



Add-on Library Machine Library (Machine Type R5)

User's Manual

BCN-B62005-770-*

User's manual revisions

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Add-on library revisions

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1. Summary

1.1 Summary

This document describes the MELSEC iQ-R series Motion controller compatible add-on library 010 "Machine Library (Machine type R5)".

1.2 Add-on library configuration

1.2.1 Add-on library naming

Application	Model	Add-on library name
3-axis configuration Joint type Machine type	MCNTYP-R005	McNType005.adm

1.2.2 Add-on module list

There is no add-on module used by the MCFUN instruction in this library.

1.2.3 File size and memory usage

The file size and memory usage of the add-on library is shown below.

Add-on library name	File size [byte]	Memory usage [byte]
McNType005.adm	5594	6144

1.3 Supported software versions

The supported software versions are shown below.

Refer to Section 1.3 of "MELSEC iQ-R Motion Controller User's Manual" for how to check the software version.

1.3.1 Operating system software

The version of the Motion controller operating system software that supports the add-on library is shown below.

Motion CPU	Model	Version
R64MTCPU	SW10DNC-RMTFW	Ver.06 or later
R32MTCPU		
R16MTCPU		

1.3.2 Engineering software

The version of the engineering software that supports the add-on library is shown below.

(1) Motion controller engineering software

Product name	Model	Version
MELSOFT MT Works2 • MT Developer2 • MR Configurator2	SW1DND-MTW2-E	1.120A or later

1.4 Restrictions by the software version

There are restrictions in which functions can be used depending on the version of the add-on library, operating system software, and engineering software.

The combination of each version and a function is shown below.

Function	Add-on library version		Operating system software version	Engineering software version	
	Major version	Minor version		MELSOFT MT Works2 (MT Developer2)	GX Works3
Machine type R5	01	01	06	1.120A	—

2. Machine type R5

2.1 Performance specifications

(1) In machine type R5, a 3-axis vertical articulated robot such as the robot illustrated below is controlled.

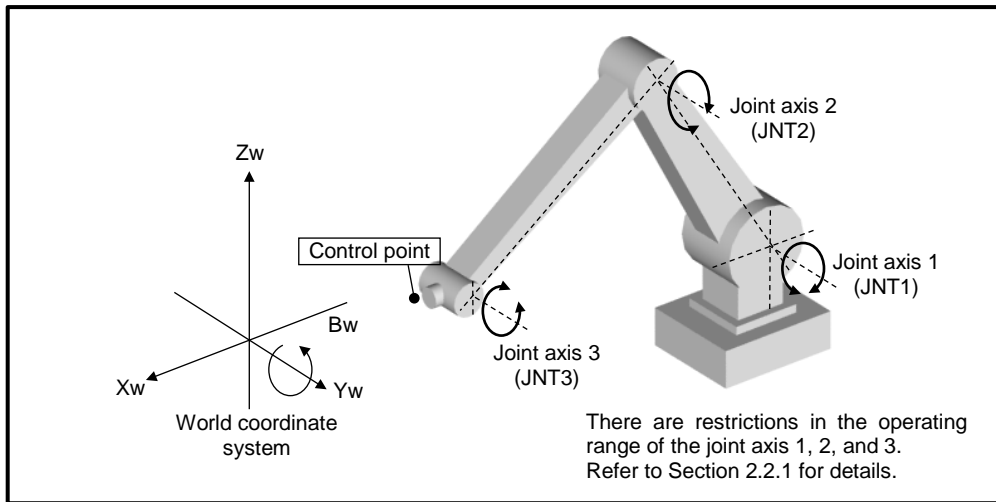


Fig. 2.1 Controlled robot

(2) The specifications for machine type R5 are shown below.

