

Hi4 Function Manual

Endless Rotation User's Manual

(Version 1.0)

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1. In advance using Endless rotation function

1.1 Available software version

Necessary software versions to use Endless rotation function are as following chart

Content	Version	Remark
Main S/W	V10.00-05	After 29 th Nov. 2001
Motion S/W	V7.03	After 29 th Nov. 2001
DSP S/W	V4.03	

Note) The version of software can be checked at Service Menu/System Version.

1.2 Explanation of Endless rotation function for R1(6th) & JIG axes

It is the function that can rotate the R1(6th) axis of robot or Jig axis which is set as a additional axis, over the software limitation. When it activated, the axis rotates within 100 turns in accordance with assigned number of rotation at the pre-appointed step.

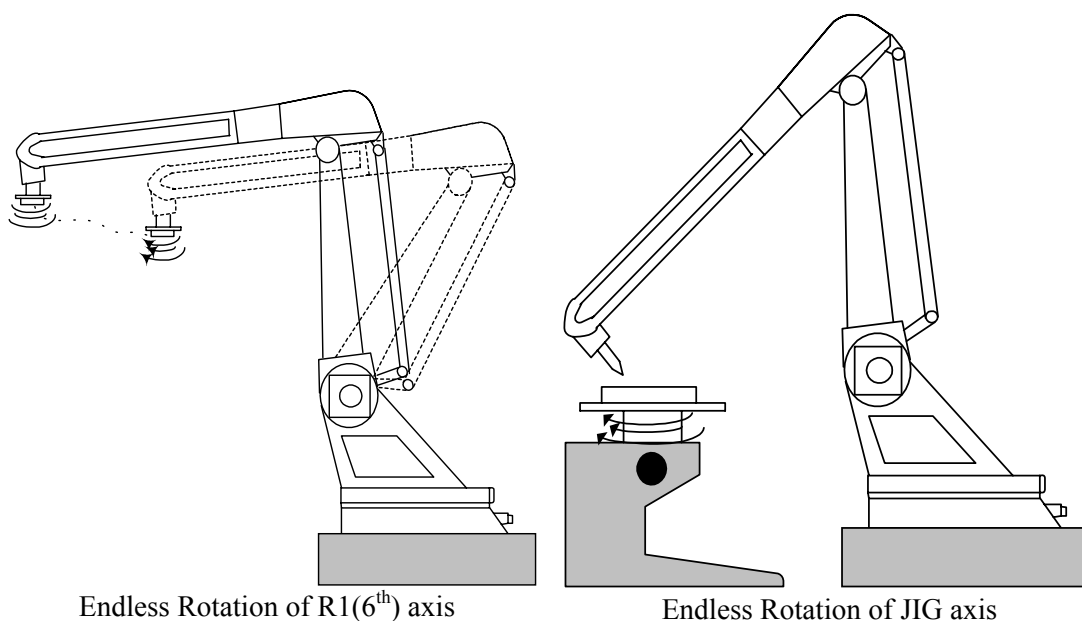
Auto reset function : conversion the position data to the value within the range of 1 turn, when robot's motion is reached at appointed Endless rotation axis step

Manual reset function : conversion the position data to the value within the range of 1 turn, when the step proceeding stopped while in rotation.

Thus, it is not necessary to rotate in counter direction after rotation by using those functions.

Keynote of this function

- ① Easy teaching (can set the number of rotation as a type of assigned figure)
- ② Can rotate over the range of software limitation
- ③ Auto reset function, Manual reset function after temporary stop



