Expanding
Possibility

Operation Manual for Hi6 Controller

STOP
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Expanding Possibility
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Hi6 Robot Controller
AutoRun V04.03.00
Release Date: 2020.01.01
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About the Manual

This manual describes the basics and structure of Hyundai Robotics' Hi6 controller as well as the common operation of industrial robots. Each chapter describes not only basic operation methods but also the methods to use various application functions.

This manual does not cover detailed application functions, such as direct teaching using a collaborative robot, methods of setting safety functions, spot welding, arc welding, positioner sync function, and sensor sync function. For details on relevant information, refer to the collaborative robot maintenance manual and individual application function manuals.

You must fully understand the contents of the manual before using the product. Moreover, keep the manual nearby so that you can refer to it whenever you need it.

This manual may be provided as reference material for customers who have purchased Hyundai Robotics products or may be used as internal training material.

This manual has been created based on standard specifications, so some contents may differ depending on the model of the product you have purchased. In addition, the contents and specifications of this manual are subject to change without prior notice to improve the performance of the product, and Hyundai Robotics is not responsible for situations that could be caused by inaccuracies or typos in the manual. For detailed information on the revision of the manual, you need to visit our internet website (www.hyundai-robotics.com).

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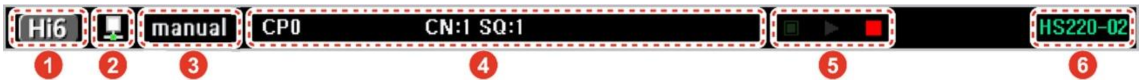
Notation Convention

In this manual, the following notation conventions and safety instructions are used to help you understand the contents.

Description of Figures

Figures are used to help you understand how to operate the product and illustrate what you can see on the screen. For the description of figures, numbers will be marked for the relevant parts, and the corresponding contents will be described as follows.



Graphical User Interface (GUI)

On the GUI, menu names and button names are enclosed in square brackets (**[ ]**) and displayed **in bold.** When you need to select multiple menus in order, mark them with the 〉 symbol between the names.

- Menu with a name: Touch the **[Menu]** button on the initial screen in manual or automatic mode.
- Multiple menus: Touch the **[Set Up]** button 〉 **[5: Initialize 〉 7: Unit Setting]** menu on the initial screen in manual mode.

Notation Method for Operation Keys

Keys that are to be pressed on the operation part of the teach pendant to operate functions will be enclosed in single arrow brackets (〈 〉) and displayed **in bold.**

- If you press the **〈Start〉** key, the automatic operation of the program created in the robot will start.

Cross Reference

It provides shortcuts to relevant information within the manual. A cross-reference will be shown in double quotation marks (“ ”) **in bold** as follows.

- For details on how to change the date and time information, refer to “**4.5 Setting of Date and Time.**”

Note

In this section are some helpful tips or additional information that could be useful when you use the product as follows.

Note	When the e icon blinks in the status bar, it means that you are in engineer mode.

Safety Cautions

Before using the product, you must read the following safety cautions for proper use, user safety, and prevention of property damage.

Danger

⚠ Danger	Imminent danger: Incompliance may cause the death of or serious injuries to the operator.

- Read the contents of the product installation in the manual and follow the instructions when installing the robot product and other devices.
- If a fatal error occurs in the software, stop using it immediately, and contact our customer support team.
- If there is a problem with the product, such as failure or damage, stop using it immediately and contact the customer support team for inquiry.

Warning

⚠ Warning	Potential danger: Incompliance may cause injuries to the operator or damage to property, such as significant damage to the product.

- The safety equipment to be used after being connected to the controller must be connected to the safety contact terminal or to the configurable digital I/O set, which is to be set as the safety I/O, in double signals. When the equipment is connected to common contact terminals or in a single signal, the regulated safety level cannot be satisfied.
- Do not put your fingers or other body parts behind the controller's inner bracket. There is a risk of electric shock or injury.
- If you are a robot application system manufacturer or a robot user, you should fully understand the contents of the manual and complete the product operation training.
- For the safety of workers and users, you must prepare appropriate safety facilities, such as safety fences, before installing the product.
- Check the specification information and perform fastening by using appropriate fixing screws. Loosened screws may lead to separation of the robot, causing it to fall or suffer damage.
- Be careful not to let conductive foreign substances, such as liquid, dust, or metal powder, enter the connection sections (power and cables). Moreover, do not poke the connection parts with a pointed object or apply excessive force to them when connecting them. Corrosion or temporary short-circuiting of the connection terminals may cause the product to explode or suffer a fire.
- Check the wiring information and connect the devices using the appropriate terminals corresponding to the type of individual devices. In particular, if a safety device is connected to a general terminal, the safety function cannot be guaranteed, so you must connect it to the terminal designed for safety devices.
- Never use a damaged cable and do not disconnect the power while the product is in use. It may cause electric shock, fire, failure, or injury.
- If the product is used for a long time, it may generate heat and cause injury, such as burns. If you need to touch the product, turn off the power and leave it for at least one hour to let it cool sufficiently before carrying out works.
- Use the teach pendant while paying attention to the movement of the robot.

- If the teach pendant warns of a fatal error, stop the robot with the emergency stop switch immediately, identify the cause, and resolve the error. If the error cannot be resolved, please contact our customer support team for an inquiry.
- Never install, modify, disassemble, or repair the product without our permission. It may cause a failure or an accident. In addition, we are not responsible for any damage to or breaking of the product if you do not follow the instructions.

Caution

⚠ **Caution**	Low-level danger factor: Incompliance may result in minor injury to the operator or damage to property, such as damage to the product.

- Do not install, modify, disassemble, or repair the product arbitrarily as it is prohibited for anyone other than our experts to arbitrarily modify the product or attach parts. If the product fails because of such acts, our free service and warranty service will be forfeited.
- A qualified installer should install the product in compliance with the related regulations and laws of the concerned country and region. When you want to install and repair the product, contact our customer support team, and ask an expert.
- Do not install and use the product in a dusty or dirty place. Dust or foreign substances may cause failure or abnormal performance of the product.
- Do not install and use the product in a place where magnetism exists or its influence reaches the product or there is electromagnetic interference. Magnetism may damage the product or cause abnormal performance.
- When operating the product, do not wear loose clothing or jewelry, and if the hair is long, take precautions to tie it back so that the hair does not get caught in the joints of the robot.
- Do not enter the operation range or touch the robot while the robot is in operation. Otherwise, there is a risk of injury.
- Prevent the product from being damaged by transporting it in a packaged state and by storing it in a dry place with low humidity. Otherwise, the moisture inside the packaging material may cause the product to get damaged or to fail.
- When it comes to storing the product, avoid places where temperature and humidity may change easily. Store the product in a clean, cool, and dry place.
- When transporting the product, maintain proper posture, and two or more people should work together. Otherwise, you may suffer injury to parts of your body, including waist, arms, and legs.
- If you use lifting equipment to transport the product, follow the safety regulations and equipment usage guidelines in the concerned country and region.
- When transporting the product, fully understand the transportation-related contents of the manual and comply with the instructions. We are not responsible for any damage to or breaking of the product because of transportation by the customer.

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1. Robot System

1.1 Basic Configuration

Industrial robots are “machines that are equipped with manipulation and movement functions based on automatic control for them to perform various works by using programs at an industrial site.” The collaborative robot is a type of industrial robot.

The robot system consists of a manipulator and a controller that controls the manipulator. A teach pendant that is to be used for setting and manually operating the robot system is attached to the controller.

- Robot: Performs various works in industrial sites such as transporting objects, assembling parts, etc.
- Controller: Adjusts the robot’s operation according to the program setting values set through the teach pendant. It can be interoperated with various external equipment or devices through the input/output port of the controller.
- Teach Pendant: A device that manages the entire robot system. It enables you to teach the robot a specific posture or setup and control the programs.

The following shows an example of the basic configuration of the robot system according to the robot type.

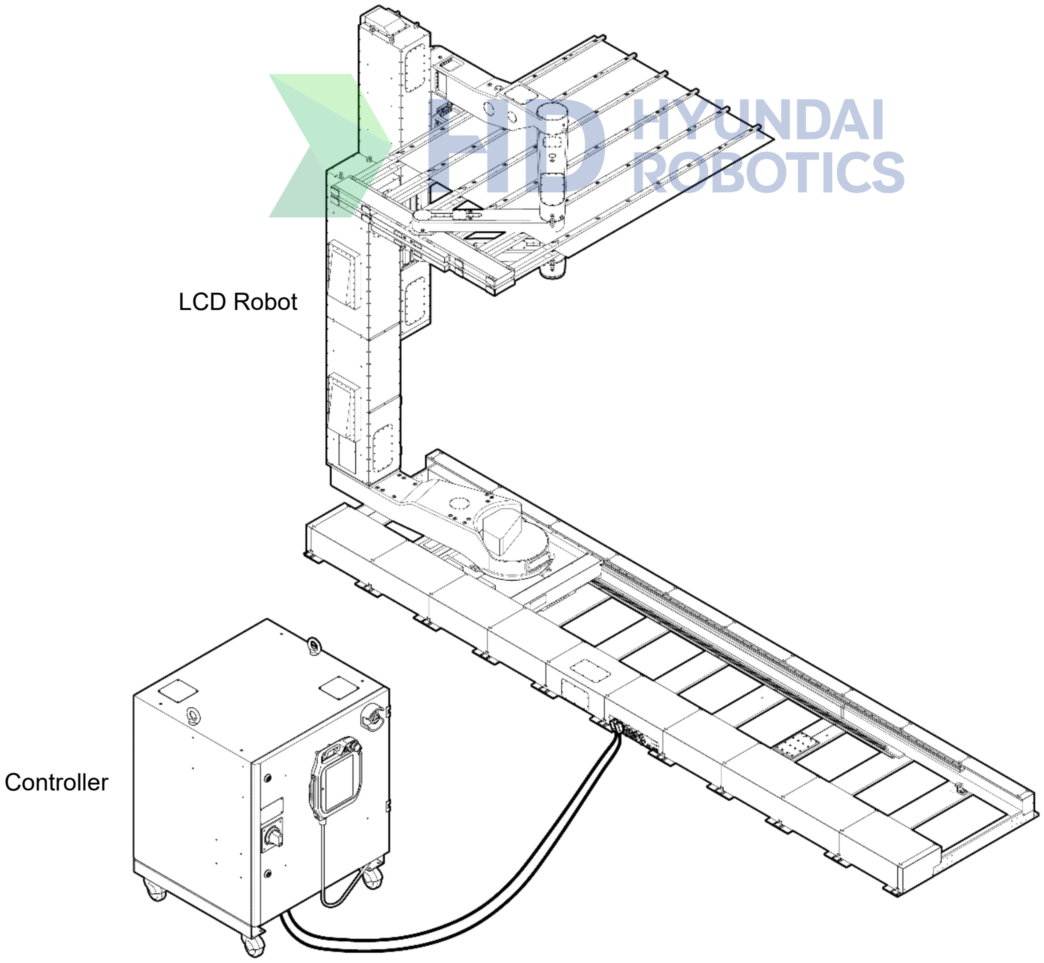


Figure 1 Basic Configuration of the LCD Robot System

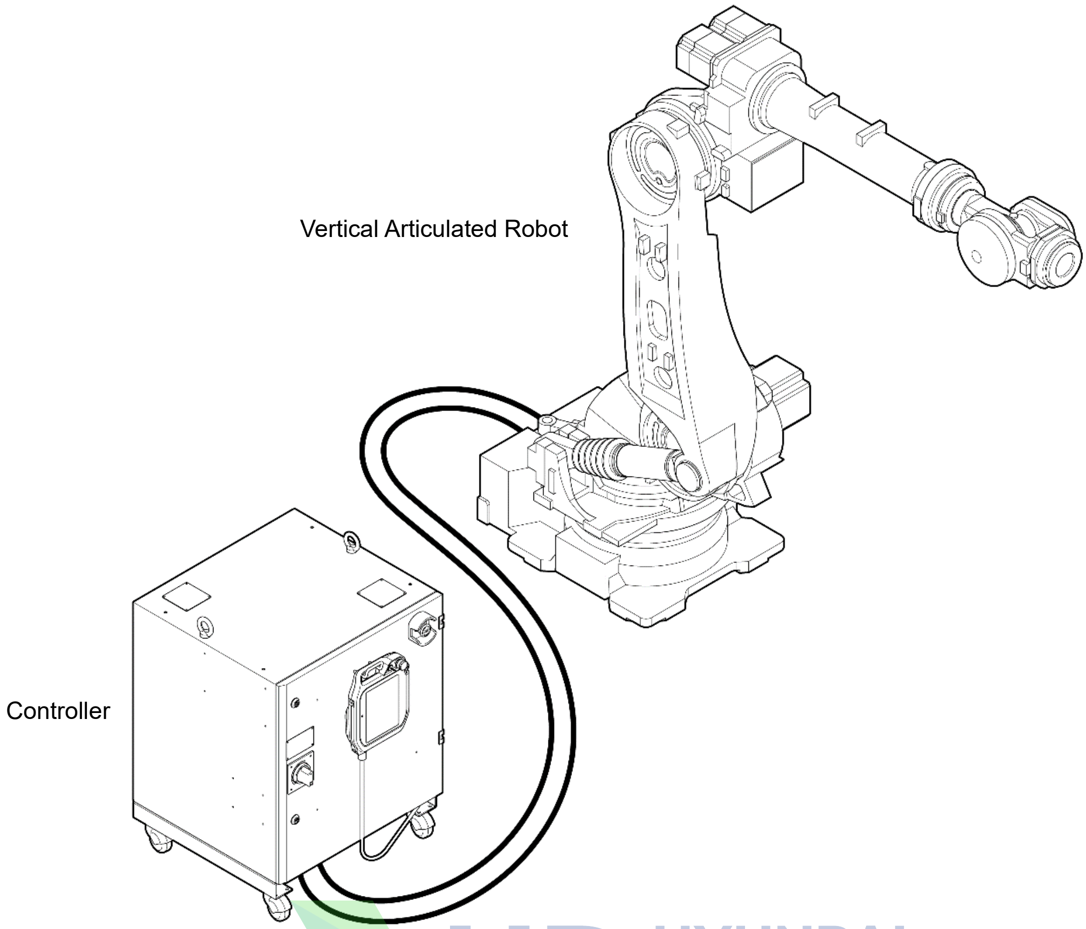

Vertical Articulated Robot
Controller

Figure 2 Basic Configuration of the Vertical Articulated Robot System

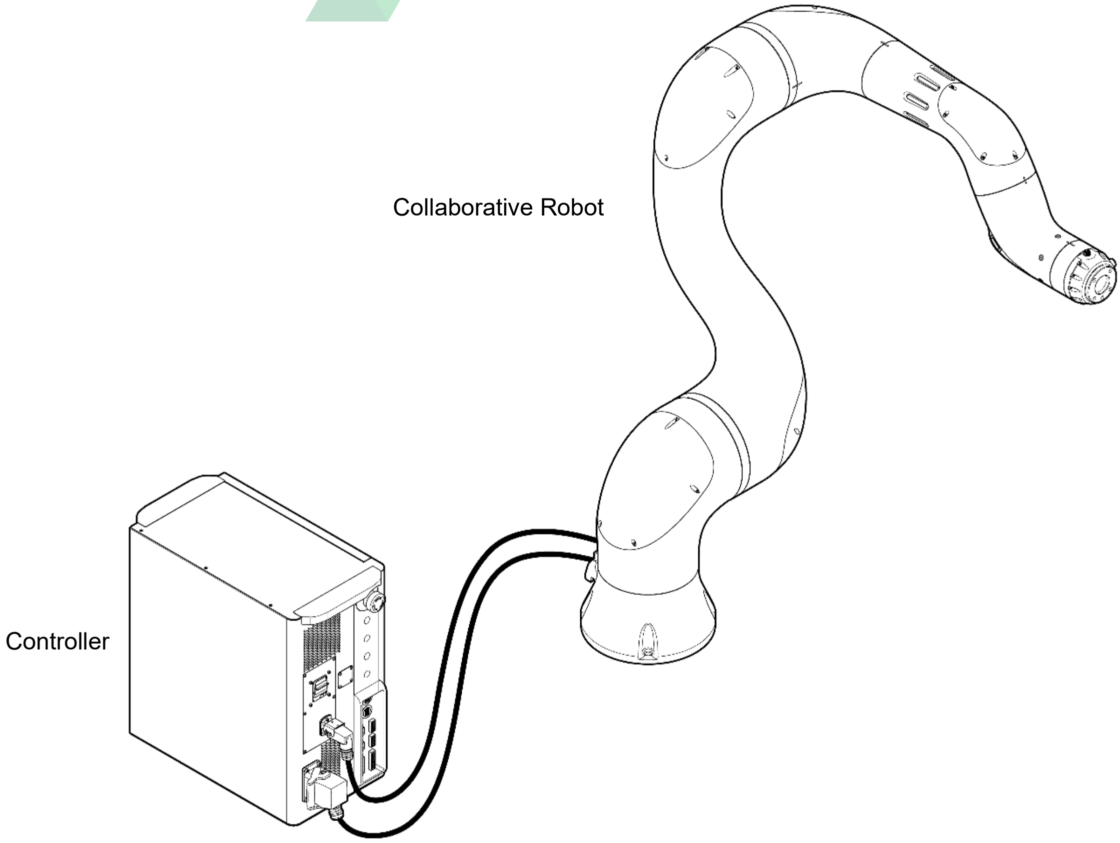

Collaborative Robot
Controller

Figure 3 Basic Configuration of the Collaborative Robot System

1.1.1 Controller

- Vertical Articulated Robot Controller

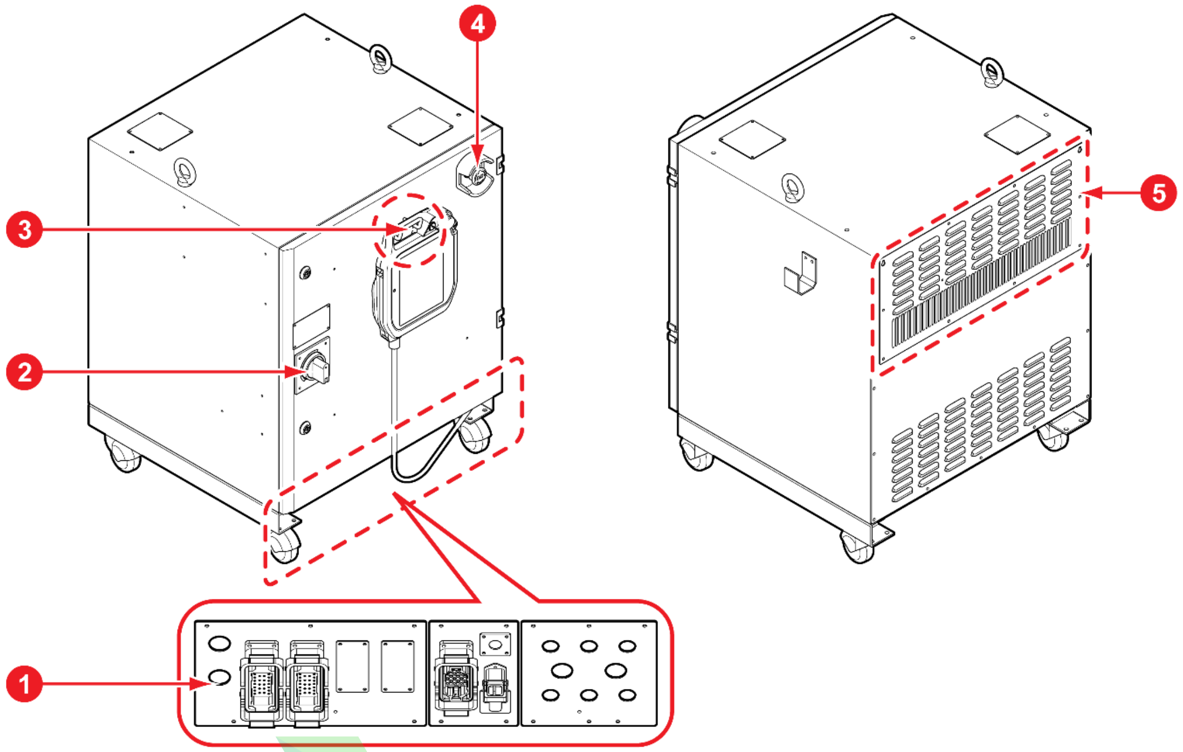


Figure 4 Front (Left) / Back (Right) of the Controller

No.	Name	Description
①	Connection part	A passage for connecting instruments and the teach pendant to the controller or for connecting application devices to internal modules
②	Power switch	Turns on or off the power of the controller
③	Hook for storing the TP	Used for hanging the teach pendant or storing it
④	Emergency stop switch	Causes the robot to stop operating when pressed in case of an emergency
⑤	Cooling fan	A device that forcibly discharges the heated air inside the controller

Collaborative Robot Controller

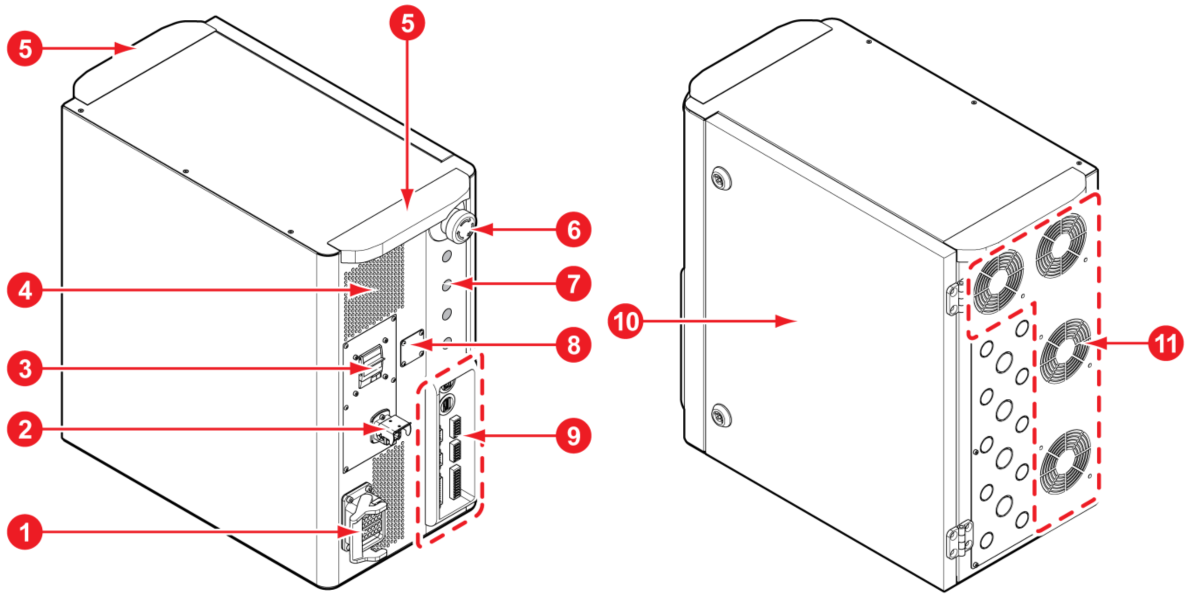


Figure 5 Front (Left) / Back (Right) of the Controller

No.	Name	Description
①	Robot cable connector	A connector that has built-in communication and power lines, making it possible to connect the controller to the equipment.
②	Power connector	A connector that supplies power to the controller.
③	Power circuit breaker	The main power of the controller can be turned on or off with the power switch.
④	Vent	An air inflow passage for cooling the controller.
⑤	Handle	It is mounted on the front and rear of the controller and used for transportation.
⑥	Emergency stop switch	When an emergency situation occurs, the operation of the robot can be stopped by pressing the emergency stop switch.
⑦	Application device connection hole	A passage to be used when an application device needs to be connected using a cable, with an internal module.
⑧	Teach pendant connection hole	A passage for the connection of a teach pendant of direct-connection type.
⑨	I/O connection block	This connects peripheral devices to the controller.
⑩	Door	You can open the side of the controller by opening the door.
⑪	Cooling fan	It is a device that forcibly discharges the heated air from inside the controller.

1.1.2 Teach Pendant

TP600 and TP630 teach pendants are supported. This operation manual describes how to use a teach pendant based on the TP600 model.

TP600 is a model developed exclusively for the Hi6 controller and provides a large touch screen.

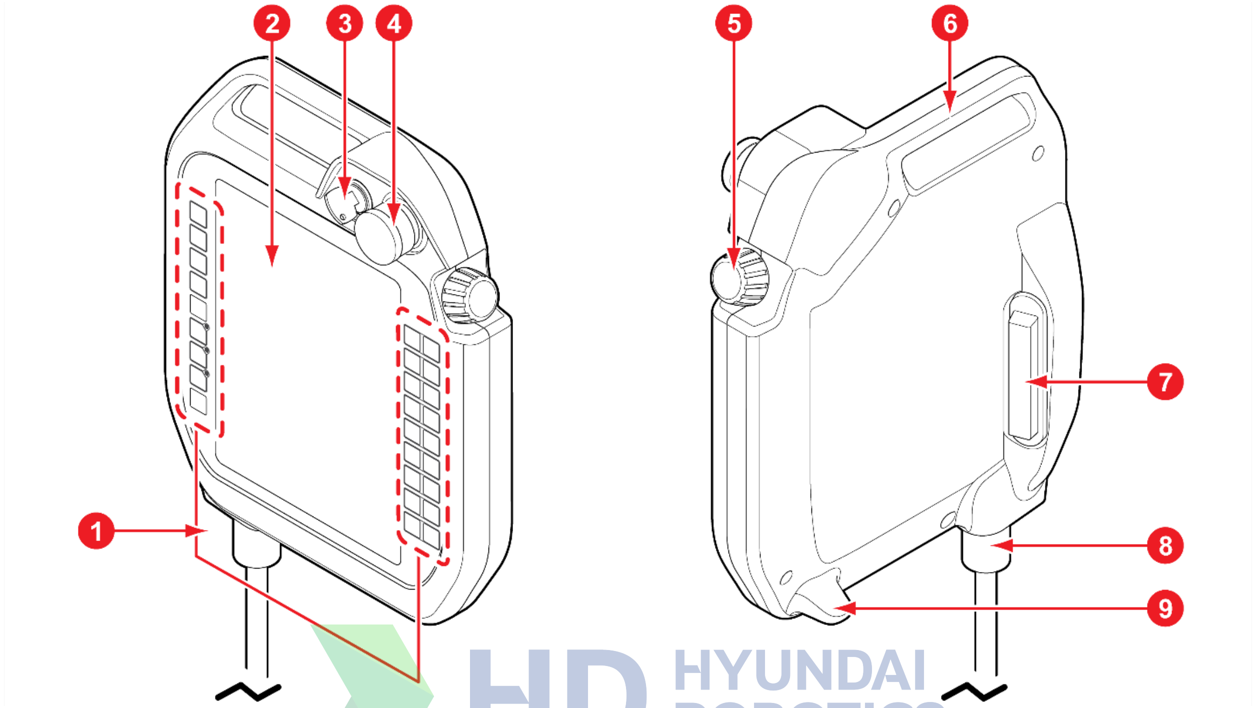


Figure 5 Front (Left) / Back (Right) of TP600

No.	Name	Description
①	Operation key	Controls the robot’s operation, inputs commands, or selects a menu
②	Display	The touch screen enables you to check and change the operation status and set the information of the robot.
③	Mode switch	You can turn the mode switch to select the operation mode (✋manual, ▭automatic, ☐→remote). If you remove the mode switch from the teach pendant, the selected operation mode will be locked.
④	Emergency stop switch	Causes the robot to stop operating when pressed in case of an emergency
⑤	Jog dial	Can be used to set the menu
⑥	Mounting bracket	Holds or hangs the teach pendant to store it
⑦	Enabling switch	A switch that is to be used as a safety switch when operating the robot with the teach pendant in manual mode • Stage 1, Stage 3: The robot operation will stop. In the case of Stage 3, the switch will recover to Stage 1 without going through Stage 2. • Stage 2: You can operate the robot.
⑧	Cable connection connector	A connector for connecting the cable to the controller

No.	Name	Description
⑨	USB connection port	Can be used to connect a device that can be accessed by USB communication such as a transportable storage device

TP630 is a model to which the same operation key usage environment as that of the existing Hi5a controller is applied, and it provides a screen with a layout similar to that of the TP600.

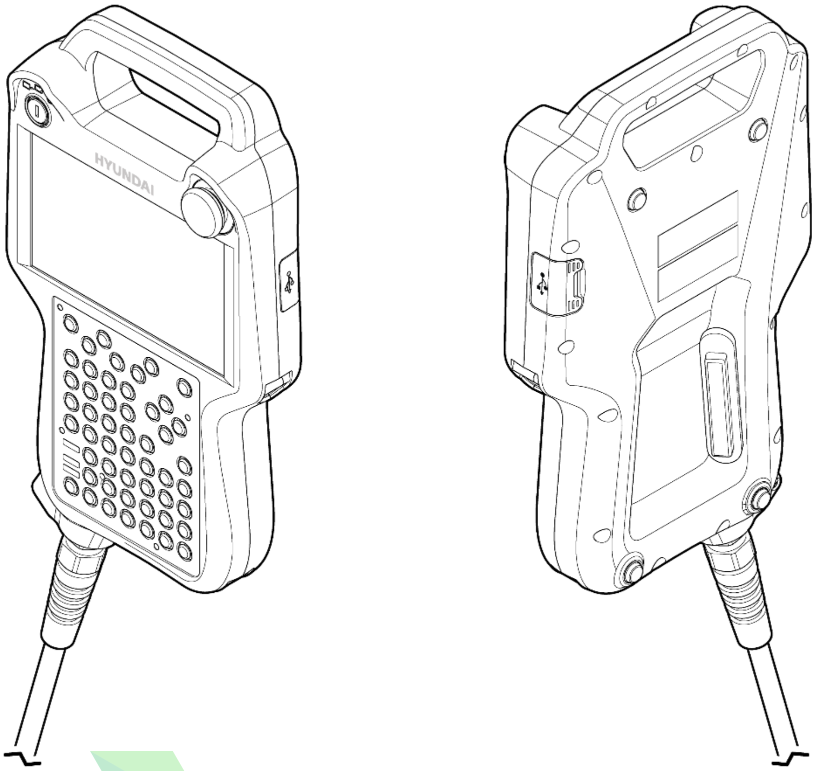
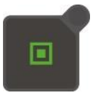
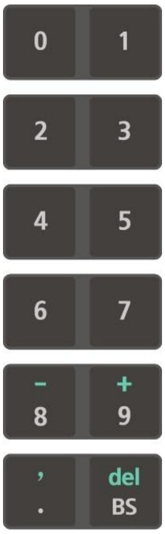


Figure 6 Front (Left) / Back (Right) of TP630

Operation Keys

Operation Key	Name	Description
shift	shift	- Pressing the **⟨shift⟩** key together with a specific key will switch the function of the specific key. - You can switch the current screen in use by pressing this key together with the ⟨↑/↓⟩ key in the JOB editing window.
ctrl	ctrl	Pressing the **⟨ctrl⟩** key together with a specific key will execute the function defined for the specific key.
↑ ↓	up/down	Pressing the ⟨↓/↑⟩ key in manual mode will make it possible to move forward and backward in the unit of step.
■	stop	Pressing the **⟨stop⟩** key will temporarily stop the robot in automatic operation. - When the robot stops, the stop lamp will be turned on, and the start lamp will be turned off. - As the robot is stopped while executing the path of the created program, there is no risk of collision with peripheral devices.
▶	start	Pressing the **⟨start⟩** key will start the automatic operation of the program created in the robot. When the robot starts operation in automatic mode, the start lamp will be turned on, and the stop lamp will be turned off.

Operation Key	Name	Description
	motor	You can supply the servo power to the motor of each axis of the robot. • Pressing the **〈motor〉** key in manual mode will make the motor lamp blink. • Pressing the **〈motor〉** key in automatic mode will turn on the motor lamp.
	enter	• If you press the **〈enter〉** key when inputting a number, the input value will be applied to the setting. • If you press the **〈enter〉** key for a response of Yes/No, Yes will be selected. • When editing a statement in manual mode, if you press the **〈enter〉** key while in the statement cursor, the cursor will switch to the word cursor that enables you to edit the parameters of the statement.
	esc	• Allows you to cancel the key input or various functions in progress • Pressing the **〈esc〉** key allows you to switch to a higher level without saving the changes.
	left/right	• Allows you to move the cursor to previous or next when inputting texts • If you press the **〈←/→〉** key in the word cursor status, you can move to the recorded step or other function parameters.
	number key	• You can input a number. • If you press this key together with the **〈shift〉** key, you can input a sign (- / +) or comma (,), or delete a statement or parameter. • **〈BS〉**: Backspace allows you to erase the characters of the text one by one at the position of the cursor input. Moreover, if you select parameters when editing command and then press the **〈BS〉** key, you can delete the entire parameter values.
	jog key	While the motor is turned on in manual mode and the enabling switch is held, the **〈enter/esc / ←/ → 〉** keys and number keys will be operated as "jog keys." • The axis name designated to each key will be displayed on the right edge of the display. • The **〈→〉** key is for the direction of increase (+), and the **〈←〉** key is for the direction of decrease (-).

1.2 Basic Use

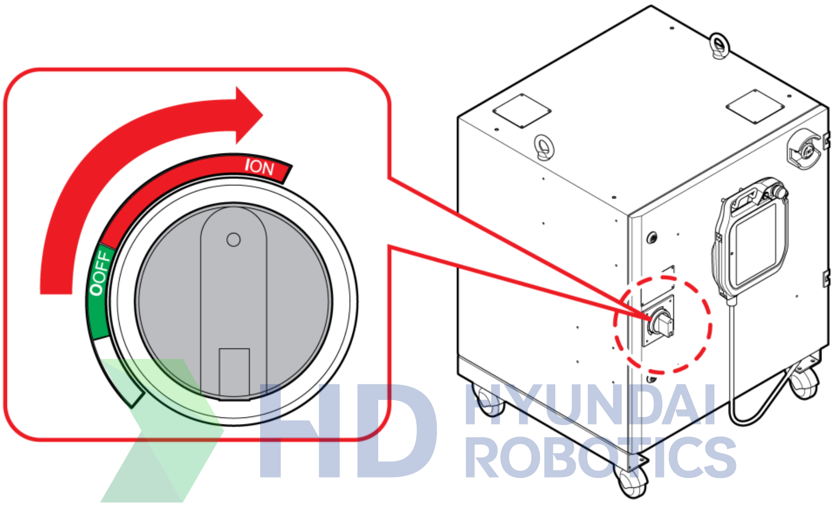
1.2.1 Turning On the Power

Note	The method of turning on and off the power may differ depending on the type of controller.

■ Vertical Articulated Robot Controller

To start up the robot, power should be supplied to the robot controller.

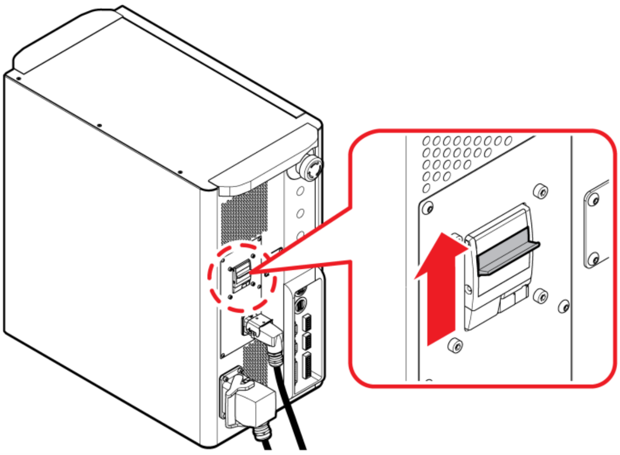
Turn the power switch on the left side of the robot controller to the ON direction to connect the main power of the controller. When the power is connected, the robot system will boot, and the display of the teach pendant will be turned on together with all the devices.



■ Collaborative Robot Controller

The power of the collaborative robot is supplied through the power connector of the controller.

Push upward the switch on the power breaker. When power is connected, the robot system will boot, the display of the teach pendant will be turned on, and the collaborative robot's LED lamp will be turned on in white.



1.2.1.1 Input of the Power to the Motor and the Operable Status

The status of the mode switch and safety plug of the teach pendant determines the input of power to the motor and the operable status.

Safety Plug	Mode Switch: Manual	Mode Switch: Automatic
Released	• Motor ON enabled • Step Forward/Backward enabled	Emergency (Motor Off)
Inputted	• Motor ON enabled • Step Forward/Backward enabled	• Motor ON enabled • Operation at normal speed

Note	Safety plugs are used for general industrial robots, whereas a light curtain instead of a safety plug is used for LCD robots.

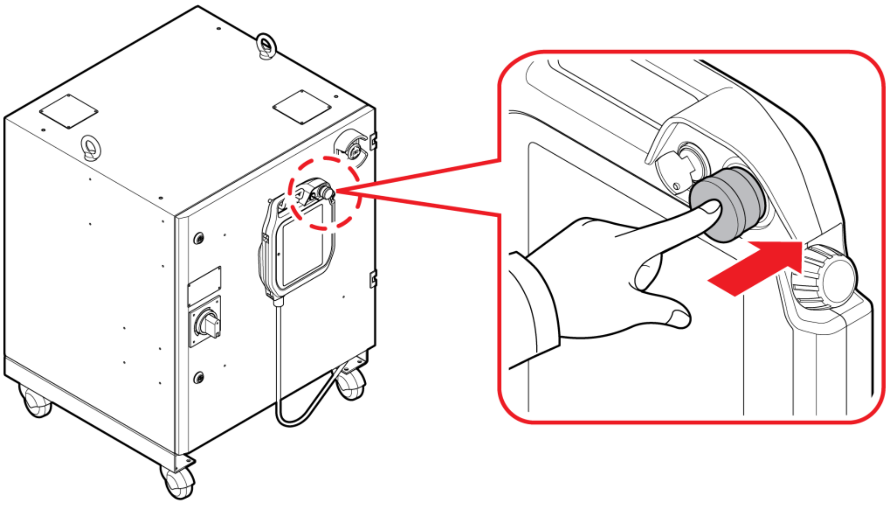
1.2.2 Turning Off the Power

It refers to all operations of stopping the robot and turning off the power button of the controller after performing all works.

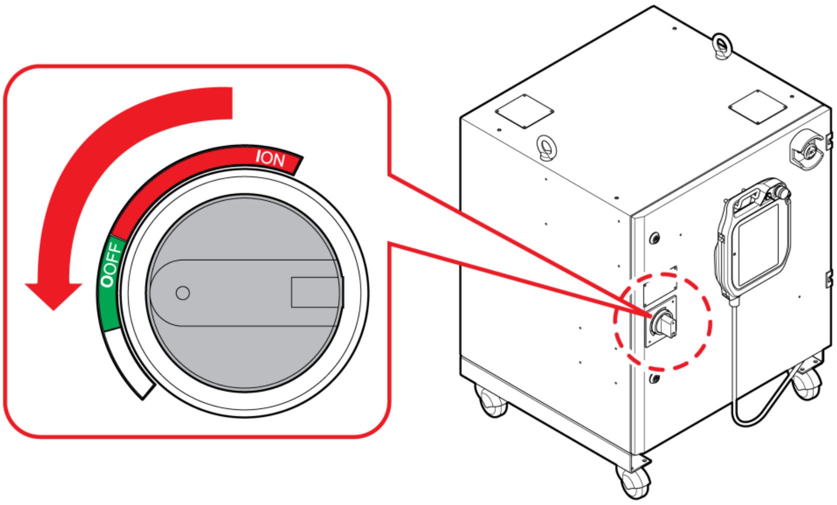
⚠ **Caution**	• If the robot will not be in use for a long time, the encoder battery may be discharged, so move the robot to the reference position and then turn off the power. • Be careful as the encoder data may be destroyed if the power is turned off while the encoder battery has a voltage drop alarm.

■ Vertical Articulated Robot Controller

1. Press the 〈Stop〉 key on the teach pendant. Then, the robot in operation will stop, and the stop lamp will be turned on.
2. Press the emergency stop switch on the teach pendant. Then, the servo power to the robot motor will be cut off, and then the motor will be turned off.

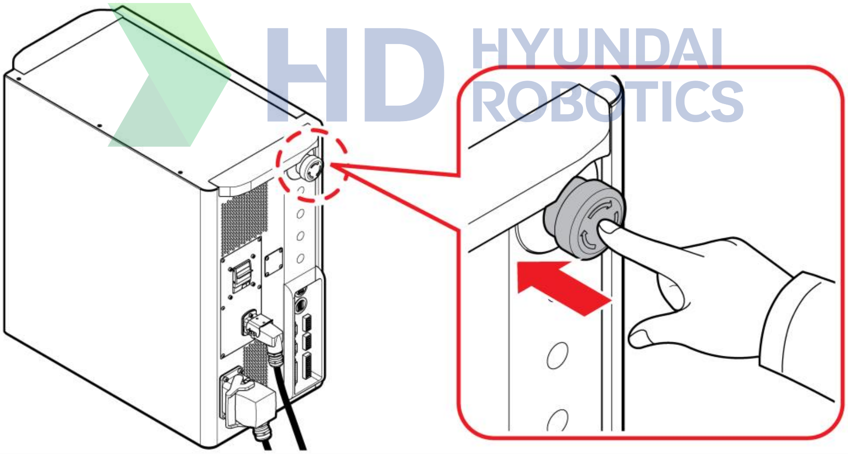


3. Turn the power switch on the left side of the robot controller to the **OFF** direction. Then, the robot system will be powered off.

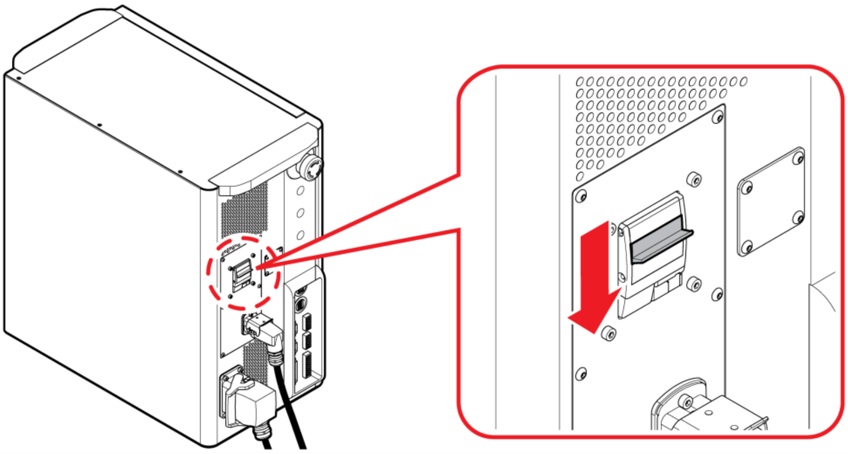


Collaborative Robot Controller

1. Press the **〈Stop〉** key on the teach pendant. The robot in operation will stop, and the stop lamp will be turned on.
2. Press the emergency stop switch on the controller. The servo power to the robot motor will be cut off, and then the motor will be turned off.



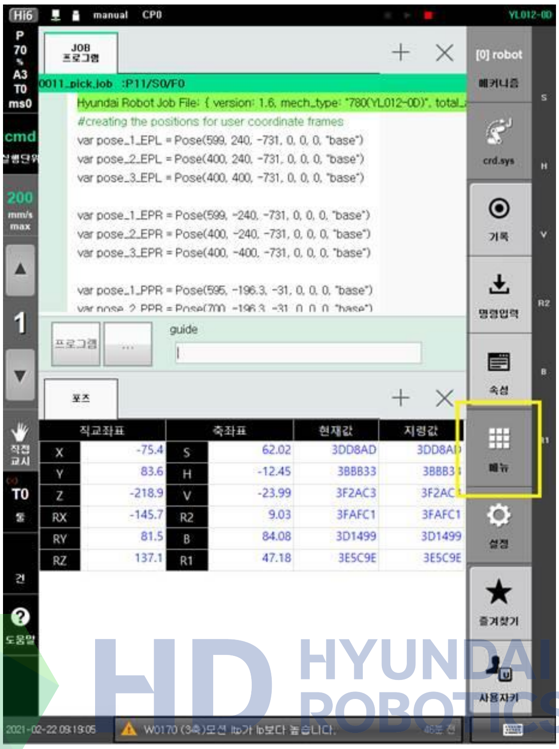
3. Push downward the switch on the power circuit breaker. When the power is cut off, the robot system will be turned off, and the display of the teach pendant and the LED lamp of the collaborative robot will be turned off.



1.2.3 Changing the language of the teach pendant screen

If you need to change the language of the teach pendant, you can change it with the following procedure. The following is an example of changing Korean to English mode.

1. Click **[메뉴]** button(메뉴) on the right-button-bar.

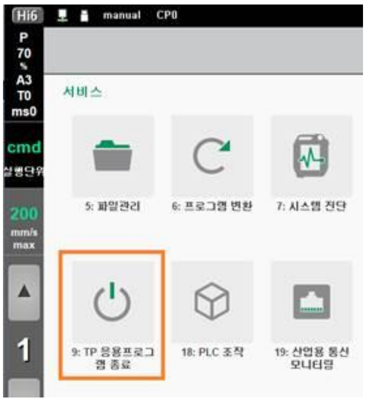

Hi6
manual
CP0
YL012-0D
P
70
%
A3
T0
ms0
cmd
실행단위
200
mm/s
max
1
JOB
프로그램
[0] robot
메커니즘
crd.sys
기록
명령입력
속성
메뉴
설정
즐겨찾기
사용자키
S
H
V
R2
B
R1
프로그램
...
guide
포즈
직접
교시
T0
툴
건
도움말

```
0011_pick.job :P11/S0/F0
Hyundai Robot Job File: { version: 1.6, mech_type: "780(YL012-0D)", total_
#creating the positions for user coordinate frames
var pose_1_EPL = Pose(599, 240, -731, 0, 0, 0, "base")
var pose_2_EPL = Pose(400, 240, -731, 0, 0, 0, "base")
var pose_3_EPL = Pose(400, 400, -731, 0, 0, 0, "base")

var pose_1_EPR = Pose(599, -240, -731, 0, 0, 0, "base")
var pose_2_EPR = Pose(400, -240, -731, 0, 0, 0, "base")
var pose_3_EPR = Pose(400, -400, -731, 0, 0, 0, "base")

var pose_1_PPR = Pose(595, -196.3, -31, 0, 0, 0, "base")
var pose_2_PPR = Pose(700, -196.3, -31, 0, 0, 0, "base")
```

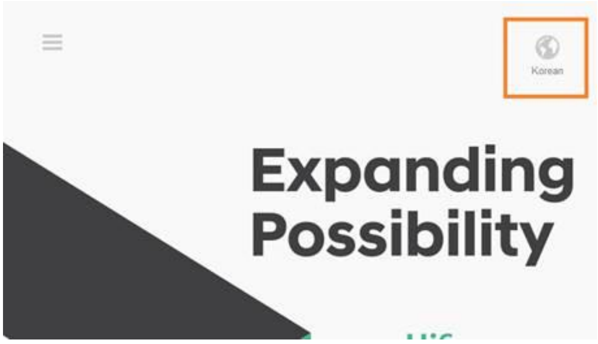
직교좌표		축좌표		현재값	지령값
X	-75.4	S	62.02	3DD8AD	3DD8A
Y	83.6	H	-12.45	3BBB33	3BBB3
Z	-218.9	V	-23.99	3F2AC3	3F2AC
RX	-145.7	R2	9.03	3FAFC1	3FAFC1
RY	81.5	B	84.08	3D1499	3D1499
RZ	137.1	R1	47.18	3E5C9E	3E5C9E

2021-02-22 09:19:05 W0170 (3축)모션 lb가 lb보다 높습니다.

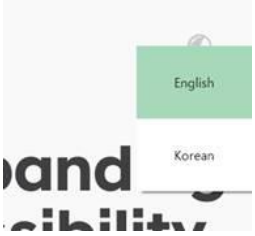
2. Select **[9: TP 응용프로그램 종료]**.(9: TP 응용프로그램 종료)


Hi6
manual
CP0
P
70
%
A3
T0
ms0
cmd
실행단위
200
mm/s
max
1
서비스
5: 파일관리
6: 프로그램 변환
7: 시스템 진단
9: TP 응용프로그램 종료
18: PLC 조작
19: 산업용 통신 모니터링

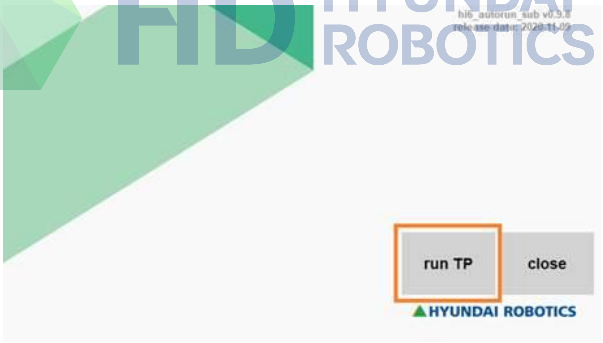
3. Click the globe icon on the top-right corner.


Korean
Expanding
Possibility

4. Select **[English]** on pop-up menu.


English
Korean

5. Click **[run TP]** button on the bottom-right corner and wait for about 8 seconds.

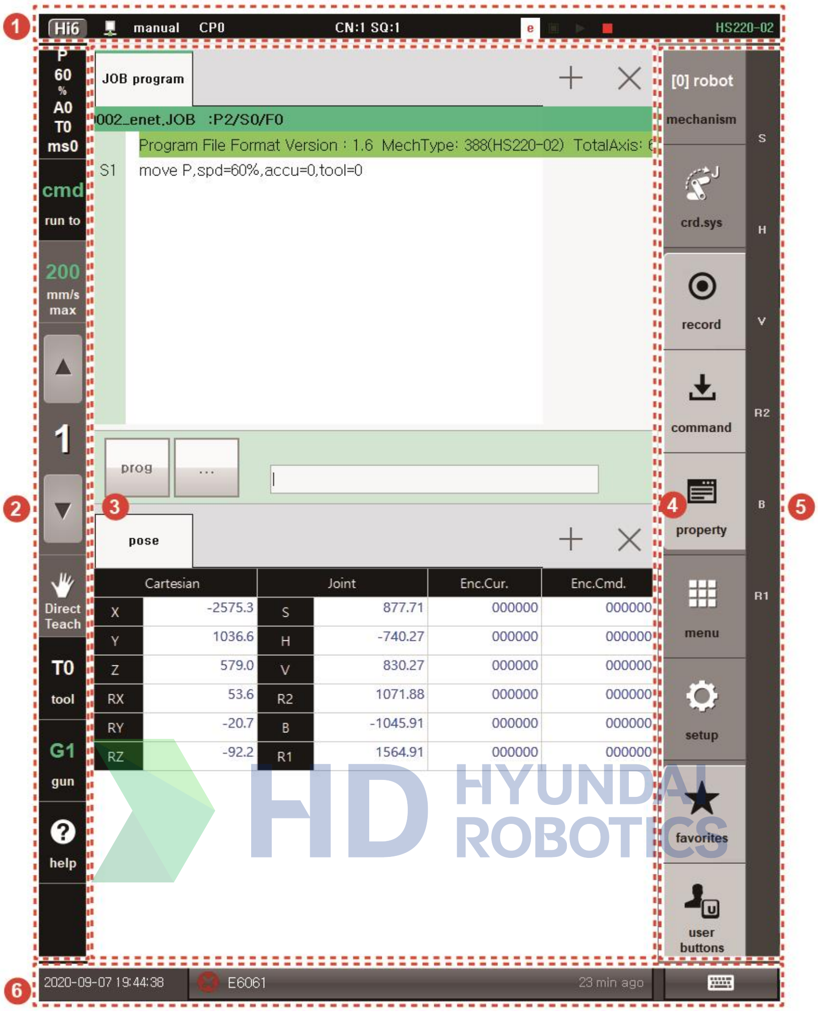


hi6_autorun_sub v0.9.8
release date: 2020.11.09

run TP
close
HYUNDAI ROBOTICS

1.2.4 Screen of the Hi6 Teach Pendant

You can control the operation of the robot or manage devices that interoperate with the robot. The Hi6 teach pendant screen is configured as follows.


①
Hi6
manual
CP0
CN:1 SQ:1
e
HS220-02
②
P
60
%
A0
T0
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
③
JOB program
prog
...
pose
④
[0] robot
mechanism
crd.sys
record
command
property
menu
setup
favorites
user buttons
⑤
S
H
V
R2
B
R1
⑥
2020-09-07 19:44:38
E6061
23 min ago

```
002_enet.JOB   :P2/S0/F0
     Program File Format Version : 1.6  MechType: 388(HS220-02)  TotalAxis:
S1   move P,spd=60%,accu=0,tool=0
```

Cartesian		Joint		Enc.Cur.	Enc.Cmd.
X	-2575.3	S	877.71	000000	000000
Y	1036.6	H	-740.27	000000	000000
Z	579.0	V	830.27	000000	000000
RX	53.6	R2	1071.88	000000	000000
RY	-20.7	B	-1045.91	000000	000000
RZ	-92.2	R1	1564.91	000000	000000

Figure 7 Configuration of the Hi6 Teach Pendant

No.	Description
①	The status bar displays the communication status and operation mode of the teach pendant and the status and mechanism of the robot system. For details, refer to "**1.2.3.1 Status Bar.**"
②	You can check and change the setting values using the function buttons. For details, refer to "**1.2.3.3 Function Buttons.**"
③	Work area. You can perform various tasks such as editing the JOB program and checking the monitoring information. You can perform multiple tasks simultaneously.
④	You can check and change the setting values of the menus and execute various functions using the menu buttons. For details, refer to "**1.2.3.4 Menu Buttons.**"
⑤	The jog bar displays the name of the axis newly selected according to the reference coordinate system of the jog execution selected using the **[Crd. Sys]** button.
⑥	Taskbar. For details, refer to "**1.2.3.2 Log bar.**" • It displays the current time information and the memory usage status of the teach pendant. You can also check error messages or warning messages.

No.	Description
	• You can display the keyboard on the screen or hide it. While using the soft keyboard, you can move the keyboard to the top of the screen.

1.2.4.1 Status Bar

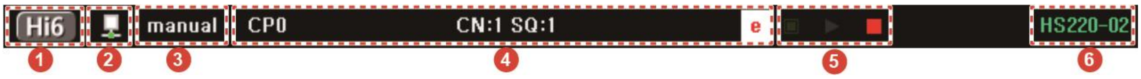


Figure 8 Status Bar

No.	Description
①	The name of the robot controller platform
②	Displays the status of Ethernet communication between the teach pendant and the COM module of the main body of the robot controller (🖥: Normal / 🖥: No response)
③	Displays the operation mode of the robot • **Manual**: This is a robot teaching mode that enables you to control the robot with a jog and create a JOB program. • **Auto**: This mode allows the robot to automatically operate through the playback of a JOB program. • **Remote Manual**: This is a state in which the mode is determined by a remote I/O signal. (Current status: Manual mode) • **Remote Auto**: It is a state in which the mode is determined by a remote I/O signal. (Current status: Auto mode)
④	Displays the various states of the robot system
⑤	Displays the operation status of the robot (🟩: Motor ON / ▶: Robot is playing back / 🟥: Robot has stopped)
⑥	Displays the model name of the selected robot mechanism

1.2.4.2 Log Bar

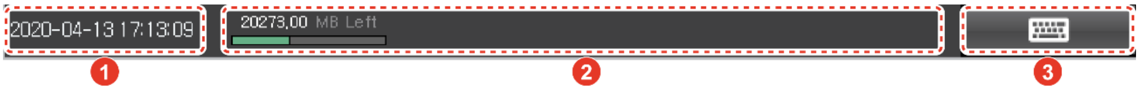
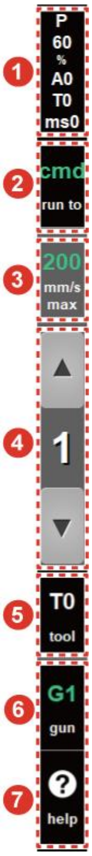


Figure 9 Log Bar

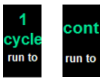
No.	Description
①	Displays the date and time information. If you touch the **[Menu]** button 〉 **[08: Setting of Date and Time]** menu, you can change the date and time information. For details on changing the date and time information, refer to "**4.5 Setting of Date and Time.**"
②	• Displays the memory (RAM) usage status of the teach pendant. Displays the used and residual capacity compared to the total capacity of the memory in a bar graph and helps check the residual capacity (MByte) numerically. • If an error or warning occurs, a notification message will appear instead of the memory usage status and will blink for about one minute and then stop. • You can check the occurrence timing of errors and warnings on the right side of the notification message. Moreover, if you touch the notification message, you can check the history of errors and warnings in a

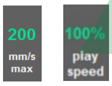
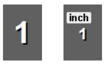
No.	Description
	new window. • For details on the notification message, refer to "**2.5 Error Information.**"
③	Displays a soft keyboard on the screen. For details on how to use the soft keyboard, refer to "**3.2.4.4 Soft Keyboard.**" • If you touch the [⇕] button while using the soft keyboard, you can move the keyboard to the top of the screen. • To hide the soft keyboard, touch the [⌨] button.

1.2.4.3 Function Buttons



No.	Description
①	**[Recording Condition]** button: You can set the basic value of the recording condition for the move statement. After touching the **[Recording Condition]** button, you need to input data related to the interpolation, moving speed and unit, accuracy, and tool number in the setting window, and then touch the [OK] button (✓).

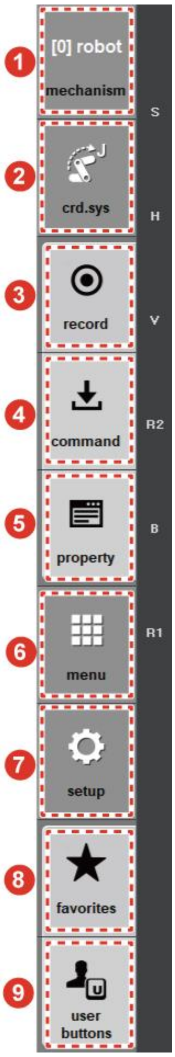
②	**[Execution Unit]** button: You can set the program execution unit in manual or automatic mode.
	 cmd
	run to
	step
	run to
	end
	run to
	• Manual mode: Touch the **[run to]** button repeatedly until the desired option appears.
	  • [cmd]: Will execute the command line by line
	  • [step]: Wil execute step by step
	  • [end]: Will execute up to the end statement
	
	• Automatic mode: After touching the **[run to]** button, set the option in the setting window.
	  • [1 cycle]: Will execute up to the end statement before stopping
	  • [cont]: Will execute up to the end statement and then execute again starting from Step 0

③	**[Speed Adjustment]** button: You can set the step speed for user safety. After touching the **[Speed Adjustment]** button, set the maximum step forward/backward speed and the automatic operation speed ratio in the setting window.  • Manual mode: Displays the speed limit of a step forward/backward (mm/sec) • Automatic mode: Displays the playback speed (%)
④	**[Jog Speed Level / Jog Inching]** button: You can set the speed level of each axis or of the cartesian jog and the use mode of the jog key. • [▲/▼]: Touch the button repeatedly until the desired speed level of each axis or of the cartesian jog (1: Low speed – 8: High speed) appears. With a long touch of the button, you can set the lowest or highest level at once.  • [1]: Touching the level value will display an **inch** mark on the top left of the level value, and the mode will switch to the inching mode. Touch the level value to return to normal mode. Then, the **inch** mark will disappear.
⑤	**[Tool]** button: You can check and set the selected tool number. After touching the **[Tool]** button, input the tool number in the setting window and then touch the **[OK]** button.
⑥	G1 gun G1 gun **[Gun]** button: You can check the selected gun number and set the gun to an ON/OFF state. Check the gun number and touch the **[Gun]** button. Then, the gun will switch to an ON or OFF state, and the color of the button will change.
⑦	**[Help]** button: Displays detailed information about the selected statement or an error message or a warning message

Note	• Jog inching mode: In normal mode, the robot keeps moving while you are pressing the jog key, but in inching mode, the robot moves only as much as the set value of each inching level and

	then stops, so you can operate the robot in detail.
	- Gun
	  - It will determine whether to record the gun squeeze operation during the step recording process when you use spot welding. When this button is pressed together with the 〈shift〉 key, the GUN signal will be outputted manually.
	  - When you use arc welding, if the lamp is on during automatic operation, arc welding will be progressed. If the lamp is off, arc welding will not be progressed, but only the taught trajectory will be checked.

1.2.4.4 Menu Buttons

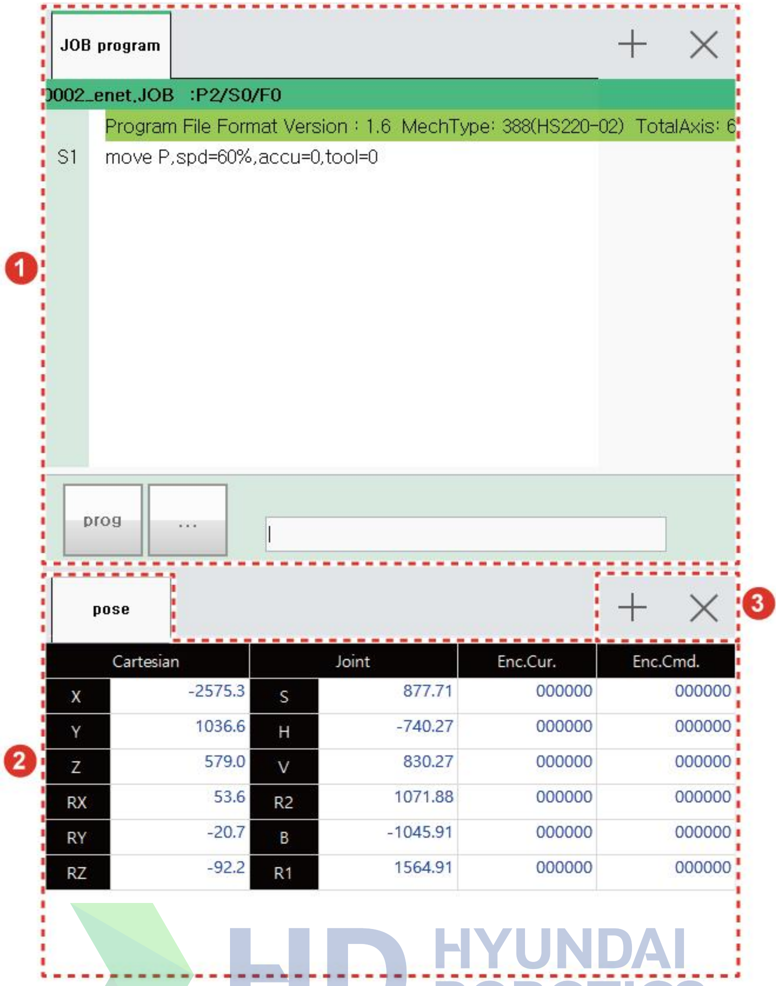


No.	Description
①	Mechanism: You can check and set the selected mechanism. Touch the **[Mechanism]** button repeatedly until the desired mechanism group appears. If the robot model is not selected during the initial setting process, the mechanism group will not be displayed, but only the **Not Initialized** mark will be displayed.
②	Coordinate System: You can check and set the reference coordinate system for the jog execution. Touch the **[Crd. Sys]** button repeatedly until the desired coordinate system mode appears. The name of the axis newly selected according to the selected reference coordinate system will be displayed on the jog bar on the right side of the screen. crd.sys - Joint Coordinate System: The name of each joint will be displayed on the jog bar. If you touch the **[-/+]** button on the right side of the joint name, you can move the corresponding joint. crd.sys - Robot Coordinate System: X, Y, Z, RX, RY, RZ, and additional axes will be displayed on the jog bar. Based on the robot coordinate system, the tooltip (TCP, Tool Center Point) of the robot can be moved or rotated. user1 - User Coordinate System: X, Y, Z, RX, RY, RZ, and additional axes will be displayed on the jog bar. The tooltip of the robot can be moved and rotated based on the user coordinate system. crd.sys - Tool Coordinate System: X, Y, Z, RX, RY, RZ, and additional axes will be displayed on the jog bar. The tooltip of the robot can be moved and rotated based on the tool coordinate system.
③	Record: You can input the move statement in the JOB program. Touch the **[Record]** button. Then, the move statement will be inputted right below the current cursor position. - The current posture of the robot will be recorded as the target pose, and when it comes to the interpolation, moving speed and unit, accuracy, and tool number in the move statement, the values set using the **[Recording Condition]** button will be applied. - The target pose and the values of the recording condition of the move statement can be edited later. pose mod. (In combination with the 〈**shift**〉 key) Position Correction: Apply the robot's current posture as the target pose of the step in the JOB program.
④	Command Inputting: Input the desired command. After touching the **[Command]** button, touch the command in the command inputting window. Then, the statement will be inputted right below the current cursor position. For details on inputting the commands, refer to "**3.2.2 Statement Inputting.**"

		delete (In combination with the 〈**shift**〉 key) Deletion: You can delete the statement in the JOB program.
	⑤	Attribute: You can check the attributes of a statement. After selecting a statement by touching it, touch the **[Attribute]** button. Then, the attribute window for the statement will appear.
		block edit (In combination with the 〈**shift**〉 key) Block Editing: You can enter the block editing mode where you can perform copying, cutting, and pasting in the JOB program. For details on block editing, refer to "**3.2.4.5 Block Editing Mode.**"
	⑥	**[Menu]**: You can use the service function menus in the program.
	⑦	**[Set up]**: You can set the user environment using the system menu of the program.
	⑧	Favorites: You can quickly execute predesignated functions using code numbers. Touch the **[Favorites]** button, input the code number, and touch the **[OK]** button. Then, the designated function will be executed.
	⑨	User Key: You can use the function assigned, as a button, to the user key area when teaching the robot. Touch the **[User buttons]** button. Then, the menu button area will be switched to the user key area, so you can use the function preassigned as a button. To return to the menu button area, touch the **[User buttons]** button or press the 〈**esc**〉 key.

1.2.4.5 Work area

The work area is an area where you can perform various tasks, such as editing JOB programs and checking the monitoring information.



002_enet.JOB :P2/S0/F0

```
    Program File Format Version : 1.6  MechType: 388(HS220-02)  TotalAxis: 6
S1  move P,spd=60%,accu=0,tool=0
```

Cartesian		Joint		Enc.Cur.	Enc.Cmd.
X	-2575.3	S	877.71	000000	000000
Y	1036.6	H	-740.27	000000	000000
Z	579.0	V	830.27	000000	000000
RX	53.6	R2	1071.88	000000	000000
RY	-20.7	B	-1045.91	000000	000000
RZ	-92.2	R1	1564.91	000000	000000

Figure 10 Layout of the Work Area

No.	Description
①	The work area consists of two-panel stacks: top and bottom. - You can perform multiple tasks simultaneously by adding a panel window to each panel stack. - You can add a new panel stack at the top and bottom of an existing panel stack or between panel stacks
②	Panel stack. The names of all currently open panels are displayed, and the selected panel window appears at the bottom. - You can change the order on the panel window by selecting a panel name by touching it and then dragging it to the desired location. - If you select a panel name by touching it and dragging it to another panel stack, you can move the location of the panel window to another panel stack. - If you select a panel name by touching it and dragging it to a location other than the existing panel stack, a new panel stack will be added, and then the panel window will open in the new panel stack.
③	- [+]: You can open a new panel window by selecting the desired monitoring item from the panel selection window. Panel windows will be added as tabs to the panel stack. - [X]: You can close the selected panel window. If there is only one panel window in the panel stack, the panel window cannot be closed.

2. Operation

Operation refers to the act of instructing the contents of the work to the robot and checking the contents. In general, when it comes to industrial robots, manual and automatic modes are used. Manual operation refers to the act of directly instructing the contents of the work to the robot, and the automatic operation refers to the act of making the robot repeatedly execute the contents of the instructed work.

2.1 Manual Operation

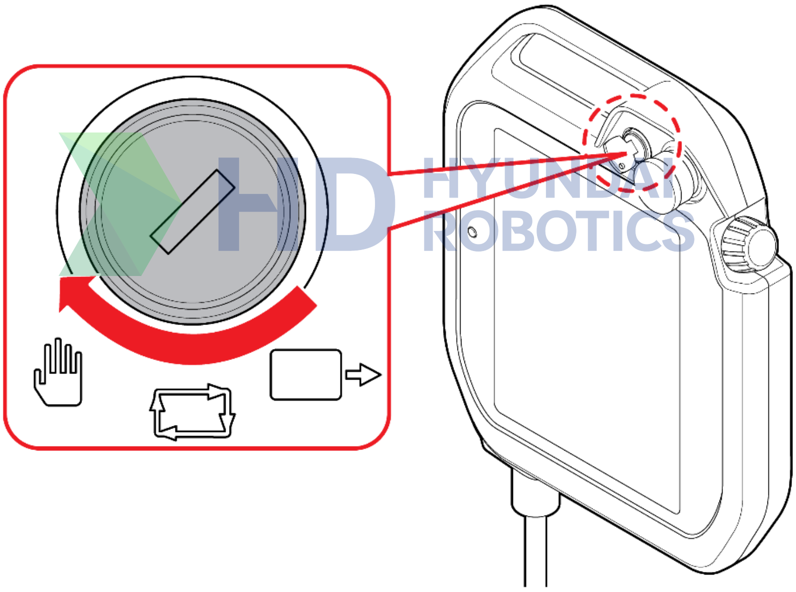
Manual operation is an operation method of directly teaching and checking the robot at a safe speed.

2.1.1 Operation Method

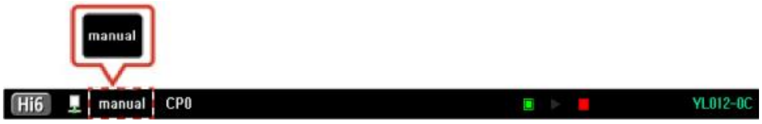
The method of instructing the contents of the work to the robot using the jog key and checking the contents of the instructed work are as follows.

1. Check whether there are people or obstacles within the safety fence and the operation range of the robot.

2. Set the operation mode to manual mode by turning the mode switch of the teach pendant.

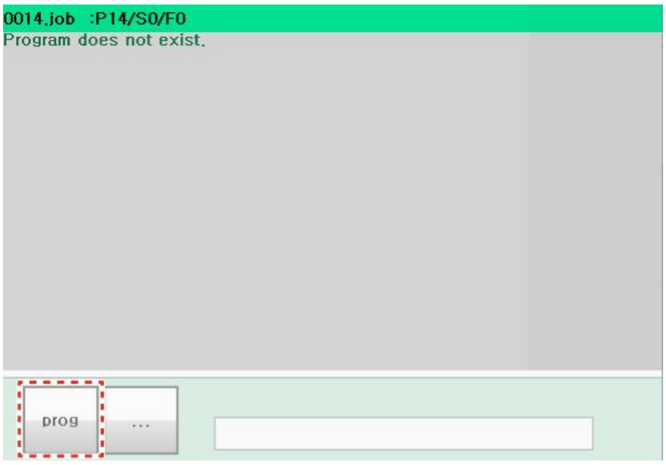


3. In the status bar of the Hi6 teach pendant screen, check whether the operation mode is set to manual mode.



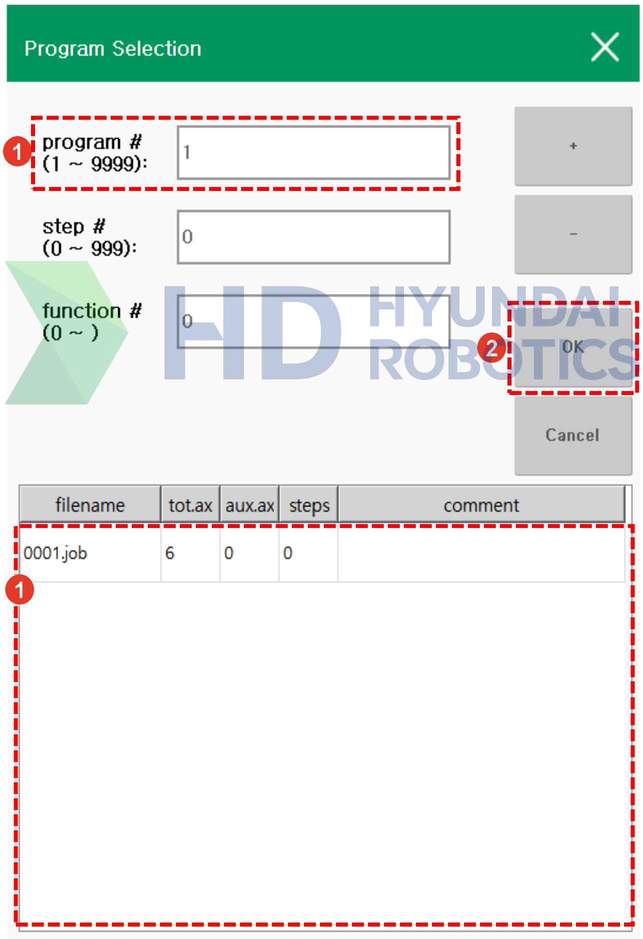
- If it is set to automatic mode, set the operation mode to manual mode by turning the mode switch of the teach pendant.

4. Touch the **[Program]** button in the JOB program window. Then, the program selection window will appear.



0014.job :P14/S0/F0
Program does not exist.

5. Select a program from the list in the program selection window or input the program number and then touch the **[OK]** button.



Program Selection

program # (1 ~ 9999): 1

step # (0 ~ 999): 0

function # (0 ~): 0

filename	tot.ax	aux.ax	steps	comment
0001.job	6	0	0	

6. Press the **〈motor〉** key on the teach pendant. Then, the motor lamp will blink, and the servo power will be ready to be supplied to the motor of each axis of the robot.

7. Press the enabling switch on the back of the teach pendant. Then, the motor lamp will be turned on, and the motor brake will be released, allowing the servo power to be supplied. The robot will be ready to move.

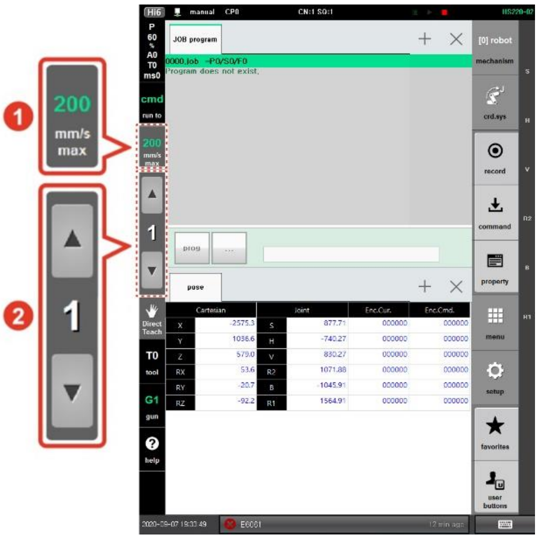
8. Operate the robot according to the speed level or movement conditions of the coordinate system using the jog key.

   - To save the robot's location, touch the **[Record]** button at the desired location. Then the step will be recorded.

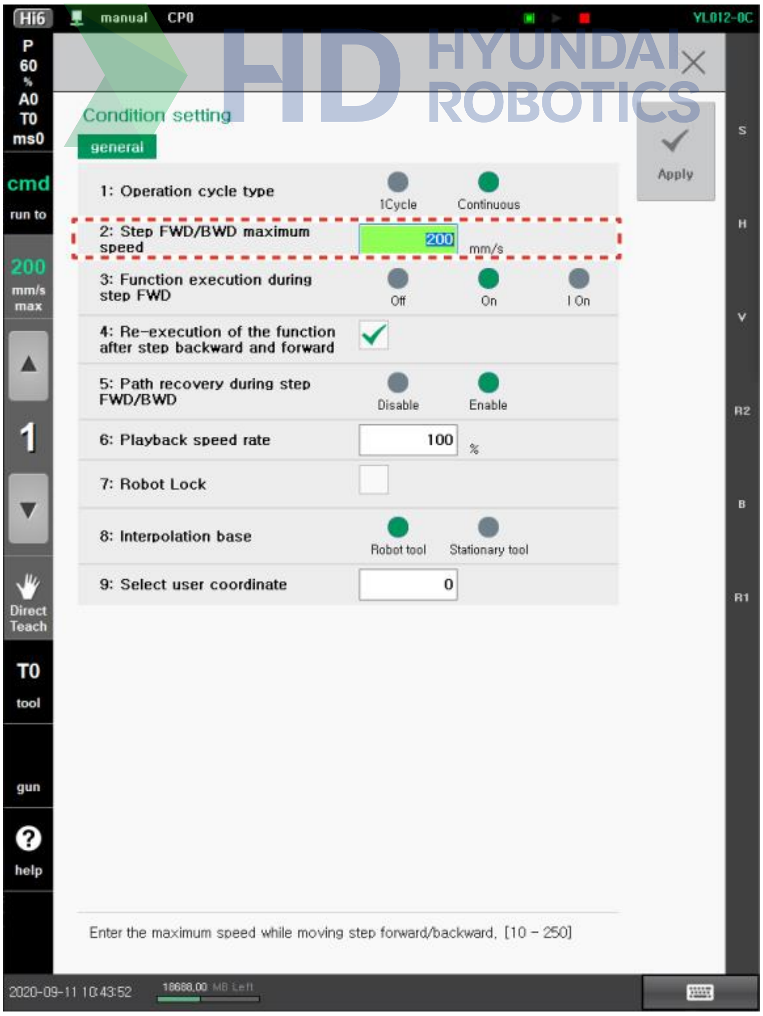
- To record the function required for the step, touch the **[Command Inputting]** button.
- To check the robot's location while manually moving it forward or backward, press the 〈 ↓ / ↑ 〉 key. While you are pressing the 〈 ↓ / ↑ 〉 key, the robot will move in the unit of step. When the robot reaches the target step, the execution completion mark (.) will appear in front of the command, and then the robot will stop.

2.1.2 Operation Speed Adjustment

In manual mode, you can operate the robot using the step forward/backward operation and manual jog operation. With the function button on the left side of the Hi6 teach pendant screen, you can check and adjust the step forward/backward speed limit (①) and the jog's speed level (②).


①
200
mm/s
max
②
▲
1
▼

To set the step speed limit, touch the **[Speed Adjustment]** button and then input the speed value in the setting window. The step forward/backward speed limit will be displayed in numbers along with the unit (mm/sec) on the **[Speed Adjustment]** button. The maximum speed of the robot tool and link will be limited below the speed limit.


Hi6
manual
CP0
YL012-0C
P
60
%
A0
T0
ms0
cmd
run to
200
mm/s
max
▲
1
▼
Direct Teach
T0
tool
gun
help
Apply
S
H
V
R2
B
R1
2020-09-11 10:43:52
18688.00 MB Left

Condition setting

general

1: Operation cycle type ○ 1Cycle ● Continuous

2: Step FWD/BWD maximum speed 200 mm/s

3: Function execution during step FWD ○ Off ● On ○ I On

4: Re-execution of the function after step backward and forward ☑

5: Path recovery during step FWD/BWD ○ Disable ● Enable

6: Playback speed rate 100 %

7: Robot Lock ☐

8: Interpolation base ● Robot tool ○ Stationary tool

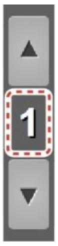
9: Select user coordinate 0

Enter the maximum speed while moving step forward/backward. [10 – 250]

For example, if the speed limit in manual mode is set to 250 mm/s and the recorded step speed is 1,000 mm/s, the moving speed of the step will be limited to 250 mm/s during the step forward/backward operation. When the recorded speed is 100 mm/s, the robot will move at 100 mm/s because the recorded speed does not exceed the speed limit.

Note	In automatic mode, the **[Speed Adjustment]** button will display the playback speed (%) instead of the step speed limit (mm/sec).

To set the jog speed level (1: Low to 8: High), touch the [▲/▼] button repeatedly until the desired speed level appears. The jog speed level will be displayed in numbers between the [▲/▼] buttons. Even in this case, the maximum speed of the robot tool and link will be limited below the speed limit.

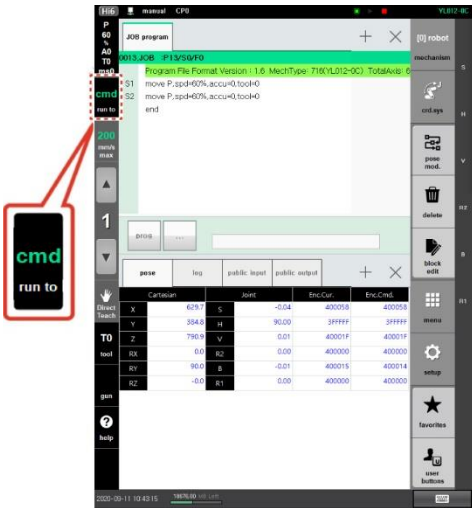


⚠ Caution	If the length and angle in the tool data are set differently from the actual values, the tool may operate too fast in manual mode. Before operating the robot, you must make sure that the tool data is set correctly.

2.1.3 Step Forward/Backward

The step forward/backward is one of the methods of operating the robot in manual mode and refers to the act of playing back a recorded program. By manipulating the robot in the step forward/backward operation, you can check the recorded program path and mutual interlock relationship at a range of safe speed.

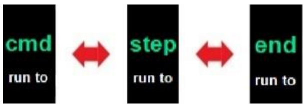
The execution unit for the step forward/backward operation can be checked and set from the **[run to]** button on the left side of the Hi6 teach pendant screen.


Hi6
manual
CP0
YL012-0C
P
60
%
A0
T0
m=0
cmd
run to
200
mm/s
max
1
JOB program
[0] robot
mechanism
crd.sys
pose mod.
delete
block edit
menu
setup
favorites
user buttons
prog
...
pose
log
public input
public output
Direct Teach
T0
tool
gun
help
2020-09-11 10:43:15
10676.00 MB Left
cmd
run to

```
0013.JOB  :P13/S0/F0
    Program File Format Version : 1.6  MechType: 716(YL012-0C)  TotalAxis: 6
S1  move P,spd=60%,accu=0,tool=0
S2  move P,spd=60%,accu=0,tool=0
    end
```

Cartesian		Joint		Enc.Cur.	Enc.Cmd.
X	629.7	S	-0.04	400058	400058
Y	384.8	H	90.00	3FFFFF	3FFFFF
Z	790.9	V	0.01	40001F	40001F
RX	0.0	R2	0.00	400000	400000
RY	90.0	B	-0.01	400015	400014
RZ	-0.0	R1	0.00	400000	400000

To set the execution unit for the step forward/backward operation, touch the **[run to]** button repeatedly until the desired option appears.


cmd
run to
step
run to
end
run to

- **[cmd]**: Will execute the command line by line
- **[step]**: Will execute step by step
- **[end]**: Will execute up to the end statement

When the execution unit is set as **cmd** or **step**, the robot will ignore the set accuracy area and reach the recorded step. If it is set as **end**, the robot will operate on the same path as the one for playing back in automatic mode.

When you set the execution unit as **cmd** or **step** and perform the step forward/backward operation, the robot will operate on a path without cornering. For details on cornering, refer to "**2.3.1.4 Accuracy.**"

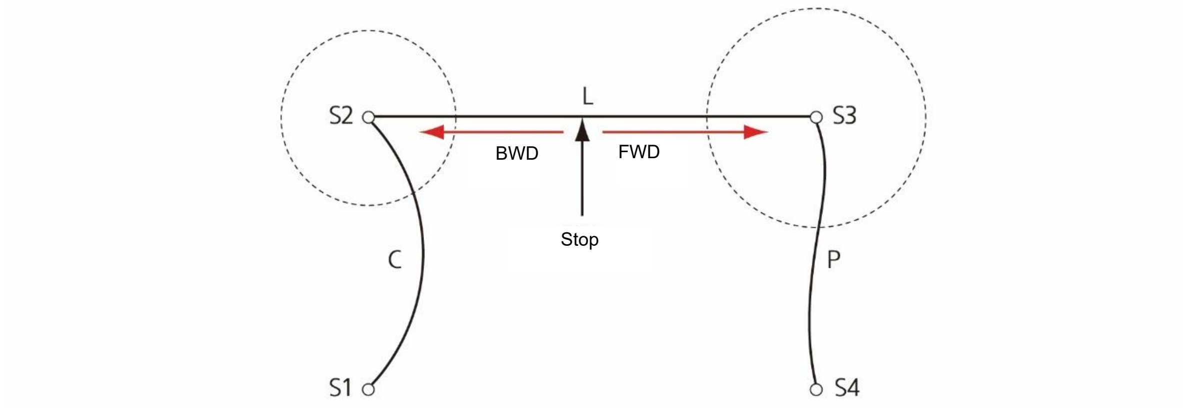


Figure 11 Playback Forward/Backward Path When cmd/step Setting is Performed

If you set the execution unit as **end** and then perform the step forward/backward operation, the path of the robot will change according to the stop position. In other words, if the robot stops at a place other than at cornering and then executes the forward operation, the robot will recover the original cornering path, but if the robot executes the backward operation, the robot will move to the recorded step, and at this time, the robot will stop at the recorded step and then move immediately to the previous step. When the robot stops at cornering, the robot will maintain its previous cornering path both when moving forward and when moving backward.

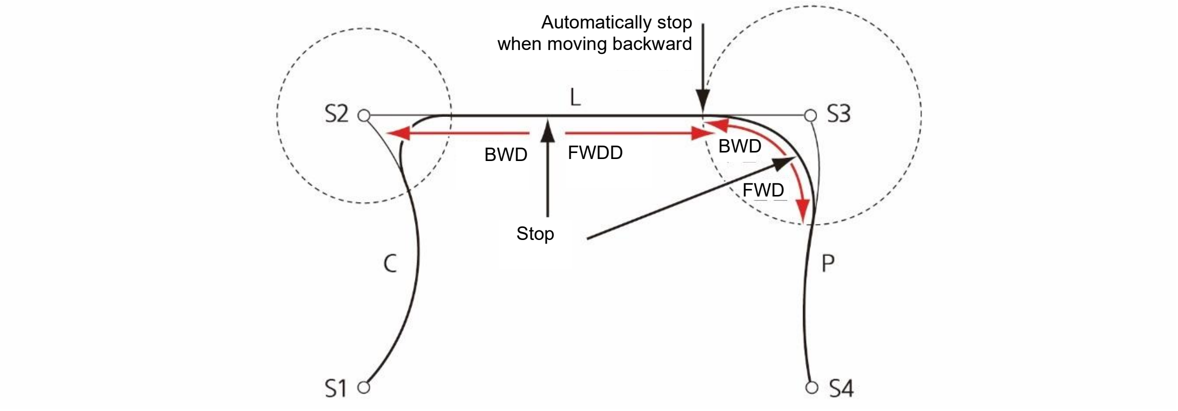


Figure 12 Playback Forward/Backward Path When End Setting is Performed

When the robot stops at cornering and then executes the forward operation, the robot will operate on the original cornering path. Here, if the robot executes the backward operation and then, without reaching the previous step completely, executes the forward operation again, the robot may not be able to create the original cornering path in some cases. In other words, if the distance of the step becomes shorter than the original distance, making it impossible to meet the existing accuracy condition, a smaller cornering path than the original one will be created.

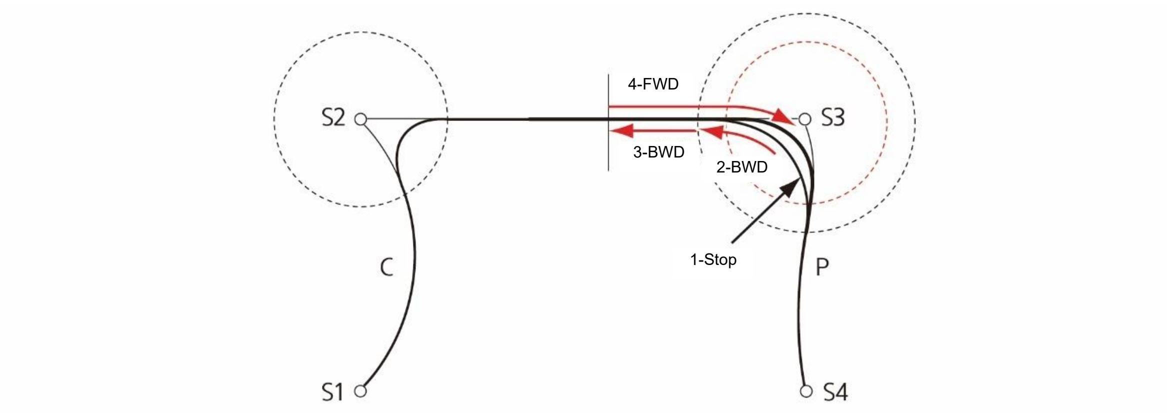
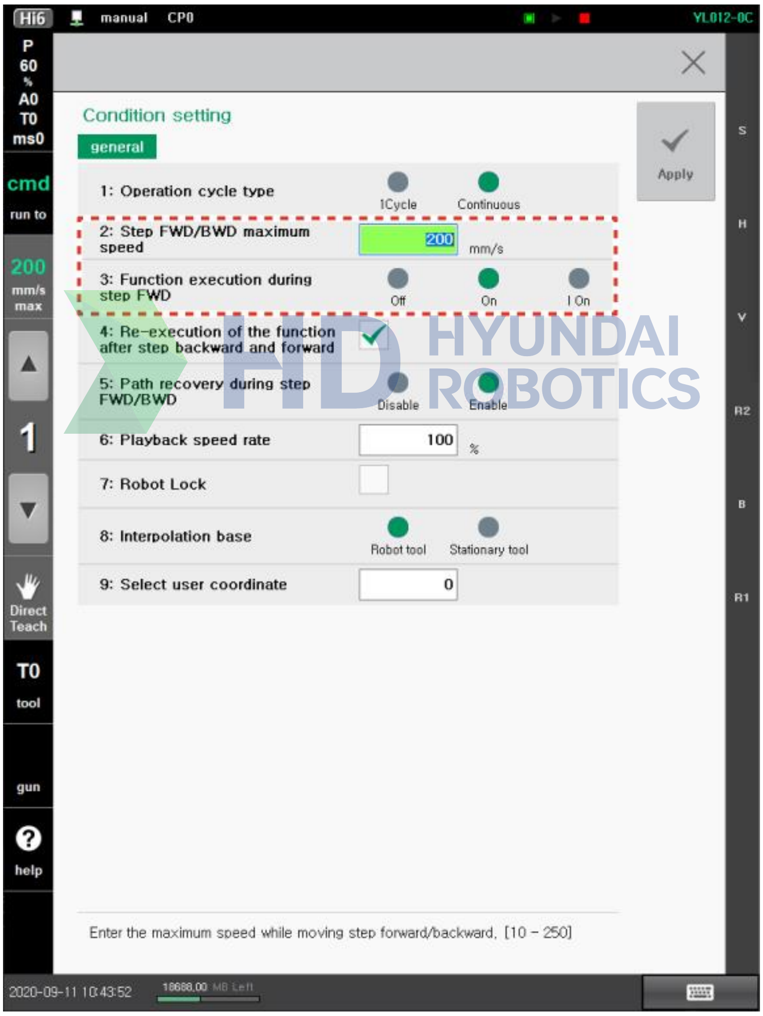

4-FWD
S2
S3
3-BWD
2-BWD
C
1-Stop
P
S1
S4

Figure 13 Example of the Robot Path Change During Step Forward/Backward Operation

You can set the maximum speed for the step forward/backward operation and set whether to execute functions as well. After touching the **[run to]** button on the left side of the Hi6 teach pendant screen, set the speed value and function execution option in the setting window.


Hi6
manual
CP0
YL012-0C
P
60
%
A0
T0
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
gun
help
Apply
S
H
V
R2
B
R1
2020-09-11 10:43:52
18688.00 MB Left

Condition setting

general

1: Operation cycle type ○ 1Cycle ● Continuous

2: Step FWD/BWD maximum speed 200 mm/s

3: Function execution during step FWD ○ Off ● On ○ I On

4: Re-execution of the function after step backward and forward ☑

5: Path recovery during step FWD/BWD ○ Disable ● Enable

6: Playback speed rate 100 %

7: Robot Lock ☐

8: Interpolation base ● Robot tool ○ Stationary tool

9: Select user coordinate 0

Enter the maximum speed while moving step forward/backward. [10 ~ 250]

- **[2: Step FWD/BWD maximum speed]**: Same as the value set for the speed in manual operation
- **[3: Function execution during step FWD]**: You can select the function execution option.
  - **Off**: The function will not be executed for the step forward/backward operation. Regardless of the conditions of the external I/O, you can check only the robot path. Be careful as the interlock with the external system will not work.
  - **On**: You can execute all functions. Should be used after the external interlock is completed.

