WARNING

THE INSTALLATION SHALL BE MADE BY QUALIFIED INSTALLATION PERSONNEL AND SHOULD CONFORM TO ALL NATIONAL AND LOCAL CODES

Hyundai Robot

Hi4aER071001FMEN3

Hi4a Controller Function Manual

Endless Rotation

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Before using the function

1.1. Software version that is possible to use

- Minimum Hi4a version to use the main function is as following.

Table 1-1 Minimum controller setting to use the endless rotational function

Items	Version
MAIN S/W	V10.00-05
MOTION S/W	V7.03
DSP S/W	V4.03

It can confirm at the main version of 『[PF1]: Service』 → 『7: System checking』 → 『1: System version』.

1.2. Endless function of R1 and JIG axis

The function uses at the additional-axis to set up of R1 axis or JIG axis of robot and can use as two ways.

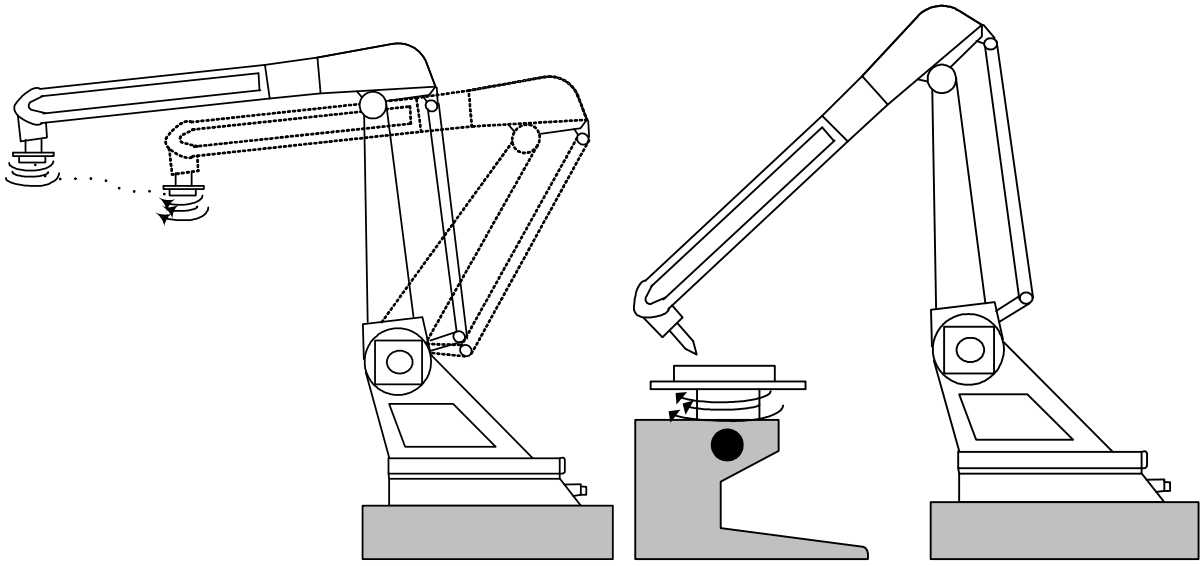
The first, designate the number of rotation (within 100 rotations) and program the axis to rotate as much frequency as designated.

The second, rotatory angle of endless within ± 180deg exceeds the range; it is possible to convert to the rotatory angle within same rage mechanically.

※ For example, rotatory angle 370deg is identical with 0deg mechanically. If you use the main function at the time, it changes the current location from 360deg to 0deg.

- Special feature of function

  ① Simple designation in number of rotation (Support exclusive function)
  ② Rotation is possible within the range that doesn't get out of the range of softlimit
  ③ Automatic reset function as the angle within 1 rotation when reaching at the step location
  ④ Endless reset function that is calculated by the angle within 1 rotation



R1 axis Endless function JIG axis Endless function

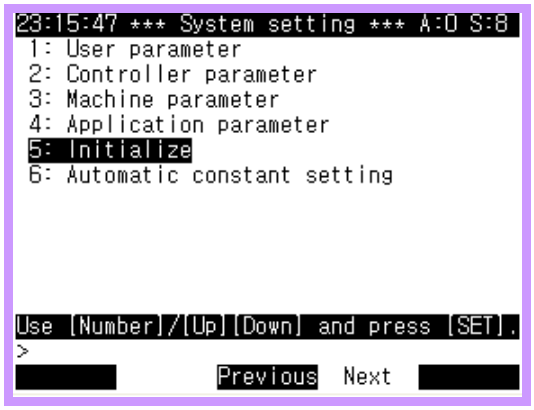
Figure 1.1 Endless function of R1 and JIG axis

It can use the endless rotational function at R1 axis and rotational JIG axis as above diagram.

