FANUC Series 16*i*-MODEL B
FANUC Series 18*i*-MODEL B
FANUC Series 160*i*-MODEL B
FANUC Series 180*i*-MODEL B
FANUC Series 160*is*-MODEL B
FANUC Series 180*is*-MODEL B

PARAMETER MANUAL

B-63530EN/03

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 :

Model name	Abbreviation	
FANUC Series 16*i*-TB	16*i*-TB	Series 16*i*
FANUC Series 16*i*-MB	16*i*-MB	
FANUC Series 160*i*-TB	160*i*-TB	Series 160*i*
FANUC Series 160*i*-MB	160*i*-MB	
FANUC Series 160*i*s-TB	160*i*s-TB	Series 160*i*s
FANUC Series 160*i*s-MB	160*i*s-MB	
FANUC Series 18*i*-TB	18*i*-TB	Series 18*i*
FANUC Series 18*i*-MB5	18*i*-MB5	
FANUC Series 18*i*-MB	18*i*-MB	
FANUC Series 180*i*-TB	180*i*-TB	Series 180*i*
FANUC Series 180*i*-MB5	180*i*-MB5	
FANUC Series 180*i*-MB	180*i*-MB	
FANUC Series 180*i*s-TB	180*i*s-TB	Series 180*i*s
FANUC Series 180*i*s-MB5	180*i*s-MB5	
FANUC Series 180*i*s-MB	180*i*s-MB	

NOTE

1 For ease of explanation, the models may be classified as follows:
T series:
16*i*-TB/160*i*-TB/160*i*s-TB/18*i*-TB/180*i*-TB/180*i*s-TB
M series:
16*i*-MB/160*i*-MB/160*i*s-MB/18*i*-MB5/ 180*i*-MB5/ 180*i*s-MB5/18*i*-MB/180*i*-MB/180*i*s-MB

2 In this manual, the 18*i*/180*i*/180*i*s-MB indicates both the 18*i*/180*i*/180*i*s-MB5 and 18*i*/180*i*/180*i*s-MB unless otherwise specified.

3 Some functions described in this manual may not be applied to some products.
For details, refer to the DESCRIPTIONS (B-63522EN).

Related manuals of Series 16*i*/18*i*/21*i*/160*i*/180*i*/210*i*/160*i*s/180*i*s/210*i*s-MODEL B

The following table lists the manuals related to Series 16*i*, Series 18*i*, Series 21*i*, Series 160*i*, Series 180*i*, Series 210*i*, Series 160*i*s, Series 180*i*s, Series 210*i*s-MODEL B. This manual is indicated by an asterisk(*).

Related manuals of Series 16*i*/18*i*/21*i*/160*i*/180*i*/210*i*/160*i*s/180*i*s/ 210*i*s-MODEL B

Manual name	Specification number	
DESCRIPTIONS	B-63522EN	
CONNECTION MANUAL (HARDWARE)	B-63523EN	
CONNECTION MANUAL (FUNCTION)	B-63523EN-1	
Series 16*i*/18*i*/160*i*/180*i*/160*i*s/180*i*s-TB OPERATOR'S MANUAL	B-63524EN	
Series 16*i*/160*i*/160*i*s-MB, Series 18*i*/180*i*/180*i*-MB5, Series 18*i*/180*i*/180*i*s-MB OPERATOR'S MANUAL	B-63534EN	
Series 21*i*/210*i*/210*i*s-TB OPERATOR'S MANUAL	B-63604EN	
Series 21*i*/210*i*/210*i*s-MB OPERATOR'S MANUAL	B-63614EN	
MAINTENANCE MANUAL	B-63525EN	
Series 16*i*/18*i*/160*i*/180*i*/160*i*s/180*i*s-MODEL B PARAMETER MANUAL	B-63530EN	*
Series 21*i*/210*i*/210*i*s-MODEL B PARAMETER MANUAL	B-63610EN	
PROGRAMMING MANUAL		
Macro Compiler/Macro Executor PROGRAMMING MANUAL	B-61803E-1	
C Language Executor PROGRAMMING MANUAL	B-62443EN-3	
FANUC MACRO COMPILER (For Personal Computer) PROGRAMMING MANUAL	B-66102E	
CAP (T series)		
FANUC Super CAP*i* T OPERATOR'S MANUAL	B-63284EN	
FANUC Symbol CAP*i* T OPERATOR'S MANUAL	B-63304EN	
MANUAL GUIDE For Lathe PROGRAMMING MANUAL	B-63343EN	
MANUAL GUIDE For Lathe OPERATOR'S MANUAL	B-63344EN	
CAP (M series)		
FANUC Super CAP*i* M OPERATOR'S MANUAL	B-63294EN	
MANUAL GUIDE For Milling PROGRAMMING MANUAL	B-63423EN	
MANUAL GUIDE For Milling OPERATOR'S MANUAL	B-63424EN	
PMC		
PMC Ladder Language PROGRAMMING MANUAL	B-61863E	
PMC C Language PROGRAMMING MANUAL	B-61863E-1	
Network		
I/O Link-II OPERATOR'S MANUAL	B-62924EN	
Profibus-DP Board OPERATOR'S MANUAL	B-62924EN	
Ethernet Board/DATA SERVER Board OPERATOR'S MANUAL	B-63354EN	
FAST Ethernet Board/FAST DATA SERVER OPERATOR'S MANUAL	B-63644EN	
DeviceNet Board OPERATOR'S MANUAL	B-63404EN	
PC function		
Screen Display Function OPERATOR'S MANUAL	B-63164EN	

Related manuals of SERVO MOTOR αi series

The following table lists the manuals related to SERVO MOTOR αi series

Manual name	Specification number
FANUC AC SERVO MOTOR αis series FANUC AC SERVO MOTOR αi series DESCRIPTIONS	B-65262EN
FANUC AC SPINDLE MOTOR αi series DESCRIPTIONS	B-65272EN
FANUC LINEAR MOTOR series DESCRIPTIONS	B-65222EN
FANUC SERVO AMPLIFIER αi series DESCRIPTIONS	B-65282EN
FANUC AC SERVO MOTOR αis series FANUC AC SERVO MOTOR αi series FANUC AC SPINDLE MOTOR αi series FANUC SERVO AMPLIFIER αi series MAINTENANCE MANUAL	B-65285EN
FANUC AC SERVO MOTOR αis series FANUC AC SERVO MOTOR αi series PARAMETER MANUAL	B-65270EN
FANUC AC SPINDLE MOTOR αi series PARAMETER MANUAL	B-65280EN
FANUC AC SERVO MOTOR αis series FANUC AC SERVO MOTOR αi series FANUC AC SERVO MOTOR βis series PARAMETER MANUAL	B-65270EN

Related manuals of SERVO MOTOR α series

The following table lists the manuals related to SERVO MOTOR α series

Manual name	Specification number
FANUC AC SERVO MOTOR α series DESCRIPTIONS	B-65142E
FANUC AC SPINDLE MOTOR α series DESCRIPTIONS	B-65152E
FANUC SERVO AMPLIFIER α series DESCRIPTIONS	B-65162E
FANUC SERVO MOTOR α series MAINTENANCE MANUAL	B-65165E
FANUC AC SERVO MOTOR α series PARAMETER MANUAL	B-65150E
FANUC AC SPINDLE MOTOR α series PARAMETER MANUAL	B-65160E

Either of the following servo motors and the corresponding spindle can be connected to the CNC covered in this manual.

- FANUC SERVO MOTOR αi series
- FANUC SERVO MOTOR α series

This manual mainly assumes that the FANUC SERVO MOTOR αi series of servo motor is used. For servo motor and spindle information, refer to the manuals for the servo motor and spindle that are actually connected.

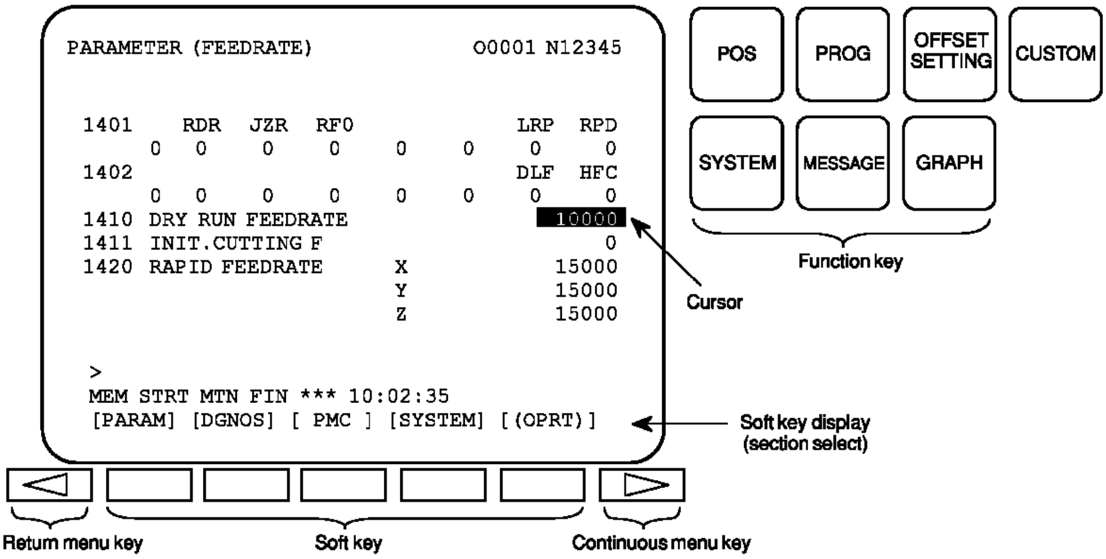
TABLE OF CONTENTS

APPENDIX

1 DISPLAYING PARAMETERS

Follow the procedure below to display parameters.

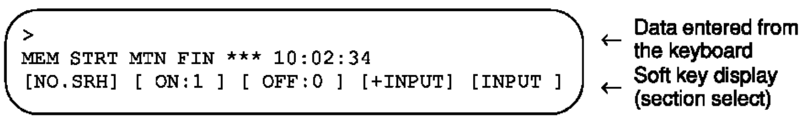
(1) Press the SYSTEM function key on the MDI as many times as required, or alternatively, press the SYSTEM function key once, then the [PARAM] section display soft key. The parameter screen is then selected.



(2) The parameter screen consists of multiple pages. Use step (a) or (b) to display the page that contains the parameter you want to display.
   (a) Use the page select key or the cursor move keys to display the desired page.
   (b) Enter the data number of the parameter you want to display from the keyboard, then press the [NO.SRH] soft key. The parameter page containing the specified data number appears with the cursor positioned at the data number. (The data is displayed in reverse video.)

NOTE

If key entry is started with the section select soft keys displayed, they are replaced automatically by operation select soft keys including [NO.SRH]. Pressing the [(OPRT)] soft key can also cause the operation select keys to be displayed.



2 SETTING PARAMETERS FROM MDI

Follow the procedure below to set parameters.

(1) Place the NC in the MDI mode or the emergency stop state.

(2) Follow the substeps below to enable writing of parameters.

1. To display the setting screen, press the OFFSET SETTING function key as many times as required, or alternatively press the OFFSET SETTING function key once, then the [SETTING] section select soft key. The first page of the setting screen appears.
2. Position the cursor on "PARAMETER WRITE" using the cursor move keys.

```
SETTING (HANDY)                    O0001  N00010

 PARAMETER WRITE = 0   (0:DISABLE 1:ENABLE)
 TV CHECK        = 0   (0:OFF     1:ON)
 PUNCH CODE      = 0   (0:EIA     1:ISO)
 INPUT UNIT      = 0   (0:MM      1:INCH)
 I/O CHANNEL     = 0   (0-3:CHANNEL NO.)
```

3. Press the [(OPRT)] soft key to display operation select soft keys.

```
 >
 MDI STOP *** *** *** 10:03:02
 [NO.SRH] [ ON:1 ] [ OFF:0 ] [+INPUT] [INPUT]
```

← Soft key display (section select)

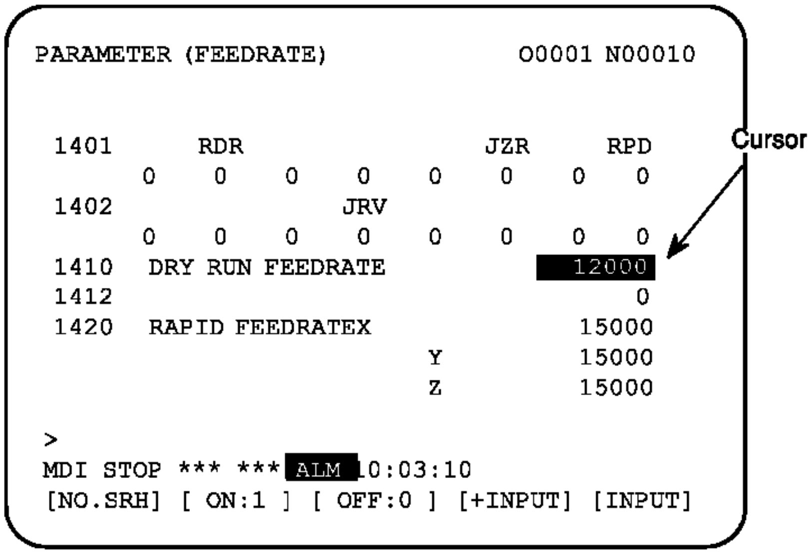
4. To set "PARAMETER WRITE=" to 1, press the [ON:1] soft key, or alternatively enter 1 and press the [INPUT] soft key. From now on, the parameters can be set. At the same time an alarm condition (P/S100 PARAMETER WRITE ENABLE) occurs in the CNC.

(3) To display the parameter screen, press the SYSTEM function key as many times as required, or alternatively press the SYSTEM function key once, then the [PARAM] section select soft key.
(See Chapter 1 "DISPLAYING PARAMETERS.")

(4) Display the page containing the parameter you want to set, and position the cursor on the parameter. (See Chapter 1 "DISPLAYING PARAMETERS.")

(5) Enter data, then press the [INPUT] soft key. The parameter indicated by the cursor is set to the entered data.

[Example] 12000 [INPUT]



Data can be entered continuously for parameters, starting at the selected parameter, by separating each data item with a semicolon (;).

[Example]

Entering 10;20;30;40 and pressing the [INPUT] key assigns values 10, 20, 30, and 40 to parameters in order starting at the parameter indicatedby the cursor.

(6) Repeat steps (4) and (5) as required.

(7) If parameter setting is complete, set "PARAMETER WRITE=" to 0 on the setting screen to disable further parameter setting.

(8) Reset the NC to release the alarm condition (P/S100).
If an alarm condition (P/S000 PLEASE TURN OFF POWER) occurs in the NC, turn it off before continuing operation.

3 INPUTTING AND OUTPUTTING PARAMETERS THROUGH THE READER/PUNCHER INTERFACE

This section explains the parameter input/output procedures for input/output devices connected to the reader/puncher interface.
The following description assumes the input/output devices are ready for input/output. It also assumes parameters peculiar to the input/output devices, such as the baud rate and the number of stop bits, have been set in advance. (See Section 4.2.)

3.1 OUTPUTTING PARAMETERS THROUGH THE READER/PUNCHER INTERFACE

(1) Select the EDIT mode or set to Emergency stop.

(2) To select the parameter screen, press the SYSTEM function key as many times as required, or alternatively press the SYSTEM function key once, then the [PARAM] section select soft key.

(3) Press the [(OPRT)] soft key to display operation select soft keys, then press the forward menu key located at the right-hand side of the soft keys to display another set of operation select keys including [PUNCH].

```
PARAMETER (FEEDRATE)                 O0001  N00010

 1401      RDR                   JZR       RPD
        0    0    0    0    0    0    0    0
 1402                JRV
        0    0    0    0    0    0    0    0
 1410   DRY RUN FEEDRATE             12000         ← Cursor
 1412                                    0
 1420   RAPID FEEDRATEX              15000
                          Y          15000
                          Z          15000

 >
 MDI STOP *** *** ALM 10:03:10                     ← State display
  [NO.SRH] [ON:1] [OFF:0] [+INPUT] [INPUT]         ← Soft key display
                                                     (operation select)
```

(4) Pressing the [ALL] or [NON-0]soft key changes the soft key display as shown below:

```
>
EDIT STOP *** *** *** 10:35:03
[      ] [      ] [ ALL ] [      ] [ NON-0]
```

(5) Pressing the [PUNCH] soft key changes the soft key display as shown below:

```
>
EDIT STOP *** *** *** 10:35:03
[      ] [      ] [      ] [CANCEL] [ EXEC ]
```

(6) Press the [EXEC] soft key to start parameter output. When parameters are being output, "OUTPUT" blinks in the state display field on the lower part of the screen.

```
>
EDIT STOP *** *** *** 10:35:04    OUTPUT           ← OUTPUT blinking
[      ] [      ] [      ] [CANCEL] [ EXEC ]
```

(7) When parameter output terminates, "OUTPUT" stops blinking. Press the RESET key to interrupt parameter output.

3.2 INPUTTING PARAMETERS THROUGH THE READER/PUNCHER INTERFACE

(1) Place the NC in the emergency stop state.

(2) Enable parameter writing.

1. To display the setting screen, press the OFFSET SETTING function key as many times as required, or alternatively press the OFFSET SETTING function key once, then the [SETTING] section select soft key. The first page of the setting screen appears.
2. Position the cursor on "PARAMETER WRITE" using the cursor move keys.
3. Press the [(OPRT)] soft key to display operation select soft keys.
4. To set "PARAMETER WRITE=" to 1, press the ON:1 soft key, or alternatively enter 1, then press the [INPUT] soft key. From now on, parameters can be set. At the same time an alarm condition (P/S100 PARAMETER WRITE ENABLE) occurs in the NC.

(3) To select the parameter screen, press the SYSTEM function key as many times as required, or alternatively press the SYSTEM key once, then [PARAM] soft key.

(4) Press the [(OPRT)] soft key to display operation select keys, then press the forward menu key located at the right-hand side of the soft keys to display another set of operation select soft keys including [READ].

```
>
EDIT STOP -EMG- ALM 10:37:30                        ← State display
[      ] [ READ ] [PUNCH] [      ] [      ]         ← Soft key display
```

(5) Pressing the [READ] soft key changes the soft key display as shown below:

```
>
EDIT STOP -EMG- ALM 10:37:30
[      ] [      ] [      ] [CANCEL] [ EXEC ]
```

(6) Press the [EXEC] soft key to start inputting parameters from the input/output device. When parameters are being input, "INPUT" blinks in the state display field on the lower part of the screen.

```
>
EDIT STOP -EMG- ALM 10:37:30    INPUT               ← INPUT blinking
[      ] [      ] [      ] [CANCEL] [ EXEC ]
```

(7) When parameter input terminates, "INPUT" stops blinking. Press the RESET key to interrupt parameter input.

(8) When parameter read terminates, "INPUT" stops blinking, and an alarm condition (P/S000) occurs in the NC. Turn it off before continuing operation.

4 DESCRIPTION OF PARAMETERS

Parameters are classified by data type as follows:

Table 4 Data Types and Valid Data Ranges of Parameters

Data type	Valid data range	Remarks
Bit Bit axis	0 or 1	
Byte Byte axis	-128 to 127 0 to 255	In some parameters, signs are ignored.
Word Word axis	-32768 to 32767 0 to 65535	In some parameters, signs are ignored.
2-word 2-word axis	-99999999 to 99999999	

NOTE

1 For the bit type and bit axis type parameters, a single data number is assigned to 8 bits. Each bit has a different meaning.

2 The axis type allows data to be set separately for each control axis.

3 The valid data range for each data type indicates a general range. The range varies according to the parameters. For the valid data range of a specific parameter, see the explanation of the parameter.

(1) Notation of bit type and bit axis type parameters

	#7	#6	#5	#4	#3	#2	#1	#0
0000			**SEQ**			**INI**	**ISO**	**TVC**

Data No. Data #0 to #7 are bit positions.

(2) Notation of parameters other than bit type and bit axis type

1023	**Number of the servo axis for each axis**

Data No. Data.

NOTE

1 The bits left blank in Chapter 4 “DESCRIPTION OF PARAMETERS” and parameter numbers that appear on the display but are not found in the parameter list are reserved for future expansion. They must always be 0.

2 Parameters having different meanings between the T series and M series and parameters that are valid only for the T or M series are indicated in two levels as shown below. Parameters left blank are unavailable.

[Example1]

Parameter No. 5010 has different meanings for the T series and M series.

5010	Tool nose radius compensation ...	T series
	Tool compensation C ...	M series

[Example2]

DPI is a parameter common to the M and T series, but GSB and GSC are parameters valid only for the T series.

	#7	#6	...	#0	
3401	GSC	GSB		DPI	T series
				DPI	M series

[Example3]

The following parameter is provided only for the M series.

1450		T series
	F1 digit feed ...	M series

4.1 PARAMETERS OF SETTING

	#7	#6	#5	#4	#3	#2	#1	#0
0000			SEQ			INI	ISO	TVC

At least one of these parameters can also be set on the "Setting screen".

[Data type] Bit

TVC TV check
0 : Not performed
1 : Performed

ISO Code used for data output
0 : EIA code
1 : ISO code

INI Unit of input
0 : In mm
1 : In inches

SEQ Automatic insertion of sequence numbers
0 : Not performed
1 : Performed

When a program is prepared by using MDI keys in the part program storage and edit mode, a sequence number can automatically be assigned to each block in set increments. Set the increment to parameter No. 3216.

	#7	#6	#5	#4	#3	#2	#1	#0
0001							FCV	

At least one of these parameters can also be set on the "Setting screen".

[Data type] Bit

FCV Tape format
0 : Series 16 standard format
1 : Series 15 format

NOTE

1 Programs created in the Series 15 tape format can be used for operation on the following functions:
(1) Subprogram call M98
(2) Threading with equal leads G32 (T series)
(3) Canned cycle G90, G92, G94 (T series)
(4) Multiple repetitive canned cycle G71 to G76 (T series)
(5) Drilling canned cycle G73, G74, G76, G80 to G89 (M series)
(6) Cutter compensation C (M series)

2 When the tape format used in the Series 15 is used for this CNC, some limits may add. Refer to the Series 16*i*/18*i*/160*i*/180*i*/160*i*s/180*i*s-MODEL B OPERATOR'S MANUAL.

	#7	#6	#5	#4	#3	#2	#1	#0
0002	SJZ							RDG

At least one of these parameters can also be set on the "Setting screen".

[Data type] Bit

RDG Remote diagnosis is
0 : Not performed.
1 : Performed.
To use an RS-232C serial port for performing remote diagnosis, connect and setup the modem, cable, and the like, then set 1 in this parameter. When using a modem card, the setting is not necessary.

SJZ Manual reference position is performed as follows:
0 : When no reference position has been set, reference position return is performed using deceleration dogs. When a reference position is already set, reference position return is performed using rapid traverse and deceleration dogs are ignored.
1 : Reference position return is performed using deceleration dogs at all times.

NOTE
SJZ is enabled when bit 3 (HJZ) of parameter No.1005 is set to 1. When a reference position is set without a dog, (i.e. when bit 1 (DLZ) of parameter No.1002 is set to 1 or bit 1 (DLZx) of parameter No.1005 is set to 1) reference position return after reference position setting is performed using rapid traverse at all times, regardless of the setting of SJZ.

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

At least one of these parameters can also be set on the "Setting screen".

[Data type] Bit axis

MIRx Mirror image for each axis
0 : Mirror image is off.
1 : Mirror image is on.

AICx The travel distance of an axis command is:
0 : Determined by the value specified with the address.
1 : Always handled as an incremental value.

RMVx Releasing the assignment of the control axis for each axis
0 : Not released
1 : Released

NOTE
RMVx is valid when bit 7 (RMBx) of parameter No. 1005 is 1.

0020	I/O CHANNEL: Selection of an input/output device or selection of input device in the foreground

This parameter can also be set on the “Setting screen”.

[Data type] Byte

[Valid data range] 0 to 35

The CNC provides the following interfaces for data transfer to and from the host computer and external input/output devices:

- Input/output device interface (RS-232C serial port 1 or 2)
- Remote buffer interface (RS-232C/RS-422)
- DNC1/DNC2 interface

In addition, data can be transferred to and from the power mate CNC via the FANUC I/O Link.

This parameter selects the interface used to transfer data to and from an input/output device.

Setting	Description
0 or 1	RS-232C serial port 1
2	RS-232C serial port 2
3	Remote buffer interface
4	Memory card interface (NC side)
5	Data server interface
6	The DNC operation is performed or M198 is specified by FOCAS1/Ethernet or DNC1/Ethernet.
7	Memory card interface (touch panel side)
10	DNC1/DNC2 interface, OSI-Ethernet
12	DNC1 interface #2
15	M198 is specified by FOCAS1/HSSB. (Bit 1 (NWD) of parameter No. 8706) must also be specified.)
16	The DNC operation is performed or M198 is specified by FOCAS1/ HSSB (port 2).
20 21 22 to 34 35	Group 0 Group 1 Group 2 to Group 14 Group 15 Data is transferred between the CNC and a power mate CNC in group n (n: 0 to 15) via the FANUC I/O Link.

Supplemental remark 1

If the DNC operation is performed with FOCAS1/HSSB, the setting of parameter No. 20 does not matter. The DMMC signal <G042.7> is used.

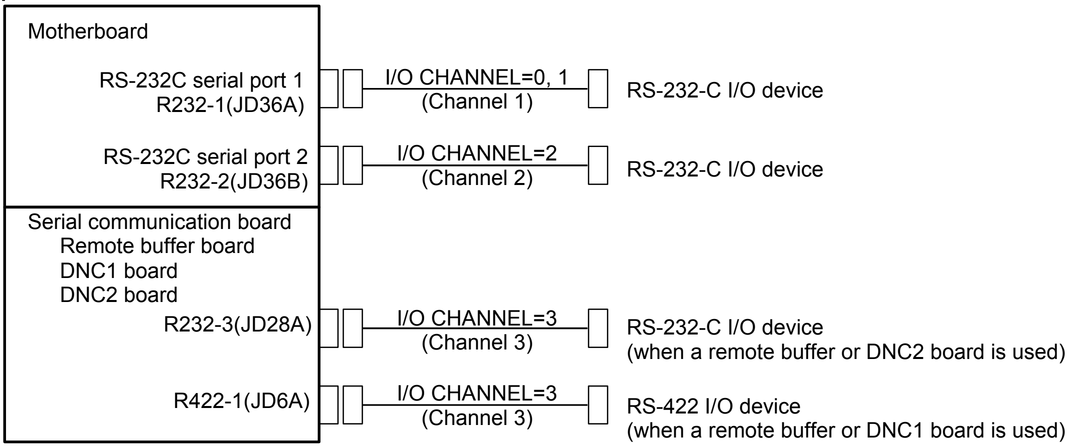
Supplemental remark 2

If bit 0 (IO4) of parameter No. 110 is set to control the I/O channels separately, the I/O channels can be divided into four types: input and output in the foreground and input and output in the background. If so, parameter No. 20 becomes a parameter for selecting the input device in the foreground.

NOTE

1 An input/output device can also be selected using the setting screen. Usually, the setting screen is used.

2 The specifications (such as the baud rate and the number of stop bits) of the input/output devices to be connected must be set in the corresponding parameters for each interface beforehand. (See Section 4.2.) I/O CHANNEL = 0 and I/O CHANNEL = 1 represent input/output devices connected to RS-232C serial port 1. Separate parameters for the baud rate, stop bits, and other specifications are provided for each channel.



3 The input/output device interface may be referred to as the reader/puncher interface.
RS-232C serial port 1 and RS-232C serial port 2 are also referred to as channel 1 and channel 2, respectively. The remote buffer interface is also referred to as channel 3.

0021	Setting of the output device in the foreground
0022	Setting of the input device in the background
0023	Setting of the output device in the background

These parameters can also be set on the “Setting screen”.

[Data type] Byte

[Valid data range] 0 to 3, 5, 10

These parameters are valid only when bit 0 (IO4) of parameter No. 110 is set to control the I/O channels separately.

The parameters set individual input/output devices if the I/O channels are divided into these four types: input and output in the foreground and input and output in the background. The input device in the foreground is set in parameter No. 20. For the details of the settings, see the table provided with the description of parameter No. 20.

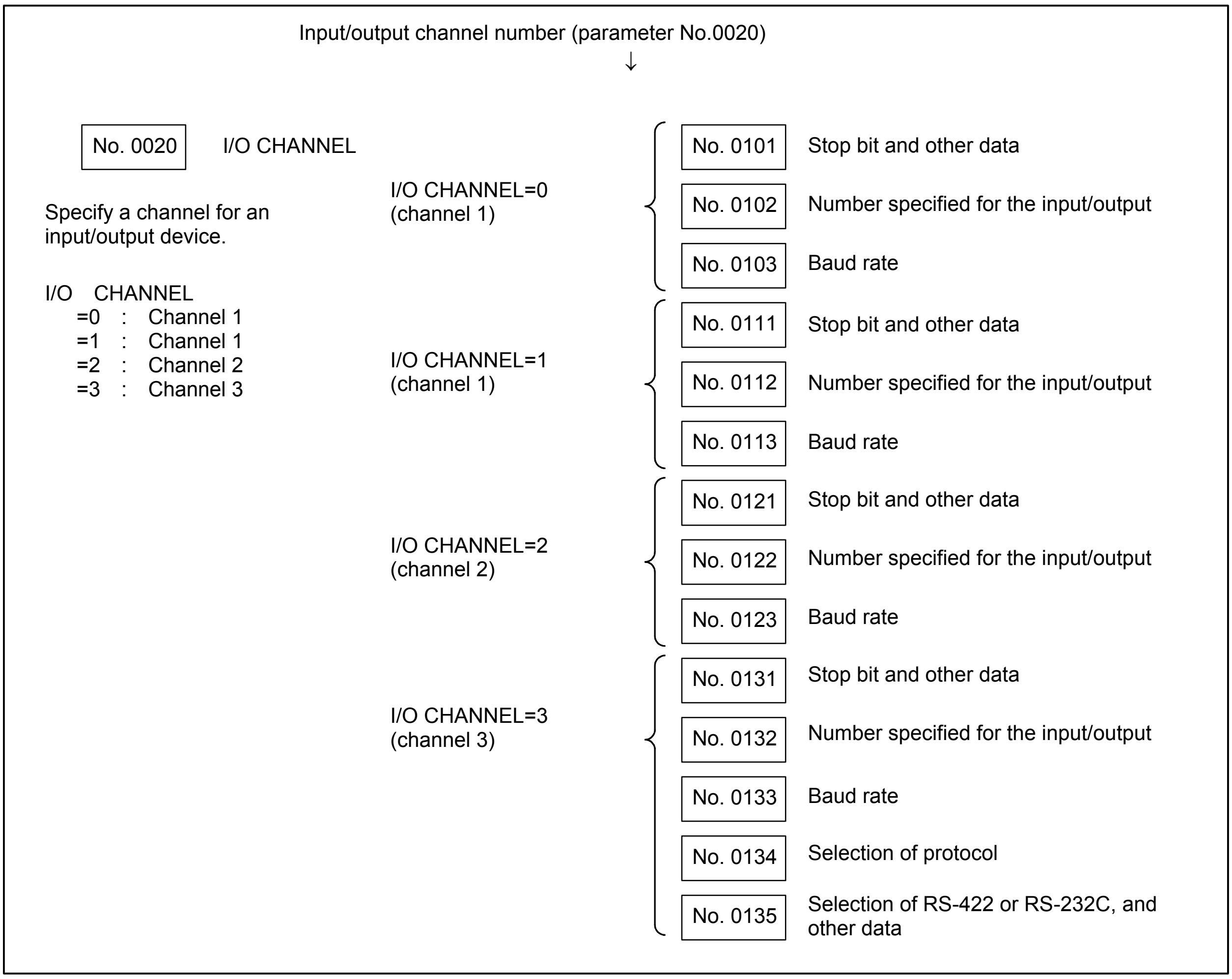
NOTE

If different input/output devices are simultaneously used in the foreground and background, just a value from 0 to 3 can be specified for the background device.

If an attempt is made to use a busy input/output device, an alarm (P/S233 or BP/S233) will be raised. Note that the settings 0 and 1 indicate the same input/output device.

4.2 PARAMETERS OF READER/PUNCHER INTERFACE OR REMOTE BUFFER

To exchange data (such as programs and parameters) with an external input/output device by using the input/output device interface (RS-232C serial port) or remote buffer interface, the parameters described below need to be set.
In the setting parameter I/O CHANNEL, specify which of the input/output devices connected to the three channels (RS-232C serial port 1, RS-232C serial port 2, and remote buffer interface) is to be used.
Furthermore, set the specifications (specification number, baud rate, the number of stop bits, and so forth) of the input/output device connected to each channel in the parameters corresponding to each channel beforehand.
For setting of the specifications of channel 1, two sets of parameters are available.
Fig. 4.2 shows the input/output device interface parameters corresponding to each channel.



4.2.1 Parameters Common to all Channels

0024	Port for communication with the PMC ladder development tool (FANUC LADDER-III)

This parameter can also be set on the “Setting screen”.

[Data type] Byte

This parameter sets the port to be used for communication with the PMC ladder development tool (FANUC LADDER-III).

0 : According to the setting on the PMC online screen
1 : RS-232C serial port 1 (JD36A)
2 : RS-232C serial port 2 (JD36B)
10 : High-speed interface (HSSB (COP7) or Ethernet)
11 : High-speed interface or RS-232C serial port 1
12 : High-speed interface or RS-232C serial port 2

	#7	#6	#5	#4	#3	#2	#1	#0
0100	ENS	IOP	ND3		NCR	CRF	CTV	

[Data type] Bit

CTV: Character counting for TV check in the comment section of a program.
0 : Performed
1 : Not performed

CRF EOB (end of block) to be output in the ISO code:
0 : Depends on the setting of bit 3 (NCR) of parameter No. 100.
1 : is "CR""LF".

NOTE
The EOB output patterns are as shown below:

NCR	CRF	EOB output format
0	0	"LF" "CR" "CR"
0	1	"CR" "LF"
1	0	"LF"
1	1	"CR" "LF"

NCR Output of the end of block (EOB) in ISO code
0 : LF, CR, CR are output.
1 : Only LF is output.

ND3 In DNC operation, a program is:
0 : Read block by block. (A DC3 code is output for each block.)
1 : Read continuously until the buffer becomes full. (A DC3 code is output when the buffer becomes full.)

NOTE
In general, reading is performed more efficiently when ND3 set to 1. This specification reduces the number of buffering interruptions caused by reading of a series of blocks specifying short movements. This in turn reduces the effective cycle time.

IOP Specifies how to stop program input/output operations.
0 : An NC reset can stop program input/output operations.
1 : Only the [STOP] soft key can stop program input/output operations. (A reset cannot stop program input/output operations.)

ENS Action taken when a NULL code is found during read of EIA code
0 : An alarm is generated.
1 : The NULL code is ignored.

	#7	#6	#5	#4	#3	#2	#1	#0
0110								IO4

[Data type] Bit

IO4 Separate control of I/O channel numbers is:
0 : Not performed.
1 : Performed.
If the I/O channels are not separately controlled, set the input/output device in parameter No. 20.
If the I/O channels are separately controlled, set the input device and output device in the foreground and the input device and output device in the background in parameters No. 20 to No. 23 respectively.
Separate control of I/O channels makes it possible to perform background editing, program input/output, and the like during the DNC operation.

4.2.2 Parameters of Channel 1 (I/O CHANNEL=0)

	#7	#6	#5	#4	#3	#2	#1	#0
0101	NFD				ASI			SB2
	NFD				ASI		HAD	SB2

[Data type] Bit

SB2 The number of stop bits
0 : 1
1 : 2

HAD An alarm raised for the internal handy file is:

0 : Not displayed in detail on the NC screen. (PS alarm 86 is displayed.)

1 : Displayed in detail on the NC screen.

ASI Code used at data input/output

0 : EIA or ISO code (Input: Automatic determination/Output: Setting of bit 1 (ISO) of parameter No. 0000)

1 : ASCII code for both input and output

> **NOTE**
> When using ASCII code for data input/output (when setting ASI to 1), set also bit 1 (ISO) of parameter No. 0000 to 1.

NFD Feed before and after the data at data output

0 : Output

1 : Not output

> **NOTE**
> When input/output devices other than the FANUC PPR are used, set NFD to 1.

0102	Number specified for the input/output device (when the I/O CHANNEL is set to 0)

[Data type] Byte

Set the number specified for the input/output device used when the I/O CHANNEL is set to 0, with one of the set values listed in Table 4.2.2 (a).

Table 4.2.2 (a)

Set value	Input/output device
0	RS-232C (Used control codes DC1 to DC4)
1	FANUC CASSETTE ADAPTOR 1 (FANUC CASSETTE B1/ B2)
2	FANUC CASSETTE ADAPTOR 3 (FANUC CASSETTE F1)
3	FANUC PROGRAM FILE Mate, FANUC FA Card Adaptor FANUC FLOPPY CASSETTE ADAPTOR, FANUC Handy File FANUC SYSTEM P-MODEL H
4	RS-232C (Not used control codes DC1 to DC4)
5	Portable tape reader
6	FANUC PPR FANUC SYSTEM P-MODEL G, FANUC SYSTEM P-MODEL H

0103	Baud rate (when the I/O CHANNEL is set to 0)

[Data type] Byte

Set baud rate of the input/output device used when the I/O CHANNEL is set to 0, with a set value in Table 4.2.2 (b).

Table 4.2.2 (b)

Set value	Baud rate (bps)	Set value	Baud rate (bps)
1	50	9	2400
2	100	10	4800
3	110	11	9600
4	150	12	19200
5	200	13	38400
6	300	14	57600
7	600	15	76800
8	1200	16	115200

4.2.3 Parameters of Channel 1 (I/O CHANNEL=1)

	#7	#6	#5	#4	#3	#2	#1	#0
0111	NFD				ASI			SB2

[Data type] Bit

These parameters are used when I/O CHANNEL is set to 1. The meanings of the bits are the same as for parameter No. 0101.

0112	Number specified for the input/output device (when I/O CHANNEL is set to 1)

[Data type] Byte

Set the number specified for the input/output device used when the I/O CHANNEL is set to 1, with one of the set values listed in Table 4.2.2 (a).

0113	Baud rate (when I/O CHNNEL is set to 1)

[Data type] Byte

Set the baud rate of the input/output device used when I/O CHANNEL is set to 1, with a value in Table 4.2.2 (b).

4.2.4 Parameters of Channel 2 (I/O CHANNEL=2)

	#7	#6	#5	#4	#3	#2	#1	#0
0121	NFD				ASI			SB2

[Data type] Bit

These parameters are used when I/O CHANNEL is set to 2. The meanings of the bits are the same as for parameter No. 0101.

0122	Number specified for the input/output device (when I/O CHANNEL is set to 2)

[Data type] Byte

Set the number specified for the input/output device used when I/O CHANNEL is set to 2, with a value in Table 4.2.2 (a).

0123	Baud rate (when the I/O CHANNEL is set to 2)

[Data type] Byte

Set the baud rate of the input/output device used when I/O CHANNEL is set to 2, with a value in Table 4.2.2 (b).

4.2.5 Parameters of Channel 3 (I/O CHANNEL=3)

	#7	#6	#5	#4	#3	#2	#1	#0
0131	NFD				ASI			SB2

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

These parameters are used when I/O CHANNEL is set to 3. The meanings of the bits are the same as for parameter No. 0101.

0132	Number specified for the input/output device (when I/O CHANNEL is set to 3)

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

[Data type] Byte

Set the number specified for the input/output device used when I/O CHANNEL is set to 3, with a number in Table 4.2.2 (a).

0133	Baud rate (when the I/O CHANNEL is set to 3)

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

[Data type] Byte

Set the baud rate of the input/output device used when the I/O CHANNEL is set to 3 according to the table 4.2.5.

Valid data range: 1 to 15 (up to a baud rate of 86400 bps) for the RS-422 interface or 1 to 12 (up to a baud rate of 19200 bps) for the RS-232C interface.

Table 4.2.5

Set value	Baud rate (bps)	Set value	Baud rate (bps)
1	50	9	2400
2	100	10	4800
3	110	11	9600
4	150	12	19200
5	200	13	38400
6	300	14	76800
7	600	15	86400
8	1200		

	#7	#6	#5	#4	#3	#2	#1	#0
0134			CLK	NCD		SYN	PRY	

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

PRY Parity bit
0 : Not used
1 : Used

SYN Reset/alarm in protocol B
0 : Not reported to the host
1 : Reported to the host with SYN and NAK codes

NCD CD (signal quality detection) of the RS-232C interface
0 : Checked
1 : Not checked

CLK Baud rate clock when the RS-422 interface is used
0 : Internal clock
1 : External clock

NOTE
When the RS-232C interface is used, set this bit to 0.

	#7	#6	#5	#4	#3	#2	#1	#0
0135	RMS				R42	PRA	ETX	ASC

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

ASC Communication code except NC data
- 0 : ISO code
- 1 : ASCII code

ETX End code for protocol A or extended protocol A
- 0 : CR code in ASCII/ISO
- 1 : ETX code in ASCII/ISO

> **NOTE**
> Use of ASCII/ISO is specified by bit 0 (ASC) of parameter No. 135.

PRA Communication protocol
- 0 : Protocol B
- 1 : Protocol A

R42 Interface
- 0 : RS-232C interface
- 1 : RS-422 interface

RMS State of remote/tape operation when protocol A is used
- 0 : Always 0 is returned.
- 1 : Contents of the change request of the remote/tape operation in the SET command from the host is returned.

	#7	#6	#5	#4	#3	#2	#1	#0
0138	MDN	OWN			BIO		FNL	MDP
	MDN	OWN					FNL	MDP

[Data type] Bit

MDP In data output by a memory card, the series information is:
- 0 : Not added to the output file name.
- 1 : Added to the output file name.

FNL In data output by RS-232C of the loader control function, the series information is:
- 0 : Not added to the output file name.
- 1 : Added to the output file name.

BIO In multi-path control, NC data input/output via the memory card interface is:
- 0 : Controlled on a path-by-path basis.
- 1 : Controlled in a batch for all paths.

OWM When NC data or NC programs are punched to the memory card, a file overwrite confirmation message is:
- 0 : Displayed.
- 1 : Not displayed.

MDN The DNC operation function by a memory card is:
0 : Disabled.
1 : Enabled. (A PCMCIA card attachment is required.)

NOTE
Use a PCMCIA card attachment suited to the CNC to secure the memory card in the CNC.

4.3 PARAMETERS OF DNC1/DNC2 INTERFACE

	#7	#6	#5	#4	#3	#2	#1	#0
0140					ECD	NCE		BCC

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

BCC The BCC value (block check characters) is:
0 : Checked.
1 : Not checked.
This parameter is dedicated to the DNC2 interface.
Even if the BCC value is not checked, the BCC value itself must be specified.

NCE The ER (RS-232C) and TR (RS422) signals are:
0 : Checked.
1 : Not checked.
This parameter is dedicated to the DNC2 interface.

ECD Error code of negative acknowledgment
0 : A four-digit hexadecimal error code is added to a negative acknowledgment.
1 : No error code is added to a negative acknowledgment.
This parameter is dedicated to the DNC2 interface.

> **NOTE**
> To use FANUC DNC2 communications library for the host computer, set this parameter to 1.

0141	System for connection between the CNC and host (DNC1 interface)

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

[Data type] Byte
[Valid data range] 1 or 2
This parameter specifies the system for connection (DNC1 interface) between the CNC and host.
Set value
1 : Point-to-point connection
2 : Multipoint connection

0142	Station address of the CNC (DNC1 interface)

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

[Data type] Byte

[Valid data range] 2 to 52

This parameter specifies the station address of the CNC when the CNC is connected via the DNC1 interface using multipoint connection.

0143	Time limit specified for the timer monitoring a response (DNC2 interface)

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

[Data type] Byte

[Unit of data] sec

[Valid data range] 1 to 60 (The standard setting is 3.)

0144	Time limit specified for the timer monitoring the EOT signal (DNC2 interface)

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

[Data type] Byte

[Unit of data] sec

[Valid data range] 1 to 60 (The standard setting is 5.)

0145	Time required for switching RECV and SEND (DNC2 interface)

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

[Data type] Byte

[Unit of data] sec

[Valid data range] 1 to 60 (The standard setting is 1.)

0146	Number of times the system retries holding communication (DNC2 interface)

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

[Data type] Byte
[Unit of data] Number of times
[Valid data range] 1 to 10 (The standard setting is 3.)

Set the maximum number of times the system retries holding communication with the remote device if the remote device uses an invalid protocol in the data-link layer or the remote device does not respond to the request.

0147	Number of times the system sends the message in response to the NAK signal (DNC2 interface)

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

[Data type] Byte
[Unit of data] Number of times
[Valid data range] 1 to 10 (The standard setting is 2.)

Set the maximum number of times the system retries sending the message in response to the NAK signal.

0148	Number of characters in overrun (DNC2 interface)

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

[Data type] Byte
[Valid data range] 10 to 225 (The standard setting is 10.)

Set the number of characters the system can receive after transmission is stopped (CS off).

0149	Number of characters in the data section of the communication packet (DNC2 interface)

NOTE

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

[Data type] Word

[Valid range] 80 to 256 (The standard setting is 256.)

If the specified value is out of range, a value of 80 or 256 is used.

The standard setting is 256.

This parameter determines the maximum length of the packet used in transmission over the DNC2 interface. Including the two characters at the start of the packet, the four characters used for a command, and the three characters at the end, the maximum number of characters in the packet is nine plus the number specified in parameter No.0149.

Length of the packet

DLE	STX	Command	Data section	DEL	ETX	BCC
2 bytes		4 bytes	80 to 256 bytes	3 bytes		

4.4 PARAMETERS OF M-NET INTERFACE

	#7	#6	#5	#4	#3	#2	#1	#0
0161	SRS		PEO	SRP		SRL		

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

SRL Number of characters used in the serial interface
0 : Seven bits
1 : Eight bits

SRP Vertical parity in the serial interface
0 : Vertical parity is not checked.
1 : Vertical parity is checked.

PEO Either odd or even parity is used for vertical parity in the serial interface
0 : Odd parity is used.
1 : Even parity is used.

> **NOTE**
> This bit is effective when bit SRP is set to 1.

SRS Stop bit in the serial interface
0 : One stop bit is used.
1 : Two stop bits are used.

0171	Length of DI data in bytes in M-NET

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

[Data type] Byte

[Valid range] 1 to 32

Specify the length of DI data in bytes (number of byte of data actually transferred from the PLC unit to the CNC unit) in the serial interface.

0172	Length of DO data in bytes in M-NET

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

[Data type] Byte
[Valid range] 1 to 32
Specify the length of DO data in bytes (number of bytes of data actually transferred from the CNC unit to the PLC unit) in the serial interface.

NOTE
When a self-loop test is performed, specify the same value in parameters No.0171 and No.0172.

0173	Station address in M-NET

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

[Data type] Byte
[Valid range] 1 to 15
Specify a station address in the serial interface.

0174	Baud rate in M-NET

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

[Data type] Byte
[Valid range] 0 to 6 (The standard setting is 3.)
Specify a baud rate for the serial interface.

Set value	Baud rate (bps)
1	2400
2	4800
3	9600
4	19200
5	38400
6	57600
7	76800

0175	Time required for connecting two stations in M-NET

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

[Data type] Word
[Unit of data] msec
[Valid range] 1 to 32767 (The standard setting is 10000.)
Specify a time limit from when the connection sequence is completed for the self-station to when the normal transfer sequence starts in the serial interface.

0176	Time required for polling in M-NET

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

[Data type] Word
[Unit of data] msec
[Valid data range] 1 to 32767 (The standard setting is 500.)
Specify a time limit for polling in the normal sequence at the self-station in the serial interface.

0177	Time required from SAI to BCC in M-NET

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

[Data type] Word
[Unit of data] msec
[Valid data range] 1 to 32767 (The standard setting is 50.)
Specify a time limit from when the SAI signal starts to be transferred to when the BCC signal has been sent.

0178	Time between a reception and the next transmission in M-NET

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

[Data type] Word
[Unit of data] msec
[Valid data range] 1 to 32767 (The standard setting is 1.)
Specify the time from when data has been received to when the next data starts to be transmitted.

4.5 PARAMETERS OF REMOTE DIAGNOSIS

	#7	#6	#5	#4	#3	#2	#1	#0
0002								RDG

[Data type] Bit

RDG Remote diagnosis is:
0 : Not performed.
1 : Performed.
If an RS-232C serial port is used to carry out remote diagnosis, connect and set up the modem, cable, and the like, then set 1 in this parameter. When using a modem card, the setting is not necessary.

	#7	#6	#5	#4	#3	#2	#1	#0
0201		MCB				NCR	ASC	SB2

[Data type] Bit

SB2 The number of stop bits is
0 : 1.
1 : 2.
To carry out remote diagnosis, set 0.

ASC The code to be used for data output is:
0 : ISO code.
1 : ASCII code.
To carry out remote diagnosis, set 1.

NCR EOB (end of block) is output as:
0 : "LF""CR""CR".
1 : Just as "LF".
To carry out remote diagnosis, set 1.

MCB The baud rate setting for data input/output between the modem card and CNC is:
0 : 9600 bps (fixed).
1 : Determined by the setting of parameter No. 203.
For the detailed setting while MCB is set to 1, see parameter No. 203.

0203	Baud rate (for remote diagnosis)

[Data type] Byte

Set the baud rate of data input/output by remote diagnosis, with reference to the tables given below.

When using an RS-232C serial port

Set value	Baud rate (bps)
1	50
2	100
3	110
4	150
5	200
6	300

Set value	Baud rate (bps)
7	600
8	1200
9	2400
10	4800
11	9600
12	19200

When using a modem card (when bit 6 (MCB) of parameter No. 201 is set to 1)

Set value	Baud rate (bps)
1	28800
2	38400
3	57600
4	-
5	-
6	300

Set value	Baud rate (bps)
7	600
8	1200
9	2400
10	4800
11	9600
12	19200

NOTE

The tables above indicate the baud rates of communication between the CNC and modem. The actual communication baud rate may be lowered, depending on the modem and communication line.

0204	Remote diagnosis channel

[Data type] Byte

[Valid data range] 0, 1, 2

The interface to be used for remote diagnosis is:

0,1 : RS-232C serial port 1 (channel 1).

2 : RS-232C serial port 2 (channel 2).

To carry out remote diagnosis using RS-232C, the reader/puncher interface is required.

0211	Password 1 for remote diagnosis
0212	Password 2 for remote diagnosis
0213	Password 3 for remote diagnosis

[Data type] 2-word

[Valid data range] 1 to 99999999

Specify a password for using the remote diagnosis function.

The remote diagnosis function has the following password settings. Data can be protected by preventing a third party from accessing any system parameter or machining program without permission.

Password 1:

Set a password for the whole service of the remote diagnosis function. (The whole remote diagnosis service is available only when this password is input on the host side (PC, for instance).)

Password 2:

Set a password of a part program. (The input/output, verification, and the like of a program are possible only when this password is input on the host side (PC, for instance).)

Password 3:

Set a password of a parameter. (The input/output or the like of a parameter is possible only when this password is input on the host side (PC, for instance).)

NOTE

Once any value other than 0 is specified as a password, the password can be changed only when the same value is specified in the corresponding keyword (parameters No. 221 to No. 223). If any value other than 0 is specified as a password, the password setting is not displayed on the parameter screen (blank display is provided). Take great care when setting the password.

0221	Keyword 1 for remote diagnosis
0222	Keyword 2 for remote diagnosis
0223	Keyword 3 for remote diagnosis

[Data type] 2-word

[Valid range] 1 to 99999999

Set a keyword corresponding to a password of the remote diagnosis function.
Keyword 1: Keyword for password 1 (parameter No. 211)
Keyword 2: Keyword for password 2 (parameter No. 212)
Keyword 3: Keyword for password 3 (parameter No. 213)
If any value other than 0 is specified as a password (parameters No. 211 to No. 213), the password can be changed only when the same value is specified as the corresponding keyword.

NOTE

The keyword value is reset to 0 at power-up. On the parameter screen, the keyword setting is not displayed (blank display is provided).

4.6 PARAMETERS OF DNC1 INTERFACE #2

	#7	#6	#5	#4	#3	#2	#1	#0
0231	NFD				ASI			SB2

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

SB2 Number of stop bits
- 0 : 1 bit
- 1 : 2 bits

ASI Data input code
- 0 : IEA or ISO (automatic recognition)
- 1 : ASCII Code

NFD When data is out, feed holes are
- 0 : Output before and after data section
- 1 : Not output

0233	Baud rate (DNC1 interface #2)

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

[Data type] Byte

[Valid data range] 1 to 15

Specify a baud rate.

Set value	Baud rate (bps)
1	50
2	100
3	110
4	150
5	200
6	300
7	600
8	1200

Set value	Baud rate (bps)
9	2400
10	4800
11	9600
12	19200
13	38400
14	76800
15	86400

0241	Mode of connection between the host and CNC (DNC1 interface #2)

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

[Data type] Byte
[Valid data range] 1 or 2
This parameter sets the mode of connection between the host and CNC.

Setting	Mode
1	Point-to-point mode
2	Multipoint mode

0242	CNC station address (DNC 1 interface #2)

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

[Data type] Byte
[Valid data range] 2 to 52
This parameter sets a CNC station address when the CNC is to be connected in the multipoint mode.

4.7 PARAMETERS OF MEMORY CARD INTERFACE

	#7	#6	#5	#4	#3	#2	#1	#0
0300								PCM

[Data type] Bit

PCM If the CNC screen display function is enabled, when a memory card interface is provided on the NC side,

0 : The memory card interface on the NC side is used.

1 : The memory card interface on the PC side is used.

This parameter is valid when 4 (memory card interface) is set in parameter No. 20. This parameter is valid only while the CNC screen display function is active.

4.8 PARAMETERS OF FACTOLINK

	#7	#6	#5	#4	#3	#2	#1	#0
0801								SB2

[Data type] Bit

SB2 The number of stop bits is:
0 : 1 bit.
1 : 2 bits.
(Set the number of stop bits when an RS-232C port is specified as the FACTOLINK communication port.)

0802	Communication channel for the FACTOLINK

[Data type] Byte

Set the communication port for use with the FACTOLINK.
1 : RS-232C serial port 1
2 : RS-232C serial port 2
11 : Ethernet board port 1
12 : Ethernet board port 2
13 : Ethernet board port 3
21 : Embedded Ethernet

0803	Communication baud rate for the FACTOLINK

[Data type] Byte

Set the communication baud rate when an RS-232C port is specified as the FACTOLINK communication port.
10 : 4800 bps
11 : 9600 bps
12 : 19200 bps (Recommendation value)

	#7	#6	#5	#4	#3	#2	#1	#0
0810			FMN	FTM	FYR	FCL	FAS	BGS

[Data type] Bit

BGS When the FACTOLINK screen is not displayed, FACTOLINK alarm task communication is:
0 : Not activated.
1 : Activated.

FAS If FACTOLINK uses the Answer or AnswerEx command, the answer number A01. is:
0 : Displayed in the answer field.
1 : Not displayed in the answer field.

FCL The FACTOLINK clock is:
0 : Not displayed in reverse video.
1 : Displayed in reverse video.

FYR In the FACTOLINK clock display, years in the 99/01/23 00:00 format (bit 4 (FTM) of parameter No. 0810 set to 1) are represented:
0 : By a two-digit number.
1 : By a four-digit number.

FTM The FACTOLINK clock is displayed in this format:
0 : Wed Nov 12 00:00:00
1 : 97/11/12 00:00:00

FMN The FACTOLINK screen is displayed:
0 : In color.
1 : With two levels of gray.

0811	Logging type for the FACTOLINK

[Data type] Byte

0812	PMC address of logging data for the FACTOLINK

[Data type] Word

0813	Logging data length for the FACTOLINK

[Data type] Word

0814	Logging wait address for the FACTOLINK

[Data type] Word

0815	FACTOLINK logging data transmission interval

[Data type] 2-word

0820	FACTOLINK device address (1)
0821	FACTOLINK device address (2)
0822	FACTOLINK device address (3)
0823	FACTOLINK device address (4)
0824	FACTOLINK device address (5)
0825	FACTOLINK device address (6)
0826	FACTOLINK device address (7)
0827	FACTOLINK device address (8)
0828	FACTOLINK device address (9)

[Data type] Byte

See following manuals for the parameters related to the FACTOLINK.

- FANUC Ethernet Board/DATA SERVER Board OPARATOR'S MANUAL (B-63354EN)
- FANUC FACTOLINK SCRIPT FUNCTION OPERATOR'S MANUAL (B-75054EN)

4.9 PARAMETERS OF DATA SERVER

	#7	#6	#5	#4	#3	#2	#1	#0
0900							ONS	DSV

[Data type] Bit

DSV The data server function is
0 : Enabled
1 : Disabled

ONS When the O number of the data server file name and the O number in an NC program do not match:
0 : The O number of the file name takes priority.
1 : The O number in the NC program takes priority.

0921	OS selected for host computer 1 of data server

0922	OS selected for host computer 2 of data server

0923	OS selected for host computer 3 of data server

[Data type] Word
[Valid data range] 0 to 1
0 : Windows95/98/NT is selected.
1 : UNIX or VMS is selected.

0924	Latency setting for DNC1/Ethernet or FOCAS1/Ethernet

[Data type] Word
[Unit of data] msec
[Valid data range] 0 to 255
Set service latency of DNC1/Ethernet or FOCAS1/Ethernet while DNC1/Ethernet or FOCAS1/Ethernet is used together with the data server function.
If a value between 0 and 2 is set, 2 msec is assumed.

4.10 PARAMETERS OF ETHERNET

0931	Special character code corresponding to soft key [CHAR-1]
0932	Special character code corresponding to soft key [CHAR-2]
0933	Special character code corresponding to soft key [CHAR-3]
0934	Special character code corresponding to soft key [CHAR-4]
0935	Special character code corresponding to soft key [CHAR-5]

[Data type] Byte

[Valid data range] 32 to 95

These parameters are provided to allow a special character that is not provided on the MDI panel but needed in a user name, password, or login DIR to be input by pressing a soft key on the Ethernet parameter screen.

If a value other than 0 is input as a parameter, the special character assigned to the corresponding input soft key [CHAR-1] to [CHAR-5] is displayed.

The special character codes correspond to the ASCII codes.

Sample special character codes

Special character	Code	Special character	Code	Special character	Code
Blank	32	)	41	<	60
!	33	*	42	>	62
"	34	+	43	?	63
#	35	,	44	@	64
$	36	-	45	[	91
%	37	.	46	^	92
&	38	/	47	#	93
'	39	:	58	]	94
(	40	;	59	_	95

4.11 PARAMETERS OF POWER MATE CNC MANAGER

	#7	#6	#5	#4	#3	#2	#1	#0
0960		2CH	ASG	SPW	PMN	MD2	MD1	SLV

[Data type] Bit

SLV When the power mate CNC manager is selected, the screen displays:
0 : One slave.
1 : Up to four slaves with the screen divided into four.

MD1,MD2 These parameters set a slave parameter input/output destination.

MD2	MD1	Input/output destination
0	0	Part program storage
0	1	Memory card

In either case, slave parameters are output in program format.

PMN The power mate CNC manager function is:
0 : Enabled.
1 : Disabled. (Communication with slaves is not performed.)

SPW With the power mate CNC manager, slave parameters:
0 : Can be set at all times, regardless of the setting of PWE.
1 : Follow the setting of PWE.

ASG Whether the number of bytes allocated to the input/output destination of the β amplifier with the I/O Link is 16 is:
0 : Not checked.
1 : Checked.

2CH The power mate CNC manager communicates with:
0 : Channel 2
1 : Channel 1

NOTE
1 This parameter is valid only when I/O Link point extension (to 2 channels) is supported.
2 Even when this parameter is set to 0, the power mate CNC manager communicates with channel 1 if no β amplifier with the I/O Link is connected with channel 2.
3 When this parameter is set to 1, the power mate CNC manager does not communicate with channel 2 if no β amplifier with the I/O Link is connected with channel 1.

4.12 PARAMETERS OF AXIS CONTROL/INCREMENT SYSTEM

	#7	#6	#5	#4	#3	#2	#1	#0
1001								INM

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

INM Least command increment on the linear axis
- 0 : In mm (metric system machine)
- 1 : In inches (inch system machine)

	#7	#6	#5	#4	#3	#2	#1	#0
1002	IDG			XIK		SFD	DLZ	JAX
	IDG			XIK	AZR	SFD	DLZ	JAX

[Data type] Bit

JAX Number of axes controlled simultaneously in jog feed, manual rapid traverse and manual reference position return
- 0 : 1 axis
- 1 : 3 axes

DLZ Function setting the reference position without dog
- 0 : Disabled
- 1 : Enabled (enabled for all axes)

> **NOTE**
> 1 This function can be specified for each axis by bit 1 (DLZx) of parameter No.1005.
> 2 For a system including an axis of Cs contour control or spindle positioning, avoid using this parameter. Use bit 1 (DLZx) of parameter No. 1005 instead to set just a required axis.

SFD The function for shifting the reference position is
- 0 : Not used.
- 1 : Used.

AZR When no reference position is set, the G28 command causes:
0 : Reference position return using deceleration dogs (as during manual reference position return) to be executed.
1 : P/S alarm No.090 to be issued.

NOTE
When the function for setting the reference position without dogs (refer to bit 1 (DLZ) of parameter No. 1002) is used, the G28 command specified before a reference position is set causes P/S alarm No.090 to be issued, regardless of the setting of AZR.

XIK When bit 1 (LRP) of parameter No.1401, is set to 0, namely, when positioning is performed using non-linear type positioning, if an interlock is applied to the machine along one of axes in positioning,
0 : The machine stops moving along the axis for which the interlock is applied and continues to move along the other axes.
1 : The machine stops moving along all the axes.

IDG When the reference position is set without dogs, automatic setting of bit 0 (IDGx) of parameter No.1012 to prevent the reference position from being set again is:
0 : Not performed.
1 : Performed.

	#7	#6	#5	#4	#3	#2	#1	#0
1004	IPR					ISD	ISC	
	IPR	IPI					ISC	ISA

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

ISA, ISC, ISD The least input increment and least command increment are set.

ISD	ISC	ISA	Least input increment and least command increment	Symbol
0	0	0	0.001 mm, 0.001 deg, or 0.0001 inch	IS-B
0	0	1	0.01 mm, 0.01 deg, or 0.001 inch	IS-A
0	1	0	0.0001 mm, 0.0001 deg, or 0.00001 inch	IS-C
1	0	0	0.00001 mm, 0.00001 deg, or 0.000001 inch	IS-D

NOTE
IS-A cannot be used at present.

IPI Bit 7 (IPR) of parameter No. 1004 is:

0 : Parameter that requires the power to be turned off before continuation of operation and is invalid in the case of inch input.

1 : Parameter that does not require the power to be turned off before continuation of operation and is valid even in the case of inch input.

IPR Whether the least input increment for each axis is set to a value 10 times as large as the least command increment is specified, in increment systems of IS-B or IS-C at setting mm.

0 : The least input increment is not set to a value 10 times as larg as the least command increment.

1 : The least input increment is set to a value 10 times as large as the least command increment.

If IPR is set to 1, the least input increment is set as follows:

Increment system	Least input increment
IS-B	0.01 mm, 0.01 deg, or 0.0001 inch
IS-C	0.001 mm, 0.001 deg, or 0.00001 inch

NOTE

For IS-A, the least input increment cannot be set to a value 10 times as large as the least command increment.
The least input increment is not multiplied by 10 also when the pocket calculator type decimal point programming (bit 0 (DPI) of parameter No. 3401) is used.

	#7	#6	#5	#4	#3	#2	#1	#0
1005	RMBx	MCCx	EDMx	EDPx	HJZx		DLZx	ZRNx

[Data type] Bit axis

ZRNx When a command specifying the movement except for G28 is issued in automatic operation (memory, MDI, or DNC operation) and when a return to the reference position has not been performed since the power was turned on

0 : An alarm is generated (P/S alarm 224).

1 : An alarm is not generated.

> **NOTE**
> 1 The state in which the reference position has not been established refers to that state in which reference position return has not been performed after power-on when an absolute position detector is not being used, or that state in which the association of the machine position with the position detected with the absolute position detector has not been completed (see the description of bit 4 (APZx) of parameter No. 1815) when an absolute position detector is being used.
> 2 To use a function that establishes the reference point and makes a movement with a command other than G28, such as an axis of Cs contour control, set this parameter for the relative axis.
> 3 When the Cs axis coordinate establishment function (bit 2 (CSF) of parameter No. 3712) is used, it is recommended to set this parameter to 0.

DLZx Function for setting the reference position without dogs

0 : Disabled

1 : Enabled

> **NOTE**
> 1 This parameter is valid when bit 1 (DLZ) of parameter No. 1002 is set to 0. When bit 1 (DLZ) of parameter No. 1002 is set to 1, the function for setting the reference position without dogs is enabled for all axes, regardless of the setting of this parameter.
> 2 Do not set this parameter for a Cs contour control axis and spindle positioning axis.

HJZx When a reference position is already set:

0 : Manual reference position return is performed with deceleration dogs.

1 : Manual reference position return is performed using rapid traverse without deceleration dogs, or manual reference position return is performed with deceleration dogs, depending on the setting of bit 7 (SJZ) of parameter No.0002.

> **NOTE**
> When the function for setting the reference position without dogs (refer to bit 1 (DLZ) of parameter No. 1002) is used, positioning at the reference position is performed at the rapid traverse rate at all times in reference position return operation after reference position establishment, regardless of the setting of HJZ.

EDPx External deceleration signal in the positive direction for each axis

0 : Valid only for rapid traverse

1 : Valid for rapid traverse and cutting feed

EDMx External deceleration signal in the negative direction for each axis

0 : Valid only for rapid traverse

1 : Valid for rapid traverse and cutting feed

MCCx When an axis become the removal state using the controlled axis removal signal or setting:

0 : MCC is turned off

1 : MCC is not turned off. (Servo motor excitation is turned off, but the MCC signal of the servo amplifier is not turned off.)

> **NOTE**
> This parameter is used to remove only one axis, for example, when a two-axis or three-axis amplifier is used. When two-a axis or three-axis amplifier is used and only one axis is removed, servo alarm No.401 (V-READY OFF) is usually issued. However, this parameter, when set to 1, prevents servo alarm No.401 from being issued.
> Note, however, that disconnecting a servo amplifier from the CNC will cause the servo amplifier to enter the V-READY OFF status. This is a characteristic of all multiaxis amplifiers.

RMBx Releasing the assignment of the control axis for each axis (signal input and setting input)

0 : Invalid

1 : Valid

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

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit axis

ROTx, ROSx Setting linear or rotary axis.

ROSx	ROTx	Meaning
0	0	Linear axis (1) Inch/metric conversion is done. (2) All coordinate values are linear axis type. (Is not rounded in 0 to 360°.) (3) Stored pitch error compensation is linear axis type (Refer to parameter No.3624.)
0	1	Rotary axis (A type) (1) Inch/metric conversion is not done. (2) Machine coordinate values are rounded in 0 to 360°. Absolute coordinate values or relative coordinate values are rounded or not rounded by bit 0 (ROAx) or bit 2 (RRLx) of parameter No. 1008. (3) Stored pitch error compensation is the rotation type. (Refer to parameter No.3624) (4) Automatic reference position return (G28, G30) is done in the reference position return direction and the move amount does not exceed one rotation.
1	0	Setting is invalid (unused)
1	1	Rotary axis (B type) (1) Inch/metric conversion, absolute coordinate values and relative coordinate values are not done. (2) Machine coordinate values, absolute coordinate values, and relative coordinate values are linear axis type. (Is not rounded in 0 to 360°.) (3) Stored pitch error compensation is linear axis type (Refer to parameter No.3624.) (4) Cannot be used with the rotary axis roll-over function and the index table indexing function (M series).

For the rotary axis used for cylindrical interpolation, set ROTx to 1.
For the C-axis (workpiece axis) used with the hobbing function, be sure to set ROTx to 1.

DIAx Either a diameter or radius is set to be used for specifying the amount of travel on each axis.

0 : Radius
1 : Diameter

ZMIx The direction of reference position return on each axis.
0 : Positive direction
1 : Negative direction

> **NOTE**
> The direction of the initial backlash, which occurs when power is switched on, is opposite to the direction of a reference position return.

	#7	#6	#5	#4	#3	#2	#1	#0
1007	PRSx				RAAx	OKIx	ALZx	RTLx
					RAAx	OKIx		

[Data type] Bit axis

RTLx A reference position return operation performed on a rotary axis is of:
0 : Rotary axis type.
1 : Linear axis type.

> **NOTE**
> Reference position return operations of rotary axis type and linear axis type differ from each other as follows, depending on the timing for pressing a dog (deceleration signal for reference position return):
> Linear axis type:
> If a dog is pressed before a one-rotation signal is detected, P/S alarm No. 090 is issued.
> Rotation type axis:
> If a dig is pressed before a one-rotation signal is detected, reference position return operation is continued with no alarm issued.

ALZx In automatic reference position return:
0 : A reference position return operation is performed by positioning. If no reference position return operation is performed after power-on, a reference position return operation is performed according to the same sequence as for manual reference position return.
1 : A reference position return operation is performed according to the same sequence as for manual reference position return.

> **NOTE**
> This parameter does not affect an axis on which a reference position return operation is performed without dogs.

OKIx Upon completion of reference position return in reference position setting with mechanical stopper:

0 : P/S alarm 000 is issued.
(When reference position setting with mechanical stopper is used with this parameter setting, an absolute-position detector is needed.)

1 : P/S alarm 000 is not issued.
(Even when reference position setting with mechanical stopper is used with this parameter setting, no absolute-position detector is needed.)

RAAx When an absolute command is specified for a rotary axis:

0 : The end point coordinates and direction of rotation conform to bit 1 (RABx) of parameter No.1008.

1 : The end point coordinates conform to the absolute value of the value specified in the command. The rotational direction conforms to the sign of the value specified in the command.

> **NOTE**
> 1 This parameter is valid when the rotary axis control function is provided and the rotary axis roll-over function is applied (bit 0 (ROAx) of parameter No.1008 is set to 1).
> 2 This parameter is equal to bit 3 (RAAx) of parameter No.1008. After this parameter is set, the power does not need to be turned off.

PRSx In automatic reference position return (G28), automatic coordinate system presetting is:

0 : Not performed.

1 : Performed.

	#7	#6	#5	#4	#3	#2	#1	#0
1008			**RMCx**		**RAAx**	**RRLx**	**RABx**	**ROAx**

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit axis

ROAx The rotary axis roll-over function is

0 : Invalid

1 : Valid

> **NOTE**
> ROAx specifies the function only for a rotary axis (for which bit 0 (ROTx) of parameter No.1006 is set to 1)

RABx In the absolute commands, the axis rotates in the direction
0 : In which the distance to the target is shorter.
1 : Specified by the sign of command value.

> **NOTE**
> RABx is valid only when ROAx is set to 1.

RRLx Relative coordinates are
0 : Not rounded by the amount of the shift per one rotation
1 : Rounded by the amount of the shift per one rotation

> **NOTE**
> 1 RRLx is valid only when ROAx is set to 1.
> 2 Assign the amount of the shift per one rotation in parameter No.1260.

RAAx The rotation direction of a rotary axis and end point coordinates in the absolute command mode:
0 : Agree with the setting of bit 1 (RABx) of parameter No.1008.
1 : Agree with the absolute value of the specified value for the end point coordinates and the sign of the specified value for the rotation direction.

> **NOTE**
> This parameter is enabled when the rotary axis control function is provided and the rotary axis roll-over function is used (with bit 0 (ROAx) of parameter No.1008 set to 1).

RMCx When machine coordinate system selection (G53) or high-speed machine coordinate system selection (G53P1) is used, bit 1 (RABx) of parameter No. 1008 for setting the rotation direction of an absolute command and bit 3 (RAAx) of parameter No. 1007 or parameter No. 1008 for rotary axis control used with the rotary axis roll-over function are:
0 : Invalid.
1 : Valid.

1010	Number of CNC-controlled axes

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

[Data type] Byte

[Valid data range] 1, 2, 3, ..., the number of controlled axes

Set the maximum number of axes that can be controlled by the CNC.

[Example] Suppose that the first axis is the X axis, and the second and subsequent axes are the Y, Z, A, B, and C axes in that order, and that they are controlled as follows:

X, Y, Z, and A axes: Controlled by the CNC
A axis: Controlled by the CNC and PMC
B and C axes: Controlled by the PMC
Then set this parameter to 4 (total 4: 1st to 4th axes)
With this setting, the fifth and sixth axes (B and C axes) are controlled only by the PMC, and therefore cannot be controlled directly by the CNC.

	#7	#6	#5	#4	#3	#2	#1	#0
1012								IDGx

[Data type] Bit axis

IDGx The function for setting the reference position again, without dogs, is:

0 : Not inhibited.

1 : Inhibited.

> **NOTE**
> 1 IDGx is enabled when bit 7 (IDG) of parameter No.1002 is set to 1.
> 2 When the function for setting the reference position, without dogs, is used, and the reference position is lost for some reason, an alarm requesting reference position return (No.300) is generated when the power is next turned on. If the operator performs reference position return, as a result of mistakenly identifying the alarm as that requesting the operator to perform a normal reference position return, an invalid reference position may be set. To prevent such an operator error, bit 0 (IDGx) of parameter No.1012 is provided to prevent the reference position from being set again without dogs.
> (1) If bit 7 (IDG) of parameter No.1002 is set to 1, bit 0 (IDGx) of parameter No.1012 is automatically set to 1 when the reference position is set using the function for setting the reference position without dogs. This prevents the reference position from being set again without dogs.
> (2) Once the reference position is prevented from being set for an axis again, without dogs, any attempt to set the reference position for the axis without dogs results in the output of an alarm (No.090).
> (3) When the reference position must be set again without dogs, set IDGx to 0 before setting the reference position.

	#7	#6	#5	#4	#3	#2	#1	#0
1015	DWT	WIC	SVS	ZRL	RHR			
	DWT	WIC		ZRL	RHR			

[Data type] Bit

RHR After increment system (inch/metric) switching, for the rotary axis, the first G28 command causes reference position return:

0 : At a low speed.

1 : At a high speed/

ZRL For high-speed reference position return according to G28, second to fourth reference position return according to G30, and G53 command:

0 : Non-linear type positioning is performed.

1 : Linear type positioning is performed.

This parameter is valid when bit 1 (LRP) of parameter No. 1401 is set to 1.

SVS When the servo along an axis is turned off, simple synchronous control is:

0 : Released.

1 : Not released.

WIC Workpiece origin offset measurement value direct input is:

0 : Valid only in the currently selected workpiece coordinate system.

1 : Valid in all coordinate systems.

NOTE

When this parameter is set to 0, a measurement value direct input operation can be performed in the currently selected workpiece coordinate system or external workpiece coordinate system. A warning is issued if an attempt is made for measurement value direct input of any other workpiece origin offset.

DWT When a dwell time is specified with P, the unit of data is:

0 : 1 msec when IS-B is used, or 0.1 msec when IS-C is used

1 : 1 msec (not dependent on the increment system)

1020	Program axis name for each axis

[Data type] Byte axis

Set the program axis name for each controlled axis, using one of the values listed in the following table:

Axis name	Setting	Axis name	Setting	Axis name	Setting	Axis name	Setting
X	88	U	85	A	65	E	69
Y	89	V	86	B	66	-	-
Z	90	W	87	C	67	-	-

NOTE

1 With the T series, when G code system A is used, neither U, V, nor W can be used as an axis name. Only when G code system B or C is used, U, V, and W can be used as axis names.

2 The same axis name cannot be assigned to more than one axis.

3 When the second auxiliary function is provided, the address used by the second auxiliary function (address B with the T series or, with the M series, the address specified in parameter No.3460) cannot be used as an axis name.

4 With the T series, when address C or A is used for chamfering, corner rounding, or direct drawing dimension programming (when the CCR parameter (bit 4 of parameter No.3405) is set to 1), addresses C or A cannot be used as an axis name.

5 Only with the T series, address E can be used as an axis name. Address E cannot be used with the M series. When address E is used as an axis name, note the following:
- When G code system A is used, address E is always assigned to an absolute command.
- When an equal-lead threading command (G32) is issued in the Series 15 command format, address E cannot be used to specify the thread lead. Use address F to specify the thread lead.

1022	Setting of each axis in the basic coordinate system

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

[Data type] Byte axis

To determine the following planes used for circular interpolation, cutter compensation C (for the M series), tool nose radius compensation (for the T series), etc., each control axis is set to one of the basic three axes X, Y, and Z, or an axis parallel to the X, Y, or Z axis.

G17: Plane Xp-Yp
G18: Plane Zp-Xp
G19: Plane Yp-Zp

Only one axis can be set for each of the three basic axes X, Y, and Z, but two or more parallel axes can be set.

Set value	Meaning
0	Neither the basic three axes nor a parallel axis
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

1023	Number of the servo axis for each axis

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

[Data type] Byte axis

[Valid data range] 1, 2, 3, ..., number of controlled axes /-1,-2,-3,-4 (-4 can be used in Series 16*i*/160*i*/160*is* only)

Set the servo axis for each control axis.
Usually set to same number as the control axis number.
The control axis number is the order number that is used for setting the axis-type parameters or axis-type machine signals
To use a controlled axis as a spindle, specify -1.
Setting bit 7 (CSS) of parameter No. 3704 to 1 enables the second to fourth serial spindles to be assigned as Cs contour axes.
When one of the second to fourth serial spindles is used as a Cs contour axis, set a value from -2 to -4.
When Cs contour control is used for a virtual Cs axis, make a setting for spindle assignment.
Refer to FSSB section of CONNECTION MANUAL (FUNCTION) B-63523EN-1.

> **NOTE**
> 1 When the dual check safety function is used, the first servo axis is required at all times. When the dual check safety function is used under multi-path control, the first servo axis cannot be exchanged between paths.
> More details are provided below:
> - For 1-path control, 1-CPU 2-path control, or loader control
>   An axis with parameter No. 1023 set to 1 is required for tool post 1 (or the loader).
> - For 2-CPU 2-path control or 2-CPU 3-path control
>   An axis with parameter No. 1023 set to 1 is required for tool post 1, and an axis with parameter No. 1023 set to 9 is required for tool post 2.
>
> 2 For electric gear box controlled axes, two axes needs to be paired as a set. So, make the following setting:
> - Set one of 1, 3, 5, and 7 for a slave axis. For a dummy axis to be paired with the slave axis, set a value obtained by adding 1 to the setting for the slave axis.

1031	Reference axis

[Data type] Byte axis

[Valid data range] 1, 2, 3, ..., number of controlled axes

Some parameters for using high-precision/AI high-precision/AI nano high-precision contour control are common to all axes. The unit of some of those parameters varies according to the increment system. The unit of such parameters is matched with the increment system of a reference axis. This parameter is used to set the ordinal number of an axis to be used as the reference axis.
If 0 is set, the specification of 1 is assumed.

4.13 PARAMETERS OF COORDINATES

	#7	#6	#5	#4	#3	#2	#1	#0
1201	WZR		AWK		FPC	ZCL	ZPI	ZPR
			AWK		FPC	ZCL	ZPI	ZPR

[Data type] Bit

ZPR Automatic setting of a coordinate system when the manual reference position return is performed
0 : Not set automatically
1 : Set automatically

> **NOTE**
> 1 ZPR is valid while a workpiece coordinate system function is not provided. If a workpiece coordinate system function is provided, making a manual reference position return always causes the workpiece coordinate system to be established on the basis of the workpiece origin offset (parameters No. 1220 to No. 1226), irrespective of this parameter setting.
> 2 If an absolute-position detector is used in a system not using a workpiece coordinate system function, set this parameter.

ZPI Coordinates at the reference position when a coordinate system is set automatically
0 : Value set in parameter No.1250 is used.
1 : For input in mm, the value set in parameter 1250 is used, or for input in inches, the value set in parameter No.1251 is used.
This bit is ineffective, when a workpiece coordinate system option is provided, however.

ZCL Local coordinate system when the manual reference position return is performed
0 : The local coordinate system is not canceled.
1 : The local coordinate system is canceled.

FPC When the floating reference position is specified using soft keys on the current position display screen
0 : The value of the displayed relative position is not preset. (In other words, the value does not change.)
1 : The value of the displayed relative position is preset to 0.

AWK When the workpiece origin offset value is changed
0 : The absolute position display changed when the next buffering block is performed.
1 : The absolute position display is changed immediately. (Only when automatic operation is not activated)
Changed value is valid after buffering the next block.

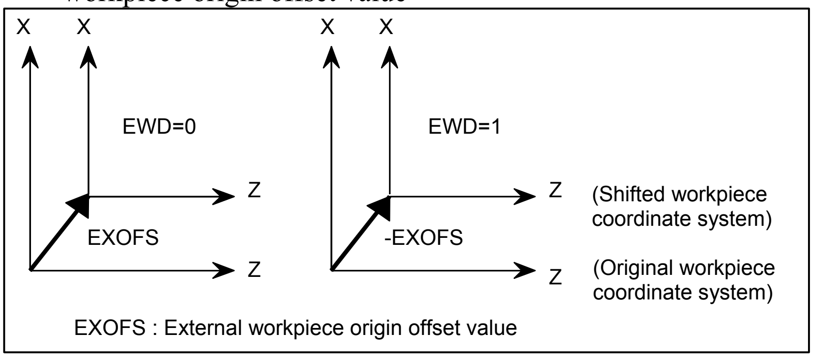
WZR Upon reset, the workpiece coordinate system is:
0 : Not returned to that specified with G54
1 : Returned to that specified with G54

NOTE
If bit 2 (D3R) of parameter No. 5400 is set to 1, this parameter setting is ignored in the three-dimensional coordinate conversion mode. A reset does not cause the workpiece coordinate system to be returned to that specified with G54.

	#7	#6	#5	#4	#3	#2	#1	#0
1202			SNC		RLC	G50	EWS	EWD
			SNC	G52	RLC			

[Data type] Bit

EWD The shift direction of the workpiece coordinate system is:
0 : The direction specified by the external workpiece origin offset value
1 : In the opposite direction to that specified by the external workpiece origin offset value



EWS Shift value of the workpiece coordinate system and external workpiece origin offset value are
0 : Stored in the separate memory areas.
1 : Stored in the same memory area, that is, the shift and the offset values are the same.

G50 When the CNC has commands G54 to G59 specifying workpiece coordinate systems (optional function), if the G50 command for setting a coordinate system (or the G92 command in G command system B or C) is specified,
0 : G50 is executed and no alarm is issued.
1 : G50 is not executed and a P/S alarm (No. 010) is issued.

RLC Local coordinate system is
0 : Not cancelled by reset
1 : Cancelled by reset

G52 In local coordinate system setting (G52), a cutter compensation vector is:
0 : Not considered.
1 : Considered.

> **NOTE**
> Select a local coordinate system setting operation when cutter compensation is applied, and when two or more blocks specifying no movement exist prior to the specification of G52, or when G52 is specified after cutter compensation mode is canceled without eliminating the offset vector.

SNC After a servo alarm is reset, the local coordinate system (G52/G92 (M series), G52/G50 (T series)) is:
0 : Cleared.
1 : Not cleared.

> **NOTE**
> If a setting is made to cancel the local coordinate system upon reset (if bit 1 (RLC) of parameter No. 1202 is set to 1), the local coordinate system is cleared even when this parameter is set to 1.

	#7	#6	#5	#4	#3	#2	#1	#0
1203		MMD	3DW	WZP		68A		EMC
		MMD	3DW	WZP				EMC

[Data type] Bit

EMC The extended external machine zero point shift function is:
0 : Disabled.
1 : Enabled.

> **NOTE**
> 1 To use the extended external machine zero point shift function, the external machine zero point shift function or the external data input function is required.
> 2 When the extended machine zero point shift function is enabled, the conventional external machine zero point shift function is disabled.

68A In automatic coordinate system setting with an absolute-position detector when the mode for mirror image for double turret (G68) is set:
0 : Mirror image for double turret is not considered.
1 : Mirror image for double turret is considered.

WZP In the three-dimensional coordinate conversion mode, a modification to the workpiece coordinate system from the MDI is:
0 : Not prohibited.
1 : Prohibited.

3DW When any of the following:
- Workpiece coordinate system selection (G54 to G59, G54.1P)
- Coordinate system setting (G50, G92)
- Local coordinate system (G52)

is specified in the three-dimensional coordinate conversion mode:
0 : An alarm is issued (P/S 049 alarm).
1 : No alarm is issued.

MMD In manual operation on an axis for which mirror image is enabled, the move direction on the axis is:
0 : Not the same as the direction in automatic operation.
1 : Same as the direction in automatic operation.

NOTE
The move direction on an axis in manual operation in the three-dimensional coordinate conversion mode is the same as the direction in automatic operation at all times, regardless of the setting of this parameter.

	#7	#6	#5	#4	#3	#2	#1	#0
1203			R2O	R1O				

[Data type] Bit

R1O The signal output of the first reference position is:
0 : Invalid.
1 : Valid.
The reference position signal output function is needed. See the description of parameter No. 1245.

R2O The signal output of the second reference position is:
0 : Invalid.
1 : Valid.
The reference position signal output function is needed. See the description of parameter No. 1246.

1220	External workpiece origin offset value

[Data type] 2-word axis

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Linear axis (input in mm)	0.01	0.001	0.0001	mm
Linear axis (input in inches)	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

This is one of the parameters that give the position of the origin of workpiece coordinate system (G54 to G59). It gives an offset of the workpiece origin common to all workpiece coordinate systems. In general, the offset varies depending on the workpiece coordinate systems. The value can be set from the PMC using the external data input function.

1221	Workpiece origin offset value in workpiece coordinate system 1 (G54)
1222	Workpiece origin offset value in workpiece coordinate system 2 (G55)
1223	Workpiece origin offset value in workpiece coordinate system 3 (G56)
1224	Workpiece origin offset value in workpiece coordinate system 4 (G57)
1225	Workpiece origin offset value in workpiece coordinate system 5 (G58)
1226	Workpiece origin offset value in workpiece coordinate system 6 (G59)

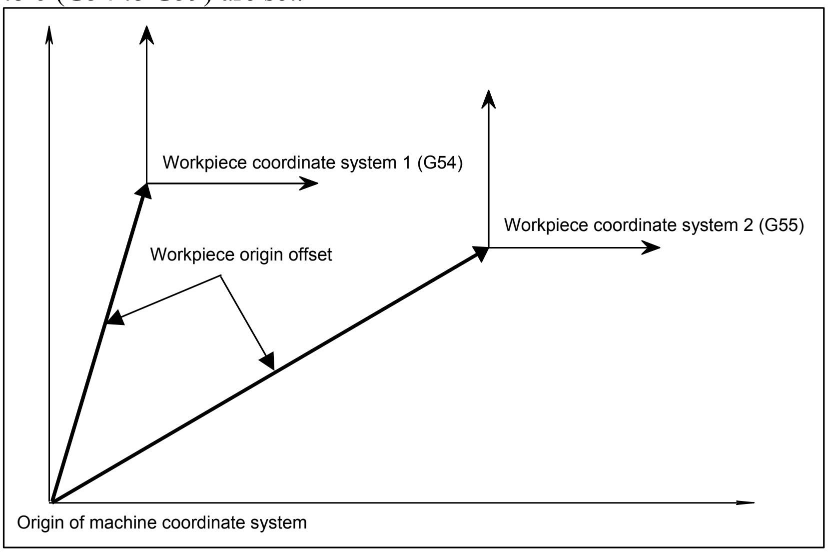
[Data type] 2-word axis

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Linear axis (input in mm)	0.01	0.001	0.0001	mm
Linear axis (input in inches)	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

The workpiece origin offset values in workpiece coordinate systems 1 to 6 (G54 to G59) are set.



NOTE

The workpiece origin offset can also be set using the workpiece coordinate system screen.

1240	**Coordinate value of the first reference position on each axis in the machine coordinate system**
1241	**Coordinate value of the second reference position on each axis in the machine coordinate system**
1242	**Coordinate value of the third reference position on each axis in the machine coordinate system**
1243	**Coordinate value of the fourth reference position on each axis in the machine coordinate system**

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

[Data type] 2-word axis
[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

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

1244	**Coordinates of the floating reference position for each axis**

[Data type] 2-word axis
[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

This parameter specifies the coordinates of the floating reference position for each axis. The parameter is automatically set when the floating reference position is specified using soft keys on the current position display screen.

1245	Address number of the internal relay (R signal) of the PMC for signal output of the first reference position

1246	Address number of the internal relay (R signal) of the PMC for signal output of the second reference position

[Data type] Word

[Unit of data] 0 to 66535

Set the address number of the R signal for signal output of the first/second reference position. If the address number of a nonexistent R signal is set in any of these parameters, the reference position signal output function is disabled.

See the descriptions of bit 4 (R1O) and bit 5 (R2O) of parameter No. 1205.

1250	Coordinate value of the reference position used when automatic coordinate system setting is performed

[Data type] 2-word axis

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Linear axis (input in mm)	0.01	0.001	0.0001	mm
Linear axis (input in inches)	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

Set the coordinate value of the reference position on each axis to be used for setting a coordinate system automatically.

1251	Coordinate value of the reference position on each axis used for setting a coordinate system automatically when input is performed in inches

[Data type] 2-word axis

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Linear axis (input in inches)	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the coordinate value of the reference position on each axis to be used for setting a coordinate system automatically when input is performed in inches.

> **NOTE**
> This parameter is valid when bit 1 (ZPI) of parameter No. 1201 is set to 1.

1260	Amount of a shift per one rotation of a rotary axis

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

[Data type] 2-word axis
[Unit of data]

	IS-A	IS-B	IS-C
Unit of data	0.01 deg	0.001 deg	0.0001 deg
Standard value	36000 deg	360000 deg	3600000 deg

[Valid data range] 1000 to 99999999

Set the amount of a shift per one rotation of a rotary axis.
For the rotary axis used for cylindrical interpolation, set the standard value.

1280	First address of the signal group used by the external machine zero point shift extension

[Data type] Word
[Valid data range] 0 to 65535

Set the first address of the signal group used by the external machine zero point shift extension. If 100 is specified, R0100 to R0115 can be used.

R0100	Shift amount of external machine zero point shift extension for the first axis (LOW)
R0101	Shift amount of external machine zero point shift extension for the first axis (HIGH)
R0102	Shift amount of external machine zero point shift extension for the second axis (LOW)
R0103	Shift amount of external machine zero point shift extension for the second axis (HIGH)
:	:
R0114	Shift amount of external machine zero point shift extension for the eighth axis (LOW)
R0115	Shift amount of external machine zero point shift extension for the eighth axis (HIGH)

NOTE
1 If the specified number is not present, the external machine zero point shift extension is disabled.
2 A shift amount of the external machine zero point shift extension can be written from the C executer or macro executer.
3 This parameter is valid when bit 0 (EMC) of parameter No. 1203 is set to 1.

1290	Distance between two opposite tool posts in mirror image for double turret

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] 0 to 99999999

Set the distance between two opposite tool posts in mirror image for double turret.

4.14 PARAMETERS OF STORED STROKE CHECK

	#7	#6	#5	#4	#3	#2	#1	#0
1300	BFA	LZR	RL3			LMS	NAL	OUT

[Data type] Bit

OUT The area inside or outside of the stored stroke check 2 is set as an inhibition area (setting by the parameters No.1322 and No.1323).
0 : Inside
1 : Outside

NAL Specifies whether to issue an alarm related to stored stroke check 1, as follows:
0 : To issue an alarm.
1 : Not to issue an alarm; the stroke limit reached signal <F124> or <F126> is output (for a manual operation).

LMS The EXLM <G007#6> signal for switching stored stroke check
0 : Disabled
1 : Enabled

NOTE
Stored stroke check 1 supports two pairs of parameters for setting the prohibited area. The stored stroke limit switching signal is used to enable either of the prohibited areas set with these parameter pairs.
(1) Prohibited area I:
Parameters No.1320 and No.1321
(2) Prohibited area II:
Parameters No.1326 and No.1327

RL3 Stored stroke check 3 release signal RLSOT3 <G007#4> is
0 : Disabled
1 : Enabled

LZR Checking of stored stroke check 1 during the time from power-on to the manual reference position return
0 : The stroke check 1 is checked.
1 : The stroke check 1 is not checked

NOTE
When an absolute position detector is used and a reference position is already set upon power-up, stored stroke limit check 1 is started immediately after power-up, regardless of the setting.

BFA When a command that exceeds a stored stroke check 1or 3 is issued
0 : An alarm is generated after the stroke check is exceeded.
1 : An alarm is generated before the stroke check is exceeded.

NOTE
The tool stops at a point up to F/7500 mm short of or ahead of the boundary.
(F: Feedrate when the tool reaches the boundary (mm/min))

	#7	#6	#5	#4	#3	#2	#1	#0
1301	PLC	OTF		OF1	OTA	NPC		DLM
	PLC	OTF	OTS	OF1	OTA	NPC		DLM

[Data type] Bit

DLM The stored stroke limit switching signals <G104, G105> for each axial direction is:
0 : Disabled.
1 : Enabled.

NPC As part of the stroke limit check performed before movement, the movement specified in G31 (skip) and G37 (automatic tool length measurement (for M series) or automatic tool compensation (for T series)) blocks is:
0 : Checked
1 : Not checked

OTA If the tool is already in the prohibited area at power-up (or when the conditions of interference check are satisfied), an alarm of stored stroke limit 2 (inside), stored stroke limit 3, or interference check is:
0 : Immediately raised.
1 : Not raised before a movement is made. (No movement can be made in an interference check of T series.)

Remark) When the alarm is immediately raised, the system enters the state before power-down.

If this parameter is set to 1, no alarm is raised before a movement is made. If the direction of this movement is a direction away from the prohibited area, movements can be made in the opposite direction only. Accordingly, there is danger that the tool enters the prohibited area without an alarm.

OF1 If the tool is moved into the range allowed on the axis after an alarm is raised by stored stroke check 1,
0 : The alarm is not canceled before a reset is made.
1 : The OT alarm is immediately canceled.

NOTE
In the cases below, the automatic release function is disabled. To release an alarm, a reset operation is required.
1 When a setting is made to issue an alarm before a stored stroke limit is exceeded (bit 7 (BFA) of parameter No. 1300)
2 When an another overtravel alarm (such as stored stroke check 2, stored stroke check 3, and interference check) is already issued
3 When an overtravel alarm is already issued with the high-precision contour control function or the chopping function in the M series

OTS If a stored stroke limit alarm is raised by setting bit 7 (BFA) of parameter No. 1300 to 1, the axial movement stops:
0 : Before the boundary of stored stroke check.
1 : On the boundary of stored stroke check.

⚠ **CAUTION**
To enable this parameter, the manual linear/circular interpolation function is required. If this function is not provided, this parameter setting is ignored.

OTF When an overtravel alarm is issued:
0 : No signal is output.
1 : A signal is output to F124 and F126.
PLC Stroke limit check before movement is:
0 : Not performed
1 : Performed

	#7	#6	#5	#4	#3	#2	#1	#0
1310							**OT3x**	**OT2x**

[Data type] Bit axis
OT2x Whether stored stroke check 2 is checked for each axis is set.
0 : Stored stroke check 2 is not checked.
1 : Stored stroke check 2 is checked.
OT3x Whether stored stroke check 3 is checked for each axis is set.
0 : Stored stroke check 3 is not checked.
1 : Stored stroke check 3 is checked.

1320	Coordinate value of stored stroke check 1 in the positive direction on each axis
1321	Coordinate value of stored stroke check 1 in the negative direction on each axis

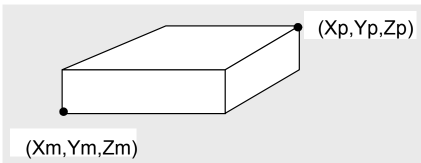
[Data type] 2-word axis

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

The coordinate values of stored stroke check 1 in the positive and negative directions are set for each axis in the machine coordinate system. The outside area of the two checks set in the parameters is inhibited.



Set the machine coordinates of the boundaries in the positive direction (Xp, Yp, and Zp) using parameter No. 1320, and those of the boundaries in the negative direction (Xm, Ym, and Zm) using parameter No. 1321. The prohibited area thus becomes the hatched area in the figure on the left.

NOTE

1. For axes with diameter programming, a diameter value must be set.
2. When the parameters are set as follows, the stroke becomes infinite:
   parameter No.1320 < parameter No.1321
   For movement along the axis for which infinite stroke is set, only increment commands are available. (The stored stroke limit switching signal also becomes invalid.) If an absolute command is issued for this axis, the absolute register may overflow, and normal movement will not result.
3. The prohibited area specified with these parameters is invalid if bit 2 (LMS) of parameter No. 1300 is set to 1 and stored stroke limit switching signal EXLM <G007#6> is set to 1. In such a case, the settings of parameter Nos. 1326 and 1327 are used, instead.

1322	Coordinate value of stored stroke check 2 in the positive direction on each axis

1323	Coordinate value of stored stroke check 2 in the negative direction on each axis

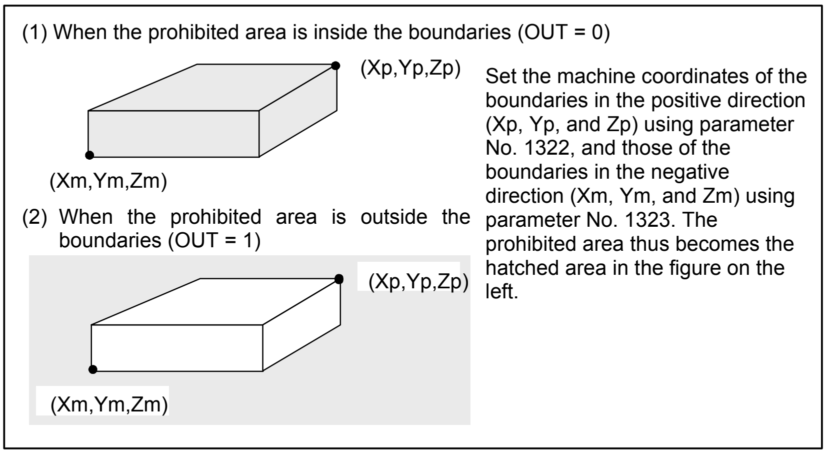
[Data type] 2-word axis

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

Set the coordinate values of stored stroke check 2 in the positive and negative directions for each axis in the machine coordinate system. Bit 0 (OUT) of parameter No. 1300, sets either the area outside of the area inside specified by two checks are the inhibition area.



NOTE

For axes with diameter programming, a diameter value must be set.

1324	Coordinate value of stored stroke check 3 in the positive direction on each axis
1325	Coordinate value of stored stroke check 3 in the negative direction on each axis

[Data type] 2-word axis
[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

Set the coordinate values of stored stroke check 3 in the positive and negative directions for each axis in the machine coordinate system. The area inside the checks set in the parameter is inhibited.

> **NOTE**
> Specify diameters for any axis for which diameter programming is specified.

1326	Coordinate value II of stored stroke check 1 in the positive direction on each axis
1327	Coordinate value II of stored stroke check 1 in the negative direction on each axis

[Data type] 2-word axis
[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

Set the coordinate values of stored stroke check 1 in the positive and negative directions for each axis in the machine coordinate system.
When stroke check switching signal EXLM <G007#6> is ON, stroke check are checked with parameter Nos. 1326 and 1327, not with parameter Nos. 1320 and 1321. The area outside that set by parameter Nos. 1326 and 1327 is inhibited.

> **NOTE**
> 1 Specify diameter values for any axes for which diameter programming is specified.
> 2 These parameters are invalid if bit 2 (LMS) of parameter No. 1300 is set to 0, or if stored stroke limit switching signal EXLM <G007#6> is set to 0. In such a case, the settings of parameter Nos. 1320 and 1321 are used, instead.

4.15 PARAMETERS OF CHUCK AND TAILSTOCK BARRIER (T SERIES)

1330	Profile of a chuck

[Data type] Byte

[Valid data range] 0 or 1

0 : Chuck which holds a workpiece on the inner surface
1 : Chuck which holds a workpiece on the outer surface

1331	Dimensions of the claw of a chuck (L)

1332	Dimensions of the claw of a chuck (W)

1333	Dimensions of the part of a claw at which a workpiece is held (L1)

1334	Dimensions of the part of a claw at which a workpiece is held (W1)

1335	X coordinate of a chuck (CX)

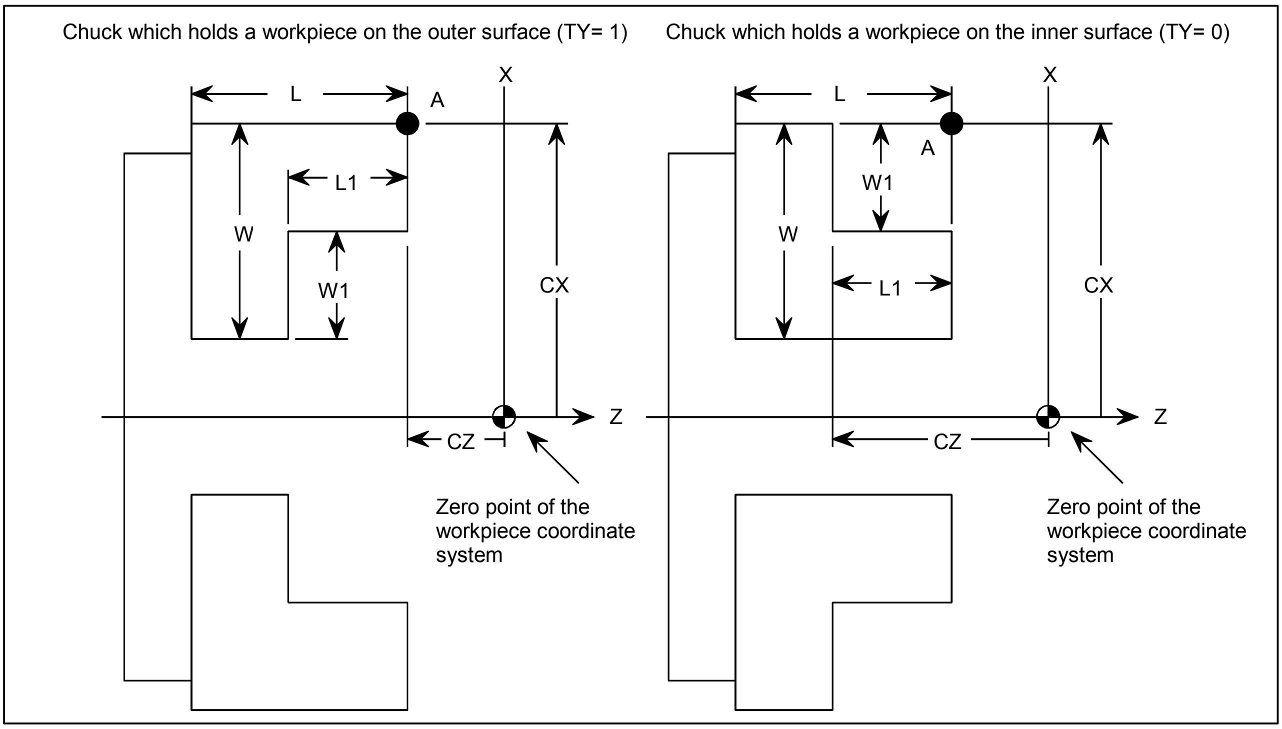
1336	ZX coordinate of a chuck (CZ)

[Data type] 2-word

[Unit of data]

Input increment	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm
Inch machine	0.0001	0.00001	inch

[Valid range] No.1331 to No.1334: 0 to 99999999
No.1335 to No.1336: -99999999 to 99999999
Specify the profile of a chuck.



Symbol	Description
TY	Profile of a chuck (0: Chuck which holds a workpiece on the inner surface, 1: Chuck which holds a workpiece on the outer surface)
CX	X coordinate of a chuck
CZ	Z coordinate of a chuck
L	Dimensions of the claw of a chuck
W	Dimensions of the claw of a chuck (radius input)
L1	Dimensions of the part of a claw at which a workpiece is held
W1	Dimensions of the part of a claw at which a workpiece is held (radius input)

TY Specifies the profile of a chuck. When TY is set to 0, the chuck holding a workpiece on the inner surface is specified. When TY is set to 1, the chuck holding a workpiece on the outer surface is specified. The profile of the chuck is assumed to be symmetrical with respect to the Z-axis.

CX, and CZ Specify the position (point A) of a chuck with the coordinates of the workpiece coordinate system. In this case, do not use the coordinates of the machine coordinate system.

NOTE

Specifying the coordinates with a diameter or radius depends on whether the corresponding axis conforms to diameter or radius programming. When the axis conforms to diameter programming, specify the coordinates with a diameter.

L, L1, W and W1 Define the profile of a chuck.

NOTE
Always specify W and W1 with radiuses. Specify L and L1 with radiuses when the Z-axis conforms to radius programming.

1341	Length of a tailstock (L)

1342	Diameter of a tailstock (D)

1343	Length of a tailstock (L1)

1344	Diameter of a tailstock (D1)

1345	Length of a tailstock (D1)

1346	Diameter of a tailstock (D2)

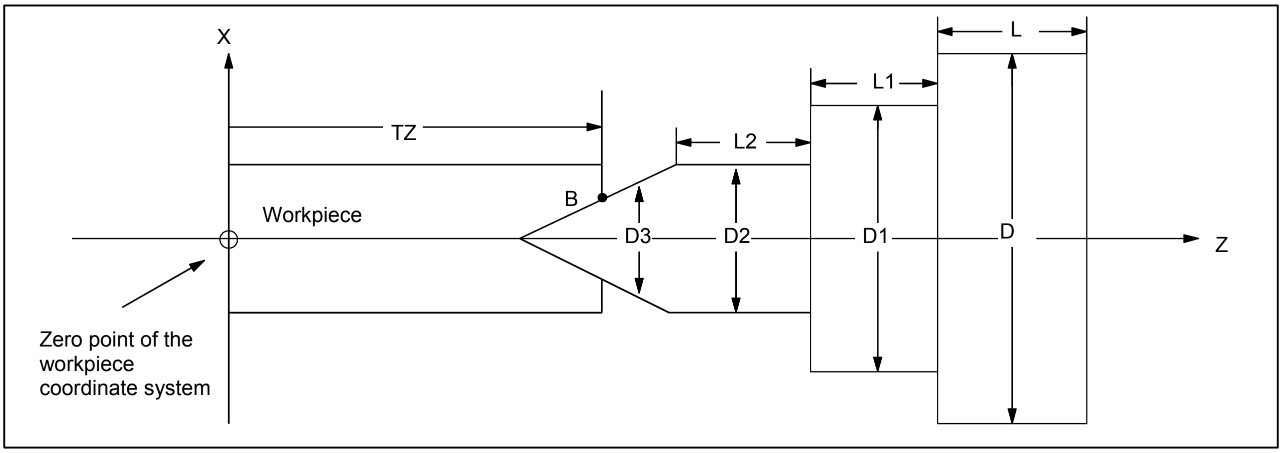
1347	Diameter of the hole of a tailstock (D3)

1348	Z coordinate of a tailstock (TZ)

[Data type] 2-word
[Unit of data]

Input increment	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm
Inch machine	0.0001	0.00001	inch

[Valid range] No.1341 to No.1347: 0 to 99999999
No.1348: -99999999 to 99999999
Specify the profile of a tailstock.



Symbol	Description
TZ	Z-axis coordinate of a tailstock
L	Length of a tailstock
D	Diameter of a tailstock (diameter input)
L1	Length of a tailstock (1)
D1	Diameter of a tailstock (1) (diameter input)
L2	Length of a tailstock (2)
D2	Diameter of a tailstock (2) (diameter input)
D3	Diameter of the hole of a tailstock (diameter input)

TZ: Specifies the position (point B) of a tailstock with the Z-axis coordinate of the workpiece coordinate system. In this case, do not use the coordinate of the machine coordinate system. The profile of a tailstock is assumed to be symmetrical with respect to the Z-axis.

NOTE
Specifying the position of a tailstock with a radius or diameter depends on whether the Z-axis conforms to radius or diameter programming.

L, L1, L2, D, D1, D2, and D3 Define the profile of a tailstock.

NOTE
Always specify D, D1, D2, and D3 with diameters. Specify L, L1, and L2 with radiuses if the Z-axis conforms to radius programming.

4.16 PARAMETERS OF FEEDRATE

	#7	#6	#5	#4	#3	#2	#1	#0
1401		RDR	TDR	RF0		JZR	LRP	RPD
		RDR	TDR	RF0			LRP	RPD

[Data type] Bit

RPD Manual rapid traverse during the period from power-on time to the completion of the reference position return.
- 0 : Disabled (Jog feed is performed.)
- 1 : Enabled

LRP Positioning (G00)
- 0 : Positioning is performed with non-linear type positioning so that the tool moves along each axis independently at rapid traverse.
- 1 : Positioning is performed with linear interpolation so that the tool moves in a straight line.

> **NOTE**
> 1 When using a multi-path system, set this parameter to the same value for all paths.
> 2 Be sure to set this parameter to 1 when performing three-dimensional coordinate conversion or using the tilted working plane command mode.

JZR The manual reference position return at jog feedrate
- 0 : Not performed
- 1 : Performed

RF0 When cutting feedrate override is 0% during rapid traverse,
- 0 : The machine tool does not stop moving.
- 1 : The machine tool stops moving.

TDR Dry run during threading or tapping (tapping cycle G74 or G84, rigid tapping)
- 0 : Enabled
- 1 : Disabled

RDR Dry run for rapid traverse command
- 0 : Disabled
- 1 : Enabled

	#7	#6	#5	#4	#3	#2	#1	#0
1402				JRV	OV2	JOV		NPC
					OV2	JOV		NPC

[Data type] Bit

NPC The feed per rotation command is:
0 : Ineffective when a position coder is not provided.
1 : Effective even when a position coder is not provided (because the CNC converts it to the feed per minute command from F command S command).

> **NOTE**
> To use a position coder, set this parameter to 0. While this parameter is set to 1, threading cannot be performed even if a position coder is provided.

JOV Jog override is:
0 : Enabled
1 : Disabled (tied to 100%)

OV2 2nd feedrate override is
0 : Specified every 1%
1 : Specified every 0.01%

> **NOTE**
> Signals used for 2nd feedrate override are:
> *AFV0 to *AFV7 <G013> when OV2 = 0
> *APF00 to *AFP15 <G094, G095> when OV2 = 1

JRV Jog feed or incremental feed is
0 : Performed at feed per minute.
1 : Performed at feed per rotation.

> **NOTE**
> Specify a feedrate in parameter No.1423.

	#7	#6	#5	#4	#3	#2	#1	#0
1403	RTV							MIF

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

MIF Cutting feedrates at feed per minute is specified by F commands
0 : In units of 1 mm/min for millimeter machines or 0.01 inches/min for inch machines.
1 : In unit of 0.001 mm/min for millimeter machines or 0.00001 inches/min for inch machines.

NOTE
M series are not equipped with this parameter. Cutting feedrates are specified by F commands in units of 0.001 mm/min for millimeter machines or 0.00001 inches/min for inch machines.

RTV Override while the tool is retracting in threading
0 : Override is effective.
1 : Override is not effective.

	#7	#6	#5	#4	#3	#2	#1	#0
1404	FC0			HCF	FRV	F8A	DLF	HFC

[Data type] Bit

HFC The feedrate for helical interpolation is:
0 : Clamped so that the feedrates along a circular and linear axis do not exceed the maximum cutting feedrate specified by parameter (No.1422 or 1430).
1 : Clamped so that the composite feedrate along a circular and linear axis does not exceed the maximum cutting feedrate specified by parameter (No.1422).

DLF After a reference position is set, manual reference position return performed at:
0 : Rapid traverse rate (parameter No.1420)
1 : Manual rapid traverse rate (parameter No.1424)

NOTE
This parameter selects a feedrate for reference position return performed without dogs. This parameter also selects a feedrate when manual reference position return is performed according to bit 7 (SJZ) of parameter No.0002 using rapid traverse without deceleration dogs after a reference position is set.

<For T series>

F8A Valid data range for an F command in feed-per-minute mode

0 : Range specified with bit 0 (MIF) of parameter No.1403

1:

Input increment	Units	IS-A, IS-B	IS-C
Metric input	mm/min	0.001 to 240000.	0.001 to 100000.
Inch input	inch/min	0.00001 to 9600.	0.00001 to 4000.
Rotary axis	deg/min	1 to 240000.	1 to 100000.

<For M series>

F8A Valid data range for an F command with a decimal point in feed-per minute mode

0:

Input increment	Units	IS-A, IS-B	IS-C
Metric input	mm/min	0.001 to 99999.999.	
Inch input	inch/min	0.00001 to 999.99999.	
Rotary axis (mm)	deg/min	1 to 240000.	1 to 100000.
Rotary axis (inch)	deg/min	1 to 9600.	1 to 4000.

1:

Input increment	Units	IS-A, IS-B	IS-C
Metric input	mm/min	0.001 to 240000.	0.001 to 100000.
Inch input	inch/min	0.00001 to 9600.	0.00001 to 4000.
Rotary axis	deg/min	1 to 240000.	1 to 100000.

FRV For inch input, the valid range of the feedrate specified for feed per revolution is:

0 : Standard range. (F0.000001 to 9.999999 inches per revolution)

1 : Extended to F50.0 inches per revolution. (F0.000001 to 50.000000 inches per revolution)

HCF As a feedrate for helical interpolation in AI contour control (M series) or AI nano contour control (M series/T series):

0 : The composite feedrate is specified.

1 : The feedrate along an arc is specified.

FC0 Specifies the behavior of the machine tool when a block (G01, G02, G03, etc.) containing a feedrate command (F command) that is 0 is issued during automatic operation, as follows:

0 : A P/S alarm (No.011) is displayed, and the block is not executed.

1 : No alarm is displayed, and the block is executed.

	#7	#6	#5	#4	#3	#2	#1	#0
1405		FCI	EDR			PCL		
		FCI	EDR				FD3	F1U

[Data type] Bit

F1U Specifies the units of the data for the parameters that set the feedrates of the one-digit F code feed (parameter Nos. 1451 to 1459).

Input increment	Units of data	
	When F1U is 0	When F1U is 1
Metric machine	0.1 mm/min	1 mm/min
Inch machine	0.01 inch/min	0.1 inch/min
Rotary axis	0.1 deg/min	1 deg/min

FD3 The number of significant digits of the fractional part in the feedrate command (F command) for feed per revolution is:

0 : Up to two decimal positions (three decimal positions for inch input).

1 : Up to three decimal positions (four decimal positions for inch input).

PCL The function for feed per rotation without the position coder is:

0 : Not used.

1 : Used.

NOTE

The option for constant surface speed control without the position coder is required.
To set this parameter to 1, set bit 0 (NPC) of parameter No. 1402 to 0.

EDR This parameter selects a parameter used for setting of an external deceleration rate in the case of interpolation-type rapid traverse (with bit 1 (LRP) of parameter No. 1401 set to 1).

0 : Parameter No. 1426 is used to set an external deceleration rate in the case of interpolation-type rapid traverse.

1 : The first axis of parameter No. 1427 is used to set an external deceleration rate in the case of interpolation-type rapid traverse.
When EDR is set to 1, the first axis of the external deceleration rate parameter for rapid traverse is used also for external deceleration 2, 3, 4, and 5.

FCI In the case of inch input and feed per rotation, the cutting feedrate is clamped to:

0 : 9600inch/min.

1 : 144000inch/min.

	#7	#6	#5	#4	#3	#2	#1	#0
1406							ED3	ED2

[Data type] Bit

ED2 External deceleration 2 is:
0 : Invalid.
1 : Valid.

ED3 External deceleration 3 is:
0 : Invalid.
1 : Valid.

	#7	#6	#5	#4	#3	#2	#1	#0
1407				RHT	ACS			
	ACF			RHT	ACS			

[Data type] Bit

ACS If positioning of linear interpolation type involving a Cs axis is specified in a mode other than the three-dimensional coordinate conversion mode, and reference position return operation on the Cs axis is not completed yet:
0 : A movement is made for positioning of non-linear interpolation type (rapid traverse on each axis independently).
1 : P/S alarm No. 5334 is issued.

NOTE
In the three-dimensional coordinate conversion mode, P/S alarm No. 5334 is issued, regardless of the setting of this parameter.

RHT As a feedrate for helical interpolation in high-precision contour control or AI/AI nano high-precision contour control:
0 : The feedrate along an arc is specified.
1 : The composite feedrate is specified.

ACF In the AI contour control/AI nano contour control mode, the feedrate is clamped to the following value:
0 : The feedrate is clamped to the setting of parameter No. 1432 or setting of parameter No. 1422, whichever smaller.
(If both parameters are set to 0, P/S alarm No. 5157 is issued.)
1 : The feedrate is clamped to the setting of parameter No. 1432 if the parameter No. 1432 is set to a value other than 0.
The feedrate is clamped to the setting of parameter No. 1422 if the parameter No. 1432 is set to 0.
P/S alarm No. 5157 is issued if parameter No. 1422 is set to 0.
Parameter No. 1422 = Maximum cutting feedrate
Parameter No. 1432 = Maximum cutting feedrate for each axis in the advanced preview control mode

1408	#7	#6	#5	#4	#3	#2	#1	#0
								RFD

[Data type] Bit axis

RFD The feedrate about a rotary axis is controlled:

0 : In the usual method.

1 : By converting the rotation speed about the rotary axis into the travel speed on the circumference of a virtual circle.
Set the radius of the virtual circle in parameter No. 1465.

1410	Dry run feedrate and jog feedrate in manual linear/circular interpolation

[Data type] Word

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800

Set the dry run rate when the manual feedrate is overridden by 100%. Specify the jog feedrate when the override is 100% for manual linear or circular interpolation.

1411	
	Cutting feedrate in automatic operation (initial value)

This parameter can also be set on the “Setting screen”.

[Data type] Word

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range
Metric machine	1 mm/min	6 to 32767
Inch machine	0.1 inch/min	6 to 32767

When the machine requires little change in cutting feedrate during cutting, a cutting feedrate can be specified in the parameter. This eliminates the need to specify a cutting feedrate (F command) in the NC program.

The cutting feedrate set by this parameter is valid after the CNC is placed in the clear state by power-up or a reset until a feedrate is specified by a program command (F command). After a feedrate is specified by the F command, the feedrate becomes valid.

1414	Feedrate for retrace

[Data type] 2-word

This parameter sets the feedrate for retrace when the retrace function is used.

(1) For rapid traverse

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 240000	6 to 100000
Inch machine	0.1 inch/min	6 to 96000	6 to 48000
Rotary axis	1 deg/min	6 to 240000	6 to 100000

NOTE

When 0 is set in this parameter, the rapid traverse rate that is set in parameter No.1420 is used for retrace.

(2) For cutting feed

When a value other than 0 is specified in this parameter, the same feedrate as an F command specified using the value without a decimal point is set and is used for retrace. When 0 is specified in this parameter, the programmed feedrate (F command) is used for retrace.

1420	Rapid traverse rate for each axis

[Data type] 2-word axis

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	30 to 240000	6 to 100000
Inch machine	0.1 inch/min	30 to 96000	6 to 48000
Rotary axis	1 deg/min	30 to 240000	6 to 100000

Set the rapid traverse rate when the rapid traverse override is 100% for each axis.

With this parameter and parameter No. 1773, a reference acceleration rate for optimum torque acceleration/deceleration is found.

1421	F0 rate of rapid traverse override for each axis

[Data type] Word axis

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	30 to 15000	30 to 12000
Inch machine	0.1 inch/min	30 to 6000	30 to 4800
Rotary axis	1 deg/min	30 to 15000	30 to 12000

Set the F0 rate of the rapid traverse override for each axis.

Rapid traverse override signal		Override value
ROV2	ROV1	
0	0	100%
0	1	50%
1	0	25%
1	1	F0

F0: Parameter No. 1421

1422	Maximum cutting feedrate for all axes

[Data type] 2-word

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 240000	6 to 100000
Inch machine	0.1 inch/min	6 to 96000	6 to 48000

Specify the maximum cutting feedrate.
A feedrate in the tangential direction is clamped in cutting feed so that it does not exceed the feedrate specified in this parameter.

NOTE

1. A maximum cutting feedrate can be specified for each axis only during linear interpolation and circular interpolation by using parameter No. 1430.
2. Even when parameter No. 1430 is used, clamping to a maximum cutting feedrate based on parameter No. 1422 is enabled during polar coordinate interpolation, cylindrical interpolation, and involute interpolation (M series).

1423	Feedrate in jog feed for each axis

[Data type] Word axis

(1) In M series, or in T series when bit 4 (JRV) of parameter No.1402, is set to 0 (feed per minute), specify a jog feedrate at feed per minute with a manual feedrate override of 100%.

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

(2) When bit 4 (JRV) of parameter No.1402, is set to 1 (feed per revolution) in T series, specify a jog feedrate (feed per revolution) under a manual feedrate override of 100%.

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range
Metric machine	0.01 mm/rev	0 to 32767
Inch machine	0.001 mm/rev	
Rotary axis	0.01 deg/rev	

1424	Manual rapid traverse rate for each axis

[Data type] 2-word axis

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	30 to 240000	30 to 100000
Inch machine	0.1 inch/min	30 to 96000	30 to 48000
Rotary axis	1 deg/min	30 to 240000	30 to 100000

Set the rate of manual rapid traverse when the rapid traverse override is 100% for each axis.

NOTE

If 0 is set, the rate set in parameter No.1420 is assumed.

1425	FL rate of the reference position return for each axis

[Data type] Word axis

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

Set feedrate (FL rate) after deceleration when the reference position return is performed for each axis.

1426	External deceleration rate 1 of cutting feed

[Data type] Word

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800

Set the external deceleration rate of cutting feed.

1427	External deceleration rate 1 of rapid traverse for each axis

[Data type] Word axis

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

Set the external deceleration rate of rapid traverse for each axis.

1428	Reference position return feedrate for each axis

[Data type] 2-word axis

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	30 to 240000	6 to 100000
Inch machine	0.1 inch/min	30 to 96000	6 to 48000
Rotary axis	1 deg/min	30 to 240000	6 to 100000

This parameter sets a rapid traverse rate for reference position return operation using deceleration dogs, or for reference position return operation before a reference position is established.
This parameter is also used to set a feedrate for the rapid traverse command (G00) in automatic operation before a reference position is established.

NOTE

1. This parameter is invalid for an axis using the scale with absolute addressing reference marks.
2. When 0 is set in this parameter, this parameter disables the reference position return feedrate setting function.

<table>
<tr><th colspan="2" rowspan="3"></th><th colspan="2">Before a reference position is established</th><th colspan="2">After a reference position is established</th></tr>
<tr><th colspan="2">No. 1428</th><th colspan="2">No. 1428</th></tr>
<tr><th>=0</th><th>≠0</th><th>=0</th><th>≠0</th></tr>
<tr><td colspan="2">Reference position return by G28</td><td rowspan="2">No.1420</td><td rowspan="4">No.1428</td><td colspan="2" rowspan="2">No.1420</td></tr>
<tr><td colspan="2">Raped traverse command (G00) in automatic operation</td></tr>
<tr><td rowspan="2">Manual reference position return</td><td>Without dogs (*1)</td><td rowspan="2">No.1424</td><td colspan="2">No.1420 or No.1424 (*3)</td></tr>
<tr><td>With dogs (*1)</td><td>No.1424</td><td>No.1428</td></tr>
<tr><td colspan="2">Manual raped traverse</td><td colspan="2">No.1423 or No.1424 (*2)</td><td colspan="2">No.1424</td></tr>
</table>

*1 With/without dogs: Reference position return operation not using/using deceleration dogs

*2 For manual rapid traverse before a reference position is established, a jog feedrate (parameter No.1423) or manual raped traverse rate (parameter No.1424) is used according to the setting of bit 0 (RPD) of parameter No.1401.

*3 The raped traverse rate set in parameter No.1424 or No.1420 is used according to the setting of bit 1 (DLF) of parameter No.1404 when reference position return is performed without dogs, or when reference position return operation is performed with bit 7 (SJZ) of parameter No.0002 set to 1 after a reference position is established (when reference position return operation is performed using rapid traverse without deceleration dogs).

1430	Maximum cutting feedrate for each axis

[Data type] 2-word axis
[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 240000	6 to 100000
Inch machine	0.1 inch/min	6 to 96000	6 to 48000
Rotary axis	1 deg/min	6 to 240000	6 to 100000

Specify the maximum cutting feedrate for each axis.
A feedrate for each axis is clamped in cutting feed so that it does not exceed the maximum feedrate specified for each axis.

NOTE

1 This parameter is valid only during linear interpolation and circular interpolation. Even when this parameter is set, clamping to a maximum cutting feedrate based on parameter No. 1422 is enabled during polar coordinate interpolation, cylindrical interpolation, and involute interpolation (M series).

2 When this parameter is set to 0 for all axes, clamping to a maximum cutting feedrate based on parameter No. 1422 is enabled.

This means that if a value other than 0 is set for any of the axes with this parameter, clamping to a maximum cutting feedrate is performed for all axes during linear interpolation or circular interpolation according to this parameter.

1431	Maximum cutting feedrate for all axes in the advanced preview control mode

[Data type] 2-word

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	0 to 240000	0 to 100000
Inch machine	0.1 inch/min	0 to 96000	0 to 48000
Rotary axis	1 deg/min	0 to 240000	0 to 100000

Specify the maximum cutting feedrate for all axes in the advanced preview control mode.
A feedrate in the tangential direction is clamped in cutting feed so that it does not exceed the feedrate specified in this parameter.

NOTE

1 To specify the maximum cutting feedrate for each axis, use parameter No.1432 instead.

2 In a mode other than the advanced preview control mode, the maximum cutting feedrate specified in parameter No.1422 or No.1430 is applied and the feedrate is clamped at the maximum feedrate.

1432	Maximum cutting feedrate for each axis in the AI contour control mode or advanced preview control mode

[Data type] 2-word axis

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	0 to 240000	0 to 100000
Inch machine	0.1 inch/min	0 to 96000	0 to 48000
Rotary axis	1 deg/min	0 to 240000	0 to 100000

Specify the maximum cutting feedrate for each axis in the AI contour control mode or advanced preview control mode.
A feedrate for each axis is clamped during cutting feed so that it does not exceed the maximum cutting feedrate specified for each axis.

NOTE

1 This parameter is effective only in linear and circular interpolation. In polar coordinate, cylindrical, and involute interpolation, the maximum feedrate for all axes specified in parameter No.1431 is effective.
2 If a setting for each axis is 0, the maximum feedrate specified in parameter No.1431 is applied to all axes and the feedrate is clamped at the maximum feedrate.
3 In a mode other than the AI contour control mode or advanced preview control mode, the maximum cutting feedrate specified in parameter No.1422 or No.1430 is applied and the feedrate is clamped at the maximum feedrate.
4 In the HPCC mode, if values are specified in both parameters No. 1430 and No. 1432, the setting of parameter No. 1432 takes priority. If nothing is specified in parameter No. 1430, the feedrate is clamped to the value specified in parameter No. 1422.

1434	Maximum allowable manual handle feedrate 1 for each axis

[Data type] Word axis

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

Set a maximum allowable manual handle feedrate for each axis.

1436	Maximum allowable feedrate for the feedrate check function for each axis

[Data type] 2-word axis
[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	0, 30 to 240000	0, 6 to 100000
Inch machine	0.1 inch/min	0, 30 to 96000	0, 6 to 48000
Rotary axis	1 deg/min	0, 30 to 240000	0, 6 to 100000

This function is invalid when this parameter is set to 0.
Set a maximum allowable feedrate for each axis. If the value set in this parameter is exceeded, a decelerated stop occurs with P/S alarm No. 5323 ("Excessive Feedrate").
The deceleration check function checks data obtained by converting the setting of this parameter to a travel distance moved every 8 msec.

1440	External deceleration rate 2 of cutting feed

[Data type] Word
[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800

Set the external deceleration rate of cutting feed.

1441	External deceleration rate 2 of rapid traverse for each axis

[Data type] Word axis
[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

Set the external deceleration rate of rapid traverse for each axis.

1442	Maximum allowable manual handle feedrate 2 for each axis

[Data type] Word axis

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

Set a maximum allowable manual handle feedrate for each axis.

1443	External deceleration rate 3 of cutting feed

[Data type] Word

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800

Set the external deceleration rate of cutting feed.

1444	External deceleration rate 3 of rapid traverse for each axis

[Data type] Word axis

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

Set the external deceleration rate of rapid traverse for each axis.

1445	Maximum allowable manual handle feedrate 3 for each axis

[Data type] Word axis

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

Set a maximum allowable manual handle feedrate for each axis.

1450	Change of feedrate for one graduation on the manual pulse generator during one-digit F feed code

[Data type] Byte

[Valid data range] 1 to 127

Set the constant that determines the change in feedrate as the manual pulse generator is rotated one graduation during one-digit F feed code.

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

In the above equation, set n. That is, the number of revolutions of the manual pulse generator, required to reach feedrate Fmaxi is obtained. Fmaxi refers to the upper limit of the feedrate for a one-digit F code feed command, and set it in parameters No. 1460 or No. 1461.

Fmax1: Upper limit of the feedrate for F1 to F4 (parameter No. 1460)

Fmax2: Upper limit of the feedrate for F5 to F9 (parameter No. 1461)

1451	Feedrate for one-digit F code feed command F1
1452	Feedrate for one-digit F code feed command F2
1453	Feedrate for one-digit F code feed command F3
1454	Feedrate for one-digit F code feed command F4
1455	Feedrate for one-digit F code feed command F5
1456	Feedrate for one-digit F code feed command F6
1457	Feedrate for one-digit F code feed command F7
1458	Feedrate for one-digit F code feed command F8
1459	Feedrate for one-digit F code feed command F9

These parameters can also be set on the "Setting screen".

[Data type] 2-word

[Unit of data, valid data range]

(1) When the F1U parameter (bit 0 of parameter No.1405) is 0

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	0.1 mm/min	6 to 150000	6 to 120000
Inch machine	0.01 inch/min	6 to 60000	6 to 48000
Rotary axis	0.1 deg/min	6 to 150000	6 to 120000

(2) When the F1U parameter (bit 0 of parameter No.1405) is 1

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

These parameters set the feedrates for one-digit F code feed commands F1 to F9. When a one-digit F code feed command is specified, and the feedrate is changed by turning the manual pulse generator, the parameter-set value also changes accordingly.

1460	Upper limit of feedrate for the one-digit F code feed command (F1 to F4)

1461	Upper limit of feedrate for the one-digit F code feed command (F5 to F9)

[Data type] 2-word

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

Set the upper limit of feedrate for the one-digit F code feed command. As the feedrate increases by turning the manual pulse generator, the feedrate is clamped when it reaches the upper limit set. If a one-digit F feed command F1 to F4 is executed, the upper limit is that set in parameter No. 1460. If a one-digit F code feed command F5 to F9 is executed, the upper limit is that set in parameter No. 1461.

1465	Virtual radius for feedrate control about rotary axis

[Data type] 2-word axis

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric input	0.01	0.001	0.0001	mm
Inch input				inch

[Valid data range] 0 to 99999999

Set the radius of a virtual circle when using such a control method that the feedrate of a rotary axis is converted to a travel speed on a circle of a virtual radius.

NOTE

1 Note that the increment system remains unchanged regardless of whether metric input or inch input is used.

2 This function is enabled when bit 0 (ROTx) of parameter No. 1006 and bit 0 (RFDx) of parameter No. 1408 are set to 1.

3 Be careful when setting bit 0 (RFDx) of parameter No. 1408 and parameter No. 1465 (virtual radius). In particular, when this function is used with a small virtual radius value, axis movement speeds up.

4 If a large value is set for the amount of travel and parameter No. 1465 (virtual radius), an alarm (P/S 5307: Internal data exceeded an allowable range.) is issued.

5 This function cannot be used in the following modes:
Rapid traverse, inverse time feed (G93), feed per revolution (G94), threading, high-precision contour control, AI high-precision contour control, AI nano high-precision contour control, AI contour control, AI nano contour control, high-speed cycle machining, high-speed remote buffer A, high-speed remote buffer B, high-speed linear interpolation, position control function

1466	Feedrate for retraction in a threading cycle

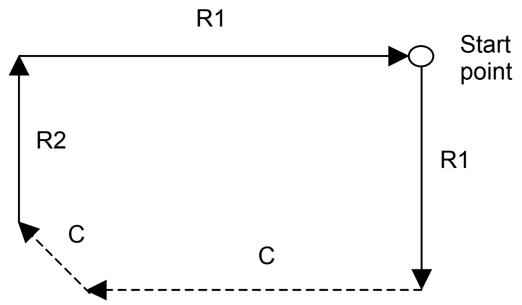
[Data type] 2-word

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	30 to 240000	6 to 100000
Inch machine	0.1 inch/min	30 to 96000	6 to 48000
Rotary axis	1 deg/min	30 to 240000	6 to 100000

Set a feedrate for retraction in a threading cycle. If 0 is set in this parameter, a movement is made at the feedrate (rapid traverse rate) set in parameter No. 1420.

[Example] For G92



In the figure above, R1 represents a rapid traverse rate, and C represents a cutting feedrate.
Set R2 in this parameter. If 0 is set in this parameter, R2 and R1 represent the same feedrate.

This parameter is useful also for retraction at feed hold time when the threading cycle retract option is specified.

4.17 PARAMETERS OF ACCELERATION/DECELERATION CONTROL

		#7	#6	#5	#4	#3	#2	#1	#0
1601				NCI	RTO				
			ACD	NCI	RTO		OVB		

[Data type] Bit

OVB Block overlap in cutting feed

0 : Blocks are not overlapped in cutting feed.

1 : Blocks are overlapped in cutting feed.

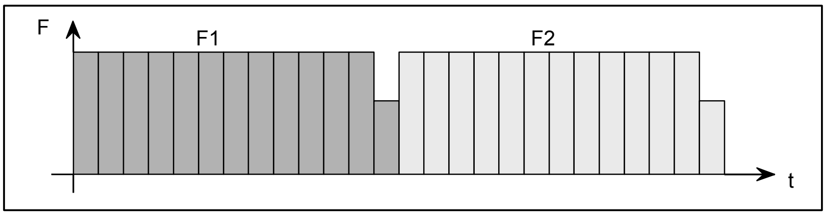
Block overlap outputs the pulses remaining at the end of pulse distribution in a block together with distribution pulses in the next block. This eliminates changes in feedrates between blocks.

Block overlap is enabled when blocks containing G01, G02, or G03 are consecutively specified in G64 mode. If minute blocks, however, are specified consecutively, overlap may not be performed.

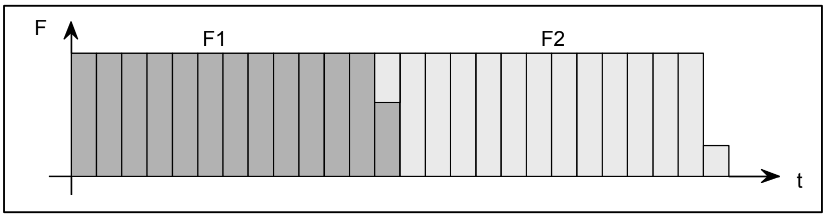
The following pulses in block F2 are added to the pulses remaining at the end of pulse distribution in block F1.

$$\text{(Number of pulses to be added)} = F2 \times \frac{\text{(Number of pulses required at the end of block F1)}}{F1}$$

When F1 = F2



When block overlap is disabled



When block overlap is enabled

RTO Block overlap in rapid traverse

0 : Blocks are not overlapped in rapid traverse.

