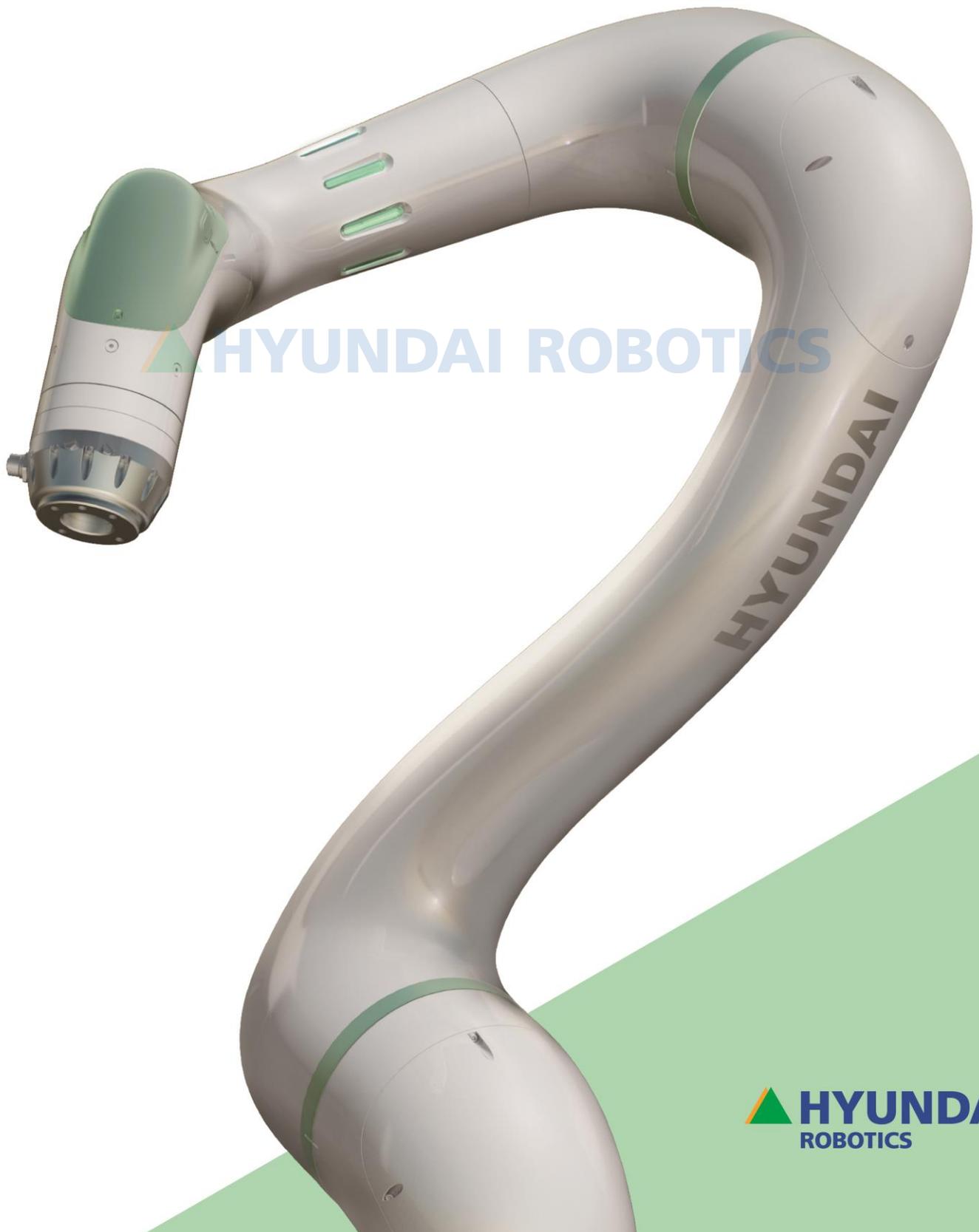


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Maintenance Manual for Collaborative Robot



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About this manual

This manual describes the safety, installation, use, and maintenance methods of collaborative robots manufactured by Hyundai Robotics.

Before using the product, read and fully understand the content of this manual. In addition, keep this manual at a handy place so that it can be read any time when necessary.

This manual may be provided to customers who purchase products of Hyundai Robotics, or may be used as a material for internal training programs.

As this manual has been prepared based on standard specifications, it may not apply equally to all models that you purchase. In addition, the details and specifications of this manual are subject to changes for improving product performance without notice, and Hyundai Robotics will not take responsibilities for any consequences of incorrect details, typos, or omissions of this manual. For detailed information on revisions, please visit our website (www.hyundai-robotics.com).

Copyright

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Notation rules

This manual utilizes the following expression rules and safety directions for easy understanding.

■ Description by figures

Figures are used for easy understanding of how to operate the product and for describing screens. When a description is made by a figure, the pertaining part is marked with the figure number that describes the part as shown in the following:



■ GUI (Graphical User Interface)

In regard to GUI, any menu name or a button name will be in brackets ([]), and in the **bold type**. When multiple menus need to be selected in the listed order, the menu names will be separated by the symbol, > .

- Menu having a title: On the initial screen of the manual or the automatic mode, select the **[Menu]** button.
- Multiple menus: In the initial screen of the manual mode, select the **[Setting]** button > **[5: Reset]** > **[7: Unit Setting]** menu.

■ Manipulation key notation method

Any key to be pressed in the functional manipulation area of the teach pendant will be in angle brackets (< >), and in the **bold type**.

- Pressing the **<Start>** key will initiate the automatic execution of the sequence programmed into the robot.

■ Cross references

This provides the shortcut to the related information in the manual. Cross references will be in quotation marks, and in the **bold type**.

- For details of making changes in date and time information, see “**4.5 Date and time setting.**”

■ References

Useful or additional information on using the product will be provided as follows:

Remarks	Blinking of the  icon in the status bar indicates the engineer mode.
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Safety precautions

For ensuring proper product use, user safety, and for preventing property damages, make sure to read and fully understand the following precautions before using the product.

■ Danger



Danger

Pending risk: If not conformed to, operator deaths or severe injuries may occur.

- Carry out risk assessment on the entire system, not the individual devices. Connecting other devices to the product may increase the risk level of the product or create new risks. If the devices of the robot integrated system have different risk levels, prepare safety devices based on the device of the highest risk level in preparedness for risks.
- In installing the robot product and other devices, make sure to read, fully understand, and conform to the product installation instructions described in the manual.
- In case of any issues of the product such as faults and damages, immediately stop using the product, and contact our Customer Support Team.

■ Warning



Warning

Potential risk: If not conformed to, operator injuries or property damages including serious product damages may occur.

- Take adequate safety measures according to the result of risk assessment, and accurately assign the safe range of robot installation. During the robot operation, product damages or user injuries may occur.
- Persons who manufacture robot application systems or use the robot must read and fully understand the manual, and take training in robot operation.
- For the safety of operators and users, prepare adequate safety facilities such as safety fences before installing the product.
- Secure sufficient space so that the robot arm can move freely. During the robot operation, product damages or user injuries may occur.
- Fasten locking bolts to the specified torque according to the specification sheet. Lose bolts may lead to damages of the robot due to falling from the installation position.
- Pay attention to the product connections (power and cables) so that no conducting substances such as liquid, dust, and metal particles infiltrate. Do not poke the connection with sharp objects, or apply excessive force during cable connection. Corrosion or temporary short circuits of connectors may lead to product explosion or fires.
- Check the wiring specification, and connect devices with terminals that are suitable for device types. In particular, make sure to connect safety devices to dedicated terminals because connecting them to general terminals does not guarantee safety functions.
- Never use damaged cables, and do not disconnect cables while the product is in operation. It may lead to electric shocks, fires, faults, and injuries.
- Long-time use of the product may generate overheating and lead to injuries such as burns. In the event it is necessary to touch the product, sufficiently cool down the product by powering it off and leaving it for at least one hour.

- Never arbitrarily install, modify, disassemble or repair the product. It may lead to faults and accidents. Hyundai Robotics will not take responsibilities for product damages caused by such arbitrary actions.

■ Caution



Caution

Minor risk: If not conformed to, minor operator injuries or property damages including product damages may occur.

- Do not arbitrarily install, modify, disassemble or repair the product. It is prohibited for persons other than experts from Hyundai Robotics to modify the product or attach parts to the product. Product faults caused by it will void free-of-charge services and warranty services.
- In the event it is necessary to install or repair the product, contact our Customer Support Team to consign the work to experts.
- Do not install or use the product at a place having much dust or dirt. Dust or foreign matters may lead to product faults or malfunction.
- Do not install or use the product at a place of magnetism, or a place which is affected by magnetism, or a place of electromagnetic interferences. Magnetism may lead to product damages or malfunction.
- In operating the product, do not wear loose outfit or accessories. If you wear long hair, tie it at the back of the head so that it is not entangled between joints and the like of the robot.
- While the product is in operation, do not enter its operating range or touch the robot. It may lead to injuries.
- Transport the product as it is packaged for preventing product damages, and store it at a dry and low-humidity place. Storing it at a humid place may lead to product damages or faults due to moisture infiltration.
- Store the product at a place clean, cool, dry, and free from high variation in temperature and humidity.
- The product should be moved by two or more persons, maintaining the correct posture. If not, the persons may be subject to physical injuries in the waist, arms, legs and the like.
- In moving the product by means of a lifting equipment, conform to the local and national safety regulations and the instructions for equipment use.
- Before moving the product, read and conform to the moving instructions specified in the manual. Hyundai Robotics will not take responsibilities for product damages caused by customer's product transportation.

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1. Safety

1.1 Safety requirements

1.1.1 Applicable standards

This product has been designed and manufactured in compliance with ISO 10218-1, a safety standard of industrial robots, and ISO/TS 15066, a standard specifying safety requirements for collaborative operation. The safety standards applicable to this product are as follows:

- ISO 10218-1:2011 Robots and robotic devices - Safety requirements for industrial robots - Part 1: Robots
- ISO 10218-2:2011 Robots and robotic devices - Safety requirements for industrial robots - Part 2: Robot systems and integration
- ISO/TS 15066:2016 Robots and robotic devices - Safety requirements - Industrial collaborative workspace
- IEC 61508-1:2010 Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 1: General requirements
- IEC 61508-2:2010 Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems
- IEC 61508-3:2010 Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 3: Software requirements
- IEC 61508-4:2010 Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 4: Definitions and abbreviations
- IEC 61508-5:2010 Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 5: Examples of methods for the determination of safety integrity levels
- IEC 61508-6:2010 Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 6: Guidelines on the application of IEC 61508-2 and IEC 61508-3
- IEC 61508-7:2010 Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 7: Overview of techniques and measures
- IEC 61800-5-1:2007/A1:2017 Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy
- IEC 61800-5-2:2015 Adjustable speed electrical power drive systems - Part 2: General requirements - Rating specifications for low voltage adjustable speed a.c. power drive systems
- ISO 13849-1:2015 Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design
- ISO 13849-2:2012 Safety of machinery - Safety-related parts of control systems - Part 2: Validation
- IEC 62061:2005/A2:2015 Safety of machinery. Functional safety of safety-related electrical, electronic and programmable electronic control systems
- IEC 61784-3:2016 Industrial communication networks - Profiles - Part 3: Functional safety fieldbuses - General rules and profile definitions
- IEC 61800-3:2017 Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods

- IEC 61000-6-7:2014 Electromagnetic compatibility (EMC) - Part 6-7: Generic standards - Immunity requirements for equipment intended to perform functions in a safety-related system (functional safety) in industrial locations
- IEC 61326-3-1:2017 Electrical equipment for measurement, control and laboratory use. EMC requirements. Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) - General industrial applications

1.1.2 Safety performance

The safety performance of the collaborative robot is as follows:

Category	Safety performance	Applicable standards
HFT	1	IEC 61508/62061/61800-5-2
SIL (Safety Integrity Level)	2	
Category	3	ISO 13849-1
PL (Performance Level)	d	



1.2 Safety measures

This section describes the safety functions embedded into the product, and the measures for ensuring the safety of users and operators.

1.2.1 Safety functions

The collaborative robot is intended to carry out collaborative works based on the following safety functions. For the details of the safety functions, see the “**Safety Function Manual for Collaborative Robots.**”

- STO: Safe Torque Off
- SS1: Safe Stop 1
- SS2: Safe Stop 2
- EM (Emergency) Stop
- Protective Stop
- SBC: Safe Brake Control
- Safety Outputs
- Safety Inputs
- SOS: Safe Operating Stop
- Joint-SLP, Joint Angle Monitoring
- Joint-SLS, Joint Angular Speed Monitoring
- Joint- SLT, Joint Torque Monitoring
- Collision Detection
- TCP-SLP, TCP Position Monitoring
- TCP Orientation Monitoring
- TCP-SLS, TCP Speed Monitoring
- TCP Force Monitoring
- Momentum Monitoring
- Power Monitoring

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1.2.2 Safety training

In order to effectively use the product functions, the user must read and fully understand the manual, and install, use, and maintain the product in the proper manner. The product user will be responsible for having the full knowledge of and conforming to the robot-related safety regulations of the locality in which the robot is installed and used, and for the proper designing, installation, and operation of the safety devices that can guarantee the safety of the workers of the robot system.

- All the workers who install, use, and maintain the robot system must read and fully understand the manual. In particular, they must be fully knowledgeable of the safety precautions (⚠).
- Hyundai Robotics establishes and implements plans for providing training in product installation, use, and maintenance. Product operators and workers must take the relevant training programs before handling the product.
- Workers who are responsible for the robot's teaching and checkups must take a training program in robot use and safety before handling the robot. The safety training program covers the following topics:
 - The concept of safety, and the purposes and functions of the safety devices
 - The procedures for handling the robot safely
 - The performance and potential risks of the robot and robot system
 - The works and the like relating to the application of specific robots

1.2.3 Safety labels

On the inside and outside of the controller, nameplates, warning signs, safety symbols and the like are attached. Check the labels for ensuring safety.

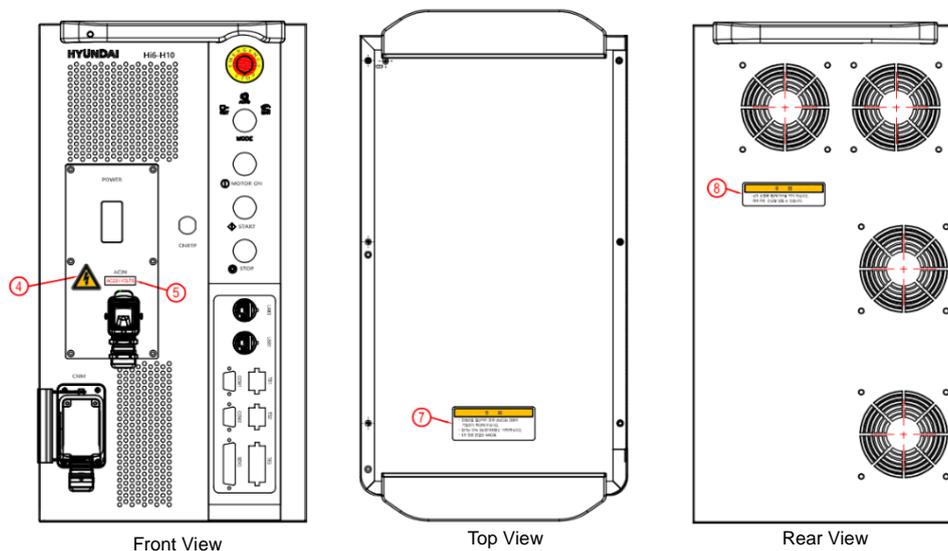


Figure 1 Figure 2 Safety label attachment points: front (left) / top (center) / rear (right)

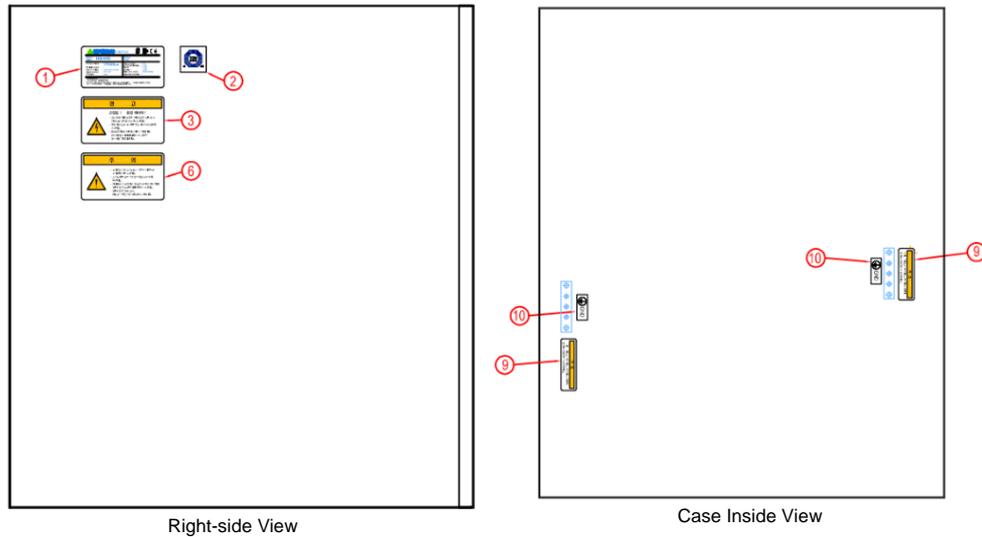


Figure 3 Safety label attachment points: side (left) / inner side (right)

**Warning**

Never make behaviors that damage safety labels, such as moving the position of the nameplate, warning signs, safety symbols, nomenclature markings, cable markings and the like attached to the controller, or hiding them by putting paint or covers.

**Caution**

Indicate the robot installation areas and hazard areas with distinct shapes, color, or styles, so that they are clearly distinguished from other facilities and equipment.

1.2.4 Emergency stop

The emergency stop function is actuated in emergency where a worker or object enters a hazard area. All the emergency stop switches are installed at places easily accessible from outside the safety areas.

When the emergency stop function is actuated, the robot will immediately stop moving in any case.

- The servo system power of the robot will be cut off and the motor brake will be actuated.
- On the teach pendant screen, an emergency stop message will appear.

1.2.4.1 Emergency stop switches

One emergency stop switch is installed each at the controller and the teach pendant. In case of emergency, press an emergency stop switch.

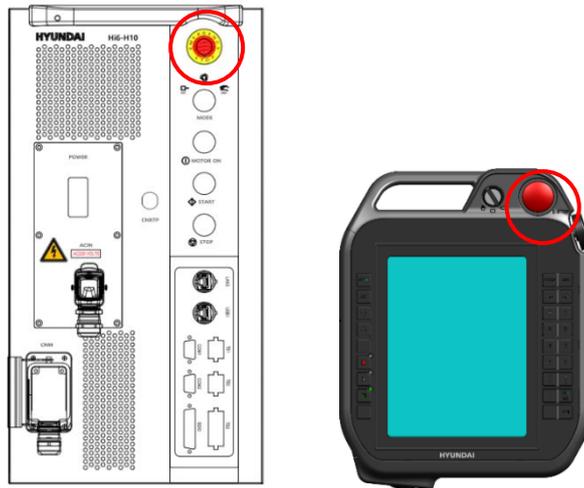


Figure 4 Emergency stop switches: controller (left) / teach pendant (right)

1.2.4.2 Connecting to emergency stop devices of external systems

In addition to the emergency stop switches installed by default, it is possible to add external emergency stop XL devices according to site conditions and applications. For more details, see “3.3.2.3 Terminal block (TB3): common safety signal I/O.”

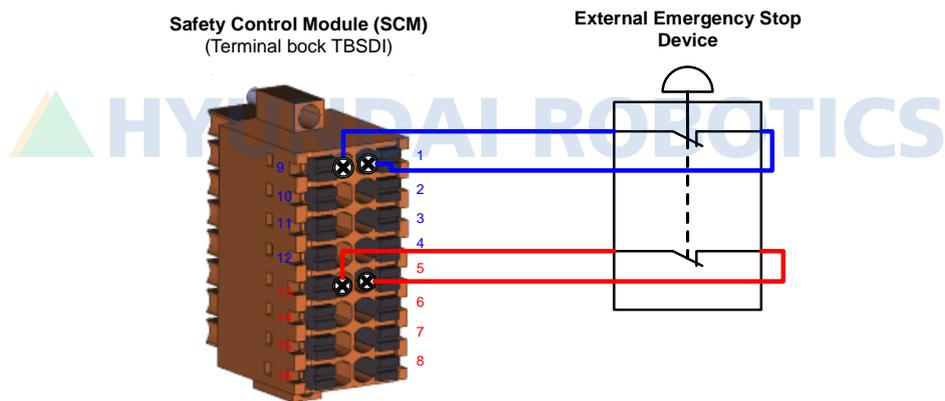


Figure 5 Connecting emergency stop device of a safety control module (SCM)

Note	See the details of “3.3.2.2 Terminal block (TB2): dedicated safety signal input” and “4.3.2 Safety control module.”
-------------	---

1.3 Risk assessment

In composing a robot integrated system, risk assessment is so important a factor that most countries specify it as a statutory requirement. Because safety assessments of robot installation vary depending on methods for integrating robots into systems, the risks of robot integrated systems cannot be assessed only by robots themselves.

System administrators should carry out risk assessment on system composition and operation according to the instructions specified in ISO 12100 and ISO 10218-2. The technical specifications of ISO/TS 15066 may be also referred to.

Carry out risk assessment in consideration of the entire processes of the integrated system including robots. The major objectives of risk assessment are as follows:

- Basic setting of robot use and robot teaching
- Problem diagnosis and maintenance
- Normal operation of installed robots

After installing robots and composing the system, risk assessment must be carried out. In risk assessment, the major points to be determined include the adequacy of the safety devices of robot integrated systems, and the necessity for additional emergency stop devices or other safety devices.

It is very important to compose robot integrated systems based on the identification of adequate safety devices. Compose robot integrated systems referring to the relevant details of the manual.

For collaborative robots, it is possible to set TCP speed, pressure, power, momentum, collision detection, limit values of reduction ratio, and limit values of joint-specific angles, speeds, and torques. In addition, safety functions can be composed by using safety-related I/Os. For more details for the composition of safety functions, see the “**Safety Function Manual for Collaborative Robots.**”

In the **[Safety functions]** menu, the safety-related functions of the collaborative robot can be set, including the following:

- Force and power limits: Limit the force and pressure at which the robot should stop in case of collision between the robot and an operator.
- Momentum limits: Limit energy and impact load by decreasing the robot's motion speed in case of collision between the robot and an operator.
- Joint and TCP position limits: Limit the robot's motion so that it does not move to body parts such as the user's neck or head.
- TCP and tool posture limits: Limit motion to reduce risks relating to specific sections or characteristics of tools and operating parts (e.g.: sharp points of tools or objects under operation).
- Speed limits: Limit the speed of the robot at a low speed so that an operator can escape collision with the robot.

In addition, safety-related functions can be composed by installing the robot at a specific location or using safety I/Os.

The major categories of the risk assessment of robot integrated systems include the following:

- Collision severity of robots
- Collision probability of robots
- Collision avoidance probability of robots

In composing robot systems, if risk factors (e.g.: use of tools unintended for collaborative robots) are not sufficiently removed by the robot's safety functions, the necessity for additional protective devices can be identified in the risk assessment.

1.4 Potential risks

In the risk assessment of a robot integrated system, if the assessment result indicates that risk factors are not sufficiently removed only by the robot's safety functions, additional protective measures must be established.

In establishing additional protective measures, the following should be considered:

- Finger pinching (entanglement) between the robot base and the installation support during installation
- Injuries (such as poking and piercing) due to sharp edges or protruding parts of obstacles or tools in the operating area
- Injuries due to collision with the robot (such as bruises, falling, bone fractures)
- Injuries due to obstacles around the robot (such as poking, piercing, and bone fractures)
- Injuries due to loose connections
- Injuries due to toxic or hazardous substances under work (such as skin damages, and breathing disorders)
- Displacement of objects under work due to abrupt power shut-offs
- Erroneous activation of emergency stop switches due to confusion with those of other equipment
- Errors due to arbitrary modification of the settings of safety functions

Because the types of potential risks vary depending on system compositions, risk assessment must be carried out before using a robot integrated system.

1.5 Validity and responsibilities

The user should conform to the safety requirements specified in the safety laws and regulations of the country and locality in which the robot is installed and used. Responsibilities of suppliers and users of robot integrated systems include but are not limited to the following:

- Risk assessment of robot integrated systems
- Addition or removal of safety devices according to the result of risk assessment
- Checking that robot integrated systems are properly composed, installed and set
- Establishment of the methods and instructions for using robot integrated systems, and provision of user training
- Management of safety devices (prohibition of users from arbitrary modification and manipulation of safety devices)
- Provision of important pieces of information, contact addresses and the like relating to product use and safety
- Provision of all types of technical documents including manuals

The safety-related content of this manual does not cover all the risk factors and situations that may occur during product use.



2. Introduction to the product

This product, which is an industrial collaborative robot that can be used for moving objects or assembling parts by using various tools, may be used only in environments that meet the requirements specified in this manual. This product, which is manufactured for the purpose of collaborative works with persons, has safety functions that enable collaborative works without physical protective devices.



Figure 6 Collaborative robot and controller



Caution

In composing a system linked with tools, objects under work, and other additional equipment, final risk assessment must be carried out for verifying safety of the system before using it.

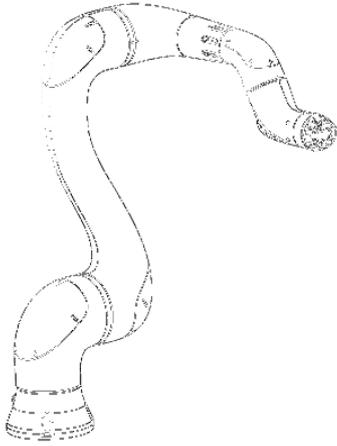
2.1 Intended uses of the product

This product may be used only for the specified intended uses. Use of this product for other purposes than the intended uses will be considered as an inappropriate behavior. Hyundai Robotics will not take responsibilities for injuries or property losses including product damages and faults caused by unintended uses of this product. Examples of improper uses of this product include the following:

- Using the product as a means of stepping on
- Using the product for moving persons or animals
- Using the product in areas relating to healthcare and human lives
- Using the product in environments of explosion hazards
- Using the product without carrying out risk assessment
- Using the product in conditions where the requirements for the performance of safety functions are not met
- Using the product at places where the performance and environmental requirements are not met
- Using the product (e.g. for welding) at places where electromagnetic waves higher than those specified in the international standard (IEC) are radiated

2.2 Product components

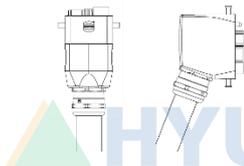
Upon purchasing the product, make sure to check that it includes all the components supposed to be supplied. If it does not include any components, contact our Customer Support Team or make a query on our website (www.hyundai-robotics.com).



