0	0	0	0	0	0	0	0	0
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	0	0	-7680	0	0	0	-9216	0	0
2057	D-PHASE CUR	0	0	0	0	0	0	0	0	0	0	0
2058	D-PHASE CUR	0	0	0	0	0	0	0	0	0	0	0
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	7282	7282	6554	5462	4369	7282	5462	4046	5259	5462	6372
2061	INERTIA	2136	4195	3213	2827	2073	3648	2540	1986	2756	2720	2344
2062	OVC K1	32698	32711	32714	32707	32706	32711	32714	32709	32709	32708	32729
2063	OVC K2	873	719	681	758	774	719	680	739	737	749	489
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	OVC LIMIT	2590	2131	1549	1199	688	2131	1075	658	947	1184	1112
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	0	20480	20480	0	20480	0	20480	0	20480	0	0
2086	RATED CURRENT	1184	1074	915	805	610	1074	763	596	716	801	776
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	227	502	884	1005	1768	1005	1768	2261	2261	741	2111
2110	MGSTCM	0	0	0	0	0	0	0	0	0	0	0
2111	DETQLM	0	0	0	0	0	0	0	0	0	0	0
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	0	0	0	0	0	0	0	0	0	0	0
2128	MFWKCE	0	0	0	0	0	0	0	0	0	0	0
2129	MFWKBL	0	0	0	0	0	0	0	0	0	0	0
2133	PHDLY1	0	0	0	0	0	0	0	0	0	0	0
2134	PHDLY2	0	0	0	0	0	0	0	0	0	0	0
2159	CGMAX	6168	0	0	0	0	0	0	0	0	6934	0
2160	CGMPY	5215	0	0	0	0	0	0	0	0	2560	0
2161	OVC STP	0	0	0	0	0	0	0	0	0	0	0
2162	OVC2 K1	0	0	0	0	0	0	0	0	0	0	0
2163	OVC2 K2	0	0	0	0	0	0	0	0	0	0	0
2164	OVC2 LIMIT	0	0	0	0	0	0	0	0	0	0	0
2165	MAX CURRENT	45	45	45	85	85	85	85	185	185	85	85
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	12222	0	0	0	0	0	0	0	0	7100	0
2591	PK2PLS	-14500	0	0	0	0	0	0	0	0	-10000	0
2595	HRV4PLS	1117	0	0	0	0	0	0	0	0	1629	0

When water cooling is used, modify the following parameters from the values listed above to those listed below.

2062	POVC1	32490	32539	32551	32526	32521	32539	32551	32532	32533	32529	32614
2063	POVC2	3481	2867	2718	3023	3085	2867	2713	2949	2940	2987	1925
2065	POVCLMT	10358	8523	6194	4794	2753	8523	4301	2631	3788	4738	4383
2086	RATED CURRENT	2368	2148	1831	1611	1221	2148	1526	1193	1432	1602	1540
2161	OVCSTP	-	-	-	-	-	-	-	-	140	-	-

	Motor model	LiS9000 C2/2 (400V)	LiS11000 C2/2HV (400V)	LiS11000 C2/2 (400V)	LiS15000 C2/3HV (400V)	LiS15000 C2/2 (400V)	LiS10000 C3/2HV (400V)	LiS10000 C3/2 (400V)	LiS17000 C3/2HV (400V)	LiS17000 C3/2 (400V)	LiS3000 M2/2-B (400V)	LiS3000 M2/2HV-B (400V)
	Motor specification	0454-B110	0455-B010	0455-B110	0456-B010	0456-B110	0457-B010	0457-B110	0459-B010	0459-B110	0462-B120	0462-B020
	Motor ID No.	385	387	389	391	393	395	397	399	401	657	663
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00000000	00001000	00001000	00001000	00001000	00001000	00001000
2004		00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	10000011	00000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000101	00000100
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00000000	00000000	00000000	00000000	00000000	00000100	00000000	00001000	00000000	00001100	00001110
2014		00000000	00000000	00000000	00000000	00000000	00000100	00000000	00001000	00000000	00001100	00001110
2210		00000100	00000100	00000100	00000100	00000100	00000000	00000100	00000100	00000100	00000000	00000100
2211		00001000	00001000	00001000	00001000	00000000	00001000	00000000	00001000	00000000	00000000	00001000
2300		10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000
2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	01000110	01000110
2560		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00100010	00101010
2561		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2562		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2563		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2040	CUR GAIN I	910	605	702	989	1243	3010	839	709	253	8000	1832
2041	CUR GAIN P	-4971	-3361	-4479	-6312	-4058	-6519	-4103	-3688	-3693	-28000	-7436
2042	CUR GAIN 3	-2696	-2694	-2695	-2695	-2697	-2695	-2695	-1330	-2696	-2703	-2710
2043	VEL GAIN I	7	10	9	10	7	10	9	7	7	6	5
2044	VEL GAIN P	-98	-136	-121	-131	-87	-129	-125	-99	-99	-86	-71
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	-11674	-8363	-9409	-8681	-13022	-8849	-9086	-11497	-11497	-13254	-16035
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	0	0	0	0	0	0	0	0	0	0	0
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	0	0	0	0	0	-12032	0	0	0
2057	D-PHASE CUR	0	0	0	0	0	0	0	0	0	0	0
2058	D-PHASE CUR	0	0	0	0	0	0	0	0	0	0	0
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	5663	7282	6877	7282	4855	7282	6877	5259	6877	4551	4161
2061	INERTIA	2108	2942	2616	2835	1890	2781	2708	2140	2140	1857	1535
2062	POVC1	32728	32723	32730	32730	32729	32722	32720	32711	32711	32612	32614
2063	POVC2	494	560	474	471	483	576	597	709	709	1955	1921
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	POVCLMT	879	1661	1312	1396	621	1707	1358	981	981	1610	1340
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	0	-24576	0	0	0	-4096	20480	-24576	20480	0	0
2086	RATED CURRENT	689	948	843	869	578	961	857	729	729	466	425
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	2348	2087	2348	3104	4566	2043	2098	4197	4197	888	1015
2110	MGSTCM	0	0	0	0	0	0	0	0	0	1048	1078
2111	DETQLM	0	0	0	0	0	0	0	0	0	0	0
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	0	0	0	0	0	0	0	0	0	0	0
2128	MFWKCE	0	0	0	0	0	0	0	0	0	8000	4000
2129	MFWKBL	0	0	0	0	0	0	0	0	0	3075	1554
2133	PHDLY1	0	0	0	0	0	0	0	0	0	0	0
2134	PHDLY2	0	0	0	0	0	0	0	0	0	0	0
2159	CGMAX	0	0	0	0	0	0	0	0	0	9772	11822
2160	CGMPY	0	0	0	0	0	0	0	0	0	2622	2618
2161	OVCSTP	0	0	0	0	0	0	0	0	0	130	130
2162	POVC21	0	0	0	0	0	0	0	0	0	32752	32752
2163	POVC22	0	0	0	0	0	0	0	0	0	206	204
2164	POVCLMT2	0	0	0	0	0	0	0	0	0	296	246
2165	MAX CURRENT	185	85	185	185	365	85	185	185	365	85	45
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	0	0	0	0	0	0	0	0	0	6600	4150
2591	PK2PLS	0	0	0	0	0	0	0	0	0	-11650	-17600
2595	HRV4PLS	0	0	0	0	0	0	0	0	0	1012	1010

When water cooling is used, modify the following parameters from the values listed above to those listed below.

2062	POVC1	32610	32589	32616	32563	32558	32584	32577	32542	32542	31608	31622
2063	POVC2	1972	2236	1894	2557	2623	2298	2384	2829	2829	14504	14327
2065	POVCLMT	3514	6644	5250	7601	3378	6828	5432	3925	3925	9992	8375
2086	RATED CURRENT	1379	1897	1686	2029	1352	1923	1715	1458	1458	1163	1064
2161	OVCSTP	-	-	140	140	-	-	140	-	-	130	130
2162	POVC21	-	-	-	-	-	-	-	-	-	32746	32746
2163	POVC22	-	-	-	-	-	-	-	-	-	277	277
2164	POVCLMT2	-	-	-	-	-	-	-	-	-	1835	1538

	Motor model	LiS4500 M2/2-B (400V)	LiS4500 M2/2HV-B (400V)	LiS4500 M3/2-B (400V)	LiS4500 M3/2HV-B (400V)	LiS6000 M2/2-B (400V)	LiS6000 M2/2HV-B (400V)	LiS7000 M3/2-B (400V)	LiS7000 M3/2HV-B (400V)	LiS7500 M2/2-B (400V)	LiS7500 M2/2HV-B (400V)	LiS9000 M2/2-B (400V)
	Motor specification	0463-B120	0463-B020	0468-B120	0468-B020	0464-B120	0464-B020	0469-B120	0469-B020	0465-B120	0465-B020	0466-B120
	Motor ID No.	658	664	679	685	659	665	680	686	660	666	661
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		10000011	00000011	10000011	10000011	10000011	00000011	10000011	10000011	10000011	00000011	10000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000101	00000100	00000101	00000101	00000101	00000100	00000101	00000101	00000101	00000100	00000101
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00000010	00000110	00000110	00000110	00001110	00001110	00001110	00001100	00001010	00001010	00000110
2014		00000010	00000110	00000110	00000110	00001110	00001110	00001110	00001100	00001010	00001010	00000110
2210		00000000	00000100	00000000	00000100	00000000	00000100	00000100	00000100	00000000	00000100	00000000
2211		00000000	00001000	00000000	00000000	00000000	00001000	00000000	00000000	00000000	00001000	00000000
2300		10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000
2301		01000110	01000110	01000110	01000110	01000110	01000110	01000110	01000110	01000110	01000110	01000110
2560		00100010	00101010	00100010	00101010	00100010	00101010	00100010	00101010	00100010	00101010	00100010
2561		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2562		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2563		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2040	CUR GAIN I	6800	1685	8000	4000	8000	2338	2650	2500	9600	1174	7600
2041	CUR GAIN P	-26800	-5273	-25800	-13500	-28800	-8236	-8800	-11250	-30000	-6952	-27000
2042	CUR GAIN 3	-2709	-2710	-2705	-2705	-2710	-2710	-2705	-2728	-2710	-2710	-2710
2043	VEL GAIN I	8	8	7	7	5	5	5	5	6	6	7
2044	VEL GAIN P	-111	-102	-99	-100	-64	-66	-63	-69	-79	-82	-94
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	-10247	-11172	-11488	-11376	-17691	-17145	-18066	-16391	-14346	-13908	-12072
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	0	0	0	0	0	0	0	0	0	0	0
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	0	0	0	0	0	0	0	0	0
2057	D-PHASE CUR	0	0	0	0	0	0	0	0	0	0	0
2058	D-PHASE CUR	0	0	0	0	0	0	0	0	0	0	0
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	6827	6241	6035	5935	4046	4161	4025	4451	5057	5201	6068
2061	INERTIA	2402	2203	2142	2163	1391	1435	1362	1501	1715	1769	2038
2062	POVC1	32614	32617	32588	32586	32612	32612	32592	32590	32613	32615	32614
2063	POVC2	1931	1893	2255	2275	1955	1947	2195	2228	1940	1911	1931
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	POVCLMT	3580	2938	3251	3172	1272	1340	1410	1748	1974	2062	2829
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	0	0	0	0	0	0	0	0	0	0	0
2086	RATED CURRENT	696	630	660	648	415	425	437	486	513	528	618
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	931	1015	1020	1034	2095	2030	2315	2100	2094	2030	2095
2110	MGSTCM	1557	1304	1310	1292	1048	1060	1054	1055	1042	1048	1304
2111	DETQLM	0	0	0	0	0	0	0	0	0	0	0
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	0	0	0	0	0	0	0	0	0	0	0
2128	MFWKCE	1100	1000	1200	4000	8000	1000	2000	4000	8000	1000	1000
2129	MFWKBL	3078	1548	3072	1556	3076	1542	3072	1550	3076	1542	3078
2133	PHDLY1	0	0	0	0	0	0	0	0	0	0	0
2134	PHDLY2	0	0	0	0	0	0	0	0	0	0	0
2159	CGMAX	7195	7199	7454	7196	14652	14135	14145	14391	9254	10280	7711
2160	CGMPY	2650	2646	2640	2640	2616	2617	2615	2620	2630	2631	2643
2161	OVCSTP	130	130	130	130	130	130	130	130	130	130	130
2162	POVC21	32752	32752	32750	32750	32752	32752	32751	32751	32752	32752	32752
2163	POVC22	205	203	220	220	206	205	217	218	205	204	205
2164	POVCLMT2	658	540	597	583	234	246	259	321	363	379	520
2165	MAX CURRENT	85	45	85	45	185	85	185	85	185	85	185
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	6775	5350	7500	5250	4000	3900	6250	3750	5750	3830	7350
2591	PK2PLS	-10500	-16300	-12600	-15075	-10200	-17000	-11750	-14000	-11275	-14175	-12150
2595	HRV4PLS	1114	1010	1215	1011	1215	1212	1111	910	1010	1010	1112
When water cooling is used, modify the following parameters from the values listed above to those listed below.												
2062	POVC1	32183	32052	31994	31963	31618	31603	31418	31425	31616	31666	32004
2063	POVC2	7312	8946	9678	10061	14376	14563	16871	16791	14402	13772	9555
2065	POVCLMT	12545	12545	12545	12545	7840	8375	8799	10720	12267	12545	12545
2086	RATED CURRENT	1744	1599	1633	1622	1030	1064	1091	1204	1288	1335	1547
2161	OVCSTP	130	130	130	130	130	130	130	130	130	130	130
2162	POVC21	32725	32733	32731	32731	32746	32746	32746	32746	32746	32745	32735
2163	POVC22	542	441	467	467	277	277	277	277	277	292	408
2164	POVCLMT2	4129	3468	3641	3641	1440	1538	1616	1969	2253	2418	3247

	Motor model	LiS9000 M2/2HV-B (400V)	LiS9000 M3/2-B (400V)	LiS9000 M3/2HV-B (400V)	LiS11000 M2/2-B (400V)	LiS11000 M2/2HV-B (400V)	LiS11000 M3/2-B (400V)	LiS11000 M3/2HV-B (400V)	LiS14000 M3/2-B (400V)	LiS14000 M3/2HV-B (400V)	LiS16000 M3/2-B (400V)	LiS16000 M3/2HV-B (400V)
	Motor specification	0466-B020	0470-B120	0470-B020	0467-B120	0467-B020	0471-B120	0471-B020	0472-B120	0472-B020	0473-B120	0473-B020
	Motor ID No.	667	681	687	662	668	682	688	683	689	684	690
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		00000011	10000011	10000011	10000011	00000011	10000011	10000011	10000011	10000011	10000011	10000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000100	00000101	00000101	00000101	00000100	00000101	00000101	00000101	00000101	00000101	00000101
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00000110	00001000	00000110	00000010	00000000	00000000	00000000	00001110	00001110	00001010	00001100
2014		00000110	00001000	00000110	00000010	00000000	00000000	00000000	00001110	00001110	00001010	00001100
2210		00000100	00000100	00000100	00000000	00000100	00000000	00000100	00000000	00000100	00000100	00000100
2211		00001000	00000000	00000000	00000000	00001000	00000000	00000000	00000000	00000000	00000000	00000000
2300		10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000	10000000
2301		01000110	01000110	01000110	01000110	01000110	01000110	01000110	01000110	01000110	01000110	01000110
2560		00101010	00101010	00101010	00100010	00101010	00101010	00101010	00101010	00101010	00101010	00101010
2561		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2562		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2563		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2040	CUR GAIN I	1387	2600	5000	7000	242	9000	4200	10400	3050	2850	4000
2041	CUR GAIN P	-5925	-8300	-14000	-24200	-2895	-27200	-13300	-32000	-11750	-8250	-13000
2042	CUR GAIN 3	-2710	-2705	-2706	-2710	-2710	-2706	-2706	-2705	-2706	-2705	-2706
2043	VEL GAIN I	7	6	7	8	8	8	8	4	7	5	5
2044	VEL GAIN P	-97	-81	-90	-109	-113	-102	-112	-60	-89	-70	-68
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	-11700	-14070	-12678	-10414	-10096	-11209	-10128	-19024	-12745	-16377	-16669
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	0	0	0	0	0	0	0	0	0	0	0
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	0	0	0	0	0	0	0	0	0
2057	D-PHASE CUR	0	0	0	0	0	0	0	0	0	0	0
2058	D-PHASE CUR	0	0	0	0	0	0	0	0	0	0	0
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	6241	5364	5935	7080	7282	6712	7282	4025	3957	4697	4616
2061	INERTIA	2103	1749	1941	2363	2437	2195	2430	1294	1931	1503	1476
2062	POVC1	32612	32592	32591	32614	32609	32593	32583	32617	32613	32601	32599
2063	POVC2	1949	2197	2216	1924	1990	2191	2315	1887	1937	2083	2110
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	POVCLMT	3023	2506	3093	3838	4194	3915	4857	1217	1206	1824	1784
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	0	0	0	0	0	0	0	0	0	0	0
2086	RATED CURRENT	639	581	648	720	753	728	811	406	404	496	491
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	2030	2345	2113	2094	2030	2313	2090	4651	3116	4616	4619
2110	MGSTCM	1304	1298	1298	1554	1548	1549	1549	1082	1082	1048	1048
2111	DETQLM	0	0	0	0	0	0	0	0	0	0	0
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	0	0	0	0	0	0	0	0	0	0	0
2128	MFWKCE	1000	2000	1000	8000	1000	1000	5000	3000	3000	5000	4000
2129	MFWKBL	1542	1546	1539	3073	1542	1540	1536	1544	1548	1537	1536
2133	PHDLY1	0	0	0	0	0	0	0	0	0	0	0
2134	PHDLY2	0	0	0	0	0	0	0	0	0	0	0
2159	CGMAX	7199	9509	6944	5399	6425	7198	6168	17471	18496	13622	12849
2160	CGMPY	2646	2634	2642	2657	2660	2652	2660	2615	2614	2624	2624
2161	OVCSTP	130	130	130	130	130	130	130	130	130	130	130
2162	POVC21	32752	32751	32751	32752	32751	32751	32750	32752	32752	32751	32751
2163	POVC22	205	217	218	204	208	217	222	202	205	212	213
2164	POVCLMT2	555	460	568	705	770	719	892	224	222	335	328
2165	MAX CURRENT	85	185	85	185	85	185	85	365	185	365	185
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	3650	9900	5500	6400	5000	8850	6600	5400	3600	7100	3700
2591	PK2PLS	-13000	-13625	-15300	-10900	-13850	-13150	-14875	-10400	-13950	-11500	-12800
2595	HRV4PLS	1010	1010	1011	1214	1111	1114	1011	1212	1414	909	1414

When water cooling is used, modify the following parameters from the values listed above to those listed below.

2062	POVC1	32052	31744	31963	32228	32261	32161	32261	31529	31519	31417	31416
2063	POVC2	8946	12799	10061	6744	6338	7586	6338	15485	15618	16892	16896
2065	POVCLMT	12545	12545	12545	12545	12545	12545	12545	8232	8007	11991	11584
2086	RATED CURRENT	1599	1457	1613	1802	1867	1822	2015	1055	1041	1274	1252
2161	OVCSTP	130	130	130	130	130	130	130	130	130	130	130
2162	POVC21	32733	32740	32732	32721	32717	32720	32706	32746	32746	32746	32746
2163	POVC22	441	355	451	585	638	605	779	277	277	277	277
2164	POVCLMT2	3468	2877	3532	4405	4732	4513	5508	1512	1471	2202	2128

	Motor model	LiS300 S1/4-B (400V)	LiS600 S1/4-B (400V)	LiS600 S2/3-B (400V)	LiS900 S1/4-B (400V)	LiS1200 S2/3-B (400V)	LiS1800 S2/3-B (400V)					
	Motor specification	0424-B200	0425-B200	0427-B200	0426-B200	0428-B200	0429-B200					
	Motor ID No.	405	406	411	407	412	413					
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000					
2004		10000011	10000011	10000011	10000011	10000011	10000011					
2005		00000000	00000000	00000000	00000000	00000000	00000000					
2006		00000000	00000000	00000000	00000000	00000000	00000000					
2007		00000000	00000000	00000000	00000000	00000000	00000000					
2008		00000000	00000000	00000000	00000000	00000000	00000000					
2009		00000000	00000000	00000000	00000000	00000000	00000000					
2010		00000101	00000101	00000101	00000101	00000101	00000101					
2011		00000000	00000000	00000000	00000000	00000000	00000000					
2012		00000000	00000000	00000000	00000000	00000000	00000000					
2013		00000110	00000110	00000110	00001100	00000110	00001100					
2014		00000110	00000110	00000110	00001100	00000110	00001100					
2210		00000000	00000000	00000000	00000000	00000000	00000000					
2211		00000000	00000000	00000000	00000000	00000000	00000000					
2300		10000000	10000000	10000000	10000000	10000000	10000000					
2301		01000110	01000110	01000110	01000110	01000110	01000110					
2560		00100000	00100000	00101000	00100000	00101000	00100000					
2561		00000000	00000000	00000000	00000000	00000000	00000000					
2562		00000000	00000000	00000000	00000000	00000000	00000000					
2563		00000000	00000000	00000000	00000000	00000000	00000000					
2040	CUR GAIN I	800	1500	2400	800	3200	4000					
2041	CUR GAIN P	-5000	-6800	-13000	-5000	-15400	-17000					
2042	CUR GAIN 3	-2685	-2685	-2689	-2686	-2689	-2691					
2043	VEL GAIN I	7	6	6	4	5	4					
2044	VEL GAIN P	-93	-78	-77	-56	-68	-49					
2045	VEL GAIN 3	0	0	0	0	0	0					
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235					
2047	OBSERVER POA1	-12217	-14527	-14839	-20368	-16797	-23130					
2048	BLACC CMP	0	0	0	0	0	0					
2049	DPFMX	0	0	0	0	0	0					
2050	OBSERVER POK1	956	956	956	956	956	956					
2051	OBSERVER POK2	510	510	510	510	510	510					
2052	OVER SPEED	0	0	0	0	0	0					
2053	DB-CMP PPMAX	21	21	21	21	21	21					
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894					
2055	DB-CMP PHYST	319	319	319	319	319	319					
2056	EMFCMP	0	0	0	0	0	0					
2057	D-PHASE CUR	0	0	0	0	0	0					
2058	D-PHASE CUR	0	0	0	0	0	0					
2059	PPBAS	0	0	0	0	0	0					
2060	TCMD LIMIT	5826	5826	5826	4369	5826	4369					
2061	INERTIA	2014	1694	1658	1208	1465	1064					
2062	POVC1	32583	32633	32633	32662	32663	32675					
2063	POVC2	2315	1691	1691	1325	1309	1166					
2064	TGALMLV	4	4	4	4	4	4					
2065	POVCLMT	3108	2291	2291	1015	1784	895					
2066	ACC FB GAIN	0	0	0	0	0	0					
2067	TCMD FILTER	0	0	0	0	0	0					
2074	AALPH	0	0	0	0	0	0					
2086	RATED CURRENT	648	557	557	370	491	348					
2090	ROBSTL	0	0	0	0	0	0					
2099	ONEPSL	400	400	400	400	400	400					
2100	INPA1	0	0	0	0	0	0					
2101	INPA2	0	0	0	0	0	0					
2102	DBLIM	0	0	0	0	0	0					
2103	ABVOF	0	0	0	0	0	0					
2104	ABTSH	0	0	0	0	0	0					
2105	TORQUE CONST.	87	175	174	349	352	689					
2110	MGSTCM	1298	1298	1304	1044	1298	1044					
2111	DETQLM	0	0	0	0	0	0					
2112	AMRDML	0	0	0	0	0	0					
2113	HRV FILT	0	0	0	0	0	0					
2127	NINTCT	0	0	0	0	0	0					
2128	MFWKCE	0	0	2000	0	1000	2000					
2129	MFWKBL	0	0	1542	0	1542	1540					
2133	PHDLY1	0	0	0	0	0	0					
2134	PHDLY2	0	0	0	0	0	0					
2159	CGMAX	-28417	22118	13644	-28417	11569	18003					
2160	CGMPY	2600	2610	2620	2600	2630	2610					
2161	OVCSTP	130	130	130	130	130	130					
2162	POVC21	32750	32753	32753	32755	32755	32756					
2163	POVC22	222	191	191	165	164	152					
2164	POVCLMT2	571	421	421	186	328	164					
2165	MAX CURRENT	25	45	25	85	45	85					
2302	TQLIM AT STOP	0	0	0	0	0	0					
2304	ACCBSLM	0	0	0	0	0	0					
2305	ACDCEBD	0	0	0	0	0	0					
2310	DCIDBS	0	0	0	0	0	0					
2316	LIMLIM	0	0	0	0	0	0					
2574	VELOVC	0	0	0	0	0	0					
2576	DDOVC	0	0	0	0	0	0					
2590	PK1PLS	4000	5000	9000	4000	12200	12400					
2591	PK2PLS	-13000	-13000	-23400	-13000	-27200	-29000					
2595	HRV4PLS	2050	1944	1524	2050	1317	1424					

When water cooling is used, modify the following parameters from the values listed above to those listed below.

2062	POVC1	31927	31927	31927	31788	31927	31784					
2063	POVC2	10508	10508	10508	12252	10508	12304					
2065	POVCLMT	12545	12545	12545	8028	12545	8056					
2086	RATED CURRENT	1390	1392	1392	1042	1392	1044					
2161	OVCSTP	130	130	130	130	130	130					
2162	POVC21	32742	32742	32742	32746	32742	32746					
2163	POVC22	320	321	321	277	321	277					
2164	POVCLMT2	2621	2630	2630	1475	2630	1480					

10.4 STANDARD PARAMETERS FOR THE DD MOTORS

Series 90G0, 90J0, 90K0, 90GP, and 90JP (for Series 30*i*/31*i*/32*i*/35*i*-B, Power Motion *i*-A, DSA-B)
Series 90E0 and 90E1 (for Series 30*i*/31*i*/32*i*-A)
Series 90D0 (for Series 30*i*/31*i*-A)
Series 90M0, 90L0, 90M8, and 90L8 (for Series 0*i*-F)
Series 90C5 and 90C8 (for Series 0*i*-D)
Series 90E5 and 90E8 (for Series 0*i*-D)
Series 90H0 (for Series 0*i* Mate-D)

10.4.1 DD Motor D*i*S-B and D*i*S Series [200V]

	Motor model	DiS400 250 (200V)	DiS22 600 (200V)	DiS85 400 (200V)	DiS110 300 (200V)	DiS260 300 (200V)	DiS260 600 (200V)	DiS370 300 (200V)	DiS800 250 (200V)	DiS1200 250 (200V)	DiS1500 200 (200V)	DiS2100 150 (200V)
	Motor specification	0485-B20x	0482-B10x	0483-B20x	0484-B10x	0484-B30x	0484-B31x	0484-B40x	0485-B40x	0485-B50x	0486-B30x	0487-B30x
	Motor ID No.	419	421	423	425	427	429	431	433	435	437	439
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00000000	00000000	00000000	00000000	00000000	00001000	00000000	00001000	00001000	00000000	00000000
2014		00000000	00000000	00000000	00000000	00000000	00001000	00000000	00001000	00001000	00000000	00000000
2210		00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100
2211		00001000	00001000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2300		10000110	10000110	10000100	10000100	10000100	10000100	10000100	10000100	10000100	10000100	10000100
2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2560		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2040	CUR GAIN I	494	621	344	156	313	571	478	738	517	640	637
2041	CUR GAIN P	-1949	-2202	-2368	-1045	-2146	-4138	-3338	-2500	-3361	-4779	-4762
2042	CUR GAIN 3	-2943	-2946	-2491	-2448	-2485	-2573	-2515	-2996	-2408	-2619	-2620
2043	VEL GAIN I	415	157	242	420	326	240	264	386	430	839	1760
2044	VEL GAIN P	-3713	-1410	-2164	-3763	-2919	-2146	-2361	-3461	-3850	-7513	-15770
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	2271	5982	3897	2241	2889	3931	3572	2437	2190	1122	535
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	0	0	0	0	0	0	0	0	0	0	0
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	0	0	0	0	0	0	0	0	0
2057	D-PHASE CUR	0	0	0	0	0	0	0	0	0	0	0
2058	D-PHASE CUR	0	0	0	0	0	0	0	0	0	0	0
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	7282	7282	7282	7282	7282	5352	7282	5648	5648	7282	7282
2061	INERTIA	1354	514	552	960	754	752	733	1613	1634	2740	3631
2062	OVC K1	32743	32689	32683	32682	32682	32679	32705	32713	32677	32682	32682
2063	OVC K2	308	988	1069	1069	1069	1111	782	690	1113	1069	1069
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	OVC LIMIT	903	2826	3172	3173	3173	1710	2322	1200	1940	3173	3173
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	20480	20480	0	0	0	0	0	0	0	0	0
2086	RATED CURRENT	753	1237	1310	1310	1310	963	1121	868	1028	1310	1310
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	8080	448	1167	1510	3570	4857	6020	16519	21246	20598	25635
2110	MGSTCM	1281	1793	0	0	0	0	0	0	0	0	0
2111	DETQLM	1535	8568	0	0	0	0	0	0	0	0	0
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	0	0	0	0	0	0	0	0	0	0	0
2128	MFWKCE	16776	0	0	0	0	0	0	0	0	0	0
2129	MFWKBL	14	0	0	0	0	0	0	0	0	0	0
2133	PHDLY1	0	0	0	0	0	0	0	0	0	0	0
2134	PHDLY2	0	0	0	0	0	0	0	0	0	0	0
2159	CGMAX	0	0	0	0	0	0	0	0	0	0	0
2160	CGMPY	0	0	0	0	0	0	0	0	0	0	0
2161	OVC STP	120	0	0	0	0	0	0	0	0	0	0
2162	OVC2 K1	0	0	0	0	0	0	0	0	0	0	0
2163	OVC2 K2	0	0	0	0	0	0	0	0	0	0	0
2164	OVC2 LIMIT	0	0	0	0	0	0	0	0	0	0	0
2165	MAX CURRENT	85	25	45	85	85	165	85	165	165	165	165
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	0	0	0	0	0	0	0	0	0	0	0
2591	PK2PLS	0	0	0	0	0	0	0	0	0	0	0
2595	HRV4PLS	0	0	0	0	0	0	0	0	0	0	0
Remarks		*5	*5									
		When liquid cooling is used, use the OVC parameters described in Subsection 3.2.1.3, "Parameter setting procedure 3 (OVC alarm parameters)".										

	Motor model	DiS3000 150 (200V)	DiS85 1000 (200V)	DiS110 1000 (200V)	DiS260 1000 (200V)	DiS22 1500 (200V)						
	Motor specification	0487-B40x	0483-B22x	0484-B12x	0484-B32x	0482-B12x						
	Motor ID No.	441	443	445	447	449						
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000						
2004		00000011	00000011	00000011	00000011	00000011						
2005		00000000	00000000	00000000	00000000	00000000						
2006		00000000	00000000	00000000	00000000	00000000						
2007		00000000	00000000	00000000	00000000	00000000						
2008		00000000	00000000	00000000	00000000	00000000						
2009		00000000	00000000	00000000	00000000	00000000						
2010		00000000	00000000	00000000	00000000	00000000						
2011		00000000	00000000	00000000	00000000	00000000						
2012		00000000	00000000	00000000	00000000	00000000						
2013		00000000	00000001	00000001	00000001	00000001						
2014		00000000	00000000	00000000	00000000	00000000						
2210		00000100	00000100	00000100	00000100	00000100						
2211		00000000	00001000	00001000	00001000	00001010						
2300		10000100	10000110	10000110	10000110	10000110						
2301		10000000	00000000	00000000	00000000	00000000						
2560		00000000	00000000	00000000	00000000	00000000						
2040	CUR GAIN I	817	480	301	290	562						
2041	CUR GAIN P	-6084	-1395	-1001	-916	-1568						
2042	CUR GAIN 3	-2616	-3002	-3024	-3016	-2948						
2043	VEL GAIN I	1635	220	292	243	202						
2044	VEL GAIN P	-14643	-1971	-2614	-2178	-1811						
2045	VEL GAIN 3	0	0	0	0	0						
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235						
2047	OBSERVER POA1	576	4278	3227	3871	4657						
2048	BLACC CMP	0	0	0	0	0						
2049	DPFMX	0	0	0	0	0						
2050	OBSERVER POK1	956	956	956	956	956						
2051	OBSERVER POK2	510	510	510	510	510						
2052	OVER SPEED	0	0	0	0	0						
2053	DB-CMP PPMAX	21	21	21	21	21						
2054	DB-CMP PDDP	1894	1894	1894	1894	1894						
2055	DB-CMP PHYST	319	319	319	319	319						
2056	EMFCMP	0	0	0	0	0						
2057	D-PHASE CUR	0	-12846	-20535	-10266	-17944						
2058	D-PHASE CUR	0	-2731	-1183	-1821	-2257						
2059	PPBAS	0	0	0	0	0						
2060	TCMD LIMIT	7282	7282	7282	7282	7282						
2061	INERTIA	3331	717	960	795	660						
2062	OVC K1	32682	32346	32434	32580	32439						
2063	OVC K2	1069	5276	4174	2354	4109						
2064	TGALMLV	4	4	4	4	4						
2065	OVC LIMIT	3173	15735	12437	6423	10559						
2066	ACC FB GAIN	0	0	0	0	0						
2067	TCMD FILTER	0	0	0	0	0						
2074	AALPH	0	20480	8192	8192	0						
2086	RATED CURRENT	1310	2919	2595	1865	2576						
2090	ROBSTL	0	0	0	0	0						
2099	ONEPSL	400	400	400	400	400						
2100	INPA1	0	0	0	0	0						
2101	INPA2	0	0	0	0	0						
2102	DBLIM	0	0	0	0	0						
2103	ABVOF	0	0	0	0	0						
2104	ABTSH	0	0	0	0	0						
2105	TORQUE CONST.	3667	1281	2175	4784	348						
2110	MGSTCM	0	2313	1027	1537	2049						
2111	DETQLM	0	11647	14212	11620	16720						
2112	AMRDML	0	0	0	0	0						
2113	HRV FILT	0	0	0	0	0						
2127	NINTCT	0	0	0	0	0						
2128	MFWKCE	0	10500	15000	9800	6500						
2129	MFWKBL	0	278	533	287	792						
2133	PHDLY1	0	0	0	0	30735						
2134	PHDLY2	0	0	0	0	10270						
2159	CGMAX	0	0	0	0	0						
2160	CGMPY	0	0	0	0	0						
2161	OVC STP	0	0	0	0	0						
2162	OVC2 K1	0	0	0	0	0						
2163	OVC2 K2	0	0	0	0	0						
2164	OVC2 LIMIT	0	0	0	0	0						
2165	MAX CURRENT	165	45	85	165	25						
2302	TQLIM AT STOP	0	0	0	0	0						
2304	ACCBSLM	0	0	0	0	0						
2305	ACDCEBD	0	0	0	0	0						
2310	DCIDBS	0	0	0	0	0						
2316	LIMLIM	0	0	0	0	0						
2574	VELOVC	0	0	0	0	0						
2576	DDOVC	0	0	0	0	0						
2590	PK1PLS	0	0	0	0	0						
2591	PK2PLS	0	0	0	0	0						
2595	HRV4PLS	0	0	0	0	0						
Remarks			*5	*5	*5	*5						
		When liquid cooling is used, use the OVC parameters described in Subsection 3.2.1.3, "Parameter setting procedure 3 (OVC alarm parameters)".										

	Motor model	DiS15 1000 (200V)	DiS60 400 (200V)	DiS70 300 (200V)	DiS150 300 (200V)	DiS200 300 (200V)	DiS250 250 (200V)	DiS500 250 (200V)	DiS1000 200 (200V)	DiS1500 100 (200V)	DiS2000 100 (200V)	DiS2000 150 (200V)
	Motor specification	0492-B100	0493-B200	0494-B100	0494-B300	0494-B400	0495-B200	0495-B400	0496-B300	0497-B300	0497-B400	0497-B490
	Motor ID No.	551	553	555	557	559	561	563	565	567	569	571
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000010	00000010	00000010	00000010	00000010	00000010	00001010	00001010	00001010	00001010
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00000000	00001000	00000110	00000110	00000110	00000000	00000000	00000000	00000000	00000000	00000100
2014		00000000	00001000	00000110	00000110	00000110	00000000	00000000	00000000	00000000	00000000	00000100
2210		00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100
2211		00011000	00001000	00001000	00001000	00011000	00001000	00001000	00011000	00011000	00011000	00001000
2300		10000110	10000110	10000110	10000110	10000110	10000110	10000110	10000110	10000110	10000110	10000110
2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	10010100	10000000	10000000	10000000
2560		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2040	CUR GAIN I	309	538	296	379	451	294	321	434	490	637	448
2041	CUR GAIN P	-1713	-3794	-2764	-3215	-3966	-2458	-2569	-2352	-3676	-5353	-3457
2042	CUR GAIN 3	-3067	-3102	-3117	-3128	-3135	-3129	-3138	-3173	-3176	-3177	-3177
2043	VEL GAIN I	69	86	180	149	141	334	297	558	760	689	620
2044	VEL GAIN P	-618	-772	-1614	-1331	-1261	-2996	-2664	-4997	-6812	-6171	-5554
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	13637	10929	5224	6336	6686	2815	3165	1688	1238	1367	1518
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	720	240	180	180	180	150	150	120	60	60	90
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	0	0	0	0	0	0	0	0	0
2057	D-PHASE CUR	0	0	0	0	0	0	0	0	0	-1038	0
2058	D-PHASE CUR	0	0	0	0	0	0	0	0	0	-489	0
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	7282	5462	6190	6190	6190	7282	7282	7282	7282	7282	6473
2061	INERTIA	226	281	589	485	460	1093	972	1823	2485	2251	2026
2062	OVC K1	32675	32675	32684	32714	32721	32707	32723	32677	32682	32709	32707
2063	OVC K2	1160	1160	1056	679	590	761	567	1135	1078	740	763
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	OVC LIMIT	3300	1856	2178	1419	1237	2196	1646	3231	3076	2136	1739
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	-20480	-32768	-24576	-20480	-4096	-4096	20480	-20480	28672	24576	12288
2086	RATED CURRENT	1440	845	1005	944	881	1175	1062	1421	1390	1176	1045
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	612	2865	3521	7830	11266	10329	20150	3349	5516	8086	8984
2110	MGSTCM	2305	1793	1793	1793	1793	1793	2049	2049	2049	2049	2049
2111	DETQLM	8854	6174	5173	5173	2625	3890	3890	2680	1184	1244	2218
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	0	0	0	0	0	0	0	0	0	0	0
2128	MFWKCE	16000	4000	0	4000	6000	7000	5000	10000	5000	15000	10000
2129	MFWKBL	277	6158	0	5134	2581	3861	3861	2588	1042	1042	2069
2133	PHDLY1	0	0	0	0	0	0	0	0	0	0	0
2134	PHDLY2	0	0	0	0	0	0	0	0	0	0	0
2159	CGMAX	0	0	0	0	0	0	0	0	0	0	0
2160	CGMPY	0	0	0	0	0	0	0	0	0	0	0
2161	OVC STP	0	0	0	0	0	0	0	0	0	0	0
2162	OVC2 K1	0	0	0	0	0	0	0	0	0	0	0
2163	OVC2 K2	0	0	0	0	0	0	0	0	0	0	0
2164	OVC2 LIMIT	0	0	0	0	0	0	0	0	0	0	0
2165	MAX CURRENT	25	45	45	85	85	85	165	165	165	165	365
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	72	0	0	0	36	0	0	24	12	12	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	0	0	0	0	0	0	0	0	0	0	0
2591	PK2PLS	0	0	0	0	0	0	0	0	0	0	0
2595	HRV4PLS	0	0	0	0	0	0	0	0	0	0	0
Remarks		*2,*5	*5	*5	*5	*2,*5	*5	*5	*2,*3,*5	*2,*3*,5	*2,*3,*5	*3,*5
		When liquid cooling is used, use the OVC parameters described in Subsection 3.2.1.3, "Parameter setting procedure 3 (OVC alarm parameters)".										

	Motor model	DiS60 2000 (200V)	DiS70 1500 (200V)	DiS150 1500 (200V)	DiS500 1000 (200V)							
	Motor specification	0493-B220	0494-B120	0494-B320	0495-B420							
	Motor ID No.	577	579	581	583							
PRM NO	SERVO PRM.	Liquid cooling only	Liquid cooling only	Liquid cooling only	Liquid cooling only							
2003		00001000	00001000	00001000	00001000							
2004		00000011	00000011	00000011	00000011							
2005		00000000	00000000	00000000	00000000							
2006		00001000	00001000	00001000	00001000							
2007		00000000	00000000	00000000	00000000							
2008		00000000	00000000	00000000	00000000							
2009		00000000	00000000	00000000	00000000							
2010		00000001	00000001	00000001	00000001							
2011		00000000	00000000	00000000	00000000							
2012		00000000	00000000	00000000	00000000							
2013		00001000	00001000	00001000	00001010							
2014		00101000	00101000	00101000	00101010							
2210		00000100	00000100	00000100	00000100							
2211		00000000	00000000	00000000	00000000							
2300		10000100	10000100	10000100	10000100							
2301		01000000	01000000	01000000	01000000							
2560		00000000	00000000	00000000	00000000							
2040	CUR GAIN I	337	227	373	469							
2041	CUR GAIN P	-1938	-1380	-1809	-2197							
2042	CUR GAIN 3	-3094	-3115	-3130	-3131							
2043	VEL GAIN I	93	210	172	267							
2044	VEL GAIN P	-837	-1883	-1537	-2395							
2045	VEL GAIN 3	0	0	0	0							
2046	VEL GAIN 4	-8235	-8235	-8235	-8235							
2047	OBSERVER POA1	10081	4479	5487	3521							
2048	BLACC CMP	0	0	0	0							
2049	DPFMX	0	0	0	0							
2050	OBSERVER POK1	956	956	956	956							
2051	OBSERVER POK2	510	510	510	510							
2052	OVER SPEED	1200	1200	1200	720							
2053	DB-CMP PPMAX	21	21	21	21							
2054	DB-CMP PDDP	1894	1894	1894	1894							
2055	DB-CMP PHYST	319	319	319	319							
2056	EMFCMP	-9472	-9472	0	-8960							
2057	D-PHASE CUR	-10267	-5147	-2616	-1341							
2058	D-PHASE CUR	-1625	-1821	-2048	-1821							
2059	PPBAS	0	0	0	0							
2060	TCMD LIMIT	5370	5416	5416	5158							
2061	INERTIA	49	109	89	139							
2062	OVC K1	32517	32467	32438	32567							
2063	OVC K2	3235	3761	4128	2517							
2064	TGALMLV	4	4	4	4							
2065	OVC LIMIT	4529	5409	5864	3427							
2066	ACC FB GAIN	0	0	0	0							
2067	TCMD FILTER	0	0	0	0							
2074	AALPH	-32768	-32768	0	-24576							
2086	RATED CURRENT	2293	2506	2610	1995							
2090	ROBSTL	60	70	130	250							
2099	ONEPSL	400	400	400	400							
2100	INPA1	42	44	70	110							
2101	INPA2	0	0	0	0							
2102	DBLIM	0	0	0	0							
2103	ABVOF	0	0	0	0							
2104	ABTSH	0	0	0	0							
2105	TORQUE CONST.	2642	3019	6781	22416							
2110	MGSTCM	1793	2049	2049	1793							
2111	DETQLM	0	0	0	0							
2112	AMRDML	0	0	0	0							
2113	HRV FILT	0	0	0	0							
2127	NINTCT	0	0	0	0							
2128	MFWKCE	0	0	0	0							
2129	MFWKBL	0	0	0	0							
2133	PHDLY1	0	0	0	0							
2134	PHDLY2	0	0	0	0							
2159	CGMAX	0	0	0	0							
2160	CGMPY	0	0	0	0							
2161	OVC STP	106	106	0	0							
2162	OVC2 K1	32633	32678	32643	32630							
2163	OVC2 K2	1683	1130	1558	1719							
2164	OVC2 LIMIT	1389	1024	515	323							
2165	MAX CURRENT	85	85	165	365							
2302	TQLIM AT STOP	0	0	0	0							
2304	ACCBSLM	0	0	0	0							
2305	ACDCEBD	0	0	0	0							
2310	DCIDBS	0	0	0	0							
2316	LIMLIM	0	0	0	0							
2574	VELOVC	1200	1200	1200	720							
2576	DDOVC	0	0	0	0							
2590	PK1PLS	0	0	0	0							
2591	PK2PLS	0	0	0	0							
2595	HRV4PLS	0	0	0	0							
Remarks		*3, *6,*7	*3,*6,*7	*3,*6,*7	*3,*6,*7							
		When liquid cooling is used, use the OVC parameters described in Subsection 3.2.1.3, "Parameter setting procedure 3 (OVC alarm parameters)".										

	Motor model	DiS120 600 (200V)	DiS500 1200 (200V)	DiS1000 1000-385 (200V)	DiS1000 1000 (200V)	DiS15 1000-B (200V)	DiS60 400-B (200V)	DiS60 2000-B (200V)	DiS120 600-B (200V)	DiS70 300-B (200V)	DiS70 1500-B (200V)	DiS150 300-B (200V)
	Motor specification	0493-B400	0495-B421	0499-B420	0496-B320	2392-B100	2393-B200	2393-B220	2393-B400	2394-B100	2394-B120	2394-B300
	Motor ID No.	575	585	587	589	593	595	597	599	601	603	605
PRM NO	SERVO PRM.	Liquid cooling only	Liquid cooling only	Liquid cooling only	Liquid cooling only			Liquid cooling only	Liquid cooling only			
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		10000011	10000011	10000011	10000011	10000011	10000011	10000011	10000011	10000011	10000011	10000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00001010	00001000	00001000	00001000	00000000	00000010	00001000	00001010	00000010	00001000	00000010
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000001	00000001	00000001	00000001	00000000	00000000	00000001	00000001	00000000	00000001	00000000
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00001010	00000101	00001001	00001001	00000000	00001000	00001000	00001010	00000110	00001000	00000110
2014		00101010	00100100	00101000	00101000	00000000	00001000	00101000	00101010	00000110	00101000	00000110
2210		00000000	00000000	00000000	00000000	00000100	00000100	00000100	00000000	00000100	00000100	00000100
2211		00000000	00000000	00000000	00000000	00011000	00001000	00000000	00000000	00001000	00000000	00001000
2300		10000101	10000101	10000101	10000101	10000110	10000110	10000100	10000101	10000110	10000100	10000110
2301		01000110	01000110	01000110	01000110	00000000	00000000	01000000	01000110	00000000	01000000	00000000
2560		01110011	01110001	01110001	01010001	00000001	00000001	00000001	01110011	00000011	00100001	00000011
2040	CUR GAIN I	9200	2350	3000	1350	309	538	337	9200	296	227	379
2041	CUR GAIN P	-20000	-7500	-20000	-11300	-1713	-3794	-1938	-20000	-2764	-1380	-3215
2042	CUR GAIN 3	-3098	-3136	-3169	-3172	-3067	-3102	-3094	-3098	-3117	-3115	-3128
2043	VEL GAIN I	91	371	429	614	69	86	93	91	180	210	149
2044	VEL GAIN P	-814	-3324	-3842	-5504	-618	-772	-837	-814	-1614	-1883	-1331
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	10355	2537	2195	1532	13637	10929	10081	10355	5224	4479	6336
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	720	1440	600	600	720	240	1200	720	180	1200	180
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	0	0	0	0	-9472	0	0	-9472	0
2057	D-PHASE CUR	-11014	-1356	-1330	-2660	0	0	-10267	-11014	0	-5147	0
2058	D-PHASE CUR	-2100	-3004	-1900	-1950	0	0	-1625	-2100	0	-1821	0
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	5462	7282	6068	6068	7282	5462	5370	5462	6190	5416	6190
2061	INERTIA	0	0	0	0	226	281	49	0	589	109	485
2062	OVC K1	32485	32423	32294	32464	32675	32675	32517	32485	32684	32467	32714
2063	OVC K2	3533	4309	5920	3800	1160	1160	3235	3533	1056	3761	679
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	OVC LIMIT	5207	10998	9941	9867	3300	1856	4529	5207	2178	5409	1419
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	0	0	0	0	-20480	-32768	-32768	0	-24576	-32768	-20480
2086	RATED CURRENT	2236	3249	3089	3115	1440	845	2293	2236	1005	2506	944
2090	ROBSTL	66	400	280	300	0	0	60	66	0	70	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	36	77	190	175	0	0	42	36	0	44	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	5041	16150	31811	30412	612	2865	2642	5041	3521	3019	7830
2110	MGSTCM	1793	2561	2561	2561	2305	1793	1793	1793	1793	2049	1793
2111	TQLIM IN DEC.	0	0	0	0	8854	6174	0	0	5173	0	5173
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	0	0	0	0	0	0	0	0	0	0	0
2128	MFWKCE	0	0	0	0	16000	4000	0	0	0	0	4000
2129	MFWKBL	0	0	0	0	277	6158	0	0	0	0	5134
2133	PHDLY1	0	0	0	0	0	0	0	0	0	0	0
2134	PHDLY2	0	0	0	0	0	0	0	0	0	0	0
2159	CGMAX	10284	2580	7188	4110	6682	5180	10260	10284	8990	10275	12078
2160	CGMPY	7760	2660	5220	5220	5200	5180	5185	7760	5120	5190	2630
2161	OVC STP	117	122	115	115	0	0	106	117	0	106	0
2162	OVC2 K1	32713	32659	32686	32674	0	0	32633	32713	0	32678	0
2163	OVC2 K2	687	1362	1025	1175	0	0	1683	687	0	1130	0
2164	OVC2 LIMIT	6001	588	284	343	0	0	1389	6001	0	1024	0
2165	MAX CURRENT	85	365	365	365	25	45	85	85	45	85	85
2302	TQLIM AT STOP	0	14	12	11	0	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	72	0	0	0	0	0	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	4349	4551	4248	0	0	0	0	0	0	0
2574	VELOVC	720	1440	1200	1175	0	0	1200	720	0	1200	0
2576	DDOVC	-24324	-23285	-20985	-6649	0	0	0	-24324	0	0	0
2590	PK1PLS	5500	10000	26000	2120	9200	10000	17500	5500	3000	18500	4250
2591	PK2PLS	-9000	-14000	-32000	-14000	-20900	-29000	-24000	-9000	-9500	-23000	-8775
2595	HRV4PLS	1222	0	0	1120	1525	1013	1525	1222	916	1217	1010
Remarks		*8	*8	*8	*8	*8	*8	*8	*8	*8	*8	*8
		When liquid cooling is used, use the OVC parameters described in Subsection 3.2.1.3, "Parameter setting procedure 3 (OVC alarm parameters)".										

	Motor model	DiS150 1500-B (200V)	DiS200 300-B (200V)	DiS250 250-B (200V)	DiS500 250-B (200V)	DiS500 1200-B (200V)	DiS1000 1000-385-B (200V)	DiS1000 200-B (200V)	DiS1000 1000-B (200V)	DiS1500 100-B (200V)	DiS2000 100-B (200V)	DiS2000 150-B (200V)
	Motor specification	2394-B320	2394-B400	2395-B200	2395-B400	2395-B421	2399-B420	2396-B300	2396-B320	2397-B300	2397-B400	2397-B490
	Motor ID No.	607	609	612	614	616	619	621	623	625	627	629
PRM NO	SERVO PRM.	Liquid cooling only				Liquid cooling only	Liquid cooling only		Liquid cooling only			
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		10000011	10000011	10000011	10000011	10000011	10000011	10000011	10000011	10000011	10000011	10000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00001000	00000010	00000010	00000010	00001000	00001000	00001010	00001000	00001010	00001010	00001010
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000001	00000000	00000000	00000000	00000001	00000001	00000000	00000001	00000000	00000000	00000000
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00001000	00000110	00000000	00000000	00000101	00001001	00000000	00001001	00000000	00000000	00000100
2014		00101000	00000110	00000000	00000000	00100100	00101000	00000000	00101000	00000000	00000000	00000100
2210		00000100	00000100	00000100	00000100	00000000	00000000	00000100	00000000	00000100	00000100	00000100
2211		00000000	00011000	00001000	00001000	00000000	00000000	00011000	00000000	00011000	00011000	00001000
2300		10000100	10000110	10000110	10000110	10000101	10000101	10000110	10000101	10000110	10000110	10000110
2301		01000000	00000000	00000000	00000000	01000110	01000110	10010100	01000110	10000000	10000000	10000000
2560		00100001	00101011	00000001	00000001	01110001	01110001	00100011	01010001	00100011	00101011	00000011
2040	CUR GAIN I	373	451	294	321	2350	3000	434	1350	490	637	448
2041	CUR GAIN P	-1809	-3966	-2458	-2569	-7500	-20000	-2352	-11300	-3676	-5353	-3457
2042	CUR GAIN 3	-3130	-3135	-3129	-3138	-3136	-3169	-3173	-3172	-3176	-3177	-3177
2043	VEL GAIN I	172	141	334	297	371	429	558	614	760	689	620
2044	VEL GAIN P	-1537	-1261	-2996	-2664	-3324	-3842	-4997	-5504	-6812	-6171	-5554
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	5487	6686	2815	3165	2537	2195	1688	1532	1238	1367	1518
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	1200	180	150	150	1440	600	120	600	60	60	90
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	0	0	0	0	0	0	0	0	0
2057	D-PHASE CUR	-2616	0	0	0	-1356	-1330	0	-2660	0	-1038	0
2058	D-PHASE CUR	-2048	0	0	0	-3004	-1900	0	-1950	0	-489	0
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	5416	6190	7282	7282	7282	6068	7282	6068	7282	7282	6473
2061	INERTIA	89	460	1093	972	0	0	1823	0	2485	2251	2026
2062	OVC K1	32438	32721	32707	32723	32423	32294	32677	32464	32682	32709	32707
2063	OVC K2	4128	590	761	567	4309	5920	1135	3800	1078	740	763
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	OVC LIMIT	5864	1237	2196	1646	10998	9941	3231	9867	3076	2136	1739
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	0	-4096	-4096	20480	0	0	-20480	0	28672	24576	12288
2086	RATED CURRENT	2610	881	1175	1062	3249	3089	1421	3115	1390	1176	1045
2090	ROBSTL	130	0	0	0	400	280	0	300	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	70	0	0	0	77	190	0	175	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	6781	11266	10329	20150	16150	31811	3349	30412	5516	8086	8984
2110	MGSTCM	2049	1793	1793	2049	2561	2561	2049	2561	2049	2049	2049
2111	TQLIM IN DEC.	0	2625	3890	3890	0	0	2680	0	1184	1244	2218
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	0	0	0	0	0	0	0	0	0	0	0
2128	MFWKCE	0	6000	7000	5000	0	0	10000	0	5000	15000	10000
2129	MFWKBL	0	2581	3861	3861	0	0	2588	0	1042	1042	2069
2133	PHDLY1	0	0	0	0	0	0	0	0	0	0	0
2134	PHDLY2	0	0	0	0	0	0	0	0	0	0	0
2159	CGMAX	6410	5150	7448	7697	2580	7188	12084	4110	11560	3085	25198
2160	CGMPY	5120	5120	5120	5189	2660	5220	5120	5220	7760	5120	2610
2161	OVC STP	0	0	0	0	122	115	0	115	0	0	0
2162	OVC2 K1	32643	0	0	0	32659	32686	0	32674	0	0	0
2163	OVC2 K2	1558	0	0	0	1362	1025	0	1175	0	0	0
2164	OVC2 LIMIT	515	0	0	0	588	284	0	343	0	0	0
2165	MAX CURRENT	165	85	85	165	365	365	165	365	165	165	365
2302	TQLIM AT STOP	0	0	0	0	14	12	0	11	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	36	0	0	0	0	24	0	12	12	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	0	0	0	4349	4551	0	4248	0	0	0
2574	VELOVC	1200	0	0	0	1440	1200	0	1175	0	0	0
2576	DDOVC	0	0	0	0	-23285	-20985	0	-6649	0	0	0
2590	PK1PLS	17000	10000	14400	14400	10000	26000	7250	2120	4500	5100	5175
2591	PK2PLS	-23000	-17500	-29700	-30400	-14000	-32000	-12500	-14000	-12500	-18600	-12125
2595	HRV4PLS	1319	704	1011	1113	0	0	1414	1120	1009	1113	0
Remarks		*8	*8	*8	*8	*8	*8	*8	*8	*8	*8	*8
		When liquid cooling is used, use the OVC parameters described in Subsection 3.2.1.3, "Parameter setting procedure 3 (OVC alarm parameters)".										

10.4.2 DD Motor D*i*S-B and D*i*S Series [400V]

	Motor model	DiS400 250 (400V)	DiS22 600 (400V)	DiS85 400 (400V)	DiS110 300 (400V)	DiS260 300 (400V)	DiS260 600 (400V)	DiS370 300 (400V)	DiS800 250 (400V)	DiS1200 250 (400V)	DiS1500 200 (400V)	DiS2100 150 (400V)
	Motor specification	0485-B20x	0482-B10x	0483-B20x	0484-B10x	0484-B30x	0484-B31x	0484-B40x	0485-B40x	0485-B50x	0486-B30x	0487-B30x
	Motor ID No.	420	422	424	426	428	430	432	434	436	438	440
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00000000	00000000	00000000	00000000	00000000	00001000	00000000	00001000	00001000	00000000	00000000
2014		00000000	00000000	00000000	00000000	00000000	00001000	00000000	00001000	00001000	00000000	00000000
2210		00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100
2211		00001000	00001000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2300		10000110	10000110	10000100	10000100	10000100	10000100	10000100	10000100	10000100	10000100	10000100
2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2560		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2040	CUR GAIN I	494	374	172	78	157	321	239	496	291	360	359
2041	CUR GAIN P	-1352	-1042	-1184	-523	-1073	-2327	-1669	-1588	-1891	-2688	-2679
2042	CUR GAIN 3	-2943	-2946	-2491	-2448	-2485	-2573	-2515	-2996	-2408	-2619	-2620
2043	VEL GAIN I	415	157	242	420	326	213	264	343	382	746	1565
2044	VEL GAIN P	-3713	-1410	-2164	-3763	-2919	-1907	-2361	-3076	-3422	-6678	-14017
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	2271	5982	3897	2241	2889	4422	3572	2742	2464	1263	602
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	0	0	0	0	0	0	0	0	0	0	0
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	0	0	0	0	0	0	0	0	0
2057	D-PHASE CUR	0	0	0	0	0	0	0	0	0	0	0
2058	D-PHASE CUR	0	0	0	0	0	0	0	0	0	0	0
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	7282	7282	7282	7282	7282	4758	7282	5020	5020	6473	7282
2061	INERTIA	1354	514	552	960	754	752	733	1613	1634	2740	3226
2062	OVC K1	32743	32689	32683	32682	32682	32679	32705	32713	32678	32700	32682
2063	OVC K2	308	988	1069	1069	1069	1111	782	690	1130	845	1069
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	OVC LIMIT	903	2826	3172	3173	3173	1351	2322	948	1529	2507	3173
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	20480	0	0	0	0	0	0	0	0	0	0
2086	RATED CURRENT	753	1237	1310	1310	1310	856	1121	772	914	1165	1310
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	8080	448	1167	1510	3570	5464	6020	18584	23902	23173	28839
2110	MGSTCM	1281	1793	0	0	0	0	0	0	0	0	0
2111	DETQLM	0	25660	0	0	0	0	0	0	0	0	0
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	0	0	0	0	0	0	0	0	0	0	0
2128	MFWKCE	0	0	0	0	0	0	0	0	0	0	0
2129	MFWKBL	0	0	0	0	0	0	0	0	0	0	0
2133	PHDLY1	0	0	0	0	0	0	0	0	0	0	0
2134	PHDLY2	0	0	0	0	0	0	0	0	0	0	0
2159	CGMAX	0	0	0	0	0	0	0	0	0	0	0
2160	CGMPY	0	0	0	0	0	0	0	0	0	0	0
2161	OVC STP	120	0	0	0	0	0	0	0	0	0	0
2162	OVC2 K1	0	0	0	0	0	0	0	0	0	0	0
2163	OVC2 K2	0	0	0	0	0	0	0	0	0	0	0
2164	OVC2 LIMIT	0	0	0	0	0	0	0	0	0	0	0
2165	MAX CURRENT	85	25	45	85	85	185	85	185	185	185	185
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	0	0	0	0	0	0	0	0	0	0	0
2591	PK2PLS	0	0	0	0	0	0	0	0	0	0	0
2595	HRV4PLS	0	0	0	0	0	0	0	0	0	0	0
Remarks		*5	*5									
		When liquid cooling is used, use the OVC parameters described in Subsection 3.2.1.3, "Parameter setting procedure 3 (OVC alarm parameters)".										