1 : Blocks are overlapped in rapid traverse.

> **NOTE**
> See the description of parameter No.1722.

NCI In-position check at deceleration

0 : Performed

1 : Not performed

ACD Automatic corner deceleration function is:
0 : Not used.
1 : Used.

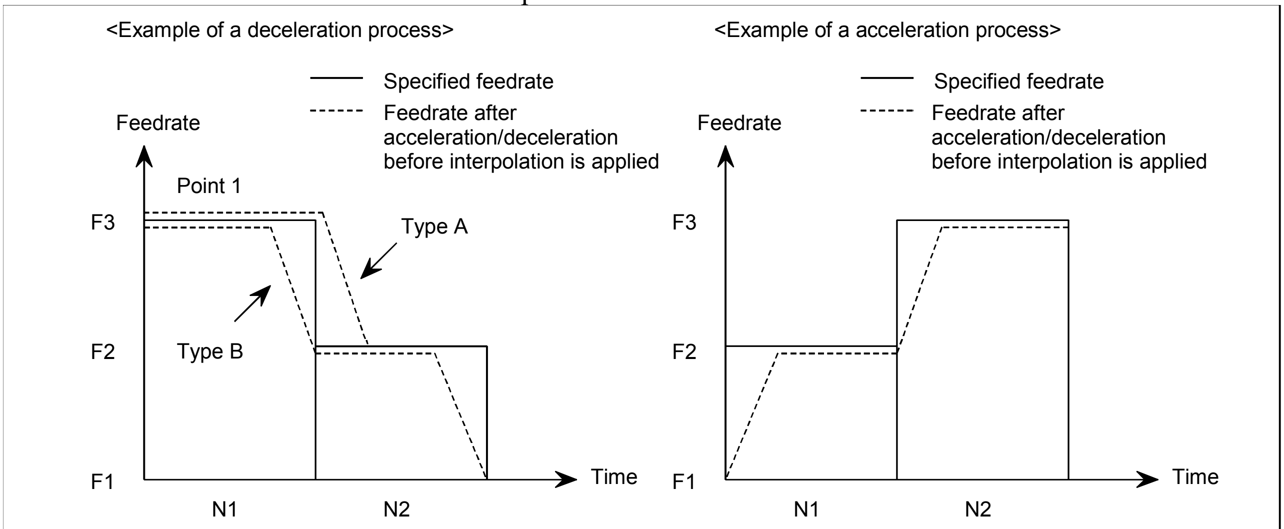
	#7	#6	#5	#4	#3	#2	#1	#0
1602		LS2	G8S		BS2	COV		FWB
		LS2	G8S	CSD	BS2	COV		FWB

[Data type] Bit

FWB Cutting feed acceleration/deceleration before interpolation
0 : Type A of acceleration/deceleration before interpolation is used.
1 : Type B of acceleration/deceleration before interpolation is used.

Type A:
When a feedrate is to be changed by a command, acceleration/deceleration starts after the program enters the block in which the command is specified.

Type B:
When a feedrate is to be changed by a command, deceleration starts and terminates at the block before the block in which the command is specified.
When a feedrate is to be changed by a command, acceleration starts after the program enters the block in which the command is specified.



To change the feedrate from F3 to F2, it is necessary to start reducing the feedrate at point 1.

COV The outer arc cutting feedrate change function of the automatic corner override function is:
0 : Not used.
1 : Used.

BS2 The type of acceleration/deceleration after interpolation for cutting feed in the advanced preview control mode/high-precision contour control mode or in the AI high-precision/AI nano high-precision contour control mode is:

0 : Specified by bit 6 (LS2) of parameter No. 1602.
1 : Bell-shaped acceleration/deceleration.

(1) In the advanced preview control mode/high-precision contour control mode

BS2	LS2	Acceleration/deceleration
0	0	Exponential acceleration/deceleration after interpolation
0	1	Linear acceleration/deceleration after interpolation. (The option for linear acceleration/deceleration after interpolation for cutting feed is required.)
1	0	Bell-shaped acceleration/deceleration after interpolation. (The option for bell-shaped acceleration/deceleration after interpolation for cutting feed is required.)

(2) In the AI high-precision/AI nano high-precision contour control mode

BS2	LS2	Acceleration/deceleration
0	0	No acceleration/deceleration
0	1	Linear acceleration/deceleration. (The option for linear acceleration/deceleration after interpolation for cutting feed is required.)
1	0	Bell-shaped acceleration/deceleration. (The option for bell-shaped acceleration/deceleration after interpolation for cutting feed is required.)
1	1	Bell-shaped acceleration/deceleration. (The option for bell-shaped acceleration/deceleration after interpolation for cutting feed is required.)

CSD In the automatic corner deceleration function,

0 : Angles are used for controlling the feedrate.
1 : Differences in feedrates are used for controlling the feedrate.

G8S Serial spindle advanced preview control is:

0 : Disabled.
1 : Enabled.

When enabled, advanced preview control can be applied to the following functions:

- Rigid tapping
- Cs contour control
- Spindle positioning (only when bit 3 of parameter No.1800 is 1)

NOTE

1 When using simple spindle synchronous control, set this parameter to 0.
2 When using composite control in Cs contour control, set this parameter to 0.
3 When exercising Cs contour control in the AI high-precision/AI nano high-precision contour control mode, set this parameter to 1.

LS2 The type of acceleration/deceleration when bit 3 (BS2) of parameter No. 1602 is set to 0 is:
0 : Exponential acceleration/deceleration, or no acceleration/ deceleration is applied.
1 : Linear acceleration/deceleration. (The function for linear acceleration/deceleration after interpolation for cutting feed is required.)
See the description of bit 3 (BS2) of parameter No. 1602.

	#7	#6	#5	#4	#3	#2	#1	#0
1603	BEL	RBL		RPT	RSB			
	BEL	RBL		RPT	SBL			

[Data type] Bit

RSB The type of acceleration/deceleration before interpolation in the AI high-precision/AI nano high-precision contour control mode is:
0 : Linear type.
1 : Bell-shaped type.

SBL In high-precision contour control, the bell-shaped acceleration/ deceleration before interpolation is performed:
0 : Based on a constant acceleration/deceleration change rate.
1 : Based on a constant acceleration/deceleration change time.
Set the time constant in parameter No. 8416.

NOTE
1. In AI high-precision/AI nano high-precision contour control, either bit 3 of parameter No. 1603 or bits 1 and 7 of parameter No. 8402 can be used to specify the type of acceleration/deceleration.
2. However, if the settings differ from each other (if the bell-shaped type is set for only one side), acceleration/deceleration before interpolation is assumed to be of bell-shaped type.
3. For bell-shaped acceleration/deceleration in AI high-precision/AI nano high-precision contour control, the constant acceleration/deceleration change time type is assumed.

PRT The acceleration/deceleration of interpolation-type rapid traverse is performed:
0 : With a constant inclination.
1 : With a constant time.

NOTE
1 An acceleration/deceleration time constant and override for rapid traverse are used.
2 Rapid traverse block overlap cannot be used.
3 When using a multi-path system, set this parameter to the same value for all paths.
4 When performing three-dimensional coordinate conversion or using the tilted working plane command mode, set this parameter to 1. Otherwise, no strict linear movement can be made.

RBL In the AI contour control mode for M series or AI nano contour control mode for M/T series, acceleration/deceleration of rapid traverse is:
0 : Linear acceleration/deceleration.
1 : Bell-shaped acceleration/deceleration.

NOTE
Bit 4 (PRT) of parameter No. 1603 is invalid.

BEL In the AI contour control mode for M series or AI nano contour control mode for M/T series:
0 : Linear acceleration/deceleration before look-ahead interpolation is used.
1 : Bell-shaped acceleration/deceleration before look-ahead interpolation is used.

	#7	#6	#5	#4	#3	#2	#1	#0
1604								
					DS3	DS2		

[Data type] Bit
DS2 If a setting is made to issue an overtravel alarm with stored stroke check 2 in linear acceleration/deceleration before interpolation, the function for performing deceleration to reach the feedrate set in parameter No. 12700 before the issue of such an alarm is:
0 : Disabled.
1 : Enabled.
DS3 If a setting is made to issue an overtravel alarm with stored stroke check 3 in linear acceleration/deceleration before interpolation, the function for performing deceleration to reach the feedrate set in parameter No. 12701 before the issue of such an alarm is:
0 : Disabled.
1 : Enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
1610				JGLx			CTBx	CTLx

[Data type] Bit axis

CTLx Acceleration/deceleration in cutting feed including feed in dry run

0 : Exponential acceleration/deceleration is applied.

1 : Linear acceleration/deceleration after interpolation is applied.

NOTE

If the optional function of linear acceleration/deceleration after interpolation in cutting feed is not provided, exponential acceleration/deceleration is used irrespective of this setting.
To use bell-shaped acceleration/deceleration after interpolation, set this parameter to 0 and select the acceleration/deceleration using bit 1 (CTBx) of parameter No.1610.

Parameter		Acceleration/deceleration
CTBx	CTLx	
0	0	Exponential acceleration/deceleration
0	1	Linear acceleration/deceleration after interpolation
1	0	Bell-shaped acceleration/deceleration after interpolation

CTBx Acceleration/deceleration in cutting feed including feed in dry run

0 : Exponential acceleration/deceleration or linear acceleration/deceleration after interpolation is applied (depending on the setting in bit 0 (CTLx) of parameter No.1610).

1 : Bell-shaped acceleration/deceleration after interpolation is applied.

NOTE

This parameter is effective only when the function of bell-shaped acceleration/deceleration after interpolation in cutting feed is provided. If the function is not provided, the setting in bit 0 (CTLx) of parameter No.1610, determines the type of acceleration/deceleration irrespective of the setting in this parameter.

JGLx Acceleration/deceleration in jog feed

0 : Exponential acceleration/deceleration is applied.

1 : Linear acceleration/deceleration after interpolation or bell-shaped acceleration/deceleration after interpolation is applied (depending on which is used for cutting feed).

1620	Time constant T or T_1 used for linear acceleration/deceleration or bell-shaped acceleration/deceleration in rapid traverse for each axis

[Data type] Word axis
[Unit of data] msec
[Valid data range] 0 to 4000

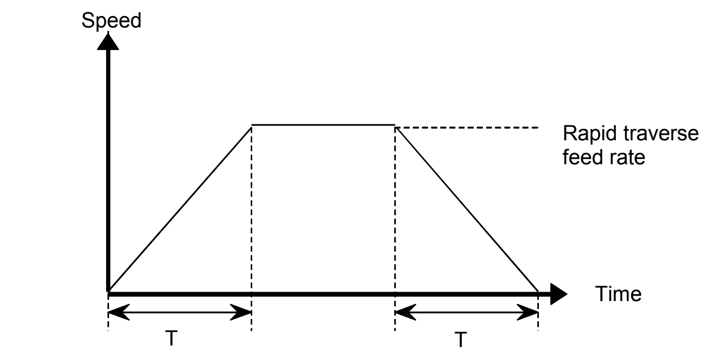
Specify a time constant used for acceleration/deceleration in rapid traverse. (When the optional function of bell-shaped acceleration/ deceleration in rapid traverse is provided, bell-shaped acceleration/ deceleration is applied in rapid traverse. If the function is not provided, linear acceleration/deceleration is applied.)

(1) When the function is provided, set this parameter to time constant T_1 used in bell-shaped acceleration/deceleration in rapid traverse, and set parameter No.1621 to time constant T_2.
(2) When the function is not provided, specify a time constant used in linear acceleration/deceleration.

NOTE

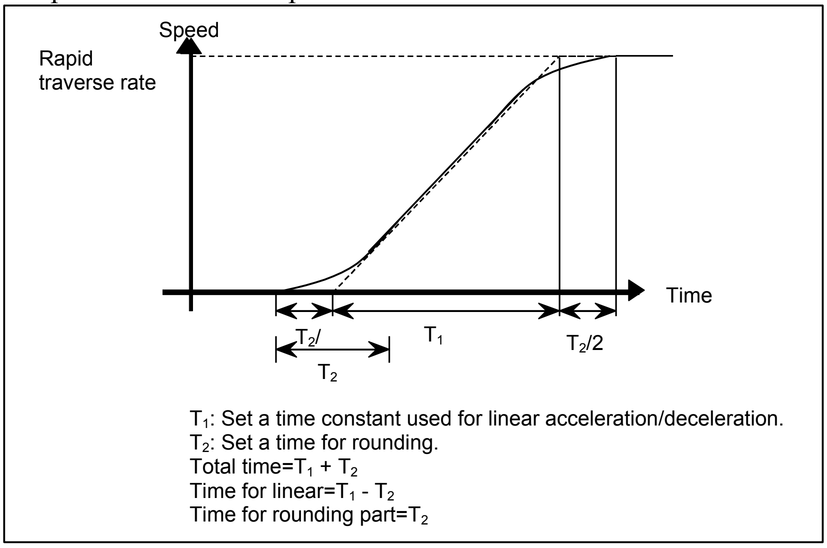
1 When parameter No.1621 (time constant T_2 used for bell-shaped acceleration/deceleration in rapid traverse) is set to 0, linear acceleration/ deceleration is applied in rapid traverse even if the function is provided. In this case, this parameter stands for a time constant used in linear acceleration/deceleration in rapid traverse.
2 Depending on the set time constant value, a movement may be made for a certain period of time at a feedrate slightly lower than the rapid traverse rate before the rapid traverse rate is reached by acceleration. To avoid this phenomenon, set a multiple of 8 as the time constant.

<Rapid traverse linear acceleration/deceleration>



T: Time constant for linear acceleration/deceleration

<Rapid traverse bell-shaped acceleration/deceleration>



Set the value when the rapid traverse rate is 100%. If it is under 100%, the total time is reduced. (Constant acceleration method)
The value of T_1 is determined from the torque of motor. Usually set the value of T_2 to 24 msec or 32 msec.

1621	Time constant t T_2 used for bell-shaped acceleration/deceleration in rapid traverse for each axis

[Data type] Word axis
[Unit of data] msec
[Valid data range] 0 to 512

Specify time constant T_2 used for bell-shaped acceleration/ deceleration in rapid traverse for each axis.

NOTE

1 This parameter is effective when the function of bell-shaped acceleration/deceleration in rapid traverse is provided. Set parameter No.1620 to time constant T_1 used for bell-shaped acceleration/deceleration in rapid traverse, and set this parameter to time constant T_2.
For details of time constants T_1 and T_2, see the description of parameter No.1620.

2 When this parameter is set to 0, linear acceleration/ deceleration is applied in rapid traverse. (The setting in parameter No.1620 is used as a time constant in linear acceleration/deceleration.)

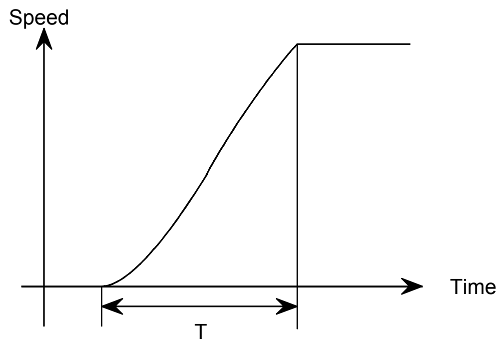
1622	Time constant of exponential acceleration/deceleration in cutting feed for each axis

[Data type] Word axis
[Unit of data] msec
[Valid data range] 0 to 4000 (exponential acceleration/deceleration in cutting feed)
0 to 512 (linear or bell-shaped acceleration/deceleration after interpolation in cutting feed)

Set the time constant used for exponential acceleration/deceleration in cutting feed, bell-shaped acceleration/deceleration after interpolation, or linear acceleration/deceleration after interpolation in cutting feed for each axis. Except for special applications, the same time constant must be set for all axes in this parameter. If the time constants set for the axes differ from each other, proper straight lines and arcs cannot be obtained.

This parameter is valid for threading, irrespective of the acceleration/deceleration type. For threading cycles G76 and G92 (G78 in the G code system B or C), this parameter is valid for operations other than exponential acceleration/deceleration. (T series)

Bell-shaped acceleration/deceleration after interpolation in cutting feed



T : Total time. it is constant irrespective of feed rate.
(Time constant is constant).

The curve corresponds to that $T_1 = T/2$ and $T_2 = T/2$ set in parameter No.1620 and No. 1621.

1623	FL rate of exponential acceleration/deceleration in cutting feed for each axis

[Data type] Word axis

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	0, 6 to 15000	0, 6 to 12000
Inch machine	0.1 inch/min	0, 6 to 6000	0, 6 to 4800
Rotary axis	1 deg/min	0, 6 to 15000	0, 6 to 12000

Set the lower limit (FL rate) of exponential acceleration/deceleration in cutting feed for each axis.

NOTE
Except for special applications, this parameter must be set to 0 for all axes. If a value other than 0 is specified, proper straight lines and arcs cannot be obtained.

1624	Time constant of acceleration/deceleration in jog feed for each axis.

[Data type] Word axis

[Unit of data] msec

[Valid data range] 0 to 4000 (exponential acceleration/deceleration in jog feed)
0 to 512 (linear or bell-shaped acceleration/deceleration after interpolation in jog feed)

Set the time constant used for exponential acceleration/deceleration, bell-shaped acceleration/deceleration, or linear acceleration/deceleration after interpolation in jog feed for each axis. The type to select depends on the settings of bits 0 (CTLx), 1 (CTBx), and 4 (JGLx) of parameter No. 1610.

1625	FL rate of exponential acceleration/deceleration in jog feed for each axis.

[Data type] Word axis

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

Set the lower limit (FL rate) of exponential acceleration/deceleration in jog feed for each axis.

1626	**Time constant of exponential acceleration/deceleration in the threading cycle for each axis**

[Data type] Word axis

[Unit of data] msec

[Valid data range] 0 to 4000

Set the time constant used for exponential acceleration/deceleration in the threading cycle (G76, G92 (G78 in G code system B or C)) for each axis.

If the acceleration/deceleration type is not exponential acceleration/deceleration, parameter No. 1622 becomes valid.

1627	**FL rate of exponential acceleration /deceleration in the threading cycle for each axis**

[Data type] Word axis

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800

Set the lower limit (FL rate) of exponential acceleration/deceleration in the threading cycle (G76, G92 (G78 in G code system B or C)) for each axis.

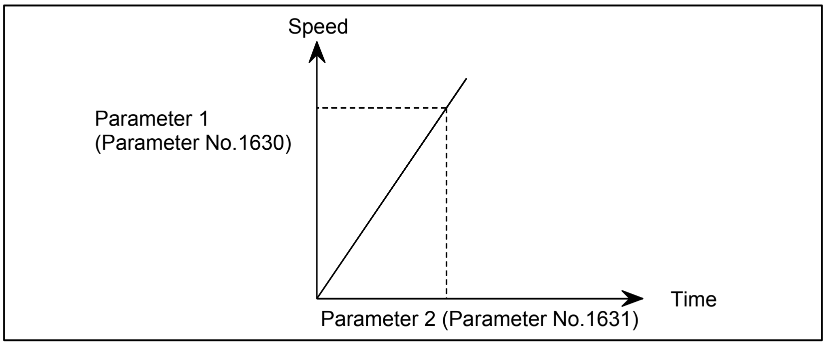
1630	Parameter 1 for setting an acceleration for linear acceleration/deceleration before interpolation (maximum machining feedrate during linear acceleration/deceleration before interpolation)

[Data type] 2-word

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 240000	6 to 100000
Inch machine	0.1 inch/min	6 to 96000	6 to 48000

This parameter is used to set an acceleration for linear acceleration/deceleration before interpolation. In this parameter, set a maximum machining speed during linear acceleration/deceleration before interpolation. In parameter No.1631, set a time used to reach the maximum machining speed.



NOTE
1 When 0 is set in parameter No.1630 or parameter No.1631, linear acceleration/deceleration before interpolation is disabled.
2 In the advanced preview control mode, parameter No.1770 and parameter No.1771 are valid.

1631	Parameter 2 for setting an acceleration for linear acceleration/deceleration before interpolation (time used to reach the maximum machining speed during linear acceleration/deceleration before interpolation.)

[Data type] Word

[Unit of data] 1 msec

[Valid data range] 0 to 4000

This parameter is used to set an acceleration for linear acceleration/deceleration before interpolation. In this parameter, set the time (time constant) used to reach the speed set in parameter No.1630.

NOTE

1 When 0 is set in parameter No.1630 or parameter No.1631, linear acceleration/deceleration before interpolation is disabled.
2 In parameter Nos. 1630 and 1631, set values that satisfy the following:
Parameter No.1630 / Parameter No.1631 $\geq$ 5
3 In the advanced preview control mode, parameter No.1770 and parameter No.1771 are valid.

1633	Time (time constant) used to reach a maximum machining speed during linear acceleration/deceleration before interpolation (for a rotary axis)

[Data type] Word

[Unit of data] 1 msec

[Valid data range] 0 to 4000

This parameter sets an acceleration rate (for a rotary axis) for linear acceleration/deceleration before interpolation.

Set a time (time constant) used to reach the speed set in parameter No. 1630.

The acceleration rate set in this parameter is applied to a command involving a rotary axis. (The acceleration rate set in parameter No. 1631 is applied to a command not involving a rotary axis.)

NOTE

If 0 is set in this parameter, the acceleration rate set in parameter No. 1631 is applied even to a command involving a rotary axis.

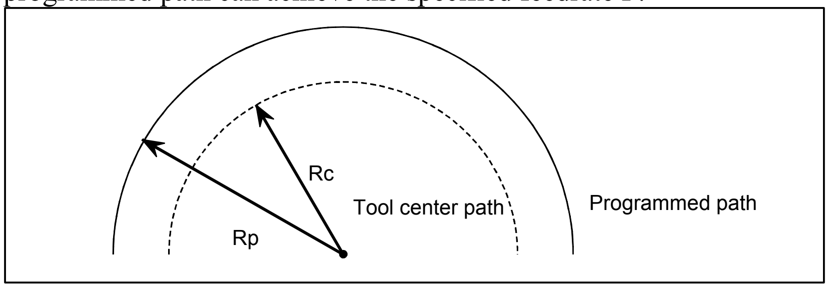
1710	Minimum deceleration ratio (MDR) of the inner circular cutting rate in automatic corner override

[Data type] Byte
[Unit of data] %
[Valid data range] 1 to 100

This parameter sets the minimum deceleration ratio (MDR) when the inner circular cutting speed is changed by automatic corner override.
In circular cutting with an inward offset, the actual feedrate for a specified feedrate (F) is expressed as follows:

$$F \times \frac{Rc}{Rp}$$

Rc: Radius of the path of the cutter's center.
Rp: Programmed radius
Then, the actual feedrate is controlled so that the feedrate on the programmed path can achieve the specified feedrate F.



If Rc is too small in comparison with Rp, such that Rc/Rp ≒ 8 0, the cutter will stop. Thus, set the minimum deceleration ratio (MDR) so that the actual speed is F × (MDR) when Rc/Rp ≒ 0.

1711	Angle (θp) used to recognize an inner corner in inner corner override

[Data type] Byte
[Unit of data] degree
[Valid data range] 1 to 179 (standard value = 91)

This parameter sets the angle used to recognize an inner corner for inner corner override by automatic corner override.

1712	Amount of override for an inner corner override

[Data type] Byte
[Unit of data] %
[Valid data range] 1 to 100 (standard value = 50)

Set the amount of override for an inner corner.
This parameter sets the amount of override for inner corner override by automatic corner override.

1713	Distance Le from the starting point in inner corner override

[Data type] 2-word
[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric input	1	0.1	0.01	mm
Inch input	0.1	0.01	0.001	inch

[Valid data range] 0 to 3999

This parameter sets the distance Le from the starting point in an inner comer override by automatic corner override.

1714	Distance Ls up to the ending point in inner corner override

[Data type] 2-word
[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric input	1	0.1	0.01	mm
Inch input	0.1	0.01	0.001	inch

[Valid data range] 0 to 3999

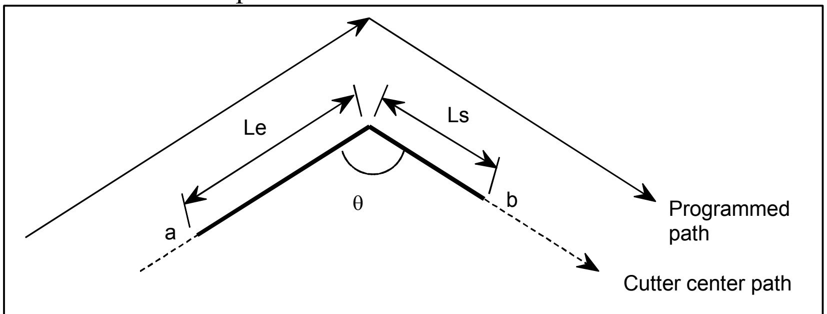
This parameter sets the distance Ls up to the end point in an inner comer override by automatic corner override.

If $\theta \leq \theta p$, the inside of a comer is recognized. (θp is set in parameter No. 1711.)

When an inner corner is recognized, the feedrate is overridden in the range of Le in the block immediately before the intersection of the corner and Ls in the next block following the intersection.

Ls and Le are each a straight line connecting the intersection of the corner and a given point on the tool center path.

Ls and Le are set in parameter Nos. 1713 and 1714.



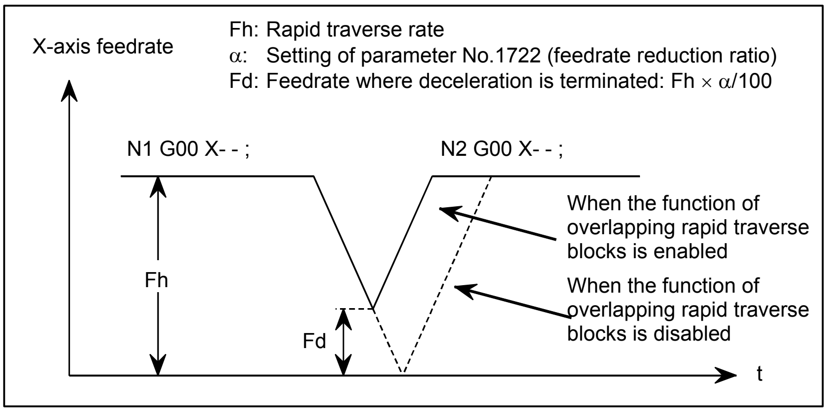
An override is applied from point a to b.

1722	Rapid traverse feedrate reduction ratio for overlapping rapid traverse blocks

[Data type] Byte axis
[Unit of data] %
[Valid data range] 1 to 100

This parameter is used when rapid traverse blocks are arranged successively, or when a rapid traverse block is followed by a block that does not cause, movement. When the feedrate for each axis of a block is reduced to the ratio set in this parameter, the execution of the next block is started.

[Example]



NOTE
The parameter No.1722 is effective when bit 4 (RT0) of parameter No.1601 is set to 1.

1730	Maximum feedrate for arc radius R

[Data type] Word
[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	8 to 15000	8 to 12000
Inch machine	0.1 inch/min	8 to 6000	8 to 4800

Set a maximum feedrate for the arc radius set in parameter No.1731. Set this parameter when the arc radius-based feedrate clamping function is enabled.

1731	Arc radius value corresponding to a maximum feedrate

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Linear axis (millimeter machine)	0.01	0.001	0.0001	mm
Linear axis (inch machine)	0.001	0.0001	0.00001	inch

[Valid data range] 1000 to 99999999

Set the arc radius corresponding to the maximum feedrate set in parameter No.1730. Set this parameter when the arc radius-based feedrate clamping function is enabled.

1732	Minimum value (RV min) for arc radius-based feedrate clamp

[Data type] Word

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	0 to 15000	0 to 12000
Inch machine	0.1 inch/min	0 to 6000	0 to 4800

The arc radius-based feedrate clamping function reduces the maximum feedrate as the arc radius decreases. When the specified maximum feedrate is not greater than RVmin (minimum value for arc radius-based feedrate clamping), RVmin is used as the maximum feedrate.

1740	Critical angle subtended by two blocks for automatic corner deceleration

[Data type] 2-word

[Unit of data] 0.001 deg

[Valid data range] 0 to 180000

Set a critical angle to be subtended by two blocks for corner deceleration when the angle-based automatic corner deceleration function is used.

The angle subtended by two blocks is defined as θ in the examples shown below.

Angle subtended by two straight lines

Angle subtended by an arc and its tangent

1741	Feedrate for assuming the termination of automatic corner deceleration (for acceleration/deceleration after interpolation)

[Data type] Word axis

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

Set the feedrate for assuming the termination of deceleration in automatic corner deceleration.

1762	Exponential acceleration/deceleration time constant for cutting feed in the advanced preview control mode

[Data type] Word axis

[Unit of data] msec

[Valid data range] 0 to 4000

Set an exponential acceleration/deceleration time constant for cutting feed in the advanced preview control mode.

1763	Minimum speed in exponential acceleration/deceleration for cutting feed in the advanced preview control mode

[Data type] Word axis

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

Set minimum speed (FL) in exponential acceleration/deceleration for cutting feed in the advanced preview control mode.

1768	**Time constant for linear acceleration/deceleration or bell-shaped acceleration/deceleration during cutting feed in advanced preview control mode, AI contour control mode, or AI nano contour control mode** **or** **Time constant for acceleration/deceleration after interpolation during cutting feed in high-precision contour control mode or AI/AI-nano high-precision contour control mode**

[Data type] Word

[Valid data range]

Function name	Valid data range
Advanced preview control	0, 8 to 512
AI advanced preview control	
AI contour control	0, 8 to 256
AI nano contour control	0, 8 to 512

Function name	Valid data range (Bits 4, 5, and 6 of parameter No. 8480) #4=0 #5=1 #6=0	#4=1 #5=0 #6=0	#4=0 #5=0 #6=0	#4=1 #5=1 #6=1
High-precision contour control	0, 8 to 256	0, 8 to 128	0, 8 to 64	-
AI high-precision contour control, AI nano high-precision contour control, Functions for five-axis machining	-	-	0, 8 to 256	0, 8 to 128

This parameter sets a time constant for linear acceleration/deceleration or bell-shaped acceleration/deceleration during cutting feed on an axis-by-axis basis in the advanced preview control mode, AI contour control mode, AI nano contour control mode, high-precision contour control mode, AI high-precision contour control mode, or AI nano high-precision contour control mode.

Which type to use is specified with bit 3 (BS2) and bit 6 (LS2) of parameter No. 1602.

If a value not within the valid data range indicated above is set, the value is clamped to the maximum allowable value indicated above.

1769	**Time constant for linear acceleration/deceleration or bell-shaped acceleration/deceleration during cutting feed in advanced preview control mode, AI contour control mode, AI nano contour control mode, high-precision contour control mode, AI high-precision contour control mode, or AI nano high-precision contour control mode (in each axis)**

[Data type] Word axis
[Unit of data] msec
[Valid data range] See the description of parameter No. 1768.

This parameter sets a time constant for linear acceleration/deceleration or bell-shaped acceleration/deceleration during cutting feed on an axis-by-axis basis in the advanced preview control mode, AI contour control mode, AI nano contour control mode, high-precision contour control mode, AI high-precision contour control mode, or AI nano high-precision contour control mode.

Which type to use is specified with bit 3 (BS2) and bit 6 (LS2) of parameter No. 1602.

NOTE

1 If 0 is set in parameter No. 1769 for all axes, the value set in parameter No. 1768 is valid. Except for a special application, set a time constant in parameter No. 1768, which is common to all axes.

2 If a different time constant is set in parameter No. 1769, no correct linear or circular figure can be obtained.

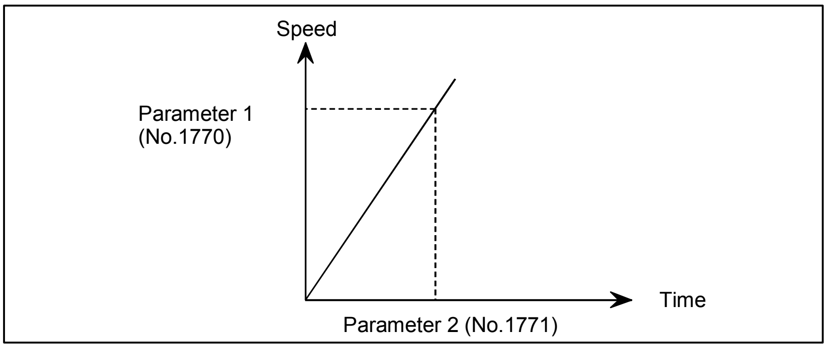
1770	Parameter 1 for setting an acceleration for linear acceleration/deceleration before interpolation (maximum machining speed during linear acceleration/deceleration before interpolation)

[Data type] 2-word

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 240000	6 to 100000
Inch machine	0.1 inch/min	6 to 96000	6 to 48000

This parameter is used to set an acceleration for linear acceleration/deceleration before interpolation. In this parameter, set the maximum machining speed during linear acceleration/ deceleration before interpolation. Set the time used to reach the maximum machining speed in parameter No.1771.



NOTE

When 0 is set in parameter No.1770 or parameter No.1771, linear acceleration/deceleration before interpolation is disabled.

1771	Parameter 2 for setting an acceleration for linear acceleration/deceleration before interpolation (time used to reach the maximum machining speed during linear acceleration/deceleration before interpolation)

[Data type] Word

[Unit of data] msec

[Valid range] 0 to 4000

This parameter is used to set an acceleration for linear acceleration/deceleration before interpolation. In this parameter, set the time (time constant) used to reach the speed set in parameter No.1770.

NOTE

1 When 0 is set in parameter No.1770 or parameter No.1771, linear acceleration/deceleration before interpolation is disabled.

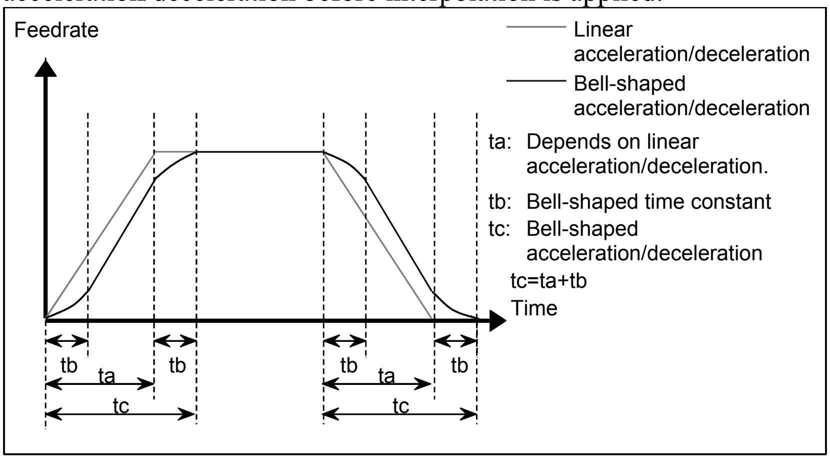
2 In parameter Nos. 1770 and 1771, set values that satisfy the following:
Parameter No.1770 / Parameter No.1771 $\geq$ 5

3 If 0 is set in either parameter No. 1770 or parameter No. 1771 in AI contour control or AI nano contour control, P/S alarm No. 5157 is issued.

1772	Time constant for bell-shaped acceleration/deceleration of acceleration time fixed type before look-ahead interpolation

[Data type] Byte
[Unit of data] msec
[Valid data range] 0 to 255

This parameter is used to set a time constant when bit 7 (BEL) of parameter No. 1603 is set to 1, that is, when bell-shaped acceleration/deceleration before look-ahead interpolation is selected in AI contour control mode (M series) or AI nano contour control mode (M/T series). Set the value of tb as shown below. When 0 is set, linear acceleration/deceleration before interpolation is applied.



> **NOTE**
> The option for bell-shaped acceleration/deceleration before look-ahead interpolation is required. This parameter is enabled only in AI contour control mode (M series) or AI nano contour control mode (M/T series).

1773	Time constant T_1 used for bell-shaped acceleration/deceleration in rapid traverse for each axis, or time constant T used for linear acceleration/deceleration in rapid traverse for each axis applicable to the optimum torque acceleration/deceleration function

[Data type] Word axis

[Unit of data] msec

[Valid data range]

Function name	Valid data range	
	Constant acceleration	Constant time
	Bit 1 (LRP) of parameter No. 1401 = 0 or Bit 1 (LRP) of parameter No. 1401 = 1 and Bit 4 (PRT) of parameter No. 1603 = 0	Bit 1 (LRP) of parameter No. 1401 = 1 and Bit 4 (PRT) of parameter No. 1603 =
Ordinary operation	0 to 4000	0 to the total of time constants for individual axes not exceeding 4096 msec
Advanced preview control		

Function name	Valid data range	
	Acceleration/deceleration before interpolation	Acceleration/deceleration after interpolation
	Bit 1 (AIR) of parameter No. 7054 = 0 or Bit 1 (AIR) of parameter No. 7054 = 1 and Bit 1 (LRP) of parameter No. 1401 = 1	Bit 1 (AIR) of parameter No. 7054 = 1 and Bit 1 (LRP) of parameter No. 1401 = 1
AI advanced preview control	0 to 4000	
AI contour control		
AI nano contour control		

Function name	Valid data range
High-precision contour control	0 to 4000
AI high-precision contour control, AI nano high-precision contour control, Functions for five-axis machining	

No.1620 : This parameter sets a time constant for linear acceleration/deceleration in rapid traverse or a time constant (T_1) for bell-shaped acceleration/deceleration in rapid traverse.

No.1773 : This parameter sets a time constant (T_1) used for bell-shaped acceleration/deceleration in rapid traverse for each axis, or a time constant used for linear acceleration/deceleration in rapid traverse for each axis applicable to the optimum torque acceleration/deceleration function in the AI contour control mode, AI nano contour control mode, high-precision contour control mode, AI high-precision contour control mode, AI nano high-precision contour control mode, or five-axis machining function mode. For an axis with 0 set in this parameter, the value set in parameter No. 1620 is valid.

NOTE

1 Parameter No. 1773 cannot be used in the ordinary operation mode, advanced preview control mode, and AI advanced preview control mode. Use parameter No. 1620.

2 If the parameter or parameters indicated below are used, acceleration/deceleration before interpolation is applied. In this case, positioning of linear interpolation type is performed.
AI advanced preview control, AI contour control, or AI nano contour control:
Bit 1 (AIR) of parameter No. 7054 = 0, or
Bit 1 (LRP) of parameter No. 1401 = 1 and
Bit 1 (AIR) of parameter No. 7054 = 1
AI high-precision contour control, AI nano high-precision contour control, or five-axis machining function mode:
Bit 5 (FRP) of parameter No. 19501 = 1

3 If settings are made (bit 7 (SG0) of parameter No. 8403 = 1, bit 0 (STG) of parameter No. 8404 = 1, and bit 1 (HG0) of parameter No. 8404 = 1) so that rapid traverse operation in the high-precision contour control mode is performed ordinarily with the RISC board, acceleration/deceleration of constant time type in rapid traverse (bit 1 (LRP) of parameter No. 1401 = 1, bit 4 (PRT) of parameter No. 1603 = 1) cannot be used.

4 If acceleration/deceleration in rapid traverse in the AI high-precision contour control mode, AI nano high-precision contour control mode, or five-axis machining function mode is set as acceleration/deceleration after interpolation (bit 5 (FRP) of parameter No. 19501 = 0), acceleration/deceleration of constant time type in rapid traverse (bit 1 (LRP) of parameter No. 1401 = 1, bit 4 (PRT) of parameter No. 1603 = 1) cannot be used.

5 If the optimum torque acceleration/deceleration function is enabled, a reference acceleration rate for optimum torque acceleration/deceleration is found with this parameter and parameter No. 1420.
If 0 is set, the setting of parameter No. 1620 is valid.
If an acceleration rate found by calculation is greater than 100000.0, a reference acceleration rate of 100000.0 mm/sec^2 is assumed.
If 0 is set in both of this parameter and parameter No. 1620, the following are assumed as reference acceleration values:
1000.0 mm/sec^2 100.0 inch/sec^2 100.0 deg/sec^2
If 0 is set for all axes, however, optimum torque acceleration/deceleration is not performed.

1774	Time constant t T_2 for each axis used for bell-shaped acceleration/deceleration in rapid traverse of optimum torque acceleration/deceleration

[Data type] Word axis
[Unit of data] msec
[Valid data range]

Function name	Valid data range
Ordinary operation	0 to 512
Advanced preview control	

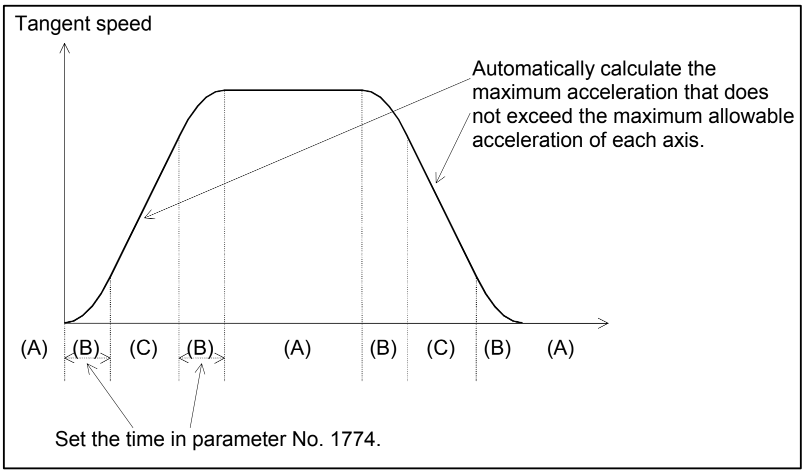
Function name	Valid data range	
	Acceleration/deceleration before interpolation	Acceleration/deceleration after interpolation
	Bit 1 (AIR) of parameter No. 7054 = 0 or Bit 1 (AIR) of parameter No. 7054 = 1 and Bit 1 (LRP) of parameter No. 1401 = 1	Bit 1 (AIR) of parameter No. 7054 = 1 and Bit 1 (LRP) of parameter No. 1401 = 1
AI advanced preview control	0 to 512	
AI contour control	0 to 512	0 to 256
AI nano contour control		0 to 512

Function name			Valid data range			
			Bits 4, 5, and 6 of parameter No. 8480			
			#4=0 #5=1 #6=0	#4=1 #5=0 #6=0	#4=0 #5=0 #6=0	#4=1 #5=1 #6=1
High-precision contour control			0 to 256	0 to 128	0 to 64	-
AI high-precision contour control, AI nano high-precision contour control, Functions for five-axis machining	Acceleration/ deceleration after interpolation	Parameter FRP (No.19501#5)=0	-	-	0 to 256	0 to 128
	Acceleration/ deceleration before interpolation	Parameter FRP (No.19501#5)=1	-	-	0 to 200	0 to 100

No.1621 : This parameter sets a time constant (T_2) for bell-shaped acceleration/deceleration in rapid traverse for each axis.

No.1774 : This parameter sets a time constant (T_2) used for bell-shaped acceleration/deceleration in rapid traverse for each axis in the AI contour control mode, AI nano contour control mode, high-precision contour control mode, AI high-precision contour control mode, AI nano high-precision contour control mode, or five-axis machining function mode. For an axis with 0 set in this parameter, the value set in parameter No. 1621 is valid.

If a value not within the valid data range indicated above is set, the value is clamped to the maximum allowable value indicated above.



NOTE

1 Parameter No. 1774 cannot be used in the ordinary operation mode, advanced preview control mode, and AI advanced preview control mode. Use parameter No. 1621.

2 To use bell-shaped acceleration/deceleration, the option and/or parameter indicated below needs to be set.
Ordinary operation and advanced preview control:
Rapid traverse bell-shaped acceleration/deceleration option
AI advanced preview control:
Rapid traverse bell-shaped acceleration/deceleration option and
Bit 6 (RBL) of parameter No. 1603 = 1
AI contour control and AI nano contour control:
Bit 6 (RBL) of parameter No. 1603 = 1
AI high-precision contour control, AI nano high-precision contour control, and Functions for five-axis machining:
Bit 0 (HRB) of parameter No. 19504 = 1

3 If acceleration/deceleration in rapid traverse in the AI high-precision contour control mode, AI nano high-precision contour control mode, or five-axis machining function mode is set as acceleration/deceleration before interpolation, the settings of parameter No. 1621 and parameter No. 1774 for the reference axis set in parameter No. 1031 are valid. (Setting on an axis-by-axis basis is disabled.)

4 When the optimum torque acceleration/deceleration function is enabled
Set an acceleration change time in bell-shaped acceleration/deceleration (period of time from the constant speed state (A) until the acceleration/deceleration state (C) is reached at an acceleration rate calculated by optimum torque acceleration/deceleration: time of (B) in the figure above).

1775	(Must not be used) *(Always set 0.)

1776	(Must not be used) *(Always set 0.)

1777	Minimum speed for the automatic corner deceleration function (for advanced preview control)

[Data type] Word

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800

Set a speed at which the number of buffered pulses in deceleration is assumed to be 0 when linear acceleration/deceleration before interpolation is used.

1778	Minimum speed for the automatic corner deceleration function (for linear acceleration/deceleration before interpolation)

[Data type] Word

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800

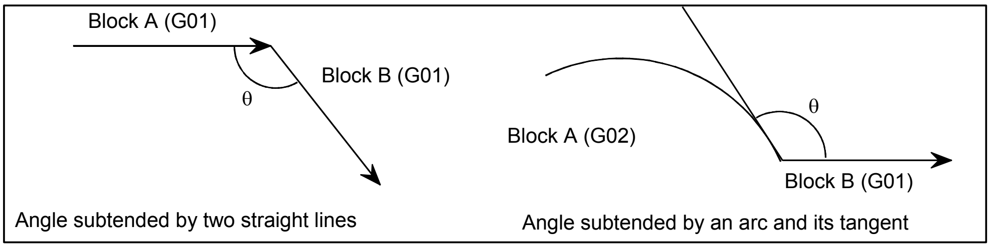
Set a speed at which the number of buffered pulses in deceleration is assumed to be 0 when linear acceleration/deceleration before interpolation is used.

1779	Critical angle subtended by two blocks for automatic corner deceleration (for advanced preview control)

[Data type] 2-word
[Unit of data] 0.001 deg
[Valid data range] 0 to 180000

Set a critical angle to be subtended by two blocks for corner deceleration when the angle-based automatic corner deceleration function is used.

The angle subtended by two blocks is defined as θ in the examples shown below.



1780	Allowable speed difference for the speed difference-based corner deceleration function (for linear acceleration/deceleration before interpolation)

[Data type] Word
[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800

Set the speed difference for the speed difference-based automatic corner deceleration function when linear acceleration/deceleration before interpolation is used.

1781	Allowable speed difference for the speed difference-based corner deceleration function (for linear acceleration/deceleration after interpolation)

[Data type] Word axis
[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

Set speed difference for the speed difference-based automatic corner deceleration function when linear acceleration/deceleration after interpolation used.

1783	Allowable speed difference for the speed difference based corner deceleration function (for linear acceleration/deceleration before interpolation)

[Data type] Word axis

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

A separate allowable feedrate difference can be set for each axis. The allowable feedrate difference is set for each axis with this parameter. Among the axes that exceed the specified allowable feedrate difference, the axis with the greatest ratio of the actual feedrate difference to the allowable feedrate difference is used as the reference to calculate the reduced feedrate at the corner.

1784	Speed when overtravel alarm has generated during acceleration/deceleration before interpolation

[Data type] Word

[Unit of data, valid data range]

Input increment	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

Deceleration is started beforehand to reach the feedrate set in the parameter when an overtravel alarm is issued (when a limit is reached) during linear acceleration/deceleration before interpolation. By using this parameter, the overrun distance that occurs when an overtravel alarm is output can be reduced.

This parameter can be applied also to a rapid traverse block by setting bit 0 (OTR) of parameter No. 7057 (M series).

NOTE

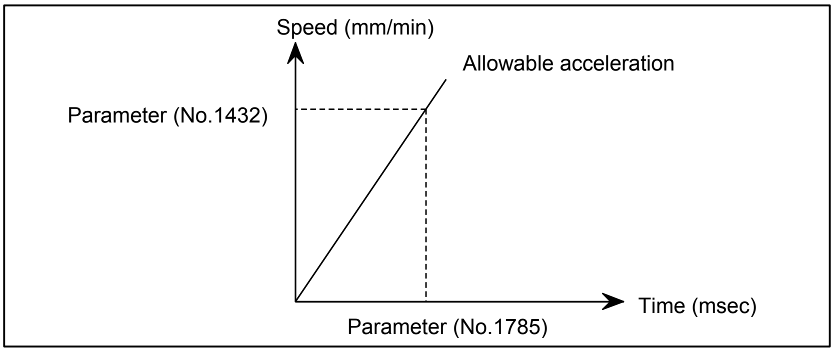
1. When 0 is set in this parameter, the control described above is not exercised.
2. Use type-B linear acceleration/deceleration before interpolation (by setting bit 0 (FWB) of parameter No.1602 to 1).
3. The control described above is applicable only to stored stroke check 1.
4. The control described above is applied to the axes specified in the current block and the next block. By setting bit 5 (ODA) of parameter No. 7055, the control can be made applicable only to the axis specified in the current block.

1785	Parameter for determining an allowable acceleration when the feedrate is set by acceleration

[Data type] Word axis
[Unit of data] msec
[Valid data range] 0 to 32767

This parameter sets the time required to attain the maximum cutting feedrate to determine the allowable acceleration when the feedrate is determined by acceleration in AI contour control mode (M series) or AI nano contour control mode (M/T series).

The maximum cutting feedrate and the data set in this parameter are used to determine the allowable acceleration. As the maximum cutting feedrate parameter, parameter No.1432 (maximum cutting feedrate in AI contour control mode (M series) or AI nano contour control mode (M/T series)) is used.



1786	Time (time constant) for reaching the maximum machining speed in linear acceleration/deceleration before interpolation in the AI contour control mode (M series), AI nano contour control mode (M series), or advanced preview control mode (M and T series) (for a rotary axis)

[Data type] Word
[Unit of data] msec
[Valid data range] 0 to 4000

This parameter sets the acceleration (for a rotary axis) of the linear acceleration/deceleration before interpolation in the AI contour control mode (M series), AI nano contour control mode (M series), or advanced preview control mode (M and T series).

Set the time (time constant) that elapses before the speed set in parameter No. 1770 is reached. The acceleration set in the parameter is applied to the command that includes a rotary axis. (The rate set in parameter No. 1771 is applied to the command that does not include a rotary axis.)

NOTE

If 0 is set in this parameter, the acceleration/deceleration set in parameter No. 1771 is also applied to a command involving a rotary axis.

1787	Time constant for bell-shaped acceleration/deceleration of acceleration time fixed type before look-ahead interpolation in the AI contour control mode or AI nano contour control mode (for a rotary axis)

[Data type] Byte
[Unit of data] msec
[Valid data range] 0 to 255

This parameter sets a time constant (for a rotary axis) when bell-shaped acceleration/deceleration before look-ahead interpolation is used in the AI contour control mode or AI nano contour control mode. The time constant set in this parameter is applied to a command involving a rotary axis. (The time constant set in parameter No. 1772 is applied to a command not involving to a rotary axis.)

NOTE
1 The option for bell-shaped acceleration/deceleration before look-ahead interpolation is required.
2 This parameter is valid only when a value other than 0 is set in parameter No. 1786.

1788	Allowable amount of acceleration change for each axis in speed control based on acceleration change under jerk control (for AI contour control (M series)/AI nano contour control (M/T series))

[Data type] 2-word axis
[Unit of data]

Input increment	IS-B	IS-C	Unit of data
Metric machine	0.001	0.0001	mm/s^2
Inch machine	0.0001	0.00001	$inch/s^2$
Rotary axis	0.001	0.0001	deg/s^2

[Valid data range] 0 to 99999999

This parameter sets an allowable amount of acceleration change for each axis in speed control based on acceleration change under jerk control in the AI contour control (M series) or AI nano contour control (M/T series) mode.
For an axis with 0 set in this parameter, speed control based on acceleration change is disabled.
If 0 is set for all axes, speed control based on acceleration change is not exercised.

1789	**Allowable amount of acceleration change for each axis in speed control based on acceleration change under jerk control when linear interpolation operations are performed successively (for AI contour control (M series)/AI nano contour control (M/T series))**

[Data type] 2-word axis

[Unit of data]

Input increment	IS-B	IS-C	Unit of data
Metric machine	0.001	0.0001	mm/s^2
Inch machine	0.0001	0.00001	$inch/s^2$
Rotary axis	0.001	0.0001	deg/s^2

[Valid data range] 0 to 99999999

This parameter sets an allowable amount of acceleration change for each axis in speed control based on acceleration change under jerk control when linear interpolation operations are performed successively in the AI contour control (M series) or AI nano contour control (M/T series) mode.

In speed control based on acceleration change at a corner between linear interpolation operations, the allowable amount of acceleration change set in this parameter instead of parameter No. 1788 is valid.

For an axis with 0 set in this parameter, the allowable amount of acceleration change set in parameter No. 1788 is valid.

For an axis with 0 set in parameter No. 1788, speed control based on acceleration change is disabled, so that this parameter has no effect.

1790	**Ratio of jerk change time in smooth bell-shaped acceleration/deceleration before interpolation (for AI contour control (M series)/AI nano contour control (M/T series))**

[Data type] Byte

[Unit of data] %

[Valid data range] 0 to 50

This parameter sets the ratio of jerk change time to acceleration change time(*1) in smooth bell-shaped acceleration/deceleration before look-ahead interpolation in the AI contour control (M series) or AI nano contour control (M/T series) mode.

If 0 or a value not within the valid data range is set in this parameter, smooth bell-shaped acceleration/deceleration before look-ahead interpolation is not performed in the AI contour control (M series) or AI nano contour control (M/T series) mode.

(*1) Parameter No. 1772 for acceleration/deceleration before look-ahead interpolation (cutting feed).
Parameter No. 1774 for linear acceleration/deceleration before interpolation in rapid traverse.

4.18 PARAMETERS OF SERVO (1 OF 2)

	#7	#6	#5	#4	#3	#2	#1	#0
1800			TRC	RBK	FFR	OZR	CVR	

[Data type] Bit

CVR When velocity control ready signal VRDY is set ON before position control ready signal PRDY comes ON
0 : A servo alarm is generated.
1 : A servo alarm is not generated.

OZR When manual reference position return is attempted in the halt state during automatic operation (feed hold stop state) under any of the conditions listed below:
0 : Manual reference position return is not performed, with P/S alarm No.091.
1 : Manual reference position return is performed without an alarm occurring.

< Conditions >
(1) When there is a remaining distance to travel.
(2) When an auxiliary function (M function, S function, T function, or B function) is being executed.
(3) When a cycle such as a dwell cycle or canned cycle is being executed.

FFR Feed-forward control is enabled for
0 : Cutting feed only
1 : Cutting feed and rapid traverse

RBK Backlash compensation for each rapid traverse and cutting feed is:
0 : Not performed
1 : Performed

TRC The servo trace function is:
0 : Disabled
1 : Enabled (Also set parameter No.1870.)
The digital servo software for learning control is necessary.

	#7	#6	#5	#4	#3	#2	#1	#0
1801			CIN	CCI			PM2	PM1
			CIN	CCI				

[Data type] Bit

PM1, PM2 Sets a gear ratio between the spindle and motor when the servo motor-based speed control function is used.

Magnification	PM2	PM1
1/1	0	0
1/2	0	1
1/4	1	0
1/8	1	1

Magnification=
spindle speed / motor speed

CCI The in-position area for cutting feed is:
0 : Set in parameter No.1826 (same as for rapid traverse).
1 : Set in bit 5 (CIN) of parameter No.1801.

CIN When bit 4 (CCI) of parameter No.1801 = 1, the in-position area for cutting feed is:
- 0 : Use value in parameter No.1827 if the next block is also for cutting feed, or use value in parameter No.1826 if the next block is not for cutting feed.
- 1 : Use value in parameter No.1827, regardless of the next block. (The setting of parameter No.1826 is used for rapid traverse, and the setting of parameter No.1827 is used for cutting feed.)

	#7	#6	#5	#4	#3	#2	#1	#0
1802			DPS	B15		DC2	DC4	CTS
	FWC			B15		DC2	DC4	

NOTE
After this parameter is set, the power needs to be turned off.

[Data type] Bit

CTS The servo motor-based speed control function is:
- 0 : Not used
- 1 : Used

DC4 When the reference position on an encoder (linear scale/rotary encoder) with absolute address reference marks is established:
- 0 : An absolute position is established by detecting three reference marks.
- 1 : An absolute position is established by detecting four reference marks.

NOTE
When an encoder with distance-coded reference marks (linear scale/rotary encoder) (detection circuit C) is used, the setting of this parameter is invalid.

DC2 The reference position on the linear scale with absolute address reference marks is established:

0 : As determined by bit 1 (DC4) of parameter No. 1802.

1 : By establishing the absolute position through detection of two reference marks.

NOTE

1 When using this parameter set to 1, set the direction of the encoder origin in bit 4 (SCPx) of parameter No. 1817.

2 This parameter is invalid when a rotary encoder with absolute address reference marks is used (when bit 3 (DCRx) of parameter No. 1815 is set to 1). Even if this parameter is set to 1, the setting of the DC4 parameter is followed.

3 When an encoder with distance-coded reference marks (linear scale/rotary encoder) (detection circuit C) is used, the setting of this parameter is invalid.

B15 In backlash compensation, the travel direction is determined:

0 : Without consideration of the compensation amount (pitch error, straightness, external machine coordinate shift, etc.).

1 : In consideration of the compensation amount. (FS15 format)

DPS When servo motor-based speed control is applied, a position coder is:

0 : Used

1 : Not used

FWC The processing of command multiplication (CMR) is performed:

0 : After acceleration/deceleration after interpolation.

1 : Before acceleration/deceleration after interpolation.

	#7	#6	#5	#4	#3	#2	#1	#0
1803				TQF			TQA	TQI

[Data type] Bit

TQI While torque restriction is applied, in-position check is:

0 : Performed.

1 : Not performed.

TQA While torque restriction is applied, checking for an excessive error in the stopped state/during movement is:

0 : Performed.

1 : Not performed.

TQF When torque control is performed by an axis control command of the PMC axis control function, follow-up operation is:

0 : Not performed.

1 : Performed.

	#7	#6	#5	#4	#3	#2	#1	#0
1804		SAK	ANA	IVO			BLC	

[Data type] Bit axis

BLC During circular interpolation by jog feed (manual circular interpolation function), the backlash acceleration function is:
0 : Disabled.
1 : Enabled.

IVO When an attempt is made to release an emergency stop while the VRDY OFF alarm ignore signal is 1:
0 : The emergency stop state is not released until the VRDY OFF alarm ignore signal is set to 0.
1 : The emergency stop state is released.

> **NOTE**
> When a reset is issued while the VRDY OFF alarm ignore signal is set to 1 and the motor activating current is low, the reset state can also be released, provided this parameter is set to 1.

ANA When an unexpected disturbance torque is detected for an axis:
0 : Movement along all axes is stopped, and a servo alarm is output.
1 : No servo alarm is output, and movement along only the axes of the group containing the axis with the unexpected disturbance torque is stopped in interlock mode. (The group number of each axis is set in parameter No.1881.)

SAK When the VRDY OFF alarm ignore signal IGNVRY is 1, or when the VRDY OFF alarm ignore signals IGVRY1 to IGVRY8 are 1:
0 : Servo ready signal SA is set to 0.
1 : Servo ready signal SA remains set to 1.

	#7	#6	#5	#4	#3	#2	#1	#0
1805							TQU	

[Data type] Bit

TQU If follow-up is not performed by the torque control command of PMC axis control, the servo error counter is:
0 : Updated.
1 : Not updated.

> **NOTE**
> 1 This parameter is valid if follow-up is not performed (bit 4 (TQF) of parameter No. 1803 is set to 0).
> 2 When torque control is switched to position control, a reference position return must be made.

	#7	#6	#5	#4	#3	#2	#1	#0
1807						SWP		

[Data type] Bit

SWP This parameter specifies an operation to be performed in a warning state (such as the stop of a fan) of the α*i* servo amplifier.

0 : An alarm is issued when the amplifier is in a warning state. Automatic operation is placed in the feed hold state, and the servo axis is decelerated to a stop.

1 : No alarm is issued when the amplifier is in a warning state. Automatic operation is continued. Servo activation is turned off when a state transition is made from a warning state to an alarm state.

	#7	#6	#5	#4	#3	#2	#1	#0
1815		NRTx	APCx	APZx	DCRx	DCLx	OPTx	
		NRTx	APCx	APZx	DCRx	DCLx	OPTx	RVSx

NOTE

When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit axis

RVSx To set rotary axis B type for an axis that uses a scale with no speed data, speed data is:

0 : Not preserved by the NC.

1 : Preserved by the NC.

NOTE

1 When rotary axis B type is used and the movable range is one rotation or more, the use of a scale that has speed data is recommended.

2 This parameter is valid only for an axis of rotary axis B type.

3 Speed data immediately before power-off is preserved by the NC so that the coordinate is found from the data at the next power-on time. So, if a movement is made on the axis by 180 deg or more during power-off, the coordinate may shift more than one rotation.

4 If the setting of this parameter is modified, perform a reference position establishment operation again.

OPTx Position detector

0 : A separate Pulsecoder is not used.

1 : A separate Pulsecoder is used.

For an absolute-position system using Inductosyn, set this parameter to 1.

DCLx As a separate position detector:

0 : An encoder with absolute address reference marks (linear scale/rotary encoder)/encoder with distance-coded reference marks (linear scale/rotary encoder) (detection circuit C) is not used.

1 : An encoder with absolute address reference marks (linear scale/rotary encoder)/encoder with distance-coded reference marks (linear scale/rotary encoder) (detection circuit C) is used.

NOTE

When using an encoder with absolute address reference marks (linear scale/rotary encoder) or encoder with distance-coded reference marks (linear scale/rotary encoder) (detection circuit C) (closed loop system), set bit 1 (OPTx) of parameter No. 1815 to 1. When using a linear scale with distance-coded reference marks (detection circuit C) (linear motor system), set bit 1 (OPTx) of parameter No. 1815 to 0.

DCRx As an encoder with absolute address reference marks:

0 : A linear scale with absolute address reference marks is used.

1 : A rotary encoder with absolute address reference marks is used.

NOTE

1 Set bit 2 (DCLx) of parameter No. 1815 to 1.

2 When using a rotary encoder with distance-coded reference marks (detection circuit C), set this parameter to 0.

APZx Machine position and position on absolute position detector when the absolute position detector is used

0 : Not corresponding

1 : Corresponding

NOTE

When an absolute position detector is used, after primary adjustment is performed or after the absolute position detector is replaced, this parameter must be set to 0, power must be turned off and on, then manual reference position return must be performed. This completes the positional correspondence between the machine position and the position on the absolute position detector, and sets this parameter to 1 automatically.

APCx Position detector
0 : Other than absolute position detector
1 : Absolute position detector (absolute Pulsecoder)
For an absolute-position system using Inductosyn, set this parameter to 1.

NRTx When the machine coordinate on a rotary axis passes 0 deg or a machine coordinate rounding value (360 deg or the setting of parameter No. 1260):
0 : The reference position (parameter No. 1860/1861) is updated.
1 : The reference position (parameter No. 1860/1861) is not updated.
Set this parameter to 1 when using a scale that does not hold speed data.

> **NOTE**
> 1 This parameter is valid only for an axis of rotary axis A type.
> 2 Be sure to set this parameter for an axis of rotary axis A type that uses a scale with no speed data.
> 3 If the setting of this parameter is modified, perform a reference position establishment operation again.

	#7	#6	#5	#4	#3	#2	#1	#0
1817		TANx		SCPx	SCRx	SBLx		
		TANx		SCPx	SCRx	SBLx		

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit axis

SBLx Smooth backlash interpolation is :
0 : Disabled.
1 : Enabled.

SCRx To set rotary axis B type for a rotary axis that uses a scale with no speed data, speed data conversion is:
0 : Not performed.
1 : Performed.

> **NOTE**
> 1 This parameter is valid only for an axis of rotary axis B type.
> 2 Do not set this parameter even for an axis of rotary axis B type if no discontinuity point in scale data exists within the movable range of the rotary axis.
> 3 If the setting of this parameter is modified, perform a reference position establishment operation again.
> 4 With the T series, this parameter is valid only for a rotary encoder with distance-coded reference marks (detection circuit C).

SCPx When bit 2 (DC2) of parameter No. 1802 is set to 1, the encoder origin of an encoder with absolute address reference marks (linear scale/rotary encoder) is:
0 : Placed on the minus side.
(The reference position is placed in the plus direction when viewed from the encoder origin.)
1 : Placed on the plus side.
(The reference position is placed in the minus direction when viewed from the encoder origin.)

> **NOTE**
> 1 If this parameter is set to an incorrect value, a coordinate system is established incorrectly. In such a case, reverse the setting then perform a reference position establishment operation again.
> 2 When an encoder with distance-coded reference marks (linear scale/rotary encoder) (detection circuit C) is used, the setting of this parameter is invalid.

TANx Tandem control
0 : Not used
1 : Used

> **NOTE**
> Set this parameter to both master axis and slave axis.

	#7	#6	#5	#4	#3	#2	#1	#0
1818					SDCx	DG0x	RF2x	RFSx

[Data type] Bit axis

RFSx If automatic reference position return (G28) is specified when no reference position is established on an axis for which an encoder with absolute address reference marks (linear scale/rotary encoder)/encoder with distance-coded reference marks (linear scale/rotary encoder) (detection circuit C) is used:

0 : A movement is made to a reference position after reference position establishment.

1 : No movement is made to a reference position after reference position establishment, and operation is completed.

RF2x If automatic reference position return (G28) is specified when a reference position is established on an axis for which an encoder with absolute address reference marks (linear scale/rotary encoder)/encoder with distance-coded reference marks (linear scale/rotary encoder) (detection circuit C) is used:

0 : A movement is made to the reference position.

1 : No movement is made to the intermediate position and reference position, and operation is completed.

DG0x On an axis for which an encoder with absolute address reference marks (linear scale/rotary encoder) is used, a rapid traverse command and reference position return based on jog feed are:

0 : Disabled.

1 : Enabled.

SDCx An encoder with distance-coded reference marks (linear scale/rotary encoder) (detection circuit C) is:

0 : Not used.

1 : Used.

NOTE

When this parameter is set, the power must be turned off before operation is continued. Note that P/S 0 (power-off request alarm) is not issued.

	#7	#6	#5	#4	#3	#2	#1	#0
1819						DATx	CRFx	FUPx
	NAHx					DATx	CRFx	FUPx

[Data type] Bit axis

FUPx To perform follow-up when the servo is off is set for each axis.

0 : The follow-up signal, *FLWU, determines whether follow-up is performed or not.
When *FLWU is 0, follow-up is performed.
When *FLWU is 1, follow-up is not performed.

1 : Follow-up is not performed.

NOTE
When the index table indexing function (M series) is used, be sure to set FUPx of the 4th axis (index table indexing axis) to 1.

CRFx When servo alarm No.445 (software disconnection), No.446 (hardware disconnection), No.447 (hardware disconnection (separate type)), or No.421 (excessive dual position feedback error) is issued:

0 : The reference position setting remains as is.

1 : The system enters the reference position undefined state.

DATx When a manual reference position return operation is performed using an encoder with absolute address reference marks (linear scale/rotary encoder)/encoder with distance-coded reference marks (linear scale/rotary encoder) (detection circuit C), parameter Nos. 1883 and 1884 are:

0 : Not set automatically.

1 : Set automatically.

The procedure for automatic setting is as follows:

<1> Set a proper value in each of parameter Nos. 1815, 1821, and 1882.
* For an encoder with distance-coded reference marks (linear scale/rotary encoder) (detection circuit C), parameter No. 1882 need not be set.

<2> Position the machine manually at the reference position.

<3> Set this parameter to 1.

<4> Perform a manual reference position return operation. Upon completion of manual reference position return operation, parameter Nos. 1883 and 1884 are set, and this parameter is set to 0 automatically.

NAHx In the advanced preview control mode, advanced preview feed-forward is:

0 : Used

1 : Not used

NOTE
Set 1 for a PMC-based control axis.

1820	Command multiplier for each axis (CMR)

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

[Data type] Byte axis

Set a command multiplier indicating the ratio of the least command increment to the detection unit for each axis.

Least command increment = detection unit × command multiplier

Relationship between the increment system and the least command increment

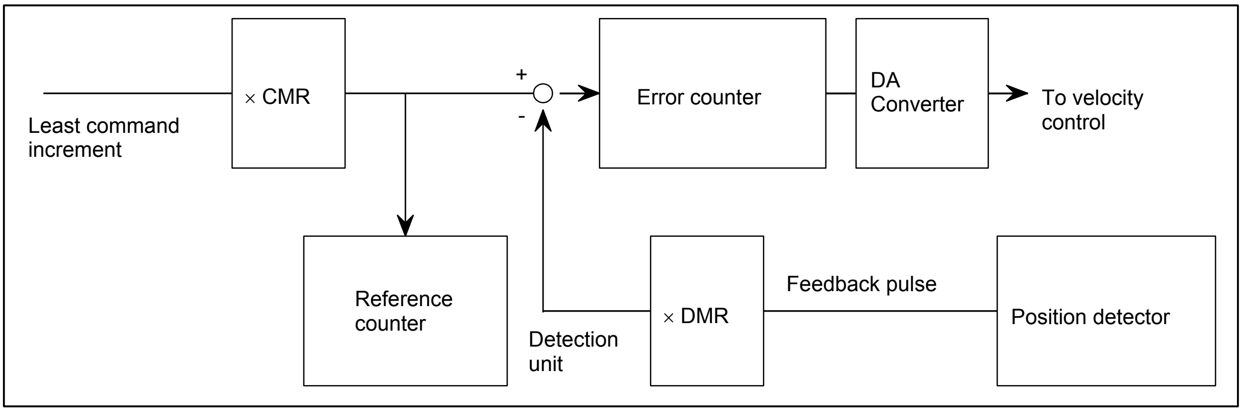
(1) T series

			Least input increment	Least command increment
IS-B	Metric machine	Metric input	0.001 mm (diameter programming)	0.0005 mm
			0.001 mm (radius programming)	0.001 mm
		Inch input	0.0001 inch (diameter programming)	0.0005 mm
			0.0001 inch (radius programming)	0.001 mm
	Inch machine	Metric input	0.001 mm (diameter programming)	0.00005 inch
			0.001 mm (radius programming)	0.0001 inch
		Inch input	0.0001 inch (diameter programming)	0.00005 inch
			0.0001 inch (radius programming)	0.0001 inch
	Rotary axis		0.001 deg	0.001 deg
IS-B	Metric machine	Metric input	0.0001 mm (diameter programming)	0.00005 mm
			0.0001 mm (radius programming)	0.0001 mm
		Inch input	0.00001 inch (diameter programming)	0.00005 mm
			0.00001 inch (radius programming)	0.0001 mm
	Inch machine	Metric input	0.0001 mm (diameter programming)	0.000005 inch
			0.0001 mm (radius programming)	0.00001 inch
		Inch input	0.00001 inch (diameter programming)	0.000005 inch
			0.00001 inch (radius programming)	0.00001 inch
	Rotary axis		0.0001 deg	0.0001 deg

(2) M series

Input increment	Least input increment and least command increment			
	IS-A	IS-B	IS-C	Units
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

Setting command multiply (CMR), detection multiply (DMR), and the capacity of the reference counter



Set the magnification ratios of CMR and DMR so that the weight of positive inputs to the error counter equals that of negative inputs.

$$\frac{\text{Least command increment}}{\text{CMR}} = \text{Detection unit} = \frac{\text{Feedback pulse unit}}{\text{DMR}}$$

The feedback pulse unit varies according to the type of detector.

$$\text{Feedback pulse unit} = \frac{\text{The amount of travel per rotation of the Pulsecoder}}{\text{The number of pulses per rotation of the Pulsecoder}}$$

As the size of the reference counter, specify the grid interval for the reference position return in the grid method.

$$\text{Size of the reference counter} = \frac{\text{Grid interval}}{\text{Detection unit}}$$

Grid interval = The amount of travel per rotation of the Pulsecoder

The value set in the parameter is obtained as follows:

(1) When command multiplier is 1/2 to 1/27

$$\text{Set value} = \frac{1}{\text{(Command multiplier)}} + 100$$

Valid data range: 102 to 127

(2) When command multiply is 1 to 48

Set value = 2 × command multiplier

Valid data range: 2 to 96

> **NOTE**
> When command multiplier is 1 to 48, the set value must be determined so that an integer can be set for command multiplier.

1821	Reference counter size for each axis

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

[Data type] 2-word axis
[Unit of data] Detection unit
[Valid data range] 0 to 99999999

Set the size of the reference counter.

When using an encoder with absolute address reference marks (linear scale/rotary encoder), set the interval of mark 1 of the encoder with absolute address reference marks (linear scale/rotary encoder).

> **NOTE**
> When a scale with distance-coded reference marks (detection circuit C) is used, this parameter is used for an ordinary purpose (reference counter size for each axis).

1825	Servo loop gain for each axis

[Data type] Word axis
[Unit of data] 0.01 s^{-1}
[Valid data range] 1 to 9999

Set the loop gain for position control for each axis.
When the machine performs linear and circular interpolation (cutting), the same value must be set for all axes. When the machine requires positioning only, the values set for the axes may differ from one another. As the loop gain increases, the response by position control is improved. A too large loop gain, however, makes the servo system unstable.
The relationship between the positioning deviation (the number of pulses counted by the error counter) and the feedrate is expressed as follows:

$$\text{Positioning deviation} = \frac{\text{Feedrate}}{60 \times (\text{loop gain})}$$

Unit :

Positioning deviation	:	mm, inches, or deg
Feedrate	:	mm/min, inches/min, or deg/min
loop gain	:	s^{-1}

1826	In-position width for each axis

[Data type] Word axis
[Unit of data] Detection unit
[Valid data range] 0 to 32767

The in-position width is set for each axis.
When the deviation of the machine position from the specified position (the absolute value of the positioning deviation) is smaller than the in-position width, the machine is assumed to have reached the specified position. (The machine is in the in-position state.)

1827	In-position width in cutting feed for each axis

[Data type] Word axis
[Unit of data] Detection unit
[Valid data range] 0 to 32767

Set an in-position width for each axis in cutting feed. This parameter is valid when bit 4 (CCI) of parameter No.1801=1.

1828	Positioning deviation limit for each axis in movement

[Data type] 2-word axis
[Unit of data] Detection unit
[Valid data range] 0 to 99999999

Set the positioning deviation limit in movement for each axis.
If the positioning deviation exceeds the positioning deviation limit during movement, a servo alarm is generated, and operation is stopped immediately (as in emergency stop).
Usually, set the positioning deviation for rapid traverse plus some margin in this parameter.

1829	Positioning deviation limit for each axis in the stopped state

[Data type] Word axis
[Unit of data] Detection unit
[Valid data range] 0 to 32767

Set the positioning deviation limit in the stopped state for each axis.
If, in the stopped state, the positioning deviation exceeds the positioning deviation limit set for stopped state, a servo alarm is generated, and operation is stopped immediately (as in emergency stop).
When the dual check safety function is used, the CNC and monitor check for a positioning deviation on each axis at all times. If the monitor detects that a positioning deviation has exceeded the positioning deviation limit at stop time, servo alarm No. 474 is issued only in safety signal mode C (state where the guard is opened according to an input guard open request).

1830	Axis-by-axis positional deviation limit at servo-off time

[Data type] 2-word axis
[Unit of data] Detection unit
[Valid data range] 0 to 99999999

This parameter is used to set a positional deviation limit at servo-off time, on an axis-by-axis basis.
If the value specified with this parameter is exceeded at servo-off time, a servo alarm (No.410) is issued to cause an immediate stop (same as an emergency stop). Usually, set the same value as a positional deviation at stop time (parameter No.1829).

> **NOTE**
> When this parameter is set to 0, no positional deviation limit check is made at servo-off time.

1832	Feed stop positioning deviation for each axis

[Data type] 2-word axis
[Unit of data] Detection unit
[Valid data range] 0 to 99999999

Set the feed stop positioning deviation for each axis.
If the positioning deviation exceeds the feed stop positioning deviation during movement, pulse distribution and acceleration/ deceleration control are stopped temporarily. When the positioning deviation drops to the feed stop positioning deviation or below, pulse distribution and acceleration/deceleration control are resumed.
The feed stop function is used to reduce overshoot in acceleration/ deceleration mainly by large servo motors.
Usually, set the middle value between the positioning deviation limit during movement and the positioning deviation at rapid traverse as the feed stop positioning deviation.

> **NOTE**
> If this parameter is set to 0, the feed stop function is disabled.

1836	Servo error amount where reference position return is possible

[Data type] Byte axis
[Unit of data] Detection unit
[Valid data range] 0 to 127

This parameter sets a servo error used to enable reference position return in manual reference position return.
Usually, set this parameter to 0. (When 0 is set, 128 is assumed as the default.)

NOTE
When bit 0 (PLC01) of parameter No.2000 is set to 1, a value ten times greater than the value set in this parameter is used to make the check.
Example)
When bit 0 (PLC0) of parameter No. 2000 is 1 and the set value is 10, if the servo error amount is 100 or greater, reference position return is enabled.

1838	Positioning deviation limit for each axis during movement in safety signal mode C

[Data type] Byte axis
[Unit of data] Detection unit
[Valid data range] 0 to 127

Set a positioning deviation limit for each axis during movement in safety signal mode C (state where the guard is opened according to an input guard open request) when the dual check safety function is used.
If a positioning deviation during movement has exceeded the positioning deviation limit during movement, servo alarm No. 411 is issued, resulting in an instantaneous stop (same as an emergency stop).
When the dual check safety function is used, the CNC and monitor check for a positioning deviation on each axis at all times. If the monitor detects that a positioning deviation has exceeded the positioning deviation limit during movement, servo alarm No. 475 is issued only in safety signal mode C (state where the guard is opened according to an input guard open request).
If the guard is open, a movement on an axis is made at a speed within the safety speed range. So, set a value smaller than the positioning deviation limit in movement (parameter No. 1828) usually.

1846	Distance for starting the second smooth backlash compensation

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

[Data type] 2-word axis
[Unit of data] Detection unit
[Valid data range] 0 to 99999999

For each axis, set the distance from the position where the axis movement direction is reversed to the position where the second smooth backlash compensation is started.

If the following conditions are not satisfied, smooth backlash compensation is disabled:

Value of parameter No. 1846 ≥ 0
Value of parameter No. 1846 < Value of parameter No. 1847

1847	Distance for stopping the second smooth backlash compensation

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

[Data type] 2-word axis
[Unit of data] Detection unit
[Valid data range] 0 to 99999999

For each axis, set the distance from the position where the axis movement direction is reversed to the position where the second smooth backlash compensation is ended.

If the following conditions are not satisfied, smooth backlash compensation is disabled:

Value of parameter No. 1846 ≥ 0
Value of parameter No. 1846 < Value of parameter No. 1847

1848	Compensation value of the first smooth backlash compensation

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

[Data type] Word axis
[Unit of data] Detection unit
[Valid data range] -9999 to 9999

For each axis, set the compensation value of the first smooth backlash compensation. If the setting of this parameter is greater than the total of backlash compensation values, smooth backlash compensation is not performed.
If a negative backlash compensation value (parameter No. 1851) is specified for each axis, set a negative value in this parameter as well.
If the signs of backlash compensation values (parameter No. 1851) differ from each other, compensation is performed assuming that the compensation value of the first smooth backlash compensation is 0.

1850	Grid shift and reference position shift for each axis

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

[Data type] 2-word axis
[Unit of data] Detection unit
[Valid data range]
(1) 0 to 99999999 (for reference shift position)
(2) Reference counter size (set by parameter No. 1821) or less (for grid shift)

Set the amount of a grid shift or reference position shift for each axis to shift the reference position. Up to the maximum value counted by the reference counter can be specified as the grid shift.
In case of bit 2 (SFD) of parameter No.1002 is 0: Grid shift
In case of bit 2 (SFD) of parameter No.1002 is 1:
Reference shift position

1851	Backlash compensation value for each axis

[Data type] Word axis
[Unit of data] Detection unit
[Valid data range] -9999 to +9999

Set the backlash compensation value for each axis.
When the machine moves in a direction opposite to the reference position return direction after the power is turned on, the first backlash compensation is performed.
For smooth backlash compensation, set a backlash compensation value at the end of second backlash compensation output.

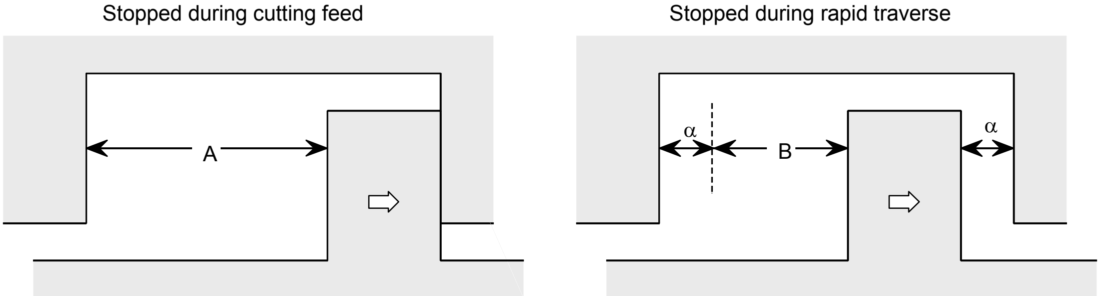
1852	Backlash compensation value used for rapid traverse for each axis

[Data type] Word axis
[Unit of data] Detection unit
[Valid data range] -9999 to +9999

Set the backlash compensation value used in rapid traverse for each axis. (This parameter is valid when bit 4 (RBK) of parameter No. 1800, is set to 1.)
More precise machining can be performed by changing the backlash compensation value depending on the feedrate, the cutting feed or the rapid traverse.
Let the measured backlash at cutting feed be A and the measured backlash at rapid traverse be B. The backlash compensation value 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	$\pm\alpha$	$\pm(-\alpha)$
Opposite direction	±A	±B	$\pm B\ (B+\alpha)$	$\pm B\ (B+\alpha)$

$\alpha = (A-B)/2$ (α : Machine overtravel amount)
The positive or negative direction for compensation values is the direction of movement.



Assign the measured backlash at cutting feed (A) in parameter No.1851 and that at rapid traverse (B) in parameter No.1852.

NOTE
1 Jog feed is regarded as cutting feed.
2 The backlash compensation for each rapid traverse and cutting feed is not performed until the first reference position return is completed after the power is turned on. The normal backlash compensation is performed according to the value specified in parameter No.1851 irrespective of a rapid traverse and a cutting feed.
3 The backlash compensation for each rapid traverse and cutting feed is performed only when bit 4 (RBK) of parameter No.1800, is set to 1. When bit 4 (RBK) of parameter No.1800 is set to 0, the normal backlash is performed.

1867	Threshold value for scale data conversion (common to all axes)

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] 0 to 99999999

If scale data is greater than the setting of this parameter, data for one rotation is subtracted from the scale data to ensure scale data continuity within the movable range. Be sure to set the scale data (angle from a discontinuity point) of a position outside the movable range as a threshold value. This parameter is common to all axes. This parameter is invalid for an axis with a nonzero value set in parameter No. 1868 used for each axis.

NOTE

1 When this parameter is set, the power must be turned off before operation is continued.
2 This parameter is valid only for those axes with bit 3 (SCR) of parameter No. 1817 set to 1.
3 If the setting of this parameter is modified, perform a reference position establishment operation again.
4 With the T series, this parameter is valid for a rotary encoder with distance-coded reference marks (detection circuit C).

1868	Threshold value for scale data conversion (for each axis)

[Data type] 2-word axis

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] 0 to 99999999

If scale data is greater than the setting of this parameter, data for one rotation is subtracted from the scale data to ensure scale data continuity within the movable range. Be sure to set the scale data (angle from a discontinuity point) of a position outside the movable range as a threshold value. For those axes with 0 set in this parameter, parameter No. 1867 common to all axes is valid.

NOTE

1. When this parameter is set, the power must be turned off before operation is continued.
2. This parameter is valid only for those axes with bit 3 (SCR) of parameter No. 1817 set to 1.
3. If the setting of this parameter is modified, perform a reference position establishment operation again.
4. With the T series, this parameter is valid for a rotary encoder with distance-coded reference marks (detection circuit C).

1870	Number of the program for storing servo trace data

[Data type] Word axis

[Valid data range] 0 to 9999

Set the number of the program for storing servo trace data.

1871	Program number where servo trace data is stored (when the program number is 8 digits)

[Data type] 2-word axis

[Valid data range] 0 to 99999999

Set a program number where servo trace data is to be stored, when the program number is 8 digits.

NOTE

Do not use parameter No.1870, which is dedicated to the standard function (4-digit O number), when the program number is 8 digits.

1874	Numerator of the conversion coefficient for inductosyn position detection

1875	Denominator of the conversion coefficient for inductosyn position detection

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

[Data type] Word axis
[Valid data range] 1 to 32767

Set a conversion coefficient for inductosyn position detection for each axis. The value set is determined as follows:

$$\frac{\text{No. 1874}}{\text{No. 1875}} = \frac{\text{Number of position feedback pulses per motor revolution}}{1{,}000{,}000}$$

1876	One-pitch interval of the inductosyn

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

[Data type] Word axis
[Unit of data] Detection unit
[Valid data range] 1 to 32767

Set a one-pitch interval of the inductosyn for each axis.

SUPPLEMENTAL REMARK
To use an absolute-position detector using Inductosyn, set the following digital servo parameters as well:
Bit 4 (INDx) of parameter No. 2015
The absolute-position detect function by Inductosyn is:
0 : Disabled.
1 : Enabled.
Parameter No. 2141 Inductosyn data acquisition time
Set a time requirement for acquiring the Inductosyn data. If the setting is 0, 20 msec is assumed. (For the setting, contact the scale manufacturer.)

1880	Unexpected disturbance torque detection alarm timer

[Data type] Word
[Unit of data] msec
[Valid data range] 0 to 32767 (200 msec is assumed when 0 is set)

This parameter sets the time from the detection of an unexpected disturbance torque until a servo alarm is issued. The specified value is rounded up to the nearest integral multiple of 8 msec.

[Example] When 30 is specified, the value is rounded up to 32 (msec).

1881	Group number when an unexpected disturbance torque is detected

[Data type] Byte axis

[Valid data range] 0 to 8

This parameter sets the group number of each axis, used when an unexpected disturbance torque is detected.

If an unexpected disturbance torque is detected for an axis, only the movement along the axes of the group containing the axis with the unexpected disturbance torque is stopped. If 0 is set for an axis, movement along that axis is stopped whenever an unexpected disturbance torque is detected for any axis.

[Example] Assume that the following settings have been made. If an unexpected disturbance torque is detected for the sixth axis, movement along the second, fourth, sixth, and seventh axes is stopped. If an unexpected disturbance torque is detected for the fourth axis, movement along the fourth and seventh axes is stopped.

Parameter No.1881	Setting
(First axis)	1
(Second axis)	2
(Third axis)	1
(Fourth axis)	0
(Fifth axis)	3
(Sixth axis)	2
(Seventh axis)	0

NOTE

This parameter is enabled when bit 5 (ANA) of parameter No.1804 is set to 1.

1882	Space between the mark-2 indications on the linear scale with absolute addressing reference marks

[Data type] 2-word axis

[Unit of data] Detection unit

[Valid data range] 0 to 99999999

This parameter sets the interval of mark 2 of an encoder with absolute addressing reference marks (linear scale/rotary encoder).

NOTE

When an encoder with distance-coded reference marks (linear scale/rotary encoder) (detection circuit C) is used, the setting of this parameter is invalid.

1883	Distance 1 from the mark origin of an encoder with absolute addressing reference marks/encoder with distance-coded reference marks (detection circuit C) to the reference position

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

[Data type] 2-word axis
[Unit of data] Detection unit
[Valid data range] -99999999 to 99999999

1884	Distance 2 from the mark origin of an encoder with absolute addressing reference marks/encoder with distance-coded reference marks (detection circuit C) to the reference position

NOTE
1 When this parameter is set, the power must be turned off before operation is continued.
2 If a value not within the valid data range is specified in this parameter when an encoder with distance-coded reference marks (linear scale/rotary encoder) (detection circuit C) is used, P/S 5325 may be issued at reference position establishment time.

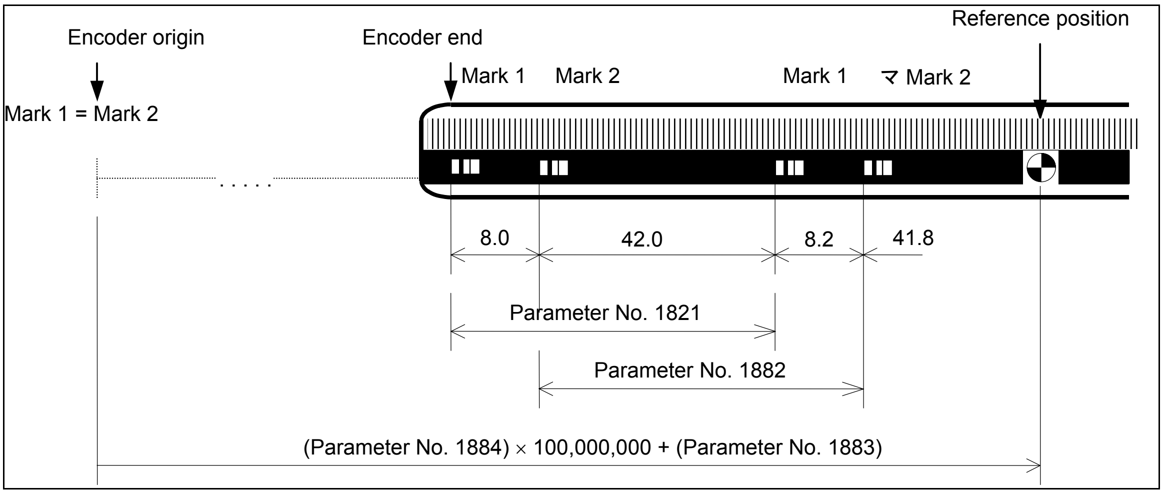
[Data type] Word axis
[Unit of data] Detection unit × 100,000,000
[Valid data range] -20 to 20

This parameter is used when the distance from the encoder origin to the reference position is not within the range set in parameter No. 1883.

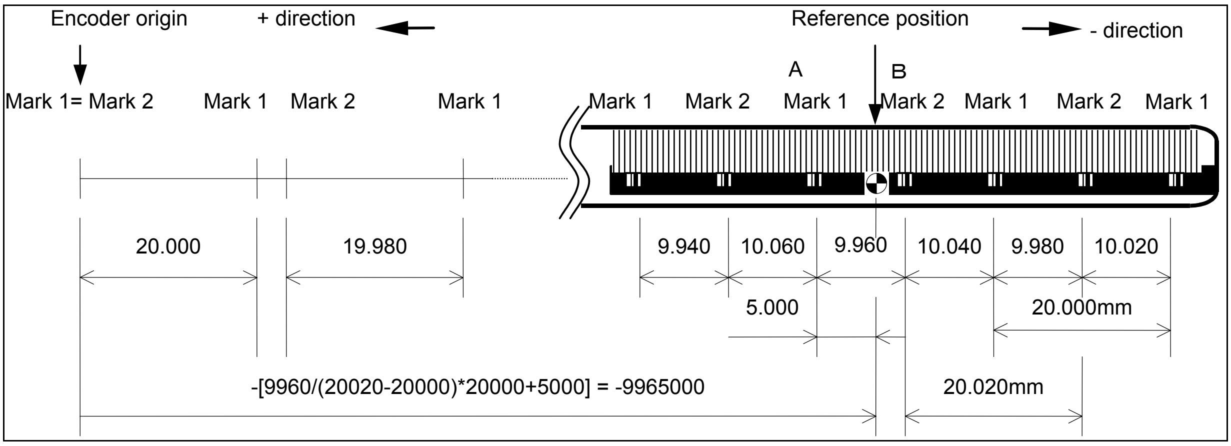
In parameter Nos. 1883 and 1884, set the distance from the origin of an encoder with absolute addressing reference marks (linear scale/rotary encoder)/encoder with distance-coded reference marks (linear scale/rotary encoder) (detection circuit C) to the reference position. The distance from the origin of an encoder to the reference position can be found by the following expression:

Distance from the origin of an encoder to the reference position
= No.1884 × 100,000,000 + No.1883

The origin of an encoder represents the point where mark 1 and mark 2 match. Usually, this point is a virtual point not physically existing on the encoder. (See the figure below.)
Set a positive value if the reference position is located in the + direction when viewed from the encoder point. Set a negative value if the reference position is located in the - direction when viewed from the encoder point.



[Example of parameter setting] When an encoder as shown below is used on an IS-B millimeter machine



Parameter No.1821 (Mark 1 interval) = 20000
Parameter No.1882 (Mark 2 interval) = 20020
Parameter No.1883 (Reference position) = Position A + 5.000
= Distance between A and B / (Mark 2 - Mark 1) × Mark 1 + 5000
= 9960 / (20020-20000) × 20000 + 5000
= 9965000
-9965000 (Reference position located in the minus direction)

[Method of setting parameter No. 1883]

(When an encoder with absolute addressing reference marks (linear scale/rotary encoder) is used)

If it is difficult to measure the distance from the encoder origin to the reference position (parameter No. 1883), the distance can be determined using the procedure below.

1 Set bit 1 (OPTx) of parameter No. 1815 to 1, bit 2 (DCLx) of parameter No. 1815 to 1, and bit 3 (DCRx) of parameter No. 1815 to 0/1 to enable an encoder with absolute addressing reference marks (linear scale/rotary encoder).
Set a proper value in parameter Nos. 1821 and 1882.
Set 0 in parameter No. 1240.
Set 0 in parameter Nos. 1883 and 1884.
2 Establish a reference position at a proper location.
(As the result, the machine coordinate represents the distance from the encoder origin to the current position.)
3 Position the machine accurately at the reference position by jog feed or handle feed.
4 In parameter No. 1883, set the machine coordinate (diagnosis screen No. 301) converted to the detection unit (diagnosis screen No. 301 multiplied by CMR).
5 Set parameter No. 1240 if necessary.

NOTE
This method cannot be used if the distance from the encoder origin to the reference position exceeds 99,999,999.

[Method of setting parameter No. 1883]
(When an encoder with distance-coded reference marks (linear scale/rotary encoder) (detection circuit C) is used)

A value to be set in parameter No. 1883 can be determined using the procedure below.

1 Set bit 1 (OPTx) of parameter No. 1815 to 0/1 and bit 2 (DCLx) of parameter No. 1815 to 1 to enable an encoder with distance-coded reference marks (linear scale/rotary encoder) (detection circuit C).
Set 0 in parameter No. 1240.
Set 0 in parameter Nos. 1883 and 1884.
2 Establish a reference position at a proper location.
(As the result, the machine coordinate represents the distance from the encoder origin to the current position.)
3 Position the machine accurately at the reference position by jog feed or handle feed.
4 In parameter No. 1883, set the machine coordinate (diagnosis screen No. 301) converted to the detection unit (diagnosis screen No. 301 multiplied by CMR).
5 Set parameter No. 1240 if necessary.

NOTE
This method cannot be used if the distance from the encoder origin to the reference position exceeds 99,999,999.

1885	Maximum allowable value for total travel during torque control

[Data type] Word axis
[Unit of data] Detection unit
[Valid data range] 0 to 32767

This parameter sets the maximum allowable value for the total travel (error counter value) for an axis placed under torque control, as specified by the axis control command of the PMC axis control function. If the total travel exceeds the parameter-set value while torque control is applied, a servo alarm (No.423) is generated.

> **NOTE**
> This parameter is enabled when bit 4 (TQF) of parameter No.1803 is 0 (follow-up is not performed during torque control).

1886	Positional deviation when torque control is canceled

[Data type] Word axis
[Unit of data] Detection unit
[Valid data range] 0 to 32767

This parameter sets the positional deviation used when torque control, performed for an axis according to the axis control command of the PMC axis control function, is canceled and position control is resumed. After the positional deviation has fallen to the parameter-set value, switching to position control is performed.

> **NOTE**
> This parameter is enabled when bit 4 (TQF) of parameter No.1803 is 0 (follow-up is not performed during torque control).

1890	Servo motor speed for detection

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

[Data type] Word
[Unit of data] min^{-1}
[Valid data range] 0 to 8000

The servo motor speed of each axis is monitored and a motor speed detection signal is output indicating whether the speed of each axis exceeds the value set in this parameter (set in the Y address specified in parameter No.1891)

> **NOTE**
> No motor speed detection signals are output when the servo/spindle motor speed detection function is not used or 0 is set in this parameter.

1891	Initial value of the Y address where motor speed detection signals are output

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

[Data type] Word

[Valid data range] 0 to 126, 1000 to 1013, 1020 to 1033

This parameter specifies the Y address where motor speed detection signals are output.

The spindle motor speeds and servo motor speed of each axis are monitored and motor speed detection signals are output to the Y address specified in this parameter and (Y address +1) to indicate whether speeds exceed the values set in the parameters.

- Y address n :
  Servo motor speed detection signals are output.
  (See the description of parameter No.1890.)
- Y address n+1 :
  Spindle motor speed detection signals are output.
  (See the description of parameter No.4345.)

	#7	#6	#5	#4	#3	#2	#1	#0
Y (n+0)	DSV8	DSV7	DSV6	DSV5	DSV4	DSV3	DSV2	DSV1

	#7	#6	#5	#4	#3	#2	#1	#0
Y (n+1)	Reserved						DSP2	DSP1

n : setting value

DSV1-DSV8 Motor speed detection signals of servo motors for axis 1 to axis 8

DSP1, DSP2 Motor speed detection signals of the first and second serial spindles

> **NOTE**
> 1 No motor speed detection signals are output when the servo/spindle motor speed detection function is not used, the value 0 or a value beyond the allowable data range is specified in this parameter, or an input/output address specified within the allowable data range represents an address where no I/O device is mounted.
> 2 Be sure to specify a Y address that is not used with a PMC sequence program (ladder).
> 3 When controlling two path lathe, ensure that the same value is not set for 1 path lathe and 2 path lathe. (Set a separate address for 1 path lathe and 2 path lathe.)

1895	Servo motor axis number used for a milling tool

[Data type] Byte

[Valid data range] 1, 2, 3, ..., number of controlled axes

This parameter sets the servo motor axis number used for displaying the speed of a milling tool that incorporates a servo motor.

1896	Number of gear teeth on the servo motor axis side

[Data type] Word

[Valid data range] 1 to 9999

This parameter sets the number of servo motor axis gear teeth used for displaying the speed of a milling tool that incorporates a servo motor.

1897	Number of gear teeth on the milling axis side

[Data type] Word

[Valid data range] 1 to 9999

This parameter sets the number of milling axis gear teeth used for displaying the speed of a milling tool that incorporates a servo motor.

	#7	#6	#5	#4	#3	#2	#1	#0
1901				RFD				

[Data type] Bit

RFD In the jog feed mode, the fine acceleration/deceleration function and feed-forward function are:

0 : Disabled.

1 : Enabled.

NOTE

1 This parameter does not affect an axis placed under PMC axis control. Instead, the setting of PMC axis control is followed. To enable the fine acceleration/deceleration function and feed-forward function when PMC axis control is exercised, advanced preview control needs to be enabled on the PMC controlled axis. (See the descriptions of bits 3 (G8C) and 4 (G8R) of parameter No. 8004).)

2 Note that if the unexpected disturbance torque detection function for cutting/rapid traverse is used, this parameter switches the threshold value (0: Rapid traverse threshold value, 1: Cutting feed threshold value).

3 In the cases indicated below, the fine acceleration/deceleration function and feed-forward function in the jog feed mode are disabled, regardless of the setting of this parameter. As the threshold value of the unexpected disturbance torque detection function for cutting/rapid traverse, a rapid traverse threshold value is used.

- All axes used in manual rigid tapping
- Chopping axis in chopping operation (M series only)

	#7	#6	#5	#4	#3	#2	#1	#0
1902		DCE			STP		ASE	FMD

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

> ⚠ **WARNING**
> Be sure to set bits 5 and 7 of parameter No. 1902 to 0. If any of these bits is set to 1, the safety function may not operate normally.

[Data type] Bit

FMD The FSSB setting mode is:

0 : Automatic setting mode.
(When information including an axis-amplifier relationship is set on the FSSB setting screen, parameter Nos. 1023, 1905, 1910 through 1919, 1936, and 1937 are set automatically.)

1 : Manual setting 2 mode.
(Set parameter Nos. 1023, 1905, 1910 through 1919, 1936, and 1937 manually.)

> **NOTE**
> When using the dual check safety function, set the FMD parameter to 1 to set the manual setting 2 mode.

ASE When automatic setting mode is selected for FSSB setting (when the FMD parameter (bit 0 of parameter No.1902) is set to 0), automatic setting is:

0 : Not completed.

1 : Completed.
(This bit is automatically set to 1 upon the completion of automatic setting.)

STP When the dual check safety function is used, an MCC off Test at power-off time is:

0 : Conducted. (When the power is turned on, the warning "Conduct Safety Test." is indicated, and the MCC off Test execution request signal RQT is output.)

1 : Not conducted.

NOTE

1 The STP parameter is used temporarily, for example, when a MCC off Test is not to be made at power-on as in the case of machine adjustment. Usually, set STP = 0.

2 Even when STP = 1, a MCC off Test is required if the power is turned 24 hours or more after the completion of the previous MCC off Test.

⚠ **WARNING**

Set STP = 0 after the STP parameter is used temporarily as in the case of machine adjustment.

DCE The dual check safety function is:

0 : Disabled.

1 : Enabled.

NOTE

Usually set the DCE = 1 in the dual check safety function. The system cannot start-up because MCC-on enable signal (MCF) = 0 when the DCE = 0.

	#7	#6	#5	#4	#3	#2	#1	#0
1903			FO2	FO1				

NOTE

When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

FO1 The first FSSB I/O unit is:

0 : Not used.

1 : Used.

FO2 The second FSSB I/O unit is:
0 : Not used.
1 : Used.

> **NOTE**
> 1 On the FSSB, an FSSB I/O module and separate detector interface unit (pulse module) are handled as units of the same type. The term "first unit" or "second unit" used in the descriptions here represents the ordinal number of a unit counted without making a distinction between FSSB I/O modules and separate detector interface units. For example, suppose that one FSSB I/O module and one separate detector interface unit are used and that the separate detector interface unit is connected on the FSSB closer to the CNC and the FSSB I/O module is connected on the FSSB farther from the CNC. In this case, the FSSB I/O module is the "second unit".
> 2 An FSSB I/O module can also be used according to the conventional setting method (setting using bits 4 and 5 of parameter No. 1905, parameter No. 1936, and parameter No. 1937). When bits 4 and 5 of parameter No. 1903 are used, bits 4 and 5 of parameter No. 1905, parameter No. 1936, and parameter No. 1937 need not be set.

	#7	#6	#5	#4	#3	#2	#1	#0
1904		DCNx						DSPx

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit axis

DSPx
0 : Two axes use one DSP. (Ordinary axes)
1 : One axis uses one DSP. (Axes such as a learning control axis)

> **NOTE**
> Parameter No.1904 is set on the FSSB setting screen. So, parameter No.1904 should not have to be specified directly. This parameter need not be set in FSSB manual setting 2 mode.

DCNx The checks of the target axis by the dual check safety function are:
0 : Made.
1 : Not made.

> ⚠ **CAUTION**
> 1 The DCN bit cannot disable the checks by the dual check safety function for all the controlled axes.
> 2 Set the DCN bit to 1 for the slave axis under tandem control or for the tool axis of a simple electric gear box or electric gear box 2-pair.

> ⚠ **WARNING**
> The checks by the dual check safety function are not made on an axis for which the DCN bit is set to 1. Set the DCN bit to 0 for normal axes.

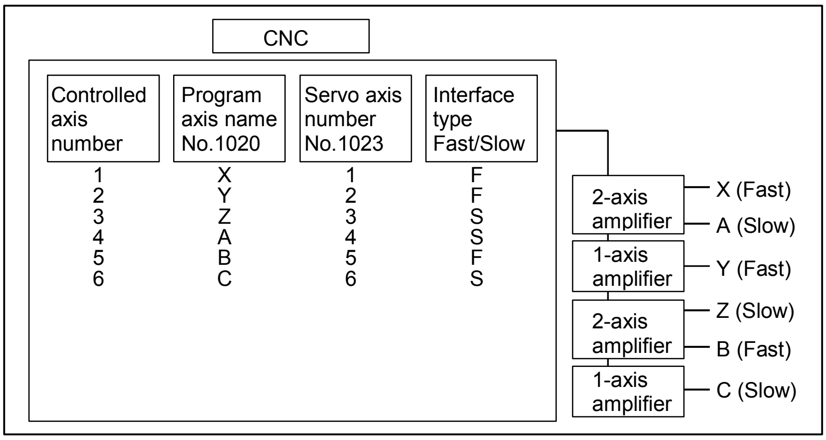
	#7	#6	#5	#4	#3	#2	#1	#0
1905	PM2x	PM1x	IO2x	IO1x				FSLx

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit axis

FSLx The type of interface used between the servo amplifier and servo software is:
0 : Fast type.
1 : Slow type.
The user can choose between two interface types for servo data transfer: fast type or slow type. Set this parameter so that the following conditions are satisfied:

- When a one-axis amplifier is used, either the fast type or slow type interface can be used.
- When a two-axis amplifier is used, the use of the fast type for both axes is not allowed. The slow type can be used for both axes.
- When a three-axis amplifier is used, the requirement for a two-axes amplifier described above applies to the first and second axes, and the requirement for a one-axis amplifier, again described above, applies to the third axis.
- When an odd number is specified for parameter No.1023, the fast type interface must be used. However, the slow type may be used for an EGB workpiece axis, learning control axis, high-speed current loop axis, and high-speed interface axis.
- When an even number is specified for parameter No.1023, only the slow type interface can be used. (The FSL bit must always be set to 1.)



IO1x A first I/O module supporting FSSB is:
0 : Not used.
1 : Used.

IO2x A second I/O module supporting FSSB is:
0 : Not used.
1 : Used.

> **NOTE**
> 1 On the FSSB, an FSSB I/O unit and separate detector interface unit (pulse module) are handled as units of the same type. The term "first unit" or "second unit" used in the descriptions here represents the ordinal number of a unit counted without making a distinction between FSSB I/O units and separate detector interface units. For example, suppose that one FSSB I/O unit and one separate detector interface unit are used and that the separate detector interface unit is connected on the FSSB closer to the CNC and the FSSB I/O unit is connected on the FSSB farther from the CNC. In this case, the FSSB I/O unit is the "second unit".
> 2 An FSSB I/O unit is controlled with the first servo axis. For an axis with parameter No. 1023 = 1 (or with parameter No. 1023 = 9 for tool post 2 under 2-CPU 2-path control or tool post 2 under 2-CPU 3-path control), set IO1 (or IO2) to 1. For other axes, set IO1 to 0 and IO2 to 0.

PM1x The first separate detector interface unit is:
0 : Not used.
1 : Used.

PM2x The second separate detector interface unit is:
0 : Not used.
1 : Used.

> **NOTE**
> When automatic setting mode is selected for FSSB setting (when the FMD parameter (bit 0 of parameter No.1902) is set to 0), parameter No.1905 is automatically set when input is performed with the FSSB setting screen. When manual setting 2 mode is selected for FSSB setting (when the FMD parameter (bit 0 of parameter No.1902) is set to 1), parameter No.1905 must be set directly. When a separate detector interface unit is used, a connector number must be set in the corresponding parameter (No.1936 or No.1937).

1910	Address conversion table value for slave 1 (ATR)
1911	Address conversion table value for slave 2 (ATR)
1912	Address conversion table value for slave 3 (ATR)
1913	Address conversion table value for slave 4 (ATR)
1914	Address conversion table value for slave 5 (ATR)
1915	Address conversion table value for slave 6 (ATR)
1916	Address conversion table value for slave 7 (ATR)
1917	Address conversion table value for slave 8 (ATR)
1918	Address conversion table value for slave 9 (ATR)
1919	Address conversion table value for slave 10 (ATR)

NOTE
When these parameters are set, the power must be turned off before operation is continued.

[Data type] Byte
[Valid data range] 0 to 7, 16, 40, 48

These parameters set address conversion table values for slaves 1 to 10.
A slave is the generic name given to a device such as a servo amplifier or separate detector interface unit, connected to the CNC via an FSSB optical cable. Smaller numbers, starting from 1 are assigned to slaves closer to the CNC; the maximum number that can be assigned is 10. A two-axis amplifier has two slaves, while a three-axis amplifier has three slaves. Set each parameter as described below, depending on whether the slave is an amplifier or separate detector interface unit, or when no slave exists.

- When the slave is an amplifier:
  Set the value obtained by subtracting 1 from the setting of parameter No.1023 for the axis to which the amplifier is assigned.
- When the slave is a separate detector interface unit:
  Set 16 for the first separate detector interface unit (closest to the CNC).
  Set 48 for the second separate detector interface unit (furthest from the CNC).
- When no slave exists
  Set 40. When using the simple electric gear box (EGB) function, however, set a value as described below.

NOTE

1 When using the simple electric gear box (EGB) function
The EGB axis (axis set with parameter No.7771) does not actually require an amplifier. So, assume that the EGB axis is connected to a dummy amplifier. Accordingly, as the address conversion table value for a nonexistent slave, set the value obtained by subtracting 1 from the setting made for parameter No.1023 for the EGB axis, instead of setting 40.

2 When automatic setting mode is selected for FSSB setting (when bit 0 (FMD) of parameter No.1902 is set to 0), parameters No.1910 to No.1919 are automatically set when input is performed with the FSSB setting screen. When manual setting 2 mode is selected for FSSB setting (when bit 0 (FMD) of parameter No.1902 is set to 1), parameter No.1910 to No.1919 must be directly set.

- Examples of axis configurations and parameter settings

CNC

Controlled axis number	Program axis name No.1020	Servo axis number No.1023
1	X	1
2	Y	3
3	Z	4
4	A	2
5	B	5
6	C	6

	Slave number	ATR No.1910 to 1919	Axis
1-axis amplifier	1	0	X
2-axis amplifier	2	1	A
	3	2	Y
2-axis amplifier	4	3	Z
	5	4	B
M1	6	16	(M1)
1-axis amplifier	7	5	C
M2	8	48	(M2)
	9	40	(None)
	10	40	(None)

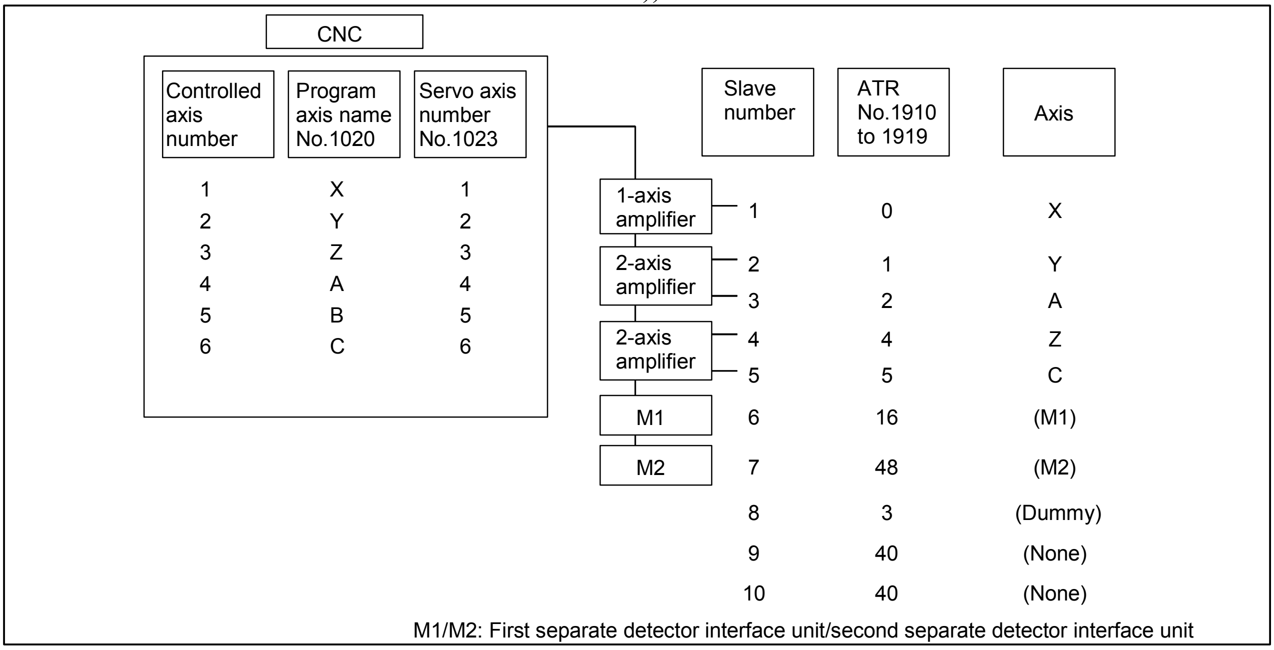
CNC

Controlled axis number	Program axis name	Servo axis number No.1023
1	X	1
2	Y	3
3	Z	4
4	A	2
5	B	5
6	C	6

	Slave number	ATR No.1910 to 1919	Axis
1-axis amplifier	1	0	X
2-axis amplifier	2	2	Y
	3	3	Z
2-axis amplifier	4	1	A
	5	4	B
M1	6	16	(M1)
1-axis amplifier	7	5	C
M2	8	48	(M2)
	9	40	(None)
	10	40	(None)

M1/M2: First separate detector interface unit/second separate detector interface unit

- Example of axis configuration and parameter settings when the simple electric gear box (EGB) function is used
  (EGB workpiece axes: A axis, EGB axis, B axis (Parameter No.7771=5))



1920	Controlled axis number for slave 1 (dedicated to the FSSB setting screen)
1921	Controlled axis number for slave 2 (dedicated to the FSSB setting screen)
1922	Controlled axis number for slave 3 (dedicated to the FSSB setting screen)
1923	Controlled axis number for slave 4 (dedicated to the FSSB setting screen)
1924	Controlled axis number for slave 5 (dedicated to the FSSB setting screen)
1925	Controlled axis number for slave 6 (dedicated to the FSSB setting screen)
1926	Controlled axis number for slave 7 (dedicated to the FSSB setting screen)
1927	Controlled axis number for slave 8 (dedicated to the FSSB setting screen)
1928	Controlled axis number for slave 9 (dedicated to the FSSB setting screen)
1929	Controlled axis number for slave 10 (dedicated to the FSSB setting screen)

NOTE
When these parameters are set, the power must be turned off before operation is continued.

[Data type] Byte
[Valid data range] 0 to 8

These parameters are used to set the controlled axis numbers for slaves 1 to 10.

NOTE
These parameters are set using the FSSB setting screen. So, these parameters should not normally have to be specified directly. These parameters need not be set in FSSB manual setting 2 mode.

1931	Connector number for the first separate detector interface unit (dedicated to the FSSB setting screen)

1932	Connector number for the second separate detector interface unit (dedicated to the FSSB setting screen)

NOTE
When these parameters are set, the power must be turned off before operation is continued.

[Data type] Byte axis
[Valid data range] 0 to number of connectors provided on each separate detector interface unit

When a separate detector interface unit is used, these parameters set a separate detector interface unit connector number for each axis.

NOTE
These parameters are set using the FSSB setting screen. So, these parameters should not normally have to be specified directly. These parameters need not be set in FSSB manual setting 2 mode.

1933	Cs contour control axis (dedicated to the FSSB setting screen)

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

[Data type] Byte axis
[Valid data range] 0, 1

When Cs contour control is to be applied for an axis, this parameter must be set to 1 for that axis.

NOTE
This parameter is set using the FSSB setting screen. So, this parameter should not normally have to be specified directly. This parameter need not be set in FSSB manual setting 2 mode.

1934	Master and slave axis numbers subject to tandem control (dedicated to the FSSB setting screen)

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

[Data type] Byte axis
[Valid data range] 0 to 8

This parameter is used to set an odd number, and the subsequent even number, for a master axis and slave axis subject to tandem control, respectively.

NOTE
This parameter is set using the FSSB setting screen. So, this parameter should not normally have to be specified directly. This parameter need not be set in FSSB manual setting 2 mode.

1936	Connector number of the first separate detector interface unit
1937	Connector number of the second separate detector interface unit

NOTE
When these parameters are set, the power must be turned off before operation is continued.

[Data type] Byte axis
[Valid data range] 0 to 7

When a separate detector interface unit is used, each of these parameters sets the value obtained by subtracting 1 from a separate detector interface unit connector number for each axis. That is, values of 0 through 7 are set for connector numbers 1 through 8. In addition, bits 6 and 7 of parameter No.1905 must be set. For an axis that does not use a separate detector interface unit, 0 must be set.
Any connector can be used for any axis, however the connectors in a single separate detector interface unit should be used in ascending order of connector number. For instance, connector 4 of a separate detector interface unit cannot be used without using connector 3 of the same separate detector interface unit.

[Example]

Controlled axis	Connector number for the first separate detector interface unit	Connector number for the second separate detector interface unit	No.1936	No.1937	Bits 7 and 6 of No.1905
X	1	Not used	0	0	0, 1
Y	Not used	2	0	1	1, 0
Z	Not used	1	0	0	1, 0
A	Not used	Not used	0	0	0, 0
B	2	Not used	1	0	0, 1
C	Not used	3	0	2	1, 0

NOTE
When automatic setting mode is selected for FSSB setting (when bit 0 of parameter No.1902 is set to 0), these parameters are automatically set when input is performed with the FSSB setting screen.
When manual setting 2 mode is selected for FSSB setting (when bit 0 of parameter No.1902 is set to 1), these parameters must be set directly.

1942	**Safety speed for each axis**
13821	**Safety speed 1 for each axis**
13822	**Safety speed 2 for each axis**
13823	**Safety speed 3 for each axis**
13824	**Safety speed 4 for each axis**

[Data type] 2-word axis

[Unit of data, valid data range]

Input increment	Units of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	0 to 240000	0 to 100000
Inch machine	0.1 inch/min	0 to 96000	0 to 48000
Rotary axis	1 deg/min	0 to 240000	0 to 100000

Set a safety speed for each axis.
The CNC and monitor always check the velocity command of each axis in the dual check safety function. If the safety speed is exceeded on one axis at least, the guard unlock signal (*LGD) is brought to 0, to disable guard unlocking. The state in which the safety speed is not exceeded on any axis is one condition for setting the guard unlock signal (*LGD) to 1 (to enable guard unlocking).
If the safety speed is exceeded in safety signal mode C (state in which a guard open request is input and the guard is open), a servo alarm No.476 or No.494 is issued for the corresponding axis.
Up to four safety speeds can be set. Which safety speeds to choose depends on the safety speed/safety position selection signal (safety input signal).
Safety speed 1 assumes the value of parameter No. 1942 if parameter No. 1942 is not set to 0. Safety speed 1 assumes the value of parameter No. 13821 if parameter No. 1942 is set to 0.

$$\text{Safety speed 1} = \begin{cases} \text{Parameter No.1942 (parameter No.1942} \neq 0) \\ \text{Parameter No.13821 (parameter No.1942} = 0) \end{cases}$$

By setting bit 1 (TR2x) of parameter No. 13802 to 1, a safety speed can be monitored not by mm/min, inch/min, and deg/min but by motor speed (min^{-1}).

NOTE

1 Safety speed monitoring is performed by converting a specified speed to the detection unit. So, a calculation error can occur.
2 Safety speed parameter No. 1942, and No. 13821 through No. 13824 are safety parameters, so that these parameters are protected using the key and code of Dual check safety. To modify a safety speed parameter, set a code for safety parameters as the key for safety parameters (parameter No. 3226).
3 When the value of a safety speed parameter (No. 1942, No. 13821 through No. 13824) has been changed, the power must be turned off before operation is continued.
4 When diameter programming is used, set a speed based on diameter programming.

1943	Safe machine position of each axis (+ direction)
1944	Safe machine position of each axis (- direction)
13831	Safe machine position 1 of each axis (+ direction)
13832	Safe machine position 1 of each axis (- direction)
13833	Safe machine position 2 of each axis (+ direction)
13834	Safe machine position 2 of each axis (- direction)
13835	Safe machine position 3 of each axis (+ direction)
13836	Safe machine position 3 of each axis (- direction)
13837	Safe machine position 4 of each axis (+ direction)
13838	Safe machine position 4 of each axis (- direction)

[Data type] 2-word axis

[Unit of data, valid data range]

Input increment	IS-A	IS-B	IS-C	Unit
Metric input	0.01	0.001	0.0001	mm
Inch input	0.001	0.0001	0.00001	inch

Set a safe machine position for each axis.
The CNC and monitor always check the machine position on each linear axis in the dual check safety function.
In safety signal mode B (state in which a guard open request is input, and the guard is closed), if there is at least one linear axis whose machine position is not in the safe machine position, the guard unlock signal (*LGD) is set to 0 to disable guard unlocking. The state in which the machine positions of all linear axes are within the safe machine positions is one condition for setting the guard unlock signal (*LGD) to 1 (to enable guard unlocking). If the machine position on a linear axis exceeds the safe machine position in safety signal mode C (state in which a guard open request is input and the guard is open), a servo alarm No.477 or No.495 is issued.
Up to four safe machine positions can be set. Which safe machine positions to choose depends on the safety speed/safety position selection signal (safety input signal).
Safe machine position 1 assumes the value of parameter No. 1943 (No. 1944) if parameter No. 1943 (No. 1944) is not set to 0. Safe machine position 1 assumes the value of parameter No. 13831 (13832) if parameter No. 1943 (No. 1944) is set to 0.

$$\text{Safe machine position 1 (+ direction)} = \begin{cases} \text{Parameter No.1943 (No.1943} \neq 0) \\ \text{Parameter No.13831 (No.1943} = 0) \end{cases}$$

$$\text{Safe machine position 1 (- direction)} = \begin{cases} \text{Parameter No.1944 (No.1944} \neq 0) \\ \text{Parameter No.13832 (No.1944} = 0) \end{cases}$$

> **NOTE**
> 1 Safe machine position monitoring is performed only for a linear axis. Safe machine position monitoring is not performed for a rotary axis.
> 2 Safe machine position monitoring is performed only for an axis that has a reference position already established. Safe machine position monitoring is not performed for an axis that does not have a reference position established yet.
> 3 Safe machine position parameter No. 1943, No. 1944, and No. 13831 through No. 13836 are safety parameters, so that these parameters are protected using the key and code of Dual check safety. To modify a safe machine position parameter, set a code for safety parameters as the key for safety parameters (parameter No. 3226).
> 4 When the value of a safe machine position parameter (No. 1943, No. 1944, No. 13831 through No. 13836) has been changed, the power must be turned off before operation is continued.

1945	Safety input signal check timer

[Data type] Word
[Unit of data] msec
[Valid data range] 0 to 1000

For input signals related to the dual check safety function (safety input signals), two paths are used: one path for input to the CNC via the PMC, and the other for input to the monitor via the FSSB. The CNC and monitor exchange the input signals with each other at all times to check each other. If a mismatch greater than the time set in this parameter is detected between an input signal via one path and the same signal via the other path, a servo alarm No.479 or No.486 is issued. If a value of less than 16 is specified, a specification of 16 msec is assumed.
When a value greater than 1000 is set, the specification of 1000 msec is assumed.

> **NOTE**
> Set identical values in parameters No.1945 for the following: two tool posts under 2-CPU 2-path control with axis change between paths, two tool posts under 1-CPU 2-path control, or tool posts 2 and 3 under 2-CPU 3-path control.

1946	MCC off Test timer

[Data type] Word
[Unit of data] msec
[Valid data range] 0 to 32767

When MCC off Test mode is set with the dual check safety function, the CNC conducts a safety output signal MCC off Test. If a MCC off Test is not completed within the time set in this parameter, a servo alarm No.488 is issued.
If a value of less than 0 is specified, a specification of 10000 msec is assumed.

1947	MCC-off timer 1
1948	MCC-off timer 2

[Data type] Word
[Unit of data] msec
[Valid data range] 0 to 32767

When the MCC-on enable signal (MCF) needs to be set to 0 (MCC off) with the dual check safety function for a cause such as an alarm or emergency stop, the CNC and monitor set MCC-on enable signal (MCF) to 0 when an MCC-off timer value has elapsed after the alarm or emergency stop state.
If a spindle alarm is issued, however, the timers are not used. Instead, MCC-on enable signal (MCF) is set to 0 immediately.
If the MCC is cut off while the spindle motor is rotating, the spindle motor will continue to rotate (free-run) and stop after time. When the spindle motor should stop as quickly as possible, please use these parameters and control the spindle motor to stop, and after that cut MCC off.

State	Timer used
When a spindle alarm is issued	No timer is used.
When the guard is closed	MCC-off timer 1 (No. 1947)
When the guard is open	MCC-off timer 2 (No. 1948)

NOTE

Set identical values in parameters No.1947 for the following: two tool posts under 2-CPU 2-path control with axis change between paths, two tool posts under 1-CPU 2-path control, or tool posts 2 and 3 under 2-CPU 3-path control. Set identical values in parameters No.1948 likewise.

1950	Brake signal timer

[Data type] Word
[Unit of data] msec
[Valid data range] 0 to 32767

Set a time period from when the monitor in the dual check safety function detects that the MCC contact state signal (*SMC2) is 0 (MCC on state) until the brake release signal (*BRK) goes 1 (brake release enabled). If a value less than 0 is specified, 2500 msec is assumed. Usually, specify 0.

NOTE

Set identical values in parameters No.1950 for the following: two tool posts under 2-CPU 2-path control with axis change between paths, two tool posts under 1-CPU 2-path control, or tool posts 2 and 3 under 2-CPU 3-path control.

	#7	#6	#5	#4	#3	#2	#1	#0
1959								

[Data type] Bit

Set all bits to 0.

⚠ WARNING

Always set all bits of parameter No.1959 to 0.
If 1 is set, a safety function of dual check safety is not worked normally.

1970	**Value of address translation table corresponding to slave 1 of the second path (ATR)**
1971	**Value of address translation table corresponding to slave 2 of the second path (ATR)**
1972	**Value of address translation table corresponding to slave 3 of the second path (ATR)**
1973	**Value of address translation table corresponding to slave 4 of the second path (ATR)**
1974	**Value of address translation table corresponding to slave 5 of the second path (ATR)**
1975	**Value of address translation table corresponding to slave 6 of the second path (ATR)**
1976	**Value of address translation table corresponding to slave 7 of the second path (ATR)**
1977	**Value of address translation table corresponding to slave 8 of the second path (ATR)**
1978	**Value of address translation table corresponding to slave 9 of the second path (ATR)**
1979	**Value of address translation table corresponding to slave 10 of the second path (ATR)**

NOTE
When these parameters are set, the power must be turned off before operation is continued.

[Data type] Byte
[Valid data range] 0 to 7, 16, 40, 48

Set the values of address translation table corresponding to slaves 1 to 10 of the second path. The settings are the same as those of the first path (parameters No. 1910 to No. 1919).

1980	**Controlled axis number for slave 1 of the second path (dedicated to the FSSB setting screen)**
1981	**Controlled axis number for slave 2 of the second path (dedicated to the FSSB setting screen)**
1982	**Controlled axis number for slave 3 of the second path (dedicated to the FSSB setting screen)**
1983	**Controlled axis number for slave 4 of the second path (dedicated to the FSSB setting screen)**
1984	**Controlled axis number for slave 5 of the second path (dedicated to the FSSB setting screen)**
1985	**Controlled axis number for slave 6 of the second path (dedicated to the FSSB setting screen)**
1986	**Controlled axis number for slave 7 of the second path (dedicated to the FSSB setting screen)**
1987	**Controlled axis number for slave 8 of the second path (dedicated to the FSSB setting screen)**
1988	**Controlled axis number for slave 9 of the second path (dedicated to the FSSB setting screen)**
1989	**Controlled axis number for slave 10 of the second path (dedicated to the FSSB setting screen)**

NOTE

When these parameters are set, the power must be turned off before operation is continued.

[Data type] Byte

[Valid data range] 0 to 8

Set the controlled axis numbers for slaves 1 through 10 of the second path. Set the same values as for the first path (parameter Nos. 1920 through 1929).

1991	**Connector number for the first separate detector interface unit of the second path (dedicated to the FSSB setting screen)**
1992	**Connector number for the second separate detector interface unit of the second path (dedicated to the FSSB setting screen)**

NOTE

When these parameters are set, the power must be turned off before operation is continued.

[Data type] Byte axis

[Valid data range] 0 to the number of connectors of each separate detector interface unit

When using separate detector interface units, set the connector number of the separate detector interface unit for each axis (second path).

Set the same values as for the first path (parameter Nos. 1931 and 1932).

1993	Cs contour control axis of the second path (dedicated to the FSSB setting screen)

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

[Data type] Byte axis
[Valid data range] 0, 1

When exercising Cs contour control, set 1 for the axis (second path).
Set the same value as for the first path (parameter No. 1933).

1994	Master and slave axis numbers of the second path subject to tandem control (dedicated to the FSSB setting screen)

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

[Data type] Byte axis
[Valid data range] 0 to 8

When exercising tandem control, set an odd number and the subsequent even number for the master axis and slave axis, respectively (second path).
Set the same values as for the first path (parameter No. 1934).

1996	Connector number of the first separate detector interface unit of the second path
1997	Connector number of the second separate detector interface unit of the second path

NOTE
When these parameters are set, the power must be turned off before operation is continued.

[Data type] Byte axis
[Valid data range] 0 to 7

When using separate detector interface units, set the value obtained by subtracting 1 from the connector number of the separate detector interface unit for each axis (second path).
Set the same values as for the first path (parameter Nos. 1936 and 1937).