Table 2.1 Machine type R5 specifications

Item		Specifications
Machine type		5
Operating range type		0: Type 0, 1: Type1
Joint axis configuration	Joint axis 1 (JNT1)	Rotating axis Operating range: -177.50000 to 177.50000 [degree]
	Joint axis 2 (JNT2)	Rotating axis Operating range: Type 0: -177.50000 to 177.50000 [degree] Type 1: 2.50000 to 357.50000 [degree]
	Joint axis 3 (JNT3)	Rotating axis Operating range: -177.50000 to 177.50000 [degree]
	Joint axis 4 (JNT4)	—
	Joint axis 5 (JNT5)	—
	Joint axis 6 (JNT6)	—
Machine control	Control unit	mm
	Control coordinate (World coordinate system)	X_w : -214748364.8 to 214748364.7 [μm] Z_w : -214748364.8 to 214748364.7 [μm] B_w : 0.00000 to 359.99999 [degree] FL1: An attitude flag is available.
Coordinate conversion	Base conversion	Available
	Tool conversion	Available
JOG operation	Joint JOG	JOG operation for each joint axis
	Machine JOG	JOG operation for each coordinate component of the world coordinate system (X_w , Z_w , and B_w)

2.2 Robot structure and coordinate system

The structure of the robot controlled in machine type R5 is shown below.

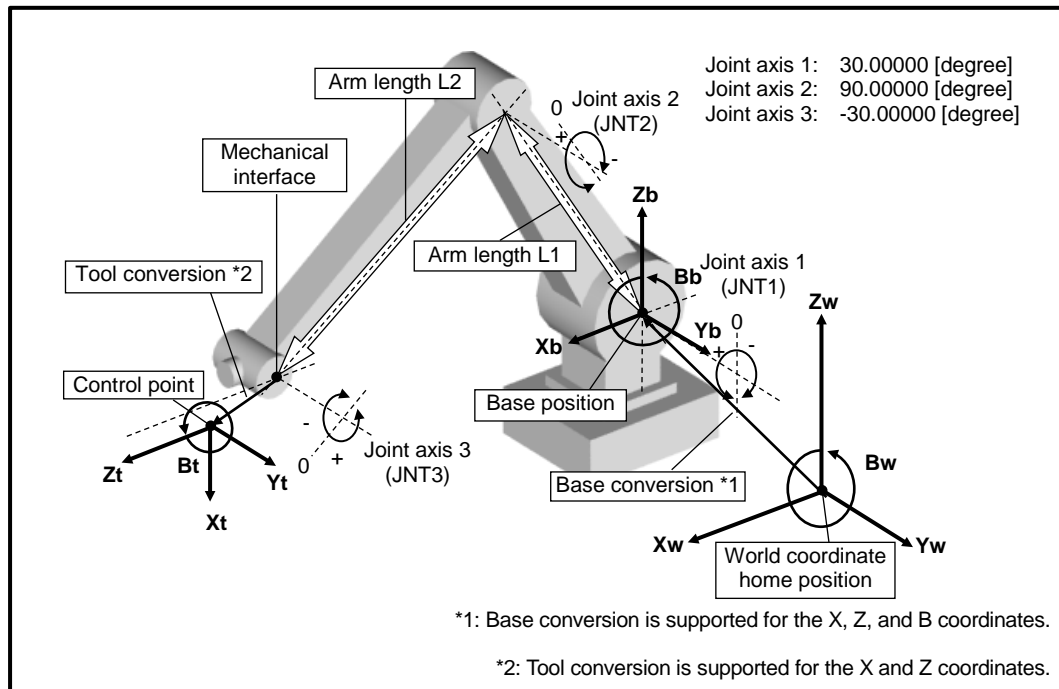


Fig. 2.2 Robot structure

2.2.1 Joint axis configuration

- (1) The robot is a 3-axis (joint axis 1 to 3) configuration vertical articulated robot.
- (2) Refer to Table 2.8 for axis units (axis setting parameter).

Table 2.2 Joint axis configuration

Joint axis	Operation	Remarks
Joint axis 1 (JNT1)	Rotating axis	Operating range: -177.50000 to 177.50000 [degree]
Joint axis 2 (JNT2)	Rotating axis	Operating range: Type 0: -177.50000 to 177.50000 [degree] Type 1: 2.50000 to 357.50000 [degree]
Joint axis 3 (JNT3)	Rotating axis	Operating range: -177.50000 to 177.50000 [degree]
Joint axis 4 (JNT4)	—	—
Joint axis 5 (JNT5)	—	—
Joint axis 6 (JNT6)	—	—

- (3) Configure a system with joint axis movement directions and 0.00000 [degree] positions as shown in the diagram below.

