



HCR-5
Collaborative Robot
User Manual

June 2017

Preface

Before installing the product, please read this manual fully and make sure you follow the instructions in it.

The content of the manual is maintained latest as of the date when it is written. The product information is subject to change without prior notice to users.

If you are uncertain about any requirements, recommendations or safety procedures described in the manual, please, consult with Hanwha Techwin Co.

Note

- Some of illustrations in the manual intends to help users in understanding the system concepts and installation issues. The actual product may differ from the manual.
 - Please keep this manual in a safe place for future reference.
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Chapter 1 Product Overview

1.1 Collaborative Robot System

Hanwha Techwin's collaborative robot, HCR-5 is a user-friendly robot that provides an automation environment where it can safely collaborate next to humans in various fields.

Easy setting

By using the direct teaching feature and the intuitive S/W GUI, users can easily configure and control the robot.

- While holding the robot gently, users can implement desired movements, so that the robot can detect and memorize movements.
- Users can preview the robot movement in a real time 3D and use the icon based intuitive GUI for easy operation.
- As the installation method is simple, even if users are not robot engineers, they can easily configure the initial setting and program the robot.

Flexible rearrangement

Users can easily rearrange the robot, so that it can be applied to various processes easily and quickly.

- Since users can operate the robot in small space, it is possible to rearrange the robot without changing the layout of the manufacturing line.
- The robot is light weighted and easy to move, and its simple programming environment allows the robot to be easily adapted to high-mix, low-volume production.

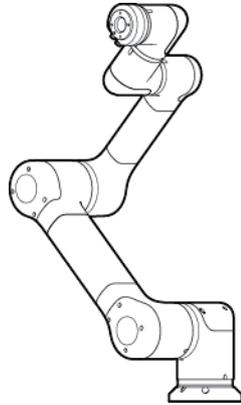
Safe collaboration

Using the various safety features, users can safely work next to the robot without using additional safety tools or devices.

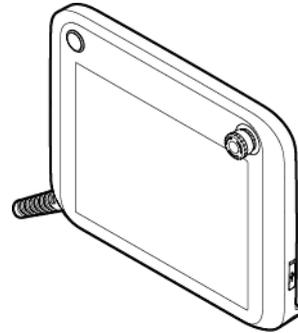
- The robot is automatically stopped when it detects an impact, so as long as the working range of the robot and the user are guaranteed, it can be installed anywhere for safe use.

1.2 System Components

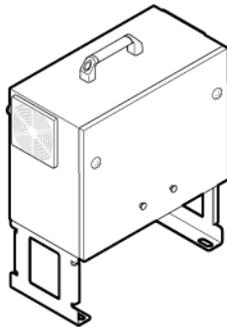
The following is a list of system components.



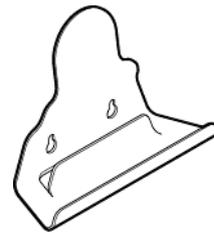
Robot arm



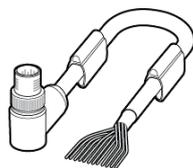
Teaching pendant



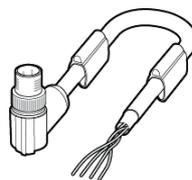
Robot controller



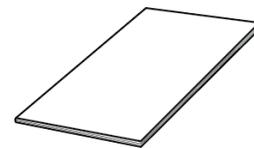
Teaching pendant fixing bracket



12 pin tool cable



4 pin tool cable

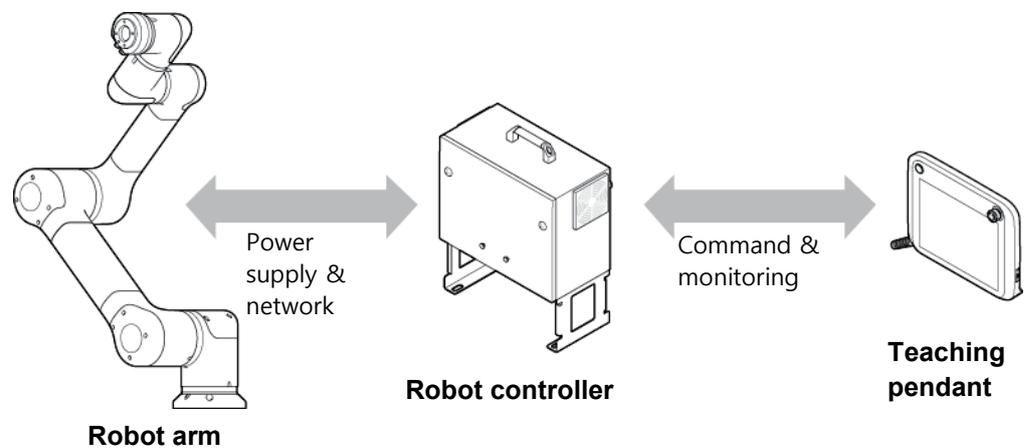


User manual

The following list indicates the quantity of each component.

Robot	Robot arm	1 EA
Controller and teaching pendant	Robot controller	1 EA
	Teaching pendant	1 EA
	Teaching pendant fixing bracket	1 EA
Others	12 pin tool cable	1 EA
	4 pin tool cable	1 EA
	User manual	1 EA

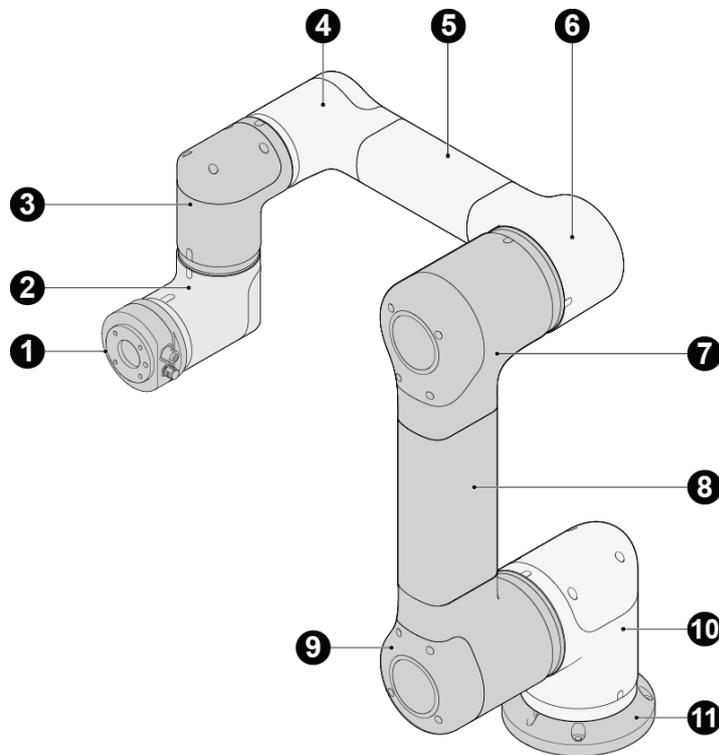
1.3 Basic System Configuration



- **Robot arm:** It is an industrial collaborative robot that can be used to convey objects or assemble parts, and it can be used by attaching various tools such as grippers.
- **Robot controller:** Can control the robot arm's various movements according to the program prepared by the user. It can be connected with various devices and equipment through its various I/O ports.
- **Teaching pendant(TP):** It is a device used for system operation. It can teach the robot a specific position or control and configure the robot in many ways.

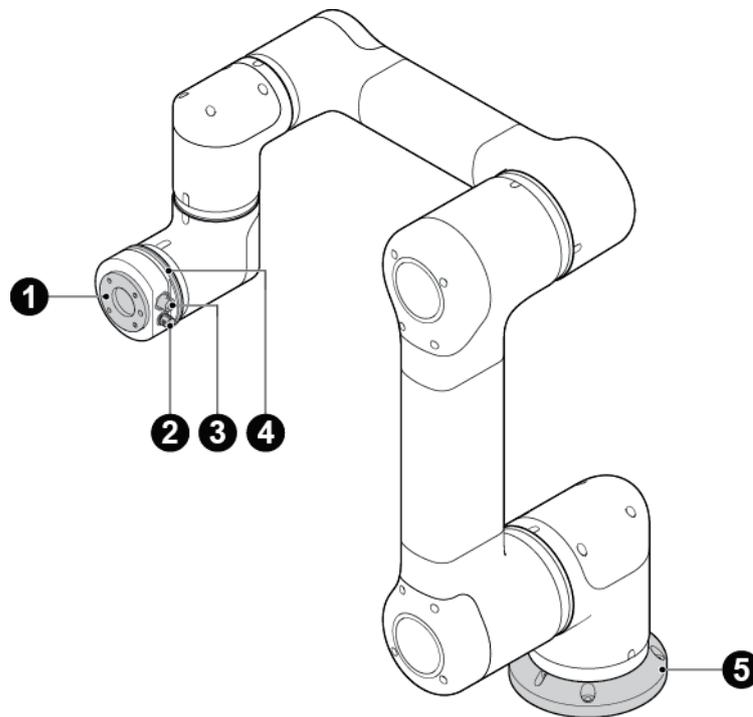
1.4 Overview of Robot Arms

Parts and joints



1	Tool Flange	5	Lower Arm	9	J2 Shoulder
2	J6 Wrist3	6	Elbow	10	J1
3	J5 Wrist2	7	J3	11	Base
4	J4 Wrist1	8	Upper Arm		

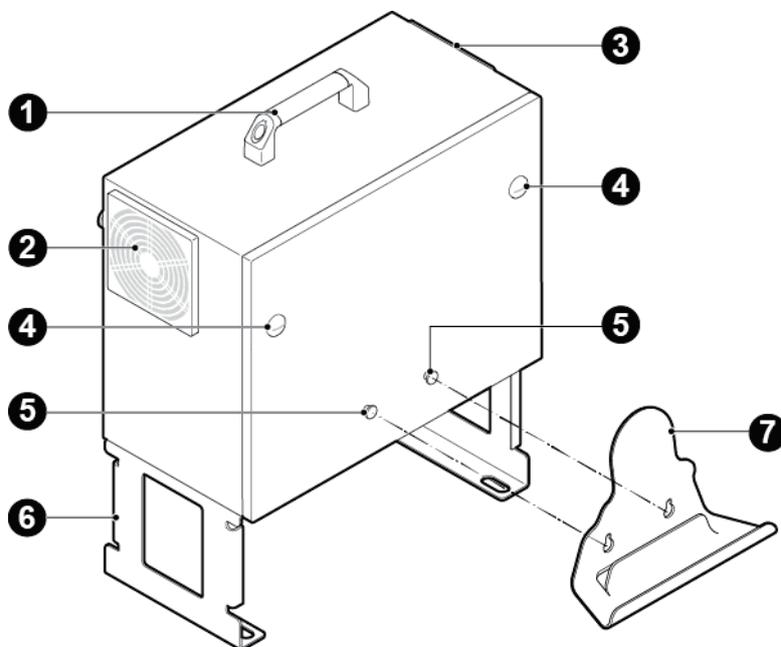
Functions



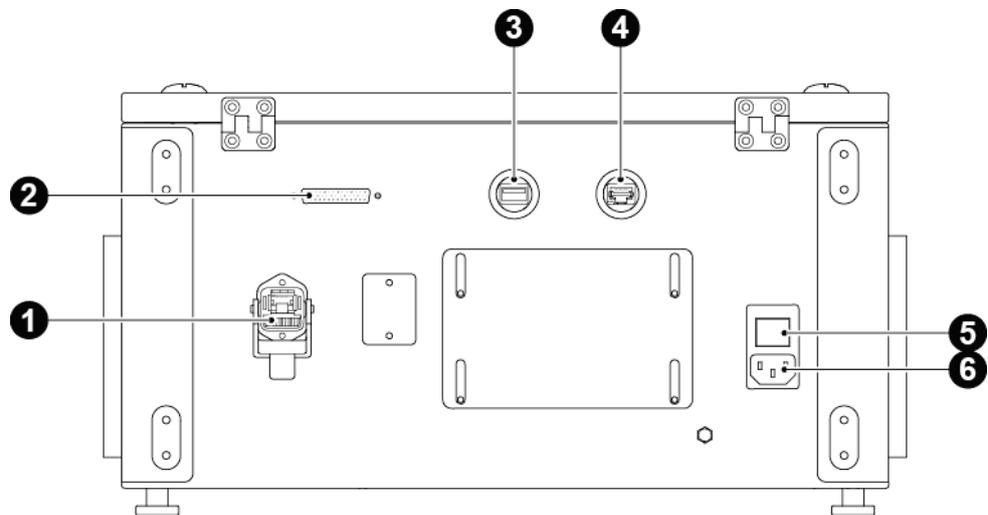
No.	Name	Description
①	Tool flange	It is the area in the robot where a tool is mounted. For more details, refer to 3.4 Connecting Tools to Robots .
②	Tool I/O	It is the I/O port used to control a tool. For more details about specifications, refer to Appendix D Port Pin Map .
③	EtherCAT	It is the Ethernet based port used for communication with a tool. For more details about specifications, refer to Appendix D Port Pin Map .
④	LED	Indicates the status of robot. <ul style="list-style-type: none"> • Green: Operation mode • Blue: Direct teaching mode • Red: Emergency stop mode
⑤	Robot base	It is the area in the robot that is fixed to the ground or wall.

1.5 Overview of Robot Controller

Front



No.	Name
①	Handle
②	Air exhaust hole (exhaust hole filter)
③	Air intake hole (intake hole filter)
④	Controller cover locking screw
⑤	Teaching pendant fixing hook
⑥	Controller fixing bracket
⑦	Teaching pendant fixing bracket

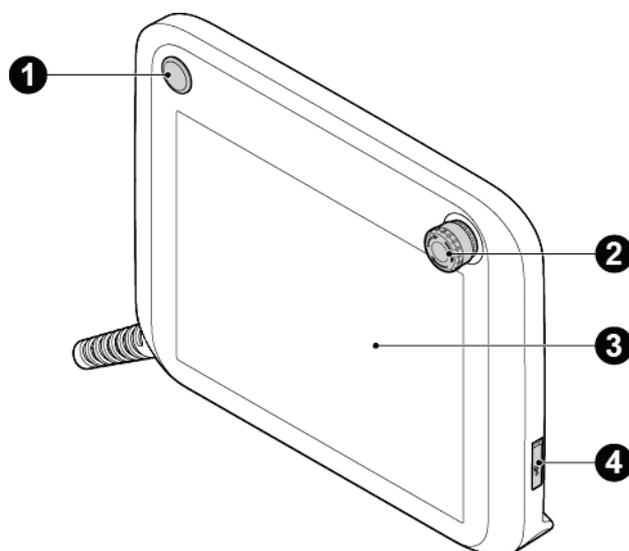
Bottom

No.	Name
①	Robot connector
②	Teaching pendant connector
③	USB port
④	Ethernet port
⑤	Power button
⑥	AC power socket

Note Ports 3, 4 are not available depending on the model.

1.6 Overview of Teaching Pendant

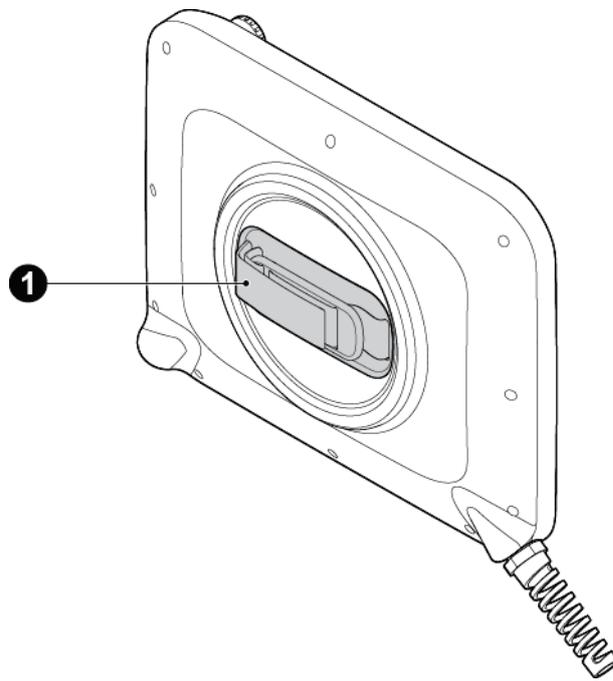
Front



No.	Name	Description
1	Power button	Turn on/off the power of the teaching pendant. For more details, refer to 4.2 Turning on the Teaching Pendant .
2	Emergency stop button	Press it to stop the robot. For more details, refer to 2.7 Emergency Stop .
3	Touch screen	A resistive touch screen that detects a touch even if user wears a glove.
4	USB port	USB 2.0 port that can be used by plugging in a USB memory, keyboard, mouse, etc. ¹

¹Some devices may not be compatible with the teaching pendant.

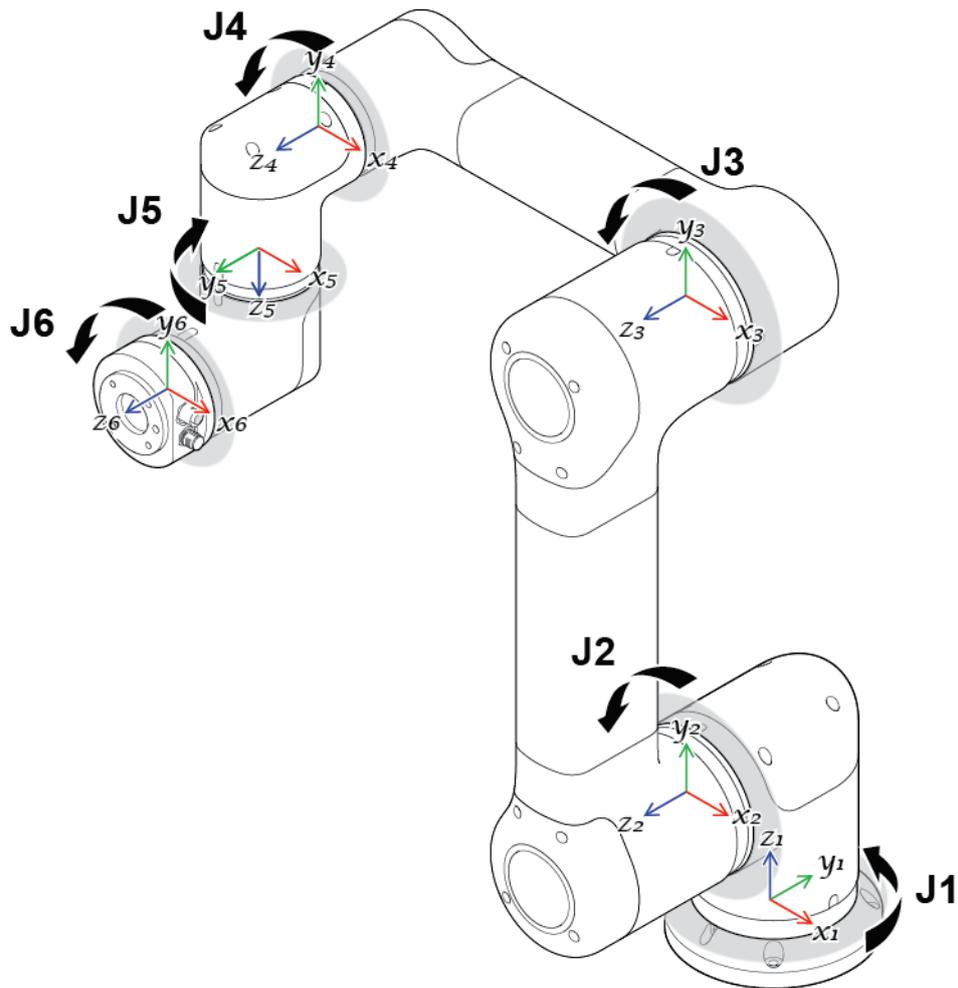
Rear



No.	Name	Description
1	Handle	Users can insert their hands and lift the teaching pendant for use. Users can turn the handle and insert their hand in the desired direction.

1.7 Axial Coordinates and Operational Range

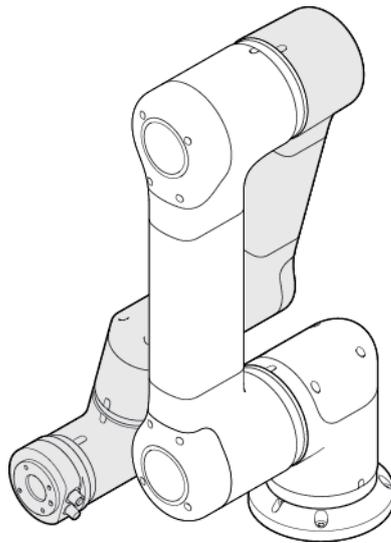
It consists of a total of six axes and an axis of each joint has the following coordinates and operational ranges. The direction of arrow indicates the (+) rotational angle and the opposite direction of arrow indicates the (-) rotational angle.



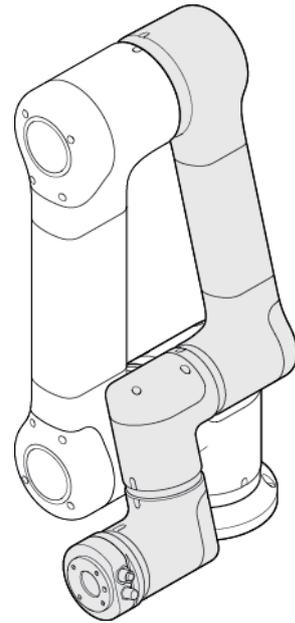
Operational axis	Operational range
J1 axis	$-180^\circ < rz_1 \leq +180^\circ$
J2 axis	$-180^\circ < rz_2 \leq +180^\circ$
J3 axis	$-165^\circ < rz_3 \leq +165^\circ$
J4 axis	$-180^\circ < rz_4 \leq +180^\circ$

Operational axis	Operational range
J5 axis	$-180^\circ < rz_5 \leq +180^\circ$
J6 axis	$-180^\circ < rz_6 \leq +180^\circ$

Note The J3 axis has a limited operational range due to its unique structure.



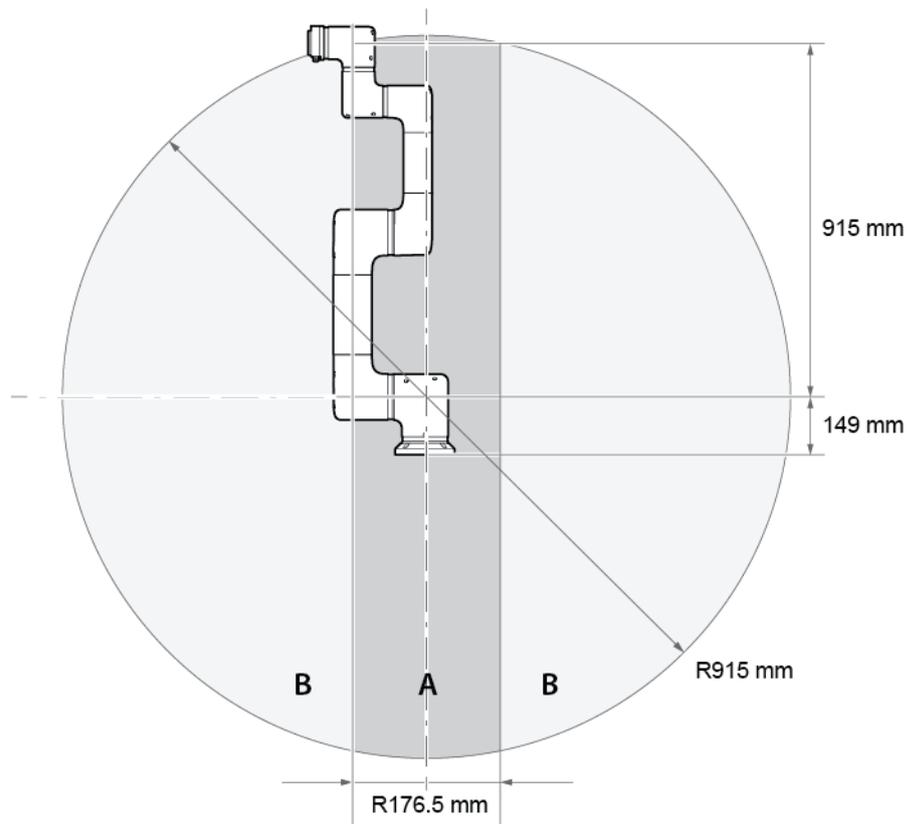
When the J3 axis is at $+165^\circ$



When the J3 axis is at -165°

1.8 Robot's Working Range

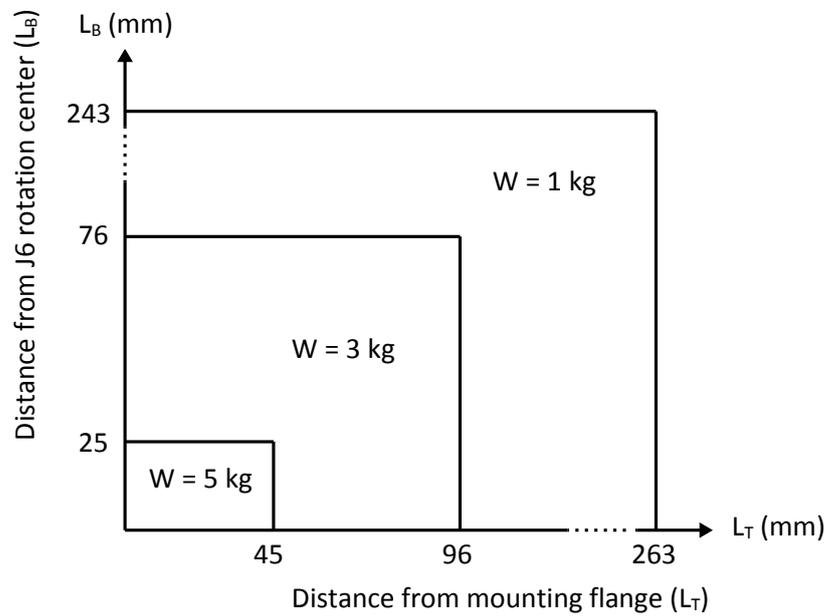
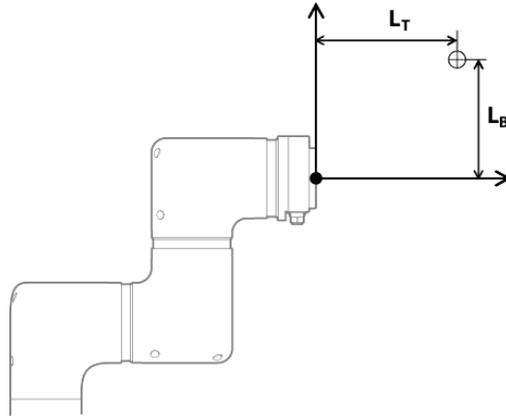
The radius of rotation for the robot when its arm is fully stretched is 915 mm. The radius of 176.5 mm from the center axis of the base is the area where the robot arm cannot reach due to its structure.



- A: Working range where the robot arm cannot reach
- B: Working range where the robot arm can reach

1.9 Maximum load capacity for the tool

The load capacity of the robot arm may vary depending on the distance between the tool flange and the payload's center of gravity. The load capacity per distance is as follows:



Chapter 2 Safety

2.1 Safety Marks in the User Manual

The user manual contains the following safety marks.

 **Danger**

If a user does not obey the safety mark, then it can cause a severe accident including death or serious injury of a user.

 **Warning**

If a user does not obey the safety mark, then it can cause an accident including serious injury of a user.

 **Caution**

If a user does not obey the safety mark, then it can cause a damage to the product or injury of a user.

2.2 General Safety Cautions

Danger

User needs to install the robot and the electrical equipment by complying with the instructions given in Chapter 3 Installation.

Warning

- Robot application system manufacturers and robot users should be familiar with this manual and complete the robot operation training.
- Make sure sufficient space is available so the robot arm can move freely.
- When using the robot, a user should not wear loose clothes or accessories. If you have long hairs, then tie it in the back so that it does not stuck in the robot's joints.
- Do not ever use a damaged robot.
- If a fatal error occurs in the software, then immediately stop it and contact the product supplier.
- Check if values such as the robot installation angle, tool settings and safety settings are correctly inputted.
- Do not connect the safety device to a general I/O. Safety device is used only for safety related I/O.
- When using the teaching pendant, pay close attention to the robot's movements.
- When the robot is operating, do not enter the working range of the robot or touch the robot.
- Do not modify the robot on your own. If a user causes a problem by modifying or remodeling the product on their own, then Hanwha Techwin will not be responsible for it in any sort of way.
- The robot and the controller can generate heat after long hours of use. Do not touch the robot after long hours of use. If you need to touch the robot, then power off the controller and cool down the robot first.
- When the robot collides with an external object, a significant level of kinetic energy is generated, which is proportional to the speed and the payload. (Kinetic energy = $1/2 \times \text{mass} \times \text{speed}^2$)
- Regarding the robot installation, make sure to use a proper configuration for installation. If robot mounting, tool weight, tool's center of gravity, tool length, safety configuration, etc. are not correctly entered, the direct teaching or collision detection function may not work properly.

- You should use the direct teaching function in a safe environment. DO NOT use it if there is a sharp part or cause of jamming in a tool or surrounding installations.
- Correctly enter tool related information (the length, weight, center of gravity of the tool, etc.) before using the direct teaching function. If you enter information different from the actual specification of the tool, you may experience malfunction when using the direct teaching function.
- If a joint is operated at the speed beyond a certain limit when using the direct teaching function, it may make an emergency stop for the safety of operators.

 **Caution**

- It is recommended that you test all the functions separately before using the machine or other robot that can damage the robot. If other machine or robot is damaged by programming errors or robot failures, Hanwha Techwin will not be responsible for it.
- Do not expose the robot to a strong magnetic field. Your robot can be damaged.

2.3 Intended Use

This robot may be used for transport, and assembly of objects with tools. However, use it only under the environment specified by its specifications.

Since the safety function is built in, the collaborative work is possible without physical protective fence. However, for the final system applied with robot, the risk assessment should be conducted on the whole system before use.

The system integrator or the end user who implements the robot applied final system shall take the responsibilities as follows:

(These are examples and are not limited to them.)

- Use in potentially explosive environment.
- Medical applications and human life related applications
- Use in human and animal transportation
- Use without the risk assessment
- Use in places where the performance of the safety function is not sufficient
- Use beyond its performance and environmental specifications

2.4 Potential Dangers

If the risk assessment, conducted by the final system manufacturer who applied the robot, concludes that it is not possible to fully reduce the risk only with the built-in safety function, additional protective measures should be established.

Consider potential dangers as follows:

- Injuries that may occur if the human body part such as finger is caught in the robot joints (confinement).
- Injuries caused by sharp edges or corners of tools (stab or penetration)
- Injuries caused by objects around the robot (stab, penetration, or falling)
- Injuries that may occur when working on toxic or hazardous materials (skin damage or dyspnea)
- Injuries caused by collisions with the robot (bruise or fracture)
- Injuries caused by loosely coupled parts.
- Injuries caused by objects separated or fallen from the tool.

Note Potential dangers that may occur vary depending on the final system.

2.5 Limitation of Liability

This user manual does not cover all of the peripherals affecting the safety. A system installer must comply with the safety requirements according to the safety rules and laws of the country where the robot is installed.

The robot is configured as the final system interconnected with peripherals. This user manual covers neither the design, installation, operation of the final system nor all of the peripherals including the safety device.

The final system which applied the robot shall be designed and installed according to the safety requirements in compliance with laws and regulations of the country where it is installed.

The system integrator or the end user who implements the robot applied final system shall take the responsibilities as follows:

(These are examples and are not limited to them.)

- Risk assessment on the final system

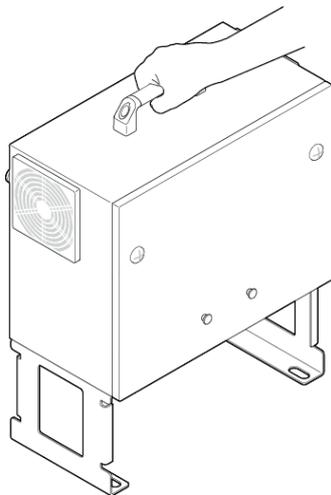
- Addition of safety devices according to the risk assessment results
- To check whether the system is correctly designed, set up and installed
- Definition on how to use the system
- Providing information on operation and safety as well as contact information
- Provision of technical documents including the user manual

Complying with the safety items in the user manual does not mean that all possible risks are prevented.

2.6 Transportation

The weight of the robot arm is 20.8 kg and that of the controller box is 20.2 kg. A minimum of two people is required for moving it safely.

Carry the controller box by holding the handle at the top.



! Warning

During transportation, avoid damages caused by falling accidents. The warranty does not cover any damage caused during transportation.

2.7 Emergency Stop

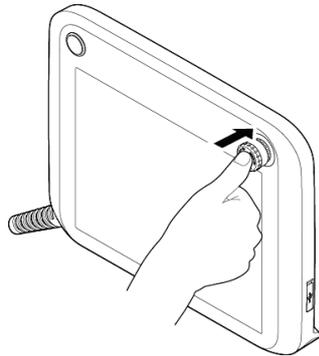
You can press the emergency stop button to immediately stop the robot in case of emergency. The emergency stop button is basically located in the teaching pendant and you can stop the robot by connecting another emergency stop button to the robot controller.

