



Add-on Library Machine Library (Machine Type R4)

User's Manual

BCN-B62005-769-A

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 009 "Machine Library (Machine type R4)".

1.2 Add-on library configuration

1.2.1 Add-on library naming

Application	Model	Add-on library name
2-axis configuration Joint type Machine type	MCNTYP-R004	McnType004.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	Add-on library version		File size [byte]	Memory usage [byte]
	Major version	Minor version		
McنType004.adm	01	01	4386	4480
	01	02	4578	4736

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 R4	01	01	06	1.120A	—
Machine type R4 Operating range type 1	01	02	06	1.120A	—

2. Machine type R4

2.1 Performance specifications

(1) In machine type R4, a 2-axis vertical articulated robot such as the robot illustrated below is controlled.

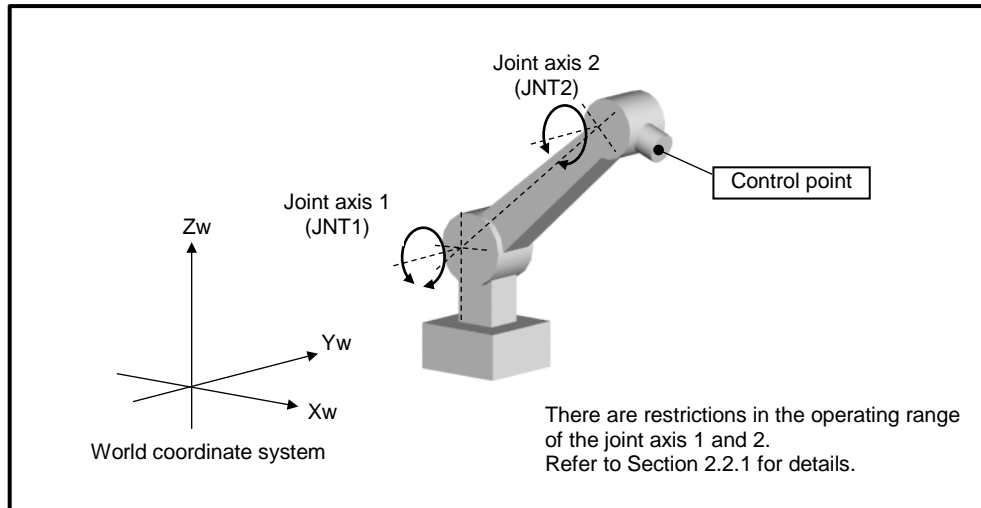


Fig. 2.1 Controlled robot

(2) The specifications for machine type R4 are shown below.

Table 2.1 Machine type R4 specifications

Item		Specifications
Machine type		4
Operating range type		0: Type 0, 1: Type 1
Joint axis configuration	Joint axis 1 (JNT1)	Rotating axis Operating range: Type 0: -177.50000 to 177.50000 [degree] Type 1: Arbitrary *1
	Joint axis 2 (JNT2)	Rotating axis Operating range: Type 0: -177.50000 to 177.50000 [degree] Type 1: Arbitrary *1
	Joint axis 3 (JNT3)	—
	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] 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)

*1: Set the operating range so that there is 5.00000 [degree] or more outside of the operating range in 1 rotation.

2.2 Robot structure and coordinate system

The structure of the robot controlled in machine type R4 is shown below.