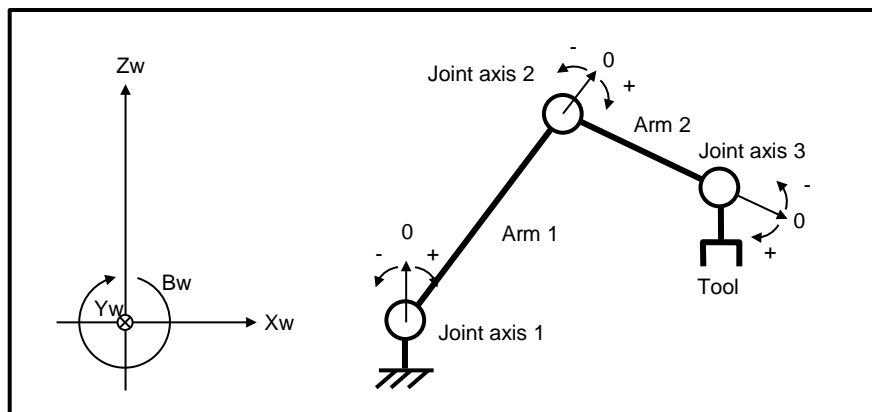


Fig. 2.3 Joint axis of robot

- (4) The operating range of joint axis 1 is shown below. Set each axis stroke limit (fixed parameter) within the following operating range.

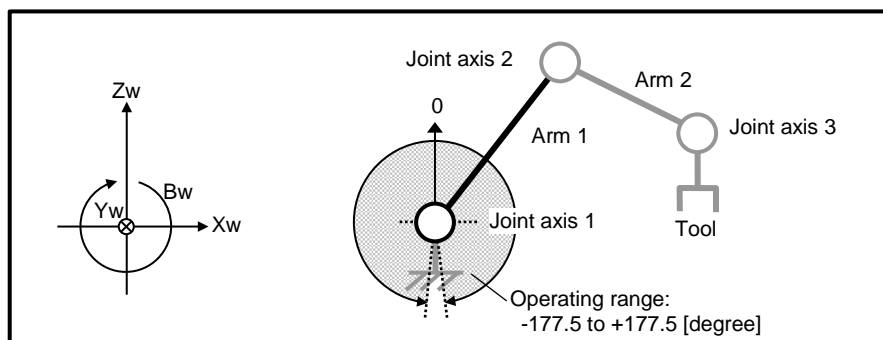


Fig. 2.4 Operating range of joint axis 1

- (5) The operating ranges of joint axis 2 are shown below. Set each axis stroke limit (fixed parameter) within the following operating ranges.

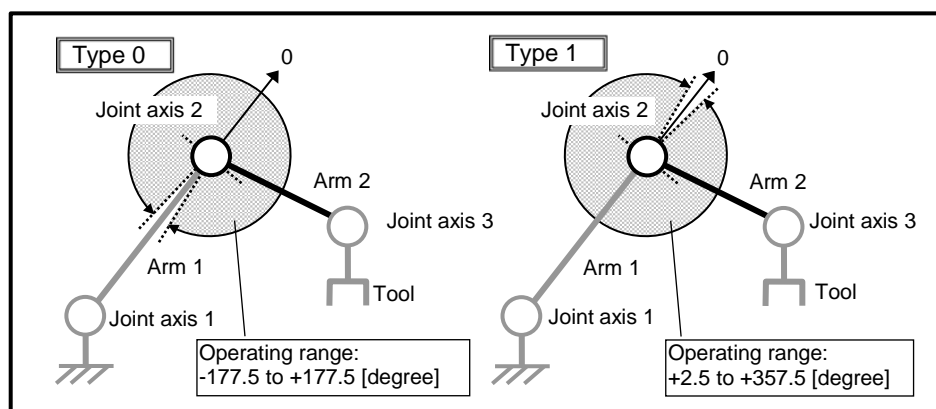


Fig. 2.5 Operating range of joint axis 2

- (6) The operating range of joint axis 3 is shown below. Set each axis stroke limit (fixed parameter) within the following operating range.

