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HEAVY INDUSTRIES CO.,LTD.

WARNING

INSTALLATION SHOULD ONLY BE PERFORMED BY QUALIFIED INSTALLATION PERSONNEL AND MUST CONFORM TO ALL NATIONAL AND LOCAL CODES

Hyundai Robot

Hi5AA091101FMEN1

Hi5 Controller Function Manual

Additional Axis

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Contents

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1 Introduction

The main purpose of this chapter is to describe the registration of an additional axis to the robot.

[Steps of registration]

- Preparations

  (1) Prepare the body (robot + additional axis) and wire harness.

  (2) Prepare controller, BD542 1 set (if applying more than 3 additional axes), additional axis AMP and various cables for signals.

  (3) Additional axis constant
  Prepare input data, including axis specifications and configuration of additional axis, reduction ratio, motor and AMP, according to the registration form of additional axis constant (Clause 3.2).

  (4) Acceleration and deceleration time of additional axis
  Prepare data to input the acceleration and deceleration time of additional axis command (Clause 3.2).

- Registration of robot type and additional axis constant parameter
  Connect wire harness between the body and controller, initialize the system, select a robot type, input the number of additional axes and input the additional axis constant. (The maximum number of control axis is total 16 axes including robot)
  - In the event that the robot is shipped after registering a robot type and additional axis constant parameter, the steps described above will not be required.

- Connection and inspection
  Turn off the power of the controller → Connect a wire required for the body and controller → Turn on the power of controller → Calibrate encoder and set servo gun to base location (Axis constant).

- Completion
  Set the operating environment of additional axis, and save ROBOT.MCH file to an external memory unit (HRView, USB memory).

2 Preparations

- Confirm all parts and materials to be connected.
- Confirm that the pre-calculated data or selected additional axis information are prepared. Reduction ratio, AMP specification, Motor specification, maximum speed, acceleration time, etc.
- The following describes the appropriate combination of BD542 and AMP according to the number of axes:

  1 ~ 6 axes (Basic 6-axes robot): BD542 1 unit, 6 axes AMP 1 unit
  7 ~ 8 axes (Basic 6 axes + up to 2 additional axes):
  BD542 1 unit, 6 axes AMP 1 unit, 1 axis AMP 2 units
  More than 9 axes: Please consult with our company to determine system configuration.

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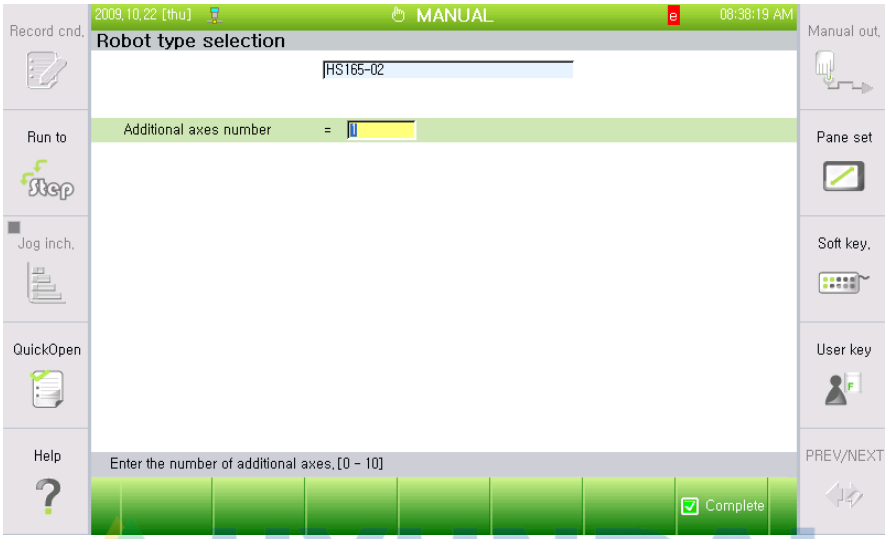
Registration of robot type and Additional axis constant

3.1. Setting robot type and the number of additional axes

(1) Select a robot type to be used by selecting 『[F2]: System』 → 『5: Initialize』 → 『2: Robot type selection』 from the menu in manual mode.