Caution

In the event of a collision or an emergency stop while driving over the speed of 120°/sec, check the zeroing of the robot joint and calibrate it if needed. After that, check if the movement path of the tool set in the operating program is correct. Contact the manufacturer or the service representative if you need the zeroing adjustment.

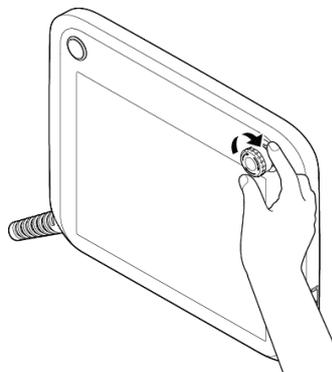
Using emergency stop

You can press the emergency stop button in the teaching pendant to immediately stop the robot.



Canceling emergency stop

Turn the emergency stop button clockwise to cancel emergency stop.



2.8 Safety Fence

Unlike other kinds of industrial robots that adopt physical fences, virtual fences are implemented to make sure that the robot arm does not reach out of certain limits. For more details, refer to [8.2 Setting Safety Boundaries](#).

2.9 Limits of Speed and Rotational Angles

By limiting the rotational angle and speed of each joint, you can secure your safety. For more details, refer to [8.1 Limiting Robot Movement](#).

2.10 Operating Robots without Driving Power

In case of emergency, when the robot is not driven by power, an adult can move each axis with their own force.

Caution

If you use excessive force to move the axis when the robot is not being driven by power, it can overload the driving unit. The manufacturer is not responsible for the failure caused by excessive force.

2.11 Safety Controller

The safety controller for HCR-5 complies with the ISO13849 Cat3, PLd class.

2.12 Risk Assessment

The risk assessment is one of the important factors when configuring a robot configured system. The degree of safety regarding robot installation varies depending

on the way of integrating it into the entire system, so it is not possible to perform the risk assessment with the robot alone.

The person who configures the robot included system to perform the risk assessment of the robot should install and operate it according to instructions of ISO 12100 and ISO10218-2 standards. For further information, refer to the Technical Specification ISO/TS15066.

You must perform the risk assessment right after the robot is installed. The main objectives of the risk assessment are to set up safety configuration suitable for the surrounding environment and robot settings and to find out the need for additional emergency stop buttons and protective measures.

It is possible to configure functions related to safety of the collaborative robot from the Safety Configuration Setting menu. Available functions are as follows:

- Joint Rotation Limit: You can limit the angle of each joint.
- Joint Speed Limit: You can limit the speed of each joint.
- TCP Speed Limit: You can limit the max speed for the TCP's linear movement.
- Force Limit: You can limit the maximum force that stops the robot when it detects a collision with a surrounding object.
- Safety Boundary Limit: You can build a virtual fence within the robot working area to prevent robot arms or tools from moving beyond the boundary for the safety of users.
- Redundant I/O Setting: You can set up redundancy to an I/O terminal to input/output important safety-related information.

If dangers are not sufficiently reduced or removed through the safety related functions above, add more protective measures to remove them. The manufacturer is not responsible for accidents caused by noncompliance with relevant requirements of international standards and local laws and regulations in relation to installation or due to not performing review on those requirements during the risk assessment as above.

Chapter 3 Installation

The installer should install and operate the robot according to instructions of ISO 12100 and ISO10218-2 standards and comply with relevant requirements of international standards such as ISO/TS 15066 and local laws and regulations.

The manufacturer is not responsible for accidents caused by noncompliance with relevant requirements of international standards and local laws and regulations or due to not performing review on the risk assessment as mentioned in Section 2.12.

3.1 Installation Locations

It is recommended to install the system in a place which meets conditions as follows:

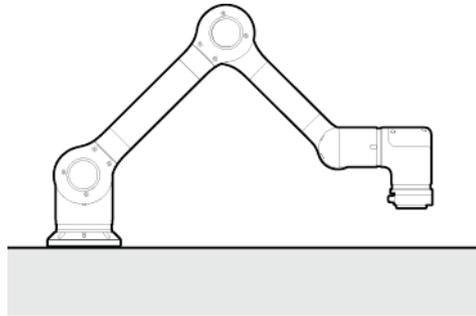
- A building with earthquake-resistant design
- A place without water leaks
- A place free of flammability or explosives
- A place that maintains the constant temperature and humidity
- A place with little dusts

 **Caution**

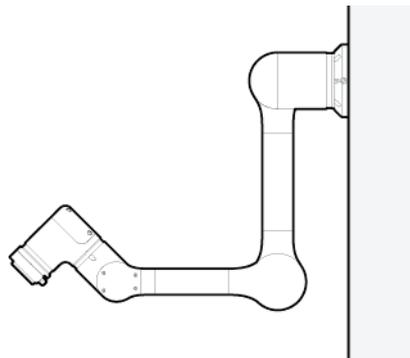
If the system is not installed in a recommended place, the performance and the life span of the robot may be reduced.

3.2 Installation Types

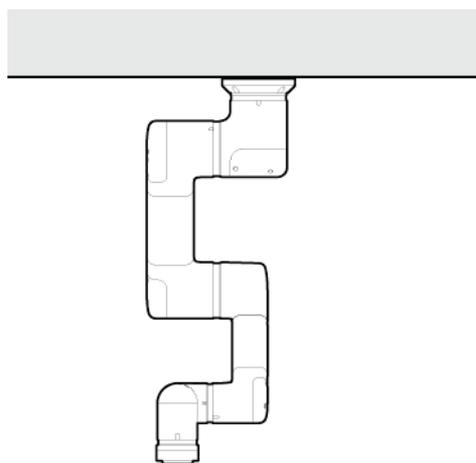
You can install the robot arm on ceiling, wall or floor as follows.



Example of installation on floor

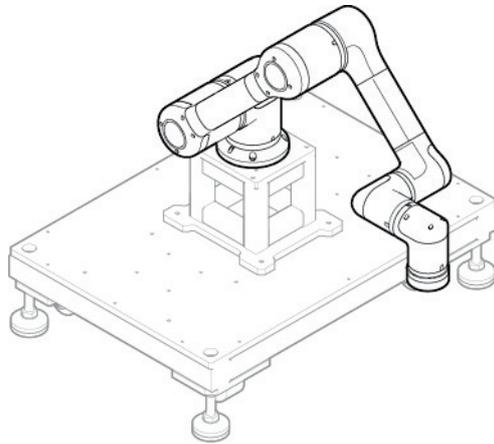


Example of installation on wall

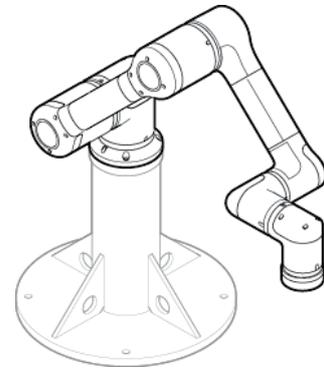


Example of installation on ceiling

You can also install it on a moving dolly or fixed post.



Example of installation on a moving dolly



Example of installation on a fixed post

! **Warning**

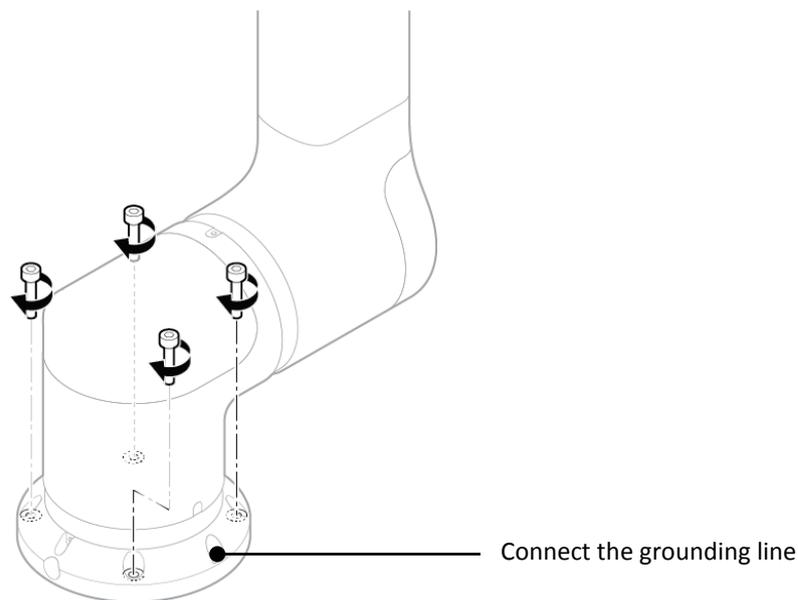
If you install the robot on a moving dolly, you must make sure the moving dolly is fixed to the ground when operating the robot.

Note The moving dolly or fixed post is not included in the product package.

After installing the robot, you must configure the robot installation information depending on each type of installation. For more details, refer to [7.1 Setting the Robot Installation Angles](#).

3.3 Fixing Robots

You can install the robot arm on the ceiling, wall or floor by using 4 pieces of M8 bolts not shorter than 15mm and it is recommended to fasten those bolts with 45 Nm torque. If the strength or levelness of the installation ground is not sufficient for supporting the robot arm, then you can use a fixing base for installation. In this case, if you want to install the robot arm in an accurate location, then you can use two $\Phi 8$ location determination pins to determine the location. In addition, to prevent electrostatic charges, you must connect the grounding line using a piece of M4 x 10 mm bolt.



Warning

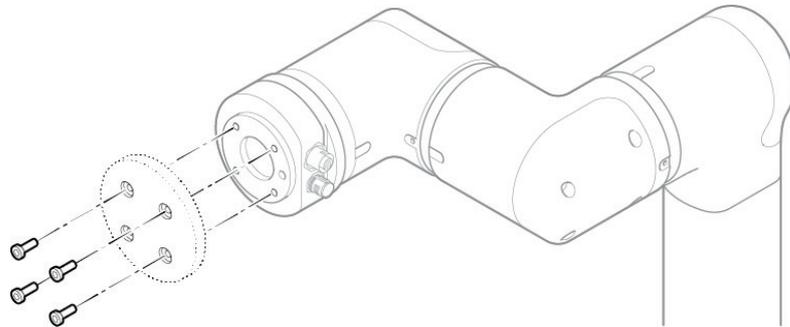
- When fixing the robot, securely fasten the bolts to prevent them from getting loose.
- Install it on a flat ground that can withstand the robot's weight and the weight that is generated when the robot is operating.
- Check that the installation plane of the robot arm is completely in contact with its base plane.

Note

- The base fixing bolt is not included in the product package.
- For more details about specifications of the robot base, refer to Appendix B Dimensions for Installation.

3.4 Connecting Tools to Robots

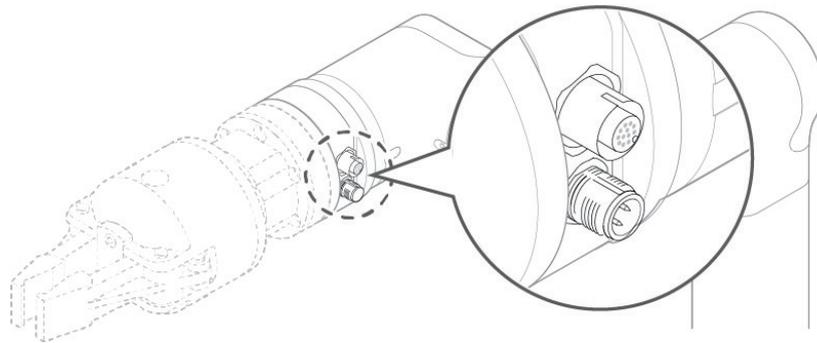
1. Using four sets of M6 bolts, fix a tool to the tool flange.



Note

- Tools and fixing M6 bolts are not included in the product package.
- The tool combination method varies from tool to tool. For more detailed methods, refer to the user manual provided by the tool maker.
- For more details about specifications of tool flange, refer to Appendix C Tool Flange Cross Section.

2. After fixing the tool, connect the necessary cables to the tool I/O or the EtherCAT port.
 - For the tool I/O, you can select one from the analog input (current (0 – 20 mA), voltage (0 – 10 V)), the digital input (4Ch) and the digital output (4Ch, 0, 12, 24 Vdc).



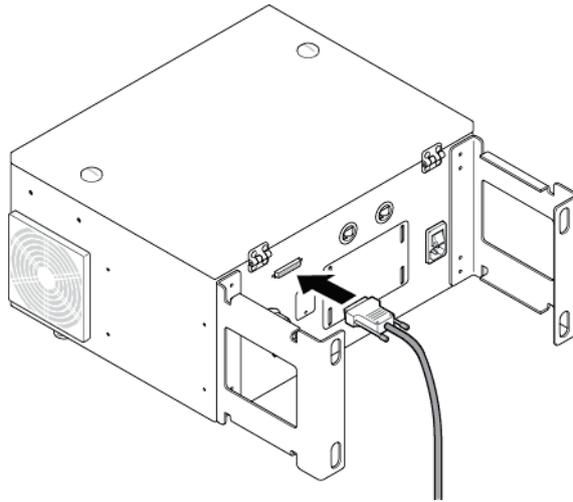
Note

- For more details about specifications of the pin maps for the tool I/O and the EtherCAT, refer to Appendix D Port Pin Map.

3.5 Connecting Cables

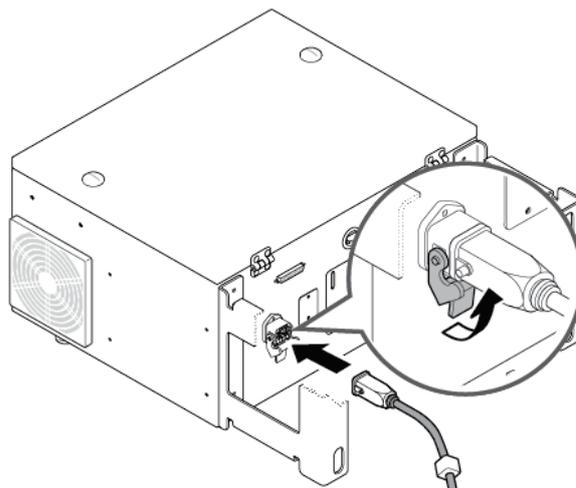
Connecting the teaching pendant to the robot controller

After connecting the teaching pendant cable, by using fixing bolts for the connector, securely fasten it, so that the cable does not slip out.



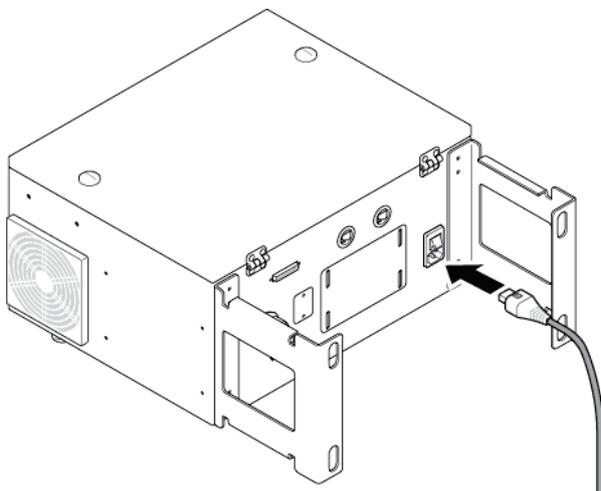
Connecting the robot arm to the robot controller

After connecting the robot arm cable to the robot controller, hook a fixing latch, so that the cable does not slip out.



Connecting the power supply to the robot controller

Connect the power cable approved in your country to the power terminal. Robot controller's power terminal accepts standard IEC plugs.



The minimum requirements for power supply are ground, main fuses and circuit breakers, and they should be prepared by the person who prepares for installation.

The following electrical specifications are applicable to power supplies.

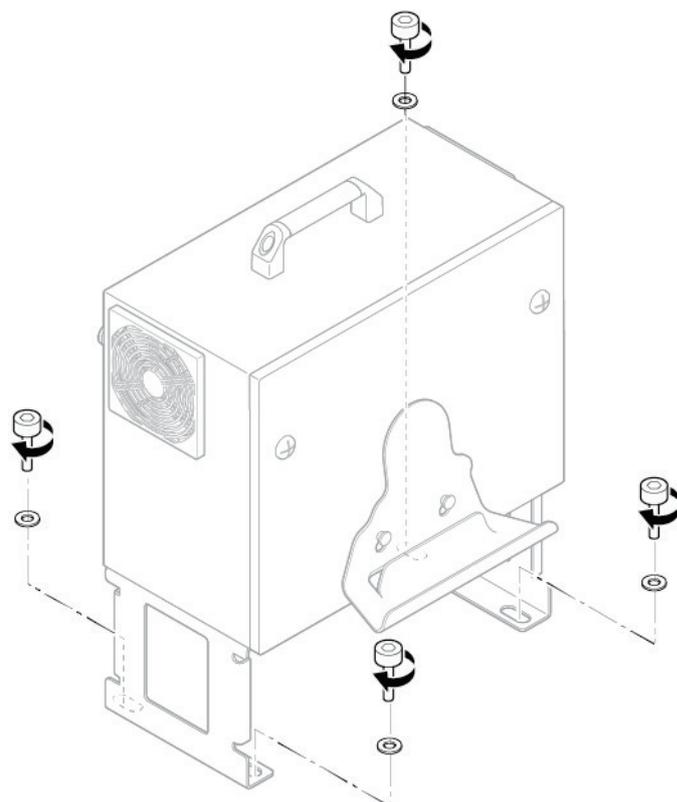
Input power	100 ~ 240 VAC
External power supply fuse	8 ~ 16 A (100 ~ 240 V)
Input frequency	47 ~ 63 Hz

Caution

While the robot is on, do not remove the robot connector, the power connector or the teaching pendant connector.

3.6 Fixing the Controller Box

The controller box can be fixed to the ground by using the fixing bracket at the bottom. Fix it with M14 bolts not shorter than 45 mm in combination with flat washers.

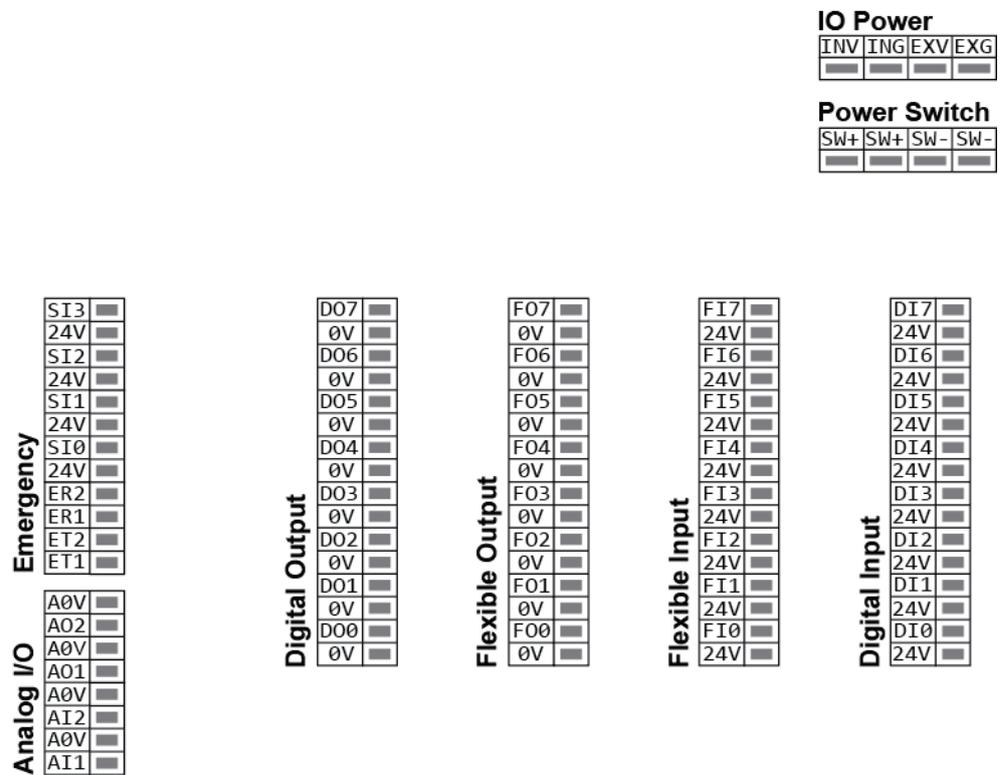


Note Bolts or screws fixing the controller box are not included in the product package.

3.7 Overview of Controller I/O

If you want to connect other external equipment to your controller, then you must first connect it to the I/O inside the controller box. The controller I/O is very flexible, so it can be connected to various equipment such as relays, PLC, and emergency stop buttons.

The following electrical interface layout exists for the area inside the controller box.



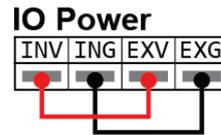
3.8 Common Spec for Digital I/O

The section defines the electrical specifications of the following 24V digital I/O for the controller box.

- Safety Input: 4 EA
- Flexible I/O: Input 8 EA, Output 8 EA
- General I/O (Digital I/O): Input 8 EA, Output 8 EA

By implementing the terminal block called IO Power (J8), you can supply power to the digital I/O from an internal 24V power supply or external power supply. The left two blocks are composed of internal 24V(INT_24V), GND and the right two blocks are composed of external 24V(EXT_24V), GND. They can supply power from the outside to the digital I/O.

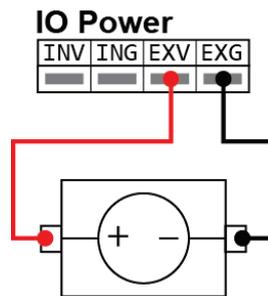
Basically, internal 24V power is supplied for use. The basic power supply configuration is as follows.



INV	Internal 24 V I/O power supply	Current limit: 2 A
ING	Internal 24 V I/O GND	Typ. DC 24 V
EXV	External 24 V I/O power supply	Min. DC 23 V
EXG	External 24 V I/O GND	Max. DC 26 V

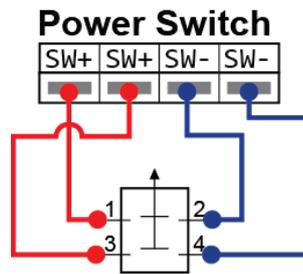
If the digital I/O power supply provided from the inside of the controller is not sufficient, then you can connect an additional power supply externally. If an internal/external power supply is used, then the current limit of 2A is applied.

If the digital I/O requires more current, then you can connect an external power supply as follows.



Note If the current is over the upper limit, then the digital I/O fuse can blow off. If the fuse is blown off, you need to replace it.

You can configure the terminal block called as Power Switch (J9) to use it as an external power supply switch.



SW+	Push Button Input
SW+	Push Button Input
SW-	GND
SW-	GND

The following electrical specifications apply to the internal or external power supply.

Terminal	Parameter	Minimum	Format	Maximum	Unit
Internal 24V power supply					
INT_24V – INT_GND	Voltage	23	24	25	V
INT_24V – INT_GND	Current	0	–	2	A
External 24V requirements					
24V – 0V	Voltage	20	24	29	V
24V – 0V	Current	0	–	2	A

The digital I/O is manufactured by complying with the IEC 61131-2 standard. The following electrical specifications apply.

Terminal	Parameter	Minimum	Format	Maximum	Unit
Digital output					
COx / DOx	Current	0	–	0.2	A
COx / DOx	Voltage drop	0	–	0.5	V
COx / DOx	Leakage current	0	–	0.1	mA
COx / DOx	Functions	–	PNP	–	Format
COx / DOx	IEC 61131-2	–	1A	–	Format
Digital input					

Terminal	Parameter	Minimum	Format	Maximum	Unit
EIx/SIx/CIx/DIx	Voltage		–		V
EIx/SIx/CIx/DIx	OFF area		–		V
EIx/SIx/CIx/DIx	ON area		–		V
EIx/SIx/CIx/DIx	Current (11–30V)		–		mV
EIx/SIx/CIx/DIx	Functions	–	PNP	–	Format
EIx/SIx/CIx/DIx	IEC 61131-2	–	3	–	Format

3.9 Configuring the Safety Input

Since a single signal loss should not lead to a loss of the safety function, all the I/O's related to the safety should be duplexed.

Safety Input should always comply with the common specs of the digital I/O.

When you install the safety device or equipment, you should comply with the instructions from Chapter 2 Safety and Chapter 3 Installation.

Safety inputs include emergency stop and safety protection stop. Emergency stop input is for emergency stopping of the robot and safety protection stop input is for protection of all the safety classes. Their functions are different from each other in this sense.

	Emergency Stop	Safety protection stop
Robot stops the movement	Example	Example
Run the program	Stop	Pause
Robot power	Off	On
Initialization	Manual	Auto or manual
Frequency of use	Low	Mid
Re-initialization required	Break release only	No
Stop category (IEC 60204)	1	2
Performance level (ISO 13849-1)	PLd	PLd

Using the Flexible I/O, you can set the Safety I/O additionally. For example, you can use the emergency stop output. In addition, you can configure the Flexible I/O for the safety function in the GUI.

! Danger

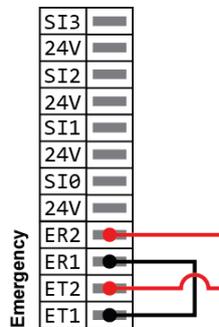
Do not connect safety signals to normal PLCs. Only safety PLCs must be connected to safety signals. If you do not comply with the warning, then the safety stop function may fail, causing severe injury or even death. The safety signal and the general I/O signal should be separated from each other.

! Warning

- All the safety class I/O's are duplexed. By separating the channels, you should make sure the safety function is not initiated by a signal failure.
 - Before installing the robot, you must check the safety functions. In addition, the function should be checked for defects periodically.
-

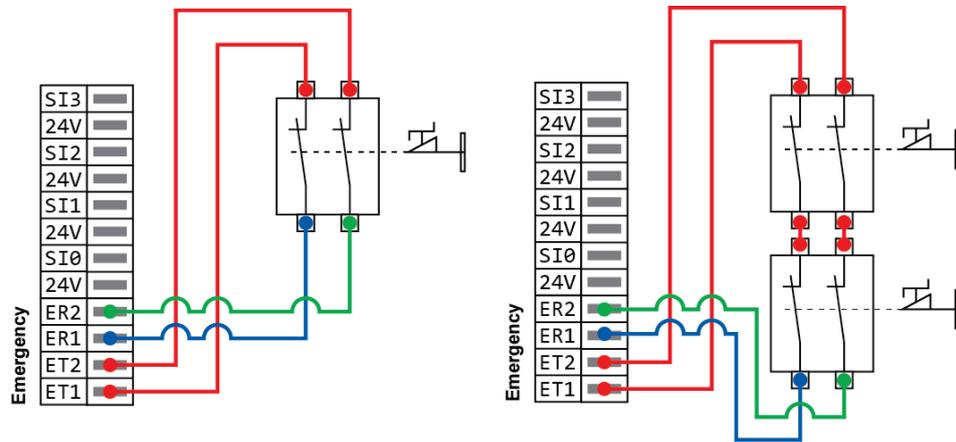
Initial safety configuration

The safety configuration for the robot is set to default initially when it is shipped to you, so no additional configuration is required. The initial safety configuration is shown as follows.



Connecting the emergency stop button

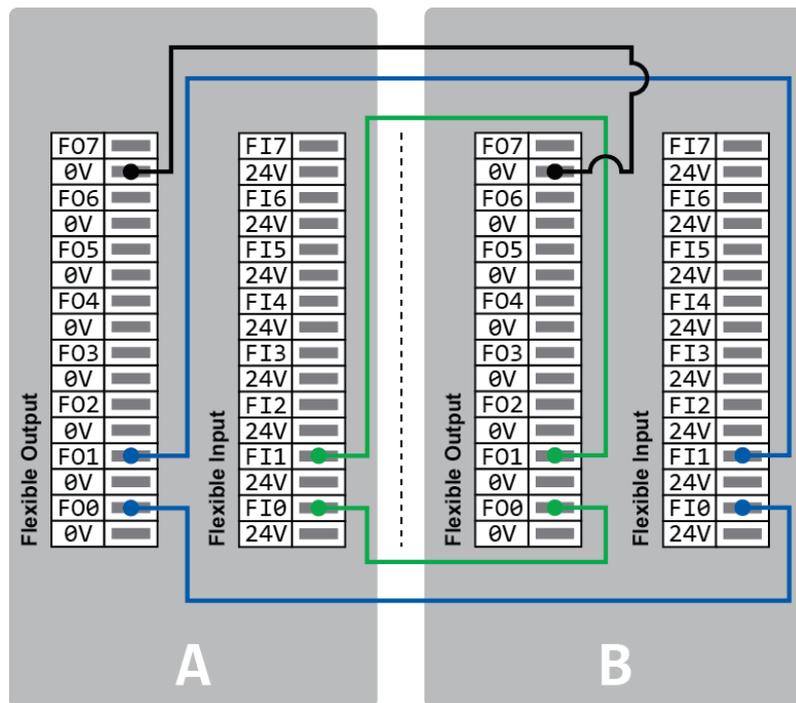
It is recommended that you connect one or more emergency stop button. The emergency stop button is composed as follows.



Sharing emergency stop circuits with other equipment

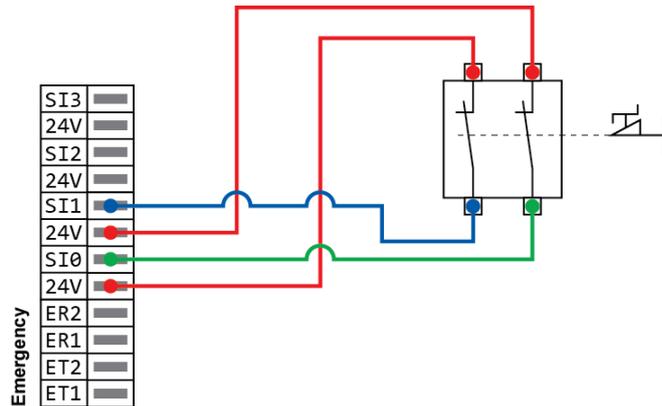
When you use the robot with other equipment, it is recommended that you share the same emergency stop circuits. If you do, then you will not have to check which emergency stop button you have to use in case of emergency.

Before sharing the emergency stop function with other equipment, you must configure the Flexible I/O functions in the GUI. You can configure the emergency stop function as follows.

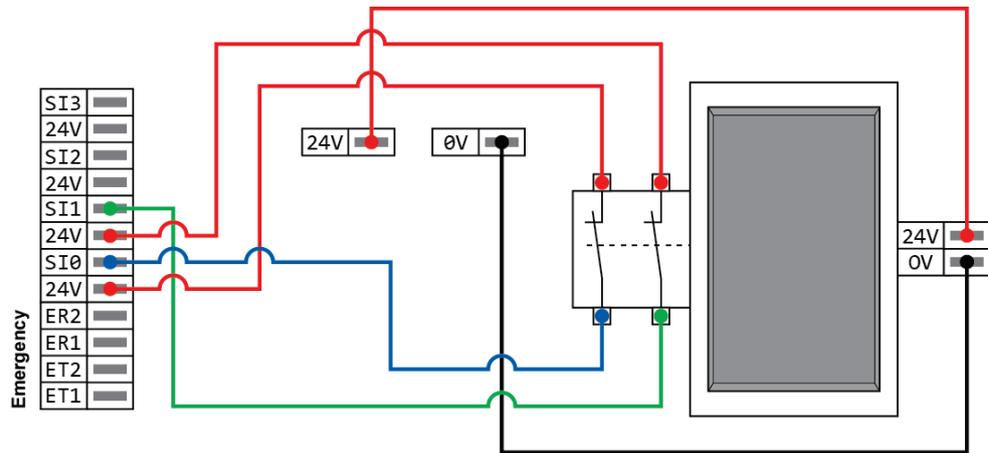


Safety protection stop and restart

As an example of basic safety protection device, basically, when the door opens, you can press the door switch to stop the robot. You can configure the function as follows.

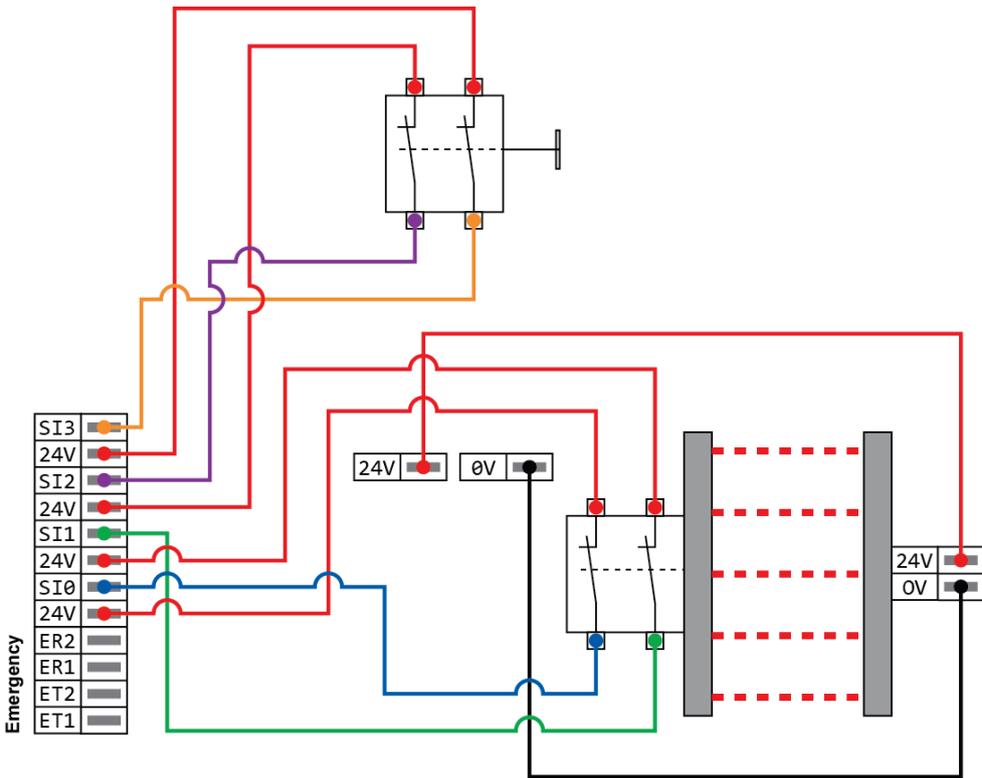


If you cannot close the door after a worker passed through it, then you can use the following features. The Flexible I/O may require you to use the reset button outside the door to resume robot operation. As another way to resume robot operation, you can use the safety mat or the safety class laser scanner.