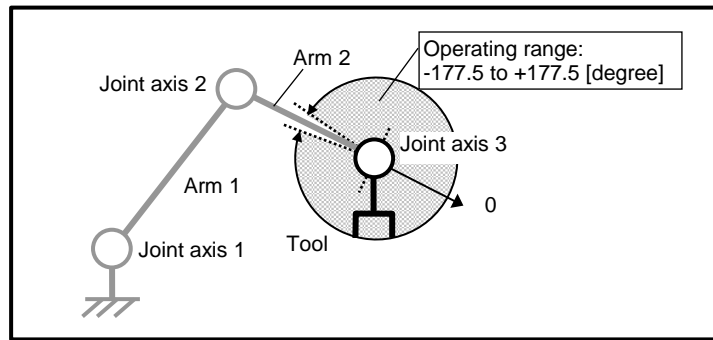


Fig. 2.6 Operating range of joint axis 3

2.2.2 Coordinate configuration

(1) The robot is configured by the X, Z, and B coordinates, and the structure flag (FL1).

The world coordinate system, base coordinate system, and tool coordinate system are shown in the table below.

Table 2.3 Coordinate configuration

Coordinate axis	Remarks
X	Position of the control point in the X direction. The unit is $\times 10^{-1} \mu\text{m}$.
Y	Not used.
Z	Position of the control point in the Z direction. The unit is $\times 10^{-1} \mu\text{m}$.
A	Not used.
B	Inclination of the tool against the Y coordinate axis (the inclination of Zt coordinate axis of the tool coordinate system). The unit is [degree]. The ring address ranges from 0.00000 to 359.99999 [degree].
C	Not used.
FL1	bit 4: Indicates the robot attitude.

Table 2.4 Coordinate system

Coordinate system	Symbol	Remarks
World coordinate system	(Xw, Zw, Bw)	The coordinate system set to the ground or the floor.
Base coordinate system	(Xb, Zb, Bb)	The coordinate system set to the base of the robot.
Tool coordinate system	(Xt, Zt, Bt)	The coordinate system with the control point as the home position.

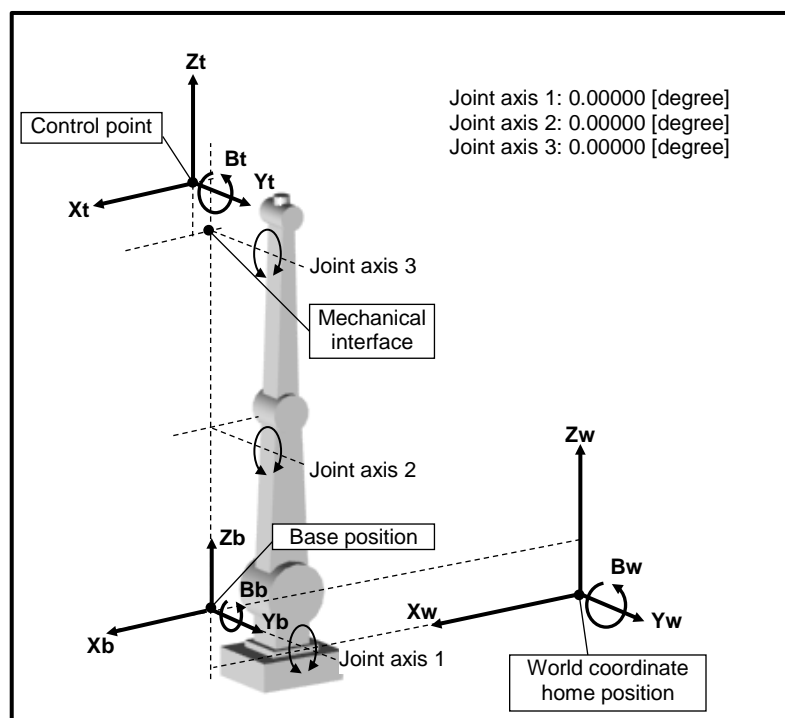


Fig. 2.7 Robot coordinate system

- (2) The base position is the center of rotation of joint axis 1.
- (3) The mechanical interface is the center of rotation of joint axis 3.
- (4) Set the interpolation control unit to [mm].
(Set with the parameter block specified by machine parameter.)
- (5) The control point is specified by the X, Z, and B coordinates, and the structure flag of the world coordinate system, base coordinate system, and tool coordinate system.
- (6) The B coordinate is the inclination of the tool (Tz coordinate axis) against the Y coordinate axis. When each joint axis is in the state illustrated in the above figure, the B coordinate is 0.00000 [degree].

