FANUC

GE Fanuc Automation

Computer Numerical Control Products

Series 15 / 150 – Model B

Parameter Manual

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Warnings, Cautions, and Notes as Used in this Publication

Warning

Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

Caution

Caution notices are used where equipment might be damaged if care is not taken.

Note

Notes merely call attention to information that is especially significant to understanding and operating the equipment.

This document is based on information available at the time of its publication. While efforts have been made to be accurate, the information contained herein does not purport to cover all details or variations in hardware or software, nor to provide for every possible contingency in connection with installation, operation, or maintenance. Features may be described herein which are not present in all hardware and software systems. GE Fanuc Automation assumes no obligation of notice to holders of this document with respect to changes subsequently made.

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DEFINITION OF WARNING, CAUTION, AND NOTE

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

WARNING

Applied when there is a danger of the user being injured or when there is a damage of both the user being injured and the equipment being damaged if the approved procedure is not observed.

CAUTION

Applied when there is a danger of the equipment being damaged, if the approved procedure is not observed.

NOTE

The Note is used to indicate supplementary information other than Warning and Caution.

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

PREFACE

The models covered by this manual, and their abbreviations are :

<table>
<tr><th>Product Name</th><th colspan="3">Abbreviations</th></tr>
<tr><td>FANUC Series 15–TB</td><td>15–TB</td><td rowspan="6">15–T</td><td rowspan="9">T series</td></tr>
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<tr><td>FANUC Series 150–MB</td><td>150–MB</td></tr>
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(*1) The FANUC Series 15TED/TEE/TEF–MODEL B–4 is a software–fixed CNC capable of 4 contouring axes switchable out of 8 axes for milling machines and machining centers.
Further the following functions can not be used in the 15TED, 15–TEE or 15TEF.

- Increment system D/E (Increment system C is an option function)
- Helical interpolation B
- OSI/ETHERNET function
- High–precision contour control using RISC
- Macro compiler (self compile function)
- MMC–III, MMC–IV
- Connecting for personal computer by high–speed serial–bus

(*2) The FANUC Series 15MEK/MEL–MODEL B–4 is a software–fixed CNC capable of 4 contouring axes switchable out of 8 axes for milling machines and machining centers.
Further the following functions can not be used in the 15MEK or 15MEL.

- Increment system D/E (Increment system C is an option function)
- Helical interpolation B
- Plane switching
- Designation direction tool length compensation
- 2 axes electric gear box
- Manual interruption of 3–dimensional coordinate system conversion
- 3–dimensional cutter compensation
- Trouble diagnosis guidance
- OSI/ETHERNET function
- High–precision contour control using RISC
- Macro compiler (self compile function)
- MMC–III, MMC–IV
- Smooth interpolation
- Connecting for personal computer by high–speed serial–bus

Manuals related to FANUC Series 15/150–MODEL B are as follows.
This manual is marked with an asterisk (*).

List of Manuals Related to Series 15/150–MODEL B

Manual Name	Specification Number	
FANUC Series 15–TB/TFB/TTB/TTFB DESCRIPTIONS	B–62072E	
FANUC Series 15/150–MODEL B For Machining Center DESCRIPTIONS	B–62082E	
FANUC Series 15/150–MODEL B CONNECTION MANUAL	B–62073E	
FANUC Series 15/150–MODEL B CONNECTION MANUAL (BMI Interface)	B–62073E–1	
FANUC Series 15–MODEL B For Lathe OPERATOR'S MANUAL (Programming)	B–62554E	
FANUC Series 15–MODEL B For Lathe OPERATOR'S MANUAL (Operation)	B–62554E–1	
FANUC Series 15/150–MODEL B For Machining Center OPERATOR'S MANUAL (Programming)	B–62564E	
FANUC Series 15/150–MODEL B For Machining Center OPERATOR'S MANUAL (Operation)	B–62564E–1	
FANUC Series 15/150–MODEL B PARAMETER MANUAL	B–62560E	*
FANUC Series 15/150–MODEL B MAINTENANCE MANUAL	B–62075E	
FANUC Series 15–MODEL B DESCRIPTIONS (Supplement for Remote Buffer)	B–62072E–1	
FANUC Series 15–MODEL B PROGRAMMING MANUAL (Macro Compiler / Macro Executer)	B–62073E–2	
PMC		
FANUC PMC–MODEL N/NA PROGRAMMING MANUAL (Ladder Language)	B–61013E	
FANUC PMC–MODEL NB/NB2 PROGRAMMING MANUAL (Ladder Language)	B–61863E	
FANUC PMC–MODEL N/NA PROGRAMMING MANUAL (C Language)	B–61013E–2	
FANUC PMC–MODEL NB PROGRAMMING MANUAL (C Language)	B–61863E–1	
FANUC PMC–MODEL N/NA PROGRAMMING MANUAL (C Language – Tool Management Library)	B–61013E–4	
Conversational Automatic Programming Function		
CONVERSATIONAL AUTOMATIC PROGRAMMING FUNCTION FOR MACHINING CENTER (Series 15–MF/MFB) PROGRAMMING MANUAL	B–61263E	
CONVERSATIONAL AUTOMATIC PROGRAMMING FUNCTION FOR MACHINING CENTER (Series 15–MF/MFB) OPERATOR'S MANUAL	B–61264E	
CONVERSATIONAL AUTOMATIC PROGRAMMING FUNCTION FOR LATHE (Series 15–TF/TTF/TFB/TTFB) OPERATOR'S MANUAL	B–61234E	
CONVERSATIONAL AUTOMATIC PROGRAMMING FUNCTION II FOR LATHE (Series 15–TFB/TTFB) OPERATOR'S MANUAL	B–61804E–2	
Tracing / Digitizing		
FANUC Series 15–MB DESCRIPTIONS (Supplement for Tracing / Digitizing)	B–62472E	
FANUC Series 15–MB CONNECTION MANUAL (Supplement for Tracing / Digitizing)	B–62473E	
FANUC Series 15–MB OPERATOR'S MANUAL (Supplement for Tracing / Digitizing)	B–62474E	
Gas, Laser Plasma Cutting Machine		
FANUC Series 15–MB DESCRIPTIONS (FOR GAS, LASER PLASMA CUTTING MACHINE)	B–62082EN–1	
Multi–Teaching Function		
FANUC Series 15–MB CONNECTION MANUAL (Multi–Teaching Function)	B–62083E–1	
Multiple–axis and Multiple–path Control Function		
FANUC Series 15–TTB OPERATOR'S MANUAL (Supplement Explanations for Multiple–axis and Multiple–path Control Function)	B–62074E–1	

Table of Contents

1. DISPLAYING PARAMETERS

1.1 Displaying Parameters Other Than Pitch Error Compensation Data

(1) Press the SERVICE, CHAPTER, and PARAM soft keys in this order. Alternatively, press the SERVICE hard key several times. The parameter screen is displayed.

(2) Enter the number of the parameter to be displayed, then press the INP–NO. soft key.

Alternatively, instead of entering the parameter number, the cursor or page key can be used to change the screen.

1.2 Displaying Pitch Error Compensation Data

(1) Press the SERVICE, CHAPTER, and PITCH soft keys in this order. Alternatively, press the SERVICE hard key several times. The parameter screen is displayed.

(2) Enter the number of the parameter to be displayed, then press the INP–NO. soft key.

Alternatively, instead of entering the parameter number, the cursor or page key can be used to change the screen.

2. SETTING PARAMETERS

2.1 Parameter Tape Formats

2.1.1 Parameter tape formats other than tape format for pitch error compensation

Parameters are classified according to data formats, as follows:

Data format	Data range	Remarks
Bit type	0 or 1	
Bit axis type	0 or 1	
Byte type	0 to ±127	
Byte axis type	0 to ±127	
Word type	0 to ±32767	
Word axis type	0 to ±32767	
2–word type	0 to ±99999999	
2–word axis type	0 to ±99999999	

NOTE 1 "Axis" means that independent data can be set for each control axis.
NOTE 2 A valid data range is a general range. The valid range depends on parameters. For details, see the explanation of each parameter.

(1) Format of bit parameter tape

N ___ P____ ;

N ___ : A 4–digit numeric value following address N specifies a parameter number. (Positive integer)

P ____ : An 8–digit numeric value following address P specifies parameter value 0 or 1. Each data number contains eight bit–type parameters. Parameter value 0 or 1 of bit 0 is set in the first digit. Parameter value 0 or 1 of bit 7 is set in the eighth digit. (Positive integer)

; : End of block (LF for ISO code and CR for EIA code)

NOTE 1 Addresses N and P must be specified in that order.
NOTE 2 Leading zeros cannot be omitted.
Example
N0000 P00010001 ;

(2) Format of bit axis parameter tape

N ___ A __ P ____;

N ___ : A 4–digit numeric value following address N specifies a parameter number. (Positive integer)

A __ : Axis number (1 to 6). (Positive integer)

P ____ : An 8–digit numeric value following address P specifies parameter value 0 or 1. Each data number contains eight bit–type parameters. Parameter value 0 or 1 of bit 0 is set in the first digit. Parameter value 0 or 1 of bit 7 is set in the eighth digit. (Positive integer)

; : End of block (LF for ISO code and CR for EIA code)

NOTE 1 Addresses N, A, and P must be specified in that order.
NOTE 2 Leading zeros cannot be omitted.
Example
N0012 A1 P00000011 ;
N0012 A2 P00000010 ;
N0012 A3 P00000010 ;

(3) Format of byte parameter tape

N ___ P ____ ;

N ___ : A 4–digit numeric value following address N specifies a parameter number. (Positive integer)

P ____ : A numeric value following address P specifies a parameter value. (Integer)
The valid data range that can be set depends on parameters.

; : End of block (LF for ISO code and CR for EIA code)

NOTE Addresses N and P must be specified in that order.
Example
N2010 P100 ;

(4) Format of byte axis parameter tape

N ___ A __ P ____ ;

N ___ : A 4–digit numeric value following address N specifies a parameter number. (Positive integer)

A __ : Axis number (1 to 6). (Positive integer)

P ____ : A numeric value following address P specifies a parameter value. (Integer)
The valid data range that can be set depends on parameters.

; : End of block (LF for ISO code and CR for EIA code)

NOTE Addresses N, A, and P must be specified in that order.
Example
N1020 A1 P88 ;
N1020 A2 P89 ;
N1020 A3 P90 ;
The parameters of each axis can be specified in one block as follows:
M1020 A1 P88 A2 P89 A3 P90;

(5) Format of word parameter tape
Same as the format of the byte parameter tape

(6) Format of word axis parameter tape
Same as the format of the byte axis parameter tape

(7) Format of two words parameter tape
Same as the format of the byte parameter tape

(8) Format of two words axis parameter tape
Same as the format of the byte axis parameter tape

Example of NC tape where parameters other than pitch error compensation data are punched

```
% ;
N0  P1 ;
N3  P0 ;
N10 P10 ;
N11 P0 ;
    :
    :
    :
%
```

2.1.2 Format of pitch error compensation tape

N ___ P ____ ;

N ___ : A 5–digit numeric value following address N specifies a number which is equal to (10000 + number of pitch error compensation point). (Positive integer)

P ____ : A numeric value following address P specifies the value of pitch error compensation data. (Integer) –7 to 7 can be set (valid range).

; : End of block (LF for ISO code and CR for EIA code)

NOTE Addresses N and P must be specified in that order.
Example of punching NC tape with pitch error compensation data (ISO code)

```
% ;
N10000 P1 ;
N10001 P4 ;
N10002 P–7 ;
N10003 P3 ;
N10004 P2 ;
      :
      :
      :
%
```

2.2 Setting Parameters Using Parameter Tape

1 Set the emergency stop status.

2 Press the SETTING soft or hard key to select the setting screen.

3 Enter 8000.

4 Press the INP–NO. soft key to display parameter No. 8000.

5 Enter 1 and press the INPUT soft key. PWE, a bit of parameter No. 8000 is set to 1, thereby enabling subsequent parameter setting. The NC enters the alarm status.

6 Press the function menu key to restore the soft keys to the function selection status.

7 Press the SERVICE soft key, then press the PARAM soft key, or press the SERVICE hard key several times. The parameter screen is displayed.

8 Set the parameter tape in the tape reader.

9 Press the READ soft key, then press the ALL soft key. The parameter tape is read and the parameters are set.

10 Temporarily turn off NC power.

2.3 Setting Parameters from the MDI

1 Set the MDI mode or emergency stop status.

2 Press the SETTING soft or hard key to select the setting screen.

3 Enter 8000.

4 Press the INP–NO. soft key to display parameter No. 8000.

5 Enter 1 and press the INPUT soft key. PWE, a bit of parameter is set to 1, thereby enabling subsequent parameter setting. The NC enters the alarm status.

6 Press the function menu key to restore the soft keys to the function selection status.

7 Press the SERVICE soft key, then press the PARAM soft key (for pitch error compensation data, press PITCH), or press the SERVICE hard key several times. The parameter screen is displayed.

8 Enter the number of the parameter to be set and press the INP–NO. soft key. The screen containing the parameter to be set is displayed.

9 Enter the data to be set and press the INPUT soft key. The entered data is set.

To continuously enter data items from the selected parameter, delimit them with a comma (;).

Example

When 10;20;30;40 is entered and the INPUT soft key is pressed, 10, 20, 30, and 40 are sequentially set, starting at the parameter indicated by the cursor.

10 Repeat steps (7), (8), and (9).

11 When parameter setting is completed, set PWE a bit of parameter No. 8000 to 0 to inhibit subsequent parameter setting.

12 Reset the NC and release the alarm “Parameters can be set.” If the alarm “The parameter requesting that NC power be turned off once has been set” is issued, turn off the NC power.

NOTE 1 The blank bits in the parameter list (4. “Description of Parameters”) and the parameter numbers that are displayed on the CRT but not listed in the list are reserved for future expansion. Be sure to set these bits to 0.

NOTE 2 Be sure to set digital servo parameters in the emergency stop status. Data set in statuses other than the emergency stop status is invalid. The following digital servo numbers can be set:

1700 to 1738, 1806 to 1890, 1852 to 1879, 1891, and 1895, 1951 to 1999

2.4 Procedure for Setting Digital Servo Parameters

After connecting the NC and the motor, use the following procedure to set the digital servo parameters.
For details on digital servo parameters, refer to HAC Servo Unit Maintenance Manual (B–65005).I

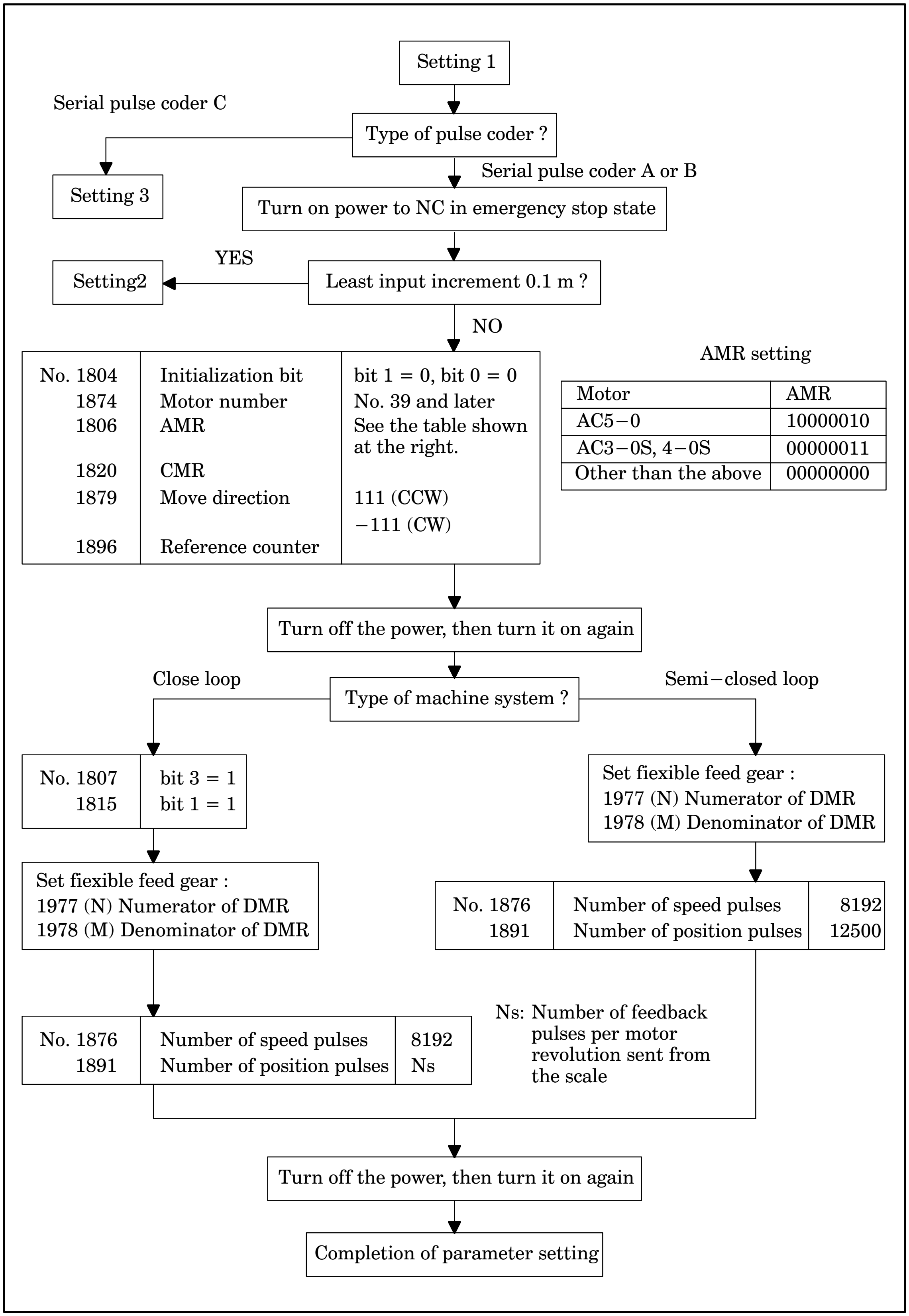
(1) First, press the NC soft key SERVICE several times. Then, the screen (servo setting screen) shown below appears on the CRT.

```
SERVO SETTING                          01000 N0000
                                  X axis    Z axis
Initialization bit              00000000  00000000
Motornumber                            0         0
AMR                             00000000  00000000
CMR                                    0         0
Feed gear  N                           0         0
Feed gear  M                           0         0
Move direction                         0         0
Number of speed pulses                 0         0
Number of position pulses              0         0
Reference counter                      0         0
Number=
```

Initialization bit		No. 1804
Motor number		No. 1874
AMR		No. 1806
CMR		No. 1820
Feed gear	N	No. 1977
(N/M)	M	No. 1978
Move direction		No. 1879
Number of speed pulses		No. 1876
Number of position pulses		No. 1891
Reference counter		No. 1896

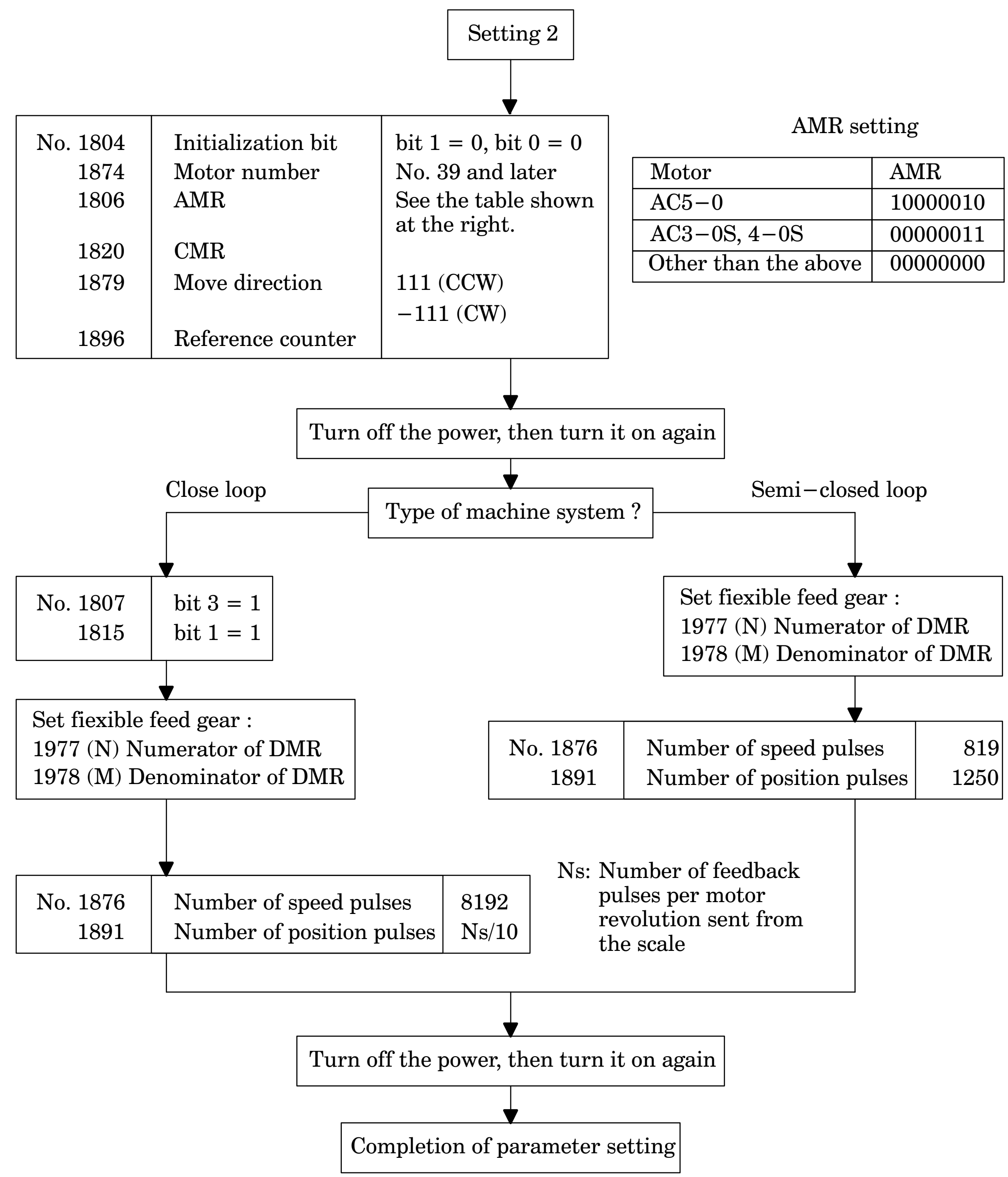
(2) Complete servo parameter initialization by setting each parameter on this screen according to the flow-charts described below.

[Flowchart for servo parameter initialization]

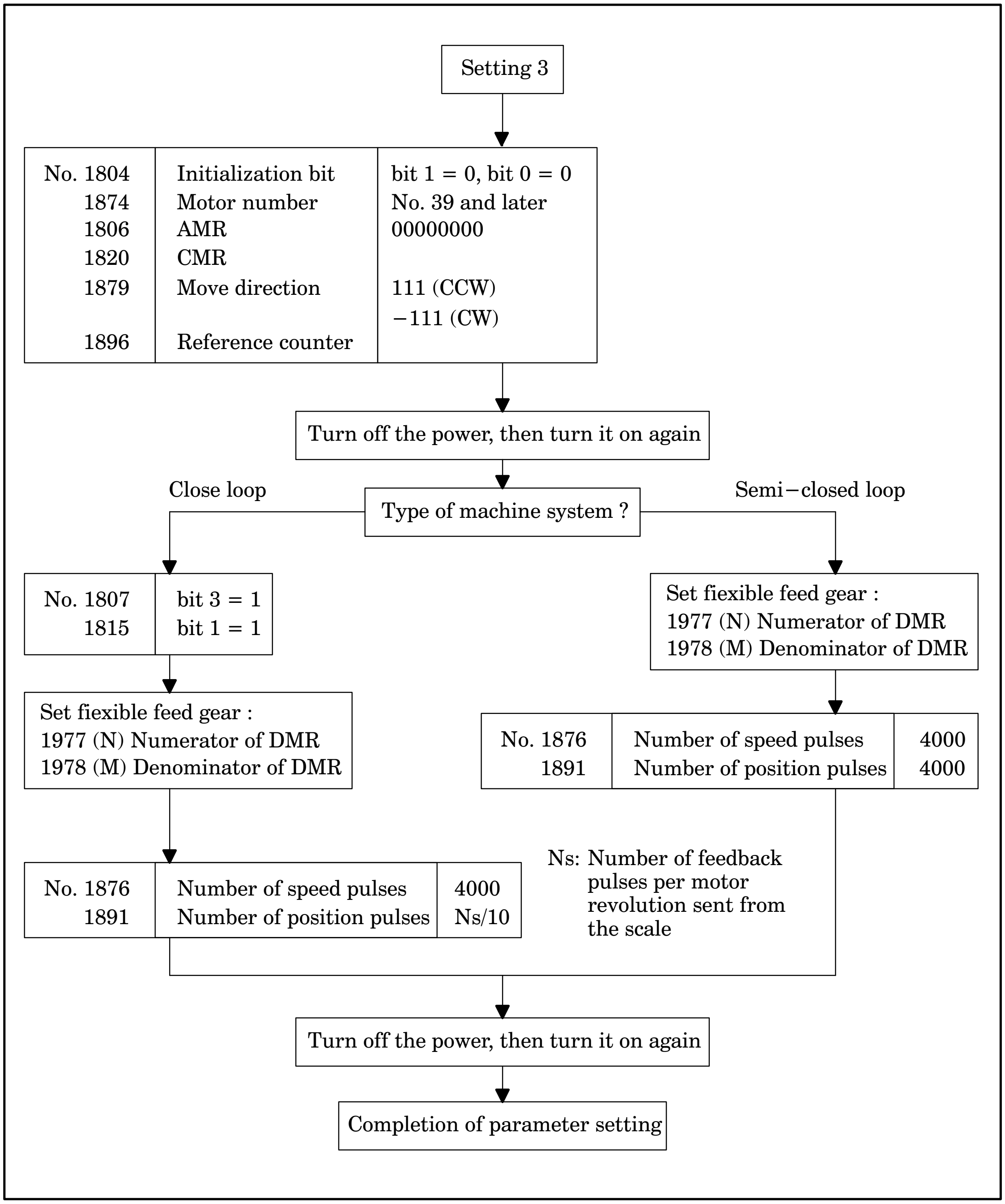


[Flowchart for setting when serial pulse coder A or B is used with a least input increment of 0.1µm]

NOTE	An optional parameter for 0.1µm control is required.



[Flowchart for setting when serial pulse coder C is used with a least input increment of 0.1µm]



[Setting the flexible feed gear]

When using a motor with a serial pulse coder, be sure to use the flexible feed gear for DMR setting.

An alarm is issued when the flexible feed gear is not used.

(Serial pulse coder A or B)

$$\frac{\text{Numerator of DMR (No. 1977)}}{\text{Denominator of DMR (No. 1978)}} = \frac{\text{Number of position feedback pulses per motor revolution}}{1{,}000{,}000}$$

NOTE 1 The maximum specifiable number is 32767 for both the numerator and denominator. So, reduce the above fraction to its lowest terms.

NOTE 2 When the T Series motor (serial pulse coder B) is used, the numerator of DMR (No. 1977) must not be greater than 250,000, and the denominator of DMR (No. 1978) must be 1,000,000.

NOTE 3 Make sure the numerator <denominator.
Whenthenumeraor > denominator, an alarm is issued.

(Serial pulse coder C)

$$\frac{\text{Numerator of DMR (No. 1977)}}{\text{Denominator of DMR (No. 1978)}} = \frac{\text{Number of position feedback pulses per motor revolution}}{40{,}000}$$

NOTE The maximum specifiable number is 32767 for both the numerator and denominator. So, reduce the above fraction to its lowest terms.

(Closed loop)

$$\frac{\text{Numerator of DMR (No. 1977)}}{\text{Denominator of DMR (No. 1978)}} = \frac{\text{Number of position feedback pulses per motor revolution}}{\text{Number of pulse per encoder revolution}}$$

NOTE The maximum specifiable number is 32767 for both the numerator and denominator. So, reduce the above fraction to its lowest terms.

2.5 Compatibility of Parameters with the Series 15–MA, –TA, –TTA, –MF, –TF, and –TTF

1) For the above models, there were parameters for which the increment system used increased by a factor of ten when the high–resolution detector interface was used (when PLC01, a bit of parameter No. 1804 is set to 1). However, for the Series 15–MB, –TB, –TTB, –MFB, –TFB, and –TTFB, the units remain the same.

   The following parameters for the models that used the high–resolution detection interface are no longer compatible. For the Series 15–MB, –TB, –TTB, –MFB, –TFB, and –TTFB, be sure to specify the settings for the following parameters with values ten–times larger than the original settings.

   — Parameters

     1410, 1411, 1421, 1423, 1424, 1425, 1426, 1427, 1428
     1451, 1452, 1453, 1454, 1455, 1456, 1457, 1458, 1459, 1460, 1461
     1621, 1623, 1625, 1627, 1629
     1827, 1828, 1829, 1830, 1832, 1837, 1850, 1896
     7211, 7212, 7213, 7214, 7311, 7312, 7313

2) For the above models, there where parameters for which the increment system used increased by a factor of ten when a maximum feedrate of 12 to 24 m per minute was used (when F24, a bit of parameter No. 1804, is set to 1). However, for the Series 15–MB, –TB, –TTB, –MFB, –TFB, and –TTFB, the units remain the same.

   The following parameters for the models that used the high–resolution detector interface are no longer compatible. For the Series 15–MB, –TB, –TTB, –MFB, –TFB, and –TTFB, be sure to specify the settings for the following parameters with values ten–times larger than the original settings.

   — parameters

     1420, 1422

3. PUNCHING PARAMETER TAPE

3.1 Punching All Parameters

1 Connect a punch unit to the input/output interface.

2 Set the EDIT mode.

3 Press the SERVICE soft key, then press the PARAM soft key, or press the SERVICE hard key several times. The parameter screen is displayed.

4 Press the PUNCH soft key, then press the ALL soft key. All the parameters are punched.

3.2 Punching Parameters Other Than Pitch Error Compensation

1 Connect a punch unit to the input/output interface.

2 Set the EDIT mode.

3 Press the SERVICE soft key, then press the PARAM soft key, or press the SERVICE hard key several times. The parameter screen is displayed.

4 Press the PUNCH soft key, then press the PARAM soft key. Parameters other than pitch error compensation are punched.

3.3 Punching Pitch Error Compensation Data

1 Connect a punch unit to the input/output interface.

2 Set the EDIT mode.

3 Press the SERVICE soft key, then press the PITCH soft key, or press the SERVICE hard key several times. The pitch error compensation data screen is displayed.

4 Press the PUNCH soft key, then press the PITCH soft key. Pitch error compensation data is punched.

4. DESCRIPTION OF PARAMETERS

Parameters are classified according to functions.

4.1 Parameters Related to Settings

	#7	#6	#5	#4	#3	#2	#1	#0
0000		RMTDG	DNC	EIA	NCR	ISP	CTV	TVC

Setting input

Data type : Bit

TVC Specifies whether TV check is performed.

0 : Do not perform.

1 : Perform.

CTV Specifies whether characters are counted for TV check during control out.

0 : Count.

1 : Do not count.

ISP Specifies whether ISO codes contain a parity bit.

0 : Contain parity bit.

1 : Do not contain parity bit.

(A parity bit is located at channel 8 in a punched tape in the ISO code.)

NCR Specifies how to punch an EOB (end–of–block) code when using ISO codes.

0 : Punch LF CR CR.

1 : Punch LF.

EIA Specifies the code system to use for punch codes.

0 : ISO code

1 : EIA code

DNC Specifies conditions for DNC operation with the remote buffer.

0 : Enable high–speed distribution if high–speed distribution conditions are satisfied.

1 : Perform normal distribution.

RMTDG Specifies whether to perform remote diagnosis.

0 : Not performed.

1 : Performed.

	#7	#6	#5	#4	#3	#2	#1	#0
0003	XTST					KGRG	NKGRH	

Setting input

Data type : Bit

NKGRH Specifies whether to stop drawing graphic A when the screen is switched to another one during drawing.

0 : Stop.

1 : Do not stop.

KGRG In the graphic guidance function.

0 : Graphics are drawn for guidance.

1 : Graphics are not drawn for guidance.

XTST Specifies how data is obtained for the internal investigation function used when diagnostic guidance is activated.

0 : Read specified data automatically.

1 : Use data input by the operator as the function value.

NOTE When this bit is set to 1, the user can set the internal investigation function to any value. This allows the user to check and debug the knowledge base.

		#7	#6	#5	#4	#3	#2	#1	#0
0010		SB0	SBC	SBM	SB8	SB7	GRPBG	SQN	INI

Setting input

Data type : Bit

INI Specifies whether the increment system is metric or in inches.

0 : Metric input

1 : Inch input

SQN Specifies whether sequence numbers are automatically inserted.

0 : Do not insert.

1 : Insert.

GRPBG Specifies whether to display an graphic display or background graphic display.

0 : Graphic Display

1 : Background Graphic Display

SB7 Specifies whether to stop after each block of custom macro statements in programs 07000 to 07999.

0 : Do not stop after each block.

1 : Stop after each block. (Used to debug custom macros.)

SB8 Specifies whether to stop after each block of custom macro statements in programs 08000 to 08999.

0 : Do not stop after each block.

1 : Stop after each block. (Used to debug custom macros.)

SBM Specifies whether to stop after each block of custom macro statements in any program.

0 : Do not stop after each block. (However, when stopping is specified in SB7 or SB8, stopping will occur in programs affected by these parameters.)

1 : Stop after each block. (Used to debug custom macros.)

SBC Specifies whether to stop after each block in hole–machining canned cycles (Not used in the Series 15–TT).

0 : Do not stop after each block.

1 : Stop after each block. (Used when trouble occurs with canned cycles.)

SBO Specifies whether to stop after each block automatically generated in the NC for cutter or tool tip radius compensation.

0 : Do not stop after each block.

1 : Stop after each block. (Used when trouble occurs with cutter or tool tip radius compensation.)

		#7	#6	#5	#4	#3	#2	#1	#0
0011		G50	HSO	NOT	TIM		HSDLD	ND8	NE8

Setting input

Data type : Bit

NE8 Specifies whether to permit editing of 08000 to 08999 programs.

0 : Permit editing.

1 : Do not permit editing.

ND8 Specifies whether to display the program being executed on the CRT for programs 08000 to 08999.

0 : Display program being executed.

1 : Do not display program being executed.

HSDLD Specifies whether the high–speed part program registration function is used.

0 : Not used.

1 : Used.

Normally, set this bit to 0.

When there is no need to display custom macros or other programs being executed, set this parameter to 1.

This function speeds up the registration of part programs in the foreground mode (EDIT mode). In the background mode, part programs are registered at normal speed.

If the power is disconnected during registration of part programs, the system operates as follows when the power is restored:

(1) Displays “CLEAR PROGRAM FILE (HSPD DLOAD)” on the CRT screen.

(2) Clears all part programs (including high–speed machining programs).

(3) Halts when the IPL monitor screen is displayed.

To restart the system, select “6 END IPL” by entering 6, or turn the power off then on again.

When part programs are being registered, they are not displayed.

When part programs are being registered, screens cannot be updated in some cases.

TIM Specifies the information displayed on the screen for the program No. and name directory.

0 : Display program No., name, and memory used.

1 : Display program No., name, and processing time.

NOT Specifies whether to use tool Nos. to specify output of tool pot Nos. and tool offsets.

0 : Use tool Nos. (H/D codes cannot be used to specify tool length compensation and cutter compensation).

1 : Do not use tool Nos. (H/D codes can be used to specify tool length compensation and cutter compensation Neither entering H or D codes in the tool life management function nor specifying H99 codes or D99 codes can be performed.).

HSO Specifies operation performed when the G10.3 L1/L2 command is used.

0 : Skip the program up to G11.3 and execute high–speed machining using previously registered data (call operation mode).

1 : Convert commands up to G11.3 into high–speed machining data, then register the data and use it to perform high–speed machining (register operation mode).

G50 Specifies whether to allow use of code G50 (G92 in G code system B and C; for specifying the coordinate system) when using the Series 15–T.

0 : Allow G50 (G92 in G code system B and C) to be used in a program command

1 : Do not allow G50 (G92 in G code system B and C) to be used in a program command. If G50 is used, a P/S alarm will be generated.

Set this parameter to 1 when the coordinate system is set using a tool geometry offset (instead of G50). In this case, an alarm will be generated if G50 is used inadvertently.

	#7	#6	#5	#4	#3	#2	#1	#0
0012	RMVx						SCLx	MIRx

Setting input

Data type : Bit axis

MIRx For each axis, specifies whether to use its mirror image.

0 : Do not use mirror image (normal).

1 : Use mirror image (mirror).

SCLx For each axis, specifies whether scaling is used (only for the Series 15–M)

0 : Use scaling.

1 : Do not use scaling.

RMVx For each axis, specifies whether to detach the shaft corresponding to the control axis.

0 : Do not detach.

1 : Detach.

Effective when RMBx, a bit of parameter No. 1005, is set to 1.

	#7	#6	#5	#4	#3	#2	#1	#0
0013		DSYS	HDIO	HKEY	NDSP			PCMN

Setting input

Data type : Bit

PCMN Specifies whether to display the PMC user screen (PCMDI) directly with the PMC/CNC key.

0 : Do not display the screen.

1 : Display the screen.

NDSP Specifies whether to display multiple subscreens on the PMC screen.

0 : Display multiple subscreens.

1 : Do not display multiple subscreens.

HKEY Specifies whether to store the history of key operations with the operation history function key.

0 : Do not store the history.

1 : Store the history.

HDIO Specifies whether to store the history of DI/DO with the operation history function key.

0 : Do not store the history.

1 : Store the history.

DSYS Specifies whether to display the system history screen.

0 : Do not display the screen.

1 : Display the screen.

	#7	#6	#5	#4	#3	#2	#1	#0
0014	HD2	BDSP					FMST	

Setting input

Data type : Bit

FMST Specifies whether to output alarm OH001, ”FAN MOTOR STOP.”

0 : Output the alarm.

1 : Do not display the alarm.

BDSP Specifies the units used for the file sizes in the disk directory display.

0 : Meters (metric input) or feet (inch input)

1 : Bytes

HD2 Specifies whether the size of one file can exceed 2000 m when using a floppy cassette, the PRO GRAM FILE Mate, HANDY FILE, or FA card.

0 : Within 2000 m

1 : Can exceed 2000 m

	#7	#6	#5	#4	#3	#2	#1	#0
0015				KYON	HION	HPOF	SPOF	SVOF

Parameter input

Data type : Bit

SVOF Specifies whether to display the servo screen.

0 : Display the servo screen.

1 : Do not display the servo screen.

SPOF Specifies whether to display the spindle screen.

0 : Display the spindle screen.

1 : Do not display the spindle screen.

HPOF Specifies whether to display the screen for high–precision contour control.

0 : Display the screen.

1 : Do not display the screen.

HION

0 :The operation history is not displayed. (Note that the alarm history is still displayed.)

1 : The operation history is displayed.

KYON

0 : [ERASE] key on the operation history screen is disabled.

1 : [ERASE] key on the operation history screen is enabled.

NOTE On the operation history screen, using the erase key can erase:
- Operation history data
- Alarm history data

0016	Screen saver start time

Setting entry

Data type : Byte

Data unit : Minute

Data range : 0 to 127

When the operator does not operate the keyboard for the period specified in this parameter, the saver screen is displayed. When 0 is specified, the screen saver function is disabled.

0020	Interface No. of input device for foreground

Setting input

Data type : Byte

Assignment of input device numbers for foreground

0 : Reader connected to JD5A of main CPU board

1 : Reader connected to JD5A of main CPU board (Settings 0 and 1 are identical.)

2 : Reader connected to JD5B of main CPU board

3 : Reader connected to JD5J of the subboard

4 : DNC1

9 : PMC

10: Remote buffer

13: Reader connected to JD6D of the subboard

14: Data Server

15: MMC DNC operation interface

16: MMC upload/download interface

Perform system reset after setting this parameter.

0021	Interface No. of output device for foreground

Setting input

Data type : Byte

Assignment of output device numbers for foreground

1 : Punch connected to JD5A of main CPU board

2 : Punch connected to JD5B of main CPU board

3 : Punch connected to JD5J of the subboard

4 : DNC1

9 : PMC

10: Remote buffer

13: Punch connected to JD6D of the subboard

14: Data Server

15: MMC DNC operation interface

16: MMC upload/download interface

Perform system reset after setting this parameter.

0022	Interface No. of input device for background

Setting input

Data type : Byte

Assignment of input device numbers for background

0 : Reader connected to JD5A of main CPU board

1 : Reader connected to JD5A of main CPU board (Settings 0 and 1 are identical.)

2 : Reader connected to JD5B of main CPU board

3 : Reader connected to JD5J of the subboard

4 : DNC1

9 : PMC

10: Remote buffer

13: Reader connected to JD6D of the subboard

14: Data Server

15: MMC DNC operation interface

16: MMC upload/download interface

Perform system reset after setting this parameter.

0023	Interface No. of output device for background

Setting input

Data type : Byte

Assignment of output device numbers for background

1 : Punch connected to JD5A of main CPU board

2 : Punch connected to JD5B of main CPU board

3 : Punch connected to JD5J of the subboard

4 : DNC1

9 : PMC

10: Remote buffer

13: Punch connected to JD6D of the subboard

14: Data Server

15: MMC DNC operation interface

16: MMC upload/download interface

Perform system reset after setting this parameter.

0031	Initial value used for automatic setting of sequence Nos.

Setting input

Data type : Two words

Valid range : 0 to 99999

0032	Increment used for automatic setting of sequence Nos.

Setting input

Data type : Two words

Valid range : 0 to 99999

4.2 Parameters Related to Timers

0100	Timer 1 (time accumulated since power–on)

Parameter input

Data type : Two words
Unit : Minutes
Valid range : 0 to 99999999
Timer 1 : Sets and displays the time accumulated since power–on.

0101	Timer 2 (time accumulated during automatic operation)

Setting input (For the Series 15–TT, this parameter is for the first tool post.)

Data type : Two words
Unit : Milliseconds
Valid range : 0 to 60000
Timer 2 : Sets and displays the time accumulated during automatic operation.

0102	Timer 3 (time accumulated during automatic operation)

Setting input (For the Series 15–TT, this parameter is for the first tool post.)

Data type : Two words
Unit : Minutes
Valid range : 0 to 99999999
Timer 3 : Sets and displays the time accumulated during automatic operation.

0103	Timer 4 (time accumulated during cutting)

Setting input (For the Series 15–TT, this parameter is for the first tool post.)

Data type : Two words
Unit : Milliseconds
Valid range : 0 to 60000
Timer 4 : Sets and displays the time accumulated during cutting.

0104	Timer 5 (time accumulated during cutting)

Setting input (For the Series 15–TT, this parameter is for the first tool post.)

Data type : Two words
Unit : Minutes
Valid range : 0 to 99999999
Timer 5 : Sets and displays the time accumulated during cutting.

0105	Timer 6 (time accumulated while general–purpose integrating meter activating signal TMRON is on)

Setting input

Data type : Two words

Unit : Milliseconds

Valid range : 0 to 60000

Timer 6 : Sets and displays the time accumulated while the TMRON signal is on.

There is an integrating meter in the control unit that is activated by an input signal from the machine. This integrating meter can be preset by this parameter.

0106	Timer 7 (time accumulated while general–purpose integrating meter activating signal TMRON is on)

Setting input

Data type : Two words

Unit : Minutes

Valid range : 0 to 99999999

Timer 7 : Sets and displays the time accumulated while the TMRON signal is on.

There is an integrating meter in the controller that is activated by an input signal from the machine side. This integrating meter can be preset by this parameter.

0107	Total number of parts machined

Setting input

Data type : Two words

Unit : Number of parts

Valid range : 0 to 99999

Sets and displays the total number of parts machined.

For the Series 15–TT, this parameter applies to the first spindle.

0108	Total number of parts

Setting input

Data type : Two words

Unit : Number of parts

Valid range : 0 to 99999999

For the Series 15–TT, this parameter indicates the total number of parts for the first spindle.

0109	Number of parts required

Setting input

Data type : Two words

Unit : Number of parts

Valid range : 0 to 99999999

When the total number of machined parts (parameter No. 0107) exceeds the number of parts required, a signal is output to the machine.

For the Series 15–TT, this parameter indicates the total number of parts machined by the first spindle.

0111	Timer 8 (time accumulated during automatic operation of the 2nd tool post)

Setting input (only for the Series 15–TT)

Data type : Two words

Unit : Milliseconds

Valid range : 0 to 60000

Timer 8 : Sets and displays the time accumulated during automatic operation of the second tool post.

0112	Timer 9 (time accumulated during automatic operation of the 2nd tool post)

Setting input (only for the Series 15–TT)

Data type : Two words

Unit : Minutes

Valid range : 0 to 99999999

Timer 9 : Sets and displays the time accumulated during automatic operation of the second tool post.

0113	Timer 10 (time accumulating during cutting with the 2nd tool post)

Setting input (only for the Series 15–TT)

Data type : Two words

Unit : Milliseconds

Valid range : 0 to 60000

Timer 10 : Sets and displays the time accumulated during cutting with the second tool post.

0114	Timer 11 (time accumulating during cutting with the 2nd tool post)

Setting input (only for the Series 15–TT)

Data type : Two words

Unit : Minutes

Valid range : 0 to 99999999

Timer 11 : Sets and displays the time accumulated during cutting with the second tool post.

0117	Total number of parts machined (with the 2nd spindle)

Setting input (only for the Series 15–TT)

Data type : Two words

Unit : Number of parts

Valid range : 0 to 99999999

This parameter indicates the total number of parts machined by the second spindle.

0118	Total number of parts machined (with the 2nd spindle)

Setting input (only for the Series 15–TT)

Data type : Two words

Unit : Number of parts

Valid range : 0 to 99999999

This parameter indicates the total number of parts machined by the second spindle.

0119	Number of parts required to be machined (with the 2nd spindle)

Setting input (only for the Series 15–TT)

Data type : Two words

Unit : Number of parts

Valid range : 0 to 99999999

This parameter indicates the total number required to be machined by the second spindle.

4.3 Parameters Related to Axis Control

	#7	#6	#5	#4	#3	#2	#1	#0
1000	HLB	EMI	EHM		FPI	XIK	CSZ	CIP

Parameter input

Data type : Bit

CIP Specifies whether to perform an in–position check after deceleration.

0 : Do not perform in–position check (during deceleration, wait until the feedrate reaches zero before executing next block).

1 : Perform in–position check (during deceleration, wait until the feedrate reaches zero and then also confirm the machine reaches the specified position before executing next block).

CSZ Specifies whether to enable the in–position check signal (*CSMZ)

0 : Disable

1 : Enable

XIK When axis interlock is applied during non–linear interpolation positioning (when LRP, a bit of parameter No. 1400 is se to 0), specifies whether to stop only the axis to which interlock was applied or all axes.

0 : Stop axis to which interlock was applied. (Other axes continue operation.)

1 : Stop all axes.

FPI Specifies whether to perform an in–position check at the temporary stop–point in G60 mode.

0 : Do not perform in–position check.

1 : Perform in–position check.

EHM Specifies conditions when handle interruption is valid.

0 : When in G01, G02, or G03 mode, handle interruption is valid during automatic operation startup, stopping, and resting.

1 : Handle interruption is only valid for G01, G02, and G03 blocks during automatic operation startup.

EMI Specifies validity of manual interrupts and manual setup operations during simultaneous manual–automatic operation.

0 : Manual interrupts are invalid and manual setup operations are valid.

1 : Manual interrupts and manual setup operations are valid.

HLB Specifies the rotation axes during 3–dimensional handle feed when the axis of the tool is on the Z–axis

0 : Axes A and C.

1 : Axes B and C.

NOTE Set TLAX and SLAB, bits of parameter No. 7550 to 0. If either of these bits is set to 1, HLB will be ignored.

	#7	#6	#5	#4	#3	#2	#1	#0
1001	CHPX	PED	PGDM		IMCW	NCOD		RPC

Parameter input (only for the Series 15–M)

Data type : Bit

RPC Specifies whether the axes are switched when a reference position return (G29) is performed.

0 : Axes are switched.

1 : Axes are switched.

NCOD Specifies the conditions for calculating a spline when $0 \leqq t \leqq T$.

0 : T = 1 for the first segment of the spline and T is the ratio of the chord of each consecutive segment to the chord of the first segment.

Assuming that the specified point array is P_1, P_2, ..., P_n and T of each segment is T_1, T_2, ..., T_{n-1}, the following equations are satisfied:

T = P P / P P = 1
T = P P / P P
....
T_{n-} = Pn– Pn / P P

1 : T = 1 for all segments.

IMCW Specifies the forward direction of one rotation axis of the two axes for which hypothetical axis control is possible.

0 : Forward direction is counterclockwise.

1 : Forward direction is clockwise.

PGDM Specifies whether the G code (G10.9) for selecting diameter or radius programming is valid for axis commands in the program.

0 : Invalid.

1 : Valid.

PED Specifies whether to enable the external deceleration function in axis control by PMC.

0 : Disables the external deceleration function.

1 : Enables the external deceleration function.

CHPX Specifies whether the settings that specify the chopping axis and chopping rate can be set.

0 : Can be set.

1 : Cannot be set.

	#7	#6	#5	#4	#3	#2	#1	#0
1002					DC4	ROPS	INM	

Parameter input

Data type : Bit

INM Specifies whether the detection unit for the linear axis of the machine is metric or in inches.

0 : Metric

1 : Inches

ROPSSpecifies which parameter enables or disables the roll–over function for a rotation axis.

0 : RDAx bit of parameter 1008

1 : RDA2x bit of parameter 1009

DC4 Specifies how to establish a reference position for a linear scale having reference marks.

0 : An absolute position is established by detecting three reference marks.

1 : An absolute position is established by detecting four reference marks.

	#7	#6	#5	#4	#3	#2	#1	#0
1004	PDSx	DSPx	ISDx			IPRx	ISFx	ISRx

Parameter input

Data type : Bit

ISRx, ISFx, ISDx, ISEx (parameter No. 1009) Specify an increment system for each axis

ISEx Specifies an increment system for each axis in parameter No. 1009.

ISEx	ISDx	ISFx	ISRx	Least input increment, least command increment	Abbr.
0	0	0	0	0.001 mm, 0.001 deg, or 0.0001 inch	IS–B
0	0	0	1	0.01 mm, 0.01 deg, or 0.001 inch	IS–A
0	0	1	0	0.0001 mm, 0.0001 deg, or 0.00001 inch	IS–C
0	1	0	0	0.00001 mm, 0.00001 deg, or 0.000001 inch	IS–D
1	0	0	0	0.000001 mm, 0.000001 deg, or 0.0000001 inch	IS–E

Always set the increment system of the spindle positioning (indexing) axis to 0.001 deg (IS–B).

> **NOTE** When using the Series 15–TT, select the same increment system for those axes that have the same axis name assigned with head 1/head 2.

IPRx Specifies whether to set the least input increment of each axis to ten times the least command increment.

0 : Do not set to ten times the least command increment.

1 : Set to ten times the least command increment.

When the above parameter is set to 1, the least input increments become as follows:

IS–A	0.01 mm, 0.01 deg, or 0.001 inch
IS–B	0.01 mm, 0.01 deg, or 0.001 inch
IS–C	0.001 mm, 0.001 deg, or 0.0001 inch
IS–D	0.0001 mm, 0.0001 deg, or 0.00001 inch
IS–E	0.00001 mm, 0.00001 deg, or 0.000001 inch

> **NOTE** When IS–A is used as the increment system, the least input increment cannot be set to ten times the least command increment.

DSPx Specifies whether to display axis positions on the position screen and other screens.

0 : Display axis positions.

1 : Do not display axis positions.

> **NOTE** When using the electronic gear box function (EGB), specify 1 for the dummy axis of the EGB to disable position display.

This parameter is used to select whether the following screens are displayed:

Position, program check, operating monitor, tool offset, and graphics screens

This parameter does not affect the axis display on the following screens:

Workpiece offset, parameter, diagnosis, and servo check screens

PDSx Specifies whether to display axis positions on the playback screen.

0 : Do not display axis positions.

1 : Display axis positions.

NOTE 1 This parameter is valid when the total number of controllable axis is six or more. Set parameters to 1 which correspond to five axes of which the positions are displayed. However, note that this parameter is ineffective when the NXT –AX and PRV –AX soft keys are displayed on the playback screen.

NOTE 2 When increment system IS–D is selected, the maximum travel (largest value that can be specified at once) for linear and circular interpolation is as follows:

No. of simultaneous moving axis.	Maximum travel	
2	7500.00000 mm	750.000000 inch
3	6000.00000 mm	600.000000 inch
4	5300.00000 mm	500.000000 inch
5	4800.00000 mm	480.000000 inch
6	4300.00000 mm	430.000000 inch

NOTE 3 Values specified when IS–D is selected
The unit of values for the following addresses are 0.00001 mm, 0.00001 deg, and 0.000001 inch. For example, if X1000 is specified (in the case of decimal point input), the resulting values are X0.01 mm, X0.01 deg, and X0.001 inch.

Table 3 Basic address and command value range

Function	Address	Metric input	Inch input
Dimension ward	X, Y, Z, A, B, C, U, V, W, I, J, K, R	±9999.99999 mm or deg	±999.999999 inch or deg
Feedrate per minute	F	0.0001 to 10000 mm/min	0.00001 to 1000 inch/min
Feedrate per revolution thread leading	F	0.0000001 to 5.0000000 mm/rev	0.00000001 to 0.50000000 inch/rev

NOTE 1 When inch input is used on a millimeter machine or metric input is used on an inch machine, the command value range differs partially.

NOTE 2 When an arc radius is specified using R, it can be specified as ± 999999999 (nine digits).

	#7	#6	#5	#4	#3	#2	#1	#0
1005	RMBx	ZNGx	EDMx	EDPx	PLZx	ALZx	ZMGx	ZRNx

Parameter input

Data type : Bit axis

ZRNx Specifies whether the reference position return function is provided for each axis.
0 : Provided
1 : Not provided

ZMGx Specifies the method to use for reference position return for each axis.
0 : Grid method
1 : Magnetic switch method

To use the magnetic switch method, OPTx (bit 1 of parameter No. 1815) must be set to 1.

ALZx Specifies the method to use for automatic reference position return (G28).
0 : Return to reference position using positioning control (rapid traverse). If reference position return has not been performed since power–on, it is performed using the same operation sequence as for manual reference position return.
1 : Use the same operation sequence as for manual reference position return.

Usually, set this bit to 0.

PLZx Specifies the condition for presetting the work coordinate system when manual reference position return is performed.
0 : Preset only when in reset state (e.g. OP signal is off).
1 : Always preset.

See ZNP in parameter No. 2402, which is common to all axes.

EDPx For each axis, specifies whether the external deceleration signal for the positive direction is valid during cutting feed.
0 : Invalid
1 : Valid

EDMx For each axis, specifies whether the external deceleration signal for the negative direction is valid during cutting feed.
0 : Invalid
1 : Valid

ZNGx Specifies whether machine lock is valid for each axis.
0 : Invalid
1 : Valid

RMBx For each axis, specifies whether the control axis detach signal and setting input RMVx (parameter No.0012) is valid.
0 : Invalid
1 : Valid

	#7	#6	#5	#4	#3	#2	#1	#0
1006	RTRx	NDCx	ZMIx		DIAx	ROPx	ROSx	ROTx

Parameter input

Data type : Bit axis

ROTx Specifies whether the axis requires inch/metric conversion.

0 : Axis requires inch/metric conversion (linear axis).

1 : Axis does not require inch/metric conversion (rotation axis).

ROSx Specifies whether the machine coordinate system used for stroke check and automatic reference position return is linear or rotational.

0 : Linear (linear axis)

1 : Rotation (rotation axis)

For a rotation axis, the machine coordinate system is normalized to 0 to 360 degrees. In this case, automatic reference position return (G28, G30) is performed in the same direction as manual reference position return and the degree of rotation does not exceed 360 degrees. Also see the item on parameter No. 1260.

ROPx Specifies whether the machine coordinate system used to perform the retained pitch error compensation is linear or rotational.

0 : Linear (linear axis)

1 : Rotation (rotation axis)

When the coordinate system used is rotational, up to the angle which corresponds to one cycle of retained pitch error compensation data can be specified. This allows pitch compensation to be performed for pitch compensation cycles of other than 360 degrees. Also see the item on parameter No. 5425.

DIAx Specifies whether movement along each axis is specified by diameter or radius.

0 : Specified by radius.

1 : Specified by diameter.

ZMIx Specifies the direction of manual reference position return.

0 : Positive direction

1 : Negative direction

NDCx Specifies the normal direction control axis.

0 : Not normal direction control axis

1 : Normal direction control axis (only one axis can be specified as the normal direction control axis.)

RTRx Specifies whether retract operation is performed along an axis when the electronic gear box function or functions for hobbing machines are used.

1 : Performed.

0 : Not performed.

	#7	#6	#5	#4	#3	#2	#1	#0
1007	DOGx	GRDx	RINC	RREL	RG90	RSRV		FAX

Data type : Bit axis

FAX Specifies whether the fixture ofset is valid for each axis.

0 : Invalid.

1 : Valid.

RSRV When an absolute command is executed (when RINC, a bit of parameter No. 1007 is set to 0), speci fies whether the direction of rotation is determined by the sign of the value specified by the command.

0 : Not determined.

1 : Determined by command value (counterclockwise when value is positive and clockwise when value is negative)

RG90 Specifies the type of commands used for the multiple rotary control axes.

0 : Either absolute or incremental commands determined by G90 or G91 mode

1 : Absolute commands

RREL Specifies whether the current position of the multiple rotary control axes in the relative coordinate system is displayed with the value rounded off within one rotation.

0 : Not performed.

1 : Performed.

RINC In multiple rotary axis control, when the NC converts the command value to the corresponding value within 360°, with the difference between the converted value and the current position being regarded as the angular displacement through which the axis is to be rotated, this bit specifies whether to turn in whichever direction minimizes the displacement in G90 mode.

0 : Do not turn to closest direction.

1 : Turn to closest direction.

GRDx Dog–less reference position setting is

0 : Performed more than once.

1 : Not performed more than once.

DOGx In the manual reference position return mode

0 : Dog–less reference position setting is disabled.

1 : Dog–less reference position setting is enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
1008			SPOE	RAS			PROT	RDAx

Data type : Bit axis

RDAx Specifies whether the roll–over function for a rotation axis is executed.

0 : Not executed.

1 : Executed.

NOTE The RDAx bit is valid only for a rotation axis.

PROT Specifies the multiple rotary control axes.

0 : Not rotary control axis

1 : Rotary control axis

RAS Specifies whether to enable the automatic reference position setting signals (RAST1, RAST2, RAST3, etc.), when the automatic reference position setting function is used.

0 : Disable the signals.

1 : Enable the signals.

SPOE Specifies whether the relevant axis is a spindle positioning axis.

0 : Not a spindle positioning axis

1 : Spindle positioning axis

This parameter is valid only for Multi Axes Control (Max.24 axes) series.

	#7	#6	#5	#4	#3	#2	#1	#0
1009	NADFV	PMCE	MCC	ZNDPx	PDIAx	RDA2x	ISEx	

Parameter input

Data type : Bit axis

ISEx Specifies the increment system for each axis (IS–E)

This parameter is set in combination with ISRx, ISFx, and ISDx of parameter No. 1004. For details, see the item on parameter No. 1004.

NOTE 1 When IS–E is selected as the increment system, the maximum travel (largest value that can be specified at once) becomes as shown in the table below for linear and circular interpolation.

No. of simultaneous moving axis.	Maximum travel	
2	750.000000 mm	75.0000000 inch
3	600.000000 mm	60.0000000 inch
4	530.000000 mm	53.0000000 inch
5	480.000000 mm	48.0000000 inch
6	430.000000 mm	43.0000000 inch

NOTE 2 Program command values when IS–E is selected
The units of values for the following addresses are 0.000001 mm, 0.000001 deg, and 0.0000001 inch. For example, if X1000 is specified (in the case of decimal point input, when DPI, a bit of parameter No. 2400 is set to 0), the resulting values are X0.001 mm, X0.001 deg, and X0.0001 inch.

Basic Address and Command Value Range

Function	Address	Metric input	Inch input
Dimension ward	X, Y, Z, A, B, C, U, V, W, I, J, K, R	±999.999999 mm or deg	±99.9999999 inch
Feedrate per minute	F	0.00001 to 1000 mm/min	0.000001 to 100 inch/min
Feedrate per revolution thread leading	F	0.00000001 to 0.50000000 mm/rev	0.000000001 to 0.050000000 inch/rev

When inch input is used on a millimeter machine or metric input is used on an inch machine, the command value range differs partially.

RDA2x Specifies whether the roll–over function for a rotation axis is executed.

0 : Not executed.

1 : Executed.

NOTE The RDA2x bit is valid only for a rotation axis.

PDIAx Specifies whether axis commands are specified by means of diameter or radius programming in the program.

0 : Radius programming

1 : Diameter programming

The PDIAx bit is valid only when the PGDM bit (bit 5 of parameter 1001) is set to 1.

The DIAx bit (bit 3 of parameter 1006) is automatically set at power–on and reset.

Data can be changed by specifying G10.9.

ZNDPx

0 : The set value is displayed on the workpiece reference position offset setting menu.

1 : The set value is not displayed on the workpiece reference position offset setting menu.

NOTE	This parameter also determines whether to display the set value on the workpiece reference position offset setting menu of the multi-submenu.

MCC Specifies the behavior of the servo amplifier MCC signal in an axis–detached state as follows:

0 : turned off

1 : not turned off

If an axis is detached when this parameter is 1, the servo motor is de–energized, but the servo amplifier MCC signal is not dropped. Even if one axis is detached in a two–axis amplifier configuration, this function suppresses alarm SV013, ”IMPROPER V–READY OFF” for the other axis.

If a cable connecting a servo system and the CNC (command cable or feedback cable) is removed for a detached axis, however, the SV013 alarm occurs for the other axis. In a fully closed system, the SV013 alarm may also occur for that axis. These symptoms occur because of the characteristic of a multi–axis amplifier such as two–axis or three–axis amplifier.

NOTE 1	Regardless of the state of this parameter (bit 5 of data No. 1009), it is necessary to cause a return to the reference position for a detached axis before a move command is issued. Otherwise, alarm PS181, ”ZERO RETURN NOT FINISHED” will occur, prompting for a return to the reference position.
NOTE 2	This function cannot be used for a system with an absolute position detector (bit 5 of parameter No. 1815 = 1).
NOTE 3	For a system not using a 2–axis amplifier, it is always necessary to reset bit 5 (MCC) of parameter No. 1009 to 0.

PMCE During HPCC mode using RISC, this axis

0 : Becomes neither a chopping axis nor an axis controlled by PMC.

1 : Becomes a chopping axis or an axis controlled by PMC.

NADFV Even when the advanced feed forward is available (Parameter 1811#2(ADV)=1), the advanced feed forward for this axis is:

0 : Performed

1 : Not performed

Set “1” for the chopping axis or the axis controlled by PMC.

	#7	#6	#5	#4	#3	#2	#1	#0
1010							RFDCT	

Parameter input

Data type : Bit axis

RFDCT Specifies the feedrate control method for the rotary axis as follows:

0 : Ordinary method

1 : The rotation speed of the rotary axis is converted to the surface speed on the periphery of an imaginary circle.
See data No. 2524 for details.

1020	Symbolic name for each axis

Parameter input

Data type : Byte axis

A symbolic name is set for each control axis using the values in the table below.

Axis name	Specified value	Axis name	Specified value	Axis name	Specified value
X Y Z	88 89 90	A B C	65 66 67	U V W	85 86 87

For the Series 15–T and 15–TT, A, U, V, and W cannot be used as symbolic axis names. (However, U, V, and W can be used as symbolic axis names by setting of the parameter U, V, W (No. 2403#6) when G–code system B or C for 15–T is used.)

NOTE 1 When the tool length compensation option (compensates length along the tool axis) is used, be sure to specify A, B, or C.

NOTE 2 When the optional axis name expansion function is used, the following addresses can be used as axis names:

Axis name	Specified value
I	73
J	74
K	75
E	69

NOTE 3 There are three possible axis arrangements. The user should be familiar with the axis arrangements, because they have considerable bearing on the display of data for each axis or on the signal connection between the NC and power magnetics cabinet. In the following explanation, synchronization control refers to a function supported only for multiaxis control.

(1) Input axis arrangement

The input axis arrangement is used for part–program specification and jog feed commands. A synchronization control axes or tandem control axes is regarded as a single axis. Overtravel, interlock, and other signals are connected according to this arrangement.

(2) Axis arrangement for setting and displaying data for each axis

This axis arrangement is used when parameters and diagnostic data are displayed on the CRT screen. When a synchronization control axis or tandem control axis is provided, a slave axis is added subsequent to the input axis arrangement. When multiple synchronization control axes and tandem control axes are provided, slave axes must be arranged in order of their master axes in the input axis arrangement.

(3) Drive axis arrangement

This axis arrangement is used to connect servo motor signals and NZ (near zero) signals (for multiaxis control only).

The servo axis arrangement is determined by parameter No. 1023. Specify the synchronization control and tandem axes as follows:

Tandem control axes

Multiaxis control only →

Tandem axis / Axis type	1st axis	2nd axis	3rd axis	4th axis	5th axis	6th axis	7th axis
Master axis	1	3	5	7	9	11	13
Slave axis	2	4	6	8	10	12	14

NOTE For parameter No. 1021, set 77 for the master axis (M) or 83 for the slave axis (S).

Synchronization control axes

Axis type \ Synchronous axis	1st axis	2nd axis	3rd axis	4th axis
Master axis	1	5	9	13
Slave axis	2	6	10	14

Example The following 5–axis configuration contains the X, Y, Z, A, and B axes, where the Y and B axes are tandem control axes:

Axis No.	Control axis arrangement	Axis arrangement for display(P1020)	P1023	Drive axis arrangement
1	X	X (88)	3	YM
2	★Y	YM (89)	1	YS
3	Z	Z (90)	4	X
4	A	A (65)	7	Z
5	★B	BM (66)	5	BM
6		YS (89)	2	BS
7		BS (65)	6	A

NOTE 1 Those axes marked ★ are tandem control axes.
NOTE 2 Subscript M indicates a master axis, while S indicates a slave axis.

1021	Parallel axis numbers

Parameter input

Data type : Byte axis

Valid range : 0 to (number of control axes)

Specify the axis numbers of parallel axes.

Parallel axes are specified with natural numbers starting from 1. For any axis that is not operated in parallel, specify 0.

For synchronous control with a fandem axis or a multiaxis system, specify 77 for the master axis, and 83 for a slave axis.

1022	Designation of each axis in relation to the basic coordinate system

Parameter input

Data type : Byte axis

Set each control axis to X, Y, or Z or any axis parallel to X, Y, or Z so that they may be used in determining the following:

·Circular interpolation surface

·Cutter compensation surface (only for the Series 15–M)

·Tool tip radius compensation surface (only for the Series 15–T and 15–TT)

·G17: Xp–Yp surface

·G18: Zp–Xp surface

·G19: Yp–Zp surface

·Xp–Yp–Zp for 3–dimensional tool compensation

Note that X, Y, and Z can each only be set to one axis, but that axes parallel to X, Y, and Z can be set to two or more axes.

Specified value	Meaning
0	A rotary axis (Not basic three axes nor parallel axes)
1	Axis X of basic three axes
2	Axis Y of basic three axes
3	Axis Z of basic three axes
5	An axis parallel to axis X
6	An axis parallel to axis Y
7	An axis parallel to axis Z

1023	Servo axis number of each axis

Parameter input

Data type : Byte

Valid range : 1 to (number of control axes)

Specify the number of the servo axis that corresponds to each control axis.

Normally, set each servo and control axis to the same numbers.

For example, when using the spindle positioning function (indexing) with axis C, add 16 to the servo axis number to get the parameter value.

Example How to calculate parameter value for C

When there are X, Z, and C(C):

16 + 3 = 19 (set parameter to 19)

When there are X, Z, Y, and C(C):

16 + 4 = 20 (set parameter to 20)

The control axis number and servo axis number of an axis with an absolute position detector must be the same.

When using the electronic gear box function (EGB), be sure to specify for the EGB slave axis and EGB dummy axis, the values listed below.

Combination	(1)	(2)	(3)	(4)	(5)
EGB slave axis	1	3	5	7	9
EGB dummy axis	2	4	6	8	10

1025	Axis of the basic coordinate system that is used as a rotary axis in spline interpolation.

Parameter input

Data type : Byte axis

Usually, spline interpolation is performed on the three basic axes, X, Y, and Z. It can also be performed on a rotary axis (axis for which parameter No. 1022 is 0). In this case the rotary axis substitutes for the basic axis specified using this parameter. This setting is used to determine which of the I, J, K, P, Q, and R addresses is to be used for the rotary axis when the first– and second–order differential vectors are specified at the beginning of spline interpolation.

Settings:

1 : The rotary axis is assumed to be the X–axis. So, the first– and second–order differential vectors are specified using I and P.

2 : The rotary axis is assumed to be the Y–axis. So, the first– and second–order differential vectors are specified using J and Q.

3 : The rotary axis is assumed to be the Z–axis. So, the first– and second–order differential vectors are specified using K and R.

Example

When spline interpolation is performed for X, Y, and C, this parameter should be set to 3 for the C–axis.

G06.1 X1234 Y2411 C3350 I0 J0 K0 P0003 Q0003 R0003;
X... Y... C... ;
.....

CAUTION 1 When spline interpolation is performed for the rotary axis, this parameter must be set (if the first–order differential vector is specified, and the exponent is omitted from P, Q, and R).

CAUTION 2 For spline interpolation B, the first–order differential vector is specified with a decimal number, but the P, Q, or R specification is not used. To perform interpolation for the rotary axis, however, it is necessary to specify this parameter.

1030	Command address of the second miscellaneous function

Parameter input

Data type : Byte

Specify the command address of the second miscellaneous function as A, B, C, U, V, or W. However, any address already used as an axis name cannot also be used as the command address of the second miscellaneous function.

For the Series 15–T and 15–TT, A, U, V, and W cannot be used as the command address of the second miscellaneous function.

Address	Specified value	Address	Specified value
A	65	U	85
B	66	V	86
C	67	W	87

1031	Reference axis

Parameter input

Data type : Byte

Valid range : 1 to 15

The units of parameters common to all axes, such as the dry run feedrate and feedrate specified by code F with one digit, vary according to the increment system.

In the Series 15, the effective increment system for each axis is selected using a parameter. The units of these parameter must match the increment system of the reference axis. Select the axis to use as the reference axis.

1032	Designation of linear axis used for polar coordinate interpolation

1033	Designation of rotation axis used for polar coordinate interpolation

Parameter input

Data type : Byte

Valid range : 1 to (number of control axes)

Set the numbers of the control axes to use as the linear and rotation axes for polar coordinate interpolation.

1034	Control axis number of tool rotation axis used for polygonal turning

Parameter input
Data type : Byte
Valid range : 1 to (number of control axes)
Set the number of the control axis to use as the tool rotation axis for polygonal turning.

1049	Axis switching number

Setting input (only for the Series 15–M)
Data type : Byte
Select one of the six combinations for switching axes. The machine axes x, y, and z correspond to program addresses X, Y, and Z as follows:

Axis interchange number	Program address		
	X	Y	Z
0	x	y	z
1	x	z	y
2	y	x	z
3	y	z	x
4	z	x	y
5	z	y	x

1050	No. of the linear axis to which hypothetical control is applied

1051	No. of the rotation axis to which hypothetical control is applied

Parameter input
Data type : Byte
Valid range : 1 to (number of control axes)
Set the numbers of the control axes corresponding to the linear and rotation axes to which hypothetical control is applied.

1052	Tool eccentricity (mm or inches)

Parameter input
Data type : Two words
Valid range : 0 to 99999999
Unit of data :

Setting range	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

1053	Name of hypothetical axis

Parameter input

Data type : Byte

The symbolic name of the axis used for hypothetical axis control is set using the values in the table below.

Axis name	Setting	Axis name	Setting	Axis name	Setting
X Y Z	88 89 90	A B C	65 66 67	U V W	85 86 87

1054	Limit specified by the software for forward direction of hypothetical axis (mm or inches)

1055	Limit specified by the software for reverse direction of hypothetical axis (mm or inches)

Parameter input

Data type : Two words

Valid range : –99999999 to 99999999

Unit of data :

Setting range	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

1056	Automatic override tolerance ratio for polar coordinate interpolation

Parameter input

Data type : Byte

Valid range : 0 to 100

Unit of data : 1%

Typical setting : 90% (treated as 90% when set to 0)

Set the tolerance ratio of the fastest cutting feedrate to the speed of the rotation axis during automatic override of polar coordinate interpolation.

1057	M–code for turning on hypothetical axis control mode

Parameter input

Data type : Byte

Valid range : 0 to 99

Set the M code for turning on hypothetical axis control mode.

1058	M–code for turning off hypothetical axis control mode

Parameter input

Data type : Byte

Valid range : 0 to 99

Set the M code for turning off hypothetical axis control mode.

1059	Specification of an axis as a hypothetical axis in the basic coordinate system

Parameter input

Data type : Byte

If a value not listed in the table below is specified, 2 (Y–axis of the basic three axes) is assumed.

Specified value	Meaning
1	X–axis of the basic three axes
2	Y–axis of the basic three axes
3	Z–axis of the basic three axes
5	Axis parallel to the X–axis
6	Axis parallel to the Y–axis
7	Axis parallel to the Z–axis

4.4 Parameters Related to Chopping

1191	Chopping axis

Parameter input

Data type : Byte

Valid range : 1 to (number of control axes)

Set the number of the servo axis that corresponds to the chopping axis.

1192	Chopping reference position (R position)

1193	Upper limit for chopping

1194	Lower limit for chopping

Parameter input

Data type : Two words

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Machine in the metric system	0.01	0.001	0.0001	0.00001	0.000001	mm
Machine in the inch system	0.001	0.0001	0.00001	0.000001	0.0000001	inch
Rotary axis	0.01	0.001	0.0001	0.00001	0.000001	deg

Valid range : –99999999 to 99999999

Set data in absolute coordinates.

1195	Chopping rate

Parameter input

Data type : Two–word axis

Unit of data :

Increment system	Unit
Millimeter input	1.00 mm/min
Inch input	0.01 inch/min

Valid range : 1 to 1000000

1196	Chopping compensation coefficient

Parameter input

Data type : Byte

Unit of data : %

Valid range : 0 to 100

Specify the coefficient by which to multiply the compensation values for servo delay and acceleration/deceleration delay occurring during chopping.

1197	Maximum feedrate during chopping

Parameter input

Data type : Two–word axis

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Machine in the metric system	100.0	10.0	1.0	0.1	0.01	mm/min
Machine in the inch system	10.0	1.0	0.1	0.01	0.001	inch/min
Rotary axis	100.0	10.0	1.0	0.1	0.01	deg/min

Valid range : 1 to 100000

Set the value that will be used to limit the chopping rate.

When this parameter is set to 0 for the chopping axis, chopping is not performed.

4.5 Parameters Related to Coordinate Systems

	#7	#6	#5	#4	#3	#2	#1	#0
1200	ACP	NZA			WZMS	MONS	FPC	

Parameter input

Data type : Bit

FPC Specifies whether to preset the relative position display to zero when the floating reference position is set using soft key MEM–FRP.

0 : Do not set to 0 (relative position display remains unchanged).

1 : Set to 0.

MONS Specifies whether to shift coordinate systems when data is written into the system variable which specifies the distance to be caused by a manual interrupt.

0 : Shift all workpiece coordinate system and local coordinate systems.

1 : Do not shift any workpiece coordinate system or local coordinate system. (This is the same operation as that specified by the cancel soft key on the manual–interrupt–distance screen.)

WZMS Manual input of workpiece zero offset on the WORK ZERO OFFSET screen is :

0 : Not possible

1 : Possible

NZA Specifies whether to issue the PS181 alarm if the machine is in the lock state when the reference position return function is enabled, and a move command is specified for an axis along which the reference position return is not completed.

0 : Issue the alarm.

1 : Do not issue the alarm.

0 : Issue the alarm.

1 : Do not issue the alarm.

ACP Specifies whether to perform the automatic workpiece coordinate system preset when the machine lock signal switches from on to off in the reset state.

0 : Do not perform the preset.

1 : Perform the preset.

1220	Offset from the workpiece reference point for all axes	(15–M)
	Shift for the workpiece coordinate system	(15–T)

Setting input

Data type : Two–word axis

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Linear axis (mm)	0.01	0.001	0.0001	0.00001	0.000001	mm
Linear axis (inch)	0.001	0.0001	0.00001	0.000001	0.0000001	inch
Rotary axis	0.01	0.001	0.0001	0.00001	0.000001	deg

Valid range : –99999999 to 99999999

This is one of the parameters that sets the position of the origin in a work coordinate system (G54 to G59). While the offset of the origin of a workpiece coordinate system may differ for each work coordinate system, this parameter provides an offset common to all workpiece coordinate systems. Normally, this parameter is set automatically by data input (external data input) from the machine.

1221	Offset of the origin of workpiece coordinate system 1

1222	Offset of the origin of workpiece coordinate system 2

1223	Offset of the origin of workpiece coordinate system 3

1224	Offset of the origin of workpiece coordinate system 4

1225	Offset of the origin of workpiece coordinate system 5

1226	Offset of the origin of workpiece coordinate system 6

Setting input

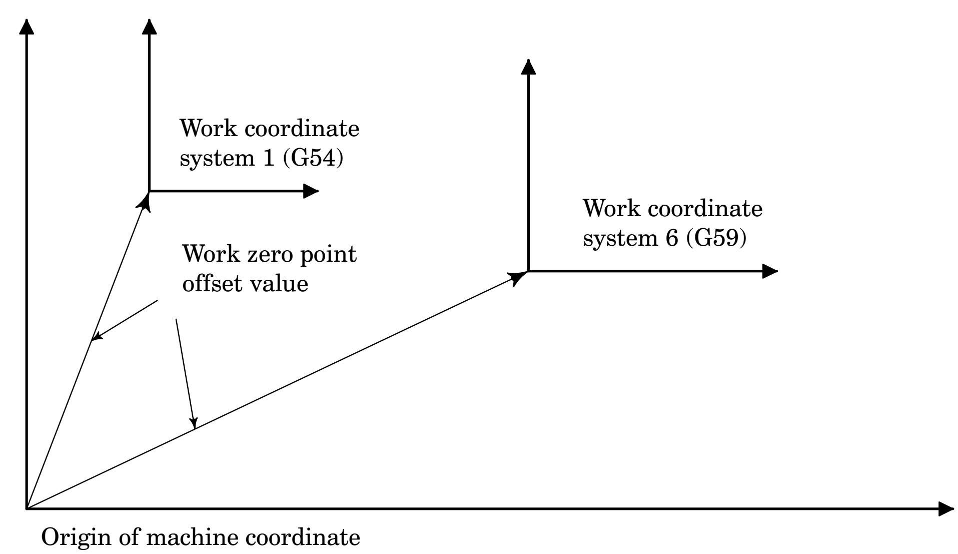
Data type : Two–word axis

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Linear axis (mm)	0.01	0.001	0.0001	0.00001	0.000001	mm
Linear axis (inch)	0.001	0.0001	0.00001	0.000001	0.0000001	inch
Rotary axis	0.01	0.001	0.0001	0.00001	0.000001	deg

Data range : ±99999999

Work zero point offset values are established for work coordinate systems 1 – 6 (G54–G59)



1240	Coordinates of the first reference position in the machine coordinate system

1241	Coordinates of the second reference position in the machine coordinate system

1242	Coordinates of the third reference position in the machine coordinate system

1243	Coordinates of the fourth reference position in the machine coordinate system

Parameter input

Data type : Two–word axis

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch
Rotary axis	0.01	0.001	0.0001	0.00001	0.000001	deg

Valid range : –99999999 to 99999999

Set the coordinates of the first to fourth reference positions in the machine coordinate system.

1244	Floating reference position in G30.1

Parameter input

Data type : Two–word axis

Valid range : –99999999 to 99999999

Increment system :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch
Rotary axis	0.01	0.001	0.0001	0.00001	0.000001	deg

1260	Angular displacement about the rotation axis when the connected motor rotates one turn

Parameter input

Data type : Two–word axis

Unit of data :

Increment system	Unit of data	Standard setting
IS–A	0.01deg	36000
IS–B	0.001deg	360000
IS–C	0.0001deg	3600000
IS–D	0.00001deg	36000000
IS–E	0.000001deg	360000000

Set the angular displacement about the rotation axis when the connected motor rotates one turn.

Valid range: –99999999 to 99999999

4.6 Parameters Related to Feedrate

	#7	#6	#5	#4	#3	#2	#1	#0
1400			AOV	LRP	SKF	RPD	TDR	RDR

Parameter input

Data type : Bit

RDR Specifies whether dry runs can be performed for the rapid traverse command.

0 : Cannot be performed.

1 : Can be performed.

TDR Specifies whether dry runs can be performed for the threading and tapping commands.

0 : Cannot be performed.

1 : Can be performed.

RPD Specifies whether manual rapid traverse can be performed during the period from the power on to reference position return.

0 : Cannot be performed.

1 : Can be performed.

SKF Specifies the feedrate of the skip function (G31, G31.1, G31.2, G31.3 – only G31 for the Series 15–T and 15–TT).

0 : Feedrate specified by the F code in the program

1 : Feedrate specified by parameter parameter No. 1428

NOTE See the item on bit 5 of parameter No. 7200 for multi–step and high–speed skip.

LRP Selects the method used for positioning (GOO).

0 : Non–linear interpolation (each axis moves independently at the rapid traverse feedrate)

1 : Linear interpolation (tool path is linear)

AOV Specifies whether to enable the secondary feedrate override.

0 : Disable.

1 : Enable.

	#7	#6	#5	#4	#3	#2	#1	#0
1401			DRS		RFO	HTG	NED	

Parameter input

Data type : Bit

NED Specifies effective range of external deceleration.

0 : Affects all feed movement.

1 : Affects only rapid traverse.

HTG Specifies how to specify a feedrate for helical and helical involute interpolation.

0 : Specify a feedrate in the direction tangent to an arc or involute curve.

1 : Specify a tangential feedrate for axes including linear axes

RFO Specifies whether to stop during rapid traverse when the cutting feedrate override is set to 0%.

0 : Stop.

1 : Do not stop.

DRS Specifies whether to enable skip signals during a dry run.

0 : Disable.

1 : Enable.

	#7	#6	#5	#4	#3	#2	#1	#0
1402			CAFC			OVRDI		ROV8

Parameter input

Data type : Bit

ROV8 Specifies override of the rapid traverse feedrate.

0 : The override is F0, Fn, 50%, or 100%, as specified by input signals ROV1 and ROV2.

1 : The override is determined by seven input signals (*RV0B to *RV6B) in 1% units within a range from 0% to 100%.

OVRDI Selects how to specify the PMC axis control override.

0 : Specify in PMC axis control command block.

1 : Specify directly by input signal from PMC.

CAFC Specifies whether cutting point speed control is performed during cutter compensation C mode (the Series 15–M) and tool nose radius compensation mode (the Series 15–T/TT).

0 : Not perfomed.

1 : Performed.

	#7	#6	#5	#4	#3	#2	#1	#0
1403			OVRIM					APO

Data type : Bit

APO The least increment for the second feedrate override is

0 : 1%

1 : 0.01%

This parameter is effective only when AOV (bit 5 of parameter No. 1400) is 1.

CAUTION This parameter is not effective for the distributed processing function with remote buffers. The conventional second feedrate override (with 1% increments) is used.

OVRIM Specifies the timing when the changed override and dry–run signals are made effective when look-ahead acceleration/deceleration before interpolation or high–precision contour control is used, and also specifies whether high–precision contour control is enabled in inverse–time feed mode.

0 : The signals are read when blocks are read. For those blocks which have been read into the multi-buffer, these signals are not made effective. The feedrate is changed after those blocks have been executed.

High–precision contour control is disabled for inverse–time feed.

1 : When the signals are changed, the feedrate is immediately changed accordingly.

High–precision contour control is enabled for inverse–time feed.

CAUTION 1 Set bit 2 of parameter No. 7614 to 0.

CAUTION 2 No override is applied to the feedrate calculated by the High–Precision Contour Control function (HPCC).

NOTE To prevent large impacts from being applied to the machine during dry run or when the override is increased, the dry–run feedrate and cutting feedrate are clamped at the feedrate determined by the High–Precision Contour Control function (HPCC).

	#7	#6	#5	#4	#3	#2	#1	#0
1404						POVSIG	PCROVR	

Parameter input

Data type : Bit

PCROVR Specifies whether to enable override for rapid traverse, reference position return, and positioning in the machine coordinate system in axis control by PMC.

0 : Disables override.

1 : Enables override.

POVSIG Specifies the override signals that can be used for rapid traverse, reference position return, and positioning in the machine coordinate system in axis control by PMC.

0 : ROV1 and ROV2, or RV0B to RV6B

1 : ROV1E and ROV2E

The following table shows the relationship between the feedrate and override for rapid traverse, reference position return, and positioning in the machine coordinate system:

1409#2	1404#1	1404#2	1402#0	Feedrate	Override
0	0	/	/	Feedrate set in parameter No. 1420	Not applied
	1	0	0	Feedrate set in parameter No. 1420	ROV1, ROV2
			1	Feedrate set in parameter No. 1420	RV0B to RV6B
		1	/	Feedrate set in parameter No. 1420	ROV1E, ROV2E
1	/	/	/	PMC data feedrate	PMC axis control override

	#7	#6	#5	#4	#3	#2	#1	#0
1409					TRQFU	RPD	F10	

Parameter input

Data type : Bit axis

F10 Sets the units of the feedrate data specified in the cutting feed command (feed per minute) in axis control by PMC.

F10	Metric input	Inch input
0	1 mm/min	0.01 inch/min
1	10 mm/min	0.1 inch/min

RPD Sets the feedrate for rapid traverse along the PMC–controlled axis, reference position return, and positioning in the machine coordinate system in axis control by PMC.

0 : Feedrate set in parameter No. 1420

1 : Feedrate specified as the feedrate data in the axis control command

CAUTION When rapid traverse, reference position return, and positioning in the machine coordinate system are performed in axis control by PMC by using conversational macros, RPD (parameter No. 1409 #2) becomes ineffective. This means that only the feedrate set in parameter No. 1420 can be used for execution.

TRQFU Specifies whether to perform follow–up for torque control.

0 : Not performed.

1 : Performed.

1410	Dry run feedrate

Parameter input

Data type : Two–words

Unit of data : Depends on the increment system of the basic axes.

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	10.0	1.0	0.1	0.01	0.001	mm/min
Inch system machine	1.0	0.1	0.01	0.001	0.0001	inch/min
Rotary axis	10.0	1.0	0.1	0.01	0.001	deg/min

Even when PLC01 of parameter No. 1804 is set to 1, the unit of data is not multiplied by 10.

Valid range : 1 to 1000000

For BMI interface

Set the dry run feedrate for when the jog feedrate dial is turned to 100%.

For FS6 interface

Set the dry run feedrate for when the jog feedrate dial is turned to the 22nd position. The typical setting is 500 for a millimeter machine or 2000 for an inch machine.

For FS3 interface

Set the dry run feedrate for when the feedrate override dial is turned to 130%. The typical setting is 500 for a millimeter machine or 2000 for an inch machine.

1411	Arbitrary manual angle feedrate

Parameter input (only for the Series 15–M)

Data type : Word

Unit of data : Depends on the increment system of the basic axes.

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	10.0	1.0	0.1	0.01	0.001	mm/min
Inch system machine	1.0	0.1	0.01	0.001	0.0001	inch/min

Even when PLC01 of parameter No. 1804 is set to 1, the unit of data is not multiplied by 10.

Valid range : 1 to 1000000

Set the arbitrary manual angle feedrate for when the jogging feedrate dial is turned to 100%.

1412	Percentage value for rapid traverse override F1

Parameter input

Data type : Byte

Unit of data : %

Valid range : 0 to 100

Set the percentage value to use for rapid traverse override F1.

1413	Maximum number of buffered manual handle feed pulses

Parameter input

Data type : Byte

Valid range : 0 to 4

Manual handle feed cannot be used to move the machine at a faster rate than the rapid traverse feedrate. Therefore, when the manual handle feedrate exceeds the rapid traverse feedrate, the excess manual pulses can be stored and used to move the machine an equivalent distance at the rapid traverse feedrate (i.e. pulses are buffered). Set the size of this buffer in this parameter.

Buffer size = (rapid traverse feedrate) × 2**(setting)/7500 (Two asterisks (**) indicate an exponent)

Normally, set this parameter to 0.

1414	Magnification n of manual handle feed

Parameter input

Data type : Word

Valid range : 1 to 2000 (1 to 2000 magnification)

Set the magnification rate for when movement selection signal MP2 for manual handle feed is on. Normally, set this parameter to 100.

Movement selection signal			Movement (manual handle feed)
MP4	MP2	MP1	
0	0	0	Least input increment × 1
0	0	1	Least input increment × 10
0	1	0	Least input increment × n
0	1	1	Least input increment × n

However, when HDF of parameter 7608 is set to 1 (meaning that movement by manual handle feed is 1000–times the least input increment), the movement values become as shown in the table below. The letter n in the table below is the value set in parameter No. 1414. This parameter has a valid range of 1 to 2000 and is usually set to 1000.

Movement selection signal			Movement (manual handle feed)
MP4	MP2	MP1	
0	0	0	Least input increment × 1
0	0	1	Least input increment × 10
0	1	0	Least input increment × 100
0	1	1	Least input increment × n

(0: Signal low, 1: Signal high)

1417	Rapid traverse ratio during the period from the power on to manual reference position return

Parameter input

Data type : Byte

Unit of data : %

Valid range : 1 to 100

Set the rapid traverse ratio to use in the below expression. This expression is used to calculate the effective rapid traverse feedrate during the period from the power on to manual reference position return.

(rapid traverse feedrate) = (feedrate set in parameter No. 1420) × (value set in this parameter) / 100
When 0 is set, the feedrate is assumed to be 100%.

1420	Rapid traverse feedrate along each axis

Parameter input
Data type : Two–word axis
Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	100.0	10.0	1.0	0.1	0.01	mm/min
Inch system machine	10.0	1.0	0.1	0.01	0.001	inch/min
Rotary axis	100.0	10.0	1.0	0.1	0.01	deg/min

Valid range : 1 to 100000
Set the rapid traverse feedrate for each axis for when rapid traverse override is 100%.
Even when F24 of parameter No. 1804 is set to 1, the unit of data is not multiplied by 10.

1421	F0 feedrate for each axis for rapid traverse override

Parameter input
Data type : Two–word axis
Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	10.0	1.0	0.1	0.01	0.001	mm/min
Inch system machine	1.0	0.1	0.01	0.001	0.0001	inch/min
Rotary axis	10.0	1.0	0.1	0.01	0.001	deg/min

Even when PLC01 of parameter No. 1804 is set to 1, the unit of data is not multiplied by 10.
Valid range : 8 to 1000000
Set the F0 feedrate for each axis for rapid traverse override.

1422	Maximum cutting feedrate for each axis

Parameter input
Data type : Two–word axis
Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	100.0	10.0	1.0	0.1	0.01	mm/min
Inch system machine	10.0	1.0	0.1	0.01	0.001	inch/min
Rotary axis	100.0	10.0	1.0	0.1	0.01	deg/min

Valid range : 1 to 100000
Set the maximum cutting feedrate for each axis.
Even when F24 of parameter No. 1804 is set to 1, the unit of data is not multiplied by 10.

1423	Jogging feedrate for each axis

Parameter input

Data type : Two–word axis

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	10.0	1.0	0.1	0.01	0.001	mm/min
Inch system machine	1.0	0.1	0.01	0.001	0.0001	inch/min
Rotary axis	10.0	1.0	0.1	0.01	0.001	deg/min

Even when PLC01 of parameter No. 1804 is set to 1, the unit of data is not multiplied by 10.

Valid range : 1 to 1000000

For BMI interface

Set the jogging feedrate for each axis for when the jog feedrate dial is turned to 100%.

For FS6 interface

Set the jogging feedrate for each axis for when the jog feedrate dial is turned to the 22nd position.

The typical setting is 500 for a millimeter machine or 2000 for an inch machine.

For FS3 interface

Set the jogging feedrate for each axis for when the feedrate override dial is turned to 130%.

The typical setting is 500 for a millimeter machine or 2000 for an inch machine.

This parameter also specifies the dry run feedrate for each axis when dry runs are enabled for rapid traverse (when PDR, a bit of parameter No. 1400 is set to 1), but the RT signal (rapid traverse signal) is off.

The meaning of the data is the same as for jogging.

1424	FM feedrate for each axis for manual reference position return

Parameter input

Data type : Two–word axis

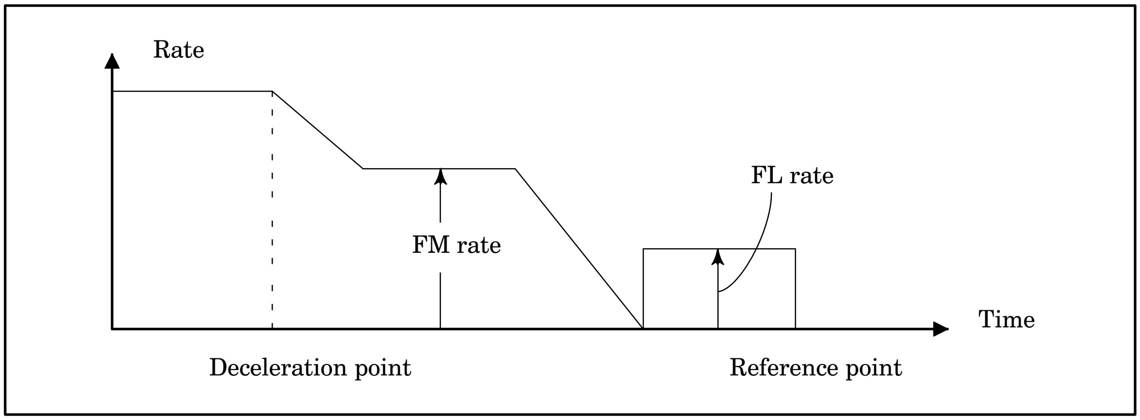
Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	10.0	1.0	0.1	0.01	0.001	mm/min
Inch system machine	1.0	0.1	0.01	0.001	0.0001	inch/min
Rotary axis	10.0	1.0	0.1	0.01	0.001	deg/min

Even when F24 of parameter No. 1804 is set to 1, the unit of data is not multiplied by 10.

Valid range : 8 to 1000000

Set the FM feedrate for each axis for manual reference position return when the magnetic switch method is used. Linear acceleration/deceleration is applied to movement at the FM feedrate. When reference position return is performed using the grid method, there is no need to set this parameter since the FM feedrate is not used.



1425	FL feedrate for each axis for manual reference position return

Parameter input

Data type : Two–word axis

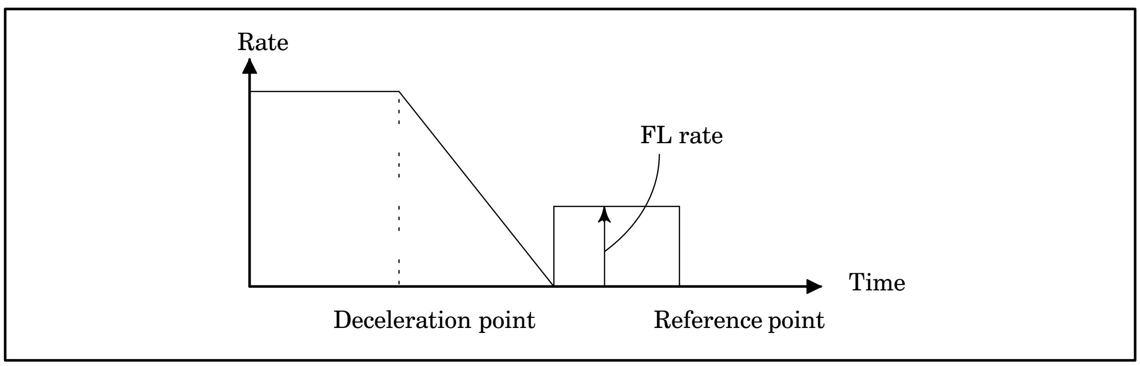
Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	10.0	1.0	0.1	0.01	0.001	mm/min
Inch system machine	1.0	0.1	0.01	0.001	0.0001	inch/min
Rotary axis	10.0	1.0	0.1	0.01	0.001	deg/min

Even when PLC01 of parameter No. 1804 is set to 1, the unit of data is not multiplied by 10.

Valid range : 8 to 1000000

For each axis, set the FL feedrate to be used after deceleration occurs in reference position return.



1426	External deceleration rate during cutting feed

Parameter input

Data type : Two words

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	10.0	1.0	0.1	0.01	0.001	mm/min
Inch system machine	1.0	0.1	0.01	0.001	0.0001	inch/min
Rotary axis	10.0	1.0	0.1	0.01	0.001	deg/min

Even when PLC01 of parameter No. 1804 is set to 1, the unit of data is not multiplied by 10.

Valid range : 1 to 1000000

Set the external deceleration rate used during cutting feed and positioning using linear interpolation (G00).

1427	External deceleration rate for each axis during rapid traverse

Parameter input

Data type : Two–word axis

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	10.0	1.0	0.1	0.01	0.001	mm/min
Inch system machine	1.0	0.1	0.01	0.001	0.0001	inch/min
Rotary axis	10.0	1.0	0.1	0.01	0.001	deg/min

Even when PLC01 of parameter No. 1804 is set to 1, the unit of data is not multiplied by 10.

Valid range : 8 to 1000000

This parameter sets the external deceleration feedrate used in rapid traverse or in the PMC axis control command.

1428	Skip function (G31) feedrate

Parameter input

Data type : Two words

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	1.0	1.0	1.0	1.0	1.0	mm/min
Inch system machine	1.0	1.0	1.0	1.0	1.0	inch/min
Rotary axis	1.0	1.0	1.0	1.0	1.0	deg/min

Even when PLC01 of parameter No. 1804 is set to 1, the unit of data is not multiplied by 10.

Valid range : 1 to 1000000

Set the feedrate for the skip function (G31). This parameter is valid when SKF, a bit of parameter No. 1400, is set to 1, namely the skip function feedrate is the value set in this parameter.

NOTE See parameter Nos. 7211 to 7214 for multi–step and high–speed skip.

1450	Resolution of the feedrate specified by the F code with a one–digit number

Parameter input (only for the Series 15–M)

Data type : Byte

Valid range : 1 to 127

Set the constant used to determine the change in the feedrate when the manual pulse generator is rotated one graduation while that F code with a one–digit number is specified.

$$\Delta F = \frac{F\,max\,i}{100n} \quad (i = 1,\ 2)$$

This parameter is represented in the above expression as the letter n. Set n to determine how many times the manual pulse generator needs to be rotated for the feedrate to become Fmaxi. Fmaxi in the above expression represents the upper limit for the feedrate specified by the F code with a one–digit number. The limit is set in parameter Nos. 1460 and 1461.

