WARNING

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

HD HYUNDAI ROBOTICS

Hyundai Robot

Hi5a-S230418CMEN18

Hi5a-S/P/C/T/J Controller Maintenance Manual

- Hi5a- S00/S10/S60
- Hi5a- S20/S30
- Hi5a- S80
- Hi5a- C3*/C4*/C5*/C6*
- Hi5a- P10/P20
- Hi5a- T10
- Hi5a- J00

HD HYUNDAI ROBOTICS

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1.1. Introduction

The main purpose of this chapter is to describe the safety of personnel who use, repair, and operate the industrial robot. While this manual is written mainly for the handling of the controller, the performance of the explosion-proof function is an item certified, together with the manipulator, for the whole system. Therefore, you should carefully read and understand the instruction manual of the machine.

This manual describes safety precautions for robot manipulator and controller, in complies with the safety regulation of EU Machinery Directive 98/37/EC(2006/42/EC) and US OSHA. And the robot manipulator and controller is manufactured to comply with the safety standards EN ISO 10218-1:2011 and ANSI/NFPA 79:2021.

Every operator, who installs, replaces, adjusts, manipulates, maintains, and repairs, must read thoroughly and fully understand the manipulation and maintenance manual, in particular, the special attention must be paid to the WARNING symbol, the most important marking related to the safety.

Installation, replacement, adjustment, manipulation, maintenance, and repair of robot system must be performed by the personnel who was duly trained for these purposes, following the indicated operating procedure.

This company is planning and carrying out the relevant training such as maintenance, repair, and manipulation for the above operations, so robot users make sure that robot operators should get the relevant training. And make sure that the robot handling work should be carried out only by the operators who completed this training course.

Hyundai Robotics user of industrial robot has responsibility to observe the safety regulation related to robot adopted in corresponding countries and responsibility to design, install and operate safety equipment well in order to protect workers who work at robot system.

The dangerous zone of robot system, that is the working range in which the robot, tool, and peripheral equipment are operated, must be safeguarded to prevent workers or objects from entering the zone. If a person or object should nevertheless enter the dangerous zone, make sure that the robot system is immediately shut down by emergency stop system. The operators of robot system have a responsibility to take all necessary steps to make correct installation, examination and operation of the relevant safety devices.

The areas for which the robot can be applied and the environment in which it can be used are as follows.

Applicable areas

It is applied to the industrial robot used by installing on the surface of wall or plane (axes addable). It is also appropriate for controlling operation in the dotted section or consecutive section.

Major application is

- Spot welding
- Arc welding
- Cutting
- Handling
- Assembly
- Application such as Sealing
- Palletizing
- Grinding
- LCD manufacturing process

For the other use than the above emergency application, make a contact with our company to consult on the robot use and possible applications.

Disable environment

Our robot must not be used in a highly explosive environment and the areas contaminated by oil, flammable materials or chemical materials. (Prohibited to be installed and manipulated.)

● Hi5a-P10/P20

The areas for which the robot can be applied and the environment in which it can be used are as follows.

Applicable areas

It is applied to the Painting robot used by installing on the surface of wall or plane (axes addable). It is also appropriate for controlling operation in the dotted section or consecutive section.

For the other use than the above emergency application, make a contact with our company to consult on the robot use and possible applications.

Disable environment

Our robot must not be used in a highly explosive environment and the areas contaminated by oil, flammable materials or chemical materials.
It is recommended to use it in the environment of Zone I. (Prohibited to be installed and manipulated.)

EXPLOSION-PROOF SPECIFICATION

This robotic system is built in a complex explosion-proof structure that integrates the pressurized explosion-proof structure with the intrinsically safe explosion-proof structure.

The structure of the robot and the painting equipment realizes the explosion-proof function that uses pressure. The pressure inside the machine is retained higher than the air pressure of the painting booth, thereby preventing the inflow of gas from the outside as well as possible hazards that could occur to electric connections, for example, between the motor and the encoder inside the manipulator.

The robot should maintain a pressure higher than the atmospheric pressure to start normally. If this condition is not satisfied, the electrical connection will be cut off.

Purge any explosive gas before supplying power to the equipment in the booth. Perform air purging when the controller power is turned on so that explosive gas can be purged below the reference concentration. If stable pressure is maintained, the robot will be set to a state in which it can operate. If the internal air pressure does not reach the reference pressure, the controller immediately cuts off the power supply.

The robot cannot be started until the air purging operation is performed again to purge the gas surely even after the fault is cleared.

The pressure switch is always in operation to monitor the manipulator's pressure. The energy supplied for the operation of the system is limited by the intrinsically safe explosion-proof structures, so the energy supply cannot exceed the explosion threshold within the paint booth.

This robotic system is certified for explosion-proofness by an international certification institute. To sustain its explosion-proof performance, adding or changing any system or parts that may affect the system is prohibited. Only approved products shall be used for maintenance. If these parts fail or need to be replaced, please contact Hyundai Robotics.

The pressurized explosion-proof structure prevents the motor and internal wirings inside the manipulator from exploding. However, such protection does not cover the separate harness that connects the manipulator and the controller. If the harness is exposed to a solvent, the cable can be damaged, and ground-fault circuiting or short-circuiting could take place, which could possibly lead to a fire. Make sure that the external harness is exposed to a large amount of solvent.

It is also recommended to regularly test the surface of the cable and the protective tube to prevent damage, and to replace the harness every three to five years.

Purge the explosive gas inside the booth before supplying power to the robotic system and equipment. Install and activate a pressure detection system inside the booth.

Explosion-proof robots are certified for explosion-proofness to ensure safe operation in gas or explosive atmospheres (integration of pressurized and intrinsically safe structures to realize the explosion-proof specification). Take extreme precautions to handle this system properly. Otherwise, serious accidents, such as explosions, could take place.

1.2. Relevant Safety Regulations

The robot is designed as per ISO 10218-1:2011 safety standards for industrial robots, and furthermore in comply with ANSI/NFPA 79:2021 regulations.

1.2.1. Explosion-proof safety regulations

Electrical systems that perform explosion-proof function and any approved changes should conform to the following standards.

IECEx ATEX	Ex ib [ib] pxb IIB T4 Gb Ⓔx II 2 G Ex ib [ib] pxb IIB T4 Gb

IECEx / ATEX Standards:

IEC 60079-0: 2017 Ed.7 / EN IEC 60079-0: 2018
"Electrical apparatus for explosive gas atmospheres,
Part 0 : General Requirements"

IEC 60079-2: 2014 Ed 6 / EN 60079-2: 2014
"Electrical apparatus for explosive gas atmospheres,
Part 2 : Equipment protection by pressurized enclosure 'p'"

IEC 60079-11: 2011 Ed 6 / EN 60079-11: 2012
"Electrical apparatus for explosive gas atmospheres,
Part 11 : Equipment protection by Intrinsic safety 'i'"

1.3. Safety Training

All the personnel who intend to teach, operate or inspect the robot must be trained in an approved robotic operation and safety training course before start-up. The safety training course includes the following details:

- Purpose and functions of safety devices
- Safety procedure to handle the robot
- Performance of robot or the robot system and possible hazards
- Tasks associated with any specific robot applications
- Safety concepts, etc.

1.4. Safety Related Nameplate

1.4.1. Safety Marking

For the purpose of effective safety instructions, the following safety symbols are used in this manual.

Table 1-1 Safety marking

Symbols		Descriptions
Warning		Indicate a highly dangerous situation, meaning that operating or handling in a wrong manner could result in death or serious injury to personnel, or damage to equipment. Attention should be paid to the operation and handling.
Mandatory		Indicate the compulsory measures that should be taken
Prohibited		Indicate the prohibited actions and/or operations that should not be performed.

1.4.2. Safety Nameplate

Identification plates, warning label and safety symbols are attached to the robot and to the inside and outside of control panel. The designation labels and cable Mark for wire harness between the robot and control panel, and the cables inside/outside of control panel are provided.

All of these plates, labels, symbols and marks constitute safety-relevant parts of the robot and the control panel. They must remain attached to the robot manipulator and control panel at their clearly visible positions all the time for the safety and their full performance.

The painted markings on the floor and signs indicating dangerous zones must be clearly distinguished in form, color, and style from other markings on the machine near the robot system or inside the plant facilities where the robot system is installed.

It is forbidden to remove, cover, or paint over by way of spoiling the clearly visible identification plates, warning labels, safety symbols, designation labels and cable marks.

1.5. Definition of Safety Functions

Emergency Stop Functions – IEC 204-1,10,7

There is one emergency stop button on the controller and teach pendant respectively. If necessary, additional emergency buttons can be connected to the robot's safety chain circuit. The emergency stop function, which overrides all other robot controls, can bring the current operation to a halt by cutting off the power supply to the motors of individual axes. This function will also shut down the power supply to other dangerous functions, which are controlled by the robot, to prevent them from being used

Safety Stop Function - EN ISO 10218-1:2011

A safety stop circuit needs to be configured, and, through this circuit, each robot should be connected with the safeguards and interlocks. The robot should have a number of electrical input signals which can be used to connect external safety devices, such as safety gates, safety pads, and safety lamps. These signals allow the robot's safety functions to be activated by all equipment, including peripheral equipment and the robot itself.

Speed Limitation Function - EN ISO 10218-1:2011

In a manual mode, the maximum speed of the robot is limited to 250 mm per second.
The speed limitation applies not only to the TCP(Tool Center Point), but to all parts of manual mode robot. The speed of equipment mounted on the robot should be possibly monitored.

Restricting working Envelope - ANSI/NFPA 79:2021

Operation area of each axis is restricted by soft limit and hardware limit. Axis 1, 2, and 3 can also be restricted by means of mechanical stopper.

Operation Mode Selection - ANSI/NFPA 79:2021

The robot can be operated either in the manual mode or auto mode. In the manual mode, the robot can be operated only by using the teach pendant.

1.6. Installation

1.6.1. Safety Fence

Install safety fence against the possible collision between the robot and workers, so that no worker may approach the robot.

Install safety fence against the possible collision between the robot and workers, so that no worker may approach the robot. When operators or other personnel enter the robot's working envelope by accident, it may cause an accident. Install the safety fence to stop the robot when one, who intends to replace for TIP DRESSING or TIP changing replacement, or to inspect welding equipment, opens the fence gate and approaches the equipment during operation.

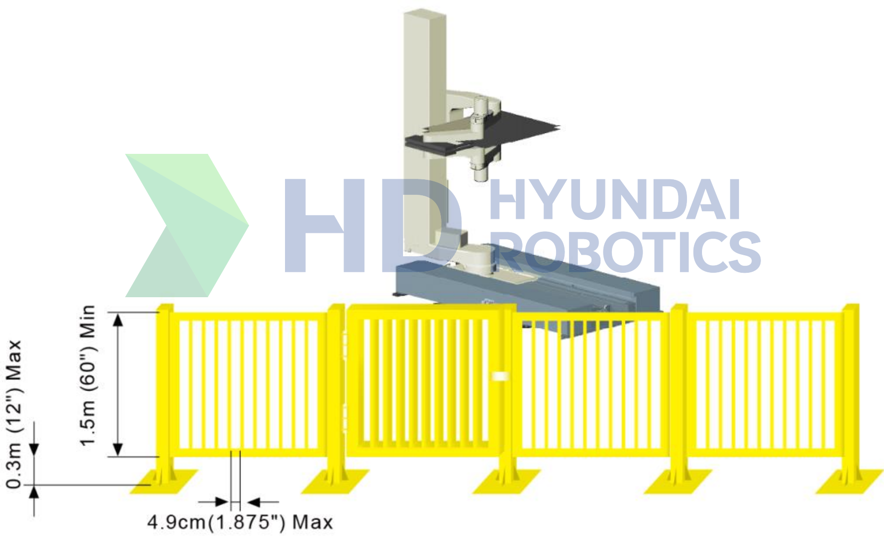


Figure 1.1 Recommended size for safety net and entrance gate (slot type entrance gate)

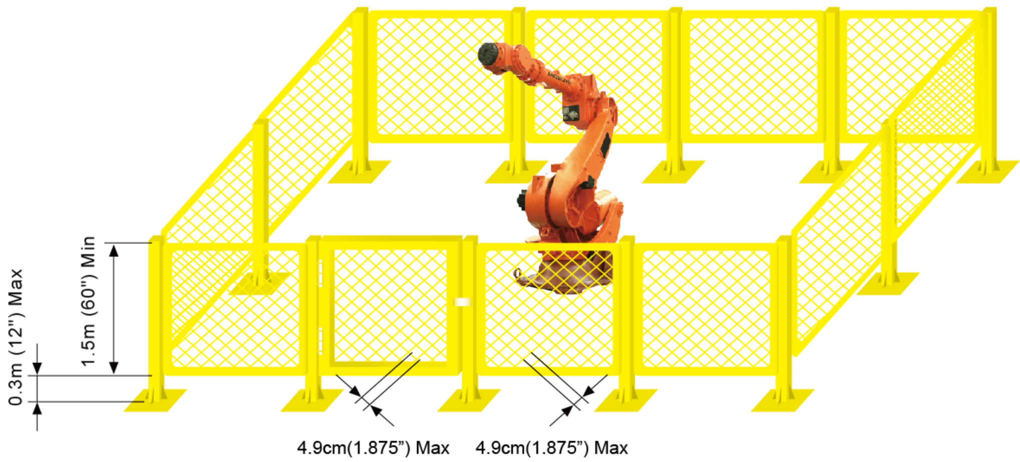


Figure 1.2 Recommended size for safety net and entrance gate (square type entrance gate)

(1) Safety net should be installed by static type in principle, and should not have hazardous parts such as prominence and depression or keen part, etc.

(2) Install the safety fence with an entrance gate, and register the safety plug at the gate so that it does not open unless pulling the plug out. Wiring should be carried out in a way that the robot should be in the operation ready OFF status as well as in the motor OFF status when the safety plug is pulled out or safety net is open.

(3) In order to operate the robot with the safety plug pulled out, wiring should be carried out in a way that will allow the playback to take place at a low speed.

(4) The emergency stop button should be installed at a place where it can be pushed quickly by the operator.

(5) If no safety net is to be installed, devices such as photoelectric switches, and mat switches, should be installed, instead of the safety plug, to cover the overall area within the robot's operation range in a way that the robot can be stopped automatically when a person enters the robot's operation range.

(6) Operation area of robot (hazardous area) should be distinguished by the method like painting on floor.

1.6.2. Placement of Robot & Peripheral Equipment

Please make sure that robot and peripheral equipment should be arranged by following method.

(1) In case of connecting primary power of controller or peripheral devices, please work after checking whether supply power has been deleted. There is a possible danger of electric shock because the high voltage such as 220V and 440V is used as its primary power.

(2) Post a sign [No enter during operation] up the safety fence gate, and inform the operators of its purport.

(3) Arrange such devices as controller, interlock panel, and other manipulation panels to be handled outside of the safety fence.

(4) When installing operation stand, install the emergency stop button on the stand. Make sure that stopping in an emergency situation can be initiated from any place from which the robot is operated.

(5) Make sure that the robot manipulator and the wiring and piping of controller, interlock panel, and timer should not be placed in the way of operator's working range so that they would not be directly stepped on by FORK and LIFT. Otherwise, the operator may suffer electrocution or the wire may suffer disconnection.

(6) Place the controller, interlock panel, and handling stand within the sight of robotic performance. It may cause a major accident to operate the robot while the robot is malfunctioning in an area where the robot’s activity cannot be observed, or while the operator is working on it.

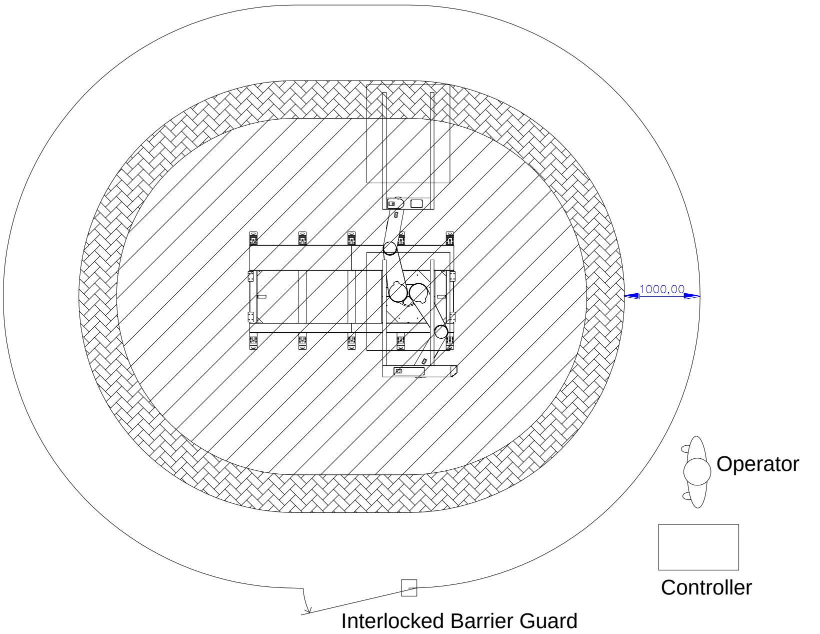
(7) Restrict the robot's working envelope by using the soft limits and the mechanical stopper if the necessary working envelope is narrower than the robot’s workable envelope. When the robot is to move beyond the restricted envelop due to abnormal operation, such as the robot being handled in a wrong way, the robot will be stopped automatically in advance thanks to the function that restricts the workable envelop.

(8) During the welding work, spatter could fall down to workers or the workers could be injured by burning, or fire could break out. Install such devices as a glare shield or a cover in the full sight of robot's working envelope.

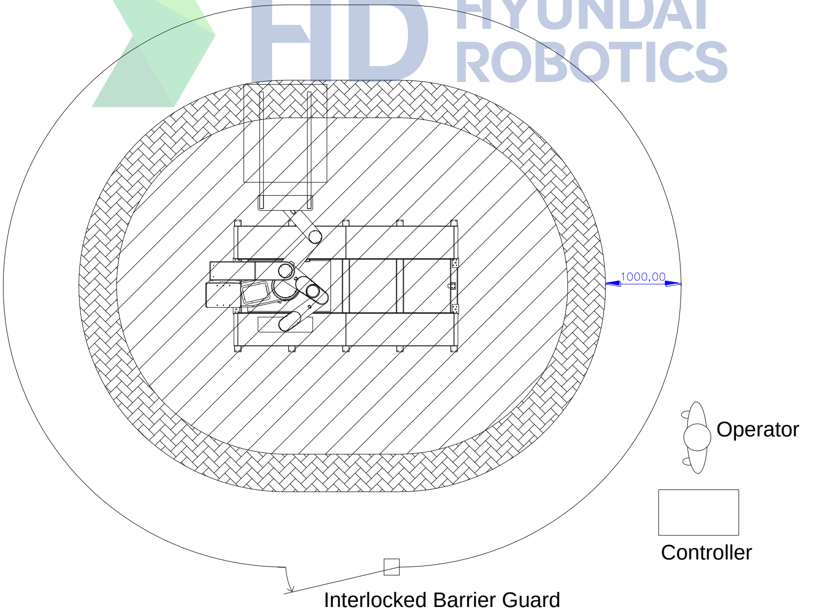
(9) Make sure that the device indicating the robot's running condition, whether automatic or manual mode, can be noticeable even from a slightly distant location. In the case of automatic start-up, a buzzer or a warning lamp will be useful.

(10) Make sure that there is no projecting part in the robot's peripheral equipment. Cover it, if necessary. It usually could cause an accident if the operator comes in touch with it. And it may cause a major accident when the operator tumbles while being astonished at the sudden movement of the robot.

(11) Don't make the system designed to allow the workers to carry the Work in and out using their hands through the safety fence. It could be a cause of accident associated with compressing or amputating.



(Cylinder type)



(Beam type)

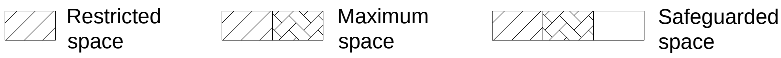


Figure 1.3 Arrangement of LCD robot peripheral devices and workers

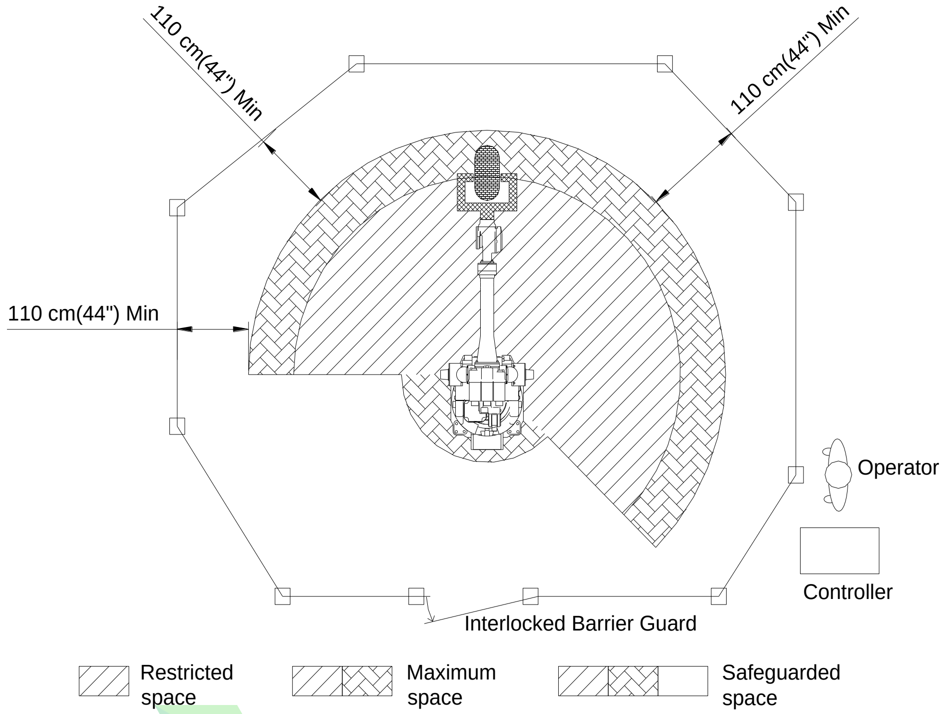


Figure 1.4 Arrangement of general robot peripheral devices and workers

1.6.3. Installing the Robot

Please install the robot in accordance with following method surely.

Install the robot as per the planning and layout which has been previously reviewed and studied for its optimized performance and functionality. In case of poor conditions for robot installation, the serious problems can take place, including error of relative position between robot and workpiece during operation, bad performance quality of robot caused by vibration, shortening lifetime, and cause of serious accidents. Thus, pay attention to the following precautions when installing the robot.

General Safety Precautions

(1) Design and install the robot system properly in compliance with laws, regulations, and safety requirements enable in the country where the robot system is installed.

(2) All the workers for the robot system must have the complete knowledge on the information specified in the application and supplementary manual, and proficiently operate and handle the industrial robot.

(3) Installation workers of robot must follow the safety instructions and apply them to the installation when they face any safety problems.

(4) System provider must ensure that all the circuits utilizing safety functions perfectly perform in a safe way.

(5) Install main power supply to be disconnected from outside of the robot's working envelope.

(6) System provider must ensure that all the circuits utilizing emergency stop function perfectly perform in a safe way.

(7) For the immediate emergency stop, install emergency stop button within the accessible distance for the operator.

Technical Safety Precautions

(1) Eliminate any interference with peripheral equipment considering the dimension and working envelope.

(2) Avoid such place for installing which is directly exposed to the sun, extremely humid, contaminated by oil or chemicals, and containing a large amount of metal powder and explosive gas.

(3) Install at the ambient temperature ranged 0~40℃.

(4) Secure sufficient space for the easier disassembly and maintenance.

(5) Install safety fence with a gate, and prohibit any person from entering the robot's working envelope.

(6) Remove any obstacles out of the robot's working envelope.

(7) Take a special measure, considering thermodynamics of controller, if the robot is installed near the heating elements or places exposed directly to the sun.

(8) Take a special measure if the robot is installed in a place of abundant dust such as metal powder in the air.

(9) Install the robot not to transmit welding electric current. In other word, insulate SPOT GUN with/from the robot's wrist.

(10) Grounding is very critical in preventing electric shock and malfunction caused by noise, and thus install as following instructions.

① Install an exclusive grounding terminal using class 3 or higher. (For the input voltage of 400V of higher, use special class 3 or higher.)

② Connect grounding line into the grounding bus-bar inside of the control panel.

③ In case of direct grounding on the floor by anchoring, two-point grounding both by robot manipulator and by controller can produce a "ground loop" and contrariwise cause abnormal operation. In this case, connect the grounding line to the base of robot manipulator and disconnect the second grounding point to the controller. If the robot vibrates even after stopping, double-check the grounding status because the possible main causes could be an incomplete grounding or "ground loop".

④ In the use of internal transgun(GUN), there is a possible danger of dropping because the primary power cable is directly connected to the spot gun. In this case, directly connect the grounding line to the base of robot manipulator in order to prevent any electric shock and protect the control panel, but do not connect it to the controller.

(11) This equipment includes an intrinsically safe circuit. Instructions related to this can be found in

'3.7.4 Controller and Grounding' of 'Hi5a Controller Maintenance Manual'.

(12) No batteries can be installed in payload areas without authorization.

(13) The rating of electronic devices installed in J2 ➔ AC220V, 50/60Hz.

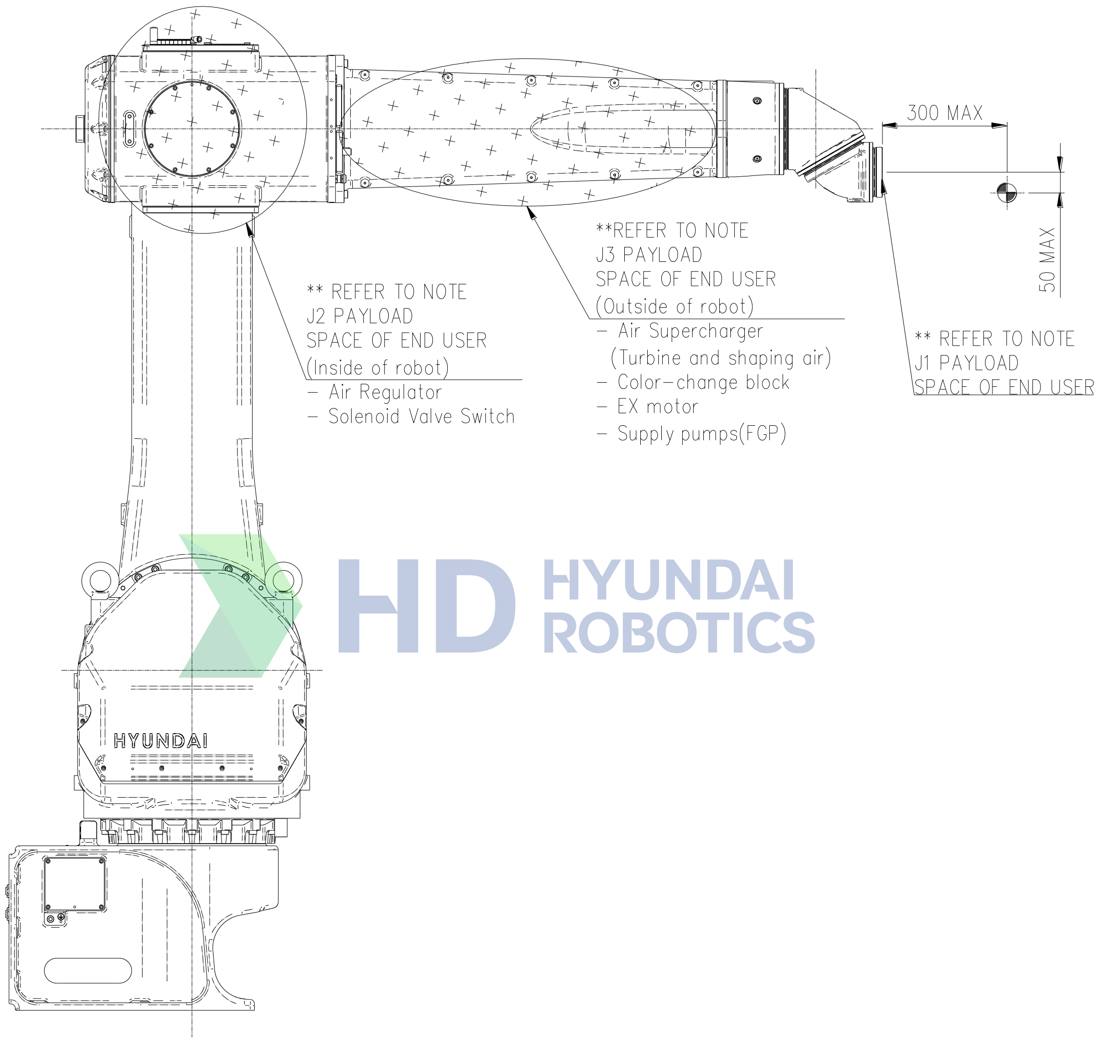


Figure 1.5 Attachment location of painting equipment

(14) Wiring between purge controller Hi5a-P20 and panting robot shall be in accordance with IEC 60079-14 or relevant installation standard.

(15) To avoid the risk of ignition due to static electricity, the user should take the following precautions.

- Robot jacket should be selected in accordance with IEC/EN 60079-0 and IEC/EN 60079-14.
- External earthing wire shall be secured at fixed bar

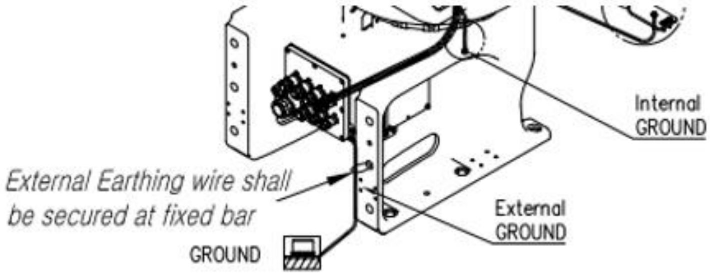


Figure 1.6 Correct External earthing wire connection

- Cable lugs should be used as below table 1-2

Table 1-2 Suitable cable lugs

MANUFACTURER	METAL GRADE	PRODUCT NUMBER	CROSS SECTIONAL AREA(㎟)
JEONO	KS C 2620	JOR35-6 (Internal)	16
		JOR35-8 (External)	

(16) To prevent corrosion, the user should take the following precautions.

- Washer should be fitted between (**bolt and cable lug) and (cable lug and ground)** as shown below Figure 1-7

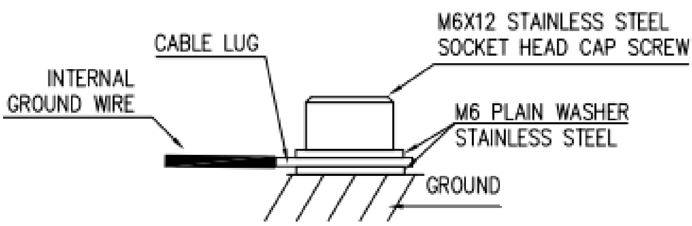


Figure 1.7 Appropriate use of washers

1.6.4. Space for Robot Installation

Install robot after securing sufficient space for maintaining the robot manipulator, controller, and other peripheral equipment. To install the main body and controller, please secure the above mentioned installation area. Install controller outside of the safety fence in order to monitor the robot manipulator and to operate in a safe way.
When installing, be sure to make it easier to perform the maintenance when opening the Controller door. Secure the available space. The specifications of the controller can change according to the type of the controller. (For more details, please refer to the “Maintenance manual”.)

1.7. Safety Operation for Robot Handling

Follow the safety instructions to prevent any accidents. Don't modify nor ignore safety devices or circuits at any time, and be careful of electric shock.
All the normal operations in an automatic mode must be performed outside of the safety fence. Check the robot's working envelope if anyone is inside before operating.

1.7.1. Safety Precautions for Robot Handling

Please observe following countermeasures because safety is very important for the test operation of the robot.

(1) Do not handle the robot other than such personnel as operators handling the robot and other possible operators and supervisors who were designated as whom duly trained in an approved robotic training course and become familiar enough with the proper operation of the safety and robotic functions.

(2) Be sure to wear helmets, goggles, and safety shoes.

(3) Perform the work in pairs. One person must be ready to press the emergency stop button in an emergency while the other must perform his work quickly but carefully within the robot's working envelope. Always check the escape route before working.

(4) Make sure that there is no one in the working envelope when the power source is on.

(5) Operations such as teaching must be performed outside of the robot's working envelope. However, if the operation is performed within the working envelope after stopping the robot, enter the envelope with safety plug or key switch for converting to automatic mode. Make sure that other operators do not change it into automatic mode by accident. Also, pay close attention to the specific direction of robotic movement in case of abnormal operation and malfunction.

(6) Supervisors should follow the instructions below.
 ① Be located at a place where you could take an entire view of robot, and commit yourself to monitoring.
 ② Press the emergency stop button immediately when abnormality is found.
 ③ Anyone is forbidden to be near the operating area other than those who are engaged in the operation.

(7) In a manual mode, the speed of teaching is limited to 250mm/sec.

(8) In teaching, post a sign [Under Teaching].

(9) Operators must pull the safety plug out, and enter the safety fence with the plug.

(10) Do not use any devices causing noise in and around the teaching area.

(11) Handle the teach pendant button, while checking the teaching point with your naked eyes, and do not handle it just relying on your sense.

(12) It is a repairing part to be prepared for when you buy many sets.

(13) In teaching, check and examine carefully under your feet. In particular, in high teaching for more than 2M, secure a safe zone on which you may step before teaching.

(14) Instructions for any abnormal operations.
① Press immediately the emergency stop button when any abnormal operations are found.
② Be sure to check if the relevant equipment is stopped when checking the abnormality in an emergency stop.
③ In case that the robot stops automatically due to power failure, investigate possible causes and take actions after confirming that the robot completely stops.
④ In case of malfunction of emergency stop devices, immediately disconnect the main power and investigate possible causes to take necessary actions.
⑤ Investigation of the failure must be conducted only by a designated person. For the re-operation after emergency stop, operators must clarify the cause of failure and take necessary actions, and then operate the robot again following the proper procedure.

(15) Write out the operating rules proper to working details and installing location regarding the operation and handling method for the robot, and the necessary actions for robot's any failure. In addition, it is recommended to operate the robot in accordance with the operating rules.

(16) Instructions when the robot stops
Make sure not to approach the robot even when it seems to be stopped. Most accidents occur from a sudden movement of robot which seemed to be stopped when one approaches it. The conditions that the robot stops are as follows.

Table 1-3 State of Robot Stop

No.	State of Robot	Drive Power	Access
1	Pause (Minor failure, Pause switch)	ON	X
2	Emergency stop (Major failure, Emergency stop switch, Safety gate)	OFF	O
3	Input signal standby of peripheral equipment (START INTERLOCK)	ON	X
4	Playback Completion	ON	X
5	Standby	ON	X

Even in the accessible state of robot, be watchful against any possible sudden movement of robot. Make sure to avoid approaching the robot without precautions for emergency under all circumstances.

- **During temporary halt, the entrance countermeasure same as entrance of teaching work should be considered at the case (nozzle contact, welded part detected, arc error, and so on) of opening entrance gate for simple management against error.**

(17) Clean up any split oil, tools, and impurities in the safety fence after completing robotic operation. Accidents such as conduction may occur in the working envelope contaminated by oil, or scattered tools on its floor. Make a habit of organizing and cleaning things up.

1.7.2. Safety Precautions for Operating Test

Please observe following countermeasures because safety on robot operation is very important.

In case of operating test, errors in design or teaching and inferiority in manufacturing are possibly seen in the entire system such as teaching program, jig, and sequence. Thus, be more careful and safe in case of operating test. Accidents may occur by these combined causes.

(1) Before handling, check the stop buttons and signal functions to stop the robot such as emergency stop button or stop button. And then, check the abnormality - detective movements. Above all, it is the most critical to check all the stop signals. It would be the most important to stop the robot when any possible accidents are predicted.

(2) In case of operating test, start the robot at low speed(approximately 20%~30%) in the variable speed function, and repeat it more than one cycle to check the movements. If any errors are found, immediately correct them. After then, increase in speed (50% → 75% → 100%) gradually, and repeat more than one cycle respectively to check the movements. Operating at high speed from the very beginning may cause a serious accident.

(3) In case of operating test, it is hard to predict what problems would happen. Do not enter the safety fence during operating test. Unexpected accidents are likely to occur because of its low reliability.

1.7.3. Safety Precautions for Automatic Operation

Please observe following countermeasures because safety on robot automatic operation is very important.

(1) While posting a sign [Do Not Enter During Operation] up the safety fence gate, ask the operators not to enter during operation. If the robot stops, you may enter the safety fence under your full understanding of the situation.

(2) Be sure to check if any operators are inside of the safety fence when starting the automatic operation. Operating without checking the presence of operators may cause a personal injury.

(3) Before starting the automatic operation, check and confirm that the program number, step number, mode, and starting selection are in the possible state for automatic operation. If starting with the other programs or steps selected, the robot could move in an unpredicted way, and lead to an accident.

(4) Before starting the automatic operation, check if the robot is properly located to get started. Check whether the program number or step number is identical with the location of robot. Even if it's all identical, accidents are still possible to occur due to an abnormal movement when the robot is differently located.

(5) Be prepared to immediately press the emergency stop button when starting the automatic operation. Immediately press the emergency stop button in case of robot's unexpected movements or emergency.

(6) Be sure to detect any abnormalities by checking the route, condition, or sound of robot movement. Sometimes the robot may be abnormally operated including a sudden break down. However, it will show a certain indication before the break down. Understand the robot's normal condition well in order to catch the symptom in advance.

(7) When any abnormality is detected from the robot, immediately stop and take proper actions on it. Using the robot before any proper actions taken may cause an interruption of produce as well as serious failure leading to a very serious personal injury.

(8) When checking the robot's movement after the proper actions taken for the abnormality, do not operate the robot with operators inside of the safety fence. Unexpected accidents are possibly to occur because its low reliability may cause another abnormality.

1.8. Safety Precautions for Access to Safety Fence

Please observe following countermeasures because safety on robot automatic operation is very important.

The robot is very heavy and strong, even at low speeds. When entering the safety fence, one must observe the relevant safety regulations of its pertinent country.
The operators always must be aware of the unexpected movements of robot. Robots are able to move fast shortly after being stopped. The operators should know that the robot is able to move in a different route, without any notice, by means of external signals. Thus, when trying to stop the robot during teaching or operating test, one should be able to stop the robot with a teach pendant or control panel.

When entering the working envelope through the safety gate, you must take the teach pendant with yourself so that other people cannot operate the robot. Make sure to post up the control panel a sign indicating the state of robot handling.

People must understand the followings when they are to enter the robot's working envelope

(1) Do not enter the working envelope other than teaching person.

(2) Operation set-up mode of controller must be a manual mode in the control panel.

(3) Always wear the approved working suite.(Do not wear a loose clothes as you please)

(4) Do not wear gloves when handling controller.

(5) Do not leave innerwear such as underwear, shirts, or necktie out of the working suite.

(6) Do not wear personal accessories such as big earrings, rings, or necklaces.

(7) Make sure to wear safety shoes, helmet, and goggles and if necessary, wear other self-protective outfit such as safety gloves.

(8) Make sure that the emergency stop circuit is working correctly and in its proper function, turns MOTOR OFF when pressing the emergency stop button in the control panel and teach pendant before handling the robot.

(9) Make your posture face-to-face with the robot manipulator when performing your work.

(10) Follow the predetermined working procedure.

(11) Be prepared for emergency exit or safe place considering that the robot may unexpectedly rush at you.