Safety protection stop and reset button

Before using the light curtain interface as a safety protection interface, it requires external reset complying with the safety limits. The reset button should be a duplexed channel type and you can configure it as follows.



3.10 Configuring the General Digital I/O

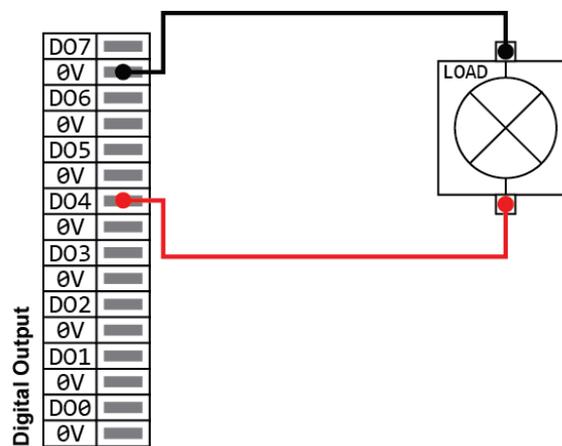
If not used as a safety function, then you can use the Flexible I/O as a general purpose digital I/O.

The general digital I/O should comply with the common specifications of digital I/O.

The general digital I/O can be used to configure relays or PLC systems. In this configuration, if the program is not running, the output is maintained low at all times.

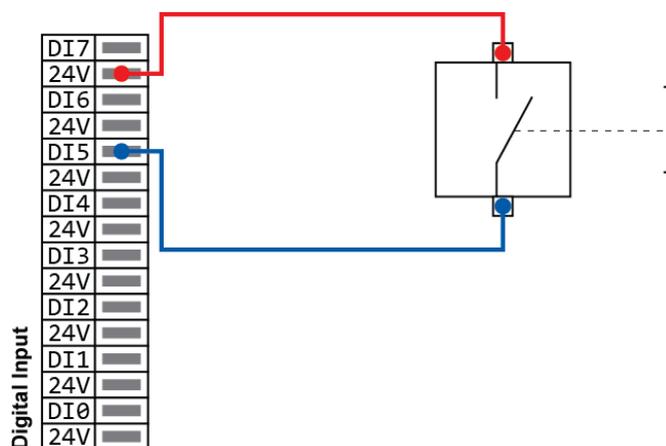
Load control with digital outputs

You can control loads with digital outputs. You can configure it as follows.



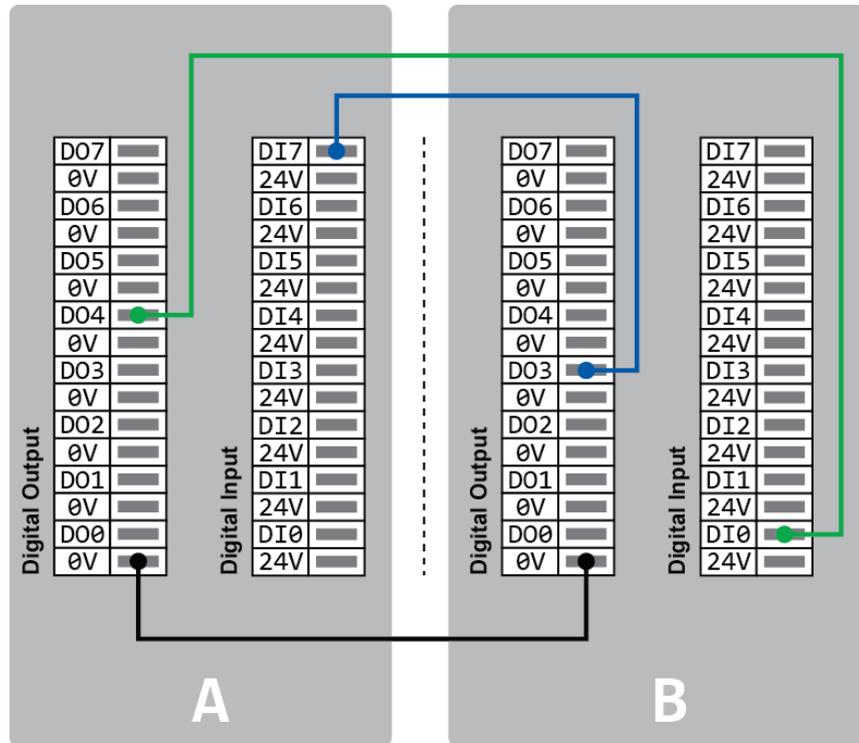
Digital input control using buttons

You can connect a simple button to a digital input. You can configure it as follows.



Communicating with other equipment or PLC

The digital I/O can be configured to communicate with other equipment if a common GND is established and if the equipment uses PNP technology. You can configure it as follows.



3.11 Configuring the General Analog I/O

It can be used to set or measure voltage (0–10V) or current (4–20mA) between two equipment.

For high reliability, it is recommended that you use the following method.

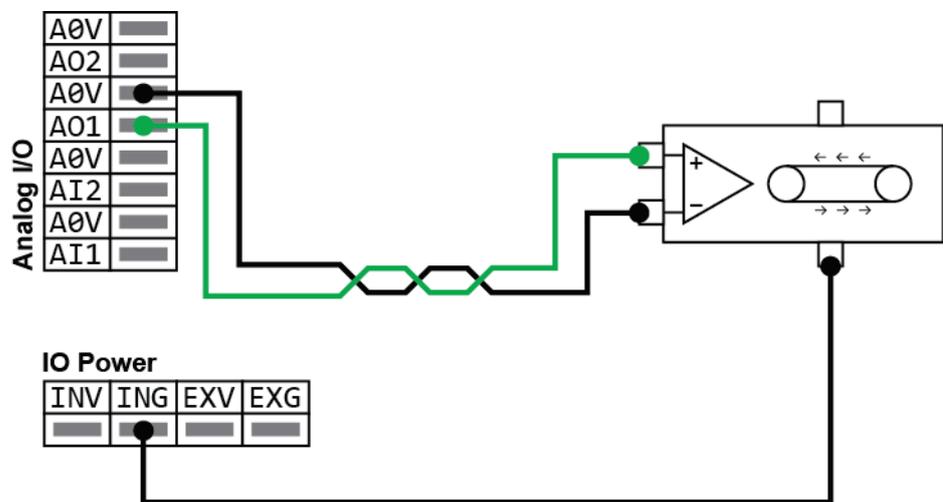
- Use the analog ground closes to the I/O.
- Equipment and control box should share the same ground. Analog I/O is not insulated in the control box.
- Use the cable that is shielded or twist paired. Connect it to the ground shield of the power (J12) terminal.
- The current signal is not sensitive to noise, so simply use an equipment operating in current mode.

The input mode can be set in the GUI. The following electrical specifications apply to the I/O.

Terminal	Parameter	Minimum	Format	Maximum	Unit
Current mode input					
AIx – AG	Current	4	–	20	mA
AIx – AG	Resistance	–	20	–	Ohm
AIx – AG	Resolution	–	12	–	Beat
Voltage mode input					
AIx – AG	Current	0	–	10	V
AIx – AG	Resistance	–	12	–	Kohm
AIx – AG	Resolution	–	12	–	Beat
Current mode output					
AOx – AG	Current	4	–	20	mA
AOx – AG	Resistance	0	–	10	V
AOx – AG	Resolution	–	12	–	Beat
Voltage mode output					
AOx – AG	Voltage	0	–	10	V
AOx – AG	Current	–20	–	20	mA
AOx – AG	Resistance	–	1	–	ohm
AOx – AG	Resolution	–	12	–	Beat

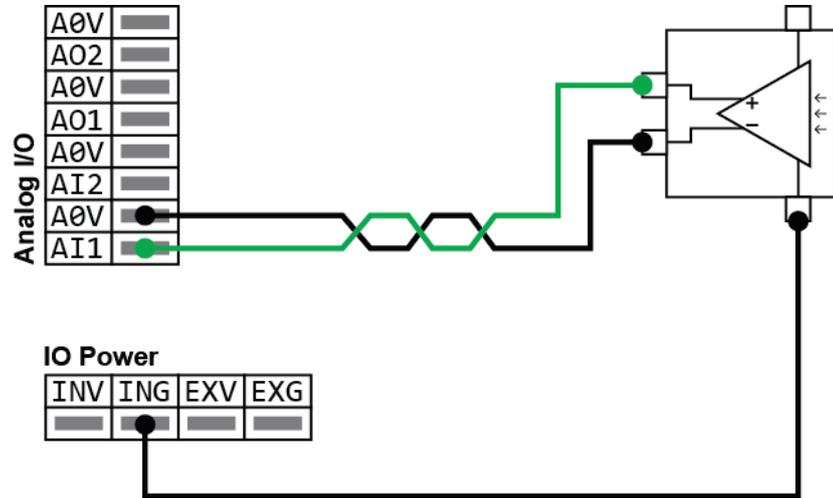
Analog output

You can use analog outputs as speed control inputs to the conveyor belt. You can configure it as follows.



Analog input

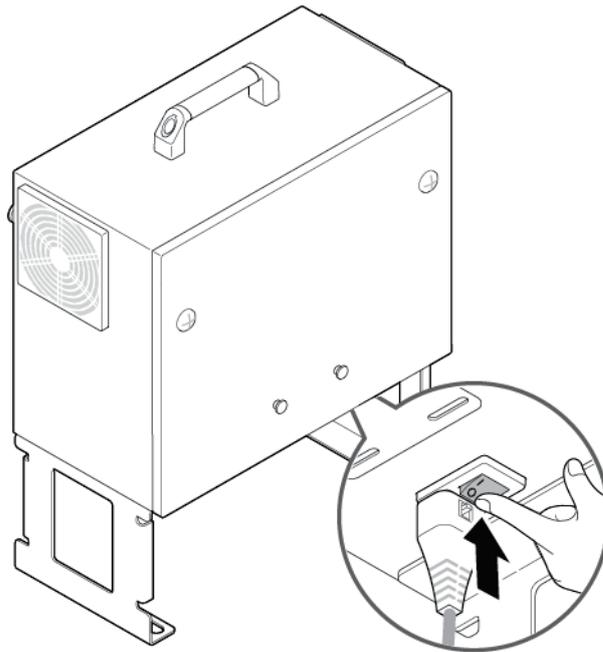
You can use analog sensor outputs as analog inputs. You can configure it as follows.



Chapter 4 Getting Started

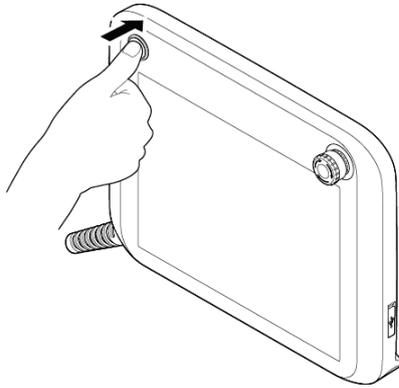
4.1 Turning on the Robot Controller

Turn on the power switch at the bottom of the controller. If you turn on the power switch for the controller, power will be supplied to the controller.



4.2 Turning on the Teaching Pendant

Turn on the power button at the left top of the teaching pendant.



Caution

- Do not turn on the teaching pendant with USB devices connected. It may cause problems with starting the system. Connect it after the system is booted completely.
 - Do not unnecessarily touch the screen while booting the system. It may cause problems with starting the system.
-

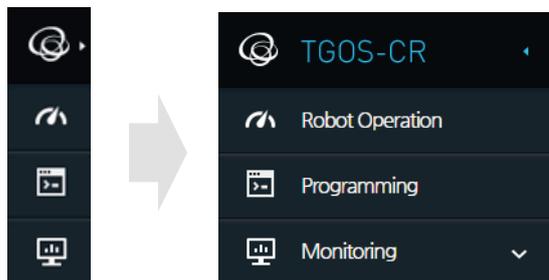
Chapter 5 Software Overview

5.1 Menu Overview

Expanding menu



Press the expanding menu button at the left top of the screen to expand the menu. You can check the name of each menu and if a sub menu exists, then you can select it as well.



Robot Operation



You can configure basic operation / control (start, pause) of your robot. For more details, refer to [Chapter 10 Starting the Robot](#).

Programming



You can configure the robot's movements. For more details, refer to [Chapter 9 Programming](#).

Monitoring



You can check the real time condition of the robot arm. For more details, refer to [Chapter 11 Monitoring](#).

Robot Setting



You can configure the installation information before operating the robot. For more details, refer to [Chapter 7 Setting Robots](#).

Safety Setting



You can configure the safety items before operating the robot safely. For more details, refer to [Chapter 8 Safety Related Settings](#).

Device Setting



You can configure an external equipment that will be linked to the robot. For more details, refer to [Chapter 12 Linking with External Equipment](#).

Management



You can register a robot or user and manage logs, etc. For more details, refer to [Chapter 6 Registering Robots and Users](#), [15.4 Viewing and Managing Logs](#) & [15.5 Managing the Robot System Configuration](#).

SW Configuration



You can configure the operation software environment. For more details, refer to [Chapter 13 Environment Setting](#).

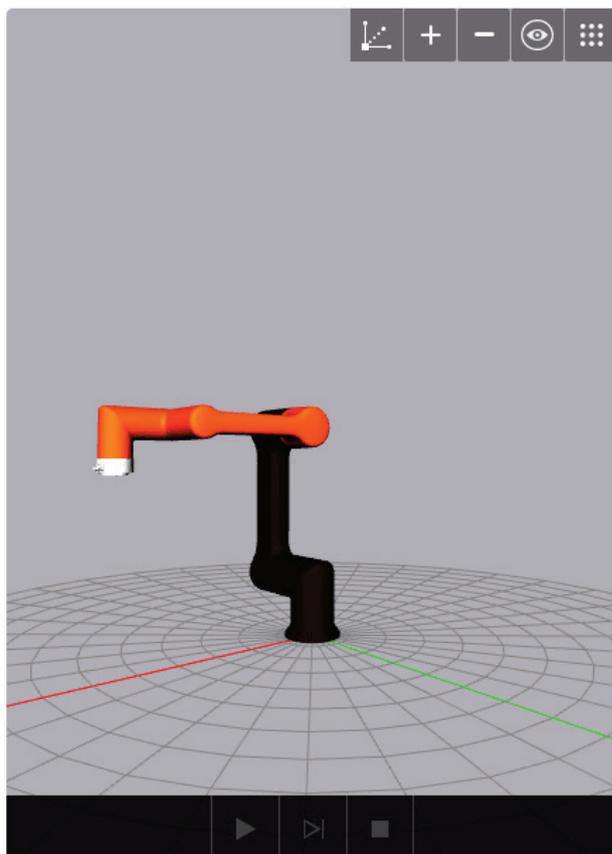
Manual Move



You can control the robot manually. For more details, refer to [5.3 Manual Move Screen](#).

5.2 3D Preview Screen

The system provides a screen where you can preview the robot's movement or coordinates in 3D. You can drag on the screen in the desired direction to change the screen perspectives.



Screen display setting button

You can configure the information displayed on the preview screen and the screen layout.

Basic setting button	
	Hide or unhide the TCP coordinates.
	Initialize the size of the preview screen.
	Decrease the size of the preview screen. (Level 10)

	Increase the size of the preview screen. (Level 10)
	Unhide the additional setting button.
	Hide the additional setting button.

Additional setting button

	Hide or unhide the point of the movement path for the tool currently programmed.
	Hide or unhide the location/direction of the TCP currently set for the robot.
	Hide or unhide the movement path currently programmed.
	Hide or unhide the safety borders currently set for the robot.

Note Depending on the purpose of the menu, some buttons are not available in the preview screen.

Robot task control button

You can preview the programmed robot tasks.

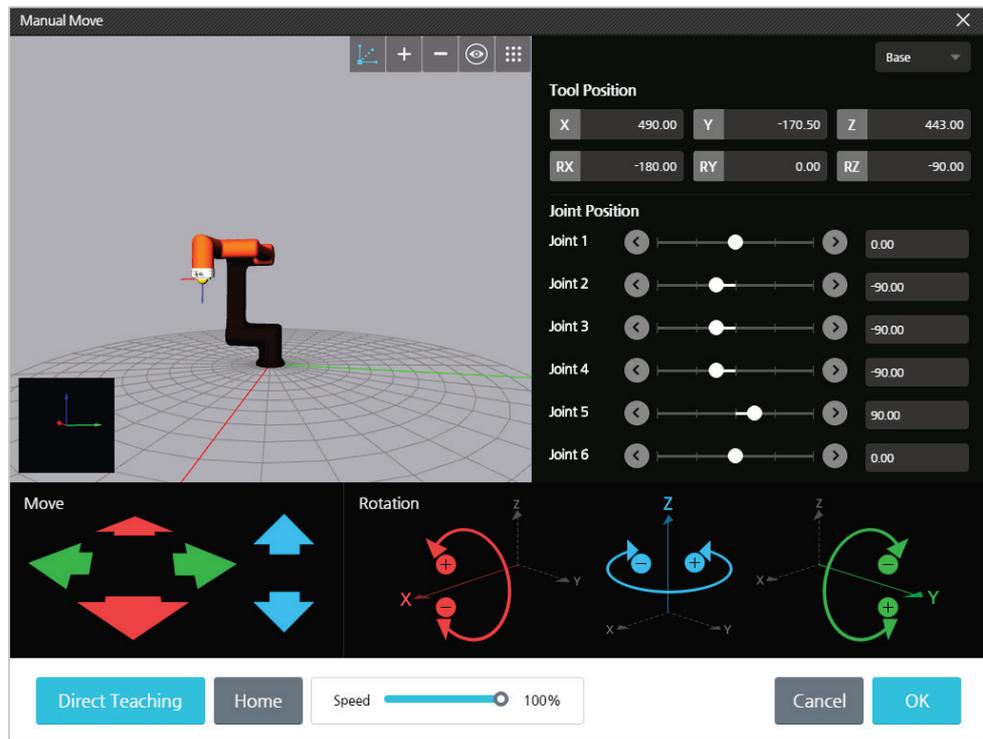
	Start the program from the beginning or at the selected task. When you press the Start button, it changes to the Pause button.
	Pause the running program. When you press the Pause button, it changes to the Start button again.
	Execute the unit command that are currently selected.
	Terminate an ongoing task.

Note Depending on the purpose of the menu, some buttons are not available in the preview screen.

5.3 Manual Move Screen

On this screen, you can control the robot's positions. By using jog control or direct teaching, you can control the robot's position.

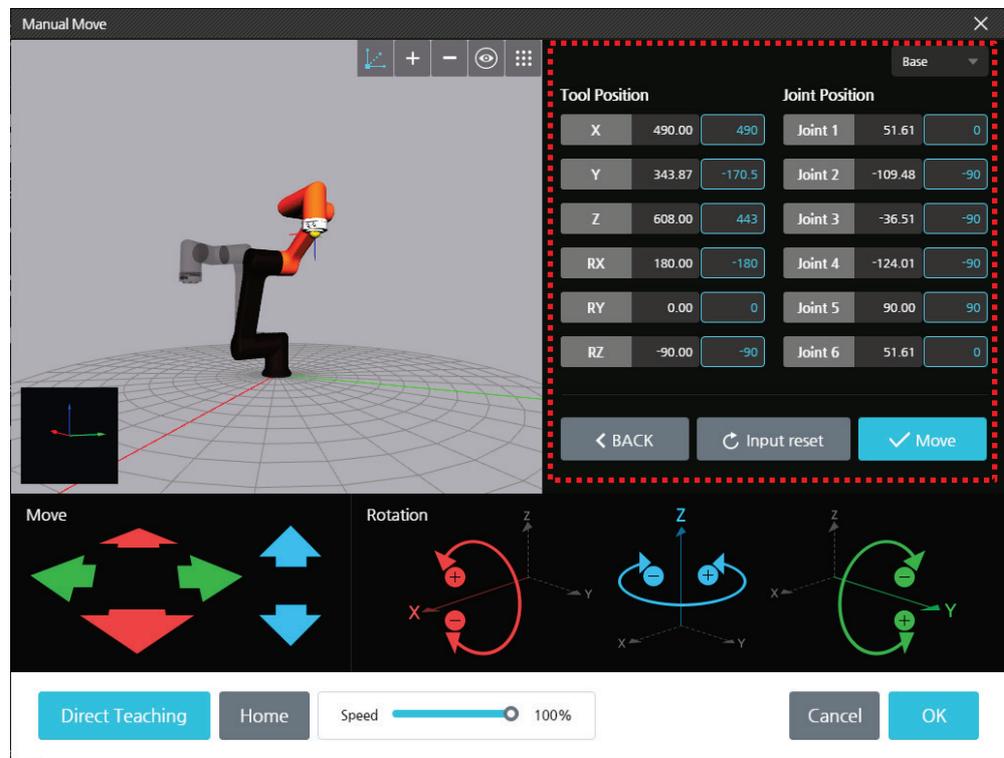
Press the  **Manual Move** button in the main menu.



- **Tool Position:** Displays the coordinates of TCP. You can modify it by entering specific coordinates.
- **Joint Position:** Displays the angle of the joints. You can modify it by entering a specific angle.
- **Move:** Adjusts the coordinates of TCP by using jog buttons.
- **Rotation:** Rotates the TCP by using jog buttons.
- **Direct Teaching:** If you manually adjust the robotic arm as you press this button, the system detects any changes in the joint position.
- **Home:** Shifts the robot to its initial position.
- **Speed:** Adjusts the movement speed of the robotic arm when you control the robotic arm manually.

Note Depending on the purpose of the menu that uses the manual robot control function, the screen layout may differ accordingly.

If you press the coordinate value on the screen, the screen will be changed as follows, and then you can enter the coordinates and the joint angles on your own.



- Press the **BACK** button to return to the previous screen.
- Press the **Move** button to move the robot arm to the preset position.
- Press the **Input reset** button to reset the coordinates and joint angles you input to the current coordinate of the robot.

Warning

When controlling the robot manually, check that there is no obstacle or person around the robot before operating it.

Caution

- When using the direct teaching function, check that the center of gravity of the TCP payload is correctly entered. Entering an incorrect value may cause malfunction.
- If you drive a joint beyond a certain speed while using the direct teaching function, it may make a noise and make an emergency stop for the safety of operators.

5.4 Virtual Keypad

The operation software accepts touch based inputs, so you can use a virtual keypad on the screen. Depending on the input types, there are three types of virtual keypads as follows.

Text keypad

You can enter or edit simple English texts or special characters. You can use the Shift key to toggle between uppercase/lowercase.



- If you want to display your inputted text, press the **Accept** key.
- If you want to delete the entire inputted text string, press the  button.
- If you want to close the keypad, then press the  button at the right top.

Note The **Accept** key is deactivated and cannot be used if there is no inputted text string.

Number keypad

You can enter or edit simple numbers.



- If you want to display your inputted numbers, press the **Enter** key.
- If you want to delete the entire inputted text string, press the  button.
- If you want to close the keypad, then press the  button at the right top.

Note The **Enter** key is deactivated and cannot be used if there is no inputted text string.

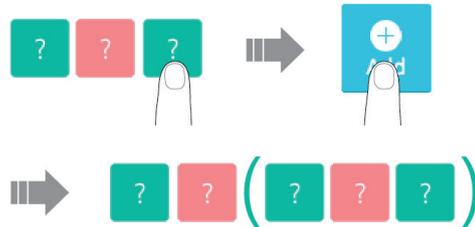
Expression keypad

You can enter or edit simple expression.

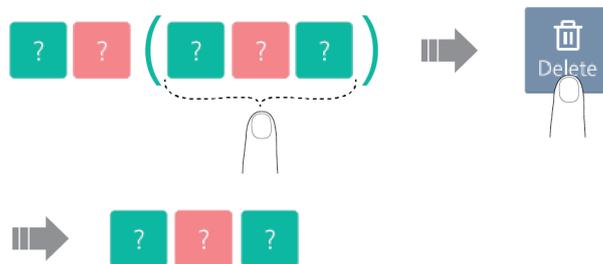


- Basically, an expression is composed of  three input items.
 - Green input field: You can enter fixed variables and numbers.
 - Orange input field: You can enter an arithmetic operator.

- **Add an expression:** Select a green input field and press the **Add** button. The selected green input items will be changed to the three basic input items and added into the parenthesis.



- **Delete an expression:** After selecting any item in the parenthesis, press the **Delete** button. The basic input item added into the parenthesis will be deleted.



- If you want to delete the selected input item, then press the **Clear** key.
- If you want to display the inputted expression, press the **Enter** key.
- If you want to close the keypad, then press the **×** button at the right top.

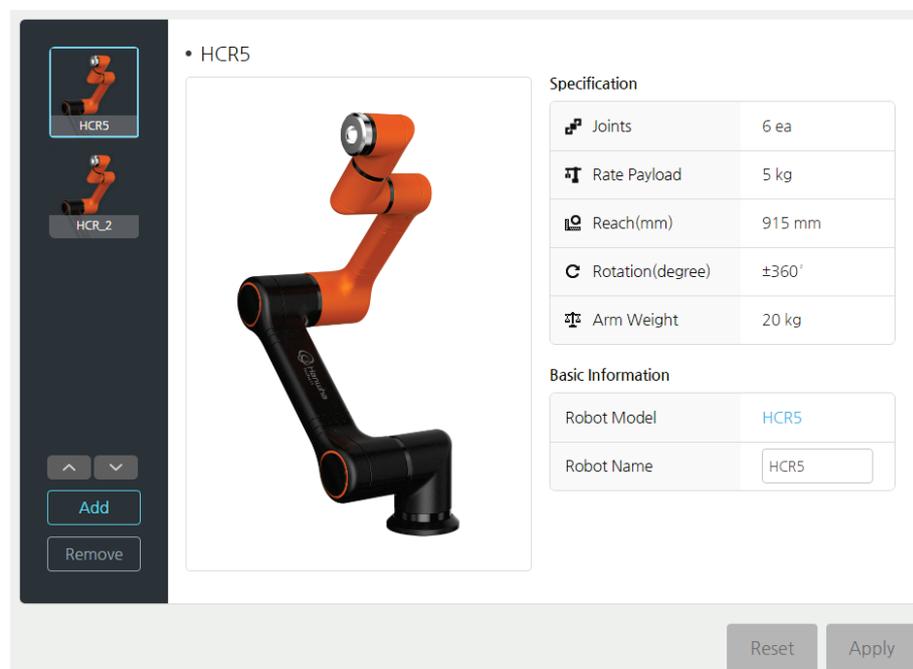
Chapter 6 Registering Robots and Users

After installing the robot, turn on the system for the first time. Only the **Management** menu will be seen. If there is no robot registered, other menus will not be seen.

6.1 Managing Robots

You can register a new robot to be linked to the controller or change the robot name.

In the main menu, select  **Management** > **Robot**.



The screenshot displays the robot management interface. On the left, a vertical sidebar contains a list of robots: 'HCR5' (selected) and 'HCR_2'. Below the list are 'Add' and 'Remove' buttons. The main area shows a 3D model of the HCR5 robot. To the right, the 'Specification' table is displayed:

Specification	
Joints	6 ea
Rate Payload	5 kg
Reach(mm)	915 mm
Rotation(degree)	±360°
Arm Weight	20 kg

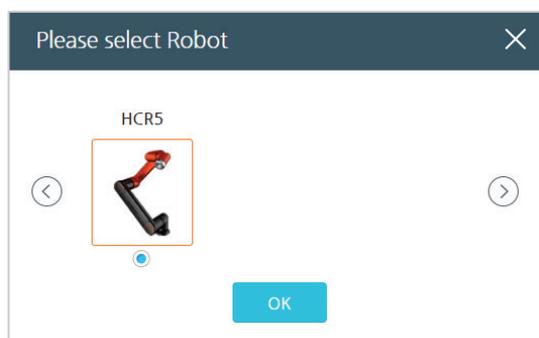
Below the specifications, the 'Basic Information' section shows:

Basic Information	
Robot Model	HCR5
Robot Name	<input type="text" value="HCR5"/>

At the bottom right, there are 'Reset' and 'Apply' buttons.

Registering robots

1. Press the **Add** button.
2. Add a robot and press the **OK** button.



3. Enter the robot name and press the **Apply** button.
4. When the restart confirmation window appears, press the **OK** button.
 - You must restart the system for normal operation.

Note The number of robots that can be registered depends on the software version and controller options. (In the early version, you can register only one robot.)

Deleting robots

1. In the list of registered robots, select a robot.
2. Press the **Delete** button.
3. When the confirmation window appears, press the **OK** button.
4. Press the **Apply** button.

Note If you want to delete a robot, then you must restart the system.

Modifying the robot name

1. In the list of registered robots, select a robot.
2. After pressing the text box having the robot name, modify it as you want.

Basic Information

Robot Model	HCR5
Robot Name	<input style="border: 2px dashed red;" type="text" value="HCR5"/>

3. Press the **Apply** button.

6.2 Managing Users

You can make sure only specific users can use the software by registering them. Also, you can grant an individual right to each user to limit their access to the menus.

In the main menu, select  **Management** > **User**.

ID ▾

Search Keyword

	Name	ID	E-Mail	Level
<input type="checkbox"/>	Hanwha	Hanwha	Hanwha@hanwha.com	Operation

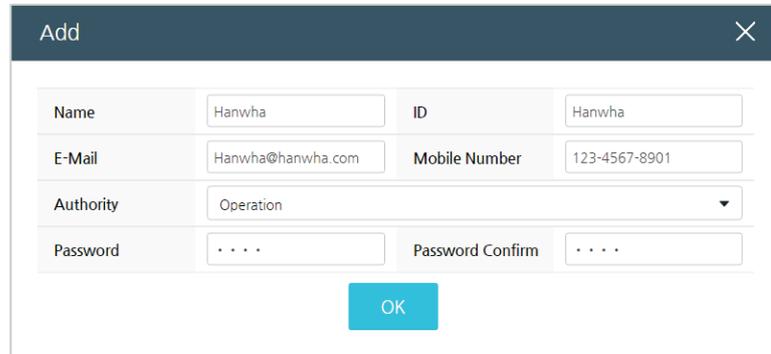
Add

Delete

Edit User

Adding users and setting authorities

1. Press the **Add** button.
2. Set the user information and their authorities and press the **OK** button.



The screenshot shows a modal window titled "Add" with a close button (X) in the top right corner. The form contains the following fields:

Name	<input type="text" value="Hanwha"/>	ID	<input type="text" value="Hanwha"/>
E-Mail	<input type="text" value="Hanwha@hanwha.com"/>	Mobile Number	<input type="text" value="123-4567-8901"/>
Authority	<input type="text" value="Operation"/>		
Password	<input type="password" value="....."/>	Password Confirm	<input type="password" value="....."/>

At the bottom center of the form is a blue button labeled "OK".

- The length of text that can be inputted is limited as follows.
 - **Name:** 25 letters
 - **ID/Password:** 20 letters
 - **E-Mail:** 30 letters
 - You can choose one of the following two authorities.
 - **Admin:** Can use all the functions of the software.
 - **Operation:** Cannot use the safety and the critical setting functions. Settings can be all inquired about.
3. Press the **Apply** button.
 - After adding, modifying or deleting a user, you must press the **Apply** button, so that the result is applied to the system.

Note

- If you are an operation user who lost the password, ask the admin user. The admin user can modify the password for an operation user.
- If the admin user's password is lost, then contact Hanwha Techwin Co.

Menu available to each authority

Depending on the authority set in User Management, the following menus become available. Even if you are not logged in, you can still use some menus.

Main menu	Sub menu	Admin	Operator	Log Off
Robot Operation		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Programming		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Monitoring	Robot Status	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	I/O Status	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Robot Setting	Mounting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	TCP Setup	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	I/O Setup	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	MODBUS TCP	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Safety Setting	Motion Limit	<input type="radio"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Safety I/O	<input type="radio"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Safety Boundary	<input type="radio"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Device Setting	Vision System	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Management	User	<input type="radio"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Robot	<input type="radio"/>	<input type="radio"/>	<input checked="" type="checkbox"/>
	Log	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Setting Management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
SW Configuration	General	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Network	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	SW update	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Shutdown	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Zeroing Robot		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

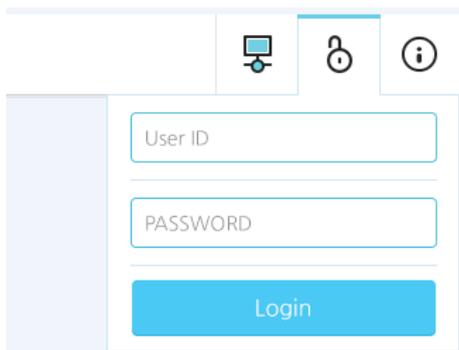
Note

- The **Zeroing Robot** menu and the **SW update** menu are only accessible by the Super Admin user.
- If you need assistance with zeroing, contact the manufacturer or a local service center.