	Motor model	DiS3000 150 (400V)										
	Motor specification	0487-B40x										
	Motor ID No.	442										
PRM NO	SERVO PRM.											
2003		00001000										
2004		00000011										
2005		00000000										
2006		00000000										
2007		00000000										
2008		00000000										
2009		00000000										
2010		00000000										
2011		00000000										
2012		00000000										
2013		00000000										
2014		00000000										
2210		00000100										
2211		00000000										
2300		10000100										
2301		10000000										
2560		00000000										
2040	CUR GAIN I	459										
2041	CUR GAIN P	-3422										
2042	CUR GAIN 3	-2616										
2043	VEL GAIN I	1453										
2044	VEL GAIN P	-13016										
2045	VEL GAIN 3	0										
2046	VEL GAIN 4	-8235										
2047	OBSERVER POA1	648										
2048	BLACC CMP	0										
2049	DPFMX	0										
2050	OBSERVER POK1	956										
2051	OBSERVER POK2	510										
2052	OVER SPEED	0										
2053	DB-CMP PPMAX	21										
2054	DB-CMP PDDP	1894										
2055	DB-CMP PHYST	319										
2056	EMFCMP	0										
2057	D-PHASE CUR	0										
2058	D-PHASE CUR	0										
2059	PPBAS	0										
2060	TCMD LIMIT	7282										
2061	INERTIA	2960										
2062	OVC K1	32682										
2063	OVC K2	1069										
2064	TGALMLV	4										
2065	OVC LIMIT	3173										
2066	ACC FB GAIN	0										
2067	TCMD FILTER	0										
2074	AALPH	0										
2086	RATED CURRENT	1310										
2090	ROBSTL	0										
2099	ONEPSL	400										
2100	INPA1	0										
2101	INPA2	0										
2102	DBLIM	0										
2103	ABVOF	0										
2104	ABTSH	0										
2105	TORQUE CONST.	4125										
2110	MGSTCM	0										
2111	DETQLM	0										
2112	AMRDML	0										
2113	HRV FILT	0										
2127	NINTCT	0										
2128	MFWKCE	0										
2129	MFWKBL	0										
2133	PHDLY1	0										
2134	PHDLY2	0										
2159	CGMAX	0										
2160	CGMPY	0										
2161	OVC STP	0										
2162	OVC2 K1	0										
2163	OVC2 K2	0										
2164	OVC2 LIMIT	0										
2165	MAX CURRENT	185										
2302	TQLIM AT STOP	0										
2304	ACCBSLM	0										
2305	ACDCEBD	0										
2310	DCIDBS	0										
2316	LIMLIM	0										
2574	VELOVC	0										
2576	DDOVC	0										
2590	PK1PLS	0										
2591	PK2PLS	0										
2595	HRV4PLS	0										
Remarks		When liquid cooling is used, use the OVC parameters described in Subsection 3.2.1.3, "Parameter setting procedure 3 (OVC alarm parameters)".										

	Motor model	DiS15 1000 (400V)	DiS60 400 (400V)	DiS70 300 (400V)	DiS150 300 (400V)	DiS200 300 (400V)	DiS250 250 (400V)	DiS500 250 (400V)	DiS1000 200 (400V)	DiS1500 100 (400V)	DiS2000 100 (400V)	DiS2000 150 (400V)
	Motor specification	0492-B100	0493-B200	0494-B100	0494-B300	0494-B400	0495-B200	0495-B400	0496-B300	0497-B300	0497-B400	0497-B490
	Motor ID No.	552	554	556	558	560	562	564	566	568	570	572
PRM NO	SERVO PRM.											
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00000000	00000000	00000000	00000000	00000010	00000010	00000010	00000010	00001010	00001010	00000010
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00000000	00001000	00000110	00000110	00000110	00000000	00000100	00000100	00000100	00000100	00000100
2014		00000000	00001000	00000110	00000110	00000110	00000000	00000100	00000100	00000100	00000100	00000100
2210		00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100
2211		00001000	00001000	00001000	00001000	00011000	00001000	00001000	00001000	00001000	00011000	00001000
2300		10000110	10000110	10000110	10000110	10000110	10000110	10000110	10000110	10000110	10000110	10000110
2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	10010100	10000000	10000000	10000000
2560		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2040	CUR GAIN I	154	269	148	189	226	158	181	244	276	358	224
2041	CUR GAIN P	-857	-1897	-1382	-1607	-1983	-1150	-1445	-1323	-2068	-3011	-1729
2042	CUR GAIN 3	-3067	-3102	-3117	-3128	-3135	-3129	-3138	-3173	-3176	-3177	-3177
2043	VEL GAIN I	69	86	180	149	141	334	264	496	676	612	620
2044	VEL GAIN P	-618	-772	-1614	-1331	-1261	-2996	-2368	-4442	-6055	-5485	-5554
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	13637	10929	5224	6336	6686	2815	3561	1899	1393	1537	1518
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	1200	480	360	360	360	300	300	240	120	120	180
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	0	0	0	0	-11264	-11264	-11264	-11264	0
2057	D-PHASE CUR	0	0	0	0	0	0	0	0	0	-2054	0
2058	D-PHASE CUR	0	0	0	0	0	0	0	0	0	-430	0
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	7282	5462	6190	6190	6190	7282	6473	6473	6473	6473	6473
2061	INERTIA	226	281	589	485	460	1093	864	1620	2209	2001	2026
2062	OVC K1	32675	32675	32684	32714	32721	32707	32723	32677	32682	32709	32707
2063	OVC K2	1160	1160	1056	679	590	761	567	1135	1078	740	763
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	OVC LIMIT	3300	1856	2178	1419	1237	2196	1301	2553	2430	1688	1739
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	-20480	-32768	-24576	-20480	-4096	-8192	20480	-20480	28672	24576	12288
2086	RATED CURRENT	1440	845	1005	944	881	1175	944	1266	1235	1045	1045
2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	612	2865	3521	7830	11266	10329	22669	3768	6206	9097	8984
2110	MGSTCM	2049	1793	1793	1793	1793	1793	2049	2305	2049	2049	2049
2111	DETQLM	0	0	0	0	7710	12900	11311	6229	3212	2161	4727
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	0	0	0	0	0	0	0	0	0	0	0
2128	MFWKCE	0	0	0	0	0	0	0	0	0	0	0
2129	MFWKBL	0	0	0	0	0	0	0	0	0	0	0
2133	PHDLY1	0	0	0	0	0	0	0	0	0	0	0
2134	PHDLY2	0	0	0	0	0	0	0	0	0	0	0
2159	CGMAX	0	0	0	0	0	0	0	0	0	0	0
2160	CGMPY	0	0	0	0	0	0	0	0	0	0	0
2161	OVC STP	0	0	0	0	0	0	0	0	0	0	0
2162	OVC2 K1	0	0	0	0	0	0	0	0	0	0	0
2163	OVC2 K2	0	0	0	0	0	0	0	0	0	0	0
2164	OVC2 LIMIT	0	0	0	0	0	0	0	0	0	0	0
2165	MAX CURRENT	25	45	45	85	85	85	185	185	185	185	365
2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	72	0	0	0	0	24	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0
2574	VELOVC	0	0	0	0	0	0	0	0	0	0	0
2576	DDOVC	0	0	0	0	0	0	0	0	0	0	0
2590	PK1PLS	0	0	0	0	0	0	0	0	0	0	0
2591	PK2PLS	0	0	0	0	0	0	0	0	0	0	0
2595	HRV4PLS	0	0	0	0	0	0	0	0	0	0	0

When liquid cooling is used, modify the following parameters from the values listed above to those listed below.

2062	POVC1	32401	32275	32449	32391	32368	32487	32454	32286	32384	32366	32369
2063	POVC2	4589	6169	3986	4717	5004	3513	3923	6024	4796	5019	4992
2065	POVCLMT	11603	8321	7432	8580	9014	9212	8015	11469	9514	9883	9838
2086	RATED CURRENT	2595	2108	2108	2108	2108	2109	2317	2760	2445	2497	2492
2161	OVCSTP	125	127	120	120	123	110	110	110	112	110	110
2162	POVC21	32601	32581	32629	32599	32594	32623	32596	32686	32686	32713	32705
2163	POVC22	2091	2337	1735	2118	2172	1813	2156	1029	1024	687	792
2164	POVCLMT2	8308	5958	5321	6143	6454	6595	5738	8212	6812	7076	7044
Remarks		*5	*5	*5	*5	*2,*5	*5	*5	*5	*3,*5	*2,*3,*5	
		When liquid cooling is used, use the OVC parameters described in Subsection 3.2.1.3, "Parameter setting procedure 3 (OVC alarm parameters)".										

	Motor model	DiS5000 50 (400V)	DiS200 150 (400V)	DiS60 2000 (400V)	DiS70 1500 (400V)	DiS150 1500 (400V)	DiS500 1000 (400V)					
	Motor specification	0488-B400	0494-B450	0493-B220	0494-B120	0494-B320	0495-B420					
	Motor ID No.	573	574	578	580	582	584					
PRM NO	SERVO PRM.			Liquid cooling only	Liquid cooling only	Liquid cooling only	Liquid cooling only					
2003		00001000	00001000	00001000	00001000	00001000	00001000					
2004		00000011	00000011	00000011	00000011	00000011	00000011					
2005		00000000	00000000	00000000	00000000	00000000	00000000					
2006		00001010	00000010	00001000	00001000	00001000	00001000					
2007		00000000	00000000	00000000	00000000	00000000	00000000					
2008		00000000	00000000	00000000	00000000	00000000	00000000					
2009		00000000	00000000	00000000	00000000	00000000	00000000					
2010		00000000	00000001	00000001	00000001	00000001	00000001					
2011		00000000	00000000	00000000	00000000	00000000	00000000					
2012		00000000	00000000	00000000	00000000	00000000	00000000					
2013		00000000	00000110	00001000	00001000	00001010	00001010					
2014		00000000	00000110	00101000	00101000	00101010	00101010					
2210		00000100	00000100	00000100	00000100	00000100	00000100					
2211		00011000	00000000	00000000	00000000	00000000	00000000					
2300		10000110	10000110	10000100	10000100	10000100	10000100					
2301		10010100	01000000	01000000	01000000	01000000	01000000					
2560		00000000	00000000	00000000	00000000	00000000	00000000					
2040	CUR GAIN I	417	648	183	128	180	224					
2041	CUR GAIN P	-3875	-4214	-943	-724	-954	-991					
2042	CUR GAIN 3	-3181	-3134	-3094	-3115	-3130	-3131					
2043	VEL GAIN I	1096	139	93	210	153	267					
2044	VEL GAIN P	-9817	-1245	-837	-1883	-1366	-2395					
2045	VEL GAIN 3	0	0	0	0	0	0					
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235					
2047	OBSERVER POA1	859	6772	10081	4479	6173	3521					
2048	BLACC CMP	0	0	0	0	0	0					
2049	DPFMX	0	0	0	0	0	0					
2050	OBSERVER POK1	956	956	956	956	956	956					
2051	OBSERVER POK2	510	510	510	510	510	510					
2052	OVER SPEED	60	180	2400	1800	1800	1200					
2053	DB-CMP PPMAX	21	21	21	21	21	21					
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894					
2055	DB-CMP PHYST	319	319	319	319	319	319					
2056	EMFCMP	0	0	-9472	-9472	-8704	0					
2057	D-PHASE CUR	-527	0	-10267	-5147	-2610	-1341					
2058	D-PHASE CUR	-665	0	-1625	-1821	-1821	-1821					
2059	PPBAS	0	0	0	0	0	0					
2060	TCMD LIMIT	7282	6190	5370	5416	4814	5158					
2061	INERTIA	3581	0	49	109	79	139					
2062	OVC K1	32731	32721	32517	32467	32438	32567					
2063	OVC K2	459	590	3235	3761	4128	2517					
2064	TGALMLV	4	4	4	4	4	4					
2065	OVC LIMIT	1337	1237	4529	5409	4633	3427					
2066	ACC FB GAIN	0	0	0	0	0	0					
2067	TCMD FILTER	0	0	0	0	0	0					
2074	AALPH	24576	-24576	-32768	24576	8192	0					
2086	RATED CURRENT	916	880	2293	2506	2320	1995					
2090	ROBSTL	0	0	129	150	213	319					
2099	ONEPSL	400	400	400	400	400	400					
2100	INPA1	0	0	44	44	70	110					
2101	INPA2	0	0	0	0	0	0					
2102	DBLIM	0	0	0	0	0	0					
2103	ABVOF	0	0	0	0	0	0					
2104	ABTSH	0	0	0	0	0	0					
2105	TORQUE CONST.	22101	11412	2642	3019	7628	22416					
2110	MGSTCM	1793	2049	1793	2049	2049	1793					
2111	DETQLM	767	3925	0	0	0	0					
2112	AMRDML	0	0	0	0	0	0					
2113	HRV FILT	0	0	0	0	0	0					
2127	NINTCT	0	0	0	0	0	0					
2128	MFWKCE	16000	4000	0	0	0	0					
2129	MFWKBL	540	2581	0	0	0	0					
2133	PHDLY1	0	0	0	0	0	0					
2134	PHDLY2	0	0	0	0	0	0					
2159	CGMAX	0	0	0	0	0	0					
2160	CGMPY	0	0	0	0	0	0					
2161	OVC STP	0	0	106	106	0	0					
2162	OVC2 K1	0	0	32633	32678	32643	32630					
2163	OVC2 K2	0	0	1683	1130	1558	1719					
2164	OVC2 LIMIT	0	0	347	455	181	116					
2165	MAX CURRENT	185	45	85	85	185	365					
2302	TQLIM AT STOP	0	0	0	0	0	0					
2304	ACCBSLM	0	0	0	0	0	0					
2305	ACDCEBD	12	0	0	0	0	0					
2310	DCIDBS	0	0	0	0	0	0					
2316	LIMLIM	0	0	0	0	0	0					
2574	VELOVC	0	0	2400	1800	1800	1200					
2576	DDOVC	0	0	0	0	0	0					
2590	PK1PLS	0	0	0	0	0	0					
2591	PK2PLS	0	0	0	0	0	0					
2595	HRV4PLS	0	0	0	0	0	0					

When liquid cooling is used, modify the following parameters from the values listed above to those listed below.

2062	POVC1	32559	32368	32517	32467	32438	32567					
2063	POVC2	2617	5004	3235	3761	4128	2517					
2065	POVCLMT	7076	9014	4529	5409	4633	3427					
2086	RATED CURRENT	2097	2363	2293	2506	2320	1995					
2161	OVCSTP	110	123	106	106	0	0					
2162	POVC21	32722	32594	32633	32678	32643	32630					
2163	POVC22	569	2127	1683	1130	1558	1719					
2164	POVCLMT2	5066	6454	1389	455	181	116					
Remarks												
		When liquid cooling is used, use the OVC parameters described in Subsection 3.2.1.3, "Parameter setting procedure 3 (OVC alarm parameters)".										

	Motor model	DiS120 600 (400V)	DiS500 1200 (400V)	DiS1000 1000-385 (400V)	DiS1000 1000 (400V)	DiS5000 500 (400V)	DiS500 150 (400V)	DiS15 1000-B (400V)	DiS60 400-B (400V)	DiS60 2000-B (400V)	DiS120 600-B (400V)	DiS70 300-B (400V)
	Motor specification	0493-B400	0495-B421	0499-B420	0496-B320	0488-B430	0495-B450	2392-B100	2393-B200	2393-B220	2393-B400	2394-B100
	Motor ID No.	576	586	588	590	591	592	594	596	598	600	602
PRM NO	SERVO PRM.	Liquid cooling only	Liquid cooling only	Liquid cooling only	Liquid cooling only	Liquid cooling only	Liquid cooling only				Liquid cooling only	
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		10000011	10000011	10000011	10000011	10000011	10000011	10000011	10000011	10000011	10000011	10000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00001010	00001000	00001000	00001000	00001000	00001010	00000000	00000000	00001000	00001010	00000000
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000001	00000001	00000001	00000001	00000001	00000001	00000000	00000000	00000001	00000001	00000000
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00001010	00000101	00001001	00001001	00001001	00001000	00000000	00001000	00001000	00001010	00000110
2014		00101010	00100100	00101000	00101000	00101000	00001000	00000000	00001000	00101000	00101010	00000110
2210		00000000	00000000	00000000	00000000	00000000	00000000	00000100	00000100	00000100	00000000	00000100
2211		00000000	00000000	00000000	00000010	00000010	00000000	00001000	00001000	00000000	00000000	00001000
2300		10000101	10000101	10000101	10000101	10000101	10000111	10000110	10000110	10000100	10000101	10000110
2301		01000110	01000110	01000110	01000110	11000110	01000110	00000000	00000000	01000000	01000110	00000000
2560		01110001	01110001	01110001	01010001	01010001	01100011	00000001	00000001	00101001	01110001	00000001
2040	CUR GAIN I	2700	1400	2000	630	1200	6000	154	269	183	2700	148
2041	CUR GAIN P	-12000	-3500	-7000	-4600	-10000	-21000	-857	-1897	-943	-12000	-1382
2042	CUR GAIN 3	-3098	-3136	-3169	-3172	-3149	-3136	-3067	-3102	-3094	-3098	-3117
2043	VEL GAIN I	91	371	429	614	1435	291	69	86	93	91	180
2044	VEL GAIN P	-814	-3324	-3842	-5504	-12851	-2608	-618	-772	-837	-814	-1614
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	10355	2537	2195	1532	656	3233	13637	10929	10081	10355	5224
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	720	1440	1200	1200	600	180	1200	480	2400	720	360
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	0	0	0	0	0	0	0	0	-9472	0	0
2057	D-PHASE CUR	-15369	-1356	-1330	-2660	-939	0	0	0	-10267	-15369	0
2058	D-PHASE CUR	-1600	-3004	-1900	-1950	-1800	0	0	0	-1625	-1600	0
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	5462	7282	6068	6068	6675	6099	7282	5462	5370	5462	6190
2061	INERTIA	0	0	0	0	0	0	226	281	49	0	589
2062	OVC K1	32485	32423	32294	32464	32561	32705	32675	32675	32517	32485	32684
2063	OVC K2	3533	4309	5920	3800	2583	791	1160	1160	3235	3533	1056
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	OVC LIMIT	5207	10998	9941	9867	6993	1599	3300	1856	4529	5207	2178
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	0	0	0	0	0	0	-20480	-32768	-32768	0	-24576
2086	RATED CURRENT	2236	3249	3089	3115	2591	1048	1440	845	2293	2236	1005
2090	ROBSTL	150	600	550	570	630	0	0	0	129	150	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	52	77	143	154	358	0	0	0	44	52	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	5041	16150	31811	30412	16884	20585	612	2865	2642	5041	3521
2110	MGSTCM	1793	2561	2561	2561	2049	2049	2049	1793	1793	1793	1793
2111	TQLIM IN DEC.	0	0	0	0	0	5702	0	0	0	0	0
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	0	0	0	0	0	0	0	0	0	0	0
2128	MFWKCE	0	0	0	0	0	4000	0	0	0	0	0
2129	MFWKBL	0	0	0	0	0	3086	0	0	0	0	0
2133	PHDLY1	0	0	0	25635	12900	0	0	0	0	0	0
2134	PHDLY2	0	0	0	7687	6410	0	0	0	0	0	0
2159	CGMAX	4626	3097	4638	4628	9522	7194	4632	6923	2580	4626	10275
2160	CGMPY	5200	2660	5220	10340	7760	5220	5205	5180	1340	5200	5120
2161	OVC STP	117	122	115	115	119	0	0	0	106	117	0
2162	OVC2 K1	32713	32659	32686	32674	32674	0	0	0	32633	32713	0
2163	OVC2 K2	687	1362	1025	1175	1175	0	0	0	1683	687	0
2164	OVC2 LIMIT	5669	588	284	343	224	0	0	0	347	5669	0
2165	MAX CURRENT	85	365	365	365	545	85	25	45	85	85	45
2302	TQLIM AT STOP	0	14	12	11	6	0	0	0	0	0	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	4349	4551	4248	4046	0	0	0	0	0	0
2574	VELOVC	720	1440	1200	1175	600	0	0	0	2400	720	0
2576	DDOVC	-32273	-23285	-20985	-6649	-7159	0	0	0	0	-32273	0
2590	PK1PLS	9400	5400	14000	1000	8000	7750	3200	8600	7000	9400	13000
2591	PK2PLS	-18600	-7000	-18000	-6800	-24000	-9500	-10300	-20100	-13000	-18600	-25000
2595	HRV4PLS	1423	0	0	3860	1351	1516	1522	1528	1520	1423	1320
Remarks		*8	*8	*8	*8	*8	*8	*8	*8	*8	*8	*8
		When liquid cooling is used, use the OVC parameters described in Subsection 3.2.1.3, "Parameter setting procedure 3 (OVC alarm parameters)".										

	Motor model	DiS70 1500-B (400V)	DiS150 300-B (400V)	DiS150 1500-B (400V)	DiS200 300-B (400V)	DiS200 150-B (400V)	DiS250 250-B (400V)	DiS500 250-B (400V)	DiS500 1200-B (400V)	DiS500 150-B (400V)	DiS1000 1000-385-B (400V)	DiS1000 200-B (400V)
	Motor specification	2394-B120	2394-B300	2394-B320	2394-B400	2394-B450	2395-B200	2395-B400	2395-B421	2395-B450	2399-B420	2396-B300
	Motor ID No.	604	606	608	610	611	613	615	617	618	620	622
PRM NO	SERVO PRM.	Liquid cooling only		Liquid cooling only							Liquid cooling only	
2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
2004		10000011	10000011	10000011	10000011	10000011	10000011	10000011	10000011	10000011	10000011	10000011
2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2006		00001000	00000000	00001000	00000010	00000010	00000010	00000010	00001000	00001010	00001000	00000010
2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2010		00000001	00000000	00000001	00000000	00000001	00000000	00000000	00000001	00000001	00000001	00000000
2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2013		00001000	00000110	00001010	00000110	00000110	00000000	00000100	00000101	00001000	00001001	00000100
2014		00101000	00000110	00101010	00000110	00000110	00000000	00000100	00100100	00001000	00101000	00000100
2210		00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000000	00000000	00000000	00000100
2211		00000000	00001000	00000000	00011000	00000000	00001000	00001000	00000000	00000000	00000000	00001000
2300		10000100	10000110	10000100	10000110	10000110	10000110	10000110	10000101	10000111	10000101	10000110
2301		01000000	00000000	01000000	00000000	01000000	00000000	00000000	01000110	01000110	01000110	10010100
2560		00100001	00000001	00100001	00001001	00100011	00101001	00000001	01110001	01100011	01110001	00000001
2040	CUR GAIN I	128	189	180	226	648	158	181	1400	6000	2000	244
2041	CUR GAIN P	-724	-1607	-954	-1983	-4214	-1150	-1445	-3500	-21000	-7000	-1323
2042	CUR GAIN 3	-3115	-3128	-3130	-3135	-3134	-3129	-3138	-3136	-3136	-3169	-3173
2043	VEL GAIN I	210	149	153	141	139	334	264	371	291	429	496
2044	VEL GAIN P	-1883	-1331	-1366	-1261	-1245	-2996	-2368	-3324	-2608	-3842	-4442
2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
2047	OBSERVER POA1	4479	6336	6173	6686	6772	2815	3561	2537	3233	2195	1899
2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
2052	OVER SPEED	1800	360	1800	360	180	300	300	1440	180	1200	240
2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
2056	EMFCMP	-9472	0	-8704	0	0	0	-11264	0	0	0	-11264
2057	D-PHASE CUR	-5147	0	-2610	0	0	0	0	-1356	0	-1330	0
2058	D-PHASE CUR	-1821	0	-1821	0	0	0	0	-3004	0	-1900	0
2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
2060	TCMD LIMIT	5416	6190	4814	6190	6190	7282	6473	7282	6099	6068	6473
2061	INERTIA	109	485	79	460	0	1093	864	0	0	0	1620
2062	OVC K1	32467	32714	32438	32721	32721	32707	32723	32423	32705	32294	32677
2063	OVC K2	3761	679	4128	590	590	761	567	4309	791	5920	1135
2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
2065	OVC LIMIT	5409	1419	4633	1237	1237	2196	1301	10998	1599	9941	2553
2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
2074	AALPH	24576	-20480	8192	-4096	-24576	-8192	20480	0	0	0	-20480
2086	RATED CURRENT	2506	944	2320	881	880	1175	944	3249	1048	3089	1266
2090	ROBSTL	150	0	213	0	0	0	0	600	0	550	0
2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
2100	INPA1	44	0	70	0	0	0	0	77	0	143	0
2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
2102	DBLIM	0	0	0	0	0	0	0	0	0	0	0
2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
2105	TORQUE CONST.	3019	7830	7628	11266	11412	10329	22669	16150	20585	31811	3768
2110	MGSTCM	2049	1793	2049	1793	2049	1793	2049	2561	2049	2561	2305
2111	TQLIM IN DEC.	0	0	0	7710	3925	12900	11311	0	5702	0	6229
2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
2127	NINTCT	0	0	0	0	0	0	0	0	0	0	0
2128	MFWKCE	0	0	0	0	4000	0	0	0	4000	0	0
2129	MFWKBL	0	0	0	0	2581	0	0	0	3086	0	0
2133	PHDLY1	0	0	0	0	0	0	0	0	0	0	0
2134	PHDLY2	0	0	0	0	0	0	0	0	0	0	0
2159	CGMAX	5160	8985	2600	11319	7723	11313	5134	3097	7194	4638	9254
2160	CGMPY	1340	2630	5185	5120	7760	5120	5120	2660	5220	5220	5120
2161	OVC STP	106	0	0	0	0	0	0	122	0	115	0
2162	OVC2 K1	32678	0	32643	0	0	0	0	32659	0	32686	0
2163	OVC2 K2	1130	0	1558	0	0	0	0	1362	0	1025	0
2164	OVC2 LIMIT	455	0	181	0	0	0	0	588	0	284	0
2165	MAX CURRENT	85	85	185	85	45	85	185	365	85	365	185
2302	TQLIM AT STOP	0	0	0	0	0	0	0	14	0	12	0
2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2305	ACDCEBD	0	0	0	72	0	0	0	0	0	0	0
2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2316	LIMLIM	0	0	0	0	0	0	0	4349	0	4551	0
2574	VELOVC	1800	0	1800	0	0	0	0	1440	0	1200	0
2576	DDOVC	0	0	0	0	0	0	0	-23285	0	-20985	0
2590	PK1PLS	4500	9700	6000	12800	4200	13000	4200	5400	7750	14000	8150
2591	PK2PLS	-9000	-22000	-13000	-29500	-9000	-18200	-13500	-7000	-9500	-18000	-28200
2595	HRV4PLS	1620	1839	1625	909	907	1311	2144	0	1516	0	1221
Remarks		*8	*8	*8	*8	*8	*8	*8	*8	*8	*8	*8
		When liquid cooling is used, use the OVC parameters described in Subsection 3.2.1.3, "Parameter setting procedure 3 (OVC alarm parameters)".										

	Motor model	DiS1000 1000-B (400V)	DiS2000 100-B (400V)	DiS2000 150-B (400V)	DiS5000 50-B (400V)	DiS5000 500-B (400V)						
	Motor specification	2396-B320	2397-B400	2397-B490	2388-B400	2388-B430						
	Motor ID No.	624	628	630	631	632						
PRM NO	SERVO PRM.	Liquid cooling only				Liquid cooling only						
2003		00001000	00001000	00001000	00001000	00001000						
2004		10000011	10000011	10000011	10000011	10000011						
2005		00000000	00000000	00000000	00000000	00000000						
2006		00001000	00001010	00000010	00001010	00001000						
2007		00000000	00000000	00000000	00000000	00000000						
2008		00000000	00000000	00000000	00000000	00000000						
2009		00000000	00000000	00000000	00000000	00000000						
2010		00000001	00000000	00000000	00000000	00000001						
2011		00000000	00000000	00000000	00000000	00000000						
2012		00000000	00000000	00000000	00000000	00000000						
2013		00001001	00000100	00000100	00000000	00001001						
2014		00101000	00000100	00000100	00000000	00101000						
2210		00000000	00000100	00000100	00000100	00000000						
2211		00000010	00011000	00001000	00011000	00000010						
2300		10000101	10000110	10000110	10000110	10000101						
2301		01000110	10000000	10000000	10010100	11000110						
2560		01010001	00101011	00001001	00101011	01010001						
2040	CUR GAIN I	630	358	224	417	1200						
2041	CUR GAIN P	-4600	-3011	-1729	-3875	-10000						
2042	CUR GAIN 3	-3172	-3177	-3177	-3181	-3149						
2043	VEL GAIN I	614	612	620	1096	1435						
2044	VEL GAIN P	-5504	-5485	-5554	-9817	-12851						
2045	VEL GAIN 3	0	0	0	0	0						
2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235						
2047	OBSERVER POA1	1532	1537	1518	859	656						
2048	BLACC CMP	0	0	0	0	0						
2049	DPFMX	0	0	0	0	0						
2050	OBSERVER POK1	956	956	956	956	956						
2051	OBSERVER POK2	510	510	510	510	510						
2052	OVER SPEED	1200	120	180	60	600						
2053	DB-CMP PPMAX	21	21	21	21	21						
2054	DB-CMP PDDP	1894	1894	1894	1894	1894						
2055	DB-CMP PHYST	319	319	319	319	319						
2056	EMFCMP	0	-11264	0	0	0						
2057	D-PHASE CUR	-2660	-2054	0	-527	-939						
2058	D-PHASE CUR	-1950	-430	0	-665	-1800						
2059	PPBAS	0	0	0	0	0						
2060	TCMD LIMIT	6068	6473	6473	7282	6675						
2061	INERTIA	0	2001	2026	3581	0						
2062	OVC K1	32464	32709	32707	32731	32561						
2063	OVC K2	3800	740	763	459	2583						
2064	TGALMLV	4	4	4	4	4						
2065	OVC LIMIT	9867	1688	1739	1337	6993						
2066	ACC FB GAIN	0	0	0	0	0						
2067	TCMD FILTER	0	0	0	0	0						
2074	AALPH	0	24576	12288	24576	0						
2086	RATED CURRENT	3115	1045	1045	916	2591						
2090	ROBSTL	570	0	0	0	630						
2099	ONEPSL	400	400	400	400	400						
2100	INPA1	154	0	0	0	358						
2101	INPA2	0	0	0	0	0						
2102	DBLIM	0	0	0	0	0						
2103	ABVOF	0	0	0	0	0						
2104	ABTSH	0	0	0	0	0						
2105	TORQUE CONST.	30412	9097	8984	22101	16884						
2110	MGSTCM	2561	2049	2049	1793	2049						
2111	TQLIM IN DEC.	0	2161	4727	767	0						
2112	AMRDML	0	0	0	0	0						
2113	HRV FILT	0	0	0	0	0						
2127	NINTCT	0	0	0	0	0						
2128	MFWKCE	0	0	0	16000	0						
2129	MFWKBL	0	0	0	540	0						
2133	PHDLY1	25635	0	0	0	12900						
2134	PHDLY2	7687	0	0	0	6410						
2159	CGMAX	4628	13639	11571	14388	9522						
2160	CGMPY	10340	5190	5120	4432	7760						
2161	OVC STP	115	0	0	0	119						
2162	OVC2 K1	32674	0	0	0	32674						
2163	OVC2 K2	1175	0	0	0	1175						
2164	OVC2 LIMIT	343	0	0	0	224						
2165	MAX CURRENT	365	185	365	185	545						
2302	TQLIM AT STOP	11	0	0	0	6						
2304	ACCBSLM	0	0	0	0	0						
2305	ACDCEBD	0	24	0	12	0						
2310	DCIDBS	0	0	0	0	0						
2316	LIMLIM	4248	0	0	0	4046						
2574	VELOVC	1175	0	0	0	600						
2576	DDOVC	-6649	0	0	0	-7159						
2590	PK1PLS	1000	3375	12000	2750	8000						
2591	PK2PLS	-6800	-9600	-29000	-13875	-24000						
2595	HRV4PLS	3860	1312	1221	1313	1351						
Remarks		*8	*8	*8	*8	*8						
		When liquid cooling is used, use the OVC parameters described in Subsection 3.2.1.3, "Parameter setting procedure 3 (OVC alarm parameters)".										

APPENDIX

A ANALOG SERVO ADAPTER (ASA) SETTING PROCEDURE

(1) Overview

The analog servo adapter (ASA) is used to drive the motor with the analog servo that receives the velocity command as an analog voltage. This appendix describes how to set ASA parameters.

NOTE
1 For the CNCs that support this function, contact FANUC.
2 For analog servo axes, only the feed-forward, backlash compensation, pitch error compensation, and position gain switch functions can be used as digital servo functions.

(2) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	J(10) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	J(10) and subsequent editions	HRV4
Series 0*i*-F	90M0 90L0 90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 0*i*-D	90C5 90C8 90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(3) Setting parameters

(1) Setting start: Switch on the CNC power from an emergency stop.
(2) Set up the FSSB. Switch the power off and on again.
(3) Initialize the servo parameters. Switch the power off and on again.
(4) Enable the analog servo interface function. Switch the power off and on again. This completes the setting.

(4) FSSB setting

(a) Connecting the analog servo adapter requires that the FSSB be set up manually. (The FSSB setting screen cannot be used.)

	#7	#6	#5	#4	#3	#2	#1	#0
1902								FMD

FMD (#0) The FSSB setting is made in:
0: Automatic setting mode
1: Manual setting mode ← To be set

(b) Directly enter all parameters listed in the following table. Before doing this, sufficiently understand the meaning of each parameter. For detailed descriptions about parameter setting, refer to the respective CNC Connection Manuals and Parameter Manuals. Analog and digital servo axes can be used together as shown in the reference examples below.

Parameter number			Meaning
30*i*-B Series Power Motion *i*-A 0*i*-F Series	**30*i*-A Series**	**0*i*-D Series**	
1023	1023	1023	Servo axis number for each axis
—	1905#6,7,1,2	1905#6,7	Selection of interface unit used
24000–24031 24032–24063	14340–14357 14358–14375	14340–14357	Conversion table value for slave number (*1)
24096	1936	1936	Connector number for interface unit 1 (*2)
24097	1937	1937	Connector number for interface unit 2 (*2)
24098	1938	—	Connector number for interface unit 3 (*2)
24099	1939	—	Connector number for interface unit 4 (*2)
24100	—	—	Connector number for interface unit 5
24101	—	—	Connector number for interface unit 6
24102	—	—	Connector number for interface unit 7
24103	—	—	Connector number for interface unit 8
24104–24111	14376–14383	14376–14383	Conversion table value for connector number of interface unit 1
24112–24119	14384–14391	14384–14391	Conversion table value for connector number of interface unit 2
24120–24127	14392–14399	—	Conversion table value for connector number of interface unit 3
24128–24135	14400–14407	—	Conversion table value for connector number of interface unit 4
24136–24143	—	—	Conversion table value for connector number of interface unit 5
24144–24151	—	—	Conversion table value for connector number of interface unit 6
24152–24159	—	—	Conversion table value for connector number of interface unit 7
24160–24167	—	—	Conversion table value for connector number of interface unit 8
24064–24095	14408–14425	—	Conversion table value for slave number on additional-axis board
24168–24175	14444–14451	—	Conversion table value for connector number of interface unit 1 on additional-axis board
24176–24183	14452–14459	—	Conversion table value for connector number of interface unit 2 on additional-axis board
24184–24191	-—	—	Conversion table value for connector number of interface unit 3 on additional-axis board
24192–24199	-—	—	Conversion table value for connector number of interface unit 4 on additional-axis board

NOTE

1 The FSSB settings for the analog servo adapter are also used for the separate detector interface unit.
(Bits 6, 7, 1, and 2 of parameter No. 1905 (30*i*-A Series, 0*i*-D Series) are shared.)

2 The slave number of an analog servo axis must be added behind the last slave number of the units actually connected to the FSSB line. (See the setting examples provided below.)

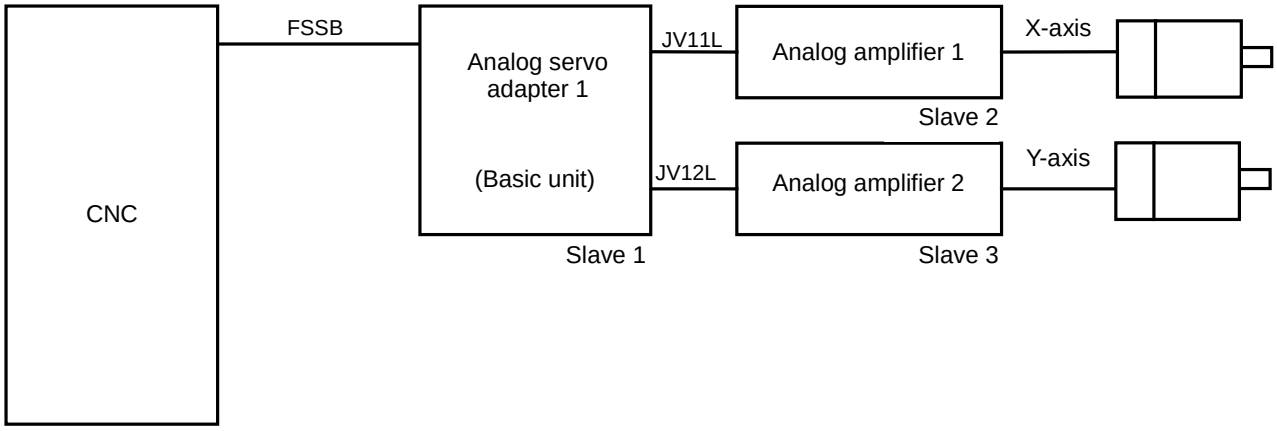
3 With the 30*i*-A Series and 0*i*-D Series, up to two interface units (a separate detector interface unit and analog servo interface unit) can be connected per FSSB line. Therefore, the first and second interface units are connected to the FSSB1 line, and the third and fourth interface units are connected to the FSSB2 line. With the 30*i*-B Series, Power Motion *i*-A, and 0*i*-F Series, up to four separate detector interface units and analog servo adapters can be connected per FSSB line.

4 When multiple axes share one connector of the separate detector interface unit (1 is set to bit 5 of parameter No. 14476), set parameter Nos. 24104 to 24199.

(Reference) FSSB setting example where an analog servo adapter is used

[Setting example 1: Two analog servo axes]

Make the analog servo adapter slave 1. Assume that analog amplifiers are connected behind the analog servo adapter, so they will be slaves 2 and 3.



30*i*-B Series, Power Motion *i*-A, 0*i*-F Series

Parameter No.	24000	24001	24002	24003–24095
Set value	3001	1001	1002	1000

Parameter No.	1023	24096	24097–24103
X-axis	1	1	0
Y-axis	2	2	0

Parameter No.	24104	24105	24106–24111
Set value	1001	1002	1000

30*i*-A Series, 0*i*-D Series

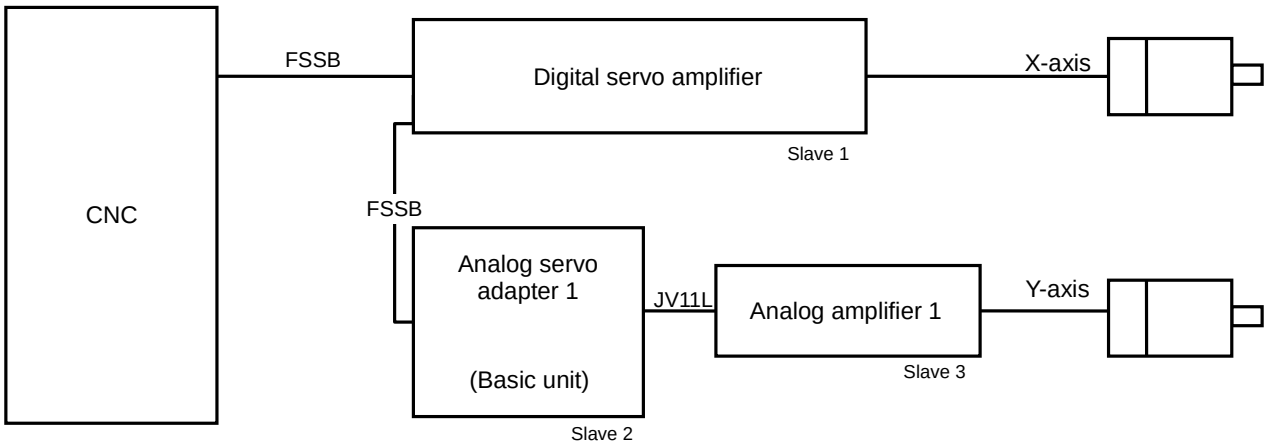
Parameter No.	14340	14341	14342	14343–14357
Set value	64	0	1	-96

Parameter No.	1023	1905	1936	1937
X-axis	1	01000000	0	0
Y-axis	2	01000000	1	0

Parameter No.	14376	14377	14378–14407
Set value	0	1	32

[Setting example 2: One digital servo axis + one analog servo axis]

The digital servo amplifier and analog servo adapter are slaves 1 and 2, according to the order in which they are connected to the FSSB. Assuming that the axis connected to the analog servo amplifier is behind the analog servo adapter, it is slave 3.



30*i*-B Series, Power Motion *i*-A, 0*i*-F Series

Parameter No.	24000	24001	24002	24003–24095
Set value	1001	3001	1002	1000

Parameter No.	1023	24096	24097–24103
X-axis	1	0	0
Y-axis	2	1	0

Parameter No.	24104	24105–24111
Set value	1002	1000

30*i*-A Series, 0*i*-D Series

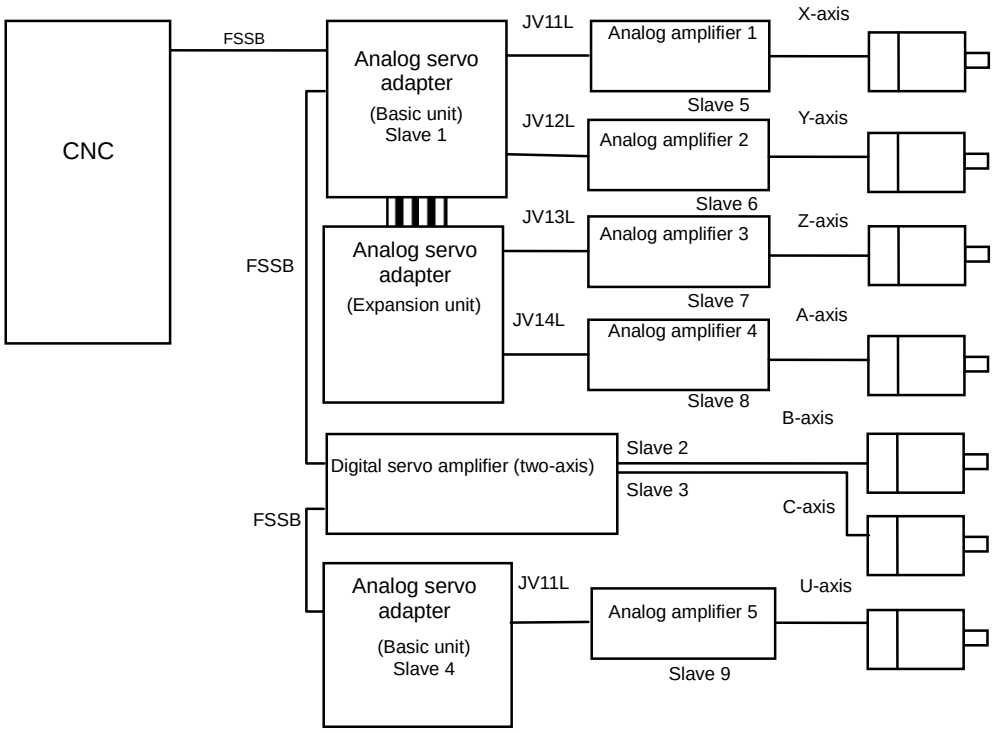
Parameter No.	14340	14341	14342	14343–14357
Set value	0	64	1	-96

Parameter No.	1023	1905	1936	1937
X-axis	1	00000000	0	0
Y-axis	2	01000000	0	0

Parameter No.	14376	14377–14407
Set value	1	32

[Setting example 3: Five analog servo axes + two digital servo axes]

The first analog servo adapter (including expansion) is slave 1, the two digital servo amplifiers are slaves 2 and 3, and the second analog servo adapter is slave 4, according to the order in which they are connected to the FSSB. Assuming that the analog amplifiers are connected behind the analog servo adapter, they are slaves 5 to 9.



30*i*-B Series, Power Motion *i*-A, 0*i*-F Series

Parameter No.	24000	24001	24002	24003	24004	24005	24006	24007	24009	24010–24095
Set value	3001	1005	1006	3002	1001	1002	1003	1004	1007	1000

Parameter No.	1023	24096	24097	24097–24103
X-axis	1	1	0	0
Y-axis	2	2	0	0
Z-axis	3	3	0	0
A-axis	4	4	0	0
B-axis	5	0	0	0
C-axis	6	0	0	0
U-axis	7	0	1	0

Parameter No.	24104	24105	24106	24107	24108–24111	24112	24113–24119
Set value	1001	1002	1003	1004	1000	1007	1000

30*i*-A Series, 0*i*-D Series

Parameter No.	14340	14341	14342	14343	14344	14345	14346	14347	14348	14349–14357
Set value	64	4	5	−56	0	1	2	3	6	−96

Parameter No.	1023	1905	1936	1937
X-axis	1	01000000	0	0
Y-axis	2	01000000	1	0
Z-axis	3	01000000	2	0
A-axis	4	01000000	3	0
B-axis	5	00000000	0	0
C-axis	6	00000000	0	0
U-axis	7	10000000	0	0

Parameter No.	14376	14377	14378	14379	14380–14383	14384	14385–14407
Set value	0	1	2	3	32	6	32

(5) Servo parameter initialization

For axes connected to an analog servo circuit, initialize the servo parameters as listed below.

Parameter number	Name	Set value
2000	Initialization bit	00000000
2020	Motor ID number	252 (for HRV2)
2001	AMR	00000000
1820	CMR	Perform the same initialization as for digital servos according to your machine tool.
2084	FFG (numerator)	
2085	FFG (denominator)	
2022	Movement direction	111 (counterclockwise) or −111 (clockwise)
1821	Reference counter	Specify the number of pulses per motor revolution (after FFG) in the same manner as for the digital servo circuit.
2023	Number of velocity pulses	Set value = 1536.797 × E E is the voltage (V) that corresponds to a velocity command of 1000 min^{-1}.
2024	Number of position pulses	Specify the number of pulses per motor revolution (before FFG) in the same manner as for the digital servo circuit.

NOTE

Although differences in HRV settings are not directly related to analog servo axes, they must be initialized with the same HRV settings due to the relationship with the settings of other digital servo axes.

(6) Setting the analog servo function

To enable the analog servo function, set the following parameters for the axes to be connected to an analog servo circuit. (It is also necessary to enable the dummy serial feedback function.)

	#7	#6	#5	#4	#3	#2	#1	#0
2009				**ANALOG**				**DMY**

DMY (#0) The serial feedback dummy function is:
0: Disabled.
1: Enabled. ← To be set

ANALOG (#4) The analog servo interface function is:
0: Disabled.
1: Enabled. ← To be set

2165	**Maximum amplifier current**

Specify 0 for the axis to be connected to an analog servo circuit.

B PARAMETERS AFFECTED BY DETECTION UNIT CHANGES

If the detection unit is changed with a CMR or flexible feed gear, it is also necessary to change the parameters depending on detection units. This appendix lists these parameters.
For details of these parameters, refer to the respective CNC parameter manuals.

Appendix B, "PARAMETERS AFFECTED BY DETECTION UNIT CHANGES," consists of the following sections:

B.1 PARAMETERS FOR 30*i*-A Series, 30*i*-B Series

No.	Description
1821	Reference counter capacity for individual axis
1826	Effective area (in-position check) for individual axis
1827	Effective area (in-position check) for individual axis at cutting feed
1828	Position error limit for individual axis during movement
1829	Position error limit for individual axis at stop
1830	Position error limit for individual axis with servo off
1832	Position error limit for individual axis with feed at stop
1836	Servo error amount within which reference position return is assumed to be possible
1844	Distance to first grid point when reference position shift of the reference position shift function is set to 0 or when reference position return is performed with grid shift
1846	Distance for starting second stage compensation in smooth backlash compensation
1847	Distance for ending second stage compensation in smooth backlash compensation
1848	First stage compensation value in smooth backlash compensation
1850	Grid shift/reference position shift for individual axis
1851	Backlash compensation for individual axis
1852	Backlash compensation for individual axis at rapid traverse
1882	Mark 2 intervals on linear scale interface with absolute address reference mark
1883	Distance from scale origin to reference position 1 (linear scale with absolute address reference marks) or Distance from base point to reference position 1 (linear scale with an absolute address origin)
1884	Distance from scale origin to reference position 2 (linear scale with absolute address reference marks) or Distance from base point to reference position 2 (linear scale with an absolute address origin)
1885	Permissible cumulative movement value during torque control
1886	Position error with torque control canceled
2033	For vibration damping control: position pulses conversion coefficient
2078	Dual position feedback conversion coefficient (numerator)
2079	Dual position feedback conversion coefficient (denominator)
2082	Backlash acceleration stop amount (when two-stage backlash acceleration is disabled) Second stage acceleration start position (when two-stage backlash acceleration Type-1 is enabled) Second stage acceleration attenuation start position (when two-stage backlash acceleration Type-2 is enabled)
2084	Flexible feed gear numerator
2085	Flexible feed gear denominator
2089	Backlash acceleration base pulse (when two-stage backlash acceleration is disabled) Second stage acceleration end position (when two-stage backlash acceleration is enabled)
2101	Overshoot compensation valid level
2103	Unexpected disturbance torque detection amount retrace distance
2118	Dual position feedback function: alarm detection level of Semi-Full error
2119	Function for changing the proportional gain in the stop state: stop level
2173	Lift amount in lifting function against gravity at emergency stop (Bit 7 of No. 2298 = 0 when SWDBSx = 1)

No.	Description
2263	Detection unit parameter
2373	Lift amount in lifting function against gravity at emergency stop (Bit 7 of No. 2298 = 0 when SWDBSx = 0)
2382	Torsion preview control: maximum compensation value (LSTCM)
2386	Torsion preview control: Acceleration torsion compensation value K1 (LSTK1)
2387	Torsion preview control: Acceleration torsion compensation value K2 (LSTK2)
2388	Torsion preview control: Acceleration torsion compensation value K3 (LSTK3)
2391	Torsion preview control: Acceleration torsion compensation value K1N (LSTK1N)
2392	Torsion preview control: Acceleration torsion compensation value K2N (LSTK2N)
2393	Torsion preview control: Acceleration torsion compensation value K3N (LSTK3N)
2404	Synchronous axes automatic compensation: Maximum compensation
3623	Pitch error compensation magnification for individual axis
3627	Pitch error compensation value at reference position when movement to reference position is made in the direction opposite to reference position return direction
5019	Distance to prevent chattering for direct input of tool offset value measured B
5184	In-position width for a place other than a hole bottom (normal operation)
5185	In-position width for a place other than a hole bottom (for retraction in peck drilling cycle)
5186	In-position width for a place other than a hole bottom (for shift operation in boring cycle (G76, G87))
5187	In-position width for a hole bottom
5300	First-spindle rigid tapping effective area (in-position check) for tapping axis
5302	Second-spindle rigid tapping effective area (in-position check) for tapping axis
5304	Third-spindle rigid tapping effective area (in-position check) for tapping axis
5306	Fourth-spindle rigid tapping effective area (in-position check) for tapping axis
5310	First-spindle rigid tapping position error limit for tapping axis during movement
5312	First-spindle rigid tapping position error limit for tapping axis at stop
5350	Second-spindle rigid tapping position error limit for tapping axis during movement
5352	Second-spindle rigid tapping position error limit for tapping axis at stop
5354	Third-spindle rigid tapping position error limit for tapping axis during movement
5356	Third-spindle rigid tapping position error limit for tapping axis at stop
5358	Fourth-spindle rigid tapping position error limit for tapping axis during movement
5360	Fourth-spindle rigid tapping position error limit for tapping axis at stop
5761	Compensation at compensation point a for movement axis 1
5762	Compensation at compensation point b for movement axis 1
5763	Compensation at compensation point c for movement axis 1
5764	Compensation at compensation point d for movement axis 1
5771	Compensation at compensation point a for movement axis 2
5772	Compensation at compensation point b for movement axis 2
5773	Compensation at compensation point c for movement axis 2
5774	Compensation at compensation point d for movement axis 2
5781	Compensation at compensation point a for movement axis 3
5782	Compensation at compensation point b for movement axis 3
5783	Compensation at compensation point c for movement axis 3
5784	Compensation at compensation point d for movement axis 3
5871	Compensation α at compensation point a for individual axis (gradient compensation)
5872	Compensation β at compensation point b for individual axis (gradient compensation)
5873	Compensation γ at compensation point c for individual axis (gradient compensation)
5874	Compensation δ at compensation point d for individual axis (gradient compensation)
6287	Position error limit at torque limit skip
7113	Manual handle feed magnification m (Note: Need not be changed if the least input increment is not changed)
7114	Manual handle feed magnification n (Note: Need not be changed if the least input increment is not changed)
7772	Number of pulses from position detector per rotation of tool axis
7773	Number of pulses from position detector per rotation of workpiece axis
7782	Number of pulses from position detector per rotation of EGB master axis [axis type]
7783	Number of pulses from position detector per rotation of EGB slave axis [axis type]
8181	Synchronous error limit for each axis (synchronous and composite control)

No.	Description
8323	Limit of position error check in feed axis synchronous control
8326	Difference in reference counter value between master axis and slave axis
8331	Maximum permissible synchronous error in synchronous error excess alarm 1
8332	Maximum permissible synchronous error in synchronous error excess alarm 2
8333	Synchronous error zero width for each axis
8335	Synchronous error zero width 2 for each axis
8377	Permissible error at start of chopping compensation
10864 – 10873	Compensation 1 at compensation point 1 for compensated axis 1 of three-dimensional machine position compensation Compensation 10 at compensation point 10 for compensated axis 1 of three-dimensional machine position compensation
10874 – 10883	Compensation 1 at compensation point 1 for compensated axis 2 of three-dimensional machine position compensation – Compensation 10 at compensation point 10 for compensated axis 2 of three-dimensional machine position compensation
10884 – 10893	Compensation 1 at compensation point 1 for compensated axis 3 of three-dimensional machine position compensation – Compensation 10 at compensation point 10 for compensated axis 3 of three-dimensional machine position compensation
11013	Position error limit for individual axis during movement
11014	Position error limit for individual axis at stop
11211	Linear gradient compensation CMP0
13351 – 13354	Compensation at compensation point a for movement axis 4 – Compensation at compensation point d for movement axis 4
13361 – 13364	Compensation at compensation point a for movement axis 5 – Compensation at compensation point d for movement axis 5
13371 – 13374	Compensation at compensation point a for movement axis 6 – Compensation at compensation point d for movement axis 6
14010	Maximum permissible movement amount at reference position setup of linear scale with absolute addressing reference marks

- **Setting data for shifting external machine coordinate systems**

  The setting data for shifting external machine coordinate systems (with no parameter No. assigned) must also be changed depending on the detection unit.

B.2 PARAMETERS FOR Power Motion *i*-A, DSA-B

No.	Description
1821	Reference counter capacity for individual axis
1826	Effective area (in-position check) for individual axis
1827	Effective area (in-position check) for individual axis at cutting feed
1828	Position error limit for individual axis during movement
1829	Position error limit for individual axis at stop
1830	Position error limit for individual axis with servo off
1832	Position error limit for individual axis with feed at stop
1836	Servo error amount within which reference position return is assumed to be possible
1844	Distance to first grid point when reference position shift of the reference position shift function is set to 0 or when reference position return is performed with grid shift
1850	Grid shift/reference position shift for individual axis
1851	Backlash compensation for individual axis
1852	Backlash compensation for individual axis at rapid traverse
1872	Servo position error check value
1882	Mark 2 intervals on linear scale interface with absolute address reference mark
1883	Distance from scale origin to reference position 1 (linear scale with absolute address reference marks) or Distance from base point to reference position 1 (linear scale with an absolute address origin)
1884	Distance from scale origin to reference position 2 (linear scale with absolute address reference marks) or Distance from base point to reference position 2 (linear scale with an absolute address origin)
1885	Permissible cumulative movement value during torque control
1886	Position error with torque control canceled
2033	For vibration damping control: position pulses conversion coefficient
2078	Dual position feedback conversion coefficient (numerator)
2079	Dual position feedback conversion coefficient (denominator)
2082	Backlash acceleration stop amount (when two-stage backlash acceleration is disabled) Second stage acceleration start position (when two-stage backlash acceleration Type-1 is enabled) Second stage acceleration attenuation start position (when two-stage backlash acceleration Type-2 is enabled)
2084	Flexible feed gear numerator
2085	Flexible feed gear denominator
2089	Backlash acceleration base pulse (when two-stage backlash acceleration is disabled) Second stage acceleration end position (when two-stage backlash acceleration is enabled)
2101	Overshoot compensation valid level
2103	Unexpected disturbance torque detection amount retrace distance
2118	Dual position feedback function: alarm detection level of Semi-Full error
2119	Function for changing the proportional gain in the stop state: stop level
2173	Lift amount in lifting function against gravity at emergency stop (Bit 7 of No. 2298 = 0 when SWDBSx = 1)
2263	Detection unit parameter
2373	Lift amount in lifting function against gravity at emergency stop (Bit 7 of No. 2298 = 0 when SWDBSx = 0)
2382	Torsion preview control: maximum compensation value (LSTCM)
2386	Torsion preview control: Acceleration torsion compensation value K1 (LSTK1)
2387	Torsion preview control: Acceleration torsion compensation value K2 (LSTK2)
2388	Torsion preview control: Acceleration torsion compensation value K3 (LSTK3)
2391	Torsion preview control: Acceleration torsion compensation value K1N (LSTK1N)
2392	Torsion preview control: Acceleration torsion compensation value K2N (LSTK2N)
2393	Torsion preview control: Acceleration torsion compensation value K3N (LSTK3N)
2404	Synchronous axes automatic compensation: Maximum compensation
3623	Pitch error compensation magnification for individual axis
3627	Pitch error compensation value at reference position when movement to reference position is made in the direction opposite to reference position return direction
6287	Position error limit at torque limit skip

No.	Description
7113	Manual handle feed magnification m (Note: Need not be changed if the least input increment is not changed)
7114	Manual handle feed magnification n (Note: Need not be changed if the least input increment is not changed)
8323	Limit of position error check in feed axis synchronous control
8326	Difference in reference counter value between master axis and slave axis
8331	Maximum permissible synchronous error in synchronous error excess alarm 1
8332	Maximum permissible synchronous error in synchronous error excess alarm 2
8333	Synchronous error zero width for each axis
8335	Synchronous error zero width 2 for each axis
8694	Servo position error limit in pressure and position control mode
14010	Maximum permissible movement amount at reference position setup of linear scale with absolute addressing reference marks

- **Setting data for shifting external machine coordinate systems**
  The setting data for shifting external machine coordinate systems (with no parameter No. assigned) must also be changed depending on the detection unit.

B.3 PARAMETERS FOR 0*i*-F Series, 0*i*-D Series

No.	Description
1821	Reference counter capacity for individual axis
1826	Effective area (in-position check) for individual axis
1827	Effective area (in-position check) for individual axis at cutting feed
1828	Position error limit for individual axis during movement
1829	Position error limit for individual axis at stop
1830	Position error limit for individual axis with servo off
1832	Position error limit for individual axis with feed at stop
1836	Servo error amount within which reference position return is assumed to be possible
1844	Distance from the point at which deceleration dog is turned off to first grid point when reference position shift of the reference position shift function is set to 0
1846	Distance for starting second stage compensation in smooth backlash compensation
1847	Distance for ending second stage compensation in smooth backlash compensation
1848	First stage compensation value in smooth backlash compensation
1850	Grid shift/reference position shift for individual axis
1851	Backlash compensation for individual axis
1852	Backlash compensation for individual axis at rapid traverse
1882	Mark 2 intervals on linear scale interface with absolute address reference mark
1883	Distance from scale origin to reference position 1 (linear scale with absolute address reference marks) or Distance from base point to reference position 1 (linear scale with an absolute address origin)
1884	Distance from scale origin to reference position 2 (linear scale with absolute address reference marks) or Distance from base point to reference position 2 (linear scale with an absolute address origin)
1885	Permissible cumulative movement value during torque control
1886	Position error with torque control canceled
2033	For vibration damping control: position pulses conversion coefficient
2078	Dual position feedback conversion coefficient (numerator)
2079	Dual position feedback conversion coefficient (denominator)
2082	Backlash acceleration stop amount (when two-stage backlash acceleration is disabled) Second stage acceleration start position (when two-stage backlash acceleration Type-1 is enabled) Second stage acceleration attenuation start position (when two-stage backlash acceleration Type-2 is enabled)
2084	Flexible feed gear numerator
2085	Flexible feed gear denominator

No.	Description
2089	Backlash acceleration base pulse (when two-stage backlash acceleration is disabled) Second stage acceleration end position (when two-stage backlash acceleration is enabled)
2101	Overshoot compensation valid level
2103	Unexpected disturbance torque detection amount retrace distance
2118	Dual position feedback function: alarm detection level of Semi-Full error
2119	Function for changing the proportional gain in the stop state: stop level
2173	Lift amount in lifting function against gravity at emergency stop (Bit 7 of No. 2298 = 0 when SWDBSx = 1)
2263	Detection unit parameter
2373	Lift amount in lifting function against gravity at emergency stop (Bit 7 of No. 2298 = 0 when SWDBSx = 0)
2404	Synchronous axes automatic compensation: Maximum compensation
3623	Pitch error compensation magnification for individual axis
3627	Pitch error compensation value at reference position when movement to reference position is made in the direction opposite to reference position return direction
5300	First-spindle rigid tapping effective area (in-position check) for tapping axis
5302	Second-spindle rigid tapping effective area (in-position check) for tapping axis
5310	First-spindle rigid tapping position error limit for tapping axis during movement
5312	First-spindle rigid tapping position error limit for tapping axis at stop
5350	Second-spindle rigid tapping position error limit for tapping axis during movement
5352	Second-spindle rigid tapping position error limit for tapping axis at stop
5761	Compensation at compensation point a for movement axis 1
5762	Compensation at compensation point b for movement axis 1
5763	Compensation at compensation point c for movement axis 1
5764	Compensation at compensation point d for movement axis 1
5871	Compensation α at compensation point a for individual axis (gradient compensation)
5872	Compensation β at compensation point b for individual axis (gradient compensation)
5873	Compensation γ at compensation point c for individual axis (gradient compensation)
5874	Compensation δ at compensation point d for individual axis (gradient compensation)
6287	Position error limit at torque limit skip
7113	Manual handle feed magnification m (Note: Need not be changed if the least input increment is not changed)
7114	Manual handle feed magnification n (Note: Need not be changed if the least input increment is not changed)
7772	Number of pulses from position detector per rotation of tool axis
7773	Number of pulses from position detector per rotation of workpiece axis
8181	Synchronous error limit for each axis (synchronous and composite control)
8323	Limit of position error check in feed axis synchronous control
8326	Difference in reference counter value between master axis and slave axis
11013	Position error limit for individual axis during movement
11014	Position error limit for individual axis at stop
14010	Maximum permissible movement amount at reference position setup of linear scale with absolute addressing reference marks

- **Setting data for shifting external machine coordinate systems**

  The setting data for shifting external machine coordinate systems (with no parameter No. assigned) must also be changed depending on the detection unit.