- **I On**: You can execute only the input wait function. It should be used when it is necessary to check the safety through the external interlock.

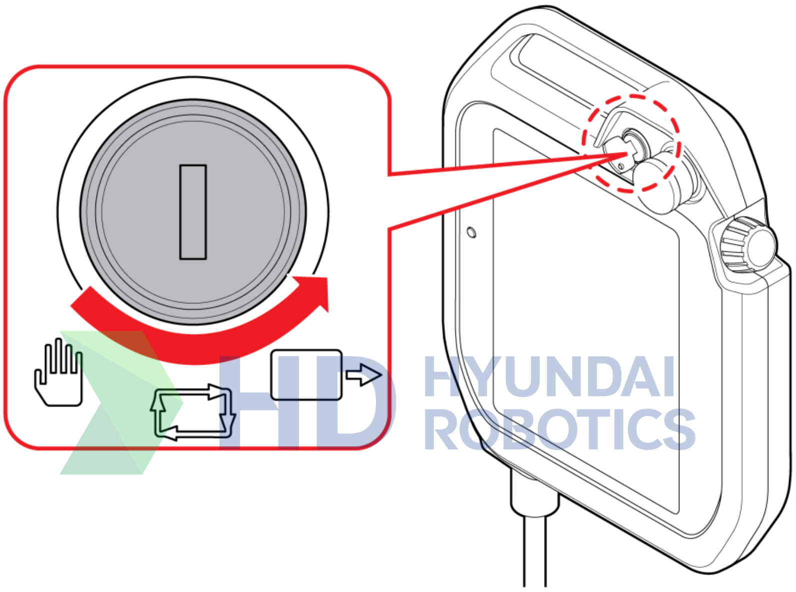
2.2 Automatic Operation

Automatic operation is an operation method of teaching the robot the contents of the work that it should execute and then making the robot perform the work.

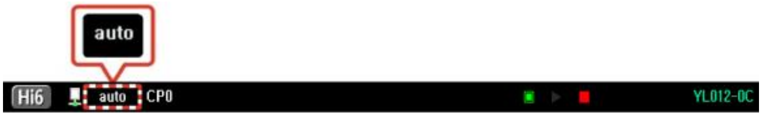
2.2.1 Operation Method

It is the method to teach the robot the contents of the work and then make it perform the work is as follows.

1. Check whether there are people or obstacles within the safety fence and the operation range of the robot.
2. Set the operation mode to automatic mode by turning the mode switch of the teach pendant.

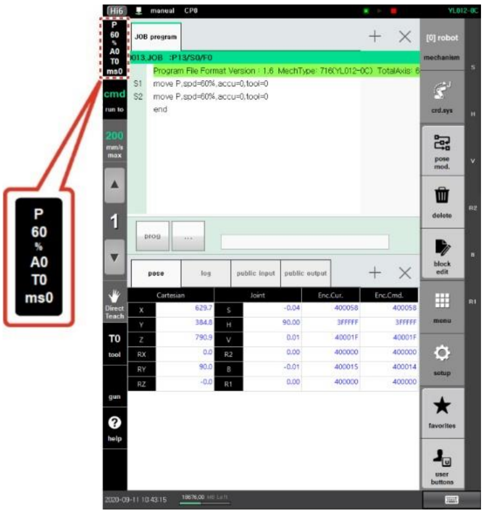


3. On the status bar of the Hi6 teach pendant screen, check whether the operation mode is set to automatic mode.



- If it is set to manual mode, turn the mode switch of the teach pendant to set the operation mode to automatic mode.

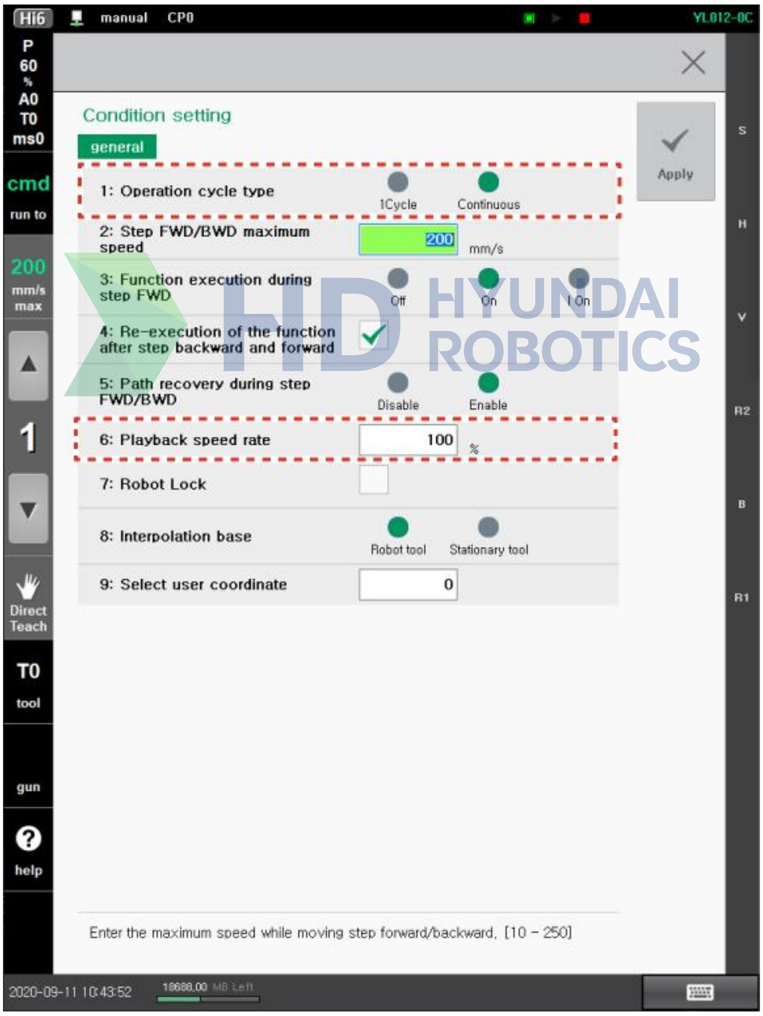
4. Touch the **[Speed Adjustment]** button on the left side of the initial screen. Then, the condition setting window will appear.


Hi6
manual
CP0
YL012-0C
P
60
%
A0
T0
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
gun
help
JOB program
[0] robot
mechanism
crd.sys
pose mod.
delete
block edit
menu
setup
favorites
user buttons
prog
...
pose
log
public input
public output
2020-09-11 10:43:15
18676.00 MB Left

```
0013.JOB   :P13/S0/F0
     Program File Format Version : 1.6  MechType: 716(YL012-0C)  TotalAxis: 6
S1   move P,spd=60%,accu=0,tool=0
S2   move P,spd=60%,accu=0,tool=0
     end
```

Cartesian		Joint		Enc.Cur.	Enc.Cmd.
X	629.7	S	-0.04	400058	400058
Y	384.8	H	90.00	3FFFFF	3FFFFF
Z	790.9	V	0.01	40001F	40001F
RX	0.0	R2	0.00	400000	400000
RY	90.0	B	-0.01	400015	400014
RZ	-0.0	R1	0.00	400000	400000

5. Set the program repetition option and robot operation speed.


Hi6
manual
CP0
YL012-0C
P
60
%
A0
T0
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
gun
help
Apply
S
H
V
R2
B
R1
2020-09-11 10:43:52
18688.00 MB Left

Condition setting

general

1: Operation cycle type ○ 1Cycle ● Continuous

2: Step FWD/BWD maximum speed 200 mm/s

3: Function execution during step FWD ○ Off ● On ○ I On

4: Re-execution of the function after step backward and forward ✓

5: Path recovery during step FWD/BWD ○ Disable ● Enable

6: Playback speed rate 100 %

7: Robot Lock ☐

8: Interpolation base ● Robot tool ○ Stationary tool

9: Select user coordinate 0

Enter the maximum speed while moving step forward/backward. [10 – 250]

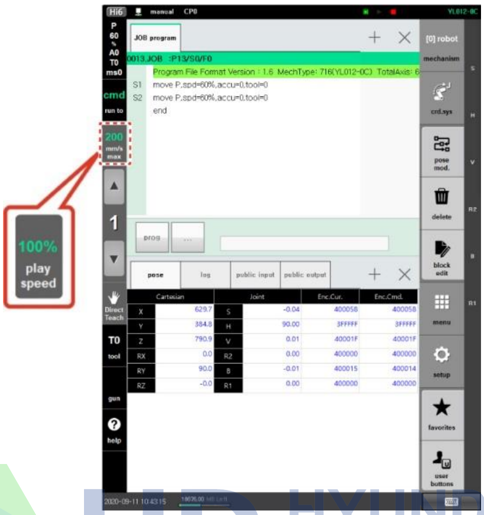
- **[1: Operation Cycle type]**: You can set whether to repeat the program that will be executed during automatic operation.
- **[6: Playback speed rate]**: You can set the operation speed (%) of the robot when a program is played back in automatic mode.

  For example, if the operation speed is set to 100, the robot will move at the recorded speed of the step, and if it is set to 50, the robot will move at the ratio of 50% of the recorded speed.

6. Press the 〈**start**〉 key on the teach pendant. The start lamp will be turned on, and the robot will perform the work according to the created program.

2.2.2 Operation Speed Adjustment

In automatic operation, the **[Speed Adjustment]** button on the left side of the Hi6 teach pendant screen will display the robot's operation speed (%) while the program is being played back. The displayed operation speed is the ratio of the robot's moving speed to the speed recorded in the step.

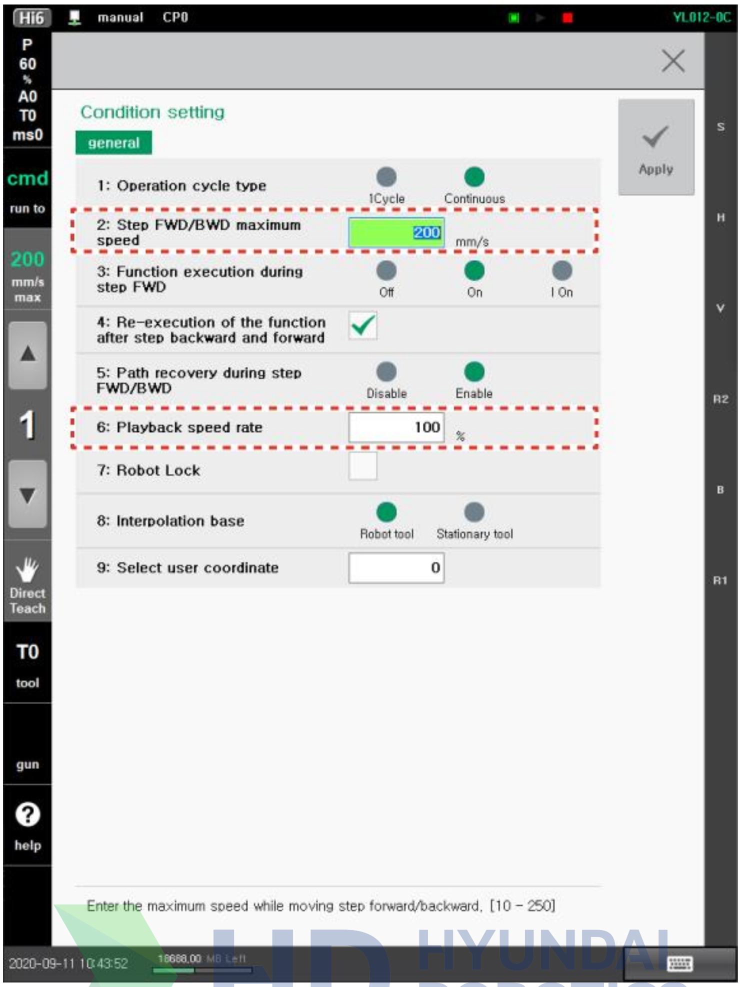

Hi6
manual
CP0
YL012-0C
P
60
%
A0
T0
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
gun
help
JOB program
[0] robot
mechanism
crd.sys
pose mod.
delete
block edit
menu
setup
favorites
user buttons
prog
...
pose
log
public input
public output
100%
play
speed
2020-09-11 10:43:15
18676.00 MB Left

```
0013.JOB  :P13/S0/F0
     Program File Format Version : 1.6  MechType: 716(YL012-0C)  TotalAxis: 6
S1   move P,spd=60%,accu=0,tool=0
S2   move P,spd=60%,accu=0,tool=0
     end
```

Cartesian		Joint		Enc.Cur.	Enc.Cmd.
X	629.7	S	-0.04	400058	400058
Y	384.8	H	90.00	3FFFFF	3FFFFF
Z	790.9	V	0.01	40001F	40001F
RX	0.0	R2	0.00	400000	400000
RY	90.0	B	-0.01	400015	400014
RZ	-0.0	R1	0.00	400000	400000

Note	In manual mode, the **[Speed Adjustment]** button will display the step speed limit, instead of the playback speed (%).

In automatic mode, you can adjust the operation speed of the robot, without modifying the program, by changing the value of the automatic operation speed ratio in the condition setting. After touching the **[Speed Adjustment]** button on the left side of the Hi6 teach pendant screen, set the option values of the **[2: Step FWD/BWD maximum speed]** and **[6: Playback speed rate]** in the setting window.



Condition setting

general

1: Operation cycle type ○ 1Cycle ● Continuous

2: Step FWD/BWD maximum speed 200 mm/s

3: Function execution during step FWD ○ Off ● On ○ I On

4: Re-execution of the function after step backward and forward ☑

5: Path recovery during step FWD/BWD ○ Disable ● Enable

6: Playback speed rate 100 %

7: Robot Lock ☐

8: Interpolation base ● Robot tool ○ Stationary tool

9: Select user coordinate 0

Enter the maximum speed while moving step forward/backward. [10 ~ 250]

2.3 Step

A step refers to a specific posture (the position of each axis or the position of the tooltip) that is to be recorded in the job program and taken by the robot. In other words, a step is one position that the robot will reach through a movement.

The robot performs various functions while moving from one step to another. For movement from one step to another, a movement condition such as a move, which is a movement command, is required.

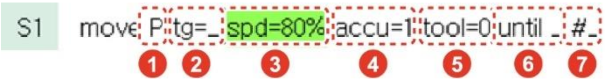
- It is the basic unit of robot programming. This is a command for the manipulator to move. It consists of minimum information that is necessary for the operation of the robot.
- Movement conditions: These are the step statement parameters such as robot position, interpolation, speed, accuracy, and tool number.

2.3.1 Step Statement Parameters

The step statement parameters are the movement conditions required for the step movement of the robot, such as the robot position, interpolation, speed, accuracy, and tool number of the robot, in addition to move, a movement command.

Parameters of the step statement are divided into default parameters and optional parameters. The default parameters are the essential ones for a step, and the optional parameters are the ones that can be added when necessary.

The step statement is configured as follows.



```
S1    move P tg=_ spd=80% accu=1 tool=0 until _ #_
```

No.	Parameter	Description
①	Interpolation	Interpolated path between steps P (Joint interpolation), L (Linear interpolation), C (Circular interpolation), SP (Stationary tool interpolation off), SL (Stationary tool linear interpolation), SC (Stationary tool circular interpolation)
②	Pose	A parameter to record a position. This parameter may be omitted, and a pose may be designated after the statement (hidden pose). Target pose (X, Y, Z, Rx, Ry, Rz, Cfg) {Coordinate system} + Shift (X, Y, Z, Rx, Ry, Rz) {Coordinate system}
③	Speed	Operation speed of the robot (Unit: mm/sec, cm/min, %, sec)
④	Accuracy	A value of the allowable error (0–7) between the current position and the recorded position that occurs when the robot moves to the target step
⑤	Tool number	Number of the tool in use (0–31)
⑥	Stop condition	A condition for the robot to stop moving to execute the next command (step or function)
⑦	Comment	Description of the step

2.3.1.1 Interpolation

Interpolation refers to the interpolated path between steps, and the interpolation method for the [Step N] determines the form of the path between [Step N-1] and [Step N].

- P-PTP (Point-to-Point)

  It is the fastest of the general interpolation modes as it interpolates the path between two steps based on individual axes, not the tooltip. Considering the characteristics of industrial robots that consist of rotation joints, the path of the tooltip is usually shaped in a C form.

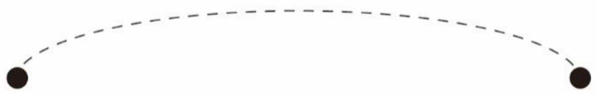


Figure 14 Example of the Tooltip Path in P-PTP Interpolation

- L-Linear interpolation

  It moves in a linear line between two steps in Cartesian space. It is used for a case in which a linear path is needed, such as an arc welding section. The movement will take place while the wrist posture changes automatically as follows.

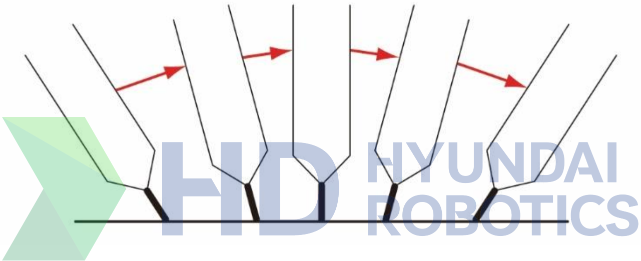


Figure 15 Example of L-Linear Interpolation

During the linear interpolation, under certain conditions, the robot cannot automatically change the wrist posture, and such a condition is called the singular posture.

Note	Singular postures in which the posture interpolation cannot be performed are as follows. • If the B-axis is near the dead zone: For details on the dead zone setting, refer to "**7.4.5 B-axis No-Use Area.**" • When the sign of the B-axis changes: When the sign of the B-axis angle switches (- → +) or (+ → -) • When the angle variation of the R2 and R1 axes exceeds 180 degrees • When the center of the B-axis (axis 5) or the tooltip passes the center of rotation of the S-axis (axis 1): There may be an error in the trajectory as well as in the posture. • When the angle variation of the S-axis exceeds 180 degrees

- C-Circular interpolation

  It moves in a circular path created between two steps. There should be three points to determine the circle, and the references for selecting them are as follows.

  - At the time of moving from [Step n] to [Step n+1], if the interpolation method of [Step n+1] is C-circular interpolation, it is required to refer to the next step [Step n+2].

- If the interpolation method of [Step n+2] is C-circular interpolation, it is required to determine the circle based on [Step n], [Step n+1], and [Step n+2], and among them, movement should take place along the arc of the section of [Step n] - [Step n+1].

- If the interpolation method of [Step n+2] is not a circular interpolation, it is required to refer to the previous step [Step n-1] and determine the circle based on [Step n-1], [Step n], and [Step n+1], and among them, movement should take place along the arc of the section of [Step n] - [Step n+1].

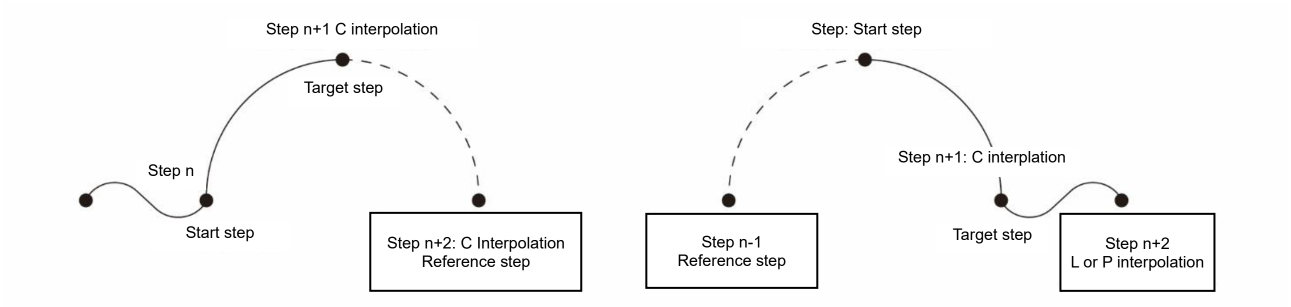

Step n+1 C interpolation
Target step
Step n
Start step
Step n+2: C Interpolation
Reference step
Step: Start step
Step n+1: C interplation
Step n-1
Reference step
Target step
Step n+2
L or P interpolation

Figure 16 Example 1 of C-Circular Interpolation

If you use the criteria of selecting three points required for determining the circle, you can create a program through the double registration of the same point, even in the case of a continuous arc.

In this way, by determining the interpolation method of the step in consideration of the path to move along and using the same point dual registration function, you can create a program as desired.

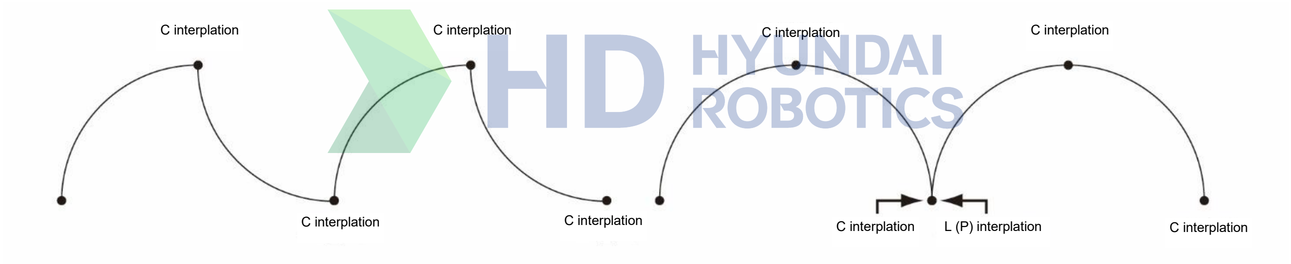

C interplation
C interplation
C interplation
C interplation
C interplation
C interplation
C interplation
L (P) interplation
C interplation

Figure 17 Example 2 of C-Circular Interpolation

- Stationary tool interpolation

This method will be used when the robot owns the workpiece and perform the work using an externally fixed tool. In this case, the interpolation will be performed based on the workpiece owned by the robot.

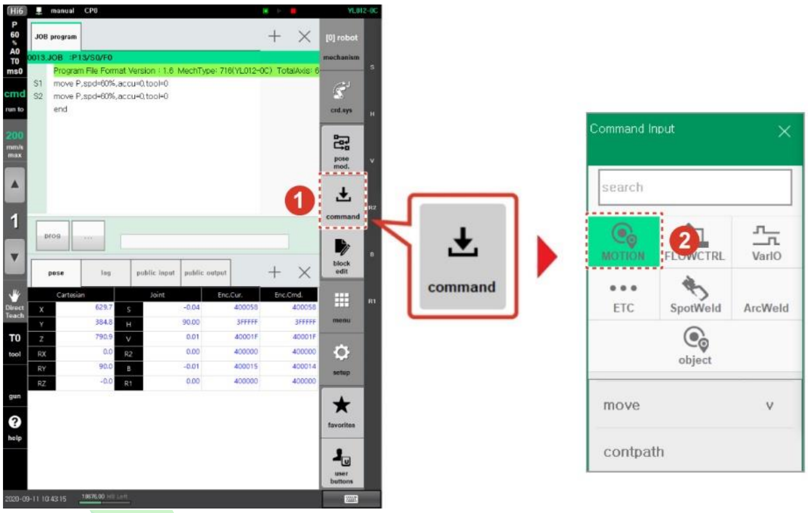
For details on the types of interpolation for stationary tools, refer to “**7.3.6.2 Stationary Tool Coordinate System.**”

2.3.1.2 Pose

A pose is a parameter to record the position. If you input a move, the movement command, by using the **[Command]** button, you should designate the pose expression in the tg (target) parameter. When the move statement is inputted using the **[Record]** button, the tg parameter will not appear. At the moment of touching the **[Record]** button, the position and posture of the manipulator will be recorded, but they will not be displayed on the JOB editing screen, which is why they are called a hidden pose.

The method to input a pose using the menu button on the right side of the Hi6 teach pendant screen is as follows.

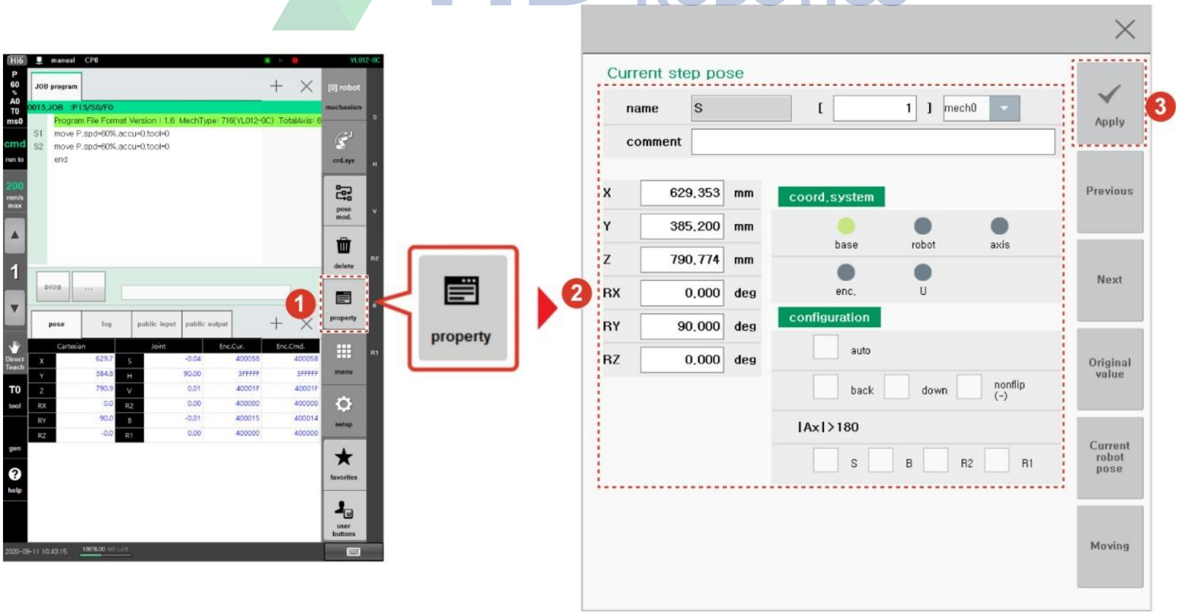
- After touching the **[Command]** button, select **[Motion]** and then input the statement.



```
0013.JOB :P13/S0/F0
Program File Format Version : 1.6 MechType: 716(YL012-0C) TotalAxis: 6
S1  move P,spd=60%,accu=0,tool=0
S2  move P,spd=60%,accu=0,tool=0
    end
```

JOB program
[0] robot
crd.sys
pose mod.
command
block edit
menu
setup
favorites
user buttons
pose
log
public input
public output
①
command
Command Input
search
MOTION
②
FLOWCTRL
VarIO
ETC
SpotWeld
ArcWeld
object
move
contpath

- After touching the **[property]** button, set the attributes of the current robot pose and then touch the **[Apply]** button.



Current step pose

name: S [1] mech0

comment:

X 629.353 mm
Y 385.200 mm
Z 790.774 mm
RX 0.000 deg
RY 90.000 deg
RZ 0.000 deg

①
property
delete
②
coord.system
base
robot
axis
enc.
U
configuration
auto
back
down
nonflip (-)
|Ax|>180
S
B
R2
R1
③
Apply
Previous
Next
Original value
Current robot pose
Moving

The pose variable and shift variable will be saved in the following formats.

Pose Variable	Shift Variable
(X, Y, Z, Rx, Ry, Rz, {Coordinate system}, {config.})	(X, Y, Z, Rx, Ry, Rz, {Coordinate system})

{Coordinate system}: "base" = Base coordinate system "robot" = Robot coordinate system "user{n}" = User coordinate system (n refers to a number) "joint" = Joint coordinate system "encoder"= Encoder	{Coordinate system}: "base" = Base coordinate system "robot" = Robot coordinate system "user{n}" = User coordinate system (n refers to a number) "joint" = Joint coordinate system

2.3.1.3 Speed

The operation speed of the robot can be displayed using the following four types of units. They can be used in all interpolation methods.

- ㎜/sec, ㎝/min: Sets the maximum speed of the TCP (Tool Center Point) of the robot.

  The maximum speed of the robot will be automatically calculated by the controller based on the position and acceleration/deceleration parameters. If the setting value is larger than the maximum speed limit of the performance of the robot, the robot will operate only at the maximum speed limit.

- sec: Sets the robot moving time.

  The shortest robot moving time will be automatically calculated by the controller based on the position and acceleration/deceleration parameters. If the setting value is shorter than the shortest time limit of the performance of the robot, the robot will operate only at the shortest time limit.

- %: Sets the ratio of the robot moving speed to the maximum speed at which the robot can operate.

  When this is set to 100%, the robot will operate at the maximum speed within the allowable range.

2.3.1.4 Accuracy

It will determine the accuracy (the degree of approach to the recorded position) at which the robot passes through the step when progressing the target step. When the robot moves to the target step, if the error between the current position and the recorded position that occurs when the robot moves to the target step is less than a certain value, the robot will move to the next step. The value of the allowable error at this time is called accuracy.

A path that is newly created within the accuracy range (0–7) according to the accuracy is called a cornering path. In general, the higher the accuracy, the faster the cornering speed, which is advantageous in terms of moving time.

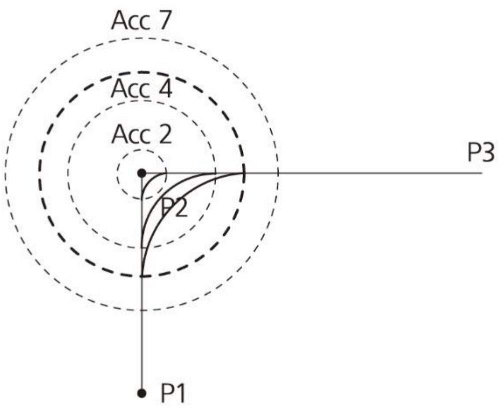


Figure 18 Change of the Path P2 Because of Accuracy

Accuracy 0 has the highest accuracy, and Accuracy 7 has the greatest error. Accuracy will be applied in a way that it cannot be greater than 1/2 of the length of the shorter trajectory of both trajectories of the target step. In other words, you can apply the expression “**Accuracy ≤ min (P1-P2, P2-P3) / 2**” in the example above. In this expression, the TCP distance is used for explanation, but the same concept can be applied to the angle.

In the case of a robot, the value of the applicable accuracy level will be defined based on the tooltip distance and posture angle of the robot. When it comes to additional axes, the value in the case of the linear axis will be defined based on the length, and the value in the case of the rotation axis will be defined based on the angle. You can directly change the values in the **[Set up〉 3: Robot Parameter〉 6: Accuracy]** menu. For details on the value of the accuracy level, refer to “**7.4.6 Accuracy.**”

The figure below shows how the cornering path is created according to the value of the accuracy level. If there is a general 6-axis articulated robot and an additional axis, the value of accuracy level can be set individually for TCP (tooltip distance), ORN (position angle), and AUX (additional axis distance). Because all the values of relevant accuracy levels should be satisfied, the cornering path will be created based on the smallest value among TCP, ORN, and AUX. The cornering path will be created in a constant curve, regardless of the speed variation, while satisfying the convex hull property. However, errors of several millimeters (mm) may occur at low speed and high speed because of servo delay.

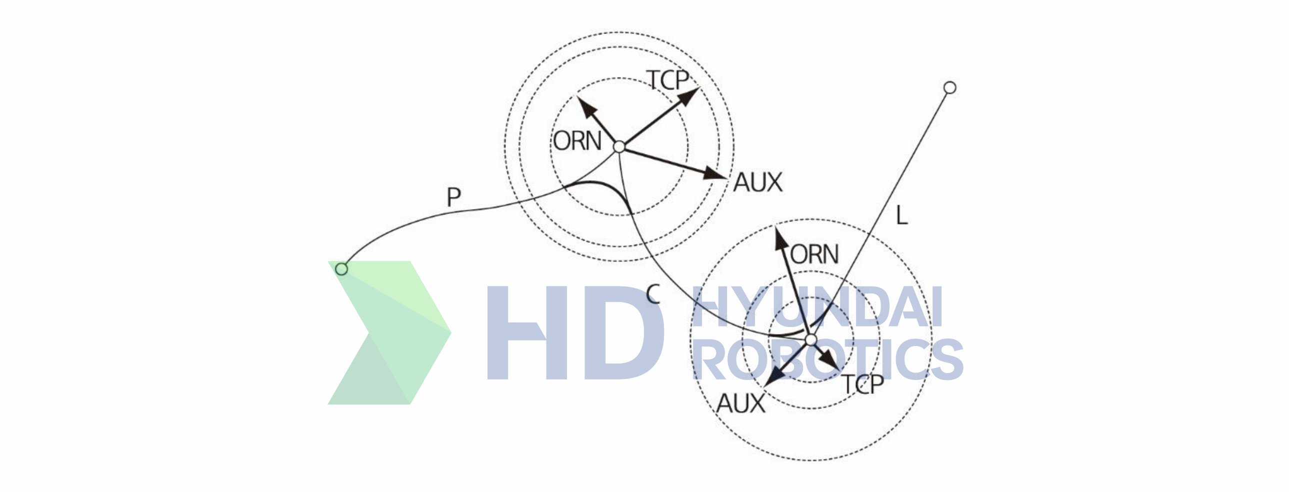


Figure 19 Creation of the Cornering Path According to the Value of Accuracy Level

Note	The mode of creating the cornering path according to the value of accuracy level will be applied to all types of interpolation in the same manner. In the case of P interpolation, the TCP distance accuracy will be applied, but errors may occur.

The cornering path will not exceed the convex polygon area because of the convex hull property, as shown below.

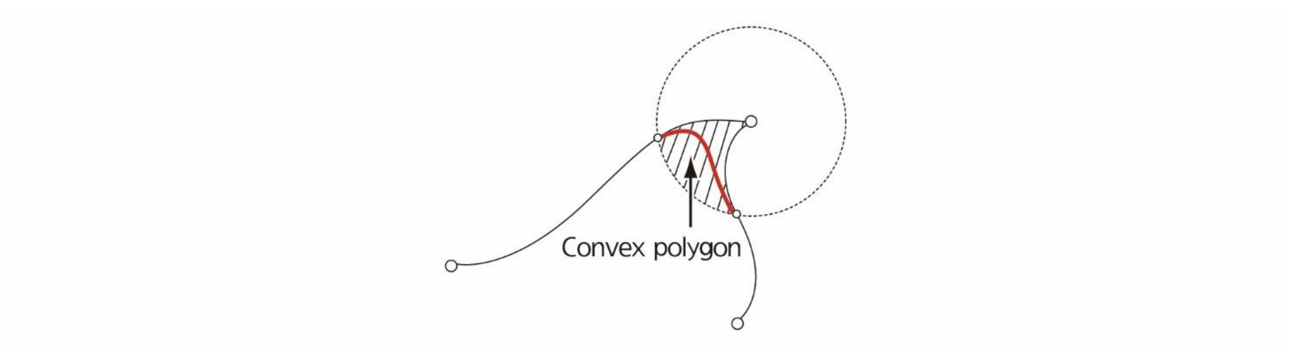


Figure 20 All Points on the Cornering Path within the Convex Polygon Area

2.3.1.5 Tool Number

The robot position will be determined by the position and posture of the tooltip. You can designate the tool number (0–31) that will be used.

2.3.1.6 Stop Condition

When the conditional expression “after until” is satisfied, the robot stops moving and executes the next command (step or function).

The value of the conditional expression “after until” can be checked through the return value of the result () function. You can check whether the move operation is terminated by a conditional expression.

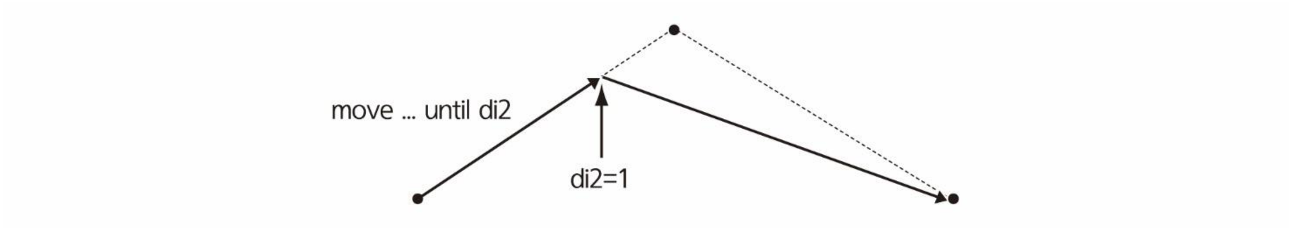


Figure 21 Example of Stop Conditions

Note	For details on the robot language, refer to the “**Robot Language Function Manual.**”

2.3.1.7 Comment

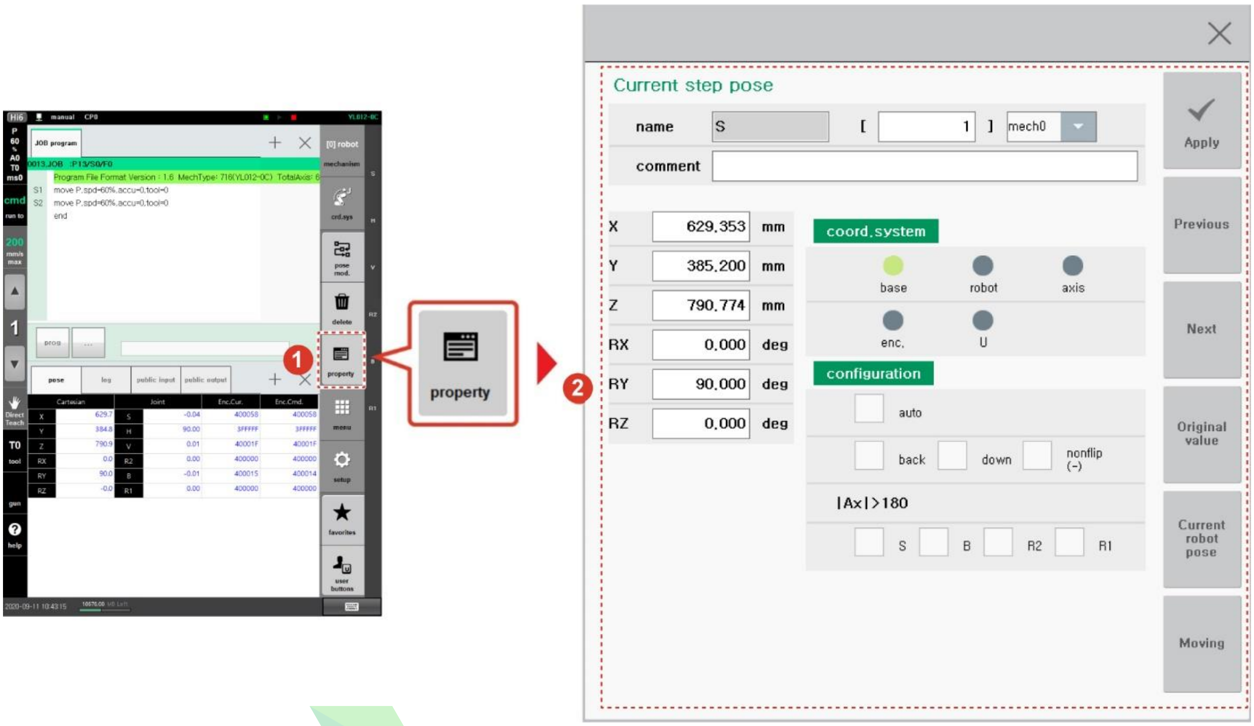
You can input a comment for the description of a step. You can input the contents of comments conveniently by using the soft keyboard.

2.3.2 Recording and Changing a Step Position

You can record or change the robot position and posture of the recorded step using the **[Record]** button.

2.3.2.1 Axis Angle Recording Coordinate

In manual mode, if the **[1: Pose Recording Form]** option in the **[Set up〉 1: User Environment]** menu is set to axis angle, touch the **[property]** button in the move statement. The following attributes window will appear. The position of the robot recorded by the encoder can only be checked, and the position data cannot be modified.



name S [1] mech0
comment

X	629.353	mm
Y	385.200	mm
Z	790.774	mm
RX	0.000	deg
RY	90.000	deg
RZ	0.000	deg

2.3.2.2 Base and Robot Recording Coordinates

The position and posture of the robot can be displayed differently depending on the coordinate system. If there is no travel axis, the base coordinate and the robot coordinate will generally be the same. If the travel axis is defined, the position and posture of the robot tool will be displayed differently depending on whether it is the base coordinate and the robot coordinate.

In manual mode, if the **[1: Pose Recording Form]** option in the **[Set up〉 1: User Environment]** menu is set to base or robot, touch the **[property]** button in the move statement. You can check the position and posture of the robot tool in the attributes window.

Note	If you would like to change the pose recording form, please contact our customer support team to ask an expert or an engineer.

For one tooltip position and its orientation, there may be multiple postures because of the characteristics of the instrument, so to define one posture, the robot form (config.) should be designated.

Collaborative robots can be restricted by the soft limit because of their mechanical structures. When the robot is not in operation, you can release the soft limit or set it to a large value.

- auto: Regarding the current posture of the robot, the items that come later will be automatically determined. If this mode is not set, a determination will be performed based on whether the items below are designated or not.
- back: The tooltip of the robot is in the – direction on the X-axis of the robot coordinate system, meaning the rear. If this is not designated, the tooltip will be in the + direction, meaning the front.
- down: Relationship between the H-axis and V-axis. If this is designated, the result will be the bottom. If this is not designated, the result will be top.

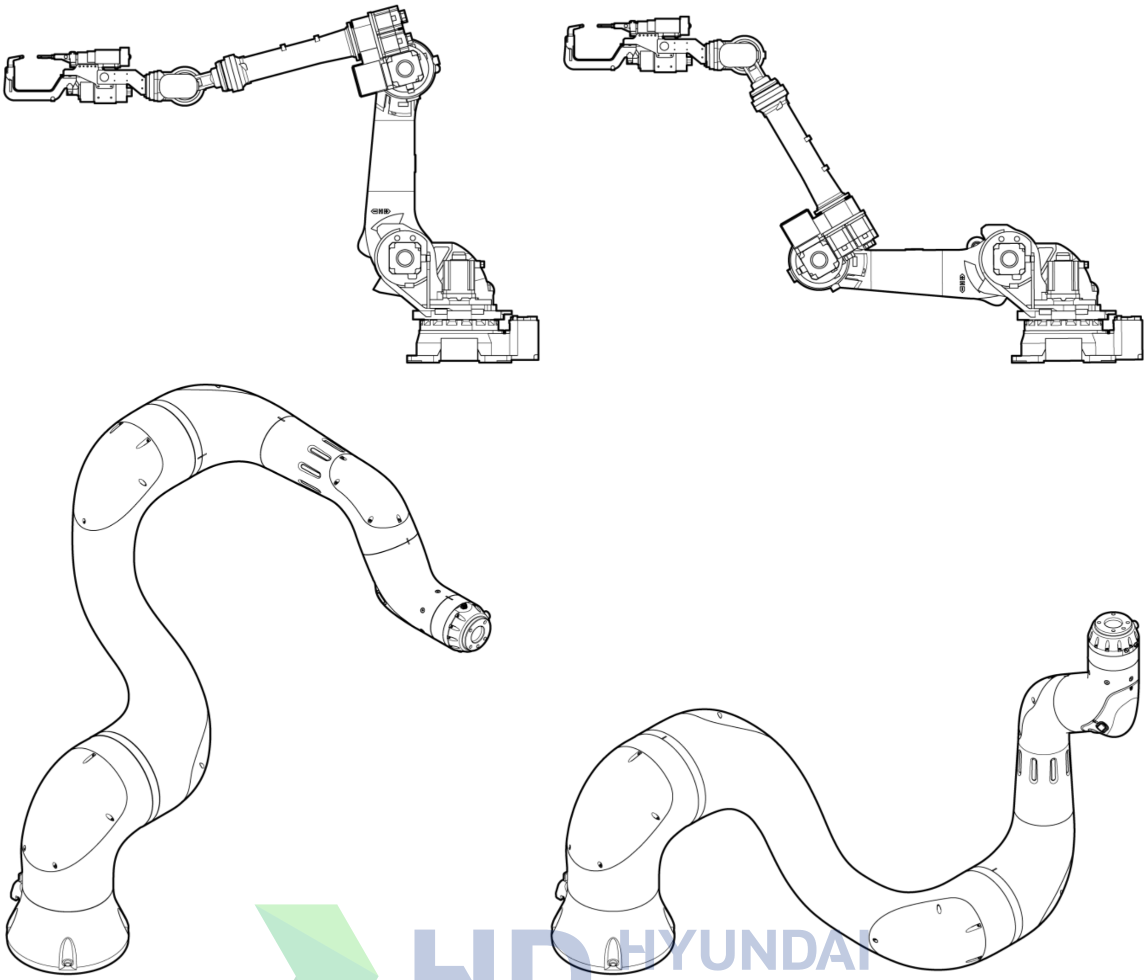


Figure 22 Posture of the H and V Axes: Up (Left), Down (Right)

- flip: Flip with the B-axis coordinate being a + value. If this is not designated, the result will be non-flip with a - value. The red arrow in the figure shows the direction of the top of the wrist axis.

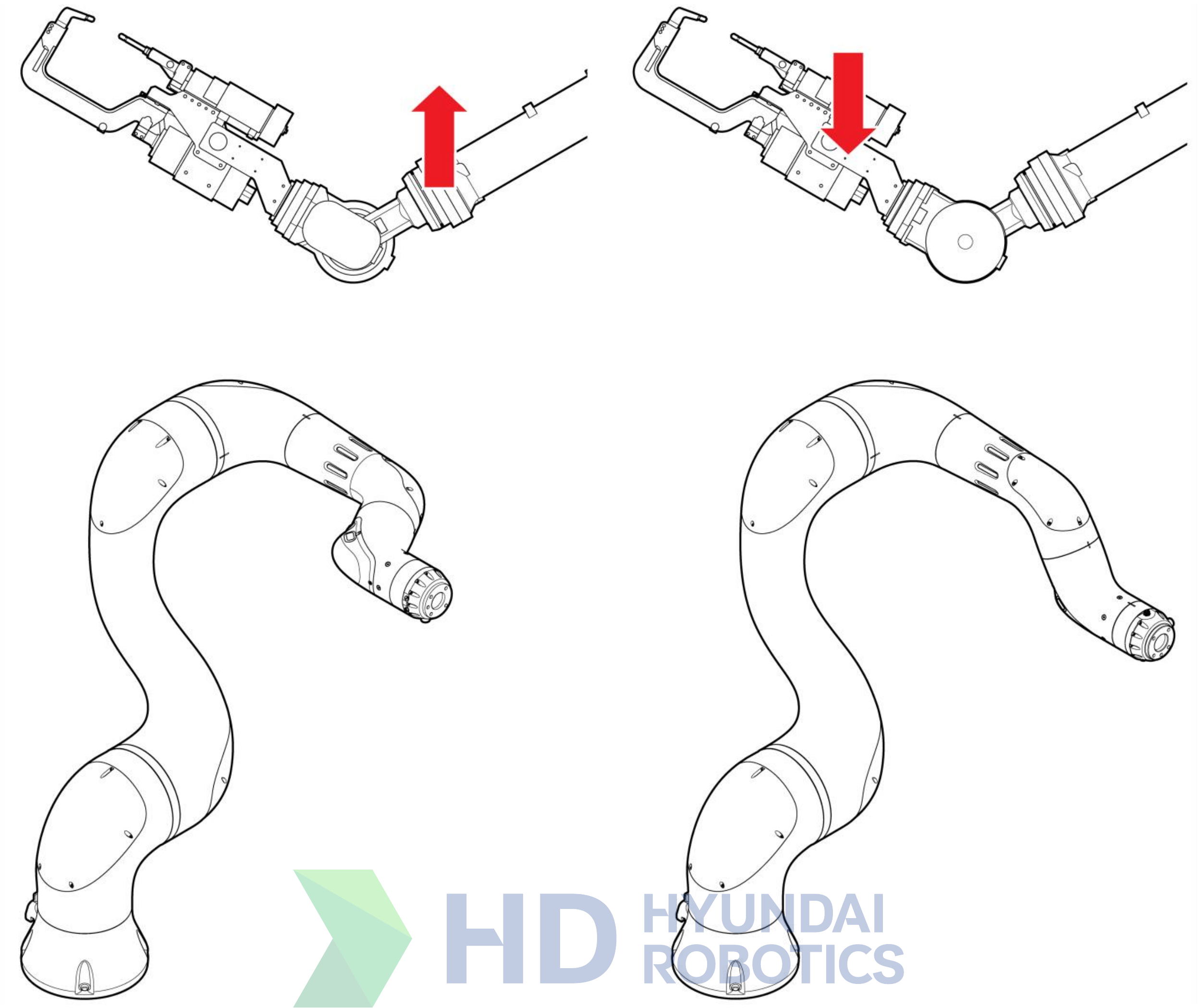


Figure 23 Flip (Left) / Non-flip (Right) Posture

- S (|S|>=180): The absolute value of the S-axis angle is more than 180 degrees. If not designated, it will be less than 180 degrees.
- B (|B|>=180): The absolute value of the B-axis angle is more than 180 degrees. If not designated, it will be less than 180 degrees.
- R2 (|R2|>=180): The absolute value of the R2-axis angle is more than 180 degrees. If not designated, it will be less than 180 degrees.
- R1 (|R1|>=180): The absolute value of the R1-axis angle is more than 180 degrees. If not designated, it will be less than 180 degrees.

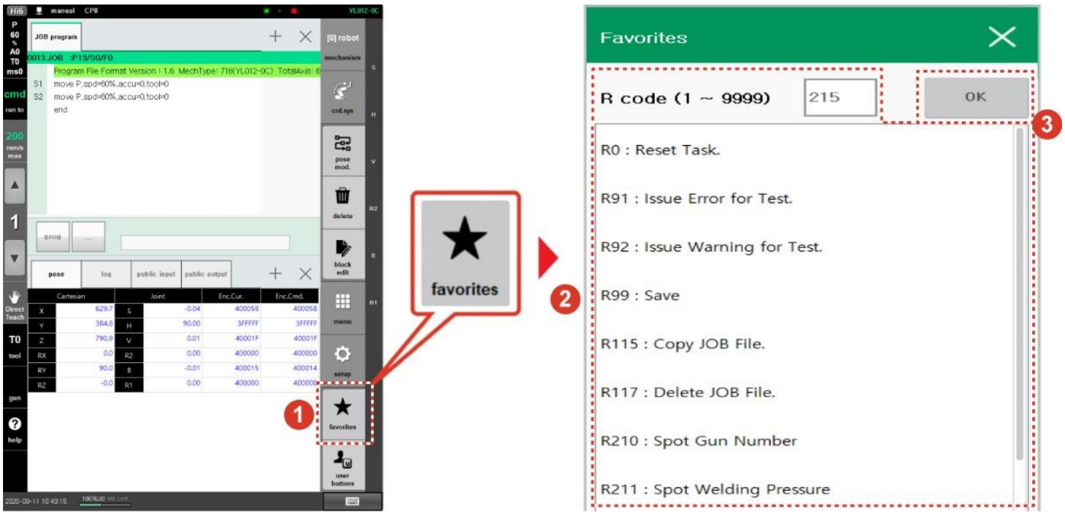
The coordinate system will be saved as **[Pose Variable].crd** (Example: po32.crd), and one of the following strings will be designated. If it is an empty string, the basic value will be recognized as **joint**.

```
Base coordinate system         = "base"
Robot coordinate system        = "robot"
Joint coordinate system        = "joint"
Encoder                        = "encoder"
User coordinate system         = "u1" – "u10"
```

2.4 R Codes

R codes are unique code numbers assigned to specific functions. Assigning unique code numbers to frequently used functions can help you use those functions quickly. For details on R codes, refer to "**8 R codes.**"

After touching the **[Favorites]** button on the right side of the Hi6 teach pendant screen, input the code number and touch the **[OK]** button. Then the predefined function will be executed.



R code (1 ~ 9999) 215

R0 : Reset Task.

R91 : Issue Error for Test.

R92 : Issue Warning for Test.

R99 : Save

R115 : Copy JOB File.

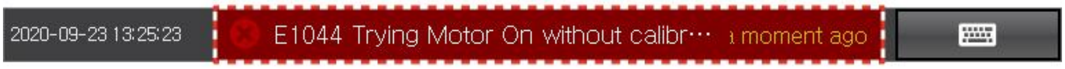
R117 : Delete JOB File.

R210 : Spot Gun Number

R211 : Spot Welding Pressure

2.5 Error Information

When a problem occurs, a notification will appear on the taskbar at the bottom of the Hi6 teach pendant screen and will blink for about one minute. You can check the error code, notification message, and the time of error occurrence.

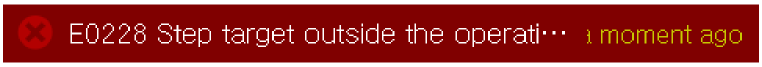


2020-09-23 13:25:23 E1044 Trying Motor On without calibr··· ı moment ago

2.5.1 Error Type

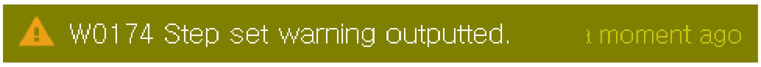
Troubles in the robot system are divided into errors and warnings.

- Error: It is trouble serious enough to stop the robot operation, and the code number in the notification message starts with E.



E0228 Step target outside the operati··· ı moment ago

- Warning: The robot will continue to operate, but a warning is a trouble that requires you to check whether or not a response action has been taken. The code number in the notification message starts with W.

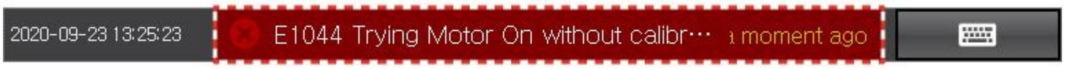


W0174 Step set warning outputted. ı moment ago

2.5.2 Error Handling

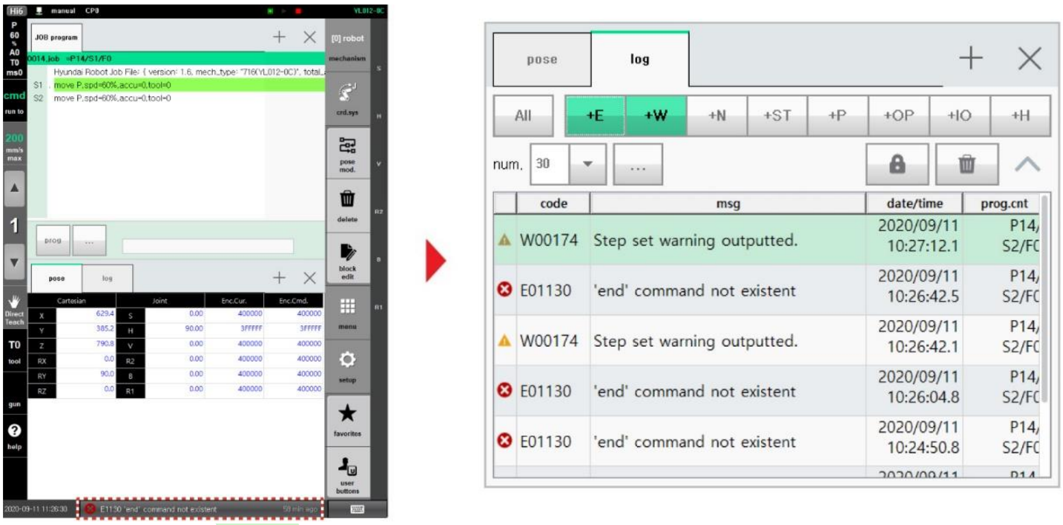
The following shows how to check and deal with various system troubles, such as system failures or operational errors.

- Check the notification on the taskbar. An error code, notification message, and time of error occurrence will appear.



2020-09-23 13:25:23 E1044 Trying Motor On without calibr··· a moment ago

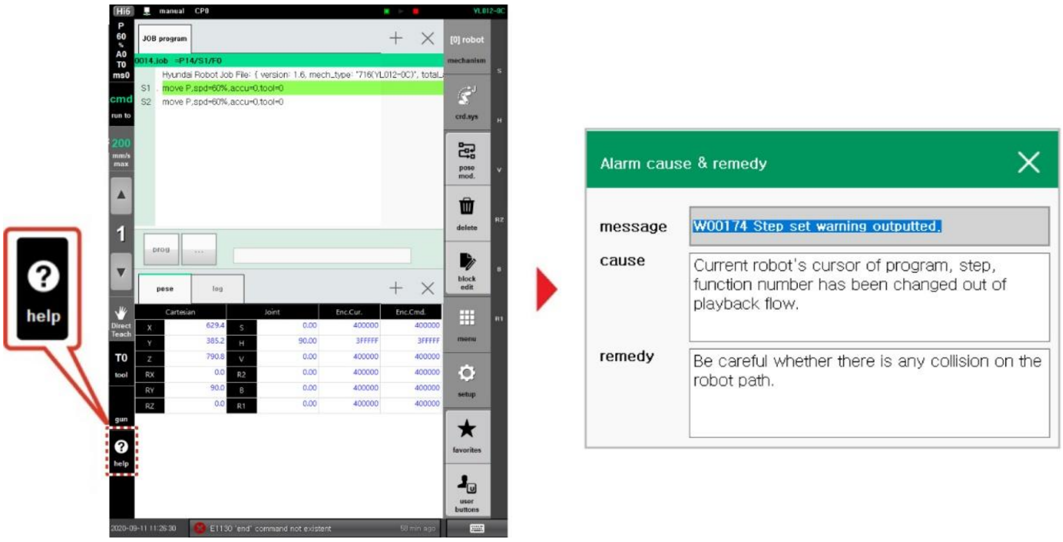
- Touch the notification on the taskbar. Then, the error and warning history will appear in a new window.



	code	msg	date/time	prog.cnt
⚠	W00174	Step set warning outputted.	2020/09/11 10:27:12.1	P14/ S2/F
⊗	E01130	'end' command not existent	2020/09/11 10:26:42.5	P14/ S2/F
⚠	W00174	Step set warning outputted.	2020/09/11 10:26:42.1	P14/ S2/F
⊗	E01130	'end' command not existent	2020/09/11 10:26:04.8	P14/ S2/F
⊗	E01130	'end' command not existent	2020/09/11 10:24:50.8	P14/ S2/F

  - You can also open the error and warning history window by touching the **[+]** button at the top right of the task panel stack and selecting **[log]**.
  - The error and warning history will be displayed in chronological order, and the most recent troubles will be highlighted.

- Touch the **[Help]** button on the left side of the Hi6 teach pendant screen. You can check the error code, the notification message, the cause of the trouble, and how to take action for it.



Alarm cause & remedy

message: W00174 Step set warning outputted.

cause: Current robot's cursor of program, step, function number has been changed out of playback flow.

remedy: Be careful whether there is any collision on the robot path.

2.6 User Buttons

By assigning the desired functions to the buttons in the user button area on the right side of the Hi6 teach pendant screen, you can conveniently use them when teaching a robot.

2.6.1 Switching of the User Button Area

Touch the **[User buttons]** button on the right side of the Hi6 teach pendant screen until the desired area appears. Then, the menu button area will be switched to the user button area. In the user key area, the key signal output function and the spot application function are assigned and provided by default.

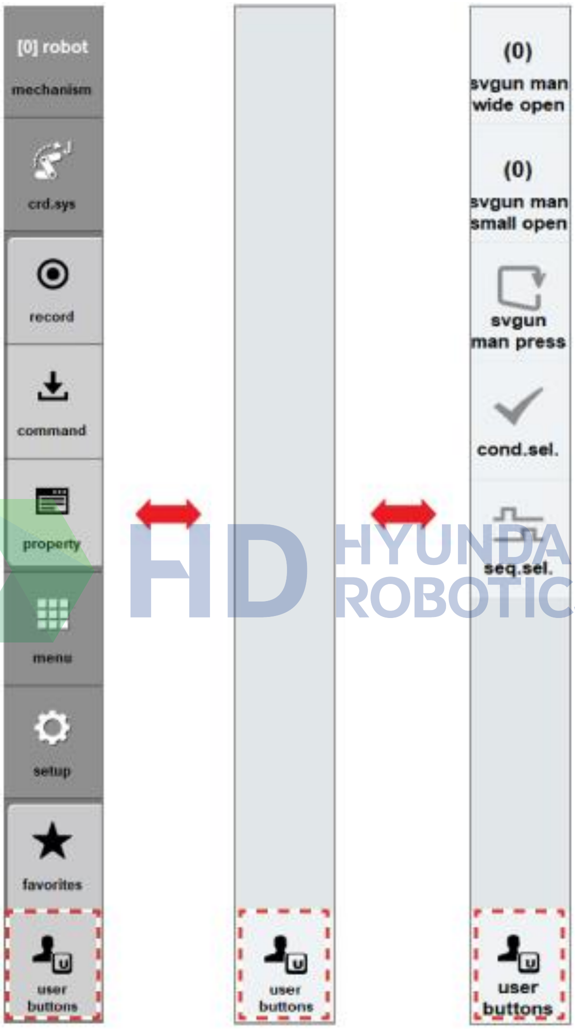

[0] robot
mechanism
crd.sys
record
command
property
menu
setup
favorites
user buttons
user buttons
(0)
svgun man wide open
(0)
svgun man small open
svgun man press
cond.sel.
seq.sel.
user buttons

Figure 24 Switching to the User Key Area

- If you press the **[User buttons]** button while pressing the **〈shift〉** key, you can switch the area in the opposite direction.
- In the user button area, the key signal output function and the spot application function are assigned.
  - The key signal output function area will stay empty as the initial state in which no button is registered.
  - The spot application function area will have buttons registered, which can be used for teaching the robot.

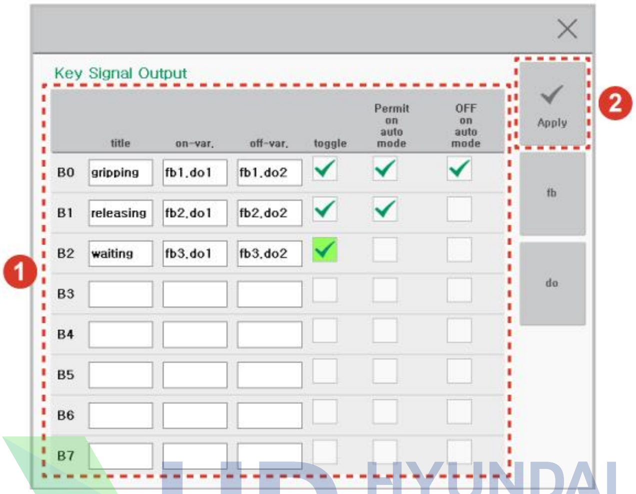
2.6.2 Button Registration for Each Area

You can register the desired function in the user key area with a button. Up to eight functions can be registered.

2.6.2.1 Key Signal Output Function Area

You can simply turn on/off the desired output signal by registering it with a button.

1. Touch the **[User Buttons]** button repeatedly until the key signal output function area appears.
2. While pressing the **<ctrl>** key, touch the **[User Buttons]** button. The key signal output setting window will appear.
3. After setting the function name and option to display on the button, touch the **[OK]** button.



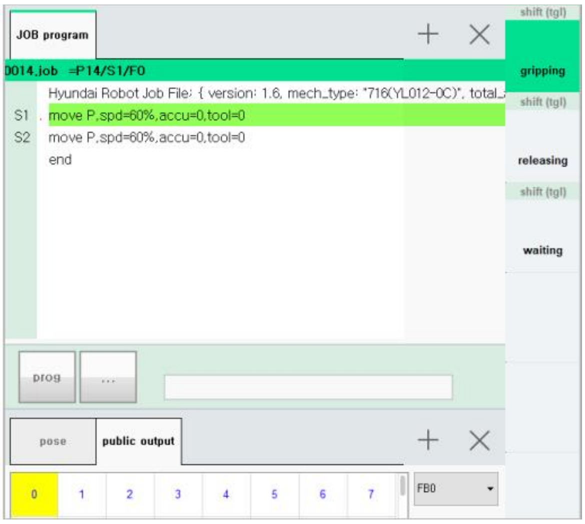
Key Signal Output

	title	on-var.	off-var.	toggle	Permit on auto mode	OFF on auto mode
B0	gripping	fb1.do1	fb1.do2	☑	☑	☑
B1	releasing	fb2.do1	fb2.do2	☑	☑	☐
B2	waiting	fb3.do1	fb3.do2	☑	☐	☐
B3				☐	☐	☐
B4				☐	☐	☐
B5				☐	☐	☐
B6				☐	☐	☐
B7				☐	☐	☐

- **[Title]**: This is the function name to be displayed on the button.
- **[on-var.]**: This is the name of the signal output variable or of the number type variable. This is the name of the variable whose value will be turned ON (assign 1) when the button is turned ON.
- **[off-var.]**: This is the name of the signal output variable or the number type variable. This is the name of the variable whose value will be turned ON (assign 1) when the button is turned OFF.
- **[Toggle]**: This helps you perform the setting in a way that the functions registered with the buttons can be activated or deactivated whenever you touch the buttons. If the toggle function is not used, the functions registered with the button will be activated only while the button is being touched.
- **[Permit on Auto Mode]**: This allows the variable value output function even in automatic mode.
- **[Off on Auto Mode]**: This turns off all variable values (assign 0) in automatic mode.

Note	You can easily input the signal output variable value using the **[fb]** button and the **[do]** button. For example, input 2.9 and press the **<enter>** key. It will be converted to and displayed as fb2.do9. If you input 9 without decimal point and press the **<enter>** key, it will be converted to do9.

4. Check the buttons in the key signal output function area, and touch each button to make sure that the set value is properly applied.



```
0014.job  =P14/S1/F0
   Hyundai Robot Job File: { version: 1.6, mech_type: "716(YL012-0C)", total_
S1 . move P,spd=60%,accu=0,tool=0
S2   move P,spd=60%,accu=0,tool=0
     end
```

JOB program
+
×
shift (tgl)
gripping
shift (tgl)
releasing
shift (tgl)
waiting
prog
...
pose
public output
0
1
2
3
4
5
6
7
FB0

Note	You can also assign the desired output signals to the buttons in the key signal output function area in the **[Set Up〉 Control Parameter〉 Input/Output Signal Setting〉 Key Signal Output]** menu. For details, refer to "**7.3.2.8 Key Signal Output**."

2.6.2.2 Spot Application Function Area

For details on the spot application function, refer to the "**Hi6 Controller Spot Welding Function Manual.**"

2.7 Coordinate System

Coordinates in space are used to determine the direction of the robot's movement. Hi6 controller has the joint coordinate system, robot coordinate system, user coordinate system, and tool coordinate system.

- Joint coordinate system: You can move the corresponding joint when touching the **[-/+]** button on the right side of the joint name

  The buttons on the right are for the + direction, and the buttons on the left are for the - direction. For example, when you move the first joint in the joint coordinate system, the **⟨esc⟩** key will be for the + direction, and the **⟨enter⟩** key will be for the – direction. When you move the second joint, the **⟨→⟩** key will be for the + direction, and the **⟨←⟩** key will be for the – direction.

- Robot/User/Tool Coordinate System: The tooltip (TCP, Tool Center Point) of the robot can be moved and rotated based on each coordinate system.

2.7.1 Jog Keys

It will be used in manual mode. When you are holding the enabling switch while the motor is turned on, the **⟨enter⟩**, **⟨esc⟩**, and **⟨←/→⟩** keys and number keys on the teach pendant will operate as "jog keys."

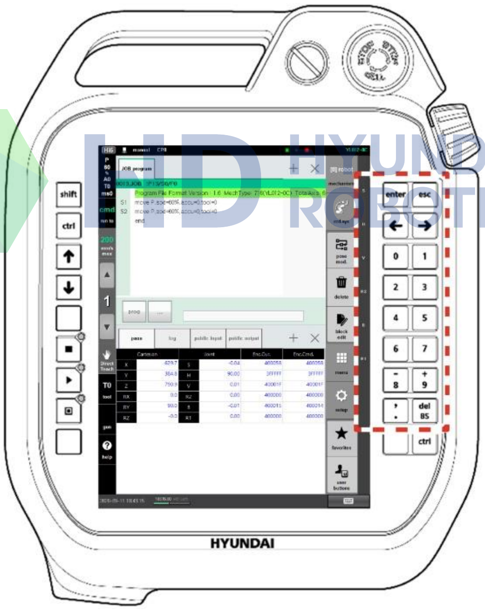


Figure 25 Jog Keys on the Teach Pendant

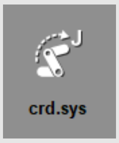
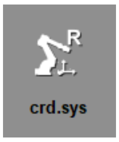
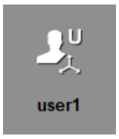
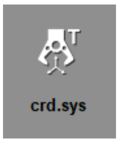
- The name of the axis assigned to each key will be displayed in the jog bar at the right edge of the display.
- The operation keys on the right are for the direction of increase (+), and the operation keys on the left are for the direction of decrease (-).

Only in the case in which the selected mechanism is mechanism [0] robot selected during jogging, if the total number of axes of the next mechanism [1] is less than two, they will be assigned according to the order of the registered additional axes. At this time, if unassigned keys remain in the mechanism [1] and the next mechanism has room, in terms of the number of axes to which the remaining axes can be assigned, they will be sequentially assigned.

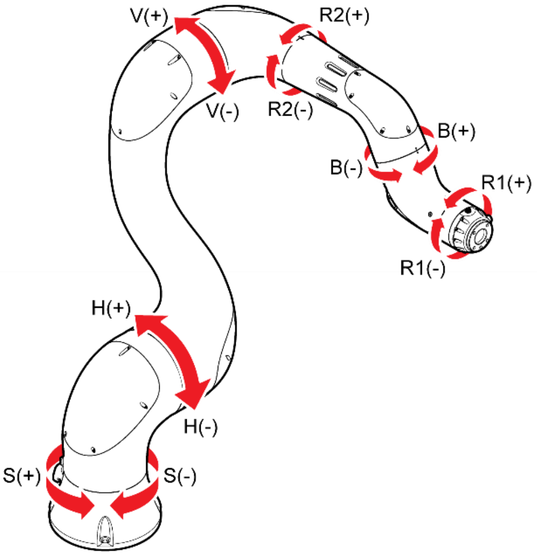
For example, whether to perform an assignment for the axes J7 and J8 according to the number of axes of the mechanisms for the additional axes will be as follows.

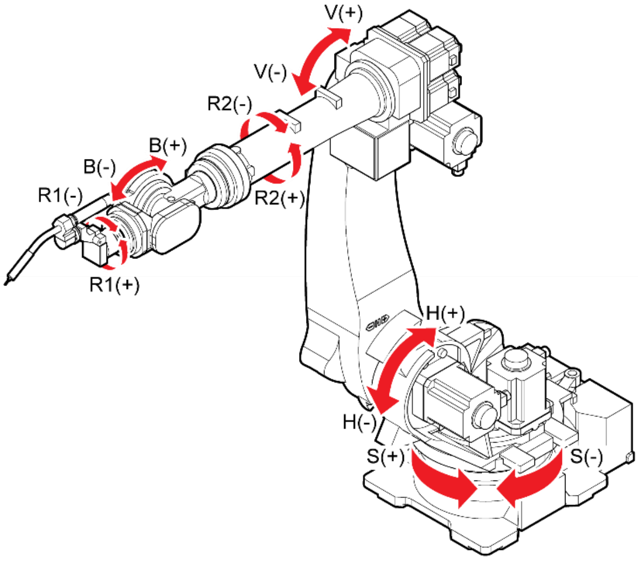
Mechanism [0]	Mechanism [1]	Mechanism [2]	Whether to assign for J7 axis / J8 axis
6-axis robot	Travel axis, Axis 1	Positioner, Axis 1	J7: Travel axis / J8: Positioner
	Travel axis, Axis 1	Positioner, Axis 2	J7: Travel axis / J8: Not assigned
	Travel axis, Axis 2	Positioner, Axis 2	J7: Travel axis 1 / J8: Travel axis 2
	Travel axis, Axis 3	Positioner, Axis 1	J7: Not assigned / J8: Not assigned

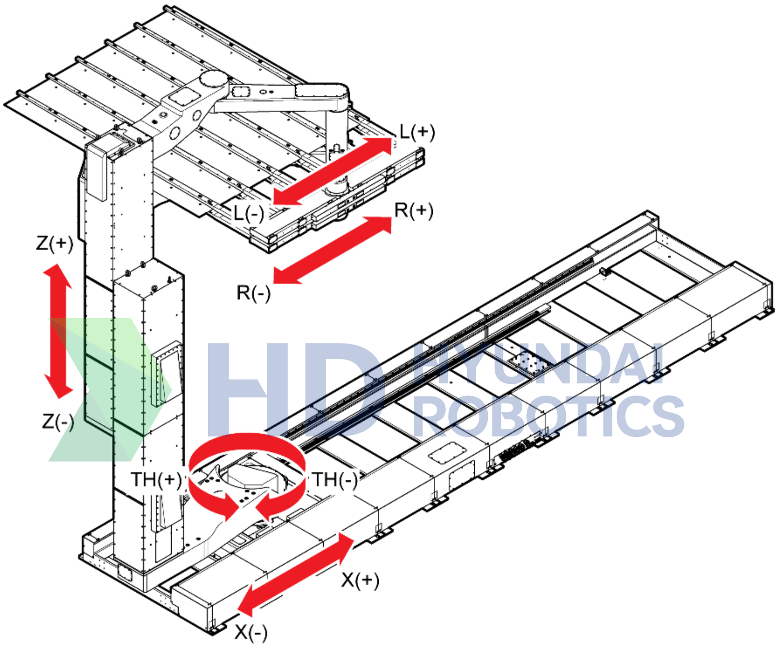
2.7.2 Joint Coordinate System

Joint Coordinate System	Robot Coordinate System	User Coordinate System	Tool Coordinate System
			

1. Turn on the motor in manual mode and hold the enabling switch on the back of the teach pendant.
2. Select the joint coordinate system by repeatedly touching the **[Crd. Sys]** button on the right side of the Hi6 teach pendant screen. Then, the jog bar will display the name of each joint.
3. Operate the robot with the jog keys. Each joint of the robot moves independently.







Note	For details on the robot's progress direction in relation to the jog keys, refer to "**2.7.1 Jog Keys.**"

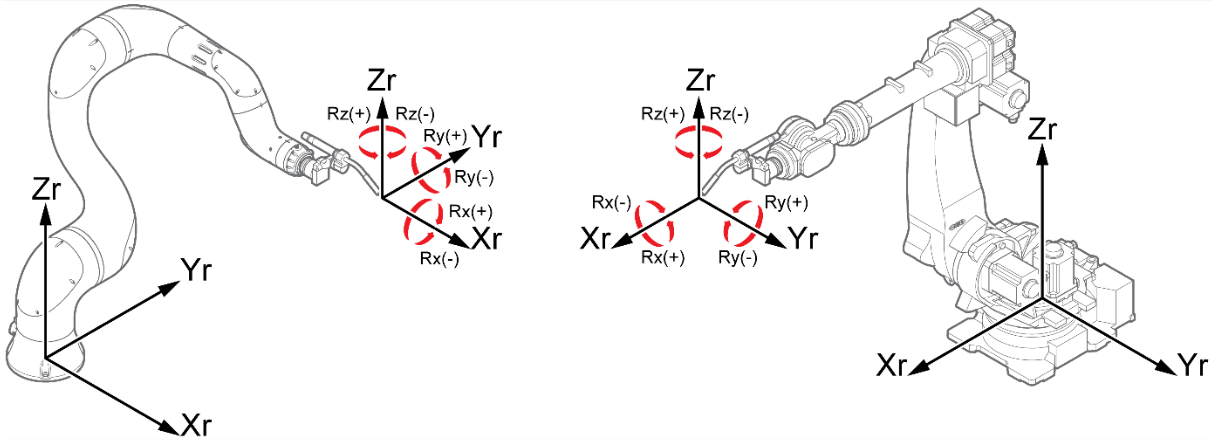
2.7.3 Robot Coordinate System

Joint Coordinate System	Robot Coordinate System	User Coordinate System	Tool Coordinate System
J crd.sys	R crd.sys	U user1	T crd.sys

1. Turn on the motor in manual mode and hold the enabling switch on the back of the teach pendant.

2. Select the robot coordinate system by repeatedly touching the **[Crd. Sys]** button on the right side of the Hi6 teach pendant screen. Then, the jog bar will display X, Y, Z, RX, RY, RZ, and additional axes.

3. Operate the robot with the jog keys. The robot will move as follows.



Note

- For details on the robot's progress direction in relation to the jog keys, refer to "**2.7.1 Jog Keys.**"
- If you use your right hand, you can easily understand the operation of the robot in the robot coordinate system.

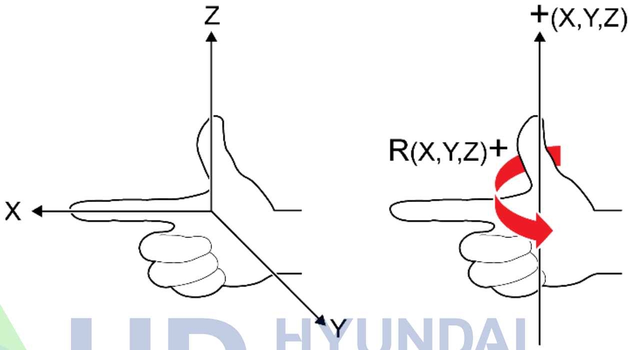


Figure 26 Coordinate System Direction (Left) / Rotation Direction (Right)

- If you put the progress direction of the right index finger in the X direction of the robot coordinate system, while you stand on the back of the robot, the progress direction of the thumb becomes the Z direction, and the progress direction of the middle finger becomes the Y direction.
- If you put the thumb of the right hand in the direction of the central axis of rotation, the direction of the other folded fingers becomes the + direction of the rotation direction.

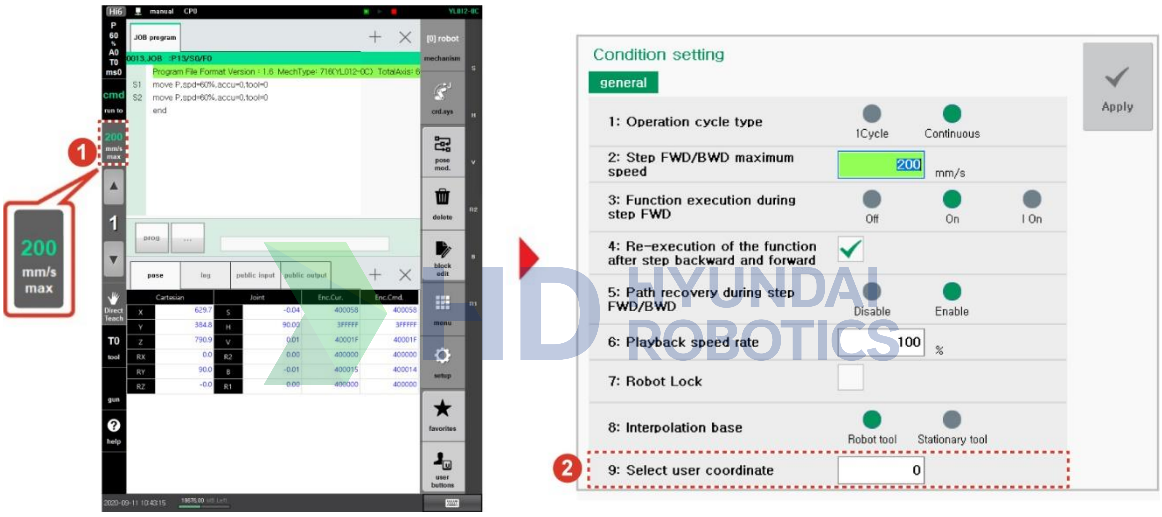
2.7.4 User Coordinate System

Joint Coordinate System	Robot Coordinate System	User Coordinate System	Tool Coordinate System
J crd.sys	R crd.sys	U user1	T crd.sys

1. On the right side of the initial screen, touch the **[Set up] button 〉 [2: Control Parameter〉 7: Coordinate System Registration〉 1: User Coordinate System]** menu and then register the user coordinate system.

Note	For details on how to register the user coordinate system, refer to “**7.3.6.1 User Coordinate System.**”

2. Touch the **[Speed Adjustment]** button at the top left of the initial screen and then set the coordinate system in the **[9: Select user coordinate]** option. You can choose the user coordinate system instead of the Cartesian coordinate system.



Condition setting

general

1: Operation cycle type ○ 1Cycle ● Continuous

2: Step FWD/BWD maximum speed 200 mm/s

3: Function execution during step FWD ○ Off ● On ○ I On

4: Re-execution of the function after step backward and forward ☑

5: Path recovery during step FWD/BWD ○ Disable ● Enable

6: Playback speed rate 100 %

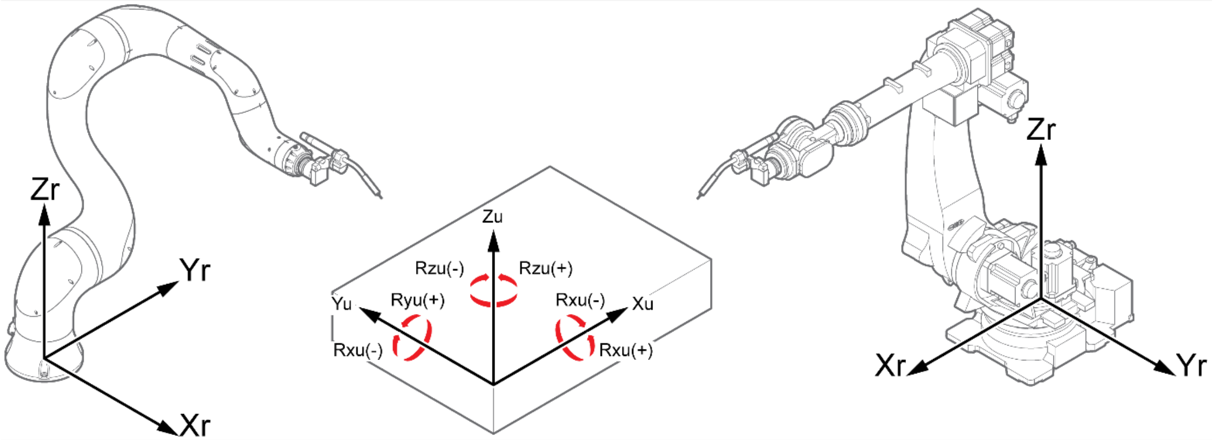
7: Robot Lock ☐

8: Interpolation base ● Robot tool ○ Stationary tool

9: Select user coordinate 0

Apply

3. Operate the robot with the jog keys. The robot will move as follows.

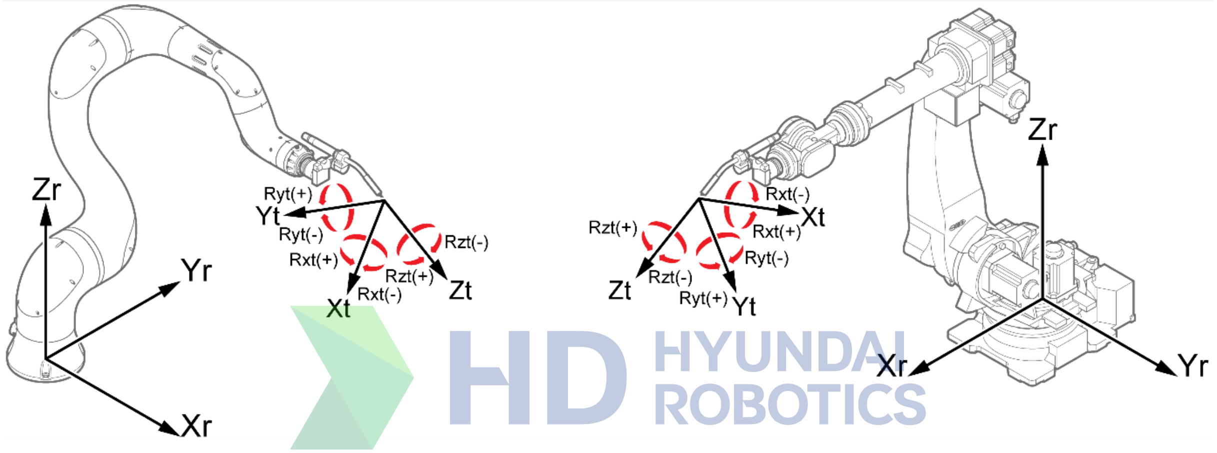


Note	• For details on the robot’s progress direction in relation to the jog keys, refer to “**2.7.1 Jog Keys.**”

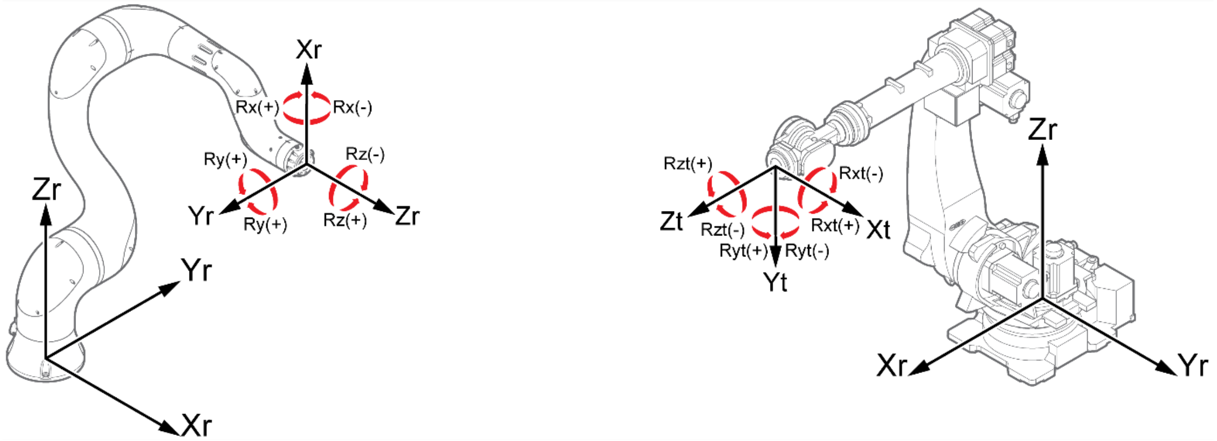
2.7.5 Tool Coordinate System

Joint Coordinate System	Robot Coordinate System	User Coordinate System	Tool Coordinate System
crd.sys	crd.sys	user1	crd.sys

1. Turn on the motor in manual mode and hold the enabling switch on the back of the teach pendant.
2. Select the tool coordinate system by repeatedly touching the **[Crd. Sys]** button on the right side of the Hi6 teach pendant screen. Then, the jog bar will display X, Y, Z, RX, RY, RZ, and additional axes.
3. Operate the robot with the jog keys. The robot will move as follows.
    - If a torch is attached to the robot


Zr
Yr
Xr
Ryt(+)
Yt
Ryt(-)
Rxt(+)
Rzt(+)
Rxt(-)
Xt
Rzt(-)
Zt
Rzt(+)
Zt
Rzt(-)
Ryt(+)
Yt
Ryt(-)
Rxt(+)
Rxt(-)
Xt
Zr
Xr
Yr

- If no torch is attached to the robot


Xr
Rx(+)
Rx(-)
Ry(+)
Rz(-)
Yr
Ry(+)
Rz(+)
Zr
Zr
Yr
Xr
Rzt(+)
Zt
Rzt(-)
Ryt(+)
Yt
Rxt(-)
Rxt(+)
Xt
Ryt(-)
Zr
Xr
Yr

Note	For details on the robot's progress direction in relation to the jog keys, refer to "**2.7.1 Jog Keys.**"

2.8 Optimization of the Axis Origin and Tool Length

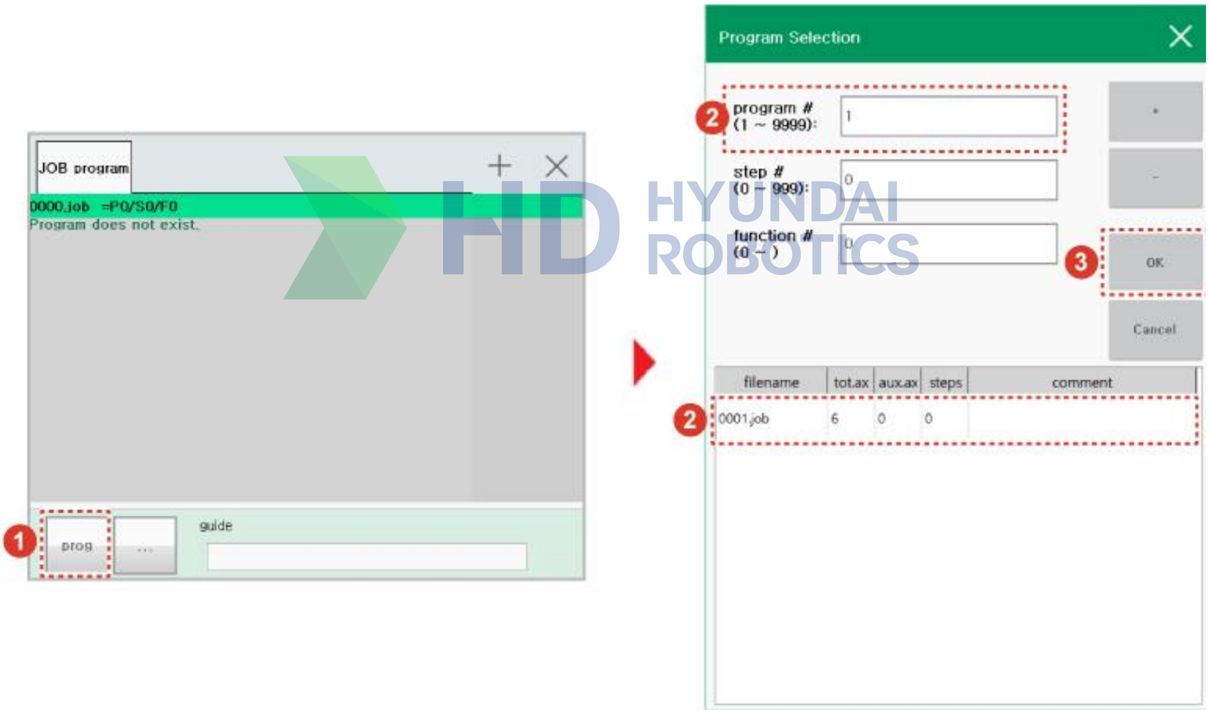
You can make it possible for the axis integer and tool length to be automatically set to improve the accuracy of the linear interpolation trajectory and coordinate shifting.

- You can make it possible for the distance to the tooltip, which is difficult to measure in 3D, to be automatically set. The parameters to be calibrated are the axis origins of the H, V, R2, and B axes and the tool length in the X, Y, and Z directions.
- You can perform “optimization of axis origin and tool length” and of “tool length.”

⚠ Caution	You should optimize the “axis origin and tool length” before teaching the robot program. If the “axis origin and tool length” is optimized while a robot program has been created already, the position in the existing program may change.

The following shows how to set the optimization of the axis origin and tool length:

1. Set the operation mode to manual mode using the mode switch on the teach pendant.
2. After touching the **[Prog]** button in the JOB program window, input the program number, and then touch the **[OK]** button.