6.3 Login/Logout

Logging in

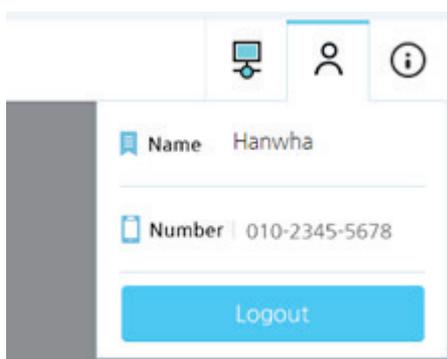
While logged off, the  icon is displayed at the right top of the screen. After finishing registering a user, while logged off, press the  icon and enter your ID/password and press the **Login** button.



A screenshot of a login form. At the top right, there are three icons: a computer monitor, a robot head, and an information 'i' icon. The robot head icon is highlighted with a blue border. Below the icons are two input fields: the first is labeled 'User ID' and the second is labeled 'PASSWORD'. Below these fields is a blue button labeled 'Login'.

Logging out

While logged in, the  icon is displayed at the right top of the screen. While logged in, press the  icon and press the **Logout** button.

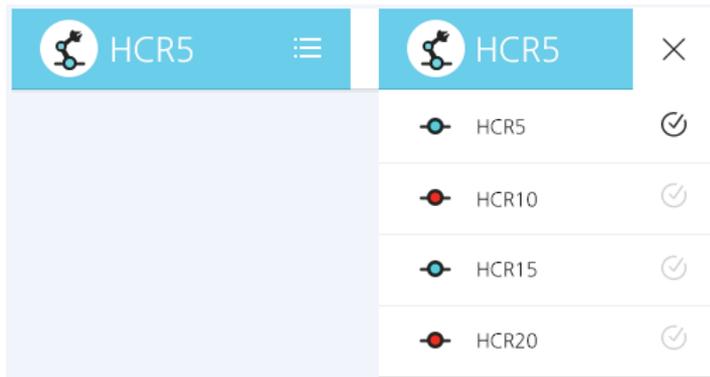


A screenshot of a user profile and logout form. At the top right, there are three icons: a computer monitor, a user person icon, and an information 'i' icon. The user person icon is highlighted with a blue border. Below the icons, the user's details are shown: 'Name | Harwha' and 'Number | 010-2345-5678'. Below these details is a blue button labeled 'Logout'.

6.4 Selecting Robots and Checking Status

Selecting robots

If one or more robots are registered, then you can select a robot to set or control. Press the robot name appearing at the left top of the screen, the list of registered robots will appear. Select a robot from there.



Note The number of robots that can be registered depends on the software version.

Checking the robot status

By press the  robot icon in the Robot Selection button or the  status icon at the right top of the screen, you can check the robot's status.

- Green: Normal connection
- Red: Communication failure

Chapter 7 Setting Robots

7.1 Setting the Robot Installation Angles

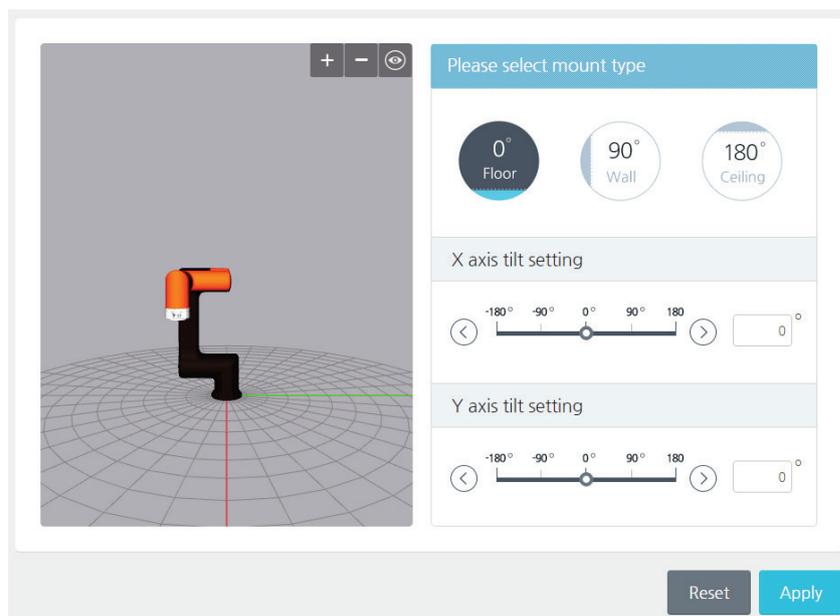
After installing a robot, you must set the robot installation angle.

The purpose of this process is to make sure that actual operation of the robot arm looks same as what we saw in the preview screen and let the controller know the direction of gravity.

Warning

The system is unable to automatically recognize the tilt of the ground where the robot arm's base is installed and the working range, so before operating the robot, you must enter accurate inputs depending on the installation type.

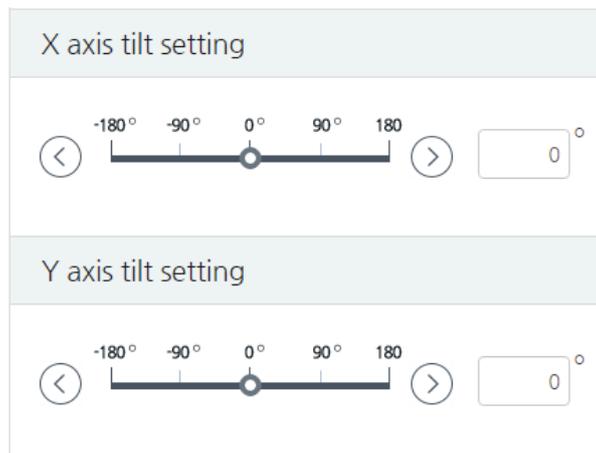
In the main menu, select the  **Robot Setting** > **Mounting** menu.



- Depending on the tilt of the ground where the robot arm's base is installed, set the angle accordingly.
 - If installed on the ground, then press **0°**, if installed on the wall, press **90°**, or if installed on the ceiling, press **180°** to set the tilt value more quickly.



- You can touch the gauge or press the left/right   buttons to fine tune the tilt for the X/Y axis.



-  You can touch the input window to enter the angle value directly.
- Press the **Apply** button to apply the settings to the system.
 - Press the **Cancel** button to revert to the previous settings.

7.2 Setting TCP

When you mount a tool in the robot arm for the first time, you must also set the TCP (Tool Center Point). By setting the tip location/direction and the weight of the mounted tool, you can calculate the robot's motion.

You can set a different TCP for each of multiple robots linked, and if you want to use multiple tools for a single robot, then you can save different settings and retrieve and apply them to a newly replaced tool.

To set the TCP, in the main menu, select  **Robot Setting** > **TCP Setup**.

Warning

If the TCP profile is incorrectly entered, accidents such as collision and jamming may occur while operating the robot and the robot may operate incorrectly while using the direct teaching function. In addition, as the singularity of the robot arm may vary depending on the TCP, the program previously prepared may not work or the robot arm may not operate as expected. Make sure to enter the correct value according to the TCP type before operating the robot.

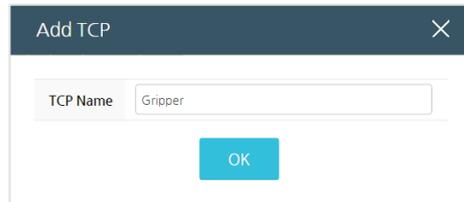
Creating a new TCP profile

3. Press the **Add** button.



4. Enter the new TCP name and press the **OK** button.

- You may enter up to 25 characters. Special characters other than '-' and '_' are not allowed.



5. Enter the TCP information.

Position	Orientation	Center of Gravity <input checked="" type="checkbox"/> Use
X 123	RX 30	CX 10
Y 256	RY 10	CY 20
Z 100	RZ 20	CZ 30
NOTICE Please refer to the coordination in Pic1		
Tool Length 301.11 mm	Payload 1.5 kg	

- Position:** Enter the coordinate values (X, Y, Z) with respect to the center of the cross section of the location where a tool is mounted. The unit is in mm.
- Orientation:** Set the tool direction (Rx, Ry, Rz).
- Center of Gravity:** Set the center of weight for a tool.

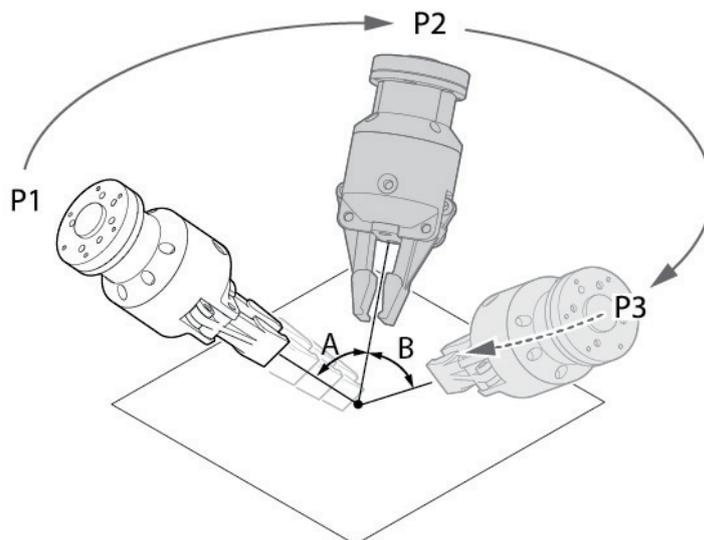
- Check the checkbox to enable the option.
 - If you do not use the option, all the values are set to zero.
 - Min:0, max: 300, The unit is in mm.
 - **Tool Length:** Indicates the tool length.
 - The tool length is automatically calculated but users cannot enter it on their own.
 - **Payload:** Set the tool weight.
 - If not specified, it is automatically set to 0.00.
6. Press the **Save** button.
- If successfully saved, then the **Set Active TCP** button is activated.
7. If you want to apply the newly set TCP profile to the robot, press the **Set Active TCP** button.
- The robot will receive the currently selected TCP profile setting values.

- | | |
|-------------|---|
| Note | <ul style="list-style-type: none">• If no TCP is set in the robot, then the “Empty” TCP is set by default.• Default settings for Empty TCP: Position (0,0,0); Orientation (0,0,0); Center of Gravity (0,0,0) with the Use check box cleared. |
|-------------|---|

Calculating the TCP position

By using the direct teaching function, you can calculate the position of TCP.

To calculate the position of TCP accurately, receive the position data from various angles with respect to one point and analyze them.



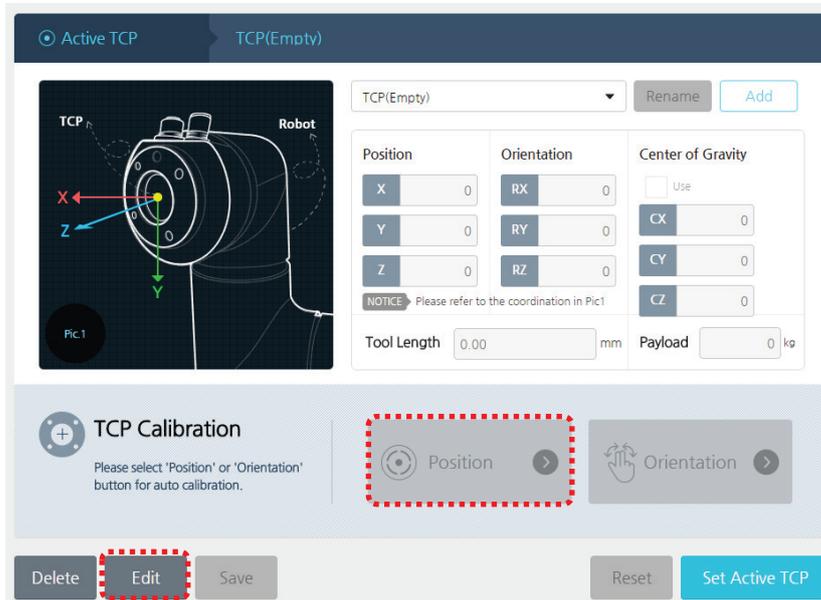
After moving a tool to face a certain point at P1, enter the position data. After that, move to an arbitrary point, P2 and let it face the same point and enter the position data. Proceed this way until you have at least three points. The angle between each point (A, B) should be at least 10°.

Note

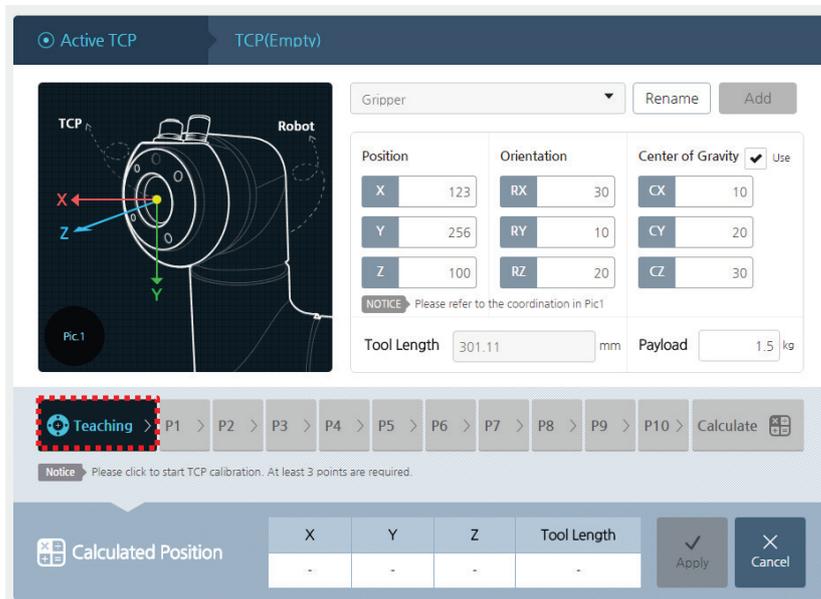
- A tool is not included in the product package.
- The TCP location may not be calculated correctly depending on the tool shape or the TCP movement.
- Since only the TCP location is calculated, you should enter the weight and the center of gravity of the tool before direct teaching.

To calculate the position of TCP, proceed as follows.

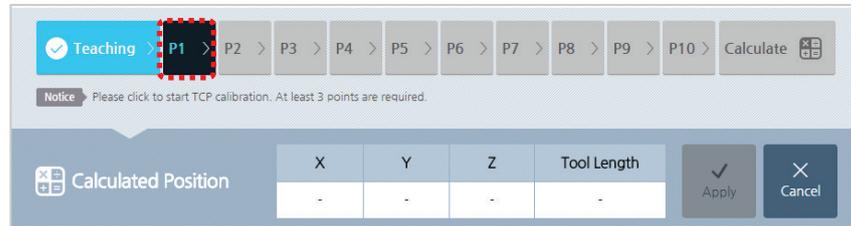
1. After pressing the **Edit** button, press the **Position** button.



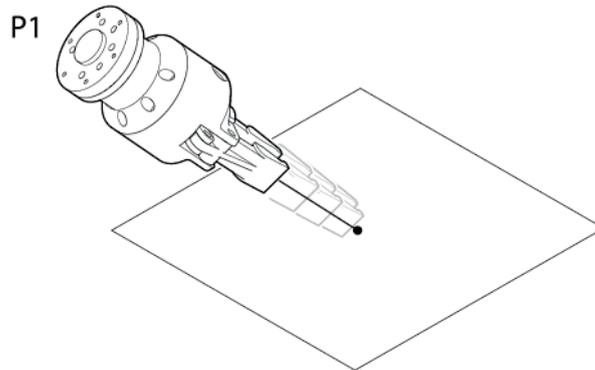
2. Press the **Teaching** button.



3. Press the **P1** button when it is activated.
 - If you press the **P1** button, the **Manual Move** screen will appear.



4. While pressing down the **Direct Teaching** button in the **Manual Move** screen, move the robot arm to place the tip of the tool right at the reference point.
 - For more descriptions on the **Manual Move** screen, refer to 5.3 Manual Move Screen.



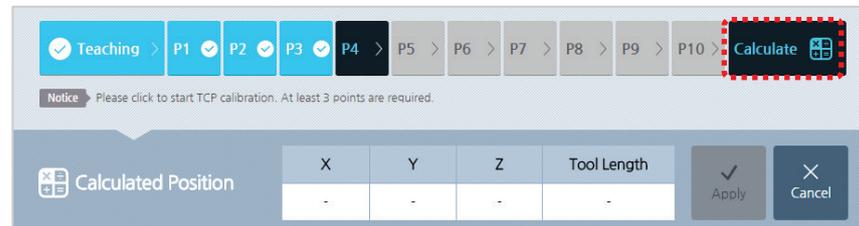
5. In the **Manual Move** screen, press the **OK** button.

6. When the **P2** button is activated, repeat steps 3 through 5.
 - An error will occur if the previously inputted coordinate and the currently inputted coordinate do not differ by more than 10°. The point button with errors will be marked in red. If an error occurs, then you need to change and reset the angle for that point.

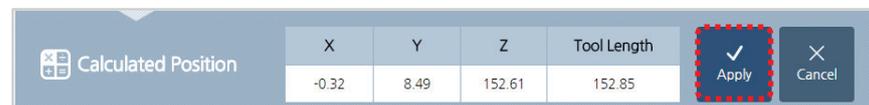


- The more the point data is, the more accurate the calculation result becomes. You can set the maximum 10 points.

7. Press the **Calculate** button.
 - The **Calculate** button will be activated only if the minimum three points are set properly.



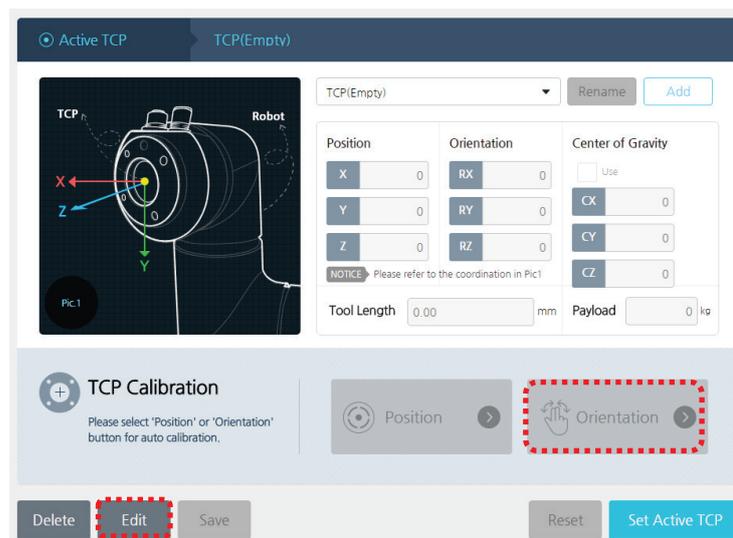
8. Check the calculated position result and press the **Apply** button.
 - Press the **Cancel** button to cancel the task.



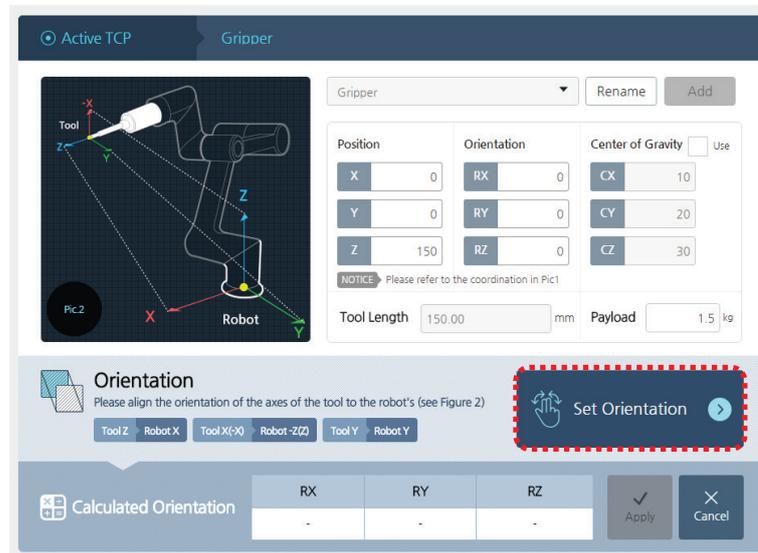
Setting the TCP orientation

You can calculate the orientation of the tool in the tool coordinate system automatically.

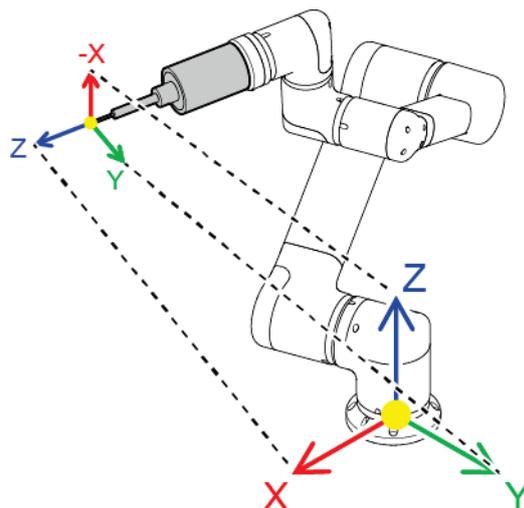
1. Press the **Edit** button and press the **Orientation** button.



2. Press the **Set Orientation** button.
 - If you press the **Set Orientation** button, the **Manual Move** screen will appear.

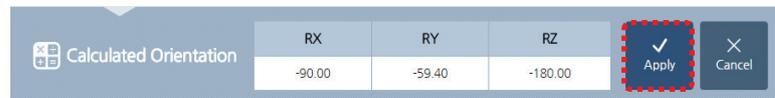


3. In the **Manual Move** screen, use jog control and **Direct Teaching** button to adjust the tool orientation as follows.
 - For more details on the **Manual Move** screen, refer to 5.3 Manual Move Screen.
 - As shown in the figure below, let the Z, -X, and Y axes for the tool face the same direction as the X, Z, and Y axes for the robot base respectively.



4. In the **Manual Move** screen, press the **OK** button.

5. Press the **Apply** button to apply the settings to the system.
 - Press the **Cancel** button to cancel the task.



Changing the TCP profile name

1. Select the TCP setting profile to modify.



2. Press the **Edit** button.
3. Press the **Rename** button.
4. Enter the desired name and press the **OK** button.
 - You can enter the max 25 letters but cannot use special characters.
5. Press the **Save** button.

Editing the TCP profile

After checking the name of TCP profile currently used by the selected robot, and proceed as follows.

1. Select the TCP profile to edit.
2. Press the **Edit** button.
 - You cannot edit the TCP profile currently being used by another robot.
 - You cannot edit an empty profile.
 - While you are editing it, the **Set Active TCP** button is deactivated.
3. When you are finished with modifications, press the **Save** button.
 - When you are finished with saving, the **Set Active TCP** button is activated.
 - If you want to revert the modified settings to the previous setting, then press the **Cancel** button.

Deleting the TCP profile

After checking the name of TCP profile currently used by the selected robot, and proceed as follows.

1. Select the TCP profile to modify.
2. Press the **Delete** button.
 - You cannot delete the TCP profile currently being used by another robot.
 - You cannot delete an empty profile.
3. Press the **OK** button.

7.3 Setting Inputs/Outputs

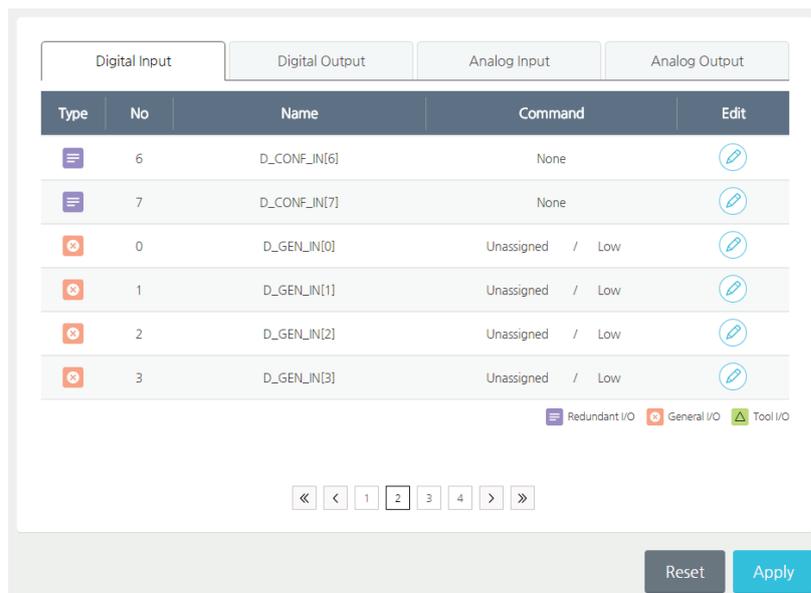
By changing the name of I/O used by the controller, you can make sure they are easily detected and also assign a function to be executed depending on the input/output signals.

In the main menu, select  **Robot Setting > I/O Setup.**

Types of digital I/O

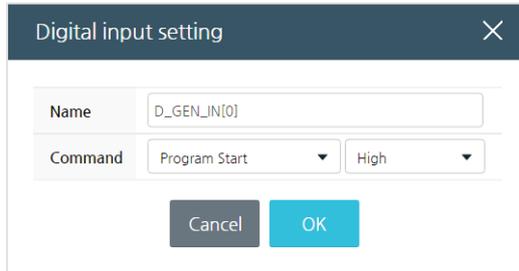
There are three types of digital I/O as follows.

- **Redundant I/O:** Input and output with duplexed connections for the safety purposes.
- **General I/O:** Input and output for general purposes.
- **Tool I/O:** Input and output related to tools.



Editing the digital inputs/outputs settings

Press the **Edit**  icon for the digital I/O item to modify. The following edit window will appear.



Digital input setting		✕
Name	D_GEN_IN[0]	
Command	Program Start	High
Cancel OK		

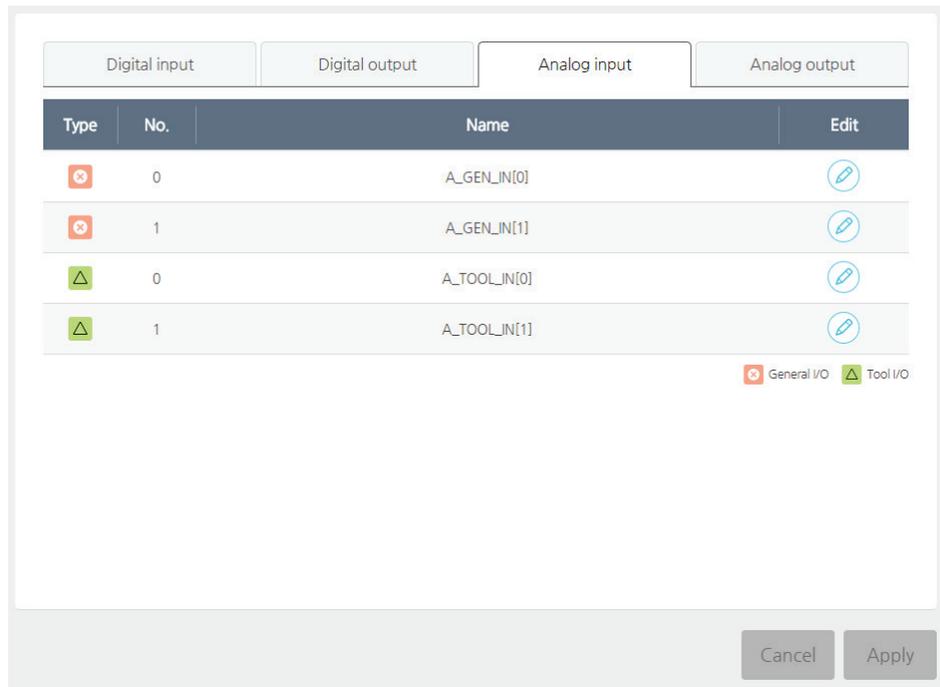
- **Name:** Use a name easy for a user to identify or the existing name.
 - You cannot use the same name already in use by another I/O.
 - Max 15 letters (30 bytes) are allowed. Special characters cannot be used.
- **Command:** Set the command to be executed when the preset value (**Low/High**) is inputted or outputted to the I/O terminal.
 - Unassigned: The I/O is not used.
 - **Program Start:** Start the program.
 - **Program Stop:** Stop the program.
 - **Program Pause:** Pause the program.

Note You can only change the name, if it is a redundant I/O.

Types of analog I/O

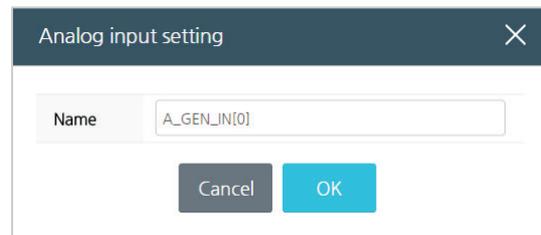
There are three types of analog I/O as follows.

- **General I/O:** Input and output for general purposes.
- **Tool I/O:** Input and output related to tools.



Editing the analog I/O setting

Press the **Edit**  icon of the analog input or output item to modify and the editing window will appear as follows:



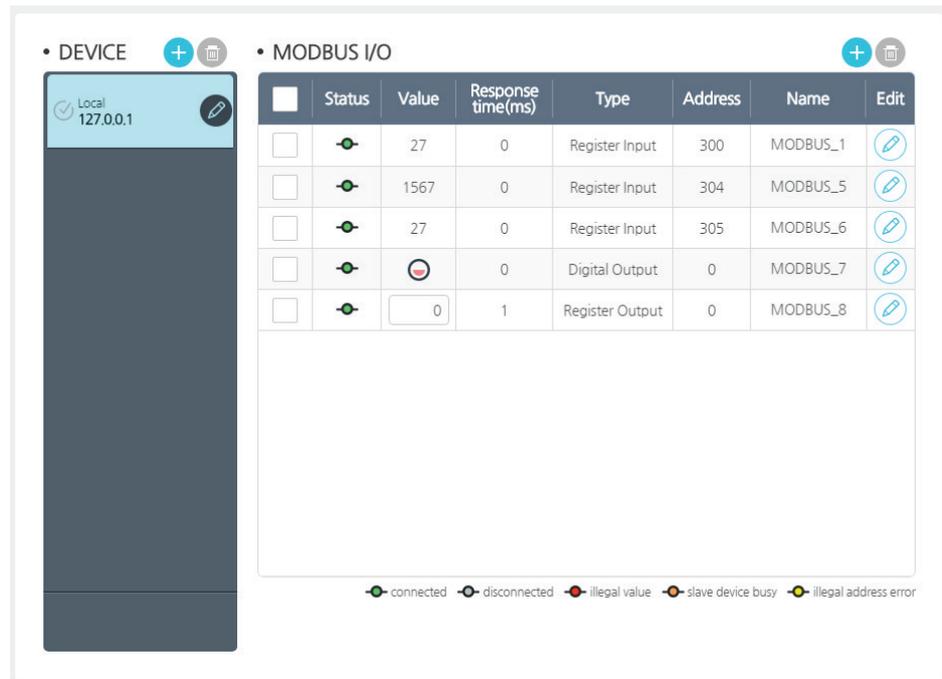
- **Name:** Use a name easy for a user to identify or change the existing name.
 - You cannot use the same name already in use by another I/O.
 - Max 15 letters (30 bytes) are allowed. Special characters cannot be used.

Note For analog I/O, you can only change its name.

7.4 Configuring MODBUS TCP

TCP based MODBUS is supported as an extended interface to communicate with external devices such as PLCs. It is implemented in software and enables to set lots of IOs.

From the main menu, select **Robot Setting** > **MODBUS TCP**.



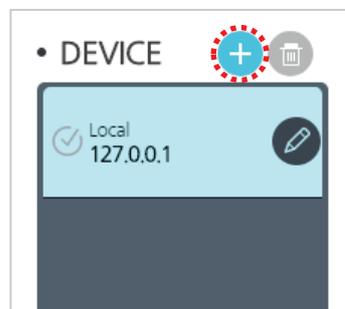
	Status	Value	Response time(ms)	Type	Address	Name	Edit
<input type="checkbox"/>		27	0	Register Input	300	MODBUS_1	
<input type="checkbox"/>		1567	0	Register Input	304	MODBUS_5	
<input type="checkbox"/>		27	0	Register Input	305	MODBUS_6	
<input type="checkbox"/>			0	Digital Output	0	MODBUS_7	
<input type="checkbox"/>		<input type="text" value="0"/>	1	Register Output	0	MODBUS_8	

connected
 disconnected
 illegal value
 slave device busy
 illegal address error

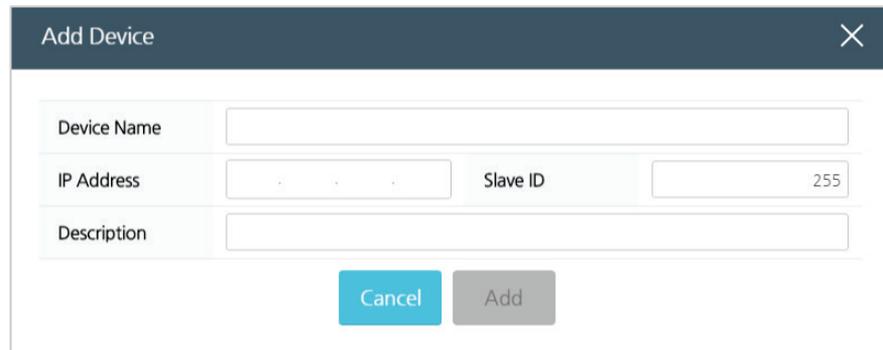
Registering devices

To use MODBUS I/O, register a device to share I/O information with.