B.4 PARAMETERS FOR Series 16*i*, 18*i*, 21*i*, 0*i*/0*i* Mate-C

No.	Description
1821	Reference counter capacity for individual axis
1826	Effective area (in-position check) for individual axis
1827	Effective area (in-position check) for individual axis at cutting feed
1828	Position error limit for individual axis during movement
1829	Position error limit for individual axis at stop
1830	Position error limit for individual axis with servo off
1832	Position error limit for individual axis with feed at stop
1836	Servo error amount within which reference position return is assumed to be possible
1846	Distance for starting second stage compensation in smooth backlash compensation
1847	Distance for ending second stage compensation in smooth backlash compensation
1848	First stage compensation value in smooth backlash compensation
1850	Grid shift/reference position shift for individual axis
1851	Backlash compensation for individual axis
1852	Backlash compensation for individual axis at rapid traverse
1876	Inductosyn 1-pitch interval
1877	Inductosyn shift
1882	Mark 2 intervals on linear scale having reference marks
1883	Distance from origin to reference position on linear scale having reference marks
1884	Distance from origin to reference position on linear scale having reference marks
1885	Permissible cumulative movement value during torque control (PMC axis control)
1886	Position error with torque control canceled (PMC axis control)
2033	For vibration damping control: position pulses conversion coefficient
2078	Dual position feedback conversion coefficient (numerator)
2079	Dual position feedback conversion coefficient (denominator)
2082	Backlash acceleration stop amount (when two-stage backlash acceleration is disabled) Second stage acceleration start position (when two-stage backlash acceleration is enabled)
2084	Flexible feed gear numerator
2085	Flexible feed gear denominator
2101	Overshoot compensation valid level
2103	Unexpected disturbance torque detection amount retrace distance
2118	Dual position feedback function: alarm detection level of Semi-Full error
2119	Function for changing the proportional gain in the stop state: stop level
2173	Lifting function against gravity at emergency stop: distance to lift (When SWDBSx = 1)
2263	Detection unit parameter
2373	Lifting function against gravity at emergency stop: distance to lift (When SWDBSx = 0)
2382	Torsion preview control: maximum compensation value (LSTCM)
2386	Torsion preview control: Acceleration torsion compensation value K1 (LSTK1)
2387	Torsion preview control: Acceleration torsion compensation value K2 (LSTK2)
2388	Torsion preview control: Acceleration torsion compensation value K3 (LSTK3)
2391	Torsion preview control: Acceleration torsion compensation value K1N (LSTK1N)
2392	Torsion preview control: Acceleration torsion compensation value K2N (LSTK2N)
2393	Torsion preview control: Acceleration torsion compensation value K3N (LSTK3N)
2404	Synchronous axes automatic compensation: Maximum compensation
3623	Pitch error compensation magnification for individual axis
5300	Rigid tapping effective area (in-position check) for tapping axis
5302	Second-spindle rigid tapping effective area (in-position check) for tapping axis
5304	Third-spindle rigid tapping effective area (in-position check) for tapping axis
5310	Rigid tapping position error limit for tapping axis during movement
5312	Rigid tapping position error limit for tapping axis at stop
5314	Rigid tapping position error limit for tapping axis during movement
5350	Second-spindle rigid tapping position error limit for tapping axis during movement
5352	Second-spindle rigid tapping position error limit for tapping axis at stop

No.	Description
5354	Third-spindle rigid tapping position error limit for tapping axis during movement
5356	Third-spindle rigid tapping position error limit for tapping axis at stop
5761	Compensation at compensation point a for movement axis 1 (straightness compensation)
5762	Compensation at compensation point b for movement axis 1 (straightness compensation)
5763	Compensation at compensation point c for movement axis 1 (straightness compensation)
5764	Compensation at compensation point d for movement axis 1 (straightness compensation)
5771	Compensation at compensation point a for movement axis 2 (straightness compensation)
5772	Compensation at compensation point b for movement axis 2 (straightness compensation)
5773	Compensation at compensation point c for movement axis 2 (straightness compensation)
5774	Compensation at compensation point d for movement axis 2 (straightness compensation)
5781	Compensation at compensation point a for movement axis 3 (straightness compensation)
5782	Compensation at compensation point b for movement axis 3 (straightness compensation)
5783	Compensation at compensation point c for movement axis 3 (straightness compensation)
5784	Compensation at compensation point d for movement axis 3 (straightness compensation)
5871	Compensation α at compensation point a for individual axis (gradient compensation)
5872	Compensation β at compensation point b for individual axis (gradient compensation)
5873	Compensation γ at compensation point c for individual axis (gradient compensation)
5874	Compensation ε at compensation point d for individual axis (gradient compensation)
7113	Manual handle feed magnification m (Note: Need not be changed if the least input increment is not changed)
7114	Manual handle feed magnification n (Note: Need not be changed if the least input increment is not changed)
8313	Limit to difference in position error between master and slave axes (pair under simplified synchronization control)
8315	Maximum compensation for synchronization (pair under simplified synchronization control)
8316	Difference in reference counter value between master axis and slave axis (pair under simplified synchronization control)
8323	Limit to difference in position error between master and slave axes (more than one pair under simplified synchronization control)
8325	Maximum compensation for synchronization (more than one pair under simplified synchronization control)
8326	Difference in reference counter value between master axis and slave axis (more than one pair under simplified synchronization control)

- **Setting data for shifting external machine coordinate systems**
  The setting data for shifting external machine coordinate systems (with no parameter No. assigned) must also be changed depending on the detection unit.

B.5 PARAMETERS FOR Power Mate *i*

No.	Description
1821	Reference counter capacity for individual axis
1826	Effective area (in-position check) for individual axis
1827	Effective area (in-position check) for individual axis at cutting feed
1828	Position error limit for individual axis during movement
1829	Position error limit for individual axis at stop
1830	Position error limit for individual axis with servo off
1832	Position error limit for individual axis with feed at stop
1836	Servo error amount within which reference position return is assumed to be possible (This parameter is used when ISC is used.)
1850	Grid shift/reference position shift for individual axis
1851	Backlash compensation for individual axis
1852	Backlash compensation for individual axis at rapid traverse
1872*	Servo position error check value

No.	Description
1882	Mark 2 intervals on linear scale having reference marks
1883	Distance from origin to reference position on linear scale having reference marks
1884	Distance from origin to reference position on linear scale having reference marks
1885	Permissible cumulative movement value during torque control (PMC axis control)
1886	Position error with torque control canceled (PMC axis control)
2033	For vibration damping control: position pulses conversion coefficient
2078	Dual position feedback conversion coefficient (numerator)
2079	Dual position feedback conversion coefficient (denominator)
2082	Backlash acceleration stop amount (when two-stage backlash acceleration is disabled) Second stage acceleration start position (when two-stage backlash acceleration is enabled)
2084	Flexible feed gear numerator
2085	Flexible feed gear denominator
2101	Overshoot compensation valid level
2103	Unexpected disturbance torque detection amount retrace distance
2118	Dual position feedback function: alarm detection level of Semi-Full error
2119	Function for changing the proportional gain in the stop state: stop level
2173	Lifting function against gravity at emergency stop: distance to lift (When SWDBSx = 1)
2263	Detection unit parameter
2373	Lifting function against gravity at emergency stop: distance to lift (When SWDBSx = 0)
2404	Synchronous axes automatic compensation: Maximum compensation
3623	Pitch error compensation magnification for individual axis (H is optional.)
5300(D)	Rigid tapping effective area (in-position check) for tapping axis
5310(D)	Rigid tapping position error limit for tapping axis during movement
5312(D)	Rigid tapping position error limit for tapping axis at stop
5314(D)	Rigid tapping position error limit for tapping axis during movement
5761	Compensation at compensation point a for movement axis 1 (straightness compensation)
5762	Compensation at compensation point b for movement axis 1 (straightness compensation)
5763	Compensation at compensation point c for movement axis 1 (straightness compensation)
5764	Compensation at compensation point d for movement axis 1 (straightness compensation)
5771	Compensation at compensation point a for movement axis 2 (straightness compensation)
5772	Compensation at compensation point b for movement axis 2 (straightness compensation)
5773	Compensation at compensation point c for movement axis 2 (straightness compensation)
5774	Compensation at compensation point d for movement axis 2 (straightness compensation)
5781	Compensation at compensation point a for movement axis 3 (straightness compensation)
5782	Compensation at compensation point b for movement axis 3 (straightness compensation)
5783	Compensation at compensation point c for movement axis 3 (straightness compensation)
5784	Compensation at compensation point d for movement axis 3 (straightness compensation)
7113	Manual handle feed magnification m (Note: Need not be changed if the least input increment is not changed)
7114	Manual handle feed magnification n (Note: Need not be changed if the least input increment is not changed)
8313	Limit to difference in position error between master and slave axes (pair under simplified synchronization control)
8315	Maximum compensation for synchronization (pair under simplified synchronization control)
8316	Difference in reference counter value between master axis and slave axis (pair under simplified synchronization control)
8323(H)	Limit to difference in position error between master and slave axes (more than one pair under simplified synchronization control)
8325(H)	Maximum compensation for synchronization (more than one pair under simplified synchronization control)
8326(H)	Difference in reference counter value between master axis and slave axis (more than one pair under simplified synchronization control)

The parameter No. indicated with an asterisk (*) is related to a function unique to the Power Mate.
The parameter No. suffixed with "(D)" is related to the functions dedicated to the Power Mate *i*-D.
The parameter No. suffixed with "(H)" is related to the functions dedicated to the Power Mate *i*-H.

B.6 PARAMETERS FOR Series 15*i*

No.	Description
1414	Manual handle feed magnification m (Note: Need not be changed if the least input increment is not changed)
1418	Manual handle feed magnification n (Note: Need not be changed if the least input increment is not changed)
1718	For vibration damping control: position pulses conversion coefficient
1729	Dual position feedback function: alarm detection level of Semi-Full error
1730	Function for changing the proportional gain in the stop state: stop level
1827	Effective area (in-position check) for individual axis
1828	Position error limit for individual axis during movement
1829	Position error limit for individual axis at stop
1830	Position error limit for individual axis with servo off
1832	Position error limit for individual axis with feed at stop
1837	Rigid tapping position error limit during movement
1841	Servo error amount within which reference position return is assumed to be possible
1843	Position error limit at torque limit skip
1844	Grid shift for reference position shift function
1846	Distance for starting second stage compensation in smooth backlash compensation
1847	Distance for ending second stage compensation in smooth backlash compensation
1848	First stage compensation value in smooth backlash compensation
1849	Backlash compensation for individual axis at rapid traverse
1850	Grid shift for individual axis
1851	Backlash compensation for individual axis
1881	Permissible error at start of chopping compensation
1896	Mark 1 intervals on linear scale interface with absolute address reference mark
1912	Synchronous error zero width for each axis
1913	Maximum permissible synchronization error for each axis at rapid traverse
1914	Maximum permissible synchronization error for each axis at stop
1917	Synchronous error zero width 2 for each axis
1971	Dual position feedback conversion coefficient (numerator)
1972	Dual position feedback conversion coefficient (denominator)
1975	Backlash acceleration stop amount (when two-stage backlash acceleration is disabled) Second stage acceleration start position (when two-stage backlash acceleration is enabled)
1977	Flexible feed gear numerator
1978	Flexible feed gear denominator
1994	Overshoot compensation valid level
1996	Unexpected disturbance torque detection amount retrace distance
2676	Detection unit parameter
2786	Distance to lift for the lifting function against gravity at emergency stop
2795	Torsion preview control: maximum compensation value (LSTCM)
2799	Torsion preview control: Acceleration torsion compensation value K1 (LSTK1)
2800	Torsion preview control: Acceleration torsion compensation value K2 (LSTK2)
2801	Torsion preview control: Acceleration torsion compensation value K3 (LSTK3)
2804	Torsion preview control: Acceleration torsion compensation value K1N (LSTK1N)
2805	Torsion preview control: Acceleration torsion compensation value K2N (LSTK2N)
2806	Torsion preview control: Acceleration torsion compensation value K3N (LSTK3N)
2817	Synchronous axes automatic compensation: Maximum compensation
5226	Mark 2 intervals on linear scale having reference marks
5227	Distance from origin to reference position on linear scale having reference marks
5423	Pitch error compensation magnification
5433	Second cyclic pitch error compensation magnification
5428	Pitch error compensation value at reference position when movement to reference position is made in the direction opposite to reference position return direction (absolute value)

No.	Description
5449	Three-dimensional error compensation magnification
5450	Three-dimensional error compensation magnification
5451	Three-dimensional error compensation magnification
5471	Compensation α at compensation point a for individual axis
5472	Compensation β at compensation point b for individual axis
5473	Compensation γ at compensation point c for individual axis
5474	Compensation ε at compensation point d for individual axis
5504	Compensation point d for movement axis 1 subjected to straightness compensation
5551	Compensation at compensation point a for movement axis 1
5552	Compensation at compensation point b for movement axis 1
5553	Compensation at compensation point c for movement axis 1
5554	Compensation at compensation point d for movement axis 1
5561	Compensation at compensation point a for movement axis 2
5562	Compensation at compensation point b for movement axis 2
5563	Compensation at compensation point c for movement axis 2
5564	Compensation at compensation point d for movement axis 2
5571	Compensation at compensation point a for movement axis 3
5572	Compensation at compensation point b for movement axis 3
5573	Compensation at compensation point c for movement axis 3
5574	Compensation at compensation point d for movement axis 3
5591	Compensation magnification for movement axis 1 subjected to straightness compensation
5592	Compensation magnification for movement axis 2 subjected to straightness compensation
5593	Compensation magnification for movement axis 3 subjected to straightness compensation
5594	Compensation magnification for movement axis 4 subjected to straightness compensation
5595	Compensation magnification for movement axis 5 subjected to straightness compensation

C PARAMETERS RELATED TO HIGH-SPEED AND HIGH PRECISION OPERATIONS

The *i* series CNCs are provided with some functions for high-speed and high precision operations. This appendix lists parameters categorized by model and function and their standard setting values so as to make it easy to tune the functions.

Appendix C consists of the following two items:

(1) CNC model-specific information
This section lists high-speed and high precision functions and parameters related to them for individual CNC models.
The parameter tables in this section contain standard setting values.

(2) Servo parameters
This section lists servo parameters common to all CNC models and standard setting values for them.

NOTE

1 Use the standard setting values included in the parameter tables as reference data for initialization.
If a parameter needs tuning based on the machine type, determine a final setting for the parameter according to the characteristic of the machine and how it will be used.
To reduce machining time, change parameters from standard settings to speed priority I to speed priority II while checking the operation status. (The settings for speed priority II can reduce much more machining time than the settings for speed priority I.)

2 For the specifications of CNC models and detailed explanations about their functions, refer to the respective CNC manuals.

3 In the following table, a circle indicates that the item is supported, a triangle indicates partial support, and an X indicates non-support.

4 A hyphen "-" indicates that there is no recommended setting.
Set the parameter according to the machine specifications (motor, ball screw pitch, etc.).

C.1 MODEL-SPECIFIC INFORMATION

C.1.1 Series 30*i*/31*i* /32*i*-A/B

[Functions related to high-speed and high precision operations]

High-speed high precision functions	AI contour control I	AI contour control II (Note 1)	AI contour control II + High-speed processing (Note 2)
Series30*i*-A/B	○	○	○
Series31*i*-A/B/A5/B5	○	○	○
Series32*i*-A/B	○	○	×
Acc./dec. before interpolation			
Type	Linear / Bell-shaped	Linear / Bell-shaped / Smooth bell-shaped	Linear / Bell-shaped / Smooth bell-shaped
Acceleration setting for each axis	○	○	○
Velocity control			
Velocity control by speed difference among axes	○	○	○
Velocity control by acceleration in circular interpolation	○	○	○
Acceleration-based velocity control	○	○	○
Cutting load-based velocity control	×	○	○
Jerk control	×	○	○
Optimum torque acc./dec.	○	○	○
Other functions			
Nano interpolation	○	○	○
5-axis machining functions (Note 3)	○	○	○
Smooth interpolation (Note 4)	○	○	○
NURBS (Note 4)	○	○	○
Nano smoothing (Note 5)	○	○	○

NOTE

1 In FS30*i* systems controlling more than four paths and more than 20 axes, this function cannot be used.
2 In FS30*i* and FS31*i* systems controlling more than two paths and more than 12 axes, this function cannot be used.
3 These functions can be used with the FS30*i*-A/B and FS31*i*-A5/B5 only.
4 These functions cannot be used with the FS32*i*.
5 These functions cannot be used with the FS32*i*-A.

[Parameters]

Described below are the parameters that must be specified individually for each high-speed and high precision cutting machine function.

Use the standard setting values included in the parameter tables as reference data for initialization. If a parameter needs tuning based on the machine type, determine a final setting for the parameter according to the characteristic of the machine and how it will be used.

- Standard settings (precision priority)
  When there is vibration or significant impact, or when machining is to be performed more precisely, make settings based on the standard settings.
- Cutting time-priority setting
  To reduce machining time, make settings for speed priority I then for speed priority II in stages. The settings for speed priority II can reduce much more machining time than the settings for speed priority I.

(1) AI contour control I, AI contour control II

- **Parameters that need tuning based on the machine type**

Parameter No.	Set value			Description
	Standard setting	Speed priority I	Speed priority II	
1420	—	—	—	Maximum rapid traverse rate (mm/min) for individual axes
1432	—	—	—	Maximum cutting feedrate (mm/min) for individual axes
1620	—	—	—	Time constant (msec) for linear-shaped acc./dec. in rapid-traverse for individual axes
1621	—	—	—	Time constant T2 (msec) for bell-shaped acc./dec. in rapid-traverse for individual axes
11242	24	16	16	Time constant (msec) for acc./dec. after rapid traverse interpolation for individual axes in acc./dec. mode before rapid traverse interpolation
1769	24	16	16	Time constant (msec) for acc./dec. after cutting feed interpolation for individual axes
1660	700.0	2000.0	4000.0	Acceleration in acc./dec. before cutting feed interpolation (for constant-acceleration part) (Acceleration is specified in mm/sec^2 for individual axes.)
1772	64	48	32	Time constant of bell-shaped acc./dec. before interpolation (msec) (for constant-acceleration part)
1783	400.0	500.0	1000.0	Allowable speed difference (mm/min) in acceleration-dependent on speed difference at corners
1737	525.0	1500.0	3000.0	Permissible acceleration in deceleration by acceleration (Acceleration is specified in mm/sec^2 for individual axes.)
1735	525.0	1500.0	3000.0	Permissible acceleration in deceleration by acceleration in circular interpolation (Acceleration is specified in mm/sec^2 for individual axes.)

- **Parameters that do not usually need to be tuned that often and can be left at fixed values**

Parameter number	Standard setting	Description
1401#1	0	Rapid traverse is of a non-linear type.
	1	Rapid traverse is of a linear type (Set this parameter to 1 if acc./dec. before rapid traverse interpolation is to be used.)
1602#6,#3	#6,#3	
	1,0	Acc./dec. after interpolation is of a linear type
	1,1	Acc./dec. after interpolation is of a bell-shaped type (Note 1)
7055#3	1/0	To be set to 1 if a function that changes the time constant for bell-shaped acc./dec. before interpolation is to be used.

Parameter number	Standard setting	Description
7066	mm / inch 10000.0/3937.0	Reference speed (mm/min / inch/min) for a function that changes the time constant for bell-shaped acc./dec. before interpolation
19501#5	0/1	Set this parameter to 1 if acc./dec. before rapid traverse interpolation is to be used.
19503#0	0/1	When using smooth velocity control as velocity control by acceleration, set 1. (Note 2)
8451#4	0/1	Set this parameter to 1 if cutting load-dependent override is to be used. (This parameter is used if the mechanical rigidity of the Z-axis is low.) (Note 2)
19515#1	0/1	When using the slant type for override by cutting load, set 1. (Note 2)
19516	80	Region 1 override (%) for the cutting load-based deceleration function (doesn't need to be specified if bit 4 of parameter No. 8451 = 0 or bit 1 of parameter No. 19515 = 0) (Note 2)
8456	80	Region 2 override (%) for the cutting load-based deceleration function (doesn't need to be specified if bit 4 of parameter No. 8451 = 0) (Note 2)
8457	70	Region 3 override (%) for the cutting load-based deceleration function (doesn't need to be specified if bit 4 of parameter No. 8451 = 0) (Note 2)
8458	60	Region 4 override (%) for the cutting load-based deceleration function (doesn't need to be specified if bit 4 of parameter No. 8451 = 0) (Note 2)

NOTE

1 To perform bell-shaped acc./dec. after cutting feed interpolation, the option for bell-shaped acc./dec. after cutting feed interpolation is required.

2 These functions cannot be used with AI contour control I.

C.1.2 Series 35*i*-B, Power Motion *i*-A

[Functions related to high-speed and high precision operations]

High-speed high precision functions	Advanced preview control	
	Series 35*i*-B	Power Motion *i*-A
Acc./dec. before interpolation		
Type	Linear	
Acceleration setting for each axis	○	
Velocity control		
Velocity control by speed difference among axes	○	
Velocity control by acceleration in circular interpolation	×	○
Acceleration-based velocity control	×	
Cutting load-based velocity control	×	
Jerk control	×	
Optimum torque acc./dec.	×	
Other functions		
Nano interpolation	○	
5-axis machining functions	×	
Smooth interpolation	×	
NURBS	×	
Nano smoothing	×	

[Parameters]

Described below are the parameters that must be specified individually for each high-speed and high precision cutting machine function.

Use the standard setting values included in the parameter tables as reference data for initialization. If a parameter needs tuning based on the machine type, determine a final setting for the parameter according to the characteristic of the machine and how it will be used.

- Standard settings (precision priority)
  When there is vibration or significant impact, or when machining is to be performed more precisely, make settings based on the standard settings.
- Cutting time-priority setting
  To reduce machining time, make settings for speed priority I then for speed priority II in stages. The settings for speed priority II can reduce much more machining time than the settings for speed priority I.

(1) Advanced preview control

- **Parameters that need tuning based on the machine type**

Parameter No.	Set value			Description
	Standard setting	Speed priority I	Speed priority II	
1420	—	—	—	Rapid traverse rate (mm/min) for individual axes
1432	—	—	—	Maximum cutting feedrate (mm/min) for individual axes
1620	—	—	—	Time constant (msec) for linear-shaped acc./dec. in rapid-traverse for individual axes
1621	—	—	—	Time constant T2 (msec) for bell-shaped acc./dec. in rapid-traverse for individual axes
11242	24	16	16	Time constant (msec) for acc./dec. after rapid traverse interpolation for individual axes in acc./dec. mode before rapid traverse interpolation
1769	24	16	16	Time constant (msec) for acc./dec. after cutting feed interpolation for individual axes
1660	700.0	2000.0	4000.0	Acceleration in acc./dec. before cutting feed interpolation (for constant-acceleration part) (Acceleration is specified in mm/sec^2 for individual axes.)
1783	400.0	500.0	1000.0	Allowable speed difference (mm/min) in acceleration-dependent on speed difference at corners
1735	525.0	1500.0	3000.0	Permissible acceleration in deceleration by acceleration in circular interpolation (Acceleration is specified in mm/sec^2 for individual axes.) (Note 1)

- **Parameters that do not usually need to be tuned that often and can be left at fixed values**

Parameter number	Standard setting	Description
1401#1	0	Rapid traverse is of a non-linear type.
	1	Rapid traverse is of a linear type (Set this parameter to 1 if acc./dec. before rapid traverse interpolation is to be used.)
1602#6	#6	Set this parameter to 1 if linear-type acc./dec. after interpolation is to be used.
19501#5	0/1	Set this parameter to 1 if acc./dec. before rapid traverse interpolation is to be used.

NOTE
These functions cannot be used with the FS35*i*-B.

C.1.3 Series 0*i*/0*i* Mate-D

[Functions related to high-speed and high precision operations]

High-speed high precision functions	Advanced preview control	AI advanced preview control	AI contour control I	AI contour control II
Series0*i*-MD	×	○	○	○
Series0*i*-TD	○	×	○	○
Series0*i* Mate-MD	×	○	○	×
Series0*i* Mate-TD	×	×	○	×
Acc./dec. before interpolation				
Type	Linear	Linear	Linear / Bell-shaped	Linear / Bell-shaped / Smooth bell-shaped
Acceleration setting for each axis	○	○	○	○
Function for changing the time constant of bell-shaped acc./dec. (Note 1)	×	×	○	○
Velocity control				
Velocity control by speed difference among axes	○	○	○	○
Velocity control by acceleration in circular interpolation	○	○	○	○
Acceleration-based velocity control	×	○	○	○
Smooth velocity control	×	×	×	○
Cutting load-based velocity control	×	×	×	○
Jerk control	×	×	×	○
Function for ignoring the velocity command	×	×	×	○
Other functions				
Nano interpolation	○	○	○	○
Nano smoothing	×	×	×	○

NOTE

1 The function for changing the time constant of bell-shaped acc./dec. is contained in the option for bell-shaped acc./dec. before look ahead interpolation.

[Parameters]

Described below are the parameters that must be specified individually for each high-speed and high precision cutting machine function.

Use the standard setting values included in the parameter tables as reference data for initialization. If a parameter needs tuning based on the machine type, determine a final setting for the parameter according to the characteristic of the machine and how it will be used.

- Standard settings (precision priority)
  When there is vibration or significant impact, or when machining is to be performed more precisely, make settings based on the standard settings.
- Cutting time-priority setting
  To reduce machining time, make settings for speed priority I then for speed priority II in stages. The settings for speed priority II can reduce much more machining time than the settings for speed priority I.

(1) Advanced preview control

- **Parameters that need tuning based on the machine type**

Parameter number	Set value			Description
	Standard setting	Speed priority I	Speed priority II	
1420	—	—	—	Rapid traverse rate (mm/min) for individual axes
1432	—	—	—	Maximum cutting feedrate (mm/min) for individual axes
1620	—	—	—	Time constant (msec) for linear-shaped acc./dec. in rapid-traverse for individual axes / Time constant T1 (msec) for bell-shaped acc./dec. in rapid-traverse for individual axes
1621	—	—	—	Time constant T2 (msec) for bell-shaped acc./dec. in rapid-traverse for individual axes
1769	24	16	16	Time constant (msec) for acc./dec. after cutting feed interpolation for individual axes
1660	700.0	2000.0	4000.0	Acceleration of acc./dec. before interpolation (portion with fixed acceleration) (Acceleration is specified in mm/sec^2 for individual axes.)
1783	400.0	500.0	1000.0	Allowable speed difference (mm/min) in acceleration-dependent on speed difference at corners
1737	525.0	1500.0	3000.0	Permissible acceleration in deceleration by acceleration (Acceleration is specified in mm/sec^2 for individual axes.)
1735	525.0	1500.0	3000.0	Permissible acceleration in deceleration by acceleration in circular interpolation (Acceleration is specified in mm/sec^2 for individual axes.)

- **Parameters that do not usually need to be tuned that often and can be left at fixed values**

Parameter number	Standard setting	Description
1401#1	0	Rapid traverse is of a non-linear type.
	1	Rapid traverse is of a linear type (Set this parameter to 1 if acc./dec. before rapid traverse interpolation is to be used.)
1602#6,#3	#6,#3	
	1,0	Acc./dec. after interpolation is of a linear type
	0,1	Acc./dec. after interpolation is of a bell-shaped type (Note 1)
19501#5	0/1	Set this parameter to 1 if acc./dec. before rapid traverse interpolation is to be used.

NOTE

1 Performing bell-shaped acc./dec. after cutting feed interpolation requires the bell-shaped acc./dec. after cutting feed interpolation option (FS0i-MD). With the FS0i-TD, bell-shaped acc./dec. after cutting feed interpolation cannot be used.

(2) AI advanced preview control

- **Parameters that need tuning based on the machine type**

Parameter number	Set value			Description
	Standard setting	Speed priority I	Speed priority II	
1420	—	—	—	Rapid traverse rate (mm/min) for individual axes
1432	—	—	—	Maximum cutting feedrate (mm/min) for individual axes
1620	—	—	—	Time constant (msec) for linear-shaped acc./dec. in rapid-traverse for individual axes / Time constant T1 (msec) for bell-shaped acc./dec. in rapid-traverse for individual axes
1621	—	—	—	Time constant T2 (msec) for bell-shaped acc./dec. in rapid-traverse for individual axes
1769	24	16	16	Time constant (msec) for acc./dec. after cutting feed interpolation for individual axes
1660	700.0	2000.0	4000.0	Acceleration of acc./dec. before interpolation (portion with fixed acceleration) (Acceleration is specified in mm/sec^2 for individual axes.)
1783	400.0	500.0	1000.0	Allowable speed difference (mm/min) in acceleration-dependent on speed difference at corners
1737	525.0	1500.0	3000.0	Permissible acceleration in deceleration by acceleration (Note 1) (Acceleration is specified in mm/sec^2 for individual axes.)
1735	525.0	1500.0	3000.0	Permissible acceleration in deceleration by acceleration in circular interpolation (Acceleration is specified in mm/sec^2 for individual axes.)

- **Parameters that do not usually need to be tuned that often and can be left at fixed values**

Parameter number	Standard setting	Description
1401#1	0	Rapid traverse is of a non-linear type.
	1	Rapid traverse is of a linear type (Set this parameter to 1 if acc./dec. before rapid traverse interpolation is to be used.)
1602#6,#3	#6,#3	
	1,0	Acc./dec. after interpolation is of a linear type
	0,1	Acc./dec. after interpolation is of a bell-shaped type (Note 2)
19501#5	0/1	Set this parameter to 1 if acc./dec. before rapid traverse interpolation is to be used.

NOTE

1 This function cannot be used with advanced preview control.

2 Performing bell-shaped acc./dec. after cutting feed interpolation requires the bell-shaped acc./dec. after cutting feed interpolation option (FS0i-MD). With the FS0i-TD, bell-shaped acc./dec. after cutting feed interpolation cannot be used.

(3) AI contour control I, AI contour control II

- **Parameters that need tuning based on the machine type**

Parameter number	Set value			Description
	Standard setting	Speed priority I	Speed priority II	
1420	—	—	—	Rapid traverse rate (mm/min) for individual axes
1432	—	—	—	Maximum cutting feedrate (mm/min) for individual axes
1620	—	—	—	Time constant (msec) for linear-shaped acc./dec. in rapid-traverse for individual axes / Time constant T1 (msec) for bell-shaped acc./dec. in rapid-traverse for individual axes
1621	—	—	—	Time constant T2 (msec) for bell-shaped acc./dec. in rapid-traverse for individual axes
1769	24	16	16	Time constant (msec) for acc./dec. after cutting feed interpolation for individual axes
1660	700.0	2000.0	4000.0	Acceleration of acc./dec. before interpolation (portion with fixed acceleration) (Acceleration is specified in mm/sec^2 for individual axes.)
1772	64	48	32	Time constant of bell-shaped acc./dec. before interpolation (msec) (for constant-acceleration part)
1783	400.0	500.0	1000.0	Allowable speed difference (mm/min) in acceleration-dependent on speed difference at corners
1737	525.0	1500.0	3000.0	Permissible acceleration in deceleration by acceleration (Acceleration is specified in mm/sec^2 for individual axes.)
1735	525.0	1500.0	3000.0	Permissible acceleration in deceleration by acceleration in circular interpolation (Acceleration is specified in mm/sec^2 for individual axes.)

- **Parameters that do not usually need to be tuned that often and can be left at fixed values**

Parameter number	Standard setting	Description
1401#1	0	Rapid traverse is of a non-linear type.
	1	Rapid traverse is of a linear type (Set this parameter to 1 if acc./dec. before rapid traverse interpolation is to be used.)
1602#6,#3	#6,#3	
	1,0	Acc./dec. after interpolation is of a linear type
	0,1	Acc./dec. after interpolation is of a bell-shaped type (Note 1)
7055#3	0/1	To be set to 1 if a function that changes the time constant for bell-shaped acc./dec. before interpolation is to be used.
7066	mm / inch 10000.0/3937.0	Reference speed (mm/min / inch/min) for a function that changes the time constant for bell-shaped acc./dec. before interpolation
19501#5	0/1	Set this parameter to 1 if acc./dec. before rapid traverse interpolation is to be used.
19503#0	0/1	When using smooth velocity control as velocity control by acceleration, set 1. (Note 2)
8451#4	0/1	Set this parameter to 1 if cutting load-dependent override is to be used. (This parameter is used if the mechanical rigidity of the Z-axis is low.) (Note 2)
8451#7	0/1	Set this parameter to 1 if the function for ignoring the velocity command is to be used. (Note 2)
19515#1	0/1	When using the slant type for override by cutting load, set 1. (Note 2)
19516	80	Region 1 override (%) for the cutting load-based deceleration function (doesn't need to be specified if bit 4 of parameter No. 8451 = 0 or bit 1 of parameter No. 19515 = 0) (Note 2)
8456	80	Region 2 override (%) for the cutting load-based deceleration function (doesn't need to be specified if bit 4 of parameter No. 8451 = 0) (Note 2)

Parameter number	Standard setting	Description
8457	70	Region 3 override (%) for the cutting load-based deceleration function (doesn't need to be specified if bit 4 of parameter No. 8451 = 0) (Note 2)
8458	60	Region 4 override (%) for the cutting load-based deceleration function (doesn't need to be specified if bit 4 of parameter No. 8451 = 0) (Note 2)

NOTE

1 Performing bell-shaped acc./dec. after cutting feed interpolation requires the bell-shaped acc./dec. after cutting feed interpolation option (FS0i-MD). With the FS0i-TD, bell-shaped acc./dec. after cutting feed interpolation cannot be used.

2 These functions can only be used with AI contour control II.

C.1.4 Series 16*i*/18*i*/21*i*/0*i*/0*i*Mate-MB, 0*i*/0*i* Mate-MC/20*i*-FB

[Functions related to high-speed and high precision operations]

High-speed high precision functions	Advanced preview control (APC)	AI advanced preview control (AI-APC)	AI contour control (AICC)	AI nano contour control (AI nano CC)	High-precision contour control (HPCC)	AI high-precision contour control (AI-HPCC)	AI nano high-precision contour control (AI nano HPCC)
Series 0*i* Mate -MC	×	○	×	×	×	×	×
Series 0*i*-MC	×	○	○	×	×	×	×
Series20*i*-FB	○	×	○	×	×	×	×
Series 0*i* Mate -MB	×	○	×	×	×	×	×
Series 0*i*-MB	×	○	○	×	×	×	×
Series21*i*-MB	○	○	○	○	×	×	×
Series18*i*-MB	○	×	○	○	○	○	○
Series16*i*-MB	○	×	○	○	○	○	○
Acc./dec. before interpolation							
Type	Linear	Linear / Bell-shaped	Linear / Bell-shaped / Smooth bell-shaped	Linear / Bell-shaped / Smooth bell-shaped	Linear / Bell-shaped	Linear / Bell-shaped / Smooth bell-shaped	Linear / Bell-shaped / Smooth bell-shaped
Time constant setting for individual axes	×	×	×	×	×	○	○
Velocity control							
Automatic corner deceleration	○	○	○	○	○	○	○
Arc radius-based velocity control	○	○	○	○	○	○	○
Acceleration-based velocity control	×	○	○	○	○	○	○
Cutting load-based velocity control	×	×	×	×	○	○	○
Jerk control (Note 1)	×	×	Δ	Δ	×	○	○
Optimum torque acc./dec.	×	×	×	×	×	○	○

High-speed high precision functions	Advanced preview control (APC)	AI advanced preview control (AI-APC)	AI contour control (AICC)	AI nano contour control (AI nano CC)	High-precision contour control (HPCC)	AI high-precision contour control (AI-HPCC)	AI nano high-precision contour control (AI nano HPCC)
Other functions							
Nano interpolation	×	×	×	○	×	×	○
5-axis machining functions	×	×	×	×	×	○	○
Smooth interpolation	×	×	×	×	○	○	○
NURBS	×	×	×	×	○	○	○
Nano smoothing	×	×	×	×	×	○	○
Additional hardware	None	None	None	None	RISC board is necessary.		

NOTE
Jerk control can be used in the Series 16*i*-MB/18*i*-MB.

[Parameters]

Described below are the parameters that must be specified individually for each high-speed and high precision cutting machine function.
Use the standard setting values included in the parameter tables as reference data for initialization. If a parameter needs tuning based on the machine type, determine a final setting for the parameter according to the characteristic of the machine and how it will be used.

- Standard settings (precision priority)
  When there is vibration or significant impact, or when machining is to be performed more precisely, make settings based on the standard settings.
- Cutting time-priority setting
  To reduce machining time, make settings for speed priority I then for speed priority II in stages. The settings for speed priority II can reduce much more machining time than the settings for speed priority I.

NOTE
1 Performing bell-shaped acc./dec. after interpolation requires the look-ahead bell-shaped acc./dec. after interpolation option.
2 Performing linear-shaped acc./dec. after cutting feed interpolation requires the linear-shaped acc./dec. after cutting feed interpolation option.
3 To perform bell-shaped acc./dec. after cutting feed interpolation, the option for bell-shaped acc./dec. after cutting feed interpolation is required.
4 Performing bell-shaped acc./dec. in rapid-traverse requires the bell-shaped acc./dec. in rapid-traverse option.

(1) Advanced preview control

- **Parameters that need tuning based on the machine type**

Parameter No.	Set value			Description
	Standard setting	Speed priority I	Speed priority II	
1432	—	—	—	Maximum cutting feedrate (mm/min) for individual axes
1620	—	—	—	Time constant (msec) for linear-shaped acc./dec. in rapid-traverse for individual axes
1621	—	—	—	Time constant T2 (msec) for bell-shaped acc./dec. in rapid-traverse for individual axes
1730	3060	5150	7275	Feedrate upper limit (mm/min) for arc radius R
1731	5000	5000	5000	Arc radius R (1 μm) for arc radius-based feedrate upper limit
1732	100	100	100	Arc radius-based feedrate clamp lower speed limit (mm/min)
1768	24	16	16	Time constant (msec) for acc./dec. after cutting feed interpolation
1770	10000	10000	10000	Maximum cutting feedrate (mm/min) during acc./dec. before interpolation
1771	240	80	40	Time (msec) allowed before a maximum cutting feedrate during acc./dec. before interpolation is reached
1783	400	500	1000	Allowable speed difference (mm/min) in acceleration-dependent on speed difference at corners
1784	—	—	—	Speed (mm/min) at occurrence of overtravel alarm To be specified according to the overrun distance at overtravel

- **Parameters that do not usually need to be tuned that often and can be left at fixed values**

Parameter number	Standard setting	Description
1602#0	1	The type of linear-shaped acc./dec. before interpolation is B.
1602#4	1	Automatic deceleration at corners is under speed difference-dependent control
1602#6,#3	#6,#3	
	1,0	Acc./dec. after interpolation is of a linear type (to be specified when FAD is used)
	1,1	Acc./dec. after interpolation is of a bell-shaped type (to be specified when FAD is not used)
1802#7	0/1	To be set to 1 if the CMR setting is 2 or greater (parameter No. 1820 setting is 4 or greater).
3403#0	1	To be set to the standard setting value.

(2) AI advanced preview control

- **Parameters that need tuning based on the machine type**

Parameter No.	Set value			Description
	Standard setting	Speed priority I	Speed priority II	
1432	—	—	—	Maximum cutting feedrate (mm/min) for individual axes
1620	—	—	—	Time constant (msec) for linear-shaped acc./dec. in rapid-traverse for individual axes
1621	—	—	—	Time constant T2 (msec) for bell-shaped acc./dec. in rapid-traverse for individual axes
1730	3060	5150	7275	Feedrate upper limit (mm/min) for arc radius R
1731	5000	5000	5000	Arc radius R (1 μm) for arc radius-based feedrate upper limit
1732	100	100	100	Arc radius-based feedrate clamp lower speed limit (mm/min)
1768	24	16	16	Time constant (msec) for acc./dec. after cutting feed interpolation
1770	10000	10000	10000	Maximum cutting feedrate (mm/min) during acc./dec. before interpolation
1771	240	80	40	Time (msec) allowed before a maximum cutting feedrate during acc./dec. before interpolation is reached
1772	64	48	32	Time constant of bell-shaped acc./dec. before interpolation (for constant-time part) (msec)
1783	400	500	1000	Allowable speed difference (mm/min) in acceleration-dependent on speed difference at corners
1784	—	—	—	Speed (mm/min) at occurrence of overtravel alarm To be specified according to the overrun distance at overtravel
1785	320	112	56	Parameter (msec) for determining an allowable acceleration in determining acceleration-dependent speed. The parameter is to be set with the time allowed before a maximum cutting feedrate (parameter No. 1432) is reached. A maximum cutting feedrate of 10000 mm/min is used as the standard setting value.

- **Parameters that do not usually need to be tuned that often and can be left at fixed values**

Parameter number	Standard setting	Description
1602#6,#3	#6,#3	
	1,0	Acc./dec. after interpolation is of a linear type (to be specified when FAD is used)
	1,1	Acc./dec. after interpolation is of a bell-shaped type (to be specified when FAD is not used)
1603#7	1	Acc./dec. before interpolation is of bell-shaped type. (0: Linear-shaped acc./dec. before interpolation)
1802#7	0/1	To be set to 1 if the CMR setting is 2 or greater (parameter No. 1820 setting is 4 or greater).

(3) AI contour control

- **Parameters that need tuning based on the machine type**

Parameter No.	Set value			Description
	Standard setting	Speed priority I	Speed priority II	
1432	—	—	—	Maximum cutting feedrate (mm/min) for individual axes
1620	—	—	—	Time constant (msec) for linear-shaped acc./dec. in rapid-traverse for individual axes
1621	—	—	—	Time constant T2 (msec) for bell-shaped acc./dec. in rapid-traverse for individual axes
1730	3060	5150	7275	Feedrate upper limit (mm/min) for arc radius R
1731	5000	5000	5000	Arc radius R (1 μm) for arc radius-based feedrate upper limit
1732	100	100	100	Arc radius-based feedrate clamp lower speed limit (mm/min)
1768	24	16	16	Time constant (msec) for acc./dec. after cutting feed interpolation
1770	10000	10000	10000	Maximum cutting feedrate (mm/min) during acc./dec. before interpolation
1771	240	80	40	Time (msec) allowed before a maximum cutting feedrate during acc./dec. before interpolation is reached
1772	64	48	32	Time constant of bell-shaped acc./dec. before interpolation (for constant-time part) (msec)
1783	400	500	1000	Allowable speed difference (mm/min) in acceleration-dependent on speed difference at corners
1784	—	—	—	Speed (mm/min) at occurrence of overtravel alarm To be specified according to the overrun distance at overtravel
1785	320	112	56	Parameter (msec) for determining an allowable acceleration in determining acceleration-dependent speed. The parameter is to be set with the time allowed before a maximum cutting feedrate (parameter No. 1432) is reached. A maximum cutting feedrate of 10000 mm/min is used as the standard setting value.

- **Parameters that do not usually need to be tuned that often and can be left at fixed values**

Parameter number	Standard setting	Description
1602#6,#3	#6,#3	
	1,0	Acc./dec. after interpolation is of a linear type (if bell-shaped acc./dec. before interpolation is used)
	1,1	Acc./dec. after interpolation is of a bell-shaped type (if linear-shaped acc./dec. before interpolation is used)
1603#7	1	Acc./dec. before interpolation is of bell-shaped type. (0: Linear-shaped acc./dec. before interpolation)
1802#7	0/1	To be set to 1 if the CMR setting is 2 or greater (parameter No. 1820 setting is 4 or greater).
7050#5	1	To be set to the standard setting value.
7050#6	0	To be set to the standard setting value.
7052#0	0/1	To be set to 1 for the PMC and Cs axes.
7055#3	1/0	To be set to 1 if a function that changes the time constant for bell-shaped acc./dec. before interpolation is to be used.
7058	0	To be set to the standard setting value.
7066	mm / inch 10000/3937	Reference speed (mm/min / inch/min) for a function that changes the time constant for bell-shaped acc./dec. before interpolation

(4) AI nano contour control

- **Parameters that need tuning based on the machine type**

Parameter No.	Set value			Description
	Standard setting	Speed priority I	Speed priority II	
1432	—	—	—	Maximum cutting feedrate (mm/min) for individual axes
1620	—	—	—	Time constant (msec) for linear-shaped acc./dec. in rapid-traverse for individual axes
1621	—	—	—	Time constant T2 (msec) for bell-shaped acc./dec. in rapid-traverse for individual axes
1730	3060	5150	7275	Feedrate upper limit (mm/min) for arc radius R
1731	5000	5000	5000	Arc radius R (1 μm) for arc radius-based feedrate upper limit
1732	100	100	100	Arc radius-based feedrate clamp lower speed limit (mm/min)
1768	24	16	16	Time constant (msec) for acc./dec. after cutting feed interpolation
1770	10000	10000	10000	Maximum cutting feedrate (mm/min) during acc./dec. before interpolation
1771	240	80	40	Time (msec) allowed before a maximum cutting feedrate during acc./dec. before interpolation is reached
1772	64	48	32	Time constant of bell-shaped acc./dec. before interpolation (for constant-time part) (msec)
1783	400	500	1000	Allowable speed difference (mm/min) in acceleration-dependent on speed difference at corners
1784	—	—	—	Speed (mm/min) at occurrence of overtravel alarm To be specified according to the overrun distance at overtravel
1785	320	112	56	Parameter (msec) for determining an allowable acceleration in determining acceleration-dependent speed. The parameter is to be set with the time allowed before a maximum cutting feedrate (parameter No. 1432) is reached. A maximum cutting feedrate of 10000 mm/min is used as the standard setting value.

- **Parameters that do not usually need to be tuned that often and can be left at fixed values**

Parameter number	Standard setting	Description
1602#6,#3	#6,#3	
	1,0	Acc./dec. after interpolation is of a linear type (if bell-shaped acc./dec. before interpolation is used)
	1,1	Acc./dec. after interpolation is of a bell-shaped type (if linear-shaped acc./dec. before interpolation is used)
1603#7	1	Acc./dec. before interpolation is of bell-shaped type. (0: Linear-shaped acc./dec. before interpolation)
1802#7	0/1	To be set to 1 if the CMR setting is 2 or greater (parameter No. 1820 setting is 4 or greater).
7052#0	0/1	To be set to 1 for the PMC and Cs axes.
7053#0	0	AI nano contour control is enabled. (1: AI contour control is enabled.)
7055#3	1/0	To be set to 1 if a function that changes the time constant for bell-shaped acc./dec. before interpolation is to be used.
7058	0	To be set to the standard setting value.
7066	mm / inch 10000/3937	Reference speed (mm/min / inch/min) for a function that changes the time constant for bell-shaped acc./dec. before interpolation

(5) High-precision contour control

- **Parameters that need tuning based on the machine type**

Parameter No.	Set value			Description
	Standard setting	Speed priority I	Speed priority II	
1432	—	—	—	Maximum cutting feedrate (mm/min) for individual axes
1620	—	—	—	Time constant (msec) for linear-shaped acc./dec. in rapid-traverse for individual axes
1621	—	—	—	Time constant T2 (msec) for bell-shaped acc./dec. in rapid-traverse for individual axes
1768	24	16	16	Time constant (msec) for acc./dec. after cutting feed interpolation
8400	10000	10000	10000	Maximum cutting feedrate (mm/min) during acc./dec. before interpolation
8401	240	80	40	Time (msec) allowed before a maximum cutting feedrate during acc./dec. before interpolation is reached
8410	400	500	1000	Allowable speed difference (mm/min) in acceleration-dependent on speed difference at corners
8416	64	48	32	Time constant of bell-shaped acc./dec. before interpolation (for constant-time part) (msec)
8470	320	112	56	Parameter (msec) for determining an allowable acceleration in determining acceleration-dependent speed. The parameter is to be set with the time allowed before a maximum cutting feedrate (parameter No. 1432) is reached. A maximum cutting feedrate of 10000 mm/min is used as the standard setting value.

- **Parameters that do not usually need to be tuned that often and can be left at fixed values**

Parameter number	Standard setting	Description
1602#6,#3	#6,#3	
	1,0	Acc./dec. after interpolation is of a linear type (if bell-shaped acc./dec. before interpolation is used)
	1,1	Acc./dec. after interpolation is of a bell-shaped type (if linear-shaped acc./dec. before interpolation is used)
1802#7	0/1	To be set to 1 if the CMR setting is 2 or greater (parameter No. 1820 setting is 4 or greater).
7510	—	Largest of controlled-axis numbers for which high precision contour control is performed
8402#7,#1, 1603#3	1,1, 1	Acc./dec. before interpolation is of bell-shaped type. (with the acceleration change fixed)
8402#4	0	To be set to the standard setting value.
8402#5	1	To be set to the standard setting value.
8403#7,#1, 8404#1,#0	1,1 1,1	No alarm is raised on an M, S, T, B, or rapid traverse command. Rapid traverse is processed on the RISC side.
8420	180	Number of blocks to be looked ahead (0: 120 blocks)
8451#0	1	To be set to the standard setting value.
8451#4	0/1	Set this parameter to 1 if cutting load-dependent override is to be used. (This parameter is used if the mechanical rigidity of the Z-axis is low.)
8456	80	Region 2 override (%) for the cutting load-based deceleration function (doesn't need to be specified if bit 4 of parameter No. 8451 = 0)
8457	70	Region 3 override (%) for the cutting load-based deceleration function (doesn't need to be specified if bit 4 of parameter No. 8451 = 0)
8458	60	Region 4 override (%) for the cutting load-based deceleration function (doesn't need to be specified if bit 4 of parameter No. 8451 = 0)
8459#0	0	To be set to the standard setting value.
8459#1	1	To be set to the standard setting value.
8475#2	1	Automatic deceleration at corners is enabled.
8475#3	1	Acceleration-dependent determination of speed during arc interpolation is enabled.
8480#4	0/1	To be set to 1 if the software series on the RISC side is B435. Otherwise, to be set to 0.
8480#5	0	To be set to the standard setting value.
8480#6	0	To be set to the standard setting value.
8485#0	1/0	Scaling/coordinate system rotation in high precision contour control mode is enabled/disabled. (An option is necessary.)
8485#1	1/0	A canned cycle in high precision contour control mode is enabled/disabled. (An option is necessary.)
8485#2	1/0	A helical interpolation in high precision contour control mode is enabled/disabled. (An option is necessary.)
8485#4	1/0	An involute interpolation in high precision contour control mode is enabled/disabled. (An option is necessary.)
8485#5	1/0	A smooth interpolation in high precision contour control mode is enabled/disabled. (An option is necessary.)

(6) AI high precision contour control, AI nano high precision contour control

- **Parameters that need tuning based on the machine type**

Parameter No.	Set value			Description
	Standard setting	Speed priority I	Speed priority II	
1432	—	—	—	Maximum cutting feedrate (mm/min) for individual axes
1620	—	—	—	Time constant (msec) for linear-shaped acc./dec. in rapid-traverse for individual axes
1621	—	—	—	Time constant T2 (msec) for bell-shaped acc./dec. in rapid-traverse for individual axes
1768	24	16	16	Time constant (msec) for acc./dec. after cutting feed interpolation
8400	10000	10000	10000	Maximum cutting feedrate (mm/min) during acc./dec. before interpolation
19510	240	80	40	Time (msec) allowed before a maximum cutting feedrate is reached for an individual axis during acc./dec. before interpolation. If this parameter is 0, the setting in parameter No. 8401 is used.
8410	400	500	1000	Allowable speed difference (mm/min) in acceleration-dependent on speed difference at corners
8416	64	48	32	Time constant of bell-shaped acc./dec. before interpolation (for constant-time part) (msec)
8470	320	112	56	Parameter (msec) for determining an allowable acceleration in determining acceleration-dependent speed. The parameter is to be set with the time allowed before a maximum cutting feedrate (parameter No. 1432) is reached. A maximum cutting feedrate of 10000 mm/min is used as the standard setting value.

- **Parameters that do not usually need to be tuned that often and can be left at fixed values**

Parameter number	Standard setting	Description
1602#6,#3	#6,#3	
	1,0	Acc./dec. after interpolation is of a linear type (if bell-shaped acc./dec. before interpolation is used)
	1,1	Acc./dec. after interpolation is of a bell-shaped type (if linear-shaped acc./dec. before interpolation is used)
1802#7	0/1	To be set to 1 if the CMR setting is 2 or greater (parameter No. 1820 setting is 4 or greater).
7510	—	Largest of controlled-axis numbers for which high precision contour control is performed
8402#7,#1,	1,1,	Acc./dec. before interpolation is of bell-shaped type. (with the acceleration change fixed)
8403#1	1	No alarm is raised on an M, S, T, B, or rapid traverse command.
8451#4	0/1	Set this parameter to 1 if cutting load-dependent override is to be used. (This parameter is used if the mechanical rigidity of the Z-axis is low.)
19516	80	Region 1 override (%) for the cutting load-based deceleration function (doesn't need to be specified if bit 4 of parameter No. 8451 = 0)
8456	80	Region 2 override (%) for the cutting load-based deceleration function (doesn't need to be specified if bit 4 of parameter No. 8451 = 0)
8457	70	Region 3 override (%) for the cutting load-based deceleration function (doesn't need to be specified if bit 4 of parameter No. 8451 = 0)

Parameter number	Standard setting	Description
8458	60	Region 4 override (%) for the cutting load-based deceleration function (doesn't need to be specified if bit 4 of parameter No. 8451 = 0)
8480#4	0	To be set to the standard setting value.
8480#5	0	To be set to the standard setting value.
8480#6	0	To be set to the standard setting value.
19501#6	1/0	To be set to 1 if a function that changes the time constant for bell-shaped acc./dec. before interpolation is to be used.
19504#0	1	Bell-shaped rapid traverse acc./dec. is used.
19520	mm / inch 10000/3937	Reference speed (mm/min / inch/min) for a function of changing the time constant for bell-shaped acc./dec. before interpolation
19600#0	0/1	Scaling is performed on the CNC side or, in 5-axis control mode, on the RISC side. (An option is necessary.)
19600#1	0/1	Programmable mirror image is performed on the CNC side or, in 5-axis control mode, on the RISC side. (An option is necessary.)
19600#2	0/1	Rotary dynamic fixture offset is performed on the CNC side or, in 5-axis control mode, on the RISC side. (An option is necessary.)
19600#3	0/1	Coordinate rotation is performed on the CNC side or, in 5-axis control mode, on the RISC side. (An option is necessary.)
19600#4	0/1	Three-dimensional coordinate conversion is performed on the CNC side or, in 5-axis control mode, on the RISC side. (An option is necessary.)
19600#5	0/1	Cutter compensation C is performed on the CNC side or, in 5-axis control mode, on the RISC side. (An option is necessary.)

C.1.5 Series 15*i*-MB

[Functions related to high-speed and high precision operations]

High-speed high precision functions		Look-ahead acc./dec. before interpolation	Fine HPCC
Series 15*i*-MB		○	○
Acc./dec. before interpolation			
	Type	Linear / Bell-shaped	Linear / Bell-shaped / Smooth bell-shaped
	Time constant setting for individual axes	○	○
Velocity control			
	Automatic corner deceleration	○	○
	Arc radius-based velocity control	○	○
	Acceleration-based velocity control	×	○
	Cutting load-based velocity control	×	○
	Jerk control	×	○
	Optimum torque acc./dec.	○	○
Other functions			
	Nano interpolation	○	○
	5-axis machining functions	○	○
	Smooth interpolation	○	○
	NURBS	○	○
	Nano smoothing	○	○
Additional hardware		None	None

[Parameters]

Use the standard setting values included in the parameter tables as reference data for initialization. If a parameter needs tuning based on the machine type, determine a final setting for the parameter according to the characteristic of the machine and how it will be used.

- Standard settings (precision priority)
  When there is vibration or significant impact, or when machining is to be performed more precisely, make settings based on the standard settings.
- Cutting time-priority setting
  To reduce machining time, make settings for speed priority I then for speed priority II in stages. The settings for speed priority II can reduce much more machining time than the settings for speed priority I.

• Parameters that need tuning based on the machine type

Parameter number	Set value			Description
	Standard setting	Speed priority I	Speed priority II	
1478	400.0	500.0	1000.0	Allowable speed difference (mm/min) in acceleration-dependent on speed difference at corners
1635	24	16	16	Time constant (msec) for acc./dec. after interpolation
1656	64	48	32	Time constant (msec) for bell-shaped acc./dec. before interpolation (portion with the time fixed)
1660	700.0	2000.0	4000.0	Acceleration of linear-/bell-shaped acc./dec. before interpolation (portion with the acceleration fixed) (Acceleration is specified in mm/sec^2 for individual axes.)
1663	525.0	1500.0	3000.0	Permissible acceleration in deceleration by acceleration (HPCC mode) (Acceleration is specified in mm/sec^2 for individual axes.)
1665	525.0	1500.0	3000.0	Permissible acceleration in deceleration by acceleration in circular interpolation (non-HPCC mode) (Acceleration is specified in mm/sec^2 for individual axes.)

• Parameters that do not usually need to be tuned that often and can be left at fixed values

Parameter number	Standard setting	Description
1483	100.0	Lower speed limit to acceleration-dependent deceleration (HPCC mode) (mm/min)
1491	100.0	Lower speed limit to deceleration acceleration-dependent (non-HPCC mode) (mm/min)
1517#6	0	Speed difference- or acceleration-dependent deceleration type 0: Compatible with the 15B (by making the most of allowable speed difference and acceleration for each axis). 1: Fixed speed regardless of the direction of movement as long as the same contour is involved.
1600#4	0	0: Linear- or bell-shaped acc./dec. after interpolation is enabled (Note 1) 1: Exponential acc./dec. after interpolation is enabled
1603#6	1/0	To be set to 1 if a function that changes the time constant for bell-shaped acc./dec. before interpolation is to be used.
1473	mm / inch 10000.0/3937.0	Reference speed (mm/min / inch/min) for a function that changes the time constant for bell-shaped acc./dec. before interpolation
2401#6	0	Setting this parameter to 1 enables look-ahead acc./dec. before interpolation and multibuffer when the power is switched on and in the cleared state. Fine HPCC is also enabled if available. If it is reset to 0, it is turned on with the G05.1Q1 command.
7565#7	0	Setting this parameter to 1 causes a specified speed to be ignored and assumes that the speed set in parameter No. 7567 is specified

Parameter number	Standard setting	Description
7567	0	Specified clamp value in the fine HPCC mode (mm/min (input unit)) If the parameter setting is 0, no clamping takes place except for the maximum cutting speed specified in parameter No. 1422.
7565#4	0/1	Set this parameter to 1 if the cutting load-based deceleration function is to be enabled. (This parameter is used if the mechanical rigidity of the Z-axis is low.)
7697#1	0/1	When using the slant type for override by cutting load, set 1. (Note 2)
7698	80	Override of area 1 in deceleration by cutting load (This setting is unnecessary if bit 4 of parameter No. 7565 is set to 0 or bit 1 of parameter No. 7697 is set to 0.) (%) (Note 2)
7591	80	Region 2 override (%) for the cutting load-based deceleration function (doesn't need to be specified if bit 4 of parameter No. 7565 = 0)
7592	70	Region 3 override (%) for the cutting load-based deceleration function (doesn't need to be specified if bit 4 of parameter No. 7565 = 0)
7593	60	Region 4 override (%) for the cutting load-based deceleration function (doesn't need to be specified if bit 4 of parameter No. 7565 = 0)
8495#0	0/1	When using smooth velocity control as velocity control by acceleration, set 1. (Note 2)

NOTE

1 To perform bell-shaped acc./dec. after cutting feed interpolation, the option for bell-shaped acc./dec. after cutting feed interpolation is required.

2 Only fine HPCC can be used.

C.2 SERVO PARAMETERS RELATED TO HIGH-SPEED AND HIGH PRECISION OPERATIONS

Described below are the servo parameters that need to be set and tuned for high-speed and high precision operations.
To specify parameters, follow this procedure.

1. First specify one of items (1) to (3) about fixed parameters that are dependent on the CNC model and mode to be used.
2. Specify item (4) about parameters to be tuned in common to all CNC models and modes. (See Chapters 3 and 4 of this parameter manual for explanations about how to tune the parameters and detailed descriptions of the related functions.)
3. If you want to use SERVO HRV control, specify item (5).

(1) When HRV2 and fine ACC./Dec. is used (Series 16*i*/18*i*/21*i*/20*i*/0*i*-B/C)

- Using advanced preview control in the Series 16*i*/18*i*/21*i*
- Using AI advanced preview control in the Series 21*i*/20*i*/0*i*-B/C (servo software Series 90B0)

For the above cases, make the following settings for using HRV2 control and fine acc./dec.

- **Parameters that do not usually need to be tuned that often and can be left at fixed values**

Parameter number FS16*i*, etc.	Standard setting	Description
2003#3	1	Enables PI control function
2003#5	1	Enables backlash acceleration
2004	0X000011 (Note)	HRV2 current control
2005#1	1	Enables feedforward
2006#4	1	Uses the latest feedback data for velocity feedback.
2007#6	1	Enables FAD (Fine acc./dec.)
2015#6	1	Enables two-stage backlash acceleration
2016#3	1	Enables variable proportional gain in the stop state
2017#7	1	Enables the velocity loop high cycle management function.
2018#2	1	Changes the second override format for stage-2 backlash acceleration.
2040	Standard parameter for HRV2	Current integral gain
2041	Standard parameter for HRV2	Current proportional gain
2092	10000	Advanced preview (position) feed-forward coefficient
2119	2 (detection unit 1 μm) 20 (detection unit 0.1 μm)	For variable proportional gain function in the stop state: judgment level for stop state (specified in detection units)
2146	50	Stage-2 backlash acceleration end timer
2202#1	1	Cutting/rapid traverse velocity loop gain variable
2209#2	1	Enables FAD of linear type.

NOTE
Keep the bit indicated with X (bit 6) at the standard setting.