Parameters No.2000 to 2999 are for digital servo, The following parameters are not explained in this manual. Refer to FANUC AC SERVO MOTOR $\alpha is/\alpha i/\beta is$ series PARAMETER MANUAL (B-65270EN)

No.	Data type	Contents							
2000	Bit axis				PGEX	PRMC		DGPR	PLC0
2001	Bit axis	AMR7	AMR6	AMR5	AMR4	AMR3	AMR2	AMR1	AMR0
2002	Bit axis					PFSE			
2003	Bit axis	V0FS	OVSC	BLEN	NPSP	PIEN	OBEN	TGAL	
2004	Bit axis					TRW1	TRW0	TIB0	TIA0
2005	Bit axis	SFCM	BRKC					FEED	
2006	Bit axis				ACCF		PKVE		FCBL
2007	Bit axis	FRCA	FAD					IGVRO	ESP2AX
2008	Bit axis	LAXD	PFBS	VCTM	SPPC	SPPR	VFBA	TNDM	
2009	Bit axis	BLST	BLCU				ADBL		SERD
2010	Bit axis	POLE		HBBL	HBPE	BLTE	LINE		
2011	Bit axis			RCCL				FFALWY	SYNMOD
2012	Bit axis	STNG		VCM2	VCM1			MSFE	
2013	Bit axis	APTG							HRV3
2014	Bit axis	(Reserve)							
2015	Bit axis	BZNG	BLAT	TDOU				SSG1	PGTW
2016	Bit axis					K2VC			ABNT
2017	Bit axis	PK25	OVCR	RISC	HTNG				DBST
2018	Bit axis	PFBC					OVR8	MOVO	REVS
2019	Bit axis	DPFB						TANDMP	
2020	Word axis	Motor number							
2021	Word axis	Load inertia ratio							
2022	Word axis	Direction of motor rotation							
2023	Word axis	Number of velocity pulses							
2024	Word axis	Number of position pulses							
2028	Word axis	Position gain switching speed							
2029	Word axis	Effective speed for integral acceleration at low speed							
2030	Word axis	Effective speed for integral deceleration at low speed							
2033	Word axis	Position feedback pulse							
2034	Word axis	Vibration damping control gain							
2039	Word axis	Second-stage acceleration for two-stage backlash acceleration							
2040	Word axis	Current loop integral gain (PK1)							
2041	Word axis	Current loop proportional gain (PK2)							
2042	Word axis	Current loop gain (PK3)							
2043	Word axis	Velocity loop integral gain (PK1V)							
2044	Word axis	Velocity loop proportional gain (PK2V)							
2045	Word axis	Velocity loop incomplete integral gain (PK3V)							
2046	Word axis	Velocity loop gain (PK4V)							
2047	Word axis	Observer parameter (POA1)							
2048	Word axis	Backlash acceleration							
2049	Word axis	Maximum amplitude for dual position feedback							
2050	Word axis	Observer parameter (POK1)							
2051	Word axis	Observer parameter (POK2)							
2053	Word axis	Current dead zone compensation (PPMAX)							
2054	Word axis	Current dead zone compensation (PDDP)							
2055	Word axis	Current dead zone compensation (PHYST)							
2056	Word axis	Variable current loop gain during deceleration (EMFCMP)							
2057	Word axis	Phase D current at high-speed (PVPA)							

No.	Data type	Contents
2058	Word axis	Phase D current limit (PALPH)
2059	Word axis	Counterelectromotive force compensation (EMFBAS)
2060	Word axis	Torque limit
2062	Word axis	Overload protection coefficient (OVC1)
2063	Word axis	Overload protection coefficient (OVC2)
2064	Word axis	Soft disconnection alarm level
2065	Word axis	Overload protection coefficient (OCVLMT)
2066	Word axis	Acceleration feedback gain
2067	Word axis	Torque command filter
2068	Word axis	Feed forward coefficient
2069	Word axis	Velocity feed forward coefficient
2070	Word axis	Backlash acceleration timing
2071	Word axis	Time during which backlash acceleration is effective, Static friction compensation count
2072	Word axis	Static friction compensation
2073	Word axis	Stop judgment parameter
2074	Word axis	Velocity-dependent current loop gain
2077	Word axis	Overshoot prevention counter
2078	Word axis	Conversion coefficient for dual position feedback (numerator)
2079	Word axis	Conversion coefficient for dual position feedback (denominator)
2080	Word axis	First-order lag time constant for dual position feedback
2081	Word axis	Zero width for dual position feedback
2082	Word axis	Backlash acceleration stop amount
2083	Word axis	Brake control timer (msec)
2084	Word axis	Flexible feed gear (numerator)
2085	Word axis	Flexible feed gear (denominator)
2086	Word axis	Rated current parameter
2087	Word axis	Torque offset / Tandem control/Preload value
2088	Word axis	Machine velocity feedback coefficient gain
2089	Word axis	Backlash acceleration base pulse
2091	Word axis	Non-linear control parameter
2092	Word axis	Advanced preview feed forward coefficient
2094	Word axis	Backlash acceleration amount in the negative direction
2095	Word axis	Feed-forward timing adjustment coefficient
2097	Word axis	Static friction compensation stop parameter
2098	Word axis	Current phase lead compensation coefficient
2099	Word axis	N-pulse suppression level
2101	Word axis	Overshoot compensation effective level
2102	Word axis	Final clamp value for actual current limit
2103	Word axis	Amount of track back upon detection of unexpected disturbance torque
2104	Word axis	Unexpected disturbance torque detection alarm level in cutting (cutting when switching is used)
2105	Word axis	Torque constant
2107	Word axis	Velocity loop gain override
2109	Word axis	Fine acceleration/deceleration time constant (rapid traverse when switching is used)
2110	Word axis	Magnetic saturation compensation (base/coefficient)
2111	Word axis	Deceleration torque limit (base/coefficient)
2112	Word axis	AMR conversion coefficient 1
2113	Word axis	Resonance elimination filter 1: attenuation center frequency (Hz)
2114	Word axis	Stage 2 acceleration amount override for two-stage backlash acceleration
2116	Word axis	Unexpected disturbance torque detection, dynamic friction compensation value
2118	Word axis	Excessive error level between semi-closed and closed loops
2119	Word axis	Stop level with variable proportional gain

No.	Data type	Contents							
2126	Word axis	Tandem control, time constant for switching position feedback							
2127	Word axis	Non-interacting control coefficient							
2128	Word axis	Weak magnetic flux compensation (coefficient)							
2129	Word axis	Weak magnetic flux compensation (base/limit)							
2130	Word axis	Smoothing compensation performed twice per pole pair							
2131	Word axis	Smoothing compensation performed four times per pole pair							
2132	Word axis	Smoothing compensation performed six times per pole pair							
2133	Word axis	Deceleration phase delay compensation coefficient (PHDLY1)							
2134	Word axis	Deceleration phase delay compensation coefficient (PHDLY2)							
2137	Word axis	Stage 1 acceleration amount override for two-stage backlash acceleration							
2138	Word axis	Linear motor AMR conversion coefficient 2							
2139	Word axis	Linear motor AMR offset							
2142	Word axis	Threshold for detecting unexpected disturbance torque during rapid traverse							
2143	Word axis	Fine acceleration/deceleration time constant 2 (at cutting)							
2144	Word axis	Position feed forward coefficient for cutting							
2145	Word axis	Velocity feed forward coefficient for cutting							
2146	Word axis	Two-stage backlash acceleration end timer							
2148	Word axis	Deceleration decision level (HRV control)							
2154	Word axis	Static friction compensation function. Decision level for movement restart after stop.							
2156	Word axis	Torque command filter (at rapid cutting)							
2161	Word axis	OVC magnification at a stop (OVCSTP)							
2162	Word axis	Second overload protection coefficient (POVC21)							
2163	Word axis	Second overload protection coefficient (POVC22)							
2164	Word axis	Second overload protection coefficient (POVCLMT2)							
2165	Word axis	Maximum amplifier current							
2167	Word axis	Stage 2 acceleration amount offset for two-stage backlash acceleration							
2177	Word axis	Resonance elimination filter 1: attenuation bandwidth (Hz)							
2180	Word axis	Linear motor smoothing compensation : phase delay compensation.							
2185	Word axis	Position pulse conversion coefficient							
2200	Bit axis		P2EX	RISCMC		ABGO	IQOB		OVSP
2201	Bit axis		CPEE					RNVL	CROF
2202	Bit axis				DUAL	OVS1	PIAL	VGCG	FADCH
2203	Bit axis			TCMD4X	FRC2		CRPI		
2204	Bit axis	DBS2		PGW2				HSTP10	
2205	Bit axis				HDIS	HD2O	FLDY		
2206	Bit axis	HSSR			HBSF				
2207	Bit axis					PK2D50			
2209	Bit axis		PGAT			FADPGC	FADL		
2210	Bit axis		ESPTM1	ESPTM2			PK12S2		
2211	Bit axis							PHCP	
2212	Bit axis	OVQK	OVQK						
2214	Bit axis				FFCHG				
2215	Bit axis	ABT2						TCPCLR	
2223	Bit axis	BLCUT2							DISOBS
2225	Bit axis						TSA05	TCMD05	
2270	Bit axis	DSTIN	DSTTAN	DSTWAV		ACREF			AMR60
2271	Bit axis						RETR2		
2273	Bit axis							WSVCPY	
2274	Bit axis								HP2048
2275	Bit axis								800PLS
2318	Word axis	Disturbance elimination filter : gain							
2319	Word axis	Disturbance elimination filter : inertia ratio							

No.	Data type	Contents
2320	Word axis	Disturbance elimination filter : inverse function gain
2321	Word axis	Disturbance elimination filter : time constant
2322	Word axis	Disturbance elimination filter : acceleration feedback limit
2323	Word axis	Variable current PI rate
2324	Word axis	Variable proportional gain function in the stop state : arbitrary magnification at a stop (for cutting only)
2325	Word axis	Tandem disturbance elimination control function/integral gain (main axis) Tandem disturbance elimination control function/phase coefficient (sub-axis)
2326	Word axis	Disturbance input : gain
2327	Word axis	Disturbance input : start frequency
2328	Word axis	Disturbance input : end frequency
2329	Word axis	Number of disturbance input measurement points
2333	Word axis	Tandem disturbance elimination control function /incomplete integral time constant (main axis)
2334	Word axis	Current loop gain magnification (enabled only during high-speed HRV current control)
2335	Word axis	Velocity loop gain magnification (enabled only during high-speed HRV current control)
2338	Word axis	2-stage backlash acceleration function : stage-2 acceleration amount limit value
2339	Word axis	2-stage backlash acceleration function : stage-2 acceleration amount (negative direction)
2340	Word axis	2-stage backlash acceleration function : stage-2 acceleration amount override (negative direction)
2341	Word axis	2-stage backlash acceleration function : stage-2 acceleration amount limit value (negative direction)
2345	Word axis	Disturbance estimation function : dynamic friction compensation value in the stop state
2346	Word axis	Disturbance estimation function : dynamic friction compensation limit value
2352	Word axis	Active resonance elimination filter : detection level
2359	Word axis	Resonance elimination filter 1 : damping
2360	Word axis	Resonance elimination filter 2 : attenuation center frequency
2361	Word axis	Resonance elimination filter 2 : attenuation bandwidth
2362	Word axis	Resonance elimination filter 2 : damping
2363	Word axis	Resonance elimination filter 3 : attenuation center frequency
2364	Word axis	Resonance elimination filter 2 : attenuation bandwidth
2365	Word axis	Resonance elimination filter 3 : damping
2366	Word axis	Resonance elimination filter 4 : attenuation center frequency
2367	Word axis	Resonance elimination filter 4 : attenuation bandwidth
2368	Word axis	Resonance elimination filter 4 : damping
2369	Word axis	Smoothing compensation performed twice per pole pair (negative direction)
2370	Word axis	Smoothing compensation performed four times per pole pair (negative direction)
2371	Word axis	Smoothing compensation performed six times per pole pair (negative direction)
2373	Word axis	Lifting function against gravity at emergency stop : Distance to lift
2374	Word axis	Lifting function against gravity at emergency stop : Lifting time
2395	Word axis	Feed-forward timing adjustment function (for use when FAD is enabled)

4.19 PARAMETERS OF DI/DO

	#7	#6	#5	#4	#3	#2	#1	#0
3001	MHI			ZPO		RWM		
	MHI					RWM		

[Data type] Bit

RWM RWD signal indicating that rewinding is in progress
0 : Output only when the tape reader is being rewound by the reset and rewind signal RRW
1 : Output when the tape reader is being rewound or a program in memory is being rewound by the reset and rewind signal RRW

ZPO The reference position return completion signal for G28 or G30 is:
0 : Output upon completion of reference position return operation.
1 : Output at the time of positioning at the reference position after completion of reference position return operation.

> **NOTE**
> Even if a reference position return operation is performed in the machine lock state when this parameter is set to 0, the reference position return completion signal is output as the result of execution of G28 or G30.

MHI Exchange of strobe and completion signals for the M, S, T, and B codes
0 : Normal
1 : High-speed

	#7	#6	#5	#4	#3	#2	#1	#0
3002				IOV				

[Data type] Bit

IOV For the feedrate override signal, second feedrate override signal, and rapid traverse override signal:
0 : Negative logic is used.
1 : Positive logic is used.

	#7	#6	#5	#4	#3	#2	#1	#0
3003	MVG	MVX	DEC	DAU	DIT	ITX		ITL
		MVX	DEC		DIT	ITX		ITL

[Data type] Bit

ITL Interlock signal for all axes
0 : Enabled
1 : Disabled

ITX Interlock signals for each axis
0 : Enabled
1 : Disabled

DIT Interlock for each axis direction
0 : Enabled
1 : Disabled

DAU If bit 3 (DIT) of parameter No. 3003 is set to 0, the interlock signal of each axial direction is:
0 : Enabled only in manual operation and disabled in automatic operation.
1 : Enabled in both manual operation and automatic operation.

DEC Deceleration signal (*DEC1 to *DEC8) for reference position return
0 : Deceleration is applied when the signal is 0.
1 : Deceleration is applied when the signal is 1.

MVX The axis-in-movement signal is set to 0 when:
0 : Distribution for the axis is completed. (The signal is set to 0 in deceleration.)
1 : Deceleration of the axis is terminated, and the current position is in the in-position. (If, however, a parameter specifies not to make in-position during deceleration, the signal turns to "0" at the end of deceleration.)

MVG While drawing using the dynamic graphics function (with no machine movement), the axis-in-movement signal is:
0 : Output
1 : Not output

NOTE
In case of M series the signal is not output.

	#7	#6	#5	#4	#3	#2	#1	#0
3004			OTH				BCY	BSL

[Data type] Bit

BSL The block start interlock signal *BSL and cutting block start interlock signal *CSL are:
0 : Disabled.
1 : Enabled.

BCY When more than one operation is performed by one block command such as a canned cycle, the block start interlock signal *BSL is:
0 : Checked only at the beginning of the first cycle.
1 : Checked at the beginning of every cycle.

NOTE
This is enabled when bit 0 (BSL) of parameter No.3004 is set to 1.

OTH The overtravel limit signal is:
0 : Checked
1 : Not checked

⚠ WARNING
For safety, usually set 0 to check the overtravel limit signal.

	#7	#6	#5	#4	#3	#2	#1	#0
3006						EPS	EPN	GDC

[Data type] Bit

GDC As the deceleration signal for reference position return:
0 : X009/X007 is used.
1 : G196/G1196 is used. (X009/X007 is disabled.)

EPN Workpiece number search signals are assigned to:
0 : PN1, PN2, PN4, PN8, and PN16 <G009>.
1 : EPN0 to EPN13 <G024, G025>.

EPS When a program is searched using the workpiece number search function, it is started by:
0 : Automatic operation start signal ST (when automatic operation (memory operation) is started).
1 : Workpiece number search start signal EPNS <G025#7>. (Search is not started by ST.)

	#7	#6	#5	#4	#3	#2	#1	#0
3008						XSG		

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

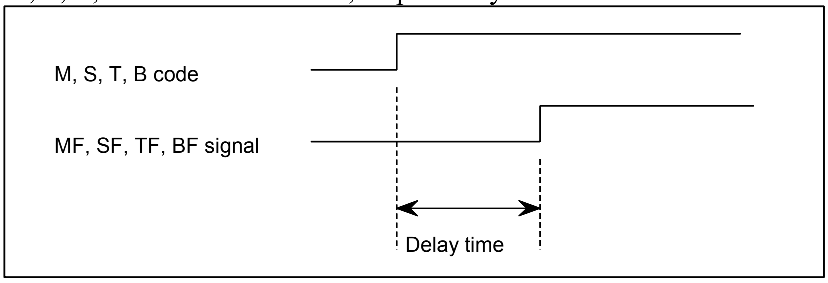
[Data type] Bit

XSG The signal assigned to an X address is:
0 : Assigned to a fixed address.
1 : Changeable to an arbitrary address. (However, the emergency stop signal *ESP<X008#4> cannot be changed.)
When this bit is set to 1, set parameter No. 3012 to No. 3014.

3010	Time lag in strobe signals MF, SF, TF, and BF

[Data type] Word
[Unit of data] msec
[Valid data range] 16 to 32767

The time required to send strobe signals MF, SF, TF, and BF after the M, S, T, and B codes are sent, respectively.

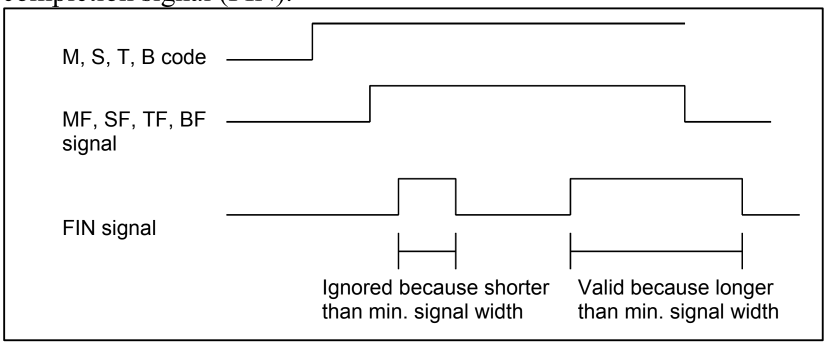


NOTE
The time is counted in units of 8 msec. If the set value is not a multiple of eight, it is raised to the next multiple of eight.
Example)
When 30 is set, 32 msec is assumed.
When 32 is set, 32 msec is assumed.
When 100 is set, 104 msec is assumed.

3011	Acceptable width of M, S, T, and B function completion signal (FIN)

[Data type] Word
[Unit of data] msec
[Valid data range] 16 to 32767

Set the minimum signal width of the valid M, S, T, and B function completion signal (FIN).



NOTE
The time is counted in units of 8 msec. If the set value is not a multiple of eight, it is raised to the next multiple of eight.
Example)
When 30 is set, 32 msec is assumed.

3012	Address to which the skip signal is to be assigned

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

[Data type] Word

[Valid data range] 0 to 127

Set an address to which the skip signal (SKIPn), measurement position arrival signal (XAE, YAE (M series only), ZAE), manual feed interlock signal for each axis direction, or tool offset value write signal (±MIT1 (T series only), ±MIT2 (T series only)) is to be assigned.
This parameter is valid when bit 2 (XSG) of parameter No. 3008 is set to 1.

3013	Address to which the deceleration signal for reference position return is to be assigned

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

[Data type] Word axis

[Valid data range] 0 to 127

Set an address to which the deceleration signal for reference position return (*DECn) for each axis is to be assigned.
This parameter is valid when bit 2 (XSG) of parameter No. 3008 is set to 1.

3014	Bit position to which the deceleration signal for reference position return is to be assigned

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

[Data type] Byte axis

[Valid data range] 0 to 7

Set a bit position to which the deceleration signal for reference position return (*DECn) for each axis is to be assigned. Set an address in parameter No. 3013.
This parameter is valid when bit 2 (XSG) of parameter No. 3008 is set to 1.

3017	Output time of reset signal RST

[Data type] Word
[Unit of data] 16 msec
[Valid data range] 0 to 255

To extend the output time of reset signal RST, the time to be added is specified in this parameter.
(RST signal output time) =
(time required for reset) + (parameter) × 16 msec

3030	Allowable number of digits for the M code

3031	Allowable number of digits for the S code

3032	Allowable number of digits for the T code

3033	Allowable number of digits for the B code (second auxiliary function)

[Data type] Byte
[Valid data range] 1 to 8

Set the allowable numbers of digits for the M, S, T, and B codes.

NOTE
Up to 5 digits can be specified in the S code

4.20 PARAMETERS OF DISPLAY AND EDIT (1 OF 2)

	#7	#6	#5	#4	#3	#2	#1	#0
3100	COR			FPT	FKY	SKY	CEM	
	COR				FKY	SKY	CEM	

[Data type] Bit

CEM On screens such as the operation history screen and help screen, keys on the MDI panel are indicated:
0 : In English.
1 : With graphics qualifying for CE marking. (A character generator supporting graphics qualifying for CE marking is required.)

SKY MDI key board use:
0 : Standard keys.
1 : Small keys.

> **NOTE**
> Set this parameter when using the 9.5"/10.4" LCD (with ten-soft key type display unit). After this parameter has been set, the power must be turned off then back on for the setting to become effective.

FKY MDI keyboard
0 : Small type keyboard is used.
1 : Standard keyboard is used.

> **NOTE**
> Set this parameter when using the 7.2"/8.4" LCD (with seven-soft key type display unit). After this parameter has been set, the power must be turned off then back on for the setting to become effective.

FPT MDI keyboard for Symbol CAP *i* T
0 : Not used.
1 : Used

> **NOTE**
> When Symbol CAP *i* T function is equipped, this parameter is not required to be set to 1.

COR Display
0 : Monochrome display
1 : Color display

> **NOTE**
> When using the 8.4" LCD, set this bit to 1.

	#7	#6	#5	#4	#3	#2	#1	#0
3101	SBA			BGD			KBF	
				BGD			KBF	

[Data type] Bit

KBF When the screen or mode is changed, the contents of the key-in buffer are:

0 : Cleared.

1 : Not cleared.

> **NOTE**
> When KBF = 1, the contents of the key-in buffer can all be cleared at one time by pressing the SHIFT key followed by the CAN key.

BGD In background editing, a program currently selected in the foreground:

0 : Cannot be selected. (BP/S alarm No.140 is issued disabling selection.)

1 : Can be selected. (However, the program cannot be edited, only displayed.)

SBA When two-path control is applied, the current positions on the current position display screen are displayed:

0 : In the order of path 1, followed by path 2.

1 : In the order of path 2, followed by path 1.

	#7	#6	#5	#4	#3	#2	#1	#0
3102		SPN	HNG	ITA	CHI	FRN	GRM	JPN
	DTH	SPN	HNG	ITA	CHI	FRN	GRM	JPN

	#7	#6	#5	#4	#3	#2	#1	#0
3119							POR	

	#7	#6	#5	#4	#3	#2	#1	#0
3190			CZE	SWE	HUN	POL		

> **NOTE**
> When these parameters are set, the power must be turned off before operation is continued.

[Data type] Bit

Select the language to be used for the display.

RUS	CH2	CZE	SWE	HUN	POL	POR	DTH	SPN	HNG	ITA	CHI	FRN	GRM	JPN	Language
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	English
0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	Japanese
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	German
0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	French
0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	Chinese (traditional character)
0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	Italian
0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	Korean
0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	Spanish
0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	Dutch
0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	Portuguese
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	Polish
0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	Hungarian
0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	Swedish
0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	Czech
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	Chinese (simplified character)
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Russian

	#7	#6	#5	#4	#3	#2	#1	#0
3103	ABR					NMH	DIP	
						NMH		

[Data type] Bit

D1P When two-path control is applied, the current position display screen displays:

0 : The current positions of the two paths regardless of the tool post select signal.

1 : The current position of a path selected by the tool post select signal.

> **NOTE**
> Set this parameter when using the seven-soft key type display unit.

NMH The system alarm history screen is:
0 : Not displayed.
1 : Displayed.

ABR When two-path control system using a seven-soft key type display unit and absolute position/relative position display requires two current position display screens (When the total number of control axes for both paths is 5 or more and the number of control axes for each path is 5 or less):
0 : The first screen displays path 1 data and the second screen displays path 2 data.
1 : The first screen displays the data of the path selected with the tool post selection signal and the second screen displays the data of the other path.

> **NOTE**
> When ABR=1, bit7 (SBA) of parameter No.3101 is disabled.

	#7	#6	#5	#4	#3	#2	#1	#0
3104	DAC	DAL	DRC	DRL	PPD			MCN

[Data type] Bit

MCN The machine position is:
0 : Displayed according to the output system.
(The machine position is displayed in millimeters for a metric output machine or in inches for an inch output machine, regardless of whether metric input/inch output is specified.)
1 : Displayed according to the unit of input.
(When input is made in mm, the machine position is displayed in mm, and when input is made in inches, the machine position is displayed in inches accordingly.)

PPD Relative position display when a coordinate system is set
0 : Not preset
1 : Preset

> **NOTE**
> When PPD is set to 1 and the absolute position display is preset by one of the following, the relative position display is also preset to the same value as the absolute position display:
> (1) The manual reference position return
> (2) Setting of a coordinate system by G92 (G50 for T series G code system A)

DRL Relative position

0 : The actual position displayed takes into account tool length compensation (M series) or tool offset (T series).

1 : The programmed position displayed does not take into account tool length compensation (M series) or tool offset (T series).

NOTE

1 When tool geometry compensation in the T series is performed by a coordinate system shift (bit 4 (LGT) of parameter No. 5002 is 0), the program position excluding the amount of tool geometry compensation is always displayed, regardless of the DRL setting.

2 Be sure to set this parameter to 0 when performing three-dimensional coordinate conversion or using the tilted working plane command.

DRC Relative position

0 : The actual position displayed takes into account cutter compensation (M series) or tool nose radius compensation (T series).

1 : The programmed position displayed does not take into account cutter compensation (M series) or tool nose radius compensation (T series).

NOTE

Be sure to set this parameter to 0 when performing three-dimensional coordinate conversion or using the tilted working plane command.

DAL Absolute position

0 : The actual position displayed takes into account tool length compensation (M series) or tool offset (T series).

1 : The programmed position displayed does not take into account tool length compensation (M series) or tool offset (T series).

NOTE

1 When tool geometry compensation in the T series is performed by a coordinate system shift (bit 4 (LGT) of parameter No. 5002 is 0), the program position excluding the amount of tool geometry compensation is always displayed, regardless of the DRL setting.

2 Be sure to set this parameter to 0 when bit 6 (DAK) of parameter No. 3106 is set to 1.

DAC Absolute position

0 : The actual position displayed takes into account cutter compensation (M series) or tool nose radius compensation (T series).

1 : The programmed position displayed does not take into account cutter compensation (M series) or tool nose radius compensation (T series).

NOTE

Be sure to set this parameter to 0 when bit 6 (DAK) of parameter No. 3106 is set to 1.

	#7	#6	#5	#4	#3	#2	#1	#0
3105						DPS	PCF	DPF
	SMF					DPS	PCF	DPF

[Data type] Bit

DPF Display of the actual speed on the current position display screen, program check screen and program screen (MD1 operation)

0 : Not displayed

1 : Displayed

PCF Addition of the movement of the PMC-controlled axes to the actual speed display

0 : Added

1 : Not added

NOTE

For each setting, movement along any axis other than those controlled by the CNC (see the description of parameter No. 1010) is not reflected in the actual speed display.

DPS Actual spindle speed and T code

0 : Not always displayed

1 : Always displayed

NOTE

For the M series, the threading and synchronous feed option is required to display the actual spindle speed.

SMF During simple synchronous control, movement along a slave axis is: (see the parameter No.8311)

0 : Included in the actual speed display

1 : Not included in the actual speed display

	#7	#6	#5	#4	#3	#2	#1	#0
3106	OHS	DAK	SOV	OPH	SPD		GPL	DHD
	OHS	DAK	SOV	OPH			GPL	

[Data type] Bit

DHD On the program screen, simultaneous multi-path editing is:
0 : Disabled.
1 : Enabled.

GPL Directory display and punch for each group is:
0 : Disabled
1 : Enabled

SPD During multi-spindle control, names for actual spindle speed values are displayed:
0 : Regardless of the selected spindle position coder (in second position coder selection signal (PC2SLC))
1 : Depending of the selected spindle position coder (in second position coder selection signal (PC2SLC))

SPD=0	SPD=1	
Spindles 1 and 2	Spindle 1	Spindle 2
S	S1	S2
SACT	SACT1	SACT2
ACT, S		

NOTE
When SPD is set to 1, during two-path control, the actual spindle speed names for a spindle of path 2 are displayed in reverse video.

OPH The operation history screen is:
0 : Not displayed.
1 : Displayed.

SOV The spindle override value is:
0 : Not displayed.
1 : Displayed.

NOTE
This parameter is enabled only when bit 2 (DPS) of parameter No.3105 is set to 1.

DAK When the tilted working plane command or three-dimensional coordinate conversion mode is used, absolute coordinates are displayed as follows:
0 : Coordinates in the program coordinate system (feature coordinate system) are displayed.
1 : Coordinates in the workpiece coordinate system are displayed.

NOTE
This parameter has an effect only when the tilted working plane command or three-dimensional coordinate conversion mode is used.

OHS Operation history sampling is:
0 : Performed. (Usually, set this parameter to 0 (to perform sampling).)
1 : Not performed.

	#7	#6	#5	#4	#3	#2	#1	#0
3107	MDL			SOR	REV	DNC		

[Data type] Bit

DNC Upon reset, the program display for DNC operation is:
0 : Not cleared
1 : Cleared

REV The unit of actual cutting feedrate display in the feed per revolution mode is:
0 : MM/MIN or INCH/MIN
1 : MM/REV or INCH/REV

SOR Display of the program directory
0 : Programs are listed in the order of registration.
1 : Programs are listed in the order of program number.

MDL Display of the modal state on the program display screen
0 : Not displayed
1 : Displayed (only in the MDI mode)

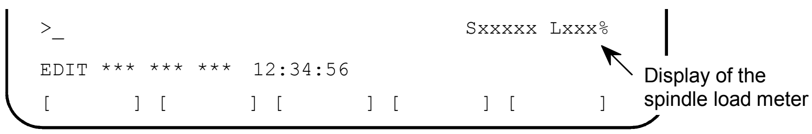
	#7	#6	#5	#4	#3	#2	#1	#0
3108	JSP	SLM		WCI		PCT		

[Data type] Bit

PCT On the seven-soft key display program check screen and twelve-soft key type display position screen, T code displayed
0 : Is a T code specified in a program (T).
1 : Is a T code specified by the PMC (HD. T/NX. T)
When the tool management function is used, a value displayed follows the setting of bit 1 (THN) of parameter No. 13200.

WCI On the workpiece coordinate system screen, a counter input is:
0 : Disabled.
1 : Enabled.

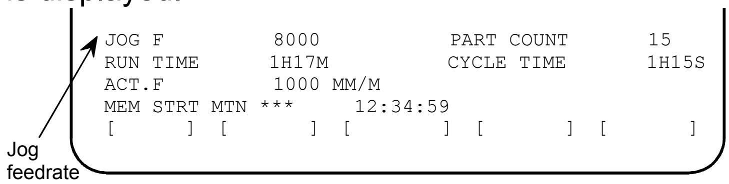
SLM The spindle load meter is:
0 : Not displayed.
1 : Displayed.



NOTE
1 This parameter is enabled only when bit 2 (DPS) of parameter No.3105 is set to 1.
2 This is valid only for serial spindles.

JSP On the current position display screen and program check screen, jog feedrate or dry run feedrate is:
0 : Not displayed.
1 : Displayed.

> **NOTE**
> In manual operation mode, the jog feedrate is displayed. In automatic operation mode, the dry run feedrate is displayed. In each case, the feedrate to which a manual feedrate override has been applied is displayed.



	#7	#6	#5	#4	#3	#2	#1	#0
3109			RHD			IKY	DWT	
		BGO	RHD			IKY	DWT	

[Data type] Bit

DWT Character W in the display of tool wear/geometry compensation amount
0 : The characters are displayed at the left of each number.
1 : The characters are not displayed.

IKY On the tool offset screen and workpiece shift screen (T series), soft key [INPUT] is:
0 : Displayed.
1 : Not displayed.

RHD When a manual handle interrupt is generated, the relative position display is:
0 : Not updated.
1 : Updated.

> **NOTE**
> This parameter is enabled when bit 2 (INH) of parameter No.7100 is 1.

BGO On the background drawing screen, when the OFFSET SETTING function key is pressed:
0 : The machining-side screen is resumed.
1 : A background drawing offset, workpiece coordinate system offset, and macro variable are displayed. (In this case, "BGGRP" appears in the bottom right section of the screen, enabling you to check the data for background drawing.)

	#7	#6	#5	#4	#3	#2	#1	#0
3110				OPC		AHC		OFA
				OPC		AHC		

[Data type] Bit

OFA The axis names on the offset screen, Y-axis offset screen, and 4th axis offset screen are:
0 : Always X, Z, Y, and E.
1 : As specified by parameter No. 1020.

AHC With a soft key, the alarm history:
0 : Can be cleared.
1 : Cannot be cleared.

OPC On the operation history screen, the [CLEAR] soft key is:
0 : Not enabled.
1 : Enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
3111	NPA	OPS	OPM			SVP	SPS	SVS

[Data type] Bit

SVS Servo tuning screen
0 : Not displayed
1 : Displayed

SPS Spindle tuning screen
0 : Not displayed
1 : Displayed

SVP Synchronization errors displayed on the spindle tuning screen
0 : Instantaneous values are displayed.
1 : Peak-hold values are displayed.

OPM Operating monitor
0 : Not displayed
1 : Displayed

OPS The speedometer on the operating monitor screen indicates:
0 : Spindle motor speed
1 : Spindle speed

NPA Action taken when an alarm is generated or when an operator message is entered
0 : The display shifts to the alarm or message screen.
1 : The display does not shift to the alarm or message screen.

	#7	#6	#5	#4	#3	#2	#1	#0
3112			OPH		EAH	OMH		SGD

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

SGD Servo waveform
0 : Not displayed
1 : Displayed

> **NOTE**
> If SGD is set to 1, no graphic display other than servo waveform display is done.

OMH The external operator message history screen is:
0 : Not displayed.
1 : Displayed.

EAH Messages of the external alarm/macro alarm in alarm history:
0 : Not recorded
1 : Recorded

OPH The operation history log function is:
0 : Displayed.
1 : Enable.

	#7	#6	#5	#4	#3	#2	#1	#0
3113	MS1	MS0	DCL					MHC

[Data type] Bit

MHC External operator message history data:
0 : Cannot be cleared.
1 : Can be cleared. (Such data can be cleared using the [CLEAR] soft key.)

DCL The compensation function for the touch panel on the display is:
0 : Disabled.
1 : Enabled.

MS0, MS1 A combination of the number of characters preserved as external operator message history data and the number of history data items is set according to the table below.

MS1	MS0	Number of history data characters	Number of history data items
0	0	255	8
0	1	200	10
1	0	100	18
1	1	50	32

NOTE
When the values of MS0 and MS1 are changed, all preserved external operator message history data is cleared.

	#7	#6	#5	#4	#3	#2	#1	#0
3114		ICS	IUS	IMS	ISY	IOF	IPR	IPO

[Data type] Bit

IPO When the POS function key is pressed while the position display screen is being displayed:
0 : The screen is changed.
1 : The screen is not changed.

IPR When the PROG function key is pressed while the program screen is being displayed:
0 : The screen is changed.
1 : The screen is not changed.

IOF When the OFFSET SETTING function key is pressed while the offset/setting screen is being displayed:
0 : The screen is changed.
1 : The screen is not changed.

ISY When the SYSTEM function key is pressed while the system screen is being displayed:
0 : The screen is changed.
1 : The screen is not changed.

IMS When the MESSAGE function key is pressed while the message screen is being displayed:
0 : The screen is changed.
1 : The screen is not changed.

IUS When the CUSTOM (using small MDI unit) or GRAPH (using standard MDI unit) function key is pressed while the custom or graphic screen is being displayed:
0 : The screen is changed.
1 : The screen is not changed.

ICS When the CUSTOM (using standard MDI unit) function key is pressed while the custom screen is being displayed:
0 : The screen is changed.
1 : The screen is not changed.

	#7	#6	#5	#4	#3	#2	#1	#0
3115			APLx		NDFx	SFMx	NDAx	NDPx
		D10x	APLx		NDFx		NDAx	NDPx

[Data type] Bit axis

NDPx Display of the current position for each axis
0 : The current position is displayed.
1 : The current position is not displayed.

> **NOTE**
> When using the electric gear box (EGB) function, set 1 for the EGB dummy axis to disable current position display.

NDAx Position display using absolute coordinates and relative coordinates is:
0 : Performed.
1 : Not performed. (Machine coordinates are displayed.)

SFMx In current position display, subscripts are:
0 : Added to the absolute, relative, and machine coordinate axis names.
1 : Assed only to the machine coordinate axis names.

> **NOTE**
> This parameter is disabled in the two-path control system.

NDFx To the actual speed display, axis movement data is:
0 : Added.
1 : Not added.

> **NOTE**
> Even if bit 1 (PCF) of parameter No.3105 is set to 0, so as to add PMC controlled axis movement data to the actual speed display, the movement data for a PMC controlled axis for which NDFx is set to 1 is not added to the actual speed display.

APLx When the active offset value modification mode based on manual feed is selected, relative position display is automatically:
0 : Not preset.
1 : Preset.

Use this parameter to return a modified offset value to the original value before modification in the active offset value modification mode based on manual feed. A modified offset value can be returned to the original value by making a manual movement on the axis so that the relative position display (counter) indicates the position of 0.

D10x The current positions (absolute position, relative position, machine position, remaining travel, and travel by manual handle interrupt), and workpiece origin offset are:
0 : Displayed as usual. (Not multiplied by ten.)
1 : Multiplied by ten, and displayed.

[Example]
The current position on the Y-axis is multiplied by ten and displayed.
X 1.2345 → X 1.2345
Y 1.2345 → Y 12.345
Z 1.2345 → Z 1.2345

	#7	#6	#5	#4	#3	#2	#1	#0
3116	MDC	T8D	COA	FOV		PWR		

[Data type] Bit
PWR Alarm No.100 (parameter enable) :
0 : Clear by CAN + RESET key
1 : Clear by RESET key
FOV In the field of specified feedrate F on the program check screen,
0 : The specified feedrate is displayed.
1 : (Specified feedrate) x (override) is displayed.
COA While an external alarm state is present or while an external message is being displayed, automatic screen erasure is:
0 : Performed.
1 : Not performed.

NOTE
The value of this parameter set for path 1 is valid.
The values of path 2/3 or loader are invalid.

T8D T codes that are always displayed are displayed with:
0 : Four digits.
1 : Eight digits.
This parameter expands the T code display to eight digits for the continuous S or T display (bit 2 (DPS) of parameter No. 3105 is set to 1).

MDC On the maintenance information screen, maintenance information by operating soft key :
0 : All clear disable.
1 : All clear enable.

	#7	#6	#5	#4	#3	#2	#1	#0
3117	P9D					ANS	SPP	
	P9D					ANS		SMS

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

SMS On the program check screen, the soft key to enable or disable the graph of spindle speed and load is:
0 : Not displayed.
1 : Displayed.

SPP On the diagnosis screen, spindle position data (the number of pulses from the position coder, detected after the detection of the one-revolution signal) is:
0 : Not displayed.
1 : Displayed. (Diagnosis Nos. 445 to 447)

ANS The axis name subscript set in parameter No. 3131 is:
0 : Displayed only for the current position.
1 : Displayed not only for the current position but also displayed on the parameter screen, diagnosis screen, alarm screen, and alarm history screen.

P9D The format of the screen displayed on the PC side by the CNC screen display function is:
0 : 14-inch type.
1 : 9-inch type.
This parameter is valid when the CNC is not equipped with a display unit.

	#7	#6	#5	#4	#3	#2	#1	#0
3118					AS4	AS3	AS2	AS1

[Data type] Bit

AS1 to AS4 When the actual spindle speeds (SACT) of the first spindle, second spindle, third spindle, and fourth spindle are displayed, each value is:
0 : The value calculated based on the feedback pulses from the position coder.
1 : The value calculated from the spindle motor speed (the same as the spindle speed displayed on the operating monitor screen).

> **NOTE**
> The fourth serial spindle can be used only with the Series 16*i*/160*i*/160*i*s.

	#7	#6	#5	#4	#3	#2	#1	#0
3119	NVG			F2K	TPA	DDS	POR	
	NVG				TPA	DDS	POR	

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

POR Display in Portuguese is:
0 : Disabled.
1 : Enabled.

DDS When the touch panel control option is available, the touch panel is:
0 : Enabled.
1 : Disabled.

TAP When the external touch panel interface option is available, the external touch panel is:
0 : Enabled.
1 : Disabled.

F2K As the LCD/MDI keyboard, Symbol CAP*i* T (CAP-II) combined with a unified standard keyboard is:
0 : Not used.
1 : Used.

NVG When a color display device is used, VGA mode is:
0 : Used.
1 : Not used. (Conventional type)

3120	Time from the output of an alarm to the termination of sampling (waveform diagnosis function)

[Data type] Word
[Unit of data] msec
[Valid data range] 1 to 32760

When the waveform diagnosis function is used, this parameter sets the time form the output of a servo alarm until data collection. Storage operation is stopped because of the alarm. (This means that the termination of data collection can be delayed by a specified time.)

3121	Selection of waveform diagnosis data of storage type (waveform diagnosis function)

[Data type] Byte
[Valid data range] 0 to 1

The sixth type of sampling data collected by waveform diagnosis of storage type is:
0 : Heat simulation data
1 : Spindle load meter

3122	Time interval used to record time data in operation history

[Data type] Word
[Unit of data] min
[Valid data range] 0 to 1439

Time data is recorded in operation history at set intervals.
When 0 is specified in this parameter, 10 minutes is assumed as the default. However, note that time data is not recorded if there is no data to be recorded at the specified time.

3123	Time until automatic screen clear function is applied

[Data type] Byte
[Unit of data] min
[Valid data range] 1 to 255

This parameter specifies the period that must elapse before the automatic screen clear function is applied.
This parameter is valid when bit 1 (COK) of parameter No. 3208 is 0. However, the automatic screen clear function is disabled if 0 is set in this parameter.

NOTE
1. When the automatic screen clear function is enabled, manual screen clearing with CAN+FUNCTION is disabled.
2. With two-path control, this parameter is valid only when it is set on the path 1 side.
3. For the Series 160*i*/180*i*/160*i*s/180*i*s, the CNC screen clear function is unavailable.

	#7	#6	#5	#4	#3	#2	#1	#0
3124	D08	D07	D06	D05	D04	D03	D02	D01
3125	D16	D15	D14	D13	D12	D11	D10	D09
3126	D24	D23	D22	D21	D20	D19	D18	D17
3127								D25

[Data type] Bit

Dxx (xx: 01 to 25) When modal G code is displayed on the program check screen and the program check-P screen when two-path control is applied, the xx group G code is:
0 : Displayed.
1 : Not displayed.

NOTE
Set these parameters when using the seven-soft key display unit.

3130	Axis display order for current position display screens

[Data type] Byte axis

[Valid data range] 0, 1 to the number of controlled axes

This parameter specifies the order in which axes are displayed on the current position display screens (absolute, relative, overall, and handle interrupt screens) during two-path control when the seven-soft key type display unit is used.

> **NOTE**
> This parameter is valid only for the common screens for two-path control. Axes are displayed in the order of their axis numbers on individual screens for each path and two-path simultaneous display screens.

3131	Subscript of each axis name

[Data type] Byte axis

This parameter specifies a subscript (one character) of each axis name with a code.

An axis name is followed by a subscript (one character) specified by this parameter.

For example, this parameter can be used to identify which path the coordinate of an axis displayed on the current position display screen belongs to.

> **NOTE**
> 1 When multi-path control is used, set this parameter for each path.
> 2 For characters and codes, see the correspondence table in Appendix A.
> 3 If the character code 0 is set when multi-path control is used, each path number is displayed as a subscript.

[Example] When the configuration of axes is X, Z, C and Y in path 1 and X, Z, and B in path 2

(1) Setting for path 1

Parameter 3131x	65 (A)	
Parameter 3131z	49 (1)	XA, Z1, CS, and Y1 are
Parameter 3131c	83 (S)	displayed as axis names.
Parameter 3131y	0 (1)	

(2) Setting for path 2

Parameter 3131x	66 (B)	XB, Z2, and B are
Parameter 3131z	0 (2)	displayed as axis names.
Parameter 3131b	32 (space)	

3132	Axis name (absolute coordinate) for current position display

3133	Axis name (relative coordinate) for current position display

[Data type] Byte axis

[Valid data range] 0 to 255

These parameters set the axis name for current position display.

When G code system B or C is used, the axis name set in parameter No.3132 is used for both absolute and relative coordinate axes.

The values set in these parameters are used only for display.

For a command address, the axis name set in parameter No.1020 is used.

When 0 is specified in these parameters, the value set in parameter No.1020 is used.

3134	Axis display order on workpiece coordinate system screen and workpiece shift screen

[Data type] Byte axis

[Valid data range] 0, 1 to the number of controlled axes

This parameter specifies the order in which axes are displayed on the workpiece coordinate system screen and workpiece shift screen (for T series).

When the parameters of all axes are set to 0, all axes are displayed.

When the parameters of some axes are set, the axes for which a value of 0 is specified do not appear. The displayed axes are consecutive without spaces being left for non-displayed axes.

3140	Display color for path name

[Data type] Byte

[Valid data range] -7 to 7

This parameter sets the display color for a path name.
When screen display supporting VGA is used (bit 7 (NVG) of parameter No. 3119 = 0), set a color assignment number. Use the color setting screen to check the relationships between settings and display colors. When 0 is set in this parameter, color assignment number 3 is used.
When screen display not supporting VGA is used (bit 7 (NVG) of parameter No. 3119 = 1), set a color number.
The values that can be set and their corresponding display colors are shown in the following table:

Setting	Display color
0	Standard display colors (*1)
1/-1	Red/red in reverse video
2/-2	Green/green in reverse video
3/-3	Yellow/yellow in reverse video
4/-4	Blue/blue in reverse video
5/-5	Purple/purple in reverse video
6/-6	Light blue/light blue in reverse video
7/-7	White/white in reverse video

*1 The standard display colors are as follows:
Status display for path 1: Yellow
Status display for path 2: Yellow in reverse video

3141	Path name (1st character)
3142	Path name (2nd character)
3143	Path name (3rd character)
3144	Path name (4th character)
3145	Path name (5th character)
3146	Path name (6th character)
3147	Path name (7th character)

[Data type] Byte

Specify a path name with codes (two-path control).

Any character string consisting of alphanumeric characters, katakana characters, and special characters with a maximum length of seven characters can be displayed as a series name.

NOTE

1 These parameters are dedicated to the two-path control.
  Specify these parameters for each series.

2 For characters and codes, see the correspondence table in Appendix A.

3 When codes are 0, HEAD1 and HEAD2 for T series and PATH1 or PATH2 for M series are displayed.

[Example] When the names of path 1 and 2 are specified as TURRET1 and TURRET2, respectively.

(1) Setting for path 1	(2) Setting for path 2
Parameter No. 3141 = 84 (T)	Parameter No. 3141 = 84 (T)
Parameter No. 3142 = 85 (U)	Parameter No. 3142 = 85 (U)
Parameter No. 3143 = 82 (R)	Parameter No. 3143 = 82 (R)
Parameter No. 3144 = 82 (R)	Parameter No. 3144 = 82 (R)
Parameter No. 3145 = 69 (E)	Parameter No. 3145 = 69 (E)
Parameter No. 3146 = 84 (T)	Parameter No. 3146 = 84 (T)
Parameter No. 3147 = 49 (1)	Parameter No. 3147 = 50 (2)

3150	Display title character color

[Data type] Byte

[Valid data range] 0 to 7

Specify a display title character color by selecting a color assignment number or color number.

When screen display supporting VGA is used (bit 7 (NVG) of parameter No. 3119 = 0), set a color assignment number. Use the color setting screen to check the relationships between settings and display colors. When 0 is set in this parameter, color assignment number 2 is used.

When screen display not supporting VGA is used (bit 7 (NVG) of parameter No. 3119 = 1), set a color number.

The values that can be set and their corresponding display colors are shown in the following table:

If 0 or a value not within the valid data range is set in this parameter, the standard color (green) is used as display title character color.

Setting	Display color
0	Standard display color(green)
1	Red
2	Green
3	Yellow
4	Blue
5	Purple
6	Light blue
7	White

3151	Number of the axis for which the 1st load meter for the servo motor is used
3152	Number of the axis for which the 2nd load meter for the servo motor is used
3153	Number of the axis for which the 3rd load meter for the servo motor is used
3154	Number of the axis for which the 4th load meter for servo motor is used
3155	Number of the axis for which the 5th load meter for servo motor is used
3156	Number of the axis for which the 6th load meter for servo motor is used
3157	Number of the axis for which the 7th load meter for servo motor is used
3158	Number of the axis for which the 8th load meter for servo motor is used

[Data type] Byte

[Valid data range] 0, 1, . . . , the number of control axes

Set the numbers of the axes for which measurement values on the load meters for the eight servo motors are displayed on the operating monitor screen. Set the parameters to 0 for those axes for which a load meter need not be displayed.

3163	Time required to smooth the spindle load meter readings

[Data type] Byte
[Unit of data] 32 msec
[Valid data range] 0 to 32

When the spindle load meter reading is displayed (see the description of bit 6 (SLM) of parameter No.3108), smoothing can be applied to the spindle load meter reading to prevent flickering. This parameter sets the time width for smoothing.

Setting	Time for smoothing (msec)
0	256
1	32
2	64
3	96
:	:
32	1024

Each smoothing operation is performed for a time width of between 32 msec and 1024 msec.

3170	Number of units connected for the CRT link function

[Data type] Byte
[Valid data range] 0 to 16

When multiple CNCs share the LCD/MDI unit for the CRT link, set the number of units connected. The parameter setting for a device with device number 0 is valid.
When 0 is set in this parameter, a setting is made for connection of two units.

3181	Blinking character in high-precision contour control mode (1st character)
3182	Blinking character in high-precision contour control mode (2nd character)
3183	Blinking character in high-precision contour control mode (3rd character)
3184	Blinking character in high-precision contour control mode (4th character)
3185	Blinking character in high-precision contour control mode (5th character)
3186	Blinking character in high-precision contour control mode (6th character)
3187	Blinking character in high-precision contour control mode (7th character)

[Data type] Byte
[Valid data range] 0 to 255

By using character codes, set blinking characters to be used in the high-precision contour control mode.

NOTE
1. Set character codes according to the character code list in Appendix A.
2. When 0 is set, HPCC blinks.

	#7	#6	#5	#4	#3	#2	#1	#0
3190	RUS	CH2	CZE	SWE	HUN	POL		

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

POL Display in Polish is:
0 : Not performed.
1 : Performed.

HUN Display in Hungarian is:
0 : Not performed.
1 : Performed.

SWE Display in Swedish is:
0 : Not performed.
1 : Performed.

CZE Display in Czech is:
0 : Not performed.
1 : Performed.

CH2 Display in Chinese simplified characters is:
0 : Not performed.
1 : Performed.

RUS Display in Russian is:
0 : Not performed.
1 : Performed.

	#7	#6	#5	#4	#3	#2	#1	#0
3191		CAP	FSS		STS			FPS
		CAP			STS	WKI		

[Data type] Bit

FPS The unit of display of the numeric part of actual cutting feedrate display in the feed per revolution mode is:
0 : Feedrate per minute.
1 : Feedrate per spindle revolution.

WKI On the workpiece coordinate system setting screen, the soft key [INPUT] is:
0 : Displayed.
1 : Not displayed.

STS When data is input on the setting screen, a confirmation message is:
0 : Not displayed.
1 : Displayed.

FSS When bit 3 (REV) of parameter No. 3107 is set to 1, and bit 0 (FPS) of parameter No. 3191 is set to 1, the unit of actual cutting feedrate display is:
0 : [mm/min, inch/mm] in the feed per minute mode or [mm/rev, inch/rev] in the feed per revolution mode
1 : [mm/rev, inch/rev] at all times

CAP The display position of the [ALL] soft key displayed after pressing the [CLEAR] soft key for clearing an offset value on the offset screen is:
0 : Not changed.
1 : Changed.

> **NOTE**
> The [ALL] soft key is displayed at the same position as the [CLEAR] soft key. So, if the [CLEAR] soft key is pressed twice inadvertently, all offset data may be cleared.
> When this parameter is set to 1, the display position of the [ALL] soft key is changed. So, even if the [CLEAR] soft key is pressed twice inadvertently, there is no risk of clearing all offset data.

	#7	#6	#5	#4	#3	#2	#1	#0
3192	PLD		RDM			TRA	T2P	TTP
			RDM			TRA	T2P	

[Data type] Bit

TTP Under multi-path control, on the parameter screen, diagnosis screen, and setting screen (parameter portion) of paths 1 and 2, numbers are:
0 : Checked.
1 : Not checked.
In the third path under three-path control by 2 CPUs, numbers are not checked on the screens indicated above.

T2P If two points are pressed on the touch panel, it is assumed that:
0 : A mid point is pressed.
1 : The first point is pressed.

> **NOTE**
> 1 If two or more points are pressed during a sampling period, it is assumed that a mid point is pressed.
> 2 If a C executer application or the like has a touch panel drag (move in pressed state) function, set this parameter to 0.
> 3 In open CNC, the parameter is valid just for CNC screen display function.

TRA If a point on the touch panel is kept pressed for a time specified in parameter No. 3197 or longer,
0 : P/S alarm (No. 5303) is not raised.
1 : P/S alarm (No. 5303) is raised.

NOTE
1 If an C executer application or the like has a touch panel repeat (continue pressing) function, set this parameter to 0.
2 In open CNC, the parameter is valid just for the CNC screen display function.

RDM Machine remote diagnosis message notification function is:
0 : Valid.
1 : Invalid.

PLD When a 9.5/10.4-inch display unit is used, current position display on the left side of the display screen in a 1-path system, and the servo axis load meter and spindle load meter display function on the program check screen in a 2-path or 3-path system are:
0 : Disabled.
1 : Enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
3194							RPR	RPD
					DPD	DPR		

[Data type] Bit

RPD When the diameter/radius dynamic switching function is enabled and the radius value command mode is set, an absolute coordinate, relative coordinate, and distance to go on a diameter axis are:
0 : Displayed as radius values. (Half of diameter values)
1 : Displayed as diameter values.

RPR When the diameter/radius dynamic switching function is enabled and the radius value command mode is set, a machine coordinate on a diameter axis is:
0 : Displayed as a diameter value.
1 : Displayed as a radius value. (Half of a diameter value)

DPR When the diameter/radius dynamic switching function is enabled and the diameter value command mode is set, an absolute coordinate, relative coordinate, and distance to go on a radius axis are:
0 : Displayed as diameter values. (Two times greater than radius values)
1 : Displayed as radius values.

DPD When the diameter/radius dynamic switching function is enabled and the diameter value command mode is set, a machine coordinate on a radius axis is:
0 : Displayed as a radius value.
1 : Displayed as a diameter value. (Two times greater than a radius value)

	#7	#6	#5	#4	#3	#2	#1	#0
3195						CPR		

[Data type] Bit

CPR With the function key SYSTEM, the parameter set supporting screen is:
0 : Displayed.
1 : Not displayed.

3197	Detection time of continuous pressing on touch panel

[Data type] Byte
[Unit of data] sec
[Valid data range] 0 to 255

This parameter is valid if bit 2 (TRA) of parameter No. 3192 is set to 1.
Set a period of continuous pressing on the touch panel which causes P/S5305 alarm to be raised. If 0 is set, a period of 20 s is assumed.

	#7	#6	#5	#4	#3	#2	#1	#0
3201	MIP	NPE	N99		PUO	REP	RAL	RDL

[Data type] Bit

RDL When a program is registered by input/output device external control
0 : The new program is registered following the programs already registered.
1 : All registered programs are deleted, then the new program is registered. Note that programs which are protected from being edited are not deleted.

RAL When programs are registered through the reader/puncher interface
0 : All programs are registered.
1 : Only one program is registered.

REP Action in response to an attempt to register a program whose number is the same as that of an existing program
0 : An alarm is generated.
1 : The existing program is deleted, then the new program is registered. Note that if the existing program is protected from being edited, it is not deleted, and an alarm is generated.

PUO When address O of a program number is output in ISO code:
0 : ":" is output.
1 : "O" is output.

N99 With an M99 block, when bit 6 (NPE) of parameter No.3201 is set to 0, program registration is assumed to be:
0 : Completed
1 : Not completed

NPE With an M02, M30, or M99 block, program registration is assumed to be:
0 : Completed
1 : Not completed

MIP Program registration by external start signal (MINP) :
0 : Not performed.
1 : Performed.

		#7	#6	#5	#4	#3	#2	#1	#0
3202			PSR	CPD	NE9	OSR	CND	OLV	NE8

[Data type] Bit

NE8 Editing of subprograms with program numbers 8000 to 8999
0 : Not inhibited
1 : Inhibited
The following edit operations are disabled:
(1) Program deletion (Even when deletion of all programs is specified, programs with program numbers 8000 to 8999 are not deleted.)
(2) Program output (Even when outputting all programs is specified, programs with program numbers 8000 to 8999 are not output.)
(3) Program number search
(4) Program editing of registered programs
(5) Program registration
(6) Program collation
(7) Displaying programs

OLV When a program other than the selected program is deleted or output:
0 : The display of the selected program is not held.
1 : The display of the selected program is held.

CND By using the [CONDENSE] soft key on the program directory screen, the program condensing operation is:
0 : Not performed. (The [CONDENSE] soft key is not displayed.)
1 : Performed.

OSR In programming number search, when pressing soft key [O SRH] without inputting program number by key :
0 : Search the following program number
1 : Operation is invalid

NE9 Editing of subprograms with program numbers 9000 to 9999
0 : Not inhibited
1 : Inhibited
The following program editing during operation is invalid.
(1) Program deletion (Even when deletion of all programs is specified, programs with program numbers 9000 to 9999 are not deleted.)
(2) Program punching (Even when punching of all programs is specified, programs with program numbers 9000 to 9999 are not punched.)
(3) Program number search
(4) Program editing after registration
(5) Program registration
(6) Program collation
(7) Displaying programs

CPD When an NC program is deleted, a confirmation message and confirmation soft key are:
0 : Not output.
1 : Output.

PSR Search for the program number of a protected program
0 : Disabled
1 : Enabled

> **NOTE**
> If this parameter is set, a protected program is also displayed.

	#7	#6	#5	#4	#3	#2	#1	#0
3203	MCL	MER	MZE	PIO				
	MCL	MER	MZE					

[Data type] Bit

PIO When two-path control is controlled, program input/output is:
0 : Controlled separately for each tool post.
1 : Controlled on a two-path control basis for path 1 and path 2.

MZE After MDI operation is started, program editing during operation is:
0 : Enabled
1 : Disabled

MER When the last block of a program has been executed at single block operation in the MDI mode, the executed block is:
0 : Not deleted
1 : Deleted

> **NOTE**
> When MER is set to 0, the program is deleted if the end-of-record mark (%) is read and executed. (The mark % is automatically inserted at the end of a program.)

MCL Whether a program prepared in the MDI mode is cleared by reset
0 : Not deleted
1 : deleted

	#7	#6	#5	#4	#3	#2	#1	#0
3204		MKP	SPR	P9E	P8E	EXK		PAR

[Data type] Bit

PAR When a small keyboard is used, characters "[" and "]" are:
0 : Used as "[" and "]".
1 : Used as "(" and ")".

EXK During program editing in the EDIT mode, character input with soft key [C-EXT] is:
0 : Performed. ([C-EXT] soft key is displayed.)
1 : Not performed.

NOTE
The [C-EXT] soft key is used to select an operation on the program screen. This soft key enables the entry of "(", ")", and "@" using soft keys. This soft key is useful when using the small MDI keyboard, which does not have the "(", ")", and "@" keys.

P8E Editing of subprograms 80000000 to 89999999 is:
0 : Not inhibited
1 : Inhibited
The following editing types become impossible.
(1) Program deletion (Even when deletion of all programs is specified, programs with program numbers 80000000 to 89999999 are not deleted.)
(2) Program punching (Even when punching of all programs is specified, programs with program numbers 80000000 to 89999999 are not punched.)
(3) Program number search
(4) Program editing after registration
(5) Program registration
(6) Program collation
(7) Displaying programs

NOTE
This parameter is valid when the program number O8-digit option is selected.

P9E Editing of subprograms 90000000 to 99999999 are:
0 : Not inhibited
1 : Inhibited
The following editing types become impossible.
(1) Program deletion (Even when deletion of all programs is specified, programs with program numbers 90000000 to 99999999 are not deleted.)
(2) Program punching (Even when punching of all programs is specified, programs with program numbers 90000000 to 99999999 are not punched.)
(3) Program number search
(4) Program editing after registration
(5) Program registration
(6) Program collation
(7) Displaying programs

NOTE
This parameter is valid when the program number O8-digit option is selected.

SPR Program numbers in the 9000 range for specific programs are:
0 : Not added with 90000000
1 : Added with 90000000
[Example]
The program numbers for G codes used to call custom macros are as follows:
SPR = 0: 00009010 to 00009019
SPR = 1: 90009010 to 90009019
Subprogram numbers 9500 to 9510 used by the pattern data input function are as follows:
SPR = 0: 00009500 to 00009510
SPR = 1: 90009500 to 90009510

> **NOTE**
> This parameter is valid when the program number O8-digit option is selected.

MKP When M02, M30, or EOR(%) is executed during MDI operation, the created MDI program is:
0 : Erased automatically.
1 : Not erased automatically.

> **NOTE**
> If the bit 6 (MER) of parameter No. 3203 is 1, executing the last block provides a choice of whether to automatically erase a created program.

	#7	#6	#5	#4	#3	#2	#1	#0
3205	MCK	BGF	BGC	OSC	PNS	CMO	CHG	COL

[Data type] Bit
COL When a program is displayed or output, any colons (:) in the comments of the program are:
0 : Converted to letter O
1 : Displayed or output as is
CHG When the change function of the extended edit function is used:
0 : Once the user has decided whether to make a change, the cursor is moved to the target position.
1 : The cursor is moved to the change source, after which the user can choose whether to make a change.
CMO In extended tape editing, the copy or move operation:
0 : Is performed in the usual way.
1 : Can also copy or move data from a program to a key-in buffer in units of words.
PNS On the program screen, a search by a cursor key is:
0 : Performed.
1 : Not performed.
OSC On the offset screen, offset value erasure by a soft key is:
0 : Enabled.
1 : Disabled.

BGC When background editing is started:
- 0 : Programs to be edited are initialized (to the state where no selection is made).
- 1 : The editing of the previously edited program is continued. (Continued editing is possible only when foreground editing and operation are not performed (to allow continued editing).)

BGF Background editing or program registration from a FOCAS1/DNC1/DNC2 host is performed using:
- 0 : Standard method.
- 1 : High-speed method.

MCK The system tape memory check function is:
- 0 : Not used.
- 1 : Used. (This setting is inhibited.)

	#7	#6	#5	#4	#3	#2	#1	#0
3206	NS2	DWB	S2K	PHS		3CP	MIF	PCP
	NS2	DWB	S2K	PHS			MIF	PCP

[Data type] Bit

PCP Program copy operation between two paths is
- 0 : Disabled.
- 1 : Enabled.

MIF Editing of the maintenance information screen is:
- 0 : Not prohibited.
- 1 : Prohibited.

3CP Program copy operation among three paths is:
- 0 : Disabled.
- 1 : Enabled.

PHS The selection of an operation history signal and parameters (No. 12801 to No. 128900) are:
- 0 : Not linked.
- 1 : Linked.

S2K In dual screens of CNC display screen function, key control is switched by:
- 0 : DI signal <G0295#7>.
- 1 : Pressing the top-left corner of the screen. (A touch panel is required.)

DWB Absolute position display in the three-dimensional coordinate conversion mode using BOP:
- 0 : Is based on coordinates in the workpiece coordinate system.
- 1 : Follows the setting of bit 6 (DAK) of parameter No. 3106.

NS2 Dual screens of CNC display screen function are:
- 0 : Not used.
- 1 : Used.

	#7	#6	#5	#4	#3	#2	#1	#0
3207								OM4

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

OM4 A message displayed on the external operator message screen can have:
0 : Up to 256 characters, and just a single message can be displayed.
1 : Up to 64 characters, and up to four messages can be displayed.

	#7	#6	#5	#4	#3	#2	#1	#0
3208							COK	SKY

[Data type] Bit

SKY The function key SYSTEM on the MDI panel is:
0 : Enabled.
1 : Disabled.

COK The automatic screen erase function is:
0 : Enabled.
1 : Disabled.

NOTE
1 The setting specified for path 1 is followed. The setting for path 2/3 or loader is ignored.
2 If this parameter is set to 1, manual screen erasure by the CAN + FUNCTION key is enabled, irrespective of the setting of parameter No. 3123.

	#7	#6	#5	#4	#3	#2	#1	#0
3209				UPP		NFU		MPD

[Data type] Bit

MPD When a subprogram is executed, the main program number is:
0 : Not displayed.
1 : Displayed. (for 10.4” LCD and 9.5” LCD)

NFU If a function key is pressed to clear or display the screen display with the erase CRT screen display function/automatic Erase CRT screen display function, screen switching based on the function key is:
0 : Performed.
1 : Not performed.

UPP A program protected using cnc_upload3() of the FOCAS1/ETHERNET function is:
0 : Not uploaded.
1 : Uploaded if searchable.

3210	Password

[Data type] 2-word

This parameter sets a password for protecting program Nos. 9000 to 9999. When a value other than zero is set in this parameter and this value differs from the keyword set in parameter No.3211, bit 4 (NE9) of parameter No.3202 for protecting program Nos. 9000 to 9999 is automatically set to 1. This disables the editing of program Nos. 9000 to 9999. Until the value set as the password (set in parameter No. 3210) is set as a keyword (set in parameter No. 3211), NE9 cannot be set to 0 and the password cannot be modified.

NOTE

1. The state where password ≠ 0 and password ≠ keyword is referred to as the locked state. When an attempt is made to modify the password by MDI input operation in this state, the warning message "WRITE PROTECTED" is displayed to indicate that the password cannot be modified. When an attempt is made to modify the password with G10 (programmable parameter input), P/S alarm No.231 is issued.
2. When the value of the password is not 0, the parameter screen does not display the password. Care must be taken in setting a password.

3211	Keyword

[Data type] 2-word

When the value set as the password (set in parameter No.3210) is set in this parameter, the locked state is released and the user can now modify the password and the value set in bit 4 (NE9) of parameter No.3202.

NOTE

The value set in this parameter is not displayed. When the power is turned off, this parameter is set to 0.

3216	Increment in sequence numbers inserted automatically

This parameter can also be set on the “Setting screen”.

[Data type] Word

[Valid data range] 0 to 9999

Set the increment for sequence numbers for automatic sequence number insertion (when bit 5 (SEQ) of parameter No. 0000, is set to 1.)

3218	
	Program number to be registered in input/output simultaneous operation (4-digit program number)

[Data type] Word

[Valid data range] 1 to 9999

When a program entered through the input/output unit is executed and registered in memory at the same time in input/output simultaneous operation, this parameter sets a program number for that program.

> **NOTE**
> 1 If a value that falls outside the valid data range is specified, the number of the input program is used as is as the registered program number.
> 2 When the 8-digit program number function is used, use parameter No.3219 instead of parameter No.3218.

3219	**Program number to be registered in synchronous input/output operation (8-digit program number)**

[Data type] 2-word

[Valid data range] 0 to 99999999

When a program entered through the input/output unit is executed and registered in memory at the same time in synchronous input/output operation, this parameter sets a program number for that program.

> **NOTE**
> 1 If a value that falls outside the valid data range is specified, the number of the input program is used as is as the registered program number.
> 2 When the 8-digit program number function is not used, use parameter No.3218 instead of parameter No.3219.

3220	Password

[Data type] 2-word
[Valid data range] 0 to 99999999

This parameter sets a password.
When a value other than zero is set for this parameter, it is regarded as being a password. Once a password has been set, the display of the setting (password) field is cleared. In addition, program display, input/output, and editing operations are locked.
The parameter can be set when the parameter is unlocked, that is, when the parameter is 0, or when the value of this parameter is the same as the keyword (parameter No.3221).

NOTE
This parameter is used to encrypt keys and programs.

3221	Keyword

[Data type] 2-word
[Valid data range] 0 to 99999999

When the same value as the password is set in this parameter, the lock is released (unlock state). The value set in this parameter is not displayed.

NOTE
This parameter is used to encrypt keys and programs.

3222	Program protection range (minimum value)

3223	Program protection range (maximum value)

[Data type] 2-word
[Valid data range] 0 to 9999

Those programs whose program numbers are within the range set in these parameters can be locked. These parameters set the minimum and maximum values of the program numbers to be locked.

[Example] When the minimum value = 7000 and the maximum value = 8499, programs O7000 to O8499 are locked.
When the minimum value = 0 and the maximum value = 0, programs O9000 to O9999 are locked.

3225	Code for safety parameters

[Data type] 2-word

[Valid data range] 0 to 99999999

Set a code (password) for protecting against modifications to parameters related to the dual check safety function (safety parameters). When a code for safety parameters is set, the parameters are locked. At this time, the setting (code) is not displayed but is blank, and safety parameter input is disabled. If an attempt is made to input data in a locked safety parameter, the result indicated in the table below is produced, depending on the method of input. No attempt is successful.

Input method	Result
MDI input	Warning "WRITE PROTECT"
G10 (programmable parameter input)	P/S231 FORMAT ERROR IN G10 L50
Input via the reader/puncher interface	No alarm is issued, but parameter input is disabled.
Input through a window	Completion code 7 (write protect)

A code for safety parameters can be set when the safety parameters are not locked, that is, when the code for safety parameters is 0, or when the code for safety parameters is the same as the key for safety parameters (No. 3226).

The following safety parameters are protected by a code for safety parameters:

No.1023, No.1829, No.1838, No.1902#3, No.1902#5, No.1902 #6, No.1904#0, No.1904#1, No.1904#2, No.1904#3, No.1904#4, No.1904#5, No1904#6, No.1942, No.1943, No.1944, No.1945, No.1946, No.1947, No.1948, No.1950, No.1959, No.3225, No.4372, No.4438, No.4440, No.4442, No.13821 to No.13824, No.13831 to No.13838, No.13880 to No.13911, No.13920 to No.13951, No.13960 to No.13991

3226	Key for safety parameters

[Data type] 2-word

[Valid data range] 0 to 99999999

When the same value as the code for safety parameters is set in this parameter, the key is opened to enable modifications to the safety parameters. The value set in this parameter is not displayed. When the power is turned off, the value set in this parameter is cleared, resulting in the locked state.

NOTE

Once a key is set, the key must be cancelled or memory must be cleared before the safety parameters can be modified. Moreover, the code for the safety parameters cannot be modified. Be careful when setting a code for safety parameters.

	#7	#6	#5	#4	#3	#2	#1	#0
3232					P9D	P8D	ND9	ND8

[Data type] Bit

ND8 When a program with a program number from 8000 to 8999 is being executed as a subprogram or macro program, the display of the program on the program screen is:
0 : Not prohibited.
1 : Prohibited.

ND9 When a program with a program number from 9000 to 9999 is being executed as a subprogram or macro program, the display of the program on the program screen is:
0 : Not prohibited.
1 : Prohibited.

P8D When a program with a program number from 80000000 to 89999999 is being executed as a subprogram or macro program, the display of the program on the program screen is:
0 : Not prohibited.
1 : Prohibited.

P9D When a program with a program number from 90000000 to 99999999 is being executed as a subprogram or macro program, the display of the program on the program screen is:
0 : Not prohibited.
1 : Prohibited.

3241	Character blinking in the AI contour control mode (first character)
3242	Character blinking in the AI contour control mode (second character)
3243	Character blinking in the AI contour control mode (third character)
3244	Character blinking in the AI contour control mode (fourth character)
3245	Character blinking in the AI contour control mode (fifth character)
3246	Character blinking in the AI contour control mode (sixth character)
3247	Character blinking in the AI contour control mode (seventh character)

[Data type] Byte

[Valid data range] 0 to 255

Set the character codes of characters blinking in the AI contour control mode.

NOTE

1 Set character codes according to the character code list in Appendix A.

2 When 0 is set, AICC blinks.

3251	Character blinking in the AI nano contour control mode (first character)

3252	Character blinking in the AI nano contour control mode (second character)

3253	Character blinking in the AI nano contour control mode (third character)

3254	Character blinking in the AI nano contour control mode (fourth character)

3255	Character blinking in the AI nano contour control mode (fifth character)

3256	Character blinking in the AI nano contour control mode (sixth character)

3257	Character blinking in the AI nano contour control mode (seventh character)

[Data type] Byte

[Valid data range] 0 to 255

Set the character codes of characters blinking in the AI nano contour control mode.

> **NOTE**
> 1 Set character codes according to the character code list in Appendix A.
> 2 When 0 is set, AI NANO blinks.

	#7	#6	#5	#4	#3	#2	#1	#0
3290	KEY	MCM		IWZ	WZO	MCV	GOF	WOF

[Data type] Bit

WOF Setting the tool wear offset value by MDI key input is:
- 0 : Not disabled
- 1 : Disabled (With parameter No.3294 and No.3295, set the offset number range in which updating the setting is to be disabled.)

GOF Setting the tool geometry offset value by MDI key input is:
- 0 : Not disabled
- 1 : Disabled (With parameter No.3294 and No.3295, set the offset number range in which updating the setting is to be disabled.)

MCV Macro variable and tool life management setting by MDI key input is:
- 0 : Not disabled
- 1 : Disabled

WZO Setting a workpiece origin offset value by MDI key input is:
- 0 : Not disabled
- 1 : Disabled

IWZ Setting a workpiece origin offset value or workpiece coordinate system shift value (T series) by MDI key input in the automatic operation activation or halt state is:
0 : Not disabled
1 : Disabled

MCM The setting of custom macro vaiables by MDI key operation is:
0 : Enabled regardless of the mode.
1 : Enabled only in the MDI mode.

KEY For memory protection keys:
0 : The KEY1, KEY2, KEY3, and KEY4 signals are used.
1 : Only the KEY1 signal is used.

NOTE

The functions of the signals depend on whether KEY=0 or KEY=1.

When KEY = 0:
- KEY1 : Enables tool offset value, workpiece origin offset value, and workpiece coordinate system shift value (T series) to be input.
- KEY2: Enables setting data, macro variables, and tool life management data to be input.
- KEY3: Enables program registration and editing.
- KEY4: Enables PMC data (counter and data table) to be input.

When KEY = 1:
- KEY1 : Enables program registration and editing, and enables PMC data.
- KEY2 to KEY4: Not used

	#7	#6	#5	#4	#3	#2	#1	#0
3291								WPT

[Data type] Bit

WPT The input of the tool wear compensation amount is:
0 : Enabled according to memory protection key signal KEY1.
1 : Always enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
3292	PK5							

[Data type] Bit

PK5 The KEYPRM signal (memory protection signal, parameter write setting) is:
0 : Disabled.
1 : Enabled.

When this parameter is set to 1, PWE on the setting screen is invalid, and memory protection/parameter write setting is performed with the KEYPRM signal<G046#0>.

3294	Start number of tool offset values whose input by MDI is disabled

3295	Number of tool offset values (from the start number) whose input by MDI is disabled

[Data type] Word

When the modification of tool offset values by MDI key input is to be disabled using bit 0 (WOF) of parameter No.3290 and bit 1 (GOF) of parameter No.3290, parameter Nos. 3294 and 3295 are used to set the range where such modification is disabled. In parameter No.3294, set the offset number of the start of tool offset values whose modification is disabled. In parameter No.3295, set the number of such values.

When 0 or a negative value is set in parameter No.3294 or parameter No.3295, no modification of the tool offset values is allowed.

When the value set with parameter No.3294 is greater than the maximum tool offset count, no modification is allowed.

[Example] The following setting disables the modification of both the tool geometry compensation values and tool wear compensation values corresponding to offset numbers 51 to 60:

Bit 1 (GOF) of parameter No.3290=1 (Disables tool offset value modification.)

Bit 0 (WOF) of parameter No.3290=1 (Disables tool wear compensation value modification.)

Parameter No.3294 = 51

Parameter No.3295 = 60

If bit 0 (WOF) of parameter No.3290 is set to 0, the modification of the tool offset values alone is disabled. The tool wear compensation values may be modified.

	#7	#6	#5	#4	#3	#2	#1	#0
3301	HDC				HCG	HCA		HCC

[Data type] Bit

HCC In the VGA-compatible mode display,
- 0 : A 256-color bit map data of the screen hard copy is created.
- 1 : A 16-color bit map data of the screen hard copy is created.

HCA An alarm message related to hard copy is:
- 0 : Not displayed.
- 1 : Displayed.

HCG In a monochrome bit map data of the screen hard copy,
- 0 : Black and white are not inverted. (same as the screen image)
- 1 : Black and white are inverted.

HDC A screen hard copy is:
- 0 : Not provided.
- 1 : Provided.

NOTE

For the Series 160*i*/180*i*/160*i*s/180*i*s, the screen hard copy is unavailable.

4.21 PARAMETERS OF PROGRAMS

	#7	#6	#5	#4	#3	#2	#1	#0
3401	GSC	GSB					FCD	DPI
			ABS	MAB				DPI

[Data type] Bit

DPI When a decimal point is omitted in an address that can include a decimal point
- 0 : The least input increment is assumed.
- 1 : The unit of mm, inches, or second is assumed. (pocket calculator type decimal point programming)

FCD When an F command and a G command (G98, G99) for feed per minute or feed per revolution are specified in the same block, and the G command (G98, G99) is specified after the F command, the F command is:
- 0 : Assumed to be specified in the mode (G98 or G99) when the F command is specified
- 1 : Assumed to be specified in the mode of the G command (G98 or G99) of the same block

NOTE

1 When FCD = 1:
If the block containing a G command (G98, G99) does not include an F command, the last F command specified is assumed to be specified in the G command mode of the block.
Example
N1 G99 ;
N2 Faaaa G98 ; - Faaaa is assumed to be specified in the G98 mode.
N3 Fbbbb ; - Fbbbb is assumed to be specified in the G98 mode.
N4 G99 ; - Fbbbb is assumed to be specified in G99 mode.

2 In G code system B or C, G98 and G99 function are specified in G94 and G95.

MAB Switching between the absolute and incremental commands in MDI operation
- 0 : Performed by G90 or G91
- 1 : Depending on the setting of bit 5 (ABS) of parameter No.3401

ABS Program command in MDI operation
- 0 : Assumed as an incremental command
- 1 : Assumed as an absolute command

NOTE

ABS is valid when bit 4 (MAB) of parameter No.3401 is set to 1.

GSB, GSC The G code system is set.

GSC	GSB	G code
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
3402	G23	CLR		FPM	G91			G01
	G23	CLR			G91	G19	G18	G01

[Data type] Bit

G01 Mode entered when the power is turned on or when the control is cleared

0 : G00 mode (positioning)

1 : G01 mode (linear interpolation)

G18 and G19 Plane selected when power is turned on or when the control is cleared

G19	G18	G17, G18 or G19 mode
0	0	G17 mode (plane XY)
0	1	G18 mode (plane ZX)
1	0	G19 mode (plane YZ)

G91 When the power is turned on or when the control is cleared

0 : G90 mode (absolute command)

1 : G91 mode (incremental command)

FPM When the power is turned on

0 : Feed per revolution on

1 : Feed per minute mode

CLR RESET key on the MDI panel, external reset signal, reset and rewind signal, and emergency stop signal

0 : Cause reset state.

1 : Cause clear state.

For the reset and clear states, refer to Appendix in the Operator's Manual.

G23 When the power is turned on

0 : G22 mode (stored stroke check on)

1 : G23 mode (stored stroke check off)

	#7	#6	#5	#4	#3	#2	#1	#0
3403		AD2	CIR					

[Data type] Bit

CIR When neither the distance (I, J, K) from a start point to the center nor an arc radius (R) is specified in circular interpolation (G02, G03):

0 : The tool moves to an end point by linear interpolation.

1 : P/S alarm No.022 is issued.

AD2 Specification of the same address two or more times in a block is:
0 : Enabled (Next specification is enabled.)
1 : Disabled (P/S alarm No. 5074)

NOTE
1 When 1 is set, specifying two or more G codes of the same group in a block will also result in an alarm being issued.
2 Up to three M codes can be specified in a single block, when bit 7 (M3B) of parameter No.3404 is set to 1.

	#7	#6	#5	#4	#3	#2	#1	#0
3404	M3B	EOR	M02	M30		SBP	POL	
	M3B	EOR	M02	M30		SBP	POL	NOP

[Data type] Bit

NOP When a program is executed, a block consisting of an O (program number), EOB, or N (sequence number) is:
0 : Not ignored, but regarded as being one block.
1 : Ignored.

POL For a command address allowing a decimal point, omission of the decimal point is:
0 : Enabled
1 : Disabled (P/S alarm No. 5073)

SBP Address P of the block including M198 in the subprogram call function
0 : Indicating a file number
1 : Indicating a program number

M30 When M30 is specified in a memory operation:
0 : M30 is sent to the machine, and the head of the program is automatically searched for. So, when the ready signal FIN is returned and a reset or reset and rewind operation is not performed, the program is executed, starting from the beginning.
1 : M30 is sent to the machine, but the head of the program is not searched for. (The head of the program is searched for by the reset and rewind signal.)

M02 When M02 is specified in memory operation
0 : M02 is sent to the machine, and the head of the program is automatically searched for. So, when the end signal FIN is returned and a reset or reset and rewind operation is not performed, the program is executed, starting from the beginning.
1 : M02 is sent to the machine, but the head of the program is not searched for. (The head of the program is searched for by the reset and rewind signal.)

EOR When the end-of-record mark (%) is read during program execution:
0 : P/S alarm No. 5010 occurs. (Automatic operation is stopped, and the system enters the alarm state.)
1 : No alarm occurs. (Automatic operation is stopped, and the system is reset.)

M3B The number of M codes that can be specified in one block
0 : One
1 : Up to three

	#7	#6	#5	#4	#3	#2	#1	#0
3405	QAB	QLG	DDP	CCR	G36	PPS	DWL	AUX
							DWL	AUX

[Data type] Bit

AUX The least increment of the command of the second auxiliary function specified with a decimal point
0 : Assumed to be 0.001
1 : Depending on the input increment. (For input in mm, 0.001 is assumed, or for input in inches, 0.0001 is assumed.)

DWL The dwell time (G04) is:
0 : Always dwell per second.
1 : Dwell per second in the feed per minute mode, or dwell per rotation in the feed per rotation mode.

PPS The passing-point signal output function is:
0 : Not used
1 : Used

G36 For a G code used with the automatic tool compensation function:
0 : G36/G37 is used.
1 : G37.1/G37.2 is used.

NOTE
If it is necessary to perform circular threading (counterclockwise), set this parameter to 1.

CCR Addresses used for chamfering/corner R
0 : Address used for chamfering/corner R is "I" or "K", not "C". In direct drawing dimension programming, addresses ",C", ",R", and ",A" (with comma) are used in stead of "C", "R", and "A".
1 : Addresses used for chamfering/corner R and direct drawing dimension programming are "C", "R", and "A" without comma. (Thus, addresses A and C cannot be used as the names of axes.)

DDP Angle commands by direct drawing dimension programming
0 : Normal specification
1 : A supplementary angle is given.

QLG When the passing-point signal output function is used, the remaining distance to be traveled specified in address ",Q" is:
0 : The combined distance of all axes
1 : The distance of the longest axis

NOTE
This parameter is valid when bit 7 (QAB) of parameter No.3405 = 0.

QAB When the passing-point signal output function is used, address ",Q" specifies:
0 : Remaining distance to be traveled
1 : Coordinate value of the longest axis

	#7	#6	#5	#4	#3	#2	#1	#0
3406	C07		C05	C04	C03	C02	C01	
	C07		C05	C04	C03	C02	C01	

	#7	#6	#5	#4	#3	#2	#1	#0
3407		C14			C11	C10		C08
	C15	C14	C13		C11	C10	C09	C08

	#7	#6	#5	#4	#3	#2	#1	#0
3408								C16
				C20	C19	C18	C17	C16

	#7	#6	#5	#4	#3	#2	#1	#0
3409	CFH							
	CFH							C24

[Data type] Bit

Cxx (xx: 01 to 24) When bit 6 (CLR) of parameter No.3402 is 1, the reset button on the MDI panel, the external reset signal, the reset and rewind signal, or emergency stop will,
0 : Clear the G code with group number xx.
1 : Not clear the G code with group number xx.

CFH When bit 6 (CLR) of parameter No.3402 is 1, the RESET key on the MDI panel, the external reset signal, the reset and rewind signal, or emergency stop will,
0 : Clear F codes, H codes (for the M series), D codes (for the M series), and T codes (for the T series).
1 : Not clear F codes, H codes (for the M series), D codes (for the M series), and T codes (for the T series).

3410	Tolerance of arc radius

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric input	0.01	0.001	0.0001	mm
Inch input	0.001	0.0001	0.00001	inch

[Valid data range] 1 to 99999999

When a circular interpolation command (G02, G03) is executed, the tolerance for the radius between the start point and the end point is set. If the difference of radii between the start point and the end point exceeds the tolerance set here, a P/S alarm No.20 is informed.

NOTE

When the set value is 0, the difference of radii is not checked. In the HPCC mode, a check is made for a difference in the arc radius even if the set value is "0" (with allowable limit = 0).

3411	M code preventing buffering 1
3412	M code preventing buffering 2
3413	M code preventing buffering 3
:	:
3420	M code preventing buffering 10

[Data type] 2-word

[Valid data range] 0 to 255

Set M codes that prevent buffering the following blocks. If processing directed by an M code must be performed by the machine without buffering the following block, specify the M code.

M00, M01, M02, and M30 always prevent buffering even when they are not specified in these parameters.

3421	Minimum value 1 of M code preventing buffering
3422	Maximum value 1 of M code preventing buffering
3423	Minimum value 2 of M code preventing buffering
3424	Maximum value 2 of M code preventing buffering
3425	Minimum value 3 of M code preventing buffering
3426	Maximum value 3 of M code preventing buffering
3427	Minimum value 4 of M code preventing buffering
3428	Maximum value 4 of M code preventing buffering
3429	Minimum value 5 of M code preventing buffering
3430	Maximum value 5 of M code preventing buffering
3431	Minimum value 6 of M code preventing buffering
3432	Maximum value 6 of M code preventing buffering

[Data type] 2-word
[Valid data range] 0 to 65535

Set M codes that prevent buffering the following blocks. When a specified M code is within the range specified with parameter Nos. 3421 and 3422, 3423 and 3424, 3425 and 3426, 3427 and 3428, 3429 and 3430, or 3431 and 3432, buffering for the next block is not performed until the execution of the block is completed.

NOTE
1 The specification of a minimum value that exceeds the specified maximum value is invalid.
2 When there is only one data item, set the following: minimum value = maximum value.

3435	Center angle limit of an arc with R specified

[Data type] Byte
[Unit of data] degree
[Valid data range] 0 to 180

When circular interpolation with R specified (G02, G03) is specified, set an allowable center angle limit. If circular interpolation is specified with a center angle exceeding the limit specified in this parameter, P/S alarm No. 23 is issued.
If 0 is set in this parameter, the semicircular R specification alarm function is disabled.

3441	**First of the M codes assigned to item numbers 100 to 199**
3442	**First of the M codes assigned to item numbers 200 to 299**
3443	**First of the M codes assigned to item numbers 300 to 399**
3444	**First of the M codes assigned to item numbers 400 to 499**

[Data type] 2-word

[Valid data range] 0 to 99999999

The M code group check function checks if a combination of up to three M codes specified in a block is valid, and the function issues an alarm if an invalid combination is detected. Before this function can be used, up to 500 M codes must be divided into no more than 128 groups. A set number from 0 to 499 is assigned to each of the 500 M codes. The group to which each M code with a set number assigned belongs is specified using the M code group setting screen.

The set numbers 0 to 499 correspond to M000 to M499. These parameters allow arbitrary M codes to be assigned in units of 100 M codes to the set numbers 100 to 499.

Parameter No.3441 : Sets the M codes corresponding to the set numbers 100 to 199.

Parameter No.3442: Sets the M codes corresponding to the set numbers 200 to 299.

Parameter No.3443: Sets the M codes corresponding to the set numbers 300 to 399.

Parameter No.3444: Sets the M codes corresponding to the set numbers 400 to 499.

Each parameter sets the M code that corresponds to the first of the set numbers allocated to the parameter, thus assigning 100 successive M codes. For example, when parameter No.3441 = 10000 is set, the M codes corresponding to the set numbers 100 to 199 are M10000 to M10099.

NOTE

1 When the value 0 is set in a parameter, the specification of 100 added to the value of the previous parameter is assumed. For example, when No.3441=10000, and No.3442=0 are specified:
The M codes corresponding to the set numbers 100 to 199 are: M10000 to M10099
The M codes corresponding to the set numbers 200 to 299 are: M10100 to M10199
Specifying 0 for parameter No.3441 has the same effect as specifying for parameter No.3441 = 100.

2 When a is specified for parameter No.3441, b is specified for parameter No.3442, c is specified for parameter No.3443, and d is specified for parameter No.3444, the following relationships must be satisfied:
$a + 99 < b$, $b + 99 < c$, $c + 99 < d$

	#7	#6	#5	#4	#3	#2	#1	#0
3450				NPS	CQD			
	BDX				CQD			AUP

[Data type] Bit

AUP When a command for the second auxiliary function contains a decimal point or negative sign:
0 : The command is invalid.
1 : The command is valid.

> **NOTE**
> For the T series, a decimal point and negative sign are supported for commands for the second auxiliary function, regardless of the setting made with this parameter.

CQD The method used for determining the amount of travel in circular interpolation is:
0 : Series 16 type.
1 : Series 15 type.

NPS A block that contains M98 Pxxx or M99, and which contains no addresses other than O and N:
0 : As a one-block NC statement involving no movement.
(A single-block stop is caused.)
1 : As a macro statement.
(A single-block stop is not caused. Moreover, the block is not regarded as a block involving no movement in tool nose radius compensation mode.)

BDX A decimal point specified with address B is handled:
0 : In the conventional way.
1 : In the same way as in a system equipped with the second auxiliary function.

In a system without second auxiliary function, the decimal point specified with address B can be handled as in a system equipped with the second auxiliary function. The following parameters can be used:

- Bit 0 (AUP) of parameter No. 3450
- Bit 0 (AUX) of parameter No. 3405

	#7	#6	#5	#4	#3	#2	#1	#0
3451								
				NBN	CCK	SDP		GQS

[Data type] Bit

GQS When G33 is specified, the threading start angle shift function (Q) is:
0 : Disabled.
1 : Enabled.

SDP The function to specify an S command with decimal point is:
0 : Not used.
1 : Used.
An S command with one decimal place can be specified. However, the S command value is rounded off to the nearest whole number.
[Example]
Relationships between specified value and S code output/alarm
S200.5 → S code output value = 201
S200.2 → S code output value = 200
S200.12 → P/S007 alarm is raised.

CCK If chamfering/corner R is enabled and if the end point specified in an arc command is not complete,
0 : No alarm is raised.
1 : An alarm (P/S058 alarm) is raised.
This parameter specifies whether an alarm is raised if chamfering/corner R is enabled, if the end point specified in an arc command is not complete, and if an address is omitted.
If the end point is omitted in an arc command, chamfering/corner R may affect the omitted point, and the operation may not be performed as intended by the programmer. If this parameter is specified, an alarm can be raised for that type of program execution.

NBN If bit 0 (NOP) of parameter No. 3404 is set to 1, a block including just N (sequence number) is:
0 : Ignored.
1 : Not ignored but handled as a single block.

	#7	#6	#5	#4	#3	#2	#1	#0
3453								CRD

[Data type] Bit

CRD If the functions of chamfering/corner R and direct drawing dimension programming are both enabled,
0 : Chamfering or corner R is enabled.
1 : Direct drawing dimension programming is enabled.
If the functions of chamfering/corner R and direct drawing dimension programming are both specified, this parameter specifies which function is used.
This parameter is displayed also on the setting screen. ("CHAMFERING/DIRECT DRAWING DIMENSION PROGRAMMING") The function to be enabled can be changed from the setting screen or parameter screen.

	#7	#6	#5	#4	#3	#2	#1	#0
3454								RF2

[Data type] Bit

RF2 The reference position return commands, G28.2 and G30.2, for making no in-position check during reference position return operation are:

0 : Disabled.
1 : Enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
3455								
								AXDx

[Data type] Bit axis

AXD If a decimal point is omitted for an address with which a decimal point can be used, the value is determined:

0 : In accordance with the least input increment.
1 : In millimeters, inches, or seconds. (pocket calculator type decimal point programming)

NOTE

1 This parameter is valid if bit 0 (DPI) of parameter No. 3401 is set to 0.
2 Because some addresses (such as R and K) are not related to an axis, setting this parameter for all axes is not equivalent to setting bit 0 (DPI) of parameter No. 3401 to 1.
3 This parameter cannot be used together with:
- High-speed remote buffer B
- Macro executor
- Basic operation package
- Macro call argument
- Tool length/workpiece origin measurement B function
- Super CAP*i* M
- High-speed linear interpolation function
- Rotary table dynamic fixture offset function
- Interference check between 2-path

	#7	#6	#5	#4	#3	#2	#1	#0
3456								
							LSVx	

[Data type] Bit axis

LSVx Slide axis control for link metho is:

0 : Not used.

1 : Used.

> **NOTE**
> 1 When this parameter is set, the power must be turned off before operation is continued.
> 2 Before the power is turned off after this parameter is set, it is recommended to set the quadratic expression coefficient parameters (No. 14981 to No. 14983) and the deceleration ratio minimum slide position parameter (No. 14984).
> 3 This control is exercised upon completion of reference position setting.
> 4 When simple synchronous control is used, set this parameter for both of the master axis and slave axis.

3460	Address for second auxiliary function

[Data type] Byte

This parameter specifies the address used for the second auxiliary function, as follows:

Axes names cannot be used to specify the address.

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

Address B is assumed when a value other than the above is set.

3471	Allowable difference between the specified end position and the end position obtained from the increase/decrease and frequency in conical/spiral interpolation

[Data type] 2-word axis

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric input	0.01	0.001	0.0001	mm
Inch input	0.001	0.0001	0.00001	inch

[Valid data range] 0 to 99999999

This parameter sets the maximum allowable difference (absolute value) between the specified end position and the end position obtained from the increase/decrease and frequency in conical/spiral interpolation.

3472	Minimum radius needed to maintain the actual speed in conical/spiral interpolation

[Data type] 2-word axis

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric input	0.01	0.001	0.0001	mm
Inch input	0.001	0.0001	0.00001	inch

[Valid data range] 1000 to 99999999 (metric input)
10000 to 99999999 (inch input)
If this parameter value is 0 or a value outside the valid data range, the minimum value of the range is assumed.
In conical/spiral interpolation, the speed is generally held constant. In an area near the center, the spiral radius decreases, resulting in an extremely high angular velocity. To prevent this, once the spiral radius has reached the parameter-set value, the angular velocity subsequently remains constant. As a result, the actual speed decreases.

4.22 PARAMETERS OF PITCH ERROR COMPENSATION

	#7	#6	#5	#4	#3	#2	#1	#0
3601							EPC	

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

EPC The pitch error compensation on an axis of Cs contour control on the slave side during spindle simple synchronous control is:
0 : The same as that on the master axis.
1 : Just for the slave axis.
To use unique pitch error compensation, set a pitch error compensation data number in parameters No. 3661 to 3674, and set the specified pitch error compensation data to desired unique pitch error compensation.
If bit 0 (BDP) of parameter No. 3605 is set to use bi-directional pitch error compensation, set parameters No. 3676 to 3684 as well.

	#7	#6	#5	#4	#3	#2	#1	#0
3605					ROPx	ISTx	IIPx	BDPx

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit axis

BDPx Bi-directional pitch error compensation is:
0 : Not used.
1 : Used.

NOTE
1 The function of bi-directional pitch error compensation is required.
2 The function of stored pitch error compensation is required.

IIPx Interpolation type pitch error compensation is:
0 : Not used.
1 : Used.

NOTE
1 The function of interpolation type pitch error compensation is required.
2 The function of stored pitch error compensation is required.

ISTx Interpolation type straightness compensation is:
0 : Not used.
1 : Used.

NOTE
1 This parameter is valid when the interpolation type straightness compensation option is added.
2 To use the interpolation type straightness compensation function or 128-point straightness compensation function, the interpolation type straightness compensation option and stored pitch error compensation option are required.
3 Parameters related to these functions are included among parameter No. 5700 and later, as well as parameter No. 13381 and later.
4 To use these functions, the number of pitch error compensation points along the moving axis must be 128 or less.

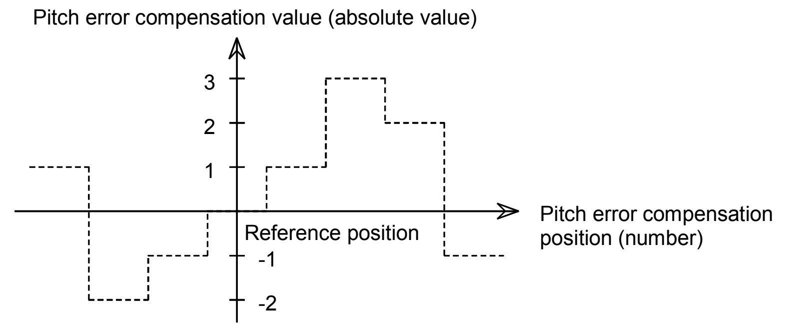
ROPx The pitch error compensation interval of a rotary axis (type A) is:
0 : Subject to the restriction "minimum value = maximum feedrate (rapid traverse rate)/7500".
1 : Not subject to the restriction "minimum value = maximum feedrate (rapid traverse rate)/7500".

3620	Number of the pitch error compensation position for the reference position for each axis

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

[Data type] Word axis
[Unit of data] Number
[Valid data range] 0 to 1023

Set the number of the pitch error compensation position for the reference position for each axis.



Compensation position number	31	32	33	34	35	36	37
Set compensating value	-3	+1	+1	+1	+2	-1	-3

In the above example, set 33 as the number of the pitch error compensation position for the reference position.

3621	Number of the pitch error compensation position at extremely negative position for each axis

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

[Data type] Word axis
[Unit of data] Number
[Valid data range] 0 to 1023

Set the number of the pitch error compensation position at the extremely negative position for each axis.

3622	Number of the pitch error compensation position at extremely positive position for each axis

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

[Data type] Word axis
[Unit of data] Number
[Valid data range] 0 to 1023

Set the number of the pitch error compensation position at the extremely positive position for each axis.
This value must be larger than set value of parameter (No.3620).

3623	Magnification for pitch error compensation for each axis

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

[Data type] Byte axis
[Unit of data] 1
[Valid data range] 0 to 100

Set the magnification for pitch error compensation for each axis.
If the magnification is set to 1, the same unit as the detection unit is used for the compensation data. If 0 is set, the same magnification selected by setting 1 is selected.

3624	Interval between pitch error compensation positions for each axis

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

[Data type] 2-word axis

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] 0 to 99999999

The pitch error compensation positions are arranged with equal spacing. The space between two adjacent positions is set for each axis.
The minimum interval between pitch error compensation positions is limited and obtained from the following equation:
Minimum interval between pitch error compensation positions = maximum feedrate (rapid traverse rate)/7500
Units:
Minimum interval between pitch error compensation positions: mm, inch, deg
Maximum feedrate: mm/min, inch/min, deg/min

[Example] When the maximum feedrate is 15000 mm/min, the minimum interval between pitch error compensation positions is 2 mm.
If setting a magnification causes the absolute value of the compensation amount at a compensation position to exceed 100, enlarge the interval between the compensation positions by using a multiple calculated as follows:
Multiple = maximum compensation amount (absolute value)/
128 (Round the remainder up to the nearest integer.)
Minimum interval between pitch error compensation positions =
Value obtained from the above maximum feedrate × multiple

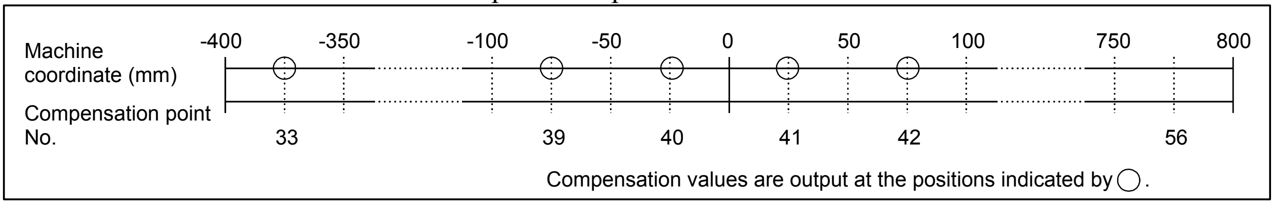
Examples of parameter setting

[Example 1] For linear axis

- Machine stroke: -400 mm to + 800 mm
- Interval between the pitch error compensation positions: 50 mm
- No. of the compensation position of the reference position: 40

If the above is specified, the No. of the farthest compensation point in the negative direction is as follows:
No. of the compensation position of the reference position -
(Machine stroke length in the negative direction /
Interval between the compensation points) + 1
= 40 - 400/50 + 1
=33

No. of the farthest compensation position in the positive direction is as follows:
No. of the compensation position of the reference position +
(Machine stroke length in the positive direction /
Interval between the compensation positions)
= 40 + 800/50
= 56
The correspondence between the machine coordinate and the compensation position No. is as follows:

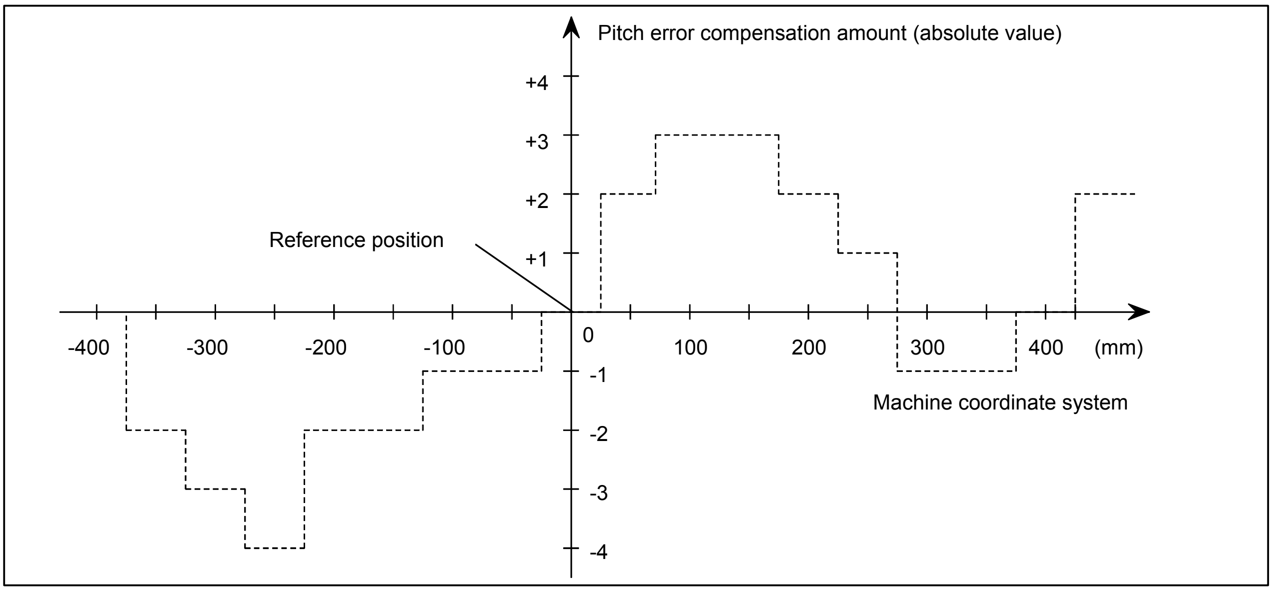


Therefore, set the parameters as follows:

Parameter	Setting
No. 3620 : Compensation point number for reference position	40
No. 3621 : Compensation point number for farthest point in the negative direction	33
No. 3622: Compensation point number for farthest point in the positive direction	56
No. 3623: Compensation magnification	1
No. 3624: Compensation point interval	50000

The compensation value is output at the compensation position No. corresponding to each section between the coordinates.
The following is an example of the compensation values.

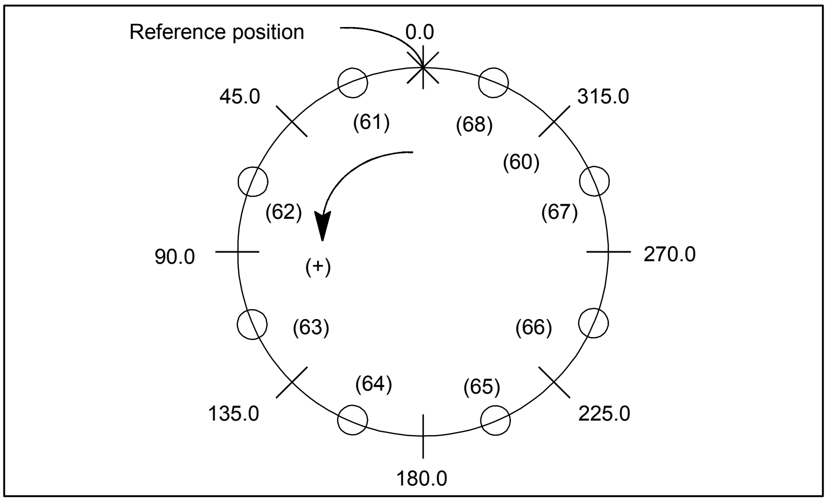
No.	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
Compensation values	+2	+1	+1	-2	0	-1	0	-1	+2	+1	0	-1	-1	-2	0	+1	+2



[Example 2] For the rotary axis

- Amount of movement per rotation: 360°
- Interval between pitch error compensation position: 45°
- No. of the compensation position of the reference position: 60

If the above is specified, the No. of the farthest compensation position in the negative direction for the rotary axis is always equal to the compensation position No. of the reference position.
The No. of the farthest compensation position in the positive direction is as follows:
No. of the compensation position of the reference position +
(Move amount per rotation /
Interval between the compensation position)
= 60 + 360/45
= 68
The correspondence between the machine coordinate and the compensation position No. is as follows:
The compensation value is output at the circled position ○.
If the sum of the compensation value from 61 to 68 is not zero, the pitch error per rotation accumulates, resulting in a positional shift.
For compensation position 60, set the same compensation value as for 68.

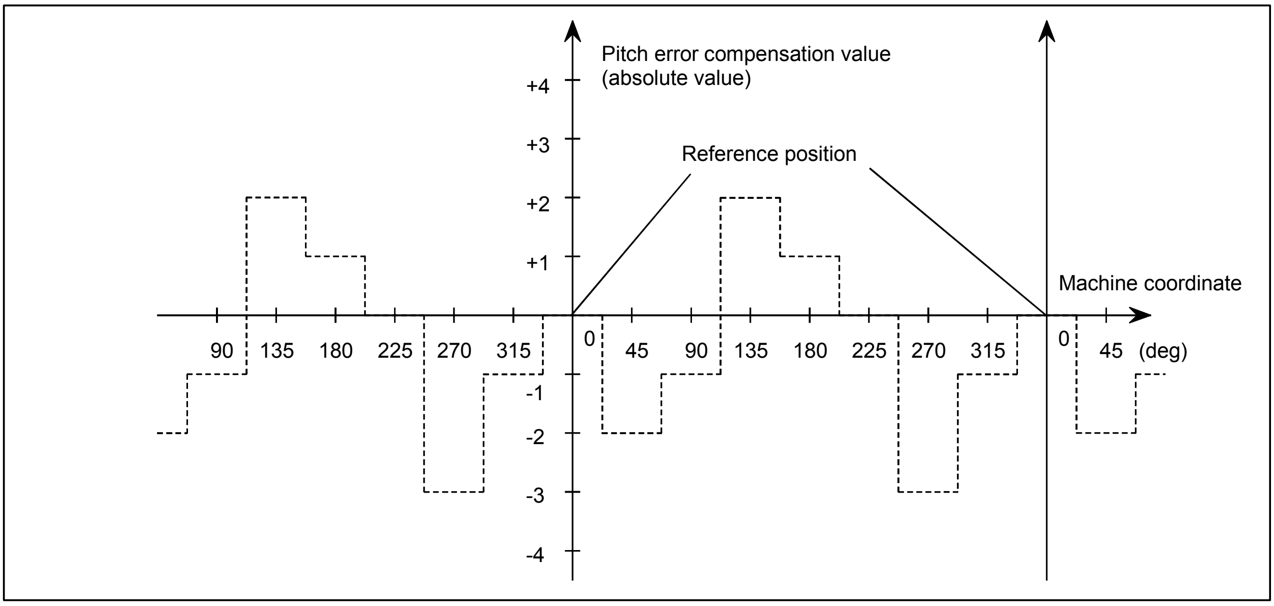


Set the parameters as follows:

Parameter	Setting
No. 3620 : Compensation point number for reference position	60
No. 3621 : Compensation point number for farthest point in the negative direction	60
No. 3622: Compensation point number for farthest point in the positive direction	68
No. 3623: Compensation magnification	1
No. 3624: Compensation point interval	45000

The following is an example of compensation values.

No. of the compensation position	60	61	62	63	64	65	66	67	68
Compensation value	+1	-2	+1	+3	-1	-1	-3	+2	+1



3625	Travel distance per revolution in pitch error compensation of rotary axis type

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

[Data type] 2-word axis
[Valid data range] 0 to 99999999

If the pitch error compensation of rotary axis type is performed (bit 1 (ROSx) of parameter No. 1006 is set to 0 and bit 0 (ROTx) of parameter No. 1006 is set to 1), set the travel distance per revolution. The travel distance per revolution does not have to be 360 degrees, and a cycle of pitch error compensation of rotary axis type can be set.
However, the travel distance per revolution, compensation interval, and number of compensation points must satisfy the following condition:
(Travel distance per revolution) =
(Compensation interval) × (Number of compensation points)
The compensation at each compensation point must be set so that the total compensation per revolution equals 0.

NOTE
1 If 0 is set, the travel distance per revolution becomes 360 degrees.
2 When setting a value other than 360 degrees (including 0), set the same value as set in parameter No. 1260.

3626	Number of pitch error compensation point at the farthest end in the negative direction (for movement in the negative direction)

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

[Data type] Word axis
[Unit of data] Number
[Valid data range] 0 to 1023, 3000 to 4023

When using bi-directional pitch error compensation, set the number of pitch error compensation point at the farthest end in the negative direction for a movement in the negative direction.

NOTE
1 For a movement in the positive direction, set the compensation point number at the farthest end in the negative direction in parameter No. 3621.
2 A set of compensation data items for a single axis should not be set to lie astride 1023 and 3000.

3627	Pitch error compensation (absolute value) at reference position when a movement to the reference position is made from the direction opposite to the direction of reference position return

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

[Data type] Word axis
[Unit of data] Detection unit
[Valid data range] -32768 to 32767

Set the absolute value of pitch error compensation at reference position when a movement to the reference position is made from the negative direction if the direction of reference position return (bit 5 (ZMI) of parameter No. 1006) is positive or from the positive direction if the direction of reference position return is negative.

3661	**Number of pitch error compensation point in the reference position if pitch error compensation is carried out on an axis of Cs contour control on the slave side during spindle simple synchronous control (for the first spindle)**
3662	**Number of pitch error compensation point in the reference position if pitch error compensation is carried out on an axis of Cs contour control on the slave side during spindle simple synchronous control (for the second spindle)**
3663	**Number of pitch error compensation point in the reference position if pitch error compensation is carried out on an axis of Cs contour control on the slave side during spindle simple synchronous control (for the third spindle)**
3664	**Number of pitch error compensation point in the reference position if pitch error compensation is carried out on an axis of Cs contour control on the slave side during spindle simple synchronous control (for the fourth spindle)**
3666	**Number of pitch error compensation point at the farthest end in the negative direction if pitch error compensation is carried out on an axis of Cs contour control on the slave side during spindle simple synchronous control (for the first spindle)**
3667	**Number of pitch error compensation point at the farthest end in the negative direction if pitch error compensation is carried out on an axis of Cs contour control on the slave side during spindle simple synchronous control (for the second spindle)**
3668	**Number of pitch error compensation point at the farthest end in the negative direction if pitch error compensation is carried out on an axis of Cs contour control on the slave side during spindle simple synchronous control (for the third spindle)**
3669	**Number of pitch error compensation point at the farthest end in the negative direction if pitch error compensation is carried out on an axis of Cs contour control on the slave side during spindle simple synchronous control (for the fourth spindle)**
3671	**Number of pitch error compensation point at the farthest end in the positive direction if pitch error compensation is carried out on an axis of Cs contour control on the slave side during spindle simple synchronous control (for the first spindle)**
3672	**Number of pitch error compensation point at the farthest end in the positive direction if pitch error compensation is carried out on an axis of Cs contour control on the slave side during spindle simple synchronous control (for the second spindle)**

3673	Number of pitch error compensation point at the farthest end in the positive direction if pitch error compensation is carried out on an axis of Cs contour control on the slave side during spindle simple synchronous control (for the third spindle)

3674	Number of pitch error compensation point at the farthest end in the positive direction if pitch error compensation is carried out on an axis of Cs contour control on the slave side during spindle simple synchronous control (for the fourth spindle)

[Data type] Word
[Unit of data] Number
[Valid data range] 0 to 1023

These parameters are used if bit 1 (EPC) of parameter No. 3601 is set to 1, so that pitch error compensation is carried out on an axis of Cs contour control on the slave side during spindle simple synchronous control, separately from that on the master side. Set the pith error compensation data number to be assigned to the parameter of the spindle which becomes the axis of Cs contour control on the slave side.

NOTE
1 When these parameters are set, the power must be turned off before operation is continued.
2 The fourth spindle can be used just in Series 16*i*/160*i*/160*i*s.

3676	**Number of compensation point at the farthest end in the negative direction in a movement in the negative direction if bi-directional pitch error compensation is carried out on an axis of Cs contour control on the slave side during spindle simple synchronous control (first spindle)**

3677	**Number of compensation point at the farthest end in the negative direction in a movement in the negative direction if bi-directional pitch error compensation is carried out on an axis of Cs contour control on the slave side during spindle simple synchronous control (second spindle)**

3678	**Number of compensation point at the farthest end in the negative direction in a movement in the negative direction if bi-directional pitch error compensation is carried out on an axis of Cs contour control on the slave side during spindle simple synchronous control (third spindle)**

3679	**Number of compensation point at the farthest end in the negative direction in a movement in the negative direction if bi-directional pitch error compensation is carried out on an axis of Cs contour control on the slave side during spindle simple synchronous control (fourth spindle)**

[Data type] Word
[Unit of data] Number
[Valid data range] 0 to 1023, 3000 to 4023, 0 to 2599, 3000 to 5599

If bi-directional pitch error compensation is used (bit 0 (BDP) of parameter No. 3605 is set to 1), set the number of the compensation point at the farthest end in the negative direction for a movement in the negative direction.

NOTE

1 When these parameters are set, the power must be turned off before operation is continued.
2 These parameters are valid if pitch error compensation on an axis of Cs contour control on the salve side during spindle simple synchronous control is carried out just for the slave axis (bit 1 of parameter No. 3601 is set to 1).
3 The number of the compensation point at the farthest end in the negative direction for a movement in the positive direction is set in parameters No. 3666 to No. 3669.
4 A set of compensation data items for a single axis cannot be set to lie astride 1023 and 3000 or astride 2599 and 5599.
5 The fourth spindle can be used just in Series 16*i*/160*i*/160*i*s.

3681	Pitch error compensation at the reference position if a movement to the reference position is made from the direction opposite to the direction of reference position return (first spindle)

3682	Pitch error compensation at the reference position if a movement to the reference position is made from the direction opposite to the direction of reference position return (second spindle)

3683	Pitch error compensation at the reference position if a movement to the reference position is made from the direction opposite to the direction of reference position return (third spindle)

3684	Pitch error compensation at the reference position if a movement to the reference position is made from the direction opposite to the direction of reference position return (fourth spindle)

[Data type] Word

[Unit of data] Detection unit

[Valid data range] -32768 to 32767

These parameters are set if bi-directional pitch error compensation is used in Cs contour control on the slave side during spindle simple synchronous control (bit 0 (BDP) of parameter No. 3605 is set to 1). Set the absolute value of pitch error compensation at the reference position when the movement is made in the negative direction if the direction of reference position return (bit 5 (ZMI) of parameter No. 1006) is positive or in the positive direction if the direction of reference position return is negative.

NOTE

1 When these parameters are set, the power must be turned off before operation is continued.
2 These parameters are valid if pitch error compensation on an axis of Cs contour control on the slave side during spindle simple synchronous control is carried out just on the slave axis (bit 1 (EPC) of parameter No. 3601 is set to 1).
3 The fourth spindle can be used just in Series 16*i*/160*i*/160*i*s.

4.23 PARAMETERS OF SPINDLE CONTROL

	#7	#6	#5	#4	#3	#2	#1	#0
3700	ESP		ESV	MSE			NRF	
	ESP		ESV	MSE			NRF	CRF

[Data type] Bit

CRF Arbitrary position reference setting for Cs axis is:
0 : Not used.
1 : Used.

> **NOTE**
> 1 If an intermediate point is specified with G28, a movement is made to the intermediate point and that point is set as a reference position.
> 2 Arbitrary position reference setting for Cs axis is not usable if the master axis in automatic phase matching based on the spindle EGB function is a Cs contour control axis.

NRF The first move command (such as G00 and G01) after the serial spindle is switched to Cs axis contouring control performs:
0 : Positioning after returning to the reference position.
1 : Normal positioning.

> **NOTE**
> When the Cs axis coordinate establishment function is used, it is recommended to set this parameter to 1.

MSE A rigid tapping synchronous error output when bit 5 (ESV) of parameter No. 3700 is set to 1 or bit 7 (ESP) of parameter No. 3700 is set to 1 is:
0 : Positional deviation synchronous error (equivalent to DGN No. 456).
1 : Machine position synchronous error (equivalent to DGN No. 459).

ESV When bit 7 (ESP) of parameter No. 3700 is set to 1, a rigid tapping synchronous error is:
0 : Not output to the servo system.
1 : Output to the servo system.

> **NOTE**
> Set this parameter as required for servo or spindle tuning using the SERVO GUIDE. Upon completion of tuning, return the setting to 0.

ESP A rigid tapping synchronous error is:

0 : Not output to the spindle.

1 : Output to the spindle.

> **NOTE**
> Set this parameter as required for servo or spindle tuning using the SERVO GUIDE. Upon completion of tuning, return the setting to 0.

	#7	#6	#5	#4	#3	#2	#1	#0
3701			SS3	SS2			ISI	

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

ISI The serial interface for the first and second spindles are:

0 : Used.

1 : Not used.

> **NOTE**
> This parameter is valid when the spindle serial output option is provided. It is used when the CNC is started with serial interface control for the first and second serial spindles disabled temporarily (for example, for CNC startup tuning). Usually, it should be set to 0.
> Use bit 6 (ESS) of parameter No. 3702 when serial interface control on one path only is to be disabled in 2-path control.
> If the serial interface for the third serial spindle is disabled for the same reason, bit 5 (SS3) of parameter No. 3701 must be 0. (This parameter does not disable the serial interface of the third spindle.)
> If this parameter is set to 1 when using the serial spindle and analog spindle at the same time, the analog spindle is set the first axis.

SS2 In serial spindle control, the second spindle is:
0 : Not used.
1 : Used.

> **NOTE**
> This parameter is valid, when the spindle serial output option is provided and bit 1 (ISI) of parameter No.3701 is 0.
> 1 Confirmation of connection of the second serial spindle amplifier, and communication with it
> 2 Control of the second spindle during non-synchronous control (SIND2)
> When this parameter is set, it is also necessary to set the serial spindle parameter for the second spindle.

SS3 In serial spindle control, the third spindle is:
0 : Not used.
1 : Used.

> **NOTE**
> This parameter is valid, the spindle serial output option and the three-spindle serial output option are provided.

Parameter setting			Serial spindles to be used
Bit 1 (SS4) of No.3704	Bit 5 (SS3) of No.3704	Bit 4 (SS2) of No.3704	
0	0	0	First spindle only
0	0	1	First and second spindles
0	1	0	First and third spindles
0	1	1	First to third spindles
1	1	0	First, third, and fourth spindles
1	1	1	First to fourth spindles

> **NOTE**
> 1 To connect a serial spindle as the third or fourth spindle, the function of three/four-spindle serial output is required.
> 2 The fourth serial spindle can be used just in Series 16*i*/160*i*/160*i*s.

	#7	#6	#5	#4	#3	#2	#1	#0
3702	ECS	ESS	EAS	ESI	OR2	OR1	EMS	OR3
	ECS	ESS	EAS		OR2	OR1	EMS	OR3

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

OR3 The spindle orientation function based on an externally set stop position is:
0 : Not used by the third spindle motor.
1 : Used by the third spindle motor.

NOTE
When the spindle orientation function based on an externally set stop position is used, the position coder-based spindle orientation stop position set parameters (No.4031 and No.4204) are ineffective.

EMS Multi-spindle control function
0 : Used
1 : Not used

NOTE
Set this parameter for a path that does not require multi-spindle control in 2-path or 3-path control.

OR1 Whether the stop-position external-setting type orientation function is used by the first spindle motor
0 : Not used
1 : Used

OR2 Whether the stop-position external-setting type orientation function is used by the second spindle motor
0 : Not used
1 : Used

ESI The spindle positioning function is
0 : Used
1 : Not used

NOTE
When the spindle positioning option is specified in 2-path or 3-path control, set this parameter for a path that does not require the spindle positioning function.

EAS For path 1, path 2, or path 3, the S analog output function is:
0 : Used.
1 : Not used.

ESS For path 1, path 2, or path 3, the S serial output function is:
0 : Used.
1 : Not used.

ECS For path 1, path 2, or path 3, the Cs contour control function is:
0 : Used.
1 : Not used.

NOTE
Parameter EAS, ESS, and ECS are used for 2-path control or 3-path control. These parameters are used to determine whether the optional function, S analog output function, S serial output function, and Cs contour control function, are used for each path.

	#7	#6	#5	#4	#3	#2	#1	#0
3703					MPP	3SP	RSI	2SP

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

2SP Specifies whether one or two spindles are controlled (2-path control).
0 : One spindle (two tool posts)
1 : Two spindle (two tool posts)

RSI Spindle command selection for 2-path control :
0 : Affects commands from SIND for the first spindle
1 : Does not affect commands from SIND for the first spindle (Spindle commands from SIND always control spindles in the same path, regardless of spindle command selection signals SLSPA and SLSPB <G063#2 and #3>.)

3SP Spindle control setting in three-path control
0 : One-spindle or two-spindle control (Spindle control is not performed on the third tool post.)
1 : Three-spindle control (The spindles are individually controlled on the first to third tool posts.)

The selection of one-spindle or two-spindle control depends on the setting of bit 0 (2SP) of parameter No. 3703.
Under three-path control, spindle control is performed as indicated below.

2SP	3SP	Spindle control
0	0	Three-path one-spindle control
1	0	Three-path two-spindle control
0	1	Three-path three-spindle control
1	1	Three-path three-spindle control

MPP Under multi-spindle control, the spindle is not selected by a spindle signal (SWS1 to SWS4 <G027#0 to #2, G026 #3>, SLSPA/SLSPB <G063#2 and #3>), and a programmed command (address P) is:
0 : Not used.
1 : Used.

> **NOTE**
> If this parameter is set to 1, set parameters No. 3781 to No. 3784 as well.

	#7	#6	#5	#4	#3	#2	#1	#0
3704	CSS	PCS	SSY	SSS		OR4	SS4	

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

SS4 Under serial spindle control, the fourth serial spindle is:
0 : Not used.
1 : Used.
Bit 5 (SS3) and bit 4 (SS2) of parameter No. 3701 and this parameter specify the number of spindles to be connected.
See the table added to the description of bit 5 (SS3) and bit 4 (SS2) of parameter No. 3701.

> **NOTE**
> 1 To use the fourth serial spindle, the third serial spindle is required.
> 2 The fourth serial spindle can be used just in Series 16*i*/160*i*/160*i*s.

OR4 For the fourth serial spindle, the function for controlling the spindle orientation of the stop position external setting type is:
0 : Not used.
1 : Used.

> **NOTE**
> The fourth serial spindle can be used just in Series 16*i*/160*i*/160*i*s.

SSS Spindle synchronous control by each spindle is:
0 : Not performed.
1 : Performed.
The master axis and slave axis of spindle synchronous control can be selected from the first to fourth spindles.
The target spindle of spindle synchronous control is specified in parameters No. 4831 to 4834.
In addition, the following signals affect the control.
Signals of spindle synchronous control of each spindle
SPSYC1 to SPSYC4 <G288#0 to #3>
Signals of synchronous control of the spindle phase for each spindle
SPPHS1 to SPPHS4 <G289#0 to #3>

NOTE
The fourth spindle can be used just in Series 16*i*/160*i*/160*i*s.

SSY Spindle simple synchronous control by each spindle is:
0 : Not performed.
1 : Performed.
The master axis and slave axis of spindle simple synchronous control can be selected from the first to fourth spindles.
The target spindle of spindle simple synchronous control is set in parameters No. 4821 to No. 4824.
In addition, the following signals affect the control.
Signals of spindle simple synchronous control of each spindle
ESSYC1 to ESSYC4 <G264#0 to #3>
Parking signals of spindle simple synchronous control of each spindle
PKESE1 to PKESE4 <G265#0 to #3>

NOTE
The fourth serial spindle can be used just in Series 16*i*/160*i*/160*i*s.

PCS If the third or fourth serial spindle is connected under multi-spindle control, the third or fourth position coder selection signal (PC3SLC, PC4SLC <G026#0 and #1>) is:
0 : Not used.
1 : Used.

NOTE
1 If the position coder feedback is exchanged between paths under multi-path control of T series (spindle feedback selection signals SLPCA and SLPCB <G064#2 and #3>), set this parameter to the same setting for the paths.
2 The fourth serial spindle can be used just in Series 16*i*/160*i*/160*i*s.
3 When one of the second to fourth spindles is used as a hob axis, set this parameter to 1.

CSS On the second to fourth spindles, Cs contour control is:
0 : Not performed.
1 : Performed.
If Cs contour control is performed on each spindle as specified by this parameter, set parameter No. 1023 as indicated below.
Setting
-1 = Axis of Cs contour control by the first spindle
-2 = Axis of Cs contour control by the second spindle
-3 = Axis of Cs contour control by the third spindle
-4 = Axis of Cs contour control by the fourth spindle (Series 16*i*/160*i*/160*is* only)

> **NOTE**
> 1 A single spindle cannot be specified as multiple axes of Cs contour control.
> 2 Under multi-path control, a spindle of another path cannot be assigned.
> 3 This parameter cannot be used with the spindle positioning function. When using the spindle positioning function, set bit 7 (CSS) of parameter No. 3704 to 0.

	#7	#6	#5	#4	#3	#2	#1	#0
3705				EVS				ESF
		SFA	NSF		SGT	SGB	GST	ESF

[Data type] Bit

ESF When the spindle control function (Spindle analog output or spindle serial output) is used, and the constant surface speed control function is used or bit 4 (GTT) of parameter No.3706 is set to 1:
0 : S codes and SF are output for all S commands.
1 : S codes and SF are not output for an S command in constant surface speed control mode (G96 mode) or for an S command used to specify maximum spindle speed clamping (G92S---; (G50 for G code system A (T series)))

> **NOTE**
> For the T series, this parameter is enabled when bit 4 (EVS) of parameter No.3705 is set to 1.
> For the M series, SF is not output:
> (1) For an S command used to specify maximum spindle speed clamping (G92S---;) in constant surface speed control mode
> (2) When bit 5 (NSF) of parameter No.3705 is set to 1

GST The SOR signal is used for:
0 : Spindle orientation
1 : Gear shift

> **NOTE**
> If the function of constant surface speed control or bit 4 (GTT) of parameter No. 3706 is specified, this parameter is invalid.

SGB Gear switching method
0 : Method A (Parameters No. 3741 to No. 3743 for the maximum spindle speed at each gear are used for gear selection.)
1 : Method B (Parameters No. 3751 and No. 3752 for the spindle speed at the gear switching point are used for gear selection.)

SGT Gear switching method during tapping cycle (G84 and G74)
0 : Method A (Same as the normal gear switching method)
1 : Method B (Gears are switched during tapping cycle according to the spindle speed set in parameters No. 3761 and No. 3762).

EVS When the spindle control function (Spindle analog output or spindle serial output) is used, S codes and SF are:
0 : Not output for an S command.
1 : Output for an S command.

> **NOTE**
> The output of S codes and SF for an S command in constant surface speed control mode (G96), or for an S command used to specify maximum spindle speed clamping (G50S---;) depends on the setting of bit 0 (ESF) of parameter No.3705.

NSF If the function of constant surface speed control is specified or if bit 4 (GTT) of parameter No. 3706 is set to 1 and when an S code is specified,
0 : SF is output.
1 : SF is not output.

SFA The SF signal is output:
0 : When gears are switched.
1 : Irrespective of whether gears are switched.

	#7	#6	#5	#4	#3	#2	#1	#0
3706	TCW	CWM	ORM		PCS		PG2	PG1
	TCW	CWM	ORM	GTT			PG2	PG1

[Data type] Bit

PG2 and PG1 Gear ratio of spindle to position coder

Magnification	PG2	PG1
×1	0	0
×2	0	1
×4	1	0
×8	1	1

$$\text{Magnification}=\frac{\text{Number of spindle revolutions}}{\text{Number of position coder revolutions}}$$

PCS When two or three paths are used and multi-spindle control is exercised on each path, the selection of the feedback signal of the position coder in a selected path, regardless of the state of the PC2SLC signal (G0028#7, G1028#7, G2028#7) of the selected path, is:

0 : Impossible.

1 : Possible. (When three paths are used, the position coder of a path is selected with signals below:
SLPCA$^{\#1}$<G0064#2>, SLPCA$^{\#2}$<G1064#2>,
SLPCA$^{\#3}$<G2064#2>, SLPCB$^{\#1}$<G0064#3>,
SLPCB$^{\#2}$<G1064#3>, SLPCB$^{\#3}$<G2064#3>)

On a 3-path lathe, a position coder feedback signal selection can be made as indicated in the table below. (The "-" mark indicates irrelevancy to PC selection on the path side.)

<1> When the bit 3 (PCS) of Parameter No.3706 is set to 1.

	Position coder to be selected	**SLPCA$^{\#1}$**	**SLPCB$^{\#1}$**	**PC2SLC$^{\#1}$**	**PC2SLC$^{\#2}$**	**PC2SLC$^{\#3}$**
Path 1	PC1$^{\#1}$	1	0	0	-	-
	PC2$^{\#1}$	1	0	1	-	-
	PC1$^{\#2}$	0	1	0	-	-
	PC2$^{\#2}$	0	1	1	-	-
	PC1$^{\#3}$	1	1	0	-	-
	PC2$^{\#3}$	1	1	1	-	-

	Position coder to be selected	**SLPCA$^{\#2}$**	**SLPCB$^{\#2}$**	**PC2SLC$^{\#1}$**	**PC2SLC$^{\#2}$**	**PC2SLC$^{\#3}$**
Path 2	PC1$^{\#1}$	1	0	-	0	-
	PC2$^{\#1}$	1	0	-	1	-
	PC1$^{\#2}$	0	1	-	0	-
	PC2$^{\#2}$	0	1	-	1	-
	PC1$^{\#3}$	1	1	-	0	-
	PC2$^{\#3}$	1	1	-	1	-

	Position coder to be selected	**SLPCA$^{\#3}$**	**SLPCB$^{\#3}$**	**PC2SLC$^{\#1}$**	**PC2SLC$^{\#2}$**	**PC2SLC$^{\#3}$**
Path 3	PC1$^{\#1}$	1	0	-	-	0
	PC2$^{\#1}$	1	0	-	-	1
	PC1$^{\#2}$	0	1	-	-	0
	PC2$^{\#2}$	0	1	-	-	1
	PC1$^{\#3}$	1	1	-	-	0
	PC2$^{\#3}$	1	1	-	-	1

<2> When the bit 3 (PCS) of Parameter No.3706 is set to 0.

	Position coder to be selected	SLPCA$^{\#1}$	SLPCB$^{\#1}$	PC2SLC$^{\#1}$	PC2SLC$^{\#2}$	PC2SLC$^{\#3}$
Path 1	PC1$^{\#1}$	1	0	0	-	-
	PC2$^{\#1}$	1	0	1	-	-
	PC1$^{\#2}$	0	1	-	0	-
	PC2$^{\#2}$	0	1	-	1	-
	PC1$^{\#3}$	1	1	-	-	0
	PC2$^{\#3}$	1	1	-	-	1

	Position coder to be selected	SLPCA$^{\#2}$	SLPCB$^{\#2}$	PC2SLC$^{\#1}$	PC2SLC$^{\#2}$	PC2SLC$^{\#3}$
Path 2	PC1$^{\#1}$	1	0	0	-	-
	PC2$^{\#1}$	1	0	1	-	-
	PC1$^{\#2}$	0	1	-	0	-
	PC2$^{\#2}$	0	1	-	1	-
	PC1$^{\#3}$	1	1	-	-	0
	PC2$^{\#3}$	1	1	-	-	1

	Position coder to be selected	SLPCA$^{\#3}$	SLPCB$^{\#3}$	PC2SLC$^{\#1}$	PC2SLC$^{\#2}$	PC2SLC$^{\#3}$
Path 3	PC1$^{\#1}$	1	0	0	-	-
	PC2$^{\#1}$	1	0	1	-	-
	PC1$^{\#2}$	0	1	-	0	-
	PC2$^{\#2}$	0	1	-	1	-
	PC1$^{\#3}$	1	1	-	-	0
	PC2$^{\#3}$	1	1	-	-	1

NOTE

Note that the specifications of the spindle command selection signals SLSPA and SLSPB, and the spindle feedback selection signals SLPCA and SLPCB vary, depending on whether 2-path control or 3-path control is exercised.

GTT Selection of a spindle gear selection method

0 : Type M.

1 : Type T.

NOTE

1 The gear selection method differs as described below. For details, refer to the description of spindle control in the connection manual (function part).

Type M:

The CNC determines a proper gear from the parameter setting and S command value, and requests the PMC to specify the gear and its switching.

In addition, spindle control is exercised according to a gear selected by the CNC.

Type T:

The CNC exercises spindle control according to a gear selected by the PMC.

2 When the constant surface speed control option is selected, type T is selected, regardless of whether this parameter is specified.

3 When the multi-spindle function option is used with the M series, the gear selection method of type T needs to be selected. So, set this parameter when the constant surface speed control option is not selected.

4 When type T spindle gear switching is selected, the following parameters have no effect:

Bit 2 (SGB) of parameter No. 3705, parameter No. 3751, parameter No. 3752, bit 3 (SGT) of parameter No. 3705, parameter No.3761, parameter No.3762, bit 6 (SFA) of parameter No. 3705, parameter No.3735, parameter No.3736

On the other hand, parameter No. 3744 becomes usable for ordinary spindle control.

ORM Voltage polarity during spindle orientation

0 : Positive

1 : Negative

TCW, CWM Voltage polarity when the spindle speed voltage is output

TCW	CWM	Voltage polarity
0	0	Both M03 and M04 positive
0	1	Both M03 and M04 negative
1	0	M03 positive, M04 negative
1	1	M03 negative, M04 positive

	#7	#6	#5	#4	#3	#2	#1	#0
3707			P42	P41	P32	P31	P22	P21

[Data type] Bit

P22 and P21 Gear ratio of spindle to second position coder

Magnification	P22	P21
×1	0	0
×2	0	1
×4	1	0
×8	1	1

$$\text{Magnification} = \frac{\text{Number of spindle revolutions}}{\text{Number of position coder revolutions}}$$

> **NOTE**
> This parameter is valid when the multi-spindle control option is selected.

P32 and P31 Set the gear ratio of spindle to position coder (for the third spindle).

Magnification	P32	P31
×1	0	0
×2	0	1
×4	1	0
×8	1	1

P42 and P41 Set the gear ratio of spindle to position coder (for the fourth spindle)

Magnification	P42	P41
×1	0	0
×2	0	1
×4	1	0
×8	1	1

> **NOTE**
> 1 The parameters P32 and P31 and the parameters P42 and P41 are valid when the multi-spindle control option is selected and bit 6 (PCS) of parameter No. 3704 is set to 1.
> 2 The parameters P42 and P41 are valid only for Series 16*i*/160*i*/160*i*s.

	#7	#6	#5	#4	#3	#2	#1	#0
3708		TSO	SOC	SVD	SSP		SAT	SAR
		TSO	SOC	SVD	SSP			SAR

[Data type] Bit

SAR The spindle speed arrival signal is:

0 : Not checked

1 : Checked

SAT Check of the spindle speed arrival signal at the start of executing the threading block
0 : The signal is checked only when bit 0 (SAR) of parameter No. 3708, is set.
1 : The signal is always checked irrespective of whether SAR is set.

> **NOTE**
> When threading blocks are consecutive, the spindle speed arrival signal is not checked for the second and subsequent threading blocks.

SSP The spindle speed read window (No. 138) reads the speed of the spindle:
0 : Specified by the spindle feedback selection signal SLPCA or SLPCB <G064#2 or #3>.
1 : Of the path if the SPW signal <G195#0> is set to 1.
This parameter is used, for instance, to read the speed of a specific spindle by the window (No. 138), not depending on the actual control.

SVD When the SIND signal is on, the detection of spindle speed fluctuation is:
0 : Disabled
1 : Enabled

SOC During constant surface speed control (G96 mode), the speed clamp by the maximum spindle speed clamp command (M series: G92 S_; T series: G50 S_;) is carried out:
0 : Before spindle speed override.
1 : After spindle speed override.
If this parameter is set to 0, the spindle speed may exceed the maximum spindle speed (numeric value following S in G92 S_; (M series) or G50 S_; (T series)).
If this parameter is set to 1, the spindle speed is limited to the maximum spindle speed.
The spindle speed is limited to the upper limit of spindle speed specified in parameter No. 3772, irrespective of the setting of this parameter.

TSO During a threading or tapping cycle, the spindle override is:
0 : Disabled (tied to 100%).
1 : Enabled.

> **NOTE**
> During rigid tapping, the override is tied to 100%, irrespective of the setting of this parameter.

	#7	#6	#5	#4	#3	#2	#1	#0
3709	THR				MRS	MSI	RSC	SAM
				SMC	MRS	MSI	RSC	

[Data type] Bit

SAM The sampling frequency to obtain the average spindle speed
0 : 4 (Normally, set to 0.)
1 : 1

RSC In the constant surface speed control mode, the surface speed of a rapid traverse block is calculated:
0 : In accordance with the coordinates of the end point.
1 : In accordance with the current value, as in cutting feed.

MSI In multi-spindle control, the SIND signal is valid
0 : Only when the first spindle is valid (SIND signal for the 2nd, 3rd spindle becomes ineffective)
1 : For each spindle irrespective of whether the spindle is selected (Each spindle has its own SIND signal).

MRS When the S 12-bit code signals and actual spindle speed signals are output in multi-spindle control:
0 : Signals common to the first through fourth spindles are used. In this case, information about a spindle selected by the spindle selection signal (SWS1-SWS3<G027#0-#2>) and SWS4<G026#3>) is output.
1 : Information about each of the first through fourth spindles is output on individual signals.

Signal	When MRS is set to 0	When MRS is set to 1
S 12-bit code signals : R01O-R12O<F036,F037> Actual spindle speed signals : AR0-AR15<F040,F041>	First spindle (SWS1 = 1) Second spindle (SWS1 = 0, SWS2 = 1) Third spindle (SWS1-SWS2 = 0, SWS3 = 1) Fourth spindle (SWS1-SWS3 = 0, SWS4 = 1)	First spindle
S 12-bit code signals 2 : R01O3-R12O2<F200,F201> Actual spindle speed signals 2 : AR200-AR215<F202,F203>	-	Second spindle
S 12-bit code signals 3 : R01O3-R12O3<F204,F205> Actual spindle speed signals 3 : AR300-AR315<F206,F207>	-	Third spindle
S 12-bit code signals 4 : R01O4-R12O4<F270,F271> Actual spindle speed signals 4 : AR400-AR415<F272,F273>	-	Fourth spindle

NOTE

1 To use this parameter, the multi-spindle control option and serial spindle option are required.
2 To use the actual spindle speed signals, the actual spindle speed output option is required.
3 The fourth spindle (serial spindle) can be used only with Series 16*i*/160*i*/160*i*s.

SMC The function to check a large S command is:
0 : Not used.
1 : Used.
If a spindle gear of M type is selected, this function compares the specified S value and the settings of parameters No. 3741 to No. 3743 and raises an alarm if the S value is greater.
If this function is used, specifying an S value larger than the settings of parameters No. 3741 to No. 3743 causes P/S alarm 5310 to be raised.