Fmax1 Upper feedrate limit for F1 to F4 (1460)

Fmax2 Upper feedrate limit for F5 to F9 (1461)

1451	F1 feedrate
1452	F2 feedrate
1453	F3 feedrate
1454	F4 feedrate
1455	F5 feedrate
1456	F6 feedrate
1457	F7 feedrate
1458	F8 feedrate
1459	F9 feedrate

Setting input (only for the Series 15–M)

Data type : Two words

Unit of data : The setting unit used here is the smallest of all those for all controlled axes.

NOTE The actual feedrate may differ from the setting of this parameter, because it is an integral multiple of ΔF, calculated from the setting of parameter No. 1450.

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	10.0	1.0	0.1	0.01	0.001	mm/min
Inch system machine	1.0	0.1	0.01	0.001	0.0001	inch/min
Rotary axis	10.0	1.0	0.1	0.01	0.001	deg/min

Even when PLC01 of parameter No. 1804 is set to 1, the unit of data is not multiplied by 10.

Valid range : 1 to 1000000

Specify the feedrate assigned to each F code with a one–digit number, F1 to F9.

When the F code with a one–digit number is in effect, rotating the manual pulse generator will vary the feedrate. This parameter changes along with the changes in the feedrate.

1460	Upper feedrate limit for F1 to F4

1461	Upper feedrate limit for F5 to F9

Parameter input (only for the Series 15–M)

Data type : Two words

Unit of data : The setting unit used here is the smallest of all those for all controlled axes.

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	10.0	1.0	0.1	0.01	0.001	mm/min
Inch system machine	1.0	0.1	0.01	0.001	0.0001	inch/min
Rotary axis	10.0	1.0	0.1	0.01	0.001	deg/min

Even when PLC01 of parameter No. 1804 is set to 1, the unit of data is not multiplied by 10.

Valid range : 0 to 1000000

These are the upper limits for the feedrates specified by the F codes with a one–digit number. When the feedrate is increased by turning the manual pulse generator, these upper limits are used to clamp the feedrate. The upper limit of feedrates for F1 to F4 is specified in parameter No. 1460. The upper limits of feedrate for F5 to F9 is specified in parameter No. 1461.

1472	Feedrate when the normal–direction control axis swivels

Parameter input

Data type : Two–word axis

Unit of data : deg/min

Valid range : 1 to 15000

Set the feedrate used when the normal–direction control axis swivels.

1478	Critical speed and allowable speed difference for automatic corner deceleration

Parameter input

Data type : Two–word axis

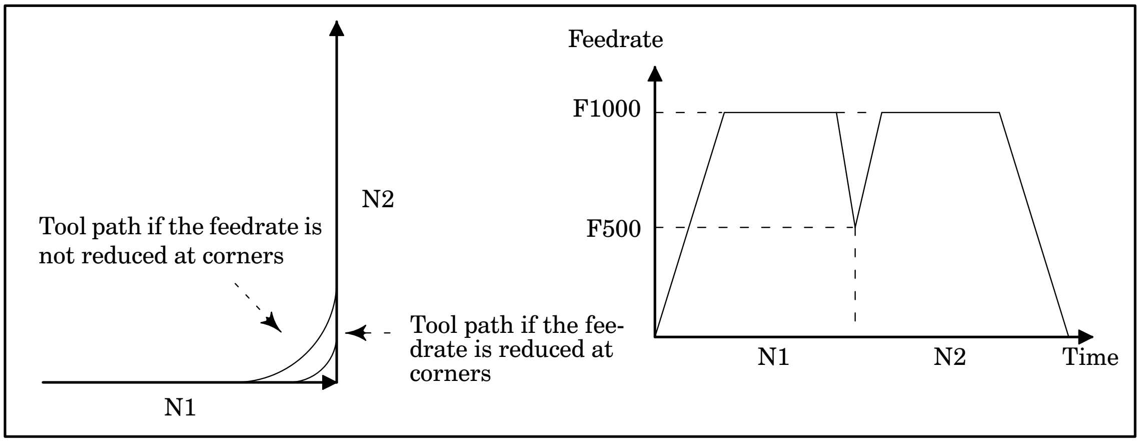
Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Millimeter machine	100.0	10.0	1.0	0.1	0.01	mm/min
Inch machine	10.0	1.0	0.1	0.01	0.001	inch/min
Rotation axis	100.0	10.0	1.0	0.1	0.01	deg/min

Valid data range : 0 to 32767. When 0 is specified for all axes, the tool is not decelerated at the corner.

When a function for determining the feedrate based on the corner feedrate difference in acceleration/deceleration before look–ahead interpolation and high–precision contour control is used, if a change in a feedrate component on each axis at a boundary between blocks is about to exceed the value set in this parameter, acceleration/deceleration before interpolation is applied to reduce the feedrate to the value obtained for that purpose.

Example The tool changes its direction of movement by 90 degrees (from along theX–axis to along the Y–axis) when a feedrate of 1, 000 min/min is specified and an allowable feedrate difference of 500 mm/min is set.



1479	Feedrate used to indicate completion of automatic corner deceleration

Parameter input

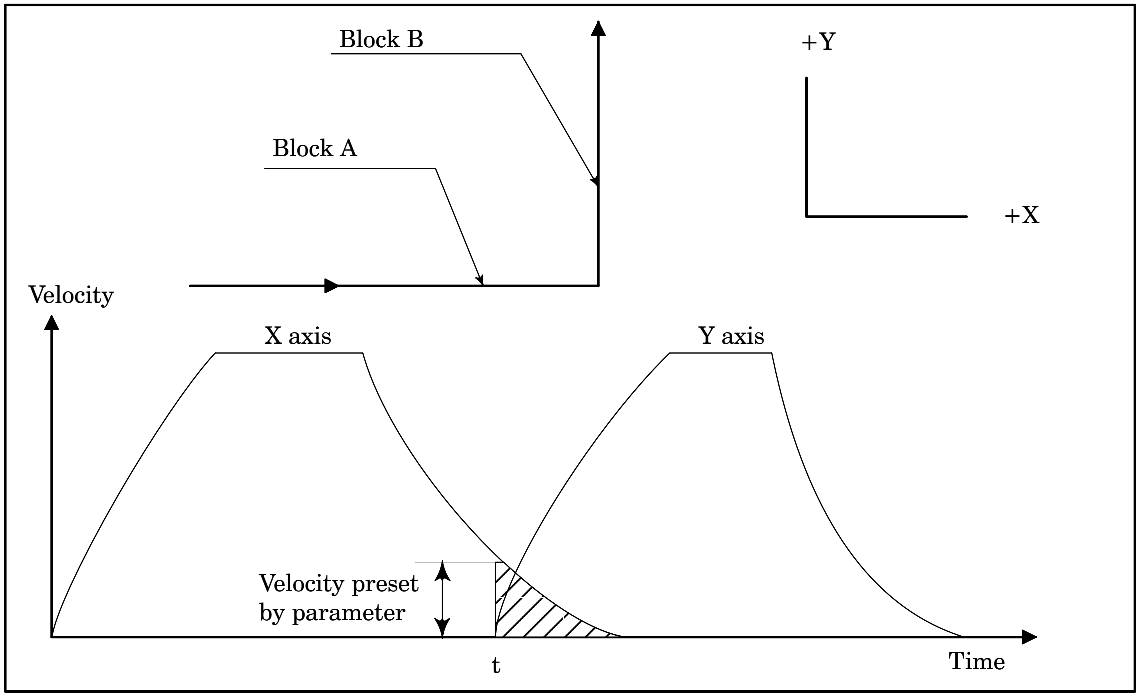
Data type : Two–word axis

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	10.0	1.0	0.1	0.01	0.001	mm/min
Inch system machine	1.0	0.1	0.01	0.001	0.0001	inch/min
Rotary axis	10.0	1.0	0.1	0.01	0.001	deg/min

In continuous cutting mode (G64), when one cutting feed block (block A) is followed by another cutting feed block (block B), the automatic corner deceleration function determines whether to decelerate during block A.

This function compares the absolute difference of the feedrate components (if the tool does not move along a certain axis, the feedrate component is 0 along the axis) along each axis in block A and B with the value set in parameter 1478. If absolute difference in the feedrate components for even one of the axes exceeds the value set in parameter 1478, this function automatically decelerates the machine at the end of block A. When the decelerated feedrate in the acceleration/deceleration circuit of each axis drops below the value set in parameter 1479, cutting proceeds to the next block (block B).



The residual pulses left in the acceleration/deceleration circuit of the X axis at time t are shown by the shadowed portion. However, because the decelerated feedrate in the acceleration/ deceleration circuit of the X axis has dropped below the value preset in this parameter, cutting proceeds to the next block.

The feedrate component of each axis, in the case of a linear interpolation block, is the tangential feedrate along the axis obtained by multiplying the override by the feedrate specified in that block. In the case of a circular interpolation block, the feedrate component of each axis is the tangential feedrate along the axis obtained by multiplying the override by the feedrate specified in that block at the start point (block B) or end point (block A). The override here refers to feedrate override being selected at the time when the information of the block is read.

Example When the control axes are X, Y, Z, and A

(i) Linear interpolation block

G01G91X x Y y Z z F f ;

$Fx = f \times \frac{x}{K} \times ovr$ .... Feedrate component along the X axis

$Fy = f \times \frac{y}{K} \times ovr$ .... Feedrate component along the Y axis

$Fz = f \times \frac{z}{K} \times ovr$ .... Feedrate component along the Z axis

$Fa = 0$ .... Feedrate component along the A axis

Where K = X + Y + Z

ovr : Feedrate override

(ii) Circular interpolation block (corresponding to block B)

G17G02X x Y y I i J j F f ;

$Fx = f \times \frac{j}{\sqrt{i^2 + j^2}} \times ovr$ .... Feedrate component along the X axis

$Fy = f \times \frac{i}{\sqrt{i^2 + j^2}} \times ovr$ .... Feedrate component along the Y axis

Fz = 0 .... Feedrate component along the Z axis

Fa = 0 .... Feedrate component along the A axis

If feed per rotation (G95) or feed at the feedrate specified by the F code with a one–digit number is specified in block A or B, no check is made to see if automatic corner deceleration is necessary.

In dry run mode, checks are made to see if automatic corner deceleration is necessary, just as during normal operation.

1482	Time constant for acceleration/deceleration performed after interpolation for cutting feed during automatic feedrate control in high–precision contour control

Parameter input

Data type : Word axis

Unit of data : msec

Valid range : 0 to 4000

Set the time constant used for acceleration/deceleration performed after interpolation for cutting feed during automatic feedrate control in high–precision contour control.

During automatic feedrate control, this constant is used instead of the constant normally used (parameter No. 1622).

Parameter No. 1635 is used if RISC–based high–precision contour control or advance feed forward is used (ADV of parameter 1811 = 1).

1490	Upper feedrate limit at radius R

Parameter input (only for the Series 15–M)

Data type : Two words

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	100.0	10.0	1.0	0.1	0.01	mm/min
Inch system machine	10.0	1.0	0.1	0.01	0.001	inch/min

Valid range : 0 to 100000

Set the upper limit of the feedrate at the radius set in parameter No. 1492.

1491	Lower feedrate limit (RVmin) clamped by radius

Parameter input (only for the Series 15–M)

Data type : Two words

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	100.0	10.0	1.0	0.1	0.01	mm/min
Inch system machine	10.0	1.0	0.1	0.01	0.001	inch/min

Valid range : 0 to 100000

When using the ”feedrate clamp by radius” function, reducing the radius causes the feedrate clamp value to decrease. If the feedrate clamp value becomes smaller than the value specified for this parameter, the specified parameter value is used as the feedrate clamp value.

1492	Radius corresponding to the upper feedrate limit

Parameter input (only for the Series 15–M)

Data type : Two words

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 1000 to 99999999

Specify the radius corresponding to the upper feedrate limit set in parameter No. 1490.

1493	Cutting feedrate

Setting input

Data type : Two words

Unit of data :

Incremental Unit	Data unit
Input by mm	1.0 mm/min
Input by inch	0.01 inch/min

Valid range : 0 (cutting feedrate is set by the program)

1 to (maximum cutting feedrate)

Set the cutting feedrate in this parameter for machines that do not require changes in the cutting feedrate during machining. By using this parameter, cutting feedrates (F codes) do not need to be specified in NC command data.

Turn the power off then on again after changing this parameter.

1494	Feedrate during reverse movement

Parameter input

Data type : Two words

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	10.0	1.0	0.1	0.01	0.001	mm/min
Inch system machine	1.0	0.1	0.01	0.001	0.0001	inch/min
Rotary axis	10.0	1.0	0.1	0.01	0.001	deg/min

Valid range : 1 to 1000000

Set the feedrate to use during reverse movement. When set to 0, reverse movement is performed at the feedrate specified in the program.

4.7 Parameters Related to Screen for Specifying High–Speed and High–Precision Machining

	#7	#6	#5	#4	#3	#2	#1	#0
1517					NAR	NAM	NAF	NAS

Setting input

Data type : Bit

NAS Specifies whether the automatic setting function is enabled on the HPCC (SETTING) screen.

0 : Enabled.

1 : Disabled.

NAF Specifies whether the automatic tuning function (FINE) is enabled on the HPCC (SETTING) screen.

0 : Enabled.

1 : Disabled.

NAM Specifies whether the automatic tuning function (MEDIUM) is enabled on the HPCC (SETTING) screen.

0 : Enabled.

1 : Disabled.

NAR Specifies whether the automatic tuning function (ROUGH) is enabled on the HPCC (SETTING) screen.

0 : Enabled.

1 : Disabled.

1518	Minimum value of the feed–forward factor determined during automatic tuning on the HPCC (SETTING) screen

Parameter input

Data type : Word

Unit of data : 0.01%

Valid data range : 0 to 9900

Specify the minimum value of the feed–forward factor determined during calculation by automatic tuning.

The automatic tuning function sets the feed–forward factor to the minimum value when the calculated feed–forward factor is lower than the minimum value. This parameter has a default value of 9400 during automatic setting.

Whenever a finishing level higher than the determined level is specified after the lower limit has been specified, the feed–forward factor is set to the minimum value. In such a case, the same time constant after interpolat ion is obtained because it is calculated using the minimum feed–forward factor. Therefore, automatic calculation may produce the same result for different finishing levels. In this case, specify 0 in this parameter and ret ry automatic tuning.

4.8 Parameters Related to Acceleration/Deceleration Control

	#7	#6	#5	#4	#3	#2	#1	#0
1600	RDEx		JGEx	CTEx				REXx

Parameter input

Data type : Bit axis

REXx Specifies acceleration/deceleration for rapid traverse as follows:

0 : constant–acceleration linear acceleration/deceleration, or if bit 5 (RTREL) of parameter No. 1601 = 1, bell–shaped acceleration/deceleration.
1 : constant–acceleration time acceleration/deceleration

CTEx Specifies method of acceleration/deceleration used during cutting feed and dry runs.

0 : Linear acceleration/deceleration is used. However, when the bell–shaped acceleration/decelera tion option is selected, bell–shaped acceleration/deceleration is used.
1 : Exponential acceleration/deceleration

> **NOTE** With the Series 15–A, exponential acceleration/deceleration was the default acceleration/deceleration method. With the Series 15–B, however, linear acceleration/deceleration is the default acceleration/deceleration method.

JGEx Specifies the method of acceleration/deceleration used during jogging.

0 : Bell–shaped acceleration/deceleration when bell–shaped option is available. Linear acceleration/deceleration when option for linear acceleration/deceleration after interpolation for cutting feed is available
1 : Exponential acceleration/deceleration

> **NOTE** With the Series 15–A, exponential acceleration/deceleration was the default acceleration/deceleration method. With the Series 15–B, however, linear acceleration/deceleration is the default acceleration/deceleration method.

RDEx Specifies the constant–acceleration time acceleration/deceleration for rapid traverse as follows:

0 : exponential acceleration/deceleration
1 : linear or bell–shaped acceleration/deceleration

	#7	#6	#5	#4	#3	#2	#1	#0
1601			RTBEL					

Parameter input

Data type : Bit

RTBEL

0 : Liner acceleration/deceleration for rapid traverse
1 : Bell–shaped acceleration/deceleration for rapid traverse

To apply bell–shaped acceleration/deceleration to the corresponding axis, specify time constant T_1 in parameter No. 1620 and time constant T_2 in parameter No. 1636, in addition to setting this bit to 0.

	#7	#6	#5	#4	#3	#2	#1	#0
1603								SBELL

Parameter input

Data type : Bit

SBELL The Look–ahead ACC/DEC before Interpolation is

0 : Linear type
1 : Bell shaped ACC/DEC with constant acceleration changing time

	#7	#6	#5	#4	#3	#2	#1	#0
1604								MIRTNA

Parameter input

Data type : Bit axis

MIRTNA Specifies whether the jog feed acceleration/deceleration time constant is valid for manual handle interrupt or jog feed (interrupt type) acceleration/deceleration.

0 : Valid (cutting feed acceleration/deceleration time constant (parameter No. 1622) and jog feed acceleration/deceleration time constant (parameter No. 1624) are valid).

1 : Invalid (only the cutting feed acceleration/deceleration time constant is valid).

1620	Time constant (T) for linear acceleration/deceleration or time constant (T_1) for bell–shaped acceleration/deceleration for rapid traverse along each axis

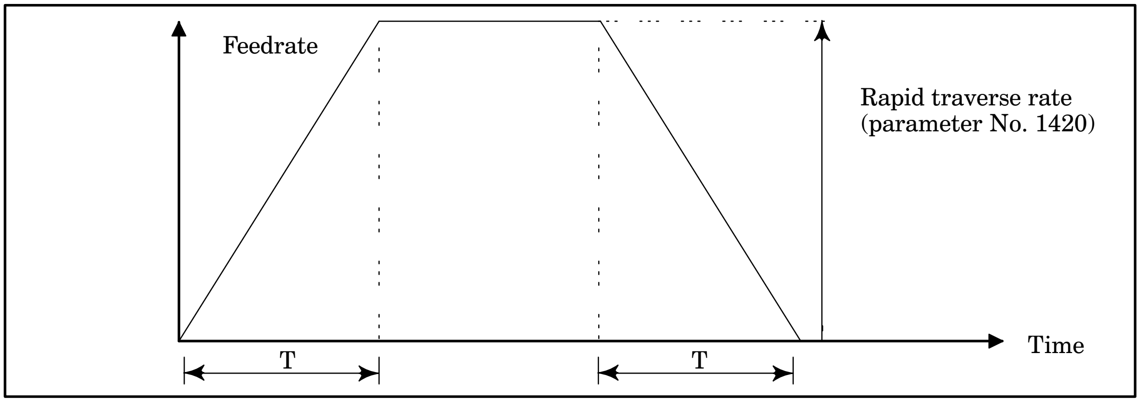
Parameter input

Data type : Word axis

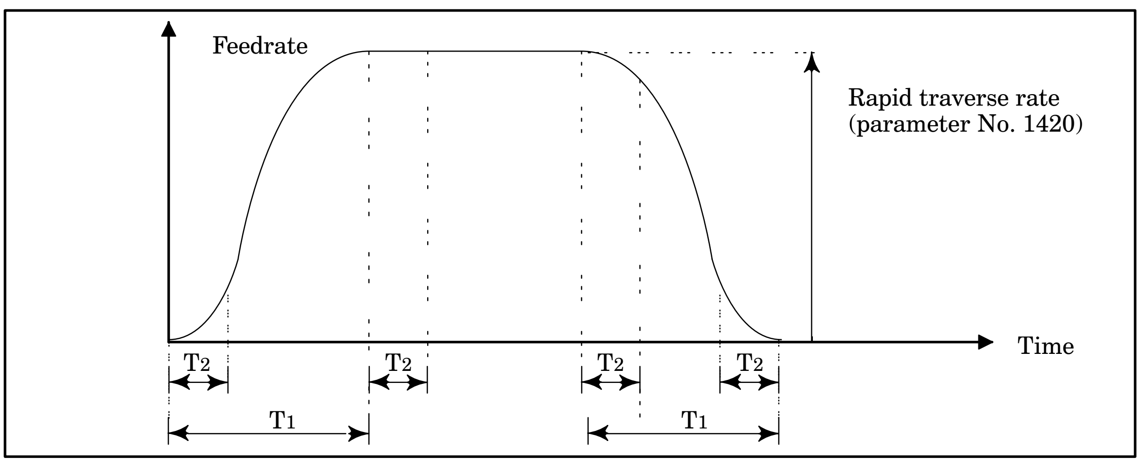
Unit of data : msec

Valid data range : 0 to 4000

Example For linear acceleration/deceleration (when REXx of parameter No. 1600 is 0 and RTBEL of parameter No. 1601 is 0)



For bell–shaped acceleration/deceleration (when REXx of parameter No. 1600 is 0 and RTBEL of parameter No. 1601 is 1)



T_1 : Value of parameter No. 1620

T_2 : Value of parameter No. 1636 (Specify these time constants so that $T_1 \geqq T_2$.)

Total acceleration/deceleration time : $T_1 + T_2$

Acceleration/deceleration time for linear feedrate increase : $T_1 - T_2$

Acceleration/deceleration time for nonlinear feedrate increase : T_2

1621	FL feedrate for linear or bell–shaped acceleration/deceleration for rapid traverse along each axis

Parameter input

Data type : Two words

Unit of data :

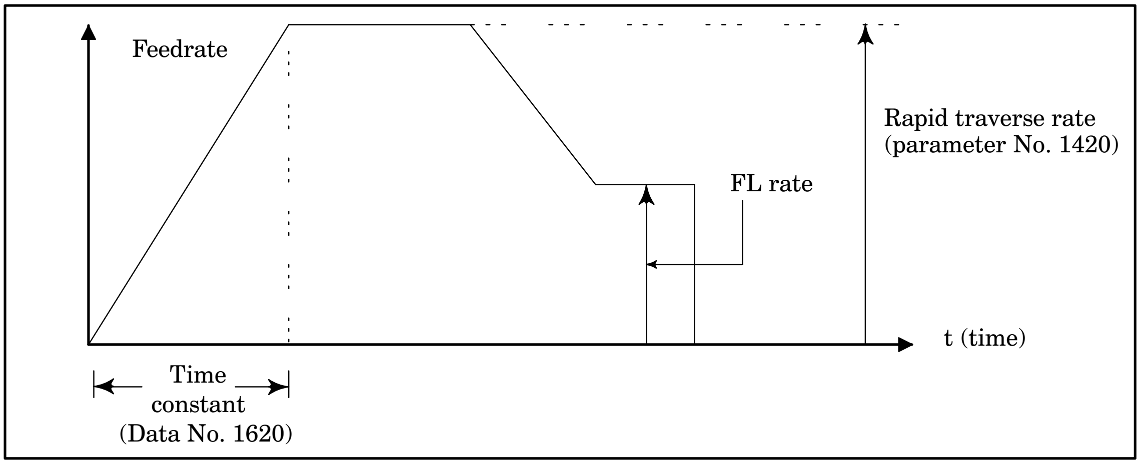
Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	10.0	1.0	0.1	0.01	0.001	mm/min
Inch system machine	1.0	0.1	0.01	0.001	0.0001	inch/min
Rotary axis	10.0	1.0	0.1	0.01	0.001	deg/min

Even when PLC01 of parameter No. 1804 is set to 1, the unit of data is not multiplied by 10.

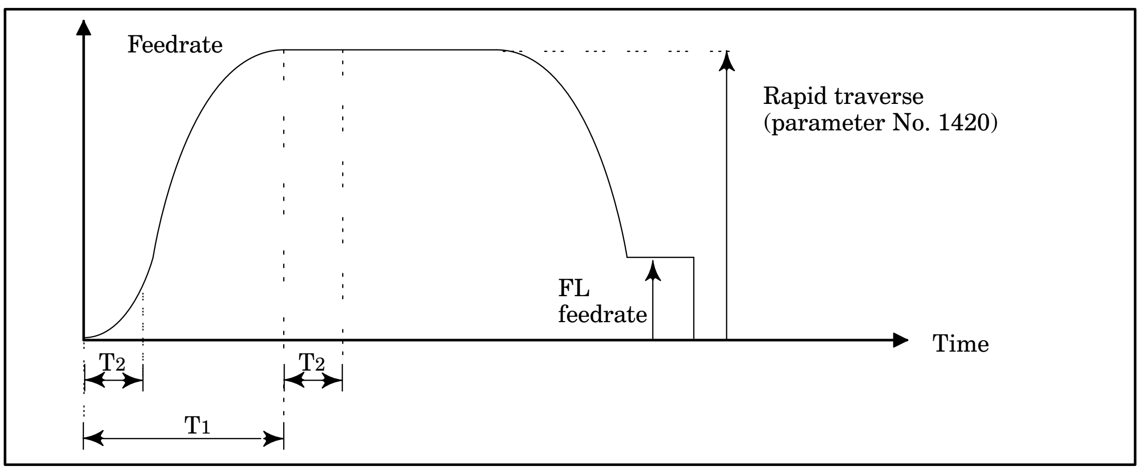
Valid range : 0 to 1000000

Specify the FL feedrate for linear or bell–shaped acceleration/deceleration for rapid traverse along each axis.

Example Liner acceleration/deceleration



For bell–shaped acceleration/deceleration



T_1 : Parameter No. 1620

T_2 : Parameter No. 1636

NOTE	When the feedrate is decelerated to the value set in this parameter at any point regardless of whether during a linear or nonlinear feedrate increase, the tool moves at that feedrate for the remaining distance then stops.

1622	Cutting feed acceleration/deceleration time constant for each axis

Parameter input

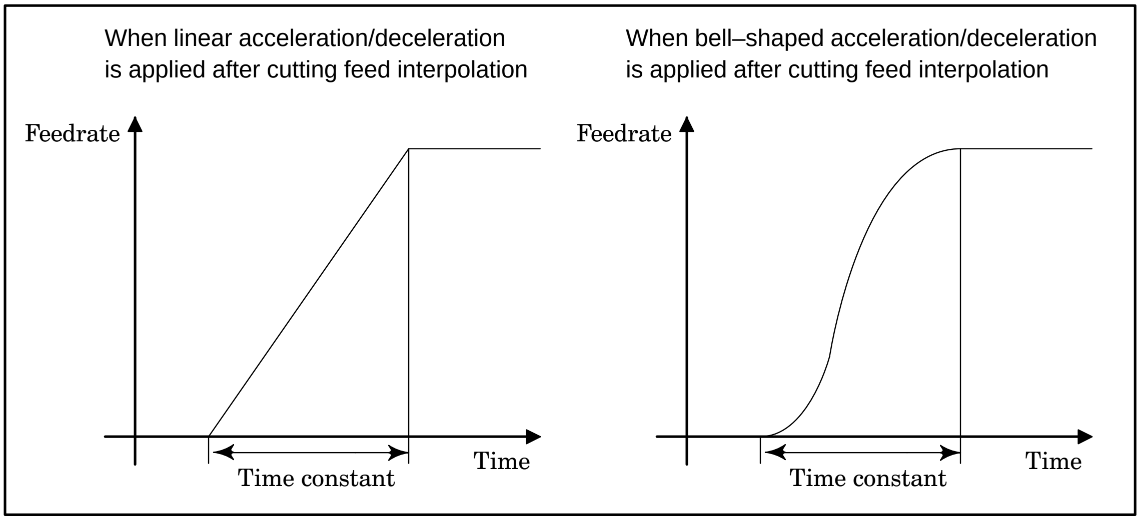
Data type : Word axis

Unit of data : msec

Valid range : 0 to 4000

However, note that the valid range is 0 to 2000 when the bell–shaped acceleration/deceleration option is provided, and that the valid range is 0 to 1000 in the case of a machine using 2ms binary–input DNC operation.

For each axis, set the time constant used for acceleration/ deceleration during cutting feed. Except in special cases, this time constant should be set to the same value for all axes. When different values are specified, the desired straight and curved lines will not be obtained.



The time constant is fixed irrespective of the feedrate (fixed time constant method).

1623	FL feedrate for cutting feed acceleration/deceleration after interpolation along each axis

Parameter input

Data type : Word axis

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Millimeter machine	10.0	1.0	0.1	0.01	0.001	mm/min
Inch machine	1.0	0.1	0.01	0.001	0.0001	inch/min
Rotation axis	10.0	1.0	0. 1	0.01	0.001	deg/min

Even when a high–resolution detector is mounted (when the PLC01 bit of parameter No. 1804 is set to 1), the above units of data are not multiplie d by 10.

Valid data range : 0 to 32767

Be sure to always set 0 in this parameter for all axes, except for a special application. Otherwise, correct linear or circular figures cannot be obtained.

1624	Jog acceleration/deceleration time constant for each axis

Parameter input
Data type : Word axis
Unit of data : msec
Valid range : 0 to 4000
For each axis, set the time constant used for acceleration/ deceleration during jog feed.

1625	FL feedrate for each axis for acceleration/deceleration during jog feed

Parameter input
Data type : Two–word axis
Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	10.0	1.0	0.1	0.01	0.001	mm/min
Inch system machine	1.0	0.1	0.01	0.001	0.0001	inch/min
Rotary axis	10.0	1.0	0.1	0.01	0.001	deg/min

Even when PLC01 of parameter No. 1804 is set to 1, the unit of data is not multiplied by 10.
Valid range : 0 to 1000000
For each axis, set the FL feedrate used for acceleration/ deceleration during jog feed.

1626	Time constant for each axis for acceleration/deceleration during the threading cycle

Parameter input (only for the Series 15–T and 15–TT)
Data type : Word axis
Unit of data : msec
Valid range : 1 to 4000
For each axis, set the time constant used for exponential acceleration/deceleration during the threading cycle (G76 and G78 (G92 in G code system A)).

CAUTION This parameter is also used for acceleration/deceleration before interpolation during threading (G33 (G32 in G code system A)).

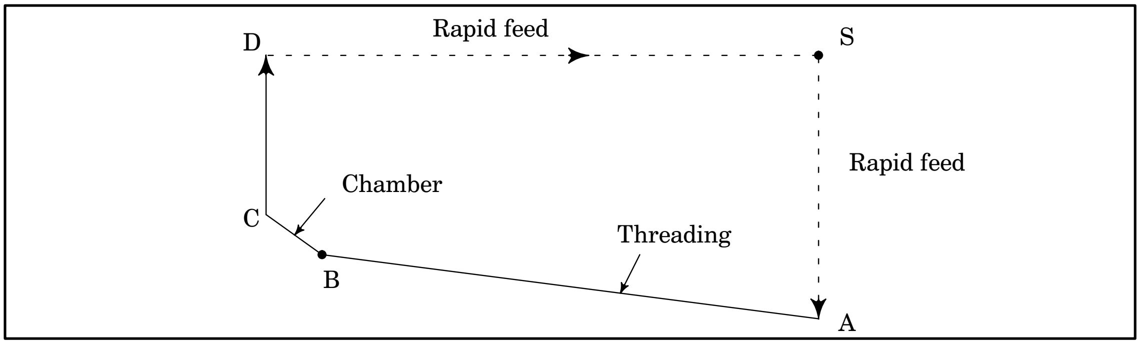
1627	FL feedrate for each axis for acceleration/deceleration during the threading cycle

Parameter input (only for the Series 15–T and 15–TT)
Data type : Two–word axis
Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	10.0	1.0	0.1	0.01	0.001	mm/min
Inch system machine	1.0	0.1	0.01	0.001	0.0001	inch/min
Rotary axis	10.0	1.0	0.1	0.01	0.001	deg/min

Even when PLC01 of parameter No. 1804 is set to 1, the unit of data is not multiplied by 10.
Valid range : 0 to 1000000
For each axis, set the FL feedrate used for acceleration/ deceleration during the threading cycle.

Except in special cases, set this parameter to 0.



Operation	Time constant	FL speed
A → B Threading	Data number 1622	1623
B → C → D	1626	1627

The time constant in parameter No. 1622 and the FL feedrate in parameter No. 1623 are used during normal threading (G33 (G32 in G code system A)).

1628	Exponential function type rapid traverse acceleration/deceleration time constant, or time constant for linear or bell–shaped rapid traverse acceleration/deceleration with constant acceleration time, for individual axes

Parameter input

Data type : Word axis

Unit of data : msec

Valid range : 0 to 4000

Specifies the exponential function type rapid traverse acceleration/deceleration time constant, or time constant for linear or bell–shaped rapid traverse acceleration/deceleration with constant acceleration time, for individual axes.

1629	FL feedrate for exponential acceleration/deceleration for rapid traverse along each axis

Parameter input

Data type : Two–word axis

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	10.0	1.0	0.1	0.01	0.001	mm/min
Inch system machine	1.0	0.1	0.01	0.001	0.0001	inch/min
Rotary axis	10.0	1.0	0.1	0.01	0.001	deg/min

Even when PLC01 of parameter No. 1804 is set to 1, the unit of data is not multiplied by 10.

Valid range : 0 to 1000000

Specify the FL feedrate for exponential acceleration/deceleration for rapid traverse along each axis.

1630	Parameter 1 for determining linear acceleration/deceleration before interpolation

Parameter input

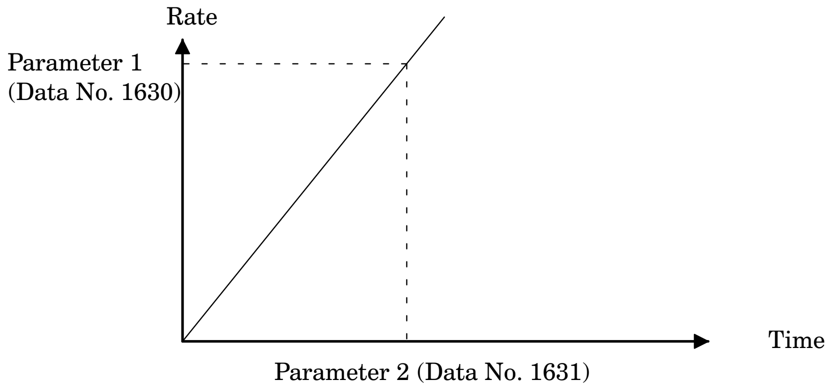
Data type : Two words

Unit of data : (increment system used for reference axis, set in parameter No. 1031)

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	100.0	10.0	1.0	0.1	0.01	mm/min
Inch system machine	10.0	1.0	0.1	0.01	0.001	inch/min
Rotary axis	100.0	10.0	1.0	0.1	0.01	deg/min

Valid range : 1 to 32767

Set the parameter for determining linear acceleration/ deceleration before interpolation. Normally, this parameter is set to the maximum cutting feedrate for the reference axis.



1631	Parameter 2 for determining linear acceleration/deceleration before interpolation

Parameter input

Data type : Word

Unit of data : msec

Valid range : 0 to 4000

Specify the time it takes to reach the feedrate set in parameter 1.

CAUTION This parameter is used when acceleration/deceleration before look–ahead interpolation or high–precision contour control is used. Parameter No. 1653 is used in ordinary mode, in which these functions are not used.

NOTE If parameter No. 1630 or 1631 is set to 0, the linear acceleration/ deceleration before interpolation function becomes invalid.

1635	Time constant for cutting feed acceleration/deceleration after interpolation in automatic feedrate control for high–precision contour control

Parameter input

Data type : Word axis

Unit of data : msec

Valid data range : 0 to 4000

Time constants in a range between 0 and 1000 ms are made valid for RISC–based high–precision contour control (HPCC) mode. If a value greater than 1000 is specified, 1000 msec is assumed (in the HPCC mode only) .

Be sure to always set the same time constant in this parameter for all axes, except for a special application. Otherwise, correct linear or circular figures cannot be obtained.

1636	Time constant for bell–shaped acceleration/deceleration for rapid traverse along each axis (T_2)

Parameter input

Data type : Word axis

Unit of data : msec

Valid data range : 0 to 1000

Set time constant T_2 of bell–shaped acceleration/deceleration for rapid traverse along each axis.

Specify this parameter so that it does not exceed the value of parameter No. 1620 (T_1).

1643	Allowable acceleration for feedrate determination based on acceleration in high–precision contour control

Parameter input

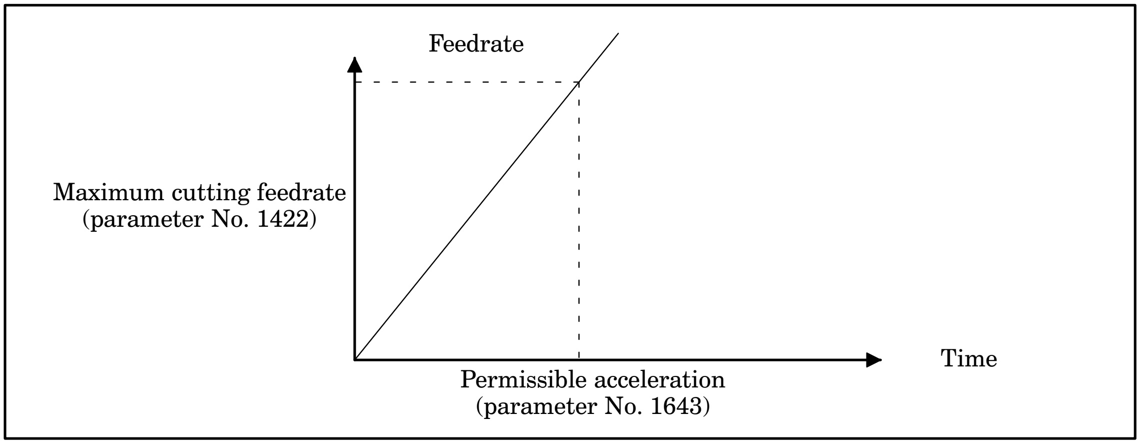
Data type : Word axis

Unit of data : msec

Valid range : 0 to 32767

Set the time it takes to reach the maximum cutting feedrate for each axis (specified in parameter No. 1422). This value is used to set the permissible acceleration for the function that determines the feedrate according to the acceleration during automatic feedrate control.

This function controls the feedrate so that the acceleration of each axis does not exceed the peak acceleration shown in the figure below. The larger the value set in this parameter, the less the shock to the machine and the smaller the machining error during machining.



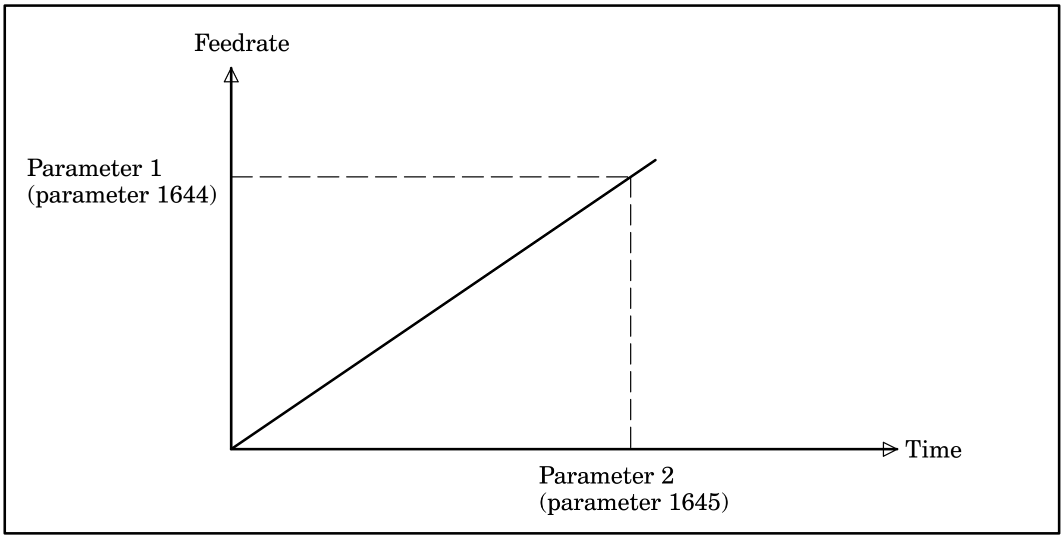
1644	Parameter 1 to set acceleration/deceleration for each axis when a constant feedrate command for PMC axis control is specified

Parameter input

Data type : Word axis

Unit of data : rpm

Valid data range : 0 to 32767



1645	Parameter 2 to set acceleration/deceleration for each axis when a constant feedrate command for PMC axis control is specified

Parameter input

Data type : Word axis

Unit of data : msec

Valid data range : 0 to 32767

Specify the time it takes to reach the feedrate set in parameter 1.

NOTE When parameter No. 1645 is set to 0, the acceleration/deceleration function is disabled.

1653	Parameter 3 for setting the rate of linear acceleration/deceleration before interpolation

Parameter input

Data type : Word

Unit of data : 1 msec

Valid data range : 0 to 4000

Specify the time required to attain the speed set in parameter 1 (parameter No.1630).

Separate time constants for acceleration/deceleration before interpolation are provided for the advance control mode and normal mode. This parameter specifies the time constant of acceleration/deceleration before interpolat ion in the normal mode. When this parameter is set to 0, acceleration/deceleration before interpolation is disabled in the normal mode.

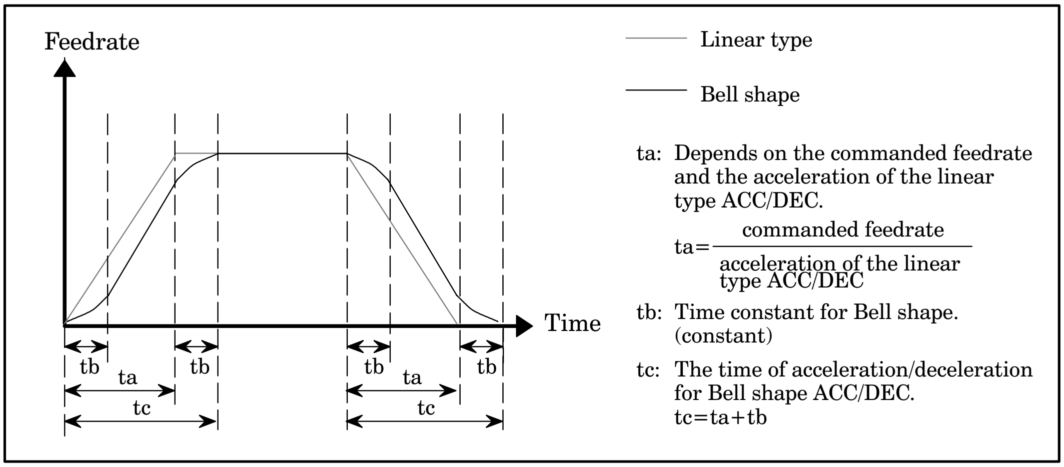
1656	Time constant for bell shape ACC/DEC with constant acceleration changing time (tb)

Parameter input

Data type : Word

Unit of data : msec

Valid data range : 0 to 100



4.9 Parameters Related to Servo

The following parameters are not explained in this manual :
Refer to "FANUC AC SERVO AMP LIFIER MAINTENANCE MANUAL (B–65005E)" for details.

No.	Data type	contents							
1806	Bit axis	AMR7	AMR6	AMR5	AMR4	AMR3	AMR2	AMR1	AMR0
1807	Bit axis					PFSEL			
1808	Bit axis	VOFST	OVSCMP	BLENBL	IPSPRS	PIENBL	OBENBL	TGALRM	*NDL8
1809	Bit axis			TRW1	TRW0	TINA1	TINA0	TINB1	TINB0
1852	Word axis	Current loop gain (PK1)							
1853	Word axis	Current loop gain (PK2)							
1854	Word axis	Current loop gain (PK3)							
1855	Word axis	Velocity loop gain (PK1V)							
1856	Word axis	Velocity loop gain (PK2V)							
1857	Word axis	Incomplete integral coefficient (PK3V)							
1858	Word axis	Velocity loop gain (PK4V)							
1859	Word axis	Velocity control observer parameter (POA1)							
1860	Word axis	Improvement of velocity control (BLCMP)							
1861	Word axis	(Reserve)							
1862	Word axis	Velocity control observer parameter (POK1)							
1863	Word axis	Velocity control observer parameter (POK2)							
1864	Word axis	(Reserve)							
1865	Word axis	Compensation for current non–operating area (PPMAX)							
1866	Word axis	Compensation for current non–operating area (PDDP)							
1867	Word axis	Compensation for current non–operating area (PHYST)							
1868	Word axis	Back electromotive force compensation (EMFCMP)							
1869	Word axis	Current phase control (PVPA)							
1870	Word axis	Current phase control (PALPH)							
1871	Word axis	Back electromotive force compensation (EMFBAS)							
1872	Word axis	Torque limit (TQLIM)							
1873	Word axis	Back electromotive force compensation (EMFLMT)							
1874	Word axis	Motor type in each axis							
1875	Word axis	Load inertia ratio in each axis							
1876	Word axis	Number of position detection feedback pulses (PULCO)							
1877	Word axis	Overload protection coefficient (OVC1)							
1878	Word axis	Overload protection coefficient (OVC2)							
1879	Word axis	Direction of motor rotation in each axis							
1883	Bit axis		BCTL		HSAXIS			FEEDFD	
1884	Bit axis								FCBLCM
1891	Word axis	Number of position detection feedback pulses (PPLS)							
1892	Word axis	TG alarm level (TGALMLV)							
1893	Word axis	Overload protection coefficient (OVCLMT)							
1894	Word axis	PK2VAUX							
1895	Word axis	Torque command filter (FILTER)							
1951	Bit axis	(Reserve)							

No.	Data type	contents							
1952	Bit axis	(Reserve)							
1953	Bit axis	BLSTP	BLCUT				ADBLSH		
1954	Bit axis			BLS	PES	BLTEN			SPBIT
1955	Bit axis	DPFBCT		PGEXPD					
1956	Bit axis			VCMD2	VCMD1			MSFEN	
1957	Bit axis			TDOUT					
1958	Bit axis								ABNTDT
1959	Bit axis				HDN				
1960	Bit axis	(Reserve)							
1961	Word axis	Feed forward coefficient (FALPH)							
1962	Word axis	Velocity loop feed forward coefficient (VFFLT)							
1963	Word axis	Backlash compensation acceleration parameter (ERBLM)							
1964	Word axis	Backlash compensation acceleration parameter (PBLCT)							
1965	Word axis	(Reserve)							
1966	Word axis	(Reserve)							
1967	Word axis	Velocity dependent current loop gain (AALPH)							
1968	Word axis	(Reserve)							
1969	Word axis	1 msec acceleration feedback gain (WKAC)							
1970	Word axis	Overshoot preventive counter (OSCTPL)							
1971	Word axis	Numerator of dual position feedback conversion coefficient (DPFCH1)							
1972	Word axis	Denominator of dual position feedback conversion coefficient (DPFCH2)							
1973	Word axis	Time constant of dual position feedback (DPFTC)							
1974	Word axis	Zero width of dual position feedback (DPFZW)							
1975	Word axis	Backlash acceleration end amount (BLENDL)							
1976	Word axis	Brack control hold time (MOFCT)							
1977	Word axis	Numerator when the flexibly feed gear is used (SDMR1)							
1978	Word axis	Denominator when the flexibly feed gear is used (SDMR2)							
1979	Word axis	Rated current parameter (RTCVRR)							
1980	Word axis	Torque offset of new type backlash acceleration (TCPRLD)							
1981	Word axis	Mechanical speed feedback coefficient (MCNFB)							
1982	Word axis	Base pulse in backlash acceleration (BLBSL)							
1983	Word axis	(Reserve)							
1984	Word axis	(Reserve)							
1985	Word axis	(Reserve)							
1986	Word axis	(Reserve)							
1987	Word axis	(Reserve)							
1988	Word axis	(Reserve)							
1989	Word axis	(Reserve)							
1990	Word axis	(Reserve)							
1991	Word axis	Phase progress compensation coefficient in deceleration (DEPVPL)							
1992	Word axis	1 pulse suppress level for serial pulse coder A and B (ONEPSL)							
1993	Word axis	(Reserve)							
1994	Word axis	(Reserve)							
1995	Word axis	(Reserve)							

No.	Data type	contents
1996	Word axis	(Reserve)
1997	Word axis	(Reserve)
1998	Word axis	(Reserve)
1999	Word axis	(Reserve)

1738	Abnormal load detection alarm timer

Parameter input

Data type : Word

Unit of data : msec

Valid range : 0–32767 (Specifying 0 automatically sets 200 msec.)

Specify the period of time from when an abnormal load is detected to when a servo alarm is issued.

1758	Maximum speed in workpiece–axis acceleration/deceleration for the electronic gear box automatic phase alignment function

Data type : Word axis

Valid range : 0 to 32000

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Rotary axis	100.0	10.0	1.0	0.1	0.01	deg/min

1759	Time constant related to the maximum speed in workpiece–axis acceleration/deceleration for the electronic gear box automatic phase alignment function

Data type : Word axis

Valid range : 0 to 2000

Unit of data : msec

The acceleration used in workpiece–axis acceleration/deceleration is determined as follows:

$$\text{Acceleration} = \frac{\text{Maximum speed (parameter No. 1758)}}{\text{Time constant for the maximum speed (parameter No. 1759)}}$$

	#7	#6	#5	#4	#3	#2	#1	#0
1800			CIN	CCI	RTFWD	FVF	CVR	

Parameter input

Data type : Bit

CVR Specifies whether to issue a servo alarm if velocity control ready signal VRDY turns on before position control ready signal PRDY turns on.

0 : Does not issue a servo alarm.

1 : Issues a servo alarm.

Normally, set CVR to 1.

FVF Specifies whether to perform follow–up in the servo off mode.

0 : Does not perform follow–up (mechanical clamp in the servo off mode).

1 : Performs follow–up (mechanical handle in the servo off mode).

RTFWD

0 : Disables forward feed control during rapid traverse.

1 : Enables forward feed control during rapid traverse.

Normally, forward feed control is enabled only when cutting feed is performed. When this parameter is set to 1, forward feed is also enabled during rapid traverse. This decreases positional deviation in the servo, reducing the time for entering an effective area during positioning.

CCI Specifies the value to be used as the effective area during cutting feed (cutting–feed effective area).

0 : Uses parameter 1827, which is also used for rapid traverse.

1 : Uses parameter 1838, which is used only for cutting feed.

When a positioning block is specified or an exact stop is specified in a cutting feed block, the block decelerates the tool at the end of the block for a position check. The cutting/rapid traverse position check function al lows the effective area (parameter 1838) to be set separately for cutting feed in addition to the effective area (parameter 1827) for rapid traverse.

For example, a larger effective area can be set for rapid traverse, while an ordinary small effective area is set for cutting feed. This can reduce machining time (positioning time) without reducing machining precision.

The CCI bit of parameter 1800 is used to select whether this new function or the standard position check function is used. When this position check function is selected, it is effective for all axes. For axes that do not require this function, set the same data in parameters 1827 and 1838.

When a rapid traverse block terminates, a position check is performed using the value set in rapid–traverse–specific parameter 1827. When a cutting feed block terminates and the next block specifies cutting feed, a position check is performed using the value set in cutting–specific parameter 1838; if the next block specifies rapid traverse, however, a position check is performed using the value in rapid–traverse–specific parameter 1827. Furthermore, when a cutting feed block terminates, cutting–specific parameter 1838 can always be used for a position check regardless of the next block. This is specified by the CIN bit of parameter 1800.

Upon termination of a cutting feed block, the effective area is determined as follows:

CIN bit (bit 5) of parameter 1800	Next block	
	Rapid traverse	Cutting feed
0	Rapid traverse data (1827)	Cutting feed data (1838)
1	Cutting feed data (1838)	Cutting feed data (1838)

In addition, the RTFWD bit of parameter 1800 enables forward feed for rapid traverse. When forward feed control is enabled for rapid traverse, positional deviation in the servo is decreased and the time required for enterin g the effective area during positioning is reduced.

CIN When CCI is 1, the CIN bit specifies the condition under which the cutting feed parameter defines the cutting–feed effective area.

0 : Used only when the next block specifies cutting feed.

1 : Always used regardless of the next block.

	#7	#6	#5	#4	#3	#2	#1	#0
1802				TQO	FUPx		SVFx	

Parameter input

Data type : Bit axis

SVFx Specifies whether to validate the servo off signal.

0 : Does not validate the servo off signal.

1 : Validates the servo off signal.

FUPx Whether follow–up is performed for each axis when the servo is turned off

0 : Not performed.

1 : Perfomed.

NOTE Effective when FVF (bit 2 of parameter No. 1800) is 0.

TQO Specifies whether to enable the torque override function.

0 : Disable the function. (100% override)

1 : Enable the function.

		#7	#6	#5	#4	#3	#2	#1	#0
1803						ADJNDR	CLP	ADJ	MDI

Parameter input

Data type : Bit axis

MDI Specifies the synchronous operation modification mode.

0 : Specifies the modification mode in which the master axis can be moved.

1 : Specifies the modification mode in which the slave axis can be moved.

NOTE The setting is valid when ADJ is set to 1.

(Set this bit only for the master axis.)

ADJ Specifies the synchronous control mode.

0 : Specifies the normal mode.

1 : Specifies the modification mode.

(Set this bit only for the master axis.)

CLP Specifies whether to compensate for synchronous error.

0 : Compensates for synchronous error.

1 : Does not compensate for synchronous error.

(Set this bit only for the master axis.)

ADJNDR Specifies whether to validate a command to move the machine in the direction of increasing the synchronous error in the modification mode.

0 : Ignores the command.

1 : Validates the command.

(Set this bit only for the master axis.)

		#7	#6	#5	#4	#3	#2	#1	#0
1804		CONTE	RBK				F24	DGPRM	PLC01
Standard setting:		0	0	0	0	0	0	1	0

Parameter input

Data type : Bit axis

PLC01 Specifies whether the value set in parameter No. 1876 (number of speed feedback pulses) or parameter No. 1891 (number of position feedback pulses) exceeds 32767.

0 : The value set in parameter No. 1876 or No. 1891 does not exceed 32767.

1 : The value set in parameter No. 1876 or No. 1891 exceeds 32767.

CAUTION When this parameter is set to 1, set parameter No. 1876 or No. 1891 to Y10 of the original value.

NOTE In previous models, when this parameter was set to 1, the unit of data for some parameters was multiplied by 10. With the Series 15–MB/TB/TTB/MFB/TFB/TTFB, however, the unit of data is not multiplied by 10, but remains unchanged.

When the high–resolution detector interface is used, the unit of data for some parameters has been multiplied by 10. For Series 15–MB/TB/TTB/MFB/TFB/TTFB, the unit of data is used as is; that is, it is not multiplied by 10.

The parameters listed below are not compatible with those used in the Series 15–A that have this parameter set to 1. For these models, multiply the settings by 10.

·Parameters

1410, 1411, 1421, 1423, 1424, 1425, 1426, 1427, 1428
1451, 1452, 1453, 1454, 1455, 1456, 1457, 1458, 1459, 1460, 1461
1621, 1623, 1625, 1627, 1629,
1827, 1828, 1829, 1830, 1832, 1837, 1850, 1896
7211, 7212, 7213, 7214, 7311, 7312, 7313

DGPRM Specifies whether to set the digital servo parameters specific to the motor at power–on.

0 : Sets the digital servo parameters specific to the motor.

1 : Does not set the digital servo parameters specific to the motor.

When DGPRM is set to 0 after the motor type is specified, the standard settings for the motor type are automatically set at power–on. DGPRM is also set to 1 at power–on.

F24 The unit of data for some parameters has been multiplied by 10. For Series 15–MB/TB/TTB/MFB/TFB/TTFB, the unit of data is used as is; that is, it is not multiplied by 10.

The parameters listed below are not compatible with those used in the Series 15–A that have this parameter set to 1. For these models, multiply the settings by 10.

This parameter is not used with the Series 15–MB/TB/TTB/MFB/TFB/TTFB.

·Parameters

1420 and 1422

RBK Backlash compensation applied separately for cutting feed and rapid traverse

0 : Not performed

1 : Performed

CONTE Specifies whether to specify spindle contour control for the serial interface spindle.

0 : Does not specify spindle contour control.

1 : Specifies spindle contour control.

When spindle contour control is specified for the serial interface spindle, the spindle is regarded as one of the controlled axes. That is, the spindle for which CONTE is set to 1 is the spindle for which spindle contour control is executed.

Set the following settings for an axis for which spindle contour control is to be executed:

·Rotation axis
·Least input increment: conform to the settings in increment system IS–B
·Always presetting the workpiece coordinate system with manual reference position return
·Command multiplication: 2 (multiplication: 1)

	#7	#6	#5	#4	#3	#2	#1	#0
1810		NAD						

Parameter input

Data type : Bit

NAD Specifies whether to perform A/D conversion of spindle or servo motor current.

0 : Performs A/D conversion.

1 : Does not perform A/D conversion.

	#7	#6	#5	#4	#3	#2	#1	#0
1811						ADV		HCNV

Parameter input

Data type : Bit

HCNV Specifies the type of A/D conversion data output.

0 : Standard type (32 ms)

1 : High–speed type (8 ms)

NOTE	Be sure to set 1 when A/D conversion data is read using the high–speed window. When the high–speed type is specified, block processing may require more time than when HCNV is set to 0. This is because the CNC processing load increases for A/D conversion data output.

ADV Specifies whether to use the advanced feed–forward function during acceleration/deceleration before look–ahead interpolation.

0 : Do not use the function.

1 : Use the function.

NOTE 1	The advanced feed–forward function is never used when acceleration/deceleration before look–ahead interpolation is not being applied (or automatic feedrate control for high–precision contour control is not exercised).
NOTE 2	The advanced feed–forward function can not be used when the Electronic Gear Box function (EGB) is used. Please set 1 to this parameter when EGB function is used.

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

Parameter input

Data type : Bit axis

OPTx Specifies whether to use a separate pulse coder as the position detector.

0 : Does not use any separate pulse coder.

1 : Uses a separate pulse coder.

NOTE 1	Set this bit to 1 together with bit 1 of parameter No. 1005 when using a magnetic switch for reference position return regardless of whether a separate detector is used.
NOTE 2	Refer to the parameter (No.1807#3).

APZx Indicates whether relative positioning of the machine position and absolute–position detector is complete when an absolute–position detector (absolute pulse coder) is used as the position detector.

0 : Not complete

1 : Complete

When an absolute–position detector is used: Set APZx to 0 when primary at–site adjustment is done or the absolute pulse coder is replaced. Then turn on the power, and perform manual reference position return. Relative positioning of the machine position and absolute–position detector is complete and APZx is automatically set to 1.

APCx 0 : Indicates the position detector is a detector other than an absolute–position detector.

1 : Indicates the position detector is an absolute–position detector (absolute pulse coder).

	#7	#6	#5	#4	#3	#2	#1	#0
1816	ACMx	DM3x	DM2x	DM1x	RC4x	RC3x	RC2x	RC1x

Parameter input

Data type : Bit axis

RC1x to RC4x Reference counter capacity

RC4x	RC3x	RC2x	RC1x	Reference counter capacity (Digital servo)	
				Other than high resolution detector	High resolution detector
0	0	0	0	1000	10000
0	0	0	1	2000	20000
0	0	1	0	3000	30000
0	0	1	1	4000	40000
0	1	0	0	5000	50000
0	1	0	1	6000	60000
0	1	1	0	7000	70000
0	1	1	1	8000	80000
1	0	0	0	9000	90000
1	0	0	1	10000	100000
1	0	1	0	11000	110000
1	0	1	1	12000	120000
1	1	0	0	13000	130000
1	1	0	1	14000	140000
1	1	1	0	15000	150000
1	1	1	1	16000	160000

NOTE Refer to the parameter (No.1896).

DM1x to DM3x Detecting multiplier setting

DM3x	DM2x	DM1x	Detecting multiplier
0	0	0	1/2
0	0	1	1
0	1	0	3/2
0	1	1	2
1	0	0	5/2
1	0	1	3
1	1	0	7/2
1	1	1	4

Specify the parameter for a spindle positioning (indexing) axis as follows:
Reference counter capacity RC4x to RC1x : 1001
Detection multiplication DM3x to DM1x : 111

NOTE Refer to the parameters (Nos.1920, 1977, 1978).

1) In case of pulse coder (with digital servo)

Move distance per revolution of motor (pulse coder)			Increment system (Detection unit) (µm or 10^{-4} inch)	Command multiply ratio (CMR)	Detection multiply ratio (DMR)			Reference counter capacity
					Pulse coder			
Feed screw is metric (mm)	Rotary axis (deg)	Feed screw is inch (inch)			2000 PPR	2500 PPR	3000 PPR	
12	12	1.2	1	1	–	–	4	12000
10	10	1.0	1	1	–	4	–	10000
9	9	0.9	1	1	–	–	3	9000
8	8	0.8	1	1	4	–	–	8000
7	7	0.7	1	1	3.5	–	–	7000
6	6	0.6	1	1	3	–	2	6000
5	5	0.5	1	1	2.5	2	–	5000
4	4	0.4	1	1	2	–	–	4000
3	3	0.3	1	1	1.5	–	1	3000
2	2	0.2	1	1	1	–	–	2000
1	1	0.1	1	1	0.5	–	–	1000

2) In case of pulse coder (with digital servo and with high resolution detector)

Move distance per revolution of motor system (pulse coder)			Increment system (Detection unit) (µm or 10^{-4} inch)	Command multiply ratio (CMR)	Detection multiply ratio (DMR)		Reference counter capacity
					Pulse coder		
Feed screw is metric (mm)	Rotary axis (deg)	Feed screw is inch (inch)			20000 PPR	25000 PPR	
10	10	1.0	0.1	1	–	4	100000
8	8	0.8	0.1	1	4	–	80000
7	7	0.7	0.1	1	3.5	–	70000
6	6	0.6	0.1	1	3	–	60000
5	5	0.5	0.1	1	2.5	2	50000
4	4	0.4	0.1	1	2	–	40000
3	3	0.3	0.1	1	1.5	–	30000
2	2	0.2	0.1	1	1	–	20000
1	1	0.1	0.1	1	0.5	–	10000

ACMx 0 : Does not use an optional command multiplication factor.

1 : Uses an optional command multiplication factor.

	#7	#6	#5	#4	#3	#2	#1	#0
1817		TANDEM		OPB	OPA	HYB	SYN	

Parameter input

Data type : Bit axis (set for each axis)

Set this parameter for both master and slave axes.

SYN Specifies whether to execute synchronous control.

0 : Does not execute synchronous control.

1 : Executes synchronous control.

NOTE Set SYN to 1 for the axes to be controlled synchronously. In this case, set SYN to 1 for both master and slave axes.

HYB Specifies whether to execute hybrid control.

0 : Does not execute hybrid control.

1 : Executes hybrid control.

TANDEM Specifies whether to validate tandem control.

0 : Does not validate tandem control.

1 : Validates tandem control.

OPA Specifies whether to perform type A malfunction check (check at a stop).

0 : Not performed.
1 : Performed.

OPB Specifies whether to perform type B malfunction check (check during movement).

0 : Not performed.
1 : Performed.

1820	Command multiplier for each axis (CMR)

Parameter input

Data type : Byte axis

Unit of data : Multiplied by 0.5

Valid range : 1 to 40 (multiplier at 0.5 to 20)

For each axis specify a multiplier which indicates the ratio of the least command increment to a detection unit.

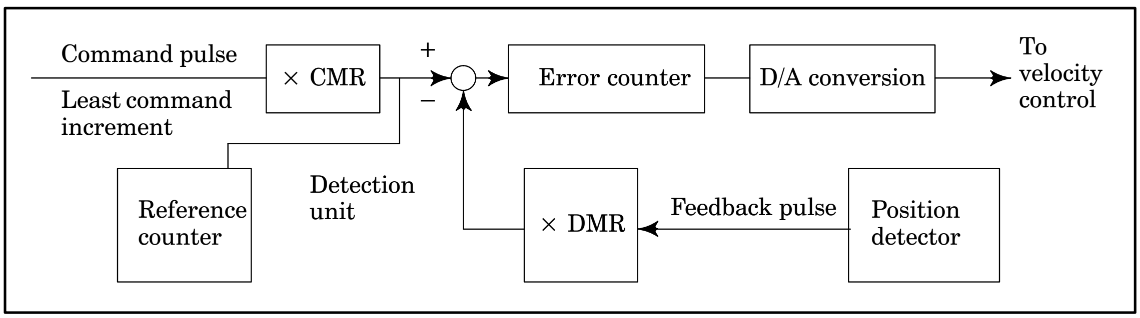
Least command increment = detection unit × command multiplication

Specify 2 (multiplication by 1) as the CMR for a spindle positioning (indexing) axis.

Relationships between increment systems and least command increments

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch
Rotary axis	0.01	0.001	0.0001	0.00001	0.00000	deg

Command multiplier (CMR), detection multiplier (DMR), and reference counter capacity



Specify CMR and DMR so that the weight for pulses used as positive input is the same as that for pulses used as negative input to the error counter in the above figure.

Least command increment/CMR = detection unit = feedback pulse unit/DMR

The feedback pulse unit depends on the position detector.

Feedback pulse unit = distance traveled per pulse coder rotation/number of pulses per pulse coder rotation (2000, 2500, or 3000)

Specify the grid interval for reference position return using the grid method as the reference counter capacity.

Reference counter capacity = grid interval/detection unit

Grid interval = distance traveled per pulse coder rotation

Specify the CMR for each axis as follows when using the optional command multiplication function. (For Series 15–M)

(i) When CMR = 1/2 to 1/27

Set ACMx (bit 7 of parameter No. 1816) to 1.

Then specify the value given by the following expression:

$$\text{Setting} = \frac{1}{\text{CMR}}$$

Valid range : 1 to 27

(ii) When CMR = 0.5 to 48

Set ACMx (bit 7 of parameter No. 1816) to 0.

Then specify the value given by the following expression.

Setting = CMR * 2

Valid range : 1 to 96

1821	Value of the numerator of a command multiplier for each axis (optional command multiplier)

Data type : Word axis

Valid range : 0 to 9999

Specify the value of the numerator of a command multiplier for each axis.

The optional command multiplier is required.

1822	Value of the denominator of a command multiplier for each axis (optional command multiplier)

Data type : Word axis

Valid range : 0 to 9999

Specify the value of the denominator of a command multiplier for each axis.

The optional command multiplier is required.

To use the optional command multiplier N/M (N: 1821, M: 1822), set a value other than 0 in parameter No. 1821 and No. 1822.

1825	Servo loop gain for each axis

Parameter input

Data type : Word axis

Unit of data : 0.01/s

Valid range : 1 to 9999

Specify the position control loop gain for each axis.

For a machine which performs linear or circular interpolation (cutting), specify the same value for all axes. For a machine which requires only positioning, different values may be specified for different axes. The larger the specified loop gain, the higher the position control response. If the loop gain is too large, the servo system becomes unstable.

The relationships between the positioning deviation (amount of pulses stored in the error counter) and feedrate are expressed as follows:

Positioning deviation = feedrate/(60 * loop gain)

Unit: Positioning deviation mm, inches, or deg

Feedrate mm/min, inches/min, or deg/min

loop gain s

1827	Valid area for each axis

Parameter input

Data type : Two–word axis

Unit of data : Detection unit. Even when PLC01 of parameter No. 1804 is set to 1, the unit of data is not multi plied by 10.

Valid range : 0 to 99999999

Specify the valid area for each axis.

When the deviation of the machine position and specified position (absolute positioning deviation) does not exceed the valid area, it is assumed that the machine reaches the specified position, that is, it moves correctly.

1828	Positioning deviation limit for each axis while it is moving

Parameter input

Data type : Two–word axis

Unit of data : Detection unit. Even when PLC01 of parameter No. 1804 is set to 1, the unit of data is not multi plied by 10.

Valid range : 0 to 99999999

Specify the positioning deviation limit for each axis while it is moving.

If the positioning deviation limit of the axis is exceeded while the axis is moving, a servo alarm is issued and the machine stops immediately (same as an emergency stop).

Generally, specify a value larger than the positioning deviation in the rapid traverse mode.

1829	Positioning deviation limit for each axis when it is stopped

Parameter input

Data type : Two–word axis

Unit of data : Detection unit. Even when PLC01 of parameter No. 1804 is set to 1, the unit of data is not multi plied by 10.

Valid range : 0 to 99999999

Specify the positioning deviation limit for each axis when it is stopped.

If the positioning deviation limit of the axis is exceeded when the axis is stopped, a servo alarm is issued and the machine stops immediately (same as an emergency stop).

1830	Positioning deviation limit for each axis in the servo off mode

Parameter input

Data type : Two–word axis

Unit of data : Detection unit. Even when PLC01 of parameter No. 1804 is set to 1, the unit of data is not multi plied by 10.

Valid range : 0 to 99999999

Specify the positioning deviation limit for each axis in the servo off mode.

If the positioning deviation limit of the axis in the servo off mode is exceeded, a servo alarm is issued and the machine stops immediately (same as an emergency stop).

Generally, specify the same value as for the positioning deviation limit for an axis when it is stopped.

1832	Feed–stop position deviation for each axis

Parameter input

Data type : Two–word axis

Unit of data : Detection unit. Even when PLC01 of parameter No. 1804 is set to 1, the unit of data is not multi plied by 10.

Valid range : 0 to 99999999

Specify the feed–stop position deviation for each axis.

The optional feed–stop function is required.

If the positioning deviation of an axis while it is moving exceeds the feed–stop position deviation for the axis, pulse distribution and acceleration/deceleration control are temporarily stopped. When the positioning deviation becomes less than the feed–stop position deviation, pulse distribution and acceleration/deceleration control are restarted.

The feed–stop function is mainly used for decreasing overshoot when a large servo motor is accelerated or decelerated.

Generally, specify the intermediate value between the positioning deviation limit while the tool moving and the positioning deviation limit for the axis in the rapid traverse mode as the feed–stop position deviation.

1834	Drift compensation amount for the spindle positioning axis

Parameter input

Data type : Word axis

Unit of data : 1Velo

Valid range : –500 to +500

This parameter can be used to compensate for drift in the position loop of the spindle positioning axis.

Feedrate command voltage (Velo) corresponding to the positional deviation = 0.000000192 x loop gain (setting value) x loop gain multiplier (setting value) x positional deviation (detection unit)

1837	Positioning deviation limit while the tool is moving in the rigid tapping mode

Parameter input

Data type : Two–word axis

Unit of data : Detection unit. Even when PLC01 of parameter No. 1804 is set to 1, the unit of data is not multi plied by 10.

Valid range : 0 to 99999999

Specify the positioning deviation limit for a drilling axis in the rigid tapping mode. (Parameter No. 1828 is used for axes other than a drilling axis in the rigid tapping mode.)

Specify the same loop gain for the drilling axis and spindle in the rigid tapping mode. The setting of parameter No. 5753 is used as the loop gain for the drilling axis and spindle in the rigid tapping mode. The loop gain of the spindle must not be excessively large. In addition, the loop gain of the drilling axis in the rigid tapping mode is generally smaller than the loop gain in other modes (parameter No. 1828). The positioning deviation limit for the drilling axis while the tool is moving in the rigid tapping mode is provided separately because the positioning deviation increases if the loop gain decreases at the same speed.

Positioning deviation (mm, inches, or deg) = $\dfrac{F}{60G}$

F : Feedrate (mm/min, inches/min, or deg/min)

G : Loop gain (1/s)

1838	Cutting–feed effective area for each axis

Parameter input

Data type : Word axis

Unit of data : Detection unit

Valid range : 0 to 32767

When the CCI bit of parameter 1800 is 1, specify the cutting–feed effective area used for each axis.

1849	Backlash compensation amount used for rapid traverse for each axis

Parameter entry

Data type : Word axis type

Unit of data : Detection unit

Valid data range : –9999 to +9999

Set the backlash compensation amount used in rapid traverse for each axis.

NOTE This parameter is valid when RBK, #6 of parameter 1804, is set to 1.

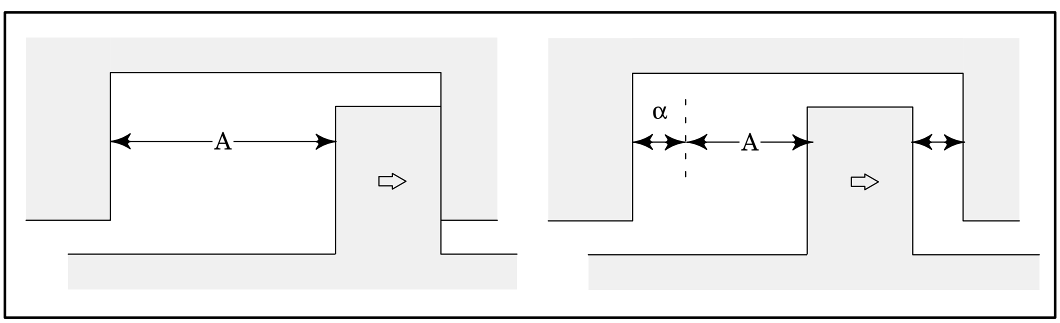
More precise machining can be performed by changing the backlash compensation amount depending on the feedrate, rapid traverse or the cutting feed for positioning.

Let the measured backlash at cutting feed be A and the measured backlash at rapid traverse be B. The backlash compensation amount is shown below depending on the change of feedrate (cutting feed or rapid traverse) and the change of the direction of movement.

Change of feedrate / Change of direction of movement	Cutting feed to cutting feed	Rapid traverse to rapid traverse	Rapid traverse to cutting feed	Cutting feed to rapid traverse
Same direction	0	0	±α	±(–α)
Opposite direction	±A	±B	±(B+α)	±(B+α)

NOTE 1 α=(A–B)/2

NOTE 2 The positive direction for compensating values is the direction of movement.



NOTE 3 Assign the measured backlash at cutting feed (A) in parameter No. 1851 and that at rapid traverse (B) in parameter No. 1849

NOTE 4 Manual continuous feed is regarded as cutting feed.

NOTE 5 The backlash compensation depending on feedrate is not performed until the first return to the reference position is completed after the power is turned on. Until then, the normal backlash compensation is performed according to the value specified in parameter No. 1851 irrespective of the feedrate.

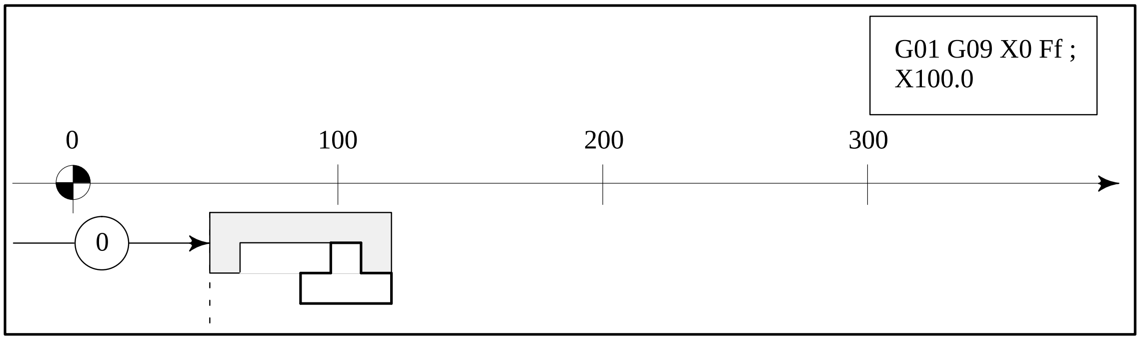
NOTE 6 The backlash compensation depending on feedrate is performed only when RBK, #6 of parameter No. 1804, is set to 1. When RBK is set to 0, the normal backlash is performed.

Measurement way of the backlash compensation amount. (example)

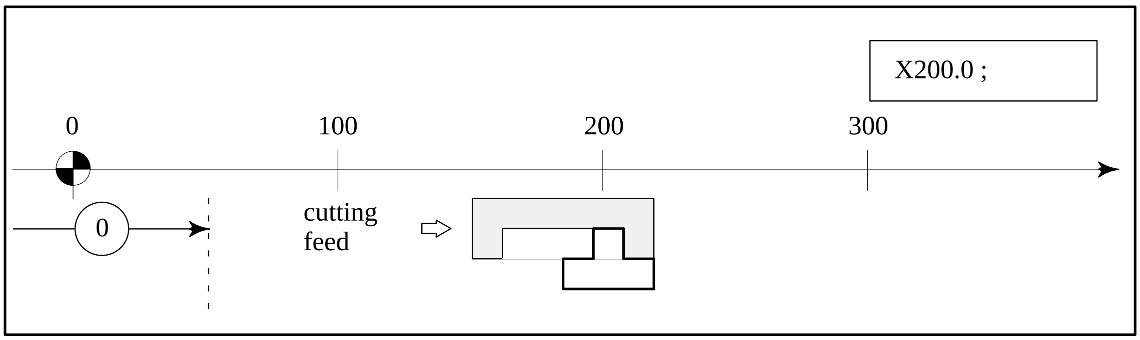
(1) Backlash compensation amount used for cutting feed.

1 The backlash compensation amount used for cutting feed (parameter No. 1851) is set to ”0”.

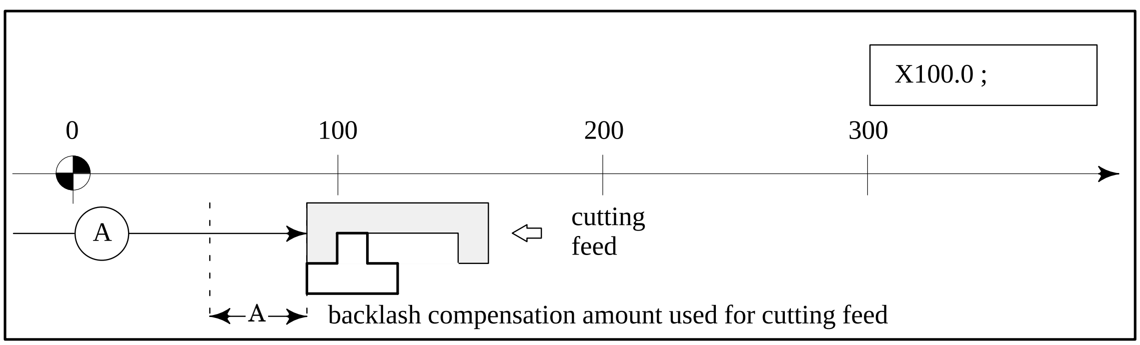
2 The axis is moved to the measurement point by the cutting feed and the dial indicator is installed. The graduation of the dial indicaotr is set to 0.



3 The axis is moved as a cutting feed in the same direction.



4 The axis is moved in an opposite direction and it returns to the measurement point. The graduation of the dial indicator is read.

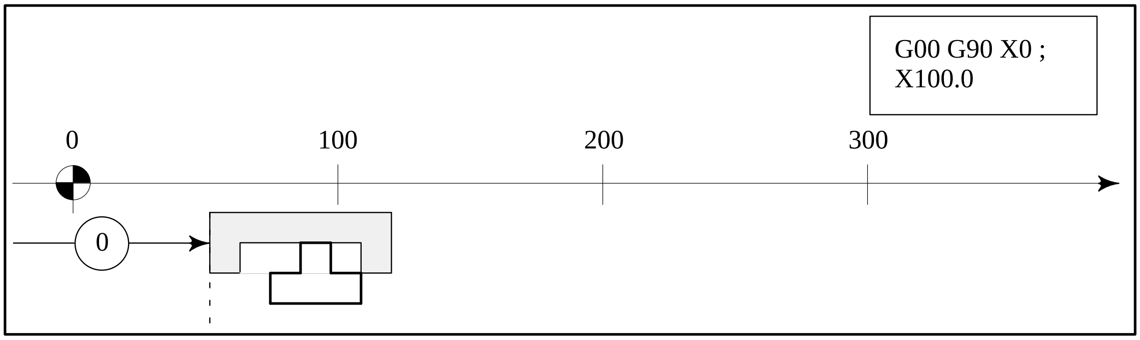


5 The backlash compensation amount is converted into detection unit and it is set in the parameter No. 1851.

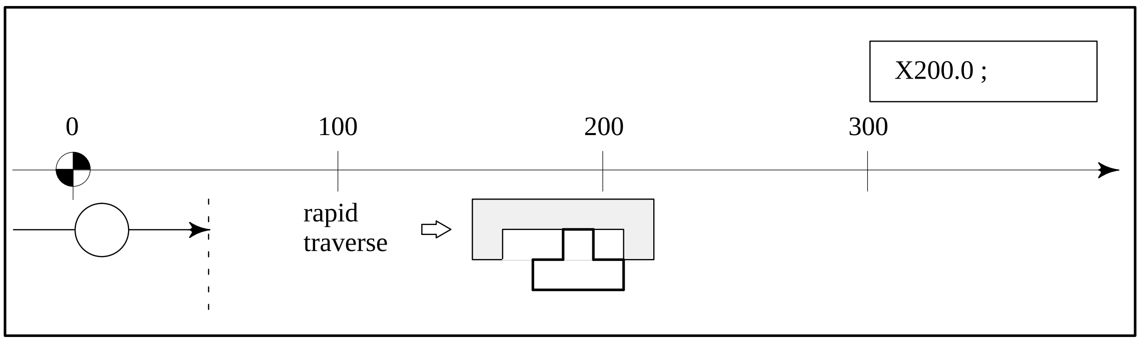
(2) Backlash compensation amount used for rapid traverse.

1 The backlash compensation amount used for rapid traverse (parameter No. 1849) is set to ”0”.

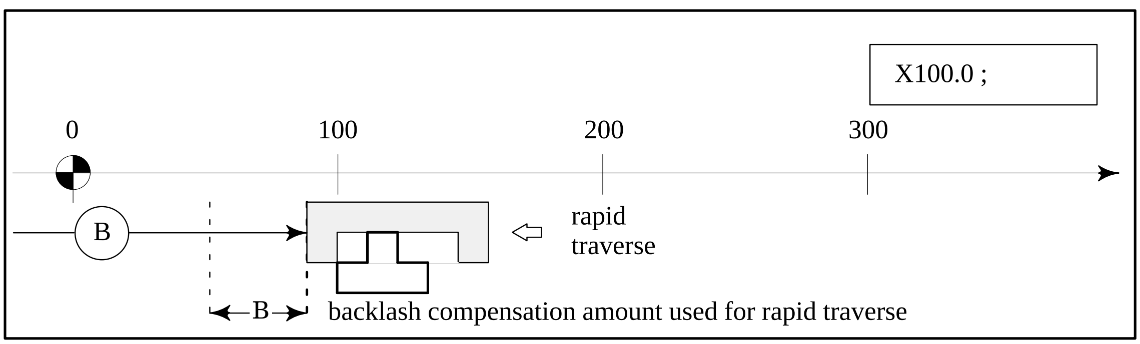
2 The axis is moved to the measurement point by the rapid traverse and the dial indicator is installed. The graduation of the dial indicator is set to 0.



3 The axis is moved as a rapid traverse in the same direction.



4 The axis is moved in an opposite direction and it returns to the measurement point. The graduation of the dial indicator is read.



5 The backlash compensation amount is converted into detection unit and it is set in the parameter No. 1849.

Action.

Here, the backlash compensation action is explained under the following assumption.

Backlash compensation amount used for cutting feed A=40

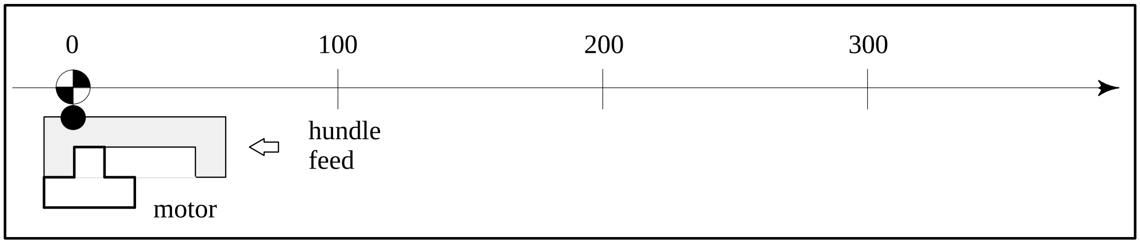
Backlash compensation amount used for rapid traverse B=20

α=(A–B)/2=10

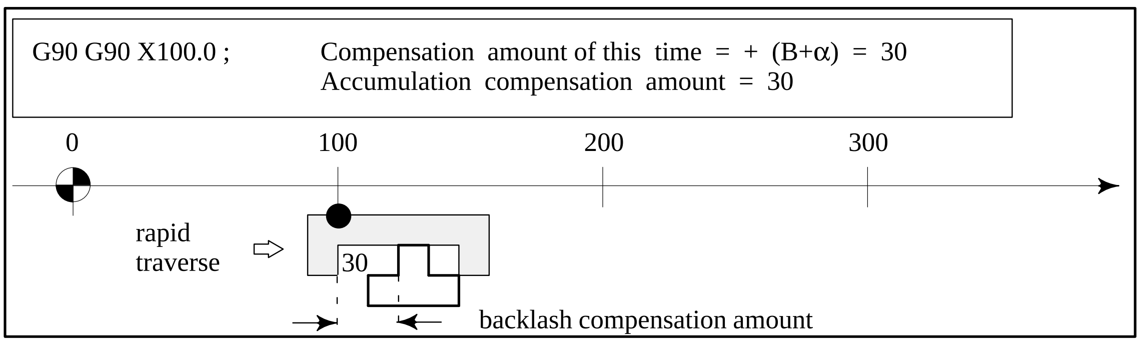
Initial backlash direction is minus

The mark ● is machine position

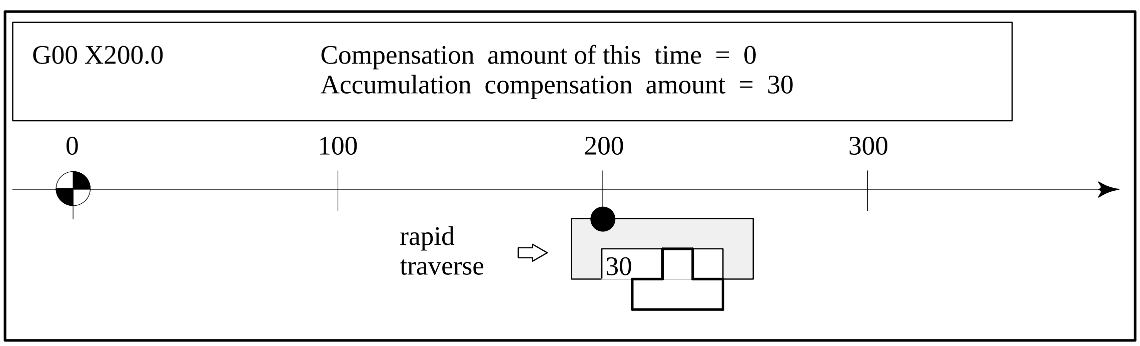
(1) Reference point return



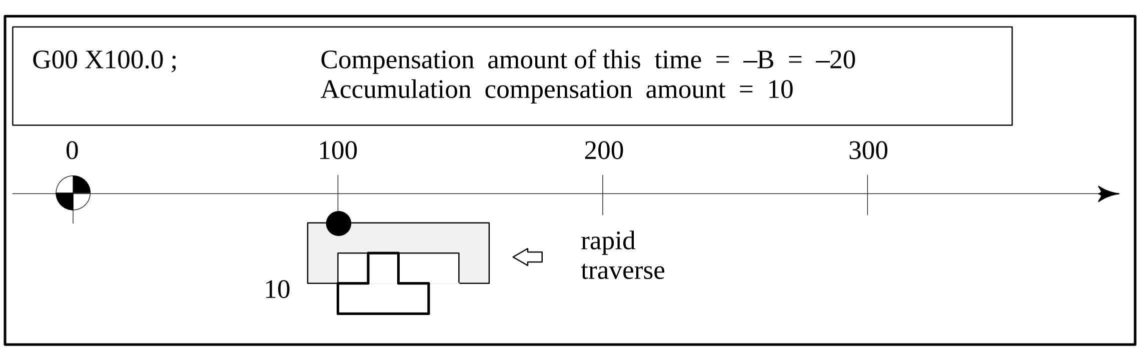
(2) From cutting feed to rapid traverse in the opposite direction



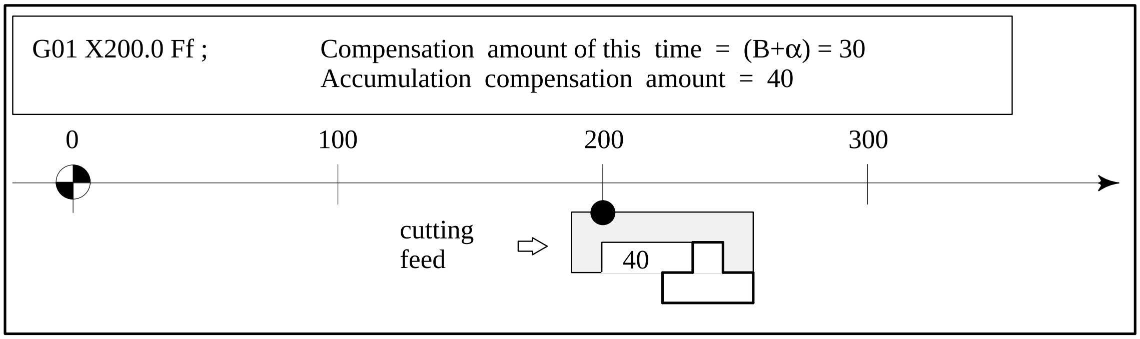
(3) From rapid traverse to cutting feed in the same direction



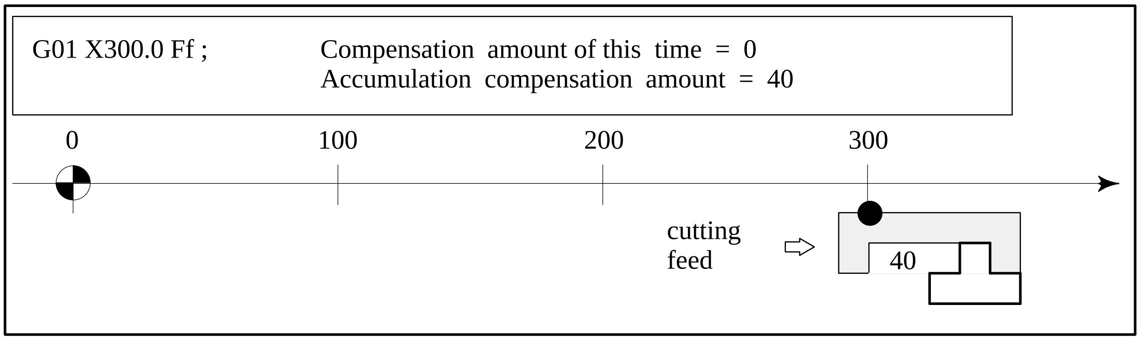
(4) From rapid traverse to cutting feed in the opposite direction



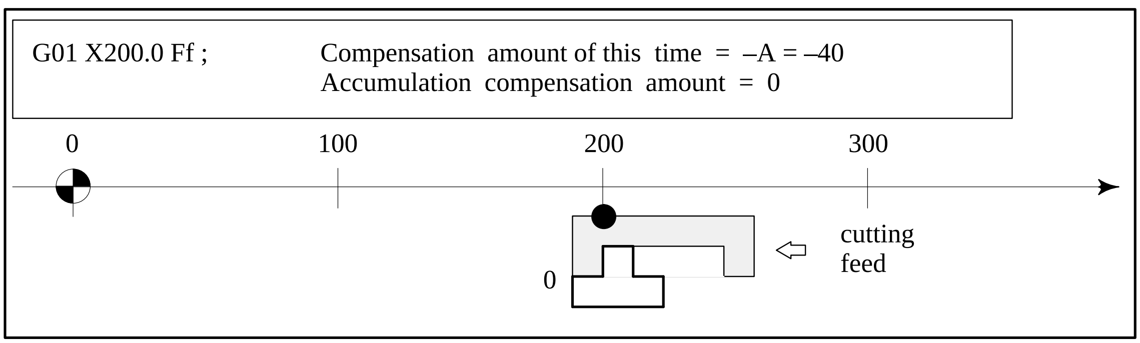
(5) From rapid traverse to cutting feed in the opposite direction



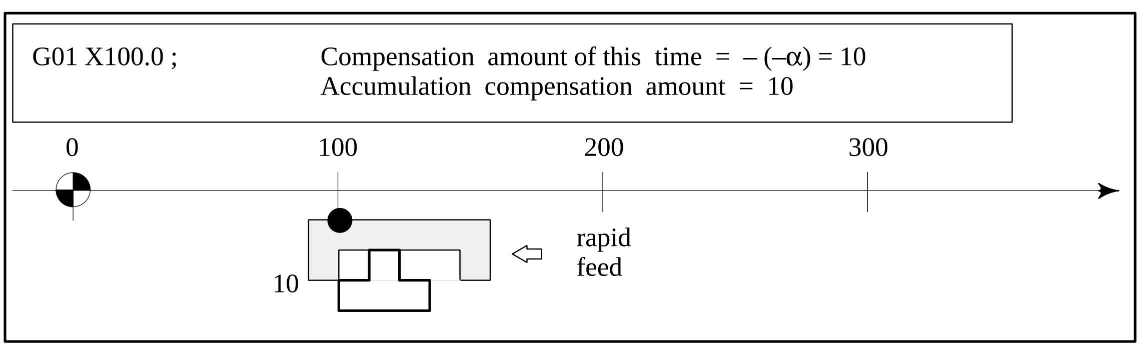
(6) From cutting feed to cutting feed in the same direction



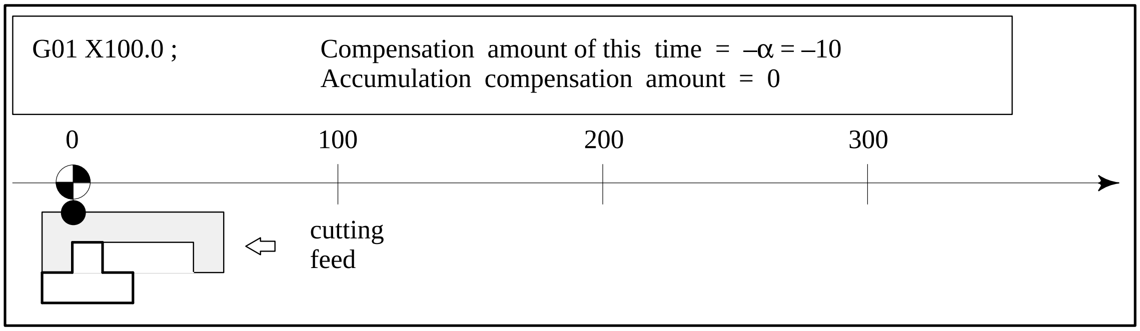
(7) From cutting feed to cutting feed in the opposite direction



(8) From cutting feed to rapid traverse in the same direction



(9) From rapid traverse to cutting feed in the same direction



1850	Grid shift for each axis

Parameter input

Data type : Two–word axis

Unit of data : Detection unit. Even when PLC01 of parameter No. 1804 is set to 1, the unit of data is not multiplied by 10.

Valid range : –99999999 to +99999999

Specify the grid shift for each axis.

The grid position can be shifted by the amount specified in the parameter to move the reference position. The grid shift must be the reference counter capacity (RC1x to RC4x in parameter No. 1816) or less.

1851	Backlash compensation for each axis

Parameter input

Data type : Word axis

Unit of data : Detection unit

Valid range : –9999 to +9999

Specify the backlash compensation for each axis.

When an axis moves in the direction opposite to the reference position return direction after power–on, the first backlash compensation is made.

Specifying backlash compensation

1 Specify multiplication by 1 for the CMR of an axis to be adjusted (setting = 2). (To match the least input increment and detection unit)

Specify 2 for the axis in parameter No. 1820.

> **NOTE** Remember the value set in parameter No. 1820 because the original value must be respecified after the backlash compensation is specified.

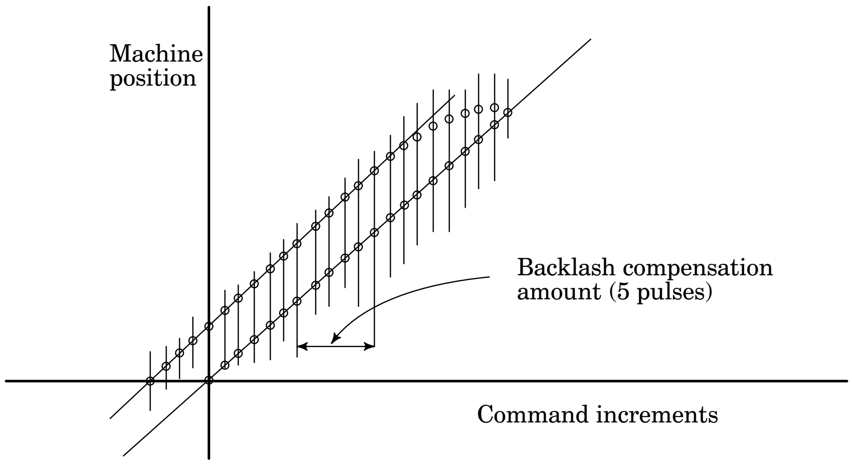
2 Specify 0 for the backlash compensation for the axis to be adjusted.

Specify 0 for the backlash compensation for the axis in parameter No. 1851.

3 Move the machine in the positive direction using continuous manual feed (rapid traverse or jogging) and stop it. Then move the machine in the same direction using step feed or manual handle feed by a command in which some least input increments are specified and stop it. Regard the position where the machine stopped as the reference position. Move the machine continuously in the same direction using commands in which the least input increment is specified until the machine travels the distance of 20 increments. Measure the stop position corresponding to each command. Then move the machine in the negative direction from the last stop position using commands in which the least input increment is specified until the machine

almost returns to the reference position. Measure the stop position corresponding to each command. Illustrate these measurement values as follows:

(See the following figure.)



At the same machine position near the center of the movement calculate the difference between the command increments of the positive and negative directions from these stop positions. Specify this value as the backlash compensation for the axis in parameter No. 1851.

NOTE 1 The machine may be moved in the negative direction first.

NOTE 2 When measuring a single axis, set other driving sections at the center of the movement or at stable positions.

4 Measure the stop positions for each axis and specify the calculated value for the axis in (3). After specifying the backlash compensations for all axes to be adjusted, respecify the original value set before measurement in parameter No. 1820.

1862	Velocity control observer

Parameter input

Data type : Word axis

Valid range : 0 to 32767

Setting value : 3559

Specify 956 when the velocity loop observer is to be used (bit 2 of parameter 1808 = 1)

1863	Velocity control observer

Parameter input

Data type : Word axis

Valid range : 0 to 32767

Setting value : 3329

Specify 510 when the velocity loop observer is to be used (bit 2 of parameter 1808 = 1)

1881	Permissible error at start of chopping compensation

Parameter input

Data type : Two–word axis

Unit of data : Detection unit

Valid range : 0 to 99999999

Chopping compensation is made when the difference between the underrun amounts at the top and bottom dead centers due to the servo position control delay is less than the setting. When 0 is specified for this parameter, no compensation is made.

1885	Software deceleration dog amount for each axis

Parameter input

Data type : Two–word axis

Unit of data : Detection unit

Valid range : 0 to 99999999

Specify a software deceleration dog amount for each axis.

The deceleration dog can be extended by applying a software mask on the deceleration dog during the reference position return. This parameter sets a software mask distance as a software deceleration dog amount.

This parameter is set automatically when digital adjustment of the reference position deceleration limit is performed.