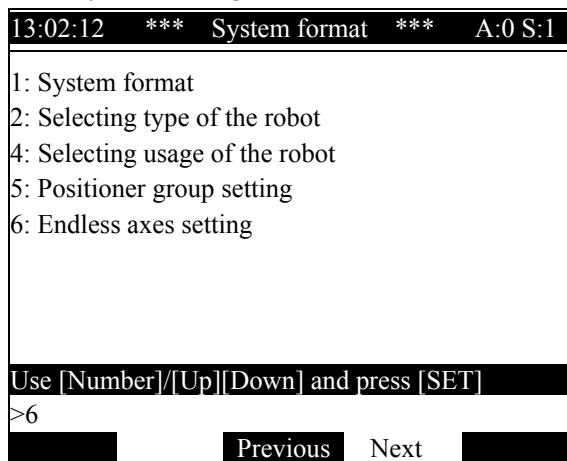
Endless Rotation of R1(6th) axis

Endless Rotation of JIG axis

2. System setting

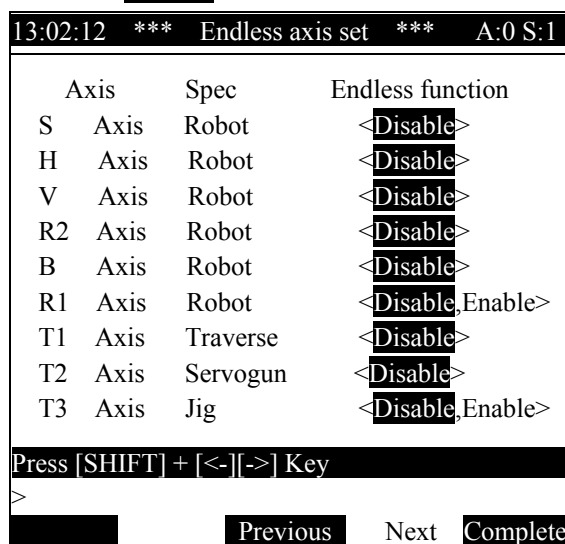
Set the axis which shall adopt Endless rotation function, after set system format and Selecting type of the robot.

System format Menu screen of System setting is as below



If choose '6', the following screen shall be appeared.

It shows that all default values are **Disable**.



In case of robot axis the R1(6th) axis has a choice <Disable,Enable> and for additional axis, the Jig axis only can be selected as a state of disable or enable. Before set, please carefully recheck the mechanism of hardware whether that can rotate or not to prevent serious malfunction.

Note) Precautions

1. Check the interference of Gripper which is attached at R1 axis's flange with robot arm itself to prevent Damage.
2. If the Jig axis is a kind of positioner as such Welding jig, check the mechanical structure whether that can rotate or not.
3. Completed all setting procedure, controller need to reboot.

3. Teaching

3.1 Input the number of rotation

- ① If press CMD key at Manual Mode, the soft key changes as below.

```

13:02:12 *** MANUAL *** A:0 S:2
Select PF menu
>Cmd No=
MOVE,I/OflowCtrl Etc. Arc Weld Assign

```

- ② Press the soft key of PF1 to select **MOVE,I/O**

```

13:02:12 *** MANUAL *** A:0 S:2
Select Command
>Cmd No=1
MOVE PRINT INPUT Sig.Out WAIT +

```

- ③ Change the selectable Command with up/down direction key, and then select Endless.

```

13:02:12 *** MANUAL *** A:0 S:2
[ENDLESS R1=10] Input Command? [Yes/No]
>Cmd No=162
SMOV ENDLESS COLDET +

```

- ④ Press [Yes] key to select ENDLESS command.

```

13:02:12 *** MANUAL *** A:0 S:2
ENDLESS R1=10
Input axis name
>R1
R1 T1 T2 T3 T4 +

```

- ⑤ After move cursor at the Endless rotation axis with up/down direction key, and then select with PF key.
- ⑥ The command inputted. The number of rotation can be modified and it can be selected within the range of -100 ~ 100.
- ⑦ To rotate multi-axes endlessly at same step, multi Endless commands can be inputted as below screen.

```

13:02:12 *** M A N U A L *** A:0 S:2
ENDLESS R1=10
ENDLESS T1=-10
ENDLESS T3=20
S1 MOVE P,S=25%,A=0,T=0
END
Select PF menu
>Cmd No=
MOVE,I/OFlowCtrl Etc. Arc Weld Assign

```

It shows that goal of R1 axis position will be modified as many as 10 turns at Step1, the T1 axis will be modified as 10 turns in reverse direction at Step1 and T3 axis will be modified as 20 turns at Step1.