NOTE

This function cannot be used together with any of bit 4 (GTT) of parameter No. 3706, constant surface speed control, or multi-spindle control.

THR The type of threading is:
0 : Type A
1 : Type B. (Be sure to set this parameter to 1 when PMC axis control is used during execution of threading.)

	#7	#6	#5	#4	#3	#2	#1	#0
3710		CSL						
		CSL			SGR			

[Data type] Bit

SGR When method B is selected (by setting bit 3 (SGT) of parameter No. 3705 to 1) for spindle gear switching in a rigid tapping cycle (G84, G74), gear switching method B is used:
0 : For both of tapping and rigid tapping.
1 : For rigid tapping only.

CSL An axis for which fine acceleration/deceleration is disabled in the Cs contour control mode is:
0 : Selected using the signal (CDFn<G0127>) from the PMC (n = 1 to 8).
1 : Axis (parameter No. 39n0) subject to interpolation with the Cs contour control axis (n = 0 to 4).

Bit 0 (CAL) of parameter No. 3712	Bit 6 (CSL) of parameter No. 3710	Operation
0	0	When the spindle of the local path is placed in the Cs contour control mode, fine acceleration/deceleration for an axis selected with CDFn<G00127> of the local path is disabled (n = 1 to 8).
0	1	When the spindle of the local path is placed in the Cs contour control mode, fine acceleration/deceleration for an axis (parameter No. 39n0) subject to interpolation with the Cs contour control axis of the local path is disabled (n = 0 to 4).
1	0	When the spindle of a path in a multi-path system is placed in the Cs contour control mode, fine acceleration/deceleration for an axis selected with CDFn<G00127> of the local path is disabled (n = 1 to 8).
1	1	When the spindle of a path in a multi-path system is placed in the Cs contour control mode, fine acceleration/deceleration for an axis (parameter No. 39n0) subject to interpolation with the Cs contour control axes of all paths is disabled (n = 0 to 4).

	#7	#6	#5	#4	#3	#2	#1	#0
3711					SDR		SDT	CDM

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

CDM The axis of Cs contour control of this path is:
0 : Not set as a hypothetical Cs axis.
1 : Set as a hypothetical Cs axis.
By setting this parameter to 1 and setting the Cs axis in parameter No. 1023, a hypothetical Cs axis is added even if the actual Cs axis is not connected. This enables composite control, which replaces the hypothetical Cs axis with an actual Cs axis connected to another path, under multi-path control.

NOTE
1 If this parameter is set to 1, an actual Cs axis cannot be connected in the same path.
2 When using a hypothetical Cs axis, set the Cs axis in parameter No. 1023, assuming that one hypothetical serial spindle is added. If an actual serial spindle is connected to the path in which the hypothetical Cs axis is used, set the following parameters as indicated in the table below, depending on the number of spindles.

Actual spindle connected to the path	Parameter No. 1023	Bit 7 (CSS) of parameter No. 3704
No spindle	-1	0
First spindle	-2	1
First and second spindles	-3	1
First, second, and third spindles	-4	1

* The total number of actual connected spindles and the hypothetical Cs axis cannot exceed 4.

3 Set the parameters of feedrate and the like for the hypothetical Cs axis. The Cs axis need not be specified in the parameters of motor (No. 4000 to No. 4393).
4 When performing composite control of the Cs axis, set bit 1 (CZM) of parameter No. 8161 to 1 at the same time. To perform composite control, the axis recomposition function is required.
5 When this parameter has been set, the power must be turned off then back on for the setting to become effective.

SDT The spindle detach function is:
0 : Disabled.
1 : Enabled.

> **NOTE**
> 1 This parameter is valid only when a serial spindle is used.
> 2 This function cannot be used in the jog mode.
> 3 This function cannot be used with the compound machining function.
> 4 To use this function, PMC-SB7 is needed.
> 5 This function is optional.

SDR During a reset, the spindle detach function is:
0 : Disabled.
1 : Enabled.

> **NOTE**
> Even if SDR is set to 0 to disable the spindle detach function during a reset, the processing in progress (such as serial spindle communication start or stop processing) is executed to the end.
> Example:
> If a reset occurs during execution of serial spindle communication stop processing when SDR is set to 0
> • The serial spindle communication stop processing in progress is executed until the processing is completed. Then, serial spindle communication start processing is not executed until the reset is cancelled.

	#7	#6	#5	#4	#3	#2	#1	#0
3712						CSF		CAL

[Data type] Bit
CAL In a multi-path system, a Cs contour control mode check is made with:
0 : Local path only.
1 : All paths.
See the description of bit 6 (CSL) of parameter No. 3710.
CSF The Cs axis coordinate establishment function is:
0 : Disabled.
1 : Enabled.

> **NOTE**
> When setting this parameter to 1, set also bit 5 of parameter No. 4353 to 1.

	#7	#6	#5	#4	#3	#2	#1	#0
3713								SIM

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

SIM If an axis move command and S command are specified in the same block when a spindle selection is made using address P (with bit 3 (MPP) of parameter No. 3703 set to 1) under multi-spindle control:
0 : The S command becomes valid after completion of movement on the axis.
1 : The S command becomes valid simultaneously when a movement is made on the axis.

3730	Data used for tuning the gain of the analog output of spindle speed

[Data type] Word
[Unit of data] 0.1 %
[Valid data range] 700 to 1250

Set data used for tuning the gain of the analog output of spindle speed.

[Adjustment method]
(1) Assign standard value 1000 to the parameter.
(2) Specify the spindle speed so that the analog output of the spindle speed is the maximum voltage (10 V).
(3) Measure the output voltage.
(4) Assign the value obtained by the following equation to parameter No.3730.

$$\text{Set value} = \frac{10\ (V)}{\text{Measured data}\ (V)} \times 1000$$

(5) After setting the parameter, specify the spindle speed so that the analog output of the spindle speed is the maximum voltage. Confirm that the output voltage is 10V.

NOTE
This parameter needs not to be set for serial spindles.

3731	Compensation value for the offset voltage of the analog output of the spindle speed

[Data type] Word

[Unit of data] Velo

[Valid data range] -1024 to +1024

Set compensation value for the offset voltage of the analog output of the spindle speed.

$$\text{Set value} = \frac{-8191 \times \text{Offset voltage (V)}}{12.5}$$

[Adjustment method]

(1) Assign standard value 0 to the parameter.
(2) Specify the spindle speed so that the analog output of the spindle speed is 0.
(3) Measure the output voltage.
(4) Assign the value obtained by the following equation to parameter No.3731.

$$\text{Set value} = \frac{-8191 \times \text{Offset voltage (V)}}{12.5}$$

(5) After setting the parameter, specify the spindle speed so that the analog output of the spindle speed is 0. Confirm that the output voltage is 0V.

> **NOTE**
> This parameter usually need not to be set for serial spindles (Set to 0).

3732	The spindle speed during spindle orientation or the spindle motor speed during spindle gear shift

[Data type] Word

[Valid data range] 0 to 20000

Set the spindle speed during spindle orientation or the spindle motor speed during gear shift.

When bit 1 (GST) of parameter No. 3705, is set to 0, set the spindle speed during spindle orientation in min^{-1}.

When bit 1 (GST) of parameter No. 3705, is set to 1, set the spindle motor speed during spindle gear shift calculated from the following formula.

For a serial spindle

$$\text{Set value} = \frac{\text{Spindle motor speed during spindle gear shift}}{\text{Maximum spindle motor speed}} \times 16383$$

For an analog spindle

$$\text{Set value} = \frac{\text{Spindle motor speed during spindle gear shift}}{\text{Maximum spindle motor speed}} \times 4095$$

3735	Minimum clamp speed of the spindle motor

[Data type] Word

[Valid data range] 0 to 4095

Set the minimum clamp speed of the spindle motor.

$$\text{Set value} = \frac{\text{Minimum clamp speed of the spindle motor}}{\text{Maximum spindle motor speed}} \times 4095$$

> **NOTE**
> If the function of constant surface speed control or bit 4 (GTT) of parameter No. 3706 is specified, this parameter is invalid.

3736	Maximum clamp speed of the spindle motor

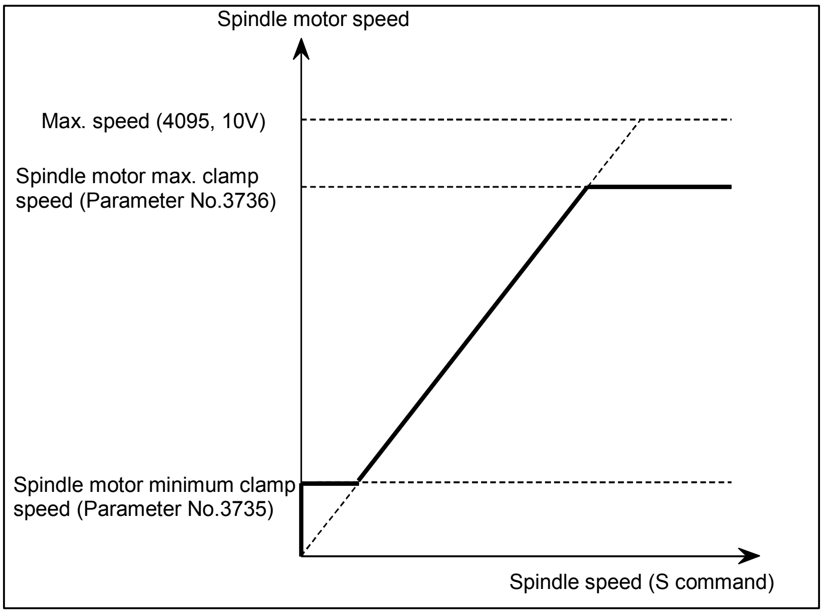
[Data type] Word

[Valid data range] 0 to 4095

Set the maximum clamp speed of the spindle motor.

$$\text{Set value}=\frac{\text{Maximum clamp speed of the spindle motor}}{\text{Maximum spindle motor speed}}\times 4095$$

> **NOTE**
> If the function of constant surface speed control or bit 4 (GTT) of parameter No. 3706 is specified, this parameter is invalid.
> In this case, the maximum clamp speed of spindle motor cannot be specified. However, the maximum spindle speed can be specified by the following parameters.
> No.3772 (for the first axis)
> No.3802 (for the second axis)
> No.3882 (for the third axis)
> No.3850 (for the fourth axis : only 16*i*/160*i*/160*i*s)



3740	Time elapsed prior to checking the spindle speed arrival signal

[Data type] Byte

[Unit of data] msec

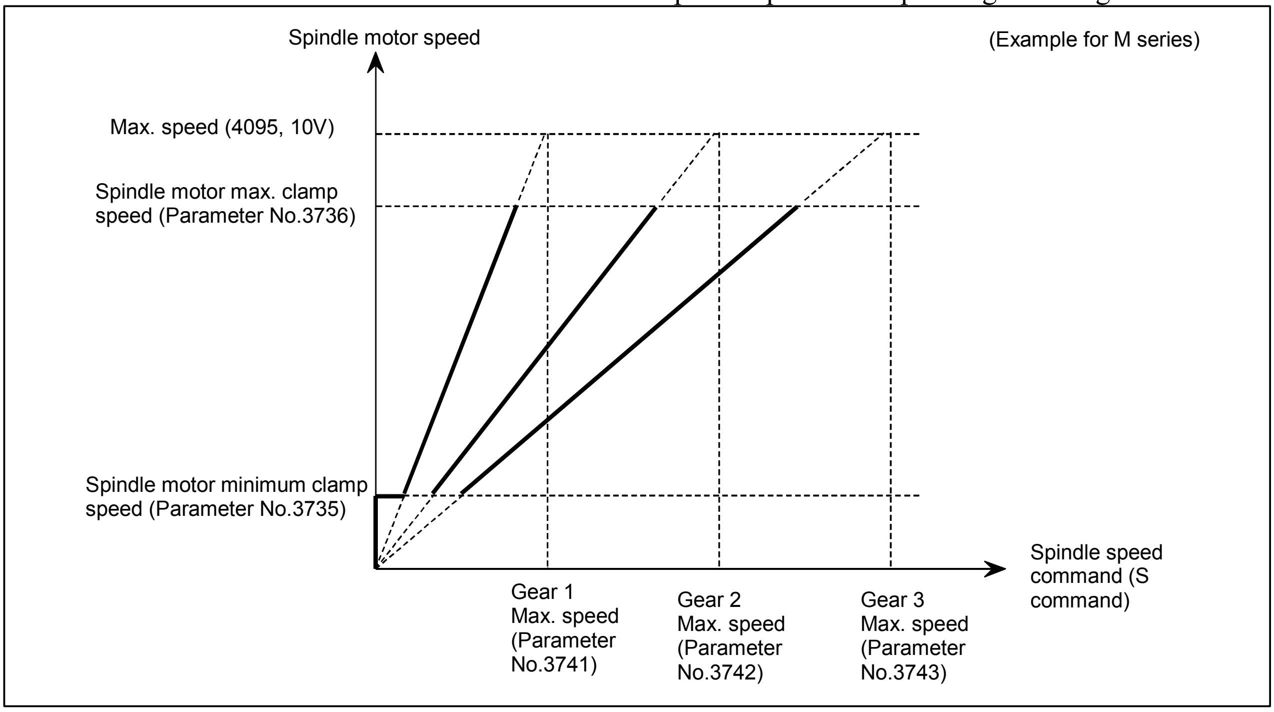
[Valid data range] 0 to 225

Set the time elapsed from the execution of the S function up to the checking of the spindle speed arrival signal.

3741	**Maximum spindle speed for gear 1**
3742	**Maximum spindle speed for gear 2**
3743	**Maximum spindle speed for gear 3**
3744	**Maximum spindle speed for gear 4** (Note)

[Data type] 2-word
[Unit of data] min^{-1}
[Valid data range] 0 to 32767

Set the maximum spindle speed corresponding to each gear.



NOTE

If a type-T gear shift scheme is selected for the M series (with the constant surface speed control option installed or bit 4 (GTT) of parameter No. 3706 = 1), parameter No. 3744 is usable also in the M series.

Note, however, that, even in this case, only up to three main gear stages are usable for rigid tapping.

3751	Spindle motor speed when switching from gear 1 to gear 2

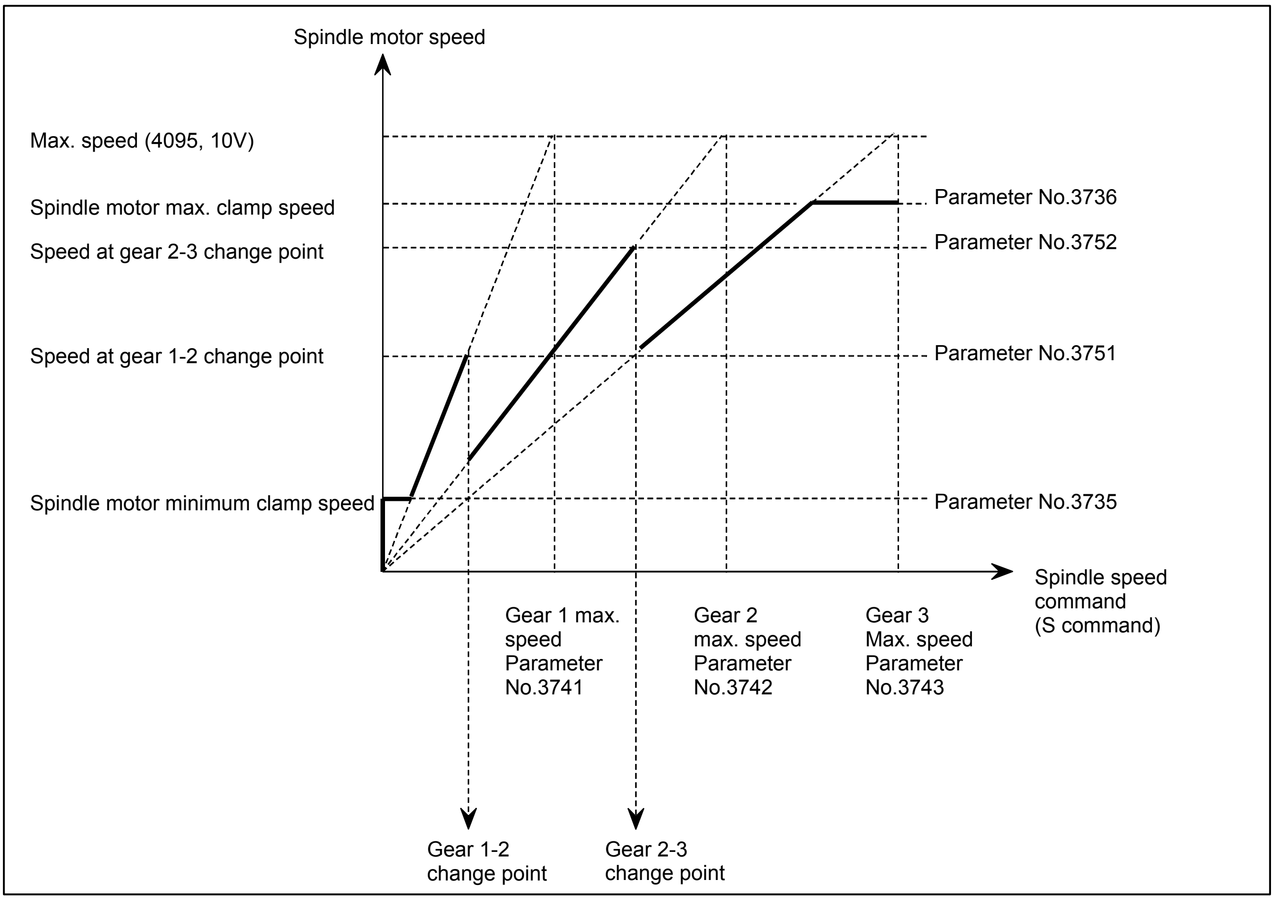
3752	Spindle motor speed when switching from gear 2 to gear 3

[Data type] Word

[Valid data range] 0 to 4095

For gear switching method B (bit 2 (SGB) of parameter No. 3705 is set to 1), set the spindle motor speed when the gears are switched.

$$\text{Set value} = \frac{\text{Spindle motor speed when the gears are switched}}{\text{Maximum spindle motor speed}} \times 4095$$

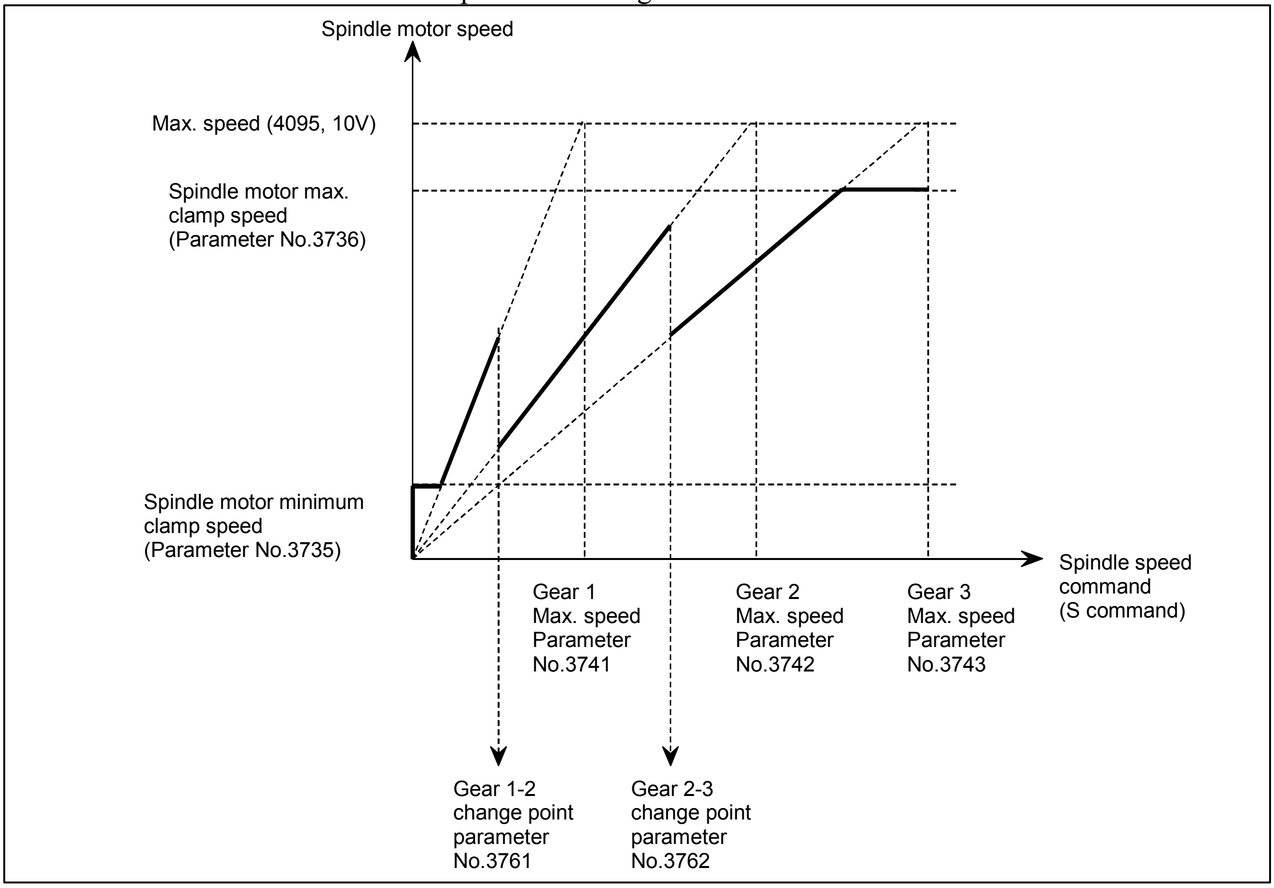


3761	**Spindle speed when switching from gear 1 to gear 2 during tapping**

3762	**Spindle speed when switching from gear 2 to gear 3 during tapping**

[Data type] 2-word
[Unit of data] min^{-1}
[Valid data range] 0 to 32767

When method B is selected (bit 3 (SGT) of parameter No. 3705 is set to 1) for the tapping cycle gear switching method, set the spindle speed when the gears are switched.



3770	Axis as the calculation reference in constant surface speed control

[Data type] Byte

[Valid data range] 0, 1 to number of controlled axes

Set the axis as the calculation reference in constant surface speed control.

> **NOTE**
> When 0 is set, constant surface speed control is always applied to the X-axis. In this case, specifying P in a G96 block has no effect on the constant surface speed control.

3771	Minimum spindle speed in constant surface speed control mode (G96)

[Data type] 2-word

[Unit of data] min^{-1}

[Valid data range] 0 to 32767

Set the minimum spindle speed in the constant surface speed control mode (G96).

The spindle speed in constant surface speed control is clamped to the speed given by parameter No. 3771.

3772	Maximum spindle speed

[Data type] 2-word

[Unit of data] min^{-1}

[Valid data range] 0 to 32767

This parameter sets the maximum spindle speed.

When a command specifying a speed exceeding the maximum speed of the spindle is specified, or the speed of the spindle exceeds the maximum speed because of the spindle speed override function, the spindle speed is clamped at the maximum speed set in the parameter.

NOTE

1 For M series, this parameter is valid if the function of constant surface speed control is provided or bit 4 (GTT) of parameter No. 3706 is set to 1.

2 When the constant surface speed control option is selected, the spindle speed is clamped at the maximum speed, regardless of whether the G96 mode or G97 mode is specified.

3 When 0 is set in this parameter, the speed of the spindle is not clamped.

4 When spindle speed command control is applied using the PMC, this parameter has no effect, and the spindle speed is not clamped.

5 When the multi-spindle control option is selected, set the maximum speed for each spindle in the following parameters:

Parameter No.3772:
Sets the maximum speed for the first spindle.

Parameter No.3802:
Sets the maximum speed for the second spindle.

Parameter No.3822:
Sets the maximum speed for the third spindle.

Parameter No.3850:
Sets the maximum speed for the fourth spindle.
(for Series 16*i*/160*i*/160*i*s only)

3781	P code for selecting the first spindle in multi-spindle control
3782	P code for selecting the second spindle in multi-spindle control
3783	P code for selecting the third spindle in multi-spindle control
3784	P code for selecting the fourth spindle in multi-spindle control

NOTE
When these parameters are set, the power must be turned off before operation is continued.

[Data type] Word
[Valid data range] 0, 1 to 32767

If bit 3 (MPP) of parameter No. 3703 is set to 1, set the P code to select each spindle under multi-spindle control. Specify the P code in a block containing the S command.

[Example] If the P code value for selecting the second spindle is set to 3,
S1000 P3;
causes the second spindle to rotate at S1000.

NOTE
1 These parameters are valid if bit 3 (MPP) of parameter No. 3703 is set to 1.
2 If this parameter is set to 0, the corresponding spindle cannot be selected by a P code.
3 Under multi-path control, the P code specified here is valid for each path.
For instance, if the P code to select the first spindle of path 2 is set to 21, specifying S1000 P21; in path 1 causes the first spindle of path 2 to be rotated at S1000.
4 Identical P code values cannot be used for different spindles. (Identical P code values cannot be used even if the paths are different.)
5 If this parameter is used (bit 3 (MPP) of parameter No. 3703 is set to 1), signals SWS1 to SWS4 <G027#0 to #2, G026#3> and SLSPA/SLSPB <G063#2 and #3> become invalid.
6 To use this parameter, the multi-spindle control function is needed.
7 Parameter No. 3784 is valid only for Series 16*i*/160*i*/160*i*s.

3802	Maximum speed of the second spindle

[Data type] 2-word
[Unit of data] min^{-1}
[Valid data range] 0 to 32767

Parameter sets the maximum speed for the second spindle.
When a command specifying a speed exceeding the maximum speed of the spindle is specified, or the speed of the spindle exceeds the maximum speed because of the spindle speed override function, the spindle speed is clamped at the maximum speed set in the parameter.

> **NOTE**
> 1 This parameter is valid when the multi-spindle control option is selected.
> 2 For this parameter to be valid with the M series, the multi-spindle control option needs to be selected, and the constant surface speed control option needs to be selected, or bit 4 (GTT) of parameter No. 3706 needs to be set to 1. (This setting is required to enable multi-spindle control with the M series.)
> 3 When the constant surface speed control option is selected, the spindle speed is clamped to a maximum speed, regardless of whether the G96 mode or G97 mode is set.
> 4 When this parameter is set to 0, parameter No. 3772 (maximum speed of the first spindle) is valid. The spindle speed is not clamped when parameter No. 3772 is set to 0.
> 5 When spindle speed command control is applied using the PMC, this parameter has no effect, and the spindle speed is not clamped.

3811	Maximum spindle speed for gear 1 of the second spindle

3812	Maximum spindle speed for gear 2 of the second spindle

[Data type] 2-word
[Unit of data] min^{-1}
[Valid data range] 0 to 32767

Set the maximum spindle speed for each gear of the second spindle.

> **NOTE**
> These parameters are used for the multi-spindle control.

3820	Data for tuning the gain of the analog output of the third-spindle speed

[Data type] Word
[Unit of data] 0.1%
[Valid data range] 700 to 1250

Set the data used for tuning the gain of the analog output of the third spindle speed. (See explanation of parameter No. 3730.)

> **NOTE**
> This parameter is used for controlling the multi-spindles.

3821	Offset-voltage compensation value of the analog output of the third-spindle speed

[Data type] Word
[Unit of data] Velo
[Valid data range] -1024 to 1024

Set the offset-voltage compensation value of the analog output of the third-spindle speed. (See explanation of parameter No. 3731.)

> **NOTE**
> This parameter is used for controlling the multi-spindles.

3822	Maximum speed of the third spindle

[Data type] 2-word
[Unit of data] min^{-1}
[Valid data range] 0 to 32767

This parameter sets the maximum speed for the third spindle.
When a command specifying a speed exceeding the maximum spindle speed is specified, or the spindle speed exceeds the maximum speed because of the spindle speed override function, the spindle speed is clamped at the maximum speed set in the parameter.

NOTE
1. This parameter is valid when the multi-spindle control option is selected.
2. For this parameter to be valid with the M series, the multi-spindle control option needs to be selected, and the constant surface speed control option needs to be selected, or bit 4 (GTT) of parameter No. 3706 needs to be set to 1. (This setting is required to enable multi-spindle control with the M series.)
3. When the constant surface speed control option is selected, the spindle speed is clamped to a maximum speed, regardless of whether the G96 mode or G97 mode is set.
4. When this parameter is set to 0, parameter No. 3772 (maximum speed of the first spindle) is valid. The spindle speed is not clamped when parameter No. 3772 is set to 0.
5. When spindle speed command control is applied using the PMC, this parameter has no effect, and the speed of the spindle is not clamped.

3831	Maximum spindle speed for gear 1 of the third spindle
3832	Maximum spindle speed for gear 2 of the third spindle

[Data type] 2-word
[Unit of data] min^{-1}
[Valid data range] 0 to 32767

Set the maximum spindle speed for each gear of the third spindle.

NOTE
These parameters are used for the multi-spindle control.

3841	Servo motor spindle control axis number

[Data type] Byte

[Valid data range] 1 to 6

Set the axis number of an axis subject to servo motor spindle control and servo motor spindle synchronous control. When 0 is set in this parameter, servo motor spindle control and servo motor spindle synchronous control are disabled. To perform servo motor spindle synchronous control, bit 4 (SPSx) of parameter No. 2016 needs to be set.

3842	Maximum allowable speed for servo motor spindle control

[Data type] 2-word

[Unit of data] min^{-1}

[Valid data range] 0 to 9999

Set a maximum allowable spindle speed for servo motor spindle control.

3843	Acceleration/deceleration time constant for servo motor spindle control

[Data type] Word

[Unit of data] msec

[Valid data range] 0 to 4000

Set an acceleration/deceleration time constant for servo motor spindle control and servo motor spindle synchronous control. The type of acceleration/deceleration is linear. Set a period of time used for the spindle speed to reach 1000 min^{-1}.

3844	Number of a spindle used as the master

[Data type] Byte

[Valid data range] 0 to 32

Set the number of a spindle (position coder) used for servo motor spindle synchronous control. The tens digit represents a path, and the ones digit represents a position coder number within each path. To synchronize the servo axis of path 2 with the second position coder of path 1 under 2-path control, for example, set 12 in this parameter for path 2. When 0 is set in the tens digit, the local path is assumed. When 0 is set in both of the tens digit and ones digit, the first position coder of the local path is assumed.

⚠ **WARNING**

Combinations of position coders and servo motors to be synchronized with each are determined by the wiring. So, even if the setting of this parameter is modified, the combinations of position coders and servo motors cannot be changed. This parameter is used for acceleration or deceleration when the synchronous control mode is turned on or off.

If a value not matching the wiring-based combinations is specified, acceleration/deceleration is not performed correctly, resulting in a dangerous situation. So, be sure to set a value that matches the wiring.

3850	Upper limit of spindle speed of the fourth spindle

[Data type] 2-word

[Unit of data] min^{-1}

[Valid data range] 0 to 32767

Set the upper limit of spindle speed of the fourth spindle.

NOTE

1 This parameter is valid when the multi-spindle control option is selected.

2 For this parameter to be valid with the M series, the multi-spindle control option needs to be selected, and the constant surface speed control option needs to be selected, or bit 4 (GTT) of parameter No. 3706 needs to be set to 1. (This setting is required to enable multi-spindle control with the M series.)

3 When the constant surface speed control option is selected, the spindle speed is clamped to a maximum speed, regardless of whether the G96 mode or G97 mode is set.

4 When this parameter is set to 0, parameter No. 3772 (maximum speed of the first spindle) is valid. The spindle speed is not clamped when parameter No. 3772 is set to 0.

5 When spindle speed command control is applied using the PMC, this parameter has no effect, and the spindle speed is not clamped.

6 This parameter is valid just for Series 16*i*/160*i*/160*i*s.

3851	Maximum spindle speed corresponding to gear 1 of the fourth spindle
3852	Maximum spindle speed corresponding to gear 2 of the fourth spindle

[Data type] 2-word
[Unit of data] min^{-1}
[Valid data range] 0 to 32767

Set the maximum spindle speed corresponding to each gear of the fourth spindle.

NOTE
1. These parameters are used for multi-spindle control.
2. These parameters are valid just for Series 16*i*/160*i*/160*i*s.

Parameters for Control of Serial Interface Spindle Cs Contouring Control Axis

No.	Data type		Description
3900	Byte		Number of the servo axis whose loop gain is to be changed according to the set values of parameters No. 3901 to No. 3904 when the Cs contouring axis is controlled (set values 0 to 8)
3901	Word	First group	Loop gain for the servo axis when the Cs contouring axis is controlled for spindle gear 1 selection
3902	Word		Loop gain for the servo axis when the Cs contouring axis is controlled for spindle gear 2 selection
3903	Word		Loop gain for the servo axis when the Cs contouring axis is controlled for spindle gear 3 selection
3904	Word		Loop gain for the servo axis when the Cs contouring axis is controlled for spindle gear 4 selection
3910	Byte		Number of the servo axis whose loop gain is to be changed according to the set values of parameters No. 3911 to No. 3914 when the Cs contouring axis is controlled (set values 0 to 8)
3911	Word	Second group	Loop gain for the servo axis when the Cs contouring axis is controlled for spindle gear 1 selection
3912	Word		Loop gain for the servo axis when the Cs contouring axis is controlled for spindle gear 2 selection
3913	Word		Loop gain for the servo axis when the Cs contouring axis is controlled for spindle gear 3 selection
3914	Word		Loop gain for the servo axis when the Cs contouring axis is controlled for spindle gear 4 selection
3920	Byte		Number of the servo axis whose loop gain is to be changed according to the set values of parameters No. 3921 to No. 3924 when the Cs contouring axis is controlled (set values 0 to 8)
3921	Word	Third group	Loop gain for the servo axis when the Cs contouring axis is controlled for spindle gear 1 selection
3922	Word		Loop gain for the servo axis when the Cs contouring axis is controlled for spindle gear 2 selection
3923	Word		Loop gain for the servo axis when the Cs contouring axis is controlled for spindle gear 3 selection
3924	Word		Loop gain for the servo axis when the Cs contouring axis is controlled for spindle gear 4 selection
3930	Byte		Number of the servo axis whose loop gain is to be changed according to the set values of parameters No. 3931 to No. 3934 when the Cs contouring axis is controlled (set values 0 to 8)
3931	Word	Fourth group	Loop gain for the servo axis when the Cs contouring axis is controlled for spindle gear 1 selection
3932	Word		Loop gain for the servo axis when the Cs contouring axis is controlled for spindle gear 2 selection
3933	Word		Loop gain for the servo axis when the Cs contouring axis is controlled for spindle gear 3 selection
3934	Word		Loop gain for the servo axis when the Cs contouring axis is controlled for spindle gear 4 selection
3940	Byte		Number of the servo axis whose loop gain is to be changed according to the set values of parameters No. 3941 to No. 3944 when the Cs contouring axis is controlled (set values 0 to 8)
3941	Word	Fifth group	Loop gain for the servo axis when the Cs contouring axis is controlled for spindle gear 1 selection
3942	Word		Loop gain for the servo axis when the Cs contouring axis is controlled for spindle gear 2 selection
3943	Word		Loop gain for the servo axis when the Cs contouring axis is controlled for spindle gear 3 selection
3944	Word		Loop gain for the servo axis when the Cs contouring axis is controlled for spindle gear 4 selection

[Setting method] First, select servo axes which perform interpolation with the Cs contouring axis. (Up to five axes can be selected.)
When there is no servo axis for interpolation with the Cs contouring axis, set the parameters No. 3900, No. 3910, No. 3920, No. 3930, and No. 3940 to 0 to terminate parameter setting.
When there are servo axes for interpolation with the Cs contouring axis, the parameters must be set according to the procedure below for each axis.

(1) Set the number of a servo axis (1 to 8) for interpolation with the Cs contouring axis in parameters 39n0 (n = 0, 1, 2, 3, and 4).
(2) Set loop gain values of the servo axis specified in (1) above which is used when the Cs contouring axis is controlled in parameters No. 39n1, No. 39n2, No. 39n3, and No. 39n4. (There are four stages for main gears used.)
(3) When the number of specified servo axes is less than 5, set the remaining parameter No. 39n0 to 0 to terminate parameter setting.

When the number of a Cs contouring axis is set to parameter No. 39n0, the parameter is assumed to be set to 0.

NOTE

1 In general, it is difficult to set a high loop gain for a spindle motor axis when compared with a servo axis. These parameters are provided so that, by changing the loop gain of a servo axis that requires interpolation with the Cs contour axis, interpolation control can be exercised correctly between the Cs axis and servo axis while the spindle exercises Cs contour control.

2 The loop gain of the servo axis is changed using the parameter settings made for a spindle gear selected at the time of conversion from the spindle mode to the Cs contour control mode.
In normal use, it is unlikely that the gear of the spindle is switched during Cs contour control. However, note that if the gear of the spindle is changed during Cs contour control, the loop gain of the servo axis is not changed.

3 Even when multiple Cs axes are used with one path (bit 7 (CSS) of parameter No. 3704 = 1), these parameters are shared.

Parameters for serial interface spindle or spindle

Parameters Nos. 4000 to 4539 below are basically used with the serial spindle amplifier (SPM). For details of these parameters, refer to either of the following manuals and other related documents, depending on the spindle that is actually connected.

- FANUC AC SPINDLE MOTOR αi series PARAMETER MANUAL (B-65280EN)
- FANUC AC SPINDLE MOTOR α series PARAMETER MANUAL (B-65160E)

	#7	#6	#5	#4	#3	#2	#1	#0
4000								
:	:							
4015	(No user setting allowed = Note 1)							
:	:							
4019	(Note 2)							

[Data type] Bit axis (spindle)

4020	
:	:
4133	

[Data type] Word axis (spindle)

4134	
4135	

[Data type] 2-word axis (spindle)

4136	
:	:
4175	

[Data type] Word axis (spindle)

	#7	#6	#5	#4	#3	#2	#1	#0
4176								
:	:							
4191	(No user setting allowed = Note 1)							
:	:							
4195	(Note 2)							

[Data type] Bit axis (spindle)

4196	
:	:
4309	

[Data type] Word axis (spindle)

4310	

4311	

[Data type] 2-word axis (spindle)

4312	
:	:
4351	

[Data type] Word axis (spindle)

	#7	#6	#5	#4	#3	#2	#1	#0
4352								

	#7	#6	#5	#4	#3	#2	#1	#0
4353								

[Data type] Bit axis (spindle)

4354	
:	:
4372	

[Data type] Word axis (spindle)

	#7	#6	#5	#4	#3	#2	#1	#0
4373								

	#7	#6	#5	#4	#3	#2	#1	#0
4374								

[Data type] Bit axis (spindle)

4375	
:	:
4393	

[Data type] Word axis (spindle)

	#7	#6	#5	#4	#3	#2	#1	#0
4394								

	#7	#6	#5	#4	#3	#2	#1	#0
4403								

[Data type] Bit axis (spindle)

4404	
:	:
4466	

[Data type] Word axis (spindle)

	#7	#6	#5	#4	#3	#2	#1	#0
4467								

	#7	#6	#5	#4	#3	#2	#1	#0
4476								

[Data type] Bit axis (spindle)

4477	
:	:
4539	

[Data type] Word axis (spindle)

Notes on parameters of the spindle amplifier with the serial interface

NOTE

1 Among the parameters of the spindle amplifier with the serial interface, parameters Nos. 4015 and 4191 cannot be changed by the users.
These parameters require to assign optional software to the CNC and are automatically set depending on the type of the software.

2 To set the parameters of the spindle amplifier with the serial interface automatically, set bit 7 of parameter No.4019 (if the sub spindle is set in the CNC with the spindle switching function, use parameter No.4195) to 1, assign the model code of the motor to be used to parameter No.4133 (if the sub spindle is set in the CNC with the spindle switching function, use parameter No.4309), turn off the power of the CNC and spindle amplifier, and restart the CNC and spindle amplifier.

3 Parameters No.4000 to No.4539 are used in the processing on the spindle amplifier. For details of these parameters, refer to either of the following manuals, depending on the serial spindle that is actually used.
- FANUC AC SPINDLE MOTOR αi series PARAMETER MANUAL (B-65270EN)
- FANUC AC SPINDLE MOTOR α series PARAMETER MANUAL (B-65160E)

NOTE

4 The CNC can control up to four spindle amplifiers (three spindle amplifiers for Series 18*i*/180*i*/180*i*s) with the serial interface.
When the spindle amplifier provides the spindle switching function, one spindle amplifier can control two spindle motors using the switching function.
The output switching function can be used in spindle motors to be connected.
Up to eight spindles, or sixteen types, can be used by switching the spindle motors. (The number of spindles that can controlled simultaneously is the same as the number of spindle amplifiers, that is four spindles.) Parameters of the spindle amplifier with the serial interface correspond to the above functions as follows:
(1) Parameter No.4000 to No.4539 "S1": First spindle amplifier
Parameter No.4000 to No.4539 "S2": Second spindle amplifier
Parameter No.4000 to No.4539 "S3": Third spindle amplifier
Parameter No.4000 to No.4539 "S4" (only for Series 16*i*/160*i*/160*i*s): Fourth spindle amplifier
(2) Parameter No.4000 to No.4175 "S1"/"S2"/"S3"/"S4": When the spindle switching function is not provided, or for the main spindle in the spindle amplifier when the function is provided.
Parameter No.4176 to No.4351 "S1"/"S2"/"S3"/"S4": For the sub spindle in the spindle amplifier when the spindle switching function is provided.
(3) Parameters at low speed when the output switching function is provided.
Parameters No.4136 to No.4175 "S1"/"S2"/"S3"/"S4": When the spindle switching function is not provided, or for the main spindle when the function is provided.
Parameters No.4284 to No.4351 "S1"/"S2"/"S3"/"S4": For the sub spindle when the spindle switching function is provided.

5 The CNC stores the parameters of the spindle amplifier with the serial interface. The CNC sends them to the spindle amplifier at the system power on and they are used in the unit.
These parameters are sent from the CNC to the spindle amplifier in a batch when:
- The CNC is switched on.
- The serial spindle is restarted by a reset that is carried out after spindle communication alarm 749 occurs (because the spindle control unit is switched off or because of noise).

If these parameters are rewritten, they are sent from the CNC to the spindle amplifier sequentially when:
- The parameters have been entered from the MDI.
- The parameters have been entered as programmable (G10).
- The parameters have been entered via the reader/puncher interface.

To set parameters automatically, upload parameters corresponding to the motor model from the spindle amplifier to the CNC prior to the procedure specified above.
The parameters of the spindle amplifier with serial interface can be changed after the system starts. Changing the parameters (No.4000 to No.4539 "S1", "S2", "S3","S4") in the CNC sends them to the spindle amplifier at an appropriate time and the parameters in the unit are updated. (Be careful not to change parameters incorrectly.)

6 The fourth spindle amplifier can be used just in Series 16*i*/160*i*/160*i*s.

	#7	#6	#5	#4	#3	#2	#1	#0
4800	SPK	EPZ		SYM	ND4	ND3	ND2	ND1
	SPK	EPZ			ND4	ND3	ND2	ND1

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

ND1 In controlling the spindle synchronous control, the direction of the first spindle motor rotation is:
0 : The direction indicated by the command sign
1 : The opposite direction to that indicated by the command sign

ND2 In controlling the spindle synchronous control, the direction of the 2nd spindle motor rotation is:
0 : The direction indicated by the command sign
1 : The opposite direction to that indicated by the command sign

ND3 Under spindle synchronous control, the direction of rotation of the third spindle motor is:
0 : The same as the specified sign.
1 : The opposite of the specified sign.
This parameter is usable only when parameter SSS (bit 4 of parameter No. 3704) = 1.

ND4 Under spindle synchronous control, the direction of rotation of the fourth spindle motor is:
0 : The same as the specified sign.
1 : The opposite of the specified sign.
This parameter is usable only when parameter SSS (bit 4 of parameter No. 3704) = 1.

NOTE
This parameter is valid just for Series 16*i*/160*i*/160*i*s.

SYM As the maximum allowable spindle speed for spindle synchronous control:
0 : The maximum allowable spindle speed of the master spindle is used.
1 : The maximum allowable spindle speed of the master spindle or slave spindle, whichever smaller, is used.

EPZ If an axis of Cs contour control is used under spindle simple synchronous control, positioning to an axis of Cs contour control immediately after the parking signal is switched is performed by:
0 : Usual positioning operation.
1 : Positioning operation including reference position return.

SPK As the parking signals for spindle simple synchronous control:
0 : PKESS1 <G122#6> (first spindle) and PKESS2 <G122#7> (second spindle) are used.
1 : PKESS1 <G031#6> (first spindle) and PKESS2 <G031#7> (second spindle) are used.

	#7	#6	#5	#4	#3	#2	#1	#0
4802							SYW	SYR

[Data type] Bit

SYR In spindle synchronous control by CNC program, the value of address R is:
- 0 : Phase shift amount of the slave spindle.
- 1 : Phase shift amount of the master spindle.

SYW The block immediately after spindle synchronous control G51.8 by CNC program is:
- 0 : Executed immediately when PSYFN signal <G348#0> is set to 1.
- 1 : Executed after completion of spindle synchronous control or spindle phase synchronous control.

4810	Error pulse between two spindles when synchronizing phases in the serial spindle synchronous control mode

[Data type] Byte

[Unit of data] Pulse

[Valid data range] 0 to 255

Set the difference in error pulses between two spindles when synchronizing phases in the serial spindle synchronous control mode.

When the difference in error pulse between two spindles is within the value set in this parameter, the spindle phase synchronous control completion signal FSPPH becomes "1".

This parameter is used to check the difference in phase in synchronous control and to confirm the completion of synchronous control in the serial spindle synchronous control mode.

Serial spindle parameters such as parameter No. 4032 also need to be set to spindle synchronous control.

4811	Allowable error count for the error pulses between two spindles in the serial spindle synchronous control mode or simple synchronous control mode

[Data type] Word

[Unit of data] Pulse

[Valid data range] 0 to 32767

Set the allowable error count for the error pulses between two spindles in the serial spindle synchronous control mode or simple synchronous control mode.

> **NOTE**
> This parameter is used to output the inter-spindle phase error detection signal SYCAL in the serial spindle synchronous control mode. The SYCAL <F044#4> signal becomes "1" when a phase error exceeding the value set in this parameter is found. When you are going to use this parameter to detect error pulses during simple synchronous control, pay attention to the mode of the spindle, and set the parameter as required. (The parameter is invalid in spindle mode. It is valid in Cs contour control, rigid tapping, and spindle positioning mode; the detection unit per pulse differs, however.)

4812	Master spindle in spindle synchronous control

4813	Slave spindle in spindle synchronous control

[Data type] Byte

[Valid data range] 0, 1 to number of spindles or m × 10+n (m: 1 to number of paths, n: 1 to number of spindles)

Set a master spindle/slave spindle in spindle synchronous control.

[Setting value]

1 to 4 : First to fourth serial spindle of the local path
11 to 14 : First to fourth serial spindle of path 1
21 to 24 : First to fourth serial spindle of path 2
31 to 34 : First to fourth serial spindle of path 3

> **NOTE**
> These parameters are valid only under spindle synchronous control by CNC program. If spindle synchronous control ON (G51.8) is specified by programming when 0 is set, an alarm is issued.

4821	Master axis of first spindle under spindle simple synchronous control
4822	Master axis of second spindle under spindle simple synchronous control
4823	Master axis of third spindle under spindle simple synchronous control
4824	Master axis of fourth spindle under spindle simple synchronous control

[Data type] Byte

[Valid data range] 1 to number of spindles

Set the slave axis and master axis for spindle simple synchronous control by spindles. Set the axis number of the master axis for the axis to be used as the slave axis.

NOTE

1 When these parameters are set, the power must be turned off before operation is continued.
2 These parameters are valid if bit 5 (SSY) of parameter No. 3704 is set to 1.
3 Such a parameter setting that multiple slave axes are set for one master axis is possible. However, note that one master axis can exercise spindle simple synchronous control on one slave only simultaneously. One master axis cannot exercise spindle simple synchronous control on multiple slave axes simultaneously.
4 Parameter No. 4824 is valid just for Series 16*i*/160*i*/160*i*s.

4826	**Permissible synchronous error under spindle simple synchronous control in which the first spindle is the slave axis**

4827	**Permissible synchronous error under spindle simple synchronous control in which the second spindle is the slave axis**

4828	**Permissible synchronous error under spindle simple synchronous control in which the third spindle is the slave axis**

4829	**Permissible synchronous error under spindle simple synchronous control in which the fourth spindle is the slave axis**

[Data type] Word
[Unit of data] Pulse
[Valid data range] 0 to 32767

Set a permissible error of error pulse between two spindles in the mode of spindle simple synchronous control. The data unit is the unit of the detector used meanwhile.

NOTE
1 These parameters are valid if bit 5 (SSY) of parameter No. 3704 is set to 1.
2 These parameters are used to output the signals of synchronous error detection under spindle synchronous control SYCAL1 to SYCAL4 <F043#0 to #3>.
3 Under spindle simple synchronous control in the spindle mode, no synchronous error is detected.
4 Parameter No. 4829 is valid just for Series 16*i*/160*i*/160*i*s.

4831	Master axis of first spindle under spindle synchronous control
4832	Master axis of second spindle under spindle synchronous control
4833	Master axis of third spindle under spindle synchronous control
4834	Master axis of fourth spindle under spindle synchronous control

[Data type] Byte

[Valid data range] 1 to number of spindles

Set the slave axis and master axis of spindle synchronous control by spindles. Set the axis number of the master axis for the axis to be handled as the slave axis.

NOTE

1. When these parameters are set, the power must be turned off before operation is continued.
2. These parameters are valid if bit 4 (SSS) of parameter No. 3704 is set to 1.
3. Multiple slave axes cannot simultaneously enter the synchronous control mode for a single master axis.
4. Parameter No. 4834 is valid only for Series 16*i*/160*i*/160*i*s.

	#7	#6	#5	#4	#3	#2	#1	#0
4900								FLR

[Data type] Bit

FLR When the spindle speed fluctuation detection function is used, the rates of allowance (q) and fluctuation (r) those are set in parameters No.4911 and No.4912, respectively are set in steps of:

0 : 1%

1 : 0.1%

	#7	#6	#5	#4	#3	#2	#1	#0
4901								STT

[Data type] Bit

STT In multi-path or multi-spindle control, the spindle that detects spindle speed fluctuation is:

0 : The first spindle of the path for which spindle speed fluctuation detection is specified.

1 : The spindle selected by the position coder feedback signal.

NOTE
When this parameter is set to 0, it is necessary that the first spindle should be selected by the position coder feedback signal.

4911	Rapid (q) of the fluctuation of spindle speed which is assumed to be the specified spindle speed

[Data type] Word

[Unit of data, valid data range]

Unit of data	1%	0. 1% (T series)
Valid data range	1 to 100	1 to 1000

NOTE
Unit of data depends on bit 0 (FLR) of parameter No.4900 (T series only)

Set the ratio (q) of the spindle speed which is assumed to be the specified spindle speed in the spindle speed fluctuation detection function.

Let the commanded speed be Sc. When the actual spindle speed reaches between (Sc-Sq) and (Sc+Sq), it is assumed to be the commanded speed.

The spindle speed fluctuation detection starts.

where,

$$Sq = Sc \times \frac{q}{100}$$

4912	Spindle speed fluctuation ratio (r) for which no alarm is activated in the spindle speed fluctuation detection function

[Data type] Word

[Unit of data, valid data range]

Unit of data	1%	0. 1% (T series)
Valid data range	1 to 100	1 to 1000

NOTE
Unit of data depends on bit 0 (FLR) of parameter No.4900 (T series only).

Set the spindle speed fluctuation ratio (r) for which no alarm is activated in the spindle speed fluctuation detection function.

4913	Spindle speed fluctuation value (d) for which no alarm is activated in the spindle speed fluctuation detection function

[Data type] Word

[Unit of data] min^{-1}

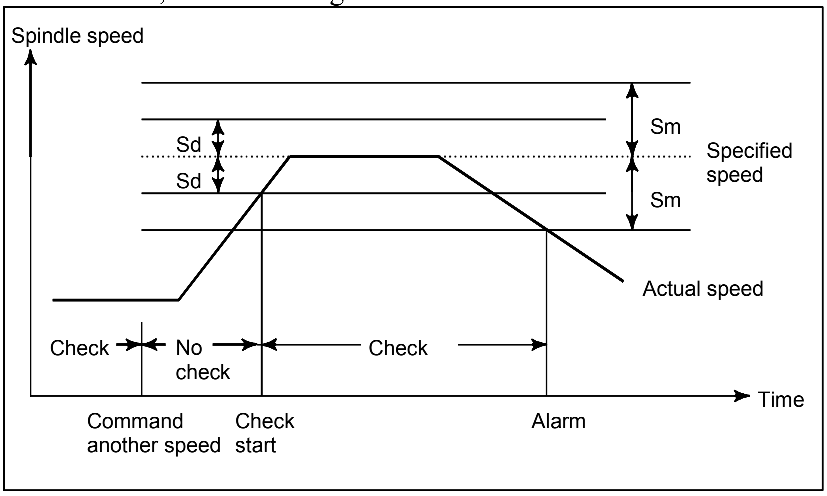
[Valid data range] 0 to 32767

Set the allowable fluctuation speed (Sd) for which no alarm is activated in the spindle speed fluctuation detection function.
The function for detecting spindle speed fluctuation checks whether the actual speed varies for the specified speed or not. Sd or Sr, whichever is greater, is taken as the allowable fluctuation speed (Sm).
An alarm is activated when the actual spindle speed varies for the commanded speed (Sc) under the condition that the variation width exceeds the allowable variation width (Sm).

Sd: The allowable constant variation width which is independent of the specified spindle speed (Sd is set with parameter No. 4913.)

Sr: The allowable variation width which is obtained by multiplying Sc (commanded spindle speed) by r (constant ratio). (r is set with parameter No. 4912.)

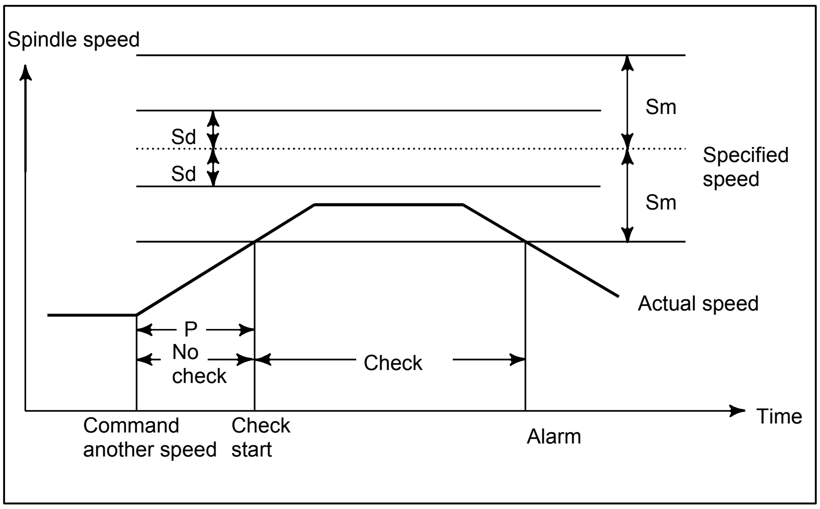
Sm: Sd or Sr, whichever is greater



4914	Time (p) elapsed from when the commanded spindle speed is changed to the start of spindle speed fluctuation detection

[Data type] 2-word
[Unit of data] msec
[Valid data range] 0 to 999999

Set the time elapsed from when the specified spindle speed is changed to the start of spindle speed fluctuation detection in the spindle speed fluctuation detection function. That is, the fluctuation in the spindle speed is not detected until the specified time elapses from when the specified spindle speed is changed.



	#7	#6	#5	#4	#3	#2	#1	#0
4950	IMB	ESI	TRV			ISZ	IDM	IOR

[Data type] Bit

IOR Resetting the system in the spindle positioning mode
0 : Does not releases the mode.
1 : Releases the mode

IDM The positioning direction for the spindle using a M code is
0 : The positive direction
1 : The negative direction

ISZ When an M code for spindle orientation is specified in spindle positioning:
0 : The spindle rotation mode is cleared and the mode is switched to the spindle positioning mode, and spindle orientation operation is performed.
1 : The spindle rotation mode is cleared and the mode is switched to the spindle positioning mode but spindle orientation operation is not performed.

TRV Rotation direction of spindle positioning is set to:
0 : The positive direction
1 : The reverse direction

ESI Selection of a spindle positioning specification

0 : The conventional specification is used.

1 : The extended specification is used.

> **NOTE**
>
> The extended specification includes the following two extensions:
>
> (1) With the conventional specification, the number of M codes for specifying a spindle positioning angle is always 6. With the extended specification, an arbitrary number of such M codes from 1 to 255 can be selected by parameter setting (See parameter No.4964.)
>
> (2) The maximum feedrate for spindle positioning (setting of parameter No.1420) can be extended from 240000 to 269000 (in increments of 10 deg/min).

IMB When the spindle positioning function is used, half-fixed angle positioning based on M codes uses:

0 : Specification A

1 : Specification B

> **NOTE**
>
> In the case of half-fixed angle positioning based on M codes, three types of spindle positioning operations can occur:
>
> (1)The spindle rotation mode is cleared, then the mode is switched to the spindle positioning mode.
>
> (2)Spindle positioning is performed in the spindle positioning mode.
>
> (3)The spindle positioning mode is cleared, then the mode is switched to the spindle rotation mode.
>
> In the case of specification A:
>
> Operations (1) to (3) are specified using separate M codes.
>
> (1)Specified using M codes for performing spindle orientation. (See parameter No.4960)
>
> (2)Specified using M codes for specifying a spindle positioning angle. (See parameter No.4962)
>
> (3)Specified using M codes for clearing spindle positioning operation. (See parameter No.4961.)
>
> In the case of specification B:
>
> When M codes for specifying a spindle positioning angle are specified, operations (1) to (3) are performed successively. (See parameter No.4962.)

4960	M code specifying the spindle orientation

[Data type] Word
[Unit of data] Integer
[Valid data range] 6 to 97

Set an M code to change the spindle rotating mode to the spindle positioning mode. Setting the M code performs the spindle orientation. Spindle positioning can be specified from the next block.

4961	M code releasing the spindle positioning mode

[Data type] Word
[Unit of data] Integer
[Valid data range] 6 to 97

Set the M code to release the spindle positioning mode and to change the mode to the spindle rotating mode.

4962	M code for specifying a spindle positioning angle

[Data type] Word
[Unit of data] Integer
[Valid data range] 6 to 92

Two methods are available for specifying spindle positioning. One method uses address C for arbitrary-angle positioning. The other use an M code for half-fixed angle positioning. This parameter sets an M code for the latter method.

- When bit 6 (ESI) of parameter No. 4950=0
  Six M code from Mα to M(α+5) are used for half-fixed angle positioning, when a is the value of this parameter.
- When bit 6 (ESI) of parameter No. 4950=1
  Set the start M code in this parameter, and set the number of M codes in parameter No. 4964. Then β M codes from Mα to M(α+β-1) are used for half fixed angle positioning.

The table below indicates the relationship between the M codes and positioning angles.

M code	Positioning angle	Example: Positioning angle when θ = 30°
Mα	θ	30°
M (α+1)	2θ	60°
M (α+2)	3θ	90°
M (α+3)	4θ	120°
M (α+4)	5θ	150°
M (α+5)	6θ	180°
:	:	:
M (α+n)	(n+1) θ	

NOTE

θ represents the basic angular displacement set in parameter No.4963.

4963	Basic angular displacement used for spindle positioning using M code

[Data type] Word
[Unit of data] degree
[Valid data range] 1 to 60

This parameter sets a basic angular displacement used for half-fixed angle positioning using M codes.

4964	Number of M codes for specifying a spindle positioning angle

[Data type] Byte
[Unit of data] Integer
[Valid data range] 0, 1 to 255

This parameter sets the number of M codes used for half-fixed angle positioning using M codes.
As many M codes as the number specified in this parameter, starting with the M code specified in parameter No. 4962, are used to specify half-fixed angle positioning.
Let α be the value of parameter No. 4962, and let β be the value of parameter No. 4964. That is, M codes from Mα to M(α+β-1) are used for half-fixed angle positioning.

NOTE
1. This parameter is valid when bit 6 (ESI) of parameter No.4950=1.
2. Make sure that M codes from Mα to M(α+β-1) do not duplicate other M codes.
3. Setting this parameter to 0 has the same effect as setting 6. That is, M code from Mα to M(α+5) are used for half-fixed angle positioning.

4970	Servo loop gain of the spindle

[Data type] Word
[Unit of data] 0.01 s^{-1}
[Valid data range] 1 to 9999

Set the servo loop gain of the spindle in the spindle positioning mode.

NOTE
This parameter is for analog spindles.

4971	Servo loop gain multiplier of the spindle for gear 1

4972	Servo loop gain multiplier of the spindle for gear 2

4973	Servo loop gain multiplier of the spindle for gear 3

4974	Servo loop gain multiplier of the spindle for gear 4

[Data type] Word

Set the servo loop gain multipliers of the spindle for gears 1 to 4.

The multipliers are used to convert the amount of the position deviation to the voltage used in the velocity command. Assign the data obtained from the following equation to the parameters.

Loop gain multiplier = 2048000 × E × A/L

where;

E : Voltage required to rotate the spindle motor at 1000 min^{-1} in the velocity command

L : Rotation angle of the spindle per one motor rotation (normally 360)

A : Unit used for the detection (degree)

[Example] Let E be 2.2 V, L be 360 degrees, and A be 0.088 degrees/pulse.

Loop gain multiplier = 2048000 × 2.2 × 0.088/360 = 1101

* When the voltage specified for the spindle motor is 10 V at a spindle speed of 4500 min^{-1}, E is regarded as 2.2 V.

NOTE

The above parameters No.4970 to No.4974 are for analog spindles.

4.24 PARAMETERS OF TOOL COMPENSATION

	#7	#6	#5	#4	#3	#2	#1	#0
5000				ASG				SBK

At least one of these parameters can also be set on the "Setting screen".

[Data type] Bit

SBK When cutter compensation C is performed in the HPCC mode or the AI high-precision/AI nano high-precision contour control mode, a block internally generated for cutter compensation C during single-block operation:
- 0 : Does not cause a single-block stop.
- 1 : Causes a single-block stop.

ASG When tool geometry compensation and tool wear compensation are enabled, the compensation value modified by active offset value modification based on manual feed is:
- 0 : Geometry compensation value.
- 1 : Wear compensation value.

	#7	#6	#5	#4	#3	#2	#1	#0
5001		EVO		EVR	TAL		TLB	TLC
		EVO	TPH	EVR	TAL	OFH	TLB	TLC

[Data type] Bit

TLC Tool length compensation
- 0 : Tool length compensation A or B (Conforms to bit 1 (TLB) of parameter No. 5001)
- 1 : Tool length compensation C

> **NOTE**
> When the T series is used, the setting of this parameter is valid only in the AI high-precision/AI nano high-precision contour control mode.

TLB Tool length compensation axis
- 0 : Always Z axis irrespective of plane specification (Tool length compensation A)
- 1 : Axis perpendicular to plane specification (G17, G18, and G19) (Tool length compensation B)

> **NOTE**
> When the T series is used, the setting of this parameter is valid only in the AI high-precision/AI nano high-precision contour control mode.

OFH Offset number of tool length compensation, cutter compensation and tool offset

0 : Specifies the tool length compensation using an H code, and cutter compensation C using a D code
Tool offset conforms to bit 5 (TPH) of parameter No. 5001.

1 : Specifies the tool length compensation, cutter compensation and tool offset using H codes

> **NOTE**
> Be sure to set this parameter to 1 for cutter compensation B.

TAL Tool length compensation C

0 : Generates an alarm when two or more axes are offset

1 : Not generate an alarm even if two or more axes are offset

> **NOTE**
> When the T series is used, the setting of this parameter is valid only in the AI high-precision/AI nano high-precision contour control mode.

EVR When a tool compensation value is changed in cutter compensation C mode:

0 : Enables the change, starting from that block where the next D or H code is specified.

1 : Enables the change, starting from that block where buffering is next performed.

> **NOTE**
> When the T series is used, the setting of this parameter is valid only in the AI high-precision/AI nano high-precision contour control mode.

TPH Specifies whether address D or H is used as the address of tool offset number (G45 to G48).

0 : D code

1 : H code

TPH is valid when bit 2 (OFH) of parameter No. 5001 is set to 0.

EVO If a tool compensation value modification is made in the offset mode (G43, G44) when tool length compensation A or tool length compensation B is performed (M series), or
if a tool compensation value modification is made when tool offset is applied (T series):

0 : The modification becomes valid starting with the block where G43, G44, or an H code is specified next (M series).
The modification becomes valid starting with the block where a T code is specified next (T series).

1 : The modification becomes valid starting with the next buffered block.

	#7	#6	#5	#4	#3	#2	#1	#0
5002	WNP	LWM	LGC	LGT		LWT	LGN	LD1

[Data type] Bit

LD1 Offset number of tool offset (Wear offset number when option of tool geometry/wear compensation is selected)
- 0 : Specified using the lower two digits of a T code
- 1 : Specified using the lower one digit of a T code

LGN Geometry offset number of tool offset (When the option of tool geometry/wear compensation is selected, it is effective.)
- 0 : Is the same as wear offset number
- 1 : Specifies the geometry offset number by the tool selection number

LWT Tool wear compensation is performed by:
- 0 : Moving the tool.
- 1 : Shifting the coordinate system.
  (Only when bit 4 (LGT) of parameter No. 5002 is set to 0)

LGT Tool geometry compensation (When the option of tool geometry/wear compensation is selected, this parameter is effective. Whenever the option is not selected, compensation is made according to the tool movement.)
- 0 : Compensated by the shift of the coordinate system (Compensation is made in the block of T code regardless of setting of bit 6 (LWM) of parameter No. 5002 at this time.)
- 1 : Compensated by the tool movement

LGC Tool geometry compensation (It is effective when the option of tool geometry / wear compensation is selected and bit 4 (LGT) of parameter No. 5002 is set to 0. When bit 4 (LGT) of parameter No. 5002 is set to 1, it is always canceled.)
- 0 : Not canceled by offset number 0
- 1 : Canceled by offset number 0

LWM Tool offset (Wear compensation when option of tool geometry/wear offset is selected, or geometry and wear compensation when bit 4 (LGT) of parameter No. 5002 is set to 1.)
- 0 : Is done in the T code block
- 1 : Is done together with the axis movement

NOTE

When the option of tool geometry/wear compensation is equipped and bit 4 (LGT) of parameter No. 5002 is set to 0, the offset is done in a T code block regardless of setting of this parameter.

WNP Imaginary tool tip direction used for tool nose radius compensation, when the geometry/wear compensation option is equipped, is the direction specified by:
- 0 : Geometry offset number
- 1 : Wear offset number

	#7	#6	#5	#4	#3	#2	#1	#0
5003	TGC	LVC		BCK	ICK	CCN	SUV	SUP
		LVK		BCK	ICK	CCN	SUV	SUP

[Data type] Bit

SUP Start up or cancel in cutter compensation C or tool radius compensation for 5-axis machining
0 : Type A
1 : Type B

SUV Start-up and cancellation of cutter compensation C or tool radius compensation for 5-axis machining are:
0 : Of type A or type B (follows the setting of bit 0 (SUP) of parameter No. 5003).
1 : Perpendicular to the next movement.

CCN When automatic reference position return (G28) is specified in the cutter compensation C mode (M series) or in tool nose radius compensation (T series):
0 : The cutter compensation or tool nose radius compensation vector is cancelled in movement to an intermediate position.
1 : The cutter compensation or tool nose radius compensation vector is not cancelled in movement to an intermediate position, but is cancelled in movement to the reference position.

ICK In HPCC mode or AI/AI-nano high-precision contour control mode, a cutter compensation C interference check is:
0 : Done
1 : Not done

BCK In HPCC mode or AI/AI-nano high-precision contour control mode, when a cutter compensation C interference check determines that the programmed move direction differs from the offset move direction by between 90 and 270 degrees:
0 : An alarm is issued.
1 : No alarm is issued.

LVC Offset value of tool offset
0 : Not cleared, but held by reset
1 : Cleared by reset

LVK Tool length offset value
0 : Cleared by reset
1 : Not cleared, but held by reset

TGC Tool geometry compensation value
0 : Not canceled by reset
1 : Canceled by reset
(Valid when bit 6 (LVC) of parameter No. 5003 is "1")

	#7	#6	#5	#4	#3	#2	#1	#0
5004	Y03				TS1		ORC	
						ODI		

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

ORC Tool offset value
- 0 : Set by the diameter programming (Can be set in only the axis under diameter programming)
- 1 : Set by the radius programming

ODI A cutter compensation amount is set using:
- 0 : A radius.
- 1 : A diameter.

TS1 When the tool offset measurement value direct input B function is used, touch sensor contact detection is based on:
- 0 : Four-contact input.
- 1 : One-contact input.

Y03 Y axis offset is :
- 0 : Used for 4th axis.
- 1 : Used for 3rd axis.

	#7	#6	#5	#4	#3	#2	#1	#0
5005		TLE	QNI			PRC		CNI

[Data type] Bit

CNI On the offset screen, Y-axis offset screen, and macro screen, the [INP.C] soft key is:
- 0 : Used.
- 1 : Not used. (The [INP.C] soft key is not displayed.)

PRC Direct input of tool offset value and workpiece coordinate-system shift value
- 0 : Not use a PRC signal
- 1 : Uses a PRC signal

QNI The direct input of tool offset value measured B function and the direct input of offset value measured B for 2-spindle lathe:
- 0 : Not automatically select the tool offset number
- 1 : Automatically selects a tool offset number

TLE When the tool offset measurement value direct input B function is used, a tool offset value, set by the offset write signal, is:
- 0 : Always received in offset write mode.
- 1 : Received only in offset write mode and during movement along an axis (where "during movement along an axis" means that the positional deviation value is other than 0).

	#7	#6	#5	#4	#3	#2	#1	#0
5006		TOS					TGC	OIM
		TOS		TCE				OIM

[Data type] Bit

OIM When the unit is switched between the inch and metric systems, automatic tool offset value conversion is:
0 : Not performed
1 : Performed

> **NOTE**
> If this parameter setting is changed, reset the tool offset data.

TGC When a T code is specified in a block containing G50, G04, or G10:
0 : No alarm occurs.
1 : P/S alarm No.245 occurs.

TCE If tool length compensation is specified during rigid tapping or drilling canned cycle operation, the axis to which tool length compensation is applied:
0 : Follows the specifications of tool length compensation C.
1 : Is a drilling axis.

> **NOTE**
> This parameter is valid when tool length compensation C is enabled (bit 0 (TLC) of parameter No. 5001 is set to 1).

TOS This parameter specifies the operation of tool length compensation:
0 : Tool length compensation is performed by a movement on an axis.
1 : Tool length compensation is performed by a coordinate system shift.

> **NOTE**
> When the T series is used, the setting of this parameter is valid only in the AI high-precision/AI nano high-precision contour control mode.

	#7	#6	#5	#4	#3	#2	#1	#0
5007								
	3OF	3OC						

[Data type] Bit

3OC If tool length compensation is not cancelled before three-dimensional coordinate conversion is specified, an alarm is:
0 : Not raised.
1 : Raised. (P/S049 alarm)

3OF If the commands of three-dimensional coordinate conversion and tool length compensation are not nested, an alarm is:
0 : Not raised.
1 : Raised. (P/S049 alarm)

[Example 1] An alarm is raised in the following cases:

```
<1> G68 X__ Y__ Z__ I0 J1 K0 R50.;
    G43 H1 ;
    G69 ;                                ← P/S049 raised
    G49 ;

<2> G43 H1 ;
    G68 X__ Y__ Z__ I0 J1 K0 R50.;
    G49 (or G43 H2, etc.);               ← P/S049 raised
    G69 ;
```

[Example 2] No alarm is raised in the following cases:

```
<3> G68 X__ Y__ Z__ I0 J1 K0 R50.;
     :
    G43 H1 ;
     :
    G49 ;
     :
    G69 ;

<4> G43 H1 ;
     :
    G68 X__ Y__ Z__ I0 J1 K0 R50.;
     :
    G69 ;
     :
    G49 ;
```

NOTE

To program as in <4> of [Example 2] above, set both bit 2 (D3R) of parameter No. 5400 and bit 6 (LVK) of parameter No. 5003 to 1, so that three-dimensional coordinate conversion and tool length compensation are not cancelled by a reset. (If a reset is made in the middle of a program, the direction of tool length compensation will be affected.)

As shown below, a command to cancel tool length compensation (G28, etc.) will not cause an alarm to be raised. If a command like this is specified in the G68 mode, program as indicated in <3> above.

```
G43 H1 ;
 :
G68 X__ Y__ Z__ I0 J1 K0 R50.;
 :                                ← Offset is cancelled.
G28 X__ Y__ Z__ ;                   No alarm is raised.
 :
G69 ;
```

	#7	#6	#5	#4	#3	#2	#1	#0
5008			QCR	MCR	CNV		CNC	CNI
		GCS	QCR	MCR	CNV	G39	CNC	CNI

[Data type] Bit

CNI Interference check for cutter compensation C (M series) or tool nose radius compensation (T series) is:
0 : Performed
1 : Not performed

CNC During interference check for cutter compensation C (M series) or tool nose radius compensation (T series), when the direction of movement after application of the offset differs from the programmed direction by between 90° and 270°:
0 : An alarm is issued.
1 : No alarm is issued.

G39 The corner circular interpolation (G39) in cutter compensation C mode is:
0 : Disabled.
1 : Enabled.

CNV The interference check and vector erasure of cutter compensation C (M series) or tool nose radius compensation (T series) are:
0 : Performed.
1 : Not performed.

MCR If G41/G42 (cutter compensation C (M series) or tool nose radius compensation (T series)) is specified in the MDI mode, an alarm is:
0 : Not raised.
1 : Raised. (P/S5257)

NOTE
In the MDI mode, cutter compensation C (M series) or tool nose radius compensation (T series) is not performed, irrespective of the setting of this parameter.

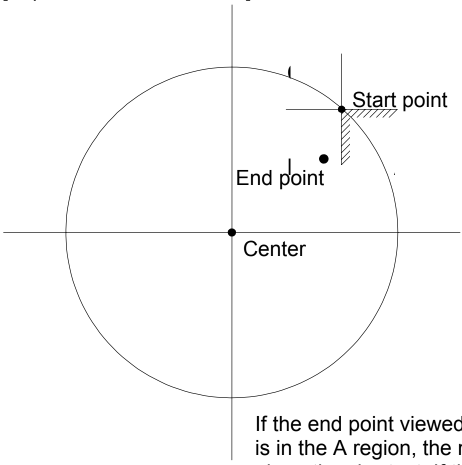
QCR The travel distance of circular interpolation in cutter compensation C (M series) or tool nose radius compensation (T series) is judged:

0 : In the tape format for Series 16.

1 : In the tape format for Series 15.

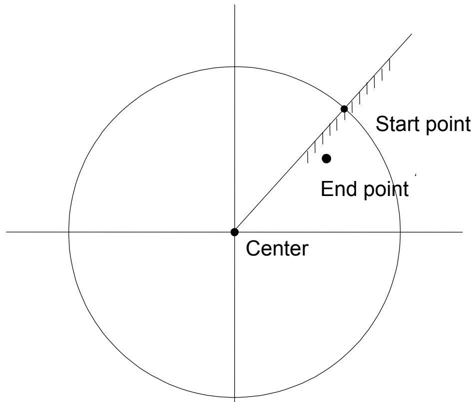
Series 16 and Series 15 determine the travel distance in different ways if the radius of arc at the start point of circular interpolation is different from that at the end point (if the end point is not on the arc). By this parameter, the method of determining the travel distance of circular interpolation can be selected.

[Tape format for Series 16]



If the end point viewed from the start point is in the A region, the movement is made along the shortcut. If the end point is in the B, C, or D region, almost a single turn is made.

[Tape format for Series 15]



If the end point is in the A region separated by the line L drawn between the start point and the center, the movement is made along the shortcut. If the end point is in the B region, almost a single turn is made.

> **NOTE**
> The setting of this parameter determines the travel distance determination method for circular interpolation not during cutter compensation C (M series) or tool nose radius compensation (T series) as well. Accordingly, if this parameter is set, the setting of bit 3 (CQD) of parameter No. 3450 is invalid.

GCS If G49 (G code for canceling tool length compensation) and G40 (G code for canceling cutter compensation) are specified in a single block, the tool length compensation is cancelled:

0 : In the next block.

1 : In the specified block.

	#7	#6	#5	#4	#3	#2	#1	#0
5009	NTT			TSD	QSA			GSG

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

GSG In the mode of tool compensation direct input B, the offset write input signal is input:
- 0 : From the machine side. <G004#2 to #5>
- 1 : From the PMC side. <G132#0 and #1, G134#0 and #1>

QSA For the angular axis control function, the direct input of tool offset value measured B function is:
- 0 : Not supported.
- 1 : Supported.

TSD When the direct input of tool offset value measured B function is used, the wrong operation prevention function is:
- 0 : Disabled.
- 1 : Enabled.

NTT If tool offset of shift type is applied in simple synchronous control, and the master axis and slave axis are irrelevant to tool offset:
- 0 : An alarm (P/S alarm 214) is issued.
- 1 : No alarm is issued.

5010	**Limit value that ignores the vector when a tool moves on the outside of a corner during tool nose radius compensation**
	Limit value that ignores the vector when a tool moves on the outside of a corner during cutter compensation C

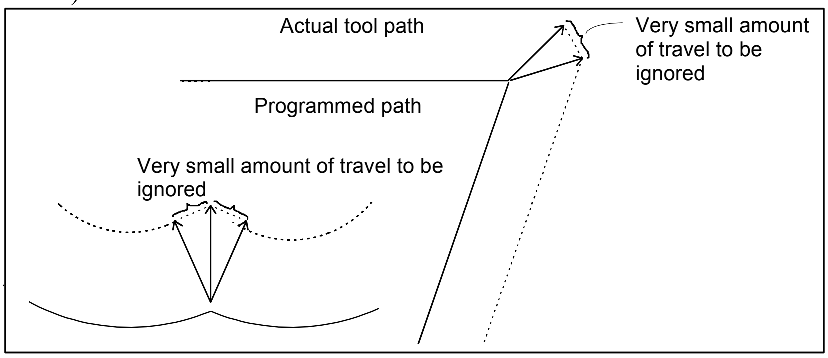
[Data type] Word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric input	0.01	0.001	0.0001	mm
Inch input	0.001	0.0001	0.00001	inch

[Valid data range] 0 to 16383

This parameter sets the limit value that ignores a slight movement occurring when a tool moves on the outside of the corner during tool nose radius compensation (T series) or cutter compensation C (M series).



5011	Denominator constant for finding a three-dimensional tool compensation vector

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric input	0.01	0.001	0.0001	mm
Inch input	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

This parameter sets the value of p in the expressions used for finding a three-dimensional tool compensation vector:

$$Vx = i \times \frac{r}{p}$$

$$Vy = j \times \frac{r}{p}$$

$$Vz = k \times \frac{r}{p}$$

where,

Vx, Vy, Vz : Components of a three-dimensional tool compensation vector along the X-axis, Y-axis, and Z-axis, or their parallel axes

i, j, k : Values specified in addresses I, J, and K in the program

r : Compensation value

p : Value set in this parameter

When 0 is set in this parameter, the following is assumed:

$$p = \sqrt{i^2 + j^2 + k^2}$$

5013	Maximum value of tool wear compensation

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric input	0.01	0.001	0.0001	mm
Inch input	0.001	0.0001	0.00001	inch

[Valid data range]

Input increment	IS-A	IS-B	IS-C
Metric input	0 to 99999	0 to 999999	0 to 9999999
Inch input	0 to 99999	0 to 999999	0 to 9999999

This parameter sets the maximum allowable tool wear compensation value. If an attempt is made to set a tool wear compensation value, the absolute value of which exceeds the value set in this parameter, the following alarm or warning is output:

Input from MDI

Warning: Too many digits

Input by G10

P/S alarm No.032: Offset value is out of range by G10.

5014	Maximum value of incremental input for tool wear compensation

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric input	0.01	0.001	0.0001	mm
Inch input	0.001	0.0001	0.00001	inch

[Valid data range]

Input increment	IS-A	IS-B	IS-C
Metric input	0 to 99999	0 to 999999	0 to 9999999
Inch input	0 to 99999	0 to 999999	0 to 9999999

Set the maximum allowable value for the tool wear compensation value, input as an incremental value. If the incremental input value (absolute value) exceeds the set value, the following alarm or warning message is output:

Input from MDI

Warning: Setting value out of range.

Input using G10

P/S alarm No.032: Offset value is out of range by G10.

5015	**Distance (XP) between reference position and X axis + contact surface** **Distance to X-axis + contact surface on the touch sensor 1 side (X1P)**

5016	**Distance (XM) between reference position and X axis - contact surface** **Distance to X-axis - contact surface on the touch sensor 1 side (X1M)**

5017	**Distance (ZP) between reference position and Z axis + contact surface** **Distance to Z-axis + contact surface on the touch sensor 1 side (Z1P)**

5018	**Distance (ZM) between reference position and Z axis - contact surface** **Distance to Z-axis - contact surface on the touch sensor 1 side (Z1M)**

[Data type] 2-word

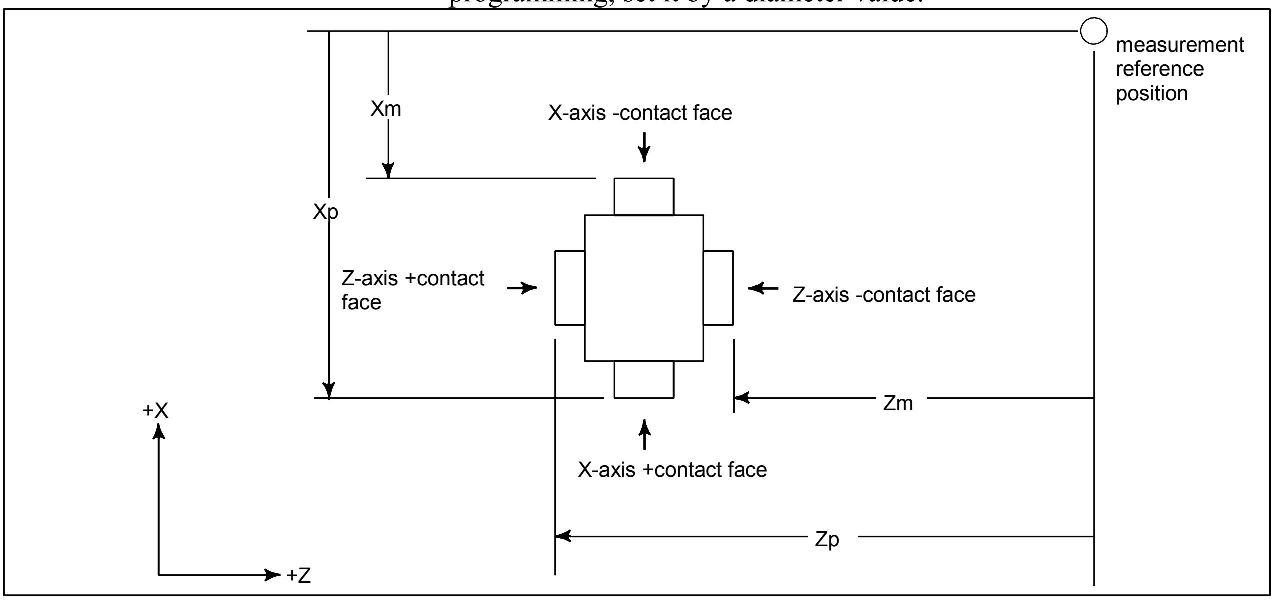
[Unit of data]

Input increment	IS-B	IS-C	Unit
Metric input	0.001	0.0001	mm
Inch input	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

These parameters are related to the direct input of tool offset value measured B function and the tool setter function for 1-turret 2-spindle lathes.

They set the distance (with sign) between the measurement reference position and sensor contact surface. For an axis under diameter programming, set it by a diameter value.



NOTE

When using two touch sensors with the direct input of tool offset value measured B function for 2-spindle lathes, set the distance of touch sensor 1. For touch sensor 2, set parameters No. 5056 through No. 5059.

5020	Tool offset number used for the measurement of workpiece origin offset value

[Data type] Byte

[Valid data range] 1 to maximum number of tool offset sets

Set a tool offset number when a workpiece coordinate system shift value is set for the direct input of tool offset value measured B function or when a workpiece origin offset is set for the direct input of tool offset value measured B function for the 2-spindle lathes. This parameter is valid when the tool offset number is not selected automatically (bit 5 (QNI) of parameter No. 5005 is set to 0).

5021	Number of pulse interpolation cycles memorized prior to contacting the touch sensor

[Data type] Byte

[Unit of data] Interpolation cycle

[Valid data range] 0 to 8

When the wrong operation prevention function is used with the direct input of tool offset value measured B function or when a touch sensor with one-contact-input type is used, set the number of pulse interpolation cycles to be memorized immediately before contacting the tool with the touch sensor by manual operation.

If 0 is set for this parameter, the specification of 8 (maximum allowable value) is assumed.

> **NOTE**
> This parameter is enabled when the bit 3 (TS1) of parameter No. 5004 is set to 1.

5023	Tool offset number used with the direct input of tool offset value measured B function (for 400 tool offsets and 999 tool offsets)

[Data type] Word

[Valid data range] 0 to number of tool offsets

Set a tool offset number used to set a workpiece origin offset with the direct input of tool offset value measured B function or the direct input of tool offset value measured B function for 2-spindle lathes.

> **NOTE**
> 1 This parameter is valid only when the number of tool offsets is 400 or 999. In other cases, use parameter No. 5020.
> 2 This parameter is valid only when automatic tool offset number selection is not performed (when bit 5 (QNI) of parameter No. 5005 is set to 0).

5030	Minimum grinding wheel diameter in minimum grinding wheel diameter check

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric input	0.01	0.001	0.0001	mm
Inch input	0.001	0.0001	0.00001	inch

[Valid data range]

Input increment	IS-A, IS-B	IS-C
Metric input	-999999 to 999999	-9999999 to 9999999
Inch input	-999999 to 999999	-9999999 to 9999999

If the compensation value corresponding to an offset number specified by an H code is smaller than the minimum grinding wheel diameter specified in this parameter during compensation with G43 or G44, the signal GWLF <F0065#3> is output to the PMC.

> **NOTE**
> This is a parameter for cylindrical grinding machines.

	#7	#6	#5	#4	#3	#2	#1	#0
5040						MOP	O2D	OWD
						MOP		

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

OWD In radius programming (bit 1 (ORC) of parameter No. 5004 is set to 1),

0 : Tool offset values of both geometry compensation and wear compensation are specified by radius.

1 : Tool offset value of geometry compensation is specified by radius and tool offset value of wear compensation is specified by diameter, for an axis of diameter programming.

O2D When the number of tool offsets is 400 or 999:

0 : A 3-digit tool offset number (the maximum number is 400 or 999) is used.

1 : A 2-digit tool offset number (the maximum number is 99) is used.

> **NOTE**
> This parameter is valid only when the option for 400 or 900 tool offsets is provided.

MOP As the DI/DO signals for the manual active tool offset function:
0 : G297#4, G297#5, G297#6, and F297#5 are used.
1 : G203#4, G203#5, G203#6, and F199#5 are used.

	#7	#6	#5	#4	#3	#2	#1	#0
5041	NM2				CRS		ATP	AOF
	NM2					UMD		AOF

[Data type] Bit

AOF When the active offset value modification mode based on manual feed is selected in the reset or cleared state, tool offset value modification is:
0 : Possible.
1 : Impossible.

[T series] Whether a tool offset value modification can be made depends on this parameter, bit 6 (LVC) of parameter No. 5003, and bit 7 (TGC) of parameter No. 5003.

	Bit 0 (AOF) of No. 5041 =0	Bit 0 (AOF) of No. 5041 =1
Bit 6 (LVC) of parameter No. 5003=0	Modifiable	Not modifiable
Bit 6 (LVC) of parameter No. 5003=1	Not modifiable	
Bit 7 (TGC) of parameter No. 5003=0	Modifiable	
Bit 7 (TGC) of parameter No. 5003=1	Not modifiable	

[M series] In the cleared state (with bit 6 (CLR) of parameter No. 3402 set to 1), whether a tool offset value modification can be made depends on this parameter and bit 7 (CFH) of parameter No. 3409.

When the bit 6 (CLR) of parameter No. 3402 is set to 1:

	Bit 0 (AOF) of No. 5041 =0	Bit 0 (AOF) of No. 5041 =1
Bit 7 (CFH) of parameter No.3409=0	Not modifiable	Not modifiable
Bit 7 (CFH) of parameter No.3409=1	Modifiable	

ATP Tool offset value modification in the active offset value modification mode based on manual feed:

0 : Enables an X-axis offset value, Z-axis offset value, and Y-axis offset value to be modified by making movements on the X-axis (first axis), Z-axis (second axis), and Y-axis (third axis). (Whether the Y-axis is the third axis or fourth axis depends on the setting of bit 7 (Y03) of parameter No. 5004.)

Axis for movement	Selected offset value	State indication in the lower-right corner of the screen
X-axis (1st axis)	X-axis offset value	TOFS
Z-axis (2nd axis)	Z-axis offset value	TOFS
Y-axis (3rd axis or 4th axis)	Y-axis offset value	TOFS

1 : Enables offset values to be modified by making movements on arbitrary axes (other than rotary axes) according to the selection signals AOFS1 and AOFS2 <G297#5 and #6>.

Selection signal		Selected offset value	State indication in the lower-right corner of the screen
AOFS2	AOFS1		
0	0	X-axis offset value	OFSX
0	1	Z-axis offset value	OFSZ
1	1	Y-axis offset value	OFSY

UMD If the program specifies no D command for cutter compensation C:

0 : Compensation data is not updated.

1 : Compensation data is updated by using a modal D value as a compensation number when the G41/G42 command is specified.

CRS If a start-up operation with a travel distance of 0 is performed after performing a reference position return operation in the state where a T code setting a virtual tool tip number other than 0 and 9 is specified, the operation of the start-up block:

0 : Does not involve a movement.

1 : Makes a movement so that the tool tip center is at the current coordinates.

NOTE

When the virtual tool tip number is 0 or 9, a movement is made so that the tool tip center is at the current coordinates, regardless of the setting of this parameter.

NM2 If two or more successive blocks that do not involve a movement are specified, or if a block specifies an M code that prevents buffering:

0 : No alarm is issued.

1 : An alarm (P/S alarm 041) is issued.

5043	Axis number for which Y-axis offset is used

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

[Data type] Byte

[Valid data range] 0, 3 to number of controlled axis

Set an axis number for which Y-axis offset is used.

If 0 or a value not within the valid data range is set, Y-axis offset is applied to the fourth axis. If bit 7 (Y03) of parameter No. 5004 is set to 1, Y-axis offset is applied to the third axis, regardless of the setting of this parameter.

The standard tool offset is applied to the first and second axes, so that Y-axis offset cannot be applied to the first and second axes.

5044	Axis number for which fourth-axis offset is used

[Data type] Byte

[Valid data range] 0, 3 to number of controlled axis

Set an axis number for which fourth-axis offset is used.

If a value from 3 to the number of controlled axes is set in this parameter, fourth-axis offset is applied to the set axis number. If 0 or a value not within the valid data range is set in this parameter, fourth-axis offset is applied to the fourth axis when bit 7 (Y03) of parameter No. 5004 is set to 1; four-axis offset is applied to the third axis when bit 7 (Y03) of parameter No. 5004 is set to 0.

The standard tool offset is applied to the first and second axes, so that fourth-axis offset cannot be applied to the first and second axes.

> **NOTE**
> 1 When this parameter is set, the power must be turned off before operation is continued.
> 2 If a setting is made to apply fourth-axis offset and Y-axis offset to the same axis, Y-axis offset only is valid, and fourth-axis offset is invalid.

	#7	#6	#5	#4	#3	#2	#1	#0
5051							WNI	DSN

[Data type] Bit

DSN When the direct input of tool offset value measured B function for 2-spindle lathes is used:

0 : One touch sensor is used for both main spindle 1 and main spindle 2.

1 : Two touch sensors are used for both main spindle 1 and main spindle 2.

WNI When a workpiece origin offset is set in the workpiece coordinate system memory with the direct input of tool offset value measured B function for 2-spindle lathes:

0 : The value is set at the current cursor position.

1 : A memory is automatically selected. (The workpiece coordinate system memory set in parameter No. 5054 or No. 5055 is selected.)

5052	**Tool offset number bias amount for tool offset measurement value setting (for 400 tool offsets and 999 tool offsets)**

[Data type] Word

[Valid data range] 0 to number of tool offsets

When the direct input of tool offset value measured B function for 2-spindle lathes is used, this parameter classifies tool offset numbers for tool offset measurement value setting as those for spindle 1 and those for spindle 2.

If 0 or a value not within the valid data range is set in this parameter, the following results:

	Tool offset number		
	99 offsets (Bit 1 (O2D) of parameter No.5040=1)	**400 offsets**	**999 offsets**
Spindle 1	1 to 49	1 to 200	1 to 499
Spindle 2	50 to 99	201 to 400	500 to 999

NOTE

This parameter is valid only when the number of tool offsets is 400 or 999. In other cases, use parameter No. 5053.

5053	Tool offset number bias amount for the direct input of tool offset value measured B function for 2-spindle lathes

[Data type] Byte
[Unit of data] Number
[Valid data range] 1 to maximum number of tool offset sets

When the direct input of tool offset value measured B function for 2-spindle lathes is used, this parameter classifies tool offset numbers for tool offset measurement value setting as those for spindle 1 and those for spindle 2.

[Example] When there are 16 tool offset sets:

	Tool offset number	
	When setting = 8	**When setting = 10**
Spindle 1	1 to 8	1 to 10
Spindle 2	9 to 16	11 to 16

If 0 or a value not within the valid data range is set in this parameter, the following results:

	Tool offset number					
	16 pairs	**32 pairs**	**64 pairs**	**99 pairs**	**400 pairs**	**999 pairs**
Spindle 1	1 to 8	1 to 16	1 to 32	1 to 49	1 to 200	1 to 499
Spindle 2	9 to 16	17 to 32	33 to 64	50 to 99	201 to 400	500 to 999

5054	G code for workpiece coordinate system for spindle 1

5055	G code for workpiece coordinate system for spindle 2

[Data type] Byte
[Unit of data] Number
[Valid data range] 54 to 59

When bit 1 (WNI) of parameter No. 5051 is set to 1 specify, in each of these parameters, a workpiece coordinate system from G54 to G59 for workpiece origin offset value setting.
Specify a workpiece coordinate system from G54 to G59 for spindle 1 and spindle 2, respectively.

NOTE
If the value set in this parameter is 0, or if the value falls outside the valid data range, 54 is assumed for the workpiece coordinate system memory for spindle 1, while 57 is assumed for the workpiece coordinate system memory for spindle 2.

5056	X-axis + (distance to contact surface) on the touch sensor 2 side (X2P)

5057	X-axis - (distance to contact surface) on the touch sensor 2 side (X2M)

5058	Z-axis + (distance to contact surface) on the touch sensor 2 side (Z2P)

5059	Z-axis - (distance to contact surface) on the touch sensor 2 side (Z2M)

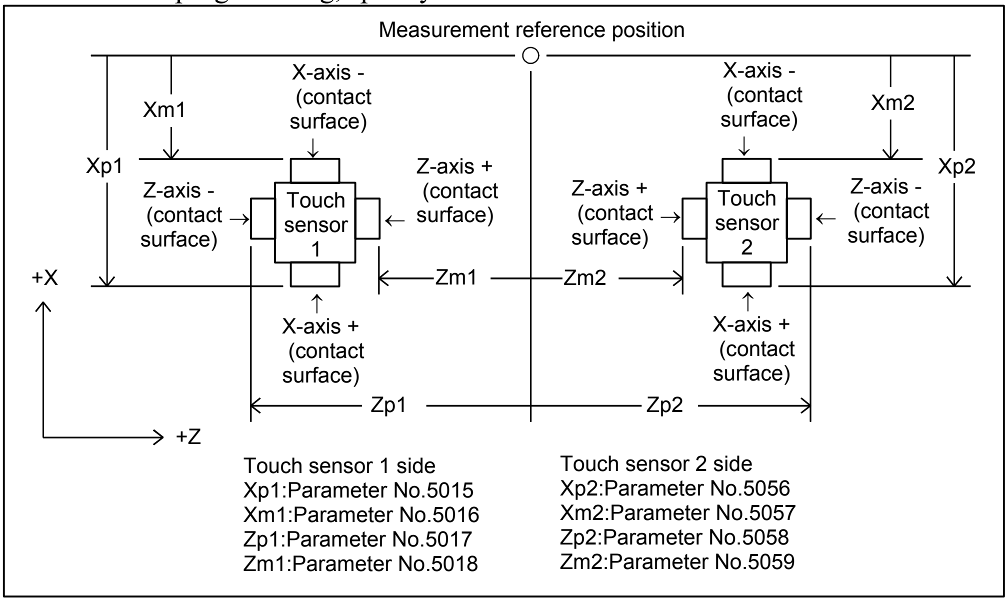
[Data type] 2-word

[Unit of data]

Input increment	IS-B	IS-C	Unit
Metric input	0.001	0.0001	mm
Inch input	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

When using two touch sensors with the direct input of tool offset value measured B function for 2-spindle lathes, set the distance (signed) from the measurement reference position on the touch sensor 2 side to each sensor contact surface. For an axis subject to diameter programming, specify a diameter.



NOTE

These parameters are valid when bit 0 (DSN) of parameter No. 5051 is set to 1.
Set data for the touch sensor 1 side in parameter No. 5015 to No. 5018.

4.25 PARAMETERS OF WHEEL WEAR COMPENSATION

5071	Number of first axis for wheel wear compensation

5072	Number of second axis for wheel wear compensation

[Data type] Byte

[Valid data range] 1 to the number of controlled axes

These parameters specify the controlled axis numbers of the first and second axes for which wheel wear compensation is applied.

5081	Coordinate of first compensation center along first axis on compensation plane

5082	Coordinate of first compensation center along second axis on compensation plane

5083	Coordinate of second compensation center along first axis on compensation plane

5084	Coordinate of second compensation center along second axis on compensation plane

5085	Coordinate of third compensation center along first axis on compensation plane

5086	Coordinate of third compensation center along second axis on compensation plane

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric input	0.01	0.001	0.0001	mm
Inch input	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

These parameters specify the coordinates (in the workpiece coordinate system) of the compensation center for wheel wear compensation.

4.26 PARAMETERS OF CANNED CYCLES

4.26.1 Parameters of Canned Cycle for Drilling

	#7	#6	#5	#4	#3	#2	#1	#0
5101		M5T			ILV	RTR		FXY
	M5B	M5T	RD2	RD1			EXC	FXY

[Data type] Bit

FXY The drilling axis in the drilling canned cycle is:
0 : Always the Z-axis
1 : The axis selected by the program

NOTE
In the case of the T series, this parameter is valid only for the drilling canned cycle in the tape format for Series 15.

EXC G81
0 : Specifies a drilling canned cycle
1 : Specifies an external operation command

RTR G83 and G87
0 : Specify a high-speed peck drilling cycle
1 : Specify a peck drilling cycle

ILV Initial point position in drilling canned cycle
0 : Not updated by reset
1 : Updated by reset

RD2, RD1 Set the axis and direction in which the tool in drilling canned cycle G76 or G87 is got free. RD2 and RD1 are set as shown below by plane selection.

RD2	RD1	G17	G18	G19
0	0	+X	+Z	+Y
0	1	-X	-Z	-Y
1	0	+Y	+X	+Z
1	1	-Y	-X	-Z

M5T When a spindle rotates from the forward to the reverse direction and vice versa in tapping cycles G84 and G74 for M series (G84 and G88 for T series), befor M04 or M03 is output:
For T series
0 : Not output M05
1 : Outputs M05
For M series
0 : Outputs M05
1 : Not output M05

M5B In drilling canned cycles G76 and G87:
0 : Outputs M05 before an oriented spindle stops
1 : Not output M05 before an oriented spindle stops

	#7	#6	#5	#4	#3	#2	#1	#0
5102	RDI	RAB	K0E	RFC	F16	QSR	MRC	

[Data type] Bit

MRC When a target figure other than a monotonically increasing or monotonically decreasing figure is specified in a multiple repetitive turning canned cycle (G71, G72):
0 : No alarm occurs.
1 : P/S alarm No.064 is occurs.

> **NOTE**
> This parameter is valid for multiple repetitive turning canned cycle type I.

QSR Before a multiple repetitive canned cycle (G70 to G73) is started, a check to see if the program contains a block that has the sequence number specified in address Q is:
0 : Not made.
1 : Made. (If the sequence number specified in address Q cannot be found, an alarm occurs and the canned cycle is not executed.)

F16 When the tape format for Series 15 is used (with bit 1 (FCV) of parameter No.0001 set to 1), a canned drilling cycle is specified using :
0 : Tape format for Series 15
1 : Tape format for Series 16. (However, the number of repetitions is specified using address L.)

RFC For the semifinish figure of G71 or G72 and for a cutting pattern of G73, tool-nose radius compensation is:
0 : Not performed.
1 : Performed.

K0E When K0 is specified in a drilling canned cycle (G80 to G89):
0 : Drilling canned cycle is performed once.
1 : Drilling canned cycle is not performed. Instead, the hole machining data is merely memorized.

RAB The R command for the drilling canned cycle in the tape format for Series 15 is:
0 : Regarded as an incremental command
1 : Regarded as:
An absolute command in the case of G code system A
An absolute command in the case of G code system B or C when the G90 mode is specified.
An incremental command in the case of G code system B or C when the G91 mode is specified.

RDI The R command for the drilling canned cycle in the tape format for Series 15:
0 : Is regarded as the specification of a radius
1 : Follows the specification of a diameter/radius for the drilling axis

		#7	#6	#5	#4	#3	#2	#1	#0
5103			TCZ	CID	COD	PNA	P15	TFD	
			TCZ				DCP	QZA	SIJ

[Data type] Bit

SIJ When the tape format for Series 15 is used (with bit 1 (FCV) of parameter No. 0001 set to 1), a tool shift value for the drilling canned cycle G76 or G87 is specified by:
0 : Address Q
1 : Address I, J, or K

TFD During a threading cycle, feed forward is:
0 : Enabled.
1 : Disabled.

QZA When the specification of the depth of cut (Q) for each time is omitted, or if Q0 is specified in a high-speed peck drilling cycle (G73) or peck drilling cycle (G83):
0 : No alarm is issued.
1 : An alarm (No.045) is issued.

P15 When the tape format for Series 15 is used, the machining sequence for pocketing using multiple repetitive canned cycle G71 or G72 follows:
0 : Series 16 specification
1 : Series 15 specification

DCP If an axis perpendicular to or parallel with a specified plane is specified in a drilling canned cycle:
0 : The drilling axis is changed to the specified axis.
1 : The specified axis is used as the positioning axis.

PNA If the tape format for Series 15 is used and if a plane without an axis is specified in the drilling canned cycle mode, an alarm is:
0 : Raised. (P/S 028)
1 : Not raised.

COD In pocketing, the order of movements on axes for returning to the start point upon completion of machining is:
0 : X-axis → Z-axis.
1 : Z-axis → X-axis.

NOTE
If this parameter is set to 1 when G71 is specified, the tool returns to the start point in the order from the Z-axis to the X-axis. So, when the tool returns to the start point after end facing, an interference between the tool and end face can be avoided.

CID When the tape format for Series 15 is used, the setting of bit 7 (IPR) of parameter No. 1004 for the depth of cut in a multiple repetitive turning canned cycle is:
0 : Invalid.
1 : Valid.

TCZ In a tapping cycle (excluding rigid tapping), an accumulated zero check in the tapping step (forward, backward) is:
0 : Not performed.
1 : Performed.
Execute a tapping cycle (excluding rigid tapping) with the servo feed forward (bit 1 of parameter No. 2005). If an impact is detected, set this parameter to 1.

	#7	#6	#5	#4	#3	#2	#1	#0
5104		PCT	MCC	SPE		FCK	BCR	
								RDC

[Data type] Bit

RDC The high-speed positioning and drilling canned cycle is:
0 : Invalid.
1 : Valid.

BCR In a boring cycle, retraction is made:
0 : At a cutting feedrate.
1 : At a rapid traverse rate.

FCK In a multiple repetitive canned cycle (G71/G72), the machining profile is:
0 : Not checked.
1 : Checked.
If this parameter is specified, the machining profile specified in the multiple repetitive canned cycle for lathe (G71/G72) and the machining start point are checked. If the relationship is incorrect, the P/S 062 alarm is raised.

An incorrect relationship between the machining profile and machining start point indicates either of the following cases.

- Although the finishing allowance is specified with a positive sign, the start point of the canned cycle is smaller than the maximum value of the machining profile.
- Although the finishing allowance is specified with a negative sign, the start point of the canned cycle is larger than the minimum value of the machining profile.

NOTE
1 The machining profile is checked before the operation of the canned cycle (not during machining).
2 The machining profile to be checked is a programmed profile. The path of retraction or return is not checked.
3 This parameter is not valid for G71 or G72 of the canned cycle for grinding.

SPE When the tape format for Series 15 is used, both-edge zigzag threading and single-edge threading with a constant depth of cut in a multiple repetitive threading cycle are:
0 : Not specifiable.
1 : Specifiable.

MCC Whether an invalid circular figure is specified in a multiple repetitive turning canned cycle (G71, G72) is:
0 : Not checked immediately before a movement is started.
1 : Checked immediately before a movement is started.

NOTE
1. This parameter is valid when bit 1 (MRC) of parameter No. 5102 is set to 1.
2. When a movement is made based on a circular command, a figure check is made, regardless of the setting of this parameter.

PCT The Q command in a tapping cycle (G84/G88) is:
0 : Invalid.
1 : Valid. (A peck tapping cycle results.)
If the depth of cut for each tapping operation is specified using address Q in G84 or G88 when this parameter is set, a peck tapping cycle results.
By setting bit 5 (PCP) of parameter No. 5200, whether the operation of a peck tapping cycle is high-speed peck tapping or peck tapping can be selected. This function can be used for both of tapping and rigid tapping. Even if this parameter is set, ordinary tapping/rigid tapping is performed when Q is not specified or Q0 is specified.

5110	C-axis clamp M code in drilling canned cycle

[Data type] 2-word
[Valid data range] 0 to 99
This parameter sets the C-axis clamp M code in a drilling canned cycle.

5111	Dwell time when C-axis unclamping is specified in drilling canned cycle

[Data type] Word
[Unit of data] msec
[Valid data range] 0 to 32767
This parameter sets the dwell time when C-axis unclamping is specified in a drilling canned cycle.

5112	Spindle forward-rotation M code in drilling canned cycle

[Data type] 2-word

[Valid data range] 0 to 255

This parameter sets the spindle forward-rotation M code in a drilling canned cycle.

> **NOTE**
> M03 is output when "0" is set.

5113	Spindle reverse-rotation M code in drilling canned cycle

[Data type] 2-word

[Valid data range] 0 to 255

This parameter sets the spindle reverse-rotation M code in a drilling canned cycle.

> **NOTE**
> M04 is output when "0" is set.

5114	Return or clearance value of drilling canned cycle G83
	Return value of high-speed peck drilling cycle G73

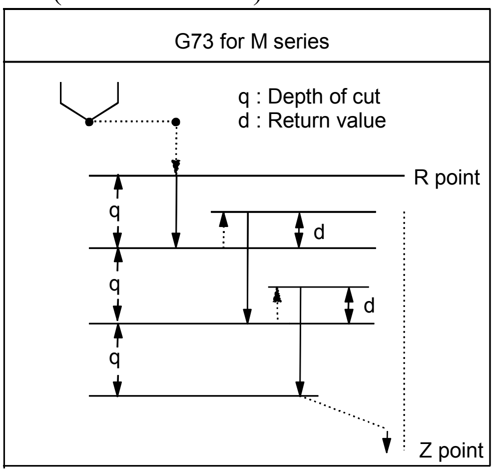
[Data type] Word

[Unit of data]

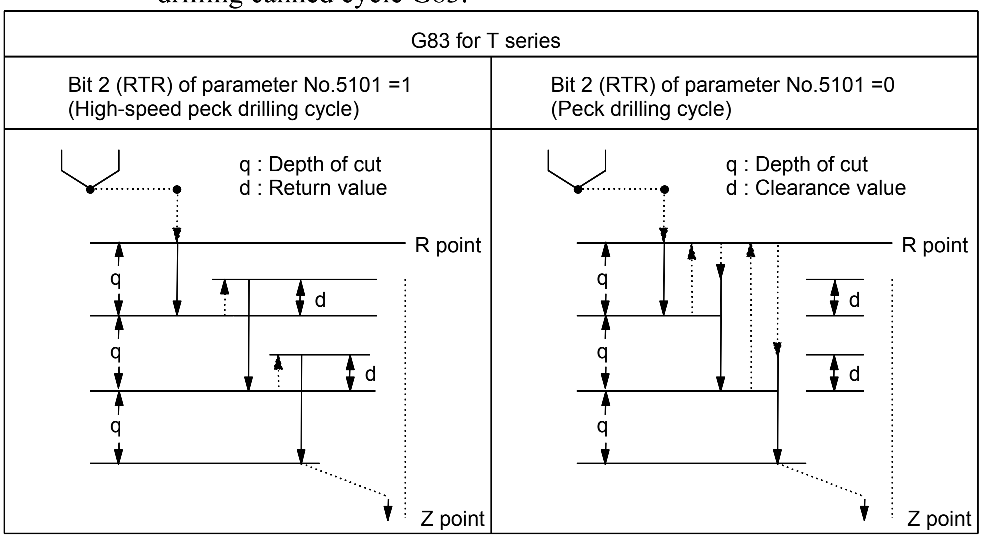
Input increment	IS-A	IS-B	IS-C	Unit
Metric input	0.01	0.001	0.001	mm
Inch input	0.001	0.0001	0.0001	inch

[Valid data range] 0 to 32767

For M series, this parameter sets the return value in high-speed peck drilling cycle G73 (G83 for T series).



For T series, this parameter sets the return or clearance value in drilling canned cycle G83.



5115	Clearance of canned cycle G83

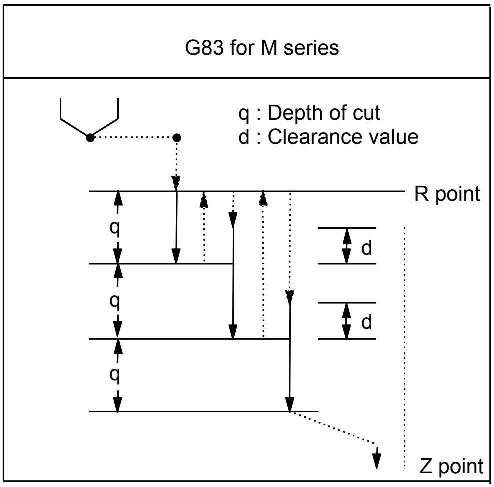
[Data type] Word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric input	0.01	0.001	0.001	mm
Inch input	0.001	0.0001	0.0001	inch

[Valid data range] 0 to 32767

This parameter sets the clearance of peck drilling cycle G83.



5121	Override value for retraction in boring cycle (G85, G89)

[Data type] Byte

[Unit of data] 100%

[Valid data range] 0, 1 to 20

Set the override value of retraction in a boring cycle.

If 20 or a greater value is specified in this parameter, the override is set to 2000%. If 0 is specified, this parameter becomes invalid, and the retraction speed becomes two times the cutting speed.

4.26.2 Parameters of Threading Cycle

5130	Chamfering distance in the threading cycles G76 and G92

[Data type] Byte
[Unit of data] 0.1 pitch
[Valid data range] 0 to 127

This parameter sets the chamfering in the threading cycles G76 and G92.

5131	Chamfering angle in threading cycle

[Data type] Byte
[Unit of data] degree
[Valid data range] 1 to 89

Set a chamfering angle in a threading cycle.

4.26.3 Parameters of Multiple Repetitive Canned Cycle

5132	Depth of cut in multiple repetitive canned cycles G71 and G72

[Data type] 2-word
[Unit of data]

Input increment	IS-B	IS-C	Unit
Metric input	0.001	0.001	mm
Inch input	0.0001	0.0001	inch

[Valid data range] 0 to 99999999

This parameter sets the depth of cut in multiple repetitive canned cycles G71 and G72.

5133	Escape in multiple repetitive canned cycles G71 and G72.

[Data type] 2-word
[Unit of data]

Input increment	IS-B	IS-C	Unit
Metric input	0.001	0.001	mm
Inch input	0.0001	0.0001	inch

[Valid data range] 0 to 99999999

This parameter sets the escape in multiple repetitive canned cycle G71 and G72.

5135	Escape in multiple repetitive canned cycle G73 in X-axis direction

5136	Escape in multiple repetitive canned cycle G73 in Z-axis direction

[Data type] 2-word
[Unit of data]

Input increment	IS-B	IS-C	Unit
Metric input	0.001	0.001	mm
Inch input	0.0001	0.0001	inch

[Valid data range] -99999999 to 99999999

This parameter sets the escape in multiple repetitive canned cycle G73 of an X, then Z axis.

5137	Division count in multiple repetitive canned cycle G73

[Data type] 2-word
[Unit of data] cycle
[Valid data range] 1 to 99999999

This parameter sets the division count in multiple repetitive canned cycle G73.

5139	Return in multiple canned cycles G74 and G75

[Data type] 2-word
[Unit of data]

Input increment	IS-B	IS-C	Unit
Metric input	0.001	0.001	mm
Inch input	0.0001	0.0001	inch

[Valid data range] 0 to 99999999

This parameter sets the return in multiple repetitive canned cycles G74 and G75.

5140	Minimium depth of cut in the multiple repetitive canned cycle G76

[Data type] 2-word
[Unit of data]

Input increment	IS-B	IS-C	Unit
Metric input	0.001	0.0001	mm
Inch input	0.0001	0.00001	inch

[Valid data range] 0 to 99999999

This parameter sets the minimum depth of cut in the multiple repetitive canned cycle G76.

5141	Finishing allowance in the multiple repetitive canned cycle G76

[Data type] 2-word

[Unit of data]

Input increment	IS-B	IS-C	Unit
Metric input	0.001	0.0001	mm
Inch input	0.0001	0.00001	inch

[Valid data range] 1 to 99999999

This parameter sets the finishing allowance in multiple repetitive canned cycle G76.

5142	Repetition count of final finishing in multiple repetitive canned cycle G76

[Data type] 2-word

[Unit of data] cycle

[Valid data range] 1 to 99999999

This parameter sets the repetition count in multiple repetitive canned cycle G76.

5143	Tool nose angle in multiple repetitive canned cycle G76

[Data type] 2-word

[Unit of data] degree

[Valid data range] When tape format for Series 15 is used: 0 to 120

When tape format for Series 15 is not used: 0, 29, 30, 55, 60, 80

This parameter sets the tool nose angle in multiple repetitive canned cycle G76.

5144	Clearance from the summit of a pocket of type II in a rough machining cycle (G71, G72)

[Data type] 2-word

[Unit of data]

Input increment	IS-B	IS-C	Unit
Linear axis (input in mm)	0.001	0.0001	mm
Linear axis (input in inches)	0.0001	0.00001	inch

[Valid data range] 0 to 99999999

This parameter sets a clearance from the summit of a pocket of type II to be passed over when a movement is made to the next pocket for rough machining after completion of rough machining of the pocket of type II in a rough machining cycle (G71, G72).

If 0 is set in this parameter, the specification of 2000 (IS-B) or 20000 (IS-C) is assumed by default.

When 0 is set in the case of IS-B metric input, for example, the clearance is 1.0 mm in the case of radius programming (with bit 3 (DIA) of parameter No. 1006 set to 0) or 2.0 mm in the case of diameter programming (with bit 3 (DIA) of parameter No. 1006 set to 1).

5150	Coasting distance in a high-speed positioning and drilling canned cycle

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric input	0.01	0.001	0.0001	mm
Inch input	0.001	0.0001	0.00001	inch

[Valid data range] 0 to 99999999

This parameter sets a coasting distance in a high-speed positioning and drilling canned cycle.

5151	
	Rapid traverse deceleration ratio for overlapping between rapid traverse blocks in a high-speed positioning and drilling canned cycle

[Data type] Byte

[Unit of data] %

[Valid data range] 0 to 100

This parameter sets a rapid traverse deceleration ratio for overlapping between rapid traverse blocks in a high-speed positioning and drilling canned cycle. In this cycle, the setting of this parameter is applied to all axes.

NOTE

In a high-speed positioning and drilling canned cycle, rapid traverse overlapping is applied even if bit 4 (RTO) of parameter No. 1601 is set to 0. To disable rapid traverse overlapping, set 0 in this parameter.

4.26.4 Parameters of Small-hole Peck Drilling Cycle

	#7	#6	#5	#4	#3	#2	#1	#0
5160					CYM			
					CYM	NOL	OLS	

[Data type] Bit

OLS When an overload torque signal is received in a small-hole peck drilling cycle, the feed and spindle speed are
0 : Not changed.
1 : Changed.

NOL When the depth of cut per action is satisfied although no overload torque signal is received in a small-hole peck drilling cycle, the feed and spindle speed are:
0 : Not changed.
1 : Changed.

CYM If a subprogram call (M98) and another NC command are specified in the same block in a canned cycle:
0 : No alarm is issued.
1 : An alarm (P/S alarm 5329) is issued.

	#7	#6	#5	#4	#3	#2	#1	#0
5161							RLV	PKG

[Data type] Bit

PKG A high-speed peck drilling cycle and peck drilling cycle are specified:

0 : Using G83/G87. Bit 2 (RTR) of parameter No. 5101 is used to make a choice between a high-speed peck drilling cycle and peck drilling cycle.

1 : Using G83/G87, and a high-speed peck drilling cycle is made specifiable by G83.5/G87.5, and a peck drilling cycle is made specifiable by G83.6/G87.6.

NOTE

This parameter is invalid when the tape format for Series 15 is used (with bit 1 (FCV) of parameter No. 0001 set to 1).

RLV When G code system A is used, a return operation performed in a drilling canned cycle is:

0 : Return to the initial level.

1 : Return to the point R level.

NOTE

When G code system B/C is used, a return operation is selected with a G code, regardless of the setting of this parameter.

G98: Return to the initial level

G99: Return to the point R level

5163	M code that specifies the small-hole peck drilling cycle mode

[Data type] 2-word

[Unit of data]

[Valid data range] 1 to 99999999

This parameter sets an M code that specifies the small-hole peck drilling cycle mode.

5164	Percentage of the spindle speed to be changed when the tool is retracted after an overload torque signal is received

[Data type] Byte
[Unit of data] %
[Valid data range] 1 to 255

This parameter sets the percentage of the spindle speed to be changed when the tool is retracted because the overload torque signal is received in a small-hole peck drilling cycle.

$S2 = S1 \times d1 \div 100$

S1: Spindle speed to be chaged
S2: Spindle speed changed

d1 is set as a percentage.

5165	Percentage of the spindle speed to be changed when the tool is retracted without an overload torque signal received

[Data type] Byte
[Unit of data] %
[Valid data range] 1 to 255

This parameter sets the percentage of the spindle speed to be changed when the tool is retracted without the overload torque signal received in a small-hole peck drilling cycle.

$S2 = S1 \times d2 \div 100$

S1: Spindle speed to be chaged
S2: Spindle speed changed

d2 is set as a percentage.

5166	Percentage of cutting feedrate to be changed when the tool is retracted after an overload torque signal is received

[Data type] Byte
[Unit of data] %
[Valid data range] 1 to 255

This parameter sets the percentage of the cutting feedrate to be changed when the tool is retracted because the overload torque signal is received in a small-hole peck drilling cycle.

$F2 = F1 \times b1 \div 100$

F1: Cutting feedrate to be changed
F2: Changed cutting feedrate

b1 is set as a percentage.

5167	Percentage of the cutting feedrate to be changed when the tool is retracted without an overload torque signal received

[Data type] Byte
[Unit of data] %
[Valid data range] 1 to 255

This parameter sets the percentage of the cutting feedrate tot be changed when the tool is retracted without the overload torque signal received in a small-hole peck drilling cycle.

$F2 = F1 \times b2 \div 100$

F1: Cutting feedrate to be changed
F2: Changed cutting feedrate

b2 is set as a percentage.

5168	Lower limit of the percentage of the cutting feedrate in a small-hole peck drilling cycle

[Data type] Byte
[Unit of data] %
[Valid data range] 0 to 255

This parameter sets the lower limit of the percentage of the cutting feedrate changed repeatedly in a small-hole peck drilling cycle to the specified cutting feedrate.

$FL = F \times b3 \div 100$

F: Specified cutting feedrate
FL: Changed cutting feedrate

Set b3 as a percentage.

5170	Number of the macro variable to which the total number of retractions during cutting is output

[Data type] Word
[Valid data range] 100 to 149

This parameter sets the number of the macro variable to which the total number of times the tool is retracted during cutting in a small-hole peck drilling cycle mode is output.

NOTE
The total number cannot be output to common variables 500 to 531.

5171	Number of the macro variable to which the total umber of retractions because of an overload signal is output

[Data type] Word

[Valid data range] 100 to 149

This parameter sets the common variable number of the custom macro to which the number of times the tool is retracted after the overload signal is received during cutting in a small-hole peck drilling cycle mode is output.

NOTE

The total number cannot be output to common variables 500 to 531.

5172	Speed of retraction to point R when no address I is issued

[Data type] Word

[Unit of data] mm/min

[Valid data range] 0 to 400

This parameter sets the speed of retraction to point R when no address I is issued in a small-hole peck drilling cycle.

5173	Speed of advancing to the position just before the bottom of a hole when no address I is issued

[Data type] Word

[Unit of data] mm/min

[Valid data range] 0 to 400

This parameter sets the speed of advancing to the position just before the bottom of a previously machined hole when no address I is issued in a small-hole peck drilling cycle.

5174	Clearance in a small-hole peck drilling cycle

[Data type] Word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Linear axis (input in mm)	0.01	0.001	0.001	mm
Linear axis (input in inches)	0.001	0.0001	0.0001	inch

[Valid data range] 0 to 32767

This parameter sets the clearance in a small-hole peck drilling cycle.

4.27 PARAMETERS OF RIGID TAPPING

	#7	#6	#5	#4	#3	#2	#1	#0
5200	SRS	FHD	PCP	DOV	SIG	CRG	VGR	G84
		FHD	PCP	DOV	SIG	CRG	VGR	G84

[Data type] Bit

G84 Method for specifying rigid tapping
- 0 : An M code specifying the rigid tapping mode is specified prior to the issue of the G84 (or G74) command. (See parameter No. 5210).
- 1 : An M code specifying the rigid tapping mode is not used. (G84 cannot be used as a G code for the tapping cycle; G74 cannot be used for the reverse tapping cycle.)

VGR Any gear ratio between spindle and position coder in rigid tapping
- 0 : Not used (The gear ratio is set in parameter No.3706.)
- 1 : Used (The gear ratio is set by parameters Nos. 5221 through 5224 and 5231 through 5234.)

NOTE
For serial spindles, set this parameter to 0 when using the DMR function for position coder signals on the spindle side.

CRG Rigid tapping mode when a rigid tapping mode cancel command is specified (G80, G01 group G code, reset, etc.)
- 0 : Canceled after rigid tapping signal RGTAP <G061#0> is set to "0".
- 1 : Canceled before rigid tapping signal RGTAP <G061#0> is set to "0".

SIG When gears are changed for rigid tapping, the use of spindle motor speed command selection signal SIND <G032 and G033> is
- 0 : Not permitted.
- 1 : Permitted.

DOV Override during extraction in rigid tapping
- 0 : Invalidated
- 1 : Validated (The override value is set in parameter No. 5211 (M/T series) or No. 5381(M series).)

PCP Tapping or rigid tapping
- 0 : Used as a high-speed peck tapping cycle
- 1 : Not used as a high-speed peck tapping cycle

When the T series is used, this parameter is valid if bit 6 (PCT) of parameter No. 5104 is set to 1. Set parameter No. 5213 to match the setting of this parameter.

FHD Feed hold and single block in rigid tapping
- 0 : Invalidated
- 1 : Validated

SRS To select a spindle used for rigid tapping in multi-spindle control:
0 : The spindle selection signals SWS1 and SWS2 (G027#0 and #1) are used. (These signals are used also for multi-spindle control.)
1 : The rigid tapping spindle selection signals RGTSP1 and RGTSP2 (G061#4 and #5) are used. (These signals are provided expressly for rigid tapping.)

	#7	#6	#5	#4	#3	#2	#1	#0
5201				OV3	OVU	TDR		
				OV3	OVU	TDR		NIZ

[Data type] Bit
NIZ Smoothing in rigid tapping is:
0 : Not performed.
1 : Performed.
TDR Cutting time constant in rigid tapping
0 : Uses a same parameter during cutting and extraction (Parameter Nos. 5261 to 5264)
1 : Not use a same parameter during cutting and extraction
Parameter Nos. 5261 to 5264: Time constant during cutting
Parameter Nos. 5271 to 5274: Time constant during extraction
OVU The increment unit of the override parameter (No. 5211 (M/T series) or No. 5381 (M series)) for tool rigid tapping extraction is:
0 : 1%
1 : 10%
OV3 The spindle speed for tool extraction is specified by program. The tool extraction function based on this spindle speed is:
0 : Disabled.
1 : Enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
5202								ORI
							RG3	ORI

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit
ORI When rigid tapping is started:
0 : Spindle orientation is not performed.
1 : Spindle orientation is performed.

NOTE
This parameter can be used only for a serial spindle.

RG3 Retraction for rigid tapping is performed according to:
0 : Input signal RTNT<G062#6>.
1 : One-shot G code G30.

	#7	#6	#5	#4	#3	#2	#1	#0
5203				OVS	RGS			
			RBL	OVS		RFF	HRM	HRG

[Data type] Bit

HRG Rigid tapping by the manual handle is:
0 : Disabled.
1 : Enabled.

> **NOTE**
> The option for rigid tapping by the manual handle is needed.

HRM When the tapping axis moves in the negative direction during rigid tapping controlled by the manual handle, the direction in which the spindle rotates is determined as follows:
0 : In G84 mode, the spindle rotates in a normal direction. In G74 mode, the spindle rotates in reverse.
1 : In G84 mode, the spindle rotates in reverse. In G74 mode, the spindle rotates in a normal direction.

REF Feed forward during movement from the initial point to point R in rigid tapping is:
0 : Disabled.
1 : Enabled.
When this parameter is set, the following function is also enabled:
- When rigid tapping is specified in advanced preview control mode, the system automatically exits from advanced preview control mode and executes rigid tapping. After termination of rigid tapping, the system automatically returns to advanced preview control mode.

RGS When bit 0 (MIF) of parameter No. 1403 is set to 1 and rigid tapping is specified in feed-per-minute mode, the spindle speed becomes:
0 : 1/1000 of the specified speed.
1 : 1/1 of the specified speed.

OVS In rigid tapping, override by the feedrate override signal and invalidation of override by the override cancel signal is:

0 : Disabled.

1 : Enabled.

Setting this parameter enables override by the feedrate override signal <G012> to be applied for rigid tapping operation (cutting and extraction) in rigid tapping.

The spindle speed override is fixed to 100%, but override is also applied to the spindle speed in synchronous control with the feedrate along the tapping axis by feedrate override.

The override cancel signal OVC <G006#4> and second feedrate override signal <G013> also become available.

NOTE

1 When this parameter is set to override the feedrate, override by parameters (see parameters Nos. 5211 (T/M series) and 5381 (M series)) is disabled.

2 Regardless of whether this parameter is set, when feedrate override is disabled by the override cancel signal OVC <G006#4>, override by parameters (see parameters Nos. 5211 (T/M series) and 5381 (M series)) is enabled.

3 An option is required separately to use the second feedrate override signal <G013>.

RBL As acceleration/deceleration for rigid tapping cutting feed:

0 : Linear acceleration/deceleration is used.

1 : Bell-shaped acceleration/deceleration is used.

NOTE

The bell-shaped acceleration/deceleration option for rigid tapping is required.

	#7	#6	#5	#4	#3	#2	#1	#0
5204	RGF						SPR	DGN

NOTE

When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

DGN On the diagnosis screen:

0 : A rigid tapping synchronous error is displayed. (Nos. 455 to 457)

1 : An error difference between the spindle and tapping axis is displayed. (Nos. 452 and 453)

SPR In rigid tapping, the parameters are:
0 : Not changed on a spindle-by-spindle basis.
1 : Changed on a spindle-by-spindle basis.

NOTE

1 When switching between the rigid tapping parameters on a spindle-by-spindle basis in rigid tapping using the second and third serial spindles, set this parameter to 1. The following parameters are supported for each spindle:

First spindle (4-stage gear)	Second spindle (2-stage gear)	Third spindle (2-stage gear)
No.5214	No.5215	No.5216
No.5221 to No.5224	No.5225, No.5226	No.5227, No.5228
No.5231 to No.5234	No.5235, No.5236	No.5237, No.5238
No.5241 to No.5244	No.5245, No.5246	No.5247, No.5248
No.5261 to No.5264	No.5265, No.5266	No.5267, No.5268
No.5271 to No.5274	No.5335, No.5336	No.5337, No.5338
No.5280	No.5341	No.5344
No.5281 to No.5284	No.5342, No.5343	No.5345, No.5346
No.5300, No.5301	No.5302, No.5303	No.5304, No.5305
No.5310 to No.5314	No.5350 to No.5353	No.5354 to No.5357
No.5321 to No.5324	No.5325, No.5326	No.5327, No5328

2 For rigid tapping using the second and third serial spindles, the multispindle control option is required.

RCK Processing for suppressing command fluctuation during rigid tapping is:
0 : Not used.
1 : Used.

	#7	#6	#5	#4	#3	#2	#1	#0
5205	REF	PKD						RCK
	REF					NRV		RCK

[Data type] Bit
RCK In rigid tapping, an excessive error during movement/at stop is:
0 : Checked regardless of whether mode is cutting (tapping) or rapid traverse.
1 : Checked only in cutting (tapping) mode.

NRV For the rigid tapping function, the spindle returns back from the bottom of a hole with:
0 : Rotating opposite to the drilling direction
1 : Rotating in the drilling direction (special purpose)

> **CAUTION**
> This parameter is used for a special purpose only. When you want to perform rigid tapping, do not set this parameter.
> If rigid tapping is performed with this parameter set, a tapping tool, workpiece, or machine may be damaged.

PKD In peck rigid tapping, diagnosis No. 457 (maximum rigid tapping synchronous error) indicates:
0 : Value for each cutting operation.
1 : Overall value down to the hole bottom.

REF Fine acceleration/deceleration in rigid tapping is:
0 : Disabled.
1 : Enabled.
Set this parameter to 1 when using the spindle fine acceleration/deceleration (FAD) function.

> **NOTE**
> When fine acceleration/deceleration is used, fine acceleration/deceleration needs to be set in each spindle/servo parameter in addition to this parameter.

5210	Rigid tapping mode specification M code

[Data type] Byte
[Valid data range] 0 to 255
This parameter sets an M code that specifies the rigid tapping mode.

> **NOTE**
> 1 The M code is judged to be 29 (M29) when "0" is set.
> 2 To use an M code whose number is greater than 255, Specify the code number with parameter No. 5212.

5211	Override value during rigid tapping extraction

[Data type] Byte
[Unit of data] 1 % or 10 %
[Valid data range] 0 to 200

The parameter sets the override value during rigid tapping extraction.

> **NOTE**
> The override value is valid when bit 4 (DOV) of the parameter No. 5200 is set to 1.
> When bit 3 (OVU) of parameter No. 5201 is set to 1, the unit of set data is 10%. An override of up to 200% can be applied to extraction.

5212	M code that specifies a rigid tapping mode

[Data type] 2-word
[Unit of data] Integer
[Valid data range] 0 to 65535

This parameter sets the M code that specifies the rigid tapping mode.
The M code that specifies the rigid tapping mode is usually set by parameter No. 5210. To use an M code whose number is greater than 255, specify the code number with parameter No. 5212.

> **NOTE**
> If the setting of this parameter is 0, the M code specifying the rigid tapping mode is determined by the setting of parameter No. 5210. Otherwise, it is determined by the setting of parameter No. 5212. The setting of parameter No. 5212 must always be within the above valid range.

5213	Return or clearance in peck tapping cycle

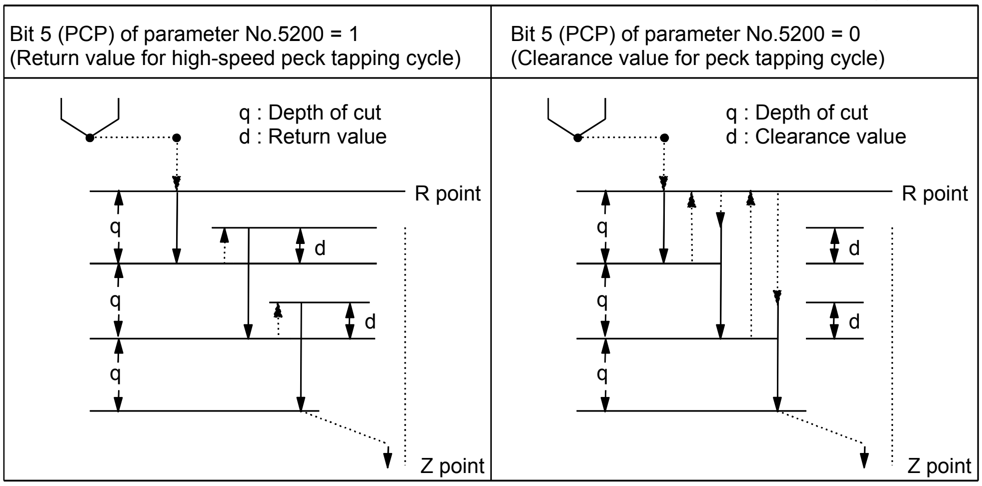
[Data type] Word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric input	0.01	0.001	0.001	mm
Inch input	0.001	0.0001	0.0001	inch

[Valid data range] 0 to 32767

This parameter sets the return or clearance in the peck tapping cycle.



5214	**Setting of an allowable rigid tapping synchronous error range**
5215	**Setting of an allowable rigid tapping synchronous error range for the second spindle**
5216	**Setting of an allowable rigid tapping synchronous error range for the third spindle**

[Data type] Word

[Unit of data] Detection unit (1/4096rev)

[Valid data range] 0 to 32767

Each of these parameters is used to set an allowable synchronous error range between a spindle used for rigid tapping and the tapping axis.

If the value set with each parameter is exceeded, rigid tapping alarm No.741 (excessive error during movement) is issued. When 0 is set, a synchronous error check is not made.

NOTE

When rigid tapping is performed using the second and third spindles

- When bit 1 (SPR) of parameter No. 5204 is set to 0, the setting of parameter No. 5214 is applied to the second and third spindles, as well as to the first spindle.
- When bit 1 (SPR) of parameter No. 5204 is set to 1, the settings of parameter No. 5215 and No. 5216 are applied to the second and third spindles, respectively.