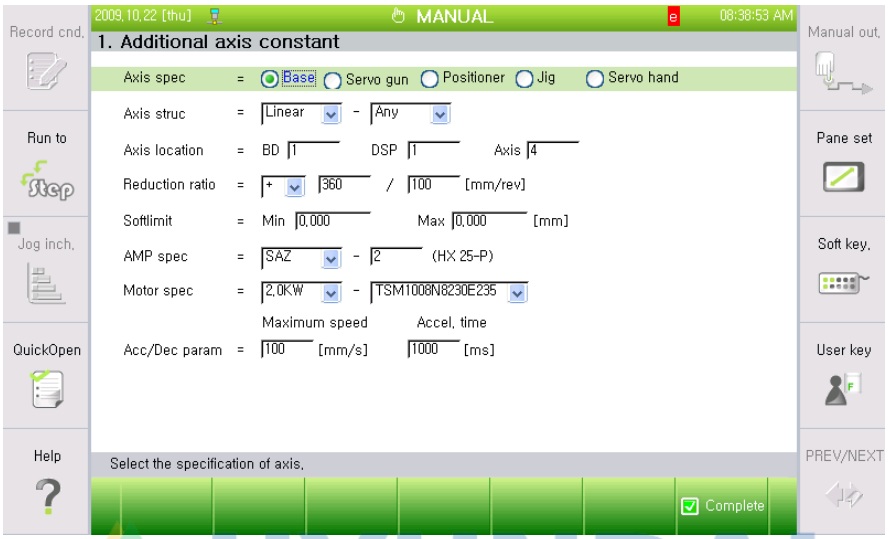


(2) Input the number of additional axes and press 『[F7]: Complete』 key to enter the additional axis constant setting menu in Clause 3.2.

※ Setting a robot type and additional axis constant is only available in the status when engineer code (R314) has been input. The “e” at the upper right of the monitor screen above indicates that the engineer code has been input.

3.2. Additional axis constant setting

(1) Select 『[F2]: System』 → 『5: Initialize』 → 『5: Additional axis constant』 from the menu in manual mode.



(2) Set the additional axis constant.

(3) To save the set data, press the 『[F7]: Complete』 key.

◆ 【Additional axis constant】 ◆

(1) Axis specification:
Select an additional axis type from <base, servo gun, positioner, jig, servo hand>.
When deciding an additional axis specification, the order of [base → servo gun → positioner → jig → servo hand] should be observed, according to the logical order of the additional axis.

(2) Axis configuration: Select the operating form and direction of the axis.
Select <X> for front/rear axis movement, <Y> for left/right axis movement and <Z> for up/down axis movement when using a translation base axis (drive axis). Select <Optional> and execute 『Base axis calibration』 if the base axis is not installed in the same direction as the robot coordinate system. Select Rx/Ry/Rz or <Optional> and execute 『Base axis calibration』 for a rotation base axis, in the same manner as for translation base axis. Refer to 『Spot welding function manual』 if setting servo gun, and 『Positioner synchronization function manual』 if using positioner.

(3) Axis location: Assign mechanical configuration of additional axis to be used by user.

BD	=[1](1~2)	=> Assign BD542 board No. (2DSP/1Board)
DSP	=[1](1~2)	=> Assign DSP No. inside of DSP BD542 board. (4Axis/1DSP)
Axis	=[4](1~4)	=> Assign axis No.

Ex.) If assigning as 1,1,4 for setting additional axis No. 6…
Basic axis 6 axes – main 3 axes (BD542 No. 1, DSP No. 1, 1~3 axes)
3 wrist axes (BD542 No. 1, DSP No. 2, 1~3 axes)
Additional 1 axis (BD542 No. 1, DSP No. 1, axis No. 4)

(4) Reduction ratio: Register the moving distance of the axis per motor rotation.
Register the moving distance of axis per number of motor rotations in mm, and the rotation angle of the axis per motor rotation in degrees for translation axis. Set “+” for symbol if the grid value of the additional axis is increased, and “-“ for symbol if the grid value of the additional axis is decreased, since the forward direction of the motor (direction of encoder is increased) conforms to the direction of axis motion. Please refer to the following examples.