- **Parameters whose settings must be changed according to the size of the machine but don't need to be tuned once set up**

Parameter number	Standard setting			Description
	Standard setting	Speed priority I	Speed priority II	
2109	24	16	16	FAD time constant

(2) When HRV2 is used, but fine acc./dec. is not (Series 30*i*/31*i*/32*i*/15*i*/16*i*/18*i*/21*i*/0*i*)

When using AI contour control I, AI contour control II, look-ahead acc./dec. before interpolation, Fine HPCC, AI nano high precision contour control, AI high precision contour control, AI nano contour control, AI contour control, or high precision contour control, make the following settings.

- **Parameters that do not usually need to be tuned that often and can be left at fixed values**

Parameter number FS30*i*,16*i*, etc. FS15*i*	Standard setting	Description
2003#3 1808#3	1	Enables PI control function
2003#5 1808#5	1	Enables backlash acceleration
2004 1809	0X000011 (Note)	HRV2 current control
2005#1 1883#1	1	Enables feedforward
2006#4 1884#4	1	Uses the latest feedback data for velocity feedback.
2015#6 1957#6	1	Enables two-stage backlash acceleration
2016#3 1958#3	1	Enables variable proportional gain in the stop state
2017#7 1959#7	1	Enables the velocity loop high cycle management function.
2018#2 1960#2	1	Changes the second override format for stage-2 backlash acceleration.
2040 1852	Standard parameter for HRV2	Current integral gain
2041 1853	Standard parameter for HRV2	Current proportional gain
2092 1985	10000	Advanced preview (position) feed-forward coefficient
2119 1730	2 (detection unit 1 μm) 20 (detection unit 0.1 μm)	For variable proportional gain function in the stop state: judgment level for stop state (specified in detection units)
2146 1769	50	Stage-2 backlash acceleration end timer
2202#1 1742#1	1	Cutting/rapid traverse velocity loop gain variable

NOTE
Keep the bit indicated with X (bit 6) at the standard setting.

(3) When using HRV1 and FAD (Series 21*i*/0*i*-B/C)

To use AI advanced preview control in the Series 21*i*/0*i*-B/C (servo software Series 9096), make the following settings for using HRV1 control and fine acc./dec.

- **Parameters that do not usually need to be tuned that often and can be left at fixed values**

Parameter number FS21*i*	Standard setting	Description
2003#3	1	Enables PI control function
2003#5	1	Enables backlash acceleration
2004	Standard parameter for HRV1	HRV1 current control
2005#1	1	Enables feedforward
2006#4	1	Uses the latest feedback data for velocity feedback.
2007#6	1	Enables FAD (Fine acc./dec.)
2015#6	1	Enables two-stage backlash acceleration
2016#3	1	Enables variable proportional gain in the stop state
2017#7	1	Enables the velocity loop high cycle management function.
2018#2	1	Changes the second override format for stage-2 backlash acceleration.
2040	Standard parameter for HRV1	Current integral gain
2041	Standard parameter for HRV1	Current proportional gain
2092	10000	Advanced preview (position) feed-forward coefficient
2119	2 (detection unit 1 μm) 20 (detection unit 0.1 μm)	For variable proportional gain function in the stop state: judgment level for stop state (specified in detection units)
2146	50	Stage-2 backlash acceleration end timer
2202#1	1	Cutting/rapid traverse velocity loop gain variable
2209#2	1	Enables FAD of linear type.

- **Parameters whose settings must be changed according to the size of the machine but don't need to be tuned once set up**

Parameter number	Standard setting			Description
	Standard setting	Speed priority I	Speed priority II	
2109	24	16	16	FAD time constant

(4) Parameters common to all CNC models (requiring tuning)

- **Parameters requiring tuning to find optimum values**

Parameter number FS30*i*,16*i*, etc. FS15*i*	Setting at tuning start	Description	Items to be referenced in tuning
2021 1875	300	Load inertia ratio (velocity gain) * When the cutting/rapid velocity gain switching function is used, this parameter is applied to rapid traverse.	While checking vibration at stop, abnormal sound during low-speed movement, vibration during high-speed rotation, and so on, find the vibration limit, and set about 70% of the limit. → See Subsection 4.3.3 (3).
2107 1700	150	Cutting load inertia ratio override (in %) * When the cutting/rapid velocity gain switching function is used, the gain magnified by this parameter setting is applied to cutting.	Same as above. → See Subsection 4.3.3 (3) and Section 5.2.
1825	Standard: 3000 Speed priority I: 5000 Speed priority II: 10000	Position gain	After determining the velocity loop gain, find the upper limit of the range in which hunting (low frequency vibration) does not occur. → See Subsection 4.3.3 (4).
2069 1962	Standard: 50 When nano interpolation is used, see Note 2. 200	Velocity feedforward coefficient	Make adjustments while observing the shape of rounded corners. → See Subsection 4.3.4 (3).
2047 1859	Standard parameter	Observer parameter	Make adjustments while observing the estimated disturbance value on the SERVO GUIDE. → See 5.9.1.
2087 1980	0	Torque offset	Make adjustments while measuring positive and negative torque commands at a constant low feedrate.
2048 1860	30	Stage-1 acceleration amount for two-stage backlash acceleration	Make adjustments while observing the quadrant protrusion size. → See Subsection 5.5.5.
2039 1724	100	Stage-2 acceleration amount	Same as above.
2082 1975	10	Stage-2 start distance (detection unit)	Same as above.
2089 1982	50	Stage-2 end distance (set with a ratio to the start distance specified in increments of 10%)	Same as above.
2114 1725	10	Stage-2 override	Same as above.

NOTE
1 There is the following relationship between the load inertia ratio and velocity loop gain (%).
Velocity loop gain (%) = (1 + load inertia ratio/256) × 100
2 The phrase "using nano interpolation" means using AI contour control I, AI contour control II, Fine HPCC, look-ahead acc./dec. before interpolation, AI nano high precision contour control, or AI nano contour control.

(5) Parameters common to all CNC models (parameters needed to use HRV3)

- **Parameters that do not usually need to be tuned that often and can be left at fixed values**

Parameter number FS30*i*,16*i*, etc. FS15*i*	Standard setting	Description
2004 1809	0X000011 (Note)	HRV2 current control (in a mode other than high-speed HRV control)
2013#0 1707#0	1	G05. In the G05.4Q1 command, high-speed HRV control (HRV3 current control)
2202#1 1742#1	1	Cutting/rapid velocity loop gain switching function
2040 1852	Standard parameter for HRV2	Current integral gain
2041 1853	Standard parameter for HRV2	Current proportional gain
2334 2747	150	Current loop gain magnification for high-speed HRV current control

NOTE
Keep the bit indicated with X (bit 6) at the standard setting.

- **Parameters that need to be tuned**

Parameter No. FS30*i*,16*i*, etc. FS15*i*	Set value	Description	Items to be referenced in tuning
2107 1700	150	Cutting load inertia ratio override (in %)	While checking vibration at stop, abnormal sound during low-speed movement, vibration during high-speed rotation, and so on, find the vibration limit, and set about 70% of the limit.
2335 2748	200	Cutting load inertia ratio override (in %) when high-speed HRV current control is in use	Same as above.

(6) Parameters for Series 30*i*/31*i*-A/B (parameters needed to use HRV4)

- **Parameters that do not usually need to be tuned that often and can be left at fixed values**

Parameter number FS30*i*	Standard setting	Description
2004	0X000011 (Note 1)	HRV3 current control (in a mode other than high-speed HRV control)
2014#0	1	In the G05.4Q1 command, high-speed HRV control (HRV4 current control)
2300#0	1	Extended HRV function
2202#1	1	Cutting/rapid velocity loop gain switching function
2040	Standard parameter for HRV2	Current integral gain
2041	Standard parameter for HRV2	Current proportional gain
2334	150	Current loop gain magnification for high-speed HRV current control

NOTE
1 Keep the bit indicated with X (bit 6) at the standard setting.

- **Parameters that need to be tuned**

Parameter No. FS30*i*	Set value	Description	Items to be referenced in tuning
2107	150	Cutting load inertia ratio override (in %)	While checking vibration at stop, abnormal sound during low-speed movement, vibration during high-speed rotation, and so on, find the vibration limit, and set about 70% of the limit.
2335	200	Cutting load inertia ratio override (in %) when high-speed HRV current control is in use	Same as above.

D VELOCITY LIMIT VALUES BY SOFTWARE

(1) Overview

The feed axis velocity is subject to the feedrate limits that depend on the internal processing of the system software and servo control software. These velocity limit values imposed by the software are explained below.

NOTE

The following permissible speeds do not include limits imposed by hardware such as motors and detectors.

- For the maximum permissible speed of a motor, refer to the specifications of the motor.
- For the maximum permissible speed of a detector, refer to the specifications of the detector.

(2) Velocity feedback (rotation speed) limit

[Limit values related to rotary motors]

Detector type	Resolution	Allowable rotation speed (30*i*A, 0*i*D)	Allowable rotation speed (30*i*B)
FANUC α*i* Pulsecoder	2^{20}, 2^{24}pulse/rev	7500min^{-1}	7500min^{-1}
Heidenhain RCN223F, 723F	2^{23}pulse/rev	937min^{-1} → 7500 min^{-1} (*1)	7500min^{-1}
Heidenhain RCN727F	2^{27}pulse/rev	937min^{-1} → 7500 min^{-1} (*1)	7500min^{-1}

[Limit values related to linear motors]

Detector type	Resolution	Allowable speed (30*i*A, 0*i*D)	Allowable speed (30*i*B)
Heidenhain LS486 (incremental) + linear motor position detection circuit	20/512 μm/pulse	609 m/min	609 m/min
Magnescale BS75A (incremental) + linear motor position detection circuit	0.1379/512 μm/pulse	4.2 m/min → 33 m/min (*1)	33 m/min
Heidenhain LC193F (absolute)	0.01 μm/pulse	157.2 m/min → 609 m/min (*1)	609 m/min
Heidenhain LC493F (absolute)	0.05 μm/pulse	609 m/min	609 m/min

(*1) For the following servo control software, velocity limits can be expanded by setting bit 6 of parameter No. 2271 to 1.

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*-A	90E0	P(16) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	P(16) and subsequent editions	HRV4
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	

(3) Position feedback (axis feedrate) limits

The following axis feedrate limits may be applied according to each of the functions.

[When ordinary position control is exercised]

Function used		Allowable axis feedrate			
Hi-speed and high precision function	**Feedforward**	**Detection unit of 1 μm**	**Detection unit of 0.1 μm**	**Detection unit of 0.01 μm**	**Detection unit of 0.001 μm**
None	Not performed / performed (advanced preview type)	IS-B:999 m/min IS-C:100 m/min → 999 m/min(*1)	IS-B:999 m/min IS-C:100 m/min → 999 m/min(*1)	IS-D:10 m/min → 100 m/min(*1)	IS-E:1 m/min → 100 m/min(*1)
AI contour control I AI contour control II	Not performed / performed (advanced preview type)				
Electric gear box	Performed (advanced preview type)	IS-B:240 m/min IS-C:100 m/min → 999 m/min(*1)	24 m/min → 999 m/min(*1)	2.4 m/min → 100 m/min(*1)	0.24 m/min → 100 m/min(*1)

When the spindle control function of a servo motor is used

Function used		Allowable feedrate			
Extension of permissible speed	**Upper speed limit increase by a factor of 10**	**Detection unit of 1/1000 deg**	**Detection unit of 1/10000 deg**	**Detection unit of 1/100000 deg**	**Detection unit of 1/1000000 deg**
Not performed (No.1013#7=0)	Not performed (No.1408#3=0)	IS-B:2775min^{-1} IS-C: 277min^{-1}	IS-B:2775min^{-1} IS-C: 277min^{-1}	IS-D:27min^{-1}	IS-E:2min^{-1}
	Performed (No.1408#3=1)	IS-B:27750min^{-1} IS-C: 2777min^{-1}	IS-B:27750min^{-1} IS-C: 2777min^{-1}	IS-D:277min^{-1}	IS-E:27min^{-1}
Performed (No.1013#7=1)	Not performed (No.1408#3=0)	IS-B:2775min^{-1} IS-C: 2775min^{-1}	IS-B:2775min^{-1} IS-C: 2775min^{-1}	IS-D:277min^{-1}	IS-E:277min^{-1}
	Performed (No.1408#3=1)	IS-B:27750min^{-1} IS-C: 27750min^{-1}	IS-B:27750min^{-1} IS-C: 27750min^{-1}	IS-D:2777min^{-1}	IS-E:349min^{-1}

* In the table, the values enclosed in a box are the limits due to the internal processing of the servo control software. For the limits due to the internal processing of the servo control software, if CMR is increased to decrease the detection unit, the permissible feedrate decreases in proportion to the detection unit. (Reducing the detection unit from 0.1 μm to 0.05 μm causes the permissible feedrate to be halved.)

* If a semi-closed system with a high resolution detector is used, using nano interpolation enables these functions to be used for position control at the highest limit of the detector resolution even if the detection unit is not subdivided.

(*1) With the servo control software and system software indicated below, the allowable feedrate value applicable when an increment system is selected from IS-C, IS-D, and IS-E is extended. A feedrate of up to 100 m/min can be specified with the IS-C, IS-D, or IS-E increment system by using matching servo control software and system software and setting the following parameters:

・ Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP 90JP	03.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	J(10) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-D	90C5 90C8	A(01) and subsequent editions A(01) and subsequent editions	
	90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	
Series 0*i*-F	90M0 90L0	02.0 and subsequent editions 01.0 and subsequent editions	
	90M8 90L8	02.0 and subsequent editions 01.0 and subsequent editions	

・ Series and editions of applicable system software

CNC	System software	
	Series	Edition
Series 30*i*-A	G00C, G01C, G02C	27 and subsequent editions
	G004, G014, G024	01 and subsequent editions
Series 31*i*-A5	G12C, G13C	27 and subsequent editions
	G124, G134	01 and subsequent editions
Series 31*i*-A	G103, G113	01 and subsequent editions
	G104, G114	01 and subsequent editions
Series 32*i*-A	G203	01 and subsequent editions (IS-E is not supported.)
	G204	01 and subsequent editions (IS-E is not supported.)
Series 0*i*-MD	D4F1	01 and subsequent editions (IS-D and IS-E are not supported.)
Series 0*i*-TD	D6F1	01 and subsequent editions (IS-D and IS-E are not supported.)
Series 0*i* Mate-MD	D5F1	01 and subsequent editions (IS-D and IS-E are not supported.)
Series 0*i* Mate-TD	D7F1	01 and subsequent editions (IS-D and IS-E are not supported.)

For the Series 30*i*/31*i*/32*i*/35*i*-B and Power Motion i-A, all series and editions support this function. (However, for the Series 32*i*-B, IS-E is not supported, and for the Series 35*i*-B and Power Motion *i*-A, IS-D and IS-E are not supported.)

・ Setting parameters
To extend the feedrate with the IS-C, IS-D, or IS-E increment systems, both of the parameters below must be set to 1. (The IS-C, IS-D, and IS-E increment systems are optional functions.)

	#7	#6	#5	#4	#3	#2	#1	#0
1013	IESP							

IESP(#7) When the IS-C, IS-D, or IS-E increment system is used, the function that can set a value range wider than the conventionally allowed one for speed and acceleration parameters is:
0: Not used.
1: Used.

NOTE
1 When this parameter is set, the number of fractional digits displayed on the parameter input screen is modified. When IS-C or IS-D is used, the number of fractional digits is reduced by 1 from the conventional number of fractional digits. When IS-E is used, the number of fractional digits is reduced by 2 from the conventional number of fractional digits.
2 When this parameter is set, the power to the CNC must be turned off before operation is continued.

	#7	#6	#5	#4	#3	#2	#1	#0
2282					ISE64			

ISE64(#3) The velocity limit when the feed forward (bit 1 of parameter No. 2005 = 1) is enabled is:
0: Applied in the same way as always.
1: Extended.

E INTRODUCTION TO SERVO TUNING

(1) What is feedback control?

The purpose of a servo is to "trace a command with no error". Thus, servo tuning refers to tuning for the purpose of tracing a command with no error (operating the controlled object at will).

- Sequential changes of acting quantity are required according to the changes of detected quantity to control the plant at will.
- This is also true of the stabilization of the plant against disturbance caused by unexpected changes of detected quantity such as the resistance during machining.

It is not possible to realize such characteristics just with an oversimplified relationship like "Acting quantity = Deviation". It is not possible to trace commands with no error unless there is a function or system to make the deviation zero. Implementation of a "control" requires a controller. Fig. E (a) shows a control system containing a controller. This is a basic form of feedback control.

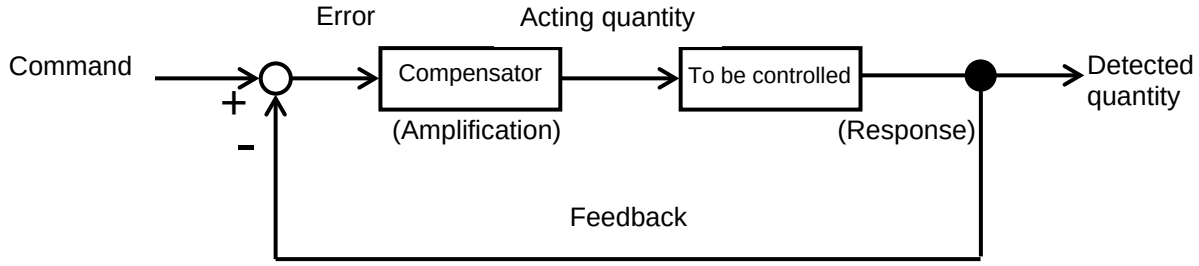


Fig. E (a) Feedback control system with controller

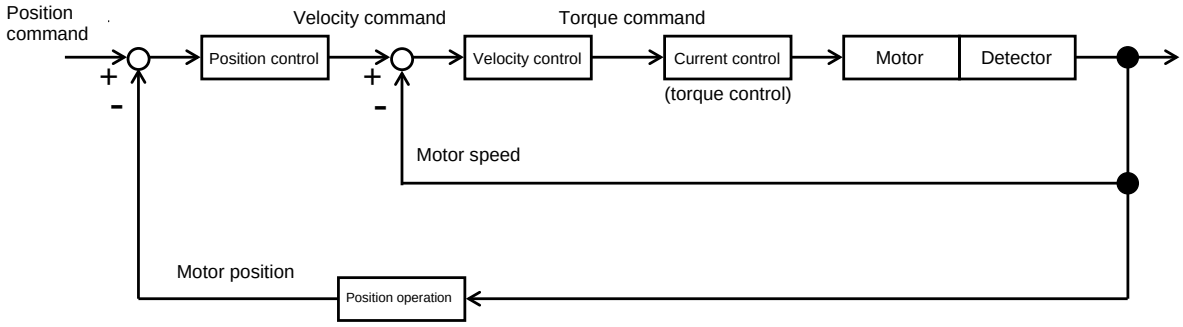


Fig. E (b) General motor control

In servo control of a motor, the position, velocity, and torque are controlled by linking them together. Fig. E (b) shows the configuration of general motor control. Servo control is realized with this triple loop structure, which has a flow of "sequential velocity changes necessary for arbitrary movement operation (position control-based velocity command creation) → sequential torque changes necessary for operation at that velocity (velocity control-based torque command creation) → sequential current changes necessary for operation at that torque (current control)".

NOTE

For electrical motors, the relationship is established as (Torque) = (Motor current) × (Torque constant). With the equation (Current command) = (Torque command) / (Torque constant), torque can be controlled as current. Therefore, we can consider "current control" to be almost synonymous with "torque control".

(2) CNC-servo system

Fig. E (c) shows a schematic diagram of the whole NC system while Fig. E (b) is a very simplified diagram. The CNC system performs acceleration/deceleration and command point creation. The servo control system performs motor driving based on the received commands.

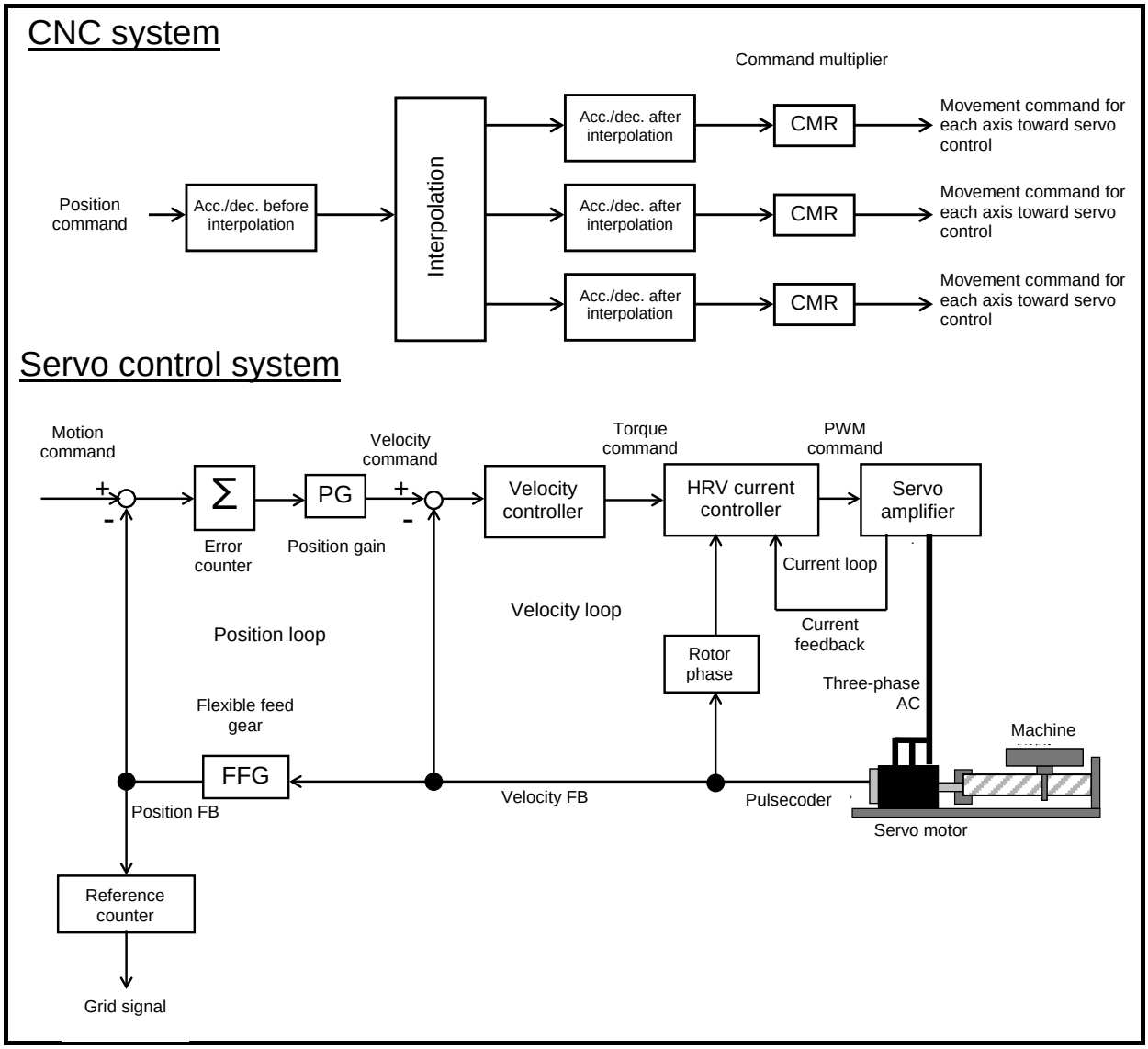


Fig. E (c) Schematic diagram of the whole numerical control system

(3) Position control

(3.1) Servo delay

We can consider position control to be "for accurate positioning by compensating for friction" from the viewpoint of machine tools. Position control realizes stable positioning operation against quickly varying position commands. Fig. E (d) shows a position control loop.

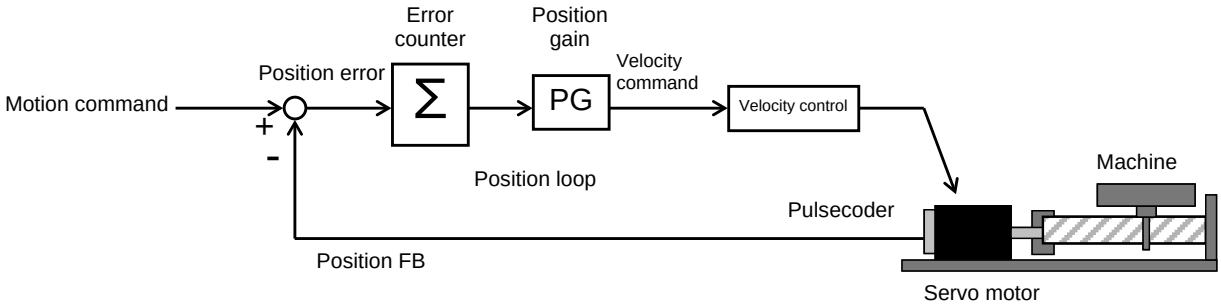


Fig. E (d) Position control loop (CMR and FFG omitted)

The position gain (gain for position control) is the time constant of the servo control system. We can think of the "Delay in servo" as indicating the position gain.

$$\text{Servo time constant [sec]} = \frac{1}{\text{Position gain [sec}^{-1}\text{]}}$$

Given that the position gain is 30 sec^{-1} (NC parameter No. 1825 = 3000), the servo time constant is 1/30 = 0.033 sec. For example, for positioning with a single-axis, the system has a delay of 33 msec.

A greater position gain leads to faster positioning. Note the following when tuning the position gain.

- If the position gain is too high, vibration and overshooting occur in the positioning operation.
- If the position gain is too low, low-frequency vibration and unstable operation occur.

(3.2) Position gain and position error

In position control, the following simple calculation is performed:

(Velocity command) = (Position gain) × (Error counter)

The sequential position error will not become zero because the error counter (the integration of position error) is multiplied by a constant to create a velocity command, which is used for velocity control. The servo would not operate if the sequential position error became zero. It is important to remember that "the servo runs because there is a position error".

On an axis running at a constant feedrate F [mm/sec], a steady position error can be calculated as follows.

$$\text{Position error [Detection unit pulse]} = \frac{F\ \text{[mm/sec]}}{PG\ \text{[sec}^{-1}\text{]}} \times \frac{1}{\text{Detection unit [mm/pulse]}}$$

Given that F = 3000 mm/min = 50 mm/sec, PG = 30 sec^{-1}, and detection unit 1 μm = 0.001 mm, then

$$\text{Position error [Detection unit pulse]} = \frac{50\ \text{[mm/sec]}}{30\ \text{[sec}^{-1}\text{]}} \times \frac{1}{0.001\ \text{[mm/pulse]}}$$

This error counter value can be confirmed on the "servo tuning screen" of the CNC, as well as with DGN300 on the diagnosis screen.

(3.3) Semi-closed and full-closed

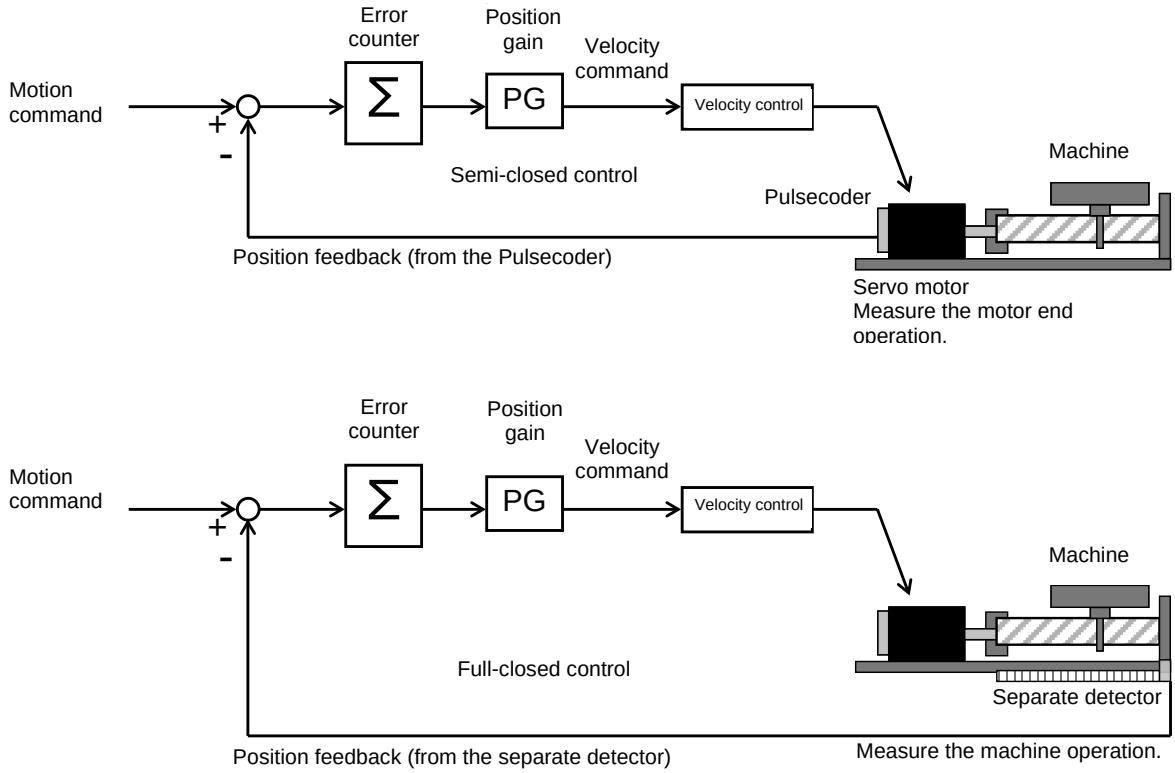


Fig. E (e) Semi-closed and full-closed

Position control systems are classified as in Fig. E (e) according to the method of detecting position to realize feedback control. Table E (a) summarizes the characteristics of these systems.

Table E (a) Differences between position control systems

	Semi-closed loop	Fully-closed loop
Definition	System for performing position control by using the information from a built-in detector (Pulsecoder) as position feedback and velocity feedback	System for performing position control by using the information from a built-in detector (Pulsecoder) as velocity feedback and the machine position information obtained from a separate detector (such as a linear scale) as position feedback
Effect	Can be manufactured at low cost because it does not require a scale.	Offers controllability independent of lost motion because it directly measures the machine position.
Remarks	Causes lost motion due to the transfer mechanism because it measures only the motor rotation angle.	May cause low-frequency vibration attributable to the machine rigidity between motor and scale.

(3.4) Least command increment and detection unit (CMR and FFG)

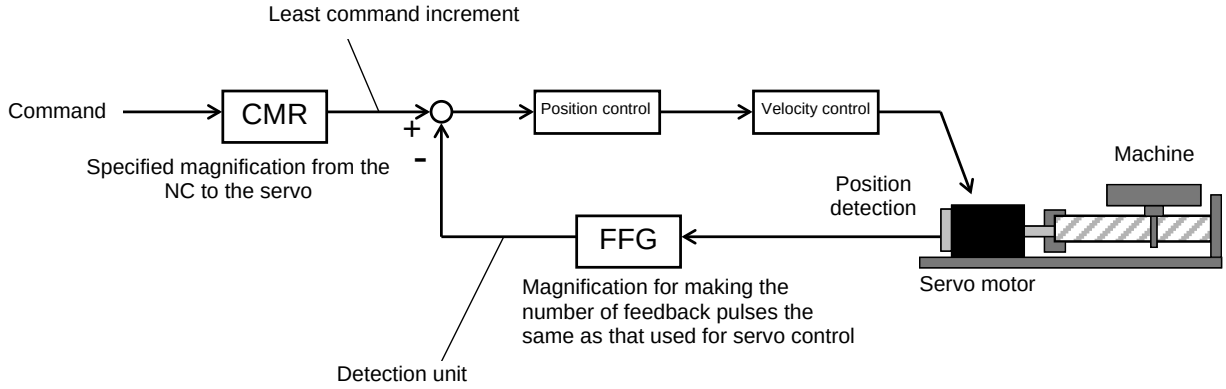


Fig. E (f) Least command increment and detection unit

CMR (command multiply ratio) is the magnification for the motion command from NC to servo. The relationship between the detection unit and the least command increment is as follows.

$$\text{CMR} = \frac{\text{Least command increment (NC side)}}{\text{Detection unit (servo side)}}$$

Given that the least command increment is 1 μm and the servo detection unit is 1 μm, then CMR must be 1 (as the parameter setting: No. 1820 = 2).

FFG (flexible feed gear) is a ratio that keeps the number of position feedback pulses equal to the number of command pulses when the machine moves in response to the command.

$$\text{FFG} = \frac{\text{Number of position feedback pulses necessary for control to move the machine by a given distance (detection unit)}}{\text{Number of pulses generated from the detector when the machine moves by a given distance}}$$

Example 1: A semi-closed linear axis driven by a ball screw with a reducer

Assume that the motor is connected with a ball screw lead of 12 mm/rev and a gear with a reduction ratio of 1/10 and that the detection unit is 1 μm. The machinery axis travels by 12 mm × 10 = 120 mm when the motor rotates once. Pulses of one motor rotation are always considered to be 1000000 pulses with a Pulsecoder.

$$\text{FFG} = \frac{12\text{mm/rev} \times \frac{1}{1/10} \times \frac{1}{0.001\text{mm/pulse}}}{1000000\text{pulse/rev}} = \frac{120000}{1000000} = \frac{12}{100}$$

Example 2: A full-closed loop with a linear scale

Assume that an encoder has a scale resolution of 0.5 μm and the detection unit is 1 μm. With a movement of 1 μm, 1 (μm) / 0.5 (μm/pulse) = 2 pulses are fed back from the encoder. The number of pulses in control is 1. Thus,

$$\text{FFG} = \frac{1}{1/0.5} = \frac{1}{2}$$

Example 3: If the denominator of FFG is greater than 32767

You can deal with such a problem by changing the CMR when the gear reduction ratio is complicated. Given that the least command increment is 1 μm and the detection unit is 0.1 μm, CMR = 1/0.1 = 10. Suppose that FFG is to be set to 511 / 33058.

This is impossible because the denominator of FFG is greater than 32767. 33058 can be written as 16529 × 2, and this "× 2" can be replaced with CMR.

- CMR = 10 × 2 = 20 (the move command gets twice as fine)
- FFG = 511 / 16529 (servo control is thinned twice as roughly)

(4) Velocity control

(4.1) Block diagram

Fig. E (g) shows a block diagram of velocity control. Unlike position control, velocity control contains integral operation, which works to make the velocity deviation zero. Bit 3 of parameter No. 2003 specifies the compensator between PI controller and I-P controller. The PI control, which realizes higher response to commands, is today's standard.

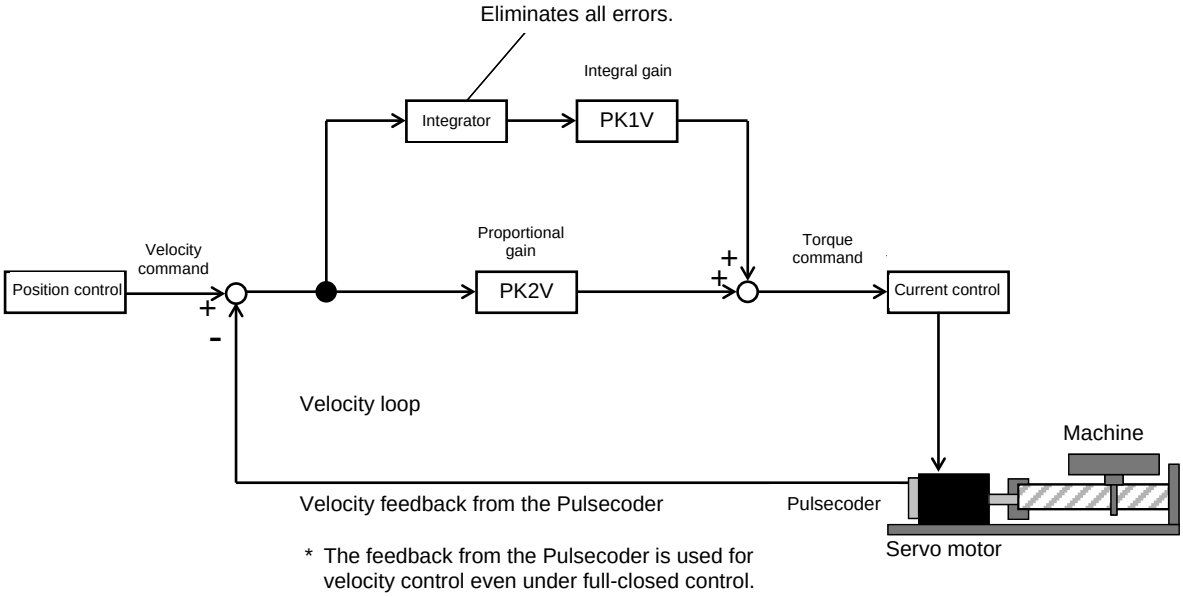


Fig. E (g) Velocity control loop (PI control)

(4.2) Compensation gain

The velocity loop compensator contains the following three elements.

1. Velocity gain (load inertia ratio: LDINT)
   Determines the response and stability of the entire velocity loop. Magnification related to both integral and proportional gains, described below.
2. Integral gain (PK1V)
   Determines the characteristics in the low-frequency area.
3. Proportional gain (PK2V)
   Determines the characteristics in the high-frequency area.

These compensation gains have impacts on the control system as shown in the Bode diagram in Fig. E (h).

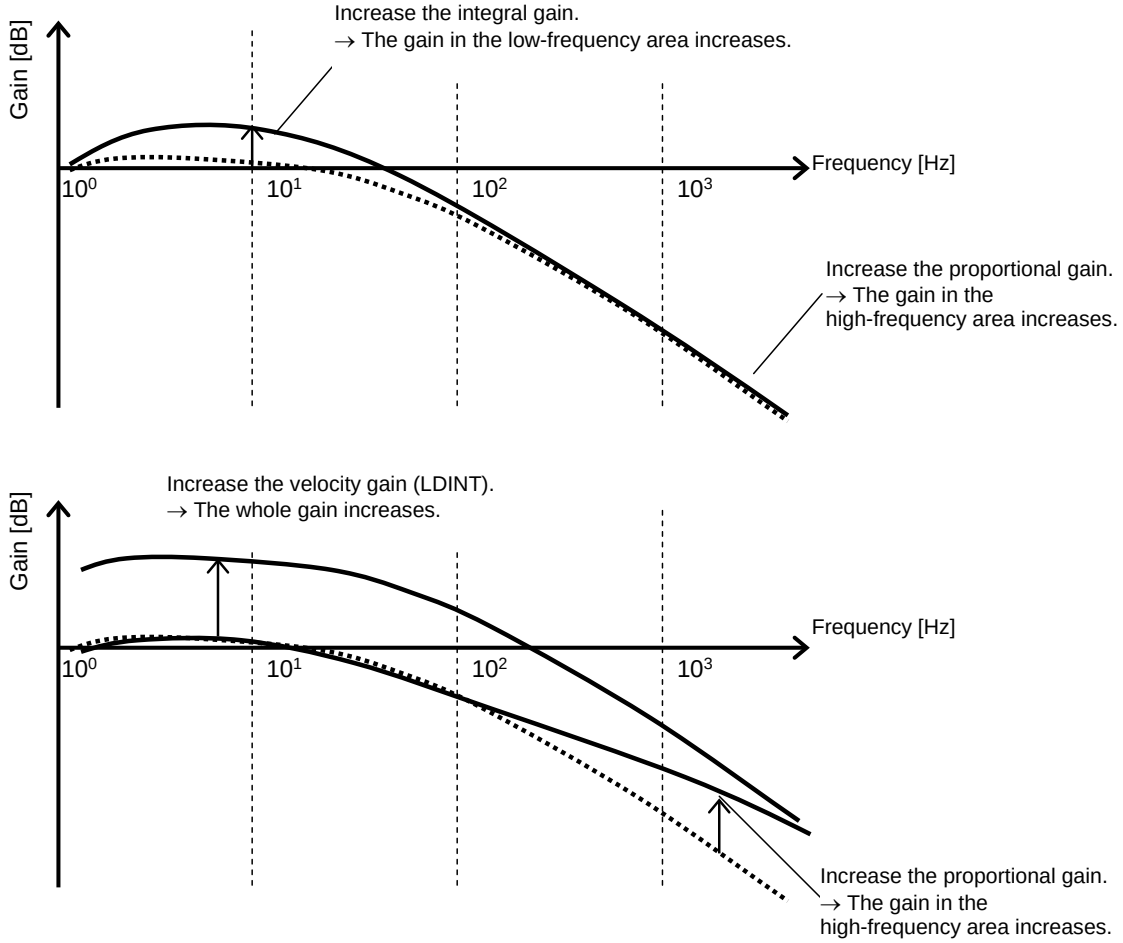


Fig. E (h) Effects of compensation gains in a velocity loop

NOTE

As illustrated in Fig. E (h), the servo control system may become unstable if the ratio of the integral gain (PK1V) to the proportional gain (PK2V) is changed too much. These compensation gains are parameters specific to each motor, so they do not need to be changed from standard parameters. We recommend that only the velocity gain (LDINT) be tuned.

The overall gain is not always raised (the curve is displaced in parallel) as in Fig. E (h) when the velocity gain (LDINT) is increased. Non-linear fluctuations may occur, such as fast growth of a local maximum point if there is a resonance.

(5) Adjustment of backlash acceleration

(5.1) Basic adjustment of backlash acceleration

A delay in velocity control, in other words, inversion delay of the machine operation, results in a quadrant protrusion. When the velocity gain and the velocity feed forward are fully adjusted, quadrant protrusions will not become so large. It will be necessary to actively use the backlash acceleration to reduce quadrant protrusions when realizing a higher velocity gain is difficult.

Perform the initial settings shown in Table E (b) before beginning adjustment. Increase parameter No. 2048 (backlash acceleration) while looking into the arc waveform with the SERVO GUIDE.

2048	Backlash acceleration amount

[Unit of data] Internal velocity command unit
[Recommended value] 0 to 600 (to be increased in increments of 20)

NOTE
If the backlash acceleration (and the backlash compensation amount) is too large, overcutting will occur on the circle. Find a value that does not cause overcut while looking at the waveform with the SERVO GUIDE.

Table E (b) Initial settings for backlash acceleration adjustment

Parameter	Recommended setting	Details
2003#5	1	Enables backlash acceleration.
2006#0	0/1	0: Semi-closed; 1: Full-closed
2009#7	1	Enables backlash acceleration stop.
2223#7	1	Enables backlash acceleration during cutting only.
2015#6	0	Disables two-stage backlash acceleration.
2048	0	Initial value of the backlash acceleration amount (to be increased in increments of 20).
2082	5 (1 μm detection) 50 (0.1 μm detection)	Initial value of the backlash acceleration stop distance (detection unit)
2071	20	Backlash acceleration time

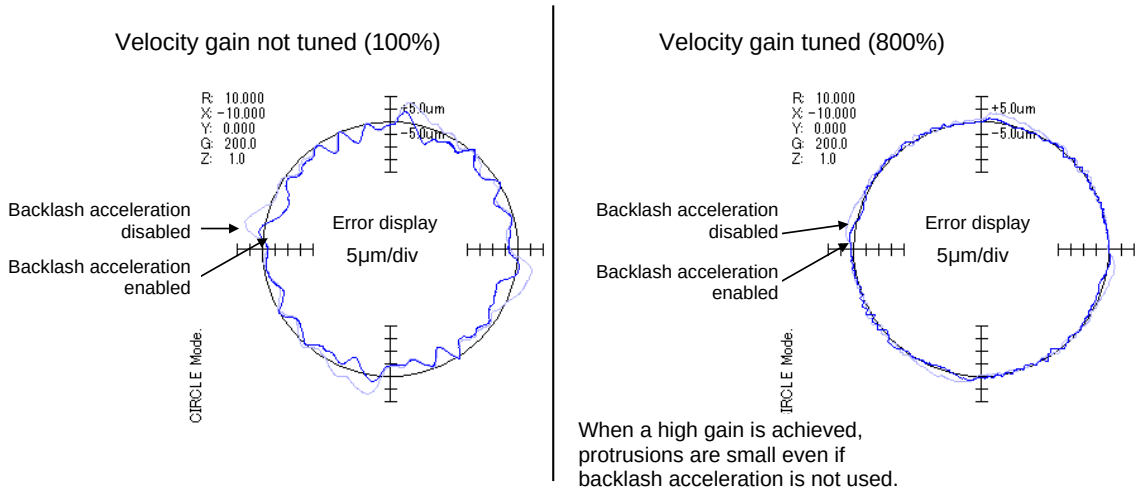


Fig. E (i) A high gain is effective in reducing quadrant protrusions (and makes it easy to adjust backlash acceleration)

Fig. E (i) shows how the precision of the circular motion (R = 10 mm and F = 4000 mm/min) differs before and after velocity gain tuning. When the velocity gain is small, the surface quality is low and the quadrant protrusions appear large. In this case, the quadrant protrusions can be reduced with backlash acceleration, but the surface quality itself cannot be improved then. When the velocity gain gets large, on the other hand, the surface quality is improved and the quadrant protrusions become small. Adjustment of backlash acceleration leads to improvement of roundness and circularity.

(5.2) Backlash acceleration override

Backlash acceleration amount
No.2048 = 100

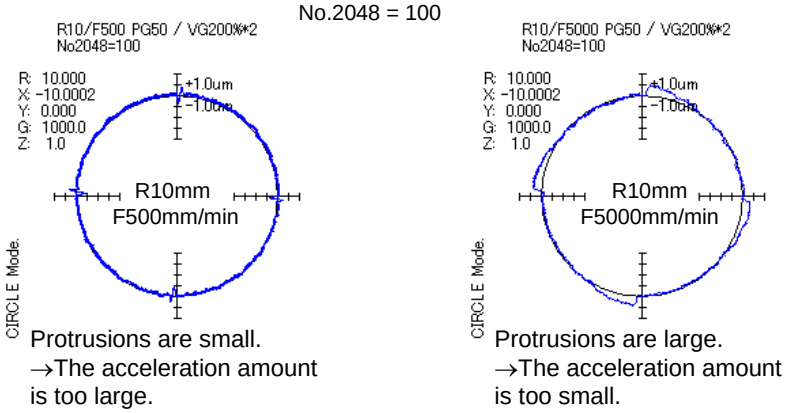


Fig. E (j) Backlash acceleration is not generally uniform

There is a difference in the quadrant protrusion size with the acceleration as shown in Fig. E (j). In such cases, adjust the backlash acceleration override. Make the adjustment in four steps, as shown in Fig. E (k).

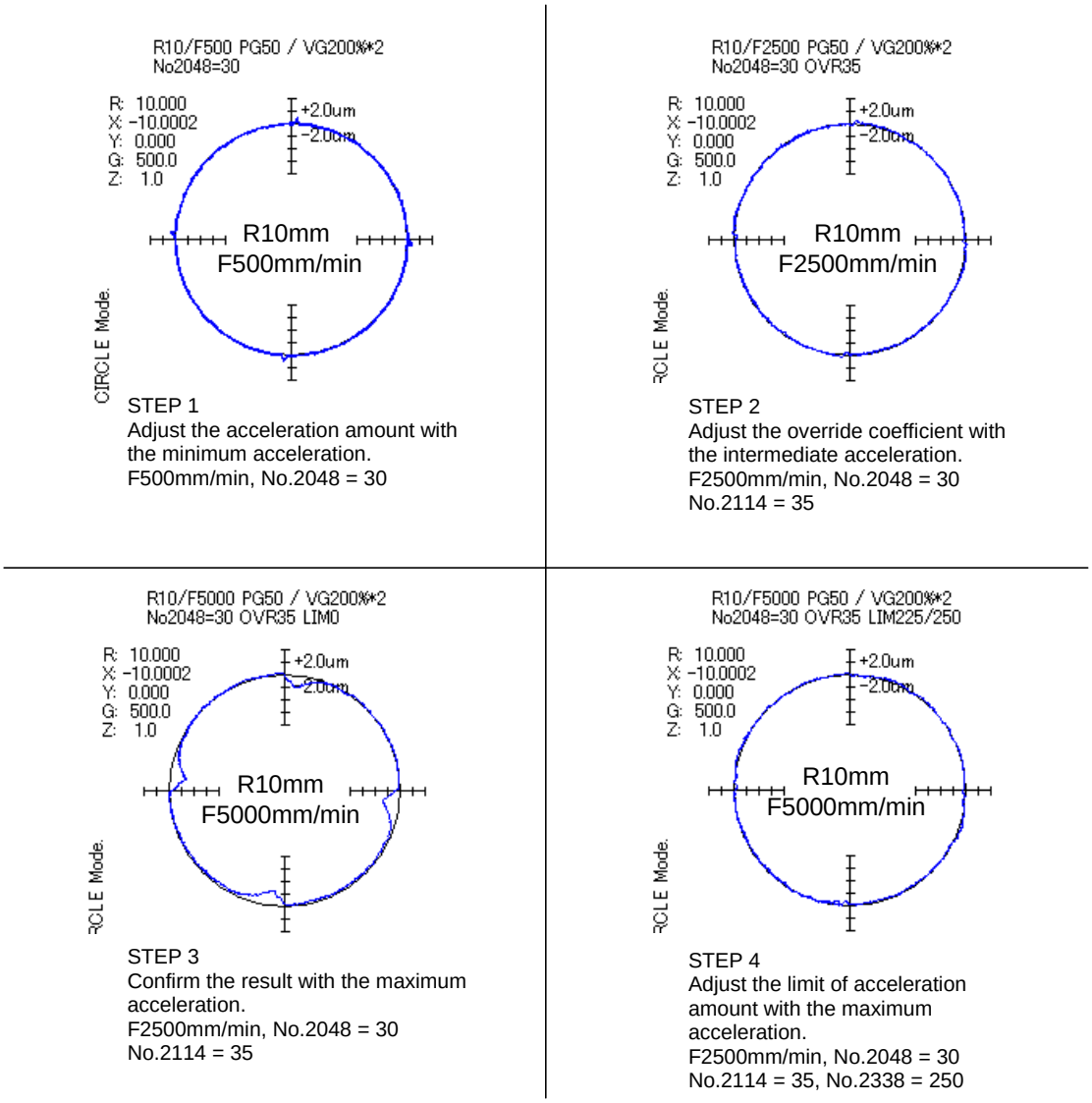


Fig. E (k) Adjustment of the backlash acceleration override (override coefficient parameter No. 2114 and acceleration amount limit parameter No. 2338)

(5.3) Direction-specific adjustment

The quadrant protrusions are horizontally or vertically asymmetric. By using the parameters given in Table E (c) appropriately, the backlash acceleration can be set for each direction, as shown in Fig. E (l).

Table E (c) Direction-specific backlash acceleration parameters

Direction-specific setting	Inversion direction	Backlash acceleration amount	Acceleration amount override	Acceleration amount limit value
No	Common	No.2048	No.2114	No.2338
Yes (No. 2094 ≠ 0)	From + to -			
	From - to +	**No.2094**	**No.2340**	**No.2341**

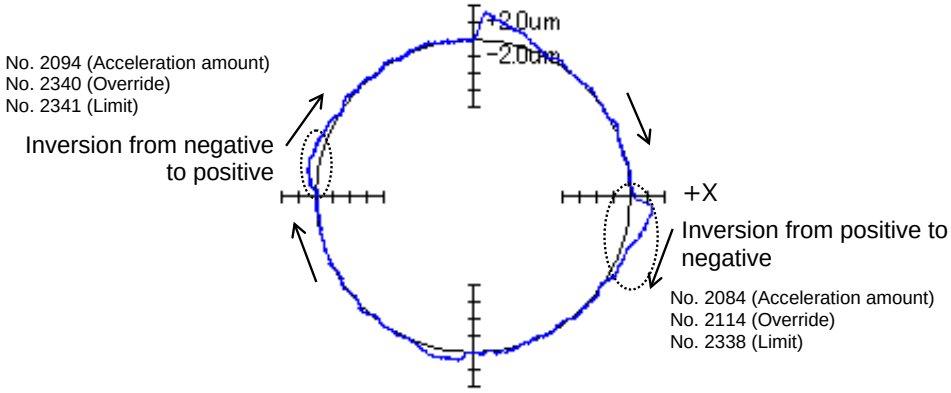


Fig. E (l) Parameters to use to accommodate asymmetric quadrant protrusions

(5.4) Disabling only acceleration during a stop

The impact of static friction tends to appear significant especially after a long stop state. In this case, backlash acceleration will cause overshoots, resulting in loss of precision. Disable backlash acceleration after a stop using the settings listed in Table E (c). It leads to preventing overshoots during a stop, as shown in Fig. E (m).

Table E (d) Disabling backlash acceleration after a stop

Parameter	Standard value	Description
2005#7	1	Enables the static friction compensation function.
2283#7	1	Disables backlash acceleration after a stop.
2073	5	Stop state judgment parameter (ITP)
2071	0	Static friction compensation function enable time
2072	0	Static friction compensation amount

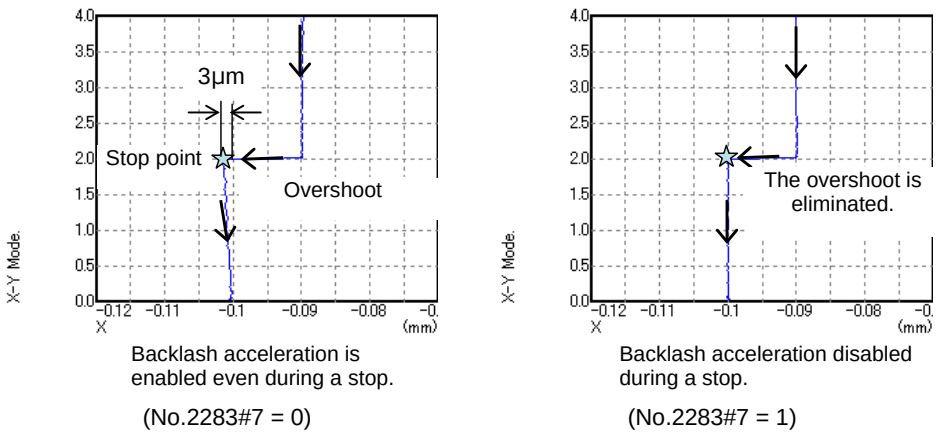


Fig. E (m) Eliminating overshoots by disabling backlash acceleration after a stop

F USING THE SERVO CHECK INTERFACE UNIT

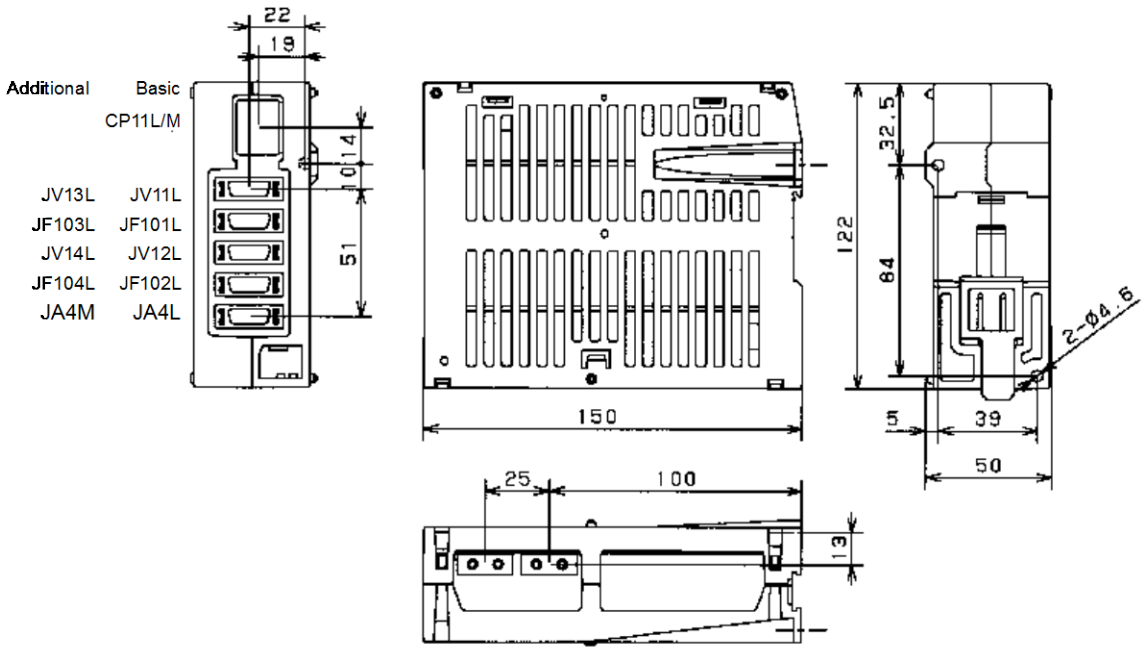
(1) Overview

With CNCs of the FS30*i* Series or later, SERVO GUIDE is basically used for servo adjustment and the servo check board connectable to conventional CNCs is not supported. Instead, a servo check interface unit is available. The servo check interface unit is connected to the FSSB (FANUC serial servo bus) and can be used, for example, to measure a VCMD waveform, which has been measurable with the conventional servo check board, by using an external measuring instrument directly.

(2) Series and editions of applicable servo software

CNC	Servo software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A	90G0 90J0 90K0 90GP 90JP	08.0 and subsequent editions 01.0 and subsequent editions 01.0 and subsequent editions 02.0 and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0 90E1	N(14) and subsequent editions 01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	N(14) and subsequent editions	HRV4
Series 0*i*-D	90C5 90C8 90E5 90E8	A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	01.0 and subsequent editions	

(3) Hardware



Name	NC	Specification	Remarks
Servo check interface unit: Basic unit	30*i*-B Series	A02B-0323-C206	Up to two channels
	30*i*-A Series, 0*i*-D Series	A02B-0303-C206	
Additional unit	30*i*-B Series	A02B-0323-C181	Up to two channels
	30*i*-A Series, 0*i*-D Series	A02B-0259-C181	

A servo check interface unit has two types of connectors, one for analog signal output and the other for detector data input, for one CNC axis. Each of a basic unit and an additional unit has four connectors and two channels of analog voltage output ports and separate detector interfaces each.
JV1xL: Connector for analog signal output
JF10xL: Connector for detector data input

(4) Setting parameters

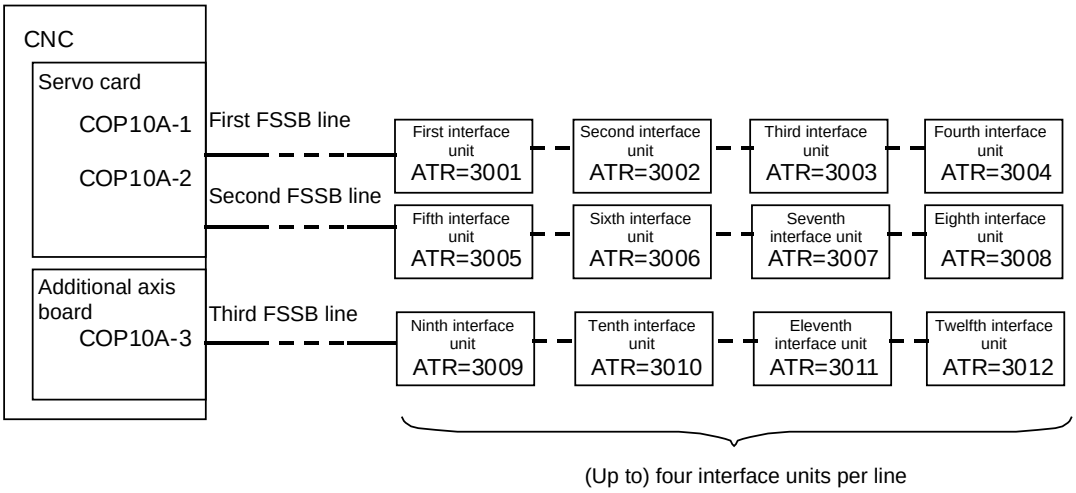


Fig. F.1 (a) Servo check interface unit connection diagram for 30*i*-B Series

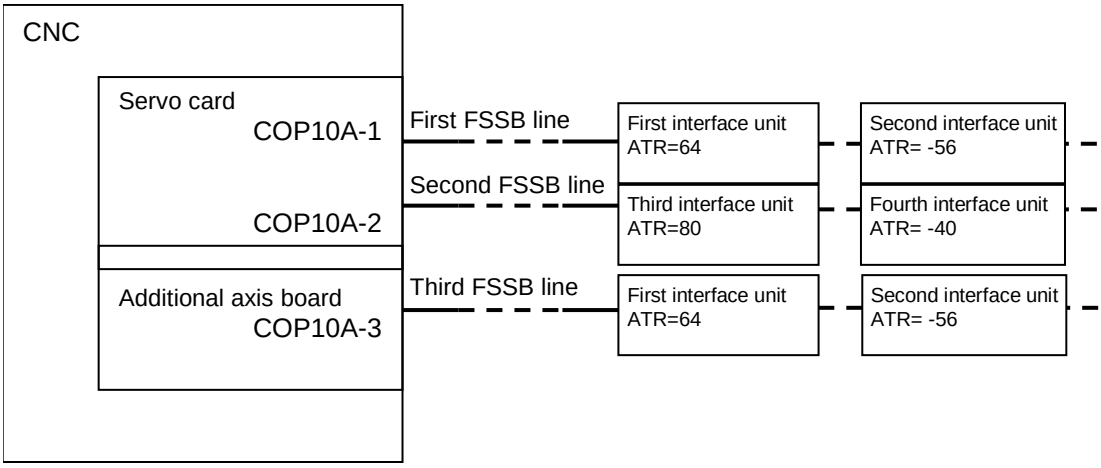


Fig. F.1 (b) Servo check interface unit connection diagram for 30*i*-A Series

	#7	#6	#5	#4	#3	#2	#1	#0
2278					PM2SCB	PM1SCB		

PM1SCB(#2) For an odd-numbered Type-C module, such as the first or third, the servo check interface unit is:
0: Disabled.
1: Enabled.

PM2SCB(#3) For an even-numbered Type-C module, such as the second or fourth, the servo check interface unit is:
0: Disabled.
1: Enabled.