1.9. Safety Precautions for Maintenance and Repair

1.9.1. Safety Precautions for Controller Maintenance and Repair

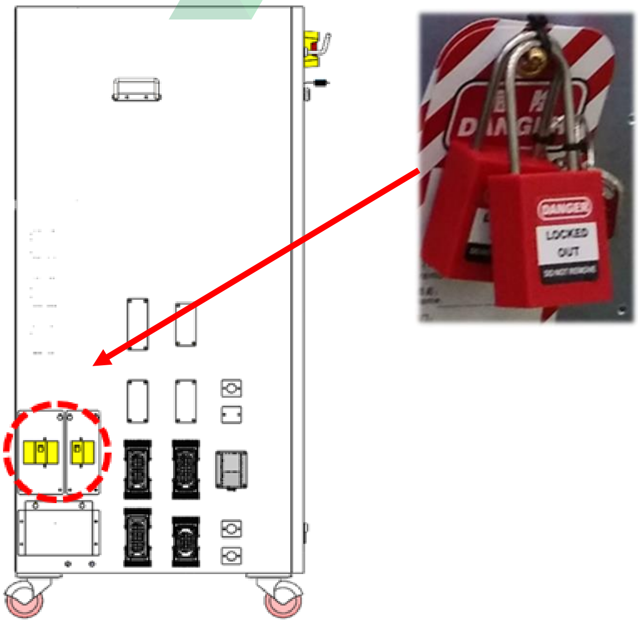
Please observe following safety countermeasures on repair and check for robot controller.

(1) Maintenance and repair of the robot must be performed by the personnel who was duly trained in the special maintenance training course and has a good knowledge of maintenance.

(2) Perform your work following the maintenance procedures for controller.

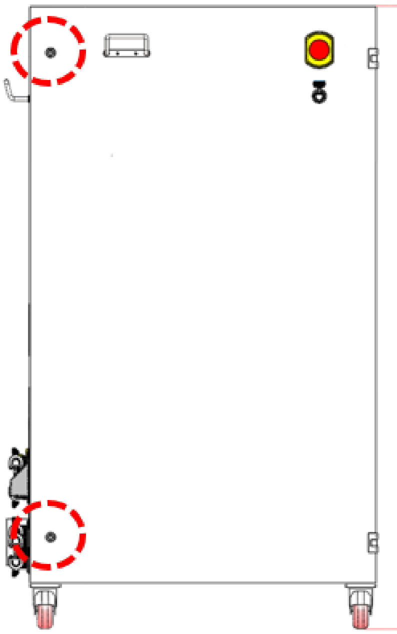
(3) Perform your maintenance and repair in a safe way by securing emergency exit or safe place.

(4) Before the daily maintenance, repair, or changing parts, be sure to power down. In addition, post a warning sign [Do Not Input Power] up the primary power so that other operators may not input power by accident. For some controllers, such as C* series controllers, where a handle breaker–type circuit breaker is not used, a locking device must be used on the circuit breaker to prevent unauthorized power input by other workers.
A locking device for each line should be used if the motor and control power lines are separated.



Personnel must use a locking device to the circuit breaker's bracket hole before inspecting the controller. A warning indication (LOTO: Lock Out Tag Out) must also be used.
The locking device must be securely locked.

Check the locking devices and warning indication, and then unlock the locking devices (two locations on the front of the door) to perform maintenance. Authorized maintenance workers must manage the relevant keys.



In the case of products such as Hi5a-C** series models, where a handle breaker is applied to the motor power and a general breaker is used to control power, you must lock the general circuit breaker first and then open the handle to check the interior. This measure prevents power from being supplied to both input lines during the inspection.

(5) When changing parts, be sure to use the specified ones.

(6) When you open the door of controller, you should turn off power, and please start working after 3 minutes.

(7) If sufficient illuminance is not secured when you perform maintenance and inspection inside the controller, you should use external lights.

(8) Please do not touch heat radiating plate of servo AMP and recovery resistance because they are very hot.

(9) After completing maintenance, be sure to close the door completely after checking if tools or other things are still remained in the controller.

(10) Maintenance and inspection personnel should ensure that they participate in regular trainings and use the regulated specifications and tools for all types of assembly and wiring works in order to prevent defects from taking place.

(11) Training should be performed so that the operators can have sufficient knowledge of explosion-proof equipment. Moreover, training materials and records should be maintained.

(12) To verify the product, the operators should be skilled and their competence should be documented and adequately assessed.

1.9.2. Safety Precautions for Robot System & Manipulator Maintenance

Please observe following safety countermeasures on repair and check for robot controller.

(1) Refer to the safety precautions for Controller maintenance and repair.

(2) Perform your maintenance and repair for the robot system and manipulator, following the indicated procedures.

(3) Be sure to disconnect the primary power of controller. Post the warning sign [Do not input power] up the primary power to prevent other workers from connecting the power.

(4) Make sure that the Arm is fixed and immovable before maintenance and repair since dropping or moving of the robot's Arm may cause a danger during maintenance and repair. (Refer to the 『Robot manipulator maintenance manual』.)

(5) Take precautions not to allow non-metallic paint to build up on the surface of the operating device, causing static electricity as a result. Periodically check the surface of the product and remove the non-metallic paint.

1.9.3. Necessary Actions after Maintenance and Repair

Please install the robot in accordance with following method surely.

(1) Check if the cables or parts of controller are properly connected.

(2) After maintenance is completed, carefully check that no tools are left around or inside of the controller and manipulator. Make sure that the door is firmly closed.

(3) Do not turn on the power if any problems or critical failures are detected.

(4) Be sure that there is no one within the working envelope, and that you are in a safe place before turning on the power.

(5) Turn on the main circuit breaker on the control panel.

(6) Check the current position and status of robot.

(7) Operate the manipulator at low speed.

1.10. Safety Functions

1.10.1. Operating a Safety Circuit

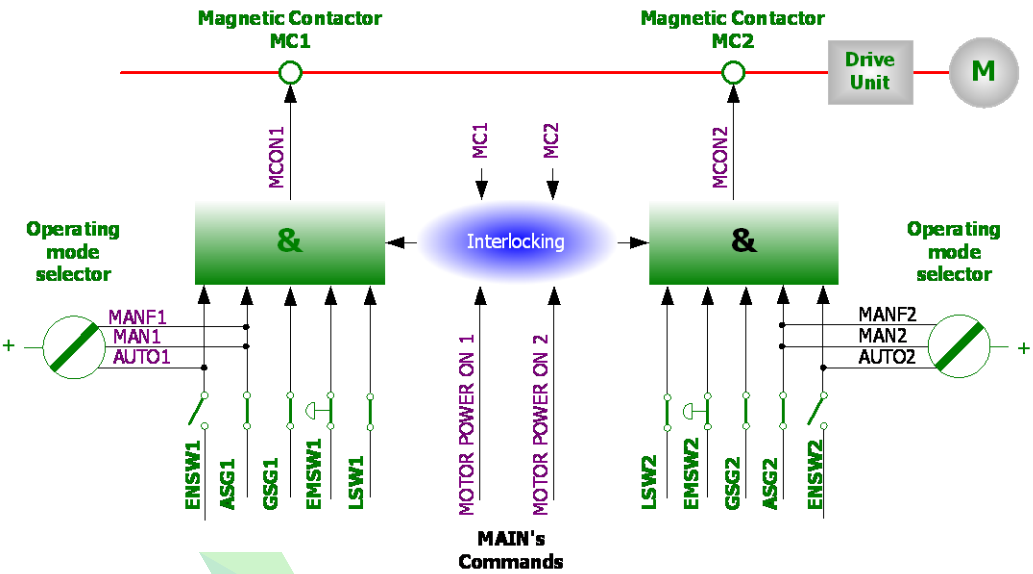


Figure 1.8 Configuration for safety chain

The robot's safety system is based on a two-channel safety circuit that is continuously monitored. If an error is detected, the power supply to the motors is disconnected and the motor brake is applied. To return the robot to MOTOR ON mode, the switches of two-channel circuit must be connected. If one of the two-channel circuit switches shorts, the contactor of motor will be disconnected leading to the application of brake, and finally the robot will be stopped. Furthermore, when safety circuit is disconnected, the interrupting call will be sent automatically to the controller to find out the possible reason for the interruption.

The safety control circuit of operation is based on dual safety electric circuit in which the controller and MOTOR ON mode are operated interactively. In order to be in MOTOR ON mode, the safety circuit consisted of several switches must be all connected. MOTOR ON mode indicates that drive power is supplied to the motors. If one of the contactors is disconnected, the robot will always return to MOTOR OFF mode.

MOTOR OFF mode indicates that drive power is removed from the robot's motors and the brakes are applied. The status of the switches is displayed on the teach pendant. (Refer to the I/O monitoring screen of "SERVICE" menu, 『Operation manual』.)

Safety circuit

The emergency stop buttons on the controller panel and on the teach pendant and external emergency stop buttons are included in the safety circuit of operation. Users may install the safety devices (safety plug, safety stop device for safe place) which are operated in the AUTO mode. In a manual mode, the signals of these safety devices are ignored. You can connect the general safety stop devices that is active in all operating modes. No one can enter the working envelope in an automatic operation mode due to the unconditional operation of the safety devices (door, safety mat, safety plug etc.). These signals are also generated in a manual mode, but the controller will keep the robot operating while ignoring the robot's teaching. In this case, maximum speed of robot is restricted to 250mm/s. Thus, the purpose of this safety stop function is to secure the safe area around the manipulator while one approaches the robot for maintenance and teaching.

When the robot is stopped with the limit switch, change the robot's position by operating it with the pendant key at the constant setting mode. (Constant setting mode refers to the state of entry into the menu 『[F2]: System』 menu)

The safety circuits must never be by-passed, modified or changed in any way.

1.10.2. Emergency stop

An emergency stop should be activated when people or equipment is located at the dangerous area. The emergency stop buttons are located both on the control panel and on the teach pendant.
All safety control devices such as emergency stop buttons on the control panel must be located outside the working envelope and easily accessible at any time.

Status of Emergency stop

When the button is pressed, the robot will operate as follows.
Robot stops immediately in any cases.

- Disconnect the servo system power.
- Motor brake is activated.
- Emergency stop message is displayed on screen.

For the emergency stop, the following two methods can operated simultaneously.

(1) Emergency stop for control panel and teach pendant (Basic)

Above the control and teach pendant console.

(2) Emergency stop of external system

External emergency stop device (button etc.) can be connected to the safety electric circuit in accordance with applied standard for the emergency stop circuit.
(Please refer to system board in “basic configuration of controller”) At this time, the emergency stop must be connected to be “Normal On” and it must be check for proper operation during test run.

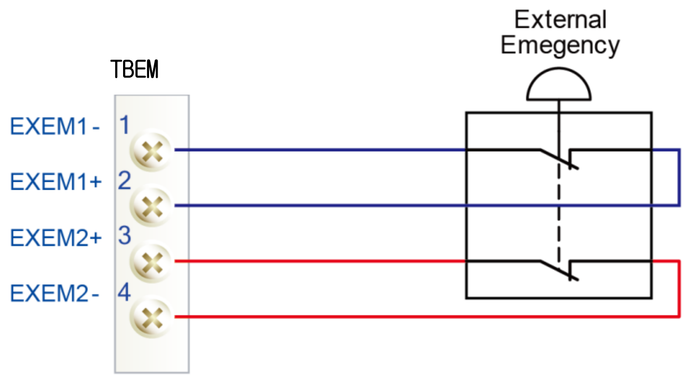


Figure 1.9 Connection with external emergency halt switch through system board terminal block TBEM

1.10.3. Operating Speed

To teach the robot, the operating mode switch must be in a MANUAL mode. Then the maximum speed of robot is limited to 250mm/s.

1.10.4. Connecting the Safety Devices

External safety devices such as light beams, light curtains, safety plug, and safety mats which can be adapted by the system builder execute interlocking the controller by way of connecting with safety circuit within the controller. These devices are used for safety device during execution of normal program in an automatic mode.

1.10.5. Restricting the working Envelope

When the robot is not necessary to reach certain area for specific applications, working envelope of the robot can be limited to secure the sufficient safety working area. This will reduce the damage or loss in case of robot's collision with external safety devices such as safety fence, etc. The movement of axes 1, 2, and 3 of HR, HX, HS and HA can be limited by means of mechanical stopper or electrical limit switches. In this case, the corresponding software limitation parameters must be also changed. If necessary, movement of wrist 3 axes can be restricted, too. Limitation of working envelope for all the axes could be carried out by the user. The robot is delivered to customer as the status of full working envelope setting.

- **Manual mode: Maximum speed is 250mm/s.**
  In a manual mode, by means of worker’s selection, workers may enter the safeguard area.

- **Auto mode: The robot can be operated via remote controller.**
  All safety devices such as safety door, safety mats, etc. are activated.
  No one may enter the safety device area of robot.

1.10.6. Monitoring Function

(1) Motor monitoring function
Motors are protected against overload by means of onboard sensors.

(2) Voltage Monitoring Function
For the protection of, the servo amp module turns off the power switch when the voltage is too low or too high.

1.11. Safety Related to End Effectors

1.11.1. Gripper

(1) When a gripper is used to grip a workpiece, there should be safety precautions for unexpected dropping of the loaded workpiece.

(2) When any end effectors or devices are installed on the robot arm, use the required size and piece of bolt, and securely fasten as per the required torque using torque wrench. Do not use the bolt which has rust or dirt on its surface.

(3) End effector must be designed and manufactured not to exceed the maximum allowable load at the wrist of robot. Even though power or air supply stops, the gripped workpiece must not be dropped from the gripper. In order to remove any risks and problems which may cause personal injury and/or physical damage, the sharp edge and projecting part of end effector must be made dull and smooth.

1.11.2. Tool / Workpiece

(1) It must be possible to replace tools such as milling cutters in a safe manner. Make sure that safety devices are working correctly until the cutters stop rotating.

(2) Tool must be designed to keep in gripping workpiece securely even though a power failure or a control failure takes place. It must be possible to release workpiece from the gripper in a manual mode.

1.11.3. Pneumatic and Hydraulic Systems

(1) The special safety regulations will apply to pneumatic and hydraulic systems.

(2) Since residual energy of pneumatic and hydraulic systems can be still remaining even after the robot stops, particular care and attention must be paid by users. Internal pressure of equipment must be removed whenever starting the repair work for pneumatic and hydraulic systems.

1.12. Liabilities

The robot system has been built in accordance with the latest technical standards and approved safety rules. Nevertheless, the serious accidents such as death or personal injury still may take place due to the collision between the robot system and peripheral equipment.

The robot system must be used by operator who has a full technical knowledge on its designated use and also pay his close attention to the possible dangers and risks involved in its operation. The use of robot system is subject to compliance with these operating instructions and the operation and maintenance manual supplied together with the robot system. The safety related functions of robot system must not be used for any purposes other than safety.

When you use the robot system for any other or additional purposes than its designated usage, you must review whether it is enable in accordance with design criteria. The manufacturers cannot take any responsibility for any damage or loss which resulted from such misuse or improper use. The users shall have the full responsibility for the risks caused by such misuse or improper use. When you use and operate the robot system for its designated use, you must have a good command of all the information contained at these operating instructions as well as the maintenance manual.

The robot system may not be put into operation until it is ensured that the functional machine or plant into which the robot system has been integrated conforms to the specifications of the EU Machinery Directive 98/37/EC(2006/42/EC) and US OSHA.

The following harmonized standards in particular were taken into account with regard to the safety of the robot system.

- ANSI/NFPA 79:2021
  Industrial Robots and Robot Systems - Safety Requirements
- ANSI/RIA/ISO 10218-1-2007
  Robots for Industrial Environment - Safety Requirements - Part 1 - Robot
- ISO 11161:2007
  Safety of machinery - Integrated manufacturing systems - Basic requirements
- EN ISO 13849-1:2008
  Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1:2006)
- EN 60204-1:2006
  Safety of machinery - Electrical equipment of machines - Part 1: General requirements (IEC 60204-1:2005 (Modified))
- EN ISO 10218-1:2011
  Robots for industrial environments - Safety requirements - Part 1: Robot (ISO 10218-1:2011)
- **IEC 60079-0: 2017 Ed.7 / EN 60079_0: 2018**
  "Electrical apparatus for explosive gas atmospheres,
  Part 0 : General Requirements“
- **IEC 60079-2: 2014 Ed 6 / EN 60079_2: 2014**
  "Electrical apparatus for explosive gas atmospheres,
  Part 2 : Equipment protection by pressurized enclosure ‘p’
- **IEC 60079-11: 2011 Ed 6 / EN 60079_11: 2012**
  "Electrical apparatus for explosive gas atmospheres,

Part 11 : Equipment protection by Intrinsic safety ‘i’“

Users must take the full responsibility for any accident caused by their negligence or non-observance of these instructions. The manufacturer will not take any liabilities and responsibilities for any damages or losses caused by the misuse or malfunction of such equipment which is not included in the contract between manufacturer and user and provided by user, or such equipment which is installed around the robot system arbitrarily by the user. User must take the full liabilities and responsibilities for any risks and damages caused by such equipment.

2

Specifications

2.1. The Detailed Specifications of Robot Controller

Table 2-1 shows the specifications of robot controller.

Table 2-1 The specifications of robot controller

Model	Hi5a-P10/P20 (Medium)	Hi5a-S00 (Medium) Hi5a-S60 (Semi-medium) Hi5a- S20/S30 (Compact) Hi5a-S80 (Large) Hi5a-J00 (Jig Robot)	Hi5a-C3* (Clean) Hi5a-C4* (Clean) Hi5a-C5* (Clean) Hi5a-C6* (Clean)	Hi5a-T10
CPU	64 bit RISC (1 GHz)			
Program Execution Method	Teaching & Playback			
Operation Method	Menu-Based Method			
Interpolation Type	PTP, Linear and Circular Interpolation			
Memory Back-Up Method	Battery Back-UP IC Memory			
Encoder Type	Absolute Encoder			
Servo Drive Unit	6-Axis All-In-One Type, Digital Servo			
Max number of controlled axes	Max. 16 Axes Simultaneously			
Step	21,000 steps			
Program Selection	255(Binary)/8(Discrete)			
Teach pendant Indication	7” Color TFT-LCD(800x480)			
Digital I/O (Option)	Input: 32 Points (Max. 256 Points) / Output: 32 Points (Max. 256 Points)			
Analog I/O (Option)	Input: 8 Points / Output: 8 Points			
Conveyor Pulse Counter	Differential & Open Collector Type			
Communications Interface	RS232C(Also for RS422): 2 Ports / Ethernet: 2 Ports / CAN: 2 Ports			

Model		Hi5a-P10/P20 (Medium)	Hi5a-S00 (Medium) Hi5a-S60 (Semi-medium) Hi5a- S20/S30 (Compact) Hi5a-S80 (Large) Hi5a-J00 (Jig Robot)	Hi5a-C3* (Clean) Hi5a-C4* (Clean) Hi5a-C5* (Clean) Hi5a-C6* (Clean)	Hi5a-T10
Fieldbus Interface (Option)		PROFINET IO-Controller / IO-Device EtherNet/IP Scanner / Adapter DeviceNet Master / Slave, PROFIBUS-DP Master / Slave CC-Link Slave(V1.10, V2.0), MODBUS(Serial)			
Board	Main(CPU)	BD511			
	Servo (DSP)	BD544			
	Back Plane	BD502			BD503T
	System	BD530/531			BD567T
	Electrical Part	BD5C2		BD5C0	-
	Fieldbus	BD525			
	CC-LINK	BD570		BD58A	
	Digital In/Out	BD580, BD581, BD582, BD583, BD587			
	Analog/Arc I/F	BD584		-	BD584
	Conveyor I/F	BD585		-	BD585 (Option)
Servo Amp	Drive Unit (6 Axis)	SD3X3Z	SD3X3Y, SD3A3D SD3A3A	SD4X2Y, SD3X3Y, SD3X3Z	BD558T
	Drive Unit (4 Axis)	-	-	SD3L1Y	-
	Drive Unit (1 Axis)	SD1X, SD1Z			BD559T
Wire Harness		CMC1, CMC2, AMC1, CEC1, AEC1, CIOC1	CMC1, CMC2, CEC1	CMC1, CMC2, CEC1, CIOC1	CMEC1
Teach pendant		TP520/TP530			
Cooling Pan		5 EA		4 EA	

Model	Hi5a-P10/P20 (Medium)	Hi5a-S00 (Medium) Hi5a-S60 (Semi-medium) Hi5a- S20/S30 (Compact) Hi5a-S80 (Large) Hi5a-J00 (Jig Robot)	Hi5a-C3* (Clean) Hi5a-C4* (Clean) Hi5a-C5* (Clean) Hi5a-C6* (Clean)	Hi5a-T10
Rated Voltage	3-phase 220V(50/60Hz)±10% Options: 380 V, 400 V, 440 V		Power: Three-phase Control: Single-phase 220V (50/60 Hz) ±10%	
Max. Power Consumption	S00/S10/S60/P10/P20/J00 : 7.8KVA S80 : 10.5KVA S20/S30 : 4.4KVA		(Power) C3*/C6*:: 11.5 KVA C4*:15.0 KVA, C5*:19.0KVA (Control) C3*/C4*: 1.0 KVA C5*/C6*: 2.0KVA	1.5KVA
Protection Class	IP54 (Dust Proof) * area of backside fan : IP2x	IP54	IP20	
Noise Level	Max. 68 dB			
Operating Temperature	0 ~ 40 ℃	0 ~ 45 ℃		
Operational Humidity	75 %			
Exterior Dimensions*1) (WxHxD)	650 x 1250 x 600	700x950x630(mm)	C3*/C4*: 600x1, 100x500(mm) C5*/C6*: 750x1350x600(mm)	260x490x450 (mm)
Weight	Standard input voltage P10/P20 : 150kg S00/S60 : 150kg S80 : 150kg S30 : 130kg S20 : 45kg S10 : 65Kg J00 : 180kg Other input voltage (Including ta transformer) P10/P20 : 220kg S00/S60 : 220kg S80 : 230kg S30 : 180kg		150 kg	24kg

Model	Hi5a-P10/P20 (Medium)	Hi5a-S00 (Medium) Hi5a-S60 (Semi-medium) Hi5a- S20/S30 (Compact) Hi5a-S80 (Large) Hi5a-J00 (Jig Robot)	Hi5a-C3* (Clean) Hi5a-C4* (Clean) Hi5a-C5* (Clean) Hi5a-C6* (Clean)	Hi5a-T10
	S20 : 100kg S10 : 130Kg J00 : 270kg			

Note 1) Customer's special order specifications are reflected separately

Table 2-2 Power Supply Requirements

Controller Type	Capacity*1) [KVA]	Input Voltage*2) [V]	Frequency [Hz]	Peak Current [A]
Hi5a-S00/S10/S60/P10/P20/J00	Max. 7.8	220/380/400/440	50/60	30
Hi5a-S20/S30	Max. 4.4	220/380/400/440	50/60	15
Hi5a-S80	Max. 10.5	220/380/400/440	50/60	50
Hi5a-C3* (except for C34)	Max. 12.5	220	50/60	30
Hi5a-C34	Max. 7.0	220	50/60	15
Hi5a-C4*	Max. 16.0	220	50/60	40
Hi5a-T10	Max. 1.5	220	50/60	15
Hi5a-C5*	Max. 21.0	220	50/60	50
Hi5a-C6*	Max. 13.5	220	50/60	30

Note 1) Power capacity:
This refers to the capacity of the power supplied to the controller. Please refer to the "Robot Manipulator Maintenance Manual" for the power capacity of each robot.
Note 2) Voltage Range: ±10% (The power terminal of controller)

2.2. Explosion-Proof Specification

Model		Hi5a-P10/P20
Robot		YP015A-**1
Boards	Paint control board	BD5D0
	Encoder switch board	BD5D1
Explosion-proof grade		Ex ib [ib] pxb IIB T4 Gb ⟨Ex⟩II 2 G Ex ib [ib] pxb IIB T4 Gb
Purging time		500 LPM / 3 minutes (YP015-**1)

3

Installation of Controller

The Install of the equipments should be performed by qualified engineer, and related law and regulation should be observed.

3.1. Components

3.1.1. Basic Components of Controller and Robot Manipulator

Basic component of robot manipulator and controller is as follows

- Robot Manipulator
- Controller
- Teach pendant
- Wire Harness

Figure 3.1 Basic Components of Manipulator and Controller (LCD Robot)

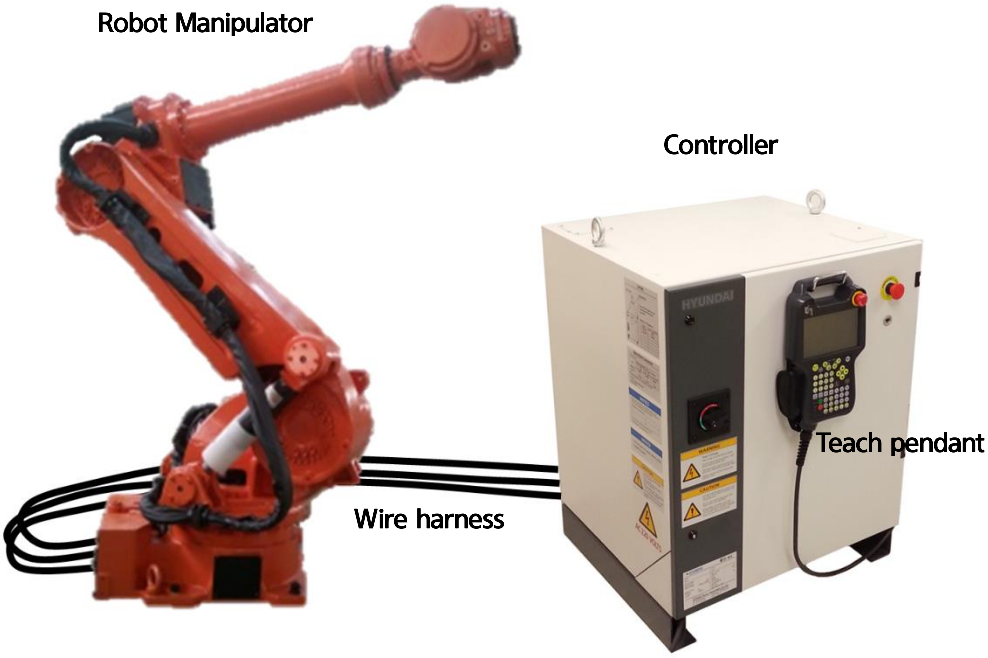


Figure 3.2 Basic Components of Manipulator and Controller (Vertical Articulated Robot)

3.1.2. Confirmation of Serial Number

Serial Number is located in the upper right of controller door.