1890	Distance along each axis for checking feedback pulses

Parameter input

Data type : Word axis

Unit of data : Detection unit

Valid range : –255 to +255

Specifies whether to check if feedback pulses are normally generated by actually rotating the servo motor to move the tool along an axis by the distance specified at power–on when a digital feedback position detector, such as a pulse coder, is used.

When 0 is specified for this parameter, this check is not made. Specify a value between 20 and 30 for this check.

1896	Capacity of the reference counter for each axis

Parameter input

Data type : Two–word axis

Valid range : 0 to 99999999

Specifies a desired reference counter capacity. When 0 is specified for this parameter, the standard setting (parameter No. 1816) is used. Even when PLC01 of parameter No. 1804 is set to 1, the unit of data is not multi plied by 10. Specify the mark 1 interval when the linear scale having reference marks is used. Turn the power on again after specifying this parameter.

1900	Current position of each axis in the machine coordinate system

Input prohibited

Data type : 2–word axis

Contains the current position of each axis in the machine coordinate system.

The stored stroke limit of each axis (parameter Nos. 5220 to 5225) is compared with the value specified for this parameter when check of the stored stroke limit immediately after power–on is specified.

This parameter is valid when the power is turned off, then turned on again.

NOTE If an axis is moved after power–off, this parameter is not updated. In this case, the check of the stored stroke limit immediately after power–on is incorrect because this parameter does not show the current position of the axis.

1910	Multiplication of the maximum permissible synchronous error immediately after power–on

Parameter input

Data type : Word axis

Unit of data : 1

Valid range : 1 to 100

This parameter checks whether the synchronous error is within the value obtained by multiplying M by the maximum permissible error in the rapid traverse mode until synchronization is established immediately after power–on. Specify the value of M.

If the value of (the maximum permissible synchronous error in the rapid traverse mode) $\times$ M exceeds 32767, the machine is clamped when the error reaches 32767.

1912	Dead zone for the synchronous error on each axis

Parameter input

Data type : 1–word axis

Unit of data : Detection unit

Valid range : 1 to 32767

When the synchronous error does not exceed the setting, it is not compensated for.

Specify this parameter only for the M–axis.

1913	Maximum permissible synchronous error for each axis in the rapid traverse mode

Parameter input

Data type : 1–word axis

Unit of data : Detection unit

Valid range : 1 to 32767

Specify the maximum permissible synchronous error for each axis in the rapid traverse mode.

Specify this parameter only for the M–axis.

1914	Maximum permissible synchronous error for each axis at machine stop

Parameter input

Data type : 1–word axis

Unit of data : Detection unit

Valid range : 1 to 32767

Specify the maximum permissible synchronous error for each axis when the machine is stopped.

Specify this parameter only for the M–axis.

1915	Compensation gain of the synchronous error for each axis

Parameter input

Data type : 1–word axis

Unit of data : 1 / 1024

Valid range : 1 to 1024

Specify the compensation gain of the synchronous error.

Compensation pulses obtained using the following expression are output to the slave axis during the 4–ms sampling time.

Specify this parameter only for the M–axis.

$$\text{Compensation pulses} = \text{synchronous error} \times \frac{Ci}{1024}$$

Ci: Compensation gain

The compensation gain is calculated using the following expression:

Compensation gain = 0.25 $\times$ Ci

1916	Threshold ratio causing synchronous error excessive alarm I for each axis

Parameter input

Data type : 1–word axis

Unit of data : 1 / 8

Valid range : 1 to 8

If the error exceeds 8 / N of the maximum permissible synchronous error, synchronous error excessive alarm I is raised. Specify a value for N.

Specify this parameter only for the M–axis.

1917	Synchronization error zero width 2 for an individual axis

Parameter input

Data type : Two–word axis

Unit of data : Detection unit

Valid range : 0 to 32767

If the synchronization error is not greater than the value set here, the synchronization error compensation smoothing suppress function is disabled.

If the synchronization error is not less than the value set here, the synchronization error compensation smoothing suppress function is enabled. The setting made for this parameter must be smaller than the value specified in parameter No. 1912. This setting is required only for the master axis.

1918	Synchronization error compensation gain 2 for an individual axis

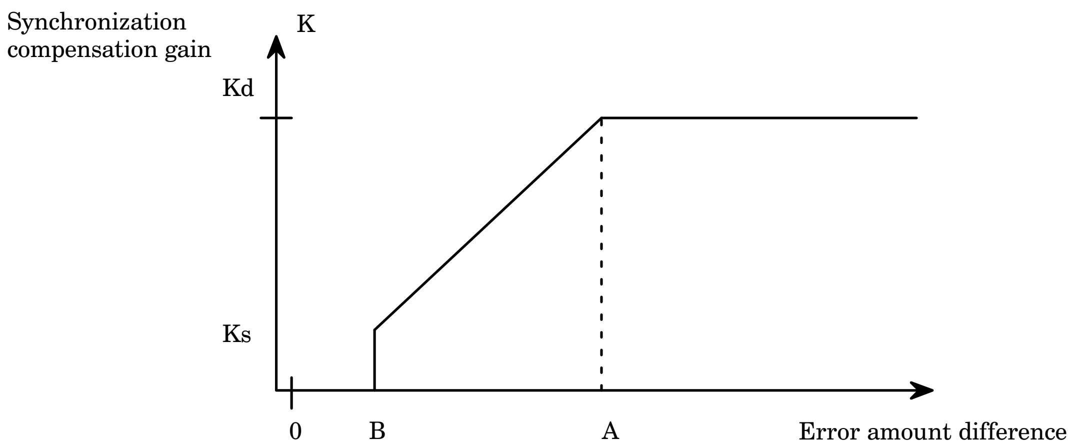
Parameter input

Data type : Word axis

Unit of data : 1/1024

Valid range : 0 to 1024

This parameter specifies synchronization error compensation gain 2 for synchronization error compensation smoothing suppression. The setting made for this parameter must be smaller than the value specified in parameter No. 1915. This setting is required only for the master axis.



A : Synchronization error zero width (parameter No. 1912)
B : Synchronization error zero width 2 (parameter No. 1917), where 0 < B < A
Kd : Synchronization error compensation gain (parameter No. 1915)
Ks : Synchronization error compensation gain 2 (parameter No. 1918), where 0 < Ks < Kd
Er : Current difference in error amounts of the master and slave axes
K : Current error compensation gain corresponding to Er

(1) Compensation is not performed if Er < B (K = 0).

(2) When B < Er < A, compensation is performed according to:

$$K=Ks+\frac{(Er-B)\ (Kd-Ks)}{A-B}$$

(3) When A < Er, compensation is performed according to:
K = Kd

CAUTION 1 If bit 4 of parameter No.1930 is 0, both parameters No.1917 and 1918 are assumed to be 0.

CAUTION 2 The synchronization error zero width (parameter No.1912) must be a positive value greater than synchronization error zero width 2 (parameter No.1917).

CAUTION 3 The synchronization error compensation gain (parameter No.1915) must be a positive value greater than synchronization error compensation gain 2 (parameter No.1918).

	#7	#6	#5	#4	#3	#2	#1	#0
1924		OPDMR3	OPDMR2	OPDMR1				

Parameter input

Data type : Bit axis

OPDMR3 to OPDMR1 Specify a detection multiplier for a malfunction check detector.

1925	Command multiplier for a malfunction check detector (CMR)

Parameter input

Data type : Byte axis

Unit of data : 0.5 times

Valid range : 1 to 40 (0.5 times to 20 times)

This parameter specifies a command multiplier for each axis in order to indicate the relationship between the least command increment and the detection unit of the malfunction check detector.

	#7	#6	#5	#4	#3	#2	#1	#0
1930				SYNCUP				STH

Data type : Bit axis

STH Specifies whether to continue hybrid control when the turning mode is selected.

0 : Continues hybrid control.

1 : Stops hybrid control.

SYNCUP Specifies whether to enable the synchronization error compensation smoothing suppress function.

0 : Disabled

1 : Enabled

This setting is required only for the master axis.

1938	Malfunction check simulator feed forward factor (conventional)

Parameter input

Data type : Word axis

Valid range : 0 to 4096

Setting value : $\alpha \times 4096$ ($0 \leqq \alpha \leqq 1$)

This parameter specifies the feed forward factor for a malfunction check simulator that applies to conventional feed forward.

1939	Malfunction check simulator feed forward factor (advance)

Parameter input

Data type : Word axis

Valid range : 0 to 4096

Setting value : $\alpha \times 4096$ ($0 \leqq \alpha \leqq 1$)

This parameter specifies the feed forward factor for a malfunction check simulator that applies to advance feed forward.

1940	Simulator time constant for malfunction check for each axis

Parameter input

Data type : Word axis

Unit of data : 1msec

Valid range : 1 to 4000

This parameter specifies a time constant for a malfunction check simulator, which consists of a linear delay system.

1941	Error limit for malfunction check A for each axis

Parameter input

Data type : Word axis

Unit of data : Detection units for the malfunction check detector

Valid range : 0 to 9999

An alarm is issued if the difference between the position where the machine is specified to stop and the position obtained using the malfunction check detector exceeds the value set in this parameter.

1942	Error limit for malfunction check B for a stop for each axis

1943	Error limit for malfunction check B for rapid traverse for each axis

Parameter input

Data type : Word axis

Unit of data : Detection units for the malfunction check detector

Valid range : 0 to 9999

An error limit is specified for malfunction check B, which performs a malfunction check during movement. A limit for a stop (1942) and a limit for rapid traverse (1943) are specified. A limit for an intermediate speed is determined by proportional distribution. An alarm is issued if the difference between the position where the machine is specified to be and the position obtained using the malfunction check detector exceeds the limit that corresponds to the current speed.

1944	Backlash compensation for malfunction check detector for each axis

Parameter input

Data type : Word axis

Unit of data : Detection units for the malfunction check detector

Valid range : 0 to 9999

This parameter specifies a backlash compensation for the malfunction check detector for each axis. After the power is supplied, backlash compensation is first performed if the machine moves in the direction opposite to the initial backlash direction.

1945	Pitch error compensation point number for the reference position for the malfunction check detector for each axis

Parameter input

Data type : Word axis

Unit of data : Number

Valid range : 1 to 128 × (number of controlled axes)

This parameter specifies the pitch error compensation point number of the malfunction check detector which corresponds to the reference position for each axis.

1946	Pitch error compensation point number at the farthest end on the negative side for the malfunction check detector for each axis

Parameter input

Data type : Word axis

Unit of data : Number

Valid range : 1 to 128 × (number of controlled axes)

This parameter specifies the pitch error compensation point number at the farthest end on the negative side for the malfunction check detector for each axis.

1947	Pitch error compensation point number at the farthest end on the positive side for the malfunction check detector for each axis

Parameter input

Data type : Word axis

Unit of data : Number

Valid range : 1 to 128 × (number of controlled axes)

This parameter specifies the pitch error compensation point number at the farthest end on the positive side for the malfunction check detector for each axis.

1948	Pitch error compensation multiplier for the malfunction check detector for each axis

Parameter input

Data type : Byte axis

Unit of data : 1 times

Valid range : 1 to 100

This parameter specifies the pitch error compensation multiplier for the malfunction check detector for each axis. If the pitch error compensation multiplier is 1, the units of the compensation become equal to the detection units of the malfunction check detector.

1949	Interval between pitch error compensation points for the malfunction check detector for each axis

Parameter input

Data type : Two–word axis

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	Unit
Metric system machine Inch system machine Rotary axis	0.01 0.001 0.01	0.001 0.0001 0.001	0.0001 0.00001 0.0001	mm inch deg

Valid range : 1 to 99999999

This parameter specifies the interval for pitch error compensation points for each axis; these points are equally spaced.

1950	Amount of movement per pitch error compensation turn of the rotary axis of the malfunction check detector for each axis

Parameter input

Data type : Two–word axis

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	Unit
Metric system machine	0.01	0.001	0.0001	mm
Inch system machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

Valid range : 1 to 99999999

See the explanation of parameter 5425 for details of the related setting method.

	#7	#6	#5	#4	#3	#2	#1	#0
1951	TRQX							

Parameter input

Data type : Bit axis

TRQX Specifies whether to perform torque control for the relevant axis.

0 : Torque control is not performed for the axis.

1 : Torque control is performed for the axis.

NOTE When torque control is to be performed, bit 3 of parameter No. 1409, and parameters No. 1998, 7767, and 7768 must be set.

	#7	#6	#5	#4	#3	#2	#1	#0
1957			TDOUT					

Parameter input

Data type : Bit axis(set for each axis)

TDOUT Specifies the output to the check board for each axis.

0 : Torque command

1 : Estimated load torque

	#7	#6	#5	#4	#3	#2	#1	#0
1958								ABNTDT

Parameter input

Data type : Bit axis(set for each axis)

ABNTDT Specifies whether the estimated load torque output function is enabled for each axis.

0 : Disabled

1 : Enabled

When the estimated load torque output function and/or the excessive–load alarm function is used, this parameter must be set.

	#7	#6	#5	#4	#3	#2	#1	#0
1959				HDN				

Data type : Bit axis

HDN : Specifies whether to detect that a separate detector has been disconnected, when the servo motor is in the speed command mode, as follows:

0 : detects that a separate detector has been disconnected.

1 : does not detect that a separate detector has been disconnected.

1996	Amount of motor reverse at abnormal load detection

Parameter input

Data type : Word axis

Unit of data : Detection unit

Valid range : 0 to 32767

This parameter specifies the amount by which the motor is reversed if an abnormal load is detected. When the motor is running at a speed lower than those listed below, it is stopped without being reversed, so the motor will not be reversed excessively. If the feedrate is not greater than the value listed for each detection unit, the motor reverses by A from the point where an abnormal load is detected, where A is the value specified in this parameter.

Detection unit	Feedrate
10µm	A/0.8 mm/min
1µm	A/8 mm/min
0.1µm	A/80 mm/min
0.01µm	A/800 mm/min
0.001µm	A/8000 mm/min

If this parameter is set to 0, the motor stops without being reversed if an abnormal load is detected.

Refer to the FANUC AC Servo Amplifier Maintenance Manual for details.

1998	Torque constant

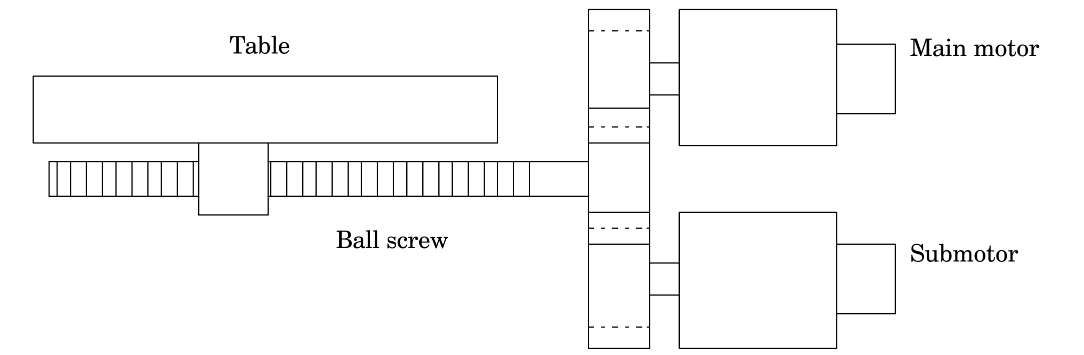
Parameter input

Data type : Word axis

This parameter specifies a torque constant for each torque characteristic of the motor.

4.10 Tandem Control

When a single motor cannot generate enough torque to move, for example, a large table, the use of two motors enables the table to be easily moved along a single axis. The main motor is used to carry out positioning; The submotor is only used to generate additional torque. This configuration doubles the torque.

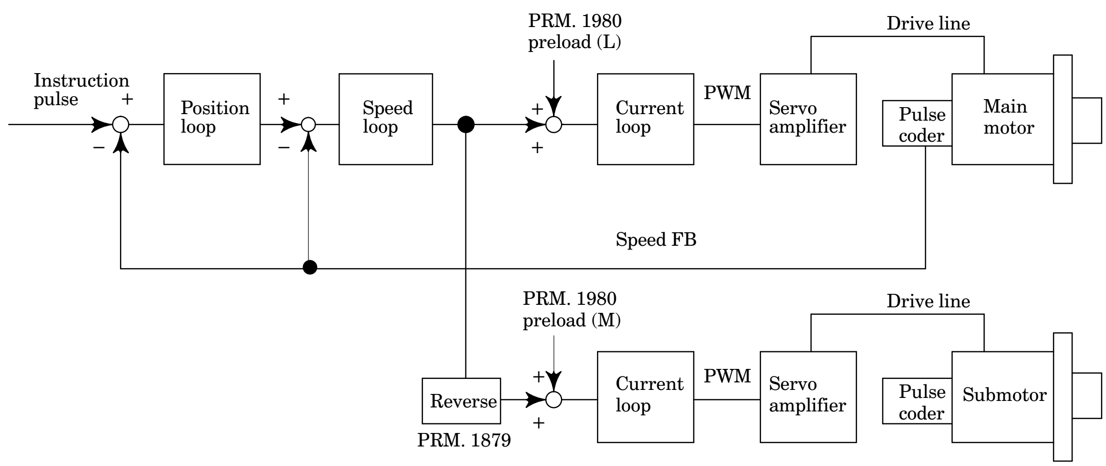


Example

The CNC control unit basically handles tandem control as single axis control. However, control of the servo parameters and monitoring of the servo alarms are, in fact, handled as two axes.

The main motor for tandem control is called a master axis and the submotor is called a slave axis.

The block diagram below illustrates tandem control.



Tandem control block diagram

4.10.1 Axis assignment of a system which includes tandem control

Axis assignments fall into the three types described below. Axis assignment takes on significant meaning when data for each axis is displayed or when signals are connected between the NC unit and the power magnetics cabinet. Axis assignment therefore must be thoroughly understood.

(1) Input axis assignment

Input axis assignment is used to execute tape or jog feed commands. Axis assignment in tandem control is handled in the same way as it is in single axis control. Connect overtravel, interlock, and similar signals according to the axis assignment.

(2) Axis assignment for setting and displaying data for each axis

This axis assignment is used to display parameters or diagnostic data for each axis on the CRT. The axis assignment is generated by adding a slave axis used for tandem control to the input axis assignment. When there is more than one tandem control axis, the order in which the slave axes are assigned must conform to the order of the master axes in input axis assignment described above.

(3) Drive axis assignment

Drive axis assignment is used to connect the servo motor and NZ (near zero) signals.

Drive axis assignment enables the use of up to three sets (seven sets for multi–axis systems) of tandem control axes. Parameter 1023 is used to specify the assignment of the servo axes; however, the tandem axes must be assigned according to the table below.

Multi–spindle system →

Tandem axis / type of axis	Axis No. 1	Axis No. 2	Axis No. 3	Axis No. 4	Axis No. 5	Axis No. 6	Axis No. 7
Master axis	1	3	5	7	9	11	13
Slave axis	2	4	6	8	10	12	14

NOTE Specify 77 for the master axis (M) and 83 for the slave axis (S) in parameter No. 1021.

Example The following table shows the assignment in which tandem control is applied to the Y– and B– axes with five input axes (X, Y, Z, A, B).

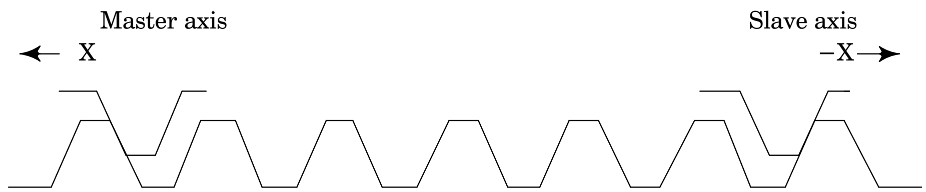
Axis No.	Control axis configuration	Display axis configuration	P1023	Drive axis configuration
1	X	X	3	YM
2	★Y	YM	1	YS
3	Z	Z	4	X
4	A	A	7	Z
5	★B	BM	5	BM
6		YS	2	BS
7		BS	6	A

NOTE 1 An asterisk (★) indicates a tandem control axis.
NOTE 2 The suffix M indicates a master axis. The suffix S indicates a slave axis.

4.10.2 Preload function

Adding offset to the torque to be controlled by the position (velocity) feedback function enables torque to be applied along each master axis (main motor) and slave axis (submotor) in opposite directions. As a result, the two motors can be made to always pull in opposite directions. This opposition enables the preload function to reduce the effect of the backlash that occurs between the master and slave axes when the two motors are connected in tandem through a series of gears. This does nothing, however, to reduce the backlash that is always generated between the ball screw and table in a mechanical system.

If the preload function applies a preload of x to the master axis and a preload of –x to the slave axis, for example, the two motors will pull in opposite directions by the preload torque while they are stopped as shown below:



NOTE	Specify the lowest preload value possible. Never specify a value that exceeds the rated torque because torque continues to be applied while the two motors are stopped, an overload alarm occurs. The preload value should be marginally larger than the relevant friction value.

4.10.3 Settings (parameters)

There are two ways of specifying parameters for tandem control axes:

i) Parameters whose settings must be the same for the master axis (M) and the slave axis (S)

ii) Parameters specified only for the master axis (S axis data is not used.)

The classification of these two types of parameter is described below. Parameters that cannot be classified as either type are generally assumed to be of type i). Therefore, in these parameters specify the same settings for the M and S axes.

CAUTION 1	Care must be taken that the settings of type i) parameters are the same for the M and S axes. If they are different, the machine may operate abnormally under tandem control.
CAUTION 2	Position control is not performed for the slave axis in a tandem configuration. The stroke check function is meaningless for the slave axis. So, parameters No. 5220 and 5222 must be set to 99999999, while parameters No. 5221 and 5223 must be set to –99999999.

NOTE	The detection units for the M and S axes under tandem control must be the same.

(1) Parameters which must be set the same data for both M and S axes

Parameter No.	Description
1004#0	Least command increment (0.01 mm)
1004#1	Least command increment (0.0001 mm)
1005#0	Reference point return presence/absence
1005#1	Reference point return method
1005#2	Reference point return is slow type
1005#3	Coordinate system preset in reference point return
1006#0	Rotary axis
1006#1	Coordinate system for stroke check and G28 is of rotary axis type
1006#2	Coordinate system for pitch error compensation is rotary axis type
1006#3	Diameter/radius specification
1006#5	Direction of reference point return
1020	Axis name
1240	Reference point position taken from machine origin
1241	Second reference point coordinates
1242	Third reference point coordinates
1243	Fourth reference point coordinates
1260	Move distance per rotation of rotary axis
1420	Rapid traverse rate
1421	Rapid traverse override F0
1600#0	Rapid traverse acceleration/deceleration type
1620	Rapid traverse linear acceleration/deceleration time constant
1621	Rapid traverse time constant FL
1622	Cutting feed time constant
1623	Cutting feed time constant FL
1624	Jog feed time constant
1625	Jog feed time constant FL
1626	Thread cutting cycle time constant
1627	Thread cutting cycle time constant FL
1628	Rapid traverse exponent type acceleration/deceleration time constant
1629	Rapid traverse exponent type acceleration/deceleration time constant FL
1802#1	Servo off axis
1815#1	Optical scale
1816	Command multiplier
1820	Detection multiplier
5210#0	Soft OT2
5210#1	Soft OT3
18XX	All digital servo parameters
19XX	All digital servo parameters

(2) Parameters which should only be set for the M axis

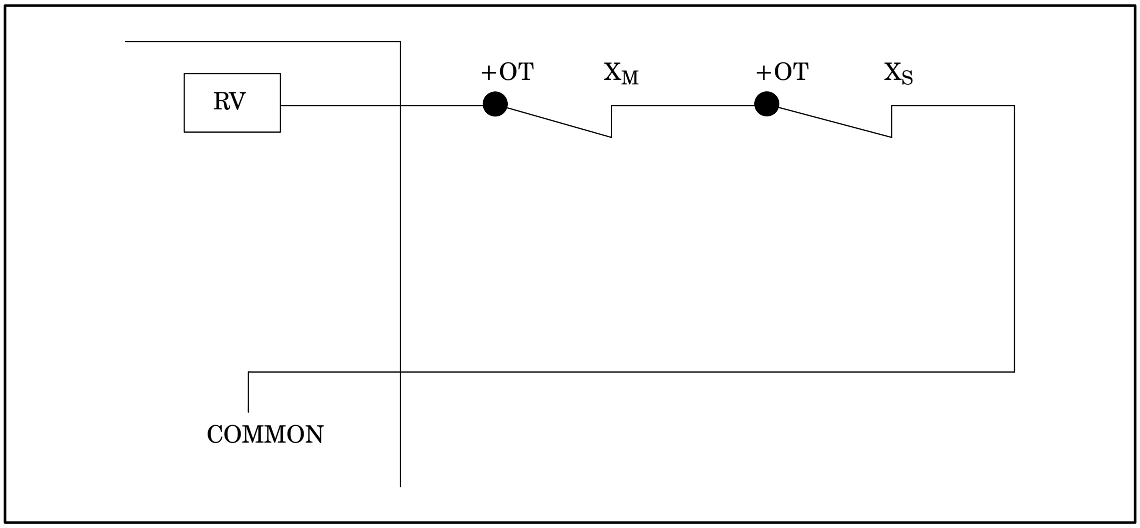
Parameter No.	Description
0012#0	Mirror image
0012#1	Scaling validity
0012#7	Servo control off
1004#2	Input x 10
1005#4	Positive direction external deceleration
1005#5	Negative direction external deceleration
1005#6	Each axis machine lock
1005#7	Servo control off
1021	Parallel axis specification
1022	Parallel axis specification
1220	External workpiece coordinate shift
1221	G54 workpiece origin offset amount
1222	G55 workpiece origin offset amount
1223	G56 workpiece origin offset amount
1224	G57 workpiece origin offset amount
1225	G58 workpiece origin offset amount
1226	G59 workpiece origin offset amount
1422	Maximum cutting feed rate
1423	Jog feed rate
1424	Manual reference point return FM rate
1425	Manual reference point return FL rate
1427	Rapid traverse external deceleration rate
2020	Soft operator’s panel positive direction button
2021	Soft operator’s panel negative direction button

4.10.4 Connection of axis signals

In addition to connecting the motor signals (pulse coder signals, for example), the DI/DO corresponding to the control axis assignment need be connected. So connecting the DI/DO corresponding to the S axis has no effect.

If the master axis and slave axis for tandem control require individual signals, transmit, a single signal to the NC unit by, for example, combining the corresponding signals via an OR circuit.

Example Connection of overtravel, interlock and similar signals



The connection of the motor signals shall conform to the assignment of the drive axes.

4.11 Parameters Related to DI/DO

	#7	#6	#5	#4	#3	#2	#1	#0
2000				OPS	STR	STJ	RWM	RSD

Parameter input

Data type : Bit

RSD The resetting (RST) signal is output:

0 : Whenever the system is reset.

1 : Only when the reset button is pressed on the MDI panel.

RWM The rewinding signal (RWD) is output:

0 : Only while the tape is rewound in the tape reader by the reset and rewind signal.

1 : While the tape is rewound in the tape reader or the reset and rewind signal searches memory for the beginning of a program.

STJ The signal indicating that automatic operation is being activated (STL):

0 : Not output during operation by manual numeric commands.

1 : Output during operation by manual numeric commands.

STR Specifies whether the STL signal is output when programs are loaded by the cycle start signal in the part program edit mode (see RDS in parameter 2200).

0 : Not output

1 : Output

OPS Specifies whether the automatic operation in–process signal (OP) is turned on when a sequence number is searched for.

0 : Not turned on

1 : Turned on

	#7	#6	#5	#4	#3	#2	#1	#0
2001	EF	6MI	MIC	POV	MPN		MOC	ENR

Parameter input

Data type : Bit

ENR At emergency stop:

0 : The system is reset.

1 : The system is not reset, but an alarm is raised. When the system is reset, the emergency stop state is released.

MOC If all the mode selection signals are turned off:

0 : No mode is assumed.

1 : The previously selected mode is assumed.

MPN Specifies whether the incremental feed is specified with the manual handle feed magnification signals MP1, MP2, and MP4.

0 : Not specified (Directly specify the feed with 32–bit data.)

1 : Specified

POV Specifies whether override signals OV1 to OV8, ROV1, and R0V2 use positive or negative logic.

0 : Negative

1 : Positive

This bit is valid only the FS3 interface.

Normally, set POV to 0. When the FS3 interface is selected (6MI), set POV to 1, if necessary.

MIC Selects the machine interface.

0 : Basic machine interface

1 : FS3 or FS6 interface

6MI specifies whether FS3 or FS6 is selected.

6MI Specifies whether FS3 or FS6 is selected.

0 : FS3 interface

1 : FS6 interface

EF Specifies whether the external operation command signal (EF) is output.

0 : Not output

1 : Output to the ZPZ (Z–axis reference position return completion signal) position

This bit is valid only when the FS3 interface is selected.

	#7	#6	#5	#4	#3	#2	#1	#0
2002	DIS		ZAIL	BSLC	STAP	NGA	J+H	

J+H

0 : Manual handle feed is valid only when the manual handle feed mode is selected. It is invalid when the continuous manual feed (manual jog feed) or incremental feed mode is selected.

1 : Manual handle feed is valid when the continuous manual feed (manual jog feed) or incremental feed mode is selected.

This bit is valid only when the FS3 interface is selected.

NGA Specifies whether the timeout of the response from the PMC is checked with the G10.1 command. (This bit is not used in Series 15–TT.)

0 : Checked

1 : Not checked

This bit is used to debug the PMC program.

STAP (for Series 15–M)

0 : The TAP signal of F001.4 is used as the tapping signal in the FS6 interface.

1 : The SSP signal of F002.7 is used as the tapping signal in the FS6 interface.

BSLC If a single–block command such as a canned cycle enables several operations to be performed, the block start interlock signal (*BSL) checks:

0 : At the beginning of execution of the first cycle only.

1 : At the beginning of execution of each cycle.

ZAIL (for Series 15–M)

In the FS3 interface, the interlock (*ILK) signal is:

0 : Used as an all–axis interlock signal.

1 : Used as a Z–axis interlock signal.

DIS Specifies whether the tool post selection signal (IHEAD1 or IHEAD2) is valid when the MDI mode is started. (For Series 15–TT)

0 : Invalid

1 : Valid

		#7	#6	#5	#4	#3	#2	#1	#0
2003			MHD	HAB	UHS	BSN	TSN	SSN	MSN

Parameter input

Data type : Bit

MSN Specifies whether a minus (–) can be used in a M code.

0 : Cannot be used

1 : Can be used

SSN Specifies whether a minus (–) can be used in an S code.

0 : Cannot be used

1 : Can be used

TSN Specifies whether a minus (–) can be used in a T code.

0 : Cannot be used

1 : Can be used

BSN Specifies whether a minus (–) can be used in the specification of the 2nd auxiliary function.

0 : Cannot be used

1 : Can be used

MSN, SSN, TSN, and BSN are valid only when the BMI interface is used.

UHS Specifies whether the handle axis selection signals are used when multi–handle specification A or B is selected.

0 : Used

1 : Not used (The selection of the manual handle feed mode enables the machine to be fed along all the axes by the handle.)

HAB

0 : Specification C

1 : Specification A or B (See also the description of parameter 7701.)

(HAB is valid only when MHD is set to 0.)

MHD The multi–handle function in the FS6 M machine interface conforms to

0 : Specification A, B, or C

1 : Specification D

UHS, HAB, and MHD are valid only when the FS6 interface is selected in Series 15–M.

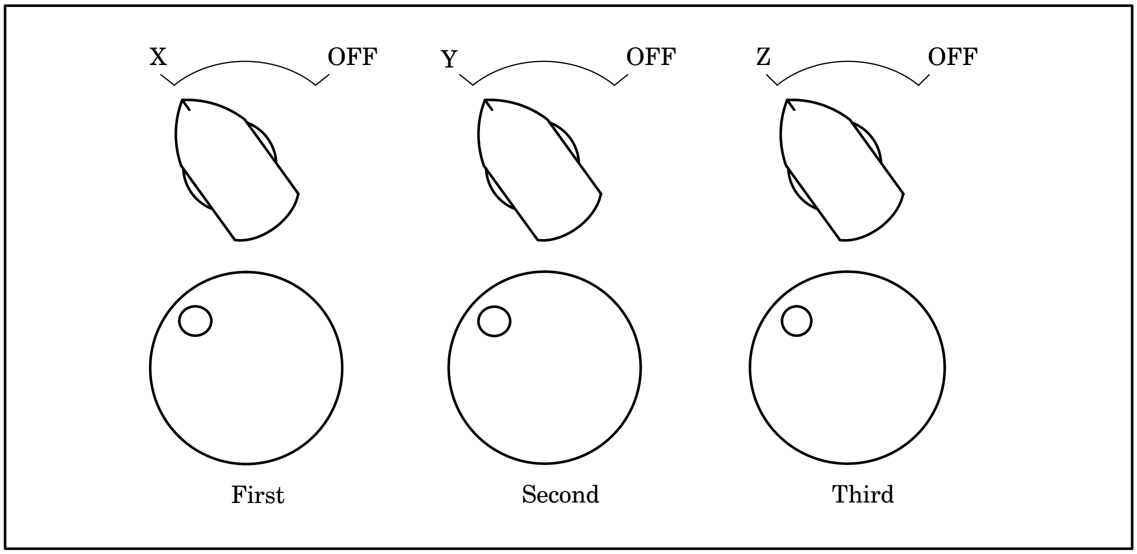
Multi–handle function in the FS6 interface (for the Series 15–M)

(1) Type A

In this specification type, the number of axes is the same as that of the manual pulse generators (manual pulse generators), and each axis is assigned to a specific manual pulse generator.

Example

Axis	Axis selection signal	Manual pulse generator
X axis	HX	First
Y axis	HY	Second
Z axis	HZ	Third



The assignment of each axis to a specific manual pulse generator can be changed by the parameter.

When UHS = 0, the manual pulse generators operate only if the corresponding handle axis selection signals are off.

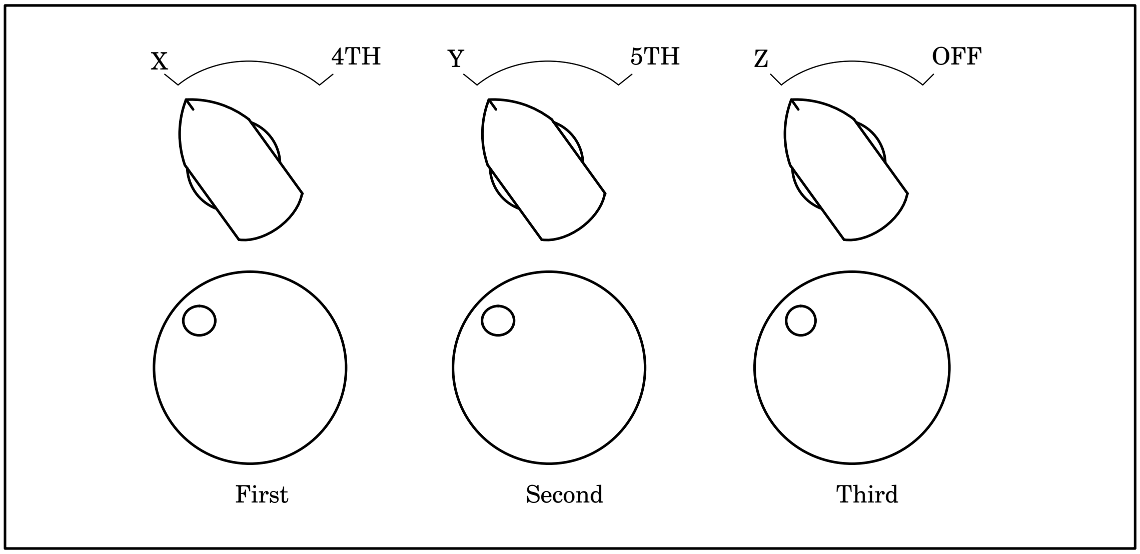
When UHS = 1, the manual pulse generators operates irrespective of the handle axis selection signals.

(2) Type B

In this specification type, the number of axes is less than that of the manual pulse generators, and each axis is assigned to a specific manual pulse generator.

Example When five axes are assigned to three manual pulse generators

Axis	Axis selection signal	Manual pulse generator
X axis	HX	First
Y axis	HY	Second
Z axis	HZ	Third
Fourth axis	H4	First
Fifth axis	H5	Second



The assignment of each axis to a specific manual pulse generator must be preset with the parameter.

When UHS = 0, the manual pulse generators operate only if the corresponding handle axis selection signals are off.

When UHS = 1, the manual pulse generators operates irrespective of the handle axis selection signals.

CAUTION A single manual pulse generator can only be used to feed the machine along a single axis. If the axis selection signals for two or more axes assigned to the same manual pulse generator are off, the machine is fed along each axis in the order: X–, Y–, Z–, 4th, and 5th axis.

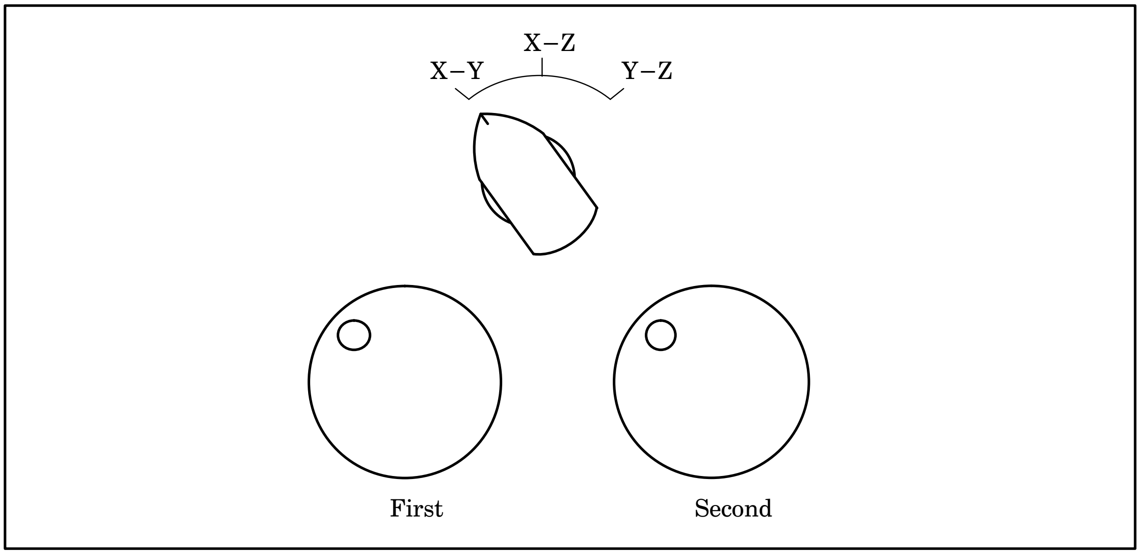
(3) Type C

In this specification type, the number of axes is less than that of the manual pulse generators, the assignment of the axes to the manual pulse generators is changed.

Example When three axes are assigned to two manual pulse generators

Axis selection signal			First manual pulse generator	Second manual pulse generator
HX	HY	HZ		
○	○	×	X axis	Y axis
○	×	○	X axis	Z axis
×	○	○	Y axis	Z axis

○ : Contact close
× : Contact open

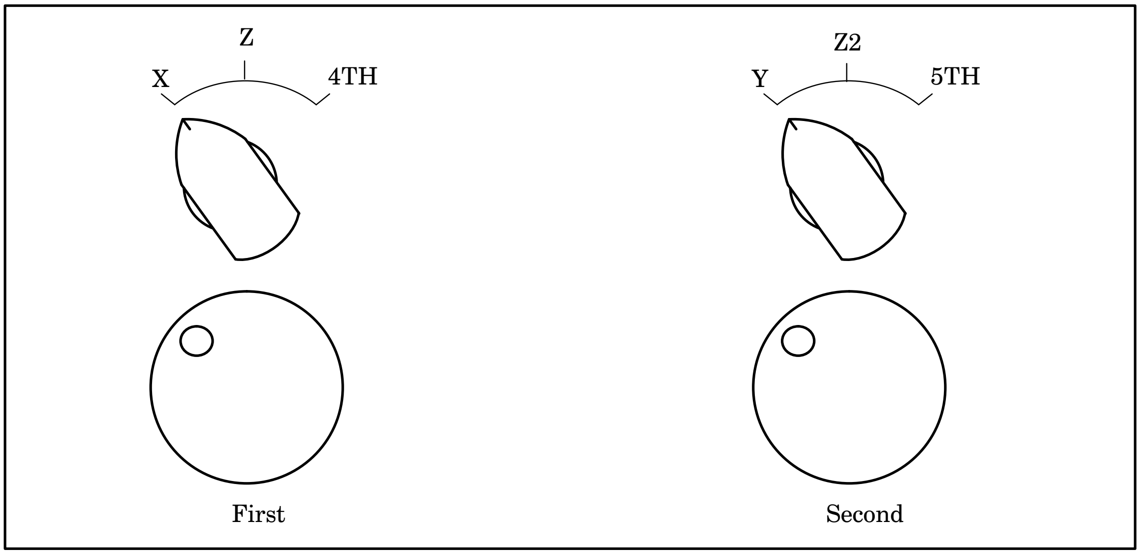


This assignment is valid only when the same number of handle axis selection signals as that of the manual pulse generators are turned off. The machine is fed along each axis by the handle of the manual pulse generator corresponding to the axis selected in the order: X–, Y–, Z–, 4th, and 5th axis. Only axes whose signals are off are fed.

(4) Type D

In this specification type, two manual pulse generators are provided. The following table indicates the axes along which the machine is fed by the handles of the respective manual pulse generators and the handle axis selection signals.

Axis	Axis selection signal	Manual pulse generator
X axis	HX	First
Y axis	HY	Second
Z axis	HZ	First
	HZ2	Second
Fourth axis	H4	First
Fifth axis	H5	Second



If both axis selection signals HZ and HZ2 are turned ON, HZ is valid.

	#7	#6	#5	#4	#3	#2	#1	#0
2004				DIHD		TSKY		MHI

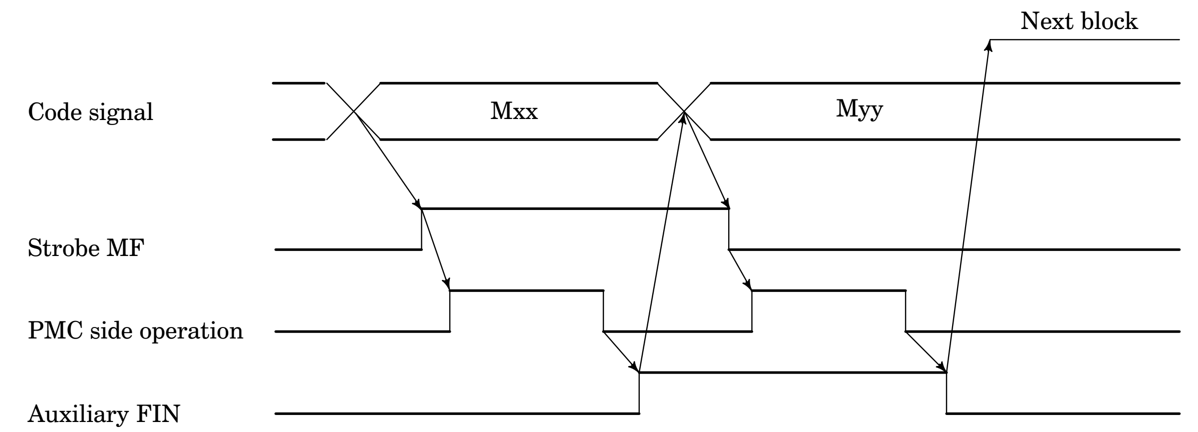
Parameter input

Data type : Bit

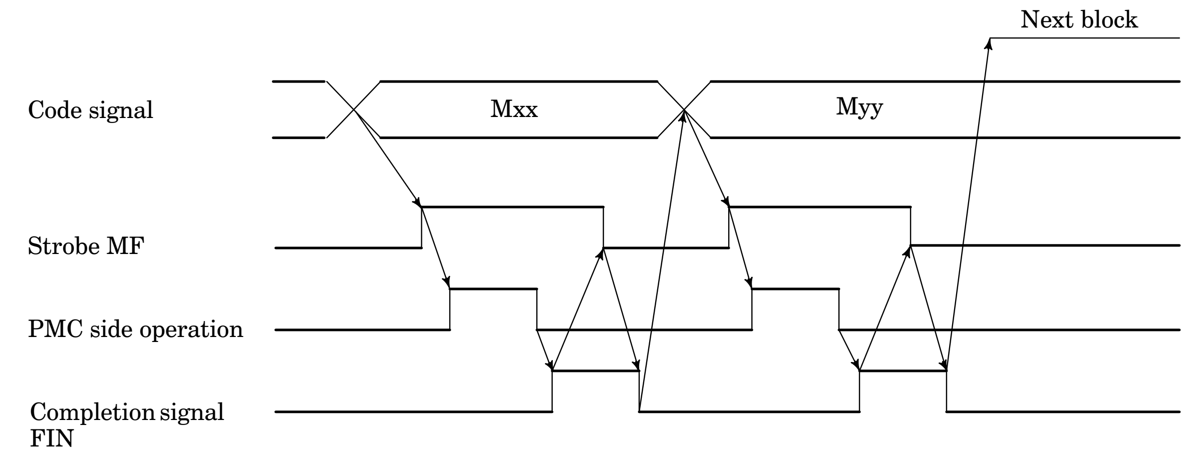
MHI The strobe and completion signals for the M, S, T, or B codes are transmitted in the:

0 : Normal system.

1 : High–speed system.



High–speed system time chart



Normal system time chart

TSKY Specifies how the test mode selection (TEST) signal and the reverse (RVS) signal are set when the retrace program editing function is executed.

0 : Set by BMI.

1 : Set by the soft keys.

DIHD Specifies whether to use a command from the host or the DI signal in tool post specification/selection when a DNC1 service function involving the specification of a tool post (main program selection, CNC data read, and CNC data write) or involving the selection of a tool post (main program start) is used.

0 : Use a command from the host for tool post specification/selection.

1 : Use the DI signal for tool post specification/selection.

	#7	#6	#5	#4	#3	#2	#1	#0
2005					REU	PCXDT	DITL	

DITL Specifies whether to enable the all–axis/axis–by–axis interlock function for the axes controlled by PMC axis control.

0 : Enable the all–axis/axis–by–axis interlock function along axes under PMC control.

1 : Disable the all–axis/axis–by–axis interlock function along axes under PMC control. (Movements along the axes are not stopped.)

PCXDT Specifies axis selection signals used for the simultaneous start command for the PMC axis control function.

0 : Use the FDxX15 to FDxX0 signals.

1 : Use the DTxX31 to DTxX0 signals.

REU Specifies whether to enable the retrace editing function.

0 : Disable the retrace editing function.

1 : Enable the retrace editing function.

NOTE	After this bit is changed, the power must be briefly turned off and then on again, for the change to take effect.

2010	Delay time of the MF, SF, TF, or BF strobe signal

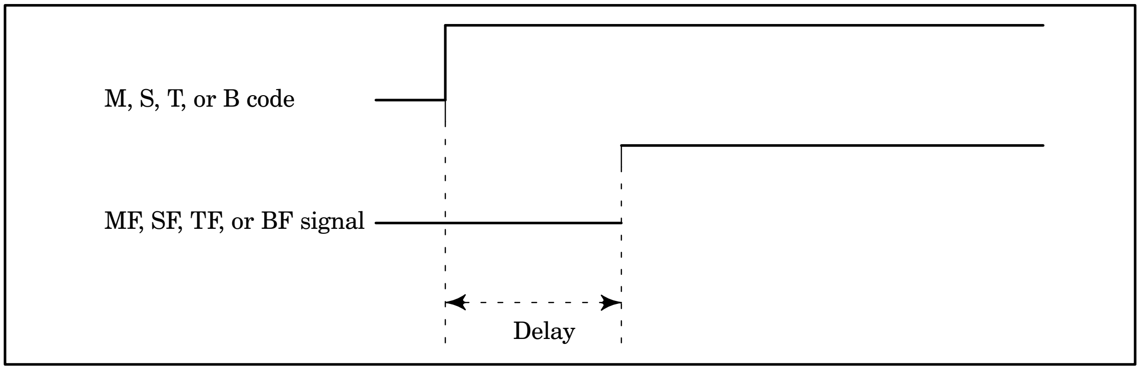
Parameter input

Data type : Word

Unit of data : 1 ms

Valid range : 0 to 32767

Specify the time waited before the MF, SF, TF, or BF strobe signal is sent after the M, S, T, or B code is sent.



2011	Minimum width of the M, S, T, or B function completion (FIN) signal

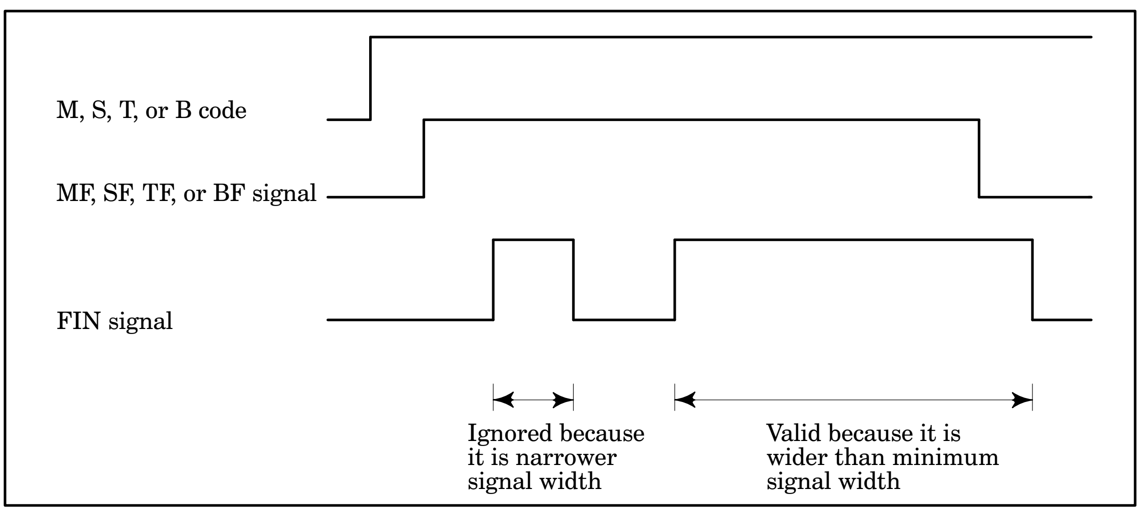
Parameter input

Data type : Word

Unit of data : 1 ms

Valid range : 0 to 32767

Specify the minimum signal width at which the M, S, T, or B function completion signal (FIN) is assumed to be valid.



2014	Time that mode unselected status is ignored

Parameter input

Data type : Word

Unit of data : 1 ms

Valid range : 0 to 32767

If parameter 2001 is specified to ignore the mode selection, when all the mode selection signals are off (MOC in parameter 2001 = 0), this parameter enables the previously selected mode to be maintained for the specified time that mode unselected status is ignored.

Normally, specify the time needed to ignore mode signal chatter.

2015	Time that invalid mode selected status is ignored

Parameter input

Data type : Word

Unit of data : 1 ms

Valid range : 0 to 32767

If an invalid combination of mode signals is input, the previously selected mode is maintained for the specified time that the invalid mode selected status is ignored. After that, however, the mode unselected status is specified.

Normally, specify the time needed to ignore mode signal chatter.

2016	Manual feedrate override clamp value

Parameter input

Data type : Two words

Unit of data : 0.01%

Valid range : 0 to 65534

This parameter specifies the value used to clamp the manual feedrate override when an override value larger than the manual feedrate override clamp value is input. This parameter is valid only when the basic machine interface (BMI) is used. Normally, set this parameter to 65534 when using the FS3 or FS6 interface.

2020	Positive (+) direction command button on the software operator's panel

Parameter input

Data type : Byte axis

Unit of data : Integer

Valid range : 0 to 9

Specify the number of the numeric key on the MDI panel which instructs manual feed in the positive (+) direction on the software operator's panel for each axis. Specifying 0 means that the MDI panel does not have any numeric key that instructs the positive (+) direction. This parameter is valid only when the small CRT/MDI panel is used.

Example

Positive (+) direction of the 1st axis (X) : Numeric key 6
Positive (+) direction of the 2nd axis (Y) : Numeric key 9
Positive (+) direction of the 3rd axis (Z) : Numeric key 8

2021	Nagative (–) direction command button on the software operator's panel

Parameter input

Data type : Byte axis

Unit of data : Integer

Valid range : 0 to 9

Specify the number of the numeric key on the MDI panel which instructs manual feed in the negative (–) direction on the software operator's panel for each axis. Specifying 0 means that the MDI panel does not have any numeric key that instructs the negative (–) direction. This parameter is valid only when the small CRT/MDI panel is used.

Example

Negative (–) direction of the 1st axis (X) : Numeric key 4
Negative (–) direction of the 2nd axis (Y): Numeric key 1
Negative (–) direction of the 3rd axis (Z) : Numeric key 2

2030	Allowable number of digits in an M code

2031	Allowable number of digits in an S code

2032	Allowable number of digits in a T code

2033	Allowable number of digits in a B code (2nd auxiliary function)

Parameter input (valid only when the BMI interface is used)

Data type : Byte

Unit of data : Integer

Valid range : 1 to 8

Specify the allowable numbers of digits in the M, S, T, and B codes.

2049	How to search for a workpiece number

Parameter input

Data type : Byte

Valid range : –127 to +127

Descriptions

0 to 99:

The specified number is used for the first and second digits of the program number for searching (4–digit number). (The input signal value for searching for the workpiece number is used for the third and fourth digits.)

Values less than 0 (negative value) or 100 or more:

Searching is carried out in ascending order using the input signal value for searching for the workpiece number for the third and fourth digits of the program number. (The first and second digits are ignored.)

> **NOTE** The decimal setting of the parameter is used unconverted. The binary input of the input signal for searching for the workpiece number is converted into the decimal value.

Example 1

2049			10		
WN16	WN8	WN4	WN2	WN1	→ 1006 is searched for.
0	0	1	1	0	

Example 2

2049			–1		
WN16	WN8	WN4	WN2	WN1	→ ??06 is searched for in ascending order.
0	0	1	1	0	

2052	Rapid traverse rate for a drilling cycle in the three–dimensional coordinate conversion mode

Parameter input

Data type : Word

Unit of data :

Increment system	Data unit
Metric input	10.0mm/min
Inch input	10.0inch/min

Valid range : 0 to 32767

Specify the rapid traverse rate of the following movement for a drilling cycle in the three–dimensional coordinate conversion mode:

(1) Rapid traverse to point R

(2) Retraction to point R

(3) Rapid traverse to the initial point

When 0 is specified, a maximum cutting feedrate is used. A cutting override is applied to motions (1) to (3) because cutting–mode operation is performed in the three–dimensional coordinate conversion mode.

4.12 Parameters Related to CRT/MDI and Editing

		#7	#6	#5	#4	#3	#2	#1	#0
2200		RDS	PAL		NM9	NPE	RAL	REP	RDL

Parameter input

Data type : Bit

RDL When all programs are loaded simultaneously in the foreground (including external I/O device control):

0 : All the programs are loaded after previously loaded programs.

1 : Previously loaded programs are deleted first, then all the programs are loaded. Edition–prohibited programs, however, are not deleted.

REP If an attempt is made to load a program whose program number is the same as that of a previously loaded program:

0 : An alarm occurs.

1 : The previously loaded program is deleted first, then the attempted program is loaded. Edition–prohibited programs, however, are not deleted. In this case, an alarm occurs.

RAL Specifies whether a single program or all programs are loaded under external I/O device control (during both foreground and background editions) or by a cycle start signal.

0 : Single program

1 : All programs

NPE While a program is loaded, M02, M30, or M99 is:

0 : Assumed to be a program end.

1 : Not assumed to a program end.

In this case, the first block of the program must contain the program number.

NM9 While a program is loaded, M99 is:

0 : Assumed to be a program end.

1 : Not assumed to a program end.

The setting of NM9 is valid only when NPE = 0. Namely, to specify the parameter so that not M99, but M02 or M30 is assumed to be a program end during program loading, set NPE to 0 and NM9 to 1.

PAL Specifies whether a single program or all programs are punched under external I/O device control (only during foreground edition).

0 : Single program

1 : All programs

RDS Specifies whether loading programs by a cycle start signal is valid.

0 : Invalid

1 : Valid

This parameter is used to load programs externally, such as from the PMC or similar devices.

		#7	#6	#5	#4	#3	#2	#1	#0
2201		NCO	EDT				SB9	ND9	NE9

Parameter input

Data type: Bit

NE9 Specifies whether editing programs 09000 to 09999 is prohibited.

0 : Not prohibited

1 : Prohibited

ND9 Specifies whether programs 09000 to 09999 are displayed while they are executed.

0 : Displayed

1 : Not displayed

Specify 1 if custom macro programs need not be displayed while they are executed.

SB9 Specifies whether a single block stop is valid for the the macro statements of programs 09000 to 09999.

0 : Not valid

1 : Valid

Specify 1 when you want to debug programs 09000 to 09999.

EDT Specifies whether program edition is enabled when the mode selector is set to the MEMORY position.

0 : Disabled

1 : Enabled

WARNING Before restarting the operation in the MEMORY mode, be sure to return the cursor to the original position.

NOTE 1 When 1 is specified

After the program is stopped in the MEMORY mode with the single block or feed hold function, the mode is changed to the EDIT mode, enabling the program to be edited.

Editing while the main program is run

·Exactly the same as the normal edit function

Editing while the subprogram is run

·The program can be edited only in units of word.

·The programs called in the TAPE or MDI mode cannot be edited.

·Only the program can be edited.

NOTE 2 When this parameter is changed, the power must be turned off, then turned on again.

NC0 Specifies whether the memory for the selected program is automatically arranged when background editing is completed.

0 : Arranged

1 : Not arranged

	#7	#6	#5	#4	#3	#2	#1	#0
2202	DVM	DSM	DEV	DES	DCR	DTL	DSE	D10

Parameter input

Data type : Bit

D10 The position data is displayed on the CRT

0 : In least input increments.

1 : In the unit obtained by multiplying the least increment unit by 10.

DSE Specifies whether the coordinate system of the incremental positions displayed on the CRT is specified.

0 : Not specified

1 : Specified

Setting 1 (specified) refers to the following:

(i) Manual reference position return

(ii) When G92 (G50 for G–code system A for the lathe system), which specifies the coordinate system, sets the absolute positions displayed on the CRT, the displayed incremental positions are also set to the same values as the displayed absolute positions.

DTL For the Series 15–M

0 : The incremental and absolute positions displayed on the CRT include the distance traveled by tool length compensation/tool length compensation in tool axis direction.

1 : The incremental and absolute positions displayed on the CRT do not include the distance traveled by tool length compensation/tool length compensation in tool axis direction. Namely, the positions specified by the program are displayed.

For Series 15–T/15–TT

0 : The incremental positions displayed on the CRT include the distance traveled by tool length compensation/tool length compensation in tool axis direction.

1 : The incremental positions displayed on the CRT do not include the distance traveled by tool length compensation/tool length compensation in tool axis direction. Namely, the positions specified by the program are displayed.

For displaying the absolute positions, see the description of DTA in parameter 2203.

DCR For Series 15–M

0 : The incremental and absolute positions displayed on the CRT include the distance traveled by tool length compensation.

1 : The incremental and absolute positions displayed on the CRT do not include the distance traveled by tool length compensation. Namely, the positions specified by the program are displayed.

For Series 15–T/15–TT

0 : The incremental positions displayed on the CRT include the distance traveled by tool tip radius compensation.

1 : The incremental positions displayed on the CRT do not include the distance traveled by tool tip radius compensation. Namely, the positions specified by the program are displayed.

For displaying the absolute positions, see the description of DTA in parameter 2203.

DES

0 : The incremental and absolute positions displayed on the CRT do not include the acceleration/deceleration control delay.

1 : The incremental and absolute positions displayed on the CRT include the acceleration/deceleration control delay.

DEV

0 : The incremental and absolute positions displayed on the CRT do not include the servo delay (positional deviation).

1 : The incremental and absolute positions displayed on the CRT include the servo delay (positional deviation).

DSM

0 : The machine positions displayed on the CRT do not include the acceleration/deceleration control delay.

1 : The machine positions displayed on the CRT include the acceleration/deceleration control delay.

DVM

0 : The machine positions displayed on the CRT do not include the servo delay (positional deviation).

1 : The machine positions displayed on the CRT include the servo delay (positional deviation).

	#7	#6	#5	#4	#3	#2	#1	#0
2203	NNO	DH2		TLN	DTA	DAP	MCN	

Parameter input

Data type : Bit

MCN The machine positions are displayed on the CRT:

0 : In millimeters for a millimeter machine or in inches for an inch machine irrespective of the unit of data.

1 : In millimeters for metric input or in inches for inch input

DAP Specifies whether the current position on the program check screen is absolute or incremental.

0 : Incremental

1 : Absolute

DTA (Only for Series 15–T/15–TT)

0 : The absolute positions displayed do not include the distance traveled by tool offset and tool tip radius compensation or tool length compensation in tool axis direction. Namely, the positions specified by the program are displayed.

1 : The absolute positions displayed include the distance traveled by tool offset and tool tip radius compensation or tool length compensation in tool axis direction.

TLN When using the tool offset function by specifying tool numbers, T codes displayed on the program check screen and T codes that can be read with system variables of custom macros indicate

0 : Pot numbers

1 : Tool numbers

DH2 (For Series 15–TT only)

The current position is displayed on the current position screen in the order:

0 : Controlled axes for the 1st tool post and controlled axes for the 2nd tool post

1 : Controlled axes for the 2nd tool post and controlled axes for the 1st tool post

Example

DH2 =	0	DH2 =	1
X1	1.234	X2	3.456
Z1	2.345	Z2	4.567
X2	3.456	X1	1.234
Z2	4.567	Z1	2.345

NNO When the number of a message is different from that of the displayed external operator message, the message:

0 : Is line–fed.

1 : Is not line–fed.

	#7	#6	#5	#4	#3	#2	#1	#0
2204						DAK	POS	NOS

Parameter input

Data type : Bit

NOS Specifies whether the actual spindle speed is displayed on the CRT.

0 : Displayed

1 : Not displayed

The actual spindle speed is displayed on the CRT based on the feedback by the position coder installed in the spindle. Specify 1 for the machine without the position coder because the machine does not require threading and feed each rotation.

POS Specifies whether the machine position and absolute position are used on windows other than the PMC window.

0 : Not used

1 : Used

NOTE Specify 0 if reducing the load under the CNC is unnecessary.

DAK Specifies whether to display coordinates in the program coordinate system or workpiece coordinate system as absolute coordinates when the three–dimensional coordinate conversion mode is set.

0 : Display coordinates in the program coordinate system.

1 : Display coordinates in the workpiece coordinate system.

Note that this parameter is effective only in the three–dimensional coordinate conversion mode.

	#7	#6	#5	#4	#3	#2	#1	#0
2205	SPA	ITA	FRE	GER	JPN	ENG		

	#7	#6	#5	#4	#3	#2	#1	#0
2206							CHN	SWE

Parameter input

Data type : Bit

ENG, JPN, GER, FRE, ITA, SPA, and SWE Select the language to be used for the character data displayed on the CRT.

CHN	SWE	SPA	ITA	FRE	GER	JPN	ENG	Language on CRT
0	0	0	0	0	0	0	1	English
0	0	0	0	0	0	1	0	Japanese
0	0	0	0	0	1	0	0	German
0	0	0	0	1	0	0	0	French
0	0	0	1	0	0	0	0	Italian
0	0	1	0	0	0	0	0	Spanish
0	1	0	0	0	0	0	0	Swedish
1	0	0	0	0	0	0	0	Chinese

The standard languages are English and Japanese, which can be switched using the settings ENG and JPN.

The use of German, French, or Italian requires optional display language switch A, while the use of Spanish, Swedish, or Chinese requires optional display language switch B.

	#7	#6	#5	#4	#3	#2	#1	#0
2207	GRTLC	GRTRC					GRSTP	GRABG

Parameter input

Data type : Bit

GRABG Specifies which to use when both graphics display A and a background graphics display are available.

0 : Foreground

1 : Background

GRSTP While background drawing is executed, a non–graphic G code is used to:

0 : Continue the drawing.

1 : Stop the drawing.

GRTRC Specifies whether cutter compensation C is enabled.

0 : Disabled

1 : Enabled

GRTLC Specifies whether tool length compensation is enabled.

0 : Disabled

1 : Enabled

		#7	#6	#5	#4	#3	#2	#1	#0
2208				DP3D	DP3T				DMK

Parameter input

Data type : Bit

DMK Specifies whether the tarvel distance is displayed on the manual overlap screen using the coordinate system before or after three–dimensional coordinate conversion.

0 : After three–dimensional coordinate conversion

1 : Before three–dimensional coordinate conversion

DP3T From the values in the current position display, the tool length compensation along the tool axis is

0 : Not subtracted.

1 : Subtracted.

DP3D For three–dimensional coordinate conversion, the remaining distance the tool must be moved is displayed

0 : About the program coordinate system.

1 : About the workpiece coordinate system.

		#7	#6	#5	#4	#3	#2	#1	#0
2209		HPHB	ORGNA		TFGR		BGMCN		

Parameter input

Data type : Bit

HPHB When using a 9–inch plasma display:

0 : The display has both high and low gradations, as normal.

1 : All CNC screens have high gradation. PMC screens, however, are displayed conventionally.

Since how to set the following parameters, parameter Nos. 2210 to 2213, differs from that for ordinal parameters, be sure to see explanations.

BGMCN Specifies whether background graphics displays are based on the absolute or machine coordinates.

0 : Absolute coordinates

1 : Machine coordinates

TFGR This parameter is set to "1" when the following warning is displayed.
In case of 15–TFB or 15–TTFB system, "FAIL TO OCCUPY GRAPHIC CPU" message is displayed at power on.

ORGNA ORIGIN and PRESET for Relative coordinate system is :

0 : B specification

1 : A specification

Example

	Command/Operation	Parameter 2202# DTL(2)=0	Parameter 2202#DTL(2)=1
A spec.	G43 Z100. H1 ; ORIGIN	Z : 110.0 Z : 0.0	Z : 100.0 Z : –10.0
B spec.	G43 Z100. H1 ; ORIGIN	Z : 110.0 Z : 10.0	Z : 100.0 Z : 0.0

Offset value of No.1 (H1) is 10.0.

2210		Password (PSW)

Parameter input

Data type : Two words

Valid range : 0 to 99999999

Specify a password. When a value other than 0 is specified, the password is assumed. When the password is specified, the display of parameter 2210 becomes blank, and program edition is locked. This parameter can be specified when (password) = 0 or (key).

2211	Key (KEY)

Parameter input

Data type : Two words

Valid range : 0 to 99999999

Specifying the same value as the setting of PSW unlocks the key. The specified value is not displayed.

2212	Minimum value for the program protection range (PMIN)
2213	Maximum value for the program protection range (PMAX)

Parameter input

Data type : Two words

Valid range : 0 to 9999

Programs in the range specified by these parameters can be protected.

Specify the range of program numbers to be protected.

Setting : 0 to 9999

Example

Parameter 2212 = 7000

Parameter 2213 = 8499

Under the above conditions, programs O7000 to O8499 are protected.

Function selection with hard keys

Function selection can be performed with not only soft keys, but also with the following hard keys:

P O S	P R O G	OFFSET	P–CHECK
SETTING	SERVICE	MESSAGE	OTHERS

These hard keys correspond to the following function selection items:

POS : Current position
PROG : Program
OFFSET : Offset
P–CHECK : Program check
SETTING : Setting
SERVICE : Service
MESSAGE : Message
OTHERS : Screen selected by parameter 2215

	#7	#6	#5	#4	#3	#2	#1	#0
2214								HLSPNU

Parameter input

Data type : Bit axis

HLSPNU Specifies whether to update the amount of manual interrupt during three–dimensional handle interrupt mode.

0 : Updated.

1 : Not updated.

2215	Function selection number defined for the OTHERS key

Parameter input

Data type : Byte

Value	Function
0	Operation history
1	Current position
2	Program
3	Offset
4	Program check
5	Setting
6	Service
7	Message
8	Drawing (option)
9	Not used
10	Conversational macro (option)
11	Not used
12	Simplified conversation (option)
13	Operation history

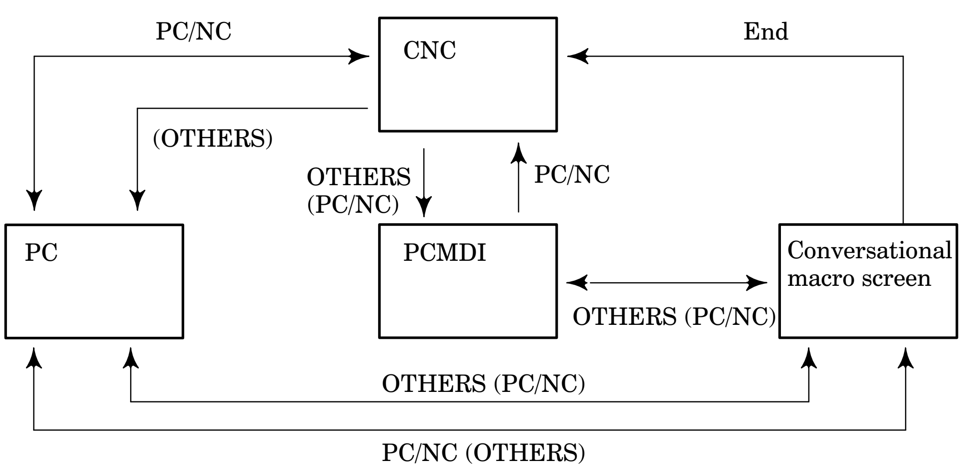
Valid data range : 0 to 13

Specify a function selection number to be defined for the OTHERS key. When 10 is set in this parameter, the conversational macro screen can be selected by pressing the OTHERS key.

When nothing is set in this parameter, operation history is selected by default.

Setting this parameter to 101 enables switching between the conversational macro screen and PCMDI screen, by pressing the OTHERS key.

When the parameter (data No. 2215) = 101, the key operations used to switch between screens are as shown below:



CNC :	OTHERS	→	PCMDI (or PC if the PCMDI cannot be displayed)
	PC/NC	→	PC (or PCMDI if bit 0 of parameter No.0013 = 1)
PCMDI :	OTHERS	→	conversational macro
	PC/NC	→	CNC (or the conversational macro if it has been activated)
PC :	OTHERS	→	conversational macro
	PC/NC	→	CNC (or the conversational macro if it has been activated)
Conversational macro :	OTHERS	→	PCMDI (or PC if the PCMDI cannot be displayed)
	PC/NC	→	PC (or PCMDI if bit 0 of parameter No.0013 = 1)
	End	→	CNC

2231	Number of the axis whose servo motor data is displayed on the 1st load meter

2232	Number of the axis whose servo motor data is displayed on the 2nd load meter

2233	Number of the axis whose servo motor data is displayed on the 3rd load meter

Parameter input

Data type : Byte

Unit of data : Axis number

Valid range : 0 or 1 to the maximum number of controlled axes

Among the four load meters, specify the numbers of the servo axes whose data items are to be displayed on the 2nd to 4th load meters. (The 1st load meter is used to display spindle data.) If the data need be displayed on only two out of three load meters, specify 0 as the number of the axis whose data is to be displayed on the 3rd load meter of the servo motor.

In Series 15–TT, specify the number of the axis whose data is to be displayed on the load meter for the 1st tool post.

2234	Rated load of the motor to be displayed on the load meter of the 1st spindle

2235	Rated load of the motor to be displayed on the load meter of the 2nd spindle

2236	Rated load of the motor to be displayed on the load meter of the 3rd spindle

2237	Rated load of the motor to be displayed on the load meter of the 4th spindle

Parameter input

Data type : Word

Valid range : 1 to 255

Specify the rated loads of the motors corresponding to the load meters.

In Series 15–TTA, the load meters for the 1st tool post are used.

2251	Number of the axis whose data is displayed on the 1st load meter for the 2nd tool post

2252	Number of the axis whose data is displayed on the 2nd load meter for the 2nd tool post

2253	Number of the axis whose data is displayed on the 3rd load meter for the 2nd tool post

Parameter input (for Series 15–TT)

Data type : Byte

Unit of data : Axis number

Valid range : 1 to the number of controlled axes

Necessary data can be displayed on up to eight load meters for two spindles and six servo axes. The spindle load meters for each tool post are displayed first.

2254	Rated load of the motor to be displayed on the load meter for the 2nd spindle

2255	Rated load of the motor to be displayed on the 1st load meter for the 2nd tool post

2256	Rated load of the motor to be displayed on the 2nd load meter for the 2nd tool post

2257	Rated load of the motor to be displayed on the 3rd load meter for the 2nd tool post

Parameter input (for Series 15–TT)

Data type : Word

Valid range : 1 to 255

Specify the rated loads of the motors corresponding to the load meters.

```
OPERATING MONITOR                          HEAD1 01234 N12345
                                           HEAD2 02345 N23456
  (ABSOLUTE)                 (FEEDRATE/SPINDLE/TOOL)
  X1      –1.234             CMD.F : 1000.000    655.35%
  Z1     –23.456             ACT.F :   9999.9 (MM/MIN)
  C1    –345.678                   :    999.9 (MM/REV)
  X2   –4567.890             CMD.S :   –55555       120%
  Z2 –56789.012              ACT.S :     5000 (RPM)
  Y2    –270.420                 T :    12345
  (LOAD METER)                 (TIMER) PARTS:99999
  S======                    % OPERATING : 1234H  56M  00S
  X===                       % CUTTING   :   60H  59M  59S
  Z========                  % FREE      :    1H  30M  30S
  C=
POSITION | PROGRAM | OFFSET | PRG±CHK | CHAPTER | +
```

```
OPERATING MONITOR                          HEAD1 01234 N12345
                                           HEAD2 02345 N23456
  (ABSOLUTE)                 (FEEDRATE/SPINDLE/TOOL)
  X1      –1.234             CMD.F : 1000.000    655.35%
  Z1     –23.456             ACT.F :   9999.9 (MM/MIN)
  C1    –345.678                   :    999.9 (MM/REV)
  X2   –4567.890             CMD.S :   –55555       120%
  Z2 –56789.012              ACT.S :     5000 (RPM)
  Y2    –270.420                 T :    12345
  (LOAD METER)                 (TIMER) PARTS:99999
  S=====                     % OPERATING : 1234H  56M  00S
  X======                    % CUTTING   :   60H  59M  59S
  Z==                        % FREE      :    1H  30M  30S
  C=
BUFFER1 | BUFFER2 | BUFFER3 | OPE.MNTR |  | +
```

Example of 9 inch CRT

The following table lists the rated loads of each motor. For example, the rated load to be set to the parameter is 168 for AC analog servo motor model 4–0.

(1) α series motor/αE series motor

Motor model (Motor specifications)	Current (Arms) and window conversion expression		Rated load current (Arms)	Window display values at the time of rated load
	Current I → Window W	Window W → Current I		
α3HV	W=128+ 6.4 *SQRT(2)*I	I=(W–128)/(6.4 *SQRT(2))	2.78	153
α6HV	W=128+ 6.4 *SQRT(2)*I	I=(W–128)/(6.4 *SQRT(2))	3.50	160
α12HV	W=128+ 3.2 *SQRT(2)*I	I=(W–128)/(3.2 *SQRT(2))	8.67	167
α22HV	W=128+ 3.2 *SQRT(2)*I	I=(W–128)/(3.2 *SQRT(2))	12.24	183
α30HV	W=128+ 3.2 *SQRT(2)*I	I=(W–128)/(3.2 *SQRT(2))	12.40	184
αC3	W=128+ 6.4 *SQRT(2)*I	I=(W–128)/(6.4 *SQRT(2))	2.78	153
αC6	W=128+ 6.4 *SQRT(2)*I	I=(W–128)/(6.4 *SQRT(2))	3.50	160
αC12	W=128+ 6.4 *SQRT(2)*I	I=(W–128)/(6.4 *SQRT(2))	5.78	180
αC22	W=128+ 3.2 *SQRT(2)*I	I=(W–128)/(3.2 *SQRT(2))	12.24	183
αC30	W=128+ 3.2 *SQRT(2)*I	I=(W–128)/(3.2 *SQRT(2))	12.65	185
αC40	W=128+ 1.6 *SQRT(2)*I	I=(W–128)/(1.6 *SQRT(2))	18.96	171
α0.5	W=128+ 10.67 *SQRT(2)*I	I=(W–128)/(10.67 *SQRT(2))	2.48	165
α1/3	W=128+ 10.67 *SQRT(2)*I	I=(W–128)/(10.67 *SQRT(2))	2.19	161
α2/2	W=128+ 10.67 *SQRT(2)*I	I=(W–128)/(10.67 *SQRT(2))	2.19	161
α2/3	W=128+ 10.67 *SQRT(2)*I	I=(W–128)/(10.67 *SQRT(2))	2.90	172
α3/3	W=128+ 3.2 *SQRT(2)*I	I=(W–128)/(3.2 *SQRT(2))	4.54	149
α6/2	W=128+ 3.2 *SQRT(2)*I	I=(W–128)/(3.2 *SQRT(2))	5.45	153
α6/3	W=128+ 1.6 *SQRT(2)*I	I=(W–128)/(1.6 *SQRT(2))	10.25	151
α12/2	W=128+ 3.2 *SQRT(2)*I	I=(W–128)/(3.2 *SQRT(2))	8.67	167
α12/3	W=128+ 1.6 *SQRT(2)*I	I=(W–128)/(1.6 *SQRT(2))	15.18	162
α22/1.5	W=128+ 3.2 *SQRT(2)*I	I=(W–128)/(3.2 *SQRT(2))	12.24	183
α22/2	W=128+ 1.6 *SQRT(2)*I	I=(W–128)/(1.6 *SQRT(2))	18.37	170
α22/3	W=128+ 0.98 *SQRT(2)*I	I=(W–128)/(0.98 *SQRT(2))	31.49	172
α30/1.2	W=128+ 1.6 *SQRT(2)*I	I=(W–128)/(1.6 *SQRT(2))	12.40	156
α30/2	W=128+ 0.98 *SQRT(2)*I	I=(W–128)/(0.98 *SQRT(2))	19.84	156
α30/3	W=128+ 0.98 *SQRT(2)*I	I=(W–128)/(0.98 *SQRT(2))	33.04	174
α40/2	W=128+ 0.98 *SQRT(2)*I	I=(W–128)/(0.98 *SQRT(2))	27.33	166
α40/FAN	W=128+ 0.98 *SQRT(2)*I	I=(W–128)/(0.98 *SQRT(2))	40.21	184
α65	W=128+ 0.58 *SQRT(2)*I	I=(W–128)/(0.58 *SQRT(2))	63.57	180
α100	W=128+ 0.38 *SQRT(2)*I	I=(W–128)/(0.38 *SQRT(2))	83.58	173
α150	W=128+ 0.38 *SQRT(2)*I	I=(W–128)/(0.38 *SQRT(2))	112.71	189
αM3	W=128+ 3.2 *SQRT(2)*I	I=(W–128)/(3.2 *SQRT(2))	5.15	151
αM6	W=128+ 1.6 *SQRT(2)*I	I=(W–128)/(1.6 *SQRT(2))	7.86	146
αM9	W=128+ 1.6 *SQRT(2)*I	I=(W–128)/(1.6 *SQRT(2))	10.69	152
2–0E	W=128+ 16 *SQRT(2)*I	I=(W–128)/(16 *SQRT(2))	2.25	179
1–0E	W=128+ 16 *SQRT(2)*I	I=(W–128)/(16 *SQRT(2))	2.77	191
αE1/3	W=128+ 10.67 *SQRT(2)*I	I=(W–128)/(10.67 *SQRT(2))	2.25	162
αE2/3	W=128+ 10.67 *SQRT(2)*I	I=(W–128)/(10.67 *SQRT(2))	2.77	170
αE3/2	W=128+ 6.4 *SQRT(2)*I	I=(W–128)/(6.4 *SQRT(2))	5.41	177
αE6/2	W=128+ 6.4 *SQRT(2)*I	I=(W–128)/(6.4 *SQRT(2))	5.41	177
αL3	W=128+ 3.2 *SQRT(2)*I	I=(W–128)/(3.2 *SQRT(2))	5.23	152
αL6	W=128+ 1.6 *SQRT(2)*I	I=(W–128)/(1.6 *SQRT(2))	10.25	151
αL9	W=128+ 1.6 *SQRT(2)*I	I=(W–128)/(1.6 *SQRT(2))	15.20	162
αL25	W=128+ 0.98 *SQRT(2)*I	I=(W–128)/(0.98 *SQRT(2))	33.23	174
αL50	W=128+ 0.98 *SQRT(2)*I	I=(W–128)/(0.98 *SQRT(2))	45.96	192

Example of calculating the rated load of the OS motor

1 Value displayed on the window when a 10 A (rms) current flows

$$W = 128 + 3.2 * \frac{(\sqrt{2} * 10)}{\text{Peak current conversion}} = 173.25$$

Or when a current flows in reverse

$$W = 128 - 3.2 * \frac{(\sqrt{2} * 10)}{} = 82.75$$

2 When 200 is displayed on the window, the valid current is calculated as follows:

$I = ((200 - 128) / 3.2) / \sqrt{2} = 15.9$ (Arms)

The current (Arms) is converted to a window value by the following expression:

$W = 128 + \alpha * \sqrt{2} * I$ …(1)

where,

W = window value

α=128/maximum servo amplifier current

I = current (Arms)

The rated motor load is obtained by substituting the rated load current of the servo motor for I (current) of equation (1) above.

3 Spindle Motor

Spindle Motor model	Voltage–digital value conversion expression	Loadmeter voltage in continuous rated	Digital value
1S, 3S 6S, 8S 12S	128 + 12.8 V	5.55	199
15S 18S 22S	128 + 12.8 V	6.66	213
2S	128 + 12.8 V	5.0	192
1.5S	128 + 12.8 V	5.0	192

2274	Number of the program to start drawing (O)

Parameter input

Data type : Word

Valid range : 0 to 9999 (0 is assumed when the range is exceeded.)

2275	Number of the sequence to start drawing (N)

Parameter input

Data type : Two words

Valid range : 0 to 99999 (0 is assumed when the range is exceeded.)

2276	Number of the program to end drawing (O)

Parameter input

Data type : Word

Valid range : 0 to 9999 (0 is assumed when the range is exceeded.)

2277	Number of the sequence to end drawing (N)

Parameter input

Data type : Two words

Valid range : 0 to 99999 (0 is assumed when the range is exceeded.)

To draw only part of a program, specify drawing start and end blocks with the four–digit program number and five–digit sequence number. When the above parameters are set to 0, the function is ignored, and the whole program is drawn. Normally, specify 0.

NOTE Blocks Oxxxx and Nxxx, which correspond respectively to the program and sequence numbers to be specified in the above parameters, must be single blocks or contain NC statements. If a subprogram, macro program, or command for calling a macro program is specified for the block, the block is ignored.

2278	Drawing program number (O)

Parameter input

Data type : Word

Valid range : 0 to 9999 (0 is assumed when the range is exceeded.)

Specify the number of the desired drawing program. Press the HEAD soft key to move the drawing program pointer to the head of the program number specified by this parameter.

2279	Maximum drawing tool number

Parameter input

Data type : Word

Valid range : 0 to 9999 (0 is assumed when the range is exceeded.)

2280	Minimum drawing tool number

Parameter input

Data type : Word

Valid range : 0 to 9999 (0 is assumed when the range is exceeded.)

To draw only part of a program, specify the maximum and minimum drawing tool numbers as well as the drawing start program number and sequence number and drawing end program number and sequence number. These parameters specify the tool number range. Drawing is enabled while the workpiece is machined using the tools in the specified range.

The parameters are invalid if the settings for the maximum and minimum drawing tool numbers are 0. When only the minimum drawing tool number is set to 0, drawing is carried out using the tool with the specified maximum tool number and all the tools with numbers lower than it. When only the maximum drawing tool number is set to 0, drawing is carried out using the tool with the specified minimum tool number and all the tools with numbers higher than it.

The maximum and minimum drawing tool numbers as well as the drawing start program and sequence numbers and drawing end program and sequence numbers can be specified.

2283	Offset 1 that can be changed during drawing

Setting input
Data type : Word
Valid range : 0 to 9999 (0 is assumed when the range is exceeded.)

NOTE When 0 is specified, the parameter is disabled.

2284	Offset 2 that can be changed during drawing

Setting input
Data type : Word
Valid range : 0 to 9999 (0 is assumed when the range is exceeded.)

NOTE When 0 is specified, the parameter is disabled.

2285	Offset 3 that can be changed during drawing

Setting input
Data type : Word
Valid range : 0 to 9999 (0 is assumed when the range is exceeded.)

NOTE When 0 is specified, the parameter is disabled.

Generally, the offsets cannot be changed with G10 or the system variable during background drawing. (These commands are ignored if they are issued.)

The three offsets specified with the above parameters can be changed during drawing, however. (The offsets used for machining are not affected.)

2291	Program numbers used for both the 1st and 2nd tool posts

Setting input (for Series 15–TT only)
Data type : Word
Valid range : 1 to 9999

Programs with program numbers that exceed the setting of this parameter are used as main programs or subprograms for both the 1st and 2nd tool posts.

Example When the setting is 7000

(i) Program Nos. 1 to 6999 : The odd program Nos. are used for the 1st tool post. The even program Nos. are used for the 2nd tool post.

(ii) Program Nos. 7000 to 9999 : These numbers can be used for both the tool posts.

2311	Name of the general–purpose switch on the software operator's panel
to	to
2388	Name of the general–purpose switch on the software operator's panel

Parameter input

Data type : Byte

Valid range : –128 to +127

Specify the names of the general–purpose switches (SIGNAL 1 to SIGNAL 8) on the software operator's panel shown in the figure on the right:

```
OPERATOR'S PANEL                          01234 N56789

   SIGNAL 1 :      OFF      ON
   SIGNAL 2 :      OFF      ON
   SIGNAL 3 :      OFF      ON
   SIGNAL 4 :      OFF      ON
   SIGNAL 5 :      OFF      ON
   SIGNAL 6 :      OFF      ON
   SIGNAL 7 :      OFF      ON
   SIGNAL 8 :      OFF      ON

ACTUAL POSITION              (ABSOLUTE)
  X  123.456                   Y –456.789
  Z  –10.047
```

Specify the character codes of each switch name in parameters 2311 to 2388.

Specify the code corresponding to S of SIGNAL 1 (083) in parameter 2311.
Specify the code corresponding to I of SIGNAL 1 (073) in parameter 2312.
Specify the code corresponding to G of SIGNAL 1 (071) in parameter 2313.
Specify the code corresponding to N of SIGNAL 1 (078) in parameter 2314.
Specify the code corresponding to A of SIGNAL 1 (065) in parameter 2315.
Specify the code corresponding to L of SIGNAL 1 (076) in parameter 2316.
Specify the code corresponding to a blank of SIGNAL 1 (032) in parameter 2317.
Specify the code corresponding to 1 of SIGNAL 1 (049) in parameter 2318.

In the same way as above, specify the following:

Specify the codes corresponding to the character string of SIGNAL 2 in parameters 2321 to 2328.
Specify the codes corresponding to the character string of SIGNAL 3 in parameters 2331 to 2338.
Specify the codes corresponding to the character string of SIGNAL 4 in parameters 2341 to 2348.
Specify the codes corresponding to the character string of SIGNAL 5 in parameters 2351 to 2358.
Specify the codes corresponding to the character string of SIGNAL 6 in parameters 2361 to 2368.
Specify the codes corresponding to the character string of SIGNAL 7 in parameters 2371 to 2378.
Specify the codes corresponding to the character string of SIGNAL 8 in parameters 2381 to 2388.

For the character codes, see the character–to–code correspondence table.

Character–to–codes Correspondence Table

Character	Code	Comment	Character	Code	Comment
A	065		6	054	
B	066		7	055	
C	067		8	056	
D	068		9	057	
E	069			032	Space
F	070		!	033	Exclamation mark
G	071		”	034	Quotation mark
H	072		#	035	Sharp
I	073		$	036	Dollar symbol
J	074		%	037	Percent
K	075		&	038	Ampersand
L	076		’	039	Apostrophe
M	077		(	040	Left parenthesis
N	078		)	041	Right parenthesis
O	079		*	042	Asterisk
P	080		+	043	Plus sign
Q	081		,	044	Comma
R	082		–	045	Minus sign
S	083		.	046	Period
T	084		/	047	Slash
U	085		:	058	Colon
V	086		;	059	Semi–colon
W	087		<	060	Left angle bracket
X	088		=	061	Sign of equality
Y	089		>	062	Right angle bracket
Z	090		?	063	Question mark
0	048		@	064	Commercial at mark
1	049		[	091	Left square bracket
2	050		^	094	
3	051		¥	092	Yen symbol
4	052		]	093	Right square bracket
5	053		_	095	Underline
				000	Space

4.13 Parameters Related to Program

	#7	#6	#5	#4	#3	#2	#1	#0
2400	GSC	GSB	DWL	M30		G70	F41	DPI

Parameter input

Data type : Bit

DPI A value with the decimal point is entered

0 : By the conventional method.

1 : In fixed–point notation.

F41 If the feed per minute of F code (G94 mode) is entered in metric without the decimal point, the unit is:

0 : 1 mm/min

1 : 0.1 mm/min

If it is entered with the decimal point, the unit is always mm/min.

G70 Inch input and metric input are specified as shown below (for the Series 15–M):

0 : G20 (inch input) and G21 (metric input)

1 : G70 (inch input) and G71 (metric input)

M30 If M30 is entered in memory operation:

0 : Only M30 is sent to the machine, and the program head is searched for by the reset and rewind signal (RRW).

1 : If M30 is sent to the machine, the program head is automatically searched for at the same time. Therefore, when completion signal FIN for M30 is returned before reset or reset and rewind, the program is reexecuted from the beginning.

For M02, see M02 of parameter No. 2403.

DWL Dwell (G04) is:

0 : Always dwell in seconds

1 : Dwell in seconds in case of feed per minute mode (G94) or dwell in revolutions in case of feed per revolution mode (G95)

GSB, GSC Selection of G code system used in Series 15–T/15–TT

GSC	GSB	G code selection
0	0	G code system A
0	1	G code system B
1	0	G code system C

	#7	#6	#5	#4	#3	#2	#1	#0
2401	NCM	MBF	G18	G95	G44	G43	G90	G01

Parameter input

Data type : Bit

G01 Mode at power on and in clear status

0 : G00 mode (positioning)

1 : G01 mode (linear interpolation)

G90 Mode at power on and in clear status

0 : G91 mode (incremental command)

1 : G90 mode (absolute command)

For G code system A in Series 15–T/15–TT, this parameter is invalid; a programmed address is used to select the incremental command or absolute command.

G43, G44 Specify G43, G44, or G49 mode at power on or in clear status (only for the Series 15–M)

G44	G43	G43, G44, G49 mode
0	0	G49 mode
0	1	G43 mode
1	0	G44 mode

G95 Mode at power on and in clear status

0 : G94 mode (feed per minute)

1 : G95 mode (feed per revolution)

G18 Mode at power on and in clear status (only for the Series 15–M)

0 : G17 mode

1 : G18 mode

In case of Series 15–T/15–TT, the G18 mode is provided when power is turned on or when the system is cleared irrespective of this parameter.

MBF Selects or cancels the multibuffer mode at power on and in the clear state.

0 : Cancels the multibuffer mode.

1 : Selects the multibuffer mode. (When the optional multibuffer 15–block/60–block function is not provided, five buffer blocks are used for the look–ahead operation.)

When the multibuffer mode is selected, the advance control function is enabled. If provided, the high–precision contour control function is also enabled.

NOTE This parameter becomes valid when the system is reset.

NCM The following modal information is cleared or not cleared by reset:

G00 to G03, G17 to G19, G54 to G59, G93 to G95, G96 to G97, G90 to G91, G43 to G49, and F codes, H codes, S codes and T codes

0 : Cleared

1 : Not cleared

Set bit 1 (NCWS) and bit 2 (ENCW) of parameter No. 7620 to separate G54 to G59 from other data items when bit 7 (NCM) of parameter No. 2401 is specified.

Parameter			Function	
NO.2401#7 (NCM)	NO.7620#2 (ENCW)	NO.7620#1 (NCWS)	Continuous–state information G54 to G59	Other continuous–state information items
0	0	0	Cleared	Cleared
0	0	1	Cleared	Cleared
0	1	0	Cleared	Cleared
0	1	1	Not cleared	Cleared
1	0	0	Not cleared	Not cleared
1	0	1	Not cleared	Not cleared
1	1	0	Cleared	Not cleared
1	1	1	Not cleared	Not cleared

	#7	#6	#5	#4	#3	#2	#1	#0
2402	SLE	SMX				ZNP	INC	

Parameter input

Data type : Bit

INC After manual intervention by manual absolute on, INC specifies whether the travel command path for absolute (G90) and for incremental (G91) are the same.

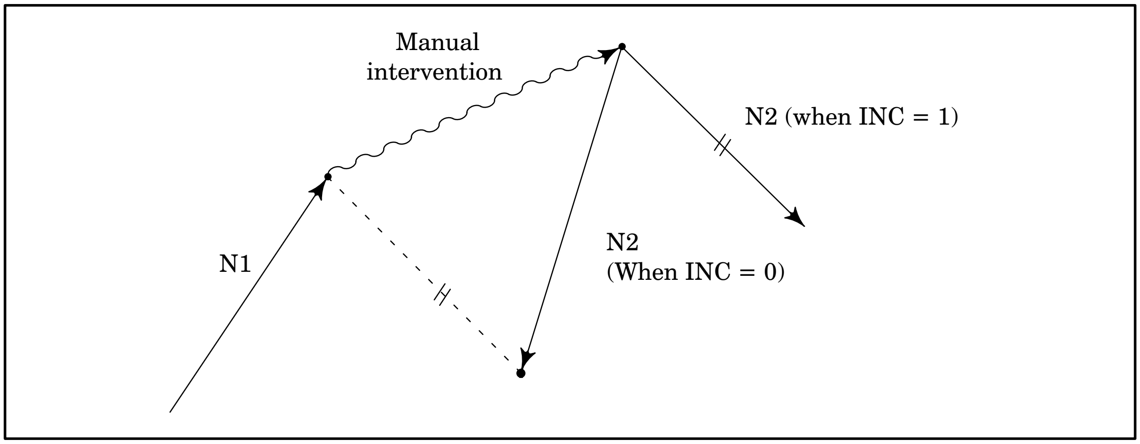
0 : Same (path for absolute)

1 : Different (path for FANUC 6)

Normally specify 1.

N1X__Y__ ;

N2G91X__Y__;



ZNP When the manual reference position return is completed, the work coordinate system is:

0 : Preset only under the reset condition (OP signal is OFF).

1 : Always preset.

CAUTION If this bit is set to 1, all axes are always preset regardless of the setting of bit 3 (PLZx) of parameter No. 1005.

SMX S code instructed in the same block as G92 (G50 for G code system A for a coordinate system setting and lathe system) is:

0 : The maximum spindle speed command is assumed.

1 : The maximum spindle speed command is not assumed. (Spindle speed command is assumed.)

SLE E code specification (only for Series 15–T/15–TT)

0 : Specifies the number of ridges per inch of screw.

1 : Specifies the thread lead.

	#7	#6	#5	#4	#3	#2	#1	#0
2403		UVW	PCM		ENS		NZN	M02

M02 When M02 is transmitted during memory operation

0 : M02 is only sent to the machine, and reset and rewind signal (RRW) is used for program heading.

1 : M02 is sent out to the machine, and a program heading is automatically executed. Consequently, when completion signal FIN for M02 is returned without reset or reset and rewind, the program is restarted from the beginning.

NZN 0 : When the manual reference position is returned, whether the coordinate system is preset depends on parameter No. 1005 PLZx or 2402 ZNP.

1 : The coordinate system is always not preset when the manual reference position is returned in all axes. (Except for the first manual reference position return after power on)

ENS When a blank code (not a punched hole) of EIA code was commanded in the significant information section:

0 : It shall be an alarm.

1 : It shall be ignored.

PCM Counting the number of parts is specified by:

0 : M code set by M02, M30, or parameter No. 2426

1 : Only M code set by parameter No. 2426

UVW (the Series 15–T only)

0 : U, V, W are not used as an axis name.

1 : U, V, W are used as an axis name. (B or C must be used in the G code system.)

	#7	#6	#5	#4	#3	#2	#1	#0
2404		KC	SFLE					

Parameter input

Data type : Bit

SFLE Specifies whether to specify a program number or file number for P specification when the external memory subprogram call function is used.

0 : Specify a program number.

1 : Specify a file number.

NOTE 1 Program numbers cannot be specified when a bubble cassette is used for external memory.
NOTE 2 Program numbers cannot be specified when a remoter buffer is used for external memory.

KC When the system is reset, the Cs axis control switching will:

0 : Be returned to its status when power is turned on.

1 : Remain unchanged.

	#7	#6	#5	#4	#3	#2	#1	#0
2405	RSO	FPR	NPAA					

Parameter input

Data type : Bit

NPAA When movement along the PMC control axis is specified by an NC program:

0 : The alarm PS450 occurs.

1 : The alarm PS450 does not occur.

WARNING If 1 is selected, the CNC move command is ignored.

FPR Specifies whether the function for feed per rotation without a position coder (the function for convert ing feed–per–rotation F into feed–per–minute F) is used in the feed–per–rotation mode (G95).

0 : Not used.

1 : Used.

RSO Specifies whether spindle override is enabled when the function for feed–per–rotation without a position coder (the function for converting feed–per–rotation F into feed–per–minute F) is being used in the feed–per–rotation mode.

0 : Disabled.

1 : Enabled.

This function is provided for machines that do not have (or use) a position coder. When a feedrate is specified in the feed–per–rotation mode, it is converted to a feedrate in the feed–per–minute mode on the assumption that the spindle turns according to the spindle speed command (S code). The tool is then moved along the feed axis at the converted feedrate.

Example G95 G01 F1. S1000 Z100. ;
When the above command is specified, the tool is moved along the Z–axis at F1000 in the feed–per–minute mode [mm/min], on the assumption that the spindle turns at 1000 revolutions per minute.

NOTE	In this function, S1 corresponds to one rpm.

When the FPR bit of parameter 2405 is set to 1, a feedrate specified in the feed–per–rotation mode is converted to a feedrate in the feed–per–minute mode on the assumption that the spindle turns according to the spindle spee d command (S code).

Example When the FPR bit of parameter 2405 is set:

O1234 ;

N01 G94 F100. ; ······ Feed–per–minute mode F100. [mm/min]

N02 G01 G90 X100. ; ···· Cutting at F100. [mm/min]

N03 G95 S300 M03 F20. ; · Feed–per–rotation mode F20. [mm/rev] S300. [rev/min]

N04 Z100. ; ········· Cutting at F6000. [mm/min]
(= 20 [mm/rev] * 300 [rev/min])

N05 S0 ; ········· S0. [rev/min]

N06 Z200. ; ········· Cutting at F0. [mm/min] D> Alarm PS187 generated
(= 20 [mm/rev] * 0 [rev/min])

N07 M05 ;

N08 M30 ;

NOTE 1 Threading is performed based on the feed signal sent from the position coder even when the FPR bit of parameter 2405 is set to 1 to use the function for feed–per–rotation without a position coder. This means that the f unction is invalid for threading commands.