NOTE
1 When these parameters are set, the power must be turned off before operation is continued.
2 If two servo check interface units are used with one axis on the CNC, it is not possible to set a combination of odd-numbered modules, such as the first and third, and even-numbered modules, such as the second and fourth. It is necessary to select one from the odd-numbered modules and one from the even-numbered modules.
3 Connect the separate detector to an even-numbered module in the following case:
When using DCS and two or more servo check interface units with one axis on the CNC

With the parameter below, set the type of data to be output to the servo check interface unit.

2315	Servo check interface unit output signal setting

- When using one servo check interface unit with one axis on the CNC
  → Set a 2-digit number (decimal).

	Tens digit	Ones digit
Setting	Axis number(*1)	Data number(*2)

- When using two servo check interface units with one axis on the CNC
  → Set a 4-digit number (decimal).

	Setting for data 2		Setting for data 1	
	Thousands digit	Hundreds digits	Tens digit	Ones digit
Setting	Axis number(*1)	Data number(*2)	Axis number(*1)	Data number(*2)

Data 1: Output from the servo check interface unit for an odd-numbered Type-C module.
Data 2: Output from the servo check interface unit for an even-numbered Type-C module.

(*1) Axis number

Axis number	No. 1023 for axis to be measured		
	Series 90G0, 90J0, 90K0, 90GP, 90JP, 90H0	Series 90E0, 90E1, 90E5, 90E8	Series 90D0, 90C5, 90C8
1	8n+1	4n+1	2n+1
2	8n+2	4n+2	2n+2
3	8n+3	4n+3	
4	8n+4	4n+4	
5	8n+5		
6	8n+6		

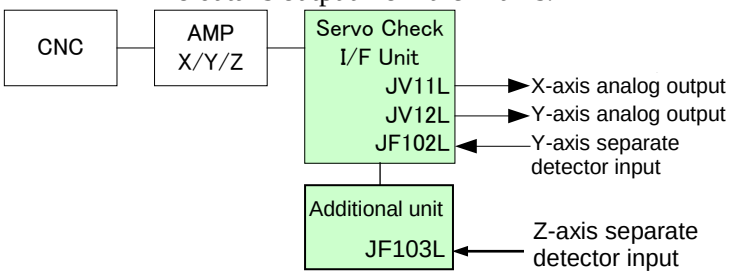
(n=0,1,2...)

(*2) Data number

Data number	Description of measurement data
0	Velocity command (VCMD)
1	Torque command (TCMD)
2	Actual speed (SPEED)
4	Position (POSF)
5	Data 1 for adjustment
6	Data 2 for adjustment

(5) Examples of setting

[Connection example 1] Configuration where the X-axis is a semi-closed axis and the Y-axis and Z-axis are full-closed axes
Velocity command data is output from the X-axis.
Position data is output from the Y-axis.
No data is output from the Z-axis.



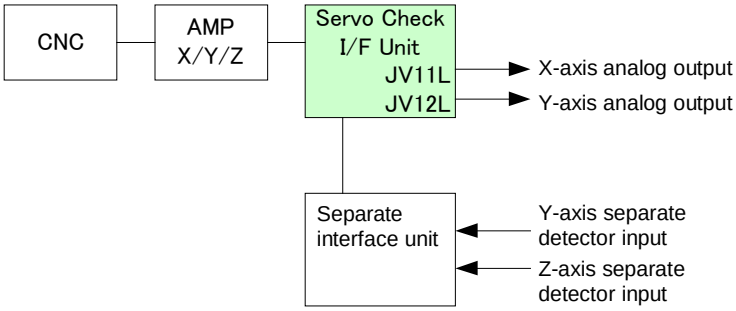
For the 30*i*-B Series

No.	Signal	Value
1023X,Y,Z		X: 1, Y: 2, Z: 3
1815X,Y,Z#1	OPTx	X: 0, Y: 1, Z: 1
1902#0	FMD	1
24096X,Y,Z		X: 1, Y: 2, Z: 3
24097X,Y,Z		X: 0, Y: 0, Z: 0
24000~24031	ATR	1001, 1002, 1003, 3001 The others are 1000.
24032~24063	ATR	All 1000
24064~24095	ATR	All 1000
24104~24111	ATRC	1001, 1002, 1003 The others are 1000.
24112~24119	ATRC	All 1000
24120~24127	ATRC	All 1000
24128~24135	ATRC	All 1000
24136~24143	ATRC	All 1000
24144~24151	ATRC	All 1000
2278#3	PM2SCB	X: 0, Y: 0, Z: 0
2278#2	PM1SCB	X: 1, Y: 1, Z: 0
2315		X: 10, Y: 24, Z: 0

For the 30*i*-A Series

No.	Signal	Value
1023X,Y,Z		X: 1, Y: 2, Z: 3
1815X,Y,Z#1	OPTx	X: 0, Y: 1, Z: 1
1902#0	FMD	1
1905X,Y,Z#7	PM2	X: 0, Y: 0, Z: 0
1905X,Y,Z#6	PM1	X: 1, Y: 1, Z: 1
1936X,Y,Z		X: 0, Y: 1, Z: 2
1937X,Y,Z		X: 0, Y: 0, Z: 0
14340~14357	ATR	0, 1, 2, 64 The others are -96.
14358~14375	ATR	All -96
14408~14425	ATR	All -96
14376~14383	ATRC	0, 1, 2, 32, 32, 32, 32, 32
14384~14391	ATRC	All 32
14392~14399	ATRC	All 32
14400~14407	ATRC	All 32
14444~14451	ATRC	All 32
14452~14459	ATRC	All 32
2278#3	PM2SCB	X: 0, Y: 0, Z: 0
2278#2	PM1SCB	X: 1, Y: 1, Z: 0
2315		X: 10, Y: 24, Z: 0

[Connection example 2] Configuration where the X-axis is a semi-closed axis and the Y-axis and Z-axis are full-closed axes
Velocity data is output from the X-axis.
Torque command data is output from the Y-axis.
No data is output from the Z-axis.



For the 30*i*-B Series

No.	Signal	Value
1023X,Y,Z		X: 1, Y: 2, Z: 3
1815X,Y,Z#1	OPTx	X: 0, Y: 1, Z: 1
1902#0	FMD	1
24096X,Y,Z		X: 1, Y: 2, Z: 0
24097X,Y,Z		X: 0, Y: 1, Z: 2
24000~24031	ATR	1001, 1002, 1003, 3001, 3002 The others are 1000.
24032~24063	ATR	All 1000
24064~24095	ATR	All 1000
24104~24111	ATRC	1001, 1002 The others are 1000.
24112~24119	ATRC	1002, 1003 The others are 1000.
24120~24127	ATRC	All 1000
24128~24135	ATRC	All 1000
24136~24143	ATRC	All 1000
24144~24151	ATRC	All 1000
2278#3	PM2SCB	X: 0, Y: 0, Z: 0
2278#2	PM1SCB	X: 1, Y: 1, Z: 0
2315		X: 12, Y: 21, Z: 0

For the 30*i*-A Series

No.	Signal	Value
1023X,Y,Z		X: 1, Y: 2, Z: 3
1815X,Y,Z#1	OPTx	X: 0, Y: 1, Z: 1
1902	FMD	1
1905X,Y,Z#7	PM2	X: 0, Y: 1, Z: 1
1905X,Y,Z#6	PM1	X: 1, Y: 1, Z: 0
1936X,Y,Z		X: 0, Y: 1, Z: 0
1937X,Y,Z		X: 0, Y: 0, Z: 1
14340~14357	ATR	0, 1, 2, 64, -56 The others are -96.
14358~14375	ATR	All -96
14408~14425	ATR	All -96
14376~14383	ATRC	0, 1, 32, 32, 32, 32, 32, 32
14384~14391	ATRC	1, 2, 32, 32, 32, 32, 32, 32
14392~14399	ATRC	All 32
14400~14407	ATRC	All 32
14444~14451	ATRC	All 32
14452~14459	ATRC	All 32
2278#3	PM2SCB	X: 0, Y: 0, Z: 0
2278#2	PM1SCB	X: 1, Y: 1, Z: 0
2315		X: 12, Y: 21, Z: 0

(6) Changing the output signal units and so forth

A voltage within ±10 V is output to the servo check interface unit. The table below indicates the default output unit of each data item.

Data number	Description of data	Data output unit (Default)
0	Velocity command (VCMD)	0.9155min^{-1}/5 V
1	Torque command (TCMD)	Max. amplifier current A/4.4 V
2	Actual speed (SPEED)	3750min^{-1}/5 V
4	Position (POSF)	3276.7 [detection unit]/1 V
5	Data 1 for adjustment	-
6	Data 2 for adjustment	-

With the parameters below, the output units and so forth of a velocity command, torque command, and actual speed can be changed as with conventional check board output.

	#7	#6	#5	#4	#3	#2	#1	#0
2015			**TDOUT**					

TDOUT(#5) Instead of a torque command, a disturbance torque is:
0: Not output.
1: Output.

	#7	#6	#5	#4	#3	#2	#1	#0
2012			**VCM2**	**VCM1**				

When a rotary motor is used

VCM2	VCM1	Specified speed/5 V
0	0	0.9155min^{-1}
0	1	14min^{-1}
1	0	234min^{-1}
1	1	3750min^{-1}

When a linear motor is used (Incremental: P = Signal pitch [μm]) (Absolute: P = Resolution [μm] × 512)

VCM2	VCM1	Specified speed/5 V
0	0	0.00375 × P m/min
0	1	0.06 × P m/min
1	0	0.96 × P m/min
1	1	15.36 × P m/min

Observe the entire movement in the DC mode with an oscilloscope then extend the range in the AC mode to check for fine fluctuations and positional variations.

	#7	#6	#5	#4	#3	#2	#1	#0
2225						TSA05	TCMD05	

TCMD05(#1) The check board output voltage of the TCMD signal is:
0: Ordinary (default).
1: Halved.
* The actual output voltage is affected by the function bit (TCMD4X) indicated below.

TSA05(#2) The check board output voltage of the SPEED signal is:
0: Ordinary (3750 min^{-1}/5 V) (default).
1: Halved (7500 min^{-1}/5 V).

The function bit (TCMD4X) indicated below increases the TCMD output voltage weight by a factor of 10 when compared with the conventional value. This function bit can be used with the bit above (TCMD05).

	#7	#6	#5	#4	#3	#2	#1	#0
2203			TCMD4X					

TCMD4X(#5) The check board output voltage of the TCMD signal is:
0: Ordinary (default).
1: Increased by a factor of 4.
By using these function bits, the output ranges of the TCMD signal and SPEED signal can be changed as indicated below.

・ TCMD signal output range

TCMD4X	TCMD05	TCMD value/4.4 V	Remarks
0	1	Max. amplifier current × 2 (A)	
0	0	Max. amplifier current (A)	Conventional mode
1	1	Max. amplifier current/2 (A)	
1	0	Max. amplifier current/4 (A)	4 compared with conventional mode

Example: Relationship between the output voltage and TCMD value [A] when an 80-A amplifier is used

TCMD4X	TCMD05	TCMD value/4.4 V
0	1	160 [A]
0	0	80 [A]
1	1	40 [A]
1	0	20 [A]

・ SPEED signal output range

TSA05	Actual speed/5 V Rotary motor	Actual speed/5 V Linear motor	Remarks
0	3750 [min^{-1}]	15.36 × P [m/min]	Conventional mode
1	7500 [min^{-1}]	30.72 × P [m/min]	

* When a linear motor is used, the meaning of P depends on the type of scale.

◇ When a high resolution serial output circuit manufactured by FANUC is used (Incremental scale) → P = Signal pitch [μm]

◇ When a scale supporting the FANUC serial interface is used (Absolute scale) → P = Resolution [μm] × 512

G SERVO FUNCTIONS THAT ARE NOT USED WITH THE 30*i* AND 0*i* Series

G.1 FINE ACCELERATION/DECELERATION (FAD) FUNCTION

(1) Overview

The fine acceleration/deceleration (fine acc./dec.) function enables smooth acc./dec. This is done by using servo software to perform some acc./dec. processing, which has previously been performed by CNCs that do not support nano interpolation. With this function, the mechanical stress and strain resulting from acc./dec. can be reduced.

(2) Features

- Acc./dec. is controlled by servo software in short intervals, allowing smooth acc./dec.
- Smooth acc./dec. can reduce the stress and strain applied to the machine.
- Because of the reduced stress and strain on the machine, a shorter time constant can be set (within the motor acceleration capability range).
- Two acc./dec. command types are supported: bell-shaped and linear acc./dec. types.
- An application of the fine acc./dec. function is found in the cutting and rapid traverse operations; for each operation, the FAD time constant, feedforward coefficient, and velocity feedforward coefficient can be used separately.

(3) Series and editions of applicable servo software

(Series 15*i*-B, 16*i*-B, 18*i*-B, 21*i*-B, 0*i*-B, 0*i* Mate-B, Power Mate *i*)

Series 9096/A(01) and subsequent editions
Series 90B0/A(01) and subsequent editions
Series 90B1/A(01) and subsequent editions
Series 90B6/A(01) and subsequent editions

(Series 0*i*-C, 0*i* Mate-C, 20*i*-B)

Series 90B5/A(01) and subsequent editions
Series 90B8/A(01) and subsequent editions

> **NOTE**
> In the 30*i* Series or 0*i*-D Series, smooth acc./dec. is always performed by nano interpolation, so the fine acc./dec. function is unnecessary. (The settings for the function are also ignored.)

(4) Setting basic parameters

	#7	#6	#5	#4	#3	#2	#1	#0
1951(FS15*i*)		FAD						
2007(FS16*i*)								

FAD (#6) 1: Enables the fine acc./dec. function.

> **NOTE**
> When this parameter is set, the power must be turned off before operation is continued.

	#7	#6	#5	#4	#3	#2	#1	#0
1749(FS15*i*) 2209(FS16*i*)						FADL		

FADL (#2) 0: FAD bell-shaped
1: FAD linear type
* Set 1 (linear type) usually.

NOTE
When this parameter is set, the power must be turned off before operation is continued.

1702(FS15*i*) 2109(FS16*i*)	Fine acc./dec. time constant (ms)

[Valid data range] 8 to 64 (Standard setting: 24)
A value exceeding the valid data range is clamped to the upper or lower limit of the range.
When the fine acc./dec. and feedforward functions are used together, set the following parameter to the coefficient.
(The parameter No. is the same as that used for advanced preview control.)

1985(FS15*i*) 2092(FS16*i*)	Position feedforward coefficient (in units of 0.01%)

[Valid data range] 100 to 10000

NOTE
1 Feedforward control is enabled by setting bit 1 of No. 1883 (Series 15*i*) or No. 2005 (Series 16*i* and so on) to 1.
2 The velocity feedforward coefficient is set in parameter No. 1962 (Series 15*i*) or No. 2069 (Series 16*i* and so on) which is the same parameter as that used for normal operation.
3 Generally, the fine acc./dec. function is enabled in cutting mode only.
4 If bit 3 of No. 1800 is set to 1, the FAD function is enabled both for cutting and rapid traverse mode.

(5) Setting parameters for the fine acc./dec. function, used separately for cutting and rapid traverse

As mentioned above, set the fine acc./dec. function bit and the bit for selecting the bell-shaped or linear type.
Then, set the following:

	#7	#6	#5	#4	#3	#2	#1	#0
1800(FS15*i*) 1800(FS16*i*)					FFR			

FFR (#3) 1: Enables feedforward in rapid traverse also.

	#7	#6	#5	#4	#3	#2	#1	#0
1742(FS15*i*) 2202(FS16*i*)								FADCH

FADCH (#0) 1: Enables the fine acc./dec. function, used separately for cutting and rapid traverse.

NOTE
When this parameter is set, the power must be turned off before operation is continued.

In cutting mode, the following parameters are used:

1766(FS15*i*)	**Fine acc./dec. time constant 2 (ms)**
2143(FS16*i*)	

[Valid data range] 8 to 64 A value that falls outside this range, if specified, is clamped to the upper or lower limit.

1767(FS15*i*)	**Position feedforward coefficient for cutting (in units of 0.01%)**
2144(FS16*i*)	

1768(FS15*i*)	**Velocity feedforward coefficient for cutting (%)**
2145(FS16*i*)	

In rapid traverse mode, the following parameters are used:

1702(FS15*i*)	**Fine acc./dec. time constant (ms)**
2109(FS16*i*)	

[Valid data range] 8 to 64 A value that falls outside this range, if specified, is clamped to the upper or lower limit.

1985(FS15*i*)	**Position feedforward coefficient for rapid traverse (in units of 0.01%)**
2092(FS16*i*)	

1962(FS15*i*)	**Velocity feedforward coefficient for rapid traverse (%))**
2069(FS16*i*)	

NOTE
1 When the settings above are made, both of the fine acc./dec. time constant and feedforward coefficient can be automatically switched for cutting feed or rapid traverse. To switch the feedforward coefficient only, use the cutting feed/rapid traverse switchable feedforward function. (See Subsection 5.5.2.)
2 When FAD, used separately for cutting and rapid traverse, is applied to axes under simple synchronous control, set the function bit for both the master and slave axes. When the function is enabled for the master axis only, switching between cutting and rapid traverse modes cannot be performed.

Table G.1 (a) Feedforward coefficient and fine acc./dec. time constant parameters classified by use

Series16*i*, 18*i*, 21*i*, 0*i*

	Parameter setting				Parameters for cutting			Parameters for rapid traverse		
	No.2005 #1	No.2007 #6	No.1800 #3	No.2202 #0	Position FF coefficient	Velocity FF coefficient	FAD time constant	Position FF coefficient	Velocity FF coefficient	FAD time constant
Cutting FF	1	0	0	0	No.2068 No.2092	No.2069	-	-	-	-
Usual FF (cutting FF + rapid traverse FF)	1	0	1	0	No.2068 No.2092	No.2069	-	No.2068 No.2092	No.2069	-
Cutting FAD	0	1	0	0	-	-	No.2109	-	-	-
Cutting/rapid traverse-specific FAD	0	1	1	1	-	-	No.2143	-	-	No.2109
Cutting FAD + cutting FF	1	1	0	0	No.2092	No.2069	No.2109	-	-	-
Cutting FAD + usual FF	1	1	1	0	No.2092	No.2069	No.2109	No.2092	No.2069	-
Cutting/rapid traverse-specific FAD + cutting/rapid traverse-specific FF	1	1	1	1	No.2144	No.2145	No.2143	No,2092	No.2069	No.2109

Series 15*i*

	Parameter setting				Parameters for cutting			Parameters for rapid traverse		
	No.1883 #1	No.1951 #6	No.1800 #3	No.1742 #0	Position FF coefficient	Velocity FF coefficient	FAD time constant	Position FF coefficient	Velocity FF coefficient	FAD time constant
Cutting FF	1	0	0	0	No.1961 No.1985	No.1962	-	-	-	-
Usual FF	1	0	1	0	No.1961 No.1985	No.1962	-	No.1961 No.1985	No1962	-
Cutting FAD	0	1	0	0	-	-	No.1702	-	-	-
Cutting/rapid traverse-specific FAD	0	1	1	1	-	-	No.1766	-	-	No.1702
Cutting FAD + cutting FF	1	1	0	0	No.1985	No.1962	No.1702	-	-	-
Cutting FAD + usual FF	1	1	1	0	No.1985	No.1962	No.1702	No.1985	No.1962	-
Cutting/rapid traverse-specific FAD + cutting/rapid traverse-specific FF	1	1	1	1	No.1767	No.1768	No.1766	No.1985	No.1962	No.1702

NOTE

1 In the above tables, the abbreviations "FF" and "FAD" refer to the feedforward function and fine acc./dec. function, respectively.

2 Of the two stacked parameter numbers in each field of the above tables, the upper one is used in non-advance mode, and the lower one is used in advance mode.

(6) Cautions for combined use of the synchronization function with the spindle axis and fine acc./dec.

The restrictions listed below are imposed on the combined use of the synchronization function between the servo axis and spindle axis and the fine acc./dec. function.
(Disable the fine acc./dec. function if combined use is impossible.)

Function	Use of FAD for servo axis		Cautions for combined use
	When FAD is disabled for spindle axis	When FAD is enabled for spindle axis	
Rigid tapping	Allowed	Allowed	**When FAD is disabled for spindle axis :** During rigid tapping, FAD and feedforward control are disabled. For synchronization, the position gain for the servo axis must be changed. See (7). **When FAD is enabled for spindle axis :** The same FAD time constant, acc./dec. type, feedforward coefficient, and position gain must be used for the servo axis (during cutting) and the spindle axis.
Advanced preview control rigid tapping	Not allowed	Allowed	The same FAD time constant, acc./dec. type, feedforward coefficient, and position gain must be used for the servo axis (during cutting) and the spindle axis.
Cs axis contour control	Not allowed	Allowed	The same FAD time constant, acc./dec. type, feedforward coefficient, and position gain must be used for the servo axis (during cutting) and the spindle axis.
Hob function	Not allowed	Not allowed	Disable the fine acc./dec. function.
EGB function	Not allowed	Not allowed	Disable the fine acc./dec. function.
Flexible synchronization	Not allowed	Allowed	The same FAD time constant, acc./dec. type, feedforward coefficient, and position gain must be used for the servo axis (during cutting) and the spindle axis.

NOTE

The spindle FAD function can be used when an α*i* spindle amplifier and FANUC Series 16*i*/18*i*/21*i* MODEL B CNC are used.
Spindle software: Series 9D50/E(05) and subsequent editions
CNC software :
M series: Series B0H1/M(13) and subsequent editions, Series BDH1M(13) and subsequent editions, Series DDH1/M(13) and subsequent editions,
Series BDH5/C(03) and subsequent editions
T series: Series B1H1/M(13) and subsequent editions, Series BEH1/M(13) and subsequent editions, Series DEH1/M(13) and subsequent editions
For details of the spindle FAD function, refer to "FANUC AC SPINDLE MOTOR *i* series, FANUC AC SPINDLE MOTOR α*i* series, FANUC AC BUILT-IN SPINDLE MOTOR B*i* series Parameter Manual (B-65280EN)".

Function	Combined use with FAD function	Cautions for combined use
Flexible synchronization (between servo axes)	Allowed	For the axes to be synchronized with each other, the same FAD time constant, feedforward coefficient, and position gain must be set.

(7) Rigid tapping synchronization when spindle axis FAD is disabled

(a) Overview

Because using fine acc./dec. causes the servo axis delay (error) to increase by 1 ms, setting up rigid tapping with fine acc./dec. results in an increase of synchronization errors against the spindle. To avoid this increase, use the following procedure to change the servo axis position gain for rigid tapping.

> **NOTE**
> In advanced preview control mode, rigid tapping cannot be used with fine acc./dec. In this case, disable fine acc./dec.

(b) Setup procedure

By setting the parameter below, the position gain can be automatically changed only for the servo axis to establish synchronization.

(Parameter)

	#7	#6	#5	#4	#3	#2	#1	#0
1749(FS15*i*)					FADPGC			
2209(FS16*i*)								

FADPGC (#3) Specifies whether to perform synchronization in rigid tapping mode when FAD is set up, as follows:

0: Not performed.

1: Performed. ← To be set

> **NOTE**
> 1 When this parameter is set, the power must be turned off before operation is continued.
> 2 If this parameter is set, the servo position gain is changed when rigid tapping is not used.
> 3 It is necessary to set this parameter for all axes that are subjected to contouring.

(Reference)

With Series 16*i* and so on, two types of parameters are available for position gain setting. By setting the parameters as described below, a position gain match can be ensured between the servo axis and spindle.

> **NOTE**
> Do not make the following setting when FADPGC = 1 is set.

a. Nos. 4065 to 4068: Spindle servo mode position loop gain

b. Nos. 5280 to 5284: Rigid tapping position loop gain

Parameter type "a" corresponds to the spindle position loop gain for rigid tapping, and parameter type b, to the servo axis position loop gain. Usually, both parameter types take the same values. For a servo axis with fine acc./dec. specified, however, set parameter type b with the values obtained using the following calculation:

$$\text{(New position gain value)} = \frac{100000}{100000 - \text{(Usually set position gain value)}} \times \text{(Usually set position gain value)}$$

Example of parameter setting)

Position gain (1/s)	Usually set value	New value
15	1500	1523
16.66	1666	1694
20	2000	2041
25	2500	2564
30	3000	3093
33.33	3333	3448
35	2500	3627
40	4000	4167
45	4500	4712
50	5000	5263

(8) Other specifications to note regarding the fine acc./dec. function

- Advanced preview control and fine acc./dec. can be used together. (The time constants before and after advanced preview interpolation, and the fine acc./dec. time constant are effective.)
- If FAD is set, then the G05 P10000 command is issued with HPCC, and FAD is disabled.
- Using the FAD function increases the position error as follows:

For FAD bell-shaped

$$\text{Increase in errors (pulses)} = \frac{\text{Feedrate (mm/min)}}{60 \times 1000 \times \text{Detection unit (mm)}} \times \left(\frac{\text{FAD time constant (ms)}}{2} + 1\right)$$

For FAD linear type

$$\text{Increase in errors (pulses)} = \frac{\text{Feedrate (mm/min)}}{60 \times 1000 \times \text{Detection unit (mm)}} \times \left(\frac{\text{FAD time constant (ms)} + 1}{2} + 1\right)$$

Example) When feed operation is performed using F1800 with a position gain of 30 (1/s) and a detection unit of 0.001 mm, the position error is normally expressed as follows:

$$\text{Errors at normal times (pulses)} = \frac{\text{Feedrate (mm/min)}}{60 \times \text{Position gain (1/s)} \times \text{Detection unit (mm)}}$$

$$= \left(\frac{1800}{60 \times 30 \times 0.001}\right. = 1000 \text{ (pulses)}$$

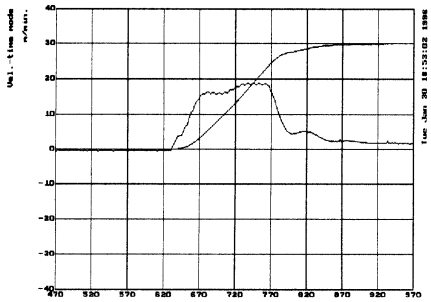
When the FAD function (FAD bell-shaped) is used with the time constant set to 64 ms, the deviation increases as follows:

$$\text{Increase in errors (pulses)} = \frac{1800}{60 \times 1000 \times 0.001} \times \left(\frac{64}{2} + 1\right) = 990 \text{ (pulses)}$$

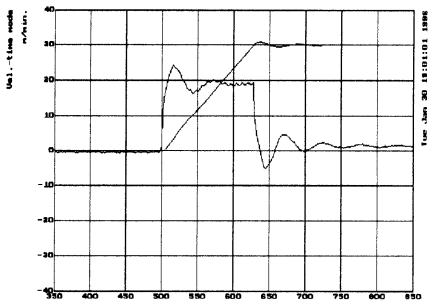
When FAD is used, the entire deviation is then obtained as follows:
Deviation when FAD is used (pulses) = 1000 + 990 = 1990 (pulses)

The combined use of the FAD function and the feedforward function does not increase the position error as much as expected, because the feedforward function decreases the delay of the command. When the FAD function is used alone, however, a higher error overestimation level must be set, considering the increase in the deviation.

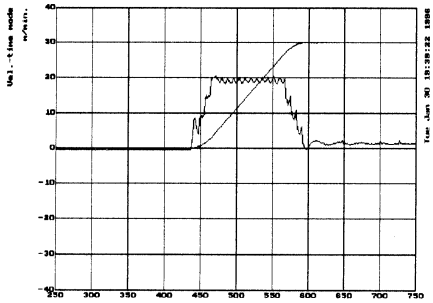
(9) Examples of applying the fine acc./dec. function



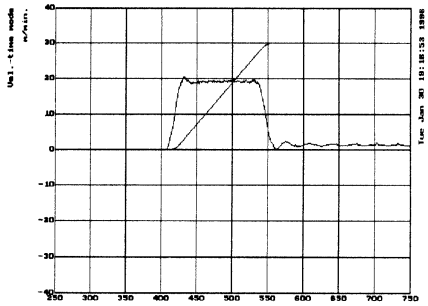
Conventional control in which the feedforward is not used



When the feedforward is used



When the feedforward and bell-shaped rapid traverse acceleration/deceleration (acceleration/deceleration with CNC) are performed



When the feedforward and fine acc./dec. are used

G.2 RISC FEEDFORWARD FUNCTION

(1) Overview

The feedforward system is used during high precision contour control based on RISC (HPCC mode) or AI contour control (AICC mode) in order to shorten the interpolation cycle, improving the performance of high-speed, high precision machining. (This function is insignificant for AI nano-contour control complying with nano-interpolation as a distribution system, AI high-precision contour control, AI nano high-precision contour control, and fine HPCC.)

By using this function, the response of the servo side can be improved when the distribution period is 4 ms, 2 ms, or 1 ms.

(2) Series and editions of applicable servo software

(Series 15*i*-B, 16*i*-B, 18*i*-B, 21*i*-B, 0*i*-B, 0*i* Mate-B, Power Mate *i*)

Series 9096/A(01) and subsequent editions(*)
Series 90B0/A(01) and subsequent editions
Series 90B1/A(01) and subsequent editions
Series 90B6/A(01) and subsequent editions

(Series 0*i*-C, 0*i* Mate-C, 20*i*-B)

Series 90B5/A(01) and subsequent editions
Series 90B8/A(01) and subsequent editions

* Series 9096 supports distribution periods of 1 ms and 2 ms only, and it does not support 4 ms.

(3) Setting parameters

<1> Set the following parameters in the same way as for the advanced preview feedforward function.
<2> Set the parameters (RISCFF and RISCMC) below.

	#7	#6	#5	#4	#3	#2	#1	#0
1959(FS15*i*) 2017(FS16*i*)			RISCFF					

RISCFF (#5) When a RISC processor is used:
0: Feedforward response remains as is.
1: Feedforward response improves when RISC is used.

	#7	#6	#5	#4	#3	#2	#1	#0
1740(FS15*i*) 2200(FS16i)			RISCMC					

RISCMC(#5) When a RISC processor is used:
0: The response to a positioning command is the same as before.
1: Feedforward response improves.

<3> By specifying a G code in the program, each mode is enabled, and the advanced preview feedforward function set above is applied.

G code		Mode
Mode ON	Mode OFF	
G05.1Q1	G05.1Q0	AI contour control mode
G05P10000	G05P0	HPCC mode

- Appendix C lists the supported CNCs.

If the modes above are off, the normal feedforward coefficient is enabled.

NOTE
1 Use this function only when a very high command response is required.
2 When using this function, set a detection unit of 0.1 μm wherever possible. (To set a detection unit of 0.1 μm, the IS-C system must be used, or the CMR and flexible feed gear must be multiplied by 10 with the IS-B system.)

H METHODS OF STARTING UP THE MACHINE WITHOUT CONNECTING AMPLIFIERS AND FEEDBACK CABLES

H.1 SERIAL FEEDBACK DUMMY FUNCTION

(1) Overview

The serial feedback dummy function is a function that allows the servo alarms for the axes of a machine to be ignored when it is to be started up without connecting servo amplifiers, servo motors, and so on.

(2) Series and edition of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0	03.0 and subsequent editions	
Power Motion *i*-A	90J0	01.0 and subsequent editions	
	90K0	01.0 and subsequent editions	
	90GP	02.0 and subsequent editions	
	90JP	01.0 and subsequent editions	
Series 30*i*/31*i*/32*i*-A	90E0	A(01) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	A(01) and subsequent editions	HRV4
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	
Series 0*i*-F	90M0	02.0 and subsequent editions	
	90L0	01.0 and subsequent editions	
	90M8	02.0 and subsequent editions	
	90L8	01.0 and subsequent editions	

(3) Setting parameters

By setting the following parameter appropriately, servo amplifier-related and built-in Pulsecoder-related alarms for those axes to which servo amplifiers or serve motors are not connected can be ignored.

	#7	#6	#5	#4	#3	#2	#1	#0
2009								**DMY**

DMY(#0) The serial feedback dummy function is:
0: Disabled.
1: Enabled.

2165	**Set 0.**

2020	**Enter an appropriate value other than 0. (Example: 252)**

To temporarily start up the machine without a separate detector, set the following parameter appropriately.

	#7	#6	#5	#4	#3	#2	#1	#0
2205						FULDMY		

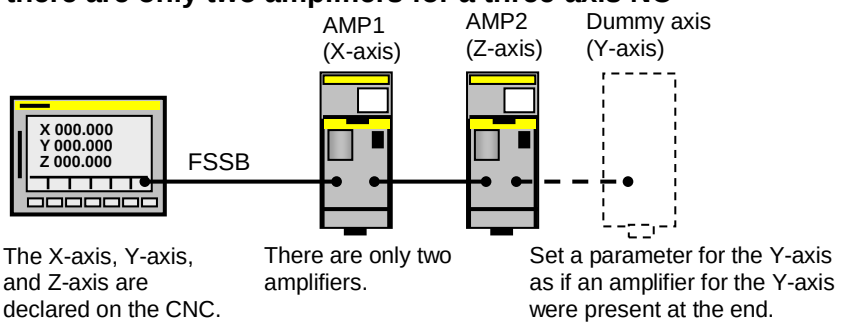
FULDMY(#2) The serial feedback dummy function for separate detector is:
0: Disabled.
1: Enabled.

NOTE
1 The serial feedback dummy function for the built-in Pulsecoder and the serial feedback dummy function for the separate detector have the following relationships:
When only the serial feedback dummy function for built-in Pulsecoder is enabled:
Alarms related to the built-in Pulsecoder and amplifier are ignored.
When only the serial feedback dummy function for separate detector is enabled:
Alarms related to the separate detector are ignored.
When both functions are enabled:
Alarms related to the built-in Pulsecoder, separate detector, and amplifier are ignored.
2 When using the serial feedback dummy function, match the control cycle (HRV) with other axes (non-dummy axes).
→ Related parameters: No. 2004, No. 2013 #0, No. 2014 #0

(4) Caution for setting the FSSB

The number of amplifiers must match that of axes due to the FSSB setting. If an axis to be set as a dummy axis does not have an amplifier, make FSSB settings as if a series of existing amplifiers were followed by another amplifier.

Example when there are only two amplifiers for a three-axis NC



Let us think about how to make the Y-axis (second axis) a dummy axis in the above configuration. Set up the parameters as follows:
(30*i*-A Series, 0*i*-D Series)

No.1023 X:1 **Y:2** Z:3
No.1902 bit1=0, bit0=1
No.1905 bit0 X:0 Y:0 Z:0
No.14340= 0
No.14341= 2
No.14342= 1
No.14343~14375= -96
No.2009 bit0 Y:1
No.2165 Y:0

(30*i*-B Series, 0*i*-F Series)

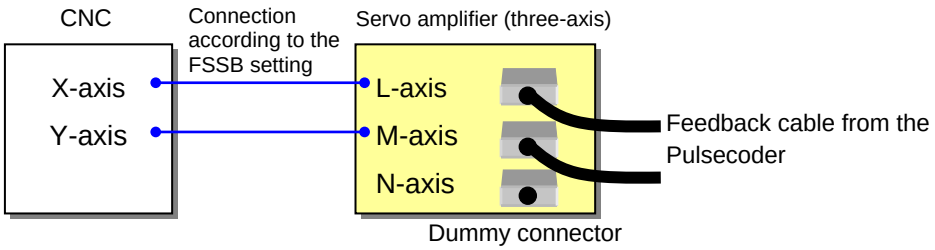
No.1023 X:1 **Y:2** Z:3
No.1902 bit1=0, bit0=1
No.24000= 1001
No.24001= 1003
No.24002= 1002
No.24002~24031= 1000
No.2009 bit0 Y:1
No.2165 Y:0

* For details of FSSB setting, refer to the respective CNC parameter manuals.

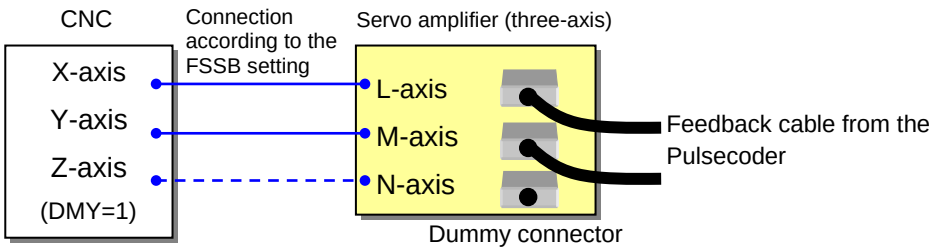
H.2 IF THERE IS AN AXIS NOT USED FOR A MULTIAXIS SERVO AMPLIFIER

If an amplifier axis (L, M, or N) is not used for a multiaxis amplifier other than the α*i*SV-B and β*i*SVSP-B, it is necessary to connect a dummy connector to the unused amplifier axis.

Information about the dummy connector	Location
Jumper between pins 11 and 12.	JFx



If you want to place a certain CNC axis using an multiaxis amplifier other than the α*i*SV-B and β*i*SVSP-B in the unused state using the serial feedback dummy function setting (DMY = 1) described in Section H.1, it is necessary to connect a dummy connector to the relevant amplifier axis.

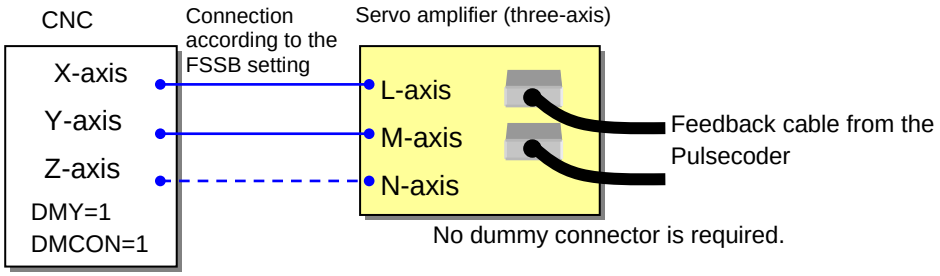


When the servo control software indicated below is used, the setting of the parameter below enables a multiaxis amplifier to be operated without inserting a dummy connector.

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*-A	90E0	L(12) and subsequent editions	
	90E1	01.0 and subsequent editions	
Series 30*i*/31*i*-A	90D0	L(12) and subsequent editions	HRV4
Series 0*i*-D	90C5	A(01) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	A(01) and subsequent editions	
	90E8	A(01) and subsequent editions	

	#7	#6	#5	#4	#3	#2	#1	#0
2279								DMCON

DMCON(#0) In emergency stop cancellation with the serial feedback dummy function enabled (DMY = 1):
0: The ready signal is not output to the amplifier.
1: The ready signal is output to the amplifier.



NOTE

The control axis detach function (detach function) is provided as a function similar to the serial feedback dummy function. Using this function causes the ready signal to the amplifier to be turned OFF. To detach a single axis from a multiaxis amplifier other than the α*i*SV-B and the β*i*SVSP-B, set bit 6 of parameter No. 1005 to 1. For details of detaching a control axis, refer to the connection manual (function) of the CNC used.

I HRV1 CONTROL PARAMETERS

Series 9096 (for Series 21*i*/ 0*i*-B, Power Mate *i*)
Series 90B0 (for Series 15*i*/16*i*/ 0*i*-B, Power Mate *i*)
Series 90B1 and 90B8 (for Series 15*i*/16*i*/20*i*-B/0*i*-C/0*i* Mate-C, Power Mate *i*)
Series 90B5 and 90B6 (for Series 15*i*/16*i*/20*i*-B/0*i*-C/0*i* Mate-C, Power Mate *i*)

NOTE
HRV1 is not supported by the Series 30*i*-A/B or 0*i* -D/F. Be careful not to set a wrong motor ID.

		Motor model	L1500 B1/4is	L3000 B2/2is	L6000 B2/2is	L9000 B2/2is	L15000 C2/2is	αis 300 2000	L3000 B2/4is	L6000 B2/4is	L9000 B2/4is	L15000 C2/3is	L300 A1/4is
		Motor specification	444-B210	445-B110	447-B110	449-B110	456-B110	456-B110	445-B210	447-B210	449-B210	456-B210	441-B200
FS15i	FS16i,etc.	Motor ID No.	90	91	92	93	94	115	120	121	122	123	124
PRM. NO.	PRM. NO.	SYMBOL											
1808	2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
1809	2004		00000110	00000110	00000110	00000110	00000110	01000110	00000110	00000110	00000110	00000110	00000110
1883	2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1884	2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1951	2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1952	2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1953	2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1954	2010		00000100	00000100	00000100	00000100	00000100	00000000	00000100	00000100	00000100	00000100	00000100
1955	2011		00000000	00000000	00000000	00000000	00000000	00100000	00000000	00000000	00000000	00000000	00000000
1956	2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1707	2013		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1708	2014		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1750	2210		00000000	00000000	00000000	00000000	00000100	00000000	00000000	00000000	00000000	00000000	00000000
1751	2211		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2713	2300		10000000	10000000	10000000	10000000	10000000	00000000	10000000	10000000	10000000	10000000	10000000
2714	2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1852	2040	CUR GAIN I	1890	4804	4804	5036	1420	1357	1620	2626	4944	2392	526
1853	2041	CUR GAIN P	-7180	-14453	-13138	-16000	-5600	-4212	-11180	-10051	-11831	-8448	-2141
1854	2042	CUR GAIN 3	-2647	-2660	-2660	-2660	-2663	-2710	-2660	-2660	-2660	-2657	-2618
1855	2043	VEL GAIN I	19	16	16	14	10	114	16	10	16	10	16
1856	2044	VEL GAIN P	-260	-214	-214	-195	-131	-1023	-214	-135	-211	-128	-217
1857	2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
1858	2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
1859	2047	OBSERVER POA1	-4371	-5321	-5321	-5849	-8681	3709	-5321	-8463	-5399	-8861	-8755
1860	2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
1861	2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
1862	2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
1863	2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
1864	2052	OVER SPEED	0	0	0	0	0	0	0	0	0	0	0
1865	2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
1866	2054	DB-CMP PDDP	1894	1894	1894	1894	1894	3787	1894	1894	1894	1894	1894
1867	2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
1868	2056	EMFCMP	0	0	0	0	0	0	0	0	0	0	0
1869	2057	D-PHASE CUR	0	0	0	0	0	-3850	0	0	0	0	0
1870	2058	D-PHASE CUR	0	0	0	0	0	-800	0	0	0	0	0
1871	2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
1872	2060	TCMD LIMIT	7282	7282	7282	7282	7282	7282	7282	4855	7282	7282	5826
1873	2061	EMFLMT	120	120	120	120	120	120	120	120	120	120	120
1877	2062	OVC K1	32670	32670	32670	32685	32712	32352	32698	32740	32698	32732	32720
1878	2063	OVC K2	1222	1222	1222	1041	703	5196	873	345	873	452	596
1892	2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
1893	2065	OVC LIMIT	3626	3626	3626	3087	2086	15494	2590	1024	2590	1340	589
1894	2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
1895	2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
1961-1966	2068-2073		0	0	0	0	0	0	0	0	0	0	0
1967	2074	AALPH	0	0	0	0	0	12288	0	0	0	0	0
1970-1976	2077-2083		0	0	0	0	0	0	0	0	0	0	0
1979	2086	RATED CURRENT	1402	1402	1402	1293	1063	2385	1184	744	1184	852	564
1980-1982	2087-2089		0	0	0	0	0	0	0	0	0	0	0
1983	2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
1984-1991	2091-2098		0	0	0	0	0	0	0	0	0	0	0
1992	2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
1993	2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
1994	2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
1995	2102	DBLIM	0	0	0	0	0	15000	0	0	0	0	0
1996	2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
1997	2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
1998	2105	TORQUE CONST.	227	455	911	1481	3104	10931	455	1450	1367	3168	52
1999	2106	LP24PA	0	0	0	0	0	0	0	0	0	0	0
1700-1702	2107-2109		0	0	0	0	0	0	0	0	0	0	0
1703	2110	MGSTCM	0	0	0	0	0	16	0	0	0	0	0
1704	2111	TQLIM IN DEC.	0	0	0	0	0	1606	0	0	0	0	0
1705	2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
1706	2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
1735	2127	NINTCT	0	0	0	0	0	0	0	0	0	0	0
1736	2128	MFWKCE	0	0	0	0	0	5500	0	0	0	0	0
1752	2129	MFWKBL	0	0	0	0	0	791	0	0	0	0	0
1753-1755	2130-2132	SMOOTH CMP	0	0	0	0	0	0	0	0	0	0	0
1756	2133	PHDLY1	0	0	0	0	0	1556	0	0	0	0	0
1757	2134	PHDLY2	0	0	0	0	0	20494	0	0	0	0	0
1782	2159	DGCSMM	0	0	0	0	0	0	0	0	0	0	0
1783	2160	TRQCUP	0	0	0	0	0	0	0	0	0	0	0
1784	2161	OVC STP	0	0	0	0	0	0	0	0	0	0	0
1785	2162	OVC2 K1	0	0	0	0	0	0	0	0	0	0	0
1786	2163	OVC2 K2	0	0	0	0	0	0	0	0	0	0	0
1787	2164	OVC2 LIMIT	0	0	0	0	0	0	0	0	0	0	0
1788	2165	MAX CURRENT	45	45	85	135	245	365	85	245	245	365	25
2716	2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2717	2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2718	2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2723	2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2729	2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0

Remarks											

		Motor model	L600 A1/4is	L900 A1/4is	L6000 B2/4is	L9000 B2/2is	L9000 B2/4is	L15000 C2/2is					
		Motor specification	442-B200	443-B200	(160A)	(160A)	(360A)	(360A)					
FS15i	FS16i,etc.	Motor ID No.	125	126	127	128	129	130					
PRM. NO.	PRM. NO.	SYMBOL											
1808	2003		00001000	00001000	00001000	00001000	00001000	00001000					
1809	2004		00000110	00000110	00000110	00000110	00000110	00000110					
1883	2005		00000000	00000000	00000000	00000000	00000000	00000000					
1884	2006		00000000	00000000	00000000	00000000	00000000	00000000					
1951	2007		00000000	00000000	00000000	00000000	00000000	00000000					
1952	2008		00000000	00000000	00000000	00000000	00000000	00000000					
1953	2009		00000000	00000000	00000000	00000000	00000000	00000000					
1954	2010		00000100	00000100	00000100	00000100	00000100	00000100					
1955	2011		00000000	00000000	00000000	00000000	00000000	00000000					
1956	2012		00000000	00000000	00000000	00000000	00000000	00000000					
1707	2013		00000000	00000000	00000000	00000110	00001010	00001010					
1708	2014		00000000	00000000	00000000	00000110	00001010	00001010					
1750	2210		00000000	00000000	00000000	00000000	00000000	00000100					
1751	2211		00000000	00000000	00000000	00000000	00000000	00000000					
2713	2300		10000000	10000000	10000000	10000000	10000000	10000000					
2714	2301		00000000	00000000	00000000	00000000	00000000	00000000					
1852	2040	CUR GAIN I	717	390	1751	6198	7416	2130					
1853	2041	CUR GAIN P	-3333	-2009	-6701	-19692	-17747	-8400					
1854	2042	CUR GAIN 3	-2618	-2618	-2660	-2660	-2660	-2663					
1855	2043	VEL GAIN I	9	13	15	12	10	7					
1856	2044	VEL GAIN P	-122	-179	-202	-158	-141	-87					
1857	2045	VEL GAIN 3	0	0	0	0	0	0					
1858	2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235					
1859	2047	OBSERVER POA1	-9339	-6367	-5642	-7199	-8099	-13022					
1860	2048	BLACC CMP	0	0	0	0	0	0					
1861	2049	DPFMX	0	0	0	0	0	0					
1862	2050	OBSERVER POK1	956	956	956	956	956	956					
1863	2051	OBSERVER POK2	510	510	510	510	510	510					
1864	2052	OVER SPEED	0	0	0	0	0	0					
1865	2053	DB-CMP PPMAX	21	21	21	21	21	21					
1866	2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894					
1867	2055	DB-CMP PHYST	319	319	319	319	319	319					
1868	2056	EMFCMP	0	0	0	0	0	0					
1869	2057	D-PHASE CUR	0	0	0	0	0	0					
1870	2058	D-PHASE CUR	0	0	0	0	0	0					
1871	2059	PPBAS	0	0	0	0	0	0					
1872	2060	TCMD LIMIT	6554	7282	7282	5917	4855	4855					
1873	2061	EMFLMT	120	120	120	120	120	120					
1877	2062	OVC K1	32720	32721	32706	32713	32737	32743					
1878	2063	OVC K2	596	583	777	687	388	313					
1892	2064	TGALMLV	4	4	4	4	4	4					
1893	2065	OVC LIMIT	589	1326	2304	2038	1151	927					
1894	2066	ACC FB GAIN	0	0	0	0	0	0					
1895	2067	TCMD FILTER	0	0	0	0	0	0					
1961-1966	2068-2073		0	0	0	0	0	0					
1967	2074	AALPH	0	0	0	0	0	0					
1970-1976	2077-2083		0	0	0	0	0	0					
1979	2086	RATED CURRENT	564	847	1117	1050	789	708					
1980-1982	2087-2089		0	0	0	0	0	0					
1983	2090	ROBSTL	0	0	0	0	0	0					
1984-1991	2091-2098		0	0	0	0	0	0					
1992	2099	ONEPSL	400	400	400	400	400	400					
1993	2100	INPA1	0	0	0	0	0	0					
1994	2101	INPA2	0	0	0	0	0	0					
1995	2102	DBLIM	0	0	0	0	0	0					
1996	2103	ABVOF	0	0	0	0	0	0					
1997	2104	ABTSH	0	0	0	0	0	0					
1998	2105	TORQUE CONST.	104	104	966	1823	2051	4656					
1999	2106	LP24PA	0	0	0	0	0	0					
1700-1702	2107-2109		0	0	0	0	0	0					
1703	2110	MGSTCM	0	0	0	0	0	0					
1704	2111	TQLIM IN DEC.	0	0	0	0	0	0					
1705	2112	AMRDML	0	0	0	0	0	0					
1706	2113	HRV FILT	0	0	0	0	0	0					
1735	2127	NINTCT	0	0	0	0	0	0					
1736	2128	MFWKCE	0	0	0	0	0	0					
1752	2129	MFWKBL	0	0	0	0	0	0					
1753-1755	2130-2132	SMOOTH CMP	0	0	0	0	0	0					
1756	2133	PHDLY1	0	0	0	0	0	0					
1757	2134	PHDLY2	0	0	0	0	0	0					
1782	2159	DGCSMM	0	0	0	0	0	0					
1783	2160	TRQCUP	0	0	0	0	0	0					
1784	2161	OVC STP	0	0	0	0	0	0					
1785	2162	OVC2 K1	0	0	0	0	0	0					
1786	2163	OVC2 K2	0	0	0	0	0	0					
1787	2164	OVC2 LIMIT	0	0	0	0	0	0					
1788	2165	MAX CURRENT	45	45	165	165	365	365					
2716	2302	TQLIM AT STOP	0	0	0	0	0	0					
2717	2304	ACCBSLM	0	0	0	0	0	0					
2718	2305	ACDCEBD	0	0	0	0	0	0					
2723	2310	DCIDBS	0	0	0	0	0	0					
2729	2316	LIMLIM	0	0	0	0	0	0					

Remarks											

		Motor model	βiS2 4000HV	αiF1 5000	βiS2 4000	βiS2/4000 40A	αiF2 5000	βiS4 4000	βiS4/4000 40A	βiS8 3000	βiS8/3000 40A	αiS2 5000	αiS2 5000HV
		Motor specification	0062	0202	0061-Bxx3	0061-Bxx3	0205	0063-Bxx3	0063-Bxx3	0075-Bxx3	0075-Bxx3	0212	0213
FS15i	FS16i,etc.	Motor ID No.	151	152	153	154	155	156	157	158	159	162	163
PRM. NO.	PRM. NO.	SYMBOL											
1808	2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
1809	2004		00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110
1883	2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1884	2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1951	2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1952	2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1953	2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1954	2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1955	2011		00100000	00000000	00100000	00100000	00100000	00000000	00000000	00000000	00000000	00000000	00100000
1956	2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1707	2013		00000100	00000000	00000100	00010000	00000000	00000000	00001110	00000000	00001110	00000000	00000000
1708	2014		00000100	00000000	00000100	00010000	00000000	00000000	00001110	00000000	00001110	00000000	00000000
1750	2210		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1751	2211		00000010	00000010	00000010	00000010	00000010	00001110	00001110	00001110	00001110	00000010	00000010
2713	2300		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2714	2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1852	2040	CUR GAIN I	225	672	280	560	680	288	576	450	900	600	420
1853	2041	CUR GAIN P	-1100	-2294	-1080	-2160	-2247	-960	-1920	-1840	-3680	-1900	-1369
1854	2042	CUR GAIN 3	-2467	-2514	-1112	-1112	-2568	-1144	-1144	-1234	-1234	-2504	-2504
1855	2043	VEL GAIN I	78	66	78	39	76	112	56	164	82	39	39
1856	2044	VEL GAIN P	-700	-594	-698	-349	-680	-1008	-504	-1476	-738	-350	-351
1857	2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
1858	2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
1859	2047	OBSERVER POA1	-1085	6384	-1089	-2178	5578	-753	-1506	5143	-1029	10853	-1081
1860	2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
1861	2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
1862	2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
1863	2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
1864	2052	OVER SPEED	5600	7000	5600	5600	7000	5600	5600	4200	4200	7000	7000
1865	2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
1866	2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
1867	2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
1868	2056	EMFCMP	0	-30	0	0	-30	-20	0	-30	0	-30	0
1869	2057	D-PHASE CUR	-10250	0	-10250	-10245	-10256	-7700	-7690	-5144	-5133	-10250	-10254
1870	2058	D-PHASE CUR	-1000	0	-1000	-500	-3300	-2240	-1120	-2700	-1350	-2000	-2300
1871	2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
1872	2060	TCMD LIMIT	6554	7282	6554	3277	7282	7282	3641	7282	3641	7282	7282
1873	2061	EMFLMT	0	0	0	0	0	0	0	0	0	0	0
1877	2062	OVC K1	32538	32613	32531	32531	32497	32289	32289	32289	32289	32528	32532
1878	2063	OVC K2	2879	1933	2963	2963	3390	5988	5988	5994	5994	3005	2953
1892	2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
1893	2065	OVC LIMIT	8560	5739	8811	2203	10085	17873	4468	17889	4472	8936	8782
1894	2066	ACC FB GAIN	-10	0	-10	-5	0	-10	-5	-10	-5	0	0
1895	2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
1961-1966	2068-2073		0	0	0	0	0	0	0	0	0	0	0
1967	2074	AALPH	20480	0	20480	0	4096	20480	0	16384	0	8192	16384
1970-1976	2077-2083		0	0	0	0	0	0	0	0	0	0	0
1979	2086	RATED CURRENT	1507	1234	1529	764	1636	2178	1089	2780	1390	1540	1526
1980-1982	2087-2089		0	0	0	0	0	0	0	0	0	0	0
1983	2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
1984-1991	2091-2098		0	0	0	0	0	0	0	0	0	0	0
1992	2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
1993	2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
1994	2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
1995	2102	DBLIM	10000	0	15000	7500	12000	0	0	0	0	0	7500
1996	2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
1997	2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
1998	2105	TORQUE CONST.	119	72	119	238	109	146	292	226	452	117	117
1999	2106	LP24PA	0	0	0	0	0	0	0	0	0	0	0
1700-1702	2107-2109		0	0	0	0	0	0	0	0	0	0	0
1703	2110	MGSTCM	1050	32	1050	564	32	782	284	1805	794	40	40
1704	2111	TQLIM IN DEC.	11600	7710	11600	11600	6460	7790	7790	7930	7930	7745	7700
1705	2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
1706	2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
1735	2127	NINTCT	2345	1188	1172	1172	1276	796	796	1442	1442	1137	1137
1736	2128	MFWKCE	1000	570	3000	6000	855	1000	2000	3500	7000	1000	1250
1752	2129	MFWKBL	2574	3211	2574	2574	3211	3130	3130	1552	1552	3851	3847
1753-1755	2130-2132	SMOOTH CMP	0	0	0	0	0	0	0	0	0	0	0
1756	2133	PHDLY1	7188	2571	7188	7188	2565	7691	7691	3852	3852	2565	7688
1757	2134	PHDLY2	8990	12850	8990	8990	12850	8976	8976	8990	8990	12825	12850
1782	2159	DGCSMM	0	0	0	0	0	0	0	0	0	0	0
1783	2160	TRQCUP	0	0	0	0	0	0	0	0	0	0	0
1784	2161	OVC STP	0	0	0	0	0	0	0	0	0	0	0
1785	2162	OVC2 K1	32766	32767	32766	32766	32766	32765	32765	32762	32762	32766	32766
1786	2163	OVC2 K2	19	13	20	20	23	42	42	74	74	20	20
1787	2164	OVC2 LIMIT	3617	2425	3723	931	4261	7551	1888	12305	3076	3776	3711
1788	2165	MAX CURRENT	10	25	25	45	25	25	45	25	45	25	10
2716	2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2717	2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2718	2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2723	2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2729	2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0

Remarks											

		Motor model	βiS4 4000HV	αiS4 5000	αiS4 5000HV	βiS8 3000HV	βiS12/2000 40A	βiS12 2000	βiS12 3000HV	αC4 3000i	βiS12 3000	αiF4 4000	βiS22 2000
		Motor specification	0064	0215	0216	0076	0077-Bxx3	0077-Bxx3	0079	0221	0078	0223	0085
FS15i	FS16i,etc.	Motor ID No.	164	165	166	167	168	169	170	171	172	173	174
PRM. NO.	PRM. NO.	SYMBOL											
1808	2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
1809	2004		00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110
1883	2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1884	2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1951	2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1952	2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1953	2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1954	2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1955	2011		00000000	00100000	00100000	00000000	00000000	00000000	00000000	00000000	00000000	00100000	00000000
1956	2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1707	2013		00000000	00000000	00000000	00000000	00001110	00000000	00000000	00000000	00000000	00000000	00000000
1708	2014		00000000	00000000	00000000	00000000	00001110	00000000	00000000	00000000	00000000	00000000	00000000
1750	2210		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1751	2211		00001110	00000010	00000010	00001110	00001110	00001110	00001110	00001000	00001110	00000010	00001110
2713	2300		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2714	2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1852	2040	CUR GAIN I	309	400	280	580	951	320	361	926	400	659	750
1853	2041	CUR GAIN P	-1092	-1154	-988	-2070	-3525	-1958	-1521	-4063	-1550	-2463	-3280
1854	2042	CUR GAIN 3	-2496	-2553	-2533	-2600	-1246	-1246	-2604	-2619	-1243	-2623	-1296
1855	2043	VEL GAIN I	112	64	64	166	115	230	170	115	170	106	242
1856	2044	VEL GAIN P	-1010	-574	-574	-1482	-1027	-2054	-1524	-1034	-1530	-953	-2172
1857	2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
1858	2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
1859	2047	OBSERVER POA1	-751	6614	-661	5118	7390	3695	4978	3670	4960	3980	3496
1860	2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
1861	2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
1862	2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
1863	2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
1864	2052	OVER SPEED	5600	7000	7000	4200	2800	2800	4200	4200	4200	5600	2700
1865	2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
1866	2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
1867	2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
1868	2056	EMFCMP	0	-5140	0	0	0	0	0	0	-30	-20	0
1869	2057	D-PHASE CUR	-7700	-10262	-8978	-5144	-3862	-3884	-5140	-5915	-5140	-11789	-3616
1870	2058	D-PHASE CUR	-3000	-3500	-4000	-3500	-2200	-4400	-3200	-1500	-2700	-180	-2800
1871	2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
1872	2060	TCMD LIMIT	7282	7282	7282	7282	3641	7282	7282	7282	7282	8010	7282
1873	2061	EMFLMT	0	0	0	0	0	0	0	0	0	0	0
1877	2062	OVC K1	32299	32289	32289	32301	32646	32284	32435	32406	32205	32446	32106
1878	2063	OVC K2	5865	5994	5994	5842	1520	6045	4164	4529	7041	4029	8275
1892	2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
1893	2065	OVC LIMIT	17504	17889	17889	17435	4511	18045	12399	13493	21044	11998	24770
1894	2066	ACC FB GAIN	-10	0	0	-10	-10	-10	-10	0	-10	0	-10
1895	2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
1961-1966	2068-2073		0	0	0	0	0	0	0	0	0	0	0
1967	2074	AALPH	8192	0	12288	12288	0	8192	20480	12288	16384	8192	12288
1970-1976	2077-2083		0	0	0	0	0	0	0	0	0	0	0
1979	2086	RATED CURRENT	2155	2824	2824	2793	1563	3126	2356	1892	2363	1784	2618
1980-1982	2087-2089		0	0	0	0	0	0	0	0	0	0	0
1983	2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
1984-1991	2091-2098		0	0	0	0	0	0	0	0	0	0	0
1992	2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
1993	2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
1994	2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
1995	2102	DBLIM	0	0	8500	0	0	0	0	0	0	15000	0
1996	2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
1997	2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
1998	2105	TORQUE CONST.	146	127	127	225	630	315	420	190	418	201	692
1999	2106	LP24PA	0	0	0	0	0	0	0	0	0	0	0
1700-1702	2107-2109		0	0	0	0	0	0	0	0	0	0	0
1703	2110	MGSTCM	777	24	32	1805	1282	1	1814	1289	1814	32	0
1704	2111	TQLIM IN DEC.	7790	10310	10290	7930	3940	3940	7930	3900	7930	5130	2866
1705	2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
1706	2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
1735	2127	NINTCT	1592	646	500	2885	1350	1350	2388	2544	1194	1443	2459
1736	2128	MFWKCE	1000	2500	3000	1500	8000	4000	3000	5000	3000	2000	4500
1752	2129	MFWKBL	3339	3847	5122	1552	280	280	2056	1812	2056	3338	562
1753-1755	2130-2132	SMOOTH CMP	0	0	0	0	0	0	0	0	0	0	0
1756	2133	PHDLY1	7686	2563	7692	3848	1812	1832	5133	3855	5133	6670	3089
1757	2134	PHDLY2	8976	12820	12850	8990	7700	8980	8978	8995	8978	8980	8982
1782	2159	DGCSMM	0	0	0	0	0	0	0	0	0	0	0
1783	2160	TRQCUP	0	0	0	0	0	0	0	0	0	0	0
1784	2161	OVC STP	0	0	0	0	0	0	0	0	0	0	0
1785	2162	OVC2 K1	32765	32762	32762	32762	32766	32760	32764	32766	32764	32766	32763
1786	2163	OVC2 K2	41	77	77	75	21	99	50	31	51	27	64
1787	2164	OVC2 LIMIT	7395	12702	12702	12424	3890	15559	8836	5701	8891	5069	10913
1788	2165	MAX CURRENT	10	25	10	10	45	25	25	25	45	45	45
2716	2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2717	2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2718	2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2723	2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2729	2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0