2.3 Positioning control parameters

The following describes the parameters set in machine type R5.

2.3.1 Machine parameter settings

The following items are set in the machine parameter.

(1) Machine parameters

Table 2.5 Machine parameter

Item		Setting value/range [unit]	Remarks	Reference section
Machine basic setting	Machine type *1	5	• Set machine type R5.	—
	Operating range type *1	0, 1	• Set the operation range of the joint axis 2. 0: Type 0 (-177.5 to 177.5 [degree]) 1: Type 1 (2.5 to 357.5 [degree])	(6)
Joint axis structure *1	J1	1 to 64	• Allocate the axis No. to be used for the joint axis 1 to 3.	—
	J2			
	J3			
	J4	0	• Joint axes 4 to 6 are not used. Set to 0.	
	J5			
	J6			
Arm length setting	L1	0.1 to 100000000.0 [μm]	• Set the arm length of the robot.	(3)
	L2	0.0 [μm]	• Arm lengths L3 to L6 are not used. The setting values are ignored.	
	L3			
	L4			
	L5			
	L6			
Machine speed setting	Parameter block designation	1 to 64	• Set the parameter block to be used in machine operation. • Set the interpolation units of the parameter block to [mm].	(2)
	Machine JOG speed limit value (mm)	0.01 to 6000000.00 [mm/min]	• Set the maximum speed for machine JOG operation.	—
	Machine JOG speed limit value (degree)	0.001 to 2147483.647 [degree/min]	• Set the maximum speed for machine JOG operation.	—
XYZ stroke limit setting	+X	-214748364.8 to 214748364.7 [μm]	• Set the movable range of the control point in the base coordinate system. When not using, set both + and - to 0.0. • When upper limit ≤ lower limit, the XYZ stroke limit check is not performed. • ±Y is not used. The setting values are ignored.	—
	-X			
	+Y	0.0 [μm]		
	-Y			
	+Z	-214748364.8 to 214748364.7 [μm]		
	-Z			
Base conversion	Bx	-99999999.9 to 99999999.9 [μm]	• Set the base position as viewed from the world coordinates at the power supply ON, or CPU reset. • Y, and A and C are not used. The setting values are ignored.	(4)
	By	0.0 [μm]		
	Bz	-99999999.9 to 99999999.9 [μm]		
	Ba	0.00000 [degree]		
	Bb	-359.99999 to 359.99999 [degree]		
	Bc	0.00000 [degree]		
Tool conversion	Tx	-99999999.9 to 99999999.9 [μm]	• Set the control point as viewed from the mechanical interface at the power supply ON, or CPU reset. • Y is not used. The setting value is ignored.	(5)
	Ty	0.0 [μm]		
	Tz	-99999999.9 to 99999999.9 [μm]		
Option setting A		H0	• Option settings A1 to A10 are not used. The setting values are ignored.	—
Option setting B		H0	• Option settings B1 to B10 are not used. The setting values are ignored.	—

*1: When setting value is outside range, a moderate error (error code: 30FAH) occurs.

(2) Parameter block designation

Set the parameter block to be used in machine JOG operation.

Set the interpolation control unit to [mm]. Set other items as required.

Table 2.6 Interpolation control unit

No.	Item	Setting value/range [unit] (setting by peripheral equipment)	Remarks
1	Interpolation control unit	mm	<ul style="list-style-type: none"> Set the unit to [mm] for the interpolation control. The unit is also used for program operation, command speed in machine JOG operation, and allowable error range for circular interpolation.

(3) Arm length setting

Arm length L1 is the distance from the center of rotation of joint axis 1 to the center of rotation of joint axis 2 on a ZX plane.

Arm length L2 is the distance from the center of rotation of joint axis 2 to the center of rotation of joint axis 3 on a ZX plane.