Collaborative robot



Controller



Robot connection cables



Teach pendant



Power connector

User manual

Note

- The available collaborative robot models are YL005, YL012, and YL015. This maintenance manual describes the methods for composing, installing, using, and maintaining them based on the YL012 model.
- Partial details including components, product parts, and methods for using may be different depending on collaborative robot models.
- If you use a hand strap, you can use the teach pendant held to the hand without having it fall.
- If you retain the packaging materials of the product, you may use them later for transporting and storing it.

2.3 Part names

Identifying the part names of the product is useful for finding out how to install and use it.

2.3.1 Collaborative robot

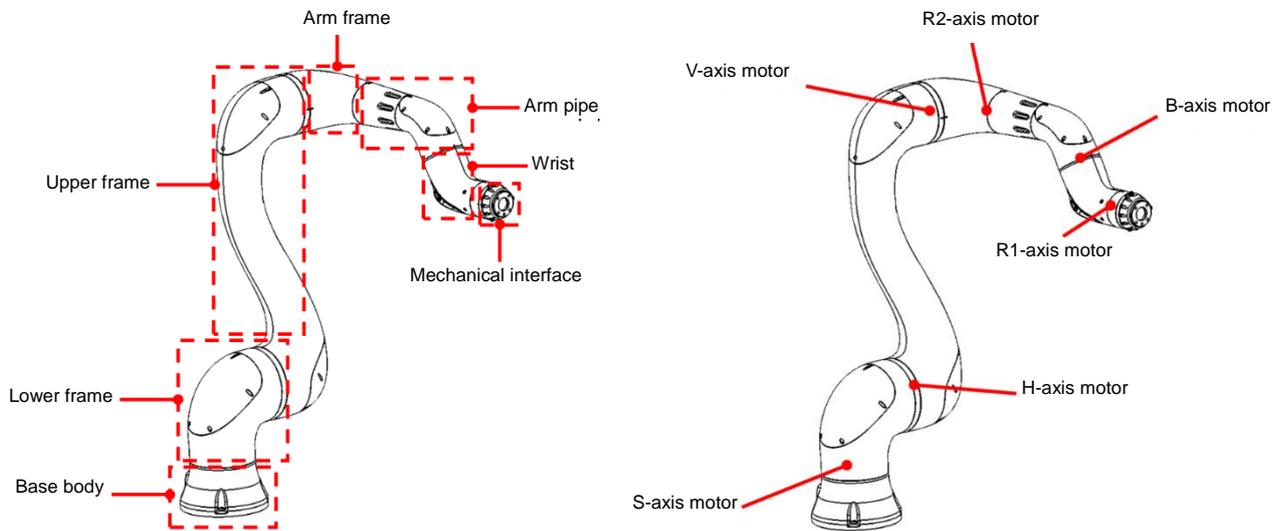


Figure 7 Layout of the collaborative robot (left) / axial motors (right)

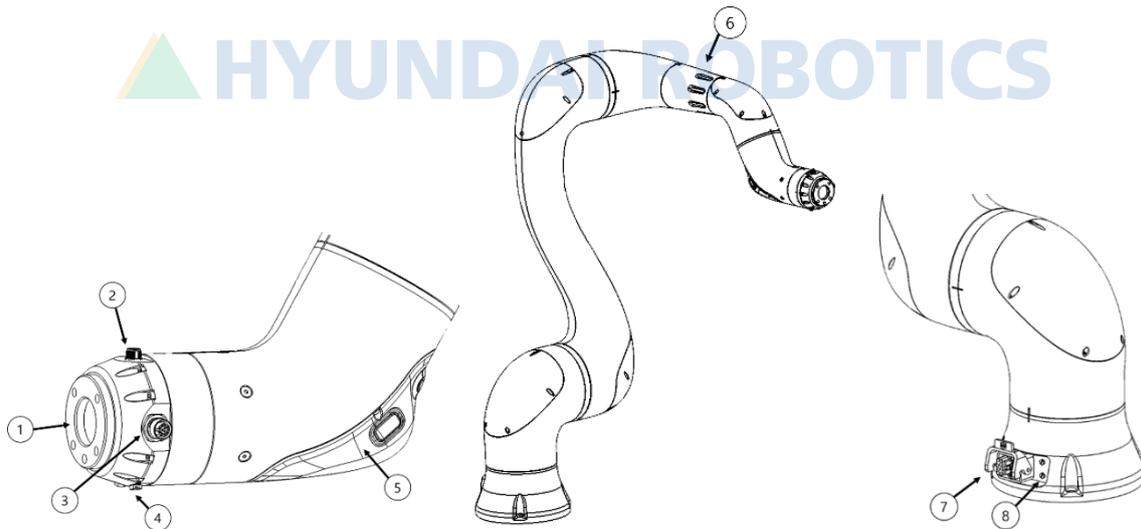


Figure Major parts of the collaborative robot

No.	Name	Description
1	Tool flange	This mounts tools to the robot.
2	EtherCAT connector	This establishes communication with tools through EtherCAT-based terminals. For more details of EtherCAT, see “3.3.1 Tool flange connection point.”
3	Tool I/O connectors	These control the motion of tools. For more details of the tool I/O, see “3.3.1 Tool flange connection point.”
4	Air outlets	(YL012, YL015) These are used for moving various tools by connecting pneumatic hoses (∅ 3.2, two pieces).
5	Hand-grip module	This is used for direct teaching.

No.	Name	Description
6	LED lamp	<p>(YL102) This indicates the operating states of the robot.</p> <ul style="list-style-type: none"> • OFF: The power of the robot system is off. • ON: The power of the robot system is on. Different colors of the LED lamp indicate the following states of the robot: <ul style="list-style-type: none"> • White: The servo motor is waiting for actuation (the power is on or the brake is on) or is in the normal stop state. • Green: The servo motor is actuated (the power is on or the brake is off). At this state, jog operation, step forward/backward motion, and playback are possible. • Blue: The servo motor is actuated in the direct teaching mode. At this state, only direct teaching is possible. • Red: The robot is stopped due to an error. Resolve the error and try actuating the servo motor.
7	Power and communication connectors	These supply power to and communicate with the robot, respectively.
8	Air inlet	This supplies pneumatic pressure through the pneumatic hose.

Note

- Air outlets are available only for the YL012 and the YL015 models.
- The LED lamp position varies depending on models. In the cases of the YL005 and the YL015 models, the LED lamp is on the upper frame cover.

2.3.2 Controller

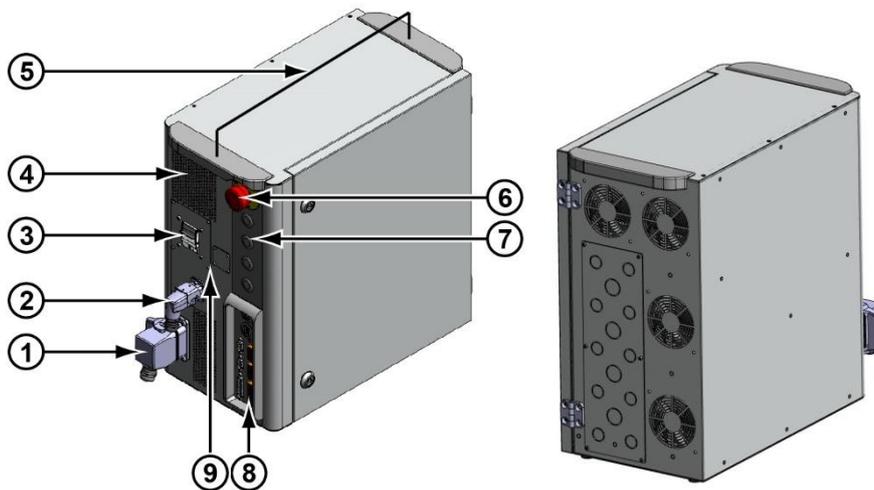


Figure 8 Controller front side (left) / rear side (right)

Simultaneous drawing of the front and the rear sides

No.	Name	Description
1	Robot cable connector	This contains the power cable and the communication cable and connects the controller with the device.
2	Power connector	This connector supplies power to the controller.
3	Power breaker	This turns on or off the main power of the controller by means of the power switch.

No.	Name	Description
4	Ventilation hole	This is the air flow path for cooling the controller.
5	Handles	These, mounted on the front and the rear of the controller, are used for moving it.
6	Emergency stop switch	In case of emergency, it is pressed to stop the motion of the robot.
7	Application device connection hole	This is the path used for passing cables connecting application devices with the internal modules.
8	I/O connection block	This connects peripheral devices to the controller.
9	Teach pendant connection hole	This is the path used for connecting a teach pendant of the direct-connection type.
10	Cooling fan	This forcibly vents out the heated air inside the controller.
11	Door	This door is used for opening a side of the controller.

2.3.3 Teach pendant

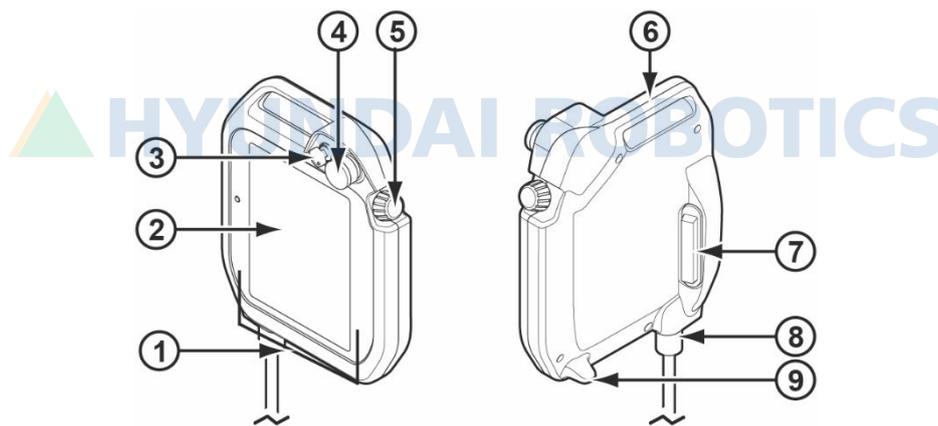


Figure 9 Teach pendant front side (left) / rear side (right)

No.	Name	Description
1	Operating keys	These are used for controlling the robot motion, entering commands, selecting and setting menus.
2	Display	This displays and allows modification of the robot's motion states and setting information.
3	Mode switch	This is rotated for selecting operating modes (automatic, manual, and remote).
4	Emergency stop switch	In case of emergency, it is pressed to stop the motion of the robot.
5	Jog dial	This is rotated for selecting menus.
6	Mounting bracket	This is used for keeping the teach pendant suspended or hung.
7	Enabling switch	This is used as a safety switch when the robot is operated by the teach pendant in the manual mode. <ul style="list-style-type: none"> Step 1, Step 3: At these steps, the robot operation is stopped. At Step 3, it

No.	Name	Description
		returns to Step 1 without going through Step 2. <ul style="list-style-type: none"> Step 2: At this step, the robot can be operated.
8	Cable connector	This connects cables with the controller.
9	USB port	This is for connecting USB devices such as portable storage media.

2.4 Nameplate

The nameplate attached on the product contains such information as robot type, manufacture number, and manufacture date. Compare it with the specifications of the purchased product.

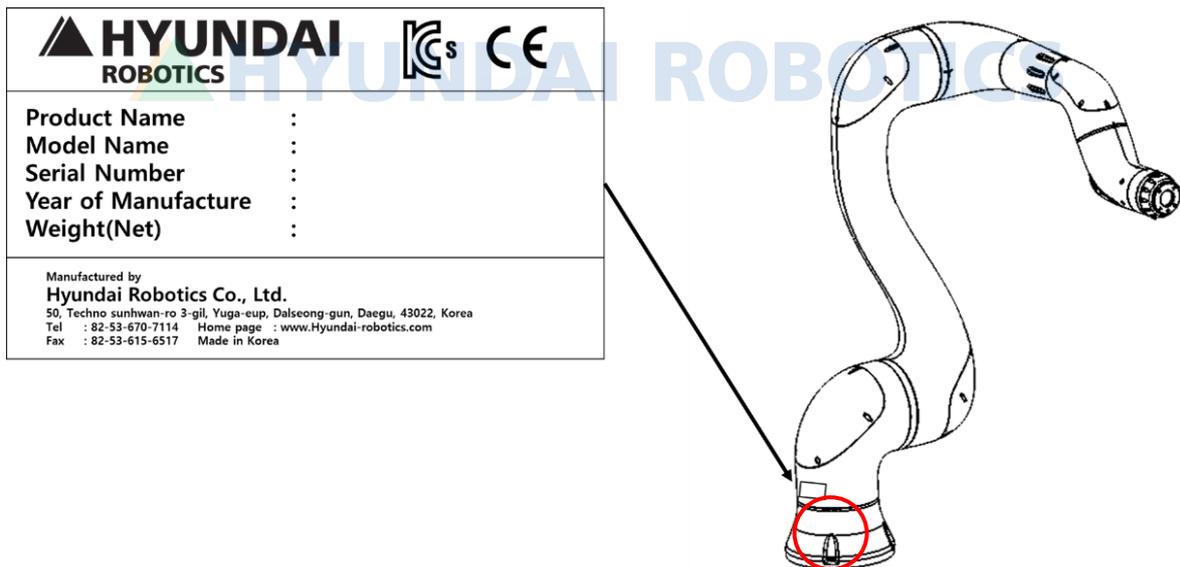
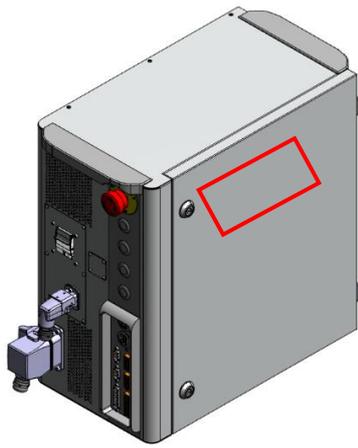


Figure 10 Nameplate of the collaborative robot



Model Name	Hi6-H10	Robot Type	
Product Name	: Robot Controller for Collaborative Tasks	Max. Current	: 20 A
Serial Number	:	Interrupting Cap.	: 2.5 kA
Rated Voltage	: AC110V/220V, 50/60Hz	SCCR	: 2.5 kA
Rated Current	: 15 A / 10A	Weight	: 27 Kg
IP Grade	: IP20	Size (W x H x D)	: 260x490x510mm
		Manufacture Date	:

Manufactured by
HYUNDAI ROBOTICS
 50, Techno sunhwan-ro 3-gil, Geum-ri, Yuga-eup, Dalseong-gun, Daegu, Republic of Korea
 Tel : +82)53-670-7072 / Web page : www.hyundai-robotics.com

Figure 11 Nameplate of the controller

The model names of Hyundai Robotics collaborative robots and controllers are denoted as follows:

Division	Information	
Collaborative robot 	1	Robot code YL: Collaborative robot
	2	Payload 005: 5 kg / 012: 12 kg / 015: 15 kg
	3	Material - : standard material
	4	Specification number
Controller 	1	Platform Hi6: Hi6 platform
	2	Controller code H: for collaborative robots
	3	Material <ul style="list-style-type: none"> • 00: Plastic case • 10: Metallic case

3. Product installation

Installing the product properly in consideration of installation location, orientation, and adjacent space can increase the product's service life and prevent performance degradation. The installation sequence of the collaborative robot is as follows:

1. Check the environments of installation and use.
2. Check the operating area of the robot.
3. Check the allowable limit of wrist axis load and the payload of the robot.
4. Compose the robot system and install devices.
5. Connect a tool.
6. Connect external devices and safety devices.
7. Set the operating area of the robot: function for limiting safety-rated ductile axis and space, and criteria for stopping distance and stopping time
8. Set safety functions.
9. Pilot-operate the robot: Check that the setting and the safety functions run normally.

Caution

- Before installing the product, make sure to carry out sufficient risk assessment, and set the safety functions based on the result of the assessment.
- For more details of the safety functions, see the “**Safety Function Manual for Collaborative Robots.**”

3.1 Environment of installation and preparation

3.1.1 Environments of installation and use

Install the product at an adequate place in consideration of the requirements for the environments of installation and use.

- The adequate temperature of use for the product is 0°C - 45°C, and the adequate storage humidity is 20%-85% RH.
- In moving or using the product, do not give high impacts to it, for example, by dropping it.
- Based on the weight of the product, move and install it by the proper method, paying attention to safety.
- Install and use the product at a hard, flat, and no-vibration place where the product cannot easily tumble.
- Do not install and use the product at a place of much water, moisture, gas, dust, or dirt.
- Do not install and use the product at a place of flammable or corrosive materials/gases, or high heat, or flames.
- Do not install and use the product at a place of sources of strong electric noises, or a place subject to the influence of such sources.

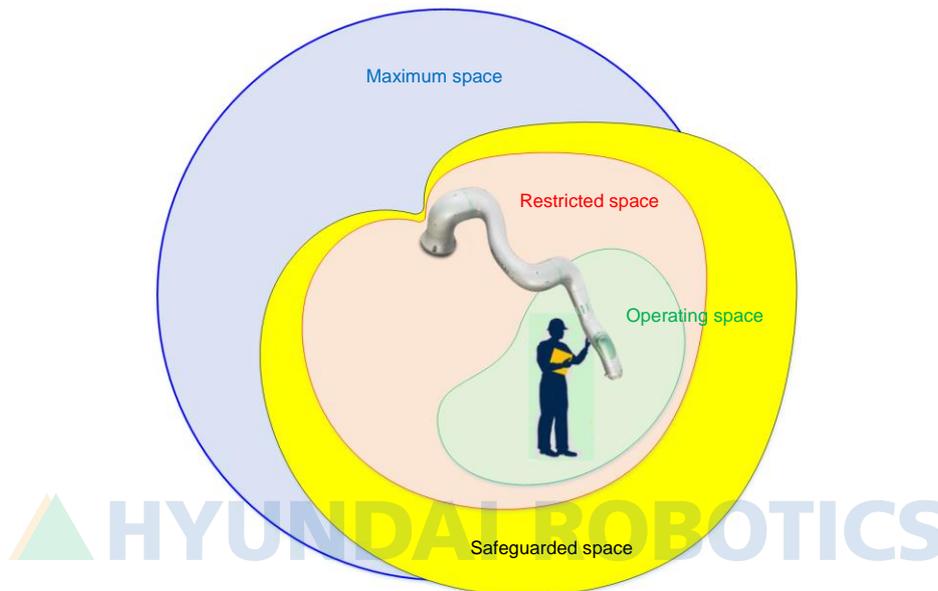
Caution

Installing the product at a non-recommended place may lead to decrease in the product performance and service life. Conform to the recommendations in installing and using the product.

3.1.2 Spaces of robot systems

Spaces of robot systems and the maximum operation spaces where collaborative robots can move vary depending on models. Check the following information, and compose the space adequately to meet the operating purpose and the maximum operating space of the model.

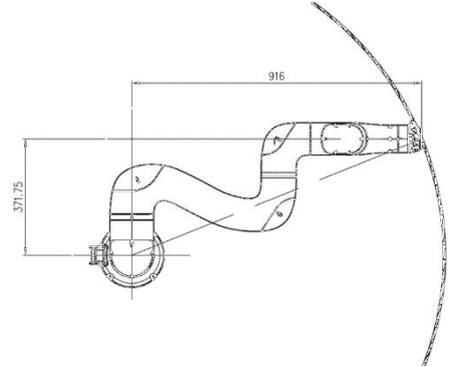
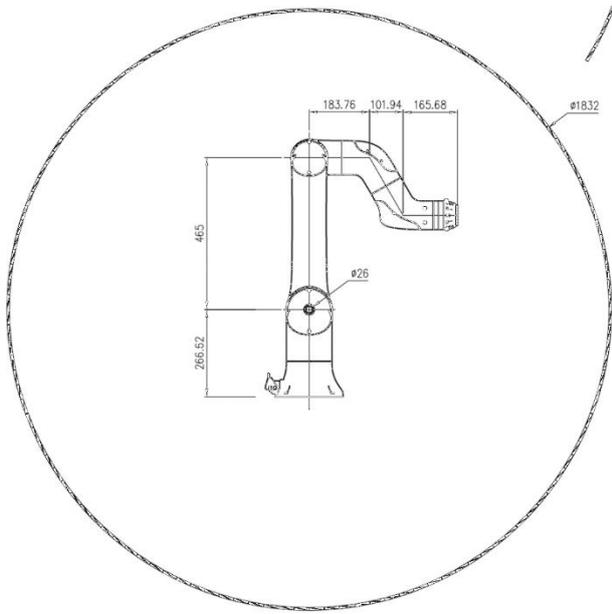
In collaborative operation in which the operator is allowed to contact the robot system, the operator should work in the operating space. On the contrary, in collaborative operation in which the operator is not allowed to contact the robot system, the operator should work only in the safeguarded space. In the general operation of industrial robots, the operator should work outside of the safeguarded space.



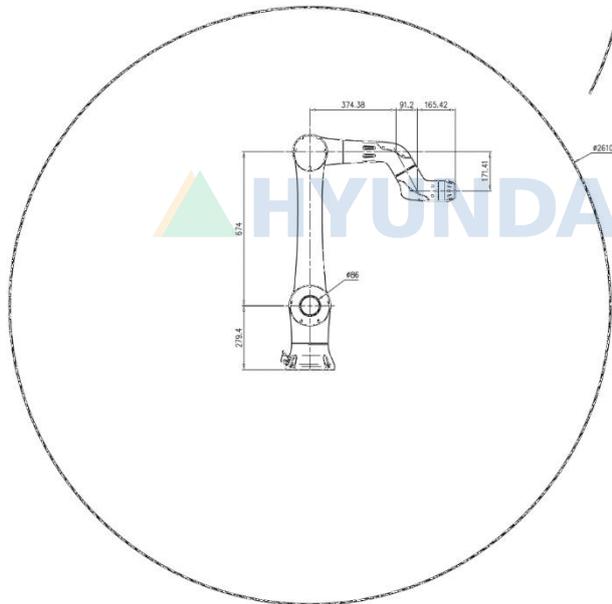
- Operating space: a part of the restricted space that is used while the robot moves according to the operating program
- Restricted space: a part of the maximum space that is restricted by restricting devices
- Safeguarded space: a space for which safeguarding devices run
- Maximum space: a space in which the robot can move to the maximum extent

The maximum spaces of collaborative robots vary depending on models. The maximum spaces of models are as follows:

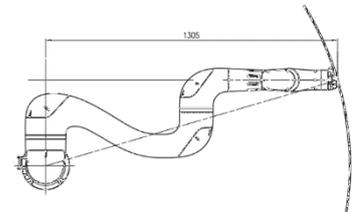
- YL005: 916 mm



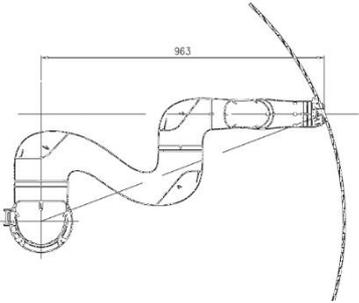
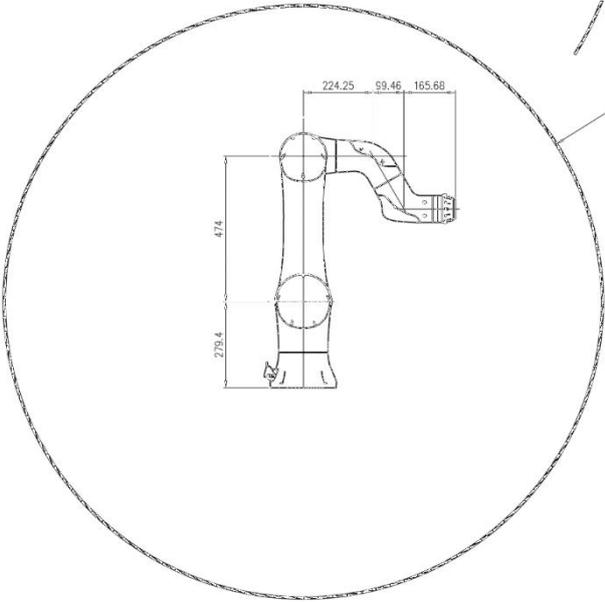
- YL012: 1,305 mm



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- YL015: 963 mm



3.1.3 Allowable limit of wrist axis load

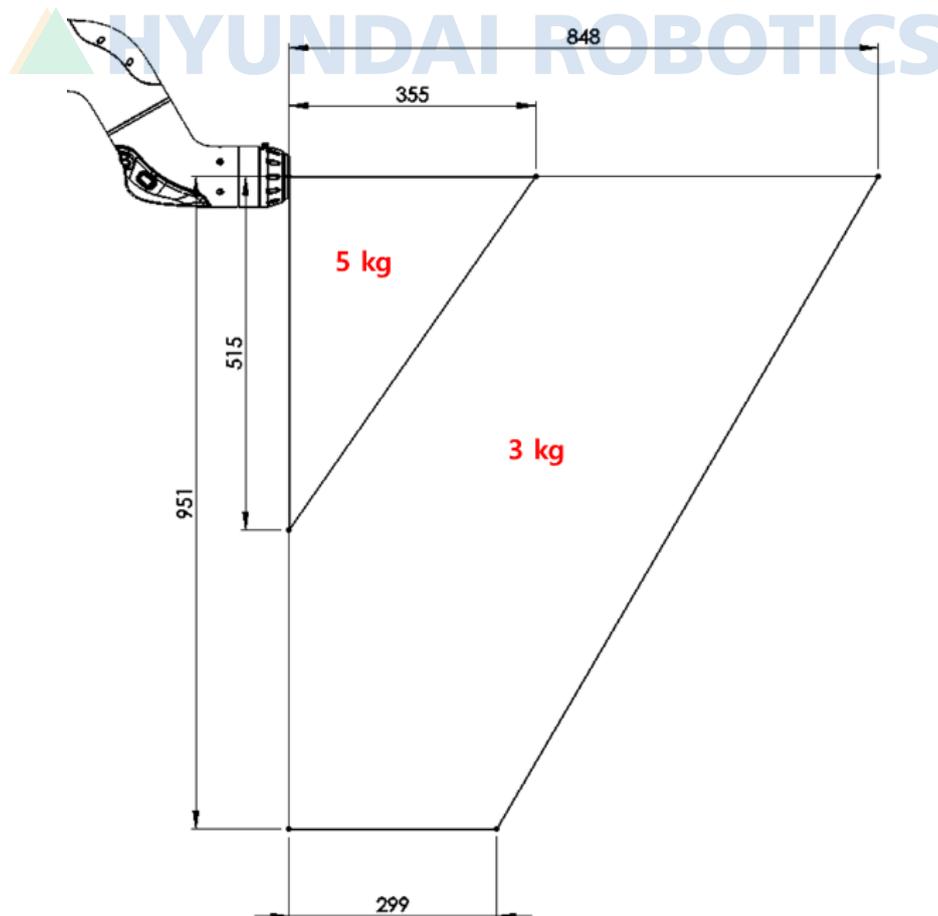
The load to be applied to the tip of the wrist axis of a collaborative robot is regulated by the allowable weight, allowable load torque, and allowable moment of inertia. The allowable limits of wrist axis load of the models are as follows:

Division		YL005	YL012	YL015
Weight		49 N (5 kgf) maximum	117.6 N (12 kgf) maximum	147 N (15 kgf) maximum
Load torque	R2-axis rotation	Rating: 48 Nm (4.9 kgf-m)	Rating: 49 Nm (5.0 kgf-m)	Rating: 49 Nm (5.0 kgf-m)
	B-axis rotation	Rating: 26.5 Nm (2.7 kgf-m)	Rating: 54.9 Nm (5.6 kgf-m)	Rating: 54.9 Nm (5.6 kgf-m)
	R1-axis rotation	Rating: 27.4 Nm (2.8 kgf-m)	Rating: 27.4 Nm (2.8 kgf-m)	Rating: 27.4 Nm (2.8 kgf-m)

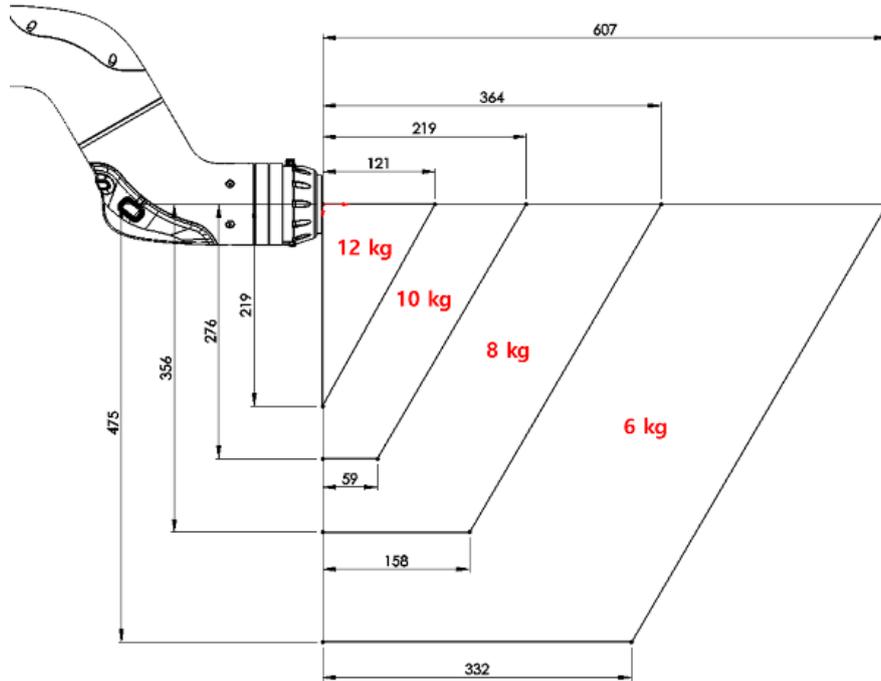
3.1.4 Payload

The maximum payloads of collaborative robots vary depending on distances to the center of gravity. The maximum payloads of the models are as follows:

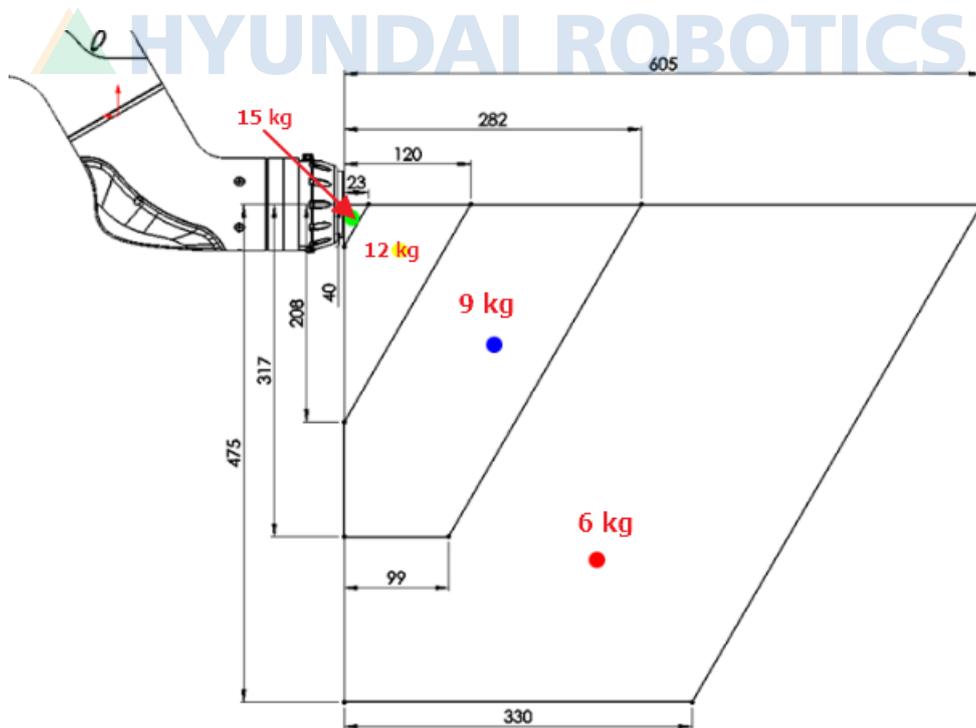
- YL005



- YL012



- YL015



3.2 Product installation

The product should be installed by qualified experts in compliance with the applicable laws and regulations of the pertaining country and locality.

- Upon unpacking the product, check that the product is not damaged during the transportation and unpacking.
- After unpacking and before installing the product, make sure to check the safety regulations and instructions, as well as the requirements for the installation and use of the product, and be fully knowledgeable of the installation method.

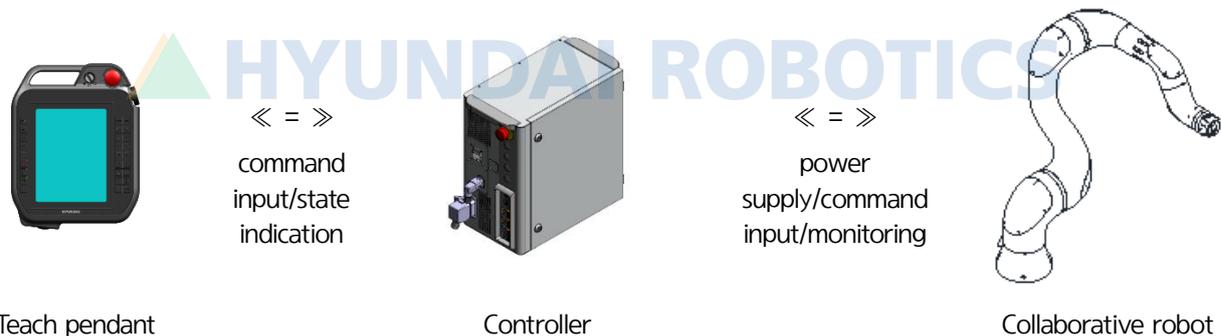


Caution

- The robot should be installed and operated according to the guidelines specified in ISO 10218-2, and in compliance with the requirements specified in the applicable international standards such as ISO/TS 15066 and national statutes.
- Hyundai Robotics (or manufacturer) will not take responsibilities for accidents due to non-compliance with the applicable international standards and national statutes, or due to non-review of “**Risk assessment.**”

3.2.1 Composition of robot systems

A collaborative robot system, as an integrated system interfaced with peripheral devices, should be composed and connected with a selection of adequate peripheral devices.



Teach pendant

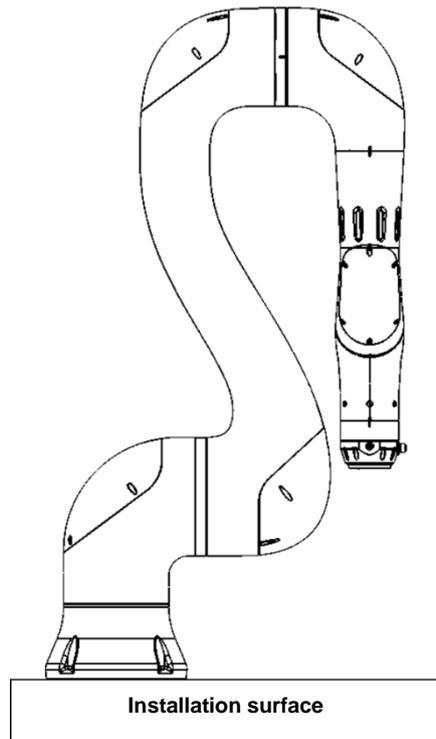
Controller

Collaborative robot

- Teach pendant: This is the I/O device that enables command input and state view for controlling the entire robot system. It can teach specific postures to the robot, or set/control the program.
- Controller: This controls the motion of the robot according to the setting values of the program configured by the teach pendant. Using the I/O ports of the controller, you can compose a system interfaced with various external equipment or devices.
- Collaborative robot: This is a robot intended for attaching various tools and making collaborative operation for moving objects or assembling parts.

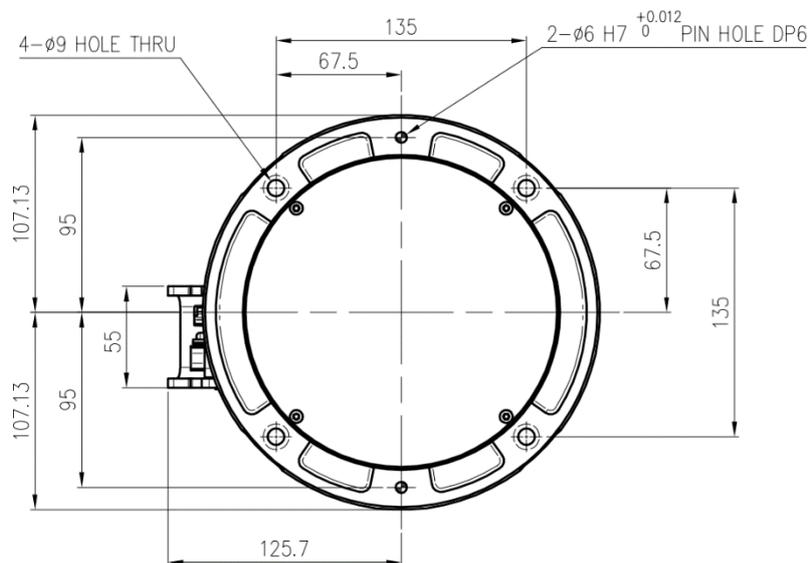
3.2.2 Robot and controller installation

1. Check the concrete thickness of the surface on which the collaborative robot will be installed. You should prepare for the installation according to the concrete thickness.
 - If it is ≥ 200 mm, fixate the mounting plate at the robot installation point, referring to “**3.2.2.1 Mounting plate installation.**”
 - If it is < 200 mm, consult with our Customer Support Team, and carry out additional foundation work.
2. Put the collaborative robot on the installation point.



Because the collaborative robot cannot stand by itself, the installation requires two or more workers. While one worker holds the robot, the other worker(s) should fixate it.

- Using hex wrench bolts (M8 (12.9), four pieces), fixate the collaborative robot.



- The proper tightening torque of the bolts is 340 kgf·cm.
- If you use the positioning pins (Φ6, two pieces), you can install the collaborative robot accurately at a specific point.
- Connecting an earth cable will prevent electrostatic discharge.
- The information on the installation positions of YL005 and YL015 are the same with that of YL012.



Tighten the bolts firmly so that they do not become loose during robot operation.

4. Ensure that the robot base completely contacts the installation surface.
5. Check the installation space of the collaborative robot, and place the robot controller at a proper point.

Caution

- Place the controller at a cool dry place, and keep it away from moisture or water.
- Allow sufficient buffer space around the controller for air circulation. Ensure that no obstacles block the vent hole and the cooling fan on the front and the rear of the controller.

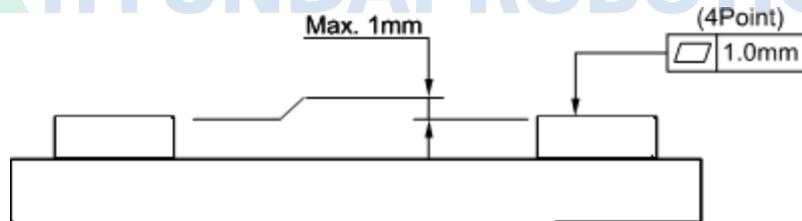
3.2.2.1 Mounting plate installation

The firmness of the floor on which the collaborative robot will be installed should be designed to minimize the dynamic impact of the robot. If the firmness of the installation surface is not sufficient for supporting the robot arm, you may use a mounting plate for the product installation.

Warning

The robot installation surface should be firm enough to bear both the weight of the robot and the load that occurs during robot operation.

6. Check the installation surface of the collaborative robot, and remove any uneven points, cracks, and the like.
7. Put the mounting plate on the surface on which the collaborative robot will be installed.
8. Pass the anchor bolts (M20) through the bolt holes of the top contacting surface of the mounting plate, and fixate them by fastening to an adequate torque or by hammering them. The anchor bolts should not protrude from the contacting surface of the mounting plate by no more than 1.0 mm (± 0.5 mm).

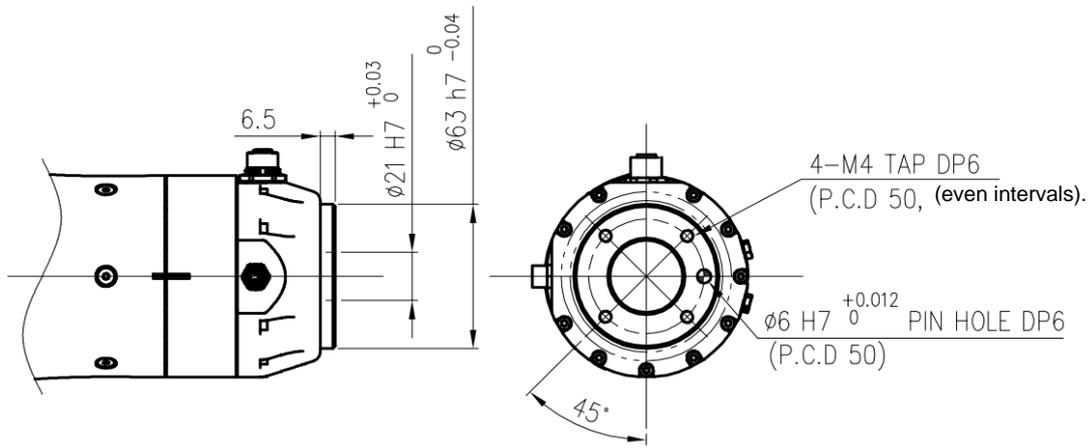


- The flatness of the other areas should be no more than ± 2 mm.
- The flatness of the four sheets of the mounting plates should be no more than 1.0 mm.
- The flatness of the four contacting surfaces of the mounting plates should be no more than 1.0 mm (± 0.5 mm).
- When necessary, fill any gaps with shims.

3.2.3 Tool connection

Connect a necessary tool to the collaborative robot.

9. Check the connection port of the tool flange of the collaborative robot.



10. Insert the tool into the tool flange, and fixate the tool to the flange by using hex wrench bolts (M6 (12.9), four pieces) and pins ($\phi 6$).

- The proper tightening torque of the bolts is 127 kgf·cm.

Figure showing the insertion of the tool into the flange (1), and bolting (2): arrows and numbers used



11. To the connectors of the tool flange, connect the tool I/O cable and the EtherCAT cable.

- If you need to use a pneumatic line, assemble the one-touch fittings (M5), and connect the hoses ($\phi 3.2$, two pieces) to the air outlets.

Figure showing the cables connected between the tool and the flange

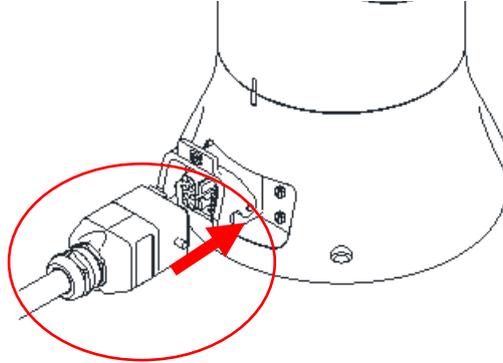
Note

- The connection methods may vary depending on tools to be used. For more details of the tool connection method, see the manual of the tool.
- For more details of the tool I/O and the pin map of EtherCAT, see “3.3.1 Tool flange connection point.”

3.2.4 Wiring

Check the connection ports of the collaborative robot and the controller, and connect them with the proper cable.

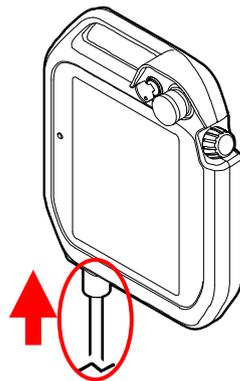
12. Insert the robot connection cable into the connection terminal of the base of the collaborative robot, and clamp the cable with the connection ring so that the cable cannot be disconnected.



13. Insert the other end of the robot connection cable into the connection terminal on the front of the controller, and clamp the cable with the connection ring so that the cable cannot be disconnected.



14. Connect the teach pendant connection cable of the controller to the cable connector of the teach pendant.



15. Referring to the power connector pin map, connect one end of the power cable to the power connector.

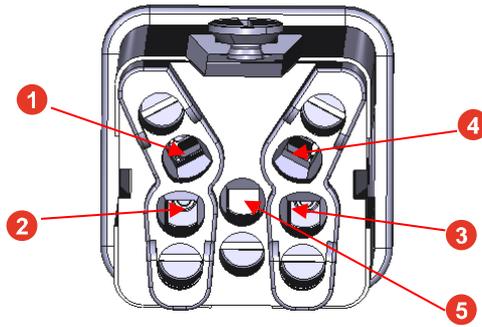
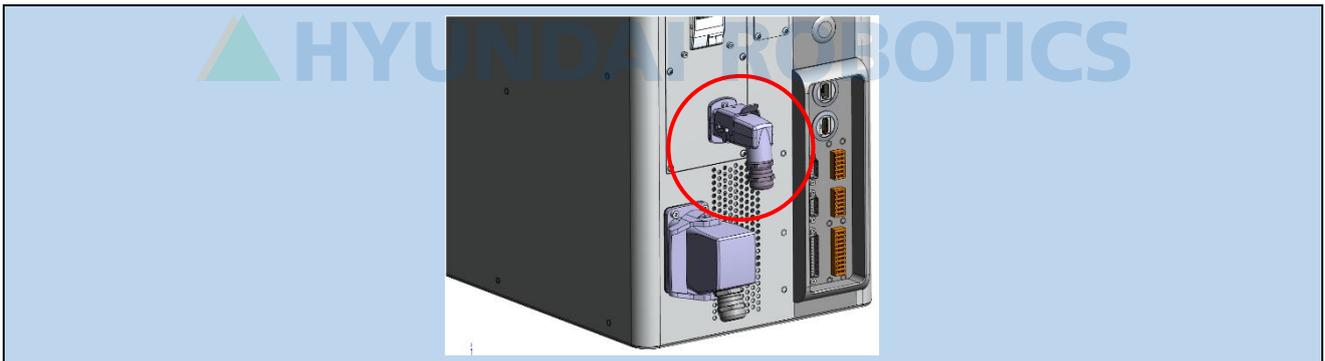


Figure 12 Power connector pin map

No.	Name	Description	Specification
1	R	AC220V L-phase	16 AWG
2	(R)	AC220V L-phase addition (connected for power increase)	16 AWG
3	(T)	AC220V T-phase addition (connected for power increase)	16 AWG
4	T	AC220V T-phase	16 AWG
5	FG	Frame ground	16 AWG

16. Connect one end of the power cable to the power connector on the front of the controller.



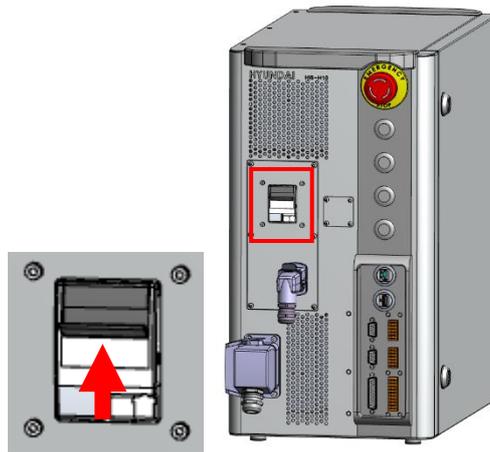
17. Connect the other end of the power cable to the power source.

 Caution	<ul style="list-style-type: none"> • Make sure to power off the product before carrying out any types of wiring, termination, and electrical work. • Check the shapes of the cable connectors, and connect the proper cables to them, without applying excessive force. Excessive force may bend or damage the pins. • Do not modify or extend cables in an arbitrary manner. • Hyundai Robotics will not take responsibilities for product damages due to customer's carelessness, unskillful operation, and errors. Never arbitrarily modify, disassemble or repair the product.
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3.2.5 Powering on

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

Push up the switch of the power breaker. When the power is applied, the robot system will boot, the display of the teaching pendant will turn, and the LED lamp of the collaborative robot will light in white.



3.3 Robot interface

Paying attention to the following precautions, connect tools and external devices.

- Make sure to power off the product before carrying out any types of wiring, termination, and electrical work.
- Check the shapes of the cable connectors, and connect the proper cables to them, without applying excessive force. Excessive force may bend or damage the pins.
- Do not modify or extend cables in an arbitrary manner.

Hyundai Robotics will not take responsibilities for product damages due to customer's carelessness, unskillful operation, and errors. Never arbitrarily modify, disassemble or repair the product.

3.3.1 Tool flange connection point

Connect the tool to the connection port of the tool flange at the tip of the collaborative robot.

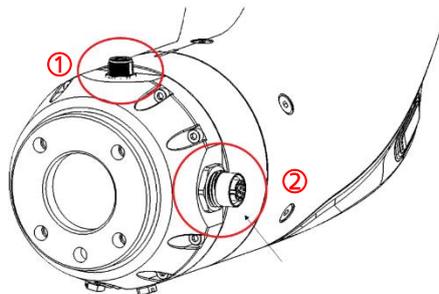
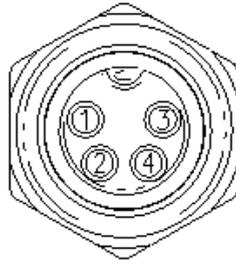


Figure 13 Tool flange connection point

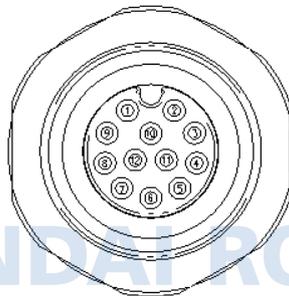
No.	Description
①	EtherCAT connection port (T4071017041-001 (TE)): for EtherCAT communication
②	Tool I/O connection port (T41171130012-001 (TE)): for controlling tool motion

3.3.1.1 T4071017041-001 (TE) pin map



No.	Description	No.	Description
1	TX +	3	RX +
2	TX -	4	RX -

3.3.1.2 T41171130012-001 (TE) pin map



No.	Description	No.	Description
1	Digital output CH0	7	Digital input CH2
2	Digital output CH1	8	Digital input CH3
3	Digital output CH2	9	Analog input CH0
4	Digital output CH3	10	Analog input CH1
5	Digital input CH0	11	Voltage output
6	Digital input CH1	12	GND

3.3.2 External device interface

You can connect various external devices to the external device interface on the front of the controller.