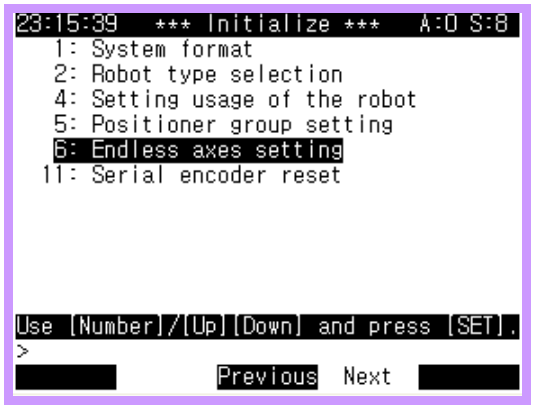
2
Initialize Setting

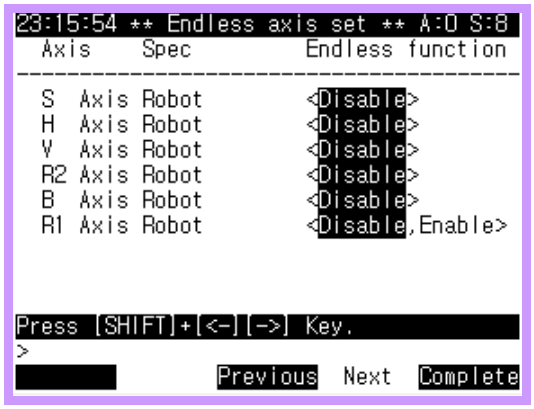
Set the axis to use the endless function after setting the initial stage of system and selecting the robot type.

(1) 『5: Initialize』 menu of 『[PF5]: System setting』 is same as following.



(2) If you select the item number 6 from above screen, the screen to set up the setting about the each axis and endless rotational axis.





(3) In the case of robot axis, R1 axis is possible to select the <Enable, Disable>, and it's possible to set up the Endless function of JIG axis in the case of additional-axis.

◆【Caution】◆

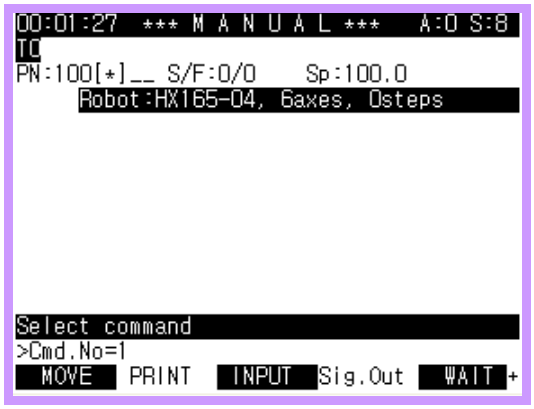
- Endless rotational function can be used at R1 axis or rotational JIG axis.
- JIG axis which uses the endless rotational function has to be designed without any machine interference.
- Even though endless axis rotates several times, it has to be installed with no interference of other installed devices.
- After set up, endless rotational function is possible when inputting the power of controller again.

3
Teaching

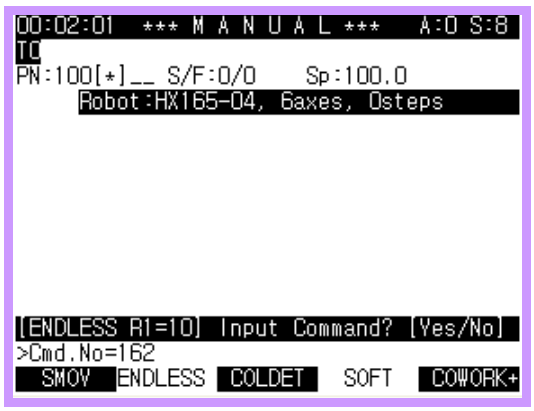
3.1. Input method of Endless rotation counter

(1) It shows the following if you press the『CMD』key at the manual mode.