Remarks											

		Motor model	αiF4 4000HV	αC8 2000i	αiF8 3000	βiS22 2000HV	αiF8 3000HV	βiS0.5 6000	βiS1 6000	βiSc8 3000	αiS8 4000	αiS8 4000HV	αiS12 4000
		Motor specification	0225	0226	0227	0086	0229	0115	0116	0075-Bxx7	0235	0236	0238
FS15i	FS16i,etc.	Motor ID No.	175	176	177	178	179	181	182	183	185	186	188
PRM. NO.	PRM. NO.	SYMBOL											
1808	2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
1809	2004		00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110
1883	2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1884	2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1951	2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1952	2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1953	2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1954	2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1955	2011		00100000	00000000	00000000	00000000	00100000	00000000	00000000	00000000	00000000	00000000	00000000
1956	2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1707	2013		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1708	2014		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1750	2210		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1751	2211		00000010	00001010	00001010	00001110	00000000	00000010	00000010	00001110	00001010	00001010	00001010
2713	2300		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2714	2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1852	2040	CUR GAIN I	525	1096	712	1025	886	141	398	450	544	694	657
1853	2041	CUR GAIN P	-2056	-4638	-3187	-4010	-3174	-511	-1137	-1840	-2352	-2700	-2522
1854	2042	CUR GAIN 3	-2619	-2651	-2651	-2665	-2645	-2415	-2388	-1234	-2616	-2636	-2639
1855	2043	VEL GAIN I	113	150	113	244	113	7	6	164	33	34	52
1856	2044	VEL GAIN P	-1009	-1342	-1009	-2182	-1008	-59	-53	-1476	-294	-306	-466
1857	2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
1858	2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
1859	2047	OBSERVER POA1	3762	2827	3760	3478	3764	-6462	-7176	5143	-1289	-1240	-815
1860	2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
1861	2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
1862	2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
1863	2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
1864	2052	OVER SPEED	5400	2800	4200	2700	3900	7500	7500	4200	5600	5600	5600
1865	2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
1866	2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
1867	2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
1868	2056	EMFCMP	0	0	0	0	0	-12850	-12850	-30	0	0	0
1869	2057	D-PHASE CUR	0	-3854	-6418	-3616	-6159	0	-11530	-5144	-7691	-7690	-5904
1870	2058	D-PHASE CUR	0	-1236	-3000	-2800	-1261	0	-1000	-2700	-2000	-2000	-2400
1871	2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
1872	2060	TCMD LIMIT	7282	7282	8010	7282	8010	6918	7282	7282	7282	7282	7282
1873	2061	EMFLMT	0	0	0	0	0	0	0	0	0	0	0
1877	2062	OVC K1	32433	32289	32383	32433	32433	32674	32695	32381	32609	32596	32534
1878	2063	OVC K2	4184	5994	4807	4185	4184	1178	915	4835	1993	2153	2923
1892	2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
1893	2065	OVC LIMIT	12461	17889	14327	12462	12461	3497	2714	14410	5920	6396	8692
1894	2066	ACC FB GAIN	0	0	0	-10	0	0	0	-10	0	0	0
1895	2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
1961-1966	2068-2073		0	0	0	0	0	0	0	0	0	0	0
1967	2074	AALPH	12288	8192	12288	12288	16384	20480	20480	16384	8192	8192	4096
1970-1976	2077-2083		0	0	0	0	0	0	0	0	0	0	0
1979	2086	RATED CURRENT	1888	2593	1950	2611	1948	1376	1212	2780	1253	1302	1518
1980-1982	2087-2089		0	0	0	0	0	0	0	0	0	0	0
1983	2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
1984-1991	2091-2098		0	0	0	0	0	0	0	0	0	0	0
1992	2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
1993	2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
1994	2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
1995	2102	DBLIM	15000	0	0	0	15000	0	0	0	0	0	0
1996	2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
1997	2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
1998	2105	TORQUE CONST.	190	277	369	689	369	42	89	226	562	541	696
1999	2106	LP24PA	0	0	0	0	0	0	0	0	0	0	0
1700-1702	2107-2109		0	0	0	0	0	0	0	0	0	0	0
1703	2110	MGSTCM	1032	1552	786	0	782	30	30	1805	519	519	521
1704	2111	TQLIM IN DEC.	12388	3880	5180	2866	0	10290	10290	7930	7780	7268	5170
1705	2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
1706	2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
1735	2127	NINTCT	2573	2380	2103	5149	4191	1009	1763	1442	2106	5103	1592
1736	2128	MFWKCE	4000	4500	1500	2500	6000	0	0	3500	4000	4500	3000
1752	2129	MFWKBL	3348	1550	1815	562	1810	0	0	1552	2580	2580	2570
1753-1755	2130-2132	SMOOTH CMP	0	0	0	0	0	0	0	0	0	0	0
1756	2133	PHDLY1	6670	3860	5140	3089	0	7690	11560	3852	5652	5150	5135
1757	2134	PHDLY2	8980	8990	8985	8982	0	12820	12880	8990	8990	8990	9000
1782	2159	DGCSMM	0	0	0	0	0	0	0	0	0	0	0
1783	2160	TRQCUP	0	0	0	0	0	0	0	0	0	0	0
1784	2161	OVC STP	0	0	0	0	0	0	0	0	0	0	0
1785	2162	OVC2 K1	32766	32763	32765	32763	32765	32767	32767	32764	32767	32767	32766
1786	2163	OVC2 K2	31	63	33	64	33	16	12	51	13	14	19
1787	2164	OVC2 LIMIT	5676	10709	6053	10854	6042	3015	2340	8896	2501	2702	3672
1788	2165	MAX CURRENT	25	25	45	25	25	25	25	25	85	45	85
2716	2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2717	2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2718	2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2723	2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2729	2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0

Remarks											

		Motor model	αiS12 4000HV	αC12 2000i	αiF12 3000	βiSc8/3000 40A	αiF12 3000HV	αC22 2000i	αiF22 3000	βiSc12 2000	αiF22 3000HV	βiSc12/2000 40A	αC30 1500i
		Motor specification	0239	0241	0243	0075-Bxx7	0245	0246	0247	0077-Bxx7	0249	0077-Bxx7	0251
FS15i	FS16i,etc.	Motor ID No.	189	191	193	194	195	196	197	198	199	200	201
PRM. NO.	PRM. NO.	SYMBOL											
1808	2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
1809	2004		00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110
1883	2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1884	2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1951	2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1952	2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1953	2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1954	2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1955	2011		00000000	00100000	00100000	00000000	00100000	00000000	00100000	00000000	00100000	00000000	00000000
1956	2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1707	2013		00000000	00000000	00000000	00001110	00000000	00000000	00000000	00000000	00000000	00001110	00000000
1708	2014		00000000	00000000	00000000	00001110	00000000	00000000	00000000	00000000	00000000	00001110	00000000
1750	2210		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1751	2211		00001010	00000010	00000000	00001110	00000000	00001010	00000000	00001110	00000000	00001110	00001010
2713	2300		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2714	2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1852	2040	CUR GAIN I	783	3809	1072	900	1044	1755	1458	320	1532	951	2644
1853	2041	CUR GAIN P	-3006	-8197	-3835	-3680	-3677	-6536	-5416	-1958	-5641	-3525	-10345
1854	2042	CUR GAIN 3	-2666	-2679	-2630	-1234	-2679	-2694	-2690	-1246	-2692	-1246	-2695
1855	2043	VEL GAIN I	52	280	192	82	193	271	198	230	197	115	166
1856	2044	VEL GAIN P	-470	-2504	-1721	-738	-1727	-2426	-1775	-2054	-1765	-1027	-1486
1857	2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
1858	2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
1859	2047	OBSERVER POA1	-808	1516	2204	-1029	2197	1565	2137	3695	2150	7390	2553
1860	2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
1861	2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
1862	2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
1863	2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
1864	2052	OVER SPEED	5600	2800	4800	4200	4800	2400	3600	2800	3600	2800	2100
1865	2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
1866	2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
1867	2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
1868	2056	EMFCMP	-20	0	-5140	0	-20	0	-2590	0	0	0	0
1869	2057	D-PHASE CUR	-5904	-1804	-8199	-5133	-8214	-2597	-5136	-3884	-4392	-3862	-1545
1870	2058	D-PHASE CUR	-3000	-2500	-747	-1350	-2350	-1942	-2800	-4400	-2824	-2200	-1300
1871	2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
1872	2060	TCMD LIMIT	7282	7282	7282	3641	7282	8010	7282	7282	7282	3641	7282
1873	2061	EMFLMT	0	0	0	0	0	0	0	0	0	0	0
1877	2062	OVC K1	32530	32289	32520	32671	32548	32114	32520	32323	32548	32646	32520
1878	2063	OVC K2	2976	5994	3101	1214	2755	8171	3101	5566	2755	1520	3101
1892	2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
1893	2065	OVC LIMIT	8848	17889	9224	3603	8192	24454	9224	16603	8192	4511	9224
1894	2066	ACC FB GAIN	0	0	0	-5	0	0	0	-10	0	-10	0
1895	2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
1961-1966	2068-2073		0	0	0	0	0	0	0	0	0	0	0
1967	2074	AALPH	8192	8192	8192	0	12288	8192	8192	8192	8192	0	8192
1970-1976	2077-2083		0	0	0	0	0	0	0	0	0	0	0
1979	2086	RATED CURRENT	1532	3020	2085	1390	2092	2911	2131	3126	2118	1563	1655
1980-1982	2087-2089		0	0	0	0	0	0	0	0	0	0	0
1983	2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
1984-1991	2091-2098		0	0	0	0	0	0	0	0	0	0	0
1992	2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
1993	2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
1994	2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
1995	2102	DBLIM	0	15000	15000	0	15000	0	15000	0	15000	0	0
1996	2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
1997	2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
1998	2105	TORQUE CONST.	690	350	517	452	516	680	929	315	934	630	1630
1999	2106	LP24PA	0	0	0	0	0	0	0	0	0	0	0
1700-1702	2107-2109		0	0	0	0	0	0	0	0	0	0	0
1703	2110	MGSTCM	521	0	32	794	774	1548	1291	1	787	1282	2059
1704	2111	TQLIM IN DEC.	6159	2168	0	7930	0	2600	0	3940	0	3940	2148
1705	2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
1706	2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
1735	2127	NINTCT	4904	4150	2388	1442	4787	3695	3272	1350	6547	1350	6680
1736	2128	MFWKCE	2000	12000	2000	7000	4000	4000	4500	4000	6000	8000	14000
1752	2129	MFWKBL	2575	1044	2568	1552	2320	1046	1301	280	1808	280	539
1753-1755	2130-2132	SMOOTH CMP	0	0	0	0	0	0	0	0	0	0	0
1756	2133	PHDLY1	6174	5150	0	3852	0	2070	0	1832	0	1812	1054
1757	2134	PHDLY2	8990	8990	0	8990	0	9000	0	8980	0	7700	9000
1782	2159	DGCSMM	0	0	0	0	0	0	0	0	0	0	0
1783	2160	TRQCUP	0	0	0	0	0	0	0	0	0	0	0
1784	2161	OVC STP	0	0	0	0	0	0	0	0	0	0	0
1785	2162	OVC2 K1	32766	32761	32765	32767	32765	32761	32765	32763	32765	32767	32766
1786	2163	OVC2 K2	20	91	38	12	39	83	40	60	40	15	23
1787	2164	OVC2 LIMIT	3738	14518	6924	2224	6969	13493	7229	10250	7142	2785	4361
1788	2165	MAX CURRENT	45	25	85	45	45	45	85	25	45	45	85
2716	2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2717	2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2718	2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2723	2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2729	2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0

Remarks											

		Motor model	βiS22/1500 FS0i	αiF30 3000	βiS22/1500 FS0i 40A	βiSc2 4000	αiF40 3000	αiF40 3000Fan	βiSc2/4000 40A	βiSc4 4000	βiSc4/4000 40A	βiS22 3000	βiS22 3000HV
		Motor specification	0084-Bxx6	0253	0084-Bxx6	0061-Bxx7	0257	0257	0061-Bxx7	0063-Bxx7	0063-Bxx7	0082	0083
FS15i	FS16i,etc.	Motor ID No.	202	203	205	206	207	208	210	211	212	213	214
PRM. NO.	PRM. NO.	SYMBOL											
1808	2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
1809	2004		00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110
1883	2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1884	2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1951	2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1952	2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1953	2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1954	2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1955	2011		00000000	00000000	00000000	00100000	00100000	00100000	00100000	00000000	00000000	00000000	00000000
1956	2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1707	2013		00000000	00000000	00001110	00000100	00000000	00000000	00010000	00000000	00001110	00001000	00001000
1708	2014		00000000	00000000	00001110	00000100	00000000	00000000	00010000	00000000	00001110	00001000	00001000
1750	2210		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1751	2211		00001110	00001010	00001110	00000010	00001010	00001010	00000010	00001110	00001110	00001110	00001110
2713	2300		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2714	2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1852	2040	CUR GAIN I	1048	597	4342	280	1289	1289	560	288	576	646	775
1853	2041	CUR GAIN P	-4337	-2334	-11170	-1080	-5048	-5048	-2160	-960	-1920	-2486	-3580
1854	2042	CUR GAIN 3	-2659	-2694	-1329	-1112	-2696	-2696	-1112	-1144	-1144	-1298	-2663
1855	2043	VEL GAIN I	280	230	140	78	191	191	39	112	56	198	192
1856	2044	VEL GAIN P	-2507	-2057	-1254	-698	-1712	-1712	-349	-1008	-504	-1766	-1722
1857	2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
1858	2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
1859	2047	OBSERVER POA1	3027	1845	6054	-1089	2216	2216	-2178	-753	-1506	4297	4406
1860	2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
1861	2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
1862	2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
1863	2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
1864	2052	OVER SPEED	1800	4800	1800	5600	4200	4200	5600	5600	5600	4200	4200
1865	2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
1866	2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894	1894
1867	2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
1868	2056	EMFCMP	0	0	0	0	0	0	0	-20	0	0	0
1869	2057	D-PHASE CUR	-2110	-5170	-2079	-10250	-2570	-2570	-10245	-7700	-7690	-6174	-6174
1870	2058	D-PHASE CUR	-4691	-1000	-2342	-1000	-2000	-2000	-500	-2240	-1120	-2843	-2843
1871	2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
1872	2060	TCMD LIMIT	7282	7282	3641	6554	7282	7282	3277	7282	3641	5462	5462
1873	2061	EMFLMT	0	0	0	0	0	0	0	0	0	0	0
1877	2062	OVC K1	32319	32515	32655	32652	32515	32431	32739	32532	32709	32520	32548
1878	2063	OVC K2	5617	3166	1411	1455	3166	4212	364	2945	738	3097	2755
1892	2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
1893	2065	OVC LIMIT	16756	9418	4189	4317	9418	12545	1079	8758	2189	9212	8192
1894	2066	ACC FB GAIN	-10	0	-10	-10	0	0	-5	-10	-5	-10	-10
1895	2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
1961-1966	2068-2073		0	0	0	0	0	0	0	0	0	0	0
1967	2074	AALPH	8192	8192	0	20480	8192	8192	0	20480	0	8192	8192
1970-1976	2077-2083		0	0	0	0	0	0	0	0	0	0	0
1979	2086	RATED CURRENT	3012	2306	1506	1529	1957	2593	764	2178	1089	2121	2069
1980-1982	2087-2089		0	0	0	0	0	0	0	0	0	0	0
1983	2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
1984-1991	2091-2098		0	0	0	0	0	0	0	0	0	0	0
1992	2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
1993	2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
1994	2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
1995	2102	DBLIM	0	0	0	15000	15000	15000	7500	0	0	0	0
1996	2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
1997	2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
1998	2105	TORQUE CONST.	597	1170	1194	119	1839	1839	238	146	292	848	869
1999	2106	LP24PA	0	0	0	0	0	0	0	0	0	0	0
1700-1702	2107-2109		0	0	0	0	0	0	0	0	0	0	0
1703	2110	MGSTCM	1025	1032	514	1050	1291	1291	564	782	284	1289	1289
1704	2111	TQLIM IN DEC.	2248	7735	2248	11600	5140	5140	11600	7790	7790	7268	7268
1705	2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
1706	2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
1735	2127	NINTCT	3290	1688	3290	1172	3041	3041	1172	796	796	1967	3894
1736	2128	MFWKCE	5500	2500	11000	3000	2000	2000	6000	1000	2000	6000	6000
1752	2129	MFWKBL	1032	2829	1032	2574	1553	1553	2574	3130	3130	2315	2315
1753-1755	2130-2132	SMOOTH CMP	0	0	0	0	0	0	0	0	0	0	0
1756	2133	PHDLY1	2580	5140	2580	7188	3087	3087	7188	7691	7691	5647	5647
1757	2134	PHDLY2	8990	8995	4382	8990	8990	8990	8990	8976	8976	12820	12820
1782	2159	DGCSMM	0	0	0	0	0	0	0	0	0	0	0
1783	2160	TRQCUP	0	0	0	0	0	0	0	0	0	0	0
1784	2161	OVC STP	0	128	0	120	128	128	120	120	120	0	0
1785	2162	OVC2 K1	32763	32764	32767	32757	32764	32717	32765	32745	32762	32765	32765
1786	2163	OVC2 K2	60	48	14	140	46	637	34	294	70	40	38
1787	2164	OVC2 LIMIT	10345	8124	2586	2665	8124	10815	666	5407	1352	7166	6815
1788	2165	MAX CURRENT	25	165	45	25	165	165	45	25	45	85	45
2716	2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2717	2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2718	2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2723	2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2729	2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0

Remarks											

		Motor model	αiS22 4000	αiS22 4000HV	αiS30 4000	αiS30 4000HV	αiS40 4000	αiS40 4000HV	αiS50 3000	αiS50 3000Fan	αiS50 3000HVFan	αiS50 3000HV	αiS100 2500Fan
		Motor specification	0265	0266	0268	0269	0272	0273	0275	0275	0276	0276	0285
FS15i	FS16i,etc.	Motor ID No.	215	216	218	219	222	223	224	225	226	227	230
PRM. NO.	PRM. NO.	SYMBOL											
1808	2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
1809	2004		00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110	01000110	01000110	00000110
1883	2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1884	2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1951	2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1952	2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1953	2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1954	2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1955	2011		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1956	2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1707	2013		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1708	2014		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1750	2210		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1751	2211		00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010
2713	2300		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2714	2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1852	2040	CUR GAIN I	714	709	689	816	748	860	528	528	680	680	874
1853	2041	CUR GAIN P	-2904	-2806	-2675	-3277	-3055	-3457	-2088	-2088	-2961	-2961	-4483
1854	2042	CUR GAIN 3	-2674	-1345	-2683	-2696	-2682	-2700	-2690	-2690	-2697	-2697	-2717
1855	2043	VEL GAIN I	69	76	82	82	92	93	69	69	70	70	91
1856	2044	VEL GAIN P	-616	-685	-733	-738	-827	-831	-622	-622	-628	-628	-819
1857	2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
1858	2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
1859	2047	OBSERVER POA1	6163	5538	5175	5143	4589	4569	6099	6099	6039	6039	4632
1860	2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
1861	2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
1862	2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
1863	2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
1864	2052	OVER SPEED	5600	5600	5400	5400	4800	4800	4200	4200	4200	4200	0
1865	2053	DB-CMP PPMAX	21	21	21	21	21	21	31979	31979	31979	31979	21
1866	2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	3	3	3	3	1894
1867	2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
1868	2056	EMFCMP	0	0	0	0	0	0	0	0	0	0	0
1869	2057	D-PHASE CUR	-7689	-7684	-6415	-6415	-5648	-5652	-5646	-5646	-5646	-5646	-4368
1870	2058	D-PHASE CUR	-2000	-1000	-3000	-3000	-3000	-3600	-2000	-2000	-2000	-2000	-1359
1871	2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
1872	2060	TCMD LIMIT	7282	7282	7282	7282	7282	7282	7282	7282	7282	7282	7282
1873	2061	EMFLMT	0	0	0	0	0	0	0	0	0	0	0
1877	2062	OVC K1	32515	32501	32515	32501	32515	32501	32558	32348	32371	32554	32309
1878	2063	OVC K2	3166	3332	3166	3332	3166	3332	2627	5245	4967	2680	5734
1892	2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
1893	2065	OVC LIMIT	9418	9912	9418	9912	9418	9912	7810	15639	14807	7968	27346
1894	2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
1895	2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
1961-1966	2068-2073		0	0	0	0	0	0	0	0	0	0	0
1967	2074	AALPH	4096	8192	4096	4096	4096	4096	4096	4096	0	0	20480
1970-1976	2077-2083		0	0	0	0	0	0	0	0	0	0	0
1979	2086	RATED CURRENT	1627	1810	1836	1847	2073	2083	1439	2037	2057	1454	2848
1980-1982	2087-2089		0	0	0	0	0	0	0	0	0	0	0
1983	2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
1984-1991	2091-2098		0	0	0	0	0	0	0	0	0	0	0
1992	2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
1993	2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
1994	2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
1995	2102	DBLIM	0	0	0	15000	15000	15000	7500	0	0	0	0
1996	2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
1997	2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
1998	2105	TORQUE CONST.	1216	1093	1470	1460	1701	1693	3312	3312	3279	3279	4589
1999	2106	LP24PA	0	0	0	0	0	0	0	0	0	0	0
1700-1702	2107-2109		0	0	0	0	0	0	0	0	0	0	0
1703	2110	MGSTCM	519	513	775	775	776	769	519	519	519	519	776
1704	2111	TQLIM IN DEC.	6224	6194	6450	6430	5682	5682	6174	6174	6174	6174	3787
1705	2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
1706	2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
1735	2127	NINTCT	2041	4264	1871	5117	1853	5230	2046	2046	4861	4861	3520
1736	2128	MFWKCE	2500	2000	4000	3000	4000	4000	6500	6500	2500	2500	6500
1752	2129	MFWKBL	2580	3092	2574	2574	2063	2063	2063	2063	2068	2068	1297
1753-1755	2130-2132	SMOOTH CMP	0	0	0	0	0	0	0	0	0	0	0
1756	2133	PHDLY1	5150	5150	5150	5150	5150	5150	5150	5150	5140	5140	2570
1757	2134	PHDLY2	8990	8990	8990	8990	8988	8988	8990	8990	9000	9000	8970
1782	2159	DGCSMM	0	0	0	0	0	0	0	0	0	0	0
1783	2160	TRQCUP	0	0	0	0	0	0	0	0	0	0	0
1784	2161	OVC STP	128	0	128	0	128	0	0	0	0	0	140
1785	2162	OVC2 K1	32766	32766	32765	32766	32765	32765	32754	32739	32738	32754	32745
1786	2163	OVC2 K2	28	28	37	30	38	38	174	365	373	178	292
1787	2164	OVC2 LIMIT	5177	5218	6687	5432	6846	6908	3300	6608	6736	3366	13952
1788	2165	MAX CURRENT	165	85	165	85	165	85	365	365	185	185	365
2716	2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2717	2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2718	2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2723	2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2729	2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0

Remarks											

		Motor model	αiS100 2500HVFan	αiS200 2500Fan	αiS100 2500	αiS100 2500HV	αiS200 2500HVFan	αiS200 2500	αiS200 2500HV	αiS300 2000	αiS300 2000HV	αiS500 2000	αiS500 2000HV
		Motor specification	0286	0288	0285	0286	0289	0288	0289	0292	0293	0295	0296
FS15i	FS16i,etc.	Motor ID No.	231	234	235	236	237	238	239	242	243	245	246
PRM. NO.	PRM. NO.	SYMBOL											
1808	2003		00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
1809	2004		00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110	01000110	00000110	01000110
1883	2005		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1884	2006		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1951	2007		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1952	2008		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1953	2009		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1954	2010		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1955	2011		00100000	00000000	00000000	00100000	00000000	00000000	00000000	00100000	00000000	00000000	00000000
1956	2012		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1707	2013		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1708	2014		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1750	2210		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1751	2211		00000000	00001010	00001010	00000000	00001010	00001010	00001010	00000000	00001010	00001010	00001010
2713	2300		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2714	2301		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1852	2040	CUR GAIN I	980	1309	874	980	1194	1309	1194	1357	1077	1943	1713
1853	2041	CUR GAIN P	-4082	-5199	-4483	-4082	-5535	-5199	-5535	-4212	-5101	-6970	-6505
1854	2042	CUR GAIN 3	-2718	-2719	-2717	-2718	-2719	-2719	-2719	-2710	-2712	-2711	-2713
1855	2043	VEL GAIN I	91	115	91	91	115	115	115	114	114	134	134
1856	2044	VEL GAIN P	-819	-1026	-819	-819	-1026	-1026	-1026	-1023	-1025	-1199	-1199
1857	2045	VEL GAIN 3	0	0	0	0	0	0	0	0	0	0	0
1858	2046	VEL GAIN 4	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235	-8235
1859	2047	OBSERVER POA1	4636	3699	4632	4636	3699	3699	3699	3709	3703	3164	3164
1860	2048	BLACC CMP	0	0	0	0	0	0	0	0	0	0	0
1861	2049	DPFMX	0	0	0	0	0	0	0	0	0	0	0
1862	2050	OBSERVER POK1	956	956	956	956	956	956	956	956	956	956	956
1863	2051	OBSERVER POK2	510	510	510	510	510	510	510	510	510	510	510
1864	2052	OVER SPEED	0	0	0	0	0	0	0	0	0	0	0
1865	2053	DB-CMP PPMAX	21	21	21	21	21	21	21	21	21	21	21
1866	2054	DB-CMP PDDP	1894	1894	1894	1894	1894	1894	1894	3787	3787	1894	3787
1867	2055	DB-CMP PHYST	319	319	319	319	319	319	319	319	319	319	319
1868	2056	EMFCMP	0	0	0	0	0	0	0	0	0	0	0
1869	2057	D-PHASE CUR	-3846	-3090	-4368	-3846	-3088	-3090	-3088	-3850	-3846	-2068	-2070
1870	2058	D-PHASE CUR	-900	-2700	-1359	-900	-3000	-2700	-3000	-800	-900	-2600	-2700
1871	2059	PPBAS	0	0	0	0	0	0	0	0	0	0	0
1872	2060	TCMD LIMIT	7282	7282	7282	7282	7282	7282	7282	7282	7282	7282	7282
1873	2061	EMFLMT	0	0	0	0	0	0	0	0	0	0	0
1877	2062	OVC K1	32309	32309	32310	32474	32309	32309	32309	32391	32391	32309	32309
1878	2063	OVC K2	5734	5734	5728	3672	5734	5734	5734	4714	4714	5734	5734
1892	2064	TGALMLV	4	4	4	4	4	4	4	4	4	4	4
1893	2065	OVC LIMIT	27346	27346	15662	15982	27346	27346	27346	23263	23263	27346	27346
1894	2066	ACC FB GAIN	0	0	0	0	0	0	0	0	0	0	0
1895	2067	TCMD FILTER	0	0	0	0	0	0	0	0	0	0	0
1961-1966	2068-2073		0	0	0	0	0	0	0	0	0	0	0
1967	2074	AALPH	12288	12288	20480	12288	12288	12288	12288	12288	12288	12288	12288
1970-1976	2077-2083		0	0	0	0	0	0	0	0	0	0	0
1979	2086	RATED CURRENT	2848	3013	1960	2033	3013	2712	2712	2483	2483	2980	2980
1980-1982	2087-2089		0	0	0	0	0	0	0	0	0	0	0
1983	2090	ROBSTL	0	0	0	0	0	0	0	0	0	0	0
1984-1991	2091-2098		0	0	0	0	0	0	0	0	0	0	0
1992	2099	ONEPSL	400	400	400	400	400	400	400	400	400	400	400
1993	2100	INPA1	0	0	0	0	0	0	0	0	0	0	0
1994	2101	INPA2	0	0	0	0	0	0	0	0	0	0	0
1995	2102	DBLIM	10000	0	0	10000	0	0	0	15000	0	0	0
1996	2103	ABVOF	0	0	0	0	0	0	0	0	0	0	0
1997	2104	ABTSH	0	0	0	0	0	0	0	0	0	0	0
1998	2105	TORQUE CONST.	4423	5973	4589	4423	5973	5973	5973	10871	10871	15096	15096
1999	2106	LP24PA	0	0	0	0	0	0	0	0	0	0	0
1700-1702	2107-2109		0	0	0	0	0	0	0	0	0	0	0
1703	2110	MGSTCM	1291	1290	776	1291	1291	1290	1291	16	1296	1296	1293
1704	2111	TQLIM IN DEC.	0	0	3787	0	3428	0	3428	1606	0	0	3714
1705	2112	AMRDML	0	0	0	0	0	0	0	0	0	0	0
1706	2113	HRV FILT	0	0	0	0	0	0	0	0	0	0	0
1735	2127	NINTCT	6952	3518	3520	6952	6729	3518	6729	0	7634	4175	8341
1736	2128	MFWKCE	2000	4000	6500	2000	4000	4000	4000	5500	5000	4000	4500
1752	2129	MFWKBL	1549	1298	1297	1549	1551	1298	1551	791	1301	1041	788
1753-1755	2130-2132	SMOOTH CMP	0	0	0	0	0	0	0	0	0	0	0
1756	2133	PHDLY1	0	2068	2570	0	2575	2068	2575	1556	2574	2069	2324
1757	2134	PHDLY2	0	12820	8970	0	8984	12820	8984	20494	12814	8981	8984
1782	2159	DGCSMM	0	0	0	0	0	0	0	0	0	0	0
1783	2160	TRQCUP	0	0	0	0	0	0	0	0	0	0	0
1784	2161	OVC STP	140	140	140	106	140	140	140	140	140	140	140
1785	2162	OVC2 K1	32745	32745	32750	32759	32745	32745	32745	32738	32738	32745	32745
1786	2163	OVC2 K2	292	292	223	112	292	292	292	375	375	292	292
1787	2164	OVC2 LIMIT	13952	13952	6581	6752	13952	13952	13952	13952	13952	13952	13952
1788	2165	MAX CURRENT	185	365	365	185	185	365	185	365	365	365	365
2716	2302	TQLIM AT STOP	0	0	0	0	0	0	0	0	0	0	0
2717	2304	ACCBSLM	0	0	0	0	0	0	0	0	0	0	0
2718	2305	ACDCEBD	0	0	0	0	0	0	0	0	0	0	0
2723	2310	DCIDBS	0	0	0	0	0	0	0	0	0	0	0
2729	2316	LIMLIM	0	0	0	0	0	0	0	0	0	0	0

Remarks											

		Motor model	αiS1000 2000HV										
		Motor specification	0298										
FS15i	FS16i,etc.	Motor ID No.	248										
PRM. NO.	PRM. NO.	SYMBOL											
1808	2003		00001000										
1809	2004		01000110										
1883	2005		00000000										
1884	2006		00000000										
1951	2007		00000000										
1952	2008		00000000										
1953	2009		00000000										
1954	2010		00000000										
1955	2011		00100000										
1956	2012		00000000										
1707	2013		00000000										
1708	2014		00000000										
1750	2210		00000000										
1751	2211		00000010										
2713	2300		00000000										
2714	2301		00000000										
1852	2040	CUR GAIN I	1053										
1853	2041	CUR GAIN P	-3316										
1854	2042	CUR GAIN 3	-2722										
1855	2043	VEL GAIN I	234										
1856	2044	VEL GAIN P	-2096										
1857	2045	VEL GAIN 3	0										
1858	2046	VEL GAIN 4	-8235										
1859	2047	OBSERVER POA1	1811										
1860	2048	BLACC CMP	0										
1861	2049	DPFMX	0										
1862	2050	OBSERVER POK1	956										
1863	2051	OBSERVER POK2	510										
1864	2052	OVER SPEED	0										
1865	2053	DB-CMP PPMAX	21										
1866	2054	DB-CMP PDDP	3787										
1867	2055	DB-CMP PHYST	319										
1868	2056	EMFCMP	0										
1869	2057	D-PHASE CUR	-3097										
1870	2058	D-PHASE CUR	-2000										
1871	2059	PPBAS	0										
1872	2060	TCMD LIMIT	7282										
1873	2061	EMFLMT	0										
1877	2062	OVC K1	32309										
1878	2063	OVC K2	5734										
1892	2064	TGALMLV	4										
1893	2065	OVC LIMIT	27346										
1894	2066	ACC FB GAIN	0										
1895	2067	TCMD FILTER	0										
1961-1966	2068-2073		0										
1967	2074	AALPH	12288										
1970-1976	2077-2083		0										
1979	2086	RATED CURRENT	2834										
1980-1982	2087-2089		0										
1983	2090	ROBSTL	0										
1984-1991	2091-2098		0										
1992	2099	ONEPSL	400										
1993	2100	INPA1	0										
1994	2101	INPA2	0										
1995	2102	DBLIM	15000										
1996	2103	ABVOF	0										
1997	2104	ABTSH	0										
1998	2105	TORQUE CONST.	28573										
1999	2106	LP24PA	0										
1700-1702	2107-2109		0										
1703	2110	MGSTCM	1296										
1704	2111	TQLIM IN DEC.	3172										
1705	2112	AMRDML	0										
1706	2113	HRV FILT	0										
1735	2127	NINTCT	8637										
1736	2128	MFWKCE	6000										
1752	2129	MFWKBL	1047										
1753-1755	2130-2132	SMOOTH CMP	0										
1756	2133	PHDLY1	2580										
1757	2134	PHDLY2	8985										
1782	2159	DGCSMM	0										
1783	2160	TRQCUP	0										
1784	2161	OVC STP	140										
1785	2162	OVC2 K1	32745										
1786	2163	OVC2 K2	292										
1787	2164	OVC2 LIMIT	13952										
1788	2165	MAX CURRENT	365										
2716	2302	TQLIM AT STOP	0										
2717	2304	ACCBSLM	0										
2718	2305	ACDCEBD	0										
2723	2310	DCIDBS	0										
2729	2316	LIMLIM	0										

Remarks										

J SETTINGS FOR THE POWER CONSUMPTION MONITOR FUNCTION

The power consumption monitor function enables the reading of data about the power consumed on servo and spindle axes by using the interfaces of the PMC window, the FOCAS2 function, and so on.
This chapter contains the settings for each motor model and for each amplifier model needed to use the power consumption monitor function.
For details of the power consumption monitor function, refer to the operator's manual of the CNC used.

J.1 POWER CONSUMPTION MONITOR INTERNAL UNIT SETTINGS AND COIL RESISTANCE SETTINGS

Table J.1 (a) Power consumption monitor internal unit settings and coil resistance setting for each motor model

Series	Motor model	Specification	Power consumption monitor internal unit		Coil resistance No. 2468	Remarks
			No.2281#1	No.2281#0		
αiS (200V)	αiS 2/5000 αiS 2/5000-B	A06B-0212-B□0□ A06B-2212-B□0□	1	0	5734	
	αiS 2/6000 αiS 2/6000-B	A06B-0218-B□0□ A06B-2218-B□0□	1	0	5734	
	αiS 4/5000 αiS 4/5000-B	A06B-0215-B□0□ A06B-2215-B□0□	1	0	2499	
	αiS 4/6000 αiS 4/6000-B	A06B-0210-B□0□ A06B-2210-B□0□	1	0	2499	
	αiS 8/4000 αiS 8/4000-B	A06B-0235-B□0□ A06B-2235-B□0□	1	0	1270	
	αiS 8/6000 αiS 8/6000-B	A06B-0232-B□0□ A06B-2232-B□0□	1	0	532	
	αiS 12/4000 αiS 12/4000-B	A06B-0238-B□0□ A06B-2238-B□0□	1	0	737	
	αiS 12/6000 αiS 12/6000-B	A06B-0230-B□0□ A06B-2230-B□0□	0	1	266	
	αiS 22/4000 αiS 22/4000-B	A06B-0265-B□0□ A06B-2265-B□0□	0	1	307	
	αiS 22/6000 αiS 22/6000-B	A06B-0262-B□0□ A06B-2262-B□0□	0	1	160	
	αiS 30/4000 αiS 30/4000-B	A06B-0268-B□0□ A06B-2268-B□0□	0	1	254	
	αiS 40/4000 αiS 40/4000-B	A06B-0272-B□0□, -B□2□ A06B-2272-B□0□, -B□2□	0	1	238	
	αiS 50/2000 αiS 50/2000-B	A06B-0042-B□0□, -B□2□ A06B-2042-B□0□, -B□2□	0	1	315	
	αiS 60/2000 αiS 60/2000-B	A06B-0044-B□0□, -B□2□ A06B-2044-B□0□, -B□2□	0	1	303	
	αiS 50/3000 αiS 50/3000-B	A06B-0275-B□0□, -B□2□ A06B-2275-B□0□, -B□2□	0	1	98	

Series	Motor model	Specification	Power consumption monitor internal unit		Coil resistance No. 2468	Remarks
			No.2281#1	No.2281#0		
αiS (200V)	αiS 50/3000FAN αiS 50/3000FAN-B	A06B-0275-B□1□, -B□3□ A06B-2275-B□1□, -B□3□	0	1	98	
	αiS 60/3000-B	A06B-2278-B□0□, -B□2□	0	1	135	
	αiS 60/3000FAN αiS 60/3000FAN-B	A06B-0278-B□1□, -B□3□ A06B-2278-B□1□, -B□3□	0	1	135	
	αiS 100/2500	A06B-0285-B□00	0	1	53	
	αiS 100/2500FAN	A06B-0285-B□10	0	1	53	
	αiS 200/2500	A06B-0288-B□00	0	1	45	
	αiS 200/2500FAN	A06B-0288-B□10	0	1	45	
	αiS 150/3000-B	A06B-2026-B□10	0	1	106	
	αiS 300/2000 αiS 300/2000-B	A06B-0292-B□10 A06B-2292-B□10, -B□50	0	1	49	*1
	αiS 500/2000 αiS 500/2000-B	A06B-0295-B□10 A06B-2295-B□10, -B□50	0	1	49	*1
αiS (400V)	αiS 2/5000HV αiS 2/5000HV-B	A06B-0213-B□0□ A06B-2213-B□0□	1	0	22118	
	αiS 2/6000HV αiS 2/6000HV-B	A06B-0219-B□0□ A06B-2219-B□0□	1	0	22938	
	αiS 4/5000HV αiS 4/5000HV-B	A06B-0216-B□0□ A06B-2216-B□0□	1	0	11469	
	αiS 4/6000HV αiS 4/6000HV-B	A06B-0214-B□0□ A06B-2214-B□0□	1	0	11469	
	αiS 8/4000HV αiS 8/4000HV-B	A06B-0236-B□0□ A06B-2236-B□0□	1	0	5325	
	αiS 8/6000HV αiS 8/6000HV-B	A06B-0233-B□0□ A06B-2233-B□0□	1	0	2048	
	αiS 12/4000HV αiS 12/4000HV-B	A06B-0239-B□0□ A06B-2239-B□0□	1	0	3441	
	αiS 12/6000HV αiS 12/6000HV-B	A06B-0237-B□0□ A06B-2237-B□0□	0	1	1065	
	αiS 22/4000HV αiS 22/4000HV-B	A06B-0266-B□0□ A06B-2266-B□0□	1	0	1024	
	αiS 22/6000HV αiS 22/6000HV-B	A06B-0263-B□0□ A06B-2263-B□0□	0	1	655	
	αiS 30/4000HV αiS 30/4000HV-B	A06B-0269-B□0□ A06B-2269-B□0□	0	1	1024	
	αiS 40/4000HV αiS 40/4000HV-B	A06B-0273-B□0□, -B□2□ A06B-2273-B□0□, -B□2□	0	1	942	
	αiS 50/2000HV αiS 50/2000HV-B	A06B-0043-B□0□, -B□2□ A06B-2043-B□0□, -B□2□	0	1	1270	
	αiS 60/2000HV αiS 60/2000HV-B	A06B-0045-B□0□, -B□2□ A06B-2045-B□0□, -B□2□	0	1	1229	

Series	Motor model	Specification	Power consumption monitor internal unit		Coil resistance No. 2468	Remarks
			No.2281#1	No.2281#0		
αiS (400V)	αiS 50/3000HV αiS 50/3000HV-B	A06B-0276-B□0□, -B□2□ A06B-2276-B□0□, -B□2□	0	1	410	
	αiS 50/3000HVFAN αiS 50/3000HVFAN-B	A06B-0276-B□1□, -B□3□ A06B-2276-B□1□, -B□3□	0	1	410	
	αiS 60/3000HV-B	A06B-2279-B□0□, -B□2□	0	1	532	
	αiS 60/3000HVFAN αiS 60/3000HVFAN-B	A06B-0279-B□1□, -B□3□ A06B-2279-B□1□, -B□3□	0	1	532	
	αiS 100/2500HV	A06B-0286-B□00	0	1	213	
	αiS 100/2500HVFAN	A06B-0286-B□10	0	1	213	
	αiS 200/2500HV	A06B-0289-B□00	0	1	188	
	αiS 200/2500HVFAN	A06B-0289-B□10	0	1	188	
	αiS 150/3000HV-B	A06B-2027-B□10	0	1	410	
	αiS 300/2000HV αiS 300/2000HV-B	A06B-0293-B□10 A06B-2293-B□10, -B□50	0	1	197	
	αiS 300/3000HV αiS 300/3000HV-B	A06B-0290-B□10 A06B-2290-B□10, -B□50	0	1	119	
	αiS 500/2000HV αiS 500/2000HV-B	A06B-0296-B□10 A06B-2296-B□10, -B□50	0	1	205	
	αiS 500/3000HV αiS 500/3000HV-B	A06B-0297-B□10 A06B-2297-B□10, -B□50	0	0	106	
	αiS 1000/2000HV αiS 1000/2000HV-B	A06B-0098-B□10 A06B-2098-B□10	0	0	41	*1
	αiS 1000/3000HV αiS 1000/3000HV-B	A06B-0099-B□50 A06B-2099-B□10	0	0	20	*1
	αiS 1500/3000HV-B	A06B-2097-B□10	0	0	10	*1
	αiS 2000/2000HV	A06B-0091-B□40	0	0	16	*1, *2
	αiS 3000/2000HV	A06B-0092-B□40	0	0	14	*1, *2
αiF (200V)	αiF 1/5000 αiF 1/5000-B	A06B-0202-B□0□ A06B-2202-B□0□	1	1	5734	
	αiF 2/5000 αiF 2/5000-B	A06B-0205-B□0□ A06B-2205-B□0□	1	0	4506	
	αiF 4/5000 αiF 4/5000-B	A06B-0223-B□0□ A06B-2223-B□0□	1	0	1638	
	αiF 8/3000 αiF 8/3000-B	A06B-0227-B□0□ A06B-2227-B□0□	1	0	2089	
	αiF 8/4000 αiF 8/4000-B	A06B-0228-B□0□ A06B-2228-B□0□	1	0	737	
	αiF 12/4000 αiF 12/4000-B	A06B-0243-B□0□ A06B-2243-B□0□	1	0	655	

Series	Motor model	Specification	Power consumption monitor internal unit		Coil resistance No. 2468	Remarks
			No.2281#1	No.2281#0		
αiF (200V)	αiF 22/3000 αiF 22/3000-B	A06B-0247-B□0□ A06B-2247-B□0□	1	0	655	
	αiF 22/4000 αiF 22/4000-B	A06B-0248-B□0□ A06B-2248-B□0□	0	1	225	
	αiF 30/4000 αiF 30/4000-B	A06B-0253-B□0□ A06B-2253-B□0□	0	1	164	
	αiF 40/3000 αiF 40/3000-B	A06B-0257-B□0□, -B□2□ A06B-2257-B□0□, -B□2□	0	1	279	
	αiF 40/3000FAN αiF 40/3000FAN-B	A06B-0257-B□1□, -B□3□ A06B-2257-B□1□, -B□3□	0	1	279	
αiF (400V)	αiF 4/5000HV αiF 4/5000HV-B	A06B-0225-B□0□ A06B-2225-B□0□	1	0	6144	
	αiF 8/3000HV αiF 8/3000HV-B	A06B-0229-B□0□ A06B-2229-B□0□	1	0	7782	
	αiF 8/4000HV αiF 8/4000HV-B	A06B-0220-B□0□ A06B-2220-B□0□	1	0	3072	
	αiF 12/4000HV αiF 12/4000HV-B	A06B-0245-B□0□ A06B-2245-B□0□	1	0	2662	
	αiF 22/3000HV αiF 22/3000HV-B	A06B-0249-B□0□ A06B-2249-B□0□	1	0	2703	
	αiF 22/4000HV αiF 22/4000HV-B	A06B-0240-B□0□ A06B-2240-B□0□	0	1	942	
	αiF 30/4000HV αiF 30/4000HV-B	A06B-0255-B□0□ A06B-2255-B□0□	0	1	655	
	αiF 40/3000HV αiF 40/3000HV-B	A06B-0259-B□0□, -B□2□ A06B-2259-B□0□, -B□2□	0	1	1106	
	αiF 40/3000HVFAN αiF 40/3000HVFAN-B	A06B-0259-B□1□, -B□3□ A06B-2259-B□1□, -B□3□	0	1	1106	
βiS (200V)	βiS 0.2/5000	A06B-0111-B□03	1	1	24576	
	βiS 0.3/5000	A06B-0112-B□03	1	1	32767	
	βiS 0.4/5000 βiS 0.4/5000-B	A06B-0114-B□03 A06B-2114-B□03	1	1	2253	
	βiS 0.5/6000 βiS 0.5/6000-B	A06B-0115-B□03 A06B-2115-B□03	1	1	3482	
	βiS 1/6000 βiS 1/6000-B	A06B-0116-B□03 A06B-2116-B□03	1	0	6144	
	βiS 1.5/6000-B	A06B-2019-B□03	1	0	3482	
	βiS 2/4000 βiS 2/4000-B	A06B-0061-B□03, -B□06 A06B-2061-B□03	1	1	6554	
	βiS 4/4000 βiS 4/4000-B	A06B-0063-B□03, -B□06 A06B-2063-B□03	1	0	3850	

Series	Motor model	Specification	Power consumption monitor internal unit		Coil resistance No. 2468	Remarks
			No.2281#1	No.2281#0		
βiS (200V)	βiS 8/3000 βiS 8/3000-B	A06B-0075-B□03, -B□06 A06B-2075-B□03	1	0	4096	
	βiS 12/2000 βiS 12/2000-B	A06B-0077-B□03, -B□06 A06B-2077-B□03	1	0	3564	
	βiS 12/3000 βiS 12/3000-B	A06B-0078-B□03 A06B-2078-B□03	1	0	1597	
	βiS 22/2000 βiS 22/2000-B	A06B-0085-B□03 A06B-2085-B□03	1	0	1802	
	βiS 22/3000 βiS 22/3000-B	A06B-0082-B□03 A06B-2082-B□03	1	0	696	
	βiS 30/2000 βiS 30/2000-B	A06B-0087-B□03 A06B-2087-B□03	1	0	614	
	βiS 40/2000 βiS 40/2000-B	A06B-0089-B□03 A06B-2089-B□03	1	0	696	
βiS (400V)	βiS 0.5/6000HV-B	A06B-2016-B□03	1	1	16794	
	βiS 1/6000HV-B	A06B-2018-B□03	1	0	26624	
	βiS 1.5/6000HV-B	A06B-2020-B□03	1	0	13722	
	βiS 2/4000HV βiS 2/4000HV-B	A06B-0062-B□03 A06B-2062-B□03	1	1	27034	
	βiS 4/4000HV βiS 4/4000HV-B	A06B-0064-B□03 A06B-2064-B□03	1	0	16384	
	βiS 8/3000HV βiS 8/3000HV-B	A06B-0076-B□03 A06B-2076-B□03	1	0	15974	
	βiS 12/3000HV βiS 12/3000HV-B	A06B-0079-B□03 A06B-2079-B□03	1	0	6554	
	βiS 22/2000HV βiS 22/2000HV-B	A06B-0086-B□03 A06B-2086-B□03	1	0	7373	
	βiS 22/3000HV βiS 22/3000HV-B	A06B-0083-B□03 A06B-2083-B□03	1	0	2785	
	βiS 30/2000HV βiS 30/2000HV-B	A06B-0088-B□03 A06B-2088-B□03	1	0	2499	
	βiS 40/2000HV βiS 40/2000HV-B	A06B-0090-B□03 A06B-2090-B□03	1	0	2703	
βiSc	βiSc 2/4000 βiSc 2/4000-B	A06B-0061-B□07 A06B-2061-B□07	1	1	6554	
	βiSc 4/4000 βiSc 4/4000-B	A06B-0063-B□07 A06B-2063-B□07	1	0	3850	
	βiSc 8/3000 βiSc 8/3000-B	A06B-0075-B□07 A06B-2075-B□07	1	0	4096	
	βiSc 12/2000 βiSc 12/2000-B	A06B-0077-B□07 A06B-2077-B□07	1	0	3564	
	βiSc 12/3000 βiSc 12/3000-B	A06B-0078-B□07 A06B-2078-B□07	1	0	1597	
	βiSc 22/2000 βiSc 22/2000-B	A06B-0085-B□07 A06B-2085-B□07	1	0	1802	
βiSc(400V)	βiSc 2/4000HV-B	A06B-2062-B□07	1	1	27034	
	βiSc 4/4000HV-B	A06B-2064-B□07	1	0	16384	
	βiSc 8/3000HV-B	A06B-2076-B□07	1	0	15974	
	βiSc 12/3000HV-B	A06B-2079-B□07	1	0	6554	

Series	Motor model	Specification	Power consumption monitor internal unit		Coil resistance No. 2468	Remarks
			No.2281#1	No.2281#0		
βiF	βiF 4/3000 βiF 4/3000-B	A06B-0051-B□03 A06B-2051-B□03	1	0	6963	
	βiF 8/2000 βiF 8/2000-B	A06B-0052-B□03 A06B-2052-B□03	1	0	4915	
	βiF 12/2000 βiF 12/2000-B	A06B-0053-B□03 A06B-2053-B□03	1	0	4915	
	βiF 22/2000 βiF 22/2000-B	A06B-0054-B□03 A06B-2054-B□03	1	0	1802	
	βiF 30/1500 βiF 30/1500-B	A06B-0055-B□03 A06B-2055-B□03	1	0	1556	
DiS (200V)	DiS15/1000(200V) DiS15/1000-B(200V)	A06B-0492-B100 A06B-2392-B100	1	1	17367	
	DiS 22/600(200V)	A06B-0482-B100	1	1	20091	
	DiS 22/1500(200V)	A06B-0482-B12□	1	1	13312	
	DiS 60/400(200V) DiS 60/400-B(200V)	A06B-0493-B200 A06B-2393-B200	1	1	13844	
	DiS 60/2000(200V) DiS 60/2000-B(200V)	A06B-0493-B220 A06B-2393-B220	1	0	3092	
	DiS 70/300(200V)	A06B-0494-B100	1	1	12042	
	DiS 70/1500(200V) DiS 70/1500-B(200V)	A06B-0494-B120 A06B-2394-B120	1	0	2232	
	DiS 85/400(200V)	A06B-0483-B200	1	1	7373	
	DiS 85/1000(200V)	A06B-0483-B22□	1	0	4649	
	DiS 110/400(200V)	A06B-0484-B100	1	1	1905	
	DiS 110/1000(200V)	A06B-0484-B12□	1	0	1802	
	DiS 120/600(200V)	A06B-0493-B400	1	0	5059	
	DiS 150/300(200V) DiS 150/300-B(200V)	A06B-0494-B300 A06B-2394-B300	1	0	5304	
	DiS 150/1500(200V) DiS 150/1500-B(200V)	A06B-0494-B320 A06B-2394-B320	1	0	981	
	DiS 200/300(200V)	A06B-0494-B400	1	0	6881	
	DiS 250/250(200V)	A06B-0495-B200	1	0	4178	
	DiS 260/300(200V)	A06B-0484-B300	1	1	3277	
	DiS 260/1000(200V)	A06B-0484-B32□	1	0	922	
	DiS 370/300(200V)	A06B-0484-B400	1	0	4301	
	DiS 400/250(200V)	A06B-0485-B204	1	0	6144	
	DiS 500/250(200V) DiS 500/250-B(200V)	A06B-0495-B400 A06B-2395-B400	1	0	1761	
	DiS 500/1000(200V)	A06B-0495-B420	1	0	473	
	DiS 800/250(200V)	A06B-0485-B400	1	0	2540	
	DiS 1000/200(200V) DiS 1000/200-B(200V)	A06B-0496-B300 A06B-2396-B300	1	0	1618	
	DiS 1000/1000(200V) DiS 1000/1000-B(200V)	A06B-0496-B320 A06B-2396-B320	1	0	276	
	DiS 1000/1000-385(200V) DiS 1000/1000-385-B(200V)	A06B-0499-B420 A06B-2399-B420	1	0	322	
	DiS 1200/250(200V)	A06B-0485-B500	1	0	3707	
	DiS 1500/100(200V)	A06B-0497-B300	1	0	2150	
	DiS 1500/250(200V)	A06B-0486-B300	1	0	1556	
	DiS 2000/100(200V)	A06B-0497-B400	1	0	2847	
	DiS 2000/150(200V)	A06B-0497-B490	1	0	717	

Series	Motor model	Specification	Power consumption monitor internal unit		Coil resistance No. 2468	Remarks
			No.2281#1	No.2281#0		
DiS (400V)	DiS 15/1000(400V) DiS 15/1000-B(400V)	A06B-0492-B100 A06B-2392-B100	1	0	17367	
	DiS 22/600(400V)	A06B-0482-B102	1	1	20091	
	DiS 60/400(400V) DiS 60/400-B(400V)	A06B-0493-B200 A06B-2393-B200	1	0	13844	
	DiS 60/2000(400V) DiS 60/2000-B(400V)	A06B-0493-B220 A06B-2393-B220	1	0	3092	
	DiS 70/300(400V) DiS 70/300-B(400V)	A06B-0494-B100 A06B-2394-B100	1	0	12042	
	DiS 70/1500(400V) DiS 70/1500-B(400V)	A06B-0494-B120 A06B-2394-B120	1	0	2232	
	DiS 85/400(400V)	A06B-0483-B202	1	1	7373	
	DiS 110/400(400V)	A06B-0484-B102	1	1	1905	
	DiS 120/600(400V)	A06B-0493-B400	1	0	5059	
	DiS 150/300(400V) DiS 150/300-B(400V)	A06B-0494-B300 A06B-2394-B300	1	0	5304	
	DiS 150/1500(400V)	A06B-0494-B320	1	0	981	
	DiS 200/300(400V)	A06B-0494-B400	1	0	6881	
	DiS 250/250(400V)	A06B-0495-B200	1	0	4178	
	DiS 260/300(400V)	A06B-0484-B302	1	0	3277	
	DiS 370/300(400V)	A06B-0484-B402	1	0	4301	
	DiS 400/250(400V)	A06B-0485-B205	1	0	6144	
	DiS 500/150(400V) DiS 500/150-B(400V)	A06B-0495-B450 A06B-2395-B450	1	0	6963	
	DiS 500/250(400V) DiS 500/250-B(400V)	A06B-0495-B400 A06B-2395-B400	1	0	1761	
	DiS 500/1200(400V) DiS 500/1200-B(400V)	A06B-0495-B421 A06B-2395-B421	0	1	219	
	DiS 800/250(400V)	A06B-0485-B402	1	0	2540	
	DiS 1000/200(400V) DiS 1000/200-B(400V)	A06B-0496-B300 A06B-2396-B300	1	0	1618	
	DiS 1000/1000(400V) DiS 1000/1000-B(400V)	A06B-0496-B320 A06B-2396-B320	0	1	276	
	DiS 1000/1000-385(400V) DiS 1000/1000-385-B(400V)	A06B-0499-B420 A06B-2399-B420	0	1	322	
	DiS 1200/250(400V)	A06B-0485-B502	1	0	3707	
	DiS 1500/100(400V)	A06B-0497-B300	1	0	2150	
	DiS 1500/250(400V)	A06B-0486-B302	0	1	1556	
	DiS 2000/100(400V)	A06B-0497-B400	1	0	2847	
	DiS 2000/150(400V)	A06B-0497-B490	0	1	717	
	DiS 5000/50(400V)	A06B-0488-B400	1	0	5468	
	DiS 5000/500(400V)	A06B-0488-B430	0	1	346	
LiS (200V)	LiS 300A1/4(200V)	A06B-0441-B200	1	1	12288	
	LiS 600A1/4(200V)	A06B-0442-B200	1	1	6144	
	LiS 900A1/4(200V)	A06B-0443-B200	1	1	4096	
	LiS 1500B1/4(200V)	A06B-0444-B2□0	1	0	6267	
	LiS 3000B2/2(200V)	A06B-0445-B1□0	1	0	10691	
	LiS 3000B2/4(200V)	A06B-0445-B2□0	1	0	2662	
	LiS 3300C1/2(200V)	A06B-0451-B1□0	1	0	5079	
	LiS 4500B2/2(200V)	A06B-0446-B1□0	1	0	6963	
	LiS 4500B2/4(200V)	A06B-0446-B2□0	1	0	1761	
	LiS 6000B2/2(200V)	A06B-0447-B1□0	1	0	5243	
	LiS 6000B2/4(200V)	A06B-0447-B2□0	1	0	1311	
	LiS 7500B2/2(200V)	A06B-0448-B1□0	1	0	4301	

Series	Motor model	Specification	Power consumption monitor internal unit		Coil resistance No. 2468	Remarks
			No.2281#1	No.2281#0		
LiS (200V)	LiS 7500B2/4(200V)	A06B-0448-B2□0	1	0	885	
	LiS 9000B2/2(200V)	A06B-0449-B1□0	1	0	3564	
	LiS 9000B2/4(200V)	A06B-0449-B210	1	0	901	
	LiS 9000C2/2(200V)	A06B-0454-B1□0	1	0	3236	
	LiS 10000C3/2(200V)	A06B-0457-B1□0	1	0	2949	
	LiS 11000C2/2(200V)	A06B-0455-B1□0	1	0	2540	
	LiS 11000C2/4(200V)	A06B-0455-B2□0	1	0	614	
	LiS 15000C2/2(200V)	A06B-0456-B1□0	1	0	1843	
	LiS 15000C2/3(200V)	A06B-0456-B2□0	1	0	819	
	LiS 17000C3/2(200V)	A06B-0459-B1□0	1	0	1720	
	LiS 3000M2/2-B(200V)	A06B-0462-B120	1	0	5407	
	LiS 3000M2/4-B(200V)	A06B-0462-B220	1	0	1331	
	LiS 4500M2/2-B(200V)	A06B-0463-B120	1	0	3604	
	LiS 4500M2/4-B(200V)	A06B-0463-B220	1	0	881	
	LiS 4500M3/2-B(200V)	A06B-0468-B120	1	0	4096	
	LiS 4500M3/4-B(200V)	A06B-0468-B220	1	0	1106	
	LiS 6000M2/2-B(200V)	A06B-0464-B120	1	0	2703	
	LiS 6000M2/4-B(200V)	A06B-0464-B220	1	0	655	
	LiS 7000M3/2-B(200V)	A06B-0469-B120	1	0	2662	
	LiS 7000M3/4-B(200V)	A06B-0469-B220	1	0	717	
	LiS 7500M2/2-B(200V)	A06B-0465-B120	1	0	2171	
	LiS 7500M2/4-B(200V)	A06B-0465-B220	1	0	532	
	LiS 9000M2/2-B(200V)	A06B-0466-B120	1	0	1802	
	LiS 9000M3/2-B(200V)	A06B-0470-B120	1	0	2048	
	LiS 9000M3/4-B(200V)	A06B-0470-B220	1	0	553	
	LiS 11000M2/2-B(200V)	A06B-0467-B120	1	0	1556	
	LiS 11000M3/2-B(200V)	A06B-0471-B120	1	0	1638	
	LiS 11000M3/4-B(200V)	A06B-0471-B220	1	0	451	
	LiS 14000M3/2-B(200V)	A06B-0472-B120	1	0	1352	
	LiS 16000M3/2-B(200V)	A06B-0473-B120	1	0	1147	
	LiS 300S1/4-B(200V)	A06B-0424-B200	1	1	11940	
	LiS 600S1/4-B(200V)	A06B-0425-B200	1	1	6021	
	LiS 600S2/3-B(200V)	A06B-0427-B200	1	1	19538	
	LiS 900S1/4-B(200V)	A06B-0426-B200	1	1	4035	
	LiS 1200S2/3-B(200V)	A06B-0428-B200	1	1	9769	
	LiS 1800S2/3-B(200V)	A06B-0429-B200	1	1	6533	
LiS (400V)	LiS 3000B2/2(400V)	A06B-0445-B1□0	1	0	10691	
	LiS 3300C1/2(400V)	A06B-0451-B1□0	1	0	5079	
	LiS 4500B2/2HV	A06B-0446-B0□0	1	0	19825	
	LiS 4500B2/2(400V)	A06B-0446-B1□0	1	0	6963	
	LiS 6000B2/2HV	A06B-0447-B0□0	1	0	15114	
	LiS 6000B2/2(400V)	A06B-0447-B1□0	1	0	5243	
	LiS 7500B2/2HV	A06B-0448-B0□0	1	0	11551	
	LiS 7500B2/2(400V)	A06B-0448-B1□0	1	0	4301	
	LiS 9000B2/2(400V)	A06B-0449-B1□0	1	0	3564	
	LiS 9000C2/2HV	A06B-0454-B0□0	1	0	14008	
	LiS 9000C2/2(400V)	A06B-0454-B1□0	1	0	3236	
	LiS 10000C3/2HV	A06B-0457-B0□0	1	0	11756	
	LiS 10000C3/2(400V)	A06B-0457-B1□0	1	0	2949	
	LiS 11000C2/2HV	A06B-0455-B0□0	1	0	11018	
	LiS 11000C2/2(400V)	A06B-0455-B1□0	1	0	2540	
	LiS 15000C2/3HV	A06B-0456-B0□0	1	0	3686	
	LiS 15000C2/2(400V)	A06B-0456-B1□0	0	1	1843	

Series	Motor model	Specification	Power consumption monitor internal unit		Coil resistance No. 2468	Remarks
			No.2281#1	No.2281#0		
L*i*S (400V)	L*i*S 17000C3/2HV	A06B-0459-B0□0	1	0	6922	
	L*i*S 17000C3/2(400V)	A06B-0459-B1□0	0	1	1720	
	L*i*S 3000M2/2-B(400V)	A06B-0462-B120	1	0	5407	
	L*i*S 3000M2/2HV-B	A06B-0462-B020	1	0	25027	
	L*i*S 4500M2/2-B(400V)	A06B-0463-B120	1	0	3604	
	L*i*S 4500M2/2HV-B	A06B-0463-B020	1	0	16712	
	L*i*S 4500M3/2-B(400V)	A06B-0468-B120	1	0	4096	
	L*i*S 4500M3/2HV-B	A06B-0468-B020	1	0	16998	
	L*i*S 6000M2/2-B(400V)	A06B-0464-B120	1	0	2703	
	L*i*S 6000M2/2HV-B	A06B-0464-B020	1	0	12534	
	L*i*S 7000M3/2-B(400V)	A06B-0469-B120	1	0	2662	
	L*i*S 7000M3/2HV-B	A06B-0469-B020	1	0	11264	
	L*i*S 7500M2/2-B(400V)	A06B-0465-B120	1	0	2171	
	L*i*S 7500M2/2HV-B	A06B-0465-B020	1	0	10035	
	L*i*S 9000M2/2-B(400V)	A06B-0466-B120	1	0	1802	
	L*i*S 9000M2/2HV-B	A06B-0466-B020	1	0	8356	
	L*i*S 9000M3/2-B(200V)	A06B-0470-B020	1	0	2048	
	L*i*S 9000M3/2HV-B	A06B-0467-B120	1	0	8397	
	L*i*S 11000M2/2-B(400V)	A06B-0467-B020	1	0	1556	
	L*i*S 11000M2/2HV-B	A06B-0471-B120	1	0	7168	
	L*i*S 11000M3/2-B(200V)	A06B-0471-B120	1	0	1638	
	L*i*S 11000M3/2HV-B	A06B-0472-B120	1	0	6758	
	L*i*S 14000M3/2-B(400V)	A06B-0472-B020	1	0	1352	
	L*i*S 14000M3/2HV-B	A06B-0473-B120	1	0	5734	
	L*i*S 16000M3/2-B(400V)	A06B-0473-B020	0	1	1147	
	L*i*S 16000M3/2HV-B	A06B-0424-B200	1	0	4915	
	L*i*S 300S1/4-B(400V)	A06B-0425-B200	1	1	11940	
	L*i*S 600S1/4-B(400V)	A06B-0427-B200	1	1	6021	
	L*i*S 600S2/3-B(400V)	A06B-0426-B200	1	1	19538	
	L*i*S 900S1/4-B(400V)	A06B-0428-B200	1	0	4035	
	L*i*S 1200S2/3-B(400V)	A06B-0429-B200	1	1	9769	

*1 If using the power consumption monitor function for an axis where multiple winding motors are used, set the above parameters for the main axis only.