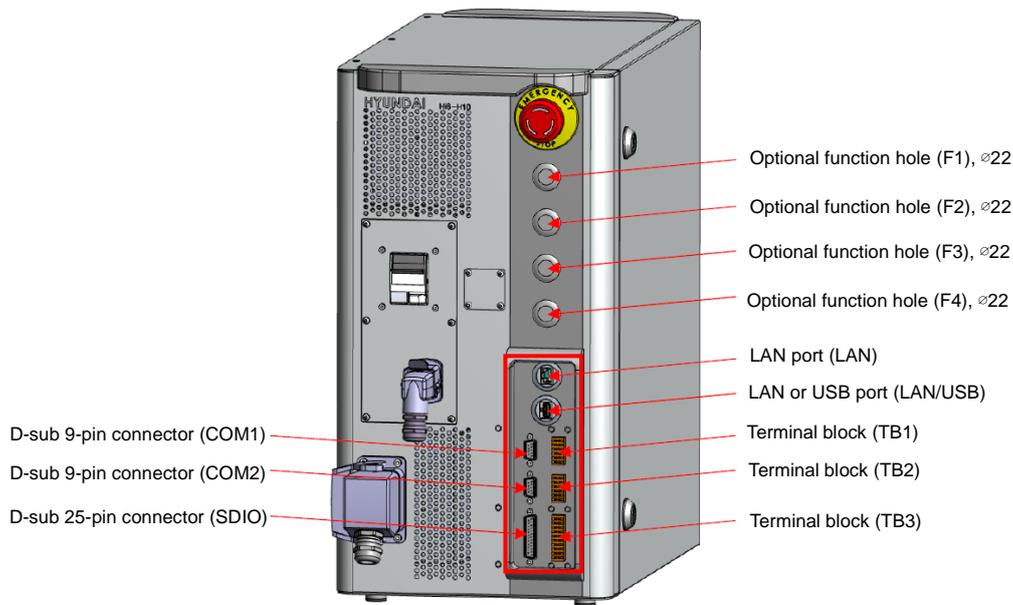
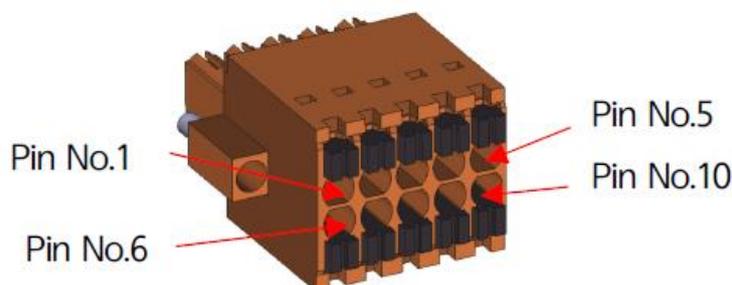


Figure 14 External device interface

No.	Description
1	LAN port
2	USB port
3	D-sub connectors <ul style="list-style-type: none"> 9-pin (COM1, COM2): serial communication (RS485, 422) 25-pin (SDIO): common digital I/O
4	Terminal blocks <ul style="list-style-type: none"> TB1: common analog I/O TB2: dedicated safety signal input TB3: common safety signal I/O
Note	<ul style="list-style-type: none"> The external device interface is described based on the composition of basic connections. If you desire to install additional optional items and connect them to the external device interface, you may change the composition of basic connections. For more details of the installation of additional optional items and the composition of connections, consult with our Customer Support Team.

3.3.2.1 Terminal block (TB1): common analog I/O signals

You can connect common analog I/O signals, two at a time, to Terminal Block, TB1. For more details of signal connection, see “4.3.2.5 Connection of common digital I/O signals (TBAIO).”



Pin number	1	2	3	4	5
Name	GAIN0_N	GAIN1_N	GND_A	GND_A	-
Usage	Ground of GAIN0 for common analog input	Ground of GAIN1 for common analog input	Common analog ground	Common analog ground	-
Internal connections of the controller	SCM TBAIO/1	SCM TBAIO/2	SCM TBAIO/3	SCM TBAIO/4	
	BD5B3T DSW1/6 OFF	BD5B3T DSW1/7 OFF	BD5B3T DSW1/8 OFF	BD5B3T DSW1/9 OFF	BD5B3T DSW1/10 OFF

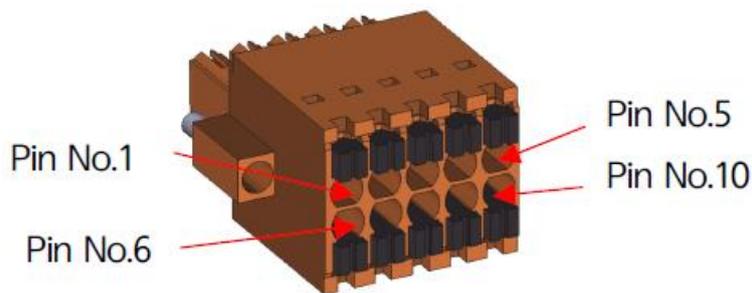
Pin number	6	7	8	9	10
Name	GAIN0	GAIN1	GAOUT0	GAOUT1	-
Usage	Common analog input 0	Common analog input 1	Common analog output 0	Common analog output 1	-
Internal connections of the controller	SCM TBAIO/5	SCM TBAIO/6	SCM TBAIO/7	SCM TBAIO/8	
	BD5B3T DSW1/6 OFF	BD5B3T DSW1/7 OFF	BD5B3T DSW1/8 OFF	BD5B3T DSW1/9 OFF	BD5B3T DSW1/10 OFF

Caution

- Set all the pins from 6 to 10 of BD5B3T DSW1 at the OFF position.
- If you set all the pins from 6 to 10 of BD5B3T DSW1 at the ON position, the pin combinations of 1-6, 2-7, 3-4, and 5-10 of the Terminal Block (TB1) will be short-circuited. Therefore, pay attention not to set them at the ON position.

3.3.2.2 Terminal block (TB2): dedicated safety signal input

You can connect I/O signals dedicated to the robot system, such as the signals of safeguarding devices, through Terminal Block, TB2. For more details of signal connection, see “4.3.2.3 Connection of I/O signals for the robot system (TBSYS1).”



Pin number	1	2	3	4	5
Name	SF_POW1	SF_POW2			
Usage	Protective stop input common (Channel 1)	Protective stop input common (Channel 2)	-	-	-
Internal connections of	SCM TBSYS1/1	SCM TBSYS1/2	-	-	-
	BD5B3T CN2/1	BD5B3T CN2/3	BD5B3T CN2/5	BD5B3T CN2/7	BD5B3T CN2/9

the controller	BD5B3T DSW1/1 OFF	BD5B3T DSW1/2 OFF	BD5B3T DSW1/3 OFF	BD5B3T DSW1/4 OFF	BD5B3T DSW1/5 OFF
Pin number	6	7	8	9	10
Name	SG1	SG2	-	-	-
Usage	Protective stop input (Channel 1)	Protective stop input (Channel 2)	-	-	-
Internal connections of the controller	SCM TBSYS1/9	SCM TBSYS1/10	-	-	-
	BD5B3T CN2/2	BD5B3T CN2/4	BD5B3T CN2/6	BD5B3T CN2/8	BD5B3T CN2/10
	BD5B3T DSW1/1 OFF	BD5B3T DSW1/2 OFF	BD5B3T DSW1/3 OFF	BD5B3T DSW1/4 OFF	BD5B3T DSW1/5 OFF

 **Caution**

- Set all the pins from 1 to 5 of BD5B3T DSW1 at the OFF position.
- If you set all the pins from 1 to 5 of BD5B3T DSW1 at the ON position, the pin combinations of 1-6, 2-7, 3-4, and 5-10 of the Terminal Block (TB2) will be short-circuited. Therefore, pay attention not to set them at the ON position.



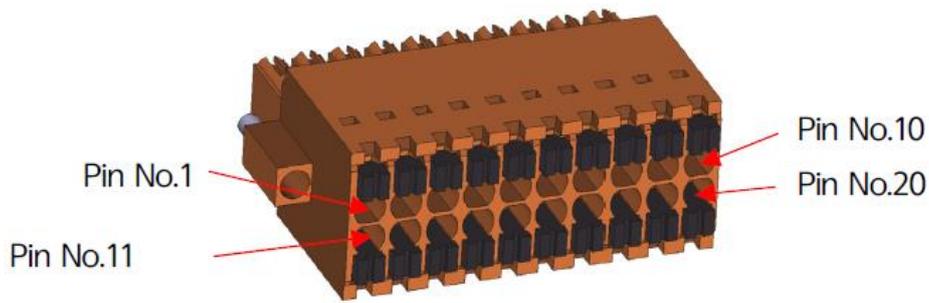
3.3.2.3 Terminal block (TB3): common safety signal I/O

You can connect common safety signal I/Os, eight at a time, to Terminal Block, TB3. You can compose the robot system by connecting various peripheral devices such as emergency stop devices, safeguarding (protective) devices, PLCs, and conveyor belt encoders.

Set the safety I/O signals according to usages, referring to “**Safety Function Manual for Collaborative Robots.**” For example, if you will not use the teach pendant and will use an enabling switch, connect it to the common safety signal input and assign input signals. The types of I/O signals that can be assigned are as follows:

- Input signals: STOP0, STOP1, STOP2, SOS, Reduced mode, Enable SW, Motor on, Mode switch-manual, Mode switch-auto, Mode switch-remote, Cartesian space #1 - #12
- Output signals: STO activation status, SOS activation status, Reduced mode activation status, Not reduced mode, Robot moving, Robot not stopping, Mode switch-manual, Mode switch-auto, Mode switch-remote, Cartesian space status #1 - #12, Violation alarm, TCP speed violation, TCP orientation violation, TCP force violation, Collision detection, Momentum violation, Power violation, SOS violation, Joint position violation, Joint speed violation, Cartesian space violation #1 - #12

For more details of signal connection, see “**4.3.2.3 Safety I/O signal connection (TBSDI, TBSDO).**”



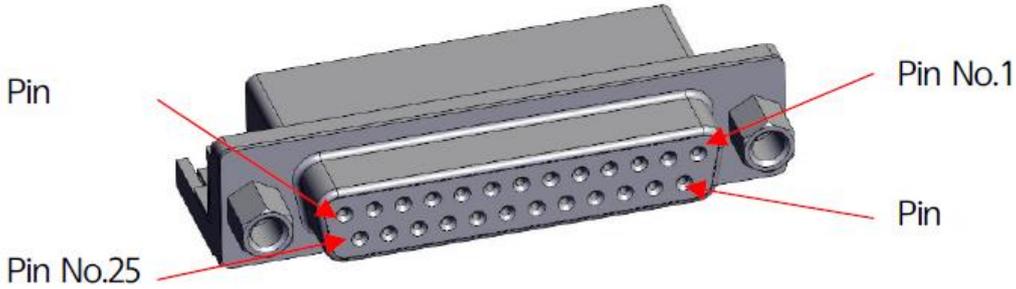
Pin number	1	2	3	4	5
Name	EX_IO_P24V	EX_IO_GND	GDOUT0	GDOUT1	GDOUT2
Internal connections of the controller	SCM TBDIO/1	SCM TBDIO/2	SCM TBDIO/3	SCM TBDIO/4	SCM TBDIO/5
	BD5B3T CN1/1	BD5B3T CN1/3	BD5B3T CN1/5	BD5B3T CN1/7	BD5B3T CN1/9
Pin number	6	7	8	9	10
Name	GDOUT3	GDOUT4	GDOUT5	GDOUT6	GDOUT7
Internal connections of the controller	SCM TBDIO/6	SCM TBDIO/7	SCM TBDIO/8	SCM TBDIO/9	SCM TBDIO/10
	BD5B3T CN1/11	BD5B3T CN1/13	BD5B3T CN1/15	BD5B3T CN1/17	BD5B3T CN1/19
Pin number	11	12	13	14	15
Name	EX_IO_P24V	EX_IO_GND	GDIN0	GDIN1	GDIN2
Internal connections of the controller	SCM TBDIO/11	SCM TBDIO/12	SCM TBDIO/13	SCM TBDIO/14	SCM TBDIO/15
	BD5B3T CN1/2	BD5B3T CN1/4	BD5B3T CN1/6	BD5B3T CN1/8	BD5B3T CN1/10
Pin number	16	17	18	19	20
Name	GDIN3	GDIN4	GDIN5	GDIN6	GDIN7
Internal connections of the controller	SCM TBDIO/16	SCM TBDIO/17	SCM TBDIO/18	SCM TBDIO/19	SCM TBDIO/20
	BD5B3T CN1/12	BD5B3T CN1/14	BD5B3T CN1/16	BD5B3T CN1/18	BD5B3T CN1/20

⚠ Caution

- Separate safety signals and common I/O signals, and never connect safety signals to other PLCs than safety PLCs. If you connect safety signals to other PLCs, it will lead to malfunction of the safety stop function, and may cause safety accidents including physical injuries.
- All the I/Os of safety grade are of redundancy structure. Make sure to separate the relevant channels to prevent signal faults from compromising the safety function.
- Make sure to power off the product before carrying out any types of wiring, termination, and electrical work.
- Hyundai Robotics will not take responsibilities for product damages due to customer's carelessness, unskillful operation, and errors. Never arbitrarily modify, disassemble or repair the product.
- Make sure to check the safety functions before robot installation, and check for anomalies at regular intervals afterwards.

3.3.2.4 D-sub 25-pin connector (SDIO): common digital I/O

You can connect digital I/O signals for external safety signals, eight at a time, to the D-sub 24-pin connector (SDIO). For more details of signal connection, see “4.3.2.3 Safety I/O signal connection (TBSDI, TBSDO).”



* Internal connections of the controller (SCM TBSIO)

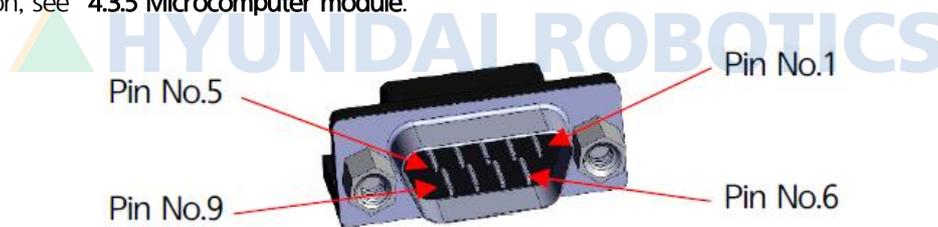
Pin number	1	2	3	4	5
Internal connections of the controller	9	10	11	12	13
Name	SDIN0	SDIN1	SDIN2	SDIN3	SDIN4
Usage	Safety signal input 0 (Channel 1)	Safety signal input 1 (Channel 1)	Safety signal input 2 (Channel 1)	Safety signal input 3 (Channel 1)	Safety signal input 4 (Channel 2)
Pin number	6	7	8	9	10
Internal connections of the controller	14	15	16	1, 2	3, 4
Name	SDIN5	SDIN6	SDIN7	SIO_POW1	SIO_POW2
Usage	Safety signal input 5 (Channel 2)	Safety signal input 6 (Channel 2)	Safety signal input 7 (Channel 2)	Safety signal input common (Channel 1)	Safety signal input common (Channel 1)
Pin number	11	12	13	14	15
Internal connections of the controller	5, 6	7, 8	-	9	10
Name	SIO_POW3	SIO_POW4	-	SDOUT0	SDOUT1
Usage	Safety signal input common (Channel 2)	Safety signal input common (Channel 2)	-	Safety signal output 0 (Channel 1)	Safety signal output 1 (Channel 1)

Pin number	16	17	18	19	20
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Internal connections of the controller	11	12	13	14	15
Name	SDOUT2	SDOUT3	SDOUT4	SDOUT5	SDOUT6
Usage	Safety signal output 2 (Channel 1)	Safety signal output 3 (Channel 1)	Safety signal output 4 (Channel 2)	Safety signal output 5 (Channel 2)	Safety signal output 6 (Channel 2)
Pin number	21	22	23	24	25
Internal connections of the controller	16	1, 2	3, 4	5, 6	7, 8
Name	SDOUT7	SIO_GND1	SIO_GND1	SIO_GND2	SIO_GND2
Usage	Safety signal output 7 (Channel 2)	Safety signal output common (Channel 1)	Safety signal output common (Channel 1)	Safety signal output common (Channel 2)	Safety signal output common (Channel 2)

3.3.2.5 D-sub 9-pin connector (COM1, COM2): serial communication (RS485, 422)

You can connect D-sub 24-pin connectors (SDIOs) to two ports for external communication. For more details of signal connection, see “4.3.5 Microcomputer module.”



* Internal connections of the controller (miniH6COM COM1, COM2) / * n=1, 2 (COM port number)

Pin number	1	2	3	4	5
Internal connections of the controller	1	2	3	4	5
Name	COMn_422_485_TX-	COMn_422_485_TX+	COMn_422_RX+	COMn_422_RX-	GND
Pin number	6	7	8	9	-
Internal connections of the controller	6	7	8	9	-
Name	COMn_DSR#	COMn_RTS#	COMn_CTS#	COMn_RL_V#	-

3.4 Stopping distance and time

You can measure the stopping distance and time of the robot system by setting its extension, speed, and load.

- Extension: 33%, 66%, 100%
- Speed: 33%, 66%, 100%
- Load: 33%, 66%, 100% (YL005: 5 kg, YL012: 12 kg, YL015: 15 kg)
- Stop categories: STOP0, STOP1 (per IEC60204-1)

3.4.1 STOP0

At STOP0, the stopping distance and time of the models at different extension and speed values are as follows:

- Extension: 100%
- Speed: 30%, 50%, 100%
- Load: maximum load of the model

Division		Stopping distance (degree)			Stopping time (sec)		
		30%	50%	100%	30%	50%	100%
YL005	S-axis						
	H-axis						
	V-axis						
YL012	S-axis						
	H-axis						
	V-axis						
YL015	S-axis						
	H-axis						
	V-axis						

3.4.2 STOP1

At STOP1, the stopping distance and time of the models at different axial extension and speed values are as follows:

■ YL005

- Extension: 33%, 66%, 100%
- Speed: 33%, 66%, 100%

Division		Stopping distance (degree)			Stopping time (sec)		
		33%	66%	100%	33%	66%	100%
S-axis	33%						
	66%						
	100%						
H-axis	33%						
	66%						
	100%						
V-axis	33%						
	66%						
	100%						

■ YL012

- Extension: 33%, 66%, 100%
- Speed: 33%, 66%, 100%

Division		Stopping distance (degree)			Stopping time (sec)		
		33%	66%	100%	33%	66%	100%
S-axis	33%						
	66%						
	100%						
H-axis	33%						
	66%						
	100%						
V-axis	33%						
	66%						
	100%						

■ YL015

- Extension: 33%, 66%, 100%
- Speed: 33%, 66%, 100%

Division		Stopping distance (degree)			Stopping time (sec)		
		33%	66%	100%	33%	66%	100%
S-axis	33%						
	66%						
	100%						
H-axis	33%						
	66%						
	100%						
V-axis	33%						
	66%						
	100%						



3.5 Safety setting

For the details of the safety setting of collaborative operation, see the “**Safety Function Manual for Collaborative Robots.**”

3.6 Programming and restarting

If the robot system boots up normally upon powering on, and if there is no safety issues, you can carry out programming and restarting.

The robot will identify the existence of safety issues through self-diagnosis, and check its conditions. After this process, you can configure common setting of the robot and safety setting for collaborative operation. Check the final setting values, carry out programming, and restart it.

- For more details of how to set and operate the robot, see “**Operation Manual for Hi6 Controllers.**”
- For the details of the safety setting of collaborative operation, see the “**Safety Function Manual for Collaborative Robots.**”

3.7 Axis restriction devices

■ Mechanical axis restriction devices

Note that the collaborative robot does not support mechanical axis restriction devices.

■ Safety rated ductile axis and space restriction device

The collaborative robot is capable of restricting safety rated ductile axis and space. For more details, see the “**Safety Function Manual for Collaborative Robots.**”

■ Dynamic restriction functions

Note that the collaborative robot does not support dynamic restriction functions.

3.8 Movement without driving power

In case of emergency or occurrence of abnormal situations, you can set so that the driving power of the robot is cut off and the axes can be moved for any workers isolated in the hazard area to make emergency escape.

For more details of the movement without driving power, see the “**Safety Function Manual for Collaborative Robots.**”

Caution

- If you release an axis of the robot when driving power is not applied to the robot, the axis may sag or drop. For safety, hold the axis by using a device such as a crane that can support the axis before releasing it.
- To be prepared for emergency and abnormal situations, all the workers that install, use, and repair the robot system must take training in movement without driving power.

3.9 Other safety precautions

- If the robot is operated manually without using the collaborative operation functions at a workplace where safety fences are installed for the purpose of operating general industrial robots, all the workers should stay out of the safeguarded space.
- Any protective devices that were temporarily stopped in a mode other than the automatic mode should be reactivated to function completely before entering the automatic mode. For example, the automatic safeguard can be disabled in the manual mode. Before entering the automatic mode, the inputs of the automatic safeguard must be enabled.



4. Maintenance

In order to use the product for a long time without anomalies, it should be checked and maintained at regular intervals. The maintenance of the robot system must be carried out by Hyundai Robotics or a service provider designated by it.

The purpose of maintenance works is to maintain the robot system at the operable state or to restore it to the operable state in case of problems. Maintenance works include not only repairs of the robot system but also diagnoses of its problems.

In checking the robot system, the applicable work safety regulations of the country or locality must be complied with. All the possibilities of risks should be tested during maintenance, and risk assessment should be carried out to verify if the system meets the safety requirements after maintenance.

In carrying out maintenance works of the collaborative robot or the controller, make sure to comply with the following safety instructions:

- Before maintenance, disconnect the power cables, and ensure that other power sources connected to the robot or the controller are turned off.
- During maintenance, keep the existing safety setting of the software as it is.
- During maintenance, take precautions so that foreign matters such as water or dust do not penetrate into the product.
- If a defective part is found, replace it with a new one having the same specifications with the part to be replaced, and return the defective part to Hyundai Robotics. Make sure to use parts, consumables, and software certified by Hyundai Robotics.
- Upon completing maintenance, reactivate the safety functions.
- Record the details of the maintenance and repair works in the technical file relating to the entire robot system.

4.1 Checks on the collaborative robot

This section describes the types, intervals, and methods of checking the collaborative robot.

The types of checks include routine checks and time-based checks according to intervals and check categories. In addition to the checks, overhaul checks should be carried out at the intervals of 35,000 operating hours.

Type of checks	Interval	Division
Routine checks	From time to time	Devices, motors, and reducers
Time-based checks	Three months	Wires, and bolts
	One year	Brakes

Note

The check intervals vary depending on operations carried out by the robot: if the robot carries out severe handling operations, it is recommended to carry out checks at 1/2 of the specified intervals.

4.1.1 Check sheet

The intervals, methods, and criteria for checking the mechanical parts of the collaborative robot are as follows:

Division	From time to time	Three months	One year	Method	Criteria
Manipulator	○			Visual inspection on dust and impurities	clean
Wiring		○		<ul style="list-style-type: none"> Visual inspection on damaged cables Visual inspection on loose cable ties 	<ul style="list-style-type: none"> no damaged cables no loose cable ties
Bolts		○		Visual inspection on broken paint markings	no broken paint markings
Motors	○			<ul style="list-style-type: none"> Check on abnormal overheating Check on abnormal noise 	<ul style="list-style-type: none"> no abnormal overheating no abnormal noise
Reducer	○			<ul style="list-style-type: none"> Check on abnormal overheating Check on abnormal noise Check on abnormal vibration 	<ul style="list-style-type: none"> temperature maintained as usual no abnormal noise vibration maintained as usual
Brakes			○	<ul style="list-style-type: none"> Operation upon the brake release switch ON/OFF (Caution: When the brake release switch is turned ON, the arm or motion axis will fall. Therefore, make sure to turn OFF the brake release switch within one second.) Visual check on brake abrasion state Check on abnormal brake noise 	<ul style="list-style-type: none"> robot stopped at brake OFF insignificant quantity of brake dust no abnormal brake noise
Clearances		○		Check on motion lag when each axis makes forward and reverse rotations	no motion lag felt by hand

- When the robot is used in severe conditions (e.g. excessive handling), carry out checks at intervals shorter than the specified intervals to ensure the performance of the robot system.
- Check all the cables, and replace any damaged cables.
- For checking on anomalies of power transmission devices (motors, reducers, etc.), check on abnormal noise in the automatic mode or the teaching mode.

4.1.2 Wiring check

The internal wiring of the collaborative robot uses cables that can withstand bending. Because disconnection or short circuit caused by damaged cables may lead to malfunction of the robot, make sure to check on the wiring at regular intervals.

Before starting works such as robot teaching within the operating space of the robot (excluding cases where driving power of industrial robot is cut off), make sure to check the following safety check requirements. If any problems are found, resolve them and take necessary actions immediately.

- Check on damaged shields and cables of external power source.
- Check on malfunction of the robot manipulator.
- Check on the operability of the emergency stop function.

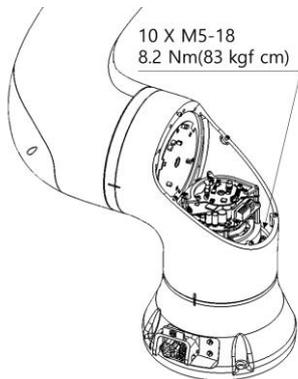
4.1.3 Bolt check

Check on the major bolts to be checked and the recommended fastening torques. Because the bolts to be checked vary depending on operations carried out by the robot, contact our Customer Support Team for more details.

Fasten the bolts mounting the integrated driving module of each axis with a torque wrench to adequate torques, and mark them with paint.

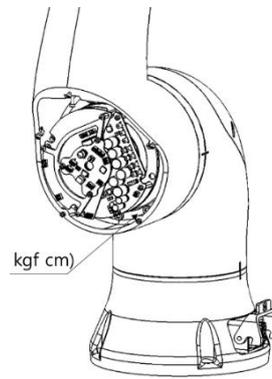
- S-axis parts to be checked

Bolts: 10 X M5-18 / torque: 8.2 Nm (83 kgf-cm)



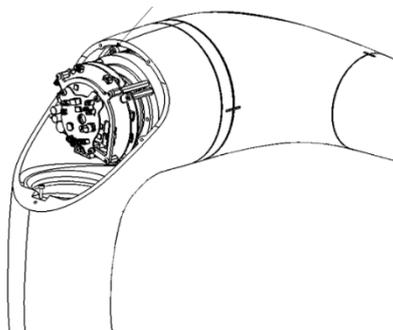
- H-axis parts to be checked

Bolts: 10 X M6-20 / torque: 13.82 Nm (141 kgf-cm)



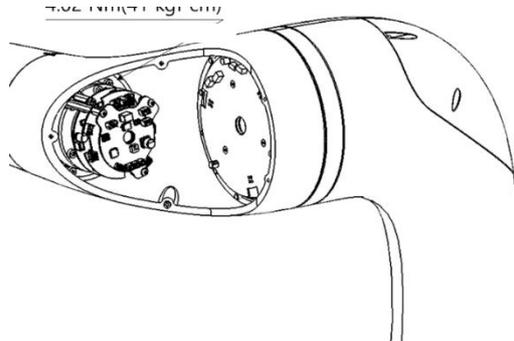
- V-axis parts to be checked

Bolts: 10 X M5-20 / torque: 8.2 Nm (83 kgf-cm)



- R2-axis parts to be checked

Bolts: 10 X M4-25 / torque: 4.02 Nm (41 kgf-cm)

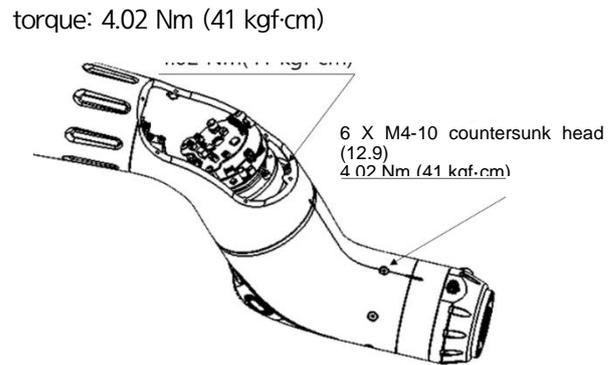
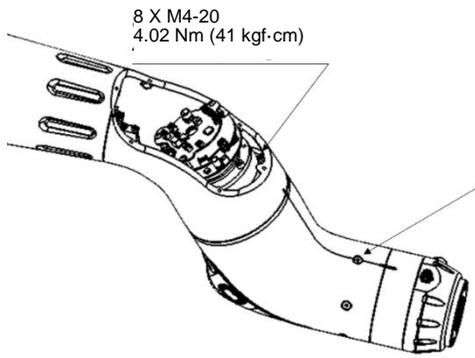


- B-axis/R1-axis parts to be checked

Bolts: 8 X M4-20 / torque: 4.02 Nm (41 kgf-cm)

- B-axis/R1-axis parts to be checked

Bolts: 6 X M4-10 countersunk head (12.9) /



4.2 Maintenance of the collaborative robot

4.2.1 Replacement of internal wiring

Check the internal wiring of the collaborative robot at 3-month intervals. Check on damaged wires, cables, and cable-protecting springs, and replace any defective parts immediately.