1. Press the Add button.



2. Enter following information in the **Add Device** screen and press the **Add** button.
 - **Device Name:** Enter the device name to be displayed on the screen.
 - **IP Address:** Enter the IP address of the device.
 - **Slave ID:** Enter the slave ID of the device. Its input range is 0 to 255 in the 3-digit integer form.
 - **Description:** You may enter the description for the device. You can enter up to 25 characters.



The screenshot shows a dialog box titled "Add Device" with a close button (X) in the top right corner. The dialog contains the following fields and buttons:

- Device Name:** A text input field.
- IP Address:** A text input field with a dotted pattern (.) for each digit.
- Slave ID:** A text input field with the number "255" displayed inside, and a range of "0 to 255" indicated above the field.
- Description:** A text input field.
- Buttons:** "Cancel" (blue) and "Add" (grey) buttons are located at the bottom center.

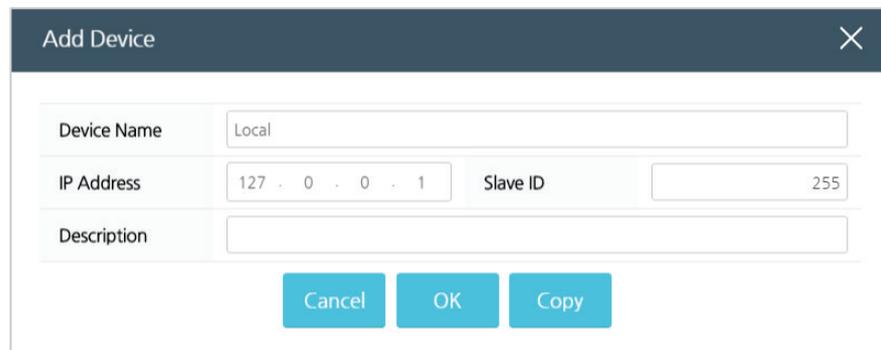
Editing/copying the device settings

You can modify settings for a device previously registered or copy the device settings to use as settings for a new device. When copying, I/O information of the device is also copied.

1. Press the Edit  button from the list of registered devices.

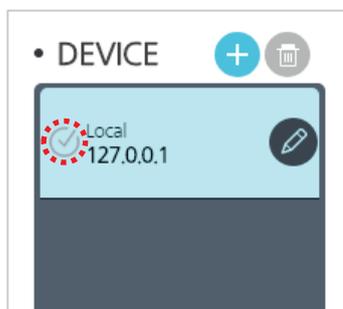


2. Modify items you want to change and press the **OK** button. Or, press the **Copy** button if you want to copy the device settings to use as settings for a new device.
 - When you press the **Copy** button, the settings of the device currently selected and information of I/Os under the device are also copied and added to the list. The name of the newly created device is the name of the device copied from with '_number' added.

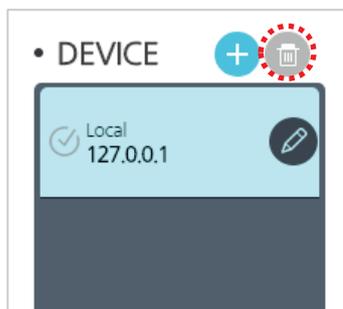
A screenshot of a dialog box titled 'Add Device' with a close button (X) in the top right corner. The dialog contains several input fields: 'Device Name' with the value 'Local', 'IP Address' with the value '127 . 0 . 0 . 1', 'Slave ID' with the value '255', and an empty 'Description' field. At the bottom of the dialog, there are three buttons: 'Cancel', 'OK', and 'Copy'.

Deleting a device in the list

1. Select a device to delete from the list.
 - Check the check box for the device.



2. Press the Delete  button, and then press the **OK** button.
 - When you delete a device, I/Os for the device will be deleted as well.



Registering I/O

After you registered a device, you must set an I/O or I/Os for it. The I/O(s) added is(are) used to read a certain value from the device or to send HCR status values to it.

The type of I/Os for the MODBUS are as follows:

- **Digital Input:** Reads digital values (High/Low) from a device.
- **Digital Output:** Sends digital values (High/Low) to a device.
- **Register Input:** Reads 2-byte values (0–65535) from a device.
- **Register Output:** Sends 2-byte values (0–65535) to a device.

1. Select a device to add an I/O to from the device list.
 - When a device is selected, I/Os currently added to it are displayed.
2. Press the Add  button.

• DEVICE		• MODBUS I/O							
Local 127.0.0.1		<input type="checkbox"/>	Status	Value	Response time(ms)	Type	Address	Name	Edit
		<input type="checkbox"/>		27	0	Register Input	300	MODBUS_1	
		<input type="checkbox"/>		1567	0	Register Input	304	MODBUS_5	
		<input type="checkbox"/>		27	0	Register Input	305	MODBUS_6	

3. Enter information of the I/O and press the **OK** button.
 - **Name:** Enter the user identifiable name of the I/O.
 - **Signal Address:** Enter the pre-defined address to be used for the I/O.
 - **Type:** Select Digital I/O or Register I/O.
 - **Frequency:** Select the frequency of data transmission for the I/O. Available frequency values are 0, 1, 2, 5 and 10.

MODBUS Setting
✕

Name

Signal Address

Type

• Advanced Option

Frequency[Hz]

Cancel

OK

Note You can use I/Os when you make a program. Especially, you can use register-type I/Os as variables in a program.

Viewing the communication status

After an I/O is registered, you can view its communication status.

<input type="checkbox"/>	Status	Value	Response time(ms)	Type	Address	Name	Edit
<input checked="" type="checkbox"/>		27	0	Register Input	300	MODBUS_1	
<input checked="" type="checkbox"/>		1567	0	Register Input	304	MODBUS_5	
<input type="checkbox"/>		27	0	Register Input	305	MODBUS_6	
<input type="checkbox"/>			0	Digital Output	0	MODBUS_7	
<input type="checkbox"/>		<input type="text" value="0"/>	1	Register Output	0	MODBUS_8	

- Normal
- Unable to connect
- Input value error
- Device response delay
- Address error

Viewing and setting the I/O values

After an I/O is registered, you can view or set its value.

<input type="checkbox"/>	Status	Value	Response time(ms)	Type	Address	Name	Edit
<input checked="" type="checkbox"/>		27	0	Register Input	300	MODBUS_1	
<input checked="" type="checkbox"/>		1567	0	Register Input	304	MODBUS_5	
<input type="checkbox"/>		27	0	Register Input	305	MODBUS_6	
<input type="checkbox"/>			0	Digital Output	0	MODBUS_7	
<input type="checkbox"/>		<input type="text" value="0"/>	1	Register Output	0	MODBUS_8	

- Digital Input: Indicates an icon for the digital value (High/Low) currently being input.
 - : High
 - : Low

- Digital Output: Indicates an icon for the digital value (High/Low) currently being output. Press the value to change it.
 - : High
 - : Low
- Register Input: Indicates the value currently read from the device.
- Register Output: Indicates the value being currently sent to the device. Press the value to change it.

Editing I/O settings

1. Press the Edit  button of an I/O to be modified from the I/O list.
2. Modify the settings and press the **OK** button.

Note It is not allowed to change the I/O type. To change the type, you must delete the I/O setting and add it again.

Deleting I/O

1. Select an I/O to delete from the I/O list.

• MODBUS I/O  

<input type="checkbox"/>	Status	Value	Response time(ms)	Type	Address	Name	Edit
<input checked="" type="checkbox"/>		27	0	Register Input	300	MODBUS_1	
<input checked="" type="checkbox"/>		1567	0	Register Input	304	MODBUS_5	
<input type="checkbox"/>		27	0	Register Input	305	MODBUS_6	
<input type="checkbox"/>			0	Digital Output	0	MODBUS_7	
<input type="checkbox"/>		<input type="text" value="0"/>	1	Register Output	0	MODBUS_8	

2. Press the Delete  icon.

• MODBUS I/O  

<input type="checkbox"/>	Status	Value	Response time(ms)	Type	Address	Name	Edit
<input checked="" type="checkbox"/>		27	0	Register Input	300	MODBUS_1	
<input checked="" type="checkbox"/>		1567	0	Register Input	304	MODBUS_5	
<input type="checkbox"/>		27	0	Register Input	305	MODBUS_6	
<input type="checkbox"/>			0	Digital Output	0	MODBUS_7	
<input type="checkbox"/>		<input type="text" value="0"/>	1	Register Output	0	MODBUS_8	

Chapter 8 Safety Settings

After configuring the installation settings, you must configure the safety settings to protect users against the dangerous situation that can arise during robot operation.

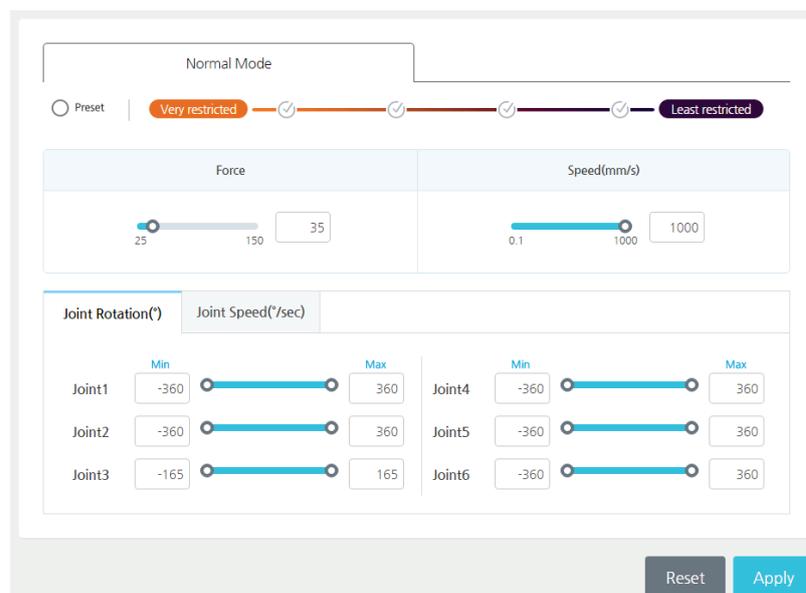
Warning

Make sure to check safety settings immediately after the robot is installed. In addition, all of the functions for safety settings must be regularly checked.

8.1 Limiting Robot Movement

To guarantee the user's safety while interacting with the robot, you can make sure that the angle and speed of robot joint does not exceed a certain limit.

Press  **Safety Setting** > **Motion Limit** in the main menu.



Default settings

Depending on the limitation on each item, four sets of default settings are provided.

If you want to use the default setting, check **Preset** and select one out of the four choices.



Manual setting method

If you want to set each item on your own, you can use the adjustment bar to change the value while **Preset** is not checked. Or, after pressing the input box, you can enter your own inputs.

Force		Speed(mm/s)	
25	150	35	
0.1	1000	1000	

Joint Rotation(°)		Joint Speed(°/sec)			
Joint1	Min: -360	Max: 360	Joint4	Min: -360	Max: 360
Joint2	Min: -360	Max: 360	Joint5	Min: -360	Max: 360
Joint3	Min: -165	Max: 165	Joint6	Min: -360	Max: 360

There are four different ways to limit the robot's movement.

- **Force:** You can limit the max force that the robot(TCP) is exerting to the outside.
- **Speed:** You can limit the max speed for the TCP's linear movement.
- **Joint Rotation:** You can limit the angle of each joint.
- **Joint Speed:** You can limit the speed of each joint.

Press the **Cancel** button to revert the settings newly changed by a user in the current tab (general mode or deceleration mode) to the previous value.

When the settings are complete, press the **Apply** button to apply it to the robot.

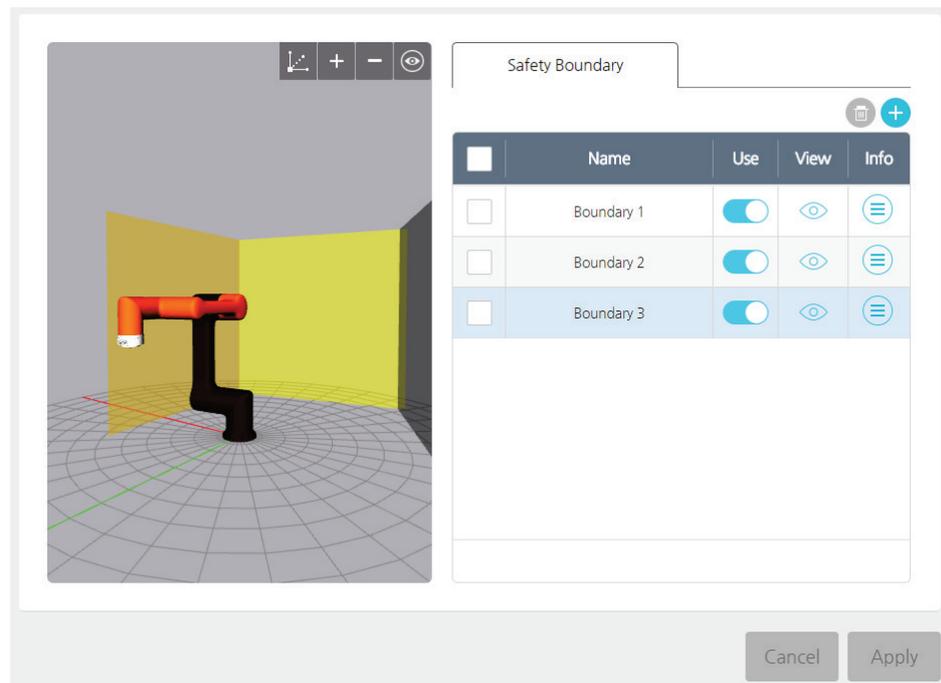
! **Caution**

- The joint speed cannot be limited with the **Speed** option. You can limit the joint speed only with the options in the **Joint Speed** tab.
- If the temperature of the operating environment for the robot arm is not greater than 10 °C during the initial start, collision detection may occur due to the limited force. If such problem occurs, increase the limit value of **Force** sufficiently, operate it at a low speed for about 30 to 60 minutes for preheating, and lower the **Force** value to use it.

8.2 Setting Safety Boundaries

To improve user safety, you can build virtual fences around the robot to prevent the robotic arm or tool from moving beyond the boundary of these virtual fences.

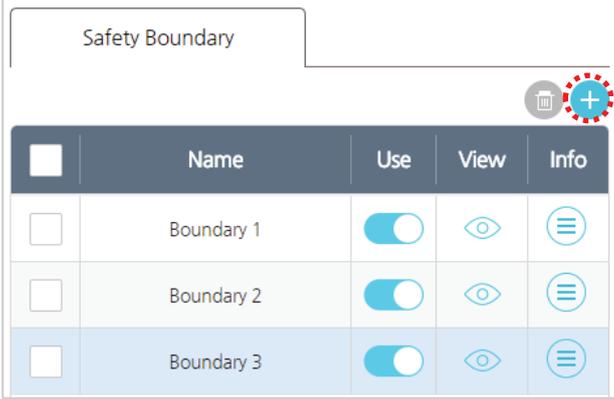
Press  **Safety Setting** > **Safety Boundary** in the main menu.



Adding safety boundary planes

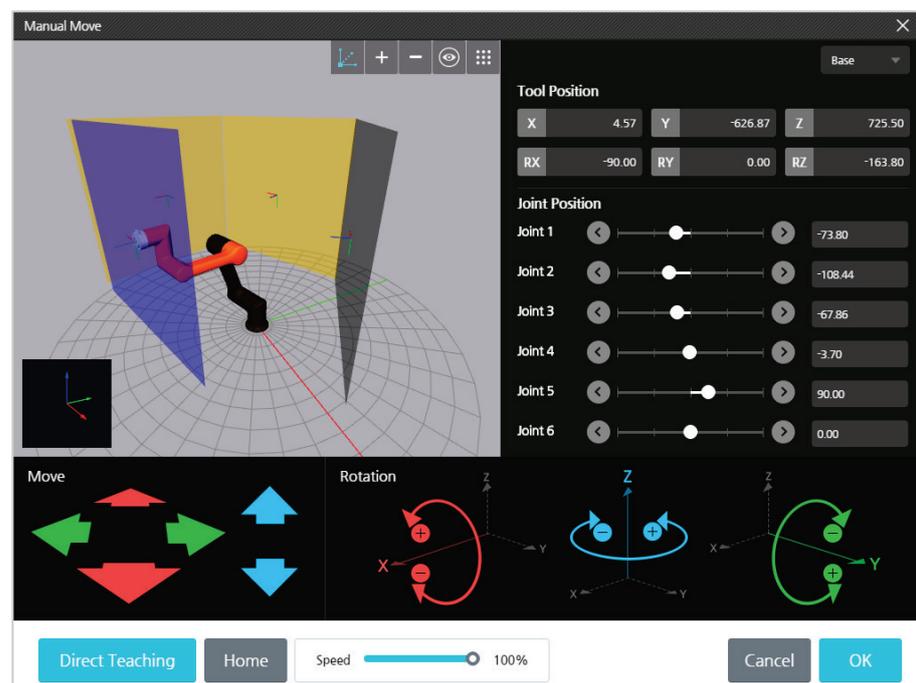
After adding multiple safety boundary planes, if necessary, you can select one of them and use it.

- To add a boundary plane, press the Add  button.
 - If you press the Add  button, the **Manual Move** screen will appear.



	Name	Use	View	Info
<input type="checkbox"/>	Boundary 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	Boundary 2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	Boundary 3	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

- In the **Manual Move** screen, use jog control and **Direct Teaching** button to set the boundary position.



- For more details on the **Manual Move** screen, refer to 5.3 Manual Move Screen.
- Your safety boundary will be created in a location that is separated from the center axis of the flange as much as the TCP length set in the TCP.

3. To save the settings, press the **OK** button.

Viewing safety boundary planes

Press the icon in the **View** column to hide or unhide the safety boundary plane in the preview screen.

<input type="checkbox"/>	Name	Use	View	Info
<input type="checkbox"/>	Boundary 1	<input checked="" type="checkbox"/>		
<input type="checkbox"/>	Boundary 2	<input checked="" type="checkbox"/>		
<input type="checkbox"/>	Boundary 3	<input checked="" type="checkbox"/>		

- : To display in the preview screen.
- : Not to display in the preview screen.

Press the **Info** icon to check the coordinates for the safety boundary.

Boundary Info			
Coordinate	X	Y	Z
Point	431.927	269.533	725.5
Direction	-0.622	-0.783	0

OK

- **Point:** Indicates the center of the 3-D where the center of the safety boundary is located.
- **Direction:** Indicates the direction(vector) for the border plane that can indicate a collision with the safety border in the controller. (Blue Z-axis on the screen)

Applying safety boundaries

1. Activate the boundary for use.

<input type="checkbox"/>	Name	Use	View	Info
<input type="checkbox"/>	Boundary 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Boundary 2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Boundary 3	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- : To use
- : Not to use

2. Press the **Apply** button.

- Press the **Cancel** button to cancel the modifications and revert to the previous settings.

Note If there are eight or more safety boundary planes in the list, press the up/down button to scroll.

Changing the name of safety boundaries

If you add a safety boundary, it will save as "Boundary" and a number by default.

1. Press the name of boundary to modify.

<input type="checkbox"/>	Name	Use	View	Info
<input type="checkbox"/>	Boundary 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Boundary 2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	Boundary 3	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2. Enter the desired name and press the **OK** button.

Boundary Name Edit
✕

Name

Deleting safety boundary settings

1. Select the safety boundary to delete.

<input type="checkbox"/>	Name	Use	View	Info
<input checked="" type="checkbox"/>	Boundary 1	<input checked="" type="checkbox"/>		
<input checked="" type="checkbox"/>	Boundary 2	<input checked="" type="checkbox"/>		
<input type="checkbox"/>	Boundary 3	<input type="checkbox"/>		

2. Press the Delete button.

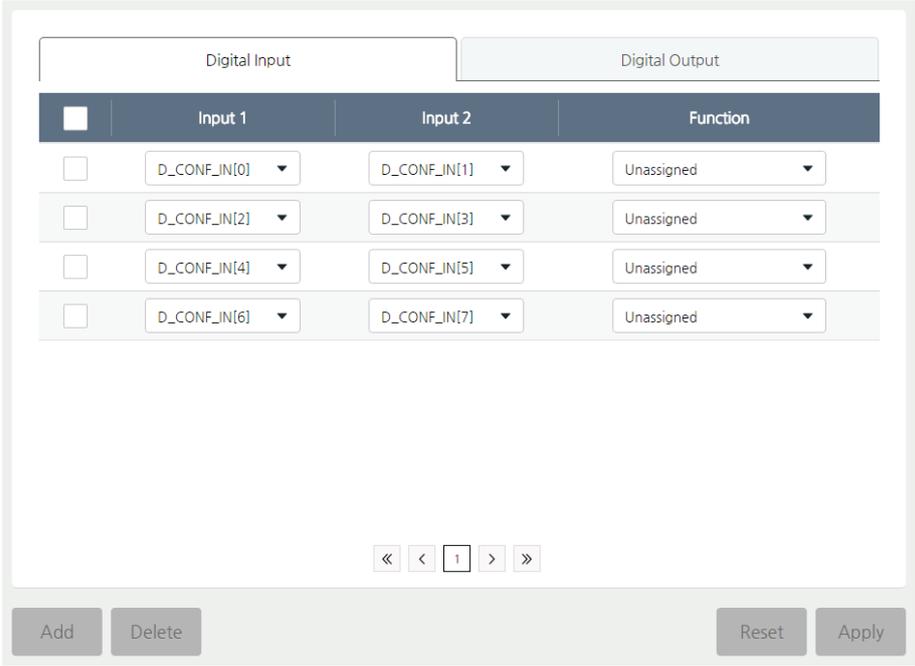
<input type="checkbox"/>	Name	Use	View	Info
<input checked="" type="checkbox"/>	Boundary 1	<input checked="" type="checkbox"/>		
<input checked="" type="checkbox"/>	Boundary 2	<input checked="" type="checkbox"/>		
<input type="checkbox"/>	Boundary 3	<input type="checkbox"/>		

3. Press the **OK** button.

8.3 Setting Redundant I/O

To guarantee the safety of the I/O terminal or input/output the important data, you can opt for using a redundant I/O, not a single I/O. If you set the redundant I/O, you are no longer checking a single I/O value. Instead, the two designated inputs or outputs check the High or Low signals to determine validity of values.

In the main menu, press  **Safety Setting** > **Redundant I/O**.



	Input 1	Input 2	Function
<input type="checkbox"/>	D_CONF_IN[0]	D_CONF_IN[1]	Unassigned
<input type="checkbox"/>	D_CONF_IN[2]	D_CONF_IN[3]	Unassigned
<input type="checkbox"/>	D_CONF_IN[4]	D_CONF_IN[5]	Unassigned
<input type="checkbox"/>	D_CONF_IN[6]	D_CONF_IN[7]	Unassigned

« < 1 > »

Add Delete Reset Apply

There are two tabs – digital input and digital output. Select the tab to set and proceed as follows.

- In case of digital inputs, the function will operate if the input is high or low.
 - In case of digital outputs, the high or low signal is sent for the assigned function.
1. Press the **Add** button.
 2. Select an I/O terminal to be used as redundant I/O.

3. Set the function to be assigned.
 - You can assign the following functions to digital inputs.
 - **Unassigned:** The function is not assigned.
 - **Emergency Stop:** If the two designated inputs are all Low (0) and the actual emergency stop button is released, it operates as if the emergency stop button is released; and if any of the inputs is High (1), it operates as if the emergency button is pressed.
 - You can assign the following functions to digital outputs.
 - **Unassigned:** The function is not assigned.
 - **Emergency Stop:** If the two designated IOs are in the emergency stop state, Low (0) is output. Otherwise, High (1) is output. When a physical emergency stop button is pressed, it operates even when the designated IO is in the emergency stop state.
 - **Robot Moving:** If the robot moves, the designated output terminal outputs Low (0). Otherwise, it outputs High (1).
 - **Robot Not Stopping:** The designated output terminal outputs High (1) till the time point when the stop command is performed after the stop command is ordered to the robot. Otherwise it outputs Low (0).
4. Press the **Apply** button.
 - Press the **Cancel** button to revert to the previous settings.

Note User can name each I/O on their own. For more details, refer to [7.3 Setting Inputs/Outputs](#).

Chapter 9 Programming

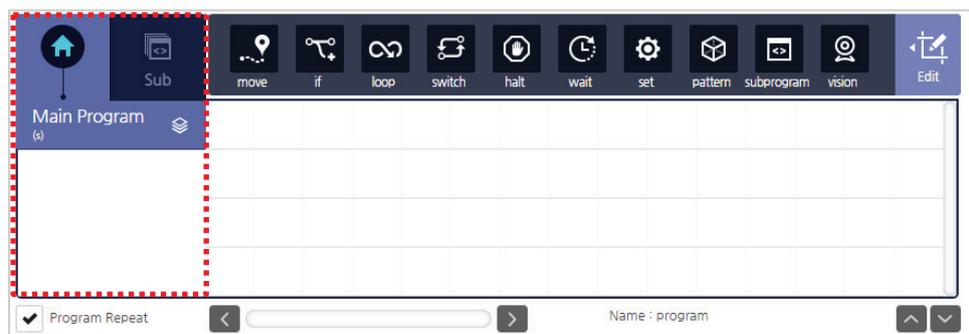
You need to program the movement ahead of time if you want your robot to perform a certain task.

To program your robot, select  **Programming** in the main menu.

9.1 How to Use Commands

Selecting a flowchart

There are two types of flow charts – main and sub.



- **Main Program:** In this screen, you can input or modify the main program.
- **Sub Program:** In the main program, you can call multiple sub programs for use. Press the **Sub** tab to move to the screen where you can create or edit a sub program. For more details about the sub program, refer to [9.14 Using a Sub Program](#).

Type of commands

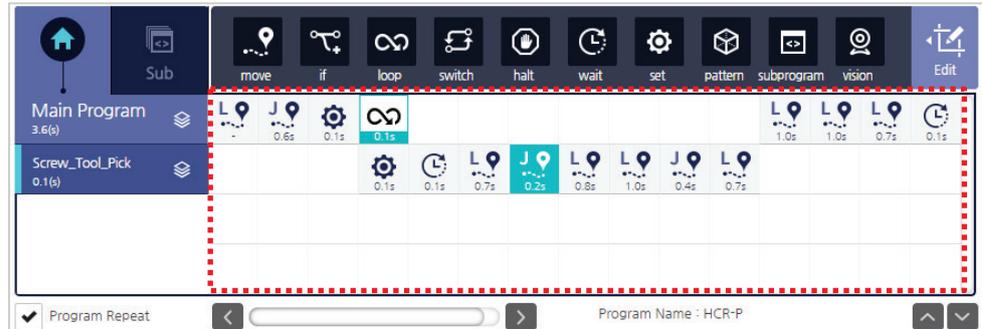
You can use the following commands in your programming – Move, If, Loop, Switch, Halt, Wait, Set, Loop, Pattern, Sub Program, and Vision.



	Move	Set the point that the TCP will move to. For more details, refer to 9.7 Move command .
	If	Branch the commands based on the conditions. For more details, refer to 9.8 IF Command .
	Loop	Repeat a specific command. For more details, refer to 9.9 LOOP Command .
	Switch	Branch the command for each case of the designated variable. For more details, refer to 9.10 SWITCH Command .
	Halt	Terminate the program.
	Wait	Tell the robot to wait until the condition entered by the user is met. For more details, refer to 9.11 WAIT Command .
	Set	Create output signals, variables and TCP profile. For more details, refer to 9.12 SET Command .
	Pattern	Tell the robot to move according to the predefined pattern. For more details, refer to 9.13 PATTERN Command .
	Sub Program	Call a sub program. For more details, refer to 9.14 Using a Sub Program .
	Vision	Use a vision equipment to scan an object. For more details, refer to 9.15 VISION Command .

Entering commands

Each time you press a command, it is inputted in the timeline one by one.



- After programming is complete, select the checkbox for **Program Repeat** to repeat the entire program continuously.
- If it overflows to the next screen due to too many commands in the flow line, you can press the up/down  or left/right  buttons to scroll.

Changing command names

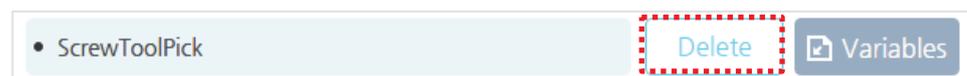
Each command offers an option necessary for execution. The same command yields a different result depending on the option setting, so you can designate a different name for each command.

After entering a command in the timeline, press the command name to modify the name.



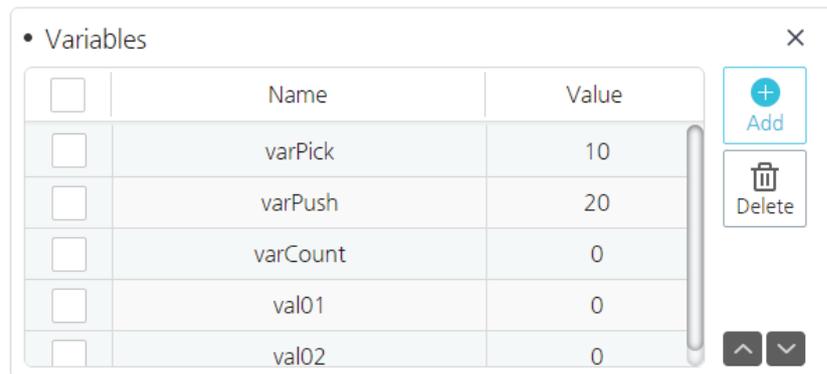
Deleting commands

1. Select a command to delete in the timeline.
2. Press the **Delete** button.



9.2 Setting Variables

At the right top of each command, press the **Variables** button to set variables to be used in programming.



Adding variables

Press the **Add** button. If you press the **Add** button, the default name and value (0) will be automatically entered.

Modifying variables

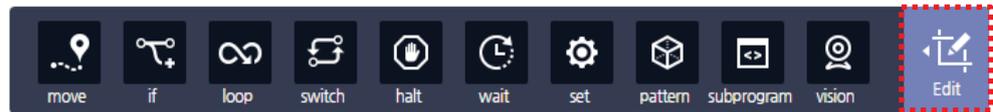
1. Press the field if you need to change the variable name or value.
2. Change it to the desired name or value and press the **OK** button.
 - The max length of variable is limited to 10 letters.
 - For a variable value, you can only enter a number. The range is from -999999999 to 999999999.

Deleting variables

1. Check the checkbox for the variable to delete.
2. Press the **Delete** button and press the **OK** button.

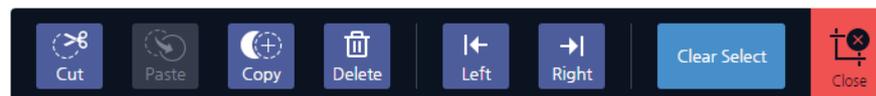
9.3 Editing programs

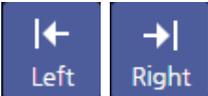
If you want to change the order or structure of commands entered in the timeline, then press the **Edit** menu button at the end of the command list.



Note You can also press the command in the timeline for more than three seconds to open the **Edit** menu.

Overview of edit menu

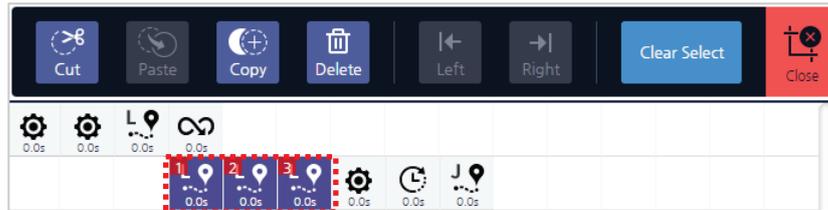


	Cut	Cut the selected command. You can crop a command to another location.
	Copy	Copy the selected command. You can copy a command to another location.
	Paste	Paste the cropped or copied command to the selected location.
	Delete	Delete the selected command from the program.
	Left or Right	Move the selected command to the left or right in the timeline.
	Clear Select	Cancel the selection of the command.
	Select Mode	Cancel the cut or copy command and return to the Select Mode.
	Close	Close the program editing mode and return to the program screen.