*2 If the torque control function is used for an axis for which one of the above motors is used, the power consumption monitor function cannot be used.

J.2 SETTINGS FOR SERVO AMPLIFIER LOSS COEFFICIENTS A AND B

Table J.2 (a) Settings for servo amplifier loss coefficients A and B

Series	Motor model	Specification	Axis	Loss coef. A No. 2469	Loss coef. B (No. 2490) HRV2	HRV3	HRV4
αiSV-B (200V)	αiSV4-B	A06B-6240-H101 A06B-6240-H121	L	832	307	397	576
	αiSV20-B	A06B-6240-H103 A06B-6240-H123	L	832	307	397	576
	αiSV40-B	A06B-6240-H104 A06B-6240-H124	L	832	269	339	486
	αiSV80-B	A06B-6240-H105 A06B-6240-H125	L	832	262	352	518
	αiSV160-B	A06B-6240-H106 A06B-6240-H126	L	1152	288	371	538
	αiSV360-B	A06B-6240-H109 A06B-6240-H129	L	1600	301	352	480
	αiSV360S-B	A06B-6240-H169	L	1472	307	365	-
	αiSV4/4-B	A06B-6240-H201	L	608	307	397	576
			M	608	307	397	576
	αiSV4/20-B	A06B-6240-H203	L	608	307	397	576
			M	608	307	397	576
	αiSV20/20-B	A06B-6240-H205	L	608	307	397	576
			M	608	307	397	576
	αiSV20/40-B	A06B-6240-H206	L	608	307	397	576
			M	608	269	339	486
	αiSV40/40-B	A06B-6240-H207	L	672	269	339	486
			M	672	269	339	486
	αiSV40/80-B	A06B-6240-H208	L	672	269	339	486
			M	672	262	352	518
	αiSV80/80-B	A06B-6240-H209	L	672	262	352	518
			M	672	262	352	518
	αiSV80/160-B	A06B-6240-H210	L	736	262	352	518
			M	736	288	371	538
	αiSV160/160-B	A06B-6240-H211	L	736	288	371	538
			M	736	288	371	538
	αiSV4/4/4-B	A06B-6240-H301 A06B-6240-H321	L	555	307	397	576
			M	555	307	397	576
			N	555	307	397	576
	αiSV20/20/20-B	A06B-6240-H305 A06B-6240-H325	L	555	307	397	576
			M	555	307	397	576
			N	555	307	397	576
	αiSV20/20/40-B	A06B-6240-H306 A06B-6240-H326	L	555	307	397	576
			M	555	307	397	576
			N	555	269	339	486
	αiSV40/40/40-B	A06B-6240-H308 A06B-6240-H328	L	661	269	339	486
			M	661	269	339	486
			N	661	269	339	486
	αiSV80/80/80-B	A06B-6240-H331	L	661	282	352	506
			M	661	282	352	506
			N	661	282	352	506
αiSVP-B (200V)	αiSVP20/20/20-5.5-B	A06B-6230-H001	L	704	307	397	-
			M	704	307	397	-
			N	704	307	397	-

Series	Motor model	Specification	Axis	Loss coef. A No. 2469	Loss coef. B (No. 2490) HRV2	HRV3	HRV4
αiSVP-B (200V)	αiSVP20/20/20-2.2-B	A06B-6230-H003	L	653	307	397	576
			M	653	307	397	576
			N	653	307	397	576
	αiSVP40/40/40-2.2-B	A06B-6230-H004	L	704	269	339	486
			M	704	269	339	486
			N	704	269	339	486
αiSV (200V)	αiSV4	A06B-6117-H101	L	832	320	416	-
	αiSV20	A06B-6117-H103	L	832	320	416	-
	αiSV40	A06B-6117-H104	L	832	294	378	-
	αiSV80	A06B-6117-H105	L	832	275	371	-
	αiSV160	A06B-6117-H106	L	1088	301	390	-
	αiSV360	A06B-6117-H109	L	1600	314	371	506
	αiSV20L	A06B-6117-H153	L	896	320	416	602
	αiSV40L	A06B-6117-H154	L	896	294	378	538
	αiSV80L	A06B-6117-H155	L	1152	275	371	544
	αiSV160L	A06B-6117-H156	L	1024	301	390	563
	αiSV4/4	A06B-6117-H201	L	544	320	416	-
			M	544	320	416	-
	αiSV4/20	A06B-6117-H203	L	544	320	416	-
			M	544	320	416	-
	αiSV20/20	A06B-6117-H205	L	544	320	416	-
			M	544	320	416	-
	αiSV20/40	A06B-6117-H206	L	544	320	416	-
			M	544	294	378	-
	αiSV40/40	A06B-6117-H207	L	608	294	378	-
			M	608	294	378	-
	αiSV40/80	A06B-6117-H208	L	608	294	378	-
			M	608	275	371	-
	αiSV80/80	A06B-6117-H209	L	608	275	371	-
			M	608	275	371	-
	αiSV80/160	A06B-6117-H210	L	608	275	371	-
			M	608	301	390	-
	αiSV160/160	A06B-6117-H211	L	608	301	390	-
			M	608	301	390	-
	αiSV20/20L	A06B-6117-H255	L	672	320	416	602
			M	672	320	416	602
	αiSV20/40L	A06B-6117-H256	L	672	320	416	602
			M	672	294	378	538
	αiSV40/40L	A06B-6117-H257	L	736	294	378	538
			M	736	294	378	538
	αiSV40/80L	A06B-6117-H258	L	672	294	378	538
			M	672	275	371	544
	αiSV80/80L	A06B-6117-H259	L	672	275	371	544
			M	672	275	371	544
	αiSV4/4/4	A06B-6117-H301	L	512	320	416	-
			M	512	320	416	-
			N	512	320	416	-
	αiSV20/20/20	A06B-6117-H303	L	512	320	416	-
			M	512	320	416	-
			N	512	320	416	-

Series	Motor model	Specification	Axis	Loss coef. A No. 2469	Loss coef. B (No. 2490) HRV2	HRV3	HRV4
αiSV (200V)	αiSV20/20/40	A06B-6117-H304	L	512	320	416	-
			M	512	320	416	-
			N	512	294	378	-
	αiSV40S/40S/40	A06B-6117-H306	L	448	288	365	-
			M	448	288	365	-
			N	448	294	378	-
αiSV-B (400V)	αiSV10HV-B	A06B-6290-H102 A06B-6290-H122	L	832	499	902	1606
	αiSV20HV-B	A06B-6290-H103 A06B-6290-H123	L	832	538	883	1530
	αiSV40HV-B	A06B-6290-H104 A06B-6290-H124	L	832	538	928	1651
	αiSV80HV-B	A06B-6290-H105 A06B-6290-H125	L	1152	550	749	1440
	αiSV180HV-B	A06B-6290-H106 A06B-6290-H126	L	1600	538	749	1421
	αiSV180HVS-B	A06B-6290-H166	L	1472	480	762	-
	αiSV360HV-B	A06B-6290-H109 A06B-6290-H129 A06B-6290-H132	L	2176	474	672	1107
	αiSV540HV-B	A06B-6290-H110 A06B-6290-H130 A06B-6290-H131	L	2752	512	-	-
	αiSV10/10HV-B	A06B-6290-H202	L	608	499	902	1606
			M	608	499	902	1606
	αiSV10/20HV-B	A06B-6290-H204	L	608	499	902	1606
			M	608	538	883	1530
	αiSV20/20HV-B	A06B-6290-H205	L	672	538	883	1530
			M	672	538	883	1530
	αiSV20/40HV-B	A06B-6290-H206	L	672	538	883	1530
			M	672	538	928	1651
	αiSV40/40HV-B	A06B-6290-H207	L	672	538	928	1651
			M	672	538	928	1651
	αiSV40/80HV-B	A06B-6290-H208	L	736	538	928	1651
			M	736	550	749	1440
	αiSV80/80HV-B	A06B-6290-H209	L	736	550	749	1440
			M	736	550	749	1440
	αiSV10/10/10HV-B	A06B-6290-H302 A06B-6290-H322	L	555	499	902	1606
			M	555	499	902	1606
			N	555	499	902	1606
	αiSV10/10/20HV-B	A06B-6290-H303 A06B-6290-H323	L	555	499	902	1606
			M	555	499	902	1606
			N	555	538	883	1530
	αiSV20/20/20HV-B	A06B-6290-H305 A06B-6290-H325	L	661	538	883	1530
			M	661	538	883	1530
			N	661	538	883	1530
	αiSV40/40/40HV-B	A06B-6290-H328	L	661	506	774	1325
			M	661	506	774	1325
			N	661	506	774	1325
αiSVP-B (400V)	αiSVP10/10/10-5.5HV-B	A06B-6280-H001	L	1056	499	902	-
			M	1056	499	902	-
			N	1056	499	902	-

Series	Motor model	Specification	Axis	Loss coef. A No. 2469	Loss coef. B (No. 2490) HRV2	HRV3	HRV4
αiSV (400V)	αiSV10HV	A06B-6127-H102	L	832	525	947	-
	αiSV20HV	A06B-6127-H103	L	832	563	928	-
	αiSV40HV	A06B-6127-H104	L	832	563	979	-
	αiSV80HV	A06B-6127-H105	L	1088	576	787	-
	αiSV180HV	A06B-6127-H106	L	1600	563	787	1498
	αiSV360HV	A06B-6127-H109	L	2176	499	704	1165
	αiSV10HVL	A06B-6127-H152	L	896	525	947	1690
	αiSV20HVL	A06B-6127-H153	L	896	563	928	1613
	αiSV40HVL	A06B-6127-H154	L	1152	563	979	1741
	αiSV80HVL	A06B-6127-H155	L	1024	576	787	1517
	αiSV10/10HV	A06B-6127-H202	L	544	525	947	-
			M	544	525	947	-
	αiSV20/20HV	A06B-6127-H205	L	544	563	928	-
			M	544	563	928	-
	αiSV20/40HV	A06B-6127-H206	L	608	563	928	-
			M	608	563	979	-
	αiSV40/40HV	A06B-6127-H207	L	608	563	979	-
			M	608	563	979	-
	αiSV40/80HV	A06B-6127-H208	L	608	563	979	-
			M	608	576	787	-
	αiSV80/80HV	A06B-6127-H209	L	608	576	787	-
			M	608	576	787	-
	αiSV10/10HVL	A06B-6127-H252	L	608	525	947	1690
			M	608	525	947	1690
	αiSV20/20HVL	A06B-6127-H255	L	672	563	928	1613
			M	672	563	928	1613
	αiSV20/40HVL	A06B-6127-H256	L	672	563	928	1613
			M	672	563	979	1741
	αiSV40/40HVL	A06B-6127-H257	L	672	563	979	1741
			M	672	563	979	1741
βiSV,-B (200V)	βiSV4,-B	A-06B-61□0-H001	L	960	320	416	-
	βiSV20,-B	A-06B-61□0-H002	L	960	320	416	-
	βiSV40,-B	A-06B-61□0-H003	L	960	294	378	-
	βiSV80,-B	A-06B-61□0-H004	L	960	275	371	-
	βiSV20/20,-B	A-06B-61□6-H201	L	512	320	416	-
			M	512	320	416	-
	βiSV40/40,-B	A-06B-61□6-H203	L	512	288	365	-
			L	512	288	365	-
βiSV,-B (400V)	βiSV10HV,-B	A-06B-61□1-H001	L	960	525	947	-
	βiSV20HV,-B	A-06B-61□1-H002	L	960	563	928	-
	βiSV40HV,-B	A-06B-61□1-H003	L	960	563	979	-
βiSVSP-B (200V)	βiSVSP 20/20-7.5-B	A06B-6320-H201	L	0	294	371	-
			M	0	294	371	-
	βiSVSP 20/20-11-B	A06B-6320-H202	L	0	294	371	-
			M	0	294	371	-
	βiSVSP 40/40-15-B	A06B-6320-H223	L	0	294	371	-
			M	0	294	371	-
	βiSVSP 40/40-18-B	A06B-6320-H224	L	0	294	371	-
			M	0	294	371	-
	βiSVSP 80/80-18-B	A06B-6320-H244	L	0	294	371	-
			M	0	294	371	-
	βiSVSP 20/20/40-7.5-B	A06B-6320-H311	L	0	294	371	-
			M	0	294	371	-
			N	0	294	371	-

Series	Motor model	Specification	Axis	Loss coef. A No. 2469	Loss coef. B (No. 2490)		
					HRV2	HRV3	HRV4
βiSVSP-B (200V)	βiSVSP 20/20/40-11-B	A06B-6320-H312	L	0	294	371	-
			M	0	294	371	-
			N	0	294	371	-
	βiSVSP 40/40/40-11-B	A06B-6320-H332	L	0	294	371	-
			M	0	294	371	-
			N	0	294	371	-
	βiSVSP 40/40/40-15-B	A06B-6320-H333	L	0	294	371	-
			M	0	294	371	-
			N	0	294	371	-
	βiSVSP 40/40/80-15-B	A06B-6320-H343	L	0	294	371	-
			M	0	294	371	-
			N	0	294	371	-
	βiSVSP 40/40/80-18-B	A06B-6320-H344	L	0	294	371	-
			M	0	294	371	-
			N	0	294	371	-
	βiSVSP 80/80/80-18-B	A06B-6320-H364	L	0	294	371	-
			M	0	294	371	-
			N	0	294	371	-
	βiSVSP 20/20-7.5-B	A06B-6321-H201	L	0	301	384	-
			M	0	301	384	-
	βiSVSP 20/20-11-B	A06B-6321-H202	L	0	301	384	-
			M	0	301	384	-
	βiSVSP 20/20/40-7.5-B	A06B-6321-H311	L	0	301	384	-
			M	0	301	384	-
			N	0	294	378	-
	βiSVSP 20/20/40-11-B	A06B-6321-H312	L	0	301	384	-
			M	0	301	384	-
			N	0	294	378	-
	βiSVSP 40/40/40-11-B	A06B-6321-H332	L	0	294	378	-
			M	0	294	378	-
			N	0	294	378	-
βiSVSP(200V)	βiSVSP 40/40-18	A06B-6164-H224#H580	L	0	294	378	-
			M	0	294	378	-
	βiSVSP 40/40/80-18	A06B-6164-H344#H580	L	0	294	378	-
			M	0	294	378	-
			N	0	275	371	-
	βiSVSP 80/80/80-18	A06B-6164-H364#H580	L	0	275	371	-
			M	0	275	371	-
			N	0	275	371	-
	βiSVSP 20/20-7.5	A06B-616△-H201#H5□0	L	0	320	416	-
			M	0	320	416	-
	βiSVSP 20/20-11	A06B-616△-H202#H5□0	L	0	320	416	-
			M	0	320	416	-
	βiSVSP 40/40-15	A06B-616△-H223#H5□0	L	0	294	378	-
			M	0	294	378	-
	βiSVSP 20/20/40-7.5	A06B-616△-H311#H5□0	L	0	320	416	-
			M	0	320	416	-
			N	0	294	378	-
	βiSVSP 20/20/40-11	A06B-616△-H312#H5□0	L	0	320	416	-
			M	0	320	416	-
			N	0	294	378	-

Series	Motor model	Specification	Axis	Loss coef. A No. 2469	Loss coef. B (No. 2490)		
					HRV2	HRV3	HRV4
βiSVSP(200V)	βiSVSP 40/40/40-15	A06B-616△-H333#H5 □0	L	0	294	378	-
			M	0	294	378	-
			N	0	294	378	-
	βiSVSP 40/40/80-15	A06B-616△-H343#H5 □0	L	0	294	378	-
			M	0	294	378	-
			N	0	275	371	-
	βiSVSP 20/20-5.5	A06B-6134-H201#A,C	L	0	294	378	-
			M	0	294	378	-
	βiSVSP 20/20-7.5	A06B-6134-H201#D	L	0	320	416	-
			M	0	320	416	-
	βiSVSP 20/20-11	A06B-6134-H202#A,C	L	0	294	378	-
			M	0	294	378	-
		A06B-6134-H202#D	L	0	320	416	-
			M	0	320	416	-
	βiSVSP 40/40-15	A06B-6134-H203#A,C, D	L	0	294	378	-
			M	0	294	378	-
	βiSVSP 20/20/40-5.5	A06B-6134-H301#A,C	L	0	294	378	-
			M	0	294	378	-
			N	0	294	378	-
	βiSVSP 20/20/40-7.5	A06B-6134-H301#D	L	0	320	416	-
			M	0	320	416	-
			N	0	294	378	-
	βiSVSP 20/20/40-11	A06B-6134-H302#A,C	L	0	294	378	-
			M	0	294	378	-
			N	0	294	378	-
		A06B-6134-H302#D	L	0	320	416	-
			M	0	320	416	-
			N	0	294	378	-
	βiSVSP 40/40/40-15	A06B-6134-H303#A,C, D	L	0	294	378	-
			M	0	294	378	-
			N	0	294	378	-
	βiSVSP 40/40/80-15	A06B-6134-H313#D	L	0	294	378	-
			M	0	294	378	-
			N	0	275	371	-
βiSVSP-B (400V)	βiSVSP 10/10-11HV-B	A06B-6331-H202	L	0	557	864	-
			M	0	557	864	-
	βiSVSP 20/20/20-11HV-B	A06B-6331-H332	L	0	512	800	-
			M	0	512	800	-
			N	0	512	800	-
	βiSVSP 40/40-18HV-B	A06B-6330-H244	L	0	525	813	-
			M	0	525	813	-
	βiSVSP 20/20/40-15HV-B	A06B-6330-H343	L	0	525	813	-
			M	0	525	813	-
			N	0	525	813	-
	βiSVSP 40/40/40-18HV-B	A06B-6330-H364	L	0	525	813	-
			M	0	525	813	-
			N	0	525	813	-

Series	Motor model	Specification	Axis	Loss coef. A No. 2469	Loss coef. B (No. 2490)		
					HRV2	HRV3	HRV4
βiSVSPc	βiSVSPc 20/20-7.5	A06B-6167-H201#H560	L	0	320	416	-
			M	0	320	416	-
	βiSVSPc 20/20-7.5L	A06B-6167-H209#H560	L	0	320	416	-
			M	0	320	416	-
	βiSVSPc 20/20-11	A06B-6167-H202#H560	L	0	320	416	-
			M	0	320	416	-
	βiSVSPc 20/20/20-7.5	A06B-6167-H301#H560	L	0	320	416	-
			M	0	320	416	-
			N	0	320	416	-
	βiSVSPc 20/20/20-7.5L	A06B-6167-H309#H560	L	0	320	416	-
			M	0	320	416	-
			N	0	320	416	-
	βiSVSPc 20/20/20-11	A06B-6167-H302#H560	L	0	320	416	-
			M	0	320	416	-
			N	0	320	416	-

J.3 SETTINGS FOR POWER SUPPLY MODULE LOSS COEFFICIENTS C AND D

Table J.3 (a) Settings for power supply module loss coefficients C and D

Series	Motor model	Specification	Loss coef. C No. 2463	Loss coef. D (No. 2491)		Resistance regeneration No. 2281#2
				Three-phase input	Single-phase input	
αiPS-B (200V)	αiPS3-B	A06B-6200-H003 A06B-6202-H003	883	730	-	0
	αiPS7.5-B	A06B-6200-H008 A06B-6202-H008	1037	659	-	0
	αiPS11-B	A06B-6200-H011 A06B-6202-H011	1037	659	-	0
	αiPS15-B	A06B-6200-H015 A06B-6202-H015	1037	653	-	0
	αiPS26-B	A06B-6200-H026 A06B-6202-H026	1344	717	-	0
	αiPS30-B	A06B-6200-H030 A06B-6202-H030	1344	704	-	0
	αiPS37-B	A06B-6200-H037 A06B-6202-H037	1344	723	-	0
	αiPS55-B	A06B-6200-H055 A06B-6202-H055	2266	672	-	0
αiPS (200V)	αiPS5.5	A06B-6140-H006	2234	659	-	0
	αiPS11	A06B-6140-H011	2477	659	-	0
	αiPS15	A06B-6140-H015	2477	653	-	0
	αiPS26	A06B-6140-H026	2925	717	-	0
	αiPS30	A06B-6140-H030	2925	704	-	0
	αiPS37	A06B-6140-H037	2925	723	-	0
	αiPS55	A06B-6140-H055	3712	672	-	0
αiPS-B (400V)	αiPS11HV-B	A06B-6250-H011	1120	397	-	0
	αiPS18HV-B	A06B-6250-H018	1120	378	-	0
	αiPS30HV-B	A06B-6250-H030	1427	499	-	0
	αiPS45HV-B	A06B-6250-H045	1427	486	-	0
	αiPS60HV-B	A06B-6250-H060	1427	486	-	0
	αiPS75HV-B	A06B-6250-H075	2349	480	-	0
	αiPS100HV-B	A06B-6250-H100	2349	480	-	0
	αiPS125HV-B	A06B-6252-H125	2963	480	-	0

Series	Motor model	Specification	Loss coef. C No. 2463	Loss coef. D (No. 2491)		Resistance regeneration No. 2281#2
				Three-phase input	Single-phase input	
αiPS (400V)	αiPS11HV	A06B-6150-H011	2906	397	-	0
	αiPS18HV	A06B-6150-H018	2906	378	-	0
	αiPS30HV	A06B-6150-H030	3584	499	-	0
	αiPS45HV	A06B-6150-H045	4237	486	-	0
	αiPS60HV	A06B-6150-H060	4237	486	-	0
	αiPS75HV	A06B-6150-H75	4134	480	-	0
	αiPS100HV	A06B-6150-H100	4134	480	-	0
αiPSR	αiPSR3	A06B-6115-H003	973	659	-	1
	αiPSR5.5	A06B-6115-H006	973	659	-	1
αiPSs (200V)	αiPSs15-B	A06B-6212-H015	1037	751	-	0
	αiPSs37-B	A06B-6212-H037	1344	832	-	0
αiPSs (400V)	αiPSs18HV-B	A06B-6262-H018	1120	434	-	0
	αiPSs45HV-B	A06B-6262-H045	1427	559	-	0
	αiPSs75HV-B	A06B-6262-H075	2349	552	-	0
	αiPSs100HV-B	A06B-6262-H100	2349	552	-	0
βiSV,-B (200V)	βiSV4,-B	A06B-61□0-H001	0	621	1024	1
	βiSV20,-B	A06B-61□0-H002	0	621	1024	1
	βiSV40,-B	A06B-61□0-H003	0	646	-	1
	βiSV80,-B	A06B-61□0-H004	0	646	-	1
	βiSV20/20,-B	A06B-6166-H201 A06B-6136-H201#A	0	710	-	1
	βiSV40/40,-B	A06B-61□6-H203	0	710	-	1
βiSV ,-B (400V)	βiSV10HV,-B	A06B-61□1-H001	0	320	-	1
	βiSV20HV,-B	A06B-61□1-H002	0	320	-	1
	βiSV40HV,-B	A06B-61□1-H003	0	320	-	1
βiSVSP-B (200V)	βiSVSP 20/20-7.5-B	A06B-6320-H201	2560	755	-	0
	βiSVSP 20/20-11-B	A06B-6320-H202	2560	755	-	0
	βiSVSP 40/40-15-B	A06B-6320-H223	2560	755	-	0
	βiSVSP 40/40-18-B	A06B-6320-H224	3328	755	-	0
	βiSVSP 80/80-18-B	A06B-6320-H244	3328	755	-	0
	βiSVSP 20/20/40-7.5-B	A06B-6320-H311	2752	755	-	0
	βiSVSP 20/20/40-11-B	A06B-6320-H312	2752	755	-	0
	βiSVSP 40/40/40-11-B	A06B-6320-H332	2752	755	-	0
	βiSVSP 40/40/40-15-B	A06B-6320-H333	2752	755	-	0
	βiSVSP 40/40/80-15-B	A06B-6320-H343	2752	755	-	0
	βiSVSP 40/40/80-18-B	A06B-6320-H344	3520	755	-	0
	βiSVSP 80/80/80-18-B	A06B-6320-H364	3520	755	-	0
	βiSVSP 20/20-7.5-B	A06B-6321-H201	2560	691	-	0
	βiSVSP 20/20-11-B	A06B-6321-H202	2560	755	-	0
	βiSVSP 20/20/40-7.5-B	A06B-6321-H311	2752	691	-	0
	βiSVSP 20/20/40-11-B	A06B-6321-H312	2752	755	-	0
	βiSVSP 40/40/40-11-B	A06B-6321-H332	2752	755	-	0

Series	Motor model	Specification	Loss coef. C No. 2463	Loss coef. D (No. 2491)		Resistance regeneration No. 2281#2
				Three-phase input	Single-phase input	
βiSVSP (200V)	βiSVSP 40/40-18	A06B-6164-H224#H580	1984	659	-	0
	βiSVSP 40/40/80-18	A06B-6164-H344#H580	2048	653	-	0
	βiSVSP 80/80/80-18	A06B-6164-H364#H580	2048	653	-	0
	βiSVSP 20/20-7.5	A06B-616△-H201#H5□0	1984	659	-	0
	βiSVSP 20/20-11	A06B-616△-H202#H5□0	1984	659	-	0
	βiSVSP 40/40-15	A06B-616△-H223#H5□0	1984	653	-	0
	βiSVSP 20/20/40-7.5	A06B-616△-H311#H5□0	2048	659	-	0
	βiSVSP 20/20/40-11	A06B-616△-H312#H5□0	2048	659	-	0
	βiSVSP 40/40/40-15	A06B-616△-H333#H5□0	2048	653	-	0
	βiSVSP 40/40/80-15	A06B-616△-H343#H5□0	2048	653	-	0
	βiSVSP 20/20-5.5	A06B-6134-H201#A,C	1664	659	-	0
βiSVSP (200V)	βiSVSP 20/20-7.5	A06B-6134-H201#D	1664	659	-	0
	βiSVSP 20/20-11	A06B-6134-H202#A,C	1664	659	-	0
		A06B-6134-H202#D	1664	659	-	0
	βiSVSP 40/40-15	A06B-6134-H203#A,C,D	1664	653	-	0
	βiSVSP 20/20/40-5.5	A06B-6134-H301#A,C	1728	659	-	0
	βiSVSP 20/20/40-7.5	A06B-6134-H301#D	1728	659	-	0
	βiSVSP 20/20/40-11	A06B-6134-H302#A,C	1728	659	-	0
		A06B-6134-H302#D	1728	659	-	0
	βiSVSP 40/40/40-15	A06B-6134-H303#A,C,D	1728	653	-	0
	βiSVSP 40/40/80-15	A06B-6134-H313#D	1728	653	-	0
βiSVSP-B (400V)	βiSVSP 10/10-11HV-B	A06B-6331-H202	2560	474	-	0
	βiSVSP 20/20/20-11HV-B	A06B-6331-H332	2752	474	-	0
	βiSVSP 40/40-18HV-B	A06B-6330-H244	3328	493	-	0
	βiSVSP 40/40/40-18HV-B	A06B-6330-H364	3520	493	-	0
βiSVSPc	βiSVSPc 20/20-7.5	A06B-6167-H201#H560	1984	659	-	0
	βiSVSPc 20/20-7.5L	A06B-6167-H209#H560	1984	659	-	0
	βiSVSPc 20/20-11	A06B-6167-H202#H560	1984	659	-	0
	βiSVSPc 20/20/20-7.5	A06B-6167-H301#H560	1984	653	-	0
	βiSVSPc 20/20/20-7.5L	A06B-6167-H309#H560	1984	653	-	0
	βiSVSPc 20/20/20-11	A06B-6167-H302#H560	1984	653	-	0

K CORRESPONDENCE OF SERVO PARAMETER NUMBERS BETWEEN Series 15*i*, AND Series 30*i*, 0*i*, AND OTHERS

The following table lists the correspondence of servo parameter numbers between Series 15*i*, and Series 30*i*, 0*i*, and others.

Series 30*i*, 0*i*, and others	Series15*i*	Series 30*i*, 0*i*, and others	Series15*i*	Series 30*i*, 0*i*, and others	Series15*i*
1815	1815	2040	1852	2085	1978
1817	1817	2041	1853	2086	1979
1821	1896	2042	1854	2087	1980
1825	1825	2043	1855	2088	1981
1851	1851	2044	1856	2089	1982
2000	1804	2045	1857	2090	1983
2001	1806	2046	1858	2091	1984
2002	1807	2047	1859	2092	1985
2003	1808	2048	1860	2093	1986
2004	1809	2049	1861	2094	1987
2005	1883	2050	1862	2095	1988
2006	1884	2051	1863	2096	1989
2007	1951	2052	1864	2097	1990
2008	1952	2053	1865	2098	1991
2009	1953	2054	1866	2099	1992
2010	1954	2055	1867	2100	1993
2011	1955	2056	1868	2101	1994
2012	1956	2057	1869	2102	1995
2013	1707	2058	1870	2103	1996
2014	1708	2059	1871	2104	1997
2015	1957	2060	1872	2105	1998
2016	1958	2061	1873	2106	1999
2017	1959	2062	1877	2107	1700
2018	1960	2063	1878	2108	1701
2019	1709	2064	1892	2109	1702
2020	1874	2065	1893	2110	1703
2021	1875	2066	1894	2111	1704
2022	1879	2067	1895	2112	1705
2023	1876	2068	1961	2113	1706
2024	1891	2069	1962	2114	1725
2025	1710	2070	1963	2115	1726
2026	1717	2071	1964	2116	1727
2027	1712	2072	1965	2117	1728
2028	1713	2073	1966	2118	1729
2029	1714	2074	1967	2119	1730
2030	1715	2075	1968	2120	1731
2031	1716	2076	1969	2121	1732
2032	1717	2077	1970	2122	1733
2033	1718	2078	1971	2123	1734
2034	1719	2079	1972	2124	1739
2035	1720	2080	1973	2125	
2036	1721	2081	1974	2126	1737

Series 30*i*, 0*i*, and others	Series15*i*	Series 30*i*, 0*i*, and others	Series15*i*	Series 30*i*, 0*i*, and others	Series15*i*
2037	1722	2082	1975	2127	1735
2038	1723	2083	1976	2128	1736
2039	1724	2084	1977	2129	1752
2130	1753	2180	2623	2230	2643
2131	1754	2181	2624	2231	2644
2132	1755	2182	2625	2232	2645
2133	1756	2183	2626	2233	2646
2134	1757	2184	2627	2234	2647
2135	1758	2185	2628	2235	2648
2136	1759	2186	2629	2236	2649
2137	1760	2187	2630	2237	2650
2138	1761	2188	2631	2238	2651
2139	1762	2189	2632	2239	2652
2140	1763	2190	2633	2240	2653
2141	1764	2191	2634	2241	2654
2142	1765	2192	2635	2242	2655
2143	1766	2193	2636	2243	2656
2144	1767	2194	2637	2244	2657
2145	1768	2195	2638	2245	2658
2146	1769	2196	2639	2246	2659
2147	1770	2197	2640	2247	2660
2148	1771	2198	2641	2248	2661
2149	1772	2199	2642	2249	2662
2150	1773	2200	1740	2250	2663
2151	1774	2201	1741	2251	2664
2152	1775	2202	1742	2252	2665
2153	1776	2203	1743	2253	2666
2154	1777	2204	1744	2254	2667
2155	1778	2205	1745	2255	2668
2156	1779	2206	1746	2256	2669
2157	1780	2207	1747	2257	2670
2158	1781	2208	1748	2258	2671
2159	1782	2209	1749	2259	2672
2160	1783	2210	1750	2260	2673
2161	1784	2211	1751	2261	2674
2162	1785	2212	2600	2262	2675
2163	1786	2213	2601	2263	2676
2164	1787	2214	2602	2264	2677
2165	1788	2215	2603	2265	2678
2166	1789	2216	2604	2266	2679
2167	1790	2217	2605	2267	2680
2168	1791	2218	2606	2268	2681
2169	1792	2219	2607	2269	2682
2170	1793	2220	2608	2270	2683
2171	1794	2221	2609	2271	2684
2172	1795	2222	2610	2272	2685
2173	1796	2223	2611	2273	2686
2174	1797	2224	2612	2274	2687
2175	1798	2225	2613	2275	2688
2176	1799	2226	2614	2276	2689
2177	2620	2227	2615	2277	2690
2178	2621	2228	2616	2278	2691
2179	2622	2229	2617	2279	2692
2280	2693	2330	2743	2380	2793

Series 30*i*, 0*i*, and others	Series15*i*	Series 30*i*, 0*i*, and others	Series15*i*	Series 30*i*, 0*i*, and others	Series15*i*
2281	2694	2331	2744	2381	2794
2282	2695	2332	2745	2382	2795
2283	2696	2333	2746	2383	2796
2284	2697	2334	2747	2384	2797
2285	2698	2335	2748	2385	2798
2286	2699	2336	2749	2386	2799
2287	2700	2337	2750	2387	2800
2288	2701	2338	2751	2388	2801
2289	2702	2339	2752	2389	2802
2290	2703	2340	2753	2390	2803
2291	2704	2341	2754	2391	2804
2292	2705	2342	2755	2392	2805
2293	2706	2343	2756	2393	2806
2294	2707	2344	2757	2394	2807
2295	2708	2345	2758	2395	2808
2296	2709	2346	2759	2396	2809
2297	2710	2347	2760	2397	2810
2298	2711	2348	2761	2398	2811
2299	2712	2349	2762	2399	2812
2300	2713	2350	2763	2400	2813
2301	2714	2351	2764	2401	2814
2302	2715	2352	2765	2402	2815
2303	2716	2353	2766	2403	2816
2304	2717	2354	2767	2404	2817
2305	2718	2355	2768	2405	2818
2306	2719	2356	2769	2406	2819
2307	2720	2357	2770	2407	2820
2308	2721	2358	2771	2408	2821
2309	2722	2359	2772	2409	2822
2310	2723	2360	2773	2410	2823
2311	2724	2361	2774	2411	2824
2312	2725	2362	2775	2412	2825
2313	2726	2363	2776	2413	2826
2314	2727	2364	2777	2414	2827
2315	2728	2365	2778	2415	2828
2316	2729	2366	2779	2416	2829
2317	2730	2367	2780	2417	2830
2318	2731	2368	2781	2418	2831
2319	2732	2369	2782	2419	2832
2320	2733	2370	2783	2420	2833
2321	2734	2371	2784	2421	2834
2322	2735	2372	2785	2422	2835
2323	2736	2373	2786	2423	2836
2324	2737	2374	2787	2424	2837
2325	2738	2375	2788	2425	2838
2326	2739	2376	2789	2426	2839
2327	2740	2377	2790	2427	2840
2328	2741	2378	2791	2428	2841
2329	2742	2379	2792	2429	2842
2430	2843	2480	2893	2530	2945
2431	2844	2481	2894	2531	2946
2432	2845	2482	2895	2532	2947
2433	2846	2483	2896	2533	2948
2434	2847	2484	2897	2534	2949

Series 30*i*, 0*i*, and others	Series15*i*	Series 30*i*, 0*i*, and others	Series15*i*	Series 30*i*, 0*i*, and others	Series15*i*
2435	2848	2485	2898	2535	2950
2436	2849	2486	2899	2536	2951
2437	2850	2487	2902	2537	2952
2438	2851	2488	2903	2538	2953
2439	2852	2489	2904	2539	2954
2440	2853	2490	2905	2540	2955
2441	2854	2491	2906	2541	2956
2442	2855	2492	2907	2542	2957
2443	2856	2493	2908	2543	2958
2444	2857	2494	2909	2544	2959
2445	2858	2495	2910	2545	2960
2446	2859	2496	2911	2546	2961
2447	2860	2497	2912	2547	2962
2448	2861	2498	2913	2548	2963
2449	2862	2499	2914	2549	2964
2450	2863	2500	2915	2550	2965
2451	2864	2501	2916	2551	2966
2452	2865	2502	2917	2552	2967
2453	2866	2503	2918	2553	2968
2454	2867	2504	2919	2554	2969
2455	2868	2505	2920	2555	2970
2456	2869	2506	2921	2556	2971
2457	2870	2507	2922	2557	2972
2458	2871	2508	2923		
2459	2872	2509	2924		
2460	2873	2510	2925		
2461	2874	2511	2926		
2462	2875	2512	2927		
2463	2876	2513	2928		
2464	2877	2514	2929		
2465	2878	2515	2930		
2466	2879	2516	2931		
2467	2880	2517	2932		
2468	2881	2518	2933		
2469	2882	2519	2934		
2470	2883	2520	2935		
2471	2884	2521	2936		
2472	2885	2522	2937		
2473	2886	2523	2938		
2474	2887	2524	2939		
2475	2888	2525	2940		
2476	2889	2526	2941		
2477	2890	2527	2942		
2478	2891	2528	2943		
2479	2892	2529	2944		

L CONNECTING A LARGE SERVO MOTOR USING A PWM DISTRIBUTION MODULE

L.1 SETTING PARAMETERS FOR A PWM DISTRIBUTION MODULE (PDM)

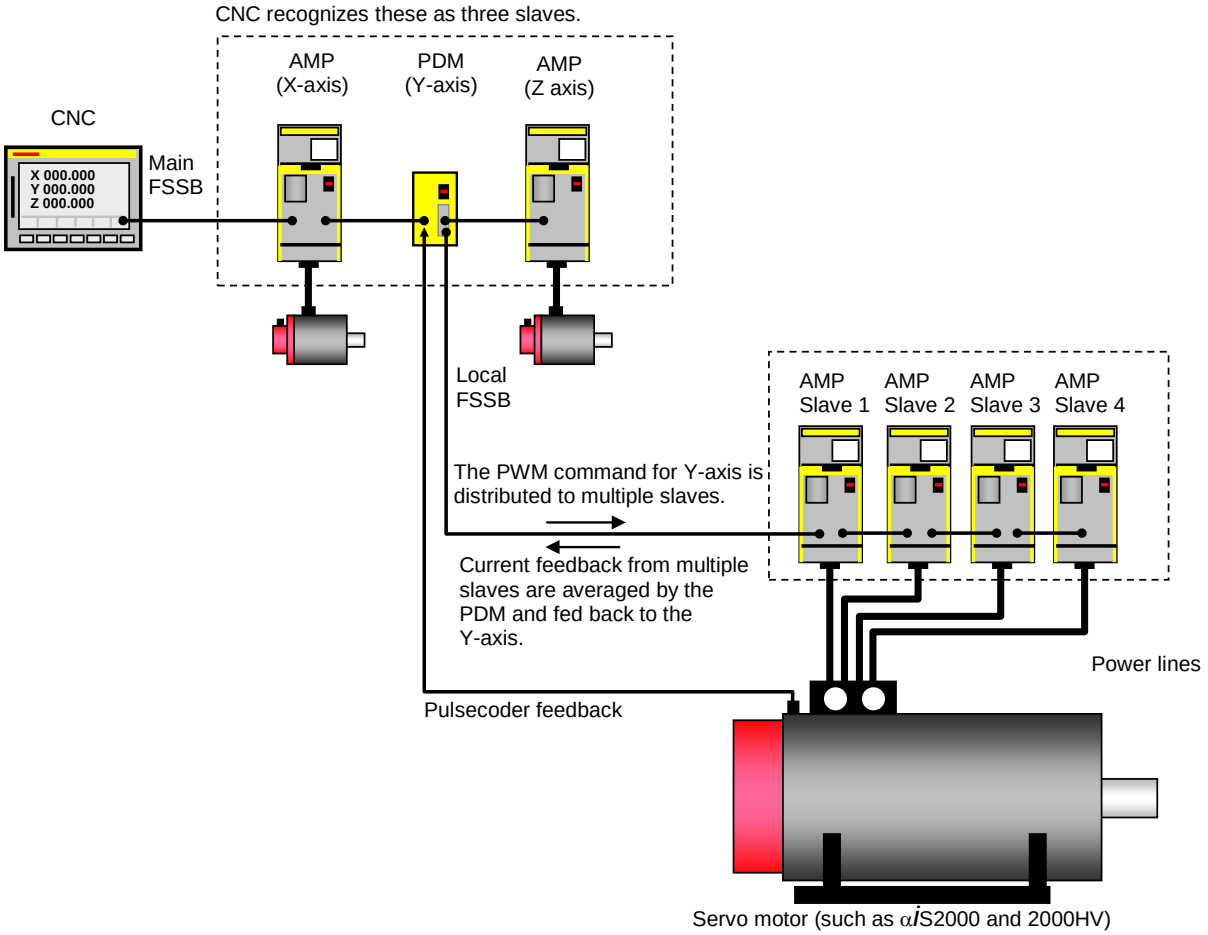
(1) Overview

The PWM distribution module (PDM) has a function for copying a PWM command for one axis received from the CNC and distributing the command copy to multiple servo amplifiers and a function for finding an average current per servo amplifier from current feedback signals received from multiple servo amplifiers and transferring the average current to the CNC. Multiple servo amplifiers connected to a PDM can be viewed from the CNC as being connected to one axis. So, by using a PDM, high power can be achieved through parallel driving without increasing the number of CNC controlled axes.

NOTE

When a PWM distribution module is used, HRV3 needs to be set. This means that one FSSB path cannot connect more than four slaves consisting of amplifiers and a PDM.

Example of connection)



(2) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 0*i*-D	90C5	D(04) and subsequent editions	
	90C8	A(01) and subsequent editions	
	90E5	D(04) and subsequent editions	
	90E8	A(01) and subsequent editions	
Series 16*i*/18*i*/21*i*-B Power Mate *i*-D/H	90B1	A(01) and subsequent editions	

To use a PDM, the following system software is needed:

CNC	System software	
	Series	Edition
Series 0*i*-MD	D4F1	01 and subsequent editions
Series 0*i*-TD	D6F1	01 and subsequent editions
Series 0*i* Mate-MD	D5F1	01 and subsequent editions
Series 0*i* Mate-TD	D7F1	01 and subsequent editions
Series 16*i*-MB	B0M1,B0N1	01 and subsequent editions
Series 16*i*-TB	-	-
Series 18*i*-MB5	BDM5,BDN5	01 and subsequent editions
Series 18*i*-MB	BDM1,BDN1	01 and subsequent editions
Series 18*i*-TB	-	-
Series 18*i*-LNB	-	-
Series 21*i*-MB	DDHA	17 and subsequent editions
	DDHK,DDK1	01 and subsequent editions
Series 21*i*-TB	-	-
Power Mate *i*-D	88E1	01 and subsequent editions
	88E3	01 and subsequent editions
Power Mate *i*-H	88F2	08 and subsequent editions
	88F3	01 and subsequent editions
DSA(HSSB)	881G	06 and subsequent editions
Pulse input type DSA	881H	02 and subsequent editions

* The PDM cannot be used with the 30*i* Series, Power Motion *i*-A, and 0*i*-F Series.

(3) Setting parameters

(a) Setting for a PDM

For axes that use a PDM, servo HRV3 control needs to be set. Set the parameters below.

Set the parameter for servo HRV2 control beforehand. Next, set the parameter below for servo HRV3 control (HR3 = 1). (For each axis)

	#7	#6	#5	#4	#3	#2	#1	#0
2013								**HR3**

HR3(#0) 0: Does not use servo HRV3 control.
1: Uses servo HRV3 control.
* When using a PDM, set **HR3 = 1**. In actual operation, this control is equivalent to HRV2 control. (The G5.4-based high-speed current control mode cannot be switched either.)

For the axes that use a PDM, set the following parameter in addition to the setting of HR3 above:

2165	**Set 0.**

If this parameter is not set, "Invalid motor/amplifier combination" may be issued.
Note that because this parameter needs to be set to 0 when a PDM is used, the servo tuning screen does not provide an actual current indication (ampere indication). (A % indication is provided.)

L.2 DATA MEASUREMENT AND DIAGNOSIS WITH A PWM DISTRIBUTION MODULE (PDM)

(1) Overview

In a configuration that uses a PWM distribution module, many motor power lines are used. If an error occurs, error location isolation may be difficult in some cases. The following functions are available to facilitate troubleshooting:

(a) PDM current monitor
- The actual current flowing through each amplifier is monitored using SERVO GUIDE.

(b) PDM's slave ready output
- The ready state of each amplifier present when the VRDY-OFF alarm is issued is displayed on the diagnosis screen of the CNC.

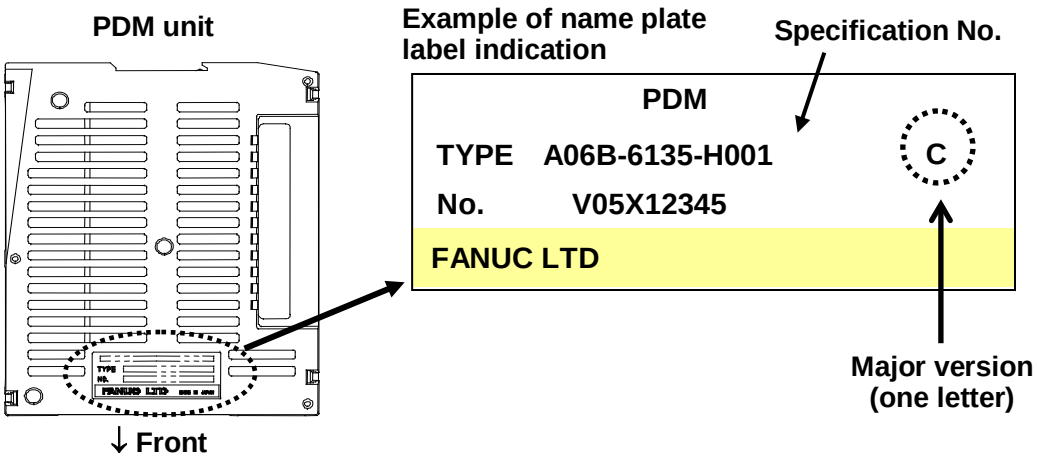
For the method of PDM-based troubleshooting, refer to "Troubleshooting of Large Servo Motors by Using a PDM (PWM Distribution Module) (A-72562-034)" as well.

(2) Series and editions of applicable servo control software

The PDM diagnosis functions are available with the following series and editions:

Function	Applicable servo control software series and edition	Applicable PDM version(*)	Applicable SERVO GUIDE version
PDM current monitor function	Series 90C5, E5/D(04) or later Series 90C8, E8/A(01) or later Series 90B1/F(06) or later	Overall version C or later	Ver3.20
PDM's slave ready output	Series 90C5, E5/D(04) or later Series 90C8, E8/A(01) or later Series 90B1/G(07) or later	Overall version C or later	—

* The overall version of a PDM can be checked with the indication provided on the label of the PDM.



The following table lists the series and editions of system software supporting SV0648 and diagnosis 656 with PDM's slave ready output.

CNC	System software	
	Series	Edition
Series 0*i*-MD	D4F1	06 and subsequent editions
Series 0*i*-TD	D6F1	06 and subsequent editions
Series 0*i* Mate-MD	D5F1	06 and subsequent editions
Series 0*i* Mate-TD	D7F1	06 and subsequent editions
Series 16*i*-MB	B0M1,B0N1	01 and subsequent editions
Series 16*i*-TB	-	-
Series 18*i*-MB5	BDM5,BDN5	01 and subsequent editions
Series 18*i*-MB	BDM1,BDN1	01 and subsequent editions
Series 18*i*-TB	-	-
Series 18*i*-LNB	-	-
Series 21*i*-MB	DDHK,DDK1	01 and subsequent editions
Series 21*i*-TB	-	-
Power Mate *i*-D	88E1	06 and subsequent editions
	88E3	04 and subsequent editions
Power Mate *i*-H	88F2	13 and subsequent editions
	88F3	04 and subsequent editions
Pulse input type DSA	-	-

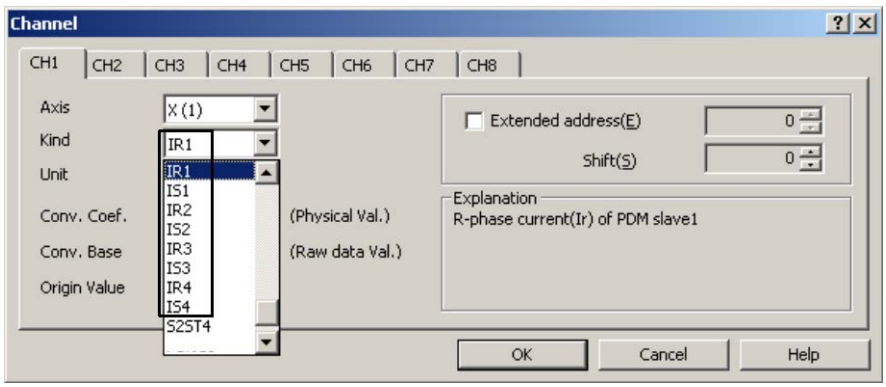
(3) PDM-related functions

(a) PDM current monitor function

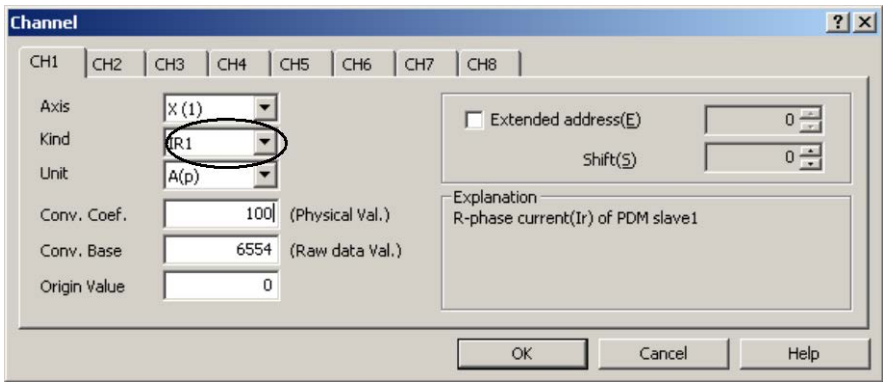
The actual current of each amplifier connected to a PDM can be measured by using SERVO GUIDE.

■ Method of setting SERVO GUIDE

From "Type", select the type of current to be measured. (Counting from the closest to the PDM of the amplifiers connected to the local FSSB, the R phase current of the n-th amplifier is represented as IRn and the S phase current of the n-th amplifier is represented as ISn.)

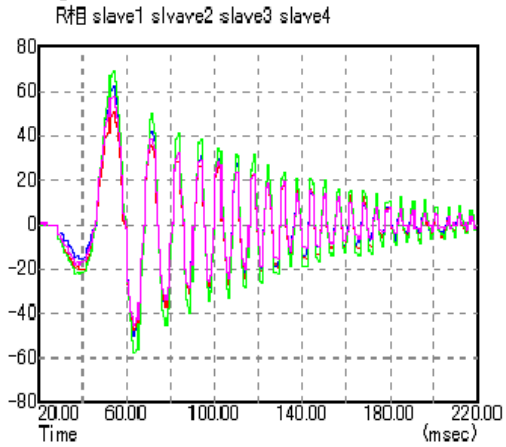


Example) When the R phase current (IR) of slave 1



NOTE The update interval of this data is 1 msec.

[Example of waveform measurement]



(b) PDM's slave ready output

With an axis that uses a PDM, the VRDY-OFF alarm is issued if there is one or more servo amplifiers that are connected to the PDM and are not placed in the ready state. To facilitate troubleshooting in such a case, the ready state of each amplifier present when the VRDY-OFF alarm is issued is displayed on the diagnosis screen of the CNC.

The diagnosis number for referencing the ready state differs depending on the alarm number. Check the diagnosis number corresponding to the displayed alarm number.

Alarm number	Alarm message	Diagnosis number
SV0648	PDM VRDY OFF (DGN656)	Diagnosis 656
SV401	VRDY OFF	Diagnosis 353

■ Diagnosis screen display when alarm SV0648 is issued

	#7	#6	#5	#4	#3	#2	#1	#0
Diagnosis 656					**VRDY4 (slave 4)**	**VRDY3 (slave 3)**	**VRDY2 (slave 2)**	**VRDY1 (slave 1)**

VREDY4-1(#3-0) Displays the ready state when VRDY OFF is issued for each amplifier of slave 1 to 4.
0: Not-ready state
1: Ready state (amplifier ready state)

You can check the bits of diagnosis 656 to determine the amplifier which causes the VRDY OFF alarm.

■ Setting parameters when alarm SV0401 is issued

If alarm SV0401 is displayed, by setting the parameters below, the ready state of each amplifier present when the VRDY OFF alarm is issued can be displayed on diagnosis No. 353. Note that the values to be set in the parameters vary, depending on whether an odd number or even number is set in parameter No. 1023 for the axis.

Parameter No. to be set	When an odd number is set in No. 1023 for the axis	When an even number is set in No. 1023 for the axis
No.2115	0	0
No.2151	3094	3222

■ Diagnosis screen display when alarm SV0401 is issued

Diagnosis 353	Amplifier ready state when the VRDY-OFF alarm is issued (in decimal)

By checking the decimal value displayed in diagnosis No. 353, the amplifier that caused the VRDY-OFF alarm to be issued can be identified. (See the table below.)

Value displayed by diagnosis No. 353	Ready state of each slave amplifier (○: Ready state, ×: Not-ready state)			
	Slave 1	Slave 2	Slave 3	Slave 4
0	○	○	○	○
1	×	○	○	○
2	○	×	○	○
3	×	×	○	○
4	○	○	×	○
5	×	○	×	○
6	○	×	×	○
7	×	×	×	○
8	○	○	○	×
9	×	○	○	×
10	○	×	○	×
11	×	×	○	×
12	○	○	×	×
13	×	○	×	×
14	○	×	×	×
15	×	×	×	×

M QUADRANT PROTRUSION TUNING USING SERVO GUIDE

(1) Overview

Quadrant protrusion compensation using Tuning Navigator of SERVO GUIDE enables you to determine the optimum parameters for the quadrant protrusion compensation function for Tuning Navigator by operating SERVO GUIDE and the CNC according to instructions shown as a wizard.

Compensation parameters are determined by performing the following operations in the wizard:

- Set the items required for tuning.
- Make a circular motion several times at three different feedrates to measure the optimum quadrant protrusion compensation (learning).
- Parameters for setting the quadrant protrusion compensation function for Tuning Navigator are displayed based on the measured compensation.
- Check the operation by applying the displayed parameters.

This appendix describes the items to be set according to the wizard and items to be tuned.

Quadrant protrusion compensation using Tuning Navigator automatically tunes the parameters for the quadrant protrusion compensation function for Tuning Navigator. It does not automatically tune the parameters for the conventional backlash acceleration function or two-stage backlash acceleration function. During tuning, some parameters are changed so that these functions are not enabled. To use the conventional backlash acceleration function or two-stage backlash acceleration function together, additionally set the required parameters after tuning.
For the specification of SERVO GUIDE and restrictions on Tuning Navigator, refer to the "FANUC SERVO GUIDE OPERATOR'S MANUAL (B-65404EN), online help of SERVO GUIDE, and relevant technical reports.

(2) Series and editions of applicable software

To use quadrant protrusion compensation navigation, the following series and editions of applicable software are required.

Servo software	Applicable series and editions
SERVO GUIDE	4.00 and subsequent editions 4.10 and subsequent editions (supports synchronous axes.) 6.00 and subsequent editions (supports trapezoidal acceleration.) 6.30 and subsequent editions (supports rotary axes.)
CNC software*	
Series 30*i*-A	G004/01 and subsequent editions, G014/01 and subsequent editions, G024/01 and subsequent editions G00C/01 and subsequent editions, G01C/01 and subsequent editions, G02C/01 and subsequent editions
Series 31*i*-A5	G124/01 and subsequent editions, G134/01 and subsequent editions G12C/01 and subsequent editions, G13C/01 and subsequent editions
Series 31*i*-A	G104/01 and subsequent editions, G114/01 and subsequent editions G103/01 and subsequent editions, G113/01 and subsequent editions
Series 0*i*-MF	D4G1/02 and subsequent editions
Series 0*i*-TF	D6G1/02 and subsequent editions
Series 0*i*-MD	D4F1/01 and subsequent editions
Series 0*i*-TD	D6F1/01 and subsequent editions
Series 0*i* Mate-MD	D5F1/01 and subsequent editions
Series 0*i* Mate-TD	D7F1/01 and subsequent editions

Servo software	Applicable series and editions
Servo software	
Series 30*i*/31*i*/32*i*/35*i*-B	90G0/06 and subsequent editions, 90J0/01 and subsequent editions, 90K0/01 and subsequent editions
Power Motion *i* –A	90G0/06 and subsequent editions, 90J0/01 and subsequent editions, 90K0/01 and subsequent editions
Series 30*i*/31*i*/32*i*-A	90D0/12 and subsequent editions, 90E0/12 and subsequent editions 90D0/15 and subsequent editions, 90E0/15 and subsequent editions (supports synchronous axes.) 90D0/16 and subsequent editions, 90E0/16 and subsequent editions (supports synchronous axes and trapezoidal acceleration.) 90E1/01 and subsequent editions (supports synchronous axes and trapezoidal acceleration.)
Series 0*i*-F	90M0/02 and subsequent editions, 90L0/01 and subsequent editions, 90M8/02 and subsequent editions, 90L8/01 and subsequent editions,
Series 0*i*-D	90C5/01 and subsequent editions, 90E5/01 and subsequent editions (supports synchronous axes and trapezoidal acceleration.) 90C8/01 and subsequent editions, 90E8/01 and subsequent editions (supports synchronous axes and trapezoidal acceleration.)

* For the Series 30*i*/31*i*/32*i*-B/35*i*-B and Power Motion *i*-A, all series and editions of system software support this function.

(3) Related parameters

The following parameters are set by quadrant protrusion tuning using Tuning Navigator.

A) Function bit

	#7	#6	#5	#4	#3	#2	#1	#0
2415	LDMPQ	LACCO2	LBLACC	LBLFIL	SQRACC	LBLIN2		

LDMPQ (#7) Damping override setting for quadrant protrusion compensation for Tuning Navigator (1 or 0)

LACCO2(#6) Acceleration amount override setting for quadrant protrusion compensation for Tuning Navigator (Normally 1)

LBLACC(#5) Quadrant protrusion compensation for Tuning Navigator is:
0: Not used.
1: Used.

LBLFIL(#4) (Normally 0)

SQRACC(#3) Acceleration amount override setting for quadrant protrusion compensation for Tuning Navigator (Normally 1)

LBLIN2(#2) (Normally 0)

To use quadrant protrusion compensation for Tuning Navigator, it is necessary to enable backlash acceleration.