- The wiring replacement intervals vary depending on operating conditions, robot's operating speed, and how long the robot operates continuously.
- Regardless of the major operation and operating conditions of the robot, replace the cables at the intervals of 16,000 hours.
- Replace wires in units.
- Wiring between the collaborative robot and the controller must be carried out in the specified length.

⚠ Caution

- The internal wiring should be done with cables of bending resistance. Only use cables of the specified types.
- For purchasing an internal cable, identify the wiring type by consulting with our Customer Support Team.
- Before replacing cables, cable-protecting springs, or hoses, check that the replacement parts are not broken or damaged.

4.2.2 Replacement of the integrated driving module

Replacement of the integrated driving module must be carried out by qualified experts who have taken the relevant training provided by Hyundai Robotics. In the event it is necessary to replace the integrated driving module, contact our Customer Support Team to consign the work to experts.

4.2.2.1 Replacement timing

Replace the integrated driving module when any of the following anomalies is found:

- Anomalies of reducers

If a reducer is damaged, abnormal noise and vibration will occur. An abnormal reducer may lead to overloading, abnormal deviation, and abnormal overheating that obstruct normal operation. It may also make the robot stop or create deviation in its position. In such cases, replace the integrated driving module.

The integrated driving module should also be replaced when the grease is replaced.

- Anomalies of motors

An abnormal motor may lead to abnormal operation such as shaking at stopping, vibration in operation, and irregular cycles (pulsation). It may also generate abnormal noise and overheating.

The phenomena of abnormal motors are similar to those of reducers. In such cases, replace the integrated driving module, and contact our Customer Support Team to request analysis.

- Anomalies of the brake

An abnormal brake will make the axes fall in the operation ready [brake OFF] state or generate overloading and abnormal noise by being actuated in the operation ready [brake ON] state. You can check on anomalies of the brake by the following methods:

- While the motor is not turned on, turn ON the brake release switch so that the robot can be moved. Before turning ON the brake release switch, take actions so that the robot arm cannot fall by the gravity.
- In the operation ready state, turn ON/OFF the brake release switch, and check that the brake operation sound is heard. If the brake operation sound is not heard, there must be a wire disconnection, in most cases. In such case, replace the integrated driving module.



- Take precautions because the robot arm may fall when the brake release switch is turned ON/OFF.
- The brake release switch is on the circuit board placed near the door inside the controller.

- Anomalies of the encoder

An abnormal encoder will lead to deviation in position, malfunction, rush, etc. It may also lead to shaking at stopping, and irregular cycles (pulsation). In such cases, check the error code through the teach pendant, and replace the integrated driving module, as necessary. Phenomena such as abnormal mechanical noise, overheating, and vibration are not related to anomalies of the encoder.



- In replacing the integrated driving module, it will happen that the worker puts some parts on the floor. Before the replacement, secure the area so that no parts can be lost or damaged.
- Replacement of the integrated driving module must be carried out by qualified experts who have taken the relevant training provided by Hyundai Robotics. In the event it is necessary to replace the integrated driving module, contact our Customer Support Team to consign the work to experts.
- After the robot is stopped and before the worker touches the integrated driving module, its temperature should be checked.
- In the case of gigabit Ethernet option, because the module replacement is not easy, contact our Customer Support Team to consign the work to experts.

4.2.2.2 Weight of the integrated driving module

In replacing the integrated driving module, take precautions for its weight.

Model	S	H	V	R2	B	R1
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Model	S	H	V	R2	B	R1
YL005	4.34 kg	4.34 kg	2.07 kg	2.07 kg	1.83 kg	1.83 kg
YL012	6.14 kg	9.97 kg	6.14 kg	2.07 kg	2.07 kg	1.83 kg
YL015	6.14 kg	9.97 kg	6.14 kg	2.07 kg	2.07 kg	1.83 kg

4.2.2.3 Tools and parts

The tools and parts required for the replacement of the integrated driving module are as follows:

- Off-the-shelf torque wrenches and extensions
- Bolts: Hex socket head, strength 12.9, electroless nickel plated or normal nickel plated
- Pins: Dowel pins of H7 tolerance or spring pins

Model	Axis	Torque wrenches	Bolts	Dowel pins	Other parts
YL005	S	M3, M4, M5	4XM3-6, 4XM3-10, 12XM4-20, 12XM5-18	3XPIN5-10	
	H	M3, M4, M5	8XM3-6, 12XM4-20, 12XM5-18	3XPIN5-10	
	V	M3, M4	8XM3-6, 12XM3-30, 9XM4-25	PIN3-6, 2XPIN4-15	
	R2	M3, M4	10XM3-6, 12XM3-30, 9XM4-20	PIN3-6, 2XPIN4-15	
	B	M3, M4	4XM3-5 small-diameter head, 6XM3-6, 12XM3-18, 6XM4-10, 8XM3-25	PIN3-6, PIN4-10	
	R1	M2.5, M3	6XM4-10 countersunk head, 4XM3-5 small-diameter head		
YL012	S	M3, M5	5XM3-6, 10XM5-18, 12XM5-40	3XPIN5-10	
	H	M3, M6	10XM3-6, 12XM6-20, 12XM6-45	3XPIN5-10	One-touch straight fitting (KQH23-00A1)
	V	M3, M5	10XM3-6, 10XM5-20, 12XM5-40	3XPIN5-10	
	R2	M3, M4	11XM3-6, 12XM3-30, 10XM4-25	PIN3-6, 2XPIN4-15	One-touch straight fitting (KQH23-00A1)
	B	M3, M4	4XM3-5 small-diameter head, XM3-6, 12XM3-30, 8XM4-20	PIN3-6, 2XPIN4-15	3XM3 NUT, M3 rubber washer, one-touch straight fitting (KQH23-00A1)
	R1	M2.5, M3	6XM4-10 countersunk head, 4XM3-5 small-		One-touch straight fitting (KQH23-00A1)

Model	Axis	Torque wrenches	Bolts	Dowel pins	Other parts
			diameter head		
YL015	S	M3, M5	5XM3-6, 10XM5-18, 12XM5-40	3XPIN5-10	
	H	M3, M6	10XM3-6, 12XM6-20, 12XM6-45	3XPIN5-10	One-touch straight fitting (KQH23-00A1)
	V	M3, M5	10XM3-6, 10XM5-20, 12XM5-40	3XPIN5-10	
	R2	M3, M4	11XM3-6, 12XM3-30, 10XM4-20	PIN3-6, 2XPIN4-15	One-touch straight fitting (KQH23-00A1)
	B	M3, M4	4XM3-5 small-diameter head, 6XM3-6, 12XM3-30, 8XM4-20	PIN3-6, 2XPIN4-15	3XM3 NUT, M3 rubber washer, one-touch straight fitting (KQH23-00A1)
	R1	M2.5, M3	6XM4-10 countersunk head, 4XM3-5 small-diameter head		One-touch straight fitting (KQH23-00A1)
	S	M3, M5	5XM3-6, 10XM5-18, 12XM5-40	3XPIN5-10	
	H	M3, M6	10XM3-6, 12XM6-20, 12XM6-45	3XPIN5-10	One-touch straight fitting (KQH23-00A1)

4.2.2.4 Recommended posture in disassembling the integrated driving module

In replacing the integrated driving module, setting the axis at the following posture will facilitate the disassembling work.

For example, in replacing the module of H-axis of YL012, the disassembling work will be easier if you set the robot's posture at the angles of 95° , 65° , or 35° , which are the angles at which the angular interval (30°) is added or subtracted from the reference angle (95°).

Model		S	H	V	R2	B	R1
YL005	Reference angle	Not applicable	Not applicable	-30	30	-15	Not applicable
	Angular gap	Not applicable	Not applicable	30	30	30	Not applicable
YL012	Reference angle	-40	95	-140	108.5	63.5	Not applicable

Model		S	H	V	R2	B	R1
	Angular gap	30	30	30	30	30	Not applicable
YL015	Reference angle	-40	95	130	-161	86	Not applicable
	Angular gap	30	30	30	30	30	Not applicable

**Caution**

If the robot cannot be driven, carry out the primary disassembling of the module, then rotate the module by using the brake release module, and carry out the rest of the disassembling.

4.2.2.5 Method for replacing the integrated driving module

Referring to “6.1 Block diagram”, first identify the position and composition of the integrated driving module of each axis.

18. Move the axis for which the integrated driving module will be replaced to the recommended posture.
19. Power off the module by turning off the power breaker.
20. Remove the bolts with a torque wrench, and remove the front or rear frame cover of the pertaining axis.
21. Disconnect the wires of the integrated driving module.
22. If it has a pneumatic hose, cut one end of it.
23. Remove the bolts at the servo drive side with a torque wrench.

**Caution**

Retain the removed robot parts securely on a flat floor.

24. Remove the bolts at the reducer with a torque wrench.

If you failed to set the robot at the recommended posture, release the brake by removing the brake connector of the servo drive, forcibly rotate the module, and remove the bolts.
25. Apply Loctite 518 on the contacting surface of the replacement module.
26. Replace the old module with a new one.
27. Set the mounting position by using the pin, and fixate the new module by fastening bolts with a torque wrench.
28. Connect the wires of the integrated driving module.
29. Using the one-touch straight fitting (KQH23-00A1), reconnect the pneumatic hose that was cut at Step 5.
30. Put the front or rear frame cover on the axis, and fixate it by fastening bolts with a torque wrench.
31. Referring to the “Encoder offset” section of the “Operation Manual for Hi6 Controller”, correct the offset of the encoder of the axis of which the module has been replaced.

**Caution**

Before correcting the encoder offset, set the operation preparation at ON, and ensure that the power is connected by pressing the enabling switch of the teach pendant for two to three seconds.

32. Run the robot, and check that it operates normally.

4.2.3 Encoder backup battery replacement

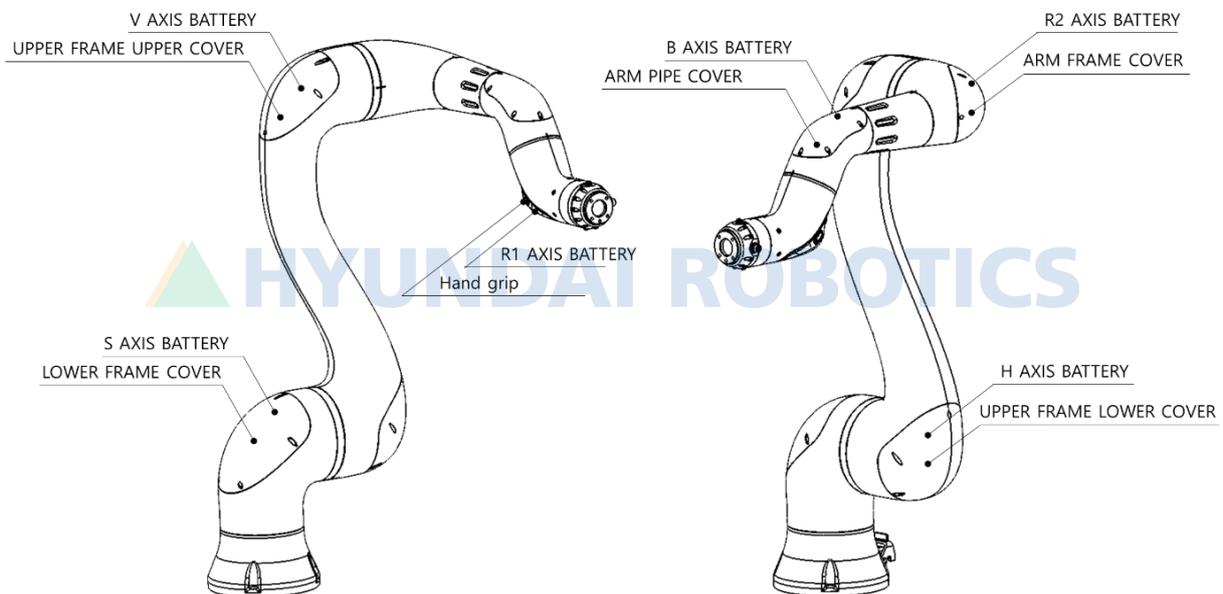
A dedicated battery attached to the serial encoder retains the position data of each axis regardless of whether power is supplied to the controller. The battery should be replaced at two-year intervals.

The method for replacing the encoder backup battery of each axis is as follows:

33. While the controller power is on, press the emergency stop switch.

 Caution	Before correcting the encoder offset, set the operation preparation at ON, and ensure that the power is connected by pressing the enabling switch of the teach pendant for two to three seconds.
--	--

34. Identify the position of the battery of each axis, and remove the frame cover of the battery by removing bolts with a torque wrench.



No.	Axis	Cover	Bolts
1	S	Lower frame cover	Hex socket bolts (M3X6, five pieces)
2	H	Upper frame cover	Hex socket bolts (M3X6, five pieces)
3	V	Upper frame cover	Hex socket bolts (M3X6, six pieces)
4	R2	Arm frame cover	Hex socket bolts (M3X6, five pieces)
5	B	Arm pipe cover	Hex socket bolts (M3X6, six pieces)
6	R1	Hand grip	M3 small-diameter bolts (four pieces)

35. Identify the orientation of the battery terminals, and replace the old battery with a new one.

 Caution	<ul style="list-style-type: none"> Only use the battery of the designated specifications (ER6C (AA 3.6 V) / manufacturer: Maxcell).
--	--

- Identify the orientation of the battery terminals, and insert the battery correctly.
- Do not recycle or arbitrarily dispose of the battery. The battery should be disposed of as an industrial waste according to the applicable national or local laws and regulations.

36. Put the frame cover on the axis, and fixate it by fastening bolts with a torque wrench.

4.2.4 Grease replacement

Because the collaborative robot uses harmonic reducers, it does not require grease replacement at regular intervals.

- However, because cases may occur where the grease should be replaced depending on the service environment of the robot, check on abnormal noise or temperature of the reducers at regular intervals.
- Grease replacement requires the replacement of the integrated driving module. If grease replacement is necessary, contact our Customer Support Team.

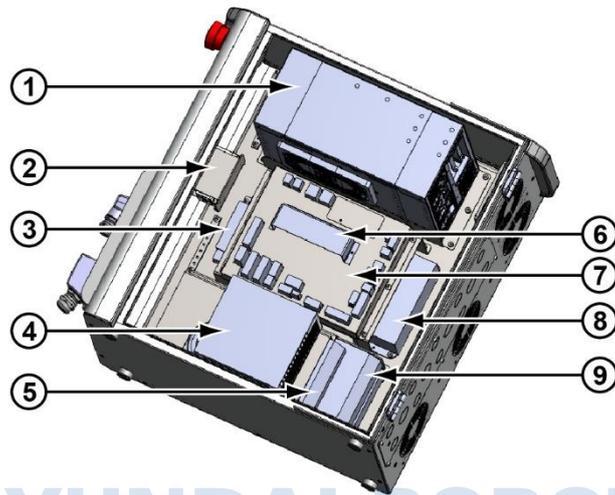


4.3 Controller check and maintenance

Because the controller is fixated to a floor, it is not subject to mechanical damages. Therefore, you don't need to check on it for mechanical damages over its service life. However, when the controller is repositioned or when it is impacted, you need to check its cables and connectors.

4.3.1 Internal structure

Identifying the structure and part names of the controller is useful for finding out how to install and maintain it.



HYUNDAI ROBOTICS
Figure 15 Internal structure of the controller

No.	Name		Description
1	Microcomputer module	miniH6COM	This makes overall control of the collaborative robot.
2	Power switch and breaker	CP1	This turns on/off the main power of the controller.
3	Noise filter	NF1	This filters conductive noise.
4	Buffer power	BUFFER	This supplies power to the microcomputer module for a certain period of time in case of blackout.
5	Power supply 2	SMPS2	This is the power source (48 V DC) of the joint actuator.
6	Power pre-charge module	PPM	This pre-charges power for the joint actuator of the collaborative robot.
7	Safety control module	SCM	This controls the safety functions of the collaborative robot.
8	Regenerative discharge module	RDM	This discharges regenerative power generated by the motor of the joint actuator.
9	Power supply 1	SMPS1	This is the power source (48 V DC) for the controlling.

4.3.2 Safety control module

The safety control module (SCM) monitors and controls the safety of the collaborative robot. For more details of its functions, see the “Safety Function Manual for Collaborative Robots.”

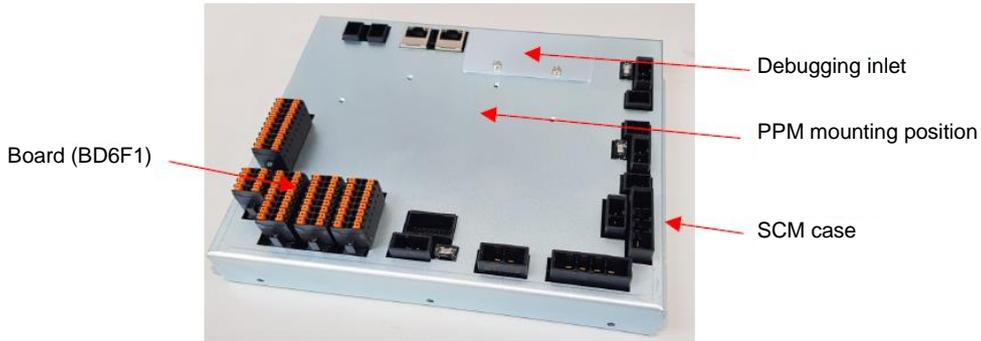


Figure 16 Safety control module (SCM)

4.3.2.1 Connection and display

The connector layout, usages, and connecting devices used by the SCM are as follows:

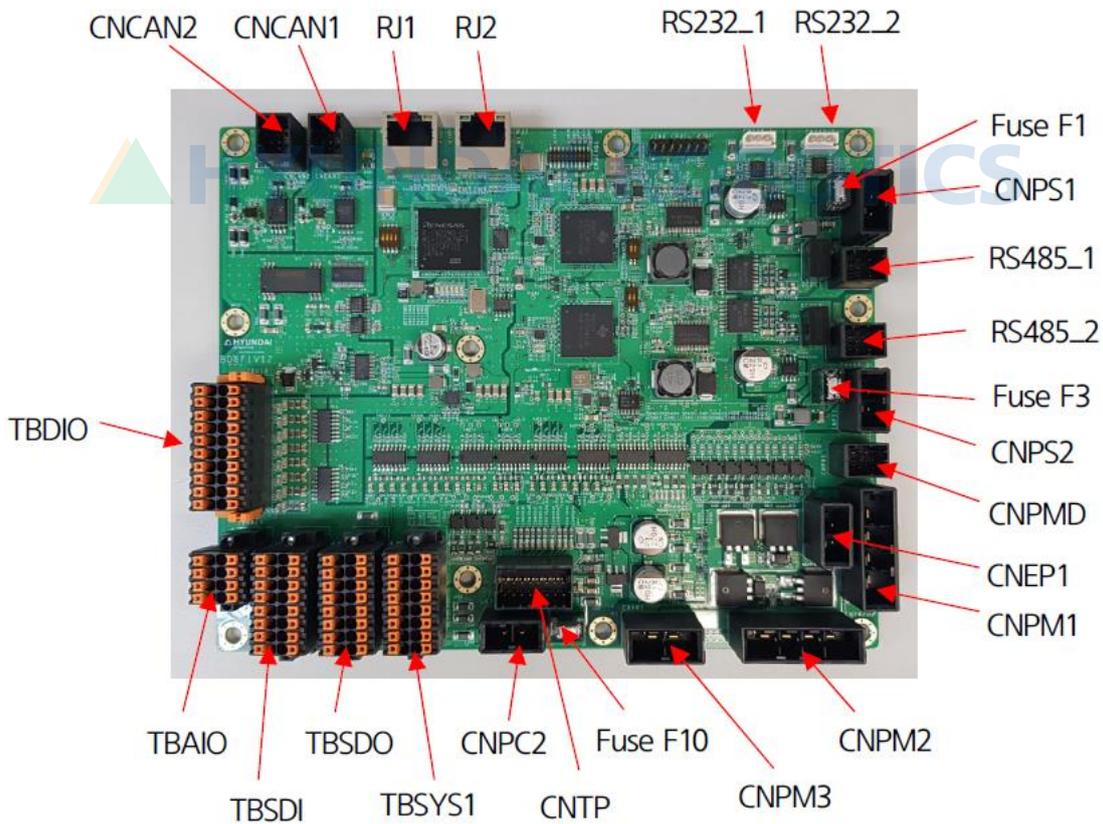


Figure 17 Safety control board (BD6F1)

Connector	Usage	External connecting device
CNPS1, 2	Power input for the safety circuit, 24 V DC (Channels 1 and 2)	Power supply (SMPS2)
CNCAN1	Data communication (exchange of torque data) with the torque sensors (Channel 1) of the mechanical parts	Robot cable connection terminal (CNM)
CNCAN2	Data communication (exchange of torque and position	Robot cable connector (CNM)

Connector	Usage	External connecting device
	data) with the torque sensors (Channel 2) and encoder (Channel 2) of the mechanical parts	
RJ1	EtherCAT communication port	Robot cable connector (CNM)
RJ2	EtherCAT communication port	Microcomputer module (miniH6COM)
CNPM1	Power input for driving motors of the mechanical parts (48 V DC)	Power supply (SMPS1)
CNPM2	Power output for driving motors of the mechanical parts (48 V DC)	Robot cable connector (CNM)
CNPM3	Power output for charging the motor driving power lines (48 V DC)	Power pre-charge module (PPM)
CNEP1	Power input for charging the motor driving power lines (48 V DC)	Safety control module (SCM)
CNPMD	Exchange of information on the state of regenerative discharge action	Regenerative discharge module (RDM)
CNPC2	Power input for I/O	Power supply (SMPS2)
TBSYS1	Input for the emergency stop switch and protective stop switch (safeguard), control of power charging function, and connection of monitoring signals	External safety switch, power pre-charge module (PPM)
TBSDO	Connection of safety output signals	Safety device
TBSDI	Connection of safety input signals	Safety device
TBAIO	Connection of general analog I/O signals	General analog devices
TBDIO	Connection of general digital I/O signals	General digital devices
RS485_1, 2	Connection of RS-485 serial communication (reserved function)	-
RS232_1, 2	Connection of RS-232 serial communication (reserved function)	-

4.3.2.2 Connection of I/O signals for the robot system (TBSYS1)

The I/O signals dedicated for the robot system are connected through TBSYS1, the terminal block of the safety control module.

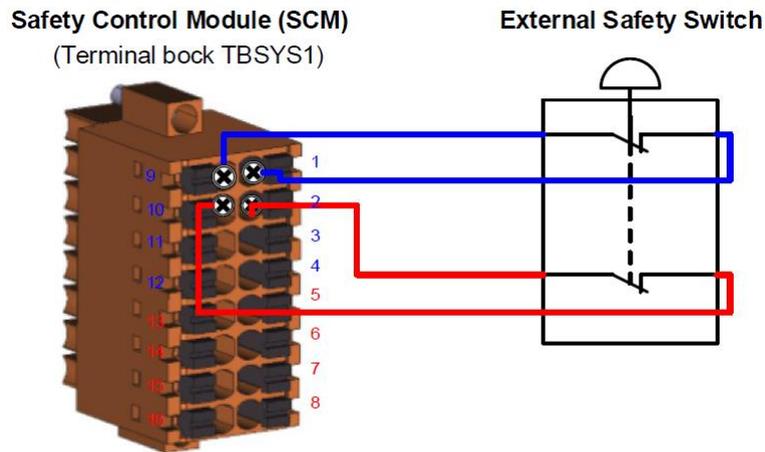


Figure 18 Connection of I/O signals for the robot system (TBSYS1)

* The pins 3 through 8 and 11 through 16 are used as dedicated signals inside the control system.

No.	Name	Usage	No.	Name	Usage
1	SF_POW1	Protective stop input common (Channel 1)	9	SG1	Protective stop input (Channel 1)
2	SF_POW2	Protective stop input common (Channel 2)	10	SG2	Protective stop input (Channel 2)
3	SF_POW1	Emergency stop input common (Channel 1) - Connection of the emergency stop switch of the control box	11	ES1	Emergency stop input (Channel 1) - Connection of the emergency stop switch of the control box
4	SF_POW2	Emergency stop input common (Channel 2) - Connection of the emergency stop switch of the control box	12	ES2	Emergency stop input (Channel 2) - Connection of the emergency stop switch of the control box
5	IN_POW1	PRIN input common	13	/PRIN	Precharge relay state input
6	IN_POW2	Reserved signal input common	14	RSV_IN2	Reserved signal input
7	SF_GND1	PRON output common	15	/PRON	Precharge relay actuation output
8	SF_GND2	Reserved signal output common	16	RSV_OUT2	Reserved signal output

4.3.2.3 Safety I/O signal connection (TBSDI, TBSDO)

The safety input signals of the safety control module receives the inputs from the emergency stop switch and the safeguard through Terminal Block, TBSDI.