5221	Number of spindle gear teeth (first-stage gear)
5222	Number of spindle gear teeth (second-stage gear)
5223	Number of spindle gear teeth (third-stage gear)
5224	Number of spindle gear teeth (fourth-stage gear)
5225	Number of second spindle gear teeth (first-stage gear)
5226	Number of second spindle gear teeth (second-stage gear)
5227	Number of third spindle gear teeth (first-stage gear)
5228	Number of third spindle gear teeth (second-stage gear)

[Data type] Word

[Valid data range] 1 to 32767

When an arbitrary gear ratio is used in rigid tapping, each of these parameters sets the number of teeth of each spindle gear.

NOTE

1 These parameters are enabled when bit 1 (VGR) of parameter No. 5200 is set to 1.

2 When a position coder is attached to the spindle, set the same value for all of parameters No. 5221 through No. 5224.

3 When the DMR function of the position coder signal is used with a serial spindle, set bit 1 (VGR) of parameter No. 5200 to 0, and set these parameters to 0.

4 When rigid tapping is performed using the second and third spindles

- When bit 1 (SPR) of parameter No. 5204 is set to 0, the settings of parameters No. 5221 and No. 5222 are applied to the second and third spindles, as well as to the first spindle.
- When bit 1 (SPR) of parameter No. 5204 is set to 1, the settings of parameters No. 5225 and No. 5226 are applied to the second spindle, while the settings of parameters No. 5227 and No. 5228 are applied to the third spindle.

5231	Number of position coder gear teeth (first-stage gear)
5232	Number of position coder gear teeth (second-stage gear)
5233	Number of position coder gear teeth (third-stage gear)
5234	Number of position coder gear teeth (fourth-stage gear)
5235	Number of position coder gear teeth for the second spindle (first-stage gear)
5236	Number of position coder gear teeth for the second spindle (second-stage gear)
5237	Number of position coder gear teeth for the third spindle (first-stage gear)
5238	Number of position coder gear teeth for the third spindle (second-stage gear)

[Data type] Word

[Valid data range] 1 to 32767

When an arbitrary gear ratio is used in rigid tapping, each of these parameters sets the number of teeth of each position coder gear.

NOTE

1 These parameters are enabled when bit 1 (VGR) of parameter No. 5200 is set to 1.
When a position coder is attached to the spindle, set the same value for all of parameters No. 5231 through No. 5234.
When a spindle motor with a built-in position coder is used, a position coder with a resolution of 2048 pulses/rev may be used. In such a case, set the actual number of teeth, multiplied by 2 (for conversion to 4096 pulses/rev).

2 When the DMR function of the position coder signal is used with a serial spindle, set bit 1 (VGR) of parameter No. 5200 to 0, and set these parameters to 0.

3 When rigid tapping is performed using the second and third spindles
- When bit 1 (SPR) of parameter No. 5204 is set to 0, the settings of parameters No. 5231 and No. 5232 are applied to the second and third spindles, as well as to the first spindle.
- When bit 1 (SPR) of parameter No. 5204 is set to 1, the settings of parameters No. 5235 and No. 5236 are applied to the second spindle, while the settings of parameters No. 5237 and No. 5238 are applied to the third spindle.

5241	Maximum spindle speed in rigid tapping (first-stage gear)
5242	Maximum spindle speed in rigid tapping (second-stage gear)
5243	Maximum spindle speed in rigid tapping (third-stage gear)
5244	Maximum spindle speed in rigid tapping (fourth-stage gear)
5245	Maximum spindle speed in rigid tapping using the second spindle (first-stage gear)
5246	Maximum spindle speed in rigid tapping using the second spindle (second-stage gear)
5247	Maximum spindle speed in rigid tapping using the third spindle (first-stage gear)
5248	Maximum spindle speed in rigid tapping using the third spindle (second-stage gear)

[Data type] 2-word

[Unit of data] min^{-1}

[Valid data range] The valid data range is determined by the spindle:position coder gear ratio as indicated in the table below.

Spindle : Position coder	Valid data range
1 : 1	0 to 7400
1 : 2	0 to 9999
1 : 4	0 to 9999
1 : 8	0 to 9999

Each of these parameters is used to set a maximum spindle speed for each gear in rigid tapping.

NOTE

1 For the M series, set the same value for both parameter No. 5241 and parameter No. 5243 for a one-stage gear system. For a two-stage gear system, set the value specified for parameter No. 5241 or No. 5242, whichever is greater, for parameter No. 5243. Otherwise, P/S alarm No.200 will be issued.

2 When rigid tapping is performed using the second and third spindles
- When bit 1 (SPR) of parameter No. 5204 is set to 0, the settings of parameters No. 5241 and No. 5242 are applied to the second and third spindles, as well as to the first spindle.
- When bit 1 (SPR) of parameter No. 5204 is set to 1, the settings of parameters No. 5245 and No. 5246 are applied to the second spindle, while the settings of parameters No. 5247 and No. 5248 are applied to the third spindle.

5261	**Linear acceleration/deceleration time constant for the spindle and tapping axis (first-stage gear)**
5262	**Linear acceleration/deceleration time constant for the spindle and tapping axis (second-stage gear)**
5263	**Linear acceleration/deceleration time constant for the spindle and tapping axis (third-stage gear)**
5264	**Linear acceleration/deceleration time constant for the spindle and tapping axis (fourth-stage gear)**
5265	**Linear acceleration/deceleration time constant for the second spindle and tapping axis (first-stage gear)**
5266	**Linear acceleration/deceleration time constant for the second spindle and tapping axis (second-stage gear)**
5267	**Linear acceleration/deceleration time constant for the third spindle and tapping axis (first-stage gear)**
5268	**Linear acceleration/deceleration time constant for the third spindle and tapping axis (second-stage gear)**

[Data type] Word
[Unit of data] msec
[Valid data range] 0 to 4000

Each of these parameters is used to set a linear acceleration/deceleration time constant for the spindle of each gear and the tapping axis in rigid tapping.
Set the period required to reach each maximum spindle speed (parameters No. 5241 through No. 5248). The set time constant, multiplied by the ratio of a specified S value to a maximum spindle speed, is actually used as a time constant.

NOTE

1 When rigid tapping is performed using the second and third spindles
   - When bit 1 (SPR) of parameter No. 5204 is set to 0, the settings of parameters No. 5261 and No. 5262 are applied to the second and third spindles, as well as to the first spindle.
   - When bit 1 (SPR) of parameter No. 5204 is set to 1, the settings of parameters No. 5265 and No. 5266 are applied to the second spindle, while the settings of parameters No. 5267 and No. 5268 are applied to the third spindle.

2 When rigid tapping bell-shaped acceleration/deceleration is enabled, set a time constant for the linear portion.

5271	**Time constant for the spindle and tapping axis in extraction operation (first-stage gear)**
5272	**Time constant for the spindle and tapping axis in extraction operation (second-stage gear)**
5273	**Time constant for the spindle and tapping axis in extraction operation (third-stage gear)**
5274	**Time constant for the spindle and tapping axis in extraction operation (fourth-stage gear)**

[Data type] Word
[Unit of data] msec
[Valid data range] 0 to 4000

Each of these parameters is used to set a linear acceleration/deceleration time constant for the spindle of each gear and tapping axis in extraction operation during rigid tapping.

NOTE

1 These parameters are enabled when bit 2 (TDR) of parameter No. 5201 is set to 1.

2 When rigid tapping is performed using the second and third spindles
   - When bit 1 (SPR) of parameter No. 5204 is set to 0, the settings of parameters No. 5271 and No. 5272 are applied to the second and third spindles, as well as to the first spindle.
   - When bit 1 (SPR) of parameter No. 5204 is set to 1, the settings of parameters No. 5335 and No. 5336 are applied to the second spindle, while the settings of parameters No. 5337 and No. 5338 are applied to the third spindle.

5280	**Position control loop gain for the spindle and tapping axis in rigid tapping (common to all gears)**
5281	**Position control loop gain for the spindle and tapping axis in rigid tapping (first-stage gear)**
5282	**Position control loop gain for the spindle and tapping axis in rigid tapping (second-stage gear)**
5283	**Position control loop gain for the spindle and tapping axis in rigid tapping (third-stage gear)**
5284	**Position control loop gain for the spindle and tapping axis in rigid tapping (fourth-stage gear)**

[Data type] Word

[Unit of data] 0.01 s^{-1}

[Valid data range] 1 to 9999

Each of these parameters is used to set a position control loop gain for the spindle and tapping axis in rigid tapping. These parameters significantly affect the precision of threading. By conducting a cutting test, make a tuning to obtain an optimal value.

When performing threading with an analog spindle, tune the loop gain multipliers (parameter No. 5291 to No. 5294) as well.

NOTE

1 When these parameters are set, the power must be turned off before operation is continued.

2 To use a varied loop gain on a gear-by-gear basis, set parameter No. 5280 to 0, and set a loop gain for each gear in parameters No. 5281 through No. 5284. The specification of a loop gain on a gear-by-gear basis is disabled if parameter No. 5280 is set to a value other than 0. In such a case, the value set in parameter No. 5280 is used as a loop gain that is common to all the gears.

3 When rigid tapping is performed using the second and third spindles

- When bit 1 (SPR) of parameter No. 5204 is set to 0, the setting of parameter No. 5280 or the settings of parameters No. 5281 and No. 5282 are applied to the second and third spindles, as well as to the first spindle.
- When bit 1 (SPR) of parameter No. 5204 is set to 1, the settings of parameters No. 5341 through No. 5343 are applied to the second spindle, while the settings of parameters No. 5344 through No. 5346 are applied to the third spindle.

5291	**Spindle loop gain multiplier in the rigid tapping mode (for gear 1)**
5292	**Spindle loop gain multiplier in the rigid tapping mode (for gear 2)**
5293	**Spindle loop gain multiplier in the rigid tapping mode (for gear 3)**
5294	**Spindle loop gain multioplier in the rigid tapping mode (for gear4)**

[Data type] Word

[Valid data range] 0 to 32767

Set the spindle loop gain multipliers for gears 1 to 4 in the rigid tapping mode. The thread precision depends on the multipliers. Find the most appropriate multipliers by conducting the cutting test and assign them to the parameters.

> **NOTE**
> These parameters are used for analog spindles.

Loop gain multiplier = 2048 × E/L × α × 1000

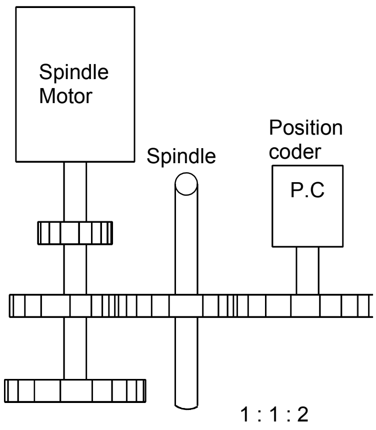
where;

E : Voltage in the velocity command at 1000 min^{-1}

L : Rotation angle of the spindle per one rotation of the spindle motor

α : Unit used for the detection

[Calculation example]



When the spindle motor, spindle, and position coder are connected as shown left, let the variables be as follows:

E = 1.667 [V] (A motor speed of 6000 min^{-1} corresponds to 10 [V].)

L = 360° (One rotation of the spindle corresponds to one rotation of the spindle motor.)

α = La/4096
= 720°/4096
= 0.17578°

La = 720° (= 360° × 2. One rotation of the position coder corresponds to two rotations of the spindle.)

4096 = The number of detected pulses per rotation of the position coder

Gear ratio between the spindle and the position coder

1:1	0.08789 degrees
1:2	0.17578 degrees
1:4	0.35156 degrees
1:8	0.70313 degrees

According to above ratio the loop gain multiplier is calculated as

2048 × 1.667/360 × 0.17578 × 1000 = 1667

* When the position coder which is built in a spindle motor sends 512 pulses per rotation, the unit used for the detection, α, is La/2048.

5300	Tapping axis in-position width in rigid tapping

5301	Spindle in-position width in rigid tapping

[Data type] Word
[Unit of data] Detection unit
[Valid data range] 1 to 32767

These parameters are used to set tapping axis and spindle in-position widths in rigid tapping.

NOTE
1 If an excessively large value is specified, the threading precision will deteriorate.
2 When rigid tapping is performed using the second and third spindles
   - When bit 1 (SPR) of parameter No. 5204 is set to 0, the settings of parameter No. 5300 and No. 5301 are applied to the second and third spindles, as well as to the first spindle.
   - When bit 1 (SPR) of parameter No. 5204 is set to 1, the settings of parameters No. 5302 and No. 5303 are applied to the second spindle, while the settings of parameters No. 5304 and No. 5305 are applied to the third spindle.

5302	Tapping axis in-position width in rigid tapping using the second spindle

5303	Spindle in-position width in rigid tapping using the second spindle

[Data type] Word
[Unit of data] Detection unit
[Valid data range] 0 to 32767

These parameters are used to set spindle and tapping axis in-position widths in rigid tapping using the second spindle.

NOTE
These parameters are enabled when bit 1 (SPR) of parameter No. 5204 is set to 1.

5304	Tapping axis in-position width in rigid tapping using the third spindle
5305	Spindle in-position width in rigid tapping using the third spindle

[Data type] Word
[Unit of data] Detection unit
[Valid data range] 1 to 32767

These parameters are used to set spindle and tapping axis in-position widths in rigid tapping using the third spindle.

> **NOTE**
> These parameters are enabled when bit 1 (SPR) of parameter No. 5204 is set to 1.

5308	In-position width at point R in rigid tapping (tapping axis)

[Data type] Word
[Unit of data] Detection unit
[Valid data range] 0 to 32767

This parameter is used to set the tapping axis in-position width at point R in rigid tapping.

5310	Positional deviation limit imposed during tapping axis movement in rigid tapping

[Data type] Word
[Unit of data] Detection unit
[Valid data range] 1 to 32767

This parameter is used to set a positional deviation limit during tapping axis movement in rigid tapping. A value that falls outside the valid data range, described above, can be specified in parameter No. 5314.

> **NOTE**
> 1 When a high-resolution detector is used, the unit must be multiplied by 10.
> 2 When rigid tapping is performed using the second and third spindles
> - When bit 1 (SPR) of parameter No. 5204 is set to 0, the setting of parameter No. 5310 (or No. 5314) is applied to the second and third spindles, as well as to the first spindle.
> - When bit 1 (SPR) of parameter No. 5204 is set to 1, the settings of parameters No. 5350 and No. 5354 are applied to the second spindle and third spindle, respectively.

5311	Limit value of spindle positioning deviation during movement in rigid tapping

[Data type] Word

[Unit of data] Detection unit

[Valid data range] 1 to 32767

This parameter sets the limit value of a spindle positioning deviation during movement in rigid tapping.

$$\text{Limit value} = \frac{S \times 360 \times 100 \times 1.5}{60 \times G \times \alpha}$$

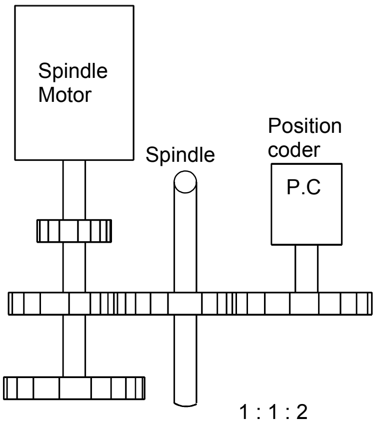
where

S : Maximum spindle speed in rigid tapping (Setting value of parameter Nos. 5241 to 5248)

G : Loop gain of rigid tapping axis (Setting value of parameter Nos. 5280 and 5284)

α : Detection unit

[Calculation example]



When the spindle motor, spindle, and position coder are connected as shown left, let the variables be as follows:

S = 3600

G = 3000

L = 360° (One spindle rotation per spindle motor rotation)

α = La/4096
= 720°/4096
= 0.17578°

La = 720°
(One position coder rotation requires two spindle rotations (= 360° × 2)).

4096 = Detection pulse per position coder rotation

$$\text{Setting value} = \frac{3600 \times 360 \times 100 \times 1.5}{60 \times 3000 \times 0.17578} = 6144$$

NOTE

1 The detection unit is α = La/2048 when the position coder built-in spindle motor uses a position coder of 512 pulses per revolution.

2 When rigid tapping is performed using the second and third spindles
- When bit 1 (SPR) of parameter No. 5204 is set to 0, the setting of parameter No. 5311 is applied to the second and third spindles, as well as to the first spindle.
- When bit 1 (SPR) of parameter No. 5204 is set to 1, the settings of parameters No. 5351 and No. 5355 are applied to the second spindle and third spindle, respectively.

5312	Positional deviation limit imposed while the tapping axis is stopped in rigid tapping

[Data type] Word
[Unit of data] Detection unit
[Valid data range] 1 to 32767

This parameter is used to set a positional deviation limit imposed while the tapping axis is stopped in rigid tapping.

NOTE

When rigid tapping is performed using the second and third spindles

- When bit 1 (SPR) of parameter No. 5204 is set to 0, the setting of parameter No. 5312 is applied to the second and third spindles, as well as to the first spindle.
- When bit 1 (SPR) of parameter No. 5204 is set to 1, the settings of parameters No. 5352 and No. 5356 are applied to the second spindle and third spindle, respectively.

5313	Positional deviation limit imposed while the spindle is stopped in rigid tapping

[Data type] Word
[Unit of data] Detection unit
[Valid data range] 1 to 32767

This parameter is used to set a positional deviation limit imposed while the spindle is stopped in rigid tapping.

NOTE

When rigid tapping is performed using the second and third spindles

- When bit 1 (SPR) of parameter No. 5204 is set to 0, the setting of parameter No. 5313 is applied to the second and third spindles, as well as to the first spindle.
- When bit 1 (SPR) of parameter No. 5204 is set to 1, the settings of parameters No. 5353 and No. 5357 are applied to the second spindle and third spindle, respectively.

5314	Positional deviation limit imposed during tapping axis movement in rigid tapping

[Data type] 2-word

[Unit of data] Detection unit

[Valid data range] 0 to 99999999

Usually, parameter No. 5310 is used to set a positional deviation limit imposed during tapping axis movement in rigid tapping. However, parameter No. 5314 can be used to set a value greater than the valid data range of parameter No. 5310 because of the resolution of the detector being used.

NOTE

1 When parameter No. 5314 is set to 0, the setting of parameter No. 5310 is used. When parameter No. 5314 is set to a value other than 0, parameter No. 5310 is disabled; in this case, the setting of parameter No. 5314 is used.

2 When rigid tapping is performed using the second and third spindles
- When bit 1 (SPR) of parameter No. 5204 is set to 0, the setting of parameter No. 5314 (or No. 5310) is applied to the second and third spindles, as well as to the first spindle.
- When bit 1 (SPR) of parameter No. 5204 is set to 1, the settings of parameters No. 5350 and No. 5354 are applied to the second spindle and third spindle, respectively.

5321	**Spindle backlash in rigid tapping (first-stage gear)**
	Spindle backlash in rigid tapping

5322	**Spindle backlash in rigid tapping (second-stage gear)**

5323	**Spindle backlash in rigid tapping (third-stage gear)**

5324	**Spindle backlash in rigid tapping (fourth-stage gear)**

5325	**Spindle backlash in rigid tapping using the second spindle (first-stage gear)**
	Spindle backlash in rigid tapping using the second spindle

5326	**Spindle backlash in rigid tapping using the second spindle (second-stage gear)**

5327	**Spindle backlash in rigid tapping using the third spindle (first-stage gear)**
	Spindle backlash in rigid tapping using the third spindle

5328	**Spindle backlash in rigid tapping using the third spindle (second-stage gear)**

[Data type] Byte
[Unit of data] Detection unit
[Valid data range] 0 to 127

Each of these parameters is used to set a spindle backlash.

NOTE

When rigid tapping is performed using the second and third spindles

- When bit 1 (SPR) of parameter No. 5204 is set to 1, the settings of parameters No. 5325 and No. 5326 are applied to the second spindle, while the settings of parameters No. 5227 and No. 5228 are applied to the third spindle.
- When bit 1 (SPR) of parameter No. 5204 is set to 0, the settings of parameters No. 5321 and No. 5322 are applied to the second spindle and third spindle, as well as to the first spindle.

5335	**Time constant for the spindle and tapping axis in second spindle extraction operation (first-stage gear)**
5336	**Time constant for the spindle and tapping axis in second spindle extraction operation (second-stage gear)**
5337	**Time constant for the spindle and tapping axis in third spindle extraction operation (first-stage gear)**
5338	**Time constant for the spindle and tapping axis in third spindle extraction operation (second-stage gear)**

[Data type] Word
[Unit of data] msec
[Valid data range] 0 to 4000

Each of these parameters is used to set a linear acceleration/deceleration time constant for the spindle and tapping axis in extraction operation during rigid tapping on a gear-by-gear basis.

NOTE
These parameters are enabled when both bit 2 (TDR) of parameter No. 5201 and bit 1 (SPR) of parameter No. 5204 are set to 1.

5341	Position control loop gain for the spindle and tapping axis in rigid tapping using the second spindle (common to all the gears)

5342	Position control loop gain for the spindle and tapping axis in rigid tapping using the second spindle (first-stage gear)

5343	Position control loop gain for the spindle and tapping axis in rigid tapping using the second spindle (second-stage gear)

[Data type] Word
[Unit of data] 0.01 s^{-1}
[Valid data range] 1 to 9999

Each of these parameters is used to set a position control loop gain for the spindle and tapping axis in rigid tapping using the second spindle.

NOTE
1 When these parameters are set, the power must be turned off before operation is continued.
2 To use a varied loop gain on a gear-by-gear basis, set parameter No. 5341 to 0, and set a loop gain for each gear in parameters No. 5342 and No. 5343.
3 These parameters are enabled when bit 1 (SPR) of parameter No. 5204 is set to 1.

5344	Position control loop gain for the spindle and tapping axis in rigid tapping using the third spindle (common to all the gears)

5345	Position control loop gain for the spindle and tapping axis in rigid tapping using the third spindle (first-stage gear)

5346	Position control loop gain for the spindle and tapping axis in rigid tapping using the third spindle (second-stage gear)

[Data type] Word
[Unit of data] 0.01 s^{-1}
[Valid data range] 1 to 9999

Each of these parameters is used to set a position control loop gain for the spindle and tapping axis in rigid tapping using the third spindle.

NOTE
1 When these parameters are set, the power must be turned off before operation is continued.
2 To use a varied loop gain on a gear-by-gear basis, set parameter No. 5344 to 0, and set a loop gain for each gear in parameters No. 5345 and No. 5346.
3 These parameters are enabled when bit 1 (SPR) of parameter No. 5204 is set to 1.

5350	Positional deviation limit imposed during tapping axis movement in rigid tapping using the second spindle

[Data type] 2-word
[Unit of data] Detection unit
[Valid data range] 1 to 99999999

This parameter sets a positional deviation limit imposed during tapping axis movement in rigid tapping using the second spindle.

> **NOTE**
> This parameter is enabled when bit 1 (SPR) of parameter No. 5204 is set to 1.

5351	Positional deviation limit imposed during spindle movement in rigid tapping using the second spindle

[Data type] Word
[Unit of data] Detection unit
[Valid data range] 1 to 32767

This parameter is used to set a positional deviation limit imposed during spindle movement in rigid tapping using the second spindle.

> **NOTE**
> This parameter is enabled when bit 1 (SPR) of parameter No. 5204 is set to 1.

5352	Positional deviation limit imposed while the tapping axis is stopped in rigid tapping using the second spindle

[Data type] Word
[Unit of data] Detection unit
[Valid data range] 1 to 32767

This parameter is used to set a positional deviation limit imposed while the tapping axis is stopped in rigid tapping using the second spindle.

> **NOTE**
> This parameter is enabled when bit 1 (SPR) of parameter No. 5204 is set to 1.

5353	Positional deviation limit imposed while the spindle is stopped in rigid tapping using the second spindle

[Data type] Word
[Unit of data] Detection unit
[Valid data range] 1 to 32767

This parameter is used to set a positional deviation limit imposed while the spindle is stopped in rigid tapping using the second spindle.

> **NOTE**
> This parameter is enabled when bit 1 (SPR) of parameter No. 5204 is set to 1.

5354	Positional deviation limit imposed during tapping axis movement in rigid tapping using the third spindle

[Data type] 2-word
[Unit of data] Detection unit
[Valid data range] 1 to 99999999

This parameter is used to set a positional deviation limit imposed during tapping axis movement in rigid tapping using the third spindle.

> **NOTE**
> This parameter is enabled when bit 1 (SPR) of parameter No. 5204 is set to 1.

5355	Positional deviation limit imposed during spindle movement in rigid tapping using the third spindle

[Data type] Word
[Unit of data] Detection unit
[Valid data range] 1 to 32767

This parameter is used to set a positional deviation limit imposed during spindle movement in rigid tapping using the third spindle.

> **NOTE**
> This parameter is enabled when bit 1 (SPR) of parameter No. 5204 is set to 1.

5356	Positional deviation limit imposed while the tapping axis is stopped in rigid tapping using the third spindle

[Data type] Word
[Unit of data] Detection unit
[Valid data range] 1 to 32767

This parameter is used to set a positional deviation limit imposed while the tapping axis is stopped in rigid tapping using the third spindle.

> **NOTE**
> This parameter is enabled when bit 1 (SPR) of parameter No. 5204 is set to 1.

5357	Positional deviation limit imposed while the spindle is stopped in rigid tapping using the third spindle

[Data type] Word
[Unit of data] Detection unit
[Valid data range] 1 to 32767

This parameter is used to set a positional deviation limit imposed while the spindle is stopped in rigid tapping using the third spindle.

> **NOTE**
> This parameter is enabled when bit 1 (SPR) of parameter No. 5204 is set to 1.

5365	Bell-shaped acceleration/deceleration time constant for the first spindle in rigid tapping (first-stage gear)

5366	Bell-shaped acceleration/deceleration time constant for the first spindle in rigid tapping (second-stage gear)

5367	Bell-shaped acceleration/deceleration time constant for the first spindle in rigid tapping (third-stage gear)

[Data type] Word
[Unit of data] msec
[Valid data range] 0 to 512

These parameters are used to set bell-shaped acceleration/deceleration time constants for the first spindle in rigid tapping.

5369	Bell-shaped acceleration/deceleration time constant for the second spindle in rigid tapping (first-stage gear)

5370	Bell-shaped acceleration/deceleration time constant for the second spindle in rigid tapping (second-stage gear)

[Data type] Word
[Unit of data] msec
[Valid data range] 0 to 512

These parameters are used to set bell-shaped acceleration/deceleration time constants for the second spindle in rigid tapping.

5373	Bell-shaped acceleration/deceleration time constant for the third spindle in rigid tapping (first-stage gear)

5374	Bell-shaped acceleration/deceleration time constant for the third spindle in rigid tapping (second-stage gear)

[Data type] Word
[Unit of data] msec
[Valid data range] 0 to 512

These parameters are used to set bell-shaped acceleration/deceleration time constants for the third spindle in rigid tapping.

5381	Override value during retraction for rigid tapping

[Data type] Byte
[Unit of data] 1% or 10%
[Valid data range] 0 to 200

This parameter is used to set the override value during retraction for rigid tapping.
If the setting is 0, no override is applied.

NOTE
This parameter is valid when bit 4 (DOV) of parameter No. 5200 is set to 1.
If bit 3 (OVU) of parameter No. 5201 is set to 1, 10% is set as the units of data. Thus, an override of up to 2000% can be applied during extraction.

5382	Amount of retraction for rigid tapping

[Data type] 2-word

[Unit of data] Input increments

[Valid data range] 0 to 99999999

During retraction for rigid tapping, the tool can be pulled out, along the tapping axis, going beyond the stored rigid tapping start position by the amount specified with this parameter.

If the tool has already been retracted from rigid tapping, it will be retracted further only by the distance specified in this parameter.

4.28 PARAMETERS OF SCALING AND COORDINATE SYSTEM ROTATION

	#7	#6	#5	#4	#3	#2	#1	#0
5400	SCR	XSC	VL3	RCW	D3C	D3R		RIN

[Data type] Bit

RIN Coordinate system rotation angle command (R)
0 : Specified by an absolute method
1 : Specified by G90 or G91

> **NOTE**
> This parameter is invalid when G code system A (T series) is used.

D3R The three-dimensional coordinate conversion mode or tilted working plane command mode can be cancelled by:
0 : The G69 (M series) command, the G69.1 (T series) command, a reset operation, or a CNC reset by signal input from the PMC.
1 : The G69 (M series) command or G69.1 (T series) command only.

> **NOTE**
> 1 When this parameter is set to 1 and bit 6 (CLR) of parameter No. 3402 is set to 1, set bit 0 (C16) of parameter No. 3408 (M series) to 1 and bit 1 (C17) of parameter No. 3408 (T series) to 1.
> 2 With the T series, the mode is not cancelled by a reset if a setting is made to perform tool offset by a coordinate system shift, even when this parameter is set to 0.
> The mode is cancelled by a reset only when bit 6 (LVC) of parameter No. 5003 is set to 1 and either bit 7 (TGC) of parameter No. 5003 or bit 4 (LGT) of parameter No. 5002 is set to 1.

D3C In a drilling canned cycle during three-dimensional coordinate conversion or tilted working plane command, rapid traverse operation is performed in:
0 : Rapid traverse mode
1 : Cutting mode

> **NOTE**
> When this parameter is set to 1, an acceleration/deceleration time constant and override for cutting feed are used.

RCW When a workpiece or local coordinate system command is issued in coordinate system rotation mode:
0 : No alarm is issued.
1 : An alarm (P/S alarm No. 5302) is issued.

VL3 When system variables #5041 to #5048 (current position coordinates) and #5061 to #5068 (skip coordinates) are read in the three-dimensional coordinate conversion mode or tilted working plane command mode:
0 : Coordinates of the workpiece coordinate system can be read.
1 : Coordinates of the program (feature) coordinate system after three-dimensional coordinate conversion can be read.

NOTE
Only G31 (low-speed skip) can be specified for #5061 to #5068 (skip coordinates). High-speed skip cannot be specified.

XSC Scaling mirror image for each axis in scaling is:
0 : Disabled. (Specify a scaling magnification common to all axes with P.)
1 : Enabled. (Specify a scaling magnification for each axis with I, J, and K.)

SCR Scaling magnification unit
0 : 0.00001 times (1/100,000)
1 : 0.001 times

	#7	#6	#5	#4	#3	#2	#1	#0
5401								SCLx

[Data type] Bit axis

SCLx Scaling
0 : Invalidated
1 : Validated

	#7	#6	#5	#4	#3	#2	#1	#0
5402								
								S8D

[Data type] Bit

S8D The unit of scaling magnification is:
0 : Dependent on the setting of bit 7 (SCR) of parameter No. 5400.
1 : 0.0000001 times (1/10,000,000)

5410	Angular displacement used when no angular displacement is specified for coordinate system rotation

This parameter can also be set on the “Setting screen”.

[Data type] 2-word

[Unit of data] 0.001 degrees

[Valid data range] -360000 to 360000

This parameter sets the angular displacement for coordinate system rotation. When the angular displacement for coordinate system rotation is not specified with address R in the block where G68 is specified, the setting of this parameter is used as the angular displacement for coordinate system rotation.

5411	Magnification used when scaling magnification is not specified

This parameter can also be set on the “Setting screen”.

[Data type] 2-word

[Unit of data] 0.001, 0.00001, or 0.0000001 times (to be selected using bit 7 (SCR) of parameter No. 5400 or bit 0 (S8D) of parameter No. 5402 (M series))

[Valid data range] 1 to 999999 (0.001 times or 0.00001 times)
1 to 99999999 (0.0000001 times) (M series)

This parameter sets the scaling magnification. This setting value is used when a scaling magnification (P) is not specified in the program.

> **NOTE**
> Parameter No. 5421 becomes valid when scaling for every axis is valid. (bit 6 (XSC) of parameter No. 5400 is set to 1.)

5412	Rapid traverse rate for a drilling canned cycle in the three-dimensional coordinate conversion or tilted working plane command mode

[Data type] 2-word

[Unit of data, valid data range]

Input increment	Units of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	30 to 240000	6 to 100000
Inch machine	0.1 inch/min	30 to 96000	6 to 48000
Rotary axis	1 deg/min	30 to 240000	6 to 100000

This parameter sets a rapid traverse rate for a drilling cycle in the three-dimensional coordinate conversion mode.

When 0 is set in this parameter, the tool is fed at the maximum allowable cutting feedrate.

5421	Scaling magnification for every axis

This parameter can also be set on the “Setting screen”.

[Data type] 2-word axis

[Unit of data] 0.001, 0.00001, or 0.0000001 times (to be selected using bit 7 (SCR) of parameter No. 5400 or bit 0 (S8D) of parameter No. 5402 (M series))

[Valid data range] -999999 to -1, 1 to 999999 (0.001 times or 0.00001 times)
-99999999 to -1, 1 to 99999999 (0.0000001 times) (M series)
This parameter sets the scaling magnification for every axis.

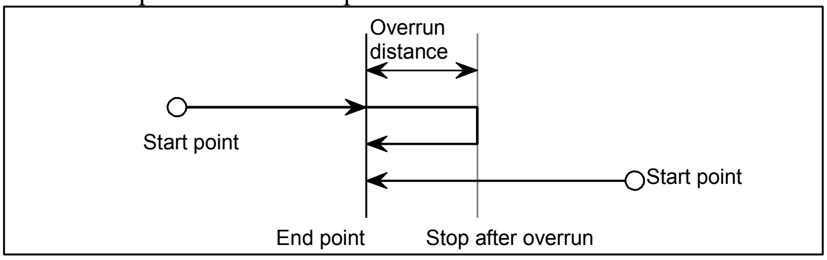
4.29 PARAMETERS OF SINGLE DIRECTION POSITIONING

	#7	#6	#5	#4	#3	#2	#1	#0
5431							PDI	MDL

[Data type] Bit

MDL Specifies whether the G code for single direction positioning (G60) is included in one-shot G codes (00 group) or modal G codes (01 group)
0 : One-shot G codes (00 group)
1 : Modal G codes (01 group)

PDI When the tool is stopped before or after a specified end point with the single direction positioning function:
0 : No in-position check is performed.
1 : An in-position check is performed.



5440	Positioning direction and overrun distance in single direction positioning for each axis

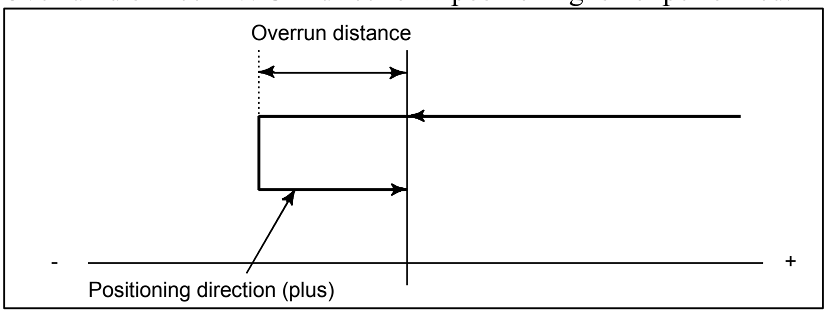
[Data type] Word axis

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] -16383 to +16383

This parameter sets the positioning direction and overrun distance in single direction positioning (G60) for each axis. The positioning direction is specified using a setting data sign, and the overrun distance using a value set here.
Overrun distance > 0: The positioning direction is positive (+).
Overrun distance < 0: The positioning direction is negative (-).
Overrun distance = 0: Uni-directional positioning is not performed.



4.30 PARAMETERS OF POLAR COORDINATE INTERPOLATION

	#7	#6	#5	#4	#3	#2	#1	#0
5450							AFC	
						PLS	AFC	

[Data type] Bit

AFC In polar coordinate interpolation mode, automatic override operation and automatic feedrate clamp operation are:

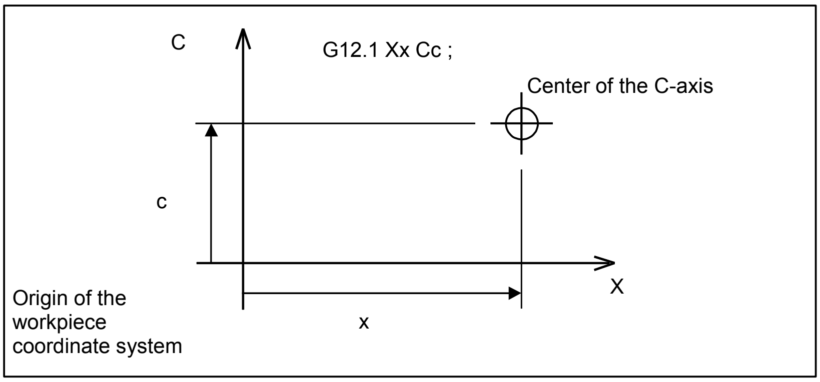
0 : Not performed.

1 : Performed.

> **NOTE**
>
> In polar coordinate interpolation mode, the feedrate component for a rotational axis increases as the tool moves closer to the center of a workpiece. Near the center of a workpiece, the maximum cutting feedrate (parameter No.5462) may be exceeded, causing servo alarm No.411 to be issued. The automatic feedrate override function and automatic feedrate clamp function automatically control the feedrate to prevent the feedrate component on a rotary axis from exceeding a specified maximum cutting feedrate.

PLS The polar coordinate interpolation shift function is:
0 : Not used.
1 : Used.
Conventionally, the origin of the workpiece coordinate system in polar coordinate interpolation was always fixed to the center of the rotary axis. By this parameter setting, the workpiece coordinate system can also be shifted in polar coordinate interpolation. This enables machining using the workpiece coordinate system with a desired point which is not the center of the rotary axis set as the origin of the coordinate system in polar coordinate interpolation.
In polar coordinate interpolation mode, specify coordinates X-C (or Y-A or Z-B) in the workpiece coordinate system with the origin set to the center of rotary axis C (or A or B) set on each polar coordinate interpolation plane in the following format:

G12.1 X_ C_ ;
(Polar coordinate interpolation with the X-axis and C-axis)
G12.1 Y_ A_ ;
(Polar coordinate interpolation with the Y-axis and A-axis)
G12.1 Z_ B_ ;
(Polar coordinate interpolation with the Z-axis and B-axis)



Example for polar coordinate interpolation with the X-axis and C-axis

> **NOTE**
> Carefully issue a command to shift the polar coordinate interpolation coordinate system with this parameter disabled because the command is recognized as a move command and the machine operates.

5460	Axis (linear axis) specification for polar coordinate interpolation

5461	Axis (rotary axis) specification for polar coordinate interpolation

[Data type] Byte
[Valid data range] 1, 2, 3, . . . Number of controlled axes
These parameters set controlled axis number of linear and rotary axes to execute polar interpolation.

5462	Maximum cutting feedrate during polar coordinate interpolation

[Data type] 2-word

[Unit of data, valid data range]

Input increment	Units of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	0, 6 to 240000	0, 6 to 100000
Inch machine	0.1 inch/min	0, 6 to 96000	0, 6 to 48000
Rotary axis	1 deg/min	0, 6 to 240000	0, 6 to 100000

This parameter sets the upper limit of the cutting feedrate that is effective during polar coordinate interpolation. If a feedrate greater than the maximum feedrate is specified during polar coordinate interpolation, it is clamped to the feedrate specified by the parameter. When this parameter is set 0, the feedrate during polar coordinate interpolation is clamped to the maximum cutting feedrate usually specified with parameter No. 1422.

5463	Allowable automatic override percentage in polar coordinate interpolation

[Data type] Byte

[Unit of data] %

[Valid data range] 0 to 100

This parameter sets an allowable percentage to find an allowable feedrate on a rotary axis in polar coordinate interpolation mode. A maximum cutting feedrate (parameter No.5462), multiplied by the allowable percentage set with this parameter represents an allowable feedrate.

$$\text{Allowable feedrate on rotary axis} = \text{Maximum cutting feedrate} \times \text{Allowable percentage}$$

In polar coordinate interpolation mode, the feedrate component on a rotary axis increases as the tool moves closer to the center of a workpiece. Near the center of a workpiece, the maximum allowable feedrate (parameter No.5462) may be exceeded. To prevent the feedrate component on a rotary axis from exceeding the maximum allowable feedrate in polar coordinate interpolation mode, the following override is automatically applied to the feedrate (automatic override):

$$\text{Override} = \frac{\text{Allowable feedrate on rotary axis}}{\text{Feedrate component on rotary axis}} \times 100\ (\%)$$

If the overridden feedrate component for a rotary axis still exceeds the allowable feedrate, the feedrate is clamped to prevent the feedrate component on a rotary axis from exceeding a maximum cutting feedrate (automatic feedrate clamp).

NOTE

When 0 is set in this parameter, a specification of 90% is assumed. When a value of 100 or greater is set with this parameter, a specification of 100% is assumed. Before the automatic override function and automatic feedrate clamp function can be used, bit 1 (AFC) of parameter No.5450 must be set to

4.31 PARAMETERS OF NORMAL DIRECTION CONTROL

5480	Controlled axis number for controlling the normal direction

[Data type] Byte
[Valid data range] 1, 2, 3, . . . Number of controlled axes
This parameter sets the controlled axis number of the axis for controlling the normal direction.

5481	Rotation feedrate of normal direction controlled axis

[Data type] Word
[Unit of data] deg/min
[Valid data range] 1 to 15000
This parameter sets the feedrate of a normal direction controlled axis that is inserted at the start point of a block during normal direction control.

5482	Limit value that ignores the rotation insertion of normal direction controlled axis

[Data type] 2-word
[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] 1 to 99999999
The rotation block of a normal direction controlled axis is not inserted when the rotation insertion angle calculated during normal direction control does not exceed this setting value. The ignored rotation angle is added to the next rotation insertion angle. The block insertion is then judged.

NOTE
1 No rotation block is inserted when 360 or more degrees are set.
2 If 180 or more degrees are set, a rotation block is inserted only when the circular interpolation is 180 or more degrees.

5483	
	Limit value of movement that is executed at the normal direction angle of a preceding block

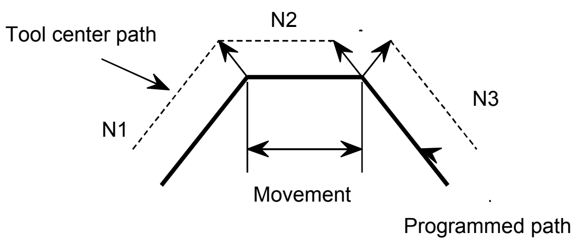
[Data type] 2-word

[Unit of data]

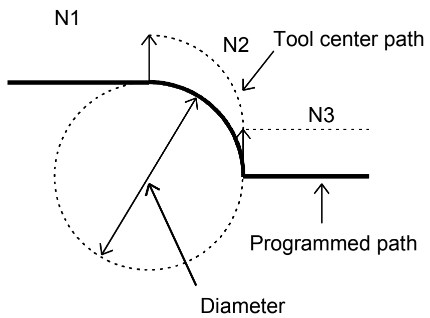
Input increment	IS-A	IS-B	IS-C	Unit
Metric input	0.01	0.001	0.0001	mm
Inch input	0.001	0.0001	0.00001	inch

[Valid data range] 1 to 99999999

This parameter sets the limit value of movement at the normal direction angle of a preceding block.



For straight line
Block N2 is machined with the tool being normal to block N1 when the movement of N2 in the figure on the left does not exceed the set value.



For arc
Arc N2 is machined with the tool being normal to block N1 when the arc diameter of N2 in the figure on the left does not exceed the setting value. A normal direction controlled axis is not controlled to move in the normal direction according to the arc movement.

	#7	#6	#5	#4	#3	#2	#1	#0
5484								
						ANM	CTI	SDC

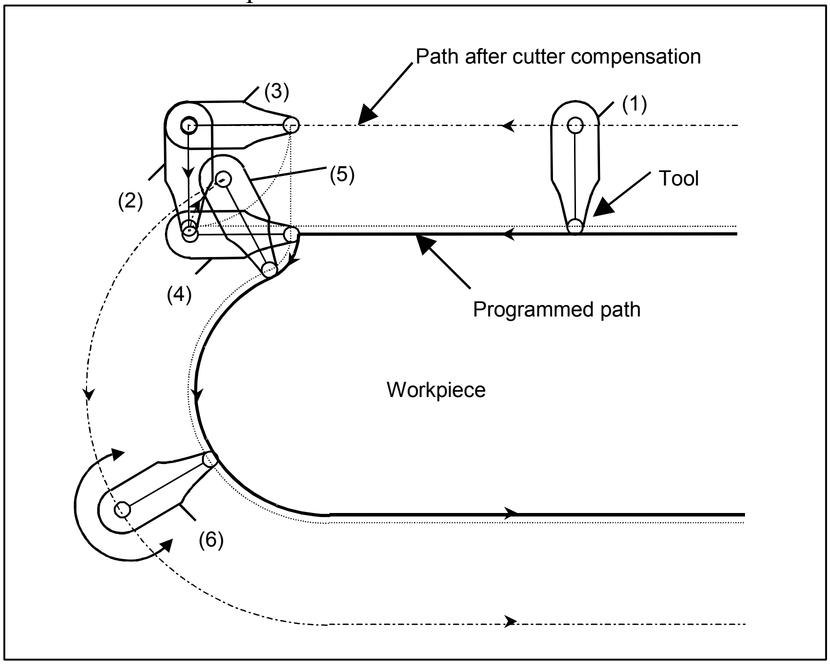
[Data type] Bit

SDC In normal direction control:

0 : A C-axis movement is automatically inserted between blocks so that the C-axis is directed at right angles to the direction of motion at the start point of each block. (After movement on the C-axis, movement (along the X-axis and Y-axis) specified by the block is performed.)

1 : If the amount of C-axis movement is smaller than the value set in parameter No.5485, a C-axis movement is not inserted before a block. Instead, it is performed together with movement along the X-axis and Y-axis.

CTI If such an arc that the vector from the center of the arc to a start point rotates in the reverse direction after cutter compensation is specified during normal direction control in the cutter compensation C mode:
0 : P/S 041 alarm is issued.
1 : The command is executed.
If this parameter is set to 1, and such an arc that the vector from the center of the arc to a start point rotates in the reverse direction after cutter compensation is specified during normal direction control in the cutter compensation C mode (see the tool path from (4) to (5) in the figure below), the tool is controlled so that the tool faces in the direction at right angles to the move direction (programmed path) before cutter compensation (see the tool path from (2) to (3) in the figure below).
Thus, as shown by the programmed path from (4) to (5) in the figure below, the inside of an arc where the radius of the workpiece is smaller than the compensation value of the tool can be cut.



NOTE
When this parameter is set to 1, no interference check is made in cutter compensation C.

ANM In AI contour control mode, the normal direction control function is:
0 : Disabled.
1 : Enabled.

5485	Limit imposed on the insertion of a single block for rotation about the normal direction controlled axis

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] 1 to 99999999

When normal direction control is applied, the amount of movement (rotation angle) on the normal direction control axis (C-axis), calculated so that the C-axis is directed at right angles to the direction of motion at the start point of a block, may be smaller than the value specified in this parameter. In such a case, the C-axis movement is not inserted before the movement (along the X-axis and Y-axis) specified by the block. Instead, the C-axis movement is performed together with the movement specified by the block. If the amount of movement (rotation angle) on the C-axis is greater than or equal to the value specified with this parameter, the C-axis movement is inserted, and the movement specified by the block is made after the completion of the C-axis movement.

NOTE

This parameter is enabled when bit 0 (SDC) of parameter No.5484 is set to 1. If a value equal to or greater than 180 degrees is specified, a C-axis movement is inserted only when circular interpolation involving a C-axis rotation of 180 degrees or more is performed.

4.32 PARAMETERS OF INDEX TABLE INDEXING

	#7	#6	#5	#4	#3	#2	#1	#0
5500	IDX	SIM		G90	INC	ABS	REL	DDP

[Data type] Bit

DDP Selection of decimal point programming method of index table indexing axis
- 0 : Conventional method (Example IS-B: B1; = 0.001 deg)
- 1 : Pocket calculator method (Example IS-B: B1; = 1.000 deg)

REL Relative position display of index table indexing axis
- 0 : Not rounded by 360 degrees
- 1 : Rounded by 360 degrees

ABS Displaying absolute coordinate value of index table indexing axis
- 0 : Not rounded by 360 degrees
  The index table indexing axis rotates 720 degrees (two rotations) when G90 B720.0; is specified from the 0-degree position. It rotates in reverse direction 720 degrees (two rotations) when G90 B0.; is specified. The absolute coordinate value then becomes 0 degree.
- 1 : Rounded by 360 degrees
  The index table indexing axis is positioned in 40 degrees when G90 B400.0; is specified from the 0-degree position. The index table indexing axis does not rotate by two or more turns when this parameter is set to 1. It also does not move when G90 B720.0; is specified from the 0-degree position.

INC Rotation in the G90 mode when negative-direction rotation command M code (parameter No.5511) is not set
- 0 : Not set to the shorter way around the circumference
- 1 : Set to the shorter way around the circumference (Set bit 2 (ABS) of parameter No.5500 to 1.)

G90 Index table indexing command
- 0 : Judged to be an absolute/increment command according to the G90/G91 mode
- 1 : Judged to be an absolute command

SIM When the same block includes a command for an index table indexing axis and a command for another controlled axis:
- 0 : A P/S alarm (No.136) is issued.
- 1 : The commands are executed. (In a block other than G00, G28, and G30, however, a P/S alarm (No.136) is issued.)

IDX Index table indexing sequence
- 0 : Type A
- 1 : Type B

	#7	#6	#5	#4	#3	#2	#1	#0
5501								
							ISP	ITI

[Data type] Bit

ITI The index table indexing function is:

0 : Enabled.

1 : Disabled.

ISP For an index table axis, servo-off operation upon completion of clamping and servo-on operation upon completion of unclamping are automatically:

0 : Performed.

1 : Not performed.

5511	
	Negative-direction rotation command M code

[Data type] 2-word

[Valid data range] 0 to 255

0 : Not use an M code that sets the index table rotation to the negative direction. The rotation direction is specified using a command and parameter (bit 3 (INC) of parameter No.5500).

1 to 255:

Sets an M code that sets the index table rotation to the negative direction. The rotation is set to the negative direction only when an M code set here is specified in the same block as an index table indexing command. If the M code is not specified in the same block, the rotation is always set to the positive direction.

> **NOTE**
> Set bit 2 (ABS) of parameter No.5500 to 1.

5512	
	Unit of index table indexing angle

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] 0 to 360000

This parameter sets the unit of index table indexing angle. A P/S alarm (No.135) generated when movement other than integer multiple of the setting value is specified.

> **NOTE**
> If 0 is specified as the setting value, any command can be specified irrespective of the unit of angle.

4.33 PARAMETERS OF INVOLUTE INTERPOLATION

5610	Limit of initial permissible error during involute interpolation

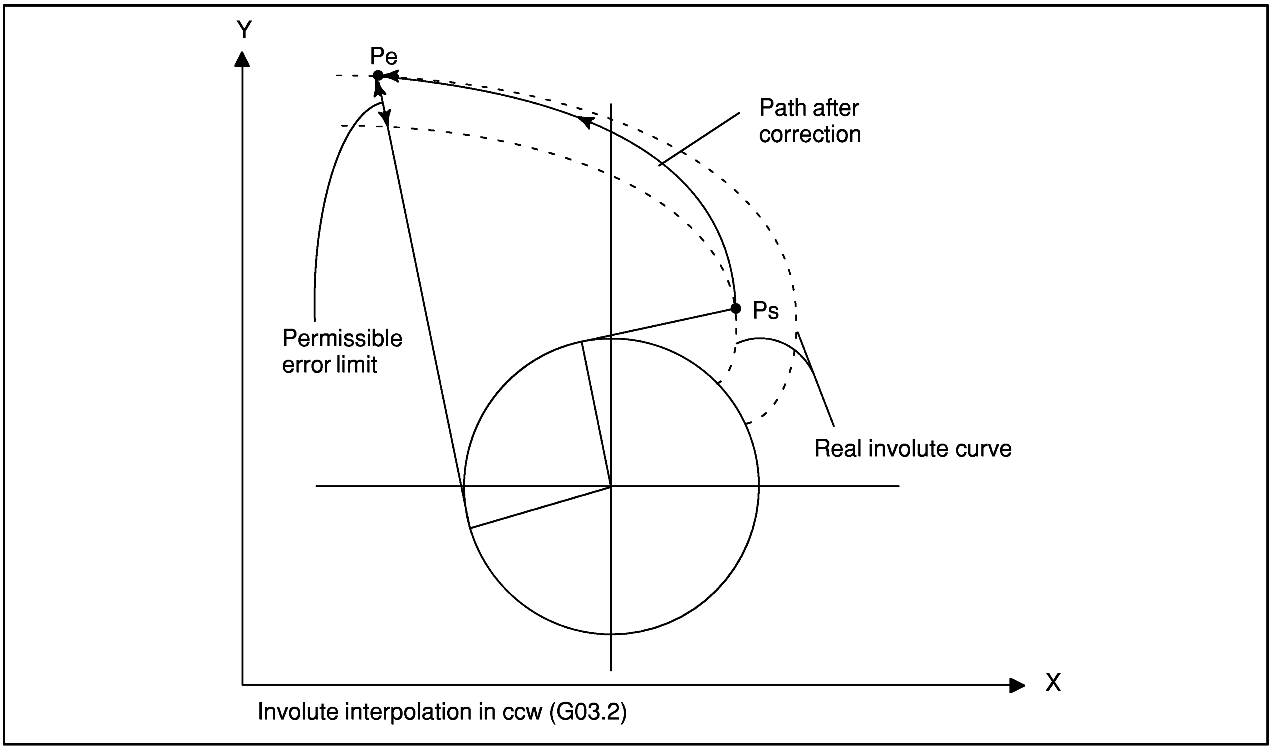
[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric input	0.01	0.001	0.0001	mm
Inch input	0.001	0.0001	0.00001	inch

[Valid data range] 0 to 99999999

This parameter sets the allowable limit of deviation between an involute curve passing through a start point and an involute curve passing through an end point for an involute interpolation command.



5611	Radius of curvature at cutting point for starting basic circle neighborhood override 1

5612	Radius of curvature at cutting point for starting basic circle neighborhood override 2

5613	Radius of curvature at cutting point for starting basic circle neighborhood override 3

5614	Radius of curvature at cutting point for starting basic circle neighborhood override 4

5615	Radius of curvature at cutting point for starting basic circle neighborhood override 5

[Data type] 2-word

[Unit of data]

Input increment	IS-B	IS-C	Unit
Metric input	0.001	0.0001	mm
Inch input	0.0001	0.00001	inch

[Valid data range] 1 to 99999999

The settings of these parameters are used for automatic speed control during involute interpolation.

5616	Override value for starting basic circle neighborhood override 2

5617	Override value for starting basic circle neighborhood override 3

5618	Override value for starting basic circle neighborhood override 4

5619	Override value for starting basic circle neighborhood override 5

[Data type] Byte

[Unit of data] %

[Valid data range] 1 to 100

The settings of these parameters are used for automatic speed control during involute interpolation.

5620	Lower override limit during involute interpolation

[Data type] Byte
[Unit of data] %
[Valid data range] 1 to 100

The setting of this parameter is used for automatic speed control during involute interpolation.

5621	Lower override limit during involute interpolation

[Data type] Word
[Unit of data] msec
[Valid data range] 1 to 32767

This parameter is used to set the maximum acceleration speed while constant acceleration control is applied during involute interpolation in high-precision contour control mode.

Set the time required until the speed set in parameter No. 8400 for setting the acceleration for linear acceleration/deceleration before interpolation is reached.

5622	Minimum speed while constant acceleration control is applied during involute interpolation

[Data type] Word
[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	100.0	10.0	1.0	mm/min
Inch machine	10.0	1.0	0.1	inch/min
Rotary axis	100.0	10.0	1.0	deg/min

[Valid data range] 1 to 32767

This parameter is used to set the minimum deceleration speed during deceleration according to the maximum acceleration speed (parameter No. 5621) while constant acceleration control is applied during involute interpolation in high-precision contour control mode.

NOTE

When parameter No. 5621 or No. 5622 is set to 0, constant acceleration control is not applied during involute interpolation in high-precision contour control mode.

4.34 PARAMETERS OF EXPONENTIAL INTERPOLATION

	#7	#6	#5	#4	#3	#2	#1	#0
5630								
								SPN

[Data type] Bit

SPN The amount of linear axis division (span value) in exponential interpolation is:
0 : Specified with parameter No. 5643.
1 : Specified using address K in a block containing G02.3/G03.3. When address K is not specified, the value set with parameter No. 5643 is used.

5641	
	Linear axis number subject to exponential interpolation

[Data type] Byte

[Valid data range] 1 to number of controlled axes

This parameter sets the ordinal number, among the controlled axes, for the linear axis to which exponential interpolation is applied.

5642	
	Rotary axis number subject exponential interpolation

[Data type] Byte

[Valid data range] 1 to number of controlled axes

This parameter sets the ordinal number, among the controlled axes, for the rotary axis to which exponential interpolation is applied.

5643	
	Amount of linear axis division (span value) in exponential interpolation

[Data type] 2-word

[Valid data range]

Input increment	IS-A	IS-B	IS-C	Unit
Metric input	0.01	0.001	0.0001	mm
Inch input	0.001	0.0001	0.00001	inch

[Valid data range] 1 to 99999999

This parameter sets the amount of linear axis division in exponential interpolation when bit 0 (SPN) of parameter No.5630 is set to 0.

4.35 PARAMETERS OF FLEXIBLE SYNCHRONOUS CONTROL

5660	Master axis number (group A)

5661	Slave axis number (group A)

5662	Master axis number (group B)

5663	Slave axis number (group B)

5664	Master axis number (group C)

5665	Slave axis number (group C)

5666	Master axis number (group D)

5667	Slave axis number (group D)

[Data type] Byte

[Valid data range] 1 to number of controlled axis

These parameters sets the master and slave axes in flexible synchronous control.

> **NOTE**
> A master axis number must be smaller than the axis number of the corresponding slave axis.

	#7	#6	#5	#4	#3	#2	#1	#0
5668					ACD	ACC	ACB	ACA

[Data type] Bit

ACA The machine coordinate on the slave axis of group A is:
0 : Updated.
1 : Not updated.

ACB The machine coordinate on the slave axis of group B is:
0 : Updated.
1 : Not updated.

ACC The machine coordinate on the slave axis of group C is:
0 : Updated.
1 : Not updated.

ACD The machine coordinate on the slave axis of group D is:
0 : Updated.
1 : Not updated.

NOTE
1 An absolute-position detector is unusable with the slave axis of a group for which the corresponding parameter is set.
2 If a parameter above is set, the absolute coordinate on the corresponding slave axis is not updated even at flexible mode cancellation time.
3 If flexible synchronization is performed in the AI nano contour control, AI high-precision contour control, or AI nano high-precision contour control mode, machine coordinates are updated at all times, regardless of the setting of these parameters.

5670	M code number for turning flexible synchronous control mode on (group A)
5671	M code number for turning flexible synchronous control mode off (group A)
5672	M code number for turning flexible synchronous control mode on (group B)
5673	M code number for turning flexible synchronous control mode off (group B)
5674	M code number for turning flexible synchronous control mode on (group C)
5675	M code number for turning flexible synchronous control mode off (group C)
5676	M code number for turning flexible synchronous control mode on (group D)
5677	M code number for turning flexible synchronous control mode off (group D)

[Data type] Word
[Valid data range] 0 to 999

These parameters set M code numbers for turning flexible synchronous control mode on and off during automatic operation.

5680	Numerator (q) for determining the gear ratio for flexible synchronous control (group A)

5681	Denominator (p) for determining the gear ratio for flexible synchronous control (group A)

5682	Numerator (q) for determining the gear ratio for flexible synchronous control (group B)

5683	Denominator (p) for determining the gear ratio for flexible synchronous control (group B)

5684	Numerator (q) for determining the gear ratio for flexible synchronous control (group C)

5685	Denominator (p) for determining the gear ratio for flexible synchronous control (group C)

5686	Numerator (q) for determining the gear ratio for flexible synchronous control (group D)

5687	Denominator (p) for determining the gear ratio for flexible synchronous control (group D)

[Data type] 2-word
[Valid data range] -99999999 to 99999999

These parameters set the gear ratio of each pair of master and slave axes.

5690	Exponent (k) for the denominator of the gear ratio for flexible synchronous control (group A)

5691	Exponent (k) for the denominator of the gear ratio for flexible synchronous control (group B)

5692	Exponent (k) for the denominator of the gear ratio for flexible synchronous control (group C)

5693	Exponent (k) for the denominator of the gear ratio for flexible synchronous control (group D)

[Data type] Byte

[Valid data range] 0 to 8

These parameters set the exponent for the denominator for determining the gear ratio of each pair of master and slave axes.

The gear ratio is calculated as follows:

$$\frac{q}{P \times 10^{k}}$$

where,

p: Denominator for determining the gear ratio for flexible synchronous control

q: Numerator for determining the gear ratio for flexible synchronous control

k: Exponent for the denominator of the gear ratio for flexible synchronous control

4.36 PARAMETERS OF STRAIGHTNESS COMPENSATION (1 OF 2)

	#7	#6	#5	#4	#3	#2	#1	#0
5700						SMT	ST6	RTS

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

RTS When compensation is rewritten for the straightness compensation function, it is enabled:
- 0 : After power-off.
- 1 : Immediately.

When this function is enabled, no power-off alarm is issued even if compensation parameters for straightness compensation (No. 5761 to No. 5784) are rewritten.

ST6 Combination of moving axis and compensation axis is:
- 0 : 3 combinations
- 1 : 6 combinations

SMT Parameters (No.13391 to No.13396) for straightness compensation magnification
- 0 : Are effective only for the first moving axis when two or more moving axes are set using the same axis number.
- 1 : Are effective for the respective moving axes even when two or more moving axes are set using the same axis number.

5711	Axis number of moving axis 1
5712	Axis number of moving axis 2
5713	Axis number of moving axis 3
5714	Axis number of moving axis 4
5715	Axis number of moving axis 5
5716	Axis number of moving axis 6

NOTE

1 When these parameters are set, the power must be turned off before operation is continued.

2 Parameter No. 5714 to No. 5716 are valid only when bit 1 (ST6) of parameter No. 5700 is set to 1.

[Data type] Byte

[Valid data range] 1 to number of controlled axes (When 0, compensation is not performed.)

Set the axis numbers of moving axes.

5721	Axis number of compensation axis 1 for moving axis 1
5722	Axis number of compensation axis 2 for moving axis 2
5723	Axis number of compensation axis 3 for moving axis 3
5724	Axis number of compensation axis 4 for moving axis 4
5725	Axis number of compensation axis 5 for moving axis 5
5726	Axis number of compensation axis 6 for moving axis 6

NOTE

1 When these parameters are set, the power must be turned off before operation is continued.

2 Parameter No. 5724 to No. 5726 are valid only when bit 1 (ST6) of parameter No. 5700 is set to 1.

[Data type] Byte

[Valid data range] 1 to number of controlled axes (When 0, compensation is not performed.)

Set the axis numbers of compensation axes.

5731	Compensation point number a of moving axis 1
5732	Compensation point number b of moving axis 1
5733	Compensation point number c of moving axis 1
5734	Compensation point number d of moving axis 1
5741	Compensation point number a of moving axis 2
5742	Compensation point number b of moving axis 2
5743	Compensation point number c of moving axis 2
5744	Compensation point number d of moving axis 2
5751	Compensation point number a of moving axis 3
5752	Compensation point number b of moving axis 3
5753	Compensation point number c of moving axis 3
5754	Compensation point number d of moving axis 3

NOTE
When these parameters are set, the power must be turned off before operation is continued.

[Data type] Word
[Unit of data] Number
(Compensation point numbers in stored pitch error compensation)
[Valid data range] 0 to 1023
Set four compensation points for each moving axis.

5761	**Compensation corresponding compensation point number a of moving axis 1**
5762	**Compensation corresponding compensation point number b of moving axis 1**
5763	**Compensation corresponding compensation point number c of moving axis 1**
5764	**Compensation corresponding compensation point number d of moving axis 1**
5771	**Compensation corresponding compensation point number a of moving axis 2**
5772	**Compensation corresponding compensation point number b of moving axis 2**
5773	**Compensation corresponding compensation point number c of moving axis 2**
5774	**Compensation corresponding compensation point number d of moving axis 2**
5781	**Compensation corresponding compensation point number a of moving axis 3**
5782	**Compensation corresponding compensation point number b of moving axis 3**
5783	**Compensation corresponding compensation point number c of moving axis 3**
5784	**Compensation corresponding compensation point number d of moving axis 3**

NOTE

When these parameters are set, the power must be turned off before operation is continued. However, this requirement is not applicable when bit 0 (RTS) of parameter No. 5700 is set to 1.

[Data type] Word
[Unit of data] Detection unit
[Valid data range] -32768 to 32767

Set compensation for each compensation point.

4.37 PARAMETERS OF INCLINATION COMPENSATION

5861	Compensation point number a for each axis
5862	Compensation point number b for each axis
5863	Compensation point number c for each axis
5864	Compensation point number d for each axis

NOTE
When these parameters are set, the power must be turned off before operation is continued.

[Data type] Word axis
[Unit of data] Number
[Valid data range] 0 to 1023

These parameters set the compensation points for inclination compensation. The points are set for the compensation point numbers for stored pitch error compensation.

NOTE
Set compensation point numbers such that a < b < c < d is satisfied.

5871	Compensation α at compensation point number a for each axis
5872	Compensation β at compensation point number b for each axis
5873	Compensation γ at compensation point number c for each axis
5874	Compensation ε at compensation point number d for each axis

[Data type] Word axis
[Unit of data] Detection unit
[Valid data range] -32767 to 32767

These parameters set compensation for each compensation point.
If pitch error compensation is applied at the same compensation point, the valid data range is narrowed by the amount of compensation.

4.38 PARAMETERS OF CUSTOM MACROS

	#7	#6	#5	#4	#3	#2	#1	#0
6000	SBV		SBM	HGO		HMC		G67
	SBV		SBM	HGO	V15	HMC		G67

[Data type] Bit

G67 If the macro call cancel command (G67) is specified when the macro call mode (G66) is not set:
0 : P/S alarm No.122 is issued.
1 : The specification of G67 is ignored.

HMC A custom macro is executed:
0 : At a normal speed.
1 : At a high-speed.

NOTE
When this parameter is set, the CNC executes a custom macro first. For this reason, when this parameter is set, performance of the following functions may be degraded:
- Screen display of CNC
- C language executor (excluding high-level tasks)
- Macro executor (excluding execution macros)
- Embedded Ethernet

V15 As system variable numbers for tool offset:
0 : The standard system variable numbers for the Series 16 are used.
1 : The same system variable numbers as those used for the Series 15 are used.
The tables below indicate the system variables for tool offset numbers 1 to 999. The values for tool offset numbers 1 to 200 can be read from or assigned to the system variables in parentheses.

(1) Tool offset memory A

	System variable number	
	V15 = 0	V15 = 1
Wear offset value	#10001 to #10999 (#2001 to #2200)	#10001 to #10999 (#2001 to #2200)

(2) Tool offset memory B

	System variable number	
	V15 = 0	V15 = 1
Geometry offset value	#11001 to #11999 (#2201 to #2400)	#10001 to #10999 (#2001 to #2200)
Wear offset value	#10001 to #10999 (#2001 to #2200)	#11001 to #11999 (#2201 to #2400)

(3) Tool offset memory C

		System variable number	
		V15 = 0	V15 = 1
H-Code	Geometry offset value	#11001 to #11999 (#2201 to #2400)	#10001 to #10999 (#2001 to #2200)
	Wear offset value	#10001 to #10999 (#2001 to #2200)	#11001 to #11999 (#2201 to #2400)
D-Code	Geometry offset value	#13001 to #13999	#12001 to #12999
	Wear offset value	#12001 to #12999	#13001 to #13999

HGO When a GOTO statement for specifying custom macro control is executed:

0 : A high-speed branch is not caused to 30 sequence numbers, immediately following the point of execution.

1 : A high-speed branch is caused to 30 sequence numbers, immediately before the point of execution.

SBM Custom macro statement

0 : Not stop the single block

1 : Stops the single block

If you want to disable the single blocks in custom macro statements using system variable #3003, set this parameter to 0. If this parameter is set to 1, the single blocks in custom macro statements cannot be disabled using system variable #3003. To control single blocks in custom macro statements using system variable #3003, use bit 7 (SBV) of parameter No. 6000.

NOTE

1 This bit is invalid when bit 0 (NOP) of parameter No. 6000 is set to 1. (M series)

2 When block look-ahead is enabled, a block look-ahead operation is performed even in single-block operation. So, a macro statement is also executed when read in advance.

3 In the cutter compensation C mode, a block look-ahead operation is performed even in single-block operation to calculate a path intersection after offsetting. So, turn off the cutter compensation C mode when subjecting a macro statement to single-block stop operation.

SBV Custom macro statement

0 : Not stop the single block

1 : Stops the single block

To control single blocks in custom macro statements using system variable #3003, use this parameter to enable or disable single blocks in custom macro statements.

This bit is valid when bit 5 (SBM) of parameter No. 6000 is set to 0.

	#7	#6	#5	#4	#3	#2	#1	#0
6001	CLV	CCV	TCS	CRO	PV5		PRT	MIF

[Data type] Bit

MIF The system variable number for the custom macro interface signal is:
- 0 : Not extended.
- 1 : Extended.

PRT Reading 0 when data is output using a DPRINT command
- 0 : Outputs a space
- 1 : Outputs no data

PV5 Custom macro common variables:
- 0 : Nos. 500 to 599 are output.
- 1 : Nos. 100 to 199 and Nos. 500 to 599 are output.

CRO ISO code in BPRWT or DPRNT command
- 0 : Outputs only LF after data is output
- 1 : Outputs LF and CR after data is output

TCS Subprogram
- 0 : Not called using a T code
- 1 : Called using a T code

CCV Custom macro's common variables Nos. 100 to 149 (or Nos. 100 to 199 when the option for adding custom macro's common variables is specified)
- 0 : Cleared to "vacant" by reset
- 1 : Not cleared by reset

CLV Custom macro's local variables Nos. 1 to 33
- 0 : Cleared to "vacant" by reset
- 1 : Not cleared by reset

	#7	#6	#5	#4	#3	#2	#1	#0
6003	MUS	MCY	MSB	MPR	TSE	MIN	MSK	

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

MSK Absolute coordinates at that time during custom macro interrupt
- 0 : Not set to the skip coordinates (system variables #5061 and later)
- 1 : Set to the skip coordinates (system variables #5061 and later)

MIN Custom macro interrupt
- 0 : Performed by interrupting an in-execution block (Custom macro interrupt type I)
- 1 : Performed after an in-execution block is completed (Custom macro interrupt type II)

TSE Custom macro interrupt signal UINT <G053#3>
- 0 : Edge trigger method (Rising edge)
- 1 : Status trigger method

MPR Custom macro interrupt valid/invalid M code
- 0 : M96/M97
- 1 : M code set using parameters (Nos. 6033 and 6034)

MSB Interrupt program
- 0 : Uses a dedicated local variable (Macro-type interrupt)
- 1 : Uses the same local variable as in the main program (Subprogram- type interrupt)

MCY Custom macro interrupt
- 0 : Not performed during cycle operation
- 1 : Performed during cycle operation

MUS Interrupt-type custom macro
- 0 : Not used
- 1 : Used

	#7	#6	#5	#4	#3	#2	#1	#0
6004						VHD	MFZ	NAT
			D15				MFZ	NAT

[Data type] Bit

NAT Specification of the results of custom macro functions ATAN
- 0 : The result of ATAN is 0 to 360.0.
- 1 : The result of ATAN is -180 to 0 to 180.0.

MFZ If the angle of a custom macro operation command SIN, COS, or TAN is 1.0×10^{-8} or below or if the result of operation is not accurately 0, the operation result is:
- 0 : Handled as underflow.
- 1 : Normalized to 0.

VHD With system variables #5121 to #5128
- 0 : Tool offset values (geometry offset values) are read.
- 1 : The amount of interrupt shift caused by a manual handle interruption is read.

D15 When tool compensation memory C is used, for reading or writing tool offset values (for up to offset number 200) for D code (tool radius), the same system variables, #2401 to #2800, as Series 15 are:
- 0 : Not used.
- 1 : Used.

D code		
Offset number	Geometry offset value	Tool wear compensation value
1	#2401	#2601
2	#2402	#2602
:	:	:
200	#2600	#2800

NOTE

When the D15 parameter is set to 1, system variables #2500 to #2806, for workpiece origin offset values, cannot be used. Instead, use system variables #5201 to #5324.

6005	#7	#6	#5	#4	#3	#2	#1	#0
								SQC
							ADR	SQC

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

SQC Calling a subprogram with its sequence number by the subprogram call function is:
0 : Disabled.
1 : Enabled.

ADR Calling a subprogram with address E by the subprogram call function using a custom macro and macro executor special code is:
0 : Disabled.
1 : Enabled.
Address E can be set for parameters Nos. 6090 and 6091.

6006	#7	#6	#5	#4	#3	#2	#1	#0
								MLG
							MMG	MLG

[Data type] Bit

MLG In conditional decision statements in custom macros, logical operations:
0 : Cannot be used.
1 : Can be used.

MMG The system variables (#4001 to #4022) for reading modal information can read:
0 : Modal information specified in up to the immediately preceding block.
1 : Modal information specified in the block currently being executed.

	#7	#6	#5	#4	#3	#2	#1	#0
6010	*7	*6	*5	*4	*3	*2	*1	*0

	#7	#6	#5	#4	#3	#2	#1	#0
6011	=7	=6	=5	=4	=3	=2	=1	=0

	#7	#6	#5	#4	#3	#2	#1	#0
6012	#7	#6	#5	#4	#3	#2	#1	#0

	#7	#6	#5	#4	#3	#2	#1	#0
6013	[7	[6	[5	[4	[3	[2	[1	[0

	#7	#6	#5	#4	#3	#2	#1	#0
6014	]7	]6	]5	]4	]3	]2	]1	]0

[Data type] Bit

These parameters are used for input/output with EIA codes.
The numeral of a suffix indicates the bit position in a code.
*0 to *7 : Set the hole pattern of an EIA code indicating *.
=0 to =7 : Set the hole pattern of an EIA code indicating =.
#0 to #7 : Set the hole pattern of an EIA code indicating #.
[0 to [7 : Set the hole pattern of an EIA code indicating [.
] 0 to] 7 : Set the hole pattern of an EIA code indicating].
0 : Corresponding bit is 0
1 : Corresponding bit is 1.

6030	M code that calls the program entered in file

[Data type] 2-word
[Valid data range] 0, 1 to 255

This parameter sets an M code that calls the program entered in a file.

> **NOTE**
> The M code is judged to be M198 when 0 is specified as the setting value.

6033	M code that validates a custom macro interrupt

6034	M code that invalidates a custom macro interrupt

[Data type] 2-word
[Valid data range] 0 to 255

These parameters set the custom macro interrupt valid/invalid M codes.

> **NOTE**
> These parameters can be used when bit 4 (MPR) of parameter No.6003 is set to 1. M96 is used as a valid M code and M97 is used as an invalid M code when bit 4 (MPR) of parameter No.6003 is set to 0, irrespective of the state of these parameters.

6036	Number of custom macro variables common with two paths (#100's)

[Data type] Word

[Unit of data] Number of custom macro variables

[Valid data range] 0 to 100

This parameter specifies the number of variables commonly used for both paths 1 and 2 (custom macro variables common with two paths) that are included in custom macro variables #100 to #149 (#199).

The custom macro variables common with two paths can be written from or read into either of the paths.

[Example] When this parameter is set to 10, the custom macro variables are specified as follows:

Custom macro variables #100 to #109:
Used commonly between two paths

Custom macro variables #110 to #149 (#199):
Used independently for each path

NOTE
1 This parameter is dedicated to the 2-path control.
2 When this parameter is set to 0, custom macro variables #100 to #149 (#199) are not used commonly between two paths.

6037	Number of custom macro variables common with two paths (#500's)

[Data type] Word

[Unit of data] Number of custom macro variables

[Valid data range] 0 to 500

This parameter specifies the number of variables commonly used for both paths 1 and 2 (custom macro variables common with two paths) that are included in custom macro variables #100 to #531 (#999).

The custom macro variables common with two paths can be written from or read into either of the paths.

[Example] When this parameter is set to 10, the custom macro variables are specified as follows:

Custom macro variables #500 to #509:
Used commonly between two paths

Custom macro variables #510 to #531 #(999):
Used independently for each path

NOTE
1 This parameter is dedicated to the 2-path control.
2 When this parameter is set to 0, custom macro variables #500 to #531 (#999) are not used commonly between two paths.

6050	G code that calls the custom macro of program number 9010
6051	G code that calls the custom macro of program number 9011
6052	G code that calls the custom macro of program number 9012
6053	G code that calls the custom macro of program number 9013
6054	G code that calls the custom macro of program number 9014
6055	G code that calls the custom macro of program number 9015
6056	G code that calls the custom macro of program number 9016
6057	G code that calls the custom macro of program number 9017
6058	G code that calls the custom macro of program number 9018
6059	G code that calls the custom macro of program number 9019

[Data type] Word

[Valid data range] 1 to 999

These parameters set the G codes that call the custom macros of program numbers 9010 through 9019.

> **NOTE**
> Setting value 0 is invalid. No custom macro can be called by G00.

6071	M code that calls the subprogram of program number 9001
6072	M code that calls the subprogram of program number 9002
6073	M code that calls the subprogram of program number 9003
6074	M code that calls the subprogram of program number 9004
6075	M code that calls the subprogram of program number 9005
6076	M code that calls the subprogram of program number 9006
6077	M code that calls the subprogram of program number 9007
6078	M code that calls the subprogram of program number 9008
6079	M code that calls the subprogram of program number 9009

[Data type] 2-word

[Valid data range] 1 to 99999999

These parameters set the M codes that call the subprograms of program numbers 9001 through 9009.

> **NOTE**
> Setting value 0 is invalid. No subprogram can be called by M00.

6080	M code that calls the custom macro of program number 9020
6081	M code that calls the custom macro of program number 9021
6082	M code that calls the custom macro of program number 9022
6083	M code that calls the custom macro of program number 9023
6084	M code that calls the custom macro of program number 9024
6085	M code that calls the custom macro of program number 9025
6086	M code that calls the custom macro of program number 9026
6087	M code that calls the custom macro of program number 9027
6088	M code that calls the custom macro of program number 9028
6089	M code that calls the custom macro of program number 9029

[Data type] 2-word
[Valid data range] 1 to 99999999

These parameters set the M codes that call the custom macros of program numbers 9020 through 9029.

> **NOTE**
> Setting value 0 is invalid. No custom macro can be called by M00.

6090	ASCII code that calls the subprogram of program number 9004
6091	ASCII code that calls the subprogram of program number 9005

[Data type] Byte
[Valid data range] 65 (A:41H) to 90 (Z:5AH)

These parameters set the ASCII codes that call subprograms in decimal.
Addresses that can be used are as follows:
T series : A, B, F, H, I, K, M, P, Q, R, S, T
M series: A, B, D, F, H, I, J, K, L, M, P, Q, R, S, T, X, Y, Z

> **NOTE**
> 1 When these parameters are set, the power must be turned off before operation is continued.
> 2 Set 0 when no subprogram is called

4.39 PARAMETERS OF ONE TOUCH MACRO

6095	Number of programs used for one touch macro calls

[Data type] Byte
[Unit of data] Number of programs
[Valid data range] 0 to 16

This parameter specifies the number of programs used for one touch macro calls. When 3 is set, for example, three programs can be called. In this case, the three signals, MCST1, MCST2, and MCST3, among MCST1 through MCST16 are enabled as the macro call activation signals for calling the programs. If this parameter is set to 0, this function is disabled.

6096	Number of the first program of programs used for one touch macro calls

[Data type] Word
[Unit of data] Number
[Valid data range] 1 to 9999

Register the O number of the first program used for one touch macro calls. When 9000 is set, for example, the relationship between the macro call activation signals (MCSTx) and program numbers activated by the signals is as follows:

MCST1 signal : Activates O9000
(when the value of parameter No. 6095 is 1 or greater).
MCST2 signal : Activates O9001
(when the value of parameter No. 6095 is 2 or greater).
MCST3 signal : Activates O9002
(when the value of parameter No. 6095 is 3 or greater).
:
MCST15 signal : Activates O9014
(when the value of parameter No. 6095 is 15 or greater).
MCST16 signal : Activates O9015
(when the value of parameter No. 6095 is 16).

6097	Start address of signals used for one touch macro calls

[Data type] Word
[Unit of data] Number
[Valid data range] 0 to 65535

This parameter specifies the start address of signals (such as the macro call activation signal MCSTx) used for one touch macro calls. When 500 is set, for example, R500 through R506 are used as signals for one touch macro calls.
If a nonexistent number is set, this function is disabled.

4.40 PARAMETERS OF PATTERN DATA INPUT

6101	First variable number displayed on pattern data screen 1
6102	First variable number displayed on pattern data screen 2
6103	First variable number displayed on pattern data screen 3
6104	First variable number displayed on pattern data screen 4
6105	First variable number displayed on pattern data screen 5
6106	First variable number displayed on pattern data screen 6
6107	First variable number displayed on pattern data screen 7
6108	First variable number displayed on pattern data screen 8
6109	First variable number displayed on pattern data screen 9
6110	First variable number displayed on pattern data screen 10

[Data type] Word

[Valid data range] 0, 100 to 199, 500 to 999

These parameters specify the first variable number displayed on the pattern data screen selected from the pattern menu screen. When 0 is set, 500 is assumed.

4.41 PARAMETERS OF POSITIONING BY OPTIMAL ACCELERATION

	#7	#6	#5	#4	#3	#2	#1	#0
6131							EOA	OAD

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit axis

OAD The function for positioning by optimal acceleration is:
0 : Not used.
1 : Used.

EOA For a movement along the PMC axis, the function for positioning by optimal acceleration is:
0 : Disabled.
1 : Enabled.
Bit 0 (OAD) of parameter No. 6131 must also be set to 1.

	#7	#6	#5	#4	#3	#2	#1	#0
6132								ILP

[Data type] Bit

ILP For the function for positioning by optimal acceleration, loop gain switching is:
0 : Performed.
1 : Not performed.

6136	Distance D1 to the first stage of positioning by optimal acceleration for each axis
6137	Distance D2 to the second stage of positioning by optimal acceleration for each axis
6138	Distance D3 to the third stage of positioning by optimal acceleration for each axis

[Data type] 2-word axis

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric input	0.01	0.001	0.0001	mm
Inch input	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] 0 to 99999999

These parameters set the distances to the first to third stages of positioning by optimal acceleration for each axis.

Set the positioning distances used when the function for 4-stage switching of the rapid traverse rate, time constant, and loop gain based on positioning distance is used.

NOTE

About parameter No. 6136 to No. 6138

1 When these parameters are set, D1 < D2 < D3 must be satisfied.
2 Up to four stages of switching are possible. When using up to the third stage, for example, set D3=99999999.
3 Use a diameter value to set an axis for diameter programming. When 10.000 mm is set in a parameter above for an axis for diameter programming, switching is performed on a boundary where a diameter value of 10.000 mm has been moved.
4 If both of these parameters (4-stage switching for each axis) and parameter No. 6141 and No. 6156 (7-stage switching applicable to all axes) are set, the former parameters have priority.

6141	Distance D1 for level 1 (metric input)
6142	Distance D2 for level 2 (metric input)
6143	Distance D3 for level 3 (metric input)
6144	Distance D4 for level 4 (metric input)
6145	Distance D5 for level 5 (metric input)
6146	Distance D6 for level 6 (metric input)

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Linear axis (inch input)	0.01	0.001	0.0001	mm
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] 0 to 99999999

These parameters set the positioning distances used when the function for adjusting the rapid traverse rate, time constant, and loop gain to one of seven levels according to the positioning distance is used. (The settings are common to all axes.)

6151	Distance D1 to the first stage (for inch input)
6152	Distance D2 to the second stage (for inch input)
6153	Distance D3 to the third stage (for inch input)
6154	Distance D4 to the fourth stage (for inch input)
6155	Distance D5 to the fifth stage (for inch input)
6156	Distance D6 to the sixth stage (for inch input)

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Linear axis (inch input)	0.001	0.0001	0.00001	mm
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] 0 to 99999999

These parameters set positioning distances when the function for 7-stage switching of the rapid traverse rate, time constant, and loop gain based on positioning distance is used. (These parameters are common to all axes.)

NOTE

About parameter No. 6141 to No. 6156

1. When these parameters are set, D1 < D2 < D3 < D4 < D5 < D6 must be satisfied.
2. Up to seven stages of switching are possible. When using up to the fourth stage, for example, set D4=99999999.
3. Use a diameter value to set an axis for diameter programming. When 10.000 mm is set in a parameter above for an axis for diameter programming, switching is performed on a boundary where a diameter value of 10.000 mm has been moved.
4. Set a distance for each axis in each of these parameters. These parameters do not specify a block length. When G00 X10. Z10.; is specified, the block length is 14.142 mm, but distance determination is performed by comparing the specified value (10.000 mm) for each axis with these parameters.
5. If both of these parameters (7-stage switching applicable to all axes) and parameter No. 6136 to No. 6138 (4-stage switching for each axis) are set, parameter No. 6136 to No. 6138 (4-stage switching for each axis) have priority. (For axes for which parameter No. 6136 to No. 6138 (4-stage switching for each axis) are not specified, parameter No. 6141 to No. 6156 are valid.)

6161	First-stage rapid traverse rate
6162	Second-stage rapid traverse rate
6163	Third-stage rapid traverse rate
6164	Fourth-stage rapid traverse rate
6165	Fifth-stage rapid traverse rate
6166	Sixth-stage rapid traverse rate
6167	Seventh-stage rapid traverse rate

[Data type] 2-word axis
[Unit of data, valid data range]

Input increment	Units of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	30 to 240000	30 to 100000
Inch machine	0.1 inch/min	30 to 96000	30 to 48000
Rotary axis	1 deg/min	30 to 240000	30 to 100000

Specify rapid traverse rates for each axis.

6171	First-stage rapid traverse time constant
6172	Second-stage rapid traverse time constant
6173	Third-stage rapid traverse time constant
6174	Fourth-stage rapid traverse time constant
6175	Fifth-stage rapid traverse time constant
6176	Sixth-stage rapid traverse time constant
6177	Seventh-stage rapid traverse time constant

[Data type] Word axis
[Unit of data] msec
[Valid data range] 8 to 4000
Specify rapid traverse time constants for each axis.

6181	First-stage rapid traverse servo loop gain
6182	Second-stage rapid traverse servo loop gain
6183	Third-stage rapid traverse servo loop gain
6184	Fourth-stage rapid traverse servo loop gain
6185	Fifth-stage rapid traverse servo loop gain
6186	Sixth-stage rapid traverse servo loop gain
6187	Seventh-stage rapid traverse servo loop gain

[Data type] Word axis
[Unit of data] 0.01 s^{-1}
[Valid data range] 1 to 9999

Specify rapid traverse servo loop gains for each axis.

6191	Time constant T2 for bell-shaped acceleration/deceleration for first-stage rapid traverse during positioning by optimal acceleration
6192	Time constant T2 for bell-shaped acceleration/deceleration for second-stage rapid traverse during positioning by optimal acceleration
6193	Time constant T2 for bell-shaped acceleration/deceleration for third-stage rapid traverse during positioning by optimal acceleration
6194	Time constant T2 for bell-shaped acceleration/deceleration for fourth-stage rapid traverse during positioning by optimal acceleration
6195	Time constant T2 for bell-shaped acceleration/deceleration for fifth-stage rapid traverse during positioning by optimal acceleration
6196	Time constant T2 for bell-shaped acceleration/deceleration for sixth-stage rapid traverse during positioning by optimal acceleration
6197	Time constant T2 for bell-shaped acceleration/deceleration for seventh-stage rapid traverse during positioning by optimal acceleration

[Data type] Word axis
[Unit of data] msec
[Valid data range] 0 to 512

These parameters set time constant T2 for bell-shaped acceleration/ deceleration for the rapid traverse in each stage of positioning by optimal acceleration for each axis.

4.42 PARAMETERS OF SKIP FUNCTION

	#7	#6	#5	#4	#3	#2	#1	#0
6200	SKF	SRE	SLS	HSS	MIT		SK0	GSK
	SKF	SRE	SLS	HSS			SK0	

[Data type] Bit

GSK In skip cutting (G31), the skip signal SKIPP <G006#6> is:
- 0 : Not used as a skip signal.
- 1 : Used as a skip signal.

SK0 This parameter specifies whether the skip signal is made valid under the state of the skip signal SKIP <X004#7> and the multi-step skip signals <X004#0 to #7> (for the T series only).
- 0 : Skip signal is valid when these signals are 1.
- 1 : Skip signal is valid when these signals are 0.

MIT In skip cutting (G31), the tool compensation measurement value direct input B signals +MIT1, -MIT1, +MIT2, and -MIT2 <X004#2 to #5> are :
- 0 : Not used as skip signals.
- 1 : Used as skip signals.

HSS
- 0 : The skip function does not use high-speed skip signals.
- 1 : The skip function uses high-speed skip signals.

SLS
- 0 The multi-step skip function does not use high-speed skip signals while skip signals are input.
- 1 : The multi-step skip function uses high-speed skip signals while skip signals are input.

SRE When a high-speed skip signal is used:
- 0 : The signal is considered to be input at the rising edge (0 → 1).
- 1 : The signal is considered to be input at the falling edge (1 → 0).

SKF Dry run, override, and automatic acceleration/deceleration for G31 skip command
- 0 : Disabled
- 1 : Enabled

	#7	#6	#5	#4	#3	#2	#1	#0
6201	SPE			IGX	TSA	TSE	SEB	SEA
	SPE		CSE	IGX	TSA	TSE	SEB	SEA

[Data type] Bit

SEA When a high-speed skip signal goes on while the skip function is used, acceleration/deceleration and servo delay are:
- 0 : Ignored.
- 1 : Considered and compensated (type A).

SEB When a high-speed skip signal goes on while the skip function is used, acceleration/deceleration and servo delay are:
0 : Ignored.
1 : Considered and compensated (type B).

> **NOTE**
> There are two types of compensation: Types A and B. With the skip function, the current position is stored in the CNC according to the skip signal. However, the current position stored in the CNC contains servo delay. The machine position is therefore deviated by the servo delay. The deviation can be obtained from the position deviation of the servo and the error generated due to feedrate acceleration/deceleration performed by the CNC. If the deviation can be compensated, it is not necessary to include the servo delay in measurement errors. The deviation can be compensated with the following two types by the parameter as follows:
> (1) Type A: The deviation is the value calculated from the cutting time constant and servo time constant (loop gain).
> (2) Type B: The deviation is the error due to acceleration/deceleration and the position deviation when the skip signal goes on.

TSE When the torque limit skip function (G31 P99/98) is used, the skip position held in a system variable is:
0 : Position that is offset considering the delay (positional deviation) incurred by the servo system.
1 : Position that does not reflect the delay incurred by the servo system.

> **NOTE**
> The torque limit skip function stores the current position in the CNC when the torque limit arrival signal is turned on. However, the current position in the CNC includes a servo system delay, so that the position is shifted from the machine position by an amount corresponding to the servo system delay. The value of this shift can be determined from the servo system positional deviation. When TSE is set to 0, a skip position is determined by subtracting the positional deviation from the current position. When TSE is set to 1, the current position (including the servo system delay) is used as the skip position, without considering any shift or position deviation.

TSA When the torque limit skip function (G31 P99/98) is used, torque limit arrival monitoring is performed for:
- 0 : All axes.
- 1 : Only those axes that are specified in the block containing the G31 command.

IGX When the high-speed skip function is used, SKIP <X004#7>, SKIPP <G006#6>, and +MIT1 to -MIT2 <X004#2 to #5> are:
- 0 : Enabled as skip signals.
- 1 : Disabled as skip signals.

NOTE

1 SKIPP <G006#6> and +MIT1 to -MIT2 <X004#2 to #5> are enabled only when bit 0 (GSK) of parameter No. 6200 is set to 1 and bit 3 (MIT) of parameter No. 6200 is set to 1. Note also that these signals are enabled only for the T series.

2 The skip signals for the multi-step skip function (SKIP, SKIP2 to SKIP8) can also be disabled.

CSE For continuous high-speed skip command G31 P90, high-speed skip signals are :
- 0 : Effective at either a rising or falling edge (depending on the setting of bit 6 (SRE) of parameter No. 6200)
- 1 : Effective for both the rising and falling edges

SPE For the skip function (G31), the skip signal <X004#7> is:
- 0 : Disabled.
- 1 : Enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
6202	1S8	1S7	1S6	1S5	1S4	1S3	1S2	1S1

	#7	#6	#5	#4	#3	#2	#1	#0
6203	2S8	2S7	2S6	2S5	2S4	2S3	2S2	2S1

	#7	#6	#5	#4	#3	#2	#1	#0
6204	3S8	3S7	3S6	3S5	3S4	3S3	3S2	3S1

	#7	#6	#5	#4	#3	#2	#1	#0
6205	4S8	4S7	4S6	4S5	4S4	4S3	4S2	4S1

	#7	#6	#5	#4	#3	#2	#1	#0
6206	DS8	DS7	DS6	DS5	DS4	DS3	DS2	DS1

[Data type] Bit

1S1 to 1S8 Specify which high-speed skip signal is enabled when the G31 skip command is issued. The bits correspond to the following signals:

1S1	HDI0
1S2	HDI1
1S3	HDI2
1S4	HDI3
1S5	HDI4
1S6	HDI5
1S7	HDI6
1S8	HDI7

1S1 to 1S8, 2S1 to 2S8, 3S1 to 3S8, 4S1 to 4S8, DS1 to DS8

Specify which skip signal is enabled when the skip command (G31, or G31P1 to G31P4) and the dwell command (G04, G04Q1 to G04Q4) are issued with the multi-step skip function.

The following table shows the correspondence between the bits, input signals, and commands.

The setting of the bits have the following meaning :

0 : The skip signal corresponding to the bit is disabled.

1 : The skip signal corresponding to the bit is enabled.

High-speed skip function		Multi-step skip function					
Command / Input signal	G31	Command / Input signal	G31 G31P1 G04Q1	G31P2 G04Q2	G31P2 G04Q2	G31P4 G04Q4	G04
HDI0	1S1	SKIP/HDI0	1S1	2S1	3S1	4S1	DS1
HDI1	1S2	SKIP2/HDI1	1S2	2S2	3S2	4S2	DS2
HDI2	1S3	SKIP3/HDI2	1S3	2S3	3S3	4S3	DS3
HDI3	1S4	SKIP4/HDI3	1S4	2S4	3S4	4S4	DS4
HDI4	1S5	SKIP5/HDI4	1S5	2S5	3S5	4S5	DS5
HDI5	1S6	SKIP6/HDI5	1S6	2S6	3S6	4S6	DS6
HDI6	1S7	SKIP7/HDI6	1S7	2S7	3S7	4S7	DS7
HDI7	1S8	SKIP8/HDI7	1S8	2S8	3S8	4S8	DS8

NOTE
HDI0 to HDI7 are high-speed skip signals.

	#7	#6	#5	#4	#3	#2	#1	#0
6208								
	9S8	9S7	9S6	9S5	9S4	9S3	9S2	9S1

[Data type] Bit

9S1 to 9S8 Specify which high-speed skip signal to be enabled for the continuous high-speed skip command G31P90 or the EGB skip command G31.8.
The bits correspond to signals as follows:

9S1	HDI0
9S2	HDI1
9S3	HDI2
9S4	HDI3
9S5	HDI4
9S6	HDI5
9S7	HDI6
9S8	HDI7

Set each bit as follows:
0 : The corresponding skip signal is invalid.
1 : The corresponding skip signal is valid.

	#7	#6	#5	#4	#3	#2	#1	#0
6210							ROS	
				ASB	ASL		ROS	CS3

[Data type] Bit

CS3 As the continuous high-speed skip command:
0 : G31 P90 is used.
1 : G31.9 is used.
With G31 P90, when a high-speed skip signal is input, the absolute coordinates are stored in custom macro variables #5061 through #5068. When the next high-speed skip signal is input, these variables are updated. With G31.9, when a high-speed skip signal is input, the absolute coordinates are sequentially stored in the custom macro variables specified in the G31.9 block.

ROS When the skip position goes beyond the roll-over range, the values of system variables #5061 through #5068 indicating the skip signal position:
0 : Are not rolled over.
1 : Are rolled over similar to the absolute coordinates.

ASB, ASL These bits set the type of and time constant for acceleration/deceleration after interpolation for the skip function in the advanced preview control/AI contour control mode as indicated in the table below.

ASB	ASL	Type of acceleration/ deceleration	Parameter No. for time constant
0	1	Linear type	Parameter No. 6280 (When 0 is set, parameter No. 1769 (1768) is used.)
1	—	Bell-shaped	
0	0	This function is disabled. (See NOTE.)	

Let T be a time constant. When bell-shaped acceleration/deceleration is specified, T1 = T/2 and T2 = T/2 as in the case of ordinary bell-shaped acceleration/deceleration after interpolation in cutting feed, resulting in acceleration/deceleration with no linear portion.

NOTE

When ASB = 0 and ASL = 0, the acceleration/deceleration type set by bit 3 (BS2) of parameter No. 1602 or bit 6 (LS2) of parameter No. 1602, and the time constants set by parameter No. 1762, No. 1768, or No. 1769 are valid.

	#7	#6	#5	#4	#3	#2	#1	#0
6215								CSTx

[Data type] Bit axis

CSTx For the Cs contour controlled axis, the torque limit skip function is:

0 : Disabled.

1 : Enabled.

Torque limit skip operation is performed for the Cs counter controlled axis by using the serial spindle torque limit command signal TLMH<G070, G074, G204, G266> and the load detection signal LDT1<F045, F049, F196, F266>.

> **NOTE**
> When this parameter is set to perform torque limit skip operation for a Cs counter controlled axis, note the following:
> 1 For the Cs contour controlled axis (spindle) that uses the torque limit skip function, set bit 4 of serial spindle parameter No. 4009 to 1 so that load detection signals are output even during acceleration/deceleration.
> 2 If the disturbance torque detection state (LDT1 = 1) is set when the torque limit command is specified (TLMH1 = 1) in the Cs mode, no excessive error check at stop is performed for the axis.
> 3 If the disturbance torque detection state (LDT1 = 1) is set in the Cs mode, no in-position check is made for the axis.

6220	Period during which input is ignored for continuous high-speed skip signal

[Data type] Byte

[Unit of data] 8 msec

[Valid data range] 3 to 127 (× 8 msec)

This parameter specifies the period that must elapse between a high-speed skip signal being input and input of the next high-speed skip signal being enabled, for the continuous high-speed skip function. This parameter is used to ignore chattering in skip signals.

> **NOTE**
> If a value that falls outside the range is specified, 3 (24 msec) is assumed.

6221	Time period for which skip operation is not performed after specification of torque limit skip

[Data type] Word

[Unit of data] msec

[Valid data range] 0 to 65535

This parameter sets a period of time from the specification of torque limit skip until skip operation is enabled. During a set period of time, skip operation is not performed.

4.43 PARAMETERS OF AUTOMATIC TOOL OFFSET (T SERIES) AND AUTOMATIC TOOL LENGTH MEASUREMENT (M SERIES)

	#7	#6	#5	#4	#3	#2	#1	#0
6240								AE0

[Data type] Bit

AE0 Measurement position arrival is assumed when the automatic tool offset signals XAE and ZAE <X004#0 and #1> (T series) or the automatic tool length measurement signals XAE, YAE, and ZAE <X004#0, #1, and #2> (M series) are:

0 : 1

1 : 0

6241	Feedrate during measurement of automatic tool offset
	Feedrate during measurement of automatic tool length measurement

[Data type] Word

[Unit of data, valid data range]

Input increment	Units of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800

This parameter sets the feedrate during measurement of automatic tool offset (T series) and automatic tool length measurement (M series).

6251	γ value on X axis during automatic tool offset
	γ value during automatic tool length measurement

6252	γ value on Z axis during automatic tool offset

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric input	0.01	0.001	0.0001	mm
Inch input	0.001	0.0001	0.00001	inch

[Valid data range] 1 to 99999999

These parameters set the e value during automatic tool offset (T series) automatic tool length measurement (M series).

> **NOTE**
> Set a radius value irrespective of whether the diameter programming or the radius programming is specified.

6254	ε value on X axis during automatic tool offset
	ε value during automatic tool length measurement

6255	ε value on Z axis during automatic tool offset

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric input	0.01	0.001	0.0001	mm
Inch input	0.001	0.0001	0.00001	inch

[Valid data range] 1 to 99999999

These parameters set the e value during automatic tool offset (T series) or automatic tool length measurement (M series).

> **NOTE**
> Set a radius value irrespective of whether the diameter programming or the radius programming is specified.

6280	Time constant for acceleration/deceleration after interpolation for the skip function for each axis in the advanced preview control/AI Cs contour control mode

[Data type] Word axis

[Unit of data] msec

[Valid data range] 0 to 512

This parameter sets a time constant for acceleration/deceleration after interpolation for the skip function for each axis in the advanced preview control/AI Cs contour control mode.

This parameter is valid when bit 3 (ASL) of parameter No. 6210 or bit 4 (ASB) of parameter No. 6210 is set to 1. (See the descriptions of bit 3 (ASL) and bit 4 (ASB) of parameter No. 6210.)

If 0 is set in this parameter, the setting of parameter No. 1769 is used. If 0 is set in parameter No. 1769 as well, the setting of parameter No. 1768 is used.

4.44 PARAMETERS OF EXTERNAL DATA INPUT

	#7	#6	#5	#4	#3	#2	#1	#0
6300	EEX			ESR	ESC			

[Data type] Bit

ESC When a reset is input between input of the external data input read signal ESTB <G002#7> and execution of a search, the external program number search function:
0 : Performs a search.
1 : Does not perform a search.

ESR External program number search
0 : Disabled
1 : Enabled

EEX PMC EXIN function
0 : Conventional specifications
1 : Extended specifications
If you want to handle data unavailable with the PMC/EXIN command according to the conventional specifications, such as an 8-digit program number, in an external program number search, set this bit to 1.
To use this function for multi-path control, the setting for the first path (main) is used. The EXIN specifications cannot be changed for each path. For details of EXIN and how to change ladder software, refer to the PMC specifications and other manuals.

6310	Number of external operator messages for which message numbers are increased by adding a value

[Data type] Word
[Valid data range] 0, 1 to 1000

For each of external operator messages as many as the number set in this parameter, a message number increased by adding 2000 is displayed.

NOTE
1 When this parameter is set, the power must be turned off before operation is continued.
2 This parameter is invalid if 0 or a value not within the valid data range is set in this parameter.

4.45 PARAMETERS OF FINE TORQUE SENSING

	#7	#6	#5	#4	#3	#2	#1	#0
6350	FTS			FTA	FTP	FTM	TQ2	TQ1

[Data type] Bit

TQ2, TQ1 These parameters set the buffering interval for the fine torque sensing function.

TQ2	TQ1	Interval
0	0	8 msec
0	1	16 msec
1	0	32 msec
1	1	Disabled

FTM By the fine torque sensing function, model machining is:
0 : Not monitored.
1 : Monitored.

FTP By the fine torque sensing function, absolute coordinates are:
0 : Not monitored.
1 : Monitored.

FTA The detection level in the torque monitor screen is:
0 : Not associated with the threshold value for an unexpected disturbance torque detection alarm (parameter No. 2104 (servo) or No. 4341 (spindle)).
1 : Associated with it.
When this bit is set to 1 and soft key [END] is pressed after the detection level is changed on the torque monitor screen, the detection level is reflected in parameter No. 2104 or No. 4341.

FTS As spindle data for fine torque sensing:
0 : Disturbance load torque data is used.
1 : All torque data (data for the load meter) is used.

6360	Target axis 1 for fine torque sensing
6361	Target axis 2 for fine torque sensing
6362	Target axis 3 for fine torque sensing
6363	Target axis 4 for fine torque sensing

[Data type] Byte

[Valid data range] -4 to 8

These parameters set the numbers of target controlled axes for fine torque sensing.

Set 1 to 8 for a servo axis and -1 to -4 for a spindle axis.

If a value of 0 is set for target axis 1, no fine torque sensing is performed.

When the number of target axes is N, use parameters for target axes 1 to N.

[Example]

Parameter	Setting
Target axis 1	1
Target axis 2	2
Target axis 3	0
Target axis 4	3

According to the above settings, sensing is performed only for the first and second axes, and is not performed for the third axis.

4.46 PARAMETERS OF MANUAL HANDLE RETRACE

	#7	#6	#5	#4	#3	#2	#1	#0
6400	MG4	MGO	RVN	HMP	HM8	HM5	HFW	HRP

[Data type] Bit

HRP With the manual handle retrace function, the rapid traverse rate is clamped, assuming that:
0 : An override of 10% is used.
1 : An override of 100% is used.
(See the description of parameter No. 6405 as well.)

HFW With the manual handle retrace function, program execution can be performed:
0 : In both forward and backward directions.
1 : Only in the forward direction.

HM8, HM5

HM8	HM5	M code group setting
0	0	Standard (20 groups of four)
0	1	16 groups of five
1	0	10 groups of eight

These parameters set the number of M code groups and the number of M codes in each group.
(See explanations of parameters Nos. 6411 to 6490.)
When 16 groups of five are used, the meanings of parameters are changed as follows:
Group A No.6411(1) to No.6415(5)
Group B No.6416(1) to No.6420(5)
:
Group P No.6486(1) to No.6490(5)
When 10 groups of eight are used, they are changed as follows:
Group A No.6411(1) to No.6418(8)
Group B No.6419(1) to No.6426(8)
:
Group J No.6483(1) to No.6490(8)

HMP When reverse or backward movement is disabled for a path:
0 : Reverse or backward movement is not disabled for other paths.
1 : Reverse or backward movement is also disabled for other paths.

RVN When the manual handle retrace function is used, M codes other than grouped M codes:
0 : Do not disable backward movement.
1 : Disable backward movement.

> **NOTE**
> When this parameter is set to 1, M codes other than grouped M codes disable backward movement in general. Exceptionally, however, the following M codes allow backward movement:
> - Subprogram call based on M98/M99
> - Subprogram call based on an M code
> - Macro call based on an M code
> - Waiting M code

MGO When the manual handle retrace function is used, handle pulses during execution of a G code related to measurement are:
0 : Valid.
1 : Invalid. A speed with an override of 100% is used for execution at all times.

MG4 When the manual handle retrace function is used, a block where G04 enabling multi-step skip:
0 : Does not disable backward movement.
1 : Disables backward movement.

	#7	#6	#5	#4	#3	#2	#1	#0
6401	STO	HST						ADC

[Data type] Bit

ADC If a move command and an auxiliary function (M/S/T/B code) are specified in the same block when the manual handle retrace function is used, the block:
0 : Does not disable reverse movement.
1 : Disables reverse movement.

HST When the manual handle retrace function is used, the time display field on the status display line of the CNC screen:
0 : Does not display status.
1 : Displays status.

STO If a move command and S code or T code are specified in the same block when the manual handle retrace function is used, the output timings of those codes in forward movement and backward movement are:
0 : Different.
1 : Same.

6405	**Override value for clamping the rapid traverse rate used with the manual handle retrace function**

[Data type] Byte
[Unit of data] %
[Valid data range] 0 to 100

This parameter sets an override value for clamping the rapid traverse rate used with the manual handle retrace function. If a value greater than 100 is set in this parameter, the rapid traverse rate is clamped to an override of 100%. This parameter is invalid if 0 is set in this parameter. In this case, the setting of bit 0 (HRP) of parameter No. 6400 is used.

6410	**Travel distance per pulse generated from the manual pulse generator for the manual handle retrace function**

[Data type] Byte
[Unit of data] %
[Valid data range] 0 to 100

This parameter sets the travel distance per pulse generated from the manual pulse generator for the manual handle retrace function.
The distance traveled by the machine when the manual handle is actually turned can be found by the following expression:

$$\text{Specified speed} \times \text{Number of handle pulses per second} \times \text{Handle magnification} \times \frac{\text{Setting of this parameter}}{100} \times \frac{8}{1000}$$

6411	M code (1) in group A for backward movement by the manual handle retrace function
6412	M code (2) in group A for backward movement by the manual handle retrace function
6413	M code (3) in group A for backward movement by the manual handle retrace function
6414	M code (4) in group A for backward movement by the manual handle retrace function
6415	M code (1) in group B for backward movement by the manual handle retrace function
6416	M code (2) in group B for backward movement by the manual handle retrace function
6417	M code (3) in group B for backward movement by the manual handle retrace function
6418	M code (4) in group B for backward movement by the manual handle retrace function
6419	M code (1) in group C for backward movement by the manual handle retrace function
6420	M code (2) in group C for backward movement by the manual handle retrace function
6421	M code (3) in group C for backward movement by the manual handle retrace function
6422	M code (4) in group C for backward movement by the manual handle retrace function
6423	M code (1) in group D for backward movement by the manual handle retrace function
6424	M code (2) in group D for backward movement by the manual handle retrace function
6425	M code (3) in group D for backward movement by the manual handle retrace function
6426	M code (4) in group D for backward movement by the manual handle retrace function
6427	M code (1) in group E for backward movement by the manual handle retrace function
6428	M code (2) in group E for backward movement by the manual handle retrace function

6429	M code (3) in group E for backward movement by the manual handle retrace function
6430	M code (4) in group E for backward movement by the manual handle retrace function
6431	M code (1) in group F for backward movement by the manual handle retrace function
6432	M code (2) in group F for backward movement by the manual handle retrace function
6433	M code (3) in group F for backward movement by the manual handle retrace function
6434	M code (4) in group F for backward movement by the manual handle retrace function
6435	M code (1) in group G for backward movement by the manual handle retrace function
6436	M code (2) in group G for backward movement by the manual handle retrace function
6437	M code (3) in group G for backward movement by the manual handle retrace function
6438	M code (4) in group G for backward movement by the manual handle retrace function
6439	M code (1) in group H for backward movement by the manual handle retrace function
6440	M code (2) in group H for backward movement by the manual handle retrace function
6441	M code (3) in group H for backward movement by the manual handle retrace function
6442	M code (4) in group H for backward movement by the manual handle retrace function
6443	M code (1) in group I for backward movement by the manual handle retrace function
6444	M code (2) in group I for backward movement by the manual handle retrace function
6445	M code (3) in group I for backward movement by the manual handle retrace function
6446	M code (4) in group I for backward movement by the manual handle retrace function

6447	M code (1) in group J for backward movement by the manual handle retrace function
6448	M code (2) in group J for backward movement by the manual handle retrace function
6449	M code (3) in group J for backward movement by the manual handle retrace function
6450	M code (4) in group J for backward movement by the manual handle retrace function
6451	M code (1) in group K for backward movement by the manual handle retrace function
6452	M code (2) in group K for backward movement by the manual handle retrace function
6453	M code (3) in group K for backward movement by the manual handle retrace function
6454	M code (4) in group K for backward movement by the manual handle retrace function
6455	M code (1) in group L for backward movement by the manual handle retrace function
6456	M code (2) in group L for backward movement by the manual handle retrace function
6457	M code (3) in group L for backward movement by the manual handle retrace function
6458	M code (4) in group L for backward movement by the manual handle retrace function
6459	M code (1) in group M for backward movement by the manual handle retrace function
6460	M code (2) in group M for backward movement by the manual handle retrace function
6461	M code (3) in group M for backward movement by the manual handle retrace function
6462	M code (4) in group M for backward movement by the manual handle retrace function
6463	M code (1) in group N for backward movement by the manual handle retrace function
6464	M code (2) in group N for backward movement by the manual handle retrace function

6465	M code (3) in group N for backward movement by the manual handle retrace function
6466	M code (4) in group N for backward movement by the manual handle retrace function
6467	M code (1) in group O for backward movement by the manual handle retrace function
6468	M code (2) in group O for backward movement by the manual handle retrace function
6469	M code (3) in group O for backward movement by the manual handle retrace function
6470	M code (4) in group O for backward movement by the manual handle retrace function
6471	M code (1) in group P for backward movement by the manual handle retrace function
6472	M code (2) in group P for backward movement by the manual handle retrace function
6473	M code (3) in group P for backward movement by the manual handle retrace function
6474	M code (4) in group P for backward movement by the manual handle retrace function
6475	M code (1) in group Q for backward movement by the manual handle retrace function
6476	M code (2) in group Q for backward movement by the manual handle retrace function
6477	M code (3) in group Q for backward movement by the manual handle retrace function
6478	M code (4) in group Q for backward movement by the manual handle retrace function
6479	M code (1) in group R for backward movement by the manual handle retrace function
6480	M code (2) in group R for backward movement by the manual handle retrace function
6481	M code (3) in group R for backward movement by the manual handle retrace function
6482	M code (4) in group R for backward movement by the manual handle retrace function

6483	M code (1) in group S for backward movement by the manual handle retrace function
6484	M code (2) in group S for backward movement by the manual handle retrace function
6485	M code (3) in group S for backward movement by the manual handle retrace function
6486	M code (4) in group S for backward movement by the manual handle retrace function
6487	M code (1) in group T for backward movement by the manual handle retrace function
6488	M code (2) in group T for backward movement by the manual handle retrace function
6489	M code (3) in group T for backward movement by the manual handle retrace function
6490	M code (4) in group T for backward movement by the manual handle retrace function

[Data type] Word

[Unit of data] 0 to 9999

These parameters set the M codes in each group for backward movement by the manual handle retrace function.

For backward movement for an M code, the modal M code in the same group set by the parameter is output. The first M code in each group is set as the default at a reset.

When the number of M codes in a group is 3 or less, set the parameter corresponding to an unused M code to 0.

(For backward movement for "M0", "M0" is output regardless of which M code is set for the parameter.)

For an M code which is not set in any group by any of the above parameters, the M code for forward movement is output.

With these parameters, an M code in the same group can be output in backward movement only when the M code is the first M code in each block. When a block contains two or more M codes, the same M codes as output in forward movement are output as a second M code and up.

NOTE

The names of the above parameters Nos. 6411 to 6490 indicate those when 20 groups of four M codes are used for convenience of explanation. The actual numbers of groups and of M codes in each group are determined according to the settings of bits 3 (HM8) and 2 (HM5) of parameter No. 6400. Also see the explanation of those parameters when setting the above parameters.

4.47 PARAMETERS OF GRAPHIC DISPLAY

4.47.1 Parameters of Graphic Display / Dynamic Graphic Display

	#7	#6	#5	#4	#3	#2	#1	#0
6500		NZM			DPA	GUL	SPC	GRL
			DPO					

[Data type] Bit

GRL Graphic display at 2-path control
- 0 : Path 1 is displayed on the left, and path 2 is displayed on the right.
- 1 : Path 1 is displayed on the right, and path 2 is displayed on the left.

SPC Graphic display at 2-path control is done
- 0 : On two spindles and two tool posts
- 1 : On one spindle and two tool posts

GUL
- 0 : The positions of X1- and X2-axes are not replaced with each other in the coordinate system specified with parameter No. 6509.
- 1 : The positions of X1- and X2-axes are replaced with each other in the coordinate system specified with parameter No. 6509.

> **NOTE**
> This parameter is for two-path control.

DPA Current position display on the graphic display screen
- 0 : Displays the actual position to ensure tool nose radius compensation
- 1 : Displays the programmed position

DPO Current position on the solid drawing (machining profile drawing) or tool path drawing screen
- 0 : Not appear
- 1 : Appears

NZM
- 0 : The screen image is not enlarged by specifying the center of the screen and magnification. (The screen image is enlarged by specifying the range and magnification using the two cursors.)
- 1 : The screen image is enlarged by specifying the center of the screen and magnification.

	#7	#6	#5	#4	#3	#2	#1	#0
6501			CSR					
			CSR	FIM	RID	3PL	TLC	ORG

[Data type] Bit

ORG Movement when coordinate system is altered during drawing
- 0 : Draws in the same coordinate system
- 1 : Draws in the new coordinate system (only for the tool path drawing)

TLC In solid drawing
- 0 : Not compensate the tool length
- 1 : Compensates the tool length

3PL In solid drawing, a three-view drawing is created:
- 0 : In third angle projection
- 1 : In first angle projection

RID In solid drawing
- 0 : Draws a plane without edges.
- 1 : Draws a plane with edges.

FIM Machining profile drawing in solid drawing
- 0 : Displayed in the coarse mode
- 1 : Displayed in the fine mode

CSR While the screen image is enlarged, the shape of the graphic cursor is:
- 0 : A square. (■)
- 1 : An X. (X)

	#7	#6	#5	#4	#3	#2	#1	#0
6503						CYG		
							MST	

[Data type] Bit

MST In check drawing (animated simulation) using the dynamic graphic display function, the M, S, and T code commands in the program are:
- 0 : Ignored.
- 1 : Output to the machine in the same way as in normal operation.

CYG CY-axis drawing coordinate system setting
- 0 : The CY-axis animated simulation coordinate system is not set.
- 1 : The CY-axis animated simulation coordinate system is set.

When this parameter is set to "1", parameter No. 6510 is invalid.
When bit 1 (SPC) of parameter No. 6500 is set to "1", this parameter is invalid.

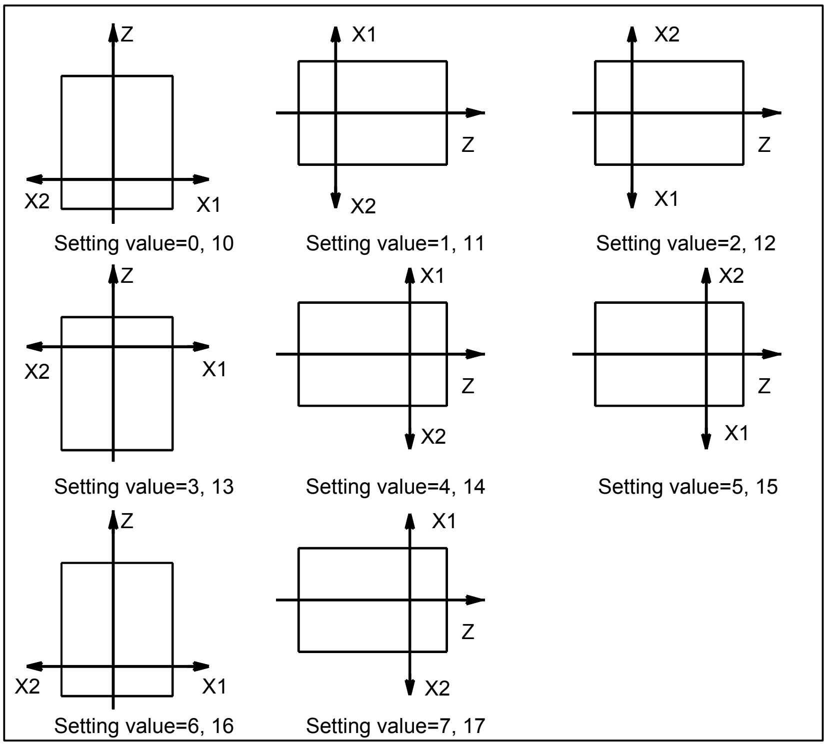
6509	Coordinate system for drawing a single spindle (2-path control)

[Data type] Byte

[Valid data range] 0 to 7 and 10 to 17 (However, 0 to 7 are the same settings as 10 to 17.)

This parameter sets the coordinate system for drawing a single spindle (bit 1 (SPC) of parameter 6500 = 1) for 2-path control.

The following shows the relationship between the setting value and the drawing coordinate systems:



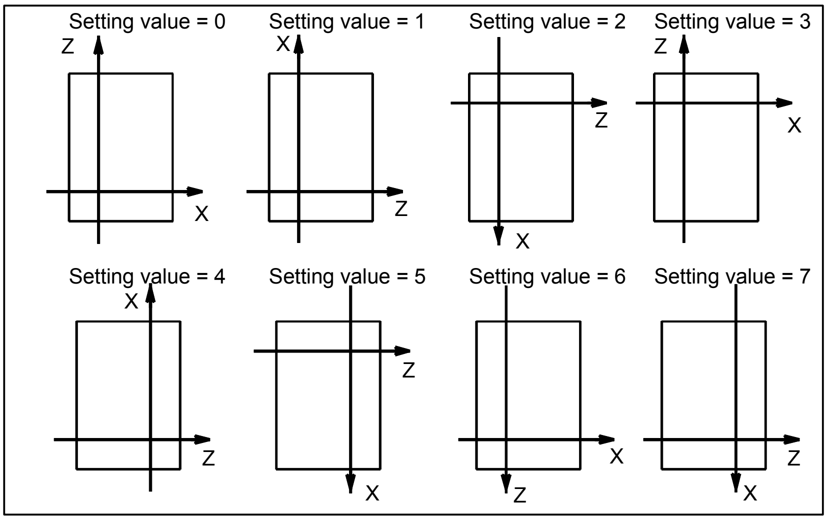
6510	Drawing coordinate system

[Data type] Byte

[Valid data range] 0 to 7

This parameter specifies the drawing coordinate system for the graphic function.

The following show the relationship between the setting value and the drawing coordinate systems.



NOTE

This parameter is specified for each tool post in the 2-path control. A different drawing coordinate system can be selected for each tool post.

6511	Right margin in solid drawing

6512	Left margin in solid drawing

6513	Upper margin in solid drawing

6514	Lower margin in solid drawing

[Data type] Word
[Unit of data] Dot

These parameters set the machining profile drawing position in margins. The unit is a dot.

Parameter No.	Margin area	Standard setting value			
		Bit 5 (DPO) of No.6500 = 0		Bit 5 (DPO) of No.6500 = 1	
		7.2"LCD 8.4"LCD	9.5"LCD 10.4"LCD	7.2"LCD 8.4"LCD	9.5"LCD 10.4"LCD
6511	Right	0	0	200	100
6512	Left	0	0	0	0
6513	Upper	25	32	25	32
6514	Lower	0	10	0	10

DPO is set in bit 5 (DPO) of parameter No. 6500.

6515	Change in cross-section position in tri-plane drawing

[Data type] Byte
[Unit of data] Dot
[Valid data range] 0 to 10

This parameter sets the change in the cross-section position when a soft key is continuously pressed in tri-plane drawing. When 0 is specified, it is set to 1.

6520	C-axis number for dynamic graphic display

[Data type] Byte
[Valid data range] 0, 1 to number of controlled axes

This parameter sets a C-axis number for dynamic graphic display. When 0 or a value greater than the number of controlled axes is specified with this parameter, the third axis is assumed.

4.47.2 Parameters of Graphic Color

6561	Standard color data for graphic color number 1
6562	Standard color data for graphic color number 2
6563	Standard color data for graphic color number 3
6564	Standard color data for graphic color number 4
6565	Standard color data for graphic color number 5
6566	Standard color data for graphic color number 6
6567	Standard color data for graphic color number 7
6568	Standard color data for graphic color number 8
6569	Standard color data for graphic color number 9
6570	Standard color data for graphic color number 10
6571	Standard color data for graphic color number 11
6572	Standard color data for graphic color number 12
6573	Standard color data for graphic color number 13
6574	Standard color data for graphic color number 14
6575	Standard color data for graphic color number 15
6581	Standard color data for character color number 1
6582	Standard color data for character color number 2
6583	Standard color data for character color number 3
6584	Standard color data for character color number 4
6585	Standard color data for character color number 5
6586	Standard color data for character color number 6
6587	Standard color data for character color number 7
6588	Standard color data for character color number 8

6589	Standard color data for character color number 9
6590	Standard color data for character color number 10
6591	Standard color data for character color number 11
6592	Standard color data for character color number 12
6593	Standard color data for character color number 13
6594	Standard color data for character color number 14
6595	Standard color data for character color number 15

[Data type] 2-word

[Unit of data] rr gg bb: 6-digit number (rr: Red gg: Green bb: Blue)
When a number of less than six digits is set, the system assumes that 0 has been specified for the unspecified higher digit(s).

[Valid data range] Data of each color: 00 to 15 (same value as the tone level data on the color setting screen)
When a value of more than 15 is set, the system assumes that 15 has been specified.

[Example]
Set 10203 in this parameter when the color tone levels are as follows:
Red: 1 Green: 2 Blue: 3

> **NOTE**
> To set the color of the VGA display, use the color setting screen. Note that the color changes when the settings of parameters No. 6561 through No. 6595 are modified.

4.48 PARAMETERS OF RUN HOUR AND PARTS COUNT DISPLAY

	#7	#6	#5	#4	#3	#2	#1	#0
6700							PRT	PCM

[Data type] Bit

PCM M code that counts the total number of machined parts and the number of machined parts
0 : M02, or M30, or an M code specified by parameter No.6710
1 : Only M code specified by parameter No.6710

PRT Upon reset, the required part count arrival signal PRTSF<F062#7> is:
0 : Turned off.
1 : Not turned off.

6710	M code that counts the total number of machined parts and the number of machined parts

[Data type] 2-word
[Valid data range] 0 to 255 except 98 and 99

The total number of machined parts and the number of machined parts are counted (+1) when the M code set is executed.

> **NOTE**
> Set value 0 is invalid (the number of parts is not counted for M00). Data 98 and 99 cannot be set.

6711	Number of machined parts

This parameter can also be set on the “Setting screen”.

[Data type] 2-word
[Unit of data] One piece
[Valid data range] 0 to 99999999

The number of machined parts is counted (+1) together with the total number of machined parts when the M02, M30, or a M code specified by parameter No.6710 is executed.

> **NOTE**
> The number of parts is not counted for M02, M03, when bit 0 (PCM) of parameter No. 6700 is set to 1.

6712	Total number of machined parts

This parameter can also be set on the “Setting screen”.

[Data type] 2-word

[Unit of data] One piece

[Valid data range] 0 to 99999999

This parameter sets the total number of machined parts.
The total number of machined parts is counted (+1) when M02, M30, or an M code specified by parameter No.6710 is executed.

> **NOTE**
> The number of parts is not counted for M02, M03, when bit 0 (PCM) of parameter No. 6700 is set to 1.

6713	Number of required parts

This parameter can also be set on the “Setting screen”.

[Data type] Word

[Unit of data] One piece

[Valid data range] 0 to 9999

This parameter sets the number of required machined parts.
Required parts finish signal PRTSF <F062#7> is output to PMC when the number of machined parts reaches the number of required parts. The number of parts is regarded as infinity when the number of required parts is 0. The PRTSF <F062#7> signal is then not output.

6750	Integrated value of power-on period

[Data type] 2-word

[Unit of data] min

[Valid data range] 0 to 99999999

This parameter displays the integrated value of power-on period.

6751	Operation time (integrated value of time during automatic operation) I

This parameter can also be set on the “Setting screen”.

[Data type] 2-word

[Unit of data] msec

[Valid data range] 0 to 60000

6752	Operation time (integrated value of time during automatic operation) II

This parameter can also be set on the “Setting screen”.

[Data type] 2-word

[Unit of data] min

[Valid data range] 0 to 99999999

This parameter displays the integrated value of time during automatic operation (neither stop nor hold time included).

The actual time accumulated during operation is the sum of parameters No. 6751 and No. 6752.

6753	Integrated value of cutting time I

This parameter can also be set on the “Setting screen”.

[Data type] 2-word

[Unit of data] msec

[Valid data range] 1 to 60000

6754	Integrated value of cutting time II

This parameter can also be set on the “Setting screen”.

[Data type] 2-word

[Unit of data] min

[Valid data range] 0 to 99999999

This parameter displays the integrated value of a cutting time that is performed in cutting feed such as linear interpolation (G01) and circular interpolation (G02 or G03).

The actual time accumulated during cutting is the sum of parameters No. 6753 and No. 6754.

6755	Integrated value of general-purpose integrating meter drive signal (TMRON) ON time I

This parameter can also be set on the “Setting screen”.

[Data type] 2-word

[Unit of data] msec

[Valid data range] 0 to 60000

6756	Integrated value of general-purpose integrating meter drive signal (TMRON) ON time II

This parameter can also be set on the “Setting screen”.

[Data type] 2-word

[Unit of data] min

[Valid data range] 0 to 99999999

This parameter displays the integrated value of a time while input signal TMRON <G053#0> from PMC is on.

The actual integrated time is the sum of parameters No. 6755 and No. 6756.

6757	Operation time (integrated value of one automatic operation time) I

This parameter can also be set on the “Setting screen”.

[Data type] 2-word

[Unit of data] msec

[Valid data range] 0 to 60000

6758	Operation time (integrated value of one automatic operation time) II

This parameter can also be set on the “Setting screen”.

[Data type] 2-word

[Unit of data] min

[Valid data range] 0 to 99999999

This parameter displays the one automatic operation drive time (neither stop nor hold state included). The actual time accumulated during operating is the sum of parameter No. 6757 and No. 6758. The operation time is automatically preset to 0 during the power-on sequence and the cycle start from the reset state.

4.49 PARAMETERS OF TOOL LIFE MANAGEMENT

	#7	#6	#5	#4	#3	#2	#1	#0
6800			SNG	GRS	SIG	LTM	GS2	GS1
	M6T	IGI	SNG	GRS	SIG	LTM	GS2	GS1

[Data type] Bit

GS1, GS2 This parameter sets the combination of the number of tool life groups which can be entered, and the number of tools which can be entered per group as shown in the table below.

GS2	GS1	M series		T series	
		Group count	Tool count	Group count	Tool count
0	0	1 to 16 1 to 64	1 to 16 1 to 32	1 to 16 1 to 16	1 to 16 1 to 32
0	1	1 to 32 1 to 128	1 to 8 1 to 16	1 to 32 1 to 32	1 to 8 1 to 16
1	0	1 to 64 1 to 256	1 to 4 1 to 8	1 to 64 1 to 64	1 to 4 1 to 8
1	1	1 to 128 1 to 512	1 to 2 1 to 4	1 to 16 1 to 128	1 to 16 1 to 4

The values on the lower row in the table apply when for the M series, the “addition of 512 tool pairs for tool life management” option is provided, and for the T series, the “addition of 128 tool pairs for tool life management” option is provided.

LTM Tool life
0 : Specified by the number of times
1 : Specified by time

SIG Group number is
0 : Not input using the tool group signal during tool skip (The current group is specified.)
1 : Input using the tool group signal during tool skip

GRS Tool exchange reset signal TLRST<G048#7>
0 : Clears only the execution data of a specified group
1 : Clears the execution data of all entered groups

SNG Input of the tool skip signal TLSKP <G048#5> when a tool that is not considered tool life management is selected.
0 : Skips the tool of the group used last or of the specified group (using bit 3 (SIG) of parameter No.6800).
1 : Ignores a tool skip signal

IGI Tool back number
0 : Not ignored
1 : Ignored

M6T T code in the same block as M06
0 : Judged as a back number
1 : Judged as a next tool group command

	#7	#6	#5	#4	#3	#2	#1	#0
6801		EXG	E1S			LFV	TSM	
	M6E	EXT	E1S		EMD	LFV		

[Data type] Bit

TSM When a tool takes several tool numbers, life is counted in tool life management:
0 : For each of the same tool numbers.
1 : For each tool.

LFV When a life count override counted by time with the extended tool life management function or when a life value is counted by time with the tool management function, the tool life count override signals *TLV0 to *TLV9 <G049#0 to G050#1> are:
0 : Invalid.
1 : Valid.

EMD An asterisk (*) indicating that a tool has been expired is displayed,
0 : When the next tool is selected
1 : When the tool life is expired

E1S When the life of a tool is measured in time-based units:
0 : The life is counted every four seconds.
1 : The life is counted every second. (The maximum life is 1075 (minutes).)

> **NOTE**
> This parameter is valid when bit 2 (LTM) of parameter No.6800 is set to 1.

EXT Specifies whether the extended tool life management function (for M series) is used.
0 : Not used
1 : Used

EXG Tool life management data registration by G10 (for T series) is:
0 : Performed after the data for all tool groups has been cleared.
1 : Performed by adding/changing or deleting the data for a specified group.

> **NOTE**
> When EXG = 1, address P in the block including G10 can be used to specify whether data is to be added/changed or deleted (P1: add/change, P2: delete). When P is not specified, the data for all tool groups is cleared before the tool life management data is registered.

M6E When a T code is specified in the same block as M06
0 : The T code is processed as a return number or as a group number selected next. Either is set by bit 7 (M6T) of parameter No. 6800.
1 : The tool group life is counted immediately.

	#7	#6	#5	#4	#3	#2	#1	#0
6802								T99
	RMT	TSK	TGN	ARL	GRP	E17	TCO	T99

[Data type] Bit

T99 If a tool group whose life has expired is found to exist when M99 is executed in the main program:
- 0 : The tool change signal is not output.
- 1 : The tool change signal is output.

TCO When function code 171 or 172 (tool life management data write) of the PMC window function is specified, tool data of a tool in the currently selected group that is currently not in use:
- 0 : Cannot be cleared.
- 1 : Can be cleared.

E17 When function code 171 or 172 (tool life management data write) of the PMC window function is specified to clear tool life management data of the tool currently in use in the currently selected group:
- 0 : The tool data is not cleared and operation terminates normally.
- 1 : The tool data is not cleared and completion code 13 is output.

GRP As management data for the tool life arrival notice signal TLCHB <F064#3> :
- 0 : Parameters Nos. 6844 and 6845 are used.
- 1 : The value set for each group with the extended tool life management function is used.

By setting the remaining life until new tool selection for each group, the signal TLCHB <F064#3> is output when the value obtained by subtracting the tool use count (COUNT) from the life setting (LIFE) reaches the value (remaining life) set for each group.

NOTE
This parameter is valid only when tool life management B is used.

ARL The tool life arrival notice signal TLCHB <F064#3> of tool life management is:
- 0 : Output for each tool.
- 1 : Output for the last tool in a group.

This parameter is valid only when bit 3 (GRP) of parameter No. 6802 is set to 1.

TGN In tool life management B, the arbitrary group number set function is:
- 0 : Not used.
- 1 : Used.

TSK When the life is specified by time and the last tool in a group is skipped in tool life management:
- 0 : The count for the last tool indicates the life value.
- 1 : The count for the last tool is not changed.

RMT Specifies when to turn off the tool life arrival notice signal TLCHB<F064#3> , as follows:

0 : The actual remaining life is longer than that specified in a parameter ("less than" type).

1 : The actual remaining life is not equal to that specified in a parameter ("equal" type).

	#7	#6	#5	#4	#3	#2	#1	#0
6803							LFE	LGR
							LFE	

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

LGR When the tool life management function is used, a tool life type is:

0 : Chosen based on bit 2 (LTM) of parameter No.6800 for all groups.

1 : Set to either count or duration on a group-by-group basis.

When LGR is set to 1, the specification of address Q is added to the G10 (tool life management data setting) command format. As shown in the example below, specify the tool life of each group as either a count (Q1) or a duration (Q2). If address Q is omitted for a group, the specification of bit 2 (LTM) of parameter No.6800 applies to the group.

[Example]

When bit 2 (LTM) of parameter No.6800 is set to 0. (The tool life is specified as a count.)

G10 L3 ;
P1 L10 Q1 ; (Q1: The life of group 1 is specified as a count.)
:
P2 L20 Q2 ; (Q2: The life of group 2 is specified as a duration.)
:
P3 L20 ; (Omission of Q: The life of group 3 is specified as a count.)
:
G11 ;
M30 ;
%

LFE When a tool life is specified by count:

0 : A count value from 0 to 9999 can be specified.

1 : A count value from 0 to 65535 can be specified.

	#7	#6	#5	#4	#3	#2	#1	#0
6804							TC1	
						ETE	TC1	E10

[Data type] Bit

E10 When a tool life value is specified by time, the life is counted:
0 : At intervals of 4 seconds.
1 : At intervals of 10 seconds.

NOTE
This parameter is valid when bit 2 (LTM) of parameter No. 6800 is set to 1.