0000.job =P0/S0/F0
Program does not exist.

program # (1 ~ 9999): 1
step # (0 ~ 999): 0
function # (0 ~): 0

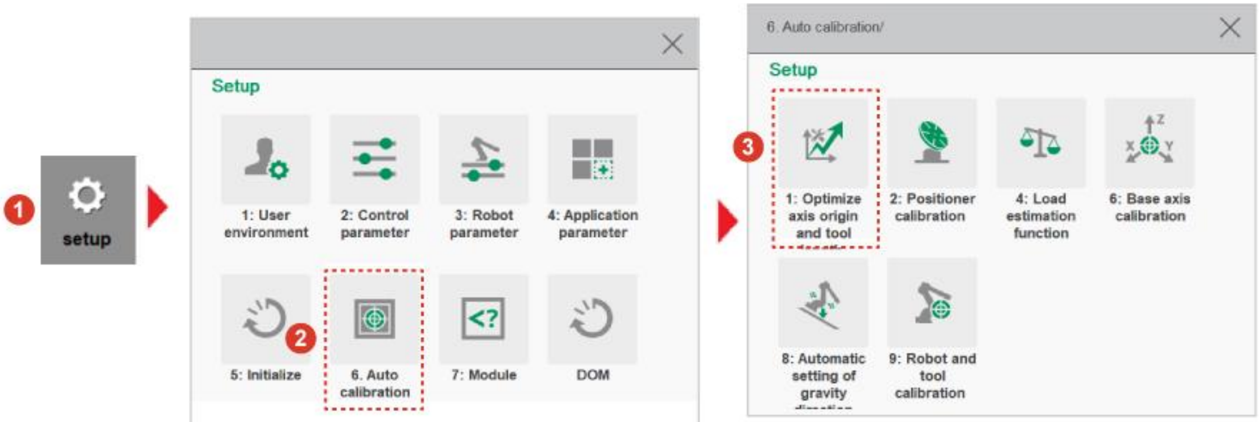
filename	tot.ax	aux.ax	steps	comment
0001.job	6	0	0	

3. Press the **〈motor〉** key on the teach pendant, and then the motor lamp will blink.
    - If the motor is not turned on, check the error message on the log bar and resolve the trouble.
4. Operate the robot using the jog key while holding the enabling switch on the back of the teach pendant.
5. Place a pointed needle at an arbitrary location within the operation range of the robot, and then match the tooltip of the robot to it. The distance from the front end of the robot to the matched tooltip will be optimized.
6. Record the step by touching the **[Record]** button on the right side of the Hi6 teach pendant screen.

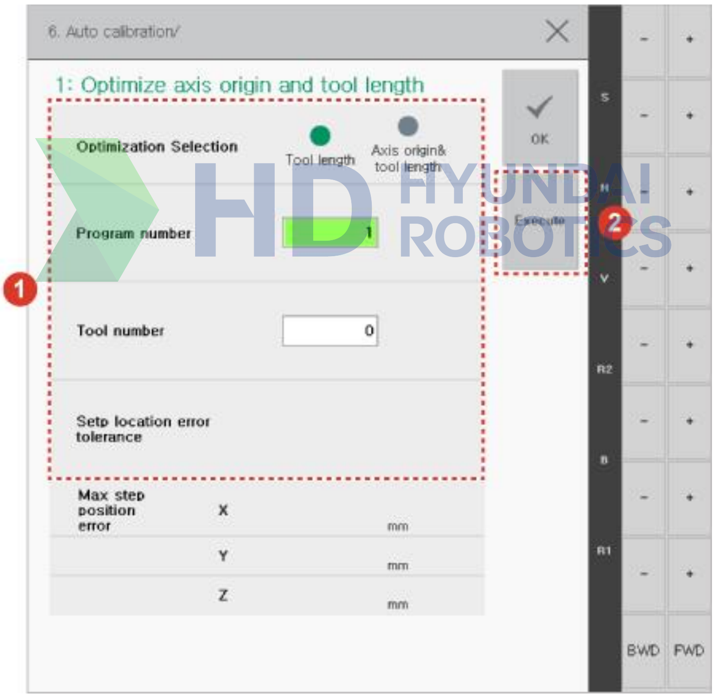
◉
record

7. Change the robot's posture and repeat the above steps 5–6 more than four times.
    - Change the robot's posture using all six axes as much as possible. Moreover, change the axis angle by at least 30 degrees.

8. Touch the **[Set up]** button 〉 **[6: Auto Calibration 〉 1: Optimize axis origin and tool length]** menu.


①
setup
Setup
1: User environment
2: Control parameter
3: Robot parameter
4: Application parameter
5: Initialize
②
6. Auto calibration
7: Module
DOM
6. Auto calibration/
Setup
③
1: Optimize axis origin and tool
2: Positioner calibration
4: Load estimation function
6: Base axis calibration
8: Automatic setting of gravity
9: Robot and tool calibration

9. Set the program number, tool number, and step position error allowable range created for the automatic calibration, and then touch the **[Execute]** button. Then the selected axis origin and tool length will be set.


6. Auto calibration/

1: Optimize axis origin and tool length

Optimization Selection ● Tool length ○ Axis origin& tool length

Program number: 1

Tool number: 0

Setp location error tolerance

Max step position error: X mm, Y mm, Z mm

①
②
OK
Execute
S
H
V
R2
B
R1
-
+
BWD
FWD

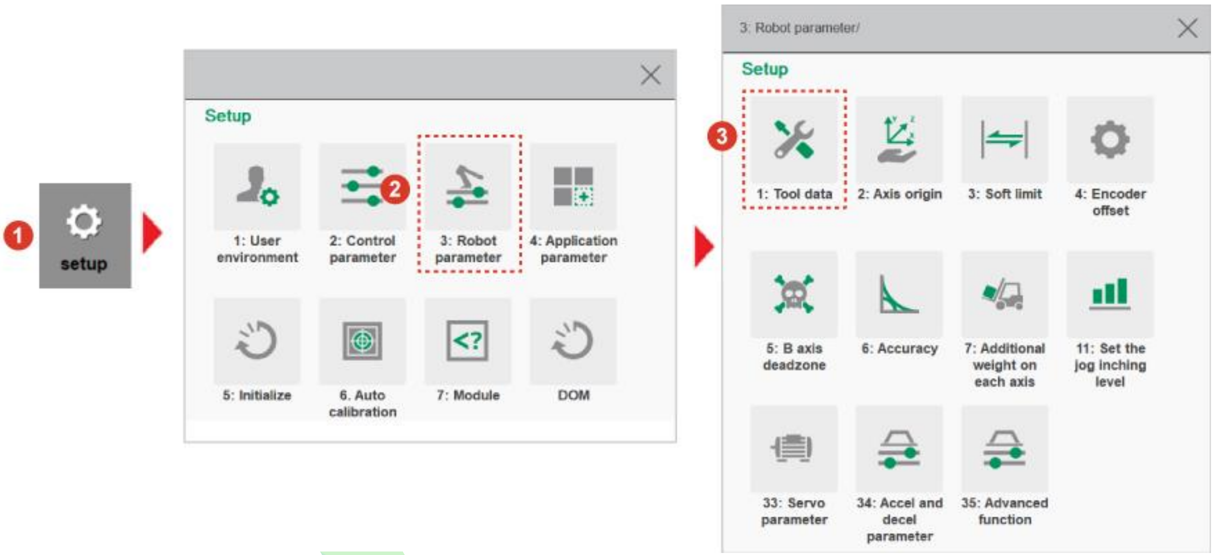
- You should select **Tool Length** in the **[Optimization Selection]** option, starting from the automatic calibration of the second tool, when you use multiple tools. If you select **Axis Origin and Tool Length**, the previously set tool information will not match.

Note	For details on this function, refer to "**7.7.1 Optimization of Axis Origin and Tool Length.**"

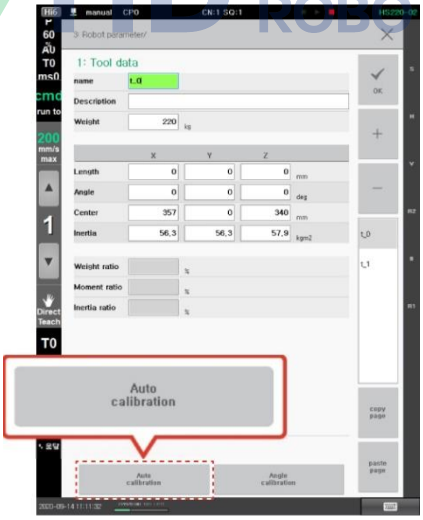
2.9 Tool Data Automatic Calibration

After determining the axis origin and tool length through automatic calibration, etc., if the tool is deformed, you can simply determine new tool data. At this time, the axis origin should have been determined and maintained. In addition, a fixed reference point should be taught after the tool length is determined and the angle calibration is completed. If tool deformation occurs, place the tool in the same position at the reference point designated prior to the deformation, and then perform automatic tool data calibration.

1. Touch the **[Set up]** button 〉 **[3: Robot Parameter〉 1: Tool Data]** menu.


①
setup
Setup
1: User environment
2: Control parameter
②
3: Robot parameter
4: Application parameter
5: Initialize
6. Auto calibration
7: Module
DOM
3: Robot parameter/
Setup
③
1: Tool data
2: Axis origin
3: Soft limit
4: Encoder offset
5: B axis deadzone
6: Accuracy
7: Additional weight on each axis
11: Set the jog inching level
33: Servo parameter
34: Accel and decel parameter
35: Advanced function

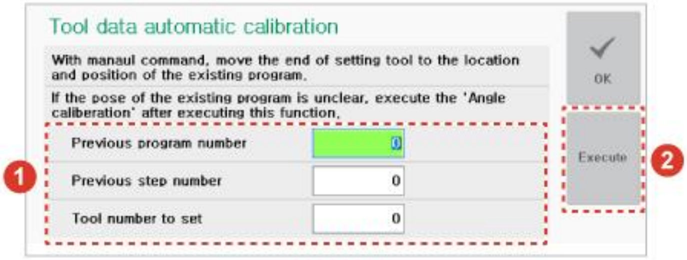
2. After touching the **[Auto Calibration]** button, move the tooltip to the original position using the jog key.


Hi6
manual
CP0
CN:1 SQ:1
HS220-02
3: Robot parameter/
OK
copy page
paste page
Auto calibration
Angle calibration

1: Tool data

name	t_0			
Description				
Weight	220			kg
	X	Y	Z	
Length	0	0	0	mm
Angle	0	0	0	deg
Center	357	0	340	mm
Inertia	56,3	56,3	57,9	kgm2
Weight ratio				%
Moment ratio				%
Inertia ratio				%

3. After checking the program number of the predetermined reference point, the step number, and the tool number, touch the **[Execute]** button.


OK
Execute
①
②

Tool data automatic calibration

With manaul command, move the end of setting tool to the location and position of the existing program.

If the pose of the existing program is unclear, execute the 'Angle caliberation' after executing this function.

Previous program number	0
Previous step number	0
Tool number to set	0

Note	For details on this function, refer to "**7.4.1 Tool Data.**"

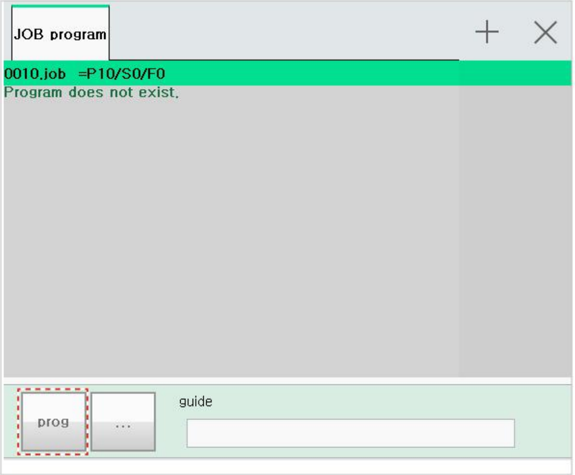
3. Program Writing

You can write and manage programs so that the robot can perform works and achieve the desired results.

3.1 Program Management

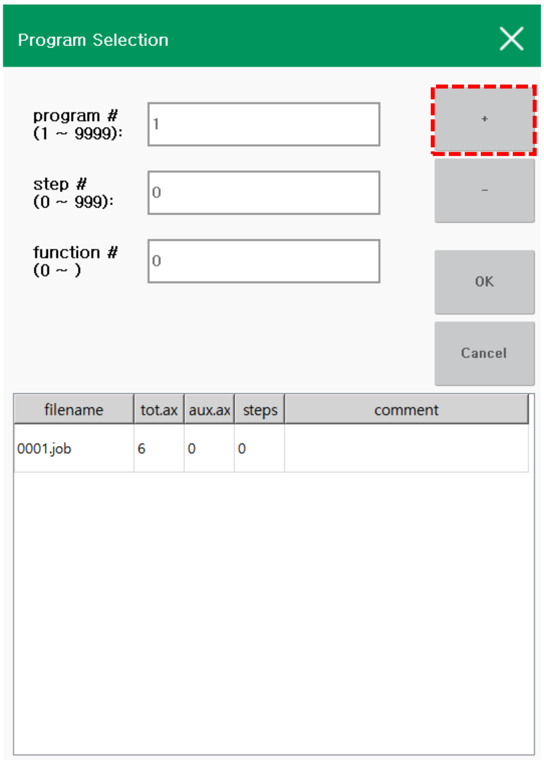
While the robot is stopped, you can create, modify, and delete programs.

1. In the JOB program window, touch the **[Prog]** button. Then, the program selection window will appear.



0010.job =P10/S0/F0
Program does not exist.

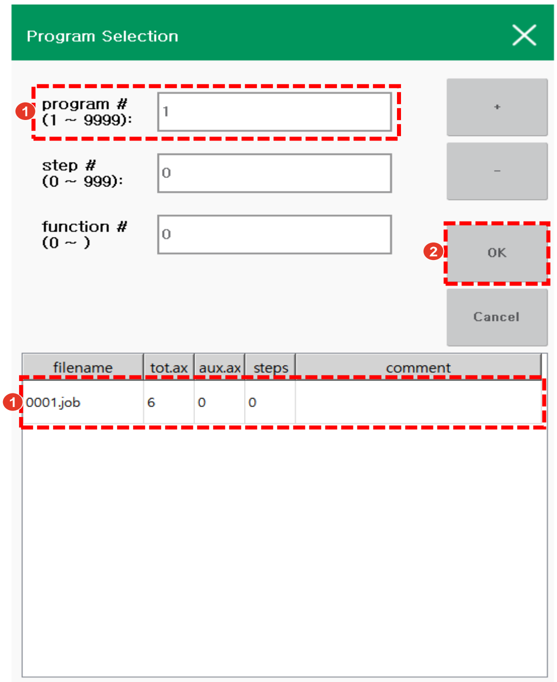
2. You can create, modify, and delete programs.
   - To add a new program, touch the **[+]** button and then input the relevant contents by referring to "**3.2 Program Writing.**"



program # (1 ~ 9999): 1
step # (0 ~ 999): 0
function # (0 ~): 0

filename	tot.ax	aux.ax	steps	comment
0001.job	6	0	0	

- To open a program to check and modify its contents, input the program number, or select a program from the list and then touch the **[OK]** button. Then, the selected program will be opened in the JOB program window.



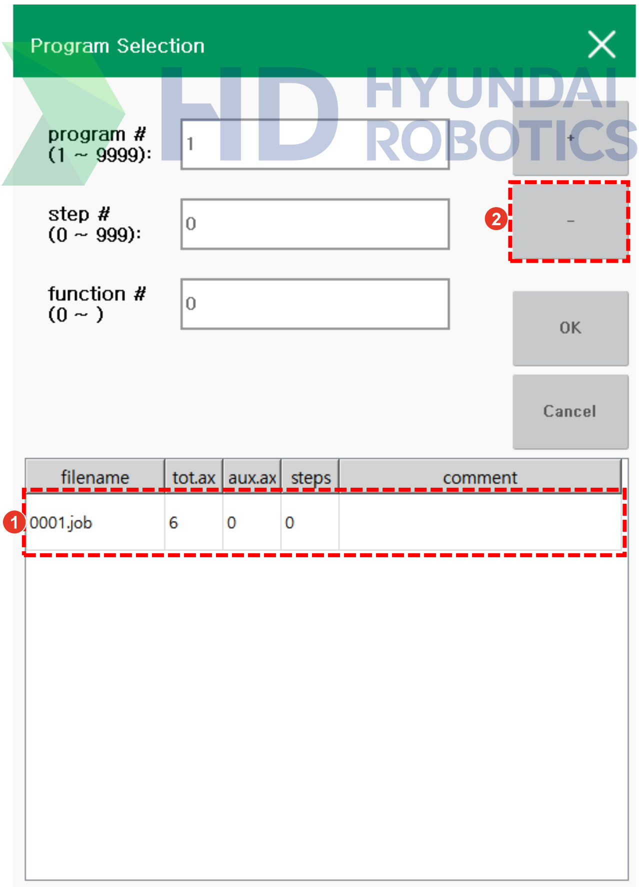
program # (1 ~ 9999): 1

step # (0 ~ 999): 0

function # (0 ~): 0

filename	tot.ax	aux.ax	steps	comment
0001.job	6	0	0	

- To delete a program, select the program from the list and touch the **[-]** button.



program # (1 ~ 9999): 1

step # (0 ~ 999): 0

function # (0 ~): 0

filename	tot.ax	aux.ax	steps	comment
0001.job	6	0	0	

  - You can delete a program from the file list (**[Menu〉 5: File Management]**). For details, refer to “**4.2 File Management.**”
  - You can quickly delete a program using the R code (**R117**). For details, refer to “**8.4 R117 Program Deletion.**”

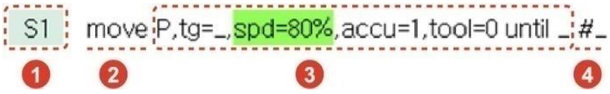
3.2 Program Writing

To get the desired result, you can write and edit a program consisting of various statements that instruct the robot to operate. You can write programs in manual mode.

3.2.1 Statements

A general program consists of a step command that instructs the robot to move and a function command that instructs the robot to carry out work after the movement.

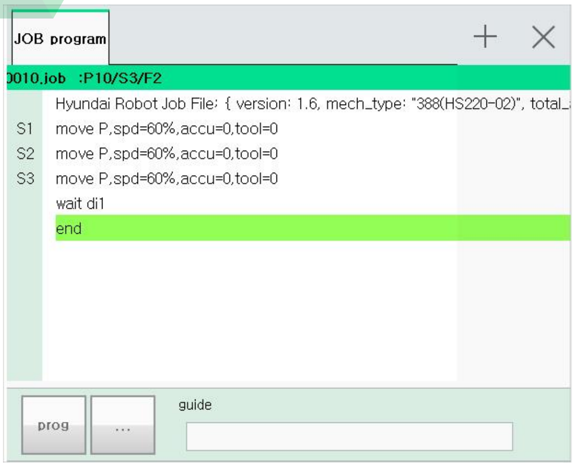
A statement is largely divided into a command and a parameter, which is an additional item. The parameters are divided into default parameters essential for a statement and optional parameters that can be omitted.



No.	Description	No.	Description
①	Step number	③	Parameter
②	Command	④	Comment

Note	For details on parameters, refer to “**2.3.1 Step Statement Parameters.**”

When you input a statement, basic setting values will be automatically inputted into the default parameters and can be changed. Optional parameters are marked with a symbol (_), and you can input the parameter values by selecting the parameters. Moreover, parameters that can be inputted will be displayed as buttons on the right side of the screen.



```
0010.job   :P10/S3/F2
     Hyundai Robot Job File: { version: 1.6, mech_type: "388(HS220-02)", total_
S1   move P,spd=60%,accu=0,tool=0
S2   move P,spd=60%,accu=0,tool=0
S3   move P,spd=60%,accu=0,tool=0
     wait di1
     end
```

Figure 27 Editing a Command – Inputting Parameter Values

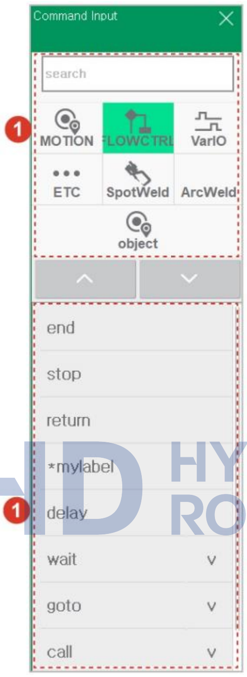
When editing the command parameters, you can edit variables, expressions, and strings by using the operation keys on the teach pendant and the menu buttons on the right side of the screen, or by using the soft keyboard.

3.2.2 Statement Inputting

3.2.2.1 General Statement Inputting

1. In manual mode, touch the **[Command]** button on the right side of the initial screen. Then, the command inputting window will appear.

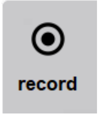
2. Touch a statement group or input command and then select the command from the list. The statement will be inputted immediately below the current cursor position.


Command Input
search
1
MOTION
FLOWCTRL
VarIO
ETC
SpotWeld
ArcWeld
object
end
stop
return
*mylabel
1
delay
wait
goto
call

- In the case of command with multiple parameter forms, a check mark (✓) will appear on the right. You can check and select the parameter form by touching the command in the list.
- For details on each statement, refer to the "**Hi6 Robot Language Function Manual.**"

3.2.2.2 Inputting of a Step Statement with a Hidden Pose

To input the current posture of the robot as a move command, touch the **[Record]** button on the right side of the Hi6 teach pendant screen.



When you input a command using the **[Record]** button, the pose variable will not appear in the step, unlike the general command inputting mode, so it is called a hidden pose.

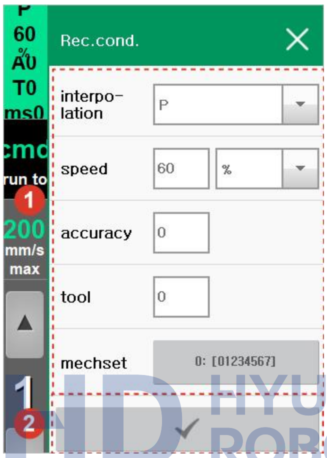
3.2.2.3 Recording Condition

When a statement is inputted using the **[Record]** button, the current posture of the robot will be recorded as the target pose, and the value set in advance using the **[Rec.cond.]** button will be applied to the move command (move) parameter. The following shows the method of setting the recording condition of a statement.

1. Touch the **[Rec.cond.]** button on the left side of the Hi6 teach pendant screen. Then, the recording condition setting window will appear.

P
60
%
AU
T0
ms0

2. After setting the interpolation, moving speed and unit, accuracy, and tool number, touch the **[OK]** button (✓).



interpo-lation: P

speed: 60 %

accuracy: 0

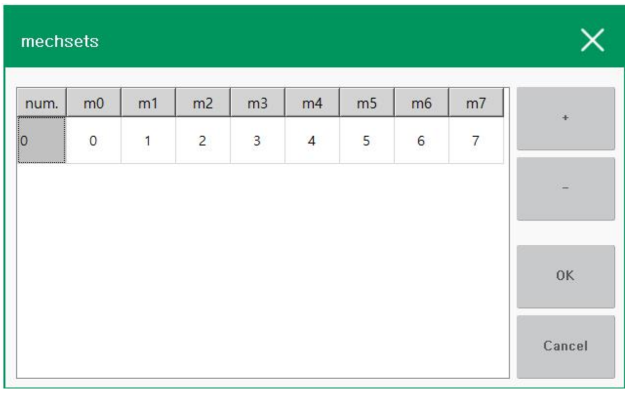
tool: 0

mechset: 0: [01234567]

- When position recording is performed, the move statement will be recorded based on the condition set in the recording condition.
- In the mechanism set, you can designate the configuration of the mechanism to be stored when position recording is performed.

If you briefly touch the **[mechsets]** button, the predefined mechanism set numbers will appear in sequence.

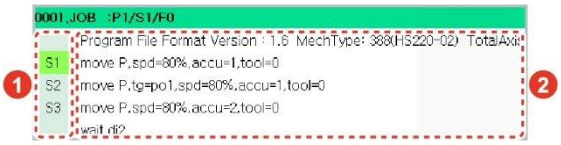
If you touch and hold the **[mechsets]** button, you can modify the existing set configuration in the Mechanism Set setting window, or add or delete a mechanism set by using the **[+]** or **[-]** button.



num.	m0	m1	m2	m3	m4	m5	m6	m7
0	0	1	2	3	4	5	6	7

3.2.3 Statement Configuration

A statement consists of an address area and a statement area.

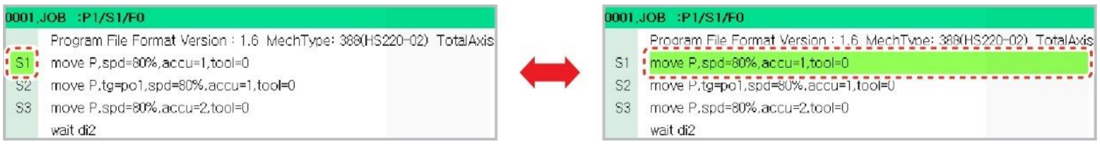


```
0001.JOB  :P1/S1/F0
    Program File Format Version : 1.6  MechType: 388(HS220-02)  TotalAxis
S1  move P,spd=80%,accu=1,tool=0
S2  move P,tg=po1,spd=80%,accu=1,tool=0
S3  move P,spd=80%,accu=2,tool=0
    wait di2
```

Figure 28 Areas Comprising a Statement

No.	Area	Description
①	Address area	Displays the line number (1 to 9999) and step number (S1 to S999)
②	Statement area	Displays a statement

You can move the cursor position between the address area and the statement area by pressing the ⟨←/→⟩ key on the teach pendant. Pressing the ⟨↓/↑⟩ key will allow you to move the cursor up and down between the lines within the selected area.



```
0001.JOB  :P1/S1/F0
    Program File Format Version : 1.6  MechType: 388(HS220-02)  TotalAxis
S1  move P,spd=80%,accu=1,tool=0
S2  move P,tg=po1,spd=80%,accu=1,tool=0
S3  move P,spd=80%,accu=2,tool=0
    wait di2
```

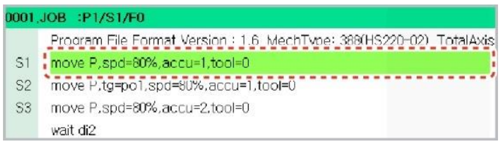
Figure 29 Moving the Cursor Between Areas (Left: Address Area. Right: Statement Area)

3.2.4 Statement Editing

You can edit the statement in the JOB program window using the operation keys on the teach pendant and the menu buttons on the right side of the screen. Using the soft keyboard, you can edit variables, expressions, and strings.

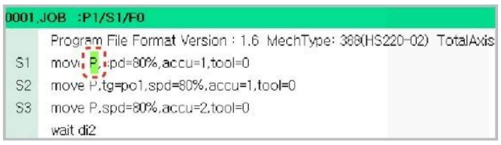
In the statement area, you can check and edit statements by switching the status of the cursor according to the selected object.

- Statement cursor Status: You can check a statement while the entire line of the statement is selected.



```
0001.JOB  :P1/S1/F0
    Program File Format Version : 1.6  MechType: 388(HS220-02)  TotalAxis
S1  move P,spd=80%,accu=1,tool=0
S2  move P,tg=po1,spd=80%,accu=1,tool=0
S3  move P,spd=80%,accu=2,tool=0
    wait di2
```

- Word cursor Status: You can check and edit a statement while the individual parameters of the statement are selected.



```
0001.JOB  :P1/S1/F0
    Program File Format Version : 1.6  MechType: 388(HS220-02)  TotalAxis
S1  move P,spd=80%,accu=1,tool=0
S2  move P,tg=po1,spd=80%,accu=1,tool=0
S3  move P,spd=80%,accu=2,tool=0
    wait di2
```

3.2.4.1 Statement Editing Method

The following shows how to edit a statement.

1. In the JOB program window, select the statement area by pressing the ⟨←/→⟩ key on the teach pendant. The statement area will be selected while in the statement cursor status.

2. Press the 〈**enter**〉 key on the teach pendant while in the statement cursor status. Then, switching to the statement cursor status will occur and a parameter will be selected, and the selected parameter value will appear in the input area at the bottom.

3. Edit the parameter value using the operation keys on the teach pendant and the menu buttons on the right side of the screen.

   - Pressing the 〈←/→〉 key will allow you to move the cursor in the left or right direction between parameters

   - Parameters that can be inputted will be displayed as buttons on the right side of the screen. You can easily input parameters by selecting the desired buttons.

   - You can edit variables, expressions, and strings using the soft keyboard.

4. Press the 〈**enter**〉 key. Then, the contents of the change will be applied, allowing the parameter value of the statement to be changed and the cursor to move to the next parameter.

   - To cancel the change, press the 〈**esc**〉 key.

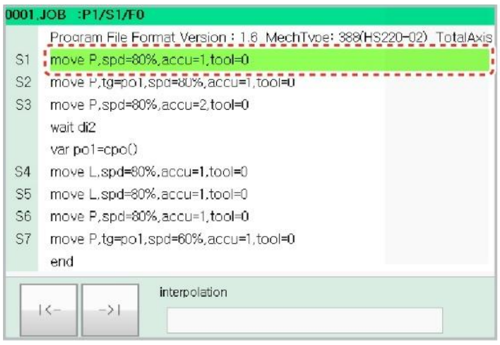
5. You can edit another parameter by repeating the above steps 2–3.

6. Press the 〈**enter**〉 key to complete the editing. The changes will be saved in the JOB program, and the cursor will return to the statement cursor status.

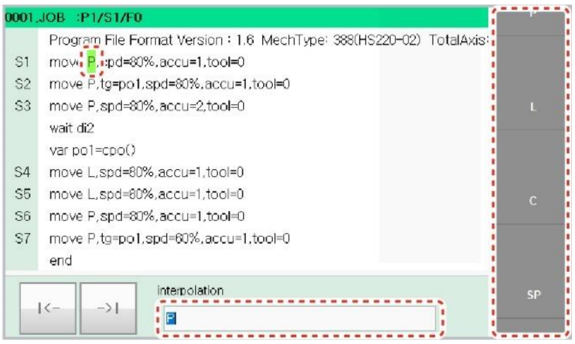
3.2.4.2 Example of Statement Editing

With an example of changing the interpolation parameter from P (joint interpolation) to L (linear interpolation), the following describes how to edit a statement.

1. Press the 〈**enter**〉 key on the teach pendant while in the statement cursor status. Then, the statement cursor will change to the word cursor status, allowing the P (joint interpolation), which is the interpolation parameter of the move statement, to be selected. In the input area, P, which is the current setting value of interpolation, will be displayed and the interpolation parameter that can be inputted will be displayed as buttons on the right side of the screen.



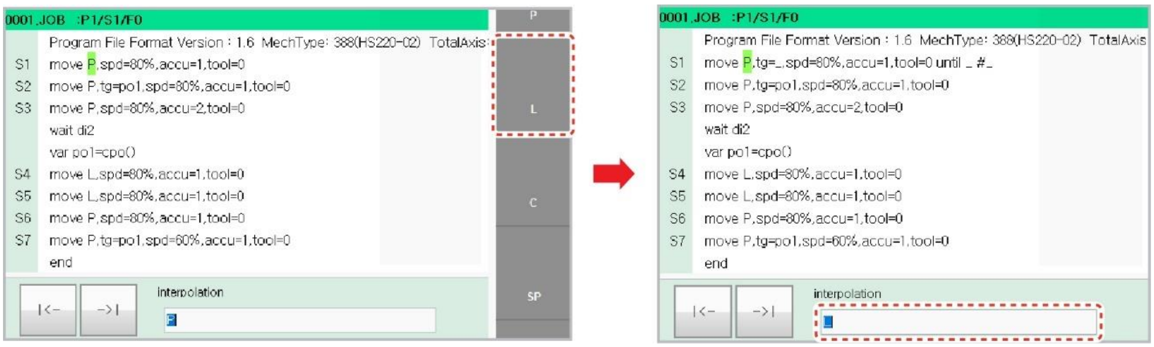
```
0001.JOB  :P1/S1/F0
    Program File Format Version : 1.6  MechType: 388(HS220-02)  TotalAxis
S1  move P,spd=80%,accu=1,tool=0
S2  move P,tg=po1,spd=80%,accu=1,tool=0
S3  move P,spd=80%,accu=2,tool=0
    wait di2
    var po1=cpo()
S4  move L,spd=80%,accu=1,tool=0
S5  move L,spd=80%,accu=1,tool=0
S6  move P,spd=80%,accu=1,tool=0
S7  move P,tg=po1,spd=60%,accu=1,tool=0
    end
```



```
0001.JOB  :P1/S1/F0
    Program File Format Version : 1.6  MechType: 388(HS220-02)  TotalAxis:
S1  move P,spd=80%,accu=1,tool=0
S2  move P,tg=po1,spd=80%,accu=1,tool=0
S3  move P,spd=80%,accu=2,tool=0
    wait di2
    var po1=cpo()
S4  move L,spd=80%,accu=1,tool=0
S5  move L,spd=80%,accu=1,tool=0
S6  move P,spd=80%,accu=1,tool=0
S7  move P,tg=po1,spd=60%,accu=1,tool=0
    end
```

interpolation: P

2. Touch the **[L]** button among the buttons on the right side of the screen. Then, L (linear interpolation) will be displayed in the input area.



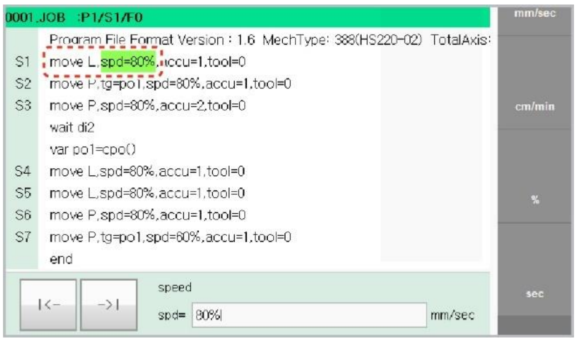
```
0001.JOB  :P1/S1/F0
     Program File Format Version : 1.6  MechType: 388(HS220-02)  TotalAxis:
S1   move P,spd=80%,accu=1,tool=0
S2   move P,tg=po1,spd=80%,accu=1,tool=0
S3   move P,spd=80%,accu=2,tool=0
     wait di2
     var po1=cpo()
S4   move L,spd=80%,accu=1,tool=0
S5   move L,spd=80%,accu=1,tool=0
S6   move P,spd=80%,accu=1,tool=0
S7   move P,tg=po1,spd=60%,accu=1,tool=0
     end
```

Interpolation: P

```
0001.JOB  :P1/S1/F0
     Program File Format Version : 1.6  MechType: 388(HS220-02)  TotalAxis
S1   move P,tg=_,spd=80%,accu=1,tool=0 until _ #_
S2   move P,tg=po1,spd=80%,accu=1,tool=0
S3   move P,spd=80%,accu=2,tool=0
     wait di2
     var po1=cpo()
S4   move L,spd=80%,accu=1,tool=0
S5   move L,spd=80%,accu=1,tool=0
S6   move P,spd=80%,accu=1,tool=0
S7   move P,tg=po1,spd=60%,accu=1,tool=0
     end
```

interpolation

3. Press the **⟨enter⟩** key. The interpolation parameter of the statement will change to L, and then the cursor will move to the next parameter, allowing the moving speed to be selected.



```
0001.JOB  :P1/S1/F0
     Program File Format Version : 1.6  MechType: 388(HS220-02)  TotalAxis:
S1   move L,spd=80%,accu=1,tool=0
S2   move P,tg=po1,spd=80%,accu=1,tool=0
S3   move P,spd=80%,accu=2,tool=0
     wait di2
     var po1=cpo()
S4   move L,spd=80%,accu=1,tool=0
S5   move L,spd=80%,accu=1,tool=0
S6   move P,spd=80%,accu=1,tool=0
S7   move P,tg=po1,spd=60%,accu=1,tool=0
     end
```

speed

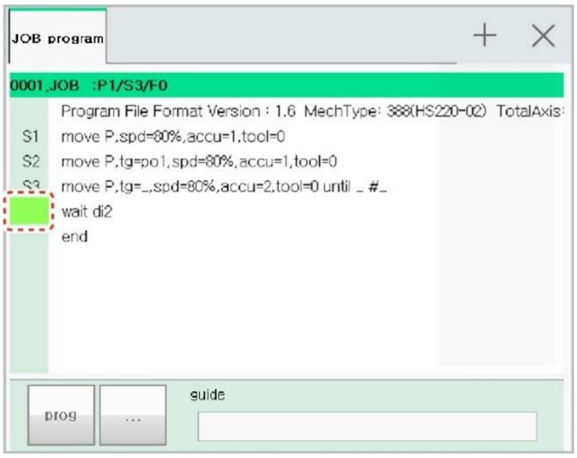
spd= 80% mm/sec

4. Press the **⟨enter⟩** key to complete editing. The contents of the change will be saved in the JOB program, and then the cursor will return to the statement cursor status.

3.2.4.3 Line Number Editing Method

The line number can be set to any number between 1 and 9999.

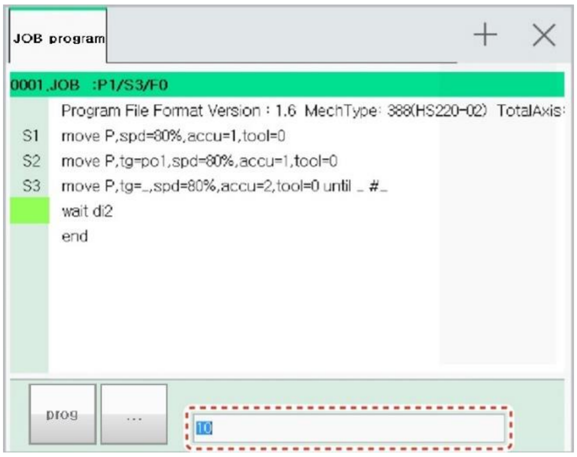
1. In the JOB program window, select the address area by pressing the ⟨←/→⟩ key on the teach pendant. Then, the address area will be selected.
    - If the cursor is in the statement cursor status while in the statement area, press the ⟨←⟩ key to move the cursor to the address area.



```
0001.JOB  :P1/S3/F0
     Program File Format Version : 1.6  MechType: 388(HS220-02)  TotalAxis:
S1   move P,spd=80%,accu=1,tool=0
S2   move P,tg=po1,spd=80%,accu=1,tool=0
S3   move P,tg=_,spd=80%,accu=2,tool=0 until _ #_
     wait di2
     end
```

guide

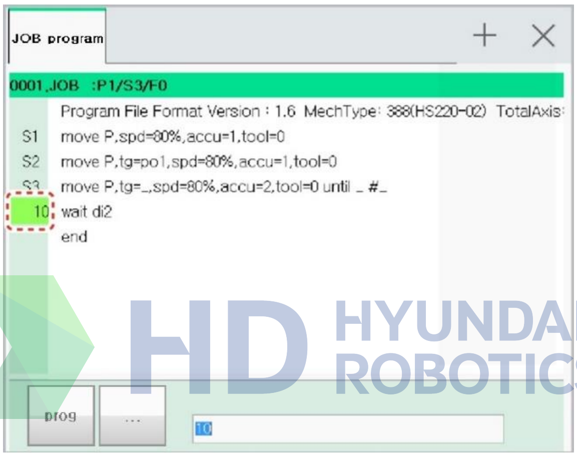
2. In the address area, select a line by pressing the ⟨↓/↑⟩ key and then edit the line number.
    - To input a line number, input the line number in the input area using the number keys.



```
0001.JOB  :P1/S3/F0
     Program File Format Version : 1.6  MechType: 388(HS220-02)  TotalAxis:
S1   move P,spd=80%,accu=1,tool=0
S2   move P,tg=po1,spd=80%,accu=1,tool=0
S3   move P,tg=_,spd=80%,accu=2,tool=0 until _ #_
     wait di2
     end
```

- To delete a line number, press the 〈BS〉 key. Then, the address value of the line number will be removed from the input area.

3. Press the 〈enter〉 key to complete the editing. The contents of the change will be saved in the JOB program.



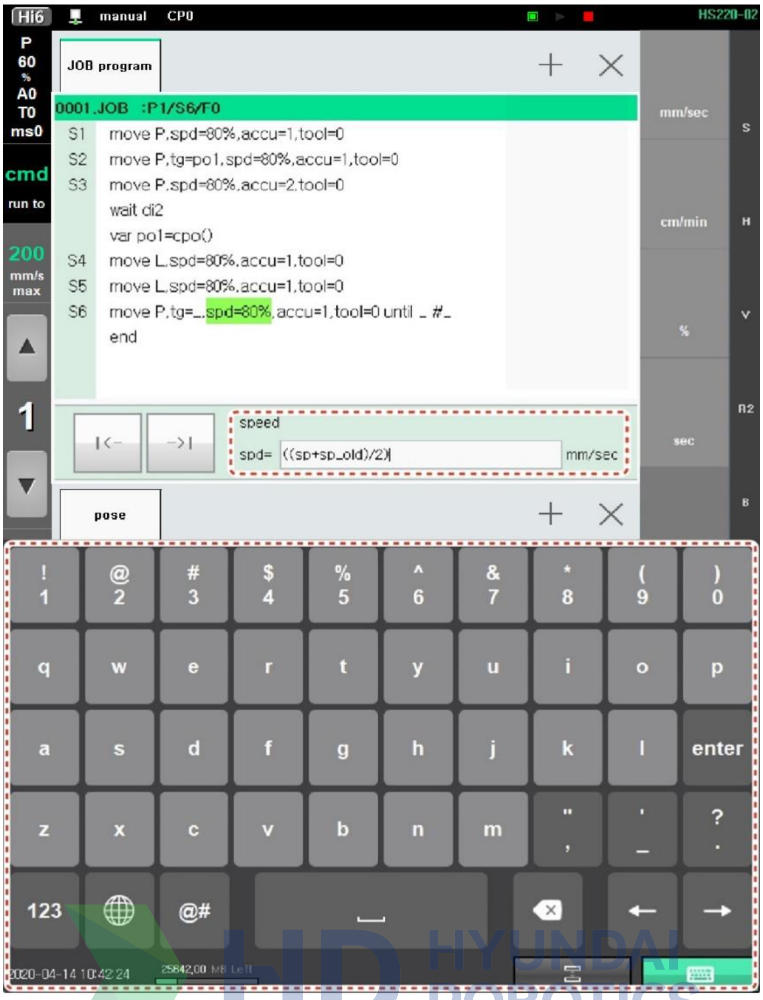
```
0001.JOB  :P1/S3/F0
     Program File Format Version : 1.6  MechType: 388(HS220-02)  TotalAxis:
S1   move P,spd=80%,accu=1,tool=0
S2   move P,tg=po1,spd=80%,accu=1,tool=0
S3   move P,tg=_,spd=80%,accu=2,tool=0 until _ #_
10   wait di2
     end
```

3.2.4.4 Soft Keyboard

You can easily input variables, expressions, and strings using the soft keyboard on the Hi6 teach pendant screen.

1. Touch the [⌨] button on the log bar of the Hi6 teach pendant screen. Then, a soft keyboard will appear at the bottom of the screen.

2. You can input variables, expressions, and strings in the input area using the soft keyboard. The existing parameter values will be removed, and the inputted texts will be displayed.



```
0001.JOB :P1/S6/F0
S1   move P,spd=80%,accu=1,tool=0
S2   move P,tg=po1,spd=80%,accu=1,tool=0
S3   move P,spd=80%,accu=2,tool=0
     wait di2
     var po1=cpo()
S4   move L,spd=80%,accu=1,tool=0
S5   move L,spd=80%,accu=1,tool=0
S6   move P,tg=_,spd=80%,accu=1,tool=0 until _ #_
     end
```

speed

spd= ((sp+sp_old)/2) mm/sec

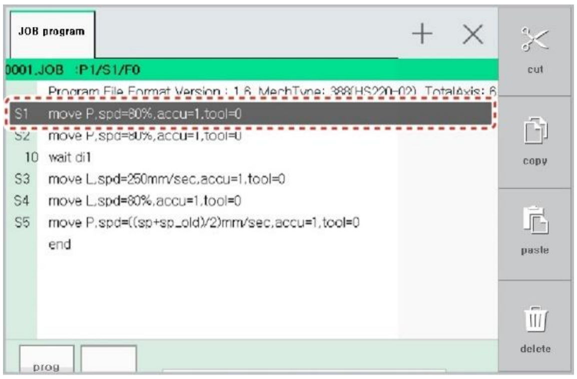
- If you touch the [|<-/->|] button on the left side of the input area, you can move the cursor position, allowing you to insert the text at the desired position.
- You can input numbers and special characters by touching the [123/@#] button.
- You can change the input language by touching the [🌐] button.
- You can input a capital letter or a symbol by touching the key while pressing the **〈shift〉** key on the teach pendant.
- You can move the keyboard to the top of the screen by touching the [⇕] button.

3. When you have finished editing the text, you can hide the soft keyboard by touching the [⌨] button at the bottom right of the soft keyboard.

3.2.4.5 Block Editing Mode

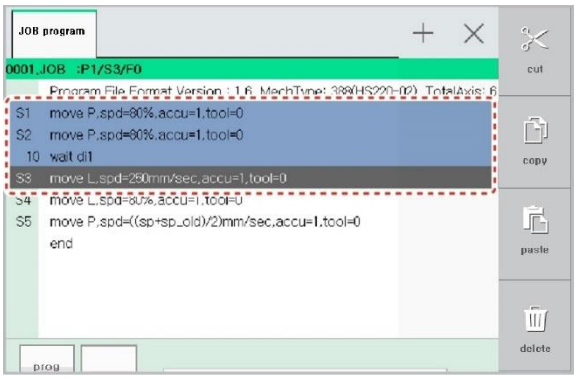
You can copy, move, and delete a line or multiple lines of the program by designating it or them as a block.

1. While pressing the **〈shift〉** key on the teach pendant, touch the **[Block Editing]** button on the right side of the JOB program window. Then, the block editing mode will be activated.
2. Place the cursor on the desired line using the **〈↓/↑〉** keys on the teach pendant and then press the **〈enter〉** key. Then, the line on which the cursor is placed will be selected as the start line of the block.



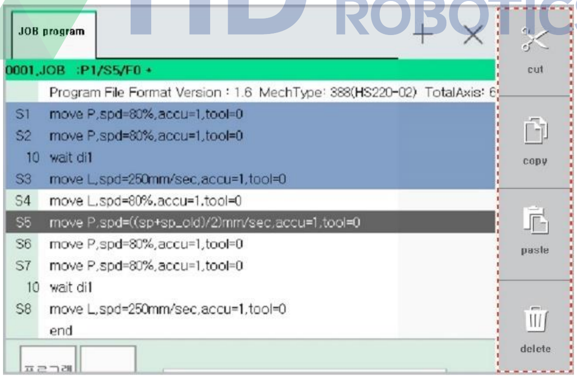
```
0001.JOB  :P1/S1/F0
    Program File Format Version : 1.6  MechType: 388(HS220-02)  TotalAxis: 6
S1  move P,spd=80%,accu=1,tool=0
S2  move P,spd=80%,accu=1,tool=0
 10 wait di1
S3  move L,spd=250mm/sec,accu=1,tool=0
S4  move L,spd=80%,accu=1,tool=0
S5  move P,spd=((sp+sp_old)/2)mm/sec,accu=1,tool=0
    end
```

3. Move the cursor by turning the jog dial on the teach pendant. Then, the section from the start line to the line to which the cursor is moved to will be selected as a block.



```
0001.JOB  :P1/S3/F0
    Program File Format Version : 1.6  MechType: 388(HS220-02)  TotalAxis: 6
S1  move P,spd=80%,accu=1,tool=0
S2  move P,spd=80%,accu=1,tool=0
 10 wait di1
S3  move L,spd=250mm/sec,accu=1,tool=0
S4  move L,spd=80%,accu=1,tool=0
S5  move P,spd=((sp+sp_old)/2)mm/sec,accu=1,tool=0
    end
```

4. You can edit the statement in the area that is selected as a block using the function buttons on the right side of the screen.



```
0001.JOB  :P1/S5/F0 *
    Program File Format Version : 1.6  MechType: 388(HS220-02)  TotalAxis: 6
S1  move P,spd=80%,accu=1,tool=0
S2  move P,spd=80%,accu=1,tool=0
 10 wait di1
S3  move L,spd=250mm/sec,accu=1,tool=0
S4  move L,spd=80%,accu=1,tool=0
S5  move P,spd=((sp+sp_old)/2)mm/sec,accu=1,tool=0
S6  move P,spd=80%,accu=1,tool=0
S7  move P,spd=80%,accu=1,tool=0
 10 wait di1
S8  move L,spd=250mm/sec,accu=1,tool=0
    end
```

- **[Cut]:** You can cut the area selected as a block and save it in the clipboard so that it can be pasted to another location.
- **[Copy]**: You can copy the area selected as a block and save it in the clipboard so that it can be pasted to another location.
- **[Paste]:** Paste the area saved in the clipboard to the desired location.

  To paste the statement saved in the clipboard, you should select the cursor position using the jog dial and then touch the **[Paste]** button. Then, the statement will be inputted into the line right below the current cursor position.
- **[Delete]**: You can delete the selected area.

5. When you complete editing a block, press the **〈esc〉** key on the teach pendant or touch the **[Close]** button on the right side of the screen to exit the block editing mode.

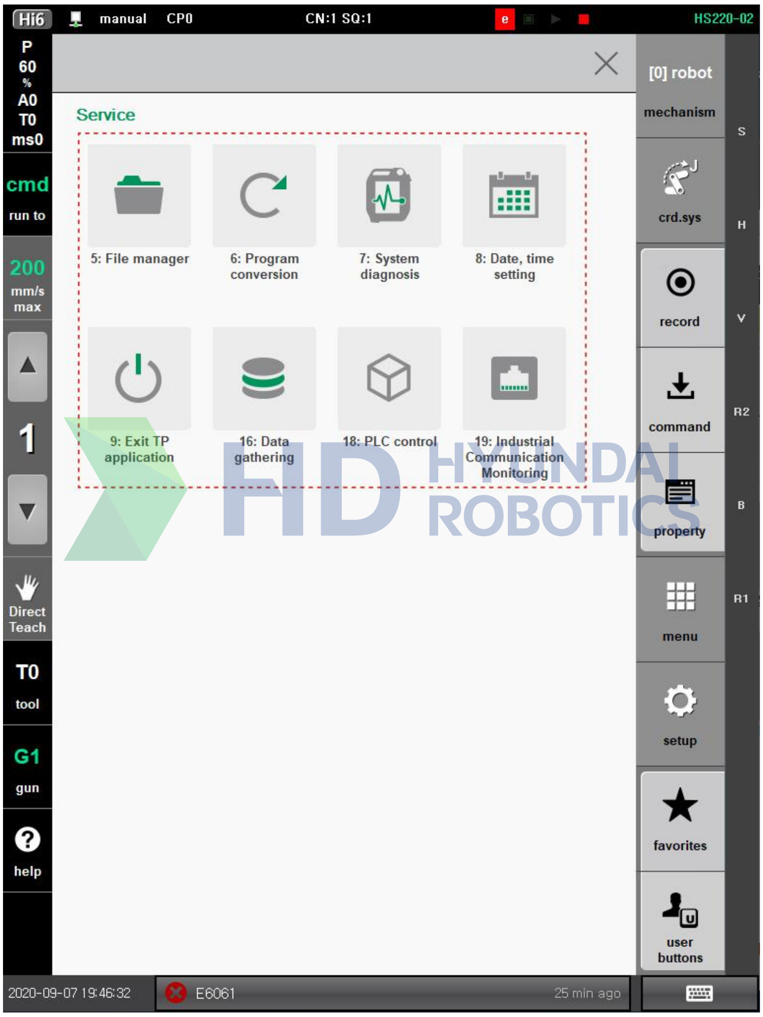
4. Menu

You can use the program’s various service function menus such as variable and file management.

4.1 Use of Menus

1. In manual or automatic mode, touch the **[Menu]** button on the right side of the initial screen. Various service menus of the program will be displayed.

2. Selecting the desired menu will enable you to manage files, programs, teach pendants, or to check the status of the robot system.

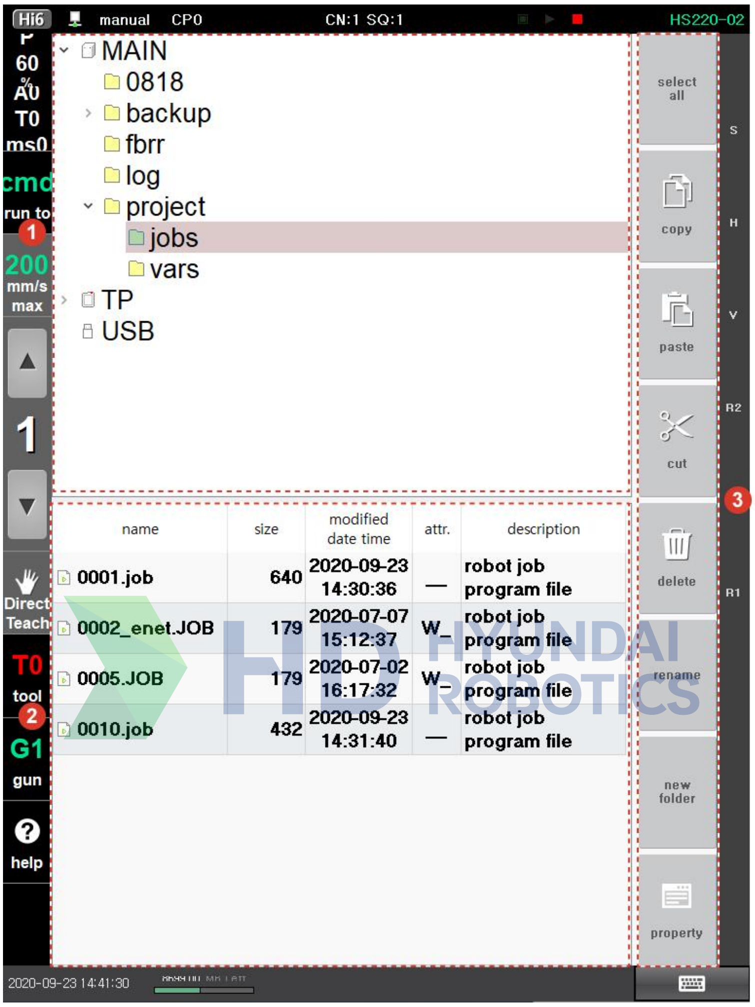

Hi6
manual
CP0
CN:1 SQ:1
HS220-02
P
60
%
A0
T0
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
Service
5: File manager
6: Program conversion
7: System diagnosis
8: Date, time setting
9: Exit TP application
16: Data gathering
18: PLC control
19: Industrial Communication Monitoring
[0] robot
mechanism
crd.sys
record
command
property
menu
setup
favorites
user buttons
S
H
V
R2
B
R1
2020-09-07 19:46:32
E6061
25 min ago

- **[5: File Manager]**: You can manage files in the main board’s internal memory, teach pendant, or removable storage device.
- **[6: Program Conversion]**: You can convert the data, such as the condition and location of the created program, by batch or individually.
- **[7: System Diagnosis]**: You can check the status of the robot and controller and update the system version.
- **[8: Date, time setting]**: You can set the date and time of the controller.

4.2 File Management

You can manage files in the main board's internal memory, teach pendant, or removable storage device.

1. Touch the **[5: File Manager]** menu. Then, a list of folders of each device and a list of files saved in the selected folder will appear.
2. Check and manage the folder structure and saved files by device.


Hi6
manual
CP0
CN:1 SQ:1
HS220-02
MAIN
0818
backup
fbrr
log
project
jobs
vars
TP
USB
select all
copy
paste
cut
delete
rename
new folder
property
S
H
V
R2
R1
60
AU
T0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
①
②
③
2020-09-23 14:41:30

name	size	modified date time	attr.	description
0001.job	640	2020-09-23 14:30:36	—	robot job program file
0002_enet.JOB	179	2020-07-07 15:12:37	W_	robot job program file
0005.JOB	179	2020-07-02 16:17:32	W_	robot job program file
0010.job	432	2020-09-23 14:31:40	—	robot job program file

No.	Description
①	This is a list of folders in the main board's internal memory, teach pendant, and removable storage devices. You can check the folder structure. • **[MAIN]**: The files saved in the mainboard (M/B) will be used for the actual robot operation. • **[TP]** / **[USB]**: The teach pendant (T/P) and a removable storage device (USB) will be used for data backup. The **[USB]** folder will appear only when a removable storage device is connected to the teach pendant. • You can move the cursor in the folder list by turning the jog dial on the teach pendant. • If you select [›] or [˅] in the folder list and press the **〈enter〉** key, you can show or hide subfolders. • When you select a folder, you can check the list of files saved in the folder.
②	Shows the list of the files saved in the selected folder. You can check the name, size, last modified date, protected status, and additional information of each file.

③	You can manage files and folders using the function buttons.

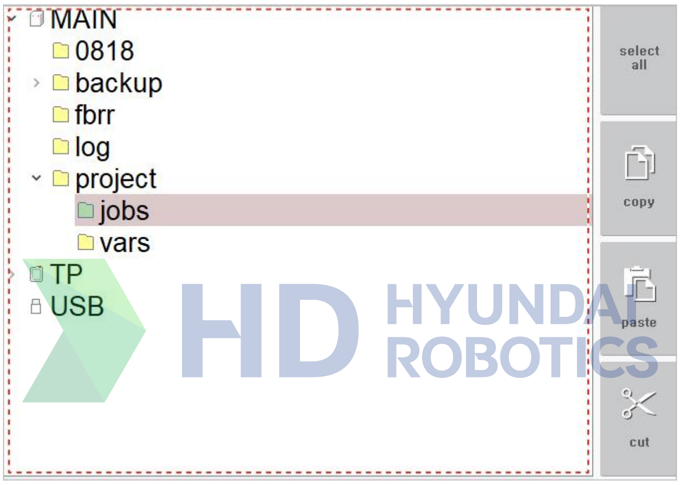
Note	- It is the same function as "R17 File Management" of R codes. - When a removable storage device is connected to the teach pendant, the **[USB]** icon (🖫) will appear on the status bar of the Hi6 teach pendant screen.

⚠ Caution	Never remove the removable storage device from the teach pendant while performing operations such as copying or deleting files. Data may be corrupted.

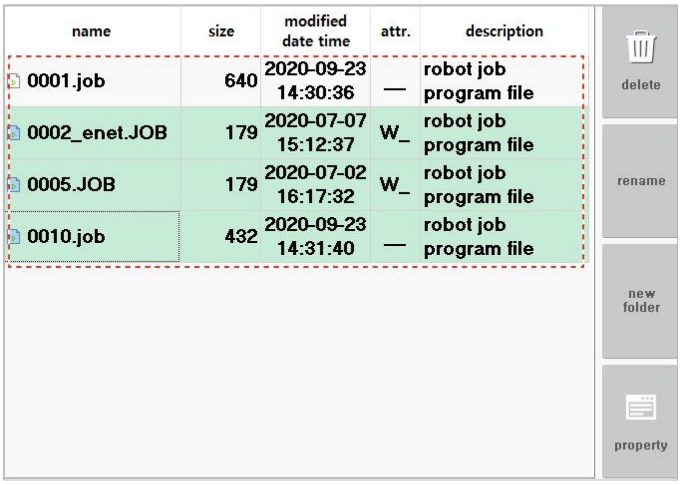
4.2.1 File Management

Select one or multiple files to copy, move, or delete.

1. Select a folder in the folder list using the jog dial on the teach pendant. A list of files saved in the selected folder will appear.



2. Select the desired file in the file list by touching it.

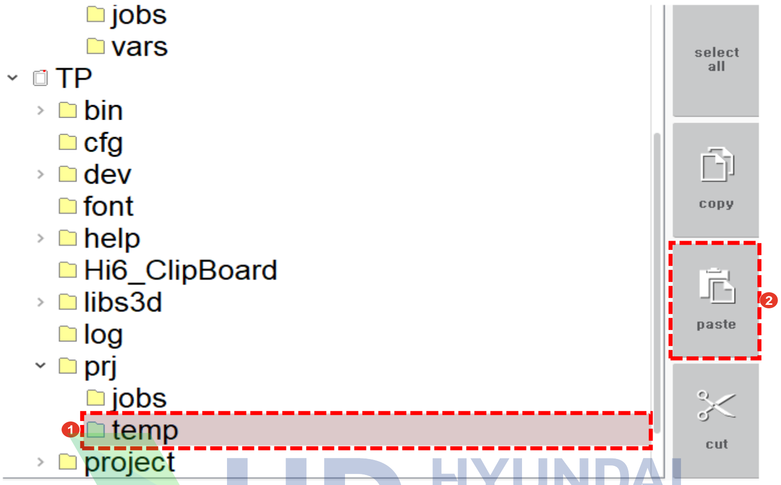


name	size	modified date time	attr.	description
0001.job	640	2020-09-23 14:30:36	—	robot job program file
0002_enet.JOB	179	2020-07-07 15:12:37	W_	robot job program file
0005.JOB	179	2020-07-02 16:17:32	W_	robot job program file
0010.job	432	2020-09-23 14:31:40	—	robot job program file

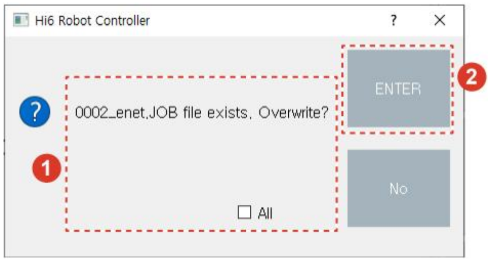
- You can select multiple files one by one by touching each file while pressing the **⟨ctrl⟩** key.
- If you touch two files while pressing the **⟨shift⟩** key, you can select all files between the two files at once.
- If you touch the **[Select All]** button on the right side of the screen, you can select all files at once.

Press the **⟨esc⟩** key to cancel the file selection.

3. You can copy, move, or delete the selected file using the function buttons on the right side of the screen.
   - **[Copy]**: Copy the selected file and save it in a temporary folder so that it can be pasted into another folder.
   - **[Paste]**: You can paste the file saved in the clipboard to the desired folder.
   - **[Cut]**: You can cut the selected file and save it in a temporary folder so that it can be pasted into another folder.
   - **[Delete]**: You can delete the selected file. A protected file (with the protection mark (W_) in the attributes) cannot be deleted.
4. To paste a file into a folder, select the folder using the jog dial and then touch the **[Paste]** button. Then, the file will be pasted to the selected folder.


jobs
vars
TP
bin
cfg
dev
font
help
Hi6_ClipBoard
libs3d
log
prj
jobs
① temp
project
select all
copy
paste ②
cut

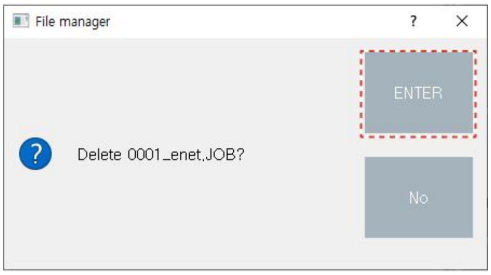
   - If the selected folder has a file with a duplicate name, a duplication notification window will appear. Handle it by setting whether to overwrite it.


Hi6 Robot Controller
?
✕
ENTER
②
①
No

0002_enet.JOB file exists. Overwrite?

☐ All

   - To delete a file, touch the **[Delete]** button, and then touch the **[ENTER]** button in the confirmation window.

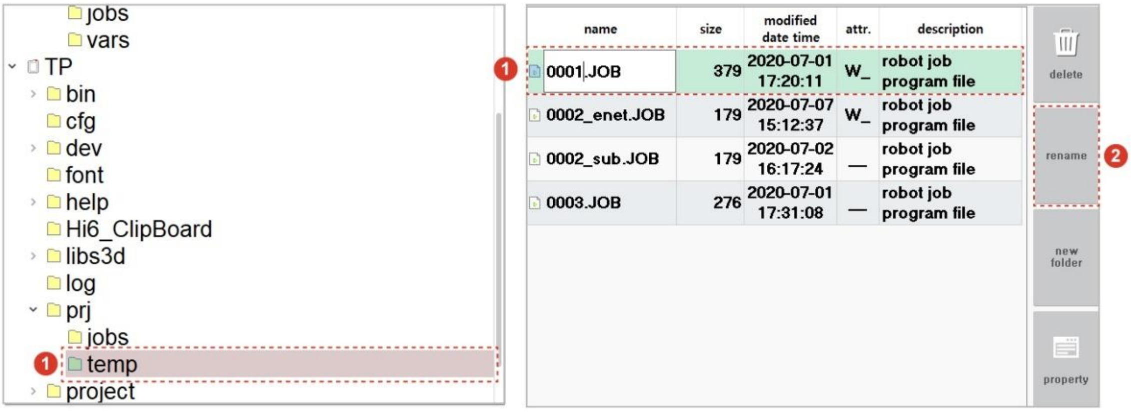

File manager
?
✕
ENTER
No

Delete 0001_enet.JOB?

4.2.2 Renaming of a File and Folder

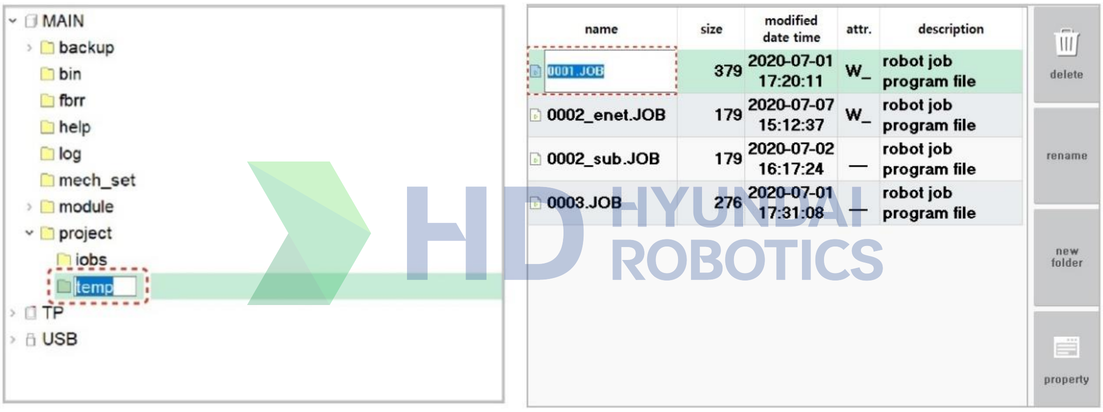
You can rename a file or folder. You can also rename multiple files or folders at once.

1. Touch the desired file (or folder) in the file (or folder) list to select it, and then touch the **[Rename]** button on the right side of the screen.


jobs
vars
TP
bin
cfg
dev
font
help
Hi6_ClipBoard
libs3d
log
prj
jobs
① temp
project
①
delete
② rename
new folder
property

name	size	modified date time	attr.	description
0001.JOB	379	2020-07-01 17:20:11	W_	robot job program file
0002_enet.JOB	179	2020-07-07 15:12:37	W_	robot job program file
0002_sub.JOB	179	2020-07-02 16:17:24	—	robot job program file
0003.JOB	276	2020-07-01 17:31:08	—	robot job program file

2. Input the file (or folder) name in the input area.


MAIN
backup
bin
fbrr
help
log
mech_set
module
project
jobs
temp
TP
USB
delete
rename
new folder
property

name	size	modified date time	attr.	description
0001.JOB	379	2020-07-01 17:20:11	W_	robot job program file
0002_enet.JOB	179	2020-07-07 15:12:37	W_	robot job program file
0002_sub.JOB	179	2020-07-02 16:17:24	—	robot job program file
0003.JOB	276	2020-07-01 17:31:08	—	robot job program file

- You can input the number simply by using the operation keys on the teach pendant. (〈←/→〉 keys: For moving the cursor. Number keys: For inputting a number)
- To input a text including numbers, touch the [⌨] button on the log bar to use the soft keyboard.

3. Press the 〈**enter**〉 key. Then, the new name you inputted in the list will appear.

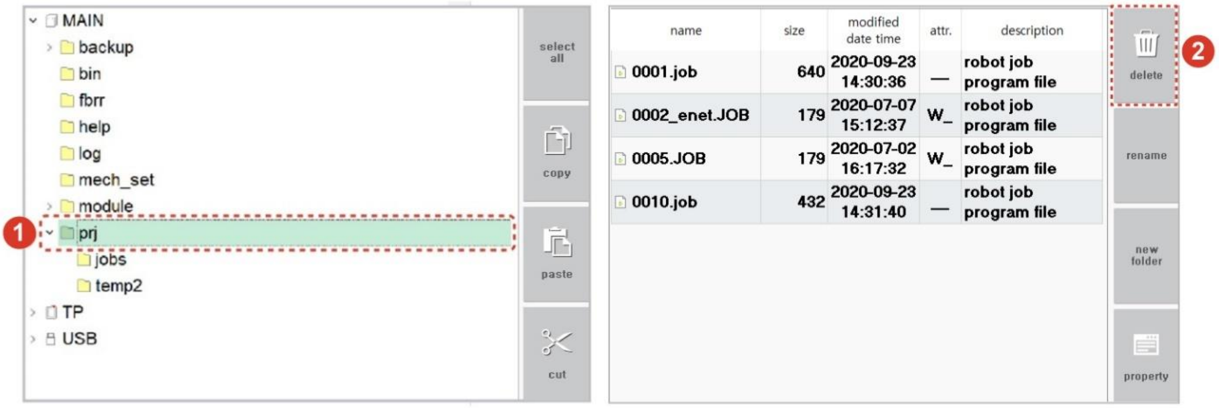
Note	
	- You can also rename a protected file. - Even if a file is renamed, the information such as size, modified date, and attributes will remain the same as before. - It is the same function as “R116 Program Number Change” of R codes.

4.2.3 Folder Management

You can delete a folder or add a new one.

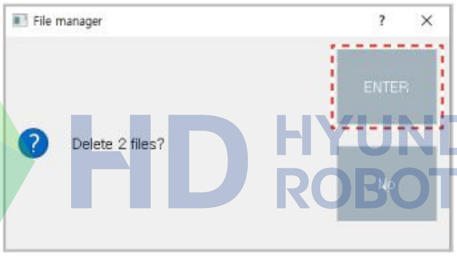
4.2.3.1 Folder Deletion

1. Select a folder in the folder list using the jog dial on the teach pendant and then touch the **[Delete]** button on the right side of the screen.


MAIN
backup
bin
fbrr
help
log
mech_set
module
1
prj
jobs
temp2
TP
USB
select all
copy
paste
cut
delete
2
rename
new folder
property

name	size	modified date time	attr.	description
0001.job	640	2020-09-23 14:30:36	—	robot job program file
0002_enet.JOB	179	2020-07-07 15:12:37	W_	robot job program file
0005.JOB	179	2020-07-02 16:17:32	W_	robot job program file
0010.job	432	2020-09-23 14:31:40	—	robot job program file

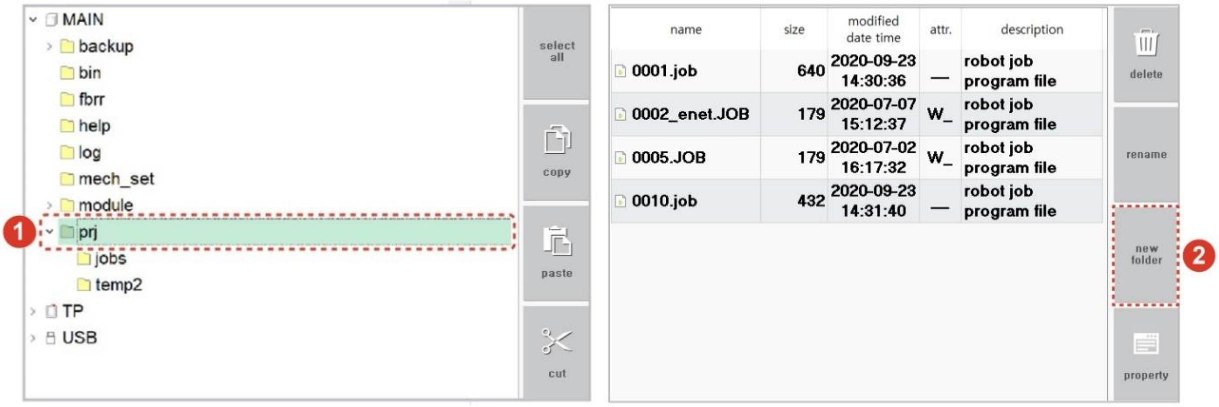
2. In the confirmation window, touch the **[ENTER]** button. The selected folder and all files saved in it will be deleted.


File manager
?
✕
ENTER
No

Delete 2 files?

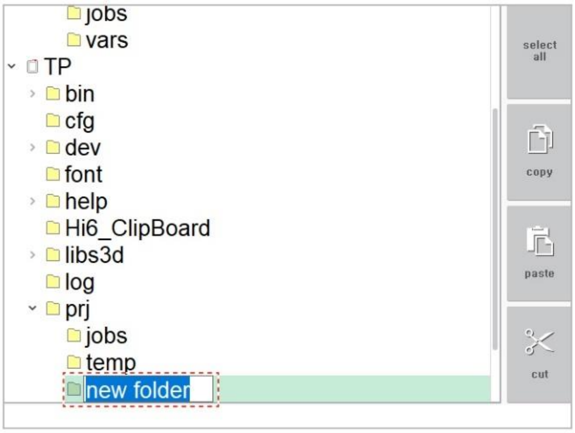
4.2.3.2 Folder Creation

1. Select a folder in the folder list using the jog dial of the teach pendant and then touch the **[New Folder]** button on the right side of the screen. Then, a new folder will be added under the selected folder.


MAIN
backup
bin
fbrr
help
log
mech_set
module
1
prj
jobs
temp2
TP
USB
select all
copy
paste
cut
delete
rename
new folder
2
property

name	size	modified date time	attr.	description
0001.job	640	2020-09-23 14:30:36	—	robot job program file
0002_enet.JOB	179	2020-07-07 15:12:37	W_	robot job program file
0005.JOB	179	2020-07-02 16:17:32	W_	robot job program file
0010.job	432	2020-09-23 14:31:40	—	robot job program file

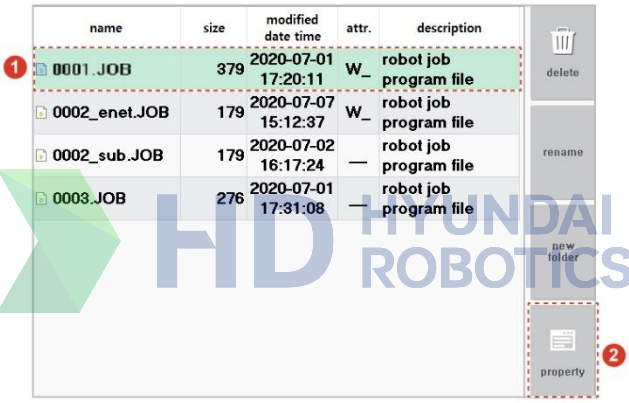
2. Input the name of the new folder and then press the **<enter>** key.


jobs
vars
TP
bin
cfg
dev
font
help
Hi6_ClipBoard
libs3d
log
prj
jobs
temp
new folder
select all
copy
paste
cut

4.2.4 File Protection

Protect your important files by performing a setting that can make it impossible to change or delete a program.

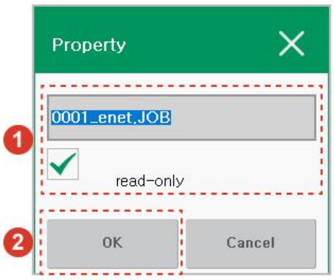
1. Select the file and touch the **[property]** button. Then, the attribute setting window will appear.



name	size	modified date time	attr.	description
0001.JOB	379	2020-07-01 17:20:11	W_	robot job program file
0002_enet.JOB	179	2020-07-07 15:12:37	W_	robot job program file
0002_sub.JOB	179	2020-07-02 16:17:24	—	robot job program file
0003.JOB	276	2020-07-01 17:31:08	—	robot job program file

①
delete
rename
new folder
property
②

2. Check the file name and touch the **[Read Only]** checkbox to select it and then touch the **[OK]** button. A protection mark (W_) will appear in the attributes of the file list.



Property

0001_enet.JOB

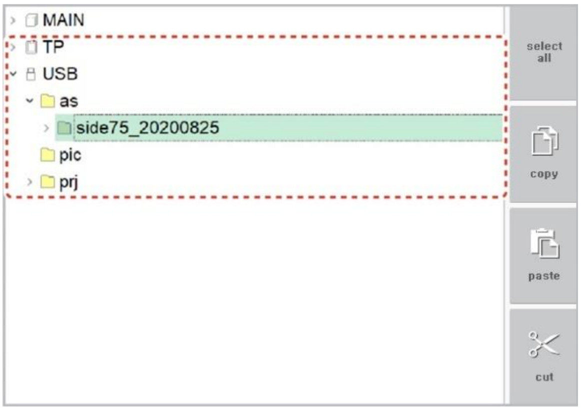
☑ read-only

①
②
OK
Cancel

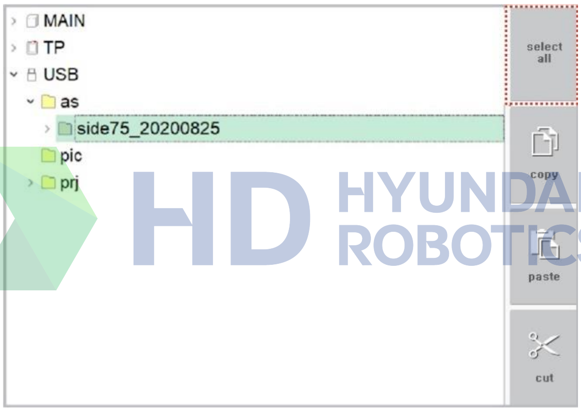
4.2.5 Data Backup

You can save the history of the memory buffer as a file, and back up the project (project/) and history (log/) folders.

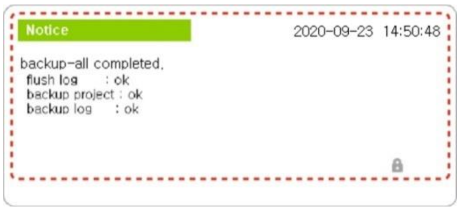
1. By using the jog dial on the teach pendant, select the folder where you want to save the backup data in the teach pendant (T/P) or removable storage device (USB) folder in the folder list.


MAIN
TP
USB
as
side75_20200825
pic
prj
select all
copy
paste
cut

2. While pressing the **〈shift〉** key, touch the **[Select all]** button at the right side of the screen. The data backup will start.


MAIN
TP
USB
as
side75_20200825
pic
prj
select all
copy
paste
cut

3. When data backup (it will take about 30 seconds) is completed, check the backup result in the notification window.

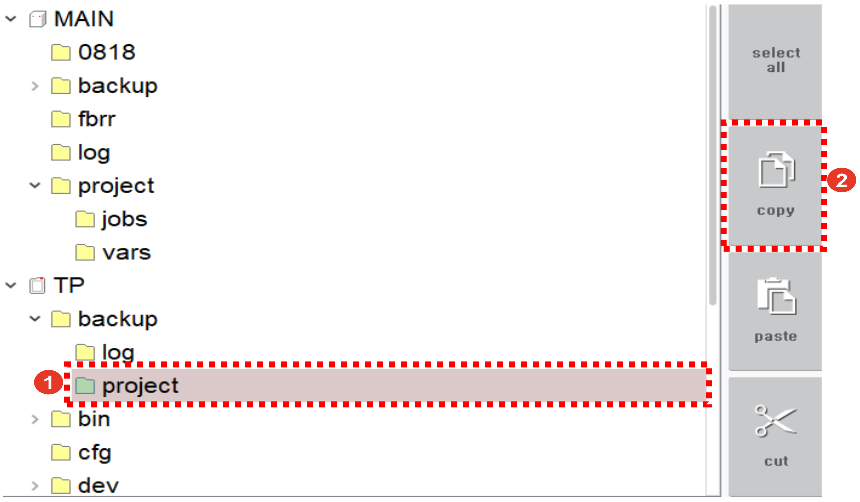


```
2020-09-23  14:50:48

backup-all completed.
 flush log      : ok
 backup project : ok
 backup log     : ok
```

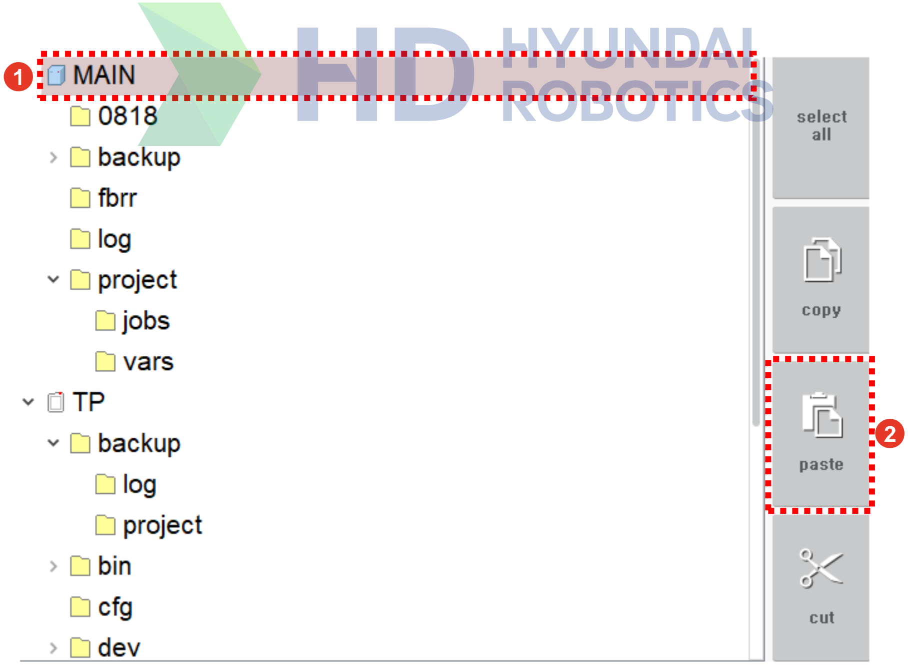
4.2.6 Data Restoration

This function helps restore the project (project/) and history (log/) that are previously backed up.

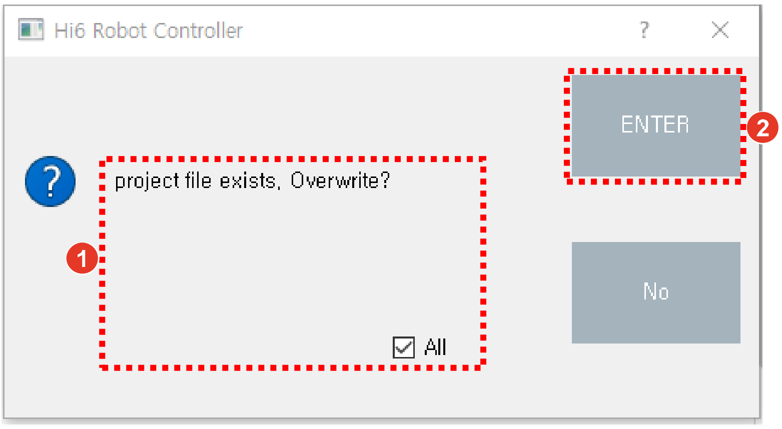
1. By using the teach pendant's jog dial, select the project (project/) folder backed up in the teach pendant (T/P) or removable storage device (USB), and then touch the **[Copy]** button.


MAIN
0818
backup
fbrr
log
project
jobs
vars
TP
backup
log
1
project
bin
cfg
dev
select all
copy
2
paste
cut

2. By using the teach pendant's jog dial, select the [MAIN] folder in the folder list, and then touch the [Paste] button.


1
MAIN
0818
backup
fbrr
log
project
jobs
vars
TP
backup
log
project
bin
cfg
dev
select all
copy
paste
2
cut

3. In the duplicate notification window, touch the checkbox for **[All]** to select it, and then touch the **[OK]** button. The backup data will be restored on the main board.



Hi6 Robot Controller

project file exists, Overwrite?

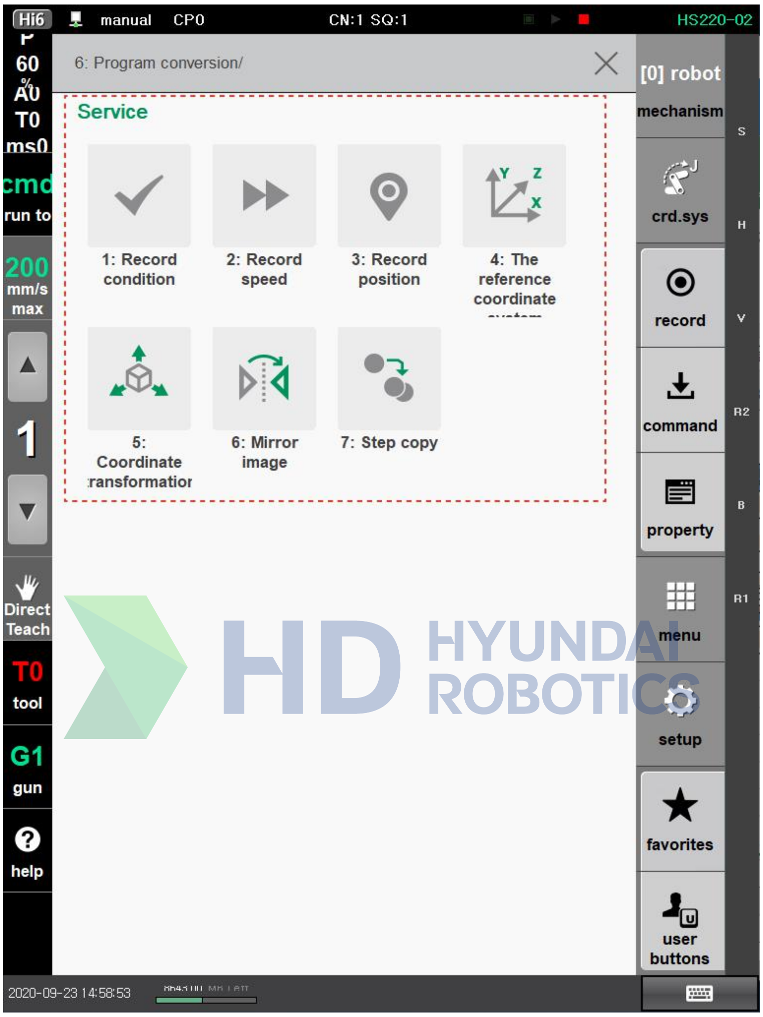
☑ All

4. Turn the power of the controller back on.

4.3 Program Conversion

You can write a new program by modifying the conditions and location of the created program by batches or individually, or by shifting coordinates.

1. Touch the **[6: Program Conversion]** menu. Then, the program conversion menu will appear.
2. Select the desired menu and then modify the program conditions and location, or write a new program.


Hi6
manual CP0
CN:1 SQ:1
HS220-02
6: Program conversion/
Service
1: Record condition
2: Record speed
3: Record position
4: The reference coordinate system
5: Coordinate transformation
6: Mirror image
7: Step copy
[0] robot
mechanism
crd.sys
record
command
property
menu
setup
favorites
user buttons
60 %
T0
cmd
run to
200 mm/s max
1
Direct Teach
T0 tool
G1 gun
help
2020-09-23 14:58:53

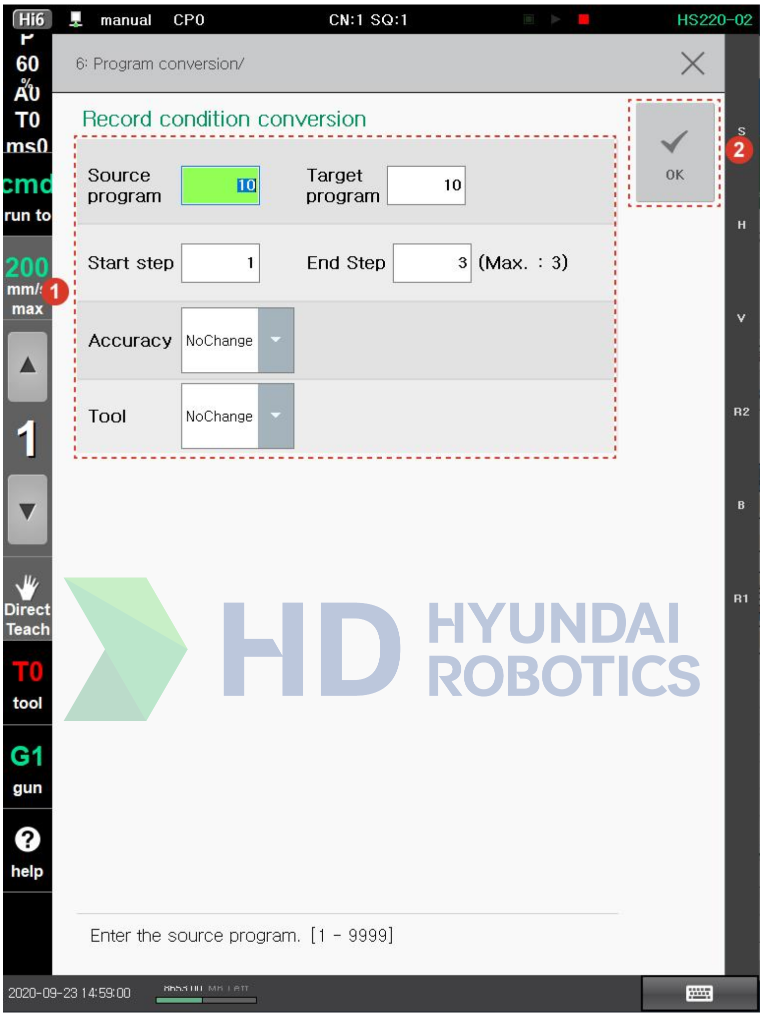
Note	During the startup of the robot, the use of the menus **[4: The reference coordinate system]**, **[5: Coordinate transformation]**, **[6: Mirror Image]**, and **[7: Step Copy]** will be restricted.

4.3.1 Recording Condition

You can change and set the recording condition for a specific step of the program and then apply it to the existing program, or write a new program.

1. Touch the **[6: Program Conversion 〉 1: Record condition conversion]** menu. Then, the recording condition conversion setting window will appear.

2. After setting the recording condition option, touch the **[OK]** button.



6: Program conversion/

Record condition conversion

Source program 10
Target program 10
Start step 1
End Step 3 (Max. : 3)
Accuracy NoChange
Tool NoChange

Enter the source program. [1 - 9999]

- **[Source program]/[Target program]**: You can input the number of the original program (Initial setting value: The currently selected program) whose recording conditions you want to change and the number of the new program you want to save after the change of recording conditions. If you set the number of the target program to match the same number as that of the original program, the original program will be overwritten by and replaced with a new program.

- **[Start Step]/[End Step]**: You can set the range of the steps (Initial setting value: 1/last step) to which you will apply the change of recording conditions.

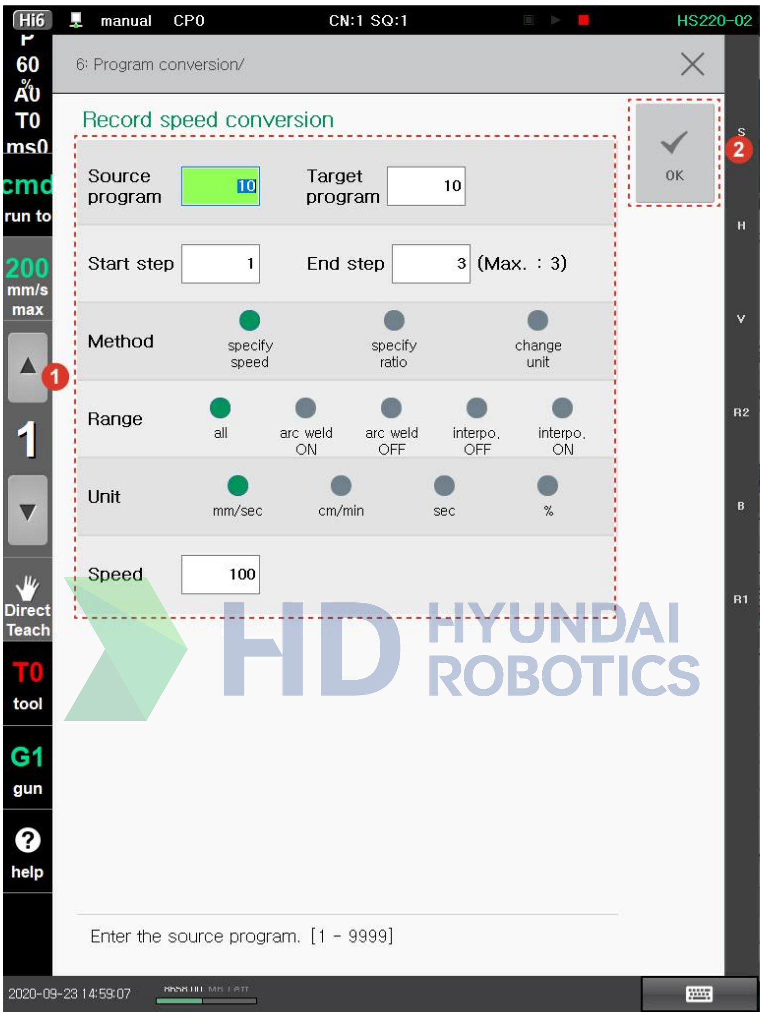
- **[Accuracy], [Tool]**: You can change the recording conditions.