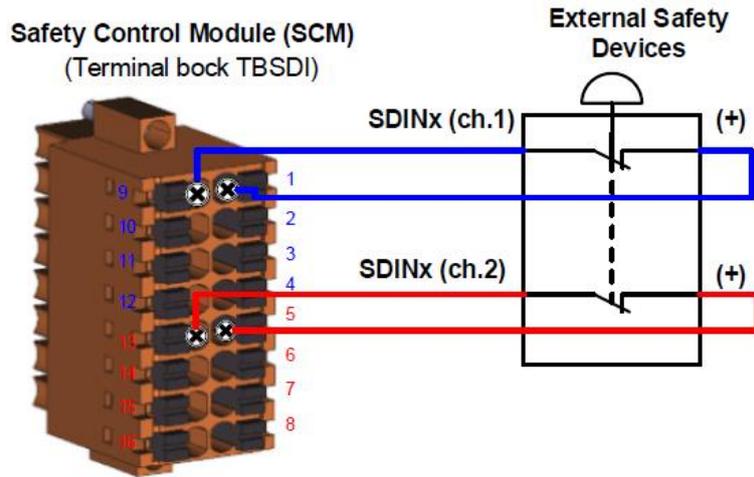


Figure 19 Safety input signal connection (TBSDI)

No.	Name	Usage	No.	Name	Usage
1	SIO_POW1	Safety signal input common (Channel 1)	9	SDIN0	Safety signal input 0 (Channel 1)
2	SIO_POW1	Safety signal input common (Channel 1)	10	SDIN1	Safety signal input 1 (Channel 1)
3	SIO_POW1	Safety signal input common (Channel 1)	11	SDIN2	Safety signal input 2 (Channel 1)
4	SIO_POW1	Safety signal input common (Channel 1)	12	SDIN3	Safety signal input 3 (Channel 1)
5	SIO_POW2	Safety signal input common (Channel 2)	13	SDIN4	Safety signal input 4 (Channel 2)
6	SIO_POW2	Safety signal input common (Channel 2)	14	SDIN5	Safety signal input 5 (Channel 2)
7	SIO_POW2	Safety signal input common (Channel 2)	15	SDIN6	Safety signal input 6 (Channel 2)
8	SIO_POW2	Safety signal input common (Channel 2)	16	SDIN7	Safety signal input 7 (Channel 2)

The safety signals of the safety control module output to the safety devices necessary for the application through Terminal Block, TBSDO.

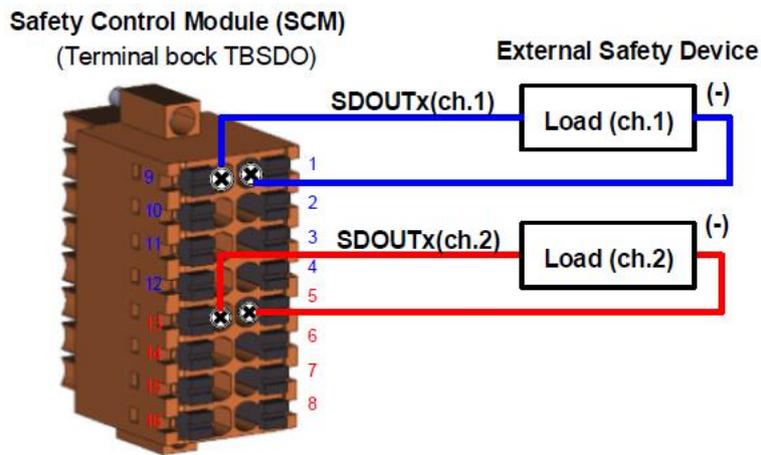


Figure 20 Safety output signal connection (TBSDO)

No.	Name	Usage	No.	Name	Usage
1	SIO_GND1	Safety signal output common (Channel 1)	9	SDOUT0	Safety signal output 0 (Channel 1)
2	SIO_GND1	Safety signal output common (Channel 1)	10	SDOUT1	Safety signal output 1 (Channel 1)
3	SIO_GND1	Safety signal output common (Channel 1)	11	SDOUT2	Safety signal output 2 (Channel 1)
4	SIO_GND1	Safety signal output common (Channel 1)	12	SDOUT3	Safety signal output 3 (Channel 1)
5	SIO_GND2	Safety signal output common (Channel 2)	13	SDOUT4	Safety signal output 4 (Channel 2)
6	SIO_GND2	Safety signal output common (Channel 2)	14	SDOUT5	Safety signal output 5 (Channel 2)
7	SIO_GND2	Safety signal output common (Channel 2)	15	SDOUT6	Safety signal output 6 (Channel 2)
8	SIO_GND2	Safety signal output common (Channel 2)	16	SDOUT7	Safety signal output 7 (Channel 2)

4.3.2.4 Connection of common digital I/O signals (TBDIO)

Common digital input signals are connected through Terminal Block, TBDIO (eight signals at the maximum can be connected). In the following example, External Device is input to GDIN1, and External Device 2 is input to GDIN6.

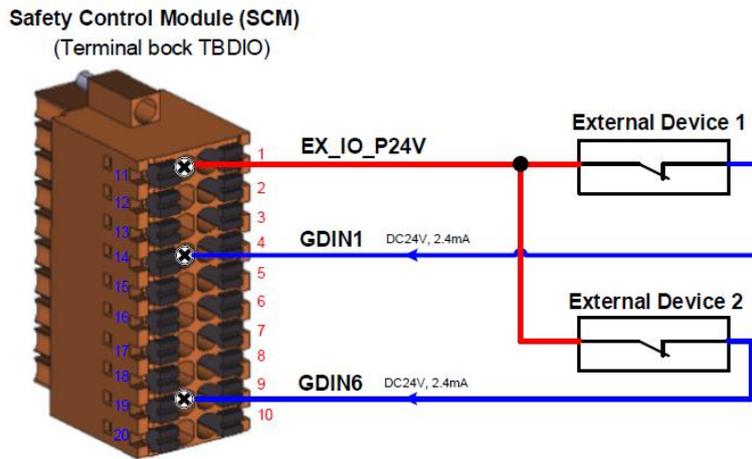


Figure 21 Connection of common digital input signals (TBDIO)

Common digital output signals are connected through Terminal Block, TBDIO (eight at the maximum). In the following example, the load of External Device 1 is operated through output to GDOUT2, and the load of External Device 2 is operated through output to GDOUT7.

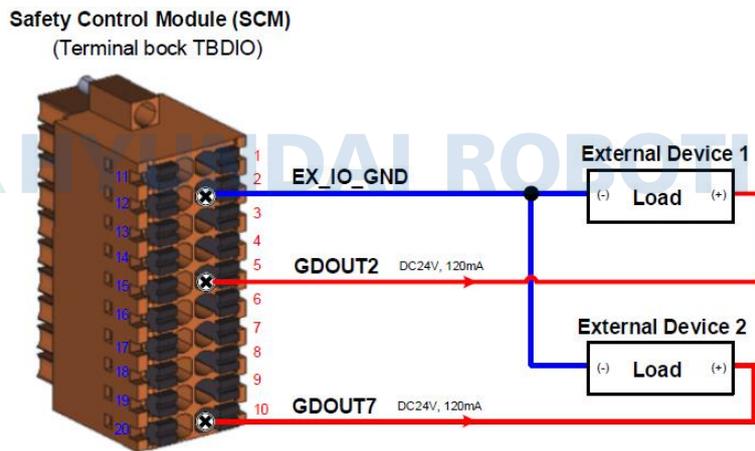


Figure 22 Connection of common digital output signals (TBDIO)

No.	Name	Usage	No.	Name	Usage
1	EX_IO_P24V	Common digital signal power	11	EX_IO_P24V	Common digital signal power
2	EX_IO_GND	Common digital signal power GND	12	EX_IO_GND	Common digital signal power GND
3	GDOUT0	Common digital signal output 0	13	GDIN0	Common digital signal input 0
4	GDOUT1	Common digital signal output 1	14	GDIN1	Common digital signal input 1
5	GDOUT2	Common digital signal output 2	15	GDIN2	Common digital signal input 2
6	GDOUT3	Common digital signal output 3	16	GDIN3	Common digital signal input 3
7	GDOUT4	Common digital signal output 4	17	GDIN4	Common digital signal input 4
8	GDOUT5	Common digital signal output 5	18	GDIN5	Common digital signal input 5
9	GDOUT6	Common digital signal output 6	19	GDIN6	Common digital signal input 6
10	GDOUT7	Common digital signal output 7	20	GDIN7	Common digital signal input 7

4.3.2.5 Connection of common digital I/O signals (TBAIO)

Common analog input signals are connected through TBAIO (two at the maximum). In the following example, External Device 1 is input to GAIN0, and External Device 2 is input to GAIN1.

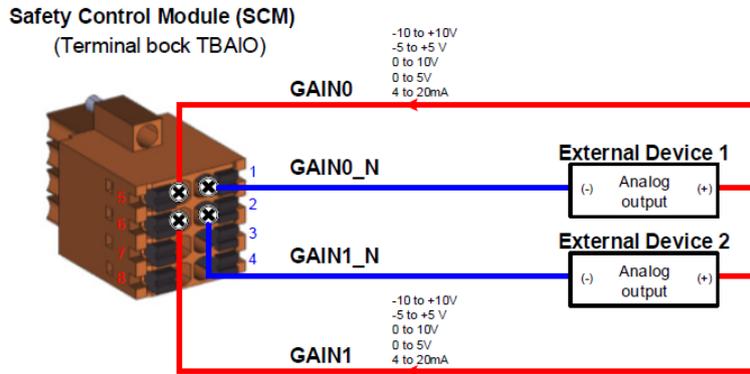


Figure 23 Connection of common digital input signals (TBAIO)

Common analog output signals are connected through TBDIO (two at the maximum). In the following example, the load of External Device 1 is operated through output to GAOUT0, and the load of External Device 2 is operated through output to GAOUT1.

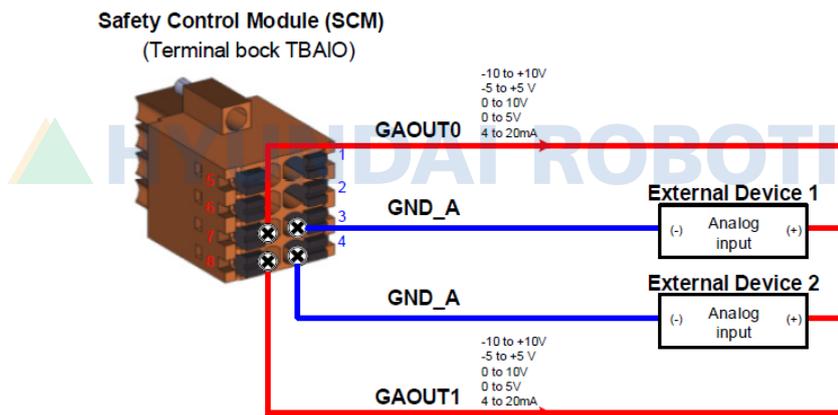


Figure 24 Connection of common analog output signals (TBAIO)

No.	Name	Usage	No.	Name	Usage
1	GAIN0_N	Ground of GAIN0 for common analog input	5	GAIN0	Common analog input 0
2	GAIN1_N	Ground of GAIN1 for common analog input	6	GAIN1	Common analog input 1
3	GND_A	Common analog GND	7	GAOUT0	Common analog output 0
4	GND_A	Common analog GND	8	GAOUT1	Common analog output 1

4.3.2.6 Information on major components

The safety control module is not allowed to be subjected to maintenance because it is classified as a safety management item. Specification information on its major components other than the fuses is not provided.

Component	Usage	Specification
F1, F3	Fuses for preventing overcurrent of the power to the safety circuit (Channels 1 and 2)	3A (Littelfuse 0453 003)
F10	Fuse for preventing overcurrent of the power to the external I/O	10A (Littelfuse 0453 005)

4.3.3 Power pre-charge module (PPM)

The PPM pre-charges power for driving the motor of the joint actuator installed for the collaborative robot. It is composed of relays that open/close the charging system, and a resistor that prevents inrush current.

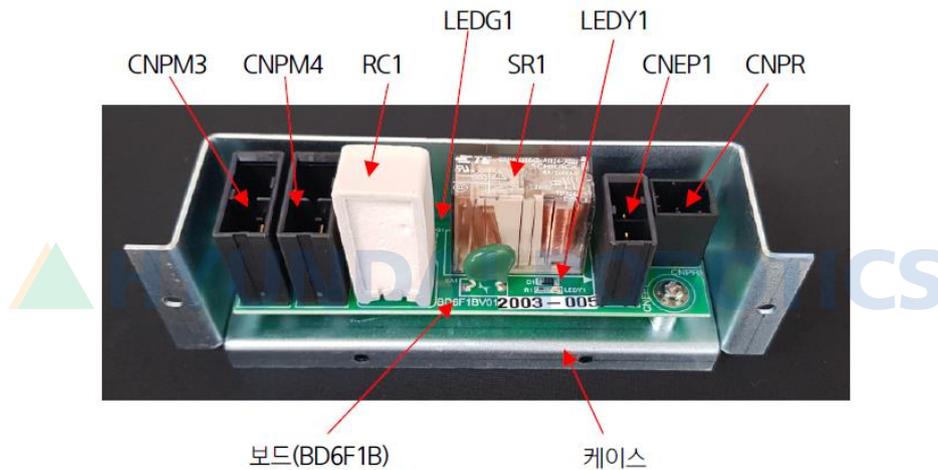


Figure 25 Power pre-charge module (PPM)

4.3.3.1 Connection and display

The connector layout, usages, and connecting devices used by the PPM are as follows:

Connector	Usage	External connecting device
CNPM3	Output terminal of the 48 V DC output power (for motor)	Regenerative discharge module (RDM) CNPM3
CNPM4	Input terminal of the 48 V DC output power (for motor)	Safety control module (SCM) CNPM3
CNEP1	Input terminal of the 48 V DC source power (for motor)	Safety control module (SCM) CNEP1
CNPR	Control of the power charge function and connection of monitoring signals	Safety control module (SCM) TBSYS1

The details of the state display of the PPM are as follows:

LED	Usage	Display details
-----	-------	-----------------

LED	Usage	Display details
LEDY1	Indication of the state of operating command for the relays that open/close the charging system	<ul style="list-style-type: none"> Lamp on: Under charging command Lamp off: Not under charging command
LEDG1	Indication of the operating state of the relays that open/close the charging system	<ul style="list-style-type: none"> Lamp on: Under charging Lamp off: Not under charging

4.3.3.2 Information on major components

The PPM utilizes small power resistors for preventing inrush current, and is connected serially to the charging system. Because the opening/closing of the charging system may give significant impact on the system, the PPM utilizes safety relays for state monitoring.

Component	Usage	Specification
Resistor for preventing inrush current (RC1)	Prevention of inrush current during pre-charging	<ul style="list-style-type: none"> PQR10 10Ω 10 W (ceramic wire wound resistor)
Safety relay (SR1)	Opening/closing of the pre-charging system	<ul style="list-style-type: none"> V23047-A1024-A501 5 A, 250 V AC Force-guided relay

4.3.4 Regenerative discharge module (RDM)



The RDM prevents strong electricity components from being damaged by regenerative power generated by the deceleration of the motor. It is composed of a board, regenerative discharge resistor, and a case.

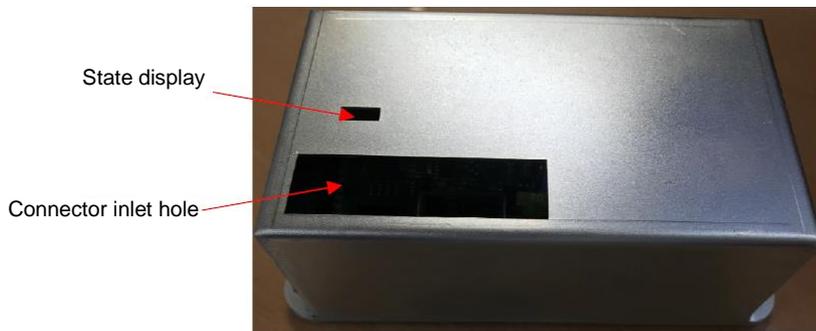


Figure 26 Outside view of the RDM



Figure 27 Inside view of the RDM

4.3.4.1 Connection and display

The connector layout, usages, and connecting devices used by the RDM are as follows:

Connector	Usage	External connecting device
CNPM3	Connection of 48 V DC power line (for motor)	Power pre-charge module (PPM) CNPM3
CNRDM	Connection of state information signals	Safety control module (SCM) CNPMD

The details of the state display of the RDM are as follows:

LED	Usage	Display details (lamp state)
LED7	Detection of overheating of the regenerative discharge resistor or overcurrent of the discharge current	Overheating of the regenerative discharge resistor (95°C) or Overcurrent of the discharge current (15A)
LED8	Detection of disconnection of the regenerative discharge resistor	The regenerative discharge resistor is disconnected (displayed even during the regenerative discharge operation)
LED9	Detection of regenerative discharge operation	Under regenerative discharge operation
LED10	Detection of regenerative discharge overtime	Occurrence of regenerative discharge operation for 10 ms or longer

4.3.4.2 Information on major components

The regenerative discharge board uses fuses for protecting components against overcurrent, and a regenerative discharge resistor. The fuses are mounted at upstream of the board and at the upstream of the regenerative discharge resistor, while the resistor is mounted at the downstream of the board. For the inside composition and component specifications, see the following figure and table.

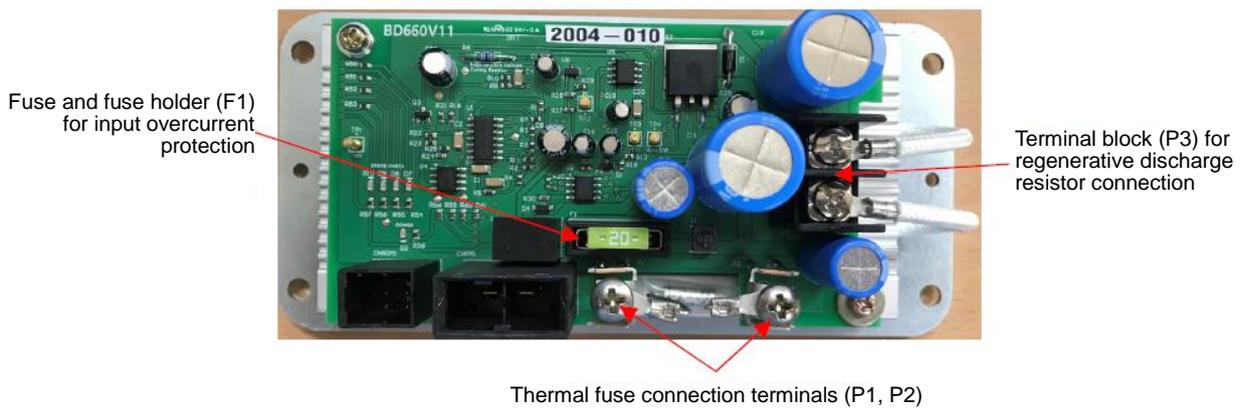


Figure 28 Inside view of the RDM (top)

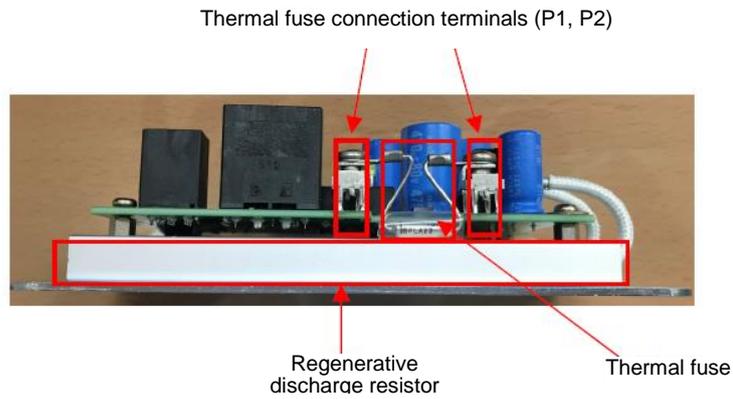


Figure 29 Inside view of the RDM (side)

Component	Usage	Specification
Thermal fuse	Protection from overcurrent of regenerative operation and overheating of the regenerative discharge resistor	15A, 93°C
Fuse for protecting from overcurrent of input terminal	Protection of overcurrent of input power	58V, 20A
Regenerative discharge resistor	Resistor for discharging regenerative current	5Ω , 100W



4.3.5 Microcomputer module

The microcomputer module (miniH6COM, EBC-GF53) drives and controls the collaborative robot based on the Hi6 control platform. For more details of this module, see “[Operation Manual for Hi6 Controllers.](#)”

The composition of the external interface, COM ports, and power connector of the microcomputer module is as follows:

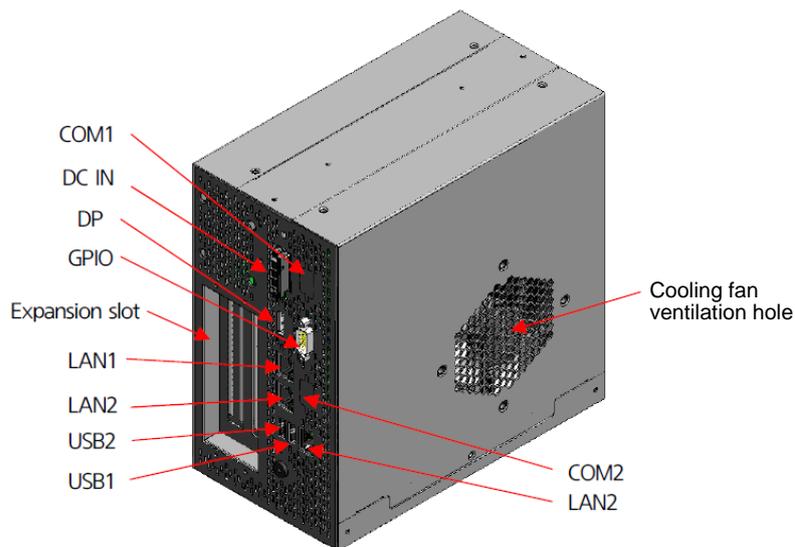


Figure30 External interface of the microcomputer module

Port	Usage	Specification	Count
DP	Display	Display port	1
LAN1, LAN2, LAN3	Wired LAN	Giga LAN	3
USB1, USB2	USB	USB2.0	2
COM1, COM2	Serial communication	RS-232/422/485	2
GPIO	Digital I/O	8-bit, Dsub-9	1
DC IN	Power input	12-24 V DC, 10A	1
-	Extension slot	PCIe x1, PCI	2

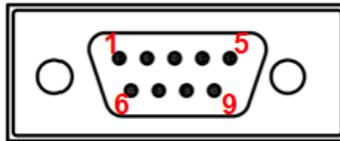


Figure 31 COM port (male) pin map

No.	Name	No.	Name
1	COMn_422_485_TX-	6	COMn_DSR#
2	COMn_422_485_TX+	7	COMn_RTS#
3	COMn_422_RX+	8	COMn_CTS#
4	COMn_422_RX-	9	COMn_RI_V#
5	GND		

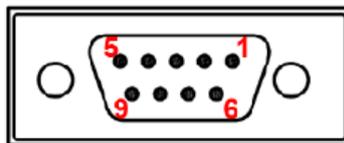


Figure 32 COM port (female) pin map

No.	Name	No.	Name
1	COMn_422_485_TX-	6	COMn_DSR#
2	COMn_422_485_TX+	7	COMn_RTS#
3	COMn_422_RX+	8	COMn_CTS#
4	COMn_422_RX-	9	COMn_RI_V#
5	GND		

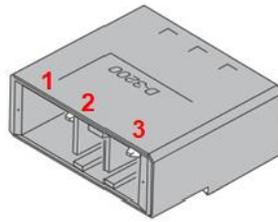


Figure 33 DCIN (power connector) pin map

No.	Name	No.	Name
1	DC24V	3	GND
2	FG		

4.3.6 Power supply

For the stable driving of the collaborative robot, SMPSs and buffer modules of the outputs of 48 V DC and 24 V DC are used.

Component	Usage	Specification
SMPS1	Power supply for motor driving	<ul style="list-style-type: none"> 2,000 W, 48 V DC RSP-2000-48, 295 (L) x 127 (W) x 41 (H) mm, 1.95 kg
SMPS2	Power supply for controlling	<ul style="list-style-type: none"> 320 W, 24 V RSP-320-24, 215 (L) x 115 (W) x 30 (H) mm, 0.9 kg
BUFFER	Power buffer for controlling	<ul style="list-style-type: none"> 24 V DC, 40 A QUINT4-BUFFER/24DC/40, 125 (L) x 130 (W) x 56 (H) mm, 1 kg

4.3.7 Teach pendant

The teach pendant (TP600) directly manipulates the collaborative robot, and checks its state of operation and setting.



Figure 34 Teach pendant

The teach pendant is connected with the microcomputer module (miniH6COM, EBC-GF53) through Ethernet communication, and has major functions as follows:

- Monitoring: Operating program, data of the axes, I/O signals, robot state, etc.
- History management: System version, operating time, error history, stoppage history, etc.
- File management: Upload/download of versions and teach programs
- Parameter setting: User environment, control, robot, application, automatic integer setting, etc.
- Robot teaching: Registration of jog and teaching programs
- Robot operation: Motor on, start, stop, and mode setting

The teach pendant has a 3-step enabling switch, an emergency stop switch, etc. for user safety. At its lower part, it has a USB connection port (Type A) for storing or downloading files to USB memory sticks, etc. For more details of how to use the teach pendant, see the “Operation Manual for Hi6 Controllers” and the “Safety Function Manual for Collaborative Robots.”

4.3.8 PCI communication card (optional)

The PCI communication installed in the collaborative robot controller enables industrial communication. This section describes the models, composition, and functions of a PCI communication card for Ethernet, which is a general model. For more details, see Hilscher’s “PC Cards CIFX 50 Model” (PC Cards CIFX 50 50E 70E 100EH UM 51 EN).