NOTE 2 When this function is enabled, the following functions are also enabled:
– Signals related to feedrate override
– Signals related to spindle override
– Dry run signal
– Clamping the maximum cutting feedrate for each axis
– Dwell per rotation

	#7	#6	#5	#4	#3	#2	#1	#0
2407	CDSP					RMTI		EFPL

Data type : Bit

EFPL Whether plane conversion is performed for a G92 or G92.1 command

0 : Not performed

1 : Performed

This parameter is effective only when the multi–buffer operation is performed (bit 5 of parameter No. 0000 is set to 0). For other operations, the setting of bit 6 of parameter No. 2401 is valid.

RMTI Specifies the mode for multibuffer and look–ahead acceleration/deceleration before interpolation when the power is turned on or the system is reset.

0 : The mode is set to off.

1 : The mode is set to on.

CDSP

0 : Smooth interpolation is disabled.

1 : Smooth interpolation is enabled.

Set 1 when performing smooth interpolation.

2410	Arc radius error limit value

Setting input

Data type : Two words

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric entry	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch entry	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range: 0 to 99999999

Specify a valid limit value as the difference between the radius values at the start and end points for circular interpolation command.

Standard setting: 20

2411	M code 1 which does not put the following block in the buffer register

2412	M code 2 which does not put the following block in the buffer register

2413	M code 3 which does not put the following block in the buffer register

2414	M code 4 which does not put the following block in the buffer register

2415	M code 5 which does not put the following block in the buffer register

2416	M code 6 which does not put the following block in the buffer register

2417	M code 7 which does not put the following block in the buffer register

2418	M code 8 which does not put the following block in the buffer register

2419	M code 9 which does not put the following block in the buffer register

2420	M code 10 which does not put the following block in the buffer register

Parameter input

Data type : Byte

Valid range : 0 to 255

Specify M codes that do not put the following block in the buffer register. If there is an M code whose next block should not be put in the buffer register until the M function processing terminates in the machine specify these M codes.

M00, M01, M02, and M30 are M codes that do not put the following block in the buffer register even though these parameters are not specified for them.

Parameter Nos. 2503 and 2504 can also be used to specify these M codes.

Buffering is not suppressed if this parameter is set to the same M code value as that set in the subprogram call M code (data Nos. 7071 to 7079) or macro call M code (data Nos. 7080 to 7089).

2426	M code for counting up the number of parts

Parameter input

Data type : Byte

Unit : Integer

Valid range : 0 to 97

2429	M code for tool replacement

Parameter input

Data type : Word

Unit : Integer

Valid range : 0 to 9999 (except for 01, 02, 30, 98, and 99)

The M code starts counting the tool life in the tool life management function and validates the length offset and diameter offset in the tool offset by the tool number.

If 0 is set, it is regarded as 6 (M06).

2430	Cs–axis number

Parameter input

Data type : Byte

Unit of data : Axis number

Valid range : 1 to the maximum number of control axes

Example When the control axis configuration is X1, Z1, C1, X2, Z2, Y2, and B2, the setting of parameter No. 2430 for C1 is 3 because the C1–axis is used as the third axis. (When there are one spindle and two tool posts, always specify the boundary control axis number between tool post 1 and tool post 2 for parameter No. 2430.)

2431	M code to execute subprogram call in external memory

Data type : Word

Valid range : 1 to 999

NOTE When 0 is set, M198 is used to execute an external memory subprogram call.
M01, M02, M30, M98, M99 cannot be used for this purpose.

2440	Minimum radius to which a specified feedrate is kept in spiral interpolation or conical interpolation

Parameter input

Data type : Two word

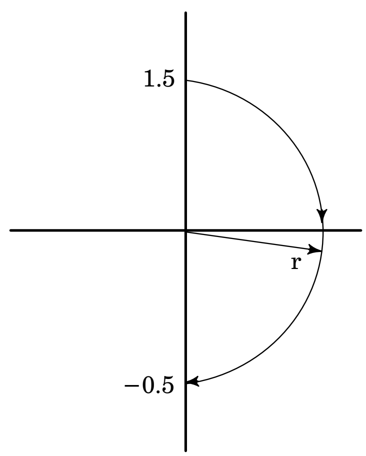
Unit of data and valid range:

Increment system			Data range	
	Millimeter input	Inch input	Millimeter input	Inch input
IS–A IS–B IS–C IS–D IS–E	0.01 0.001 0.0001 0.00001 0.000001	0.001 0.0001 0.00001 0.000001 0.0000001	1000 to 99999999	10000 to 99999999

If this parameter is set to or out of range, it is assumed that the minimum value in the data range is specified.

In spiral interpolation and conical interpolation, the feedrate is usually kept constant. When the radius of a spiral becomes small near the center of the spiral, however, the corresponding angular velocity may become very high. To prevent this from occurring, the system keeps the angular velocity constant when the radius of a spiral reaches the value specified in parameter No. 2440, resulting in a lower velocity than before.

An example is shown below.



Specified feedrate : F100
Parameter No. 2440 (r) : 1000
Increment system : IS−B

When spiral interpolation is used under the above conditions, the feedrate is F100 for a radius larger than the value specified in parameter No. 2440. The feedrate is gradually reduced as the radius becomes smaller and is a bout F65 at the end point of the spiral.

2482	Waiting M codes

Parameter input

Data type : Word

Valid range : 100 to 999

Specify the range of a waiting M code.

Example A setting of 500 enables the use of 500 to 999 as waiting M codes.

2503	Range of M codes without buffering (1)

2504	Range of M codes without buffering (2)

Parameter input

Data type : Long type

Valid range : 0–999999

Neither parameter No. 2503 nor parameter No. 2504 can be used with the 15–TTB/15–TTFB.

Specify the range of M codes without buffering. The upper limit is represented by the first three digits of the parameter value, and the lower limit by the last three digits. Two ranges can be specified, using parameters No. 2503 and 2504. If the specified upper and lower limits are found to be incompatible, the entered parameter is invalidated.

Example To prevent M10 to M19 and M80 to M89 from being buffered, specify 19010 in parameter No. 2503 and 89080 in parameter No. 2504.

Parameters No. 2411 to 2418 each specify an M code without buffering. Parameters No. 2503 and 2504 can be used together with these parameters, and allow a series of M codes to be specified simultaneously.

2510	Involute interpolation allowable error limit

Parameter input

Data type : Two words

Unit of data :

Setting unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine input	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine input	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to 99999999

The involute interpolation command is used to specify the limit value allowed as a shift between the involute curve passing through the start point and the involute curve passing through the end point.

A negative value is compared as its absolute value.

2511	Permissible difference between the positions of the specified end point and the end point calculated from the increment or decrement and number of circles in spiral or conical interpolation

Parameter input

Data type : Two–word axis

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E
Millimeter input	0.01	0.001	0.0001	0.00001	0.000001
Inch input	0.001	0.0001	0.00001	0.000001	0.0000001

Valid data range : 0 to 99999999

Specify the maximum permissible difference (absolute value) between the positions of the specified end point and the end point calculated from the increment or decrement and number of circles in spiral or conical interpolation.

2520	A starting M code from which an M code group is set (1)

2521	A starting M code from which an M code group is set (2)

2522	A starting M code from which an M code group is set (3)

2523	A starting M code from which an M code group is set (4)

Parameter entry

Data type : Two words

Data unit : M code number

Data range : 0,100 to 99999999

Code numbers 0 to 99 on the M code group setting screen correspond to M00 to M99. Up to 400 additional M codes can be added on the M code group setting screen, in units of 100 codes. To add M codes, set the first number of each set of 100 M codes to be added in one of these parameters. When 0 is set, however, no M codes are added on the M code group setting screen.

When setting these parameters, comply with the condition specified below. If the condition is not satisfied, no M codes are added on the M code group setting screen, in the same way as when 0 is set.

(Setting condition)

The values set in parameters 1 to 4 (excluding 0) must satisfy the following inequalities:

99 < 1, 1 + 99 < 2, 2 + 99 < 3, 3 + 99 < 4

(Example of setting) · · When the number of digits of M code is four.

(1) When (1) = “ 0 ” , (2) = “ 0 ” , (3) = “ 0 ” , (4) = “ 0 ” are set:

CODE
0000
:
0099

M code groups can be set for M0000 to M0099.
(Parameters 1 to 4 are ignored when 0 is set.)

(2) When (1) = “ 200 ” , (2) = “ 0 ” , (3) = “ 550 ” , (4) = “ 800 ” are set:

CODE
0000
:
0099
0200
:
0299
0550
:
0649
0800
:
0899

M code groups can be set for M0000 to M0099, M0200 to M0299, M0550 to M0649, and M0800 to M0899.
(Parameter 2 is ignored when 0 is set.)
In this case, M0200 to M0299, M0550 to M0649, and M0800 to M0899 are also displayed on the M code group setting screen.

(3) When (1) = “ 50 ” , (2) = “ 100 ” , (3) = “ 150 ” , (4) = “ 200 ” are set:

CODE
0000
:
0099
0100
:
0199
0200
:
0299

M code groups can be set for M0000 to M0099, M0100 to M0199, and M0200 to M0299. (Parameters 1 to 3 are ignored because they do not satisfy the condition.)
In this case, M0100 to M0199 and M0200 to M0299 are also displayed on the M code group setting screen.

(4) When (1) = “ 9650 ” , (2) = “ 9750 ” , (3) = “ 9850 ” , (4) = “ 9950 ” are set:

CODE
0000
: 100
0099
9650
: 100
9749
9750
: 100
9849
9850
: 100
9949
9950
: 50
9999

M code groups can be set for M0000 to M0099, M9650 to M9749, M9750 to M9849, M9850 to M9949, and M9950 to M9999.
(Up to M9999 is valid when M codes are represented in four–digit format.)
In this case, M9650 to M9749, M9750 to M9849, M9850 to M9949, and M9950 to M9999 are also displayed on the M code group setting screen.

2524	Radius of an imaginary circle related to the feedrate control of the rotary axis

Parameter input

Data type : Two–word axis

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to 999999999

This parameter specifies the radius of an imaginary circle for a control method in which the feedrate of the rotary axis is converted to the speed of movement on the circumference of the imaginary circle.

The feedrate for a command related to a rotary axis is usually controlled in such a way that the specified distance is traveled within the time obtained by:

$$L = \sqrt{\Delta X^2 + \Delta Y^2 + \Delta Z^2 + \Delta B^2 + \Delta C^2}$$

$$T = \frac{L}{F}$$

If RFDCT (parameter No. 1010) is 1, the value obtained by converting the rotational speed of the rotary axis to the speed of movement on the circumference of the imaginary circle. So, the feedrate is controlled in such a way that the specified distance is traveled within the time T obtained by:

$$L' = \sqrt{\Delta X^2 + \Delta Y^2 + \Delta Z^2 + (\pi * \ell_B * \Delta B/180)^2 + (\pi * \ell_C * \Delta C/180)^2}$$

$$T' = \frac{L'}{F}$$

ℓ_B, ℓ_C : Imaginary circle radius (specified in parameter No. 2524)

This way, the speed of movement on the circumference of the imaginary circle becomes the specified feedrate.

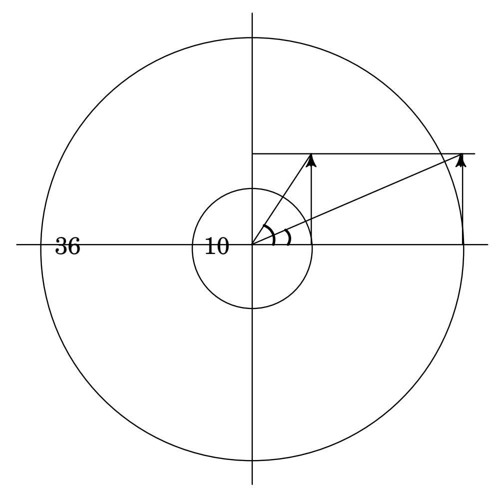
CAUTION 1 This function is disabled for rapid traverse, screw threading, feed per rotation, and inverse–time feed.
CAUTION 2 Enabled for dry run.
CAUTION 3 This function is enabled when bit 0 of parameter No. 1006 and bit 1 of parameter No. 1010 are set to 1.
CAUTION 4 To use this function to control a parallel axis, set parameter No. 2524 to the same value for both master and slave axes.

NOTE Bit 1 of parameter No. 1010 and parameter No. 2524 for this function can be rewritten using G10.

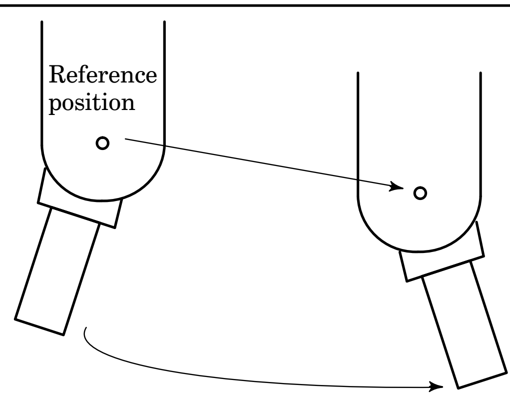
Example 1 If G91 G01 B10. F10. ; is specified in setting units B (IS–B):

(1) The time required for movement is about 10.47 s if parameter No. 2524 is set to 10000. The speed of movement on the circumference of an imaginary circle with a radius of 10 mm at the right corresponds to the specified speed 10 mm/min (or 10 inch/min for inch inputs).

(2) The required movement time is about 37.7 s if parameter No. 2524 is set to 30000. The speed of movement on the circumference of an imaginary circle with a radius of 36 mm at the right corresponds to a specified speed of 10 mm/min (or 10 inch/min for inch input).



Example 2 The following figure applies when bit 1 of parameter No. 1010 = 1 and parameter No. 2524 = 0.



For a machine in which the direction of the tool varies according to the rotary axis as shown above, the specified speed corresponds to the speed of movement at the reference position, because, if bit 1 of parameter No. 1010 = 1 and parameter No. 2524 = 0, the speed component on the rotary axis is ignored.

NOTE	In this case, if a command is issued only to the rotary axis, the tool moves at the maximum cutting feedrate.

2900	Distance between facing tool posts

Parameter input (the Series 15–T only)

Data type : Two words

Unit of data :

Setting unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to +99999999

If the mirror image for the facing tool posts is used, specify the distance between the facing tool posts (radius specification).

7672	Max. move distance of a block where smooth interpolation is done

Parameter input

Data type : Two words

Data unit : Comforms to the setting of standard axis.

Data range : 0 to 99999999

This parameter specifies the maximum machining length for smooth interpolation. Smooth interpolation is not performed for those blocks that machine a segment that is longer than the value set in the parameter. Set this parameter to the maximum segment lengthof the polygonal lines that approximate to a metal die workpiece having a constant tolerance.

	#7	#6	#5	#4	#3	#2	#1	#0
7710					MGCK			MCGO

Parameter entry

Data type : Bit

MCGO In the program restart M/S/T/B code output function

0 : Only the last M code is output.

1 : The last M code for each M code group is output.

This bit, however, is valid only when the option for the M code grouping function is specified and bit 3 (MOPR) of parameter 7620 is 1.

MGCK When multiple M codes are specified in a single block, M code group check is:

0 : Not performed

1 : Performed

4.14 Parameters Related to Serial Spindle Output and Cs Contour Control Function

4.14.1 Automatic setting method of serial interface spindle parameters (upload from spindle amplifier to CNC)

(1) Set bit 0 of parameter 5606 to 1 for use of the serial interface spindle. (Set bit 1 of parameter No. 5606 to 1 for spindle No. 2 of the Series 15–TT.)

(2) Set the motor model number of the serial interface spindle in parameter 3133. If the spindle is to be switched, set the motor model No. of the subspindle in parameter No. 3453. (Specify parameter Nos. 3273 and 3673 for spindle No. 2 of the Series 15–TT.)

(3) Set bit 0 of parameter No. 5607 to 0 for automatic setting of the serial interface spindle parameters. (Set bit 1 of parameter No. 5607 to 0 for spindle No. 2 of the Series 15–TT).

(4) Turn the power off.

(5) Turn the power on again.

(6) Check that the parameters have been set automatically. Bit 0 of parameter No. 5607 is set to 1. (Bit 1 of parameter No. 5607 is set to 1 for spindle No. 2 of the Series 15–TT.)

Parameter settings should also be made in parameter Nos. 3000 to 3135 and in parameter Nos. 3280 to 3495. (Parameter settings are made in parameter Nos. 3140 to 3275 and in parameter Nos. 3500 to 3715 for spindle No. 2 of the Series 15–TT.)

4.14.2 Transfer method of serial interface spindle parameters (download from CNC to the spindle amplifier)

(1) First set the parameter for use of the serial interface spindle. All the spindle parameters will then be automatically transferred when the power is turned on.

4.14.3 Other parameters

(1) When LDSPA of parameter No. 5603 is set to 0

When changes are made to parameter Nos. 3000 to 3019, 3032 to 3135 and 3280 to 3495, turn the power off, then turn it on again to transfer the new settings. (Parameter Nos. 3140 to 3159, 3172 to 3275, and 3500 to 3715 when the Series 15–TT uses two spindles)

When changes are made to parameter Nos. 3020 to 3031, new settings are automatically transferred. Therefore, the power need not be turned off. (Parameter Nos. 3160 to 3171 when the Series 15–TT uses two spindles)

(2) When LDSPA of parameter No. 5603 is set to 1

When changes are made to parameter Nos. 3000 to 3135 and 3280 to 3495, the new parameter settings are automatically transferred. Therefore, the power need not be turned off.

(Parameter Nos. 3140 to 3275 and 3500 to 3715 when the Series 15–TT uses two spindles)

4.14.4 Warning

Spindle parameter modifications made via the PMC–WINDOW are not automatically transferred. Turn the power off after making modifications.

4.14.5 Parameters

Spindle contour control axis parameter settings

When carrying out spindle contour control using the serial interface spindle, the spindle contour control axis parameters (1800 to 1999) should be set as shown below.

Data No.	Bit	Extra information
1802	SVFx	Servo OFF signal operative/inoperative
1804	PLC01	Set so that high resolution pulse coder is not used.
	DGPRM	Set so that digital servo parameters for individual motors are not set when power is switched ON.
	F24	Maximum feed rate for digital servo with high resolution detector should be set at 8 to 12,000 per minute.
	CONTE	Set so that this spindle is a serial interface.
1807	PFSEL	Set so that position detectors other than motors, such as the separate type pulse coder and the optical scale, are not used in position sensing.
1815	OPTx	Set so that the separate type pulse coder is not used as a position detector.
	APZx	Set so that the position sensors are devices other than absolute position detectors.
1820	——	Set the command multiply number for each spindle to 2 (i.e. multiplication by 2).
1827	——	In–position width for each spindle
1828	——	Position deviation limit, while traveling, for each spindle.
1829	——	Position deviation limit, while stopping, for each spindle.
1830	——	Position deviation limit when servo is OFF, for each spindle.
1832	——	Position deviation limit, during feed stop, for each axis.
1837	——	Limit values of position deviation occurring during traverse in rigid tap mode.

Associated parameters
5603#3, 5606#0, #1, 5607#0, #1, 5609#0, #1.

	#7	#6	#5	#4	#3	#2	#1	#0
3000				RETSV	RETRN	POSC1	ROTA2	ROTA1
Standard setting:	0	0	0	0	0	0	0	0

ROTA1 Relationship between spindle rotation direction and spindle motor rotation direction

0 : Spindle and motor rotate in the same direction

1 : Spindle and motor rotate in reverse directions

Method of judging the spindle rotation direction (see Note 1)

Judge the spindle rotation direction in the same way as when the motor rotation direction was judged viewed from the motor shaft.

For example, when the spindle and motor are connected by a belt, the same rotation direction is set.

ROTA2 Indicates the spindle rotation direction by the move command (+).

0 : Rotates the spindle counterclockwise.

1 : Rotates the spindle clockwise.

POSC1 Position coder installation direction

0 : Spindle and position coder rotate in the same direction.

1 : Spindle and position coder rotate in reverse directions.

To judge the position coder rotation direction, view the rotation direction from the shaft of the position coder.

RETRN Indicates the reference position return direction.

0 : The spindle returns counterclockwise to the reference position.

1 : The spindle returns clockwise to the reference position.

RETSV Indicates the reference position return direction in the servo mode (for rigid tapping).

0 : The spindle returns counterclockwise to the reference position.

1 : The spindle returns clockwise to the reference position.

	#7	#6	#5	#4	#3	#2	#1	#0
3001	CAXIS3	CAXIS2	CAXIS1		MGSEN	POSC2	MRDY2	MRDY1
Standard setting:	0	0	0	0	0	0	0	1

MRDY1 Specifies whether the MRDYA signal (machine ready signal) is used (see Note 2).

0 : Not used (The MRDYA signal should always be set to 1)

1 : Used

MRDY2 Shuts off power by the MRDYA signal (machine ready signal). (See Note 2.)

0 : Turns off the MCC (electromagnetic contactor) when the MRDYA signal is OFF.

1 : Turns off the excitation only when the MRDYA signal is set to OFF.

POSC2 Specifies whether the position coder signal is used.

0 : Not used

1 : Used

When using the spindle synchronization control function, servo mode (rigid tapping) function, or position coder spindle orientation function, set this bit to "1".

If this bit is set to "To use=1" in the state that the position coder signal is not being input, note that the position coder signal disconnection alarm (AL–27) will occur.

MGSEN Magnetic sensor installation direction

0 : Motor and magnetic sensor rotate in the same direction.

1 : Motor and magnetic sensor rotate in reverse directions.

CAXIS1 Specifies whether the Cs–axis control position detector (installed in the spindle) is used.

0 : Not used

1 : Used

CAXIS2 Specifies whether the Cs–axis control position detector signal is also used for speed detection.

0 : Not used (when the spindle and spindle motor are separate).

1 : Used (for the built–in motor)

CAXIS3 Position detector installation direction in Cs–axis control mode

0 : Spindle and position detector rotate in the same direction.

1 : Spindle and position detector rotate in reverse directions.

	#7	#6	#5	#4	#3	#2	#1	#0
3003	PCPL2	PCPL1		PCTYPE	DIRCT2	DIRCT1		PCMGSL
Standard setting:	0	0	0	0	0	0	0	0

PCMGSL Selects the position coder or magnetic sensor spindle orientation function.

0 : Position coder spindle orientation function

1 : Magnetic sensor spindle orientation function

DIRCT1 to DIRCT2 Set the rotation direction for spindle orientation.

DIRCT2	DIRCT1	Direction of rotation for spindle orientation
0	0	Same as direction of immediately preceding action
0	1	Same as direction of immediately preceding action
1	0	Counter–clockwise (CCW) as seen from motor shaft
1	1	Clockwise (CW) as seen from motor shaft

PCTYPE Sets the position coder type (number of pulses in one rotation)

0 : 1024 p/rev

1 : 512 p/rev

*When using the position coder equivalent signal built into the Cs–axis detector, set this bit to 0.

PCPL1 to PCPL2 Set the number of pulses of the position coder equivalent signal built into the Cs–axis control detector.

POSD2	POSD1	Position coder equivalent signal pulse no.	Detector outer diameter
0	0	1024 p/rev	65ϕ
0	1	2048 p/rev	130ϕ
1	0	3072 p/rev	195ϕ
1	1	1536 p/rev	97.5ϕ

	#7	#6	#5	#4	#3	#2	#1	#0
3007			PCLS					
Standard setting:	0	0	0	0	0	0	0	0

PCLS Specifies whether to perform the position coder signal disconnection detection using the Cs–axis control detector.

0 : Performs disconnection detection.

1 : Does not perform disconnection detection.

* Checks AL–26 (Cs–axis control speed detection signal disconnection), AL–27 (position coder sig nal discon nection), and AL–28 (Cs–axis control position detection signal disconnection).
* Normally set to 0.
* When the disconnection alarm occurs during adjustment of the position and speed feedback signal waveform, making the adjustment difficult, temporarily set this parameter to 1. After adjustment, re set it to 0.

	#7	#6	#5	#4	#3	#2	#1	#0
3011		RGI2	ADJG	MXPW	POLE		VDT2	VDT1
Standard setting:	0	0	0	0	X	0	X	X

X : Depends on the motor model.

VDT1 to VDT2 Setting of speed detector

VDT2	VDT1	Setting of speed detector
0	0	——
0	1	128 p/rev
1	0	256 p/rev
1	1	512 p/rev

POLE Number of motor poles

0 : 2 poles

1 : 4 poles

PWMX Setting of maximum output during acceleration and deceleration

0 : Depends on the motor model.

1 : Depends on the motor model.

ADJG Judging the acceleration and deceleration status at maximum output during acceleration and deceleration

0 : Depends on the motor model.

1 : Depends on the motor model.

RGI2 Judging the secondary current coefficient at rigid tapping

0 : Depends on the motor model.

1 : Depends on the motor model.

	#7	#6	#5	#4	#3	#2	#1	#0
3013			DS4	DS3	DS2	DS1	ESED	ESEC
Standard setting:	0	0	X	X	X	X	1	1

X : Depends on the amplifier model.

ESEC Setting of the detection edge for one rotation signal of the position coder

0 : CCW = rising edge CW = falling edge

1 : CCW, CW = rising edge

ESED Setting of the detection edge for one rotation signal of the Cs–axis position detection signal

0 : CCW = rising edge CW = falling edge

1 : CCW, CW = rising edge

DS4 to DS1 Setting the power dead zone data

0110 : Unit for 6S to 12S

1001 : Unit for 15S to 22S

	#7	#6	#5	#4	#3	#2	#1	#0
3015						SPDSW		ORIENT
Standard setting:	0	0	0	0	0	0	0	0

ORIENT Spindle orientation function availability (CNC software option)

0 : Spindle orientation function not available

1 : Spindle orientation function available

SPDSW Presence of speed range switching function (CNC software option)

0 : Without speed range switching function

1 : With speed range switching function

	#7	#6	#5	#4	#3	#2	#1	#0
3016					FFSMTH			
Standard setting:	0	0	0	0	0	0	0	0

FFSMTH Presence of smoothing function on feed forward control

0 : Without smoothing function

1 : With smoothing function

3020	Maximum speed (MAXSPD)

Unit of data : rpm
Valid range : 0 to 32767
Standard setting : Depends on a motor model.
This data is used to set the maximum speed of the AC spindle motor.

3021	Maximum speed in Cs–axis control mode (MXSPDC)

Unit of data : rpm
Valid range : 0 to 250
Standard setting : 100
Set the maximum spindle speed in Cs–axis control mode.

3022	Speed arrival level (SARDT)

Unit of data : 0.1%
Valid range : 0 to 1000 (0 to 100%)
Standard setting : 150 (15%)
This data is used to set the detection range of the speed arrival signal (SARA).
When the motor speed is within ±(setting data/10)% of the commanded speed, the bit of speed arrival signal (SARA) is set to 1.

3023	Speed detection level (SDTDT)

Unit of data : 0.1%
Valid range : 0 to 1000 (0 to 100%)
Standard setting : 30 (3%)
This data is used to set the detection range of the speed detection signal (SDTA).
When the motor speed is equal to or less than (setting data/10)% of the maximum speed, the bit of the speed arrival signal (SDTA) is set to 1.

3024	Speed zero detection level (SSTDT)

Unit of data : 0.01%
Valid range : 0 to 10000 (0 to 100%)
Standard setting : 75 (0.75%)
This data is used to set the detection range of the speed zero signal (SSTA).
When the motor speed is equal to or less than (setting data/100)% of the maximum speed, the bit of the speed zero signal (SSTA) is set to 1.

3025	Setting of torque limit value (TLMDATA)

Unit of data : 1%
Valid range : 0 to 100 (0 to 100%)

Standard setting : 50 (50%)

This data is used to set the torque limit value for maximum output torque when the torque limit command HIGH (TLMHA) or torque limit command LOW (TLMLA) is entered.

The data indicates the limit value when the maximum torque is set to 100%.

Torque limit command LOW TLMLA	Torque limit command HIGH TLMHA	Details
0	0	No torque limitation exists.
0	1	Limited to the setting value of this parameter.
1	0	Limited to approximately half as compared with that of TLMH.
1	1	

3026	Load detection level 1 (LDTDT1)

Unit of data : 1%

Valid range : 0 to 100 (0 to 100%)

Standard setting : 83 (83%)

This data is used to set the detection range of load detection level 1 (LDTDT1).

When the motor output is equal to or greater than the setting data % of the maximum rated output, the bit of load detection signal 1 (LDT1A) is set to 1.

3027	Load output level 2 (LDTDT2)

Unit of data : 1%

Valid range : 0 to 100 (0 to 100%)

Standard setting : 95 (95%)

This data is used to set the detection range of load detection level 2 (LDTDT2).

When the motor output is equal to or greater than the setting data % of the maximum rated output, the bit of load detection signal 2 (LDT2A) is set to 1.

3028	Setting of limited output pattern (PWRLMT)

Unit of data :

Valid range : 0 to 6

Standard setting : 0

Select an appropriate pattern from the following:

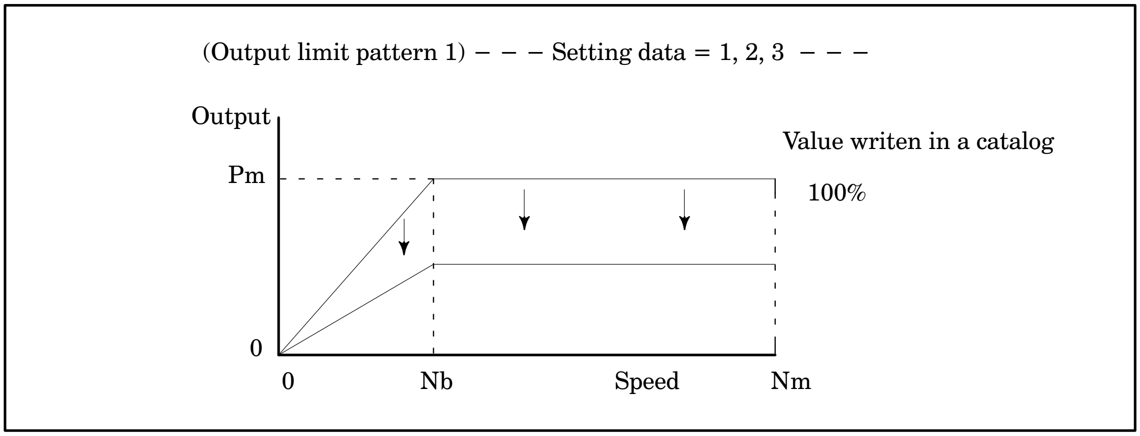
A : When the motor is slowly accelerated or decelerated with the output being clamped at the specified value and operation is performed at rated output in normal rotation: (Setting data: 1 or 4)

(The function is similar to the software start/stop)

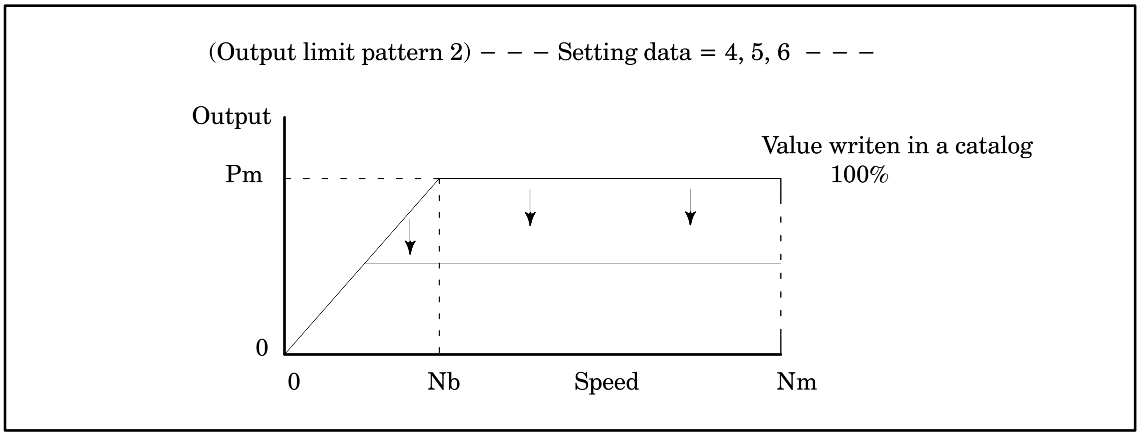
B : When the motor is operated at the maximum rated output and the output is limited in normal rotation: (Setting data: 2 or 5)

C : When a machine with different output specifications is produced using the same motor and servo unit: (Setting data: 3 or 6)

Details	Setting data	
	Pattern 1	Pattern 2
Output is not limited.	0	0
Output is limited on acceleration/deceleration only.	1	4
Output is not limited on acceleration/deceleration and it is limited on normal rotation.	2	5
Output is limited over all operations.	3	6



$$\text{Pout} = \frac{\text{Setting value of } 3029 / 6529}{100} \times \text{Pm}$$



$$\text{Pout} = \frac{\text{Setting value of } 3029 / 6529}{100} \times \text{Pm}$$

3029	Output limit (MXPWDT)

Unit of data : 1%

Valid range : 0 to 100 (0 to 100%)

Standard setting : 100 (100%)

This data is used to set the limit when the maximum output (allowable overload capacity) is 100%.

This set value is valid when output is limited by setting parameter No. 3028/6528.

Output limit = Maximum output × (setting data)%

3030	Soft start/stop setting time (SOSTDT)

Unit of data : rpm/sec

Valid range : 0 to 32767

Standard setting : 0

The data is used to set the soft start/stop time constant.

The time from the stop state to the maximum speed is set.

3031	Position coder system orientation stop position

Unit of data :

Valid range : 0 to 4095

Standard setting : 0

This data is used to set the stop position of position coder system orientation.

It can be set every 360 degrees/4096.

This parameter is valid when bits 2 and 3 of the parameter (PRM 5609) are not set to use the external stop position spindle orientation function.

This parameter is invalid when the external stop position spindle orientation function is used. The stop position is set according to the DI/DO signal serial interface spindle orientation stop position command (SHA00 – SHA11) (SHB00 – SHB11 for No. 2 spindle).

3032	Acceleration/deceleration time constant at synchronized spindle control

Unit of data : rpm/sec

Valid range : 0 to 32767

Standard setting : 0 (0 rpm/sec)

This parameter sets the time constant for acceleration and deceleration when the synchronization rotational speed command has been changed during spindle synchronization control. When performing rotational speed synchronization and phase synchronization during acceleration or deceleration, the time constant for both spindles will be matched to the spindle axis with the larger inertia or the larger acceleration/deceleration time.

If the time constant is too small, it may result in overshooting and hunting.

If the time constant is too large, the unit will take a long time to achieve a synchronized rotation speed.

When the value is set to 0, the time constant will not function.

Be sure to set the same value for tool post 1 and tool post 2.

3033	Synchronized spindle speed arrival level

Unit of data : rpm

Valid range : 0 to 32767

Standard setting : 10 (10 rpm)

When the value for the deviation of the speed of the spindle motors is within the set level (with respect to the synchronization rotational speed command during spindle synchronization control), the spindle synchronization control complete signal will be 1.

3034	Shift amount at spindle phase synchronized control

Unit of data : Pulse
Valid range : 0 to 4095
Standard setting : 0 (0 pulse)

This parameter sets the amount of shift from the reference position (one rotation signal) during synchronized control of the spindle phase.

3035	Compensation data for spindle phase synchronized control

Unit of data : Pulse/2 msec
Valid range : 0 to 4095
Standard setting : 10

This parameter is used to reduce speed fluctuations when matching spindle phases in spindle phase synchronized control.

When this parameter is set to 0, the phasing amount will be commanded once, so the positional deviation will suddenly increase. Consequently, the speed fluctuations during phasing will also increase.

By using this parameter to command the number of pulses (set with the parameter) for the phasing amount every 2 msec, phasing can be performed smoothly.

3036	Feed–forward coefficient

Unit of data : %
Valid range : 0 to 100 (0 to 100%)
Standard setting : 0%

This parameter sets the feed–forward coefficient when performing feed–forward control in the servo mode (rigid tapping) and Cs–axis control mode.

3037	Velocity loop feed–forward coefficient

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

This parameter sets the feed–forward coefficient of the velocity loop when performing feed–forward control in the servo mode (rigid tapping) and Cs–axis control mode.

3040	Velocity loop proportional gain during normal operation (HIGH gear) (VPGH)

3041	Velocity loop proportional gain during normal operation (LOW gear) (VPGL)

Unit of data :
Valid data : 0 to 32767
Standard setting : 10

This parameter sets the velocity loop proportional gain during normal operation.

When the clutch/gear signal (CTH1A) in the spindle control signals sent from the PMC to NC is set to 0, the parameters of the HIGH gear are selected. When it is set to 1, the parameters of the LOW gear are selected.

3042	Velocity loop proportional gain at spindle orientation (HIGH gear) (VPGHOR)

3043	Velocity loop proportional gain at spindle orientation (LOW gear) (VPGLOR)

Unit of data :

Valid range : 0 to 32767

Standard setting : 10

This parameter sets the velocity loop proportional gain during spindle orientation.

When the clutch/gear signal (CTH1A) in the spindle control signals sent from the PMC to NC is set to 0, the parameters of the HIGH gear are selected. When it is set to 1, the parameters of the LOW gear are selected.

3044	Velocity loop proportional gain in the servo mode/in synchronized control (HIGH gear) (VPGHSV)

3045	Velocity loop proportional gain in the servo mode/in synchronized control (LOW gear) (VPGLSV)

Unit of data :

Valid range : 0 to 32767

Standard setting : 10

This parameter sets the speed loop proportional gain in the servo mode (rigid tapping, etc.) and in synchronized control.

When the clutch/gear signal (CTH1A) in the spindle control signals sent from the PMC to NC is set to 0, the parameters of the HIGH gear are selected. When it is set to 1, the parameters of the LOW gear are selected.

3046	Velocity loop proportional gain in Cs–axis control mode (HIGH gear) (VPGHCF)

3047	Velocity loop proportional gain in Cs–axis control mode (LOW gear) (VPGLCF)

Unit of data :

Valid data : 0 to 32767

Standard setting : 30

This parameter sets the speed loop proportional gain in the Cs–axis control mode.

3048	Velocity loop integral gain during normal operation (HIGH gear) (VIGH)

3049	Velocity loop integral gain during normal operation ((LOW gear) (VIGL)

Unit of data :
Valid data : 0 to 32767
Standard setting : 10
This parameter sets the speed loop integral gain during normal operation.

3050	Velocity loop integral gain at spindle orientation (HIGH gear) (VIGHOR)

3051	Velocity loop integral gain at spindle orientation (LOW gear) (VIGLOR)

Unit of data :
Valid data : 0 to 32767
Standard setting : 10
This parameter sets the speed loop integral gain during spindle orientation.

3052	Velocity loop integral gain in servo mode/in synchronized control (HIGH gear) (VIGHSV)

3053	Velocity loop integral gain in servo mode/in synchronized control (LOW gear) (VIGLSV)

Unit of data :
Valid data : 0 to 32767
Standard setting : 10
This parameter sets the speed loop integral in the servo mode (rigid tapping etc.) and in synchronized control.

3054	Velocity loop integral gain in Cs–axis control mode (HIGH gear) (VIGHCF)

3055	Velocity loop integral gain in Cs–axis control mode (LOW gear) (VIGLCF)

Unit of data :
Valid data : 0 to 32767
Standard setting : 50
This parameter sets the speed loop integral gain in the Cs–axis control mode.

3056	Gear ratio (HIGH) (GEARH)

3057	Gear ratio (MEDIUM HIGH) (GEARMH)

3058	Gear ratio (MEDIUM LOW) (GEARML)

3059	Gear ratio (LOW) (GEARL)

Unit of data : Number of motor rotations needed for spindle to rotate once x 100

Valid range : 0 to 32767

Standard setting : 100 (gear ratio 1:1)

This parameter sets the gear ratio of the spindle and AC spindle motor.

Set the state of the gear or clutch to correspond to the clutch/gear signals (CTH1A, CTH2A) among the spindle control signals sent from the PMC to NC.

Example If the motor must rotate 2.5 times to rotate the spindle once, set data to 250.

3060	Position gain at orientation (HIGH) (ORPGH)

3061	Position gain at orientation (MEDIUM HIGH) (ORPGMH)

3062	Position gain at orientation (MEDIUM LOW) (ORPGML)

3063	Position gain at orientation (LOW) (ORPGL)

Unit of data : 0.01 sec^{-1}

Valid range : 0 to 32767

Standard setting : 1000

This parameter sets the position gain at orientation.

3064	Modification rate of position gain at orientation completion. (DRARDT)

Unit of data : 1%

Valid range : 0 to 1000

Standard setting : 100 (100%)

This parameter sets the modification rate of position gain when orientation is completed.

3065	Position gain in servo mode/in synchronized control (HIGH) (CFPGH)

3066	Position gain in servo mode/in synchronized control (MEDIUM HIGH) (CFPGMH)

3067	Position gain in servo mode/in synchronized control (MEDIUM LOW) (CFPGML)

3068	Position gain in servo mode/in synchronized control (LOW) (CFPGL)

Unit of data : 0.01 sec^{-1}

Valid range : 0 to 32767

Standard setting : 1000

This parameter sets the position gain in the servo mode or in synchronized control.

3069	Position gain in Cs–axis control mode (HIGH) (CFPGH)

3070	Position gain in Cs–axis control mode (MEDIUM HIGH) (CFPGMH)

3071	Position gain in Cs–axis control mode (MEDIUM LOW) (CFPGML)

3072	Position gain in Cs–axis control mode (LOW) (CFPGL)

Unit of data : 0.01 sec^{-1}

Valid range : 0 to 32767

Standard setting : 3000

This parameter sets the position gain in Cs–axis control mode.

3073	Grid shift amount in servo mode (rigid tapping) (SVMSHT)

Unit of data : 1 pulse unit (4096 p/rev)

Valid range : 0 to 4095

Standard setting : 0

This parameter sets data when shifting the reference position in servo mode. With + data, the spindle reference position shifts counterclockwise by the number of set pulses.

3075	Orientation completion signal detection level (ORARLV)

Unit of data : Position coder → ±1 pulse units

Magnetic sensor → ±0.1 degree units

Valid range : 0 to 100

Standard setting : 10

This parameter sets the detection level for the orientation completion signal (ORARA).

When orientation is complete and the spindle is positioned within the range of set data, the orientation completion signal (ORARA) bit in the spindle status signal will be 1.

3076	Motor speed limit at orientation (ORVLMD)

Unit of data : 1%

Valid range : 0 to 100

Standard setting : 33

This parameter sets the motor speed limit at orientation.

Motor speed limit = Orientation speed × (set data) / 100 rpm

(Orientation speed = position gain × gear ratio × 60 / 2 rpm)

3077	Position shift at orientation stop (ORSHFT)

Unit of data : Position coder → ±1 pulse units
Magnetic sensor → ±0.01 degree units

Valid range : Position coder → –4095 to +4095
Magnetic sensor → –100 to +100

Standard setting : 0

This parameter sets this data when shifting the spindle position at orientation stop using the position coder.

With + data, the spindle is shifted counterclockwise by the number of set pulses and stops.

At magnetic sensor orientation stop, this parameter measures the shift from the position where the magnetic sensor and magnet are opposite each other.

With + data, the spindle shifts counterclockwise.

3078	MS signal constant = (L / 2) / (2 × π × H) × 4096 (MSCONT)

L : Length of the magnet (unit=mm),

H : Distance between the spindle center and the magnet (unit=mm)

Unit of data :

Valid range : 80 to 1000

Standard setting : 200

For magnet sensor orientation, set the MS signal constant by substituting the length of the magnet (unit=mm) for L and the distance between the spindle center and the magnet (unit=mm) for H in the formula above. Normally substitute 50 (mm) for L.

Example When H = 100 mm and L = 50 mm,
MS signal constant = (50 / 2) / (2 × 3.14 × 100) × 4096 = Approx. 163
In this case, set 163 for the MS signal constant.

3079	MS signal gain adjustment (MSGAIN)

Unit of data :

Valid range : –128 to +127

Standard setting : 0

This parameter adjusts the amplitude of the MS signal at magnetic sensor orientation.

3080	Regenerative power limit (DECDT)

Unit of data : 1%

Valid range : 0 to 100

Standard setting : Depends on the motor model

This parameter adjusts the deceleration time so it is equal to the acceleration time.

If it is set to be larger, the deceleration time becomes shorter.

If it is set to be smaller, the deceleration time becomes longer.

However, when the regenerative power is excessive, the regenerative limit circuit is activated and the current waveform of the motor changes so that an abnormal sound may come from the motor. In this case, set a smaller value to eliminate the abnormal sound.

3081	Delay time until the motor power is cut off (SVOFDA)

Unit of data : 10 ms

Valid range : 0 to 1000

Standard setting : 20 (200 ms)

The motor power is cut off after stopping the motor (zero speed is detected). However, when the power is cut off immediately after detecting the zero speed signal, the motor may rotate at low speed due to inertia. This parameter sets the time from when the zero speed signal is detected until the power is cut off.

3082	Time setting during acceleration/deceleration (BUSYDA)

Unit of data : 1 sec

Valid range : 0 to 255

Standard setting : 10 (10 sec)

When the deviation between the feedrate command and motor speed exceeds the setting level, an excess speed deviation alarm normally occurs. However, if the feedrate command is changed during acceleration/deceleration, the motor speed cannot respond accordingly, and an excess speed deviation alarm occurs. In this case, this parameter sets the acceleration/deceleration time for preventing the excess speed deviation alarm from occurring even if there is speed deviation during the setting time.

When the lathe load inertia is large, the acceleration/deceleration time increases. Thus, set the value accordingly.

3083	Motor voltage setting at normal rotation (MVLNRD)

Unit of data : 1%

Valid range : 0 to 100

Standard setting : Depends on the motor model

3084	Motor voltage setting at orientation (MVLORD)

Unit of data : 1%

Valid range : 0 to 100

Standard setting : Depends on the motor model.

3085	Motor voltage setting in servo mode (MVLSVD)

Unit of data : 1%

Valid range : 0 to 100

Standard setting : Depends on the motor model.

3086	Motor voltage setting in Cs–axis control mode (MVLCFD)

Unit of data : 1%

Valid range : 0 to 100

Standard setting : Depends on the motor model.

3087	Overspeed level (OVSDT)

Unit of data : 1%

Valid range : 0 to 200

Standard setting : 115 (115%)

This parameter sets the overspeed level.

When the speed is equal to or greater than the speed obtained by multiplying the maximum speed by (setting data)%, an overspeed alarm occurs.

3088	Detection level for excess speed deviation at motor shaft lock (EREXZD)

Unit of data : 0.01%

Valid range : 0 to 10000

Standard setting : 75 (0.75%)

This parameter sets the detection level for excess speed deviation at motor shaft lock.

When the speed deviation is equal to or greater than the value obtained by multiplying the maximum speed by (setting data)% at motor shaft lock, a motor lock alarm is issued.

3089	Detection level for excess speed deviation during motor rotation (EREXND)

Unit of data : 0.01%

Valid range : 0 to 1000

Standard setting : 200

This parameter sets the detection level for excess speed deviation during motor rotation.

When the speed deviation is equal to or greater than the value obtained by multiplying the maximum speed by (setting data)%, a speed deviation excess alarm occurs.

3090	Overload detection level (OVLDT)

Unit of data : 1%

Valid range : 0 to 100

Standard setting : 90

This parameter sets the overload detection level. When the motor load is equal to or greater than the value obtained by multiplying the maximum output by (setting data)% for a long time, a short–time overload alarm occurs.

3091	Modification rate of position gain at return to reference position in servo mode (SVMZRN)

Unit of data : 1%

Valid range : 0 to 100

Standard setting : 100 (100%)

This parameter sets the modification rate of the position gain when returning to the reference position in servo mode.

3092	Modification rate of position gain at return to reference position in Cs–axis control mode. (CFMZRN)

Unit of data : 1%

Valid range : 0 to 100

Standard setting : 100 (100%)

This parameter sets the modification rate of the position gain when returning to the reference position in Cs–axis control mode.

3093	Estimated constant of acceleration (ACFCG)

Unit of data :

Valid range : 0 to 32767

Standard setting : 0

This parameter sets a constant determined by estimating acceleration of the overall spindle rotation system without disturbance torque in order to compensate for disturbance torque.

3094	Disturbance torque compensation constant (ACFEG)

Unit of data :

Valid range : 0 to 32767

Standard setting : 0

This parameter sets a constant for compensating for disturbance torque.

3095	Adjustment of speedometer output voltage (SMGAIN)

Unit of data : 0.1%

Valid range : –1000 to +100 (–100% to +10%)

Standard setting : 0

This parameter is set when the speedometer is finely adjusted.

With + data, the output voltage will increase.

3096	Adjustment of load meter output voltage (LMGAIN)

Unit of data : 0.1%

Valid range : –1000 to +100 (–100% to +10%)

Standard setting : 0

This parameter is set when the load meter is finely adjusted.

With + data, the output voltage will increase.

3097	Spindle speed feedback gain (SPTSAG)

Unit of data:

Valid range: 0 to 32767

Standard setting: 0

This parameter is set to feed back the spindle speed and compensate for disturbance torque when performing Cs–axis control in a system where the spindle and spindle motor are linked by a gear or belt.

3100	Base speed of motor output specification (TRCHPS)

Unit of data : rpm

Valid range : 0 to 32767

Standard setting : Depends on the motor model.

3101	Output limit of motor output specification (PWLMTD)

Unit of data : %

Valid range : 0 to 100

Standard setting : Depends on the motor model.

3102	Base speed (TRCHPT)

Unit of data : rpm

Valid range : 0 to 32767

Standard setting : Depends on the motor model.

3103	Speed at which a decrease in magnetic flux begins (PHICPT)

Unit of data : rpm
Valid range : 0 to 32767
Standard setting : Depends on the motor model.

3104	Proportional gain of current loop (in normal operation) (CLPPG)

Unit of data :
Valid range : 0 to 32767
Standard setting : Depends on the motor model.

3105	Proportional gain of current loop (in Cs–axis control mode) (CLPPGC)

Unit of data :
Valid range : 0 to 32767
Standard setting : Depends on the motor model.

3106	Integral gain of current loop (in normal operation) (CLPIG)

Unit of data :
Valid range : 0 to 32767
Standard setting : Depends on the motor model.

3107	Integral gain of current loop (in Cs–axis control mode) (CLPIGC)

Unit of data :
Valid range : 0 to 32767
Standard setting : Depends on the motor model.

3108	Zero point for integral gain of current loop (CLPIPT)

Unit of data : rpm
Valid range : 0 to 32767
Standard setting : Depends on the motor model.

3109	Velocity coefficient for proportional gain of current loop (CLPCMD)

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

3110	Current conversion constant (ICONV)

Unit of data :
Valid range : 0 to 32767
Standard setting : Depends on the motor model.

3111	Secondary current coefficient for excitation current (I2WCOD)

Unit of data :
Valid range : 0 to 100
Standard setting : Depends on the motor model.

3112	Predicted current constant (CRTEST)

Unit of data :
Valid range : 0 to 32767
Standard setting : Depends on the motor model.

3113	Slip constant (SLPCON)

Unit of data :
Valid range : 0 to 32767
Standard setting : Depends on the motor model.

3114	Compensation constant for high–speed rotation slip (CLPCMK)

Unit of data :
Valid range : 0 to 255
Standard setting : Depends on the motor model.

3115	Compensation coefficient for voltage applied to motor in the dead zone (VLTCMD)

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

3116	Compensation coefficient for electromotive force (ECNSTD)

Unit of data : %
Valid range : 0 to 200
Standard setting : Depends on the motor model.

3117	Compensation coefficient for phase of electromotive force (Vx element) (PHSCMD)

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

3118	Speed coefficient for electromotive force compensation (PWMCMD)

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

3120	Dead zone compensation data (DTDATA)

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

3121	Time constant for torque change (TRCHTD)

Unit of data : 1 ms
Valid range : 0 to 1000
Standard setting : Depends on the motor model.

3123	Short time overload detection time (OVLTMD)

Unit of data : 1 sec
Valid range : 0 to 500
Standard setting : 30 (30 sec)

3125	Timer setting for automatic operation (DRVTMD)

Unit of data : 0.1 sec
Valid range : 0 to 32767
Standard setting : 100 (10 sec)

3126	Velocity command in automatic operation mode (VCMDAT)

Unit of data : rpm
Valid range : 0 to maximum speed of motor
Standard setting : 1000

3127	Load meter display value at maximum output (LMDATA)

Unit of data : %
Valid range : 0 to 500
Standard setting : Depends on the motor model.

3128	Maximum output zero point (MXPWZR)

Unit of data : rpm
Valid range : 0 to 32767
Standard setting : Depends on the motor model.

3129	Secondary current coefficient for rigid tapping (RG12W)

Unit of data :
Valid range : 0 to 100
Standard setting : Depends on the motor model.

3133	Motor model code (MODELD)

Unit of data :
Valid range : 0 to 63 (for standard motors)
Valid range : 64 to 104 (for output switch motors)
Standard setting : Depends on the motor model.
This parameter sets the model code when the initial parameter of the spindle motor is set.
The following parameter must also be set at the same time:
Series 15 : Parameter No. 5607 bit 0=0

3135	Grid shift in Cs–axis control mode (LONG WORD) (GRDSHT)

Unit of data : Number of pulses (0.001 degree)
Valid range : –360000 to +360000
Standard setting : 0

* This parameter sets the number of pulses from one signal rotation to the machine reference position in Cs–axis control mode.

3280	Motor voltage setting for normal operation (MVLNRD) *For output switching

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

3281	Motor voltage setting in servo mode (MVLSVD) *For output switching

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

3282	Base speed of motor output specification (TRCHPS) *For output switching

Unit of data : rpm
Valid range : 0 to 32767
Standard setting : Depends on the motor model.

3283	Output limit of motor output specification (PWLMTD) *For output switching

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

3284	Base speed (TRCHPT) *For output switching

Unit of data : rpm
Valid range : 0 to 32767
Standard setting : Depends on the motor model.

3285	Speed at which a decrease in magnetic flux begins (PHICPT) *For output switching

Unit of data : rpm
Valid range : 0 to 32767
Standard setting : Depends on the motor model.

3286	Proportional gain of current loop (in normal operation) (CLPPG) *For output switching

Unit of data :
Valid range : 0 to 32767
Standard setting : Depends on the motor model.

3287	Integral gain of current loop (in normal operation) (CLPIG) *For output switching

Unit of data :
Valid range : 0 to 32767
Standard setting : Depends on the motor model.

3288	Zero point for integral gain of current loop (CLPIPT) *For output switching

Unit of data : rpm
Valid range : 0 to 32767
Standard setting : Depends on the motor model.

3289	Velocity coefficient for proportional gain of current loop (CLPCMD) *For output switching

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

3290	Current conversion constant (ICONV) *For output switching

Unit of data :
Valid range : 0 to 32767
Standard setting : Depends on the motor model.

3291	Secondary current coefficient for excitation current (I2WCOD) *For output switching

Unit of data :
Valid range : 0 to 100
Standard setting : Depends on the motor model.

3292	Predicted current constant (CRTEST) *For output switching

Unit of data :
Valid range : 0 to 32767
Standard setting : Depends on the motor model.

3293	Slip constant (SLPCON) *For output switching

Unit of data :
Valid range : 0 to 32767
Standard setting : Depends on the motor model.

3294	Compensation constant for high–speed rotation slip (CLPCMK) *For output switching

Unit of data :
Valid range : 0 to 255
Standard setting : Depends on the motor model.

3295	Compensation constant for voltage applied to motor in the dead zone (VLTCMD) *For output switching

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

3296	Compensation constant for electromotive force (ECNSTD) *For output switching

Unit of data : %
Valid range : 0 to 200
Standard setting : Depends on the motor model.

3297	Compensation constant for phase of electromotive force (Vx element) (PHSCMD) *For output switching

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

3298	Velocity coefficient for electromotive force compensation (PWMCMD) *For output switching

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

3301	Time constant for torque change (TRCHTD) *For output switching

Unit of data : 1 ms
Valid range : 0 to 1000
Standard setting : Depends on the motor model.

3302	Maximum output zero point (MXPWZR) *For output switching

Unit of data : 1 rpm
Valid range : 0 to 32767
Standard setting : Depends on the motor model.

3303	Secondary current coefficient for rigid tapping (RGI2W) *For output switching

Unit of data :
Valid range : 0 to 32767
Standard setting : Depends on the motor model.

3391	Time constant for spindle load monitor magnetic flux compensation

Parameter input

Data type : Word

Data unit : 1msec

Data range : 0 to 8192

Standard setting : Depends on the motor model.

This parameter compensates for delay of magnetic flux generated inside the spindle against the command value.

When 0 is set, it is assumed that no delay occurs against the command value.

3392	Spindle load monitor torque constant

Parameter input

Data type : Word

Data range : 0 to 32767

Standard setting : Depends on the motor model.

The constant is determined by maximum output torque and inertia and is used for the observer processing.

3393	Spindle load monitor observer gain 1

Parameter input

Data type : Word

Data range : 0 to 32767

Standard setting : 500

3394	Spindle load monitor observer gain 2

Parameter input

Data type : Word

Data range : 0 to 32767

Standard setting : 500

3485	Unexpected load detection level (spindle)

Parameter input

Data type : Word

Data unit : 0.01%

Data range : 0 to 10000

Set a level for detecting the unexpected load signal by specifying a ratio (0. 01% unit) to the maximum motor output torque.

When 0 is set in this parameter, the unexpected load detection signal is not output.

Parameters on the 2nd spindle

1st spindle	2nd spindle	Contents
3391	3611	Time constant for spindle load monitormagnetic flux compensation
3392	3612	Spindle load monitor torque constant
3393	3613	Spindle load monitor observer gain 1
3394	3614	Spindle load monitor observer gain 2
3485	3705	Unexpected load detection level

spindle No. 2 parameters

The parameters of spindle No.2 are listed below.

In this list, corresponding parameter Nos. for both spindle No. 1 and spindle No. 2 are listed side by side.

For details of these parameters, refer to the section about individual parameters for spindle No. 1, which has the same contents as spindle No. 2.

The AMP. No. indicates the parameter No. in the spindle amplifier.

No.1 spindle	No.2 spindle	AMP.No.	Description
3000	3140	0	Bit parameter
3001	3141		Bit parameter
3002	3142	1	Bit parameter
3003	3143		Bit parameter
3004	3144	2	Bit parameter
3005	3145		Bit parameter
3006	3146	3	Bit parameter
3007	3147		Bit parameter
3008	3148	4	Bit parameter
3009	3149		Bit parameter
3010	3150	5	Bit parameter
3011	3151		Bit parameter
3012	3152	6	Bit parameter
3013	3153		Bit parameter
3014	3154	7	Bit parameter
3015	3155		Bit parameter
3016	3156	8	Bit parameter
3017	3157		Bit parameter
3018	3158	9	Bit parameter
3019	3159		Bit parameter
3020	3160	10	Maximum speed
3021	3161	11	Maximum speed in Cs contour control (MXSPDC)
3022	3162	12	Speed arrival level
3023	3163	13	Speed detecting level
3024	3164	14	Speed zero detecting level
3025	3165	15	Setting of torque limit value
3026	3166	16	Load detecting level 1
3027	3167	17	Load detecting level 2
3028	3168	18	Output limit pattern setting
3029	3169	19	Output limit value

No.1 spindle	No.2 spindle	AMP.No.	Description
3030	3170	20	Soft start / stop setting time
3031	3171	21	Position coder system orientation stop position
3032	3172	22	Acceleration / deceleration time constant at spindle synchronization control
3033	3173	23	Spindle synchronization rotation speed arrival level
3034	3174	24	Shift amount at spindle phase synchronization control
3035	3175	25	Compensation data for spindle phase synchronization
3036	3176	26	Feedback/forward coefficient
3037	3177	27	Velocity loop feed forward coefficient
3038	3178	28	
3039	3179	29	
3040	3180	30	Velocity loop proportion gain on normal operation (HIGH)
3041	3181	31	Velocity loop proportion gain on normal operation (LOW)
3042	3182	32	Velocity loop proportion gain on orientation (HIGH)
3043	3183	33	Velocity loop proportion gain on orientation (LOW)
3044	3184	34	Velocity loop proportion gain on servo mode / on synchronization control (HIGH)
3045	3185	35	Velocity loop proportion gain on servo mode / on synchronization control (LOW)
3046	3186	36	Velocity loop proportion gain in Cs contour control (HIGH)
3047	3187	37	Velocity loop proportion gain in Cs contour control (LOW)
3048	3188	38	Velocity loop integral gain on normal operation (HIGH)
3049	3189	39	Velocity loop integral gain on normal operation (LOW)
3050	3190	40	Velocity loop integral gain on orientation (HIGH)
3051	3191	41	Velocity loop integral gain on orientation (LOW)
3052	3192	42	Velocity loop integral gain on servo mode / on synchronization control (HIGH)
3053	3193	43	Velocity loop integral gain on servo mode / on synchronization control (LOW)
3054	3194	44	Velocity loop integral gain in Cs contour control (HIGH)
3055	3195	45	Velocity loop integral gain in Cs contour control (LOW)
3056	3196	46	Gear ratio (HIGH)
3057	3197	47	Gear ratio (MEDIUM HIGH)
3058	3198	48	Gear ratio (MEDIUM LOW)
3059	3199	49	Gear ratio (LOW)

No.1 spindle	No.2 spindle	AMP.No.	Description
3060	3200	50	Position gain on orientation (HIGH)
3061	3201	51	Position gain on orientation (MEDIUM HIGH)
3062	3202	52	Position gain on orientation (MEDIUM LOW)
3063	3203	53	Position gain on orientation (LOW)
3064	3204	54	Modification rate of position gain on orientation end
3065	3205	55	Position gain on servo mode / on synchronization control (HIGH)
3066	3206	56	Position gain on servo mode / on synchronization control (MEDIUM HIGH)
3067	3207	57	Position gain on servo mode / on synchronization control (MEDIUM LOW)
3068	3208	58	Position gain on servo mode / on synchronization control (LOW)
3069	3209	59	Position gain in Cs contour control (HIGH)
3070	3210	60	Position gain in Cs contour control (MEDIUM HIGH)
3071	3211	61	Position gain in Cs contour control (MEDIUM LOW)
3072	3212	62	Position gain in Cs contour control (LOW)
3073	3213	63	Grid shift amount in servo mode(RIGID TAPPING)
3074	3214	64	
3075	3215	65	Orientation completion signal detection level
3076	3216	66	Motor speed limit value on orientation
3077	3217	67	Orientation stop position shift value
3078	3218	68	MS signal constant
3079	3219	69	Ms signal gain adjustment
3080	3220	70	Limitation of regenerative power
3081	3221	71	Delay time until the motor power is cut off
3082	3222	72	Time setting during acceleration / deceleration
3083	3223	73	Motor voltage setting on normal rotation
3084	3224	74	Motor voltage setting on orientation
3085	3225	75	Motor voltage setting on servo mode / on simultaneous control
3086	3226	76	Motor voltage setting in Cs contour control
3087	3227	77	Overspeed level
3088	3228	78	Velocity error excess detecting level on motor restriction
3089	3229	79	Velocity error excess detecting level on motor rotation
3090	3230	80	Overload detecting level
3091	3231	81	Reduction rate of position gain in returning reference point on servo mode
3092	3232	82	Reduction rate of position gain in Cs contour control reference point return
3093	3233	83	Estimating constant of acceleration
3094	3234	84	Constant of the torque disturbance compensation
3095	3235	85	Adjustment of speed meter output voltage
3096	3236	86	Adjustment of load meter output voltage
3097	3237	87	Spindle speed feedback gain
3098	3238	88	
3099	3239	89	

No.1 spindle	No.2 spindle	AMP.No.	Description
3100	3240	90	Base speed of motor output specifications
3101	3241	91	Limit value for motor output specifications
3102	3242	92	Base speed
3103	3243	93	Magnetic flux down start speed
3104	3244	94	Current loop proportion gain in normal operation
3105	3245	95	Current loop proportion gain in Cs contour control
3106	3246	96	Current loop integral gain in normal operation
3107	3247	97	Current loop integral gain in Cs contour control
3108	3248	98	Current loop integral gain zero point
3109	3249	99	Current loop proportion gain speed coefficient
3110	3250	100	Current conversion constant
3111	3251	101	Secondary current for excitation current
3112	3252	102	Current prediction constant
3113	3253	103	Slip constant
3114	3254	104	Slip compensation constant of high–speed rotation
3115	3255	105	Motor applied voltage compensation constant by dead band
3116	3256	106	Electromotive voltage compensation coefficient
3117	3257	107	Electromotive voltage phase compensation coefficient
3118	3258	108	Electromotive voltage compensation speed coefficient
3119	3259	109	
3120	3260	110	Dead band compensation data
3121	3261	111	Time constant of torque change
3122	3262	112	
3123	3263	113	Momentary overload detection time
3124	3264	114	
3125	3265	115	Timer setting for automatic operation
3126	3266	116	Velocity command on automatic operation mode
3127	3267	117	Load meter display value on maximum output
3128	3268	118	Maximum output limit zero point
3129	3269	119	Secondary electrical current coefficient parameters on rigid tap
3130	3270	120	
3131	3271	121	
3132	3272	122	
3133	3273	123	Motor model code
3134	3274	124	
		125	
3135	3275	126	Grid shift amount in Cs contour control
		127	Grid shift amount in Cs contour control
3280	3500	128	Setting of motor voltage during normal rotation (For output switching)
3281	3501	129	Setting of motor voltage on servo mode (For output switching)

No.1 spindle	No.2 spindle	AMP.No.	Description
3282	3502	130	Base speed motor output specifications (For output switching)
3283	3503	131	Limiting value for motor output specifications (For output switching)
3284	3504	132	Base speed (For output switching)
3285	3505	133	Initial speed with weakened flux (For output switching)
3286	3506	134	Proportional gain of current loop during normal operation (For output switching)
3287	3507	135	Integral gain of current loop during normal operation (For output switching)
3288	3508	136	Zero point of current loop integral gain (For output switching)
3289	3509	137	Speed coefficient of current loop proportional gain (For output switching)
3290	3510	138	Current conversion constant (For output switching)
3291	3511	139	Secondary current coefficient for exciting current (For output switching)
3292	3512	140	Expected current constant (For output switching)
3293	3513	141	Slip constant (For output switching)
3294	3514	142	Slip compensation constant for high–speed rotation (For output switching)
3295	3515	143	Compensation constant for voltage imposed on motor due to dead zone (For output switching)
3296	3516	144	Electromotive voltage compensation coefficient (For output switching)
3297	3517	145	Electromotive voltage phase compensation coefficient (For output switching)
3298	3518	146	Electromotive voltage compensation speed coefficient (For output switching)
3299	3519	147	
3300	3520	148	
3301	3521	149	Time constant of change in torque (For output switching)
3302	3522	150	Maximum output zero point (For output switching)
3303	3523	151	Secondary electrical current coefficient on rigid tap (For output switching)
3304	3524	152	
3305	3525	153	
3306	3526	154	
3307	3527	155	
3308	3528	156	
3309	3529	157	
3310	3530	158	
3311	3531	159	
3312	3532	160	
3313	3533	161	
3314	3534	162	
3315	3535	163	
3316	3536	164	
3317	3537	165	
3318	3538	166	
3319	3539	167	
3320	3540	168	
3321	3541		

No.1 spindle	No.2 spindle	AMP.No.	Description
3322	3542	169	
3323	3543		
3324	3544	170	
3325	3545		
3326	3546	171	
3327	3547		
3328	3548	172	
3329	3549		
3330	3550	173	
3331	3551		

4.15 Parameters Related to Waveform Diagnosis Function

4640	Type of the 1st–waveform data to be sampled (first data)

4641	Type of the 1st–waveform data to be sampled (second data)

4645	Type of the 2nd–waveform data to be sampled (first data)

4646	Type of the 2nd–waveform data to be sampled (second data)

Parameter input

Data type : Byte

Valid data range : 0 to 7 except 3 and 4

Specify up to two types for the 1st–waveform data items and up to two types for the 2nd–waveform data items to be sampled.

0 : Servo error for the nth axis (pulses, detection units)
1 : Number of pulses to be generated for the nth axis servo (pulses, detection units)
2 : Torque for the nth axis servo (%)
5 : Actual speed for the nth axis (pulses, detection units)
6 : Value of the electric current command for the nth axis servo (%)
7 : Data during heat simulation for the nth axis (%)

NOTE The servo torque and the value of the electric current command are represented as percentages of the corresponding settings in parameter 1979.

4.16 Parameters Related to Graphic Display

4821	Specifying cutting feed color

Parameter input

Data type : Byte

Valid range : 0 to 7

Setting data : 0: White 1: Red 2: Green 3: Yellow
4: Blue 5: Violet 6: Light blue 7: White

Specify the cutting feed color drawn on the screen during machining.

4822	Specifying rapid traverse color

Parameter input

Data type : Byte

Valid range : 0 to 7

Setting data : 0: White 1: Red 2: Green 3: Yellow
4: Blue 5: Violet 6: Light blue 7: White

Specify the rapid traverse color drawn during machining.

4823	Specifying a drawing plane

Parameter input

Data type : Byte

Valid range : 1 to 9

Setting data : 1: X–Y plane 2: Y–Z plane 3 : Z–X plane
4: X–Y–Z three–dimensional plane(Note 2) 5 : Y–X plane
6: Z–Y plane 7: X–Z plane
8: X–Z–Y three–dimensional plane(Note 2)
9: X–Y–Z bi–plane(Note 2)

NOTE 1 Depending on how parameter No. 7703 is set, the axis name changes. The above axis names are assumed when X is the first graphic display axis, Y is the second axis, and Z is the third axis.

NOTE 2 The Series 15–T does not support three–dimensional drawing and bi–plane drawing.

Set the number of the plane to be drawn.

Normally, the number of the plane to be drawn is set on the parameter screen for graphic display drawing.

4824	Color indicating reverse operation

Parameter input

Data type : Byte

Valid range : 0 to 7

Setting : 0 : White, 1 : Red, 2 : Green, 3 : Yellow,
4 : Blue, 5 : Violet, 6 : Light blue, 7 : White

Specify the color used to indicate reverse operation when a figure is drawn on the graphic display during machining.

4831	Initial value of horizontal anglar displacement

Parameter input

Data type : Word

Valid range : –360 to +360

Unit : 1 degree

Set the initial value of horizontal angular displacement used in a three–dimensional drawing. (Valid only with the Series 15–M)

4832	Angular displacement on horizontal plane of vertical rotation axis

Parameter input

Data type : Word

Valid range : –360 to +360

Unit : 1 degree

Set the angular displacement on a horizontal plane of a vertical rotation axis used in a three–dimensional drawing. (Valid only with the Series 15–M)

4833	Horizontal angular displacement

Parameter input

Data type : Word

Valid range : –360 to +360

Unit : 1 degree

Set the horizontal angular displacement used in a three–dimensional drawing. (Valid only with the Series 15–M)

Normally, the horizontal angular displacement is set on the parameter screen for graphic display drawing.

4834	Vertical angular displacement

Parameter input

Data type : Word

Valid range : –360 to +360

Unit : 1 degree

Set the vertical angular displacement used in a three–dimensional drawing. (Valid only with the Series 15–M)

Normally, the vertical angular displacement is set on the parameter screen for graphic display drawing.

4835	Graphic display magnification

Parameter input

Data type : Word

Valid range : 1 to 10000

Unit : 0.01%

Set the display magnification of a workpiece coordinate system on a graphic screen.

Normally, the graphic display magnification is set on the parameter screen for graphic display drawing.

4881	Center coordinate of drawing screen

Parameter input

Data type : Two words axis

Valid range : –99999999 to +99999999

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric input	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch input	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Set the center coordinate of the figure to be drawn.

Normally, the center coordinate is set on the parameter screen for graphic display drawing.

4882	Maximum coordinate of drawing screen

Parameter input

Data type : Two words axis

Valid range : –99999999 to +99999999

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric input	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch input	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Set the maximum coordinate of the figure to be drawn.

Normally, the maximum coordinate is set on the parameter screen for graphic display drawing.

4883	Minimum coordinate of drawing screen

Parameter input

Data type : Two words axis

Valid range : –99999999 to +99999999

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric input	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch input	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Set the minimum coordinate of the figure to be drawn.

Normally, the minimum coordinate is set on the parameter screen for graphic display drawing.

7703	Axis in graphic display

Setting input

Data type : Byte axis

Valid range : 0 to 3

Setting:

Setting	Description
1	First axis in graphic display
2	Second axis in graphic display
3	Third axis in graphic display
0	No axis is used in graphic display

4.17 Parameters Related to Reader/Punch Interfaces

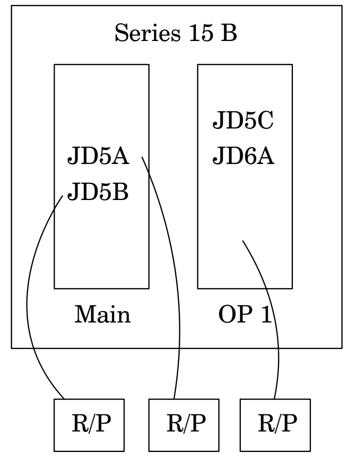
Correlation diagrams for parameters related to reader/punch interfaces are given below.

Parameters related to the reader/punch interface

The correlation diagrams of the parameters related to the reader/punch interface are given below.

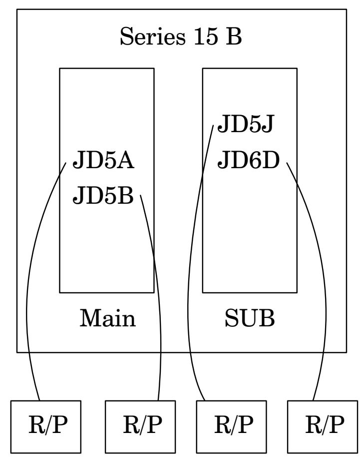
1) Main CPU board + Option 1 board (with communication functions)

Channel 1 : JD5A of the main CPU board
Channel 2 : JD5B of the main CPU board
Channel 10 : JD5C (RS–232–C) or JD6A (RS–422) of OP1.
Only one of the two can be used.
Which is used is specified with bit 0
of parameter No. 5000.



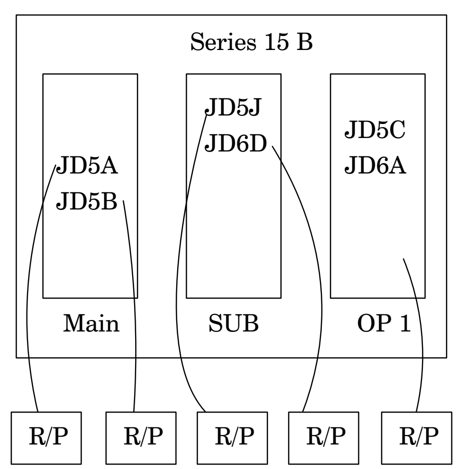
2) Main CPU board + Additional axis board (SUB, ADAX)

Channel 1 : JD5A of the main CPU board
Channel 2 : JD5B of the main CPU board
Channel 3 : JD5J of the sub–board
Channel 13 : JD6D of the sub–board



3) Main CPU board + Sub–board (additional axis) + Option 1 board (with communication functions)

Channel 1 : JD5A of the main CPU board
Channel 2 : JD5B of the main CPU board
Channel 3 : JD5J of the sub–board
Channel 13 : JD6D of the sub–board
Channel 10 : JD5C or JD6A of OP1.
Only one of the two can be used.
Which is used is specified with bit 0
of parameter No. 5000.



Connector for RS–232–C : JD5A, JD5B, JD5C, JD5J
Connector for RS–422 : JD6A, JD6D

NOTE	The option 1 board contains a remote buffer.

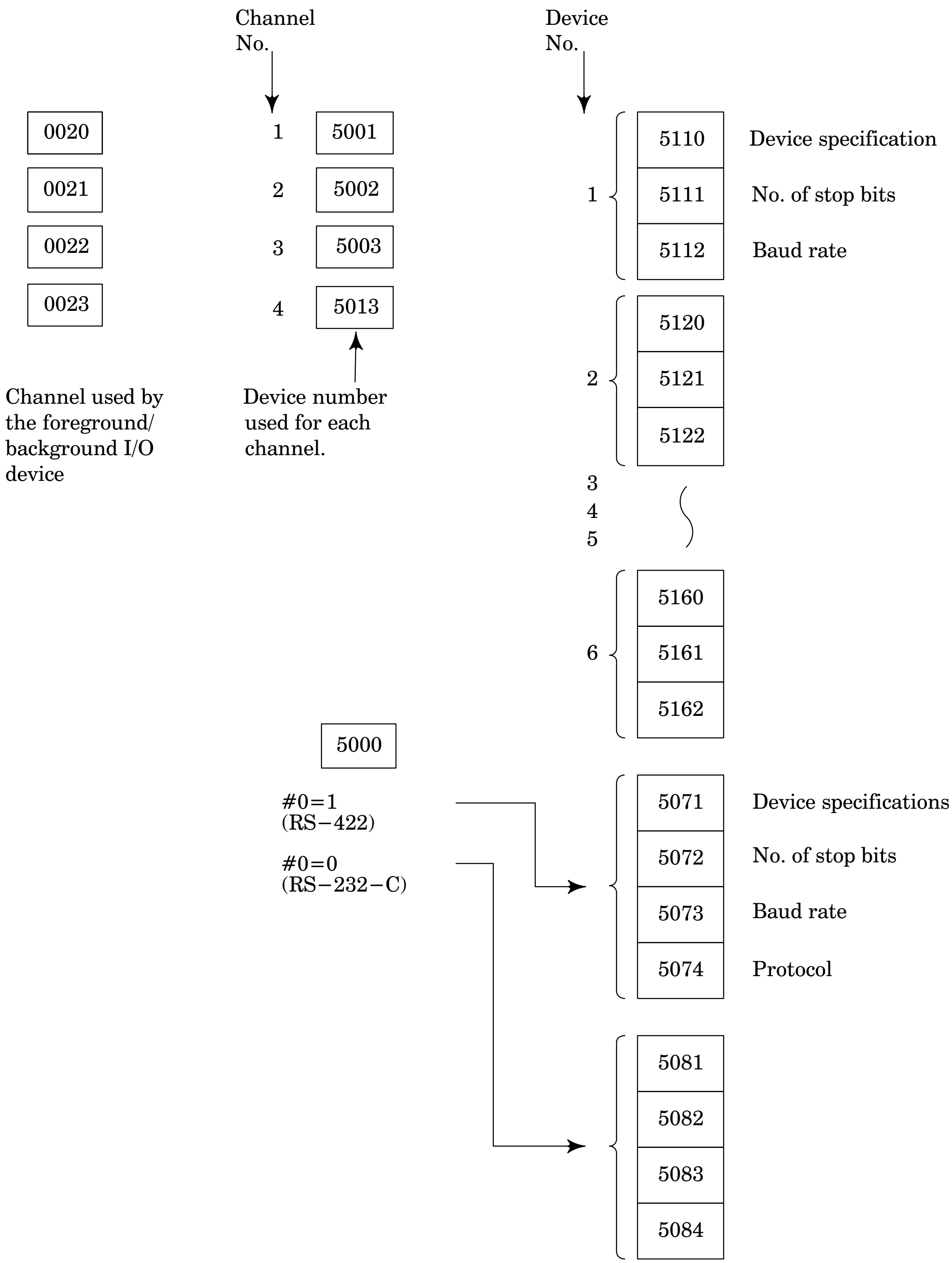
Each reader/punch unit is temporarily assigned device numbers 1 to 6.

When you have four reader/punch units, for example, assign device numbers 1 to 4 to them.

Set the specifications of the assigned reader/punch units in parameter Nos. 5110 to 5162. Set the device numbers of the reader/punch units connected to channels 1, 2, 3, and 13 in parameter Nos. 5001, 5002, 5003, and 5013.

Set the specifications of the host computer connected to the remote buffer in parameter Nos. 5071 to 5084. A parameter that specifies which reader/punch unit is connected to channel 10 is not provided because the remote buffer is always connected to channel 10.

Parameter Nos. 0020 to 0023 select which channels are used as input/output units for foreground/background. These parameters are normally set on a dedicated screen called the SETTING HANDY screen.



	#7	#6	#5	#4	#3	#2	#1	#0
5000		RBCNV	RBRSV	RBCDC	RBETX	RBTCC	RBECH	RB422

Parameter input

Data type: Bit

Parameter No. 5000 specifies settings for the remote buffer.

RB422 Interface between the host computer and remote buffer

0 : RS–232–C

1 : RS–422

RBESH Switching from remote operation to tape operation or vice versa (valid only for protocol A)

0 : 0 is always sent to the SAT data part (byte position 1).

1 : The SET data part (byte position 1) is echoed back to the SET data part (byte position 1).

RBTCC Communication code

Communication code for protocol A

0 : ASCII

1 : ISO

Communication code (DC1, DC3) for protocol B or extended protocol B

0 : ISO

1 : ASCII

RBETX Message end code (valid only for protocol A)

0 : ASCII/ISO CR code

1 : ASCII/ISO ETX code

RBTCC is used to select ASCII/ISO.

RBCDC Specifies whether to check the CD (Carrier Detect) signal of the RS–232–C interface.

0 : The CD signal is checked.

1 : The CD signal is not checked.

RBRSV Reserved

Always set this parameter to 0.

RBCNV Specifies whether to use the remote buffer conversion function (distribution processing function).

0 : The remote buffer conversion function is used.

1 : The remote buffer conversion function is not used.

5001	Device number of reader/punch unit connected to JD5A of MAIN

5002	Device number of reader/punch unit connected to JD5B of MAIN

5003	Device number of reader/punch unit connected to JD5J of additional axis board

Setting input

Data type : Byte

Valid range : 1 to 6

Set the device numbers of the reader/punch units connected to connectors CD4A, CD4B, and CD4.

Set the code numbers of the reader/punch units corresponding to device numbers 1 to 6 in parameter Nos. 5100 to 5162.

5013	Device number of reader/punch unit connected to JD6D of additional axis board

Setting input

Data type : Byte

Valid range : 1 to 6

Set the device number of the reader/punch unit connected to the RS–422 interface.

Set the code numbers of the reader/punch units corresponding to device numbers 1 to 6 in parameter Nos. 5110 to 5162.

5028	Substitute character on the MDI keypad (1)

Parameter input

Data type : Word

Setting value : ASCII code (in decimal)

5029	Character which does not exist on the MDI keypad (1)

Parameter input

Data type : Word

Setting value : ASCII code (in decimal)

5030	Substitute character on the MDI keypad (2)

See parameter No. 5028.

5031	Character which does not exist on the MDI keypad (2)

See parameter No. 5029.

5032	Substitute character on the MDI keypad (3)

See parameter No. 5028.

5033	Character which does not exist on the MDI keypad (3)

See parameter No.5029.

These parameters (Nos.5028 to 5030) enable existing MDI keys to be used in place of characters which do not exist on the MDI keypad, thus allowing characters other than those labeled on the MDI keys to be used in a host directory name on the data server (setting 1). These parameters are provided in three sets. A set of parameters No. 5032 and 5033 is usable not only for the host directory but also for the host file.

Example To specify ¥DSERVER¥NCPROG as a host directory, ”¥” cannot be entered from the MDI keypad. So, you may want to use ”@” in place of ”¥”. This is done by setting 64 (decimal representation of ASCII character @) in parameter No. 5028, and 92 (decimal representation of ASCII character ¥) in parameter No. 5029, then specifying @DSERVER@NCPROG as a host directory; the data server converts this name to ¥DSERVER¥NCPROG.

NOTE	If parameter Nos. 5028 and 5029 are both 0, it is assumed that: Parameter No. 5028 = 32 (space) Parameter No. 5029 = 92 (¥)

5060	HDLC baud rate in DNC1

Setting input

Data type : Byte

Set this parameter to 51 because the HDLC baud rate is fixed at 460K bps in DNC1.

5061	CNC/host connection type in DNC1

Setting input

Data type : Byte

Valid range : 1 to 2

Sets the CNC/host connection type in DNC1.

1. Point to point
2. Multi–point

5062	CNC station address in DNC1

Setting input

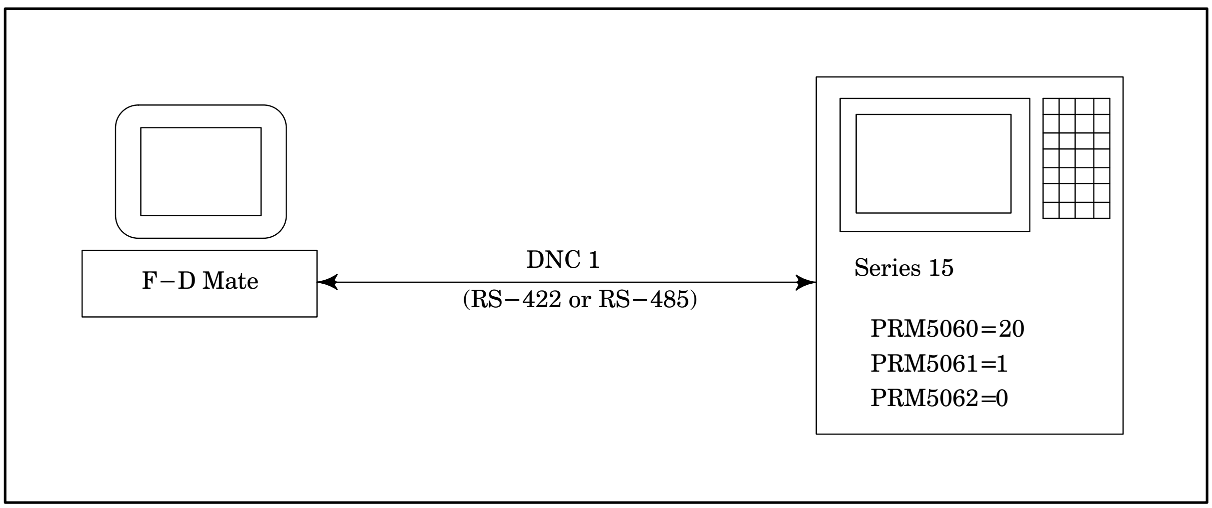
Data type : Byte

Valid range : 2 to 31

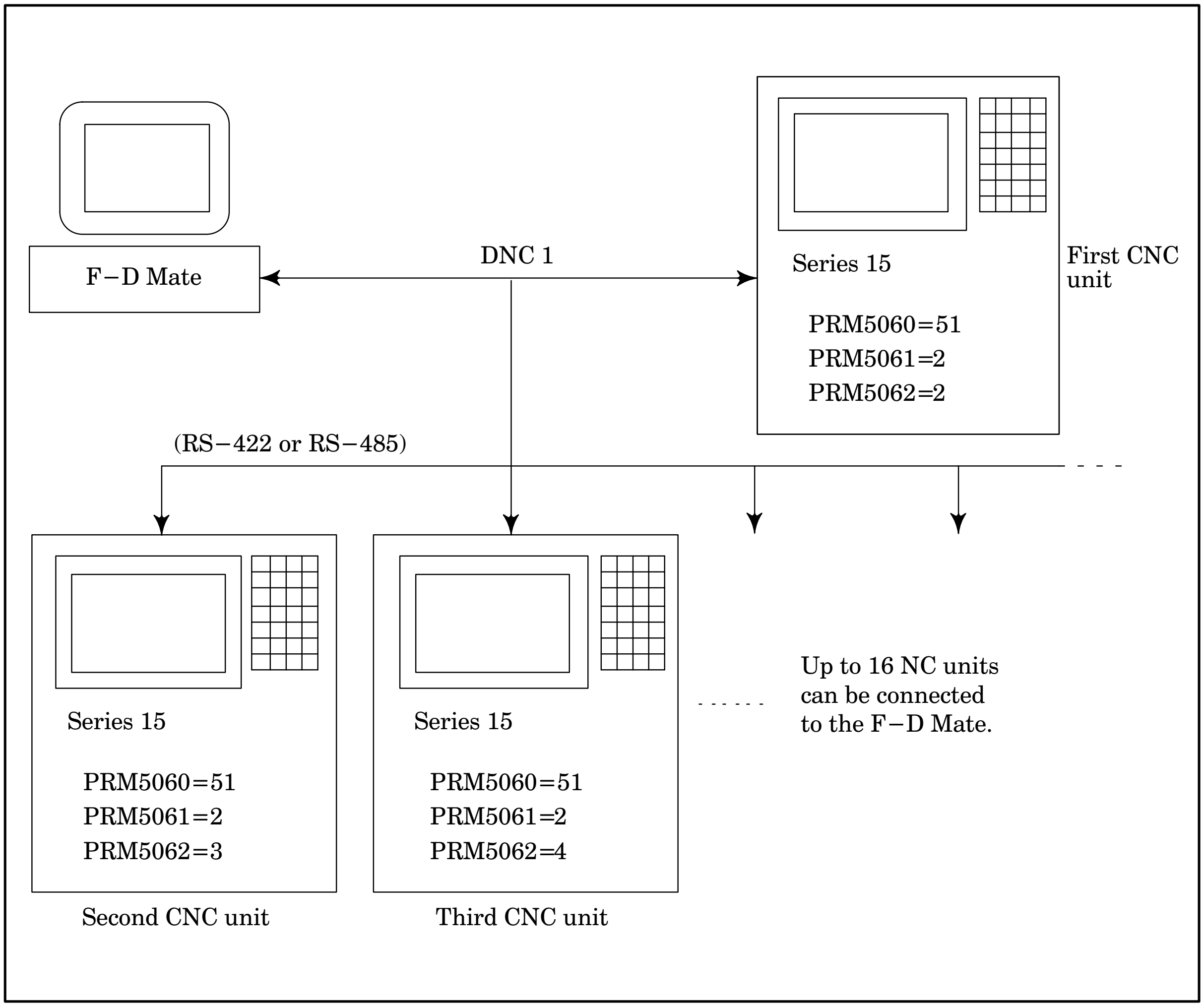
Set the CNC station address in DNC1 (valid only when multi–point is set as the CNC/host connection format).

Example

1 Point–to point mode



2 Multi–point mode



5070	Boundary baud rate to be synchronized with external clock

Setting input

Data type : Byte

Valid range : 1 to 15

Set the boundary baud rate needed when the clock received by CNC is synchronized with the clock of the host computer.

If the set baud rate is exceeded, the clock received by CNC is synchronized with the clock of the host computer.

Set point	Baud rate
1	50
2	100
3	110
4	150
5	200
6	300
7	600
8	1200

Set point	Baud rate
9	2400
10	4800
11	9600
12	19200
13	38400
14	76800
15	86400

When using PROGRAM FILE Mate, set 13.

5071	Code number of RS–422 input/output unit

Setting input

Data type : Byte

Valid range :

Code number	Specifications
8	PROGRAM FILE
9	Set this code number when using PROGRAM FILE Mate in HDLC protocol.
0	Other specifications

For example, when using a personal computer as the host computer of the remote buffer, set 0.

5072	Number of RS–422 stop bits

Setting input

Data type : Byte

Valid range : 1 to 2

5073	RS–422 baud rate

Setting input
Data type : Byte
Valid range : 1 to 15

Set point	Baud rate
1	50
2	100
3	110
4	150
5	200
6	300
7	600
8	1200

Set point	Baud rate
9	2400
10	4800
11	9600
12	19200
13	38400
14	76800
15	86400

When using PROGRAM FILE Mate in HDLC protocol, set the RS–422 baud rate according to the following tables:

Set point	Baud rate
16	153600
17	307200
18	335127
19	368640
20	409600

Set point	Baud rate
21	460800
22	526628
23	614400
24	737280
25	921600

5074	RS–422 protocol selection

Setting input
Data type : Byte
Valid range : 1 to 5
Setting: 1: Protocol B
2: Protocol B'
3: Protocol A
4: Protocol A'
5: When PROGRAM FILE Mate is used in HDLC protocol

For details on protocols, refer to the description of the remote buffer.

5081	Code number of RS–232–C input/output unit

5082	Number of RS–232–C stop bits

5083	RS–232–C baud rate

5084	RS–232–C protocol selection

5110	Code number of reader/punch unit corresponding to device number 1

Setting input

Data type : Byte

Valid range : 1 to 8

Set the code number of reader/punch unit corresponding to device number 1.

The table below gives the correspondence between code numbers and specifications of reader/punch units.

Spec. number	Reader/puncher device specifications
1	Control codes (DC1–DC4) are used. A punch outputs a feed. Tape reader
2	Control codes (DC1–DC4) are not used. A punch outputs a feed.
3	Control codes (DC1–DC4) are used. A punch does not output a feed.
4	Control codes (DC1–DC4) are not used. A punch does not output a feed.
5	Portable tape reader
6	PPR, Handy File (Local mode)
7	FANUC cassette
8	Floppy cassette, PROGRAM FILE Mate, Handy File (Remote mode)

Be sure to set 5 to use the rewinding function with the RS–232–C interface.

5111	Number of stop bits of reader/punch unit corresponding to device number 1

Setting input

Data type : Byte

Valid range : 1 to 2

Set the number of stop bits of reader/punch unit corresponding to device number 1.

5112	Baud rate of reader/punch unit corresponding to device number 1

Setting input

Data type : Byte

Valid range : 1 to 12

Set the baud rate of the reader/punch unit corresponding to device number 1.

The table below gives the correspondence between the specified numbers and baud rate.

Specified number	Baud rate	Specified number	Baud rate
1	50	7	600
2	100	8	1200
3	110	9	2400
4	150	10	4800
5	200	11	9600
6	300	12	19200

5120	Code number of reader/punch unit corresponding to device number 2

5121	Number of stop bits of reader/punch unit corresponding to device number 2

5122	Baud rate of reader/punch unit corresponding to device number 2

5130	Code number of reader/punch unit corresponding to device number 3

5131	Number of stop bits of reader/punch unit corresponding to device number 3

5132	Baud rate of reader/punch unit corresponding to device number 3

5140	Code number of reader/punch unit corresponding to device number 4

5141	Number of stop bits of reader/punch unit corresponding to device number 4

5142	Baud rate of reader/punch unit corresponding to device number 4

5150	Code number of reader/punch unit corresponding to device number 5

5151	Number of stop bits of reader/punch unit corresponding to device number 5

5152	Baud rate of reader/punch unit corresponding to device number 5

5160	Code number of reader/punch unit corresponding to device number 6

5161	Number of stop bits of reader/punch unit corresponding to device number 6

5162	Baud rate of reader/punch unit corresponding to device number 6

The method for setting these parameters is the same as for setting the specifications of the input/output unit corresponding to device number 1.

4.18 Parameters Related to Stroke Limit

	#7	#6	#5	#4	#3	#2	#1	#0
5200	PLC			BG0	BZR			OUT

Parameter input

Data type : Bit

OUT Specifies whether to use the interior or exterior of stored stroke limit 2 (valid only with the Series 15–M) as the inhibited area. Alternatively, specifies whether to use the interior or exterior of stored stroke limit 3 (valid only with the Series 15–T and Series 15–TT) as the inhibited area.

0 : The interior of stored stroke limit 2 or 3 is used as the inhibited area.

1 : The exterior of stored stroke limit 2 or 3 is used as the inhibited area.

BZR Specifies whether to check the stored stroke limit immediately after the power has been turned on.

1 : Stored stroke limit is checked immediately after the power has been turned on.

0 : Stored stroke limit is not checked immediately after the power has been turned on.

(The stored stroke limit is not checked until reference position return by G28 or automatic reference position return is completed.)

NOTE 1 This parameter is not validated immediately even if it is switched after the power has been turned on. To validate this parameter, turn the power off once, then on again.

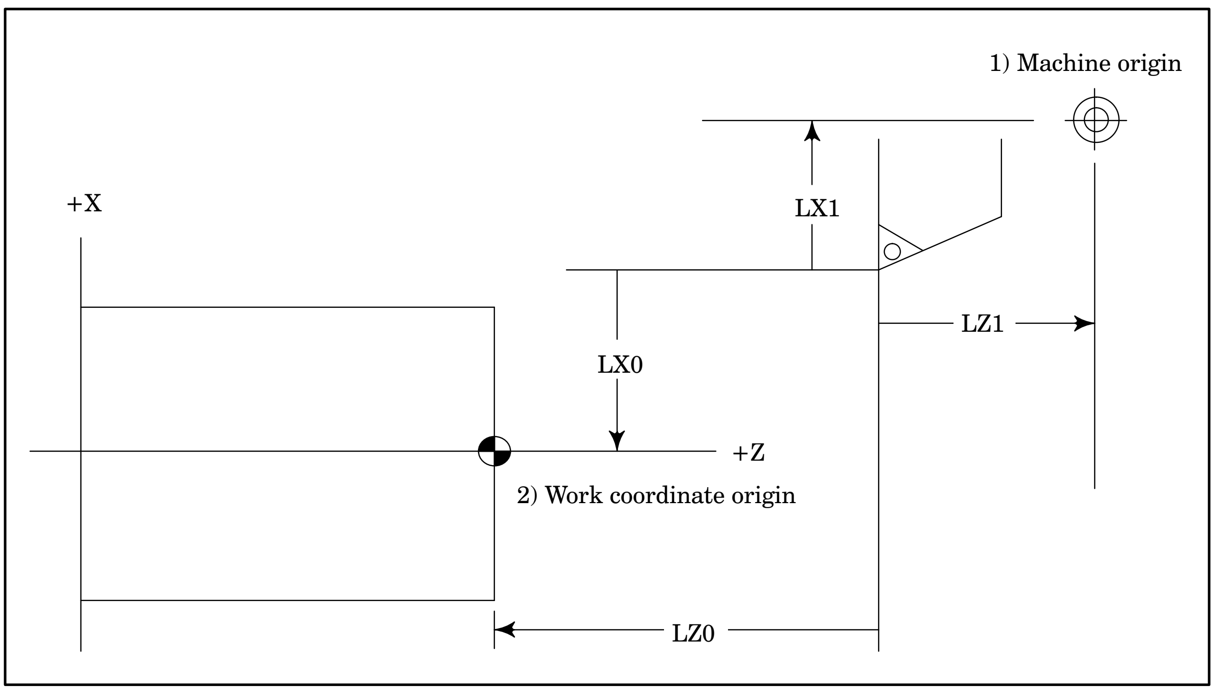
NOTE 2 When an absolute–position detector is provided, the stored stroke limit is checked immediately after the power has been turned on regardless of this parameter's setting.

NOTE 3 This parameter is invalid for multiaxis systems.

BG0 This parameter is effective only when the chuck/tailstock barrier option is provided. If "compensating for tool offset (geometry, wear) by shifting the workpiece coordinate (parameter No. 6001, LGT=0 or LWT=1)" is set, set this parameter according to the concept of a standard tool as follows:

0 : When the machine tool is at the machine zero point, the tip of the standard tool is assumed to be a virtual tool at the workpiece coordinate origin.

1 : When the machine tool is at the machine zero point, the tip of the standard tool is assumed to be a virtual tool at the machine zero point.



To define the distance (LX1, LZ1) between the tip of each tool and the machine zero point as a tool offset when the machine tool is at the machine zero point, set BG0 to 1. To define the distance (LX0, LZ0) between the tip of each tool and the workpiece coordinate origin as a tool offset, set BG0 to 0.