Ex. 1) For a rotation axis using 1/100 reduction gear only…
Axis rotates 360 degrees with 100 rotations of the motor,
Reduction ratio = + 360 / 100 [deg/rev]

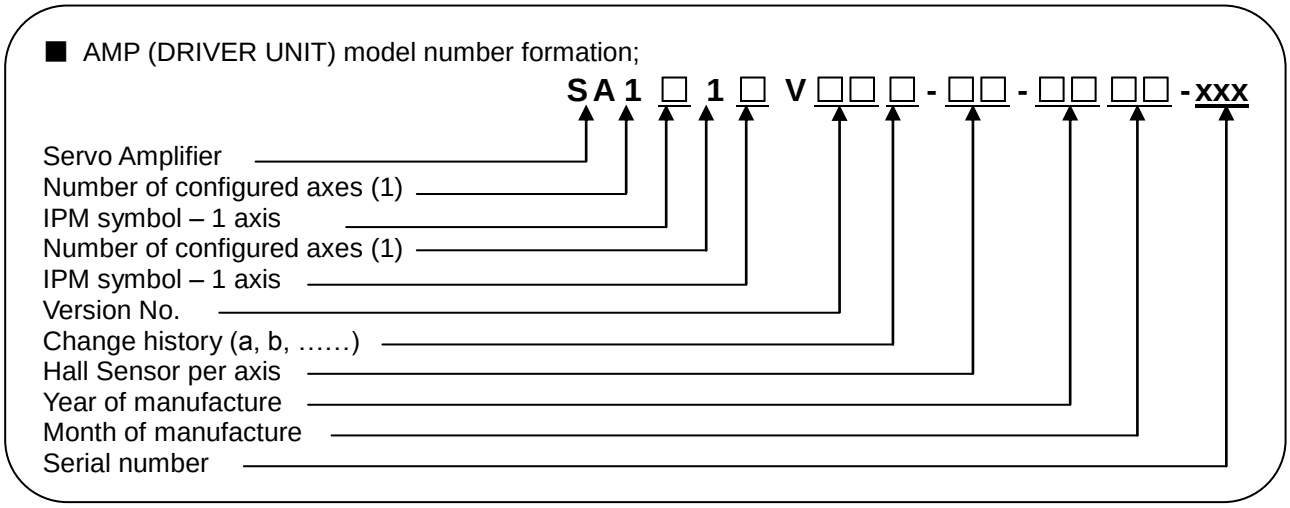
Ex. 2) For a translation axis using 1/20 reduction gear and PCD 110mm rack and pinion…
Axis moves 110xPhi (=3.14159)=345.5749[mm] with 20 motor rotations
Reduction ratio = + 3455749 /200000 [mm/rev]

Ex. 3) For a translation axis using 1/5 reduction gear and Lead 5mm ball screw…
Axis moves 5 mm with 5 motor rotations
Reduction ratio = + 5 / 5 [mm/rev]

(5) Soft limit: Set valid moving zone of robot (Soft limit of additional axis).
If setting translation axis in [mm] and rotation axis in [degrees], setting values will be reflected in 『[F2]: System』 → 『3: Robot parameter』 → 『3: Soft limit』.

(6) AMP specification: Select the AMP specification to be used for the additional axis.
Select the AMP specification by selecting the IPM signal form and inputting Hall Sensor specification as a number from 0 to 5. The form specification of AMP is as follows.

■ AMP (DRIVER UNIT) model number formation;



The following rated capacity will be given according to IPM symbols and Hall Sensor symbols.

AMP Model	IPM symbols	IPM Current rate	Hall Sensor	Full Scale current
Large	L	150Apeak	0	140.62Apeak
			1	93.75Apeak
	X	100Apeak	2	46.87Apeak
	Y	75Apeak	3	28.12Apeak
			4	18.75Apeak
	Z	50Apeak	5	9.37Apeak
Small	A	30Apeak	3	28.12Apeak
			4	18.75Apeak
	D	10Apeak	5	9.37Apeak

(7) Motor specification: Select the motor specification used for additional axis.
Select motor capacity first, and then select motor specification.

(8) Acceleration and deceleration parameter: Set the maximum speed and acceleration time of the additional axis.
These setting values will be applied in the same manner as the setting values of [F2]: System』 → 『3: Robot parameter』 → 『34: Accel and decel parameter』. The maximum speed of the additional axis is assigned by the user, and is restricted according to the rated speed of motor. If vibration occurs during the operation of an additional axis, acceleration time should be adjusted.