4.3.2 Recording Speed Conversion

You can change the recording speed for a specific step of the program and apply it to the existing program, or create a new program.

1. Touch the **[6: Program Conversion 〉 2: Record speed conversion]** menu. Then, the recording speed conversion setting window will appear.

2. After setting the recording speed option, touch the **[OK]** button.



6: Program conversion/

Record speed conversion

Source program: 10
Target program: 10
Start step: 1
End step: 3 (Max. : 3)
Method: ● specify speed ○ specify ratio ○ change unit
Range: ● all ○ arc weld ON ○ arc weld OFF ○ interpo. OFF ○ interpo. ON
Unit: ● mm/sec ○ cm/min ○ sec ○ %
Speed: 100

Enter the source program. [1 - 9999]

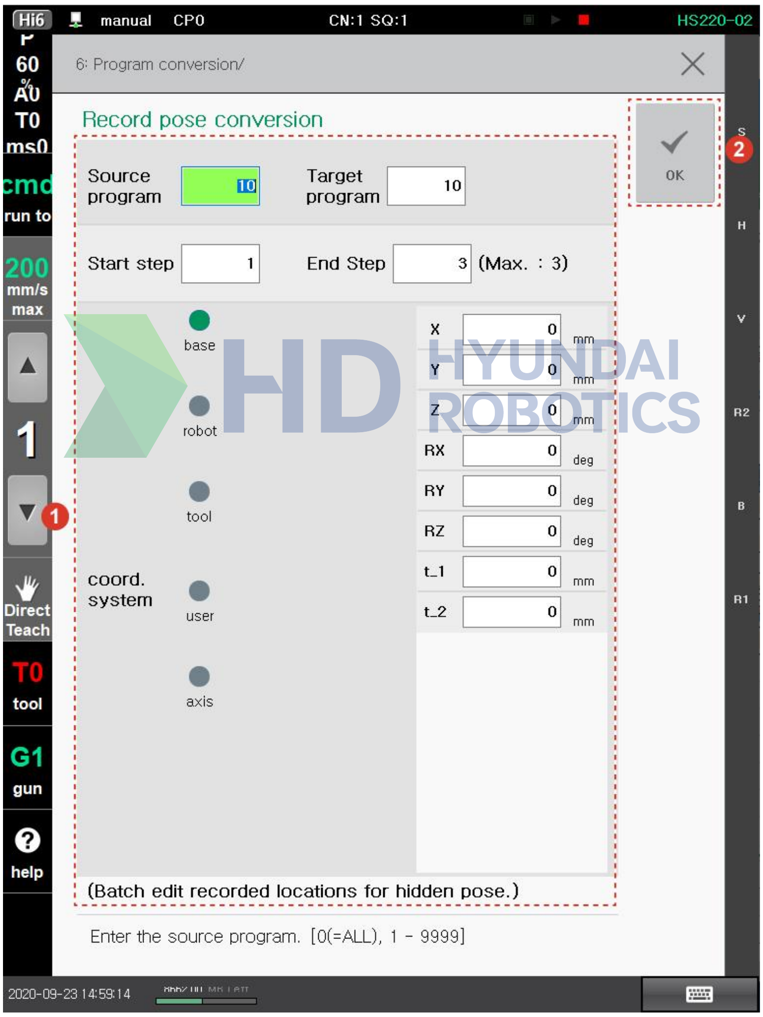
- **[Source program]/[Target program]**: You can input the number of the original program (Initial setting value: The currently selected program) whose recording speed you want to change and the number of the new program you want to save after the change of recording speed. If you set the number of the target program to match the same number as that of the original program, the original program will be overwritten by and replaced with a new program.
- **[Start Step]/[End Step]**: You can set the range of the steps (Initial setting value: 1/last step) to which you will apply the change of the recording speed.
- **[Method]**: You can set the method of designating the speed.
  - **[specify Speed]**: You can convert the recorded speeds by batch.
  - **[specify ratio]**: If the unit of the recorded speed and the unit of speed selected in the **[Unit]** option match with each other, the speed can be converted to a ratio against the recorded speed.
  - **[change unit]**: You can convert the unit of the recorded speed.

- **[Range]**: You can set the application section within the range of the steps of which recording speed you want to change.
- **[Unit]**: You can set the unit of speed. When the speed designation method is selected as **[specify ratio]**, only those that match the unit of the speed recorded in the step will be converted to the percentage of the ratio.
- **[Speed]**: This will mean the ratio value if you select the **[specify ratio]** as the speed designation method.

4.3.3 Recording Position

You can change and set the coordinate system of the step position recorded as a hidden pose in a specific step of the program and apply it to the existing program or create a new program.

1. Touch the **[6: Program Conversion 〉 3: Record Pose conversion]** menu. Then the recording position conversion setting window will appear.
2. After setting the recording position option, touch the **[OK]** button.



6: Program conversion/

Record pose conversion

Source program 10

Target program 10

Start step 1

End Step 3 (Max. : 3)

coord. system: ● base ○ robot ○ tool ○ user ○ axis

X	0	mm
Y	0	mm
Z	0	mm
RX	0	deg
RY	0	deg
RZ	0	deg
t_1	0	mm
t_2	0	mm

(Batch edit recorded locations for hidden pose.)

Enter the source program. [0(=ALL), 1 - 9999]

2020-09-23 14:59:14

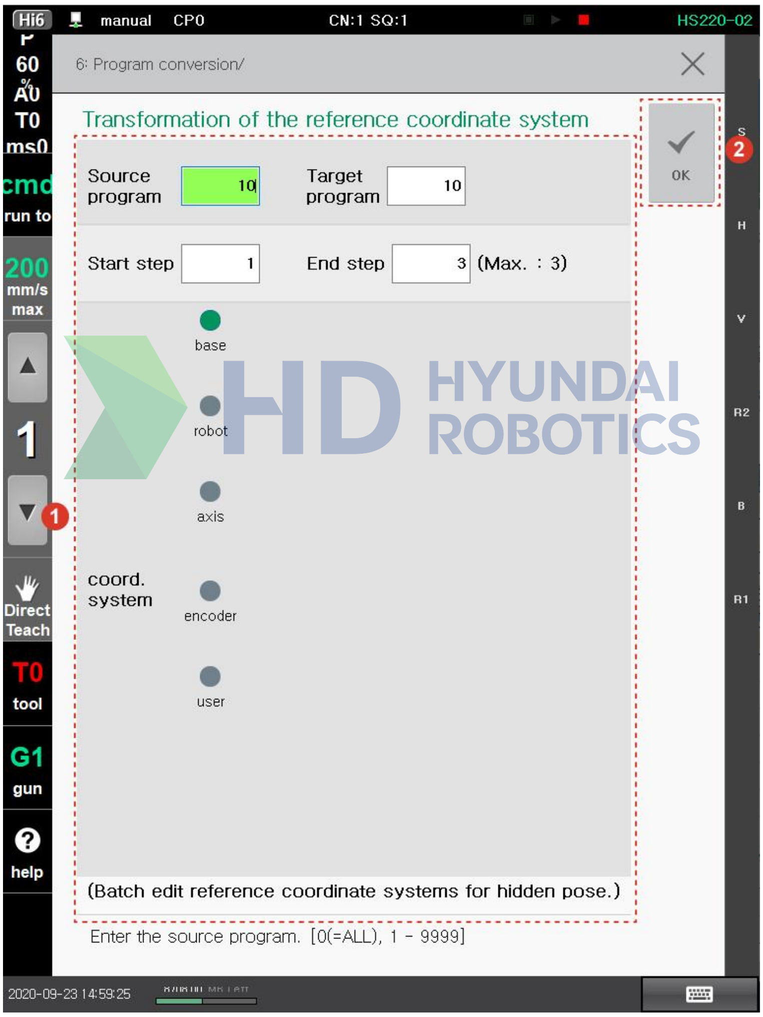
- **[source program]/[Target program]**: You can input the number of the original program (Initial setting value: The currently selected program) of which recording position you want to change and the number of the new program you want to save after the change of recording position. If you set the number of the target program to match the same number as that of the original program, the original program will be overwritten by and replaced with a new program.
- **[Start Step]/[End Step]**: You can set the range of the steps (Initial setting value: 1/last step) to which you will apply the change of the recording position.

- **[Coord. System Format]**: You can select the coordinate system to shift the position data recorded in the step. If you select base, robot, tool, or user, the position data will be converted to Cartesian coordinate values, and if you select joint, the position data will be converted to axis angles.

4.3.4 Recording Coordinate System

You can change the coordinate system of the step position recorded as a hidden pose. You can check the coordinate system you have changed to by pressing the quick open button at the concerned step. During the startup of the robot, the use of the **[4: Transformation of the reference coordinate system]** menu will be restricted.

1. Touch the **[6: Program Conversion 〉 4: Transformation of the reference coordinate system]** menu. Then, the recording coordinate system shifting setting window will appear.
2. After setting the recording coordinate system option, touch the **[OK]** button.



Transformation of the reference coordinate system

Source program 10 Target program 10

Start step 1 End step 3 (Max. : 3)

coord. system
● base
○ robot
○ axis
○ encoder
○ user

(Batch edit reference coordinate systems for hidden pose.)

Enter the source program. [0(=ALL), 1 - 9999]

2020-09-23 14:59:25

- **[Source program]/[Target program]**: You can input the number of the original program (Initial setting value: The currently selected program) of which recording coordinate system you want to change and the number of the new program you want to save after the change of recording coordinate system. If you set the number of the target program to match the same number as that of the original program, the original program will be overwritten by and replaced with a new program.
- **[Start Step]/[End Step]**: You can set the range of the steps (Initial setting value: 1/last step) to which you will apply the change of the recording coordinate system.
- **[Coordinate System Format]**: You can select a coordinate system that you want to designate newly.

4.3.5 Coordinate Shifting

The coordinate shifting function is a function that enables you to create a program without additional teaching even if a workpiece of the same shape, as shown in Image 2, is placed at a different location after a program taught on the workpiece (Image 1).

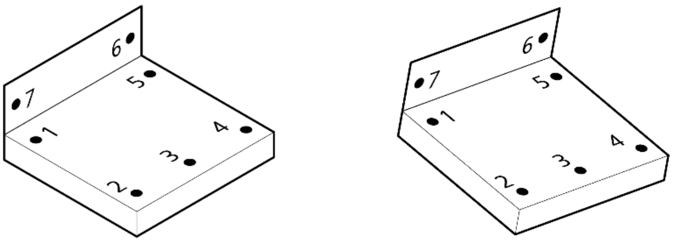
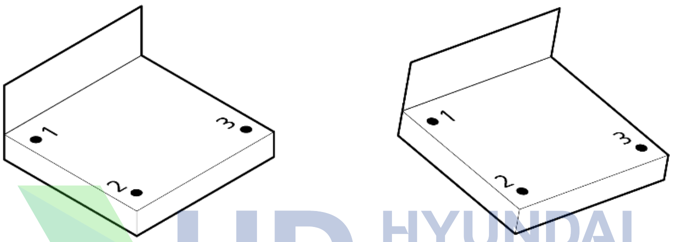


Image 1

Image 2

Figure 30 Coordinate Shifting

It is required to have three reference points to use the coordinate shifting function. You can create Program A by marking three reference points on the workpiece at the initial position. After moving the position of the workpiece, write Program B using the previously marked three reference points.



Program A

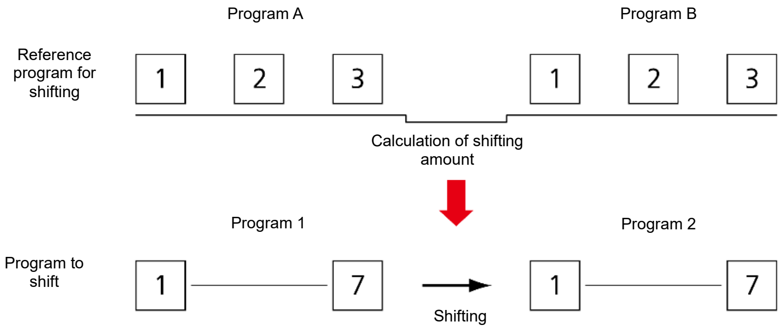
Program B

Figure 31 Coordinate Shifting Program

⚠ Caution

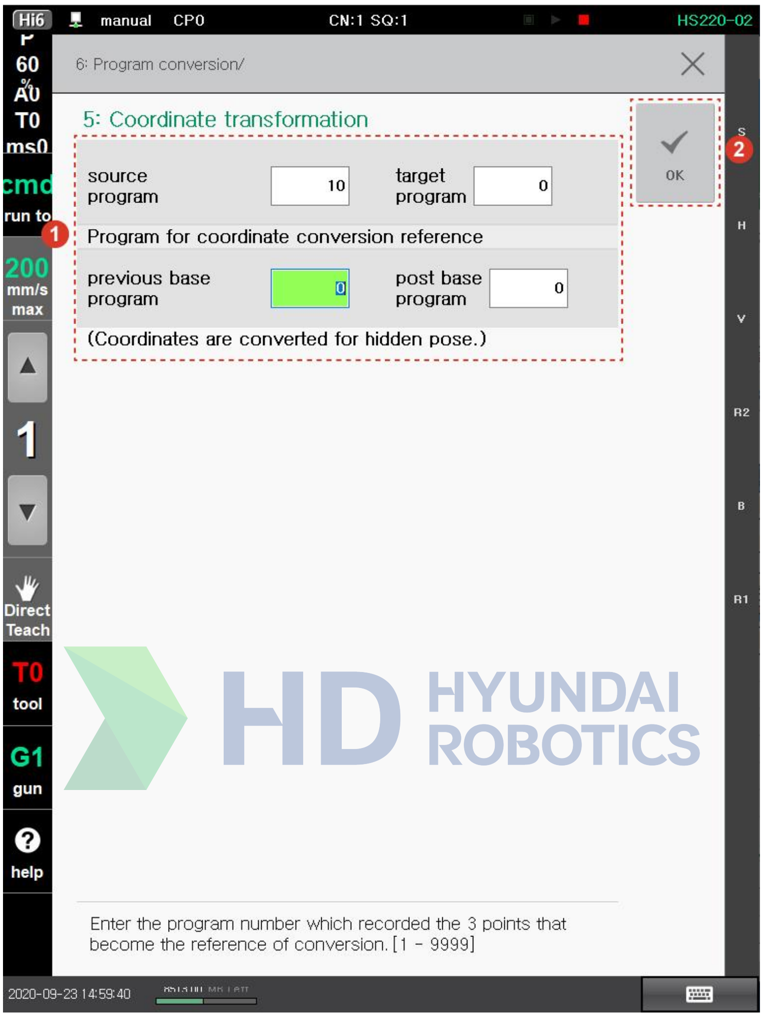
- The accuracy of the coordinate shifting program will be affected by the accuracy of teaching the three reference points in coordinate shifting. Perform teaching as accurately as possible for the three reference points.
- Set the distance between the three reference points as far as possible in coordinate shifting.

You can shift the existing program (Program 1) to a new program (Program 2) by calculating the coordinate shifting amount in three steps that are the basis of Program A and Program B.


Program A
Program B
Reference program for shifting
1
2
3
1
2
3
Calculation of shifting amount
Program 1
Program 2
Program to shift
1
7
Shifting
1
7

The use of the **[5: Coordinate transformation]** menu will be restricted during the startup of the robot. The method to use the coordinate shifting function is as follows.

1. Touch the **[6: Program Conversion 〉 5: Coordinate transformation]** menu. Then the coordinate shifting setting window will appear.
2. After setting the coordinate shifting option, touch the **[OK]** button.



6: Program conversion/

5: Coordinate transformation

source program: 10

target program: 0

Program for coordinate conversion reference

previous base program: 0

post base program: 0

(Coordinates are converted for hidden pose.)

Enter the program number which recorded the 3 points that become the reference of conversion. [1 - 9999]

- **[Source program]/[Target program]**: You can set the number of the existing teaching program (Program number in Image 1) and the number of a new program (Program number in Image 2) that is to be created through coordinate shifting.
- **[Previous base program]/ Post base program]**: You can set the number (Number of Program A) of the program in which the three points as the basis for coordinate shifting are recorded and the number (Number of the Program B) of the program in which the three points as the basis for coordinate shifting are recorded.

4.3.6 Mirror Image

You can write a program in which the position of the S axis and the posture of the wrist axis are symmetrical based on the Y-Z plane at the 0° position of the S axis of the robot.

This function is useful when instructing two robots on the left and right to perform the same operation, such as welding the body of a vehicle. First, teach an operation to one robot and then open the program of the taught operation and convert it into a mirror image. Then, a program symmetrical to the S axis will be written.

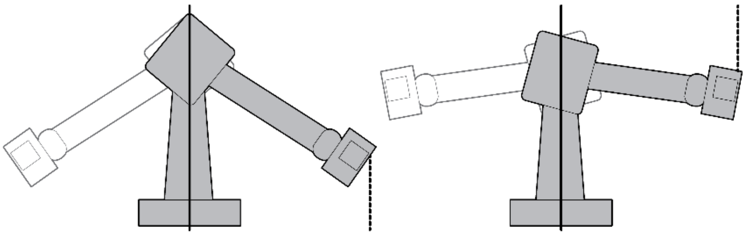
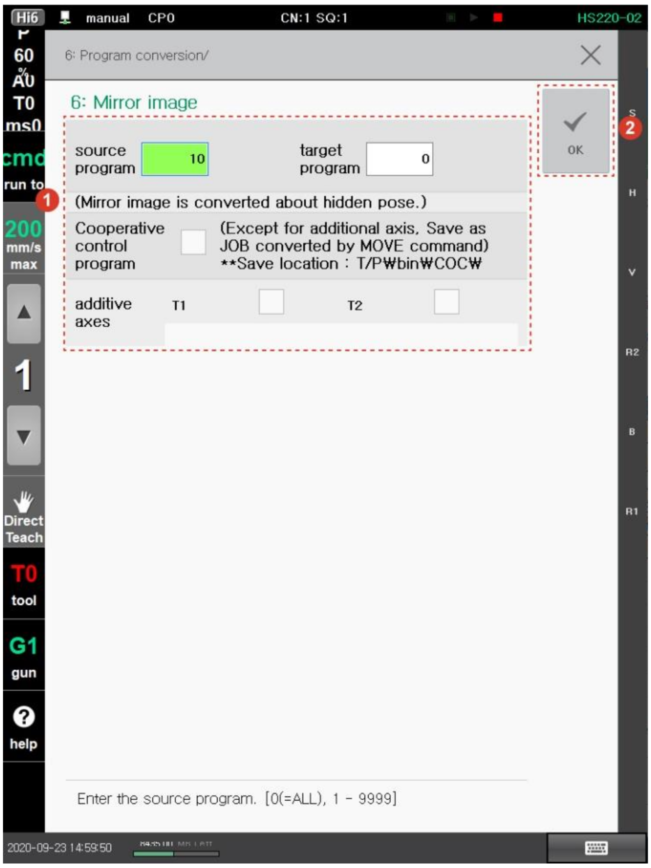


Figure 32 Original Program (Left) / Program Converted Through Mirror Image (Right)

Note	The mirror image function is not supported for collaborative robots.

The use of the **[6: Mirror Image]** menu will be restricted during the startup of the robot. The method to use the mirror image function is as follows.

1. Touch the **[6: Program Conversion > 6: Mirror Image]** menu. Then, the mirror image setting window will appear.
2. After setting the mirror image conversion option, touch the **[OK]** button.
   - **[Source program]/[Target program]**: You can set the number of the existing program and the number of the new program that is to be created through conversion using a mirror image.



6: Program conversion/

6: Mirror image

source program: 10

target program: 0

(Mirror image is converted about hidden pose.)

Cooperative control program ☐ (Except for additional axis, Save as JOB converted by MOVE command) **Save location : T/P₩bin₩COC₩

additive axes T1 ☐ T2 ☐

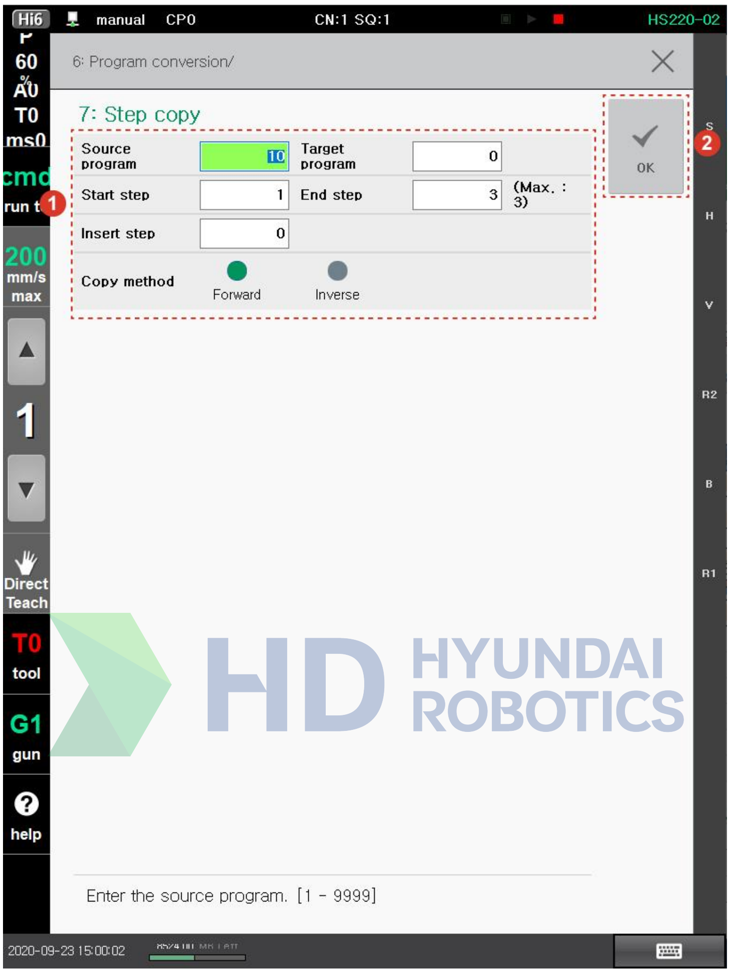
Enter the source program. [0(=ALL), 1 - 9999]

2020-09-23 14:59:50

4.3.7 Step Copy

You can copy part of a program to another program or the same program. The functions recorded in the step will also be copied. During the startup of the robot, the use of the **[7: Step Copy]** menu will be restricted.

1. Touch the **[6: Program Conversion 〉 7: Step Copy]** menu. The step copying setting window will appear.
2. After setting the step copying option, touch the **[OK]** button.



Source program 10

Target program 0

Start step 1

End step 3 (Max. : 3)

Insert step 0

Copy method ● Forward ● Inverse

Enter the source program. [1 - 9999]

- **[Source program]/[Target program]**: You can set the number of the original program of which you want to copy the step and the number of the new program that you want to create by pasting the copied step. If you set the target program number as the same number as the original program number, the original program will be overwritten by and replaced with the new program.
- **[Start Step]/[End Step]**: You can set the range of steps that you want to copy (Initial setting value: 1/last step).
- **[Insert Step]**: You can set the reference step to which you want to paste the copied step. The copied step will be pasted right after the reference step.
- **[Copy Method]**: You can select the progress direction of the copied step.
  - **[Forward/Inverse]:** You can paste the copied steps in the same order as the original program or the reverse order of the original program.

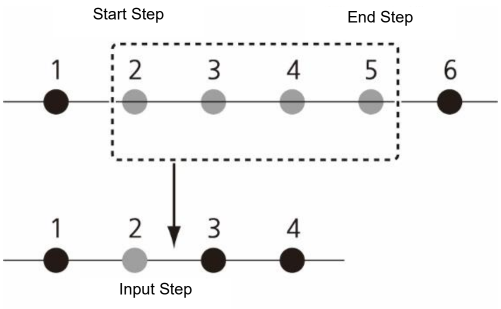
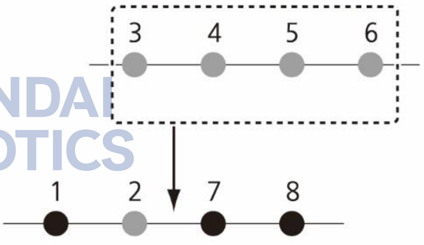
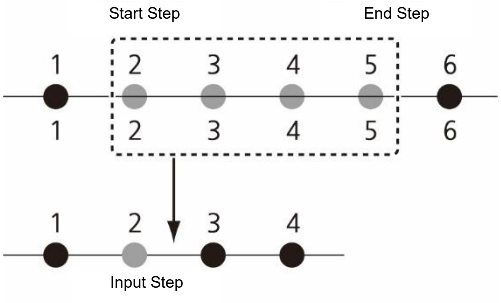
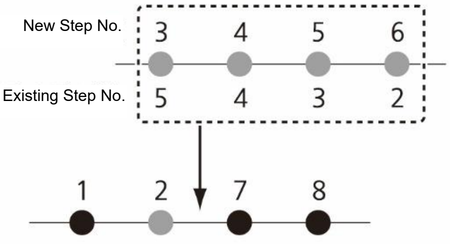
Note	• You cannot copy a protected program. • If the END function is recorded in the copied step, the function will be copied together. Delete the function when necessary. • If a function that makes it possible to jump (GOTO, GOSUB) to a step outside the copied range is

	recorded in the copied step, the function will be copied, but the number will not be changed automatically. Please change the number after copying.

4.3.7.1 Example of Step Copy

You can copy the steps 2–5 of the program 1 to step 2 of the program 2 (set as the input step) in the right and reverse directions.

The steps 2–5 of the original program (program 1) will be inserted right after the input step (step 2) of the target program (program 2) in the right direction (same order as the original program) or in the reverse direction (reverse order of the original program).

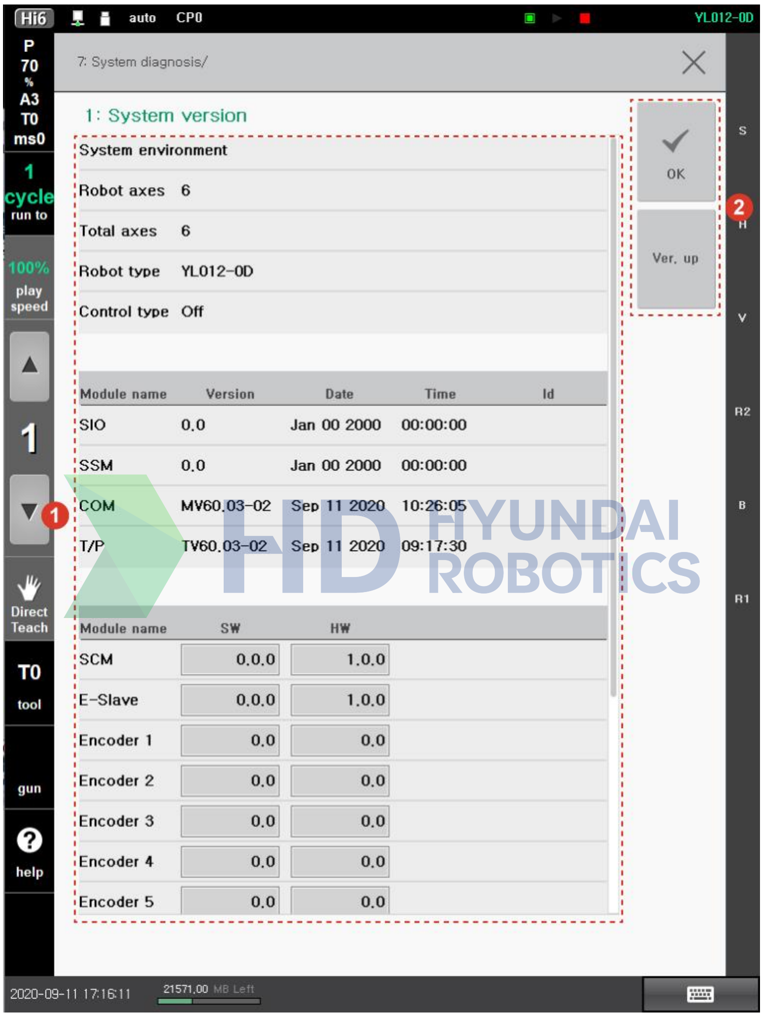
Method	Procedure	Detailed Process	
Right direction	Before copying	Source program (Program 1) ▼ ▼ Target program (Program 2)	 Start Step End Step 1 2 3 4 5 6 1 2 3 4 Input Step
	Result of copying	Program 2	
Reverse direction	Before copying	Source program (Program 1) ▼ ▼ Target program (Program 2	 Start Step End Step 1 2 3 4 5 6 1 2 3 4 5 6 1 2 3 4 Input Step
	Result of copying	Program 2	 New Step No. 3 4 5 6 Existing Step No. 5 4 3 2 1 2 7 8

4.4 System Diagnosis

You can inspect and manage the state of the robot and controller. You can check and update the version of each module of the controller.

4.4.1 System Version

1. Touch the **[7: System Diagnosis ❯ 1: System version]** menu. Then, the system environment setting window will appear.
2. Check and manage the system environment (software version) information of the robot and controller.


Hi6
auto
CP0
YL012-0D
P
70
%
A3
T0
ms0
1
cycle
run to
100%
play
speed
1
Direct
Teach
T0
tool
gun
help
7: System diagnosis/
OK
Ver. up
S
H
V
R2
B
R1
2020-09-11 17:16:11
21571.00 MB Left
①
②

1: System version

System environment

Robot axes	6
Total axes	6
Robot type	YL012-0D
Control type	Off

Module name	Version	Date	Time	Id
SIO	0.0	Jan 00 2000	00:00:00	
SSM	0.0	Jan 00 2000	00:00:00	
COM	MV60.03-02	Sep 11 2020	10:26:05	
T/P	TV60.03-02	Sep 11 2020	09:17:30	

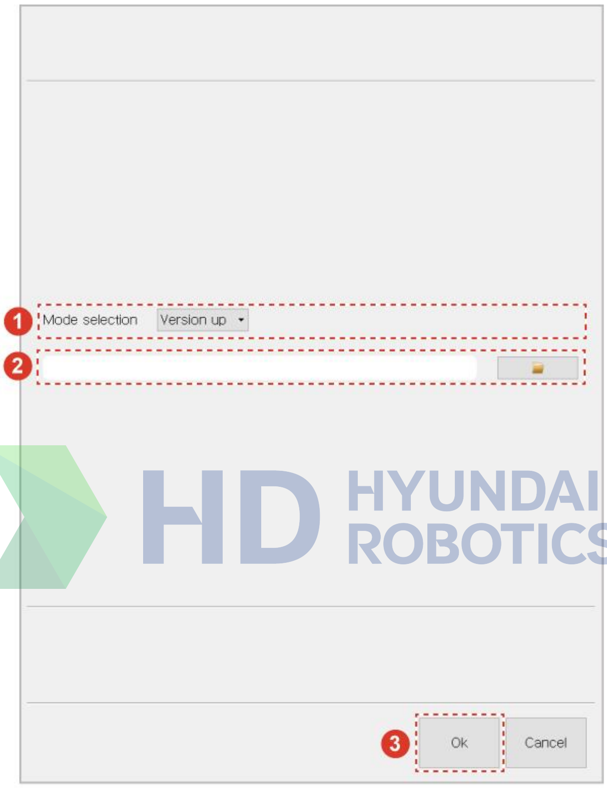
Module name	SW	HW
SCM	0.0.0	1.0.0
E-Slave	0.0.0	1.0.0
Encoder 1	0.0	0.0
Encoder 2	0.0	0.0
Encoder 3	0.0	0.0
Encoder 4	0.0	0.0
Encoder 5	0.0	0.0

No.	Description
①	System environment (software version) information of the robot and controller
②	Edit and manage the system environment using the function buttons. • **[OK]**: You can save the contents of the change. • **[Ver. Up]**: You can update the version of each module of the controller.

4.4.1.1 Controller System Updating

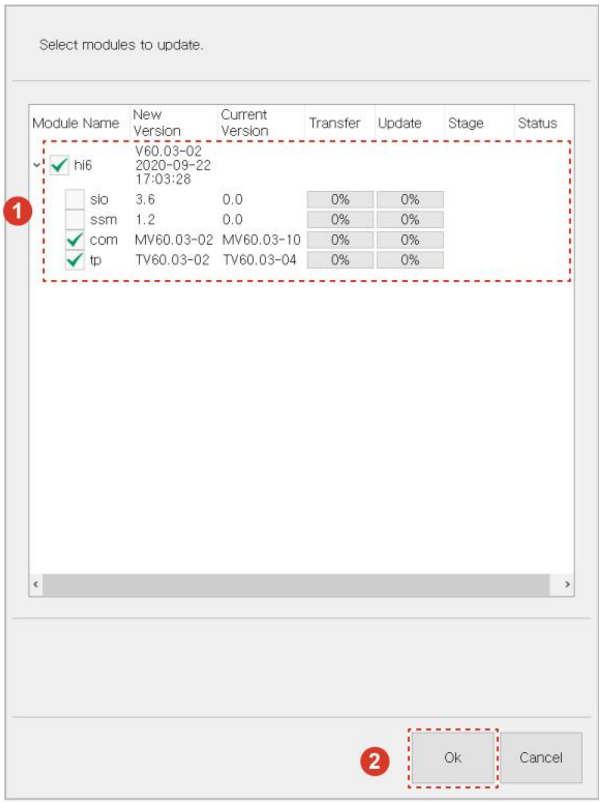
You can update the version of each module of the controller using the integrated compressed file.

1. Connect the removable storage device containing the integrated compressed file to the USB slot of the teach pendant. When the removable storage device is connected to the teach pendant, the **[USB]** icon () will appear in the status bar.
2. Touch the **[Ver. Up]** button on the right side of the system environment setting window. Then, the version upgrade program execution window will appear.
3. Select the **[Version Up]** mode by touching the drop-down menu, select the integrated compressed file using the **[Open]** button, and then touch the **[OK]** button.



Mode selection: Version up

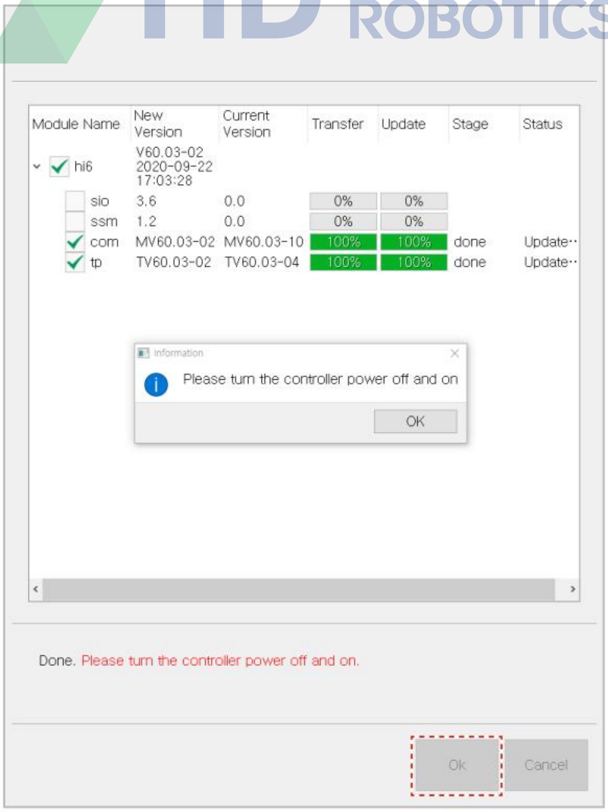
4. After selecting the module that you want to update, touch the **[OK]** button. Then, the update will start.



Select modules to update.

Module Name	New Version	Current Version	Transfer	Update	Stage	Status
☑ hi6	V60.03-02 2020-09-22 17:03:28					
☐ sio	3.6	0.0	0%	0%		
☐ ssm	1.2	0.0	0%	0%		
☑ com	MV60.03-02	MV60.03-10	0%	0%		
☑ tp	TV60.03-02	TV60.03-04	0%	0%		

5. When the update is completed, touch the **[OK]** button. Then, the version upgrade program execution window will be closed, and the controller will automatically restart.



Module Name	New Version	Current Version	Transfer	Update	Stage	Status
☑ hi6	V60.03-02 2020-09-22 17:03:28					
☐ sio	3.6	0.0	0%	0%		
☐ ssm	1.2	0.0	0%	0%		
☑ com	MV60.03-02	MV60.03-10	100%	100%	done	Update··
☑ tp	TV60.03-02	TV60.03-04	100%	100%	done	Update··

Information

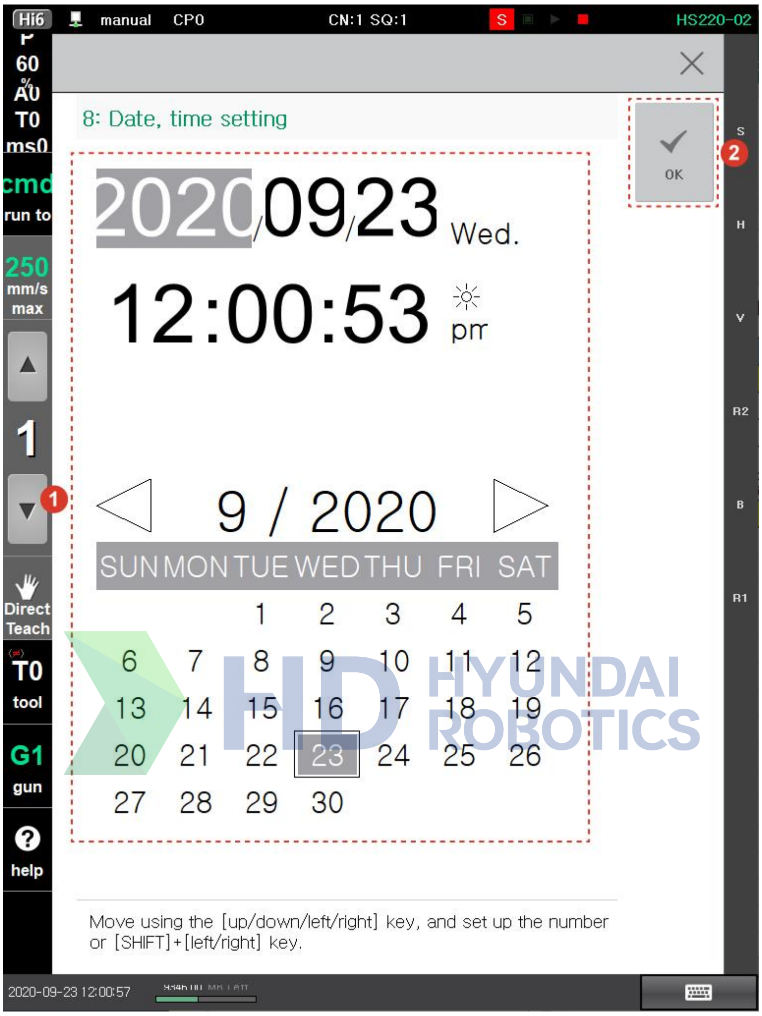
Please turn the controller power off and on

Done. Please turn the controller power off and on.

4.5 Setting of Date and Time

You can set the date and time of the controller.

1. Touch the **[8: Date, time setting]** menu. The date and time setting window will appear.
2. After setting the date and time information, touch the **[OK]** button.


Hi6
manual
CP0
CN:1 SQ:1
S
HS220-02
60
AU
T0
ms0
cmd
run to
250
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
OK
S
H
V
R2
B
R1
1
2
9 / 2020
SUN MON TUE WED THU FRI SAT
1 2 3 4 5
6 7 8 9 10 11 12
13 14 15 16 17 18 19
20 21 22 23 24 25 26
27 28 29 30
2020-09-23 12:00:57

8: Date, time setting

2020/09/23 Wed.

12:00:53 pm

Move using the [up/down/left/right] key, and set up the number or [SHIFT]+[left/right] key.

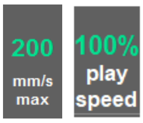
- You can perform setting by inputting the date and time by using the operation keys on the teach pendant.
  - If you press the arrow keys, the cursor will move between the date and time items (year/month/day/hour/minute/second/a.m./p.m.).
  - You can input a number by pressing the number keys. You can also adjust the value using the **<shift+ ↑ / ↓ >** keys.
- Set the date on the calendar. Touch the **[◁/▷]** button to select the year and month and then touch the date.

5. Condition Setting

You can simply change the operation conditions without modifying the program. The changed setting values will remain the same even if the controller is restarted.

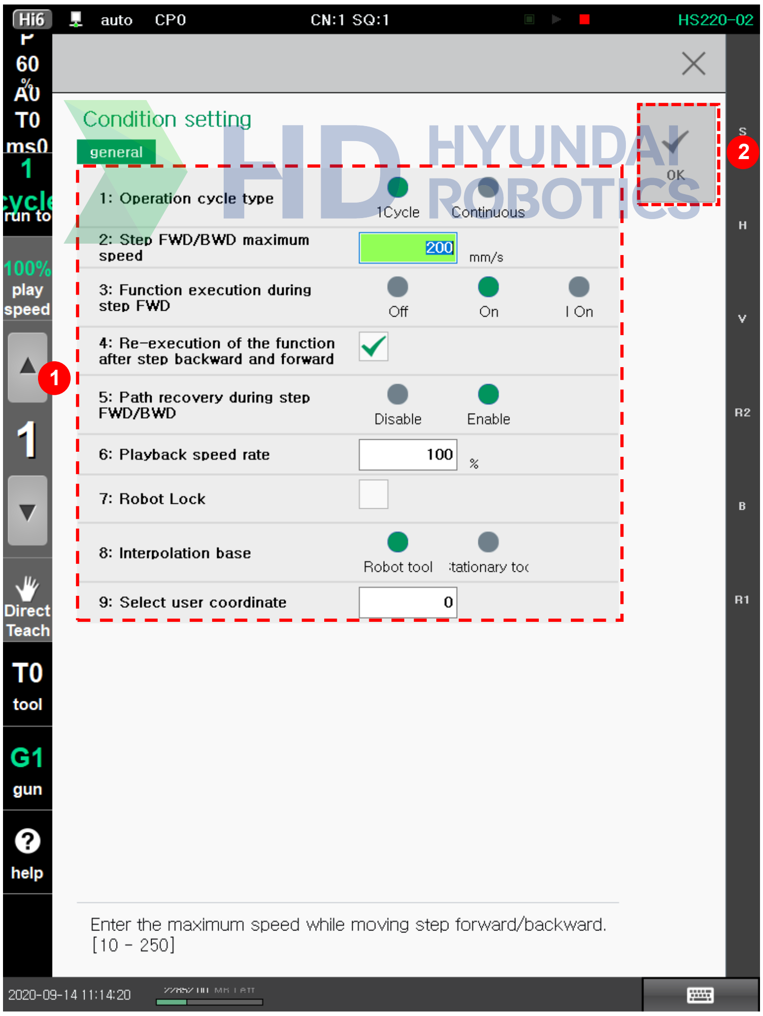
5.1 Operation Condition Setting

1. Touch the **[Speed Adjustment]** button on the upper left on the initial screen. Then, the operation conditions setting window will appear.


200
mm/s
max
100%
play
speed

Note On the **[Speed Adjustment]** button, the speed limit (mm/sec) will be displayed while in manual mode, and the playback speed (%) will be displayed in automatic mode.

2. Change the operation condition setting values by repeating the following procedure, and then touch the **[OK]** button.


Hi6
auto
CP0
CN:1 SQ:1
HS220-02
60
%
AU
T0
ms0
1
cycle
run to
100%
play
speed
1
Direct
Teach
T0
tool
G1
gun
help
OK
1
2
S
H
V
R2
B
R1
2020-09-14 11:14:20

Condition setting

general

1: Operation cycle type ● 1Cycle ○ Continuous

2: Step FWD/BWD maximum speed 200 mm/s

3: Function execution during step FWD ○ Off ● On ○ I On

4: Re-execution of the function after step backward and forward ☑

5: Path recovery during step FWD/BWD ○ Disable ● Enable

6: Playback speed rate 100 %

7: Robot Lock ☐

8: Interpolation base ● Robot tool ○ tationary toc

9: Select user coordinate 0

Enter the maximum speed while moving step forward/backward.
[10 - 250]

a. Turn the jog dial on the teach pendant. Then, the cursor will move.

b. Turn the jog dial to select the desired option, or press the numeric keys to input a number.

c. Press the 〈**enter**〉 key. Then, the contents of the change will be applied, causing the setting value to be changed, and then the cursor will move to the next item.

5.2 Information of Operation Conditions Setting

- **[1: Operation cycle type]**: You can set whether to repeat the program that will be executed during automatic operation. It can also be set while the robot is starting up, and the setting value will not be applied during manual operation.
    - **1 Cycle**: The job program will operate once and then stop. When the program END is reached, the robot will stop.
    - **Continuous**: The job program will operate continuously and repeatedly. If there is an external stop operation, the robot will stop.
- **[2: Step FWD/BWD maximum speed]**: You can set the speed limit for a step forward/backward. For details on this option, refer to "**2.1 Manual Operation.**"
- **[3: Function execution during Step FWD]**: You can set the execution option (mode) of the function recorded in the job program while in the step forward operation.
    - **Off**: Only END recorded in the job program will be executed. All other functions except for END will not be executed.
    - **On**: All functions recorded in the job program will be executed.
    - **1 On**: Only the input signal wait function and program END function will be executed.

Note	While in the step backward operation, only the input wait signal function will be executed, and all other functions will not be executed.

- **[4: Re-execution of the function after step backward and forward]**: You can perform setting in a way that the previously executed functions among the functions recorded in the job program can be executed again when in the step forward operation again after the step backward operation.
- **[5: Path recovery during step FWD/BWD]**: You can set the mode of executing path recovery when in the step forward/backward operation.
    - **Disable**: Will not execute path recovery
    - **Enable**: Will execute path recovery without confirming with the user whether to execute path recovery
- **[6: Playback speed rate]**: You can set the operation speed (%) of the robot for playback of a program in automatic mode. It does not refer to changing the speed recorded in the step of the job program, but it refers to changing the ratio, ranging from 1% to 100% of the robot's moving speed against the speed recorded in the step in batch.

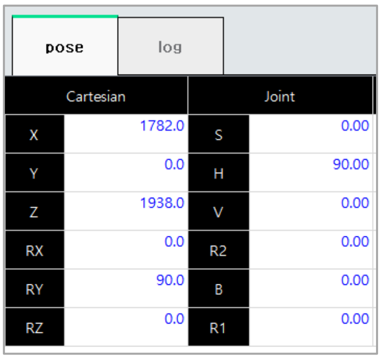
Note	If a low-speed command is inputted through an external input during automatic operation, the automatic operation speed ratio will not be applied, but the manual maximum speed (250 mm/s) will be applied.

- **[7: Robot Lock]**: You can set the job program in a way that automatic operation is possible, without moving the robot. You can check the status of I/O with the peripheral devices, the soft limit, the cycle time, etc.
- **[8: Interpolation base]**: You can set a tool that will be the reference during the manual jogging of the robot. In general, a robot tool is used as an interpolation reference.
    - **Robot Tool**: Interpolation operation will be executed based on the tool attached to the front end of the robot.

- **Stationary Tool**: Interpolation will be executed based on the front end of the tool fixed to, for example, to the floor. If a stationary tool is selected as the interpolation reference, the tool number on the left side of the initial screen will be marked with **ST0** (ST0).

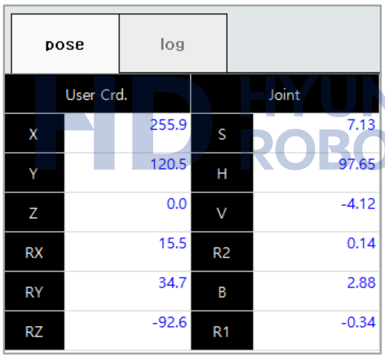
Note	If you select the stationary tool as the interpolation reference, you must set the stationary tool coordinate system. For details, refer to “**7.3.6.2 Stationary Tool Coordinate System.**”

- **[9: Select user Coordinate System Designation]**: You can set the user coordinate system number (0–10) for Cartesian operation during manual jog operation. Then, the robot will operate based on the Cartesian coordinate system in the directions of X, Y, and Z axes of the designated user coordinate system, and the coordinate values of the user coordinate system selected during the monitoring of the pose will be displayed as X, Y, and Z coordinate values of the front end of the tool.
    - If 0 is set, the robot coordinate system icon (R) will be displayed on the **[Coordinate System]** button on the right side of the screen. The operation based on the user coordinate system will be deactivated, and the operation and monitoring based on the Cartesian coordinates will be performed.



Cartesian		Joint	
X	1782.0	S	0.00
Y	0.0	H	90.00
Z	1938.0	V	0.00
RX	0.0	R2	0.00
RY	90.0	B	0.00
RZ	0.0	R1	0.00

- If a number between **1** and **10** is set, the user coordinate system icon (U) will be displayed on the **[Coordinate System]** button. The coordinate values that are changed by using the **⟨Axis Operation⟩** key will be based on the user coordinate system.



User Crd.		Joint	
X	255.9	S	7.13
Y	120.5	H	97.65
Z	0.0	V	-4.12
RX	15.5	R2	0.14
RY	34.7	B	2.88
RZ	-92.6	R1	-0.34

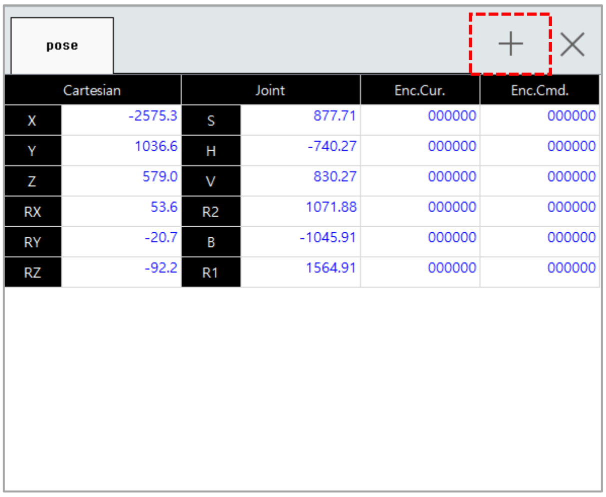
Note	You can register the user coordinate system number in the **[Set up 〉 2: Control Parameter 〉 7: Coordinate System Registration 〉1: User Coordinate System]**.

6. Monitoring

You can check the status of the robot system and various data of the controller.

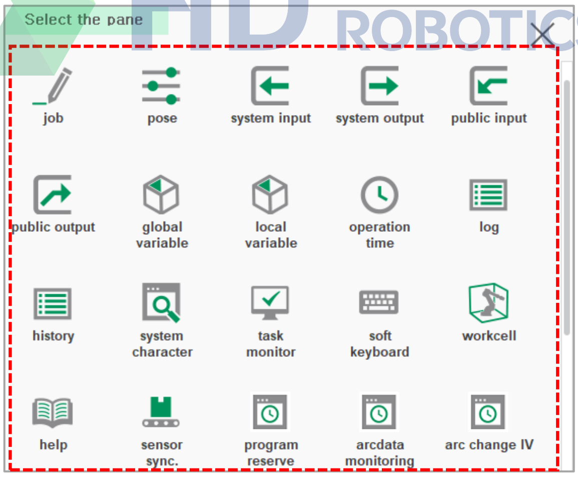
6.1 Use of the Monitoring Function

1. Touch the **[+]** button at the top right of the panel stack in the work area. The panel selection window will appear.



Cartesian		Joint		Enc.Cur.	Enc.Cmd.
X	-2575.3	S	877.71	000000	000000
Y	1036.6	H	-740.27	000000	000000
Z	579.0	V	830.27	000000	000000
RX	53.6	R2	1071.88	000000	000000
RY	-20.7	B	-1045.91	000000	000000
RZ	-92.2	R1	1564.91	000000	000000

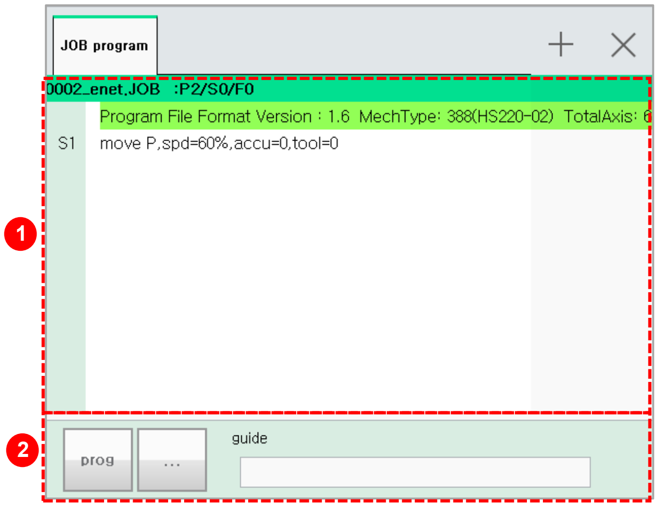
2. You can check the status of the robot system and various data of the controller by selecting the desired monitoring item in the panel selection window.


Select the pane
×
job
pose
system input
system output
public input
public output
global variable
local variable
operation time
log
history
system character
task monitor
soft keyboard
workcell
help
sensor sync.
program reserve
arcdata monitoring
arc change IV

Notes	
Notes	- All items that can be monitored will be displayed on the panel selection window. - The items that can be monitored will be displayed differently depending on the setting of the controller. - For details on how to use the panel stack and window of the work area, refer to "**1.2.4.5 Work area.**"

6.2 JOB

Touch **[JOB]** in the panel selection window. Then, the JOB program window will appear. You can check a program, and then edit or delete it or create one.



```
0002_enet.JOB   :P2/S0/F0
      Program File Format Version : 1.6  MechType: 388(HS220-02)  TotalAxis:
S1    move P,spd=60%,accu=0,tool=0
```

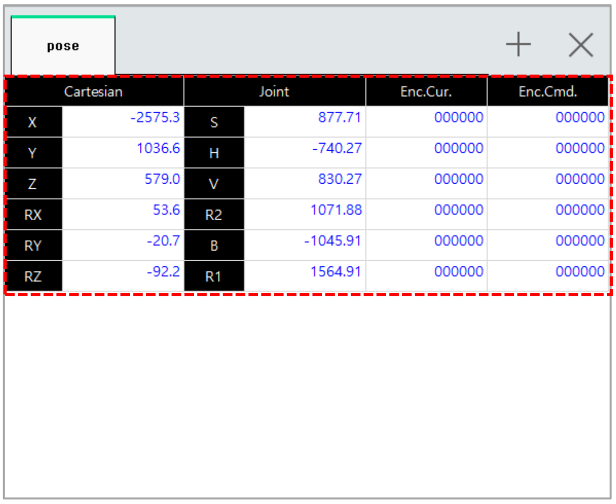
Figure 33 JOB Program

No.	Description
❶	Displays the basic information and statement of a program. You can check and edit the details of the statement.
❷	• **[Program]**: You can select or delete a program from the created program list. **[…]**: If the automatic indentation is applied incorrectly, the automatic indentation in the JOB program can be performed again. • When a program is written, the parameter value of the selected statement will be displayed in the input area.

Note	For details on how to manage and write programs, refer to "**3 Program Writing.**"

6.3 Pose

Touch **[Pose]** in the panel selection window. Then, the robot pose information window will appear. You can check the current angle of each axis of the robot, the coordinate value of the tool center point (TCP), and the current value and command value of the encoder.



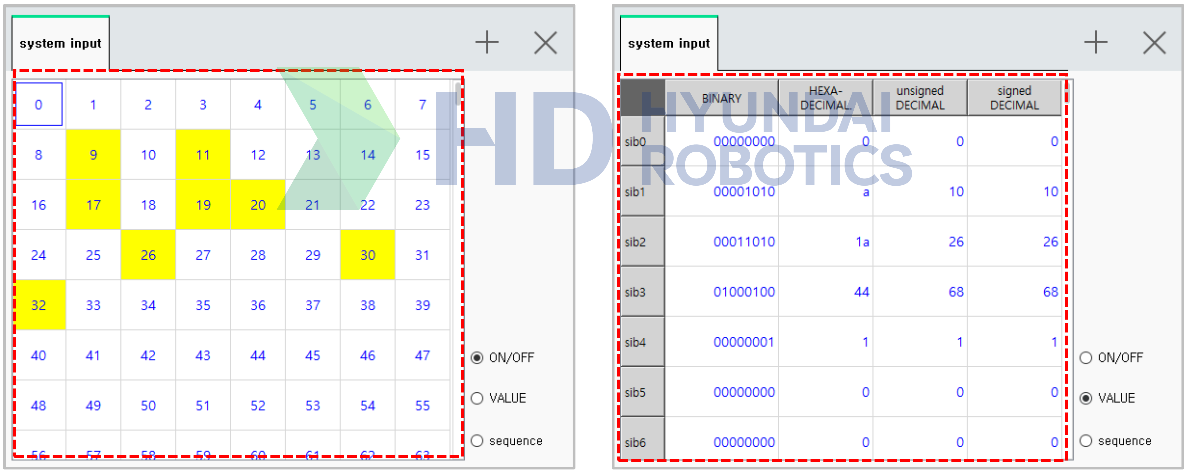
Cartesian		Joint		Enc.Cur.	Enc.Cmd.
X	-2575.3	S	877.71	000000	000000
Y	1036.6	H	-740.27	000000	000000
Z	579.0	V	830.27	000000	000000
RX	53.6	R2	1071.88	000000	000000
RY	-20.7	B	-1045.91	000000	000000
RZ	-92.2	R1	1564.91	000000	000000

Figure 34 Pose

6.4 System Input

In the panel selection window, touch **[System Input]**. Then, the input signal window will appear.

You can check the status of signals related to the robot operation and the status of the input signals preassigned to detect any abnormality that occurs to the robot and the controller.



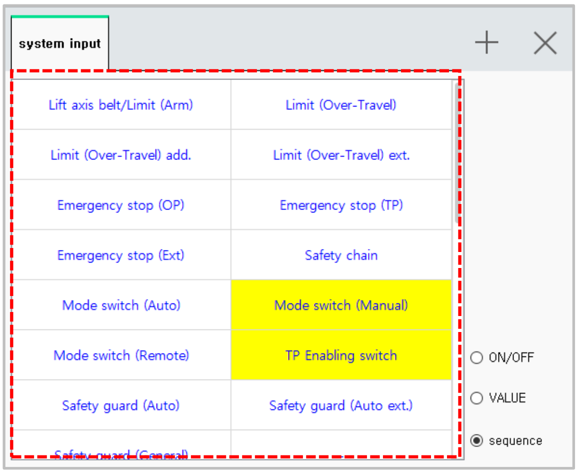
0	1	2	3	4	5	6	7
8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23
24	25	26	27	28	29	30	31
32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47
48	49	50	51	52	53	54	55
56	57	58	59	60	61	62	63

● ON/OFF
○ VALUE
○ sequence

	BINARY	HEXA-DECIMAL	unsigned DECIMAL	signed DECIMAL
sib0	00000000	0	0	0
sib1	00001010	a	10	10
sib2	00011010	1a	26	26
sib3	01000100	44	68	68
sib4	00000001	1	1	1
sib5	00000000	0	0	0
sib6	00000000	0	0	0

○ ON/OFF
● VALUE
○ sequence

Figure 35 System Input - ON/OFF Status (Left) / Value Status (Right)



Lift axis belt/Limit (Arm)	Limit (Over-Travel)
Limit (Over-Travel) add.	Limit (Over-Travel) ext.
Emergency stop (OP)	Emergency stop (TP)
Emergency stop (Ext)	Safety chain
Mode switch (Auto)	Mode switch (Manual)
Mode switch (Remote)	TP Enabling switch
Safety guard (Auto)	Safety guard (Auto ext.)
Safety guard (General)	

○ ON/OFF
○ VALUE
● sequence

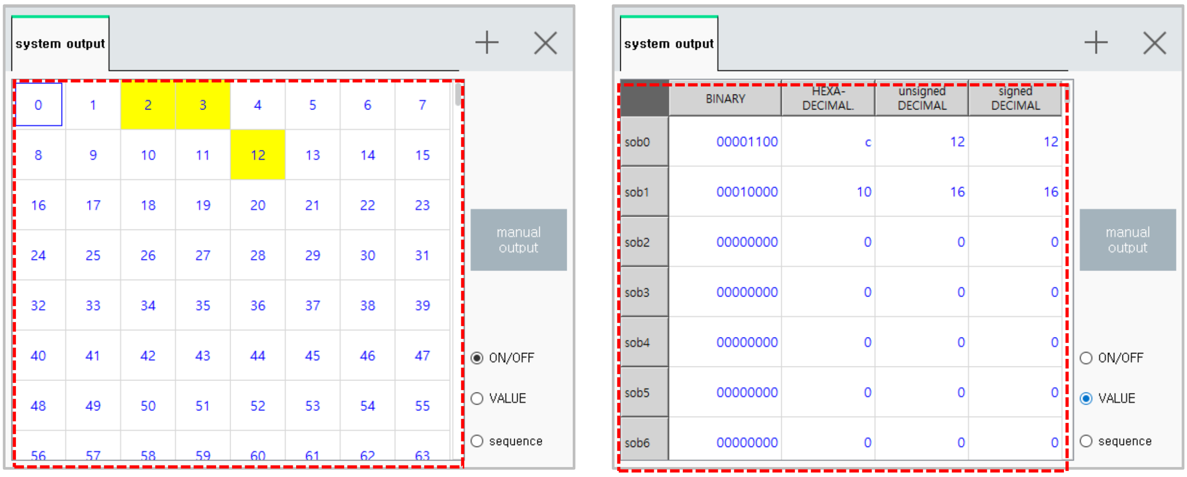
Figure 36 System Input – Sequence Status

- In the ON/OFF status and sequence status, the signals currently being inputted will be displayed in yellow.
- In the sequence status, only the status of the controller sequence signals will be displayed.
- **[ON/OFF]/[Value]/[Sequence]**: You can change the display mode of the input signal window by touching the radio button.

6.5 System Output

Touch **[System Output]** in the panel selection window. Then, the output signal window will appear.

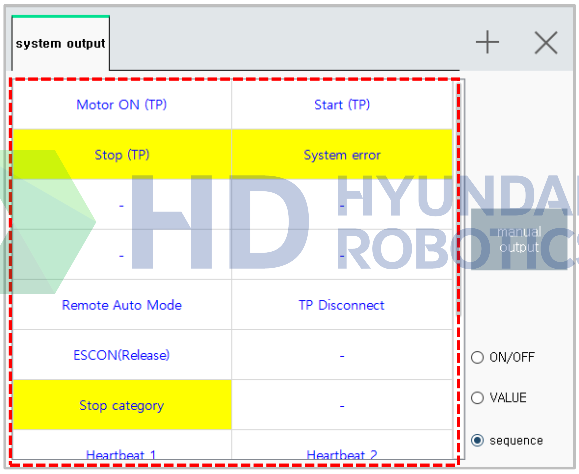
You can check the signals related to the robot operation and check the status of brake control.


system output
+
×
manual output
● ON/OFF
○ VALUE
○ sequence
system output
+
×
manual output
○ ON/OFF
● VALUE
○ sequence

0	1	2	3	4	5	6	7
8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23
24	25	26	27	28	29	30	31
32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47
48	49	50	51	52	53	54	55
56	57	58	59	60	61	62	63

	BINARY	HEXA-DECIMAL	unsigned DECIMAL	signed DECIMAL
sob0	00001100	c	12	12
sob1	00010000	10	16	16
sob2	00000000	0	0	0
sob3	00000000	0	0	0
sob4	00000000	0	0	0
sob5	00000000	0	0	0
sob6	00000000	0	0	0

Figure 37 System Output - ON/OFF Status (Left) / Value Status (Right)


system output
+
×
manual output
○ ON/OFF
○ VALUE
● sequence

Motor ON (TP)	Start (TP)
Stop (TP)	System error
-	-
-	-
Remote Auto Mode	TP Disconnect
ESCON(Release)	-
Stop category	-
Heartbeat 1	Heartbeat 2

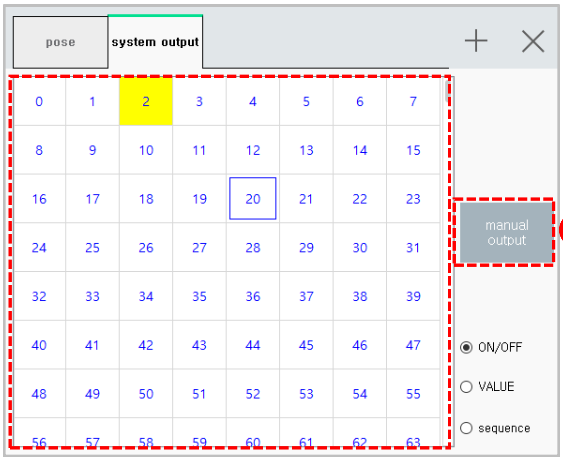
Figure 38 System Output – Sequence Status

- In the ON/OFF status and sequence status, the signals currently being outputted will be displayed in yellow.
- In the sequence status, only the status of the controller sequence signals will be displayed.
- **[ON/OFF]/[Value]/[Sequence]**: You can change the display mode of the output signal window by touching the radio button.
- **[Manual output]**: You can force the output of the selected signals while in the ON/OFF and sequence status.

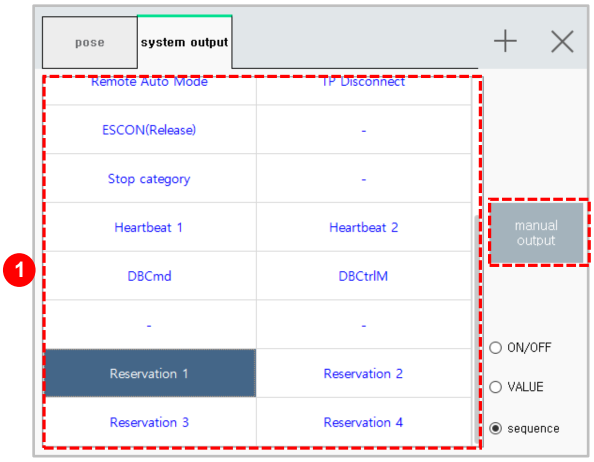
Manual Output

You can select the desired signal and force it to be outputted.

1. You can set the display mode to the ON/OFF status or sequence status by touching the **[ON/OFF]** or **[Sequence]** radio button on the right side of the system output signal window.
2. Touch a signal to select it in the signal window, and then touch the **[Manual Output]** button.

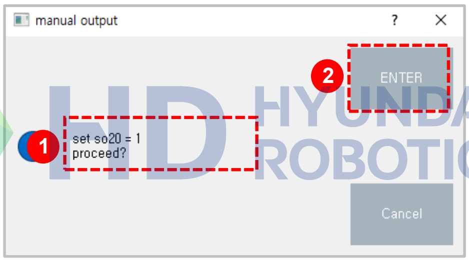

pose
system output
manual output
● ON/OFF
○ VALUE
○ sequence
1
2

0	1	2	3	4	5	6	7
8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23
24	25	26	27	28	29	30	31
32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47
48	49	50	51	52	53	54	55
56	57	58	59	60	61	62	63


pose
system output
manual output
○ ON/OFF
○ VALUE
● sequence
1
2

Remote Auto Mode	TP Disconnect
ESCON(Release)	-
Stop category	-
Heartbeat 1	Heartbeat 2
DBCmd	DBCtrlM
-	-
Reservation 1	Reservation 2
Reservation 3	Reservation 4

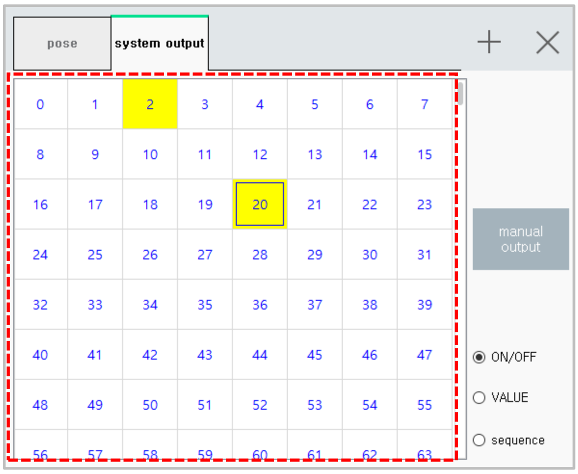
3. After checking the output conditions in the manual output confirmation window, touch the **[ENTER]** button.


manual output
?
ENTER
Cancel
1
2

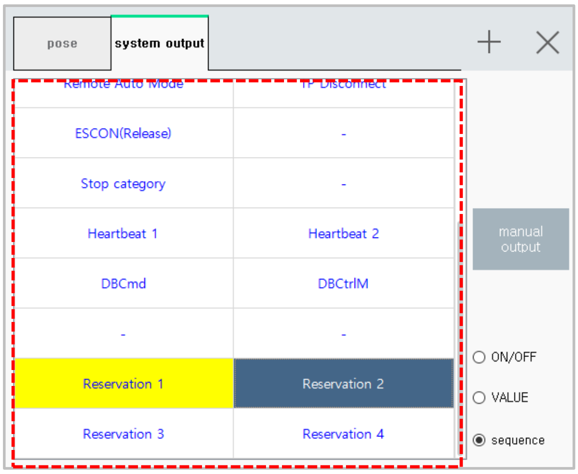
set so20 = 1
proceed?

soN	=1/0
N: Number of the signal to be outputted	Output status (1: Output, 0: No output)

4. Check the output status of the selected signal. The selected signal will be switched to the output status and displayed in yellow in the signal window.


pose
system output
manual output
● ON/OFF
○ VALUE
○ sequence

0	1	2	3	4	5	6	7
8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23
24	25	26	27	28	29	30	31
32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47
48	49	50	51	52	53	54	55
56	57	58	59	60	61	62	63

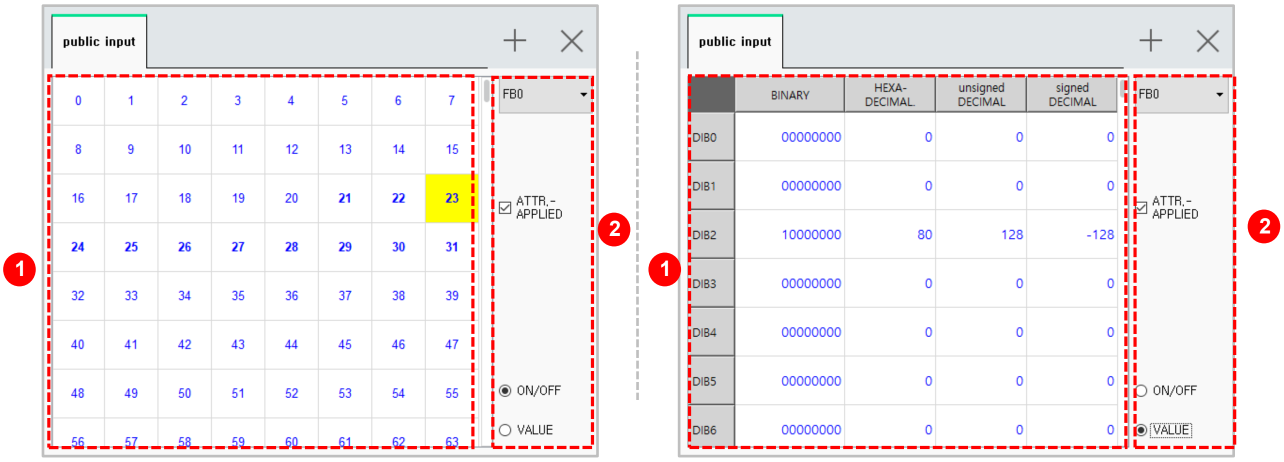

pose
system output
manual output
○ ON/OFF
○ VALUE
● sequence

Remote Auto Mode	TP Disconnect
ESCON(Release)	-
Stop category	-
Heartbeat 1	Heartbeat 2
DBCmd	DBCtrlM
-	-
Reservation 1	Reservation 2
Reservation 3	Reservation 4

6.6 Public Input

Touch **[public Input]** in the panel selection window. Then, the public input signal window will appear.

You can check the status of public input signals that are inputted through the CNIN connector of the I/O board in the controller.


public input
+
×
①
②
FB0
☑ ATTR.-APPLIED
● ON/OFF
○ VALUE
public input
①
②
FB0
☑ ATTR.-APPLIED
○ ON/OFF
● VALUE

0	1	2	3	4	5	6	7
8	9	10	11	12	13	14	15
16	17	18	19	20	**21**	**22**	**23**
24	**25**	**26**	**27**	**28**	**29**	**30**	**31**
32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47
48	49	50	51	52	53	54	55
56	57	58	59	60	61	62	63

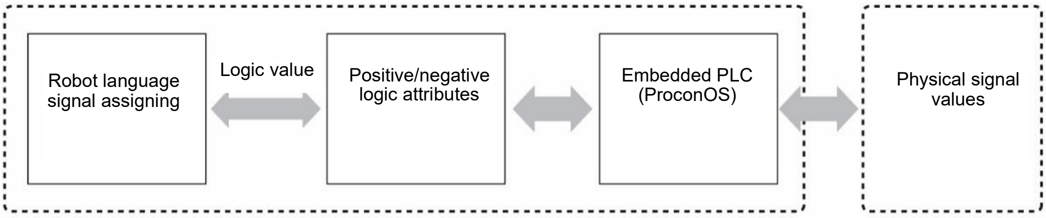
	BINARY	HEXA-DECIMAL.	unsigned DECIMAL	signed DECIMAL
DIB0	00000000	0	0	0
DIB1	00000000	0	0	0
DIB2	10000000	80	128	-128
DIB3	00000000	0	0	0
DIB4	00000000	0	0	0
DIB5	00000000	0	0	0
DIB6	00000000	0	0	0

Figure 39 Public Input Signal – ON/OFF Status (Left) / Value Status (Right)

No.	Description
①	Displays the status of general input signals • General input signals designated as the system's basic specifications or assigned by the user will be displayed **in bold**. • The signals currently being inputted will be displayed in yellow.
②	• **[FB0]**: You can select the FB block to monitor by touching the drop-down menu (FB0 - FB15). You can configure up to 16 I/O blocks, and 960 points of signals can be monitored in one block. • **[ATTR.-APPLIED]**: You can check the checkbox to perform the setting in a way that the physical input values are to be displayed before passing through the positive/negative logic attributes. The basic setting (unchecked) is that the input logic value after passing through the positive/negative logic attributes will be displayed. • **[ON/OFF]/[Value]**: You can change the signal display mode by touching the radio button.

Notes

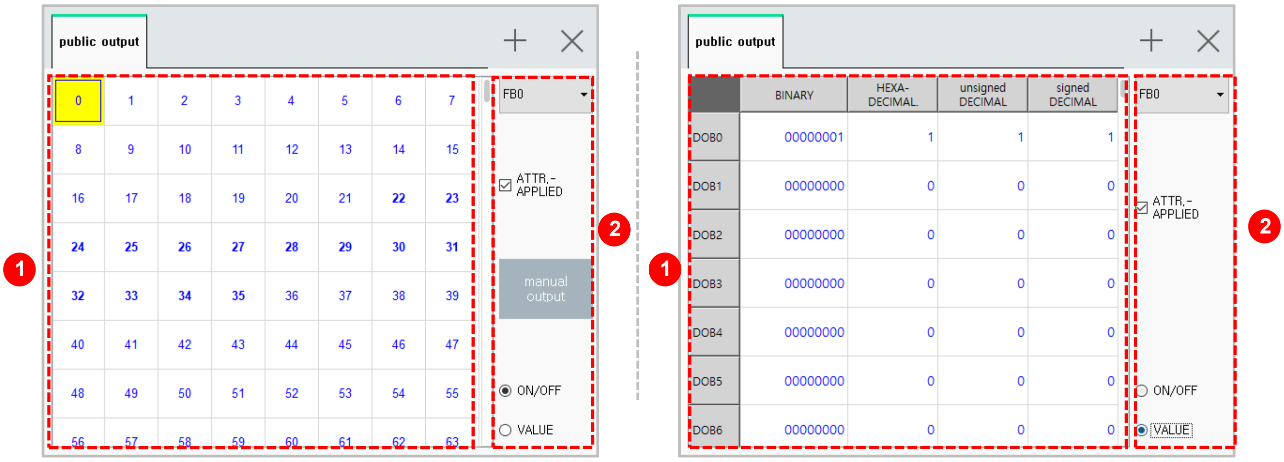
- In the case of using signals, such as fieldbus signals, by mapping them using an embedded PLC, the On/Off status of the input signals may appear differently.
- The flow of the input signals is as follows.


Robot language signal assigning
Logic value
Positive/negative logic attributes
Embedded PLC (ProconOS)
Physical signal values

6.7 Public Output

Touch **[public Output]** in the panel selection window. Then, the public output signal window will appear.

You can check the status of public output signals that are outputted through the CNOUT connector of the I/O board in the controller.


public output
①
②
FB0
☑ ATTR.-APPLIED
manual output
● ON/OFF
○ VALUE
○ ON/OFF
● VALUE

0	1	2	3	4	5	6	7
8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23
24	25	26	27	28	29	30	31
32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47
48	49	50	51	52	53	54	55
56	57	58	59	60	61	62	63

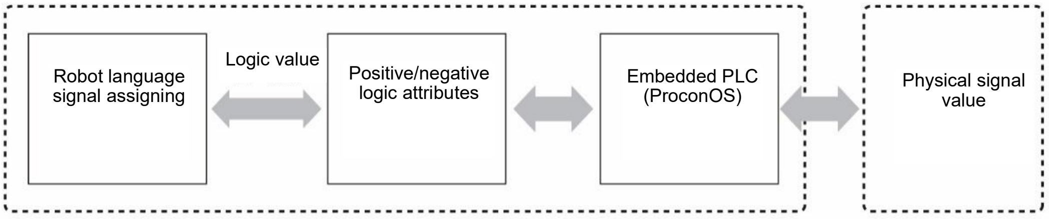
	BINARY	HEXA-DECIMAL	unsigned DECIMAL	signed DECIMAL
DOB0	00000001	1	1	1
DOB1	00000000	0	0	0
DOB2	00000000	0	0	0
DOB3	00000000	0	0	0
DOB4	00000000	0	0	0
DOB5	00000000	0	0	0
DOB6	00000000	0	0	0

Figure 40 Public Output Signal – ON/OFF Status (Left) / Value Status (Right)

No.	Description
①	Displays the status of general output signals • General output signals designated as the system's basic specifications or assigned by the user will be displayed **in bold**. • The signals currently being outputted will be displayed in yellow.
②	• **[FB0]**: You can select the FB block to monitor by touching the drop-down menu (FB0 - FB15). You can configure up to 16 I/O blocks, and 960 points of signals can be monitored using one block. • **[Manual Output]**: You can force the selected signal to be outputted. • **[ATTR.-APPLIED]**: You can check the checkbox to perform the setting in a way that the physical input values are to be displayed before passing through the positive/negative logic attributes. The basic setting (unchecked) is that the input logic value after passing through the positive/negative logic attributes will be displayed. • **[ON/OFF]/[Value]**: You can change the signal display mode by touching the radio button.

Notes

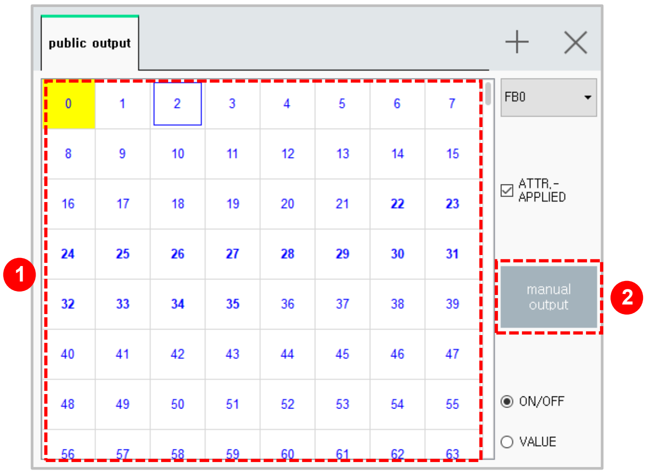
- In the case of using signals, such as fieldbus signals, by mapping them using an embedded PLC, the On/Off status of the output signals may appear differently.
- The flow of the output signals is as follows.


Robot language signal assigning
Logic value
Positive/negative logic attributes
Embedded PLC (ProconOS)
Physical signal value

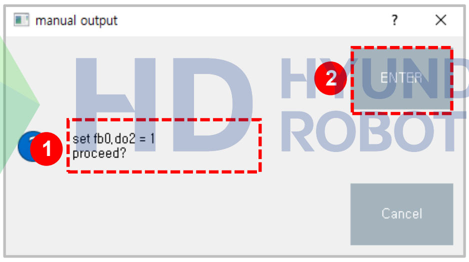
Manual Output

You can select the desired signal and force it to be outputted.

1. You can set the display mode to the ON/OFF status by touching the **[ON/OFF]** radio button on the right side of the general output signal window.
2. Touch a signal to select it in the signal window, and then touch the **[Manual Output]** button.


public output
+
×
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
FB0
☑ ATTR.-APPLIED
manual output
◉ ON/OFF
○ VALUE
1
2

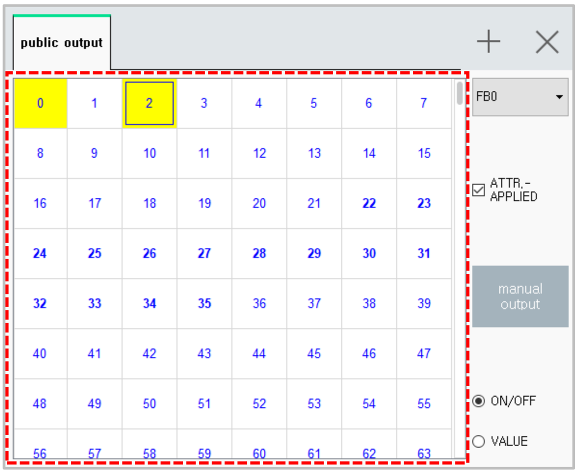
3. After checking the output conditions in the manual output confirmation window, touch the **[ENTER]** button.


manual output
?
×
ENTER
Cancel
1
2

set fb0.do2 = 1
proceed?

FbN	doN	=1/0
N: Number of the FB block to monitor	N: Number of the signal to output	Output status (**1**: Output, **0**: No output)

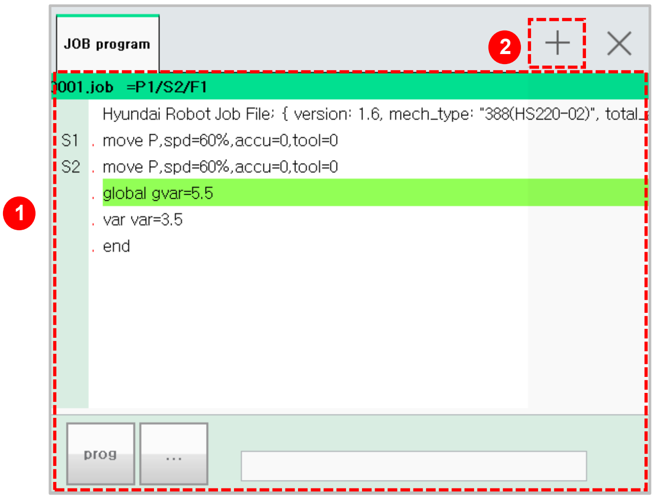
4. Check the output status of the selected signal. The selected signal will be switched to the output status and displayed in yellow in the signal window.


public output
+
×
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
FB0
☑ ATTR.-APPLIED
manual output
◉ ON/OFF
○ VALUE

6.8 Global Variables

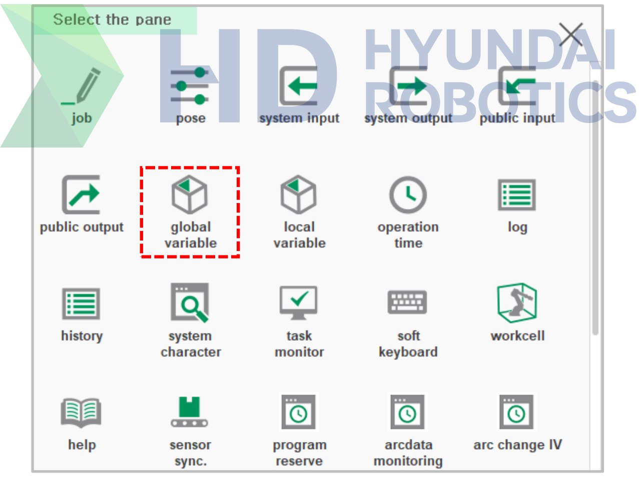
You can check the global variables defined as global in the JOB program. You can also select and change a variable value.

1. Execute the program that includes the global variables defined as global, and then touch the **[+]** button at the top right of the panel stack in the work area.

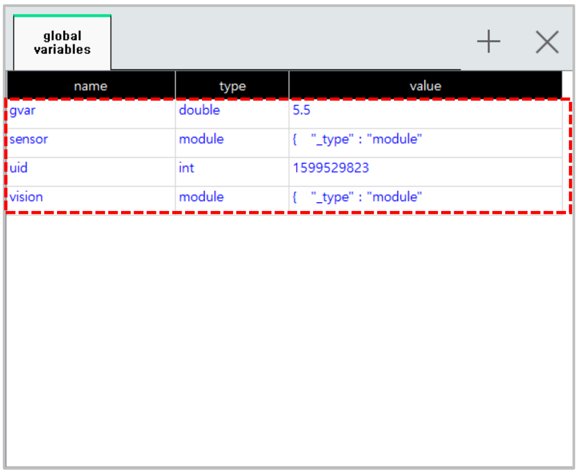

JOB program
②
①
prog
…

```
001.job  =P1/S2/F1
     Hyundai Robot Job File; { version: 1.6, mech_type: "388(HS220-02)", total_
S1 . move P,spd=60%,accu=0,tool=0
S2 . move P,spd=60%,accu=0,tool=0
   . global gvar=5.5
   . var var=3.5
   . end
```

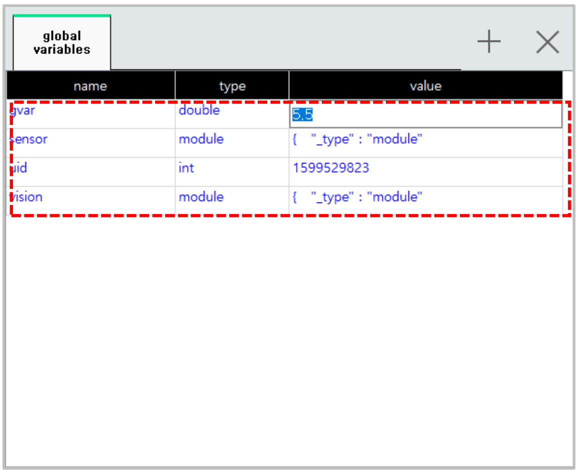
2. In the panel selection window, touch **[Global Variable]**. Then, a list of global variables included in the program will appear in a new window.


Select the pane
job
pose
system input
system output
public input
public output
global variable
local variable
operation time
log
history
system character
task monitor
soft keyboard
workcell
help
sensor sync.
program reserve
arcdata monitoring
arc change IV

3. You can check the name, type, and value of a variable. You can also select and change the value of a variable.


global variables

name	type	value
gvar	double	5.5
sensor	module	{ "_type" : "module"
uid	int	1599529823
vision	module	{ "_type" : "module"

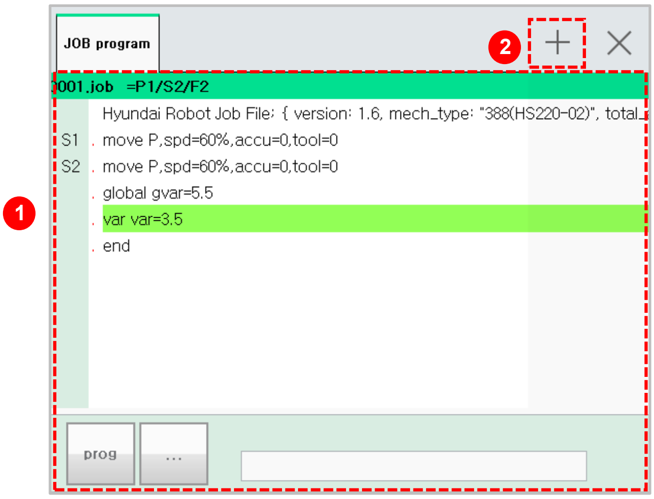

global variables

name	type	value
gvar	double	5.5
ensor	module	{ "_type" : "module"
id	int	1599529823
ision	module	{ "_type" : "module"

6.9 Local Variables

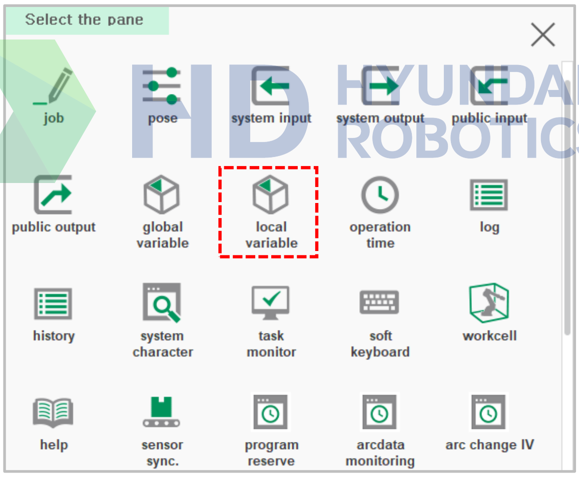
You can check the local variables defined as var in the JOB program. You can also select and change a variable value.

1. Execute the program that includes the local variables defined as var, and then touch the **[+]** button at the top right of the panel stack in the work area.

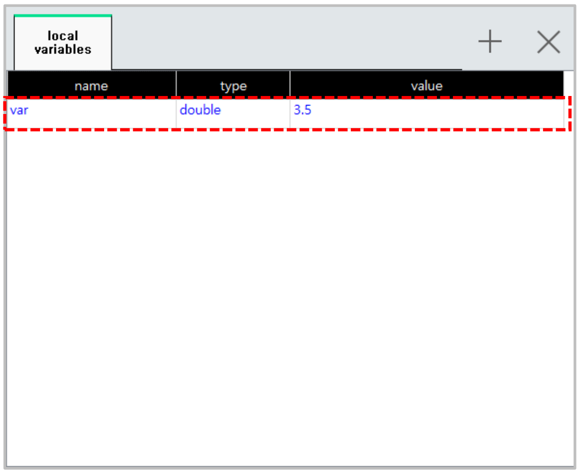

JOB program
①
②
+
prog
…

```
)001.job  =P1/S2/F2
     Hyundai Robot Job File: { version: 1.6, mech_type: "388(HS220-02)", total_
S1 . move P,spd=60%,accu=0,tool=0
S2 . move P,spd=60%,accu=0,tool=0
   . global gvar=5.5
   . var var=3.5
   . end
```

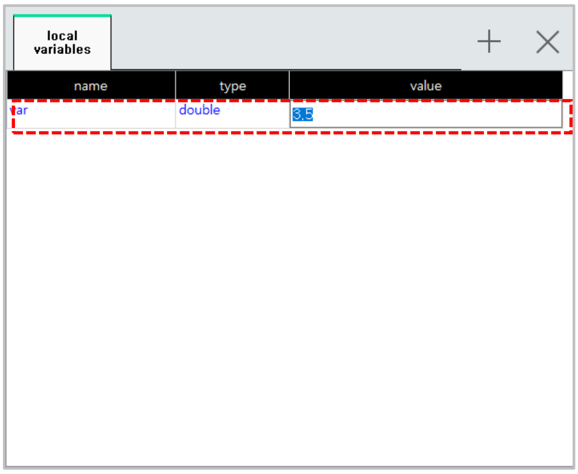
2. In the panel selection window, touch **[Local Variable]**. Then, a list of local variables included in the program will appear in a new window.


