FANUC Series 0*i*-MODEL C
FANUC Series 0*i* Mate-MODEL C

START-UP MANUAL

B-64114EN-1/01

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

PREFACE

This manual describes parameter settings required to start up the FANUC Series 0*i*-MODEL C / 0*i* Mate-MODEL C.

The manual is organized into the following chapters.

Chapter 1 Initialization of the NC parameters related to axis settings
Describes how to make the minimum initialization required to start up NC axes.
Chapter 2 Initialization of servo parameters
Describes how to make the minimum initialization required to drive the servo motor.
Chapter 3 Initialization of the other NC parameters
Describes how to make initialization required to start up the other NCs such as those related to DI/DO.
Chapter 4 Parameters recommended to be set
Describes how to set the parameters required for high-speed and high-precision machining and the servo parameters required to be adjusted.

Since "Example of setting" in the following descriptions indicates reference values for initialization, determine the best setting based on the characteristics and usage of the machine.

Related manuals

Document name	Document number	Major contents	Major usage	
FANUC Series 0*i*-MODEL C/0*i* Mate-MODEL C START-UP MANUAL	B-64114EN-1	• Initial setting	• Start up the system (Software)	*
FANUC Series 0*i*-MODEL C/0*i* Mate-MODEL C PARAMETER MANUAL	B-64120EN	• Initial setting • Setting parameters • Description of parameters	• Start up the system (Software) • Turning the system (Parameters)	
FANUC Series 0*i*-MODEL C/0*i* Mate-MODEL C CONNECTION MANUAL (FUNCTION)	B-64113EN-1	• Initial setting • Setting signals	• Setting parameters (Parameter set supporting screen) • Start up the system (Software)	
FANUC AC SERVO MOTOR αis series FANUC AC SERVO MOTOR αi series FANUC AC SERVO MOTOR βis series SERVO TUNING PROCEDURE (BASIC)	B-65264EN	• Initial setting • Servo tuning	• Setting parameters (high speed and high precision) • Turning the system (Parameters)	
FANUC AC SERVO MOTOR αis series FANUC AC SERVO MOTOR αi series FANUC AC SERVO MOTOR βis series PARAMETER MANUAL	B-65270EN	• Initial setting • Setting parameters • Description of parameters	• Start up the system (Software) • Turning the system (Parameters)	
FANUC AC SPINDLE MOTOR αi series FANUC AC SPINDLE MOTOR βi series PARAMETER MANUAL	B-65280EN	• Initial setting • Setting parameters • Description of parameters	• Start up the system (Software) • Turning the system (Parameters)	

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1 INITIALIZATION OF THE NC PARAMETERS RELATED TO AXIS SETTINGS

1.1 INITIALIZATION PROCEDURE

(1) Preparation

Switch on the NC in an emergency stop state.
Enable parameter writing (PWE = 1).
Press the SYSTEM function key several times until the PARAMETER TUNING screen (parameter set supporting screen) appears.

PARAMETER → DIAGNOSTIC → PARAMETER TUNING

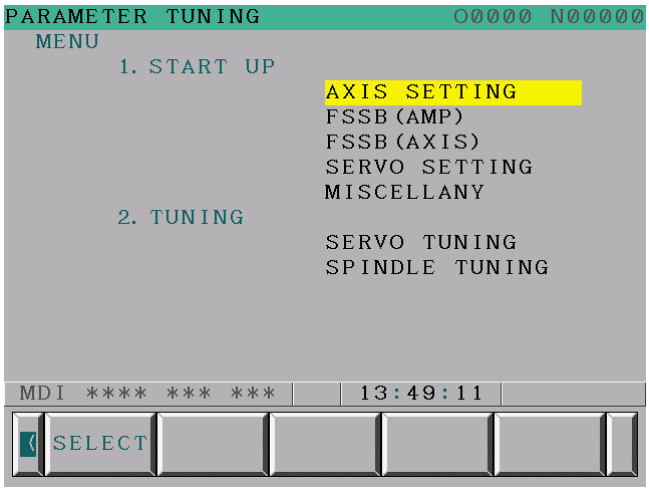


Fig. 1.1 (a) PARAMETER TUNING screen

Press soft key [(OPRT)], move the cursor to the AXIS SETTING item, and press [SELECT] to display the START UP (parameter setting) screen (Fig. 1.1 (b)). This screen is used to make the parameter settings shown below.

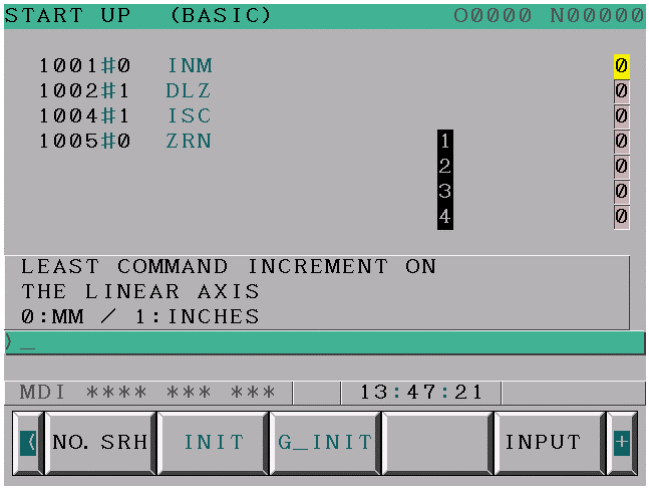


Fig. 1.1 (b) START UP screen

(2) Initialization

Parameters are initialized on the START UP screen. On the START UP screen, parameters are classified into several groups, each of which is displayed on successive pages.

Initialization is made for each group. The procedure is described below.