3.3. Mechanism setting

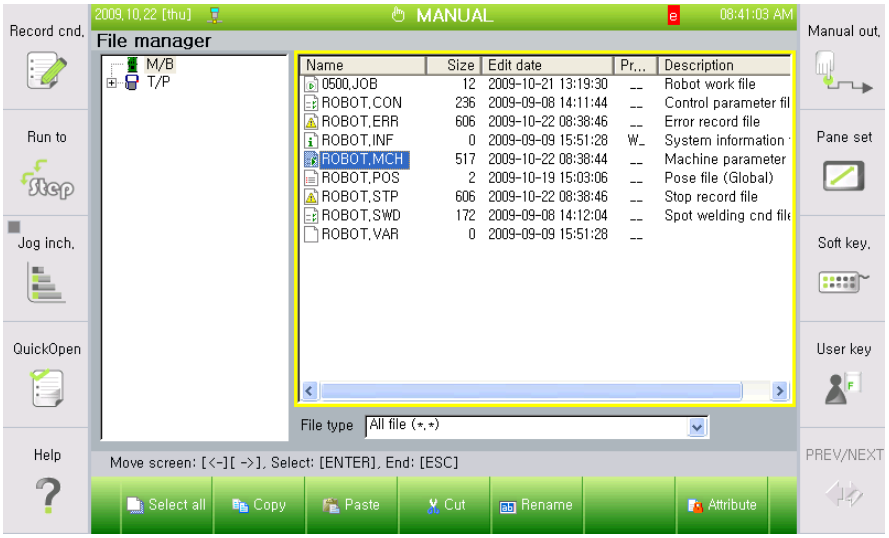
(1) Mechanism setting

Select 『[F2]: System』 → 『5: Initialize』 → 『6: Mechanism setting』 from the menu.

When in manual control mode, the mechanism group of the additional axis should be configured to allocate a jog key according to the mechanism group. Robot axis is locked up as mechanism M0, and additional axis shall be selected by classifying it into mechanisms M1~M7.

(2) Constant file backup

Copy the constant file (ROBOT.MCH) to USB memory by selecting 『[F1]: Service』 → 『5: File manager』 from the menu, or copy the file to the computer using HRView after completing additional axis setting.



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Teaching & playback

4.1. Manual control (Jog)

(1) When pressing [mechanism] key while in mechanism status of status display window on top of T/P, T/P will be displayed as [1] and manual control of mechanism group No. 1 will be enabled.

(2) Manual control of the additional axis delivers separate movement of the axis, regardless of the coordinate system. However, drive axis will move according to the coordinate system selected, as follows.
- JOINT, CART : separate movement of the drive axis (move to the setting direction of axis)
- TOOL : Robot tool end (TCP) fixed location movement (location fixed and position changed)

(3) Speed of manual movement (S8 based): 25% of the maximum speed of additional axis (However, the maximum speed for straight line shall be restricted to 250mm/sec)

4.2. Playback

(1) Interpolation Off
Arrive at a target point for each axis at the same time.

(2) Linear interpolation
Robot tool end (TCP) achieves linear interpolation (trace and position maintained) movement. Base axis moves in the connection with the robot to enable the tool end to achieve linear interpolation.
Other additional axes have no connection with the robot tool end, but reach the target point at the same time.

(3) Circular interpolation
Robot tool end (TCP) achieves linear interpolation (trace and position maintained) movement. Base axis moves in the connection with the robot to enable the tool end to achieve linear interpolation.
Additional axes have no connection with the robot tool end, but reach the target point at the same time.

(4) Shift
Shift functions (offline, online, search, palletize) are basically applied to the robot, and the additional axis only moves to a recorded location. Special attention should be paid to ensure that there is no movement of the additional axis during the search movement step in the search function. In the event that drive axis shift is required, it shall be shifted from the base coordinate system.

(5) Coordinate transformation
Since only moving elements of the robot will be transformed, and the target value of additional axis will be returned to the same value, there should be no movement of the additional axis in the original program for transformation.

(6) Applying pendant program calls
If creating a pendant program, an additional axis should not be moved. Only the pendant location for robot shall be applied.

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