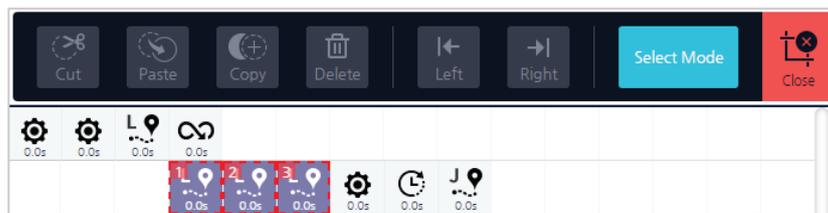
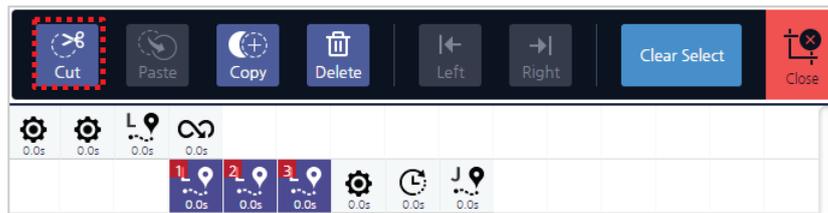
Example of program editing

In this example, you can cut a command entered in the timeline and paste it onto another location.

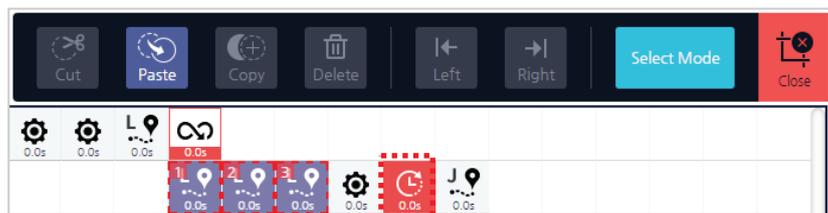
1. Select a program command to be pasted onto another location.
 - The red number marked when a command is selected indicates the order of pasting.



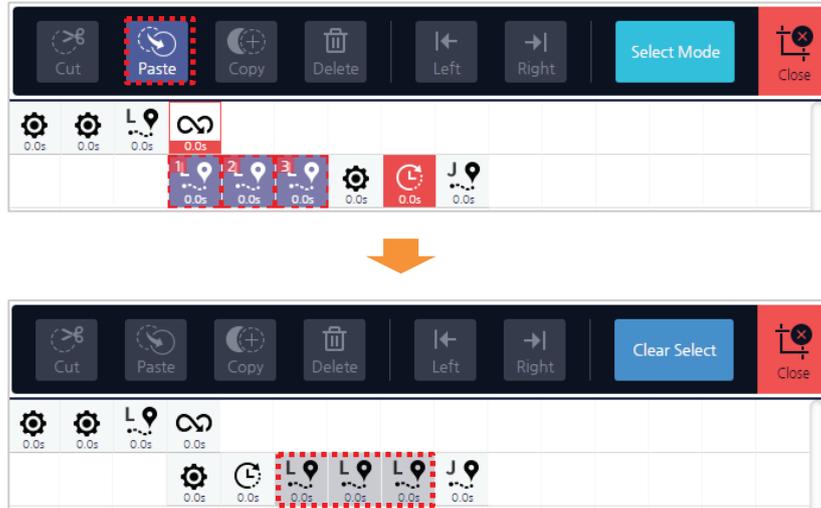
2. In the edit menu, press the **Cut** button.
 - After pressing the **Cut** (or **Copy**) button, the **Select Mode** button will be activated, so that you can cancel the edit command and return to the Select Mode again.



3. Select a location to paste it to.
 - Space between commands cannot be selected, so you must select the command right before the location of pasting.
 - Once a location is selected, the **Paste** button in the **Edit** menu will be activated.

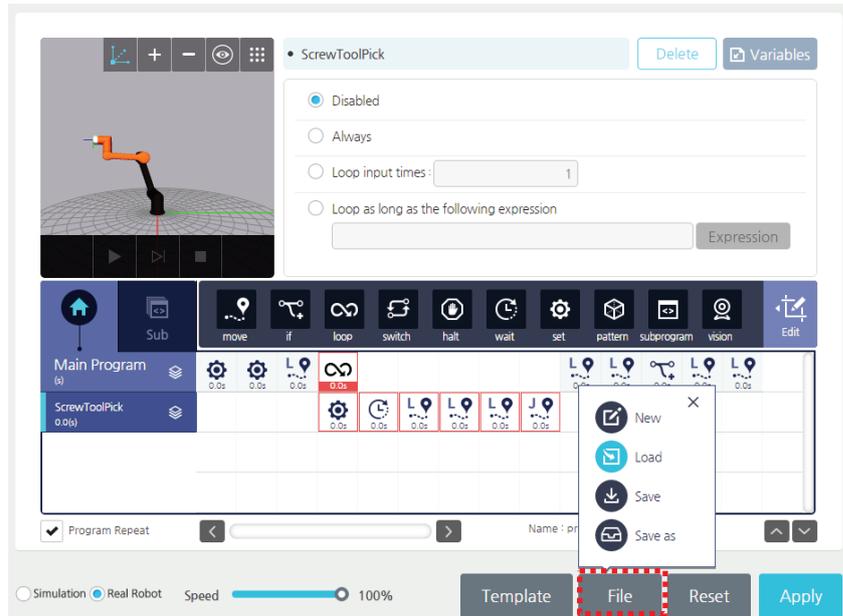


4. Press the **Paste** button.



9.4 Managing a Program

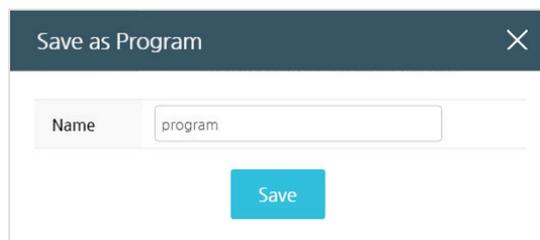
At the bottom of the programming window, press the **File** button to save, load or delete the program.



Saving a program

1. To save the completed program, select **File** > **Save** at the bottom of the screen.
2. Enter the program name and press the **OK** button.
 - Only if the program is newly saved or saved with a new name, the name input window will appear.

If you want to save the program with a different name, press **Save as** and enter the name and then press the **Save** button.



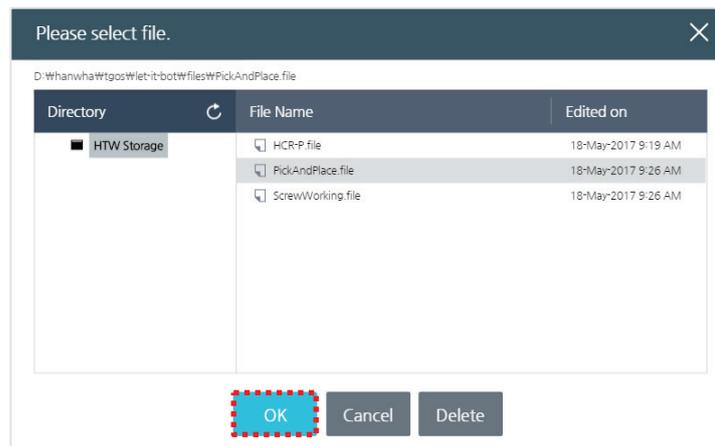
Making a new program

If you want to make a new program, then select **File** > **New** at the bottom of the screen.

Note Enter the program name when you apply or save a program.

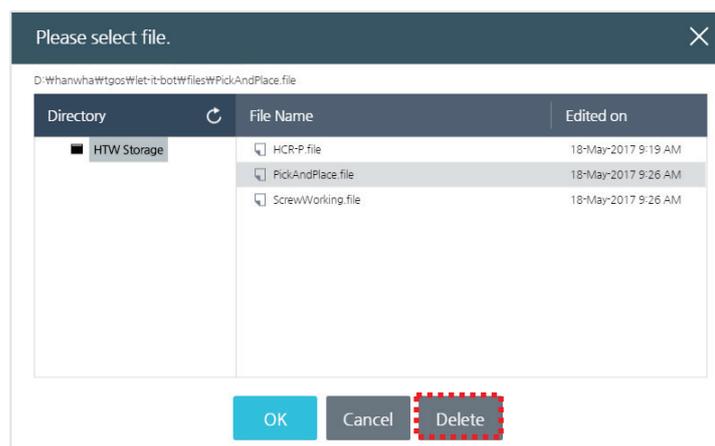
Loading a program

1. To load the saved program, select **File** > **Load** at the bottom of the screen.
2. Select a program to load and press the **OK** button.



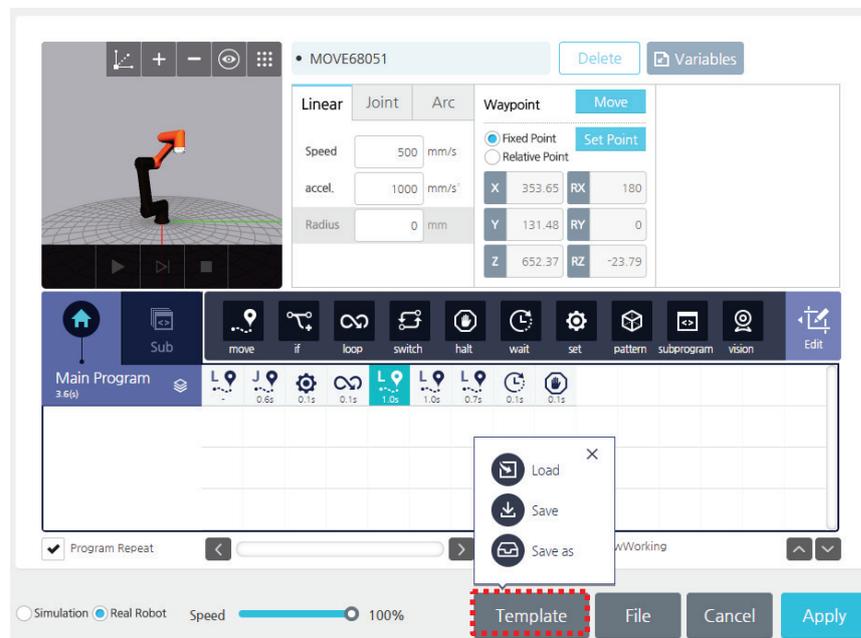
Deleting a program

1. To delete the saved program, select **File** > **Load** at the bottom of the screen.
2. Select a program to delete and press the **Delete** button.



9.5 Using Templates

You can save the prepared program structure as a template. Only the entire program structure is saved but the option for each command is not saved.



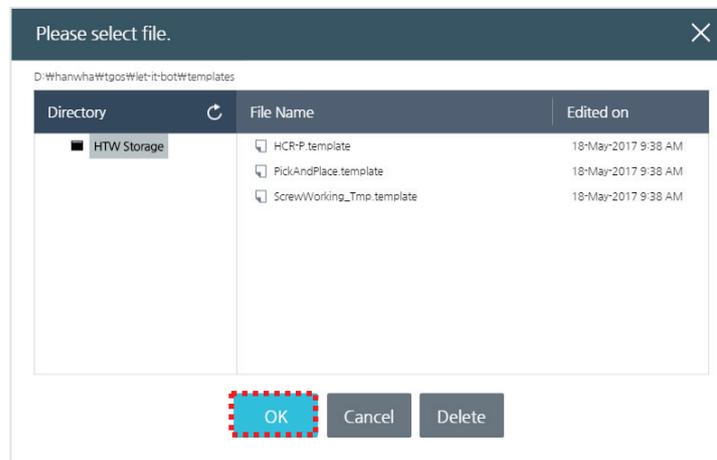
Saving as a template

To save the completed program as a template, select **Template** > **Save** at the bottom of the screen.

If you want to save the template with a different name, press **Save as** and enter the name and then press the **Save** button.

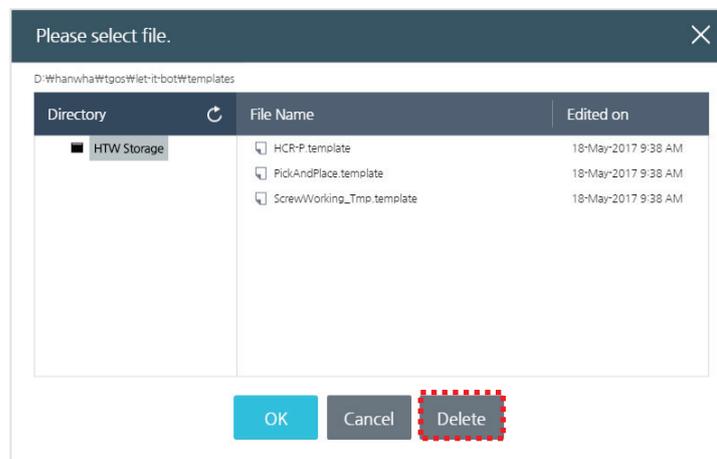
Loading a template

1. To load the saved template, select **Template** > **Load** at the bottom of the screen.
2. Select a template to load and press the **OK** button.



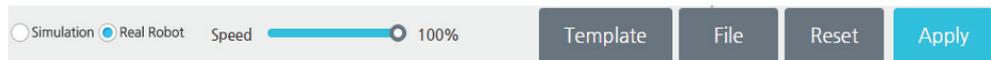
Deleting a template

1. To delete the saved template, select **Template** > **Load** at the bottom of the screen.
2. Select a template to delete and press the **Delete** button.



9.6 Applying programs

Before applying the program results to the robot or actually using it, it is necessary to do a simulation.



If you want to link the program to an actual robot or check it in previews, press the **Apply** button. To revert it to the previous settings before the changes are made, press the **Reset** button.

- To check it in preview, select **Simulation**.
- To link it to a real robot, select **Real Robot**.
- The entire program speed can be adjusted by using the **Speed** slide bar.

9.7 Move command

The command is used to move the robot arm by designating the destination and the movement method.

Selecting a movement method

There are three ways to move as follows and you can set the tool speed and acceleration for each method.

- **Linear**: A tool moves linearly between the starting point and the end point. To make the tool movement path a straight line, each joint tends to move in a more complex way.
 - **Speed**: 0.1 mm/s ~ 1000 mm/s
 - **accel.** (Acceleration): 1 mm/s² ~ 2500 mm/s²
 - **Radius**: If you enter the radius value, you need to set up the Middle point and the End waypoint additionally. For more details, refer to [Radius of Linear on page 104](#)

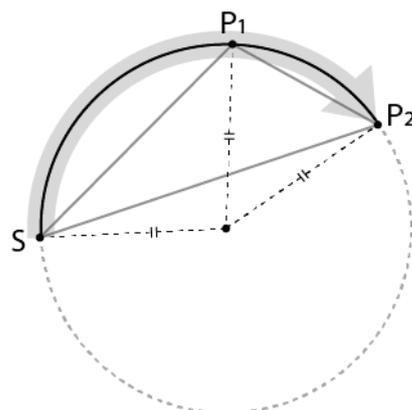
Linear	Joint	Arc	Waypoint	Move
Speed	<input type="text" value="500"/>	mm/s	<input checked="" type="radio"/> Fixed Point	<input type="button" value="Set Point"/>
accel.	<input type="text" value="1000"/>	mm/s ²	<input type="radio"/> Relative Point	
Radius	<input type="text" value="0"/>	mm	X 353.65	RX 180
			Y 131.48	RY 0
			Z 652.37	RZ -23.79

- **Joint:** The tool movement path between the starting point and the end point is ignored but the movement of joint is minimized, instead.
 - **Speed:** 0.01 deg/s ~ 180 deg/s
 - **accel.** (Acceleration): 0.1 deg/s² ~ 360 deg/s²

Linear	Joint	Arc	Waypoint		Move	
Speed	<input type="text" value="50"/>	deg/s	<input checked="" type="radio"/> Fixed Point		Set Point	
accel.	<input type="text" value="100"/>	deg/s ²	X	490	RX	-180
			Y	-170.5	RY	0
			Z	443	RZ	-90

- **Arc:** A tool moves along the circumscribed circle whose center is the circumcenter of a triangle formed by the starting point(S) and the two points (P₁, P₂).
 - **Speed:** 0.1 mm/s ~ 1000 mm/s
 - **accel.** (Acceleration): 1 mm/s² ~ 2500 mm/s²

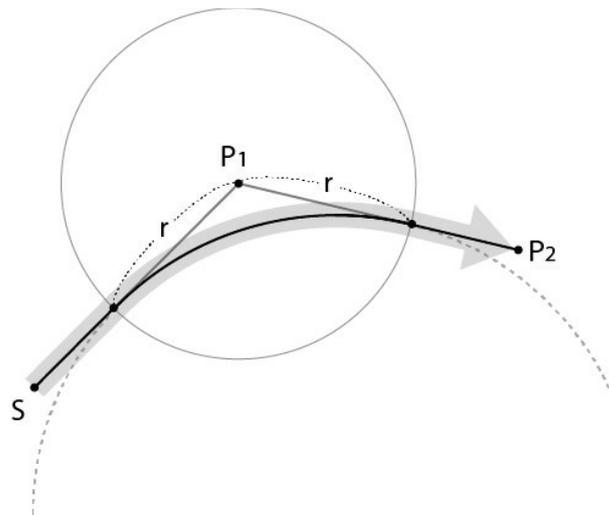
Linear	Joint	Arc	Middle Point		Move	End Waypoint		Move		
Speed	<input type="text" value="250"/>	mm/s	<input checked="" type="radio"/> Fixed Point		Set Point	<input checked="" type="radio"/> Fixed Point		Set Point		
accel.	<input type="text" value="500"/>	mm/s ²	<input type="radio"/> Relative			<input type="radio"/> Relative				
			X	490	RX	180	X	490	RX	-180
			Y	-34.25	RY	0	Y	-170.5	RY	0
			Z	302.37	RZ	-90	Z	443	RZ	-90



Note The TCP coordinates of the last position held by the robot are the coordinates of the starting point.

Radius of Linear

When the robot starts at point S and moves to P₁ before it arrives at point P₂, the linear motion is interrupted because the robot stops momentarily at point P₁. For smooth movements, enter the radius value greater than 0. Then, the robot will make a smooth curve movement before P₁ and it will continue to move naturally without ceasing. In this case, the path of the moving tool follows the arc formed by the two points where segment SP₁ and segment P₁P₂ intersect circle P₁ with a radius r, where r is the input radius.



- The radius value has max two decimal places.
- The minimum radius is zero. If you set the radius to zero, then its path is not a curve.
- The maximum radius is the minimum of the distance, SP₁ and the distance, P₁P₂.

Setting the coordinates for movement

Linear	Joint	Arc	Middle Point	Move	End Waypoint	Move
Speed	500	mm/s	<input checked="" type="radio"/> Fixed Point	Set Point	<input checked="" type="radio"/> Fixed Point	Set Point
accel.	1000	mm/s ²	<input type="radio"/> Relative		<input type="radio"/> Relative	
Radius	10	mm	X	490	RX	180
			Y	-34.25	RY	0
			Z	302.37	RZ	-90
			X	490	RX	-180
			Y	-170.5	RY	0
			Z	443	RZ	-90

To set the movement coordinates, you can either use an absolute value that is fixed in the space or a relative value that is relative to the previous location.

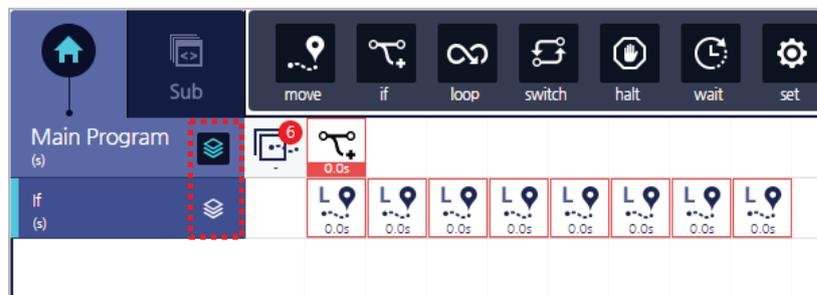
- **Fixed Point:** The 3D coordinate is received from the robot's coordinate system and used as the movement coordinate.
 - Press the **Set Point** button to launch the **Manual Move** screen. For more details about the **Manual Move** screen, refer to [5.3 Manual Move Screen](#).
- **Relative:** You can set the movement coordinate with respect to the previous location.
 - Range of coordinate (X, Y, Z) inputs: $-1500 \sim 1500$
 - Range of rotary angle (RX, RY, RZ) inputs: $-360^\circ \sim 360^\circ$

Note The inputted coordinate is examined in the control software whether it indicates an area where the robot can move to. Even if you entered an input within the range, an error can occur when the area is prohibited by the safety setting or physical restrictions.

After setting the coordinates, press the **Move** button to move the robot arm to the coordinate where a tool is set.

Displaying as groups

If the move commands are repeated two or more times, then you can use one icon to indicate them all.



In the flow chart, press the group  button, then they will be grouped as one. The number of commands in a group will be indicated by a number at the right top of the group icon.



9.8 IF Command

Use the command to initiate different commands depending on the condition.



Enter the condition in an IF statement.



- Press the text box to launch the formula keypad. For more details about the formula keypad, refer to [5.4 Virtual Keypad](#).
- If you use an IF command, an if statement will be created below the main flow.
- Select the **Use Else** checkbox to create an else statement below the if statement.

Main Flow 1.3(s)			
if 0.1(s)			
Else 0.1(s)			

- Add Else IF to add another condition under the if statement.
 - To add Else IF under IF, then press the **+ Else IF** button.
 - To delete the Else IF statement you added, select the checkbox for the Else IF statement, and press the **Delete** button.

9.9 LOOP Command

Use the command to repeatedly execute a series of commands.

- **Disabled:** Do not use a LOOP command.
- **Always:** Repeat execution.
- **Loop input times:** Repeat as many times as the entered number.
 - By default, it is set to one.
 - Max: 1,000,000
- **Loop as long as the following expression:** Repeat execution until the condition entered by the user is met.

9.10 SWITCH Command

Use the command to execute a different command depending on each specific case. An IF command is executed after assessing all the conditions branching to Else IF, but a SWITCH command is executed immediately by finding the corresponding case, thus it is much faster than execution of an IF command.

- Using the drop-down menu next to **Switch**, select a variable.
 - For more details about the variable setting, refer to 9.2 Setting Variables.

- Enter a value corresponding to each case.

- To add a Case, press the **+ Case** button.
- To delete the Case you added, select the checkbox for the Case and then press the **Delete** button.

9.11 WAIT Command

Instruct the robot to wait for a certain period.

- Disabled:** Do not use a Wait command.
- Waiting time:** Enter the duration of waiting time.
- Digital:** Wait until a digital signal is inputted to a specific digital input terminal.
 - For a digital signal, you can choose either of low or high.
- Analog:** Waits until the condition of the value set to a specific analog input terminal is met. On analog setting, whether to use the current (A) or the voltage (V) is determined by the unit set under the Monitoring menu.
- Input expression:** Wait until the conditional expression set by the user is met. You can enter the conditional expression indicating the waiting condition on your own.

9.12 SET Command

You can set a digital or analog output value or assign a specific value to a variable or even change the TCP profile currently in use.

<input checked="" type="radio"/> Disabled		
<input type="radio"/> Digital	D_CONF_OUT[0]	Low
<input type="radio"/> Analog	A_GEN_OUT[1]	0.004 A
<input type="radio"/> Variable	Val267211	12
<input type="radio"/> TCP	TCP(Empty)	

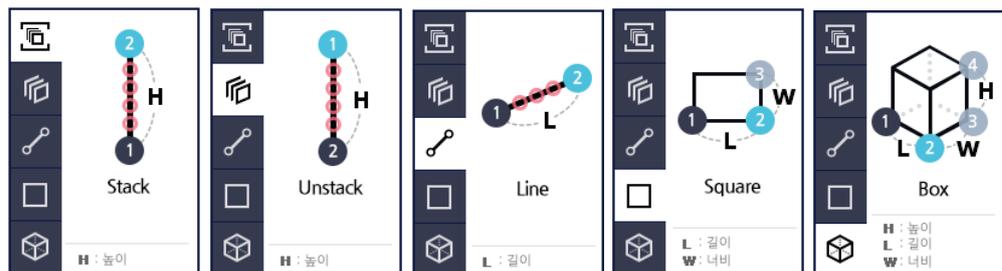
- **Disabled:** Do not use a SET command.
- **Digital:** Set a specific digital output value.
- **Analog:** Set a specific analog output value. The output unit is based on the analog unit that you set in the Monitoring menu.
- **Variable:** Assigns a specific value to a variable added to the variable list and to a register item set in the MODBUS TCP menu. Press the text box next to the variable selection menu to launch the expression keypad. For more details about the expression keypad, refer to [5.4 Virtual Keypad](#).
- **TCP:** Switch to another TCP profile.

9.13 PATTERN Command

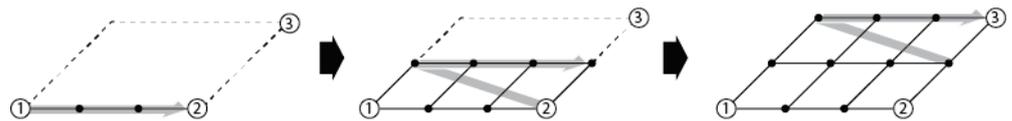
If the robot repeatedly executes the same task along the same path, you can define it as a pattern by using this command.

Pattern types

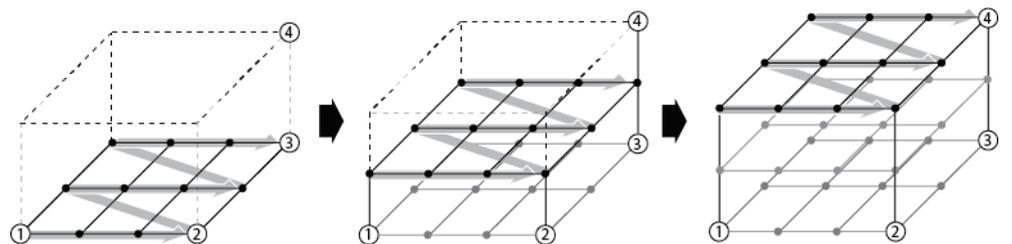
There exist the following five types of patterns.



- Stack pattern: In this pattern, the robot stacks objects while vertically moving with certain intervals.
- Unstack pattern: In this pattern, the robot unstacks objects while vertically moving with certain intervals.
- Line pattern: In this pattern, the robot repeats the same task while moving along the straight line with certain intervals.
- Square pattern: In this pattern, the robot repeats the same task while moving along the straight line and in the direction perpendicular to it.



- Box pattern: In this pattern, the robot also repeats the same task vertically which it performs in a square pattern.



Setting the pattern coordinates

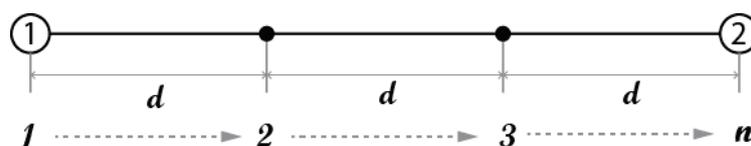
After selecting a pattern to use, set the coordinates that determine the type of pattern. The following image illustrates a box pattern.



- Select the coordinates to set by starting with number 1.
 - Select the number for the sample image or press the list of the **pattern location coordinates**.
- Press the **Set Point** button.
 - Press the **Set Point** button to launch the **Manual Move** screen. For more details about the **Manual Move** screen, refer to [5.3 Manual Move Screen](#).
 - On the **Manual Move** screen, enter the final coordinate values.
- Proceed with point setting until you reach the last number.

Setting repeat counts

For every pattern, you need to set repeat counts between the starting point and the end point on each side.

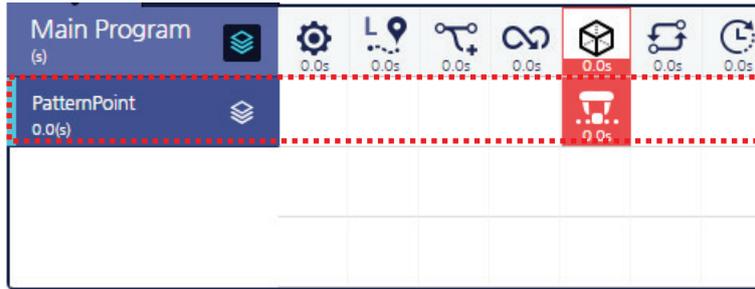


- Count (n):** the number of repeated movements on a side
- Interval (d):** the distance that the robot moved each time

- Note**
- If you do not enter the coordinates, the repeat count or the interval will not be displayed.
 - When the repeat counts are set, the intervals are automatically calculated and displayed. The intervals are not editable.

Setting pattern points

If you enter a pattern command in the timeline, then the line to set the pattern point and the  icon will be added. When each pattern repeats, if you immediately move to the next destination, then you can get interfered by an obstacle. So, by using the pattern point setting, you can avoid collisions with them and smoothly continue with the next pattern task by selecting a desirable tool path.



Press the pattern point  icon to launch the following setting screen.

Pattern Point Move Set Point

Speed mm/s

accel. mm/s²

X	490	Y	-170.5	Z	443
RX	-180	RY	0	RZ	-90

Description
Robot will be moved as relative move based on pattern point.

The options for the pattern point settings are the same as the linear movement options in the move command section, and additionally you can insert move commands before and after the pattern point to adjust the tool path.

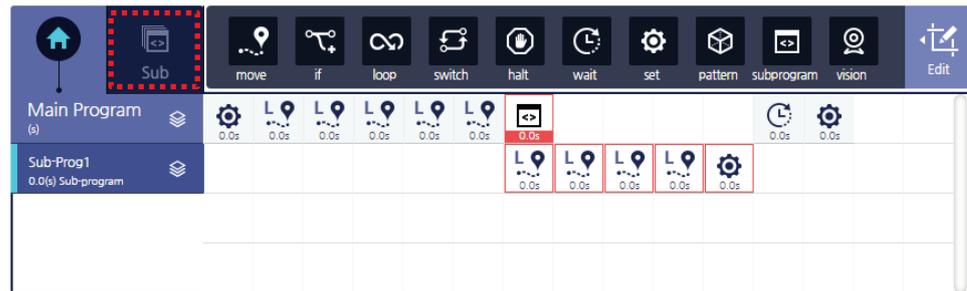
Note Only a linear type of move command can be used before and after a pattern point.

9.14 Using a Sub Program

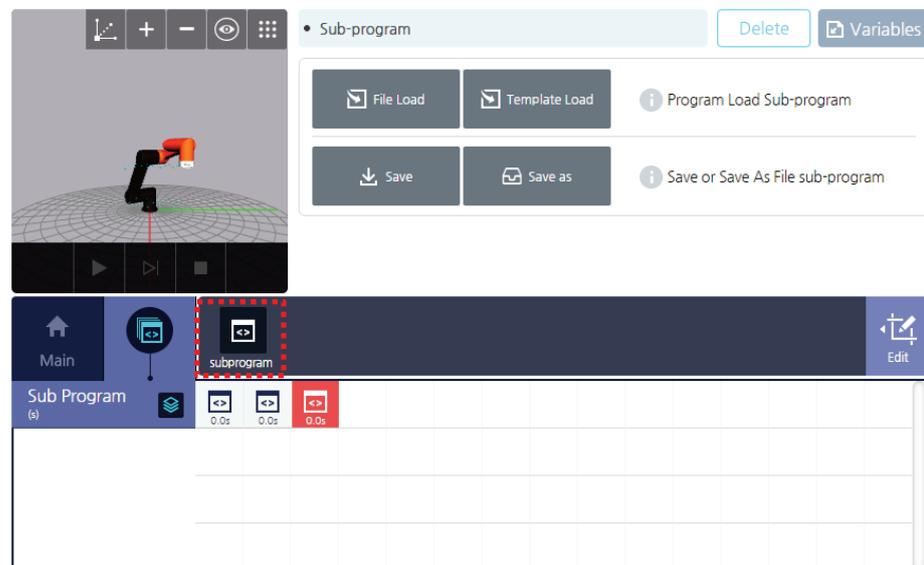
In the main program, you can call multiple sub programs for use.

Making a sub program

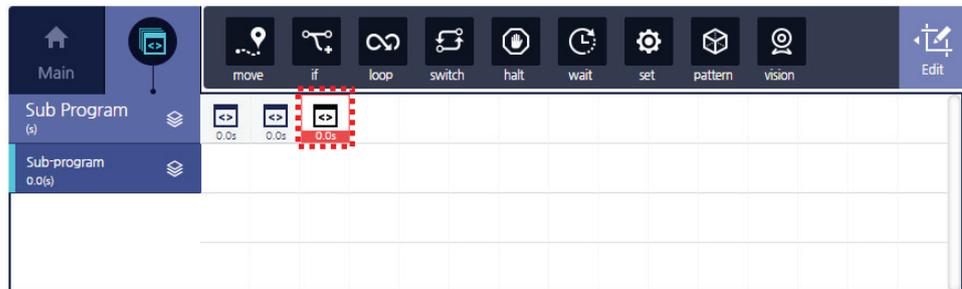
1. In the flow chart, press the **Sub** tab.



2. Press the **subprogram** button in the command menu of the **Sub** tab.
 - Once the **subprogram** button is pressed, a new sub program will be created.
 - The name of the sub program is automatically generated.
 - To delete the sub program, press the **Delete** button at the top or press the **Edit > Delete** button.

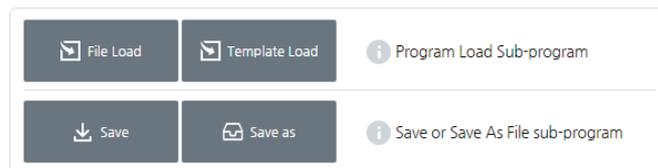


3. After pressing the sub program, create a program that will be used as a sub program.
 - Once the sub program is pressed, available commands will appear in the command menu and a time line will be created, so that you can prepare a program.