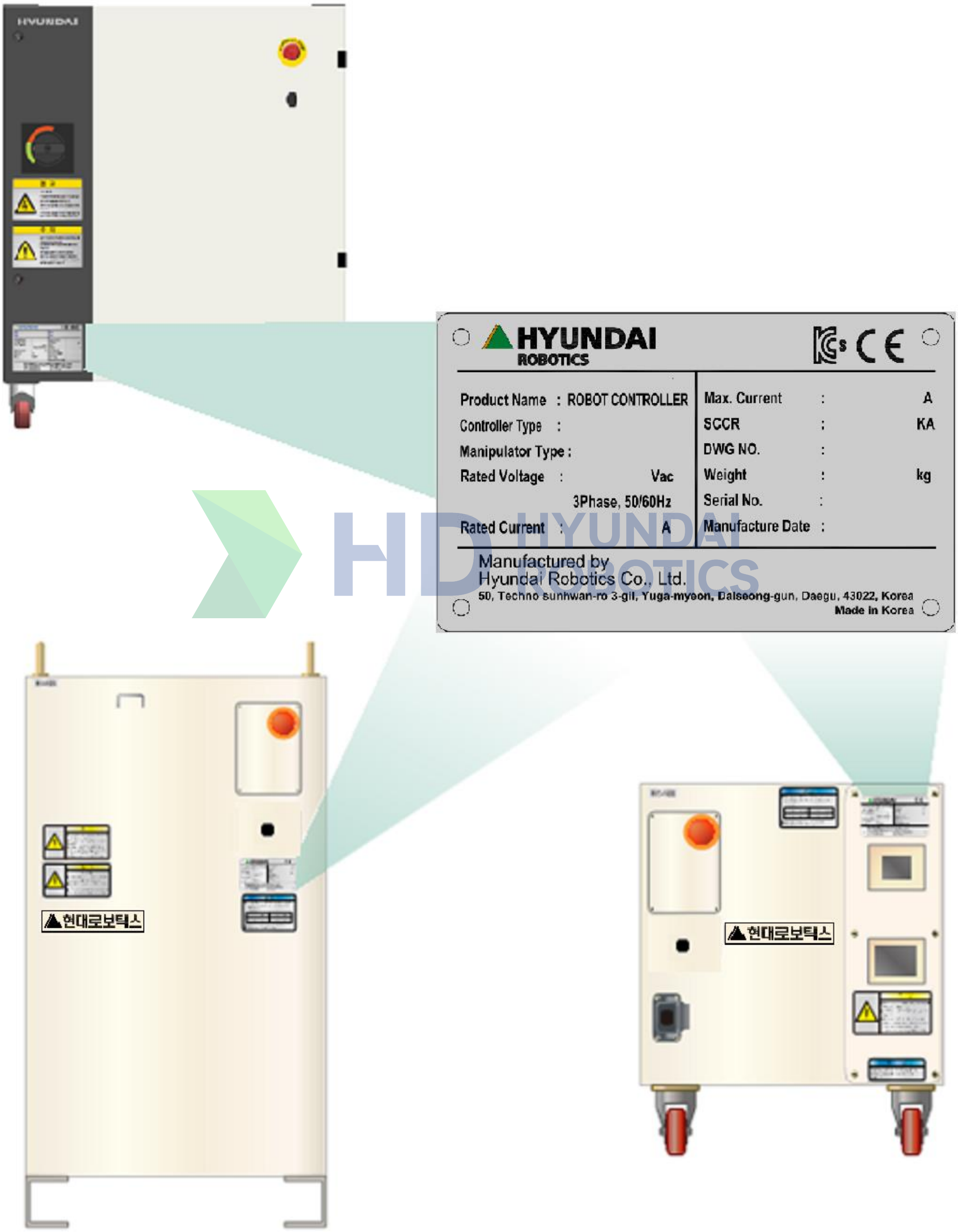


Figure 3.3 Location of Serial Number

3.1.3. Confirmation of Nameplates

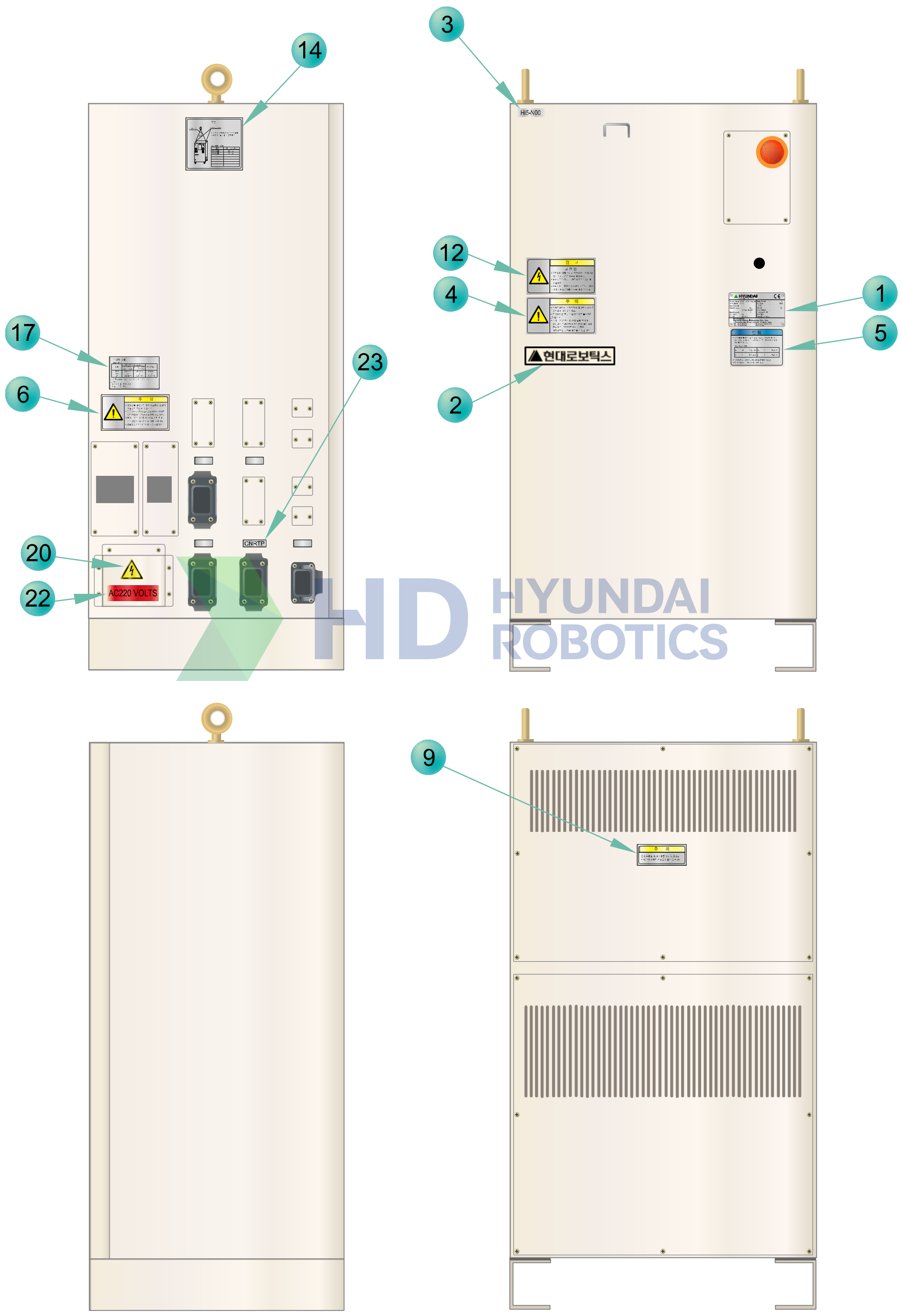


Figure 3.4 Hi5a-C3*/C4*/C5*/C6* Location of Controller Nameplate 1

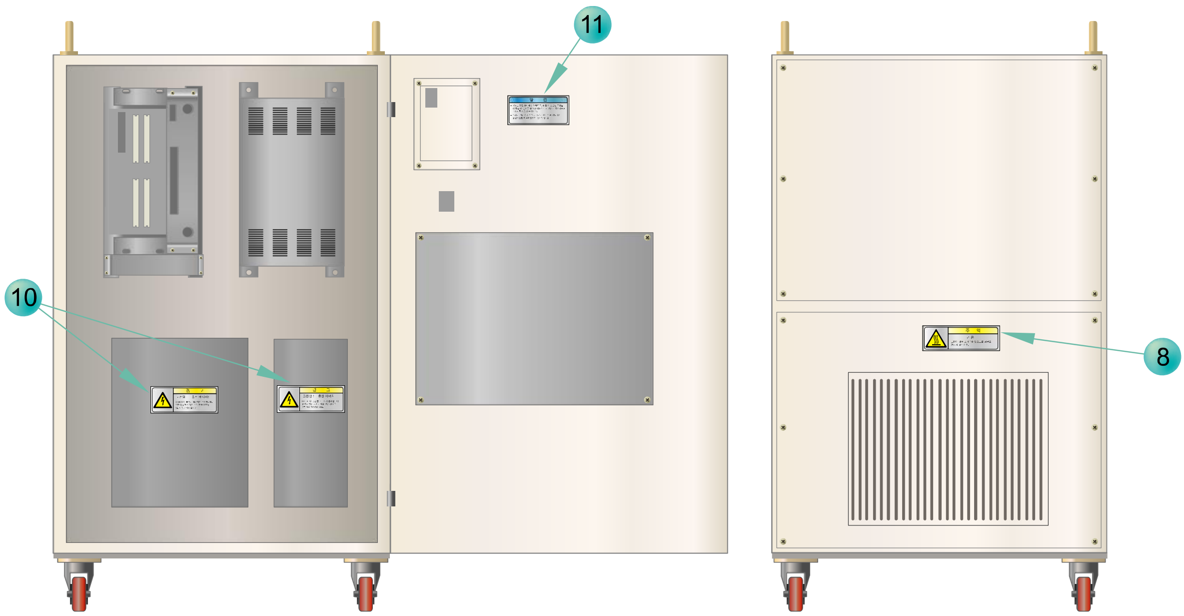


Figure 3.5 Hi5a-C3*/C4*/C5*/C6* Location of Controller Nameplate 2

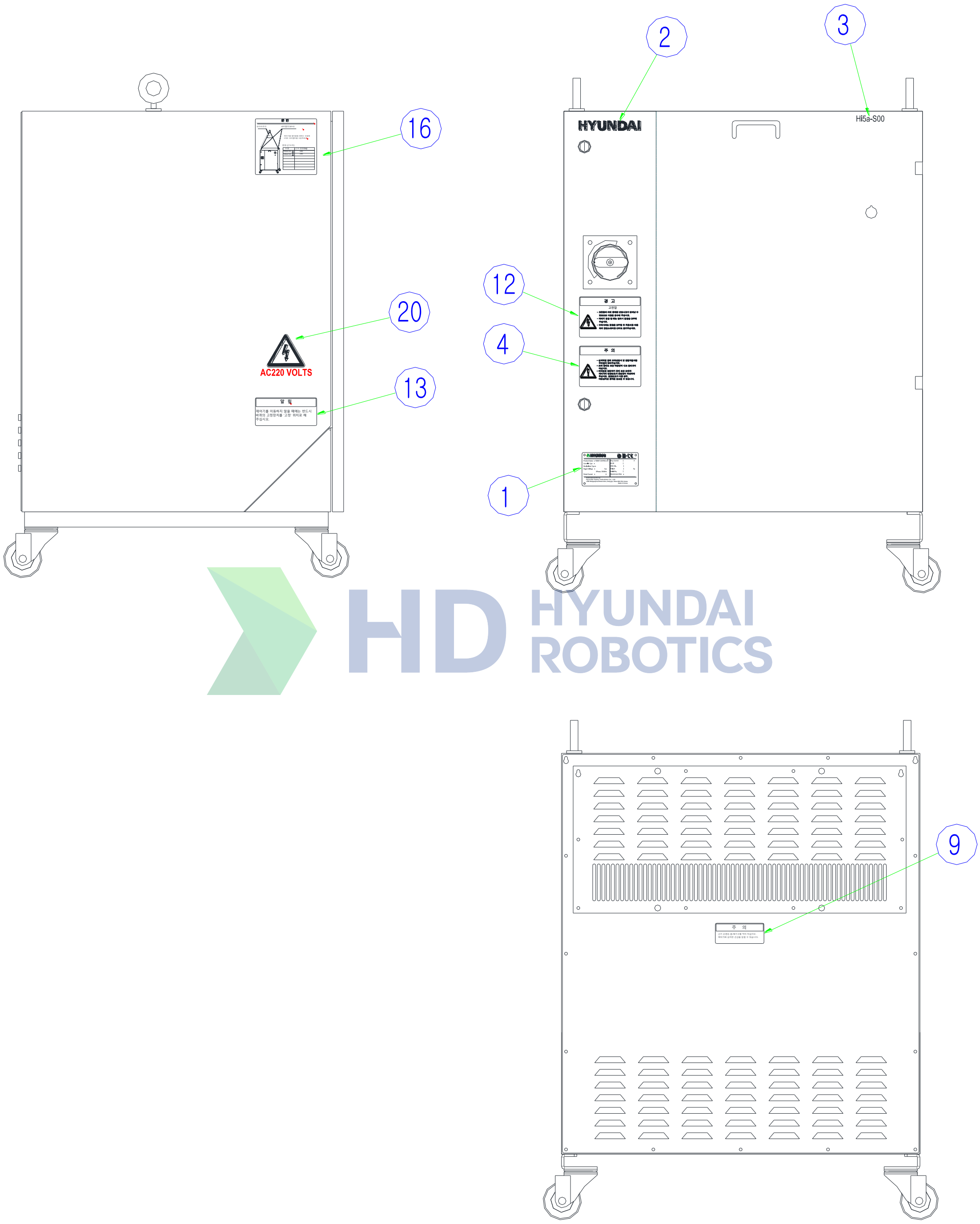


Figure 3.6 Hi5a-S** Location of Controller Nameplate 1

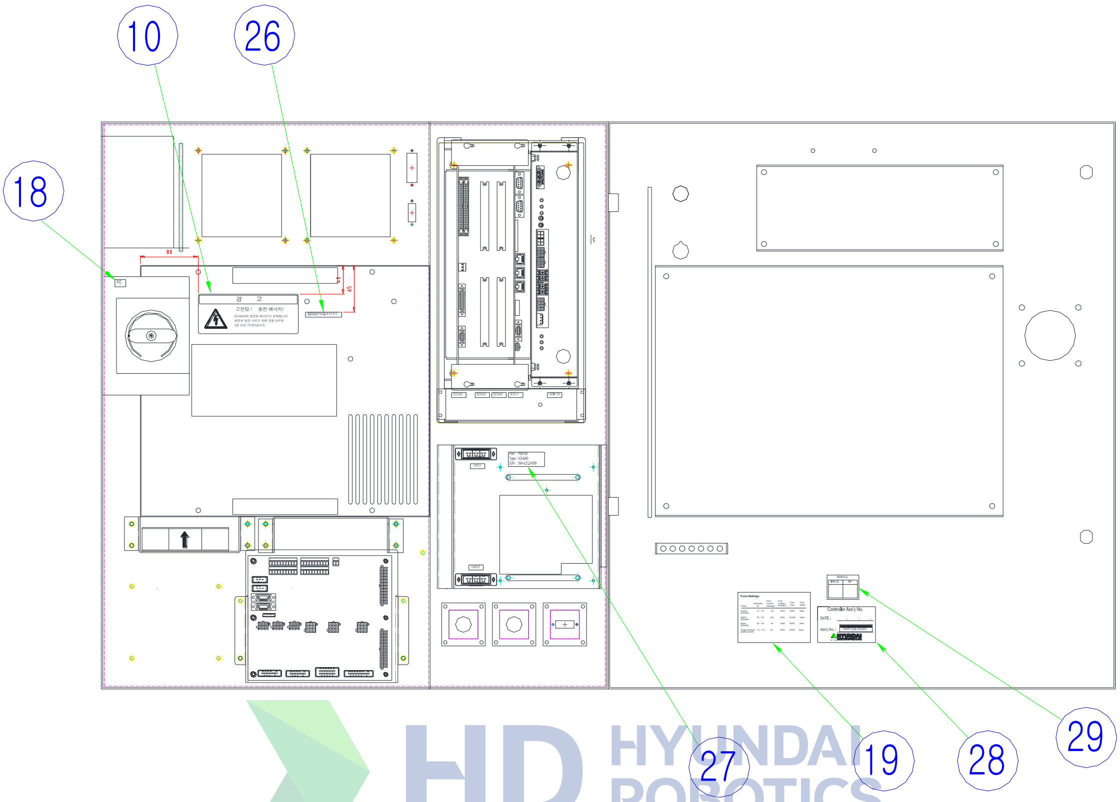


Figure 3.7 Hi5a-S** Location of Controller Nameplate 2

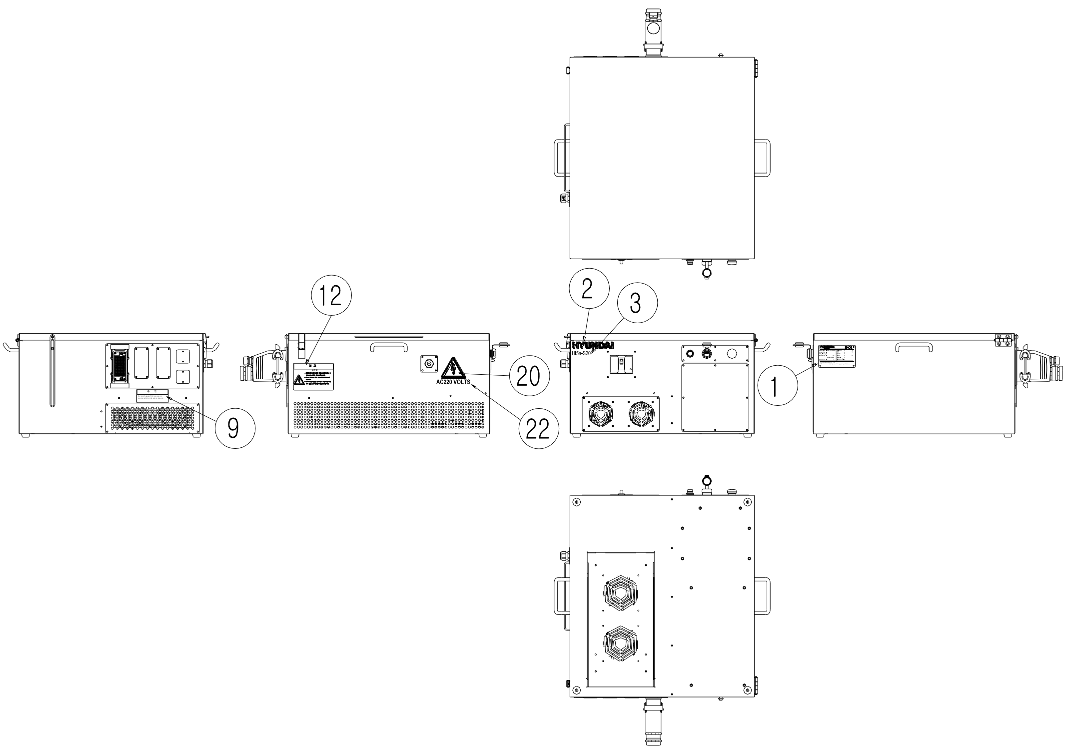


Figure 3.8 Hi5a-S20/S10 Location of Controller Nameplate 1

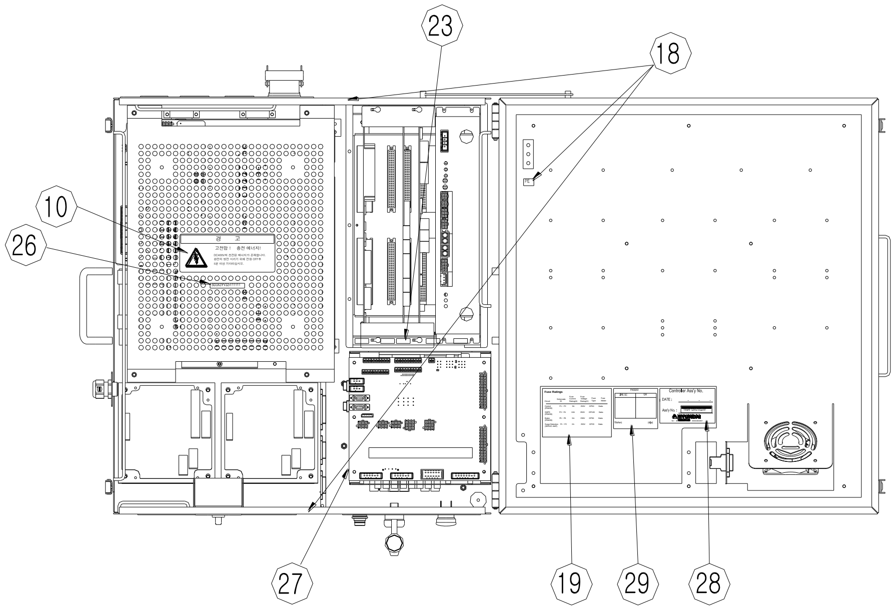


Figure 3.9 Hi5a-S20/S10 Location of Controller Nameplate 2

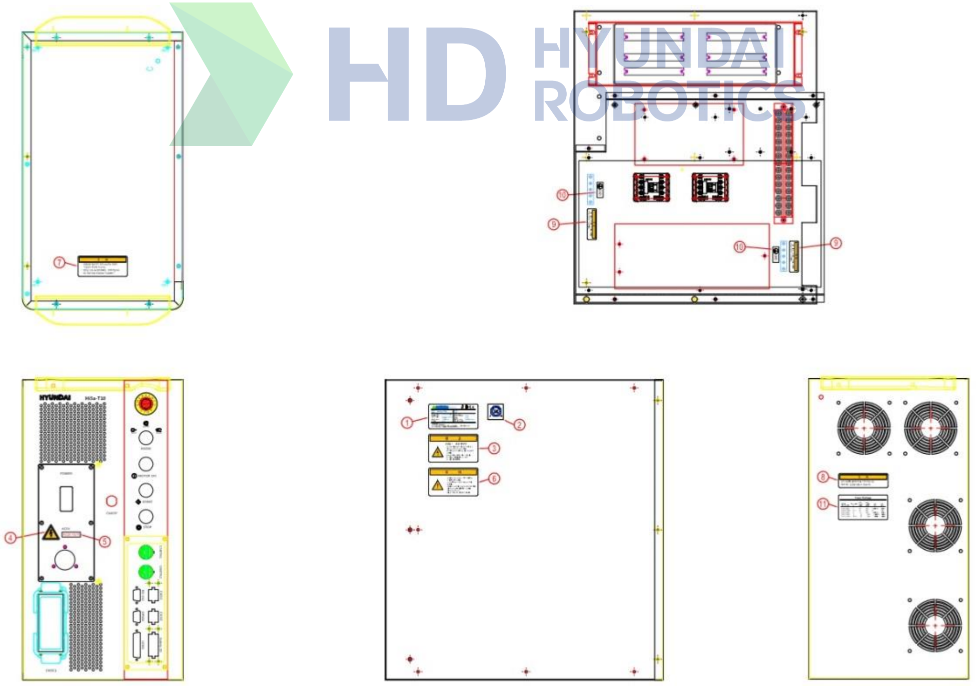
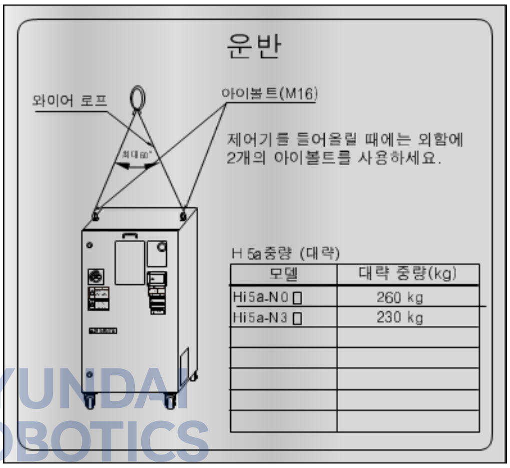
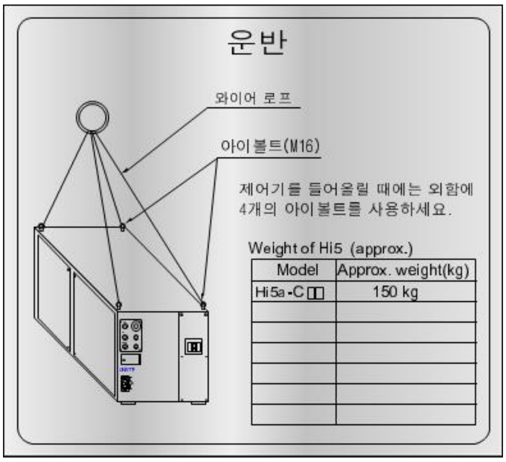
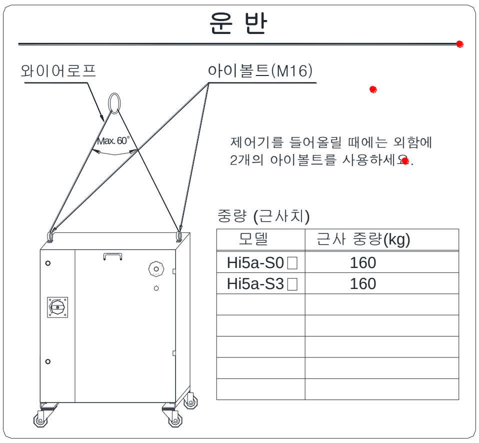
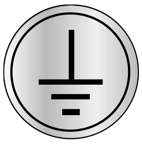


Figure 3.10 Hi5a-T10 Location of Controller Nameplate

o.	Name Plate	No.	Name Plate
1	HYUNDAI ROBOTICS Product Name : ROBOT CONTROLLER Controller Type : Manipulator Type : Rated Voltage : Vac 3Phase, 50/60Hz Rated Current : A Max. Current : A SCCR : KA DWG NO. : Weight : kg Serial No. : Manufacture Date : Manufactured by Hyundai Robotics Co., Ltd. 50, Techno sunhwan-ro 3-gil, Yuga-myeon, Dalseong-gun, Daegu, 43022, Korea Made in Korea	2	HYUNDAI ROBOTICS
3	Hi5a-S00	4	주 의 - 설치작업전에 조작설명서 및 안전지침서를 주의깊게 읽어주십시오. - 조작중에는 로봇 작업영역내로 들어가지 마십시오. - 케이블을 연결하기 전에 로봇 본체와 제어기의 일련번호가 동일한지 확인하여 주십시오. 일련번호가 다를 경우, 비정상적인 동작을 일으킬수 있습니다.
5	알 림 - 로봇 본체,제어기에는 데이타 백업용 밧데리가 부착되어 있습니다. 이 밧데리는 가동시간에 관계없이 매2년마다 교환해 주십시오. 다음 교환시기는 1. 년 월입니다. 2. 년 월입니다. 3. 년 월입니다. 4. 년 월입니다. - 밧데리 타입 : ERC6(LITHIUM BATTERY, 3.6V) - 밧데리 Maker : Hitachi Maxwell, Ltd.	6	주 의 - 전원선을 결선하기 전에 공급되는 전원이 적절한지 확인해 주십시오. - 공급되는 전압과 트랜스포머에서 선택한 입력전압이 동일한지 확인해 주십시오. - 접지는 단독 3종접지(100Ω 이하)하며 접지선은 5.5mm^2 이상 사용 하십시오 - 전원선은 5.5mm^2 이상 사용하십시오
7	주 의 손조심! 부주의시 손에 큰 상처를 입을수 있습니다.	8	주 의 고 온 표면이 매우 뜨거울수 있으므로 함부로 만지지 마십시오.
9	주 의 공기 순환용 흡/배기구를 막지 마십시오. 제어기에 심각한 손상을 입힐수 있습니다.	10	경 고 고전압 ! 충전 에너지! DC400V의 충전된 에너지가 존재합니다. 완전히 방전 시키기 위해 전원 OFF후 5분 이상 기다리십시오.

<table>
<tr><th>o.</th><th>Name Plate</th><th>No.</th><th>Name Plate</th></tr>
<tr><td>11</td><td>알 림
−PCB는 정전기에 매우 약하므로, 취급 시 충분한 주의를 해 주십시오. 이동 및 보관시는 반드시 정전기 방지처리된 포장지를 사용해 주십시오.
−수리나, 점검후 전원을 공급하기 전에 모든 커넥터가 정상적으로 체결되었는지 확인하십시오.</td><td>12</td><td>경 고
고 전 압
- 고전압에 의해 중대한 인명사고가 일어날수 있으므로 다음을 준수해 주십시오.
- 제어기문을 열 때는 반드시 전원을 OFF해 주십시오.
- 수리시에는 전원을 OFF한후 자물쇠를 이용하여 전원스위치를 OFF로 잠가주십시오.</td></tr>
<tr><td>13</td><td>알 림
제어기를 이동하지 않을 때에는 반드시 바퀴의 고정장치를 '고정' 위치로 해 주십시오.</td><td>14</td><td></td></tr>
<tr><td>15</td><td></td><td>16</td><td></td></tr>
<tr><td>17</td><td>1차 전원 연결
1. 전선 사이즈
<table>
<tr><td rowspan="2">항목</td><td colspan="2">3상 전원선(L1,L2,L3)</td><td rowspan="2">보호도체(PE)</td></tr>
<tr><td>L= ~ 50m
L= ~ 160ft</td><td>L= 50~100m
L=160~320ft</td></tr>
<tr><td>전선
최소
굵기</td><td>AWG12
or
3.5 mm²</td><td>AWG10
or
5.5 mm²</td><td>AWG10
or
5.5 mm²</td></tr>
</table>
2. 체결 토오크 : 2.6 ~ 3.7 N·m(23.0~32.7 lb·in)
3. 단자
- 단자 형태 : 링형 단자
- 볼트 규격 : M5</td><td>18</td><td>PE</td></tr>
</table>

<table>
<tr><th>o.</th><th>Name Plate</th><th>No.</th><th>Name Plate</th></tr>
<tr><td>19</td><td>
Fuse Ratings
<table>
<tr><th>Circuit</th><th>Schematic ID</th><th>Fuse Current Rating(A)</th><th>Fuse Voltage Rating(V)</th><th>Fuse Type</th><th>Fuse Maker</th></tr>
<tr><td>Control (PDM30)</td><td>F1 ~ F2</td><td>5A</td><td>250V</td><td>GP50</td><td>Daito</td></tr>
<tr><td>SMPS (PDM30)</td><td>F3 ~ F4</td><td>10A</td><td>250V</td><td>GP100</td><td>Daito</td></tr>
<tr><td>Brake (PDM30)</td><td>F5 ~ F6</td><td>5A</td><td>250V</td><td>GP50</td><td>Daito</td></tr>
<tr><td>Surge Detection (SERVO AMP)</td><td>F1 ~ F2</td><td>2A</td><td>250V</td><td>GP20</td><td>Daito</td></tr>
</table>
</td><td>20</td><td></td></tr>
<tr><td>21</td><td></td><td>22</td><td>AC220 VOLTS</td></tr>
<tr><td>23</td><td>CNRTP</td><td>26</td><td>SD3X3YV32-111111</td></tr>
<tr><td>27</td><td>Part : PSM30
Type : V2-6A0
S/N : SW-1312-999</td><td>28</td><td>Controller Ass'y No.
DATE : . . .
Ass'y No. : YM-RF1204-1302-001
HYUNDAI ROBOTICS
Tel : 82-53-670-7114 Fax : 82-53-615-6517</td></tr>
<tr><td>29</td><td>APPROVAL
<table>
<tr><th>LINE QC</th><th>QM</th></tr>
<tr><td></td><td></td></tr>
</table>
</td><td>30</td><td></td></tr>
</table>

3.2. Packing

① Attach the nameplate of model to its box.
② Cover all the exposure connectors with dust cap or polyvinyl to protect.
③ For the packing of T/P in a box, use air cushioning materials to keep LCD intact from external impact during packing.
④ Attach the list of waterproof packing to the outer box.

3.3. Transportation of Controller

Since controller is a sophisticated device, transport it using crane or forklift truck in an uneven ground or for long distance.

Be sure to check the following instructions when transporting.

① Check if the front door of controller is completely closed.
② Remove, if any, everything unfixed on the controller
③ Check if the Eye Bolt on controller is securely fastened.
④ Since the controller is a sophisticated device, transport it very carefully without any impacts.
⑤ The weight of controller is 250Kgf. If using a crane, prevent wires from damaging objects on controller.
⑥ If using a forklift truck, secure the controller to prevent shaking.
⑦ If using a vehicle, secure the manipulator and controller with a squid and so on.

3.4. Unpacking

Caution

① Be carefully aware of safety regulations and other instructions before unpacking and installing.
② Unpack the robot and controller, following the unpacking instructions.
③ Check if the place is safe enough to install the robot and controller.
④ Check if a traveling path is secured to safely move the robot and controller.
⑤ Transporting robot must be performed by a qualified personnel.
⑥ Check out any damages from transportation or unpacking.

3.5. Controller Handling

Transport the controller using crane or forklift truck.
Operating forklift truck must be performed by qualified personnel

3.5.1. Weight of Controller

Table 3-1 Weight of Controller

Model	Power Supply Transformer	Weight	
		Kg	lb
Hi5a-S00/S60	X/O(Option)	150/220	331/448
Hi5a-S80	X/O(Option)	150/230	331/485
Hi5a-S10	X/O(Option)	65/120	143/265
Hi5a-S20	X/O(Option)	45/100	100/220
Hi5a-S30	X/O(Option)	130/180	287/397
Hi5a-C3*/C4*	O	150	331
Hi5a-C5*/C6*	O	200	441
Hi5a-P10/P20	X/O(Option)	150/220	331/448
Hi5a-T10	X	24	53
Hi5a-J00	X/O(Option)	180/270	396/594

Table 3-2 Weight of Controller by Models

Model	Weight	
	Kg	lb
Teach pendant(7.5 m, TP520/TP530)	4	9
Wire harness(5 m, Hi5a-S00/S10/S60/P10/P20)	15	33
Wire harness(5 m, Hi5a-S20/S30)	10	22
Wire harness(5 m, Hi5a-S80)	15	33
Wire harness(5 m, Hi5a-C3*/C4*/C5*/C6*)	18	40
Wire harness(5 m, Hi5a-T10)	10	22

Model	Weight	
	Kg	lb
Wire harness(5 m, Hi5a-J00)	15	33

3.5.2. Transportation of Controller Using Crane

Check the following instructions when transporting the controller using a crane.

① In general, for the transportation of controller, crane wire with Eye Bolt should be used.
② Check if the wire is strong enough to hold Controller.
③ Check if the eye bolt is securely fastened.

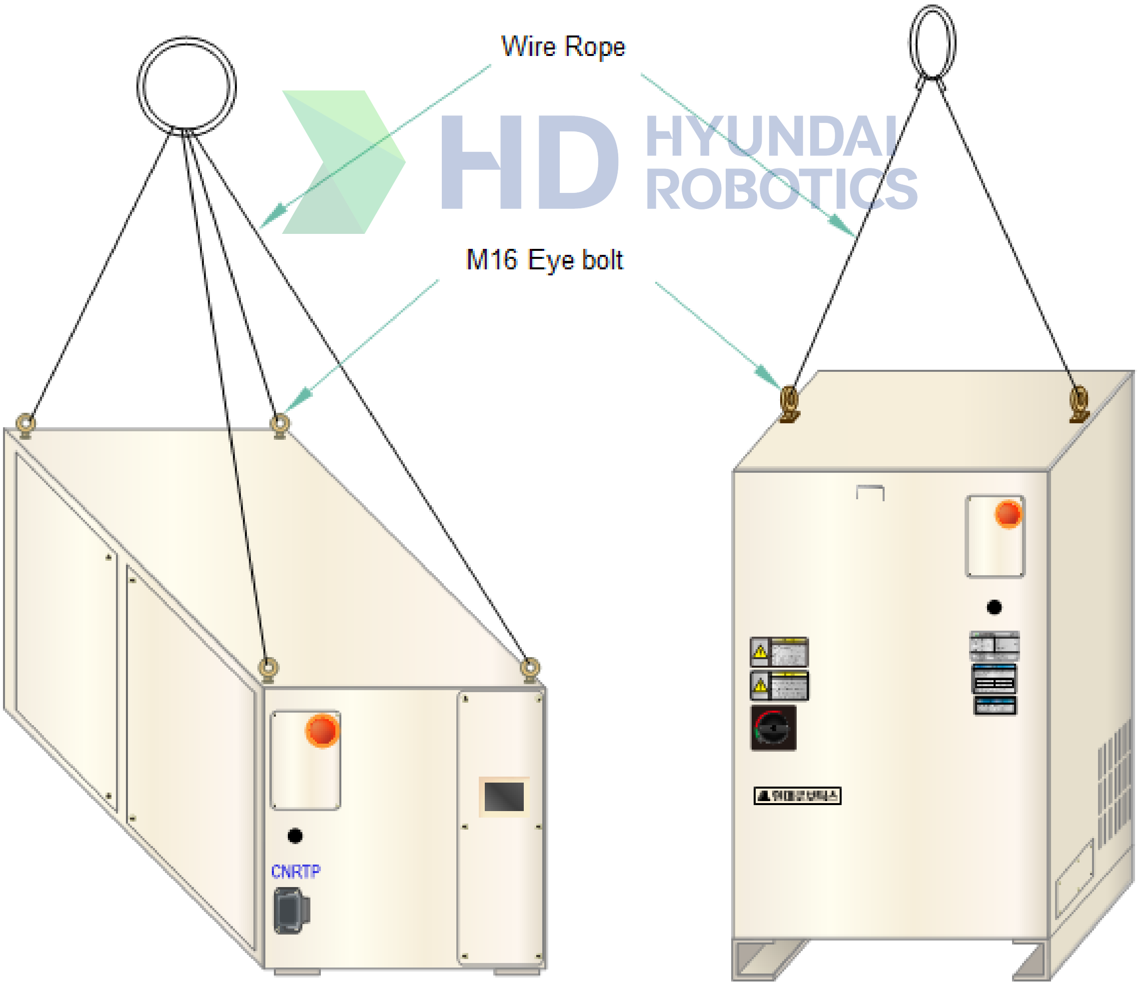


Figure 3.11 Transportation of Controller Using Crane

3.5.3. Transportation of Controller Using Forklift Truck

Check the following instructions when transporting the controller using a forklift truck.

① If transporting with wire rope, be sure to use a strong wire to hold controller.
② Check if the eye bolt is securely fastened.
③ Transport the controller as low as possible.

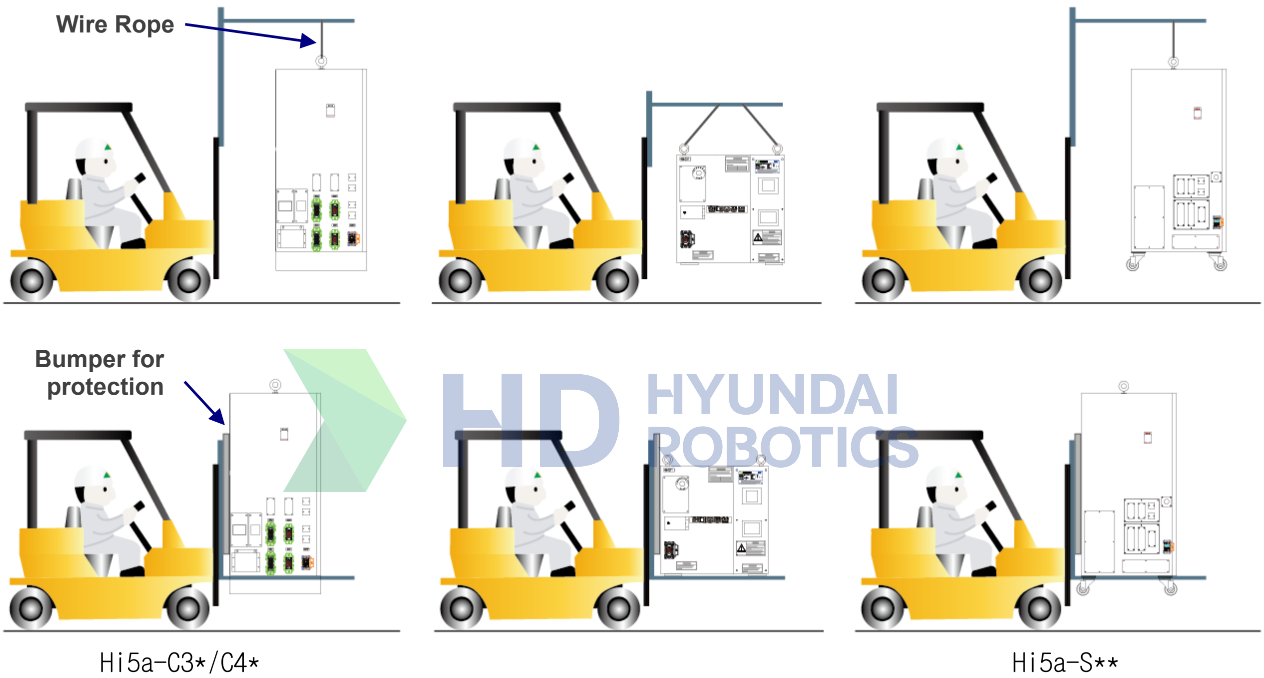


Figure 3.12 Transportation of Controller Using Forklift Truck

3.6. Space for Installation

Check the following instructions before installation.

① Secure the robot working envelope.
② Secure the space for maintenance of robot manipulator and controller.
③ Check if the installing place has such environment as follows.

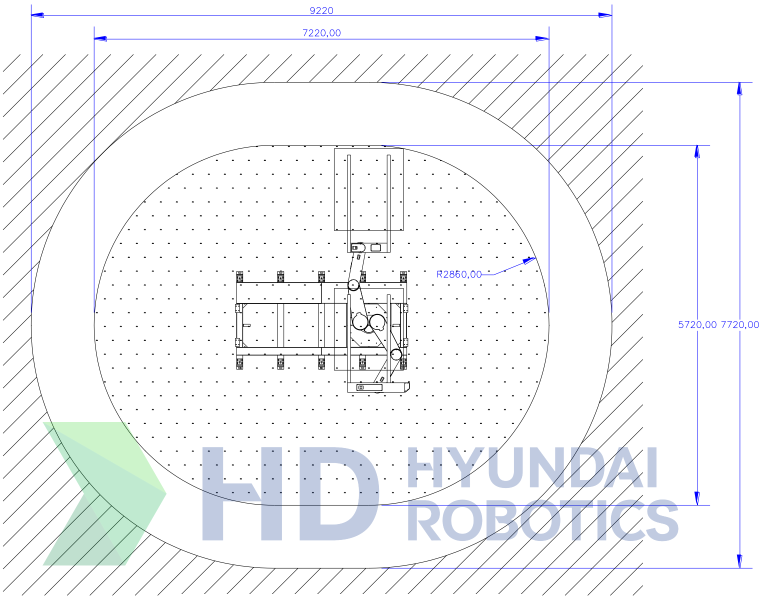
- Ambient Temperature ; 0℃ ~ 45℃
- No dust, oil, or moisture.
- No flammable, corrosive liquid or gas.
- No impact and shaking.
- Far from electrical noise generator.
- No exposed direct to the sun

3.6.1. Installation of Controller

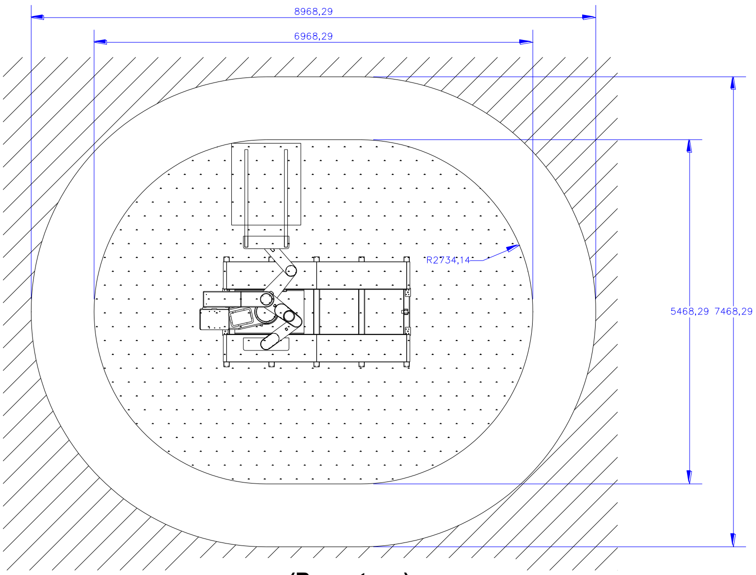
① Install the controller in a safe place outside of robot working envelope.
② If safety fence is located outside of robot working envelope, install the controller in a place where the robot's movement can be monitored from the outside of safety fence.
③ Open the front door and secure enough space for maintenance work.
④ Install the controller in a place where welding spatter and coolant are not reached.

3.6.2. Space for Installation

Secure enough space for robot manipulator and controller before installing. To install the manipulator and controller, secure the installing space as shown in the below figure. Install the controller outside of the safety fence to see the manipulator easily and to work safely. Install the controller at intervals of a minimum 500mm from the surrounding walls and the operating means (for example, a handle) of the supply disconnecting device should be easily accessible and located between 0.6~1.9m above the servicing level. An upper limit of 1.7m is recommended.



(Cylinder type)



(Beam type)