	#7	#6	#5	#4	#3	#2	#1	#0
2003			BLEN					

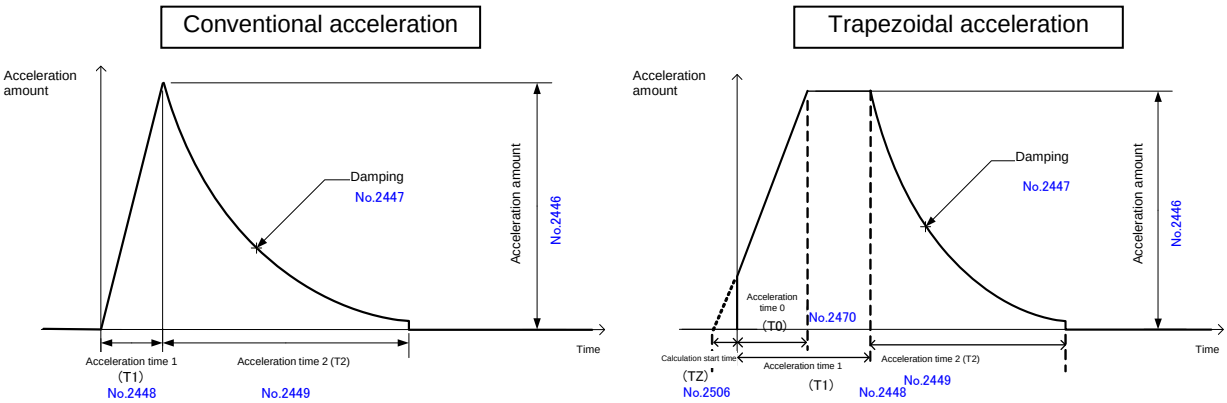
BLEN(#5) The backlash acceleration function is:
0: Not used.
1: Used.

	#7	#6	#5	#4	#3	#2	#1	#0
2018					OVR11	OVR8		

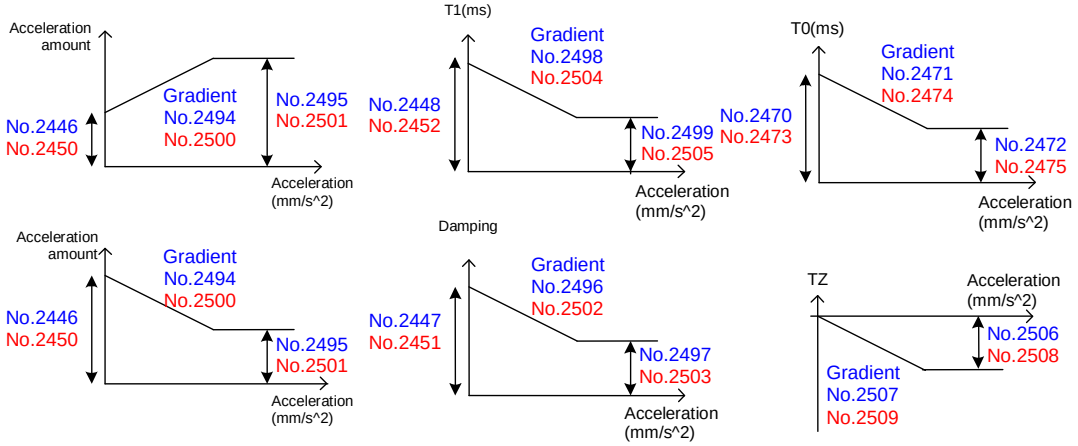
OVR11, OVR8(#3, #2) Setting of the acceleration override of two-stage backlash acceleration or quadrant protrusion compensation for Tuning Navigator
When bit 6 of parameter No. 2415 is set to 0, quadrant protrusion compensation for Tuning Navigator is also referenced.
When bit 6 of parameter No. 2415 is set to 1, quadrant protrusion compensation for Tuning Navigator is not referenced.

B) Tuning parameters

Conventional acceleration and trapezoidal acceleration are available for quadrant protrusion compensation for Tuning Navigator. When servo software applicable to trapezoidal acceleration is used, the "Use improvement" check box is automatically checked at the start of the wizard to select trapezoidal acceleration.



The override can be applied to the acceleration, acceleration time 1 (T1), damping, acceleration time 0 (T0), and calculation start time (TZ).



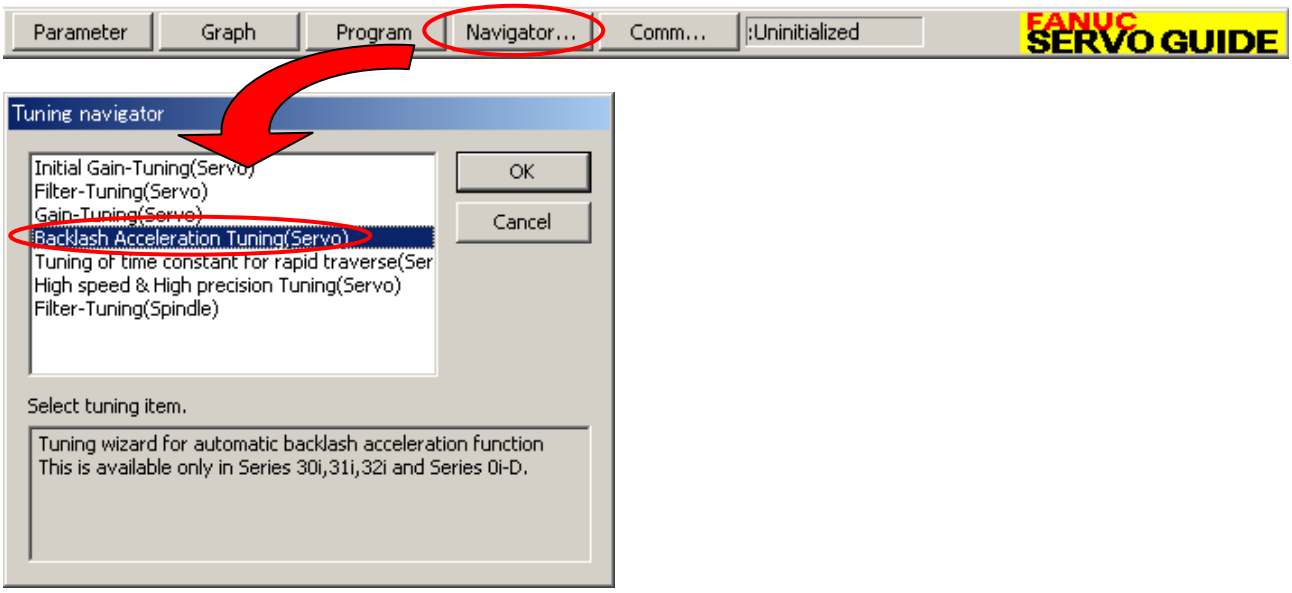
* The upper parameter is for the position direction and the lower parameter is for the negative direction.

Item	Basic setting		Override gradient		Override limit	
	Positive direction	Negative direction	Positive direction	Negative direction	Positive direction	Negative direction
Acceleration amount	No.2446	No.2450	No.2494	No.2500	No.2495	No.2501
Damping	No.2447	No.2451	No.2496	No.2502	No.2497	No.2503
TZ	–	–	No.2507	No.2509	No.2506	No.2508
T0	No.2470	No.2473	No.2471	No.2474	No.2472	No.2475
T1	No.2448	No.2452	No.2498	No.2504	No.2499	No.2505
T2	No.2449	No.2453	–	–	–	–

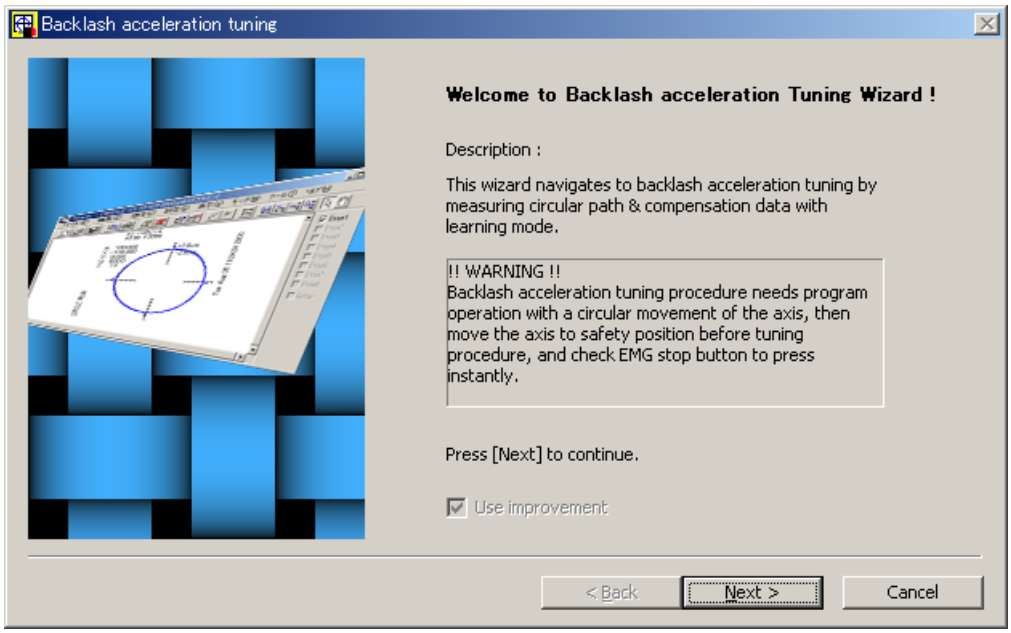
* When bit 5 of parameter No. 2415 is set to 0, the compensation according to the setting of the above parameters is disabled.

(4) Flow of quadrant protrusion tuning using Tuning Navigator

<1> On the Main Bar of SERVO GUIDE, click the **[Navigator…]** button to start Tuning Navigator. From tuning items of Tuning Navigator, select Backlash Acceleration Tuning and click **[OK]**.



<2> The start screen of the backlash acceleration tuning wizard appears. Click **[Next]**. When servo software applicable to trapezoidal acceleration is used, the "Use improvement" check box is automatically checked.



⚠ CAUTION

- Since the procedure involves a program operation, move the axis to a safe position in advance.
- Be prepared to readily press the emergency stop button in case of an abnormal operation.

<3> Select two target axes for circular motions.

Select a target axis for quadrant protrusion tuning in **[Axis1]** and a target axis for circular motions together with that axis in **[Axis2]**.

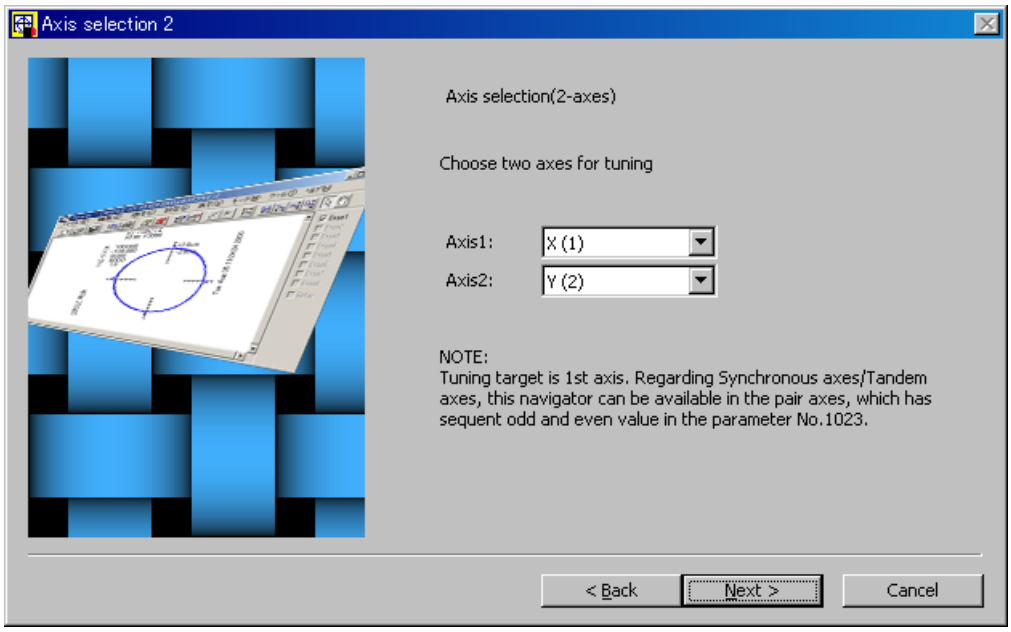
If you want to tune two axes, after the completion of the tuning of one axis, restart the wizard and select the axis selected for **[Axis1]** in **[Axis2]** and the axis selected for **[Axis2]** in **[Axis1]** for tuning.

In the case of synchronous axes or tandem axes, select the master axis.

If you select the slave axis, the servo guide will automatically switch to the master axis.

This tuning is not available for synchronous axes having multiple slave axes.

Use a series and edition of servo software that is applicable to synchronous/tandem axis tuning.

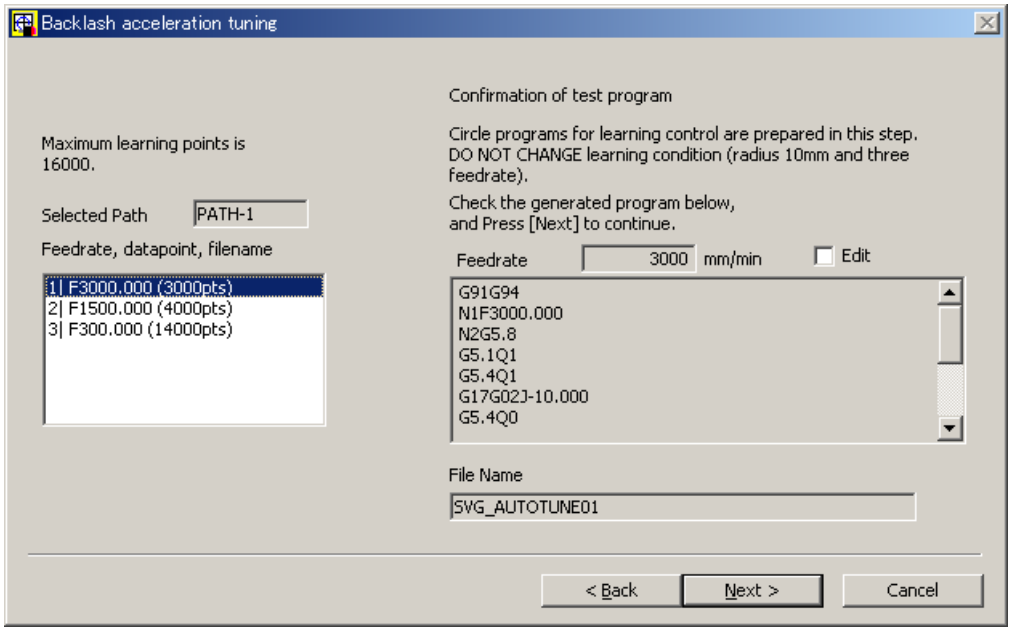


NOTE

1 When you have selected rotary axes, perform tuning by specifying a sine wave shaped position command for one axis and a sine wave whose phase is offset by 90 degrees for the other axis.
(As the tuning program, a minute line segment program is automatically generated.)

2 The backlash acceleration tuning wizard automatically changes some servo parameters during tuning. It restores the values of parameters other than those for backlash acceleration tuning to those before tuning when tuning ends or the cancel button is clicked. If the tuning ends abnormally before it is completed, see the backup file and restore the parameters to their previous settings.
Backup file: My Documents\SERVO GUIDE\SVGBLA.DAT

<4> Confirm the test programs and click **[Next]**.
Quadrant protrusion compensation is tuned using circular motions with a radius of 10 and feedrates of 300, 1500, and 3000. (The circle radius and feedrates cannot be changed.) If it is necessary to add an M code and other items, check the **[Edit]** check box and edit the program.



NOTE

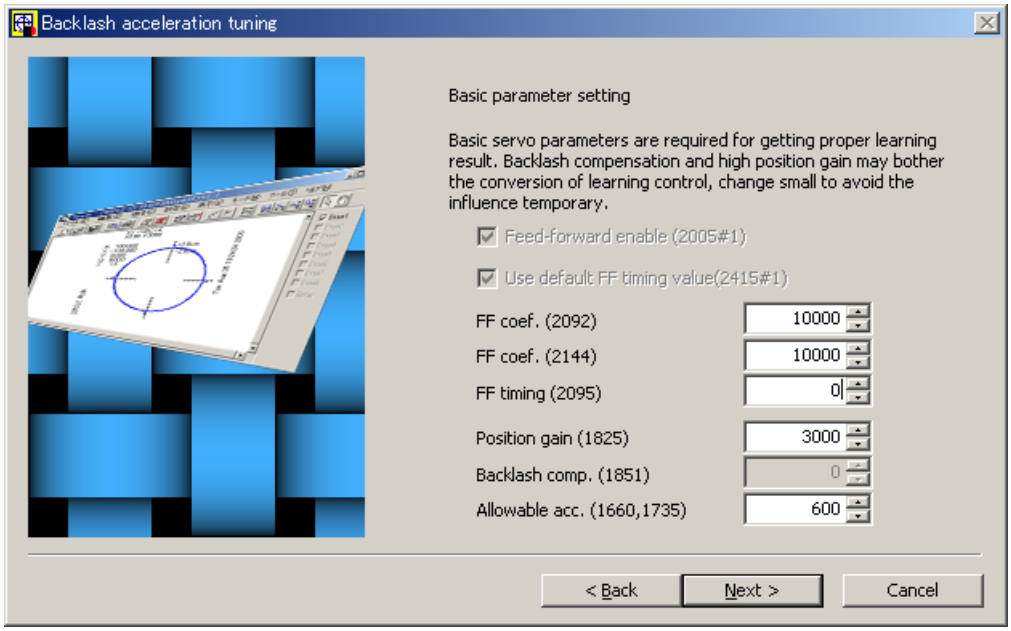
If you select rotary axes, a minute line segment program is automatically generated as the tuning program.
Note the following points:

- An environment is necessary in which the minute line segment program can be executed normally. Specifically, AI contour control (or AI advanced preview control) is required. (The program cannot be executed with normal control or advanced preview control.)
- The 30*i* series requires the AI contour control I or II option.
- In the case of 0*i*-D, the program can only be used with the M series (AI advanced preview control or AI contour control option).
- Inch input is not supported. Inch machines are not supported, either.
- An incremental command-based program is generated for an axis that supports incremental commands.
- In the case of an axis that does not support incremental commands (axes A and B of G code system A of the T series), a program is generated using absolute commands with the start point being the location where the axis is at the time of program generation.

<5> Set basic parameters.

Normally, you do not need to change the default values. Click **[Next]**.

Change values only when a shock or vibration occurs with the default values, which affects operation as shown below.

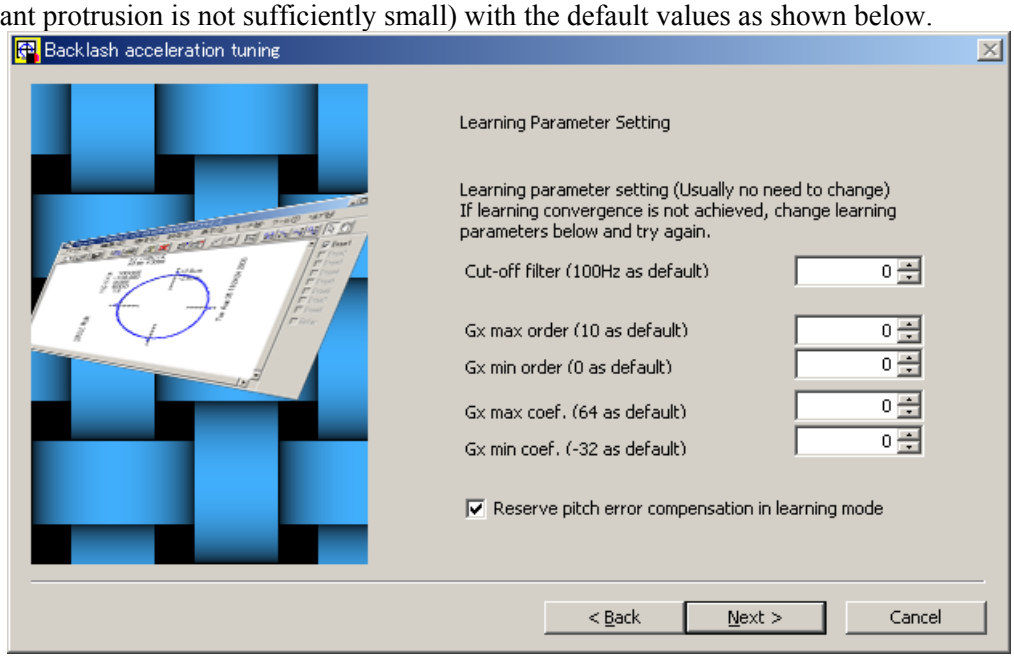


- The optimum position gain of the machine is lower than 3000. When the position gain is set to 3000, vibration occurs.
  ⇒Decrease the position gain to the optimum value of the machine. (In this case, it is necessary to change values for learning parameter setting.)
- A large shock occurs at the start and end of a circular motion and affects the measured axis (axis selected for Axis1) when the quadrant changes.
  ⇒ Decrease the allowable acceleration to within the range between 250 mm/s^2 and 600 mm/s^2.

<6> Set the parameters for learning control.

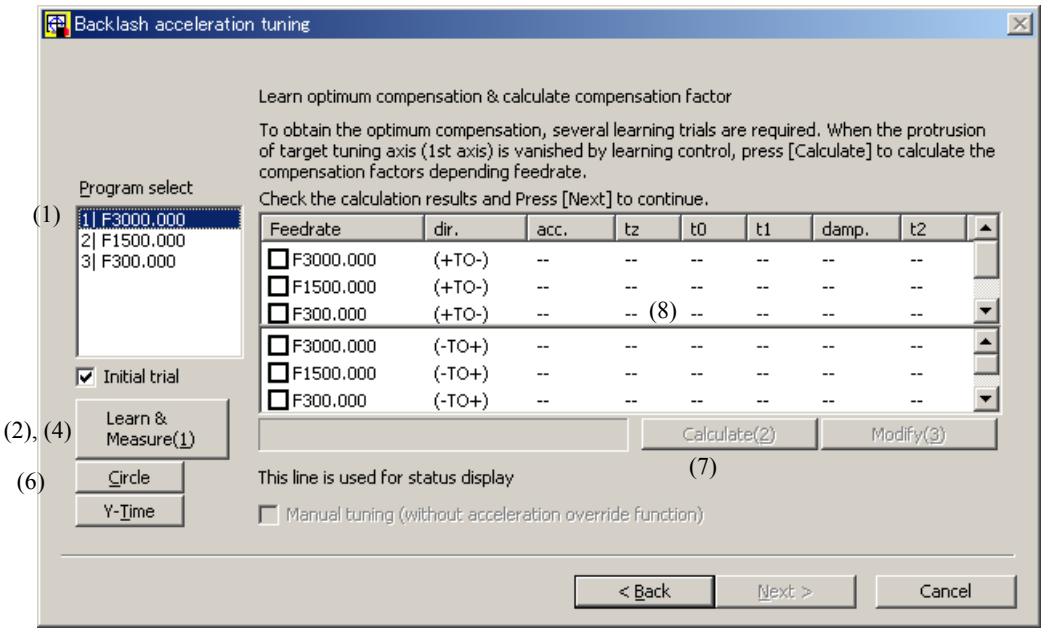
Normally, you do not need to change the default values. Click **[Next]**.

Change values only when optimum compensation calculation performed in the next step fails (the quadrant protrusion is not sufficiently small) with the default values as shown below.



- For a full-closed system with a large distortion
  Check the result of learning in step <7>. If the learning process does not end (the quadrant protrusion is not sufficiently small), increase the value of **[Gx max order]** to 0, 15, and 20 in this order so that the learning process ends.

<7> Perform learning operation to calculate the optimum compensation at each feedrate.

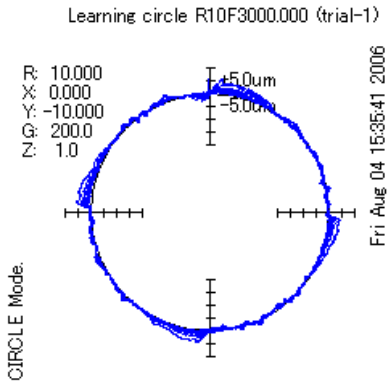


<Procedure for calculating compensation factors>

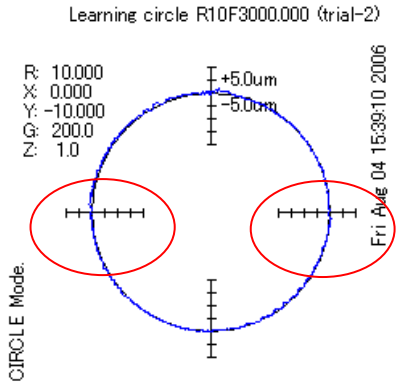
(1) Select a feedrate for tuning from the **[Program select]** list.
(2) Check that **[Initial trial]** is checked and click the **[Learn&Measure]** button.
(3) Press the "Cycle Start" button on the machine operator's panel. (Five to ten circular motions are performed.)
(4) Check that **[Initial trial]** is not checked and click the **[Learn&Measure]** button again. (Additional learning and check)
(5) Press the "Cycle Start" button on the machine operator's panel. (A circular motion is performed.)
(6) Click the **[Circle]** button to check the shape of the circle. When the quadrant protrusion is sufficiently small for the tuned axis (horizontal axis), proceed to step (7). If the protrusion is not small, repeat steps (4) to (7) until the protrusion is sufficiently small. (*)
(7) Click the **[Calculate]** button. Compensation factors are automatically calculated based on the currently obtained waveforms and added to the compensation factor list at the center of the dialog box.
(8) Perform steps (1) to (7) above for each program (F3000, F1500, and F300). When all required compensation factors are added to the list, click the **[Next]** button.

* If the shape of the circle is not improved (the protrusion is not sufficiently small) after performing steps (4) to (7) about 10 times, click the **[Back]** button. Then, change the value of a learning parameter (Gx max order) and perform steps (1) to (8) above again. (→ See the description of step <8>.)

<Example of measurement>

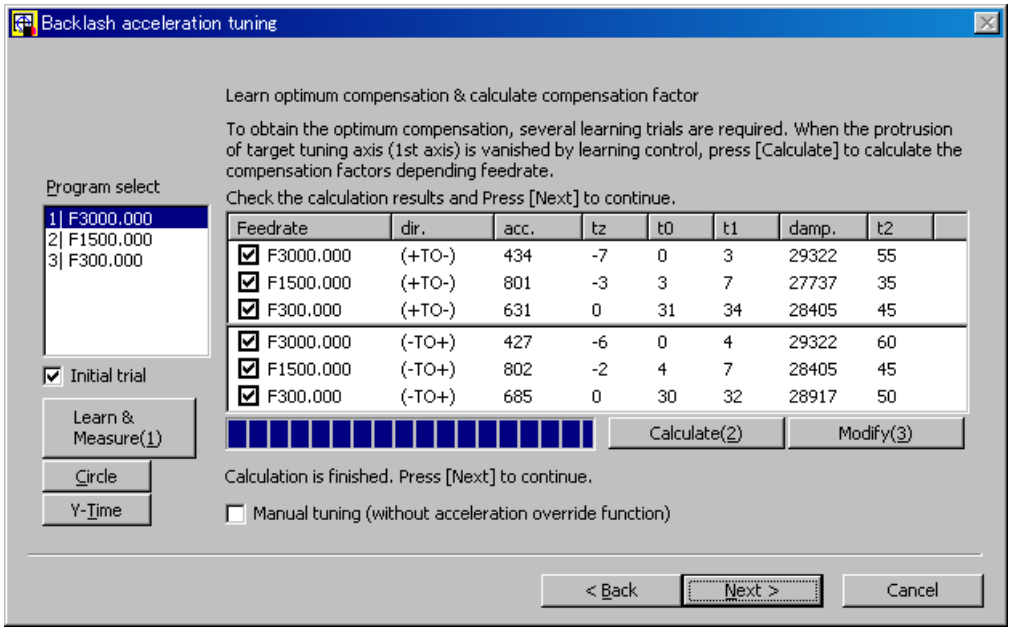


Initial learning (step (3))
The paths of five to ten circular motions are displayed at the same time. This figure shows that the quadrant protrusion becomes small as learning progresses.



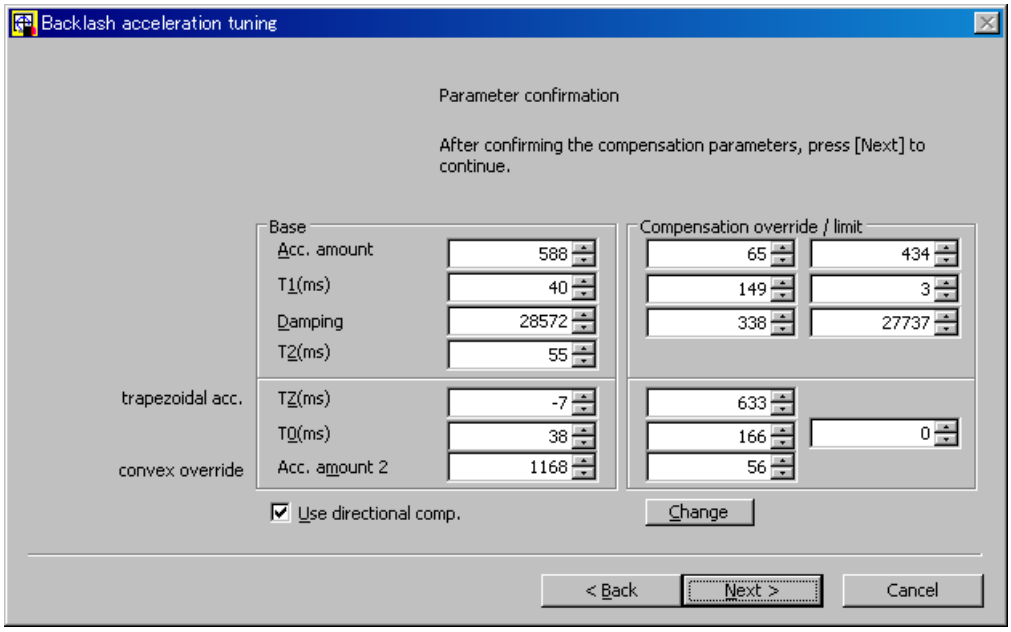
Additional learning and check (step (6))
When the quadrant protrusion is sufficiently small for the tuned axis, click the **[Calculate]** button.

<8> Calculate the compensation at all feedrates. When all required compensation factors are added to the list, click **[Next]**.

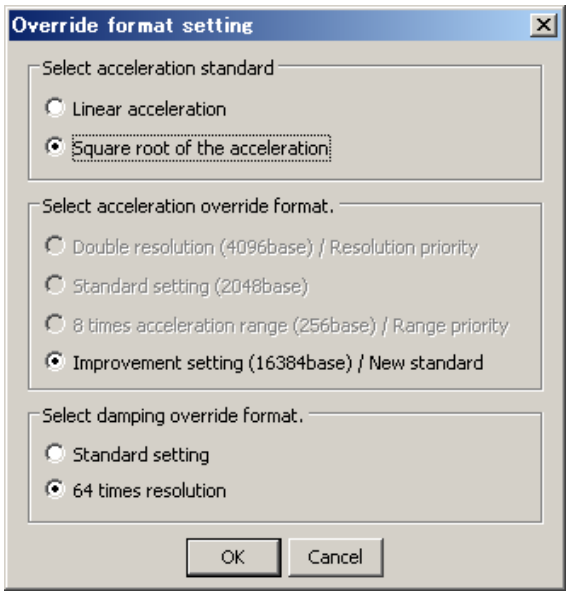


Feedrate	dir.	acc.	tz	t0	t1	damp.	t2
F3000.000	(+TO-)	434	-7	0	3	29322	55
F1500.000	(+TO-)	801	-3	3	7	27737	35
F300.000	(+TO-)	631	0	31	34	28405	45
F3000.000	(-TO+)	427	-6	0	4	29322	60
F1500.000	(-TO+)	802	-2	4	7	28405	45
F300.000	(-TO+)	685	0	30	32	28917	50

<9> The override is calculated based on the optimum compensation factors obtained in the previous step. Check the setting and click **[Next]**.



<Changing the override formats>
If you press the <Change> button in the parameter confirmation window, the Override format setting dialog box is displayed.
You can change the acceleration override format and damping override format.

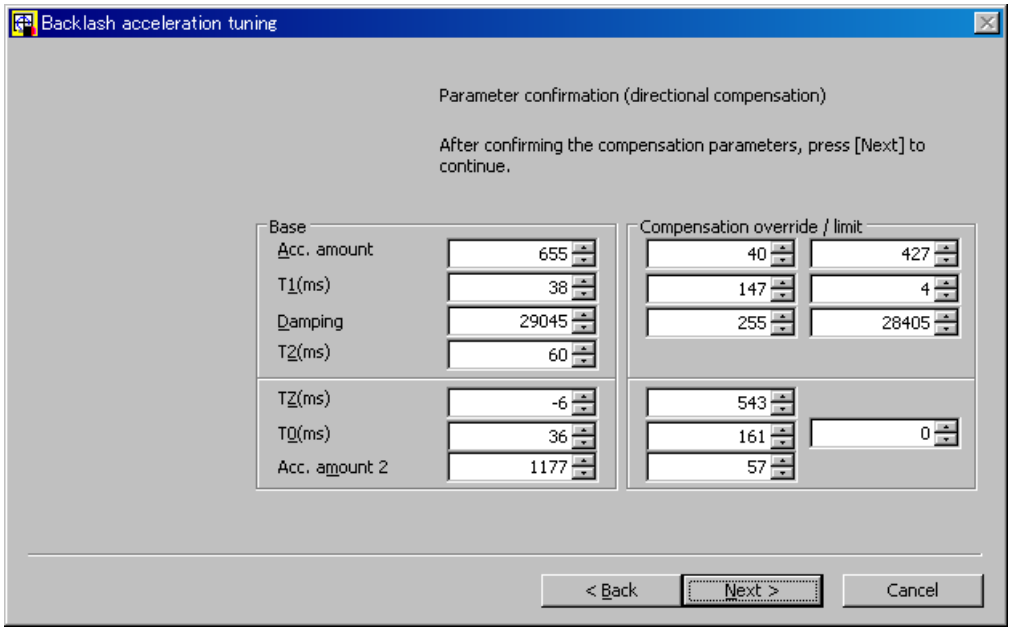


- Select acceleration standard
  Linear acceleration
  The acceleration override is calculated using the acceleration standard.
  Square root of the acceleration
  The acceleration override is calculated using the square root of the acceleration (improvement).
- Select acceleration override format.
  Double resolution (4096base) / Resolution priority
  Priority is placed on the acceleration resolution. The maximum acceleration is limited.
  Standard setting (2048base)

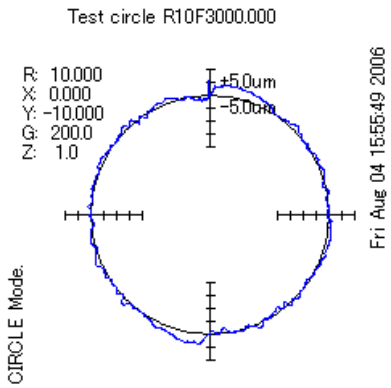
Default weight
8 times acceleration range (256base) / Range priority
The maximum acceleration will be larger. But the resolution will be worse. When the target machine has the high acceleration specification, please select this.
Improvement setting (16384base) / New standard
Setting not based on the detection unit (improvement)

- Select damping override format.
  Standard setting
  Default weight
  64 times resolution (In cases where a larger override value is necessary than the standard setting)
  The resolution of the damping override format is changed.

<10> When **[Use directional comp.]** is checked in the previous step, different compensation factors can be used for "reverse operation from the positive direction to the negative direction" and "reverse operation from the negative direction to the positive direction". Check the settings and click **[Next]**.

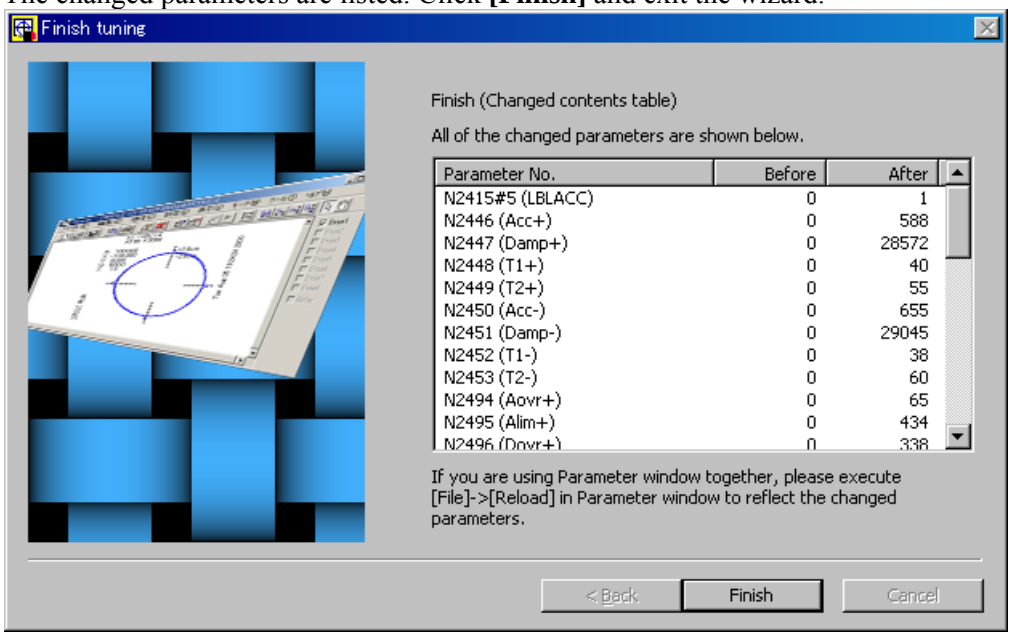


<11> Check the effect of quadrant protrusion compensation using the compensation factors determined in the previous steps. Select a feedrate from **[Program select]** and click the **[Start]** button. When there is no problem with the shape of the circle (the quadrant protrusion is improved), check **[Is it O.K.?]** and click **[Next]**.



Example of a waveform at check
Check the effect of the application of the quadrant protrusion compensation factors for the reduction of the quadrant protrusion. The compensation factors are applied only to the tuned axis (horizontal axis).

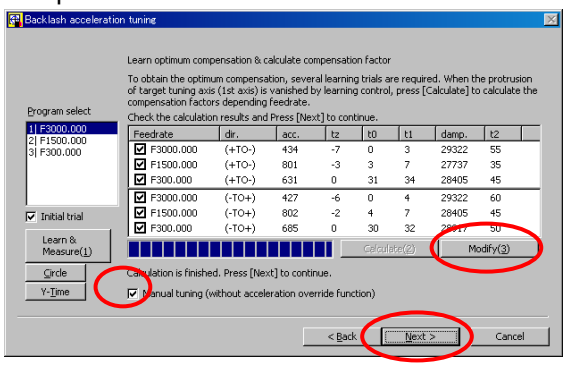
<12> The changed parameters are listed. Click **[Finish]** and exit the wizard.



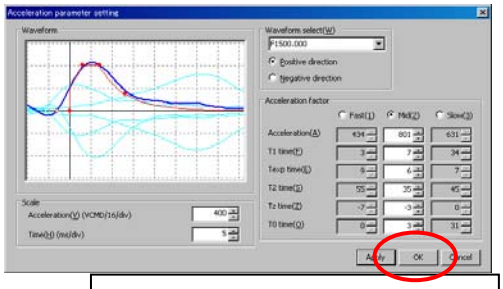
(5) Manually fine-tuning compensation factors

You can move back and forth among the following three screens: "Learn optimum compensation & calculate compensation factor", "Acceleration setting optimize", and "Measurement of circle (verify)" to manually fine-tune optimum compensation factors for each feedrate.

"Learn optimum compensation & calculate compensation factor" screen

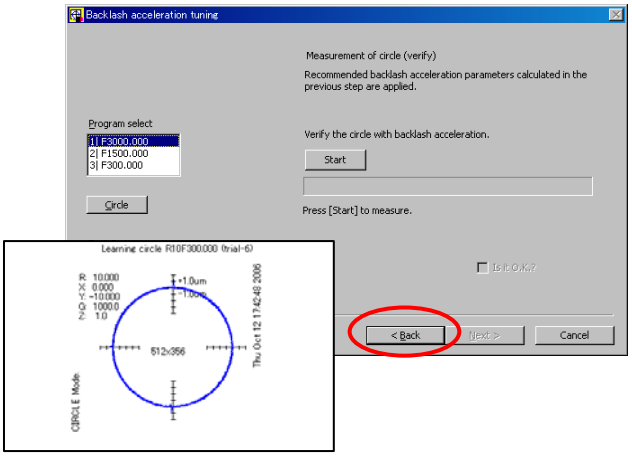


"Acceleration parameter setting" screen



<1> Modify acceleration factors.

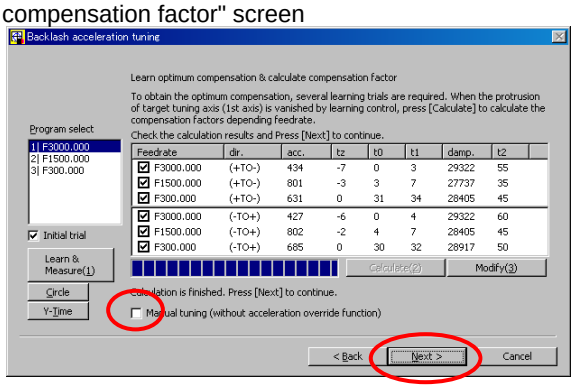
"Measurement of circle(verify)" screen



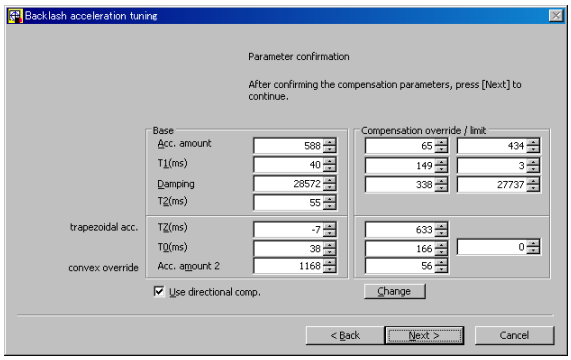
<2> Check the shape of the circle based on modified factors.

After the completion of factor fine-tuning for each feedrate, uncheck the [Manual tuning] check box on the "Learn optimum compensation & calculate compensation factor" screen and click the **[Next]** button. The "Parameter confirmation" screen appears and the override is calculated based on the acceleration factors determined above.

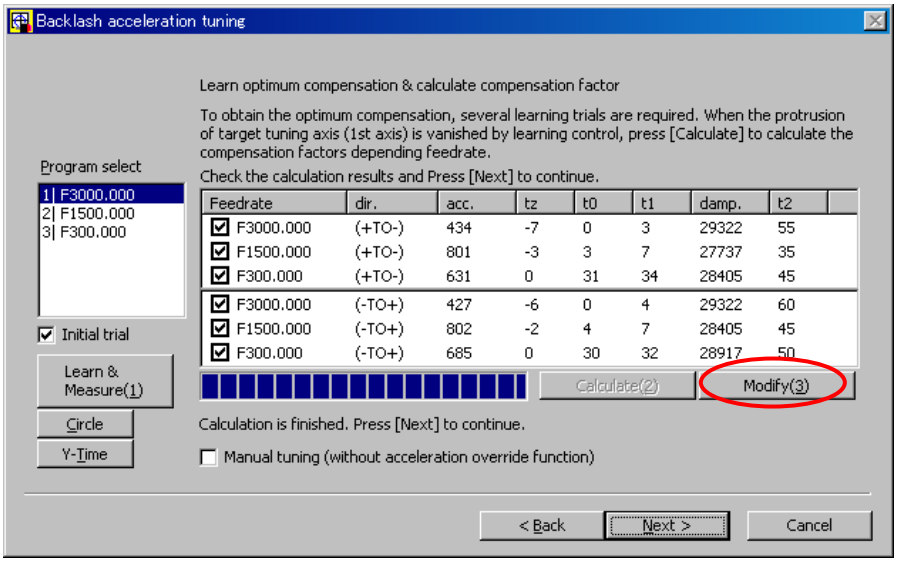
"Learn optimum compensation & calculate compensation factor" screen

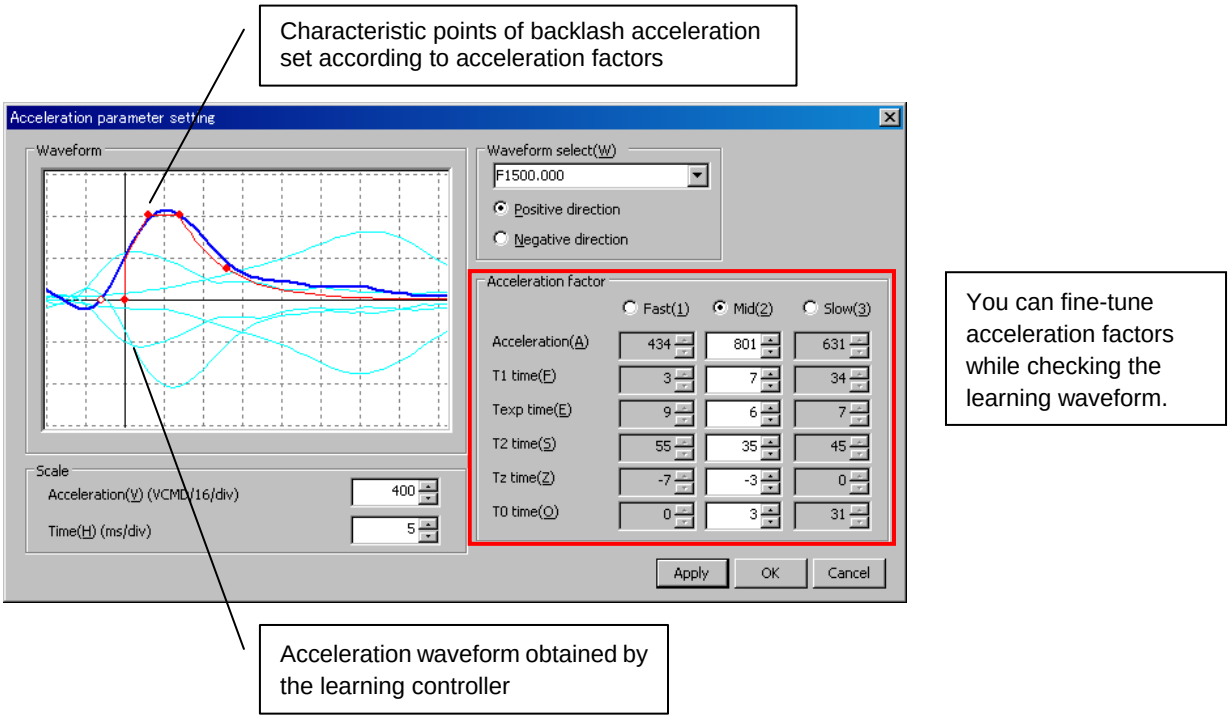


"Parameter confirmation" screen

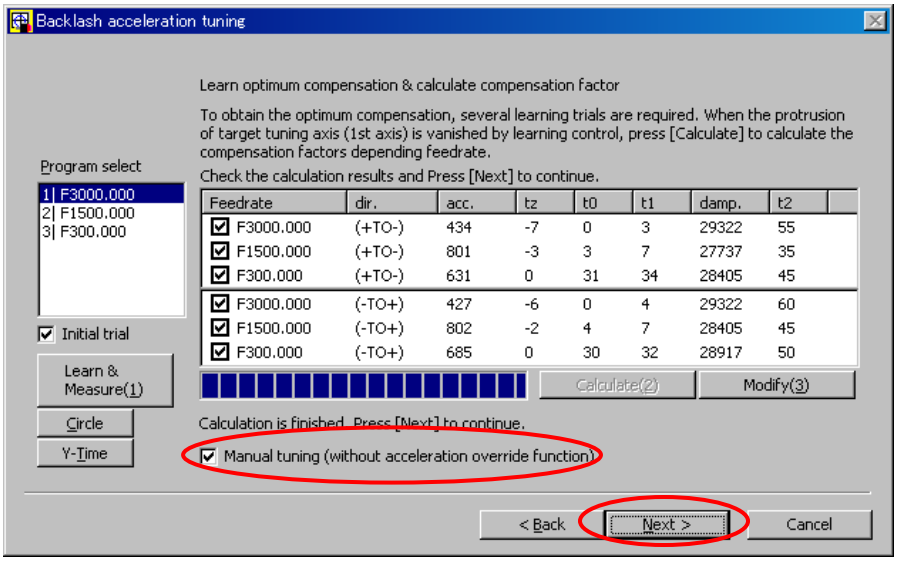


After the acceleration factors are calculated according to the result of learning, on the "Learn optimum compensation & calculate compensation factor" screen, click the **[Modify]** button. A screen appears, which allows the output of learning data at each feedrate and fine-tuning of characteristic points for compensation calculation. On this screen, you can set acceleration factors while checking the learning waveform.

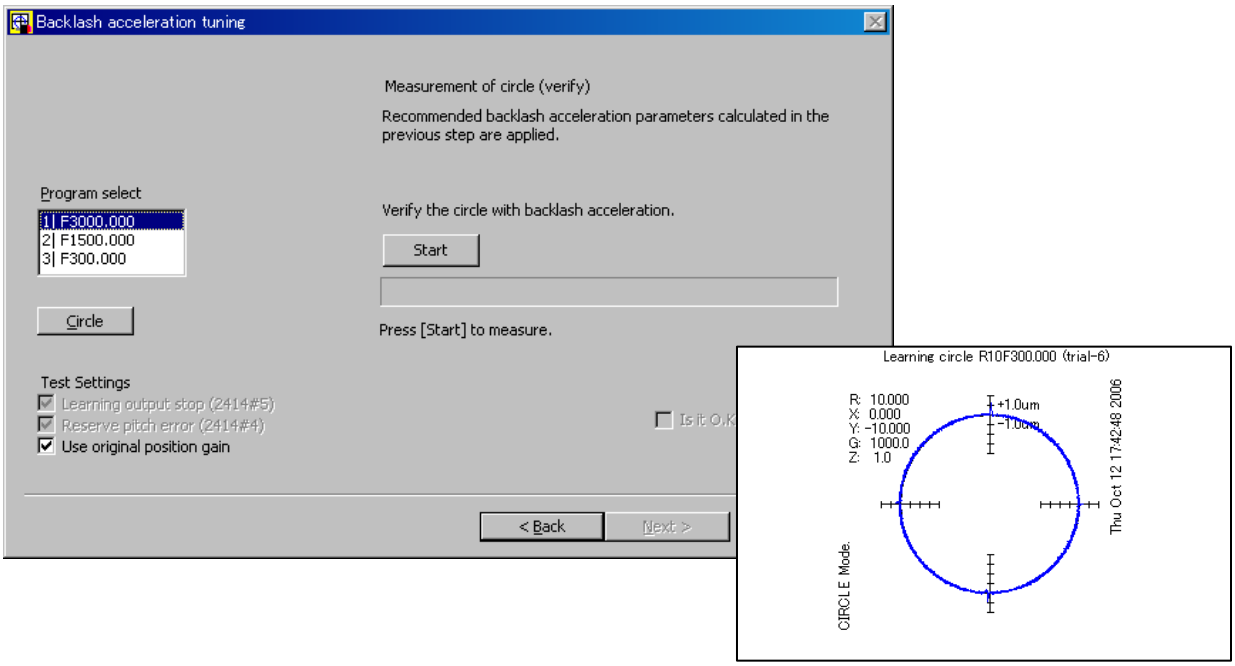




On the "Learn optimum compensation & calculate compensation factor" screen, check the **[Manual tuning]** check box and click the **[Next]** button. The "Measurement of circle (verify)" screen appears. On this screen, you can check the result of the application of acceleration factors you set.



* The Manual tuning (without acceleration override function) check box is available with SERVO GUIDE 4.10 or later.



N SERVO CARDS FOR 30*i*-B SERIES CNCs

(1) Overview

This chapter explains the servo cards for use with the 30*i*-B series, etc.

Servo card	Servo card specification	Use	Servo software series
Servo card A	A02B-0323-H094,-H095, -H096, -H097, -H098, -J120	Maintenance (*1)	Series 90G0 Series 90G3 Series 90GP
Servo card B	A02B-0323-H070, -H071, -H072, -H073, -H074, J121 A03B-0827-H070, -H071, -H072, -H073 A03B-0827-H070, -H071, -H072, -H073	Standard	Series 90J0 Series 90J3 Series 90JP
Servo card C	A02B-0323-H075, -H076, -H077, -H078 A02B-0333-H075	Function-limited version (*2)	Series 90K0

(*1) For servo card A, there are no plans to develop new functions in the future. The latest functions will be mainly supported by servo card B.

(*2) Servo card C has function limits. For details, refer to "(3) Functions that cannot be used with servo card C".

(2) Series and editions of system software

Series/editions of system software that support servo cards B and C are listed below.

CNC model	System software	
	Series	Edition
30*i*-B	G301, G311, G321, G331 G33T	44.0 and subsequent editions 05.0 and subsequent editions
31*i*-B	G401, G411 G441	44.0 and subsequent editions 05.0 and subsequent editions
31*i*-B5	G421, G431	44.0 and subsequent editions
32*i*-B	G501, G511 G541	44.0 and subsequent editions 05.0 and subsequent editions
35*i*-B	G601, G611	13.0 and subsequent editions
30*i*-LB	G3C1, G3D1	20.0 and subsequent editions
31*i*-LB	G4C1	20.0 and subsequent editions
30*i*-PB	G3E1, G3F1	20.0 and subsequent editions
31*i*-PB	G4E1	20.0 and subsequent editions
31*i*-WB	G4A1	8.0 and subsequent editions
Power Motion *i*-A	88H0	8.0 and subsequent editions
DSA-B	881S	4.0 and subsequent editions

(3) Functions that cannot be used with servo card C

The following options, hardware, and servo functions cannot be used with servo card C.

■ Options

Option name	Model	Specification
EDM power supply communication control (HSSB connection)	30*i*-B	A02B-032*-R811
Die sinking EDM function	30*i* -B	A02B-032*-R822
Feed axis synchronous control	30*i* -B	A02B-03**-J843
High precision learning control A	30*i* -B	A02B-032*-J706
High precision learning control B	30*i*-B	A02B-032*-J705
High precision learning control C	30*i*-B	A02B-032*-R692
Learning control for parts cutting A	30*i*-B	A02B-032*-R510
Learning control for parts cutting B	30*i*-B	A02B-032*-R539
Control function for link type press	PM*i*-A	A02B-0334-S603
Pressure and position control function	PM*i*-A	A02B-0334-R400

■ Hardware

Hardware name	Specification
Acceleration sensor α*i* GS0.1-3D	A860-2090-T301
Servo check interface unit (basic)	A02B-0323-C206
Analog monitor unit	A02B-0334-C231
Customer's board	A02B-0323-J150
Digital servo adapter (EtherCAT interface)	A03B-0827-B812
Pulse input type digital servo adapter	A03B-0827-B822

■ Servo function

Function name	Parameter
Smart machining point control (with sensor)	No.2288 bit7, etc
Torsion preview control	No.2382, etc

(4) Other notes

- With quadrant protrusion adjustment using the SERVO GUIDE Tuning Navigator, learning operations are performed during parameter adjustment. In a system using servo card C, learning operations are performed only before and after axis inversion, but the adjustment results are equivalent to those obtained if using servo cards A and B.
- To use gap control (A02B-0329-J817 and A02B-0330-J817) with servo card C, servo software 90K0/02.0 or later is required.
- To use the EDM servo function (bit 0 of parameter No. 15430) with servo card C, servo software 90K0/02.0 or later is required.

O IF AN INVALID AXIS CARD AND SERVO FUNCTION COMBINATION ALARM OCCURS

(1) Overview

Series 90K0 and 90H0 do not support some functions such as smart machining point control and torsion preview control. If you enable unsupported functions, the SV0657 invalid axis card and servo function combination alarm occurs and the diagnosis screen displays the alarm detail number at No. 3508.

(2) Series and editions of applicable servo control software

CNC	Servo control software		Remarks
	Series	Edition	
Series 30*i*/31*i*/32*i*/35*i*-B Power Motion *i*-A DSA-B	90K0	01.0 and subsequent editions	
Series 0*i* Mate-D	90H0	02.0 and subsequent editions	

(3) Action to be taken

If the SV0657 invalid axis card and servo function combination alarm occurs, disable the relevant functions with the following procedure.

Procedure for displaying detail information about an invalid axis card and servo function combination alarm

You can check the functions that cause the invalid axis card and servo function combination alarm by looking at the number at No. 3508 on the diagnosis screen.

Analyzing the invalid axis card and servo function combination alarm in detail

The detail alarm data consists of four digits as shown below:

0	4	3	4

Parameter number
Last three digits of 2000 to 2999

0 to 7: Bit position
8: Word parameter

First three digits: Indicates the last three digits of the parameter No. (2000 to 2999) that causes the alarm. The following table lists the displayed numbers and corresponding parameter numbers.

* When an alarm is due to more than one parameter, these digits and parameter numbers do not match sometimes.
* When the digits are displayed on the diagnosis screen, 0s in high-order digits are not displayed.

Last digit: Indicates the bit position of the parameter that causes the alarm or that the parameter is a word parameter.
0 to 7: Indicates the bit position.
8: Indicates a word parameter.

Table O Analyzing the axis card and servo function combination alarm in detail

Detail No.	Parameter No.	Function name	Series	
			90K0	90H0
81	2008#1	Torque tandem	○	
82	2008#2	Velocity feedback average function	○	
85	2008#5	Velocity tandem	○	
162	2016#2	EDM servo	○	○
191	2019#1	Tandem disturbance elimination control	○	
318	2031	Excessive torque difference alarm	○	○
2125	2212#5	Customer's board	○	○
2235	2223#5	Multiaxis tandem (master)	○	
2236	2223#6	Multiaxis tandem	○	
2731	2273#1	Integrator copy	○	
2753	2275#3	Synchronous axes automatic compensation	○	
2754	2275#4	Slide position output	○	○
2764	2276#4	Function for enabling the first analog monitor unit (current input)	○	○
2765	2276#5	Function for enabling the second analog monitor unit (current input)	○	○
2775	2277#5	Function for enabling an acceleration sensor (in the third direction)	○	
2776	2277#6	Function for enabling an acceleration sensor (in the second direction)	○	
2777	2277#7	Function for enabling an acceleration sensor (in the first direction)	○	
2782	2278#2	Function for enabling the first servo check interface unit	○	
2783	2278#3	Function for enabling the second servo check interface unit	○	
2786	2278#6	Function for enabling the first analog monitor unit (voltage input)	○	○
2787	2278#7	Function for enabling the second analog monitor unit (voltage input)	○	○
2806	2280#6	Clamp completion or cancellation confirmation		○
2864	2286#4	Dynamic switching between whether to enable or disable the integrator copy function	○	
2883	2288#3	Interactive force compensation (position compensation)		○
2887	2288#7	Smart machining point control	○	○
2926	2292#6	Interactive force compensation (the first moving axis)		○
2927	2292#7	Interactive force compensation (specification of a moving axis)		○
2936	2293#6	Interactive force compensation (the second moving axis)		○
3828	2382	Torsion preview control (the maximum compensation value)	○	○
4163	2416#3	Torque limit of the main axis for virtual X and Z axes control		○
4164	2416#4	Function for disabling sub-axis software disconnection under virtual X and Z axes control		○
4165	2416#5	Virtual X and Z axes control		○
4170	2417#0	Function for changing the velocity control integrator with DI signal 2		○
4171	2417#1	Function for changing the velocity control integrator with DI signal 1		○
4180	2418#0	Integrator copy (Type 3) via serial link	○	
4181	2418#1	Integrator copy (Type 2) via CNC	○	
4217	2421#7	Second stage acceleration override type 2	○	
5610	2561#0	Variable preload	○	
5611	2561#1	Torque clamp	○	
5654	2565#4	Winding regeneration		○
5672	2567#2	Smart backlash (full-closed)		○
5673	2567#3	Backlash end measurement using VCMD offset		○
5676	2567#6	Error counter compensation using Semi-Full errors on even-numbered DSP axes	○	○
5677	2567#7	Error counter compensation using Semi-Full errors on odd-numbered DSP axes	○	○

P SERIES AND EDITIONS THAT SUPPORT NEW SERVO PARAMETERS

To use parameter Nos. 2694 to 2705, you need the following system software that supports them.

[Applicable series and editions of system software]

CNC	System software	
	Series	Edition
FANUC Series 30*i*/31*i*/32*i*-B	G301, G311, G321, G331, G351 G3G1, G3H1 G30A, G31A, G32A, G33A, G35A, G303, G313, G323, G333, G353, G30L, G31L, G32L, G33L, G35L, G3L3, G3M3	77.0 and subsequent editions 01.0 and subsequent editions
	G401, G411, G421, G431 G402, G451, G422, G481 G42A, G43A, G423, G433, G483, G4H3, G424, G42L, G43L, G48L, G4HL, G4N3, G4P3 G40A, G41A, G403, G413, G453, G4G3, G404, G40L, G41L, G45L, G4GL, G4L3, G4M3	77.0 and subsequent editions 04.0 and subsequent editions 01.0 and subsequent editions
	G501, G511, G521 G50A, G51A, G503, G513, G523	77.0 and subsequent editions 04.0 and subsequent editions 01.0 and subsequent editions
FANUC Series 30*i*/31*i* -LB	G3C1, G3D1, G4C1 G3C2, G3D2, G4C2 G3C3, G3D3, G4C3	28.0 and subsequent editions 02.0 and subsequent editions 03.0 and subsequent editions
FANUC Series 30*i*/31*i* -PB	G3E1, G3F1, G4E1	27.0 and subsequent editions
FANUC Series 35*i*-B	G601, G611	28.0 and subsequent editions
FANUC Series 0*i*-F	D4G1, D6G1 D4G2, D5G2, D6G2, D7G2	15.0 and subsequent editions 01.0 and subsequent editions
Power Motion *i*-A	88H0	28.0 and subsequent editions
DSA-B	881R 881S 881T 881U, 881V	04.0 and subsequent editions 12.0 and subsequent editions 03.0 and subsequent editions 01.0 and subsequent editions

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