Saving and loading a sub program

After creating a sub program in the **Sub** tab, you can save it as a file or load the sub program or template.



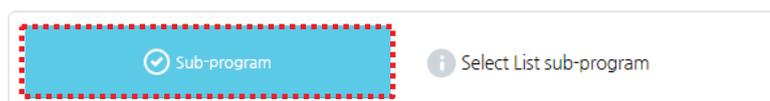
Entering a sub program

After creating and saving a sub program in the **Sub** tab, proceed as follows to use it in the main program.

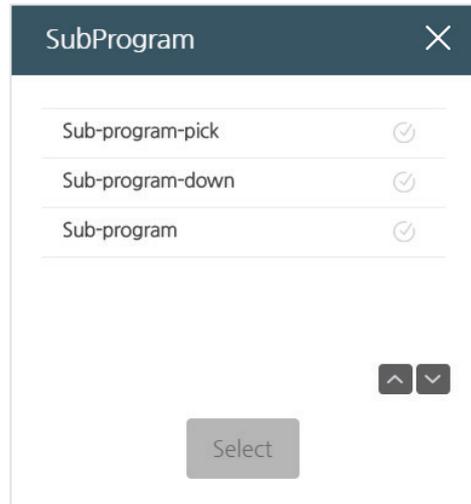
1. Enter the **subprogram** command in the main program.



2. Press the **Sub-program** button.
 - After selecting a sub program, the sub program name will be displayed on the button.

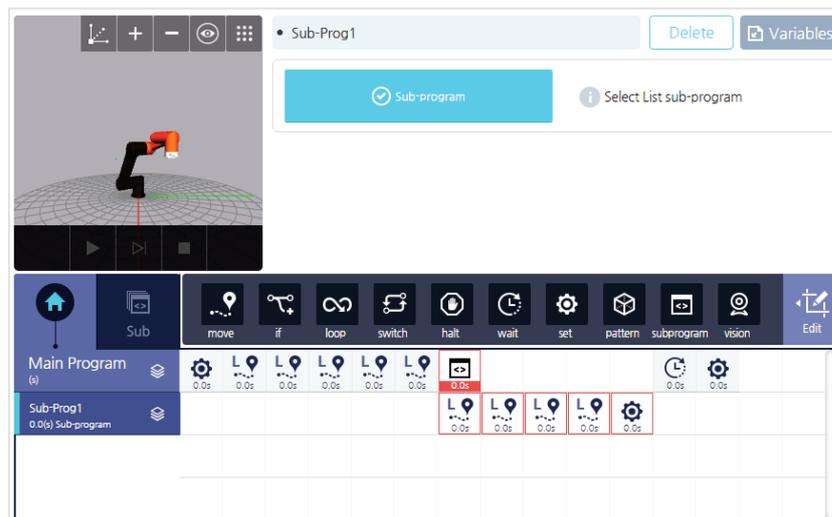


3. Select a sub program for use and press the **Select** button.



Once a sub program is selected, the **subprogram** command will be added to the timeline as shown below, and a sub program line will be added at the bottom to indicate the content of the sub program.

In the main program, you can also modify the content of the sub program. Since the sub programs in the main and sub tabs are linked to each other, modification made in one of them will be also reflected in the other.



Note

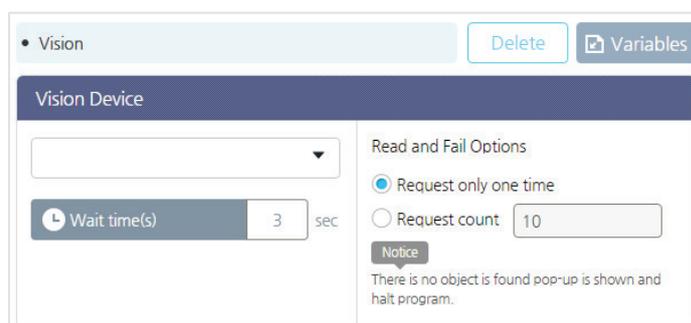
In the main program, you can modify the content of sub program but you cannot save it. If you want to save modifications made for the sub program in the main program, you must save it in the Sub tab.

9.15 VISION Command

You can communicate with a vision equipment by using the vision data configured in the **Device Setting** menu.

Setting basic options

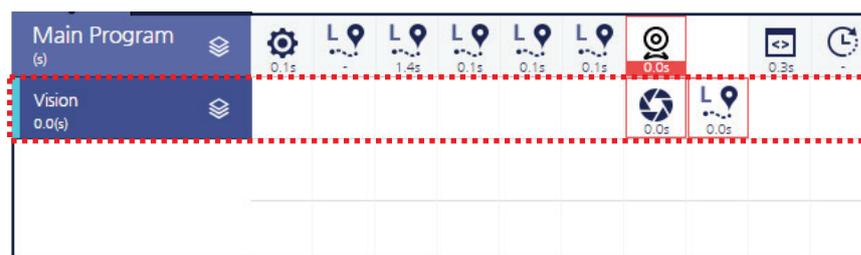
Press the drop-down menu to select a desired vision equipment and set the waiting time and the data receiving option.



- **Wait time(s):** After a vision equipment moves to the recording location, it may require some waiting time until the robot arm's position is stabilized. (No waiting time is required depending on the robot speed.) Set the waiting time for responses after requesting data from a vision equipment.
 - Default: 3 sec
 - Input range: 1 ~ 10
- **Read and Fail Options:** You can set the number of data requests in case data receiving is unstable.
 - **Request only one time:** Request data only once. (Default)
 - **Request count:** The input range is 2 ~ 10.

Setting the movement speed

Once you have entered the **vision** command, a vision capture point  and a moving point will be created below the vision command.



You can set the vision capture point  on the following screen.

Move Speed	
Speed	<input type="text" value="500"/> mm/s
accel.	<input type="text" value="1000"/> mm/s ²
<p>Description</p> <p>Please set the speed and acceleration to move to the capture location.</p>	

You can set the movement speed/acceleration for a vision camera attached in the robot to move to the recording location.

- The same input range of speed/acceleration is used as in linear movement.
- Since the **scan position** is configured in the **Device Setting** menu, you do not need to set it in the vision command again.

Setting the movement location

After a vision equipment arrives at the location, you can use an additional Move command to adjust the Z-axis for the TCP. You can use a Move command under a Vision command as follows.

Move Speed	Set Move Point(Z)
Speed	<input type="text" value="50"/> mm/s
accel.	<input type="text" value="100"/> mm/s ²
	<input type="text" value="474.25"/> mm <input type="button" value="Set Point"/>
	<p>Description</p> <p>You don't need to input X, Y and RX, RY, RZ data because these data will be received from Vision camera. Please input height data.</p>

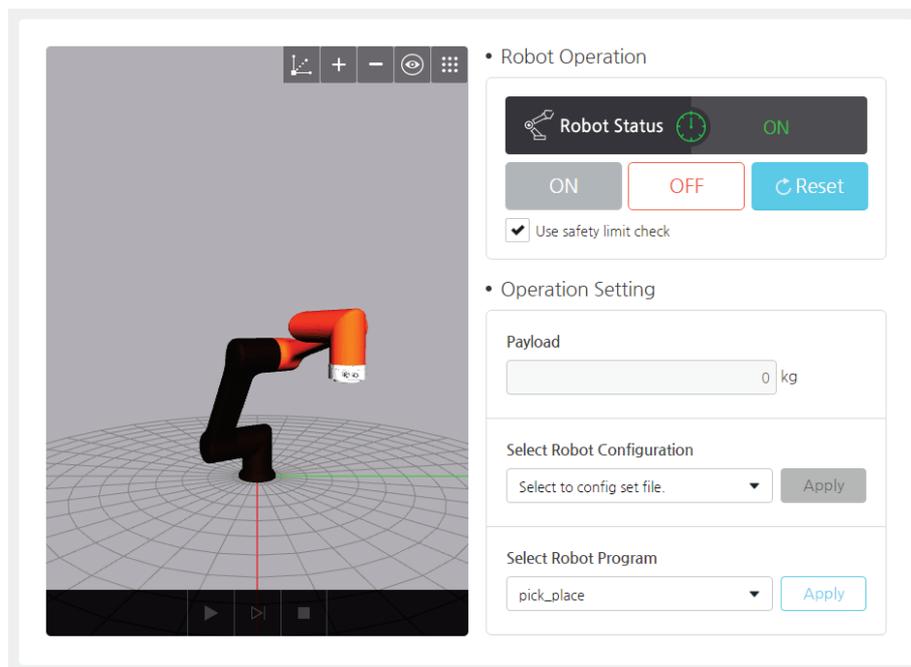
- The same input range of speed/acceleration is used as in linear movement.
- The X, Y coordinates and the RX, RY, RZ coordinates used are received from a vision equipment and only the Z coordinate can be set to user's preference.

Note If you want to use a tool such as a gripper, you will need to input the **set** command additionally.

Chapter 10 Starting the Robot

Starting the robot means that you are powering up the servo motor and get ready for its operation.

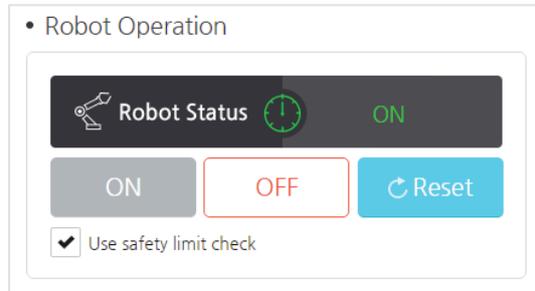
Select  **Robot Operation** in the main menu.



Note If your robot is already registered, then it will appear in the initial screen after booting up the system.

Turning ON/OFF the robot

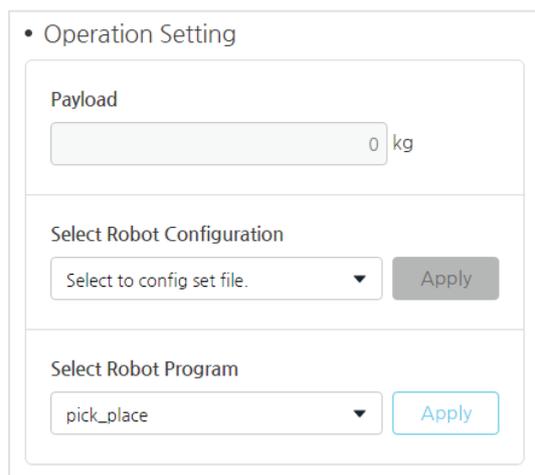
You can check the start/end status of your robot at present, and turn on or off the robot.



- **ON:** Power up the motor for the robot joints and get ready for robot operation. If the robot status is **ON**, then the **OFF** button will be activated and the **ON** button will be deactivated.
- **OFF:** Power off the motor for the robot joints and enable robot operation. If the robot status is **OFF**, then the **ON** button will be activated and the **OFF** button will be deactivated.
- **Reset:** If the robot is malfunctioning or uncontrollable temporarily then initialize the controller.

Checking and setting the robot operation data

You can check the effective weight applied to the currently selected robot and quickly retrieve the saved robot settings and program and apply them to the system.

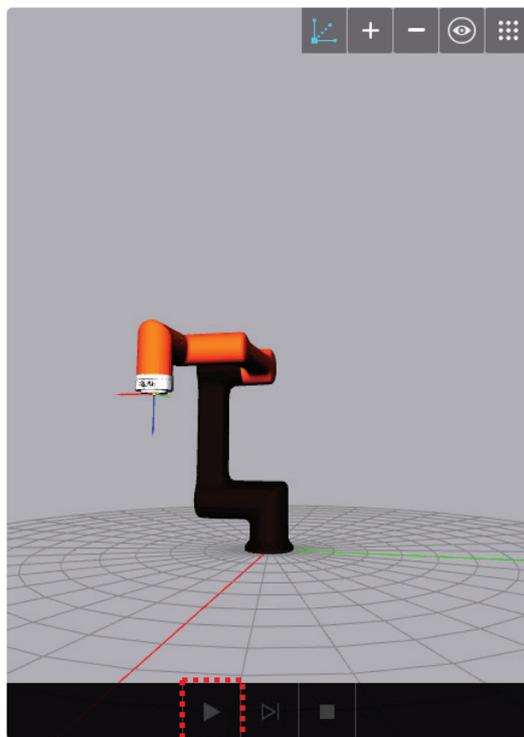


- **Payload:** Indicates the effective weight applied to the currently selected robot.

- **Select Robot Configuration:** A user can load a robot configuration file exported to a local storage. For more details about how to export robot settings, refer to [15.5 Managing the Robot System Configuration](#).
- **Select Robot Program:** You can select one of the program files stored in a local storage and quickly apply it to the system.

Operating the robot

If you want to operate your robot according to the program selected in the operation setting, then press the  button in the preview window. For more details about the preview screen, refer to [5.2 3D Preview Screen](#).



Chapter 11 Monitoring

You can check the selected robot's position/status and I/O status in real time.

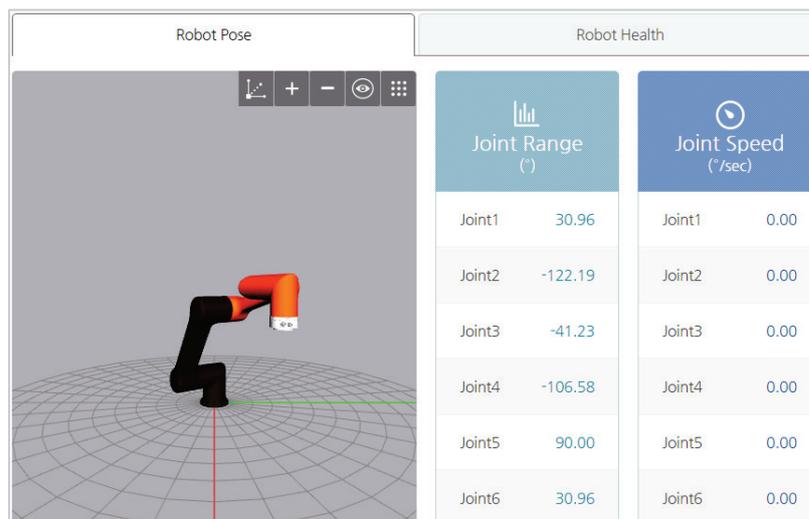
11.1 Monitoring the Robot

You can check the robot's position and status in real time.

Select  **Monitoring** > **Robot Status** in the main menu.

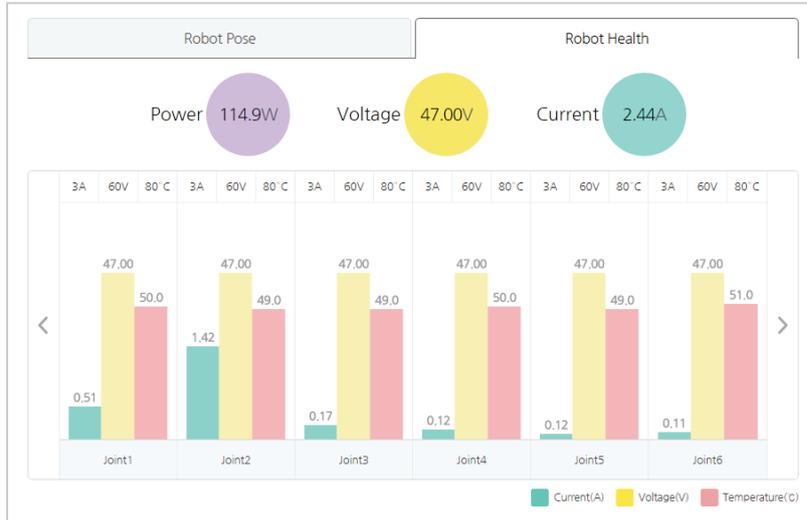
Monitoring the robot positions

In the robot position tab, you can check the position of the selected robot (joint angle and speed) and see how it is moving in real time in 3D preview.



Checking the robot status

In the robot status tab, you can check the selected robot's power consumption, voltage or current.



11.2 Monitoring Inputs/Outputs

You can check and set the real time I/O status of robot.

In the main menu, select **Monitoring > I/O Status**.

Note The monitoring period is 10 Hz.

- You can check the status of digital I/O by examining the following icons.
 - Digital signal high
 - Digital signal low
 - No signal
- The input terminals that users cannot adjust the values for and the output terminals that users can adjust the values for are marked as follows.

Input terminal



CONF_IN[0]

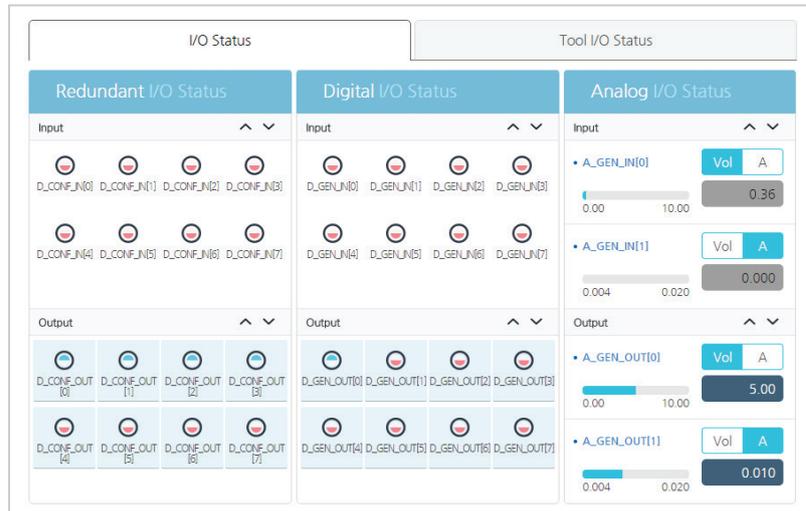
Output terminal



CONF_OUT[0]

Monitoring controller inputs/outputs

In the **I/O Status** tab, the status of signals transmitted to and received from the I/O terminal of the controller are displayed in real time.

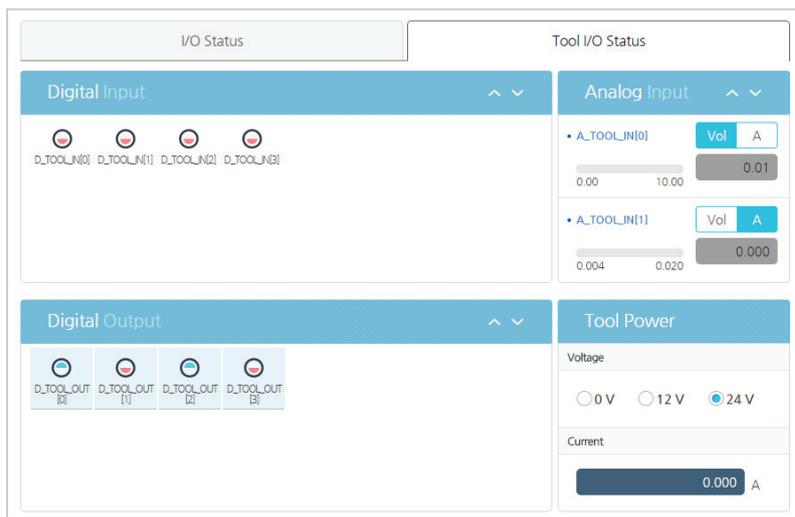


- You can press the I/O status icons to switch digital outputs to high and low. For example, if you press (High) then it switches to (Low).
- For analog outputs, you can press the icon to enter values.
 - Voltage range: 0 ~ 10.00 V
 - Current range: 0.004 ~ 0.02 A
- You can select either voltage or current as the analog I/O unit.
 - : Voltage(V) is used.
 - : Current(A) is used.
- If you change the unit of analog output, the output is changed to a minimum.

- Note**
- The number of terminals may vary depending on the controller specifications.
 - If not all the terminals are displayed on the screen, press the up/down scroll button to scroll them.

Monitoring tool inputs/outputs

In the **Tool I/O Status** tab, the status of signals transmitted to and received from the I/O terminal of the tool flange are displayed in real time.



- A tool's digital inputs/outputs and analog inputs are set and displayed in the same way those of the controller are set and displayed.
- If you can set the output voltage to a tool, then you can select one from 0 V, 12 V, or 24 V.

Note

- The value of the tool's current cannot be configured by the user.
- If the robot status is servo-off or the emergency stop button is pressed to stop the robot, the monitoring screen may display abnormal information.

Chapter 12 Linking with External Equipment

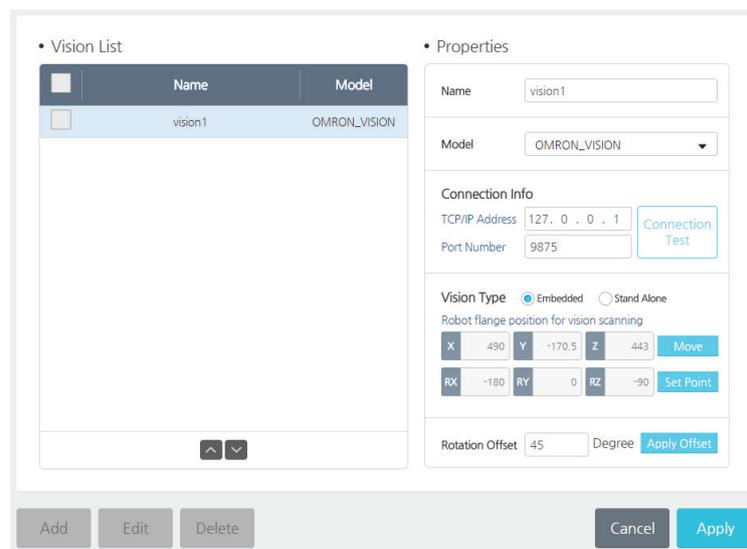
You can link your robot to an external equipment such as a vision equipment (object detection camera), and conveyor system.

Note Different external equipment is supported depending on the software version.

12.1 Using a Vision System

You can register an equipment to be linked to the robot and configure necessary settings.

In the main menu, press  **Device Setting** > **Vision System**.



Name	Model
vision1	OMRON_VISION

Properties

Name: vision1

Model: OMRON_VISION

Connection Info

TCP/IP Address: 127.0.0.1

Port Number: 9875

Vision Type

Embedded Stand Alone

Robot flange position for vision scanning

X: 490 Y: -170.5 Z: 443

RX: -180 RY: 0 RZ: -90

Rotation Offset: 45 Degree

Buttons: Add, Edit, Delete, Cancel, Apply

Note If multiple robots are operating simultaneously, then you do not need to configure one by one since the equipment setting is commonly applied to them all.

Adding a vision equipment

Press the **Add** button. They will be added under names such as Vision1, Vision2 to the list and they become configurable.

Setting a vision equipment

- **Name:** Enter the equipment name. (The length of name is limited to 15 letters and special characters cannot be used.)
- **Model:** Select the manufacturer for your vision equipment.

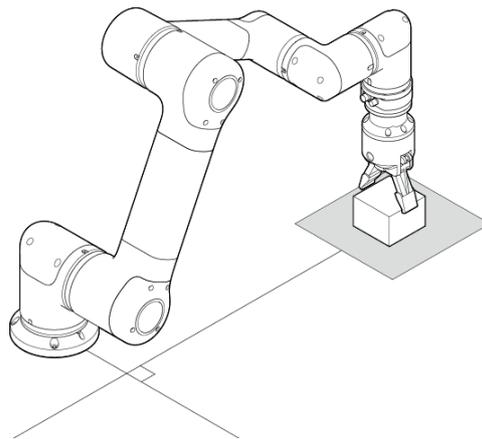
Note Different vision equipment is supported depending on the software version.

- **Connection info:** Enter the TCP/IP address and the port number necessary for communication between a vision equipment and the robot.
 - Range of port number: 0 ~ 65535
 - Press the **Connection Test** button to check the status of connection with a vision equipment by using the connection data.
- **Vision Type:** Select a type of vision installation.
 - **Embedded:** Attached to the robot arm.
 - **Stand Alone:** Fixed to another location and detached from the robot arm.
- **Scan Position:** If the vision type is **Embedded**, the setting is necessary for moving the robot arm to the scanning location.
 - Press the **Move** button to move the robot arm to desired location and view it there.
 - Press the **Set Point** button to launch the manual control screen. For more details about the manual control screen, refer to [5.3 Manual Move Screen](#).
- **Rotation Offset:** If the vision type is **Stand Alone**, you can set the angle between the robot's location and the scanning location, so that the rotational angle for an object necessary for a gripper to hold it. Press the **Set Offset** button to automatically set the rotation offset. For more details, refer to the next page.

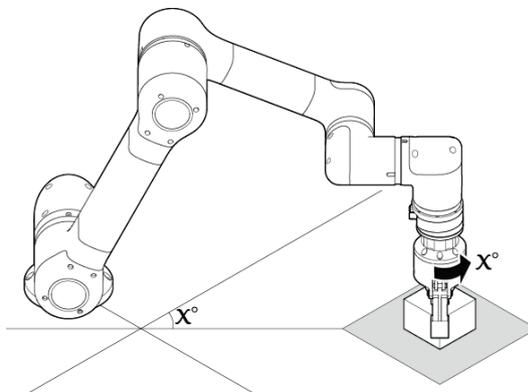
Understanding rotation offsets

When a vision equipment scans an object, the angle of shifted position for an object is used the reference for a vision equipment. Thus, the angle data of object that a vision equipment sends to the robot is obtained from the perspectives of vision equipment. Now, if the robot does not know the angle between the scanning location and the its position (rotation offset), then the robot will assess the scanned angle data from its own perspectives and use a gripper accordingly, thus making it hard to pick up an object accurately.

As shown below, if the scanning location is same as the basic TCP location of robot (A) all it has to do is to rotate the gripper angle by as much as the angle of scanned object. However, if the scanning location is shifted by X degrees from the robot base, then when an object is scanned, although a vision equipment detects the angle of object as same as from the location (A), its gripper will have to rotate by X degrees to pick it up. In other words, from the robot's perspectives, it is same as if an object is shifted by X degrees, so, a rotation offset is required to compensate for the angle of object sent from a vision equipment.



A. When the scanning location and the robot's location are on the same line



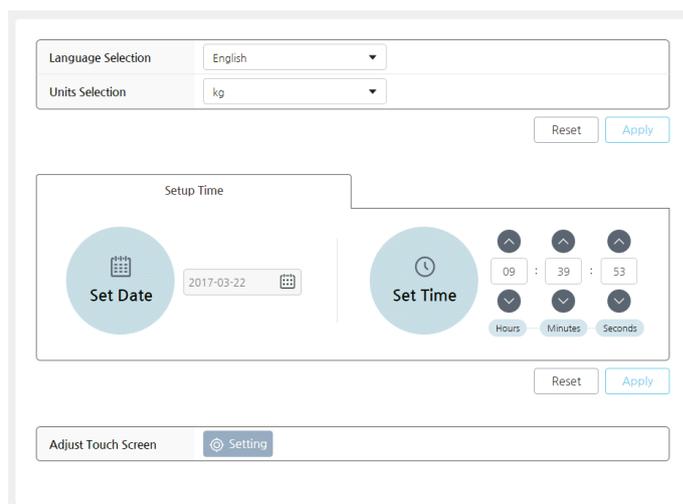
B. When the scanning location and the robot's location are shifted by X°

Chapter 13 Environment Setting

13.1 General Setting

You can select the desired UI language and unit also set the time/date.

In the main menu, press  **SW Configuration** > **General**.



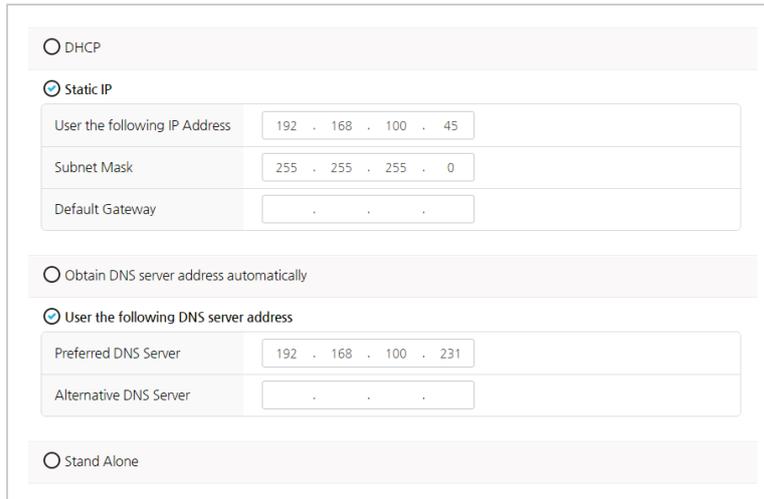
- **Language Selection:** You can select a language for the UI.
- **Units Selection:** You can select units of weight.
- **Set Date / Set Time:** You can set the system date/time.
- **Adjust Touch Screen:** If it is hard to touch a desired location on the screen, then you can correct the touch locations.

Note The language and unit settings are immediately applied to the system without restarting it, but the time/date are applied to the system after restarting it.

13.2 Network setting

You can configure the network settings for Ethernet communication of your operation software.

In the main menu, press  **SW Configuration** > **Network**.



The screenshot shows a network configuration interface with three main sections:

- DHCP:** A radio button is unselected.
- Static IP:** A radio button is selected. Below it are three input fields:
 - User the following IP Address: 192 . 168 . 100 . 45
 - Subnet Mask: 255 . 255 . 255 . 0
 - Default Gateway: . . .
- Obtain DNS server address automatically:** A radio button is unselected.
- Use the following DNS server address:** A radio button is selected. Below it are two input fields:
 - Preferred DNS Server: 192 . 168 . 100 . 231
 - Alternative DNS Server: . . .
- Stand Alone:** A radio button is unselected.

- **DHCP:** IP address is automatically assigned.
- **Static IP:** Fixed IP address is used.
- **Obtain DNS server address automatically:** DNS address is automatically received.
- **Use following DNS server address:** Use the DNS server designated by the user.
- **Do not use:** Do not connect to the network. Use it as standalone.

Note For more details about network settings, consult with your system network administrator.

Chapter 14 Turning Off the System

14.1 Shutting Down the Operation Software

To shut down the operation software, proceed as follows.

1. Select  **SW Configuration** > **Shutdown** in the main menu.
2. Press the **OK** button.

- Note**
- You can press the power button of the teaching pendant to shut it down.
 - If the operation software does not shut down properly, press and hold the power button of the teaching pendant for 5 to 10 seconds.

 **Caution**

Shutting down the system improperly may cause problems for the software. If the software has a problem after abnormal system termination due to the reason that the system is forcefully turned off by the power switch or the Power button of TP, or the power is out, contact Hanwha Techwin.

14.2 Turning Off Controllers

After shutting down the operation software, press the power switch to turn off the controller.

Chapter 15 Maintenance

15.1 Inspection Items and Periods

Periodic inspections are required to maintain the robot in the best condition for a long period of time. An inspector should prepare and execute an inspection plan.

The following items require periodic inspections. If you found some problems during inspections, and you can resolve them on your own, contact Hanwha Techwin Co.

Inspection item	What to inspect	Periods	
Robot arm	All	Check if the robot moves to the desired destination according to the program.	Daily
	All	Remove stains, dusts and pollutants.	3 months
	All	Check if the robot arm or tool sags when you turn on/off the servo power.	Daily
	Main bolts	Check if the bolts exposed to the outside of the robot is loose.	3 months
	Motor	Check for abnormal heat generation or noises.	Daily
Controller	Cable	Check the cable connections.	
	Internal	Remove dusts from the inside.	6 months
	Filter	Remove dusts from the filter.	

15.2 Checking the Robot Arm

Inspection period

Inspect at least once every year. The inspection period may vary depending on the inspection area.

Checking and cleaning the robot arm

1. Move the robot arm to home.
2. Turn on the controller.
3. Check the followings.
 - Check the cable connecting the controller and the robot arm.
 - Check if the screws exposed outside is loose or unfastened.
 - Check for defects in the motor, the brake and the decelerator.
4. Remove stains, dusts and pollutants.

15.3 Checking the Controller

If dusts accumulate inside the controller, electrostatics or overheating can cause product malfunctions. Periodically check the inside of the controller and clean off dusts and check if the internal cables are connected properly.

Inspection period

Inspect at least once every six months.

Note	The inspection periods may vary depending on the installation environment.
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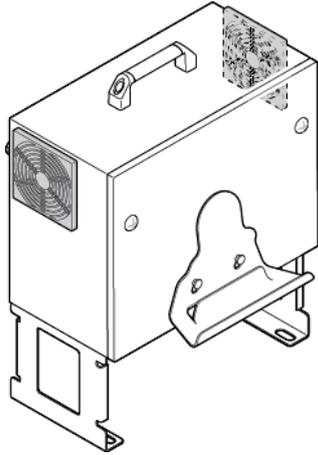
Checking and cleaning the controller

1. Turn off the power for the controller.
2. Open the cover for the controller.
3. Check if there are dusts inside the controller.

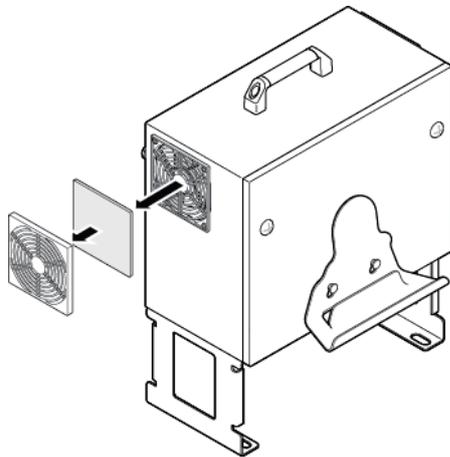
4. If there are dusts, then use a vacuum cleaner to carefully remove dusts.
5. Check if the connector cables are connected properly.