3.2 Record of Step

(1) When the number of rotation is less than 100

After move R1 axis and additional axis to target position, record the Step as interpolation OFF status.

```

13:02:12 *** M A N U A L *** A:0 S:2
ENDLESS R1=10
ENDLESS T3=20
S1 MOVE P,S=25%,A=0,T=0
Select PF menu
>Cmd No=
MOVE,I/OFlowCtrl Etc. Arc Weld Assign

```

Note) Precaution

1. The interpolation of Endless rotation step must be selected P(interpolation OFF) status.
2. If the interpolation selected as linear(L) or circular(C) at step the Endless rotation function shall not executed.
3. Only the very next step effective after Endless rotation function. To use this function at the other step it need to record again at that step.
4. The recorded position of Step is recorded position + number of rotation * 360(deg).

(2) When the number of rotation is over 100

It needs to record 2 times with same step.

```

13:02:12 *** M A N U A L *** A:0 S:2
ENDLESS R1=100
S1 MOVE P,S=25%,A=0,T=0
ENDLESS R1=100
S2 MOVE P,S=25%,A=0,T=0
Select PF menu
>Cmd No=
MOVE,I/OFlowCtrl Etc. Arc Weld Assign

```

The Endless rotation range is -100 ~ 100 . That is why it cannot rotate over 100 turns repeatedly.

However if you record 2 times, it can rotate over 100 turns. That means that the range is not limitation for same direction but limitation for 1 time.

Note) In case of setting 2 more times with same rotation axis

In this case the last command only valid.

```

13:02:12 *** M A N U A L *** A:0 S:2
ENDLESS R1=10
ENDLESS R1=10
S1 MOVE P,S=25%,A=0,T=0
Select PF menu
>Cmd No=
MOVE,I/OFlowCtrl Etc. Arc Weld Assign
    
```

For instance, refer to above screen the target position is recorded position+10 turns position at S1 Step. Even if the sum of both number of rotation is less than 100, the last line command only shall be executed.

Note)

- Function to activate Endless function must be placed and recorded before the step to be used in Endless function.** General function recorded in step is executed after reaching to Step. However, in Endless function, and rotated position is changed as target position as much as number of turns from the next step of the reference position after defining number of turn.

Therefore Endless function must be placed and recorded right before the reference step

Example)

Namely if current the position of R1 is 30 deg and the following program is programmed, target position is calculated in following format. In order to assign step 1 as endless rotation Step, place Endless function right before step 1.

```

13:02:12 *** M A N U A L *** A:0 S:2
ENDLESS R1=10
S1 MOVE P,S=25%,A=0,T=0
END
Select PF menu
>Cmd No=
MOVE,I/OFlowCtrl Etc. Arc Weld Assign
    
```

Target position of R1 axis in Step S1 and reset position	
R1 target position of Step 1	= Recorded position of R1 + 360*Number of turn = 30(deg) + 360(deg/count)*10(count) = 3630(deg)
auto reset position after reaching step	= Recorded of R1 = 30 (deg)

- Reference step for endless rotation is only valid in interpolation OFF .(Motion version mv7.03)
- ENDLESS function is valid in single step and afterward step is not valid.

4. Playback

4.1 Operation method

- ① Mode on the controller cabinet is switched to 'AUTO'.
- ② Press start button on the controller cabinet.
- ③ Press button on the cabinet.

4.2 Continuity

Step assigned as Endless function is always non continuous step (Assigned step is the step at the right after Endless function command)

4.3 Execution condition of ENDLESS function

- 1) Execute program in AUTO
- 2) Even though in the manual mode, except step back case, Endless function can be executed

4.4 Stop of Endless step in rotation

When operator activates stop in rotation of reaching to step assigned as endless step, robot stops and current axis position is not reset automatically. Select Monitoring/ 1:Axis data Service menu to check current turning number,

Note)

1. If stop is activated during endless rotation, turning number might be over-much. In this case, be careful that current position can be recorded if step position modification and step record is carried out.
2. In this case, reset the value within one turn and record to clear the problem.(Refer to R350 CODE)

4.5 Restart after stop

Remaining turning will be carried out as restart is pressed after stop in step. Number of turning is reset after reaching step

5. Reset function of Endless axis

Reset of an endless rotation axis is the function that converts encoder value and number of turn in each axis to the value between $-180(\text{deg}) \sim 180(\text{deg})$.

When the next step is moved without resetting the number of turns, the following problem will be resulted.