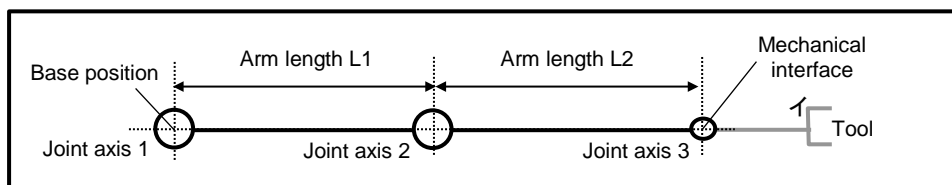


Fig. 2.8 Arm length

When the operating range type is Type 1, and L1 equals L2, singularity of the control point occurs when the difference of joint axis 1 and 2 is 180.00000 [degree] (the state of joint axis 1 and the mechanical interface overlapping: Fig. 2.9).

Perform the interpolation operation to the singularity by joint interpolation specified by JOINT coordinates.

[Cautions]

When the joint axis passes near the singularity, the command speed may be excessive in linear/circular interpolation or machine JOG operation.

When the joint axis passes near the singularity, use joint interpolation.

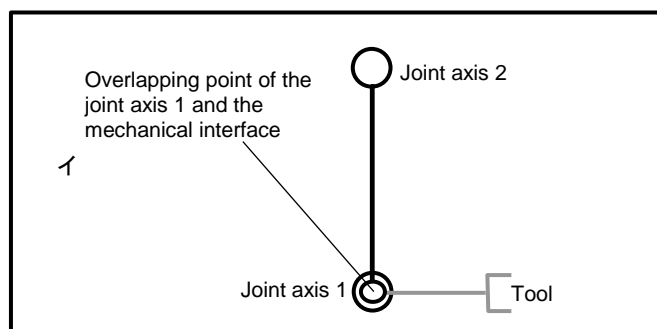


Fig. 2.9 Singularity

(4) Base conversion

Set the base position as viewed from the world coordinates.

The base position (the home position of the base coordinate system) is the center of rotation of joint axis 1.

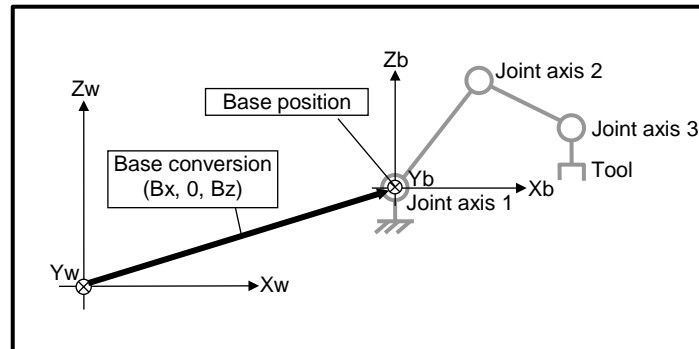


Fig. 2.10 Base conversion

(5) Tool conversion

Set the control point as viewed from the mechanical interface.

The mechanical interface is the center of rotation of joint axis 3.

When joint axis 3 is at 0.00000 [degree], the arm extends to Zt direction of the tool coordinate system (tool conversion: Tz components).

When the tool conversion is set as $(Tx, Ty, Tz) = (0, 0, 0)$, the mechanical interface is the control point.