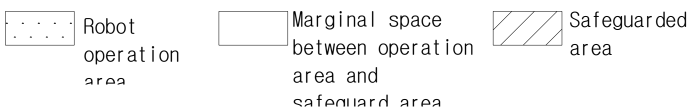


Figure 3.13 Installing space for LCD robot

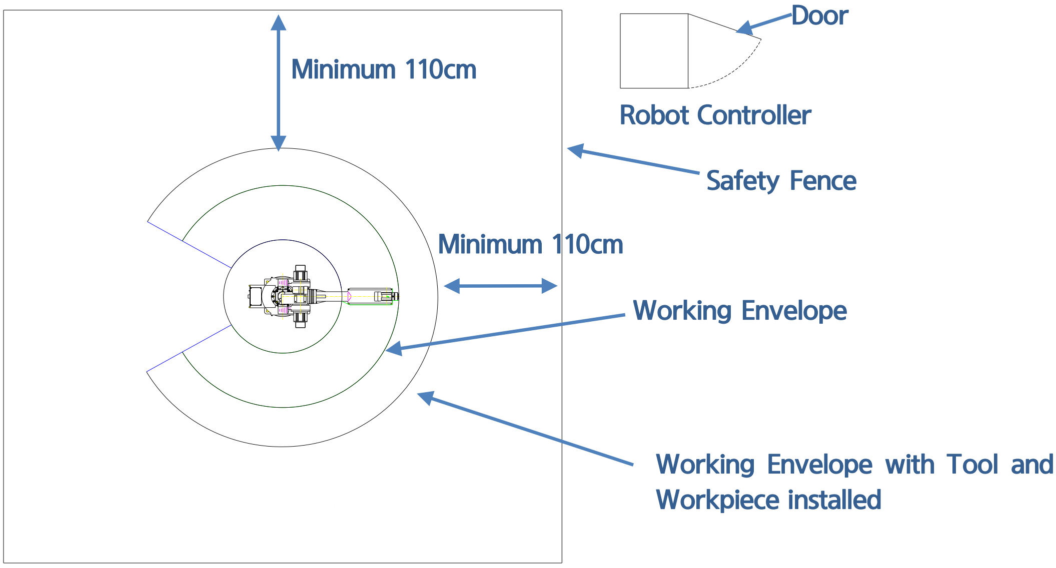


Figure 3.14 Install space for general type robot

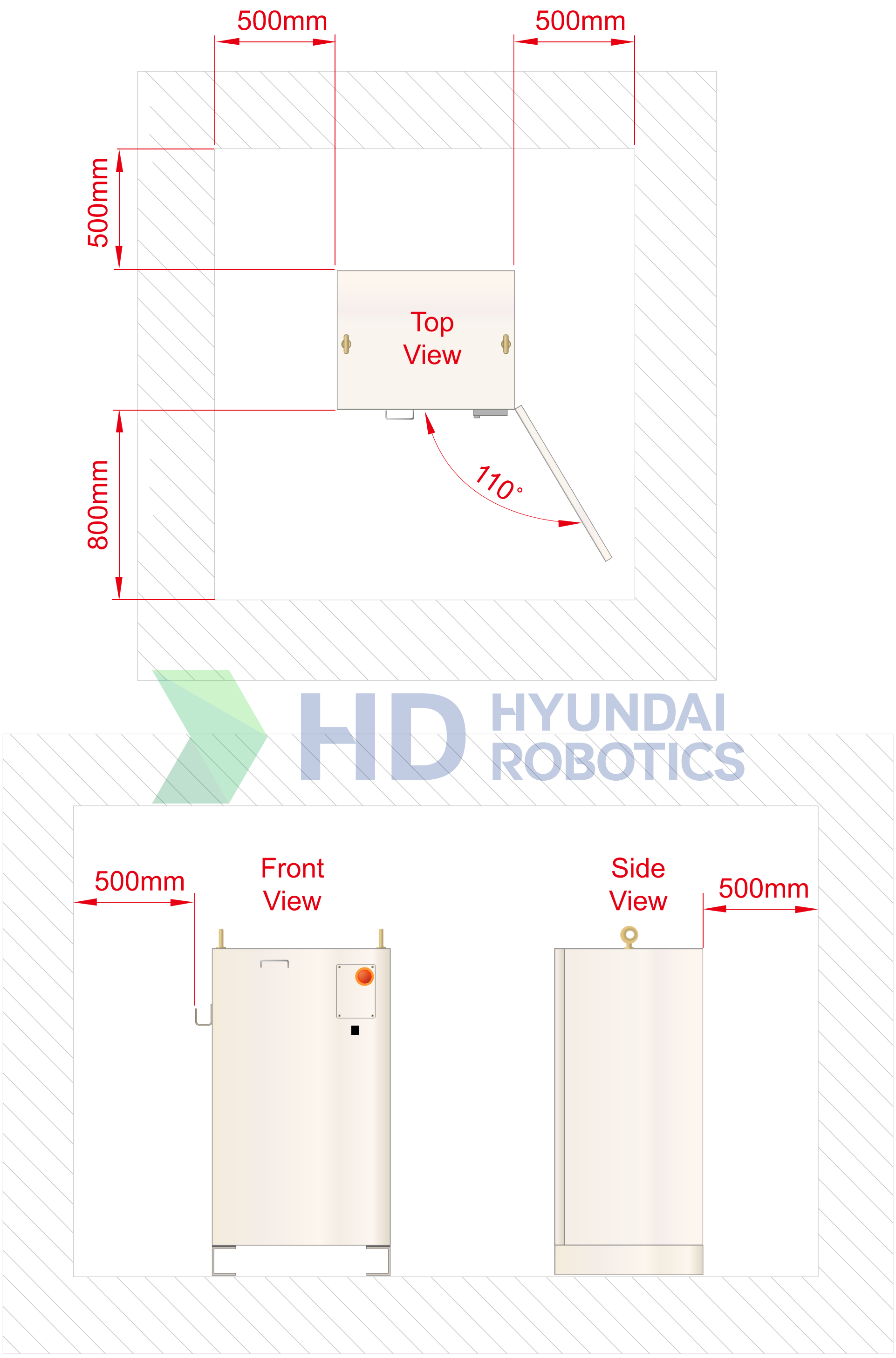


Figure 3.15 Installing space for Hi5a-C3*/C4*, Hi5a-S** controller

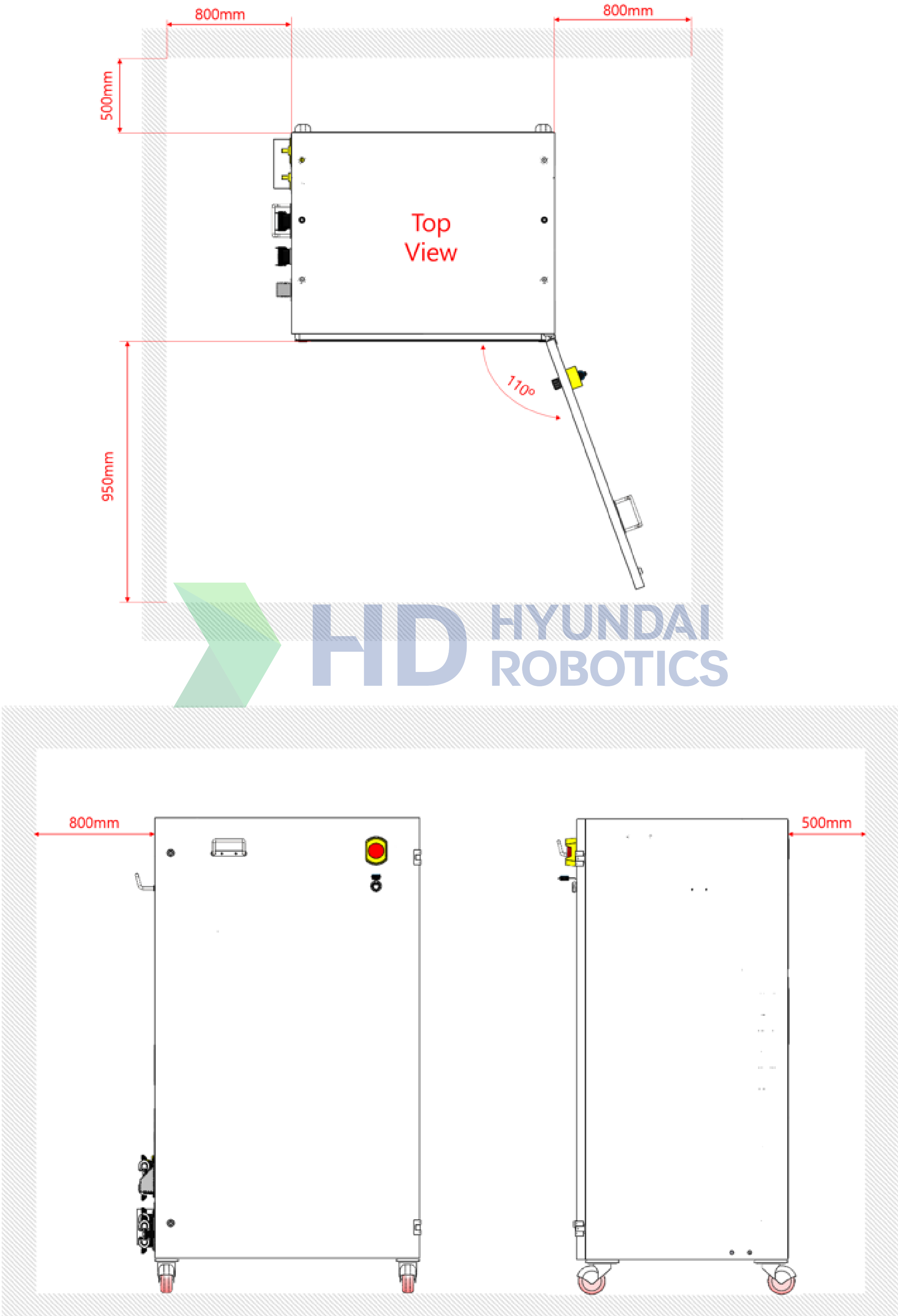


Figure 3.16 Installing space for Hi5a-C5*/C6* controller

3.6.3. Dimension of Controller

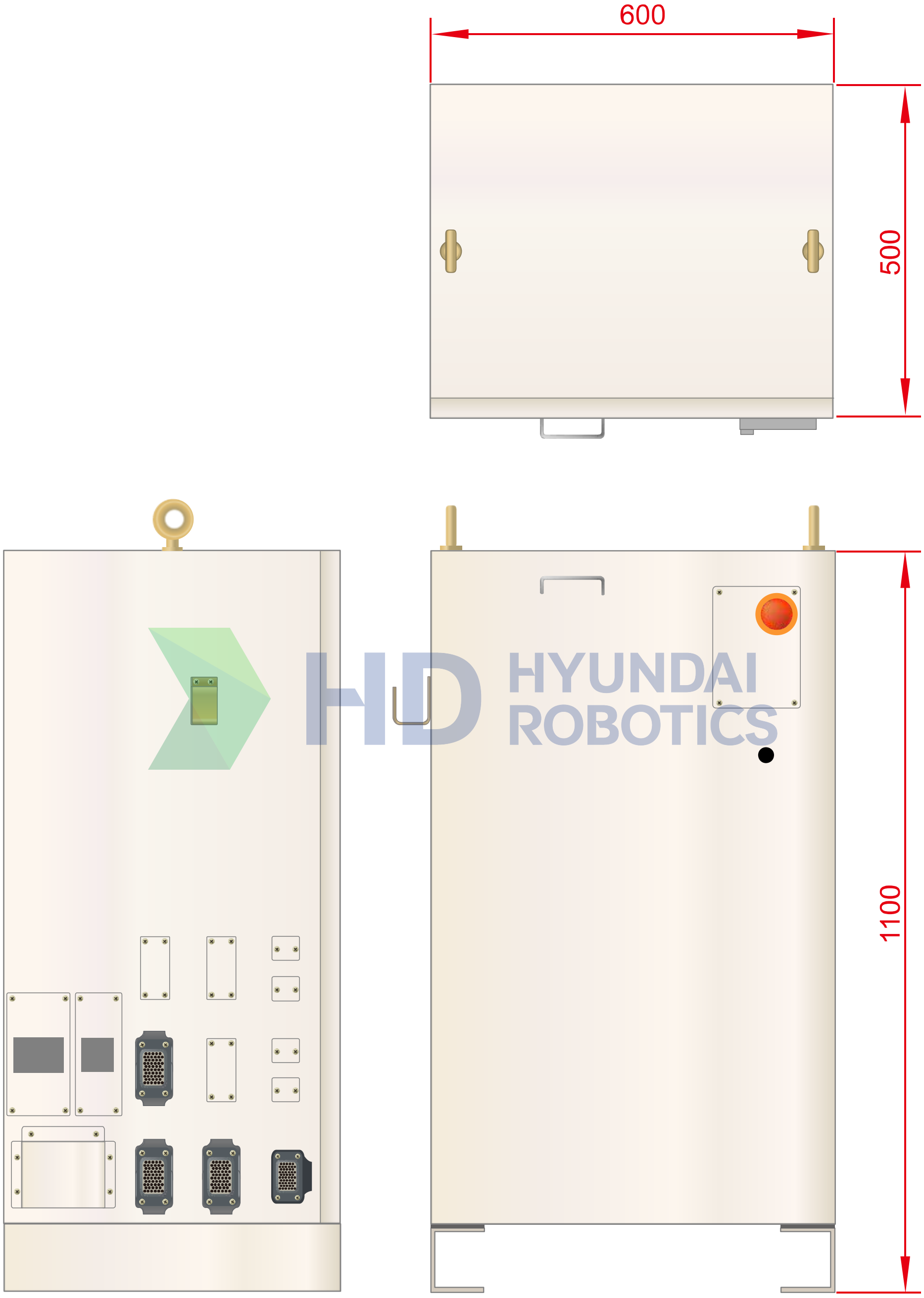


Figure 3.17 Dimension of Hi5a-C3*/C4* Controller (Unit: mm)

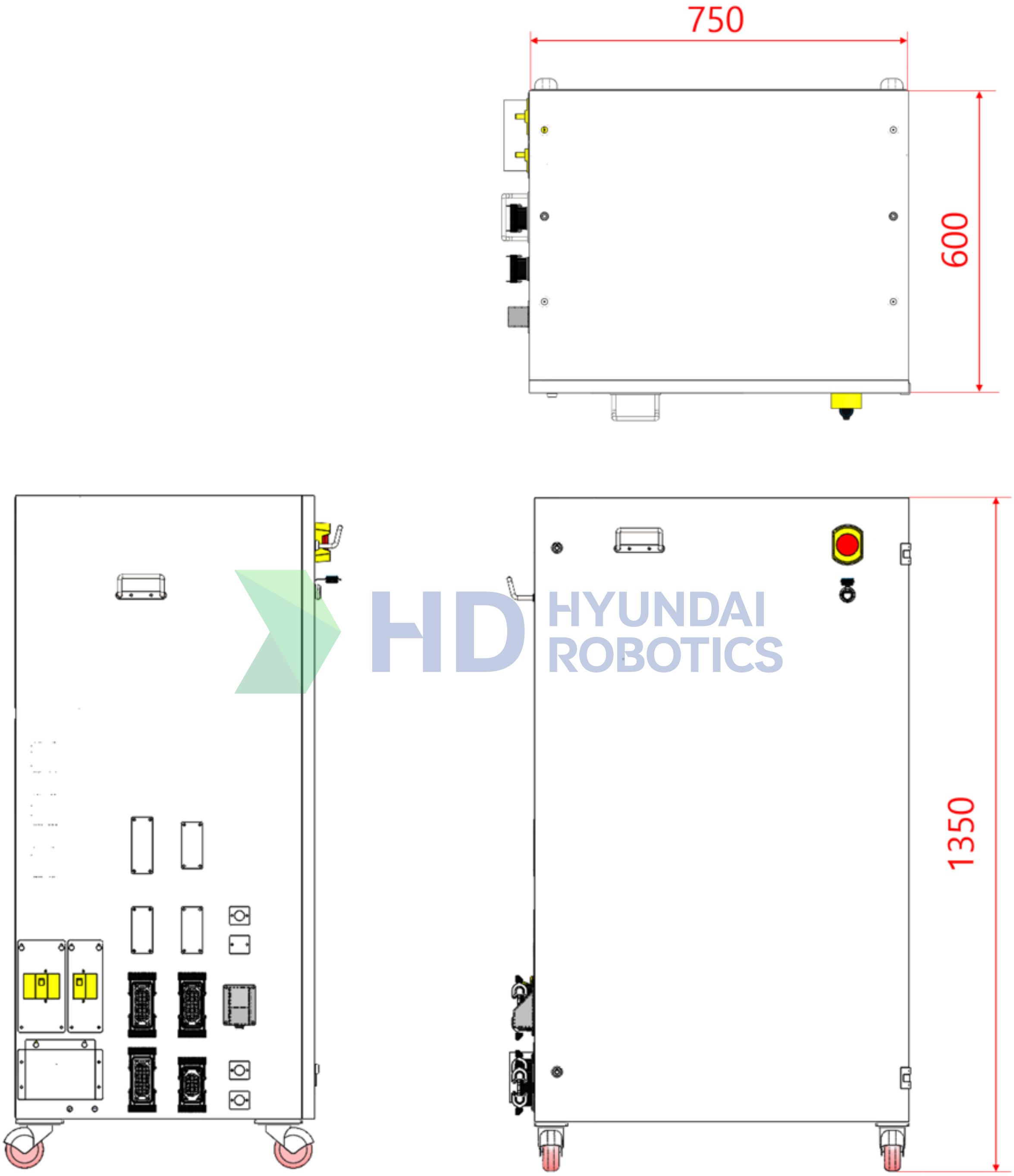


Figure 3.18 Dimension of Hi5a-C5*/C6* Controller (Unit: mm)

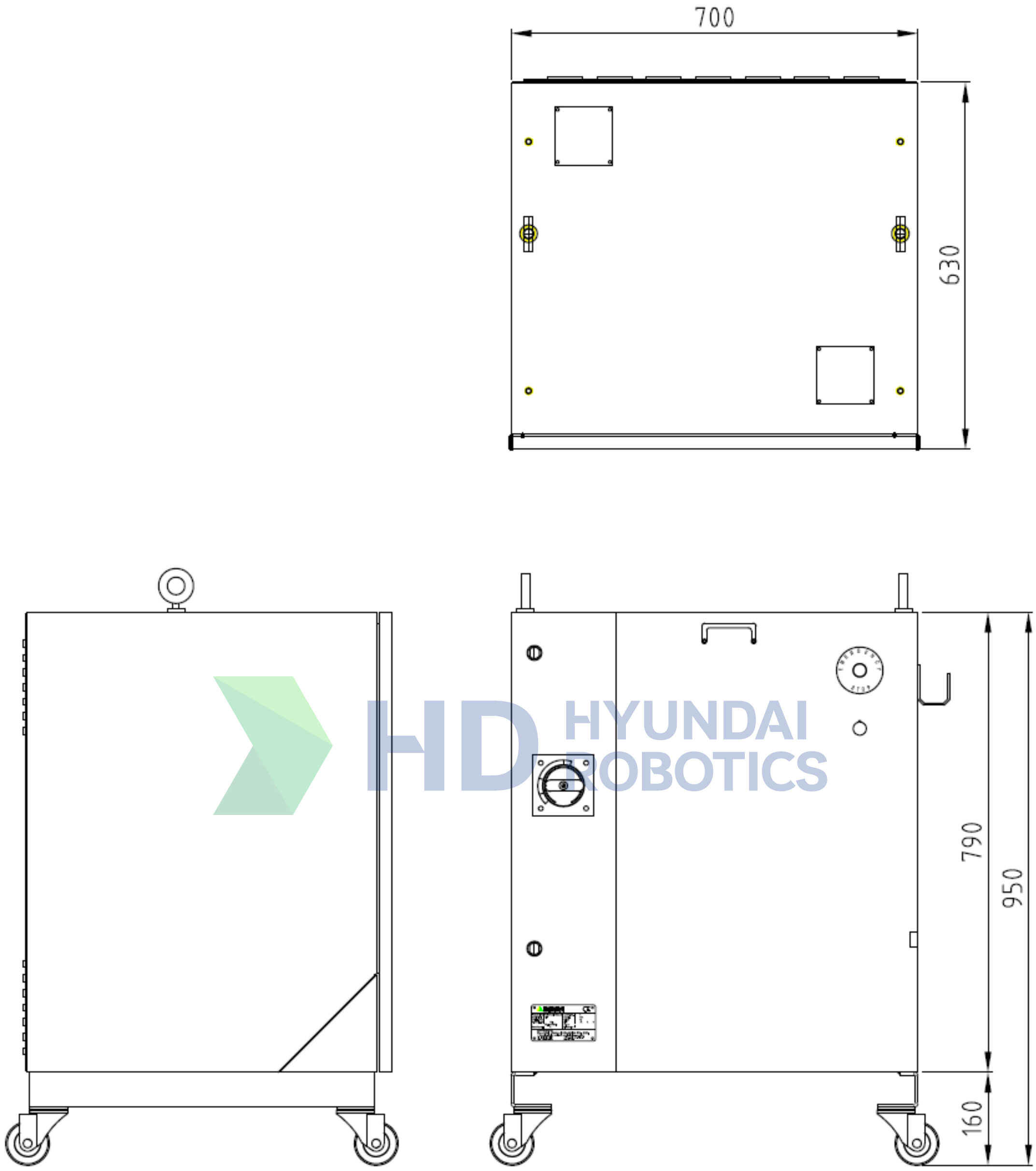


Figure 3.19 Dimension of Hi5a-S** Controller (Unit: mm)

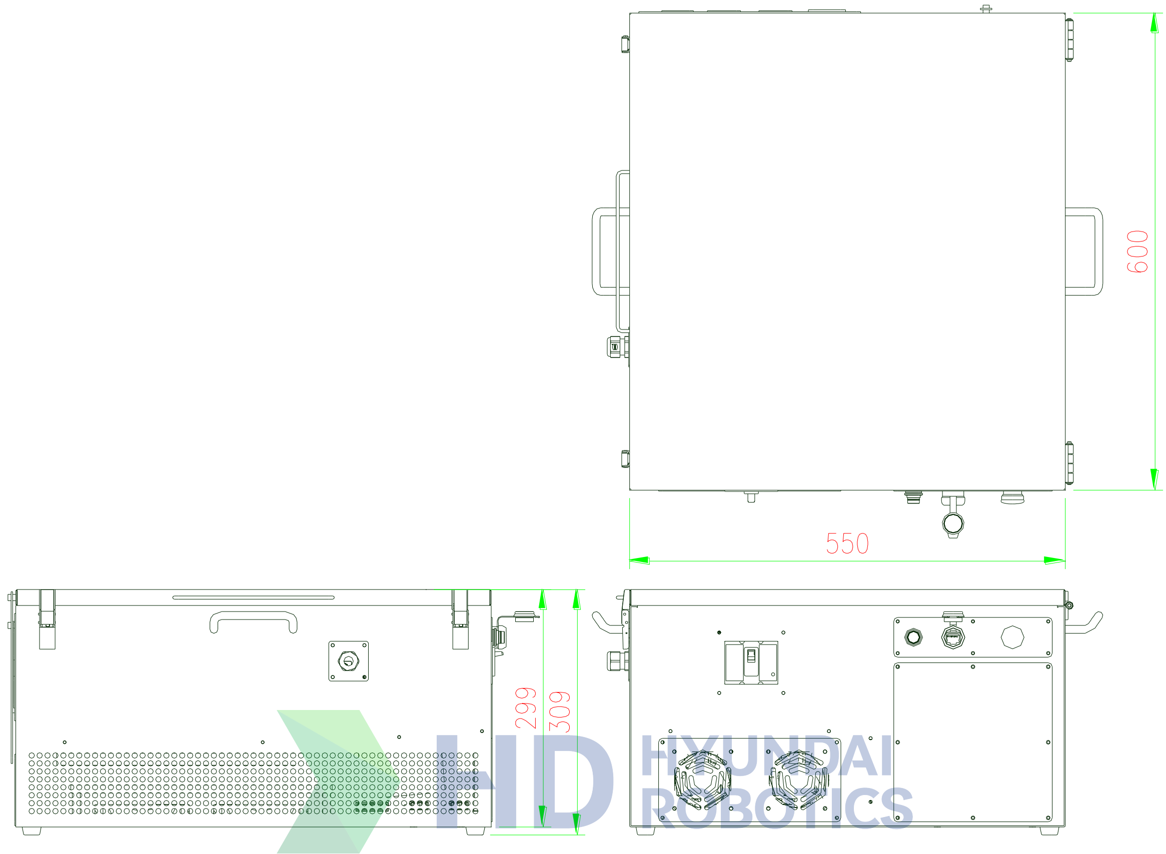


Figure 3.20 Dimension of Hi5a-S20 Controller (Unit: mm)

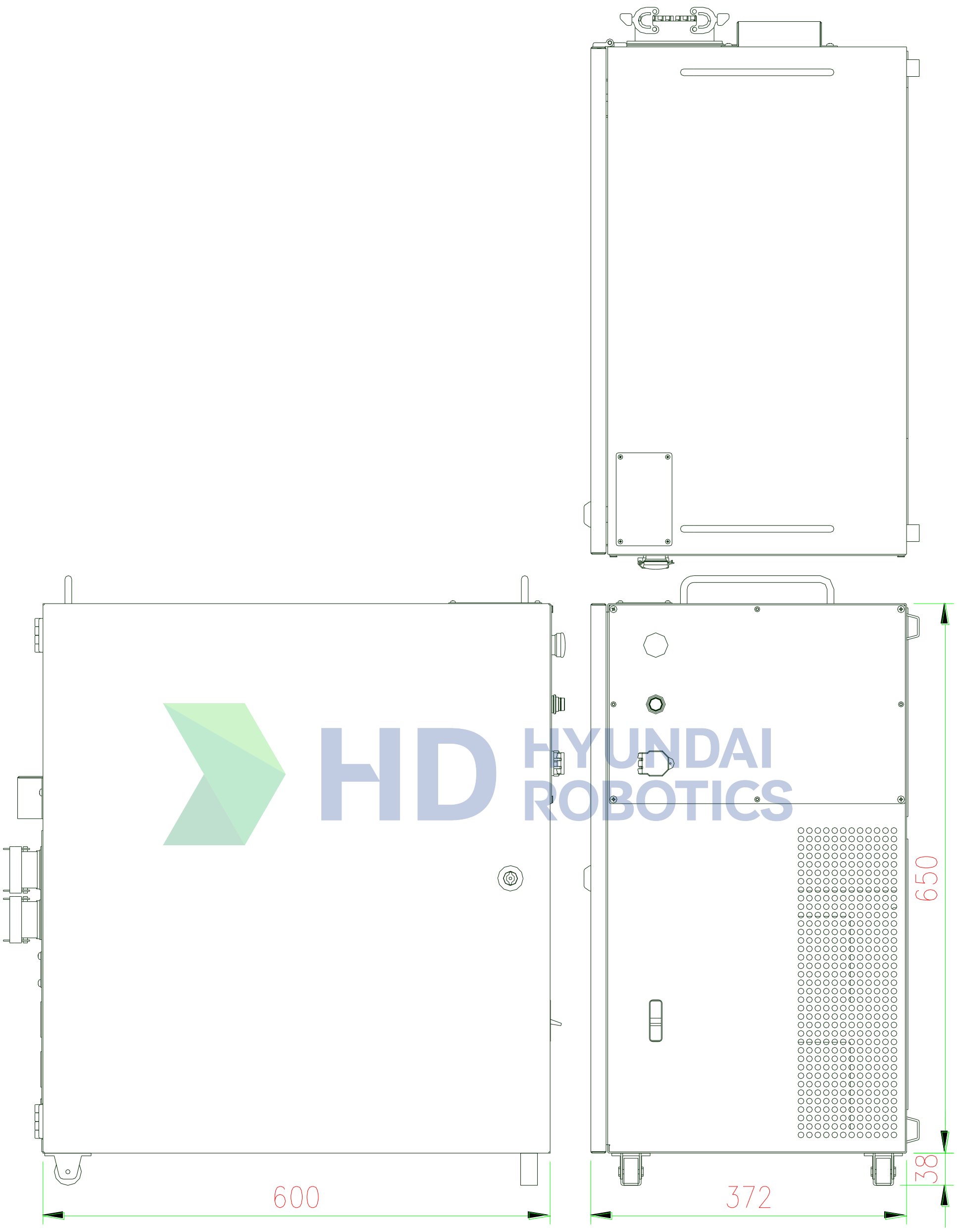


Figure 3.21 Dimension of Hi5a-S10 Controller (Unit: mm)

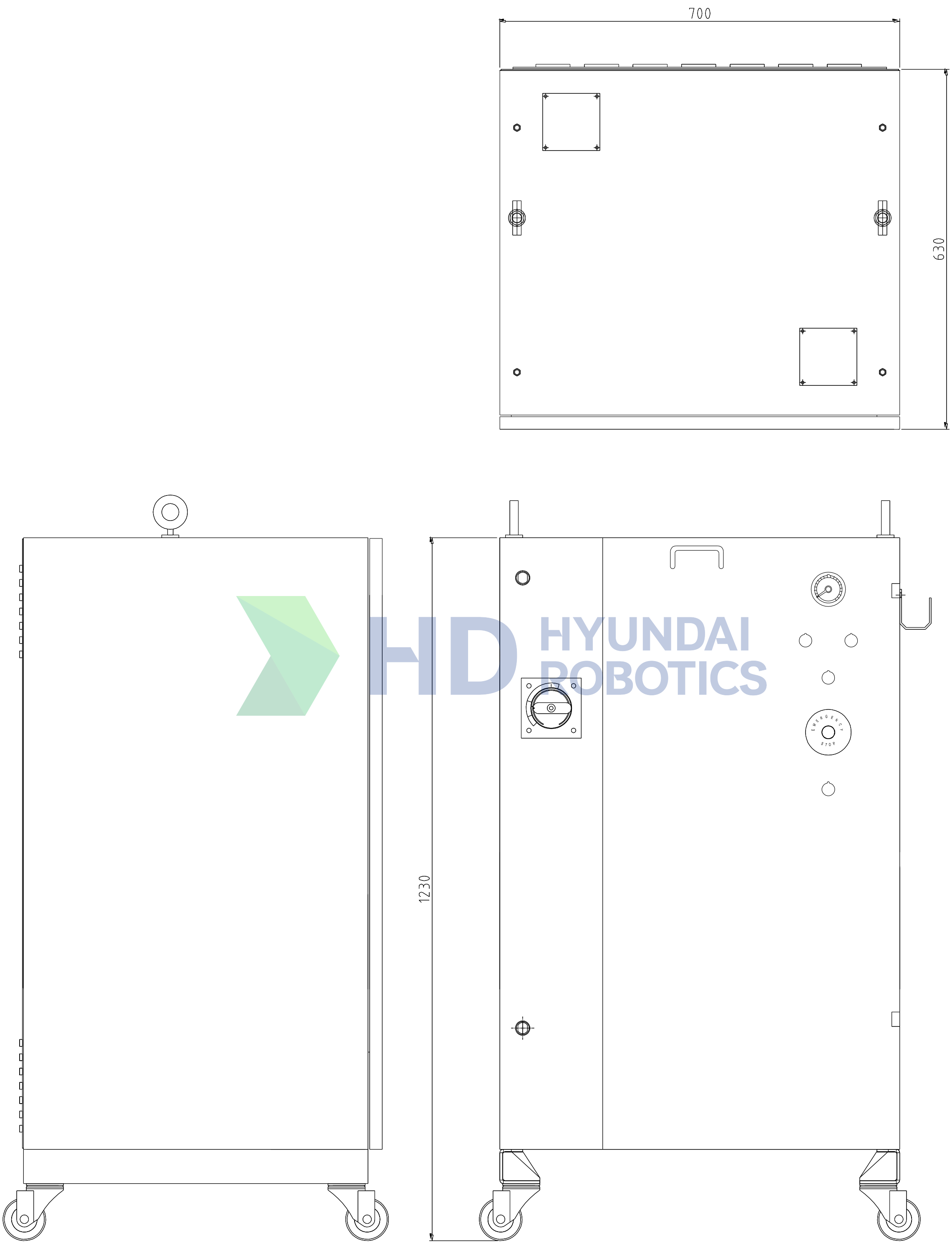


Figure 3.22 Dimension of Hi5a-P10/P20 Controller (Unit: mm)

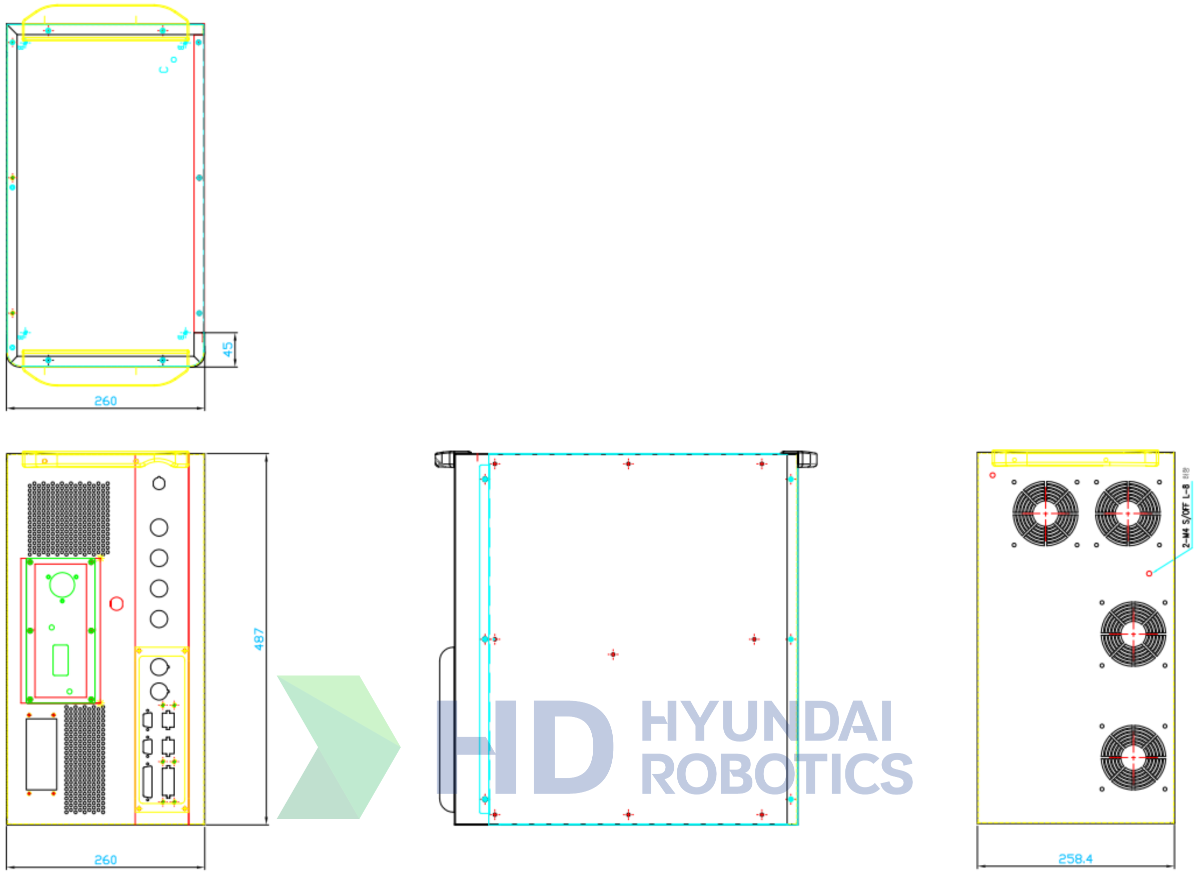


Figure 3.23 Dimension of Hi5a-T10 Controller (Unit: mm)

3.7. Connection

Caution

① Turn the main power switch of controller "OFF" before connecting cables, and use a lock to lock the main power switch.
② There is charged energy of DC 400V in the controller. Be careful. Turn the power switch "OFF" to discharge the energy, and wait for 5 minutes at least
③ When handling PCB, be careful of any damages from static electricity.
④ Wiring and interconnecting should be performed by qualified personnel.

3.7.1. Connection of Teach Pendant

Connect the cable connector of Teach Pendant to CNRTP receptacle in the side of controller.

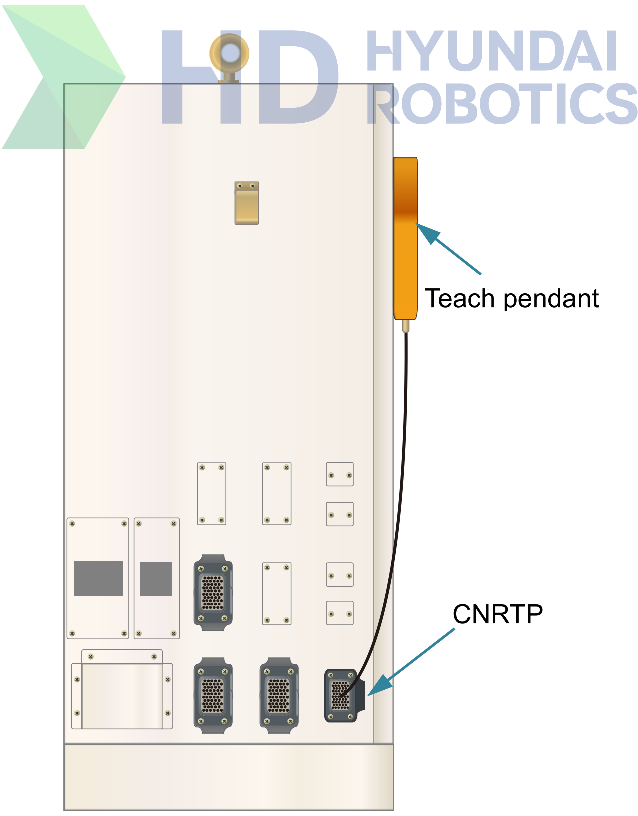


Figure 3.24 Hi5a-C3*/C4*/C5*/C6* Connection of Teach Pendant

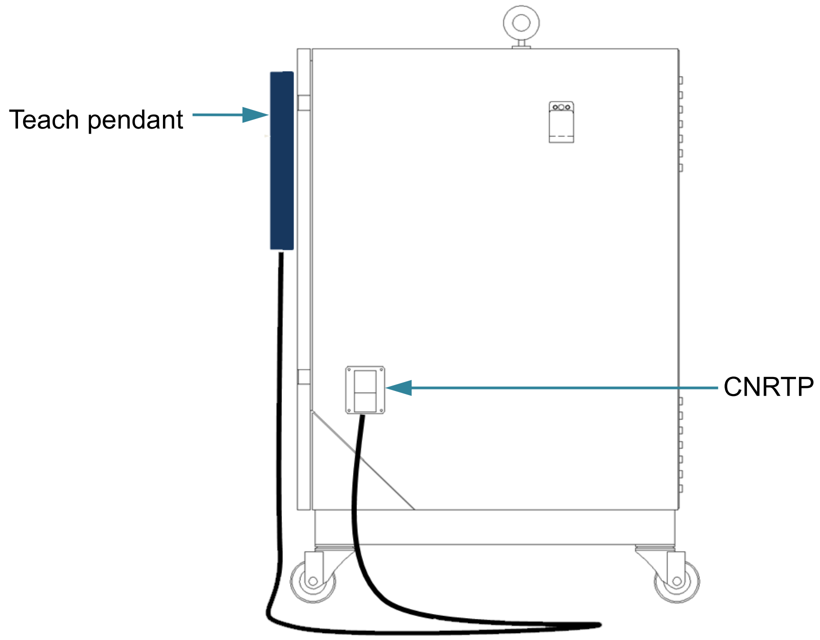


Figure 3.25 Hi5a-S**/P10/P20 Connection of Teach Pendant

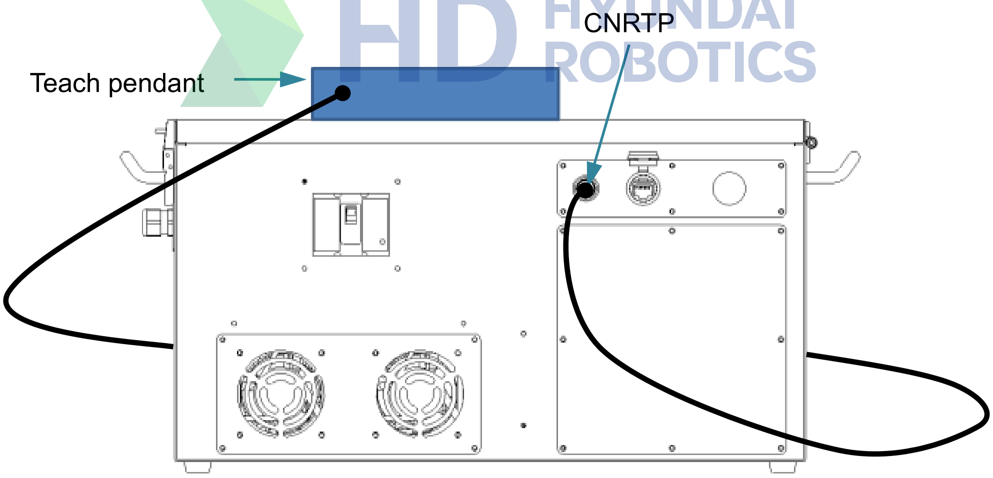


Figure 3.26 Hi5a-S20 Connection of Teach Pendant

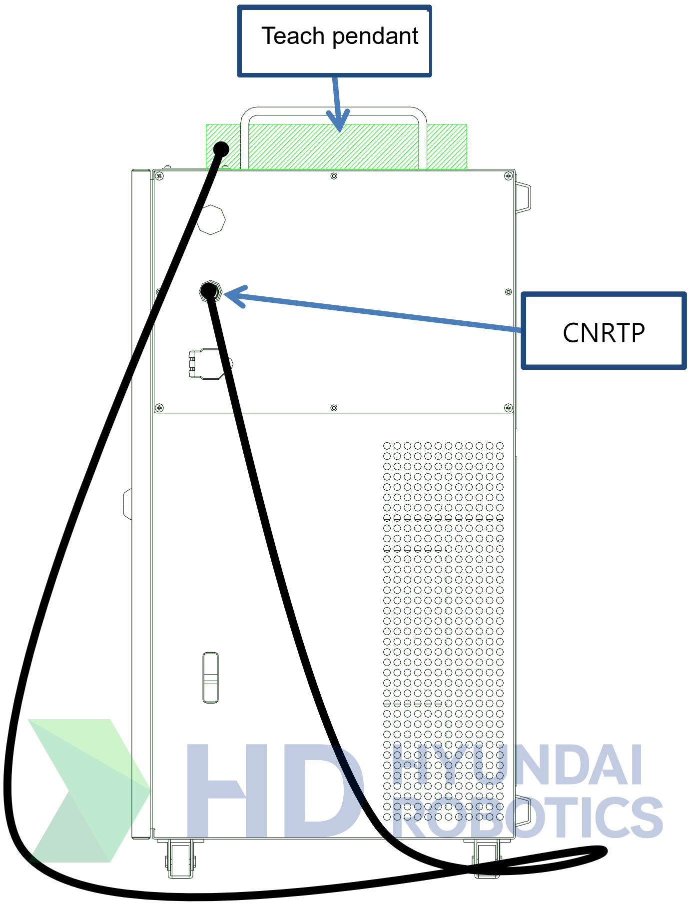


Figure 3.27 Hi5a-S10 Connection of Teach Pendant

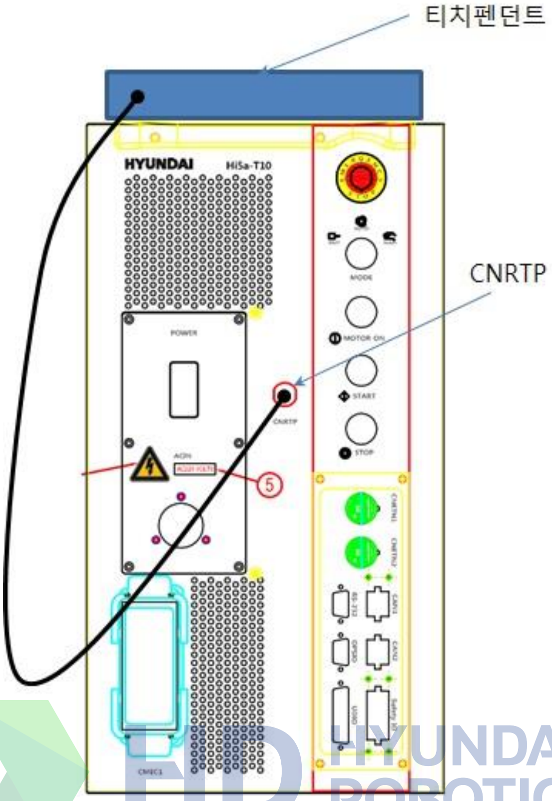


Figure 3.28 Hi5a-T10 Connection of Teach Pendant

3.7.2. Connection of Manipulator and Controller

Connect the robot manipulator to the controller by using wire harness. Check the respective name of receptacles before connecting.