PLC Specifies whether to perform pre–move stroke check.

0 : Pre–move stroke check is not performed.

1 : Pre–move stroke check is performed.

CAUTION	This parameter is valid only when the pre–move stroke option is provided.

	#7	#6	#5	#4	#3	#2	#1	#0
5201						TILM	TILE	SSLWRN

Setting entry

Data type : bit type

SSLWRN When movement exceeding stored stroke limit 1 is specified during manual operation

0 : An alarm is issued in the same way as for the conventional specifications.

1 : A warning message is displayed.

TILE Transverse inhibit limit check is:

0 : Disabled

1 : Enabled

TILM Movement along an axis is stopped, and only the absolute coordinates areupdated, when the relation ship between the absolute coordinate along the axis and transverse inhibit limit (parameter No. 5251) is:

0 : Absolute coordinate > Transverse inhibit limit

1 : Absolute coordinate < Transverse inhibit limit

	#7	#6	#5	#4	#3	#2	#1	#0
5210							OT3x	OT2x

Setting input

Data type: Bit axis

OT2x Specifies whether to check stored stroke limit 2 for each axis (valid when OUT (bit 0) of parameter No. 5200 is set to 0.).

0 : Stored stroke limit 2 is not checked for each axis.

1 : Stored stroke limit 2 is checked for each axis.

NOTE 1	If OUT (bit 0) of parameter No. 5200 is set to 1, stored stroke limit 2 is checked for all the controlled axes.
NOTE 2	In the Series 15–T and Series 15–TT, the interior of stored stroke limit 2 is always used as the inhibited area.

OT3x Specifies whether to check stored stroke limit 3 for each axis (valid when OUT (bit 0) of parameter No. 5200 is set to 0).

0 : Stored stroke limit 3 is not checked for each axis.

1 : Stored stroke limit 3 is checked for each axis.

NOTE	If OUT (bit 0) of parameter No. 5200 is set to 1, stored stroke limit 3 is checked for all the controlled axes.

5220	Positive (+) direction coordinate of stored stroke limit 1 of each axis

Setting input
Data type : Two words axis
Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch
Rotary axis	0.01	0.001	0.0001	0.00001	0.000001	deg

Valid range : –99999999 to +99999999

Set the coordinate in the positive–direction machine coordinate system of stored stroke limit 1 for each axis.

5221	Negative (–) direction coordinate of stored stroke limit 1 of each axis

Setting input
Data type : Two words axis
Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch
Rotary axis	0.01	0.001	0.0001	0.00001	0.000001	deg

Valid range : –99999999 to +99999999

Set the coordinate in the negative–direction machine coordinate system of stored stroke limit 1 for each axis.

5222	Positive (+) direction coordinate of stored stroke limit 2 of each axis

Setting input
Data type : Two words axis
Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch
Rotary axis	0.01	0.001	0.0001	0.00001	0.000001	deg

Valid range : –99999999 to +99999999

Set the coordinate in the positive–direction machine coordinate system of stored stroke limit 2 for each axis.

5223	Negative (–) direction coordinate of stored stroke limit 2 of each axis

Setting input
Data type : Two words axis
Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch
Rotary axis	0.01	0.001	0.0001	0.00001	0.000001	deg

Valid range : –99999999 to +99999999

Set the coordinate in the negative–direction machine coordinate system of stored stroke limit 2 for each axis.

5224	Positive (+) direction coordinate of stored stroke limit 3 of each axis

Setting input (valid only with the Series 15–T and Series 15–TT)

Data type : Two words axis

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch
Rotary axis	0.01	0.001	0.0001	0.00001	0.000001	deg

Valid range : –99999999 to +99999999

Set the coordinate in the positive–direction machine coordinate system of stored stroke limit 3 for each axis.

5225	Negative (–) direction coordinate of stored stroke limit 3 of each axis

Setting input (valid only with the Series 15–T and Series 15–TT)

Data type : Two words axis

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch
Rotary axis	0.01	0.001	0.0001	0.00001	0.000001	deg

Valid range : –99999999 to +99999999

Set the coordinate in the negative–direction machine coordinate system of stored stroke limit 3 for each axis.

5230	Chuck figure selection (TY)

Parameter input

Data type : Byte

Meaning of data :

0: Chuck that grasps a workpiece at its inner surface

1: Chuck that grasps a workpiece at its outer surface

Parameter Nos. 5230 to 5248 are normally set on the chuck/tailstock barrier setting screen.

5231	Chuck claw length (L)

Parameter input
Data type : Two words
Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to +99999999

5232	Chuck claw size (W)

Parameter input
Data type : Two words
Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to +99999999

5233	Grasping length of chuck claw (L1)

Parameter input
Data type : Two words
Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to +99999999

5234	Grasping level difference of chuck claw (W1)

Parameter input
Data type : Two words
Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to +99999999

5235	Chuck position along the X–axis (CX)

Parameter input
Data type : Two words
Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : –99999999 to +99999999

5236	Chuck position along the Z–axis (CZ)

Parameter input
Data type : Two words
Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : –99999999 to +99999999

5241	Tailstock length (L)

Parameter input
Data type : Two words
Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to +99999999

5242	Tailstock diameter (D)

Parameter input
Data type : Two words
Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to +99999999

5243	Tailstock length 1 (L1)

Parameter input

Data type : Two words

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to +99999999

5244	Tailstock diameter 1 (D1)

Parameter input

Data type : Two words

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to +99999999

5245	Tailstock length 2 (L2)

Parameter input

Data type : Two words

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to +99999999

5246	Tailstock diameter 2 (D2)

Parameter input

Data type : Two words

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to +99999999

5247	Tailstock hole diameter (D3)

Parameter input

Data type : Two words

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to +99999999

5248	Tailstock position along the Z–axis (TZ)

Parameter input

Data type : Two words

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : –99999999 to +99999999

5250	Axis number for transverse inhibit limit check

Setting entry

Data type : Byte

Data range : 1 to Control axis number

This parameter specifies the axis number of the control axis subjected totransverse inhibit limit check. The absolute coordinate along the axis is checked.

5251	Transverse inhibit limit value

Setting entry

Data type : Two words

Data unit :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Linear axis (mm input)	0.01	0.001	0.0001	0.00001	0.000001	mm
Linear axis (inch input)	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Data range : ± 999999999

When the absolute coordinate along the axis selected with setting parameter No. 5250 exceeds the transverse inhibit limit, the CNC stops movement along the axis, and updates the absolute coordinates only. Once the absolute coordinates again fall within the range of the transverse inhibit limit, the CNC resumes movement along that axis.

4.19 Parameters Related to Position Switching Function

	#7	#6	#5	#4	#3	#2	#1	#0
5200						OTSP	POSW	

Parameter input

Data type : Bit

POSW The position switching function is

0 : Disabled

1 : Enabled

OTSP Specifies whether to stop the machine if an overtravel alarm occurs during PMC axis control.

1 : Stepped.

0 : Not stepped.

5270	PSWA01
5271	PSWA02
5272	PSWA03
52703	PSWA04
5274	PSWA05
5275	PSWA06
5276	PSWA07
5277	PSWA08
5278	PSWA09
5279	PSWA10

Data type : Byte

Varid data : 0 to maximum controllable axes

Parameters 5270 to 5279 sequentially specify the control axes for which the first to tenth position switching functions are performed; that is, parameter 5270 specifies the control axis for first position switching function, parameter 5271 specifies the control axis for the second position switching function, and so on.

Value	Contents
0	Does not perform the position switching function.
1	First axis
2	Second axis
:	:
15	Fifteenth axis

If a value less than 0 or more than the maximum number of controllable axes is specified, 0 is assumed and the position switching function is not performed.

5280	PSW101

5281	PSW102

5282	PSW103

5283	PSW104

5284	PSW105

5285	PSW106

5286	PSW107

5287	PSW108

5288	PSW109

5289	PSW110

Data unit : 2–word

Varid data range : –999999999 to +999999999

Parameters 5280 to 5289 sequentially specify the maximum value of the machine coordinate ranges in which the first to tenth position switching signals are output; that is, parameter 5280 specifies the machine coordinate rang e in which the first position switching signal is output, parameter 5281 specifies the machine coordinate range in which the second position switching signal is output, and so on.

5290	PSW201
5291	PSW202
5292	PSW203
5293	PSW204
5294	PSW205
5295	PSW206
5296	PSW207
5297	PSW208
5298	PSW209
5299	PSW210

Data unit : 2–word

Varid data range : –999999999 to +999999999

Parameters 5290 to 5299 sequentially specify the minimum value of the machine coordinate ranges in which the first to tenth position switching signals are output; that is parameter 5290 specifies the machine coordinate range in which the first position switching signal is output, parameter 5291 specifies the machine coordinate range in which the second position switching signal is output, and so on.

4.20 Parameters Related to Reference Marks

	#7	#6	#5	#4	#3	#2	#1	#0
1008		DCLx						

Data type : Bit axis

DCLx Specifies whether to use a linear scale having reference marks as a separate position detector.
0 : Not used.
1 : Used.

5226	Mark 2 interval for a linear scale having reference marks

Data type : Two–word axis
Unit of data : Detection unit
Valid range : 1 to 99999999

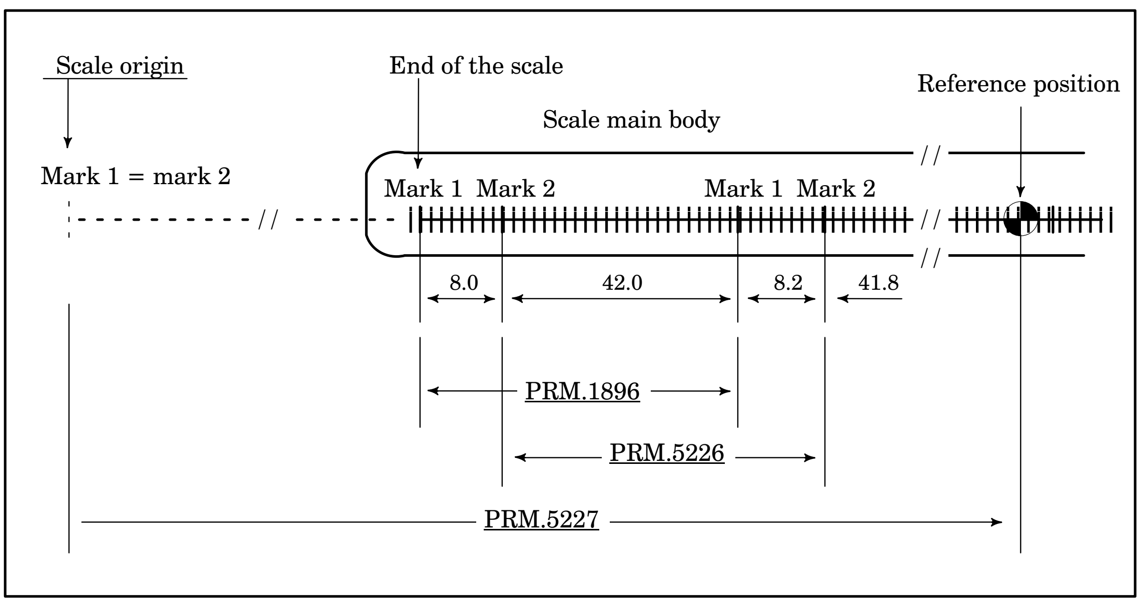
Specifies the mark 2 interval for a linear scale having reference marks.

5227	Distance between the origin of the linear scale having reference marks and the reference position

Data type : Two–word axis
Unit of data : Detection unit
Valid range : –999999999 to +999999999

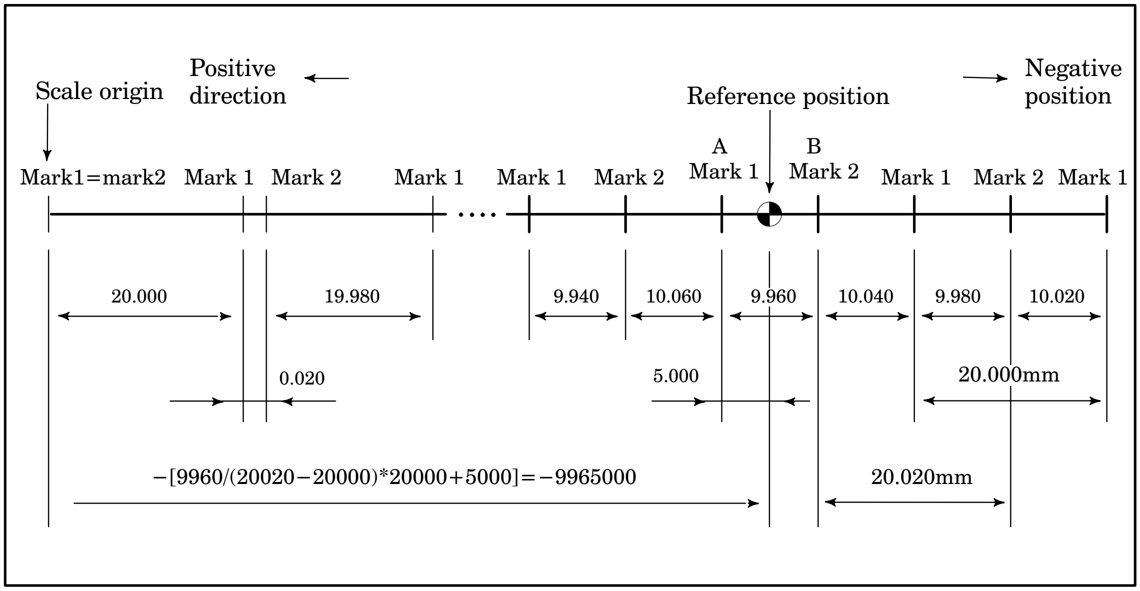
Specifies the distance between the origin of the linear scale having reference marks and the reference position. The "scale origin" here is that point where mark 1 coincides with mark 2. Usually, this point does not physically exist on the scale. (See the following chart.)

If the reference position is in the positive direction as viewed from the scale origin, this parameter must be a positive value.
If the reference position is in the negative direction as viewed from the scale origin, this parameter must be a negative value.



[Example of parameter setting]

Suppose the following scale is used on an IS–B metric system machine.



Parameter No. 1896 (mark 1 interval)

= ”20000”

Parameter No. 5226 (mark 2 interval)

= ”20020”

Parameter No. 5227 (reference position)

= point A position + 5.000

$$= \frac{\text{A–to–B distance}}{\text{Mark 2 interval – mark 1 interval}} \text{*Mark 1 interval+5.000}$$

$$= \frac{9960}{20020–20000} \text{*20000+5000}$$

=9965000

→”–9965000” (if the reference position is in the negative direction)

[Example of setting parameter No. 5227]

If it is difficult to measure the distance (parameter No. 5227) between the scale origin and the reference position, obtain it by means of the following procedure.

1 Enable this function by setting parameter Nos. 1815, 1807, and 1008.
Set an appropriate value for parameter Nos. 1896 and 5226.
Set 0 for parameter No. 1240.
Set 0 for parameter No. 5227.

2 Establish the origin at an appropriate position using the method described in Section 2.1.
(As a result, the machine coordinates will correspond to the distance between the scale origin and the current position.)

3 Accurately set the machine to the reference position either by jog or handle feeding.

4 Set parameter No. 5227 using the value obtained by converting the machine coordinates to detection unit format (by adding the machine coordinates to CMR).

5 Set parameter No. 1240 as required.

4.21 Parameters Related to Pitch Error Compensation

Stored pitch error compensation function

(1) Function

The stored pitch error compensation function can compensate for pitch errors in detection units for each axis.

This function becomes valid after the machine tool has returned to the reference position.

(2) Specifications

The compensation is set in the reference position to which the machine tool returned as the compensation zero point for each compensation interval. The compensation interval is set for each axis.

i) Axes that can be compensated: All axes

ii) Number of compensation points

0 to {128 × (number of controlled axes)–1} (total of axes)

iii) Compensation range

For each compensation point : 0 to ±7 x compensation magnification (detection unit)

Compensation magnification : 0 to 100

(3) Setting

Set the following parameters:

(1) Number of a pitch error compensation point corresponding to the reference position for each axis:
Parameter No. 5420

(2) Number of pitch error compensation point with the largest negative value for each axis:
Parameter No. 5421

(3) Number of pitch error compensation point with the largest positive value for each axis:
Parameter No. 5422

(4) Magnification of pitch error compensation for each axis:
Parameter No. 5423

(5) Interval of pitch error compensation points for each axis:
Parameter No. 5424

(6) Angular displacement per rotation in rotation–axis pitch error compensation (valid for rotation axis):
Parameter No. 5425

(7) Pitch error compensation data:
Set compensation data corresponding to the number of each pitch error compensation point.

5420	Number of pitch error compensation point–of–reference position for each axis

Parameter input

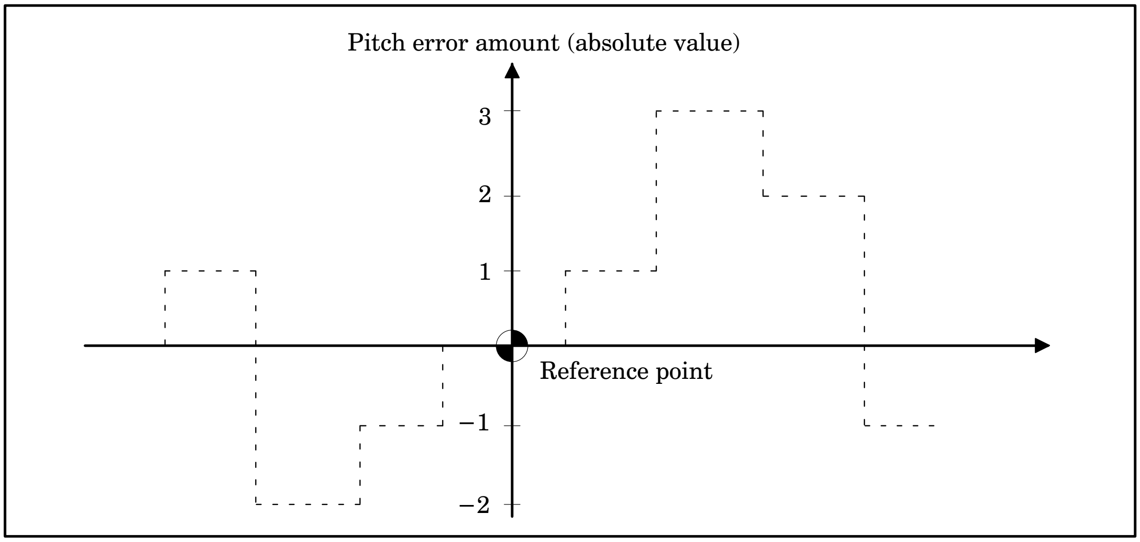
Data type : Word axis

Unit of data :

Valid range : 0 to {128 x (number of controlled axes)–1}

Set the number of the pitch error compensation point corresponding to the reference position for each axis.

Example



Compensation point number	30	31	32	33	34	35	36	37
Specified compensation amount	+1	–3	+1	+1	+1	+2	–1	–3

In the above example, 33 is set as the number of the pitch error compensation point corresponding to the reference position.

In pitch error compensation within 360 degrees, a compensation point number is specified with the 0–degree point (machine zero point) set as the reference point.

If the reference point is not located at the 0–degree point (machine zero point), set parameters as follows:

- Set the parameter (No. 5424) specifying the interval between pitch error compensation points so that the reference point is a multiple of the interval away from the 0–degree point (machine zero point).
- Set the parameter (No. 5422) specifying the number of the farthest compensation point in the positive direction so that it specifies the 360–degree point.
- Set the parameter (No. 5425) specifying angular–displacement per rotation to 360 degrees.

5421	Number of pitch error compensation point with the largest negative value for each axis

Parameter input

Data type : Word axis

Unit of data : Number

Valid range : 0 to {128 × (number of controlled axes)–1}

Set the number of the pitch error compensation point with the largest negative value for each axis. In the previous example, 30 is set.

In pitch error compensation within 360 degrees, be sure to assign the number of the farthest pitch error compensation point in the negative direction to a compensation point positioned next to the 0–degree point in the posit ive direction.

5422	Number of pitch error compensation point with the largest positive value for each axis

Parameter input

Data type : Word axis

Unit of data : Number

Valid range : 0 to {128 x (number of controlled axes)–1}

Set the number of the pitch error compensation point with the largest positive value for each axis. In the above example, 37 is set.

5423	Magnification of pitch error compensation for each axis

Parameter input

Data type : Byte axis

Unit of data : ×1

Valid range : 0 to 100

Set the magnification of pitch error compensation for each axis.

When 1 is set as the magnification of pitch error compensation, the unit for compensation data is the same as that of the detection unit.

5424	Interval of pitch error compensation points for each axis

Parameter input

Data type : Two words axis

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch
Rotary axis	0.01	0.001	0.0001	0.00001	0.000001	deg

Valid range : 0 to 99999999

Pitch error compensation points are set at regular intervals. Set this interval for each axis.

The minimum interval of pitch error compensation points is determined from the following equation:

Minimum interval = maximum feedrate / 7500

Unit : mm, inch, deg, mm/min, inch/min, or deg/min

Example When the maximum feedrate is 15000 mm/min, the minimum interval of pitch error compensation points is 2 mm.

5425	Angular–displacement per rotation in rotation–axis pitch error compensation

Parameter input

Data type : Two words axis

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch
Rotary axis	0.01	0.001	0.0001	0.00001	0.000001	deg

Valid range : 0 to 99999999

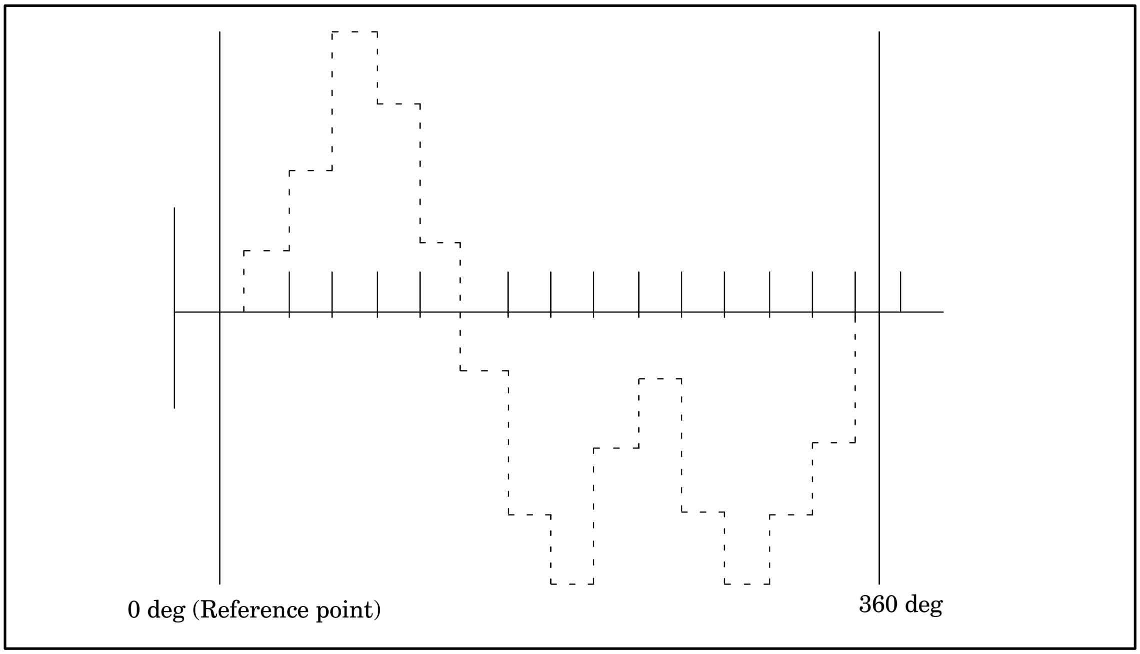
For rotation axis pitch error compensation (ROPx of parameter No. 1006 is set to 1), set angular displacement per rotation for each axis. The angular displacement per rotation is not necessarily 360. The period in rotation axis pitch error compensation can be set.

The angular displacement per rotation, compensation interval, and number of compensation points must satisfy the following equation:

Angular displacement per rotation = compensation interval x number of compensation points

The sum of the compensation per rotation must always be 0.

Example



Compensation point number	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Specified compensation amount	+1	+1	+2	–1	–2	–2	–2	–1	+2	+1	–2	–1	+1	+1	+2

Specify the parameters as follows for the above example.

Data number	5420	5421	5422	5423	5424	5425
Specified value	10	11	25	1	24000	360000

[Interpolating pitch error compensation]

As shown in Fig. 1 below, the conventional pitch error compensation method outputs a pitch compensation pulse at every interval between pitch error compensation points.

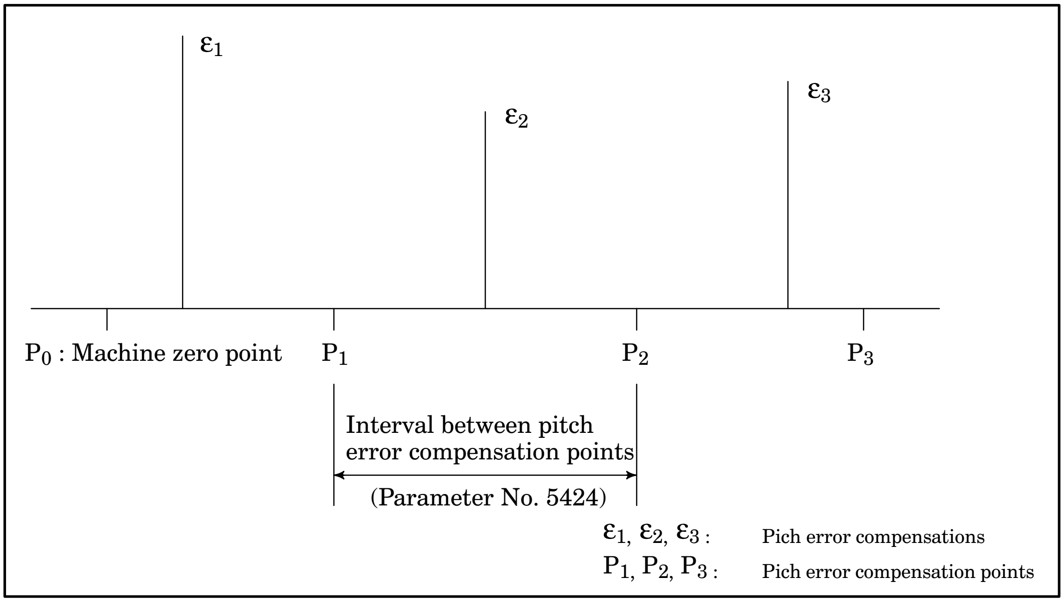


Fig. 1 Conventional pitch error compensation method

The interpolating pitch error compensation method, in contrast, outputs several pulses between pitch error compensation points. As shown in Fig. 2 below, pulses are output at a constant interval between adjacent pitch error compensation points depending on the pitch error compensations.

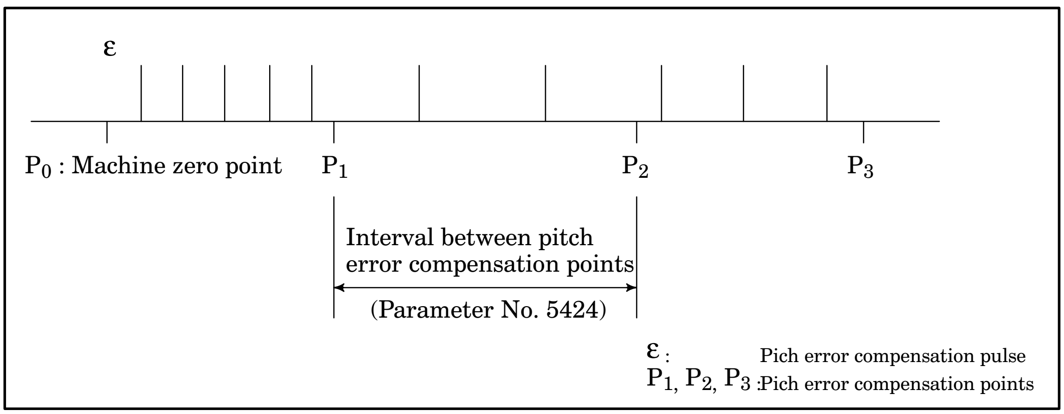


Fig. 2 Interpolating pitch error compensation method

When the second cyclical pitch error compensation is used at the same time, pitch error compensations are output according to the interpolating pitch error compensation method between each pitch error compensation point set by the second cyclical pitch error compensation.

If the feedrate is too fast, several compensation pulses may be output at once. The following minimum interval is necessary to prevent this from occurring:

Minimum interval between pitch error compensation points = (Fmax/7500)*(Pmax + 1) where Fmax: Maximum feedrate Pmax: Maximum pitch error compensation

Example When the maximum feedrate is 15000 mm/min and the maximum pitch error compensation is 7 pulses, the minimum interval between compensation points is 16 mm.

Use this function only on a system with a sub–CPU.

NOTE 1 Interpolating pitch error compensation cannot be used in spindle positioning.
NOTE 2 Interpolating pitch error compensation cannot be used in a machine tool which runs in high–speed operation or in ultra–high–speed operation.

	#7	#6	#5	#4	#3	#2	#1	#0
5426	IPPE							

Data type : Bit axis

IPPE The interpolating pitch error compensation method is

0 : Not used.

1 : Used.

[The second cyclical pitch error compensation method]

When the rotary table is rotated with gears, two types of cyclical pitch error occur: Error due to rotation of the rotary table and error due to rotation of a gear rotating the table. Pitch error compensation is applied to both types of error.

As shown in Fig. 1, when there is only one pair of gears between the rotary table and servo motor, the conventional pitch error compensation method is applied to gear A and the second cyclical pitch error compensation method is applied to gear B.

As shown in Fig. 2, when there are several pairs of gears between the rotary table and servo motor, the conventional pitch error compensation method is applied to gear A and second cyclical pitch error compensation method is applied to cyclical pitch errors which occur in each cyclical error compensation interval for gear A.

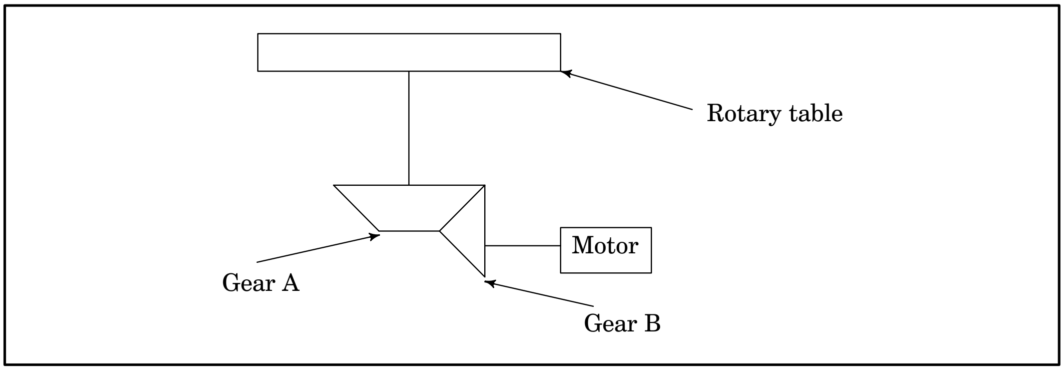


Fig. 1 Second cyclical pitch error compensation for one pair of gears

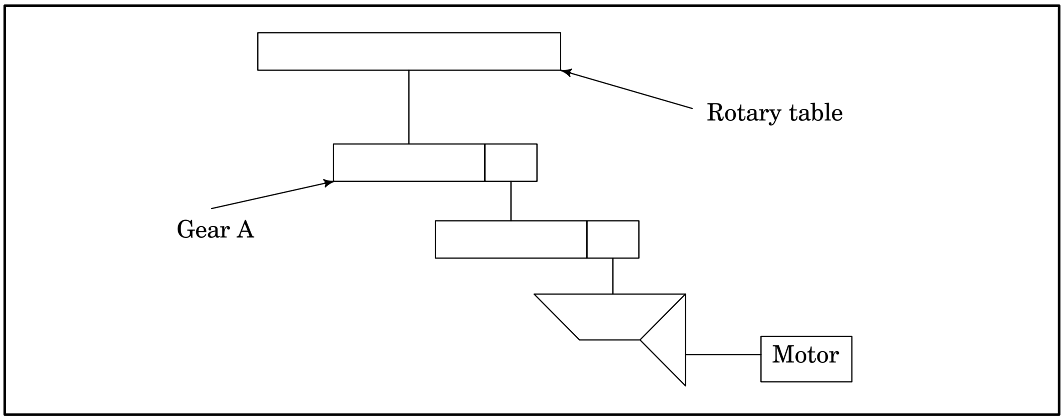


Fig. 2 Second cyclical pitch error compensation for several pairs of gears

A rotary table is used here as an example. The second cyclical pitch error compensation method can also be used for a linear axis with gears.

For example, in the configuration shown in Fig. 3, the conventional pitch error compensation method is applied to the ball screw and the second cyclical pitch error compensation method is applied to gear A.

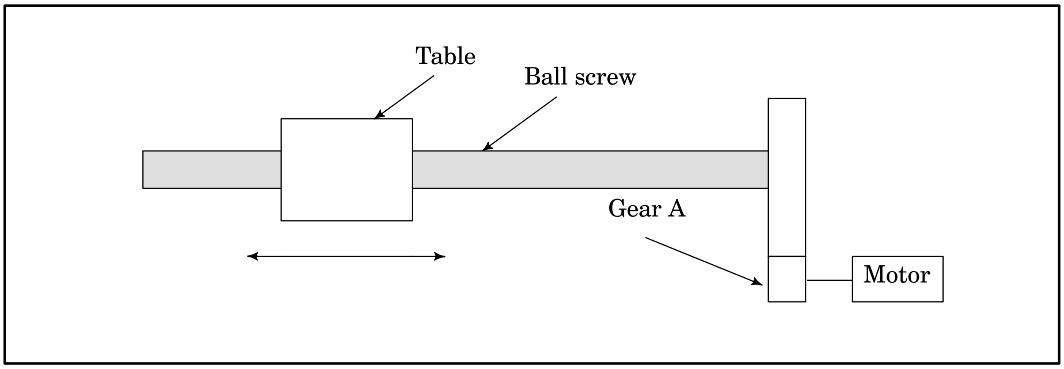
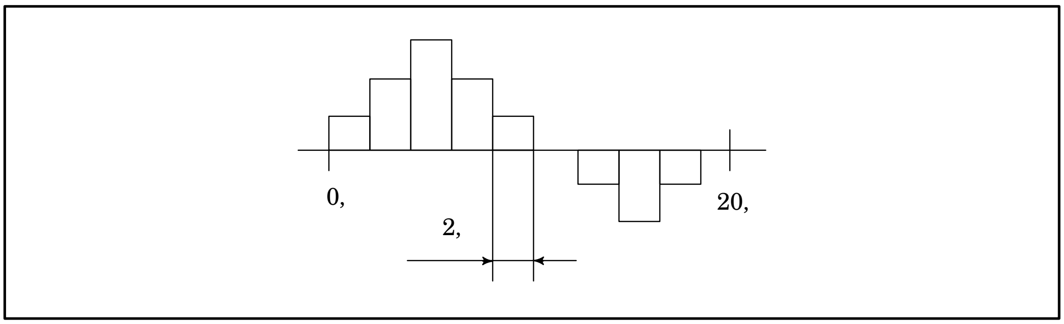


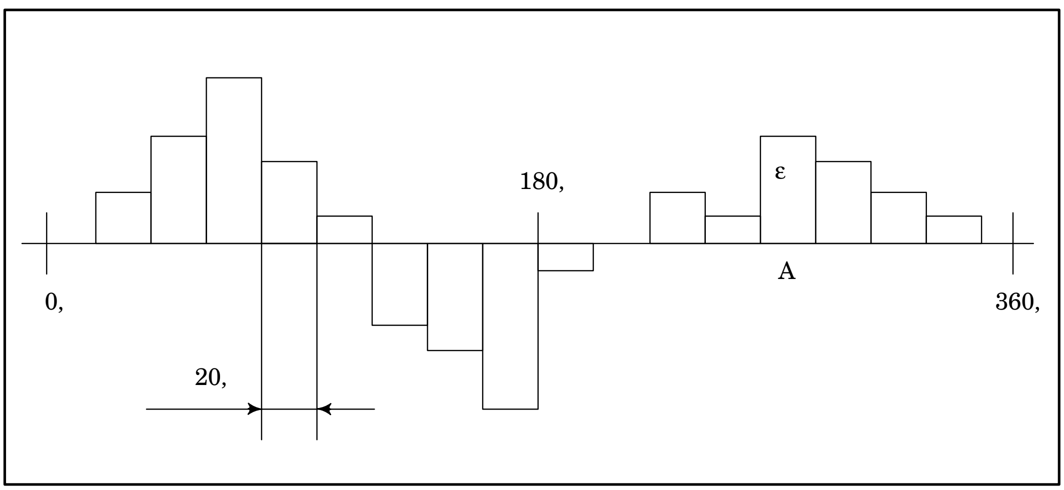
Fig. 3 Second cyclical pitch error compensation for a linear axis

When the rotary table is rotated with gears, two types of cyclical pitch error occur: Error due to rotation of the rotary table and error due to rotation of a gear rotating the table. The second cyclical pitch error compen sation method compensates for these two types of error.

–Cyclical pitch error due to rotation of the gear (When the rotary table rotates 20 per rotation of the gear)



–Cyclical pitch error per revolution (360)



–Cyclical pitch error at A after the two types of error are combined

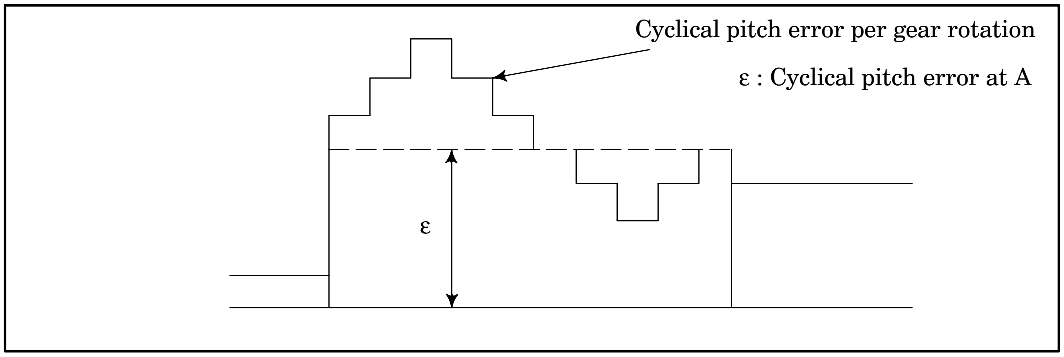


Fig. 4 Second cyclical pitch error compensation

Fig. 4 above shows an example of applying the second cyclical pitch error compensation. This compensation method compensates for the cyclical pitch error due to rotation of the gear and the pitch error with a period of 360 .

CAUTION 1 Second cyclical pitch error compensation cannot be applied to an axis to which spindle positioning is applied.

CAUTION 2 Second cyclical pitch error compensation cannot be applied to a machine tool which runs in high–speed DNC operation or in ultra–high–speed DNC operation.

CAUTION 3 Second cyclical pitch error compensation cannot be applied to an axis for which the second detector used for malfunction check is provided.

NOTE 1 The number of the farthest second cyclical pitch error compensation point in the negative direction and the number of the farthest second cyclical pitch error compensation point in the positive direction for each ax is are specified in parameters. If these two parameters are set to 0 or the same value, second cyclical pitch error compensation is not performed.

NOTE 2 The maximum number of points to which pitch error compensation or second cyclical pitch error compensation can be applied is 768. As the number of points to which second cyclical pitch error compensation is applied increases, the number of points to which pitch error compensation is applied decreases correspondingly; that is, second cyclical pitch error compensation points + pitch error compensation points = 768.

NOTE 3 When Interpolating pitch error compensation is used together with second cyclical pitch error compensation.
Interpolating compensation values are output in the output pulse format within the intervals of second cyclical pitch error compensation.

NOTE 4 Second cyclical pitch error compensation is added to rotation–axis pitch error compensation.

NOTE 5 Be sure to specify compensation so that the total amount of compensation per rotation is 0.

NOTE 6 Second cyclical pitch error compensation becomes valid after reference position return is performed.

5430	Number of the farthest second cyclical pitch error compensation point in the negative direction for each axis

Parameter input
Data type : Word axis
Unit of data : Number
Valid data range : 0 to (number of controlled axes multiplied by 128–1)

The point specified with this parameter is used as a compensation reference point. It is also used for synchronizing this compensation with the usual pitch error compensation. The compensation at the compensation reference point must be 0.

5431	Number of the farthest second cyclical pitch error compensation point in the positive direction for each axis

Parameter input
Data type : Word axis
Unit of data :
Valid data range : 0 to (number of controlled axes multiplied by 128–1)

5432	Interval between the second cyclical pitch error compensation points for each axis

Parameter input
Data type : Two–Word axis
Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Millimeter machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch
Rotary axis	0.01	0.001	0.0001	0.00001	0.000001	deg

Valid data range : 0 to 99999999

Example When the rotary table rotates 20 degrees per gear rotation

Compensation No.	10	11	12	13	14	15
Compensation	0	+1	+2	–1	–1	–1

To apply the compensation described above, set the parameters as follows:

Parameter No.	5430	5431	5432
Setting	10	15	4000 (4deg)

5433	Multiplier for the second cyclical pitch error compensation for each axis

Parameter input
Data type : Byte axis
Unit of data :
Valid data range : 0 to 100

Specify a multiplier for the second cyclical pitch error compensation for each axis. When the multiplier is set to 1, the unit of compensation data is the same as the detection unit.

[Compensation for pitch error in both directions]

This function enables pitch error compensation for both positive and negative movement directions to be specified and performs pitch error compensation for each movement direction separately, based on the specified amount. When the direction of movement is inverted, this function automatically obtains the compensation to be applied from the pitch error compensation data and performs compensation for the new movement direction in a way similar to conventional backlash compensation. In this way, the difference in the path between positive and negative directions is further reduced.

(1) Data setting method

Specify the following data.

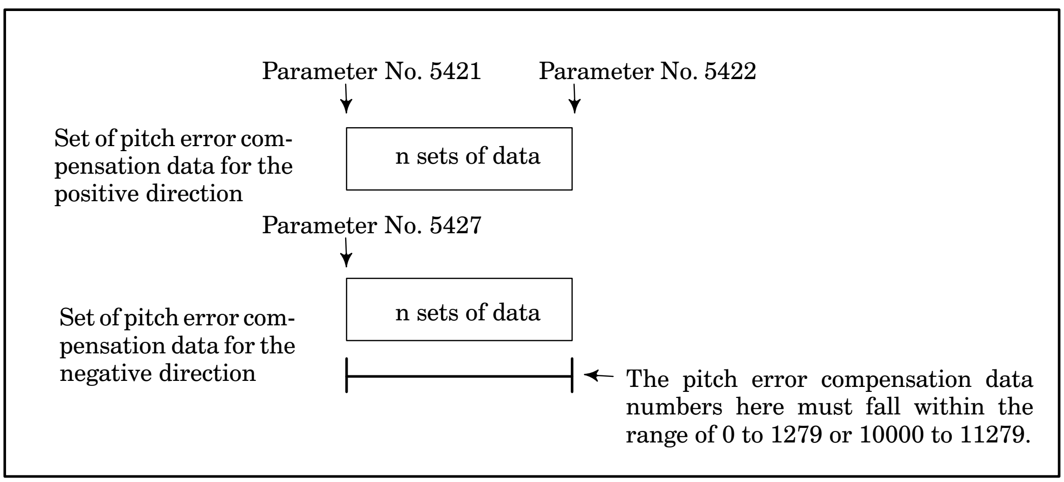
Parameters (specified for individual axes)

Data No.	Description
5426#5	Whether to enable pitch error compensation for both directions. When set to 1, the pitch compensation is enabled.
5420	Pitch error compensation point number for the reference position
5421	Pitch error compensation point number at the farthest end on the negative side for positive–direction movement
5422	Pitch error compensation point number at the farthest end on the positive side for positive–direction movement
5423	Pitch error compensation multiplier
5424	Pitch error compensation point interval
5425	For rotary axis type pitch error compensation, an amount of movement per rotary axis rotation
5427	Pitch error compensation point number at the farthest end on the negative side for negative–direction movement
5428	Pitch error compensation (absolute value) at the reference position for movement to the reference position in the direc tion opposite to that for the reference position return

Pitch error compensation data

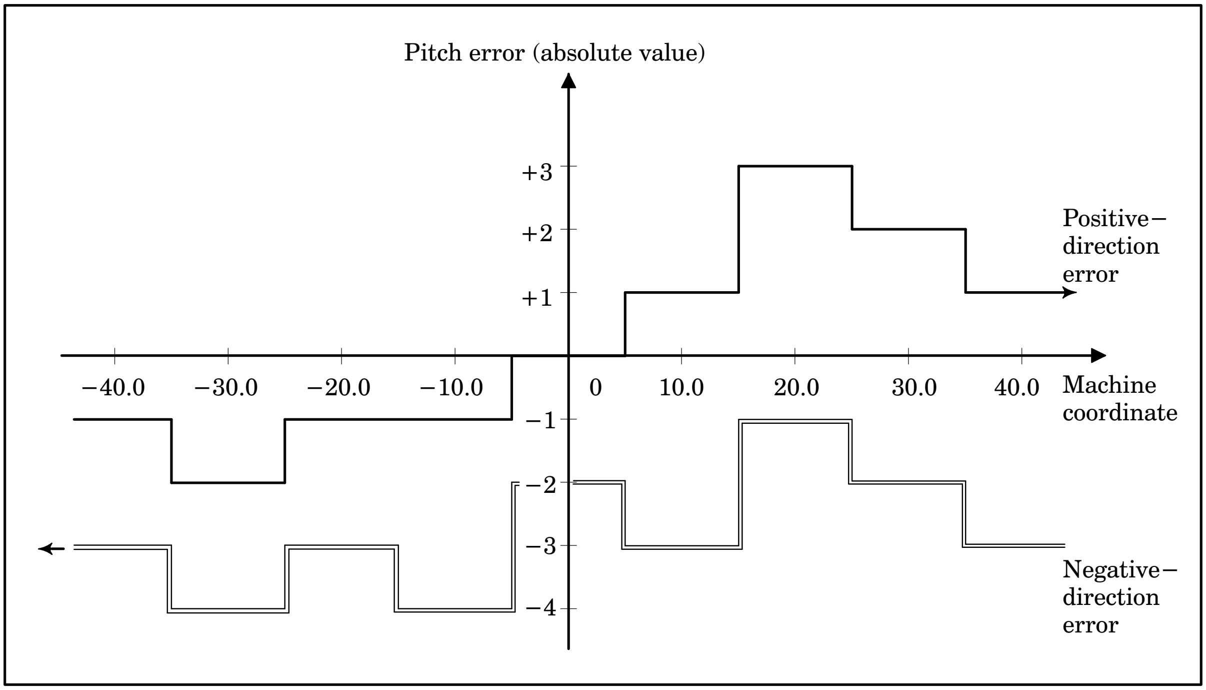
In addition to the conventional 1280 items (0 to 1279) of pitch error compensation data, an additional 1280 items (10000 to 11279) are also available.

These data items can be used for either direction. However, a set of pitch error compensation data (set of data in either the positive or negative direction) cannot extend from 1279 to 10000.



(2) Example of data setting

Suppose that the direction of manual reference position return is positive for an axis (linear axis) having a pitch error shown below and that it is necessary to specify the pitch error data and parameters as listed below.



Positive–direction pitch error data

	Compensation point number	20	21	22	23	24	25	26	27
(NOTE 1)	Compensation setting	–1	+1	0	+1	+1	+2	–1	–1

NOTE 1 The pitch error data must always be an incremental value as viewed in the negative direction (from the left side in the above chart).

Negative–direction pitch error data

(NOTE 2)	Compensation point number	30	31	32	33	34	35	36	37
(NOTE 3)	Compensation setting	–1	+1	–1	+2	–1	+2	–1	–2

NOTE 2 The number of negative–direction pitch error data items must be equal to the number of positive–direction pitch error data items.

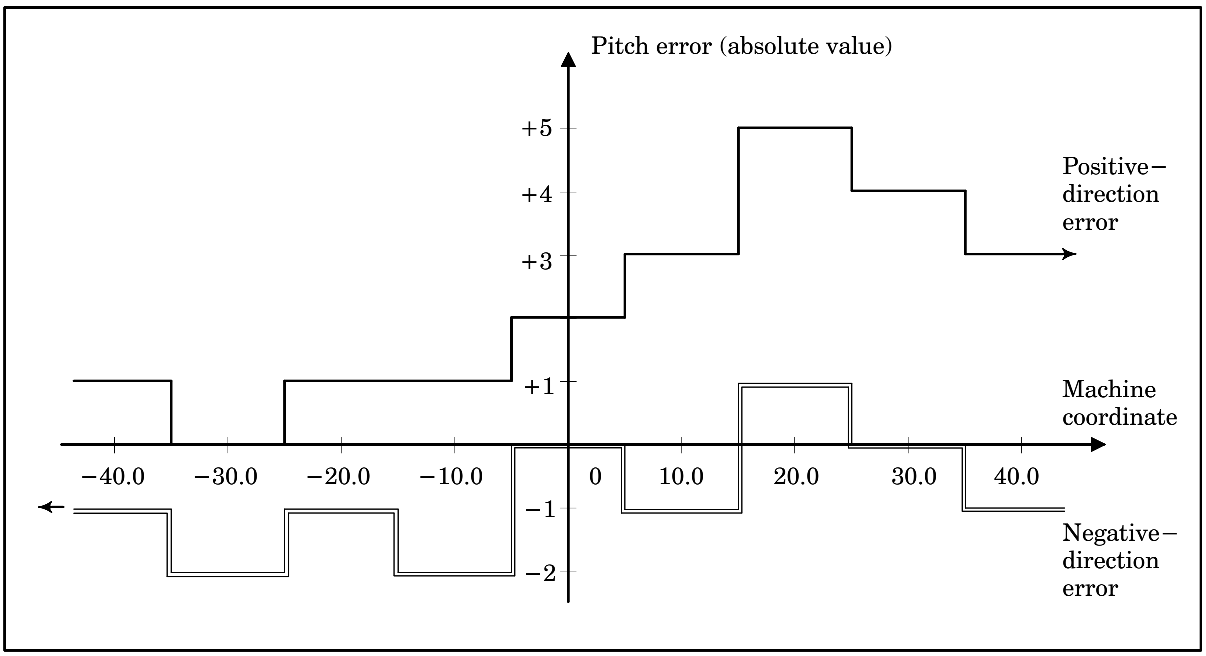
NOTE 3 The negative–direction pitch error data must always be an incremental value as viewed in the negative direction.

Parameters

	Data number	Setting value	Description
	5426#5	1	Whether to enable pitch error compensation for both directions
	5420	23	Pitch error compensation point number for the reference position
	5421	20	Pitch error compensation point number at the farthest end on the negative side for positive–direction movement
	5422	27	Pitch error compensation point number at the farthest end on the positive side for positive–direction movement
	5423	1	Pitch error compensation multiplier
	5424	10000	Pitch error compensation point interval
	5425	–	For rotary axis type pitch error compensation, an amount of movement per rotary axis rotation
	5427	30	Pitch error compensation point number at the farthest end on the negative side for negative–direction movement
(NOTE 4)	5428	–2	Pitch error compensation (absolute value) at the reference position for movement to the reference position in the direction opposite to that for the reference position return

NOTE 4 This example assumes that the direction of manual reference position return is positive. So, parameter No. 5428 specifies –2, which is a pitch error compensation amount (absolute value) at the reference position for negative–direction movement.

The following chart relates to the axis having the same pitch error as that described on the previous page, when the direction of manual reference position return is negative.



In this case, parameter No. 5428 must be +2.

(3) Example of compensation

If the movement listed below occurs after manual reference position return in the same example as that in the previous data setting example, except for the manual reference position return direction which is positive in this example, the pitch error compensation pulses listed below are output.

Movement from:

0.0	to	40.0
40.0	to	–40.0
–40.0	to	0.0

Machine coordinates	Pitch error compensation pulse	
0.0	–	
5.0	–1	
15.0	–2	
25.0	+1	
35.0	+1	
40.0	+5	(NOTE 1)
35.0	–2	
25.0	–1	
15.0	+2	
5.0	–1	
–5.0	+2	
–15.0	–1	
–25.0	+1	
–35.0	–1	
–40.0	–2	(NOTE 2)
–35.0	+1	
–25.0	–1	
–15.0	0	
–5.0	–1	
0.0	–	

NOTE 1 Compensation for movement direction inversion is performed at position 40.0, where the movement direction changes from positive to negative.

A value of +5 pulses is calculated as follows:

+5 = – ((–4) – (+1))

Pitch error compensation value (absolute in the positive direction) at position 40.0

Pitch error compensation value (absolute in the negative direction) at position 40.0

NOTE 2 Compensation for movement direction inversion is performed at position –40.0, where the movement direction changes from negative to positive.

A value of –2 pulses is calculated as follows:

–2 = – ((–1) – (–3))

Pitch error compensation value (absolute in the negative direction) at position –40.0

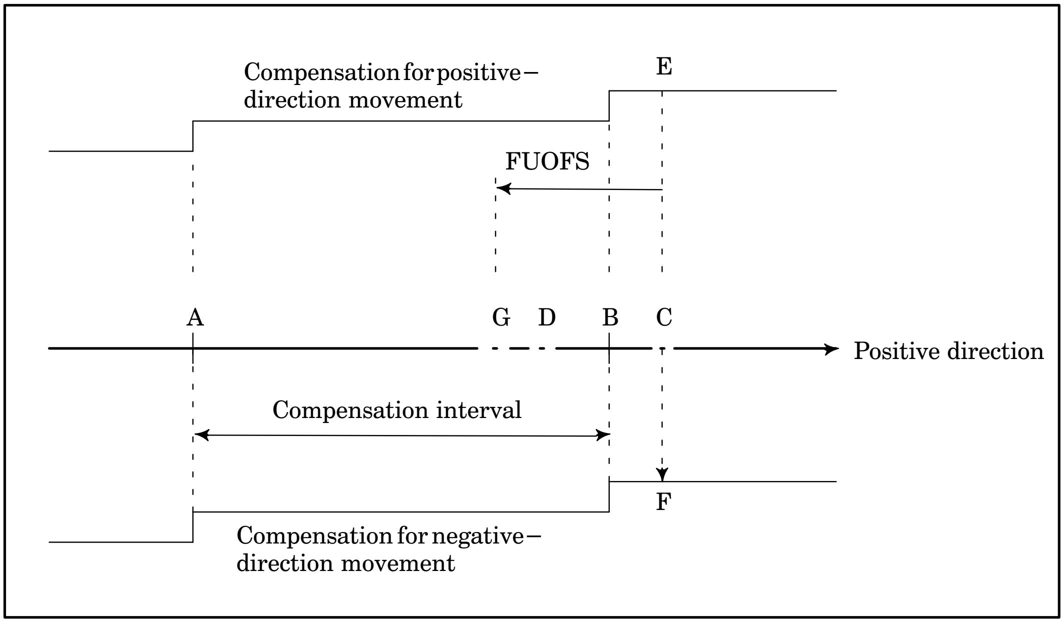
Pitch error compensation value (absolute in the positive direction) at position –40.0

Assume that the machine stops at point C on the following chart after moving in the positive direction, and oscillates between C an D after follow–up.

(1) Movement direction inversion at point C

The machine stops at point C in the following chart after moving in the positive direction, and starts moving in the opposite direction after follow–up. At this point, the machine is subjected to compensation for movement direction inversion that corresponds to movement from E to F in the chart.

At this time, point G is set up. It is separated from point C by FUOFS in the next movement direction.



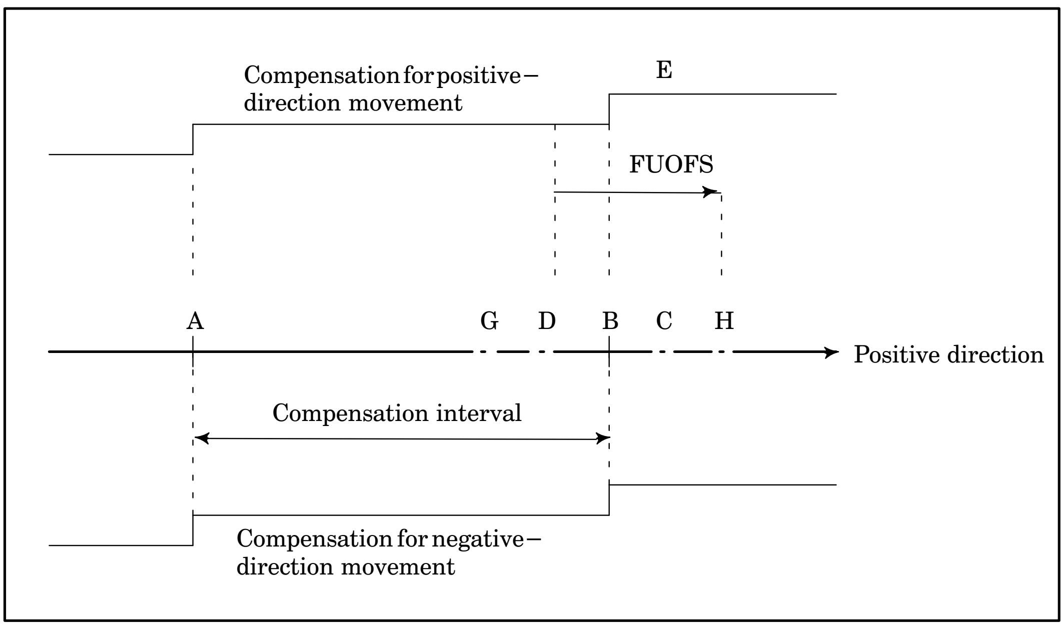
(2) Movement from C to D (negative direction)

Pitch error compensation is performed at point B for the negative–direction movement.

(3) Movement direction inversion at point D

If the direction of movement is inverted at point D again, compensation for movement direction inversion is not performed, because point G has not been reached during movement from C to D.

At this time, point H is set up. It is separated from point D by FUOFS in the next movement direction.



(4) Movement from D to C (positive direction)

Pitch error compensation for positive–direction movement is not performed at point B, because the machine stays between D and H during movement from point D to point C.

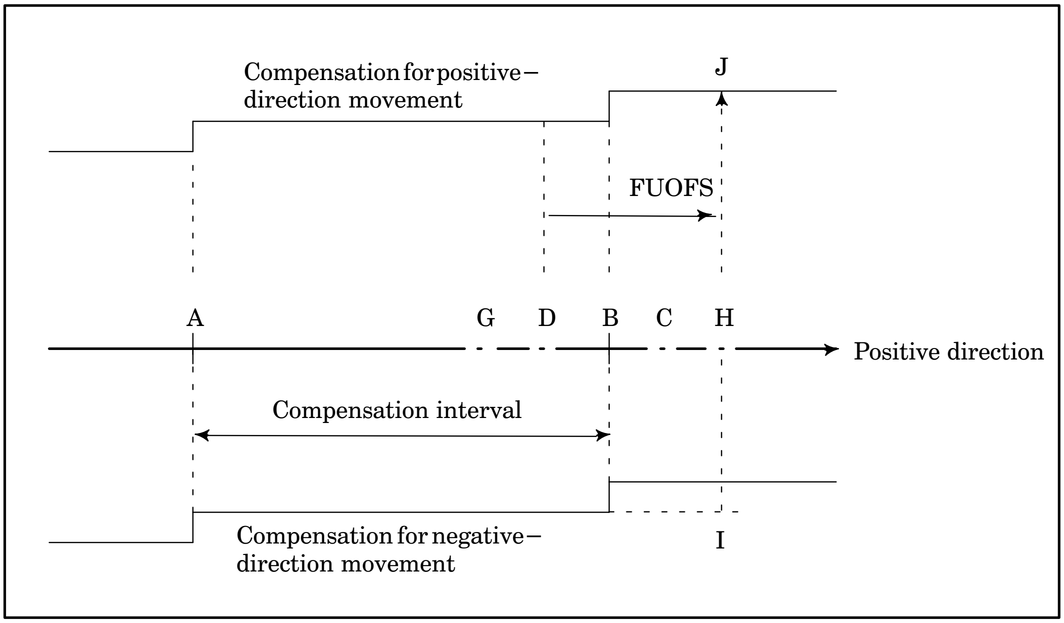
(5) Oscillation after (4)

If the oscillation that occurs after (4) is within the range of G to H, pitch error compensation is not performed.

Pitch error compensation is performed again in the following cases.

(i) When compensation point H is exceeded in positive–direction movement

The amount of compensation in this case is equal to the value accumulated so far, that is, the distance from I to J in the following chart.

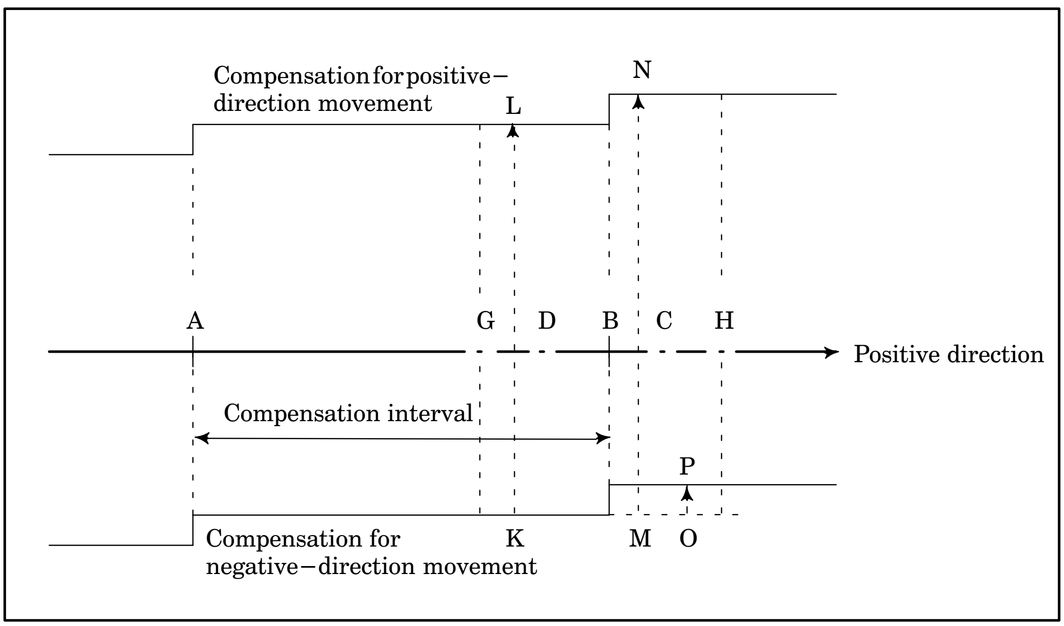


(ii) When point A is passed over or the movement direction is inverted after compensation point G is exceeded in negative–direction movement

(iii) When follow–up is released

A no–compensation range between G and H is eliminated after follow–up is released. So, pitch error compensation is performed as usual.

If follow–up is released between G and H, compensation is performed as shown below.



(a) If follow–up is released between G and B for positive–direction movement

Compensation that corresponds to the distance between K and L in the above chart is applied.

(b) If follow–up is released between B and H for positive–direction movement

Compensation that corresponds to the distance between M and N in the above chart is applied.

(c) If follow–up is released between G and B for negative–direction movement

Compensation is not performed, because compensation for movement direction inversion and pitch error compensation at point B are performed when the movement direction is inverted for the first time during follow–up.

(d) If follow–up is released between B and H for negative–direction movement

Compensation that corresponds to the distance between O and P in the above chart is applied.

(4) Cautions

(1) The use of this function requires two options: compensation for pitch error in both directions and stored pitch error compensation.

(2) This function is enabled after manual reference position return or low–speed automatic reference position return has been performed. If an absolute pulse coder is used, however, this function is enabled as soon as the power is applied.

(3) If the machine has been moved to the reference position in the reference position return direction, always set the absolute value for the pitch error compensation pulse to 0.

(4) If this function and backlash compensation are used simultaneously, the backlash compensation pulse is superimposed on the movement direction inversion compensation pulse.

(5) If this function is used for a rotary axis, when the rotary axis makes one turn, it must return to exactly the same point as that to which is was positioned before starting to rotate, that is, the total pitch error compensation for one turn of the rotary axis must be 0 in both the positive and negative directions.

(6) This function is usable together with the interpolation–type pitch error compensation function.

(5) Special operation (at follow–up)

The controlled axis is likely to oscillate within an effective area at follow–up. If the oscillation passes back and forth through a compensation point, repetition of the positive– and negative–direction compensation may amplify this oscillation. Moreover, applying compensation at movement direction inversion may increase the oscillation further.

To overcome this problem, compensation for pitch error in both directions at follow–up is performed as described below.

Compensation for pitch error in both directions at follow–up is performed only when the movement exceeds a certain range, that is, FUOFS.

For stored–type pitch error compensation:

FUOFS = effective area value (data No. 1827) + compensation multiplier (data No. 5423) x 8

For interpolation–type pitch error compensation:

FUOFS = effective area value (data No. 1827) + 8

	#7	#6	#5	#4	#3	#2	#1	#0
5426			BDPE					

Parameter input

Data type : Bit axis

BDPE Specifies whether to perform pitch error compensation for one or two directions.

0 : Pitch error compensation for one direction (conventional method)

1 : Pitch error compensation for two directions

5427	Pitch error compensation number at the farthest end on the negative side for negative–direction movement

Parameter input

Data type : Word axis

Unit of data : Number

Valid range : 0 to 1279, 10000 to 11279

This parameter specifies a pitch error compensation number at the farthest end on the negative side for negative–direction movement when pitch error compensation for both directions is applied.

5428	Pitch error compensation (absolute value) at the reference position for movement to the reference position in the direction opposite to that for the reference position return

Parameter input

Data type : Word axis

Unit of data : Detection unit

Valid range : –32768 to 32767

This parameter specifies a pitch error compensation amount (absolute value) at the reference position for movement to the reference position in the negative direction if the reference position return (ZMIx in data No. 1006) is in the positive position, or in the positive direction if the reference position return is in the negative direction.

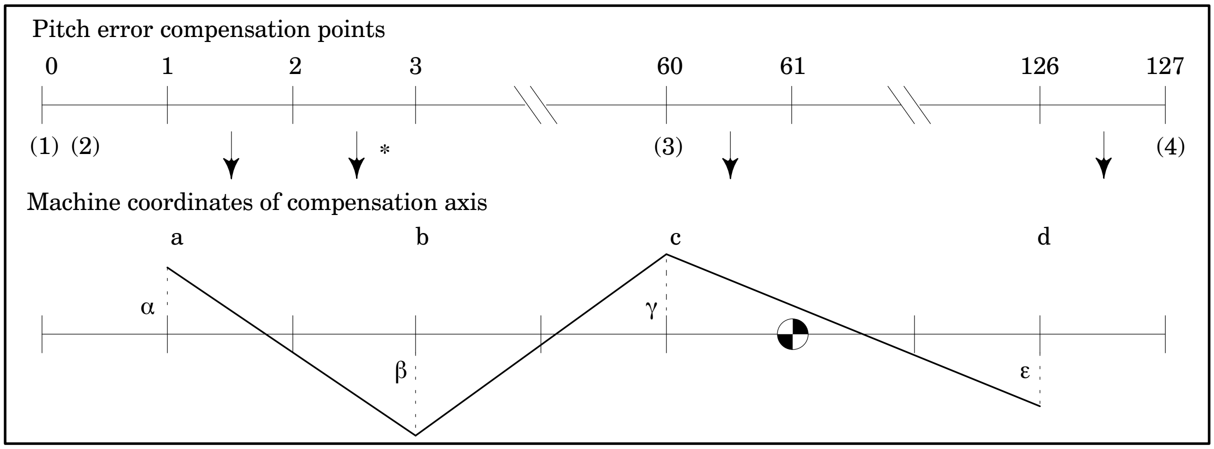
4.22 Parameters Related to Gradient Compensation (Valid only with the Series 15–M and Series 15–T)

(1) Outline

Machining accuracy can be improved and the life of machine tools can be extended by compensating for the errors (feed screw pitch error compensation, etc.) in detection units caused by machine system positions. Gradient compensation is performed along the linear approximation of the curve created from the compensation points set in parameters and the compensation corresponding to the compensation points.

(2) Function

Three linear approximations of the curve are created from the four compensation points set in the parameters and the compensation corresponding to the compensation points. Gradient compensation is performed along these linear approximations of the curve for each compensation interval of pitch error compensation points. Then, the gradient compensation is superposed on the pitch error compensation.



Suppose that the following parameters for stored pitch error compensation are set:

(1) Number of pitch error compensation point with the largest negative value (parameter No. 5421)

(2) Interval of pitch error compensation points (parameter No. 5424)

(3) Pitch error compensation number of reference position (parameter No. 5420)

(4) Pitch error compensation point with the largest positive value (parameter No. 5422)

Set parameters for gradient compensation as follows:

a, b, c, d	Compensation point numbers	(parameter Nos. 5461 to 5464)
α, β, γ, ε	Compensation at compensation points a, b, c, and d	(parameter Nos. 5471 to 5474)

In the above figure, a, b, c, and d correspond 1, 3, 60, and 126, respectively.

In stored pitch error compensation, the compensation is set for each compensation point. In gradient compensation, however, calculating the compensation for each compensation point is enabled by setting four representative compensation points and the compensation corresponding to the points.

Example In the above figure, the compensation at each of the compensation points between point a and point b is calculated from the formula: (β–α)/(b–a).

(3) Notes

(1) The gradient compensation function can be used after the compensation axis has returned to the reference position.

(2) After setting parameters for gradient compensation, be sure to turn off the NC power. (When the parameters are set, the alarm “POWER MUST BE OFF” occurs.)

(3) Set parameters for gradient compensation according to the following conditions:

- The compensation at each compensation point must be within the range –128 to 127.
- Compensation points must be set so that “a ≦ b ≦ c ≦ d” is satisfied.
- Compensation points must exist between the compensation point with the largest positive value and that with the largest negative value in the stored pitch error compensation data for each axis. Four compensation points can be set to 0 at a time. In this case, compensation is not performed.

(4) To add the gradient compensation function option, the stored pitch error compensation option is needed. In this case, the number of compensation points of each axis must be equal to or less than 128.

(5) The gradient compensation function can apply to both linear and rotation axes.

5461	Compensation point number a for each axis

5462	Compensation point number b for each axis

5463	Compensation point number c for each axis

5464	Compensation point number d for each axis

Parameter input

Data type : Word axis

Unit of data : Number

Valid range : 0 to 128 x (number of controlled axes)

Set gradient compensation points. The compensation points to be set become the compensation numbers in stored pitch error compensation.

5471	Compensation α at compensation point number a for each axis

5472	Compensation β at compensation point number b for each axis

5473	Compensation γ at compensation point number c for each axis

5474	Compensation ε at compensation point number d for each axis

Parameter input

Data type : Word axis

Unit of data : Detection unit

Valid range : –32768 to +32767

Set the compensation for each compensation point.

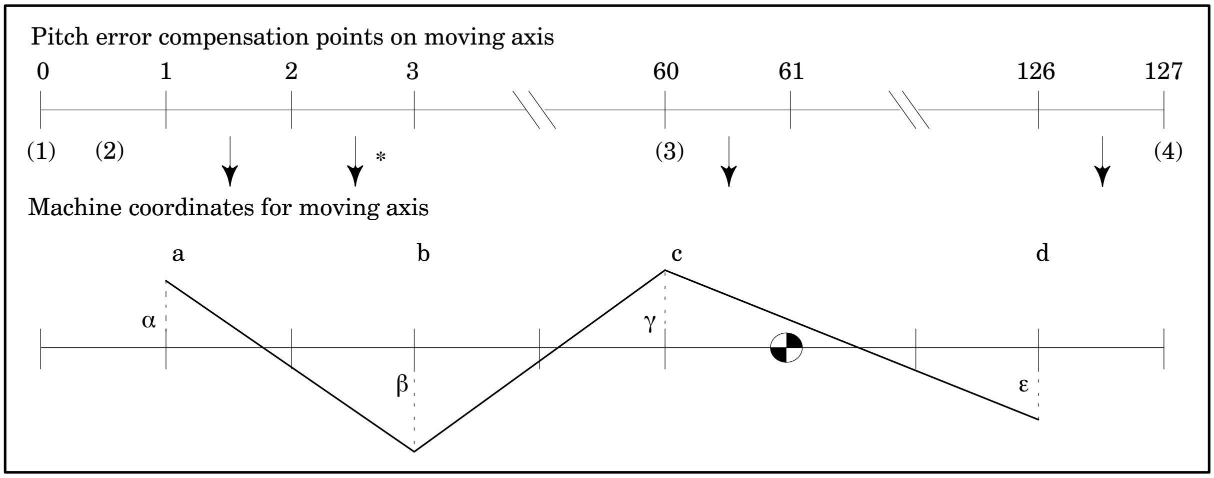
4.23 Parameters Related to Straightness Compensation (Valid only with the Series 15–M and Series 15–T)

4.23.1 Straigtness Compensation

(1) Outline

For a machine tool with a long stroke, deviations in straightness between axes may deteriorate machining accuracy. For this reason, when an axis moves, other axes are compensated in detection units to improve straightness. This improvement results in better machining accuracy. This function is called straightness compensation.

(2) Outline of function



Parameters for stored pitch error compensation

(1) Number of pitch error compensation point with the largest negative value (parameter No. 5421)

(2) Interval of pitch error compensation points (parameter No. 5424)

(3) Pitch error compensation number of reference position (parameter No. 5420)

(4) Pitch error compensation point with the largest positive value (parameter No. 5422)

Parameters for straightness compensation

a, b, c, d	Compensation point numbers of the moving axis	(parameter No. 5501 to 5524)
α, β, γ, ε	Compensation for compensation axis	(parameter No. 5551 to 5574)

When an axis (parameter Nos. 5481 to 5483) moves, the corresponding compensation axis (parameter No. 5491 to 5493) is compensated.

That is, the compensation axis is compensated at the pitch error compensation point of the moving axis.

Example In the above figure, compensation is applied to compensation point number 3 at the location indicated by an asterisk (*).

The compensation from point a to point b is calculated from the formula: $(\beta-\alpha)/(b-a)$.

(3) Notes

(1) The straightness compensation function can be used after a moving axis and its compensation axis have returned to the reference position.

(2) After setting parameters for straightness compensation, be sure to turn off the NC power. (When the parameters are set, the alarm “POWER MUST BE OFF” occurs.)

(3) Set parameters for straightness compensation according to the following conditions:

·The compensation at a compensation point must be within the range –128 to 127.

·Compensation points must be set so that “a ≦ b ≦ c ≦ d” is satisfied.

·Compensation points must exist between the compensation point with the largest positive value and that with the largest negative value in the stored pitch error compensation data for each axis. Four compensation points can be set to 0 at a time. In this case, compensation is not performed.

(4) To add the straightness compensation function option, the stored pitch error compensation option is needed.

In this case, the number of compensation points of each axis between the compensation point with the largest positive value and that with the largest negative value in the stored pitch error compensation data must be equal to or less than 128.

(5) Straightness compensation data is superposed on stored pitch error compensation data and output.

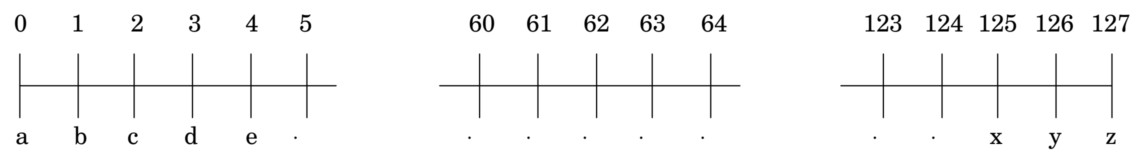
4.23.2 Straigtness Compensation at 128 points

(1) General

In the same way as for normal pitch error compensation, this new function allows compensation data to be specified at up to 128 equidistant points. This enables straightness compensation to be applied more precisely.

This also enables up to five sets of move and compensation axes to be combined in straightness compensation.

(2) Detailed Specifications of Straightness Compensation at 128 Points



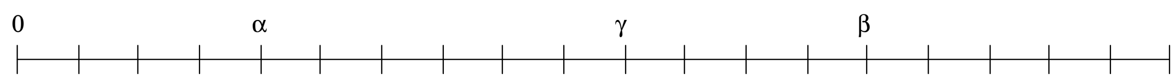
(a) Up to 128 compensation points can be specified.

(b) The compensation data (a, b, c, ... y, or z) has a value of between –7 and +7 at each point.

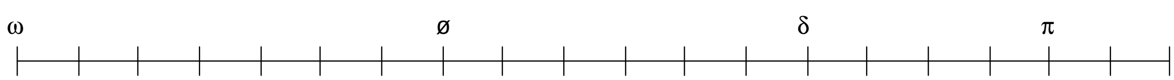
(c) Data setting and the timing when compensation is applied are the same as those for pitch error compensation.

(d) The number of straightness compensation points is equal to the number of stored pitch error compensation points for a move axis.

Stored pitch error compensation points for a move axis



Straightness compensation point for a move axis



α : Number of the pitch error compensation point located at the most negative position along each axis (parameter No. 5421)

β : Number of the pitch error compensation point located at the most positive position along each axis (parameter No. 5422)

γ : Number of the pitch error compensation point located at the reference position for each axis (parameter No. 5422)

δ : Number of the straightness compensation point located at the reference position for a move axis

ø : Number of the straightness compensation point located at the most negative position along a move axis (parameter Nos. 5581 to 5585)

π : Number of the straightness compensation point located at the most positive position along a move axis

ω : First number of a straightness compensation point (Maximum number of control axes x 128)

These points have the following relationships.

(i) $\pi = ø + (\beta - \alpha)$

(ii) $\delta = ø + (\gamma - \alpha)$

(e) The interval between the compensation points is the same as in normal pitch error compensation. It cannot be set arbitrarily.

(f) The compensation multiplier can be specified separately to that for normal pitch error compensation.

(g) The amount of compensation at a compensation point along a move axis is added to the stored pitch error compensation data for the corresponding compensation axis, then output.

(h) To use this function, specify pitch error compensation for a move axis at up to 128 points.

(i) After the straightness compensation parameters have been set, briefly turn the CNC power off, then back on again. (If the parameters have been set, the “POWER MUST BE OFF” alarm is displayed.)

(3) Setting and Displaying Straightness Compensation Data

This straightness–compensation–at–128–points function allows straightness compensation data to be set and displayed next to pitch error compensation data on the display and setting screen.

Straightness compensation point numbers are assigned within the following range for five sets (five axes) of 128 points.

(Maximum number of control axes x 128) to (maximum number of control axes + maximum number of axes to which straightness compensation is applied) x 128–1

(a) Input/output of straightness compensation data

Straightness compensation data at 128 points can be input/output using parameters in the same way as pitch error compensation data. The corresponding parameter number is equal to the straightness compensation point number, plus 10,000. (This parameter numbering is the same as for pitch error compensation data.)

Straightness compensation data at 128 points is input/output together with pitch error compensation data. When the compensation data output by this function is input to a system which is not provided with this function, the “ILLEGAL NUMBER” alarm displayed.

(b) Output–file names (Floppy directory display)

When compensation data is output to a Floppy Cassette when the straightness–compensation–at–128–points function is being used, the following files are created.

PITCH	:	File for pitch error compensation data and straightness compensation data
PARAM. AND. PITCH	:	File for parameters, pitch error compensation data, and straightness com pensation data

(c) Editing straightness compensation data by using the G10 parameters

In the same way as for pitch error compensation data, straightness compensation data at 128 points can be modified by inputting G10 parameters. In the same way as for modifying pitch error data, a compensation data number is specified with the corresponding point number, plus 10,000.

This function allows straightness compensation data to be modified during automatic operation, without turning off the system power. Compensation interval, compensation multiplier, and other data, however, cannot be modified.

(d) Input/output of straightness compensation data by using the NC window function

Straightness compensation data at 128 points can be input or output from the PMC or MMC by using the NC window function.

(4) Notes

(a) When the tool moves quickly, multiple compensation pulses may be output at one time depending on the amount of straightness compensation.

(b) In a machine that performs high–speed DNC operation or ultra–high–speed DNC operation, this function cannot be used.

(c) In a machine provided with malfunction check, this function cannot be used.

(d) To use this function, the option for stored pitch error compensation is required, in addition to the option for the function.

4.23.3 Interpolation–type straightness compensation

(1) General

In interpolation–type straightness compensation, the straightness compensation pulses are distributed over a range of an interval of the pitch error comensation and output.

The compensation data ranges from –7 to +7 on up to 128 compensation points.

(2) Compensation Method

(a) Conventional straightness compensation

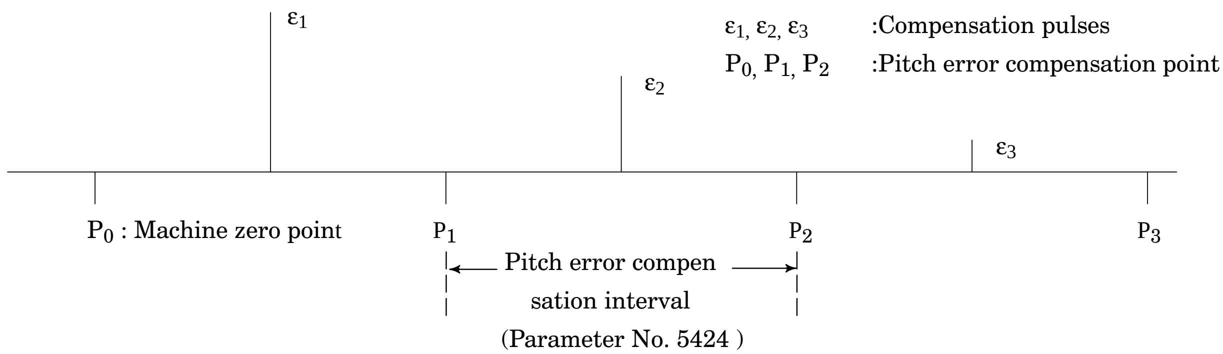


Fig. 1 Conventional Straightness Compensation

In conventional straightness compensation, the amount of straightness compensation is output at an interval of the pitch error compensation, as shown in Fig. 1.

(b) Interpolation–type Straightness Compensation

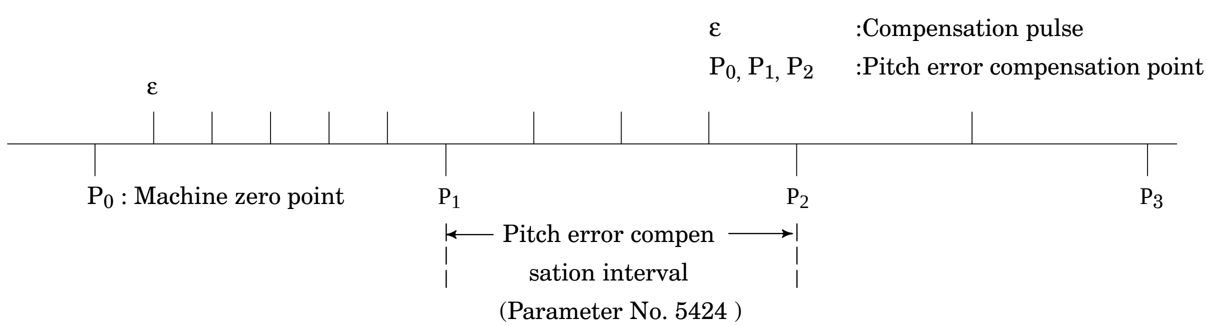


Fig. 2 Interpolation–type Straightness Compensation

In interpolation–type straightness compensation, the straightness compensation pulses are divided into multiple unit pulses, output at equal intervals in each interval of pitch error compensation, as shown in Fig. 2.

(3) Compensation Data

In the same way as for stored pitch error compensation, five sets of up to 128 data items, each having a value of between –7 and +7, can be specified for interpolation–type straightness compensation.

These data items are handled in the same way as for straightness compensation B. These items are displayed on pages subsequent to those for pitch error compensation data, can be edited from the MDI/CRT panel, and can be input/output to and from external input/output devices. The items can also be modified by using the G10 parameters, as described in 2.3.

The compensation data area is assigned to part program storage. This function uses an amount of storage equal to a tape length of about 1.3 m.

(4) Editing Compensation Data by Using the G10 Parameters

Five sets of compensation data specified at up to 128 points can be modified by using the G10 parameters. In the same way as pitch error data is modified, a compensation data number is specified as the corresponding data number, plus 10,000.

This function allows compensation data to be modified during automatic operation, without having to turn off the system's power. Parameters related to move axes, compensation axes, compensation interval, and the compensation multiplier, however, cannot be modified.

(5) Notes

(a) When the tool moves quickly, multiple compensation pulses may be output at one time, depending on the degree of straightness compensation.

(b) In a system having 15 axes, combinations of control–axis numbers, assigned to move axes and compensation axes using parameters, are restricted as follows:

Within servo axis Nos. 1 to 4, all combinations are supported.

Within servo axis Nos. 5 to 8, all combinations are supported.

Within servo axis Nos. 9 to 12, all combinations are supported.

Within servo axis Nos. 13 to 15, all combinations are supported.

Combinations other than those described above are not allowed.

(c) Interpolation–type straightness compensation and conventional straightness compensation (straightness compensation B) cannot be simultaneously applied to a single move axis. They can be simultaneously applied to different move axes, however.

(d) In a machine that performs high–speed DNC operation or ultra–high–speed DNC operation, this function cannot be used.

(e) In a machine provided with malfunction check, this function cannot be used.

(f) To use this function, the option for stored pitch error compensation is required in addition to the option for the function.

(g) Parameter settings related to the move and compensation axes, and the effective compensation multiplier

Parameters related to the move and compensation axes can be set in the following ways.

1) One compensation axis can be specified for one move axis.

Example 1 of setting the parameters:

Move axes		Compensation axes		Effective multiplier
Parameter no.	Set	Parameter no.	Set	
5481	1	5491	2	Value set to parameter no. 5591.
5482	3	5492	4	Value set to parameter no. 5592.
5483	5	5493	6	Value set to parameter no. 5593.
5484	7	5494	8	Value set to parameter no. 5594.
5485	9	5495	10	Value set to parameter no. 5595.

When the first axis moves, compensation is applied to the second axis. When the third axis moves, compensation is applied to the fourth axis, and so on.

The effective multiplier for each combination of the move and compensation axes is specified in the parameter listed in the table above.

2) Two or more compensation axes can be specified for a single move axis.

Example 2 of setting the parameters:

Move axes		Compensation axes		Effective multiplier
Parameter no.	Set	Parameter no.	Set	
5481	1	5491	2	Value set to parameter no. 5591.
5482	1	5492	3	Value set to parameter no. 5592.
5483	1	5493	4	Value set to parameter no. 5593.
:				

In this way, two or more compensation axes can be specified for a single move axis.

3) A compensation axis can be set as a move axis.

Example 3 of setting the parameters:

Move axes		Compensation axes		Effective multiplier
Parameter no.	Set	Parameter no.	Set	
5481 5482 5483 :	1 2 3	5491 5492 5493	2 3 4	Value set to parameter no. 5591. Value set to parameter no. 5592. Value set to parameter no. 5593.

In this way, a compensation axis can be set as a move axis.

With this setting, however, no compensation is made for the amount of compensation applied to a move axis.

4) Two or more move axes cannot be specified for a single compensation axis.

Example 4 of setting the parameters:

Move axes		Compensation axes	
Parameter no.	Set	Parameter no.	Set
5481 5482 :	1 2	5491 5492	3 3

In this way, two or more move axes cannot be specified as a compensation axis.

	#7	#6	#5	#4	#3	#2	#1	#0
5426		IPCS						

Parameter entry

Data type : Bit axis

IPCS Interpolation–type straightness compensation

0 : Is not applied.

1 : Is applied.

This parameter is effective only for move axes whose axis numbers are specified in parameter Nos.5481 to 5485.

5481	Axis number of moving axis 1
5482	Axis number of moving axis 2
5483	Axis number of moving axis 3
5484	Axis number of moving axis 4
5485	Axis number of moving axis 5

Parameter input

Data type : Byte

Unit of data : Axis number (When 0, compensation is not performed.)

Valid range : 1 to Number of controlled axes

Set the axis numbers of moving axes.

5491	Axis number of compensation axis 1 for moving axis 1
5492	Axis number of compensation axis 2 for moving axis 2
5493	Axis number of compensation axis 3 for moving axis 3
5494	Axis number of compensation axis 4 for moving axis 4
5495	Axis number of compensation axis 5 for moving axis 5

Parameter input

Data type : Byte

Unit of data : Axis number (When 0, compensation is not performed.)

Valid range : 1 to Number of controlled axes

Set the axis numbers of compensation axes.

5501	Compensation point number a of moving axis 1
5502	Compensation point number b of moving axis 1
5503	Compensation point number c of moving axis 1
5504	Compensation point number d of moving axis 1
5511	Compensation point number a of moving axis 2
5512	Compensation point number b of moving axis 2
5513	Compensation point number c of moving axis 2
5514	Compensation point number d of moving axis 2
5521	Compensation point number a of moving axis 3
5522	Compensation point number b of moving axis 3
5523	Compensation point number c of moving axis 3
5524	Compensation point number d of moving axis 3

Parameter input

Data type : Word

Unit of data : Number

Valid range : 0 to 128 x number of controlled axes

NOTE Compensation point numbers in stored pitch error compensation

Set four compensation points for each moving axis.

5551	Compensation corresponding to compensation point number a of moving axis 1

5552	Compensation corresponding to compensation point number b of moving axis 1

5553	Compensation corresponding to compensation point number c of moving axis 1

5554	Compensation corresponding to compensation point number d of moving axis 1

5561	Compensation corresponding to compensation point number a of moving axis 2

5562	Compensation corresponding to compensation point number b of moving axis 2

5563	Compensation corresponding to compensation point number c of moving axis 2

5564	Compensation corresponding to compensation point number d of moving axis 2

5571	Compensation corresponding to compensation point number a of moving axis 3

5572	Compensation corresponding to compensation point number b of moving axis 3

5573	Compensation corresponding to compensation point number c of moving axis 3

5574	Compensation corresponding to compensation point number d of moving axis 3

Parameter input

Data type : Word

Unit of data : Detection unit

Valid range : –32768 to +32767

NOTE Set compensation for each compensation point.

5581	Compensation point number of most negative side of move axis 1

5582	Compensation point number of most negative side of move axis 2

5583	Compensation point number of most negative side of move axis 3

5584	Compensation point number of most negative side of move axis 4

5585	Compensation point number of most negative side of move axis 5

Parameter entry

Data type : Word

Data unit : Number

Data range : Max. no. of controlled axes x 128 to (Max. no. of controlled axes + 5) x 128–1

Specify the straightness compensation point number located at the most negative position for each move axis.

When the vaule is out of the above range, no compensation is done.

5591	Straightness compensation multiplier of move axis 1

5592	Straightness compensation multiplier of move axis 2

5593	Straightness compensation multiplier of move axis 3

5594	Straightness compensation multiplier of move axis 4

5595	Straightness compensation multiplier of move axis 5

Parameter entry

Data type : Byte

Data unit : 1

Data range : 1 to 100

Specify the straightness compensation multiplier for each move axis.

When the straightness compensation multiplier is set to 1, compensation data is counted in the detection units. When the multiplier is set to 0, straightness compensation is not applied.

When this parameter is 0, no compensation is done.

	#7	#6	#5	#4	#3	#2	#1	#0
5580							SCMT	

Parameter entry

Data type : Bit

SCMT Parameters (NO. 5591 to NO. 5595) for straightness compensation multiplier:

0 : are effective to the first move axis number when the same axis is specified in two or more move axis numbers.

1 : are effective to respective move axis numbers even when the same axis is specified in two or more move axis numbers.

When the interpolation–type starightness compensation is used, be sure to set this parameter to 1.

4.24 Parameters Related to Spindle Control

	#7	#6	#5	#4	#3	#2	#1	#0
5600	SBI	GST	SGS	EFP	SOM	GSM	M4M	M3M

Parameter input

Data type: Bit

The settings in parameter No. 5600, excluding SBI, are valid only for the FS3 or FS6 interface. They are invalid for the basic machine interface (BMI).

M3M When M03 (spindle CW rotation) is specified, the polarity of the spindle speed analog output voltage is:

0 : +

1 : –

M4M When M04 (spindle CCW rotation) is specified, the polarity of the spindle speed analog output voltage is:

0 : +

1 : –

GSM The polarity of the spindle speed analog output voltage during gear shift is:

0 : +

1 : –

SOM The polarity of the spindle speed analog output voltage during spindle orientation is:

0 : +

1 : –

EFP The polarity of the spindle speed analog output voltage during spindle orientation at the time of gear shift is:

0 : Depends on M03 (spindle CW rotation) or M04 (spindle CCW rotation). Parameters GSM and SOM are invalid.

1 : Depends on parameters GSM and SOM. Parameters GSM and SOM are valid.

SGS The gear change system during thread cutting or tapping is:

0 : A type (Same as ordinary gear change system)

1 : B type (The gear is changed at the spindle speed specified in parameter Nos. 5631 to 5637.)

GST For the FS3 interface, the spindle orientation signal SOR activates:

0 : Spindle orientation

1 : Gear shift

Normally, set GST to 0.

SBI The spindle speed output is:

0 : Analog output

1 : 12–bit binary output

For Series 15–TT with two spindles, select the first spindle speed output with this setting and set the second spindle speed output in SB2 (bit 7) of parameter No. 5605.

	#7	#6	#5	#4	#3	#2	#1	#0
5601	SCD	TPB	SFA	NSF	GSB	SAL	SOC	SOV

Parameter input

Data type: Bit

The settings in parameter No. 5601 are valid only for the FS3 or FS6 interface. They are invalid for the basic machine interface (BMI).

SOV The spindle override is:

0 : Invalid

1 : Valid

SOC The spindle override during thread cutting (G33) or tapping (Series 15–T: G84, G84.1, Series 15–M: G74, G84, G63) is:

0 : Valid

1 : Invalid

SAL When a spindle speed is specified beyond the maximum spindle motor speed (parameter No. 5619):

0 : The machine clamps at the maximum spindle motor speed set in the parameter (parameter No. 5619).

1 : The machine raises a programming error alarm.

GSB In the Series 15–M, the gear select signal output is:

0 : Code output

1 : Signal output in 1:1 relation to the gear selection

NSF In the Series 15–M, when the gear select signal is output, the SF signal is:

0 : Generated

1 : Not generated

SFA In the Series 15–M, the SF signal is generated when:

0 : The gear select signal is output.

1 : An S code is specified.

TPB In the Series 15–M, the type of spindle speed analog output and spindle speed binary output is:

0 : A type

1 : B type

For A type, no gear select signal is input, and a spindle speed is output corresponding to the status of the gear select signal output.

For B type, a gear select signal is input, and a spindle speed is output corresponding to the status of the gear select signal input. The gear select signal is output in the same manner as for A type.

Set TPB to 1 for Series 15–T.

SCD In the Series 15–M, for the gear selection on the machine:

0 : The gear select signal is generated.

1 : The gear select signal is not generated. The specified S code is output in the BCD format.

	#7	#6	#5	#4	#3	#2	#1	#0
5602	SAR	RSC	TLE	TPE	NAL	GIB	SCB	SSA

Parameter input

Data type: Bit

Settings SSA, SCB, GIB, and SAR of parameter No. 5602 are effective only for the FS3 or FS6 interface. They are ineffective for the basic machine interface (BMI).

SSA The contact of the spindle stop signal (SSTP) is:

0 : B contact (Spindle stop at logic “0”)

1 : A contact (Spindle stop at logic “1”)

(Set SSA to 0 for Series 15–TT.)

SCB For Series 15–M, for the gear selection on the machine:

0 : Either the gear select signal or an S code in the BCD format is output.
Setting SCD (bit 7) in parameter No. 5601 specifies which one is to be output.

1 : Both the gear select signal and an S code in the BCD format are output.

GIB The data type of the gear select signal input is:

0 : Code (Four–stage gear selection by two bits: for the FS3 and FS6M interfaces)

1 : Bit (Four–stage gear selection by four bits: for the FS6T interface)

(Set GIB to 0 for Series 15–TT)

NAL The alarm on the spindle speed control unit is:

0 : Checked

1 : Not checked

For Series 15–TT with two spindles, use this setting for the first spindle, and set the second spindle with NA2 (bit 3) of parameter No. 5604.

TPE In the Series 15–M, at the current position of the axis under a constant surface speed control, the tool offset compensation (G45 to G48) value is:

0 : Included

1 : Not included

TLE At the current position value of the axis under a constant surface speed control, the tool length com pensation value (or tool offset compensation value for a lathe system) is:

0 : Included

1 : Not included. (Position specified by the program)

Normally, set TLE to 1.

RSC For a positioning command (such as G00) under a constant surface speed control:

0 : The constant surface speed control is performed using the present position.

1 : The constant surface speed control is not performed using the present position but by using the coordinate of the end point.

SAR The speed arrival signal is:

0 : Not used

1 : Used

(Set SAR to 0 for Series 15–TT.)

	#7	#6	#5	#4	#3	#2	#1	#0
5603	PDC	BNT			LDSPA	CC0	SC2	GCS

Parameter input

Data type: Bit

GCS The spindle gear selection is performed by:

(Valid only for the FS3 or FS6 interface)(Not used in the Series 15–TT)

0 : Using the settings in parameter Nos. 5621 to 5628 (spindle speed corresponding to each gear).

1 : Setting the spindle speed at each gear switching point to parameter Nos. 5641 to 5647 and using the specified data.
In this case, the minimum spindle speed under a constant surface speed control cannot be set. (Refer to parameter Nos. 5641 to 5647.)

SC2 In the Series 15–M, the gear selection on the machine is:

0 : Controlled by SCD (bit 7) in parameter No. 5601 and SCB (bit 2) in parameter No. 5602.

1 : Output as an S code in 2–digit BCD format.

CC0 (In the Series 15–T)

When G92S_ (or G50S_ in G code system A: maximum spindle speed setting) is specified, in the constant surface speed control mode, clamping at the spindle speed is:

0 : Not performed

1 : Performed at 0 rpm.

This parameter is valid only for the 3T or 6T interface.

LDSPA When parameters are overwritten:

0 : Only some of the serial interface spindle parameters are transmitted.

1 : All the serial interface spindle parameters are transmitted.

NOTE	For information about which parameters are transmitted when LDSPA is set to 0, see the section on automatic setting. Set LDSPA to 1 only when the spindle is being adjusted. Otherwise, set it to 0.

BNT The spindle speed fluctuation detection is judged:

0 : If either a certain time (parameter No. 5722) has elapsed since the specified speed was changed, or the actual speed is within a certain error of the specified speed.

1 : A certain time (parameter No. 5722) has elapsed since the specified speed was changed.

PDC Disconnection check of the position coder is:

0 : Performed

1 : Not performed

Normally, set PDC to 0. PDC is temporarily set to 1 for a field adjustment, for example, for testing the system without connecting the position coder.