TC1 During automatic operation, preset of the tool life counter is:
0 : Disabled.
1 : Enabled.

ETE In extended tool life management, as the mark indicating that the life of the last tool in a group has expired:
0 : "@" is also used.
1 : "*" is used.

6810	
	Tool life management ignored number

[Data type] Word
[Valid data range] 0 to 9999

This parameter sets the tool life management ignored number.
When the set value is subtracted from a T code, a remainder is used as the tool group number of tool life management when a value exceeding the set value is specified in the T code.

6811	Tool life count restart M code

[Data type] 2-word

[Valid data range] 0 to 255 (not including 01, 02, 30, 98, and 99)

When 0 is specified, it is ignored.

- For tool life management:
  1 When the life is specified by the number of times, the tool exchange signal is output when a tool life count restart M code is specified if tool life of at least one tool group is expired. A tool in life is selected in the specified group when a T code command (tool life management group command) is specified after the tool life count restart M code is specified. A tool life counter is then incremented by one.
  2 When the life is specified by time, a tool in life is selected in the specified group when a T code command (tool life management group command) is specified after the tool life count restart M code is specified.
- For the tool management function:
  When a tool life count restart M code is specified, the counting of the life of the tool attached to the spindle position is started.
  1 When the life is counted by the number of times, the life count target is switched to the tool attached to the spindle position, and the life count is incremented by 1.
  2 When the life is counted by time, only an operation for switching the life count target to the tool attached to the spindle position is performed.
  When the tool attached to the spindle position is not a tool life management target, no operation is performed.

6844	Remaining tool life (use count)

[Data type] Word

[Unit of data] Count

[Valid data range] 0 to 9999

This parameter sets a remaining tool life (use count) used to output the tool life arrival notice signal TLCHB <F064#3> when the tool life is specified as a use count.

NOTE

1 When the remaining life (use count) of a selected tool reaches the value specified with this parameter, tool life arrival notice signal TLCHB is output to the PMC.

2 If a value greater than the life of a tool is specified with this parameter, the tool life arrival notice signal TLCHB is not output.

6845	Remaining tool life (use duration)

[Data type] 2-word
[Unit of data] min
[Valid data range] 0 to 4300

This parameter sets the remaining tool life (use duration), used to output the tool life arrival notice signal TLCHB <F064#3> when the tool life is specified as a use duration.

> **NOTE**
> 1 When the remaining life (use duration) of a selected tool reaches the value specified in this parameter, tool life arrival notice signal TLCHB is output to the PMC. The tool life management function allows the user to specify a tool life either as a use duration or use count for each tool group. For a group whose life is specified as a use count, parameter No.6844 is used. For a group whose life is specified as a use time, this parameter is used.
> 2 If a value greater than the life of a tool is specified with parameter No.6845, the tool life arrival notice signal TLCHB is not output.

6846	Number of remaining tools in the group

[Data type] Byte
[Valid data range] 0 to 127

This parameter sets the number of remaining tools in the group.
If the number of remaining tools of the currently used group has decreased to or below the value set in this parameter, the signal TLAL<F154#0> is output. When 0 is set in this parameter, this signal is not output.

4.50 PARAMETERS OF POSITION SWITCH FUNCTIONS

	#7	#6	#5	#4	#3	#2	#1	#0
6901					PSF	PCM	EPS	IGP

[Data type] Bit

IGP During follow-up for the absolute position detector, position switch signals are:
0 : Output
1 : Not output

EPS The number of position switches is:
0 : Up to 10.
1 : Up to 16.

PCM Position switch signals are output:
0 : Without considering acceleration/deceleration and servo delay.
1 : With considering acceleration/deceleration and servo delay.

PSF In high-precision contour control mode (M/T series), AI high-precision contour control mode (M/T series), AI nano high-precision contour control mode (M/T series), AI contour control mode (M series), AI nano contour control mode (M series), or advanced preview control mode (M/T series), position switches are:
0 : Not used.
1 : Used.

NOTE
1 The position switch signals are output considering acceleration/deceleration after interpolation and servo delay. Acceleration/deceleration after interpolation and servo delay are considered even for position switch signal output in a mode other than the high-precision contour control mode (M/T series), AI high-precision contour control mode (M/T series), AI nano high-precision contour control mode (M/T series), AI contour control mode (M series), AI nano contour control mode (M series), and advanced preview control mode (M/T series). When this parameter is set to 1, however, signals are output from the position switches at different times from the specified ones.
2 When using the direction-dependent type high-speed position switch, set bit 1 (HPE) of parameter No. 8501 to 0 (to consider a servo delay amount for decision of direction).

6910	Axis corresponding to the first position switch
6911	Axis corresponding to the second position switch
6912	Axis corresponding to the third position switch
6913	Axis corresponding to the fourth position switch
6914	Axis corresponding to the fifth position switch
6915	Axis corresponding to the sixth position switch
6916	Axis corresponding to the seventh position switch
6917	Axis corresponding to the eighth position switch
6918	Axis corresponding to the ninth position switch
6919	Axis corresponding to the tenth position switch
6920	Axis corresponding to the eleventh position switch
6921	Axis corresponding to the twelfth position switch
6922	Axis corresponding to the thirteenth position switch
6923	Axis corresponding to the fourteenth position switch
6924	Axis corresponding to the fifteenth position switch
6925	Axis corresponding to the sixteenth position switch

[Data type] Byte
[Valid data range] 0 to number of controlled axes

These parameters sequentially specify the numbers of the controlled axes corresponding to the 1st through 16th position switch functions. The corresponding position switch signal is output to the PMC when the machine coordinate of the corresponding axis is within the range set in parameters.

NOTE
Set 0 for the number corresponding to a position switch which is not to be used.

6930	Maximum operation range of the first position switch
6931	Maximum operation range of the second position switch
6932	Maximum operation range of the third position switch
6933	Maximum operation range of the fourth position switch
6934	Maximum operation range of the fifth position switch
6935	Maximum operation range of the sixth position switch
6936	Maximum operation range of the seventh position switch
6937	Maximum operation range of the eighth position switch
6938	Maximum operation range of the ninth position switch
6939	Maximum operation range of the tenth position switch
6940	Maximum operation range of the eleventh position switch
6941	Maximum operation range of the twelfth position switch
6942	Maximum operation range of the thirteenth position switch
6943	Maximum operation range of the fourteenth position switch
6944	Maximum operation range of the fifteenth position switch
6945	Maximum operation range of the sixteenth position switch

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

These parameters sequentially set the maximum operation ranges of the 1st through 16th position switches.

6950	Minimum operation range of the first position switch
6951	Minimum operation range of the second position switch
6952	Minimum operation range of the third position switch
6953	Minimum operation range of the fourth position switch
6954	Minimum operation range of the fifth position switch
6955	Minimum operation range of the sixth position switch
6956	Minimum operation range of the seventh position switch
6957	Minimum operation range of the eighth position switch
6958	Minimum operation range of the ninth position switch
6959	Minimum operation range of the tenth position switch
6960	Minimum operation range of the eleventh position switch
6961	Minimum operation range of the twelfth position switch
6962	Minimum operation range of the thirteenth position switch
6963	Minimum operation range of the fourteenth position switch
6964	Minimum operation range of the fifteenth position switch
6965	Minimum operation range of the sixteenth position switch

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

These parameters sequentially set the minimum operation ranges of the 1st through 16th position switches.

4.51 PARAMETERS OF MANUAL OPERATION AND AUTOMATIC OPERATION

	#7	#6	#5	#4	#3	#2	#1	#0
7001	MFM				JSP	JST		MIN

[Data type] Bit

MIN The manual intervention and return function is:
0 : Disabled.
1 : Enabled.

JST In manual numerical command, the cycle start lamp signal STL <F000#5> indicating that automatic operation is being started is:
0 : Not output.
1 : Output.

JSP For the manual numerical command function, spindle control by the CNC is:
0 : Not enabled.
1 : Enabled.

MFM For the manual linear or manual circular interpolation function, modifying a value specified with a command during jog feed in the guidance direction (approach direction):
0 : Immediately starts moving according to the new value.
1 : Stops moving.

	#7	#6	#5	#4	#3	#2	#1	#0
7002					JBF		JSF	JMF
					JBF	JTF	JSF	JMF

[Data type] Bit

JMF In manual numerical command, M function command is:
0 : Allowed.
1 : Not allowed.

JSF In manual numerical command, S function command is:
0 : Allowed.
1 : Not allowed.
(See the description of bit 3 (JSP) of parameter No. 7001 as well.)

JTF In manual numerical command, T function command is:
0 : Allowed.
1 : Not allowed.

JBF In manual numerical command, B function command is:
0 : Allowed.
1 : Not allowed.

	#7	#6	#5	#4	#3	#2	#1	#0
7010								**JMVx**

[Data type] Bit axis

JMVx In manual numerical command, axis movement command is:
0 : Allowed.
1 : Not allowed. (When the command is specified, a warning message is displayed, and the command is not executed.)

7015	Least command increment setting for jog feed

[Data type] Word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] 0 to 10000

This parameter sets the least command increment for jog feed when PMC signal JGUNIT <G0023#0> is set to 1. If the setting of this parameter is 0, a value of 1 is recognized.

	#7	#6	#5	#4	#3	#2	#1	#0
7050								
		MI1	**MI0**					**RV1**

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

RV1 When the tool moves backwards after feed hold during forward feed with the retrace function:
0 : The block is split at the feed hold position and stored.
1 : The block is stored without being split.

Command block in program
- - - - - - - *- - - - - - ->

If the tool moves backwards after feed hold at position indicated with *

When RV1 = 0
The block is split into two blocks and stored.
- - - - - - - > - - - - - - - >

When RV1 = 1
The block is stored as is.
- - - - - - - - - - - - - - - >

MI0, MI1 Set this parameter as indicated below.

When AI contour control is specified

MI1	**MI0**	**Bit 0 (NMI) of Parameter No.7052**	
0	1	0	When the servo FAD function is used
		1	Axes used with the following function: • Servo FAD function • PMC axis • Cs axis • Index table indexing axis set for follow-up (fourth axis)
0	0	0/1	Axis for which the servo FAD function is used

When AI nano contour control is specified

MI1	**MI0**	**Bit 0 (NMI) of Parameter No.7052**	
0	0	0	When the servo FAD function is used
		1	Axes used with the following function: • Servo FAD function • PMC axis • Cs axis • Index table indexing axis set for follow-up (fourth axis)

	#7	#6	#5	#4	#3	#2	#1	#0
7051								
					ACR			

[Data type] Bit

ACR When rigid tapping is specified in AI contour control mode or AI nano contour control mode, the mode is:

0 : Not turned off.

1 : Turned off.

When the serial spindle does not support advanced preview control of rigid tapping, AI contour control mode or AI nano contour control mode must be turned off in rigid tapping.

Setting this parameter and satisfying the following conditions can automatically turn AI contour control mode or AI nano contour control mode off only during execution of rigid tapping when rigid tapping is specified in AI contour control mode or AI nano contour control mode.

<Conditions>

- To specify rigid tapping mode, use "the method for specifying M29 S**** prior to the tapping command."
  If a method other than the above is used, P/S alarm No. 5110 is issued.
- The interval between M29 (rigid tapping mode specification M code) and the completion signal (FIN) must be at least 32 msec.
- The rigid tapping mode cancel command and cutting feed move command cannot be specified simultaneously. If they are specified simultaneously, P/S alarm No. 5110 is issued.
  (Additional information: The rigid tapping mode cancel command and rapid traverse move command can be specified in the same block.)
- Set bit 2 (CRG) of parameter No. 5200 to 0.
  (This setting specifies that rigid tapping mode is canceled when the rigid tapping signal RGTAP is set to "0".)

	#7	#6	#5	#4	#3	#2	#1	#0
7052								NMI

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit axis

NMI Set this parameter as indicated below.

	NMI
• Axis for which bit 7 (NAHx) of parameter No. 1819 is set to 1 (for not using advanced preview feed forward) • Axes used for the function below when the servo FAD function is not used: - PMC axis - Cs axis - Index table indexing axis set for follow-up (fourth axis)	1
When the servo FAD function is used	0

	#7	#6	#5	#4	#3	#2	#1	#0
7053								
							AIP	NAN

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

NAN G5.1Q1 specifies:
0 : AI nano contour control
1 : AI contour control

AIP When AI contour control is exercised, stroke limit check before move is:
0 : Disabled.
1 : Enabled.

> **NOTE**
> Stroke limit check before move needs to be enabled (with bit 7 (PLC) of parameter No. 1301 set to 1).

	#7	#6	#5	#4	#3	#2	#1	#0
7054							AIR	
			AIL		AZR	FNS	AIR	HPL

[Data type] Bit

HPL If a command not usable in the HPCC mode is included when the HPCC mode is specified under AI contour control/AI nano contour control, the command is:
0 : Processed in the ordinary mode on the NC side.
1 : Processed in the AI contour control/AI nano contour control mode on the NC side.

AIR In AI contour control mode (M series) or AI nano contour control mode (T/M series), the rapid traverse type is:
0 : Linear interpolation type positioning. (Acceleration/deceleration before interpolation is valid.)
1 : According to the setting of bit 1 (LRP) of parameter No. 1401.

NOTE
Be sure to set this parameter to 0 when executing the three-dimensional coordinate conversion mode or tilted working plane command mode under AI contour control or AI nano contour control.

FNS If an S code is specified in the AI contour control mode, the movement specified in the same block is:
0 : Decelerated to a stop.
1 : Not decelerated to a stop.

AZR In AI contour control mode, the G27, G28, G30, G30.1, and G53 commands are executed:
0 : In normal mode. (Advanced preview feed forward is valid.)
1 : In AI contour control mode.

NOTE
The setting of 1 is valid only for AI contour control. For AI nano contour control, set this bit to 0.

AIL When non-linear type positioning is specified in AI contour control mode or AI nano contour control mode and an axis-by-axis interlock signal is input:
0 : The tool stops along all axes.
1 : The setting of bit 4 (XIK) of parameter No. 1002 is used.

	#7	#6	#5	#4	#3	#2	#1	#0
7055			ODA					
			ODA	ADP	BCG	ALZ	AF1	ACO

[Data type] Bit

ACO In AI contour control mode:

0 : Automatic corner override and changing both internal and external circular feedrates are disabled.

1 : Automatic corner override and changing the internal circular feedrate are enabled, and whether to enable changing the external circular feedrate depends on the setting of bit 2 (COV) of parameter No. 1602.

AF1 During one-digit F code feed in AI contour control mode, changing the feedrate by the manual handle is:

0 : Disabled.

1 : Enabled.

ALZ If no reference position has been established and G28 is specified in AI contour control mode:

0 : P/S alarm No. 090 is issued.

1 : AI contour control mode is turned off and the command is executed.

BCG The function of changing the time constant for bell-shaped acceleration/deceleration before interpolation in AI contour control mode or AI nano contour control mode is:

0 : Disabled.

1 : Enabled.

See the description of parameter No. 7066 as well.

In AI high-precision contour control mode or AI nano high-precision contour control mode, bit 6 (BCG) of parameter No.19501 and parameter No.19520 should be set.

ADP One-direction positioning in AI Cs contour control/AI nano contour control mode is:

0 : Executed in the ordinary mode.

1 : Executed in AI contour control/AI nano contour control mode.

ODA The distance to a stored stroke limit under AI contour control (M series) or advanced preview control is determined with respect to:

0 : Axes specified in the current block and the next block.

1 : Axis specified in the current block.

	#7	#6	#5	#4	#3	#2	#1	#0
7057								
		CAI		CRF	FLX			OTR

[Data type] Bit

OTR For a rapid traverse block, the setting of parameter No. 1784 is:

0 : Invalid.

1 : Valid.

FLX Flexible synchronous control under AI contour control, AI nano contour control, high-precision contour control, AI high-precision contour control, or AI nano high-precision contour control is:
0 : Invalid.
1 : Valid.

CRF When a feedrate based on arc radius in helical interpolation is clamped:
0 : A found clamp feedrate is treated as a clamped circular feedrate.
1 : A found clamp feedrate is treated as a clamped feedrate involving a helical axis.

NOTE
This parameter is valid when a specified feedrate is specified as a composite feedrate for an arc and helical axis.

CAI A combination of the AI contour control mode or AI nano contour control mode with the chopping mode is:
0 : Invalid.
1 : Valid.

7066	Acceleration/deceleration reference speed for the function of changing the time constant for bell-shaped acceleration/deceleration before interpolation in AI contour control mode or AI nano contour control mode

[Data type] 2-word
[Unit of data, valid data range]

Input increment	Units of data	Valid data range	
		IS-B	IS-C
Metric input	1 mm/min	0 - 600000	0 - 60000
Inch machine	0.1 inch/min	0 - 600000	0 - 60000

Acceleration/deceleration reference speed for the function of changing the time constant for bell-shaped acceleration/deceleration before interpolation (bit 3 (BCG) of parameter No.7055 = 1) in AI contour control mode or AI nano contour control mode is set on this parameter. When the input unit is changed, this parameter must be changed. In AI high-precision contour control mode or AI nano high-precision contour control mode, bit 6 (BCG) of parameter No. 19501 and parameter No.19520 should be set.

4.52 PARAMETERS OF MANUAL HANDLE FEED, MANUAL HANDLE INTERRUPTION AND TOOL DIRECTION HANDLE FEED

	#7	#6	#5	#4	#3	#2	#1	#0
7100				HPF	HCL	IHD	THD	JHD

[Data type] Bit

JHD Manual handle feed in jog feed mode or incremental feed in the manual handle feed
0 : Invalid
1 : Valid

	When JHD=0		When JHD=1	
	JOG feed mode	Manual handle feed mode	JOG feed mode	Manual handle feed mode
JOG feed	Valid	Invalid	Valid	Invalid
Manual handle feed	Invalid	Valid	Valid	Valid
Incremental feed	Invalid	Invalid	Invalid	Valid

THD Manual pulse generator in TEACH IN JOG mode
0 : Invalid
1 : Valid

IHD The travel increment for manual handle interruption is:
0 : Output unit, and acceleration/deceleration after interpolation is disabled.
1 : Input unit, and acceleration/deceleration after interpolation is enabled.

HCL The clearing of handle interruption amount display by soft key [CANCEL] operation is:
0 : Disabled.
1 : Enabled.

HPF When a manual handle feed exceeding the rapid traverse rate is issued,
0 : The rate is clamped at the rapid traverse rate, and the handle pulses corresponding to the excess are ignored. (The graduations of the manual pulse generator may not agree with the distance the machine has traveled.)
1 : The rate is clamped at the rapid traverse rate, and the handle pulses corresponding to the excess are not ignored, but stored in the CNC. (If the rotation of the manual pulse generator is stopped, the machine moves by the distance corresponding to the pulses preserved in the CNC, then stops.)

	#7	#6	#5	#4	#3	#2	#1	#0
7102								HNGx

[Data type] Bit axis

HNGx Axis movement direction for rotation direction of manual pulse generator
0 : Same in direction
1 : Reverse in direction

	#7	#6	#5	#4	#3	#2	#1	#0
7103	AHR	GHR	HIE	IBH	HIT	HNT	RHD	

[Data type] Bit

RHD By a reset, the amount of manual handle interruption is:
0 : Not canceled.
1 : Canceled.

NOTE
This parameter is valid when bit 2 (IHD) of parameter No. 7100 is set to 1.

HNT The manual handle feed/incremental feed magnification is:
0 : Multiplied by 1.
1 : Multiplied by 10.

HIT The manual handle interruption magnification is:
0 : Multiplied by 1.
1 : Multiplied by 10.

IBH Manual handle feed for the β servo unit using an I/O link manual pulse generator is:
0 : Disabled.
1 : Enabled.

HIE As the acceleration/deceleration type and time constant for manual handle interruption:
0 : The acceleration/deceleration type and time constant for automatic operation are used.
1 : The acceleration/deceleration type and time constant for manual feed are used.
(An acceleration/deceleration type is determined by the settings of bit 0 (CTL) of parameter No. 1610, bit 1 (CTB) of parameter No. 1610, and bit 4 (JGL) of parameter No. 1610. The time constant set in parameter No. 1624 is used. The FL feedrate set in parameter No. 1625 is used.)

NOTE
This parameter is valid when bit 2(IHD) of parameter No. 7100 is set to 1.

GHR In manual liner/circular interpolation, the direction of movement on the axis relative to the rotation direction of the guidance handle is:
0 : Same.
1 : Opposite.

AHR In manual liner/circular interpolation, the direction of movement on the axis relative to the rotation direction of the approach handle is:
0 : Same.
1 : Opposite.

	#7	#6	#5	#4	#3	#2	#1	#0
7104			HHI					
			HHI	3D2	3D1	CXC		TLX

[Data type] Bit

TLX When tool direction handle feed or normal tool direction handle feed is used, this parameter selects a tool direction when the rotary axes for the three basic axes in the basic coordinate system are positioned to the machine zero point:
0 : Z-axis direction
1 : X-axis direction

CXC Tool axis direction handle feed or normal tool direction handle feed is performed with:
0 : 5-axis machine.
1 : 4-axis machine.

3D1 When tool direction handle feed or normal tool direction handle feed is used, the coordinate of the first rotary axis is:
0 : Machine coordinate that exists when tool direction handle feed (or normal tool direction handle feed) mode is selected, or when a reset occurs.
1 : Value set in parameter No.7144.

3D2 When tool direction handle feed or normal tool direction handle feed is used, the coordinate of the second rotary axis is:
0 : Machine coordinate that exists when tool direction handle feed (or normal tool direction handle feed) mode is selected, or when a reset occurs.
1 : Value set in parameter No.7145.

HHI Manual handle interruption during high-speed cycle machining is:
0 : Disabled.
1 : Enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
7105						IOM	HDX	

[Data type] Bit

HDX I/O Link manual handles are:
0 : Automatically assigned in the I/O Link connection order.
1 : Assigned to the X signal addresses set in parameter No. 12305 to No. 12307.

IOM As the manual handle for the loader:
0 : The manual handle connected to the I/O Link on the main side is used.
1 : The manual handle connected to the I/O Link on the loader side is used.

	#7	#6	#5	#4	#3	#2	#1	#0
7106								CLH

[Data type] Bit

CLH When manual reference position return of high-speed type, reference position setting without DOG after reference position establishment, reference position setting with mechanical stopper, workpiece origin presetting is performed, the indication of a manual handle interruption amount is:

0 : Not cleared.

1 : Cleared.

7110	Number of manual pulse generators used

[Data type] Byte

[Valid data range] 1 or 2 (T series), 3 (M series)

This parameter sets the number of manual pulse generators.

7113	Manual handle feed magnification m

[Data type] Word

[Unit of data] One time

[Valid data range] 1 to 127

This parameter sets the magnification when manual handle feed movement selection signals MP1 and MP2 are set to 0 and 1.

7114	Manual handle feed magnification n

[Data type] Word

[Unit of data] One time

[Valid data range] 1 to 1000

This parameter sets the magnification when manual handle feed movement selection signals MP1 and MP2 are set to 1.

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

7117	Allowable number of pulses that can be accumulated during manual handle feed

[Data type] 2-word
[Unit of data] pulse
[Valid data range] 0 to 99999999

If manual handle feed is specified such that the rapid traverse rate will be exceeded momentarily, those pulses received from the manual pulse generator that exceed the rapid traverse rate are accumulated rather than canceled.

NOTE

If the specification of manual handle feed is such that the rapid traverse rate will be exceeded, for example, when the manual pulse generator is rotated at high-speed with a large magnification such as 100, the axial feedrate is clamped at the rapid traverse rate and those pulses received from the manual pulse generator that exceed the rapid traverse rate are ignored. In such a case, therefore, the scale on the manual pulse generator may differ from the actual amount of travel. If such a difference is not acceptable, this parameter can be set to temporarily accumulate the excess pulses in the CNC, rather than ignoring them, up to the specified maximum (pulses in excess of the set maximum are ignored). The accumulated pulses are output and converted to a move command once the feedrate falls below the rapid traverse rate by reducing the rotational speed of the manual pulse generator or stopping its rotation altogether. Note, however, that if the maximum number of pulses to be accumulated is too large, stopping the rotation of the manual pulse generator does not stop feeding until the tool moves by an amount corresponding to the pulses accumulated in the CNC.

7120	Axis configuration in tool direction handle feed and normal tool direction handle feed

[Data type] Byte

[Valid data range] 1 to 4

Let A, B, and C be the rotary axes for the basic three axes X, Y, and Z in the basic coordinate system in tool direction handle feed and normal tool direction handle feed. If the tool direction is the Z-axis when the tool on the rotary axes is at the machine zero point, the four types below are considered according to the machine axis configuration. For a 4-axis machine, types (1) and (2) are available.

(1) A-C axis type
(2) B-C axis type
(3) A-B axis (A-axis master) type
(4) A-B axis (B-axis master) type

This parameter selects a type. Values of 1 to 4 are assigned to these types (when bit 0 (TLX) of parameter No. 7104 is set to 1), in order, from top to bottom. When the X-axis represents the tool direction, the above types are changed to B-A axis type, C-A axis type, B-C axis (B-axis master) type, and B-C axis (C-axis master) type.

7121	Axis selection in tool direction handle feed mode

[Data type] Byte

[Valid data range] 1 to number of controlled axes

This parameter sets an axis number for the manual handle feed axis selection signal for the first manual pulse generator to enable tool direction handle feed mode. When the value set in this parameter matches the value of the manual handle feed axis selection signal, tool direction handle feed mode is enabled.

7141	Axis selection in the X direction for the normal tool direction handle feed

7142	Axis selection in the Y direction for the normal tool direction handle feed

[Data type] Byte

[Valid data range] 1 to 8

These parameters specify the axis selection signal for the first manual pulse generator used to enable the normal tool direction handle feed. When the setting of these parameters matches the manual handle feed axis selection signal, normal tool direction handle feed mode is enabled.

7144	Coordinate of the first rotary axis for tool direction handle feed and normal tool direction handle feed

7145	Coordinate of the second rotary axis for tool direction handle feed and normal tool direction handle feed

[Data type] 2-word
[Unit of data] 0.001 degrees
[Valid data range] -360000 to 360000

These parameters specify the coordinates (rotation degrees) of the first and second rotary axes used when bits 3 (3D1) and 4 (3D2) of parameter No. 7104 are set to 1 in tool direction handle feed and normal tool direction handle feed. When bit 2 (CXC) of parameter No. 7104 is 1, however, the coordinate of the second rotary axis is assumed to be 0 regardless of the value of 3D2 or this parameter.

4.53 PARAMETERS OF MANUAL LINEAR/CIRCULAR FUNCTION

7160	Approach handle clamp feedrate

[Data type] 2-word

[Unit of data, valid data range]

Input increment	Units of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	0 to 15000	0 to 12000
Inch machine	0.1 inch/min	0 to 6000	0 to 4800
Rotary axis	1 deg/min	0 to 15000	0 to 12000

When the setting is 0, the feedrate is not clamped.

7161	Guidance handle clamp feedrate

[Data type] 2-word

[Unit of data, valid data range]

Input increment	Units of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	0 to 15000	0 to 12000
Inch machine	0.1 inch/min	0 to 6000	0 to 4800
Rotary axis	1 deg/min	0 to 15000	0 to 12000

When the setting is 0, the feedrate is not clamped.

4.54 PARAMETERS OF REFERENCE POSITION SETTING WITH MECHANICAL STOPPER

7181	First withdrawal distance in reference position setting with mechanical stopper

[Data type] 2-word axis
[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric input	0.01	0.001	0.0001	mm
Inch input	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

When the reference position setting with mechanical stopper is used, this parameter sets a distance an axis, along which withdrawal is performed after the mechanical stopper is hit (distance from the mechanical stopper to the withdrawal point).

NOTE
Set the same direction as that set in bit 5 (ZMIx) of parameter No. 1006. Cycle operation cannot be started if the opposite direction is set.

7182	Second withdrawal distance in reference position setting with mechanical stopper

[Data type] 2-word axis
[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric input	0.01	0.001	0.0001	mm
Inch input	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

When the reference position setting with mechanical stopper is used, this parameter sets a distance an axis, along which withdrawal is performed after the mechanical stopper is hit (distance from the mechanical stopper to the withdrawal point).

NOTE
Set the same direction as that set in bit 5 (ZMIx) of parameter No. 1006. Cycle operation cannot be started if the opposite direction is set.

7183	First butting feedrate in reference position setting with mechanical stopper

[Data type] Word axis

[Unit of data, valid data range]

Input increment	Units of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	30 to 15000	30 to 12000
Inch machine	0.1 inch/min	30 to 6000	30 to 4800

When the reference position setting with mechanical stopper is used, this parameter sets the feedrate first used to hit the stopper on an axis.

7184	Second butting feedrate in reference position setting with mechanical stopper

[Data type] Word axis

[Unit of data, valid data range]

Input increment	Units of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	30 to 15000	30 to 12000
Inch machine	0.1 inch/min	30 to 6000	30 to 4800

When the reference position setting with mechanical stopper is used, this parameter sets the feedrate used to hit the stopper on an axis for a second time.

7185	Withdrawal feedrate (common to the first and second butting operations) in reference position setting with mechanical stopper

[Data type] Word axis

[Unit of data, valid data range]

Input increment	Units of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	30 to 15000	30 to 12000
Inch machine	0.1 inch/min	30 to 6000	30 to 4800

When the reference position setting with mechanical stopper is used, this parameter sets the feedrate used for withdrawal along an axis after the mechanical stopper has been hit.

7186	Torque limit value in reference position setting with mechanical stopper

[Data type] Byte axis

[Unit of data] %

[Valid data range] 0 to 100

This parameter sets a torque limit value in reference position setting with mechanical stopper.

NOTE

When 0 is set in this parameter, 100% is assumed.

4.55 PARAMETERS OF SOFTWARE OPERATOR'S PANEL

	#7	#6	#5	#4	#3	#2	#1	#0
7200		OP7	OP6	OP5	OP4	OP3	OP2	OP1

[Data type] Bit

OP1 Mode selection on software operator's panel
0 : Not performed
1 : Performed

OP2 Jog feed axis select and jog rapid traverse buttons on software operator's panel
0 : Not performed
1 : Performed

OP3 Manual pulse generator's axis select and manual pulse generator's magnification switches on software operator's panel
0 : Not performed
1 : Performed

OP4 Jog override and rapid traverse override switches on software operator's panel
0 : Not performed
1 : Performed

OP5 Optional block skip, single block, machine lock, and dry run switches on software operator's panel
0 : Not performed
1 : Performed

OP6 Protect key on software operator's panel
0 : Not performed
1 : Performed

OP7 Feed hold on software operator's panel
0 : Not performed
1 : Performed

	#7	#6	#5	#4	#3	#2	#1	#0
7201								JPC

[Data type] Bit

JPC For the name of a general-purpose switch function on the software operator's panel, the use of full-size characters is:
0 : Not allowed.
1 : Allowed.

7210	Jog-movement axis and its direction on software operator's panel "↑"
7211	Jog-movement axis and its direction on software operator's panel "↓"
7212	Jog-movement axis and its direction on software operator's panel "→"
7213	Jog-movement axis and its direction on software operator's panel "←"
7214	Jog-movement axis and its direction on software operator's panel "↙"
7215	Jog-movement axis and its direction on software operator's panel "↗"
7216	Jog-movement axis and its direction on software operator's panel "⤴"
7217	Jog-movement axis and its direction on software operator's panel "↱"

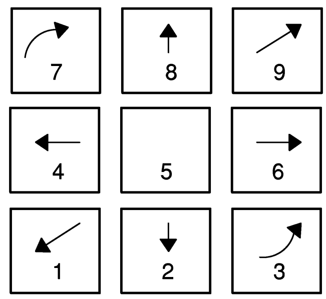
[Data type] Byte

[Valid data range] 0 to 8

On software operator's panel, set a feed axis corresponding to an arrow key on the MDI panel when jog feed is performed.

Set value	Feed axis and direction
0	Not moved
1	First axis, positive direction
2	First axis, negative direction
3	Second axis, positive direction
4	Second axis, negative direction
5	Third axis, positive direction
6	Third axis, negative direction
7	Fourth axis, positive direction
8	Fourth axis, negative direction

Arrow keys on the MDI panel



[Example] Under X, Y, and Z axis configuration, to set arrow keys to feed the axes in the direction specified as follows, set the parameters to the values given below. [8 ↑] to the positive direction of the Z axis, [2 ↓] to the negative direction of the Z axis, [6 →] to the positive direction of the X axis [4 ←] to the negative direction of the X axis, [1 ↙] to the positive direction of the Y axis, [9 ↗] to the negative direction of the Y axis

Parameter No.7210 = 5 (Z axis, positive direction)
Parameter No.7211 = 6 (Z axis, negative direction)
Parameter No.7212 = 1 (X axis, positive direction)
Parameter No.7213 = 2 (X axis, negative direction)
Parameter No.7214 = 3 (Y axis, positive direction)
Parameter No.7215 = 4 (Y axis, negative direction)
Parameter No.7216 = 0 (Not used)
Parameter No.7217 = 0 (Not used)

7220	Name of general-purpose switch on software operator's panel
:	:
7283	Name of general-purpose switch on software operator's panel

[Data type] Byte

[Example] These parameters set the names of the general-purpose switches (SIGNAL 1 through SIGNAL 8) on the software operator's panel as described below.

```
OPERATOR'S PANEL     O1234 N5678

    SIGNAL1     :  OFF   ON
    SIGNAL2     :  OFF   ON
    SIGNAL3     :  OFF   ON
    SIGNAL4     :  OFF   ON
    SIGNAL5     :  OFF   ON
    SIGNAL6     :  OFF   ON
    SIGNAL7     :  OFF   ON
    SIGNAL8     :  OFF   ON
```

These names are set using character codes that are displayed in parameters No. 7220 to No. 7283.

Parameter No.7220:
  Sets the character code (083) corresponding to S of SIGNAL 1.

Parameter No.7221:
  Sets the character code (073) corresponding to I of SIGNAL 1.

Parameter No.7222:
  Sets the character code (071) corresponding to G of SIGNAL 1.

Parameter No.7223:
  Sets the character code (078) corresponding to N of SIGNAL 1.

Parameter No.7224:
  Sets the character code (065) corresponding to A of SIGNAL 1.

Parameter No.7225:
  Sets the character code (076) corresponding to L of SIGNAL 1.

Parameter No.7226:
  Sets the character code (032) corresponding to (space) of SIGNAL 1.

Parameter No.7227:
  Sets the character code (049) corresponding to 1 of SIGNAL 1.

Parameters No. 7228 to No. 7235:
  Set the character codes of SIGNAL 2 shown in the figure above.

Parameters No. 7236 to No. 7243:
  Set the character codes of SIGNAL 3 shown in the figure above.

Parameters No. 7244 to No. 7251:
  Set the character codes of SIGNAL 4 shown in the figure above.

Parameters No. 7252 to No. 7259:
  Set the character codes of SIGNAL 5 shown in the figure above.

Parameters No. 7260 to No. 7267:
  Set the character codes of SIGNAL 6 shown in the figure above.

Parameters No. 7268 to No. 7275:
  Set the character codes of SIGNAL 7 shown in the figure above.

Parameters No. 7276 to No. 7283:
  Set the character codes of SIGNAL 8 shown in the figure above.

The character codes are shown in Appendix A CHARACTER CODE LIST.

7284	**Name of general-purpose switch on software operator's panel (extended)**
7285	**Name of general-purpose switch on software operator's panel (extended)**
7286	**Name of general-purpose switch on software operator's panel (extended)**
:	:
7299	**Name of general-purpose switch on software operator's panel (extended)**
7352	**Name of general-purpose switch on software operator's panel (extended)**
7353	**Name of general-purpose switch on software operator's panel (extended)**
7354	**Name of general-purpose switch on software operator's panel (extended)**
:	:
7399	**Name of general-purpose switch on software operator's panel (extended)**

[Data type] Byte

Set the names of the general-purpose switches (SIGNAL 9 to SIGNAL 16) on the software operator's panel, as described below.

```
OPERATOR'S PANEL     O1234 N5678

   SIGNAL1     :  OFF    ON
   SIGNAL2     :  OFF    ON
   SIGNAL3     :  OFF    ON
   SIGNAL4     :  OFF    ON
   SIGNAL5     :  OFF    ON
   SIGNAL6     :  OFF    ON
   SIGNAL7     :  OFF    ON
   SIGNAL8     :  OFF    ON
```

These names are set using the character codes displayed in parameters No.7284 through No.7299, and parameters No.7352 through No.7399.

Parameter No.7284:
    Set the character code (083) corresponding to S of SIGNAL 9.

Parameter No.7285:
    Set the character code (073) corresponding to I of SIGNAL 9.

Parameter No.7286:
    Set the character code (071) corresponding to G of SIGNAL 9.

Parameter No.7287:
    Set the character code (078) corresponding to N of SIGNAL 9.

Parameter No.7288:
    Set the character code (065) corresponding to A of SIGNAL 9.

Parameter No.7289:
    Set the character code (076) corresponding to L of SIGNAL 9.

Parameter No.7290:
    Set the character code (032) corresponding to (space) of SIGNAL 9.

Parameter No.7291:
    Set the character code (057) corresponding to 9 of SIGNAL 9.

Similarly, set character codes as shown below.
Parameters No.7292 to No.7299:
Set character codes for SIGNAL 10, shown above.
Parameters No.7352 to No.7359:
Set character codes for SIGNAL 11, shown above.
Parameters No.7360 to No.7367:
Set character codes for SIGNAL 12, shown above.
Parameters No.7368 to No.7375:
Set character codes for SIGNAL 13, shown above.
Parameters No.7376 to No.7383:
Set character codes for SIGNAL 14, shown above.
Parameters No.7384 to No.7391:
Set character codes for SIGNAL 15, shown above.
Parameters No.7392 to No.7399:
Set character codes for SIGNAL 16, shown above.
The character codes are shown in the character code correspondence table in Appendix A.

4.56 PARAMETERS OF PROGRAM RESTART

	#7	#6	#5	#4	#3	#2	#1	#0
7300	MOU	MOA						
	MOU	MOA			SJG			

[Data type] Bit

SJG Return feedrate in program restart operation

0 : Dry run feedrate

1 : Jog feedrate

MOA In program restart operation, before movement to a machining restart point after restart block search:

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.

> **NOTE**
> This parameter is enabled when bit 7 (MOU) of parameter No. 7300 is set to 1.

MOU In program restart operation, before movement to a machining restart point after restart block search:

0 : The M, S, T, and B codes are not output.

1 : The last M, S, T, and B codes are output.

7310	Movement sequence to program restart position

This parameter can also be set on the “Setting screen”.

[Data type] Byte axis

[Valid data range] 1 to number of controlled axes

This parameter sets the axis sequence when the machine moves to the restart point by dry run after a program is restarted.

[Example] The machine moves to the restart point in the order of the fourth, first, second, and third axes one at a time when the first axis = 2, the second axis = 3, the third axis = 4, and the fourth axis = 1 are set.

4.57 PARAMETERS OF HIGH-SPEED MACHINING (HIGH-SPEED CYCLE MACHINING / HIGH-SPEED REMOTE BUFFER)

	#7	#6	#5	#4	#3	#2	#1	#0
7501	IPC	IT2	IT1	IT0				CSP

[Data type] Bit

CSP Servo mode Cs contour control function is:
0 : Not used.
1 : Used.

IT0, IT1, IT2

IT2	IT1	IT0	Interpolation of G05 data (msec)
0	0	0	8
0	0	1	2
0	1	0	4
0	1	1	1
1	0	0	16
1	0	1	Prohibited
1	1	0	0.25
1	1	1	0.5

IPC
0 : The system does not monitor whether a distribution process is stopped while high-speed machining (G05) is performed with high-speed remote buffer A or B or in a cycle machining.
1 : The system monitors whether a distribution process is stopped while high-speed machining (G05) is performed with high-speed remote buffer A or B or in a cycle machining.
(P/S alarms 179 and 000 are simultaneously issued if the distribution process is stopped. In this case, the power must be turned off then on again.)

> **NOTE**
> The distribution process stops, when the host cannot send data with the high-speed remote buffer by the specified time.

	#7	#6	#5	#4	#3	#2	#1	#0
7502			LC2	LC1	L8M		PMX	
			LC2	LC1	L8M		PMX	SUP

[Data type] Bit

SUP In high-speed remote buffering and high-speed machining:
0 : Acceleration/deceleration control is not applied.
1 : Acceleration/deceleration control is applied.

PMX A PMC axis control command in high-speed cycle machining (G05) is:
0 : Ignored.
1 : Executed.

L8M In high-speed cycle machining (G05) with an interpolation period of 8 msec, digital servo learning control is:
0 : Not applied.
1 : Applied.

LC1, LC2 The servo learning function of the high-speed cycle machining retract function is enabled or disabled as indicated below.

LC2	LC1	Description
0	0	Disables the servo learning function, after which retract operation starts.
0	1	Disables the servo learning function upon the completion of retract operation.
1	0	Disables the servo learning function upon the completion of a retract cycle.

	#7	#6	#5	#4	#3	#2	#1	#0
7503				HCT	RB8	RNR	BDC	

[Data type] Bit

BDC In high-speed binary operation, the deceleration function is:
0 : Disabled.
1 : Enabled.

RNR In the reset status after retract operation by the retract function in a high-speed remote buffer:
0 : The reset signal RST <F0001#1> is set to 1.
1 : The reset signal RST <F0001#1> is set to 0.

RB8 The maximum allowable number of axes controlled by high-speed remote buffer A is:
0 : 6 axes.
1 : 8 axes.

HCT The variable number for starting storage of high-speed cycle machining distribution data is:
0 : Specified by 1/10.
1 : Specified by 1/100.

	#7	#6	#5	#4	#3	#2	#1	#0
7505							HUNx	HSCx

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit axis

HSCx Specifies whether each axis is used for high-speed distribution in a high-speed cycle or with a high-speed remote buffer.
0 : Not used for high-speed distribution.
1 : Used for high-speed distribution

HUNx Specifies whether the unit of data to be distributed during high-speed cycle machining (G05) is ten times the least input increment.
0 : The unit of data is the same as the least input increment.
1 : The unit of data is ten times the least input increment.

NOTE
This parameter is used when a data item to be distributed exceeds a word in terms of the least input increment or the maximum travel speed.
The data to be distributed for machining in a high-speed cycle for the axes in which this parameter HUNX = 1 is set.
Thus, when using parameter HUNx, set one-tenth the data to be distributed for machining in a high-speed cycle for the set axis.

7510	Maximum allowable number of simultaneous axes when G05 is specified for high-speed cycle machining, maximum allowable number of axes controlled by the high-speed remote buffer, or maximum allowable number of axes controlled in the high-precision/AI high-precision/AI nano high-precision contour control/five-axis machining function mode

[Data type] Word

[Valid data range] 1, 2, 3 to number of controlled axes

This parameter sets the maximum allowable number of simultaneous axes when G05 is specified for high-speed cycle machining, the maximum allowable number of axes controlled by the high-speed remote buffer, or the maximum allowable number of axes controlled in the high-precision/AI high-precision/AI nano high-precision contour control/five-axis machining function mode.

[Example] When the axes consists of the X-axis, Z-axis, C-axis, Y-axis, and A-axis in this order, and AI high-precision/AI nano high-precision contour control is to be enabled for the fourth axis (Y), 4 is to be set in this parameter. In this case, AI high-precision/AI nano high-precision contour control is enabled also for the X-axis, Z-axis, and C-axis.

X-axis, Z-axis, C-axis, Y-axis:

Axes for which AI high-precision/AI nano high-precision contour control is enabled

A-axis:

AI high-precision/AI nano high-precision contour control is disabled.

NOTE

When exercising simple synchronous control (M series) in the AI high-precision contour control, AI nano high-precision contour control, or five-axis machining function mode, set a value considering the slave axes for simple synchronous control. (For high-precision contour control, slave axes need not be considered.)

7514	Retract direction and retract feedrate in high-speed cycle machining retract operation

[Data type] 2-word axis

[Unit of data, valid data range]

Input increment	Units of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	-30 to -240000 30 to 240000	-30 to -100000 30 to 100000
Inch machine	0.1 inch/min	-30 to -96000 30 to 96000	-30 to -48000 30 to 48000

This parameter sets a retract direction and retract feedrate along each axis in a high-speed cycle machining retract operation. The retract direction is specified by a sign.

7515	Number of retract operation distributions in a high-speed cycle machining retract operation

[Data type] 2-word
[Unit of data] Number of distributions
[Valid data range] 0 to 99999999

This parameter sets the number of retract operation distributions in a high-speed cycle machining retract operation.

When the cycle currently being executed ends before the number of distributions specified in this parameter are performed, retract operation is terminated. When 0 is specified in this parameter, the number of retract operation distributions is assumed to be infinite. In this case, retract operation is performed until the cycle currently being executed ends.

7521	Retract time constant

[Data type] Word axis
[Unit of data] msec
[Valid data range] 1 to 4000

This parameter sets the time constant for time-setting linear acceleration/deceleration used in retract operation during high-speed remote buffer operation for each axis. (Time constant for deceleration at stop)

NOTE

The time constant setting is shifted according to the data interpolation period during high-speed remote buffer operation.

- When the interpolation period is 8 msec, a multiple of 8 in msec is used as the time constant.
- When the interpolation period is 4 msec, a multiple of 4 in msec is used as the time constant.
- When the interpolation period is 2 msec, a multiple of 2 in msec is used as the time constant.
- When the interpolation period is less than 1 msec, the unit of the time constant is msec.

When the time constant setting is not a multiple of 8, 4, or 2, it is rounded up to the nearest multiple of 8, 4, or 2.

[Example] When the setting is 9:

1) When the interpolation period is 8 msec, the time constant is 16 msec.
2) When the interpolation period is 4 msec, the time constant is 12 msec.
3) When the interpolation period is 2 msec, the time constant is 10 msec.
4) When the interpolation period is less than 1 msec, the time constant is 9 msec.

7522	Retract amount

[Data type] 2-word axis

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Linear axis (input in mm)	0.01	0.001	0.0001	mm
Linear axis (input in inches)	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

This parameter sets the amount of travel by retract operation during high-speed remote buffer operation for each axis.

7523	Retract feedrate

[Data type] 2-word axis

[Unit of data, valid data range]

Input increment	Units of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	30 to 240000	6 to 100000
Inch machine	0.1 inch/min	30 to 96000	6 to 48000
Rotary axis	1 deg/min	30 to 240000	6 to 100000

This parameter sets the traverse feedrate in retract operation during high-speed remote buffer operation for each axis.

NOTE

The sum of the feedrate in high-speed remote buffer operation and that set in this parameter is limited according to the interpolation period. If the maximum feedrate listed in the following table is exceeded, P/S alarm No. 179 is issued.

Input increment	Unit of data	Interpolated time	Valid data range	
			IS-A, IS-B	IS-C
Metric machine	1 mm/min	16,8,4 msec	490000	49000
		2 msec	980000	98000
		1 msec	1960000	196000
		0.5 msec	3920000	392000
Inch machine	0.1 inch/min	16,8,4 msec	190000	19000
		2 msec	380000	38000
		1 msec	760000	76000
		0.5 msec	1530000	153000
Rotary axis	1 deg/min	16,8,4 msec	490000	49000
		2 msec	980000	98000
		1 msec	1960000	196000
		0.5 msec	3920000	392000

7524	Reference axis for retraction

[Data type] Byte

[Valid data range] 0 to 6

In retract operation during high-speed remote buffer operation, when a reference axis passes through a fixed position in cyclic operation, deceleration can be started at the specified timing (position of the reference axis).

Set the number of a reference controlled axis in this parameter and the absolute coordinate position in parameter No. 7523. After the retract signal is input, deceleration starts when the reference axis passes through the specified absolute coordinate position.

0 : Deceleration starts immediately after the retract signal is input.

1 to 6: Deceleration starts when the specified reference axis passes through the absolute position set in parameter No. 7525.

7525	Absolute coordinate position of the reference axis for retraction

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Linear axis (input in mm)	0.01	0.001	0.0001	mm
Linear axis (input in inches)	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

In retract operation during high-speed remote buffer operation, when a reference axis passes through a fixed position in cyclic operation, deceleration can be started at the specified timing (position of the reference axis).

Set the number of a reference controlled axis in parameter No. 7524 and the absolute coordinate position in this parameter. After the retract signal is input, deceleration starts when the reference axis passes through the specified absolute coordinate position.

This parameter sets the absolute coordinate position.

4.58 PARAMETERS OF ROTARY TABLE DYNAMIC FIXTURE OFFSET

	#7	#6	#5	#4	#3	#2	#1	#0
7570								
							FK1	FTP

[Data type] Bit

FTP Fixture offset type setting
- 0 : Movement type
  (The tool moves when the fixture offset changes.)
- 1 : Shift type
  (The tool does not move when the fixture offset changes.)

FK1 When bit 7 (KEY) of parameter No. 3290 is set to 0, input of fixture offset data using MDI keys is:
- 0 : Disabled when signal KEY1 is set to 0 or enabled when the signal is set to 1.
  (Same as for the input enable conditions for the tool offset value)
- 1 : Enabled when signal KEY1 is set to 0 or disabled when the signal is set to 1.
  (Inverse of the input enable conditions for the tool offset value)

	#7	#6	#5	#4	#3	#2	#1	#0
7575								
								FAXx

[Data type] Bit axis

FAXx Axis-by-axis fixture offset is:
- 0 : Disabled.
- 1 : Enabled.

7580	Specification of a rotary axis for fixture offset (first group)
7581	Specification of linear axis 1 used for selecting a plane for fixture offset (first group)
7582	Specification of linear axis 2 used for selecting a plane for fixture offset (first group)
7583	Specification of a rotary axis for fixture offset (second group)
7584	Specification of linear axis 1 used for selecting a plane for fixture offset (second group)
7585	Specification of linear axis 2 used for selecting a plane for fixture offset (second group)
7586	Specification of a rotary axis for fixture offset (third group)
7587	Specification of linear axis 1 used for selecting a plane for fixture offset (third group)
7588	Specification of linear axis 2 used for selecting a plane for fixture offset (third group)

[Data type] Byte

[Valid data range] 1 to number of controlled axis

These parameters specify rotary axes for fixture offset and pairs of linear axes for selecting a rotation plane. Specify a pair of linear axes so that rotation from the positive direction of linear axis 1 to the positive direction is in the normal direction of the rotary axis.

Up to three groups of a rotary axis setting and two linear axis settings can be specified. The fixture offset value is calculated first for the rotary axis in the first group. Then, for the second and third groups, the fixture value is sequentially calculated using the previous calculation result. When you do not need the third group, set 0 for the rotary axis.

4.59 PARAMETERS OF POLYGON TURNING

	#7	#6	#5	#4	#3	#2	#1	#0
7600	PLZ						PQE	

[Data type] Bit

PQE The specifiable range of a rotation ratio for polygon turning is:
0 : P = 1 to 9, Q = -9 to -1, 1 to 9
1 : P = 1 to 999, Q = -999 to -1, 1 to 999

PLZ Synchronous axis using G28 command
0 : Returns to the reference position in the same sequence as the manual reference position return.
1 : Returns to the reference position by positioning at a rapid traverse.
The synchronous axis returns to the reference position in the same sequence as the manual reference position return when no return-to-reference position is performed after the power is turned on.

	#7	#6	#5	#4	#3	#2	#1	#0
7602			COF	HST	HSL	HDR	SNG	MNG

[Data type] Bit

MNG The rotational direction of the master axis in the polygon machining mode with two spindles is:
0 : Not reversed.
1 : Reversed.

SNG The rotational direction of the polygon synchronous axis in the polygon machining mode with two spindles is:
0 : Not reversed.
1 : Reversed.

HDR When phase control is exercised in polygon machining mode with two spindles (COF = 0), the phase shift direction is:
0 : Not reversed for phase synchronous control.
1 : Reversed for phase synchronous control.

> **NOTE**
> Use MNG, SNG, and HDR when the specified rotational direction of the master axis or polygon synchronous axis, or the specified phase shift direction is to be reversed in polygon machining mode with two spindles.

HSL When phase control is exercised in polygon machining mode with two spindles (COF = 0), this parameter selects the spindle that is subject to a phase shift operation for phase synchronous control:
0 : The polygon synchronous axis (second spindle) is selected.
1 : The master axis (first spindle) is selected.

HST When phase control is applied in polygon machining mode with two spindles (COF = 0), and polygon machining mode with two spindles is specified:

0 : Polygon machining mode with two spindles is entered with the current spindle speed maintained.

1 : Polygon machining mode with two spindles is entered after the spindle is stopped automatically.

NOTE

This parameter can be used, for example, when single-rotation signal detection cannot be guaranteed at an arbitrary feedrate because a separate detector is installed to detect the spindle single-rotation signal, as when a built-in spindle is used. (When bit 7 of parameter No.4016 for the serial spindle is set to 1, together with this parameter, a single-rotation signal detection position in polygon machining mode with two spindles is guaranteed.)

COF In polygon machining mode with two spindles, phase control is:

0 : Used.

1 : Not used.

NOTE

When the use of phase control is not selected, the steady state is reached in a shorter time because phase synchronous control is not applied. Once steady rotation is achieved, however, polygon machining must be completed without changing the steady state. (If the rotation is stopped, or the rotational speed altered, polygon machining is disabled because of the inevitable phase shift.)
Even when this parameter is set to 1, an R command (phase position command) in a block containing G51.2 is ignored ; no alarm is issued.

	#7	#6	#5	#4	#3	#2	#1	#0
7603	PST		RDG		PLR	SBR	QDR	RPL

[Data type] Bit

RPL Upon reset, polygon machining mode with two spindles is:

0 : Released.

1 : Not released.

QDR The rotational direction of the polygon synchronous axis on the polygon machining mode with two spindles:
- 0 : Depends on the sign (+/-) of a specified value for Q.
- 1 : Depends on the rotational direction of the first spindle. (If - is specified for Q, P/S alarm No.218 is issued.)

SBR For spindle synchronous control, speed ratio control is:
- 0 : Disabled.
- 1 : Enabled.

NOTE
1. This parameter is used to set the slave spindle speed to a multiple of the master spindle speed when the spindle synchronous control function is used.
2. This parameter is irrelevant to the polygon turning function and the polygon machining function with two spindles.
3. The spindle synchronous control option is needed.
4. Parameter Nos. 7635 and 7636 also need be set up.

PLR The machine coordinates of a tool axis for polygon turning are:
- 0 : Rounded by the setting in parameter No. 7620.
- 1 : Rounded by 360° (or the setting in parameter No. 1260 when bit 0 (ROA) of parameter No. 1008 is set to 1).

RDG On the diagnosis screen No.476, for polygon phase command value (R) with two spindles, displays:
- 0 : The specified value (in the increment system for the rotary axis).
- 1 : The actual number of shift pulses.

NOTE
A phase command is specified in address R, in units of degrees. For control, the actual shift amount is converted to a number of pulses according to the conversion formula: 360 degrees = 4096 pulses. This parameter switches the display of a specified value to that of a converted value.

PST The polygon spindle stop signal *PLSST <G038#0> is:
- 0 : Not used.
- 1 : Used.

7610	Controlled axis number of tool rotary axis for polygon turning

[Data type] Byte

[Valid data range] 1, 2, 3, . . . number of controlled axes

This parameter sets the controlled axis number of a tool rotary axis used for polygon turning.

7620	Movement of tool rotary axis per revolution

[Data type] 2-word

Input increment	IS-A	IS-B	IS-C	Unit
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] 1 to 9999999

This parameter sets the movement of a tool rotary axis per revolution.

7621	Maximum allowable speed for the tool rotary axis (polygon synchronous axis)

[Data type] Word

[Unit of data] min^{-1}

[Valid data range] For polygon turning using servo motors:

$$0 \text{ to } \frac{1.2 \times 10^8}{\text{Set value of the parameter No.7620}}$$

For polygon turning with two spindles:

Set a value between 0 and 32767, but which does not exceed the maximum allowable speed, as determined by the performance of the second spindle and other mechanical factors.

This parameter sets the maximum allowable speed of the tool rotary axis (polygon synchronous axis).

If the speed of the tool rotary axis (polygon synchronous axis) exceeds the specified maximum allowable speed during polygon turning, the speed is clamped at the maximum allowable speed. When the speed is clamped at a maximum allowable speed, however, synchronous control between the spindle and tool rotary axis (polygon synchronous axis) is lost. And, when the speed is clamped, P/S alarm No.5018 is issued.

7631	Allowable spindle speed deviation level in polygon machining with two spindles

[Data type] Byte

[Unit of data] min^{-1}

[Valid data range] 0 to 255

[Standard setting value] 1 to 10

This parameter sets the allowable level of deviation between the actual speed and specified speed of each spindle in polygon machining with two spindles. (The value set with this parameter is used for both the master axis and polygon synchronous axis.)

7632	Steady state confirmation time duration in polygon machining with two spindles

[Data type] Word

[Unit of data] msec

[Valid data range] 0 to 32767

This parameter sets the duration required to confirm that both spindles have reached their specified speeds in polygon machining with two spindles.

If the state where the speed of each spindle is within the range set with parameter No.7631, and has lasted at least for the duration specified with parameter No.7632, the spindle polygon speed arrival signal PSAR <F0063#2> is set to 1.

7635	Multiplier influencing the slave spindle speed

[Data type] Byte

[Unit of data] Slave spindle (min^{-1})/master spindle (min^{-1})

[Valid data range] 1 to 9

Set up a multiplier that will act on the distance through which the slave spindle is to move.

In speed ratio control, the relationship between the speeds of the spindles is:

Slave spindle speed = Master spindle speed × Setting of parameter No. 7635

NOTE

1 This parameter is used to set the slave spindle speed to a multiple of the master spindle speed when the spindle synchronous control function is used.

2 This parameter is irrelevant to the polygon turning function and the polygon machining function with two spindles.

3 The spindle synchronous control option is needed.

4 Bit 2 (SBR) of parameter No. 7603 and parameter No. 7636 also need be set up.

7636	Upper limit of the slave spindle speed

[Data type] Word

[Unit of data] min^{-1}

[Valid data range] 1 to 19999

Specify a clamp speed for the slave spindle. If the slave spindle speed calculated from the master spindle speed exceeds the specified slave spindle clamp speed, the actual slave spindle speed is clamped at this clamp speed. At the same time, the master spindle speed is decreased to maintain a constant spindle rotation ratio.

NOTE

1 This parameter is used to set the slave spindle speed to a multiple of the master spindle speed when the spindle synchronous control function is used.
2 This parameter is irrelevant to the polygon turning function and the polygon machining function with two spindles.
3 The spindle synchronous control option is needed.
4 Bit 2 (SBR) of parameter No. 7603 and parameter No. 7635 also need be set up.

7640	Master axis in polygon machining with two spindles

7641	Polygon synchronous axis in polygon machining with two spindles

[Data type] Byte

[Valid data range] 0, 1 to number of spindles, or
$m \times 10 + n$ (m:1 to number of paths, n:1 to number of spindles)

These parameters set the master and polygon synchronous (slave) axes in polygon machining with two spindles.

[Settings]
1 to 4 : First to fourth serial spindles of the local path
11 to 14 : First to fourth serial spindles of path 1
21 to 24 : First to fourth serial spindles of path 2
31 to 32 : First to second serial spindles of path 3

NOTE

1. Polygon machining option with two spindles is enabled only for serial spindles.
2. When any one of parameters No. 7640 and No. 7641 is set to 0, polygon turning is performed using the first spindle (master axis) and the second spindle (polygon synchronous axis) in the path to which the parameter belongs.
3. When one of the second to fourth serial spindles is used as a master axis, and the S command is to be used for the master axis, the multi-spindle control option is required.
4. When the PMC window function or G10 command is used to rewrite this parameter, rewrite this parameter before the block specifying the polygon machining command G51.2 (G251) with two spindles. When the PMC window function is used to rewrite this parameter in the block immediately before G51.2 (G251), specify the rewriting of this parameter by using an M code (parameters No. 3411 to No. 3420) without buffering.

4.60 PARAMETERS OF EXTERNAL PULSE INPUT

7681	Setting 1 for the ratio of an axis shift amount to external pulses (M)

[Data type] Word
[Valid data range] 1 to 255

7682	Setting 2 for the ratio of an axis shift amount to external pulses (N)

[Data type] Word
[Valid data range] 1 to 1000

4.61 PARAMETERS OF HOBBING MACHINE AND SIMPLE ELECTRIC GEAR BOX (EGB)

	#7	#6	#5	#4	#3	#2	#1	#0
7700		DPS			MLT	HDR	CMS	HBR
		DPS	RTO		MLT	HDR	CMS	HBR

[Data type] Bit

HBR Upon reset, synchronous control between the C-axis and hob axis (M series: G81, T series: G81.4) and the EGB synchronous control mode (G81, G81.5) are:
- 0 : Cancelled.
- 1 : Not cancelled.

CMS
- 0 : The position manually set with a single rotation signal is canceled when a synchronous control cancel command (G80 for M series, G80.4 for T series, reset) is issued.
- 1 : The position manually set with a single rotation signal is not canceled when a synchronous control cancel command (G80 for M series, G80.4 for T series, reset) is issued.

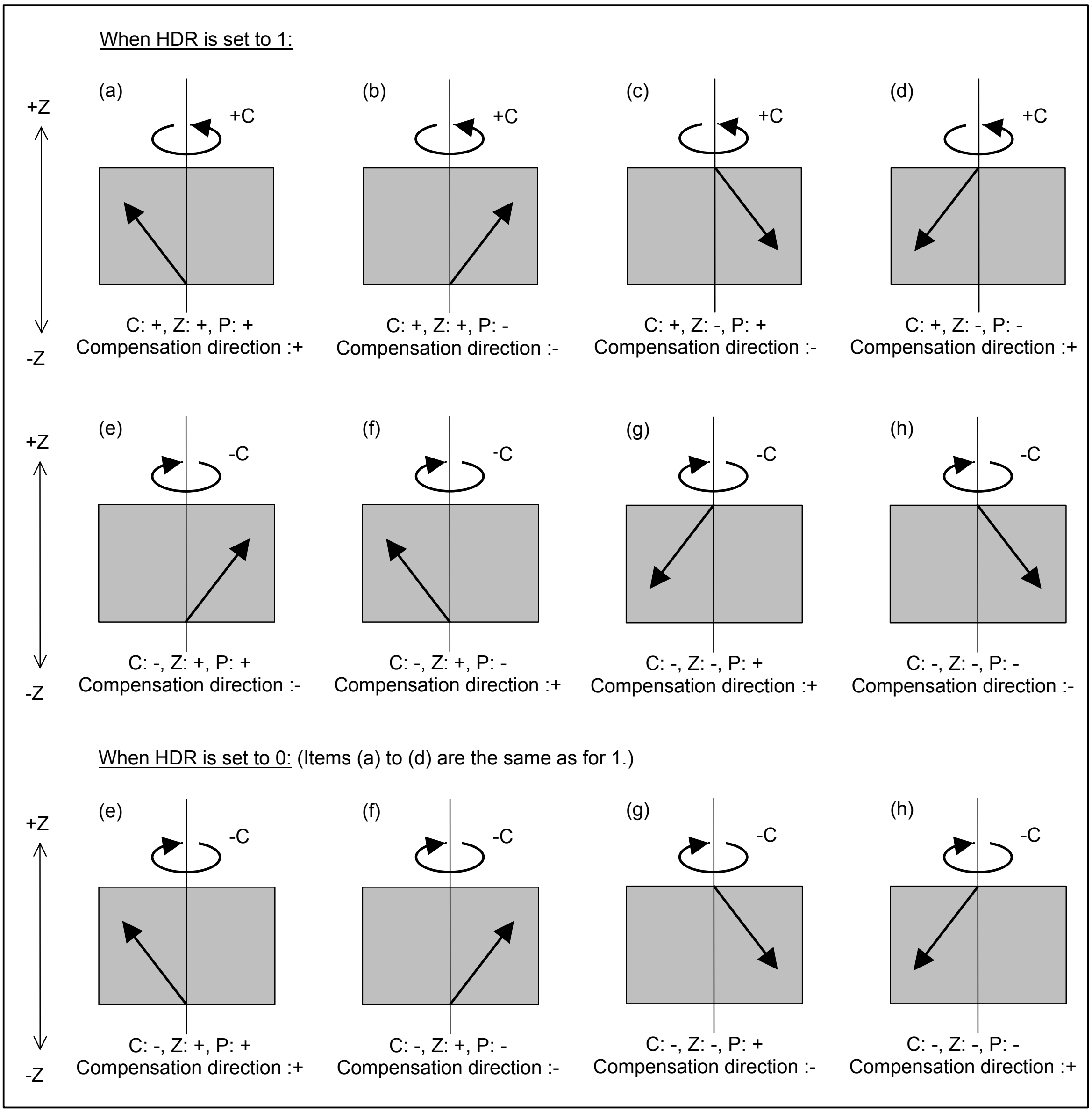
HDR Setting of the direction for compensating a helical gear (1 is usually specified.)

[Example]

When the rotation direction of the C-axis is negative (- direction) and a left-twisted helical gear is cut:

0 : A negative (-) value is specified with P.

1 : A positive (+) value is specified with P.



MLT Unit of data for the magnification for compensating C-axis servo delay (parameters No.7714 and No.7715)

0 : 0.001

1 : 0.0001

RTO Gear ratio for the spindle and position coder specified in parameter No.3706

0 : Disabled (Always specify 0.)

1 : Enabled

DPS Display of actual spindle speed
0 : The hob-axis speed is displayed.
1 : The spindle speed is displayed.

	#7	#6	#5	#4	#3	#2	#1	#0
7701	HBD		DLY	JHD		SM3	SM2	SM1
			DLY	JHD	LZE	SM3	SM2	SM1

[Data type] Bit

SM3, SM2, SM1 Specify the number of times a feedback pulse from the position coder is sampled when the hobbing machine function is used.

SM3	SM2	SM1	Number of times the pulse is sampled
0	0	0	4
0	0	1	1
0	1	0	2
0	1	1	16
1	0	0	32
1	1	0	4
1	1	1	4

LZE If L (number of hob threads) = 0 is specified at the start of EGB synchronous control:
0 : Synchronous control is started, assuming that L = 1 is specified.
1 : Synchronous control is not started, assuming that L = 0 is specified. However, helical gear compensation is performed.

JHD While the C-axis and hob axis are synchronized with each other (in the G81 mode for M series or G81.4 mode for T series), jog and handle feeds around the C-axis are
0 : Disabled
1 : Enabled

DLY Compensating C-axis servo delay with G84 for M series or G84.4 for T series is
0 : Disabled
1 : Enabled

HBD When inch input is used, a command based on a diametral pitch is:
0 : Invalid.
1 : Valid.

	#7	#6	#5	#4	#3	#2	#1	#0
7702								
	PHD	PHS			ART	U28		TDP

[Data type] Bit

TDP The specifiable number of teeth, T, of the simple electric gear box (EGB) is:
0 : 1 to 1000
1 : 0.1 to 100 (1/10 of a specified value).

NOTE
In either case, a value from 1 to 1000 can be specified.

U28 If a reference position return operation using G28 is performed after a synchronization-based movement on the U-axis under U-axis control based on the simple electric gear box (EGB):
0 : An alarm (servo alarm 405) is issued.
1 : No alarm is issued.

> **NOTE**
> After a synchronization-based movement on the axis under U-axis control, the error corresponding to synchronization pulses occurs between the machine coordinate and the actual motor position. So, when G28 is executed, servo alarm 405 is issued after moving to the reference position. If this parameter is set to 1, servo alarm 405 is not detected even when the error corresponding to synchronization pulses occurs due to U-axis control.

ART The retract function executed when an alarm is issued is:
0 : Disabled.
1 : Enabled.
When an alarm is issued, the tool is retracted at the specified feedrate by the specified amount of travel.
(Parameters Nos. 7750 and 7751)

> **NOTE**
> If a servo alarm is issued for an axis along which the tool is not retracted, servo motor activation is kept until completion of retraction.

PHS When the G81/G80 block contains no R command:
0 : Acceleration/deceleration is not performed at EGB synchronous control start/cancellation.
1 : Acceleration/deceleration is performed at EGB synchronous control start/cancellation. After acceleration/deceleration at synchronous control start, phase synchronous control is automatically performed.

PHD Direction of movement for automatic EGB phase synchronous control
0 : Positive (+) direction
1 : Negative (-) direction

	#7	#6	#5	#4	#3	#2	#1	#0
7703					LFS	ARO	ARE	ERV

[Data type] Bit

ERV During EGB synchronous control, feed per revolution is performed:
0 : For feedback pulses.
1 : For pulses converted to the feedrate for the workpiece axis.

> **NOTE**
> When this parameter is set to 1, a value needs to be set in parameter No. 7711.

ARE When the EGB alarm retract function is used, retract operation is performed:
0 : During EGB synchronous control or automatic operation (OP<F000#7> = 1).
1 : During EGB synchronous control. (Retract operation is not performed even during automatic operation if EGB synchronous control is not in progress.)

ARO When the EGB alarm retract function is used, retract operation is performed:
0 : During EGB synchronous control.
1 : During EGB synchronous control and automatic operation (OP<F000#7> = 1).

ARE	ARO	Retract operation
0	0	During EGB synchronous control or automatic operation
0	1	
1	0	During EGB synchronous control
1	1	During EGB synchronous control and automatic operation

> **NOTE**
> This parameter is valid when bit 1 (ARE) of parameter No. 7703 is set to 1.

LFS For inter-spindle synchronous control under spindle leaning control:
0 : The simple electric gear box (EGB) is used.
1 : Flexible synchronous control (FSC) is used.

> **NOTE**
> This parameter is invalid if leaning control is not used.

	#7	#6	#5	#4	#3	#2	#1	#0
7704							HBC	
								ACR

[Data type] Bit

ACR In the high-precision contour control, AI contour control, or advanced preview control mode, the general-purpose retract function is:
0 : Not used.
1 : Used.
(See the description of parameter No. 7745.)

HBC For a synchronous axis number and the number of the axial feed axis for a helical gear:
0 : The settings of parameter No. 7710 (synchronous axis number) and parameter No. 7709 (number of the axial feed axis for a helical gear) are valid.
1 : The settings of parameter No. 7718 (synchronous axis number) and parameter No. 7719 (number of the axial feed axis for a helical gear) are valid.

7709	Number of the axial feed axis for a helical gear

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

[Data type] Byte
[Valid range] 1, 2, 3 to number of controlled axes
This parameter sets the number of the axial feed axis for a helical gear. If the value out of the valid range is specified, the 3rd axis (M series) or the 2nd axis (T series) is specified.

7710	Number of a synchronous axis

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

[Data type] Byte
[Valid range] 1, 2, 3 to number of controlled axes
This parameter sets the number of the axis (workpiece) that is synchronized with the hob axis (cutter). If a value out of the valid range is specified, the 4th axis (M series) or the 3rd axis (T series) is assumed.

7711	Gear ratio for the hob axis and position coder

[Data type] Byte
[Unit of data] 1 time
[Valid range] 1 to 20
This parameter sets the gear ratio for the hob axis and position coder.

7712	Time constant for C-axis acceleration/deceleration during rotation with the hob axis and C-axis synchronized with each other

[Data type] Word
[Unit of data] msec
[Valid range] 0 to 4000

This parameter sets the time constant for C-axis exponential acceleration/deceleration during rotation with the hob axis and C-axis synchronized with each other.

> **NOTE**
> Acceleration/deceleration is applied to G01, G83 (M series), G83.4 (T series), or compensation of a helical gear with the time constant and FL speed for acceleration/deceleration during cutting feed (parameters 1622 and 1623).

7713	FL speed of C-axis acceleration/deceleration during rotation with the hob axis and C-axis synchronized each other

[Data type] Word
[Unit of data, valid data range]

Units of data	Valid data range	
	IS-B	IS-C
1 deg/min	6 to 15000	6 to 12000

This parameter sets the FL speed of C-axis exponential acceleration/deceleration during rotation with the hob axis and C-axis synchronized with each other.

7714	Magnification 2 for compensation of C-axis servo delay by G83 (M series) or G83.4 (T series)

[Data type] Word
[Unit of data] 0.0001 or 0.001 (dependent on the setting of bit 3 (MLT) of parameter No. 7700)
[Valid range] 500 to 2000

This parameter sets the magnification 2 for compensation of C-axis servo delay by G83 (M series) or G83.4 (T series).

7715	Magnification 1 for compensation of C-axis servo delay by G83 (M series) or G83.4 (T series)

[Data type] Word
[Unit of data] 0.0001 or 0.001 (dependent on the setting of bit 3 (MLT) of parameter No. 7700)
[Valid range] 500 to 2000

This parameter sets the magnification 1 for compensation of C-axis servo delay by G83 (M series) or G83.4 (T series).

7717	Delay time in EGB axis synchronous control cancellation

[Data type] Byte

[Unit of data] 0.1sec

[Valid range] 0 to 255

If a servo alarm is issued during EGB synchronous control and an alarm retract operation is performed, EGB axis synchronous control is canceled when the time set in this parameter has elapsed since completion of retract axis operation and issue of the servo alarm.

NOTE

Delay in EGB axis synchronous control cancellation using this parameter is not applicable in the following cases:

- When the servo alarm is issued for the axis engaged in EGB synchronous control
- When the activation of an axis that shares the amplifier used for the axis engaged in EGB synchronous control is turned off

7718	Number of a synchronous axis

[Data type] Byte

[Valid range] 1, 2, 3 to number of controlled axes

This parameter is valid when bit 1 (HBC) of parameter No. 7704 is set to 1.

This parameter sets the ordinal number of an axis to be used as the axis (workpiece) synchronized with the hob axis (cutter). If a value not within the valid data range is set in this parameter, the third axis is selected.

NOTE

1 If 0 is set in parameter No. 7718, the setting of parameter No. 7710 is used. If 0 is set also in parameter No. 7710 at this time, the third axis is used as the number of the synchronous axis.

2 Rewrite this parameter when hob synchronous control is canceled. Even if this parameter is rewritten during hob synchronous control (G81.4), the new setting of this parameter does not become valid until hob synchronous control is canceled then is restarted.

7719	Number of the axial feed axis for a helical gear

[Data type] Byte

[Valid range] 1, 2, 3 to number of controlled axes

This parameter is valid when bit 1 (HBC) of parameter No. 7704 is set to 1.

This parameter sets the ordinal number of the axial feed axis for a helical gear. If a value not within the valid data range is set in this parameter, the second axis is selected.

> **NOTE**
> 1 If 0 is set in parameter No. 7719, the setting of parameter No. 7709 is used. If 0 is set also in parameter No. 7709 at this time, the second axis is used as the number of the axial feed axis for a helical gear.
> 2 Rewrite this parameter when hob synchronous control is canceled. Even if this parameter is rewritten during hob synchronous control (G81.4), the new setting of this parameter does not become valid until hob synchronous control is canceled then is restarted.

	#7	#6	#5	#4	#3	#2	#1	#0
7730								RTRx

[Data type] Bit axis

RTRx Retraction function is:

0 : Disabled for each axis.

1 : Enabled for each axis.

7740	Feedrate during retraction for each axis

[Data type] 2-word axis

[Unit of data, valid data range]

Input increment	Units of data	Valid data range	
		IS-B	IS-C
Metric machine	1 mm/min	30 to 240000	6 to 100000
Inch machine	0.1 inch/min	30 to 96000	6 to 48000

This parameter sets the feedrate during retraction for each axis.

7741	Retracted distance for each axis

[Data type] 2-word axis

Input increment	Unit of data	
	IS-B	IS-C
Metric input	0.001 mm	0.0001 mm
Inch input	0.0001 inch	0.00001 inch

[Valid range] -99999999 to 99999999

This parameter sets the retracted distance for each axis.

7745	Time constant for linear acceleration/deceleration in retract operation for each axis

[Data type] Word axis

[Unit of data] msec

[Valid range] 0 to 4000

This parameter sets an acceleration rate for linear acceleration/deceleration in retract operation based on the general-purpose retract function. Set a time (time constant) used to reach the feedrate set in parameter No. 7740 for each axis.

> **NOTE**
> This parameter is valid when bit 0 (ACR) of parameter No. 7704 is set to 1.

7750	Feedrate during retraction performed when an alarm is issued

[Data type] 2-word axis

[Unit of data, valid data range]

Input increment	Units of data	Valid data range	
		IS-B	IS-C
Metric machine	1 mm/min	30 to 240000	6 to 100000
Inch machine	0.1 inch/min	30 to 96000	6 to 48000

This parameter sets the feedrate during retraction performed when an alarm is issued. Whether to perform the retraction depends on the setting of bit 3 (ART) of parameter No. 7702.

7751	
	Amount of retraction performed when an alarm is issued

[Data type] 2-word axis
[Unit of data]

Input increment	Unit of data	
	IS-B	IS-C
Metric input	0.001 mm	0.0001 mm
Inch input	0.0001 inch	0.00001 inch

[Valid data range] -99999999 to 99999999

This parameter sets the amount of retraction performed when an alarm is issued. Whether to perform the retraction depends on the setting of bit 3 (ART) of parameter No. 7702.

7771	
	Number of EGB axis

[Data type] Byte
[Valid data range] 1 to number of controlled axes

This parameter specifies the number of the EGB axis.

> **NOTE**
> 1 When this parameter is set, the power must be turned off before operation is continued.
> 2 Cannot set same number that is used as the workpiece axis.
> 3 For inch machines, a linear axis cannot be set as the EGB axis.

7772	
	Number of position detector pulses per rotation about tool axis

[Data type] 2-word
[Unit of data] Detection unit
[Valid data range] 1 to 99999999

This parameter specifies the number of pulses per rotation about the tool axis (on the spindle side), for the position detector.

Set this parameter, assuming that one cycle of the A/B phase represents four pulses.

> **NOTE**
> Specify the number of feedback pulses per rotation about the tool axis for the position detector, considering the gear ratio with respect to the position coder.

7773	Number of position detector pulses per rotation about workpiece axis

[Data type] 2-word
[Unit of data] Detection unit
[Valid data range] 1 to 99999999

This parameter specifies the number of pulses per rotation about the workpiece axis (on the slave side), for the position detector.

[Example] The number of feedback pulses for the position detector is 360000 for a rotary axis for which the detection unit is 0.001 deg.

7776	Feedrate during automatic phase synchronous control for the workpiece axis by the automatic EGB phase synchronous control function

[Data type] 2-word axis
[Unit of data]

Input increment	Unit of data	
	IS-B	IS-C
Deg/min	10.0 mm	1.0 mm

[Valid data range] -99999999 to 99999999

This parameter sets the feedrate during automatic phase synchronous control for the workpiece axis by the automatic EGB phase synchronous control function.

7777	Angle shifted from the spindle position (one-rotation signal position) the workpiece axis uses as the reference of phase synchronous control by the automatic EGB phase synchronous control function

[Data type] 2-word
[Unit of data]

Input increment	IS-B	IS-C	Unit
Rotary axis	0.001	0.0001	deg

[Valid data range] 0 to 3600000

This parameter sets the angle shifted from the spindle position (one-rotation signal position) the workpiece axis uses as the reference of phase synchronous control by the automatic EGB phase synchronous control function.

7782	Number of position detector pulses per rotation about the EGB master axis

[Data type] 2-word axis
[Unit of data] Detection unit
[Valid data range] 1 to 99999999

This parameter sets the number of position detector pulses per rotation about the EGB master axis.
Set this parameter, assuming that one cycle of the A/B phase represents four pulses.

7783	Number of position detector pulses per rotation about the EGB slave axis

[Data type] 2-word axis
[Unit of data] Detection unit
[Valid data range] 1 to 99999999

This parameter sets the number of position detector pulses per rotation about the EGB slave axis.
Set the number of pulses in the detection unit.

4.62 PARAMETERS OF AXIS CONTROL BY PMC

	#7	#6	#5	#4	#3	#2	#1	#0
8001	SKE	AUX	NCC		RDE	OVE		MLE

[Data type] Bit

MLE Whether all axis machine lock signal MLK <G044#1> is valid for PMC-controlled axes in axis control by PMC
0 : Valid
1 : Invalid

> **NOTE**
> Each-axis machine lock signals MLK1 to MLK8 <G108#0 to #7> are always valid, regardless of the setting of this parameter.

OVE Signals related to dry run and override used in axis control by PMC
0 : Same signals as those used for the CNC
(1) Feedrate override signals *FV0 to *FV7 <G012#0 to #7>
(2) Override cancellation signal OVC <G006#4>
(3) Rapid traverse override signals ROV1 and ROV2 <G014#0, #1>
(4) Dry run signal DRN <G046#7>
(5) Rapid traverse selection signal RT <G019#7>
1 : Signals specific to the PMC
(1) Feedrate override signals *FV0E to *FV7E <G151#0 to #7>
(2) Override cancellation signal OVCE <G150#5>
(3) Rapid traverse override signals ROV1E and ROV2E <G150#0, #1>
(4) Dry run signal DRNE <G150#7>
(5) Rapid traverse selection signal RTE <G150#6>

RDE Whether dry run is valid for rapid traverse in axis control by PMC
0 : Invalid
1 : Valid

NCC When a travel command is issued for a PMC-controlled axis (selected by a controlled-axis selection signal) according to the program:
0 : P/S alarm 139 is issued while the PMC controls the axis with an axis control command. While the PMC does not control the axis, a CNC command is enabled.
1 : P/S alarm 139 is issued unconditionally.

AUX The number of bytes for the code of an auxiliary function (12H) command to be output is
0 : 1 (0 to 255)
1 : 2 (0 to 65535)

SKE Skip signal during axis control by the PMC
- 0 : Uses the same signal SKIP <X004#7> as CNC.
- 1 : Uses ESKIP<X013#7>, the signal specific to axis control by PMC.

> **NOTE**
> 1 When 2-path control is used, this parameter is valid on the path 1 side only.
> 2 Even when this parameter is set to 1, the same signal, SKIP<X013#7>, as used with the CNC is used on the path 2 side.

	#7	#6	#5	#4	#3	#2	#1	#0
8002	FR2	FR1	PF2	PF1	F10	SUE	DWE	RPD

[Data type] Bit

RPD Rapid traverse rate for PMC-controlled axes in axis control by PMC
- 0 : Feedrate specified with parameter No.1420
- 1 : Feedrate specified with the feedrate data in an axis control command

DWE Minimum time which can be specified in a dwell command in PMC axis control when the increment system is IS-C
- 0 : 1 msec
- 1 : 0.1 msec

SUE Whether acceleration/deceleration is performed for an axis that is synchronized with external pulses, for external pulse synchronous control commands in PMC axis control
- 0 : Performed (exponential acceleration/deceleration)
- 1 : Not performed

F10 Set the least increment for the feedrate for cutting 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

PF1, PF2 Set the feedrate unit of feed per minute in axis control by PMC

PF2	PF1	Feedrate unit
0	0	1/1
0	1	1/10
1	0	1/100
1	1	1/1000

FR1, FR2 Set the least increment for the feedrate for cutting feed (per revolution) in axis control by PMC

<table>
<tr><th>FR2</th><th>FR1</th><th>Metric input</th><th>Inch input</th></tr>
<tr><td>0</td><td>0</td><td rowspan="2">0.0001 mm/rev</td><td rowspan="2">0.000001 inch/rev</td></tr>
<tr><td>1</td><td>1</td></tr>
<tr><td>0</td><td>1</td><td>0.001 mm/rev</td><td>0.00001 inch/rev</td></tr>
<tr><td>1</td><td>1</td><td>0.01 mm/rev</td><td>0.0001 inch/rev</td></tr>
</table>

	#7	#6	#5	#4	#3	#2	#1	#0
8003		JVB					PAX	PIM

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

PIM Specifies whether to cause an inch/metric input to affect the linear axis that is subjected only to PMC axis control (see the parameter No.1010), as follows:
0 : To affect.
1 : Not to affect.

PAX When the number of CNC-controlled axes (parameter No. 1010) is set to 0:
0 : All axes are assumed to be CNC axes.
1 : All axes are assumed to be PMC axes.

JVB When bit 4 (PVP) of parameter No. 8005 is set to 1, the maximum allowable time constant value (parameter No. 8028) is:
0 : 8000
1 : 32767

	#7	#6	#5	#4	#3	#2	#1	#0
8004	NDI	NCI	DSL			JFM	NMT	CMV
	NDI	NCI	DSL	G8R	G8C	JFM	NMT	CMV

[Data type] Bit

CMV When a move command and auxiliary function are specified from the CNC, and the system is awaiting the auxiliary function completion signal after completion of the specified axis movement:
0 : An alarm (No.130) is issued when an axis control command is issued from the PMC for the same axis.
1 : An axis control command, when issued from the PMC for the same axis, is executed.

NMT When a command is specified from the CNC for the axis on which the tool is moving according to axis control specification from the PMC:
0 : P/S alarm No.130 is issued.
1 : The command is executed without issuing an alarm, provided the command does not involve a movement on the axis.

JFM This parameter sets the units used to specify feedrate data when continuous feed is specified in axis control by the PMC.

Increment system	JFM	Metric input	Inch input	Rotary axis
IS-B	0	1 mm/min	0.01 inch/min	0.00023 min^{-1}
	1	200 mm/min	2.00 inch/min	0.046 min^{-1}
IS-C	0	0.1 mm/min	0.001 inch/min	0.000023 min^{-1}
	1	20 mm/min	0.200 inch/min	0.0046 min^{-1}

G8C Advanced preview control for the axes controlled by the PMC is:
0 : Disabled.
1 : Enabled.

> **NOTE**
> This parameter is valid for an axis for which bit 7 (NAHx) of parameter No.1819 is set to 0.

G8R Advanced preview control over axes controlled by the PMC is:
0 : Enabled for cutting feed (disabled for rapid traverse).
1 : Enabled for both cutting feed and rapid traverse.

> **NOTE**
> This parameter is valid for an axis for which bit 7 (NAHx) of parameter No.1819 is set to 0.

DSL If the selection of an axis is changed when PMC axis selection is disabled:
0 : P/S alarm No.139 is issued.
1 : The change is valid, and no alarm is issued for an unspecified system.

NCI In axis control by the PMC, a position check at the time of deceleration is:
0 : Performed.
1 : Not performed.

NDI In axis control by the PMC, when diameter programming is specified for a PMC-controlled axis:
0 : The amount of travel and feedrate are each specified with a radius.
1 : The amount of travel and feedrate are each specified with a diameter.

> **NOTE**
> NDI is valid for an axis for which diameter programming is specified (bit 3 (DIAx) of parameter No. 1006 is set to 1) when bit 1 (CDI) of parameter No. 8005 is set to 0.

	#7	#6	#5	#4	#3	#2	#1	#0
8005	MFD	IGE	IFV	PVP	DRR	R10	CDI	EDC

[Data type] Bit

EDC In axis control by the PMC, an external deceleration signal is:
0 : Disabled.
1 : Enabled.

CDI In axis control by the PMC, when diameter programming is specified for a PMC-controlled axis:
0 : The amount of travel and feedrate are each specified with a radius.
1 : The amount of travel is specified with a diameter while the feedrate is specified with a radius.

> **NOTE**
> 1 This parameter is valid when bit 3 (DIA) of parameter No.1006 is set to 1.
> 2 When CDI is set to 1, bit 7 (NDI) of parameter No.8004 is disabled.

R10 When bit 0 (RPD) of parameter No.8002 is set to 1, the unit for specifying a rapid traverse rate for the PMC axis is:
0 : 1 mm/min.
1 : 10 mm/min.

DRR For cutting feed per rotation in axis control by PMC, the dry run function is:
0 : Disabled.
1 : Enabled.

PVP With a speed command in axis control by PMC, position control is:
0 : Not exercised.
1 : Exercised.

> **NOTE**
> When using flexible synchronous control or learning control, set this parameter to 1.

IFV Override for each group in axis control by PMC is:
0 : Disabled.
1 : Enabled.

IGE When a servo alarm about the basic axis occurs, the PMC axis control alarm signal (EIALx):
0 : Changes to 1.
1 : Remains at 0.

MFD Output by each auxiliary function of the PMC axis control function is:
0 : Disabled.
1 : Enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
8006	EAL	EZR	ESI			IPA	EML	

[Data type] Bit

EML When bit 0 (MLE) of parameter No. 8001 is set to 1, for PMC axes:
0 : The all axis machine lock signal and axis-by-axis machine lock signals are disabled.
1 : The all axis machine lock signal is disabled and the axis-by-axis machine lock signals are enabled.

IPA For controlled axis at PMC axis control only (see the parameter No.1010) :
0 : The in-position check is performed when no move command is issued for the PMC axis.
1 : No in-position check is always performed.

ESI If, during movement on a PMC axis under superimposed control based on the PMC axis control extension function, an NC command block is specified for the same axis, the block is:
0 : Executed after completion of movement on the PMC axis.
1 : Executed even during movement on the PMC axis. (Superimposition command extension for PMC axis control)
To superimpose a PMC axis command on a CNC axis command, set this parameter to 1.

EZR A PMC axis:
0 : Does not follow the setting of bit 0 (ZRN) of parameter No. 1005. (The reference position return state is checked at all times.)
1 : Follows the setting of bit 0 (ZRN) of parameter No. 1005. (The reference position return state is checked according to the setting of bit 0 (ZRN) of parameter No. 1005.)

EAL When axis control by PMC is used, the function for canceling the alarm signal (EIALg) by a CNC reset operation is:
0 : Disabled.
1 : Enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
8007								NIS

[Data type] Bit

NIS With the in-position check disable signal NOINPS <G023#5> and the axis-by-axis in-position check disable signals NOINP1 to NOINP8 <G359>, PMC axis in-position checking is:
0 : Disabled.
1 : Enabled.

NOTE

With the in-position check disable signal NOINPS <G023#5> and the axis-by-axis in-position check disable signals NOINP1 to NOINP8 <G359>, ordinary in-position checking between blocks can be disabled. However, an in-position check is always made at the reference position reached by reference position return (G28, G30). On the other hand, in-position checking at an intermediate point can be disabled. To disable in-position checking at the reference position, set bit 0 (RF2) of parameter No. 3454 to 1 and specify reference position return with G28.2/G30.2.

	#7	#6	#5	#4	#3	#2	#1	#0
8008								MIRx

[Data type] Bit axis

MIRx When a PMC axis control command is issued in mirror image mode, the mirror image is:

0 : Not considered.

1 : Considered.

This parameter is valid when PMC signals MI1 to MI8 <G106#0 to #7> are set to 1 or bit 0 (MIRx) of parameter No. 0012 is set to 1.

8010	Selection of the DI/DO group for each axis controlled by the PMC

[Data type] Byte axis

[Valid data range] 1 to 4

Specify the DI/DO group to be used to specify a command for each PMC-controlled axis.

Value	Description
1	DI/DO group A (G142 to G153) is used.
2	DI/DO group B (G154 to G165) is used.
3	DI/DO group C (G166 to G177) is used.
4	DI/DO group D (G178 to G189) is used.

8020	Low-speed feedrate at reference position return in axis control by PMC (FL)

[Data type] Word axis

[Unit of data, valid data range]

Input increment	Units of data	Valid data range	
		IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

This parameter sets the low-speed feedrate (FL) at a reference position return on axis control by PMC.

NOTE

If 0 is specified, the value of parameter No. 1425 is used.

8021	Minimum speed of rapid traverse override in axis control by PMC (Fo)

[Data type] Word axis

[Unit of data, valid data range]

Input increment	Units of data	Valid data range	
		IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

This parameter sets the minimum speed (Fo) of rapid traverse override on axis control by PMC.

8022	Upper-limit rate of feed per revolution in axis control by PMC

[Data type] Word

[Unit of data, valid data range]

Input increment	Units of data	Valid data range	
		IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

This parameter sets the upper limit rate of feed per revolution on axis control by PMC.

NOTE

The upper limit specified for the first axis is valid for all axes. The specifications for the second and subsequent axes are ignored.

8028	Linear acceleration/deceleration time constant for speed commands for axis control by PMC

[Data type] Word axis

[Unit of data] msec/1000 min^{-1}

[Valid data range] 0 to 32767

This parameter sets the time required for the servo motor rotation speed to increase or decrease by 1000 min^{-1}, for each axis, as a linear acceleration/deceleration time constant for speed commands for axis control by PMC. (See the description of bit 6 (JVB) of parameter No. 8003 as well.)

NOTE

If this parameter is set to 0, acceleration/deceleration control is not applied.

8040	Travel distance per motor revolution when position control is exercised with a speed command for axis control by PMC

[Data type] 2-word axis

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] 0 to 999999999

This parameter sets a travel distance per motor revolution when position control is exercised with a speed command for axis control by PMC (when bit 4 (PVP) of parameter No. 8005 is set to 1).

4.63 PARAMETERS OF TWO-PATH CONTROL

	#7	#6	#5	#4	#3	#2	#1	#0
8100		DSB	COF				IAL	RST
								RST

[Data type] Bit

RST — RESET key on the MDI panel

0 : Effective for both paths or for both machining and background drawing sides (M series).

1 : Effective only for a path selected by the path selection signal. During background graphic (M series), the machining side does not stop.

IAL — When an alarm is raised in one tool post in the automatic operation mode,

0 : The other path enters the feed hold state and stops.

1 : The other path continues operation without stopping.

COF — The tool offset memories of paths can be used as:

0 : Memories specific to individual paths or as a combination of a specific memory and common memory.

1 : Memories common to all paths.

DSB — When one path is brought to a single-block stop during automatic operation:

0 : The other path continues operation without being stopped.

1 : The other path is placed in the feed hold state and is stopped.

	#7	#6	#5	#4	#3	#2	#1	#0
8101							STW	NWB

[Data type] Bit

NWB — The block after a waiting M code is:

0 : Buffered.

1 : Not buffered.

> **NOTE**
> If an M code is specified as an M code preventing buffering in one of parameter No. 3411 to No. 3420, buffering is not performed, regardless of the setting of this parameter.

STW — Waiting by specifying start point is:

0 : Disabled.

1 : Enabled.

> **NOTE**
> When using a multi-path system, set this parameter to the same value for all paths.

	#7	#6	#5	#4	#3	#2	#1	#0
8103							MWP	

[Data type] Bit

MWP The P command for a waiting M code is specified using:
0 : Binary value.
1 : Combination of path numbers.

8110	Waiting M code range (minimum value)

8111	Waiting M code range (maximum value)

[Data type] 2-word

[Valid data range] 0 and 100 to 99999999

The waiting M code range is specified using parameter 8110 (minimum value) and parameter 8111 (maximum value).

(Parameter No. 8110) ≤ (Waiting M code) ≤ (Parameter No. 8111)

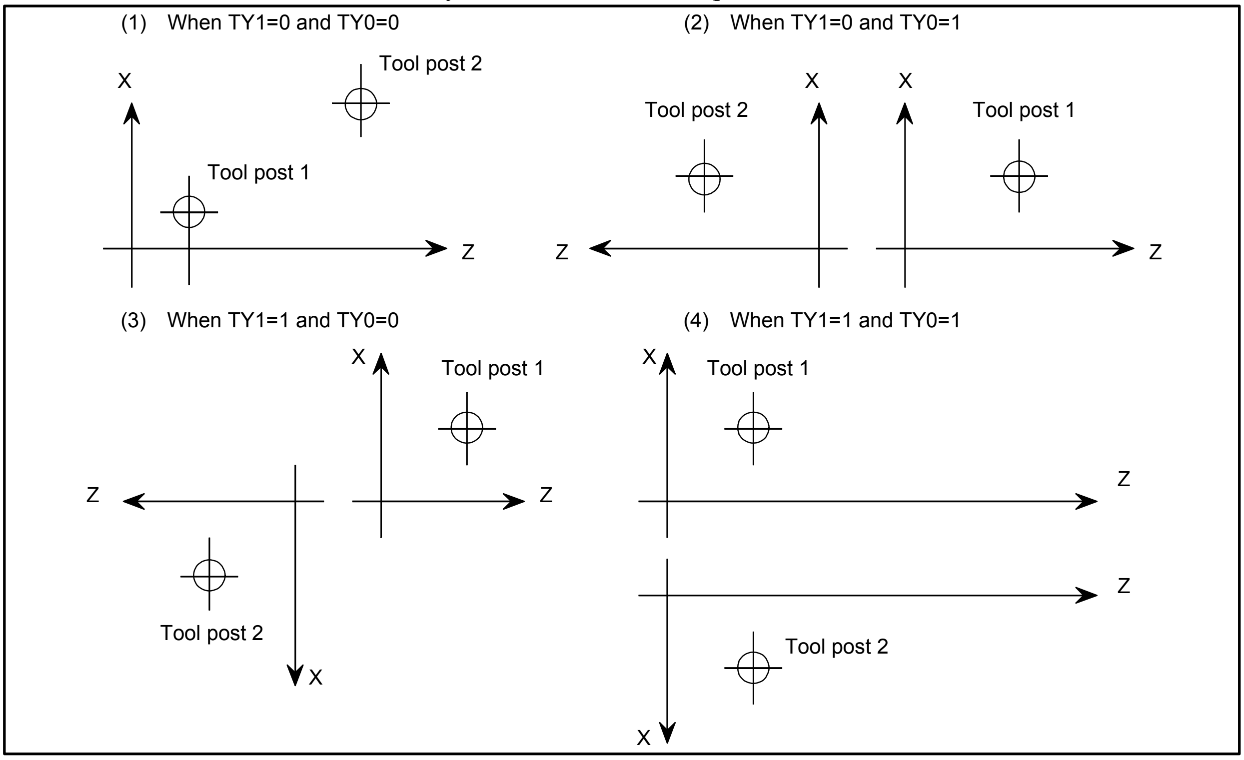
> **NOTE**
> A value of 0 indicates that the waiting M code is not used.

4.64 PARAMETERS OF INTERFERENCE CHECK BETWEEN TWO TOOL POSTS (TWO-PATH) (FOR TWO-PATH CONTROL)

	#7	#6	#5	#4	#3	#2	#1	#0
8140			ZCL	IFE	IFM	ITO	TY1	TY0
				IFE	IFM			

[Data type] Bit

TY0, TY1 This parameter specifies the relationship between the coordinate systems of the two tool posts.



ITO When offset number 0 is specified by the T code,
- 0 : Interference check between two tool posts is stopped until an offset number other than 0 is specified by the next T code.
- 1 : Interference check between two tool posts is continued according to the previously specified offset number.

IFM In manual mode, an interference check between two tool posts (T series) and interference check between two-path (M series) are:
- 0 : Not performed.
- 1 : Performed.

IFE An interference check between two tool posts (T series) and interference check between two-path (M series) are:
- 0 : Performed.
- 1 : Not performed.

ZCL Specifies whether interference along the Z axis is checked while interference check between two tool posts.
- 0 : Checked
- 1 : Not checked (Only interference along the X axis is checked.)

8141	Distance along the X-axis from a path-1 reference point to a path-2 reference point
8142	Distance along the Y-axis from a path-1 reference point to a path-2 reference point
8143	Distance along the Z-axis from a path-1 reference point to a path-2 reference point

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

8144	Interference check area figure data AI (BI)
8145	Interference check area figure data AJ (BJ)
8146	Interference check area figure data AK (BK)
8147	Interference check area figure data AX (BX)
8148	Interference check area figure data AY (BY)
8149	Interference check area figure data AZ (BZ)

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

8151	Distance along the X axis between the reference positions of tool posts 1 and 2

8152	Distance along the Z axis between the reference positions of tool posts 1 and 2

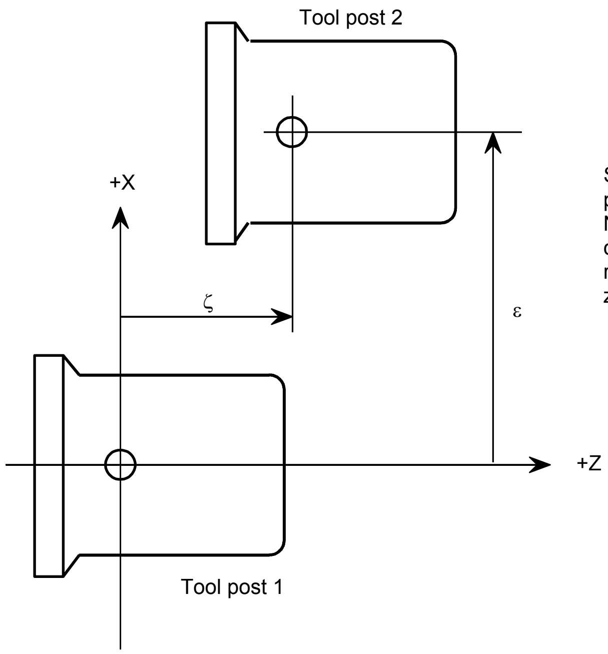
[Data type] 2-word

[Unit of data]

Input increment	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm
Inch machine	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Distance between tool posts is set in these parameters.



Specify the X and Z values (ε, ζ) of the reference position of tool post 2 in parameters No. 8151 and No. 8152, respectively, in the Z-X plane coordinate system. However, note that the reference position of tool post 1 is plotted at the zero point.

NOTE

After the parameter values are changed, perform manual reference position return for individual tool posts. Otherwise, data on the positional relationship between the tool posts stored in memory will not be updated to the new parameter values.

4.65 PARAMETERS OF SYNCHRONOUS/COMPOSITE CONTROL AND SUPERIMPOSED CONTROL

	#7	#6	#5	#4	#3	#2	#1	#0
8160	NRS	SPE	NCS		NBO	ZSI	XSI	MXC
	NRS		NCS		NBO			

[Data type] Bit

MXC During composite control of the X- or Z-axis, direct input of tool offset value measured B performs calculation based on:
0 : Machine coordinates for the path being controlled
1 : Machine coordinates for another path subject to composite control

> **NOTE**
> 1 This parameter is effective when the amounts of X-axis and Z-axis tool compensation and the amount of Z-axis workpiece coordinate system shifting are set with direct input of tool offset value measured B.
> 2 This parameter cannot be used when composite control is applied to paths for which different least command increments (metric or inch) are specified.

XSI When bit 0 (MXC) of parameter No. 8160 is set to 1, the machine coordinates along the X-axis for the other path subject to composite control are fetched:
0 : With the sign as is
1 : With the sign inverted

ZSI When bit 0 (MXC) of parameter No. 8160 is set to 1, machine coordinates along the Z-axis for the other path subject to composite control are fetched:
0 : With the sign as is
1 : With the sign inverted

NBO When bit 5 (NCS) of parameter No. 8160 is set to 1, the operation of stored stroke limits 1 and 3 is specified:
0 : So that a gradual stop occurs 8 msec after the occurrence of an ordinary overtravel limit.
1 : According to the setting of bit 7 (BFA) of parameter No. 1300.

> **NOTE**
> When this parameter is set to 1 for synchronous control, ensure that the master axis and slave axis enter a stroke limit at the same time. (Otherwise, a synchronous error occurs.)

NCS If an overtravel alarm is issued for an axis under synchronous/ composite or superimposed control, synchronous/composite or superimposed control is:
0 : Canceled.
1 : Not canceled.
If an overtravel alarm is issued for an axis under synchronous/ composite or superimposed control, the following operation is performed according to the setting of this parameter:
When NCS is set to 0 P/S alarm No. 255 may be issued together with the overtravel alarm. In this case, place the machine in the emergency stop state once, then release the alarm.
When NCS is set to 1. The machine decelerates, then stops with a delay of 8 msec in comparison with an ordinary overtravel alarm.

NOTE
With the M series, synchronous control only is enabled.

SPE The synchronous error amount is:
0 : The difference between the positioning deviation of the master axis and that of the slave axis.
1 : The difference between the positioning deviation of the master axis and that of the slave axis plus the acceleration/deceleration delay.

NOTE
When the master and slave axes have different acceleration/deceleration time constants, set 1.

NRS When the system is reset, synchronous, composite, or superimposed control is:
0 : Canceled.
1 : Not canceled.

NOTE
With the M series, synchronous control only is enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
8161	NSR		CRZ	CMW	CMX		CZM	NMR

[Data type] Bit

NMR When an axis subject to composite control is placed in servo-off state:

0 : Composite control is canceled.

1 : Composite control is not canceled, provided bit 0 (FUP) of parameter No.1819 is set to 1 to disable follow-up for the axis.

> **NOTE**
> Composite control is not stopped only when bit 0 (FUP) of parameter No.1819 is set to 1. If follow-up is disabled with the follow-up signal (*FLWU <G007#5> =1), composite control is stopped.

CZM When Cs contour control axes are placed under composite control, the composite function for Cs contour axis reference position return is:

0 : Not used.

1 : Used.

> **NOTE**
> When using the Cs axis coordinate establishment function under composite control, be sure to set this parameter to 1. If this parameter is set to 0, P/S alarm 5346 is issued.

CMX When composite control is exercised, the loop gain change function is:

0 : Not used.

1 : Used.

> **NOTE**
> 1 With this function, rigid tapping that places a tapping axis under composite control is enabled.
> 2 This function is enabled in the Cs contour control mode or rigid tapping mode.

CMW When the composite control function for zero point return commands for Cs contour axes is used (bit 1 (CZM) of parameter No.8161 = 1) with the workpiece coordinate system set function, at completion of Cs zero point return, the coordinate system is set:

0 : Based on the machine coordinate of the Cs contour axis on the same path.

1 : Based on the machine coordinate of the Cs contour axis of the composite destination.

CRZ When the composite control function for zero point return commands for Cs contour axes is used (bit 1 (CZM) of parameter No.8161 = 1), for a positioning command for a CS contour axis immediately after composite control switching between Cs contour axes:
0 : Normal positioning operation is performed.
1 : Positioning operation including zero point return is performed.

NSR When an axis under synchronous control is placed in the servo-off state:
0 : Synchronous control is canceled.
1 : Synchronous control is not canceled if a setting is made to disable follow-up for the axis (if bit 0 (FUP) of parameter No. 1819 is set to 1).

	#7	#6	#5	#4	#3	#2	#1	#0
8162	MUMx	MCDx	MPSx	MPMx	OMRx	PKUx	SERx	SMRx

[Data type] Bit axis

SMRx Mirror-image synchronous control is:
0 : Not applied. (The master and slave axes move in the same direction.)
1 : Applied. (The master and slave axes move in opposite directions.)

SERx The synchronous error is:
0 : Not detected.
1 : Detected.

NOTE
When both master and slave axes move in synchronous control, the positioning deviations of the corresponding axes are compared with each other. If the difference is greater than or equal to the value specified in parameter No.8181, an alarm occurs. When either axis is in the parking or machine-locked state, however, the synchronous error is not detected.

PKUx In the parking state,
0 : The absolute, relative, and machine coordinates are not updated.
1 : The absolute and relative coordinates are updated. The machine coordinates are not updated.

OMRx Mirror-image superimposed control is:
0 : Not applied. (The superimposed pulse is simply added.)
1 : Applied. (The inverted superimposed pulse is added.)

MPMx When composite control is started, the workpiece coordinate system is:

0 : Not set automatically.

1 : Set automatically.

> **NOTE**
> When the workpiece coordinate system is automatically set at the start of composite control, it is calculated from the following: Current machine coordinates and the workpiece coordinates at the reference position of each axis (parameter No.8184).

MPSx When composite control is terminated, the workpiece coordinate system is:

0 : Not set automatically.

1 : Set automatically.

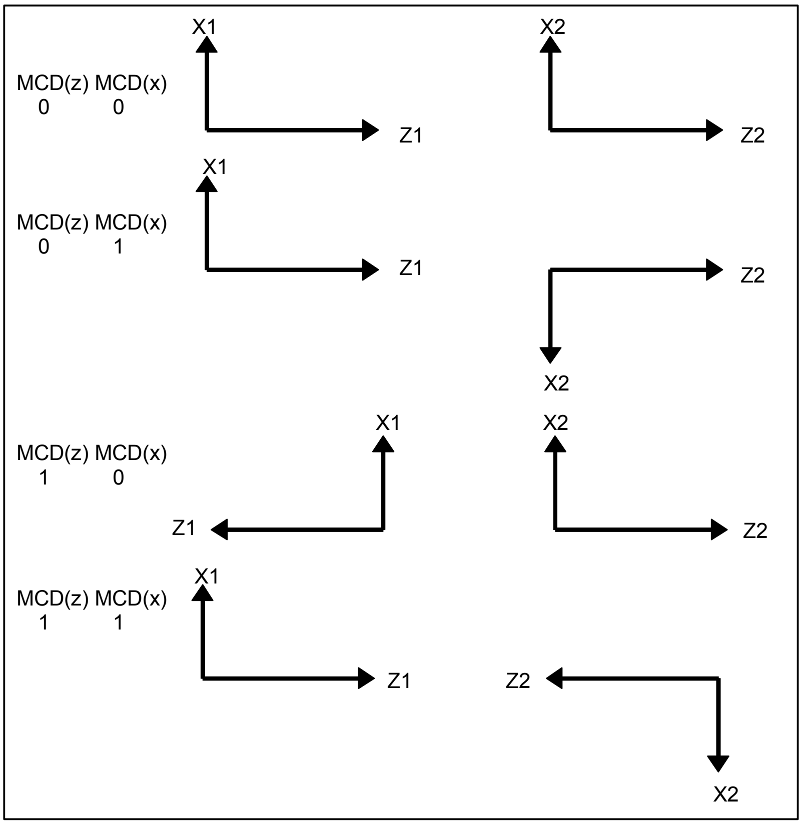
> **NOTE**
> When the workpiece coordinate system is automatically set at the end of composite control, it is calculated from the following: Current machine coordinates and the workpiece coordinates at the reference position of each axis under composite control (parameter No.1250)

MCDx The axes to be replaced with each other under composite control have the coordinate systems placed:

0 : In the same direction. Simple composite control is applied. (The axes of tool posts 1 and 2 move in the same direction.)

1 : In opposite directions. Mirror-image composite control is applied. (The axes of tool posts 1 and 2 move in opposite directions.)

This parameter determines the direction in which an axis moves. The parameter is also used to automatically set the coordinate system when composite control is started or terminated.



MUMx In composite control, a move command for the axis:

0 : Can be specified.

1 : Cannot be specified.

> **NOTE**
> Upon the execution of a move command along an axis for which MUMx is set to 1 during composite control, alarm P/S No.226 is issued.

	#7	#6	#5	#4	#3	#2	#1	#0
8163	NUMx			SCDx	SCMx	SPSx	SPMx	MDXx

> **NOTE**
> Set the parameters SPMx, SPSx, SCMx, and SCDx for the master axis. These settings are referenced during automatic workpiece coordinate setting for the master axis at the start of synchronous control.

[Data type] Bit axis

MDXx In composite control, the current position (absolute/relative coordinates) display indicates:
0 : Coordinates in the local system.
1 : Coordinates in the other system under composite control.

SPMx When synchronous control is started, automatic workpiece coordinate system setting for the master axis is
0 : Not Performed.
1 : Performed.

> **NOTE**
> When a workpiece coordinate system is automatically set at the start of synchronous control, the workpiece coordinate system is calculated from the current machine coordinates and the workpiece coordinates of each axis at the reference position set in parameter No.8185.

SPSx When synchronous control terminates, automatic workpiece coordinate system setting for the master axis is:
0 : Not performed.
1 : Performed.

> **NOTE**
> When a workpiece coordinate system is automatically set at the end of synchronous control, the workpiece coordinate system is calculated from the current machine coordinates and the workpiece coordinates for each axis at the reference position set in parameter No.1250.

SCMx When workpiece coordinates are calculated in synchronous control:
0 : The workpiece coordinates are calculated from the machine coordinates of the slave axis.
1 : The workpiece coordinates are calculated from the machine coordinates of the master axis and slave axis.

SCDx The positive (+) directions of the master axis and slave axis in the coordinate system in synchronous control are:
0 : Identical.
1 : Opposite.

NUMx When neither synchronous/composite control is applied, a move command for the axis is:
0 : Not disabled.
1 : Disabled.

NOTE
If a move command is specified for an axis with NUMx set to 1 when neither synchronous/ composite control is applied, P/S alarm No.226 is issued.

	#7	#6	#5	#4	#3	#2	#1	#0
8164		SOKx	OPSx	SPNx	MCEx	MCSx	MWEx	MWSx

[Data type] Bit axis

MWSx In automatic workpiece coordinate system setting, performed when composite control is started, a workpiece shift and position offset are:
0 : Not considered.
1 : Considered.

NOTE
MWSx is enabled when (bit 4 (MPMx) of parameter No.8162) is set to 1.

MWEx In automatic workpiece coordinate system setting, performed when composite control is canceled, a workpiece shift and position offset are:
0 : Not considered.
1 : Considered.

NOTE
MWEx is enabled when (bit 5 (MPSx) of parameter No.8162) is set to 1.

MCSx In automatic workpiece coordinate system setting, performed when composite control is started:
0 : A workpiece coordinate system is automatically set in the same way as normal.
1 : The coordinate system of the other path subject to axis recomposition is used.

NOTE
MCSx is enabled when (bit 4 (MPMx) of parameter No.8162) is set to 1.

MCEx In automatic workpiece coordinate system setting, performed when composite control is canceled:
0 : A workpiece coordinate system is automatically set in the same way as normal.
1 : The coordinate system of the other path subject to axis recomposition is used.

> **NOTE**
> MCEx is enabled when (bit 5 (MPSx) of parameter No.8162) is set to 1.

SPNx The workpiece coordinate and relative coordinate of a slave axis subject to synchronous control is:
0 : Updated.
1 : Not updated.

OPSx When superimposed control is canceled, control in which an amount of movement along a master axis subject to superimposed control is added to the workpiece coordinate of a slave axis is:
0 : Not applied.
1 : Applied.

SOKx If a master axis subject to superimposed control is also subject to synchronous control:
0 : An alarm is issued when superimposed control is started during synchronous control.
1 : No alarm is issued when superimposed control is started during synchronous control.

> **NOTE**
> 1 MWSx and MWEx are mutually exclusive, so that only one of these parameters must be selected. Similarly, MCSx and MCEx are mutually exclusive, so that only one of these parameters must be selected.
> 2 Specify these parameters for the axis of each path subject to each control function.

	#7	#6	#5	#4	#3	#2	#1	#0
8165				SMT	NA0	CPM	SVF	SIC
							SVF	

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

SIC One-path superimposed control is:
0 : Disabled.
1 : Enabled.

SVF In synchronous/composite control, for an axis under synchronous or composite control on the other path, the feed-forward function and the cutting feed and rapid traverse switching function are:
0 : Disabled.
1 : Enabled.

> **NOTE**
> With the M series, synchronous control only is enabled.

CPM When composite control is exercised, machine coordinate system selection (G53) is:
0 : Disabled.
1 : Enabled. (A travel distance is calculated so that a movement is made according to the machine coordinate system selection of the composite control target path.)

NA0 When superimposed control is turned off during movement on an axis:
0 : P/S alarm 000 is issued.
1 : P/S alarm 000 is not issued.

> **NOTE**
> If this parameter is set to 1, bit 7 (BFA) of parameter No. 1300 is invalid while superimposed control is exercised.

SMT When Cs contour control axes are placed under composite control, torque limit skip for the composite axes of other paths is:
0 : Disabled.
1 : Enabled.

> **NOTE**
> When this parameter is set to 1, bit 1 (CZM) of parameter No. 8161 also needs to be set to 1.

	#7	#6	#5	#4	#3	#2	#1	#0
8166					2OV	OVL	MIX	SYN

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

SYN For synchronous control:
0 : The 3-path interface is used.
1 : The 2-path interface is used. (Synchronous control involving axes of path 3 cannot be exercised.)

MIX For composite control:
0 : The 3-path interface is used.
1 : The 2-path interface is used. (Composite control involving axes of path 3 cannot be exercised.)

OVL For superimposed control:
0 : The 3-path interface is used.
1 : The 2-path interface is used. (Superimposed control involving axes of path 3 cannot be exercised.)

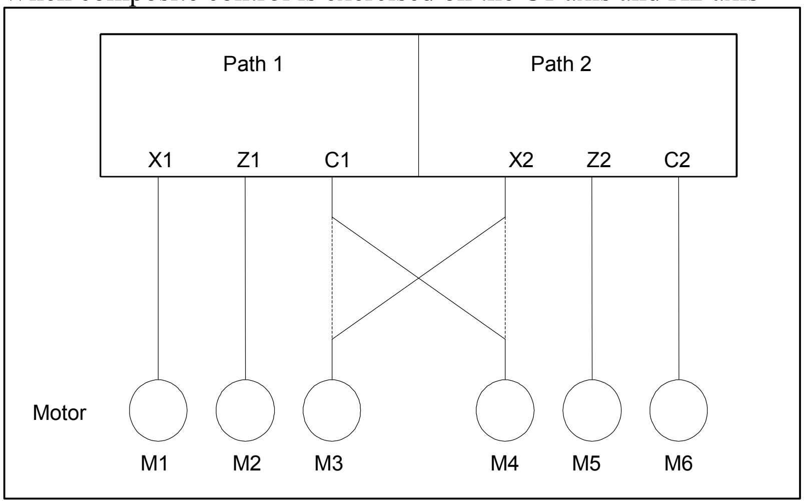
2OV When a 2-path system is used, the superimposed control function within one path is:
0 : Disabled.
1 : Enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
8167	SCPx							NLSx

[Data type] Bit axis

NLSx For an axis under composite control, acceleration/deceleration with a constant time for linear interpolation type rapid traverse (bit 4 (PRT) of parameter No. 1603) is:
0 : Enabled.
1 : Disabled.

[Example] When composite control is exercised on the C1 axis and X2 axis



To disable the acceleration/deceleration with a constant time of motor M3, set bit 0 (x) of parameter No. 8167 to 1. Similarly, to disable the acceleration/deceleration with a constant time of motor M4, set bit 0 (c) of parameter No. 8167 to 1.

SCPx If the slave axis is placed in the parking state under superimposed control, the absolute coordinate is:

0 : Not updated.

1 : Updated as follows:

Absolute coordinate of the slave axis	=	Absolute coordinate of the slave axis	-	Travel distance specified for the master axis under superimposed control

> **NOTE**
> Set this parameter for the slave axis placed under superimposed control.

8180	Master axis with which an axis is synchronized under synchronous control

[Data type] Byte axis

[Valid data range] 1,2,3,...., number of controlled axes (M/T series),
11,12,13,..., number of paths × 10 + number of controlled axes (11,12,13,...,21,22,...31,32,...) (T series), or
201,202,203,...., number of controlled axes + 200 (T series)

This parameter specifies the number of the master axis with which an axis is synchronized. When zero is specified, the axis does not become a slave axis and is not synchronized with another axis. When an identical number is specified in two or more axes, one master axis has two or more slave axes.

- Exercising synchronous control between two paths (M/T series)
  In the parameter of a slave axis, specify the axis number of the master axis with which the salve axis is to be synchronized.
  Setting: 1 to 8
  The value specified here must not exceed the maximum number of control axes.
  [Example 1]
  Synchronizing the Z2-axis with the Z1-axis

Path 1		Path 2	
Parameter No.8180x	0	Parameter No.8180x	0
Parameter No.8180z	0	Parameter No.8180z	2
Parameter No.8180c	0		
Parameter No.8180y	0		

- Exercising synchronous control between tool posts (T series)
  In the parameter of a slave axis, set the axis number of the master axis with which the slave axis is to be synchronized.
  Setting: Number of paths × 10 + Number of controlled axes
  The value specified here must not exceed the maximum number of control axes.
  Axis number of path 1 11, 12, 13, ..., controlled axis + 10 (1, 2, 3, ..., controlled axis)
  Axis number of path 2 21, 22, 23, ..., controlled axis + 20
  Axis number of path 3 31, 32, 33, ..., controlled axis + 30
- Exercising synchronous control in a path (T series)
  In the parameter of a slave axis , specify 200 plus the number of the master axis with which the slave axis is to be synchronized.
  Setting: 201 to 208
  The value specified here must not exceed 200 plus the maximum number of control axes.
  [Example 2]
  Synchronizing the Y1-axis with the Z1-axis

Tool post 1		Tool post 2	
Parameter No.8180x	0	Parameter No.8180x	0
Parameter No.8180z	0	Parameter No.8180z	0
Parameter No.8180c	0		
Parameter No.8180y	202		

8181	Synchronous error limit of each axis (synchronous/composite control)

[Data type] 2-word axis

[Unit of data] Detection unit

[Valid data range] 0 to 32767

When the synchronous error detected (Bit 1 (SERx) of parameter No.8162 is set to 1), this parameter specifies the limit of the difference between the position deviation of the slave axis and that of the master axis. Set this parameter to the slave axis.

8182	Display of the synchronous error of an axis (synchronous/composite control)

[Data type] 2-word axis

[Unit of data] Detection unit

When the synchronization deviation is detected (Bit 1 (SERx) of parameter No.8162 is set to 1), this parameter specifies the difference between the position deviation of the slave axis and that of the master axis. (The value is used for diagnosis.)

The difference between the position deviation is:

Position deviation of the master axis ± Position deviation of the slave axis
↑
Plus for a mirror-image synchronous control command
Minus for a simple synchronous control command

> **NOTE**
> Parameter No.8182 is only for display. It cannot be set value.

8183	Composite control axis of the other path in composite control for each axis

[Data type] Byte axis

[Valid data range] 0,11,12,13,..., number of paths × 10 + number of controlled axes (11,12,13,...,21,22,...31,32,...)

This parameter sets with which axis each axis is to be placed under composite control. When 0 is specified, control of the axis is not replaced under composite control. An identical number can be specified in two or more axes, but composite control cannot be exercised for all of tem at a time.

Axis number of path 1 11, 12, 13, ..., controlled axis + 10 (1, 2, 3, ..., controlled axis)

Axis number of path 2 21, 22, 23, ..., controlled axis + 20

Axis number of path 3 31, 32, 33, ..., controlled axis + 30

NOTE

Set this parameter with an axis for which the composite control axis selection signal is to be turned on/off.

8184	Coordinates of the reference point of an axis on the coordinate system of another axis under composite control

[Data type] 2-word axis

[Unit of data]

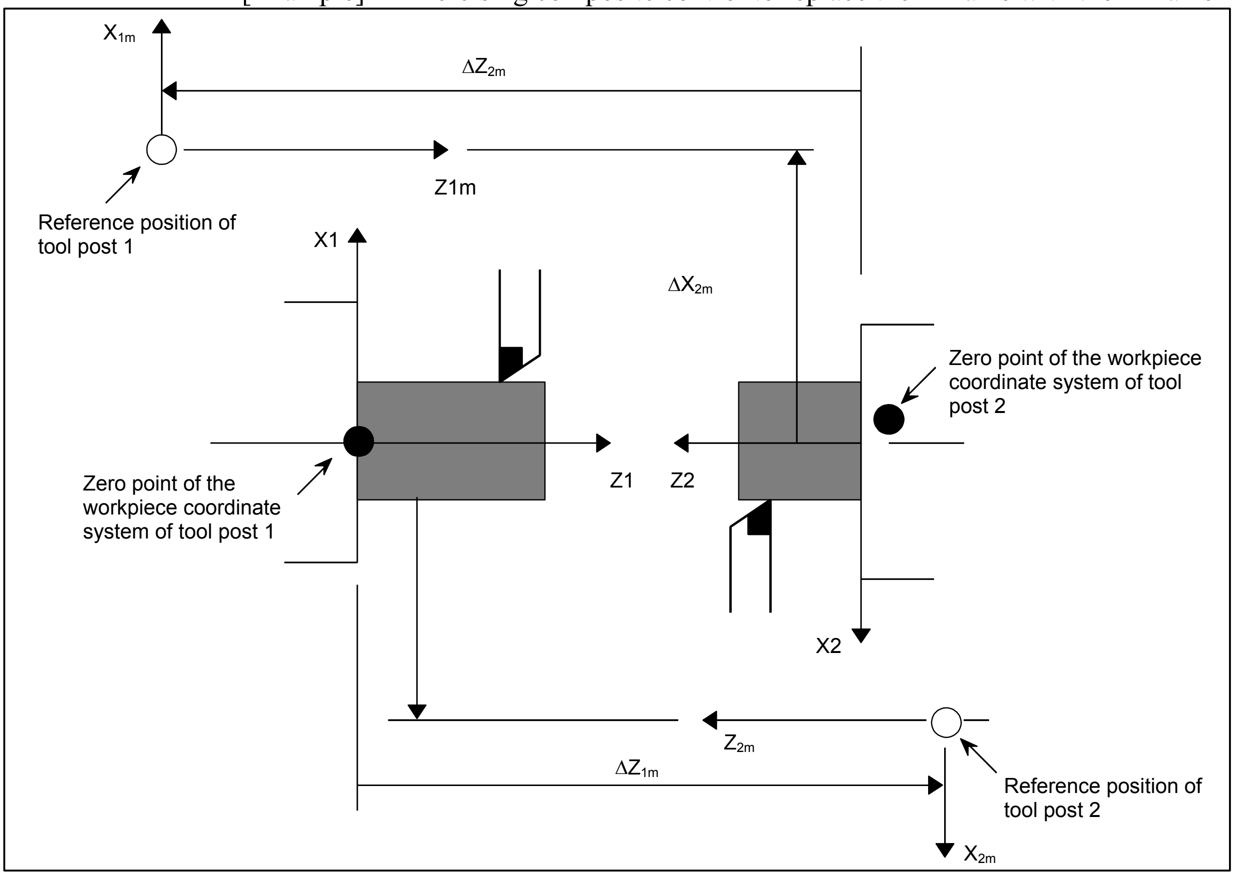
Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid range] -99999999 to 99999999

This parameter specifies the coordinates of the reference position of an axis on the coordinate system of another axis under composite control.

The parameter is validated when bit 4 (MPMx) of parameter No. 8162 is set to 1.

[Example] Exercising composite control to replace the X1-axis with the X2-axis



(ΔX_{1m}, ΔZ_{1m}) are the coordinates of the reference position of tool post 2 on the workpiece coordinate system of tool post 1. (ΔX_{2m}, ΔZ_{2m}) are the coordinates of the reference position of tool post 1 on the workpiece coordinate system of tool post 2.

ΔX_{1m} is specified for the X-axis of tool post 1 and ΔX_{2m} for the X-axis of tool post 2.

If bit 4 (MPMx) of parameter No.8162 is set to 1 when composite control is started, the workpiece coordinate system satisfying the following conditions is specified:

X1 = Value specified for the X-axis of tool post 1 ± Machine coordinate of X2

↑

Plus when bit 6 (MCDx) of parameter No.8162 of tool post 1 is set to 0
Minus when bit 6 (MCDx) of parameter No.8162 of tool post 1 is set to 1

X2 = Value specified for the X-axis of tool post 2 ± Machine coordinate of X1

↑

Plus when bit 6 (MCDx) of parameter No.8162 of tool post 2 is set to 0
Minus when bit 6 (MCDx) of parameter No.8162 of tool post 2 is set to 1

If bit 5 (MPSx) of parameter No.8162 is set to 1 when composite control is terminated, the workpiece coordinate system satisfying the following conditions is specified:

X1 = Parameter No.1250 of tool post 1 + Machine coordinate of X1
X2 = Parameter No.1250 of tool post 2 + Machine coordinate of X2

8185	Workpiece coordinates on each axis at the reference position

[Data type] 2-word axis

[Unit of data]

Input increment	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm
Inch machine	0.0001	0.00001	inch
Rotary axis	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

This parameter sets the workpiece coordinates on each master axis, subject to synchronous control, when the master and slave axes are at the reference position. This parameter is enabled when bit 1 (SPMx) of parameter No.8163 is set to 1. Set this parameter for the master axis.

8186	Master axis on each axis under superimposed control

[Data type] Byte axis

[Valid data range] 0,11,12,13,..., number of paths × 10 + number of controlled axes (11,12,13,...,21,22,...31,32,...)
21,22,23,..., number of controlled axes

This parameter specifies the axis number of the master axis under superimposed control.

When 0 is specified, the axis does not become a slave axis under superimposed control and the move pulse of another axis is not superimposed.

An identical number can be specified in two or more parameters, but superimposed control cannot be exercised for all of tem at a time.

That is, it is impossible to make superimposed control over one master axis and multiple slave axes.

Axis number of path 1 11, 12, 13, ..., controlled axis + 10 (1, 2, 3, ..., controlled axis)
Axis number of path 2 21, 22, 23, ..., controlled axis + 20
Axis number of path 3 31, 32, 33, ..., controlled axis + 30

[Example 1] When the travel distance on the Z1-axis is superimposed on the Z2-axis

1st path	2th path
Parameter No.8186x=0	Parameter No.8186x=0
Parameter No.8186z=0	Parameter No.8186z=2(12)
Parameter No.8186c=0	
Parameter No.8186y=0	

[Example 2] When the travel distance on the Z2-axis is superimposed on the Z1-axis

1st path	2th path
Parameter No.8186x=0	Parameter No.8186x=0
Parameter No.8186z=22	Parameter No.8186z=0
Parameter No.8186c=0	
Parameter No.8186y=0	

[Example 3] When the travel distance on the Z1-axis is superimposed on the Y1-axis

1st path	2th path
Parameter No.8186x=0	Parameter No.8186x=0
Parameter No.8186z=0	Parameter No.8186z=0
Parameter No.8186c=0	
Parameter No.8186y=2(12)	

[Example 4] When the travel distance on the Z2-axis is superimposed on the X2-axis

1st path	2th path
Parameter No.8186x=0	Parameter No.8186x=22
Parameter No.8186z=0	Parameter No.8186z=0
Parameter No.8186c=0	
Parameter No.8186y=0	

8190	Rapid traverse rate of an axis under superimposed control

[Data type] 2-word axis

[Unit of data, valid data range]

Input increment	Units of data	Valid data range	
		IS-B	IS-C
Metric machine	1 mm/min	30 to 240000	30 to 100000
Inch machine	0.1 inch/min	30 to 96000	30 to 48000
Rotary axis	1 deg/min	30 to 240000	30 to 100000

Set a rapid traverse rate for each of the axes when the rapid traverse override of the axes (master and slave axes) under superimposed control is 100%. The manual rapid traverse rate set in this parameter or the manual rapid traverse rate set in parameter No. 1424 (or in parameter No. 1420 if 0 is set in parameter No. 1424), whichever smaller, is used.

8191	F0 velocity of rapid traverse override of an axis under superimposed control

[Data type] Word axis

[Unit of data, valid data range]

Input increment	Units of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

Set the F0 velocity of rapid traverse override of an axis under superimposed control (each of the master and slave axes).

8192	Linear acceleration/deceleration time constant in rapid traverse of an axis under superimposed control

[Data type] Word axis

[Unit of data] msec

[Valid range] 0 to 4000

This parameter specifies the linear acceleration/deceleration time constant in rapid traverse for each of the axes (master and slave axes) under superimposed control.

8193	Maximum cutting feedrate under superimposed control

[Data type] 2-word

[Unit of data, valid data range]

Input increment	Units of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	30 to 240000	30 to 100000
Inch machine	0.1 inch/min	30 to 96000	30 to 48000
Rotary axis	1 deg/min	30 to 240000	30 to 100000

This parameter specifies the maximum cutting feedrate under superimposed control.

4.66 PARAMETERS OF ANGULAR AXIS CONTROL

	#7	#6	#5	#4	#3	#2	#1	#0
8200					AZP	AZR		AAC

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

AAC
- 0 : Does not perform angular axis control.
- 1 : Performs inclined axis control.

AZR
- 0 : The machine tool is moved along the perpendicular axis during manual reference position return along the angular axis under angular axis control.
- 1 : The machine tool is not moved along the perpendicular axis during manual reference position return along the angular axis under angular axis control.

AZP When an angular axis moves, the reference position return completion signal for the perpendicular axis, ZPx <F094, F096, F098, F100, or F116>, is:
- 0 : Not cleared.
- 1 : Cleared.

	#7	#6	#5	#4	#3	#2	#1	#0
8201	ADG	A53	ACL	ALN		AO3	AO2	AOT

[Data type] Bit

AOT When angular axis control is enabled, the values indicating the area for stored stroke check 1 (parameters Nos. 1320, 1321, 1326, and 1327) are treated as:
- 0 : Coordinates in the angular coordinate system.
- 1 : Coordinates in the Cartesian coordinate system.

AO2 When angular axis control is enabled, the values indicating the area for stored stroke check 2 (parameters Nos. 1322 and 1323) are treated as:
- 0 : Coordinates in the angular coordinate system.
- 1 : Coordinates in the Cartesian coordinate system.

AO3 When angular axis control is enabled, the values indicating the area for stored stroke check 3 (parameters Nos. 1324 and 1325) are treated as:
- 0 : Coordinates in the angular coordinate system.
- 1 : Coordinates in the Cartesian coordinate system.

ALN If a manual rapid traverse operation or reference position return operation without DOG is performed on an angular axis under angular axis control:
0 : Acceleration/deceleration time on the perpendicular axis is not controlled.
1 : Acceleration/deceleration time on the perpendicular axis is controlled to match the acceleration/deceleration time on the angular axis. (The paths on the angular axis and perpendicular axis are linear.)

NOTE
To make the paths on the angular axis and perpendicular axis linear, the same acceleration/deceleration type, time constant, and gain need to be specified.

ACL In linear interpolation type rapid traverse, the feedrate clamp function for angular axis control is:
0 : Enabled.
1 : Disabled.

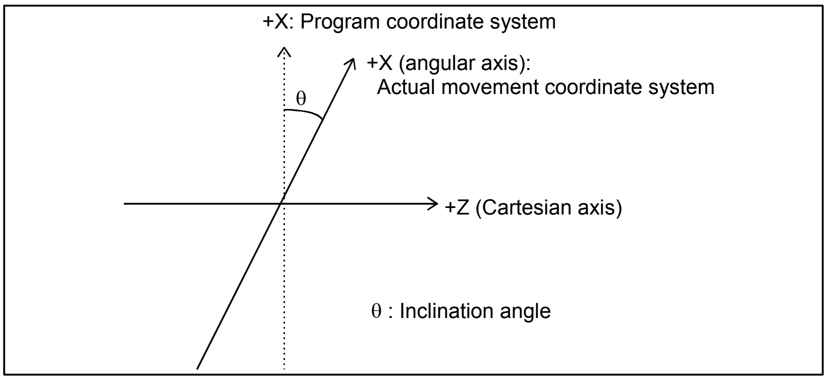
NOTE
This parameter is valid when bit 1 (LRP) of parameter No. 1401 is set to 1.

A53 If an angular axis is singly specified with a machine coordinate system command (G53) under angular axis control:
0 : A movement is made on the perpendicular axis as well.
1 : A movement is made only on the angular axis.

ADG The contents of diagnosis data Nos. 306 and 307 are:
0 : Not swapped. The angular axis and perpendicular axis are displayed in this order.
1 : Swapped. The perpendicular axis and angular axis are displayed in this order.

8210	Inclination angle for angular axis control

[Data type] 2-word
[Unit of data] 0.001 degree
[Valid data range] 20000 to 60000



8211	Axis number of an angular axis subject to angular axis control

8212	Axis number of a perpendicular axis subject to angular axis control

[Data type] Byte
[Unit of data] Number
[Valid data range] 1 to number of controlled axes

These parameters set the axis numbers of an angular axis and perpendicular axis subject to angular axis control.

4.67 PARAMETERS OF B-AXIS CONTROL

	#7	#6	#5	#4	#3	#2	#1	#0
8240	MST	ABS	SOV	TEM	REF			

[Data type] Bit

REF Reference position return operation by G28:
- 0 : Always uses deceleration dogs in the same way as a manual reference position return operation.
- 1 : Uses deceleration dogs when a reference position has not yet been set, but is performed by rapid traverse when a reference position has already been set (in the same way as an ordinary G28 command).

TEM When an offset movement is made in a block containing a T code:
- 0 : M code and MF are output before a movement along an axis.
- 1 : M code and MF are output after a movement along an axis.

SOV A G110 block:
- 0 : Overlaps the next block.
- 1 : Does not overlap the next block.