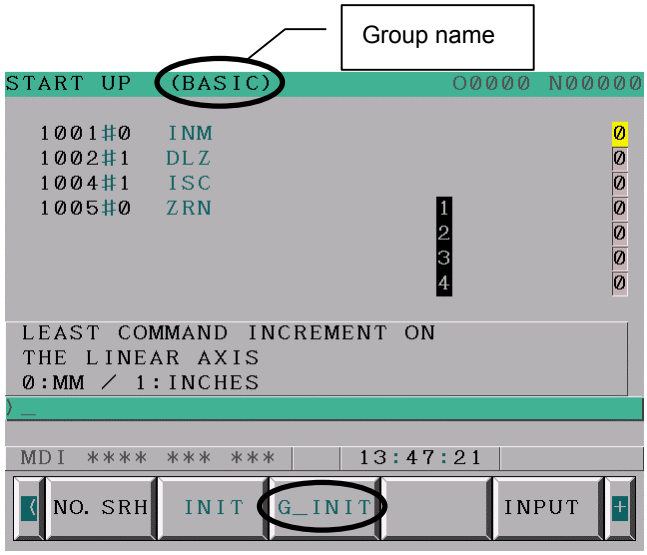
NOTE
1 Since "Example of setting" in the following descriptions indicates reference values for initialization.
Determine the best setting based on the characteristics and usage of the machine.
2 "Example of setting" in the following descriptions assumes an increment system of IS-B (bit 1 of parameter No. 1004 is 0) and metric input (bit 2 of parameter No. 0000 is 0).
3 For details on the individual parameters, refer to the parameter manual.

<1> BASIC group

<1>-1 Setting the standard values

The standard values are set for the parameters in the BASIC group.

Press the PAGEUP or PAGEDOWN key several times until the BASIC group screen appears and then press soft key [G_INIT].



The message "DO YOU SET INIT-VALUE" appears.
Press soft key [EXEC].

This sets the standard values for the parameters in the BASIC group.

NOTE
1 The parameters on all pages in the group are set to the standard values regardless of the page on which [G_INIT] is selected.
2 Some parameters have no standard value. The values of these parameters do not change even after setting the standard values.
3 Setting the standard values may issue "Alarm No. 000 (PLEASE TURN OFF POWER)" the alarm screen appears, but it is not necessary to turn off the power. Display the START UP screen again as described in "(1) Preparation" and then proceed to the next procedure.

<1>-2 Setting parameters for additional axes

When no additional axes are present, proceed to Step <<1>-3 Setting parameters without the standard values>

NOTE
1 The standard value settings made in Step <<1>-1 Setting the standard values> includes parameters for setting the standard value only for the basic axes (M series: 1st to 3rd axes, T series: 1st to 2nd axes).
In Step <<1>-2 Setting the parameters for additional axes>, the additional axis (M series: 4th and subsequent axes, T series: 3rd and subsequent axes) portions of the parameters are set manually.
2 When a parameter number is entered and then soft key [NO.SRH] is pressed, the cursor moves to the specified parameter.

Set the following parameters related to additional axes.

1020	Program axis name for each axis	Each axis

M series				T series			
Axis name	**Setting**	**Axis name**	**Setting**	**Axis name**	**Setting**	**Axis name**	**Setting**
U	85	A	65	Y	89	B	66
V	86	B	66	A	65	C	67
W	87	C	67				

1022	Setting of each axis in the basic coordinate system	Each axis

Set value	Meaning
0	Neither the basic three axes nor a parallel axis
5	Axis parallel to the X axis
6	Axis parallel to the Y axis
7	Axis parallel to the Z axis

<1>-3 Setting the parameters without the standard values

NOTE
1 Some parameters are not set to the standard value even after setting the standard value in Step <<1>-1 Setting the standard values>.
These parameters are set manually in Step <<1>-3 Setting parameters without the standard values>.
2 When a parameter number is entered and then soft key [NO.SRH] is pressed, the cursor moves to the specified parameter.

- Set the type of each axis, linear or rotation.

1006#0	Setting linear or rotation axis. 0: Linear axis 1: Rotation axis	Each axis

- Set the metric system or inch system as the liner axis output unit.

1001#0	Least command increment on the linear axis 0: In mm (metric system machine) 1: In inches (inch system machine)	All axes

- The least input increment and least command increment are set.

1004#1	Setting least input increment and least command increment 0: IS-B 1: IS-C	All axes

	Least input increment and least command increment
IS-B	0.001mm, 0.001deg, or 0.0001inch
IS-C	0.0001mm, 0.0001deg, or 0.00001inch

- Set the servo axis number as shown below.

1023	Number of the servo axis	Each axis

M series		T series	
1st axis (X axis)	1	1st axis (X axis)	1
2nd axis (Y axis)	2	2nd axis (Z axis)	2
3rd axis (Z axis)	3	3rd axis	3
4th axis	4	4th axis	4

- Specify whether the position detector is an absolute position detector.

1815#5	Position detector 0: Other than absolute position detector 1: Absolute position detector	Each axis

- When using reference position return without DOG, set the following parameters.

When using reference position return without DOG for all axes

1002#1	Function setting the reference position without DOG 0: Disabled 1: Enabled (enabled for all axes)	All axes

When using reference position return without DOG for some axes

1005#1	Function setting the reference position without DOG 0: Disabled (disabled for each axis) 1: Enabled (enabled for each axis)	Each axis

- Set the following parameters.

Parameter No.	Example of setting	Description	Type
1825	5000	Servo loop gain	Each axis
1826	10	In–position width	Each axis
1828	7000	Positioning deviation limit in movement	Each axis

<2> COORDINATE group

<2>-1 Setting the standard values

The standard values are set for the parameters in the COORDINATE group.
Follow a procedure similar to Step <<1>-1 Setting the standard values> in <<1> BASIC group>

<2>-2 Setting the parameters without the standard values

Set the following parameters.

Parameter No.	Description	Type	Unit of data
1240	Coordinate value of the first reference position on in the machine coordinate system	Each axis	Increment system
1241	Coordinate value of the second reference position in the machine coordinate system	Each axis	Increment system
1320	Coordinate value of stored stroke check 1 in the positive direction	Each axis	Increment system
1321	Coordinate value of stored stroke check 1 in the negative direction	Each axis	Increment system

<3> FEED RATE group

<3>-1 Setting the standard values

The standard values are set for the parameters in the FEED RATE group.
Follow a procedure similar to Step <<1>-1 Setting the standard values> in <<1> BASIC group>

<3>-2 Setting the parameters without the standard values

Set the following parameters.

Parameter No.	Example of setting	Description	Type
1410	1000	Dry run rate	All axes
1420	8000	Rapid traverse rate	Each axis
1421	1000	F0 rate of rapid traverse override	Each axis
1422	10000	Maximum cutting feedrate	All axes
1423	1000	Feedrate in jog feed	Each axis
1424	5000	Manual rapid traverse rate	Each axis
1425	150	FL rate of the reference position return	Each axis

<4> ACC./DEC. (Acceleration/Deceleration) group

Set the following parameters.