For Series 15–TT with two spindles, use this setting for the first spindle, and set the second spindle in PD2 of parameter No. 5604.

	#7	#6	#5	#4	#3	#2	#1	#0
5604	PD2				NA2	SFGB	RTG	2SP

Parameter input

Data type: Bit

2SP The number of spindles is (For Series 15–TT only):

0 : 1 (One spindle with two tool posts)

1 : 2 (Two spindles with two tool posts)

NOTE	Specifying 2SP enables: (1) Connection check of and communication with the second serial spindle amplifier (2) Control of the second spindle under asynchronous control

RTG The gear ratio of the spindle to the position coder at the time of rigid tapping is specified by:

0 : Parameter No. 5610. (The gear ratio must be 1:1, 2:1, 4:1, or 8:1.)

1 : Parameter Nos. 5703 and 5704. (P:Q, P = 1 to 127, Q = 1 to 127)

SFGB The gear ratio of the spindle to the position coder at the time of rigid tapping is specified:

0 : According to RTG.

1 : In parameter Nos. 5771 to 5778 and Nos. 5781 to 5788.

Set SFGB to 1 when rigid tapping is to be performed by multiple stages of gears.

NA2 For the Series 15–TT with two spindles, an alarm on the speed control unit for the second spindle is:

0 : Checked

1 : Not checked

PD2 For the Series 15–TT with two spindles, the position coder for the second spindle is:

0 : Checked

1 : Not checked

Normally set this bit to 0. Set it to 1 temporarily when other items are checked under the condition that the position coder for the second spindle is not connected at local adjustment or the like.

	#7	#6	#5	#4	#3	#2	#1	#0
5605	SB2		IDM	IOR		TSC	TEL	

Parameter input

Data type: Bit

TEL In rigid tapping, the type of acceleration and deceleration of the spindle and the drilling axis is:

0 : Exponential function acceleration/deceleration

1 : Linear acceleration/deceleration

TSC During rigid tapping, the acceleration/deceleration time constant and FL speed of the spindle and the drilling axis:

0 : Are fixed. (The time constant is set in parameter No. 5751 and the FL speed in parameter No. 5752.)

1 : Can be switched separately in three steps corresponding to the specified spindle speed. (The time constant and the FL speed are set in parameter Nos. 5760 to 5765.) (Patent pending for this system.)

When the specified spindle speed is low, a smaller time constant is applied; and as the spindle speed increases, a larger time constant is selected. This system is provided to enable rigid tap ping over a wide range of speeds.

IOR When a reset is executed during the spindle positioning (indexing) mode, the spindle positioning mode is:

0 : Canceled by the reset.

1 : Not canceled by the reset.

IDM The selection of a positive/negative direction in spindle positioning (M code specified in parameter No. 5682):

0 : The spindle is positioned in the positive direction.

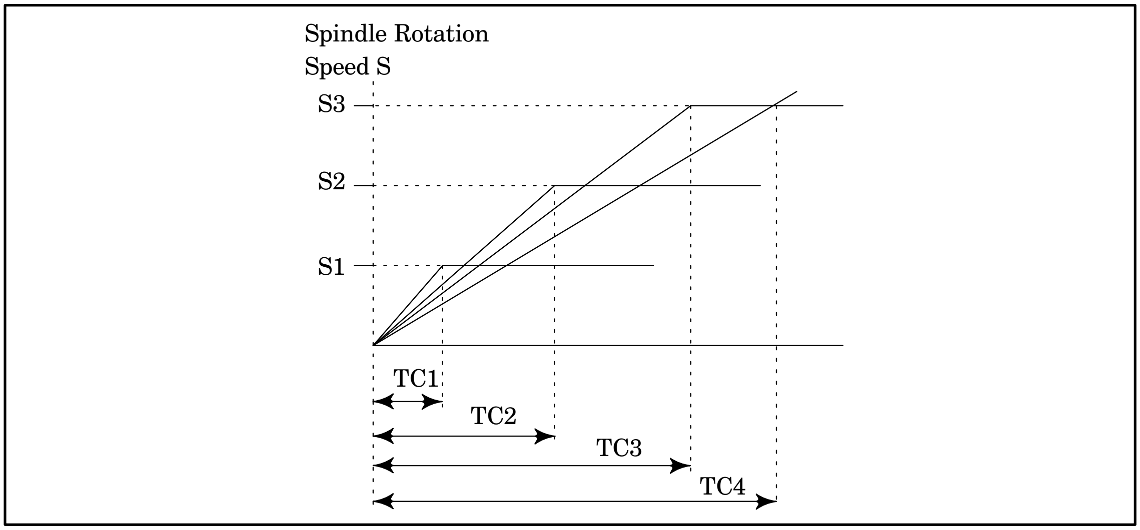
1 : The spindle is positioned in the negative direction.

SB2 For the Series 15–TT with two spindles, the type of the second spindle speed output is:

0 : Analog output

1 : Binary output

Example Linear acceleration/deceleration



Parameter Nos. and their data for the time constant and the FL speed corresponding to the spindle speed S are listed in the table below. Parameter Nos. are enclosed in parentheses.

Spindle Rotation Speed S	Time Constant	FL Speed
0 < S ≦ S1 (5757)	TC1 (5760)	FL1 (5761)
S1 < S ≦ S2 (5758)	TC2 (5762)	FL2 (5763)
S2 < S ≦S3 (5758)	TC3 (5764)	FL3 (5765)
S3 < S	TC4 (5766)	FL4 (5767)

	#7	#6	#5	#4	#3	#2	#1	#0
5606							SRAN2	SRAN1

Parameter input

Data type: Bit

SRAN1 The first spindle is:

0 : An analog spindle

1 : A serial interface spindle

When using the system with SRAN1 set to 1, set parameter Nos. 5613 and 5614 to 0.

SRAN2 The second spindle is:

0 : An analog spindle

1 : A serial interface spindle

When using the system with SRAN2 set to 1, set parameter Nos. 5663 and 5664 to 0.

NOTE An analog spindle and a serial interface spindle cannot be used in combination.

	#7	#6	#5	#4	#3	#2	#1	#0
5607							LDSP2	LDSP1

Parameter input

Data type: Bit

LDSP1 When the power is turned on, the specific parameter for the serial interface spindle of the first spindle is:

0 : Set automatically.

1 : Not set automatically.

Set LDSP1 to 0 after specifying the type of motor. When the power is turned on, the standard setting for the motor type is automatically set to the parameter and this parameter is reset to 1.

LDSP2 When the power is turned on, the specific parameter for the serial interface spindle of the second spindle is

0 : Set automatically.

1 : Not set automatically.

Set LDSP2 to 0 after specifying the type of motor.

When the power is turned on, the standard setting for the motor type is automatically set to the parameter and this parameter is reset to 1.

	#7	#6	#5	#4	#3	#2	#1	#0
5608				SREV				

Parameter input

Data type : Bit

SREV Specifies the type of relationship between the direction in which the drilling axis advances from point R to point Z and the direction in which the spindle rotates for G84.2 or G84.3 in rigid tapping mode.

0 : Type A

		Command	
		G84.2	G84.3
Point R → point Z	Positive direction	Reverse rotation	Normal rotation
	Negative direction	Normal rotation	Reverse rotation

1 : Type B

		Command	
		G84.2	G84.3
Point R → point Z	Positive direction	Normal rotation	Reverse rotation
	Negative direction	Normal rotation	Reverse rotation

	#7	#6	#5	#4	#3	#2	#1	#0
5609					MORCM2	MORCM1	NGC2	NGC1

Parameter input

Data type : Bit

NGC1 Specifies whether the servo loop gain of the axis that performs the spindle contour control is set automatically to a servo axis other than the spindle contour control axis (first spindle).

0 : Set automatically.

1 : Not set automatically.

When there is absolutely no interpolation between the spindle contour control axis and other servo axes, or when their servo loop gain is equal, set NGC1 to 1.

NGC2 Specifies whether the servo loop gain of the axis that performs the spindle contour control is set automatically to a servo axis other than the spindle contour control axis (second spindle of the Series 15–TT).

0 : Set automatically.

1 : Not set automatically.

When there is absolutely no interpolation between the spindle contour control axis and other servo axes, or when their servo loop gain is equal, set NGC2 to 1.

MORCM1 Specifies whether the first spindle motor uses the function for controlling the spindle orientation with the stop position set externally.

0 : Does not use

1 : Uses

MORCM2 Specifies to whether the second spindle motor uses the function for controlling the spindle orienta tion with the stop position set externally.

0 : Does not use

1 : Uses

NOTE MORCM2 is valid only in the Series 15–TT.

5610	Gear ratio of the spindle to the position coder

Parameter input

Data type : Byte

Unit of Data : N power to 2

Valid range : 0 to 3

When a position coder is installed on the spindle for feed per rotation (G95) or thread cutting, specify the gear ratio of the spindle to the position coder according to the table below; that is, specify the spindle speed to the position coder speed.

Gear ratio of spindle to position coder	Specified value
1	0
2	1
4	2
8	3

For the Series 15–TT with two spindles, use this parameter for the first spindle, and set the parameter for the second spindle in parameter No. 5660.

5611	Number of samples of sampling data for obtaining the mean spindle speed

Parameter input

Data type : Byte

Unit of data : N power to 2

Valid range : 0 to 4

The tool is moved according to the mean of the multiple samples of the spindle speed sampling data so that the feed per rotation (G95) and thread cutting operation is not affected by fluctuation of the spindle speed. Specifies how many samples of the sampling data are required to obtain the mean.

Number of samplings	Specified value
1	0
2	1
4	2
8	3
16	4

Normally, set it to 2.

For Series 15–TT with two spindles, use this parameter for the first spindle, and set the parameter for the second spindle in parameter No. 5661.

5612	Unit of the spindle speed to be output by the BMI

Parameter input

Data type : Byte

Unit of data : –N power to 10 rpm

Valid range : 0 to 3

Specify the unit of the specified spindle speed (R00 to R015), actual spindle speed (AR0 to AR15), and maximum spindle speed (MR0 to MR15) to be output in the BMI (basic machine interface).

Unit of spindle speed generated by BMI	Specified value
1 RPM	0
0.1 RPM	1
0.01 RPM	2
0.001 RPM	3

For the Series 15–TT with two spindles, use this parameter for the first spindle, and set the parameter for the second spindle in parameter No. 5662.

5613	Compensation value for the offset voltage of the spindle speed analog output

Parameter input

Data type : Word

Unit of data : Velo

Valid range : –1024 to +1024

Specify the compensation value for the offset voltage of the spindle speed analog output.

Setting = –8191 x offset voltage (V)/12.5

How to adjust:

1 Set the standard setting to 0.
2 Specify 0 for the S analog.
3 Measure the output voltage.
4 Set the value of the following expression to parameter No. 5613.

$$\frac{-8191 \times \text{measured voltage(V)}}{12.5\text{(V)}} = \text{Setting in parameter No.5613}$$

5 After setting the parameter, specify 0 for the S analog again and check that the output voltage is 0 V.

For Series 15–TT with two spindles, use this parameter for the first spindle, and set the parameter for the second spindle in parameter No. 5663.

The parameter must be set to 0 when a serial spindle is to be used.

5614	Data for adjusting the gain of the spindle speed analog output

Parameter input

Data type : Word

Unit of data : 0.1%

Valid range : 700 to 1250

Specify data for adjusting the gain of the spindle speed analog output.

How to adjust:

1 Set the standard setting to 1000 (for the FS3 or FS6 interface) or 800 (for the BMI interface).
2 Specify the spindle speed at which the spindle speed analog output voltage is maximized.
3 Measure the output voltage.
4 Set the value of the following expression to parameter No. 5614.

$$\frac{\text{Correct spindle speed analog output voltage}}{\text{Measured voltage}} \times 1000 \text{ (for BMI : 800)} = \text{Setting in parameter No.5614}$$

5 After setting the parameter, specify the maximum voltage of S analog again and check that the output voltage is 10.0 V.

For Series 15–TT with two spindles, use this parameter for the first spindle, and set the parameter for the second spindle in parameter No. 5664.

The parameter must be set to 0 when a serial spindle is to be used.

5615	Spindle motor speed during the spindle gear shift

Parameter input (Not used in the Series 15–TT)

Data type : Word

Valid range : 0 to 4095

Specify the spindle motor speed during the spindle gear shift.

This parameter is valid for the FS3 or FS6 interface.

5616	Time from when a spindle gear select single is issued until when the new spindle speed is output

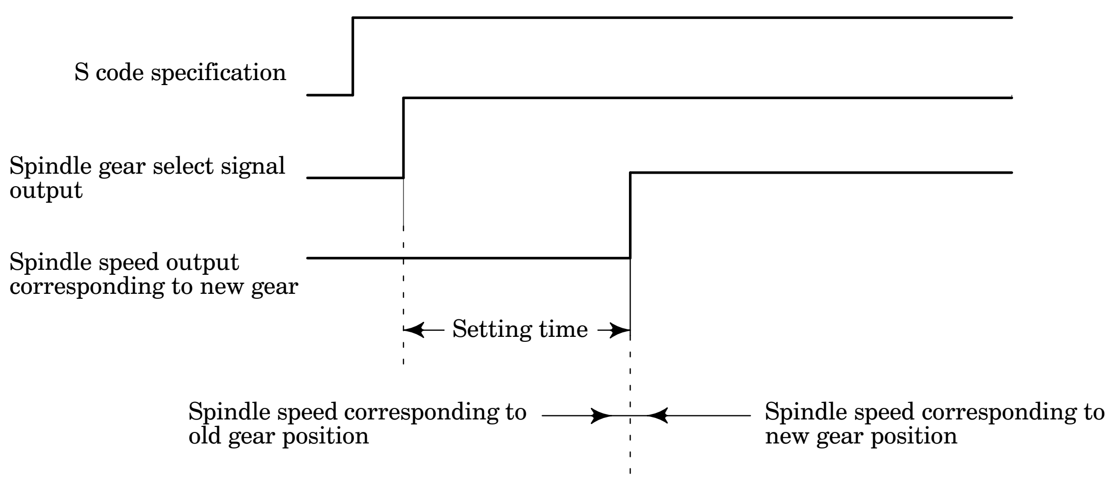
Parameter input (Not used in the Series 15–TT)

Data type : Word

Unit of data : msec

Valid range : 0 to 32767

When the type of spindle speed analog output or spindle speed binary output is A (TPB in parameter No. 5601 is set to 0), specify the time from when a spindle gear select signal is output until when the new spindle speed corresponding to the specified gear is output.



This parameter is valid when the FS3/FS6 interface is used.

5617	Spindle speed during the spindle orientation

Parameter input (Not used in the Series 15–TT)

Data type : Word

Unit of data : rpm

Valid range : 0 to 32767

Specify the spindle speed during the spindle orientation.

This parameter is valid for the FS3 or FS6 interface.

5618	Minimum clamp speed of the spindle motor

Parameter input (Not used in the Series 15–TT)

Data type : Word

Valid range : 0 to 4095

Specify the minimum clamp speed of the spindle motor.

This parameter is valid for the FS3 or FS6 interface.

Setting = (minimum clamp speed of the spindle motor/spindle motor speed corresponding to the maximum output) x 4095

5619	Maximum clamp speed of the spindle motor

Parameter input (Not used in the Series 15–TT)

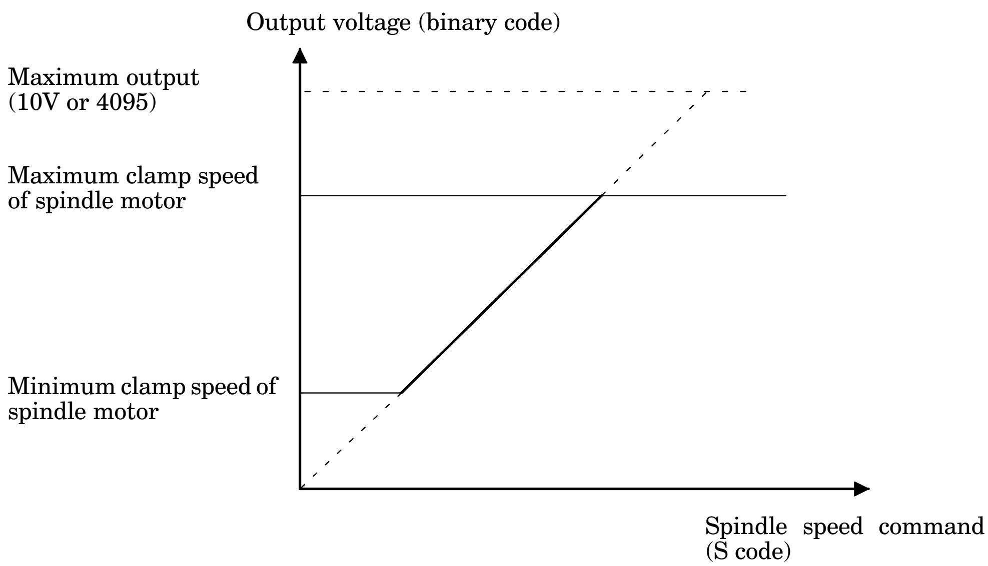
Data type : Word

Valid range : 0 to 4095

Specify the maximum clamp speed of the spindle motor.

This parameter is valid for the FS3 or FS6 interface.

Setting = (maximum clamp speed of the spindle motor/spindle motor speed corresponding to the maximum output) x 4095



5620	Time until the speed arrival signal is checked

Parameter input (Not used in the Series 15–TT)

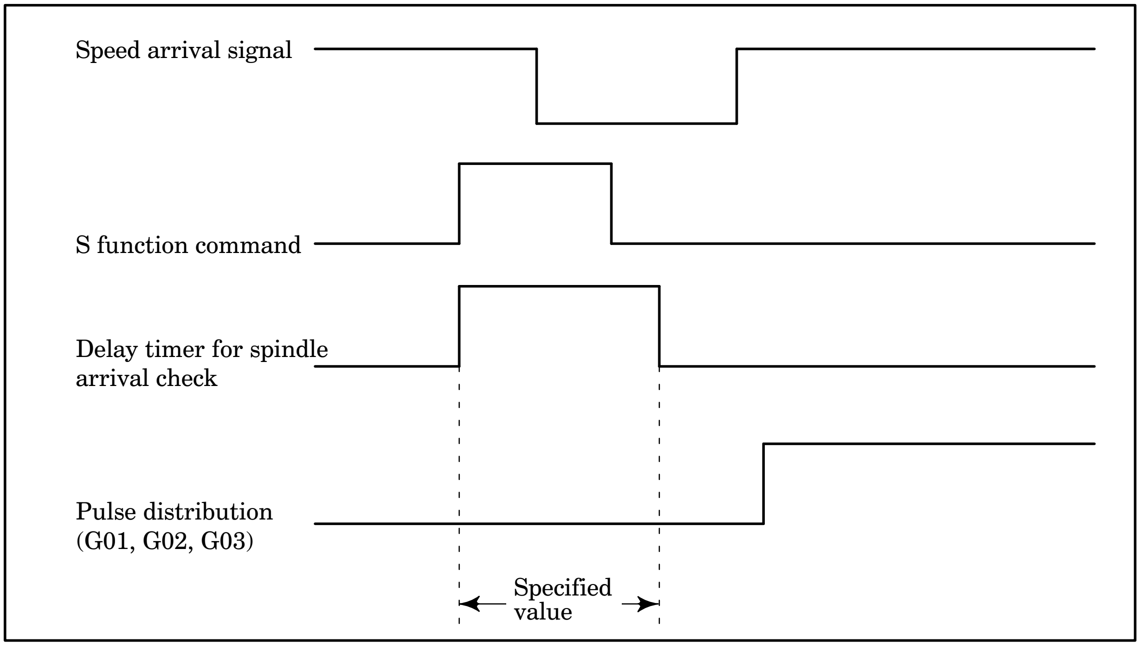
Data type : Word

Unit of data : msec

Valid range : 0 to 32767

Specify the time from when the S function is executed until when the speed arrival signal is checked.

This parameter is valid for the FS3 or FS6 interface.



Checks whether the speed arrival signal is on at the beginning of the cutting feed (G01, G02, G03, etc.) block. If it is off, the system waits until it is turned on, then begins the pulse distribution.

When the cutting feed is specified in the same block as the S function, waits for the specified length of time after the S code is sent, then checks the speed arrival signal. (See the diagram above.)

5621	Maximum spindle speed corresponding to gear 1

5622	Maximum spindle speed corresponding to gear 2

5623	Maximum spindle speed corresponding to gear 3

5624	Maximum spindle speed corresponding to gear 4

5625	Maximum spindle speed corresponding to gear 5

5626	Maximum spindle speed corresponding to gear 6

5627	Maximum spindle speed corresponding to gear 7

5628	Maximum spindle speed corresponding to gear 8

Parameter input (Not used in the Series 15–TT)

Data type : Word

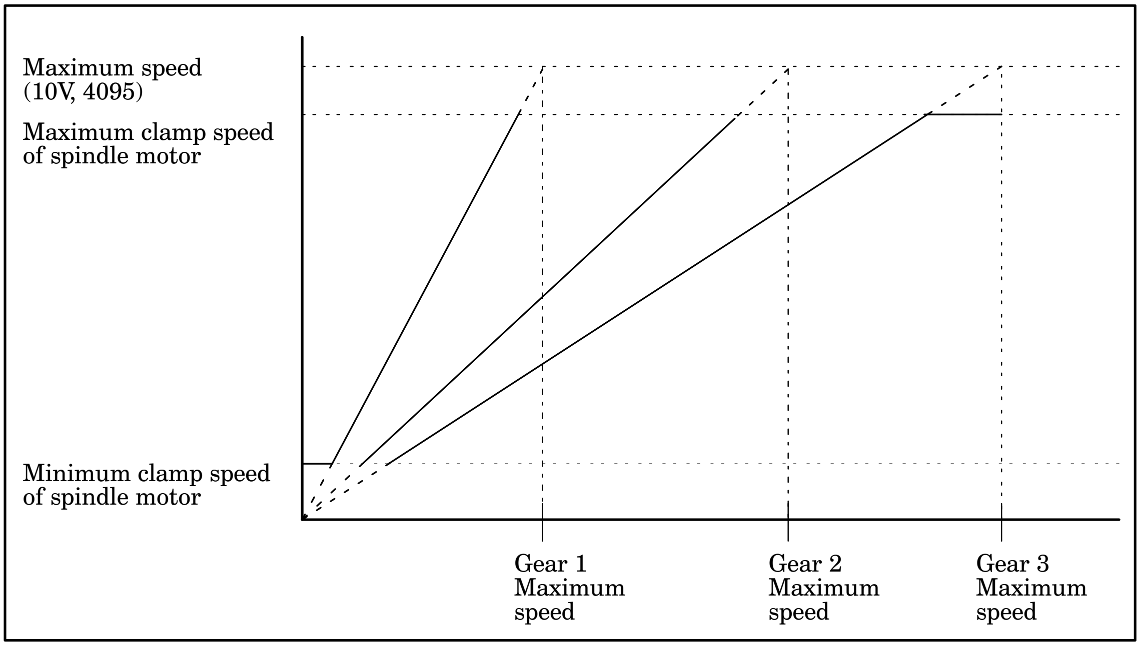
Unit of data : rpm

Valid range : 0 to 32767

Specify the spindle speed corresponding to the maximum output with each gear.

This parameter is valid for the FS3 or FS6 interface.

Specify this parameter even for the BMI interface if the the spindle speed fluctuation detection function is used.



5631	Spindle speed at the gear 1/gear 2 switching point during tapping or thread cutting

5632	Spindle speed at the gear 2/gear 3 switching point during tapping or thread cutting

5633	Spindle speed at the gear 3/gear 4 switching point during tapping or thread cutting

5634	Spindle speed at the gear 4/gear 5 switching point during tapping or thread cutting

5635	Spindle speed at the gear 5/gear 6 switching point during tapping or thread cutting

5636	Spindle speed at the gear 6/gear 7 switching point during tapping or thread cutting

5637	Spindle speed at the gear 7/gear 8 switching point during tapping or thread cutting

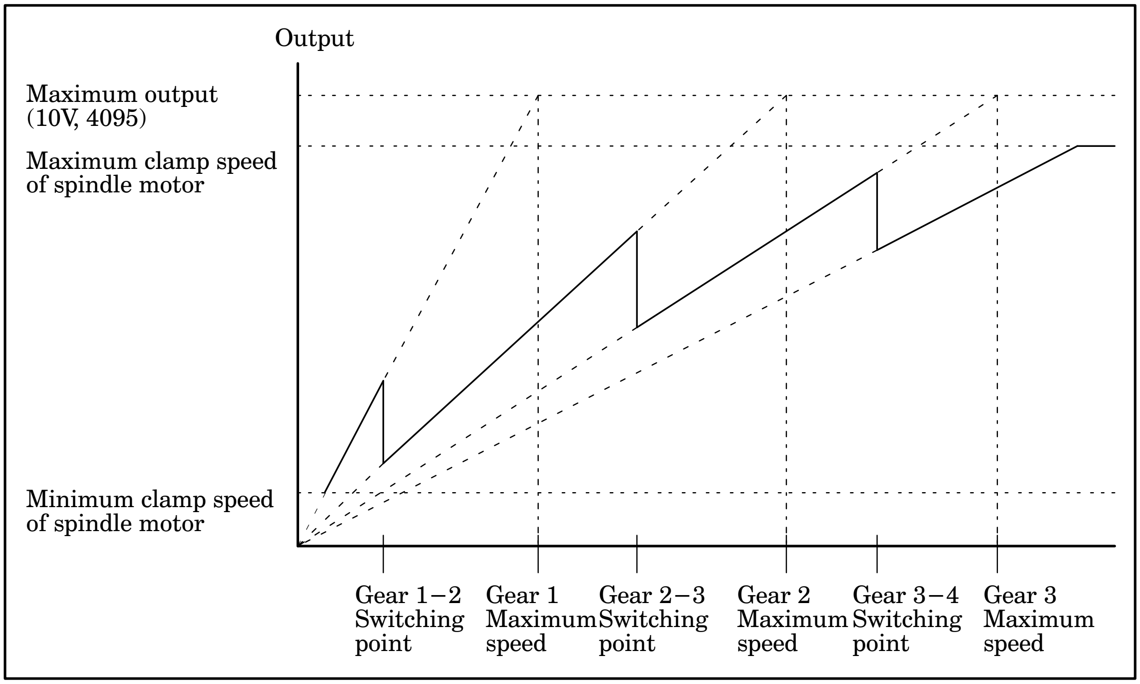
Parameter input (Not used in the Series 15–TT)

Data type : Word

Unit of data : rpm

Valid range : 0 to 32767

When the specified type of gear switching system during tapping or thread cutting is B type (SGS in parameter No. 5600 is set to 1), specify the spindle speed at each gear switching point.
This parameter is valid for the FS3 or FS6 interface.



5640	Axis No.for which the constant surface speed control is performed

Parameter input

Data type : Byte

Valid range : 0(Note), 1 to 9 (axis No.)

Specifies for which axis No. the constant surface speed control is performed. However, when the axis name for the constant surface speed control is specified by the program, the constant surface speed control is performed for the specified axis.

G96P––;

P1: X–axis, P4: U–axis, P7: A–axis

P2: Y–axis, P5: V–axis, P8: B–axis

P3: Z–axis, P6: W–axis, P9: C–axis

When no axis for the constant surface speed control is specified to P_ or P0 is specified, the constant surface speed control is performed for the axis specified by this parameter.

CAUTION When 0 is specified, the constant surface speed control is always performed on the X–axis. When this parameter is set to 0, the value for P in G96 block has no relation with the constant surface speed control.

For the Series 15–TT, use this parameter for the first tool post, and set the parameter for the second tool post in parameter No. 5670.

5641	Minimum spindle speed of gear 1 under the constant surface speed control
5642	Minimum spindle speed of gear 2 under the constant surface speed control
5643	Minimum spindle speed of gear 3 under the constant surface speed control
5644	Minimum spindle speed of gear 4 under the constant surface speed control
5645	Minimum spindle speed of gear 5 under the constant surface speed control
5646	Minimum spindle speed of gear 6 under the constant surface speed control
5647	Minimum spindle speed of gear 7 under the constant surface speed control
5648	Minimum spindle speed of gear 8 under the constant surface speed control

Parameter input (Not used in the Series 15–TT)

Data type: Word

Unit of data: rpm

Valid range: 0 to 32767

When GCS (bit 0) of parameter No. 5603 is set to 0, specify the minimum spindle speed of each gear under the constant surface speed control.

When GCS is set to 1, specify the spindle speed at each gear switching point. (Unit of data: rpm)

Data number	Meaning
5641	Spindle speed at gear 1/gear 2 switching point
5642	Spindle speed at gear 2/gear 3 switching point
5643	Spindle speed at gear 3/gear 4 switching point
5644	Spindle speed at gear 4/gear 5 switching point
5645	Spindle speed at gear 5/gear 6 switching point
5646	Spindle speed at gear 6/gear 7 switching point
5647	Spindle speed at gear 7/gear 8 switching point

Effective for FS3/FS6 interface.

5651	Axis No. of the Cs axis belonging to the first tool post

Parameter input

Data type : Byte

Unit of data : Axis No.

Valid range : 1 to maximum number of control axes

5652	Axis No. of the Cs axis belonging to the second tool post

Parameter input

Data type : Byte

Unit of data : Axis No.

Valid range : 1 to maximum number of control axes

Example When the control axes assignment is X_1, Z_1, C_1, X_2, Z_2, Y_2, B_2, and C_2, the setting in parameter No. 5651 is 3 because C_1 is the third axis, and the setting in parameter No. 5652 is 8 because C_2 is the eighth axis.

5660	Gear ratio of the spindle to the position coder for the second spindle

Parameter input (Only for Series 15–TT)

Data type : Byte

Unit of data : N power to 2

Valid range : 0 to 3

For the machine with two spindles, specify the gear ratio of the spindle to the position coder for the second spindleaccording to the table below; that is, specify the speed of the spindle to the speed of the position coder.

Gear ratio of spindle to position coder	Specified value
1	0
2	1
4	2
8	3

5661	Number of samples of sampling data for obtaining the running mean of the spindle speed for the second spindle

Parameter input (Only for Series 15–TT)

Data type : Byte

Unit of data : N power to 2

Valid range : 0 to 4

For the machine with two spindles, the tool is moved according to the running mean of multiple samples of the second spindle speed sampling data so that the feed per rotation (G95) and thread cutting operation on the second spindle is not affected by fluctuation of the spindle speed. Specifies how many samples of the sampling data are required to obtain the mean.

Number of samplings	Specified value
1	0
2	1
4	2
8	3
16	4

Normally, set to 2.

5662	Unit of the spindle speed to be output for the second spindle in the BMI

Parameter input (Only for Series 15–TT)

Data type : Byte

Unit of data : –N power to 10 rpm

Valid range : 0 to 3

For the machine with two spindles, specify the unit of the specified spindle speed (R00 #2 to R015#2), actual spindle speed (AR0 #2 to AR15#2), and maximum spindle speed (MR0 #2 to MR15#2) to be output for the second spindle in the BMI (basic machine interface).

Unit of spindle speed generated by BMI	Specified value
1 RPM	0
0.1 RPM	1
0.01 RPM	2
0.001 RPM	3

5663	Compensation value for the offset voltage of the spindle speed analog output of the second spindle

Parameter input (Only for Series 15–TT)

Data type : Word

Unit of data : Velo

Valid range : –1024 to +1024

For the machine with two spindles, specify the compensation value for the offset voltage of the spindle speed analog output of the second spindle.

The parameter must be set to 0 when a serial spindle is to be used.

5664	Data for adjusting the gain of the spindle speed analog output of the second spindle

Parameter input (Only for Series 15–TT)

Data type: Word

Unit of data: 0.1%

Valid range: 700 to 1250

For the machine with two spindles, specify the data for adjusting the gain of the spindle speed analog output of the second spindle.

The parameter must be set to 0 when a serial spindle is to be used.

5670	Axis No.on the second tool post for which the constant surface speed control is performed

Parameter input (Only for Series 15–TT)

Data type : Byte

Valid range : 0(Note), 1 to 9 (axis No.)

Specifies for which axis No. for the second tool post the constant surface speed control is performed. However, when the axis name for the constant surface speed control is specified by the program, the constant surface speed control is performed for the specified axis.

G96P__;

P1: X–axis

P2: Y–axis

P3: Z–axis

P9: C–axis

When no axis for the constant surface speed control is specified to P_ or P0 is specified, the constant surface speed control is performed for the axis specified by the above parameter.

CAUTION	When 0 is specified, the constant surface speed control is always performed on the X–axis. When this parameter is set to 0, the value for P in G96 block has no relation with the constant surface speed control.

Parameter Nos. 5680 to 5698 are the spindle positioning (indexing) function parameters.

5680	M code for specifying spindle orientation

Parameter input

Data type : Byte

Unit of data : Integer

Valid range : 6 to 97

Specify an M code for changing the mode from the spindle swiveling mode to the spindle positioning mode. This M code enables spindle orientation and it becomes possible to execute the command for spindle positioning in subsequent blocks.

5681	M code for canceling spindle positioning

Parameter input

Data type : Byte

Unit of data : Integer

Valid range : 6 to 97

Specify an M code for canceling the positioning mode and changing the mode to the spindle rotation mode.

5682	M code for specifying the spindle positioning angle

Parameter input

Data type : Byte

Unit of data : Integer

Valid data : 6 to 97

Specify an M code for spindle positioning (indexing at a semi–fixed angle).

Six different values, Mα to M (α+ 5), can be specified.

5683	Basic rotation angle for spindle positioning by an M code

Parameter input

Data type : Byte

Unit of data : Degree

Valid range : 1 to 60

5691	Servo loop gain multiplier to spindle gear 1
5692	Servo loop gain multiplier to spindle gear 2
5693	Servo loop gain multiplier to spindle gear 3
5694	Servo loop gain multiplier to spindle gear 4
5695	Servo loop gain multiplier to spindle gear 5
5696	Servo loop gain multiplier to spindle gear 6
5697	Servo loop gain multiplier to spindle gear 7
5698	Servo loop gain multiplier to spindle gear 8

Parameter input

Data type : Word

Valid range : 1 to 32767

Specify the servo loop gain multiplier to each spindle gear (1 to 8) in spindle positioning and rigid tapping.

Specify the servo loop gain multiplier to each gear.

The servo loop gain multiplier is a conversion multiplier for converting the position deviation to the speed command voltage.

Servo loop gain multiplier = 2048000 x E x A/L

Where,

E: Speed command voltage (V) necessary to rotate the motor at 1000 rpm

E = 2.2: For the spindle motor that rotates at 1000 rpm with 2.2 V (10 V, 4500 rpm)

E = 1.67: For the spindle motor that rotates at 1000 rpm with 1.67 V (10 V, 6000 rpm)

A: Unit of detection (deg)

L: Rotation angle of the spindle per motor rotation (normally 360)

Example When the rotation angle of the spindle per motor rotation is 360 deg, the motor rotates at 1000 rpm with 2.2 V and the unit of detection is 0.088 deg/pulse:

Loop gain multiplier = 2048000 x 2.2 x 0.088/360 = 1101

NOTE The provision, 2.2 V at 1000 rpm, is calculated on the condition that the spindle motor being used operates at 4500 rpm with 10 V.

Spindle positioning parameters

The following table lists spindle positioning parameters.

Axis parameters are described only for the C–axis that is related to spindle positioning.

· Analog spindle

Parameter	Data	Supplementary explanation
1004 (C) 1005 (C) 1006 (C)	00000000 XXXX1000 00000001	Always 0.001 deg (abbreviated name IS–B). ZRNc = 0, ALZc = 0, PLZc = 0, ROTc = 1, ROSc = 0, ROPc = 0, DIAc = 0
1020 (C) 1022 (C) 1023 (C)	67 0 20	Axis name C Rotary axis: 16+4 = 20 in the case of X, Y, Z or C (See note 2)
1420 (C) 1425 (C) 1620 (C)	XX XX XX	Rapid traverse speed of spindle positioning Orientation speed of spindle orientation Rapid traverse time constant of spindle positioning
1816 (C) 1820 (C) 1825 (C) 1826 (C) 1827 (C) 1834 (C) 1850 (C) 2203 (C)	01111001 2 XX XX XX XX XX XXXXXX1X	DMR = 4. Reference counter = 10000 CMR = 1 Loop gain Parameter numbers 5691 – 5698 are used. Width of in–position Drift compensation value Grid compensation value MCN = 1, Machine position in units of 0.001 deg
5605 5680 5681 5682 5683	00XX0000 XX XX XX XX	IDM: (Bit 5) Spindle positioning by M code: = 1 Perform positioning in – direction. = 0 Perform positioning in + direction IOR: (Bit 4) When it was reset = 1 Spindle positioning mode is cancelled. = 0 Spindle positioning mode is not cancelled. M code commanding the spindle orientation M code cancelling the spindle positioning M code commanding the spindle positioning angle Basic rotary angle in spindle positioning by M code
5691 5692 5693 5694 5695 5696 5697 5698	XX XX XX XX XX XX XX XX	Servo gain multiplier for gear 1 of spindle Servo gain multiplier for gear 2 of spindle Servo gain multiplier for gear 3 of spindle Servo gain multiplier for gear 4 of spindle Servo gain multiplier for gear 5 of spindle Servo gain multiplier for gear 6 of spindle Servo gain multiplier for gear 7 of spindle Servo gain multiplier for gear 8 of spindle
5610	0 – 2	Gear ratio between spindle and position coder

NOTE 1 Set a value corresponding to machines to X (XX).
NOTE 2 Set the spindle positioning axis to the last axis of controlled axis.

· Serial–interface spindle

Parameter No.	Data	Supplementary explanation
1004 (C) 1005 (C) 1006 (C)	00000000 XXXX1000 00000001	Always 0.001 deg (The abbreviation is IS–B.) ZRNc = 0, ALZc = 0, PLZc = 0, ROTc = 1, ROSc = 0, ROPc = 0, DIAc = 0
1020 (C) 1022 (C) 1023 (C)	67 0 20	Axis name C Rotation axis 16 + 4 = 20 for the X–, Y–, Z–, and C–axes (Note 2)
1420 (C) 3076 (C) 1620 (C)	XX XX XX	Rapid traverse rate for spindle positioning Spindle orientation speed Rapid traverse time constant for spindle positioning
1816 (C) 1820 (C) 3065 (C) to 3068 (C) 1827 (C) 3073 (C) 2203 (C)	01111001 2 XX XX XX XXXXXX1X	DMR = 4, Reference counter = 10000 CMR = 1 Loop gain Effective area Grid compensation amount MCN = 1, Machine position in units of 0.001 deg
5605 5680 5681 5682 5683	00XX0000 XX XX XX XX	IDM (bit 5) Specifies whether to position the spindle in the minus direction or plus direction according to the M code. 1 : Position the spindle in the minus direction. 0 : Position the spindle in the plus direction. IOR (bit 4) Specifies whether to release the spindle positioning mode upon system reset. 1 : Release the spindle positioning mode. 0 : Do not release the spindle positioning mode. M code for specifying spindle orientation M code for releasing spindle positioning M code for specifying a spindle positioning angle Basic angular displacement in spindle positioning using the M code
5610	0 to 2	Gear ratio of the spindle to the position coder

NOTE 1 In X or XX (data column), specify a machine–dependent value.
NOTE 2 Specify the last controlled axis as the spindle positioning axis.
NOTE 3 The user can select up to four stages for spindle and spindle motor gear selection.

5701	Spindle speed ratio (q) at which the system regards the spindle as having reached the specified speed.

Parameter input

Data type : Byte

Unit of data : 1%

Valid range : 1 to 50

Assuming the specified spindle speed is Sc and the ratio set in this parameter is q, then when the actual speed is within the range Sc – Sq to Sc + Sq, the system regards the spindle as having reached the specified speed and starts the spindle speed fluctuation detection.

$$\text{Where, } Sq = Sc \times \frac{q}{100}$$

5702	Ratio (r) of the allowable fluctuation range in which the spindle speed fluctuation detection does not result in an error.

Parameter input

Data type : Byte

Unit of data : 1%

Valid range : 1 to 50

5703	Gear for the spindle in rigid tapping

5704	Gear for the position coder in rigid tapping

Parameter input

Data type : Byte

Unit of data : 1

Valid range : 1 to 127

Specify the gear ratio P:Q of the spindle to the position coder in rigid tapping. Set P in parameter No. 5703 and Q in parameter No. 5704.

For example, when a spindle motor with a built–in position coder is used and the gear ratio of the spindle to the spindle motor is 1:1.45, the gear ratio of the spindle to the position coder will also be 1:1.45. Since 1:1.45 = 100:145 = 20:29 (P = 20, Q = 29), set 20 in parameter No. 5703 and 29 in parameter No. 5704.

Only one gear ratio, namely P:Q, is available in the system. Thus, for example, when two or more gear selections such as high speed, medium speed and low speed are used in rigid tapping, rigid tapping can be achieved by only one of them. However, if a position coder is installed on the spindle and the gear ratio of the spindle to the position coder is 1:1, 2:1, 4:1, or 8:1, rigid tapping can be achieved by any gear selection even when two or more gear selections are used in the system. By specifying this parameter, rigid tapping can be achieved by a different spindle to position coder gear ratio than 1:1, 2:1, 4:1, and 8:1. However, the spindle to position coder gear ratio must be 1:1, 2:1, 4:1, or 8:1 to operate feed per rotation, thread cutting and spindle positioning.

5705	Feedrate override on each return

Parameter input

Data type : Byte

Unit of data : 10%

Valid range : 1 to 20

This parameter enables feedrate override in the range 10% to 200% with 10% increments, to the feedrate on each return (zero override is regarded as 100%).

5709	Number of teeth (N) of the gear on the spindle

5710	Number of teeth (M) of the gear on the position coder

Parameter input

Data type : Word

Unit of data : 1

Valid range : 1 to 9999

5721	Allowable fluctuation speed (Sd) at which the spindle speed fluctuation detection does not result in an error.

Parameter input
Data type : Word
Unit of data : rpm
Valid range : 0 to 32767

The spindle speed fluctuation detection system uses the following method to determine whether the actual spindle speed fluctuation exceeds allowable limit. That is, using the faster of the two spindle speeds, Sd, and Sr, as the allowable fluctuation speed, Sm, the system calculates the maximum allowable spindle speed “Sm max” and the minimum allowable spindle speed “Sm min” by adding and subtracting Sm to/from the specified speed, Sc, respectively. When the actual spindle speed exceeds Sm max or becomes lower than Sm min, the system judges that fluctuation has exceeded the allowable limit and raises an alarm.

Sm max = Sc + Sm

Sm min = Sc – Sm

where, Sm is the faster of Sd and Sr

Sd: A constant, allowable fluctuation range that is independent of the specified spindle speed. Specify in parameter No. 5721.

Sr: An allowable fluctuation range obtained by multiplying a certain ratio r by the specified spindle speed, Sc. The ratio r is set in parameter No. 5702.

$$Sr = Sc \times \frac{r}{100}$$

This allowable fluctuation range increases as the specified spindle speed increases.

5722	Time from when the specified spindle speed is changed until the spindle speed fluctuation detection is started.

Parameter input
Data type : Word
Unit of data : 64 msec
Valid range : 0 to 32767

Specify time from when the specified spindle speed is changed until the spindle speed fluctuation detection is started. In other words, the system does not perform spindle speed fluctuation detection until the specified time has elapsed since the specified spindle speed was changed. However, as explained in the paragraph on parameter No. 5701, if the actual spindle speed is within the range Sc – Sq to Sc + Sq, the system starts the spindle speed fluctuation detection even before the time set in this parameter has elapsed.

5751	Time constant of the spindle and the drilling axis at acceleration/deceleration in rigid tapping

Parameter input
Data type : Word
Unit of data : msec
Valid range : 0 to 4000

5752	FL speed at acceleration/deceleration of the spindle and the drilling axis in rigid tapping

Parameter input
Data type: Two words
Unit of data:

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	10.0	1.0	0.1	0.01	0.001	mm/min
Inch system machine	1.0	0.1	0.01	0.001	0.0001	inch/min

Unit of data is multiplied by 10 when a high–resolution detector is installed.

Valid range: 0 to 1000000

Set to 0 except for special cases.

5753	Servo loop gain of the spindle and the drilling axis in rigid tapping

Parameter input

Data type : Word

Unit of data : 0.01/sec

Valid range : 1 to 9999

5754	Position deviation limit of the spindle in rigid tapping

Parameter input

Data type : Word

Unit of data : Unit of detection

Valid range : 0 to 32767

5755	Effective area of the spindle in rigid tapping

Parameter input

Data type : Word

Unit of data : Unit of detection

Valid range : 0 to 32767

Standard setting is 20.

5756	Backlash compensation of the spindle in rigid tapping

Parameter input

Data type : Word

Unit of data : Unit of detection

Valid range : –9999 to +9999

5757	Maximum spindle speed at the first stage (S1) in switching the rigid tapping time constant

Parameter input

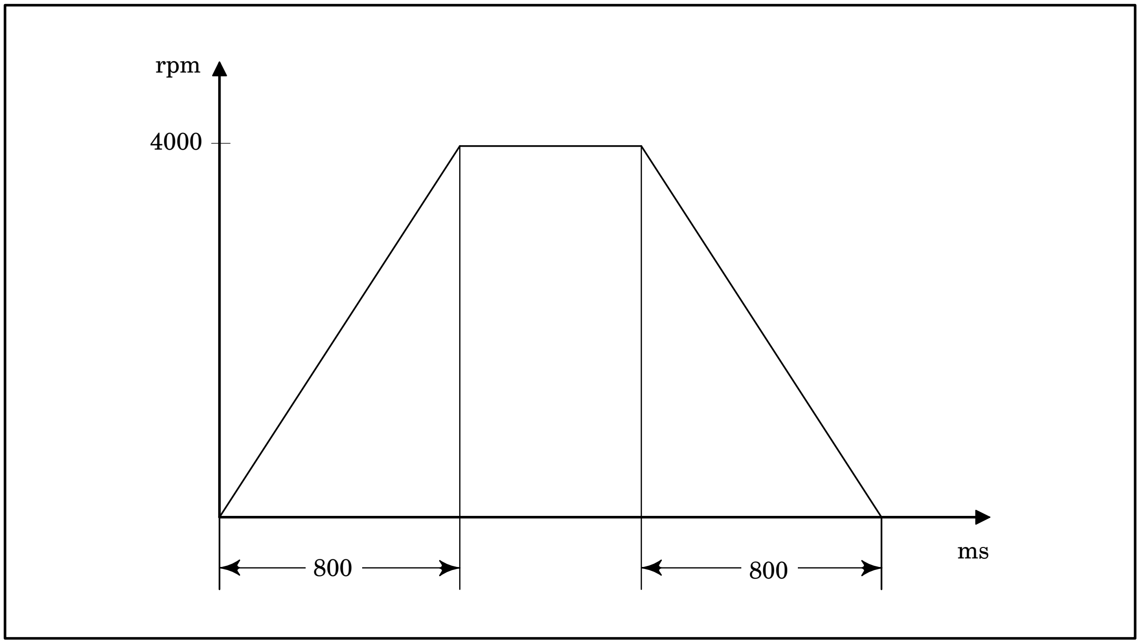
Data type : Word

Unit of data : rpm

Valid range : 0 to 32767

When the acceleration/deceleration control in rigid tapping is linear acceleration/deceleration (when TEL, bit 1 of parameter No. 5605 is set to 1), the spindle is accelerated to the speed set in this parameter within the time specified in parameter No. 5751.

Example When the setting in this parameter is 4000 and the setting in parameter No. 5751 is 800:



When S2000 is specified, the acceleration/deceleration time will be 400 ms. When S1000 is specified, the acceleration/deceleration time will be 200 ms. That is, the acceleration in the linear acceleration/deceleration control in rigid tapping is constant.

5758	Maximum spindle speed at the second stage (S2) in switching the rigid tapping time constant

5759	Maximum spindle speed at the third stage (S3) in switching the rigid tapping time constant

Parameter input

Data type : Word

Unit of data : rpm

Valid range : 0 to 32767

For more details on the data, see the explanation of TSC in parameter No: 5605.

5760	Time constant TC1 of the spindle and drilling axis in rigid tapping

5762	Time constant TC2 of the spindle and drilling axis in rigid tapping

5764	Time constant TC3 of the spindle and drilling axis in rigid tapping

5766	Time constant TC4 of the spindle and drilling axis in rigid tapping

Parameter input

Data type : Word

Unit of data : msec

Valid range : 0 to 4000

For more details on the data, see the explanation of TSC in parameter No. 5605.

5761	FL speed FL1 of the spindle and drilling axes in rigid tapping

5763	FL speed FL2 of the spindle and drilling axes in rigid tapping

5765	FL speed FL3 of the spindle and drilling axes in rigid tapping

5767	FL speed FL4 of the spindle and drilling axes in rigid tapping

Parameter input

Data type: Two words

Unit of data:

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	10.0	1.0	0.1	0.01	0.001	mm/min
Inch system machine	1.0	0.1	0.01	0.001	0.0001	inch/min

Valid range: 0 to 1000000

Set to 0 except for special cases.

For more details on the data, see the explanation of TSC in parameter No. 5605.

5771	Number of teeth on the spindle gear corresponding to gear 1 in rigid tapping

5772	Number of teeth on the spindle gear corresponding to gear 2 in rigid tapping

5773	Number of teeth on the spindle gear corresponding to gear 3 in rigid tapping

5774	Number of teeth on the spindle gear corresponding to gear 4 in rigid tapping

5775	Number of teeth on the spindle gear corresponding to gear 5 in rigid tapping

5776	Number of teeth on the spindle gear corresponding to gear 6 in rigid tapping

5777	Number of teeth on the spindle gear corresponding to gear 7 in rigid tapping

5778	Number of teeth on the spindle gear corresponding to gear 8 in rigid tapping

Parameter input

Data type : Word

Unit of data : 1

Valid range : 1 to 32767

5781	Number of teeth on the position coder gear corresponding to gear 1 in rigid tapping

5782	Number of teeth on the position coder gear corresponding to gear 2 in rigid tapping

5783	Number of teeth on the position coder gear corresponding to gear 3 in rigid tapping

5784	Number of teeth on the position coder gear corresponding to gear 4 in rigid tapping

5785	Number of teeth on the position coder gear corresponding to gear 5 in rigid tapping

5786	Number of teeth on the position coder gear corresponding to gear 6 in rigid tapping

5787	Number of teeth on the position coder gear corresponding to gear 7 in rigid tapping

5788	Number of teeth on the position coder gear corresponding to gear 8 in rigid tapping

Parameter input

Data type : Word

Unit of data : 1

Valid range : 1 to 32767

5791	Backlash compensation of the spindle when gear 1 is used in rigid tapping

5792	Backlash compensation of the spindle when gear 2 is used in rigid tapping

5793	Backlash compensation of the spindle when gear 3 is used in rigid tapping

5794	Backlash compensation of the spindle when gear 4 is used in rigid tapping

5795	Backlash compensation of the spindle when gear 5 is used in rigid tapping

5796	Backlash compensation of the spindle when gear 6 is used in rigid tapping

5797	Backlash compensation of the spindle when gear 7 is used in rigid tapping

5798	Backlash compensation of the spindle when gear 8 is used in rigid tapping

Parameter input
Data type : Word
Unit of data : Unit of detection
Valid range : –9999 to +9999

5801	Rapid traverse feedrate during orientation in rigid tapping

Parameter input
Data type : Word
Unit of data : 10deg/min
Valid range : 0 to 32767

5802	FL speed during orientation in rigid tapping

Parameter input
Data type : Word
Unit of data : 10deg/min
Valid range : 0 to 32767

5803	Amount of grid shift of the spindle during orientation in rigid tapping

Parameter input

Data type : Word

Unit of data : Unit of detection

Valid range : –2048 to +2048

5804	Allowable range for constant feedrate determination in exponential acceleration/deceleration when the rigid tapping in–progress signal is being output

Parameter input

Data type : Byte

Unit of data : Detection unit

Valid range : 0 to 127

The constant feedrate signal is output when the difference in the number of remaining pulses held in the acceleration/deceleration circuit between two adjacent distribution periods (ITPs) is zero.

In the figure below, for example, the number of remaining pulses held in the acceleration/deceleration circuit at ITP6 is:

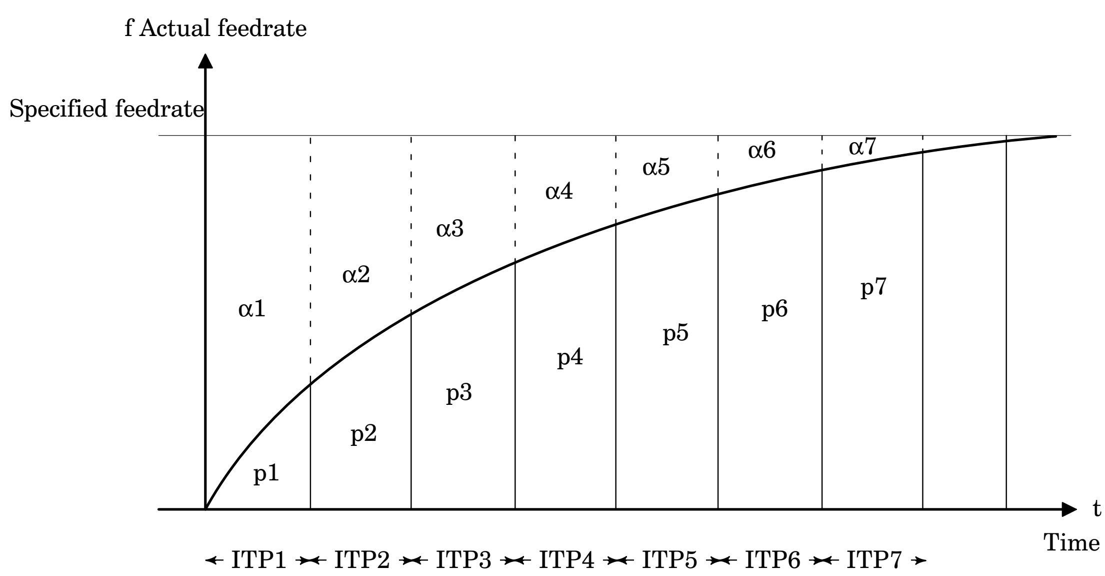
$\alpha 1 + \alpha 2 + \alpha 3 + \alpha 4 + \alpha 5 + \alpha 6$

The number of remaining pulses at ITP7 is:

$\alpha 1 + \alpha 2 + \alpha 3 + \alpha 4 + \alpha 5 + \alpha 6 + \alpha 7$

Accordingly, the difference in the number of remaining pulses in the acceleration/deceleration circuit at ITP6 and ITP7 is 7.

In exponential acceleration/deceleration, however, the difference in the number of remaining pulses in the acceleration/deceleration circuit between two adjacent ITPs does not become zero even when the constant feedrate is being kept. In this case, acceleration/deceleration is stopped assuming that the constant feedrate is reached when the difference in the number of remaining pulses in the acceleration/deceleration circuit is within the range specified in this parameter.



pn : Number of output pulses in one ITP

αn : Number of remaining pulses in the acceleration/deceleration circuit at one ITP

Rigid tapping parameters

The following table lists rigid tapping parameters.

Data number	Bit	Supplementary explanation
1837	–	Position deviation limit value during movement of drilling axis on rigid tap
5604	1	Is the gear ratio between the spindle and position coder special?
5605	1	Is the acceleration/deceleration an exponential or linear function? Normally, it is linear acceleration/deceleration.
5610	–	When the gear ratio between the spindle and position coder is equal to 1:1, 2:1, 4:1, or 8:1, let 5604#1 be 0 and set the gear ratio with this parameter. If the gear ratio is other than the above, let 5604#1 be 1 and set the gear ratio to 5703 and 5704.
5691 to 5698	–	Loop gain multipliers of 1st to 8th gear of spindle
5703 5704	– –	Gear ratio between the spindle and position coder
5751	–	Acceleration/deceleration time constants of spindle and drilling axis
5752	–	Acceleration/deceleration FL speed of spindle and drilling axis
5753	–	Loop gain of spindle and drilling axis
5754	–	Position deviation limit value of spindle
5755	–	In–position width of spindle
5756	–	Backlash amount of spindle
5757	–	Maximum speed of spindle on rigid tap. In the case of linear accelera-tion/deceleration, the time constant of 5751 becomes the acceleration time for the speed set by this parameter.
5801	–	Rapid traverse rate at orientation
5802	–	FL rate at orientation
5803	–	Spindle grid shift value at orientation

	#7	#6	#5	#4	#3	#2	#1	#0
5820	PKHD	SPSVC					SDIR2	SDIR1

SDIR1 Specifies the direction of rotation of the first spindle motor during synchronous control of the spindle:

0 : Rotates in the + direction with a + command.

1 : Rotates in the – direction with a + command.

SDIR2 Specifies the direction of rotation of the second spindle motor during synchronous control of the spindle:

0 : Rotates in the + direction with a + command.

1 : Rotates in the – direction with a + command.

SPSVC When spindle positioning is performed on the serial interface spindle:

0 : Turns on and off the servo automatically.

1 : Does not on and off the servo automatically.

Set this bit to 1 when parts including shot pins are not mechanically clamped.

PKHD On the spindle adjustment screen of the monitor, as a synchronization error:

0 : The instantaneous value of the difference in the position deviation is displayed.

1 : The peak hold value of the difference in the position deviation is displayed.

NOTE 1 The settings in this parameter are valid only in the MDI mode.

NOTE 2 While setting this parameter, some items may result in the alarm “PW OOO POWER MUST BE OFF”.

	#7	#6	#5	#4	#3	#2	#1	#0
5821					SPCHG			

Parameter input

Data type : Bit

SPCHG Specifies how spindle control is switched.

0 : By a program command (G10.7P_)

1 : By a signal (PCSPNO)

NOTE If this parameter specifies that spindle control is to be switched based on a signal, G10.7, if issued in a program, results in the PS10 alarm. This parameter is valid only for the T series.

4.25 Parameters Related to Rigid Tapping with the Series 15–TT

(1) Parameters common to analog and serial spindles

First spindle	Second spindle	
5610	5660	Gear ratio of the spindle to the position coder

Parameter input

Data type : Byte

Unit of data : 2N

Valid range : 0 to 3

Gear ratio of the spindle to the position coder	Setting
1	0
2	1
3	2
4	3
8	4

First spindle	Second spindle	
5703	5909	Gear for the spindle in rigid tapping
5704	5910	Gear for the position coder in rigid tapping

Parameter input

Data type : Byte

Unit of data : 1

Valid range : 1 to 127

Specify the gear ratio of the spindle to the position coder, P:Q, for rigid tapping. Specify P in parameter No. 5703, and Q in parameter No. 5704.

This parameter is valid when bit 1 (RTG) of parameter No. 5604 is set to 1, and bit 2 (SFGB) of parameter No. 5604 is set to 0.

First spindle	Second spindle	
5705	5911	Return feedrate override in rigid tapping

Parameter input

Data type : Byte

Unit of data : 10%

Valid range : 1 to 20

This parameter can override the feedrate on each spindle return in 10% steps within the range 10% to 200%. (When 0 is specified, 100% is assumed.)

First spindle	Second spindle	
5751	5912	Time constant of acceleration/deceleration for the spindle and drilling axis in rigid tapping

Parameter input
Data type : Word
Unit of data : msec
Valid range : 0 to 4000

First spindle	Second spindle	
5752	5913	FL feedrate of acceleration/deceleration for the spindle and drilling axis in rigid tapping

Parameter input
Data type : Word
Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Millimeter machine	10.0	1.0	0.1	0.01	0.001	mm/min
Inch machine	1.0	0.1	0.01	0.001	0.0001	inch/min

Valid range : 0 to 32767. Specify 0 except for special cases.

First spindle	Second spindle	
5754	5915	Position deviation limit for the spindle in rigid tapping

Parameter input
Data type : Word
Unit of data : Detection unit
Valid range : 0 to 32767

First spindle	Second spindle	
5755	5916	Effective area for the spindle in rigid tapping

Parameter input
Data type : Word
Unit of data : Detection unit
Valid range : 0 to 32767
The standard setting is 20.

5756	5917	Backlash compensation for the spindle in rigid tapping

Parameter input
Data type : Word
Unit of data : Detection unit
Valid range : –9999 to +9999

First spindle	Second spindle	
5757	5918	Maximum spindle speed at the first stage (S1) in switching the rigid tapping time constant
5758	5919	Maximum spindle speed at the second stage (S2) in switching the rigid tapping time constant
5759	5920	Maximum spindle speed at the third stage (S3) in switching the rigid tapping time constant

Parameter input

Data type : Word

Unit of data : rpm

Valid range : 0 to 32767

For detailed information, see the description of the TSC parameter (parameter No. 5605).

First spindle	Second spindle	
5760	5921	Time constant TC1 for the spindle and drilling axis in rigid tapping
5762	5923	Time constant TC2 for the spindle and drilling axis in rigid tapping
5764	5925	Time constant TC3 for the spindle and drilling axis in rigid tapping
5766	5927	Time constant TC4 for the spindle and drilling axis in rigid tapping

Parameter input

Data type : Word

Unit of data : msec

Valid range : 0 to 4000

For detailed information, see the description of the TSC parameter (parameter No. 5605).

First spindle	Second spindle	
5761	5922	FL feedrate FL1 for the spindle and drilling axis in rigid tapping
5763	5924	FL feedrate FL2 for the spindle and drilling axis in rigid tapping
5765	5926	FL feedrate FL3 for the spindle and drilling axis in rigid tapping
5767	5928	FL feedrate FL4 for the spindle and drilling axis in rigid tapping

Parameter input

Data type : Word

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Millimeter machine	10.0	1.0	0.1	0.01	0.001	mm/min
Inch machine	1.0	0.1	0.01	0.001	0.0001	inch/min

Valid range : 0 to 32767

For detailed information, see the description of the TSC parameter (parameter No. 5605).

First spindle	Second spindle	
5771	5929	Number of teeth on the spindle gear of gear set 1 in rigid tapping
5772	5930	Number of teeth on the spindle gear of gear set 2 in rigid tapping
5773	5931	Number of teeth on the spindle gear of gear set 3 in rigid tapping
5774	5932	Number of teeth on the spindle gear of gear set 4 in rigid tapping
5775	5933	Number of teeth on the spindle gear of gear set 5 in rigid tapping
5776	5934	Number of teeth on the spindle gear of gear set 6 in rigid tapping
5777	5935	Number of teeth on the spindle gear of gear set 7 in rigid tapping
5778	5936	Number of teeth on the spindle gear of gear set 8 in rigid tapping

Parameter input

Data type : Word

Unit of data : 1

Valid range : 1 to 32767

These parameters are valid when the gear ratio of the spindle to the position coder can be freely set (when bit 2 (SFGB) of parameter No. 5604 is set to 1).

For a serial spindle, parameter Nos. 5775 to 5778, and parameter Nos. 5933 to 5936 are not used.

First spindle	Second spindle	
5781	5937	Number of teeth on the position coder gear of gear set 1 in rigid tapping
5782	5938	Number of teeth on the position coder gear of gear set 2 in rigid tapping

5783	5939	Number of teeth on the position coder gear of gear set 3 in rigid tapping

5784	5940	Number of teeth on the position coder gear of gear set 4 in rigid tapping

5785	5941	Number of teeth on the position coder gear of gear set 5 in rigid tapping

5786	5942	Number of teeth on the position coder gear of gear set 6 in rigid tapping

5787	5943	Number of teeth on the position coder gear of gear set 7 in rigid tapping

5788	5944	Number of teeth on the position coder gear of gear set 8 in rigid tapping

Parameter input

Data type : Word

Unit of data : 1

Valid range : 1 to 32767

These parameters are valid when the gear ratio of the spindle to the position coder can be freely set (when bit 2 (SFGB) of parameter No. 5604 is set to 1).

For a serial spindle, parameter Nos. 5785 to 5788, and parameter Nos. 5941 to 5944 are not used.

(2) Parameters not common to analog and serial spindles

(a) Parameters for analog spindles

First spindle	Second spindle	
5691	5901	Servo loop gain constant for gear set 1

5692	5902	Servo loop gain constant for gear set 2

5693	5903	Servo loop gain constant for gear set 3

5694	5904	Servo loop gain constant for gear set 4

5695	5905	Servo loop gain constant for gear set 5

5696	5906	Servo loop gain constant for gear set 6

5697	5907	Servo loop gain constant for gear set 7

5698	5908	Servo loop gain constant for gear set 8

Parameter input
Data type : Word
Unit of data : 1
Valid range : 1 to 32767

Specify servo loop gain multipliers for gear sets 1 to 8.

First spindle	Second spindle	
5753	5914	Servo loop gain of the spindle and drilling axis in rigid tapping

Parameter input
Data type : Word
Unit of data : 0.01/sec
Valid range : 0 to 9999

First spindle	Second spindle	
5801	5953	Rapid traverse rate during orientation in rigid tapping

Parameter input
Data type : Word
Unit of data :

	Unit
10.0	deg/min

Valid range : 0 to 32767

First spindle	Second spindle	
5802	5954	FL feedrate during orientation in rigid tapping

Parameter input
Data type : Word
Unit of data :

	Unit
10.0	deg/min

Valid range : 0 to 32767

First spindle	Second spindle	
5803	5955	Grid shift during orientation in rigid tapping

Parameter input

Data type : Word

Unit of data : Detection unit

Valid range : –2048 to +2048

(b) Parameters for serial spindles

First spindle	Second spindle	#7	#6	#5	#4	#3	#2	#1	#0
3000	3140				RETSV				

Parameter input

Data type : Bit

RETSV Specifies the direction of spindle orientation.

0 : Spindle orientation is performed counterclockwise.

1 : Spindle orientation is performed clockwise.

3044	3184	Velocity loop proportional gain in the servo mode (gear set 1, gear set 2)
3045	3185	Velocity loop proportional gain in the servo mode (gear set 3, gear set 4)

Parameter input

Unit of data :

Valid range : 0 to 32767

Specify a velocity loop proportional gain in the servo mode (for rigid tapping, etc.).

First spindle	Second spindle	
3052	3192	Velocity loop integral gain in the servo mode (gear set 1, gear set 2)
3053	3193	Velocity loop integral gain in the servo mode (gear set 3, gear set 4)

Parameter input

Unit of data :

Valid range : 0 to 32767

Specify a velocity loop integral gain in the servo mode (for rigid tapping, etc.).

First spindle	Second spindle	
3065	3205	Servo loop gain in the servo mode (gear set 1)
3066	3206	Servo loop gain in the servo mode (gear set 2)
3067	3207	Servo loop gain in the servo mode (gear set 3)
3068	3208	Servo loop gain in the servo mode (gear set 4)

Parameter input

Unit of data : 0.01 sec–1

Valid range : 0 to 32767

Specify a servo loop gain in the servo mode (for rigid tapping, etc.).

First spindle	Second spindle	
3073	3213	Grid shift in the servo mode

Parameter input

Unit of data : +1 pulse units (4096 p/rev)

Valid range : 0 to 4095

If a command for rigid tapping includes I0 (orientation command), this parameter specifies a shift from a stop position. When a plus (+) number is specified, the orientation stop position of the spindle is shifted counter-clockwise by the specified number of pulses.

For parameter details, refer to the ”FANUC Series 15 Operator’s Manual (Appendixes).”

4.26 Parameters Related to the Electronic Gear Box (EGB)

The table below lists the parameters related to the EGB.

<table>
<tr><th>Parameter No.</th><th>Description</th></tr>
<tr><td>1004 bit6</td><td>No position indication is provided for an axis for which this parameter is set to 1.
The position indication of an EGB dummy axis is ignored. So, set this parameter for the axis to 1 to delete the position indication of the axis from the CRT screen.</td></tr>
<tr><td>1006 bit0
1006 bit1</td><td>When the amount of slave axis movement is to be specified for synchronization by setting the speed of the axis (L), the slave axis must be specified as a rotation axis by setting the ROT and ROS bits of parameter 1006 to 1.</td></tr>
<tr><td>1006 bit7</td><td>Set this parameter to 1 for an axis along which retraction is to be performed.</td></tr>
<tr><td>1023</td><td>When the electronic gear box function is used, be sure to specify the values of one of the following cases:
<table>
<tr><td>Case</td><td>(1)</td><td>(2)</td><td>(3)</td><td>(4)</td><td>(5)</td></tr>
<tr><td>EGB slave axis</td><td>1</td><td>3</td><td>5</td><td>7</td><td>9</td></tr>
<tr><td>EGB dummy axis</td><td>2</td><td>4</td><td>6</td><td>8</td><td>10</td></tr>
</table></td></tr>
<tr><td>1955 bit0</td><td>This parameter specifies the axes to be synchronized. Set 1 for both the EGB slave axis and dummy axis.</td></tr>
<tr><td>7612 bit0</td><td>This parameter specifies whether to cancel the synchronization mode by a reset.</td></tr>
<tr><td>5990</td><td>This parameter specifies the number of pulses from the position detector per spindle rotation.</td></tr>
<tr><td>5991</td><td>This parameter specifies the number of pulses from the position detector per EGB slave axis rotation.</td></tr>
<tr><td>5994</td><td>This parameter specifies an axial–feed axis number in helical compensation.</td></tr>
<tr><td>5995</td><td>This parameter specifies an axis to be synchronized using the method of command specification for a hobbing machine.</td></tr>
<tr><td>5996</td><td>This parameter specifies the number of pulses from the position detector per master axis rotation for the EGB.</td></tr>
<tr><td>5997</td><td>This parameter specifies the number of pulses from the position detector per slave axis rotation for the EGB.</td></tr>
<tr><td>5998</td><td>This parameter specifies the controlled–axis number of the master axis.</td></tr>
<tr><td>7795</td><td>This parameter specifies a retract feedrate.</td></tr>
<tr><td>7796</td><td>This parameter specifies a retract amount.</td></tr>
</table>

Parameters related to electronic gearbox automatic phase alignment

Data No.	Supplementary description
1758	Maximum speed in workpiece–axis acceleration/deceleration
1759	Time constant related to the maximum speed in workpiece–axis acceleration/deceleration
5984	Speed for workpiece–axis automatic phase alignment
5985	Angular deviation from the spindle position (position of the one–revolution signal) used as a reference for workpiece–axis phase alignment
7712 bit0	Specification of whether to perform acceleration/deceleration and automatic phase alignment when there is no R command in the G81/G80 block
7712 bit1	Movement direction for automatic phase alignment

NOTE 1 Specify a list of controlled axes such that the dummy axis is placed subsequent to the slave axis.

Example Incorrect setting

Axis name	Servo axis number (No. 1023)
X	1
Y	2
C(dummy axis)	4
C(slave axis)	3

Correct setting

Axis name	Servo axis number (No. 1023)
X	1
Y	2
C(dummy axis)	3
C(slave axis)	4

NOTE 2 The name of the dummy axis must either be the same as that of the slave axis or a unique name that is not used by any other axes. A name that cannot normally be used as an axis address (such as D) must not be specified as the dummy axis name.

NOTE 3 For the following parameters, specify the same values for both the EGB slave axis and dummy axis:

Parameter No. 1004, bit 0	Increment system (0.01 mm)
Parameter No. 1004, bit 1	Increment system (0.0001 mm)
Parameter No. 1004, bit 2	Least input increment, 10 times
Parameter No. 1006, bit 0	Inch/metric conversion (rotation axis/linear axis)
Parameter No. 1006, bit 1	Machine coordinate system type (rotation axis/linear axis)
Parameter No. 1006, bit 2	Machine coordinate system type for pitch error compensation (rotation axis/linear axis)
Parameter No. 1006, bit 3	Diameter/radius specification
Parameter No. 1420	Rapid traverse rate
Parameter No. 1421	Rapid traverse override F0 feedrate
Parameter No. 1820	Command multiplier

NOTE 4 Specify the following for the dummy axis:

Parameter No. 1816, bits 4, 5, and 6	Detecting multiplier (DMR) Set these bits to 1. (DMR = 4)
Parameter No. 1807, bit 3 and EGB parameter No. 1815, bit 1	Specify whether to use a separate detector. For the dummy axis, the connector of a separate detector is used. Specify 0 for these parameters.
Parameter No. 1890	Specify 0 for this parameter.

NOTE 5 If the following parameters are omitted, an "SV 027 ILL DGTL SERVO PARAMETER" alarm may be issued. If this alarm is issued, specify the parameters as follows:

Parameter Nos. 18XX and 19XX	Set the same value for the slave and dummy axes.
Parameter Nos. 1977 and 1978	Flexible feed gear setting. For the dummy axis, set parameter Nos. 1977 and 1978 to 1.

5984	Speed for workpiece–axis automatic phase alignment in the electronic gearbox automatic phase alignment function

Data type : Two–word

Valid range : 0 to 24000

Unit of data :

Setting unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Rotary axis	100.0	10.0	1.0	0.1	0.01	deg/min

5985	Angle deviation from the spindle position (position of the one–revolution signal) used as a reference for workpiece–axis phase alignment in the electronic gearbox automatic phase alignment function

Data type : Two–word

Valid range : 0 to 360000000

Unit of data : Complies with the setting unit for the work axis.

Setting unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Rotary axis	0.01	0.001	0.0001	0.00001	0.000001	deg

5990	Number of pulses from the position detector per spindle rotation.

Parameter input

Data type : Two words

Valid data range : 1 to 99999999

Specify a value, assuming that four pulses are generated for every A/B phase cycle.

5991	Number of pulses from the position detector per EGB axis rotation.

Parameter input

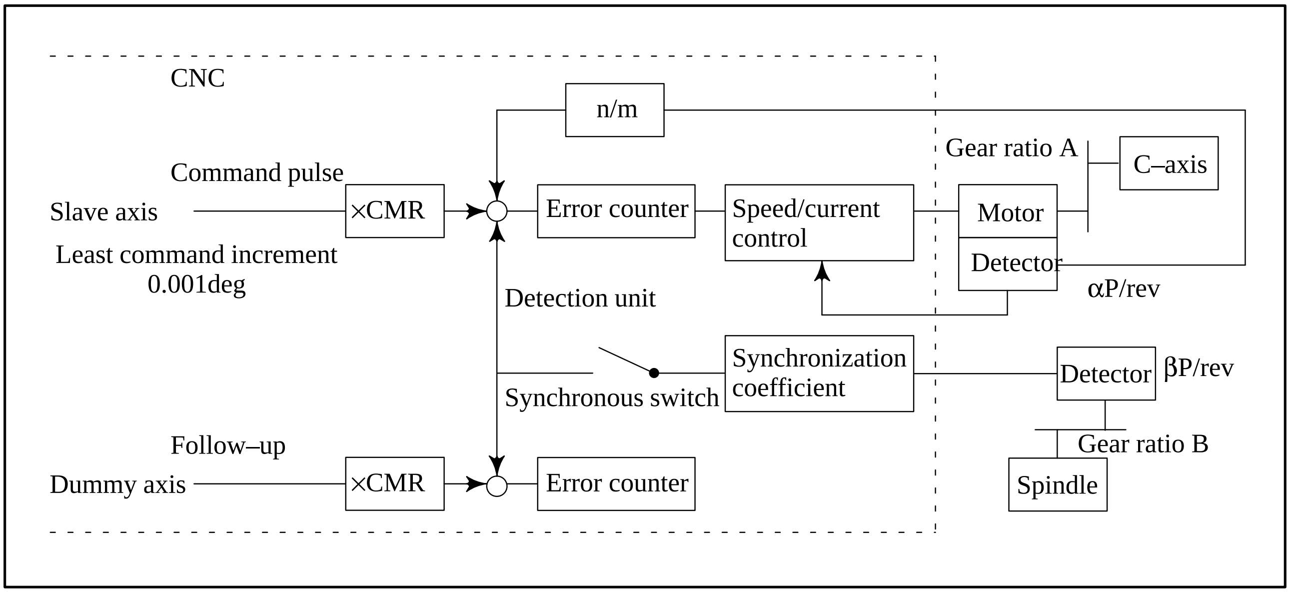
Data type : Two words

Valid data range : 1 to 99999999

Specify the number of pulses output by the detection unit.

Specify parameters 5990 and 5991 when the method of command specification for hobbing machines is used.

Example 1



Spindle and detector gear ratio B : 1/1 (The spindle and detector are connected di rectly.)

Number of pulses from the detector of the spindle : 80000 pulses per revolution (calculated assuming that four pulses are generated in one A/B phase cycle)

C–axis gear ratio A	:	1/36(The C–axis rotates one turn while the motor ro tates 36 turns.)
Number of pulses from the detector of the C–axis	:	1,000,000 pulses per revolution
C–axis CMR	:	1
Flexible feed gear n/m	:	1/100

In this case, the number of pulses per spindle rotation is obtained as follows:

$80000 \times 1/1 = 80000$

So, set parameter No. 5990 to 80000. The number of pulses generated by the detection unit per C–axis rotation is as follows:

$1000000 \div 1/36 \times 1/100 = 360000$

Set parameter No. 5991 to 360000.

Example 2 When the spindle–to–detector gear ratio is 2/3 (the spindle rotates three times for every two turns of the detector) in the above example

The number of pulses per spindle rotation is

$$80000 \times 2/3 = 160000/3 = \frac{160000}{3}$$

The result will be a fraction. In such a case, change the value of parameter No. 5991 while leaving the ratio of parameter Nos. 5990 to 5991 unchanged.

$$\frac{\text{No. 5990}}{\text{No. 5991}} = \frac{160000/3}{360000} = \frac{160000}{360000*3} = \frac{160000}{1080000}$$

Therefore, specify 160000 for parameter No. 5990 and 1080000 for parameter No. 5991.

Only the ratio of parameter Nos. 5990 to 5991 needs to be satisfied. A fraction can be reduced to its lowest terms. In this example, 16 can be specified for parameter No. 5990, and 108 for parameter No. 5991.

5994	Axial–feed axis number in helical compensation.

Parameter input

Data type : Byte

Valid data range : 0, 1, 2, 3, ... the number of axes

CAUTION When no data (= 0) is specified in this parameter, the Z–axis is set as the axial–feed axis.

5995	Axis to be synchronized using the method of command specification for a hobbing machine.

Parameter input

Data type : Byte

Valid data range : 1 to the total number of axes

When there are several groups of axes to be synchronized (for which bit 0 (SYNAXS) of parameter 1955 is set to 1), specify an axis with which to start synchronization using the following command (for a hobbing machine):

G81 T $\underline{t}$ L $\underline{\pm l}$;

t : Speed of the spindle ($1 \leqq t \leqq 1000$)

l : Speed of a synchronized axis ($1 \leqq l \leqq 21$)

Synchronization between the spindle and a specified axis is established with the ratio of ±l rotations about the synchronized axis to one spindle rotation. t and l correspond to the number of teeth and the number of threads on the hobbing machine, respectively.

If the above command is specified without setting this parameter when there are multiple groups of axes to be synchronized, alarm PS585 is issued.

This parameter is ignored when only one group of axes is to be synchronized.

5996	Number of pulses from the position detector per master axis rotation.

Parameter input

Data type : Two–word axis

Valid data range : 1 to 99999999

Specify this parameter with four pulses equaling one A/B phase cycle.

5997	Number of pulses from the position detector per slave axis rotation.

Parameter input

Data type : Two–word axis

Valid data range : 1 to 99999999

Specify the number of pulses output by the detection unit.

Specify values for parameter Nos. 5996 and 5997 in the same manner as for parameter Nos. 5990 and 5991. The setting method is the same as that explained for parameter Nos. 5990 and 5991.

Actual pulse counts are sometimes not specified with the parameters, but the ratio of the actual pulse count for the master axis to the actual pulse count for the slave axis is always maintained. As shown in example 2, if the calculated number of pulses proves to be a fraction, because of the gearing between the master and slave axis, the values to be specified with the parameters can be changed while keeping their ratio as is. In such a case, G81.5 cannot be used in the following specification methods:

G81l.5 T_ C_ ; A speed is specified for the master axis, and a displacement is specified for the slave axis.

G81.5 P_ C0 L_ ; A number of pulses is specified for the master axis, and a speed is specified for the slave axis.

G81.5 X_ C0 L_ ; A displacement is specified for the master axis, and a speed is specified for the slave axis.

5998	Controlled–axis number of the master axis.

Parameter input

Data type : Byte axis

Valid data range : 1 to the total number of controlled axes

Specify the controlled–axis number of the master axis in this parameter, when the master axis is an NC controlled axis and the feedback signal from the pulse coder used for master axis position control is also used as the pu lse signal for slave axis synchronization.

In specifying the start of synchronization, the method of specifying start of synchronization for the master axis based on the amount of movement can be used, only when the master axis is an NC controlled axis and the feedba ck signal from the pulse coder used for master axis position control is also used as the pulse signal for slave axis synchronization. In this case, however, an alarm is issued if an axis not specified in this parameter is s pecified as the master axis.

The method of specification for the master axis based on the amount of movement cannot be used if the feedback signal from a pulse coder other than the one used for master axis position control is used as the pulse signal fo r slave axis synchronization; this restriction applies even when the master axis is an NC controlled axis. In this case, the method of specifying the speed for the master axis or the method of specifying the number of pulse s must be used.

Set 0 in this parameter when the master axis is an axis other than an NC controlled axis such as the spindle.

4.27 Parameters Related to Tool Offsets

	#7	#6	#5	#4	#3	#2	#1	#0
6000	LWM	LD1	LVK	LXY	ND3	PCI	PNH	EVO

Parameter input

Data type : Bit

EVO Specifies the point from which an offset becomes effective after it has been modified.

0 : Effective from the next block that specifies a D or H code (or T code for lathe systems).

1 : Effective from the next buffered block.

PNH Specifies the code used to set the tool offset (G45 to G48) number (only for the Series 15–M).

0 : Use D code.

1 : Use H code.

Normally, set this parameter to 0.

PCI Specifies whether tool offset (G45 to G48) is valid for arc commands (only for the Series 15–M).

0 : Invalid for arc commands.

1 : Valid for arc commands.

Normally, set this parameter to 0.

ND3 Specifies how the tool offset number is set (only for the Series 15–T).

0 : Set with last 3 digits of T code.

1 : Set by parameter LD1.

This parameter is valid only when there are 160 offset settings.

LXY Specifies the axis along which tool length compensation is applied (G43 and G44; only for the Series 15–M).

0 : Always the Z axis.

1 : Axis is selected by the program.

LVK Specifies whether the tool length compensation vector (tool offset for lathe systems) is cleared by a reset.

0 : Cleared by reset.

1 : Not cleared by reset.

LD1 Specifies how the tool offset number is set (only for the Series 15–T and 15–TT).

0 : Set with last 2 digits of T code.

1 : Set with last digit of T code.

LWM Specifies when to apply the tool offset (only for the Series 15–T and 15–TT) when parameter LWT = 0 (parameter No. 6001) or LGT = 1 (parameter No. 6001) (i.e. case when the tool position is compensated by moving the tool).

0 : Applies even in blocks with no movement commands.

1 : Applies only in blocks with movement commands.

	#7	#6	#5	#4	#3	#2	#1	#0
6001	BC	CNI	LGC	LGN	LWT	LGT	CNC	CSU

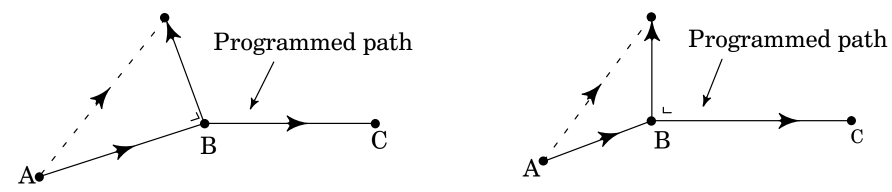
Parameter input

Data type : Bit

CSU Specifies the type of startup used for cutter compensation or tool–tip radius compensation (G41 and G42).

0 : Type A

1 : Type B



CNC Specifies whether to generate an alarm when the programmed direction of movement and offset direction of movement differ by 90x to 270x in interference check in a cutter compensation or tool–tip radius compensation (G41 and G42).

0 : Generate an alarm.

1 : Do not generate an alarm.

LGT Specifies how to perform tool geometry offset (only for the Series 15–T and 15–TT).

0 : Compensate by shifting the workpiece coordinate system.

1 : Compensate by moving the tool.

LWT Specifies how to perform tool wear compensation (only for the Series 15–T and 15–TT).

0 : Compensate by moving the tool.

1 : Compensate by shifting the workpiece coordinate system.

LGN Specifies how parameters relating to tool offset are assigned (only for the Series 15–T and 15–TT).

0 : The last 1, 2, or 3 digits of the T code specify the tool geometry offset and tool wear offset. (In other words, the geometry and wear offsets are assigned by the same setting.)

1 : The last 1, 2, or 3 digits of the T code specify the tool wear offset, and the digits before these digits (tool number) specify the tool geometry offset (i.e. last 4, 3, or 2 digits.)

LGC Specifies action to take when the tool wear and geometry offset numbers are assigned by the same setting (parameter LGN = 0) and the offset number is 0 (only for the Series 15–T and 15–TT).

0 : Cancel tool wear offset, but keep tool geometry offset.

1 : Cancel both tool wear and geometry offsets.

CNI Specifies whether to perform an interference check for cutter compensation C and tool–tip radius compensation.

0 : Perform interference check.

1 : Do not perform interference check.

BC Specifies the axes of rotation for compensating tool length in the direction of the tool axis.

0 : Axes A and C

1 : Axes B and C

NOTE To select axes A and B as the axes of rotation, set parameter TLAX of parameter No. 7550 to 1. When selecting axes A and C or B and C, set TLAX to 0.

	#7	#6	#5	#4	#3	#2	#1	#0
6002	PRC	QNI		ZCO		ORC	OFN	ORG

	#7	#6	#5	#4	#3	#2	#1	#0
6004							FTP	OUF

Parameter input

Data type : Bit

Increment system for OUF, OFN, ORG, and ONM tool offset values (parameter No.6007)

Unit and Valid Range of Tool Offset Values

ONM OUF OFN ORG				Tool Offset value unit		Setting range	
				Metric input	Inch input	Metric input	Inch input
0	0	0	1	0.01	0.001	± 999.99 (±9999.99)	± 99.999 (±999.999)
0	0	0	0	0.001	0.0001	± 999.999 (±9999.999)	± 99.9999 (±999.9999)
0	0	1	0	0.0001	0.00001	± 999.9999 (±9999.9999)	± 99.99999 (±999.99999)
0	1	0	0	0.00001	0.000001	± 99.99999 (±9999.99999)	± 9.999999 (± 999.999999)
1	0	0	0	0.000001	0.0000001	± 9.999999 (± 999.999999)	± 0.9999999 (± 99.9999999)

NOTE Values shown in parentheses are effective when the tool offset expansion option is used. When this option is used, the number of available tool offset settings becomes half the usual number.

ORC Specifies whether to set the tool offset value by diameter or radius (only for the Series 15–T and 15–TT).

0 : Set by diameter.

(Effective only for axes for which diameter programming is used. For axes for which radius programming is used, the tool offset value is set by radius regardless of the setting of this parameter.)

1 : Set by radius.

ZCO Specifies whether to cancel tool offset compensation during reference position return (only for the Se ries 15–T).

0 : Do not cancel tool offset compensation.

1 : Cancel tool offset compensation.

QNI Specifies the method used to set the tool offset number when measured tool offset input function B (only for the Series 15–T and 15–TT) or tool length measurement function B (only for the Series 15–M) is used.

0 : Select tool offset No. with cursor on MDI/CRT unit.

1 : Tool offset number is set by a signal from the machine.

PRC Specifies whether to use position record signal PRC when the tool offset is input directly (only for the Series 15–T and 15–TT).

0 : Do not use position record signal PRC.

Offset is modified by the difference between the absolute coordinates when the measured value is input and the measured value itself.

1 : Use position record signal PRC.

Offset is modified by the difference between the absolute coordinates when position record signal PRC went on and the measured value itself.

FTP Specifies the type of fixture offset.

0 : Move type (A movement is made when the fixture offset is changed.)

1 : Shift type (No movement is made when the fixture offset is changed.)

	#7	#6	#5	#4	#3	#2	#1	#0
6003	SUC	WEW	WMC	WMH	WMA	TMA	TC3	TC2

Parameter input

Data type : Bit

Bits 0 to 5 are only valid when tool length/workpiece origin measurement function B is available.

TC3	TC2	Meaning
0	0	Tool change position is the 1st reference point
0	1	Tool change position is the 2nd reference point
1	0	Tool change position is the 3rd reference point

TMA Specifies the axis for which tool length is measured.

0 : Measure tool length along the Z–axis.

1 : Tool length can be measured for any axis.

WMA Specifies the axis or axes along which the workpiece origin offset (only for the Series 15–M) is measured.

0 : Measure only along the Z–axis.

1 : Can be measured for any axis.

WMH Specifies how to measure the workpiece origin offset (only for the Series 15–M).

0 : Measure using only end surfaces.

1 : Measure using end surfaces and hole center.

WMC Specifies how to select the axis along which the work origin offset (only for the Series 15–M) is measured.

0 : Input the axis name.

1 : Use the cursor to select the axis.

WEW Specifies the write–protection state when the wear offset (only for the Series 15–T) is specified.

0 : Wear offset cannot be written unless write–enable switch is on.

1 : Wear offset can be written even if write–enable switch is off. (Only the geometry offset cannot be set when the write–enable switch is off.)

SUC Specifies the type of operation to be performed at the start–up and cancellation of the tool side compensation (three–dimensional cutter compensation).

0 : Type A or B (which type is used is determined by the CSU bit of parameter 6001)

1 : Type C

	#7	#6	#5	#4	#3	#2	#1	#0
6005							ALOC	HQST

Setting input

Data type : Bit

HQST Specifies whether to use the high–speed skip signal for the tool offset direct input B function (15–T/15–TT).

0 : Do not use the signal.

1 : Use the signal.

NOTE See parameter Nos. 7200 and 7204 for the high–speed skip signal.

ALOC Specifies whether to issue an alarm when cutter compensation is specified in the MDI mode.

0 : Do not issue an alarm.

1 : Issue an alarm (PS010).

CAUTION A command for cutter compensation is ignored in the MDI mode, regardless of whether this parameter is set or not.

	#7	#6	#5	#4	#3	#2	#1	#0
6006							NMFOFS	FTLO

Parameter input

Data type : Bit

FTLO Specifies the number of tool offset groups to be assigned to each tool post when the total number of tool offset groups is 160 (only with the Series 15–TTB).

0 : The number of tool offset groups is fixed for each tool post.

1 : The number of tool offset groups depends on the setting of parameter No. 6121.

NMFOFS For the rotary table dynamic fixture offset function, this parameter specifies whether to perform buffering for the subsequent blocks when there are a G54.2 and a rotary axis command related to a fixture offset in G54.2 mode.

0 : Not performed.

1 : Performed.

CAUTION 1 After changing this parameter, turn the power off then back on.

CAUTION 2 When this parameter is set to 1, if you change a parameter (data Nos. 6068 to 6076) or a reference fixture offset amount in G54.2 mode, the change becomes valid for all blocks that are newly buffered.

	#7	#6	#5	#4	#3	#2	#1	#0
6007					USON	NR3	OWD	ONM

Parameter input

Data type : Bit

Unit of the ONM offset (For details, see the explanation of parameter No. 6002.)

OWD Specifies whether to use a radius value or diameter value for geometric compensation and wear compensation when bit 2 (ORC) of parameter No. 6002 is set to 1.

0 : Use a radius value for both geometric compensation and wear compensation.

1 : For a diameter–specification axis, use a radius value for geometric compensation, and use a diameter value for wear compensation.

This parameter is valid only when bit 2 (ORC) of parameter No. 6002 is set to 1.

NR3 Specifies operation in three–dimensional tool offset vector generation when the programmable mirror image function is used.

0 : Operation according to bit 0 of parameter No. 7610.

1 : Only invert the mirror axis components of the offset vector.

Even when this parameter is set to 0, bit 0 of parameter No. 7610 set to 1 has the effect of this parameter (NR3) set to 1.

Note, however, that bit 0 of parameter No. 7610 also applies to two–dimensional cutter compensation. So, use this parameter to affect three–dimensional tool offset only.

7610#0 / 6007#2	0	1
0	The mirror axis components of an offset vector are inverted, and G41/G42 is also inverted(Note1).	The mirror axis components of an offset vector are inverted.
1	The mirror axis components of a three–dimensional tool offset vector are inverted. (Bit 0 of parameter No. 7610 specifies the operation of two–dimensional cutter compensation.)	

CAUTION G41/G42 is not inverted if two or more programmable mirror axes are specified.

Mirror axis components are the axis components, among vector components, to which the programmable mirror function is applicable.

USON Specifies the method of using signals with the tool offset direct input B function.

0 : Use four signals in the conventional manner.

1 : Use only one signal.

6010	Limit for ignoring the small movement resulting from cutter and tool–tip radius compensation

Setting input

Data type : Two words

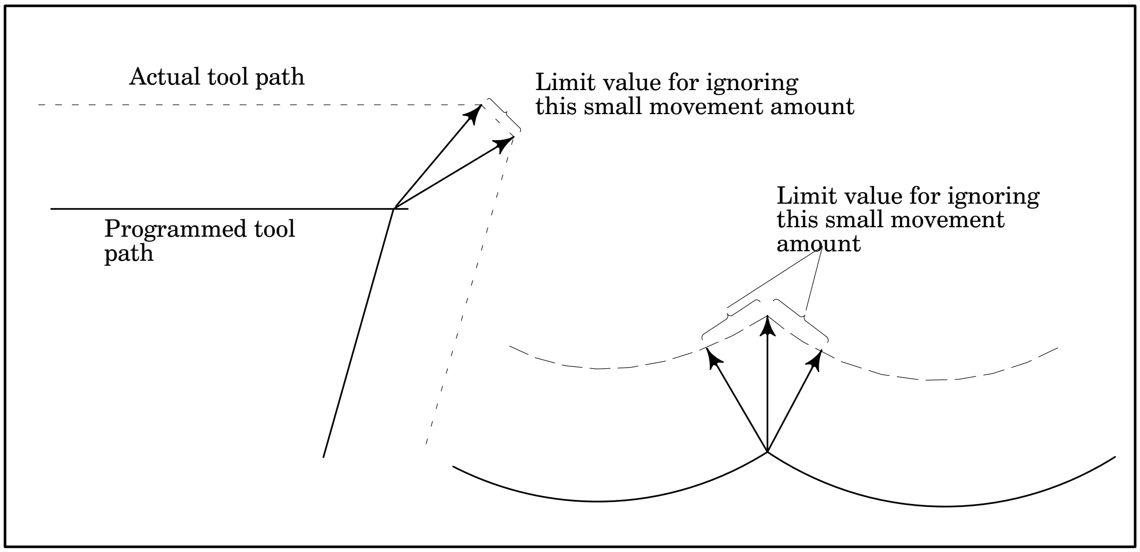
Unit of data :

Setting unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to 99999999

Set the limit for disregarding the small movement resulting from cutter and tool–tip radius compensation when the tool moves around a corner.

This limit eliminates any change in feedrate due to interruption of buffering at the corner.



6011	Constant denominator for 3–dimensional tool compension

Setting input (only for the Series 15–M)

Data type : Two words

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

The following expressions are used to calculate the 3–dimensional tool compensation vector:

$Vx = i \times r/p$

$Vy = j \times r/p$

$Vz = k \times r/p$

Vx, Vy, and Vz are vector components of the X, Y, and Z or parallel axes, the letters i, j, and k are the values specified by I, J, and K in the program, the letter r is the tool offset, and the letter p is the value set in this parameter (except when set to 0).

When this parameter is set to 0, the value p in the above expression is set according to the following expression.

$p = SQRT (i \times i + j \times j + k \times k)$

6013	Maximum tool wear offset

Parameter input (only for the 15–T and 15–TT)

Data type : Two words

Unit of data : (as set by OFN and ORG of parameter No. 6002)

Valid range :

Data range	OFN	ORG
0 to 999999	0	0
0 to 99999	0	1
0 to 9999999	1	0

Set the maximum tool wear offset. When an attempt is made to set a tool wear offset whose absolute value exceeds the maximum offset set in this parameter, an alarm is generated. When a tool offset is set (entered from the MDI, set using a G10 command, input using external data, set with a custom macro variable, etc.), a check is made to make sure that the value set does not exceed the maximum tool wear offset specified in this parameter.

When this parameter is set to 0, this check is not performed.

When the tool offset is specified by radius (ORC, a bit of parameter No. 6002, is set to 1), this parameter is also set by radius.

6014	Maximum tool wear offset in incremental input

Parameter input (only for the Series 15–T and 15–TT)

Data type : Two words

Unit of data : (as set by OFN and ORG of parameter No. 6002)

Valid range :

Data range	OFN	ORG
0 to 999999	0	0
0 to 99999	0	1
0 to 9999999	1	0

Set the maximum tool wear offset used in incremental input. When an attempt is made to use an input whose absolute value exceeds the maximum offset set in this parameter, an alarm is generated.

When an incremental input is entered to change the tool wear offset (entered from the MDI, entered using a G10 command, input using external data, entered with a custom macro variable, etc.), a check is made to make sure that the value set does not exceed the maximum tool wear offset specified in this parameter.

When this parameter is set to 0, this check is not performed.

When the tool offset is specified by radius (ORC, a bit of parameter No. 6002, is set to 1), this parameter is also set by radius.

6015	Distance from the reference position to the farthest face of a sensor along the X–axis (Xp)

6016	Distance from the reference position to the nearest face of a sensor along the X–axis (Xm)

6017	Distance from the reference position to the farthest face of a sensor along the Z–axis (Zp)

6018	Distance from the reference position to the farthest face of a sensor along the Z–axis (Zm)

Parameter input (only for the Series 15–T)

Data type : Two words

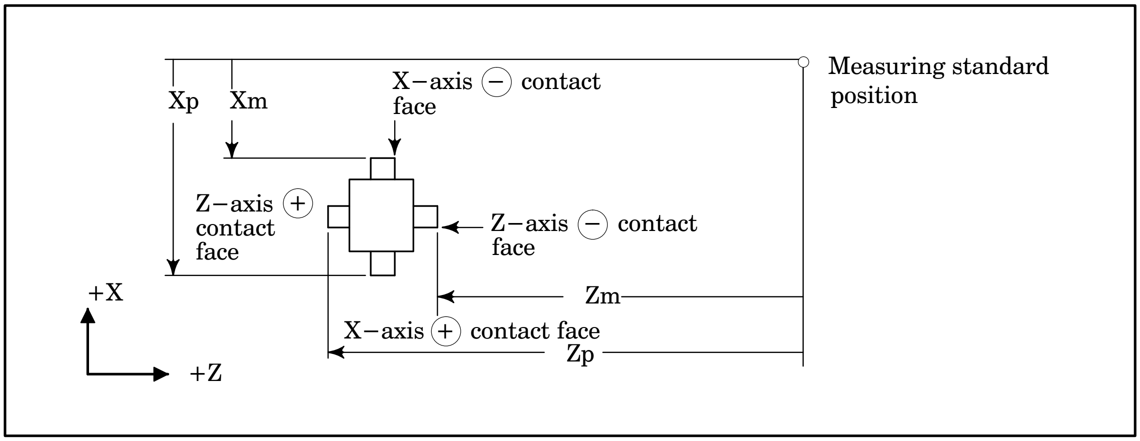
Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

This parameter is used by function B for direct input of the tool compensation.