Select the pane
job
pose
system input
system output
public input
public output
global variable
local variable
operation time
log
history
system character
task monitor
soft keyboard
workcell
help
sensor sync.
program reserve
arcdata monitoring
arc change IV

3. You can check the name, type, and value of a variable. You can also select and change the value of a variable.


local variables
+

name	type	value
var	double	3.5

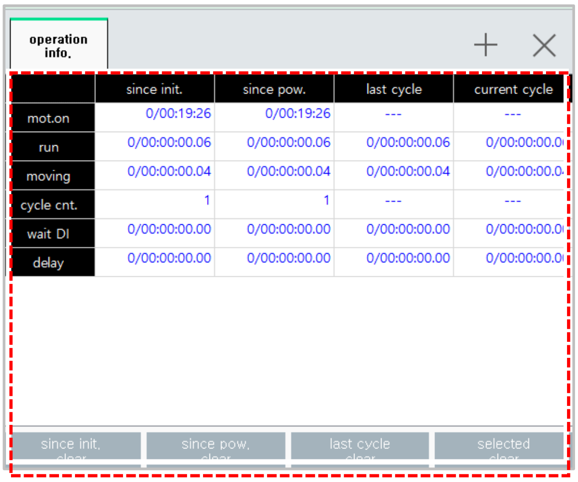

local variables
+

name	type	value
var	double	3.5

6.10 Operation time

In the panel selection window, touch **[Operation time]**. Then, the controller's operation information window will appear.

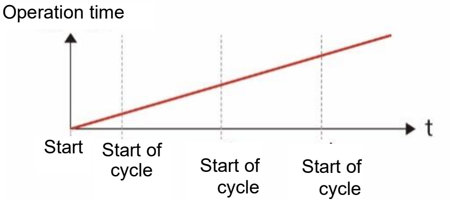
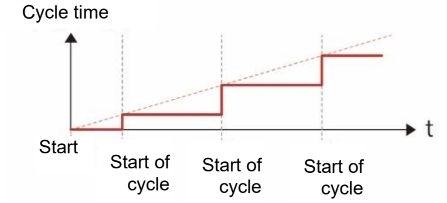
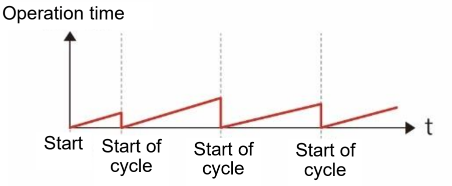
You can check the accumulated time and number of cycles for each operation of the controller created immediately after system initialization, power input, and the start of the recent cycle. You can initialize the operation information by touching the **[Clear]** button for each item at the bottom of the information.

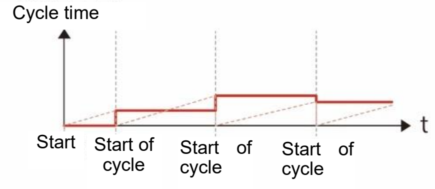


	since init.	since pow.	last cycle	current cycle
mot.on	0/00:19:26	0/00:19:26	---	---
run	0/00:00:00.06	0/00:00:00.06	0/00:00:00.06	0/00:00:00.0
moving	0/00:00:00.04	0/00:00:00.04	0/00:00:00.04	0/00:00:00.0
cycle cnt.	1	1	---	---
wait DI	0/00:00:00.00	0/00:00:00.00	0/00:00:00.00	0/00:00:00.0
delay	0/00:00:00.00	0/00:00:00.00	0/00:00:00.00	0/00:00:00.0

Figure 41 Operation information

The following shows the timing of reflection in accordance with the conditions of individual items.

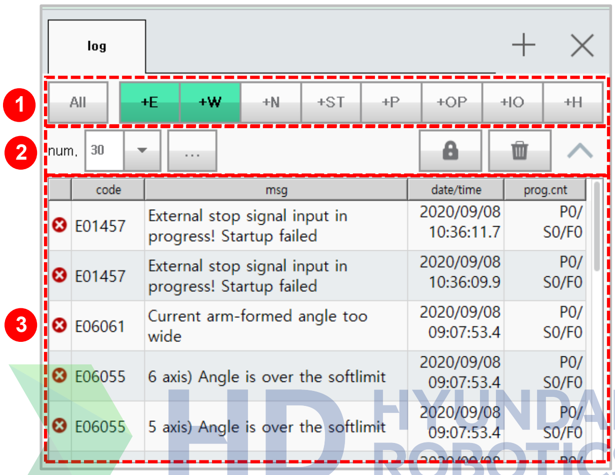
Item	Conditions	Timing of reflection
After system initialization	Time to measure	The duration of the operation time of the controller, between after the system was initialized and the present time
	Motor On time	The duration of the time of motor in between after the system was initialized and the present time
After power input	Time to measure	The duration of the operation time of the controller, between after the power was inputted and the present time 
	Recorded time of the cycle	The duration of the operation time of the controller, between after the power was inputted and the last cycle 
After the start of the latest cycle	Time to measure	The duration of the operation time of the controller, between after the cycle started (or power was inputted) and the present time 

Item	Conditions	Timing of reflection
	Recorded time of the cycle	The duration of the operation time of the controller, between after the cycle started (or power was inputted) and the last cycle 

6.11 Log

Touch **[Log]** in the panel selection window. Then, the log window will appear.

You can check the logs of errors, warnings, notification, operations, operations by the user, I/O, and executions.



code	msg	date/time	prog.cnt
E01457	External stop signal input in progress! Startup failed	2020/09/08 10:36:11.7	P0/ S0/F0
E01457	External stop signal input in progress! Startup failed	2020/09/08 10:36:09.9	P0/ S0/F0
E06061	Current arm-formed angle too wide	2020/09/08 09:07:53.4	P0/ S0/F0
E06055	6 axis) Angle is over the softlimit	2020/09/08 09:07:53.4	P0/ S0/F0
E06055	5 axis) Angle is over the softlimit	2020/09/08 09:07:53.4	P0/ S0/F0

Figure 42 Log

No.	Description
①	You can set the type of log to be displayed in the list. If you touch the button of the desired type, only the logs that match the type will appear in the list. • **[All]**: You can check all types of logs. • **[+E]/[+W]**: You can check the logs of errors or warnings. When a trouble occurs in the robot system, you can check and record the contents of the trouble, the time of trouble occurrence, as well as the program number, step number, axis data, and input/output status at the time of the trouble occurrence, and then manage the log of troubles. This makes it possible to analyze the cause of trouble or refer to the log of troubles that occurred prior to system recovery. • **[+N]**: You can check the log of notifications. • **[+ST]**: You can check the log of robot operations. When signals related to operation such as startup, stop, and mode change of the robot are inputted, the contents and time, as well as the program number, step number, axis data, and input/output status at the time of input, will be recorded. When the robot is repaired, you can refer to the log of the robot operation. • **[+P]**: You can check the log of the status that will be periodically recorded. • **[+OP]**: You can check the log of operation. • **[+IO]**: You can check the log of the variation of the input and output signals. • **[+H]**: You can check the log of the execution of the JOB program.

No.	Description

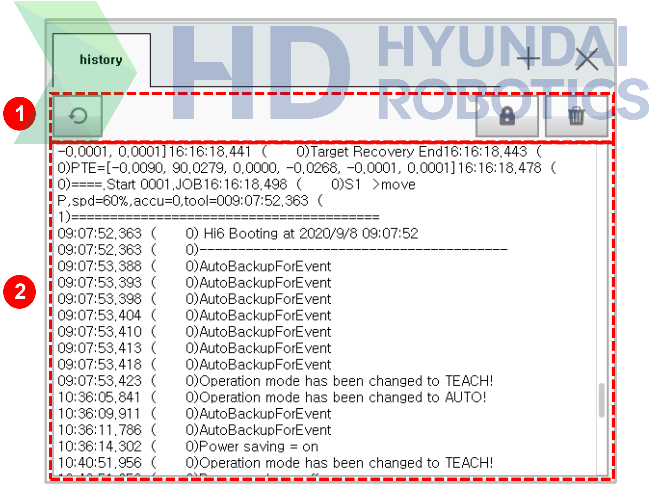
❷	• **[num.]**: You can adjust the number of logs (30, 100, 200, 500, or 1000) to be displayed in the list by touching the drop-down menu. If you select the number of logs, the latest logs as many as that number will be recalled and displayed on the screen.
	• [···]: You can open the pop-up menu.
	  • Save as log file: You can save the latest logs of the memory buffer as a file.
	  • Clear log file: You can clear the logs in memory buffer and delete all the log files. (Deleted files cannot be restored.)
	• [🔒]: You can turn off the notification for a new log. The log will not be updated, and the current status will be maintained until the lock icon is turned off.
	• [🗑]: You can delete the log displayed on the screen.

❸	A list of the logs of selected types. You can check the detailed information of the logs for individual types.

6.12 History

In the panel selection window, touch **[History]**. The history window will appear.

You can check the history as the execution history and time stamps of the job program will be outputted.



```
-0,0001, 0,0001]16:16:18,441 (      0)Target Recovery End16:16:18,443 (
0)PTE=[-0,0090, 90,0279, 0,0000, -0,0268, -0,0001, 0,0001]16:16:18,478 (
0)====,Start 0001,JOB16:16:18,498 (      0)S1  >move
P,spd=60%,accu=0,tool=009:07:52,363 (
1)========================================
09:07:52,363 (      0) Hi6 Booting at 2020/9/8 09:07:52
09:07:52,363 (      0)-----------------------------------------
09:07:53,388 (      0)AutoBackupForEvent
09:07:53,393 (      0)AutoBackupForEvent
09:07:53,398 (      0)AutoBackupForEvent
09:07:53,404 (      0)AutoBackupForEvent
09:07:53,410 (      0)AutoBackupForEvent
09:07:53,413 (      0)AutoBackupForEvent
09:07:53,418 (      0)AutoBackupForEvent
09:07:53,423 (      0)Operation mode has been changed to TEACH!
10:36:05,841 (      0)Operation mode has been changed to AUTO!
10:36:09,911 (      0)AutoBackupForEvent
10:36:11,786 (      0)AutoBackupForEvent
10:36:14,302 (      0)Power saving = on
10:40:51,956 (      0)Operation mode has been changed to TEACH!
```

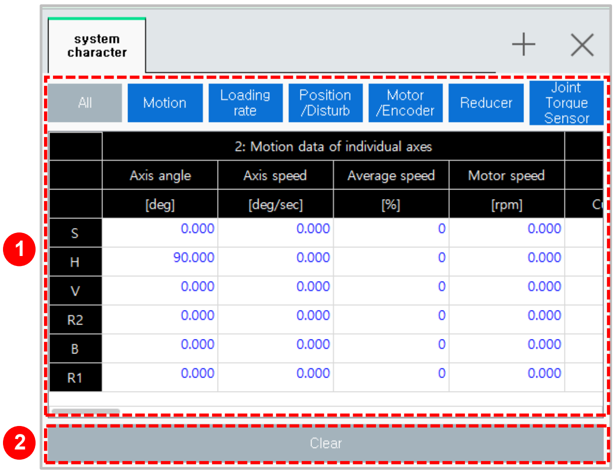
Figure 43 History

No.	Description
❶	• [⟳]: You can refresh the execution history. • [🔒]: You can turn off the notification for a new history. The history will not be updated, and the current status will be maintained until the lock icon is turned off. • [🗑]: You can clear the history displayed on the screen.
❷	This shows the execution history and time stamp of the job program. You can check the history of the executed job programs.

6.13 System Character

In the panel selection window, touch **[System character]**. Then, the system character window will appear.

You can check all the various data of the robot system or only the data of a specific type of information.


system character
+
×
All
Motion
Loading rate
Position /Disturb
Motor /Encoder
Reducer
Joint Torque Sensor
Clear
1
2

2: Motion data of individual axes

	Axis angle [deg]	Axis speed [deg/sec]	Average speed [%]	Motor speed [rpm]
S	0.000	0.000	0	0.000
H	90.000	0.000	0	0.000
V	0.000	0.000	0	0.000
R2	0.000	0.000	0	0.000
B	0.000	0.000	0	0.000
R1	0.000	0.000	0	0.000

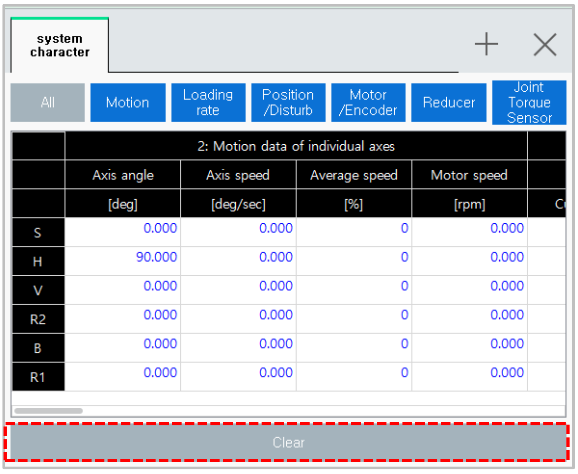
Figure 44 System character

No.	Description
❶	Displays the data of the robot system. You can check the detailed data of a specific type by selecting individual types of information shown above.
❷	**[Clear]**: For the rest of the items except for the motion of each axis, you can initialize the maximum value of the system data by type.

Initialization

You can initialize the maximum value of the data by selecting the type of information you want.

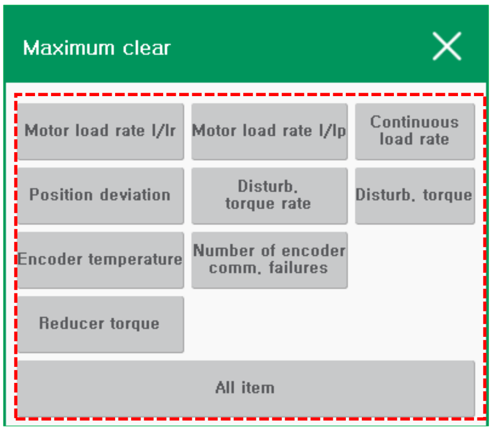
1. Touch the **[Clear]** button at the bottom of the system properties window.


system character
+
×
All
Motion
Loading rate
Position /Disturb
Motor /Encoder
Reducer
Joint Torque Sensor
Clear

2: Motion data of individual axes

	Axis angle [deg]	Axis speed [deg/sec]	Average speed [%]	Motor speed [rpm]
S	0.000	0.000	0	0.000
H	90.000	0.000	0	0.000
V	0.000	0.000	0	0.000
R2	0.000	0.000	0	0.000
B	0.000	0.000	0	0.000
R1	0.000	0.000	0	0.000

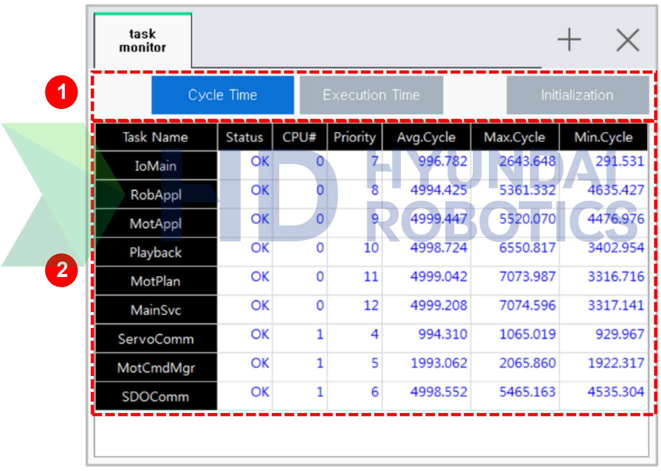
2. Touch the type of information you want to initialize. Then, the maximum value of the selected item will be initialized.


Maximum clear
Motor load rate I/Ir
Motor load rate I/Ip
Continuous load rate
Position deviation
Disturb. torque rate
Disturb. torque
Encoder temperature
Number of encoder comm. failures
Reducer torque
All item

6.14 Task monitor

In the panel selection window, touch **[Task monitor]**. Then, the task window will appear.

You can check the operation cycle and execution time information for each task.


task monitor
①
Cycle Time
Execution Time
Initialization
②

Task Name	Status	CPU#	Priority	Avg.Cycle	Max.Cycle	Min.Cycle
IoMain	OK	0	7	996.782	2643.648	291.531
RobAppl	OK	0	8	4994.425	5361.332	4635.427
MotAppl	OK	0	9	4999.447	5520.070	4476.976
Playback	OK	0	10	4998.724	6550.817	3402.954
MotPlan	OK	0	11	4999.042	7073.987	3316.716
MainSvc	OK	0	12	4999.208	7074.596	3317.141
ServoComm	OK	1	4	994.310	1065.019	929.967
MotCmdMgr	OK	1	5	1993.062	2065.860	1922.317
SDOComm	OK	1	6	4998.552	5465.163	4535.304

Figure 45 Task monitor

No.	Description
①	• **[Cycle Time]/[Execution Time]**: You can change the information type for each task. • **[Initialization]**: You can initialize the displayed information.
②	Displays the operation cycle and execution time information for each task

6.15 Soft Keyboard

In the panel selection window, touch **[Soft Keyboard]**. Then, a soft keyboard window will appear.

You can input variables, expressions, and strings, which include numbers, characters, symbols, and special symbols. For details on how to use the soft keyboard, refer to "**3.2.4.4 Soft Keyboard.**"

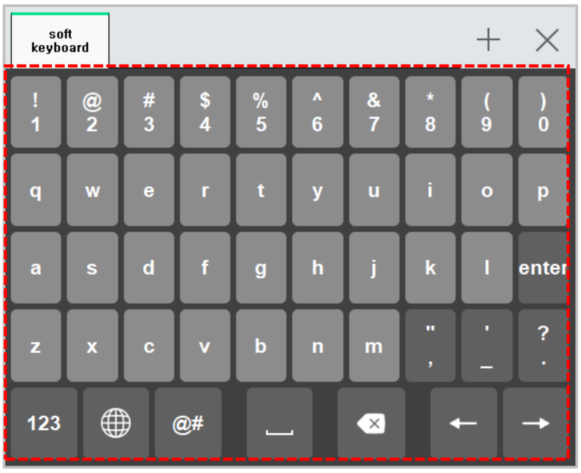


Figure 46 Soft Keyboard

6.16 Work Cell

In the panel selection window, touch **[Work Cell]**. Then, the robot's current posture will appear on the 3D screen.

By setting the safety function of the collaborative robot, you can check the setting status of the operation area (❶), tool area (❷), tool direction restriction (❸), robot elbow area (❹), prohibited area (❺).

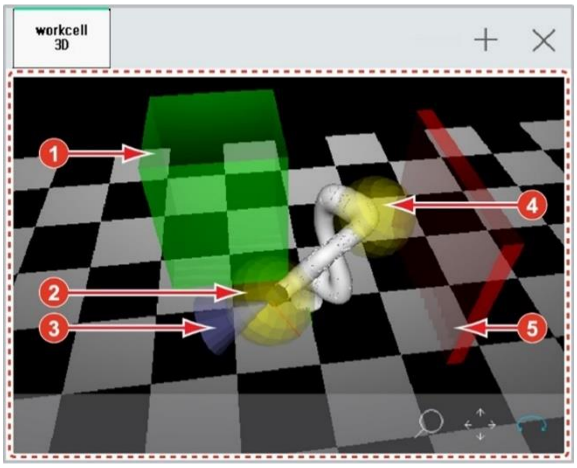


Figure 47 Work Cell Monitoring

- Select the **[Upscale/Downscale]** icon (🔍), **[Move]** icon (✥), or **[Rotate]** icon (↻) at the bottom right of the 3D screen, and then drag the screen. Then, the camera will be adjusted.
- If the setting is changed, you can apply the new settings only after closing and reopening the workcell window.

6.17 Help

In the panel selection window, touch **[Help]**. Then, you can check the usage information of the Hi6 controller in the help window of the controller.

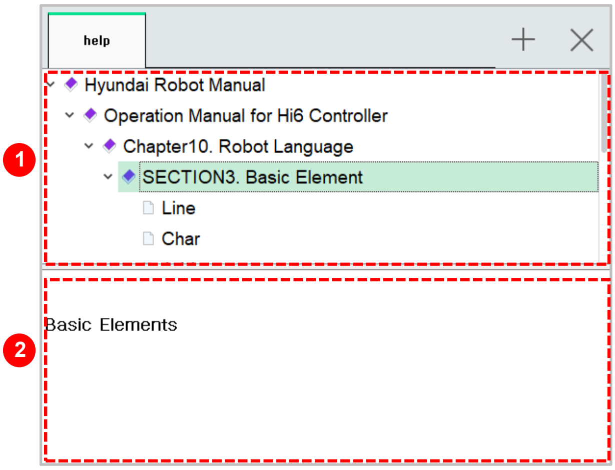

help
1
Hyundai Robot Manual
Operation Manual for Hi6 Controller
Chapter10. Robot Language
SECTION3. Basic Element
Line
Char
2
Basic Elements

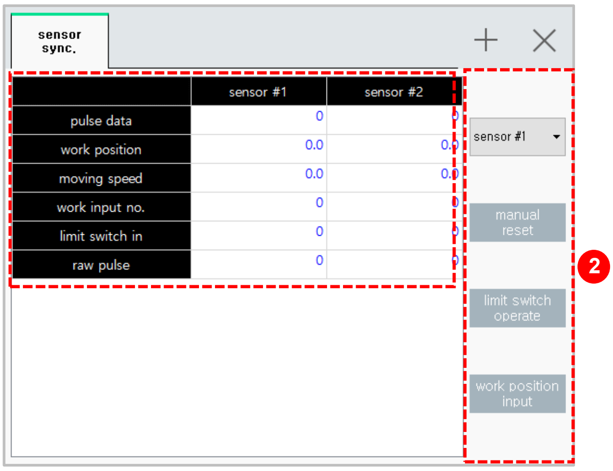
Figure 48 Help

No.	Description
❶	List of help provided in the controller • [›]/[⌄]: You can hide or display the subitems. • [🗋]: You can display the details of the selected item at the bottom.
❷	Displays the details of the item selected in the above list of help

6.18 Sensor Sync

Touch **[Sensor Sync]** in the panel selection window. Then, the sensor sync window will appear.

You can check the information related to the conveyor and press sync functions. The sensor sync function can be activated by setting the sync status as conveyor or press in the **[Set up〉 4: Application Parameter 〉 4: Sensor Sync]** menu.



	sensor #1	sensor #2
pulse data	0	0
work position	0.0	0.0
moving speed	0.0	0.0
work input no.	0	0
limit switch in	0	0
raw pulse	0	0

Figure 49 Sensor Sync Monitoring

No.	Description
①	Displays the information related to the conveyor and press sync functions of the selected sensor
②	• **[Sensor #1]**: You can select a sensor to monitor by touching the drop-down menu. • **[Manual reset]**: You can manually delete various sensor-related data (encoder pulse, sensor position, sensor speed, workpiece entry count, sync playback status, etc.). • **[Limit Switch Operate]**: You can use this function when you input the limit switch signal manually. • **[Work Position Input]**: You can manually input the sensor position value (Linear: mm. Circular: deg).

Note	For details on the sensor sync function, refer to the "**Hi6 Sensor Sync Function Manual.**"

6.19 Program reserve

In the panel selection window, touch **[Program reserve]**. Then, the scheduled program execution window will appear.

When programs are scheduled through external signals and executed in the scheduled order, you can check and change the status in the list of scheduled programs.

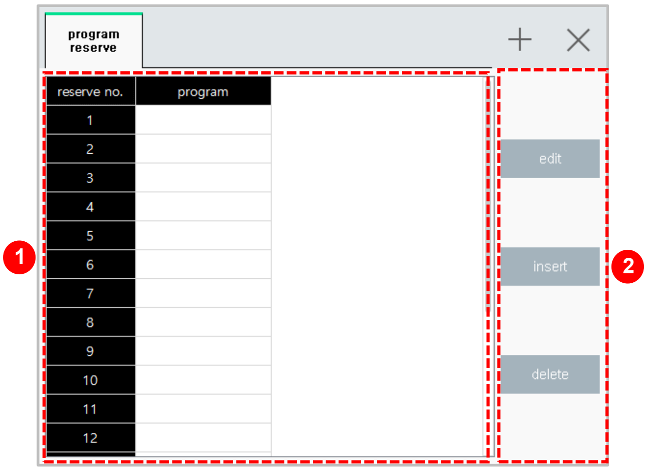


Figure 50 Program reserve

No.	Description
①	A list of scheduled programs. You can schedule 1–20 programs. • When a program being executed in remote mode is terminated, programs will be automatically executed according to the scheduled order. • When the execution of scheduled programs is completed, those programs will be deleted from the list.
②	• **[Edit]**: You can edit the list of scheduled programs. • **[Insert]**: You can add a program that will be executed on a schedule to the list of scheduled programs. • **[Delete]**: You can delete a scheduled program from the list of scheduled programs.

Notes	• The **[Program reserve]** item will be activated only when the sync status of the sensor sync function among the application functions is set as **conveyor** or **press**. • The **[Program reserve]** item will not be activated if the **[Applied Register Count]** option in the **[Set Up 〉 2: Control Parameter 〉 8: Program reserve]** menu is set as disable. • For details on the scheduled program execution, refer to the "**Hi6 Controller Scheduled Program Execution Function Manual.**"

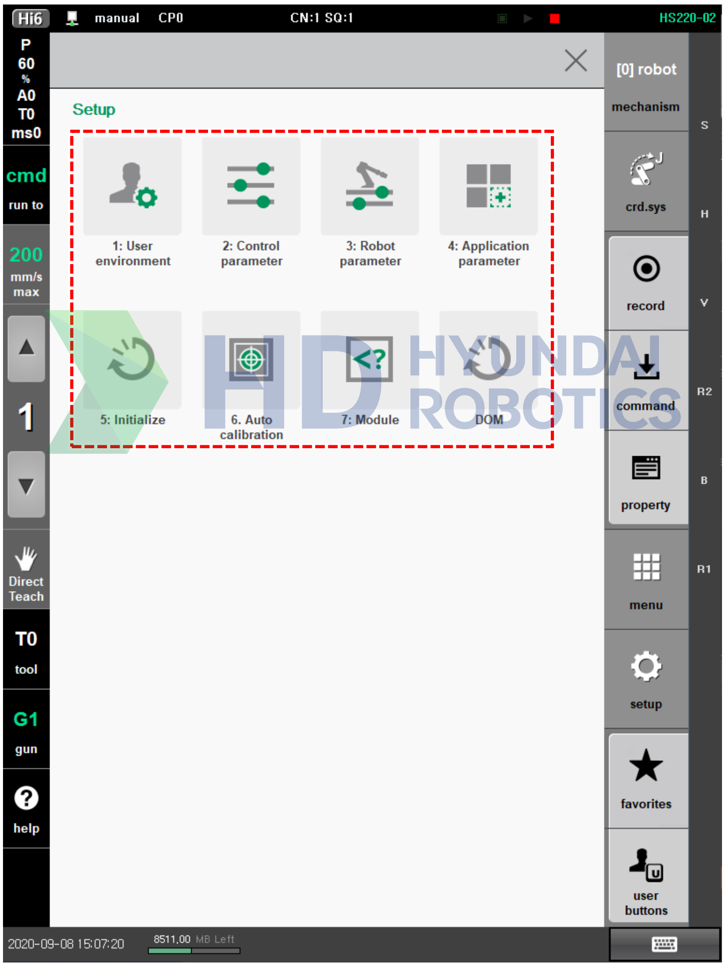
7. Set Up

In the settings item, you can check and set the user information and various parameter information.

7.1 Use of the Menus in Settings

1. In manual or automatic mode, touch the **[Set up]** button on the right side of the initial screen. Then, the program's settings menus will be displayed.

2. You can check and set the user information and various parameter information by selecting the desired menus.


Hi6
manual
CP0
CN:1 SQ:1
HS220-02
P
60
%
A0
T0
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
Setup
1: User environment
2: Control parameter
3: Robot parameter
4: Application parameter
5: Initialize
6. Auto calibration
7: Module
DOM
[0] robot
mechanism
S
H
V
R2
B
R1
crd.sys
record
command
property
menu
setup
favorites
user buttons
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HYUNDAI ROBOTICS

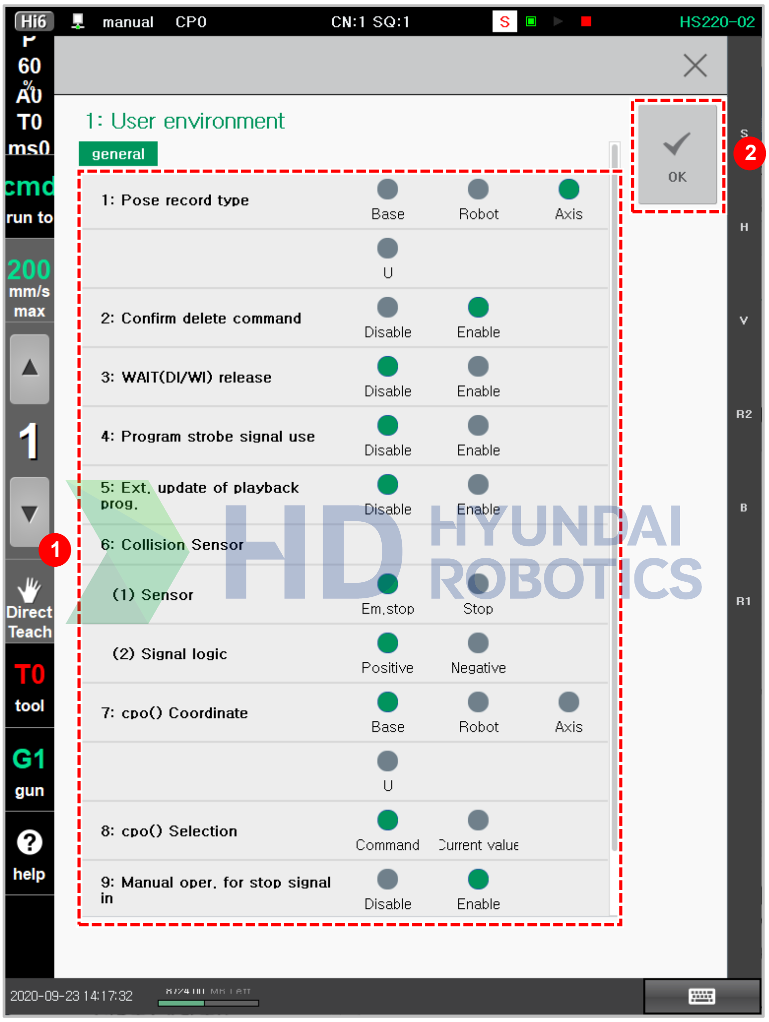
- **[1: User Environment]**: You can check and set various user conditions.
- **[2: Control Parameter]**: You can set various conditions of the controller and the input/output signals, communication information, robot ready OK signal condition, home position signal, and coordinate system.
- **[3: Robot Parameter]**: You can set various data related to robot operation and information such as the origin of each axis and operation range.
- **[4: Application Parameter]**: You can check and set various parameters for using the robot's application functions.
- **[5: Initialize]**: You can perform the initial setting of the robot system. You can also initialize the serial encoder.

- **[6: Auto Calibration]**: You can calibrate the robot's axis origin, tool length, load mass, and base axis direction, etc. using the programs taught to use the robot correctly and also by using the movement that will automatically operate.

7.2 User Environment

You can check and set various user conditions.

1. Touch the **[1: User Environment]** menu. Then, the user environment setting window will appear.
2. After setting the user environment, touch the **[OK]** button.



1: User environment

general

1: Pose record type: ○ Base ○ Robot ● Axis ○ U

2: Confirm delete command: ○ Disable ● Enable

3: WAIT(DI/WI) release: ● Disable ○ Enable

4: Program strobe signal use: ● Disable ○ Enable

5: Ext. update of playback prog.: ● Disable ○ Enable

6: Collision Sensor

(1) Sensor: ● Em.stop ○ Stop

(2) Signal logic: ● Positive ○ Negative

7: cpo() Coordinate: ● Base ○ Robot ○ Axis ○ U

8: cpo() Selection: ● Command ○ Current value

9: Manual oper. for stop signal in: ○ Disable ● Enable

- **[1: Pose Record Type]**: You can set the type of the position recording of the step to be recorded as a hidden pose.
  - **[Base]/[Robot]/[Axis Angle]**: You can record the position of the step based on the base coordinate, robot, and axis angle values.
  - **[U]**: You can record the position in the user coordinate system.
- **[Confirm Delete Command]** You can set whether to expose the deletion confirmation window when deleting a statement in manual mode.
- **[3: WAIT(DI/WI) release]**: While in the input signal wait or welding complete signal wait status, you can set whether to force the signal wait status to be deactivated using the **<shift+F3: Wait Deactivation>** keys.

- **[4: Program Strobe Signal Use]**: When selecting an external program by receiving an external digital signal, you can set the time when the external program is to be selected.
  - **[Disable]**: Makes it possible to select an external program by reading only the external program selection signal
  - **[Enable]**: Makes it possible to select an external program by reading the external program selection signal at the time when the program strobe sognal is inputted
- **[5: Ext. Update of Playback Prog.]**: You can set whether to allow the process of externally (PC) modifying the program that is being played back, and then to allow the process of downloading it to the controller (With regard to the number of the program being played back, the downloaded program will be applied from the next cycle).

⚠ Caution	If the program being played back is modified externally (PC) and downloaded to the controller, it could cause a failure of or abnormality with the product. Contact our customer support team to ask an expert or an engineer.

- **[6: Collision Sensor]**: You can set a method of stopping the robot when the collision sensor is operating.
  - **[(1) Sensor]**: When the collision sensor is operating, this function will switch the robot into the emergency stop ready off (motor off) status or stop the robot (operation ready on (motor on) status).
  - **[(2) Signal Logic]**: You can set the input signal logic of the collision sensor as **positive logic** or **negative logic**.

Notes	• If you enter the **[Set up]** menu while the motor is turned off because of the operation of the collision sensor, the motor ON and jog operations can be performed. This function can be used to move the robot that suffered a collision. • If the collision sensor operates while **[Sensor]** is set as **stop**, the robot can perform only jogging.

- **[7: cpo( ) coordinate System]**: You can set the reference of the coordinate system of the pose that is to be acquired when the pose expression (cpo()) that makes it possible to acquire the current robot pose in the job program is used.
- **[8:cpo( ) Selection]**: You can set the type of the current position value that is to be acquired when a pose expression (cpo()) that makes it possible to acquire the current position of the robot based on the coordinate system (U/Base/Joint) designated in the job program. You can select the **command value** (robot's command value (cmd)) or the **current value** (robot's current value (cur)).

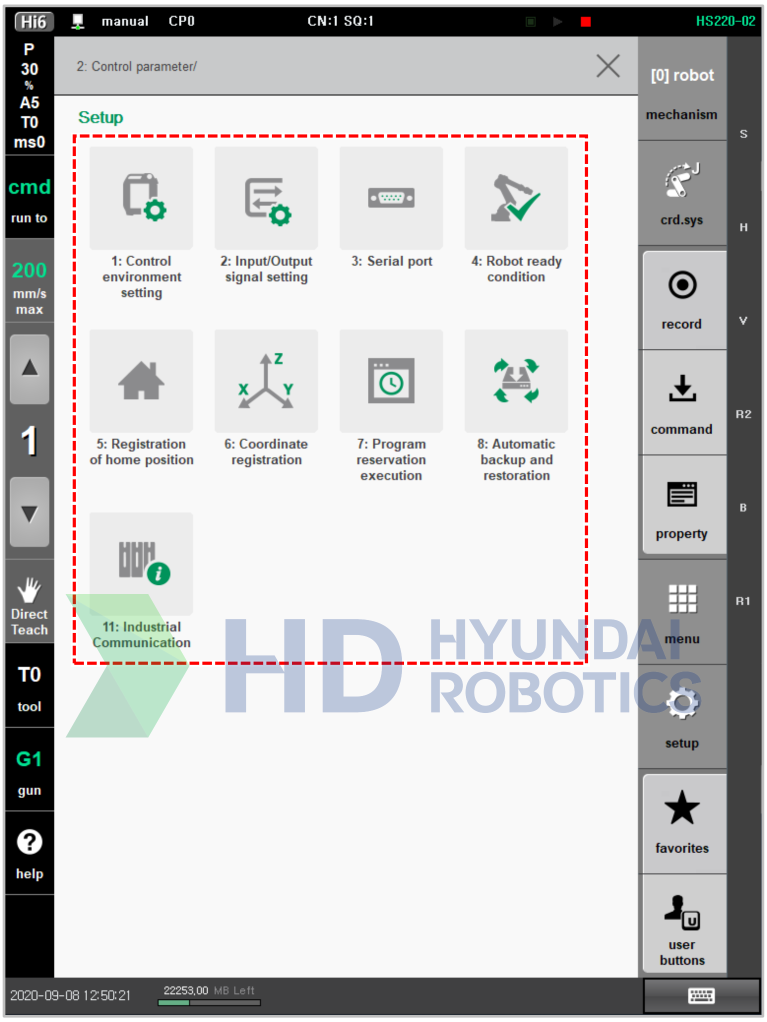
⚠ Caution	There may be an error between the robot's current value and the robot's command value because of servo delay. Set the type of the current position value according to the environment and purpose of the use.

- **[9: Manual Oper. for Stop Signal Input]**: You can set whether to enable jog operation when an external stop signal is inputted.

7.3 Control Parameter

You can set various conditions of the controller and set the input/output signal, communication information, robot ready OK signal condition, home position signal, and the coordinate system.

1. Touch the **[2: Control Parameter]** menu. Then, the control parameter menu will appear.
2. Select the desired menu and check and set various conditions of the controller.


Hi6
manual CP0
CN:1 SQ:1
HS220-02
P 30 % A5 T0 ms0
cmd
run to
200 mm/s max
1
Direct Teach
T0 tool
G1 gun
help
2: Control parameter/
Setup
1: Control environment setting
2: Input/Output signal setting
3: Serial port
4: Robot ready condition
5: Registration of home position
6: Coordinate registration
7: Program reservation execution
8: Automatic backup and restoration
11: Industrial Communication
[0] robot
mechanism
crd.sys
record
command
property
menu
setup
favorites
user buttons
S
H
V
R2
B
R1
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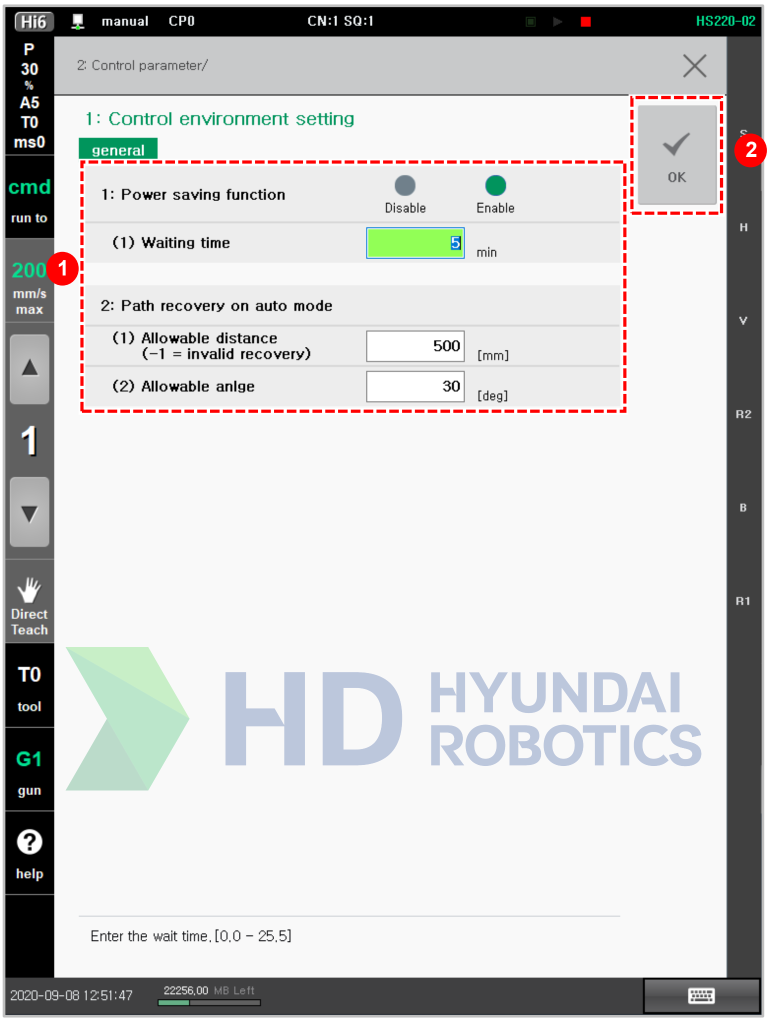
7.3.1 Control Environment Setting

You can set various conditions of the controller and perform necessary operations.

1. Touch the **[2: Control Parameter 〉 1: Control Environment Setting]** menu.
2. After setting the control environment conditions of the controller, touch the **[OK]** button.



Hi6
manual
CP0
CN:1 SQ:1
HS220-02
P
30
%
A5
T0
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
2: Control parameter/
1: Control environment setting
general
OK
S
H
V
R2
B
R1
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1
2

1: Power saving function ○ Disable ● Enable

(1) Waiting time 5 min

2: Path recovery on auto mode

(1) Allowable distance (-1 = invalid recovery) 500 [mm]

(2) Allowable anlge 30 [deg]

Enter the wait time. [0.0 – 25.5]

- **[1: Power Saving Function]**: You can set whether to use the power saving function and set the wait time.

  While the power saving function is used, if the robot is in operation stop status while in the auto mode for a long period, such as waiting for startup or waiting for an input signal, the power supply to the motor will be cut off when the wait time has expired, helping save power consumption. When an operation command is inputted in the robot, the power saving function will be automatically deactivated, allowing the power to be supplied to the motor and the robot to operate.

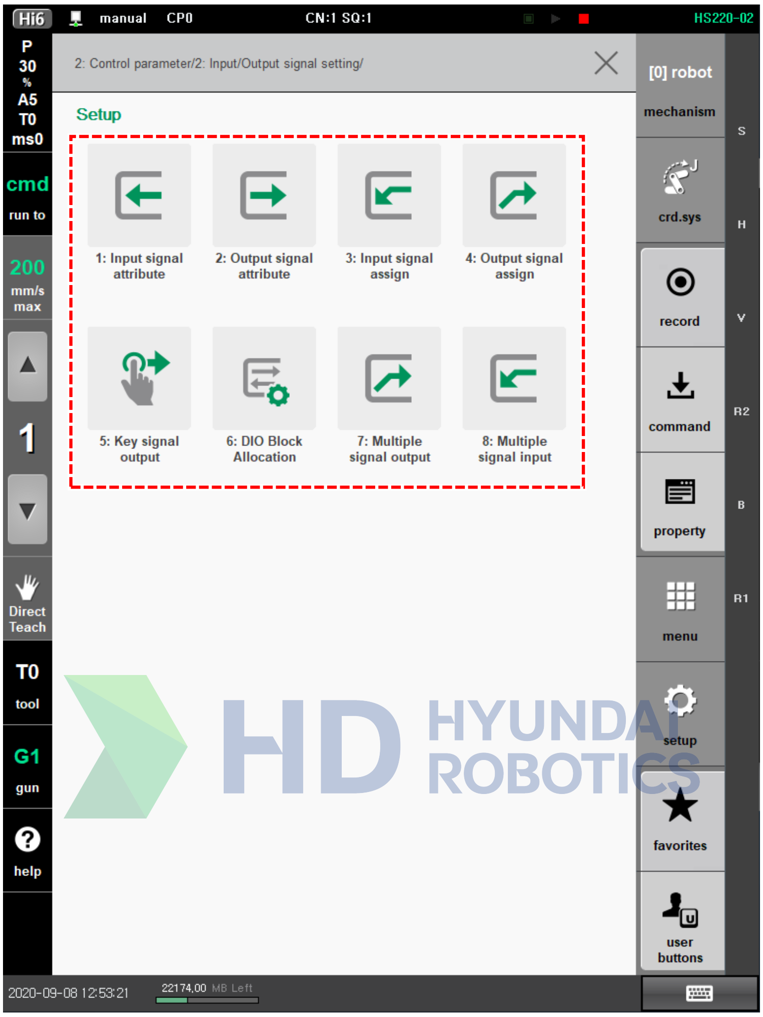
Note	Delays may occur in the process of activating/deactivating the power-saving function. When operating while expecting the speed of the robot, you should set the power saving function as **disable**.

- **[2: Path Recovery on Auto Mode]**: You can set the allowable distance and allowable angle for path recovery in automatic mode.

  During path recovery, an error will be detected if the distance and angle exceed the set allowable range. If the allowable distance is set to 1, no path recovery will take place.

7.3.2 Input/Output Signal Setting

1. Touch the **[2: Control Parameter 〉 2: Input/Output Signal Setting]** menu. Then, the input/output signal setting menu will appear.
2. Select the desired menu and set the input/output signal attributes and signal assignment, etc.


Hi6
manual
CP0
CN:1 SQ:1
HS220-02
2: Control parameter/2: Input/Output signal setting/
Setup
1: Input signal attribute
2: Output signal attribute
3: Input signal assign
4: Output signal assign
5: Key signal output
6: DIO Block Allocation
7: Multiple signal output
8: Multiple signal input
[0] robot
mechanism
crd.sys
record
command
property
menu
setup
favorites
user buttons
P
30
%
A5
T0
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
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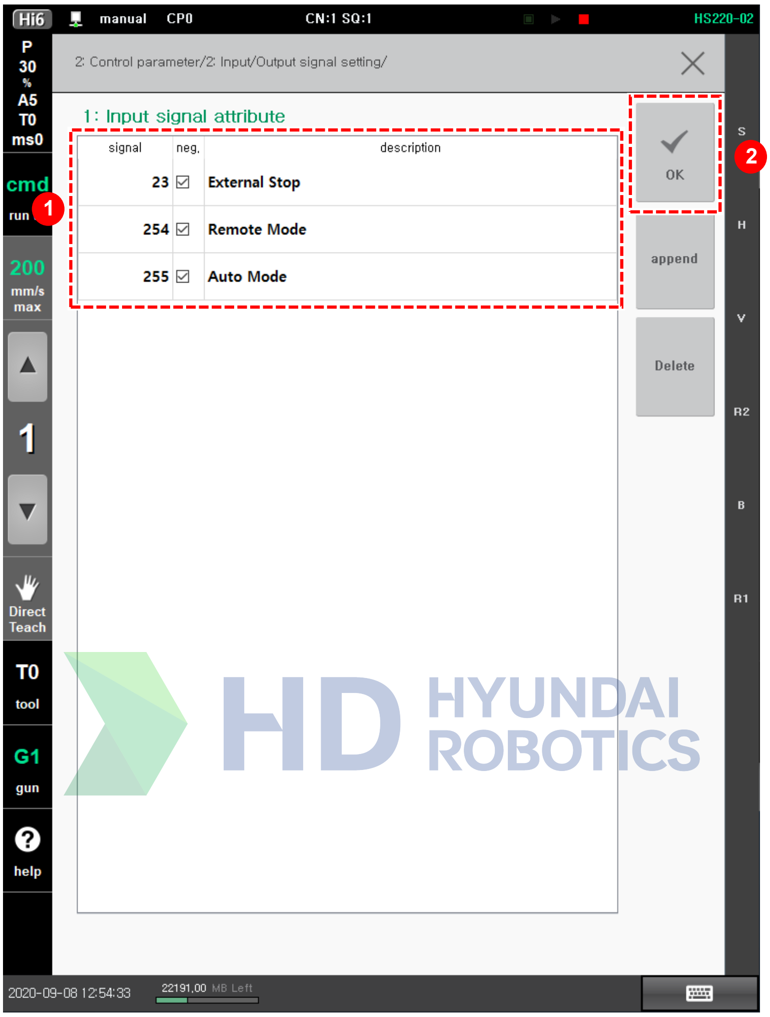
7.3.2.1 Input Signal Attribute

You can set the logic and name for a general input signal.

1. Touch the **[2: Control Parameter › 2: Input/Output Signal Setting › 1: Input Signal Attribute]** menu.
2. Check and set the general input signal list, and then touch the **[OK]** button.


Hi6
manual
CP0
CN:1 SQ:1
HS220-02
P 30 % A5 T0 ms0
cmd
run
200 mm/s max
1
Direct Teach
T0 tool
G1 gun
help
S
H
V
R2
B
R1
OK
append
Delete
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22191.00 MB Left
1
2

2: Control parameter/2: Input/Output signal setting/

1: Input signal attribute

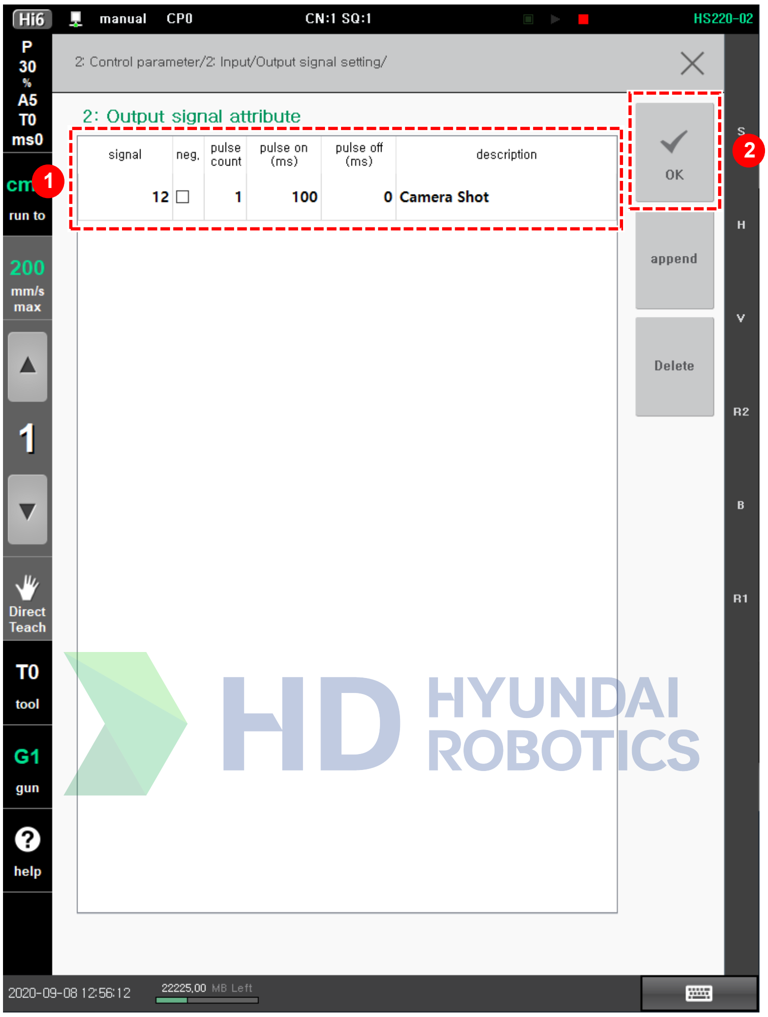
signal	neg.	description
23	☑	External Stop
254	☑	Remote Mode
255	☑	Auto Mode

- **[Append]**: You can add a new general input signal to the list.
- **[Delete]**: You can delete the general input signal from the list.

7.3.2.2 Output Signal Attribute

You can set the logic, pulse, and name for a general input signal.

1. Touch the **[2: Control Parameter ❯ 2: Input/Output Signal Setting ❯ 1: Output Signal Attribute]** menu.
2. Check and set the general input signal list, and then touch the **[OK]** button.


Hi6
manual
CP0
CN:1 SQ:1
HS220-02
P
30
%
A5
T0
ms0
cm
run to
200
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
OK
append
Delete
S
H
V
R2
B
R1
①
②
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2: Control parameter/2: Input/Output signal setting/

2: Output signal attribute

signal	neg.	pulse count	pulse on (ms)	pulse off (ms)	description
12	☐	1	100	0	Camera Shot

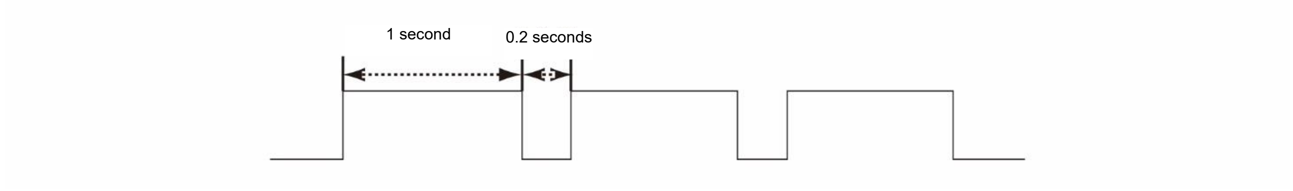
- **[Append]**: You can add a new general output signal to the list.
- **[Delete]**: You can delete the general output signal from the list.

7.3.2.3 Input/Output Signal Setting Information

- **[Signal]**: The signal to apply the attribute to. The fb block signal can be designated by inputting the block number, decimal point, and signal number in sequence.

  For example, if you want to designate the signal 35 of the block fb1, you can set it by inputting 1.35.

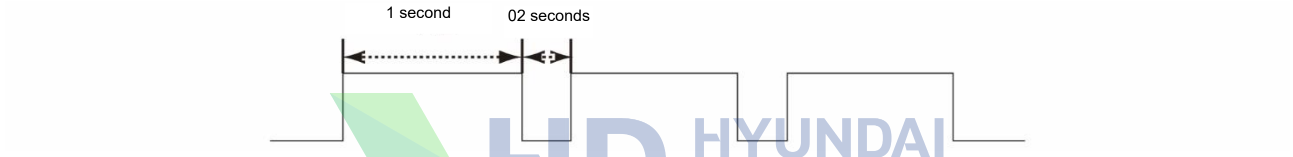
- **[Negative Logic]**: The positive logic and negative logic of the general input/output signal are as follows.



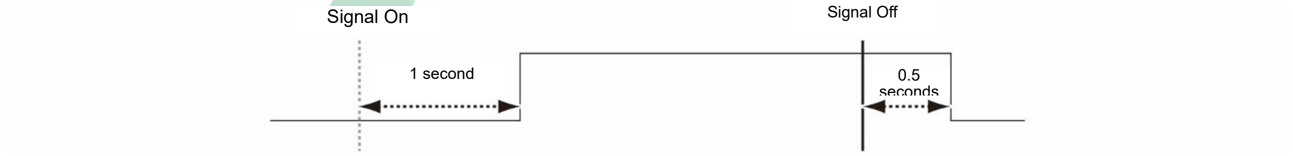
- **[Pulse Count]**: Pulse count. This is the count of pulses. If it is set to a value between 1 and 100, pulse output will occur, and if set to 0, a delayed output will occur.
- **[Pulse On]**/**[Pulse Off]**: This is the On status time and Off status time of the output signal when pulse output or delayed output occurs.

The example of the pulse output according to the pulse attribute value is as follows.

  - Pulse output: Count: 3. On status time: 1 second. Off status time: 0.2 seconds



  - Delayed output: Count: 0. On status time: 1 second. Off status time: 0.5 seconds

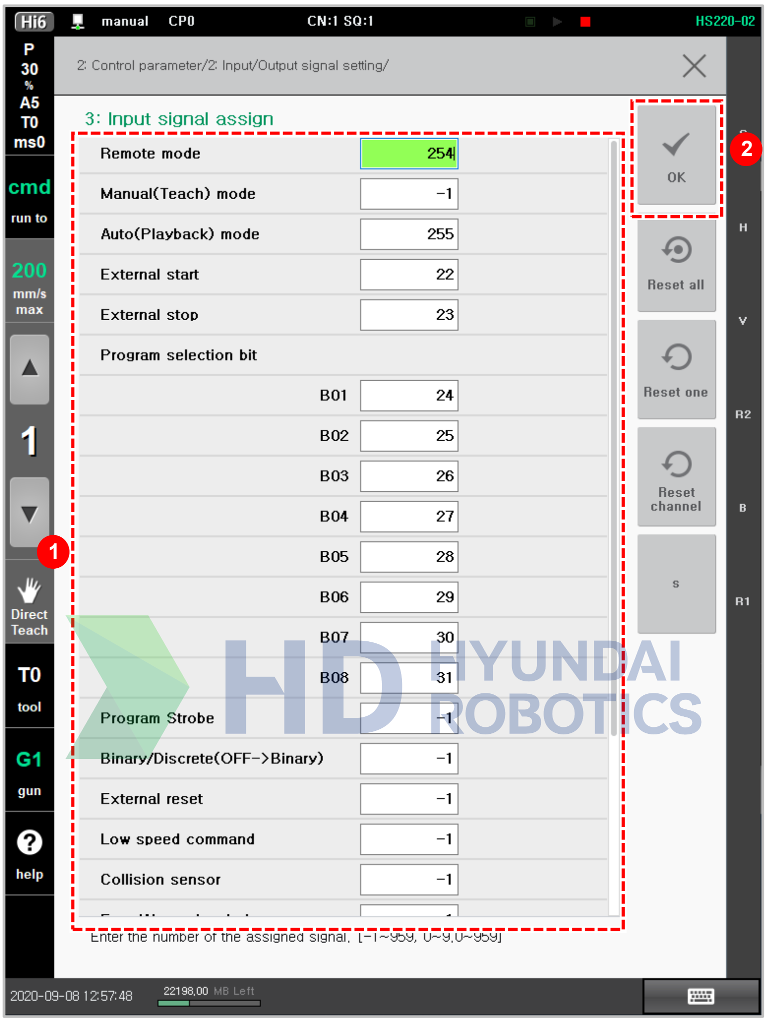


- **[Name]**: Name of the general input/output signal

7.3.2.4 Input Signal Assignment

You can remotely control the controller's state or operation using the controller input signal. The method of assigning the input signal number in the remote-control item is as follows.

1. Touch the **[2: Control Parameter 〉 2: Input/Output Signal Setting 〉 3: Input Signal Assign]** menu.
2. After inputting the input signal number in the remote control item, touch the **[OK]** button.


Hi6
manual CP0
CN:1 SQ:1
HS220-02
P
30
%
A5
T0
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
2: Control parameter/2: Input/Output signal setting/
OK
Reset all
Reset one
Reset channel
s
H
V
R2
B
R1
1
2
2020-09-08 12:57:48
22198,00 MB Left
HD HYUNDAI ROBOTICS

3: Input signal assign

Remote mode		254
Manual(Teach) mode		-1
Auto(Playback) mode		255
External start		22
External stop		23
Program selection bit		
	B01	24
	B02	25
	B03	26
	B04	27
	B05	28
	B06	29
	B07	30
	B08	31
Program Strobe		-1
Binary/Discrete(OFF->Binary)		-1
External reset		-1
Low speed command		-1
Collision sensor		-1

Enter the number of the assigned signal. [-1~959, 0~9,0~959]

- **[Reset All]**: You can reset the numbers of the input signals assigned to all remote control items.
- **[Reset One]**: You can reset the number of the input signal assigned to the selected remote control item.
- **[Reset Channel]**: You can initialize the input channel for the set input signal. The channel consists of fb0 to fb9, and fb0 will be omitted in the display in the case of fb0.
- **[S]**: You can designate the system signal when using the remote control as a system input signal. The system signal consists of "**s+number**," which combines the letter s with the signal number. For example, you can set the system signal 49 as s49.

7.3.2.5 Input Signal Setting Information

- Remote mode

  When the mode switch of the teach pendant is selected to remote (☐→), the corresponding signal should be turned on for the remote mode to be selected. If the corresponding signal is turned off, the internal mode will be selected. In general, if the mode switch of the teach pendant is selected to be remote (☐→), the user wants to select the remote mode, which is why the basic value is set to **254**, and the corresponding signal will be designated as negative logic in the input signal attribute.

- Manual (Teach) mode

  While the remote mode is selected, if the corresponding signal is turned on, you will be in a state in which the robot will be operated manually in remote mode. However, in general, there is no case of operating the robot in this state, and this mode is rarely used.

- Auto (Playback) mode

  While the remote mode is selected, if the corresponding signal is turned on, you will be in a state in which the robot will be operated automatically in remote mode. However, in general, if the mode switch of the teach pendant is selected to remote (☐→), the user wants to operate the robot automatically in remote mode, which is why the basic value is set to **255,** and the corresponding signal will be designated as negative logic in the signal attribute.

- External start

  This is used to start the robot in remote auto mode.

- External stop

  This is used to stop the robot in remote auto mode.

- Selection of an external program

  When the robot is externally started up, the timing of reading the program selection bit and determining it as an external program depends on whether to use the strobe signal.

  - When the program strobe signal use is set as **enable**: If the program strobe signal is on while there is an external startup input, the program selection bit will be read, and the read value will be determined as the program number.

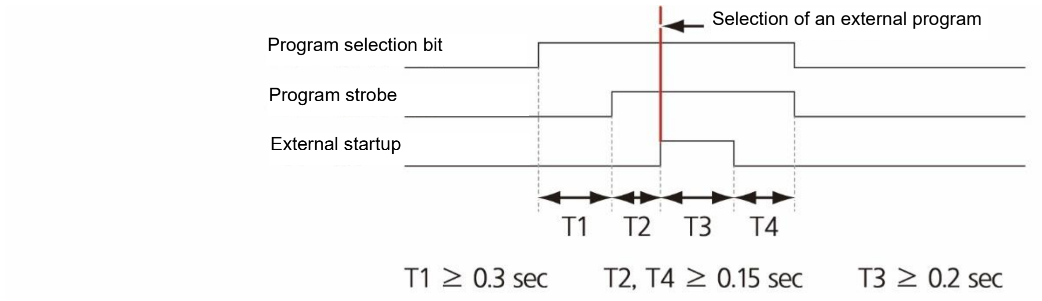


Figure 51 Diagram of the Selection of an External Program When the Program Strobe Signal is Set as 〈Enable〉

  - When the program strobe signal use is set as **disable**: After there is an external startup input, the program selection bit will be read, and if this value does not change for 90 ms, it will be determined as the program number.

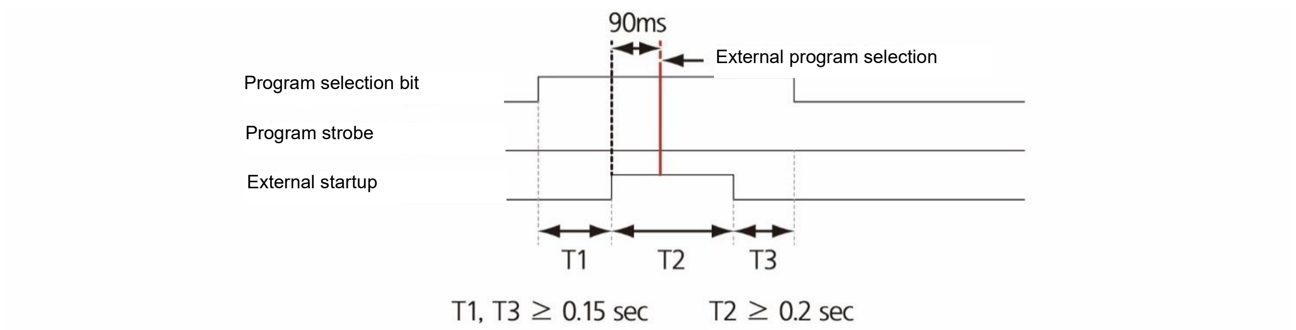


Figure 52 Diagram of Selection of an External Program When the Program Strobe Signal is 〈Disable〉

- Program selection bit and binary/discrete (off → binary)

The program selection bit is a combination of signals to select a program to execute when an external start signal is inputted. It is applied only when a step is pointed in Header or in the End currently in the TP. When a program is being executed, the program will be executed to the end.

Binary/Discrete signal is an option that determines the interpretation of the program selection bit, and if it is 0, it will be recognized as binary, and if it is 1, it will be recognized as discrete.

For example, if the program selection bit is set as follows, an example of JOB to execute according to the input is as follows.

Program Selection Bit	32	31	30	29	28	27	26	25	Example of the JOB to Execute According to the Input
Binary/Discrete Signal Assignment Value	0	0	0	0	0	0	0	1	• In the case of binary: Job #1 will be executed • In the case of discrete: Job #1 will be executed
	0	0	0	0	0	1	0	1	• In the case of binary: Job #5 will be executed • In the case of discrete: Job #1 will be executed
	0	0	0	1	0	0	0	0	• In the case of binary: Job #16 will be executed • In the case of discrete: Job #5 will be executed
	0	0	0	1	1	0	0	0	• In the case of binary: Job #24 will be executed • In the case of discrete: Job #4 will be executed

- External reset

This function is used to perform the same operation as executing the R0 step counter reset function from the teach pendant by an external signal. When the robot is starting up, this function will not operate. If this function operates normally, the execution position will move to the beginning of the program, and the occurrence status of various errors or warnings will be cleared. Refer to "**8.2 R0 for Resetting the Step Counter**" for information on this function.

- Low speed command

  This function is used to limit the robot's moving speed to within the safe speed (250 mm/s) by an external signal.

- Collision sensor

  This function is used to detect the collision of the robot and stop the robot. In conjunction with the settings in the **[System〉 1: User Environment〉 6: Collision Sensor]** menu, conditions and signal logic for stopping the robot will be determined.

- Error/Warning signal clearing

  This function is used to clear the occurrence status of various errors and warnings by an external signal.

- Joystick mode

  This function is used to manually jog the robot. It is generally used in LCD macro inspection equipment. Refer to a separate function manual for using the function.

- Door switch

  This function is used to stop the robot in movement when the door of the safety fence is opened.

- Screen saver deactivation

  If the teach pendant is not operated, the teach pendant will switch to the screen saver state when the screen off time set in the **[Menu〉 11: Teach Pendant Option]** menu has elapsed. This function is used to turn on the screen of the teach pendant by an external signal.

- External motor on

  This function is used to turn on the motor from an external operation panel.

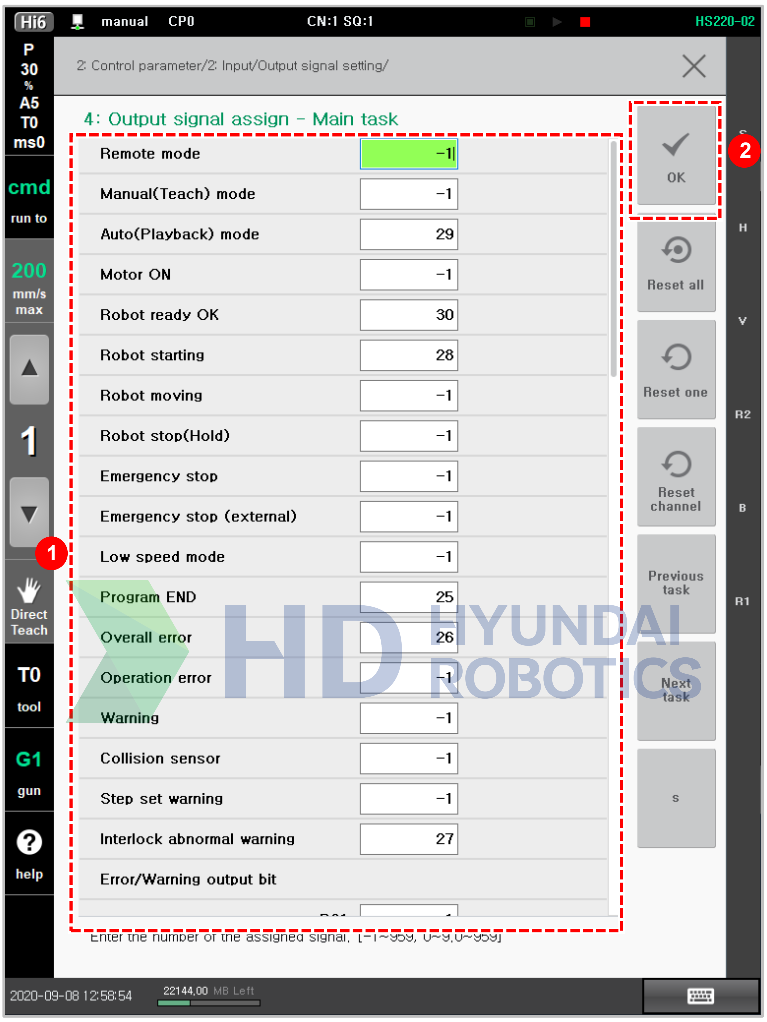
- External motor off

  This function is used to turn off the motor from an external operation panel.

7.3.2.6 Output Signal Assignment

Event information or status information that occurred in the controller can be transmitted to the outside through the controller output signal. The method of assigning output signals to the information to be transmitted to the outside is as follows.

1. Touch the **[2: Control Parameter 〉 2: Input/Output Signal Setting 〉 4: Output Signal Assign-Main task]** menu.
2. After inputting the output signal number in the information item, touch the **[OK]** button.


Hi6
manual
CP0
CN:1 SQ:1
HS220-02
P
30
%
A5
T0
ms0
cmd
run to
200
mm/s
max
1
Direct
Teach
T0
tool
G1
gun
help
OK
Reset all
Reset one
Reset channel
Previous task
Next task
s
S
H
V
R2
B
R1
1
2
2020-09-08 12:58:54
22144.00 MB Left

2: Control parameter/2: Input/Output signal setting/

4: Output signal assign - Main task

Remote mode	-1
Manual(Teach) mode	-1
Auto(Playback) mode	29
Motor ON	-1
Robot ready OK	30
Robot starting	28
Robot moving	-1
Robot stop(Hold)	-1
Emergency stop	-1
Emergency stop (external)	-1
Low speed mode	-1
Program END	25
Overall error	26
Operation error	-1
Warning	-1
Collision sensor	-1
Step set warning	-1
Interlock abnormal warning	27
Error/Warning output bit	

Enter the number of the assigned signal. [-1~959, 0~9,0~959]

- **[Reset All]**: You can reset the numbers of the output signals assigned to all information items.
- **[Reset One]**: You can reset the number of the output signal assigned to the selected information item.
- **[Reset Channel]**: You can reset the input channel of the output signal assigned to the information item (0–16: digital signal)
- **[Previous Task]/[Next Task]**: You can move to the previous or next task screen.
- **[S]**: You can designate a system signal when using the remote control through a system input signal. The system signal is in the form of “s+**number**,” which combines the letter s with the signal number. For example, you can set the system signal 49 as s49.

7.3.2.7 Output Signal Setting Information

- Remote mode

  With the mode switch of the teach pendant selected to remote (□→), the signal set in the input signal assign section should be inputted in the state of on in order to activate the remote state. This function is used to output the state to the outside.

- Manual (Teach) mode

  This function is used to output the state to the outside that the operation mode of the controller is manual.

- Auto (Playback) mode

  This function is used to output the state to the outside that the operation mode of the controller is automatic.

- Motor on

  When power is supplied to each motor by the input of the motor on signal and the driving is ready, this function is used to output the state to the outside.

- Robot ready OK

  When the current controller status satisfies all conditions set in the **[Set Up〉 2: Control Parameter〉 4: Robot Ready Condition]** menu, this function is used to output the state to the outside.

- Robot starting

  When the robot is started by the step forward/backward operation in manual mode or by the input of the start signal in automatic mode, this function is used to output this state to the outside.

- Robot moving

  When the robot is moving, this function is used to output this state to the outside.

- Robot stop (Hold)

  When the robot is stopped, contrary to the output of the start signal, this function is used to output this state to the outside.

- Emergency stop

  When there is an input signal from the emergency stop button mounted on the front of the teach pendant or of the controller is inputted, this function is used to output the state to the outside.

- Emergency stop (External)

  This function is used to output to the outside the signal from an external emergency stop device connected to the system board.

- Low speed mode

  When the signal set for the low speed command in the input signal assign section is turned on or when the robot operates at a safe speed in manual mode, this function is used to output this state to the outside.

- Program end

  When the end cycle is performed in the job program, this function is used to output this state to the outside.

- Overall error

Errors occurring in the controller are divided into the errors caused by system errors and the errors caused by the user's mistakes in operation. When an error occurs because of a system error, this function is used to output this state to the outside. The errors caused by system errors range from 1 to 999 and 2000 to 7999.

- Operation error

Errors occurring in the controller are divided into the errors caused by system errors and the errors caused by the user's mistakes in operation. When an error occurs because of the user's mistakes in operation, this function is used to output this state to the outside. For information, the errors caused by system errors range from 1 to 999 and 2000 to 7999.

- Warning

When a warning occurs in the controller, this function is used to output this state to the outside.

- Collision sensor

When the input of the collision sensor signal set in the input signal assign section is turned on and it is confirmed that a collision has occurred in the robot, this function is used to output this state to the outside.

- Step set warning

In automatic mode, it can be dangerous if the currently selected position of the cursor is different from the position in which the execution was performed previously. This function is used to output this state to the outside.

- Interlock abnormal warning

When the waiting time in the wait statement of the job program exceeds the time set in the **[Interlock Abnormal Time]** option in the **[System〉 2: Control Parameter〉 1: Control Environment Setting]** menu, this function is used to output this state to the outside.

- Error/Warning output bit, Error/Warning output selection and Error/Warning output strobe

For the error/warning output bit, error/warning output strobe, overall abnormality, operation error, and warning occurrence signals, refer to the following sequence.

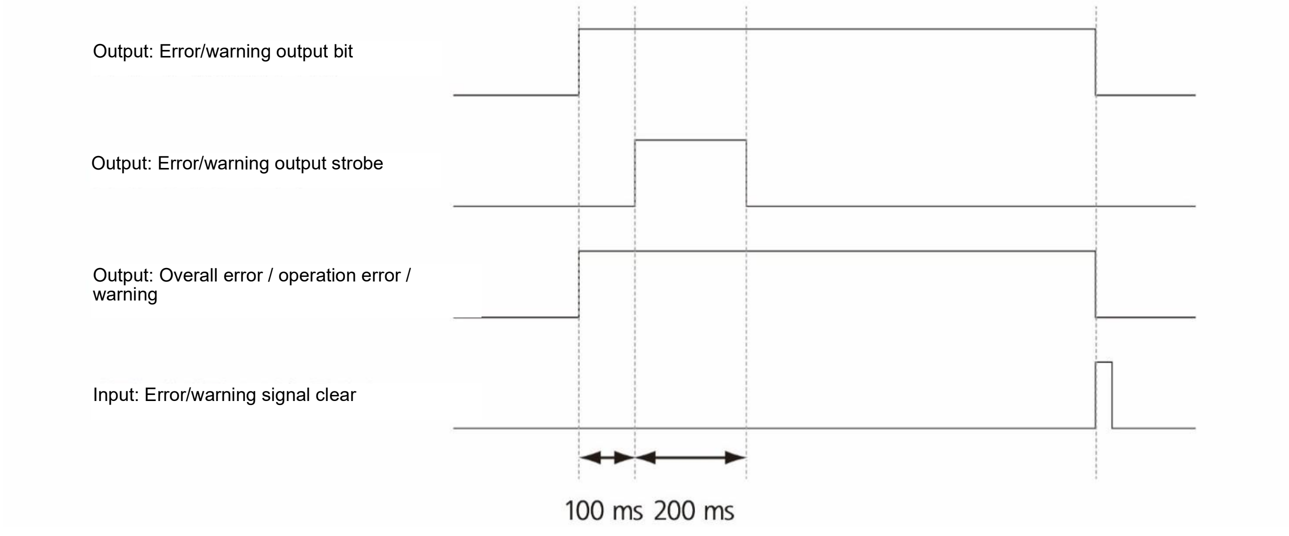

Output: Error/warning output bit
Output: Error/warning output strobe
Output: Overall error / operation error / warning
Input: Error/warning signal clear
100 ms
200 ms

Figure 53 16Bit Output

- External reset ack

When the external reset signal set in the input signal assign section is turned on, this function is used to output this state to the outside. This signal will be turned on for 200 ms and then turned off automatically.

- Program echo bit

  When a program is selected by the program selection bit set in the input signal assign section, this function is used to output the selected program number to the outside.

- Program ack

  When the robot is started by an input of the external startup signal in remote mode, this function is used to output the state to the outside. The signal will be turned on for 200 ms and then turned off automatically.

- Arc welding abnormal

  When an error related to arc welding occurs, this function is used to output this status to the outside.

- Arc deposition warning

  When welding deposition occurs during arc welding, this function is used to output this state to the outside. This signal will be turned on for 200ms and then turned off automatically.

- Robot lock state (Valid=ON)

  This function is used to output to the outside the robot lock setting status in [Condition Setting].

- Field bus abnormal, and field bus idle

  When a fieldbus communication board such as CC-LINK and DeviceNet is used, this function is used to output the communication state to the outside.

- Battery (backup, encoder) voltage drop

  When there is a voltage drop in the backup battery to maintain the state of the SRAM installed on the main board or a voltage drop in the encoder battery to maintain the value of the encoder installed on each motor, this function is used to output to the outside.

- Torque monitoring

  This function is used to output to the outside the torque value that is applied to the six axes of the robot. The torque value that will be outputted to the outside is a % value in the multiplier of 1/2.

- Grease injection alarm

  This function is used to output to the outside the condition that requires grease injection.

- Average load factor abnormality alarm

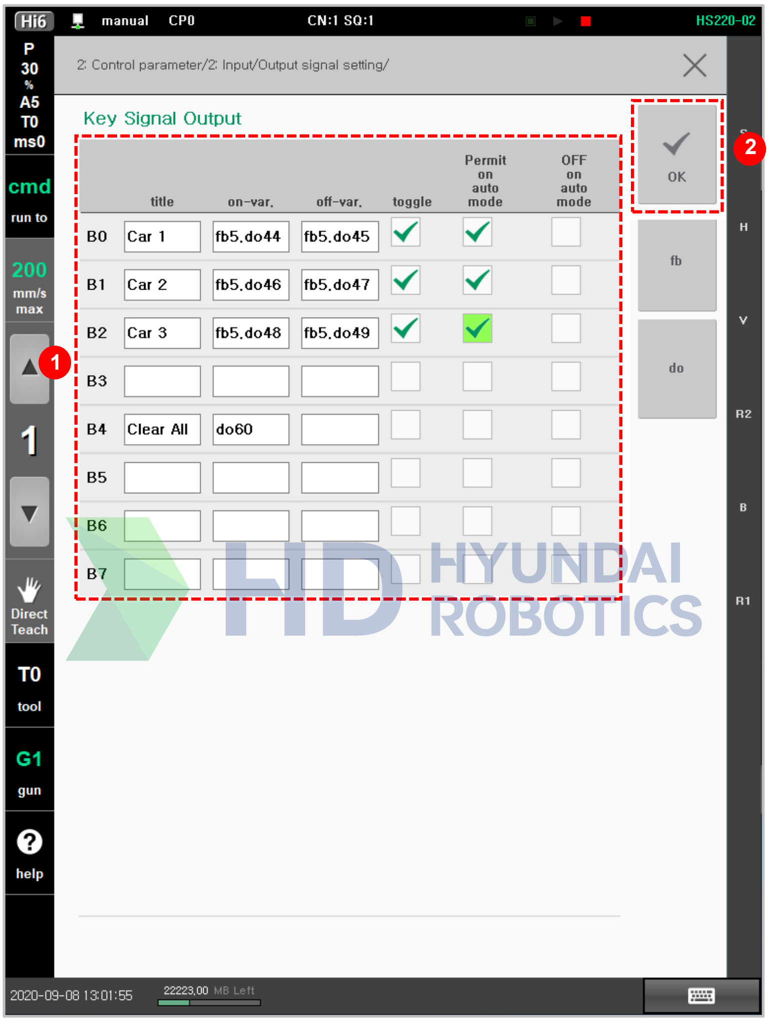
  This function is used to output to the outside the status regarding whether the robot has exceeded the average load factor during operation.

.

7.3.2.8 Key Signal Output

By assigning the output signal of the controller to the signal keys (**《shift+F1 - F8》**) of the teach pendant, you can perform setting in a way to turn on or output signal.

1. Touch the **[2: Control Parameter 〉 2: Input/Output Signal Setting 〉 5: Key Signal Output]** menu.
2. Set the label, signal, and function to the manual output keys (**《F1 - F8》**) of the teach pendant, and then touch the **[OK]** button.


Hi6
manual
CP0
CN:1 SQ:1
HS220-02
P 30 % A5 T0 ms0
cmd
run to
200 mm/s max
1
Direct Teach
T0 tool
G1 gun
help
OK
fb
do
H
V
R2
B
R1
2020-09-08 13:01:55
22223.00 MB Left
①
②

2: Control parameter/2: Input/Output signal setting/

Key Signal Output

	title	on-var.	off-var.	toggle	Permit on auto mode	OFF on auto mode
B0	Car 1	fb5.do44	fb5.do45	☑	☑	☐
B1	Car 2	fb5.do46	fb5.do47	☑	☑	☐
B2	Car 3	fb5.do48	fb5.do49	☑	☑	☐
B3				☐	☐	☐
B4	Clear All	do60		☐	☐	☐
B5				☐	☐	☐
B6				☐	☐	☐
B7				☐	☐	☐

- **[fb]/[do]**: You can easily input the signal output variable value by using numbers and decimal point only.

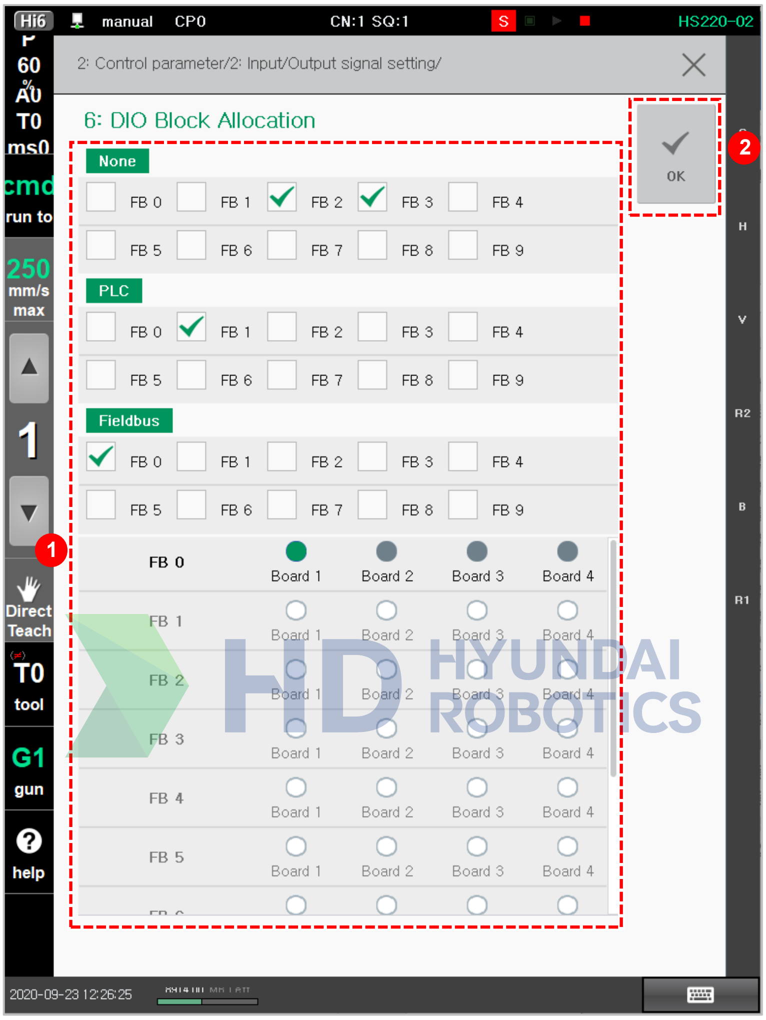
  For example, input 2.9 and press the **〈enter〉** key. Then, it will be converted to and displayed as fb2.do9. If you input 9 without decimal point and press the **〈enter〉** key, it will be converted to do9.

Note	You can register the desired output signal with a button in the user key area of Hi6 teach pendant. For details, refer to **“2.6.2.1 Key Signal Output Function Area.”**

7.3.2.9 DIO Block Allocation

You can set the method of using the controller's general input/output signals. This function can be used through connection to None, PLC, or Fieldbus item.

1. Touch the **[2: Control Parameter ❯ 2: Input/Output Signal Setting ❯ 6: DIO Block Allocation]** menu.
2. Set the connection with the DIO block of the selected FB address, and then touch the **[OK]** button.


Hi6
manual CP0
CN:1 SQ:1
S
HS220-02
60
%
AU
T0
ms0
cmd
run to
250
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
2: Control parameter/2: Input/Output signal setting/
OK
H
V
R2
B
R1
1
2
2020-09-23 12:26:25

6: DIO Block Allocation

None
☐ FB 0 ☐ FB 1 ☑ FB 2 ☑ FB 3 ☐ FB 4
☐ FB 5 ☐ FB 6 ☐ FB 7 ☐ FB 8 ☐ FB 9

PLC
☐ FB 0 ☑ FB 1 ☐ FB 2 ☐ FB 3 ☐ FB 4
☐ FB 5 ☐ FB 6 ☐ FB 7 ☐ FB 8 ☐ FB 9

Fieldbus
☑ FB 0 ☐ FB 1 ☐ FB 2 ☐ FB 3 ☐ FB 4
☐ FB 5 ☐ FB 6 ☐ FB 7 ☐ FB 8 ☐ FB 9

FB 0	● Board 1	● Board 2	● Board 3	● Board 4
FB 1	○ Board 1	○ Board 2	○ Board 3	○ Board 4
FB 2	○ Board 1	○ Board 2	○ Board 3	○ Board 4
FB 3	○ Board 1	○ Board 2	○ Board 3	○ Board 4
FB 4	○ Board 1	○ Board 2	○ Board 3	○ Board 4
FB 5	○ Board 1	○ Board 2	○ Board 3	○ Board 4

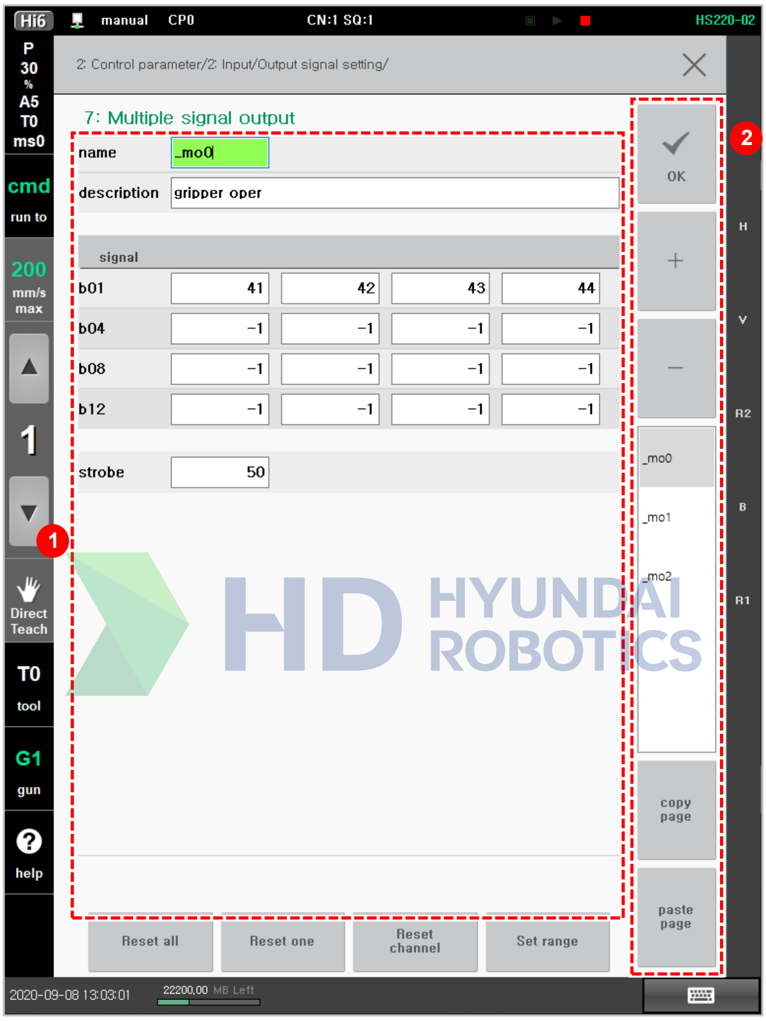
- **[None]**: The DIO block of the selected FB address will not be assigned. If nothing is selected as the initial setting value of the controller, the None item will be set.
- **[PLC]**: The DIO block of the selected FB address will be connected to PLC for the use. For the PLC operation, MULTPROG program will be used.
- **[Fieldbus]**: The DIO block of the selected FB address will be connected to the PCI communication board (Fieldbus) for the use. If the DIO block is connected to the PCI communication card, the PCI board selection window will be activated.

7.3.2.10 Multiple Signal Output

Output signals (up to 16 signals) can be created as a group, and data can be outputted through individual signals.

The data is in binary format and determines whether the output will be on or off. For example, the data to print do41 and do43 on the screen shown below is 0101 in binary (5 in decimal).

1. Touch the **[2: Control Parameter 〉 2: Input/Output Signal Setting 〉7: Multiple Signal Output]** menu
2. Set the name, signals, and strobe of the output signal group.


Hi6
manual
CP0
CN:1 SQ:1
HS220-02
P
30
%
A5
T0
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
2: Control parameter/2: Input/Output signal setting/
OK
+
−
_mo0
_mo1
_mo2
copy page
paste page
H
V
R2
B
R1
Reset all
Reset one
Reset channel
Set range
2020-09-08 13:03:01
22200.00 MB Left
1
2

7: Multiple signal output

name: _mo0

description: gripper oper

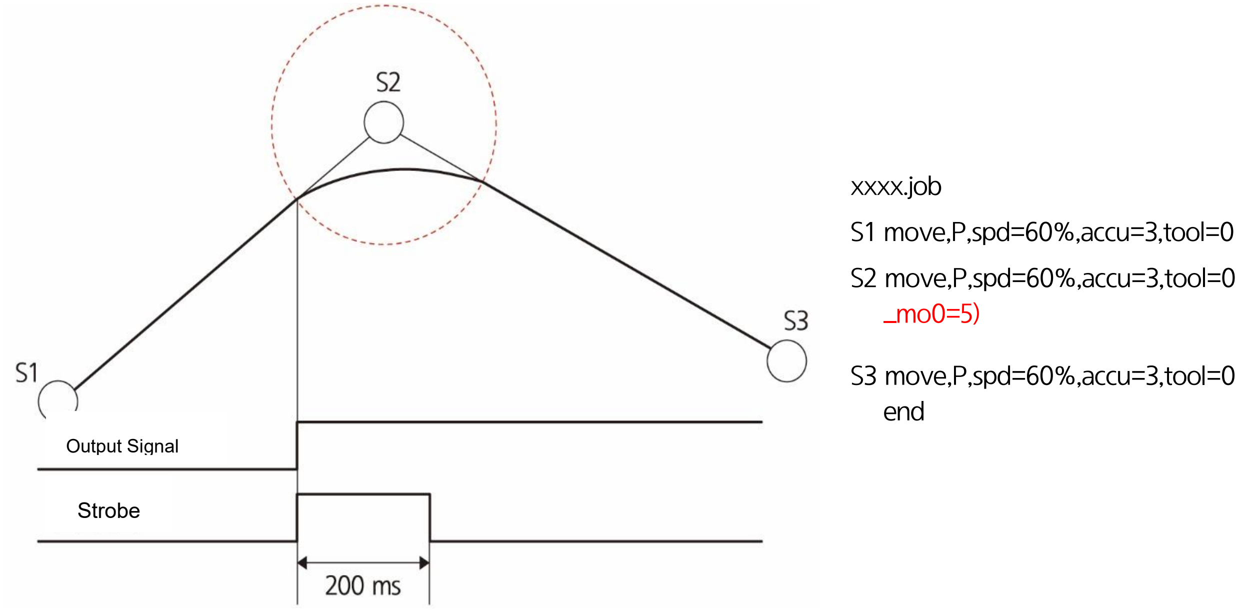
signal				
b01	41	42	43	44
b04	-1	-1	-1	-1
b08	-1	-1	-1	-1
b12	-1	-1	-1	-1

strobe: 50

No.	Description
❶	Detailed information on the group selected from the output signal group list. You can set the name, description, signal and strobe of the group. • **[Reset All]/[Reset One]:** You can reset the set value of all signals or of a selected signal to -1. • **[Reset Channel]:** You can reset the output channel of the set signal (0–9: digital signals) • **[Set Range]**: You can quickly set the signal by designating the start and end signals.
❷	• **[OK]:** You can save the edited content. • **[+]/[-]:** You can add a new output signal group or delete an output signal group. • This shows a list of output signal groups. Selecting a group name allows you to view and edit details. • **[Copy Page/Paste Page]:** You can copy the output signal group information and paste it to another group.