Parameter No.	Example of setting	Description	Type
1620	100	Time constant used for linear acceleration/deceleration in rapid traverse	Each axis
1622	32	Time constant aceeleration/deceleration in cutting feed	Each axis
1624	100	Time constant aceeleration/deceleration in jog feed	Each axis

(3) Restarting the NC

Turn off and back on the NC power. This completes the initialization of the NC parameters related to axis settings.

NOTE

1 To operate the servo axis, it is necessary to set the following signals in addition to the above parameters. For details on each signal, refer to the Connection Manual (Function).

Address	Symbol	Signal name
G008#0	*IT	Interlock signal for all axes
G008#4	*ESP	Emergency stop signal
G008#5	*SP	Feed hold signal
G010,G011	*JV	Manual feedrate override signal
G012	*FV	Feedrate override signal
G114	*+L1 to *+L8	Overtravel signals
G116	*-L1 to *-L8	Overtravel signals
G130	*IT1 to *IT8	Interlock signal for each axis

2 Manual Setting 1 is used as the FSSB setting method in this manual. When using Manual Setting 1, it is not necessary to use the FSSB (AMP) and FSSB (AXIS) items on the parameter setting aid screen.
In Manual Setting 1, restrictions are imposed on the functions and settings that can be used. The restrictions and details on FSSB settings, refer to the FSSB settings section in the Connection Manual (Function).

1.2 NC PARAMETERS RELATED TO AXIS SETTINGS

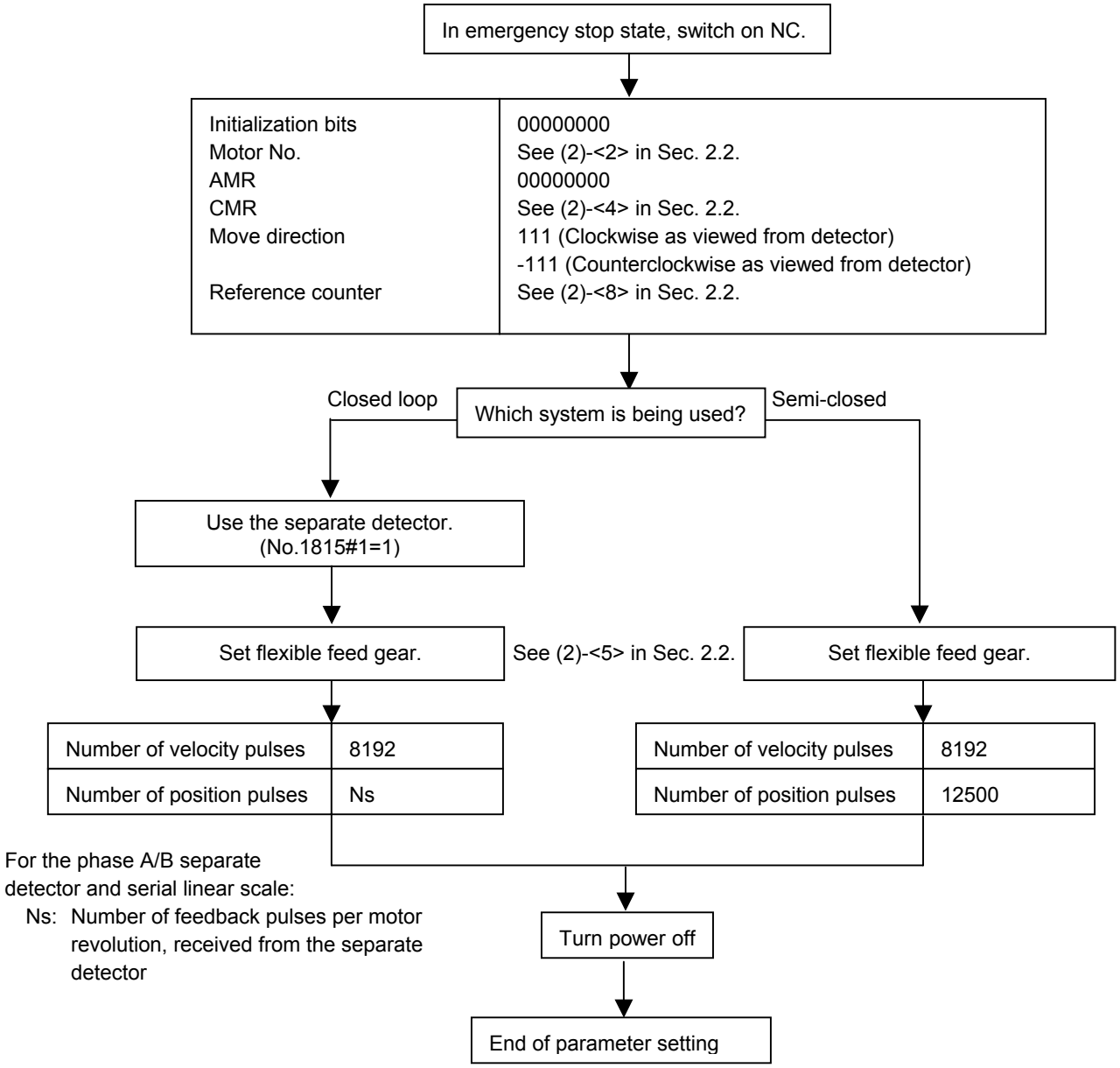
This section lists the parameters to be set during initialization of the NC parameters related to axis settings. For details on each parameter, refer to the parameter manual.