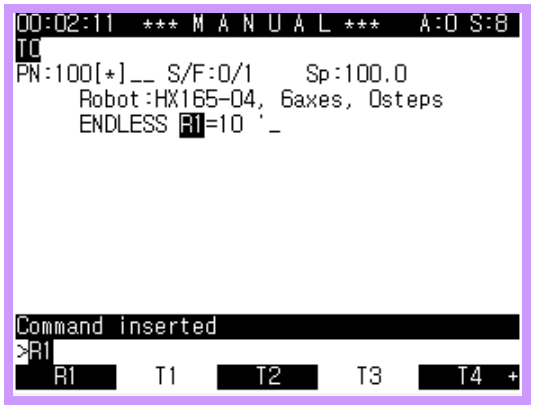
(2) Select『[PF1]: MOVE,I/O』.



(3) Change the instruction that is selectable using up/bottom arrow and select Endless.



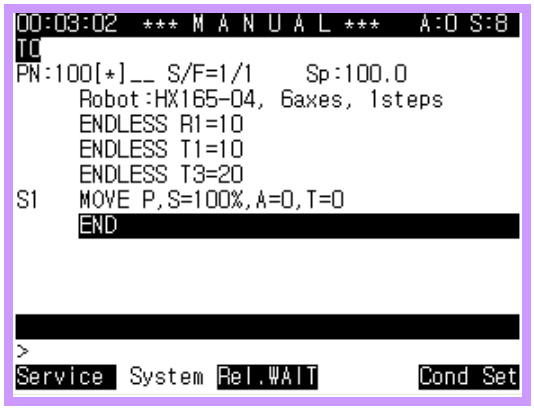
(4) Select the ENDLESS instruction by pressing [Yes] key.



(5) Indicate the key Endless rotation using the up/bottom key and select PF key.

(6) It inputs the instruction when selecting. At the time, rotational quantity is possible to correct and designation of rotational quantity is possible from -100 rotations to ~ 100 rotations.

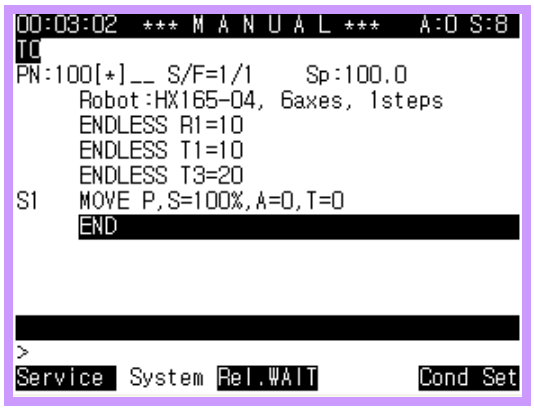
(7) In order to endless rotate the several axis at the identical step simultaneously, input several ENDLESS instruction as following.



In the above case, R1 axis at the recording location of step 1 to the 10 rotated location, T1 is from the recording location of step 1 to the -10 rotated location, T3 axis is the target location of 30 rotated location from the recording location of step 1.

3.2. Step recording

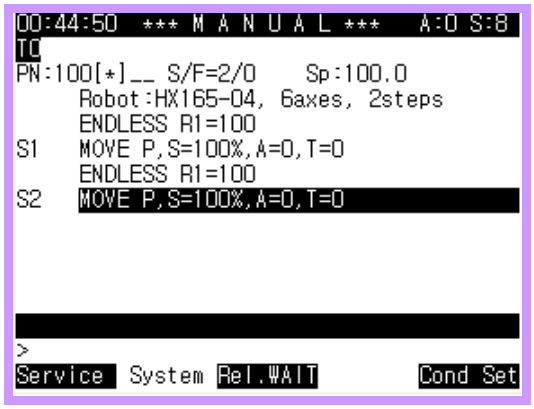
(1) Rotation quantity designates below 100 rotation
Record the step as the interpolation OFF after moving the target location of robot and additional-axis



Caution) Be cautious about following facts.