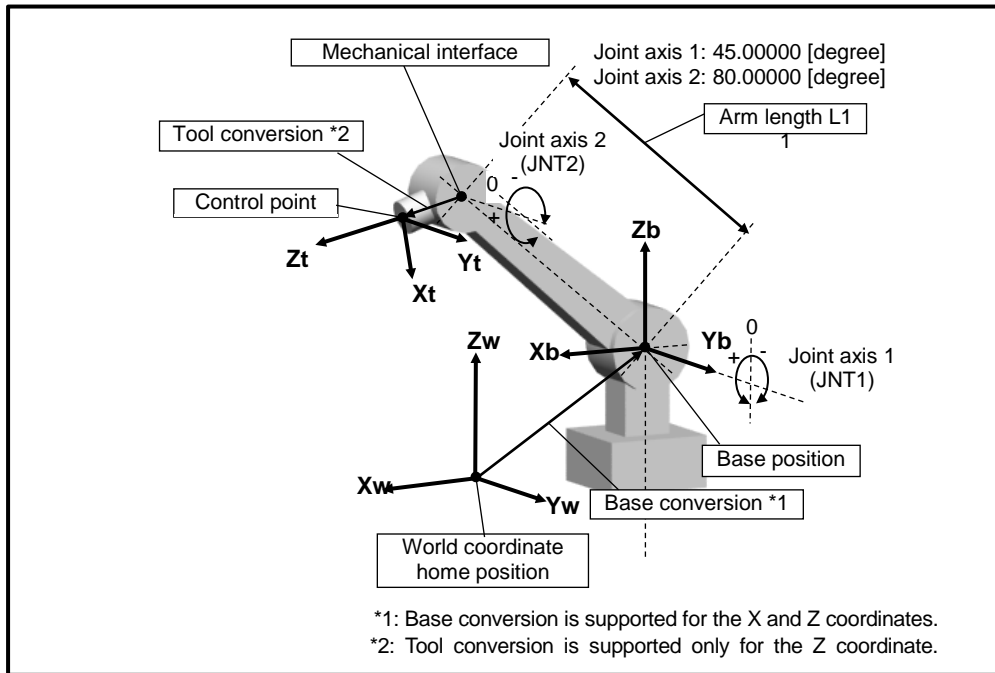


Fig. 2.2 Robot structure

2.2.1 Joint axis configuration

- (1) The robot is a 2-axis (joint axis 1 and 2) configuration vertical articulated robot.
- (2) Refer to Table 2.6 for axis units (axis setting parameter).

Table 2.2 Joint axis configuration

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

*1: Set the operating range so that there is 5.00000 [degree] or more outside of the operating range in 1 rotation.

(3) Configure a system with 0.00000 [degree] positions of each rotating axis as shown below.

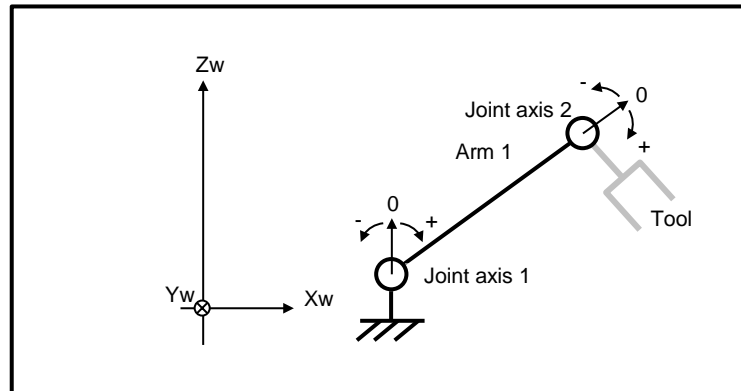


Fig. 2.3 Joint axis of robot

(4) For Type 0, the operating range of joint axis 1 is shown below. Set each axis stroke limit (fixed parameter) within the following operating range.

For Type 1, set the operating range so that there is 5.00000 [degree] or more outside of the operating range in 1 rotation.

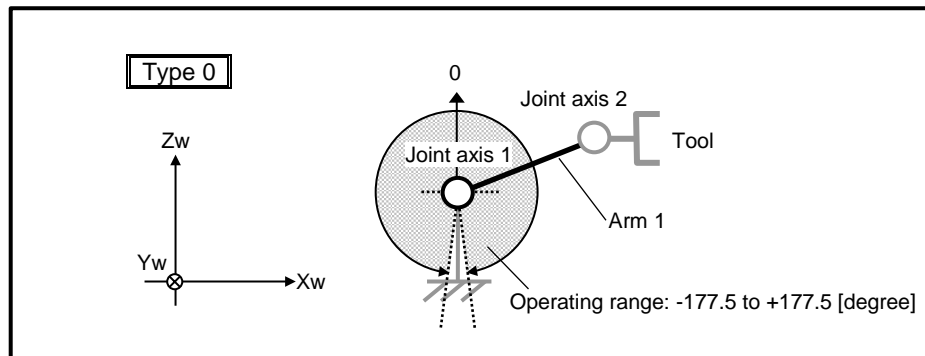


Fig. 2.4 Operating range of joint axis 1

(5) For Type 0, the operating range of joint axis 2 is shown below. Set each axis stroke limit (fixed parameter) within the following operating range.

For Type 1, set the operating range so that there is 5.00000 [degree] or more outside of the operating range in 1 rotation.