Group	Parameter No.	Summary
BASIC	1001#0	Least command increment on the linear axis 0: In mm (metric system machine) 1: In inches (inch system machine)
	1002#1	Function setting the reference position without DOG 0: Disabled 1: Enabled (enabled for all axes)
	1004#1	Setting least input increment and least command increment 0: IS-B 1: IS-C
	1005#1	Function setting the reference position without DOG 0: Disabled (disabled for each axis) 1: Enabled (enabled for each axis)
	1006#0	Setting linear or rotation axis. 0: Linear axis 1: Rotation axis
	1020	Program axis name for each axis
	1022	Setting of each axis in the basic coordinate system
	1023	Number of the servo axis
	1815#5	Position detector 0: Other than absolute position detector 1: Absolute position detector
	1825	Servo loop gain for each axis
	1826	In–position width for each axis
	1828	Positioning deviation limit in movement for each axis
COORDINATE	1240	Coordinate value of the first reference position on in the machine coordinate system for each axis
	1241	Coordinate value of the second reference position in the machine coordinate system for each axis
	1320	Coordinate value of stored stroke check 1 in the positive direction
	1321	Coordinate value of stored stroke check 1 in the negative direction
FEED RATE	1410	Dry run rate
	1420	Rapid traverse rate for each axis
	1421	F0 rate of rapid traverse override for each axis
	1422	Maximum cutting feedrate (common to all axes)
	1423	Feedrate in jog feed for each axis
	1424	Manual rapid traverse rate for each axis
	1425	FL rate of the reference position return for each axis
ACC./DEC.	1620	Time constant used for linear acceleration/deceleration in rapid traverse for each axis
	1622	Time constant aceeleration/deceleration in cutting feed for each axis
	1624	Time constant aceeleration/deceleration in jog feed for each axis

2 INITIALIZATION OF SERVO PARAMETERS

2.1 PARAMETER INITIALIZATION FLOW

Make the following settings on the servo setting screen and servo adjustment screen.



For the phase A/B separate detector and serial linear scale:

Ns: Number of feedback pulses per motor revolution, received from the separate detector

2.2 PARAMETER SETTING PROCEDURE

(1) Preparation

Switch on the NC in an emergency stop state.
Enable parameter writing (PWE = 1).
Press the SYSTEM function key several times until the PARAMETER TUNING screen (parameter set supporting screen) appears.

PARAMETER → DIAGNOSTIC → PARAMETER TUNING

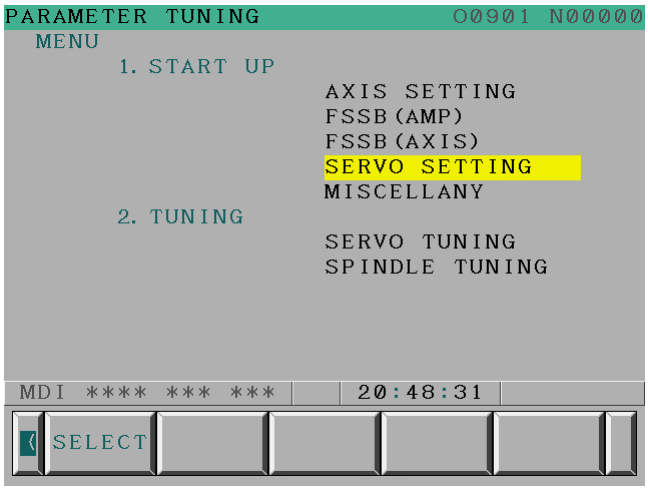


Fig. 2.2 (a) PARAMETER TUNING screen

Press soft key [(OPRT)], move the cursor to the SERVO SETTING item, and press [SELECT] to display the Servo setting screen (Fig. 2.2 (b)). When the screen appears, move the cursor to the item to be set and directly enter data.

Servo set

			X axis	Z axis
<1>	INITIAL SET BITS		00000000	00000000
<2>	Motor ID No.		258	258
<3>	AMR		00000000	00000000
<4>	CMR		2	2
<5>	Feed gear	N	1	1
<5>	(N/M)	M	100	100
<6>	Direction Set		111	111
<7>	Velocity Pulse No.		8192	8192
<7>	Position Pulse No.		12500	12500
<8>	Ref. counter		10000	10000

Fig. 2.2 (b) Servo setting screen

(2) Initialization

Start initialization. Set <1> to <8> on the servo setting screen and turn off and back on the CNC power.
For full-closed systems, first set the following parameter.

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

↑ Set 1.

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

<1> Initialization bit

Initialization bit	00000000

When initialization is completed successfully, DGPR (#1) is set to 1 and PRMC (#3) is set to 1 automatically the next time the CNC power is turned off and back on.

<2> Motor ID No. setting

Specify the motor ID number.
Select the motor number of the α*i*s/α*i*/β*i*s series servo motor to be used in the following table. The motor number consists of a motor model, a motor drawing number (4-digit number in the middle of A06B-****-B***), and the maximum current value of the driving amplifier.

α*is*/α*i* series servo motor

Motor model	Motor specification	Maximum current value of the driving amplifier	Motor type No.
α2/5000*i*s	0212	20A	262
α4/5000*i*s	0215	40A	265
α8/4000*i*s	0235	80A	285
α12/4000*i*s	0238	80A	288
α22/4000*i*s	0265	160A	315
α30/4000*i*s	0268	160A	318
α40/4000*i*s	0272	160A	322
α1/5000*i*	0202	20A	252
α2/5000*i*	0205	20A	255
α4/4000*i*	0223	40A	273
α8/3000*i*	0227	40A	277
α12/3000*i*	0243	80A	293
α22/3000*i*	0247	80A	297
α30/3000*i*	0253	160A	303
α40/3000*i*	0257	160A	307
α40/3000*i* FAN	0258	160A	308

βis series servo motor

Motor model	Motor specification	Maximum current value of the driving amplifier	Motor type No.
β0.2/5000*i*s	0210	4A	260
β0.3/5000*i*s	0211	4A	261
β0.4/5000*i*s	0114	20A	280
β0.5/5000*i*s	0115	20A	281
β1/5000*i*s	0116	20A	282
β2/4000*i*s	0061	20A	253
		40A	254
β4/4000*i*s	0063	20A	256
		40A	257
β8/3000*i*s	0075	20A	258
		40A	259
β12/3000*i*s	0078	40A	272
β22/2000*i*s	0085	40A	274

<3> AMR setting

This parameter corresponds to the number of poles of the servo motor. For the α*i*s/α*i*/β*i*s motor, be sure to set 00000000.

α*i*s/α*i*/β*i*s servo motor	00000000

<4> CMR setting

Set CMR with the scale of a distance the NC instructs the machine to move.

Setting value = (Command unit / Detection unit) × 2

CMR	2

Usually, set CMR with 2, because command unit = detection unit.