Set the distances (including sign) from the reference measurement position to each of the contact surfaces of a sensor.

Set diameter values for axes for which diameter programming is used.



6020	Bias set for the offset number for each axis

Setting input

Data type : Word axis

For the tool offset number of each axis, set the bias used during parallel operation.

The value set in this parameter is added to the specified offset number. The result indicates the number of an offset register in which offset used as the tool offset for the axis is stored.

6021	Bias set for the tool length offset number for each axis

Setting input

Data type : Word axis

For the tool length offset number of each axis, set the bias used during parallel operation.

The value set in this parameter is added to the specified offset number. The result indicates the number of an offset register in which offset used as the tool length offset is stored.

6022	Distance to the farthest contact surface

6023	Distance to the nearest contact surface

Parameter input (only for the Series 15–TT)

Data type : Two–word axis

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

This parameter is used by function B for direct input of the tool compensation value.

Set the distances (including sign) from the reference measurement position to each of the contact surfaces.

Set diameter values for axes along which diameter programming is used.

6024	Distance from the reference tool tip position to the reference measurement surface

Parameter input

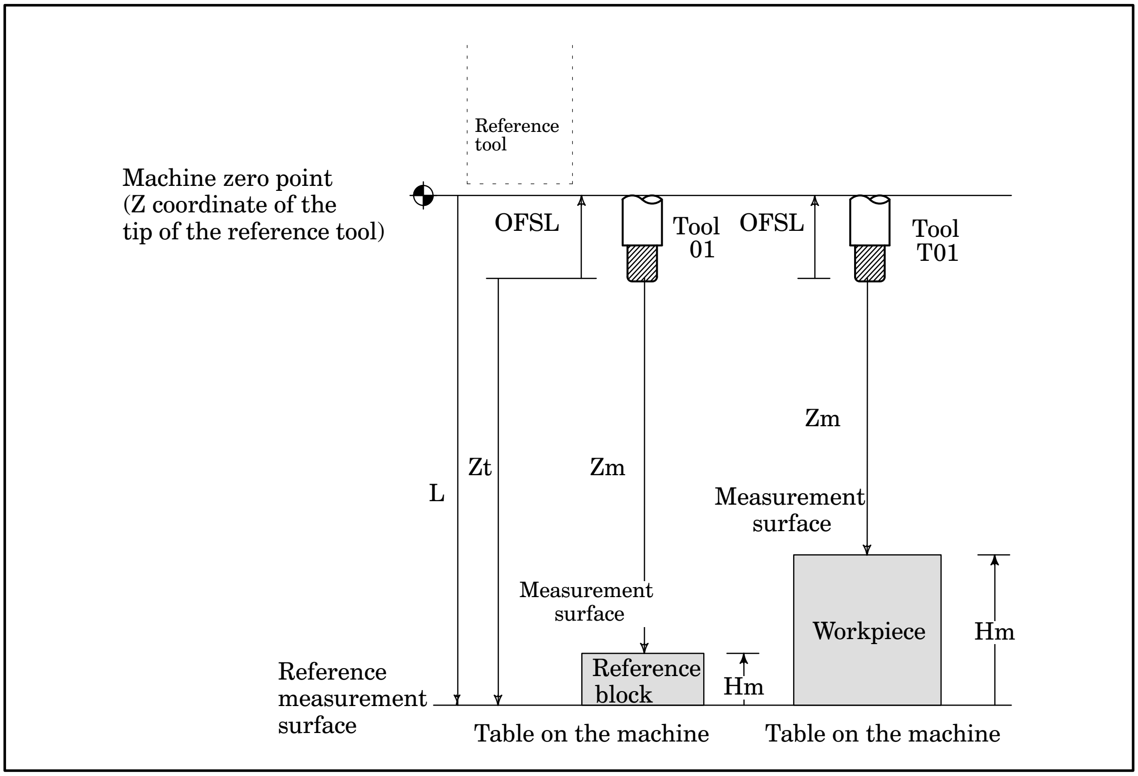
Data type : Two–word axis

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–D	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

This parameter is used by function B for measuring tool length/workpiece origin.

For each axis, set the distance from the reference tool tip to the reference measurement surface (L in the figure below) when the machine is at the machine origin.



L : Distance from the reference tool tip to the reference measurement surface when the machine is at the machine origin (machine coordinate of the reference measurement surface)

Hm : Distance from the reference measurement surface to the actual measurement surface

Zm : Distance from the measurement origin to the measurement surface (machine coordinate of the measurement surface)

(Zt : Distance from the measurement origin to the reference measurement surface (machine coordi nate of the reference measurement surface))

OFSL : Tool length offset (OFSL = Zm – Hm – L)

6027	Amount of retraction after making contact with a measurement surface

Parameter input

Data type : Two words

Unit of data : 0 to 99999999

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Millimeter machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

This parameter is related to tool offset value direct input B function.

NOTE When this parameter is set to 0, 100 is assumed.

6068	Rotation axis processed with fixture offset (first group)

6069	First linear axis constituting the fixture offset plane (first group)

6070	Second linear axis constituting the fixture offset plane (first group)

6071	Rotation axis processed with fixture offset (second group)

6072	First linear axis constituting the fixture offset plane (second group)

6073	Second linear axis constituting the fixture offset plane (second group)

6074	Rotation axis processed with fixture offset (third group)

6075	First linear axis constituting the fixture offset plane (third group)

6076	Second linear axis constituting the fixture offset plane (third group)

Parameter input

Data type : Byte

Valid data range : 1, 2, 3, ... the number of controlled axes

Specify a rotation axis and two linear axes constituting the plane of rotation for fixture offset. The order in which the linear axes are specified must be such that the rotation in the normal direction about the rotation a xis agrees with the rotation from the positive side of the first linear axis to the positive side of the second linear axis.

Up to three groups of a rotation axis and two linear axes can be specified. In calculation of the fixture offset, the data of the rotation axis of the first group is calculated first. Then, the data of the rotation axes of the second and third groups are calculated. If the second or third group is not required, specify 0 in the corresponding rotation axis parameter.

6121	Number of tool offset groups for tool post 1

Parameter input (only with the Series 15–TTB)

Data type : Word

Valid range : 1 to 159

Specify the number of tool offset groups for tool post 1. The number of remaining groups (160 – the number of tool offset groups for tool post 1) is used as the number of tool offset groups for tool post 2.

Example When 120 is specified in parameter No. 6121, the numbers of tool offset groups for tool post 1 and tool post 2 are as follows:

Tool post 1 : 120 groups

Tool post 2 : 40 groups

NOTE	This parameter is valid only when bit 0 (FTLO) of parameter No. 6006 is set to 1.

4.28 Three–Dimensional Cutter Compensation (Supplement)

Parameters related to three–dimensional cutter compensation

<table>
<tr><th>Parameter No.</th><th colspan="2">Description</th></tr>
<tr><td>6080</td><td>Rotation axis for three–dimensional cutter compensation (1st group)</td><td rowspan="10">These parameters set the relationship between the rotation and tool axes.</td></tr>
<tr><td>6081</td><td>Linear axis 1 for three–dimensional cutter compensation (1st group)</td></tr>
<tr><td>6082</td><td>Linear axis 2 for three–dimensional cutter compensation (1st group)</td></tr>
<tr><td>6083</td><td>Linear axis 3 for three–dimensional cutter compensation (1st group)</td></tr>
<tr><td>6084</td><td>Inclined angle of the rotation axis for three–dimensional cutter compensation (1st group)</td></tr>
<tr><td>6085</td><td>Rotation axis for three–dimensional cutter compensation (2nd group)</td></tr>
<tr><td>6086</td><td>Linear axis 1 for three–dimensional cutter compensation (2nd group)</td></tr>
<tr><td>6087</td><td>Linear axis 2 for three–dimensional cutter compensation (2nd group)</td></tr>
<tr><td>6088</td><td>Linear axis 3 for three–dimensional cutter compensation (2nd group)</td></tr>
<tr><td>6089</td><td>Inclined angle of the rotation axis for three–dimensional cutter compensation (2nd group)</td></tr>
<tr><td>6090</td><td colspan="2">Angle increment system</td></tr>
<tr><td>6104</td><td>Reference angle for the rotation axis (1st group)</td><td rowspan="2">Sets the angle of the rotation axis at the reference position.</td></tr>
<tr><td>6105</td><td>Reference angle for the rotation axis (2nd group)</td></tr>
<tr><td>6106</td><td>Reference angle for the tool axis (plane formed by linear axes 2 and 3)</td><td rowspan="2">Sets the angle of the tool axis at the reference position.</td></tr>
<tr><td>6107</td><td>Reference angle for the tool axis (plane formed by linear axes 3 and 1)</td></tr>
<tr><td>6114</td><td colspan="2">Limit value for regarding a block as involving no movement during tool side compensation</td></tr>
<tr><td>6115</td><td colspan="2">Variation range for determining the included angle between the tool vector and movement vector during leading edge compensation</td></tr>
<tr><td>6003#7</td><td colspan="2">Start–up/cancellation type setting 2 for tool side compensation</td></tr>
<tr><td>0010#7</td><td colspan="2">Specifies whether to perform a single block stop at a block created internally by the NC.</td></tr>
<tr><td>2202#3</td><td colspan="2">Specifies whether to exclude the amount of movement by cutter compensation from the position display.</td></tr>
<tr><td>6000#0</td><td colspan="2">Specifies a block from which a new offset value is to become valid.</td></tr>
<tr><td>6001#0</td><td colspan="2">Start–up/cancellation type setting 1 for tool side compensation</td></tr>
<tr><td>6001#1</td><td colspan="2">Specifies whether to issue an interference alarm if the movement direction changes by 90 to 270 before and after compensation.</td></tr>
<tr><td>6001#6</td><td colspan="2">Specifies whether to perform an interference check.</td></tr>
<tr><td>6010</td><td colspan="2">Limit value for ignoring a small movement generated by tool side compensation.</td></tr>
</table>

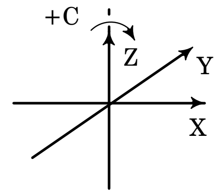
The relationship between the rotation axis and rotation plane (parameters 6080 to 6089)

These parameters set the relationship between the rotation axis and rotation plane. In general, the direction vector of the rotation axis has three direction components. With this function, calculation can be performed for the rotation axis having two arbitrary direction vectors.

1 When there is one direction component: Type 1 (The rotation axis rotates about one of the basic three axes.)

Set the following:

	(Example)
Axis number of the rotation axis	= 5 (C–axis)
Axis number of liner axis 1	= 1 (X–axis)
Axis number of liner axis 2	= 2 (Y–axis)



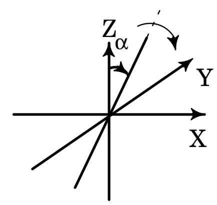
– The rotation axis is defined as follows:

The rotation axis rotates about an axis that perpendicularly intersects the plane formed by linear axes 1 and 2.

When the rotation axis rotates from the positive direction of linear axis 1 to the positive direction of linear axis 2, the rotation axis is said to rotate in the positive direction.

2 When there are two direction components: Type 2 (The rotation axis rotates about an axis that lies in a plane formed by any two of the basic three axes.)

	(Example)
Axis number of the rotation axis	= 4 (B–axis)
Axis number of liner axis 1	= 1 (X–axis)
Axis number of liner axis 2	= 2 (Y–axis)
Axis number of liner axis 3	= 3 (Z–axis)
Angle of inclination	= α



– The linear axes 1, 2, and 3 form a right–handed coordinate system.

– The angle of inclination is defined as follows:

Rotation is performed in the plane formed by linear axes 3 and 1.
When the rotation axis rotates from the positive direction of linear axis 3 to the positive direction of linear axis 1, the angle of inclination is positive.
When the rotation axis and linear axis 3 match, the angle of inclination is 0 .

– When the angle of inclination is 0 , the rotation axis is defined as follows:

The rotation axis rotates about an axis that perpendicularly intersects the plane formed by linear axes 1 and 2.
When the rotation axis rotates from the positive direction of linear axis 1 to the positive direction of linear axis 2, the rotation axis is said to rotate in the positive direction.

– When linear axis 3 is set to 0, type 1 is assumed.

Up to two groups of parameters can be set. In calculating the compensation amount, the rotation axis of the fi rst group is calculated first, then using this result, the rotation axis of the second group is calculated. When two rotation axes are used, the rotation plane may be changed by the rotation of another rotation axis; in thi s case, set the rotation plane obtained when the rotation axis position is 0 . When there is one rotation axis, set the rotation axis for the second group to 0.

6080	Rotation axis for three–dimensional cutter compensation (1st group)

6081	Linear axis 1 for three–dimensional cutter compensation (1st group)

6082	Linear axis 2 for three–dimensional cutter compensation (1st group)

6083	Linear axis 3 for three–dimensional cutter compensation (1st group)

6085	Rotation axis for three–dimensional cutter compensation (2nd group)

6086	Linear axis 1 for three–dimensional cutter compensation (2nd group)

6087	Linear axis 2 for three–dimensional cutter compensation (2nd group)

6088	Linear axis 3 for three–dimensional cutter compensation (2nd group)

Parameter input

Data type : Byte

Valid data range : 1, 2, 3, ..., the number of controlled axes, 0

Specify rotation axes and linear axes to perform three–dimensional cutter compensation.

6084	Angle of inclination for the rotation axis for three–dimensional cutter compensation (1st group)

6089	Angle of inclination for the rotation axis for three–dimensional cutter compensation (2nd group)

Parameter input

Data type : Two words

Unit of data : See the explanation of parameter 6090. Valid data range: –999999999 to 999999999

Specify the angle of inclination for each rotation axis to perform three–dimensional cutter compensation.

6090	Increment system of angles for three–dimensional cutter compensation

Parameter input

Data type : Byte

Valid data range : 0, 1, 2

Specify an angle increment system to perform three–dimensional cutter compensation. This parameter is valid for parameters 6084, 6089, 6106, and 6107.

Setting	Meaning	Least input increment
0	IS–B	0.001°
1	IS–A	0.01°
2	IS–C	0.0001°
3	IS–D	0.00001°
4	IS–E	0.000001°

6104	Reference angle for the rotation axis for three–dimensional cutter compensation (1st group)

6105	Reference angle for the rotation axis for three–dimensional cutter compensation (2nd group)

Parameter input

Data type : Two words

Unit of data :

Increment system	IS–A	IS–B	IS–C	Unit
	0.01	0.001	0.0001	deg

Valid data range : –999999999 to 999999999

Specify the reference angle for each rotation axis to perform three–dimensional cutter compensation.

6106	Reference angle for the tool axis in the plane formed by linear axes 2 and 3 (RA)

6107	Reference angle for the tool axis in the plane formed by linear axes 3 and 1 (RB)

Parameter input

Data type : Two words

Unit of data : See the explanation of parameter 6090.

Valid data range : –999999999 to 999999999

Specify the direction of each rotation axis to perform three–dimensional cutter compensation using angles RA and RB.

6114	Limit value used during intersection calculation in tool side compensation (G41.2, G42.2) to regard a block as involving no movement

Parameter input

Data type : Two words

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric input	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch input	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid data range : 0 to 99999999

When an intersection is calculated during tool side compensation, a block is regarded as involving no movement if the difference in coordinates between two points in the compensation plane is smaller than the parameter value . If the block is regarded as involving no movement, the next block is read to calculate an intersection vector. In the G41.2 or G42.2 mode, a block that moves the tool in the tool direction currently specified must be reg arded as a block involving no movement. In some cases, however, this requirement may not be satisfied because of calculation errors. To prevent this, usually set parameter 6114 to 10.

6115	Variation range used for determining the included angle between the tool vector (VT) and movement vector (VM) (0° , 180° , or 90°)

Parameter input

Data type : Word

Unit of data : 0.001 degree

Valid data range : 0 to 32767

Set a variation range used to determine whether the included angle (θ) between the tool vector (VT) and movement vector (VM) is 0° , 180° , or 90° during leading edge compensation. For example, let the included angle between VT and VM be $\theta (0 \leqq \theta \leqq 180)$, and the angle set in this parameter be $\Delta\theta$. Then, θ is determined as follows:

$0 \leqq \theta \leqq \Delta\theta$: $\theta = 0°$
$(180 - \Delta\theta) \leqq \theta \leqq < 180$: $\theta = 180°$
$(90 - \Delta\theta) \leqq \theta \leqq (90 + \Delta\theta)$: $\theta = 90°$

4.29 Parameters Related to Cylindrical Interpolation Cutting Point Compensation

	#7	#6	#5	#4	#3	#2	#1	#0
6004		CSDC	CYLA					

Parameter input

Data type : Bit

CYLA Specifies whether to use cylindrical interpolation or cylindrical interpolation cutting point compensa tion.

0 : Use cylindrical interpolation cutting point compensation.

1 : Use cylindrical interpolation.

CSDC When the cylindrical interpolation cutting point compensation function is used,

0 : Cylindrical interpolation cutting point compensation is performed between blocks.

1 : Cylindrical interpolation cutting point compensation is performed along with block movement when the amount of cylindrical interpolation cutting point compensation is smaller than the value set in parameter No. 6112.

6109	Tool offset axis number for the XY plane

6110	Tool offset axis number for the ZX plane

6111	Tool offset axis number for the YZ plane

Parameter input

Data type : Byte

Valid range : 1 to number of controlled axes

Specify a tool offset axis perpendicular to a cylindrical rotation axis.

6112	Limit for changing cylindrical interpolation cutting point compensation in a single block

Parameter input

Data type : Two words

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric input	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch input	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 1 to 99999999

The following operation is performed, depending the setting of parameter No. 6004:

1) When CSDC = 0

If the amount of cylindrical interpolation cutting point compensation is smaller than the value set in this parameter, cylindrical interpolation cutting point compensation is not performed. Instead, this amount of cylindrical interpolation cutting point compensation (called the ignored amount) is added to the next amount of cylindrical interpolation cutting point compensation to determine whether to perform cylindrical interpolation cutting point compensation.

2) When CSDC = 1

Cylindrical interpolation cutting point compensation is always performed irrespective of the difference between the amount of cylindrical interpolation cutting point compensation and the value set in this parameter.

CAUTION Set this parameter as follows:
Setting > (setting for a rotation axis in parameter No. 1422)*4/3
where 4/3 is a constant for internal processing.

6113	Amount of retraction after making contact with a measurement surface

Parameter input

Data type : Two words

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric input	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch input	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 1 to 99999999

The following operation is performed, depending on the type of interpolation:

1) For linear interpolation

If the travel distance in a specified block is smaller than the value set in this parameter, machining is performed without changing the cylindrical interpolation cutting point compensation performed in the previous block.

2) For circular interpolation

If the diameter of a specified arc is smaller than the value set in this parameter, machining is performed without changing the cylindrical interpolation cutting point compensation performed in the previous block.

4.30 Parameters Related to Canned Cycles

	#7	#6	#5	#4	#3	#2	#1	#0
6200			EXC	UIL	FCU	SIJ	DWL	FXY

Parameter input

Data type : Bit

FXY Specifies the drilling axis used during canned cycles.

0 : Always use the Z axis.

1 : Use axis selected by the program.

DWL Specifies whether the P dwell command is valid during tapping canned cycles.

0 : Invalid

1 : Valid

SIJ Specifies how to set the tool retraction direction and distance after spindle orientation in a fine boring or back boring canned cycle.

0 : Set the tool retraction direction by parameter (parameter No. 6240) and set the distance in the program (Q).

1 : Set the tool retraction direction and distance in the program (I, J, K).

FCU Specifies how to move the machine to the drilling position during canned cycles.

0 : Always use rapid traverse.

1 : Use rapid traverse when in positioning mode (G00) and use linear interpolation in other modes (G01, G02, G03).

UIL Specifies whether to change the initial level position when the origin is set through the MDI during a canned cycle.

0 : Do not change.

1 : Change. The position set through the MDI becomes the initial level position.

EXC Specifies whether G81 is used to specify a canned cycle or external operation command (only for the Series 15–M).

0 : G81 specifies a canned cycle.

1 : G81 specifies an external operation command.

	#7	#6	#5	#4	#3	#2	#1	#0
6201	RFDE	NFM	FM2	FIN	RFDA		NM5	FXB

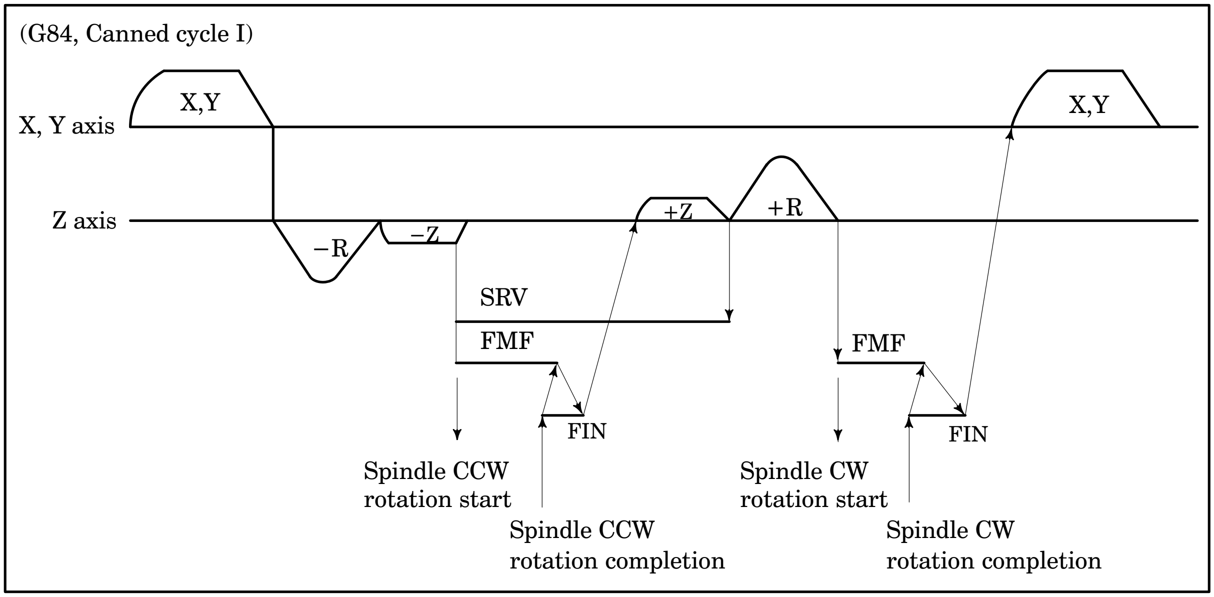
Parameter input

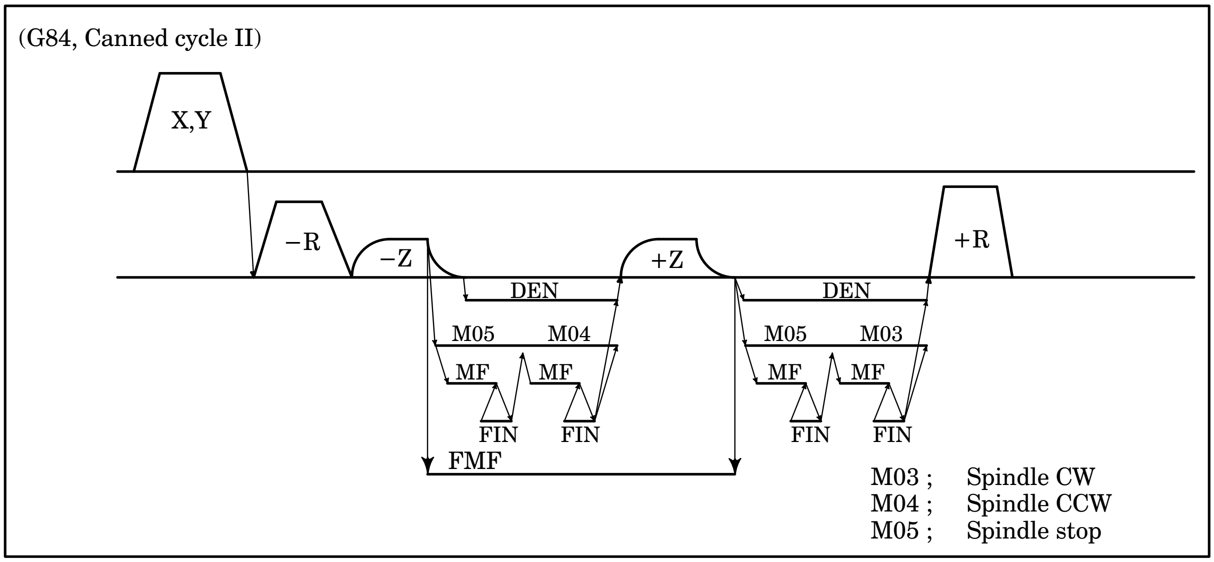
Data type : Bit

FXB Specifies how to perform spindle control during canned cycles.

0 : Perform spindle control using the spindle stop command signal (SSP) and the spindle CCW rota tion command signal (SSV) (canned cycle I).

1 : Perform spindle control using M codes (M03, M04, M05) (canned cycle II).





NM5 Specifies whether to output M05 when the direction of rotation of the spindle is changed from forward (M03) to backward (M04) or vice–versa.

0 : Output M05 (i.e. output M05 before outputting M03 or M04).

1 : Do not output M05 (i.e. do not output M05 before outputting M03 or M04).

This parameter is valid when parameter FXB = 1.

RFDA Specifies whether to generate an alarm when a fractional value (e.g. digits after the decimal point) is included in the specification of an F command for rigid tapping.

0 : Do not generate an alarm.

1 : Generate an alarm.

NOTE	When RFDA = 1, a setting of F10. will not generate an alarm, but a setting of F10.0 will generate alarm PS 007.

FIN Specifies the signal to input to indicate when operation for the spindle stop command signal (SSP) or spindle CCW rotation command signal (SRV) has been completed.

0 : FFIN signal (exclusive completion signal for the SSP and SRV signals)

1 : FIN signal (completion signal for M, S, T, and B codes)

This parameter is valid when FXB = 0.

FM2 Specifies whether to send the FMF signal after reference or initial position return when the spindle stop command signal (SSP) or spindle CCW rotation command signal (SRV) is output.

0 : Do not send the FMF signal (command for reading SSP and SRV signals).

1 : Send the FMF signal.

This parameter is valid when NFM = 0.

NFM Specifies whether to send the FMF signal when the spindle stop command signal (SSP) or spindle CCW rotation command signal (SRV) is output.

0 : Send the FMF signal (command for reading SSP and SRV signals).

1 : Do not send the FMF signal.

RFDE Specifies how to treat digits after the decimal point specified in an F command for rigid tapping.

0 : Truncate any digits specified after the decimal point.

1 : Digits specified after the decimal point are valid.

NOTE This parameter is valid only when RFDA is 0.

	#7	#6	#5	#4	#3	#2	#1	#0
6202		CDI	CDO	NRC				MOR

Parameter input (only for the Series 15–T and 15–TT)

Data type : Bit

MOR Specifies whether to perform turning cycles in blocks with no movement commands when in single turning cycle mode.

0 : Do not perform turning cycles.

1 : Perform turning cycles.

NRC Specifies whether to perform finishing after each roughing cycle (G71, G72)

0 : Perform finishing.

1 : Do not perform finishing.

CDO Specifies whether override can be applied to the depth of cut during a roughing cycle (G71, G72).

0 : Override cannot be applied.

1 : Override can be applied.

When CDO is set to 1, override is applied by using a value specified in parameter No. 6214 or a signal from the machine.

CDI Specifies how to specify override for the depth of cut during a roughing cycle (G71, G72).

0 : Specify in parameter No. 6214.

1 : Specified by a signal from the machine side.

This parameter is valid when CDO = 1.

6210	Return distance in canned cycle G73 (G83.1 for lathe systems)

Setting input

Data type : Two words

Unit of data :

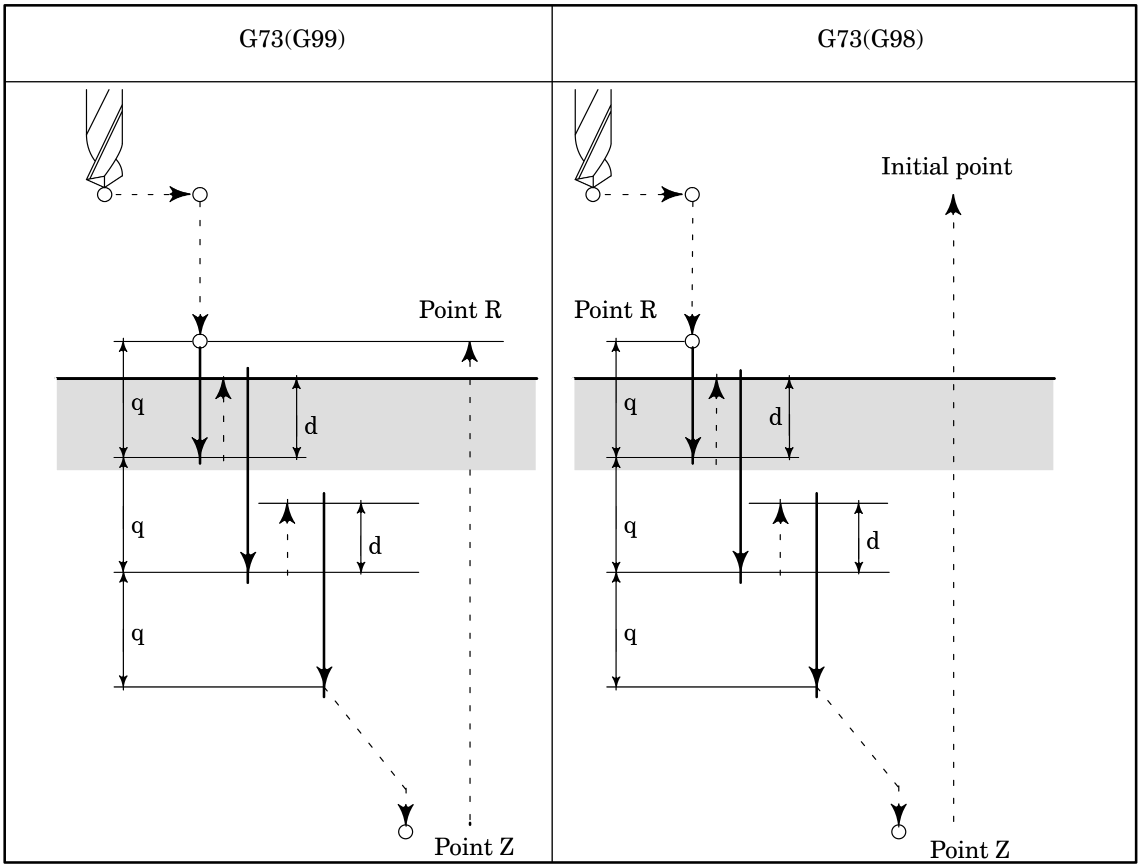
Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric input	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch input	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to 99999999

Set the return distance used in canned cycle G73 (G83.1 for lathe systems).

G73 (High speed peck drilling cycle)

d: Return amount



6211	Clearance in canned cycle G83

Setting input

Data type : Two words

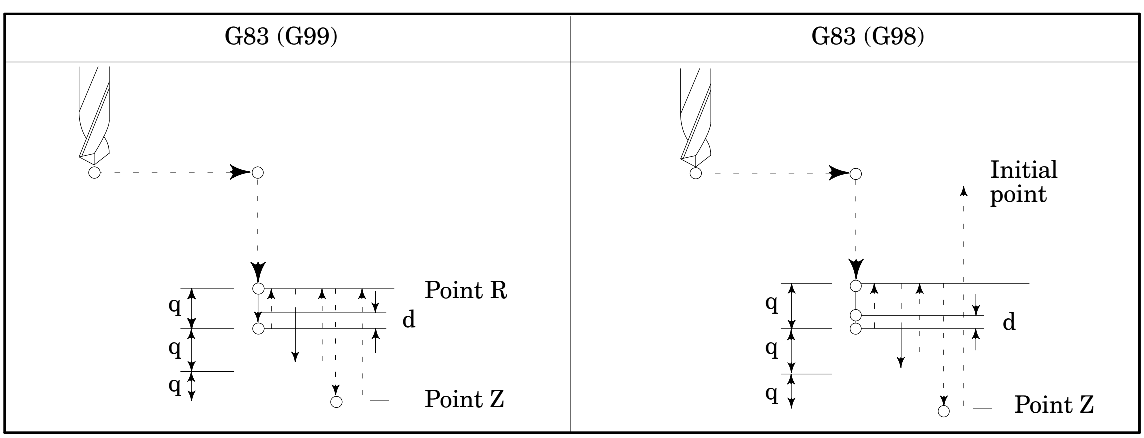
Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric input	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch input	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to 99999999

Set the clearance used in canned cycle G83.

d: Clearance amount



6212	Chamfering amount in threading cycle

Setting input (only for the Series 15–T and 15–TT)

Data type : Byte

Unit of data : 0.1 pitch

Valid range : 0 to 127

Set the chamfering amount used in threading cycles G76 and G78 (G76 and G92 in G code system A).

Chamfering starts from a set distance (specified by the chamfering amount) before the end point specified for threading.

6213	Chamfering angle in threading cycle

Setting input (only for the Series 15–T and 15–TT)

Data type : Byte

Unit of data : deg

Valid range : 0 to 60

Set the angle to use for chamfering in threading cycles G76 and G78 (G76 and G92 in G code system A).

6214	Override for the depth of cut in roughing cycle(G71, G72)

Setting input (only for the Series 15–T and 15–TT)

Data type : Byte

Unit of data : %

Valid range : 0 to 255

Set the override for the depth of cut in a roughing cycle (G71, G72).

This parameter is valid when parameters CDO = 1 and CDI = 0 (parameter No. 6202).

The override can be modified during a roughing cycle.

6215	Retraction distance in roughing cycle(G71, G72)

Setting input (only for the Series 15–T and 15–TT)

Data type : Word

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric input	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch input	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to 32767

Set the retraction distance used in a roughing cycle (G71, G72).

6216	Clearance in roughing cycle(G71, G72)

Setting input (only for the Series 15–T and 15–TT)

Data type : Word

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric input	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch input	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range: 0 to 32767

Set the clearance used in a roughing cycle (G71, G72). In a roughing cycle that has pockets, when the machine has finished roughing a pocket, the machine moves to a set distance (specified by the clearance) before the start point of the next pocket at the rapid traverse feedrate.

6217	Return distance in cutting–off cycle(G74, G75)

Setting input (only for the Series 15–T and 15–TT)

Data type : Word

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric input	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch input	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to 32767

Set the return distance used in a cutting–off cycle (G74, G75).

6218	Minimum depth of cut in threading cycle(G76)

Setting input (only for the Series 15–T and 15–TT)

Data type : Word

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric input	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch input	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to 32767

Set the minimum depth of cut used in a threading cycle (G76). If a value smaller than the minimum value specified in this parameter is set, it is clamped by this minimum.

6219	Finish allowance in threading cycle(G76)

Setting input (for the Series 15–T and 15–TT)

Data type : Word

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric input	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch input	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to 32767

Set the finish allowance used during a threading cycle (G76).

6220	Number of times to repeat last finishing cycle of threading cycle(G76)

Setting input (only for the Series 15–T and 15–TT)

Data type : Word

Unit of data :

Valid range : 0 to 255

Set the number of times to repeat last finishing cycle in a threading cycle (G76).

6221	Return distance in packing rigid tapping cycle

Setting input

Data type : Two words

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric input	0.01	0.001	0.0001	0.00001	0.000001	mm
Input in inches	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to 99999999

6240	Tool retraction direction after G76 and G87 orientation

Parameter input

Data type : Byte axis

Valid range : –15 to +15

Set the tool retraction direction used after G76 (G86.1 in lathe systems) and G82 canned spindle orientation cycles. The tool retraction direction after orientation can be set for each drilling axis. This parameter is set by specifying an axis number along with a sign (+ or –) to specify direction.

Example

When drilling axis is X, tool retraction direction after orientation is –Y, when drilling axis is Y, tool retraction direction after orientation is +Z, and when drilling axis is Z, tool retraction direction after orientation is –X:

(This parameter is set as follows for the above conditions when the 1st, 2nd, and 3rd axes correspond to X, Y, and Z.)

Set 1st axis parameter to –2 (tool retraction direction is –Y)

Set 2nd axis parameter to 3 (tool retraction direction is +Z)

Set 3rd axis parameter to –1 (tool retraction direction is –X)

Set the parameters corresponding to other axes to 0.

4.31 Parameters Related to Scaling and Coordinate Rotation

The parameters described in this section are not used in the Series 15–T and 15–TT.

	#7	#6	#5	#4	#3	#2	#1	#0
6400			CR3DM	DM3RST		RTR	SCR	RIN

Parameter input (only for the Series 15–M)

Data type : Bit

RIN Specifies whether to always set the angle (R) used to rotate a coordinate system (G68) with an absolute value.

0 : Always use an absolute value.

1 : Set depending on the mode (absolute mode (G90) or incremental mode (G91)).

SCR Specifies the magnification rate used for scaling (G51).

0 : 0.00001

1 : 0.001

RTR Specifies the degree unit used to set the angle for rotating a coordinate system (G68) and Three dimensional coordinate conversion (15M:G68, 15 T/TT:G68).

0 : 0.00001 deg

1 : 0.001 deg

DM3RST

0 : The three–dimensional coordinate conversion mode is canceled when the CNC is reset by the G69 command, a reset, the RES, ESP, or RRW input signal from the PMC.

1 : The three–dimensional coordinate conversion mode is canceled only by the G69 command.

CR3DM When the current tool position in the workpiece coordinate system is read using the custom macro system variable numbers 5041 to 5055 (ABSOT) .

0 : Even in the three–dimensional coordinate conversion mode, the coordinates that are read are those in the coordinate system not converted by coordinate conversion.

1 : In the three–dimensional coordinate conversion mode, the coordinates that are read are those in the coordinate system converted by coordinate conversion.

6410	Scaling (G51) Magnification rate

Setting input (only for the Series 15–M)

Data type : Two words

Unit of data : 0.001 or 0.00001 (as specified in SCR, a bit 1 of parameter No. 6400)

Valid range : 1 to 999999

Set the magnification rate used for scaling. The value set in this parameter is used as the default magnification rate when the magnification rate (R) is not specified in the program.

6411	Angle to rotate the coordinate system(G68)

Setting input (only for the Series 15–M)

Data type : Two words

Unit of data : 0.001 or 0.00001 (as specified in RTR, a bit of parameter No. 6400)

Valid range : –36000000 to +36000000

Set the angle used to rotate the coordinate system. The value set in this parameter is used as the default angle of rotation when the angle of rotation (R) is not specified in the program.

6421	Scaling magnification rate for each axis

Setting input

Data type : Two–word axis

Unit of data : 0.001 or 0.00001 (as set in SCR, a bit of parameter No. 6400)

Valid range : 1 to 999999

Set the scaling magnification rate for each axis.

4.32 Parameters Related to Automatic Corner Override

6610	Minimum deceleration rate(MDR) for a feedrate for cutting an arc with the internal offset

Parameter input

Data type : Byte

Unit of data : %

Valid range : 1 to 100

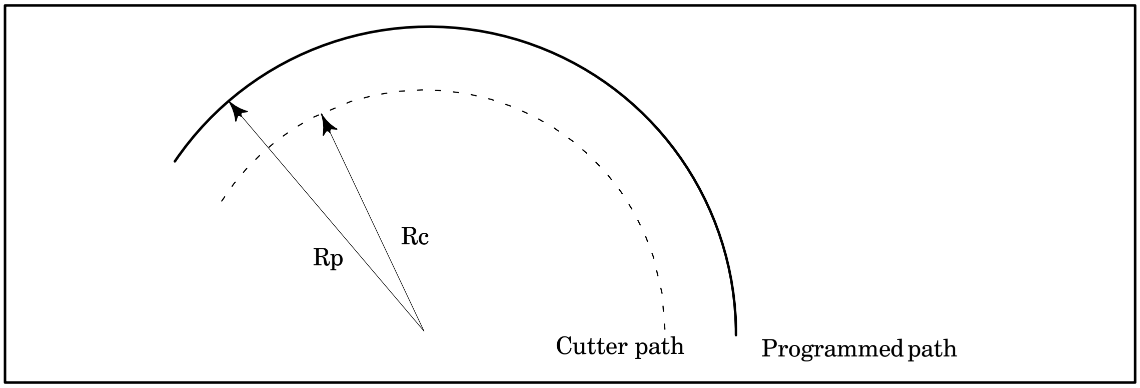
The actual feedrate to be used during cutting an arc with the internal offset is calculated using the expression $F \times \frac{Rc}{Rp}$ so that a feedrate along the programmed path is the specified feedrate (F).

Where;

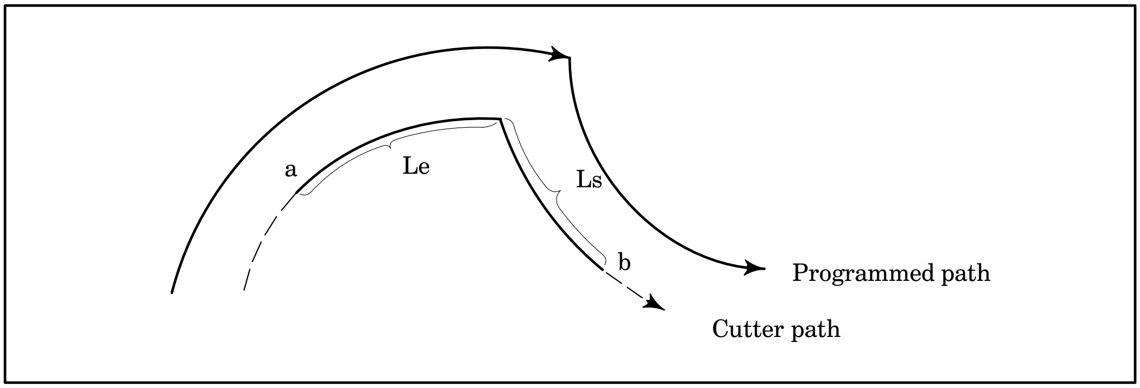
F : Specified feedrate

Rc : Cutter path radius

Rp : Programmed radius



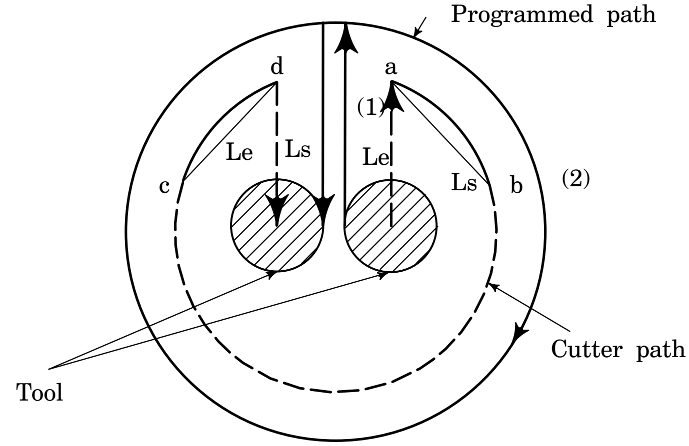
However, when Rc is very small in relation to Rp, the fraction $\frac{Rc}{Rp}$ becomes almost 0 and the cutter stops. For this reason, the minimum deceleration rate (MDR: set by this parameter) is set and the actual feedrate is calculated as F × (MDR), where $\frac{Rc}{Rp} \leqq$ MDR.



Override is in effect from point a to point b.

For an arc, override is effective for distance Le from the end point of a block.

In the same way, override is effective for distance Ls from the start point of a block.



In arc program (2) in the above figure, override is in effect during the intervals from a to b and c to d.

NOTE For the FS6, Ls and Le were the distance in a straight line from the corner. However, for Series 15, Ls and Le are the distance along the center of the cutter path.

6611	Effective angle for internal corner automatic override(θp)

Parameter input
Data type : Byte
Unit of data : 2 degrees
Valid range : 1 to 89 (2 to 178 degrees)

6612	Deceleration rate for automatic corner override(COUR)

Parameter input
Data type : Byte
Unit of data : %
Valid range : 1 to 100

6613	Distance from corner at Which to start automatic override(Le)

Setting input
Data type : Two words
Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric input	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch input	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to 99999999

6614	Distance from corner at Which to end automatic override(Ls)

Setting input

Data type : Two words

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric input	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch input	0.001	0.0001	0.00001	0.000001	0.0000001	inch

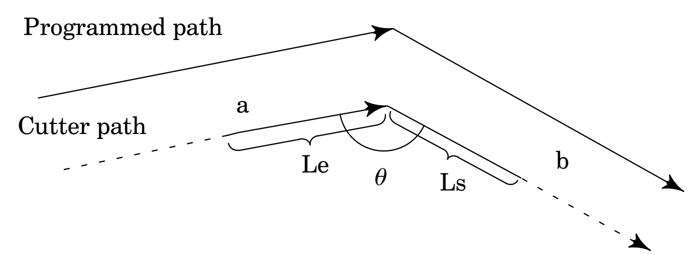
Valid range : 0 to 99999999

When $\theta \leqq \theta p$ ($2° \leqq \theta \leqq 178°$), the corner is assumed to be an inside corner. (θp is set in parameter No. 6611.)

When a corner is determined to be an inside corner, override is applied to the feedrate at an area starting from distance Le before the corner in the current block to distance Ls after the corner in the next block.

Le and Ls specify distances along a straight line from a point on the cutting path to the corner.

Le is set by parameter No. 6613 and Ls is set by parameter No. 6614.



The feedrate is overridden from point a to b.

4.33 Parameters Related to Automatic Feedrate Control Using Involute Interpolation

6620	Radius of curvature at cutting point of start of the basic circle vicinity override 1 (Rlmt1) (for external offset)

6621	Radius of curvature at cutting point of start of the basic circle vicinity override 2 (Rlmt2) (for external offset)

6622	Radius of curvature at cutting point of start of the basic circle vicinity override 3 (Rlmt3) (for external offset)

6623	Radius of curvature at cutting point of start of the basic circle vicinity override 4 (Rlmt4) (for external offset)

6624	Radius of curvature at cutting point of start of the basic circle vicinity override 5 (Rlmt5) (for external offset)

Parameter entry

Data type : Two word

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to 99999999

6630	Lower limit of override of automatic velocity control during involute interpolation (OVR1o) (for external offset)

6631	Override value at start of the basic circle vicinity override 2 (OVR2) (for external offset)

6632	Override value at start of the basic circle vicinity override 3 (OVR3) (for external offset)

6633	Override value at start of the basic circle vicinity override 4 (OVR4) (for external offset)

6634	Override value at start of the basic circle vicinity override 5 (OVR5) (for external offset)

Parameter entry

Data type : Byte

Unit of data : %

Valid range : 0 to 100

(1) The addional parameters (6625 to 6629 and 6635 to 6639) are used for internal offset.

6625	Radius of curvature at cutting point of start of the basic circle vicinity override 1 (Rlmt1) (for internal offset)

6626	Radius of curvature at cutting point of start of the basic circle vicinity override 2 (Rlmt2) (for internal offset)

6627	Radius of curvature at cutting point of start of the basic circle vicinity override 3 (Rlmt3) (for internal offset)

6628	Radius of curvature at cutting point of start of the basic circle vicinity override 4 (Rlmt4) (for internal offset)

6629	Radius of curvature at cutting point of start of the basic circle vicinity override 5 (Rlmt5) (for internal offset)

Parameter entry

Data type : Two–word

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to 99999999

6635	Lower limit of override of automatic velocity control during involute interpolation (OVR1o) (for internal offset)

6636	Override value at start of the basic circle vicinity override 2 (OVR2) (for internal offset)

6637	Override value at start of the basic circle vicinity override 3 (OVR3) (for internal offset)

6638	Override value at start of the basic circle vicinity override 4 (OVR4) (for internal offset)

6639	Override value at start of basic circle vicinity override 5 (OVR5) (for internal offset)

Parameter entry

Data type : Byte

Unit of data : %

Valid range : 0 to 100

4.34 Parameters Related to Uni–Directional Positioning

6820	Approach distance and direction of uni–directional positioning(G60)

Parameter input (only for the Series 15–M)

Data type : Word axis

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch
Rotaly axis	0.01	0.001	0.0001	0.00001	0.000001	mm

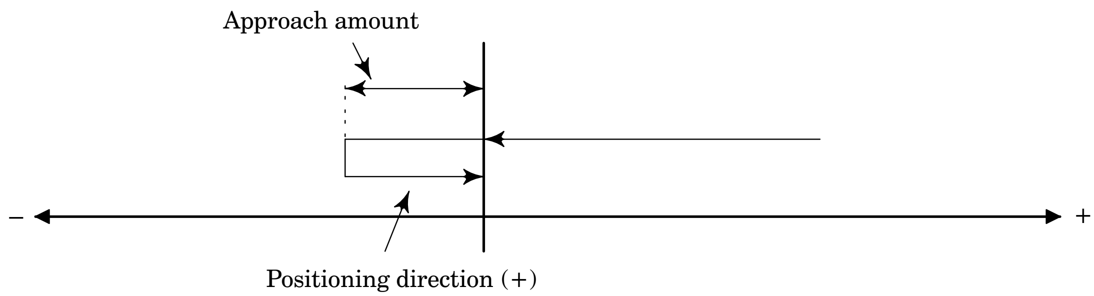
Valid range : –32767 to +32767

For each axis, set the direction and approach distance used in uni–directional positioning (G60). The positioning direction is determined by the sign and the approach distance is determined by the value set in this parameter.

Approach distance > 0 : Positioning direction is positive (+).

Approach distance < 0 : Positioning direction is negative (–).

Approach distance = 0 : Uni–directional positioning is not performed.



4.35 Parameters Related to Custom Macros

	#7	#6	#5	#4	#3	#2	#1	#0
7000	PRT	CLV	GMP	CVA	MGE	BCS	SCS	TCS

Parameter input

Data type : Bit

TCS Specifies whether to call custom macros (subprograms) using T codes:

0 : Do not call with T codes.

1 : Call with T codes.

SCS Specifies whether to call custom macros (subprograms) using S codes:

0 : Do not call with S codes.

1 : Call with S codes.

BCS Specifies whether to call custom macros (subprograms) using 2nd auxiliary function codes:

0 : Do not call with 2nd auxiliary function codes.

1 : Call with 2nd auxiliary function codes.

MGE Specifies when to make G–code continuous–state calls.

0 : Make G–code continuous–state calls after movement (equivalent to G66).

1 : Make G–code continuous–state calls for each block (equivalent to G66.1).

CVA Specifies the format for macro call arguments.

0 : Use NC format.

1 : Convert into macro format.

Example Below the argument in a subprogram is shown for CVA = 0 and CVA = 1 for G65 P_X10;

	CVA = 0	CVA = 1
#24	0.01	0.01
ADP [#24]	10.0	0.01

NOTE External operations are the same unless the ADP function is used.

GMP Specifies whether to allow user M, S, T, or B codes to be called while user G codes are being called, and whether to allow user G codes to be called while user M, S, T, or B codes are being called.

0 : Allow.

1 : Do not allow (executed as ordinary M, S, T, B, and G codes).

CLV Specifies whether to clear custom macro common variables #100 to #199 (#100 to #149 for the Series 15–TT) when the system is reset (these are common variables that are cleared when the power is turned off).

0 : Do not clear.

1 : Clear to 0.

PRT Specifies whether to output a space instead of a leading zero with DPRNT.

0 : Output a space.

1 : Output nothing.

	#7	#6	#5	#4	#3	#2	#1	#0
7001	VR5	VR1						F6W

Parameter input

Data type : Bit

F6W Specifies the type of the system variable number for the workpiece offset.

0 : Use FS9 type.

1 : Use FS6 type.

NOTE FS9 type system variable numbers can still be used even when F6W = 1.

VR1 Specifies whether to use a common variable with a 100–level number as a starting number of common variable string that can be referenced in common (only for the Series 15–TT).

0 : Do not use.

1 : Use.

VR5 Specifies whether to use a common variable with a 500–level number as a starting number of common variable string that can be referenced in common (only for the Series 15–TT).

0 : Do not use.

1 : Use.

NOTE Set common variables to use in common in parameter No. 7035.

	#7	#6	#5	#4	#3	#2	#1	#0
7002			DPG	MIN	TSE	MPR	MSB	MUS

MUS Specifies whether to use the custom macro interrupt function.

0 : Do not use custom macro interrupt function.

1 : Use custom macro interrupt function.

MSB Specifies whether local variable used in the interrupt program are the same as those in the main program.

0 : Local variables are different from those in the main program.

1 : Local variables are the same as those in the main program.

MPR Specifies how to turn on and off the custom macro interrupt.

0 : Custom macro interrupt is turned on by M96 and off by M97.

1 : M codes for custom macro interrupt control is set by parameter.

TSE Specifies the type of the custom macro interrupt.

0 : Use edge trigger–type custom macro interrupt.

1 : Use status trigger–type custom macro interrupt.

MIN Specifies when to execute NC statements in the interrupt program.

0 : Execute NC statements in the interrupt program by interrupting the block being executed.

1 : Execute NC statements in the interrupt program after the current block has completed execution.

DPG Specifies whether a decimal point can be used in a G code.

0 : Do not allow G codes to be called with a decimal point.

1 : Allow G codes to be called with a decimal point.

	#7	#6	#5	#4	#3	#2	#1	#0
7010	[7	[6	[5	[4	[3	[2	[1	[0

	#7	#6	#5	#4	#3	#2	#1	#0
7011	]7	]6	]5	]4	]3	]2	]1	]0

	#7	#6	#5	#4	#3	#2	#1	#0
7012	#7	#6	#5	#4	#3	#2	#1	#0

	#7	#6	#5	#4	#3	#2	#1	#0
7013	*7	*6	*5	*4	*3	*2	*1	*0

	#7	#6	#5	#4	#3	#2	#1	#0
7014	=7	=6	=5	=4	=3	=2	=1	=0

	#7	#6	#5	#4	#3	#2	#1	#0
7015	?7	?6	?5	?4	?3	?2	?1	?0

	#7	#6	#5	#4	#3	#2	#1	#0
7016	@7	@6	@5	@4	@3	@2	@1	@0

	#7	#6	#5	#4	#3	#2	#1	#0
7017	&7	&6	&5	&4	&3	&2	&1	&0

Parameter input

Data type : Bit

[0 to [7	Specify the EIA code indicating	"["	in the hole pattern.
]0 to]7	Specify the EIA code indicating	"]"	in the hole pattern.
#0 to #7	Specify the EIA code indicating	"#"	in the hole pattern.
*0 to *7	Specify the EIA code indicating	"*"	in the hole pattern.
=0 to =7	Specify the EIA code indicating	"="	in the hole pattern.
?0 to ?7	Specify the EIA code indicating	"?"	in the hole pattern.
@0 to @7	Specify the EIA code indicating	"@"	in the hole pattern.
&0 to &7	Specify the EIA code indicating	"&"	in the hole pattern.

The sffix numbers indicate the bit positions of the codes.

0 : Indicates that the corresponding bit is 0.

1 : Indicates that the corresponding bit is 1.

7031	(Starting number of variables to protect) – 500

Parameter input

Data type : Byte

Valid range : 0 to 127 (#500 to #627)

7032	Number of variables to protect

Parameter input

Data type : Byte

Valid range : 0 to 127 (not protected when 0)

For example, for write protection of variables Nos. 545 to 550, set parameter 7031 to 45 and set parameter 7032 to 6.

7033	M code for turning on the custom macro interrupt

7034	M code for turning off the custom macro interrupt

Parameter input

Data type : Byte

Valid range : 0 to 255

When parameter MPR (parameter No. 7002) is set to 1 (M codes for turning on and off the custom macro interrupt are set by parameter), set the M codes in these parameters to turn the custom macro interrupt on or off.

7035	Number of common variables to use in common

Setting input (only for the Series 15–TT)

Data type : Byte

Valid range : 0 to 50

Set the number of common variables to use in common for both tool posts 1 and 2. (Both 100–level and 500–level common variables are used in common. Also note that when only common variables #500 to #524 of 500–level variables can be used, only the variables up to #524 can be used even if 50 is specified in this parameter.)

Example When 10 is specified in parameter 7035

VR5 Data number 7001 #7	VR1 Data number 7001 #6	Common variable common to tool posts
0	1	#100 to #109
1	0	#500 to #509
1	1	#100 to #109, #500 to #509

7050	G code used to call custom macros of program No.9010
7051	G code used to call custom macros of program No.9011
7052	G code used to call custom macros of program No.9012
7053	G code used to call custom macros of program No.9013
7054	G code used to call custom macros of program No.9014
7055	G code used to call custom macros of program No.9015
7056	G code used to call custom macros of program No.9016
7057	G code used to call custom macros of program No.9017
7058	G code used to call custom macros of program No.9018
7059	G code used to call custom macros of program No.9019

Parameter input

Data type : Word

Valid range : –999 to +999

Set the G codes used to call the custom macros of program Nos. 9010 to 9019. However, note that when a negative value is set in this parameter, it becomes a continuous–state call.

For example, if one of these parameters is set to –11, the continuous–state call mode will be entered by G11. Whether the continuous–state call is equivalent to G66 or G66.1 depends on parameter MGE (bit #3 of parameter No. 7000).

7060	G code with decimal point used to call the custom macros of program No.9040
7061	G code with decimal point used to call the custom macros of program No.9041
7062	G code with decimal point used to call the custom macros of program No.9042
7063	G code with decimal point used to call the custom macros of program No.9043
7064	G code with decimal point used to call the custom macros of program No.9044
7065	G code with decimal point used to call the custom macros of program No.9045
7066	G code with decimal point used to call the custom macros of program No.9046
7067	G code with decimal point used to call the custom macros of program No.9047
7068	G code with decimal point used to call the custom macros of program No.9048
7069	G code with decimal point used to call the custom macros of program No.9049

Data type : Word

Valid range : –999 to +999

Set the G codes with decimal point used to call the custom macros of programs No. 9040 to 9049.

However, note that when a negative value is set in this parameter, it becomes a continuous–state call. Whether the continuous–state call is equivalent to G66 or G66.1 depends on parameter MGE (bit #3 of parameter No. 7000).

Set G codes with the decimal point in the format Gm.n. The value expressed by (m * 10 + n) is set in the parameter. The values m and n must satisfy the following relationships: $0 \leqq m \leqq 99$, $0 \leqq n \leqq 9$

7071	M code used to call subprograms of program No.9001

7072	M code used to call subprograms of program No.9002

7073	M code used to call subprograms of program No.9003

7074	M code used to call subprograms of program No.9004

7075	M code used to call subprograms of program No.9005

7076	M code used to call subprograms of program No.9006

7077	M code used to call subprograms of program No.9007

7078	M code used to call subprograms of program No.9008

7079	M code used to call subprograms of program No.9009

Parameter input

Data type : Word

Valid range : 0 to 9999

Set the M codes to call the subprograms of programs No. 9001 to 9009.

7080	M code used to call custom macros of program No.9020
7081	M code used to call custom macros of program No.9021
7082	M code used to call custom macros of program No.9022
7083	M code used to call custom macros of program No.9023
7084	M code used to call custom macros of program No.9024
7085	M code used to call custom macros of program No.9025
7086	M code used to call custom macros of program No.9026
7087	M code used to call custom macros of program No.9027
7088	M code used to call custom macros of program No.9028
7089	M code used to call custom macros of program No.9029

Parameter input

Data type : Byte

Valid range : 0 to 255

Set the M codes used to call the custom macros of programs No. 9020 to 9029. For M codes in parameter Nos. 7080 to 7089, arguments can be passed to the program being called. For M codes in parameter Nos. 7071 to 7019, arguments cannot be passed.

4.36 Parameters Related to Restarting Programs and Blocks and Tool Retraction and Recovery

7110	Order of the axis to be used for tool movement in the dry run mode when the program is restarted

Setting input

Data type: Byte axis

Valid range: 1 to the number of controlled axes

Specify the order of the axes to be used when the tool is moved to the restart point in the dry run mode after the program is restarted using the axis numbers. If the numbers to be entered exceed the specified range, an alarm occurs when the program is restarted.

4.37 Parameters Related to Skip Function

	#7	#6	#5	#4	#3	#2	#1	#0
7200	SEA	SRE	SFP	HSS	DS4	DA3	DS2	DS1

Parameter input

Data type : Bit

DS1 to DS4 : Specify which skip signal is effective for G04 (dwell). The skip signals correspond to the bits as follows. (For Series 15–M/T)

Skip signal or high–speed skip signal	Bit
SKIP 1	HDI0———DS1
SKIP 2	HDI1———DS2
SKIP 3	HDI2———DS3
SKIP 4	HDI3———DS4

HSS Specifies whether the high–speed skip signal is used by the skip function or direct input of offset value measurement B.

0 : Not used, but a conventional skip signal is used.

1 : Used

SFP Specifies a feedrate type that is used during the execution of a skip function based on the high–speed skip signal or the execution of a multi–step skip function.

0 : Feedrate of the F code specified in the program

1 : Feedrate specified with parameter Nos. 7211 to 7214

> **NOTE** For the setting of the standard skip function, see the explanation of on bit 3 of parameter No. 1400.

SRE The high–speed skip signal , high–speed measurement position match signal or direct input of offset value measurement B (15–T/15–TT) is regarded as an input signal:

0 : When the signal rises, namely, the contact is opened.

1 : When the signal falls, namely, the contact is closed.

> **NOTE** If SRE is set to 0, and the contact of the high–speed skip signal is already open, or if SRE is set to 1, and the contact is already closed, it is assumed that the skip signal is input when the skip signal is specified. Therefore, a skip takes place as soon as the skip command is specified.

SEA Specifies whether the acceleration/deceleration or servo system delay is considered when the skip signal or measurement position match signal is turned on while the skip function (for the Series 15–M only) or automatic tool compensation function/direct input of offset value measurement B (for the Series 15T/15–TT) is performed.

0 : Not considered.

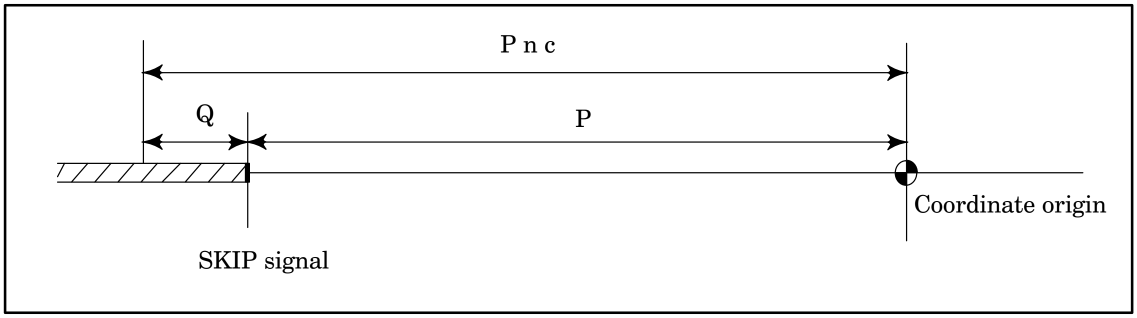
1 : Considered and compensated with compensation method type A for positional errors.

There are two compensation methods for positional errors: A and B (bit 7, SEB of parameter No. 7300). The skip function uses the skip signals to store the current position in the CNC unit. Since the current position in the CNC unit includes the servo system delay, the machine position is moved by the positional error distance corresponding to the servo system delay. The positional error can be obtained from the positional deviation of the servo system and the delay caused by the acceleration/deceleration of the feedrate in the CNC unit. The positional error need not include the servo system delay due to measurement errors.

The positional error can be assumed in SEA of parameter No. 7200 and SEB of parameter No. 7300 in the following ways:

1 Compensation method A: The value (the ovetical value) calculated from the cutting time constant and servo time constant (loop gain) is assumed to be the positional error .

2 Compensation method B: The delay caused by the acceleration/deceleration when the skip signal is turned on and the positional deviation (measured value) are considered as the positional error.



Pnc : Current position in the CNC unit when the SKIP signal is turned on (mm or inch)

P : Distance to be measured (mm or inch)

Q : Servo delay (mm or inch)

Under the above conditions, the following calculation is performed in the CNC unit:

P = Pnc – Q

The distance to be measured, P, can be read with macro variables 5061 to 5075. The measurement error is therefore only a variation caused when the SKIP signal is detected by the sensor.

Compensation method A compensates for positional errors with the following formula:

Q = Fm * 1/60 * (α * Tc/1000 + Ts/1000)

Fm : Feedrate (mm/min or inch/min)

Tc : Cutting time constant (ms) (parameter 1622)

If SKF of parameter No. 1400 is set to 1 (to specify that G31 allows the speed specified with the parameter), Tc is set to 0.

Ts : Servo time constant (ms)

When the loop gain (parameter No. 1825) is specified as G (unit: 1/s), Ts can be obtained with the formula below:

$$Ts = \frac{1000}{G}$$

α = 1 : For exponential acceleration/deceleration

or

=1/2 : For linear acceleration/deceleration after interpolation or bell shaped acceleration/ deceleration after interpolation

Example When Ts = 33 and Tc = 0

$$P = Pnc - \underbrace{Fm * 1 / 60 * 33 / 1000}_{\text{Servo delay (mm or inch)}}$$

NOTE 1 When using compensation method A, turn on the skip signal at a constant speed.

NOTE 2 This function is ineffective when the linear acceleration/deceleration before interpolation is used.

	#7	#6	#5	#4	#3	#2	#1	#0
7201	2S4	2S3	2S2	2S1	1S4	1S3	1S2	1S1
	G31.2				G31 (G31.1)			

Parameter input

Data type : Bit

1S1 to 1S4 : Specify which skip signal is effective for the G31 or G31.1 (multi–step skip function) skip command. The skip signals correspond to the bits as follows.

Conventional skip signal or high–speed skip signal		Bit
SKIP 1	HDI0	1S1
SKIP 2	HDI1	1S2
SKIP 3	HDI2	1S3
SKIP 4	HDI3	1S4

2S1 to 2S4 : Specify which skip signal is effective for the G31.2 skip command. The skip signals correspond to the bits as follows.

Conventional skip signal or high–speed skip signal		Bit
SKIP 1	HDI0	2S1
SKIP 2	HDI1	2S2
SKIP 3	HDI2	2S3
SKIP 4	HDI3	2S4

	#7	#6	#5	#4	#3	#2	#1	#0
7202	4S4	4S3	4S2	4S1	3S4	3S3	3S2	3S1
	G31.4				G31.3			

Parameter input (for the Series 15–M only)

Data type : Bit

3S1 to 3S4 : Specify which skip signal is effective for the G31.3 skip command. The skip signals correspond to the bits as follows.

Conventional skip signal or high–speed skip signal		Bit
SKIP 1	HDI0	3S1
SKIP 2	HDI1	3S2
SKIP 3	HDI2	3S3
SKIP 4	HDI3	3S4

4S1 to 4S4 : Specify which skip signal is effective for the G31.4 skip command. The skip signals correspond to the bits as follows.

Conventional skip signal or high–speed skip signal		Bit
SKIP 1	HDI0	4S1
SKIP 2	HDI1	4S2
SKIP 3	HDI2	4S3
SKIP 4	HDI3	4S4

	#7	#6	#5	#4	#3	#2	#1	#0
7203	9S4	9S3	9S2	9S1			TSKECR	

Parameter input

Data type : Bit

TSKECR Specifies whether the amount of servo error is subtracted from the skip position (system variables #5061 and above) and block end position for a skip directed by the G31P99/P98 command.

0 : Subtracted.

1 : Not subtracted.

S91 to S94 Selects a specific high–speed signal for the G31.8 high–speed skip command. The correspon dence between the signals and bits is shown below:

HDI0————9S1
HDI1————9S2
HDI2————9S3
HDI3————9S4

7211	Feedrate of the skip function(G31 or G31.1)

7212	Feedrate of the skip function(G31.2)

7213	Feedrate of the skip function(G31.3)

7214	Feedrate of the skip function(G31.4)

Parameter input (Parameter Nos. 7212 to 7214 are not used in the Series 15–T or 15–TT.)

Data type : Two words

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	1.0	1.0	1.0	1.0	1.0	mm/min
Inch system machine	1.0	1.0	1.0	1.0	1.0	inch/min
Rotary axis	1.0	1.0	1.0	1.0	1.0	deg/min

Even when PLC01 of parameter No. 1804 is set to 1, the unit of data is not multiplied by 10.

Valid range : 0 to 2400000

Specify the feedrates of the skip functions for each G code.

These parameters are effective when SFP of parameter No. 7200 is set to 1, namely, the feedrates specified with the parameters are used as the feedrates of the skip functions.

7220	Time width from acceptance of a skip signal until acceptance of the next skip signal as a valid signal in EGB skip function.

Parameter entry

Data format : Byte type

Data range : 2 to 127 (X 8msec)

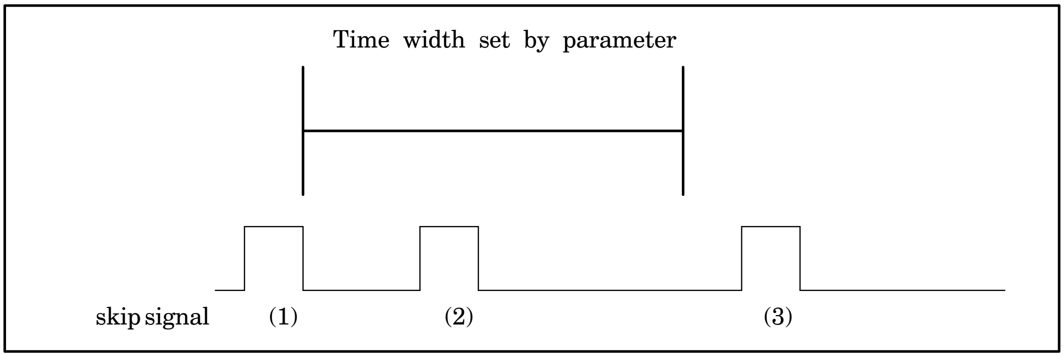
Other value is regarded as 2 X 8 msec.

In EGB skip function, the time width after a skip signal is accepted until next skip signal is able to be accepted as a valid signal is specified.

Settig value is regarded as the multiple of 8msec.

Example When 10 is set, the time width is regarded as 80msec.

It is set to prevent a system from accepting a skip signal misstakenly.



After the skip signal of (1), the skip signal of (2) is ignored because of being input within the time width. The skip signal of (3) is valid.

NOTE 1 You can select a kind of signal, conventional type signal or high speed signal for skip signal by settig parameter HSS of 7200.
In case of using high speed skip signal, you can select a valid signal among high speed signals by setting parameter 9S1–9S4 of 7203.

NOTE 2 In case that master axis of EGB is not spindle but other control axis, master axis need to be executed with PMC axis control.

NOTE 3 The skip position has the value which is calculated by machine feedback pulse and shows the machine position. So the skip position has no compensations which are calculated by deviation of servo and servo time constant (loop gain) .

4.38 Parameters Related to Automatic Tool Compensation (for the Series 15–T only) and Automatic Tool Length Measurement (for the Series 15–M only)

	#7	#6	#5	#4	#3	#2	#1	#0
7300	SEB					G36	AMH	MDC

Parameter input

Data type: Bit

MDC Specifies whether the tool measurement value is subtracted from or added to the current offset.

0 : Subtracted

1 : Added

The standard setting is 1.

AMH Specifies whether the high–speed measurement position match signal is used for automatic tool compensation.

0 : Not used (Namely, a conventional signal is used.)

1 : Used

G36 Specifies whether G36 and G37 are used instead of G37.1 and G37.2 of automatic tool compensation for the Series 15–T.

0 : Not used

1 : Used

SEB Specifies whether acceleration/deceleration and servo delay are assumed when the skip signal or measurement position match signal is turned on while the skip function (for the Series 15–M only) or automatic tool compensation function/direct input of offset value input measurement B function (for the Series 15–T/15–TT) is used.

0 : Considered

1 : Not considered and compensated for (Compensation method B)

See the description of bit 7 (SEA) of parameter No. 7200.

7311	Feedrate during tool measurement 1(for the Series 15–T/15–TT only)
	Feedrate during tool measurement (for the Series 15–M only)

7312	Feedrate during tool measurement 2(for the Series 15–T/15–TT only)

7313	Feedrate during tool measurement 3(for the Series 15–T/15–TT only)

Parameter input

Data type : Two words

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	10.0	1.0	0.1	0.01	0.001	mm/min
Inch system machine	1.0	0.1	0.01	0.001	0.0001	inch/min

Even when PLC01 of parameter No. 1804 is set to 1, the unit of data is not multiplied by 10.

Valid range : 1 to 1000000

Tool measurements 1, 2, and 3 in the Series 15–T/15–TT refer to G37.1 (same as G37), 37.2, and 37.3, respectively. Tool measurement in the Series 15–M refers to G37.

7321	Value of tool measurement 1(for the Series 15–T/15–TT only)
	Value of tool length measurement (for the Series 15–M only)

7322	Value of tool measurement 2(for the Series 15–T/15–TT only)

7323	Value of tool measurement 3(for the Series 15–T/15–TT only)

Setting input

Data type : Two words

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Linear axis(metric input)	0.01	0.001	0.0001	0.00001	0.000001	mm
Linear axis(inch input)	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : –99999999 to 99999999

(1) In lathe systems, radius programming is used for X coordinates.

(2) Specify a value larger than tool measurement .

7331	Value ε of tool measurement 1(for the Series 15–T/15–TT only)
	Value ε of tool measurement (for the Series 15–M only)

7332	Value ε of tool measurement 2(for the Series 15–T/15–TT only)

7333	Value ε of tool measurement 3(for the Series 15–T/15–TT only)

Setting input

Data type : Two words

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Linear axis(metric input)	0.01	0.001	0.0001	0.00001	0.000001	mm
Linear axis(inch input)	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : –99999999 to 99999999

In lathe systems, radius programming is used for X coordinates.

4.39 Parameters Related to Tool Life Management

	#7	#6	#5	#4	#3	#2	#1	#0
7400		ABT	SNG	RAG	LTM	SIG	GS2	GS1

Parameter input

Data type : Bit

GS1 and GS2 : Specify the desired settings in these parameters according to the following table. This table lists the combinations of the number of tool life groups that can be stored and the number of tools that can be stored per group.

GS2	GS1	In case optional function ”Tool life management 512 pairs” is not provided.		In case optional function ”Tool life management 512 pairs” is provided.		In case optional function ”Tool life management 1024 pairs” is provided.	
		Max. No. of groups	Max. No. of tools	Max. No. of groups	Max. No. of tools	Max. No. of groups	Max. No. of tools
0	0	16	16	64	32	128	32
0	1	32	8	128	16	256	16
1	0	64	4	256	8	512	8
1	1	128	2	512	4	1024	4

After changing this parameter, reenter the data with G10L3;.

SIG

1 : An input signal specifies the group number for tool skip.

0 : An input signal does not specify the group number for tool skip.

CAUTION When an input signal does not specify the group number for tool skip, tool skip is applied to the tools of the group currently used.

LTM

1 : Specifies tool life by time.

0 : Specifies tool life by frequency.

After changing this parameter, reenter the data with G10L3;.

PAG

1 : Executable data for all the registered groups is cleared when the tool replacement reset signal is input.

0 : Executable data for all the registered groups is cleared if the tool life for the specified group is ex hausted when the tool replacement reset signal is input.

SNG

1 : The tool skip signal is ignored if it is input when a tool whose life is not managed is used.

Tool skip specified on the MDI is not accepted.

0 : The tools in the group used last or the specified group (according to the setting of SIG) are skipped if the tool skip signal is input when a tool whose life is not managed is used.

ABT

1 : An alarm is not raised when the return tool number does not belong to the same group as the cur rent group during tool replacement A.

0 : An alarm is raised when the return tool number does not belong to the same group as the current group during tool replacement A.

	#7	#6	#5	#4	#3	#2	#1	#0
7401		TRU	TRST	LPF	LFV	EMD	CT2	CT1

Parameter input (for the Series 15–M only)

Data type : Bit

CT1 and CT2 Specify the tool replacement system according to the table below.

CT2	CT1	Change method
0	0	A
0	1	B
1	0	C
1	1	D

EMD Specifies the timing at which the asterisk (*) indicating exhausted tool life is displayed.

0 : Displayed when the next tool is used

1 : Displayed when the tool life is exhausted

LFV Specifies whether life count override is enabled.

0 : Disabled

1 : Enabled

LPF Specifies the control data format to be used when tool life management data is read by the PMC.

0 : Conventional control data format

1 : New control data format

CAUTION When the PMC reads or writes tool offset data by tool number, this bit must be set to 1.

TRST Specifies that the tool replacement reset signal (TLRST) is not valid during system reset (when the RST signal is high) but is valid in the:

0 : Reset state only (when the OP signal is low) (conventional setting)

1 : Reset state, automatic operation stop state (when the STL signal and SPL signal are low, and the OP signal is high), and automatic operation pause state (when the STL signal is low, and the SPL signal is high)

Note that the tool replacement reset signal is invalid when the system is placed in the stop or pause state during execution of a data setting command (G10 L3) or in the automatic operation state (when the STL signal is high).

TRU When the tool life is counted in time,

0 : Cutting times of less than four seconds are ignored.

1 : Cutting times of less than four seconds are counted as four seconds.

7440	Maximum tool group number for tool life management

Parameter input

Data type : Word

Unit of data : 1 to 9999

When the value exceeding this setting is instructed by the T code, the value obtained by subtracting the setting from the value of the T code is specified as the tool group number for tool life management.

7441	Number for ignoring tool life management(first four digits)

Parameter input

Data type : Word

Unit of data : Integer

Valid range : 0 to 9999 (0 to 99999999 when this parameter is combined with parameter No. 7440)

Up to eight digits can be used to specify the number for ignoring tool life management (tool life management ignore number) when the “tool offset by tool number” function is provided.

Specify the first four digits of the tool life management ignore number.

When the tool life management ignore number is specified as 50000000, for example, specify the number as follows:

Parameter No.7440	0	(Last four digits)
Parameter No.7441	5000	(First four digits)

7442	M code to restart counting the tool life

Parameter input

Data type : Word

Unit of data : Integer

Valid range : 0 to 9999 (except for M codes 01, 02, 30, 98, and 99)

This parameter is ignored when 0 is specified.

In the Series 15–M

When the tool life is specified with the number of times the tool has been used, the tool–change request signal is issued if the tool life of any one of the tool groups has expired when the M code to restart counting the too l life is specified. The T code (tool life management group command) specified after the M code to restart counting the tool life selects a tool whose life is not yet expired from the specified group. The next M 06 code in crements the tool life count by one.

When the tool life is specified with the time the tool has been used, specifying the M code to restart counting the tool life does not cause any operations.

In the Series 15–T or 15–TT

(1) When the tool life is specified with the number of times the tool has been used

The tool–change request signal is issued if the tool life of any one of the tool groups has expired when the M code to restart counting the tool life is specified. The T code (tool life management group command) specified a fter the M code to restart counting the tool life selects a tool whose life is not yet expired from the specified group and increments the tool life count by one.

(2) When the tool life is specified with the time the tool has been used

The T code (tool life management group command) specified after the M code to restart counting the tool life selects a tool whose life is not yet expired from the specified group.

NOTE When the M code to restart counting the tool life is specified, @ is displayed next to the tool currently being used irrespective of the specified tool life count method (number of times or time). At that time, if tool life management (tool life count) is being applied to any tool group, the management is canceled and a tool to which the management was not applied is used.

4.40 Parameters Related to Turret Axis Control

	#7	#6	#5	#4	#3	#2	#1	#0
7500	EZRN	MOVT	TNO					

Parameter input

Data type : Bit

TNO Currently selected tool number

MOVT Specifies whether the turret rotates.

0 : Does not rotate

1 : Rotates

EZRN Specifies whether the turret is already returned to the reference position.

0 : Not yet returned

1 : Already returned

These bits need not be set except in special cases because the settings are automatically specified.

	#7	#6	#5	#4	#3	#2	#1	#0
7501						NALM	TF0	T99

Parameter input

Data type : Bit

T99 The tool number to specify automatic reference position return of the turret axis is:

0 : 00 (T00yy: yy is a tool offset number.)

1 : 99 (T99yy: yy is a tool offset number.)

TF0 Specifies whether the T code is output when the T command is issued in turret indexing with the turret axis.

0 : Not output

1 : Output (In this case, the turret rotates after the FIN completion signal for the strobe signal of the T code is returned.)

NALM Specifies whether an alarm occurs if the tool number exceeds the specified range (namely, the value obtained by adding the setting of TORG in parameter No. 7512 and the setting of TMAX in parameter No. 7511) when the T command is issued in turret indexing with the turret axis.

0 : An alarm occurs.

1 : An alarm does not occur.

7511	Maximum number of tools to be set in the turret(TMAX)

Parameter input

Data type : Byte

Unit of data : Integer

Valid range : 2 to 16

7512	Number of the tool to be selected during reference position return(TORG)

Parameter input

Data type : Byte

Unit of data : Integer

Valid range : 1 to the setting of TMAX

7521	Machin position of tool number TORG

7522	Machin position of tool number(TORG+1)

.
.

7536	Machin position of tool number(TORG+15)

Parameter input

Data type : Two words

Unit of data : Least command increment

Valid range : 0 to 99999999

Specifies the machine positions of each tool using the distance from the tool having the tool number specified by TORG. Always specify parameter No. 7521 as 0 and specify the machine positions, the number of which is the maximum number of tools to be set in the turret. The machine positions must be specified in the order of ascending tool numbers.

In addition to these parameters, the following parameters for the turret axis must be specified:

(1) Control axis parameters

	#7	#6	#5	#4	#3	#2	#1	#0
1005	RMBx	ZNGx	EDMx	EDPx	PLZx	ALZx	ZMGx	ZRNx

ZRNx : Specify 1. (The reference position return function is ineffective.)

ZMGx : Specify 0 or 1. (Reference position return system)

ALZx : Specify 1. (Always low–speed reference position return)

PLZx : Specify 0. (The function is ignored)

EDPx : Specify 0. (External deceleration invalid)

EDMx : Specify 0. (External deceleration invalid)

ZNGx : Specify 0. (Machine lock invalid)

RMBx : Specify 0. (Axis removal invalid)

	#7	#6	#5	#4	#3	#2	#1	#0
1006			ZMIx		DIAx	ROPx	ROSx	ROTx

ROTx : Specify 1. (Rotation axis)

POSx : Specify 1. (Rotation axis)

ROPx : Specify 1. (Rotation axis)

DIAx : Specify 0.

ZMIx : Specify 0 or 1. (Direction of reference position return)

Parameter No. 1020 : Specify T (84) for the axis controlling the turret axis.

Parameter No. 1023 : Servo axis number for the turret axis

(2) Coordinate parameters

Parameter No. 1260 Number of pulses per turret axis rotation (Tp)

Least command increment of the turret axis: 360/Tp degrees

(3) Feedrate parameters

Parameter No. 1420 : Turret axis feedrate

Parameter No. 1421 : Turret axis feedrate for override F0

Parameter No. 1424 : FM speed for reference position return

Parameter No. 1425 : FL speed for reference position return

The increment system of the turret axis feedrate shall conform to the setting of the rotation axis.

(4) Acceleration/deceleration parameters

Parameter No. 1620 : Acceleration/deceleration time constant

Parameter No. 1621 : FL speed of acceleration/deceleration

(5) Servo parameters

Same parameter settings as those for other control axes. However, set bit 2 of parameter 1802 to 1 (servo off signal valid.)

(6) Stroke limit parameters

Same parameter settings as those for other control axes.

(7) Pitch error compensation parameters

Same parameter settings as those for other control axes.

CAUTION Specify 0 for the T axis for the axis parameters not described above.

4.41 Parameters Related to 3–Dimensional Handle Feel for 15–M

When the rotation axes of the slave–axis table are the A– and C–axes (I– and K–axes) or B– and C–axes (J– and K–axes), and the tool axis is the Z–axis (W–axis)

7537	Selection of axis parallel to the X–axis (U–axis) on the plane perpendicular to the tool axis at the slave–axis table

7538	Selection of axis parallel to the Y–axis (V–axis) on the plane perpendicular to the tool axis at the slave–axis table

7541	Selection of axes parallel to the A– and B–axes (I– and J–axes) for tool–tip rotation at the slave–axis table

7542	Selection of axis parallel to the C–axis (K–axis) for tool–tip rotation at the slave–axis table

When the rotation axes of the slave–axis table are the A– and B–axes (I– and J–axes), and the tool axis is the X–axis (or U–axis)

7537	Selection of axis parallel to the Y–axis (V–axis) on the plane perpendicular to the tool axis at the slave–axis table

7538	Selection of axis parallel to the Z–axis (W–axis) on the plane perpendicular to the tool axis at the slave–axis table

7541	Selection of axis parallel to the B–axis (J–axis) for tool–tip rotation at the slave–axis table

7542	Selection of axis parallel to the A–axis (I–axis) for tool–tip rotation at the slave–axis table

7539	Selection of axis parallel to the tool axis at the slave–axis table

Setting input

Data type : Byte

Valid range : 1 to 15

Specify the states of the axis selection signals (HS1D, HS1C, HS1B, and HS1A) for the first manual pulse generator to perform three–dimensional handle feed.

HS1D	HS1C	HS1B	HS1A	Value	HS1D	HS1C	HS1B	HS1A	Value
0	0	0	1	1	1	0	0	1	9
0	0	1	0	2	1	0	1	0	10
0	0	1	1	3	1	0	1	1	11
0	1	0	0	4	1	1	0	0	12
0	1	0	1	5	1	1	0	1	13
0	1	1	0	6	1	1	1	0	14
0	1	1	1	7	1	1	1	1	15
1	0	0	0	8					

	#7	#6	#5	#4	#3	#2	#1	#0
7540	ETHO	DTHO				TWNH		

Parameter input

Data type : Bit

TWNH Specifies whether a three–dimensional handle feed/interrupt is performed for the master–axis and slave–axis tables during twin–table control.

0 : Not performed

1 : Performed

DTHO Specifies whether the tool holder offset function for tool–axial tool length compensation is to be taken into consideration when the coordinates of the tool tip are displayed.

0 : Not considered.

1 : Considered.

ETHO Specifies whether to enable the tool holder offset function for tool–axial tool length compensation when the tool length compensation function is used.

0 : Disabled.

1 : Enabled.

7543	Specification of whether the individual axes are subject to three–dimensional handle feed/interrupt for a table

Parameter input

Data type : Byte axis

Valid range : 0 to 3

0 : Not subject to three–dimensional handle feed/interrupt (normal axis)

1 : Subject to three–dimensional handle feed/interrupt for the master–axis table

2 : Subject to three–dimensional handle feed/interrupt for the slave–axis table

3 : Subject to three–dimensional handle feed/interrupt for both the master–axis and slave–axis tables

Each axis must be named uniquely within the same table.

Allowable combinations of axis names are the same as those for the conventional three–dimensional handle feed/interrupt.

7546	Coordinates for the first axis of the rotation axis

Data type : 2–word

Unit of data :

Increment system	Unit of data
IS–A	0.01 deg
IS–B	0.001 deg
IS–C	0.0001 deg
IS–D	0.00001 deg
IS–E	0.000001 deg

This parameter specifies the angular displacement for the first rotation axis which the CNC does not control that uses the three–dimensional handle–feed function and the tool length compensation along the tool axis. This pa rameter is valid when 3D1X, bit 2 of parameter No. 7558, is set to 1.

7547	Coordinates for the second axis of the rotation axis

Data type : 2–word

Unit of data :

Increment system	Unit of data
IS–A	0.01 deg
IS–B	0.001 deg
IS–C	0.0001 deg
IS–D	0.00001 deg
IS–E	0.000001 deg

This parameter specifies the angular displacement for the second rotation axis which the CNC does not control that uses the three–dimensional handle–feed function and the tool length compensation along the tool axis. This p arameter is valid when 3D2X, bit 3 of parameter No. 7558, is set to 1.

7548	Offset value for the tool–axial tool length compensation amount

Parameter input

Data type : Two–word

Unit of data :

Setting unit	IS–A	IS–B	IS–C	Unit
Metric system machine	0.01	0.001	0.0001	mm
Inch system machine	0.001	0.0001	0.00001	inch

This parameter specifies the amount of offset that is added to the tool compensation amount for tool–axial tool length compensation.

	#7	#6	#5	#4	#3	#2	#1	#0
7550			TLAX		CCLR	BMST	SLAB	CLR

Parameter input

Data type : Bit

CLR Specifies whether the feed distance by three–dimensional handle feed is cleared when the reset key is pressed while the feed distance is displayed.

0 : Not cleared

1 : Cleared

SLAB Specifies the configuration of the rotation axes for three–dimensional handle feed.

0 : The tool axis is the Z–axis. The rotation axes are the A– and B–axes or B– and C–axes. The setting of HLB of parameter No. 1000 determines which set of axes is used.

1 : The tool axis is the Z–axis. The rotation axes are the A– and B–axes. However, handle feed is performed only along the tool axes.

NOTE	Set TLAX of parameter No. 7550 to 0. If TLAX is 1, the setting of SLAB is ignored.

BMST When the tool axis is the Z–axis, and the rotation axes are the A– and B–axes (SLAB of parameter No. 7550 = 1), the master axis is:

0 : A–axis

1 : B–axis

CCLR When the tool axis is the Z–axis, and the rotation axes are the A– and C–axes or B– and C–axes during handle feed along the tool axes (SLAB of parameter No. 7550 = 0), the C–axis coordinates are:

0 : Stored

1 : Stored as zero

TLAX Specifies the configuration of rotation axes for handle feed along the tool axes.

0 : The tool axis is the Z–axis. The rotation axes are the A– and C–axes, B– and C–axes, or A– and B–axes. (The settings of SLAB and HLB determine the configuration of the rotation axes.)

1 : The tool is the X–axis. The rotation axes are the A– and B–axes.

When the rotation axes are the A– and C–axes or B– and C–axes (the tool axis is the Z–axis)

7551	X–axis selection when an axis perpendicular to the tool axis is provided

7552	Y–axis selection when an axis perpendicular to the tool axis is provided

7554	A– and B–axis selection when a tool tip that rotates is provided

7555	C–axis selection when a tool tip that rotates is provided

When the rotation axes are the A– and B–axes (the tool axis is the X–axis)

7551	Y–axis selection when an axis perpendicular to the tool axis is provided

7552	Z–axis selection when an axis perpendicular to the tool axis is provided

7554	B–axis selection when a tool tip that rotates is provided

7555	A–axis selection when a tool tip that rotates is provided

7553	Axis selection in the tool axis direction mode

7556	Axis selection for tool length compensation along the tool axis

Setting input

Data type : Byte

Valid range : 1 to 15

Specify the states (HS1D, HS1C, HS1B, and HS1A) of the axis selection signal for the 1st manual pulse generator during three–dimensional handle feed operations.

HS1D	HS1C	HS1B	HS1A	Value	HS1D	HS1C	HS1B	HS1A	Value
0	0	0	1	1	1	0	0	1	9
0	0	1	0	2	1	0	1	0	10
0	0	1	1	3	1	0	1	1	11
0	1	0	0	4	1	1	0	0	12
0	1	0	1	5	1	1	0	1	13
0	1	1	0	6	1	1	1	0	14
0	1	1	1	7	1	1	1	1	15
1	0	0	0	8					

7557	Distance L from the pivot to the tool tip

Setting input

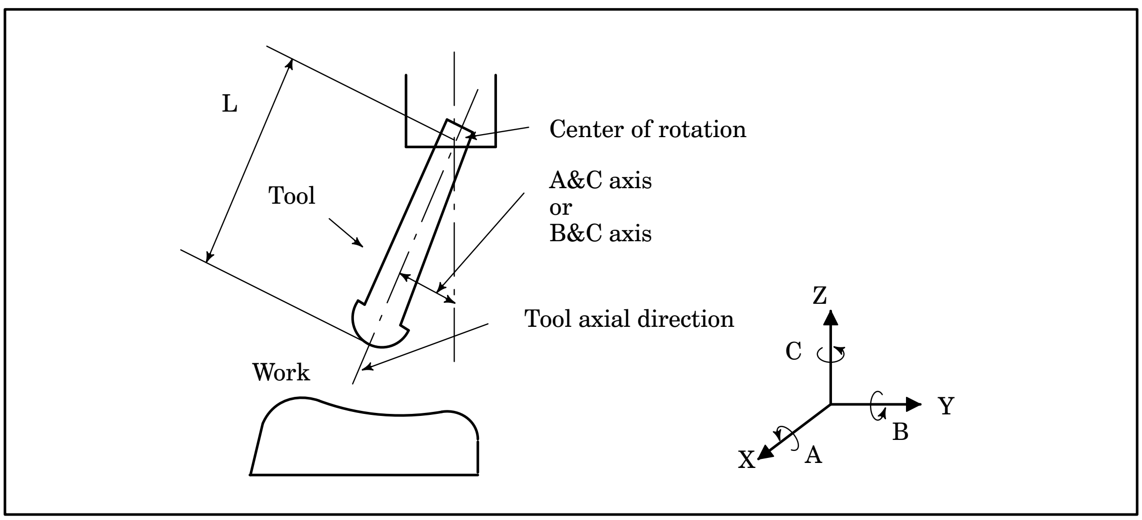
Data type : Two words

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric input	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch input	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : –99999999 to 99999999

This parameter is used to execute handle interrupt or feed of rotation around the center of the tool tip or to display the position of the tool tip. Specify the distance from the pivot to the tool tip.



		#7	#6	#5	#4	#3	#2	#1	#0
7558						3D2X	3D1X		

Data type : Bit

3D1X The value of the rotation angle of the first rotation axis used for three–dimensional handle feed and tool length compensation along the tool axis are

0 : Coordinates in the machine or workpiece coordinate system.

1 : Coordinates specified by parameter (No.7546).

3D2X The value of the rotation angle of the first rotation axis used for three–dimensional handle feed and tool length compensation along the tool axis are

0 : Coordinates in the machine or workpiece coordinate system.

1 : Coordinates specified by parameter (No.7547).

NOTE The first axis and second axis of the rotation axis are determined as follows: The axis written first in the two–axis name is the first axis, and the axis written second is the second axis; for example, the first axi s of the AC–axis is the A–axis and the second axis is the C–axis.

4.42 Parameters Related to 15–TT Three–Dimensional Handle Feed

The three–dimensional handle feed function can be used for either tool post 1 or 2. The function, however, cannot be used for both tool posts.

This function can be used only with systems that allow the function to be specified for only one of the tool posts.

For the tool post not using the three–dimensional handle feed function, be sure to set the three–dimensional handle feed parameters to 0.

	#7	#6	#5	#4	#3	#2	#1	#0
1000	HLB							

Parameter input

Data type : Bit

HLB Sets the configuration of the rotation axes for three–dimensional handle feed for tool post 1 when the tool axis is the Z–axis.

0 : A– and C–axes

1 : B– and C–axes

NOTE Set TLAX and SLAB of parameter No. 7550 to 0. If TLAX or SLAB is 1, the setting of HLB is ignored.

7546	Angular displacement of the first rotation axis of tool post 1

Parameter input

Data type : Two words

Unit of data :

Increment system	Unit of data
IS–A	0.01 deg
IS–B	0.001 deg
IS–C	0.0001 deg
IS–D	0.00001 deg
IS–E	0.000001 deg

Specify the angular displacement of the first rotation axis which is not controlled by the CNC when using the three–dimensional handle feed function and for tool post 1.

7547	Angular displacement of the second rotation axis of tool post 1

Parameter input

Data type : Two words

Unit of data :

Increment system	Unit of data
IS–A	0.01 deg
IS–B	0.001 deg
IS–C	0.0001 deg
IS–D	0.00001 deg
IS–E	0.000001 deg

Specify the angular displacement of the second rotation axis which is not controlled by the CNC when using the three–dimensional handle feed function for tool post 1.

	#7	#6	#5	#4	#3	#2	#1	#0
7550			TLAX			BMST	SLAB	CLR

Parameter input

Data type : Bit

CLR Specifies whether the indication showing the distance traveled by three–dimensional handle feed is cleared when the reset key is pressed.

0 : Not cleared

1 : Cleared

SLAB Specifies the configuration of the rotation axes for three–dimensional handle feed for tool post 1 when the tool axis is the Z–axis.

0 : A– and C–axes, or B– and C–axes. One of these combinations is determined by HLB of parameter No. 1000.

1 : A– and B–axes (only for handle feed along the tool axis)

NOTE Set TLAX of parameter No. 7550 to 0. If TLAX is 1, the SLAB setting is ignored.

BMST Specifies the master axis when the tool axis of tool post 1 is the Z–axis, and the rotation axes are the A– and B–axes (when SLAB of parameter No. 7550 is 1).

0 :A–axis

1 :B–axis

TLAX Specifies the configuration of the rotation axes and tool axis for three–dimensional handle feed for tool post 1.

0 : The tool axis is the Z–axis, and the rotation axes are the A– and C–axes, B– and C–axes, or A– and B–axes. (The combination of the rotation axes is determined by SLAB of this parameter and HLB of parameter No. 1000.)

1 : The tool axis is the X–axis, and the rotation axes are the A– and B–axes.

When three–dimensional handle feed is performed for tool post 1, set parameters according to the axis configuration as follows:

HLB	SLAB	BMST	TLAX	Tool axis	Rotation axes	Master axis
0	0	0	0	Z–axis	A– and C–axes	–
1	0	0	0	Z–axis	B– and C–axes	–
0	0	0	1	X–axis	A– and B–axes	–
0	1	0	0	Z–axis	A– and B–axes	A–axis
0	1	1	0	Z–axis	A– and B–axes	B–axis

When the rotation axes for tool post 1 are the A– and C–axes or B– and C–axes (when the tool axis is the Z–axis)

7551	Selection of axis parallel to the X–axis for tool post 1 on the plane perpendicular to the tool axis

7552	Selection of axis parallel to the Y–axis for tool post 1 on the plane perpendicular to the tool axis

7554	Selection of axes parallel to the A– and B–axes for tool post 1 for tool–tip rotation

7555	Selection of axis parallel to the C–axis for tool post 1 for tool–tip rotation

When the rotation axes for tool post 1 are the A– and B–axes (when the tool axis is the X–axis)

7551	Selection of axis parallel to the Y–axis for tool post 1 on the plane perpendicular to the tool axis

7552	Selection of axis parallel to the Z–axis for tool post 2 on the plane perpendicular to the tool axis

7554	Selection of axis parallel to the B–axis for tool post 1 for tool–tip rotation

7555	Selection of axis parallel to the A–axis for tool post 1 for tool–tip rotation

7553	Tool axis selection for tool post 1

7556	Axis selection for changing the tool length compensation along the tool axis for tool post 1

Setting input

Data type : Byte

Valid range : 1 to 15

Specify the states of the axis selection signals (HS1D, HS1C, HS1B, and HS1A) for the first manual pulse generator to perform three–dimensional handle feed.