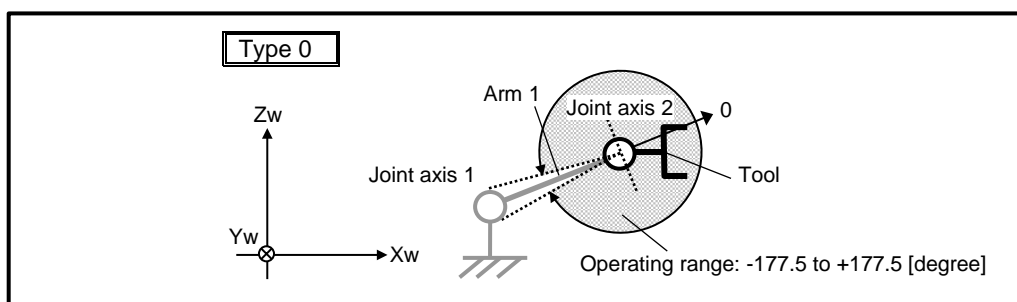


Fig. 2.5 Operating range of joint axis 2

2.2.2 Coordinate configuration

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

The world coordinate system, base coordinate system, and tool coordinate system of the robot 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	Not used.
C	Not used.
FL1	bit 4: Indicates the robot attitude.

Table 2.4 Coordinate system

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

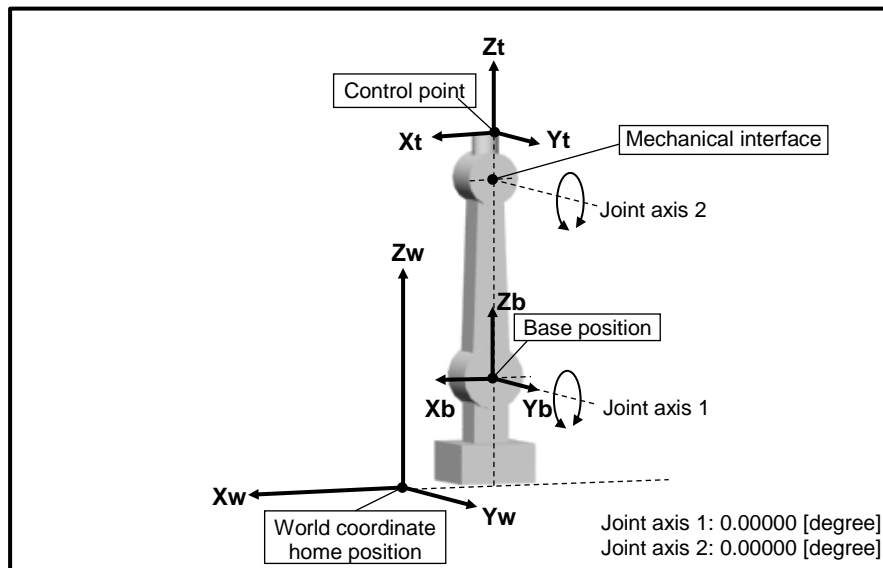


Fig. 2.6 Robot coordinate system

- (2) The base position is a center of rotation of joint axis 1.
- (3) The mechanical interface is the center of rotation of joint axis 2.
- (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 and Z coordinates and the structure flag of the world coordinate system, base coordinate system, and tool coordinate system.

2.3 Positioning control parameters

The following describes the parameters set in machine type R4.

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	4		• Set machine type R4.	—	
	Operating range type *1	0, 1		• Set the operation range of the joint axis 1 and 2. 0: Type 0 (Joint axis 1 and 2: -177.5 to 177.5 [degree]) 1: Type 1 (Joint axis 1 and 2: Arbitrary)	—	
Joint axis structure *1		J1	1 to 64	• Allocate the axis No. to be used for the joint axis 1 and 2.	—	
		J2				
		J3	0	• Joint axes 3 to 6 are not used. Set to 0.		
		J4				
		J5				
		J6				
Arm length setting		L1	0.1 to 100000000.0 [μm]	• Set the arm length of the robot.	(2)	
		L2	0.0 [μm]	• Arm lengths L2 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].	—	
	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)	0.00000 [degree/min]		• Not used. The setting value is ignored.	—	
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, B and C are not used. The setting values are ignored.	(3)	
		By	0.0 to 0.0 [μm]			
		Bz	-99999999.9 to 99999999.9 [μm]			
		Ba	0.00000 [degree]			
		Bb	0.00000 [degree]			
		Bc	0.00000 [degree]			
Tool conversion		Tx	0.0 to 0.0 [μm]	• Set the position of the control point as viewed from the mechanical interface at the power supply ON, or CPU reset. • X and Y are not used. The setting values are ignored.	(4)	
		Ty	0.0 to 0.0 [μm]			
		Tz	0.1 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) 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.