<5> Flexible feed gear setting

Set the parameters of the flexible field gear.

Flexible feed gear (numerator)	N
Flexible feed gear (denominator)	M

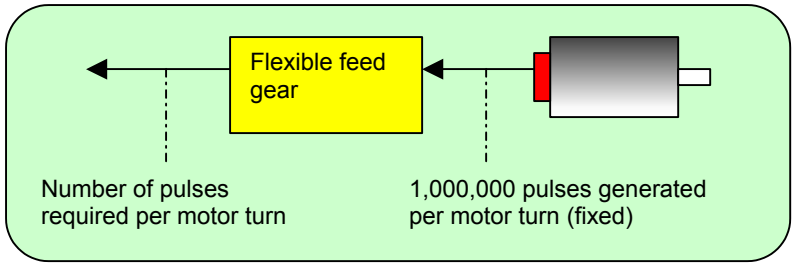
<5>-1 Semi-closed feedback loop

Examples of flexible field gear settings (gear ratio: 1 to 1)

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

(Expression of calculation of parameters)

Set the pulse skipping rate assuming that the number of pulses generated per motor turn is 1000000, regardless of the type of the pulse coder.



Flexible feed gear	Necessary position feedback pulses per motor revolution / 1,000,000 (as irreducible fraction)

NOTE

The maximum specifiable value (after reduction) of the flexible field gear is 32767 for both the numerator and denominator.

Example of setting (1)

If the ball screw used in direct coupling has a lead of 10 mm/rev and the detection unit is 1 μm

The number of pulses generated per motor turn (10 mm) is:

10/0.001 = 10,000 (pulses)

$$\frac{\text{Numerator of flexible field gear}}{\text{Denominator of flexible field gear}} = \frac{10{,}000}{1{,}000{,}000} = \frac{1}{100}$$

Example of setting (2)

If the gear reduction ratio between the rotation axis motor and table is 10:1 and the detection unit is 1/1000 degrees

- The table rotates through 360/10 (=36) degrees when the motor makes one turn.
- Since the detection unit is 1/1000 degrees, the number of position pulses generated per motor turn is:
  (36 degrees per motor turn)/(Detection unit of 1/1000 degrees) = 36000 pulses
  Therefore, the flexible gear setting is as shown below.

$$\frac{\text{Numerator of flexible field gear}}{\text{Denominator of flexible field gear}} = \frac{36{,}000}{1{,}000{,}000} = \frac{36}{100}$$

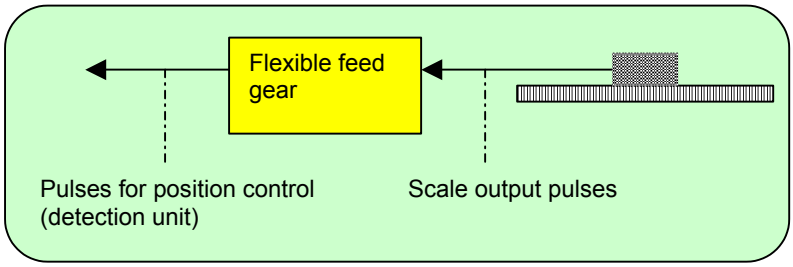
<5>-2 Full-closed feedback loop

Example of flexible field gear settings (N/M)

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

(Expression of calculation of parameters)

Set the pulse skipping rate for the number of scale output pulses



Flexible feed gear	$\frac{\text{Pulses for position control}}{\text{Scale output pulses}}$ (as irreducible fraction)

Example of setting

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

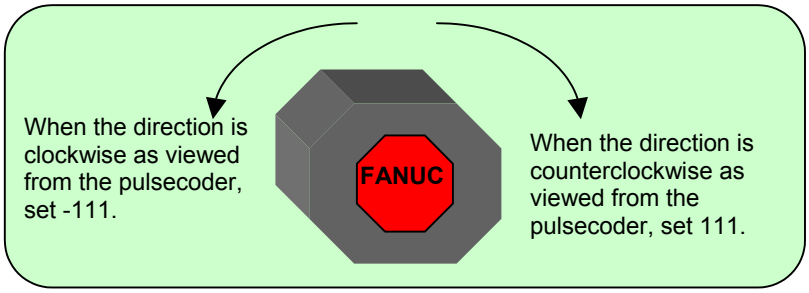
- The number of scale output pulses for movement of 1 μm is: 1 μm/0.5 μm = 2
- Since the detection unit is 1 μm, the number of pulses used for position control is 1.

Therefore, the flexible field gear setting is:

$$\frac{\text{Numerator of flexible field gear}}{\text{Denominator of flexible field gear}} = \frac{1\text{ pulse}}{2\text{ pulses}} = \frac{1}{2}$$

<6> Motor rotation direction setting

111	Clockwise as viewed from the Pulsecoder
-111	Counterclockwise as viewed from the Pulsecoder



<7> Specify the number of velocity pulses and the number of position pulses.

<7>-1 Semi-closed feedback loop

Number of velocity pulses	8192 (Fixed value)
Number of position pulses	12500 (Fixed value)

<7>-2 Full-closed feedback loop (Parallel type or Serial liner scale)

Number of velocity pulses	8192 (Fixed value)
Number of position pulses	Number of feedback pulses from the scale per motor turn

Set the number of pulses fed back from the separate detector (before processing of the flexible field gear) when the motor rotates one turn.

Example 1 :

If the ball screw used in direct coupling has a lead of 10 mm and the separate detector used has a resolution of 0.5 μm (= 0.0005 mm) per pulse

$$\text{Number of feedback pulses per motor 1rev.} = \frac{\text{Ball screw lead = 10mm}}{\text{Scale resolution = 0.0005mm}} = 20000$$

Therefore, the setting of the number of position pulses is 20000.

When the calculated number of position pulses is greater than 32767, set the number of position pulses by using the position pulse conversion factor (No. 2185) to multiply the parameter of the number of position pulses by the parameter of the conversion factor.