No.	Description
	- Select the name of the group to be copied from the list, touch the **[Copy Page]** button, select the name of the group to which the value is to be applied, and touch the **[Paste Page]** button.

For example, when a job program configured as the setting in the screen above is executed, the operation will be as follows.



```
xxxx.job
S1 move,P,spd=60%,accu=3,tool=0
S2 move,P,spd=60%,accu=3,tool=0
    _mo0=5)
S3 move,P,spd=60%,accu=3,tool=0
    end
```

Figure 54 Example of Job Program Execution

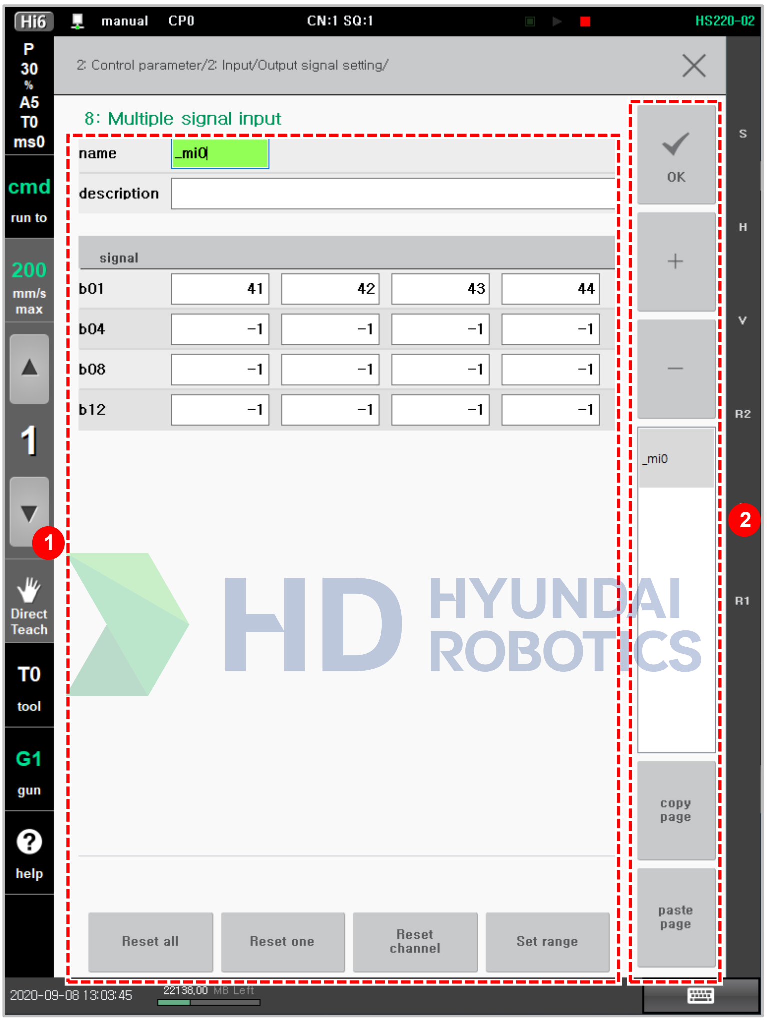
When the robot starts from S1 toward S2 and the accuracy of S2 is OK, the strobe signal will be outputted together with the signal of the designated group. The strobe signal will be turned off after 200 ms. (The strobe signal is a pulse signal of 200 ms.)

7.3.2.11 Multiple Signals Input

Input signals (up to 16 signals) can be created as a group, and data can be acquired through individual signals.

The data is in binary format and will be determined by the input on or off. For example, if di41 and di43 are on and all other signals are off, the data will be 0101 (5 in decimal).

1. Touch the **[2: Control Parameter 〉 2: Input/Output Signal Setting 〉 8: Multiple Signal Input]** menu.
2. Set the name, signals, and strobe of the input signal group.



2: Control parameter/2: Input/Output signal setting/

8: Multiple signal input

name: _mi0

description:

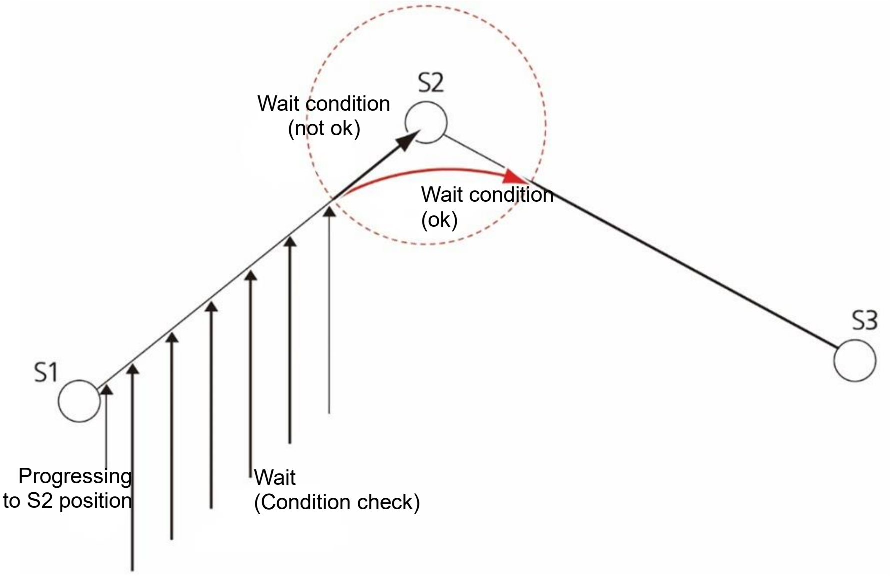
signal				
b01	41	42	43	44
b04	-1	-1	-1	-1
b08	-1	-1	-1	-1
b12	-1	-1	-1	-1

Hi6
manual
CP0
CN:1 SQ:1
HS220-02
P
30
%
A5
T0
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
OK
+
−
_mi0
copy page
paste page
Reset all
Reset one
Reset channel
Set range
S
H
V
R2
R1
1
2
2020-09-08 13:03:45
22138.00 MB Left

No.	Description
❶	Detailed information on the group selected from the input signal group list. You can set the name, description and signal of the group. • **[Reset All]**/**[Reset One]**: You can reset the set value of all signals or of a selected signal to -1. • **[Reset Channel]**: You can reset the input channel of the set signal (0–9: digital signals) • **[Set Range]**: You can quickly set the signal by designating the start and end signals.
❷	• **[OK]**: You can save the edited content. • **[+]**/**[-]**:You can add a new input signal group or delete an input signal group. • This shows a list of input signal groups. Selecting a group name allows you to check and edit details. • **[Copy Page]**/**[Paste Page]**: You can copy the input signal group information and paste it to another group.

	Select the name of the group to be copied from the list, touch the **[Copy Page]** button, select the name of the group to which the value is to be applied, and touch the **[Paste Page]** button.

For example, when a job program configured as the setting in the screen above is executed, the operation will be as follows.


S2
Wait condition
(not ok)
Wait condition
(ok)
S1
S3
Progressing
to S2 position
Wait
(Condition check)

```
xxxx.job
S1
move,P,spd=60%,accu=3,tool=0
S2
move,P,spd=60%,accu=3,tool=0
   wait (_mi0==0x5)
S3
move,P,spd=60%,accu=3,tool=0
   end
```

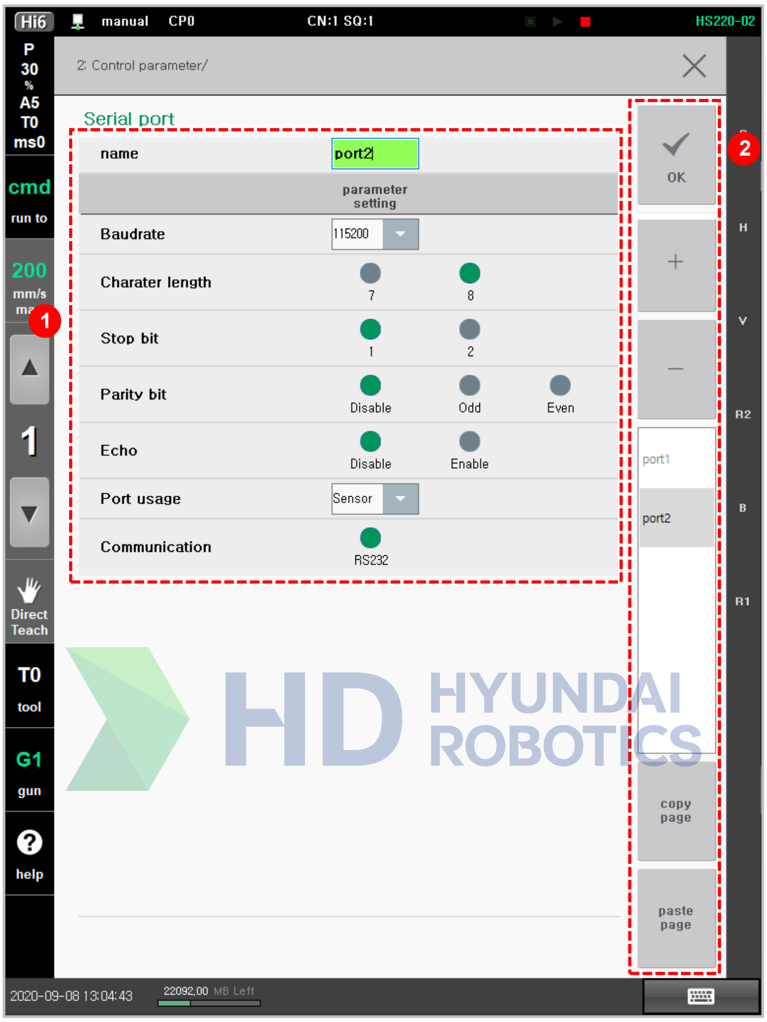
Figure 55 Example of Job Program Execution

After starting from S1 toward S2, the robot executes the wait statement. If the wait condition is satisfied before the accuracy of S2 is ok, the robot will move to the path in red. If this is not the case, the robot will wait until the wait condition is satisfied.

7.3.3 Serial Port

You can set the information required for serial port communication.

1. Touch the **[2: Control Parameter 〉 3: Serial port]** menu.
2. Set the parameters for each serial port.


Hi6
manual
CP0
CN:1 SQ:1
HS220-02
P
30
%
A5
T0
ms0
cmd
run to
200
mm/s
1
Direct Teach
T0
tool
G1
gun
help
2: Control parameter/
Serial port
parameter setting
OK
+
−
port1
port2
copy page
paste page
H
V
R2
B
R1
2020-09-08 13:04:43
22092.00 MB Left
1
2

name: port2
Baudrate: 115200
Charater length: ○ 7 ● 8
Stop bit: ● 1 ○ 2
Parity bit: ● Disable ○ Odd ○ Even
Echo: ● Disable ○ Enable
Port usage: Sensor
Communication: ● RS232

No.	Description
①	Detailed information on the port selected from the serial port list. You can set the port name and parameter values.
②	• **[OK]**: You can save the changes. • **[+]/[-]**: You can add a new serial port or delete a serial port. • A list of serial ports. Selecting a port name allows you to check and edit details. • **[Copy page]/[Paste page]**: You can copy the serial port information and paste it to another port. Select the name of the port information to be copied from the list, touch the **[Copy page]** button, select the name of the port to which the value is to be applied, and touch the **[Paste page]** button.

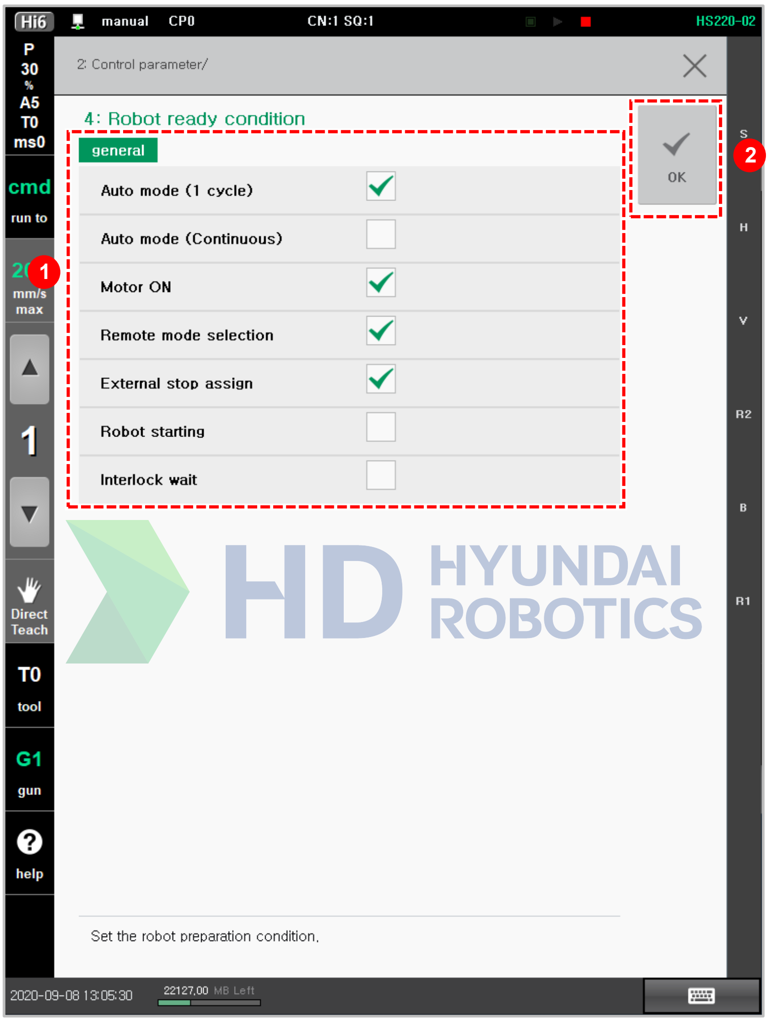
Notes	Refer to the following information when setting the usage of the serial port. • **Sensor**: For receiving the shift data by accessing the vision sensor • **LVS**: For connecting with the laser vision sensor for the weld line follow-up

	• **MODBUS**: The MODBUS slave function of the Hi6 controller

7.3.4 Robot Ready Condition

When the robot ready is completed, set the conditions for signal output in the **[Robot Ready OK]** item of the **[Set up〉 2: Control Parameter 〉 2: Input/Output Signal Setting 〉 4: Output Signal Assign]** menu.

1. Touch the **[2: Control Parameter 〉 4: Robot Ready Condition]** menu.
2. After setting the robot ready condition, touch the **[OK]** button.



2: Control parameter/

4: Robot ready condition

general

- Auto mode (1 cycle) ☑
- Auto mode (Continuous) ☐
- Motor ON ☑
- Remote mode selection ☑
- External stop assign ☑
- Robot starting ☐
- Interlock wait ☐

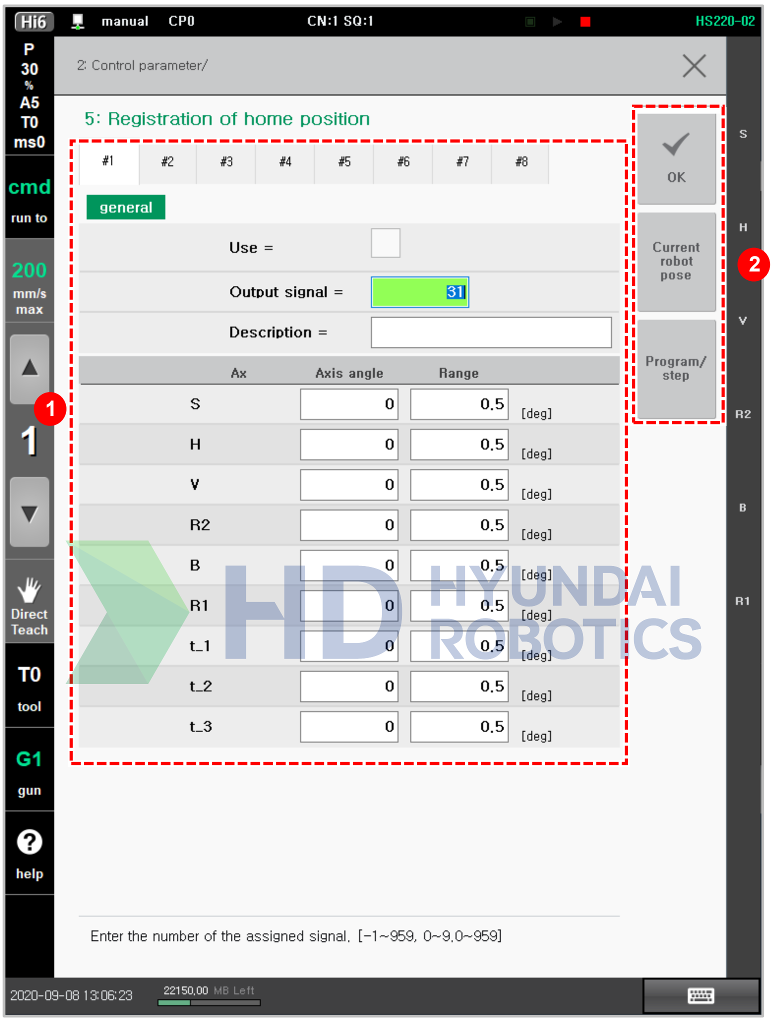
Set the robot preparation condition.

Hi6
manual
CP0
CN:1 SQ:1
HS220-02
P
30
%
A5
T0
ms0
cmd
run to
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
OK
S
H
V
R2
B
R1
HD HYUNDAI ROBOTICS
2020-09-08 13:05:30
22127.00 MB Left
①
②

7.3.5 Home Position Registration

By registering the robot's arbitrary posture as the home position, you can allow the home position signal to be outputted to the output signal field when the robot enters this position. The home position can be designated based on the posture of each axis, and up to eight postures can be registered and used, and the margin for each axis can be additionally set.

1. Touch the **[2: Control Parameter 〉 5: Registration of Home Position]** menu.
2. Select the home position tab, and then set the use, output signal, axis angle, and range.


Hi6
manual
CP0
CN:1 SQ:1
HS220-02
P
30
%
A5
T0
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
2: Control parameter/
OK
Current robot pose
Program/ step
S
H
V
R2
B
R1
①
②
2020-09-08 13:06:23
22150.00 MB Left

5: Registration of home position

#1 #2 #3 #4 #5 #6 #7 #8

general

Use = ☐

Output signal = 31

Description =

Ax	Axis angle	Range	
S	0	0.5	[deg]
H	0	0.5	[deg]
V	0	0.5	[deg]
R2	0	0.5	[deg]
B	0	0.5	[deg]
R1	0	0.5	[deg]
t_1	0	0.5	[deg]
t_2	0	0.5	[deg]
t_3	0	0.5	[deg]

Enter the number of the assigned signal. [-1~959, 0~9,0~959]

No.	Description

①	Detailed information on the home position selected in the tab. You can set the use, output signal, axis angle and range, and description.
	• **[Use]**: You can set whether to use.
	• **[Output Signal]**: You can input the output signal number.
	• **[Axis Angle]/[Range]**: You can input the axis angle and range of the robot at the home position.
	  • If the range is set to 0, home position inspection will not be performed for the axis.
	  • The range refers to a range that covers the + direction and - direction of the home point. For example, if the range is set to 0.5, the output range of the home position signal will be 1.

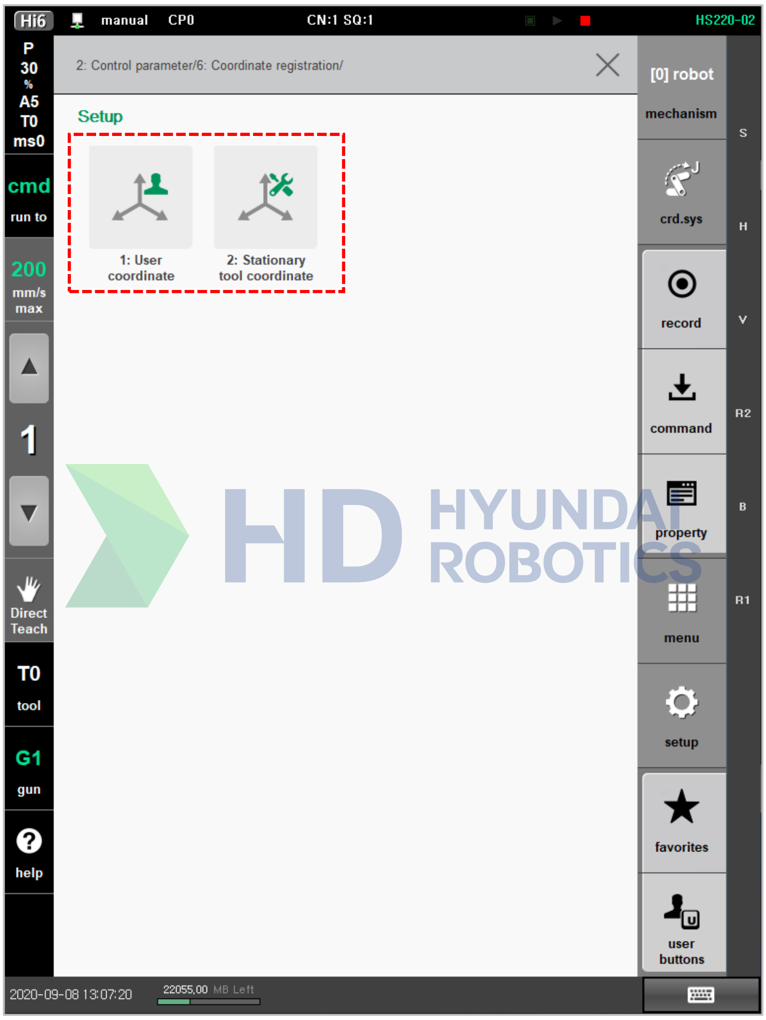
②	• **[OK]**: You can save the changes. • **[Current Robot Pose]**: The axis angle and range of the current robot posture will be automatically

	inputted. • **[Program/Step]**: If you input the program and step number, the axis angle and range of the relevant step will be automatically inputted.

7.3.6 Coordinate System Registration

1. Touch the **[2: Control Parameter 〉 6: Coordinate Registration]** menu. Then, the coordinate system registration menu will appear.

2. By selecting the desired menu, you can set the coordinate system with respect to the user coordinate system or the stationary tool coordinate system.


Hi6
manual
CP0
CN:1 SQ:1
HS220-02
P
30
%
A5
T0
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
2: Control parameter/6: Coordinate registration/
Setup
1: User coordinate
2: Stationary tool coordinate
[0] robot
mechanism
crd.sys
record
command
property
menu
setup
favorites
user buttons
S
H
V
R2
B
R1
2020-09-08 13:07:20
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7.3.6.1 User Coordinate System

The user coordinate system is a coordinate system that is to be set at a position designated by the user. To use the user coordinate system, first, teach three reference steps that are needed to define the user coordinate system, and then register the user coordinate system by designating the taught program number and user coordinate system number.

Teach three reference steps by following the procedures below.

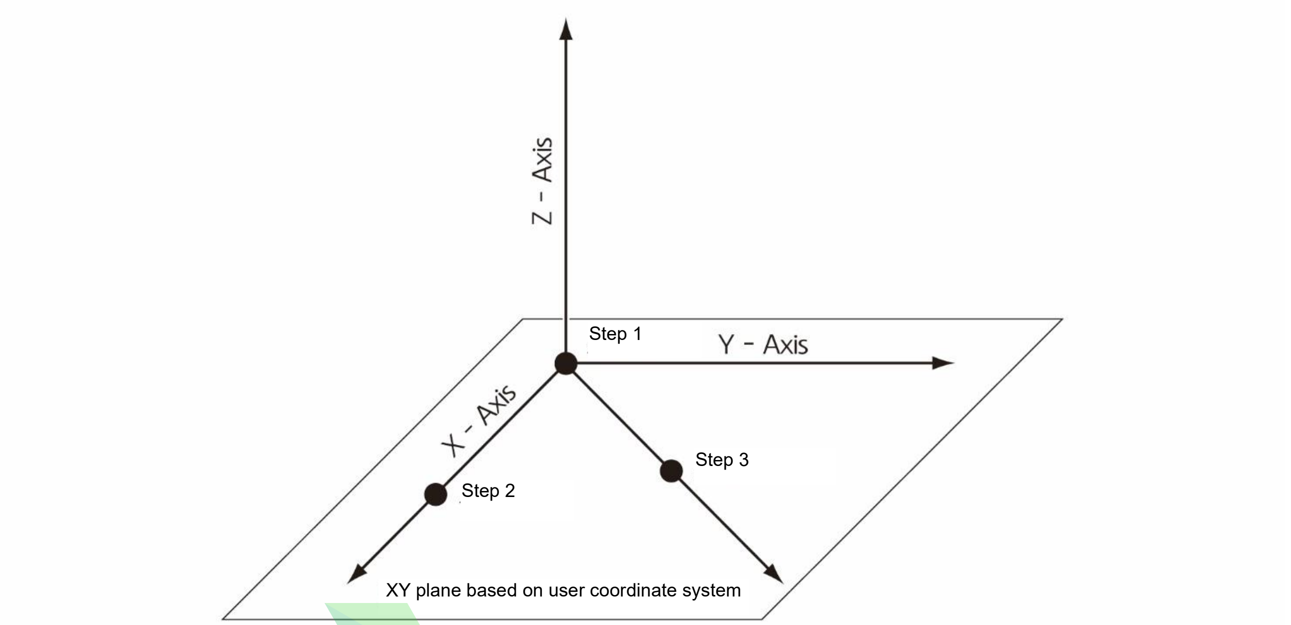


Figure 56 Method of Teaching Three Reference Steps for Defining the User Coordinate System

1. Define the origin of the user coordinate system: Teach an arbitrary point.
2. Define the X axis in the user coordinate system: Teach an arbitrary point on the X-axis line in a way that the arbitrary point can be 200 mm as distant as possible from the origin.
3. Define the XY plane in the user coordinate system (determine the Y-axis and Z-axis directions): Teach an arbitrary point on the plane consisting of the X axis and Y axis at the point where the distance from the origin is 200 mm or more as possible.

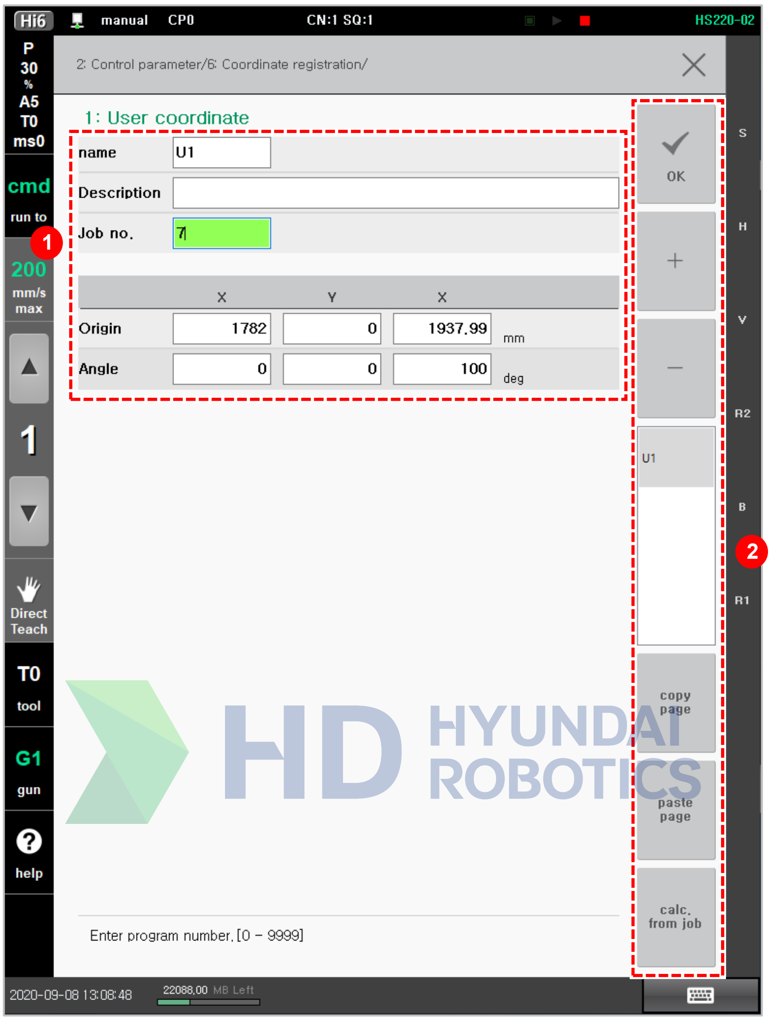
Notes	• When the teaching of the user coordinate system setting program is performed, the TCP should be set to the correct values. Check whether the tool data of the currently selected tool is inputted correctly. • You can register up to 10 user coordinate systems.

⚠ Caution	The cautions in recording the reference points for defining the coordinate system are as follows. • The reference 3 points should not exist on the same linear line. • The distance between the reference 3 points should not be too close to each other. • Subsequent steps after the XY plane in the user coordinate system is once defined will not have any effect on the coordinate system registration.

The method to register the user coordinate system by designating the taught program number and user coordinate system number is as follows.

1. Touch the **[2: Control Parameter 〉 6: Coordinate System Registration 〉 1: User Coordinate System]** menu.

2. Set the user coordinate system name and program number, and the distance and angle from each axis origin.



2: Control parameter/6: Coordinate registration/

1: User coordinate

name: U1

Description:

Job no.: 7

	X	Y	X	
Origin	1782	0	1937.99	mm
Angle	0	0	100	deg

Enter program number. [0 – 9999]

Hi6
manual
CP0
CN:1 SQ:1
HS220-02
P 30 % A5 T0 ms0
cmd
run to
200 mm/s max
1
Direct Teach
T0 tool
G1 gun
help
OK
+
−
U1
copy page
paste page
calc. from job
S
H
V
R2
B
R1
①
②
2020-09-08 13:08:48
22088.00 MB Left

No.	Description
①	Detailed information on the coordinate system selected from the user coordinate system list. You can set the coordinate system name and description, the taught program number, and the distance and angle from each axis origin.
②	• **[OK]**: You can save the changes. • **[+]/[−]**: You can add a new user coordinate system or delete a user coordinate system. • A list of user coordinate systems. Selecting the coordinate system name allows you to check and edit details. • **[Copy Page]/[Paste Page]**: You can copy the user coordinate system information and paste it into another coordinate system. After selecting the name of the coordinate system information to be copied from the list, and then touching the **[Copy Page]** button, select the name of the coordinate system to which the value is to be applied, and then touch the **[Paste Page]** button. • **[Calc.from job]**: You can calculate the user coordinate system based on the taught program to define the user coordinate system.

	If you touch the **[Calc. from job]** button after inputting the taught program number in the **[Job no.]** option, the origin and angle of the user coordinate system will be calculated.

7.3.6.2 Stationary Tool Coordinate System

A robot tool is a tool attached to the front end of the robot. In general, robots perform operations using tools attached to the robot. A typical example is arc welding. The arc welding tool is usually attached to the front end of the robot and is used to perform welding on the externally fixed workpiece.

On the other hand, in the case of a stationary tool, the tool is attached to the outside, not the robot. In this case, the robot handles the workpiece and places it on an externally fixed tool to operate. A typical operation using a stationary tool is the sealing operation. Normally, in the sealing operation, when the external tool discharges a certain amount of solvent required for sealing, the robot holds the workpiece and creates the required trajectory to operate.

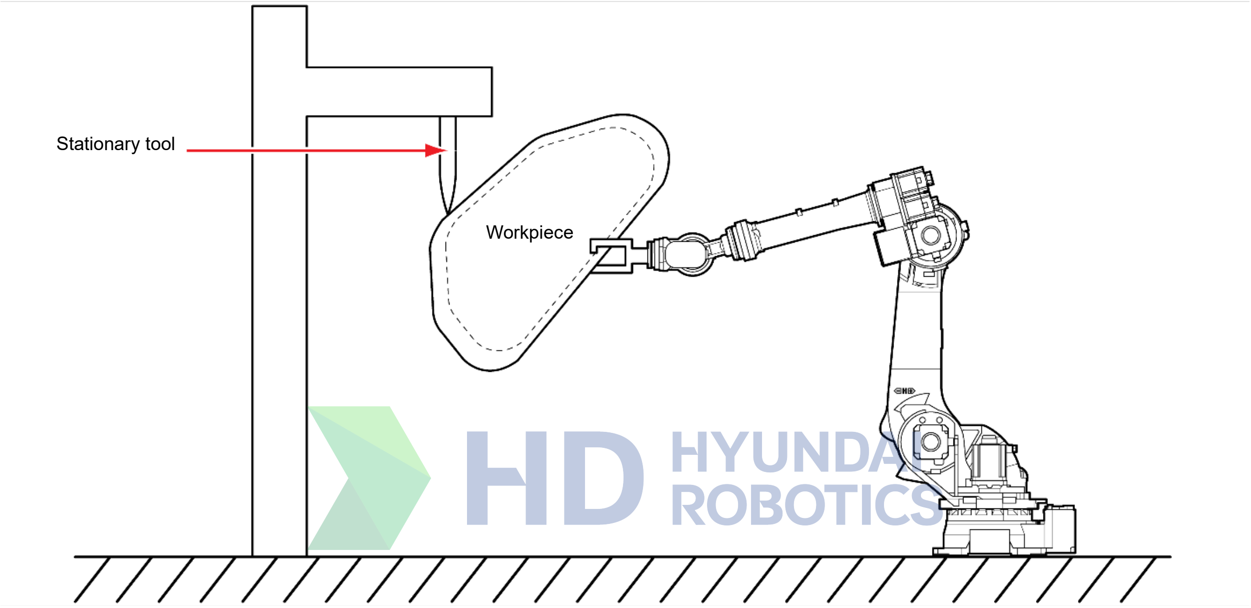


Figure 57 Example of a Sealing Operation

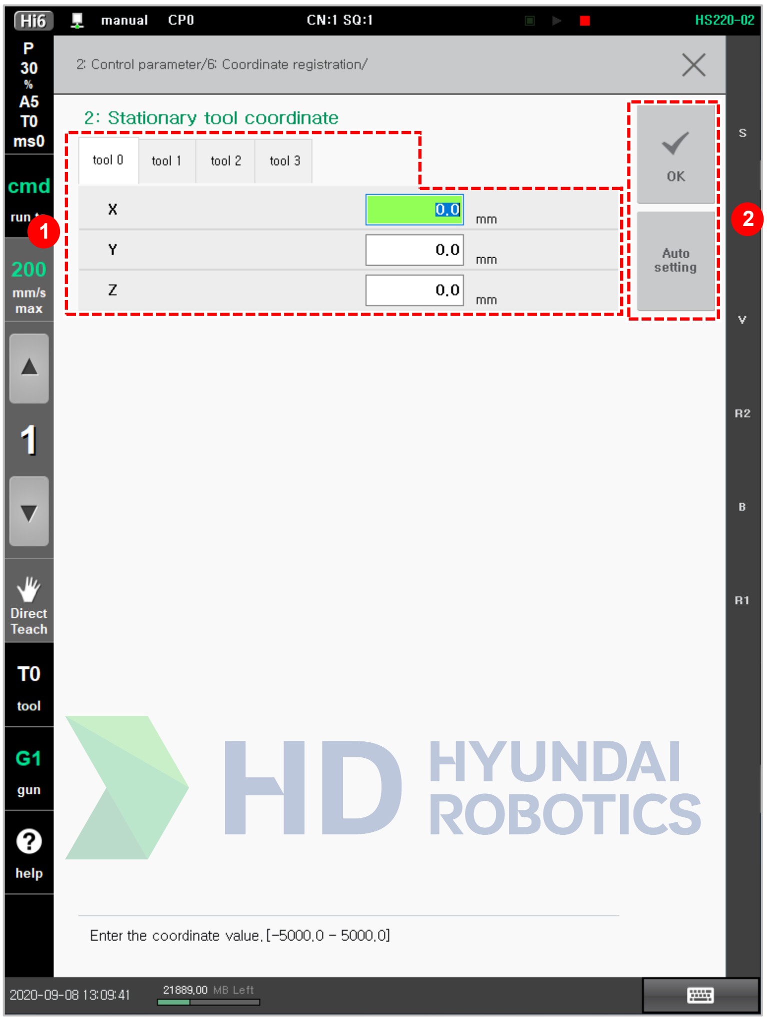
To create the required trajectory, the robot performs linear (L) and circular (C) interpolations based on the externally attached tool, not based on the tool attached to itself. At this time, the stationary tool interpolation function will be used.

When the stationary tool interpolation function is used, even if the posture of the workpiece held by the robot is changed, the moving path of the stationary tool on the workpiece can maintain the linear lines and arcs. As such, the stationary tool interpolation function must always be used for an operation for which the moving path of the external tool is important.

To use the stationary tool interpolation function, you must set the stationary tool coordinate system.

The method to set the stationary tool coordinate system is as follows.

1. Touch the **[2: Control Parameter 〉 6: Coordinate Registration 2: Stationary Tool Coordinate System]** menu.
2. Select the desired tab and register the position of the stationary tool coordinate system.


Hi6
manual CP0
CN:1 SQ:1
HS220-02
P 30 % A5 T0 ms0
cmd
run
200 mm/s max
1
Direct Teach
T0 tool
G1 gun
help
2: Control parameter/6: Coordinate registration/
2: Stationary tool coordinate
tool 0
tool 1
tool 2
tool 3
X
Y
Z
OK
Auto setting
S
V
R2
B
R1
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①
②

X	0.0	mm
Y	0.0	mm
Z	0.0	mm

Enter the coordinate value. [-5000.0 - 5000.0]

No.	Description
①	You can set a total of four stationary tool coordinate systems (tool 0 - tool 3) by selecting a tab.
②	• **[OK]**: You can save the changes. • **[Auto Setting]**: You can set the current TCP position as the position of the stationary tool coordinate system.

Setting the Current TCP Position as the Position of the Stationary Tool Coordinate System

After accurately finding the TCP based on the robot base coordinate system, you should match the stationary tool and the robot tool, as shown in the figure below, and then execute the automatic setting function using the **[Auto Setting]** button. Then, the current TCP position will be registered.

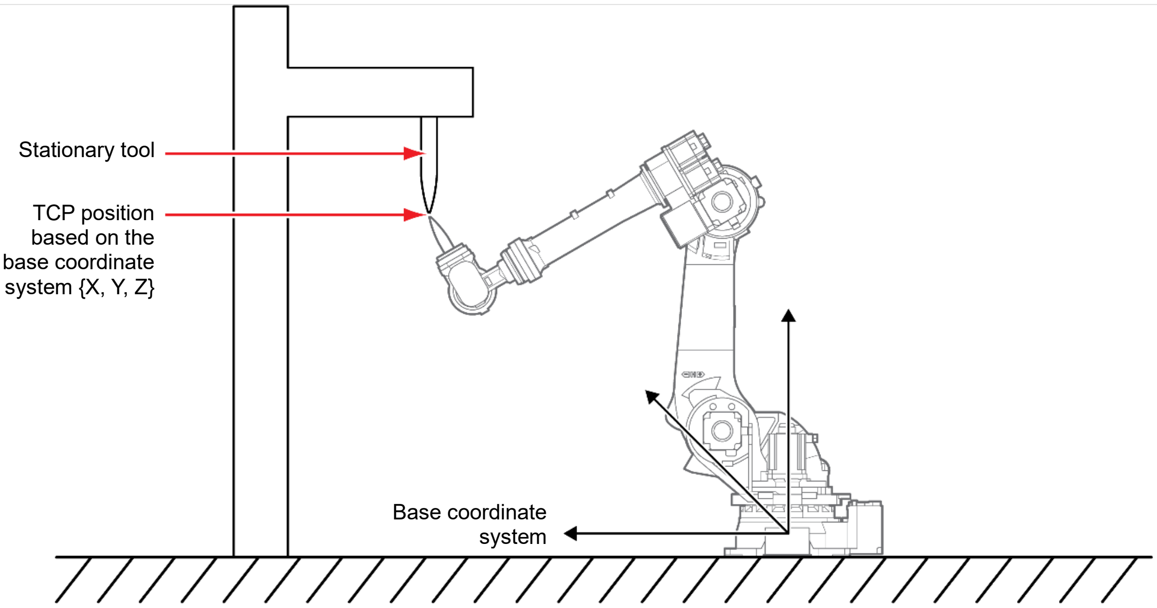
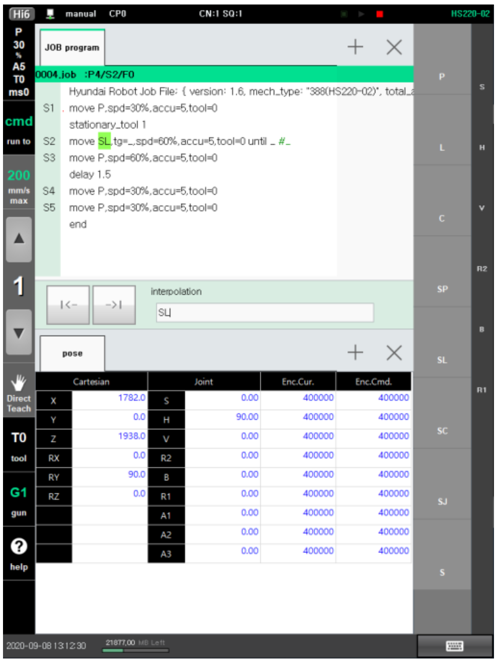

Stationary tool
TCP position based on the base coordinate system {X, Y, Z}
Base coordinate system

Figure 58 Method of Teaching Using the [Auto Setting] Button

Writing a Program Using the Stationary Tool Coordinate System

To perform the recording for the stationary tool interpolation step, you should record the step as SL or SC. Using the **[Recording Condition]** button on the upper left of the Hi6 teach pendant screen, you can change the recording condition to **SL** (stationary tool linear interpolation) or **SC** (stationary tool circular interpolation).

For example, if you register and use the stationary tool coordinate system No. 1, you can create a program as follows.


Hi6
manual
CP0
CN:1 SQ:1
HS220-02
P
30
%
A5
T0
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
JOB program
pose
P
L
C
SP
SL
SC
SJ
S
H
V
R2
B
R1
|<-
->|
2020-09-08 13:12:30
21877.00 MB Left

```
0004.job  :P4/S2/F0
     Hyundai Robot Job File; { version: 1.6, mech_type: "388(HS220-02)", total_
S1   move P,spd=30%,accu=5,tool=0
     stationary_tool 1
S2   move SL,tg=_,spd=60%,accu=5,tool=0 until _ #_
S3   move P,spd=60%,accu=5,tool=0
     delay 1.5
S4   move P,spd=30%,accu=5,tool=0
S5   move P,spd=30%,accu=5,tool=0
     end
```

interpolation: SL

Cartesian		Joint		Enc.Cur.	Enc.Cmd.
X	1782.0	S	0.00	400000	400000
Y	0.0	H	90.00	400000	400000
Z	1938.0	V	0.00	400000	400000
RX	0.0	R2	0.00	400000	400000
RY	90.0	B	0.00	400000	400000
RZ	0.0	R1	0.00	400000	400000
		A1	0.00	400000	400000
		A2	0.00	400000	400000
		A3	0.00	400000	400000

Figure 59 Example of Writing a Program When Using the Stationary Tool Coordinate System #1

Note	In the case of using the stationary servo gun, the stationary tool interpolation function is not required. This is because, in the servo gun welding, the moving path of the workpiece for the stationary servo gun does not need to be formed in a linear line or arc while only the welding point is important.

7.3.7 Scheduled Program Execution

For details on how to execute scheduled programs, refer to the **"Hi6 Controller Scheduled Program Execution Function Manual."**

7.3.8 Automatic Backup and Recovery

For details on how to automatically back up and recover the controller's data, refer to the "**Hi6 Controller Automatic Backup Function Manual.**"

7.3.9 Industrial Communication

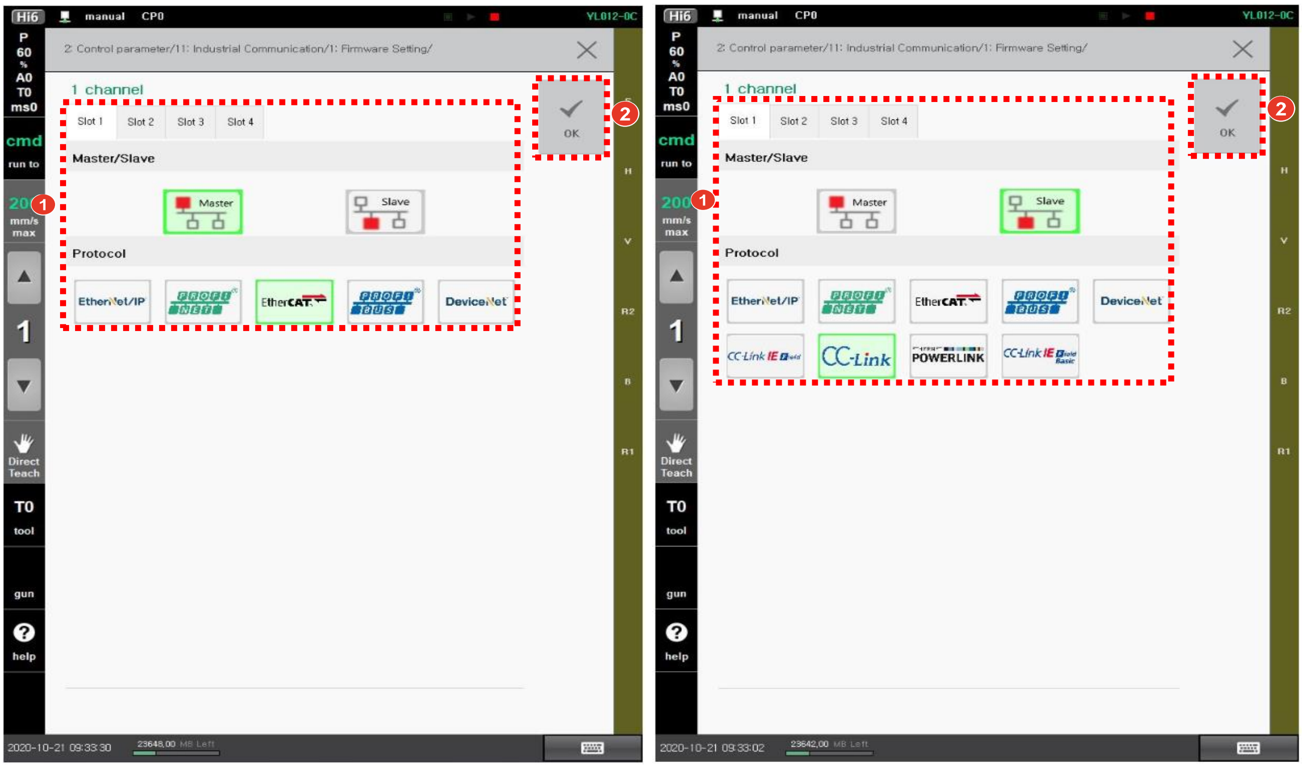
You can perform the setting of the industrial communication to use it.

1. Depending on the type of the communication to use, you need to install a PCI card and then set the slot number (1 to 4) by referring to the **"Hi6 Controller Maintenance Manual**".
2. Set the industrial communication firmware by referring to "**7.3.9.1 Firmware Setting**".
3. Turn off the power of the controller, and then turn it back on.
4. If necessary, carry out additional setting by referring to "**7.3.9.2 Industrial Communication Setting**".

7.3.9.1 Firmware Setting

You can set the firmware to be used for the industrial communication.

1. Touch the **[2: Control Parameter 〉 11: Industrial Communication 〉 1: Firmware Setting 〉 1 Channel]** menu. Then, the firmware setting screen will appear.
2. Select the desired tab and then set the communication method **(Master / Slave)** and protocol. After that, tap the **[OK]** button.


2: Control parameter/11: Industrial Communication/1: Firmware Setting/
1 channel
Slot 1
Slot 2
Slot 3
Slot 4
Master/Slave
Master
Slave
Protocol
EtherNet/IP
PROFINET
EtherCAT
PROFIBUS
DeviceNet
CC-Link IE Field
CC-Link
POWERLINK
CC-Link IE Field Basic
OK
①
②
2020-10-21 09:33:30
2020-10-21 09:33:02

⚠ Caution	When the firmware setting is completed, the CONFIG files set in the slot #1 - #4 will be all deleted. When you want to change the communication firmware in the middle of using it, you should back up the existing CONFIG setting separately and use it after restoring it.

3. Turn off the power of the controller, and then turn it back on.

⚠ Caution	When you perform the setting of the firmware to use it, the setting value will be applied to the system only after you turn off the power of the controller and then turn it back on.

7.3.9.2 Industrial Communication Setting

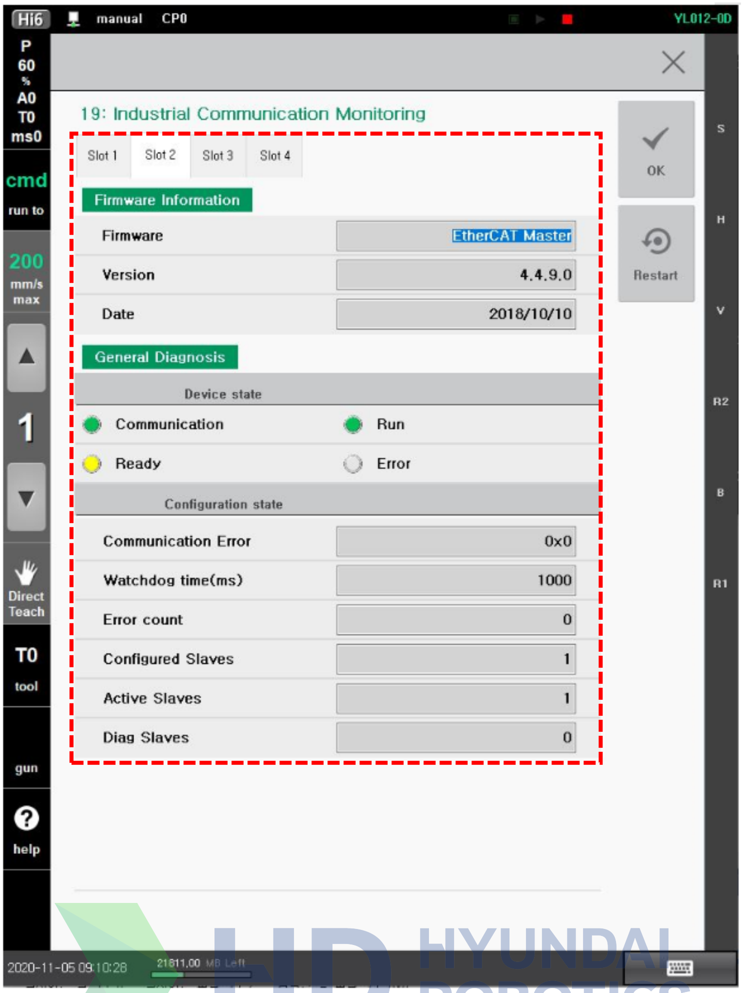
(The function to be provided later) If you set the communication method to CC-Link slave, you can set the detailed information for each type of communication inside the controller.

Note	You can set the communication information by using the “Sycon.net” program on the Hyundai Robotics internet website (www.hyundai-robotics.com).

7.3.9.3 Monitoring

You can monitor the setting information and operation status of the firmware and communication the use of which you have set in the industrial communication menu.

1. Touch **[Menu]** button 〉 **[19: Industrial Communication Monitoring]** menu. Then the screen for monitoring the industrial communication of each board will appear.
2. By selecting the desired tab, you can check the detailed information of the firmware, communication devices and communication configuration.


Hi6
manual
CP0
YL012-0D
P
60
%
A0
T0
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
gun
help
OK
Restart
S
H
V
R2
B
R1
2020-11-05 09:10:28
21811.00 MB Left

19: Industrial Communication Monitoring

Slot 1 | Slot 2 | Slot 3 | Slot 4

Firmware Information

Firmware	EtherCAT Master
Version	4.4.9.0
Date	2018/10/10

General Diagnosis

Device state

● Communication ● Run

● Ready ○ Error

Configuration state

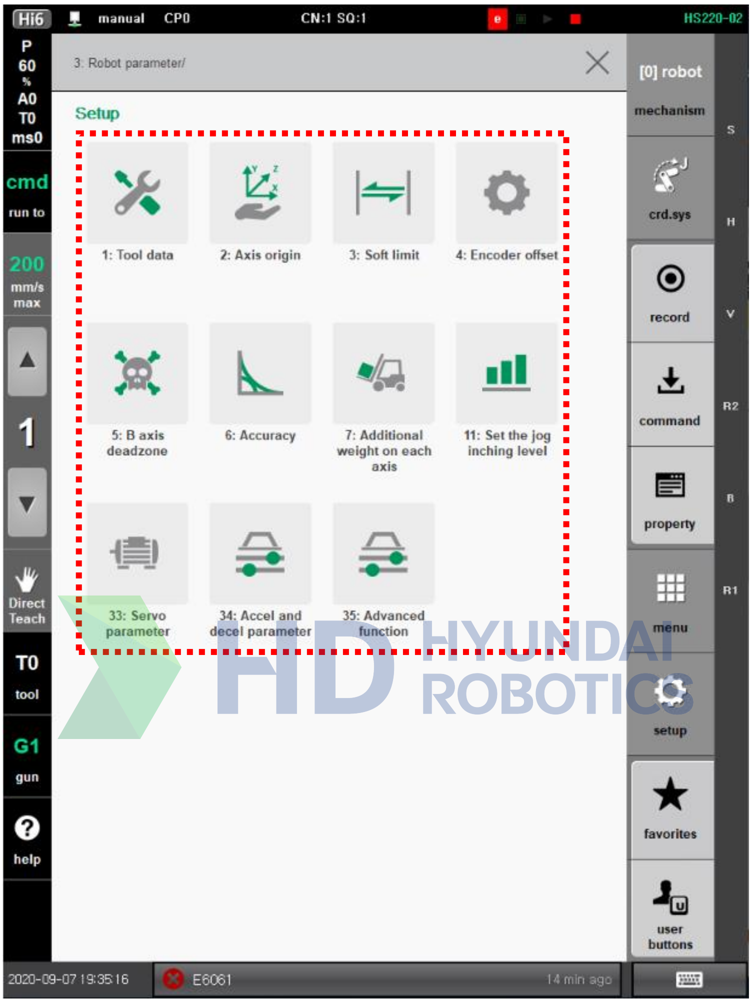
Communication Error	0x0
Watchdog time(ms)	1000
Error count	0
Configured Slaves	1
Active Slaves	1
Diag Slaves	0

Note	You can restart the industrial communication of the PCI communication card by using the **[Restart]** button.

7.4 Robot Parameters

You can set various data related to robot operation as well as information such as the origin and operation range of each axis.

1. Touch the **[3: Robot Parameter]** menu. Then, the robot parameter menu will appear.
2. You can check and set various parameters of the manipulator by selecting the desired menu.


Hi6
manual
CP0
CN:1 SQ:1
HS220-02
P
60
%
A0
T0
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
3: Robot parameter/
Setup
1: Tool data
2: Axis origin
3: Soft limit
4: Encoder offset
5: B axis deadzone
6: Accuracy
7: Additional weight on each axis
11: Set the jog inching level
33: Servo parameter
34: Accel and decel parameter
35: Advanced function
[0] robot
mechanism
crd.sys
record
command
property
menu
setup
favorites
user buttons
S
H
V
R2
B
R1
2020-09-07 19:35:16
E6061
14 min ago

7.4.1 Tool Data

You can set the distance and angle of the TCP based on the robot's R1-axis flange and register the tool's weight, center of gravity, and inertia. You can perform registration manually using the **[1: Tool data]** menu.

In another way, the tool length can be set using the automatic calibration function, and the tool's weight, center of gravity, and inertia can be registered using the load estimation function.

In the case of interpolation operation such as linear or circular interpolation, the trajectory will be created based on the TCP, so the length and angle of the tool should be accurately set before the teaching.

The Hi6 controller performs control based on the dynamics of the robot. The robot can operate quickly and safely only when the weight, center, and inertia of the tool are correctly set. If the weight, center, and inertia values of the tool are incorrect or wrong, serious problems may occur in the performance and service life of the robot.

In particular, in the case of using the tool change function, all tool information related to tool change, not only the information about each tool, but also separate numbers assigned to disconnected tools, should be inputted for the use. Moreover, even during the handling operation, the attachment/detachment status of the workpiece should be assigned to each tool number for the use.

The length of the tool is the length in each direction in the flange coordinate system. (Length in X-axis direction: Xt / Length in Y-axis direction: Yt / Length in Z-axis direction: Zt)

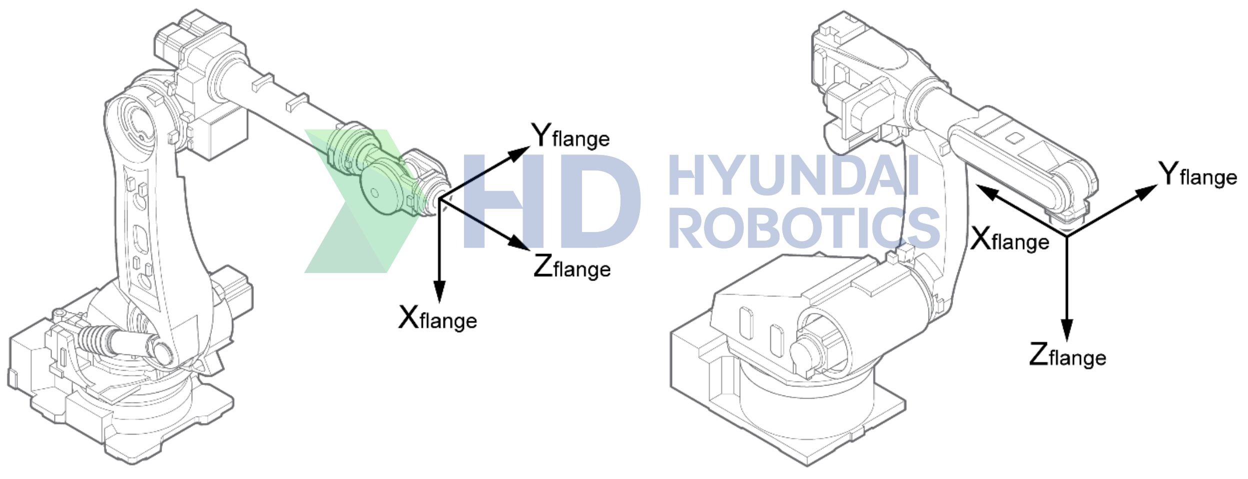


Figure 60 Flange Coordinate System for Each Robot Type

The angle of the tool is the posture conversion amount in each direction in the flange coordinate system. (Angle in X-axis direction: Rx / Angle in Y-axis direction: Ry / Angle in Z-axis direction: Rz)

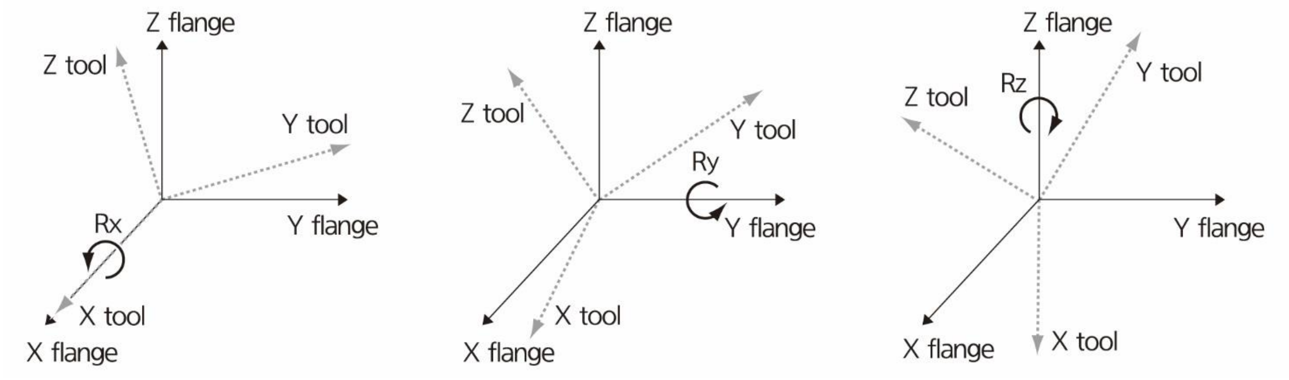


Figure 61 Tool Angle: Rotating Rx (Left) / Rotating Ry (Middle) / Rotating Rz (Right)

The length and angle of the tool will be set based on the flange coordinate system. The tool length can be set as the distance from the center of the flange coordinate system to the TCP.

The tool posture is a value acquired by performing rotation sequentially in the X, Y, and Z directions based on the tool flange coordinate system according to the tool angle set as above.

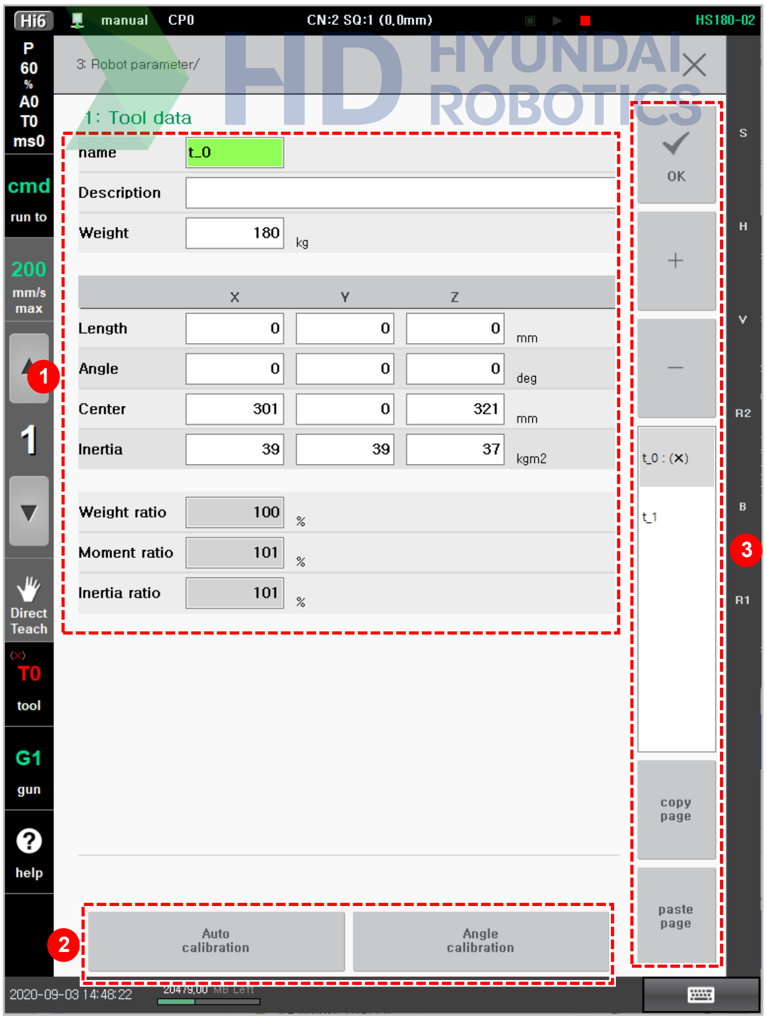
$$Rxyz = Rot(z, Rz)Rot(y, Ry)Rot(x, Rx)$$

- **Rxyz**: Tool posture rotation matrix based on the tool flange
- **Rot(z, Rz)**: Rotation matrix that rotation occurs as much as Rz in the Z-axis direction of the flange coordinate system
- **Rot(y, Ry)**: Rotation matrix that rotation occurs as much as Ry in the Y-axis direction of the flange coordinate system
- **Rot(x, Rx)**: Rotation matrix that rotation occurs as much as Rx in the X-axis direction of the flange coordinate system

7.4.1.1 Tool Data Setting

The manual method of setting the distance and angle of TCP based on the robot's R1-axis flange and registering the tool's weight, center of gravity, and inertia is as follows.

1. Touch the **[3: Robot Parameter > 1: Tool Data]** menu.
2. Set the tool data name, weight, detailed conditions of each axis, and allowable ratio.


Hi6
manual
CP0
CN:2 SQ:1 (0.0mm)
HS180-02
P
60
%
A0
T0
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
OK
+
−
t_0 : (×)
t_1
copy page
paste page
S
H
V
R2
B
R1
Auto calibration
Angle calibration
2020-09-03 14:48:22
20479.00 MB Left
1
2
3

3: Robot parameter/

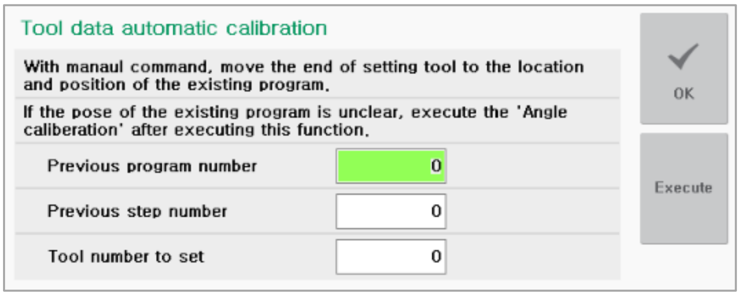
1: Tool data

name	t_0			
Description				
Weight	180			kg
	X	Y	Z	
Length	0	0	0	mm
Angle	0	0	0	deg
Center	301	0	321	mm
Inertia	39	39	37	kgm2
Weight ratio	100			%
Moment ratio	101			%
Inertia ratio	101			%

<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td>❶</td><td>Detailed information on the tool data selected from the tool data list. You can set the tool data name and description, weight, detailed conditions of each axis, and allowable ratio.</td></tr>
<tr><td>❷</td><td>

- **[Auto Calibration]**: You can create new tool data or can create tool data simply by using an existing program.

  If you want to perform setting newly at the previously taught step position, you should first place the tool, and then execute the automatic calibration function to create tool length and angle newly.



Tool data automatic calibration

With manaul command, move the end of setting tool to the location and position of the existing program.

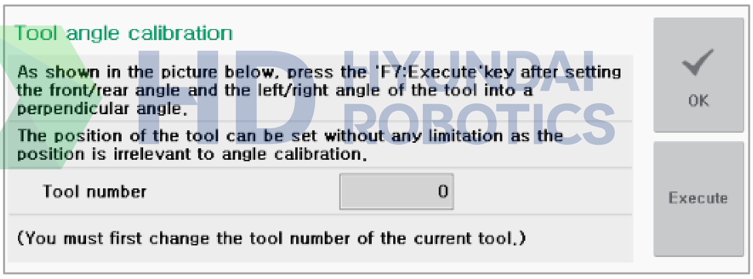
If the pose of the existing program is unclear, execute the 'Angle caliberation' after executing this function.

Previous program number: 0

Previous step number: 0

Tool number to set: 0

  - **[Previous Program Number]**: You can input the program number taught before tool deformation occurs.
  - **[Previous Step Number]**: You can input the step number for which automatic tool data calibration will be performed.
  - **[Tool Number to Set]**: You can input the tool number to be newly set.
- **[Angle Calibration]**: You can calibrate the angle of the tool.



Tool angle calibration

As shown in the picture below, press the 'F7:Execute'key after setting the front/rear angle and the left/right angle of the tool into a perpendicular angle.

The position of the tool can be set without any limitation as the position is irrelevant to angle calibration.

Tool number: 0

(You must first change the tool number of the current tool.)

</td></tr>
<tr><td>❸</td><td>

- **[OK]**: You can save the changes.
- **[+]/[-]**: You can add new tool data or delete tool data.
- Tool data list. Selecting a tool data name will allow you to check and edit detailed information.
- **[Copy page]/[Paste page]**: You can copy the tool data information and then paste it to another tool data.

  After selecting the name of the tool data information to be copied from the list and touching the **[Copy page]** button, select the name of the tool data to which the value is to be applied, and then touch the **[Paste page]** button.

</td></tr>
</table>

Notes	- In the tool data list, tool data for which load estimation is not performed will be marked with (X) to the right side of the name. - You must perform load estimation first before using the tool. The use of tools for which load estimation is not performed could cause trouble with the speed and durability of the robot. - When tool data is copied, the load estimation data will also be copied. The tool data copying and pasting functions can only be executed on the tab of the tool number for which load estimation has been performed.

7.4.1.2 Tool Data Setting Information

- **[Weight]**: Weight of the tool (kg)
- **[Length]**: Length of the tool (mm). You can set it using the automatic calibration function or the auto calibration.
- **[Angle]**: Angle of the tool (deg). You can set it using the automatic calibration function or the angle calibration function.
- **[Center]**: Position of the center of gravity of the tool based on the center of the flange (mm). You can set it using the load estimation function.
- **[Inertia]**: The moment of inertia (kg/m^2) of the tool with respect to the tool coordinate. You can set it using the load estimation function.
- Allowable Ratio: (Only for the robot models to which high-load mode is applied) This is the ratio of the current setting against the allowable reference value. The robot operation, according to the allowable ratio, is as follows.

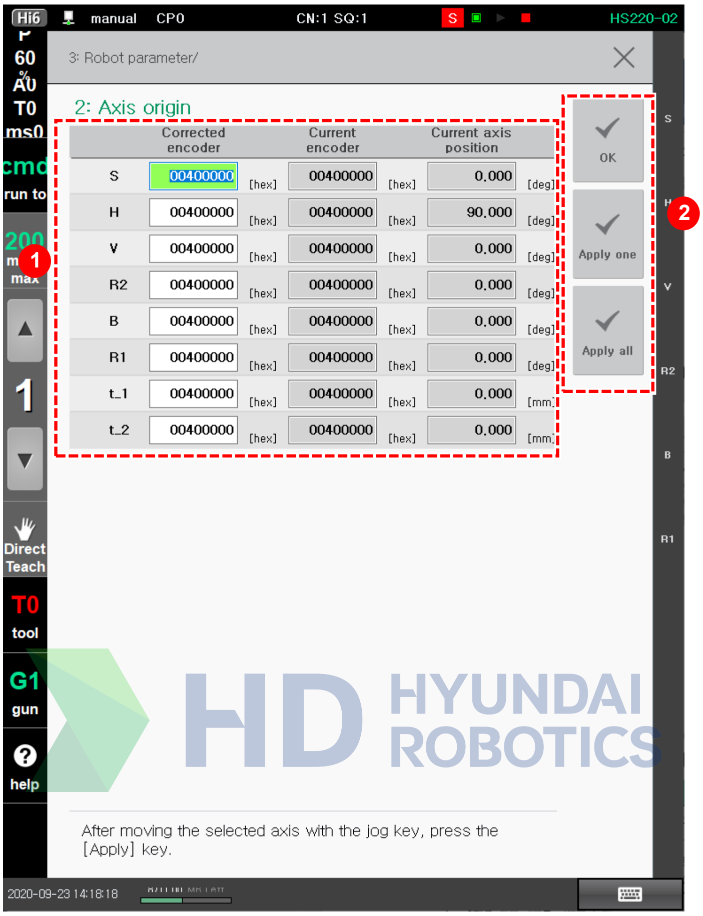
Classification	Normal	High-load mode	Exception allowable mode	Playback impossible (Large size)
Weight ratio (%)	- 100	100–120	100–120	120 -
Moment ratio (%)	- 100	100–110	100–115 (150)	115 (150) -
Inertia ratio (%)	- 100	100–130	100–150 (600)	150 (600) -

Note	The allowable ratio can be changed depending on the robot model and controller software version.

7.4.2 Axis Origin

You can register the mechanical origin position of each axis.

1. Touch the **[3: Robot Parameter 〉 2: Axis Origin]** menu.
2. Register the mechanical origin position of each axis.



2: Axis origin

	Corrected encoder		Current encoder		Current axis position	
S	00400000	[hex]	00400000	[hex]	0.000	[deg]
H	00400000	[hex]	00400000	[hex]	90.000	[deg]
V	00400000	[hex]	00400000	[hex]	0.000	[deg]
R2	00400000	[hex]	00400000	[hex]	0.000	[deg]
B	00400000	[hex]	00400000	[hex]	0.000	[deg]
R1	00400000	[hex]	00400000	[hex]	0.000	[deg]
t_1	00400000	[hex]	00400000	[hex]	0.000	[mm]
t_2	00400000	[hex]	00400000	[hex]	0.000	[mm]

After moving the selected axis with the jog key, press the [Apply] key.

No.	Description
①	Detailed information on the mechanical origin position of each axis. You can set the encoder and position of the axis. • S-axis: You can change the S-axis origin depending on the installation situation of the robot and surrounding jig. • R1-axis: You can change the origin of the R1- axis origin according to the tool attachment direction. • H, V, R2, and B axes: Can be set automatically through the automatic calibration function
②	• **[OK]**: You can save the changes. • **[Apply One]**: You can apply the selected origin position to the selected axis information. • **[Apply All]**: You can apply the selected origin position to all axis information.

⚠ Caution	
	• The axis origin setting affects the accuracy of the robot's cartesian operation. Change it to the exact value as much as possible. • If the axis origin setting is changed, the position of the previously created program will be changed. Therefore, the axis origin setting must be executed only at the initial installation stage. • If the encoder offset setting is changed, the axis origin should be newly set. Therefore, the

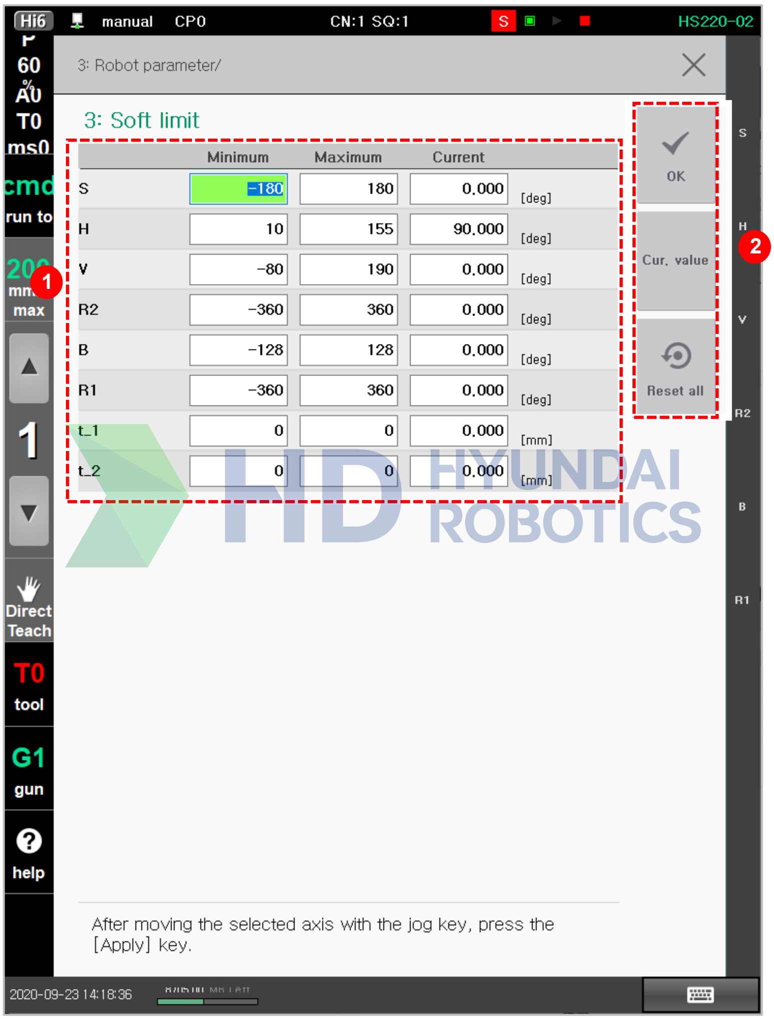
	encoder offset setting must be completed before the setting of the axis origin.

Note	At the time of the shipping from the factory, the mechanical origin position of each axis is set at the standard value (0X400000).

7.4.3 Soft Limit

You can adjust the operation range of each axis according to the robot's use environment.

1. Touch the **[3: Robot Parameter 〉 3. Soft Limit]** menu.
2. Set the operation range of each axis.


Hi6
manual
CP0
CN:1 SQ:1
S
HS220-02
60
AU
T0
ms0
cmd
run to
200
mm
max
1
Direct Teach
T0
tool
G1
gun
help
S
H
V
R2
B
R1
①
②
OK
Cur. value
Reset all
2020-09-23 14:18:36

3: Robot parameter/

3: Soft limit

	Minimum	Maximum	Current	
S	-180	180	0.000	[deg]
H	10	155	90.000	[deg]
V	-80	190	0.000	[deg]
R2	-360	360	0.000	[deg]
B	-128	128	0.000	[deg]
R1	-360	360	0.000	[deg]
t_1	0	0	0.000	[mm]
t_2	0	0	0.000	[mm]

After moving the selected axis with the jog key, press the [Apply] key.

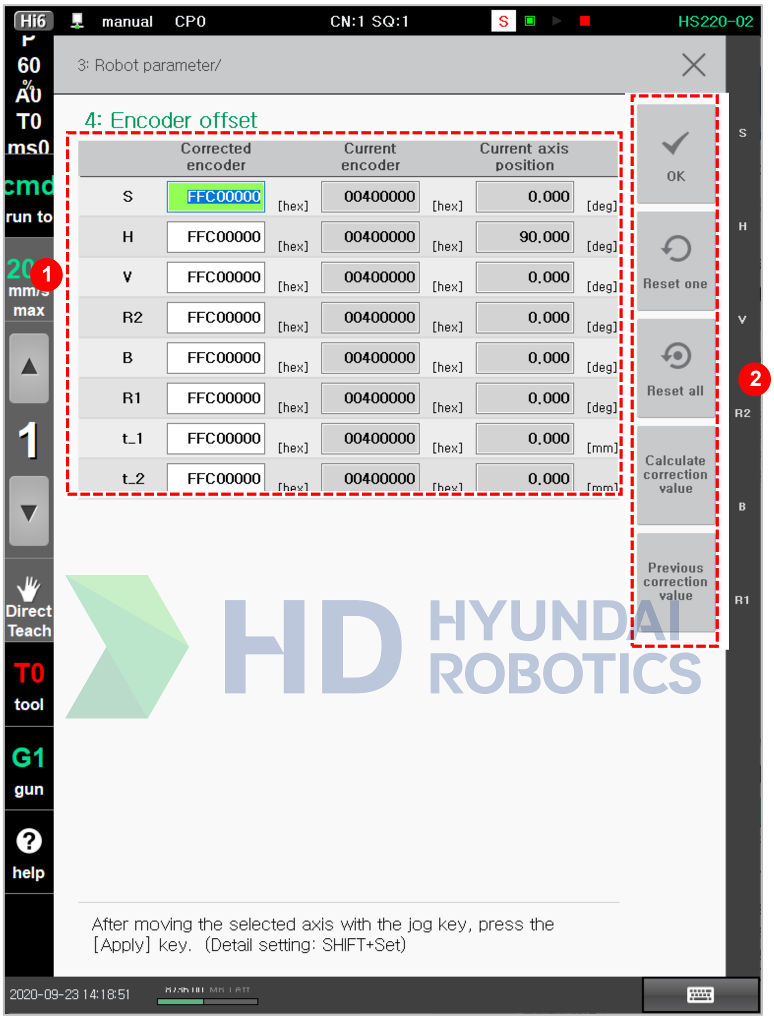
No.	Description
①	Detailed information on the operation range of each axis. You can set the minimum and maximum operation ranges of an axis and the current axis position.
②	• **[OK]**: You can save the changes. • **[Cur. Value]**: You can set the operation range of each axis based on the current robot position. • **[Reset All]**: You can initialize the operation range of all axes.

Note	At the time of the shipping from the factory, the operation range of each axis of the robot is set to a maximum.

7.4.4 Encoder Offset

The current encoder position can be set as the encoder origin position (position 0X400000). You can determine the encoder origin at the reference position of each axis of the robot (the position where the scale of each axis is attached).

1. Touch the **[3: Robot Parameter 〉 4: Encoder Offset]** menu.
2. Set the encoder offset value by adjusting the position of each axis. The encoder offset value will be recorded as a hex value (a hexadecimal number).


Hi6
manual
CP0
CN:1 SQ:1
S
HS220-02
P
60
%
A0
T0
ms0
cmd
run to
20
mm/s
max
▲
1
▼
Direct
Teach
T0
tool
G1
gun
help
3: Robot parameter/
OK
Reset one
Reset all
Calculate correction value
Previous correction value
S
H
V
R2
B
R1
1
2
2020-09-23 14:18:51

4: Encoder offset

	Corrected encoder		Current encoder		Current axis position	
S	FFC00000	[hex]	00400000	[hex]	0.000	[deg]
H	FFC00000	[hex]	00400000	[hex]	90.000	[deg]
V	FFC00000	[hex]	00400000	[hex]	0.000	[deg]
R2	FFC00000	[hex]	00400000	[hex]	0.000	[deg]
B	FFC00000	[hex]	00400000	[hex]	0.000	[deg]
R1	FFC00000	[hex]	00400000	[hex]	0.000	[deg]
t_1	FFC00000	[hex]	00400000	[hex]	0.000	[mm]
t_2	FFC00000	[hex]	00400000	[hex]	0.000	[mm]

After moving the selected axis with the jog key, press the [Apply] key. (Detail setting: SHIFT+Set)

No.	Description
❶	Detailed information on the encoder offset value of each axis. You can set the calibrated encoder value, current encoder value, and current position of an axis.
❷	• **[OK]**: You can save the changes. • **[Reset One]**/**[Reset All]**: You can initialize the encoder offset value of the selected or every axis. • **[Calculate Correction Value]**: You can calibrate the encoder offset value of the selected axis. • **[Previous Correction Value]**: You can retrieve the encoder offset value that existed prior to the calibration of the selected axis.

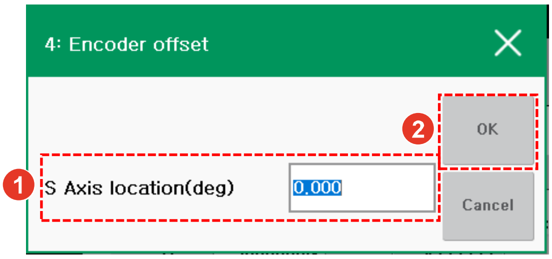
Note	The encoder offset value is set at the time of the shipping from the factory. Resetting the encoder offset value should be performed only when necessary, such as replacing the motor or encoder.

7.4.4.1 Encoder Offset Value Utilization

To continue using the existing program even after the current job program is backed up and the system is initialized **([Set up 〉 5: Initialize〉 1: System Initialization])**, the robot should maintain the reference position information that existed before initialization. If you record the encoder offset value, the previous position information of the robot can be retrieved.

After system initialization, directly input the encoder offset value as a hex value. It will be easy to input the value if you use the soft keyboard.

If the encoder offset value is recorded as the axis position value (mm or degree), you need to input the axis position value into the input window that will appear when you touch the **[Reset One]** button while pressing the **〈Shift〉** key.



4: Encoder offset

S Axis location(deg) 0.000

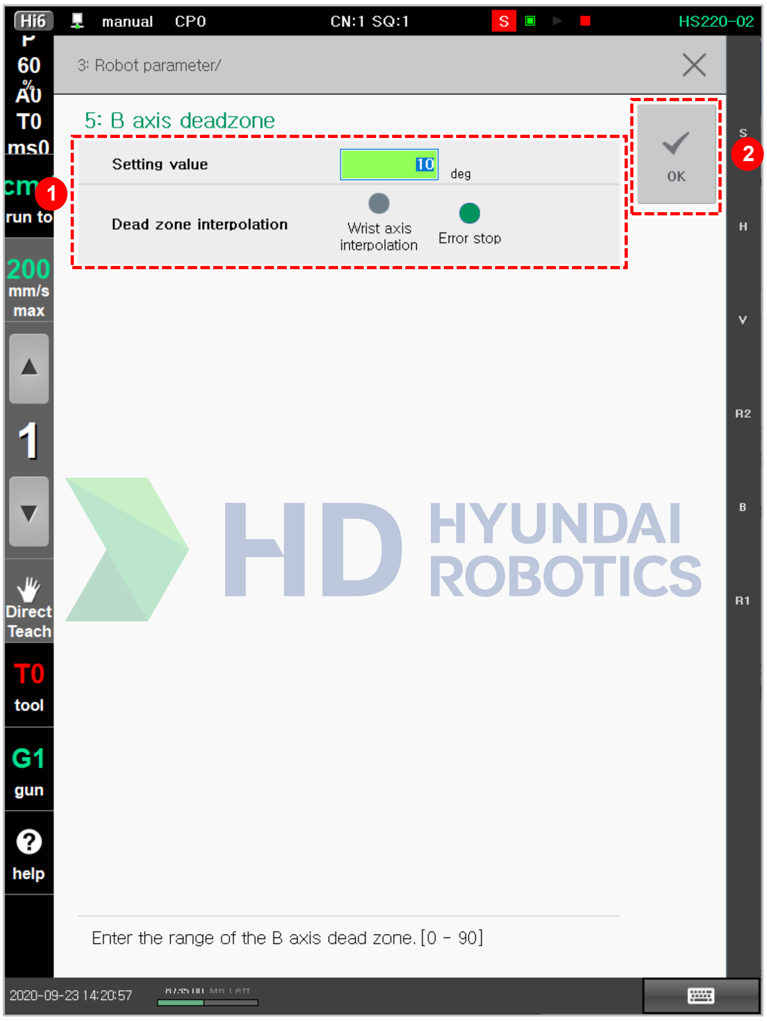
Note	The basic setting value in the axis position input window is the reference position value. If you save without inputting the axis position value, the current encoder position will be set as the origin position (0X400000).

7.4.5 B-Axis Deadzone

Around 0 degree of the B-axis, the rotational center of the R1 axis and the rotational center axis of the R2 axis will be almost in parallel. When the TCP of the robot performs interpolation such as linear interpolation or circular interpolation, the wrist axis will move rapidly even in small movements.

Set the B-axis no-use area.

1. Touch the **[3: Robot Parameter 〉 5: B-axis Deadzone]** menu.
2. After setting the angle for determining the no-use area and setting the interpolation handling mode, touch the **[OK]** button.


Hi6
manual
CP0
CN:1 SQ:1
S
HS220-02
60
%
AU
T0
ms0
cm
run to
200
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
3: Robot parameter/
5: B axis deadzone
OK
1
2
S
H
V
R2
B
R1
2020-09-23 14:20:57

Setting value: 10 deg

Dead zone interpolation: ○ Wrist axis interpolation ● Error stop

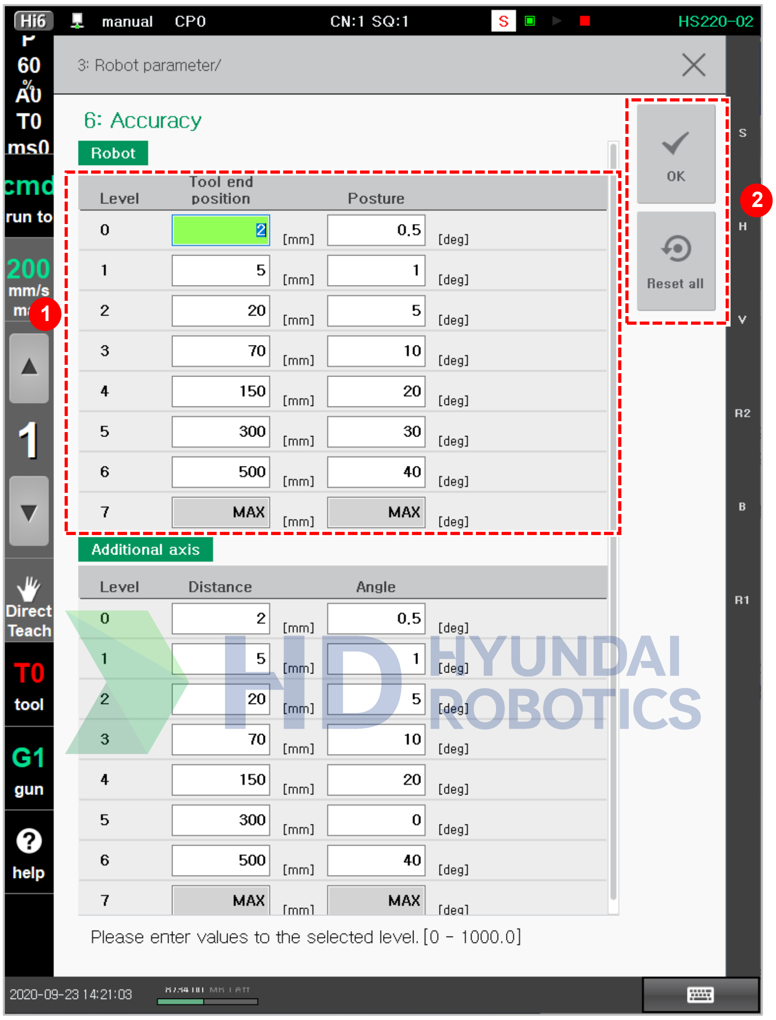
Enter the range of the B axis dead zone. [0 - 90]

- **[Setting Value]**: You can input the angle for determining the B-axis no-use area.
- **[Dead zone interpolation]**: When the trajectory of the robot has to pass through the B-axis no-use area in interpolation operation, you can perform the setting regarding the handling of errors and stopping of the robot.

7.4.6 Accuracy

You can set the detailed conditions of the accuracy level, which refers to the accuracy of passing through the step when the robot progresses the target step.

1. Touch the **[3: Robot Parameter › 6: Accuracy]** menu.
2. Set the tooltip position (TCP) and posture for each accuracy level.



3: Robot parameter/

6: Accuracy

Robot

Level	Tool end position		Posture	
0	2	[mm]	0.5	[deg]
1	5	[mm]	1	[deg]
2	20	[mm]	5	[deg]
3	70	[mm]	10	[deg]
4	150	[mm]	20	[deg]
5	300	[mm]	30	[deg]
6	500	[mm]	40	[deg]
7	MAX	[mm]	MAX	[deg]

Additional axis

Level	Distance		Angle	
0	2	[mm]	0.5	[deg]
1	5	[mm]	1	[deg]
2	20	[mm]	5	[deg]
3	70	[mm]	10	[deg]
4	150	[mm]	20	[deg]
5	300	[mm]	0	[deg]
6	500	[mm]	40	[deg]
7	MAX	[mm]	MAX	[deg]

Please enter values to the selected level. [0 - 1000.0]

No.	Description
①	Detailed information for each level. You can set the tooltip position (TCP) and posture for each accuracy level. • The accuracy level can be set to a value from 0 to 7, and the accuracy level will be recorded as one of the step statement parameters. • Accuracy level 0–6: Input the TCP distance and posture, as well as the distance and angle of the additional axis, for each level. For the robots that do not support linear or circular interpolation, such as LCD robots, the same method as for additional axes will be applied. • Accuracy level 7: The value will be automatically calculated and displayed in the controller, so you do not need to input the value directly. When the accuracy level 7 is applied, the maximum cornering path that satisfies the condition of 1/2 of the step distance will be created. Accuracy level 7 is useful when it is required to make the robot move as smoothly and quickly as possible, such as the act of LDC hand entering and exiting.