ABS The B-axis command is:
- 0 : An incremental command.
- 1 : An absolute command.

MST When an M code for starting a movement along the B-axis is specified:
- 0 : Operation is started after a ready notice using the FIN signal is received.
- 1 : Operation is started without waiting for a ready notice.

	#7	#6	#5	#4	#3	#2	#1	#0
8241						MDF	MDG	FXC

[Data type] Bit

FXC In canned cycle G84:
- 0 : The spindle is rotated clockwise or counterclockwise after M05 is output.
- 1 : The spindle is rotated clockwise or counterclockwise without first outputting M05.

MDG The initial continuous-state value for starting B-axis operation command registration is:
- 0 : G00 mode (rapid traverse).
- 1 : G01 mode (cutting feed).

MDF The initial continuous-state value for starting B-axis operation command registration is:
- 0 : G98 (feed per minute).
- 1 : G99 (feed per rotation).

	#7	#6	#5	#4	#3	#2	#1	#0
8242						NF3	BPF	COF

[Data type] Bit

COF The amount of the B-axis offset is set:
0: Separately for each path.
1: Simultaneously for all paths.

BPF For feed per revolution with the B-axis control function, the parameters for the unit of PMC feedrate data specification, bits 6 (FR1) and 7 (FR2) of parameter No. 8002 are:
0 : Valid.
1 : Invalid.

NF3 An axis number used for B-axis control on path 3 (in the case of three-path control) is specified in:
0 : Single operation format (1 to n).
1 : Multi-path-operation format (31 to 3n).
(n: Number of axes of path 3)

8250	Axis number used for B-axis control

[Data type] Byte

[Valid data range] 1 to number of controlled axes (in one-path control)
11 to ((number of controlled axes for path 1) + 10), or
21 to ((number of controlled axes for path 2) + 20) (in 2-path control)
11 to ((number of controlled axes for path 1) + 10),
21 to ((number of controlled axes for path 2) + 20), or
31 to ((number of controlled axes for path 3) + 30) (in 3-path control)

This parameter sets which axis is to be used for B-axis control.
In 1-path control, set the controlled axis number of a selected B-axis.
In 2-path control, set the axis number, used for B-axis control on path 1, added to 10 when a path 1 axis is used.
Set an axis number, used for B-axis control on path 2, added to 20 when a path 2 axis is used.
In 3-path control, set the axis number, used for B-axis control on path 1, added to 10 when a path 1 axis is used.
Set an axis number, used for B-axis control on path 2, added to 20 when a path 2 axis is used.
Set an axis number, used for B-axis control on path 3, added to 30 when a path 3 axis is used.
If the single operation format is specified for path 3 (bit 2 (NF3) of parameter No. 8242 is set to 0), however, set a number from 1 to the number of controlled axes (in the case of 3-path control).

[Example of setting]

(1) For one-path control
When the fourth axis is controlled as the B-axis, set 4 in this parameter. Furthermore, specify a DI/DO number to be used for the fourth axis in parameter No.8010.

(2) For two-path control
   (a) When B-axis control is applied to path 1 only
   When the fourth axis of path 1 is controlled as the B-axis, set 14 with this parameter. Furthermore, specify the DI/DO number to be used for the fourth axis with parameter No.8010 for path 1.
   (b) When B-axis control is applied to path 2 only
   When the fourth axis on path 2 is controlled as the B-axis, set 24 with this parameter. Furthermore, specify a DI/DO number to be used for the fourth axis in parameter No.8010 for path 2.
   (c) When B-axis control is applied separately to path 1 and path 2
   Make the settings described in (a) and (b) above.
   (d) When B-axis control is simultaneously applied to both path 1 and path 2
   When the fourth axis for path 1 is controlled as the common B-axis, set 14 with this parameter for both path 1 and path 2. Furthermore, specify a DI/DO number to be used for the fourth axis in parameter No.8010 for path 1.

(3) For three-path control

(a) When B-axis control is applied to path 1 only
When the fourth axis of path 1 is controlled as the B-axis, set 14 with this parameter. Moreover, set a DI/DO number to be used, in parameter No. 8010.

(b) When B-axis control is applied to path 2 only
When the fourth axis on path 2 is controlled as the B-axis, set 24 with this parameter. Moreover, set a DI/DO number to be used, in parameter No. 8010.

(c) When B-axis control is applied to path 3 only
When the fourth axis on path 3 is controlled as the B-axis, set 34 with this parameter. Moreover, set a DI/DO number to be used, in parameter No. 8010.

(d) When B-axis control is applied separately to path 1 and path 2
Make the settings described in (a) and (b) above.

(e) When B-axis control is applied separately to path 1 and path 3
Make the settings described in (a) and (c) above.

(f) When B-axis control is applied separately to path 2 and path 3
Make the settings described in (b) and (c) above.

(g) When B-axis control is simultaneously applied to both path 1 and path 2
When the third axis for path 1 is controlled as the common B-axis, set 13 with this parameter for both path 1 and path 2. Moreover, set a DI/DO number to be used, in parameter No. 8010.

(h) When B-axis control is simultaneously applied to both path 1 and path 3
When the third axis for path 3 is controlled as the common B-axis, set 33 with this parameter for both path 1 and path 3. Moreover, set a DI/DO number to be used, in parameter No. 8010.

(i) When B-axis control is simultaneously applied to both path 2 and path 3
When the third axis for path 2 is controlled as the common B-axis, set 23 with this parameter for both path 3 and path 3. Moreover, set a DI/DO number to be used, in parameter No. 8010.

(j) When B-axis control is simultaneously applied to both path 1 and path 2, and B-axis control is separately applied to tool post 3
Make the setting of (g) for path 1 and path 2, and make the setting of (c) for path 3.

(k) When B-axis control is simultaneously applied to both path 1 and path 3, and B-axis control is separately applied to tool post 2
Make the setting of (h) for path 1 and path 2, and make the setting of (b) for path 3.

(l) When B-axis control is simultaneously applied to both path 2 and path 3, and B-axis control is separately applied to tool post 1
Make the setting of (i) for path 1 and path 2, and make the setting of (a) for path 3.

(m) When B-axis control is simultaneously applied to all of path 1, path 2, and path 3
When controlling the third axis of path 2 as a common B-axis, set 23 with this parameter for path 1, set 23 with this parameter for path 2, and set 23 with this parameter for path 3. Moreover, set a DI/DO number to be used, in parameter No. 8010.

(n) When the single operation format is specified for path 3 (bit 2 (NF3) of parameter No. 8242 is set to 0)
Set two-path control for path 1 and path 2. Set 2 with this parameter for path 3 when controlling the second axis as a B-axis. Moreover, set a DI/DO number to be used, in parameter No. 8010.

NOTE

When using the B-axis of another path for B-axis control, create a program by using the axis name of the B-axis of the path where the program is executed.

(Example)

To operate the X-axis of path 2 from path 1 when the C-axis of path 1 is the third axis and the X-axis of path 2 is the third axis:
Set 23 with this parameter for path 1, and create the following program:
G110 C1000.;

8251	M code (G101) for specifying the start of first program operation

8252	M code (G102) for specifying the start of second program operation

8253	M code (G103) for specifying the start of third program operation

[Data type] 2-word
[Valid data range] 6 to 99999999

These parameters set M codes for starting previously registered B-axis operation programs. M codes (such as M30, M98, and M99), already used for other purposes, cannot be set.

8257	T code number for tool offset cancellation

[Data type] Byte
[Valid data range] 0 to 90

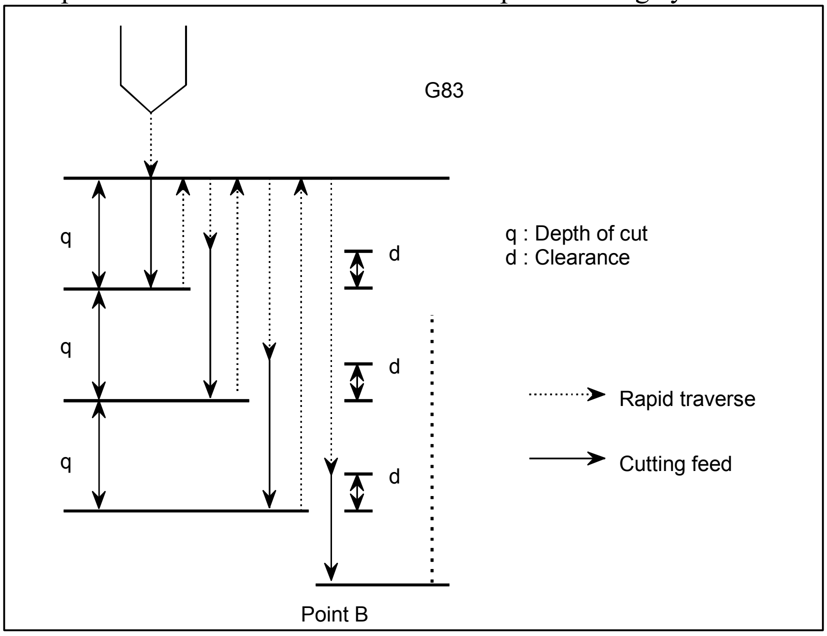
This parameter sets a T code number for tool offset cancellation. When a T code from (setting + 1) to (setting + 9) is specified, tool offset is specified.

8258	Clearance, used in canned cycle G83, for the B-axis

[Data type] 2-word
[Valid data range] 0 to 99999999
[Unit of data]

Input increment	IS-B	IS-C	Unit
Metric input	0.001	0.0001	mm
Inch input	0.0001	0.00001	inch

This parameter sets the clearance used for peck drilling cycle G83.



4.68 PARAMETERS OF SIMPLE SYNCHRONOUS CONTROL

	#7	#6	#5	#4	#3	#2	#1	#0
8301								
	SOF	SC2	SYE	SYA				

[Data type] Bit

SYA In the servo-off state in simple synchronous control, the limit of the difference between the position deviation of the master axis and that of the slave axis is:
0 : Not checked.
1 : Checked.

SYE During execution of synchronous control, the limit of the difference between position deviations (parameters No. 8313 or No. 8323) is:
0 : Checked.
1 : Not checked.

SC2 When the synchronous positioning function for simple synchronous control is used:
0 : Servo alarm No. 410 is issued if the position deviation at the time of synchronous positioning operation is greater than the value set in parameter No. 8315 or parameter No. 8325.
1 : Servo alarm No. 407 is issued if the amount of synchronous positioning is greater than the value set in parameter No. 8315 or parameter No. 8325.

SOF The synchronization compensation function in simple synchronous control (one pair) is:
0 : Not used.
1 : Used.

	#7	#6	#5	#4	#3	#2	#1	#0
8302								
	SMA				SSE		ATS	ATE

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

ATE Automatic setting of grid positioning for simple synchronous control (one pair) is:
0 : Disabled
1 : Enabled

ATS Automatic setting of grid positioning for simple synchronous control (one pair) is:
0 : Not started
1 : Started

> **NOTE**
> 1 When the bits are set to 1, bit 4 (APZx) of parameter No.1815 and parameter No.8316 for the master and slave axes are set to 0.
> 2 These bits are automatically set to 0 once grid positioning has been completed.

SSE In simple synchronous control, the external machine coordinate system shift function for the slave axis is:
0 : Not used.
1 : Used.
For axes under simple synchronous control, when the external machine coordinate system shift is performed for the master axis, it can also performed for the slave axis simultaneously.

> **NOTE**
> The simple synchronous signal must be manipulated.
> Carefully turn the simple synchronous signal on and off because the machine may move at that time.

SMA When bit 4x (APZx) of parameter No. 1015 is turned off for one axis under simple synchronous control, APZx for the other axis under simple synchronous control is:
0 : Not turned off.
1 : Turned off.
When an axis for which the simple synchronous axis parameter is set is under simple synchronous control, the simple synchronous signal is turned on for the axis.

	#7	#6	#5	#4	#3	#2	#1	#0
8303								
	SOFx						ATSx	ATEx

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit axis
ATEx In simple synchronous control, automatic setting for grid positioning is:
0 : Disabled.
1 : Enabled.

ATSx In simple synchronous control, automatic setting for grid positioning is:
0 : Not started.
1 : Started.

> **NOTE**
> When starting automatic setting for grid positioning, set ATSx to 1. Upon the completion of setting, ATSx is automatically set to 0.

SOFx In simple synchronous control, the synchronization compensation function is:
0 : Not used.
1 : Used.

> **NOTE**
> Set this parameter on the master axis side.

	#7	#6	#5	#4	#3	#2	#1	#0
8304								
								USDx

[Data type] Bit axis

USDx In simple synchronous control, the single direction synchronization compensation function uses:
0 : Axis of which machine coordinate is larger as the reference.
1 : Axis of which machine coordinate is smaller as the reference.

> **NOTE**
> Set this parameter (USDx) to the same value for both the master and slave axes.

	#7	#6	#5	#4	#3	#2	#1	#0
8305								
		TTS					USE	USC

[Data type] Bit

USC In simple synchronous control, the single direction synchronization compensation function is:
0 : Not used.
1 : Used.

> **NOTE**
> This parameter is valid only when bit 7 (SOF) of parameter No. 8301 or bit 7 (SOFx) of parameter No. 8303 is set to 1.

USE In simple synchronous control, after emergency stop, the single direction synchronization compensation function is:
0 : Used.
1 : Not used.

> **NOTE**
> This parameter is valid only when bit 7 (SOF) of parameter No. 8301 or bit 7 (SOFx) of parameter No. 8303 is set to 1.

TTS When the twin table function is used, settings such as a signal setting in operation performed singly with the slave axis are made:
0 : On the slave side.
1 : On the master side.

8311	Axis number of master axis in synchronous control

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

[Data type] Byte axis

<For the T Series>

[Valid data range] 0 to ((Number of controlled axes) - 1)

Select a master axis and slave axis in simple synchronous control. Set a master axis number with a slave axis. For the parameters for the first axis through the fourth axis of parameter No.8311, set the following:

Units digit of the parameter for the first axis →
Set the axis number of the master axis when the first axis is used as the slave axis.

Tens digit of the parameter for the first axis →
Set the axis number of the master axis when the second axis is used as the slave axis.

Units digit of the parameter for the second axis →
Set the axis number of the master axis when the third axis is used as the slave axis.

Tens digit of the parameter for the second axis →
Set the axis number of the master axis when the fourth axis is used as the slave axis.

Units digit of the parameter for the third axis →
Set the axis number of the master axis when the fifth axis is used as the slave axis.

Tens digit of the parameter for the third axis →
Set the axis number of the master axis when the sixth axis is used as the slave axis.

Units digit of the parameter for the fourth axis →
Set the axis number of the master axis when the seventh axis is used as the slave axis.

Tens digit of the parameter for the fourth axis →
Set the axis number of the master axis when the eighth axis is used as the slave axis.

Number	Tens digit	Units digit
No.8311 : First axis	Second axis	First axis
No.8311 : Second axis	Fourth axis	Third axis
No.8311 : Third axis	Sixth axis	Fifth axis
No.8311 : Fourth axis	Eighth axis	Seventh axis

Note that the axis number settings are as follows:
0 → First axis, 1 → Second axis, 2 → Third axis, 3 → Fourth axis

[Example] To use the third axis as the master axis and the fourth axis as the slave axis, set the axis number (setting of 2) of the third axis (master axis) in the tens digit for the second axis in the fourth axis (slave axis) parameter, that is, parameter No. 8311.

No. 8311 First: 00
Second: 20
Third: 00
Fourth: 00

> **NOTE**
> For an axis for which 0 is set, the first axis serves as the master axis. So, when the control signal for the axis is set to 1, the first axis serves as a master axis, and synchronous control is exercised.

<For the M Series>

[Valid data range] 0, 1 to number of controlled axes

Select a master axis and slave axis in simple synchronous control. Set a master axis number with the slave axis side. The axis number settings are: 1 → First axis, 2 → Second axis, 3 → Third axis, 4 → Fourth axis. Up to four pairs can be specified.

[Example 1] Simple synchronous control is exercised with one pair.
When using the first axis (X-axis) as the master axis, and the third axis (Z-axis) as the slave axis, set parameter No.8311 as follows:

Parameter No. 8311 X (first axis) = 0
Y (second axis) = 0
Z (third axis) = 1
A (fourth axis) = 0

[Example 2] Simple synchronous control is exercised with three pairs.
Assume that the following three pairs are to be used:
The master axis is the first axis, while a slave axis is the sixth axis.
The master axis is the second axis, while a slave axis is the fifth axis.
The master axis is the third axis, while a slave axis is the fourth axis.
For this specification, set this parameter as follows:

Parameter No.8311	X (First axis)	= 0
	Y (Second axis)	= 0
	Z (Third axis)	= 0
	(Fourth axis)	= 3
	(Fifth axis)	= 2
	(Sixth axis)	= 1

NOTE
The axis number of a master axis must always be smaller than the corresponding slave axis number. Multiple slave axes cannot be assigned to a master axis.

8312	Enabling/disabling mirror image in synchronous control

[Data type] Byte axis
[Valid data range] -127 to +128
This parameter sets the mirror image function. When 100 or a greater value is set with this parameter, the mirror image function is applied to synchronous control. Set this parameter to the slave axis.
[Example] To establish reversed synchronous control when using the third axis as the master axis and the fourth axis as the slave axis, set parameter No.8311 and parameter No.8312 as follows:

Parameter No.8311 (first axis)	= 0
Parameter No.8311 (second axis)	= 20
Parameter No.8311 (third axis)	= 0
Parameter No.8311 (fourth axis)	= 0
Parameter No.8312 (first axis)	= 0
Parameter No.8312 (second axis)	= 0
Parameter No.8312 (third axis)	= 0
Parameter No.8312 (fourth axis)	= 100

8313	Limit of the difference between the amount of position deviation of the master and slave axes (Synchronous control one pair)

[Data type] Word
[Unit of data] Detection unit
[Valid data range] 0 to 32767
Set the limit of the difference between the amount of position deviation of the master and slave axes. If the difference between them exceeds the limit assigned to this parameter, the P/S alarm (No.213) is activated.

8314	Maximum error in synchronous error check

[Data type] 2-word axis

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] 0 to 32767

The machine coordinates on a master axis and slave axis are monitored. If a difference (synchronous error) which is greater than the value specified in this parameter is detected, a servo alarm (No.407) is generated, and the machine is stopped.

Set this parameter with a master axis. When 0 is set in this parameter, no synchronous error check is made.

8315	Maximum compensation value for synchronous control (Synchronous control one pair)

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

[Data type] Word

[Unit of data] Detection unit

[Valid data range] 0 to 32767

This parameter sets the maximum compensation value for synchronous control. When a compensation value greater than the value set in this parameter is used, servo alarm No.410 of slave axis is issued.

8316	Difference between reference counters for master and slave axes (Synchronous control one pair)

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

[Data type] 2-word
[Data unit] Detection unit
[Valid data range] -99999999 to 99999999

This parameter indicates the difference between the values in the reference counter for the master axis and that for the slave axis.

NOTE
Once grid positioning has been completed, the difference between the reference counters is automatically set in this parameter. At this time, bit 1 (ATS) of parameter No.8302 is set to 0.

8317	Torque difference alarm detection time (Synchronous control one pair)

[Data type] Word
[Data unit] msec
[Valid data range] 0 to 4000 (When 0 is set, 512 msec is assumed.)

This parameter specifies the period between the servo preparation completion signal (SA <F000#6>) being set to 1 and the check of the torque difference alarm being started, for the torque difference alarm detection function.

The set value is rounded up to the nearest a multiple of 16 msec.

[Example] When 100 is specified, 112 msec is assumed.

8318	Detection timer for the limit of the difference between the position deviation of the master axis and that of the slave axis

[Data type] Word
[Unit of data] 8msec
[Valid data range] 0 to 1000

This parameter sets the time from the output of a compensation pulse to the slave axis to the start of the check of the limit of the difference between the position deviation of the master axis and that of the slave axis by the synchronization compensation function. The setting is also used for the check of an excessive error at stop.

NOTE
If a value greater than 1000 is set, a value of 1000 is assumed.

8323	Maximum allowable difference between master axis and slave axis position deviations

[Data type] Word axis
[Unit of data] Detection unit
[Valid data range] 0 to 32767

This parameter sets the maximum allowable difference between the master axis and slave axis position deviations. If a position deviation difference exceeds the value specified in this parameter, an alarm (No.213) is issued.
Set this parameter with a master axis. If 0 is specified in this parameter, no position deviation difference check is made.

8325	Maximum compensation value for synchronization compensation function

[Data type] Word axis
[Unit of data] Detection unit
[Valid data range] 0 to 32767

This parameter sets the maximum compensation value for synchronization compensation function. If a compensation value exceeds the value specified with this parameter, a servo alarm (No.407) is issued.
Specify a master axis for this parameter. To enable this parameter, set bit 7 (SOFx) of parameter No.8303 to 1.

8326	Difference between master axis and slave axis reference counters

[Data type] 2-word axis
[Unit of data] Detection unit
[Valid data range] -99999999 to 99999999

The difference between the master axis reference counter and slave axis reference counter (master axis and slave axis grid shift) is automatically set when automatic setting for grid positioning is performed. Then, the difference is transferred together with an ordinary grid shift value to the servo system when the power is turned on.
This parameter is set with a master axis.

8327	
	Torque difference alarm detection timer

[Data type] Word axis

[Unit of data] msec

[Valid data range] 0 to 4000

This parameter sets a time from the servo preparation completion signal, SA <F000#6>, being set to 1 until torque difference alarm detection is started in simple synchronous control. A fraction of less than 16 msec is rounded up.

[Example] Setting = 100: The specification of 112 msec is assumed.

Set this parameter with a master axis. If 0 is set in this parameter, the specification of 512 msec is assumed.

4.69 PARAMETERS OF SEQUENCE NUMBER COMPARISON AND STOP

8341	Program number subject to comparison and stop

This parameter can also be set on the “Setting screen”.

[Data type] Word

[Valid data range] 0 to 9999

This parameter sets the program number, including a sequence number, subject to sequence number comparison and stop. Parameter No.8342 is used to set a sequence number subject to check termination.

> **NOTE**
> A program number can also be set on the setting screen. If a program number is set on the setting screen, the value of the parameter is changed accordingly.

8342	Sequence number subject to comparison and stop

This parameter can also be set on the “Setting screen”.

[Data type] 2-word

[Valid data range] 0 to 9999

This parameter sets the sequence number subject to sequence number comparison and stop.

If the block containing the sequence number set with this parameter is executed while the program set with parameter No.8341 is being executed, a single block stop occurs after the block is executed. At this time, the setting is automatically set to 1. Upon power-up, the setting is automatically set to 0.

> **NOTE**
> A program number can also be set on the setting screen. If a sequence number is set on the setting screen, the value of the parameter is changed accordingly.

8343	Program number subject to comparison and stop (when an 8-digit program number is used)

This parameter can also be set on the “Setting screen”.

[Data type] 2-word

[Valid data range] 0 to 99999999

When a sequence number check is to be stopped, this parameter sets the program number to which a sequence number where the check is to be stopped belongs. Set a stop sequence number in parameter No.8342.

4.70 PARAMETERS OF CHOPPING

	#7	#6	#5	#4	#3	#2	#1	#0
8360	CHF					CVC		ROV

[Data type] Bit

ROV For the chopping function, a rapid traverse override for a section from the current position to the R point is determined as follows:
0 : A chopping override is enabled.
1 : An ordinary rapid traverse override is enabled.

CVC The feedrate along the chopping axis is changed:
0 : At the upper or lower dead point immediately after the feedrate change command is issued.
1 : At the upper dead point immediately after the feedrate change command is issued.

CHF On the chopping screen, the chopping speed can:
0 : Be set.
1 : Not be set.

	#7	#6	#5	#4	#3	#2	#1	#0
8361				NFR				CMX

[Data type] Bit

CMX When the amount of shortage at the lower dead point becomes smaller than the value set in parameter No. 8378, clamping at the maximum chopping feedrate:
0 : Continues.
1 : Is not performed.

> **NOTE**
> Because clamping at the maximum chopping feedrate is not performed, the final chopping feedrate may exceed the maximum chopping feedrate.

NFR Chopping speed:
0 : Does not support inch input/speed specification including the decimal point.
1 : Supports inch input/speed specification including the decimal point.

> **NOTE**
> When specifying chopping (G81.1) based on inch input or specifying a chopping speed including the decimal point, be sure to set this parameter to 1.

8370	Chopping axis

[Data type] Byte

[Valid data range] 1 to number of controlled axes

This parameter specifies which servo axis the chopping axis corresponds to.

8371	Chopping reference point (R point)

8372	Chopping upper dead point

8373	Chopping lower dead point

[Data type] 2-word

[Valid data range]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

The data set in these parameters are absolute coordinates.

8374	Chopping speed

[Data type] 2-word

[Unit of data, Valid data range]

Increment system	Units of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	30 to 240000	30 to 100000
Inch machine	0.1 inch/min	30 to 96000	30 to 48000
Rotary axis	1 deg/min	30 to 240000	30 to 100000

8375	Maximum chopping feedrate

[Data type] 2-word axis

[Unit of data, Valid data range]

Increment system	Units of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	30 to 240000	30 to 100000
Inch machine	0.1 inch/min	30 to 96000	30 to 48000
Rotary axis	1 deg/min	30 to 240000	30 to 100000

The chopping speed is clamped at a value specified in this parameter. When the parameter is set to 0, no chopping operation occurs.

8376	
	Chopping compensation scaling factor

[Data type] Byte
[Unit of data] %
[Valid data range] 0 to 100

This parameter specifies a scaling factor used to multiply the compensation value for a servo delay or acceleration/deceleration delay in an chopping operation. When this parameter is set to 0, servo delay compensation will not be applied.

8377	
	Compensation start tolerance

[Data type] Word
[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] 0 to 32767

Compensation is applied when the difference between an amount of shortage at the upper dead point and that at the lower dead point is less than the value specified in this parameter. In other words, this parameter is used to enable compensation after the chopping operation settles. When the parameter is set to 0, compensation will not be applied.

8378	
	Amount of an error permissible for starting increase in speed

[Data type] 2-word
[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric input	0.01	0.001	0.0001	mm
Inch input	0.001	0.0001	0.00001	inch
Rotary axis	0.001	0.0001	0.00001	deg

[Valid data range] 0 to 99999999

This parameter sets the amount of an error permissible for starting increase in speed.

When the amount of shortage at the lower dead point becomes smaller than the value set in this parameter, clamping at the maximum chopping feedrate is not performed.

4.71 PARAMETERS OF HIGH-SPEED AND HIGH-PRECISION CONTOUR CONTROL BY RISC (M SERIES)

4.71.1 Parameters of Acceleration/Deceleration before Interpolation

8400	Parameter 1 for determining a linear acceleration/deceleration before interpolation

[Data type] 2-word

[Unit of data, Valid data range]

Increment system	Units of data	Valid data range	
		IS-B	IS-C
Metric machine	1 mm/min	10 to 240000	1 to 24000
Inch machine	0.1 inch/min	10 to 240000	1 to 24000
Rotary axis	1 deg/min	10 to 240000	1 to 24000

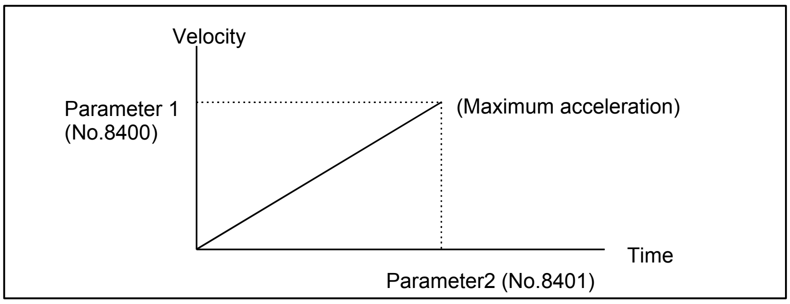
This parameter determines a linear acceleration/deceleration before interpolation. Usually, set the maximum cutting speed (parameter No.1422).

8401	Parameter 2 for determining a linear acceleration/deceleration before interpolation (common to all axes)

[Data type] Word
[Unit of data] msec
[Valid range] 0 to 4000

This parameter specifies the time required until the speed specified in parameter 1 is achieved.
When the bell-shaped acceleration/deceleration before interpolation is used, the data specified in parameter 1 and parameter 2 determines the maximum acceleration of bell-shaped acceleration/deceleration before look-ahead interpolation.

NOTE
1 When 0 is set in parameter 1 (No. 8400) or parameter 2 (No. 8401/No. 19510) for acceleration/deceleration setting, the function for acceleration/deceleration before interpolation is disabled. (Parameter No. 19510 is valid in AI high-precision/AI nano high-precision contour control.)
2 When both of parameter No. 8401 and parameter No. 19510 are set, the setting of parameter No. 19510 has priority. (Parameter No. 19510 is valid in AI high-precision/AI nano high-precision contour control.)



	#7	#6	#5	#4	#3	#2	#1	#0
8402	BDO		DST	BLK			NBL	

[Data type] Bit

NBL, BDO Select the type of acceleration/deceleration before interpolation.

BDO	NBL	Meaning
0	0	Linear type is used for acceleration/deceleration prior to look-ahead interpolation
1	1	Bell-shape type is used for acceleration/deceleration prior to look-ahead interpolation

NOTE

1 When AI high-precision/AI nano high-precision contour control is used, the type of acceleration/ deceleration can be specified with either bit 3 (RSB) of parameter No. 1603 or bits 1 (NBL) and 7 (BDO) of parameter No. 8402.

2 If the setting made with bit 3 (RSB) of parameter No. 1603 differs from the setting made with bits 1 (NBL) and 7 (BDO) of parameter No. 8402 (if bell-shaped type is specified with one parameter only), the specification of bell-shaped acceleration/ deceleration before interpolation is assumed.

BLK Be sure to set 0.

DST Be sure to set 1.

	#7	#6	#5	#4	#3	#2	#1	#0
8403	SG0						MSU	
	SG0				LM2	LM1	MSU	

[Data type] Bit

MSU When G00 or an auxiliary function (M, S, T, or B code) is specified in HPCC mode or an auxiliary function (M, S, T, or B code) is specified in AI high-precision/AI nano high-precision contour control mode:
0 : An alarm is issued.
1 : The CNC executes the command.

LM1 In HPCC mode, a stroke check before move for stored stroke limit 1 is:
0 : Not performed.
1 : Performed.

LM2 In HPCC mode, a stroke check before move for stored stroke limit 2 is :
0 : Not performed.
1 : Performed.

SG0 When G00 is specified in HPCC mode:
0 : The setting of bit 1 (MSU) of parameter No.8403 is followed.
1 : The tool is moved along the axis at the feedrate set with parameter No.8481, replacing the G00 command with the G01 command with the RISC board, regardless of the setting made for bit 1 (MSU) of parameter No.8403.

	#7	#6	#5	#4	#3	#2	#1	#0
8404	RIT							STG
	RIT						HG0	STG

[Data type] Bit
STG The positioning command (G00) is:
0 : Executed with the RISC board in a simplified manner.
1 : Executed with the RISC board in the same way as normal.

NOTE
This parameter is enabled when the SG0 parameter (bit 7 of parameter No.8403) is set to 1.

HG0 This parameter must be set to 1 in case that positioning command (G00) is executed with the RISC board in the same way as normal G00 (parameter No.8403#7=1,No.8404#0=1).
In case this parameter is set to 1, fine acceleration/deceleration is disabled at the rapid traverse in high-precision contour control mode.

Type of rapid traverse	MSU	SG0	STG	HG0
Executed on CNC side	1	0	0	0/1
Executed as G01 with the RISC board	0/1	1	0	0/1
Executed as normal G00 with the RISC board	0/1	1	1	1

RIT In high-precision contour control mode, the axis-by-axis interlock function is:
0 : Not enabled.
1 : Enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
8405								RAXx

[Data type] Bit axis

RAXx In the high-precision contour control, AI high-precision contour control, AI nano high-precision contour control, or 5-axis machining function mode, the axis is:

0 : Used as a RISC control axis.

1 : Not used as a RISC control axis.

> **NOTE**
> The setting of this parameter is valid only with the axes placed under RISC control by the setting of parameter No. 7510. Axes not placed under RISC control by the setting of parameter No. 7510 are not set as RISC control axes eve if this parameter is set to 0.

4.71.2 Parameters of Automatic Speed Control

8406	Lower limit of block movement time (for high-precision contour control)

[Data type] Byte

[Unit of data] msec

[Valid data range] 0 to 256

This parameter specifies the lower limit of block movement time during operation in the high-precision contour control mode. If the movement time of a cutting feed block is specified in this parameter, the maximum permissible speed is calculated from the programmed block movement time. If a specified feedrate exceeds this maximum permissible speed, the actual speed is automatically clamped to the maximum permissible speed.

8407	Lowest clamp speed of the deceleration function in accordance with the block movement time (for high-precision contour control)

[Data type] 2-word

[Unit of data, valid data range]

Increment system	Units of data	Valid data range	
		IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

If the travel distance of a block is very short, the speed clamp function as specified by parameter No. 8406 may result in an extremely low speed. If the speed is lower than the value specified in this parameter, the actual speed is clamped to the speed specified in this parameter.

8410	Allowable velocity difference in velocity determination considering the velocity difference at corners

[Data type] 2-word axis

[Unit of data, valid data range]

Increment system	Units of data	Valid data range	
		IS-B	IS-C
Metric machine	1 mm/min	10 to 60000	1 to 6000
Inch machine	0.1 inch/min	10 to 60000	1 to 6000
Rotary axis	1 deg/min	10 to 60000	1 to 6000

When the function for determining the velocity considering the velocity difference at corners is used, the system calculates the feedrate whereby a change in the velocity element of each axis does not exceed this parameter value at the interface between blocks. Then the machine decelerates using acceleration/deceleration before interpolation.
If 0 specified for all axes, the machine does not decelerate at corners.

	#7	#6	#5	#4	#3	#2	#1	#0
8411	RDM	RDR	RDA					

[Data type] Bit

RDA When bit 0 (RRD) of parameter No. 8414 is 1, the absolute coordinate system and remaining movement amount of current position display are displayed:
0: With a diameter value.
1: With a radius value.

RDR When bit 0 (RRD) of parameter No. 8414 is 1, the relative coordinate system of current position display is displayed:
0: With a diameter value.
1: With a radius value.

RDM When bit 0 (RRD) of parameter No. 8414 is 1, the machine coordinate system of current position display is displayed:
0: With a diameter value.
1: With a radius value.

	#7	#6	#5	#4	#3	#2	#1	#0
8412								
			FDI				HIK	EST

[Data type] Bit

EST The simple NURBS interpolation start function is:
0 : Disabled.
1 : Enabled.

HIK The high-precision knot command of NURBS interpolation is:
0 : Disabled.
1 : Enabled.

FDI Parametric feedrate control of NURBS interpolation is:
0 : Disabled.
1 : Enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
8414								RRDx

[Data type] Bit axis

RRDx For an axis based on diameter programming (with bit 3 (DIA) of parameter No. 1006 set to 1), a programmed command in the high-precision contour control mode is based on:

0 : Diameter programming
1 : Radius programming

NOTE
If a program created assuming diameter programming is executed when this parameter is set to 1, the travel distance is doubled in the high-precision contour control mode and AI high-precision/AI nano high-precision contour control mode.

8416	**Time taken until the maximum acceleration of bell-shaped acceleration/deceleration before look-ahead interpolation is reached or Acceleration change time for bell-shaped acceleration/deceleration before look-ahead interpolation**

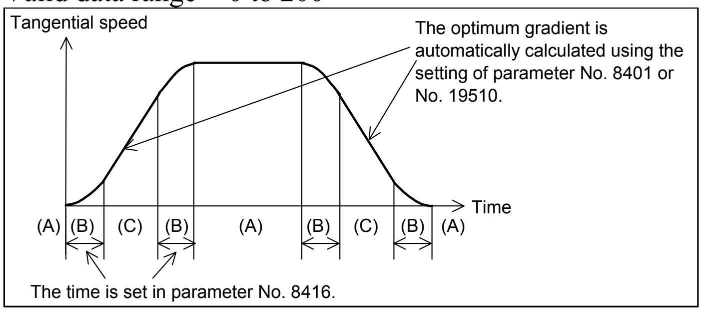
[Data type] 2-word

[Unit of data] msec

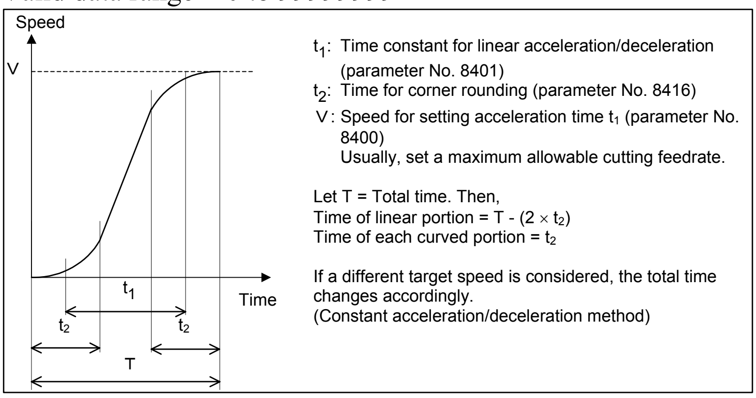
[Valid data range] See the explanation below.

(When high-precision contour control is used, a choice between (1) and (2) can be made with bit 3 (SBL) of parameter No. 1603.
For AI high-precision contour control and AI nano high-precision contour control, the specification of (1) is valid, regardless of the setting of bit 3 (SBL) of parameter No. 1603.)

(1) When high-precision contour control is used and bit 3 (SBL) of parameter No. 1603 is set to 1, or when AI high-precision contour control or AI nano high-precision contour control is used.
(When the acceleration change time (time required for changing from the constant feedrate status (A) to the constant acceleration/ deceleration status (C) at the acceleration calculated based on the acceleration set: Time (B) in the figure below) is set for bell-shaped acceleration/deceleration before look-ahead interpolation.)
Valid data range = 0 to 200



(2) When high-precision contour control is used and bit 3 (SBL) of parameter No. 1603 is set to 0.
(When the time required to reach the acceleration set with parameters Nos. 8400 and 8401 is set during bell-shaped acceleration/deceleration before look-ahead interpolation.)
Valid data range = 0 to 99999999



	#7	#6	#5	#4	#3	#2	#1	#0
8451	NOF			ZAG				USE
	NOF			ZAG		TIM		USE

At least one of these parameters can also be set on the "Setting screen".

[Data type] Bit

USE Automatic speed control is:
0 : Not applied.
1 : Applied.

TIM The deceleration function based on block movement time is:
0 : Not used.
1 : Used.

ZAG The velocity is:
0 : Not determined according to the angle at which the machine descends along the Z-axis.
1 : Determined according to the angle at which the machine descends along the Z-axis.
When setting this parameter to 1, be sure to set parameter No. 8456, No. 8457, and No. 8458.

NOF In a block where automatic speed control is validated, the F command is:
0 : Validated.
1 : Ignored.
When the parameter is set to ignore the F command, the maximum allowable velocity set in parameter No. 8465 for automatic speed control is used as a specified velocity instead of the F command.

8452	Range of velocity fluctuation to be ignored

[Data type] Byte
[Unit of data] %
[Valid range] 0 to 100 (Standard setting: 10)

8456	Override for range 2 that is applied during deceleration according to the cutting load in high-precision contour control and AI/AI-nano high-precision contour control

[Data type] Word
[Unit of data] %
[Valid data range] 1 to 100 (Standard setting: 80)

8457	Override for range 3 that is applied during deceleration according to the cutting load in high-precision contour control and AI/AI-nano high-precision contour control

[Data type] Word
[Unit of data] %
[Valid data range] 1 to 100 (Standard setting: 70)

8458	Override for range 4 that is applied during deceleration according to the cutting load in high-precision contour control and AI/AI-nano high-precision contour control

[Data type] Word

[Unit of data] %

[Valid data range] 1 to 100 (Standard setting : 60)

For the function of decelerating according to the cutting load in high-precision contour control and AI/AI-nano high-precision contour control, the override set in a parameter can be applied according to the angle at which the tool moves downward along the Z-axis.

The feedrate obtained according to other conditions is multiplied by the override for the range containing angle θ at which the tool moves downward. For range 1, no parameter is assigned and the override is always 100%, however.

Area-1 $0° \leq \theta < 30°$

Area-2 $30° \leq \theta < 45°$

Area-3 $45° \leq \theta < 60°$

Area-4 $60° \leq \theta < 90°$

	#7	#6	#5	#4	#3	#2	#1	#0
8459								
					OVR		CTY	CDC

[Data type] Bit

CDC Be sure to set to 0.

CTY Be sure to set to 1.

OVR In high-precision contour control, the override for the functions of decelerating according to the feedrate difference and acceleration is:

0 : Disabled.

1 : Enabled.

This function enables the override for the following feedrates:

- Feedrate decreased by deceleration according to the feedrate difference of acceleration/deceleration in high-precision contour control
- Feedrate decreased by deceleration according to the acceleration in high-precision contour control
- Feedrate decreased by deceleration according to the acceleration in circular interpolation
- Feedrate decreased by acceleration clamping in involute interpolation
- Lowest feedrate for deceleration according to the acceleration in high-precision contour control and circular interpolation
- Maximum feedrate for high-precision contour control

When an override is applied by this function, the maximum cutting feedrate (parameter No. 1422, 1430, or 1432) is not also exceeded.

For AI/AI-nano high-precision contour control, a setting of 1 is always assumed regardless of the setting of this parameter.

8464	Initial feedrate for automatic speed control

[Data type] 2-word

[Unit of data, valid data range]

Increment system	Units of data	Valid 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
Rotary axis	1 deg/min	10 to 240000	1 to 100000

This parameter sets the initial feedrate for automatic speed control.
In automatic speed control, the initial feedrate set with this parameter is used at the beginning if no F command is specified in the program. Usually, set the maximum cutting feedrate (specified in parameter No.1422).

8465	Maximum allowable feedrate for automatic speed control

[Data type] 2-word

[Unit of data, valid data range]

Increment system	Units of data	Valid 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
Rotary axis	1 deg/min	10 to 240000	1 to 100000

This parameter sets the maximum allowable feedrate for automatic speed control for high-precision contour control or AI/AI-nano high-precision contour control.
If a feedrate higher than the setting of this parameter is specified in the high-precision contour control or AI/AI-nano high-precision contour control mode, the feedrate is clamped to that set in this parameter.
If this parameter is set to 0, no clamping is performed.
When bit 7 (NOF) of parameter No. 8451 is set to 1, the tool moves, assuming that the feedrate set in this parameter is specified. If this parameter is set to 0 at this time, alarm P/S 0011 occurs.
Normally, the maximum cutting feedrate (parameter No. 1422, 1430, or 1432) should be set.
The maximum cutting feedrate is clamped to the setting of parameter No. 1422.

8470	Parameter for determining allowable acceleration in velocity calculation considering acceleration

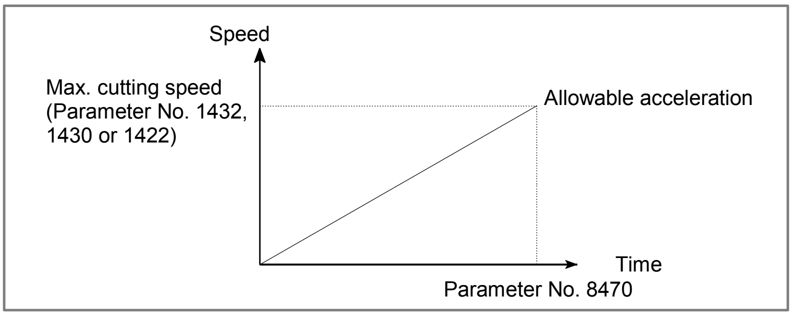
[Data type] Word axis
[Unit of data] msec
[Valid range] 0 to 32767

When the function for calculating the feedrate considering the acceleration is used under automatic speed control, this parameter is used to determine the allowable acceleration. The time required until the maximum cutting feedrate is reached must be specified here.

Allowable acceleration is determined from the maximum cutting feedrate and the value set in this parameter. Where, the maximum cutting feedrate is any of value set in parameter No. 1432, 1430 or 1422. Which parameter No. is used depends on the following conditions:

- When a value other than 0 is set to No. 1432 and 1430, the value set to No. 1432 is used.
- When 0 is set to No. 1432 and a value other than 0 is set to No. 1430, the value set to No. 1430 is used.
- When 0 is set to No. 1432 and 1430, the value set to No. 1422 is used.

As a greater value is set in this parameter, a smaller machining error occurs and a smaller shock on the machine results.



	#7	#6	#5	#4	#3	#2	#1	#0
8475					CIR	BIP		

[Data type] Bit

BIP The function of deceleration at corners is:
0 : Not used.
1 : Used. (Always set 1.)

CIR The function of automatic speed control considering acceleration and deceleration during circular interpolation is:
0 : Not used.
1 : Used.

NOTE
When 1 is set, parameter No.8470 for determining the allowable acceleration must be specified.

	#7	#6	#5	#4	#3	#2	#1	#0
8480		RI2	RI1	RI0				

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

RI2, RI1, RI0 This parameter must be set to type A or type B as indicated below.

	RI2	RI1	RI0	Remarks
Type A	0	0	1	Setting for compatibility with older models
Type B	0	0	1	Recommended setting

For systems of model B, it is recommended to set type B.

When AI high-precision/AI nano high-precision contour control is used, make one of the following settings:

	RI2	RI1	RI0
BPT 1.0msec	0	0	0
BPT 0.4msec	1	1	1

8481	Rapid traverse rate in HPCC mode

[Data type] 2-word

[Unit of data, valid data range]

Increment system	Units of data	Valid data range	
		IS-B	IS-C
Metric machine	1 mm/min	0 to 600000	0 to 60000
Inch machine	0.1 inch/min	0 to 600000	0 to 60000
Rotary axis	1 deg/min	0 to 600000	0 to 60000

When bit 7 (SG0) of parameter No.8403 is set to 1, this parameter sets the rapid traverse rate in the HPCC mode.

NOTE
The G00 command is replaced with the G01 command before execution. So, even if feedrate is specified for two axes, the rapid traverse rate set with this parameter is always used.
[Example]
If the following command is specified when a rapid traverse rate of 1000 mm/min is set F1000, rather than F1414, is used:
G00 X100.Y100.;

	#7	#6	#5	#4	#3	#2	#1	#0
8485			CDS			GO2		G51
			CDS	INV	PRW	GO2	G81	G51

[Data type] Bit

G51 Scaling and coordinate rotation in the high-precision contour control (HPCC) mode and AI high-precision/AI nano high-precision contour control mode are:
Scaling and coordinate rotation in the three-dimensional coordinate conversion mode are:
0 : Disabled.
1 : Enabled.

G81 In high-precision contour control (HPCC) mode, a canned cycle for drilling is:
0 : Disabled.
1 : Enabled.

G02 Helical interpolation in the high-precision contour control (HPCC) mode and AI high-precision/AI nano high-precision contour control mode is:
0 : Disabled.
1 : Enabled.

PRW In high-precision contour control (HPCC) mode, parameter rewriting using the PMC window is:
0 : Disabled.
1 : Enabled.

INV In high-precision contour control (HPCC) mode, involute interpolation is:
0 : Disabled.
1 : Enabled.

CDS Smooth interpolation in the high-precision contour control (HPCC) mode and AI high-precision/AI nano high-precision contour control mode is:
0 : Disabled.
1 : Enabled.

8486	Maximum travel distance of a block where smooth interpolation is applied
	Maximum allowable travel distance of a block where smooth interpolation is applied or maximum allowable travel distance of a block where nano smoothing is applied

[Data type] 2-word

[Unit of data]

Input increment	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm
Inch machine	0.0001	0.00001	inch

[Valid data range] 0 to 99999999

- This parameter specifies a block length used as a reference to decide whether to apply smooth interpolation. If the line specified in a block is longer than the value set in the parameter, smooth interpolation will not be applied to that block. This parameter can be used, for example, to specify the maximum line length of a folded line to which a metal die workpiece is approximated with some tolerance.
- This parameter sets the maximum allowable travel distance of a specified block where nano smoothing is applied.
  In a block whose travel distance is longer than the setting of this parameter, nano smoothing is canceled.

When 0 is set in this parameter, determination based on a maximum travel distance is not performed.

8487	Angle at which smooth interpolation is turned off
	Angle at which smooth interpolation is turned off, or maximum allowable angle difference between specified blocks to which nano smoothing is applied

[Data type] Word

[Unit of data] 0.1 deg

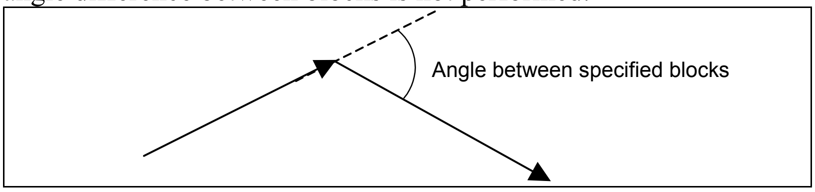
[Valid data range] 0 to 32767 (smooth interpolation)
0 to 3600 (nano smoothing)

- This parameter sets the angle used to determine whether to apply smooth interpolation.
  At a point having a difference in angle greater than this setting, smooth interpolation is turned off.

NOTE
If a value of 0 is set, the setting is assumed to be 10 degrees.

- This parameter sets a maximum allowable angle difference between specified blocks to which nano smoothing is applied.
  If the angle between specified blocks is larger than the setting of this parameter, nano smoothing is canceled.

When 0 is set in this parameter, determination based on the maximum angle difference between blocks is not performed.



8490	Minimum travel distance of a block where smooth interpolation is applied
	Minimum allowable travel distance of a block where smooth interpolation is applied or minimum allowable travel distance of a block where nano smoothing is applied

[Data type] 2-word

[Unit of data]

Input increment	IS-B	IS-C	Unit
Metric input	0.001	0.0001	mm
Inch input	0.0001	0.00001	inch

[Valid data range] 0 to 99999999

- This parameter sets a block length used to determine whether to apply smooth interpolation.
  If the line specified in a block is shorter than the value set in this parameter, smooth interpolation is not applied to that block.
- This parameter sets the minimum allowable travel distance of a specified block where nano smoothing is applied.
  In a block whose travel distance is shorter than the setting of this parameter, nano smoothing is canceled.

When 0 is set in this parameter, determination based on a minimum travel distance is not performed.

8491	Maximum tolerance for a block where smooth interpolation is applied

8492	Minimum tolerance for a block where smooth interpolation is applied

[Data type] Word

[Unit of data]

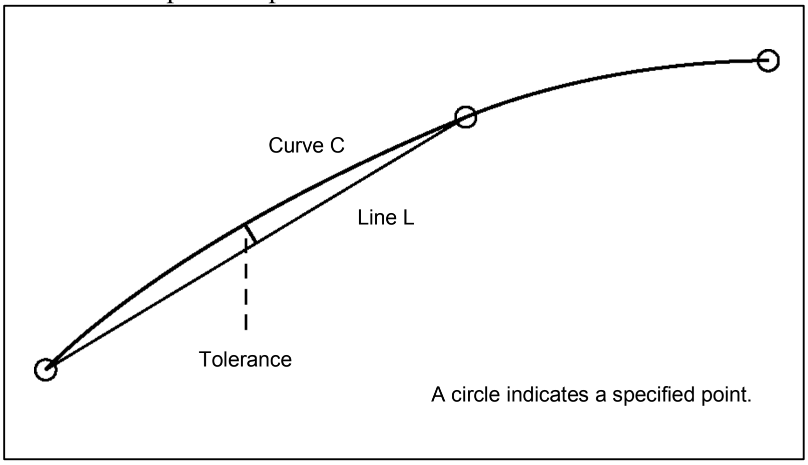
Input increment	IS-B	IS-C	Unit
Metric input	0.001	0.0001	mm
Inch input	0.0001	0.00001	inch

[Valid data range] 0 to 32767

These parameters set the maximum and minimum tolerances used to determine whether to apply smooth interpolation. If the tolerance specified in a block is larger or smaller than these settings, smooth interpolation is not applied to that block.

Usually, set about one-tenth of the setting for the maximum tolerance (No. 8491) for the minimum tolerance (No. 8492).

[Reference] Tolerance means the distance between curve C which smoothly connects the specified points and line L.



NOTE

If a value of 0 is set for the minimum tolerance (No. 8492), the minimum tolerance is assumed to be one-tenth of the maximum tolerance (No. 8491).
If a negative value is set for the minimum tolerance (No. 8492), the minimum tolerance (No. 8492) is assumed to be 0.

4.72 PARAMETERS OF HIGH-SPEED POSITION SWITCH (1 OF 2)

	#7	#6	#5	#4	#3	#2	#1	#0
8500	EPS							

[Data type] Bit

EPS The maximum number of high-speed position switches is:
0 : 6.
1 : 16.

	#7	#6	#5	#4	#3	#2	#1	#0
8501						HPT	HPE	HPO

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

HPO The output signal of a high-speed position switch is output to:
0 : Address Y. (See the explanation of parameter No. 8565.)
1 : Address F. (PMC signals <F293 or F294>)

HPE The current position used with the high-speed position switch of decision-by-direction type:
0 : Considers a servo error.
1 : Does not consider a servo error.

HPT A direction-dependent type high-speed position switch is switched:
0 : When a reference machine coordinate is passed.
1 : When a reference machine coordinate is reached.

	#7	#6	#5	#4	#3	#2	#1	#0
8504	HE8	HE7	HE6	HE5	HE4	HE3	HE2	HE1

	#7	#6	#5	#4	#3	#2	#1	#0
8505	HEG	HEF	HEE	HED	HEC	HEB	HEA	HE9

[Data type] Bit

HE1 to HEG The corresponding high-speed position switch is:
0 : Enabled.
1 : Disabled.

1 to G of a bit name corresponds to the high-speed position switch place.

These parameters specify whether to enable or disable the corresponding high-speed position switches.

A disabled high-speed position switch always outputs 0.

	#7	#6	#5	#4	#3	#2	#1	#0
8508	HM8	HM7	HM6	HM5	HM4	HM3	HM2	HM1

	#7	#6	#5	#4	#3	#2	#1	#0
8509	HMG	HMF	HME	HMD	HMC	HMB	HMA	HM9

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

HM1 to HMG The output type of the corresponding high-speed position switch is:

0 : Normal. (The machine coordinate range is used to determine whether to output the signal.)
1 : Direction-dependent type. (The machine coordinates and operation direction are used to determine whether to output the signal.)

Bit name HM1 to HMG corresponds to the high-speed position switch place.
These parameters set the output types for the corresponding high-speed position switches.

	#7	#6	#5	#4	#3	#2	#1	#0
8512	HA8	HA7	HA6	HA5	HA4	HA3	HA2	HA1

	#7	#6	#5	#4	#3	#2	#1	#0
8513	HAG	HAF	HAE	HAD	HAC	HAB	HAA	HA9

[Data type] Bit

HA1 to HAG The signal is turned on when the corresponding high-speed position switch passes through the machine coordinate position set in parameter No. 8580 to 8589 or 12221 to 12226:

0 : In the negative (-) direction.
1 : In the positive (+) direction.

Bit name HA1 to HAG corresponds to the high-speed position switch place.
When direction-dependent type is selected for the output type of a high-speed position switch in parameter No. 8508 or 8509, the corresponding parameter sets the direction.

	#7	#6	#5	#4	#3	#2	#1	#0
8516	HB8	HB7	HB6	HB5	HB4	HB3	HB2	HB1

	#7	#6	#5	#4	#3	#2	#1	#0
8517	HBG	HBF	HBE	HBD	HBC	HBB	HBA	HB9

[Data type] Bit

HB1 to HBG The signal is turned off when the corresponding high-speed position switch passes through the machine coordinate position set in parameter No. 8590 to 8599 or 12241 to 12246:

0 : In the negative (-) direction.
1 : In the positive (+) direction.

Bit name HB1 to HBG corresponds to the high-speed position switch place.

When direction-dependent type is selected for the output type of a high-speed position switch in parameter No. 8508 or 8509, the corresponding parameter sets the direction.

8565	Output address of the high-speed position switch signal

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

[Data type] Word
[Valid data range] 0, 1 to 126, 1000 to 1014, 1020 to 1034

8570	Axis corresponding to the first high-speed position switch
8571	Axis corresponding to the second high-speed position switch
8572	Axis corresponding to the third high-speed position switch
8573	Axis corresponding to the fourth high-speed position switch
8574	Axis corresponding to the fifth high-speed position switch
8575	Axis corresponding to the sixth high-speed position switch
8576	Axis corresponding to the seventh high-speed position switch
8577	Axis corresponding to the eighth high-speed position switch
8578	Axis corresponding to the ninth high-speed position switch
8579	Axis corresponding to the tenth high-speed position switch

[Data type] Byte
[Valid data range] 0 to number of controlled axes

These parameters specify the axis control numbers corresponding to the first to tenth high-speed position switches.

NOTE
Set 0 for the number corresponding to a high-speed position switch which is not to be used.

8580	**Maximum value of the operation range of the first high-speed position switch or position where the first high-speed position switch is turned on**
8581	**Maximum value of the operation range of the second high-speed position switch or position where the second high-speed position switch is turned on**
8582	**Maximum value of the operation range of the third high-speed position switch or position where the third t high-speed position switch is turned on**
8583	**Maximum value of the operation range of the fourth high-speed position switch or position where the fourth high-speed position switch is turned on**
8584	**Maximum value of the operation range of the fifth high-speed position switch or position where the fifth high-speed position switch is turned on**
8585	**Maximum value of the operation range of the sixth high-speed position switch or position where the sixth high-speed position switch is turned on**
8586	**Maximum value of the operation range of the seventh high-speed position switch or position where the seventh high-speed position switch is turned on**
8587	**Maximum value of the operation range of the eighth high-speed position switch or position where the eighth high-speed position switch is turned on**
8588	**Maximum value of the operation range of the ninth high-speed position switch or position where the ninth high-speed position switch is turned on**
8589	**Maximum value of the operation range of the tenth high-speed position switch or position where the tenth high-speed position switch is turned on**

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

Set the following value, depending on the output method of the high-speed position switch:

- For normal type
  Maximum value of the operation range of the first to tenth high-speed position switches
- For direction-dependent type
  Position where the first to tenth position switches are turned on

> **NOTE**
> For each high-speed position switch, an output method can be selected using bit 0 (HM1) of parameter No. 8508 to bit 7 (HMG) of parameter No. 8509.
> When direction-dependent type is selected, set a direction for turning on each high-speed position switch in bit 0 (HA1) of parameter No. 8512 to bit 7 (HAG) of parameter No. 8513.

8590	Minimum value of the operation range of the first high-speed position switch or position where the first high-speed position switch is turned off
8591	Minimum value of the operation range of the second high-speed position switch or position where the second high-speed position switch is turned off
8592	Minimum value of the operation range of the third high-speed position switch or position where the third t high-speed position switch is turned off
8593	Minimum value of the operation range of the fourth high-speed position switch or position where the fourth high-speed position switch is turned off
8594	Minimum value of the operation range of the fifth high-speed position switch or position where the fifth high-speed position switch is turned off
8595	Minimum value of the operation range of the sixth high-speed position switch or position where the sixth high-speed position switch is turned off
8596	Minimum value of the operation range of the seventh high-speed position switch or position where the seventh high-speed position switch is turned off
8597	Minimum value of the operation range of the eighth high-speed position switch or position where the eighth high-speed position switch is turned off
8598	Minimum value of the operation range of the ninth high-speed position switch or position where the ninth high-speed position switch is turned off
8599	Minimum value of the operation range of the tenth high-speed position switch or position where the tenth high-speed position switch is turned off

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

Set the following value, depending on the output method of the high-speed position switch:

- For normal type
  Minimum value of the operation range of the first to tenth high-speed position switches
- For direction-dependent type
  Position where the first to tenth position switches are turned on

NOTE

For each high-speed position switch, an output method can be selected using bit 0 (HM1) of parameter No. 8508 to bit 7 (HMG) of parameter No. 8509.
When direction-dependent type is selected, set a direction for turning on each high-speed position switch in bit 0 (HB1) of parameter No. 8516 to bit 7 (HBG) of parameter No. 8517.

4.73 OTHER PARAMETERS

	#7	#6	#5	#4	#3	#2	#1	#0
8650		KPG	PGU	CKM	DMA	EKY	CNA	RSK

[Data type] Bit

RSK When the RESET key is pressed, the key code is:
0 : Not passed to the application using C language executor.
1 : Passed to the application using C language executor.

CNA When an NC alarm is issued during the display of the user screen for the C language executor:
0 : The CNC alarm screen can be displayed depending on the setting of bit 7 (NPA) of parameter No.3111.
1 : The NC alarm screen is not displayed.

EKY When the C language executor is used, the extended portion of the MDI keys (9 to 11 lines) is:
0 : Not read.
1 : Read.

DMA When the C language executor is used, transfer via RS-232-C is:
0 : Not made as DMA transfer.
1 : Made as DMA transfer.

CKM When the C language executor is used, the bit matrix of the MDI keys is:
0 : Not transferred to the NC.
1 : Transferred to the NC.
Set this bit to 1 only when the NC needs to directly read the bit matrix. Usually, set this bit to 0.

PGU When the user screen for the C language executor is assigned as an NC program screen:
0 : The common screen number is used.
1 : The screen number for each operation mode is used.

NOTE
Bits 0 to 5 of the parameter No. 8650 are used with the C language executor. Any modifications to the value set for these bits does not become effective until after the system is next powered on.

KPG When the screen display is switched between the user screen for the C language executor and the NC screen:
0 : Graphic data is cleared.
1 : Graphic data is not cleared.

> **NOTE**
> 1 When a screen with a background color is displayed, this parameter is used to suppress flickering at screen switching time. When a background color similar to the one used for the NC screen is drawn on the C-EXE application screen, set this parameter to 1.
> 2 If this parameter is set to 1, graphically drawn data is not cleared but remains on the screen when the screen display is switched from the NC screen to the C-EXE application screen (or vice versa). So, be sure to initialize and draw the graphic screen when using the C-EXE application screen.

	#7	#6	#5	#4	#3	#2	#1	#0
8651								CFS

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit
CFS FACTOLINK software in:
0 : Dedicated memory card is valid.
1 : FROM is valid.

	#7	#6	#5	#4	#3	#2	#1	#0
8652	CM3	CM2	CM1	CMF				

[Data type] Bit
CMF When the [FAPT] key is pressed, the C language executor screen defined with CRT_FAPT is:
0 : Not displayed.
1 : Displayed.
CM3, CM2, CM1 If the [CUSTOM] key or [GRAPH] key (in the case of small key setting) is pressed when no macro executor is used, a C language executor screen defined below is displayed:

CM1=1: The screen defined by CRT_USR_AUX is displayed.
CM2=1: The screen defined by CRT_USR_MCR is displayed.
CM3=1: The screen defined by CRT_USR_MENU is displayed.

8661	Variable area size

[Data type] Word
[Unit of data] KByte
[Valid data range] 0 to 59 (251)

This parameter specifies the size of the static variable area that can be shared by tasks of C language executor. The maximum size is 59K bytes (251K bytes if an optional 256KB SRAM is added). The total of the SRAM disk size (parameter No. 8662) and the value of this parameter should not exceed the available SRAM size minus 1K bytes (that is, 63K or 255K bytes).

NOTE
This parameter is used for C language executor. When this setting is changed, the variable area is initialized. A change in this setting is applied at the next power-up or later.

8662	SRAM disk size

[Data type] Word
[Unit of data] KByte
[Valid data range] 4 to 63 (255)

This parameter specifies the SRAM disk size in C language executor. Specify a value greater than or equal to 4K bytes in 1K-byte units. The maximum size is 63K bytes (255K bytes if the optional 256KB SRAM is added). The total of the variable area size (parameter No. 8661) and the value of this parameter should not exceed the available SRAM size minus 1K bytes (that is, 63K or 255K bytes).

NOTE
This parameter is used for C language executor. When this setting is changed, the SRAM disk is initialized. A change in this setting is applied at the next power-up or later.

8663	Time zone setting

[Data type] 2-word
[Unit of data] sec
[Valid data range] -12×3600 to 12×3600

This parameter specifies the time-zone difference from Greenwich Mean Time in seconds. The difference for Japan is -9 hours. (The setting is $-9\times3600 = 32400$)

NOTE
This parameter is used for C language executor. A change in this setting is applied at the next power-up or later.

	#7	#6	#5	#4	#3	#2	#1	#0
8700					DMM			

[Data type] Bit

DMM In DNC operation from the PMC, OPEN CNC, or C-EXE, pre-reading is:
0 : Not performed.
1 : Performed.

	#7	#6	#5	#4	#3	#2	#1	#0
8701		CTV				WPR		
						WPR		

[Data type] Bit

WPR The function that allows parameters that are rewritten using the PMC window to be enabled during automatic operation is:
0 : Disabled.
1 : Enabled.

NOTE
If this parameter is set, a move command based on manual operation is disabled (interlock state) while parameter rewriting using the PMC window is being executed.

CTV When Symbol CAP*i* T is provided, 1 must be specified.

	#7	#6	#5	#4	#3	#2	#1	#0
8702	LFM		SME					

[Data type] Bit

SME During DNC operation or M198 calling, parameter No. 8790 (timing for executing an auxiliary macro) is:
0 : Invalid.
1 : Valid.

LFM At the beginning of program uploading in response to a request using the data window library:
0 : "LF+%" is not output.
1 : "LF+%" is output.

	#7	#6	#5	#4	#3	#2	#1	#0
8703				WSP			LCL	DLF

[Data type] Bit

DLF If an incomplete program file is created because program registration, performed via a communication board such as MAP is interrupted by a reset or alarm, the file is:
0 : Not deleted.
1 : Deleted.

> **NOTE**
> This parameter is used with the OSI/Ethernet function.

LCL When a change in the internal state of the CNC (such as a change in the number of part programs or selected programs) occurs, information about the change is:
0 : Not sent to the host.
1 : Sent to the host.

> **NOTE**
> This parameter is used with the OSI/Ethernet function.

WSP When a serial spindle parameters (No. 4000 to No. 4799) is rewritten with function code 18 (parameter write) of the PMC window function, the data is immediately:

0 : Not transferred to the spindle amplifier.

1 : Transferred to the spindle amplifier.

NOTE

1 This function cannot be used when a parameter write with all axes specified (axis specification: -1) is performed with function code 18 of the PMC window function. (Even if this parameter is set, no data is transferred to the spindle amplifiers for all axes.)

2 When starting up a spindle, for example, by a power-on operation, or when rewriting serial spindle parameters (No. 4000 to No. 4799) through the MDI keys, RS-232C, or programmable data input (G10), do not attempt to rewrite serial spindle parameters (No. 4000 to No. 4799) with the PMC window function at the same time.

3 If the stop-position external-setting type orientation function and the incremental specification type spindle orientation function (bits 2, 3, and 0 (OR1 to OR3) of parameter No. 3702, and bit 2 (OR4) of parameter No. 3704) are used, the same state as mentioned in Note 2 above results also when the value of the spindle orientation external stop position specification signal (indicated below) is changed. To change the state of the spindle orientation external stop position specification signal and rewrite spindle parameters (No. 4000 to No. 4799) in succession by using the PMC window function, insert a wait time of 50 msec or more between the two operations.

Spindle orientation external stop position specification command

For the first spindle	SHA00 to SHA11 <G078,G079>
For the second spindle	SHB00 to SHB11 <G080,G081>
For the third spindle	SHC00 to SHC11 <G208,G209>
For the fourth spindle	SHD00 to SHD11 <G270,G271>

4 If a parameter is modified using this function, a time of 1000 msec is required before the modified parameter becomes effective on the spindle amplifier. When using a parameter immediately after modifying the parameter, insert a wait time of 1000 msec or more after return of a completion code from the PMC window function.

	#7	#6	#5	#4	#3	#2	#1	#0
8706							NWD	HSD

> **NOTE**
> When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

HSD Main machining during DNC operation with FOCAS1/HSSB is:

0 : Normal operation.

1 : High-speed operation.

Set this parameter according to machining during DNC operation. Usually, when binary operation and programs containing contiguous small blocks are performed during DNC operation with FOCAS1/HSSB, high-speed operation is selected.

> **NOTE**
> For details of this parameter, also refer to "FANUC Open CNC DNC Operation Management Package OPERATOR'S MANUAL" and other manuals.

NWD During DNC operation with FOCAS1/HSSB, new DNC functions are:

0 : Not executed.

1 : Executed.

When this parameter is set, the M198 command (subprogram call) can also be executed with FOCAS1/HSSB.

> **NOTE**
> To execute the M198 command with FOCAS1/HSSB, parameter No. 20 must be set to "15".
> For details of this parameter, also refer to "FANUC Open CNC DNC Operation Management Package OPERATOR'S MANUAL" and other manuals.

8760	Program number for data registration (data input/output function using the I/O link)

[Data type] Word

[Valid data range] 0 to 9999

When the data input/output function using the I/O link is used, this parameter sets the program numbers of the programs to be used for registering data (parameters, macro variables, and diagnosis data) from Power Mates.

For a Power Mate in group n, the following program numbers are used:

For parameters: Setting + n × 10 + 0
For macro variables: Setting + n × 10 + 1
For diagnosis data: Setting + n × 10 + 2

Example: When 8000 is set

8000 :	Parameters of group 0 (I/O channel = 20)
8001 :	Macro variables of group 0 (I/O channel = 20)
8002:	Diagnosis data of group 0 (I/O channel = 20)
8010 :	Parameters of group 1 (I/O channel = 21)
8011 :	Macro variables of group 1 (I/O channel = 21)
8012:	Diagnosis data of group 1 (I/O channel = 21)
8020 :	Parameters of group 2 (I/O channel = 22)
8021 :	Macro variables of group 2 (I/O channel = 22)
8022:	Diagnosis data of group 2 (I/O channel = 22)
:	:
8150 :	Parameters of group 15 (I/O channel = 35)
8151 :	Macro variables of group 15 (I/O channel = 35)
8152:	Diagnosis data of group 15 (I/O channel = 35)

NOTE

1 When 0 is set, the input/output of parameters, macro variables, and diagnosis data cannot be performed, but program input/output processing is performed.

2 To transfer data to and from the Power Mate, the setting data "I/O CHANNEL" also needs to be set.

8781	Amount of DRAM used with the C language executor

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

[Data type] Byte
[Unit of data] 64k Byte
[Valid data range] 16 to 64

This parameter sets the amount of DRAM to be used by the C language executor. Specify a size of no less than 1024K bytes, in multiples of 64K bytes. If a value that exceeds the valid data range is specified, 0 is assumed.

> **NOTE**
> The available size depends on the amount of installed DRAM and the selected options.

8790	Timing for executing an auxiliary macro

[Data type] Word

This parameter sets the timing for executing a macro executor auxiliary macro while NC programs, offset data, and so forth are being read or punched out.
When as many characters as the number specified with this parameter are read or punched out, an auxiliary macro is executed once. When 0 is set in this parameter, no auxiliary macro is executed during read or punch processing.

	#7	#6	#5	#4	#3	#2	#1	#0
8801								

[Data type] Bit

Bit parameter 1 for machine tool builder

	#7	#6	#5	#4	#3	#2	#1	#0
8802								

[Data type] Bit

Bit parameter 2 for machine tool builder

> **NOTE**
> These parameters are used only by the machine tool builder. Refer to the relevant manual supplied by the machine tool builder for details.

8811	**2-word parameter 1 for machine tool builder**

8812	**2-word parameter 2 for machine tool builder**

8813	**2-word parameter 3 for machine tool builder**

[Data type] 2-word
-99999999 to 99999999

NOTE
These parameters are used only by the machine tool builder. Refer to the relevant manual supplied by the machine tool builder for details.

4.74 PARAMETERS OF TROUBLE DIAGNOSIS

	#7	#6	#5	#4	#3	#2	#1	#0
8850								MDG

[Data type] Bit

MDG The trouble diagnosis function is:
0 : Enabled.
1 : Disabled.

	#7	#6	#5	#4	#3	#2	#1	#0
8853	TS8	TS7	TS6	TS5	TS4	TS3	TS2	TS1

[Data type] Bit

TS8 to TS1 Concerning the heat simulation data of each servo axis:
0 : Trouble is not forecast.
1 : Trouble is forecast. (In parameter No. 8860, a forecast level is set.)

	#7	#6	#5	#4	#3	#2	#1	#0
8854	TR8	TR7	TR6	TR5	TR4	TR3	TR2	TR1

[Data type] Bit

TR8 to TR1 Concerning the disturbance load torque of each servo axis:
0 : Trouble is not forecast.
1 : Trouble is forecast. (In parameter No. 8861, a forecast level is set.)

8860	Trouble forecast level concerning heat simulation data

[Data type] Word axis
[Unit of data] %
[Valid data range] 0 to 100

8861	Trouble forecast level concerning a disturbance load torque value

[Data type] Word axis
[Unit of data] %
[Valid data range] 0 to 100

4.75 PARAMETERS OF MAINTENANCE

	#7	#6	#5	#4	#3	#2	#1	#0
8901								FAN

[Data type] Bit

FAN A fan motor error is:

0 : Detected. (When the fan motor error is detected, an overheating alarm occurs.)

1 : Not detected. (Use inhibited)

	#7	#6	#5	#4	#3	#2	#1	#0
8903								PRM

[Data type] Bit

PRM A periodic maintenance expiration message is:

0 : Not displayed.

1 : Displayed.

	#7	#6	#5	#4	#3	#2	#1	#0
8904	NMP							

[Data type] Bit

NMP On the system alarm history screen, history information is displayed (with bit 2 (NMH) of parameter No. 3103 set to 1) for:

0 : Path 1.

1 : Path currently selected.

8911	Ratio of the items on the periodic maintenance screen to the respective lives

[Data type] Byte

[Unit of data] 1%

[Valid data range] 0 to 100

On the periodic maintenance screen, if the remaining time of an item falls to a value less than the percentage of the life specified in this parameter, the remaining time is displayed in red as a warming.

8940	Title character code 1
8941	Title character code 2
:	:
8949	Title character code 10

[Data type] Byte

[Valid data range] See below.

When the CNC is turned on, up to ten characters specified in these parameters are displayed on the screen showing the series and edition of the CNC.

- The following characters can be used.
  0 to 9, A to Z, - (minus sign), . (period), and space
- The character codes to be specified are listed in the character code list in Appendix A.
- If any code other than those character codes that can be specified is specified, a space is displayed.

4.76 PARAMETERS OF EMBEDDED MACRO

	#7	#6	#5	#4	#3	#2	#1	#0
12001								IMR

[Data type] Bit

IMR If an attempt is made to enter a program having the same program number as a embedded macro program that has already been entered,

0 : An alarm is raised.

1 : The embedded program is deleted, then the new program is entered. However, if the embedded program is edit-prohibited, the program is not deleted, but an alarm is raised.

Bit 2 (REP) of parameter No. 3201	Bit 0 (IMREP) of parameter No. 12001	Program stored on tape	Embedded macro program
0	0	Alarm	Alarm
0	1	Alarm	Overwrite
1	0	Overwrite	Alarm
1	1	Overwrite	Overwrite

NOTE
1. This parameter is rewritten by the embedded macro data in FROM at power-up or at a reload operation.
2. If the key of parameter No. 12013 is locked, the embedded macro data in FROM is used.

12010	Embedded macro program referencing or editing enabled/disabled

[Data type] Byte

[Valid data range] 0 to 2

This parameter specifies whether referencing or editing of a embedded macro program is enabled or disabled.

Parameter No.12010	Edit	Reference
0	X	X
1	X	O
2	O	O

NOTE
1. This parameter is rewritten by the embedded macro data in FROM at power-up or at a reload operation.
2. If the key of parameter No. 12013 is locked, the embedded macro data in FROM is used.

12011	First embedded macro program number / First temporary memory program number
12012	Last embedded macro program number / Last temporary memory program number

[Data type] 2-word
[Valid data range] 1 to 99999999

<Explanation of the embedded macro function>

These parameters specify embedded macro programs by specifying the first and last program numbers. The other programs are part program storage programs.

[Example] Sample four-digit program numbers
Parameter No.12011= 1234
Parameter No.12012= 5678
↓
Embedded macro program number = O1234 to O5678
Part program storage program number = O0001 to O1233
O5679 to O9999

> **NOTE**
> 1 These parameters are rewritten by the embedded macro data in FROM at power-up or at a reload operation.
> 2 If the key of parameter No. 12013 is locked, the embedded macro data in FROM is used.
> 3 This parameter cannot be changed if a key for embedded macro is locked or if at least a single NC program is provided.

<Explanation of the external program temporary storage/operation function>

These parameters set programs in the temporary memory by specifying the first and last program numbers.
The other programs are part program storage programs.

[Example] Sample four-digit program numbers
Parameter No.12011= 7000
Parameter No.12012= 7999
↓
Temporary memory program number = O7000 to O7999
Part program storage program number = O0001 to O6999
O8000 to O9999

> **NOTE**
> 1 These parameters cannot be modified if even a single NC program is registered.
> 2 These parameters are used also to set program numbers with the embedded macro function. So, these parameters cannot be used simultaneously with the embedded macro function.

12013	Password/keyword for embedded macro

[Data type] 2-word

[Valid data range] -99999999 to 99999999

A password is specified to store a embedded macro program in FROM. After the embedded macro program is stored, this parameter is set to 0.

Otherwise, this parameter is used as a keyword input area. (After power-up, this parameter is set to 0.)

If the password matches the keyword, the key for embedded macro is unlocked. If the password does not match the keyword, the key for embedded macro is locked. If the password is 0 and if FROM does not include INMC, the key for embedded macro is unlocked, irrespective of the keyword.

- If locked, a embedded macro program cannot be saved. As the data items of 1 to 5 listed below, the corresponding data items of embedded macro in FROM are used.
- If unlocked, a embedded macro program can be saved. As the data items of 1 to 5 listed below, the corresponding parameter settings are used.
  1. Embedded macro program entry and overwrite disabled (bit 0 of parameter No. 12001)
  2. Embedded macro program referencing and editing enabled/disabled (parameter No. 12010)
  3. Embedded macro program number (parameters No. 12011 and No. 12012)
  4. Embedded macro series and edition (parameters No. 12015 and No. 12016)
  5. Embedded macro G code and relative program number (parameters No. 12020 to No. 12049)

NOTE

1 If the password is not 0, the password cannot be changed for the embedded macro data.

2 If all of the following conditions are satisfied, the keyword cannot be changed.
   1) A password is specified. (Password is not 0.)
   2) The macro program number range of the embedded data of FROM is different from the embedded macro program number range specified in the parameter.
   3) A program is entered.

12014	Ratio of time for program registration in the temporary memory based on M code specification to time for updating the screen display

[Data type] Word

[Valid data range] 0 to 255

This parameter sets the ratio of time for program registration in the temporary memory based on M code specification to time for updating the screen display when the external program temporary storage/operation function is used.
As a greater value is set in this parameter, time for program registration increases. This means that programs can be registered in a shorter time. On the other hand, time usable for updating the screen display decreases.

12015	Series for embedded macro

12016	Edition for embedded macro

[Data type] Word

[Valid data range] 0 to 9999

These parameters specify the series and edition of the FROM file for embedded macro. The series and edition are placed in the FROM file when the embedded macro data is saved and can be checked on the system configuration screen.

NOTE
1. These parameters are rewritten by the embedded macro data in FROM at power-up or at a reload operation.
2. If the key of parameter No. 12013 is locked, the embedded macro data in FROM is used.
3. If this parameter is set to 0, the series or edition of the FROM file for embedded macro is not displayed on the system configuration screen.

12017	M code number for program registration in the temporary memory based on M code specification

[Data type] Word

[Valid data range] 1 to 999

This parameter sets an M code number for program registration in the temporary memory with the external program temporary storage/operation function.
When 0 is set in this parameter, M298 is set.

12018	M code number for completion of program registration in the temporary memory based on M code specification

[Data type] Word
[Valid data range] 1 to 999

This parameter sets an M code number for waiting for completion of program registration in the temporary memory with the external program temporary storage/operation function.
When 0 is set in this parameter, M297 is set.

12019	M code number for program deletion from the temporary memory based on M code specification

[Data type] Word
[Valid data range] 1 to 999

This parameter sets an M code number for program deletion from the temporary memory with the external program temporary storage/operation function.
When 0 is set in this parameter, M296 is set.

12020	G code number for embedded macro (first set)
12023	G code number for embedded macro (second set)
12026	G code number for embedded macro (third set)
12029	G code number for embedded macro (fourth set)
12032	G code number for embedded macro (fifth set)
12035	G code number for embedded macro (sixth set)
12038	G code number for embedded macro (seventh set)
12041	G code number for embedded macro (eighth set)
12044	G code number for embedded macro (ninth set)
12047	G code number for embedded macro (tenth set)

[Data type] Word
[Valid data range] 1 to 999

12021	Program number for embedded macro (first set)
12024	Program number for embedded macro (second set)
12027	Program number for embedded macro (third set)
12030	Program number for embedded macro (fourth set)
12033	Program number for embedded macro (fifth set)
12036	Program number for embedded macro (sixth set)
12039	Program number for embedded macro (seventh set)

12042	Program number for embedded macro (eighth set)
12045	Program number for embedded macro (ninth set)
12048	Program number for embedded macro (tenth set)

[Data type] 2-word
[Valid data range] 1 to 99999999

12022	G code macro count for embedded macro (first set)
12025	G code macro count for embedded macro (second set)
12028	G code macro count for embedded macro (third set)
12031	G code macro count for embedded macro (fourth set)
12034	G code macro count for embedded macro (fifth set)
12037	G code macro count for embedded macro (sixth set)
12040	G code macro count for embedded macro (seventh set)
12043	G code macro count for embedded macro (eighth set)
12046	G code macro count for embedded macro (ninth set)
12049	G code macro count for embedded macro (tenth set)

[Data type] Byte
[Valid data range] 1 to 255

These parameters specify G code macros for embedded macros. A G code, corresponding macro program number, and corresponding G code count are specified. Up to ten sets of these items can be specified. If identical G code numbers are found, the one in a younger set takes priority. If any of the G code number, macro program number, and count is 0, the set is invalid.

[Example] Suppose that embedded macro program numbers are 7000 to 8999.

	First set	Second set	Third set
G code	No.12020=100	No.12023=150	No.12026=900
O number	No.12021=8000	No.12024=7500	No.12027=8300
Count	No.12022=10	No.12025=100	No.12028=30

If the parameters are specified as listed above,

The G codes from G100 to G109 correspond to O8000 to O8009.
The G codes from G150 to G249 correspond to O7500 to O7599.
The G codes from G900 to G929 correspond to O8300 to O8329.

NOTE

1. These parameters are rewritten by the embedded macro data in FROM at power-up or at a reload operation.
2. If the key of parameter No. 12013 is locked, the embedded macro data in FROM is used.

12050	M code for orientation (embedded measurement macro)

[Data type] 2-word

[Valid data range] -99999999 to 99999999

This parameter specifies an M code for probe orientation when the measurement macro is used.

NOTE

When using this parameter, specify the option for the embedded measurement macro as well. In addition, the software for the embedded measurement macro is needed. (This software, however, is not needed if the software for manual guide M is available.)

4.77 PARAMETERS OF HIGH-SPEED POSITION SWITCH (2 OF 2)

12201	Axis corresponding to the eleventh high-speed position switch
12202	Axis corresponding to the twelfth high-speed position switch
12203	Axis corresponding to the thirteenth high-speed position switch
12204	Axis corresponding to the fourteenth high-speed position switch
12205	Axis corresponding to the fifteenth high-speed position switch
12206	Axis corresponding to the sixteenth high-speed position switch

[Data type] Byte

[Valid data range] 0 to number of controlled axes

These parameters set the axis control numbers corresponding to the 11th to 16th high-speed position switches.

NOTE

Set 0 for the number corresponding to a high-speed position switch which is not to be used.

12221	Maximum value of the operation range of the eleventh high-speed position switch or position where the eleventh high-speed position switch is turned on
12222	Maximum value of the operation range of the twelfth high-speed position switch or position where the twelfth high-speed position switch is turned on
12223	Maximum value of the operation range of the thirteenth high-speed position switch or position where the thirteenth t high-speed position switch is turned on
12224	Maximum value of the operation range of the fourteenth high-speed position switch or position where the fourteenth high-speed position switch is turned on
12225	Maximum value of the operation range of the fifteenth high-speed position switch or position where the fifteenth high-speed position switch is turned on
12226	Maximum value of the operation range of the sixteenth high-speed position switch or position where the sixteenth high-speed position switch is turned on

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

Set the following value, depending on the output method of the high-speed position switch:

- For normal type
  Maximum value of the operation range of the eleventh to sixteenth high-speed position switches
- For direction-dependent type
  Position where the eleventh to sixteenth position switches are turned on

NOTE

For each high-speed position switch, an output method can be selected using bit 0 (HM1) of parameter No. 8508 to bit 7 (HMG) of parameter No. 8509.
When direction reversing type is selected, set a direction for turning on each high-speed position switch in bit 0 (HA1) of parameter No. 8512 to bit 7 (HAG) of parameter No. 8513.

12241	**Minimum value of the operation range of the eleventh high-speed position switch or position where the eleventh high-speed position switch is turned on**
12242	**Minimum value of the operation range of the twelfth high-speed position switch or position where the twelfth high-speed position switch is turned on**
12243	**Minimum value of the operation range of the thirteenth high-speed position switch or position where the thirteenth t high-speed position switch is turned on**
12244	**Minimum value of the operation range of the fourteenth high-speed position switch or position where the fourteenth high-speed position switch is turned on**
12245	**Minimum value of the operation range of the fifteenth high-speed position switch or position where the fifteenth high-speed position switch is turned on**
12246	**Minimum value of the operation range of the sixteenth high-speed position switch or position where the sixteenth high-speed position switch is turned on**

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

Set the following value, depending on the output method of the high-speed position switch:

- For normal type
  Minimum value of the operation range of the eleventh to sixteenth high-speed position switches
- For direction-dependent type
  Position where the eleventh to sixteenth position switches are turned on

NOTE

For each high-speed position switch, an output method can be selected using bit 0 (HM1) of parameter No. 8508 to bit 7 (HMG) of parameter No. 8509.
When direction-dependent type is selected, set a direction for turning on each high-speed position switch in bit 0 (HB1) of parameter No. 8516 to bit 7 (HBG) of parameter No. 8517.

4.78 PARAMETERS OF SUPERIMPOSED COMMAND FUNCTION IN BINARY OPERATION

12250	Superimposed pulses in binary operation (numerator)
12251	Superimposed pulses in binary operation (denominator)

[Data type] Word axis

[Valid data range] -32768 to 32767

These parameters specify a superimposed pulse value for the superimposed specification function in binary operation for each axis.
If 0 is set in parameter No. 12251, superimposed is not performed.

[Example] When the superimposed pulse value for one distribution operation is 0.4

Parameter No.12250=2
Parameter No.12251=5

First distribution: 2/5 pulse	→ Output 0	
Second distribution: 4/5 pulse	→ Output 0	
Third distribution: 6/5 pulse	→ Output 1	(1/5 pulse remaining)
Fourth distribution: 3/5 pulse	→ Output 0	
Fifth distribution: 5/5 pulse	→ Output 1	(0/5 pulse remaining)
: :	:	

12252	Superimposed pulse travel distance in binary operation

[Data type] 2-word axis

[Valid data range] -99999999 to 99999999

This parameter sets a superimposed pulse travel distance for the superimposed specification function in binary operation.

NOTE

1. If 0 is set in this parameter, superimposed control is not performed.
2. This parameter is valid from the start of a binary operation until the binary operation ends. If this parameter is rewritten during a binary operation, the new parameter value becomes valid starting with the next binary operation.

4.79 PARAMETERS OF SERVO SPEED CHECK

	#7	#6	#5	#4	#3	#2	#1	#0
12290							SSA	SSC

[Data type] Bit

SSC Servo speed check is:
0 : Disabled.
1 : Enabled.

SSA If the actual speed is lower than the reference speed for servo speed check set in parameter No. 12291:
0 : No alarm is issued.
1 : An alarm (servo alarm 616) is issued.

12291	Reference speed for servo speed check

[Data type] Word axis
[Unit of data] min^{-1}
[Valid data range] 0 to 8000

This parameter sets a reference speed for servo speed check when bit 0 (SSC) of parameter No. 12290 is set to 1.

4.80 PARAMETERS OF MANUAL HANDLE FUNCTIONS

12305	X signal address for the first manual handle
12306	X signal address for the second manual handle
12307	X signal address for the third manual handle

[Data type] Word

[Valid data range] 0 to 127, 200 to 327

Set an X signal address to be used for each manual handle.

These parameters are valid when bit 1 (HDX) of parameter No. 7105 is set to 1.

If an incorrect address is assigned to a manual handle for the I/O module connected to the I/O Link, the manual handle does not operate.

These parameters are valid also for the I/O Link 2 channel.

4.81 PARAMETERS OF MANUAL HANDLE FOR 5-AXIS MACHINING

12310	States of the first manual handle feed axis selection signals when tool direction handle feed and table-based vertical direction handle feed are performed

[Data type] Byte

[Valid data range] 1 to 8

This parameter sets the states of the first manual handle feed axis selection signals (HS1A to HS1D) when tool direction handle feed and table-based vertical direction handle feed are performed.
The table below indicates the correspondence between the states of the first manual handle feed axis selection signals and the parameter settings in the 5-axis machining manual feed (handle feed) mode. When the first manual handle pulse generator is turned after setting the signals corresponding to the value set in the parameter, operation is performed in the specified mode.

Table of correspondence with the manual handle feed axis selection signals

States of the first manual handle feed axis selection signals				Parameter setting
HS1D	HS1C	HS1B	HS1A	
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8

12311	States of the first manual handle feed axis selection signals when a movement is made in the first axis direction in tool axis normal direction handle feed and table-based horizontal direction handle feed

[Data type] Byte

[Valid data range] 1 to 8

This parameter sets the states of the first manual handle feed axis selection signals (HS1A to HS1D) when a movement is made in the first axis direction. (See "Table of correspondence with the manual handle feed axis selection signals" provided in the description of parameter No. 12310.)

The table below indicates the relationships of tool axis directions, first axis directions, and second axis directions.

Tool axis directions	First axis directions	Second axis directions
Z	X	Y
X	Y	Z
Y	Z	X

12312	States of the first manual handle feed axis selection signals when a movement is made in the second axis direction in tool axis normal direction handle feed and table-based horizontal direction handle feed

[Data type] Byte

[Valid data range] 1 to 8

This parameter sets the states of the first manual handle feed axis selection signals (HS1A to HS1D) when a movement is made in the second axis direction. (See "Table of correspondence with the manual handle feed axis selection signals" provided in the description of parameter No. 12310.)

12313	States of the first manual handle feed axis selection signals when the first rotary axis is turned in tool tip center rotation handle feed

[Data type] Byte

[Valid data range] 1 to 8

This parameter sets the states of the first manual handle feed axis selection signals (HS1A to HS1D) when the first rotary axis is turned in tool tip center rotation. (See "Table of correspondence with the manual handle feed axis selection signals" provided in the description of parameter No. 12310.)

12314	States of the first manual handle feed axis selection signals when the second rotary axis is turned in tool tip center rotation handle feed

[Data type] Byte

[Valid data range] 1 to 8

This parameter sets the states of the first manual handle feed axis selection signals (HS1A to HS1D) when the second rotary axis is turned in tool tip center rotation. (See "Table of correspondence with the manual handle feed axis selection signals" provided in the description of parameter No. 12310.)

12318	Distance from the tool rotation center to tool tip (tool length)

[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm
Inch machine	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

In tool tip center rotation feed and tool tip position display with the manual feed function for 5-axis machining:

When 0 is set in parameter No. 19666 (tool holder offset value):

Set the distance from the tool rotation center to the tool tip.

When a value other than 0 is set in parameter No. 19666 (tool holder offset value):

Set the distance from the tool attachment position to the tool tip. In this case, the distance from the tool rotation center to the tool tip is the value of parameter No. 19666 added to the value of this parameter.

NOTE

Specify a radius value to set this parameter.

4.82 PARAMETERS OF MANUAL HANDLE FEED

	#7	#6	#5	#4	#3	#2	#1	#0
12330	GR7	GR6	GR5	GR4	GR3	GR2	GR1	GR0

	#7	#6	#5	#4	#3	#2	#1	#0
12331	GRF	GRE	GRD	GRC	GRB	GRA	GR9	GR8

[Data type] Bit

GR0 When PMC group 0 (channel 1) is a Power Mate or I/O Link β, the pulses from the manual pulse generator connected to the I/O Link are:
0 : Transferred to that group.
1 : Not transferred to that group.

GR1 to GRD When PMC group 1 (channel 1) is a Power Mate or I/O Link β, the pulses from the manual pulse generator connected to the I/O Link are:
0 : Transferred to that group.
1 : Not transferred to that group.

GRE When PMC group 14 (channel 1) is a Power Mate or I/O Link β, the pulses from the manual pulse generator connected to the I/O Link are:
0 : Transferred to that group.
1 : Not transferred to that group.

GRF When PMC group 15 (channel 1) is a Power Mate or I/O Link β, the pulses from the manual pulse generator connected to the I/O Link are:
0 : Transferred to that group.
1 : Not transferred to that group.

NOTE
Set this parameter to 1 when the Power Mate is connected to the I/O Link.

	#7	#6	#5	#4	#3	#2	#1	#0
12332	G27	G26	G25	G24	G23	G22	G21	G20

	#7	#6	#5	#4	#3	#2	#1	#0
12333	G2F	G2E	G2D	G2C	G2B	G2A	G29	G28

[Data type] Bit

G20 When PMC group 0 (channel 2) is a Power Mate or I/O Link β, the pulses from the manual pulse generator connected to the I/O Link are:
0 : Transferred to that group.
1 : Not transferred to that group.

G21 to G2D When PMC group 1 (channel 2) is a Power Mate or I/O Link β, the pulses from the manual pulse generator connected to the I/O Link are:
0 : Transferred to that group.
1 : Not transferred to that group.

G2E When PMC group 14 (channel 2) is a Power Mate or I/O Link β, the pulses from the manual pulse generator connected to the I/O Link are:
0 : Transferred to that group.
1 : Not transferred to that group.

G2F When PMC group 15 (channel 2) is a Power Mate or I/O Link β, the pulses from the manual pulse generator connected to the I/O Link are:
0 : Transferred to that group.
1 : Not transferred to that group.

NOTE
Set this parameter to 1 when the Power Mate is connected to the I/O Link.

12350	Manual handle feed magnification m

[Data type] Word axis
[Unit of data] 1
[Valid data range] 1 to 127
This parameter sets a magnification for each axis when the manual handle feed travel distance selection signals MP1<G019#4> = 0 and MP2<G019#5> = 1.
If 0 is set in this parameter for the move target axis, the setting of parameter No. 7113 is applied.

12351	Manual handle feed magnification n

[Data type] Word axis
[Unit of data] 1
[Valid data range] 1 to 1000
This parameter sets a magnification for each axis when the manual handle feed travel distance selection signals MP1<G019#4> = 0 and MP2<G019#5> = 1.
If 0 is set in this parameter for the move target axis, the setting of parameter No. 7114 is applied.

Travel distance selection signal		Travel distance (manual handle feed/manual handle interruption)
MP2	MP1	
0	0	Least input increment × 1
0	1	Least input increment × 10
1	0	Least input increment × m
1	1	Least input increment × n

4.83 PARAMETERS OF MULTI-PATH CONTROL

12500	Axis number of the facing axis (horizontal) of tool post 1
12501	Axis number of parallel axis 1 (vertical axis) of tool post 1
12502	Axis number of parallel axis 2 (height axis) of tool post 1

[Data type] Byte

[Valid data range] 0 to 4

These parameters set the axis numbers of the facing axis (horizontal), parallel axis 1 (vertical axis), and parallel axis 2 (height axis) of tool post 1. When 0 is set in a parameter, the axis is treated as a fixed axis. (An interference check is made using only the offset value from the reference position. This means that no travel distance on the axis is included in an interference check calculation.)

12503	Number of cubes making up tool post 1

[Data type] Byte

[Valid data range] 1 to 3

This parameter sets the number of cubes that make up tool post 1. Up to three cubes are used to make up a tool post.

	#7	#6	#5	#4	#3	#2	#1	#0
12504								HVP

[Data type] Bit

HVP The face where no interference check is made is:

0 : Minis (-) side face perpendicular to the facing axis (horizontal axis).

1 : Plus (+) side face perpendicular to the facing axis (horizontal axis).

12505	Facing axis offset of point <1> of cube (a) of tool post 1
12506	Parallel axis 1 offset of point <1> of cube (a) of tool post 1
12507	Parallel axis 2 offset of point <1> of cube (a) of tool post 1
12508	Facing axis offset of point <2> of cube (a) of tool post 1

12509	**Parallel axis 1 offset of point <2> of cube (a) of tool post 1**
12510	**Parallel axis 2 offset of point <2> of cube (a) of tool post 1**
12511	**Facing axis offset of point <1> of cube (b) of tool post 1**
12512	**Parallel axis 1 offset of point <1> of cube (b) of tool post 1**
12513	**Parallel axis 2 offset of point <1> of cube (b) of tool post 1**
12514	**Facing axis offset of point <2> of cube (b) of tool post 1**
12515	**Parallel axis 1 offset of point <2> of cube (b) of tool post 1**
12516	**Parallel axis 2 offset of point <2> of cube (b) of tool post 1**
12517	**Facing axis offset of point <1> of cube (c) of tool post 1**
12518	**Parallel axis 1 offset of point <1> of cube (c) of tool post 1**
12519	**Parallel axis 2 offset of point <1> of cube (c) of tool post 1**
12520	**Facing axis offset of point <2> of cube (c) of tool post 1**
12521	**Parallel axis 1 offset of point <2> of cube (c) of tool post 1**
12522	**Parallel axis 2 offset of point <2> of cube (c) of tool post 1**

[Data type] 2-word
[Unit of data] Output unit
[Valid data range] -99999999 to 99999999

These parameters set the signed offset values from the machine zero point (or reference position) to the two diagonal points (<1> and <2>) of up to three cubes ((a), (b), and (c)) that make up tool post 1. Data set for more than the number of constituent cubes is ignored.

12525	**Axis number of the facing axis (horizontal) of tool post 2**

12526	**Axis number of parallel axis 1 (vertical axis) of tool post 2**

12527	**Axis number of parallel axis 2 (height axis) of tool post 2**

[Data type] Byte

[Valid data range] 0, 9 to 12

These parameters set the axis numbers of the facing axis (horizontal), parallel axis 1 (vertical axis), and parallel axis 2 (height axis) of tool post 2. When 0 is set in a parameter, the axis is treated as a fixed axis. (An interference check is made using only the offset value from the reference position. This means that no travel distance on the axis is included in an interference check calculation.)

12530	**Facing axis offset of point <1> of cube (a) of tool post 2**

12531	**Parallel axis 1 offset of point <1> of cube (a) of tool post 2**

12532	**Parallel axis 2 offset of point <1> of cube (a) of tool post 2**

12533	**Facing axis offset of point <2> of cube (a) of tool post 2**

12534	**Parallel axis 1 offset of point <2> of cube (a) of tool post 2**

12535	**Parallel axis 2 offset of point <2> of cube (a) of tool post 2**

12536	**Facing axis offset of point <1> of cube (b) of tool post 2**

12537	**Parallel axis 1 offset of point <1> of cube (b) of tool post 2**

12538	**Parallel axis 2 offset of point <1> of cube (b) of tool post 2**

12539	**Facing axis offset of point <2> of cube (b) of tool post 2**

12540	**Parallel axis 1 offset of point <2> of cube (b) of tool post 2**

12541	**Parallel axis 2 offset of point <2> of cube (b) of tool post 2**

12542	Facing axis offset of point <1> of cube (c) of tool post 2
12543	Parallel axis 1 offset of point <1> of cube (c) of tool post 2
12544	Parallel axis 2 offset of point <1> of cube (c) of tool post 2
12545	Facing axis offset of point <2> of cube (c) of tool post 2
12546	Parallel axis 1 offset of point <2> of cube (c) of tool post 2
12547	Parallel axis 2 offset of point <2> of cube (c) of tool post 2

[Data type] 2-word
[Unit of data] Output unit
[Valid data range] -99999999 to 99999999

These parameters set the signed offset values from the machine zero point (or reference position) to the two diagonal points (<1> and <2>) of up to three cubes ((a), (b), and (c)) that make up tool post 2. Data set for more than the number of constituent cubes is ignored.

12550	Axis number of the facing axis (horizontal) of tool post 3
12551	Axis number of parallel axis 1 (vertical axis) of tool post 3
12552	Axis number of parallel axis 2 (height axis) of tool post 3

[Data type] Byte
[Valid data range] 0, 17 to 20

These parameters set the axis numbers of the facing axis (horizontal), parallel axis 1 (vertical axis), and parallel axis 2 (height axis) of tool post 3. When 0 is set in a parameter, the axis is treated as a fixed axis. (An interference check is made using only the offset value from the reference position. This means that no travel distance on the axis is included in an interference check calculation.)

12555	Facing axis offset of point <1> of cube (a) of tool post 3
12556	Parallel axis 1 offset of point <1> of cube (a) of tool post 3
12557	Parallel axis 2 offset of point <1> of cube (a) of tool post 3

12558	Facing axis offset of point <2> of cube (a) of tool post 3
12559	Parallel axis 1 offset of point <2> of cube (a) of tool post 3
12560	Parallel axis 2 offset of point <2> of cube (a) of tool post 3
12561	Facing axis offset of point <1> of cube (b) of tool post 3
12562	Parallel axis 1 offset of point <1> of cube (b) of tool post 3
12563	Parallel axis 2 offset of point <1> of cube (b) of tool post 3
12564	Facing axis offset of point <2> of cube (b) of tool post 3
12565	Parallel axis 1 offset of point <2> of cube (b) of tool post 3
12566	Parallel axis 2 offset of point <2> of cube (b) of tool post 3
12567	Facing axis offset of point <1> of cube (c) of tool post 3
12568	Parallel axis 1 offset of point <1> of cube (c) of tool post 3
12569	Parallel axis 2 offset of point <1> of cube (c) of tool post 3
12570	Facing axis offset of point <2> of cube (c) of tool post 3
12571	Parallel axis 1 offset of point <2> of cube (c) of tool post 3
12572	Parallel axis 2 offset of point <2> of cube (c) of tool post 3

[Data type] 2-word
[Unit of data] Output unit
[Valid data range] -99999999 to 99999999

These parameters set the signed offset values from the machine zero point (or reference position) to the two diagonal points (<1> and <2>) of up to three cubes ((a), (b), and (c)) that make up tool post 3. Data set for more than the number of constituent cubes is ignored.

	#7	#6	#5	#4	#3	#2	#1	#0
12580						D12	D11	DH1

[Data type] Bit

DH1 The directions of the facing axes (horizontal axes) of tool post 1 and tool post 2 in interference check #1 are:
0 : Same.
1 : Opposite.

D11 The directions of parallel axis 1 (vertical axis) of tool post 1 and tool post 2 in interference check #1 are:
0 : Same.
1 : Opposite.

D12 The directions of parallel axis 2 (height axis) of tool post 1 and tool post 2 in interference check #1 are:
0 : Same.
1 : Opposite.

12581	Facing axis offset of the machine zero points between tool posts in interference check 1
12582	Parallel axis 1 offset of the machine zero points between tool posts in interference check 1
12583	Parallel axis 2 offset of the machine zero points between tool posts in interference check 1

[Data type] 2-word
[Unit of data] Output unit
[Valid data range] -99999999 to 99999999

Each of these parameters sets the signed offset value of the machine zero point of tool post 2 relative to the machine zero point of tool post 1 for each axis.

	#7	#6	#5	#4	#3	#2	#1	#0
12585						D22	D21	DH2

[Data type] Bit

DH2 The directions of the facing axes (horizontal axes) of tool post 1 and tool post 3 in interference check #2 are:
0 : Same.
1 : Opposite.

D21 The directions of parallel axis 1 (vertical axis) of tool post 1 and tool post 3 in interference check #2 are:
0 : Same.
1 : Opposite.

D22 The directions of parallel axis 2 (height axis) of tool post 1 and tool post 3 in interference check #2 are:
0 : Same.
1 : Opposite.

12586	Facing axis offset of the machine zero points between tool posts in interference check 2
12587	Parallel axis 1 offset of the machine zero points between tool posts in interference check 2
12588	Parallel axis 2 offset of the machine zero points between tool posts in interference check 2

[Data type] 2-word
[Unit of data] Output unit
[Valid data range] -99999999 to 99999999
Each of these parameters sets the signed offset value of the machine zero point of tool post 3 relative to the machine zero point of tool post 1 for each axis.

	#7	#6	#5	#4	#3	#2	#1	#0
12590						D32	D31	DH3

[Data type] Bit
DH3 The directions of the facing axes (horizontal axes) of tool post 2 and tool post 3 in interference check #3 are:
0 : Same.
1 : Opposite.
D31 The directions of parallel axis 1 (vertical axis) of tool post 2 and tool post 3 in interference check #3 are:
0 : Same.
1 : Opposite.
D32 The directions of parallel axis 2 (height axis) of tool post 2 and tool post 3 in interference check #3 are:
0 : Same.
1 : Opposite.

12591	Facing axis offset of the machine zero points between tool posts in interference check 3

12592	Parallel axis 1 offset of the machine zero points between tool posts in interference check 3

12593	Parallel axis 2 offset of the machine zero points between tool posts in interference check 3

[Data type] 2-word
[Unit of data] Output unit
[Valid data range] -99999999 to 99999999

Each of these parameters sets the signed offset value of the machine zero point of tool post 3 relative to the machine zero point of tool post 2 for each axis.

12600	Axis ID number for a programmed synchronous, composite, or superimposed control command

[Data type] Word axis
[Valid data range] 0 to 32767

This parameter sets an ID number for each axis to be specified at P and Q addresses.
With an axis for which 0 is set, no programmed synchronous, composite, or superimposed control is exercised.

NOTE
1 When a multi-path system is used, ensure that a unique value is set throughout all paths.
2 If a duplicate value is set, P/S alarm No. 5339 is issued when G50.4, G50.5, G50.6, G51.4, G51.5, or G51.6 is specified.

12610	Maximum tool offset number usable on a path-by-path basis

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

[Data type] Word

[Valid data range] 1 to maximum tool offset number

When bit 5 (COF) of parameter No. 8100 is set to 0, this parameter sets a maximum tool offset number usable individually for each path.

For a tool offset number not greater than the value set in this parameter, the tool offset memory assigned to each path is used. For a tool offset number greater than the value set in this parameter, the tool offset memory common to the paths is used.

If 0 or a value not within the valid data range is specified, this parameter is invalid. All tool offset numbers are used on a path-by-path basis.

4.84 PARAMETERS OF ACCELERATIOON CONTROL

12700	**Speed at overtravel occurrence time during linear acceleration/deceleration before interpolation (for stored stroke check 2)**

12701	**Speed at overtravel occurrence time during linear acceleration/deceleration before interpolation (for stored stroke check 3)**

[Data type] Word

[Unit of data, valid data range]

Increment system	Units of data	Valid data range	
		IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

If a setting is made to issue an overtravel alarm during linear acceleration/deceleration before interpolation, deceleration is performed beforehand to set the speed specified in this parameter when the alarm is issued (when the limit is reached). By using this parameter, an overrun distance traveled when an overtravel alarm is issued can be reduced.

When bit 2 (DS2) of parameter No. 1604 is set to 1, set a speed at overtravel alarm issue time for stored stroke check 2 in parameter No. 12700.

When bit 3 (DS3) of parameter No. 1604 is set to 1, set a speed at overtravel alarm issue time for stored stroke check 3 in parameter No. 12701.

NOTE

If 0 is set in parameter No. 12700 or No. 12701 when bit 2 (DS2) or bit 3 (DS3) of parameter No. 1604 is set to 1, the setting of parameter No. 1784 is used.

12710	Maximum allowable cutting feedrate for each axis in the HRV3 mode

[Data type] 2-word axis

[Unit of data, valid data range]

Increment system	Units of data	Valid data range	
		IS-B	IS-C
Metric machine	1 mm/min	0 to 240000	0 to 100000
Inch machine	0.1 inch/min	0 to 96000	0 to 48000
Rotary axis	1 deg/min	0 to 240000	0 to 100000

This parameter sets a maximum allowable cutting feedrate for each axis in the HRV3 mode. The cutting feedrate on each of the axes for which this parameter is specified is clamped to a maximum feedrate that does not exceed each maximum cutting feedrate as the result of interpolation.

NOTE

1. A maximum allowable cutting feedrate for each axis is valid only in linear interpolation and circular interpolation. In polar coordinate interpolation, cylindrical interpolation, and involute interpolation, the value common to all axes set in parameter No. 1431 is used.
2. If 0 is set in this parameter for all axes, the setting of parameter No. 1432 is used as a maximum allowable cutting feedrate.

4.85 PARAMETERS OF EXTERNAL DECELERATION POSITIONS EXPANSION

	#7	#6	#5	#4	#3	#2	#1	#0
12750							ED5	ED4

[Data type] Bit

ED4 External deceleration 4 is:
0 : Disabled.
1 : Enabled.

ED5 External deceleration 5 is:
0 : Disabled.
1 : Enabled.

12751	External deceleration rate 4 in cutting feed

[Data type] Word

[Unit of data, valid data range]

Increment system	Units of data	Valid data range	
		IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800

Set external deceleration rate for cutting feed.

12752	External deceleration rate 4 for each axis in rapid traverse

[Data type] Word axis

[Unit of data, valid data range]

Increment system	Units of data	Valid data range	
		IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

Set external deceleration rate for each axis in rapid traverse.

12753	Maximum manual handle feedrate 4 for each axis

[Data type] Word axis
[Unit of data, valid data range]

Increment system	Units of data	Valid data range	
		IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

Set a maximum manual handle feedrate for each axis.

12754	External deceleration rate 5 in cutting feed

[Data type] Word
[Unit of data, valid data range]

Increment system	Units of data	Valid data range	
		IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800

Set external deceleration rate for cutting feed.

12755	External deceleration rate 5 for each axis in rapid traverse

[Data type] Word axis
[Unit of data, valid data range]

Increment system	Units of data	Valid data range	
		IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

Set external deceleration rate for each axis in rapid traverse.

12756	Maximum manual handle feedrate 5 for each axis

[Data type] Word axis
[Unit of data, valid data range]

Increment system	Units of data	Valid data range	
		IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Inch machine	0.1 inch/min	6 to 6000	6 to 4800
Rotary axis	1 deg/min	6 to 15000	6 to 12000

Set a maximum manual handle feedrate for each axis.

4.86 PARAMETERS OF OPERATION HISTORY

12801	Number of a signal symbol table for selecting an operation history signal (01)
12802	Number of a signal symbol table for selecting an operation history signal (02)
12803	Number of a signal symbol table for selecting an operation history signal (03)
12804	Number of a signal symbol table for selecting an operation history signal (04)
12805	Number of a signal symbol table for selecting an operation history signal (05)
12806	Number of a signal symbol table for selecting an operation history signal (06)
12807	Number of a signal symbol table for selecting an operation history signal (07)
12808	Number of a signal symbol table for selecting an operation history signal (08)
12809	Number of a signal symbol table for selecting an operation history signal (09)
12810	Number of a signal symbol table for selecting an operation history signal (10)
12811	Number of a signal symbol table for selecting an operation history signal (11)
12812	Number of a signal symbol table for selecting an operation history signal (12)
12813	Number of a signal symbol table for selecting an operation history signal (13)
12814	Number of a signal symbol table for selecting an operation history signal (14)
12815	Number of a signal symbol table for selecting an operation history signal (15)
12816	Number of a signal symbol table for selecting an operation history signal (16)
12817	Number of a signal symbol table for selecting an operation history signal (17)
12818	Number of a signal symbol table for selecting an operation history signal (18)
12819	Number of a signal symbol table for selecting an operation history signal (19)
12820	Number of a signal symbol table for selecting an operation history signal (20)

[Data type] Byte

[Valid data range] 1 to 12

Set the number of a symbol table including a signal of which operation history is to be recorded for operation history channel (01) to (20) as follows:

1	: G0	to G511
2	: G1000	to G1511
3	: F0	to F511
4	: F1000	to F1511
5	: Y0	to Y127
6	: X0	to X127
9	: G2000	to G2511
10	: F2000	to F2511
11	: Y200	to Y327
12	: X200	to X327

12841	Number of a signal selected as an operation history signal (01)
12842	Number of a signal selected as an operation history signal (02)
12843	Number of a signal selected as an operation history signal (03)
12844	Number of a signal selected as an operation history signal (04)
12845	Number of a signal selected as an operation history signal (05)
12846	Number of a signal selected as an operation history signal (06)
12847	Number of a signal selected as an operation history signal (07)
12848	Number of a signal selected as an operation history signal (08)
12849	Number of a signal selected as an operation history signal (09)
12850	Number of a signal selected as an operation history signal (10)
12851	Number of a signal selected as an operation history signal (11)
12852	Number of a signal selected as an operation history signal (12)
12853	Number of a signal selected as an operation history signal (13)
12854	Number of a signal selected as an operation history signal (14)
12855	Number of a signal selected as an operation history signal (15)
12856	Number of a signal selected as an operation history signal (16)
12857	Number of a signal selected as an operation history signal (17)
12858	Number of a signal selected as an operation history signal (18)
12859	Number of a signal selected as an operation history signal (19)
12860	Number of a signal selected as an operation history signal (20)

[Data type] Word
[Valid data range] 0 to 511

Set the number of a signal of which operation history is to be recorded for operation history channel (01) to (20) with a value between 0 and 511.

	#7	#6	#5	#4	#3	#2	#1	#0
12881	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0

History record bit settings for an operation history signal (01)

	#7	#6	#5	#4	#3	#2	#1	#0
12882	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0

History record bit settings for an operation history signal (02)

	#7	#6	#5	#4	#3	#2	#1	#0
12883	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0

History record bit settings for an operation history signal (03)

	#7	#6	#5	#4	#3	#2	#1	#0
12884	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0

History record bit settings for an operation history signal (04)

	#7	#6	#5	#4	#3	#2	#1	#0
12885	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0

History record bit settings for an operation history signal (05)

	#7	#6	#5	#4	#3	#2	#1	#0
12886	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0

History record bit settings for an operation history signal (06)

	#7	#6	#5	#4	#3	#2	#1	#0
12887	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0

History record bit settings for an operation history signal (07)

	#7	#6	#5	#4	#3	#2	#1	#0
12888	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0

History record bit settings for an operation history signal (08)

	#7	#6	#5	#4	#3	#2	#1	#0
12889	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0

History record bit settings for an operation history signal (09)

	#7	#6	#5	#4	#3	#2	#1	#0
12890	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0

History record bit settings for an operation history signal (10)

	#7	#6	#5	#4	#3	#2	#1	#0
12891	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0

History record bit settings for an operation history signal (11)

	#7	#6	#5	#4	#3	#2	#1	#0
12892	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0

History record bit settings for an operation history signal (12)

	#7	#6	#5	#4	#3	#2	#1	#0
12893	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0

History record bit settings for an operation history signal (13)

	#7	#6	#5	#4	#3	#2	#1	#0
12894	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0

History record bit settings for an operation history signal (14)

	#7	#6	#5	#4	#3	#2	#1	#0
12895	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0

History record bit settings for an operation history signal (15)

	#7	#6	#5	#4	#3	#2	#1	#0
12896	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0

History record bit settings for an operation history signal (16)

	#7	#6	#5	#4	#3	#2	#1	#0
12897	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0

History record bit settings for an operation history signal (17)

	#7	#6	#5	#4	#3	#2	#1	#0
12898	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0

History record bit settings for an operation history signal (18)

	#7	#6	#5	#4	#3	#2	#1	#0
12899	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0

History record bit settings for an operation history signal (19)

	#7	#6	#5	#4	#3	#2	#1	#0
12900	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0

History record bit settings for an operation history signal (20)

[Data type] Bit

RB7 to RB0 With a signal for recording operation history set (in parameter No. 12801 to No. 12860) for each channel of (01) to (20), the history of each bit is:

0 : Not recorded. (The history of this bit is not recorded.)

1 : Recorded. (The history of this bit is recorded.)

4.87 PARAMETERS OF DISPLAY AND EDIT (2 OF 2)

	#7	#6	#5	#4	#3	#2	#1	#0
13101	ODC	NDC						

[Data type] Bit

NDC The colors (color palette values) on the screen supporting VGA of the color LCD unit are:
0 : Not changed.
1 : Changed to FANUC standard color 1 (new FANUC standard colors).

ODC The color data (color palette values) on the screen supporting VGA of the color LCD unit is:
0 : Not changed.
1 : Changed to FANUC standard color 2 (old FANUC standard colors).

NOTE
1 If the power is turned off then back on after bit 6 (NDC) of parameter No. 13101 is set to 1, the bit is automatically set to 0.
2 If the power is turned off then back on after bit 7 (ODC) of parameter No. 13101 is set to 1, the bit is automatically set to 0.
3 If 0 is set in all standard color data parameters for color 1 (No. 6561 to No. 6595), the color setting can be changed by setting the NDC or ODC parameter to 1.
4 In a multi-path system, parameter No. 13101 is applied to all paths.

	#7	#6	#5	#4	#3	#2	#1	#0
13110								JPN

NOTE
When at least one of these parameters is set, the power must be turned off before operation is continued.

[Data type] Bit

JPN The top-priority language used for trouble diagnosis/machine alarm diagnosis display is:
0 : English.
For machine alarm diagnosis, the file "GUIE_USR.MEM" has priority.
1 : Japanese
For machine alarm diagnosis, the file "GUIJ_USR.MEM" has priority.

	#7	#6	#5	#4	#3	#2	#1	#0
13112	NTD	NTA		DAP		SPI	SVI	IDW

[Data type] Bit

IDW Editing on the servo information screen or spindle information screen is
0 : Prohibited.
1 : Not prohibited.

SVI Servo information screen is
0 : Displayed.
1 : Not displayed.

SPI Spindle information screen is
0 : Displayed.
1 : Not displayed.

DAP In the advanced preview control mode, "APC" blinking display is:
0 : Not provided.
1 : Provided.

NTA On the manual feed screen for 5-axis machining, the table reference travel distance is:
0 : Displayed.
1 : Not displayed.

NTD On the manual feed screen for 5-axis machining, the tool axis reference travel distance is:
0 : Displayed.
1 : Not displayed.

13130	Path display order on the screen that displays multiple paths simultaneously

[Data type] Byte

[Valid data range] 0 to 5

This parameter sets the order of path display on the screen that displays multiple paths simultaneously when two-path or three-path control (T series only) is used.

The table below indicates the relationships between settings and display orders.

System	Setting	Order
2-path	0	1st path, 2nd path
	1	2nd path, 1st path
3-path (T series only)	0	1st path, 2nd path, 3rd path
	1	2nd path, 1st path, 3rd path
	2	1st path, 3rd path, 2nd path
	3	3rd path, 1st path, 2nd path
	4	2nd path, 3rd path, 1st path
	5	3rd path, 2nd path, 1st path

13140	**Name of the first spindle for load meter display (first character)**
13141	**Name of the first spindle for load meter display (second character)**
13142	**Name of the second spindle for load meter display (first character)**
13143	**Name of the second spindle for load meter display (second character)**
13144	**Name of the third spindle for load meter display (first character)**
13145	**Name of the third spindle for load meter display (second character)**

[Data type] Byte

Set the name of each spindle used for spindle load meter display by specifying character codes. As a name to be displayed on the screen, an arbitrary character string (not longer than two characters) consisting of numerical characters, alphabetic characters, katakana characters, and symbols (other than "!") can be used.

NOTE

1 These parameters can be used only for current position display on the left side of the display screen in a one-path system and for load meter display on the program check screen in a two-path or three-path system when a 9.5/10.4-inch display unit (with 12-soft key type) is used.

2 For the character codes, see the character code correspondence table in Appendix A.

3 Character code 33 ("!") cannot be displayed.

4 If 0 is set as a character code, the following are displayed:
First spindle: S1
Second spindle: S2
Third spindle: S3

13150	Number of sets of offset data displayed on the offset screen

[Data type] Word

[Valid data range] 0, 1 to maximum number of tool offset sets

This parameter sets the maximum allowable number of sets of offset data displayed on the offset screen.

NOTE

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

2 If 0 or a value not within the valid data range is set in this parameter, this parameter is invalid, and all offset data is displayed.

4.88 PARAMETERS OF TOOL MANAGEMENT FUNCTIONS

	#7	#6	#5	#4	#3	#2	#1	#0
13200	NFD	NAM	T0O	TP2	ETE	TRT	THN	TCF

[Data type] Bit

TCF When a T code is specified with the tool management function:
0 : A cartridge number and pot number found by the NC are output.
1 : The specified T code is output without modification.

THN When NX.T and HD.T are displayed with the tool management function:
0 : The tool type numbers at the first spindle position and the first standby position are displayed.
1 : The values specified from the PMC window are displayed.

TRT As the remaining lifetime value for outputting the tool life arrival notice signal:
0 : The remaining lifetime of the last tool is used.
1 : The sum of the remaining lifetimes of the tools with the same type number is used.

> **NOTE**
> This parameter is valid when bit 3 (ETE) of parameter No. 13200 is set to 0 (arrival notice for each type number).

ETE The tool life arrival notice signal is output:
0 : For each tool type.
1 : For each tool.

TP2 The punch-out format of cartridge management data is:
0 : New registration format (G10L76P1 format).
1 : Modification format (G10L76P2 format).

T0O When T0 is specified:
0 : A tool search is made assuming that the tool type number is 0.
1 : The cartridge number and pot number are assumed to be 0.

NAM When a T code is specified, but a valid tool with a remaining lifetime cannot be found:
0 : The alarm (PS5317) "LIVES OF ALL TOOLS EXPIRED" is issued.
1 : The alarm is not issued. Instead, the tool with the maximum tool management number is selected from the tools of the specified tool type, and TMFNFD<F315#6> is set to 1.

NFD When a T code is specified, but a valid tool with a remaining lifetime cannot be found in the cartridge:
0 : The spindle position and standby position are also searched.
1 : The spindle position and standby position are not searched.

	#7	#6	#5	#4	#3	#2	#1	#0
13201	TMD							

[Data type] Bit

TMD The screen for the tool management function is displayed in:
0 : Color.
1 : Monochrome.

	#7	#6	#5	#4	#3	#2	#1	#0
13202				DO2	DOB	DOY	DOR	

[Data type] Bit

DOR On the tool management function screen, tool nose radius compensation data is:
0 : Displayed.
1 : Not displayed.

DOY On the tool management function screen, Y-axis offset data is:
0 : Displayed.
1 : Not displayed.

DOB On the tool management function screen, B-axis offset data is:
0 : Displayed.
1 : Not displayed.

DO2 On the tool management function screen, the second geometry tool offset data is:
0 : Displayed.
1 : Not displayed.

	#7	#6	#5	#4	#3	#2	#1	#0
13203	TCN	SWC			NM4	NM3	NM2	NM1

[Data type] Bit

NM1 The first cartridge is:
0 : Searched.
1 : Not searched.

NM2 The second cartridge is:
0 : Searched.
1 : Not searched.

NM3 The third cartridge is:
0 : Searched.
1 : Not searched.

NM4 The fourth cartridge is:
0 : Searched.
1 : Not searched.

SWC The tools with the same tool type number are searched for:
0 : Tool with the shortest lifetime.
1 : Tool with the small customization data number. In this case, a customization data number is to be set in parameter No. 13260.

TCN Tool life count operation is triggered by:
0 : M06/restart M code. (A T code alone does not start counting.)
1 : T code. (Count operation is not started by M06.)

13220	Number of valid tools in tool management data

[Data type] Word

[Valid data range] 0 to 64 (Extended to 240 or 1000 by the addition of an option)

This parameter sets the number of valid tools in tool management data.

13221	M code for tool life count restart

[Data type] Word

[Valid data range] 0 to 65535 (except 01, 02, 30, 98, and 99)

When 0 is set in this parameter, this parameter is ignored.

When an M code for tool life count restart is specified, the counting of the life of the tool attached at the spindle position is started. When the type for counting the number of use times is selected, the target of life counting is switched to the tool attached at the spindle position, and the life count is incremented by 1.

When the type for counting time is selected, the target of life counting is switched to the tool attached at the spindle position but no other operations are performed. If the tool attached at the spindle position is not a tool under tool life management, no operation is performed.

The M code set in parameter No. 6811 waits for FIN. However, the M code set in this parameter does not wait for FIN.

The M code set in parameter No. 13221 must not be specified in a block where another auxiliary function is specified.

The M code set in parameter No. 13221 does not wait for FIN. So, do not use the M code for other purposes.

13222	Number of data items in the first cartridge

[Data type] Word

[Valid data range] 1 to 64 (Extended to 240 or 1000 by the addition of an option)

This parameter sets the range of data numbers to be used with the first cartridge.

13223	Start pot number of the first cartridge

[Data type] Word

[Valid data range] 1 to 9999

This parameter sets the start pot number to be used with the first cartridge. To each data number, a pot number incremented each time by 1 from the parameter value is assigned.

13227	Number of data items in the second cartridge

[Data type] Word

[Valid data range] 1 to 64 (Extended to 240 or 1000 by the addition of an option)

This parameter sets the range of data numbers to be used with the second cartridge.

13228	Start pot number of the second cartridge

[Data type] Word
[Valid data range] 1 to 9999

This parameter sets the start pot number to be used with the second cartridge. To each data number, a pot number incremented each time by 1 from the parameter value is assigned.

13232	Number of data items in the third cartridge

[Data type] Word
[Valid data range] 1 to 64 (Extended to 240 or 1000 by the addition of an option)

This parameter sets the range of data numbers to be used with the third cartridge.

13233	Start pot number of the third cartridge

[Data type] Word
[Valid data range] 1 to 9999

This parameter sets the start pot number to be used with the third cartridge. To each data number, a pot number incremented each time by 1 from the parameter value is assigned.

13237	Number of data items in the fourth cartridge

[Data type] Word
[Valid data range] 1 to 64 (Extended to 240 or 1000 by the addition of an option)

This parameter sets the range of data numbers to be used with the fourth cartridge.

13238	Start pot number of the fourth cartridge

[Data type] Word
[Valid data range] 1 to 9999

This parameter sets the start pot number to be used with the fourth cartridge. To each data number, a pot number incremented each time by 1 from the parameter value is assigned.

13250	Number of valid spindles

[Data type] Byte
[Valid data range] 0 to 4

This parameter sets the number of spindle positions usable with the tool management function.

13251	Number of valid standby positions

[Data type] Byte
[Valid data range] 0 to 4

This parameter sets the number of standby positions usable with the tool management function.

13252	M code for specifying a particular tool

[Data type] Word
[Valid data range] 0 to 65535

This parameter sets not a tool type number but an M code for directly specifying the T code of a particular tool.

13260	Customization data number to be searched for

[Data type] Byte
[Valid data range] 0 to 20

When bit 6 (SWC) of parameter No. 13203 is set to 1, this parameter sets a customization data number to be searched for.
The valid data range is 1 to 4 when the option for customization data extension is not selected. When the option for customization data extension is selected, the valid data range is 1 to 20.
When bit 6 (SWC) of parameter No. 13203 is set to 0, or a value not within the valid data range is set, the search function based on customization data is disabled, and the tool with the shortest lifetime is searched for.

13265	Number for selecting a spindle position offset number

[Data type] 2-word
[Valid data range] 0 to 999

This parameters sets an H/D code for selecting an offset number registered in the data of the tool attached at the spindle position.

NOTE

With the lathe system, address D only is used to specify a tool number and offset number, so that a restriction is imposed on the number of digits. So, the valid data range of this parameter varies according the number of digits of an offset number.
When the number of digits of an offset number is 1: up to 9
When the number of digits of an offset number is 2: up to 99
When the number of digits of an offset number is 3: up to 999

4.89 PARAMETERS OF STRAIGHTNESS COMPENSATION (2 OF 2)

13301	Compensation point number a of move axis 4
13302	Compensation point number b of move axis 4
13303	Compensation point number c of move axis 4
13304	Compensation point number d of move axis 4
13311	Compensation point number a of move axis 5
13312	Compensation point number b of move axis 5
13313	Compensation point number c of move axis 5
13314	Compensation point number d of move axis 5
13321	Compensation point number a of move axis 6
13322	Compensation point number b of move axis 6
13323	Compensation point number c of move axis 6
13324	Compensation point number d of move axis 6

NOTE

1 When these parameters are set, the power must be turned off before operation is continued.

2 Parameters No. 13301 to No. 13324 are valid only when bit 1 (ST6) of parameter No. 5700 is set to 1.

[Data type] Word

[Unit of data] Number (compensation point number in stored pitch error compensation)

[Valid data range] 0 to 1023

These parameters set four compensation points for each axis.

13351	Compensation value for compensation point a of move axis 4
13352	Compensation value for compensation point b of move axis 4
13353	Compensation value for compensation point c of move axis 4
13354	Compensation value for compensation point d of move axis 4
13361	Compensation value for compensation point a of move axis 5
13362	Compensation value for compensation point b of move axis 5
13363	Compensation value for compensation point c of move axis 5
13364	Compensation value for compensation point d of move axis 5
13371	Compensation value for compensation point a of move axis 6
13372	Compensation value for compensation point b of move axis 6
13373	Compensation value for compensation point c of move axis 6
13374	Compensation value for compensation point d of move axis 6

NOTE

1. When these parameters are set, the power must be turned off before operation is continued. However, this requirement is not applicable when bit 0 (RTS) of parameter No. 5700 is set to 1.
2. Parameters No. 13351 to 13374 are valid only when bit 1 (ST6) of parameter No. 5700 is set to 1.

[Data type] Word
[Unit of data] Detection unit
[Valid data range] -32768 to 32767

These parameters set a compensation value for each compensation point of each move axis.

4.90 PARAMETERS OF INTERPOLATION TYPE STRAIGHTNESS COMPENSATION

13381	**Number of straightness compensation point at extremely negative point of moving axis 1**
13382	**Number of straightness compensation point at extremely negative point of moving axis 2**
13383	**Number of straightness compensation point at extremely negative point of moving axis 3**
13384	**Number of straightness compensation point at extremely negative point of moving axis 4**
13385	**Number of straightness compensation point at extremely negative point of moving axis 5**
13386	**Number of straightness compensation point at extremely negative point of moving axis 6**

[Data type] Word

[Valid data range] 6000 to 6767

Set the number of the straightness compensation point at the extremely negative point for each moving axis.

When the value set in this parameter is out of the data range, an alarm is generated and compensation can not be performed.

13391	**Magnification of straightness compensation for moving axis 1**
13392	**Magnification of straightness compensation for moving axis 2**
13393	**Magnification of straightness compensation for moving axis 3**
13394	**Magnification of straightness compensation for moving axis 4**
13395	**Magnification of straightness compensation for moving axis 5**
13396	**Magnification of straightness compensation for moving axis 6**

[Data type] Byte

[Valid data range] 0 to 100

Set the magnification of straightness compensation for each moving axis.

When the magnification is set to 1, the unit of compensation data is the same as the detection unit. When the magnification is set to 0, the straightness compensation is not applied.

NOTE

1. Interpolation type straightness compensation function is available as an option.
2. To use this function, the options for interpolation type straightness compensation function and for stored pitch error compensation function are required.
3. To use interpolation type straightness compensation function, set the above parameters, as well as bit 2 (IST) of parameter No. 3605 and related parameters among parameter No. 5700 to No. 5784.

4.91 PARAMETERS OF MACHINING CONDITION SELECTING SCREEN

	#7	#6	#5	#4	#3	#2	#1	#0
13600								MCR

[Data type] Bit

MCR When an allowable acceleration rate adjustment is made with the machining condition selection function (machining parameter adjustment screen, precision level selection screen), parameter Nos. 1730 and 1731 for the feedrate clamp based on arc radius is:

0 : Modified.

1 : Not modified.

> **NOTE**
> This parameter is valid only for adjustment of parameters for advanced preview control, AI contour control, and AI nano contour control. When high-precision contour control or AI high-precision contour control is used, the parameters (No. 1730 and 1731) for feedrate clamp based on arc radius are not modified, regardless of the setting of this parameter.

	#7	#6	#5	#4	#3	#2	#1	#0
13601								MPR

[Data type] Bit

MPR The machining parameter adjustment screen is:、

0 : Displayed.

1 : Not displayed.

> **NOTE**
> 1 When this parameter is set, the power must be turned off before operation is continued.
> 2 Even when this parameter is set to 1, the precision level selection screen is displayed.

13610	Acceleration rate for acceleration/deceleration before interpolation when advanced preview control / AI contour control / AI nano contour control is used (precision level 1)
13611	Acceleration rate for acceleration/deceleration before interpolation when advanced preview control / AI contour control / AI nano contour control is used (precision level 10)

[Data type] 2-word

[Unit of data]

Increment system	Unit
Metric machine	0.001mm/sec^2

[Valid data range] 50000 to 99999999

Each of these parameters sets an acceleration rate for acceleration/deceleration before interpolation when advanced preview control/AI contour control/AI nano contour control is used. Two types of values, emphasis on speed (precision level 1) and emphasis on precision (precision level 10), can be set.

13612	Acceleration rate change time (bell-shaped) when AI contour control / AI nano contour control is used (precision level 1)
13613	Acceleration rate change time (bell-shaped) when AI contour control / AI nano contour control is used (precision level 10)

[Data type] Byte

[Unit of data] msec

[Valid data range] 0 to 100

These parameters set an acceleration rate change time (bell-shaped) in the case of emphasis on speed (precision level 1) and in the case of emphasis on precision (precision level 10) when AI contour control/AI nano contour control is used.

13614	Allowable acceleration rate change amount for each axis in speed control based on acceleration rate change under jerk control when AI contour control / AI nano contour control is used (precision level 1)
13615	Allowable acceleration rate change amount for each axis in speed control based on acceleration rate change under jerk control when AI contour control / AI nano contour control is used (precision level 10)

[Data type] 2-word axis

[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm/sec^2
Rotary axis	0.001	0.0001	deg/sec^2

[Valid data range] 0 to 99999999

Each of these parameters sets an allowable acceleration rate change amount per 1 msec for each axis in speed control based on acceleration rate change under jerk control during AI contour control / AI nano contour control.

Set a value (precision level 1) with emphasis placed on speed, and a value (precision level 10) with emphasis on precision.

13616	**Allowable acceleration rate change amount for each axis in speed control based on acceleration rate change under jerk control in successive linear interpolation operations when AI contour control / AI nano contour control is used (precision level 1)**
13617	**Allowable acceleration rate change amount for each axis in speed control based on acceleration rate change under jerk control in successive linear interpolation operations when AI contour control / AI nano contour control is used (precision level 10)**

[Data type] 2-word axis

[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm/sec^2
Rotary axis	0.001	0.0001	deg/sec^2

[Valid data range] 0 to 99999999

Each of these parameters sets an allowable acceleration rate change amount per 1 msec for each axis in speed control based on acceleration rate change under jerk control in successive linear interpolation operations during AI contour control / AI nano contour control.

Set a value (precision level 1) with emphasis placed on speed, and a value (precision level 10) with emphasis on precision.

NOTE

1 For an axis with 0 set in these parameters, parameters No. 13614 and No. 13615 are valid.

2 For an axis with 0 set in parameters No. 13614 and No. 13615, speed control based on acceleration rate change is disabled, so that the specification of this parameter has no effect.