The names and functions of the PCI communication card models are as follows:

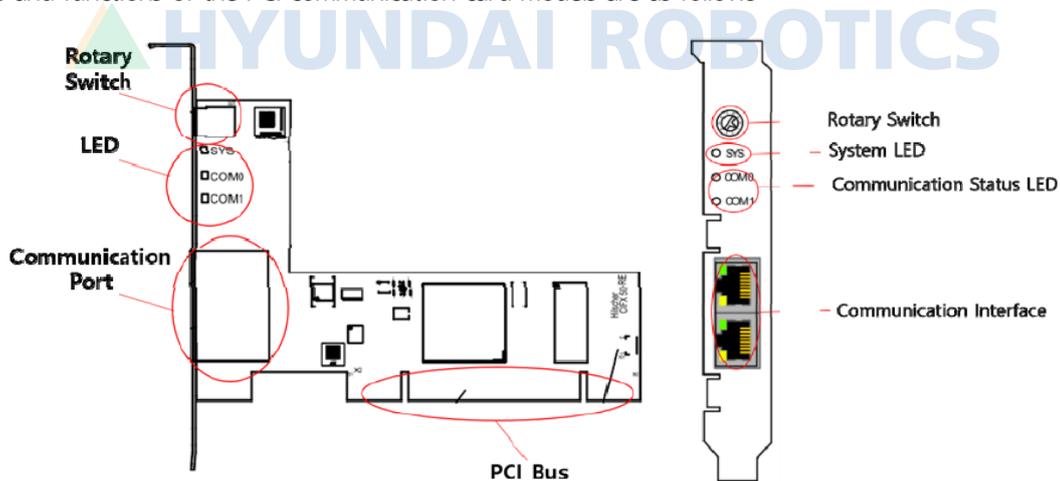


Figure 35 Outside view (left) and front view (right) of PCI communication card

No.	Name	Description
1	Rotary switch	This sets communication channels according to slot numbers. According to the position of the MiniH6COM PCI slot, set the rotary switch at 1 to 2 from the top.
2	LED lamp	<ul style="list-style-type: none"> • SYS: This displays the system state. <ul style="list-style-type: none"> • Green: The system is in normal operation. • Yellow: The system is waiting for the boot loader. • COM0, COM1: These display the communication states. <ul style="list-style-type: none"> • Green: The communication is in normal operation. • Red: A communication error has occurred.

No.	Name	Description
3	Communication connection terminal	This enables communication with external devices through a communication cable.
4	PCI bus	This, which is a bus for PC communication, enables communication with external PCs.

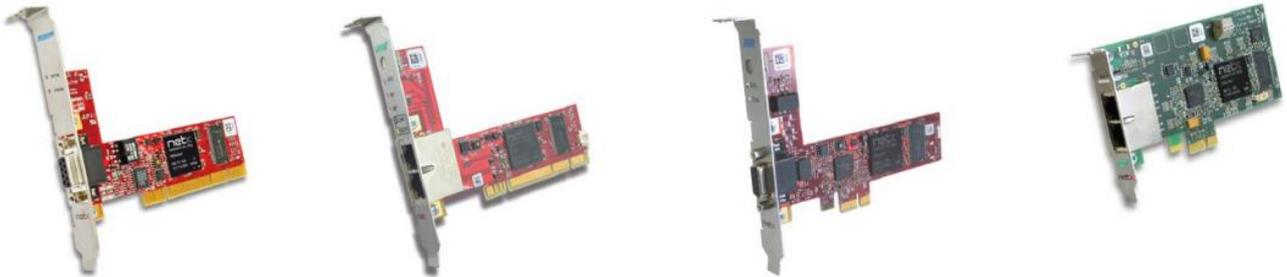


Figure 36 PCI communication card models

Model name	Description	Connector
CIFX 50-RE/ML-HRC	HRC real-time Ethernet master PCI	RJ45 socket
CIFX 50-RE-HRC	HRC real-time Ethernet slave PCI	RJ45 socket
CIFX 50E-RE/ML-HRC	HRC real-time Ethernet master PCIe	RJ45 socket
CIFX 50E-RE-HRC	HRC real-time Ethernet slave PCIe	RJ45 socket
CIFX 50-CC-HRC	CC-link slave PCI	CombiCon male connector, 5-pin
CIFX 50E-CC-HRC	CC-link slave PCIe	CombiCon male connector, 5-pin
CIFX 50-DN/ML-HRC	DeviceNet master PCI	CombiCon male connector, 5-pin
CIFX 50-DN-HRC	DeviceNet slave PCI	CombiCon male connector, 5-pin
CIFX 50E-DN/ML-HRC	DeviceNet master PCIe	CombiCon male connector, 5-pin
CIFX 50E-DN-HRC	DeviceNet slave PCIe	CombiCon male connector, 5-pin
CIFX 50-DP/ML-HRC	PROFIBUS master PCI	Dsub female connector, 9-pin
CIFX 50-DP-HRC	PROFIBUS slave PCI	Dsub female connector, 9-pin
CIFX 50E-DP/ML-HRC	PROFIBUS master PCIe	Dsub female connector, 9-pin
CIFX 50E-DP-HRC	PROFIBUS slave PCIe	Dsub female connector, 9-pin
CIFX 50E-CCIES-HRC	CC-Link IE field PCIe	RJ45 socket

4.3.8.1 Connect pin map

The pin composition of communication connectors vary depending on PCI communication cards.

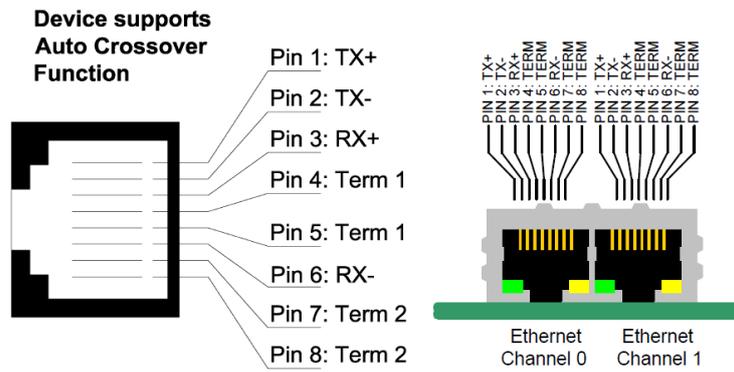


Figure 37 Ethernet pin assignments of RJ45 sockets

No.	Signal	Description
1	TX+	Transmit data +
2	TX-	Transmit data -
3	RX+	Receive data +
4	Term1	Connected to each other and terminated to PE through RC circuit (Bob Smith Termination)
5	Term1	
6	RX-	Receive data -
7	Term2	Connected to each other and terminated to PE through RC circuit (Bob Smith Termination)
8	Term2	

Isolated RS-485 interface:

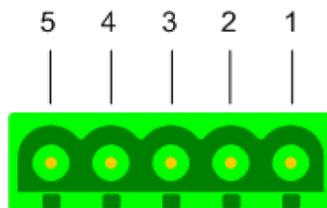


Figure 38 CC-link interface (CombiCon male connector, 5-pin)

No.	Signal	Description
1	DA	Data A
2	DB	Data B
3	DG	Data ground
4	SLD	Shield
5	FG	Field ground

Isolated ISO 11898 interface:

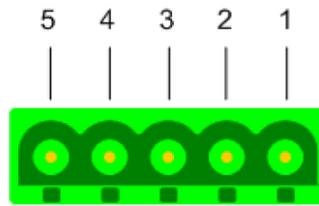


Figure 39 DeviceNet interface (CombiCon male connector, 5-pin)

No.	Signal	Description
1	V-	Reference potential DeviceNet supply voltage
2	CAN_L	CAN Low-Signal
3	Drain	Shield
4	CAN_H	CAN high-signal
5	V+	+24 V DeviceNet supply voltage

Isolated RS-485 interface:

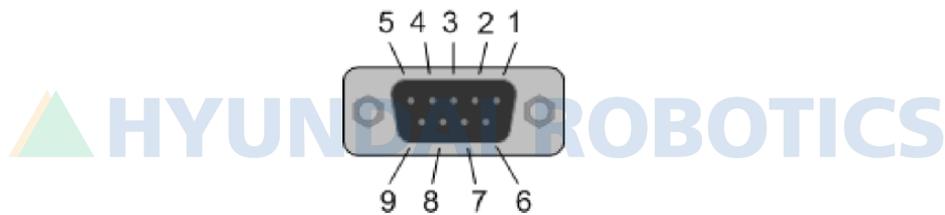


Figure 40 PROFIBUS interface (Dsub female connector, 9-pin)

No.	Signal	Description
3	RxD/TxD-P	Receive/Send Data-P respectively, connection B plug
5	DGND	Reference potential
6	VP	Positive supply voltage
8	RxD/TxD-N	Receive/Send Data- N respectively, connection A plug

5. Moving and storing

This section describes the proper methods for moving and storing the collaborative robot.

5.1 Moving method

Check the weight and precautions for the collaborative robot, move it by the proper method, paying attention to safety.

To move the collaborative robot manually, set it at the posture adequate for moving, and two or more workers lift it at the same time, and move it to the target location.

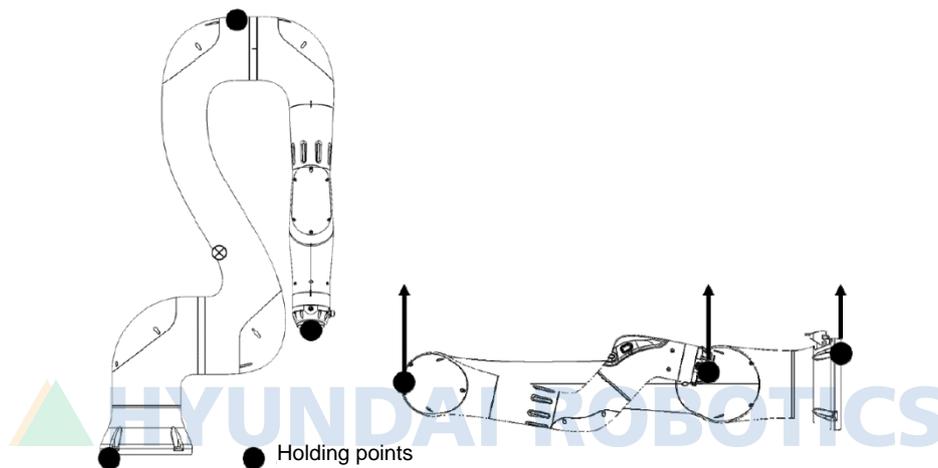


Figure 41 Manual moving

! Caution

- To move the collaborative robot manually, two or more workers should lift it at the same time, and move it.
- When two or more workers move it at the same time, connections may be damaged. Therefore, take care not to damage them.
- Putting down the collaborative robot at it is on a floor, the frame cover may be damaged.

To move the collaborative robot by means of a crane, set the robot at the posture adequate for lifting, connect it to the crane with sling belts, lift it, and move it to the target location.

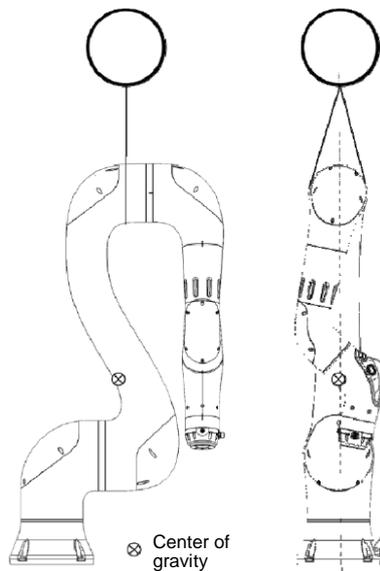


Figure 42 Moving with a crane YL012

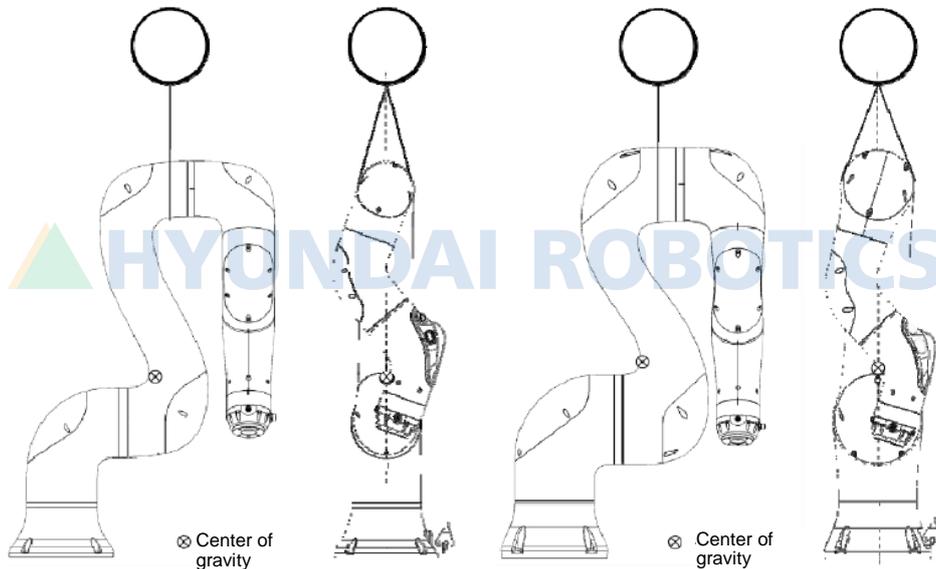


Figure 43 Moving with a crane YL005 (left) / YL015 (DN)

- The adequate robot posture for lifting is the same with that for the manual moving.

It is recommended to set the posture of the collaborative robot as it was released from the factory, referring to “5.1.1 Recommended posture.”

- The minimum capacity of the crane should be 0.2 t, while the weights of the collaborative robot models are as follows:

YL005: 27 kg, YL012: 43 kg, YL015: 41 kg



Warning

- In moving the product by means of a crane, conform to the local and national safety regulations and the instructions for equipment use.
- In moving the product by means of a crane, ensure that no workers stand under the product. Never work or pass under the crane or the product.



Caution

If an auxiliary device is attached to the collaborative robot, lifting will become harder because the center of gravity of the robot will move to another point.

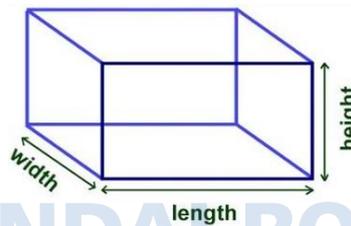
5.1.1 Recommended posture

The following is the posture of the collaborative robot when it was released from the factory. Setting the robot at this posture will facilitate moving it.

Model	Weight	S	H	V	R2	B	R1
YL005	27 kg	0	90	-70	0	0	0
YL012	43 kg	0	90	-78	0	0	0
YL015	41 kg	0	90	-73	0	0	0

5.1.2 Packaging box

The specifications of the packaging box for product transportation are as follows:



 **HYUNDAI ROBOTICS**
Figure 44 Packaging box for product transportation

Model	Length (L)	Width (W)	Height (H)
YL005			
YL012			
YL015			

5.1.3 Cautions

- Set the robot at an adequate posture for transportation, and transport it as it is packaged for preventing it from being damaged.
- In moving the collaborative robot manually, maintain the proper posture. If not, physical damages may occur.
- To move the collaborative robot manually, two or more workers should lift it at the same time, and move it.
- When two or more workers move it at the same time, connections may be damaged. Therefore, take care not to damage them.
- In moving the collaborative robot by means of a crane, conform to the local and national safety regulations and the instructions for equipment use.
- After transporting the collaborative robot wrapped with packaging materials, store it at a dry place, or put moisture absorbent in the package. Storing the robot at a high-humidity place may create moisture inside the packaging material, which may cause product anomalies.
- Before moving the product, read and conform to the instructions specified in the maintenance manual. Hyundai Robotics will not take responsibilities for product damages due to customer's carelessness, unskillful operation, and errors.

5.2 Storing method

In storing the collaborative robot without installing it, set it at the adequate posture, and store it, referring to the following instructions:

- The adequate robot posture for storing is the same with that for moving it.
- Store the collaborative robot as it is packaged, while its power and communication connections are firmly sealed.
- In storing it for a long time, make sure to take safety measures for preventing it from tumbling.
- In storing the collaborative robot wrapped with packaging materials, store it at a dry place, or put moisture absorbent in the package. Storing the robot at a high-humidity place may create moisture inside the packaging material, which may cause product damages.
- In storing the collaborative robot, avoid a place of high variations in temperature and humidity (where dew condensation occurs), and store it at a dry and cool place of an ambient temperature between -15°C and 40°C .
- Do not store the collaborative robot at a place where chemicals, acid or alkali products, batteries, circuit breakers, etc. are placed.



Caution

Storing the collaborative robot by setting it at a posture other than that recommended in the maintenance manual may make the product tumble and damaged.

5.3 Disposal



To secure user safety and to protect the environment, specific components should be managed and disposed of by the specified methods. If a component contains a hazardous industrial waste, it must not be disposed of with general industrial wastes or domestic wastes.

The materials of the components of the collaborative robot are as follows:

Component	Material
Batteries	Nickel-cadmium or lithium
Wiring devices, motors	Copper
Base body, A2 frame, second arm, wrist body, etc.	Aluminum alloy cast
Brackets, motors	Samarium cobalt (or neodymium)
Wiring devices, connectors	Plastics/rubber
Reducers, bearings	Oil/grease
First arm, wrist cover, etc.	Aluminum alloy cast

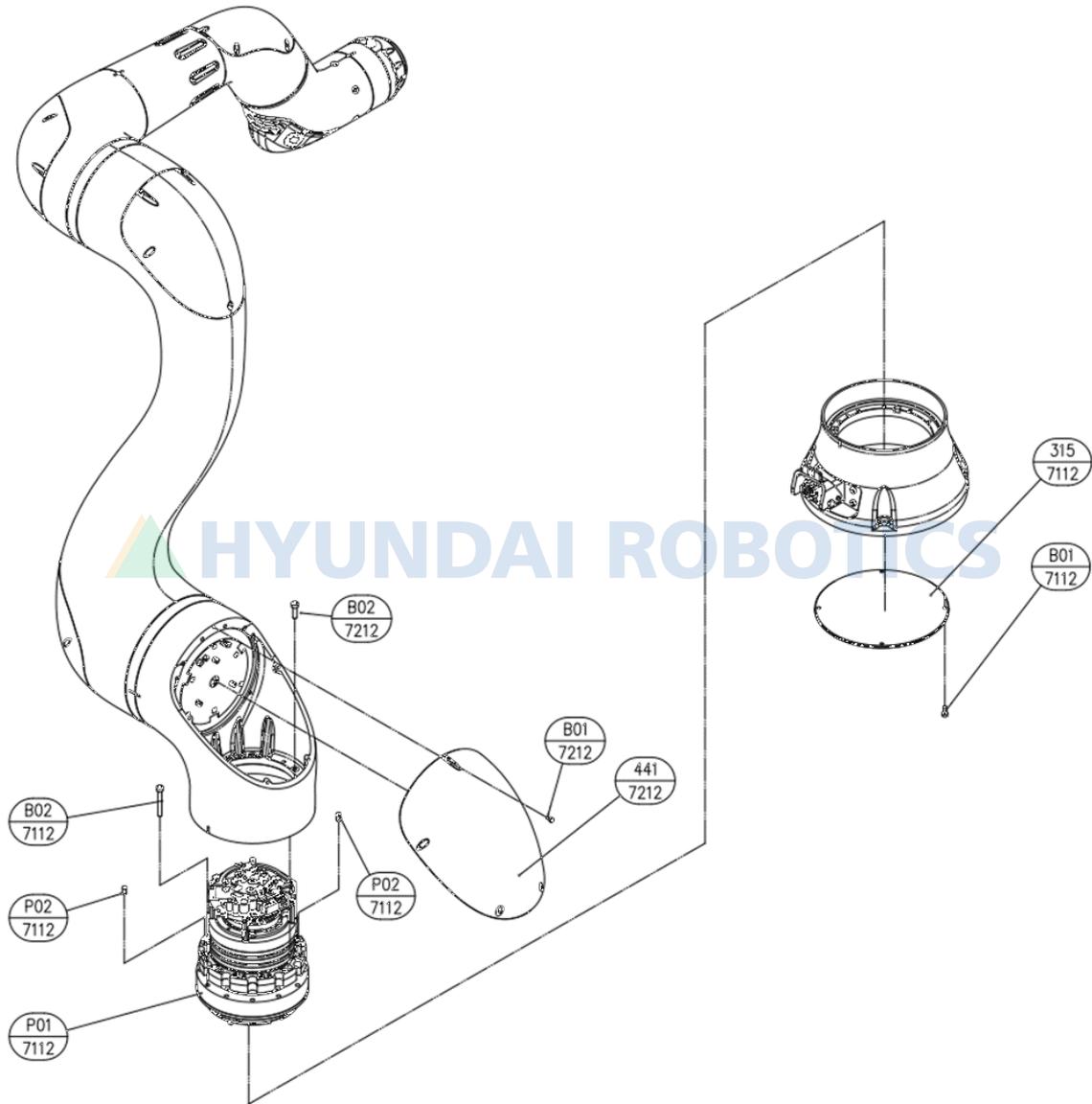
In disposing of the robot system in whole or in part, make sure to comply with the applicable laws and regulations of the pertaining country or locality. For more details of product scrapping and disposal, contact our Customer Support Team



6. Appendix

6.1 Block diagrams

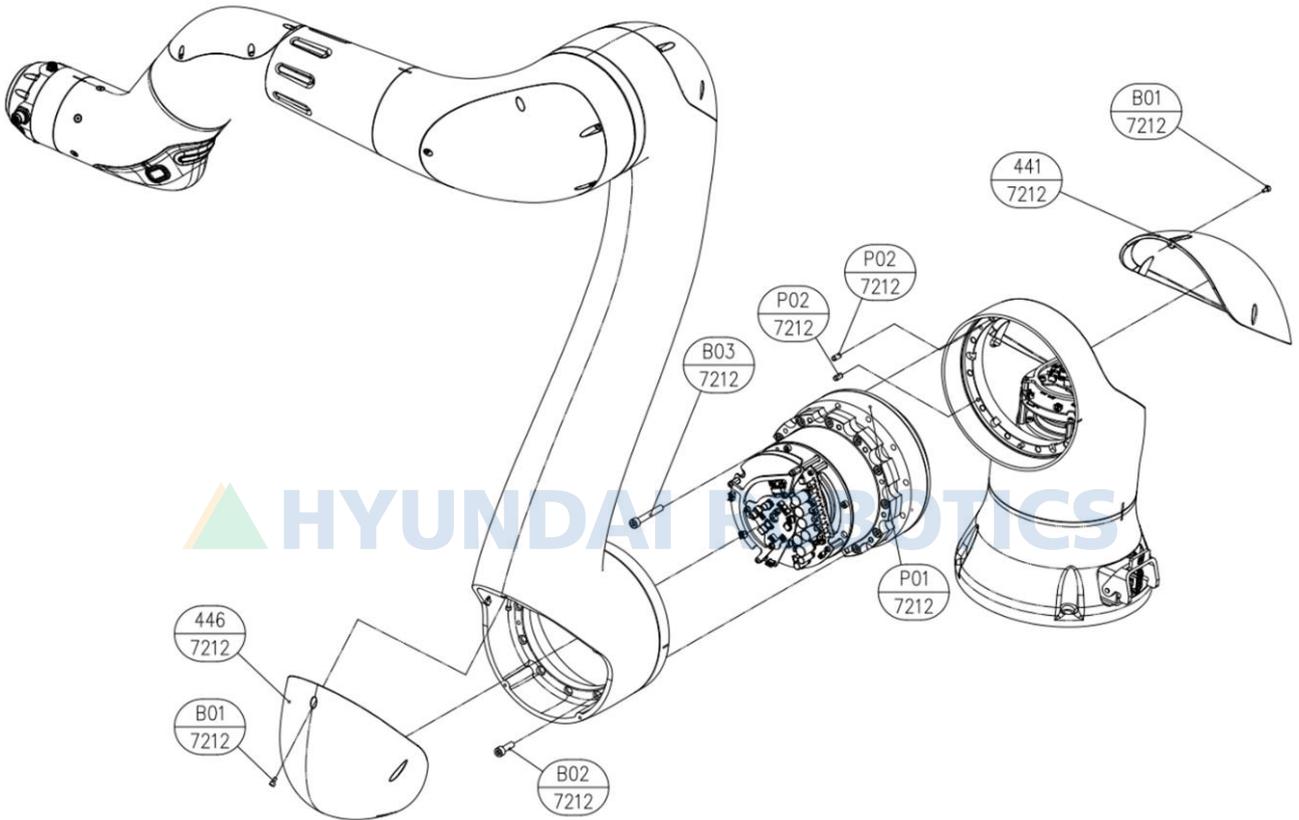
6.1.1 YL012 S-axis



No.	Description	Material (manufacturer)	Quantity
7112-315	BOTTOM COVER	A6061-T6	1
7112-P01	MODULE 32 TS	ABS	1
7112- P02	PARALLEL PIN 5X10		2
7112-B01	HEX SOCKET BOLT M4X10	12.9	4
7112-B02	HEX SOCKET BOLT M5X10	12.9	12