2024	Number of position pulses
2185	Position pulse conversion factor

Example 2 :

If the ball screw used in direct coupling has a lead of 16 mm and the separate detector used has a resolution of 0.1 μm (= 0.0001 mm) per pulse

$$\text{Number of feedback pulses per motor 1rev.} = \frac{\text{Ball screw lead = 16mm}}{\text{Scale resolution = 0.0001mm}} = 160{,}000$$

Therefore, the setting of the number of position pulses is 160000. The value exceeds 32767 and cannot be entered as the number of position pulses on the servo setting screen.
In this case, make settings as shown below.
No.2024 = 16,000
No.2185 = 10
(When the value of No. 2024 multiplied by the value of No. 2185 is 160000, another setting is allowed.)

<8> Reference counter setting

Specify the reference counter.
The reference counter is used in making a return to the reference position by a grid method.

<8>-1 Semi-closed feedback loop

Count on the reference counter	=	Number of position pulses corresponding to a single motor revolution

Example of setting

$\alpha i/\beta i$ Pulsecoder and semi-closed loop (1-μm detection)

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

<8>-2 Full-closed feedback loop

Reference counter setting	=	Z-phase (reference-position) interval divided by the detection unit

Example of setting

Example 1 :
When the Z-phase interval is 50 mm and the detection unit is 1 μm: Reference counter setting = 50,000/1 = 50,000
Example 2 :
When a rotation axis is used and the detection unit is 0.001°:
Reference counter setting = 360/0.001 = 360,000
Example 3 :
When a linear scale is used and a single Z phase exists:
Set the reference counter to 10000, 50000, or another round number.

Turn off and back on the NC power. This completes the initialization of the servo parameters.

3 INITIALIZATION OF THE OTHER NC PARAMETERS

3.1 INITIALIZATION PROCEDURE

Switch on the NC in an emergency stop state.
Enable parameter writing (PWE = 1).
Press the SYSTEM function key several times until the PARAMETER TUNING screen (parameter set supporting screen) appears.

PARAMETER → DIAGNOSTIC → PARAMETER TUNING

Fig. 3.1 (a) PARAMETER TUNING screen

Press soft key [(OPRT)], move the cursor to the MISCELLANY item, and press [SELECT] to display the parameter setting (START UP (MISC)) screen (Fig. 3.1 (b)).

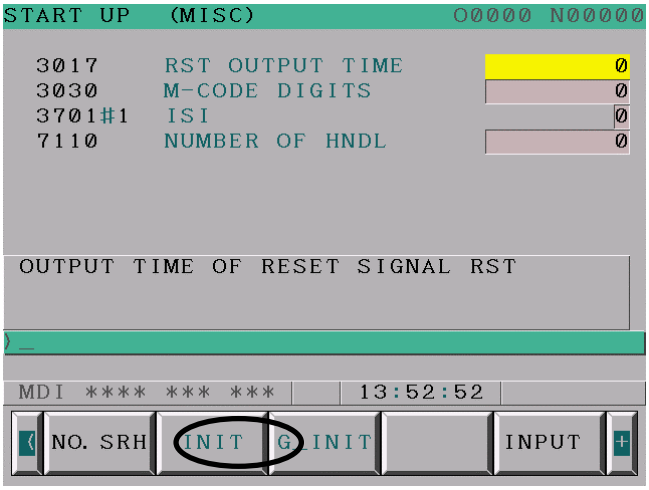


Fig. 3.1 (b) START UP (MISC) screen

Press soft key [G_INIT].

The message "DO YOU SET INIT-VALUE" appears.

Press soft key [EXEC].

This completes the initialization of the other servo parameters.

4 PARAMETERS RECOMMENDED TO BE SET

(1) Parameters related to high-speed and high-precision operations
This section describes the parameters recommended to be set for the AI advanced preview control specification and AI contour control specification.
The parameter list also shows the servo-related parameters.

(2) Minimum servo parameters required to be adjusted
This section describes the minimum servo parameters required to be adjusted based on the machine characteristics.

NOTE
First enter the standard settings.
To reduce the machining time, use a parameter for speed priority I. To further reduce the machining time, use a parameter for speed priority II.
When using a speed priority parameter, however, the machining precision decreases.

4.1 PARAMETERS RELATED TO HIGH-SPEED AND HIGH-PRECISION OPERATIONS

[Functions related to high-speed and high-precision operations]

High-speed and high-precision functions	AI advance preview control (AI-APC)	AI contour control (AICC)
Series 0*i* Mate-MC	○	
Series 0*i*-MC	○	○
Acceleration/deceleration before interpolation		
Type	Linear	Linear/Bell-shaped (*1)
Velocity control		
Automatic corner deceleration	○	○
Arc radius-based velocity control	○	○
Acceleration-based velocity control	○	○

*1 Options are required to perform bell-shaped acceleration/deceleration before interpolation and bell-shaped acceleration/deceleration after cutting feed interpolation.

(1) AI advanced preview control

- Parameters to be set based on the machine type

Parameter No.	Standard setting value			Description
	Standard setting	Speed priority I	Speed priority II	
1432	-	-	-	Maximum cutting feedrate (mm/min) for each axis
1620	-	-	-	Time constant (ms) for linear-shaped Acc./Dec. in rapid-traverse for each axis
1621	-	-	-	Time constant T2 (ms) for bell-shaped Acc./Dec. in rapid-traverse for each axis
1730	3250	5150	7275	Feedrate upper limit (mm/min) for arc radius R
1731	5000	5000	5000	Arc radius R (1 μm) for arc radius-based feedrate upper limit
1732	100	100	100	Arc radius-based feedrate clamp lower speed limit (mm/min)
1768	24	24	24	Time constant (ms) for Acc./Dec. after cutting feed interpolation
1770	10000	10000	10000	Maximum cutting feedrate (mm/min) during Acc./Dec. before interpolation
1771	240	80	40	Time (ms) allowed before a maximum cutting feedrate during Acc./Dec. before interpolation is reached
1783	400	500	1000	Allowable speed difference (mm/min) in acceleration-dependent on speed difference at corners
1784	-	-	-	Speed (mm/min) at occurrence of overtravel alarm To be specified according to the overrun distance at overtravel
1785	320	112	56	Parameter (ms) for determining an allowable acceleration in determining acceleration-dependent speed. The parameter is to be set with the time allowed before a maximum cutting feedrate (parameter No.1432) is reached. A maximum cutting feedrate of 10000 mm/min is used as the standard setting value.