13618	Ratio of jerk rate change time in smooth bell-shaped acceleration/deceleration before interpolation when AI contour control/AI nano contour control is used (precision level 1)
13619	Ratio of jerk rate change time in smooth bell-shaped acceleration/deceleration before interpolation when AI contour control/AI nano contour control is used (precision level 10)

[Data type] Byte

[Unit of data] %

[Valid data range] 0 to 50

Each of these parameters sets the ratio of jerk rate change time to acceleration rate change time in smooth bell-shaped acceleration/deceleration before interpolation when AI contour control/AI nano contour control is used.

Set a value (precision level 1) with emphasis placed on speed, and a value (precision level 10) with emphasis on precision.

NOTE

When 0 or a value not within the valid data range is set in these parameters, smooth bell-shaped acceleration/deceleration before look-ahead interpolation is not performed.

13620	Allowable acceleration rate when AI contour control / AI nano contour control is used (precision level 1)
13621	Allowable acceleration rate when AI contour control / AI nano contour control is used (precision level 10)

[Data type] 2-word axis

[Unit of data]

Increment system	Unit
Metric machine	0.001mm/sec^2

[Valid data range] 0 to 99999999

These parameters set an allowable acceleration rate in the case of emphasis on speed (precision level 1) and in the case of emphasis on precision (precision level 10) when AI contour control/AI nano contour control is used.

13622	Time constant for acceleration/deceleration after interpolation (precision level 1)
13623	Time constant for acceleration/deceleration after interpolation (precision level 10)

[Data type] Word axis
[Unit of data] msec
[Valid data range] See the description of parameter No. 1768.

These parameters set a time constant for acceleration/deceleration after interpolation in the case of emphasis on speed (precision level 1) and in the case of emphasis on precision (precision level 10).
Whether linear or bell-shaped acceleration/deceleration is used depends on the settings of bits 3 (BS2) and 6 (LS2) of parameter No. 1602.

Parameter No.1602		Acceleration/deceleration
Bit 6 (LS2)	Bit 3 (BS2)	
1	0	Linear acceleration/deceleration after interpolation for cutting feed is selected.
0	1	Bell-shaped acceleration/deceleration after interpolation for cutting feed is selected.

NOTE
1 For linear acceleration/deceleration, the function for linear acceleration/deceleration after interpolation for cutting feed is required.
2 For bell-shaped acceleration/deceleration, the function for linear acceleration/deceleration after interpolation for cutting feed is required.
3 The common parameters are applied to advanced preview control/AI contour control/AI nano contour control and high-precision contour control/AI high-precision contour control/AI nano high-precision contour control.

13624	Corner speed difference when advanced preview control / AI contour control / AI nano contour control is used (precision level 1)
13625	Corner speed difference when advanced preview control / AI contour control / AI nano contour control is used (precision level 10)

[Data type] Word axis
[Unit of data, valid data range]

Increment system	Unit	Valid data range	
		IS-B	IS-C
Metric machine	1 mm/min	6 to 15000	6 to 12000
Rotary axis	1 deg/min	6 to 15000	6 to 12000

These parameter set an allowable corner speed difference for speed determination in the case of emphasis on speed (precision level 1) and in the case of emphasis on precision (precision level 10) when advanced preview control/AI contour control/AI nano contour control is used.

13626	Maximum cutting speed (precision level 1)
13627	Maximum cutting speed (precision level 10)

[Data type] 2-word axis

[Unit of data, valid data range]

Increment system	Unit	Valid data range	
		IS-B	IS-C
Metric machine	1 mm/min	6 to 240000	6 to 100000
Rotary axis	1 deg/min	6 to 240000	6 to 100000

Each of these parameters sets a maximum cutting speed for each axis.

> **NOTE**
> The common parameters are applied to advanced preview control/AI contour control/AI nano contour control and high-precision contour control/AI high-precision contour control/AI nano high-precision contour control.

13628	Parameter number corresponding to arbitrary item 1 when advanced preview control / AI contour control / AI nano contour control is used
13629	Parameter number corresponding to arbitrary item 2 when advanced preview control / AI contour control / AI nano contour control is used

[Data type] Word

[Valid data range] 1 to 65535

These parameters set the parameter numbers corresponding to arbitrary items 1 and 2.

> **NOTE**
> 1 The parameter numbers corresponding to the following cannot be specified:
> - Bit parameters
> - Spindle parameters (No. 4000 to No. 4799)
> - Parameters that require power-off (causing P/S 0 alarm to be issued)
> - Nonexistent parameters
>
> 2 When these parameters are set, the power must be turned off before operation is continued.

13630	Value with emphasis on speed (precision level 1) of the parameter corresponding to arbitrary item 1 when advanced preview control / AI contour control / AI nano contour control is used

13631	Value with emphasis on speed (precision level 1) of the parameter corresponding to arbitrary item 2 when advanced preview control / AI contour control / AI nano contour control is used

13632	Value with emphasis on speed (precision level 10) of the parameter corresponding to arbitrary item 1 when advanced preview control / AI contour control / AI nano contour control is used

13633	Value with emphasis on speed (precision level 10) of the parameter corresponding to arbitrary item 2 when advanced preview control / AI contour control / AI nano contour control is used

[Data type] 2-word axis
[Unit of data] Depend on the type of parameter for an arbitrary item
[Valid data range] Depend on the type of parameter for an arbitrary item

13634	Precision level currently selected when advanced preview control / AI contour control / AI nano contour control is used

[Data type] Byte
[Valid data range] 1 to 10
This parameter sets the level currently selected.

NOTE
For a time constant for acceleration/deceleration after interpolation and maximum cutting speed, the common parameters are applied to advanced preview control/AI contour control/AI nano contour control and high-precision contour control/AI high-precision contour control/AI nano high-precision contour control. If different precision levels are specified for these types of control, the precision level specified later is used as the common precision level.

13660	Acceleration rate for acceleration/deceleration before interpolation when high-precision contour control / AI high-precision contour control / AI nano high-precision contour control is used (precision level 1)
13661	Acceleration rate for acceleration/deceleration before interpolation when high-precision contour control / AI high-precision contour control / AI nano high-precision contour control is used (precision level 10)

[Data type] 2-word axis

[Unit of data]

Increment system	Unit
Metric machine	0.001mm/sec^2

[Valid data range] 50000 to 99999999

Each of these parameters sets an acceleration rate for acceleration/deceleration before interpolation when high-precision contour control/AI high-precision contour control/AI nano high-precision contour control is used. Two types of values, emphasis on speed (precision level 1) and emphasis on precision (precision level 10), can be set.

NOTE

1. When high-precision contour control is used, the setting for the first axis is applied to all axes. Settings for other than the first axis are ignored.
2. When AI high-precision contour control/AI nano high-precision contour control is used, a setting is made on an axis-by-axis basis.

13662	Acceleration rate change time (bell-shaped) when high-precision contour control / AI high-precision contour control / AI nano high-precision contour control is used (precision level 1)
13663	Acceleration rate change time (bell-shaped) when high-precision contour control / AI high-precision contour control / AI nano high-precision contour control is used (precision level 10)

[Data type] 2-word

[Unit of data] msec

[Valid data range] 0 to 200

These parameters set an acceleration rate change time (bell-shaped) in the case of emphasis on speed (precision level 1) and in the case of emphasis on precision (precision level 10) when high-precision contour control/AI high-precision contour control/AI nano high-precision contour control is used.

13664	**Allowable acceleration rate change amount for each axis in speed control based on acceleration rate change under jerk control when AI high-precision contour control / AI nano high-precision contour control is used (precision level 1)**
13665	**Allowable acceleration rate change amount for each axis in speed control based on acceleration rate change under jerk control when AI high-precision contour control / AI nano high-precision contour control is used (precision level 10)**

[Data type] 2-word axis

[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm/sec^2
Rotary axis	0.001	0.0001	deg/sec^2

[Valid data range] 0 to 99999999

Each of these parameters sets an allowable acceleration rate change amount per 1 msec for each axis in speed control based on acceleration rate change under jerk control during AI high-precision contour control / AI nano high-precision contour control.

Set a value (precision level 1) with emphasis placed on speed, and a value (precision level 10) with emphasis on precision.

13666	**Allowable acceleration rate change amount for each axis in speed control based on acceleration rate change under jerk control in successive linear interpolation operations when AI high-precision contour control / AI nano high-precision contour control is used (precision level 1)**
13667	**Allowable acceleration rate change amount for each axis in speed control based on acceleration rate change under jerk control in successive linear interpolation operations when AI high-precision contour control / AI nano high-precision contour control is used (precision level 10)**

[Data type] 2-word axis

[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm/sec^2
Rotary axis	0.001	0.0001	deg/sec^2

[Valid data range] 0 to 99999999

Each of these parameters sets an allowable acceleration rate change amount per 1 msec for each axis in speed control based on acceleration rate change under jerk control in successive linear interpolation operations during AI high-precision contour control / AI nano high-precision contour control.

Set a value (precision level 1) with emphasis placed on speed, and a value (precision level 10) with emphasis on precision.

NOTE

1. For an axis with 0 set in these parameters, parameters No. 13664 and No. 13665 are valid.
2. For an axis with 0 set in parameters No. 13664 and No. 13665, speed control based on acceleration rate change is disabled, so that the specification of this parameter has no effect.

13668	**Ratio of jerk rate change time in smooth bell-shaped acceleration/deceleration before interpolation when AI high-precision contour control/AI nano high-precision contour control is used (precision level 1)**
13669	**Ratio of jerk rate change time in smooth bell-shaped acceleration/deceleration before interpolation when AI high-precision contour control/AI nano high-precision contour control is used (precision level 10)**

[Data type] Byte
[Unit of data] %
[Valid data range] 0 to 50

Each of these parameters sets the ratio of jerk rate change time to acceleration rate change time in smooth bell-shaped acceleration/deceleration before interpolation when AI high-precision contour control/AI nano high-precision contour control is used.
Set a value (precision level 1) with emphasis placed on speed, and a value (precision level 10) with emphasis on precision.

NOTE
When 0 or a value not within the valid data range is set in these parameters, smooth bell-shaped acceleration/deceleration before look-ahead interpolation is not performed.

13670	**Allowable acceleration rate when high-precision contour control / AI high-precision contour control / AI nano high-precision contour control is used (precision level 1)**
13671	**Allowable acceleration rate when high-precision contour control / AI high-precision contour control / AI nano high-precision contour control is used (precision level 10)**

[Data type] 2-word axis
[Unit of data]

Increment system	Unit
Metric machine	0.001mm/sec^2

[Valid data range] 0 to 99999999

These parameters set an allowable acceleration rate in the case of emphasis on speed (precision level 1) and in the case of emphasis on precision (precision level 10) when high-precision contour control/AI high-precision contour control/AI nano high-precision contour control is used.

13672	Corner speed difference when high-precision contour control / AI high-precision contour control / AI nano high-precision contour control is used (precision level 1)
13673	Corner speed difference when high-precision contour control / AI high-precision contour control / AI nano high-precision contour control is used (precision level 10)

[Data type] 2-word axis

[Unit of data, valid data range]

Increment system	Unit	Valid data range	
		IS-B	IS-C
Metric machine	1 mm/min	10 to 60000	1 to 6000
Rotary axis	1 deg/min	10 to 60000	1 to 6000

These parameter set an allowable corner speed difference for speed determination in the case of emphasis on speed (precision level 1) and in the case of emphasis on precision (precision level 10) when high-precision contour control / AI high-precision contour control / AI nano high-precision contour control is used.

13674	Parameter number corresponding to arbitrary item 1 when high-precision contour control / AI high-precision contour control / AI nano high-precision contour control is used
13675	Parameter number corresponding to arbitrary item 2 when high-precision contour control / AI high-precision contour control / AI nano high-precision contour control is used

[Data type] Word

[Valid data range] 1 to 65535

These parameters set the parameter numbers corresponding to arbitrary items 1 and 2.

NOTE

1 The parameter numbers corresponding to the following cannot be specified:
- Bit parameters
- Spindle parameters (No. 4000 to No. 4799)
- Parameters that require power-off (causing P/S 0 alarm to be issued)
- Nonexistent parameters

2 When these parameters are set, the power must be turned off before operation is continued.

13676	**Value with emphasis on speed (precision level 1) of the parameter corresponding to arbitrary item 1 when high-precision contour control / AI high-precision contour control / AI nano high-precision contour control is used**
13677	**Value with emphasis on speed (precision level 1) of the parameter corresponding to arbitrary item 2 when high-precision contour control / AI high-precision contour control / AI nano high-precision contour control is used**
13678	**Value with emphasis on speed (precision level 10) of the parameter corresponding to arbitrary item 1 when high-precision contour control / AI high-precision contour control / AI nano high-precision contour control is used**
13679	**Value with emphasis on speed (precision level 10) of the parameter corresponding to arbitrary item 2 when high-precision contour control / AI high-precision contour control / AI nano high-precision contour control is used**

[Data type] 2-word axis
[Unit of data] Depend on the type of parameter for an arbitrary item
[Valid data range] Depend on the type of parameter for an arbitrary item

13680	**Precision level currently selected when high-precision contour control / AI high-precision contour control / AI nano high-precision contour control is used**

[Data type] Byte
[Valid data range] 1 to 10

This parameter sets the level currently selected.

NOTE

For a time constant for acceleration/deceleration after interpolation and maximum cutting speed, the common parameters are applied to advanced preview control/AI contour control/AI nano contour control and high-precision contour control/AI high-precision contour control/AI nano high-precision contour control. If different precision levels are specified for these types of control, the precision level specified later is used as the common precision level.

4.92 PARAMETERS OF DUAL CHECK SAFETY

1942	Safety speed for each axis
13821	Safety speed 1 for each axis
13822	Safety speed 2 for each axis
13823	Safety speed 3 for each axis
13824	Safety speed 4 for each axis

[Data type] 2-word axis

[Unit of data, valid data range]

Increment system	Unit of data	Valid data range	
		IS-A, IS-B	IS-C
Metric machine	1 mm/min	0 to 240000	0 to 100000
Inch machine	0.1 inch/min	0 to 96000	0 to 48000
Rotary axis	1 deg/min	0 to 240000	0 to 100000

Set a safety speed for each axis.
The CNC and monitor always check the velocity command of each axis in the dual check safety. If the safety speed is exceeded on one axis at least, the guard unlock signal (*LGD) is brought to 0, to disable guard unlocking. The state in which the safety speed is not exceeded on any axis is one condition for setting the guard unlock signal (*LGD) to 1 (to enable guard unlocking).
If the safety speed is exceeded in safety signal mode C (state in which a guard open request is input and the guard is open), a servo alarm No.476 or No.494 is issued for the corresponding axis.
Up to four safety speeds can be set. Which safety speeds to choose depends on the safety speed/safety position selection signal (safety input signal).
Safety speed 1 assumes the value of parameter No. 1942 if parameter No. 1942 is not set to 0. Safety speed 1 assumes the value of parameter No. 13821 if parameter No. 1942 is set to 0.

$$\text{Safety speed } 1 = \begin{cases} \text{Parameter No.1942 (parameter No.1942} \neq 0) \\ \text{Parameter No.13821 (parameter No.1942} = 0) \end{cases}$$

> **NOTE**
> 1 Safety speed monitoring is performed by converting a specified speed to the detection unit. So, a calculation error can occur.

NOTE

2 Safety speed parameters No. 1942, and No. 13821 through No. 13824 are safety parameters, so that these parameters are protected using the key and code of Dual Check Safety. To modify a safety speed parameter, set a code for safety parameters as the key for safety parameters (parameter No. 3226).

3 When the value of safety speed parameters (No. 1942, No. 13821 through No. 13824) has been changed, the power must be turned off before operation is continued.

4 When diameter programming is used, set a speed based on diameter programming.

1943	Safe machine position of each axis (+ direction)
1944	Safe machine position of each axis (- direction)
13831	Safe machine position 1 of each axis (+ direction)
13832	Safe machine position 1 of each axis (- direction)
13833	Safe machine position 2 of each axis (+ direction)
13834	Safe machine position 2 of each axis (- direction)
13835	Safe machine position 3 of each axis (+ direction)
13836	Safe machine position 3 of each axis (- direction)
13837	Safe machine position 4 of each axis (+ direction)
13838	Safe machine position 4 of each axis (- direction)

[Data type] 2-word axis

[Unit of data, valid data range]

Increment system	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

Set a safe machine position for each axis.
The CNC and monitor always check the machine position on each linear axis in the dual check safety.
In safety signal mode B (state in which a guard open request is input, and the guard is closed), if there is at least one linear axis whose machine position is not in the safe machine position, the guard unlock signal (*LGD) is set to 0 to disable guard unlocking. The state in which the machine positions of all linear axes are within the safe machine positions is one condition for setting the guard unlock signal (*LGD) to 1 (to enable guard unlocking). If the machine position on a linear axis exceeds the safe machine position in safety signal mode C (state in which a guard open request is input and the guard is open), a servo alarm No.477 or No.495 is issued.

Up to four safe machine positions can be set. Which safe machine positions to choose depends on the safety speed/safety position selection signal (safety input signal).
Safe machine position 1 assumes the value of parameter No. 1943 (No. 1944) if parameter No. 1943 (No. 1944) is not set to 0. Safe machine position 1 assumes the value of parameter No. 13831 (13832) if parameter No. 1943 (No. 1944) is set to 0.

$$\text{Safe machine position 1 (+ direction)} = \begin{cases} \text{Parameter No.1943 (No.1943} \neq 0) \\ \text{Parameter No.13831 (No.1943} = 0) \end{cases}$$

$$\text{Safe machine position 1 (- direction)} = \begin{cases} \text{Parameter No.1944 (No.1944} \neq 0) \\ \text{Parameter No.13832 (No.1944} = 0) \end{cases}$$

NOTE

1. Safe machine position monitoring is performed only for a linear axis. Safe machine position monitoring is not performed for a rotary axis.
2. Safe machine position monitoring is performed only for an axis that has a reference position already established. Safe machine position monitoring is not performed for an axis that does not have a reference position established yet.
3. Safe machine position parameters No. 1943, No. 1944, and No. 13831 through No. 13836 are safety parameters, so that these parameters are protected using the key and code of dual check safety. When modifying a safe machine position parameter, set the safety parameter password in parameter No. 3226 (safety parameter key).
4. When the value of safe machine position parameters (No. 1943, No. 1944, and No. 13831 through No. 13836) has been changed, the power must be turned off before operation is continued.

13880	Axis corresponding to the 1st safe position switch
13881	Axis corresponding to the 2nd safe position switch
13882	Axis corresponding to the 3rd safe position switch
13883	Axis corresponding to the 4th safe position switch
13884	Axis corresponding to the 5th safe position switch
13885	Axis corresponding to the 6th safe position switch
13886	Axis corresponding to the 7th safe position switch
13887	Axis corresponding to the 8th safe position switch
13888	Axis corresponding to the 9th safe position switch

13889	Axis corresponding to the 10th safe position switch
13890	Axis corresponding to the 11th safe position switch
13891	Axis corresponding to the 12th safe position switch
13892	Axis corresponding to the 13th safe position switch
13893	Axis corresponding to the 14th safe position switch
13894	Axis corresponding to the 15th safe position switch
13895	Axis corresponding to the 16th safe position switch
13896	Axis corresponding to the 17th safe position switch
13897	Axis corresponding to the 18th safe position switch
13898	Axis corresponding to the 19th safe position switch
13899	Axis corresponding to the 20th safe position switch
13900	Axis corresponding to the 21st safe position switch
13901	Axis corresponding to the 22nd safe position switch
13902	Axis corresponding to the 23rd safe position switch
13903	Axis corresponding to the 24th safe position switch
13904	Axis corresponding to the 25th safe position switch
13905	Axis corresponding to the 26th safe position switch
13906	Axis corresponding to the 27th safe position switch
13907	Axis corresponding to the 28th safe position switch
13908	Axis corresponding to the 29th safe position switch
13909	Axis corresponding to the 30th safe position switch
13910	Axis corresponding to the 31st safe position switch
13911	Axis corresponding to the 32nd safe position switch

[Data type] Byte

[Valid data range] 1, 2, 3,…, Number of controlled axes

These parameters sequentially specify the controlled axis numbers corresponding to the 1st to 32nd safe position switch functions. If the machine coordinate on an axis is within the parameter-set range, the corresponding safe position switch signal is output through the PMC and through the FSSB.

NOTE

1 When 0 is set in a parameter, the setting means that the safe position switch function of the corresponding number is not used. (The safe position switch signal of the corresponding number is not output.)

> **NOTE**
> 2 If an axis for which dual check safety is disabled by setting bit 6 (DCNx) of parameter No. 1904 to 1 is specified, the safe position switch signal of the corresponding number is not output.
> 3 With all tool posts except tool post 2 in 1-CPU 2-path control or tool post 3 in 2-CPU 3-path control, the 9th to 32nd safe position switches are valid only when the FSSB I/O module (for extension) is used. When the FSSB I/O module (for extension) is not used, set 0 in parameters No. 13888 to No. 13911. If a setting is made to use the 9th to 32nd safe position switches when the FSSB I/O module (for extension) is not used, servo alarm No. 493 is issued at power-on time.
> With tool post 2 in 1-CPU 2-path control or tool post 3 in 2-CPU 3-path control, safe position switches are valid only when the FSSB I/O module for extension is used for connection to tool post 1 (in 1-CPU 2-path control) or tool post 2 (in 2-CPU 3-path control).
> When the FSSB I/O module (for extension) is not used, set 0 in parameters No. 13880 to No. 13911. If a setting is made to use safe position switches when the FSSB I/O module (for extension) is not used, servo alarm No. 493 is issued at power-on time.
> 4 Parameters No. 13880 to No. 13911 are safety parameters, so that these parameters are protected by a key and password for dual check safety. When modifying a parameter, set the safety parameter password in parameter No. 3226 (safety parameter key).
> 5 When parameters No. 13880 to No. 13911 are set, the power must be turned off before operation is continued.

13920	Maximum operation range of the 1st safe position switch
13921	Maximum operation range of the 2nd safe position switch
13922	Maximum operation range of the 3rd safe position switch
13923	Maximum operation range of the 4th safe position switch
13924	Maximum operation range of the 5th safe position switch
13925	Maximum operation range of the 6th safe position switch
13926	Maximum operation range of the 7th safe position switch
13927	Maximum operation range of the 8th safe position switch

13928	Maximum operation range of the 9th safe position switch
13929	Maximum operation range of the 10th safe position switch
13930	Maximum operation range of the 11th safe position switch
13931	Maximum operation range of the 12th safe position switch
13932	Maximum operation range of the 13th safe position switch
13933	Maximum operation range of the 14th safe position switch
13934	Maximum operation range of the 15th safe position switch
13935	Maximum operation range of the 16th safe position switch
13936	Maximum operation range of the 17th safe position switch
13937	Maximum operation range of the 18th safe position switch
13938	Maximum operation range of the 19th safe position switch
13939	Maximum operation range of the 20th safe position switch
13940	Maximum operation range of the 21st safe position switch
13941	Maximum operation range of the 22nd safe position switch
13942	Maximum operation range of the 23rd safe position switch
13943	Maximum operation range of the 24th safe position switch
13944	Maximum operation range of the 25th safe position switch
13945	Maximum operation range of the 26th safe position switch
13946	Maximum operation range of the 27th safe position switch
13947	Maximum operation range of the 28th safe position switch
13948	Maximum operation range of the 29th safe position switch
13949	Maximum operation range of the 30th safe position switch
13950	Maximum operation range of the 31st safe position switch
13951	Maximum operation range of the 32nd safe position switch

[Data type] 2-word

[Unit of data]

Increment system	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

These parameters set the maximum operation range of the 1st to 32nd safe position switches.

> **NOTE**
> 1 When the machine position is on the boundary of the specified ranges (machine position = parameter setting value), it is considered within the specified ranges.
> 2 When the setting of operation range is “maximum operation range < minimum operation range”, the safe position switch is not output.
> 3 Parameters No.13920 to No.13951 are safety parameters, so that these parameters are protected by a key and password for dual check safety. When modifying a parameter, set the safety parameter password in parameter No. 3226 (safety parameter key).
> 4 When parameters No.13920 to No.13951 are set, the power must be turned off before operation is continued.

13960	Minimum operation range of the 1st safe position switch
13961	Minimum operation range of the 2nd safe position switch
13962	Minimum operation range of the 3rd safe position switch
13963	Minimum operation range of the 4th safe position switch
13964	Minimum operation range of the 5th safe position switch
13965	Minimum operation range of the 6th safe position switch
13966	Minimum operation range of the 7th safe position switch
13967	Minimum operation range of the 8th safe position switch
13968	Minimum operation range of the 9th safe position switch
13969	Minimum operation range of the 10th safe position switch
13970	Minimum operation range of the 11th safe position switch
13971	Minimum operation range of the 12th safe position switch
13972	Minimum operation range of the 13th safe position switch
13973	Minimum operation range of the 14th safe position switch
13974	Minimum operation range of the 15th safe position switch
13975	Minimum operation range of the 16th safe position switch
13976	Minimum operation range of the 17th safe position switch
13977	Minimum operation range of the 18th safe position switch
13978	Minimum operation range of the 19th safe position switch
13979	Minimum operation range of the 20th safe position switch

13980	Minimum operation range of the 21st safe position switch
13981	Minimum operation range of the 22nd safe position switch
13982	Minimum operation range of the 23rd safe position switch
13983	Minimum operation range of the 24h safe position switch
13984	Minimum operation range of the 25th safe position switch
13985	Minimum operation range of the 26th safe position switch
13986	Minimum operation range of the 27th safe position switch
13987	Minimum operation range of the 28th safe position switch
13988	Minimum operation range of the 29th safe position switch
13989	Minimum operation range of the 30th safe position switch
13990	Minimum operation range of the 31st safe position switch
13991	Minimum operation range of the 32nd safe position switch

[Data type] 2-word

[Unit of data]

Increment system	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch
Rotary axis	0.01	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

These parameters set the minimum operation range of the 1st to 32nd safe position switches.

NOTE

1 When the machine position is on the boundary of the specified ranges (machine position = parameter setting value), it is considered within the specified ranges.
2 When the setting of operation range is “maximum operation range < minimum operation range”, the safe position switch is not output.
3 Parameters No.13960 to No.13991 are safety parameters, so that these parameters are protected by a key and password for dual check safety. When modifying a parameter, set the safety parameter password in parameter No. 3226 (safety parameter key).
4 When parameters No.13960 to No.13991 are set, the power must be turned off before operation is continued.

4.93 PARAMETERS OF SERVO (2 OF 2)

14010	Maximum allowable travel distance at FL feedrate when a reference position is established on an encoder (detection circuit C) with distance-coded reference marks

[Data type] 2-word axis
[Unit of data] Detection unit
[Valid data range] 0 to 99999999

This parameter sets a maximum allowable travel distance moved at the FL feedrate when a reference position is established on an encoder (linear scale/rotary encoder) (detection circuit C) with distance-coded reference marks. If an attempt to establish a reference position fails after moving more than the travel distance set in this parameter, P/S alarm 5326 (scale with distance-coded reference marks: reference position establishment failure) is issued. If 0 is set in this parameter, a maximum allowable travel distance at the FL feedrate is invalid when a reference position is established.

NOTE

1 If this parameter is set for a master axis or slave axis in an attempt for reference position establishment when simple synchronous control is used with the M series, the setting of the parameter is applied automatically to the other axis.

2 When angular axis control is used, the setting of this parameter is invalid for a perpendicular axis engaged in angular axis reference position establishment.

4.94 PARAMETERS OF SERVO GUIDE Mate

	#7	#6	#5	#4	#3	#2	#1	#0
14500	SVG							CLR

[Data type] Bit

CLR The SERVO GUIDE Mate is displayed in:
0 : Color.
1 : Monochrome.

SVG The SERVO GUIDE Mate is:
0 : Not used.
1 : Used.

	#7	#6	#5	#4	#3	#2	#1	#0
14501							SSP	SCM

[Data type] Bit

SCM The synchronous control mode is:
0 : Selected.
1 : Not selected.

SSP Between servo spindles:
0 : Interpolation is performed.
1 : Interpolation is not performed.

4.95 PARAMETERS OF INTERFERENCE CHECK FOR ROTARY AREA

	#7	#6	#5	#4	#3	#2	#1	#0
14900	IC4	IC3	IC2	IC1	IRB	IRA	IB2	IB1

[Data type] Bit

IB1 Setting of the group B move direction (first axis)
- 0 : The move direction of the first axis in the moving plane in group B is the same as of the first axis in the moving plane in group A.
- 1 : The move direction of the first axis in the moving plane in group B is opposite to that of the first axis in the moving plane in group A.

IB2 Setting of the group B move direction (second axis)
- 0 : The move direction of the second axis in the moving plane in group B is the same as of the second axis in the moving plane in group A.
- 1 : The move direction of the second axis in the moving plane in group B is opposite to that of the second axis in the moving plane in group A.

IRA Setting of the direction of rotation of the rotary axis for rotating group A
- 0 : For the direction of rotation of the rotary axis for rotating group A, the direction of rotation from the positive direction of the first axis in the plane to that of the second axis in the plane is used as the positive direction.
- 1 : For the direction of rotation of the rotary axis for rotating group A, the direction of rotation from the positive direction of the first axis in the plane to that of the second axis in the plane is used as the negative direction.

IRB Setting of the direction of rotation of the rotary axis for rotating group B
- 0 : For the direction of rotation of the rotary axis for rotating group B, the direction of rotation from the positive direction of the first axis in the plane to that of the second axis in the plane is used as the positive direction.
- 1 : For the direction of rotation of the rotary axis for rotating group B, the direction of rotation from the positive direction of the first axis in the plane to that of the second axis in the plane is used as the negative direction.

IC1 to IC4 Setting of the processing time for interference checks

The time required for processing all interference checks can be obtained by the following expression:

T[msec]=

(((number-of-rectangles-in-group-A) × (number-of-rectangles-in-group-B)) + (number-of-rectangles-in-group-A) × (number-of-rectangles-in-group-C)) + (number-of-rectangles-in-group-B) × (number-of-rectangles-in-group-C))) ÷ (value-set-by-IC1-to-IC4) 8

The processing time is rounded up to the nearest multiple of 8. If the value calculated for the processing time is 8 or less, the processing time is 8 msec.

Setting value	IC4	IC3	IC2	IC1
8	0	0	0	0
4	0	0	0	1
8	0	0	1	0
12	0	0	1	1
16	0	1	0	0
20	0	1	0	1
24	0	1	1	0
28	0	1	1	1
32	1	0	0	0
36	1	0	0	1
40	1	0	1	0
44	1	0	1	1
48	1	1	0	0
52 (48)	1	1	0	1
56 (48)	1	1	1	0
60 (48)	1	1	1	1

	#7	#6	#5	#4	#3	#2	#1	#0
14901	NB4	NB3	NB2	NB1	NA4	NA3	NA2	NA1

[Data type] Bit

NA1 to NA4 For the four rectangles in group A, whether the area is turned by the movement of a rotary axis is specified.

0 : The area is turned by the movement of a rotary axis in group A.

1 : The area is not turned by the movement of a rotary axis in group A.

NB1 to NB4 For the four rectangles in group B, whether the area is turned by the movement of a rotary axis is specified.

0 : The area is turned by the movement of a rotary axis in group B.

1 : The area is not turned by the movement of a rotary axis in group B.

14910	Axis number of the first axis in the plane for moving group A

[Data type] Byte
[Valid data range] 0 to number of controlled axes, or
m×10+n (m: 1 to number of paths, n: 1 to number of controlled axes)
[Settings] 0 to 8 : Controlled axes of the local path
11 to 18 : 1st to 8th axes of path 1
21 to 28 : 1st to 8th axes of path 2
Set the axis number of the first axis in the plane for moving group A.
Set the first axis in the basic plane.
If the corresponding moving axis does not exist, set 0.
[Example] To perform an interference check in plane Z-X, the first axis is the Z-axis.

14911	Axis number of the second axis in the plane for moving group A

[Data type] Byte
[Valid data range] 0 to number of controlled axes, or
m×10+n (m: 1 to number of paths, n: 1 to number of controlled axes)
[Settings] 0 to 8 : Controlled axes of the local path
11 to 18 : 1st to 8th axes of path 1
21 to 28 : 1st to 8th axes of path 2
Set the axis number of the second axis in the plane for moving group A.
Set the second axis in the basic plane.
If the corresponding moving axis does not exist, set 0.
[Example] To perform an interference check in plane Z-X, the first axis is the X-axis.

14912	Axis number of the rotary axis for rotating group A

[Data type] Byte
[Valid data range] 0 to number of controlled axes, or
m×10+n (m: 1 to number of paths, n: 1 to number of controlled axes)
[Settings] 0 to 8 : Controlled axes of the local path
11 to 18 : 1st to 8th axes of path 1
21 to 28 : 1st to 8th axes of path 2
Set the axis number of the rotary axis to be used for rotating group A.
If the corresponding rotary axis does not exist, set 0.

NOTE
Specify controlled axes of the same path as the controlled axes to be used for group A.

14913	Axis number of the first axis in the plane for moving group B

[Data type] Byte

[Valid data range] 0 to number of controlled axes, or
m×10+n (m: 1 to number of paths, n: 1 to number of controlled axes)

[Settings] 0 to 8 : Controlled axes of the local path
11 to 18 : 1st to 8th axes of path 1
21 to 28 : 1st to 8th axes of path 2

Set the axis number of the first axis in the plane for moving group B.
Set the axis parallel to the first axis for moving group A.
If the corresponding moving axis does not exist, set 0.

14914	Axis number of the second axis in the plane for moving group B

[Data type] Byte

[Valid data range] 0 to number of controlled axes, or
m×10+n (m: 1 to number of paths, n: 1 to number of controlled axes)

[Settings] 0 to 8 : Controlled axes of the local path
11 to 18 : 1st to 8th axes of path 1
21 to 28 : 1st to 8th axes of path 2

Set the axis number of the second axis in the plane for moving group B.
Set the axis parallel to the second axis for moving group A.
If the corresponding moving axis does not exist, set 0.

14915	Axis number of the rotary axis for rotating group B

[Data type] Byte

[Valid data range] 0 to number of controlled axes, or
m×10+n (m: 1 to number of paths, n: 1 to number of controlled axes)

[Settings] 0 to 8 : Controlled axes of the local path
11 to 18 : 1st to 8th axes of path 1
21 to 28 : 1st to 8th axes of path 2

Set the axis number of the rotary axis to be used for rotating group B.
If the corresponding rotary axis does not exist, set 0.

NOTE
Specify controlled axes of the same path as the controlled axes to be used for group B.

14920	Maximum point on the first axis of rectangle 1 in group A

14921	Minimum point on the first axis of rectangle 1 in group A

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the maximum and minimum points on the first axis of rectangular area 1 in group A.
When there is a rotary axis (parameter No. 14912), set the distance from the machine zero point to the position at which each moving axis in group A returns to the reference position with the rotary axis set at the basic rotation angle (parameter No. 14938).
Always set the points with radius values regardless of whether the diameter programming or radius programming is used for the axis command.
The target plane is specified by moving axes 1 and 2 in group A.
If the corresponding rectangular area does not exist, set 0.

14922	Maximum point on the second axis of rectangle 1 in group A

14923	Minimum point on the second axis of rectangle 1 in group A

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the maximum and minimum points on the second axis of rectangular area 1 in group A.
When there is a rotary axis (parameter No. 14912), set the distance from the machine zero point to the position at which each moving axis in group A returns to the reference position with the rotary axis set at the basic rotation angle (parameter No. 14938).
Always set the points with radius values regardless of whether the diameter programming or radius programming is used for the axis command.
The target plane is specified by moving axes 1 and 2 in group A.
If the corresponding rectangular area does not exist, set 0.

14924	Maximum point on the first axis of rectangle 2 in group A
14925	Minimum point on the first axis of rectangle 2 in group A

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the maximum and minimum points on the first axis of rectangular area 2 in group A.
When there is a rotary axis (parameter No. 14912), set the distance from the machine zero point to the position at which each moving axis in group A returns to the reference position with the rotary axis set at the basic rotation angle (parameter No. 14938).
Always set the points with radius values regardless of whether the diameter programming or radius programming is used for the axis command.
The target plane is specified by moving axes 1 and 2 in group A.
If the corresponding rectangular area does not exist, set 0.

14926	Maximum point on the second axis of rectangle 2 in group A
14927	Minimum point on the second axis of rectangle 2 in group A

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the maximum and minimum points on the second axis of rectangular area 2 in group A.
When there is a rotary axis (parameter No. 14912), set the distance from the machine zero point to the position at which each moving axis in group A returns to the reference position with the rotary axis set at the basic rotation angle (parameter No. 14938).
Always set the points with radius values regardless of whether the diameter programming or radius programming is used for the axis command.
The target plane is specified by moving axes 1 and 2 in group A.
If the corresponding rectangular area does not exist, set 0.

14928	Maximum point on the first axis of rectangle 3 in group A
14929	Minimum point on the first axis of rectangle 3 in group A

[Data type] 2-word
[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the maximum and minimum points on the first axis of rectangular area 3 in group A.
When there is a rotary axis (parameter No. 14912), set the distance from the machine zero point to the position at which each moving axis in group A returns to the reference position with the rotary axis set at the basic rotation angle (parameter No. 14938).
Always set the points with radius values regardless of whether the diameter programming or radius programming is used for the axis command.
The target plane is specified by moving axes 1 and 2 in group A.
If the corresponding rectangular area does not exist, set 0.

14930	Maximum point on the second axis of rectangle 3 in group A
14931	Minimum point on the second axis of rectangle 3 in group A

[Data type] 2-word
[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the maximum and minimum points on the second axis of rectangular area 3 in group A.
When there is a rotary axis (parameter No. 14912), set the distance from the machine zero point to the position at which each moving axis in group A returns to the reference position with the rotary axis set at the basic rotation angle (parameter No. 14938).
Always set the points with radius values regardless of whether the diameter programming or radius programming is used for the axis command.
The target plane is specified by moving axes 1 and 2 in group A.
If the corresponding rectangular area does not exist, set 0.

14932	Maximum point on the first axis of rectangle 4 in group A

14933	Minimum point on the first axis of rectangle 4 in group A

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the maximum and minimum points on the first axis of rectangular area 4 in group A.
When there is a rotary axis (parameter No. 14912), set the distance from the machine zero point to the position at which each moving axis in group A returns to the reference position with the rotary axis set at the basic rotation angle (parameter No. 14938).
Always set the points with radius values regardless of whether the diameter programming or radius programming is used for the axis command.
The target plane is specified by moving axes 1 and 2 in group A.
If the corresponding rectangular area does not exist, set 0.

14934	Maximum point on the second axis of rectangle 4 in group A

14935	Minimum point on the second axis of rectangle 4 in group A

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the maximum and minimum points on the second axis of rectangular area 4 in group A.
When there is a rotary axis (parameter No. 14912), set the distance from the machine zero point to the position at which each moving axis in group A returns to the reference position with the rotary axis set at the basic rotation angle (parameter No. 14938).
Always set the points with radius values regardless of whether the diameter programming or radius programming is used for the axis command.
The target plane is specified by moving axes 1 and 2 in group A.
If the corresponding rectangular area does not exist, set 0.

14936	Center of rotation of the first axis for rotating group A

14937	Center of rotation of the second axis for rotating group A

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the center of rotation of each axis for rotating group A.
Set the distance from the machine zero point to the position at which each moving axis in group A returns to the reference position.
Always set the values with radius values regardless of whether the diameter programming or radius programming is used for the axis command.
The target plane is specified by moving axes 1 and 2 in group A.
If there is no rotary axis, set 0.

14938	Reference rotation angle for the rotary axis in group A

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Rotary axis	0.01	0.001	0.0001	mm

[Valid data range] -99999999 to 99999999

Set the coordinates (reference rotation angle) of the rotary axis for setting a rectangular area in group A for the interference check function.
When the corresponding rotary axis does not exist, set 0.

14940	Maximum point on the first axis of rectangle 1 in group B

14941	Minimum point on the first axis of rectangle 1 in group B

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the maximum and minimum points on the first axis of rectangular area 1 in group B.
When there is a rotary axis (parameter No. 14915), set the distance from the machine zero point to the position at which each moving axis in group B returns to the reference position with the rotary axis set at the basic rotation angle (parameter No. 14958).
Always set the points with radius values regardless of whether the diameter programming or radius programming is used for the axis command.
The target plane is specified by moving axes 1 and 2 in group A.
If the corresponding rectangular area does not exist, set 0.

14942	Maximum point on the second axis of rectangle 1 in group B

14943	Minimum point on the second axis of rectangle 1 in group B

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the maximum and minimum points on the second axis of rectangular area 1 in group B.
When there is a rotary axis (parameter No. 14915), set the distance from the machine zero point to the position at which each moving axis in group B returns to the reference position with the rotary axis set at the basic rotation angle (parameter No. 14958).
Always set the points with radius values regardless of whether the diameter programming or radius programming is used for the axis command.
The target plane is specified by moving axes 1 and 2 in group A.
If the corresponding rectangular area does not exist, set 0.

14944	Maximum point on the first axis of rectangle 2 in group B

14945	Minimum point on the first axis of rectangle 2 in group B

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the maximum and minimum points on the first axis of rectangular area 2 in group B.
When there is a rotary axis (parameter No. 14915), set the distance from the machine zero point to the position at which each moving axis in group B returns to the reference position with the rotary axis set at the basic rotation angle (parameter No. 14958).
Always set the points with radius values regardless of whether the diameter programming or radius programming is used for the axis command.
The target plane is specified by moving axes 1 and 2 in group A.
If the corresponding rectangular area does not exist, set 0.

14946	Maximum point on the second axis of rectangle 2 in group B

14947	Minimum point on the second axis of rectangle 2 in group B

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the maximum and minimum points on the second axis of rectangular area 2 in group B.
When there is a rotary axis (parameter No. 14915), set the distance from the machine zero point to the position at which each moving axis in group B returns to the reference position with the rotary axis set at the basic rotation angle (parameter No. 14958).
Always set the points with radius values regardless of whether the diameter programming or radius programming is used for the axis command.
The target plane is specified by moving axes 1 and 2 in group A.
If the corresponding rectangular area does not exist, set 0.

14948	Maximum point on the first axis of rectangle 3 in group B
14949	Minimum point on the first axis of rectangle 3 in group B

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the maximum and minimum points on the first axis of rectangular area 3 in group B.
When there is a rotary axis (parameter No. 14915), set the distance from the machine zero point to the position at which each moving axis in group B returns to the reference position with the rotary axis set at the basic rotation angle (parameter No. 14958).
Always set the points with radius values regardless of whether the diameter programming or radius programming is used for the axis command.
The target plane is specified by moving axes 1 and 2 in group A.
If the corresponding rectangular area does not exist, set 0.

14950	Maximum point on the second axis of rectangle 3 in group B
14951	Minimum point on the second axis of rectangle 3 in group B

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the maximum and minimum points on the second axis of rectangular area 3 in group B.
When there is a rotary axis (parameter No. 14915), set the distance from the machine zero point to the position at which each moving axis in group B returns to the reference position with the rotary axis set at the basic rotation angle (parameter No. 14958).
Always set the points with radius values regardless of whether the diameter programming or radius programming is used for the axis command.
The target plane is specified by moving axes 1 and 2 in group A.
If the corresponding rectangular area does not exist, set 0.

14952	Maximum point on the first axis of rectangle 4 in group B

14953	Minimum point on the first axis of rectangle 4 in group B

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the maximum and minimum points on the first axis of rectangular area 4 in group B.
When there is a rotary axis (parameter No. 14915), set the distance from the machine zero point to the position at which each moving axis in group B returns to the reference position with the rotary axis set at the basic rotation angle (parameter No. 14958).
Always set the points with radius values regardless of whether the diameter programming or radius programming is used for the axis command.
The target plane is specified by moving axes 1 and 2 in group A.
If the corresponding rectangular area does not exist, set 0.

14954	Maximum point on the second axis of rectangle 4 in group B

14955	Minimum point on the second axis of rectangle 4 in group B

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the maximum and minimum points on the second axis of rectangular area 4 in group B.
When there is a rotary axis (parameter No. 14915), set the distance from the machine zero point to the position at which each moving axis in group B returns to the reference position with the rotary axis set at the basic rotation angle (parameter No. 14958).
Always set the points with radius values regardless of whether the diameter programming or radius programming is used for the axis command.
The target plane is specified by moving axes 1 and 2 in group A.
If the corresponding rectangular area does not exist, set 0.

14956	Center of rotation of the first axis for rotating group B
14957	Center of rotation of the second axis for rotating group B

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the center of rotation of each axis for rotating group B.
Set the distance from the machine zero point to the position at which each moving axis in group B returns to the reference position.
Always set the values with radius values regardless of whether the diameter programming or radius programming is used for the axis command.
The target plane is specified by moving axes 1 and 2 in group A.
If there is no rotary axis, set 0.

14958	Reference rotation angle for the rotary axis in group B

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Rotary axis	0.01	0.001	0.0001	mm

[Valid data range] -99999999 to 99999999

Set the coordinates (reference rotation angle) of the rotary axis for setting a rectangular area in group B for the interference check function.
When the corresponding rotary axis does not exist, set 0.

14960	Maximum point on the first axis of rectangle 1 in group C
14961	Minimum point on the first axis of rectangle 1 in group C

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the maximum and minimum points of the first axis in rectangular area 1 in group C.
The target plane is specified by moving axes 1 and 2 in group A. Set distances from the machine zero point.
If the corresponding rectangular area does not exist, set 0.

14962	Maximum point on the second axis of rectangle 1 in group C

14963	Minimum point on the second axis of rectangle 1 in group C

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the maximum and minimum points of the second axis in rectangular area 1 in group C.
The target plane is specified by moving axes 1 and 2 in group A. Set distances from the machine zero point.
If the corresponding rectangular area does not exist, set 0.

14964	Maximum point on the first axis of rectangle 2 in group C

14965	Minimum point on the first axis of rectangle 2 in group C

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the maximum and minimum points of the first axis in rectangular area 2 in group C.
The target plane is specified by moving axes 1 and 2 in group A. Set distances from the machine zero point.
If the corresponding rectangular area does not exist, set 0.

14966	Maximum point on the second axis of rectangle 2 in group C

14967	Minimum point on the second axis of rectangle 2 in group C

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the maximum and minimum points of the second axis in rectangular area 2 in group C.
The target plane is specified by moving axes 1 and 2 in group A. Set distances from the machine zero point.
If the corresponding rectangular area does not exist, set 0.

14968	Maximum point on the first axis of rectangle 3 in group C
14969	Minimum point on the first axis of rectangle 3 in group C

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the maximum and minimum points of the first axis in rectangular area 3 in group C.
The target plane is specified by moving axes 1 and 2 in group A. Set distances from the machine zero point.
If the corresponding rectangular area does not exist, set 0.

14970	Maximum point on the second axis of rectangle 3 in group C
14971	Minimum point on the second axis of rectangle 3 in group C

[Data type] 2-word

[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the maximum and minimum points of the second axis in rectangular area 3 in group C.
The target plane is specified by moving axes 1 and 2 in group A. Set distances from the machine zero point.
If the corresponding rectangular area does not exist, set 0.

14972	Maximum point on the first axis of rectangle 4 in group C

14973	Minimum point on the first axis of rectangle 4 in group C

[Data type] 2-word
[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999
Set the maximum and minimum points of the first axis in rectangular area 4 in group C.
The target plane is specified by moving axes 1 and 2 in group A. Set distances from the machine zero point.
If the corresponding rectangular area does not exist, set 0.

14974	Maximum point on the second axis of rectangle 4 in group C

14975	Minimum point on the second axis of rectangle 4 in group C

[Data type] 2-word
[Unit of data]

Input increment	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999
Set the maximum and minimum points of the second axis in rectangular area 4 in group C.
The target plane is specified by moving axes 1 and 2 in group A. Set distances from the machine zero point.
If the corresponding rectangular area does not exist, set 0.

4.96 PARAMETERS OF SLIDE AXIS CONTROL FOR LINK-TYPE PRESSES

14981	**Coefficient a for the relational expression of a slide stroke and ball screw stroke**
14982	**Coefficient b for the relational expression of a slide stroke and ball screw stroke**
14983	**Coefficient c for the relational expression of a slide stroke and ball screw stroke**

[Data type] 2-word axis
[Unit of data] 0.0001
[Valid data range] -99999999 to 99999999

These parameters set coefficients a, b, and c for the following quadratic relational expression of a slide position and ball screw position:

SLIDE = a × BS^2 + b × BS + c (SLIDE: Press slide position)
(BS: Ball screw position)

NOTE
1 The setting of the parameter No. 14983) for setting coefficient c of this quadratic expression can be modified using the window function.
2 After modifying coefficient c, turn on then off the external reset signal ERS<G008#7> to make the new value of coefficient c valid.
3 After modifying coefficients a and b, turn off then on the power to make the new values of coefficients a and b valid. If no absolute-position detector is used, the new values become valid after reference position setting.
4 When simple synchronous control is used, set these parameters for both of the master and slave axes.

14984	
	Slide position $SLIDE_0$ with a minimum deceleration ratio

[Data type] 2-word axis

[Unit of data]

Increment system	IS-A	IS-B	IS-C	Unit
Metric machine	0.01	0.001	0.0001	mm
Inch machine	0.001	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

This parameter sets a slide position with a minimum deceleration ratio.

NOTE

When simple synchronous control is used, set this parameter for both of the master and slave axes.

4.97 PARAMETERS OF AI/AI-NANO HIGH-PRECISION CONTOUR CONTROL AND FUNCTIONS RELATED FOR RISC PROCESSOR OPERATION

	#7	#6	#5	#4	#3	#2	#1	#0
19500		FNW						

[Data type] Bit

FNW When the feedrate is determined according to the feedrate difference and acceleration in AI/AI-nano high-precision contour control:

0 : The maximum feedrate at which the allowable feedrate difference and acceleration for each axis are not exceeded is used.

1 : The maximum feedrate at which the allowable feedrate difference and acceleration for each axis are not exceeded is used. The feedrate is determined so that the decreased feedrate is constant regardless of the move direction when the profile is the same.

When this parameter is set to 1, the feedrate decreased by feedrate determination according to the feedrate difference and acceleration is reduced by up to about 30% as compared with the feedrate determined when the parameter is set to 0.

		#7	#6	#5	#4	#3	#2	#1	#0
19501				FRP					
			BCG	FRP					

[Data type] Bit

FRP Acceleration/deceleration for rapid traverse in AI high-precision contour control and AI nano high-precision contour control mode is:
0 : Acceleration/deceleration after interpolation
1 : Acceleration/deceleration before interpolation
When this parameter is set to 1, the rapid traverse movement type is linear type positioning regardless of the bit 1 (LRP) of parameter No. 1401.
By setting both bit 5 (FRP) of parameter No.19501 and bit 0 (FAP) of parameter No.19540 to 1 and setting the reference acceleration parameters (No. 1420 and No.1773) for any one axis to a non-zero value, the acceleration/deceleration for rapid traverse in AI high-precision contour control and AI nano high-precision contour control will be optimum torque acceleration/deceleration.
In the following cases, set this parameter to 1:

- When optimum torque acceleration/deceleration is used
- When tool center point control for 5-axis machining, tool radius compensation for 5-axis machining, tool center point control, three-dimensional cutter compensation, or tool length compensation in tool axis direction is used
- When the three-dimensional coordinate conversion mode or tilted working plane command mode is used under AI high-precision contour control or AI nano high-precision contour control

BCG The function of changing the time constant for bell-shaped acceleration/deceleration before interpolation in AI High Precision Contour control mode or AI nano high-precision contour control mode is:
0 : Disabled.
1 : Enabled.
In AI contour control mode or AI nano contour control mode, bit 3 (BCG) of parameter No. 7055 should be set.

		#7	#6	#5	#4	#3	#2	#1	#0
19503		FLP				LNS			

[Data type] Bit

LNS Set this parameter to 1.

FLP Set this parameter to 0.

	#7	#6	#5	#4	#3	#2	#1	#0
19504								HRB

[Data type] Bit

HRB Acceleration/deceleration for rapid traverse in AI high-precision contour control and AI nano high-precision contour control mode is:
0 : Linear acceleration/deceleration
1 : Bell-shaped Acceleration/deceleration
Set a time constant for acceleration/deceleration in parameter No. 1620 or No. 1773, or in parameter No. 1621 or No. 1774.
To enable bell-shaped acceleration/deceleration in addition to optimum torque acceleration/deceleration, set this parameter to 1 and set time constant T_2 for bell-shaped acceleration/deceleration in parameter No. 1621 or No. 1774.

NOTE
If acceleration/deceleration before interpolation for rapid traverse is selected by setting bit 5 (FRP) of parameter No. 19501 to 1, time constant T_2 for bell-shaped acceleration/deceleration (parameter No. 1621 or No. 1774) set for the fist controlled axis is applied to all axes.

19510	Parameter 2 for determining an allowable acceleration rate for acceleration/deceleration before interpolation for each axis when AI high-precision/AI nano high-precision contour control is used (to be set for each axis)

[Data type] Word axis
[Unit of data] msec
[Valid data range] 0 to 1000

Set the time required to reach the feedrate set in parameter No. 8400, for each axis. Set a value so that the acceleration time to the maximum feedrate is up to 1 second.
If 0 is set for all axes, the setting of parameter No. 8401 is used.
If the allowable acceleration rate set for one axis is greater than that for another axis by a factor of 2 or more, the speed may be reduced temporarily at a corner where the move direction abruptly changes.

NOTE
1 When 0 is set in any of parameter 1 (No. 8400) and parameter 2 (No. 8401/No. 19510) used for acceleration rate setting, the function for acceleration/deceleration before interpolation is disabled. (Parameter No. 19510 is valid for AI high-precision/AI nano high-precision contour control.)
2 If both of parameter No. 8401 and parameter No. 19510 are set, the setting of parameter No. 19510 has priority.

19511	Lowest feedrate for the function of decelerating according to the acceleration in AI/AI-nano high-precision contour control

[Data type] 2-word axis

[Unit of data, Valid data range]

Increment system	Units of data	Valid 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
Rotary axis	1 deg/min	10 to 240000	1 to 100000

The function of decelerating according to the acceleration in AI/AI-nano high-precision contour control automatically calculates the optimum feedrate according to the profile.
The calculated feedrate may be very low depending on the profile, however.
In this case, to prevent the feedrate from becoming too low, deceleration is performed so that the feedrate is not below that set in this parameter.
If the override is enabled for the function of decelerating according to the cutting load, the feedrate may be lower than the lowest feedrate.

NOTE

In involute interpolation, the lowest feedrate set for "acceleration clamping near the basic circle" in automatic speed control in involute interpolation is used.

19512	**Lower feedrate limit of the deceleration function using acceleration based on circular interpolation under AI high-precision/AI nano high-precision contour control**

[Data type] 2-word
[Unit of data, Valid data range]

Increment system	Units of data	Valid 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
Rotary axis	1 deg/min	10 to 240000	1 to 100000

When the deceleration function using acceleration based on circular interpolation under AI high-precision/AI nano high-precision contour control automatically calculates an optimum feedrate so that the allowable acceleration rate specified by parameter No. 8470 and the maximum cutting feedrate are not exceeded by an acceleration rate generated by a change in move direction during circular interpolation.
However, if the radius of an arc is very small, a calculated feedrate may become too small.
To prevent the feedrate from being reduced excessively in such a case, this parameter sets a lower feedrate limit.
This parameter is valid when a value other than 0 is set in parameter No. 19513.

NOTE

During involute interpolation, the lower feedrate limit based on "acceleration clamping near the basic circle" under involute interpolation automatic speed control is used.

19513	Parameter for determining an allowable acceleration rate in feedrate determination based on acceleration during circular interpolation under AI high-precision/AI nano high-precision contour control

[Data type] Word axis
[Unit of data] msec
[Valid data range] 0 to 32767

This parameter sets a period of time for reaching a maximum cutting feedrate to determine an allowable acceleration rate when the feedrate determination function based on acceleration during automatic speed control using circular interpolation under AI high-precision/AI nano high-precision contour control is used. A maximum cutting feedrate and the data set in this parameter set an allowable acceleration rate. A maximum cutting feedrate mentioned here is the setting of parameter No. 1432, No. 1430, or No. 1422. Which of these parameters is used when an allowable acceleration rate is determined varies according to the following conditions:

- When a value other than 0 is set in parameter No. 1432 and No. 1430:
  The setting of parameter No. 1432 is used.
- When 0 is set in parameter No. 1432 and a value other than 0 is set in parameter No. 1430:
  The setting of parameter No. 1430 is used.
- When 0 is set in parameter No. 1432 and 0 is set in parameter No. 1430 as well:
  The setting of parameter No. 1422 is used.

As a greater value is set in this parameter, a smaller machining error and smaller mechanical shock result.
When 0 is set in this parameter for all axes, the setting of parameter No. 8470 is used.

Function of changing the time constant for bell-shaped acceleration/deceleration before interpolation

19520	Acceleration/deceleration reference speed for the function of changing the time constant for bell-shaped acceleration/deceleration before interpolation in AI high-precision contour control mode or AI nano high-precision contour control mode

[Data type] 2-word

[Unit of data, valid data range]

Increment system	Units of data	Valid data range	
		IS-B	IS-C
Metric machine	1 mm/min	0 - 600000	0 - 60000
Inch machine	0.1 inch/min	0 - 600000	0 - 60000

Acceleration/deceleration reference speed for the function of changing the time constant for bell-shaped acceleration/deceleration before interpolation in AI high-precision contour control mode or AI nano high-precision contour control mode is set on this parameter.
The input unit is used to set this parameter. So, when the input unit is changed, the setting of this parameter needs to be modified.
In AI contour control mode or AI nano contour control mode, parameter No. 7066 should be set.

Jerk control function

19522	Allowable acceleration change value for each axis when speed control is exercised based on acceleration change under jerk control (for AI high-precision contour control/AI nano high-precision contour control)

[Data type] 2-word axis

[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm/s^2
Inch machine	0.0001	0.00001	$inch/s^2$
Rotary axis	0.001	0.0001	deg/s^2

[Valid data range] 0 to 99999999

This parameter sets an allowable acceleration change value for each axis when speed control is exercised based on acceleration change under jerk control in the AI high-precision contour control mode or AI nano high-precision contour control mode.
If 0 is set in this parameter for an axis, speed control based on acceleration change is disabled for the axis.
If 0 is set for all axes, speed control based on acceleration change is not exercised.

19523	Allowable acceleration change value for each axis when speed control is exercised based on acceleration change under jerk control in successive linear interpolation operations (for AI high-precision contour control/AI nano high-precision contour control)

[Data type] 2-word axis

[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm/s^2
Inch machine	0.0001	0.00001	$inch/s^2$
Rotary axis	0.001	0.0001	deg/s^2

[Valid data range] 0 to 99999999

This parameter sets an allowable acceleration change value for each axis when speed control is exercised based on acceleration change under jerk control in successive linear interpolation operations in the AI high-precision contour control mode or AI nano high-precision contour control mode.

For speed control based on acceleration change at a corner between linear interpolation operations, the allowable acceleration change value set in this parameter instead of parameter No. 19522 is used.

If 0 is set in this parameter for an axis, the allowable acceleration change value set in parameter No. 19522 is used for the axis.

If 0 is set in parameter No. 19522 for an axis, speed control based on acceleration change is disabled for the axis, so that this parameter has no effect for the axis.

19524	Ratio of jerk change time in smooth bell-shaped acceleration/deceleration before interpolation (for AI high-precision contour control/AI nano high-precision contour control)

[Data type] Byte

[Unit of data] %

[Valid data range] 0 to 50

This parameter sets the ratio, in percentage, of jerk change time to acceleration change time(*1) in smooth bell-shaped acceleration/ deceleration before look-ahead interpolation in the AI high-precision contour control mode or AI nano high-precision contour control mode.

If 0 or a value not within the valid data range is set in this parameter, smooth bell-shaped acceleration/deceleration before look-ahead interpolation is not performed in the AI high-precision contour control mode or AI nano high-precision contour control mode.

*1 Parameter No. 8416 in the case of acceleration/deceleration before look-ahead interpolation (cutting feed).
Parameter No. 1621 in the case of linear acceleration/ deceleration before interpolation for rapid traverse or optimum torque acceleration/deceleration

Cutting point interpolation for cylindrical interpolation

	#7	#6	#5	#4	#3	#2	#1	#0
19530		CYS	CYA					

[Data type] Bit

CYA Specifies whether to perform cutting point interpolation for cylindrical interpolation in the cylindrical interpolation command (G07.1) during AI/AI-nano high-precision contour control mode.
0 : Perform.
1 : Do not perform.

CYS Specifies whether when the cutting point interpolation function for cylindrical interpolation is used, cutting point interpolation is performed between blocks or together with a block movement if the cutting point interpolation value is less than the setting of parameter No. 19534.
0 : Performed between blocks.
1 : Performed together with a block movement if the cutting point interpolation value is less than the setting of parameter No. 19534.

19531	Tool offset axis number for the XY plane

[Data type] Word
[Valid data range] 1 to number of controlled axis
Specify a tool offset axis that intersects the cylindrical rotary axis at right angles.

19532	Tool offset axis number for the ZX plane

[Data type] Word
[Valid data range] 1 to number of controlled axis
Specify a tool offset axis that intersects the cylindrical rotary axis at right angles.

19533	Tool offset axis number for the YZ plane

[Data type] Word
[Valid data range] 1 to number of controlled axis
Specify a tool offset axis that intersects the cylindrical rotary axis at right angles.

19534	**Limit for changing cutting point interpolation for cylindrical interpolation in a single block**

[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm
Inch machine	0.0001	0.00001	inch

[Valid data range] 1 to 999999999

The following operation is performed, depending on the setting of bit 6 (CYS) of parameter No.19530:

(1) When bit 6 (CYS) of parameter No.19530 = 0
If the amount of cutting point interpolation for cylindrical interpolation is smaller than the value set in this parameter, cutting point interpolation for cylindrical interpolation is not performed. Instead, this ignored amount of cutting point interpolation for cylindrical interpolation is added to the next amount of cutting point interpolation for cylindrical interpolation to determine whether to perform cutting point interpolation for cylindrical interpolation.

(2) When bit 6 (CYS) of parameter No.19530 = 1
If the amount of cutting point interpolation for cylindrical interpolation is smaller than the value set in this parameter, cutting point interpolation for cylindrical interpolation is performed together with the movement of the specified block.

NOTE

Set this parameter as follows:

$$\text{Setting} > \begin{array}{l}\text{(setting for a rotary axis}\\ \text{in parameter No. 1422)}\end{array} \times \frac{4}{3}$$

where 4/3 is a constant for internal processing.

19535	Limit of travel distance moved with the cutting point interpolation for cylindrical interpolation in the previous block unchanged.

[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm
Inch machine	0.0001	0.00001	inch

[Valid data range] 1 to 999999999

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 cutting point interpolation for cylindrical interpolation 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 cutting point interpolation for cylindrical interpolation in the previous block. Cutting point interpolation for cylindrical interpolation is not performed according to a circular movement.

Optimum torque acceleration/deceleration

		#7	#6	#5	#4	#3	#2	#1	#0
19540									FAP

[Data type] Bit

FAP Optimum torque acceleration/deceleration is:

0 : Disabled.

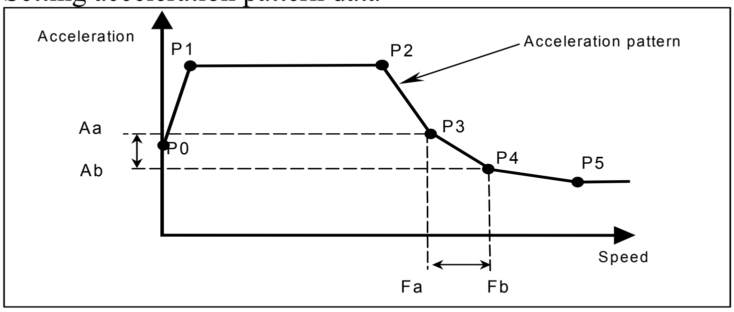
1 : Enabled.

By setting both bit 0 (FAP) of parameter No. 19540 and bit 5 (FRP) of parameter No. 19501 to 1 and setting parameter to determine the reference acceleration (No. 1420 and No.1773) as below, the acceleration/deceleration for rapid traverse in AI high-precision contour control and AI nano high-precision contour control mode will be optimum torque acceleration/deceleration. When Optimum torque acceleration/deceleration is enabled, linear type positioning for rapid traverse is selected automatically in AI high-precision contour control and AI nano high-precision contour control mode even if the bit 1 (LRP) of parameter No. 1401 is set to 0 (nonlinear type is selected). If rapid traverse is subject to optimum torque acceleration/deceleration, after-interpolation acceleration/deceleration does not apply to rapid traverse.

In optimum torque acceleration/deceleration, acceleration/deceleration is performed according to a parameter-set acceleration pattern.

An acceleration pattern is set in parameter No. 19541 to No. 19568.

Setting acceleration pattern data



Set the speed and the acceleration at each of the acceleration setting points P0 to P5 for each condition, acceleration and + move, deceleration and + move, acceleration and - move , deceleration and - move., and for each axis, The line joining the acceleration setting points is regarded a acceleration pattern.

An acceleration rate for each axis such as an acceleration rate between the speeds Fa to Fb is calculated using the corresponding acceleration rates Aa to Ab.

Tangential acceleration is controlled not to exceed the acceleration for each axis.

> **NOTE**
> It is not desirable to set a high acceleration rate abruptly for speed 0 when setting an acceleration pattern, because the machine suffers from a large shock. So, **be sure to set a lower acceleration rate for speed 0** as shown in the figure above.

19541	Optimum torque acceleration/deceleration (speed at P1)
19542	Optimum torque acceleration/deceleration (speed at P2)
19543	Optimum torque acceleration/deceleration (speed at P3)
19544	Optimum torque acceleration/deceleration (speed at P4)

[Data type] Word axis
[Unit of data] 0.01%
[Valid data range] 0 to 10000

Set a speed at P1 to P4 of the acceleration setting points (P0 to P5) by specifying a ratio to the rapid traverse rate (parameter No. 1420).
The speed at P0 is 0, and the speed at P5 is the rapid traverse rate specified with parameter (No. 1420). Any acceleration setting point for which the speed parameter (one of Nos. 19541 to 19544) is set to 0 will be skipped, and the preceding and succeeding points for which the parameter is set to a non-zero value will be joined together as acceleration pattern.

19545	Optimum torque acceleration/deceleration (acceleration at P0 during movement in + direction and acceleration)
19546	Optimum torque acceleration/deceleration (acceleration at P1 during movement in + direction and acceleration)
19547	Optimum torque acceleration/deceleration (acceleration at P2 during movement in + direction and acceleration)
19548	Optimum torque acceleration/deceleration (acceleration at P3 during movement in + direction and acceleration)
19549	Optimum torque acceleration/deceleration (acceleration at P4 during movement in + direction and acceleration)
19550	Optimum torque acceleration/deceleration (acceleration at P5 during movement in + direction and acceleration)
19551	Optimum torque acceleration/deceleration (acceleration at P0 during movement in - direction and acceleration)
19552	Optimum torque acceleration/deceleration (acceleration at P1 during movement in - direction and acceleration)
19553	Optimum torque acceleration/deceleration (acceleration at P2 during movement in - direction and acceleration)
19554	Optimum torque acceleration/deceleration (acceleration at P3 during movement in - direction and acceleration)
19555	Optimum torque acceleration/deceleration (acceleration at P4 during movement in - direction and acceleration)
19556	Optimum torque acceleration/deceleration (acceleration at P5 during movement in - direction and acceleration)
19557	Optimum torque acceleration/deceleration (acceleration at P0 during movement in + direction and deceleration)

19558	**Optimum torque acceleration/deceleration (acceleration at P1 during movement in + direction and deceleration)**
19559	**Optimum torque acceleration/deceleration (acceleration at P2 during movement in + direction and deceleration)**
19560	**Optimum torque acceleration/deceleration (acceleration at P3 during movement in + direction and deceleration)**
19561	**Optimum torque acceleration/deceleration (acceleration at P4 during movement in + direction and deceleration)**
19562	**Optimum torque acceleration/deceleration (acceleration at P5 during movement in + direction and deceleration)**
19563	**Optimum torque acceleration/deceleration (acceleration at P0 during movement in - direction and deceleration)**
19564	**Optimum torque acceleration/deceleration (acceleration at P1 during movement in - direction and deceleration)**
19565	**Optimum torque acceleration/deceleration (acceleration at P2 during movement in - direction and deceleration)**
19566	**Optimum torque acceleration/deceleration (acceleration at P3 during movement in - direction and deceleration)**
19567	**Optimum torque acceleration/deceleration (acceleration at P4 during movement in - direction and deceleration)**
19568	**Optimum torque acceleration/deceleration (acceleration at P5 during movement in - direction and deceleration)**

[Data type] Word axis

[Unit of data] 0.01%

[Valid data range] 0 to 32767

The acceleration at acceleration setting points (P0 to P5) are set for each movement direction and each acceleration/deceleration. The acceleration is set as a ratio to the reference acceleration.

When specifying an acceleration, set a ratio to the reference acceleration.

If any of the acceleration parameters Nos. 19545 to 19568 is set to 0, the acceleration is assumed 100% (reference acceleration).

If this function is enabled and both parameter No.1773 and No. 1620 for an axis are set to 0, the following values are assumed as the reference acceleration for that axis:

1000.0 mm/sec^2, 100.0 inch/sec^2, 100.0 degrees/sec^2

	#7	#6	#5	#4	#3	#2	#1	#0
19570								
								RFX

[Data type] Bit

RFX A canned cycle command in the AI contour control mode or AI nano contour control mode:

0 : Follows the setting of bit 1 (G81) of parameter No. 8485.

1 : Is executed on the RISC side.

> **NOTE**
> 1 When this parameter is set to 1, specification in the FS15 tape format is needed.
> 2 When this parameter is set to 1, a canned cycle can be specified in the three-dimensional coordinate conversion mode or tilted working plane command mode.

	#7	#6	#5	#4	#3	#2	#1	#0
19575								
								ROC

[Data type] Bit

ROC If an attempt is made to make a change to a tool offset value or tool holder offset value (parameter No. 19666) through the PMC window in the RISC mode:

0 : No change is made in the RISC mode.

1 : The change becomes effective starting with the next buffering operation.

> **NOTE**
> 1 This parameter is valid for a change to a tool length offset value or cutter compensation value used with the following functions:
> - Tool length compensation, tool center point control for 5-axis machining, tool length compensation in tool axis direction, tool center point control, tilted working plane command, cutter compensation, tool radius compensation for 5-axis machining
>
> 2 Depending on the offset value change timing, an incorrect vector may be generated on a compensation axis, resulting in the symptoms indicated below. Pay proper attention to offset value change timing.
> - No correct interference check is made. Overcutting occurs.

19581	Tolerance specification for nano smoothing

[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm
Inch machine	0.0001	0.00001	inch

[Valid data range] 0 to 99999999

This parameter sets a tolerance for a program created by very small line segments for nano smoothing. If 0 is set in this parameter, the least travel distance in the setting unit is assumed as a tolerance. A curved figure is estimated within the tolerance range.

19582	Minimum travel distance of a block that makes a decision based on an angle difference between nano smoothing blocks

[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm
Inch machine	0.0001	0.00001	inch

[Valid data range] 0 to 99999999

This parameter sets the minimum travel distance of a block that makes a decision based on an angle difference between nano smoothing blocks. If a value less than the setting of this parameter is set for a block, a decision based on an angle difference is not made in the block.

If 0 is set in this parameter, a decision based on an angle difference is made in all blocks.

In this parameter, a value greater than the setting of parameter No. 8490 for specifying the minimum travel distance of a block where nano smoothing is applied needs to be set.

4.98 PARAMETERS OF 5-AXIS MACHINING

	#7	#6	#5	#4	#3	#2	#1	#0
19600								
		RTW	RCR	R3D	RRO	RFX	RMI	RSC

[Data type] Bit

RSC The scaling function is:
- 0 : Executed on the CNC.
- 1 : Assumed to be the 5-axis control mode and executed on the RISC processor.

RMI The program mirror image function is:
- 0 : Executed on the CNC.
- 1 : Assumed to be the 5-axis control mode and executed on the RISC processor.

RFX The rotary table dynamic fixture offset function is:
- 0 : Executed on the CNC.
- 1 : Assumed to be the 5-axis control mode and executed on the RISC processor.

RRO The coordinate system rotation function is:
- 0 : Executed on the CNC.
- 1 : Assumed to be the 5-axis control mode and executed on the RISC processor.

R3D The three-dimensional coordinate conversion function is:
- 0 : Executed on the CNC.
- 1 : Assumed to be the 5-axis control mode and executed on the RISC processor.

RCR The cutter compensation C function is:
- 0 : Executed on the CNC.
- 1 : Assumed to be the 5-axis control mode and executed on the RISC processor.

RTW The tilted working plane command is:
- 0 : Executed on the CNC.
- 1 : Executed on the RISC processor.

NOTE

To enable execution on the RISC side, the option for any of AI high-precision contour control, AI nano high-precision contour control, tool center point control, tool length compensation in tool axis direction, three-dimensional cutter compensation, three-dimensional circular interpolation, tool radius compensation for 5-axis machining, and tool center point control for 5-axis machining is required.

Three-dimensional cutter compensation

	#7	#6	#5	#4	#3	#2	#1	#0
19605								
			NIC					

[Data type] Bit

NIC Specifies whether to perform an interference check when compensation plane switching occurs during three-dimensional cutter compensation.
0 : Perform.
1 : Do not perform.

	#7	#6	#5	#4	#3	#2	#1	#0
19608				N49	N43			NHC
	HEL	MIR	PRI	N49	N43	DET		NHC

[Data type] Bit

NHC A tool offset number under tool center point control (G43.4) is specified using:
0 : H code.
1 : Parameter No. 19718.

> **NOTE**
> If an H code is specified under tool center point control (G43.4) when this parameter is set to 1, P/S alarm No. 009 is issued.

DET When the programming coordinate system is fastened to the table in tool center point control for 5-axis machining (bit 5 (WKP) of parameter No.19696 is set to 1), the relative position and absolute position of a specified path are:
0 : Displayed in the programming coordinate system (fastened to the table).
1 : Displayed in the workpiece coordinate system (not fastened to the table).

N43 In the AI high-precision/AI nano high-precision contour control mode, tool length compensation specification (G43/G44):
0 : Is possible.
1 : Causes P/S alarm No. 010.

N49 In the AI high-precision/AI nano high-precision contour control mode, G49 specification:
0 : Is possible.
1 : Causes P/S alarm No. 010.

> **NOTE**
> This parameter is valid when bit 1 (CCT) of parameter No. 19609 is set to 1.

PRI Among multiple end point candidates that exist when a movement is made on a rotary axis by a command such as I, J, and K when a tilted working plane command is specified under tool center point control for 5-axis machining (type 2):

0 : A combination in which the master (first rotary axis) makes a smaller angular movement is selected for a machine of tool rotation type or table rotation type. A combination in which the table (second rotary axis) makes a smaller angular movement is selected for a machine of composite type.

1 : A combination in which the slave (second rotary axis) makes a smaller angular movement is selected for a machine of tool rotation type or table rotation type. A combination in which the tool (first rotary axis) makes a smaller angular movement is selected for a machine of composite type.

MIR When programmable mirror image is applied to a linear axis in tool center point control for 5-axis machining (type 2), mirror image is:

0 : Not applied to a specified I, J, or K command

1 : Applied to a specified I, J, or K command.

HEL When the tool is tilted toward the forward move direction by a Q command in tool center point control for 5-axis machining (type 2), a helical interpolation block:

0 : Tilts the tool in the direction of the tangent to the arc.

1 : Tilts the tool toward the direction involving the helical axis.

	#7	#6	#5	#4	#3	#2	#1	#0
19609							CCT	

[Data type] Bit

CCT The cancellation of the G codes in group 08 is:

0 : Specified by G49.

1 : Able to be specified by G49.1 as well.

NOTE

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

19610	**Rotary axis for three-dimensional cutter compensation and tool radius compensation for 5-axis machining (first group)**
19611	**Linear axis 1 for three-dimensional cutter compensation and tool radius compensation for 5-axis machining (first group)**
19612	**Linear axis 2 for three-dimensional cutter compensation and tool radius compensation for 5-axis machining (second group)**
19613	**Linear axis 3 for three-dimensional cutter compensation and tool radius compensation for 5-axis machining (third group)**

[Data type] Word

[Valid data range] 0 to number of controlled axis

Set the rotary axis and linear axes to perform three-dimensional cutter compensation or tool radius compensation for 5-axis machining (first group).

19614	**Angle of inclination for the rotary axis for three-dimensional cutter compensation and tool radius compensation for 5-axis machining (first group)**

[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Unit of data	0.001	0.0001	mm

[Valid data range] -99999999 to 99999999

Set the angle of rotation for the rotary axis to perform three-dimensional cutter compensation or tool radius compensation for 5-axis machining (first group).

19615	**Rotary axis for three-dimensional cutter compensation and tool radius compensation for 5-axis machining (second group)**
19616	**Linear axis 1 for three-dimensional cutter compensation and tool radius compensation for 5-axis machining (second group)**
19617	**Linear axis 2 for three-dimensional cutter compensation and tool radius compensation for 5-axis machining (second group)**
19618	**Linear axis 3 for three-dimensional cutter compensation and tool radius compensation for 5-axis machining (second group)**

[Data type] Word

[Valid data range] 0 to number of controlled axis

Set the rotary axis and linear axes to perform three-dimensional cutter compensation or tool radius compensation for 5-axis machining (second group).

19619	Angle of inclination for the rotary axis for three-dimensional cutter compensation and tool radius compensation for 5-axis machining (second group)

[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Unit of data	0.001	0.0001	mm

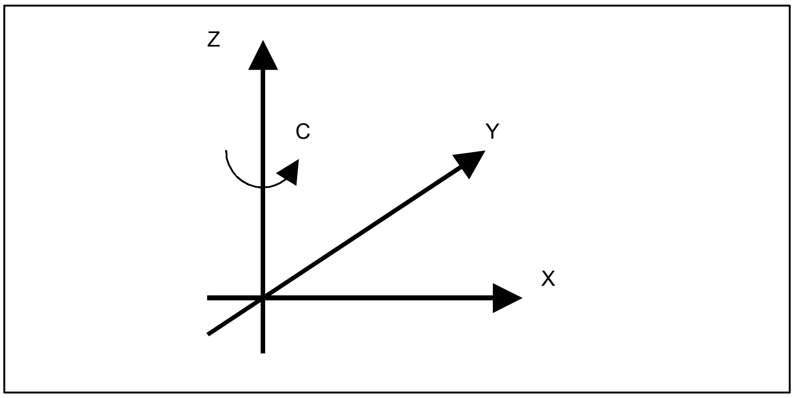
[Valid data range] -99999999 to 99999999

Set the rotary axis and linear axis to perform three-dimensional cutter compensation or tool radius compensation for 5-axis machining (second group).

Parameters No. 19610 to No. 19619

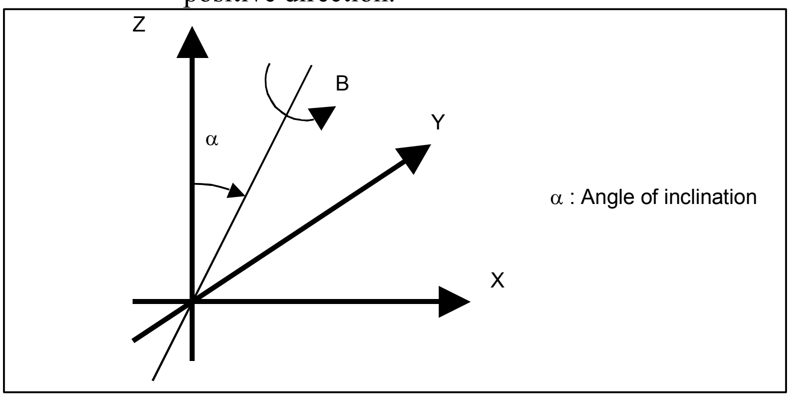
	First group	Second group
Rotary axis	19610	19615
Linear axis 1	19611	19616
Linear axis 2	19612	19617
Linear axis 3	19613	19618
Angle of inclination	19614	19619

- These parameters set the relationship between the rotary axis and rotary plane.
- Two groups can be set. Therefore, machines controlled with two rotary axes are supported.
- In the calculation of the tool direction, calculation for the rotary axis of the first group is made first, then based on the calculation result, calculation for the rotary axis for the second group is made.
- When two rotary axes are used, the rotary plane may be changed by the rotation of the other rotary axis. In this case, set the rotary plane obtained when the rotary axis position is 0 degrees.
- When there is one rotary axis, set the rotary axis of the second group to 0.
- In general, the direction vector of a rotary axis has three direction components. This function supports direction vectors with one direction component and two direction components. In each case, set the following:
  - (a) When the direction vector of a rotary axis has one direction component (type A)
    The rotary axis rotates about one of the basic three axes.
    1. Set axis numbers for the rotary axis, linear axis 1, and linear axis 2.
    2. Set the linear axis 3 and the angle of inclination to 0.
    3. The rotary axis is defined as follows:
       - The rotary axis rotates about an axis that perpendicularly intersects the plane formed by linear axis 1 and linear axis 2.
       - When the rotary axis rotates from the positive direction of linear axis 1 to the positive direction of linear axis 2, the rotary axis is said to rotate in the positive direction.



(b) When the direction vector of a rotary axis has two direction components (type B)
The rotary axis rotates about an axis that lies in a plane formed by any two of the basic three axes.

1 Set axis numbers for the rotary axis, linear axis 1, linear axis 2, and linear axis 3.
2 The linear axes 1, 2, and 3 form a right-handed coordinate system in this order.
3 The angle of inclination is defined as follows:
   - Rotation is performed in the plane formed by linear axes 3 and 1.
   - When the rotary 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 rotary axis and linear axis 3 match, the angle of inclination is 0 degrees.
4 When the angle of inclination is 0 degrees, the rotary axis is defined as follows:
   - The rotary axis rotates about an axis that perpendicularly intersects the plane formed by linear axes 1 and 2.
   - When the rotary axis rotates from the positive direction of linear axis 1 to the positive direction of linear axis 2, the rotary axis is said to rotate in the positive direction.



19620	**Reference angle for the rotary axis for three-dimensional cutter compensation and tool radius compensation for 5-axis machining (first group)**
19621	**Reference angle for the rotary axis for three-dimensional cutter compensation and tool radius compensation for 5-axis machining (second group)**

[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Unit of data	0.001	0.0001	mm

[Valid data range] -99999999 to 99999999

Set a reference angle for the rotary axis to perform three-dimensional cutter compensation or tool radius compensation for 5-axis machining .

Set an angle for the rotary axis assumed when a tool axis direction (parameters No. 19622 to No. 19623) is set.

Usually, set 0.0.

19622	Reference angle for the tool axis in the plane formed by linear axes 2 and 3 (R_A)
19623	Reference angle for the tool axis in the plane formed by linear axes 3 and 1 (R_B)

[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Unit of data	0.001	0.0001	mm

[Valid data range] -99999999 to 99999999

By using the two angles R_A and R_B, set the direction of the tool axis for exercising three-dimensional cutter compensation or tool radius compensation for 5-axis machining.

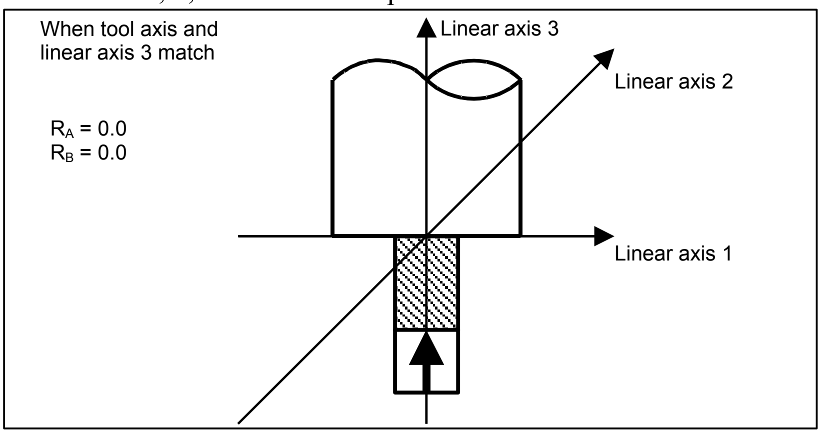
Parameters No. 19622 to No. 19623

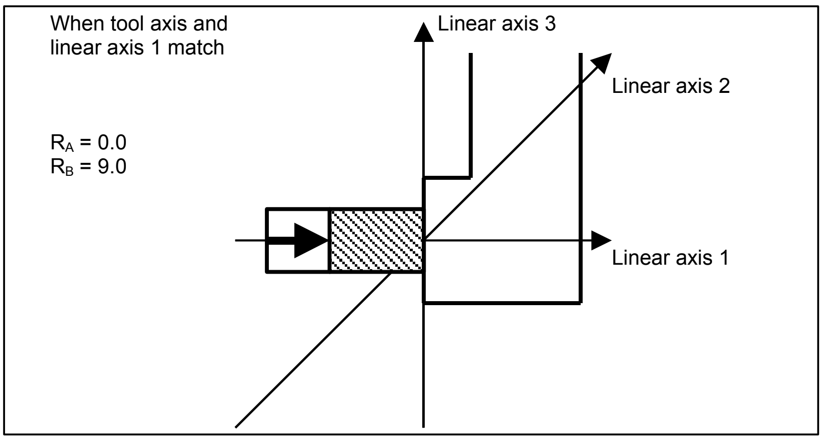
The direction of a compensation vector is set by setting an angular displacement (R_A, R_B) from the direction of linear axis 3 (parameter No.19613).

R_A: Rotation is performed in the plane formed by linear axis 2 and linear axis 3. When rotation is performed from the positive direction of linear axis 2 to the positive direction of linear axis 3, the direction of the rotation is positive.

R_B: Rotation is performed in the plane formed by linear axis 3 and linear axis 1. When rotation is performed from the positive direction of linear axis 3 to the positive direction of linear axis 1, the direction of the rotation is positive.

Linear axes 1, 2, and 3 are set in parameters No. 19611 to No. 19613.





19630	Limit for assuming the block as a non-movement block in intersection calculation for tool side compensation (G41.2, G42.2)

[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm
Inch machine	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

When an intersection calculation is made for tool side compensation, the block is assumed to be a block involving no movement if the difference in the coordinates of two points on the compensation plane is smaller than the value set in this parameter. In such a case, an additional block ahead is read for intersection calculation. Usually, set a value about 0.01 mm.

19631	Angle determination fluctuation value for leading edge offset

[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Unit of data	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

This parameter sets a variation range used to determine whether the included angle between the tool direction vector (VT) and move direction vector (VM) is 0°, 180°, or 90° during leading edge offsetting.

For example, let the included angle between VT and VM be θ (0 ≤ θ ≤ 180), and the angle set in this parameter be Δθ. Then, θ is determined as follows:

When $0 \le \theta \le \Delta\theta$ θ=0°

When $(180 - \Delta\theta) \le \theta \le 180$ θ180°

When $(90 - \Delta\theta) \le \theta \le (90 + \Delta\theta)$ θ=90°

Normally, set around 1.0 in this parameter.

19632	Distance from a programmed point (pivot point) to the tool tip position (cutting point)

[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Linear axis (metric input)	0.001	0.0001	mm
Linear axis (inch input)	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

This parameter sets the distance from a programmed point to the actual cutting point so that a vector calculation for tool radius compensation for 5-axis machining is made based on the tool tip.

If 0 is set in this parameter, the specification of the tool tip position (cutting point) for tool radius compensation for 5-axis machining is invalid.

Rewrite this parameter before turning on the mode of tool radius compensation for 5-axis machining.

19635	Effective angle in an interference check for three-dimensional cutter compensation

[Data type] 2-word

[Unit of data]

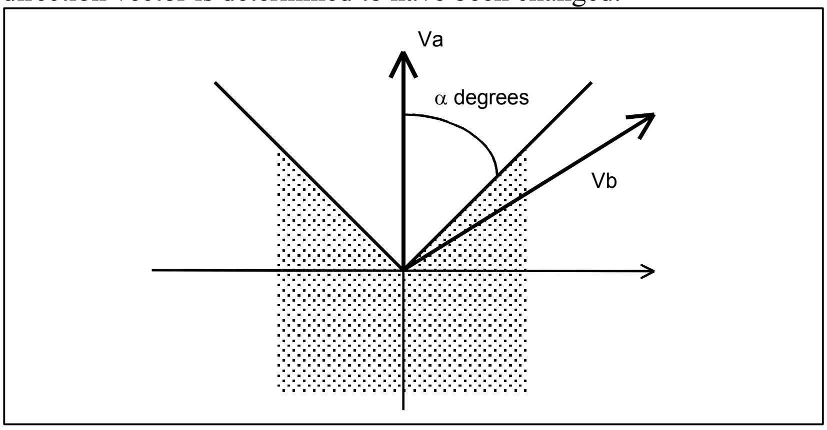
Increment system	IS-B	IS-C	Unit
Unit of data	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

A tool direction change is assumed when the angle difference between two tool direction vectors in three-dimensional cutter compensation is equal to or greater than the value set in this parameter.

When 0 is set, the specification of 45 degrees is assumed.

Let two tool direction vectors be Va and Vb. When the difference in angle is α degrees or more as shown in the figure below, the tool direction vector is determined to have been changed.



Tool length compensation in tool axis direction and tool center point control

	#7	#6	#5	#4	#3	#2	#1	#0
19650								
							RAP	RAM

[Data type] Bit axis

RAM Specifies whether to use the axis as the rotary axis for tool length compensation in tool axis direction and tool center point control.
0 : Not used as the rotary axis.
1 : Used as the rotary axis.
Select two axes from among rotary axes and set them as the rotary axes for these purposes.

RAP Specifies whether the rotary axis used for tool length compensation in tool axis direction and tool center point control.
0 : Ordinary rotary axis.
1 : Parameter axis.
If this bit is set to 0, absolute coordinates are used as the coordinates of rotary axes in tool length compensation in tool axis direction or tool center point control mode, and machine coordinates are used in three-dimensional handle feed mode. If this bit is set to 1, the value set in parameter No. 19658 is used as the coordinates of the rotary axes.
When there is no rotary axis in the controlled axes, or when there is only one rotary axis in the controlled axes, set 1 in bit 0 (RAM) and bit 1 (RAP) of parameter No. 19650 for the linear axes to which non-existent rotary axes belong, and set an angular displacement in parameter No. 19658.

[Example 1]

There are linear axes X, Y, and Z, and rotary axes A, B, and C which rotate about the X-, Y-, and Z-axes, respectively. The tool axis direction is controlled with the rotary axes A and C.

	Bit 0 (RAM) of parameter No. 19650
X	0
Y	0
Z	0
A	1
B	0
C	1

[Example 2]

The controlled axes include only the linear axes X, Y, and Z. By using the tool attachment, the tool axis is tilted in the same tool axis direction as when the A- and C-axes are rotated.

	Bit 0 (RAM) of parameter No. 19650	Bit 1 (RAP) of parameter No. 19650	Angle (parameter No. 19658)
X	1	1	45000
Y	0	0	0
Z	1	1	30000

19655	Axis number of the linear axis to which a rotary axis belongs

[Data type] Word axis

[Valid data range] 0 to number of controlled axis

This parameter is used for tool length compensation in tool axis direction and tool center point control.

When a rotary axis turns about a linear axis, the linear axis is referred to as an axis to which the rotary axis belongs, and is set using this parameter.

For a rotary axis that belongs to no linear axis, or for a linear axis, 0 is set.

[Example of setting] Axis configuration: X, Y, Z, C, A

Linear axes: X, Y, Z

Rotary axes: A(turning about the X-axis), C(turning about the Z-axis)

In the above case, set the following:

Axis number	Axis name	Setting
1	X	0
2	Y	0
3	Z	0
4	C	3
5	A	1

19656	Tool axis direction

[Data type] Word

[Valid data range] 1 to 3

Enter the tool axis direction when the two rotary axes are set at 0 degree.

Data	Tool axis direction
1	X-axis
2	Y-axis
3	Z-axis

19657	
	Master rotary axis number

[Data type] Word

[Valid data range] 0 to number of controlled axis

When a machine does not have the rotary axis that turns about the tool axis, the axis number of a rotary axis used as the master axis is set. For machines not using the master-axis configuration, 0 is set.

When the tool axis direction is controlled by two rotary axes, neither of which turns about the tool axis, one of the rotary axes is mounted on the other rotary axis as shown in the figure below. In this case, the rotary axis on which the other rotary axis is mounted is called the master axis.

Parameter number	Data					
19655	X	Y	Z	W	A	B
	0	0	0	0	1	2
19656	3					
19657	5					

19658	
	Angular displacement of a rotary axis

[Data type] 2-word axis

[Unit of data]

Increment system	IS-B	IS-C	Unit
Rotary axis	0.001	0.0001	deg

[Valid data range] -99999999 to +99999999

When using the tool length compensation in tool axis direction and tool center point control, set the coordinate of a rotary axis, among the rotary axes determining the tool axis direction, which is not controlled by the CNC. This parameter is enabled or disabled, depending on the setting of bit 1 (RAP) of parameter No. 19650.

19659	Offset value for angular displacement of a rotary axis

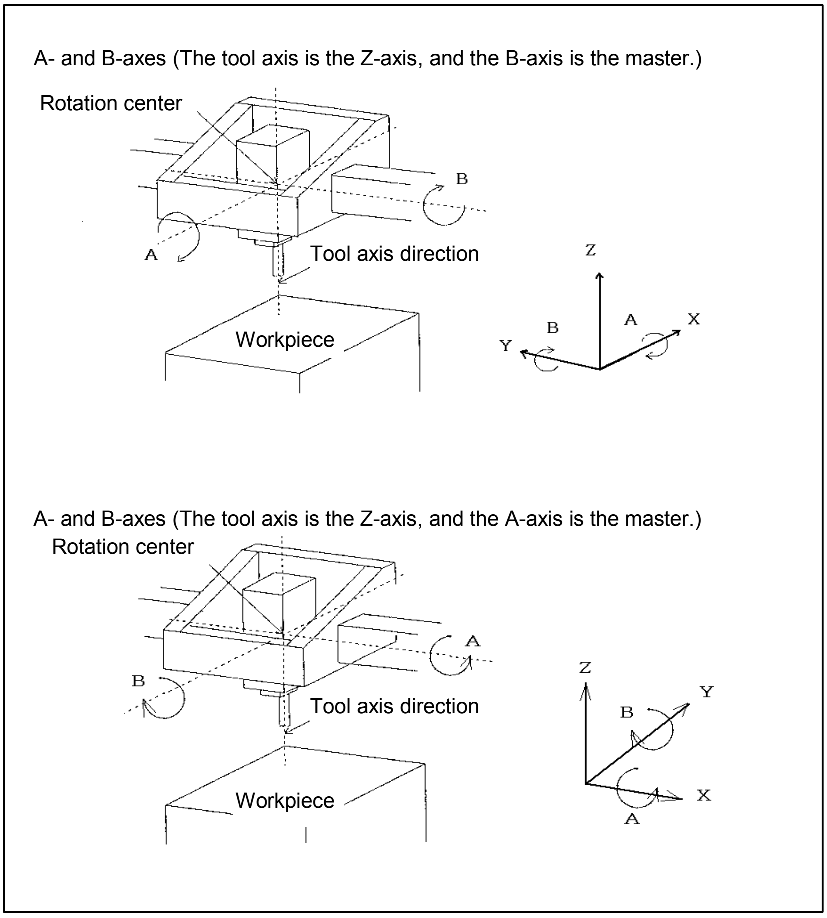
[Data type] 2-word axis

[Unit of data]

Increment system	IS-B	IS-C	Unit
Rotary axis	0.001	0.0001	deg

[Valid data range] -99999999 to +99999999

An offset can be applied to tool length compensation in tool axis direction and tool center point control to compensate for the move direction.



Example for setting parameters that determine the machine configuration

Tool axis direction: Z-axis
Axis configuration: X, Y, Z, W, A, B
Rotary axes: A-axis (axis rotating about the X-axis), B-axis (axis rotating about the Y-axis)
Master axis: A-axis

19660	Origin offset value of a rotary axis

[Data type] 2-word axis

[Unit of data]

Increment system	IS-B	IS-C	Unit
Rotary axis	0.001	0.0001	deg

[Valid data range] -99999999 to +99999999

Set an angular displacement shifted from the origin for a rotary axis when the tool length compensation in tool axis direction and tool center point control to compensate for the move direction function is used.

19661	Rotation center compensation vector in tool length compensation in tool axis direction

[Data type] 2-word axis

[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm
Inch machine	0.0001	0.00001	inch

[Valid data range] -99999999 to +99999999

In the function for tool length compensation in tool axis direction and tool center point control, set the vector from the first rotary axis center to second rotary axis center.

19662	Spindle center compensation vector in tool length compensation in tool axis direction

[Data type] 2-word axis

[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm
Inch machine	0.0001	0.00001	inch

[Valid data range] -99999999 to +99999999

Set a spindle center compensation vector when the tool length compensation in tool axis direction function or the tool center point control function is used.

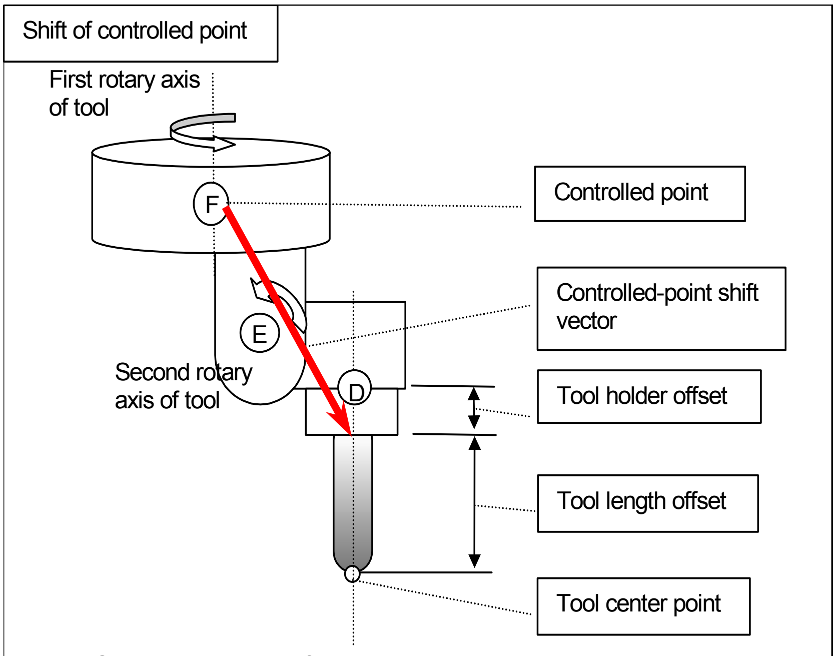
	#7	#6	#5	#4	#3	#2	#1	#0
19665	ETH		SVC	SPR				

[Data type] Bit

SPR Shift of the control point is:
0 : Calculated automatically.
1 : Set in parameter No. 19667.

SVC The control point is:
0 : Not shifted.
1 : Shifted.
The shift method is specified with bit 4 (SPR) of parameter No. 19665.

Bit 5 (SVC) of parameter No.19665	Bit 4 (SPR) of parameter No.19665	Shift of controlled point
0	—	Shift is not performed.
1	0	The controlled point is shifted according to the result of the following automatic calculation: - (Intersection offset vector between the tool axis and the first rotary axis of the tool + intersection offset vector between the second and first rotary axes of the tool + tool holder offset (parameter No. 19666)) (See the figure below.)
1	1	The controlled point is shifted. As the shift vector, the vector set in parameter No. 19667 is used.



[Controlled-point shift vector when automatically calculated]

NOTE
When the machine type that has no rotary axis for turning the tool (table rotation type with parameter No. 19680 set to 12) is used, controlled-point shift operation is not performed, regardless of the setting of this parameter.

ETH Tool holder offset function in tool length compensation is :
0 : Disabled.
1 : Enabled.

19666	Tool holder offset

[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm
Inch machine	0.0001	0.00001	inch

[Valid data range] -99999999 to +99999999

Set the offset value (tool holder offset value) specific to the machine from the rotation center of a rotary axis to the tool attachment position in the following cases:

- When the tool length compensation in tool axis direction function is used
- When tool tip center rotation handle feed and tool tip position display are performed
- When tool center point control is used
- When tool center point control for 5-axis machining is used
- When tool length compensation is used in the tilted working plane command mode (after G53.1 is specified)

However, by setting bit 7 (ETH) of parameter No. 19665 to 1, the tool holder offset function can be enabled for tool length compensation in the ordinary mode.

NOTE
Set a radius value.

19667	Controlled-point shift vector

[Data type] 2-word axis

[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm
Inch machine	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the shift vector for the controlled point. This value becomes valid when bit 5 (SVC) of parameter No. 19665 is set to 1, and bit 4 (SPR) of parameter No. 19665 is set to 1.

NOTE
Set a radius value.

19670	Character blinking in the lower-right corner of the screen during five-axis control operation (1st character)
19671	Character blinking in the lower-right corner of the screen during five-axis control operation (2nd character)
19672	Character blinking in the lower-right corner of the screen during five-axis control operation (3rd character)
19673	Character blinking in the lower-right corner of the screen during five-axis control operation (4th character)
19674	Character blinking in the lower-right corner of the screen during five-axis control operation (5th character)
19675	Character blinking in the lower-right corner of the screen during five-axis control operation (6th character)
19676	Character blinking in the lower-right corner of the screen during five-axis control operation (7th character)

[Data type] Byte

[Valid data range] 0 to 255

Set a character code to specify a character blinking in the lower-right corner of the screen during five-axis control operation.

NOTE

1. For the character codes that can be specified, see the character code correspondence table in Appendix A.
2. If 0 is set in these parameters, "5AXES" blinks.

19680	Mechanical unit type

[Data type] Byte

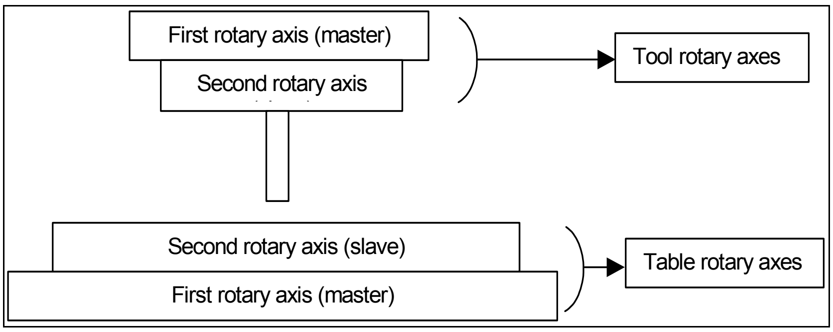
[Valid data range] 0 to 21

Specify the type of the mechanical unit.

	Controlled rotary axis	Master and slave
0	Mechanism having no rotary axis	
2	Two rotary axes of the tool	The first rotary axis is the master, and the second rotary axis is the slave.
12	Two rotary axes of the table	The first rotary axis is the master, and the second rotary axis is the slave.
21	One rotary axis of the tool + one rotary axis of the table	The first rotary axis is the tool rotary axis, and the second rotary axis is the table rotary axis.

NOTE

A hypothetical axis is also counted as a controlled rotary axis.
<Hypothetical axis>
In some cases, it is convenient to use an imaginary rotary axis whose angle is fixed to a certain value. For example, suppose that a tool is mounted in a tilted manner through an attachment. In such a case, the rotary axis considered hypothetically is a hypothetical axis. Bits 0 (IA1) and 1 (IA2) of parameter No. 19696 determine whether each rotary axis is an ordinary rotary axis or a hypothetical axis.



19681	Controlled-axis number for the first rotary axis

[Data type] Byte

[Valid data range] 0 to number of controlled axes

Set the controlled-axis number for the first rotary axis.
For a hypothetical axis (when bit 0 (IA1) of parameter No. 19696 is 1), set 0.

19682	Axis direction of the first rotary axis

[Data type] Byte

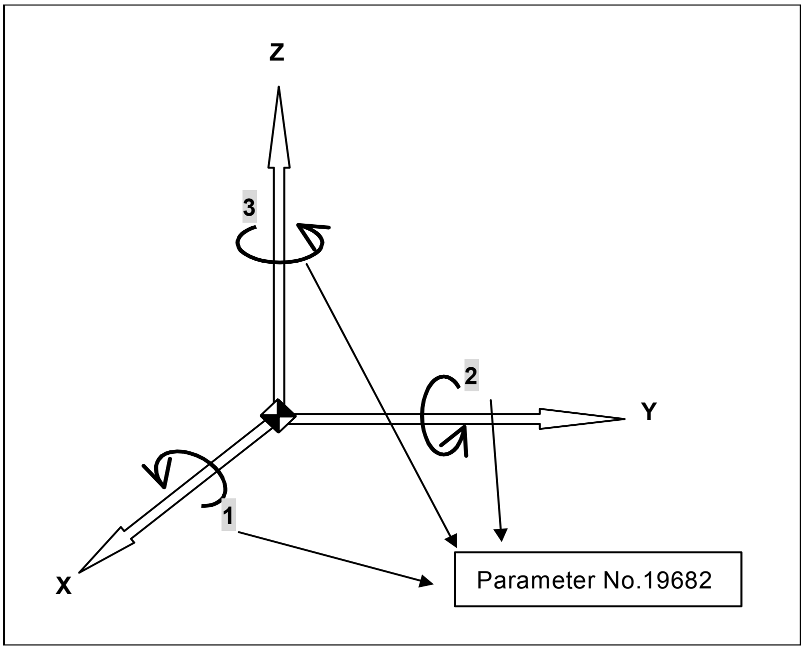
[Valid data range] 0 to 3 (T series)

0 to 6 (M series)

Specify the axis direction of the first rotary axis.

1 : On X-axis
2: On Y-axis
3: On Z-axis
4: On an axis tilted a certain angle from the X-axis from the positive X-axis to positive Y-axis
5: On an axis tilted a certain angle from the Y-axis from the positive Y-axis to positive Z-axis
6: On an axis tilted a certain angle from the Z-axis from the positive Z-axis to positive X-axis

(A value 4 to 6 is to be set when the inclined rotary axis control function is used.)



19683	Inclination angle when the first rotary axis is an inclined axis

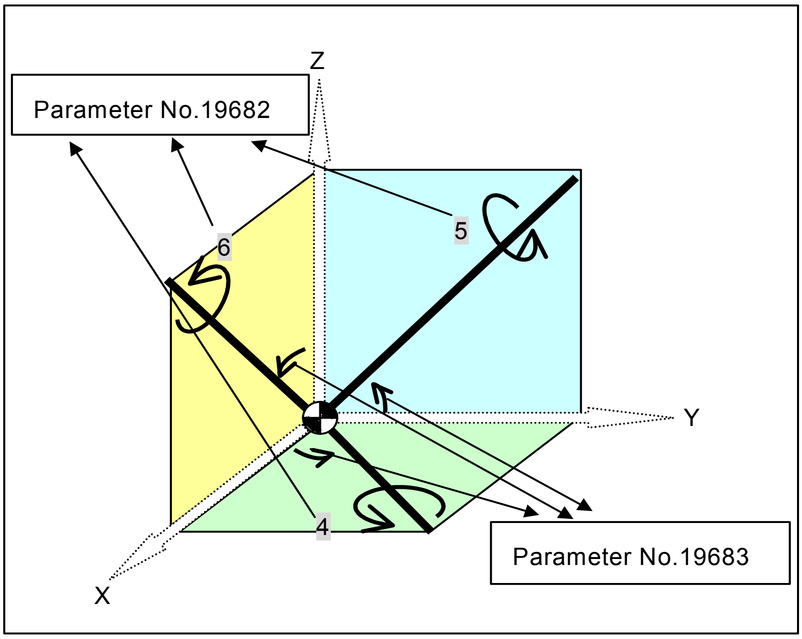
[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Unit of data	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

When a value 1 to 3 is set in parameter No. 19682, set 0 degrees.
When a value 4 to 6 is set in parameter No.19682, specify the inclination angle.



19684	Rotation direction of the first rotary axis

[Data type] Byte

[Valid data range] 0 to 1

Set the direction in which the first rotary axis rotates as a mechanical motion when a positive move command is issued.

0 : Clockwise direction as viewed from the negative to positive direction of the axis specified in parameter No. 19682 (right-hand thread rotation)

1 : Counterclockwise direction as viewed from the negative to positive direction of the axis specified in parameter No. 19682 (left-hand thread rotation)

Normally, 0 is set for a tool rotary axis, and 1 is set for a table rotary axis.

19685	Rotation angle when the first rotary axis is a hypothetical axis

[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Unit of data	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

When the first rotary axis is a hypothetical axis (bit 0 (IA1) of parameter No. 19696 is 1), set the rotation angle.

19686	Controlled-axis number for the second rotary axis

[Data type] Byte

[Valid data range] 0 to number of controlled axes

Set the controlled-axis number for the second rotary axis.

For a hypothetical axis (bit 1 (IA2) of parameter No. 19696 is 1), set 0.

19687	Axis direction of the second rotary axis

[Data type] Byte

[Valid data range] 0 to 3 (T series)

0 to 6 (M series)

Specify the axis direction of the second rotary axis.

1 : On X-axis
2: On Y-axis
3: On Z-axis
4: On an axis tilted a certain angle from the X-axis from the positive X-axis to positive Y-axis
5: On an axis tilted a certain angle from the Y-axis from the positive Y-axis to positive Z-axis
6: On an axis tilted a certain angle from the Z-axis from the positive Z-axis to positive X-axis

(A value 4 to 6 is to be set when the inclined rotary axis control function is used.)

The direction when the master axis is at 0 degrees must be set.

19688	Inclination angle when the second rotary axis is inclined

[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Unit of data	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

If parameter No. 19687 is set to a value 1 to 3, set 0 degrees.

If parameter No. 19687 is set to a value 4 to 6, set the inclination angle.

19689	Rotation direction of the second rotary axis

[Data type] Byte

[Valid data range] 0 to 1

Set the direction in which the second rotary axis rotates as a mechanical motion when a positive move command is issued.

0 : Clockwise direction as viewed from the negative to positive direction of the axis specified in parameter No. 19687 (right-hand thread rotation)

1 : Counterclockwise direction as viewed from the negative to positive direction of the axis specified in parameter No. 19687 (left-hand thread rotation)

Normally, 0 is set for a tool rotary axis, and 1 is set for a table rotary axis.

19690	Rotation angle when the second rotary axis is a hypothetical axis

[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Unit of data	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

When the second rotary axis is a hypothetical axis (bit 1 (IA2) of parameter No. 19696 is 1), set the rotation angle.

	#7	#6	#5	#4	#3	#2	#1	#0
19696			WKP				IA2	IA1
	SUP	RFC	WKP				IA2	IA1

[Data type] Bit

IA1 The first rotary axis is:

0 : An ordinary rotary axis.

1 : A hypothetical axis.

When this parameter is set to 1 (hypothetical axis), set 0 as the controlled axis number of the first rotary axis (parameter No. 19681). Also, set parameter Nos. 19682 to 19685 on the assumption that there is a rotary axis.。

IA2 The second rotary axis is:

0 : An ordinary rotary axis.

1 : A hypothetical axis.

When this parameter is set to 1 (hypothetical axis), set 0 as the controlled axis number of the second rotary axis (parameter No. 19686). Also, set parameter Nos. 19687 to 19690 on the assumption that there is a rotary axis.

WKP As the workpiece rotates, the programming coordinate system:

0 : Rotates.

1 : Does not rotate.

RFC In tool center point control for 5-axis machining, when a command that does not move the tool center point with respect to the workpiece is issued, the feedrate of the rotary axis is:
0 : The maximum cutting feedrate (parameter No. 1422).
1 : A specified feedrate.

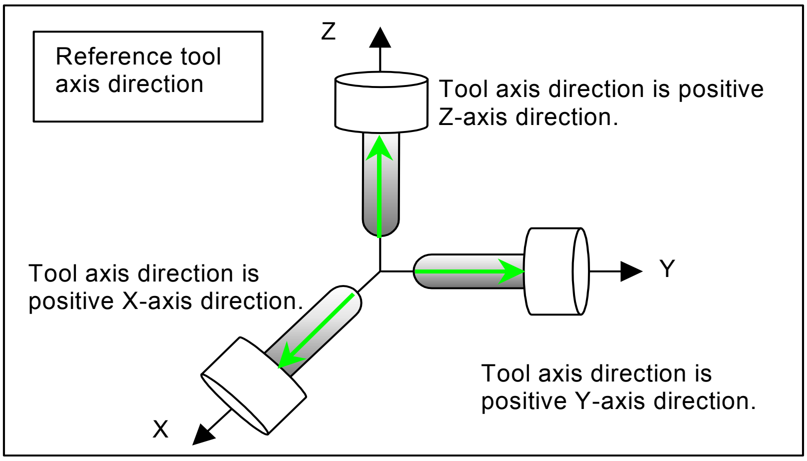
SUP When tool center point control or tool center point control for 5-axis machining is used and a path deviation is about to exceed a set limit if a movement is made at the specified speed:
0 : The speed is not reduced.
1 : The speed is reduced so that the path deviation does not exceed the set limit. Specify a limit in parameter No. 19745.

19697	Reference tool axis direction

[Data type] Byte
[Valid data range] 0 to 3

Set the tool axis direction in the machine coordinate system when the rotary axes for controlling the tool are all at 0 degrees. Also, set the tool axis direction in the machine coordinate system in a mechanism in which only the rotary axes for controlling the table are present (there is no rotary axis for controlling the tool).
1 : Positive X-axis direction
2: Positive Y-axis direction
3: Positive Z-axis direction

When the reference tool axis direction is neither the X-, Y-, nor Z-axis direction, then set appropriate angles as the reference angle R_A and reference angle R_B (parameter Nos. 19698 and 19699).



19698	**Angle when the reference tool axis direction is tilted (reference angle R_A)**
19699	**Angle when the reference tool axis direction is tilted (reference angle R_B)**

[Data type] 2-word

[Unit of data]

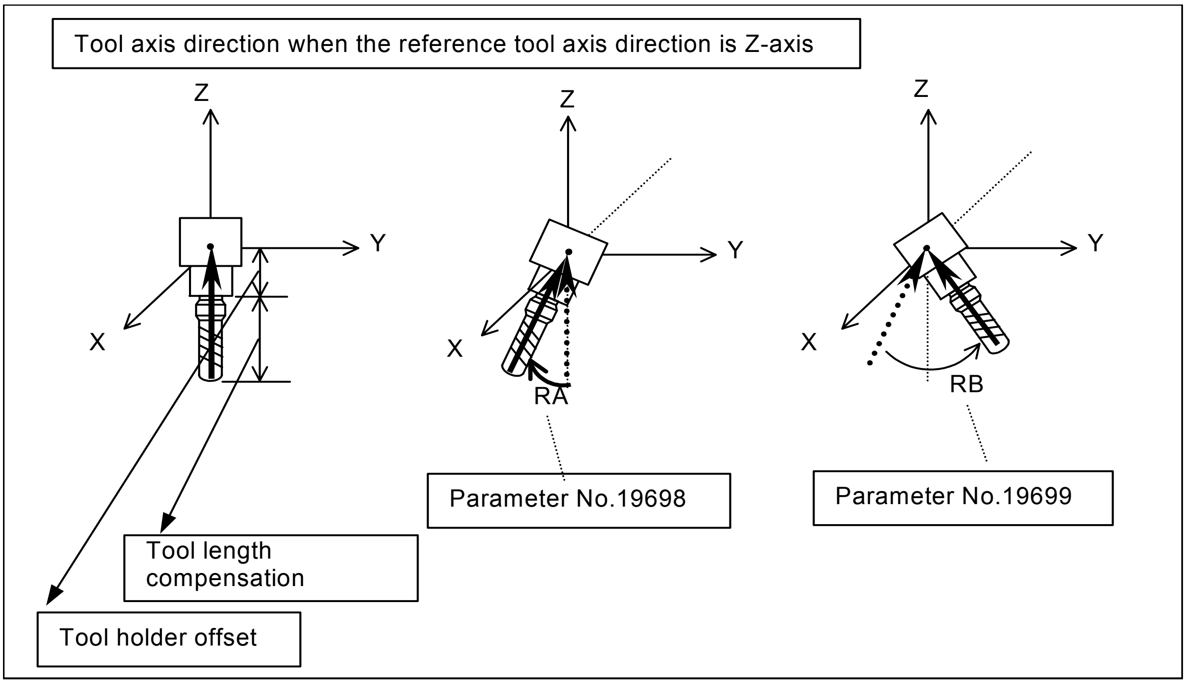
Increment system	IS-B	IS-C	Unit
Unit of data	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

When the reference tool axis direction (parameter No. 19697) is set to 1, the tool axis is tilted the R_A degrees on the Z-axis from the positive X-axis direction to positive Y-axis direction, then the tool axis is tilted the R_B degrees on the X-axis from the positive Y-axis direction to positive Z-axis direction.

When the reference tool axis direction (parameter No. 19697) is set to 2, the tool axis is tilted the R_A degrees on the X-axis from the positive Y-axis direction to positive Z-axis direction, then the tool axis is tilted the R_B degrees on the Y-axis from the positive Z-axis direction to positive X-axis direction.

When the reference tool axis direction (parameter No. 19697) is set to 3, the tool axis is tilted the R_A degrees on the Y-axis from the positive Z-axis direction to positive X-axis direction, then the tool axis is tilted the R_B degrees on the Z-axis from the positive X-axis direction to positive Y-axis direction.



19700	Rotary table position (X-axis of the basic three axes)
19701	Rotary table position (Y-axis of the basic three axes)
19702	Rotary table position (Z-axis of the basic three axes)

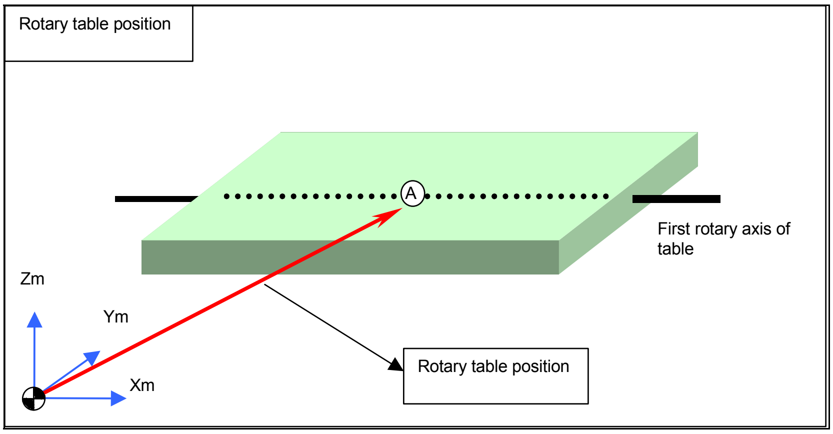
[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm
Inch machine	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set these parameters when parameter No. 19680 is set to 12 or 21. The vector from the origin of the machine coordinate system to point A on the first rotary axis of the table is set as the rotary table position in the machine coordinate system.



NOTE

1. As point A, set a position that is easy to measure on the first rotary axis of the table.
2. Set a radius value.
3. When using angular axis control, set a value in the Cartesian coordinate system.

19703	**Intersection offset vector between the first and second rotary axes of the table (X-axis of the basic three axes)**
19704	**Intersection offset vector between the first and second rotary axes of the table (Y-axis of the basic three axes)**
19705	**Intersection offset vector between the first and second rotary axes of the table (Z-axis of the basic three axes)**

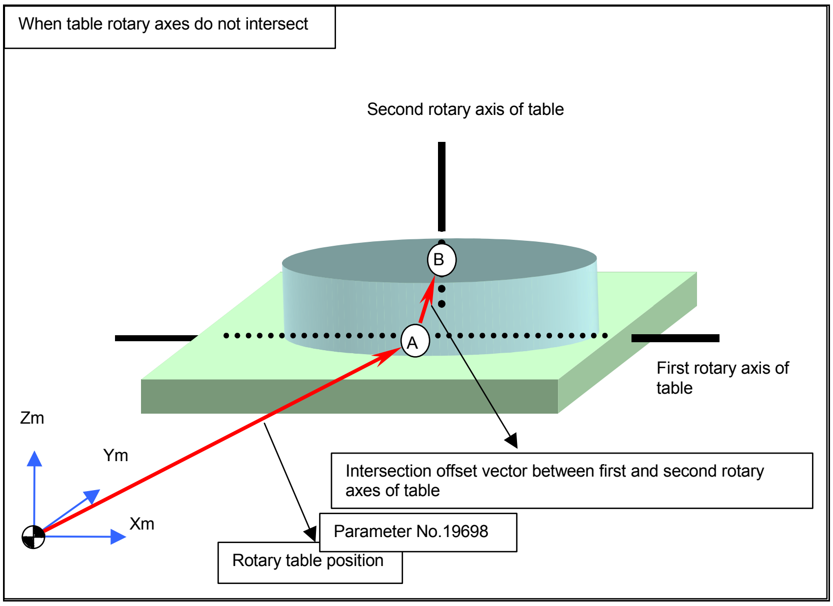
[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm
Inch machine	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set these parameters when the first rotary axis and second rotary axis of the table do not intersect. These parameters are valid when parameter No. 19680 is set to 12. When the rotary axes for controlling the table are all at 0 degrees, the vector from point A to point B on the second rotary axis of the table is set as the intersection offset vector in the machine coordinate system.



NOTE

1 As point B, set a position that is easy to measure on the second rotary axis of the table.
2 Set a radius value.
3 When using angular axis control, set a value in the Cartesian coordinate system.

19709	**Intersection offset vector between the tool axis and first rotary axis of the tool (X-axis of the basic three axes)**
19710	**Intersection offset vector between the tool axis and first rotary axis of the tool (Y-axis of the basic three axes)**
19711	**Intersection offset vector between the tool axis and first rotary axis of the tool (Z-axis of the basic three axes)**

[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm
Inch machine	0.0001	0.00001	inch

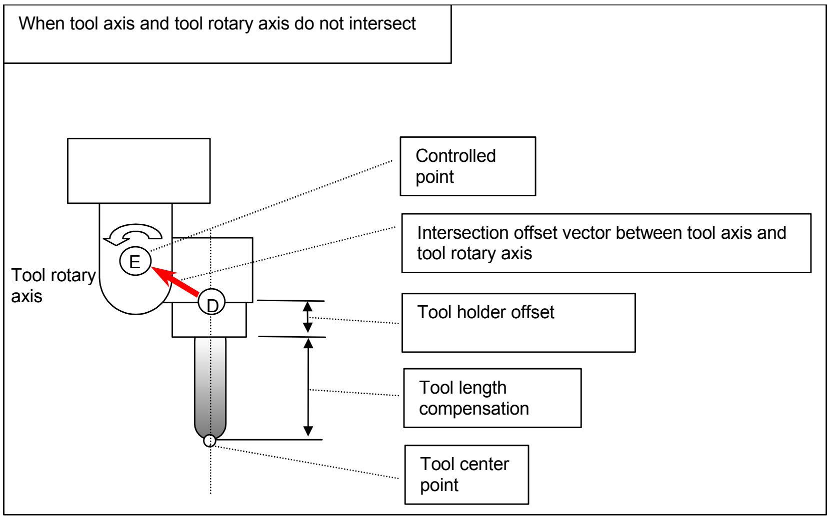
[Valid data range] -99999999 to 99999999

Set these parameters when the tool axis and tool rotary axis do not intersect.

These parameters are valid when parameter No. 19680 is set to 2 or 21.

If parameter No. 19680 is 21, set the vector from point D on the tool axis to point E determined on the tool rotary axis as the intersection offset vector in the machine coordinate system when the rotary axes for controlling the tool are all at 0 degrees.

If parameter No. 19680 is 2, set the vector from point D on the tool axis to point E determined on the second rotary axis of the tool as the intersection offset vector in the machine coordinate system when the rotary axes for controlling the tool are all at 0 degrees.



NOTE

1. Point D is determined by adding the tool length (parameter No. 12318) and tool holder offset (parameter No. 19666) to the tool tip.
2. As point E, set a position that is easy to measure.
3. Set a radius value.
4. When using angular axis control, set a value in the Cartesian coordinate system.

19712	**Intersection offset vector between the second and first rotary axes of the tool (X-axis of the basic three axes)**
19713	**Intersection offset vector between the second and first rotary axes of the tool (Y-axis of the basic three axes)**
19714	**Intersection offset vector between the second and first rotary axes of the tool (Z-axis of the basic three axes)**

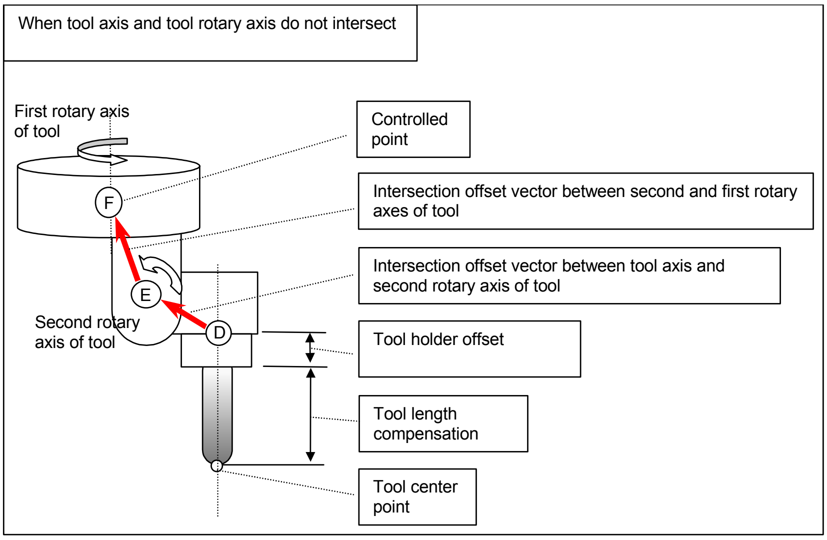
[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm
Inch machine	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set these parameters when the rotary axes of the tool do not intersect.
These parameters are valid when parameter No. 19680 is set to 2.
Set the vector from point E on the second rotary axis of the tool to point F on the first rotary axis of the tool as the intersection offset vector in the machine coordinate system when the rotary axes for controlling the tool are all at 0 degrees.



NOTE
1 As point F, set a position that is easy to measure.
2 Set a radius value.
3 When using angular axis control, set a value in the Cartesian coordinate system.

19718	Tool compensation number used for tool center point control (G43.4)

[Data type] Word

[Valid data range] 1 to 999

Set a tool compensation number used for tool center point control (G43.4).

NOTE
This parameter is used when bit 0 (NHC) of parameter No. 19608 is set to 1.

19720	Axis number of linear axis 1 in tool radius compensation for 5-axis machining
19721	Axis number of linear axis 2 in tool radius compensation for 5-axis machining
19722	Axis number of linear axis 3 in tool radius compensation for 5-axis machining

[Data type] Byte

[Valid data range] 1 to number of controlled axes

Set the axis numbers of three linear axes to exercise tool radius compensation for 5-axis machining.
(A linear axis corresponds to a coordinate axis in the workpiece coordinate system.)

19723	**Axis number of a rotary axis in tool radius compensation for 5-axis machining (1st set)**
19724	**Axis number of the linear axis corresponding to the rotary axis in tool radius compensation for 5-axis machining (1st set)**
19725	**Axis number of a rotary axis in tool radius compensation for 5-axis machining (2nd set)**
19726	**Axis number of the linear axis corresponding to the rotary axis in tool radius compensation for 5-axis machining (2nd set)**

[Data type] Byte

[Valid data range] 1 to number of controlled axes (The axis number set in parameter No. 19723 or No. 19725 may be a negative number.)

Set the axis number of a rotary axis for exercising tool radius compensation for 5-axis machining, and the axis number of the linear axis corresponding to the rotary axis. Up to two sets of data can be specified for tool radius compensation in tool radius compensation for 5-axis machining. The direction of the rotary axis of the first set varies according to the angle of the rotary axis of the second set. When only one set of rotary axis is specified, or when three-dimensional cutter compensation in tool radius compensation for 5-axis machining is used, set 0 in parameter No. 19725.

The axis number of the linear axis corresponding to a rotary axis specifies about which linear axis the rotary axis rotates. Set this axis number according to the table below.

Axis number of the linear axis corresponding to a rotary axis	Value to be set in parameter No. 19724 or parameter No. 19726	Rotation direction of a rotary axis	Direction of a rotation angle of 0 deg
Linear axis 1	Axis number of linear axis 1	Direction of rotation from the positive direction of linear axis 2 to the positive direction of linear axis 3	Positive direction of linear axis 2
Linear axis 2	Axis number of linear axis 2	Direction of rotation from the positive direction of linear axis 3 to the positive direction of linear axis 1	Positive direction of linear axis 3
Linear axis 3	Axis number of linear axis 3	Direction of rotation from the positive direction of linear axis 1 to the positive direction of linear axis 2	Positive direction of linear axis 1

If the rotation direction of a rotary axis is opposite to the value indicated in the table above, set a negative value in parameter No. 19723 or parameter No. 19725.

If the direction of a rotation angle of 0 deg differs from the value indicated in the table above, set the angle of the rotary axis in the direction above as a reference angle in each of parameter No. 19730 and parameter No. 19731.

19730	Reference angle of a rotary axis in tool radius compensation for 5-axis machining (1st set)
19731	Reference angle of a rotary axis in tool radius compensation for 5-axis machining (2nd set)

[Data type] 2-word
[Unit of data]

Increment system	IS-B	IS-C	Unit
Unit of data	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999

Set the angle of the reference position of a rotary axis for exercising tool radius compensation for 5-axis machining.

19734	Workpiece coordinate of the table coordinate system origin in tool radius compensation for 5-axis machining

[Data type] 2-word axis
[Unit of data]

Increment system	IS-B	IS-C	Unit
Linear axis (metric input)	0.001	0.0001	mm
Linear axis (inch input)	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set the workpiece coordinate of the table coordinate system origin for exercising tool radius compensation for 5-axis machining. Set this parameter for each of the three axes set in parameter No. 19720 to No. 19722.

The table coordinate system origin is the intersection of two rotary axes.

19741	Upper limit of the movement range of the first rotary axis
19742	Lower limit of the movement range of the first rotary axis

[Data type] 2-word
[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm
Inch machine	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

In tool center point control for 5-axis machining (type 2), set the upper limit and lower limit of the movement range of the first rotary axis. When the movement range of the first rotary axis is not specified, parameters No. 19741 and No. 19742 must both be set to 0.

19743	Upper limit of the movement range of the second rotary axis

19744	Lower limit of the movement range of the second rotary axis

[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm
Inch machine	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

In tool center point control for 5-axis machining (type 2), set the upper limit and lower limit of the movement range of the second rotary axis. When the movement range of the second rotary axis is not specified, parameters No. 19743 and No. 19744 must both be set to 0.

19745	Limit of the deviation from the path

[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm
Inch machine	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

Set an allowable path deviation limit when tool center point control for 5-axis machining is used. When a path deviation is about to exceed the limit set in this parameter if a movement is made at the specified speed, the speed is automatically reduced so that the path deviation does not exceed the limit. If 0 is set in this parameter, the least input increment is used as an allowable path deviation limit. This parameter is valid when bit 7 (SUP) of parameter No. 19696 is set to 1.

	#7	#6	#5	#4	#3	#2	#1	#0
19746		CRS						SAC

[Data type] Bit

SAC Rotary axis angle checking at the start of the tool center point control mode for 5-axis machining is:

0 : Disabled.

1 : Enabled.

CRS In tool center point control for 5-axis machining, when the deviation from the path during movement at the specified cutting feedrate or rapid traverse rate is determined to exceed the limit:
0 : The setting of bit 7 (SUP) of parameter No. 19696 is followed.
1 : The feedrate or rapid traverse rate is controlled so that the limit of the deviation from the path set in the parameter for the cutting feed or rapid traverse is not exceeded.
When this parameter is set to 1:
In the rapid traverse mode, the rapid traverse rate is decreased so that the deviation from the path does not exceed the limit specified in parameter No. 19751.
In the cutting feed mode, the cutting feedrate is decreased so that the deviation from the path does not exceed the limit specified in parameter No. 19752.

19747	Rotation angle at the start of the tool center point control mode for 5-axis machining applied to the first rotary axis

[Data type] 2-word
[Unit of data]

Increment system	IS-B	IS-C	Unit
Unit of data	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999
Set a rotation angle at the start of the tool center point control mode for 5-axis machining applied to the first rotary axis. This parameter is valid when bit 0 (SAC) of parameter No. 19746 is set to 1.

19748	Rotation angle at the start of the tool center point control mode for 5-axis machining applied to the second rotary axis

[Data type] 2-word
[Unit of data]

Increment system	IS-B	IS-C	Unit
Unit of data	0.001	0.0001	deg

[Valid data range] -99999999 to 99999999
Set a rotation angle at the start of the tool center point control mode for 5-axis machining applied to the second rotary axis. This parameter is valid when bit 0 (SAC) of parameter No. 19746 is set to 1.

19751	Limit of the deviation from the path (for rapid traverse)

[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm
Inch machine	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

This parameter sets the limit of the deviation from the path in the rapid traverse mode in tool center point control for 5-axis machining.
If the tool moves at the specified rate, the deviation from the path may exceed the value specified in this parameter. In this case, the rate is decreased so that the tool moves along the path.
When 0 is set, the least input increment is assumed to be the limit of the deviation from the path.
If a negative value is set, the rapid traverse rate is not decreased.
This parameter is valid when bit 6 (CRS) of parameter No. 19746 is set to 1.

> ⚠ **CAUTION**
> The error generated after the rate is decreased may be smaller than the value set in this parameter depending on the calculation error.

19752	Limit of the deviation from the path (for cutting feed)

[Data type] 2-word

[Unit of data]

Increment system	IS-B	IS-C	Unit
Metric machine	0.001	0.0001	mm
Inch machine	0.0001	0.00001	inch

[Valid data range] -99999999 to 99999999

This parameter sets the limit of the deviation from the path in the cutting feed mode in tool center point control for 5-axis machining.
If the tool moves at the specified rate, the deviation from the path may exceed the value specified in this parameter. In this case, the rate is decreased so that the tool moves along the path.
When 0 is set, the least input increment is assumed to be the limit of the deviation from the path.
If a negative value is set, the cutting feedrate is not decreased.
This parameter is valid when bit 6 (CRS) of parameter No. 19746 is set to 1.

> ⚠ **CAUTION**
> The error generated after the rate is decreased may be smaller than the value set in this parameter depending on the calculation error.

APPENDIX

A CHARACTER CODE LIST

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 marks
H	072		#	035	Shape
I	073		$	036	Dollar mark
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	Positive sign
Q	081		,	044	Comma
R	082		-	045	Negative sign
S	083		.	046	Period
T	084		/	047	Slash
U	085		:	058	Colon
V	086		;	059	Semicolon
W	087		<	060	Left angle bracket
X	088		=	061	Equal sign
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		¥	092	Yen mark
3	051		]	093	Right square bracket
4	052		^	094	
5	053			095	Underline

INDEX

Revision Record

FANUC Series 16*i*/18*i*/160*i*/180*i*/160*i*s/180*i*s-MODEL B PARAMETER MANUAL (B-63530EN)

Edition	Date	Contents	Edition	Date	Contents
03	May, 2005	• Addition of the parameters • Correction of errors			
02	Nov., 2001	• Addition of following models: − Series 160*i*s/180*i*–MODEL B − Series 18*i*/180*i*/180*i*s–MB5 • Addition of parameters • Correction of errors			
01	Feb., 2001	————			