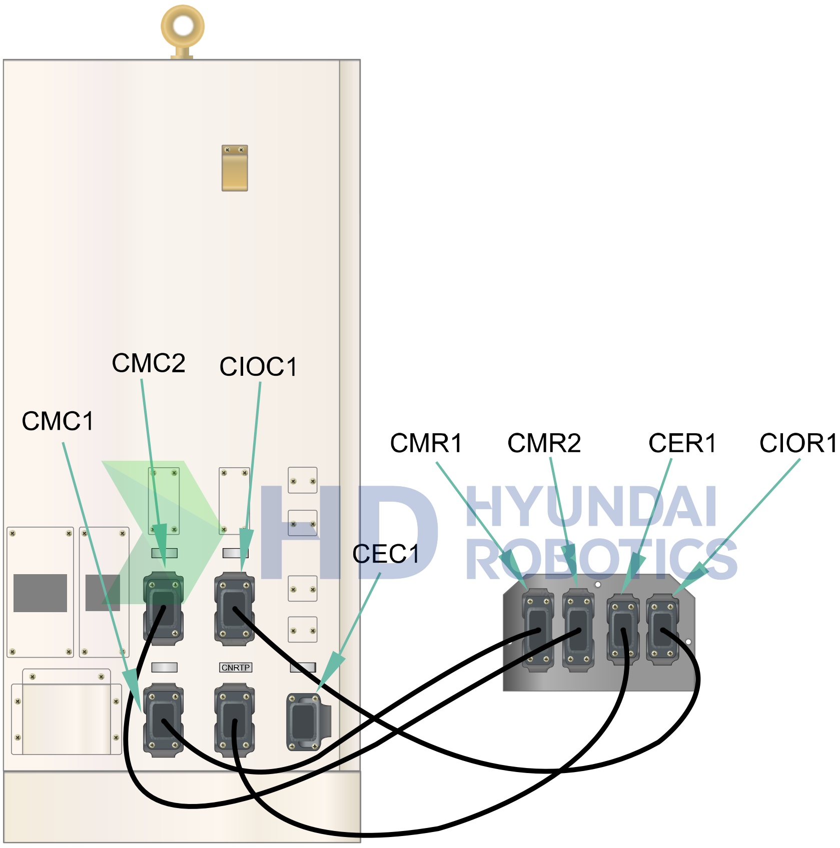


Figure 3.29 Connection of Robot Manipulator and Controller (Hi5a-C3*/C4*/C5*/C6*)

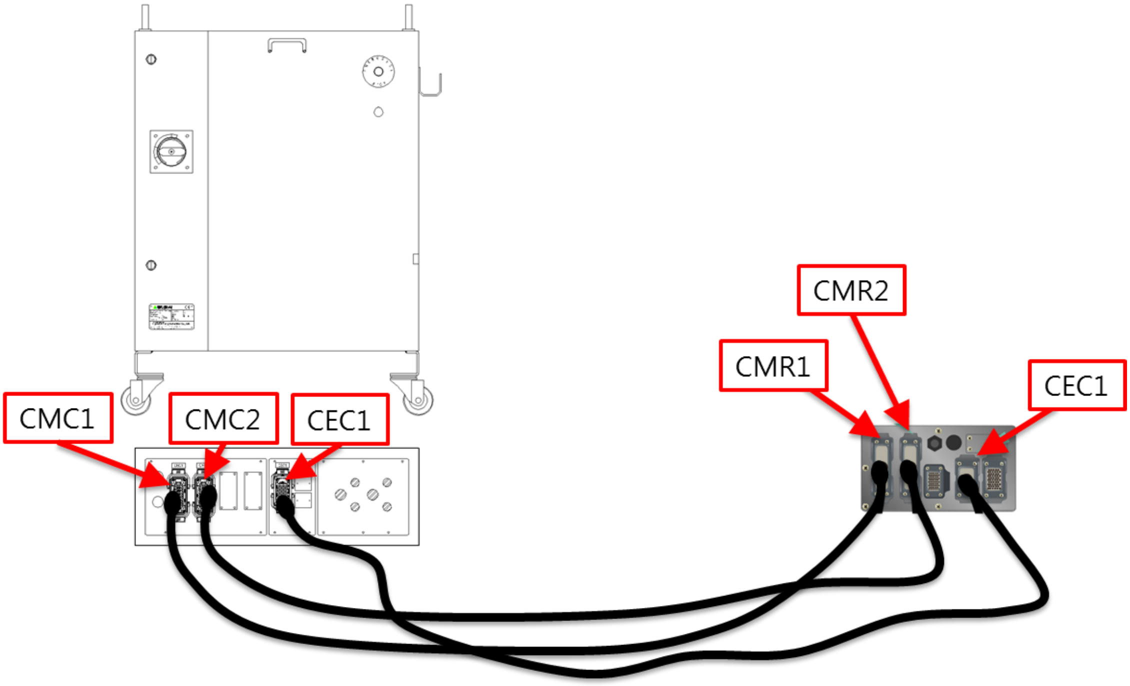


Figure 3.30 Connection of Robot Manipulator and Controller (Hi5a-S00)

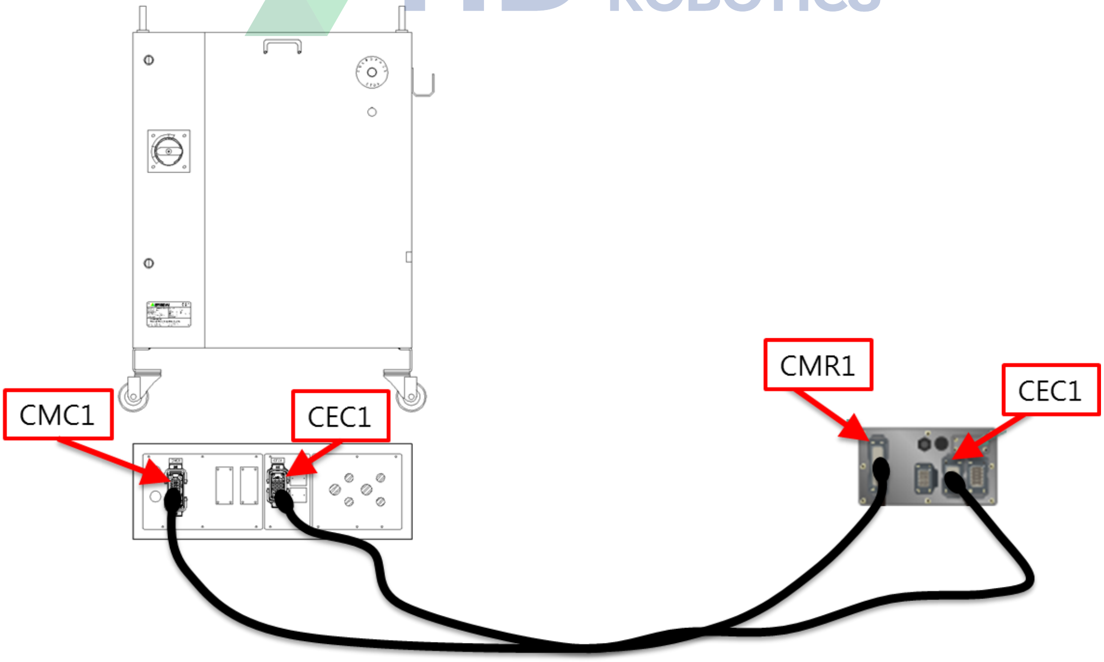


Figure 3.31 Connection of Robot Manipulator and Controller (Hi5a-S30)

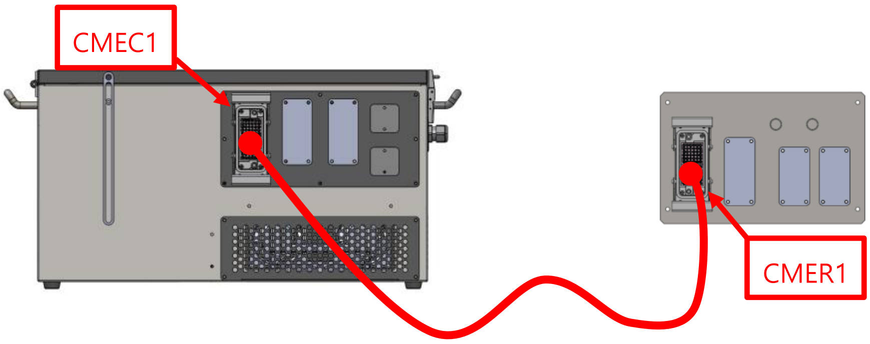
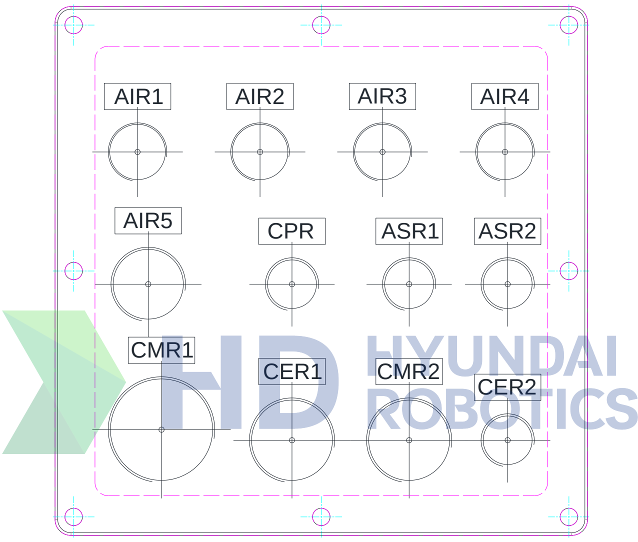


Figure 3.32 Connection of Robot Manipulator and Controller (Hi5a-S10)



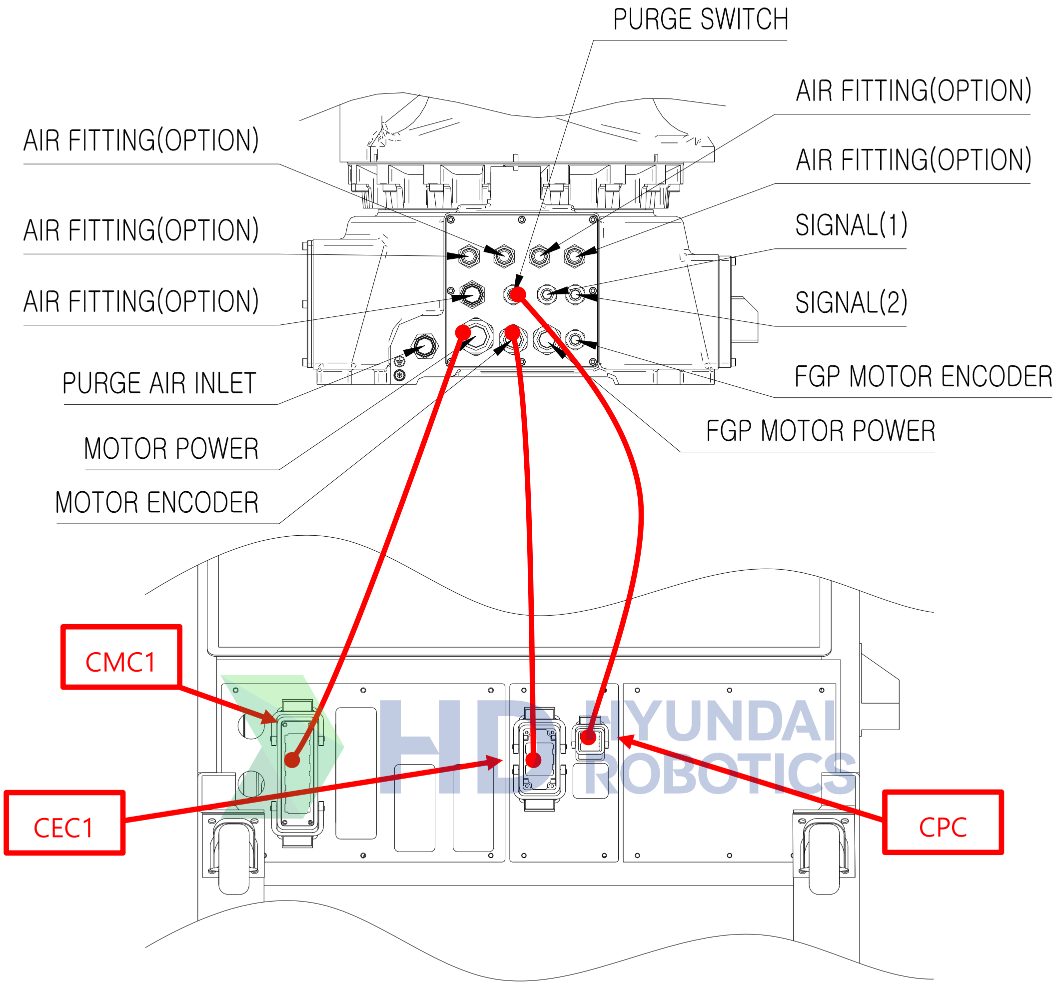


Figure 3.33 Connection of Robot Manipulator and Controller (Hi5a-P10/P20)

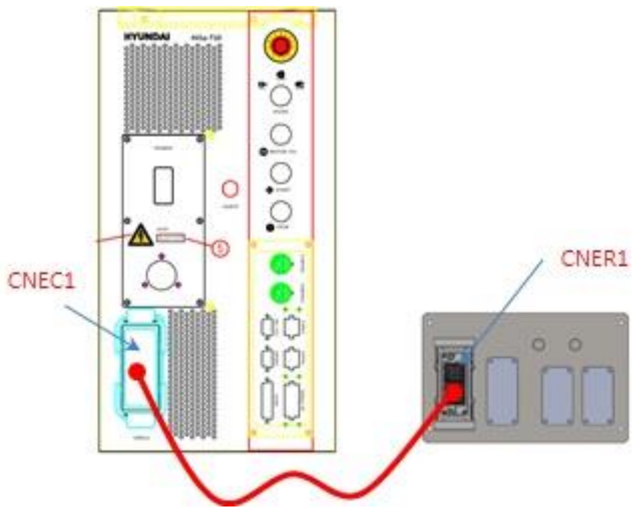


Figure 3.34 Connection of Robot Manipulator and Controller (Hi5a-T10)

3.7.3. Connection of Controller and Primary Power

Check if the power is removed from the primary power and barker (CB).
Connect the Hi5a-C3*/C4*/C5*/C6* controller to the terminal block (TBPW).
For the Hi5a-S** controller, insert the power cable into the power service outlet to connect the breaker (NFB).
Here, use a proper size of terminal for the tip of primary power cable

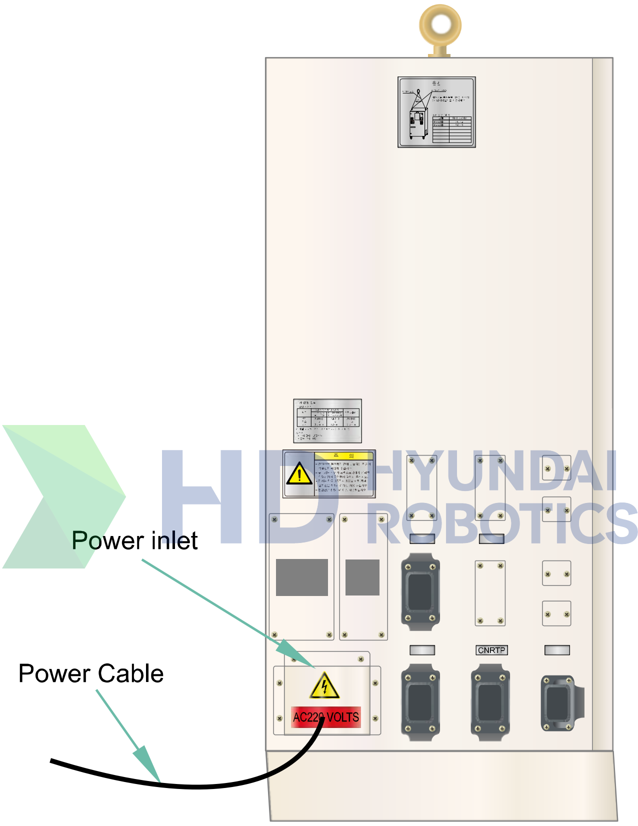


Figure 3.35 Hi5a-C3*/C4*/C5*/C6* Connection of Primary Power to Controller

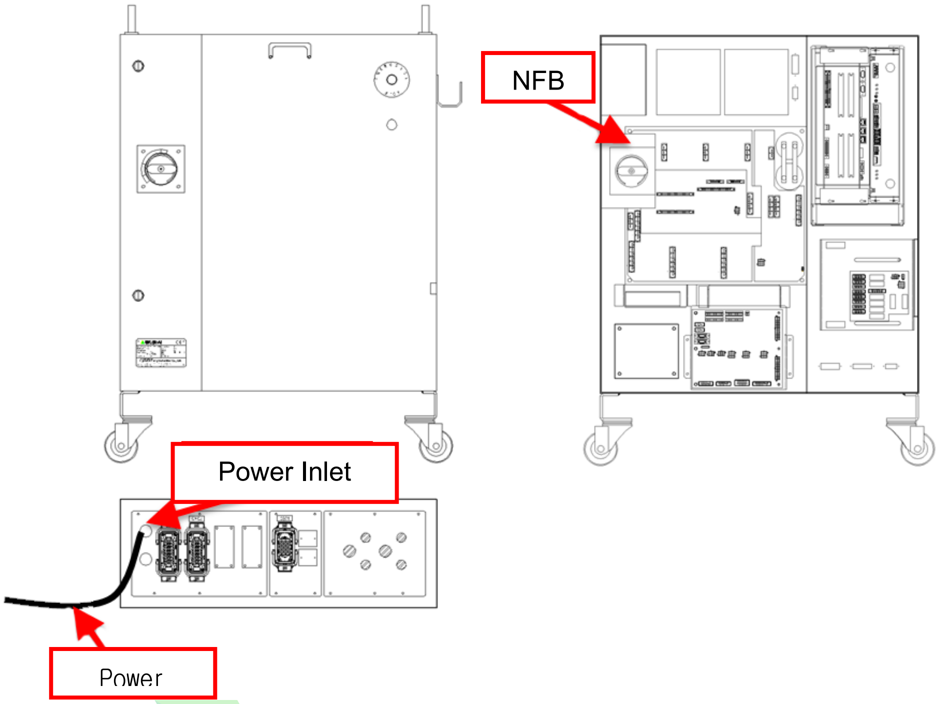


Figure 3.36 Hi5a-S**/P10/P20 Connection of Primary Power to Controller

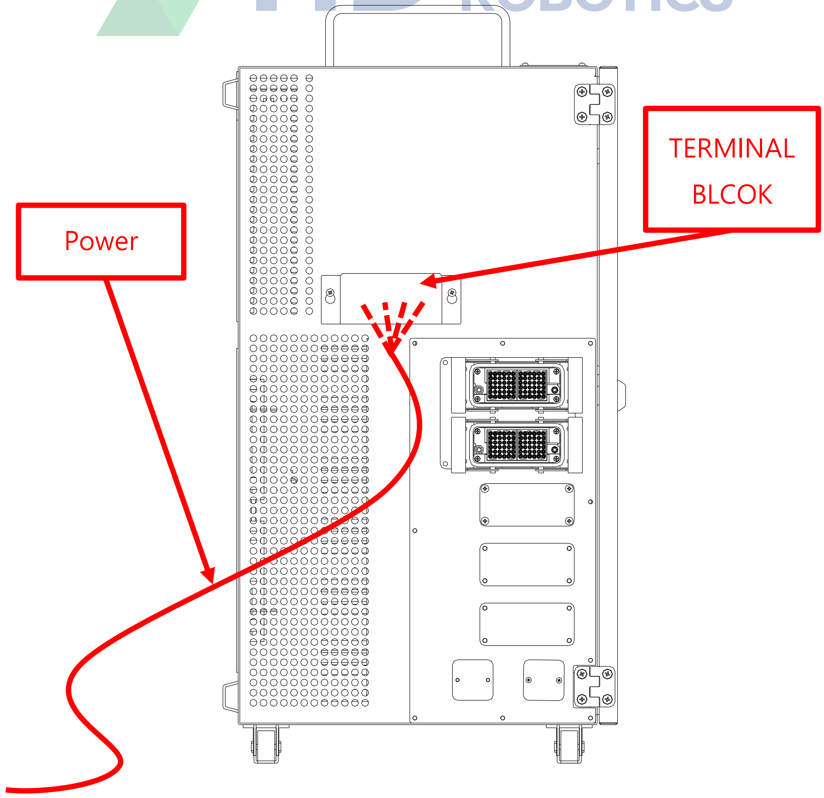


Figure 3.37 Hi5a-S20/S10 Connection of Primary Power to Controller

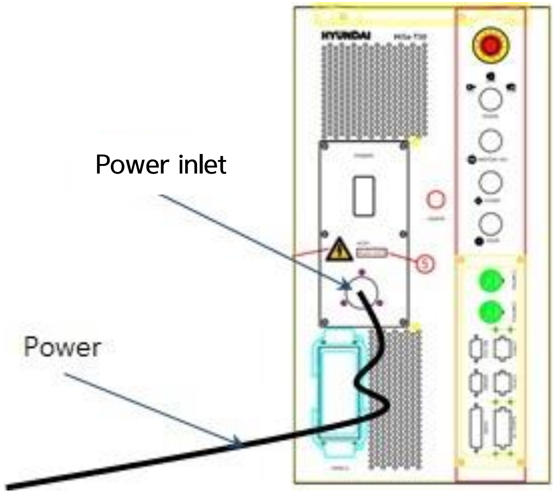


Figure 3.38 Hi5a-T10 Connection of Primary Power to Controller

3.7.3.1. Power Conditions

Table 3-3 Power Conditions

No.	Controller	Capacity*1) (KVA)	Input Voltage*2) (V)	Frequency (Hz)	Max. Current (A)
1	Hi5a-S00/S10/ S60/P10/P20/J00	Max. 7.8	220/380/400/440	50/60	30
2	Hi5a-S20/S30	Max. 4.4	220/380/400/440	50/60	15
3	Hi5a-S80	Max. 10.5	220/380/400/440	50/60	50
4	Hi5a-C3* (except for C34)	Max. 12.5	220	50/60	30
5	Hi5a-C34	Max. 7.0	220	50/60	15
6	Hi5a-C4*	Max. 16.0	220	50/60	40
7	Hi5a-C5*	Max. 21.0	220	50/60	50
8	Hi5a-C6*	Max 13.5	220	50/60	30
9	Hi5a-T10	Max. 1.5	220	50/60	15

Note 1) Power capacity:
This refers to the capacity of the power supplied to the controller. Please refer to the “Robot Maintenance Manual” for the power capacity of each robot.
Note 2) Voltage Range: ±10% (Controller Power Terminal)

3.7.3.2. Thickness of Power Cables

Table 3-4 Recommended Cable of Least Thickness

No.	Length of Cable m (feet)	Thickness of Cable (Hi5a-S00/S10/S60/S80/P10/P20/J00)		Thickness of Cable (Hi5a-S20/S30, Hi5a-T10)	
		mm^2	AWG	mm^2	AWG
1	0 ~ 50 (0 ~ 160)	5.5	10	3.5	12
2	50 ~ 100 (160 ~ 320)	5.5	10	3.5	12
3	100 ~ 180 (320 ~ 590)	8	8	5.5	10
4	180 ~ 300 (520 ~ 980)	8	8	5.5	10

No.	Length of Cable m (feet)	Thickness of Cable (Hi5a- C3*/C6*)		Thickness of Cable (Hi5a- C34)		Thickness of Cable (Hi5a-C4*)		Thickness of Cable (Hi5a-C5*)	
		mm^2	AWG	mm^2	AWG	mm^2	AWG	mm^2	AWG
1	0 ~ 50 (0 ~ 160)	5.5	10	3.5	12	8	8	10	7
2	50 ~ 100 (160 ~ 320)	5.5	10	3.5	12	10	7	12	6

3.7.4. Controller and Grounding

Connect the grounding conductor to the controller for safety.
Use the grounding conductor more than 5.5 ㎟. (Class 3 grounding)

- **Hi5a-P10/P20**

Connect the grounding conductor to the controller for safety. A dedicated ground wire is required to comply with explosion-prevention regulations. Connections must be surely checked because an incomplete connection or a connection not made may cause explosions or fires.

When wiring inside the controller is performed, two types of ground wire connection are required. For general grounding, 100 Ω or less should be applied in the connection. For circuits related to intrinsic safety, 1 Ω or less resistance with the ground should be applied in the connection. Normally, a green/yellow pattern cable is used for general grounding, while a light blue cable is used for intrinsically safe grounding.

For the manipulator and the controller, a grounding wire of UL1015 AWG 10 (5.5 SQ) or above should be used, and for intrinsically safe grounds, a grounding wire of 12 AWG (4 SQ) or above should be used for the connection to the ground terminal, as shown below.

The intrinsically safe connection cable should be kept at least 50 mm distant from other cable connections.

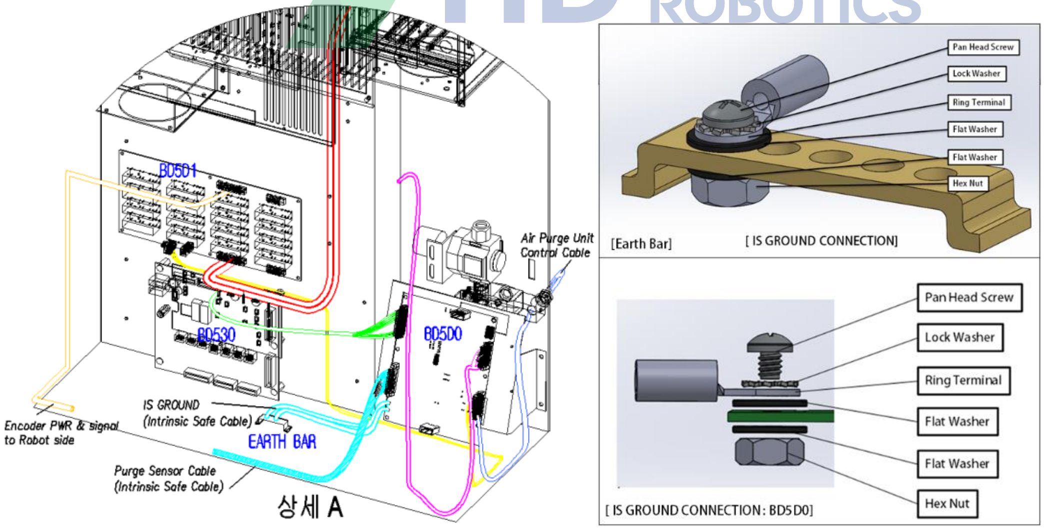


Figure 3.39 Wiring inside the controller

3.7.5. Other Cautions

① Please distinguish signal line and power line on wiring for controller and robot main body. And use a separated DUCT between high power line and signal line for wiring.
② Shield the wires with protection cover against damages, and be careful of damage from traffic.
③ Be sure to double-check the connecting relations, power specifications of controller, and specifications of power supply before primary power input.

3.7.6. Connection of the user Ethernet port

The user Ethernet port is located in the front of the controller, and the following shows the pin description and the instructions on how to connect to a PC.

Table 3-5 Pin Descriptions (RJ45 connector specifications: RJ 45P Shield)

RJ45 Pin No.	Name	Abbreviation	Direction
1	Transmit Data +	TX +	Out
2	Transmit Data -	TX -	Out
3	Receive Data +	RX +	In
6	Receive Data -	RX -	In

4

Basic Components of Controller

Please learn the components of controller, arrangement and functions of components before doing a repair work.

4.1. Components

Controller consists of the body and the teach pendant as seen in the following picture.

Figure 4.1 Hi5a-S** Controller

Figure 4.2 Hi5a-S20/S10 Controller

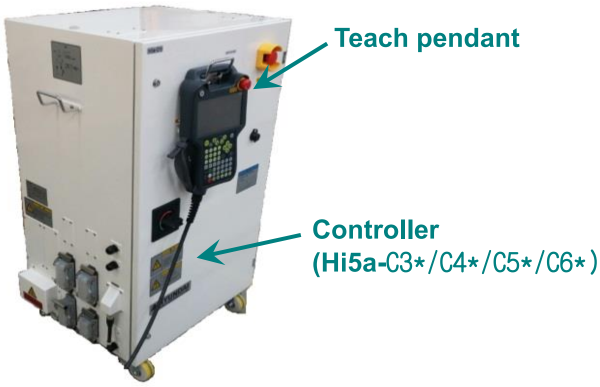


Figure 4.3 Hi5a-C** Controller

Figure 4.4 Hi5a-P10/P20 Controller

Figure 4.5 Hi5a-T10 Controller

Figure 4.6 Teach pendant (TP520/TP530)

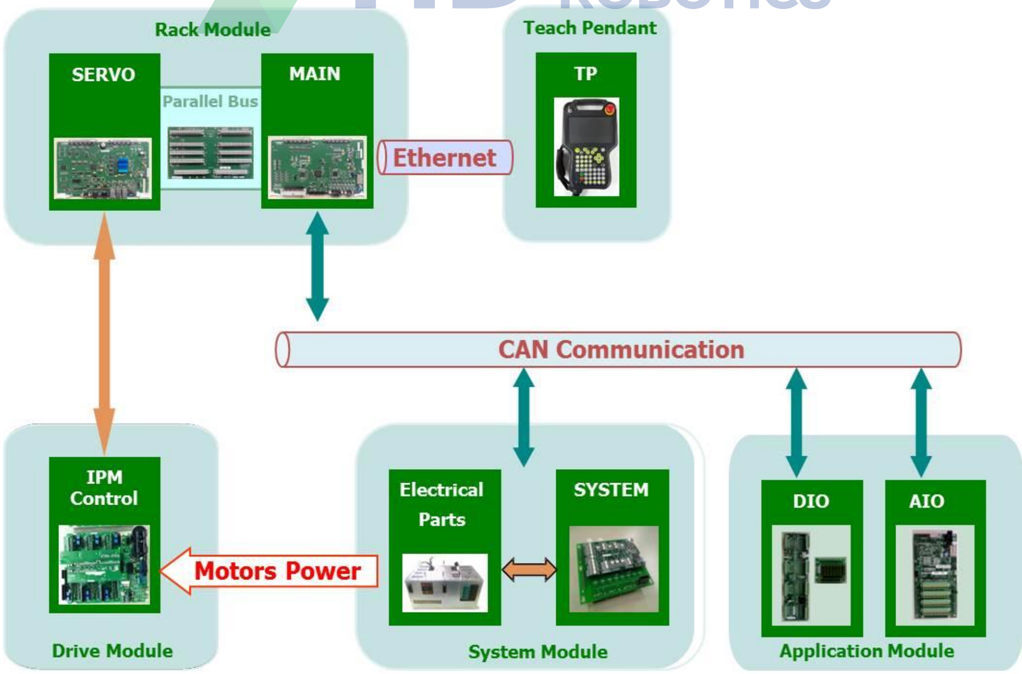


Figure 4.7 Internal Composition of Hi5a-S Controller

4.2. The Arrangement of Parts

Table 4-1 shows the main parts of Hi5a-S00/S10/J00 controller and the name of each part, and Figure 4.8, 4.9, and 4.10 shows the arrangement of them.

Table 4-1 The Name of Each Part of Hi5a-S00/S10/J00 Controller

No.	Type	Item
1	RACK	Rack
2	BD502	Backplane Board
3	SR1	DC Multi Power Unit(SMPS: HDI-191)
4	BD511	Main Board
5	BD544	Servo Board
6	BD530/531	System Board
7	PSM30	Middle-Size Electrical Module
7-1	PSM15	Small-Size Electrical Module (Hi5a-S20/S30)
7-2	PSM50	Large-Size Electrical Module (Hi5a-S80)
8	SD3X3Y	Middle-Size 6-Axis Servo Drive Unit (Standard Specifications)
8-1	SD3A3D	Small-Size 6-Axis Servo Drive Unit (Hi5a-S20/S30)
9	SD1X	100A 1-Axis Drive Unit (Option)
9-1	SD1Z	50A 1-Axis Drive Unit (Option)
9-2	SD1L	150A 1-Axis Drive Unit (Option)
10	EM. SW.	Emergency stop switch
11	CNRJ45	User Ethernet Port
12	NFB	No Fuse Breaker
13	FAN1	Rack cooling fan

No.	Type	Item
14	FAN2	Drive unit cooling fan
15~17	FAN3~5	Servo drive unit cooling fan
18	NFT1	Noise Filter
19	RDR1	Regeneration discharge resistance (Standard Specifications)
20	RDR1	Regeneration discharge resistance (Hi5a-S30)
21	TR2(optional specifications)	Input power transformer
22	CMC1	Power Cable Lead-In Connector for Motor Drive 1
23	CMC2	Power Cable Lead-In Connector for Motor Drive 2
24	CEC1	Motor Encoder Communications Cable Lead-In Connector
25	CNRTP	Teach pendant Cable Lead-In Connector

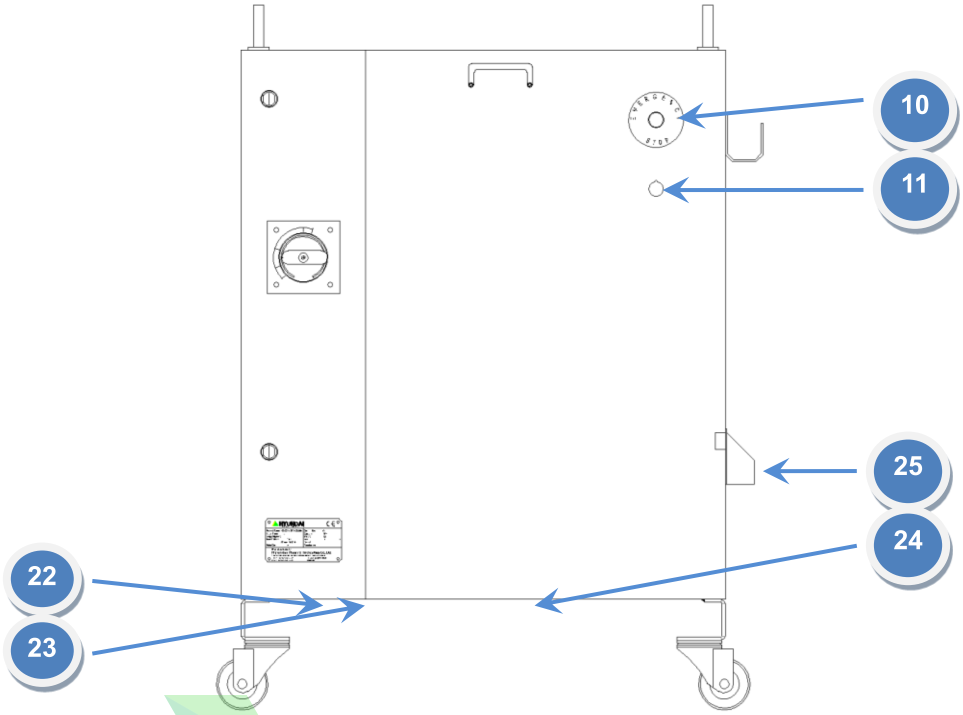


Figure 4.8 Hi5a-S00 Part arrangement parts in the exterior of a controller

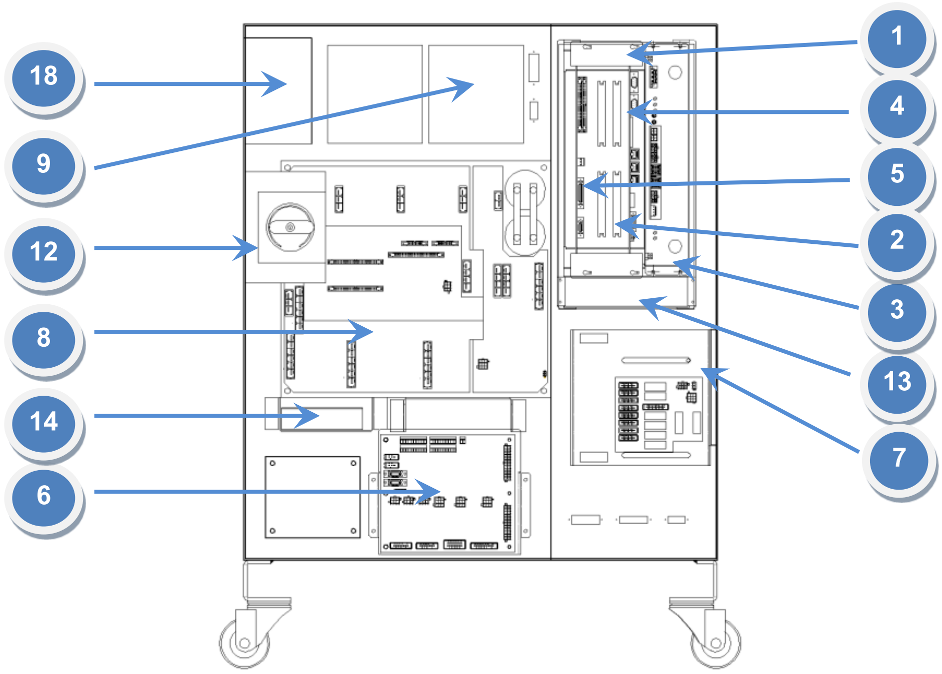
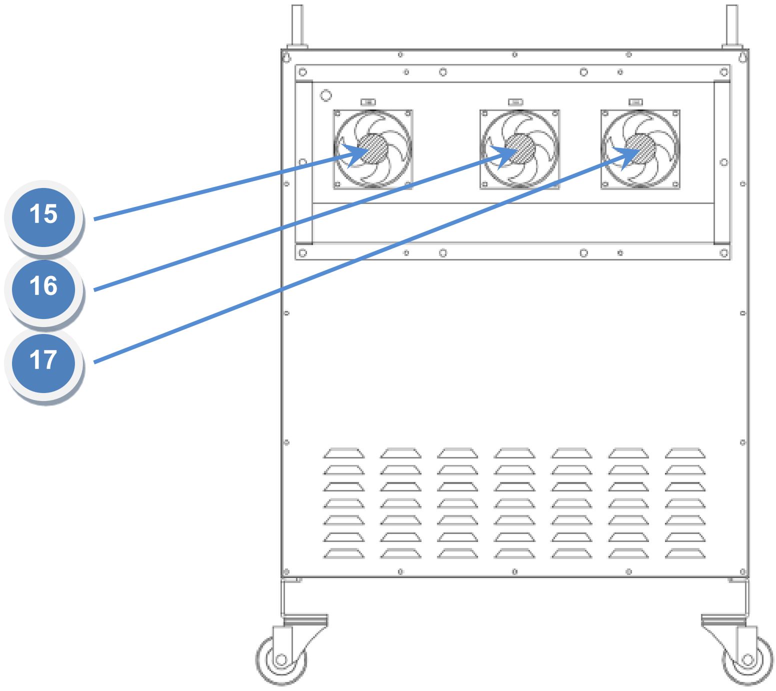


Figure 4.9 Part arrangement in the interior of the front surface of the Hi5a-S00 controller



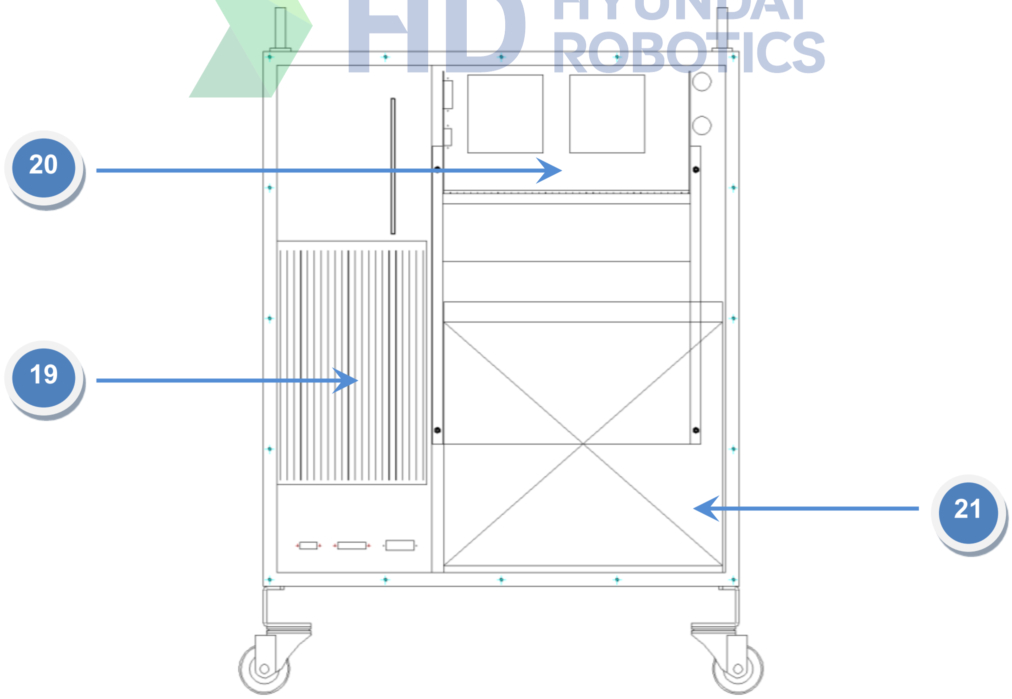


Figure 4.10 Hi5a-S00 Part layout on the back side of controller

Table 4-2 shows the main parts of Hi5a-C3*/C4*/C5*/C6* controller and the name of each part, and Figure 4.11, 4.12, 4.13 and 4.14 shows the arrangement of them.