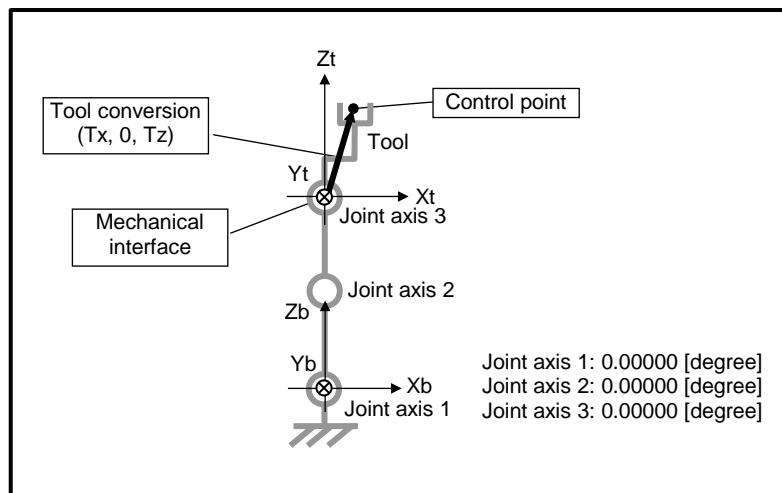


Fig. 2.11 Tool conversion

(6) Operating range type

- (a) The following two types are available for the operating range of joint axis 2. Set the operating range type suitable for the operating range of the robot. When the setting value is outside the range, a moderate error 30FAH (machine configuration error) occurs.

Table 2.7 Interpolation control unit

Operating range type	Setting value	Operating range of joint axis 2 [degree]
Type 0	0	<p>Operating range: -177.5 to +177.5 [degree]</p>
Type 1	1	<p>Operating range: +2.5 to +357.5 [degree]</p>

- (b) Set the stroke limit (fixed parameter) for each axis of joint axis 2 within the operating range (between 0.00000 and 359.99999 [degree]) of each type. When setting value is outside the operating range, a moderate error 30FAH (machine configuration error) occurs.

2.3.2 Axis setting parameter (fixed parameter) settings

Set the following items in the fixed parameter of axes defined as joint axes.

(1) Fixed parameter

Table 2.8 Fixed parameters

No.	Item	Setting value/range [unit] (setting by peripheral equipment)			Remarks
		Joint axis 1	Joint axis 2	Joint axis 3	
1	Unit setting	degree			<ul style="list-style-type: none"> Select [degree] for the unit of the joint axis.
2	Upper stroke limit	0.00000 to 177.50000 [degree]	Type 0: 0.00000 to 177.50000 [degree] Type 1: 2.50000 to 357.50000 [degree]	0.00000 to 177.50000 [degree]	<ul style="list-style-type: none"> Set the upper/lower stroke limit value of the moving range of the machine. Make sure the upper/lower stroke limit values are not the same. There are restrictions in the operating range of the joint axis 1 to 3. When the setting value is incorrect, a moderate error 30FAH (machine configuration error) occurs. Refer to (2) for details of the stroke limit setting.
3	Lower stroke limit	0.00000 to 177.50000, 182.50000 to 359.99999 [degree]	Type0: 0.00000 to 177.50000, 182.50000 to 359.99999 [degree] Type 1: 2.50000 to 357.50000 [degree]	0.00000 to 177.50000, 182.50000 to 359.99999 [degree]	

(2) Stroke limit setting

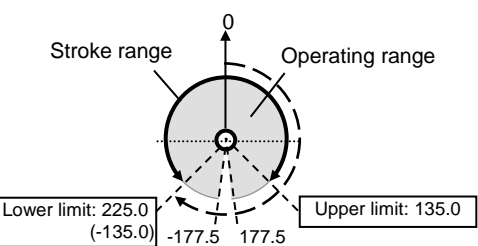
Set the stroke range (stroke limit) of each joint axis within the operating range.

Table 2.9 Operating range of rotating axis

Joint axis	Operating range [degree]	Stroke range [degree]
Joint axis 1	-177.50000 to 177.50000	182.50000 to 177.50000
Joint axis 2	The operating range differs as follows according to the operating range type. Type 0: -177.50000 to 177.50000 Type 1: 2.50000 to 357.50000	The operating range differs as follows according to the operating range type. Type 0: 182.50000 to 177.50000 Type 1: 2.50000 to 357.50000
Joint axis 3	-177.50000 to 177.50000	182.50000 to 177.50000

Set the stroke limit (fixed parameter) of joint axis 1, 2 (Type 0), and 3 within the range of 0.00000 to 359.99999 [degree].

Table 2.10 Stroke limit setting example (Joint axis 1 and 2)

Stroke range	Stroke limit setting value	
	Upper limit [degree]	Lower limit [degree]
 <p>Stroke range</p> <p>Operating range</p> <p>Lower limit: 225.0 (-135.0)</p> <p>Upper limit: 135.0</p> <p>-177.5 177.5</p>	135.00000	225.00000 (-135.00000)

2.4 Point data

(1) When using machine type R5, the setting range of point block data are as follows.