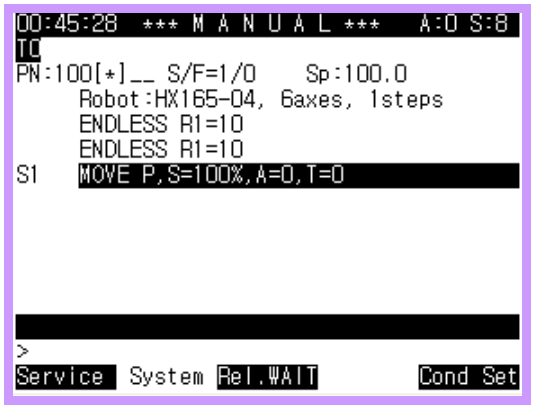
- Interpolation of endless rotational step must be selected as P (interpolation OFF) .
- The step that is taught as straight line(L) and circular arc (C) doesn't execute the endless rotational function.
- The function is valid only at the initial step after ENDLESS function is recorded and designates again after this step.
- The target location of step becomes user's 'recording location + rotation number × 360(deg)'.

(2) Rotation quantity designates over 100 rotations.
Record twice the identical step as following.



ENDLESS function is possible to input only the rotation quantity of -100~100, so it's impossible to rotate over 100 rotations continuously. If you only record the identical step twice as following, endless rotates towards identical direction. (However, S1 and S2 operate discontinuously.)

Caution) In the case of designating the identical rotation axis as identical step twice
Against the identical step, designated rotational number of final instruction is only valid when designating the identical rotational-axis.

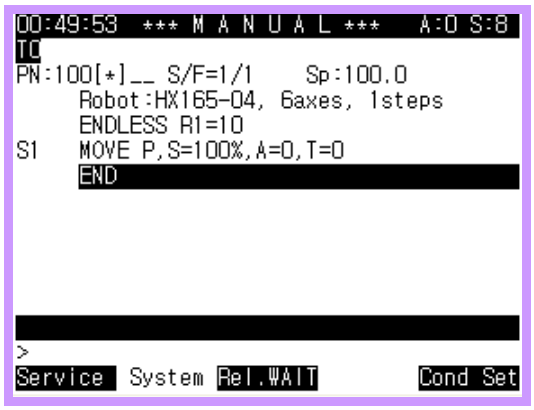


In the case of above, the target location to move the S1 step is 『recording location + 10 rotational location of R1』. In the case of above, be cautious that it doesn't add the sum of two rotational quantities even though it is below 100 and recognizes the total values.

Caution) Be cautious about the following factors.

- Endless function to execute the function has to be recorded before the executed step. The ENDLESS function has to be reflected at the location of step comes right after the rotation quantity that is set up.

  Example)
  Namely, the current location of R1 is 30 deg and the target location is as following if it is programmed as following.



Target location and reset location of R1 axis of step S1	
R1 Target Location	= Recording location of R1 + 360 × recorded rotational quantity = 30(deg) + 360(deg/count) × 10(count) = 3630(deg)
Automatic reset location after step reaching	= Recorded location of R1 = 30 (deg)

4
Playback

4.1. Operation method

(1) Switch the mode of controller to “auto”.

(2) Press the “START” button from controlled pannel.

(3) Press the “STOP” button from controller pannel when you want to stop.

4.2. Continuous process

Designated step of ENDLESS function is discontinuity step. (Step that is followed by Endless function)

4.3. Running condition of ENDLESS function

(1) Execute the program at the automatic mode.

(2) In the case of ‘Step forward’ at the manual mode, the function of ENDLESS function is enable and ‘Step backward’ is disable.

4.4. Stop while rotating of endless step

When user stops discretionally before reaching to the endless designation step, the robot stops and the current axis location doesn’t automatically reset. In the case that you want to know the current rotation quantity, you can understand the location of axis that current controller recognizes using『axis data』monitoring function of service function.

Caution) Be cautious about the following factors.