Table 4-2 The Name of Each Part of Hi5a-C3*/C4*/C5*/C6* Controller

No.	Type	Item
1	RACK	Rack
2	BD502	Backplane Board
3	SR1	DC Multi Power Unit (SMPS: HDI-191)
4	BD511	Main Board
5	BD544	Servo Board
6	BD530/531	System Board
7	PDM30	Electrical Module
8	SR4	DC power supply for falling prevention brake of elevation axis
9	SD3X3Y	Middle-Size 6-Axis Servo Drive Unit (Standard Specifications)
9-1	SD1L5X	HC2500B2D-****-1* (Option)
9-2	SD4X2Y	HC2501B2D-****-1* (Option)
9-3	SD3X3Z	HC2501B1D-****-1* (Option) Middle-Size 6-Axis Servo Drive Unit (Hi5a-C35)
9-4	SD3L1Y	HC3303B1D / HC3303B2D Large-Size 4-Axis Servo Drive Unit (Hi5a-C5* 사양)
9-5	SD3L3Y	HC3303B1DA / HC3303B2DA Large-Size 6-Axis Servo Drive Unit (Hi5a-C5* 사양)
10	BD58A	LDIO board
11	BD58B	Safety relay board
12	CNRJ45	User Ethernet Port
13	EM. SW	Emergency stop switch
14	SR2	DC power apparatus for a sensor

No.	Type	Item
15	SR3	DC power supply for robot fan
16	NFB1	Breaker of driving device wiring (No Fuse Breaker)
17	NFB2	Breaker for control power wiring (No Fuse Breaker)
18	TBMAIN1	Terminal Block for inputting driving device power (Terminal Block)
19	TBMAIN2	Terminal Block for inputting control power (Terminal Block)
20	TBPW1	Terminal Block for interior power (Terminal Block)
21	FAN1	Rack radiating fan
22~24	FAN2~4	Servo-drive unit radiating fan
25	TR1	Transformer
26	NFT1	Line Noise Filter
27~28	DR1~2	Regeneration discharge resistance
29	CMC1	Power Cable Lead-In Connector for Motor Drive 1
30	CMC2	Power Cable Lead-In Connector for Motor Drive 2
31	CEC1	Motor Encoder Communications Cable Lead-In Connector
32	CNRTP	Teach pendant Cable Lead-In Connector
33	CIOC1	Sensor cable inserted in the connector

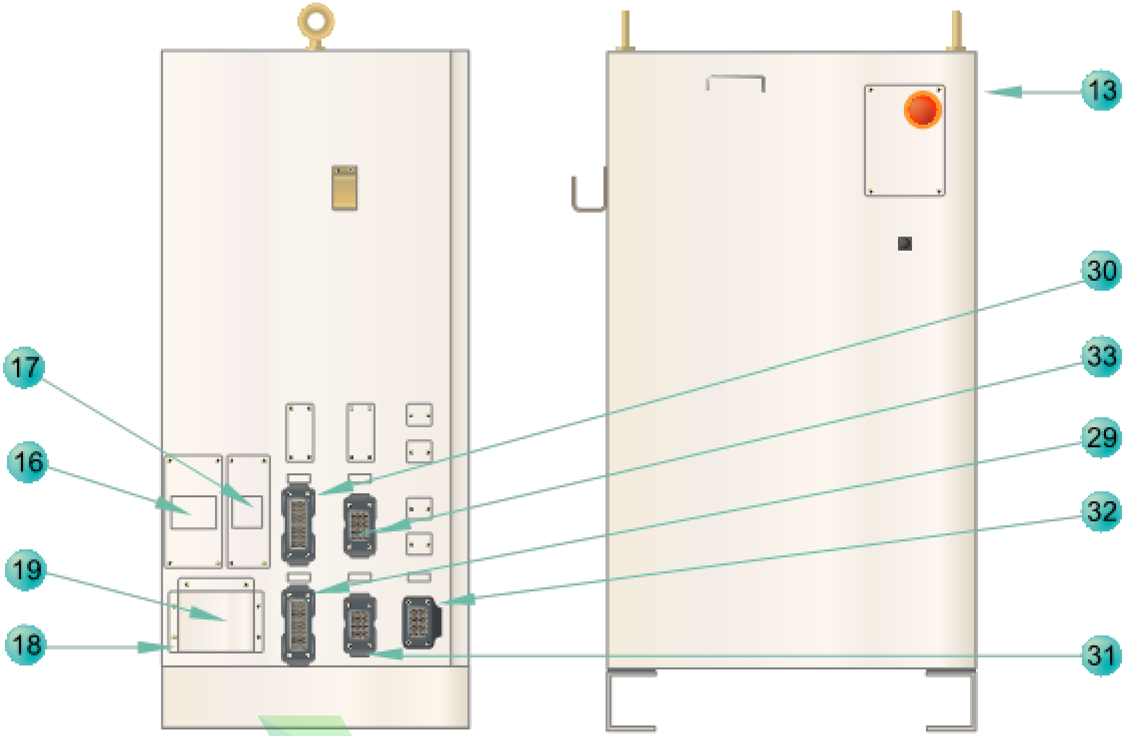


Figure 4.11 Hi5a-C3*/C4* Part arrangement parts in the exterior of the controller

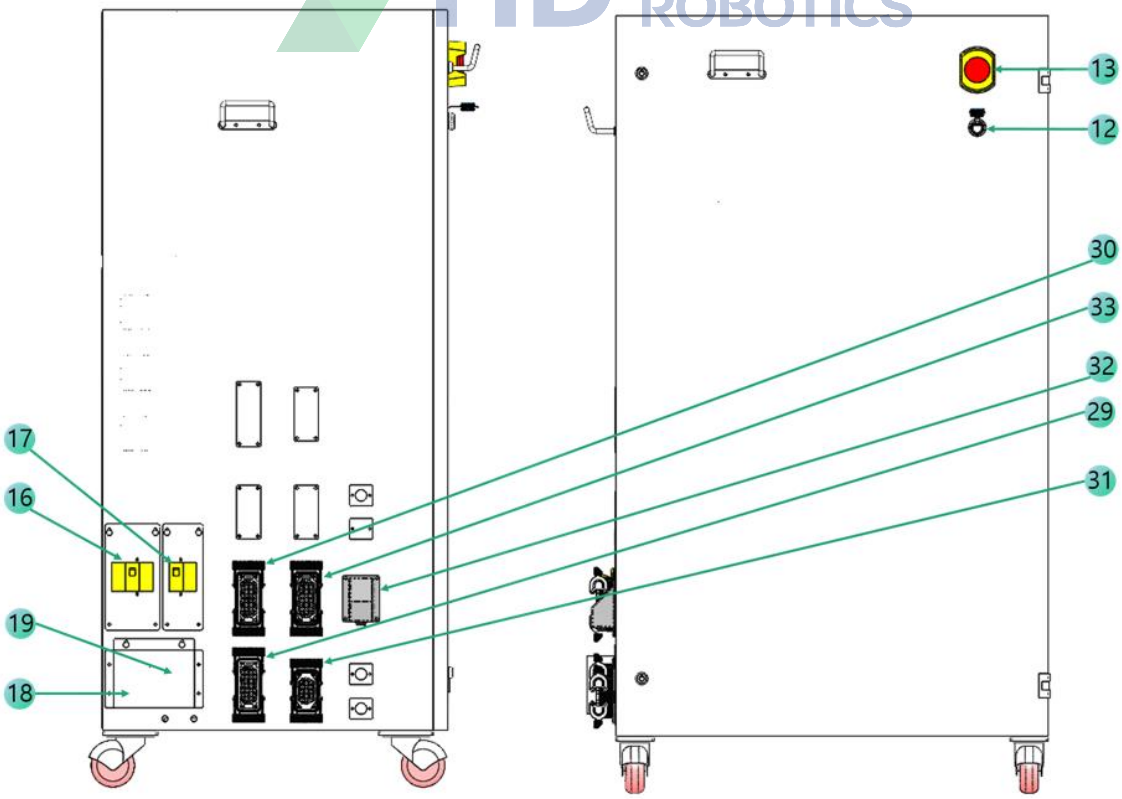
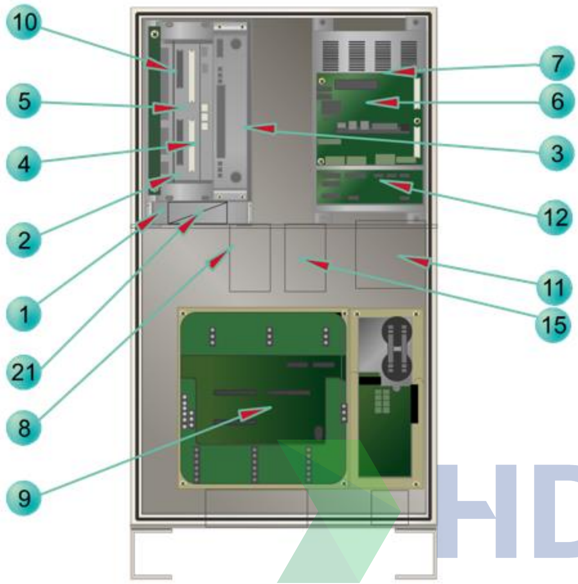


Figure 4.12 Hi5a-C5*/C6* Part arrangement parts in the exterior of the controller



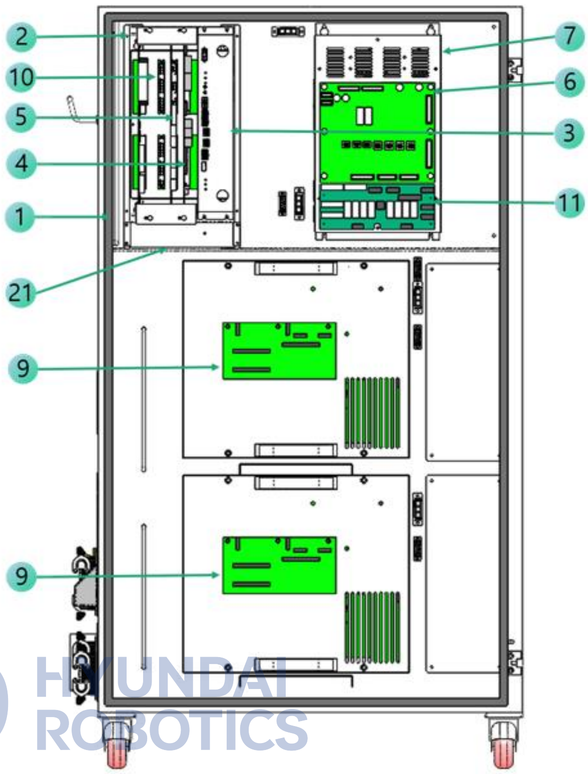


Figure 4.13 Part arrangement in the interior of the front surface of the Hi5a-C3*/C4*/C5*/C6* controller

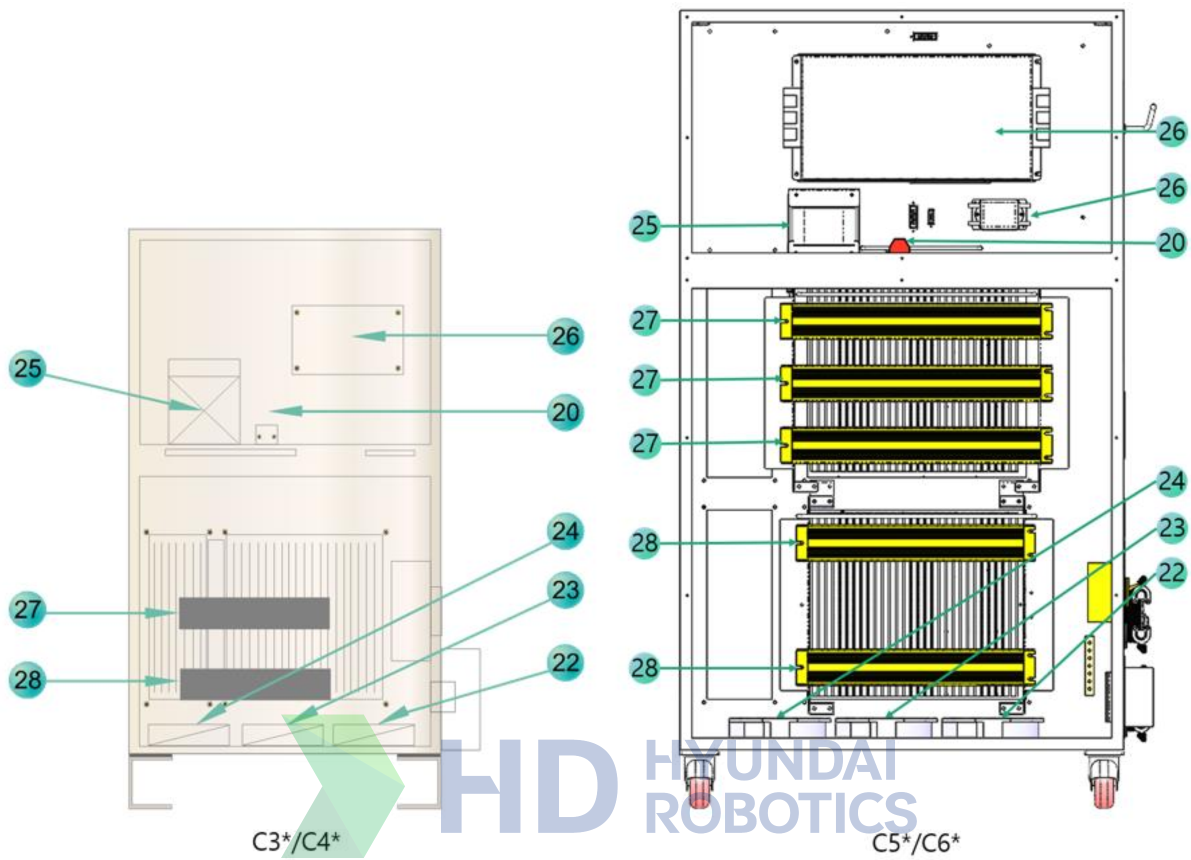


Figure 4.14 Part arrangement in the interior of the rear surface of the Hi5a-C3*/4*/C5*/C6* controller

Table 4-3 shows the main parts of Hi5a-P10/P20 controller and the name of each part, and Figure 4.15 and 4.16 shows the arrangement of them.

Table 4-3 The Name of Each Part of Hi5a-P10/P20 Controller

No.	Type	Item
1	PRESSURE GAUGE	PRESSURE GAUGE
2	DOOR LAMP	DOOR LAMP
3	EM. SW	EMERGENCY SWITCH
4	NFT1	NOISE FILTER
5	NFB1	Breaker of driving device wiring (No Fuse Breaker)
6	SD1X	100A 1-Axis Drive Unit (Option)
6-1	SD1Z	50A 1-Axis Drive Unit (Option)
6-2	SD1L	150A 1-Axis Drive Unit (Option)
7	RACK	Rack
8	BD544	Servo Board
9	BD511	Main Board
10	SR1	DC Multi Power Unit (SMPS : HDI-191)
11	BD502	Backplane Board
12	FAN1	Rack cooling fan
13	PSM30	Middle-Size Electrical Module
14	BD5C2	electric board
15	SD3X3Y	Middle-Size 6-Axis Servo Drive Unit (Standard Specifications)
16	FAN2	Drive unit cooling fan
17	BD5D1	Encoder switch board

No.	Type	Item
18	BD530/531	System Board
19	BD5D0	Air Purge control board
20	RDR1	Regeneration discharge resistance (Standard Specifications)
21	AIR PURGE UNIT	AIR PURGE UNIT
22	TR2 (optional specifications)	Input power transformer
23	FAN3	Servo drive unit cooling fan
24	FAN4	Servo drive unit cooling fan
25	FAN5	Servo drive unit cooling fan

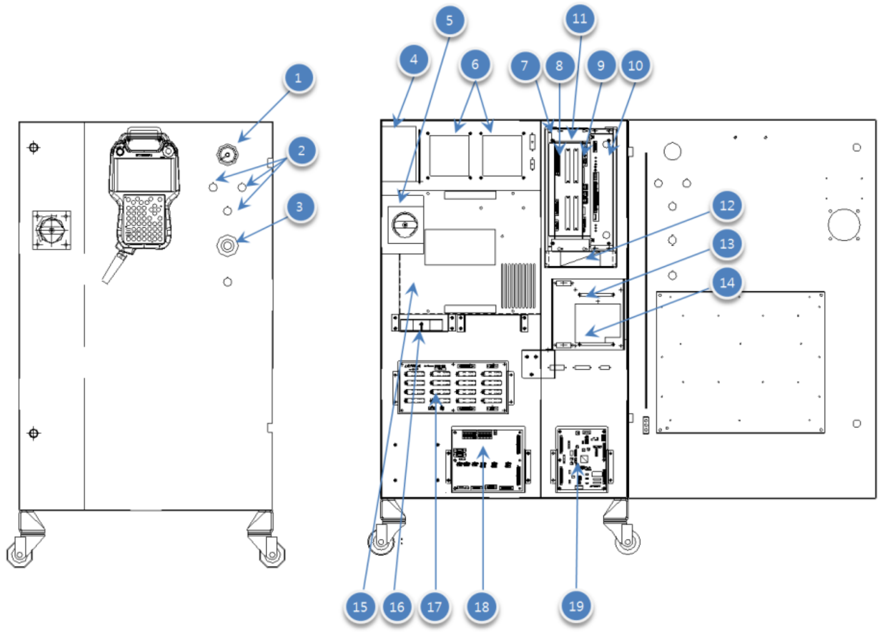


Figure 4.15 Part arrangement in the interior of the front surface of the Hi5a-P10/P20 controller

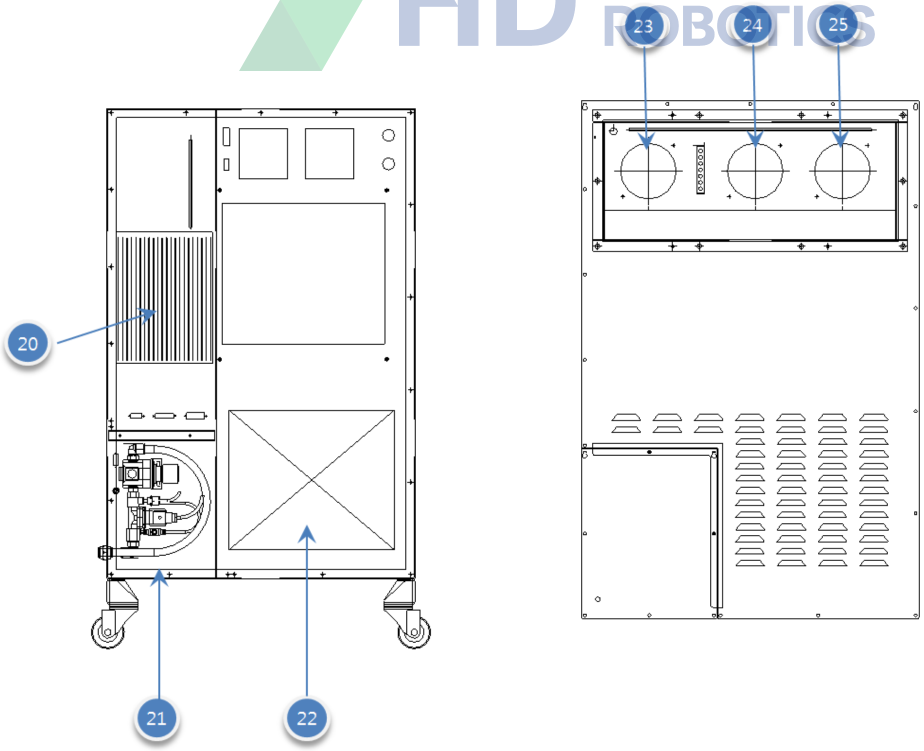


Figure 4.16 Hi5a-P10/P20 Part layout cover and on the back side of controller

The main components of the Hi5a-T10 controller and their names are as shown in Table 4-4 and are allocated as shown in Figures 4.17 and 4.18

Table 4-4 Names of Individual Parts of Hi5a-T10 Controller

No.	Type	Part name
1	BD503T	Backplane board
2	BD525	Communication board
3	BD544	Servo board
4	BD511	Main board
5	LF1	Noise filter 1
6	TB1	Terminal block 1
7	RDR1	Regeneration resistor 1
8	BD558T	Power amplifier board
9	BD567T	System board
10	EARTH BAR1	Earth bar 1
11	MC1	Magnet connector 1
12	MC2	Magnet connector 2
13	SMPS1	Control power supply system 1
14	BD5B3T	External connector board
15	EARTH BAR1	Earth bar 1
16	MCCB1	Breaker for the drive system wiring (not fuse breaker)
17	CNRTP	T/P contactor
18	MCCB1	Breaker for the drive system wiring (not fuse breaker)
19	ACIN	External power input connector

No.	Type	Part name
20	CMEC1	Internal power terminal block
21	UDIO	User digital input and output connector
22	SAFETY IO	Safety signal-related input and output connector
23	OPSIO	Operation-related input and output connector
24	CAN2	External CAN communication connector 2
25	RS-232	External serial communication (RS232) connector
26	CAN1	External CAN communication connector 1
27	CNETN2	External Ethernet connector 2
28	CNETN1	External Ethernet connector 1
29	STOP	Stop switch and lamp
30	START	Operation switch and lamp
31	MON	Motor on switch and lamp
32	MODE	Operation mode switch
33	OPEM	Emergency switch
34	FAN1	Servo drive system heat dissipation fan
35	FAN2	Servo drive system heat dissipation fan
36	FAN3	Servo drive system heat dissipation fan
37	FAN4	Servo drive system heat dissipation fan

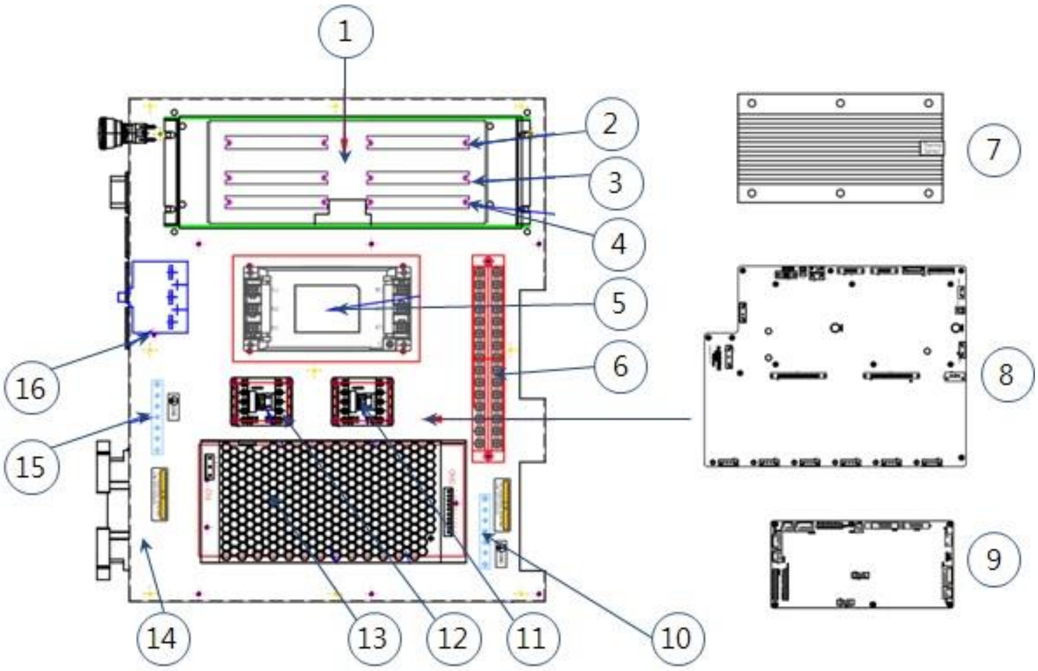


Figure 4.17 Hi5a-T10 Part arrangement parts in the interior of the controller

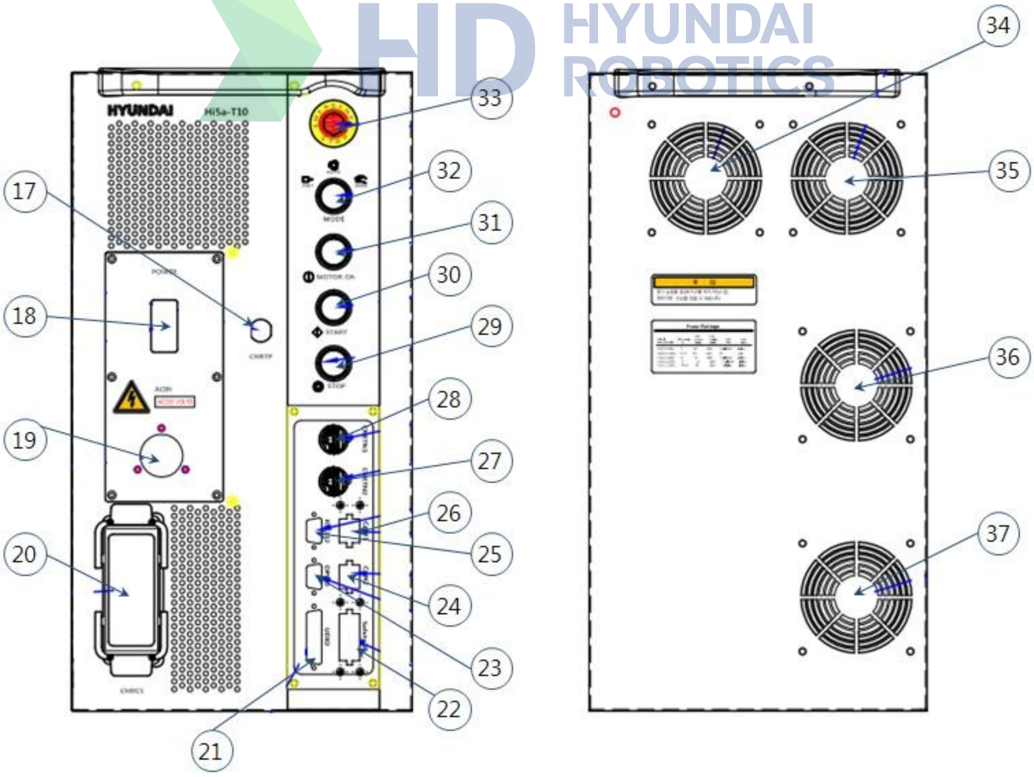


Figure 4.18 Part arrangement in the front and rear surfaces of the Hi5a-T10 controller

4.3. The Function of Each Component

Table 4-5 The Summary on the Function of Each Component

Component		Function
Board	Backplane Board (BD502)	● Bus for inter-board signal connection (4 Slots)
	Backplane Board (BD503T)	● Bus for inter-board signal connection (3 Slots)
	Main Board (BD511)	● Save point saving and operational route calculation ● Program and robot constant preservation ● Teach pendant Communications ● PC, SD Card, and Serial Communications Connection
	Servo Board (BD544)	● DSP for Servo Control ● Encoder Connection (Serial I/F)
	System Board (BD530/531) Hi5a-T10 Controller System Board (BD567T)	● In/Out within controller (I/O for system) ● Internal sequence control ● Processing of various input signals from the main unit ● Open/close output of servo motor and brake ● Safety chain circuit
Drive Unit	·Large-Size 4 Axis: SD3L1Y ·Large-Size 6 Axis: SD3L3Y ·Middle-Size 6 Axis; SD3X3Y ·Small-Size 6 Axis; SD3A3D	● Power generation for motor drive ● Regenerative power discharge ● Servo motor power amplifier circuit ● Various error reporting
DC Power Supply Unit (SMPS)	HDI-191 - Input power supply ; AC220V - Input frequency ; 50/60Hz	● Board power supply (DC+5V/8.29A) ● T/P(DC+24V/1A), ● I/O power supply (DC+24V/1.87A) ● Drive unit (DC+15V/3.5A, DC-15V/0.8A)
T/P (Teach Pendant)	TP520/TP530	● Various information display (LCD) ● Button switch input (Function/Jog) ● Emergency stop. Input of Enable and T/P On/Off
Cooling Device	Fan	● Internal air circulation ● Drive unit cooling
Electronic Module	PSM(Hi5a-S**) PDM(Hi5a-C**)	● Opening/closing of motor drive unit power ● Distribution of power

※ For the types of the components of individual controllers, refer to 'Section 2.1 The Detailed Specifications of Robot Controllers'

4.3.1. Rack and Backplane Board (BD502)

4.3.1.1. Outline

The rack has a structure as seen in Figure 4.18, which fixes various PCB boards such as SMPS, main board, and servo board. As many data and power supplies need to be connected one another in theses boards, the backplane board (BD502, BD503T) as seen in Figure 4.19 or 4.20 should be installed at the back of the PCB rack.

Figure 4.19 PCB Rack

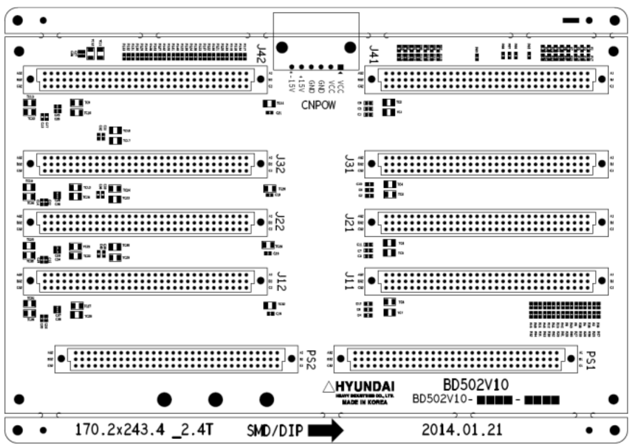


Figure 4.20 Backplane Board (BD502)

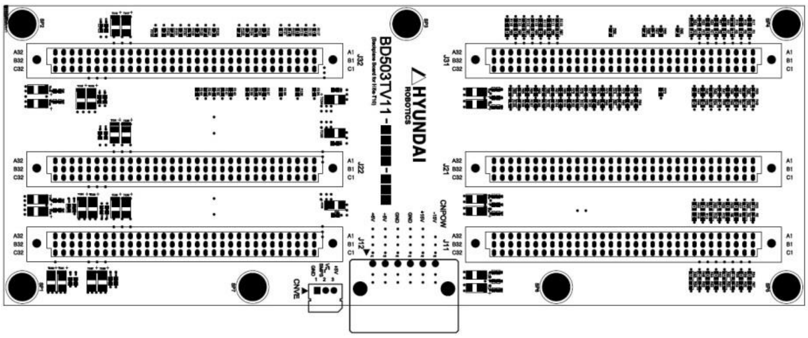


Figure 4.21 Backplane Board (BD503T)

4.3.2. Main board (BD511)

4.3.2.1. Outline

The main board carries out operations and controls for the movement of a robot and has various communications interface functions. Various Man-Machine Interface (MMI) environments can be established through the connection with surrounding devices via various communication ports such as Serial, Ethernet, and CAN. Information files regarding, for example, controller constant, error history, operation history, and teaching program are controlled through teach pendant.

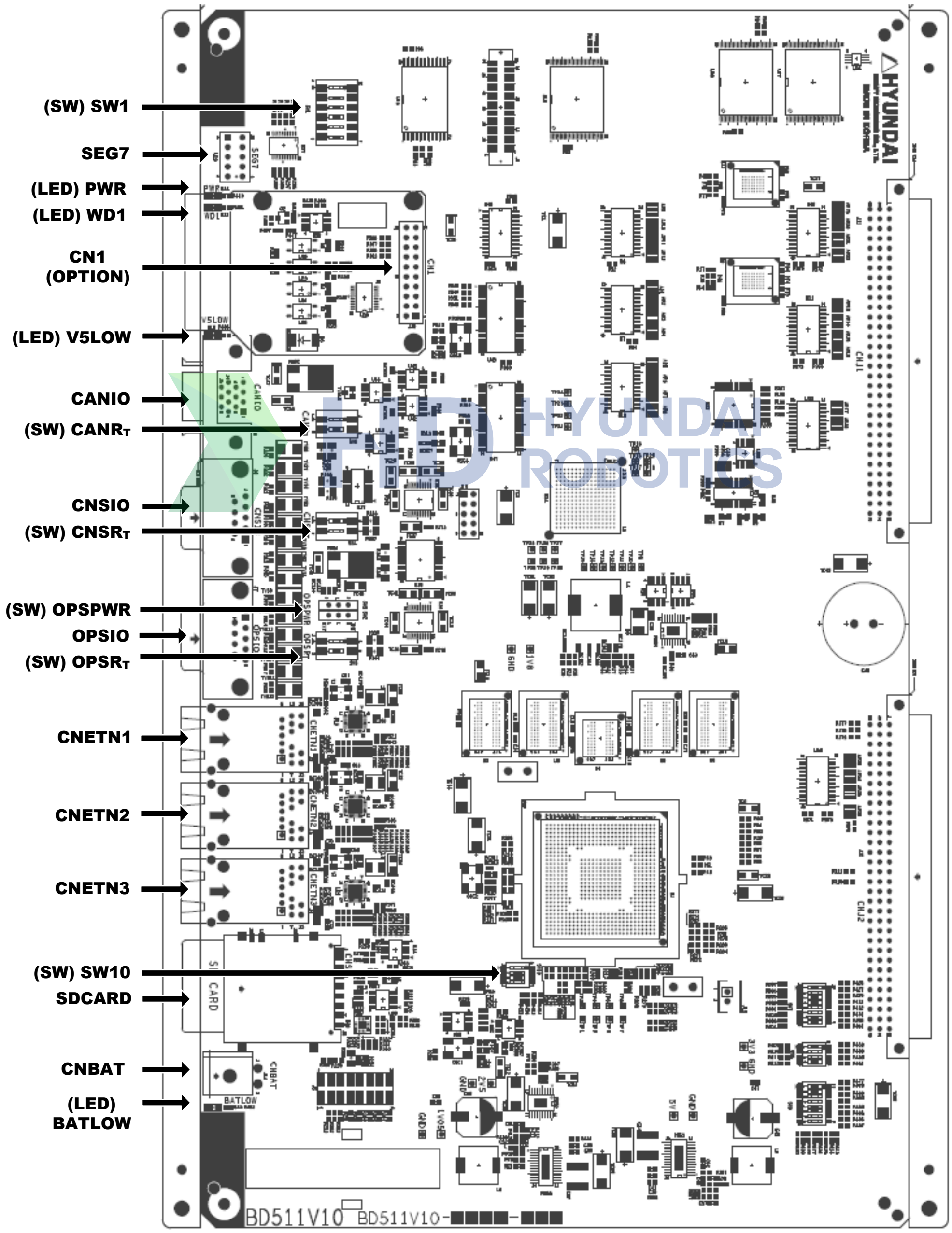


Figure 4.22 Main board (BD511)

4.3.2.2. Connector

Table 4-6 shows the use of connectors and external connecting devices.

Table 4-6 The Sorts and Uses of Main board (BD511)

Name	Use	External Connecting Device
CNSIO	Serial Port 1: (RS232/RS422/RS485)	The small door of the front panel of the controller
OPSIO	Serial Port 2: (RS232/RS422/RS485)	-
SDCARD	For system	-
CNETN1	Ethernet port: for cooperative control	-
CNETN2	Ethernet port: for communications between T/P	TP520/TP530 Connector (CNTP)
CNETN3	Ethernet port: for users (PC 1/F)	
CN1	CAN port: CAN3, CAN4 (Option)	-
CANIO	CAN port: for stem (CAN1)/ for user (CAN2)	System board connector (CAN1)
BATCN	Battery connector for back up	Battery connector

4.3.2.3. Display Devices

Table 4-7 Main board (BD511) LED

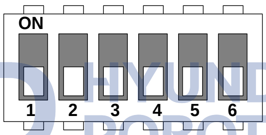
Status / Name	Color	Normal	Abnormal	Solution
PWR	Green	On	Off	Check out REG1 of the board - DC 3.3V
WD1	Red	Off	On	Make a request for board repair
V5LOW	Green	On	Off	Board input power abnormal - DC 5V
BATLOW	Yellow	On	Off	Replace the batteries for back up

4.3.2.4. Setting Unit

(1) Switch Settings

CAUTION: Users may not change the setting of DIP switch [SW1].

Table 4-8 The Method for Setting of the [SW1] Switch of the Main board (BD 511)

Switch No.		1	2	3	4	5	6
Content	OFF	Reserved					
	ON						
Initial Setting		OFF	OFF	OFF	OFF	OFF	OFF
The External Form of the Switch							

CAUTION: Users may not change the setting of DIP switch [SW10].

Table 4-9 The Method for Setting of the [SW10] Switch of the Main board (BD511)

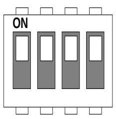
Switch No.		1	2	3	4
Content	OFF	SD CARD BOOT	Reserved		
	ON	FLASH BOOT			
Initial Setting		ON	ON	ON	ON
The External Form of the Switch					

Table 4-10 The Method for Setting of the [CANRT] Switch of the Main board (BD511)

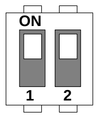
Switch No.		1	2
Content	OFF	Terminating resistance of SYSTEM CAN Board external connection	Terminating resistance of USER CAN Board external connection
	ON	Terminating resistance of SYSTEM CAN Board internal connection	Terminating resistance of USER CAN Board internal connection
Initial Setting		ON	ON
The External Form of the Switch			

Table 4-11 The Method for Setting of the [CNSRT] Switch of the Main board (BD511)

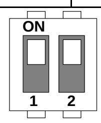
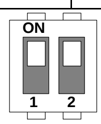
Switch No.		1	2
Content	OFF	Terminating resistance of CNSIO RS422/485 TX Board external connection	Terminating resistance of CNSIO RS422/485 RX Board external connection
	ON	Terminating resistance of CNSIO RS422/485 TX Board internal connection	Terminating resistance of CNSIO RS422/485 RX Board internal connection
Initial Setting		ON	ON
The External Form of the Switch			

Table 4-12 The Method for Setting of the [OPSRT] Switch of the Main board (BD511)

Switch No.		1	2
Content	OFF	Terminating resistance of OPSIO RS422/485 TX Board external connection	Terminating resistance of OPSIO RS422/485 RX Board external connection
	ON	Terminating resistance of OPSIO RS422/485 TX Board internal connection	Terminating resistance of OPSIO RS422/485 RX Board internal connection
Initial Setting		ON	ON
The External Form of the Switch			

Caution: The settings of the #1 and #2 pins of the switch [OPSPWR] must be identical as either INT or EXT.

Table 4-13 The Method for Setting of the [OPSPWR] Switch of the Main board (BD511)

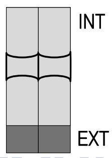
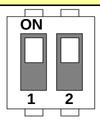
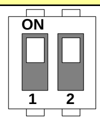
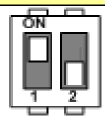
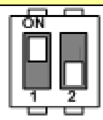
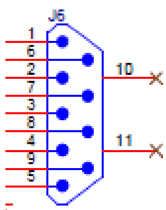
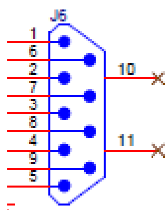
Switch No.		1	2
Content	EXT	OPSIO RS422/485 power Board external power connection	OPSIO RS422/485 GND Board external GND connection
	INT	OPSIO RS422/485 power Board internal power connection	OPSIO RS422/485 GND Board internal GND connection
Initial Setting		INT	INT
The External Form of the Switch		 INT EXT	

Table 4-14 Method to setting the main board (BD511) RS422/485 communication switches

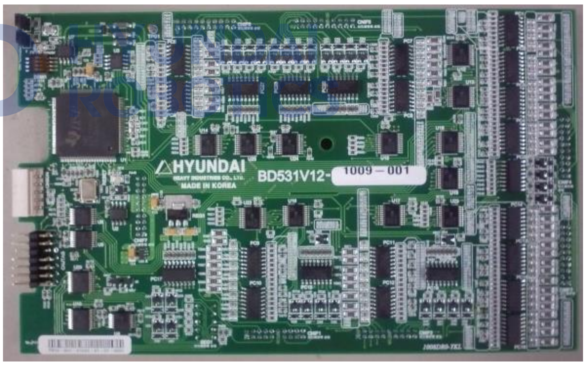
Communication method	RS422	RS485
Operation of the switches	 SW4  SW6	 SW4  SW6
Connection of connectors	 RS422 TX_H -> PIN 1 RS422 TX_L -> PIN 6 RS422 RX_H -> PIN 4 RS422 RX_L -> PIN 9	 RS485 H -> PIN 1, 4 Simultaneous connection RS485 L -> PIN 6, 9 Simultaneous connection

4.3.3. System Board (BD530/BD531, BD567T)

4.3.3.1. Outline

The system board consists of the sequence part which open and close the power of the motor according to the status of safety and the system IO part which enables the communications between related IOs and super systems. It receives various safety signals from inside and outside of the robot controller and controls the power required for the drive of the robot.