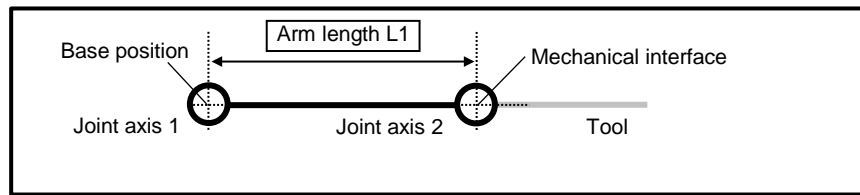


Fig. 2.7 Arm length

When the operating range type is Type 1, and L1 equals Tz, 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 control point overlapping: Fig. 2.8).

[Cautions]

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

In addition, when positioning the joint axis to the singularity, perform with joint interpolation specified by the joint axis coordinates.

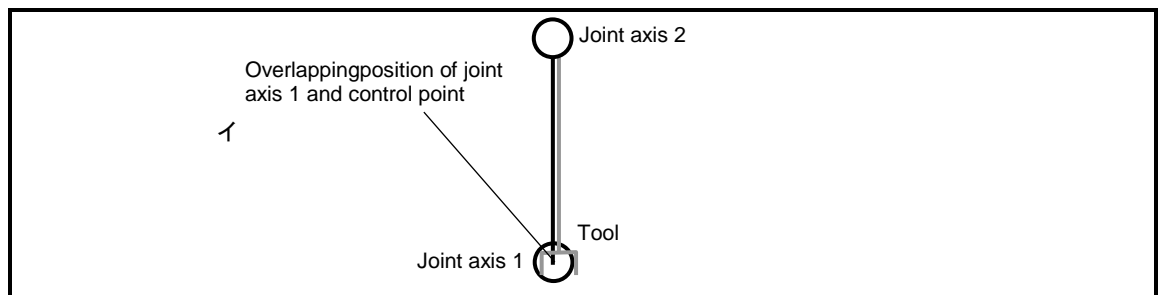


Fig. 2.8 Singularity

(3) Base conversion

Set the base position as viewed from the world coordinate home position.

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

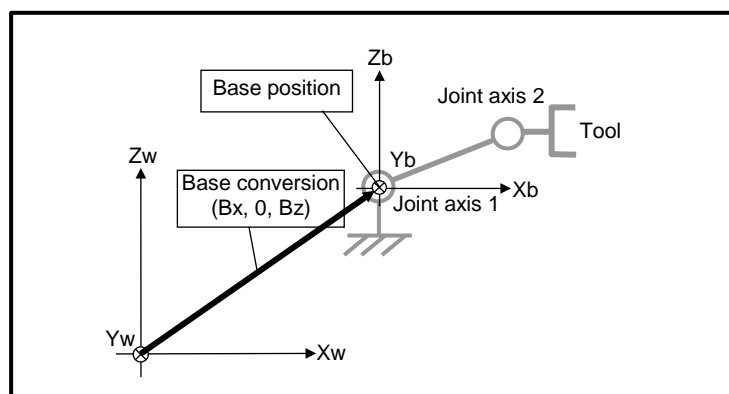


Fig. 2.9 Base conversion

(4) Tool conversion

Set the control point as viewed from the mechanical interface.

The mechanical interface is the center of rotation of joint axis 2.

When the joint axis 1 and 2 are at 0.00000 [degree], the arm extends to Z_t direction of the tool coordinate system (tool conversion: T_z components).

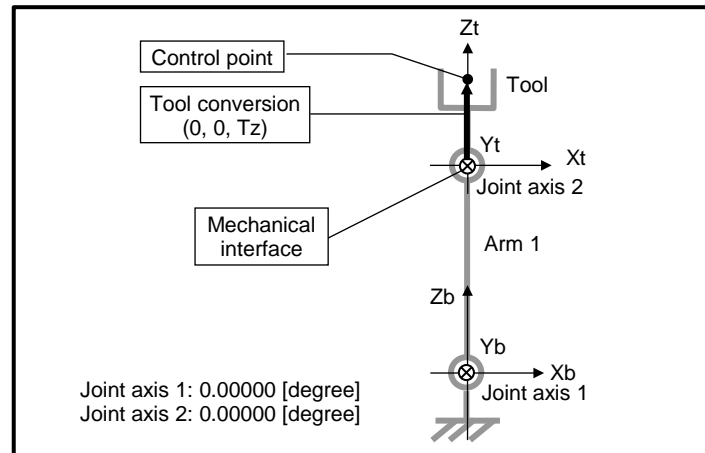


Fig. 2.10 Tool conversion

2.3.2 Axis setting parameter (fixed parameter) settings

In machine type R4, set the following items in the fixed parameter of axes defined as joint axes.