- Parameters for which a fixed value is set

Parameter No.	Standard setting value	Description
1602#6,#3	#6,#3	
	1,0	Acc./Dec. after interpolation is of a linear type (to be specified when FAD is used)

- Parameters for which a fixed value is set (servo-related parameters)

Parameter No.	Standard setting value	Description
1825	5000	Position gain
2003 #3	1	Enables PI function
2003 #5	1	Enables backlash acceleration
2005 #1	1	Enables feed-forward
2006 #4	1	Uses the latest feedback data for velocity feedback.
2007 #6	1	Enables FAD (Fine Acc./Dec.)
2009 #7	1	Enables backlash acceleration stop
2016 #3	1	Enables variable proportional gain in the stop state
2017 #7	1	Enables velocity loop high cycle management function
2021	128	Load inertia ratio
2067	1166	TCMD filter
2069	50	Velocity feed-forward coefficient
2071	20	Period during which backlash acceleration remains effective
2082	5 (1μm detection)	Timing at which the backlash acceleration is stopped (specified in detection units)
2092	10000	Advanced preview (position) feed-forward coefficient
2107	150	Cutting load inertia ratio override (in % units)
2109	16	FAD time constant
2119	2 (1μm detection)	For variable proportional gain function in the stop state : judgment level for stop state (specified in detection units)
2202 #1	1	Cutting/rapid traverse velocity loop gain switching
2209 #2	1	Enables FAD of linear type.

- Parameters to be set when using HRV3 (high-speed HRV current control)

To use servo HRV3 control, make the following settings.

Parameter No.	Standard setting value	Description
2013#0	1	In the G05.1Q1 command, high-speed HRV control (Current control cycle 62.5μs)
2334	150	Current loop gain magnification for high-speed HRV current control
2335	200	Velocity gain override (in % units) when high-speed HRV current control is in use

(2) AI contour control

- Parameters to be set based on the machine type

Parameter No.	Standard setting value			Description
	Standard setting	Speed priority I	Speed priority II	
1432	-	-	-	Maximum cutting feedrate (mm/min) for each axis
1620	-	-	-	Time constant (ms) for linear-shaped Acc./Dec. in rapid-traverse for each axis
1621	-	-	-	Time constant T2 (ms) for bell-shaped Acc./Dec. in rapid-traverse for each axis
1730	3250	5150	7275	Feedrate upper limit (mm/min) for arc radius R
1731	5000	5000	5000	Arc radius R (1 μm) for arc radius-based feedrate upper limit
1732	100	100	100	Arc radius-based feedrate clamp lower speed limit (mm/min)
1768	24	24	24	Time constant (ms) for Acc./Dec. after cutting feed interpolation
1770	10000	10000	10000	Maximum cutting feedrate (mm/min) during Acc./Dec. before interpolation
1771	240	80	40	Time (ms) allowed before a maximum cutting feedrate during Acc./Dec. before interpolation is reached
1772	64	48	32	Time constant (ms) for bell-shaped Acc./Dec. before interpolation (portion with the time fixed)
1783	400	500	1000	Allowable speed difference (mm/min) in acceleration-dependent on speed difference at corners
1784	-	-	-	Speed (mm/min) at occurrence of overtravel alarm To be specified according to the overrun distance at overtravel
1785	320	112	56	Parameter (ms) for determining an allowable acceleration in determining acceleration-dependent speed. The parameter is to be set with the time allowed before a maximum cutting feedrate (parameter No.1432) is reached. A maximum cutting feedrate of 10000 mm/min is used as the standard setting value.

- Parameters for which a fixed value is set

Parameter No.	Standard setting value	Description
1602#6,#3	#6,#3	
	1,0	Acc./Dec. after interpolation is of a linear type (if bell-shaped Acc./Dec. before interpolation is used)
	1,1	Acc./Dec. after interpolation is of a bell-shaped type (if linear-shaped Acc./Dec. before interpolation is used)
1603#7	1	Acc./Dec. before interpolation is of a bell-shaped type (0: Linear-shaped Acc./Dec. before interpolation)
7050#5	1	To be set to the standard setting value.
7050#6	0	To be set to the standard setting value.
7052#0	0/1	To be set to 1 for the PMC and Cs axes.

- Parameters for which a fixed value is set (servo-related parameters)

Parameter No.	Standard setting value	Description
1825	5000	Position gain
2003 #3	1	Enables PI function
2003 #5	1	Enables backlash acceleration
2005 #1	1	Enables feed-forward
2006 #4	1	Uses the latest feedback data for velocity feedback.
2009 #7	1	Enables backlash acceleration stop
2016 #3	1	Enables variable proportional gain in the stop state
2017 #7	1	Enables velocity loop high cycle management function
2021	128	Load inertia ratio
2067	1166	TCMD filter
2069	50	Velocity feed-forward coefficient
2071	20	Period during which backlash acceleration remains effective
2082	5 (1μm detection)	Timing at which the backlash acceleration is stopped (specified in detection units)
2092	10000	Advanced preview (position) feed-forward coefficient
2107	150	Cutting load inertia ratio override (in % units)
2119	2 (1μm detection)	For variable proportional gain function in the stop state : judgment level for stop state (specified in detection units)
2202 #1	1	Cutting/rapid traverse velocity loop gain switching

- Parameters to be set when using HRV3 (high-speed HRV current control)

To use servo HRV3 control, make the following settings.

Parameter No.	Standard setting value	Description
2013#0	1	In the G05.1Q1 command, high-speed HRV control (Current control cycle 62.5μs)
2334	150	Current loop gain magnification for high-speed HRV current control
2335	200	Velocity gain override (in % units) when high-speed HRV current control is in use

4.2 SERVO PARAMETERS REQUIRED TO BE ADJUSTED BASED ON THE MACHINE CHARACTERISTICS

This section describes the minimum servo parameters required to be adjusted after the above parameter were set.
Make the following settings and then check the machine operation and machining. If a problem occurs, change parameters as described in the Adjustment field.