- Input of various safety signals: Emergency stop, limit switch, and safeguard
- Safety duplex chain with interlock
- Signal interface of the servo drive unit: PWMON, UV, OV, and OC
- Brake operation/release:
  8 basic axes (3 main axes, 3 wrist axes, and 2 additional axes); 8 more axes extendable
- Other I/O interface



(a) Front: BD530 Board (In charge of sequence) (b) Back: BD531 Board (In charge of system IO)

Figure 4.23 System Board (BD530/BD531)

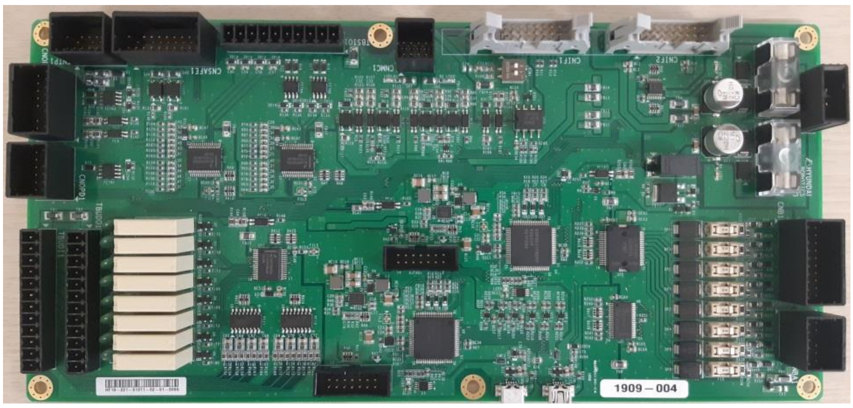


Figure 4.24 System Board (BD567T)

4.3.3.2. Connector

The following Figure shows the location and use of various connectors on BD530 board.

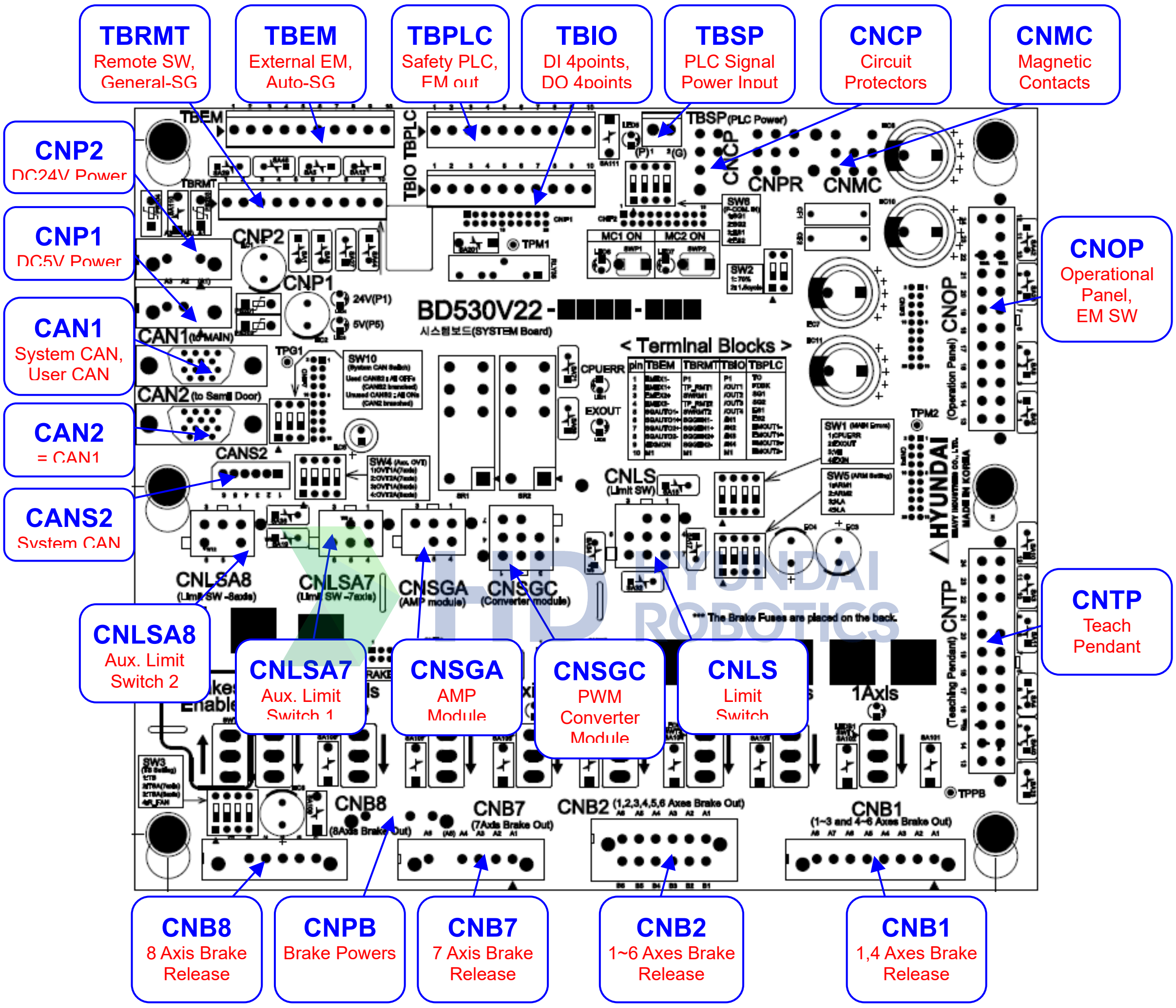


Figure 4.25 The Arrangement of the Connectors of the System Board (BD530)

Table 4-15 The Sorts and Uses of the Connectors of the System Board (BD530)

Name	Use	External Connecting Devices
CNP1	DC5V Power Supply	SMPS P5(DC5V), M5(DC5V GND)
CNP2	D24V Power Supply	SMPS P1(DC24V), M1(DC24V GND)
CAN1	CAN Communications Connection	Main CAN Output Port
CAN2	CAN Communications Connection	Small Door Board CAN Port
CANS2	CAN Communications Connection for System	Preparatory Purpose
CNOP	IN/OUT of Various Switches and LEDs of Control Panel	OP Board
CNTP	Input of Emergency Stop of T/P and Enabling Device Status	W/H CNTP
CNGD	GENERAL Safeguard Input	Safeguard Device of the Exterior of the Controller
CNLS	Arm interference, Input of the Limit Switch for Detection of Over-Travel	W/H CNE1
CNLSA7	Input limit switch for Over-travel detection of added axis 7	Additional Axes (7 Axis) W/H
CNLSA8	Input limit switch for Over-travel detection of added axis 8	Additional Axes (8 Axis) W/H
CNSGC	/PWMON Signal Output and Various Error Signals Input (OV and OC)	PWM Converter CNSGC
CNSGA	/PWMON Signal Output	AMP CNSGA
CNMC	Connection of In/Out Signals Relating to Magnetic Contact (MC1 and 2)	CNMC of Electrical Board of Electrical Module
CNPC	Connection of Various Circuit Protectors and Fuses	CNPC of Electrical Board of Electrical Module
CNPB	Brake Power Supply (PB,MB,PREPB)	SMPS Brake SMPS of Electrical Module
CNB1	Output 2 points of brake release power (for 1-3 axes and 4-6 axes), error (TS) input	W/H CNM1
CNB2	Separately output 6 points of brake release power (1, 2, 3, 4, 5, and 6 axes), error (TS) input	W/H CNM1
CNB7	Output of Additional Axis Brake Release and Error Input	Additional Axis (7 axis) W/H
CNB8	Output of Additional Brake Release and Error Input	Additional Axis (8 axis) W/H
TBEM	Input of Emergency Stop and AUTO Safeguard	Emergency Stop Switch of the Exterior of the Controller and

Name	Use	External Connecting Devices
		Safeguard Device
TBIO	In/Out of Preparatory System DIO	Preparatory IO Device in the Controller
TBPLC	Connection of safety signal for safety PLC	Safety PLC
TBRMT	Remote mode signal input and general safety guard input	Remote mode operating device and general safety guard
TBSP	Signal processing power input for PLC connection (DC24V)	Power device in the side of PLC

(1) Terminal Block for Exterior Safety Signals: TBEM

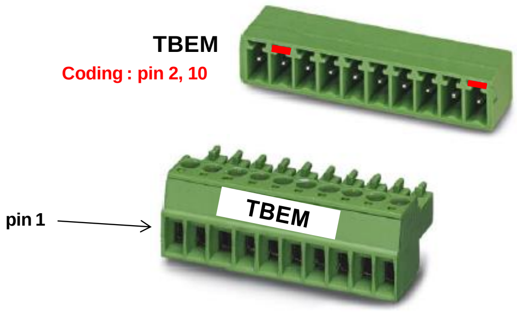


Figure 4.26 The Terminal Block of the System Board (BD530)

Table 4-16 The Terminal Block TBEM of the System Board (BD530)

Terminal No.	Terminal Name	Use	Others
1	EXEM1-	Input of External Emergency Stop Chain 1	SHORT unless external emergency stop chain 1 is used
2	EXEM1+		
3	EXEM2+	Input of External emergency Stop Chain 2	SHORT unless external emergency stop chain 2 is used
4	EXEM2-		
5	SGAUTO1-	Input of Auto Safeguard Chain 1	SHORT unless auto safeguard chain 1 is used
6	SGAUTO1+		
7	SGAUTO2+	Input of Auto Safeguard Chain 2	SHORT unless auto safeguard chain 2 is used
8	SGAUTO2-		
9	EXMON	External Motor ON Input	Input of ON/OFF with M1 being Common if the robot's motor ON is used at the external system
10	M1	External Motor ON Input (Common)	

(2) Digital input/output terminal block exclusively used for the system : TBIO

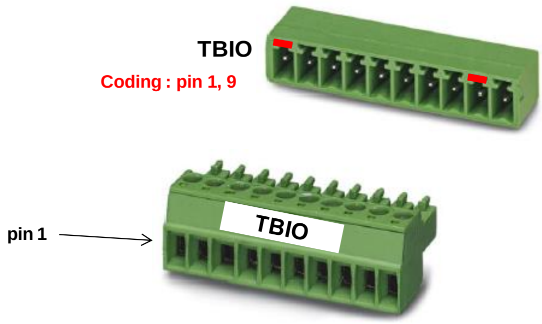


Figure 4.27 System board (BD530) terminal block TBIO

Table 4-17 Terminal Block TBIO of the System Board (BD530)

Terminal No.	Terminal Name	Use
1	P1	Digital output for the system (+) Common (DC24V)
2	DO1	Digital output signal 1 for the system (Open collector output)
3	DO2	Digital output signal 2 for the system (Open collector output)
4	DO3	Digital output signal 3 for the system (Open collector output)
5	DO4	Digital output signal 4 for the system (Open collector output)
6	DI1	Digital input signal 1 for the system
7	DI2	Digital input signal 2 for the system
8	DI3	Digital input signal 3 for the system
9	DI4	Digital input signal 4 for the system
10	M1	Digital input for the system (-) Common (DC24V GND)

(3) Terminal block for remote mode and general safety guard: TBRMT

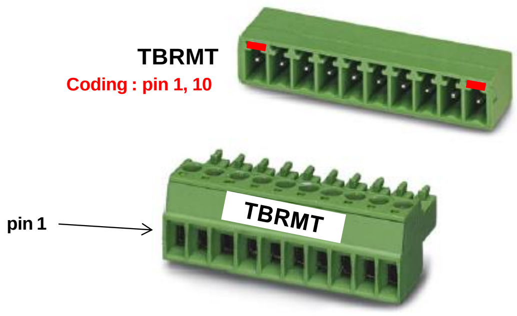


Figure 4.28 System board (BD530) terminal block TBRMT

Table 4-18 System board (BD530) terminal block TBRMT description

<table>
<tr><th>Node No.</th><th>Node Name</th><th colspan="2">Use</th></tr>
<tr><td>1</td><td>P1</td><td colspan="2">Outputting power for the system (DC24V)</td></tr>
<tr><td>2</td><td>M1_RMT</td><td colspan="2">Outputting a remote state of controller 1
(output M1 in the case of a remote state)</td></tr>
<tr><td>3</td><td>SWREMOTE
1</td><td colspan="2">Inputting a remote enable signal 1
(input M1 in the case of a remote state)</td></tr>
<tr><td>4</td><td>P1_RMT</td><td colspan="2">Outputting a remote state of controller 2
(output P1 in the case of a remote state)</td></tr>
<tr><td>5</td><td>SWREMOT2</td><td colspan="2">Inputting a remote enable signal 2
(input P1 in the case of a remote state)</td></tr>
<tr><td>6</td><td>SGGEN1-</td><td rowspan="2">Inputting general safety guard chain 1</td><td rowspan="2">Providing shorting when general safety guard chain 1 is not used</td></tr>
<tr><td>7</td><td>SGGEN1+</td></tr>
<tr><td>8</td><td>SGGEN2+</td><td rowspan="2">Inputting general safety guard chain 2</td><td rowspan="2">Providing shorting when general safety guard chain 2 is not used</td></tr>
<tr><td>9</td><td>SGGEN2-</td></tr>
<tr><td>10</td><td>M1</td><td colspan="2">Outputting system power (DC24V GND)</td></tr>
</table>

(4) Terminal block for safety IO connection: TBPLC

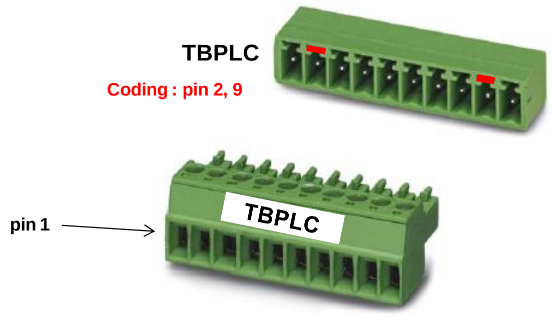


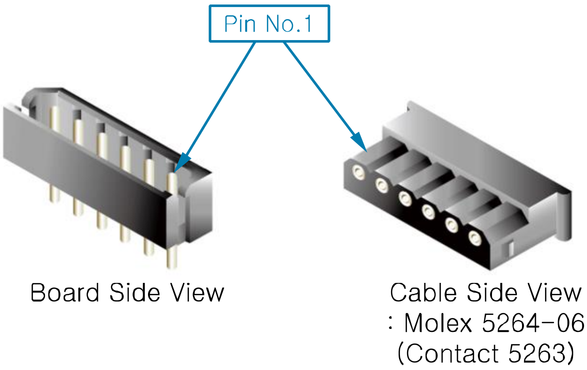
Figure 4.29 System board (BD530) terminal block TBPLC

Table 4-19 System board (BD530) terminal block TBPLC description

Node No.	Node Name	Use
1	T0	Input node for monitoring the output of safety IO
2	FDBK	Feedback signal output safety IO for TO
3	SG1	Safety guard input chain 1 from safety IO
4	SG2	Safety guard input chain 2 from safety IO
5	ES1	Emergency stop input chain 1 from safety IO
6	ES2	Emergency stop input chain 2 from safety IO
7	EMOUT1-	Internal emergency stop output chain 1
8	EMOUT1+	
9	EMOUT2+	Internal emergency stop output chain 2
10	EMOUT2-	

* Node Nos. 1-6 can be applied only to safety IO having an NPN output.

(5) Spare system CAN communication connector: CANS2



Pin No.1 : Shield
Pin No.2 : (GND)
Pin No.3 : CAN_G
Pin No.4 : CAN_L1
Pin No.5 : CAN_H1
Pin No.6 : (VCC-DC5V)

Figure 4.30 Pin arrangement in system CAN connector

The following figure simply shows the position and usage of various connectors on the BD567T board.

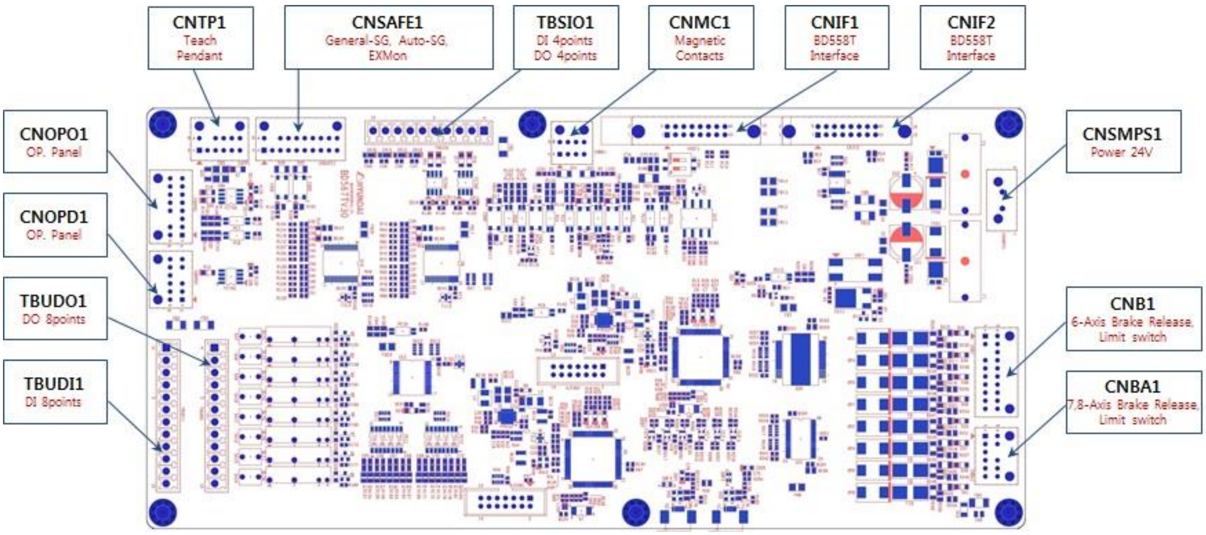


Figure 4.31 Allocation of System Board (BD567T) Connectors

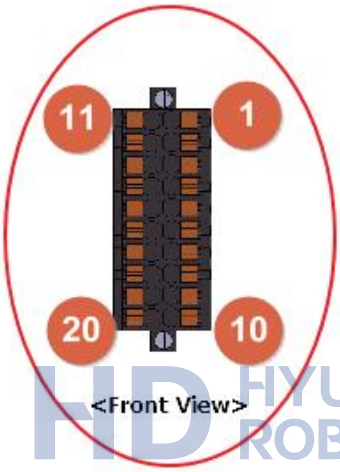
Table 4-20 Types and Usage of System Board (BD530) Connectors

Name	Usage	Connection with external devices
CNSMPS1	DC24V power input	BD558T CNSMPS2
CNIF2	CNIF2 interface 2	BD558T CNIF2, 1:1 connection
CNIF1	CNIF1 interface 1	BD558T CNIF1, 1:1 connection
CNMC1	Input and output signal connection related to magnetic contacts (MC 1 and 2)	Electric module's electric board CNMC
TBSIO1	Spare DIO input and output for devices	Controller internal spare IO device
CNSAFE1	General safety guard input	Controller external safety guard device
CNTP1	T/P's emergency stop and enabling device status input	W/H CNTP
CNOPO1	Input and output of various switches and LEDs of the operation panel	OP board and controller external safety guard device
CNOPD1	Input and output of various switches and LEDs of the operation panel	OP board and controller external safety guard device
TBUDO1	User DO 8-point	BD5B3T external connector board
TBUDI1	User DI 8-point	BD5B3T external connector board
CNBA1	Brake release power 2-point output (for 7th and 8th axes)	W/H CNM1

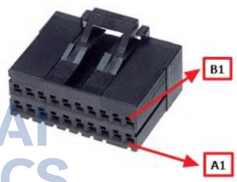
Name	Usage	Connection with external devices
	Over-travel detection limit switch input	
CNB1	Brake release power 6-point output (1st-6th axes) Over-travel detection limit switch input	W/H CNM1

(1) Hi5a-T10 Controller Front Terminal Block: Safety IO Plug

〈Hi5a-T10〉



〈Safety IO Plug〉



〈CNSAFE – BD567T〉

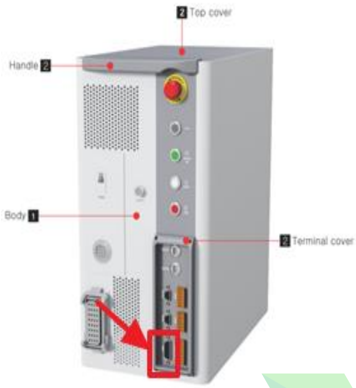
Figure 4.32 Safety IO Plug – CN1 (BD5B3T) – CNSAFE (BD567T)

Table 4-21 Description of Hi5a-T10 Safety IO Plug (BD567T)

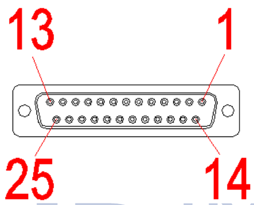
Safety IO Plug	Terminal Name	Usage		CN1 (BD5B3T)	CNSAFE (BD567T)
1	EX_SG_A1	Input of automatic safety guard A * If it is not used, short-circuit it to S_P24V. (Select 1 and 11 ↔ 8, 9 or 10.)	Safety chain 1	1	B10
11	EX_SG_A2		Safety chain 2	2	A10
2	EX_SG_B1	Input of automatic safety guard B * If it is not used, short-circuit it to S_P24V. (Select 2 and 12 ↔ 8, 9 or 10)	Safety chain 1	3	B9
12	EX_SG_B2		Safety chain 2	4	A9
3	EX_ES_A1	Input of external emergency stop A * If it is not used, short-circuit it to S_P24V. (Select 3 and 13 ↔ 8, 9 or 10)	Safety chain 1	5	B8
13	EX_ES_A2		Safety chain 2	6	A8
7	EX_EXMON1	Input of external motor on (Select 7 and 17 ↔ 8, 9 or 10).		13	B3
17	EX_EXMON2			14	A3
5	EX_EMOUT1+	Output of internal emergency stop * Outputs the TP and OP emergency stop states in contact type	Safety chain 1	9	B5
15	EX_EMOUT1-			10	A5

6	EX_EMOUT2+		Safety chain 2	11	B4
16	EX_EMOUT2-			12	A4
8/9/10	S_P24V	Output of the power exclusively for the system (DC24V)		15/17/19	A1
18/19/20	S_G	Output of the power exclusively for the system (DC24V GND)		16/18/20	B1

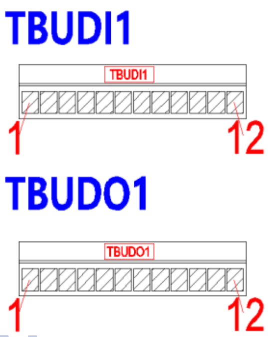
(2) Hi5a-T10 Controller Front Terminal Block: UDIO Port



〈Hi5a-T10〉



〈UDIO Port – Front View〉



〈TBUDI1, TBUDO1 – BD567T〉

Table 4-22 Description of Hi5a-T10 UDIO Port (BD567T)

UDIO Port	Terminal Name	Usage	TBUDI1	TBUDO1
1	EX_DIN1	User general-purpose input signal 1	4	-
2	EX_DIN2	User general-purpose input signal 2	5	-
3	EX_DIN3	User general-purpose input signal 3	6	-
4	EX_DIN4	User general-purpose input signal 4	7	-
5	EX_DIN5	User general-purpose input signal 5	8	-
6	EX_DIN6	User general-purpose input signal 6	9	-
7	EX_DIN7	User general-purpose input signal 7	10	-
8	EX_DIN8	User general-purpose input signal 8	11	-
9	COMIN	Common power (DC24V)	3	-
10	S_P24V	User power output (DC24V)	1	-
11	S_P24V	User power output (DC24V)		1
12	S_P24V	User power output (DC24V)		
13	N.C	No connection	-	-
14	EX_DOUT1	User general-purpose output signal 1	-	4
15	EX_DOUT2	User general-purpose output signal 2	-	5
16	EX_DOUT3	User general-purpose output signal 3	-	6
17	EX_DOUT4	User general-purpose output signal 4	-	7

18	EX_DOUT5	User general-purpose output signal 5	-	8
19	EX_DOUT6	User general-purpose output signal 6	-	9
20	EX_DOUT7	User general-purpose output signal 7	-	10
21	EX_DOUT8	User general-purpose output signal 8	-	11
22	COMOUT	Common power (DC24V GND)	-	3
23	S_G	User power output (DC24V GND)	-	12
24	S_G	User power output (DC24V GND)	12	-
25	S_G	User power output (DC24V GND)		-

4.3.3.3. Display Unit

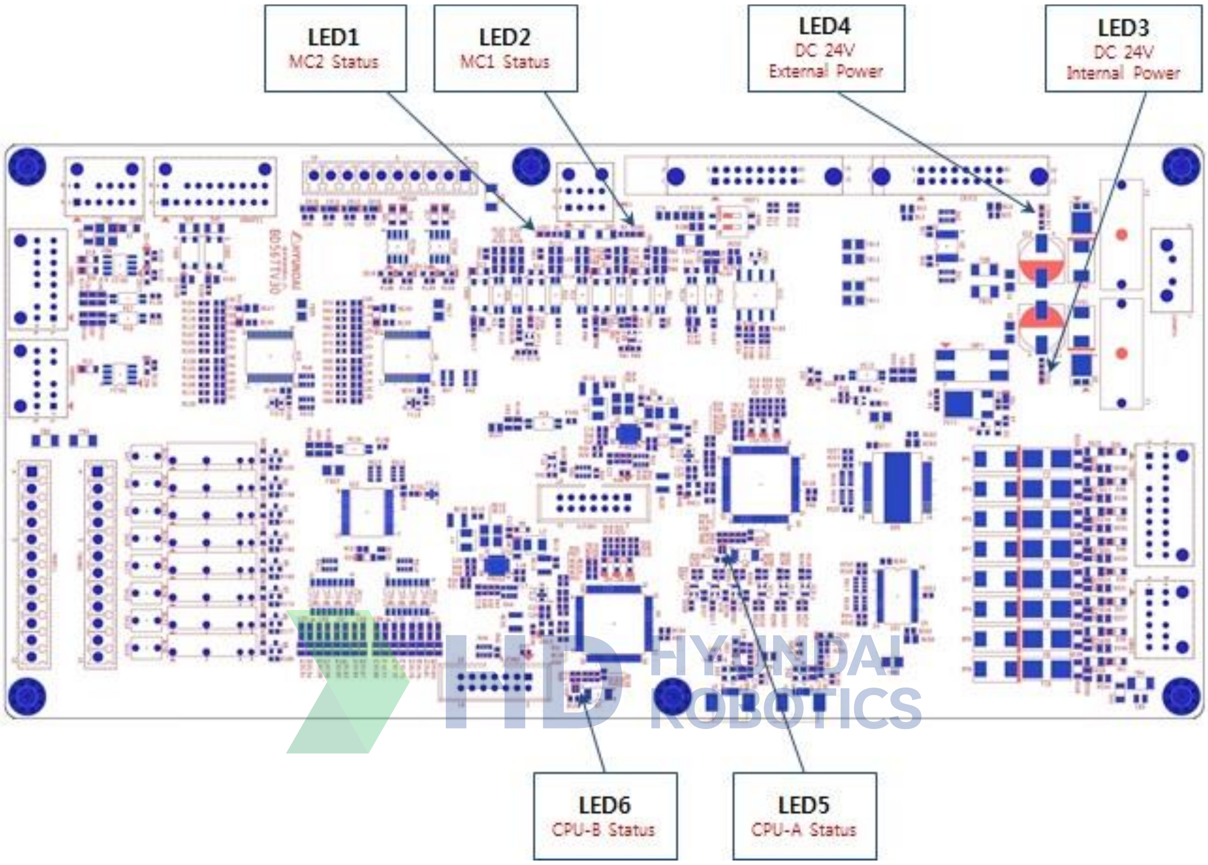


Figure 4.33 The Display Unit of the System Board (BD567T)

Table 4-23 Description of the displaying device for the system board (BD567T)

Name	Content	Color	In Normal Status	Solution
LED1	MC2	Green	On	1. Checking the MC2 status 2. Checking for the interruption of electric power 3. Checking the CNMC1 cable
LED2	MC1	Green	On	1. Checking the MC1 status 2. Checking for the interruption of electric power 3. Checking the CNMC1 cable
LED3	Internal 24 V power	Yellow	On	1. Checking 24V power within a board 2. Checking Brake 24V power 3. Checking the power cable CNSMPS1
LED4	External 24 V power	Yellow	On	1. Checking the 24 V power besides the board 2. Checking the power cable CNSMPS1
LED5	CPU_A	Green/Red	Off	1. Checking the CPU_A status 2. Checking the power cable CNSMPS1
LED6	CPU_B	Green/Red	Off	1. Checking the CPU_B status 2. Checking the power cable CNSMPS1

4.3.3.4. Setting and checking apparatus

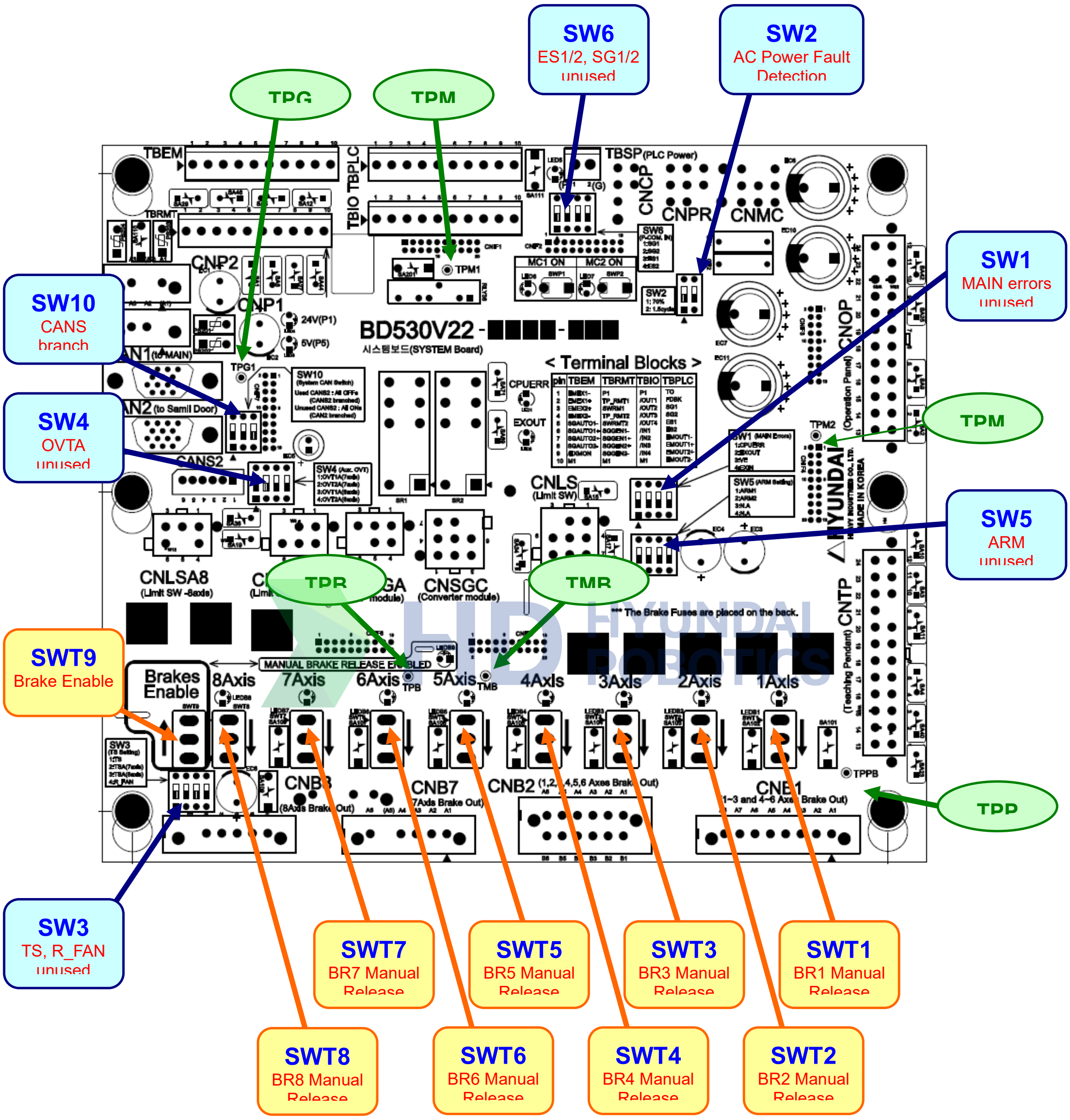


Figure 4.34 The Setting Unit of the System Board (BD530V22)

Table 4-24 System board (BD530) DIP switch SW1 (error monitoring) setting method

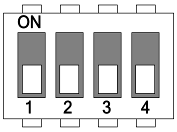
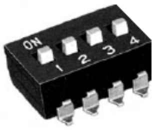
Switch No.		1	2	3	4
Use		CPUERR signal (MAIN → SYSTEM)	EXOUT signal (MAIN → SYSTEM)	Interruption detection (VE) (SYSTEM → MAIN)	EXIN signal (SYSTEM → MAIN)
Setting Content	OFF	Use	Use	Use	Use
	ON	CPUERR signal not processed	EXOUT signal not processed	Blackout detection function. Non-use	EXIN signal not used
Setting taking out time		OFF	OFF	OFF	OFF
Switch Appearance					

Table 4-25 System board (BD530) DIP switch SW2 (AC power monitoring) setting method

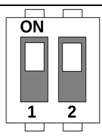
Switch No.		1	2
Use		AC power interruption detection level selection	AC power interruption detection cycle selection (based on 60Hz)
Setting Content	OFF	Detection level : 50% It is processed as a blackout when the power is not recovered during a set detection cycle (switch No. 2) if the AC power is 50% or lower than the rating.	3 cycles It is processed as a blackout when the AC power is the set detection level (switch No. 1) or lower for 3 cycles or more. *3 cycle = Approx. 50msec(60Hz), Approx. 60msec(50Hz)
	ON	Detection level : 70% It is processed as a blackout when the power is not recovered during a set detection cycle (switch No. 2) if the AC power is 70% or lower than the rating.	1.5 cycles It is processed as a blackout when the AC power is the set detection level (switch No. 1) or lower for 1.5 cycles or more. *1.5 cycle = Approx. 25msec(60Hz), Approx. 30msec(50Hz)
Setting taking out time		ON	ON
Switch Appearance			

Table 4-26 System board (BD530) DIP switch SW3 (Motor temperature sensor monitoring) setting method

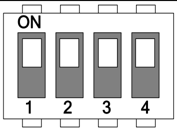
Switch No.		1	2	3	4
Use		TS detection (base axis)	TSA detection (7 axis)	TSA detection (8 axis)	R_FAN detection (FANs embedded in a robot)
Setting Content	OFF	Use	Use	Use	Use
	ON	Non-use	Non-use	Non-use	Non-use
Setting taking out time		ON	ON	ON	ON
Switch Appearance		 			

Table 4-27 System board (BD530) DIP switch SW4 (Additional axis OVT limit switch) setting method

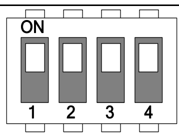
Switch No.		1	2	3	4
Use		Limit switch (chain 1) detection (7 axis)	Limit switch (chain 2) detection (7 axis)	Limit switch (chain 1) detection (8 axis)	Limit switch (chain 2) detection (8 axis)
Setting Content	OFF	Use	Use	Use	Use
	ON	Non-use	Non-use	Non-use	Non-use
Setting taking out time		ON	ON	ON	ON
Switch Appearance		 			

Table 4-28 System board (BD530V22) DIP switch SW5 (Arm interference) setting method

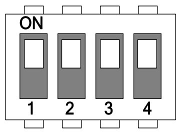
Switch No.		1	2	3	4
Use		Limit switch (chain 1) detection (Arm interference)	Limit switch (chain 2) detection (Arm interference)	-	-
Setting Content	OFF	Use	Use	-	-
	ON	Non-use	Non-use	-	-
Setting taking out time		ON	ON	ON	ON
Switch Appearance		 			

Table 4-29 System board (BD530) DIP switch SW6 (Safety IO signal monitoring) setting method

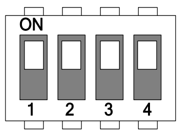
Switch No.		1	2	3	4
Use		Safety guard SG1 (chain 1) detection	Safety guard SG2 (chain 2) detection	Emergency stop ES1 (chain 1) detection	Emergency stop ES2 (chain 2) detection
Setting Content	OFF	Use	Use	Use	Use
	ON	Non-use	Non-use	Non-use	Non-use
Setting taking out time		ON	ON	ON	ON
Switch Appearance		 			

Table 4-30 System board (BD530) DIP switch SW10 (CANS Branch) setting method

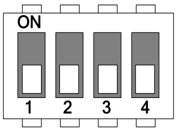
<table>
<tr><th colspan="2">Switch No.</th><th>1</th><th>2</th><th>3</th></tr>
<tr><td colspan="2">Use</td><td colspan="3">System CAN communication line branch setting</td></tr>
<tr><td rowspan="2">Setting Content</td><td>OFF</td><td colspan="3">System CAN line branch through the CANS2 connector</td></tr>
<tr><td>ON</td><td colspan="3">CAN2 connector - System CAN line branch through Small Door</td></tr>
<tr><td colspan="2">Setting taking out time</td><td>ON</td><td>ON</td><td>ON</td></tr>
<tr><td colspan="2">Switch Appearance</td><td colspan="3">
 
</td></tr>
</table>

Table 4-31 Description of system board (BD530) toggle switch SWT1-9 operation

Switch NO.	Use
SWT1	Releasing robot basic axis 1 motor brake manually (It needs to be turned on with the brake enable switch SWT9 in order to release the motor brake.)
SWT2	Releasing robot basic axis 2 motor brake manually (It needs to be turned on with the brake enable switch SWT9 in order to release the motor brake.)
SWT3	Releasing robot basic axis 3 motor brake manually (It needs to be turned on with the brake enable switch SWT9 in order to release the motor brake.)
SWT4	Releasing robot basic axis 4 motor brake manually (It needs to be turned on with the brake enable switch SWT9 in order to release the motor brake.)
SWT5	Releasing robot basic axis 5 motor brake manually (It needs to be turned on with the brake enable switch SWT9 in order to release the motor brake.)
SWT6	Releasing robot basic axis 6 motor brake manually (It needs to be turned on with the brake enable switch SWT9 in order to release the motor brake.)
SWT7	Releasing added axis 7 motor brake manually (It needs to be turned on with the brake enable switch SWT9 in order to release the motor brake.)
SWT8	Releasing added axis 8 motor brake manually (It needs to be turned on with the brake enable switch SWT9 in order to release the motor brake.)
SWT9	Enable switch to manually release the motor brake. (It is required to turn on SWT9 at the same time in order to release the motor brake using SWT1 - 7.)