HS1D	HS1C	HS1B	HS1A	Value	HS1D	HS1C	HS1B	HS1A	Value
0	0	0	1	1	1	0	0	1	9
0	0	1	0	2	1	0	1	0	10
0	0	1	1	3	1	0	1	1	11
0	1	0	0	4	1	1	0	0	12
0	1	0	1	5	1	1	0	1	13
0	1	1	0	6	1	1	1	0	14
0	1	1	1	7	1	1	1	1	15
1	0	0	0	8					

7557	Distance L from the pivot point to the tool tip for tool post 1

Setting input

Data type : Two words

Valid range : –99999999 to 99999999

Specify the distance from the pivot point of the tool to the tool tip. The distance is used for executing handle feed in the tool tip center rotation and displaying the tool tip position.

	#7	#6	#5	#4	#3	#2	#1	#0
7558					3D2X	3D1X		

Parameter input

Data type : Bit

3D1X : Specifies whether to use machine or workpiece coordinates or a value specified in parameter No. 7546 for the angular displacement of the first rotation axis when using the three–dimensional handle feed function for tool post 1.

0 : Machine coordinates or workpiece coordinates

1 : Value specified in parameter No. 7546

3D2X : Specifies whether to use machine or workpiece coordinates or a value specified in parameter No. 7547 for the angular displacement of the second rotation axis when using the three–dimensional handle feed function for tool post 1.

0 : Machine coordinates or workpiece coordinates

1 : Value specified in parameter No. 7547

NOTE 1 When setting the angular displacements of the first and second rotation axes in 3D1X and 3D2X, assume that when the rotation axes are the A– and C–axes, the A–axis is the first rotation axis, and the C–axis is the second rotation axis.

NOTE 2 When 3D1X and 3D2X are set to 0, machine coordinates are used for operating the handle in three–dimensional handle feed; for displaying the tool tip position, however, workpiece coordinates are used.

	#7	#6	#5	#4	#3	#2	#1	#0
7611	DETL							

Parameter input

Data type : Bit

DETL : Specifies the timing when the tool length compensation along the tool axis is to be updated when the number of manual interrupt pulses and the travel distance are displayed.

0 : When the execution of a block to be buffered next starts

1 : Every time the manual pulse generator turns

7750	Angular displacement of the first rotation axis of tool post 2

Parameter input

Data type : Two words

Unit of data :

Increment system	Unit of data
IS–A	0.01 deg
IS–B	0.001 deg
IS–C	0.0001 deg
IS–D	0.00001 deg
IS–E	0.000001 deg

Specify the angular displacement of the first rotation axis which is not controlled by the CNC when using the three–dimensional handle feed function for tool post 2.

7751	Angular displacement of the second rotation axis of tool post 2

Parameter input

Data type : Two words

Unit of data :

Increment system	Unit of data
IS–A	0.01 deg
IS–B	0.001 deg
IS–C	0.0001 deg
IS–D	0.00001 deg
IS–E	0.000001 deg

Specify the angular displacement of the second rotation axis which is not controlled by the CNC when using the three–dimensional handle feed function for tool post 2.

	#7	#6	#5	#4	#3	#2	#1	#0
7752		3D2B	3D1B	TAXB		BMTB	SABB	HLBB

Parameter input

Data type : Bit

HLBB Sets the configuration of the rotation axes for three–dimensional handle feed for tool post 2 when the tool axis is the Z–axis.

0 : A– and C–axes

1 : B– and C–axes

NOTE Set TAXB and SABB of parameter No. 7752 to 0. If TAXB or SABB is 1, the setting of HLBB is ignored.

SABB Specifies the configuration of the rotation axes for three–dimensional handle feed for tool post 2 when the tool axis is the Z–axis.

0 : A– and C–axes, or B– and C–axes. One of these combinations is determined by HLBB of parameter No. 7752.

1 : A– and B–axes (only for handle feed along the tool axis)

NOTE Set TAXB of parameter No. 7752 to 0. If TAXB is 1, the SABB setting is ignored.

BMTB Specifies the master axis when the tool axis of tool post 2 is the Z–axis, and the rotation axes are the A– and B–axes (when SABB of parameter No. 7752 is 1).

0 : A–axis

1 : B–axis

TAXB Specifies the configuration of the rotation axes and tool axis for three–dimensional handle feed for tool post 2.

0 : The tool axis is the Z–axis, and the rotation axes are the A– and C–axes, B– and C–axes, or A– and B–axes. (The combination of the rotation axes is determined by HLBB and SABB.)

1 : The tool axis is the X–axis, and the rotation axes are the A– and B–axes.

3D1B : Specifies whether to use machine or workpiece coordinates or a value specified in parameter No. 7750 for the angular displacement of the first rotation axis when using the three–dimensional handle feed function for tool post 2.

0 : Machine coordinates or workpiece coordinates

1 : Value specified in parameter No. 7750

3D2B : Specifies whether to use machine or workpiece coordinates or a value specified in parameter No. 7751 for the angular displacement of the second rotation axis when using the three–dimensional handle feed function for tool post 2.

0 : Machine coordinates or workpiece coordinates

1 : Value specified in parameter No. 7751

NOTE 1 When setting the angular displacements of the first and second rotation axes in 3D1B and 3D2B, assume that when the rotation axes are the A– and C–axes, the A–axis is the first rotation axis, and the C–axis is the second rotation axis.

NOTE 2 When 3D1B and 3D2B are set to 0, machine coordinates are used for operating the handle in three–dimensional handle feed; for displaying the tool tip position, however, workpiece coordinates are used.

When three–dimensional handle feed is performed for tool post 2, set parameters according to the axis configuration as follows:

HLB	SLAB	BMST	TLAX	Tool axis	Rotation axes	Master axis
0	0	0	0	Z–axis	A– and C–axes	–
1	0	0	0	Z–axis	B– and C–axes	–
0	0	0	1	X–axis	A– and B–axes	–
0	1	0	0	Z–axis	A– and B–axes	A–axis
0	1	1	0	Z–axis	A– and B–axes	B–axis

When the rotation axes for tool post 2 are the A– and C–axes or B– and C–axes (when the tool axis is the Z–axis)

7753	Selection of axis parallel to the X–axis for tool post 2 on the plane perpendicular to the tool axis

7754	Selection of axis parallel to the Y–axis for tool post 2 on the plane perpendicular to the tool axis

7756	Selection of axes parallel to the A– and B–axes for tool post 2 for tool–tip rotation

7757	Selection of axis parallel to the C–axis for tool post 2 for tool–tip rotation

When the rotation axes for tool post 2 are the A– and B–axes (when the tool axis is the X–axis)

7753	Selection of axis parallel to the Y–axis for tool post 2 on the plane perpendicular to the tool axis

7754	Selection of axis parallel to the Z–axis for tool post 2 on the plane perpendicular to the tool axis

7756	Selection of axis parallel to the B–axis for tool post 2 for tool–tip rotation

7757	Selection of axis parallel to the A–axis for tool post 2 for tool–tip rotation

7755	Tool axis selection for tool post 2

7758	Axis selection for changing the tool length compensation along the tool axis for tool post 2

Setting input

Data type : Byte

Valid range : 1 to 15

Specify the states of the axis selection signals (HS1D, HS1C, HS1B, and HS1A) for the first manual pulse generator to perform three–dimensional handle feed.

HS1D	HS1C	HS1B	HS1A	Value	HS1D	HS1C	HS1B	HS1A	Value
0	0	0	1	1	1	0	0	1	9
0	0	1	0	2	1	0	1	0	10
0	0	1	1	3	1	0	1	1	11
0	1	0	0	4	1	1	0	0	12
0	1	0	1	5	1	1	0	1	13
0	1	1	0	6	1	1	1	0	14
0	1	1	1	7	1	1	1	1	15
1	0	0	0	8					

7759	Distance L from the pivot point to the tool tip for tool post 2

Setting input

Data type : Two words

Valid range : –99999999 to 99999999

Specify the distance from the center of rotation of the tool to the tool tip. The distance is used for executing handle feed in the tool tip center rotation and displaying the tool tip position.

4.43 Parameters Related to 15–TT Tool Length Compensation Along the Tool Axis

	#7	#6	#5	#4	#3	#2	#1	#0
6005			LTWMB	LTWM				

Parameter input

Data type : Bit

LTWM Specifies the application of the tool offset for tool post 1.

0 : The conventional method is used.

1 : The tool offset is applied only to movement blocks that contain a move command.

LTWMB Specifies the application of the tool offset for tool post 2.

0 : The conventional method is used.

1 : The tool offset is applied only to movement blocks that contain a move command.

	#7	#6	#5	#4	#3	#2	#1	#0
6001	BC							

	#7	#6	#5	#4	#3	#2	#1	#0
7550			TLAX					

Parameter input

Data type : Bit

BC Specifies the rotation axes for tool post 1 for tool length compensation along the tool axis when the tool axis is the Z–axis.

0 : A– and C–axes

1 : B– and C–axes

TLAX Specifies the axis configuration (including the tool axis) for tool post 1 for tool length compensation along the tool axis.

0 : The tool axis is parallel to the Z–axis, and the rotation axes are the A– and C–axes or the B– and C–axes.

1 : The tool axis is parallel to the X–axis, and the rotation axes are the A– and B–axes.

BC	TLAX	Tool axis	Rotation axes
0	0	Parallel to the Z–axis	A– and C–axes
0	1	Parallel to the X–axis	A– and B–axes
1	0	Parallel to the Z–axis	B– and C–axes
1	1	Parallel to the X–axis	A– and B–axes

	#7	#6	#5	#4	#3	#2	#1	#0
6005					BCB			

	#7	#6	#5	#4	#3	#2	#1	#0
7752				TAXB				

Parameter input

Data type : Bit

BCB Specifies the rotation axes for tool post 2 for tool length compensation along the tool axis when the tool axis is the Z–axis.

0 : A– and C–axes

1 : B– and C–axes

TAXB Specifies the axis configuration (including the tool axis) for tool post 2 for tool length compensation along the tool axis.

0 : The tool axis is parallel to the Z–axis, and the rotation axes are the A– and C–axes or the B– and C–axes.

1 : The tool axis is parallel to the X–axis, and the rotation axes are the A– and B–axes.

BCB	TAXB	Tool axis	Rotation axes
0	0	Parallel to the Z–axis	A– and C–axes
0	1	Parallel to the X–axis	A– and B–axes
1	0	Parallel to the Z–axis	B– and C–axes
1	1	Parallel to the X–axis	A– and B–axes

7546	Angular displacement of the first rotation axis of tool post 1

Parameter input

Data type : Two words

Unit of data :

Increment system	Unit of data
IS–A	0.01 deg
IS–B	0.001 deg
IS–C	0.0001 deg
IS–D	0.00001 deg
IS–E	0.000001 deg

Specify the angular displacement of the first rotation axis which is not controlled by the CNC when using the tool length compensation along the tool axis for tool post 1.

7547	Angular displacement of the second rotation axis of tool post 1

Parameter input

Data type : Two words

Unit of data :

Increment system	Unit of data
IS–A	0.01 deg
IS–B	0.001 deg
IS–C	0.0001 deg
IS–D	0.00001 deg
IS–E	0.000001 deg

Specify the angular displacement of the second rotation axis which is not controlled by the CNC when using the tool length compensation along the tool axis for tool post 1.

7548	Offset of tool length compensation along the tool axis for tool post 1

Parameter input

Data type : Two words

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Millimeter machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

An additional offset can be applied to the tool length compensation along the tool axis. This parameter sets the offset to be applied for tool post 1.

7760	Offset of tool length compensation along the tool axis for tool post 2

Parameter input

Data type :Two words

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Millimeter machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

An additional offset can be applied to the tool length compensation along the tool axis. This parameter sets the offset to be applied for tool post 2.

	#7	#6	#5	#4	#3	#2	#1	#0
7558					3D2X	3D1X		

Parameter input

Data type : Bit

3D1X Specifies whether to use a programmed value or a value specified in parameter No. 7546 for the angular displacement of the first rotation axis when using tool length compensation along the tool axis for tool post 1.

0 : Programmed value

1 : Value specified in parameter No. 7546

3D2X Specifies whether to use a programmed value or a value specified in parameter No. 7547 for the angular displacement of the second rotation axis when using the tool length compensation along the tool axis for tool post 1.

0 : Programmed value

1 : Value specified in parameter No. 7547

NOTE When the tool axis is the Z–axis, and the A– and C–axes are specified, the first rotation axis is the A–axis, and the second rotation axis is the C–axis. When the tool axis is the Z–axis, and the B– and C–axes are specified, the first rotation axis is the B–axis, and the second rotation axis is the C–axis. When the tool axis is the X–axis, and the A– and B–axes are specified, the first rotation axis is the A–axis, and the second rotation axis is the B–axis.

7750	Angular displacement of the first rotation axis of tool post 2

Parameter input

Data type : Two words

Unit of data :

Increment system	Unit of data
IS–A	0.01 deg
IS–B	0.001 deg
IS–C	0.0001 deg
IS–D	0.00001 deg
IS–E	0.000001 deg

Specify the angular displacement of the first rotation axis which is not controlled by the CNC when using the tool length compensation along the tool axis for tool post 2.

7751	Angular displacement of the second rotation axis of tool post 2

Parameter input

Data type :Two words

Unit of data :

Increment system	Unit of data
IS–A	0.01 deg
IS–B	0.001 deg
IS–C	0.0001 deg
IS–D	0.00001 deg
IS–E	0.000001 deg

Specify the angular displacement of the second rotation axis which is not controlled by the CNC when using the tool length compensation along the tool axis for tool post 2.

		#7	#6	#5	#4	#3	#2	#1	#0
7752			3D2B	3D1B					

Parameter input

Data type : Bit

3D1B Specifies whether to use a programmed value or a value specified in parameter No. 7750 for the angular displacement of the first rotation axis when using the tool length compensation along the tool axis for tool post 2.

0 : Programmed value

1 : Value specified in parameter No. 7750

3D2B Specifies whether to use a programmed value or a value specified in parameter No. 7751 for the angular displacement of the second rotation axis when using the function for tool length compensation along the tool axis for tool post 2.

0 : Programmed value

1 : Value specified in parameter No. 7751

Example Assume that the X–, Z–, Y–, and B–axes are specified, and that the tool axis is the X–axis (the rotation axes are the A– and B–axes). Also assume that 3D1B of parameter No. 7752 is set to 1, that 3D2B is set to 0, that parameter No. 7750 is set to 0, and that the offset along the X–axis is 10.000. Then, specify the following:

G90 G43.1 X100. Z100. Y100. T0101 B45. ; (Diameter specification for the X–axis)

Then, the absolute positions for the axes are indicated on the CRT as follows. (DTA of parameter No. 2203 is set to 1 to include in the indicated values the travel distance by tool length compensation along the tool axis.)

X= 107.071

Z= 96.464

Y= 100.000

B= 45.000

4.44 Parameters Related to Designation Direction Tool Length Compensation

	#7	#6	#5	#4	#3	#2	#1	#0
7711						FWRT		EDDT

Parameter input

Data type : Bit

EDDT Specifies the mode to be entered when G41 or G42 is specified together with addresses I, J, and K in the same block.

0 : 3–dimensional tool compensation mode is entered.

1 : Designation direction tool length compensation mode is entered.

FWRT Specifies whether the feedrate in designation direction tool length compensation mode is ssumed to be the feedrate for movement including rotation–axis movement.

0 : Feedrate for movement excluding rotation–axis movement is assumed.

1 : Feedrate for movement including rotation–axis movement is assumed.

Parameters related to the designation direction tool length compensation function

Data No.	Bit	Explanation
1000	7	Rotation axis configuration when the tool axis is the Z–axis
7550	1	Rotation axis configuration when the tool axis is the Z–axis
	2	Master axis when the tool axis is the Z–axis, and the rotation axes are the A– and B–axes
	5	Axis configuration in the tool axis direction
7558	2	Specifies whether to use the parameter–set value as the angular displacement for the first rotation axis.
	3	Specifies whether to use the parameter–set value as the angular displacement for the second rotation axis.
7546	–	Angular displacement for the first rotation axis
7547	–	Angular displacement for the second rotation axis

Set the following parameters for the rotation axes:

Data No.	Bit	Setting	Meaning
1006	0	1	Rotation axis
1008	0	1	Performs rotation axis roll–over.
1260	–	IS–A : 36000 IS–B : 360000 IS–C : 3600000 IS–D : 36000000	Amount of travel per rotation of a rotation axis

4.45 Parameter Related to Upgraded 5–Axis Control Compensation

4.45.1 Specifying the coordinates

The 5–axis control functions automatically calculate the direction of the tool axis, which varies as the rotation axis (AC–axis, BC–axis, or AB–axis) moves, in order to manually move the tool with a handle or apply tool leng th compensation. The coordinates for the rotation axis, which determine the direction of the tool axis, can be set in parameters No. 7546 and 7547. The following 5–axis control functions can be used when the rotation axis is only mechanically operated and not an NC axis:

1 Three–dimensional handle feed

2 Tool length compensation along the tool axis (G43.1)

NOTE	The AC–axis means the A–axis and C–axis. The BC–axis and AB–axis also conform to this notation.

When the coordinates for the rotation axis are set in parameters for the above functions, the A–, B–, or C–axis can be used as an axis independent of the 5–axis control functions. For an axis independent of the 5–axis contr ol functions, coordinates are updated as the axis moves but are not used for the functions.

4.45.2 Display

The absolute coordinates are displayed by subtracting the tool length compensations along the tool axis.

4.45.3 Display for three–dimensional coordinate conversion

The remaining distance the tool must be moved for three–dimensional coordinate conversion can be displayed about the program coordinate system and about the workpiece coordinate system.

1 Do not set 0 (rotation axis) in the bit for the first axis in parameter No. 1022.

2 2 Set 0 in parameter No. 7554 when the coordinates for the first rotation axis are specified by parameters. Set 0 in parameter No. 7555 when the coordinates for the second rotation axis are specified by parameters.

Example Set 0 in parameter No. 7554 when the BC–axis is selected and the coordinates for the first axis (B–axis) are specified by parameters in the tool tip center rotation mode. Set the axis number of the C–axis in param eter No. 7555.

3 Do not change 3D1X and 3D2X in parameter Nos. 7546, 7547, 7554, 7555, and 7558 in the tool tip center rotation mode or for tool length compensation along the tool axis.

4 The unit for specifying the coordinates for the rotation axis in parameter Nos. 7546 and 7547 is the same as that for the reference axis (parameter No. 1031). In this case, do not use the reference axis for the rotation axis.

5 Set 0 in CCLR (bit 3 of parameter No. 7550) when the coordinates for the second rotation axis are specified by parameters. Set 0 in parameter No. 7547 when setting 0 for the C–axis.

4.46 Parameters Related to High–Precision Contour Control

The following table lists the high–resolution contour control parameters.

Specify the standard settings when using this function for the first time. These settings must be adjusted according to mechanical characteristics, workpiece type, target precision, machining speed, and so on.

Param. No.	Standard setting	Meaning
0000#5 (DNC)	1	If this is set to 1, high–speed distribution is not performed during DNC operation. When the high–resolution contour control function is to be used during DNC operation, this parameter must be set to 1, because high–resolution contour control is disabled during high–speed distribution.
1403#2	1	Set 1.
1403#5 (OVRIM)	1	Set 1 so that the feedrate override change becomes effective immediately.
1478	1/10 of No.1422	Allowable feedrate change in determining the feedrate according to the difference in the feedrate at corners
1490	Same as No. 1422	Upper limit of feedrate for clamping according to the arc radius
1491	10 (IS–B) 100 (IS–C)	Lower limit of feedrate for clamping according to the arc radius
1492	Obtained from the expression at the right	Arc radius for the upper limit of feedrate for clamping when clamping is done according to the arc radius $V \times \frac{10 \times Ta}{60}$ (V : Value set in parameter No. 1422 Ta : Value set in parameter No. 1643)
1600#4	0	0: Enables linear acceleration/deceleration after interpolation
1630	Same as No. 1422	Parameter 1 for setting the acceleration of linear acceleration/deceleration before interpolation (target speed)
1631	200	Parameter 2 for setting the acceleration of linear acceleration/deceleration before interpolation (time required to attain the target speed)
1635	32	Time constant for acceleration/deceleration after cutting feed interpolation during automatic feedrate control
1643	400	Parameter for determining the allowable acceleration when the feedrate is determined according to acceleration (time required to attain the maximum cutting speed set in parameter No. 1422)
1811#2	1	Feed–forward parameter. Set 1.
1808#3 PIENBL	1 *1	Feed–forward parameter. Set 1.
1883#1 FEEDFD	1 *1	Feed–forward parameter. Set 1.
1962	50 (indicates 50%) *1	Feedrate feed–forward factor
1985	9800 (indicates 98%) *1	Feed–forward factor
2401#6 (MBF)	0	If this is set to 1, the multi buffer mode is entered when the power is turned on or when the system is reset. If bit 0 of parameter No. 7565 is set to 1 to enable high–precision contour control, high–precision contour control is also provided.
7559#0	0	Set 0.
7559#1	1	Set 1.
7561	Same as parameter No. 1422	Set the same value as the maximum cutting feedrate.
7565#0 (USE)	1	Set 1 to enable automatic feedrate control.

Cont'd

Param. No.	Standard setting	Meaning
7565#4 (ZAG)	1	Set 1 to enable the function for determining the feedrate according to the cutting load.
7565#7 (NOF)	0	Set 0 to not ignore F commands.
7566	10	Range of ignorable feedrate variation
7567	Same as parameter No. 1422	Upper limit for automatic feedrate control
7569	0	This parameter is not currently used. Set 0.
7591	90	Override value for area 2 of the function for determining the feedrate according to the cutting load
7592	80	Override value for area 3 of the function for determining the feedrate according to the cutting load
7593	70	Override value for area 4 of the function for determining the feedrate according to the cutting load
7614#4 (BLK)	0	Set 0.
7614#5 (DST)	1	Set 1.

NOTE *1 For details, refer to the AC servo maintenance manual.

	#7	#6	#5	#4	#3	#2	#1	#0
7559							CTYP	CDEC

Parameter input

Data type : Bit

CDEC When high–precision contour control is to be used, set 0.

CTYP When high–precision contour control is to be used, set 1.

7561	Initial feedrate under automatic feedrate control

Parameter input

Data type : Two words

Unit of data : Conforms to the increment system for the reference axis (to be specified with parameter No. 1031).

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	100.0	10.0	1.0	0.1	0.01	mm/min
Inch system machine	10.0	1.0	0.1	0.01	0.001	inch/min
Rotary axis	100.0	10.0	1.0	0.1	0.01	deg/min

Valid range : 1 to 60000

Specify an initial feedrate for automatic feedrate control. If a program contains no F command when automatic feedrate control is used, the initial feedrate set in this parameter is used. Usually, set the same value as the maximum cutting feedrate (parameter No. 1422) .

	#7	#6	#5	#4	#3	#2	#1	#0
7565	NOF			ZAG				USE

Setting input

Data type : Bit

USE Specifies whether automatic feedrate control is used.

0 : Not used.

1 : Used.

ZAG Specifies whether feedrate determination based on the angle of downward movement along the Z-axis is used.

0 : Not used.

1 : Used.

NOF Specifies whether an F command is enabled or ignored in a block where automatic feedrate control is enabled.

0 : Enabled.

1 : Ignored. Instead, the maximum feedrate set in parameter No. 7567 for automatic feedrate control is used as the specified feedrate.

7566	Range when the change in the feedrate is ignored

Setting input

Data type : Byte

Unit of data : ±%

Valid range : 0 to 100

When the difference between the feedrate calculated by automatic feedrate control and the feedrate specified in the preceding block is within the above range, the feedrate is assumed to be the same feedrate as that specified in the preceding block. (In this case, the difference is calculated by assuming that the feedrate in the preceeding block is 100%.) This setting prevents the surface roughness due to frequent variations in the feedrate.

7567	Maximum feedrate under automatic feedrate control

Setting input

Data type : Two words

Unit of data : Conforms to the increment system for the reference axis.

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric input	100.0	10.0	1.0	0.1	0.01	mm/min
Inch input	10.0	1.0	0.1	0.01	0.001	inch/min

Valid range : 1 to 60000

Specifies the maximum feedrate under automatic feedrate control.

This setting supersedes all other settings under automatic feedrate control. The maximum feedrate is not exceeded.

Usually, set the same value as the maximum cutting feedrate (parameter No. 1422) .

7591	Override in area 2

Parameter input

Data type : Word

Unit of data : Percent

Valid range : 1 to 100 (Standard setting:80)

Specify the override in area 2 for determining the feedrate according to the cutting load.

7592	Override in area 3

Parameter input

Data type : Word

Unit of data : Percent

Valid range : 1 to 100 (Standard setting:70)

Specify the override in area 3 for determining the feedrate according to the cutting load.

7593	Override in area 4

Parameter input

Data type : Word

Unit of data : Percent

Valid range : 1 to 100 (Standard setting:60)

Specify the override in area 4 for determining the feedrate according to the cutting load.

4.47 Parameters Related to High–Precision Contour Control Based on a 64–Bit RISC Processor

The following tables list the parameters related to high–precision contour control based on a 64–bit RISC processor. The standard settings should be used when these parameters are used for the first time. The settings may have to be adjusted depending on the characteristics of the machine, the workpiece type, target precision, machining speed, and so on.

The subsequent sections (4.46.1 to 4.46.3) focus on those parameters dedicated to high–precision contour control based on a 64–bit RISC processor. Those parameters not covered in these sections are common to ordinary high–precision contour control. See Section 4.45 or the descriptions of the corresponding parameter Nos. for details of these parameters. Note that the descriptions of parameters that depend on the setting unit are effective only in IS–A to IS–D, because IS–E cannot be used with 64–bit RISC processor–based high–precision contour control.

Parameter No.	Standard setting	Meaning
0000#5 (DNC)	0	For DNC operation based on remote buffers, set this parameter to 0. If it is set to 1, a sufficient feedrate may not be attained in very small blocks.
1009#9 (RCAx)	–	Set this parameter to 1 for an axis that is to be placed under 64–bit RISC processor–based high–precision control.
1009#0 (PMCEx)	–	Set this parameter to 1 for an axis that can be placed under PMC axis control.
1478	1/10 of the value set in parameter No. 1422	Allowable feedrate change in determining the feedrate according to the feedrate difference at corners
1504	0 (indicates 5%)	Specifies a range where the feedrate fluctuation clamp function is disabled.
1600#4 (CTEx)	0	Enables linear acceleration/deceleration after interpolation.
1601#0 (CIRF)	1	Enables automatic feedrate control based on acceleration/deceleration during arc interpolation. Parameter No. 1643 must also be set.
1601#4	1	Enables corner deceleration.
1601#7	1	Specifies bell–shaped acceleration/deceleration before interpolation. Parameter No. 8416 must also be set.
1630	Same value as in parameter No. 1422	Parameter 1 for setting the acceleration of acceleration/deceleration before interpolation (target speed)
1631	200	Parameter 2 for setting the acceleration of acceleration/deceleration before interpolation (time required to attain the target speed)
1635	32	Time constant for acceleration/deceleration after cutting feed interpolation during automatic feedrate control
1643	400	Parameter for determining the allowable acceleration when the feedrate is determined according to the acceleration (time required to attain the maximum cutting feedrate set with parameter No. 1422)
1811#2 (ADV)	1 *1	Parameter for feed–forward. Set to 1.
1808#3 (PIENBL)	1 *1	Parameter for feed–forward. Set to 1.
1883#1 (FEEDFD)	1 *1	Parameter for feed–forward. Set to 1.
1962	50 (indicates 50%) *1	Velocity feed–forward factor
1985	9800 (indicates 98%) *1	Feed–forward factor

Parameter No.	Standard setting	Meaning
7559#0 (CDEC)	0	Set to 0.
7559#1 (CTYP)	1	Set to 1.
7559#5 (FD_HIS)	1	Enables the speed clamp function. Parameter No. 1504 must also be set.
7559#6 (FALM)	0	In automatic feedrate control, a value set with parameter No. 7561 is used instead of this parameter, if the F command is 0.
7561	Same value as that in parameter No. 1422	Set the same value as the maximum cutting feedrate.
7565#0 (USE)	1	Enables automatic feedrate control.
7565#4 (ZAG)	1	Enables the feedrate to be determined according to the angle of the Z–axis (cutting load).
7565#7 (NOF)	0	Enables the F command in a block where automatic feedrate control is enabled.
7566	0	Range in which feedrate fluctuation is ignored. No standard setting is used for this parameter. Instead, the feedrate fluctuation clamp function based on bit 5 (FD_HIS) of parameter No. 7559 and parameter No. 1504 is used.
7567	Same value as in parameter No. 1422	Specifies the upper limit for automatic feedrate control.
7569	0	This parameter is currently not used. Set to 0.
7591	90	Override value for area 2 of the function for determining the feedrate according to the cutting load.
7592	80	Override value for area 3 of the function for determining the feedrate according to the cutting load.
7593	70	Override value for area 4 of the function for determining the feedrate according to the cutting load.
7614#4 (BLK)	0	Set to 0.
7614#5 (DST)	1	Set to 1.
8403#1 (MSU)	1	Enables the positioning/auxiliary function in 64–bit RISC processor–based high–precision contour control mode.
8403#7 (SGO)	0	Specifies that rapid traverse (G00) is to comply with bit 1 (MSU) of parameter No. 8403.
8416	32	Time required to attain the maximum acceleration for bell–shaped acceleration/deceleration before look–ahead interpolation
8481	0	Rapid traverse rate used when bit 7 (SG0) of parameter No. 8403 is 1. This parameter need not be set, because bit 7 (SG0) of parameter No. 8403 is initialized to 0.

NOTE 1 Multibuffers are enabled in 64–bit RISC processor–based high–precision contour control mode regardless of whether bit 5 (DNC) of parameter No. 0000 and bit 6 (MBF) of parameter No. 2401 are set to 1 or 0.

NOTE 2 Refer to the AC Servo Amplifier maintenance manual (B–65005E) for details of those parameters marked *1.

4.47.1 Parameters related to axis control

	#7	#6	#5	#4	#3	#2	#1	#0
1009		PMCEx						RCAx

Parameter input

Data type : Bit axis

RCAx Specifies whether the relevant axis is to be placed under 64–bit RISC processor–based high–precision contour control (HPCC).

0 : Axis is not controlled in HPCC mode

1 : Axis is controlled in HPCC mode

If the axis is to be controlled in HPCC mode, this parameter must be set to 1. For those axes for which the parameter is 0, changes in the state of the axis interlock signal (*ITLn) and the axis machine lock signal (MLKn) are ignored in HPCC mode (G05 P10000).

If the axis interlock signal goes low for an axis for which this parameter is 1 or if the axis machine lock signal goes high for that axis, an interlock or machine lock is applied to all axes in HPCC mode.

In HPCC mode, therefore, it is impossible to apply an interlock or machine lock to individual axes separately.

PMCEx Specifies whether the relevant axis can be a PMC–controlled axis in 64–bit RISC processor–based high–precision contour control (HPCC) mode.

0 : Axis that cannot be a PMC–controlled axis (axis to be placed in HPCC mode)

1 : Axis that can be a PMC–controlled axis (axis not to be placed in HPCC mode)

If PMC axis control is to be used in a system that has the 64–bit RISC processor–based high–precision contour control function, this parameter must be set to 1 for those axes that can be placed under PMC axis control.

If a programmed command is issued to an axis for which PMCEx is set to 1, an alarm (PS450 IN PMC AXIS MODE) is issued, such that automatic operation is discontinued without causing the PMC axis to stop.

4.47.2 Parameters related to automatic feedrate control and acceleration/deceleration before interpolation

	#7	#6	#5	#4	#3	#2	#1	#0
1601	NWBL			BIP				CIRF

Parameter input

Data type : Bit

CIRF Specifies whether to use the automatic feedrate control function according to acceleration/deceleration during arc interpolation in 64–bit RISC processor–based high–precision contour control (HPCC) mode.

0 : The automatic feedrate control function is not used.

1 : The automatic feedrate control function is used.

If this parameter is set to 1, parameter No. 1643 (for specifying the allowable acceleration) must also be specified.

BIP Specifies whether to use corner deceleration in 64–bit RISC processor–based high–precision contour control (HPCC) mode.

0 : Corner deceleration is not used.

1 : Corner deceleration is used.

This parameter should usually be set to 1.

NWBL Specifies whether acceleration/deceleration before interpolation is to be linear or bell–shaped in 64–bit RISC processor–based high–precision contour control (HPCC) mode.

0 : Linear

1 : Bell–shaped

If this parameter is set to 1, parameter No. 8416 must also be specified.

		#7	#6	#5	#4	#3	#2	#1	#0
7559				FALM	FD_HIS				

Parameter input

Data type : Bit

FD_HIS Specifies whether to enable feedrate fluctuation clamping in 64–bit RISC processor–based high–precision contour control (HPCC) mode.

0 : Feedrate fluctuation clamping is disabled.

1 : Feedrate fluctuation clamping is enabled.

If this parameter is set to 1, the range in which feedrate fluctuation is ignored, as specified in parameter No. 7566, is disabled.

FALM Specifies whether to issue an alarm if the F command (F code) is 0 in automatic feedrate control in 64–bit RISC processor–based high–precision contour control mode.

0 : No alarm is issued; the feedrate specified in parameter No. 7561 is used.

1 : An alarm is issued.

1504	Feedrate fluctuation clamp ratio

Parameter input

Data type : Byte

Unit of data : %

Valid range : 0 to 127 (0 corresponds to 5%.)

This parameter specifies a range in which the feedrate will not be changed by the feedrate fluctuation clamp function in 64–bit RISC processor–based high–precision contour control mode.

8416	Time required to attain the maximum acceleration of bell–shaped acceleration/deceleration before look–ahead interpolation

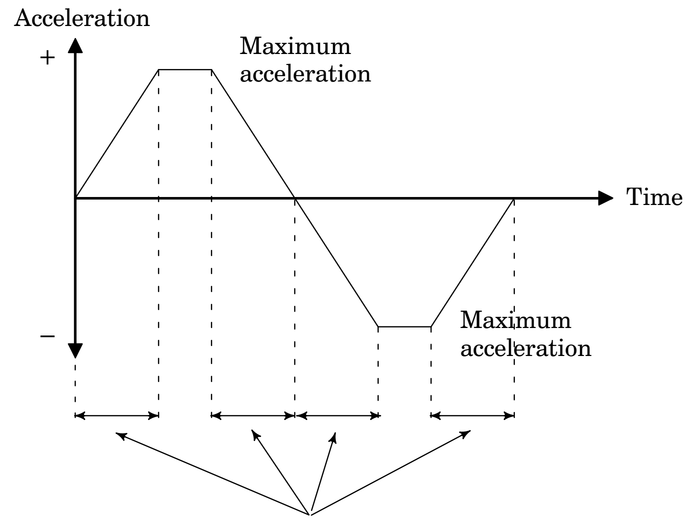
Parameter input

Data type : Two–word

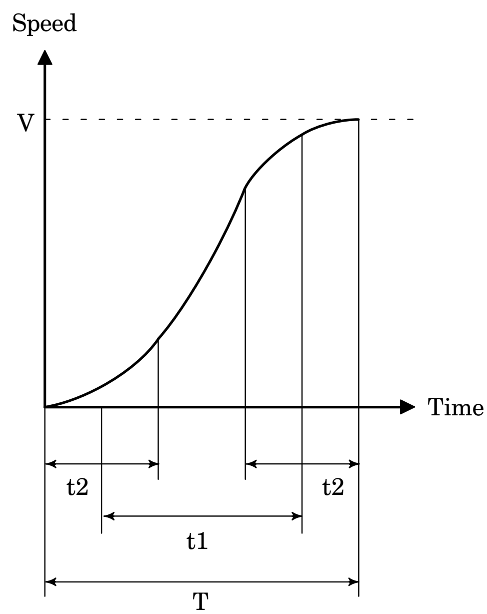
Unit of data : 1 msec

Valid range : 0 to 9999999

This parameter specifies the time required to attain the maximum acceleration of bell–shaped acceleration/deceleration before look–ahead interpolation in 64–bit RISC processor–based high–precision contour control (HPCC) mode. This parameter is also used as the time required to decelerate from the maximum acceleration to 0.



The same value must be specified for these intervals.



t1 : Time constant assumed for linear acceleration/ deceleration (parameter No. 1631)
t2 : Time required to round a corner (parameter No. 8416)
V : Speed needed to set the acceleration time t1 (parameter No. 1630)
This must usually be set to the maximum cutting feedrate.

Suppose:

Total time	= T
Time for the linear section	= T − 2 x t2
Time for each curved section	= t2

The total time varies with the target speed (constant−acceleration method).

4.47.3 Parameters related to the positioning/auxiliary function

		#7	#6	#5	#4	#3	#2	#1	#0
8403		SG0						MSU	

Parameter input

Data type : Bit

MSU Specifies whether to issue an alarm if a positioning or auxiliary function is specified in 64–bit RISC processor–based high–precision contour control (HPCC) mode.

0 : An alarm is raised.

1 : The function is executed.

SG0 Specifies whether to conform to bit 1 (MSU) of parameter No. 8403 if a positioning command (G00) is specified in 64–bit RISC processor–based high–precision contour control (HPCC) mode.

0 : Positioning conforms to bit 1 (MSU) of parameter No. 8403.

1 : Positioning does not conform to bit 1 (MSU) of parameter No. 8403; instead, simplified positioning is performed on the RISC processor board side (G00 is replaced with G01 to drive the axis at the speed specified in parameter No. 8481).

8481		Rapid traverse rate in HPCC mode

Parameter input

Data type : Two–word

Unit of data : Setting units for the reference axis (specified in parameter No. 1031)

Setting Unit	IS–A	IS–B	IS–C	IS–D	Unit
Metric system machine	100.0	10.0	1.0	0.1	mm/min
Inch system machine	10.0	1.0	0.1	0.01	inch/min
Rotary axis	100.0	10.0	1.0	0.1	deg/min

This parameter specifies the rapid traverse rate that is used when G00 is executed in a simplified way (when bit 7 (SG0) of parameter No. 8403 is 1) in 64–bit RISC processor–based high–precision contour control (HPCC) mode.

CAUTION Because G00 is replaced with G01, this rapid traverse rate is always used even if a two–axis command is issued.

Example Assuming the rapid traverse rate to be 1000 mm/min, issue the following command:
G00 X100. Y100. ;
The actual traverse rate F is F1000 rather than F1414.

4.48 Other Parameters (Parameter Numbers 7600 to 7799)

Classification	Data No.
Parameters related to Automatic tool offset	7600 7601
Parameters related to Rotary axis control/Index table indexing function	7602 7619 7631 7632 7682
Parameters related to Software operator's panel and override playback	7601 7603 7612 7617
Parameters related to interference check	7605 7651 7682 7683
Parameters related to High–speed machining function	7607
Parameters related to Manual handle feed	7608 7701
Parameters related to Exponential function interpolation	7610 7636 7637 7685
Parameters related to Synchronous/independent operation, simple synchronous, twin table control	7611 7613 7633 7702 7799
Parameters related to MMC	7613
Parameters related to Tool retracet and recover	7614
Parameters related to External memory and subprogram	7616
Parameters related to high–speed distribution/ultra–high–speed distribution in DNC operation with the remote buffer	7618 7635
Parameters related to Spline interpolation function B	7670 7671
Parameters related to Sequence number comparison and stop	7681
Parameters related to Programmable mirror image	7610
Parameters related to Graphic display	7703
Parameters related to Normal direction control	7616 7793 7794
Parameters related to each–axis scaling	7611
Parameters related to program restart and the function for displaying operating time and the number of parts	7620
Parameters related to the electronic gear box function and the hobbing–machine functions	7612 7795 7796
Parameters related to high–precision contour control	7614
Parameters related to unidirectional positioning	7616
Parameters related tool offset specified with tool numbers	7617
Parameters related to operation history	7765
Parameters related to Gentle normal direction control	7617 7620 7793

	#7	#6	#5	#4	#3	#2	#1	#0
7600	2A4	2A3	2A2	2A1	1A4	1A3	1A2	1A1
	G37.2				G37.1(G37)			

Parameter input

Data type : Bit

1A1 to 1A4 Specify a valid high–speed signal for the G37.1 (G37) command. High–speed signals and their corresponding bits are as follows:

High–speed signal	Bit
HDI0 ———	1A1
HDI1 ———	1A2
HDI2 ———	1A3
HDI3 ———	1A4

2A1 to 2A4 Specify a valid high–speed signal for the G37.2 command. (The G37.2 command is used only for the Series 15–T.) High–speed signals and their corresponding bits are as follows:

High–speed signal	Bit
HDI0 ———	2A1
HDI1 ———	2A2
HDI2 ———	2A3
HDI3 ———	2A4

	#7	#6	#5	#4	#3	#2	#1	#0
7601		OPND			3A4	3A3	3A2	3A1
					G37.3			

Parameter input (only for the Series 15–T)

Data type : Bit

3A1 to 3A4 Specify a valid high–speed signal for the G37.3 command. High–speed signals and their corresponding bits are as follows:

High–speed signal	Bit
HDI0 ———	3A1
HDI1 ———	3A2
HDI2 ———	3A3
HDI3 ———	3A4

OPND

0 : The unused switches are displayed on the software operator panel.

1 : The unused switches are not displayed on the software operator panel.

> **NOTE** Parameter Nos. 7603, 7617, and 2311 to 2388 specify whether each switch is to be used. For details, see the descriptions of each parameter.

	#7	#6	#5	#4	#3	#2	#1	#0
7602			IDDP	IINC	IG90	IREL	IABS	IDX

Data type : Bit

IDX Specifies whether the index table indexing sequence is type A or B.

0 : Type A

1 : Type B

IABS When the index table indexing function is used, this bit must be set to 1.

IREL When the current position of the index table indexing axis in the relative coordinate system is displayed:

0 : Keeps the angular displacement for the current position.

1 : Reduces the angular displacement for the current position to the equivalent value within 360 degrees.

IG90

0 : Treats commands for the index table indexing axis as absolute commands in the G90 mode or as incre mental commands in the G91 mode.

1 : Always treats commands for the rotary control axis as absolute commands.

IINC In index table indexing, when the NC converts the command value to the corresponding value within 360 , with the difference between the converted value and the current position being regarded as the angular displacement through which the axis is to be moved, this bit specifies whether to turn in whi chever direction minimizes the displacement in G90 mode.

0 : Does not turn in the direction that minimizes the displacement.

1 : Turns in the direction that minimizes the displacement.

IDDP Selects the input format of a decimal point for the index table indexing.

0 : Conventional format : [Example] B1; = 0.001 deg. (when the IS–B increment system is used)

1 : Fixed–point format : [Example] B1; = 1.000 deg. (when the IS–B increment system is used)

	#7	#6	#5	#4	#3	#2	#1	#0
7603		OPG7	OPG6	OPG5	OPG4	OPG3	OPG2	OPG1

Setting input

Data type : Bit axis

OPG1 1 : Enables the operator to select a mode on the software operator’s panel.

0 : Disables the operator to select a mode on the software operator’s panel.

OPG2 1 : Enables the operator to set the switches for selecting a jog feed axis and jog rapid traverse feedrate on the software operator’s panel.

0 : Disables the operator to set the switches for selecting a jog feed axis and jog rapid traverse feedrate on the software operator’s panel.

OPG3 1 : Enables the operator to set the switches for selecting an axis and magnification for the manual pulse generator on the software operator’s panel.

0 : Disables the operator to set the switches for selecting an axis and magnification for the manual pulse generator on the software operator’s panel.

OPG4 1 : Enables the operator to set the switches for jog feedrate, override, and rapid traverse override on the software operator’s panel.

0 : Disables the operator to set the switches for jog feedrate, override, and rapid traverse override on the software operator’s panel.

OPG5 1 : Enables the operator to set the switches for block deletion, single block, machine lock, and dry run on the software operator’s panel.

0 : Disables the operator to set the switches for block deletion, single block, machine lock, and dry run on the software operator’s panel.

OPG6 1 : Enables the operator to protect memory on the software operator's panel.
0 : Disables the operator to protect memory on the software operator's panel.

OPG7 1 : Enables the operator to hold feed on the software operator's panel.
0 : Disables the operator to hold feed on the software operator's panel.

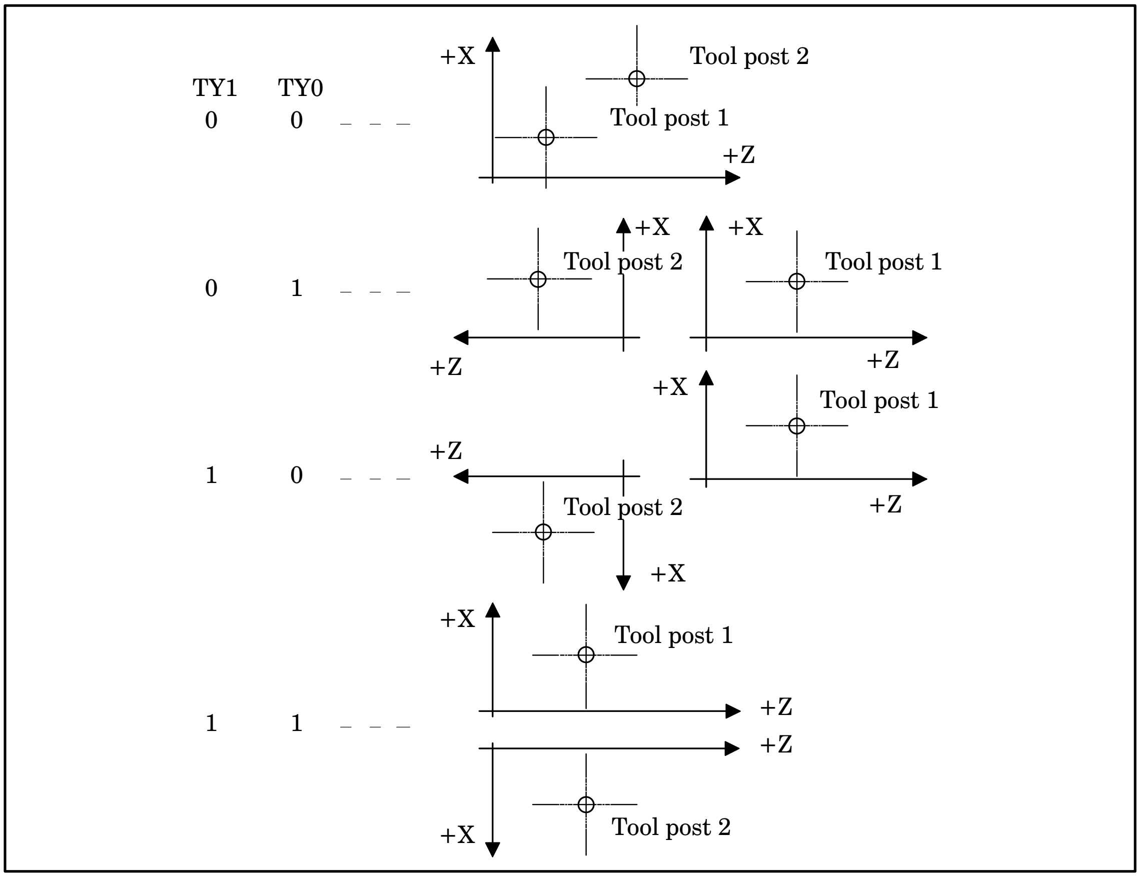
NOTE In addition to the parameter nos. listed here, parameter Nos. 2020, 2021, 2311 to 2388, 7601, and 7617 are also used on the software operator's panel.

	#7	#6	#5	#4	#3	#2	#1	#0
7605	NBC			IFE	ITO	IFM	TY1	TY0

Parameter input (only for the Series 15–TT)

Data type : Bit

TY0 and TY1 Specify positional relationship of two tool–post coordinate systems.



IFM In the manual operation mode:
0 : Does not check for tool post interference.
1 : Checks for tool post interference.

ITO When the offset number is set to 0 using the T code:
0 : Suspends checking for tool post interference until the offset number is set to a number other than 0 using the T code.
1 : Continues checking for tool post interference with the offset number which was previously set.

IFE When the conditions for checking for tool post interference are completely met:

0 : Checks for tool post interference.

1 : Does not check for tool post interference.

Normally, IFE is set to 0. When checking for tool post interference is not required, such as at machine installation, IFE is temporarily set to 1.

NBC When the block is restarted:

0 : Checks for tool post interference.

1 : Does not check for tool post interference.

	#7	#6	#5	#4	#3	#2	#1	#0
7607								RPD

Setting input

Data type : Bit

RPD When new data is loaded using the G10.3 L1 command for high–speed machining, if the data with the specified number already exists:

0 : Issues an alarm.

1 : Overwrites the old data with new data.

	#7	#6	#5	#4	#3	#2	#1	#0
7608						HDF		

Parameter input

Data type : Bit

HDF For manual handle feed:

0 : Does not use the unit which is 1,000 times the least input increment.

1 : Uses the unit which is 1,000 times the least input increment.

	#7	#6	#5	#4	#3	#2	#1	#0
7610	CBK							PNRO

Parameter input (only for the Series 15–M)

Data type : Bit

PNRO Specifies operation in offset vector generation for cutter compensation and three–dimensional tool offset in the programmable mirror image mode.

0 : Offset vector mirror axis components and G41/G42 are inverted.

1 : Only offset vector mirror axis components are inverted.

NOTE Mirror axis components are the axis vector components to which the programmable mirror image function can be applied. If more than one programmable mirror axis is present, G41/G42 is not inverted. For three–dimensional tool offset, set bit 2 of parameter No. 6007.

CBK To specify an interval in exponential interpolation for a linear axis:

0 : Uses parameter No. 7685.

1 : Uses address K and the G02.3 or G03.3 command.

		#7	#6	#5	#4	#3	#2	#1	#0
7611					XSC	MFS			

Parameter input

Data type : Bit

MFS Synchronous or independent operation can be selected:

0 : Only in the automatic operation mode. (Independent operation is always set in the manual opera tion mode.)

1 : In both the automatic and manual operation modes.

This parameter is used for the simplified synchronous function. This parameter can be changed only in the normal operation mode.

XSC Setting scaling magnification for each axis is:

0 : Invalid.

1 : Valid.

		#7	#6	#5	#4	#3	#2	#1	#0
7612			RAV	SOT	SOV	EXT			

Parameter input

Data type : Bit

RSH Specifies whether the synchronization mode (G81,G81.5) is canceled by a reset when the electronic gear box (EGB) function or functions for hobbing machines are used.

1 : Canceled by a reset.

0 : Not canceled by a reset. The mode is canceled with only the G80 or G80.5 command.

EXT Override is stored by the operation:

0 : On the CRT/MDI.

1 : Of the switches on the machine operator's panel.

SOV

0 : Only feedrate override is stored.

1 : Both feedrate and spindle speed override are stored.

SOT

0 : Outputs the spindle speed obtained by multiplying the specified spindle speed by the stored override.

1 : Outputs with a three–bit signal the stored override.

RAV When the override playback function is used, specify the distance from the start point to the end point of a line along the main axis or specify the center angle of an arc from the start point to the end point.

0 : Values specified with address R are invalid.

1 : Values specified with address R are valid.

	#7	#6	#5	#4	#3	#2	#1	#0
7613			TWJI			SPD	FED	SND

Parameter input

Data type : Bit

SND In the MMC window, the alarm status, number of the program being executed, number of sequence being executed, actual feedrate, spindle speed, absolute position, and machine position are:

0 : Not specified.

1 : Specified.

> **NOTE** When the items listed above are not required, set the SND bit to 0 to reduce communications load with the MMC.

FED In the MMC window, the actual feedrate is:

0 : Not specified.

1 : Specified.

> **NOTE** When the actual feedrate is not required, set FED to 0 to reduce CNC load.

SPD In the MMC window, the spindle speed is:

0 : Not specified.

1 : Specified.

> **NOTE** When the spindle speed is not required, set SPD to 0 to reduce CNC load.

TWJI Specifies operation in the synchronous mode or slave–axis mode of the twin table control function:

0 : Only the manual interrupt amount for the master axis is reflected in the master axis and slave axis.

1 : The manual interrupt amount for the master axis is reflected in the master axis, and the manual interrupt amount for the slave axis is reflected in the slave axis.

	#7	#6	#5	#4	#3	#2	#1	#0
7614		TRF	DST	BLK		TYP	TRS	TRI

Parameter input

Data type : Bit

TRI 0 : Treats the G10.6 command specifying retractions (retracted position) as an absolute command in the G90 mode or as an incremental command in the G91 mode.

1 : Always treats the G10.6 command specifying retractions (retracted position) as an incremental command.

TRS 0 : Resumes automatic operation after the tool is repositioned.

1 : Stops automatic operation after the tool is repositioned if the single block switch is turned on. Then resumes automatic operation when the cycle is started again.

BLK When high–precision contour control or look–ahead acceleration/deceleration before interpolation is to be used, set BLK to 0.

DST When high–precision contour control or look–ahead acceleration/deceleration before interpolation is to be used, set DST to 1.

TYP When high–precision contour control or look–ahead acceleration/deceleration before interpolation is to be used, set TYP to 0.

TRF Specifies when canned cycle operation after repositioning related to tool retraction and return is to be resumed.

0 : From the next block.

1 : From each cycle.

	#7	#6	#5	#4	#3	#2	#1	#0
7616				NDCR	EXSC		XBUF	G60MDL

Parameter input

Data type : Bit

G60MDL 0 : Treats G60 (one direction positioning) as a single–shot G code.

1 : Treats G60 (one direction positioning) as a continuous–state G code.

XBUF 0 : Deactivates the two–block look–ahead function.

1 : Activates the two–block look–ahead function.

When high–speed operation for small blocks is not required, set XBUF to 0 for single–block buffering. This ensures interoperability with conventional NC units.

EXSC 0 : Disallows the external memory subprogram to be executed.

1 : Allows the external memory subprogram to be executed.

NOTE When EXSC is set to 0, M198 is the normal M code.

NDCR Specifies whether the roll–over function is performed for the normal–direction controlled axis.

0 : Not performed

1 : Performed

	#7	#6	#5	#4	#3	#2	#1	#0
7617	SDC	OPG8			TNF			

Setting input

Data type : Bit

TNF When the tool offset function that uses tool numbers is used, if the tool number and pot number of the tool data to be deleted are not found:

0 : Issues an alarm.

1 : Takes no action.

SDC The normal direction control function enables C–axis rotation:

0 : Between blocks.

1 : At the same time as the next block is being executed (when the C–axis displacement is smaller than the value of parameter No. 7793).

OPG8 Specifies whether to use spindle override on the software operation panel.

0 : Not used (not displayed).

1 : Used.

	#7	#6	#5	#4	#3	#2	#1	#0
7618			RTMB			TM2	TM1	TM0

Parameter input

Data type : Bit

This parameter specifies data distribution time in ms for the binary input operation. In the ultrahigh–speed distribution mode, set this parameter according to the following table.

M: Number of controlled axis N: Number of simultaneously controlled axes		PRM7618			Time required for distributing data at NC statement inputs	Time required for distributing data at binary statement inputs
		TM2	TM1	TM0		
Super–high–speed mode A	M≦8 N≦3	1	0	0	1ms	1ms
		0	0	1	2ms	2ms
		0	1	0	4ms	4ms
	M≦8 4≦N≦8	1	0	0	——	——
		0	0	1	2ms	2ms
		0	1	0	4ms	4ms

NOTE A distribution time of 1 ms corresponds to 60 m/min., 2 ms corresponds to 30 m/min., and 4 ms corresponds to 15 m/min.

RTMB Among Retrace and Multi–buffer,

0 : Multi–buffer is available. (Retrace is not available.)

1 : Retrace is available. (Multi–buffer is not available.)

In 15–MB, the following features are exclusive to each other.

1. Retrace : Option J622
2. Multi–buffer : 5 blocks buffering=Basic
   : 15 blocks buffering =Option J986
   : 60 Blocks buffering =Option J722

In other words, when Retrace is available Multi–buffer is not available, and when Multi–buffer is available Retrace is not available.

So, the customer has to select which function is used, by this parameter.

	#7	#6	#5	#4	#3	#2	#1	#0
7619		RDDP						

Data type : Bit

RDDP Selects the input format of a decimal point for the rotary control axis.

0 : Conventional format : [Example] B1; = 0.001 deg. (when the IS–B increment system is used)

1 : Fixed–point format : [Example] B1; = 1.000 deg. (when the IS–B increment system is used)

	#7	#6	#5	#4	#3	#2	#1	#0
7620		MOAL	DTIM	2DRV	MOPR	ENCW	NCWS	SDF

Parameter input

Data type : Bit

SDF The feedrate specified by the gentle normal direction control function is:

0 : Feedrate for axes other than C–axis

1 : Combined feedrate including that for C–axis

NCWS Specifies the system response to a system reset.

0 : The continuous–state G code specified from G54 to G59 is set to G54.

1 : The continuous–state G code specified from G54 to G59 is not cleared.

This setting is valid when ENCW is set to 1.

ENCW Specifies whether NCWS is used.

0 : Not used

1 : Used

MOPR Specifies whether M, S, T, and B codes are output before the tool moves to the machining restart position when a block to restart the program has been searched for.

0 : Neither M, S, T, nor B code is output. The over–store mode is invalid.

1 : The M, S, T, and B codes are output. The over–store mode is valid.

2DRV

0 : Conventional one–disk drive

1 : Two–disk drive

DTIM Specifies the method of indicating the operation time in the operation time and part indication function.

0 : Indicated in hours, minutes, and seconds (conventional form)

1 : Indicated in days, hours, minutes, and seconds.

When the operation time is indicated in days, hours, minutes, and seconds, the maximum values of the day and hour counts are as follows:

Day count = 9999D (days)

Hour count = 23H (hours)

The day count is reset to 0 when it reaches its maximum value. Counting then begins from 0.

MOAL Specifies the output operation performed before the tool moves to the machining restart position.

0 : The last M, S, T, and B codes are output.

1 : All M codes and the last S, T, and B codes are output.

This setting is valid only when bit 3 (MOPR) of parameter No. 7620 is set to 1.

7631	The number of the rotary control axis and the number of the index table control axis

For the number of the rotary control axis:

Data type : Byte

Valid range : 1 to the number of control axes

Specify the number of the rotary control axis.

For the number of the index table control axis:

Data type : Byte

Specify the number of the index table control axis.

1 to 6 : Number of the control axis

When 0 is specified, the fourth axis is used.

7632	M code specifying clockwise rotation

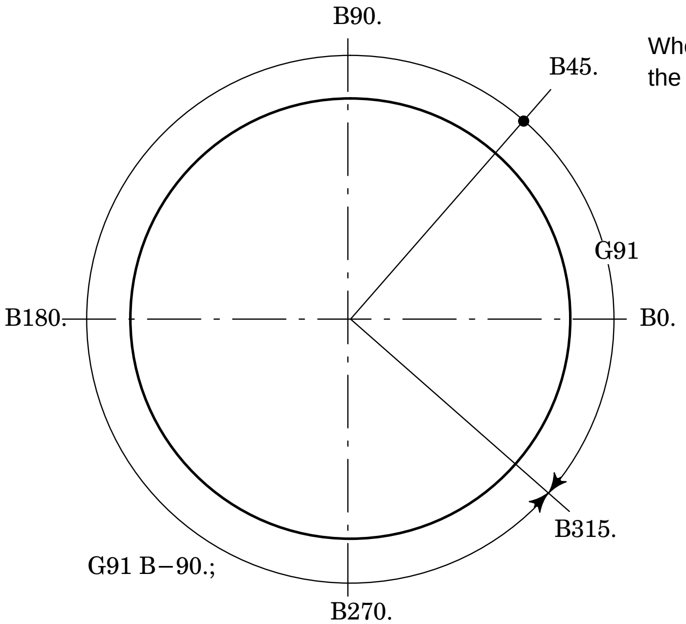
Parameter input

Data type : Byte

0 : The M code that rotates the index table clockwise is not used. Instead, other commands and the parameter described above determine the direction of rotation.

1 to 127 : Always rotates the index table counterclockwise. Rotates the index table clockwise only when the M code and index table commands are specified in the same block. This requires that IABS (bit 1) of parameter No. 7602 should be set to 1.

Specifying incremental commands when the M code specifying clockwise rotation (parameter No. 7632) is used :



When incremental commands are used for rotating the index table clockwise, the M code must be used.

Example

Specify as follows:

G91 B–90.M15;

B–90.M15;

G91 B–90.;

This rotates the index table counter-clockwise to move it to the point specified with incremental commands.

Specify as follows:

G91 B9.M15;

This rotates the index table clockwise to move it to the point specified with incremental commands.

NOTE	The M code is processed in NC units. MF and the M code are sent to the machine.

7633	M code changing synchronous control to independent control

Parameter input

Data type : Byte

Unit of data : 0 to 99

Specify the M code changing synchronous control to independent control.

7635	Number of axis operated in the high–speed DNC mode or the number of an axis which operates in the high–speed DNC mode

Parameter input

Data type : Byte

Valid range : 0 to the number of control axes

When 0 is specified, distribution is calculated for each control axis.

When five axes are provided but only three of them (the first, second, and third axes) are operated in the high–speed DNC mode, 3 must be specified.

Even when only the third axis is operated in the high–speed DNC mode, 3 must be specified.

7636	Number of the linear axis for which exponential interpolation is performed

Parameter input (only for the Series 15–M)

Data type : Byte

Valid range : 1 to the number of control axes

Specify the number of the linear axis for which exponential interpolation is performed.

7637	Number of the rotation axis for which exponential interpolation is performed

Parameter input (only for the Series 15–M)

Data type : Byte

Valid range : 1 to the number of control axes

Specify the number of the rotation axis for which exponential interpolation is performed.

7651	Interference allowance when the block is restarted

Parameter input

Data type : Word

Unit of data :

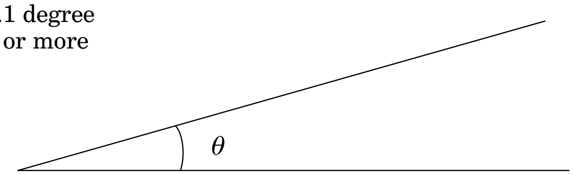
Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric input	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch input	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to 32,767

Tolerance when three–dimensional offset vectors are created in the spline interpolation mode

7670	Angle between two vectors when they are as sumed to from a single line

Data format : Word type
Data unit : 0.1 degree
Data range : 0 or more



When the angle between two vectors is not more than the specified value, the two vectors are assumed to form a single line.

7671	Maximum difference betwen the coordinates of two points along an axis when the two points are assumed to be the same point

Data type : Word

Unit of data : The reference axis specification (parameter NO. 1031) is used.

Valid range : 0 or larger

When the maximum difference between the coordinates of two points along an axis is not more than the specified value, the two points are assumed to be the same point.

7681	Sequence number to be serched for

Setting input

Data type : Word

Valid range : 1 to 9,999

Specify the sequence number to be searched for.

7682	Minimum increment in indexing the table

Data type : Two words

Unit of data : 0.01 deg. (when the IS–A increment system is used), 0.001 deg. (when the IS–B increment system is used), 0.0001 deg. (when the IS–C increment system is used), 0.00001 deg. (when the IS–D increment system is used), or 0.000001 deg. (when the IS–E increment system is used)

Valid range : 0 to 360,000

When 0 is specified, any angle can be specified.

PS alarm 198 is issued when:

– The specified angular displacement is not a multiple of the value specified in this parameter

– The value specified in the coordinate system setting (G92) and the offset from the workpiece reference point are not a multiple of the value specified in this parameter.

NOTE 1 When the IABS (bit 1) of parameter No. 7602 is set to 0, an index–angle alarm is not detected.

NOTE 2 The angular displacement and direction of rotation about the index–table axis can be changed using parameters, even when the command setting is not changed. If the specified command conflicts with the parameters which have already been specified, PS alarm 199 is issued.

7682	Distance along the X–axis from the reference point of the first tool post to the reference point of the second tool post

7683	Distance along the Z–axis from the reference point of the first tool post to the reference point the reference point of the second tool post

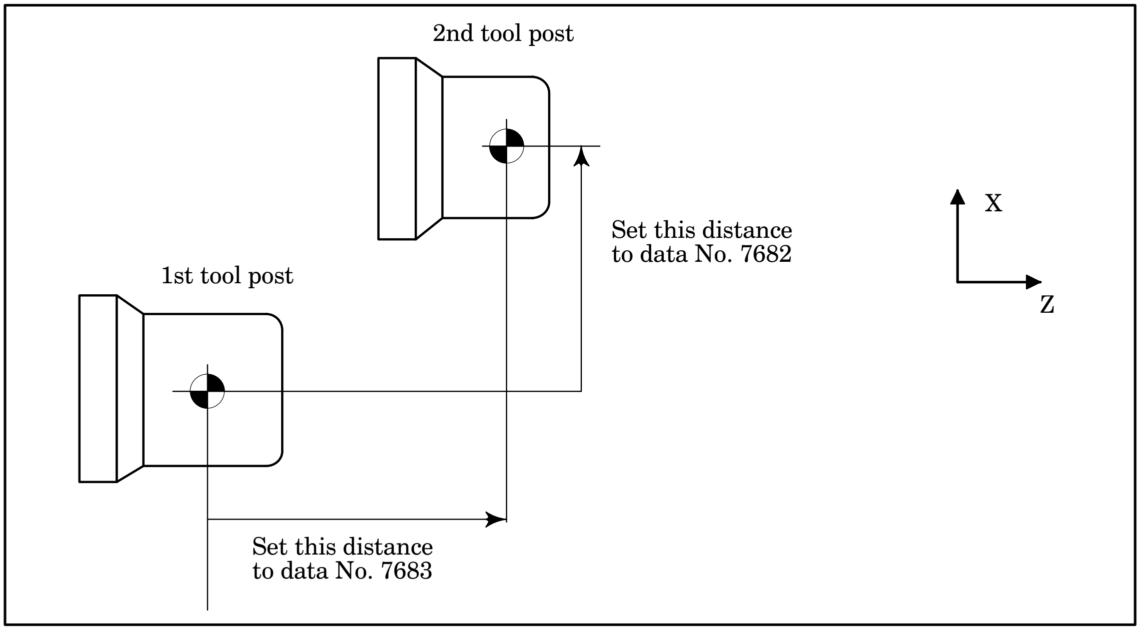
Parameter input (only for the Series 15–TT)

Data type : Two words

Unit of data :

Increment system	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric entry	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch entry	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to ±99,999,999



7685	Interval in exponential interpolation for a linear axis

Parameter input (only for the Series 15–M)

Data type : Two words

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric system machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch system machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 0 to 99,999,999

When the CBK (bit 7) parameter No. 7610 is set to 0, specify an interval in exponential interpolation for an axis.

7701	Axis and the corresponding manual handles

Parameter input (only for the Series 15–M)

Data type : Byte axis

Unit of data :

Valid range : 1 to 3

This parameter is valid only when the FS6 interface is used.

The following sample setting shows that the first manual handle is used for feeding the X–axis, the second manual handle for feeding the Y–axis and A–axis, and the third manual handle for feeding the Z–axis and B–axis.

7701 X: 1
Y: 2
Z: 3
A: 2
B: 3

7702	Number of a master axis with which the axis is synchronously controlled

Parameter input

Data type : Byte axis

Specify a master axis with which the axis is synchronously controlled by a synchronous control selection signal (SYNC1, SYNC2, SYNC3, SYNC4, etc.).

Example When control axes are specified as follows:

First axis : X–axis

Second axis : Z–axis

Third axis : C–axis

Fourth axis : Y–axis

To use synchronous control selection signal SYNC4, which synchronously controls the Y–axis with the X–axis when a command for moving the X–axis is entered, set this parameter as follows:

7702 X: 0

Z: 0

C: 0

Y: 1

	#7	#6	#5	#4	#3	#2	#1	#0
7712							PHDR	EGBACC

Bit position

EGBACC Specifies whether to perform acceleration/deceleration when EGB synchronization is started or canceled if there is no R command in a G81/G80 block.

0 : Acceleration/deceleration is not performed when EGB synchronization is started or canceled (as before).

1 : Acceleration/deceleration is performed when EGB synchronization is started or canceled, and phase alignment is performed automatically after acceleration when synchronization begins.

PHDR Specifies the direction of movement for electronic gearbox automatic phase alignment.

0 : Positive direction

1 : Negative direction

7765	Interval at which the time is recorded in the operation history

Parameter input

Data type : 1 words

Unit of data : minute

Valid data range : 1 to 1439

7767	Allowable movement cumulative value for torque control

Parameter input

Data type : Word axis

Unit of data : Detection unit

Valid range : 0 to 32767

If follow–up is not specified for torque control mode (TRQFU, parameter No. 1409), this parameter specifies an allowable movement cumulative value. If the movement cumulative value becomes greater than the specified value, a servo alarm (SV.126) is issued.

7768	Torque control cancellation limit

Parameter input

Data type : Word axis

Unit of data : Detection unit

Valid range : 0 to 32767

This parameter specifies a cancellation limit value to be used in canceling torque control mode in torque control mode if follow–up is not performed (TRQFU of parameter No. 1409).
When torque control mode is canceled, if the positional deviation is not greater than the value specified in this parameter, positional control is resumed.

7793	Lower limit under which the caluculated anglar displacement is ignored in normal–direction control

·For parameter SDC (No.7617#7)=0

Parameter input

Data type : Two words

Unit of data :

Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Rotary axis	0.01	0.001	0.0001	0.00001	0.000001	deg

Valid range : 1 to 99,999,999

When the angular displacement calculated in normal–direction control is less than the value specified in this parameter, the block that specifies the calculated angular displacement is not inserted in the program. The ignored angular displacement is added to the angular displacement to be calculated, which in turn is compared with the parameter value.

CAUTION
- When an angle of 360 degrees or larger is specified in this parameter, the block that specifies angular displacement is not inserted in the program.
- When an angle of 180 degrees or larger is specified in this parameter, the block that specifies angular displacement is not inserted in the program unless circular interpolation is performed with an angle of 180 degrees or larger.

·For parameter SDC (bit 7 of parameter No. 7617) = 1

Limit for triggering normal–direction control axis rotation using a single block

Parameter input

Data type : Two words

Valid range : 1–99999999

When parameter SDC (bit 7 of parameter No. 7617) is 1,

When the angular displacement, calculated by the normal–direction control function, is smaller than the value specified with this parameter, the rotation of the axis under the control of the normal–direction control function is executed using the same block as that which specifies movement along the X– and Y–axes. When the calculated angular displacement is greater than the specified parameter value, the axis is rotated using the single block used to specify the axis rotation.

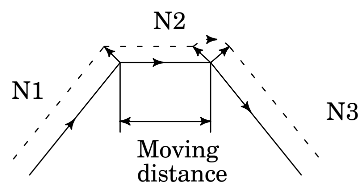
CAUTION When an angle of 180 degrees or greater is specified, the block specifying rotation is not inserted into the program, except when performing circular interpolation.

7794	Limit of the feed distance for machining with the normal–direction angle specified in the previous block

Parameter input
Data type : Two words
Unit of data :

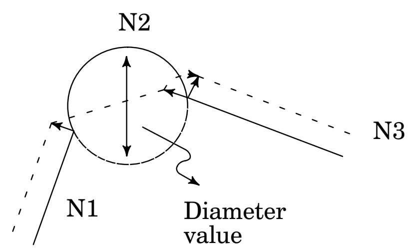
Setting Unit	IS–A	IS–B	IS–C	IS–D	IS–E	Unit
Metric input	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch input	0.001	0.0001	0.00001	0.000001	0.0000001	inch

Valid range : 1 to 99,999,999



For linear motion:

When the feed distance specified in the N2 block is smaller than the value specified in this parameter, the N2 block is executed with the tool oriented in the direction specified in the N1 block.



For circular motion:

When the diameter of the arc specified in the N2 block is smaller than the value specified in this parameter, the N2 block is executed with the tool oriented in the normal direction specified in the N1 block. The normal–direction control axis cannot be oriented in the normal direction as the tool travels along the arc.

7795	Retract feedrate used with the electronic gear box function or functions for hobbing machines

Parameter input
Data type : Two words
Valid data range : 1 to 6000
Unit :

	Increment system					
	IS–A	IS–B	IS–C	IS–D	IS–E	
Millimeter machine	100.0	10.0	1.0	0.1	0.01	mm/min
Inch machine	10.0	1.0	0.1	0.01	0.001	inch/min
Rotation axis	100.0	10.0	1.0	0.1	0.01	deg/min

Set a retract feedrate when the electronic gear box function or functions for hobbing machines are used.

7796	Retract amount used with the electronic gear box function or functions for hobbing machine

Parameter input

Data type : Two words

Valid data range : ±99999999

Unit :

	Increment system					
	IS–A	IS–B	IS–C	IS–D	IS–E	
Millimeter machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch
Rotation axis	0.01	0.001	0.0001	0.00001	0.000001	deg

Set a retract amount for each axis when the electronic gear box function or functions for hobbing machines are used.

7799	Limit for the difference between the positional deviations for the synchronized axes during simple synchronization

Data type : Two words

Valid data range : 0 to 99999999 (The positional deviation check function does not operate when 0 is set.)

Unit of data : Detection unit

During simple synchronization, alarm OT 513 is issued when the difference between the positional deviations for synchronized axes (error counter value) is greater than the value set in this parameter.

	#7	#6	#5	#4	#3	#2	#1	#0
8403	SG0						MSU	TPS

Parameter entry

Data format : Bit type

TSP When advanced feed–forward factor is written into the parameter used for actual machining, using this feature.

0 : The factor is not transferred to the Spindle (Data No. 3488) although it is transferred to the Servo (Data No.1985) .

1 : The factor is transferred to the Spindle (Data No. 3488) as well as to the Servo (Data No. 1985).

MSU When positioning or auxiliary function is specified in the HPCC mode,

0 : An alarm is generated.

1 : It is executed.

SG0 When G00 is specified in the HPCC mode,

0 : it depends on parameter 8403#1 (MSU) .

1 : it is executed simply on the RISC processor board, irrespective of parameter no. 8403#1 (MSU). (G00 is replaced with G01 and the axis moves at a rate specified by parameter no. 8481.)

Refer to 3. 5 for details.

8481	Rapid traverse rate in HPCC mode

Parameter input

Data type : Two words

Data unit :

Data range :

Increment system	Unit	Data range	
		IS- B	IS- C
Metric machine	1 mm/min	10 to 240000	1 to 100000
Inch machine	0.1 inch/min	10 to 96000	1 to 48000
Rotation axis	1 deg/min	10 to 240000	1 to 100000

When G00 is executed in a simple manner in the HPCC mode (parame ter no. 8403#7, SG0=1) , set the rapid traverse rate.

CAUTION Because G00 command is replaced with G01 and is executed, the tool moves at this speed even if 2 axes are specified.

Example When the following command is specified at rapid traver se rate=1000 mm/min., actual speed F does not become F1414 but become F1000.

G00 X100. Y100. ;

	#7	#6	#5	#4	#3	#2	#1	#0
8507			PWSR					

Parameter entry

Data format : Bit type

PWSR P–CODE program number search function is,

0 : not available.

1 : available.

4.49 Parameters Related to Maintenance

	#7	#6	#5	#4	#3	#2	#1	#0
8000						PRA	NPA	PWE

Setting input

Data type: Bit

PWE Setting Hparameter–input" parameters using the tape or MDI is:

0 : Not allowed.

1 : Allowed.

NPA When an alarm is issued, the CRT screen is:

0 : Automatically switched to the alarm message screen.

1 : Displayed continuously.

PRA When the PWE bit is set to 1 (setting Hparameter–input" parameters is allowed):

0 : Issues an alarm.

1 : Does not issue an alarm.

> **NOTE** When the power supply to the NC unit is turned off, all bits of this parameter are set to 0 for safety of the unit. To maintain the settings for this parameter after the power supply is turned off, the NCS (bit 0) of parameter No. 8010 must be set to 1.

	#7	#6	#5	#4	#3	#2	#1	#0
8010								NCS

Parameter input

Data type : Bit

NCS When the power supply to the NC unit is turned off, all the bits of parameter No. 8000 are:

0 : Set to 0.

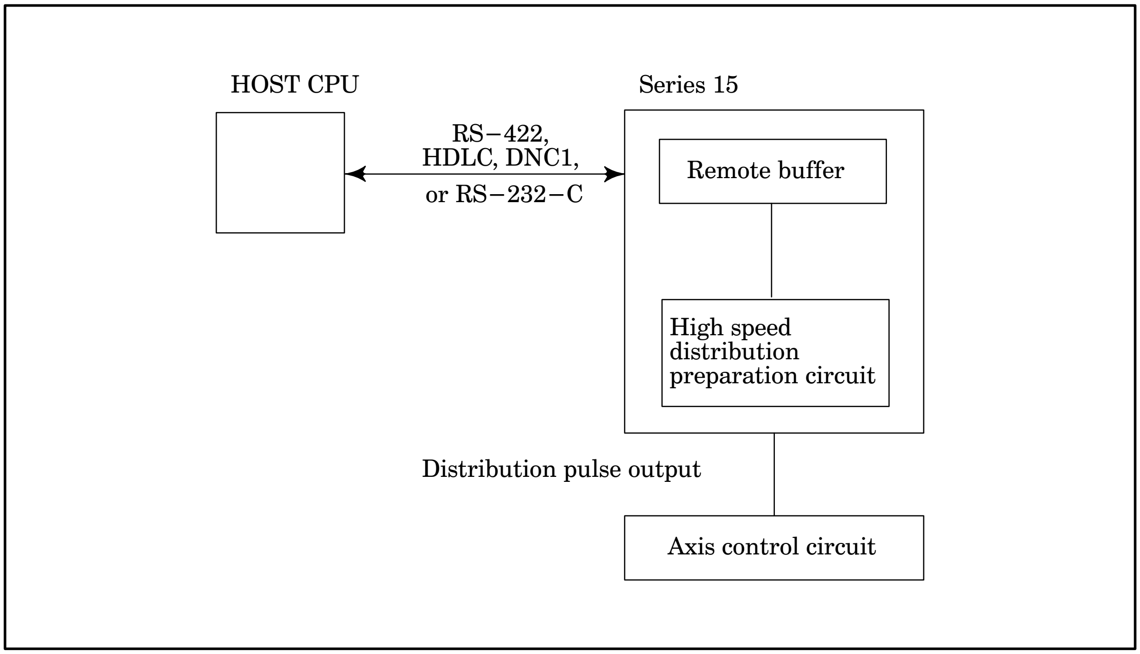
1 : Maintained.

4.50 DNC Operation with the Remote Buffer

4.50.1 High–speed distribution in DNC operation with the remote buffer

The NC unit reads and calculates a block of data to create a distribution pulse for each axis. Then the NC unit sends the pulse to the servo system to rotate the motor. If the time to create distribution pulses from a block of data is shorter than the time to rotate the motor, pulse distribution normally breaks between blocks. Therefore, when a program with sequential small blocks is executed at a high speed, the program may be suspended between blocks because of the delay in creating the distribution pulses. This means that the block processing time, time to create distribution pulses from a block of data, is a critical index of NC unit performance. The Series 15 greatly reduces the block processing time in DNC operation by using the remote buffer.

In the Series 15, distribution pulses can be created from a block of data very quickly. A program which has sequential small blocks can be executed at a high speed without suspension of the program between blocks. For example, 1–mm machining specified in a program which consists of sequential blocks can be performed at 15 m/min.



(1) Program display in high–speed distribution mode

When the system enters high–speed distribution mode, the program displays:
G05P2L4 or G05P2L8

The maximum speed in high–speed distribution mode has been improved in the mass–produced version of STEP III. The following tables list the relationships between the total number of controlled axes, the number of controlled axes that can be used simultaneously, and the maximum speed.

(a) With a sub–CPU

Total number of controlled axes M Number of controlled axes that can be used simultaneously N	NC statement input
$M \leqq 8$ $N \leqq 6$	Up to 60 m/min (data distribution time = 1 ms)
$M \leqq 8$ $7 \leqq N \leqq 8$	Up to 30 m/min (data distribution time = 2 ms)

(b) With no sub–CPU

Total number of controlled axes M Number of controlled axes that can be used simultaneously N	NC statement input
$M \leqq 8$ $N \leqq 6$	Up to 30 m/min (data distribution time = 2 ms)
$M \leqq 8$ $7 \leqq N \leqq 8$	Up to 15 m/min (data distribution time = 1 ms)

(2) Conditions on which the NC unit enters the high–speed distribution mode

In high–speed DNC operation, whether the NC unit can enter the high–speed distribution mode is automatically determined from the G codes which specify operation modes of the NC unit. The NC unit starts high–speed distribution when it is allowed to enter the high–speed distribution mode.

When the NC unit is not allowed to enter the high–speed distribution mode, it starts normal distribution. High–speed distribution does not require a dedicated G code.

Conditions of high–speed distribution are as follows:

1) Acceleration/deceleration before interpolation is not applied.

2) Blocks are in the G01 mode.

3) G codes which specify operation modes of the NC unit are specified as follows:

G code	Meaning
G13.1	Polar coordinate interpolation cancel
G15	Polar coordinate command mode cancel
G40	Cutter compensation mode cancel
G50	Scaling cancel
G50.1	Programmable mirror cancel
G67	Macro modal call A/B cancel
G69	Coordinate rotation cancel
G80	Canned cycle cancel
G94	Per minute feed

The interrupt macro canceling mode (M97) must also be specified.

When these conditions are met, the NC unit automatically starts high–speed distribution. When they are not met, the NC unit automatically starts normal distribution.

For example, during cutter compensation, normal distribution is started even though G01 blocks are specified.

(3) Conditions on which the NC unit exits from the high–speed distribution mode

The NC unit exits from the high–speed distribution mode when:

1) A G code other than G01, G90, and G91 codes is specified.

2) An address other than axis address (specified in parameter No. 1020), F, N, and G is specified.

3) A macro statement is specified.

4) An F code with a one–digit value is specified.

5) An F code with a value less than 100 is specified.

Then the NC unit starts normal distribution.

(4) Normal distribution setting

Normal distribution can always be specified, regardless of the conditions on which the NC unit enters or exits from the high–speed distribution mode.

To allow normal distribution to always be specified, set bit 5 of parameter No. 0 to 1.

Set bit 5 of parameter No. 0 to 1 also when an optional function, simplified synchronous control, twin table control, or parallel axes control, is provided.

When the least input increment for each axis is to be set so that it is ten times as large as the least command increment (bit 2 of parameter No. 1004), set bit 5 of parameter No. 0 to 1.

(5) Number of axes operated in the high–speed distribution mode

Specify the number of axes operated in the high–speed distribution mode or the number of an axis which operates in the high–speed mode in parameter No. 7635.

When 0 is specified in parameter No. 7635, all the axes are operated in the high–speed distribution mode.

(For details, see Section 4.15, Parameters for the “Reader/Punch Interface parameters.”)

(6) Notes on the high–speed distribution mode

(i) Holding feed, processing a single block, and dry run are allowed as usual.

(ii) Feedrate override is allowed.

However, note that the program monitors the override specified with the switch only at the beginning of a block. Feedrate cannot be changed even when override is changed while the block is being processed.

(iii) The maximum cutting feedrate specified in the parameter is ignored.

However, note that the feedrate specified in F multiplied by the feedrate override is clamped at 20 m/min.

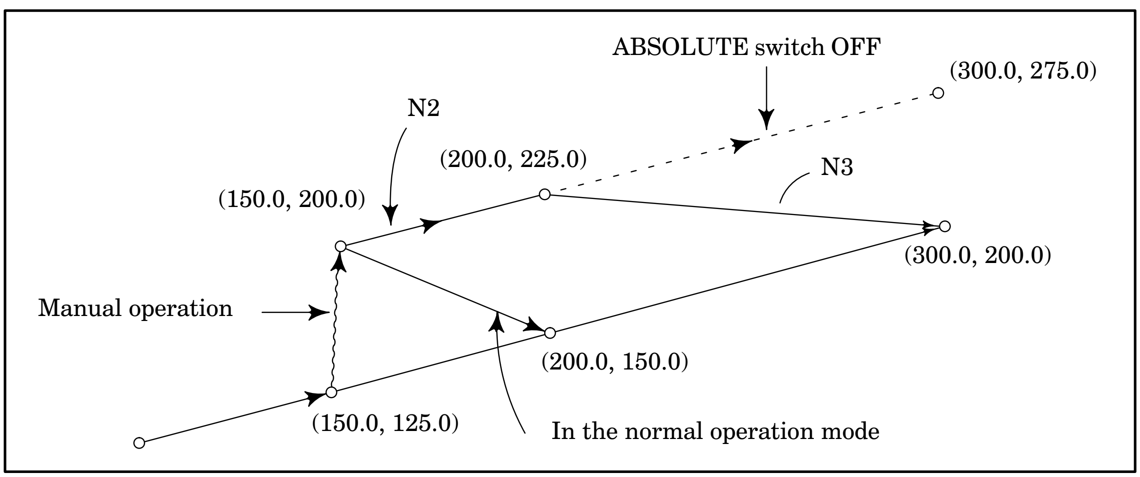
(iv) After manual intervention, the NC unit in the high–speed distribution mode moves as if the manual absolute switch was set to off, whether the switch is actually set to on or off.

When the mode is changed from high–speed distribution to normal distribution, the NC unit moves as usual according to the setting of the manual absolute switch (on or off) and the INC bit of parameter No. 2402.

For example, when the NC unit is operated by the following program on the tape with the manual absolute switch set to on:

N1 G01G90X100. Y100. F500 ;
N2 X200. Y150. ; ← Feed hold occurs during the operarion.
N3 G00X300. Y200. ; ← The high–speed distribution mode is canceled.

The figure below shows movement of the NC unit when the following processes are carried out: The feed holding switch is pressed during N2 block processing, the Y coordinate value is increased manually by 75.0, then the cycle starting switch is pressed.



(v) Normal direction control is not performed.

(vi) Simplified synchronous control is not performed.

(vii) To attain the maximum speed in high–speed distribution, it is necessary to increase the transmission rate.

Example A program for 6–axis control with a block length of 1 mm is as follows:

X0.408 Y0.408 Z0.408 A0.408 B0.408 C0.408 ;

Because, in this program, each block consists of 37 characters, the following transmission rate is required to execute this program at 60 m/min (data distribution time = 1 ms):

$$\text{Transmission rate [bps]} = \frac{C \times B \times 1000}{\text{Data distribution time [ms]}} = \frac{37 \times 8 \times 1000}{1} = 296000 \text{ [bps]}$$

C : Number of characters
B : Number of bits per character For HDLC and DNC1, the number of bits per character is 8. For other protocols, the number of bits per character is 11.

This result means that HDLC must be used.

With no sub–CPU

		PARAM 0#5 (DNC) =0	PARAM 0#5 (DNC) =1
PARAM 5000#6 (RBCNV)	=0	High–speed DNC is not performed.	High–speed DNC is not performed.
	=1	High–speed DNC is performed.	High–speed DNC is not performed.

With a sub–CPU

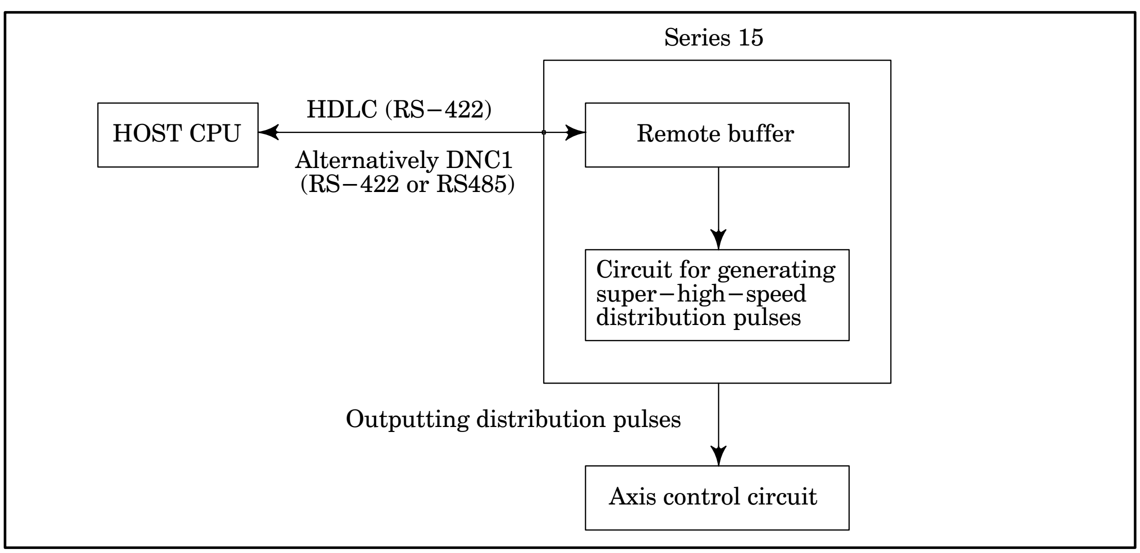
	PARAM 0#5 (DNC) =0	PARAM 0#5 (DNC) =1
	High–speed DNC is performed.	High–speed DNC is not performed

The phrase "high–speed DNC is performed" here applies when the conditions for high–speed DNC are satisfied.

4.50.2 Ultrahigh–speed distribution in DNC operation with the remote buffer

In ultrahigh–speed machining, the block processing time, time to process a block of data, is further reduced in DNC operation with the remote buffer. For example, it is assumed that NC statements (a program written with EIA, ISO, or ASCII codes), which consist of sequential blocks specifying synchronous 1–mm machining along three axes are provided. Using the normal high–speed distribution circuit, the machining is performed at 15 m/min. in DNC operation. Using the ultrahigh–speed distribution circuit, the machining is performed at 60 m/min. in DNC operation. When binary–format statements of sequential blocks specify synchronous 1–mm machining along three axes, the machining is performed at 60 m/min. in DNC operation using the ultrahigh–speed distribution circuit. The high level data link control (HDLC) procedures are carried out for communications between the host CPU and the remote buffer.

In the mass–produced version of STEP III, a maximum NC statement speed of 60 m/min is achieved by using the high–speed distribution function based on DNC operation using remote buffers (Section 4.47.1) even if the ultrahigh–speed distribution function is not used.



(1) Program display in ultrahigh–speed distribution mode

When the system enters ultrahigh–speed distribution mode, the program displays:
G05P3L8

(2) Ultrahigh–speed machining mode

In ultrahigh–speed machining mode synchronous 1–mm machining along three axes specified in NC or binary–format statements of sequential blocks is performed at up to 60 m/min. in DNC operation.

M: Number of controlled axes N: Number of simultaneously controlled axes	NC statements	Binary statements
M≦6 N≦3	Up to 60 m/min (time required for distributing data: 1 ms)	
M≦6 4≦N≦6	Up to 30 m/min (time required for distributing data: 2 ms)	

A data distribution time can be changed using the parameter.

For parameter setting, refer to the explanation of parameter No. 7618.

(3) Conditions on which the NC unit enters the ultrahigh–speed distribution mode (when NC statements are written with EIA, ISO, or ASCII codes)

For ultrahigh–speed DNC operation, specify the following dedicated G codes by which the NC unit enters or exits from the ultrahigh–speed distribution mode.

G05P3 : The NC unit enters the ultrahigh–speed distribution mode.

G05P0 : The NC unit exits the ultrahigh–speed distribution mode.

Specify G05P3 before the block where the NC unit enters the ultrahigh–speed distribution mode. Specify G05P0 after the block where the NC unit exits the ultrahigh–speed distribution mode.

(Sample program)

```
G92X0Y0Z0 ;
G01F60000. ;
G05P3 ;        ————→ The NC unit enters the ultrahigh–speed
X100Y200Z300 ;       distribution mode.
X200Y300Z400 ;
X300Y400Z500 ;
      :
X300Y200Z100 ;
G05P0 ;        ————→ The NC unit exits the ultrahigh–speed
G00Z200.Y200.Z200. ;  distribution mode.
M02 ;
```

Whether the NC unit can enter the ultrahigh–speed distribution mode by the block specified between G05P3 and G05P0 is automatically determined. As determinating factors, G codes specified before G05P3 and after G05P0 that specify operation modes of the NC unit are monitored. The NC unit starts ultrahigh–speed distribution when it is allowed to enter the ultrahigh–speed distribution mode. The NC unit starts normal distribution when it is not allowed to enter the ultrahigh–speed distribution mode.

1) Conditions on which the NC unit enters the ultrahigh–speed distribution mode

The conditions on which the NC unit enters the ultrahigh–speed distribution mode ((1) to (5) in 4.47.1) are the same as the conditions on which the NC unit enters the high–speed distribution mode.

2) The conditions on which the NC unit exits the ultrahigh–speed distribution mode include the conditions on which the NC unit exits the high–speed distribution mode and the following conditions:

(i) A comment is inserted in a block. (Example: X100(SUPER);)

(ii) A block to be skipped is specified. (Example: /X100;)

(iii) A decimal point is specified. (Example: X100.;)

(iv) The + sign is prefixed to the fed distance. (Example: X+100;)

(4) Ultrahigh–speed distribution when binary–format statements are specified

Whether the NC unit enters the ultrahigh–speed distribution mode when binary–format statements are specified is automatically determined by the setting of parameter No. 7618.

(5) Communications between the host CPU and the remote buffer

In the high–speed distribution mode, non–procedural communications between the host CPU and the remote buffer are performed using the RS–422 interface. However, in the ultrahigh–speed distribution mode, the HDLC procedures are carried out for communications. This is because non–procedural communications cannot ensure the reliability and high–speed operation required for transferring large amounts of data.

The Program File Mate for the HDLC procedures or FD–Mate for the DNC1 can be used as the host CPU.

(6) Notes on the ultrahigh–speed distribution mode

Refer to the notes on the high–speed distribution mode. In addition, take note of the following:

NOTE 1 Specify G05P3 and G05P0 as single–shot codes.

NOTE 2 Specify G05P3 and G05P0 in the program transferred from the external storage of the host computer during DNC operation.

NOTE 3 If G05P3 is specified under one of the following conditions, alarm PS891, INVALID COMMAND G05, is issued.

1 A distribution time of 500 us (corresponding to a feedrate of 120 m/min.) is specified in parameter No. 7618 in ultrahigh–speed machining mode A.

2 A servo distribution period of 2 ms is specified in parameter No. 1809.

3 The high–speed flag of parameter No. 1809 is set to 1 in ultrahigh–speed machining mode A.

NOTE 4 When ultrahigh–speed distribution is performed with binary–format statements specified, miscellaneous functions M, S, T, and B cannot be used.

NOTE 5 For details of DNC1, refer to the DNC1 Descriptions (B–61782E).

Parameters for ultrahigh–speed distribution

The following table lists and describes parameters for ultrahigh–speed distribution.

(1) General parameters

<table>
<tr><th>Parameter No.</th><th>Bit</th><th>Description</th></tr>
<tr><td rowspan="2">0000</td><td>2</td><td>Specifies whether ISO codes are used with parity bits. Set this bit to 1 when ultrahigh–speed distribution is performed with DNC1.</td></tr>
<tr><td>5</td><td>Specifies whether high–speed distribution is performed with the remote buffer. Set this bit to 0 when ultrahigh–speed distribution is performed.</td></tr>
<tr><td>1622</td><td>–</td><td>Specifies a time constant for acceleration/deceleration during cutting feed for each axis. Setting range depends on parameter No. 7618. Normally, a range of 0 to 400 ms is specified. For ultrahigh–speed machining, set this parameter according to the table below.
<table>
<tr><th>Ultrahigh–speed distribution mode</th><th>Time constant range (ms)</th></tr>
<tr><td>Binary–format or NC statements are input at a distribution time of 2 ms</td><td>0 to 1,000</td></tr>
<tr><td>Binary–format or NC statements are input at a distribution time of 1 ms</td><td>0 to 500</td></tr>
</table>
A distribution time of 1 ms corresponds to 60 m/min., and 2 ms corresponds to 30 m/min.</td></tr>
</table>

<table>
<tr><th>Parameter No.</th><th>Bit</th><th>Description</th></tr>
<tr><td rowspan="3">1809</td><td>1</td><td rowspan="3">Parameters for the digital servo
<table>
<tr><th></th><th>Velocity loop period</th><th>Bit 5</th><th>Bit 1</th></tr>
<tr><td>A</td><td>2ms</td><td>0</td><td>0</td></tr>
<tr><td>B</td><td>1ms</td><td>0</td><td>1</td></tr>
</table>
When bit 1 (DGPRM) of parameter No. 1804 is set to 0, the above two bits are automatically set to standard settings (setting A) when the power is turned on. In the ultrahigh–speed distribution mode, when binary–format or NC statements are input at a distribution time of 1 ms, set the two bits according to setting B in the table above. Note that a distribution time of 1 ms corresponds to feedrate of 60 m/min.
NOTE When setting this parameter, be sure to refer to descriptions of procedures for changing the velocity loop period from the standard value of 2 ms to 1 ms, in Appendix 7 of the Maintenance Manual (B–65005).</td></tr>
<tr><td>5</td></tr>
<tr><td></td></tr>
<tr><td>2401</td><td>6</td><td>Specify 1 in this parameter for multi–buffering.</td></tr>
<tr><td rowspan="3">7618</td><td>0</td><td rowspan="3">Specifies data distribution time in ms for the binary input operation. In the ultrahigh–speed distribution mode, set this parameter according to the specified settings.</td></tr>
<tr><td>1</td></tr>
<tr><td>2</td></tr>
<tr><td>7635</td><td>–</td><td>Specifies the number of axes specified in a block in the high–speed remote buffer mode.</td></tr>
</table>

(2) Parameters for communications

1) When the Program File Mate is used:

Parameter No.	Bit	Description
0020	–	Specifies the interface number of the input device used in the foreground. Specify 10 in this parameter when a Program File Mate is used.
0022	–	Specifies the interface number of the input device used in the background. A program can be loaded in the background, but ultrahigh–speed distribution cannot be performed in DNC operation.
5000	0	Specifies the interface between the host CPU and the remote buffer. Specify 1 in this parameter to use the RS–422 interface in the ultrahigh–speed distribution mode.
5070	–	Specifies the limit baud rate with which the Program File Mate is synchronized with an external clock. Also, specify 13 in this parameter when the Program File Mate is used in the HDLC procedures.
5071	–	Specifies the specification number for an input–output device which uses the RS–422 interface. Specify 9 in this parameter when the Program File Mate is used in the HDLC procedures.
5072	–	Specifies the number of stop bits when the RS–422 interface is used (1 or 2).
5073	–	Specifies the baud rate when the RS–422 interface is used.
5074	–	Specifies the RS–422 protocol. Specify 5 in this parameter when the Program File Mate is used in the HDLC procedures.

NOTE The Program File Mate must be used in the HDLC procedures.

2) When the FD–Mate (DNC1) is used:

Parameter No.	Bit	Description
0020	–	Specifies the interface number of the input device used in the foreground. Specify 4 in this parameter when DNC1 is used.
0022	–	Specifies the interface number of the input device used in the background. A program can be loaded in the background, but ultrahigh–speed distribution cannot be performed in DNC operation.
5060	–	Specifies the baud rate when DNC1 is used in the HDLC procedures.
5061	–	Specifies the connection mode between the CNC and host CPU when DNC1 is used.
5062	–	Specifies the CNC station address when DNC1 is used.

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[T]

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[W]

Revision Record

FANUC Series 15/150–MODEL B PARAMETER MANUAL (B–62560E)

Edition	Date	Contents	Edition	Date	Contents
02	Mar., ’97	• Addition of parameters • Addition of 150–TB, 150–TTB, 150–MB, 15TED, 15TEE 15TEF, 15MEK, and 15MEL			
01	Aug., ’94				