- You can be at the location to get the softlimit out if you stop when rotating the endless. In this case, be cautious to not to record the location if it corrects the location of step or records the step.
- In this case, the problem solves if you record the step after resetting to the value within 1 rotation. (Reference R350 CODE)

4.5. Restart after stopping

It moves as much as remained rotation quantity if you restart after stopping the step. It resets the rotation quantity when reaching to the step after moving.

5

Reset Function of Endless Axis

Reset in endless rotational axis is the function to calculate the value between -180(deg) ~ 180(deg) which the encoder value of corresponding axis and number of rotation are 1 rotation.

There is the inconveniency in the case of moving to the next step when the rotation quantity is not reset. If the location of current axis is 720deg, there is the problem to backlash until 710deg when the location of next target step is 10deg. You can use the reset function of endless axis if you don't want the backlashing.

5.1. Reset function run of endless axis

The case of endless rotational-axis reset function performs as following.

(1) When inputting the power of controller, the value between -180(deg) ~ 180(deg) when inputting the power resets automatically in the case that endless rotational-axis is not within the range of softlimit.

(2) In the case of reaching the ENDLESS target step,

(3) In the case that the ENDLESS RESET function is recorded during program instruction,

(4) In the case of resetting to the R350 code at manual/automatic mode,

5.2. Explanation of manual reset function

The step that is designated the ENDLESS function, there is no need to use the manual reset function because it resets automatically when reaching the target location. Because it doesn't automatically reset when you stop the robot optionally, the function is to use when resetting the rotational-axis within the value of 1 rotation.

5.3. Use method of step recording method function

(1) Input after finding RESET instruction and find RESET and input at the axis name using the selection key of top/bottom direction.

(2) If it records as above, setup of endless axis from S1 step becomes Enable and RESET the axis that is not on the rotation quantity within -180(deg) to 180(deg).

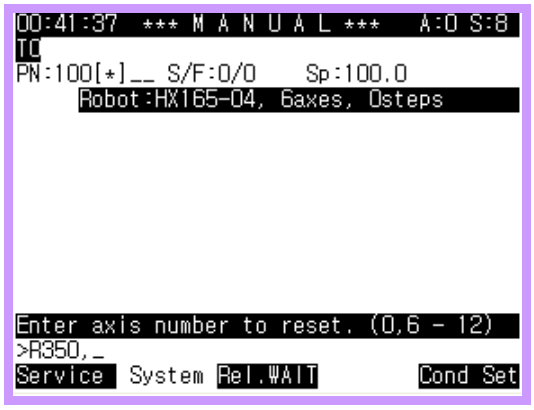
Caution) Be cautious about the following factors.

- ENDLESS RESET instruction is the function to execute after reaching to the step.
- There is no need to input the separate ENDLESS RESET instruction because the rotational quantity sets up automatically when reaching at the step designated by rotational quantity or endless.

5.4. Use method of R code input function

Rcode is possible to use at the manual/automatic mode while the robot is in stop and it's the manual rotational quantity of endless-axis reset function in the case that user rotates the axis excessively or inputting the emergency stop key as stopping during the endless rotation.

Use the R350 code.



■ Parameter explanation of R 350 CODE

R CODE	PARAMETER	EXPLANATION
R350	0	Reset about entire axis
	6-12	Reset of corresponding axis number

6
Error Code

This is the error lists that can occur while using the endless rotational function. Refer the below about the meaning of error and the plan to manage the problem.

Code	E0108 (axis ○) Enc Err:Encoder reset needed
Cause	Encoder data is out of the offset function application range.
Action	Refer to『Hi4a Controller Maintenance Manual - 5.1 Troubleshooting cases』

Code	E0172 (axis ○) Improper Endless rotation
Cause	Difference between the endless axis encoder value that is backed up and the read value when initializing is more than 0x20000.
Action	- Calibrate the endless axis encoder offset once again. - Reset the endless axis encoder and then Calibrate the encoder.

Code	E0173 Endless rotation overflow
Cause	Recorded location of endless step is in excess of encoder using range.
Action	Reset the endless position manually with R350 code, and then correct the step position.

Code	E0193 (axis ○) Improper Encoder for Endless
Cause	Pulses per rotation is incorrectly set in the first time of endless axis encoder type.
Action	Check if PULS value is 1024, 2048, 4096, 8192 for the servo parameter/motor, encoder type in the menu.

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