Table 2.11 Point data (position type) setting range

Position component	Details	Command range	
		Absolute value command (ABS)	Incremental value command (INC)
X	Position (distance) to move in the X direction	-214748364.8 to 214748364.7 [μ m]	-214748364.7 to 214748364.7 [μ m]
Y	Position (distance) to move in the Y direction *1	0.0	
Z	Position (distance) to move in the Z direction	-214748364.8 to 214748364.7 [μ m]	-214748364.7 to 214748364.7 [μ m]
A	Angle to rotate the A coordinate *1	0.00000	
B	Angle to rotate the B coordinate	0.00000 to 359.99999 [degree]	-359.99999 to 359.99999 [degree]
C	Angle to rotate the C coordinate *1	0.00000	
FL1	Structure flag 1	H0 to HFFFF	
FL2	Structure flag 2 *1	H0	

*1: The setting value is ignored.

Table 2.12 Point data (joint type) setting range

Position component	Details	Command range	
		Absolute value command (ABS)	Incremental value command (INC)
J1	Position (distance) for moving JNT1	0.00000 to 177.50000, 182.50000 to 359.99999 [degree]	-359.99999 to 359.99999 [degree]
J2	Position (distance) for moving JNT2	Type 0: 0.00000 to 177.50000, 182.50000 to 359.99999 [degree] Type 1: 2.50000 to 357.50000 [degree]	
J3	Position (distance) for moving JNT3	0.00000 to 177.50000, 182.50000 to 359.99999 [degree]	
J4	Position (distance) for moving JNT4 *1	0	
J5	Position (distance) for moving JNT5 *1		
J6	Position (distance) for moving JNT6 *1		
-	Unusable *1	H0	
-	Unusable *1	H0	

*1: The setting value is ignored.

(2) The structure of the structure flag 1 (FL1) is shown below.

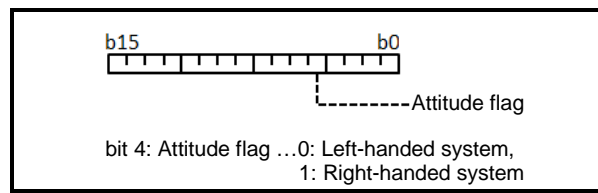


Fig. 2.12 Structure flag 1 (FL1)

(3) There is a right-handed system and a left-handed system in the attitude of the robot which is specified by bit 4 of the structure flag (FL) depending on the state of joint axis 2.

Use joint interpolation when bit 4 of the structure flag (FL1) is different at the start and end points in moving.

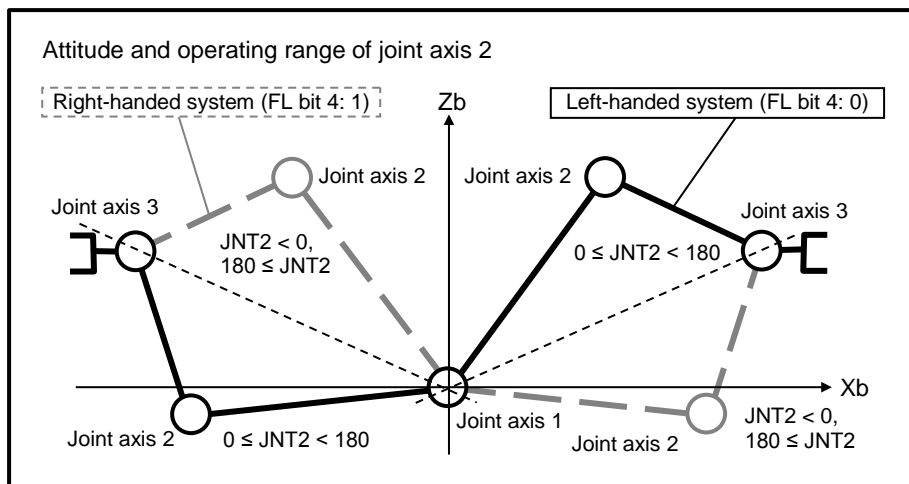


Fig. 2.13 Attitude flag