Cleaning and replacing the filter

The controller has an air suction hole and an air discharge hole, which have dust filter mounted in them.



Separate the filter from the controller and use a vacuum cleaner or air compressor to remove dusts.



15.4 Viewing and Managing Logs

You can view and manage the logs for the operation system.

Select **Management > Log** in the main menu.

The screenshot shows a web-based interface for viewing logs. At the top, there are filters for 'Operation Log', 'All', and dates '2017-06-22'. A search bar labeled 'Inquiry Keyword' is on the right. Below is a table with the following data:

Type	Controller	Robot Name	Date/Time	Log Description
Controller	HCR5	HCR5	2017-06-22 16:09:40:049	Send program/next playback command : success
Controller	HCR5	HCR5	2017-06-22 16:09:38:188	Apply program : success
Controller	HCR5	HCR5	2017-06-22 15:12:28:712	Get velocity : success
Controller	HCR5	HCR5	2017-06-22 15:11:34:505	Change active TCP : success
Controller	HCR5	HCR5	2017-06-22 14:59:34:885	Send program/play playback command : success
Controller	HCR5	HCR5	2017-06-22 14:59:23:582	Get velocity : success
Controller	HCR5	HCR5	2017-06-22 14:58:57:803	Send program/stop playback command : success
Controller	HCR5	HCR5	2017-06-22 14:58:52:767	Send program/play playback command : success
Controller	HCR5	HCR5	2017-06-22 14:58:51:192	Apply program : success
Controller	HCR5	HCR5	2017-06-22 14:58:47:319	Apply program : success

At the bottom of the table, it says 'Total Count : 66 Case'. There is a pagination bar with page numbers 1 through 5, and status icons for Information, Warning, and Error. 'Delete' and 'Export' buttons are located at the bottom right of the interface.

Deleting Logs

Press the **Delete** button and the log data found will be deleted.

Exporting Logs

1. Press the **Export** button.
2. Select the location to export the logs into and press the **OK** button.

The screenshot shows a 'Please select folder' dialog box. The path is 'C:\hanwha\#tgoswlet-it-bot\#exportLog'. The file explorer shows the following:

Directory	File Name	Date
> HTW Storage	2017-03-22_09h_47m_24s	22-Mar-2017 9:47 AM
	2017-03-22_09h_47m_53s	22-Mar-2017 9:47 AM

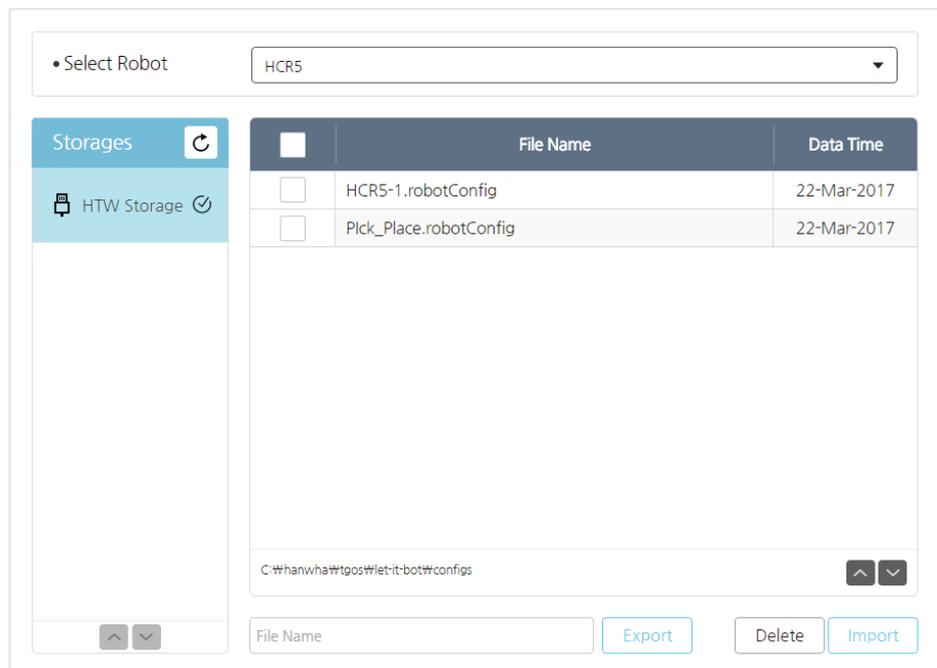
At the bottom of the dialog, there are 'OK' and 'Cancel' buttons.

When export is finished, a folder in the form of 'date-time' is created at the selected location, and the log data are saved in the folder along with the robot configuration and program files.

15.5 Managing the Robot System Configuration

You can save the robot configuration in a local or external storage device or retrieve the saved robot configuration from them.

In the main menu, select **Management** > **Setting Management**.



The screenshot displays a software interface for managing robot configurations. At the top, there is a dropdown menu labeled "Select Robot" with "HCR5" selected. Below this is a "Storages" section with a refresh icon and a list item "HTW Storage" with a refresh icon. The main area features a table with the following data:

<input type="checkbox"/>	File Name	Data Time
<input type="checkbox"/>	HCR5-1.robotConfig	22-Mar-2017
<input type="checkbox"/>	Pick_Place.robotConfig	22-Mar-2017

Below the table, there is a text field containing "C:\hanwha\rgos\let-it-bot\configs" with up and down arrow icons. At the bottom, there is a "File Name" input field and three buttons: "Export", "Delete", and "Import".

Exporting the configurations

You can save the following settings by exporting them.

Robot Setting	TCP Setup
	Mounting
Safety Setting	Motion Limit
	Safety Boundary
I/O Setup	Digital I/O
	Analog I/O

1. Select a robot to export the settings for.

2. Select the file path to export.

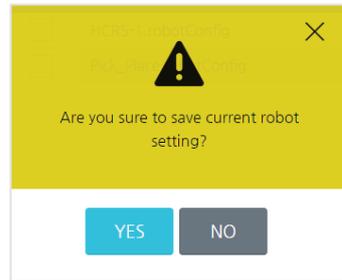
- Press the refresh  button to update the storage list and the file list.

3. Press the filename input field and enter the filename.

- Filename is limited to 25 letters, and empty character is not allowed.

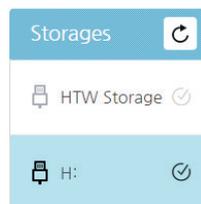
4. Press the **Export** button.

- When the confirmation window appears, press **YES**.

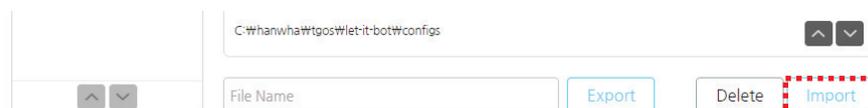


Importing the configurations

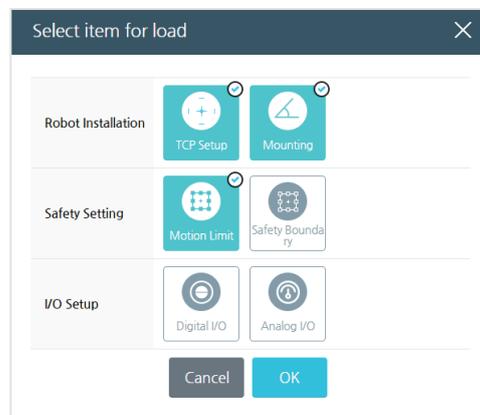
- Select the file path for importing.
 - Press the refresh  button to update the storage list and the file list.



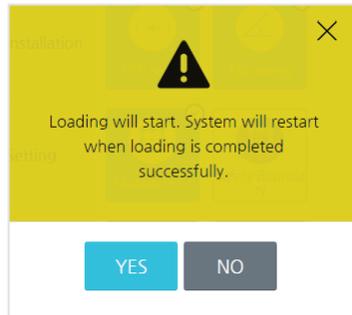
- Press the **Import** button.



- Select the configuration items to import and press the **OK** button.
 - You can select multiple items.
 - If you want to deselect it, press it again.



- When the confirmation window appears, press **YES**.



15.6 Software Update

You can update the operation software and the controller software.

In the main menu, press  **SW Configuration** > **SW Update**.

- Operation Software

Current Version	Ver. 2.11.170317
Update	<input style="width: 80%;" type="text"/> <input style="margin-left: 5px;" type="button" value="Import"/> <input style="margin-left: 10px;" type="button" value="Update"/>
- Control Software

Current Version	Ver. 1.0.0.0
Update	<input style="width: 80%;" type="text"/> <input style="margin-left: 5px;" type="button" value="Import"/> <input style="margin-left: 10px;" type="button" value="Update"/>
- Servo Driver Version Info

Joint 1	1.0.0	Joint 2	1.0.0	Joint 3	1.0.0
Joint 4	1.0.0	Joint 5	1.0.0	Joint 6	1.0.0

Cautions during update

- Update can be performed using the external storage device only.
- Update files may be composed of multiple files instead of a single file. For proper update of files, do not modify the name or path of an update file package arbitrarily.
- It is recommended to update the operating software and the control software at the same time in the versions compatible with each other. If versions incompatible with each other are installed as a result of not checking compatibility, the robot may not work normally.

- The update function is not available for general users but for the user with a certain authority. If you need an update, contact Hanwha Techwin or a local service center.

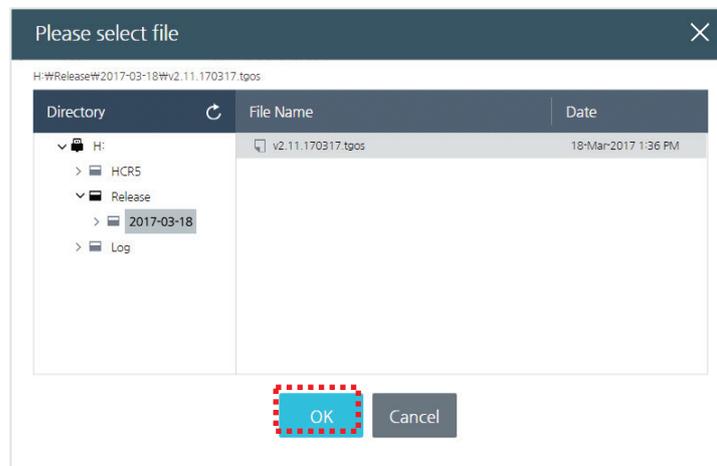
Updating the operation software

Check the version of the operation software and proceed as follows:

1. Connect the external storage device (such as the USB memory) where the update files are stored to the USB port of the teaching pendant or the controller.
2. In the software update screen, press the **Import** button.



3. Select an update file in the correct location and press the **OK** button.
 - The extension of the update file is "tgos", and the update file name contains its version. The file selection window displays applicable files only.



4. From the software update window, press the **Update** button.



When the operation software is updated, a window appears to ask whether to update the controller software additionally. If no additional update is available, the system restarts.

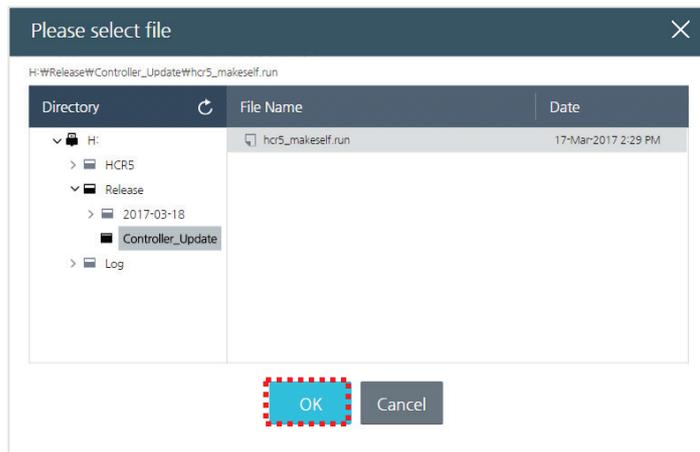
Updating the controller software

Check the version of the controller software and proceed as follows:

1. Connect the external storage device (such as the USB memory) where the update files are stored to the USB port of the teaching pendant or the controller.
2. In the software update screen, press the **Import** button.



3. Select an update file in the correct location and press the **OK** button.
 - The extension of the update file is ".run". The file selection window displays applicable files only.



4. From the software update window, press the **Update** button.



When the controller software is updated, a window appears to ask whether to update the operation software additionally. If no additional update is available, the system restarts.

Appendix A Warranty

Refer to the contract between the sales team and you.

Warranty

Our company guarantees specifications, quality and reliability that our customer demands during the warranty period.

Warranty period

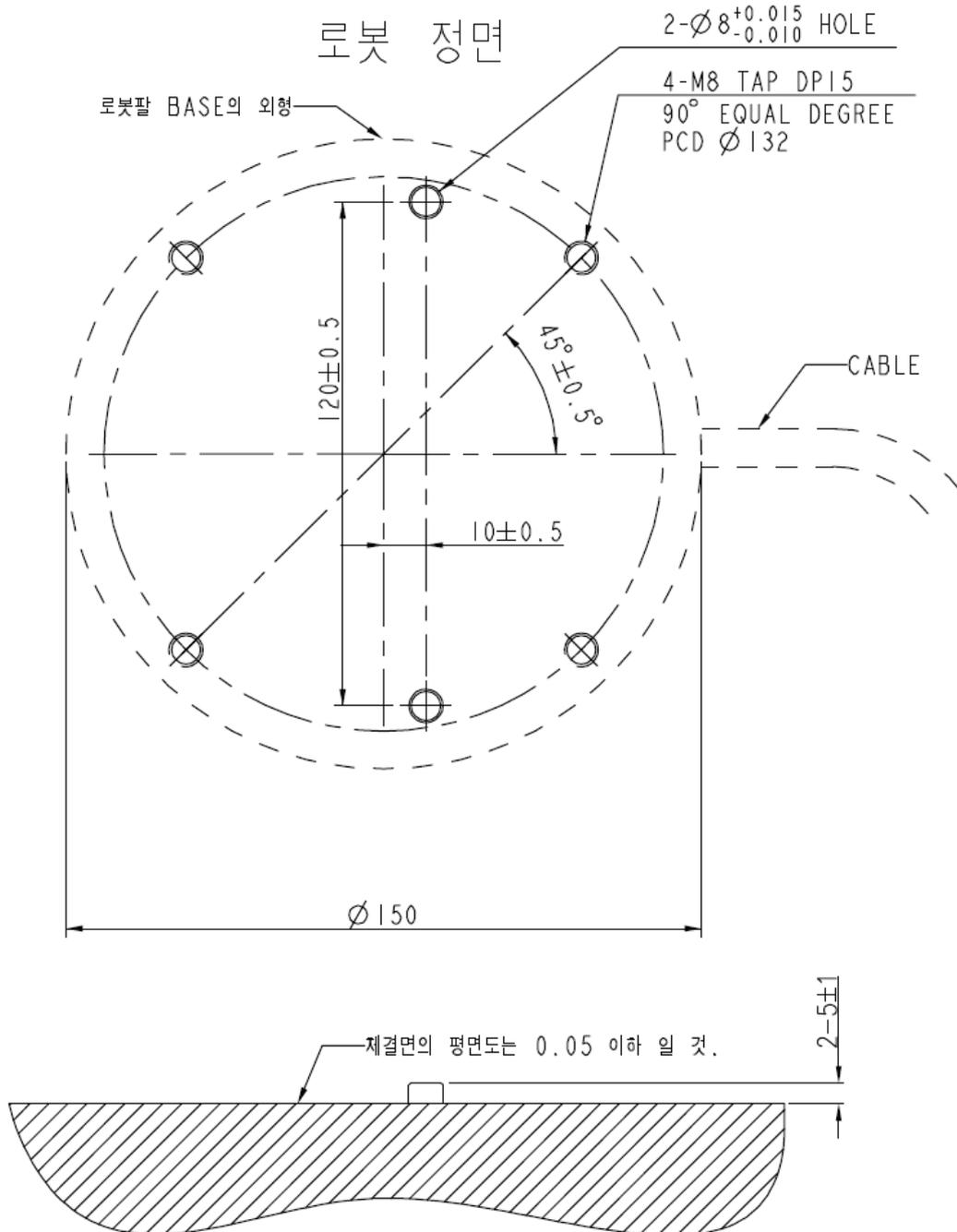
One year since the date of equipment purchase (varies depending on the contract between our company and you.)

Limitation of Liability

- If a problem occurs after the customer mounts an unauthentic part in our product, our company will not be responsible for it.
- If your product has a fault deemed as our company's responsibility, we will immediately repair it or replace the product with a good one.

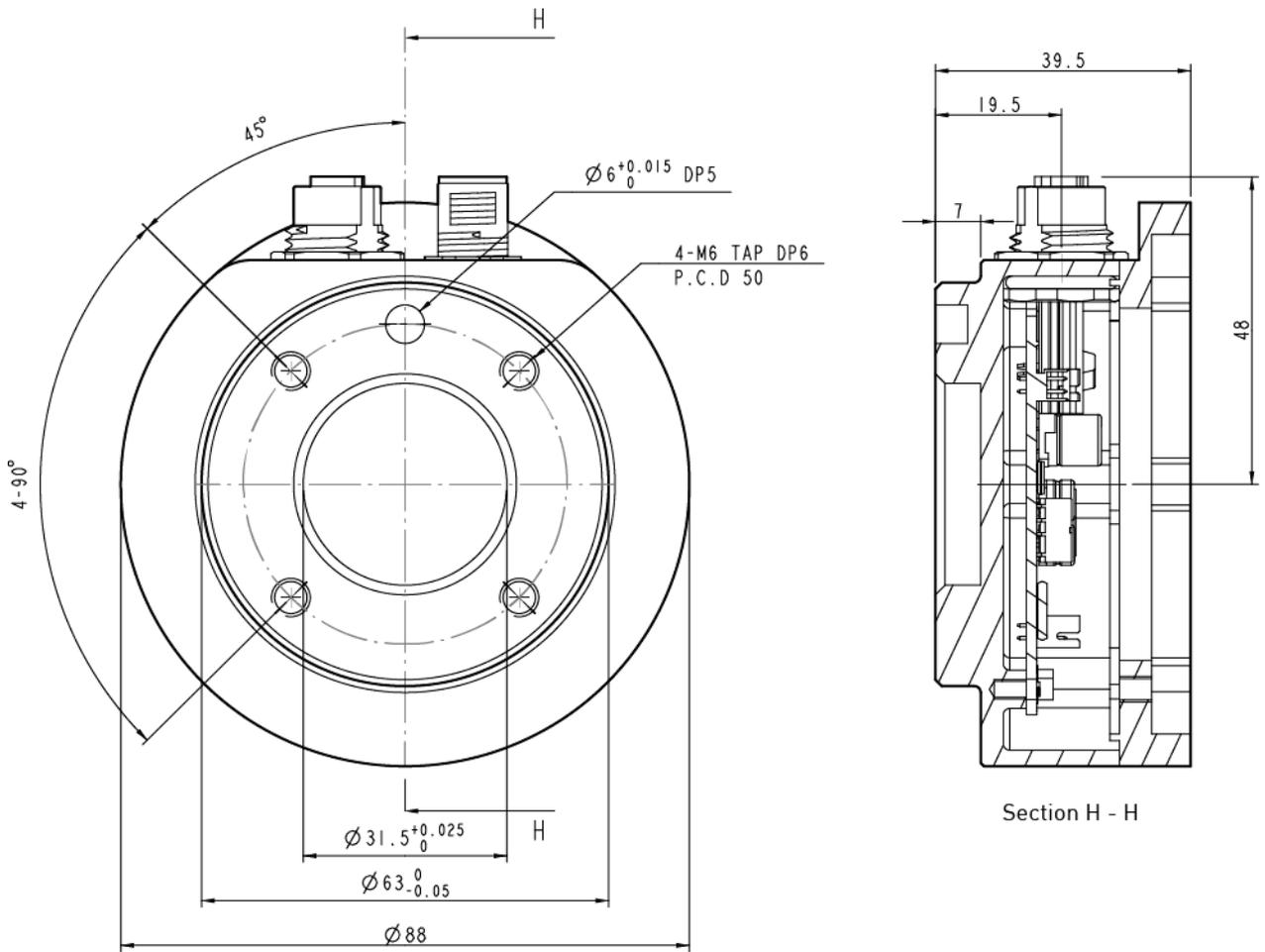
Appendix B Certification

Appendix C Dimensions for Installation



Appendix D Tool Flange Cross Section

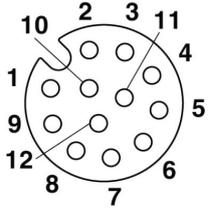
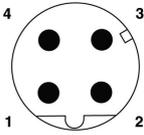
The tool flange is designed suitable for ISO9409-1-50-4-M6.



Appendix E Port Pin Map

Ports in the tool flange have the following specifications.

- Tool I/O: SACC-DSI-M12FS-12CON-M16/2,0 – 1458790
- EtherCAT: SACC-DSI-MSD-4CON-M12/0,5 SCO – 1551901

Port	Layout	Pin number	Signal	Color
Tool I/O		1	0/12/24 Vdc	Brown
		2	Ground	Blue
		3	Digital Output Ch 0	White
		4	Digital Output Ch 1	Green
		5	Digital Output Ch 2	Pink
		6	Digital Output Ch 3	Yellow
		7	Digital Input Ch 0	Black
		8	Digital Input Ch 1	Gray
		9	Digital Input Ch 2	Red
		10	Digital Input Ch 3	Violet
		11	Analog Input Ch 0	Gray/Pink
		12	Analog Input Ch 1	Red/Blue
EtherCAT		1	TX+	Red
		2	TX-	Yellow
		3	RX+	Green
		4	RX-	Blue

Appendix F System Specifications

Degree of freedom	6
Base weight	5 kg
Working radius	915 mm
Joint rage	$\pm 180^\circ$ (J3: $\pm 165^\circ$)
Repeatability	± 0.1 mm
Weight	20 kg
Bottom area size	$\varnothing 150$ mm
Temperature	0 – 50°
IP class	IP54 (Robot Arm) / IP20 (Robot Controller)
Power supply	100 – 240 VAC, 50 – 60 Hz

		Controller	Tool connector
I/O port	Digital input	16	4
	Digital output	16	4
	Analog input	2	2
	Analog output	2	–
	EtherCAT	1	1
I/O power supply	Controller: 24 V 2 A		
	Tool connector: 12 V or 24 V 1.6 A		
External communication	TCP/IP, EtherCAT, Modbus TCP, CC-link / Profinet / Ethernet / IP (optional)		
Cable length	Robot arm to controller connection cable: 6 m		
	Teaching pendant to controller connection cable: 5 m		

Appendix G Stopping Time and Distance

Stopping time and distance for stop category 0

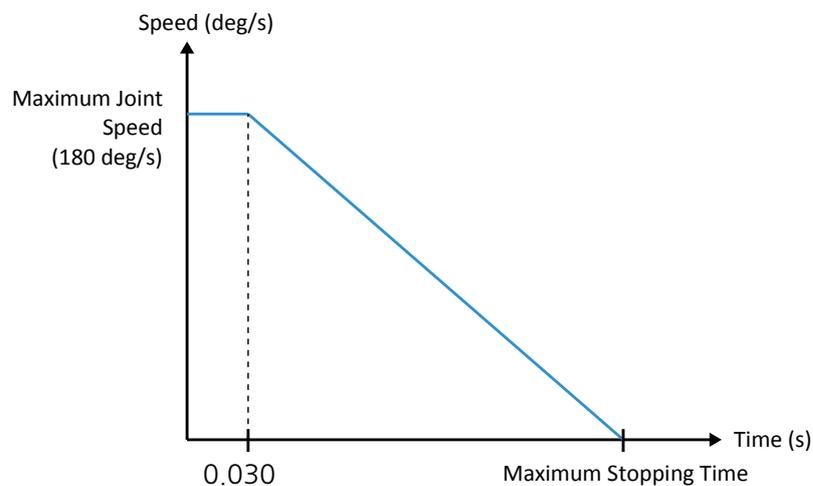
The robot configuration to measure the stopping time and the stopping distance for the stop category 0 is as follows:

- Position: Maximum load position (the position of the robot arm fully stretched horizontally to make the maximum load)
- Speed: Maximum joint speed (maximum speed of 180°/sec which can be generated at the robot joint)
- Payload: Maximum load possible to be installed on the TCP (5 kg)

The behavior to measure the stopping distance for the joint J1 was driven in parallel to the ground and joints J2 and J3 were driven perpendicular to the ground. The stop category 0 was performed when each joint reached its maximum speed.

It takes 0.03 sec for the brake to be engaged for deceleration after the stop signal is detected.

	Stopping Distance (deg.)	Stopping Time (sec.)
Joint J1	34.67	0.61
Joint J2	31.60	0.55
Joint J3	29.08	0.51

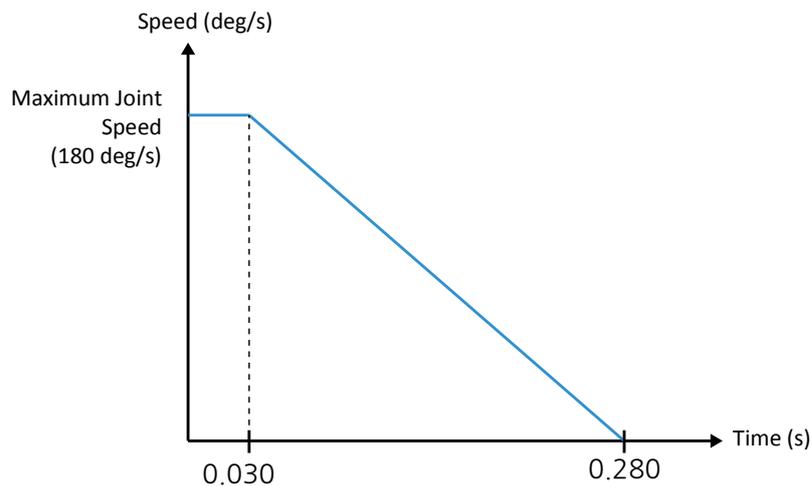


Stopping time for stop category 0

The robot configuration to measure the stopping time for the stop category 1 is as follows:

- Position: Maximum load position (the position of the robot arm fully stretched horizontally to make the maximum load)
- Speed: Maximum joint speed (maximum speed of 180°/sec which can be generated at the robot joint)
- Payload: Maximum load possible to be installed on the TCP (5 kg)

Create a behavior to stop regardless of the speed and the payload so that it comes to a full stop after a certain period (0.250sec).



Appendix H Error Codes

Code	Cause	Actions
10001	The operation software has a server connection error.	Restart the system or ask the administrator.
10002	An error occurs while the operation software communicates with the server.	Restart the system or ask the administrator.
10005	A DB connection error.	Restart the system or ask the administrator.
10006	Controller update server connection error.	Check the EPC and controller board connection cable or check the access information. If the same problem persists, then ask the administrator.
10007	A data tx/rx error occurs while the operation software communicates with the controller.	Check the EPC and controller board connection cable or check the access information. If the same problem persists, then ask the administrator.
10008	A communication error (heartbeat) occurs between the operation software and the controller.	Check the EPC and controller board connection cable or check the access information. If the same problem persists, then ask the administrator.
20001	A system initialization error.	Restart the system or ask the administrator.
20006	Vision equipment fails to detect an object.	Check the recording setting for the vision camera and check if it detects objects properly.
20007	An error occurs while receiving data from the vision equipment.	Check the vision equipment connection information and the cables.
30002	The operation software does not support the feature currently.	Check the software version installed in the system and ask the administrator.
30005	A pattern initialization error occurs while running the program.	After checking the pattern settings, try again.

Appendix H Error Codes

Code	Cause	Actions
30008	An error occurs while retrieving the file.	If the file is retrieved from an external storage device, then check the connection to it.
30010	An error occurs while exporting the file.	If the file is retrieved from an external storage device, then check the connection to it.
40001	Infinite loop is found while running the program.	After checking the program logics, make sure to avoid an infinite loop.
100002	The robot cannot be paused (without motion operation), and you cannot execute a pause command.	If the program is in the pause state with the robot operation already stopped, send the program stop command and continue the next operation.
100008	An error occurs while calculating the time for inputted motion.	Check the motion's input value and try again.
100017	A communication error occurs while sending the program's command data (motion).	Check the network cable and restart the system.
100018	A communication error occurs while sending the program's command data (stopped).	Check the network cable and restart the system.
100019	A communication error occurs while sending the program's command data (I/O).	Check the network cable and restart the system.
100020	A communication error occurs while sending the program's command data.	Check the network cable and restart the system.
100021	A communication error occurs while sending the robot data.	Check the network cable and restart the system.
100022	An error occurs while establishing communication between the controller and the EPC.	Check the network cable and restart the system.

Code	Cause	Actions
100037	The robot cannot move to the destination indicated by the transmitted command.	Check the command input and try again.
100047	You cannot execute the current jog command because the robot is still operating.	Check that the robot operation is fully stopped and retry it.
100048	At present, the robot is violating the safety settings (border, joint range).	Disable the safety setting in the operation menu and use manual control to move the robot into the working range that complies with the safety settings. For normal operation, check the Enable Safety Setting item before use.
100051	The speed input for the currently transmitted command exceeds the max speed limit.	Check the input for the command and try again.
100052	The speed input for the currently transmitted command is zero.	Check the command input and try again.
100053	The currently set speed limit is zero, so the robot may not move.	Check the safety speed limit.
100057	An error occurs while using the inputted point data to calculate the TCP.	Reset the point for TCP calculations.
100059	A speed input error.	Check the speed input range (0 ~ 1.0 (100%)).
100061	Cannot execute the currently inputted motion command.	Reset the current motion settings such as location and speed.
100075	The currently inputted motion's joint speed is zero.	Enter the joint speed greater than zero.
100076	The currently inputted joint speed violates the max speed limit.	Reset the joint speed input.
100077	The currently inputted joint speed violates the speed limit.	Reset the motion's joint speed or speed limit.

Appendix H Error Codes

Code	Cause	Actions
100078	Jog control speed violates the limit.	Check the speed limit settings.
100079	Jog control speed violates the limit for the robot.	Check the speed limit settings.
100080	The joint speed limit is set to zero.	Reset the joint speed limit input.
100100	An error occurs while calculating the inputted motion (circular).	For circular motion setting, check the start/mid/end location inputs.
100101	An error occurs in the radius value while calculating the inputted motion (circular).	For circular motion setting, check the radius input value.
100102	An error occurs while calculating the inputted motion (circular).	For circular motion setting, check the radius and input values.
100103	An error occurs while calculating the inputted motion (circular).	For circular motion setting, check the radius and input values.
203100	The operating robot's joint exceeds the range of safety operation.	<p>Press the reset button in the operation menu and move the robot into the permitted working range.</p> <p>For normal operation, check the Enable Safety Setting option before use.</p>
203101	The joint's safety speed exceeds the limit.	<p>Reset the safety speed in the safety setting menu or adjust each motion speed in the program to meet the speed limit. (The problem may occur while moving even if the speed and acceleration of each motion are entered within the allowed ranges. You must find the speed and acceleration of the motion normally operating.)</p> <p>For items related to safety setting, ask the administrator with the Admin authority to login as the Admin and set them.</p>

Code	Cause	Actions
203102	The joint's safety acceleration exceeds the limit.	If the servo is off due to an error, then turn on the servo in the operation menu and adjust each motion's acceleration in the program to meet the safety setting. (The problem may occur while moving even if the speed and acceleration of each motion are entered within the allowed ranges. You must find the speed and acceleration of the motion normally operating.)
203103	This is a one-time error that can occur when excessive torque is applied to the joint drive.	You can ignore a one-time error. If the same error persists, then you need further analyze the robot's drive and motor conditions and take additional actions.
203104	This is a one-time error that can occur when excessive torque is applied to the joint drive.	Press the reset button in the operation menu and try again. If the same error persists, ask the administrator.
203105	Out of the range of safety border.	If the servo is off due to an error, then turn on the servo in the operation menu, (if the servo is still off. then disable 'safety limit' and try to turn on the servo again) and use manual control to move the robot into the permitted working range. For items related to safety setting, ask the administrator with the Admin authority to login as the Admin and set them.
203106	Cannot move the robot to the destination that is inputted.	Check the position, speed and pose of the motion
280000	The operation or control software is down or a communication error occurs due to a cut in the cable.	Check the network cable connection. Restart the operation software. If the operation software malfunctions, then force it to stop and restart it.

Code	Cause	Actions
280001	A communication error between the controller board and the robot (EtherCAT).	<p>Press the reset button in the operation menu and press the start button after several seconds to turn on the servo motor. If the problem persists, then press and release the emergency stop button for the TP, press the reset button and check if the Start button is activated in the Operation menu after several seconds and check operation of the controller.</p> <p>If the system does not operate normally despite of actions taken as above, restart the system.</p>
280002	Drive error	<p>Use the device log in the Log Inquiry screen to inquire about the axial number that is causing errors. Press the reset button in the operation menu and see if the start button is activated after several seconds. If not activated, press and release the emergency stop button for the TP, press the reset button and check if the Start button is activated in the Operation menu after several seconds and check operation of the controller.</p> <p>If the system does not operate normally despite of actions taken as above, restart the system.</p>



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