- ① If the following step or the next step is either linear or circular interpolation step, interpolation can not possibly anticipate the movement
- ② If the following step is interpolation off step, reverse rotation in number of turn must be carried out to return the concerned position

5.1 Implementation of Reset function of Endless axis

The case where reset function of endless rotation axis is performed is as follows

- ① In the case of axis rotate amount of endless axes are out of the range between $-360(\text{deg}) \sim 360(\text{deg})$ on power ON, the rotate amount of endless axes are reset to the value between $-180(\text{deg}) \sim 180(\text{deg})$ when controller's initialization
- ② In the case of reach of step after ENDLESS function recorded
- ③ In the case of ENDLESS RESET function is recorded in the program
- ④ In the case of using R350 code to reset endless axes in manual/auto mode, rotation amount turns to the value between $-180(\text{deg}) \sim 180(\text{deg})$

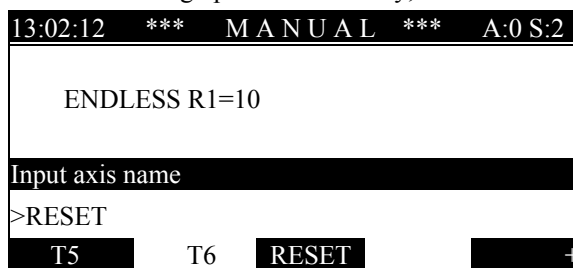
5.2 Manual reset function

If you stop the step of endless rotation during playback, reset is not activated automatically. So It might cause large rotation amount of endless axis. Besides position of teaching point can be over 1 turn without recording ENDLESS function. In these case, it is useful when a user want to modify the rotate amount of endless axes within one turn ($-180^\circ \sim 180^\circ$) without reverse rotating action.

However, in the case of the step that ENDLESS function is recorded, as reaching the step, automatically reset function is activated, so it is no necessary to use manual reset function.

5.3 Usage in the step recording

Find ENDLESS and RESET command using up/down arrow key, and enter the RESET command.



```

13:02:12 *** M A N U A L *** A:0 S:2
S1 MOVE P,S=25%,A=0,T=0
   ENDLESS RESET
Select PF menu
>Cmd No=
MOVE,I/OFlowCtrl Etc. Arc Weld Assign
    
```

The way of recording is as upper example, and reset is the axis which is endless enable and is over range from -180(deg) to 180(deg).

Note)

1. ENDLESS RESET command is the function that is executed after reaching to step.
2. In the case of the step that ENDLESS function is recorded. As reaching the step, automatically reset function is activated, so it is no necessary to use manual reset function.
3. This function is used when software limit of axis is set over -180° ~ 180°, step data is over the range, so it is used if you want to reset within one turn(-180° ~ 180°).

5.4 Usage for R350 Code Input

R350 CODE that can be used in manual/auto mode at the robot stop can be used in following cases

1. When operator intentionally and excessively rotates axis which is set as endless axis
2. When stop during endless rotation is pressed and Emergency STOP is activated

This code is used in resetting number of turns with manual.

```

13:02:12 *** M A N U A L *** A:0 S:2
Enter axis number to reset (0, 6-12)
>R350,0
Service System Rel. WAIT Cond Set
    
```

Usage of R350 CODE

R CODE	Parameter	Contents
R350	0	Reset of all axes
	6-12	Reset of proportional axis

6. Error Code

The following errors might be occurred in using Endless rotation function. Meaning of errors and countermeasures are also illustrated in following.

E0108 ○Axis)Enc Err:Encoder reset needed

When Encoder value of axis is within area that is not internally calculated. It is necessary to redo encoder offset calibration to the concerned axis

E0172 ○Axis)Improper Endless rotation

When encoder value difference between the moment of controller power off and power on is large. This is actually caused when brake for axis using endless rotation function is released and overload rotation is carried out at the controller power off. In order to resolve the problem, it is necessary to redo encoder offset calibration to the concerned axis

E0173 **Endless rotation overflow**

Rotation is over the limit in the number of turns to software control.

Reference step in endless rotation is ranged within $-180^{\circ} \sim 180^{\circ}$. Recorded position will be large as stop during endless rotation is pressed and a step is recorded. Check step data of endless rotation reference step.

If step data is O.K, reduce the number of turns to be set in one turn for setting.

E0193 **Improper Encoder for Endless**

For Endless function, software only support encoders that has 1024 or 2048 or 4096 or 8192 pulse per one turn of motor. Check encoder setting.