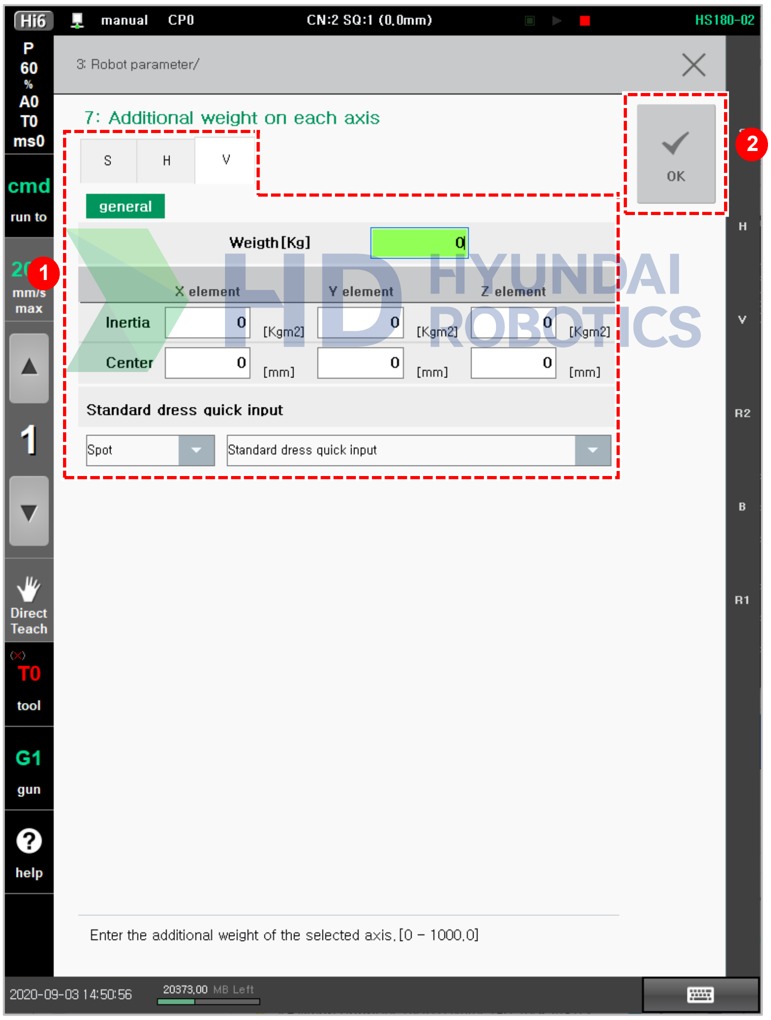
No.	Description
②	- **[OK]**: You can save the changes. - **[Reset All]**: You can initialize the TCP distance and posture for all accuracy levels.

Notes	- If you approach the accuracy level based on your understanding of the contents of “**2.3 Step**,” you can use it more easily. - In the welding step that uses a servo gun or an equalizerless gun, the controller will automatically perform restriction regardless of the set accuracy level.

7.4.7 Additional Weight of Each Axis

You can register information on a transformer or wiring support mounted on the basic axis of the robot.

1. Touch the **[3: Robot Parameter > 7: Additional Weight on Each Axis]** menu.
2. Select the basic axis tab, set the information of the mounted additional weight, and then touch the **[OK]** button.



Hi6
manual CP0
CN:2 SQ:1 (0,0mm)
HS180-02
P 60 % A0 T0 ms0
cmd
run to
mm/s max
1
Direct Teach
T0 tool
G1 gun
help
3: Robot parameter/
7: Additional weight on each axis
S
H
V
general
OK
H
V
R2
B
R1
X element
Y element
Z element
Standard dress quick input
1
2
2020-09-03 14:50:56
20373.00 MB Left

Weigth[Kg] 0

	X element		Y element		Z element	
Inertia	0	[Kgm2]	0	[Kgm2]	0	[Kgm2]
Center	0	[mm]	0	[mm]	0	[mm]

Standard dress quick input: Spot, Standard dress quick input

Enter the additional weight of the selected axis.[0 ~ 1000.0]

⚠ Caution	If the robot has an additional weight because a transformer or wiring support is mounted onto it, you must register the information on the additional weight of each axis. If the additional weight is not correctly registered, the error may get large when the tool load estimation is performed.

7.4.7.1 Coordinate System Origin of Each Axis

The X, Y, and Z directions of each axis are set in the same direction as the robot coordinate system. Refer to the following about the coordinate system origin of each axis.

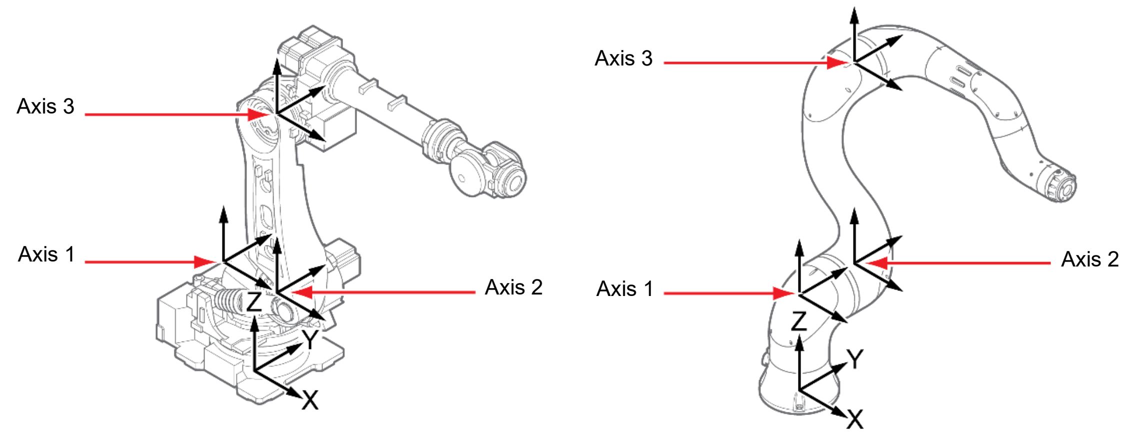


Figure 62 Coordinate System Origin of Each Axis for Each Robot Configuration

7.4.8 Collision Detection (Function to Be Available Later)

The Hi6 controller has the error detection function for overcurrent, overload, overspeed, position deviation, as well as the collision detection function, as safety functions in preparation for a case in which the robot operates under abnormal conditions or operates abnormally. These two functions will work with each other to enhance the safety of the robot.

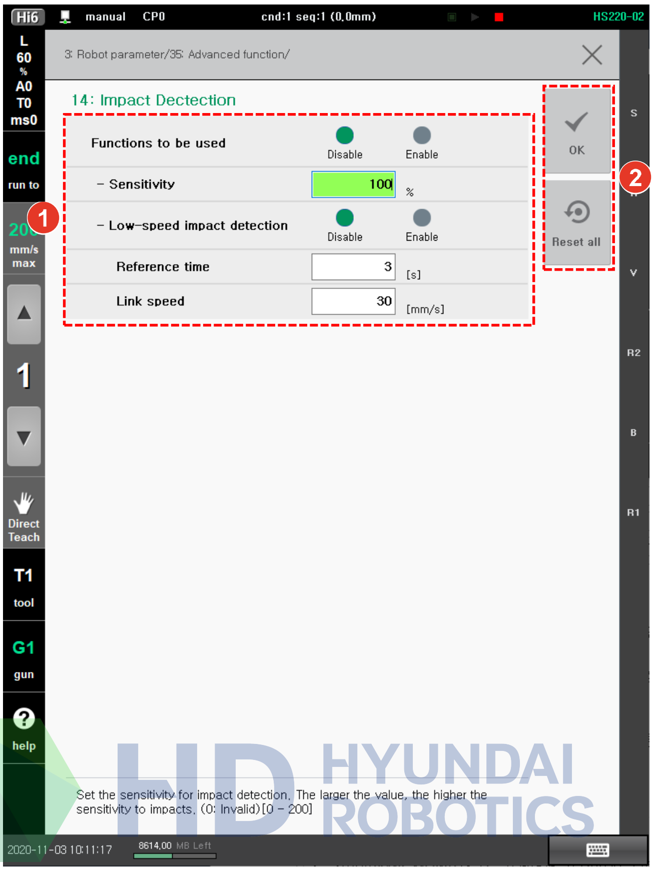
In the Hi6 controller, a model-based collision detection function is provided. The model-based collision detection function detects a collision by calculating the difference between the torque that should be normally applied during the robot's operation and the measured torque based on the dynamics model of the robot. By setting the sensitivity, you can adjust the responsiveness to the collision and make it possible to detect any contact with the outside that occurs when the robot moves at low speed.

However, the collision detection function detects the collision on the robot axis, so if the impact is not transmitted to the robot, the collision will not be detected. Moreover, the following are the points that require you to exercise precautions when using the collision detection function.

- The collision detection function will work only when the motor is turned on.
- You must execute load estimation before using the collision detection function.
- If the tool weight and the additional weight of each axis are different from the actual data, false detection may occur.
- When load estimation and sensor-based/sensorless force control functions are performed, the collision will not be detected.
- Collisions on the positioners, stationary guns, and jigs that are not attached to the robot cannot be detected.
- Special-order robots do not support the model-based collision detection function.

The following shows how to set the collision detection function.

1. Touch the **[3: Robot Parameter 〉 14: Impact Detection]** menu.
2. Set whether to use the collision detection function, and set the sensitivity, etc.



3: Robot parameter/35: Advanced function/

14: Impact Dectection

Functions to be used ● Disable ○ Enable

– Sensitivity 100 %

– Low-speed impact detection ● Disable ○ Enable

Reference time 3 [s]

Link speed 30 [mm/s]

Set the sensitivity for impact detection. The larger the value, the higher the sensitivity to impacts. (0: Invalid) [0 – 200]

No.	Description

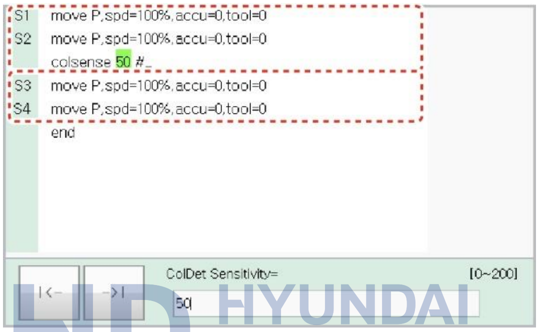
①	This is information on the use options of the collision detection function. You can set whether to use this function and set the sensitivity and whether to use the low-speed collision detection function.
	• **[Functiont to be Used]**: You can set whether to use the collision detection function.
	• **[Sensitivity]**: You can set the collision detection sensitivity. The larger the value, the more sensitive it is to impact (basic setting value: 100%).
	• **[Low-Speed Impact Detection]**: You can set whether to use the low-speed collision detection function.
	  • **[Reference Time]**: You can set the reference time for determining a collision. If an impact force occurs during the reference time, it will be determined as a collision.
	  • **[Link Speed]**: You can set the reference speed for determining a low speed. Slow-speed collision will be inspected only below the reference link speed.

②	• **[OK]**: You can save the changes. • **[Reset All]**: You can initialize the setting values of all the use options.

7.4.8.1 Collision Detection Sensitivity Setting

The collision detection sensitivity can be adjusted using the command in the JOB program.

Item	Contents
Command	ColDet Sensitivity
Description	Changing the collision detection sensitivity
How to input	command → MOTION → colsense
Syntax	ColDet Sensitivity=100
Parameter	0–200 (0: Function disabled. The larger the sensitivity value, the more sensitive it is to impact.)

Example	**[Impact Detection]** When the sensitivity is set to 100% in the menu
	S1 - S2: Detection based on the sensitivity of 100% S3–S4: Detection based on a sensitivity of 50%
	
	`S1 move P,spd=100%,accu=0,tool=0`
	`S2 move P,spd=100%,accu=0,tool=0`
	`colsense 50 #_`
	`S3 move P,spd=100%,accu=0,tool=0`
	`S4 move P,spd=100%,accu=0,tool=0`
	`end`
	ColDet Sensitivity= [0~200]
	50

⚠ **Caution**	If the sensitivity is set too high, false detection may occur. Moreover, if the sensitivity is set too low, collisions detection may not be performed.

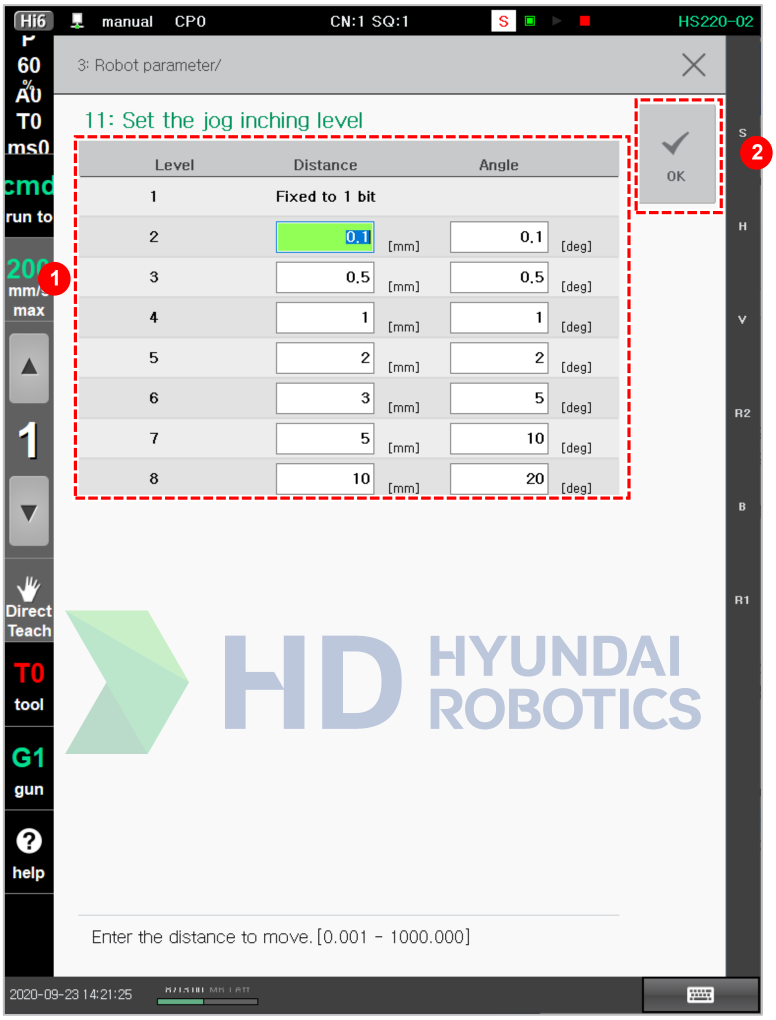
Notes

- If there is no command, collision will be detected based on the basic sensitivity set in the **[Impact Detection]** menu.
- The sensitivity set by the command will be initialized to the basic sensitivity in the following cases.
  - When encountering the END command of the main program
  - When changing the step/function
  - When resetting the step counter

7.4.9 Jog Inching Level Setting

You can limit the operation by designating the moving distance. This is useful when you want to move the robot as much as the desired distance with the jog key in manual mode.

1. Touch the **[3: Robot Parameter 〉 11: Set the Jog Inching Level]** menu.
2. After setting the distance and angle for each jog inching level, touch the **[OK]** button.



3: Robot parameter/

11: Set the jog inching level

Level	Distance		Angle	
1	Fixed to 1 bit			
2	0.1	[mm]	0.1	[deg]
3	0.5	[mm]	0.5	[deg]
4	1	[mm]	1	[deg]
5	2	[mm]	2	[deg]
6	3	[mm]	5	[deg]
7	5	[mm]	10	[deg]
8	10	[mm]	20	[deg]

Enter the distance to move. [0.001 - 1000.000]

2020-09-23 14:21:25

7.4.9.1 Main Functions of the Jog Inching Function

- Inching applicable coordinate systems
  - Inching in the joint coordinate system: Movement will take place as much as the distance (mm) and angle (deg) designated for each joint.
  - Inching in the Cartesian coordinate system
  - Inching in the tool coordinate system
  - Inching in the user coordinate system: Movement will take place as much as the amount designated for the X, Y, and Z positions (mm) and Rx, Ry, and Rz postures(deg).
- Inching level

  You can set the inching distance at the same level as the existing jog speed, so you can select eight levels of speed, and you can set the inching distance for each level.

7.4.9.2 Inching Jog Operation

The inching function is a function that does not allow the movement to take place beyond the maximum moving distance per one push of the jog key.

Even after reaching the inching distance, if you keep pressing the jog key and then release your hand, the robot will decelerate to the inching distance, and then stop.

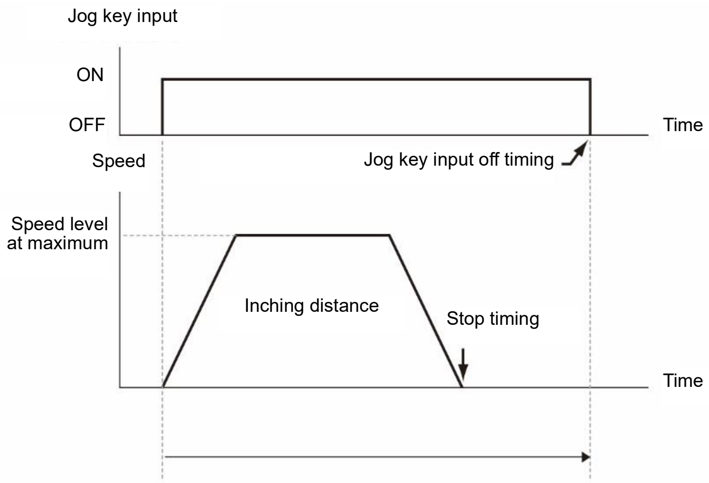

Jog key input
ON
OFF
Time
Speed
Jog key input off timing
Speed level at maximum
Inching distance
Stop timing
Time

Figure 63 When Releasing the Key After Reaching the Inching Distance

If you release the jog key before reaching the inching distance, the robot will decelerate, starting from the time you release the jog key, and then stop. At this time, the mode will be the same as the general jog mode.

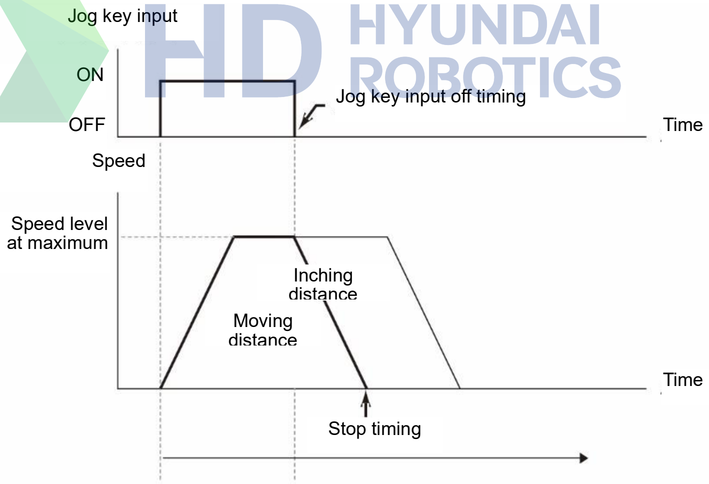
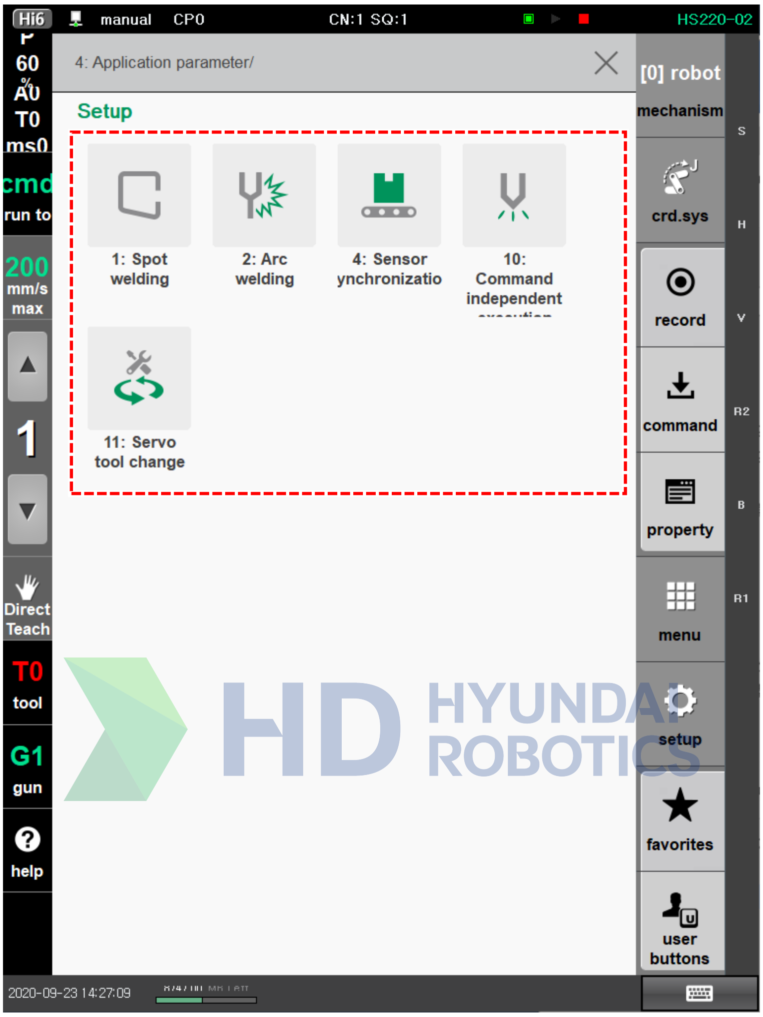

Jog key input
ON
OFF
Jog key input off timing
Time
Speed
Speed level at maximum
Inching distance
Moving distance
Time
Stop timing

Figure 64 When Releasing the Hand Before Reaching the Inching Distance

Note	In the joint coordinate system, the speed level 1 is fixed to a mode that the robot will move by 1 bit of the encoder.

7.5 Application Parameters

1. Touch the **[4: Application Parameter]** menu. Then, the application parameter menu will appear.
2. Select the desired menu, and then check and set various parameters for the use of the application functions of the robot.



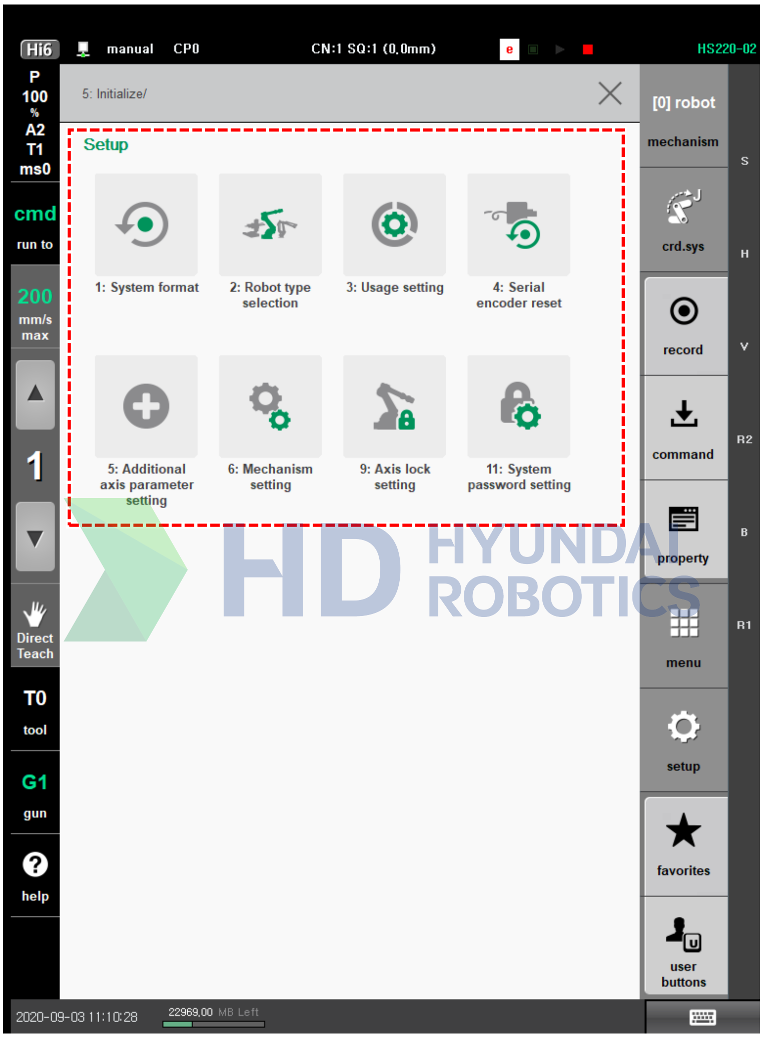
Hi6
manual CP0
CN:1 SQ:1
HS220-02
4: Application parameter/
Setup
1: Spot welding
2: Arc welding
4: Sensor ynchronizatio
10: Command independent
11: Servo tool change
[0] robot mechanism
crd.sys
record
command
property
menu
setup
favorites
user buttons
60 %
AU
T0
cmd
run to
200 mm/s max
1
Direct Teach
T0 tool
G1 gun
help
2020-09-23 14:27:09

Note	For details on how to use each menu, refer to the “**Function Manual**” for each application function.

7.6 Initialize

If the robot controller does not operate normally, initialize the system. The system initialization must be performed by an engineer who has experience in initial setting of the robots of Hyundai Robotics.

1. Touch the **[5: Initialize]** menu. Then, the menu for initialization will appear.
2. Select the desired menu, and then perform the initial setting of the robot system, and then initialize the serial encoder.


Hi6
manual
CP0
CN:1 SQ:1 (0.0mm)
HS220-02
P
100
%
A2
T1
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
5: Initialize/
Setup
1: System format
2: Robot type selection
3: Usage setting
4: Serial encoder reset
5: Additional axis parameter setting
6: Mechanism setting
9: Axis lock setting
11: System password setting
[0] robot
mechanism
crd.sys
record
command
property
menu
setup
favorites
user buttons
S
H
V
R2
B
R1
2020-09-03 11:10:28
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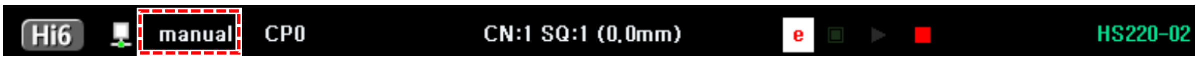
HD HYUNDAI ROBOTICS

Note	Some items in the **[Initialize]** menu will be supported only when a specific type of an additional axis is selected.

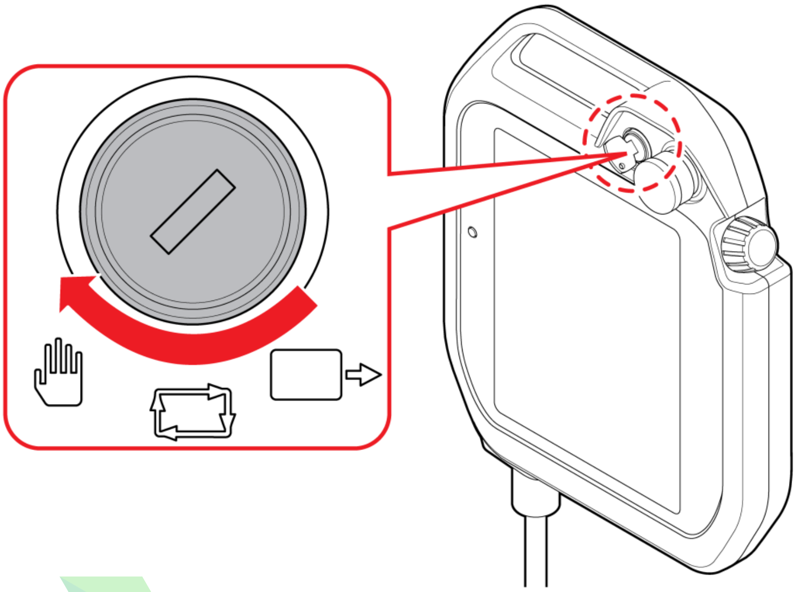
⚠ Caution	- To initialize the system, you should contact the customer support team and ask for an expert or a qualified engineer to prevent false operation. - When the system is initialized, all data and programs saved in the controller will be deleted. Before initializing the system, you should back up your data and programs and restore them if necessary. For details on Data Backup and Restoration, refer to “4.2.5 Data Backup” and “4.2.6 Data Restoration”.

7.6.1 System Format

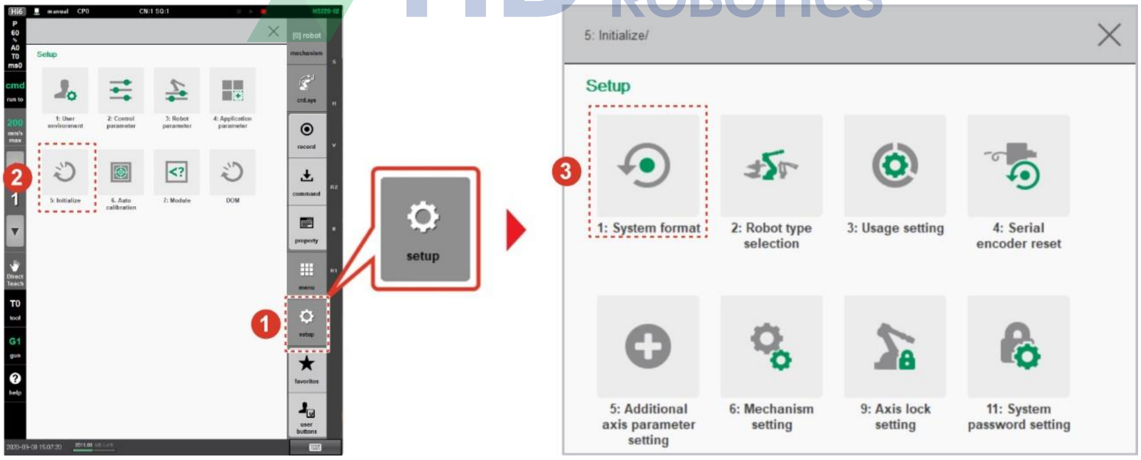
1. On the status bar of the Hi6 teach pendant screen, check if the operation mode is set to manual mode.


Hi6
manual
CP0
CN:1 SQ:1 (0.0mm)
e
HS220-02

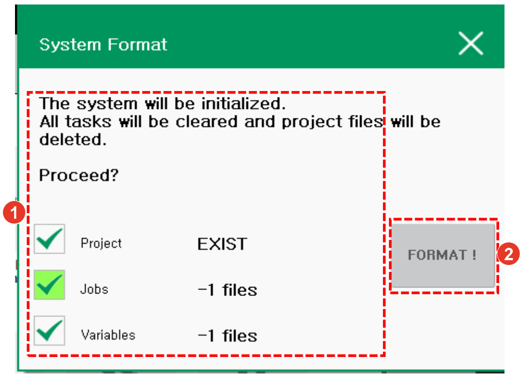
- If it is set to automatic mode, turn the mode switch of the teach pendant to set it to manual mode.



2. Touch the **[Set Up]** button 〉 **[5: Initialize** 〉 **1: System format]** menu.


Setup
1: User environment
2: Control parameter
3: Robot parameter
4: Application parameter
5: Initialize
6: Auto calibration
7: Module
DOM
①
②
setup
③
5: Initialize/
Setup
1: System format
2: Robot type selection
3: Usage setting
4: Serial encoder reset
5: Additional axis parameter setting
6: Mechanism setting
9: Axis lock setting
11: System password setting

3. After checking the saved data, touch the **[Initialize]** button. All data and programs including control parameter files and machine parameter files will be deleted, and the initial setting values will be restored.



System Format

The system will be initialized.
All tasks will be cleared and project files will be deleted.

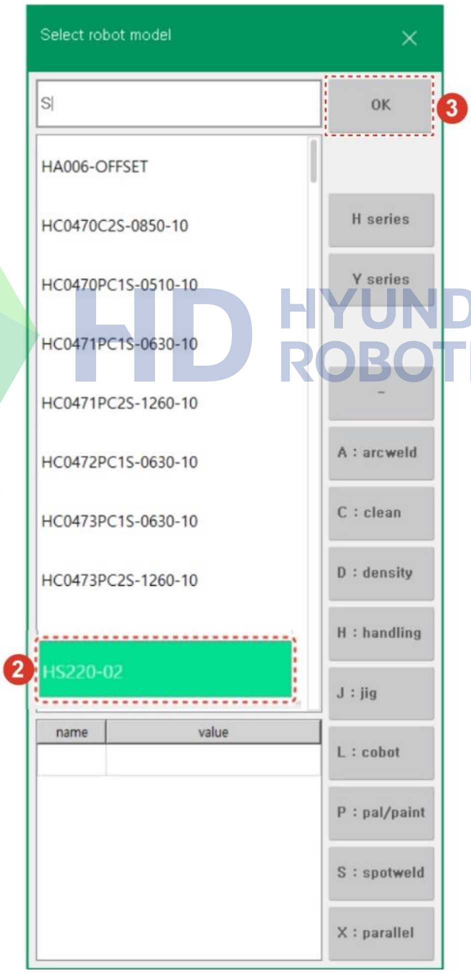
Proceed?

☑	Project	EXIST
☑	Jobs	-1 files
☑	Variables	-1 files

7.6.2 Robot Type Selection

1. Touch the **[5: Initialize > 2: Robot Type Selection]** menu. Or touch the [Mechanism] button at the top right of the Hi6 teach pendant screen.

2. Select a robot in the robot model selection window, and then touch the **[OK]** button.



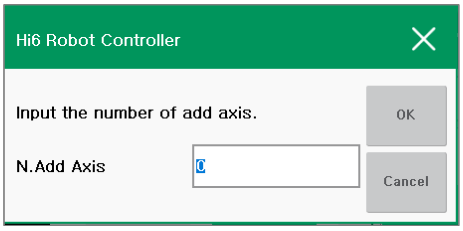
Select robot model

S|

HA006-OFFSET
HC0470C2S-0850-10
HC0470PC1S-0510-10
HC0471PC1S-0630-10
HC0471PC2S-1260-10
HC0472PC1S-0630-10
HC0473PC1S-0630-10
HC0473PC2S-1260-10
HS220-02

name	value

- You can scroll through the robot model list to check the model name, or you can input the model name to search.
- If you touch the robot usage button, only the robots belonging to the usage can be checked on the list.
- If you select a new robot model, the machine parameter file (hi6_porj.json) will be restored to the initial setting values, and various history files will also be initialized.
- If you select a system that includes additional axes such as a travel axis or a servo gun, you should set the number of additional axes. If a system consists of only robot axes without additional axes, input **0**.

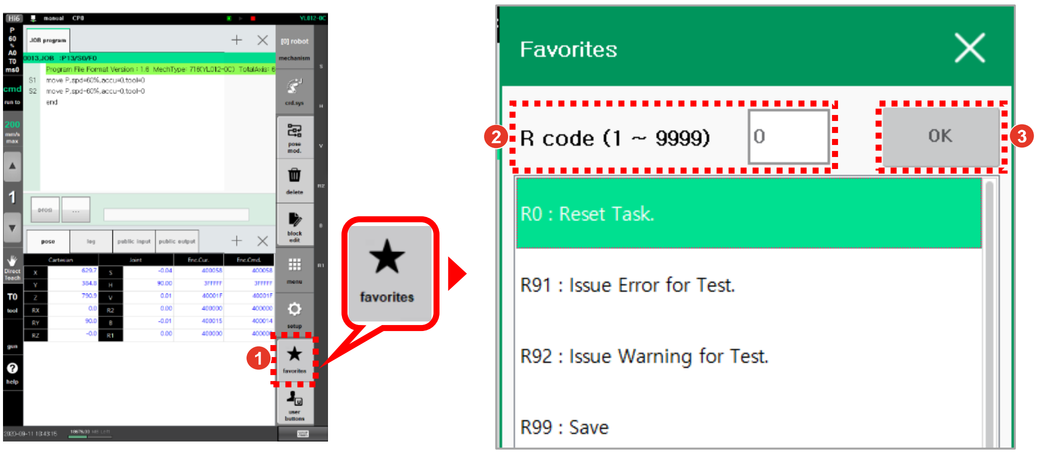


Input the number of add axis.

N.Add Axis: 0

⚠ Caution	
	- The manipulator and controller are shipped as one system. For this reason, the robot controller is equipped with a drive suitable for the drive capacity of the robot that is part of the system. - When resetting the system by initializing it, you must check the model of the robot that was set to the initial setting values when shipped from the factory, and then set the correct model.

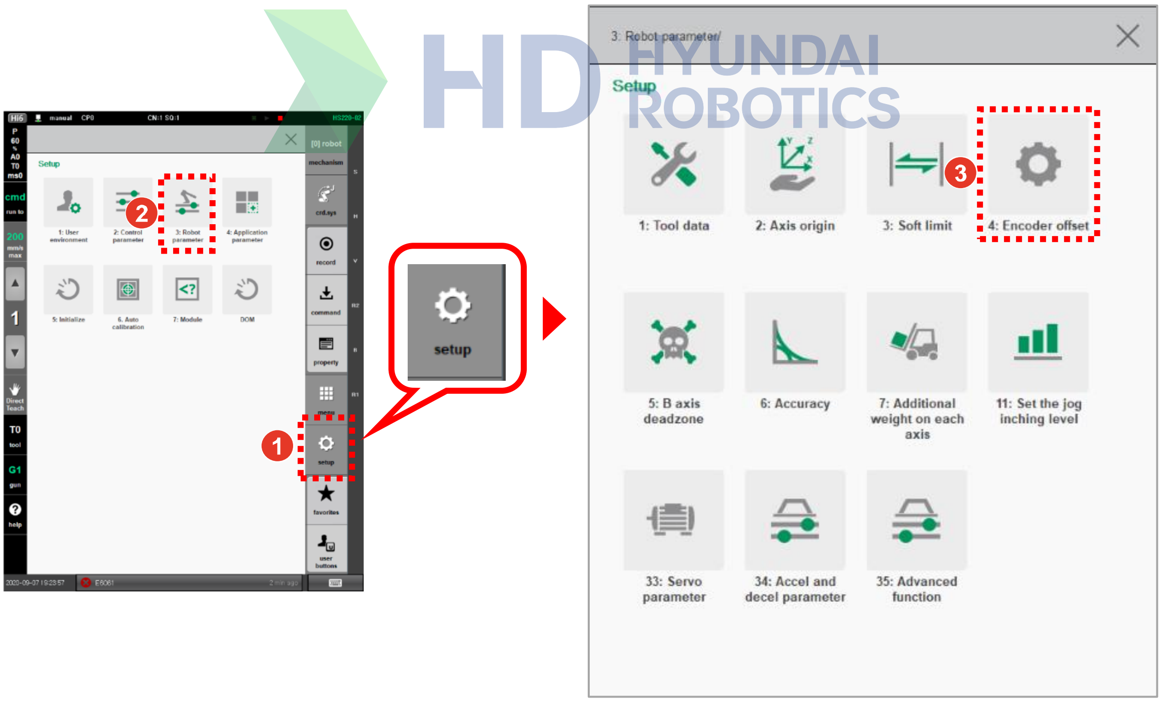
3. After touching the **[Favorites]** button at the bottom right of the Hi6 teach pendant screen, input **314** in the input area of the favorites window, and then touch the **[OK]** button


favorites
①
Favorites
② R code (1 ~ 9999)
0
OK ③
R0 : Reset Task.
R91 : Issue Error for Test.
R92 : Issue Warning for Test.
R99 : Save

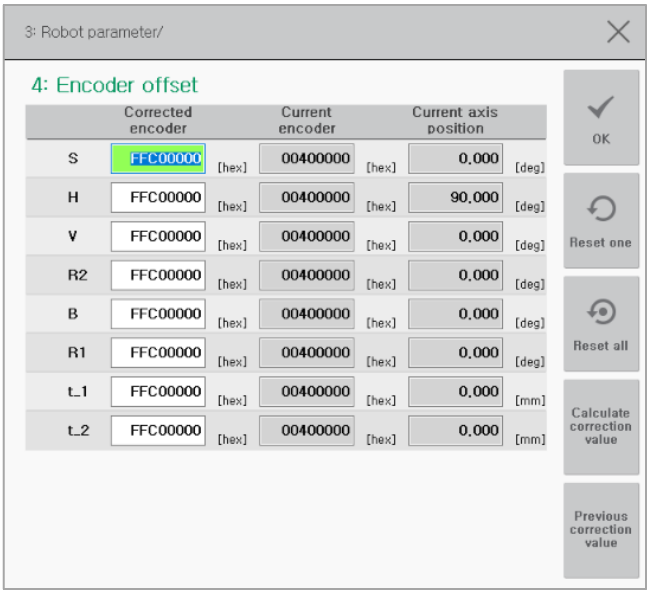
Caution

- In Engineer Mode, the Engineer Mode icon (e) will blink on the status bar.
- Use caution as a serious problem may occur in the robot system if the setting is performed incorrectly.

4. Touch the **[Set Up]** button 〉 **[3: Robot Parameter 〉 4: Encoder Offset]** menu.


Setup
1: User environment
2: Control parameter
3: Robot parameter
4: Application parameter
5: Initialize
6: Auto calibration
7: Module
DOM
setup
①
②
3: Robot parameter/
Setup
1: Tool data
2: Axis origin
3: Soft limit
③
4: Encoder offset
5: B axis deadzone
6: Accuracy
7: Additional weight on each axis
11: Set the jog inching level
33: Servo parameter
34: Accel and decel parameter
35: Advanced function

5. Perform encoder offset calibration. To turn on the motor, you should set the encoder offset temporarily even if the robot position is not the reference position.



	Corrected encoder		Current encoder		Current axis position	
S	FFC00000	[hex]	00400000	[hex]	0.000	[deg]
H	FFC00000	[hex]	00400000	[hex]	90.000	[deg]
V	FFC00000	[hex]	00400000	[hex]	0.000	[deg]
R2	FFC00000	[hex]	00400000	[hex]	0.000	[deg]
B	FFC00000	[hex]	00400000	[hex]	0.000	[deg]
R1	FFC00000	[hex]	00400000	[hex]	0.000	[deg]
t_1	FFC00000	[hex]	00400000	[hex]	0.000	[mm]
t_2	FFC00000	[hex]	00400000	[hex]	0.000	[mm]

Note

- You should perform an encoder offset setting normally after moving the robot to the reference position.
- For the initial setting, you should perform the encoder offset setting even if the robot position is not the reference position. Otherwise, the motor will not be turned on, making it impossible to drive the robot.

6. Turn off and on the power of the controller and then supply power to the motor.
7. In manual mode, move the robot safely to the reference position at low speed and then perform the encoder offset calibration again by referring to steps 7–8.
    - In the encoder offset setting item, the current encoder position will be set to **0X400000** (hexadecimal).
    - When a motor is replaced because of failure, if the encoder offset setting is performed at the same location, the recorded program can be used identically.
8. Press the **〈Program〉** key on the teach pendant, and select the program **9999** and then record one step. You can move the robot to the reference position easily.

⚠ Caution

- To initialize the system, contact the customer support team and ask an expert.
- For initialization of a collaborative root, refer to the collaborative robot safety functions manual.
- When the system is initialized, all data and programs, including control parameter files and machine parameter files, will be deleted. If you back up your data before initializing the system, it can be restored and used when necessary.

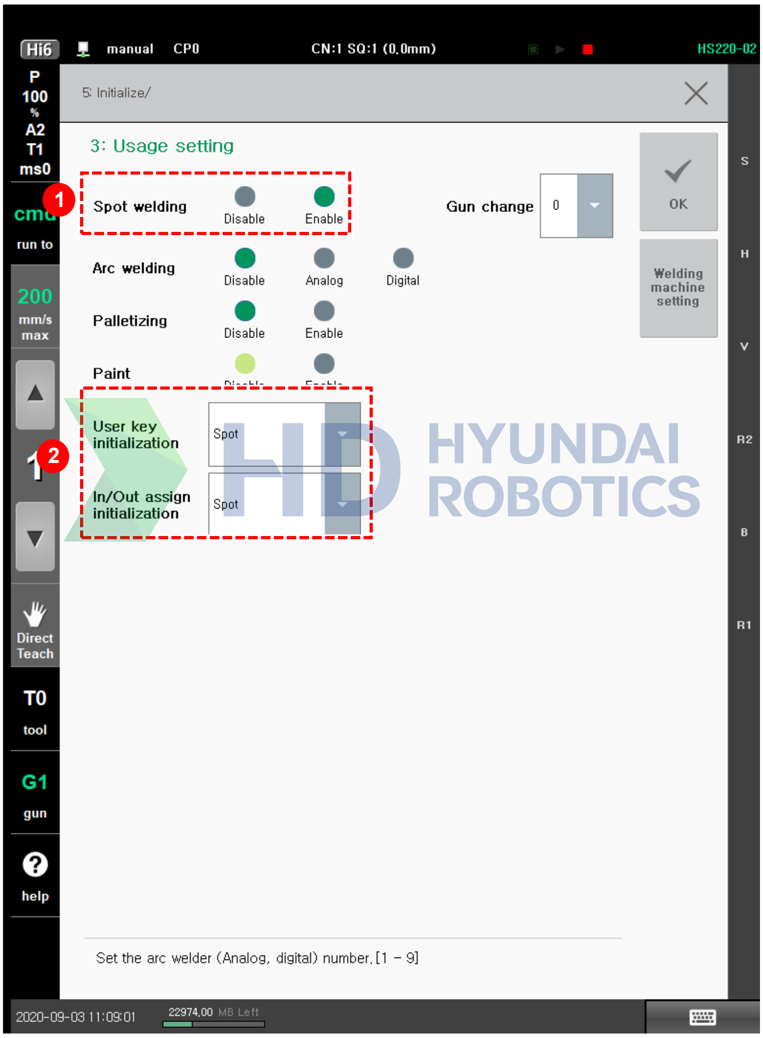
7.6.3 Usage Setting

You can select the operation usage and initialize the user key and input/output assignment signals according to the operation usage.

1. Touch the **[5: Initialize 〉 3: Usage Setting]** menu.
2. After selecting the operation usage and setting the environment conditions according to the usage, touch the **[OK]** button. Then, you can use commands related to the selected operation usage and access the relevant menus.

7.6.3.1 Spot Welding

If you select the operation usage as **spot welding**, you can use the commands related to spot welding and access the menu related to spot welding.


Hi6
manual CP0
CN:1 SQ:1 (0.0mm)
HS220-02
P 100 % A2 T1 ms0
cmd
run to
200 mm/s max
1
Direct Teach
T0 tool
G1 gun
help
5: Initialize/
S
H
V
R2
B
R1
OK
Welding machine setting
1
2
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22974.00 MB Left

3: Usage setting

Spot welding ○ Disable ● Enable

Gun change 0

Arc welding ● Disable ○ Analog ○ Digital

Palletizing ● Disable ○ Enable

Paint ○ Disable ○ Enable

User key initialization: Spot

In/Out assign initialization: Spot

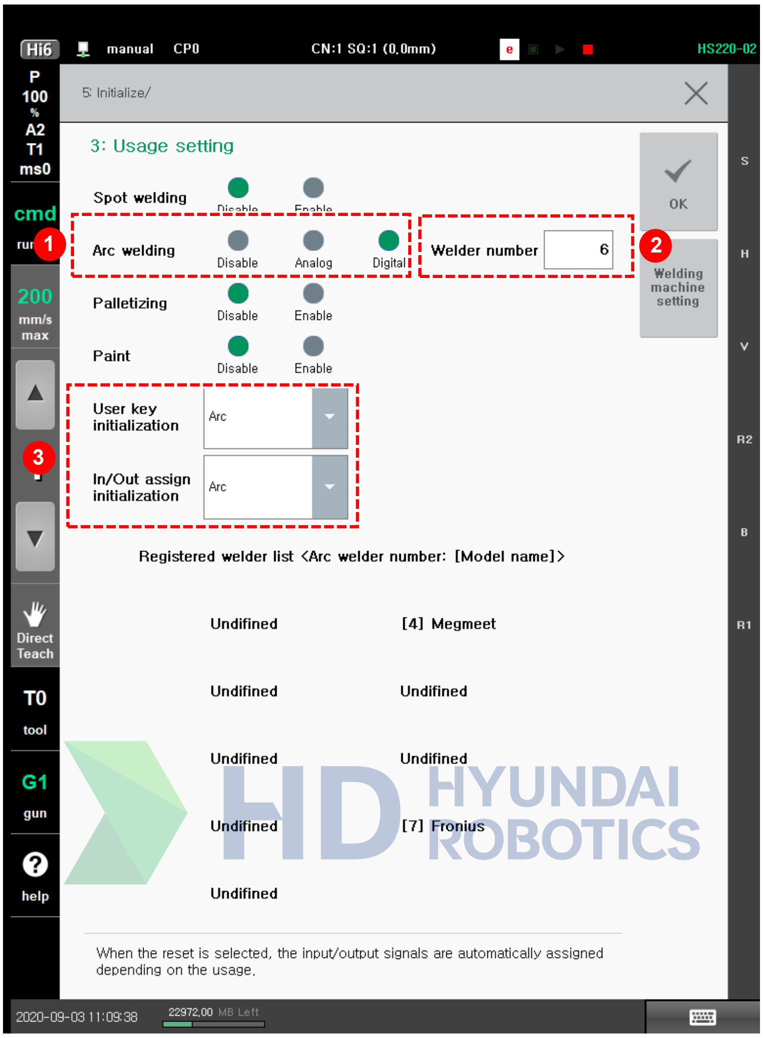
Set the arc welder (Analog, digital) number.[1 – 9]

Figure 65 Operation Usage – Spot Welding

1. Set **[Spot Welding]** as **enable**. Then, other usages will be handled as **disable**.
2. Click the **[User Key Initialization]** drop-down menu and the **[Input/Output Assign Initialization]** drop-down menu, respectively, and select **spot**.

7.6.3.2 Arc Welding

If you select the operation usage as **Arc welding**, you can use commands related to arc welding and access the menus related to arc welding.


Hi6
manual CP0
CN:1 SQ:1 (0.0mm)
HS220-02
P 100 % A2 T1 ms0
cmd
200 mm/s max
Direct Teach
T0 tool
G1 gun
help
5: Initialize/
OK
Welding machine setting
S
H
V
R2
B
R1
1
2
3
HD HYUNDAI ROBOTICS

3: Usage setting

Spot welding	● Disable	● Enable	
Arc welding	● Disable	● Analog	● Digital
Palletizing	● Disable	● Enable	
Paint	● Disable	● Enable	

Welder number: 6

User key initialization: Arc

In/Out assign initialization: Arc

Registered welder list <Arc welder number: [Model name]>

Undifined	[4] Megmeet
Undifined	Undifined
Undifined	Undifined
Undifined	[7] Fronius
Undifined	

When the reset is selected, the input/output signals are automatically assigned depending on the usage.

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Figure 66 Operation Usage – Arc Welding

1. Set the welding machine type (**analog** or **digital**) in **[Arc Welding]**. Other usages will be handled as **disable,** and a list of welders supported by the system will appear at the bottom of the screen.

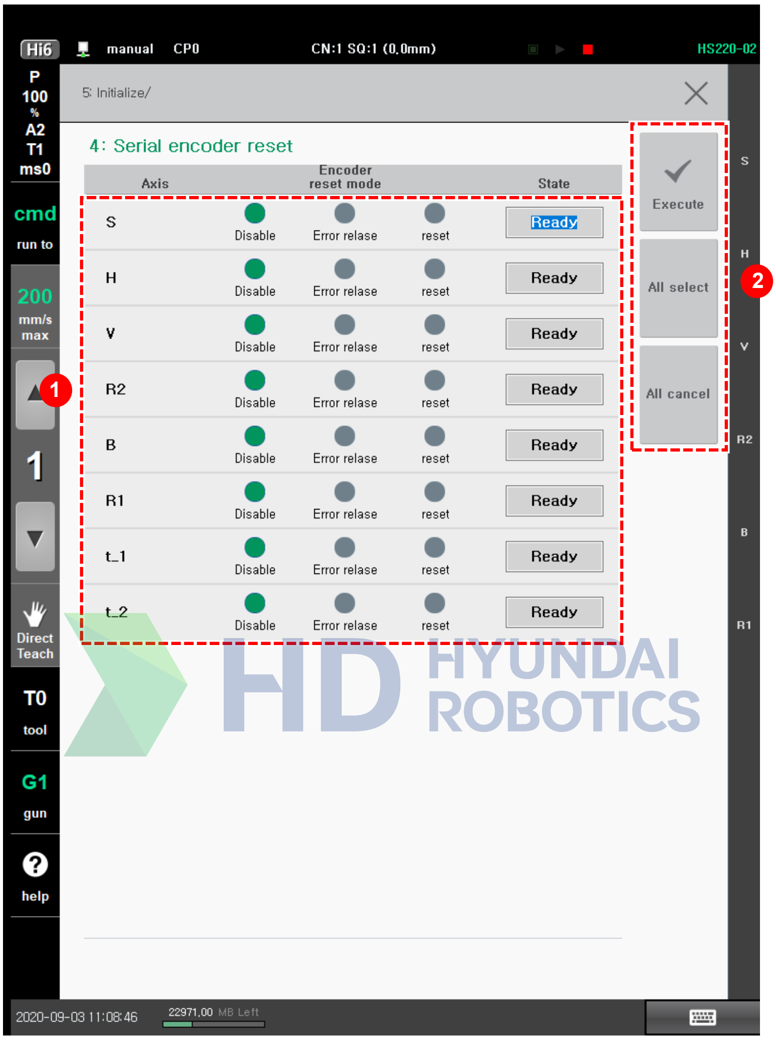
2. After checking the welder list, set the welder number.

3. Click the **[User Key Initialization]** drop-down menu and the **[Input/Output Assign Initialization]** drop-down menu, respectively, and select **arc**.

7.6.4 Serial Encoder Reset

The serial encoder stores the encoder rotation speed information in the internal memory. The encoder rotation speed can be cleared to zero by resolving the motor error state or by resetting the zero point of the encoder.

1. Touch the **[5: Initialize 〉 4: Serial Encoder Reset]** menu.
2. Set the encoder resetting mode for each axis and check the status, and then execute the resetting.


Hi6
manual
CP0
CN:1 SQ:1 (0.0mm)
HS220-02
P
100
%
A2
T1
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
5: Initialize/
Execute
All select
All cancel
S
H
V
R2
B
R1
1
2
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22971.00 MB Left

4: Serial encoder reset

Axis	Encoder reset mode	State
S	● Disable ○ Error relase ○ reset	Ready
H	● Disable ○ Error relase ○ reset	Ready
V	● Disable ○ Error relase ○ reset	Ready
R2	● Disable ○ Error relase ○ reset	Ready
B	● Disable ○ Error relase ○ reset	Ready
R1	● Disable ○ Error relase ○ reset	Ready
t_1	● Disable ○ Error relase ○ reset	Ready
t_2	● Disable ○ Error relase ○ reset	Ready

No.	Description
❶	You can set whether to use the encoder reset function for each axis and set a mode for each axis. • **[Disable]**: Serial encoder resetting will not be executed. • **[Error release]**: You can clear only the errors related to the motor encoder without clearing the encoder rotation speed. • **[Reset]**: You can clear the rotation speed by resolving the errors related to the motor encoder and then by resetting the zero point of the encoder.
❷	• **[Execute]**: You can execute the serial encoder resetting. • **[All select]**: You can select all axes at once. • **[All cancel]**: You can deselect all axes at once

⚠ Caution	• You can perform the encoder resetting when performing the initial setting of the robot system,

but never perform the encoder resetting while the robot is operating normally. However, if an encoder-related error such as a communication error occurs or the encoder battery is lost, you can perform the encoder resetting. In this case, check the actual position in the robot program so that it does not differ from the existing robot origin position.

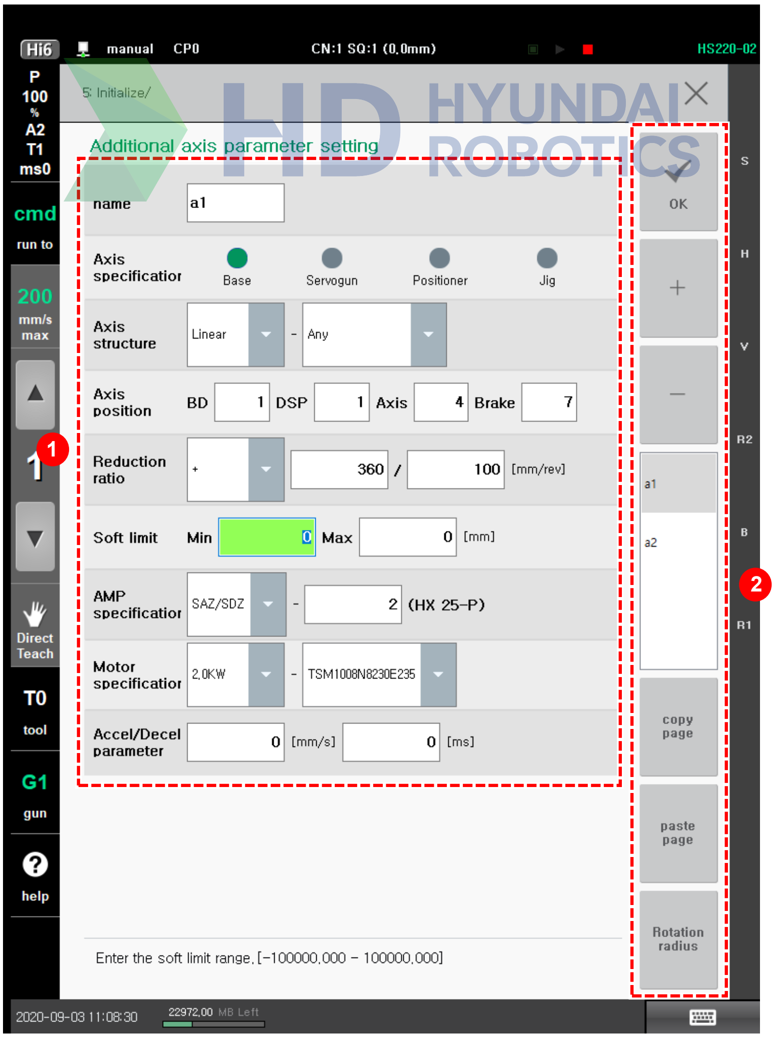
- If the power is not supplied to the controller and encoder, the position information of the encoder may be lost, possibly causing trouble in using the job program of the robot. To solve this problem, a dedicated battery is attached to the serial encoder, making it possible to record the position information regardless of the power status of the controller. If a voltage error occurs in the encoder battery, the battery must be replaced while the controller is still powered on to prevent loss of the position information.

7.6.5 Additional Axis Parameter Setting

Additional axes that can be used in addition to the robot itself include the robot's base axis (travel axis), servo gun axis, positioner axis, and jig axis. For details on the specification of each additional axis, refer to the "**Additional Axis Function Manual.**"

The method to set parameters such as the specification and configuration of the additional axes that are being used is as follows.

1. Touch the **[5: Initialize 〉 5: Additional Axis Parameter Setting]** menu.
2. Set the parameters such as the specification and configuration of the additional axes.


Hi6
manual
CP0
CN:1 SQ:1 (0.0mm)
HS220-02
P
100
%
A2
T1
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
5: Initialize/
Additional axis parameter setting
OK
+
−
a1
a2
copy page
paste page
Rotation radius
S
H
V
R2
B
R1
2
2020-09-03 11:08:30
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name: a1
Axis specification: ● Base ○ Servogun ○ Positioner ○ Jig
Axis structure: Linear - Any
Axis position: BD 1 DSP 1 Axis 4 Brake 7
Reduction ratio: + 360 / 100 [mm/rev]
Soft limit: Min 0 Max 0 [mm]
AMP specification: SAZ/SDZ - 2 (HX 25-P)
Motor specification: 2.0KW - TSM1008N8230E235
Accel/Decel parameter: 0 [mm/s] 0 [ms]

Enter the soft limit range.[-100000.000 ~ 100000.000]

No.	Description

❶	Detailed parameter setting information of the additional axis. You can check and set the name, specification, and configuration, etc. of the additional axis.
	• **[Name]**: Name of the additional axis in use
	• **[Axis Specification]**: Specification of the additional axis. You can use individual functions separately developed for each usage of the additional axis according to the specifications.
	[Axis structure]: Mechanism type of the additional axis. In the case of the specifications of some axes, you can designate the mechanism type that was registered in advance. As an exemplary case, you can select the standard positioner model in case of the position.
	• **[Axis position]**: This is the position where the axis is connected to the DSP board. You can designate the BD number, DSP number, axis number, and brake number sequentially according to the wiring specifications.
	• **[Reduction ratio]**: Information of the deceleration ratio that involves the motor and link of the additional axis
	  • The deceleration ratio sign can be set according to the rotation direction of the motor shaft when the additional axis link moves in the (+) direction. When viewed from the front, if the shaft is rotating counterclockwise, the sign will be (+), and if it is rotating clockwise, the sign will be (-).
	  • The parameter of the numerator of the deceleration ratio is the moving distance (mm or deg) of the link, and the parameter corresponding to the denominator is the motor rotation speed corresponding to the moving distance of the link. The parameters of the setting items will be defined in integer form. For parameters that will be displayed with decimals, set the deceleration ratio as an integer by multiplying the numerator and denominator by a certain multiple.
	• **[Soft limit]**: The minimum and maximum operating range of the additional axis
	• **[AMP Specification]**: The amplifier specification of the additional axis
	• **[Motor Specification]**: Model name of the motor connected to the additional axis
	• **[Accel/Decel Parameter]**: The maximum speed and acceleration time of the additional axis

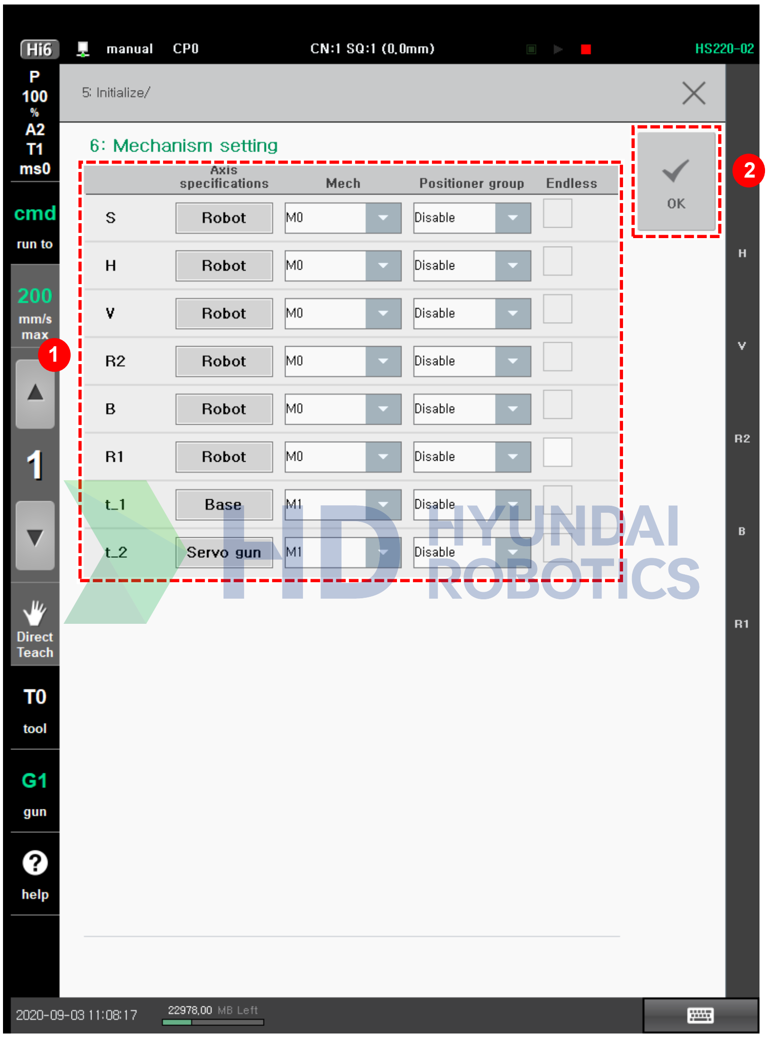
❷	• **[OK]**: You can save the changes. • **[+]/[-]**: You can add a new additional axis or delete an additional axis. • A list of additional axes. If you select the additional axis name, you can check and edit detailed parameters. • **[Copy page]/[Paste page]**: You can copy the information of the additional axis and paste it into the data of another additional axis. After selecting the information name of the additional axis to be copied from the list and then touching the **[Copy page]** button, select the name of the additional axis to which the value is to be applied, and then touch the **[Paste page]** button. • **[Rotation Radius]**: If the additional axis is a rotation axis, you can set the rotation radius to limit the linear speed when jogging.

7.6.6 Mechanism Setting

Mechanism will be used as a group during the jog operation which the jog keys are to be assigned to. In addition, mechanism is also a set of units, each of which is to be differentiated in the process of recording or editing the position of a step. When the mechanisms are set, mechanism numbers (M#) will be assigned for individual groups of axes.

The method to set the use of the endless function and set the position group is as follows.

1. Touch the **[5: Initialize 〉 6: Mechanism Setting]** menu.
2. After setting the mechanism number, positioner group number, and the use of the endless function for each axis, touch the **[OK]** button.


Hi6
manual
CP0
CN:1 SQ:1 (0.0mm)
HS220-02
P
100
%
A2
T1
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
5: Initialize/
6: Mechanism setting
OK
H
V
R2
B
R1
2020-09-03 11:08:17
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2

Axis specifications		Mech	Positioner group	Endless
S	Robot	M0	Disable	☐
H	Robot	M0	Disable	☐
V	Robot	M0	Disable	☐
R2	Robot	M0	Disable	☐
B	Robot	M0	Disable	☐
R1	Robot	M0	Disable	☐
t_1	Base	M1	Disable	☐
t_2	Servo gun	M1	Disable	☐

- **[Mech]**: By touching the drop-down menu, you can set the mechanism number of the axis.
  - If the axis specification is a robot, the mechanism number will be fixed as M0.
  - Starting with the additional axis, you can designate the mechanism number to a value ranging between M1 and M7.
  - The axes set with the same mechanism number will be managed as the same group.
  - To jog the additional axis, you can switch between mechanisms using the **[Mech]** button. At this time, if you press the jog key, jogging will take place in the order of the axes of the relevant mechanism.
- **[Positioner Group]**: You can set the positioner group number. The position group number can be set only for the axes whose specification is set as positioner.

- **[Endless]**: You can set whether to use the endless function on the axis.

Note	A set mechanism unit is the minimum unit that can be assigned to each task and can be driven. To each task, a complex combination of mechanisms can be assigned to individual tasks.

Position Group Designation Rules

- Designate the group in order starting with the lower axis.
- Designate the group not in sync as disable.
- In the case of the positioner, only up to axis 2 will be supported for the same group. Do not designate axis 3 as the same group.
- Redefining the group setting will disable the previously designated positioner calibration data, so you should execute the positioner calibration again.

Mechanism Jog Rules

- The Hi6 controller provides eight jog keys in total.
- Mechanisms will be utilized as one group during the jog operation.
- If you select the mechanism number as [M0], the jog keys for the axes 7 and 8 will be operating as an exceptional case, and it is possible to operate M1 and M2 within a range in which the total number of axes including the next mechanism is eight or less. Even in this case, if you set the mechanism number as [M1], you can perform the jog operation for the configuration elements of M1.
- The following shows the example of the usage.

Example 1) M0: Robot (Axes 1–6). M1: Travel axis (Axis 7). M2: Servo gun (Axis 8)

Select [M0] ⇒ Jog key for axes 1–6: M0. Jog key for axis 7: M1. Jog key for axis 8: M2
Select [M1] ⇒ Jog key for axis 1: M1
Select [M2] ⇒ Jog key for axis 1: M2

Example 2) M0: Robot (Axes 1–6). M1: Travel axis (Axis 7). M2: Servo gun (Axes 8–9)

Select [M0] ⇒ Jog key for axes 1–6: M0. Jog key for axis 7: M1
Select [M1] ⇒ Jog key for axis 1: M1
Select [M2] ⇒ Jog key for axes 1–2: M2

Example 3) M0: Robot (Axes 1–7). M1: Travel axis (Axis 8). M2: Servo gun (Axes 9–10)

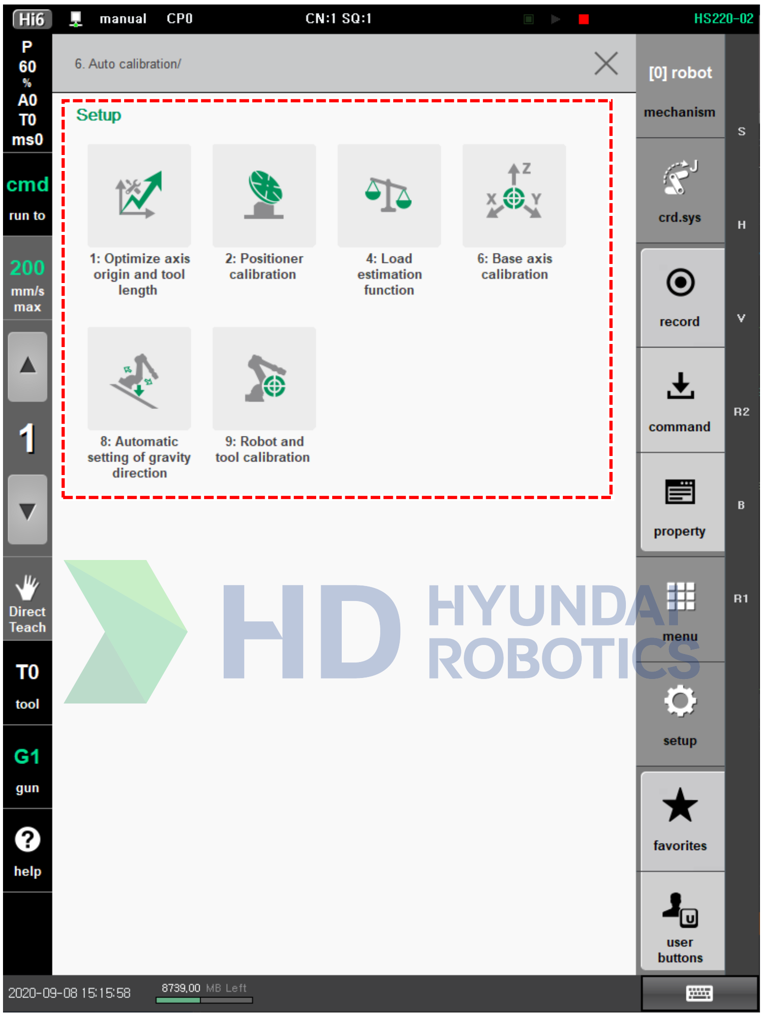
Select [M0] ⇒ Jog key for axes 1–7: M0. Jog key for axis 8: M1
Select [M1] ⇒ Jog key for axis 1: M1
Select [M2] ⇒ Jog key for axis 1: M2

7.7 Auto Calibration

To use the robot correctly, the robot's axis origin, tool length, load mass, and base axis direction can be found using the taught programs and using the movements that will be executed automatically. Those calibrated values will be automatically reflected in the robot.

1. Touch the **[6: Auto Calibration]** menu. Then, the automatic calibration menu will appear.

2. Calibrate the robot's axis origin, tool length, load mass, base axis direction, etc. by selecting the desired menu,


Hi6
manual
CP0
CN:1 SQ:1
HS220-02
P 60 % A0 T0 ms0
cmd
run to
200 mm/s max
1
Direct Teach
T0 tool
G1 gun
help
6. Auto calibration/
Setup
1: Optimize axis origin and tool length
2: Positioner calibration
4: Load estimation function
6: Base axis calibration
8: Automatic setting of gravity direction
9: Robot and tool calibration
[0] robot
mechanism
crd.sys
record
command
property
menu
setup
favorites
user buttons
S
H
V
R2
B
R1
2020-09-08 15:15:58
8739.00 MB Left

7.7.1 Optimize Axis Origin and Tool Length

The optimization of axis origin and tool length is a function to calibrate the origin and tool length of each axis of the robot without using an external measuring sensor.

Prepare two pointed tips. Fix one on the outside and the other on the tool. Then, while changing only the posture of the tooltip of the robot based on the outside fixed tip, you need to record several points using the robot program. At this time, you need to teach seven points to find the axis origin and tool length, and four points or more to find only the tool length.

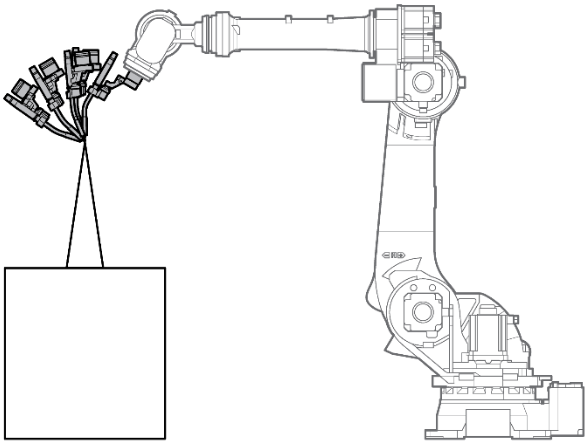


Figure 67 Method of Teaching for the Axis Origin and Tool Length Optimization Function

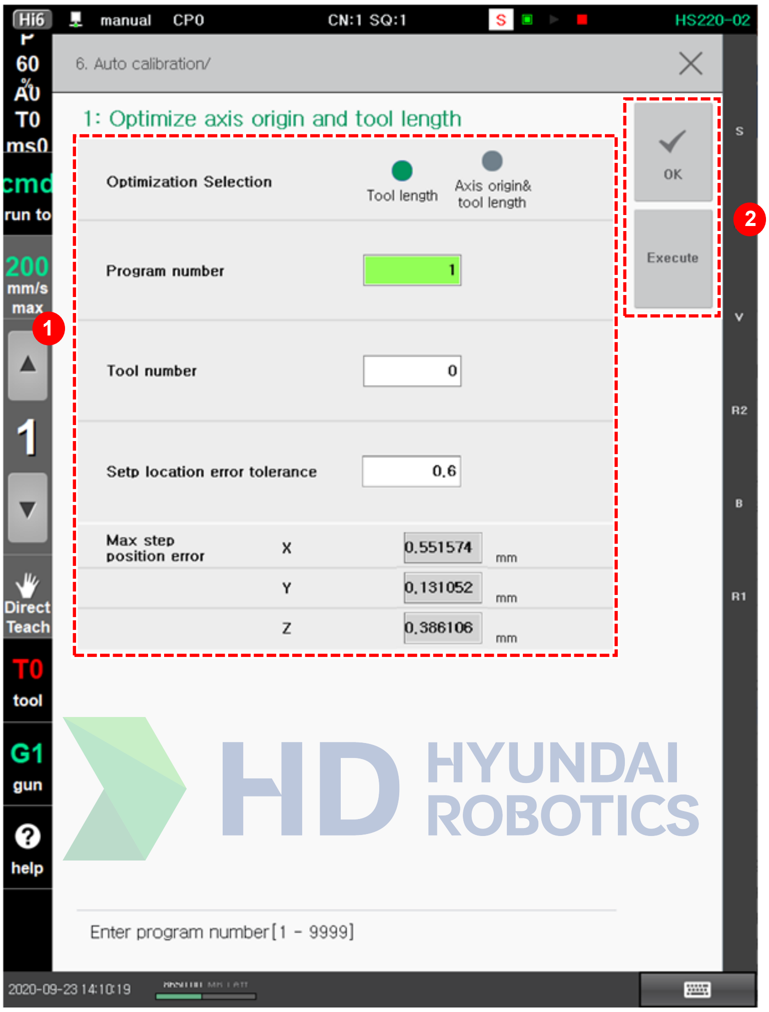
Using the axis origin and tool length optimization function, you can find the optimized tool lengths X, Y, and Z and the optimized origin of the robot H, V, R2, and B axes as well, even when no CAD data is available for them.

⚠ Caution	When the axis origin and tool length optimization function is used, the encoder offset and tool length will be changed, thus also changing the operation position of the previously taught program. Therefore, you should perform the optimization of axis origin and tool length before writing the teaching program.

Notes	• In using the axis origin and tool length optimization function, the accuracy of the teaching is proportional to the accuracy of the maximum step position error result. Therefore, you should prepare two pointed tips and perform the teaching for the tooltip to match the two tips as accurately as possible. Make sure that the accuracy of the matching between the tooltip and the fixed points in space is within 0.5 mm when visually checked. • Teach by setting a posture, with a difference of 30 deg or more, for each step so that the postures of the steps are not similar. • Operate the wrist axes (R2, B, R1) as large as possible in a step and perform teaching while keeping a sufficient (as large as possible) angle difference of the wrist axes for individual steps.

The method to use the axis origin and tool length optimization function is as follows.

1. Touch the **[6: Auto Calibration 〉 1: Optimize Axis Origin and Tool Length]** menu.
2. Select an optimization target and set detailed options.



Hi6
manual CP0
CN:1 SQ:1
HS220-02
60
AU
T0
ms0
cmd
run to
200 mm/s max
1
Direct Teach
T0 tool
G1 gun
help
6. Auto calibration/
OK
Execute
Tool length
Axis origin& tool length
HD HYUNDAI ROBOTICS
2020-09-23 14:10:19
①
②

1: Optimize axis origin and tool length

Optimization Selection: ○ Tool length ● Axis origin& tool length

Program number: 1

Tool number: 0

Setp location error tolerance: 0.6

Max step position error X: 0.551574 mm

Y: 0.131052 mm

Z: 0.386106 mm

Enter program number[1 - 9999]

No.	Description

①	Detailed parameter setting information of the additional axis. You can check and set the name, specification, and configuration of the additional axis.
	• **[Optimization Selection]**: You can select an optimization target.
	  • **[Tool Length]**: You can calibrate the robot's tool length value. If the robot origin is correctly set, you can calibrate only the tool length.
	  • **[Axis Origin & Tool Length]**: You can calibrate both the robot's origin and tool length values. Normally, this function can be used when installing a robot and then initially setting the correct origin.
	• **[Program Number]**: You can set the number of the program in which the same point is recorded in multiple postures.
	• **[Tool Number]**: This is the number of the tool to be set automatically. This should match the tool number recorded in the setting program.
	• **[Step location Error tolerance]**: You can set the error range of the automatic calibration result (the initial setting value is 0.6 mm). If the expected error is within the error range, the integer data will be automatically updated, and if the error is out of the error range, whether to reflect the integer

	will be notified to and confirmed with the user, and then the necessary handling will be performed.
❷	- **[OK]**: You can save the changes. - **[Execute]**: You can execute optimization based on the set information. The optimization result will appear in **[Max Step Position Error]**.
⚠ Caution	It requires your attention that if you calibrate both the robot origin and tool length values, all origins of the robot will change, consequently changing the position of the previously created program.

Notes	- You can also set the origin of each axis and tool length of the robot in the settings menu.
	  - Tool Length: **[Set Up 〉 3: Robot Parameter 〉 1: Tool Data]**
	  - Origin of each axis: **[Set Up 〉 3: Robot Parameter 〉 2: Axis Origin]**
	- If you calibrate the tool angle using the angle calibration function (**[Set Up 〉 3: Robot Parameter 〉 1: Tool Data]**), you should execute the origin axis and tool length optimization function first, and then execute the angle calibration. In this way, the tool data can be set correctly.

7.7.2 Positioner Calibration

Positioner calibration is a function that enables the robot to perform a synchronized follow-up with the operation of a jig device installed outside the robot or to perform a linear or circular operation relative to the jig device. The external jig device in which the positioner calibration function will be applied to is called a positioner or station.

Using the positioner calibration function makes it possible to compensate for the operational difficulties because of the limitation of the robot operation area. In other words, even if the positioner moves while the workpiece is fixed onto it, the robot can still perform a linear or circular operation on the workpiece by following up with the movement of the positioner.

You can simply set the positioner's coordinate system by performing the positioner calibration by teaching three points for a 1-axis positioner and five points for a 2-axis positioning.

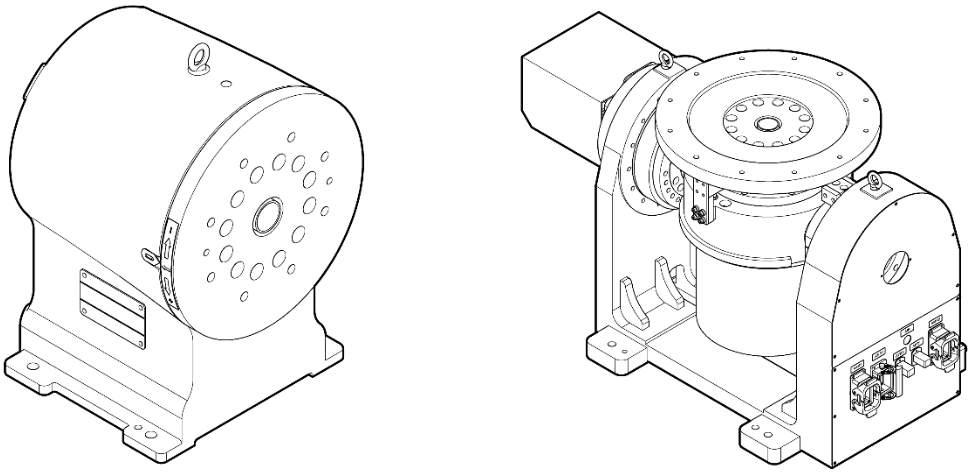


Figure 68 1-Axis Positioner (Left) / 2-Axis Positioner (Right)

The information on the main functions of the positioner calibration is as follows.

Main Functions	Description
Positioner group	1–4 groups are supported

Positioner axis count	1-axis positioner and 2-axis positioner are supported (rotation axis)
Interpolation mode	Linear interpolation and circular interpolation are supported

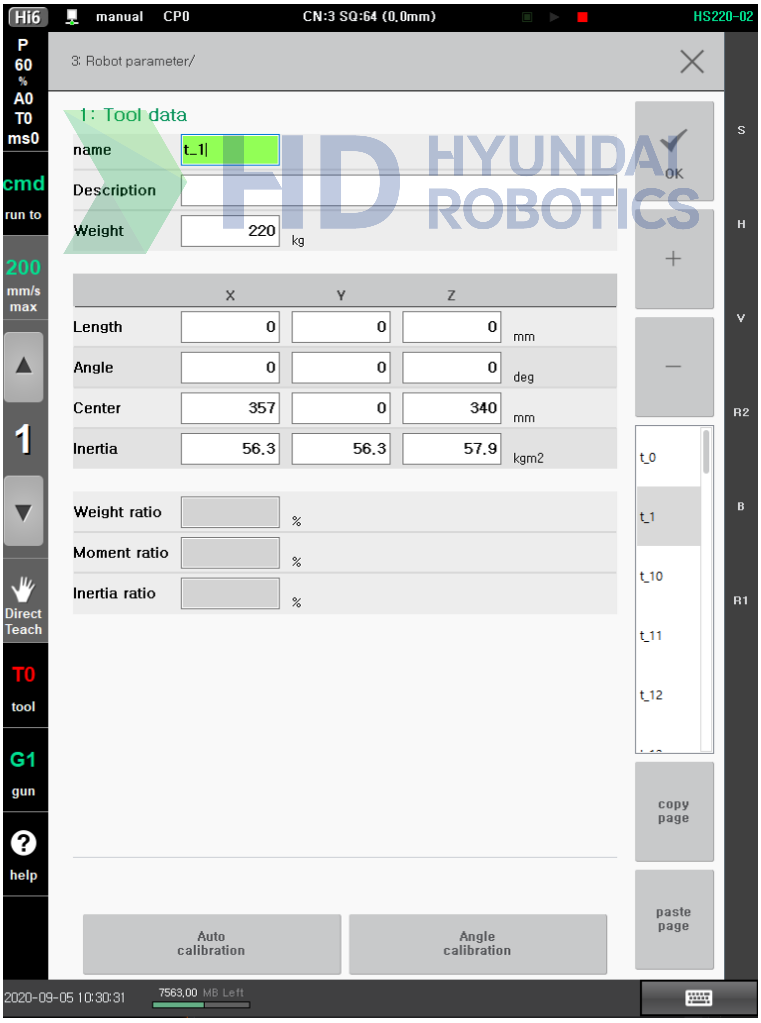
Notes	• The positioner calibration function can be used while the positioner group is set. • For more details, refer to the "**Hi6 Controller Positioner Sync Function Manual.**"

7.7.3 Load Estimation Function

Load estimation is a function that automatically calculates the physical properties (mass, center position, inertia) of the tool attached to the front end of the robot through a certain operation.

The manipulator information (mass, center of mass, inertia of each link) is registered in the controller. However, as a tool will be used after being attached to the front end of the robot when necessary, the tool information should be inputted. The information on the tool physical properties includes tool mass (kg), center position, and inertia that are necessary to safely use the robot.

If the CAD data contains the physical properties information of the tool, you can directly input the tool mass, center position, and inertia by touching the **[Set Up]** button **❯ [3: Robot Parameter ❯ 1: Tool Data]** menu of the job program.


Hi6
manual
CP0
CN:3 SQ:64 (0.0mm)
HS220-02
P
60
%
A0
T0
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
3: Robot parameter/
OK
+
—
t_0
t_1
t_10
t_11
t_12
copy page
paste page
Auto calibration
Angle calibration
S
H
V
R2
B
R1
2020-09-05 10:30:31
7563.00 MB Left

1: Tool data

name: t_1

Description:

Weight: 220 kg

	X	Y	Z	
Length	0	0	0	mm
Angle	0	0	0	deg
Center	357	0	340	mm
Inertia	56.3	56.3	57.9	kgm2

Weight ratio: %

Moment ratio: %

Inertia ratio: %

Figure 69 Tool Data Setting Screen

The tool data setting information is as follows.

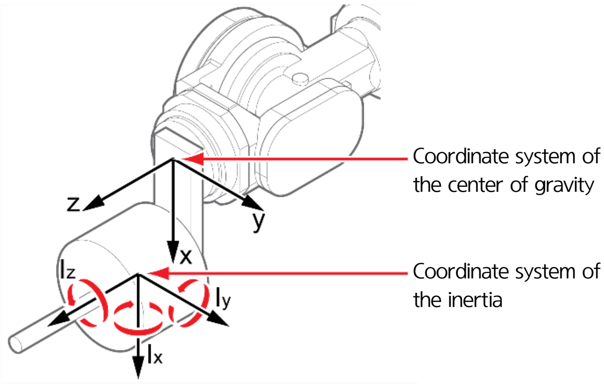
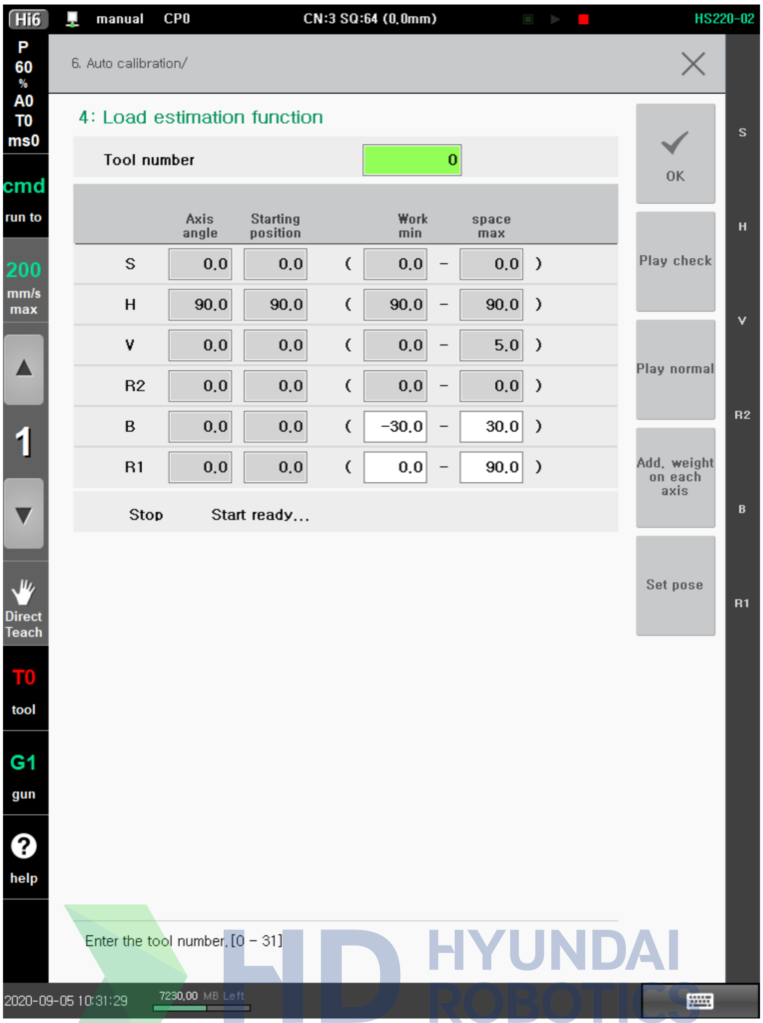

Coordinate system of the center of gravity
z
y
x
Coordinate system of the inertia
Iz
Iy
Ix

Figure 70 Tool Data

- **[Weight]**: The total weight (kg) of the tool installed at the front end of the robot
- **[Center]**: The distance (mm) in the x, y, z directions from the center of the robot flange face to the position of the center of gravity of the tool
- **[Inertia]**: The moment of inertia of the tool with respect to the tool coordinate (kg/m^2). The moment of inertia will be determined by the mass distribution around the x, y, and z axes based on the center of gravity, and will increase as the load mass is distributed farther from the rotation axis.
- Tool data coordinate system: Inertia and center will be expressed as values with respect to the x-, y-, and z-axis directions.

However, in many cases, it is difficult to determine the physical properties of the tool such as mass, inertia, and center of gravity of the tool from CAD data. At this time, you can check the physical properties of the tool using the load estimation function in the robot controller.



6. Auto calibration/

4: Load estimation function

Tool number	0

	Axis angle	Starting position		Work min		space max	
S	0.0	0.0	(	0.0	–	0.0	)
H	90.0	90.0	(	90.0	–	90.0	)
V	0.0	0.0	(	0.0	–	5.0	)
R2	0.0	0.0	(	0.0	–	0.0	)
B	0.0	0.0	(	-30.0	–	30.0	)
R1	0.0	0.0	(	0.0	–	90.0	)

Stop Start ready...

Enter the tool number.[0 – 31]

2020-09-05 10:31:29 7230.00 MB Left

Figure 71 Load Estimation Function

1. Touch the **[6: Auto Calibration 〉 4: Load Estimation Function]** menu.
2. After touching the **[Add. Weight on Each Axis]** button, input the information of the additional weight of each axis.

   If the load estimation function is performed while there is additional weight, it will be determined that all the weight objects mounted onto the robot are at the front end. For accurate load estimation, the information on the additional weight of each axis should be inputted.
3. After moving the robot to a safe area by moving the main axis of the robot, touch the **[Set pose]** button.
4. After touching the **[Wrist Axis Operation Area]** button, designate the operation area of the wrist axis to be used in the load estimation operation. Load estimation can be performed in an operation area that there is no interference not only with nearby facilities but also with the manipulator.

   If the **[Wrist Axis Operation Area]** button is not supported, skip this step, and perform the next step.
5. Touch the **[Play check]** button. Then, while the robot is operating at a low speed, you can check for any interference with nearby facilities or the manipulator.
6. After inputting the number of the tool mounted onto the robot, touch the **[Play Normal]** button. Then, load estimation will be performed, allowing the physical properties of the tool to be calculated.
7. After checking the load estimation result, touch the **[End]** button. Then, the calculated physical properties of the tool will be registered in the tool number.

Notes	• Additional weight is the overall weight of all devices that the user attaches to the robot, such as a welding dressing device and welding signal line relay box, except for the tool mounted at the front end of the robot. • The wrist axis operation area function will not be supported in some robots. • It requires your attention that the load estimation function may not be executed depending on the setting values of the wrist axis operation area function. • For details on the load estimation function, refer to the "**Load Estimation Function Manual.**"

7.7.4 Base Axis Calibration

Base axis calibration is a function to calibrate the installation direction of the axis.

It is almost impossible to install the base axis to exactly match one direction (X, Y, or Z) of the robot coordinate system. When you calculate the direction of the base axis in the controller using the base axis calibration function, you can improve the performance of the linear interpolation trajectory of the system including the base axis.