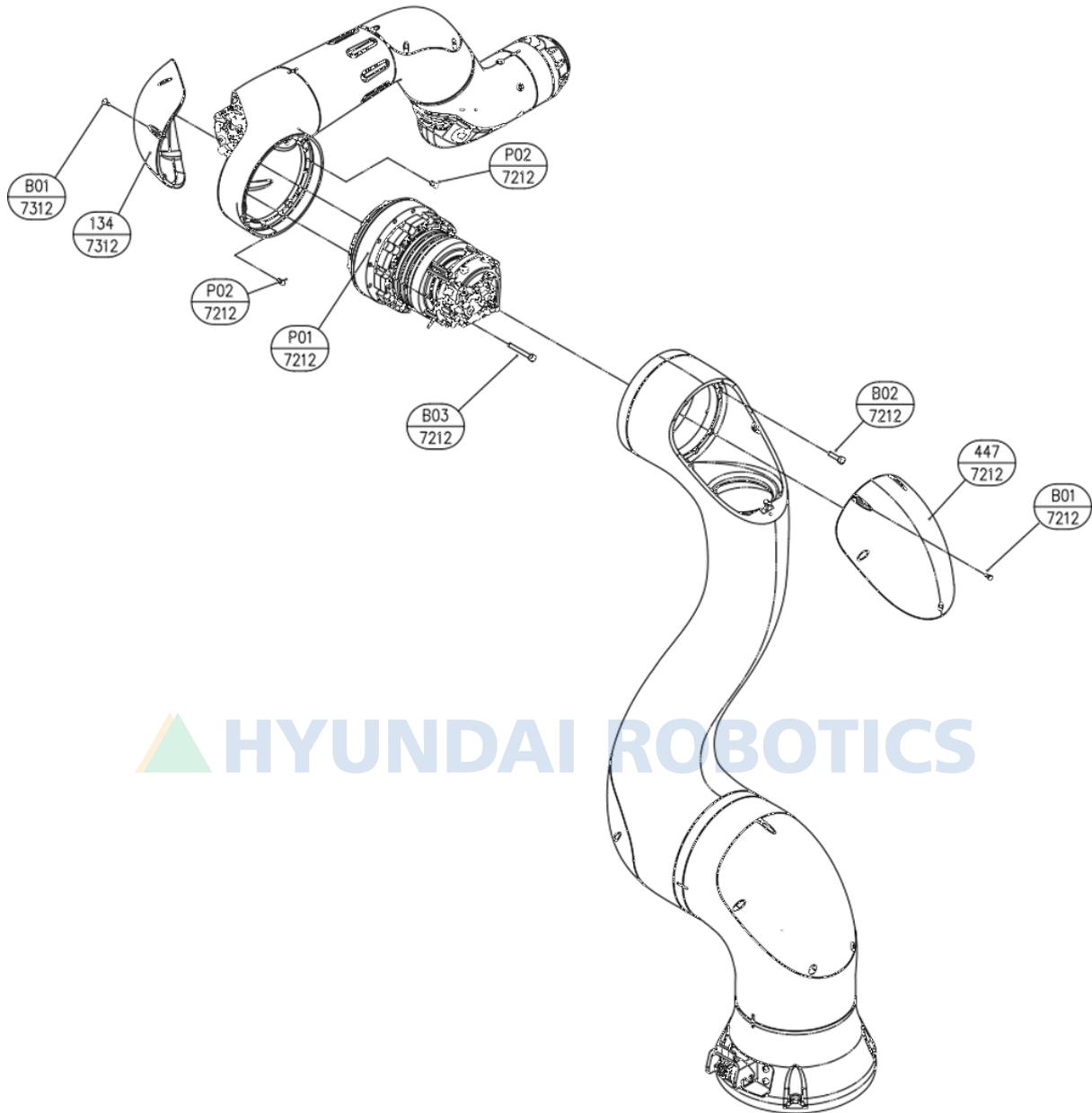
No.	Description	Material (manufacturer)	Quantity
7212-441	LOWER FRAME COVER	ABS	1
7212-B01	HEX SOCKET BOLT M3X6	12.9	5
7212-B02	HEX SOCKET BOLT M5X18	12.9	10

6.1.2 YL012 H-axis



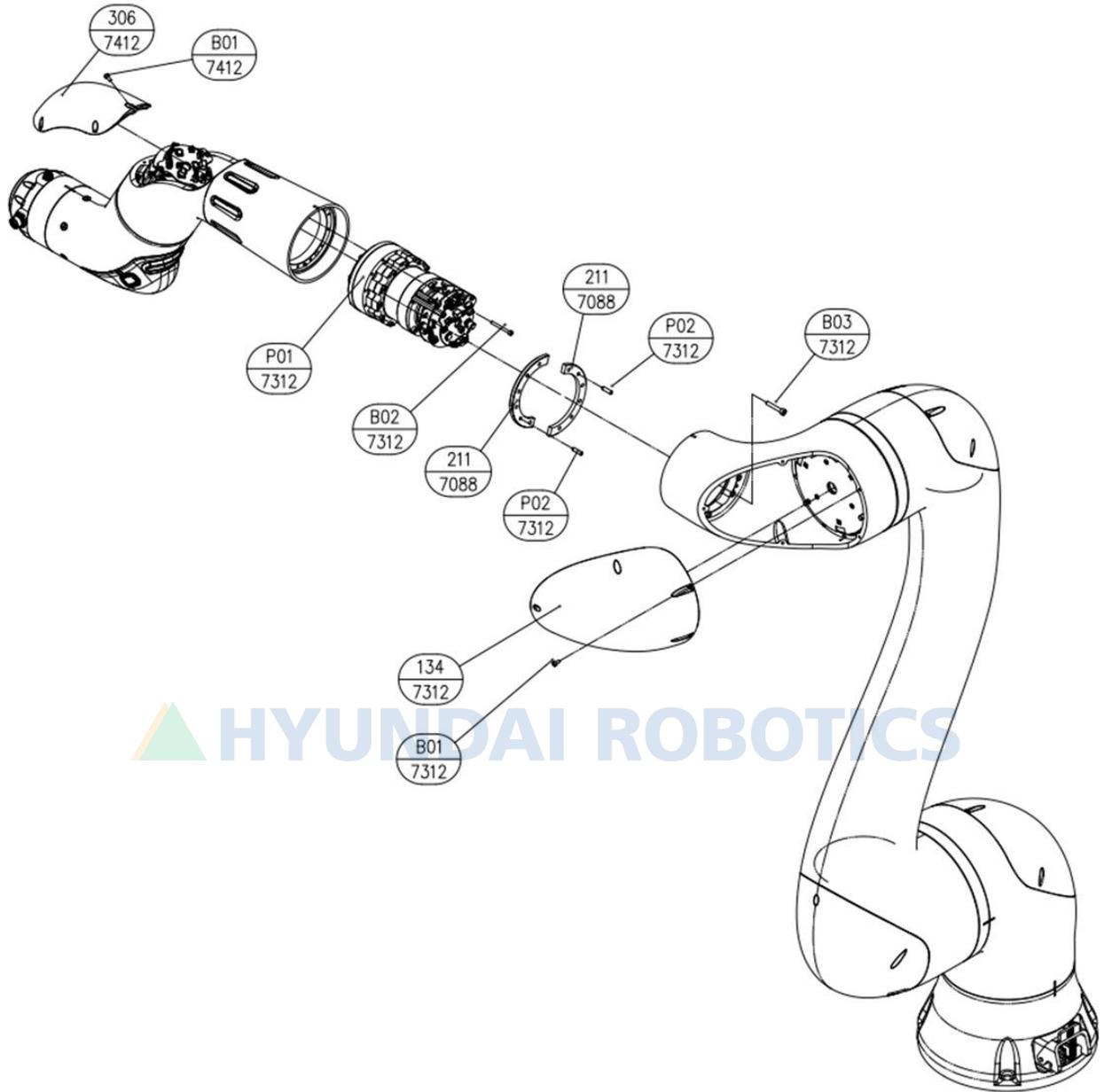
No.	Description	Material (manufacturer)	Quantity
7212-441	LOWER FRAME COVER	ABS	1
7212-446	UPPER FRAME COVER(1)	ABS	1
7212-P01	MODULE 40 TS		1
7212-P02	PARALLEL PIN 5X10		2
7212-B01	HEX SOCKET BOLT M6X6	12.9	10
7212-B02	HEX SOCKET BOLT M6X20	12.9	12
7212-B03	HEX SOCKET BOLT M6X45	12.9	12

6.1.3 YL012 V-axis



No.	Description	Material (manufacturer)	Quantity
7212-447	UPPER FRAME COVER(2)	ABS	1
7212-P01	MODULE 32 TS		1
7212- P02	PARALLEL PIN 5X10		2
7212-B01	HEX SOCKET BOLT M3X6	12.9	5
7212-B02	HEX SOCKET BOLT M5X20	12.9	12
7212-B03	HEX SOCKET BOLT M5X40	12.9	12
7312-134	ARM FRAME COVER	ABS	1
7312-B01	HEX SOCKET BOLT M3X6	12.9	

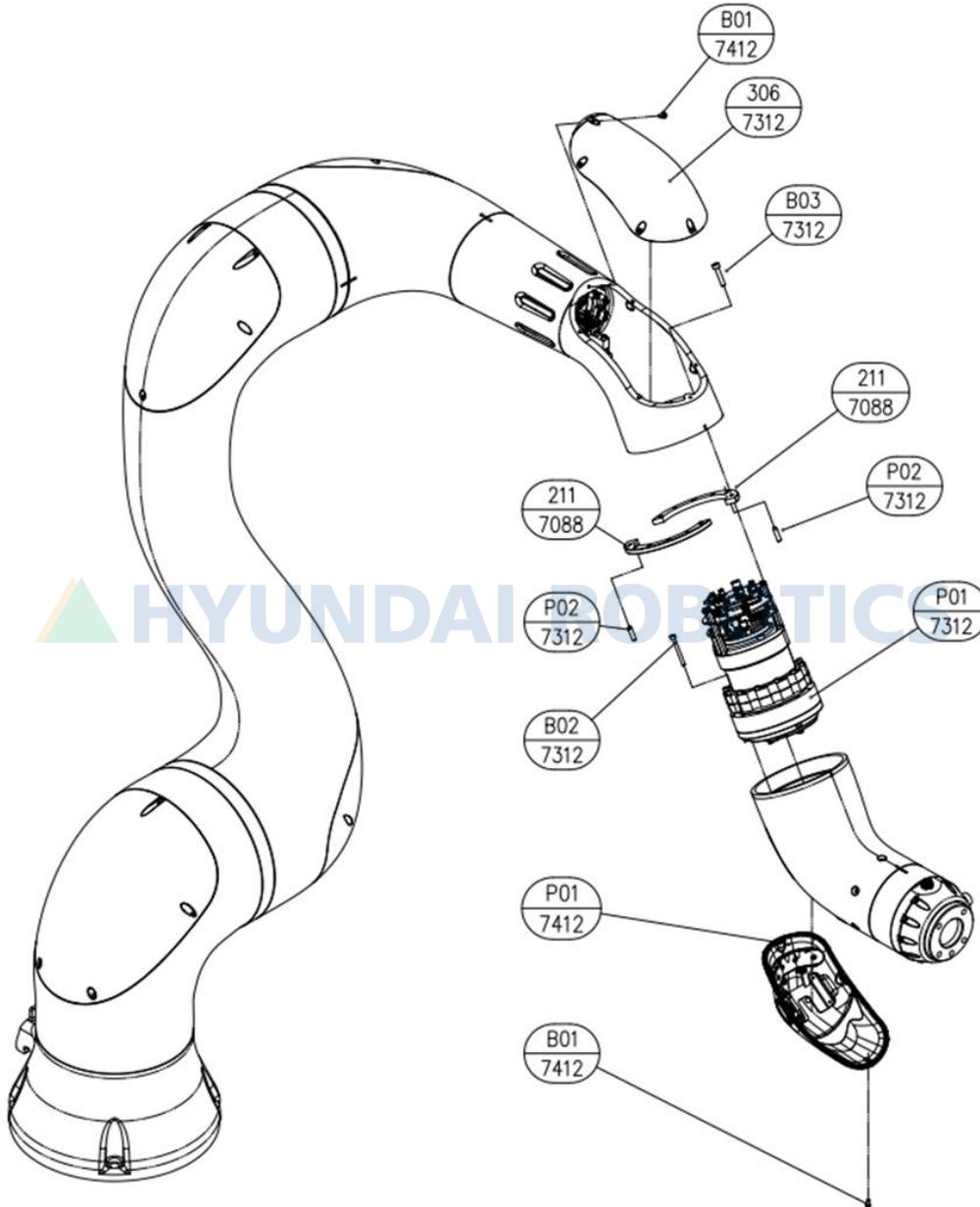
6.1.4 YL012 R2-axis



No.	Description	Material (manufacturer)	Quantity
7088-211	WASHER PLATE FOR M20	A6061-T6	2
7312-134	ARM FRAME COVER	ABS	1
7312-P01	MODULE 20 TS		1
7312-P02	PARALLEL PIN M4X15		2
7312-B01	HEX SOCKET BOLT M3X6	12.9	5
7312-B02	HEX SOCKET BOLT M3X30	12.9	12
7312-B03	HEX SOCKET BOLT M4X25	12.9	10
7412-306	ARM PIPE COVER	ABS	1

No.	Description	Material (manufacturer)	Quantity
7412-B01	HEX SOCKET BOLT M3X6	12.9	6

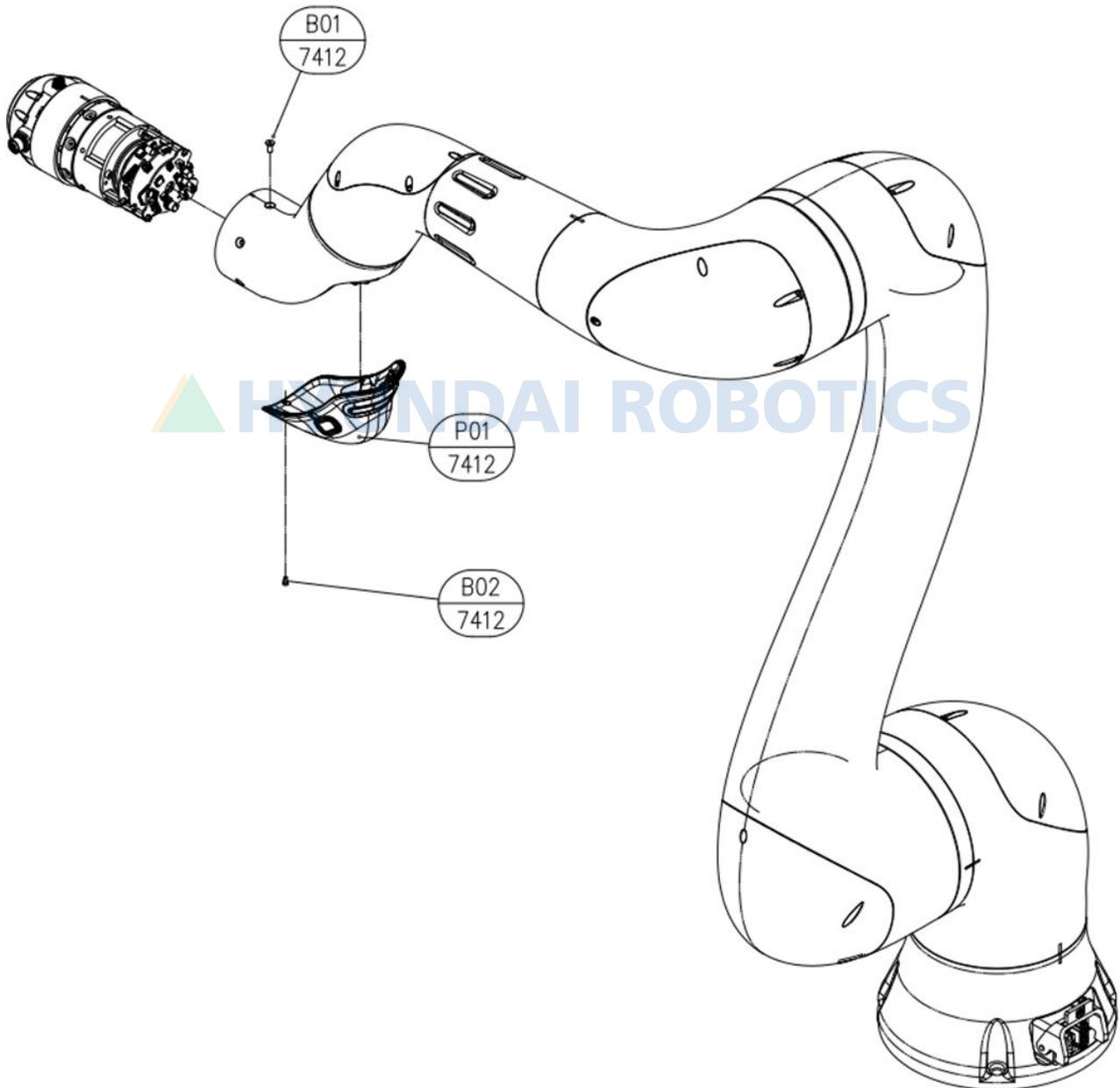
6.15 YL012 B-axis



No.	Description	Material (manufacturer)	Quantity
7088-211	WASHER PLATE FOR M20	A6061-T6	2
7312-306	ARM PIPE COVER	ABS	1
7312-P01	MODULE 20 TS		1
7312-P02	PARALLEL PIN M4X15		2
7312-B01	HEX SOCKET BOLT M3X6	12.9	6

No.	Description	Material (manufacturer)	Quantity
7312-B02	HEX SOCKET BOLT M3X30	12.9	12
7312-B03	HEX SOCKET BOLT M4X25	12.9	10
7412-P01	HAND GRIP MODULE		1
7412-B01	M3 SMALL-DIAMETER BOLT		4

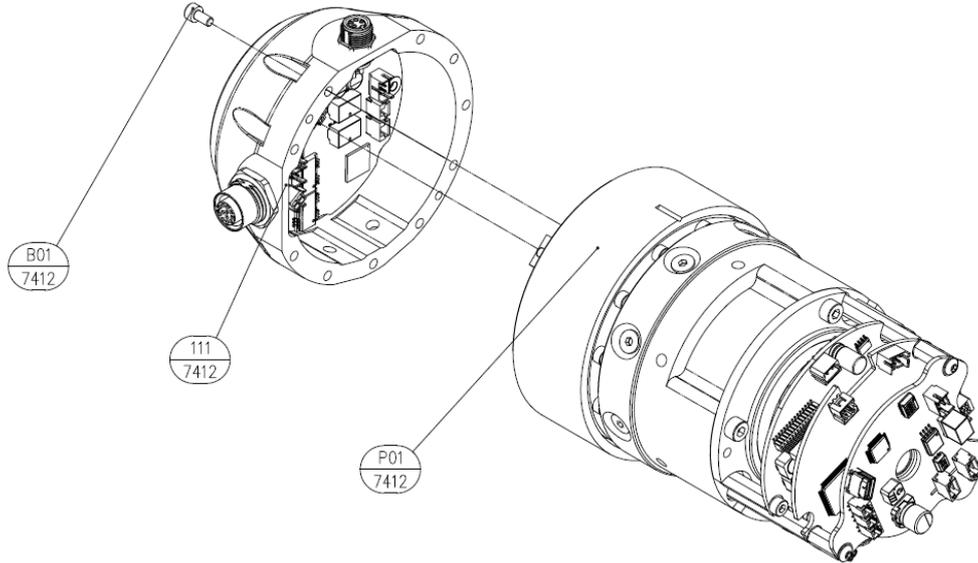
6.1.6 YL012 R1-axis



No.	Description	Material (manufacturer)	Quantity
7412-P01	HAND GRIP MODULE		1
7412-B01	HEX SOCKET FLAT HEAD SCREW M4X10	12.9	6

No.	Description	Material (manufacturer)	Quantity
7412-B02	M3 SMALL-DIAMETER BOLT	12.9	6

6.1.7 YL012 tool flange



No.	Description	Material (manufacturer)	Quantity
7412-111	MECHANICAL INTERFACE	A60610T6	1
7412-P01	MODULE 40 TS		1
7412-B01	HEX SOCKET FLAT HEAD SCREW M4X10	12.9	6

6.1.8 Power connector



No.	Division	Specification	Order no.	Manufacturer
1	PLUG ENCLOSURE	HDC 04A TWLU 1M20G	1788810000	Weidmuller
2	INSERT	HDC HA 4 MS	1498300000	Weidmuller
3	CABLE ENTRY	VG M20 - MS 68	1772220000	Weidmuller

6.2 System specifications

6.2.1 Collaborative robot

Division			YL005	YL012	YL015	
Payload			5 kg	12 kg	15 kg	
Structure			Multi-joint type	Multi-joint type	Multi-joint type	
Degree of freedom			6-axis	6-axis	6-axis	
Driving type			AC servo motor	AC servo motor	AC servo motor	
Maximum operating range	Main axis	S	Rotation	$\pm 180^\circ$	$\pm 180^\circ$	$\pm 180^\circ$
		H	Forward/backward	+270° - -90°	+270° - -90°	+270° - -90°
		V	Up/down	$\pm 180^\circ$	$\pm 180^\circ$	$\pm 180^\circ$
	Wrist axis	R2	Rotation 2	$\pm 180^\circ$	$\pm 180^\circ$	$\pm 180^\circ$
		B	Bending	$\pm 180^\circ$	$\pm 180^\circ$	$\pm 180^\circ$
		R1	Rotation 1	$\pm 180^\circ$	$\pm 180^\circ$	$\pm 180^\circ$
Maximum Speed	Main axis	S	Rotation	180° /s	180° /s	180° /s
		H	Forward/backward	180° /s	125° /s	125° /s
		V	Up/down	180° /s	180° /s	180° /s
	Wrist axis	R2	Rotation 2	180° /s	180° /s	180° /s
		B	Bending	180° /s	180° /s	180° /s
		R1	Rotation 1	180° /s	180° /s	180° /s
Position repetition accuracy			± 0.1 mm			
Ambient temperature			0 - 45°C (273 - 318° K)			
Manipulator weight			27 kg	43 kg	41 kg	
Operating radius			916 mm	1,305 mm	963 mm	
Ingress protection grade			IP54			
I/O flange			Digital I/O: 4, Analog Input: 2, Power: 12 V or 24 V (1.5 A)			

6.2.2 Controller

Division	Specification
Weight	27 kg
Dimensions	260 (W) x 490 (H) x 510 (D) mm
Ingress protection grade	IP 20
Digital I/O ports	DIO 8/8 points
Analog I/O ports	AIO 2/2 points
Rated supply voltage	110 V - 220 V AC

6.2.3 Teach pendant

Division	Specification
Weight	1186 g
Dimensions	223 (W) x 291 (H) x 73 (D) mm (w/ mode switch)
Ingress protection grade	IP 5x
Screen size	8"
Cable length	5 m

Certificates

Hyundai Robotics acquired certificates of the robot from the following official testing and certification bodies for supplying stable robot systems:

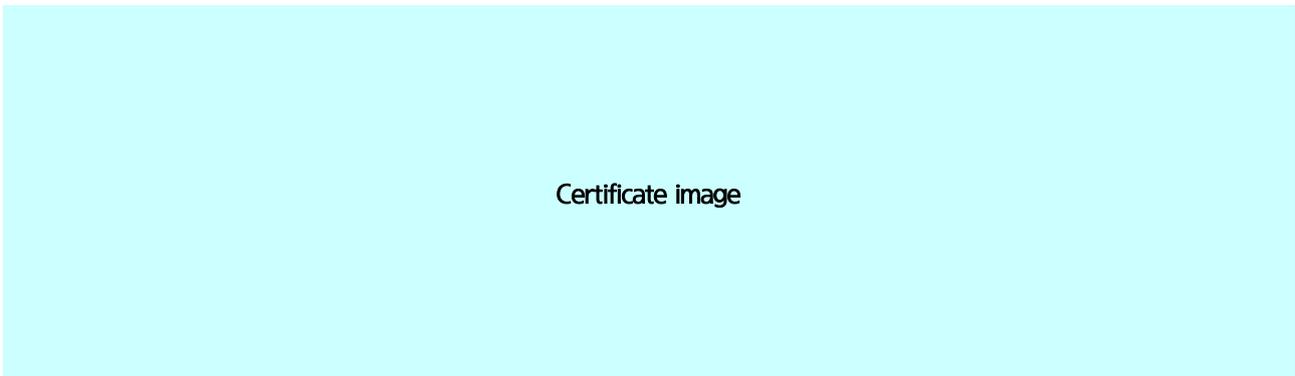
- Functional safety certificate



- CE, NRTL certificate



- Autonomous safety verification reporting certificate (KCs)



Warranty

Hyundai Robotics (hereinafter, “We”), provides warranty for raw material defects and manufacturing defects of this product according to the details specified in the Warranty Statement for protecting benefits of the customers who purchase robot systems manufactured by us and sold by us or our authorized sellers. This warranty is provided only for end-users (hereinafter, “Customers”) of our robots.

■ Warranty scope

The robot and its components (hereinafter, the “Product”) are under our warrant in terms of material and manufacturing defects.

The only responsibilities of ours and the only remedial measures relating to any of our products will be limited to repair or replacement of products deemed to have direct defects at our discretion. We will not compensate for any collateral damages or accidental, special, or consequential damages including loss of income, loss of use, loss of production, or damages of other products or equipment due to defects of our products.

■ Warranty period

We provide one-year warranty for product quality beginning on the date on which our product is delivered to a site after the customer purchase the product or the date on which the customer issues a letter of acceptance after the completion of commissioning. However, if the contract date and the delivery date (installation and commissioning completion date) do not match each other, the delivery date will be the beginning date of warranty. When the product is replaced with a new finished product, the warranty period will be calculated from the replacement date.

■ Warranty limitations and exceptions

To maintain the warranty valid, the customer should comply with the maintenance procedure specified by us, and keep the relevant records. When we decide as follows because the customer does not comply with the maintenance procedure, the warranty will be void.

- Product faults and damages due to customer's carelessness, unskillful operation, erroneous or arbitrary modification, disassembly, and repairing
- Product faults and damages due to the installation and use of parts, consumables, software, etc. that are not authorized by us
- Product faults and damages due to non-compliance with the instructions and precautions specified in the product manual
- Product faults and damages due to its use for purposes other than its intended purposes
- Product faults and damages due to use of the product at inadequate environments, or dropping or giving impact to the product.
- Product faults and damages due to arbitrary installation, repair, or maintenance carried out by persons (customers, unauthorized persons, or non-licensed maintenance workers, etc.) than installation experts.
- When the service life of consumable parts has elapsed
- When warranty service is filed after the warranty period has expired

We do not provide warranty for product damages due to external situations that are not under our reasonable control, such as thefts, intentional sabotages, fires, natural disasters, wars, or terroristic behaviors. In addition,

we will not take responsibilities for any defects of products, functionality, and performance that are beyond the scope specified in the Warranty Statement.

Customer Support

- Representative phone number: 1670-5041 | Email: robotics@hyundai-robotics.com
- Working hours: Weekdays (Monday - Friday) 09:00 - 18:00 | Closed on weekends and holidays

For details queries about products or services, please contact our Customer Support Team





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Daegu: 50 Technosunhwan-ro 3-gil, Yuga-myeon, Dalseong-gun, Daegu-si
Ulsan: Room 201-5, Automotive and Shipbuilding Engineering Hall, Maegoksaneop-ro 21, Buk-gu, Ulsan-si
Middle Region: Song-gok-gil 161, Yeomchi-eup, Asan-si, Chungcheongnam-do
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