(1) Fixed parameter

Table 2.6 Fixed parameters

No.	Item	Setting value/range [unit] (setting by peripheral equipment)		Remarks
		Joint axis 1	Joint axis 2	
1	Unit setting	degree		• Select [degree] for the unit of the joint axis.
2	Upper stroke limit	Type 0: 0.00000 to 177.50000 [degree] Type 1: Arbitrary		• 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.
3	Lower stroke limit	Type 0: 0.00000 to 177.50000, 182.50000 to 359.99999 [degree] Type 1: Arbitrary		• There are restrictions in the operating range of the joint axis 1 and 2. When setting value is incorrect, a moderate error 30FAH (machine configuration error) occurs. Refer to (2) for details of the stroke limit setting.

(2) Stroke limit setting

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

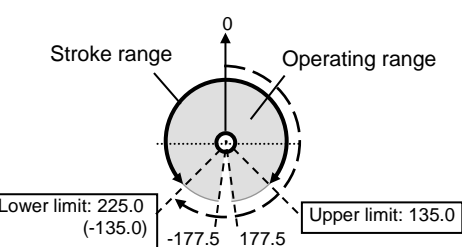
Table 2.7 Operating range of rotation axis

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

*1: Set the operating range so that there is 5.00000 [degree] or more outside of the operating range in 1 rotation.

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

Table 2.8 Stroke limit setting example (Joint axis 1 and 2)

Stroke range	Stroke limit setting value	
	Upper limit [degree]	Lower limit [degree]
	135.00000	225.00000 (-135.00000)

2.4 Point data

(1) When using machine type R4, the setting range of point block data are as follows.

Table 2.9 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 *1		
C	Angle to rotate the C coordinate *1		
FL1	Structure flag 1	H0 to HFFFF	
FL2	Structure flag 2 *1	H0	

*1: The setting value is ignored.

Table 2.10 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	Type 0: 0.00000 to 177.50000, 182.50000 to 359.99999 [degree] Type 1: 0.00000 to 359.99999 [degree]	-359.99999 to 359.99999 [degree]
J2	Position (distance) for moving JNT2		
J3	Position (distance) for moving JNT3 *1	0	
J4	Position (distance) for moving JNT4 *1		
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.

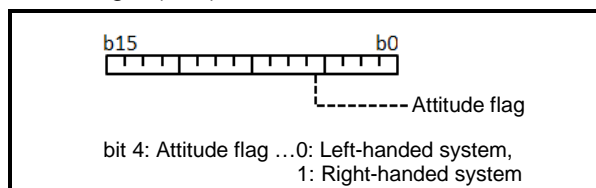


Fig. 2.11 Structure flag 1 (FL1)

(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 1 (FL1) depending to the state of the joint axis 2.

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

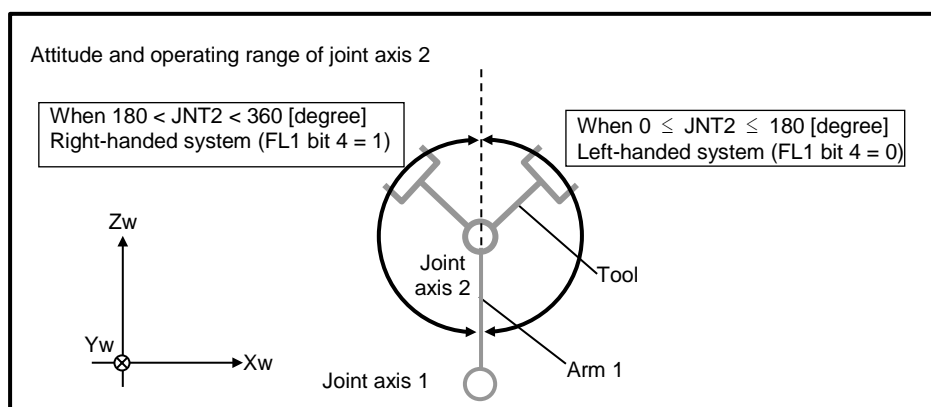


Fig. 2.12 Attitude flag