After the robot is installed on the base axis, this function makes it possible to perform position interpolation by finding the direction vector of any base axis on which the robot is installed.

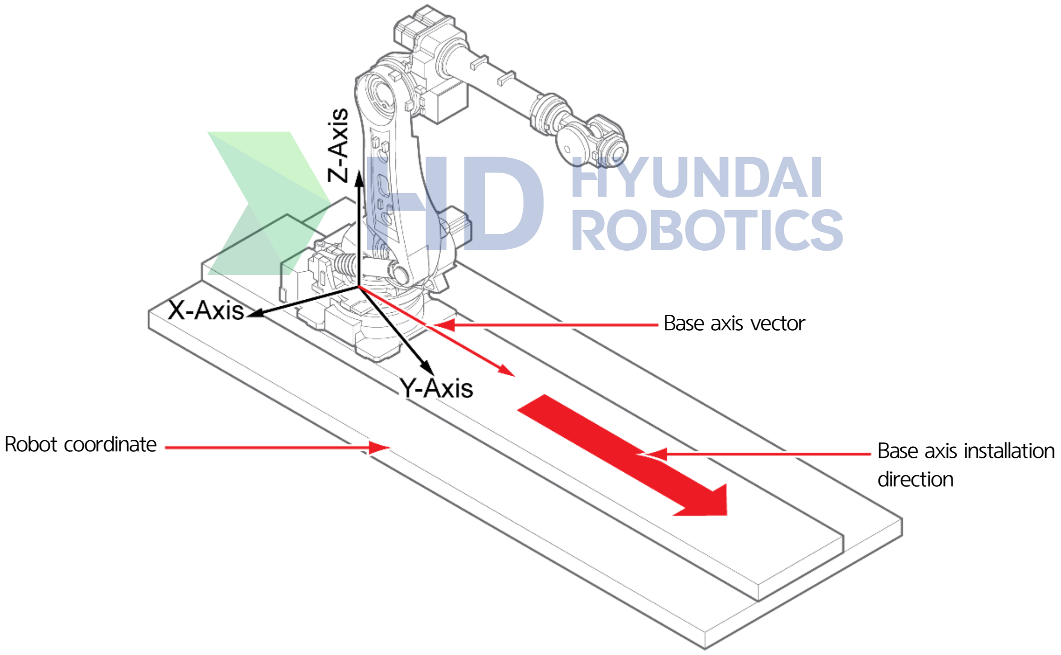


Figure 72 Base Axis Calibration

In general, the base axis is used to move the robot to the operation position. In special cases, the base axis can also be used in a case in which a linear trajectory should be guaranteed while the robot is moving on the base axis.

- When two robots with the base axis calibrated deliver the workpiece (multi-robots will be supported in the future)
- When you need to perform interpolation while operating the base axis

7.7.4.1 Base Axis Initial Setting

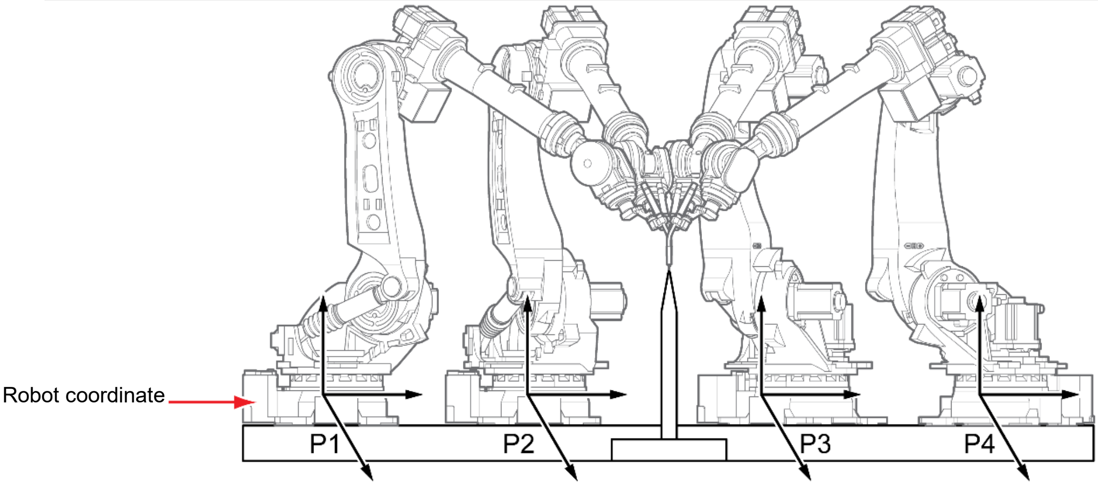
1. In manual mode, touch the **[Set up]** button 〉 **[5: Initialize〉 5: Additional Axis Parameter Setting]** menu on the right side of the initial screen.
2. After setting the parameters such as the specifications and configuration of the additional axis, touch the **[OK]** button.
    - **[Axis Specification]**: You can select the specification of the additional axis as **base**.
    - **[Axis Configuration]**: You can select the mechanism of the additional axis as **any**.
    - Other parameters: You can set other parameters according to the instrumental design value and controller configuration specifications.

Notes	• When the system is initialized, the additional axis setting menu will appear, allowing you to perform the initial setting of the base axis. • The additional axis parameter setting menu is a function for engineers, so it will not be supported for general users. For details on the additional axis parameter setting menu, contact the engineer for inquiry.

⚠ Caution	You can use the calibration function only for the first base axis, and you can set the **axis configuration** as **any** when setting the additional axis parameter. Do not set **the axis configuration** as **any** for the other base axes except for the first base axis.

7.7.4.2 Base Axis Calibration Program Teaching

1. Make a reference point in space, and then record the first reference point.
2. Move the base axis more than 200 mm and record the same point as the second step.
3. While moving 200 mm or more in the same direction as the direction you moved in step 2, record the same point as the third and fourth steps.

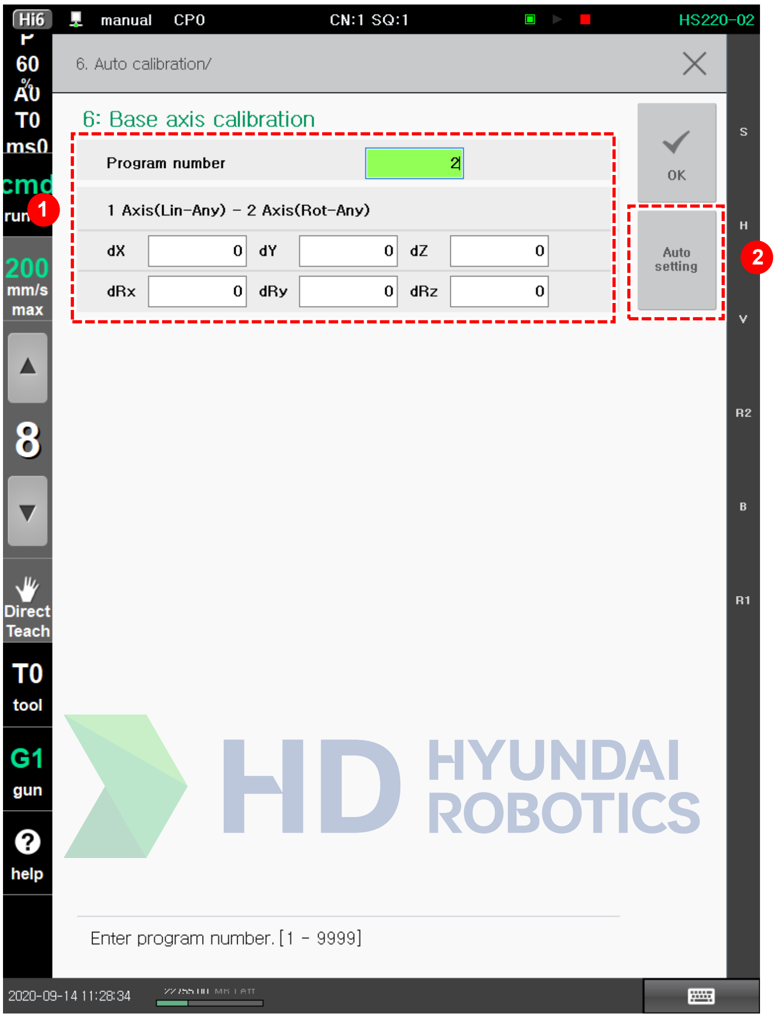


⚠ Caution	• Teach the travel axis calibration program using a tool for which robot calibration (optimization of the axis origin and tool length) has been completed. • When recording a step, record it using a tool number for base axis calibration. • Record the position by setting the moving distance of the base axis between recording steps as far as possible.

7.7.4.3 Base Axis Calibration Execution

1. Touch the **[6: Auto Calibration 〉 6: Base Axis Calibration]** menu.

2. After inputting the program number for the base axis calibration, touch the **[Auto Setting]** button.


Hi6
manual
CP0
CN:1 SQ:1
HS220-02
60
%
AU
T0
ms0
cmd
run
200
mm/s
max
8
Direct
Teach
T0
tool
G1
gun
help
6. Auto calibration/
OK
Auto
setting
S
H
V
R2
B
R1
1
2
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6: Base axis calibration

Program number	2				
1 Axis(Lin-Any) – 2 Axis(Rot-Any)					
dX	0	dY	0	dZ	0
dRx	0	dRy	0	dRz	0

Enter program number. [1 – 9999]

3. After checking the installation direction vector value of the base axis, touch the **[OK]** button.

7.7.4.4 Operation After Base Axis Calibration

If you jog the base axis after performing base axis calibration, the distance traveled in the created direction vector of the base axis will be converted into the current coordinate value.

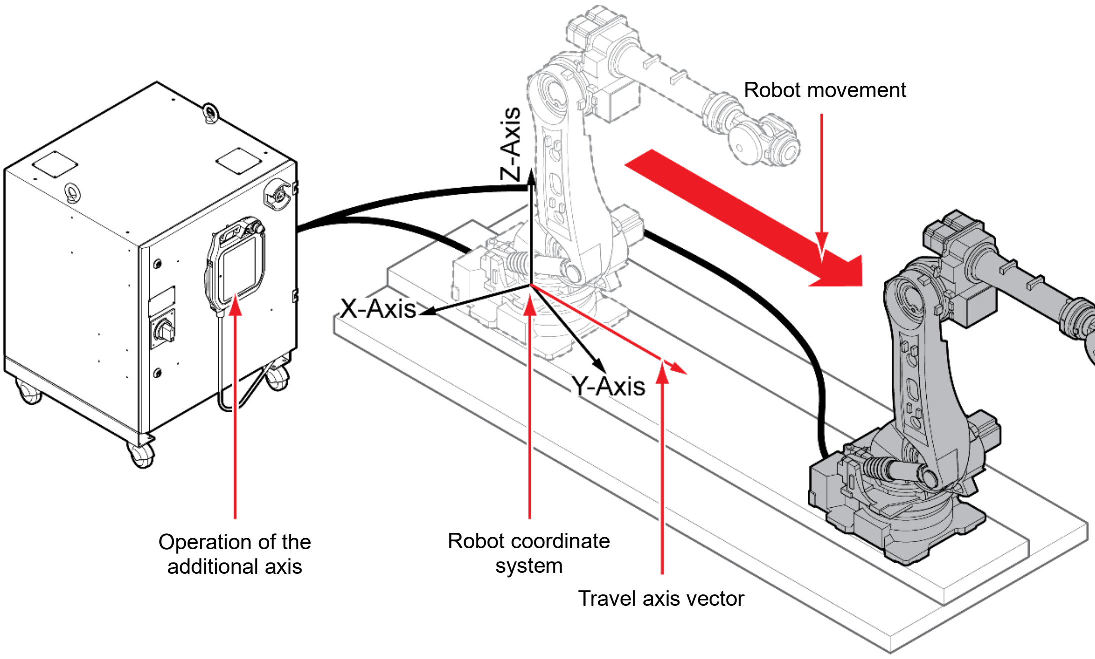


Figure 73 Operation After Calibration of the Base Axis

1. Touch the **[+]** button at the top right of the panel stack in the work area, and then touch **[Pose]** in the panel selection window.
2. Jog the base axis. The distance traveled in the direction of the base axis will be converted into X, Y, and Z values and displayed in the pose information window.
3. Record and play back the steps in the usual way.

⚠ **Caution**	Set the jog coordinate system as the tool coordinate system and jog the base axis to check whether the base axis is properly calibrated. If the tooltip fixing operation is executed, it means that the base axis has been properly calibrated.

7.7.5 Gravity Direction Auto Setting

The Hi6 controller is based on dynamics, so it is important to set the gravity direction.

In general, the robot installation direction is perpendicular to the gravity direction as follows. If the robot is installed obliquely to the ground, the gravity direction should be set in the robot controller. At this time, you can use the automatic gravity direction setting function.

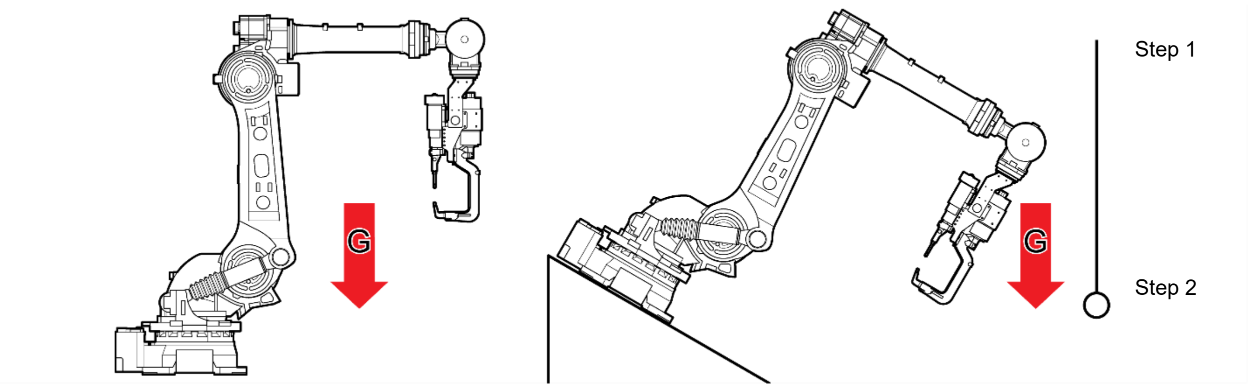
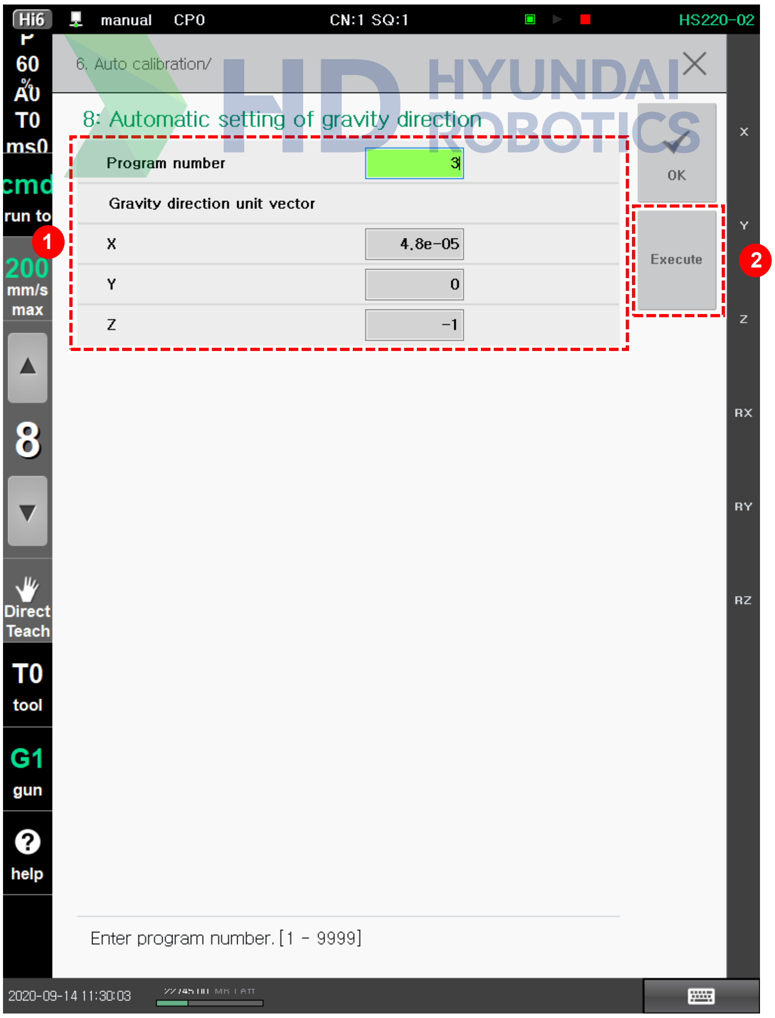

G
G
Step 1
Step 2

Figure 74 Gravity Direction of the Robot Placed on a Floor (Left) / Gravity Direction of the Robot Placed on a Slope (Right)

How to set the gravity direction is as follows.

1. Attach a weight to the outside to indicate the gravity direction, and then teach two points (Step 1, Step 2) in the direction of the gravitational action.
2. Touch the **[6: Auto Calibration 〉 8: Automatic setting of gravity direction]** menu.
3. After inputting the program number, touch the **[Execute]** button. Then, the direction vector will be calculated and displayed.


Hi6
manual
CP0
CN:1 SQ:1
HS220-02
60
%
AU
T0
ms0
cmd
run to
200
mm/s
max
8
Direct
Teach
T0
tool
G1
gun
help
OK
Execute
X
Y
Z
RX
RY
RZ
1
2
2020-09-14 11:30:03

6. Auto calibration/

8: Automatic setting of gravity direction

Program number	3
Gravity direction unit vector	
X	4.8e-05
Y	0
Z	-1

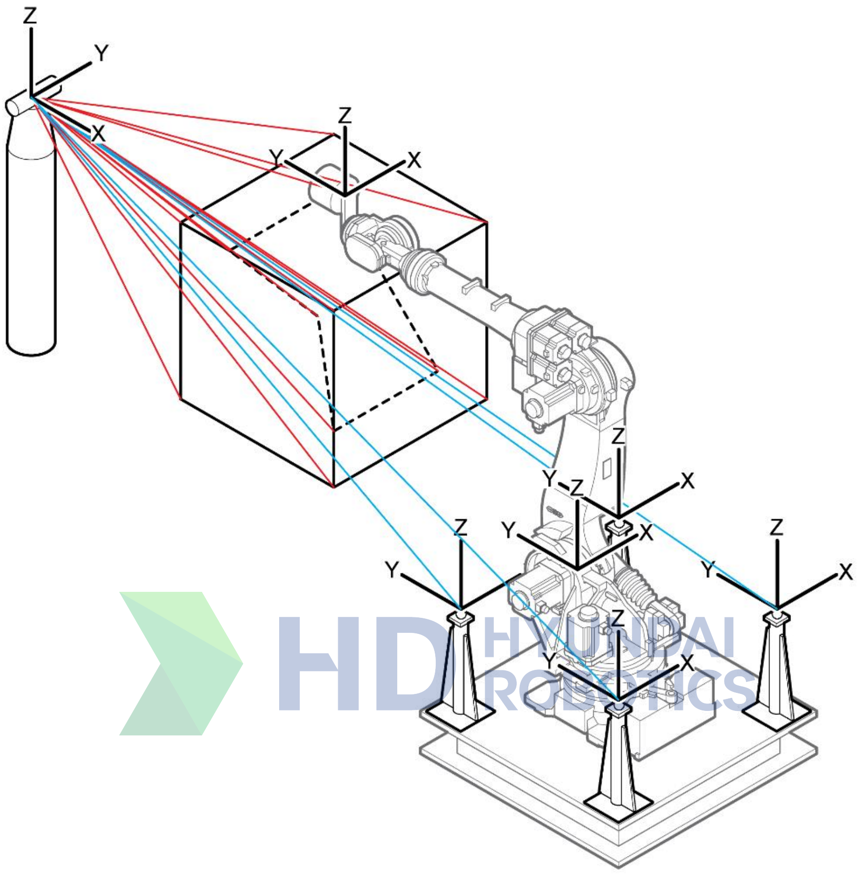
Enter program number. [1 - 9999]

4. After checking the direction vector value, touch the **[OK]** button. Then, the direction will be set as the gravity direction.

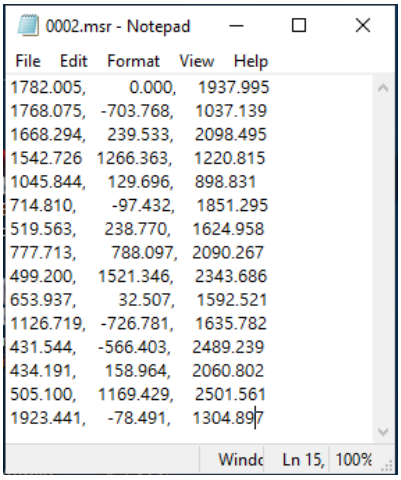
7.7.6 Calibration of the Robot and Tool

The robot and tool calibration function will be used in an environment where the position of the robot can be measured with a 3D measuring device.

1. After selecting the position to be measured at the tooltip of the robot, measure the position of more than 15 points while moving the position and posture of the robot in various ways, and record the robot positions as a program.



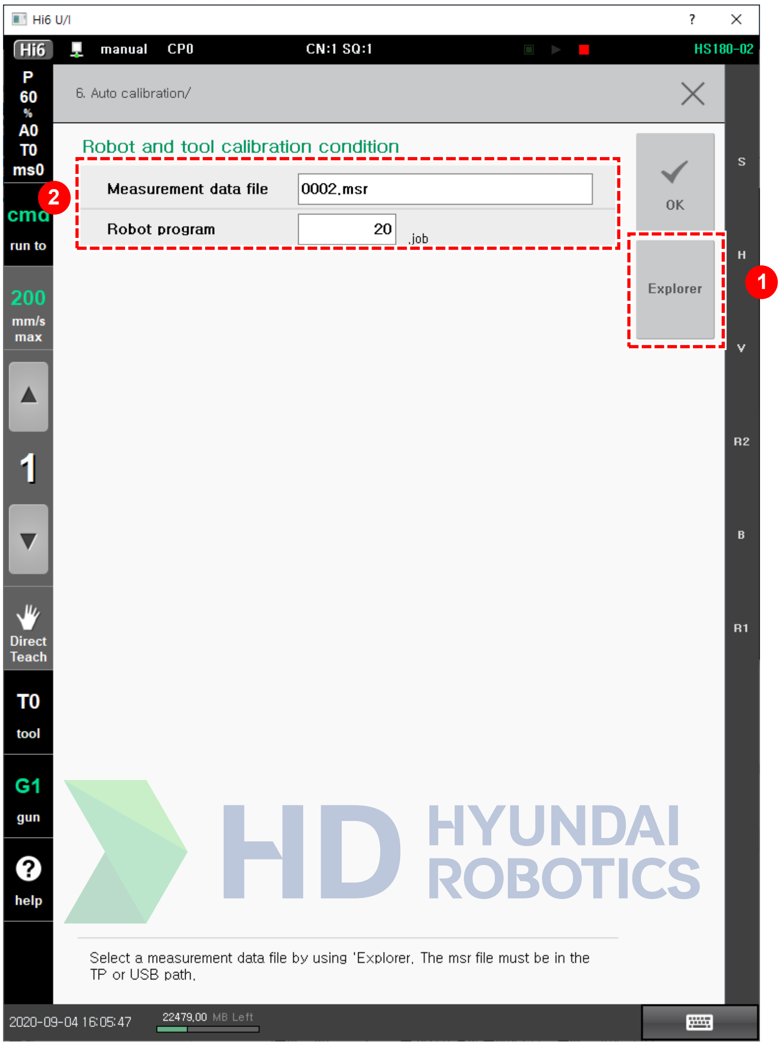
2. Organize the measured robot's position data (measuring point data) in X, Y, and Z formats, and then create a file (Format: ASCII Extension: MSR).



```
1782.005,      0.000,   1937.995
1768.075,  -703.768,   1037.139
1668.294,   239.533,   2098.495
1542.726  1266.363,   1220.815
1045.844,   129.696,   898.831
714.810,     -97.432,   1851.295
519.563,    238.770,   1624.958
777.713,     788.097,  2090.267
499.200,   1521.346,   2343.686
653.937,      32.507,   1592.521
1126.719,  -726.781,   1635.782
431.544,   -566.403,   2489.239
434.191,    158.964,   2060.802
505.100,   1169.429,   2501.561
1923.441,   -78.491,   1304.897
```

3. After saving the position data file into a removable storage device, connect the removable storage device to the teach pendant. The **[USB]** icon ( ) will appear in the status bar of the Hi6 teach pendant screen.

4. Touch the **[6: Auto Calibration 〉 9: Robot and Tool calibration condition]** menu.
5. Touch the **[Explorer]** button to select a position data file and set the robot program used for the measurement.



Hi6 U/I
?
Hi6
manual
CP0
CN:1 SQ:1
HS180-02
P
60
%
A0
T0
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
6. Auto calibration/
OK
Explorer
S
H
V
R2
B
R1
1
2
HD HYUNDAI ROBOTICS
2020-09-04 16:05:47
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Robot and tool calibration condition

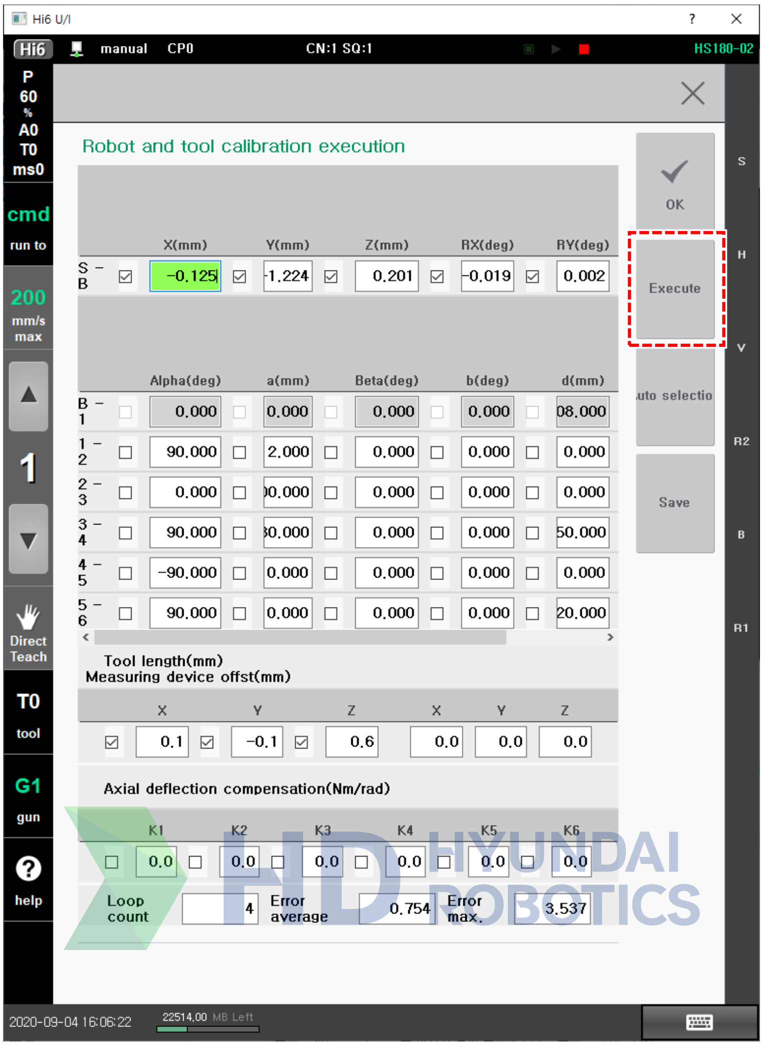
Measurement data file 0002.msr

Robot program 20 .job

Select a measurement data file by using 'Explorer. The msr file must be in the TP or USB path.

6. Touch the **[OK]** button. Then, the screen will switch to the robot and tool calibration screen.

7. Touch the **[Execute]** button on the robot and tool calibration execution screen. Then, the calibration results will appear.


Hi6 U/I
?
Hi6
manual
CP0
CN:1 SQ:1
HS180-02
P
60
%
A0
T0
ms0
cmd
run to
200
mm/s
max
1
Direct
Teach
T0
tool
G1
gun
help
OK
Execute
uto selectio
Save
S
H
V
R2
B
R1

Robot and tool calibration execution

		X(mm)		Y(mm)		Z(mm)		RX(deg)		RY(deg)
S – B	☑	-0.125	☑	-1.224	☑	0.201	☑	-0.019	☑	0.002

		Alpha(deg)		a(mm)		Beta(deg)		b(deg)		d(mm)
B – 1	☐	0.000	☐	0.000	☐	0.000	☐	0.000	☐	08.000
1 – 2	☐	90.000	☐	2.000	☐	0.000	☐	0.000	☐	0.000
2 – 3	☐	0.000	☐	0.000	☐	0.000	☐	0.000	☐	0.000
3 – 4	☐	90.000	☐	30.000	☐	0.000	☐	0.000	☐	50.000
4 – 5	☐	-90.000	☐	0.000	☐	0.000	☐	0.000	☐	0.000
5 – 6	☐	90.000	☐	0.000	☐	0.000	☐	0.000	☐	20.000

Tool length(mm)
Measuring device offst(mm)

	X		Y		Z	X	Y	Z
☑	0.1	☑	-0.1	☑	0.6	0.0	0.0	0.0

Axial deflection compensation(Nm/rad)

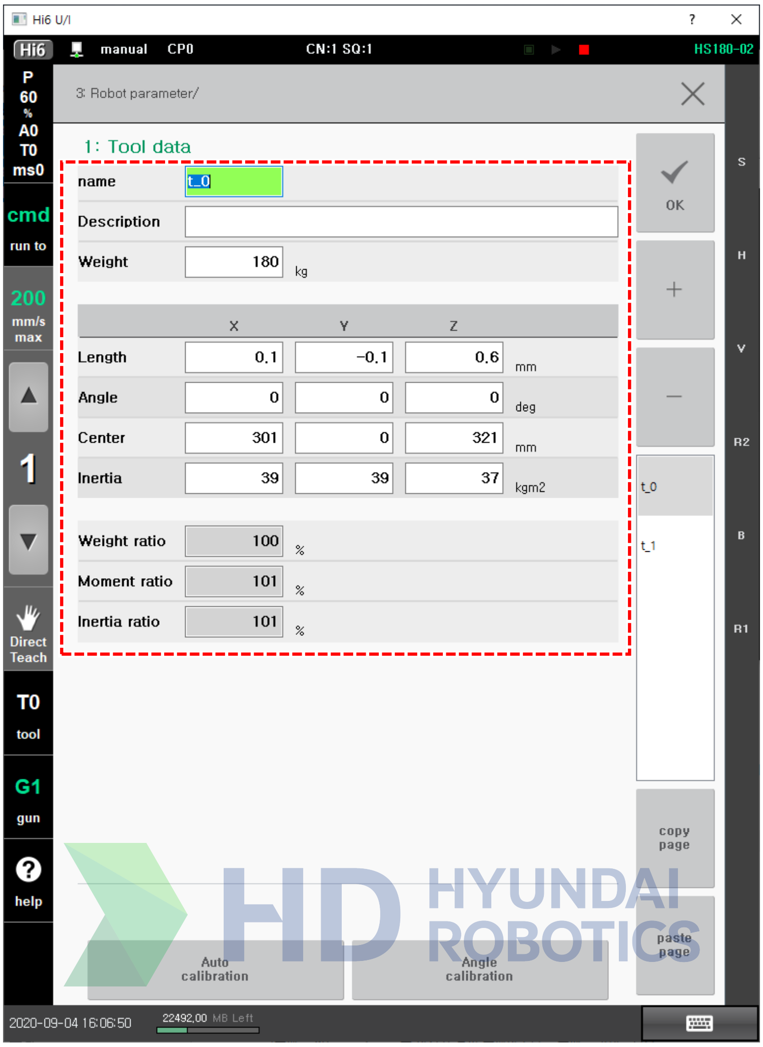
	K1		K2		K3		K4		K5		K6
☐	0.0	☐	0.0	☐	0.0	☐	0.0	☐	0.0	☐	0.0

Loop count: 4
Error average: 0.754
Error max.: 3.537

2020-09-04 16:06:22
22514.00 MB Left

8. After checking the calibration result, touch the **[OK]** button. Then, the calibration result will be automatically applied to the axis origin and tool integer.

9. Touch the **[3: Robot Parameter 〉 1: Tool Data]** menu. Then, you can check the robot calibration execution result.


Hi6 U/I
?
Hi6
manual
CP0
CN:1 SQ:1
HS180-02
P
60
%
A0
T0
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
3: Robot parameter/
OK
S
H
V
R2
B
R1
t_0
t_1
copy page
paste page
Auto calibration
Angle calibration
HD HYUNDAI ROBOTICS
2020-09-04 16:06:50
22492.00 MB Left

1: Tool data

name: t_0

Description:

Weight: 180 kg

	X	Y	Z	
Length	0.1	-0.1	0.6	mm
Angle	0	0	0	deg
Center	301	0	321	mm
Inertia	39	39	37	kgm2

Weight ratio: 100 %

Moment ratio: 101 %

Inertia ratio: 101 %

Note	The axis origin and tool length X, Y, and Z values of the axes 2–5 (H, V, R2, and B axes) of the calibration parameter are selected. To calibrate the tool only, perform execution after deselecting the value of each axis.

8. R Codes

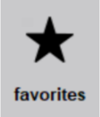
When it comes to the operating procedures for frequently used functions, such as modifying the contents of a program or changing the setting status of a controller, you can use them easily by designating specific service codes (R codes).

R codes are configured in the "**R+No.**" format, which combines R, representing Reset and Rapid, with a number.

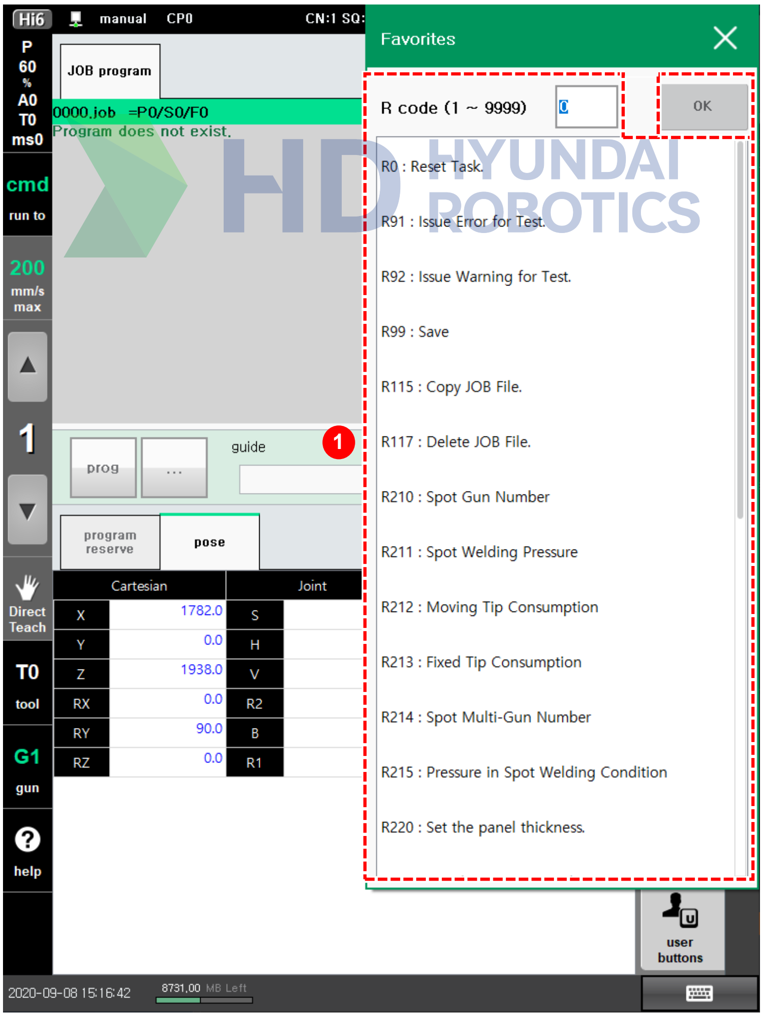
8.1 Use of R Codes

The method to execute a specified function using an R code is as follows.

1. Touch the **[Favorites]** button on the right side of the Hi6 teach pendant screen. Then, the favorites window will appear.



2. Select a code number from the list or input the code number in the input area, and then touch the **[OK]** button or press the **⟨enter⟩** key. Then, the function designated to the selected R code will be executed.


Hi6
manual CP0
CN:1 SQ:
P 60 % A0 T0 ms0
cmd
run to
200 mm/s max
1
Direct Teach
T0 tool
G1 gun
help
JOB program
0000.job =P0/S0/F0
Program does not exist.
prog
...
guide
program reserve
pose
Cartesian
Joint
user buttons
2020-09-08 15:16:42
8731.00 MB Left
Favorites
OK
①
②

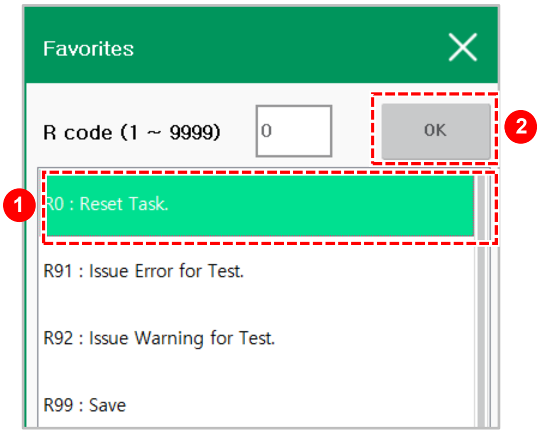
Cartesian		Joint
X	1782.0	S
Y	0.0	H
Z	1938.0	V
RX	0.0	R2
RY	90.0	B
RZ	0.0	R1

R code (1 ~ 9999) 0

R0 : Reset Task.
R91 : Issue Error for Test.
R92 : Issue Warning for Test.
R99 : Save
R115 : Copy JOB File.
R117 : Delete JOB File.
R210 : Spot Gun Number
R211 : Spot Welding Pressure
R212 : Moving Tip Consumption
R213 : Fixed Tip Consumption
R214 : Spot Multi-Gun Number
R215 : Pressure in Spot Welding Condition
R220 : Set the panel thickness.

8.2 R0 for Resetting the Step Counter

After inputting **0** in the favorites window, touch the **[OK]** button or press the **<enter>** key.


Favorites
R code (1 ~ 9999)
0
OK
2
1
R0 : Reset Task.
R91 : Issue Error for Test.
R92 : Issue Warning for Test.
R99 : Save

You can initialize the step counter to move to STEP0. You can also perform the following functions.

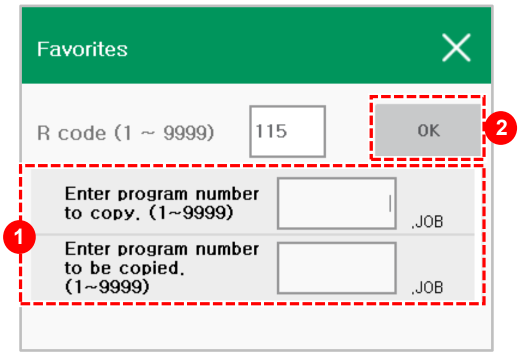
- Clearing the playback execution status
- Turning off the overall abnormality signal and lamp
- Turning off the alarm signal
- Clearing the wait status
- Clearing the status and signals of various application functions

Note	R0 code cannot be used during the startup of the robot.

8.3 R115 for Copying a Program

You can copy the JOB program on the mainboard to another program on the mainboard. After inputting the number of the program that you want to copy, input the program number to which you want to copy the copied program.

1. After inputting **115** in the favorites window, touch the **[OK]** button or press the **<enter>** key.
2. After inputting the number of the program (original) that you want to copy and also the number of the program (target) to which you want to copy the copied program, touch the **[OK]** button or press the **<enter>** key. Then, the program will be copied.


Favorites
R code (1 ~ 9999)
115
OK
2
1
Enter program number to copy. (1~9999)
.JOB
Enter program number to be copied. (1~9999)
.JOB

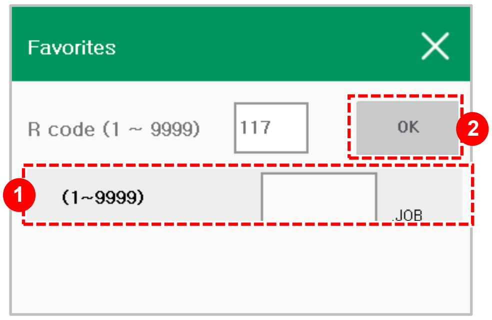
- If a program with the same number as the program to which you want to copy the copied program exists already, you should select whether to overwrite the file.
- If there is no original file to copy, a notification message ("**No Original File Exists.**") will appear.

Note	Code R115 cannot be used in automatic mode. It must be used in manual mode.

8.4 R117 for Deleting a Program

You can individually delete the programs in the internal memory.

1. After inputting **117** in the favorites window, touch the **[OK]** button or press the **〈enter〉** key.
2. After inputting the number of the program that you want to delete, touch the **[OK]** button or press the **〈enter〉** key. Then, the deletion confirmation window will appear.



R code (1 ~ 9999) 117

(1~9999)

- If there is no file to delete, a notification message (“**No File Exists.**”) will appear.
- If you want to delete a protected program, a notification message (“**A Protected File.**”) will appear.

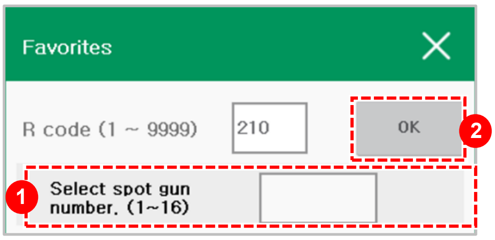
3. In the deletion confirmation window, touch the **[OK]** button or press the **〈enter〉** key. Then, the selected program will be deleted.

Note	The R117 code cannot be used in automatic mode. It must be used in manual mode.

8.5 R210 for Selecting a Spot Gun Number

You can select the spot guns to use when using multiple spot welding guns (servo guns or pneumatic guns).

1. After inputting **210** in the favorites window, touch the **[OK]** button or press the **〈enter〉** key.
2. After inputting the number of the spot gun to use, touch the **[OK]** button or press the **〈enter〉** key.



R code (1 ~ 9999) 210

Select spot gun number. (1~16)

- The selected spot gun number will be displayed on the **[Gun]** button on the left side of the Hi6 teach pendant screen.
- If you change the spot gun number, the tool number designated in the spot gun corresponding tool number will be automatically changed. You can check the spot gun corresponding tool number in the **[Set Up 〉 4: Application Parameter 〉 1: Spot Welding 〉 1: Gun Number Corresponding Tool Number and Gun Type Setting]** menu.

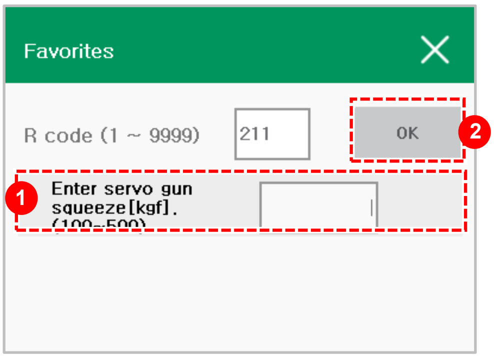
Notes	• R210 code cannot be used during the startup of the robot. • The spot gun number can be set only in the spot welding environment **([Spot Welding]** item in

	the **[Set Up 〉 5: Initialize〉 3: Usage Setting]** menu is set as **enable)**. • You can manually open, close, and squeeze the selected spot welding gun. For details on the spot welding function, refer to the "**Hi6 Controller Spot Welding Function Manual.**"

8.6 R211 for Setting the Servo Gun Squeeze Force

You can manually set the squeeze force when executing the servo gun squeeze.

1. After inputting **211** in the favorites window, touch the **[OK]** button or press the **〈enter〉** key.
2. After inputting the squeeze force, touch the **[OK]** button or press the **〈enter〉** key.



R code (1 ~ 9999) 211

Enter servo gun squeeze[kgf]. (100~500)

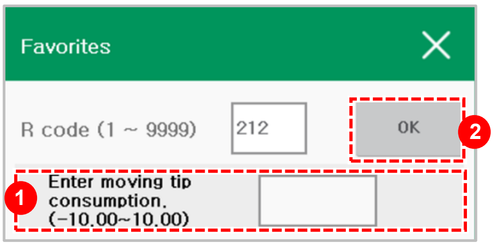
- The squeeze force in the welding condition file will not be changed.
- If the inputted squeeze force is greater than or smaller than the upper limit of the current/pressure table of the servo gun parameters, a warning message will appear.

Notes	• R211 code cannot be used during the startup of the robot. • The spot gun number can be set only in the spot welding environment (**[Spot Welding]** item in the **[Set Up 〉 5: Initialize〉 3: Usage Setting]** menu is set as **enable**). • For details on the manual setting of the servo gun squeeze force, refer to the "**Hi6 Controller Spot Welding Function Manual.**"

8.7 R212 for Presetting the Servo Gun Moving Electrode Wear Volume

You can manually set the servo gun moving electrode wear volume.

1. After inputting **212** in the favorites window, touch the **[OK]** button or press the **〈enter〉** key.
2. After inputting the moving electrode wear volume, touch the **[OK]** button or press the **〈enter〉** key.



R code (1 ~ 9999) 212

Enter moving tip consumption. (-10.00~10.00)

⚠ Caution	It requires your attention that if the setting value is set larger or smaller than the actual wear volume of the electrode, it may cause mismatching of the squeeze force or interference with the workpiece.

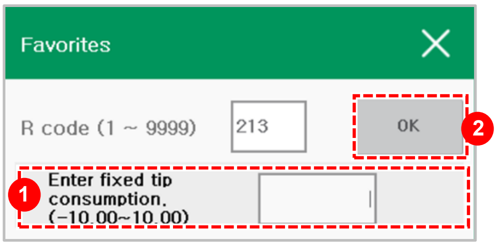
Notes	• R212 code cannot be used during the startup of the robot.

	• The spot gun number can be set only in the spot welding environment (**[Spot Welding]** item in the **[Set Up 〉 5: Initialize〉 3: Usage Setting]** menu is set as **enable**). • For details on the manual setting of the servo gun moving electrode wear volume, refer to the "**Hi6 Controller Spot Welding Function Manual.**"

8.8 R213 for Presetting the Servo Gun Fixed Electrode Wear Volume

You can manually set the servo gun fixed electrode wear volume.

1. After inputting **213** in the favorites window, touch the **[OK]** button or press the **〈enter〉** key.
2. After inputting the fixed electrode wear volume, touch the **[OK]** button or press the **〈enter〉** key.



Favorites

R code (1 ~ 9999) 213

Enter fixed tip consumption. (-10.00~10.00)

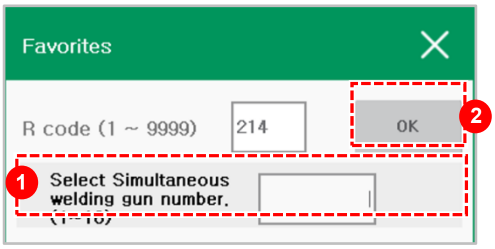
Caution	It requires your attention that if the setting value is set larger or smaller than the actual wear volume of the electrode, it may cause mismatching of the squeeze force or interference with the workpiece.

Notes	• R213 code cannot be used during the startup of the robot. • The spot gun number can only be set in the spot welding environment (**[Spot Welding]** item in the **[Set Up 〉 5: Initialize〉 3: Usage Setting]** menu is set as **enable**). • For details on the manual setting of the servo gun fixed electrode wear volume, refer to the "**Hi6 Controller Spot Welding Function Manual.**"

8.9 R214 for Selecting Welding Guns Simultaneously

You can select the numbers of spot welding guns (servo guns or pneumatic guns) that are to be used in a welding operation in which multiple spot welding guns will be used at the same time.

1. After inputting **214** in the favorites window, touch the **[OK]** button or press the **〈enter〉** key.
2. After inputting the numbers of the welding guns to use simultaneously, touch the **[OK]** button or press the **〈enter〉** key.



Favorites

R code (1 ~ 9999) 214

Select Simultaneous welding gun number. (1~10)

- The selected spot gun number will be displayed on the **[Gun]** button on the left side of the Hi6 teach pendant screen.
- If you select spot welding guns that are different in type from each other, a notification message ("**The Gun Type of the Currently Selected Gun is Set Incorrectly.**") will appear.

Notes	• R214 code cannot be used during the startup of the robot. • The spot gun number can only be set in the spot welding environment (**[Spot Welding]** item in

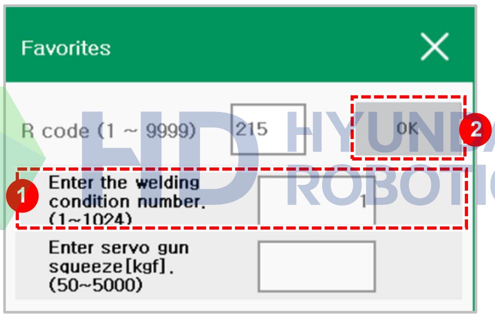
the **[Set Up 〉 5: Initialize 〉 3: Usage Setting]** menu is set as **enable.**

- You can check the setting status of the spot welding gun in the **[Set Up 〉 4: Application Parameter 〉 1: Spot Welding 〉 1: Gun Number Corresponding Tool Number and Gun Type Setting]** menu.
  - When a gun is selected as a multisync gun, the manual squeeze/open/close operations of the selected gun will be simultaneously in sync with the previously selected guns.
  - When a gun is selected as a multisync gun, if the gun LED is in the ON status, the SPOT command will be recorded in the sync spot format.
- The selected spot welding gun can be operated manually. For details on the spot welding function, refer to the "**Hi6 Controller Spot Welding Function Manual.**"

8.10 R215 for Setting the Squeeze Force in the Spot Welding Condition

You can set the squeeze force required for servo gun welding in the welding condition table. You can also set the squeeze force in the **[Set Up 〉 4: Application Parameter 〉 1: Spot Welding 〉 4: Welding Data (Condition, Sequence) 〉 2: Welding Condition]** menu.

1. After inputting **215** in the favorites window, touch the **[OK]** button or press the **〈enter〉** key.
2. After inputting the welding condition number, touch the **[OK]** button or press the **〈enter〉** key.

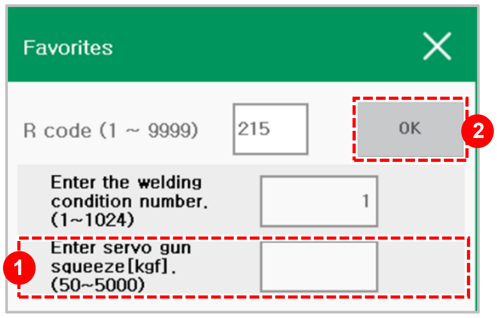


R code (1 ~ 9999) 215

Enter the welding condition number. (1~1024) 1

Enter servo gun squeeze[kgf]. (50~5000)

3. After inputting the servo gun squeeze force, touch the **[OK]** button or press the **〈enter〉** key.



R code (1 ~ 9999) 215

Enter the welding condition number. (1~1024) 1

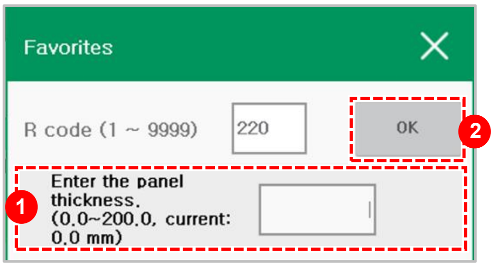
Enter servo gun squeeze[kgf]. (50~5000)

8.11 R220 for Setting the Panel Thickness (Sv)

You can manually set the panel thickness to record the servo gun spot welding step.

If you execute the one-touch recording in which the MOVE and SPOT statements are to be simultaneously recorded while only the servo gun fixed electrode is in the state of being in contact with the panel, the position of the moving electrode will be automatically recorded in the MOVE statement in consideration of the panel thickness and wear volume.

1. After inputting **220** in the favorites window, touch the **[OK]** button or press the **⟨enter⟩** key.
2. After inputting the panel thickness, touch the **[OK]** button or press the **⟨enter⟩** key.



R code (1 ~ 9999) 220

Enter the panel thickness. (0.0~200.0, current: 0.0 mm)

Note	For details on the manual setting of the panel thickness, refer to the "**Hi6 Controller Spot Welding Function Manual.**"

8.12 R358 for Changing the Servo Tool

You can manually connect and disconnect the servo tool in the servo tool change system.

To change the servo tool in the servo tool change system, you need to disconnect or connect the power and various signal lines using a physical automatic tool change (ATC) device.

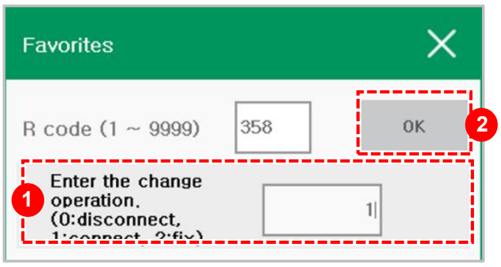
When the servo tool is a servo gun, if you want to manually perform the change work, you need to move the robot, while the motor is turned on, to the servo gun support table where you can connect or disconnect the robot, and then perform the change work. If the servo tool is a different type, such as a positioner, you can perform the change work when the preparation for connection and disconnection work is completed.

R358 servo tool change parameters and the examples are as follows.

Operation	Parameter	#1	#2
R358, #1, #2	Meaning	Disconnect, Connect, Fix	Gun number
	Setting value	0: Disconnect, 1: Connect, 2: Fix	1–16
	Example	• R358, 1, 2 (Connect the servo tool #2) • R358, 0 (Disconnect the servo tool)	

The method to change the servo tool using the R358 code is as follows.

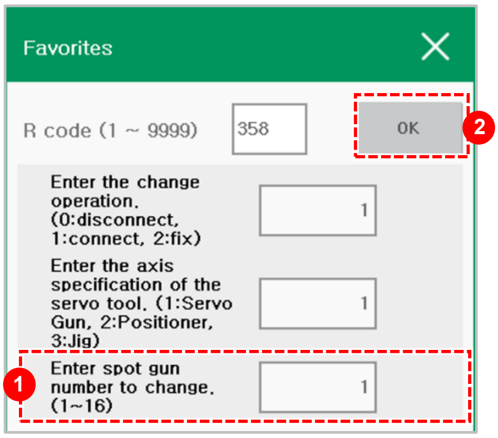
1. After inputting **358** in the favorites window, touch the **[OK]** button or press the **⟨enter⟩** key.
2. After inputting the change operation number (**0**: Disconnect, **1**: Connect, **2**: Fix), touch the **[OK]** button or press the **⟨enter⟩** key.



R code (1 ~ 9999) 358

Enter the change operation. (0:disconnect, 1

3. After inputting the number of the welding gun to change, touch the **[OK]** button or press the **<enter>** key. The selected weld gun number will be displayed on the **[Gun]** button on the left side of the Hi6 teach pendant screen.



R code (1 ~ 9999) 358

Enter the change operation. (0:disconnect, 1:connect, 2:fix) 1

Enter the axis specification of the servo tool. (1:Servo Gun, 2:Positioner, 3:Jig) 1

Enter spot gun number to change. (1~16) 1

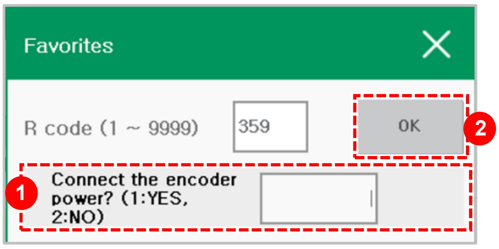
Notes	• R358 code cannot be used in automatic mode. It must be used in manual mode. • When the spot gun number is changed, the tool number designated in the spot gun corresponding tool number will be automatically changed. You can check the spot gun corresponding tool number in the **[Set Up 〉 4: Application Parameter 〉 1: Spot Welding 〉 1: Gun Number Corresponding Tool Number and Gun Type Setting]** menu. • The servo tool change setting can be performed only when the motor is turned on. • For details on the servo tool change, refer to the "**Hi6 Controller Spot Welding Function Manual.**"

8.13 R359 for Servo Tool Encoder Power On Relay

If the servo gun is applied in the servo tool change system, you need to execute this function to reset the encoder of the servo tool axis when installing the servo tool for the first time.

1. After inputting **359** in the favorites window, touch the **[OK]** button or press the **<enter>** key.

2. After inputting **1**, touch the **[OK]** button or press the **<enter>** key. Then, the power will be supplied to the encoder.



R code (1 ~ 9999) 359

Connect the encoder power? (1:YES, 2:NO)

Notes	• R359 code cannot be used in automatic mode. It must be used in manual mode. • To disable the forced power supply to the servo gun encoder, you should turn off the power of

	the controller and then turn it back on. Therefore, when the encoder reset is completed, turn off the power of the controller and turn it back on, and then progress the manual connection. • The servo tool encoder power setting function is a function for engineers, so it is not supported for general users. Please contact our engineer for more information on this feature. • For details on the servo tool encoder power setting, refer to the “**Hi6 Controller Spot Welding Function Manual.**”

⚠ Caution	Never mechanically connect or disconnect the servo gun while the encoder power is forcibly supplied.

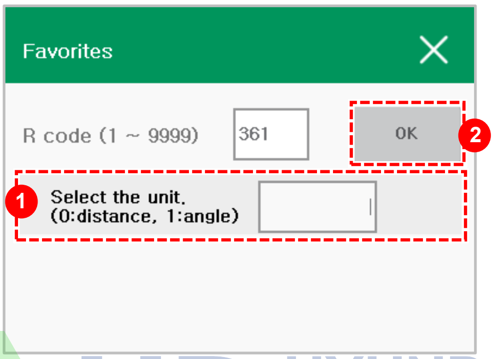
8.14 R361 for Setting the Jog Inching Level

R361 jog inching level setting information is as follows.

Operation	#1 (Unit)	#2 (Range of input values)
R361, #1, #2	0: Distance	0.001–1000.00 mm
	1: Angle	0.001–180.0 deg

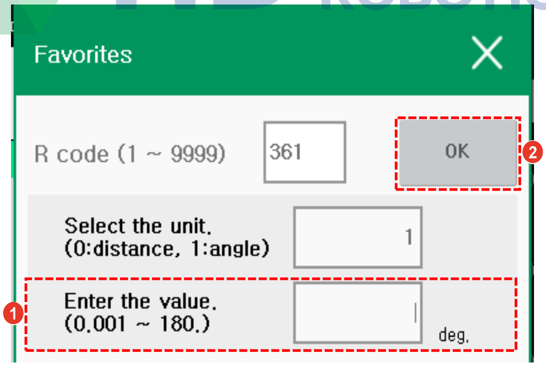
The method to change the inching distance of the currently set level is as follows.

1. After inputting **361** in the favorites window, touch the **[OK]** button or press the **⟨enter⟩** key.
2. After inputting the unit of the jog inching level (**0**: Distance. **1**: Angle), touch the **[OK]** button or press the **⟨enter⟩** key.



Select the unit.
(0:distance, 1:angle)

3. When you input **1**, you should input the inching angle, and then touch the **[OK]** button or press the **⟨enter⟩** key.



Select the unit.
(0:distance, 1:angle)
1

Enter the value.
(0.001 ~ 180.)

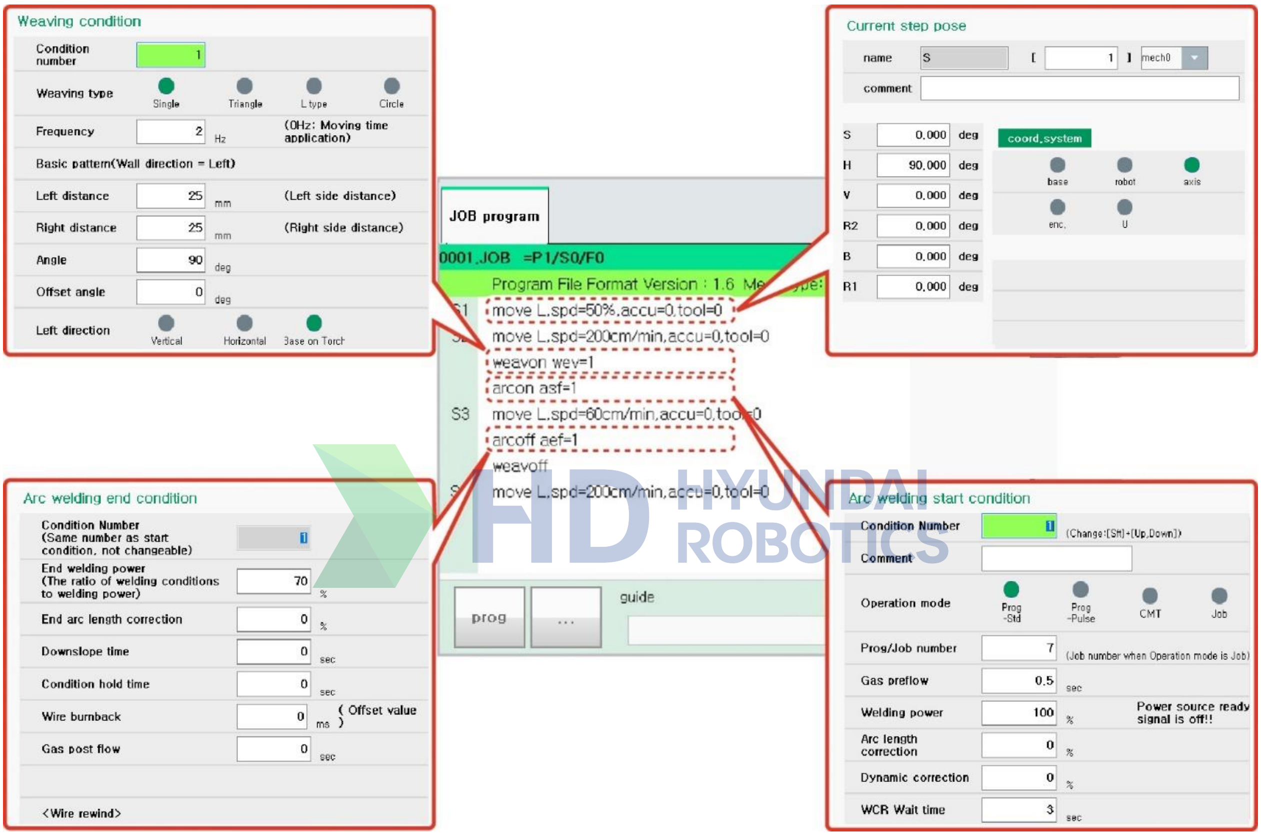
Notes	
Notes	• R361 code cannot be used in automatic mode. It must be used in manual mode. • The inching distance set using the R361 code will be set for the currently set jog level. Therefore, if the current jog speed level is 8, the inching distance corresponding to 8 will be changed. • Jog inching is possible only when the jog inching key is activated (LED On). • The jog inching level setting function is for engineers, so it is not supported for general users. Please contact our engineer for details on this function.

9. Property

When teaching a job program for a welding operation, you should set the arc welding-specific details, such as weaving, retry/restart, and characteristics of the welder, in addition to welding conditions such as voltage and current. Moreover, there are cases in which you should check the position of a step or an auxiliary point.

9.1 Use of the property Function

If you use the **[property]** button on the right side of the Hi6 teach pendant screen, you can quickly and easily set the conditions and check the position simply by a single button operation.



Weaving condition

Condition number: 1

Weaving type: ● Single ○ Triangle ○ L type ○ Circle

Frequency: 2 Hz (0Hz: Moving time application)

Basic pattern(Wall direction = Left)

Left distance: 25 mm (Left side distance)

Right distance: 25 mm (Right side distance)

Angle: 90 deg

Offset angle: 0 deg

Left direction: ○ Vertical ○ Horizontal ● Base on Torch

Current step pose

name: S [1] mech0

comment:

S: 0.000 deg

H: 90.000 deg

V: 0.000 deg

R2: 0.000 deg

B: 0.000 deg

R1: 0.000 deg

coord.system: ○ base ○ robot ● axis ○ enc. ○ U

JOB program

```
0001.JOB  =P1/S0/F0
      Program File Format Version : 1.6  Me
S1    move L,spd=50%,accu=0,tool=0
S2    move L,spd=200cm/min,accu=0,tool=0
      weavon wev=1
      arcon asf=1
S3    move L,spd=60cm/min,accu=0,tool=0
      arcoff aef=1
      weavoff
S     move L,spd=200cm/min,accu=0,tool=0
```

Arc welding end condition

Condition Number (Same number as start condition, not changeable): 1

End welding power (The ratio of welding conditions to welding power): 70 %

End arc length correction: 0 %

Downslope time: 0 sec

Condition hold time: 0 sec

Wire burnback: 0 ms (Offset value)

Gas post flow: 0 sec

<Wire rewind>

Arc welding start condition

Condition Number: 1 (Change:[Sft]+[Up,Down])

Comment:

Operation mode: ● Prog-Std ○ Prog-Pulse ○ CMT ○ Job

Prog/Job number: 7 (Job number when Operation mode is Job)

Gas preflow: 0.5 sec

Welding power: 100 % Power source ready signal is off!!

Arc length correction: 0 %

Dynamic correction: 0 %

WCR Wait time: 3 sec

Figure 75 Function for the [Attributes] Button

For example, if you touch the **[property]** button while the cursor is on the arcon statement that is for the Arc On function, the contents of the condition number used in the current statement among the welding start conditions will be displayed. On the screen, you can check or change the details of the welding start conditions. Moreover, if there is another condition file associated with the concerned condition file, you can move directly to it. In other words, the **[property]** button allows you to check and change the details of the contents related to a specific statement such as condition file or step position quickly and easily.

The following shows the method to check and change the condition file and details related to a specific command using the **[property]** button.

1. Select a specific statement, place the cursor on it, and touch the **[property]** button.
2. By referring to the following table, you can check and change the file or details related to the selected statement.

Statement	File and Contents	Description
move	Step position	Current step position or global pose variable X Y Z (mm) Rx Ry Rz (deg) T1–T10 The unit, coordinate system, and robot configuration
Refp	Reference position	

arcon asf=	Welding start condition
	Welding auxiliary condition
	Arc welder condition
		• Welding start condition: Condition number, description, voltage check, retry, operation mode, output current, output voltage, WCR waiting time, robot delay time, etc.
		• Welding auxiliary condition
		  • Retry: Count, retract time/speed, back step/welding line movement amount, shift movement amount, speed, current, voltage
		  • Restart: Count, overlap amount, moving speed, welding current, voltage, current
		  • Overlap condition setting (in the middle of welding): Arc, gas, wire, and coolant
		• Arc welder condition: Welder number, title, description, power control mode, wire diameter, protruding distance, deposition detection time, ARC OFF detection time, etc.
		  • Current properties: Polarity, command value (V), measurement value (A), and compensation value
		  • Voltage properties: Polarity, command value (V), measurement value (V), and compensation value

arcon aef=	Welding end condition Welding auxiliary condition	• Welding end condition: Condition number, description, voltage check, output current, output voltage, downslope, condition holding time, and gas postflow • Welding auxiliary condition: Automatic deposition release: Count, current, voltage, delay time
weavon wev=	Weaving condition	• Weaving condition: Gun number, weaving type, frequency, basic pattern, progress angle, boundary limit, moving time, and timer • Arc sensing condition: Arc sensing, left and right sensing start cycle, top and bottom sensing cycle, voltage factor, compensation distance per sample, etc.

3. Touch the **[Record]** button or press the **〈esc〉** key to end the operation.

- **[Record]**: You can save the changes and end the operation.
- **〈esc〉**: You can cancel the change and end the operation.

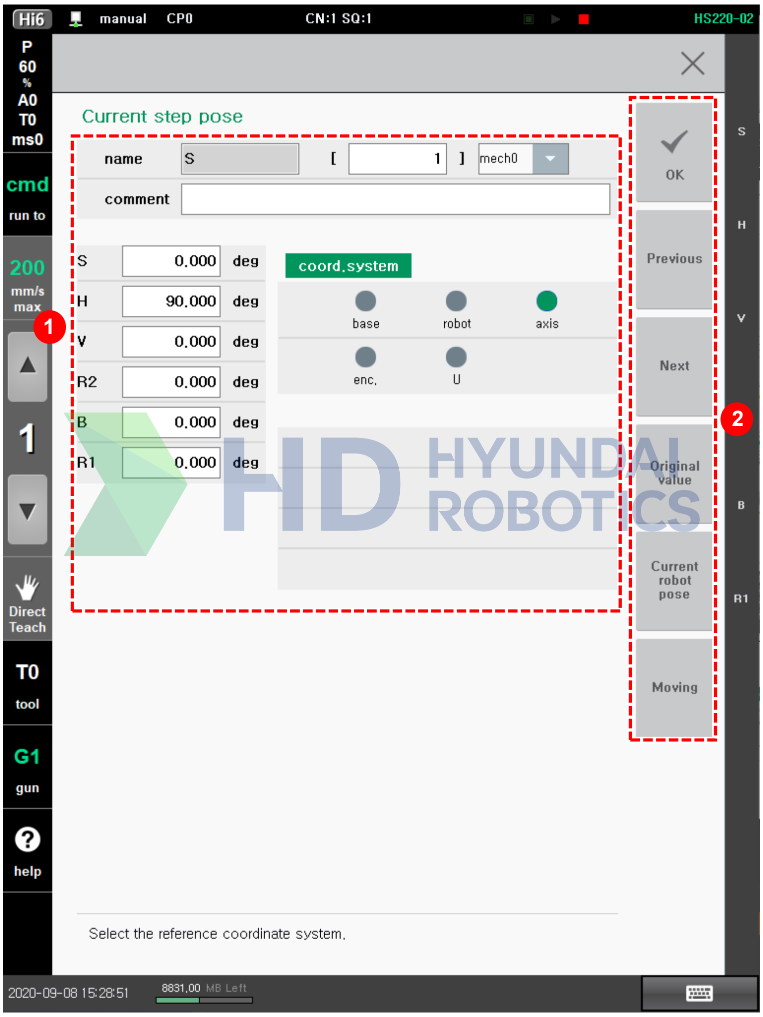
9.2 Move-Step Position

You can check or modify the position of the step in the currently selected line in the JOB program.

9.2.1 Hidden Pose Move Statement

You can check or modify the position of the current step in the hidden pose move statement (step recorded using the **[Record]** button, that is, a move statement that does not include a pose variable).

1. Touch the **[property]** button in the move command (move statement) recorded as a hidden pose. Then, the current step position will appear.
2. Check and modify the current step position.


Hi6
manual CP0
CN:1 SQ:1
HS220-02
P 60 % A0 T0 ms0
cmd
run to
200 mm/s max
1
Direct Teach
T0 tool
G1 gun
help
OK
Previous
Next
Original value
Current robot pose
Moving
S
H
V
B
R1
①
②

Current step pose

name S [1] mech0

comment

S	0.000	deg
H	90.000	deg
V	0.000	deg
R2	0.000	deg
B	0.000	deg
R1	0.000	deg

coord.system

○ base ○ robot ● axis

○ enc. ○ U

Select the reference coordinate system.

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No.	Description

①	Position information of the current step. You can check and set the name, coordinate value and coordinate system format, etc.
	• **[Name]**: Number of the current step. After inputting the step number, press the **〈enter〉** key to move to the concerned step.
	• Coordinate Value: Current coordinate value of the current step
	  • Select an item using the cursor key.
	  • After inputting a value in the desired item, press the 〈enter〉 key to reflect the change.

No.	Description
	• If the coordinate system format is set as an encoder, the coordinate value will not be changed. • **[Coord. System]**: The coordinate system format to express the position of the current step
②	• **[OK]**: You can save the changes. • **[Previous]/[Next]**: You can display the information of the previous or next step. • **[Original Value]**: You can display the original hidden pose value of the current step. • **[Current Robot Pose]**: You can display the value of the posture the robot is currently taking. • **[Moving]**: Touching the **[Moving]** button will move the robot to the recorded step position (Jog).

3. Touch the **[Record]** button. Then, the change will be saved in the job program, and the operation will end.

    - If you end the operation by pressing the **〈esc〉** key, the change will not be saved.

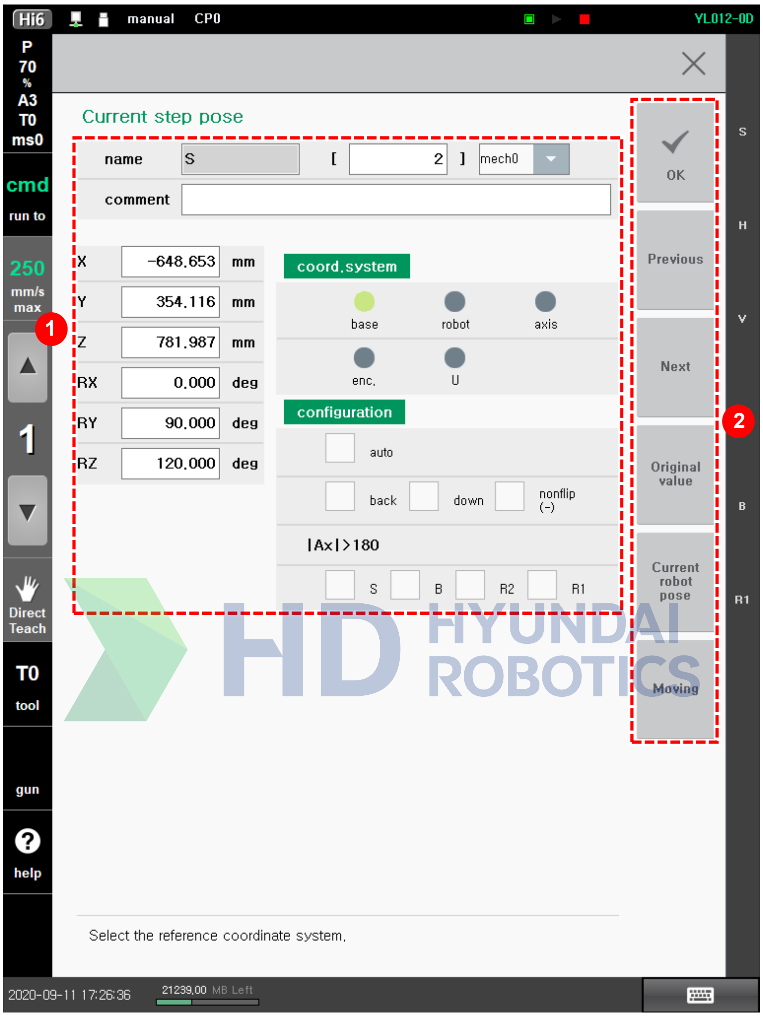
Notes	• If **[Robot Configuration]** is set as undesignated, the robot will designate a configuration the very closest to the current position of the robot. • For the designation according to the robot configuration, refer to "**2.3.2.2 Base and Robot Recording Coordinates.**"

9.2.2 Pose Recording Move Statement and Pose Assign Statement

You can edit the pose variable value in the move statement, including the pose variable or the pose variable assign statement.

1. Touch the **[property]** button in the move command (move statement) recorded as a pose variable. Then, the pose variable setting screen will appear.

2. Check and modify the current pose variable.



Current step pose

name: S [2] mech0

comment:

X	-648.653	mm
Y	354.116	mm
Z	781.987	mm
RX	0.000	deg
RY	90.000	deg
RZ	120.000	deg

coord.system: ● base ○ robot ○ axis ○ enc. ○ U

configuration: ☐ auto ☐ back ☐ down ☐ nonflip (-)

|Ax|>180: ☐ S ☐ B ☐ R2 ☐ R1

Select the reference coordinate system.

Hi6
manual
CP0
YL012-0D
P
70
%
A3
T0
ms0
cmd
run to
250
mm/s
max
1
Direct Teach
T0
tool
gun
help
OK
Previous
Next
Original value
Current robot pose
Moving
S
H
V
B
R1
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①
②

No.	Description

①	Current pose variable information. You can check and set the name, coordinate value, coordinate system format, etc.
	• **[Name]**: Name of the current pose variable
	• Coordinate value: The coordinate value of the current pose variable
	  • Select an item using the cursor key.
	  • After inputting a value in the desired item, press the ⟨enter⟩ key to reflect the change.
	  • If the coordinate system format is set as an encoder, the coordinate value will not be changed.
	• **[Coord. System]**: The coordinate system format to express the position of the current pose variable
	• **[Configuration]**: When describing the position of the robot, there are multiple solutions because of the characteristics of the device, so the robot configuration is designated to uniquely describe the configuration.

No.	Description
	• This function can only be used when the coordinate system type is set as a base or robot. • For details on the robot configuration, refer to "**2.3.2 Step Position Recording and Changing.**"
②	• **[OK]**: You can save the changes. • **[Previous]**/**[Next]**: You can display the information of the previous or next step. • **[Original Value]**: You can display the original hidden pose value of the current step. • **[Current Robot Pose]**: You can display the value of the pose the robot is currently taking. • **[Moving]**: Touching the **[Moving]** button will move the robot to the recorded step position (Jog).

3. Touch the **[Record]** button. Then, the change will be saved in the job program, and the operation will end.

   - If you end the operation by pressing the **〈esc〉** key, the change will not be saved.

9.3 Spot Welding Function

When writing the SPOT command while writing the program, if you place the cursor on the spot welding function position in manual mode and touch the **[property]** button, then the **[1: Spot Welding]** menu will be highlighted in the application parameter setting menu screen. Using the spot welding function, you can quickly modify the contents of the welding conditions and also of the welding sequence when performing spot welding.

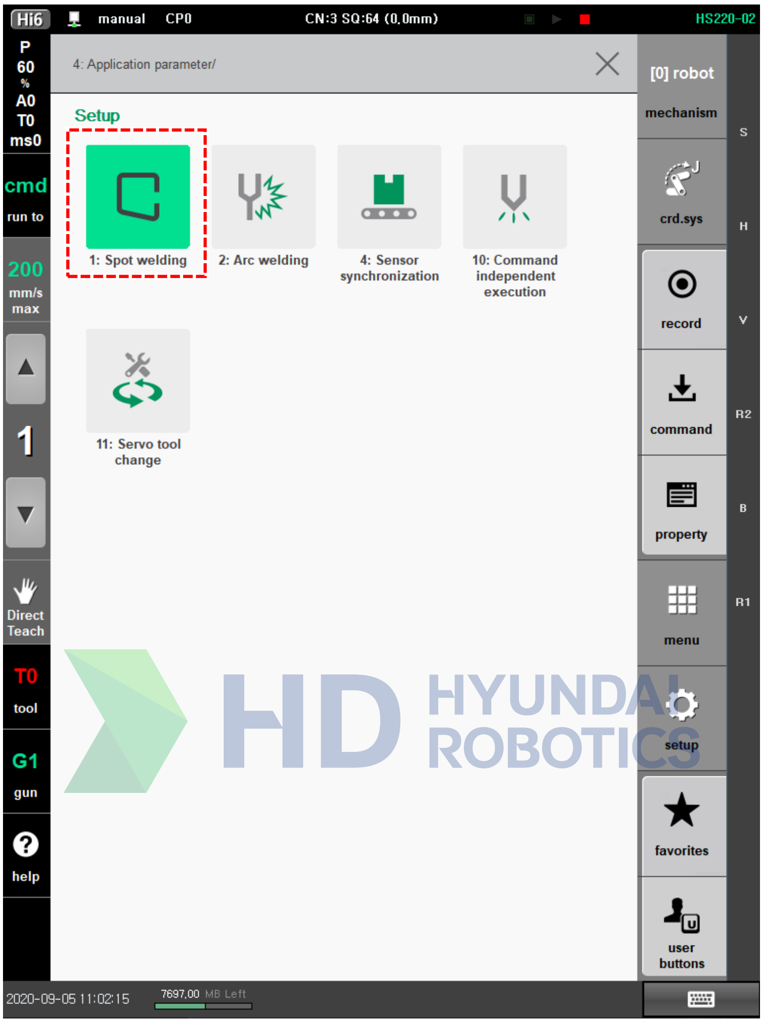
Hi6
manual
CP0
CN:3 SQ:64 (0.0mm)
HS220-02
P
60
%
A0
T0
ms0
cmd
run to
200
mm/s
max
1
Direct Teach
T0
tool
G1
gun
help
4: Application parameter/
Setup
1: Spot welding
2: Arc welding
4: Sensor synchronization
10: Command independent execution
11: Servo tool change
[0] robot
mechanism
crd.sys
record
command
property
menu
setup
favorites
user buttons
S
H
V
R2
B
R1
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Figure 76 Spot Welding Function

Notes	
	- You can use the spot welding function by touching the **[Set Up]** button 〉 **[4: Application Parameter 〉 1: Spot Welding]**. - For details on the spot welding function, refer to the "**Hi6 Controller Spot Welding Function Manual.**"

10. Robot Language

For details on the robot language, refer to the “**Hi6 Robot Language Function Manual.**”

Appendices

Rules on Occupational Safety and Health Standards, and Notice for Safety Inspection

The industrial robot should be installed in consideration of the inspection standards both of the Rules on Occupational Safety and Health Standards and of the Notice for Safety Inspection (if subject to inspection).

■ Rules on Occupational Safety and Health Standards

Article 222 (Teaching, etc.) When it is required to perform works such as teaching [this refers to setting or changing the operation sequence, position and speed of the manipulator, or checking the result, and will be the same in the following] on the robot within the operation range of an industrial robot (hereinafter referred to as “robot”), the business owner is required to take the measures described under the following items to prevent the danger that could be caused by the unexpected operation of or mistakes in the operation of the robot. However, if the works are performed with the robot’s driving source cut off, measures #1 and #2 below may not be taken 〈Revised on April 7, 2016〉.

1. Establish guidelines for the following items, and make sure that works are performed according to the guidelines.

   A. Robot operation method and sequence

   B. Manipulator speed during a work

   C. Signaling method when having two or more workers to carry out works

   D. Measures to take when finding an abnormality

   E. Measures to take when finding an abnormality and stopping the operation of the robot and restarting the operation

   F. Other measures necessary to prevent the danger that could be caused by unexpected operation of or mistakes in operation of the robot

2. Workers engaged in the works or those who monitor the workers should take measures to stop the operation of the robot immediately if an abnormality is found.

3. In the process of performing works, it is required to take measures such as putting up a marking on the start switch, for example, to indicate that works are underway, to prevent workers other than the ones currently engaged in the works from manipulating the start switch.

4. Article 223 (Prevention of Dangers during Operation) The business owner is required to install a fence of 1.8 m or more in height (the height can be adjusted lower if there is no danger that could be caused due to the height when considering the operation range of the robot) to prevent the risk of workers being injured that may occur because of the operation of the robot (excluding the operation of the robot for the teaching according to Article 222 and also the operation of the robot in compliance with conditions of Article 224). In some sections where a fence cannot be installed because of the installation of a conveyor system, etc., a responsive protective device such as a safety mat or optoelectronic protective device should be installed. However, if the Minister of Employment and Labor acknowledges that the safety standard for the robot meets the safety standards set by Korean industrial standards under Article 12 of the Industrial Standardization Act or internationally accepted safety standards, it is possible to forego measures according to the text of this document.

5. Article 224 (Including the measures to take when performing works such as repairing) When the work such as repairing, inspecting, adjusting (excluding teaching), cleaning, refueling the robot or confirming relevant results

within the operation range of the robot is underway, the business owner should take necessary measures such as locking up the start switch of the robot by using a key and managing the key separately, or putting up a signboard on the start switch indicating that a work is underway, to ensure that the robot can be stopped, and, at the same time, anyone other than the workers engaged in the work should be prevented from manipulating the start switch. However, this is not the case if a work must be performed even during the operation of the robot, and, in such situation, measures of the individual items under Article 222 are taken to prevent the danger that could be caused by an unexpected operation or mistakes in operation.

【Appendix 14】Inspection Standards for Industrial Robots (Related to Article 30)	
Automatic operation mode	A. In the automatic operation mode, safety devices such as fences should maintain the normal function, and if a person enters the protected area, the protective stop function should be activated. B. Protective stop or emergency stop should not be reset or disabled when the automatic operation mode is selected. C. Automatic operation mode should be deactivated when a stop signal is given. D. When the automatic mode is selected, the starting of the automatic mode should be possible only by a separate start operation outside the protected area. E. Changing from automatic operation mode to other operation modes should be possible only when driving is stopped.
Control of the pendant	If the pendant has a string, its length should be sufficient for the teaching operator to perform the work safely.
Electric connection devices	Electric connection devices such as electric outlets that are to be connected to the robot should not be separated arbitrarily.
Robot system layout design	The layout of the robotic system for the operation area, access, and free space should be appropriate in compliance with the following items. A. The maximum area of the robot should be checked first. Then, the restricted area and operation area should be set, and there should be a free space between the robot and obstacles such as pillars of the building. B. A passage such as a pedestrian passage should be secured for safe passage. C. Access to and from the path for the control system should be safe. D. A safety passage for approaching inspection, cleaning, repair, maintenance, etc. should be secured. E. There should be no risk of slipping, tripping, or falling over due to wiring or other dangerous sources. F. There should be no danger caused by the cable tray, etc. G. Operation controllers and auxiliary equipment (welding controllers, pneumatic valves, etc.) that workers need to access during automatic operation should be located outside the protected area.
Robot system stop function	All robot systems should have a protective stop function and also a separate emergency stop function. A. Emergency stop function 1) The robot system should have a single emergency stop function that operates for all relevant parts of the system.

【Appendix 14】Inspection Standards for Industrial Robots (Related to Article 30)	
	2) In the case of multi-robots or multi-cells, the control range can be divided, and the control range should be clearly indicated using characters or symbols near the emergency stop device. 3) When there are more than two control positions, the emergency stop device installed in each control position should always maintain its function. 4) This function should take priority over all other robot controls and, in case of an emergency stop, should remove the driving power from the robot drive unit and maintain the stop state until initialization. 5) Initialization should be performed manually only, and restarting should not be performed immediately after initialization but should be carried out through a separate starting operation. 6) The performance of the emergency stop circuit should satisfy the safety related control system performance requirements of item no. 4. B. Protective stop function 1) The robot system should be equipped with one or more protection stop circuits for connection with external protection devices. 2) When activated, the protective stop circuit should be capable of stopping the robot operation, removing the actuator power, and controlling all dangerous sources controlled by the robot. 3) Protective stop should be started manually or by control logic. 4) At least one protection stop function should be 0 stop method or 1 stop method Note 1) 0 stop method: Stopping will be performed through immediate cut-off of the actuator power Note 2) 1 stop method: the power will be cut off after the machine stops while the actuator power is supplied. 5) The performance of the protective stop circuit should satisfy the safety-related control system performance requirements of item no. 4.
Manual resetting, staring and restarting	The robot system should be appropriate in compliance with the following items to prevent unexpected starting. A. Starting and restarting should be possible only when all safety functions and protective measures are operating normally. B. If the power supply is interrupted and then resumed, a starting interlocking device should be installed to prevent the automatic starting of dangerous operations and should be reset only by manual operation. C. Start and restart control should be manually operated outside the protected area and should be impossible to activate within the protected area. D. The start and restart control unit should be located where the protected area can be visibly seen. However, if it is difficult to secure a view of the protected area, it is required to comply with one of the following items. 1) Installation of a detection device that can detect the presence of workers in the protected area 2) Installation of means to keep the door open 3) Installation of an additional device for time limit reset inside the protected area 4) Generation of audible and visual warning signals that can be sufficiently recognized inside the protected area, and provision of sufficient evacuation time

【Appendix 14】Inspection Standards for Industrial Robots (Related to Article 30)	
	E. When it comes to complying with item 4) of D above, it is required to install a sufficient number of emergency stop devices in the protected area at a location that the operator can access easily.
Protected area, fence. etc.	Protected areas and measures should be appropriate in compliance with the following items. However, in the case of cooperative robots, some applications may be excluded depending on the operation method. A. The restricted area should be located within the protected area B. The protected area should be established by means of a fence. However, when it comes to an opening for taking in and out materials or parts, the protected area should be established by a responsive protective device, etc. C. The fence for the robot cell should be appropriated in compliance with the following items. 1) The fence should be firmly installed so as not to be easily damaged by external force and should be of a structure that can be removed only with tools. 2) If the fence has an opening for taking in and out materials or parts, it is required to physically prevent workers from accessing dangerous points under, next to, or through the opening, and if such measures are not possible, it is required to take additional measures such as using responsive protective devices. 3) The height of the fence should be over 1,800 mm. However, if there is no danger that could be caused due to the height, in consideration of both the operation range of the robot and the safety distance according to KS B ISO 13857, the height of the fence may be over 1,400 mm. 4) The movable fence (entry door) should be opened to the side or in the direction of moving away from a source of danger, and should be structured in a way that it does not open toward the protected area. 5) An interlocking device should be installed to the movable fence (entry door), and it should be able to turn the source of danger into safe state before the workers approach it. However, if there is a possibility of accessing the dangerous area before the source of danger is removed, there should be a locking device for the entry door in addition to the interlocking device. 6) The movable fence (entry door) locking device should allow the start of the robot only when the movable fence (entry door) is closed and locked.

Quality Assurance

To protect the interests of customers who have purchased products manufactured by Hyundai Robotics (hereinafter the “Company”) and sold by the Company or authorized distributors, the Company provides quality assurance against defects in the raw materials and in the manufacturing of products in accordance with the contents stipulated in the quality assurance. This quality assurance is provided only to the end users (hereinafter the “Customers”) of the products.

Coverage of Quality Assurance

Products are covered by the Company’s quality assurance against defects in materials and manufacturing.

The Company’s sole responsibility and the sole remedy for the Customer with respect to all our products are limited to the repair or replacement of our products that are directly defective at our discretion. The Company will not compensate for any indirect or incidental, special, or consequential damages, such as loss of income, loss of use, loss of production, or damage to other products or equipment resulting from defects in the product.

Period of Quality Assurance

The Company guarantees the quality of the product for one year from the date that the Customer purchased the product and received it on-site, or the Customer issued the acceptance certificate after completing the trial operation. However, if the contract date is different from the delivery date (installation and trial operation completion date), the period of quality assurance will be based on the delivery date, and when the product is replaced with a new finished product, the period of assurance will be calculated from the date of replacement.

Limitation of and Exception for Assurance

To maintain quality assurance, you must follow the maintenance procedures and keep records as specified by the Company. When we decide as follows that the Customer does not comply with the terms of conditions, the quality assurance will be made invalid.

- Damage to or breakdown of the product because of the Customer’s carelessness, inexperience in operation, negligence, arbitrary modification, disassembly, or repair
- Failure of or damage to the product because of the use and installation of parts, consumables, software, etc. that are not certified by the Company
- Failure of or damage to the product because of incompliance with the instructions and precautions in the manual
- Failure of or damage to the product because of the use for purposes other than the original purpose
- Failure of or damage to the product because of the use in inappropriate environments or the dropping of the product or an impact applied to it
- Failure of or damage to the product because of the installation, repair, and maintenance by someone (customer, uncertified or unauthorized mechanic, etc.) other than an installation expert
- When the service life of a consumable part is due
- If a service request for a defect is received after the warranty period has expired

We do not provide quality assurance against damage to the product caused by external circumstances beyond our reasonable control, such as theft, willful destruction, fire, natural disasters, wars, or acts of terror. Moreover, we are not responsible for the defects in the product, operation, and performance not pertaining to the range specified in the warranty.

Customer Support

- Contact: 1670-5041 | Email: robotics@hyundai-robotics.com
- Operating hours: Weekdays (Monday–Friday) 09:00–18:00 | Weekends and holidays: Closed

For detailed inquiries about our products or services, please contact our customer support team.

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Ulsan: Rm# 201-5, Automobile & Ship Technologies Hall, 21, Maegoksaneop-ro, Buk-gu, Ulsan, Republic of Korea

Jungbu: 161, Songgok-gil, Yeomchi-eup, Asan-si, Chungcheongnam-do, Republic of Korea

Gwangju: Rm#101, Bldg. B, 170-3, Pyeongdongsandan-ro, Gwangsan-gu, Gwangju, Republic of Korea

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