Parameters required to be adjusted to find the optimal value

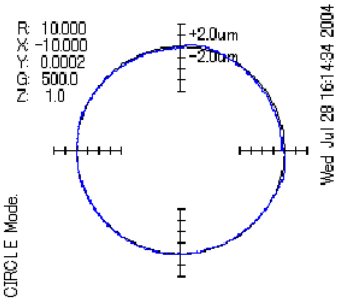
Parameter No.	Setting at tuning start	Description	Adjustment
2021	128	Load inertia ratio (LDINT) (velocity gain) (Note 1)	When vibrations occur during movement of the axis, reduce the setting to 128 → 64 → 0 in that order.
1825	5000	Position gain	If vibrations do not disappear even when the load inertia ratio is reduced to 0, reduce the position gain (No. 1825) values for all axes to 5000 → 4000 → 3000 in that order.
2048	100	Backlash acceleration	When a protrusion is found at the position where the axis movement direction is reversed, increase the setting in steps of 50. When a depression is found, decrease the setting in steps of 50.

NOTE
1 There is the following relationship between the load inertia ratio and velocity loop gain (%).
Velocity loop gain (%)
= (1 + load inertia ratio/256) × 100

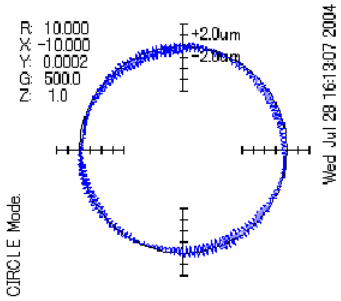
Example of conversion:
Velocity loop gain 150% -----Load inertia ratio 128
Velocity loop gain 200% -----Load inertia ratio 256
Velocity loop gain 250% -----Load inertia ratio 384
Velocity loop gain 300% -----Load inertia ratio 512

The servo guide (servo adjustment tool using PC) is useful to observe the vibration state or a protrusion/depression during reversal of the direction. Examples of observation of waveforms are shown below.

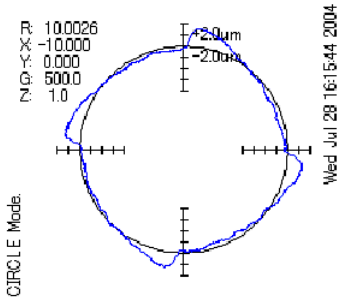
Change in the waveform depending on the load inertia ratio (velocity gain) setting and position gain setting



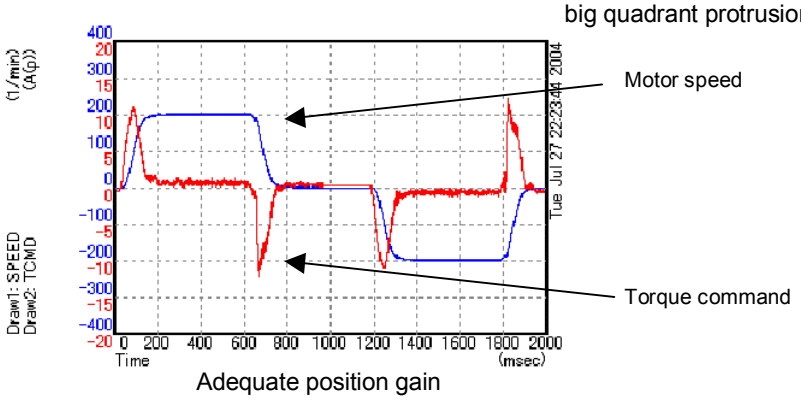
Adequate load inertia ratio (velocity gain)



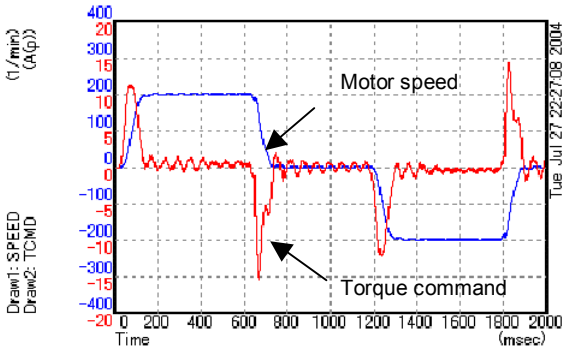
Excessive load inertia ratio (velocity gain)
High-frequency vibrations are found.



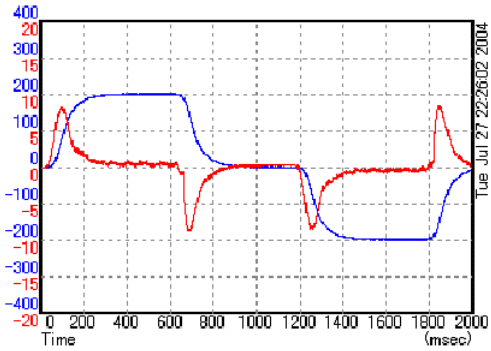
Low load inertia ratio (velocity gain)
The circle shape is not good and there are big quadrant protrusions.



Adequate position gain

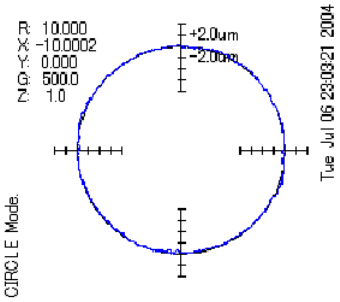


Excessively high position gain
Hunting is found during axis movement

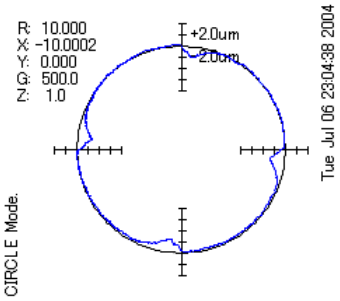


Low position gain
There is a long delay in acceleration/deceleration.

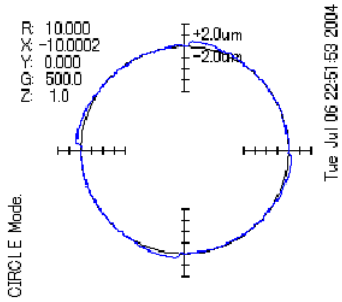
Change in the circle shape depending on the backlash acceleration setting



Adequate backlash acceleration



Excessive backlash acceleration
Depression occurs.



Small backlash acceleration
A protrusion remains.

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Revision Record

FANUC Series 0i-MODEL C / Series 0i Mate-MODEL C START-UP MANUAL (B-64114EN-1)

01	Mar., 2005	———————————————			
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