4.3.3.5. Emergency stop connection

(1) Contact point input external emergency stop

External emergency stop is operated regardless of the mode of the controller, (automatic mode, and manual mode). When the emergency stop switch input occurs, promptly remove motor power so as to secure safety. The emergency stop switch must be of a structure capable of contact point outputting. This is because a node is formed in a terminal block so as to connect the contact output of the external emergency stop switch to a duplicated safety chain as shown in the picture below. (※ Reference: Description of the node of terminal block TBEM)

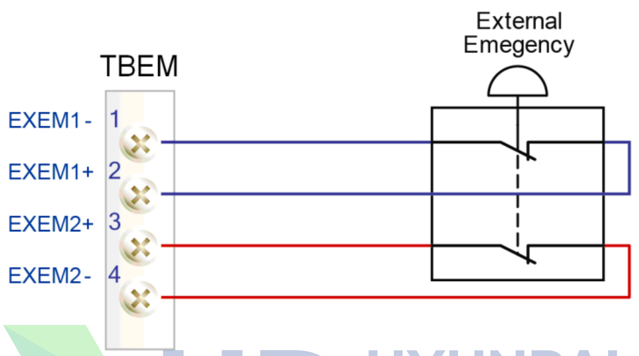


Figure 4.35 Method for connecting the external emergency stop switch to terminal block TBEM

In cases where the external emergency stop is not used, ensure input is ineffective by connecting the nodes of terminal block TBEM in the manner described below.

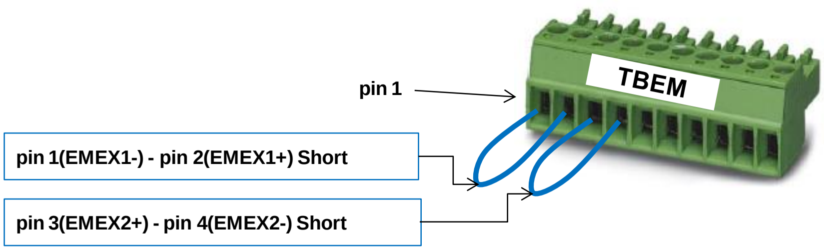


Figure 4.36 Management method when a contact point input type-external emergency stop is not used

In cases where an external emergency stop switch is installed for use, a user must operate the robot only after checking that emergency stop is operating normally. Additionally, check if emergency stop input has become ineffective. This step is necessary for worker safety.

(2) P-COM input external emergency stop

Basically, an automatic safety guard can receive contact point input from terminal block TBEM. However, a device such as a safety PLC or safety IO transmits safety guard signals to the controller through PNP output. The Figure below shows a connecting method through terminal block TBPLC in which the controller can receive PNP type output. (※ Reference: Description of the node of terminal block TBPLC)

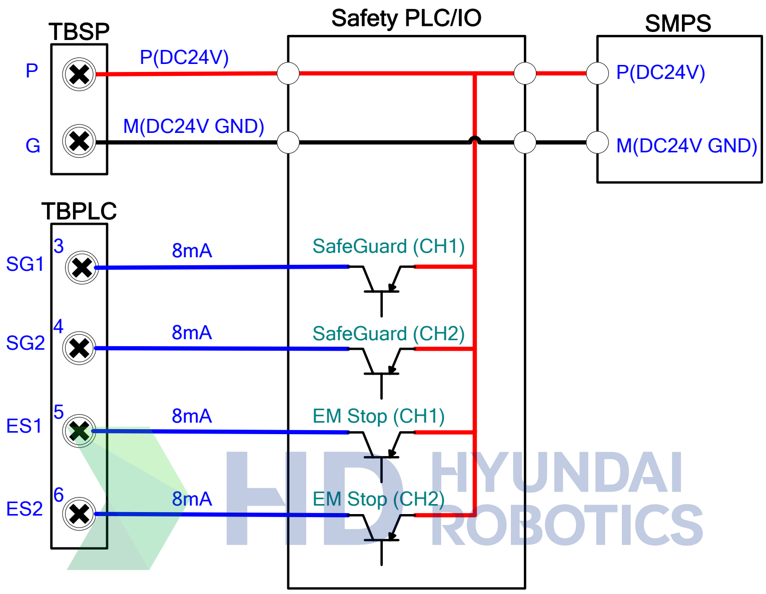


Figure 4.37 Method of connecting the automatic safety guard to an PNP output device

In cases where the P-COM input external emergency stop is not used, ensure the emergency stop input becomes ineffective by turning on switch No. 3 and switch No. 4 of DIP switch SW6, as shown below.
(※ Reference: DIP switch SW6 (safety IO safety signal monitoring) setting method)

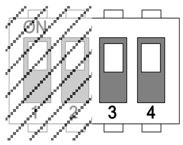


Figure 4.38 Management method in cases where the P-COM input external emergency stop is not used

In cases where an external emergency stop switch is installed for use, a user must operate the robot only after checking that emergency stop is operating normally. Additionally, check if emergency stop input has become ineffective. This step is necessary for worker safety.

(3) Internal emergency stop contact point output

When you want to use the emergency stop switch (operation panel, teach pendant, etc.) installed in the interior of the controller, or as external apparatus, use the emergency stop contact point output within terminal block TBPLC.

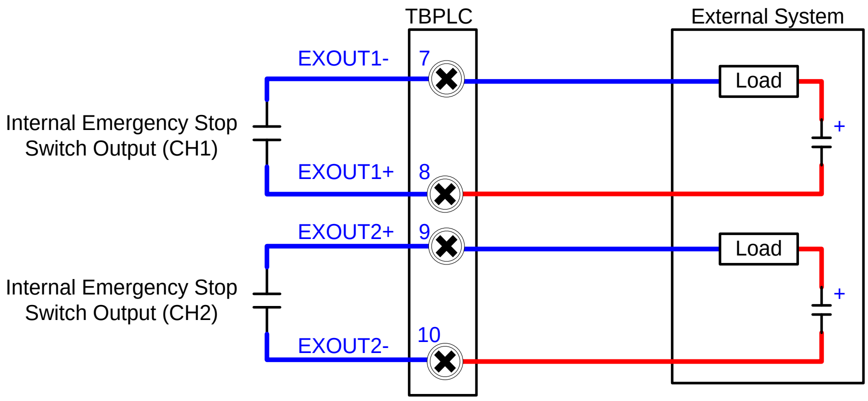


Figure 4.39 Output the internal emergency stop switch of terminal block TBPLC

4.3.3.6. Safety guard connection

(1) Typical safety guard

A typical safety guard operates regardless of the mode of the controller (automatic mode or manual mode). That is, when a person enters the interior of an installed safety guard or when the guard is cut off, the controller promptly removes motor power. The safety guard to use must have a structure capable of contact point outputting. A node is included in terminal block TBRMT so as to connect the contact point output of the safety guard to a safety chain in a duplicated manner, as shown in the Figure below. (※ Reference: Description of the node of terminal block TBRMT)

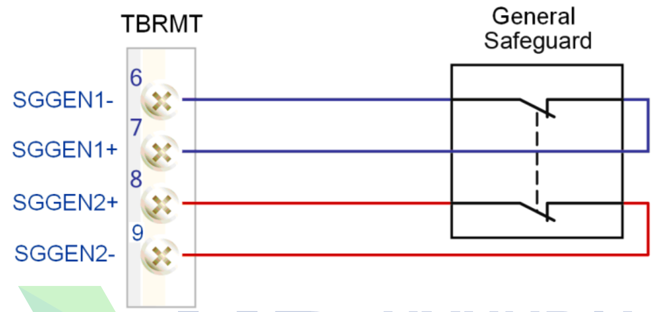


Figure 4.40 Method for connecting a typical safety guard to terminal block TBRMT

In cases where a typical safety guard is not used, ensure input becomes ineffective by connecting the nodes of terminal block TBRMT in the manner described below.

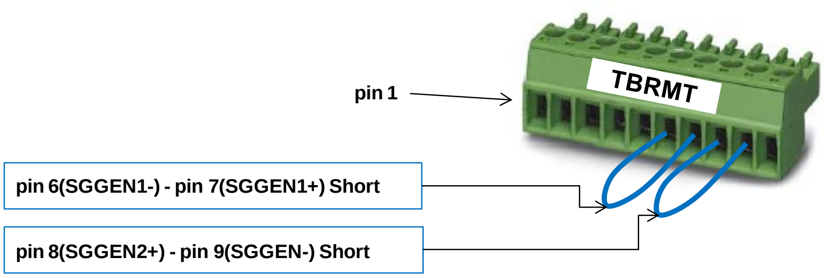


Figure 4.41 Management method in cases where a typical safety guard is not used

! In cases where an external emergency stop switch is installed for use, a user must operate the robot only after checking that emergency stop is operating normally. Additionally, check if emergency stop input has become ineffective. This step is necessary for worker safety.

(2) Contact point input automatic safety guard

An automatic safety guard operates only when the controller is in automatic mode. Similarly to a typical safety guard, the automatic safety guard must have a structure capable of contact point outputting. A node is included in terminal block TBEM so as to connect the contact point output of the safety guard to a safety chain in a duplicated manner, as shown in the Figure below. (※ Reference: Description of the node of terminal block TBEM)

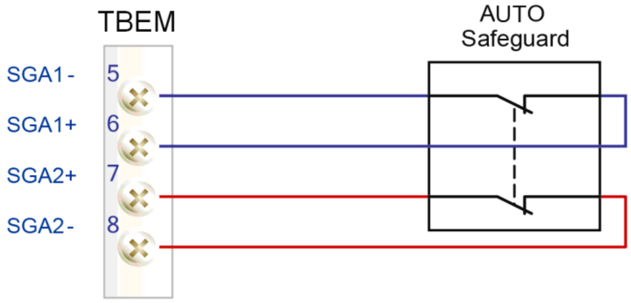


Figure 4.42 Method for connecting the contact point input automatic safety guard to terminal block TBEM

In cases where an automatic safety guard is not used, ensure input becomes ineffective by connecting the nodes of terminal block TBEM in the manner described below.

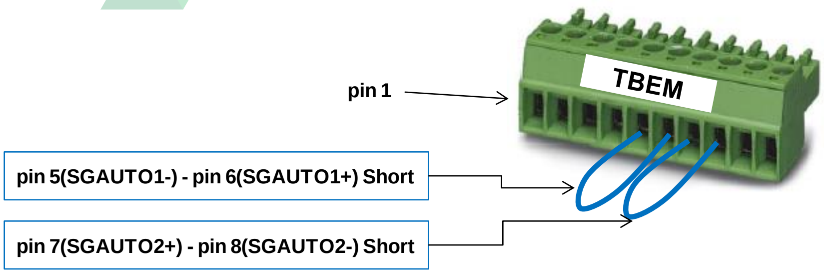


Figure 4.43 Management method in cases where a contact point input automatic safety guard is not used

In cases where an automatic safety guard is installed for use, a user must operate the robot only after checking that the safety guard is operating normally. Additionally, check if the safety guard input has become ineffective. This step is necessary for worker safety.

(3) P-COM input automatic safety guard

Essentially, an automatic safety guard can receive the contact point input from terminal block TBEM. However, a device such as safety PLC and safety IO, transmits safety guard signals to a controller through PNP output. The Figure below shows a connecting method through terminal block TBPLC in which the controller can receive PNP type output. (※ Reference: Description of the node of terminal block TBPLC)

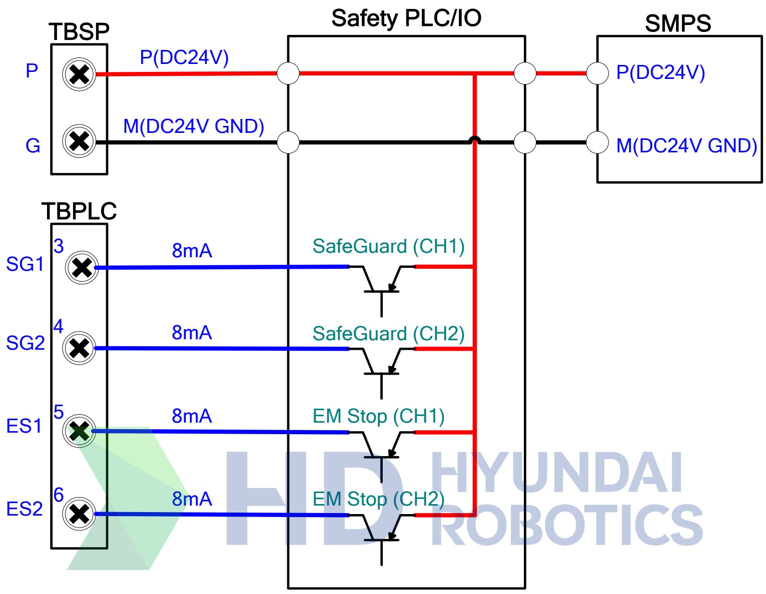


Figure 4.44 Connecting method of an automatic safety guard with respect to an PNP output device

In cases where a P-COM input automatic safety guard is not used, ensure input becomes ineffective by turning on switch No. 1 and switch No. 2 of the DIP switch SW6 as described below. (※ Reference: DIP switch SW6 (safety IO safety signal monitoring) setting method)

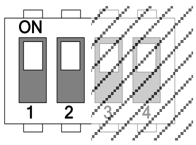


Figure 4.45 Management method in cases where P-COM input automatic safety guard is not used

In cases where an automatic safety guard is installed for use, a user must operate the robot only after checking that the safety guard is operating normally. Additionally, check if the safety guard input has become ineffective. This step is necessary for worker safety.

4.3.3.7. Remote control connection

In order to operate a remote control, the robot operation is possible only when a user has formed the wiring as below.

(1) External motor power ON signal

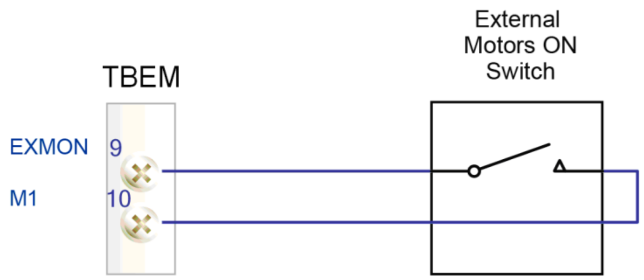


Figure 4.46 Method for inputting the external motor power ON signal into terminal block TBEM

(2) Remote switch input

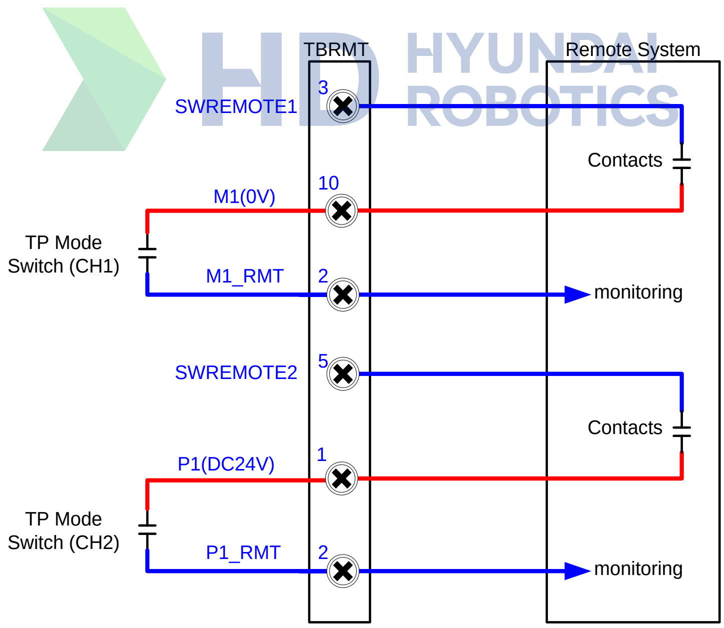


Figure 4.47 for inputting the remote switch signal into terminal block TBRMT

In cases where remote switch input is not used, ensure input becomes ineffective by connecting the nodes of terminal block TBRMT as described below.

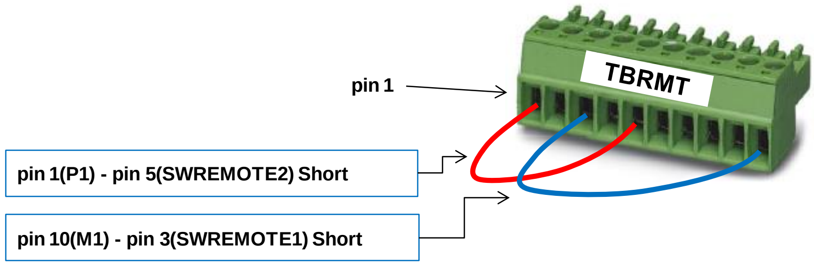


Figure 4.48 Management method in cases where remote switch input is not used

In cases where a remote switch is installed for use, a user must operate the robot only after checking that the remote switch is operating normally. Additionally, check if the remote switch input has become ineffective. This step is necessary for worker safety.

4.3.3.8. Safety PLC/IO connection

Between safety PLC or safety IO and a robot controller, emergency input signals and monitoring output signals are connected with each other as outlined below.

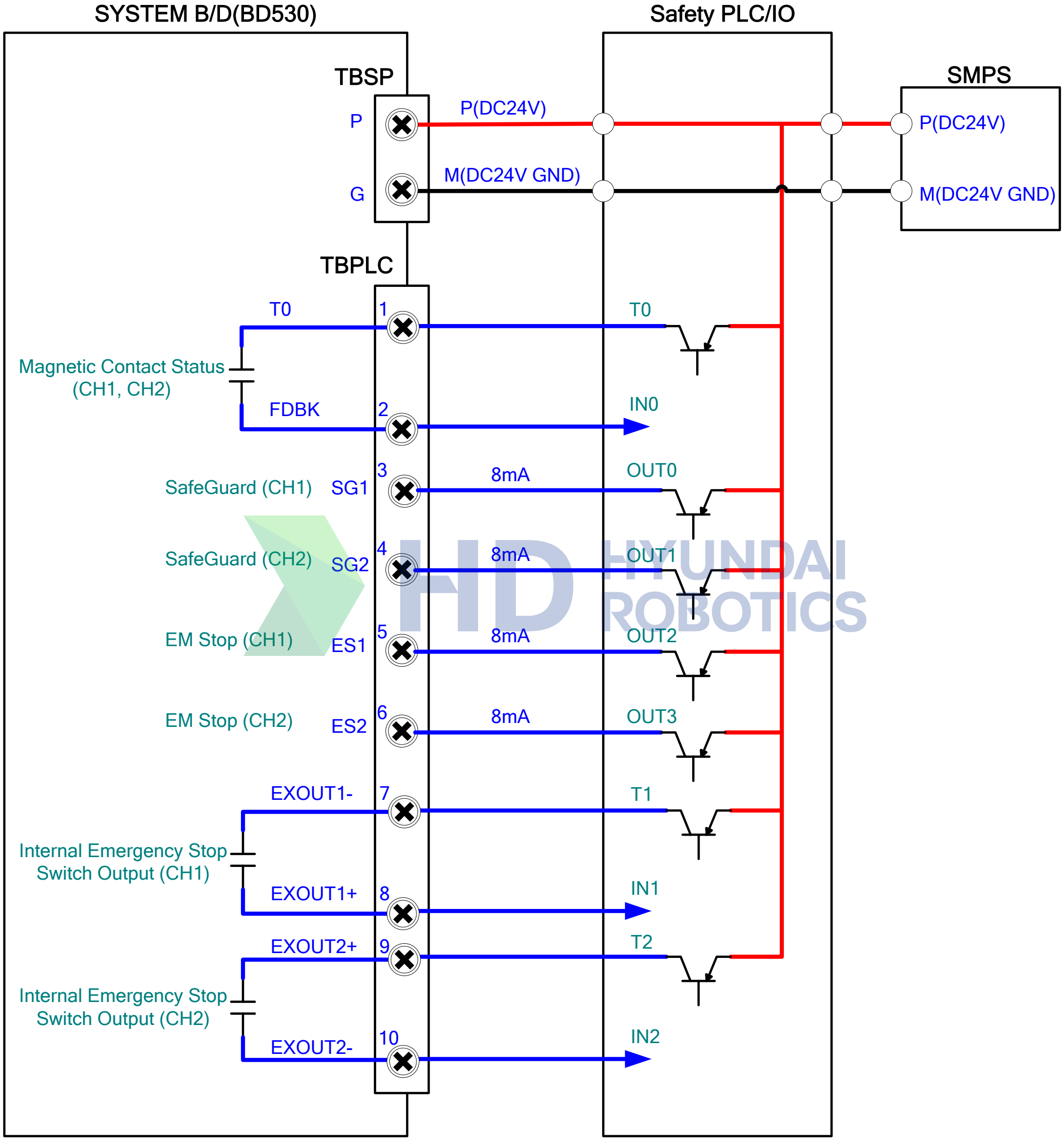


Figure 4.49 Connection method of Safety PLC/IO

In cases where external emergency stop is installed for use, a user must operate the robot only after checking that emergency stop is operating normally. Additionally, check if emergency stop input has become ineffective. This step is necessary for worker safety.

4.3.3.9. Connection of digital input/output signal for a system

(1) Digital output

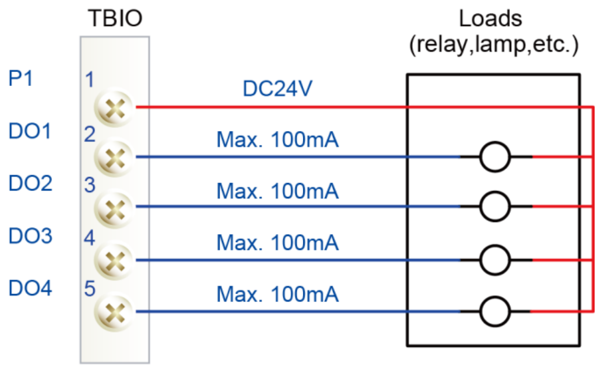


Figure 4.50 Method for connecting digital output for a system to terminal block TBIO

(2) Digital input

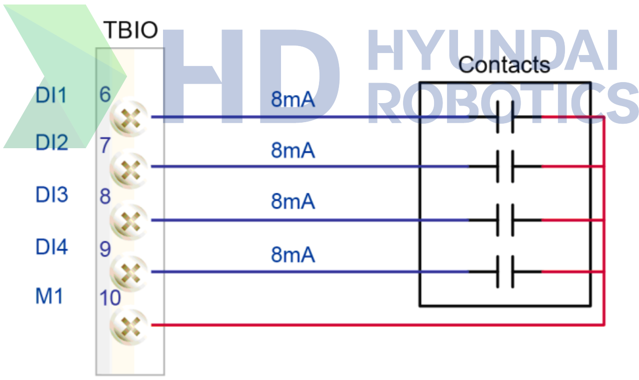


Figure 4.51 Method for connecting digital input for a system to terminal block TBIO

4.3.3.10. System CAN communication line wiring method (Version BD530V22 or higher)

There are two wiring methods for the system CAN communication line of the system board

(1) Main board - System board - Small door - Option board 1 - Option board 2

- Turn on all the elements of the dip switch SW10 of the system board
- Do not connect the CAN communication line to the CANS2 connector of the system board
- Use the system CAN connector of Small Door for the system CAN communication

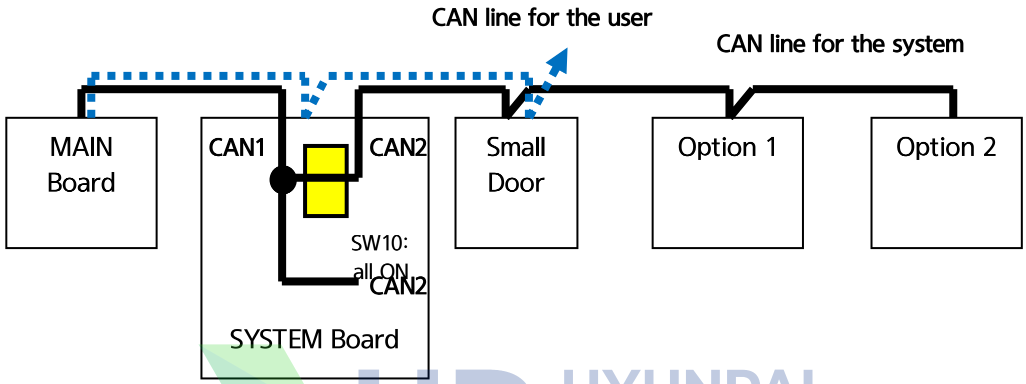


Figure 4.52 Wiring of system CAN communication line from BD530V22 but no through CANS2

(2) Main board - System board - Option board - Option board 2

- Turn off all the elements of the dip switch SW10 of the system board.
- Wiring of the system CAN communication line by using the CANS2 connector of the system board.
- Do not use the system CAN connector of Small Door.

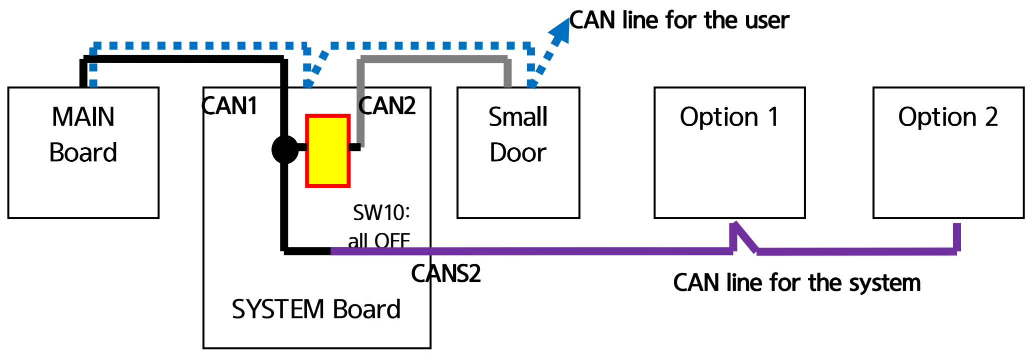


Figure 4.53 Wiring of system CAN communication line from BD530V22 through CANS2

4.3.4. Servo Board (BD544)

4.3.4.1. Outline

The servo board controls the actions of the motors for 6 axes (max. 8 axes) according to the position command form the main board, and creates PWM signals of encored signal processing, error status checking and the drive unit.

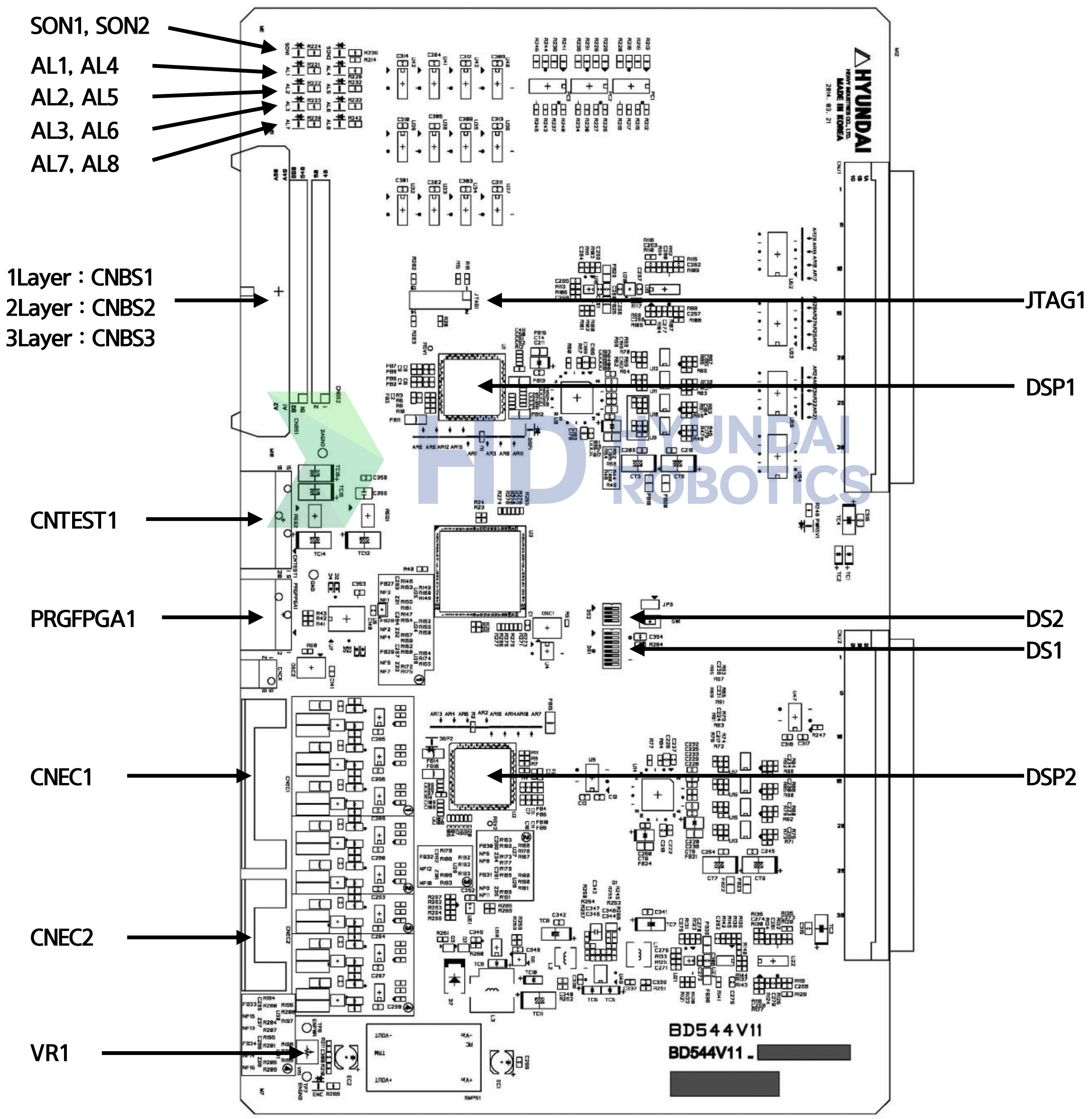


Figure 4.54 Servo Board (BD544)

4.3.4.2. Connector

Table 4-32 The Sorts and Uses of Servo Board (BD544) Connectors

Name	Use	External Device Connection
CNEC1	Encoder signal connection	CNR4
CNEC2	Additional Axis encoder signal connection	CNR7,CNR8
CNBS1,2,3	Dive unit signal connection	CNBS1,2, and 3 of Drive Unit
JTAG1	JTAG Emulator Port	JTAG Emulator
PRGFPGA1	FPGA program download port	FPGA Program Download Tool
VR1	Encoder input power control unit	

4.3.4.3. Display Unit

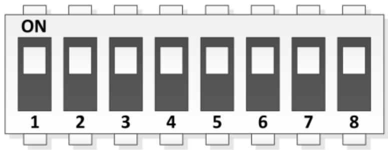
Table 4-33 Servo Board (BD544) LED

Status / Name	Color	Normal	Abnormal	Remark
AL1~8	Red	ON	OFF	ALX : X Axis (X=1~8)
SON1~2	Green	ON if Motor is ON	OFF if Motor is OFF	SON1 : 1 DSP, SON2 : 2 DSP

4.3.4.4. Setting Unit

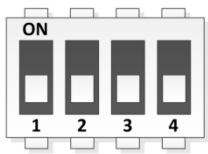
Caution: DIP switches are initially set as ON, and users may not change them.

Table 4-34 The Method for the Setting of DIP Switches (DS1) of the Servo Board (BD544)

Switch No.	1	2	3	4	5	6	7	8
Initial Setting	ON	ON	ON	ON	ON	ON	ON	ON
External Form of Switch								

Caution:
Users may not change the following settings, and if you want to expand DSP board, please contact with us.

Table 4-35 The DIP Switch (DS2: Pin 1) of the Servo Board (BD544)

Content \ Name		DS2			
		1	2	3	4
DSP1(U1), DSP2(U2) Setting	Designate 1DSP(U1) and 2DSP(U2)	OFF	OFF	OFF	OFF
	Designate 3DSP(U1) and 4DSP(U2)	ON	OFF	OFF	OFF
Initial Settings					

4.3.5. Drive Unit

4.3.5.1. SD3X3Y (Medium-Size) and SD3L3Y (Large-Size) 6-Axis integrated Drive Unit

The drive unit plays a role of amplifying power by sending current to each motor according to the current command from the servo board. The 6 axis all-in-one drive unit can operate 6 motors at the same time, and the following table shows its components.

Diode module converter is integrated with servo amp, and the 3-phase current from the electric module is rectified with a diode module; converted to DC; and stored in the smoothing capacitor. When the speed of the robot is reduced, power generated from a motor is consumed through a transistor and resistance. The diode module converter is constructed as shown below.

Table 4-36 The Components of SD3X3Y (Medium-Size) and SD3L3Y (Large-Size) 6-Axis integrated Drive Unit)

Component		Function
BD552 (Logic Board)		Separation of the PWM signal from the servo board into upper and lower IPM drive signals, and execution of error processing
BD551 (IPM Board)	Gate Drive Module	Generation of IPM gate signals
	Gate Power Module	Generation of gate power
	Current Detection Unit	Detection of the current flowing into the motor
BD561 (Converter Board)	Rectifier Unit	Generation of DC power circuit provided from the AC input main power.
	Regenerative Control	Drive of IGBT if PN voltage increases
	Error Detection Unit	The detection of overvoltage, overheated regenerative resistance, and bibliographic data input errors
Other Components	Heat Sink	Emits heat generated by power modules
	IPM	Switching Device
	Capacitor	DC power smoothing
	Regenerative IGBT	Execution of regenerative control

■ **Type number system of medium(Lagre) 6-axis integrated drive unit**

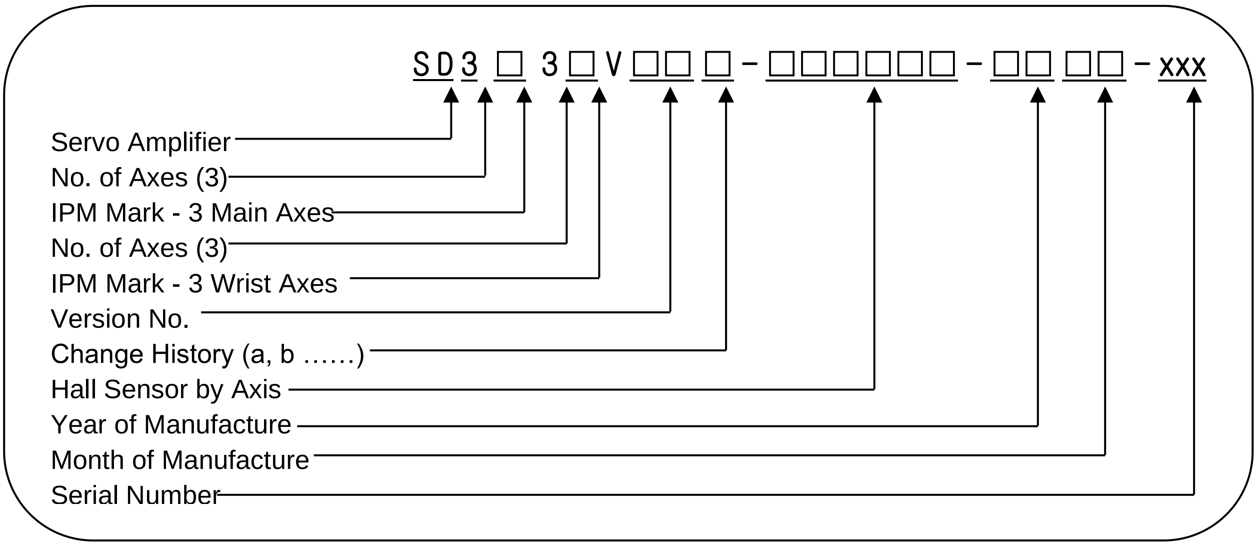


Table 4-37 Type code of medium(Large) 6-axis integrated drive unit

Classification	Mark of Type
Servo Drive	SD

Table 4-38 Specifications of medium(Large) 6-axis integrated drive unit

Item	Classification		Application	
IPM Capa.	3X	3Y	HS180, HH300, HX400	6-Axis integrated Type
	4X	2Y	HC2502B2D, HC2503B2D	
	3L	3Y	HC3303B1DA, HC3303B2DA	
Year	00 ~ 99		Year of Manufacture: 2000 ~ 2099	
Month	01 ~ 12		Month of Manufacture: 1 ~ 12	
Serial No.	001 ~ 999		No. of units manufactured per month: 1 ~ 999	

Table 4-39 Medium(Large) Size IPM Capacity

Medium Size(Large Size)	**L**	(IPM Rated Current) 150A, (Hall Sensor Rated Current) 4V/75A
	X	(IPM Rated Current) 100A, (Hall Sensor Rated Current) 4V/50A
	Y	(IPM Rated Current) 75A, (Hall Sensor Rated Current) 4V/50A
	Z	(IPM Rated Current) 50A, (Hall Sensor Rated Current) 4V/25A

Table 4-40 Hall sensor code for medium(Large) IPM

AMP Model	Hall Sensor Mark (Spec.)	Full-Scale Current (Im)	AMP Feedback Constant (Iv)
Medium (Large) servo drive unit	0 (4V/75A)	140.62Apeak	**PM150CL1B060(150A)**
	1 (4V/50A)	93.75Apeak	**PM100CL1B060(100A) PM75CL1B060(75A) PM50CL1B060(50A)**
	2 (4V/25A)	46.87Apeak	
	3 (4V/15A)	28.12Apeak	
	4 (4V/10A)	18.75Apeak	
	5 (4V/ 5A)	9.37Apeak	

Table 4-41 Specifications of medium(large) 6-axis regenerative IGBT

Regenerative IGBT	**L**	150A, Regenerative Resistance: 2Ω 2000W 2EA Applicable

Table 4-42 Specifications of medium(large) 6-axis integrated electrolytic condenser

Chemical Condenser	**2C**	3300uF 2EA

Caution:
As the drive unit varies depending on the robot, so please check out the form of it in replacing it.

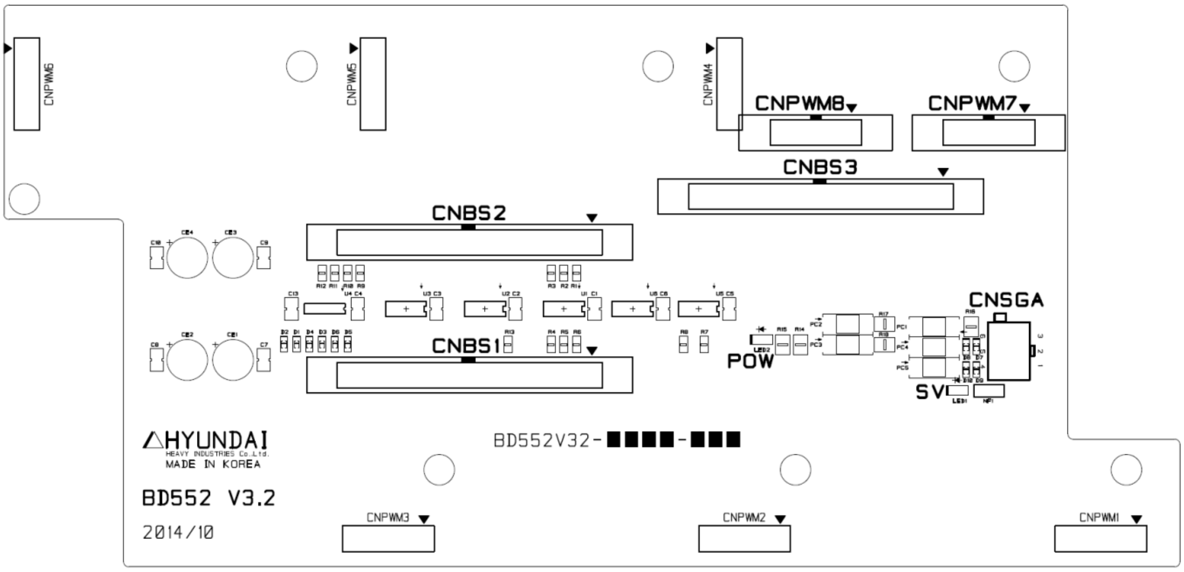


Figure 4.55 BD552 Component Layout

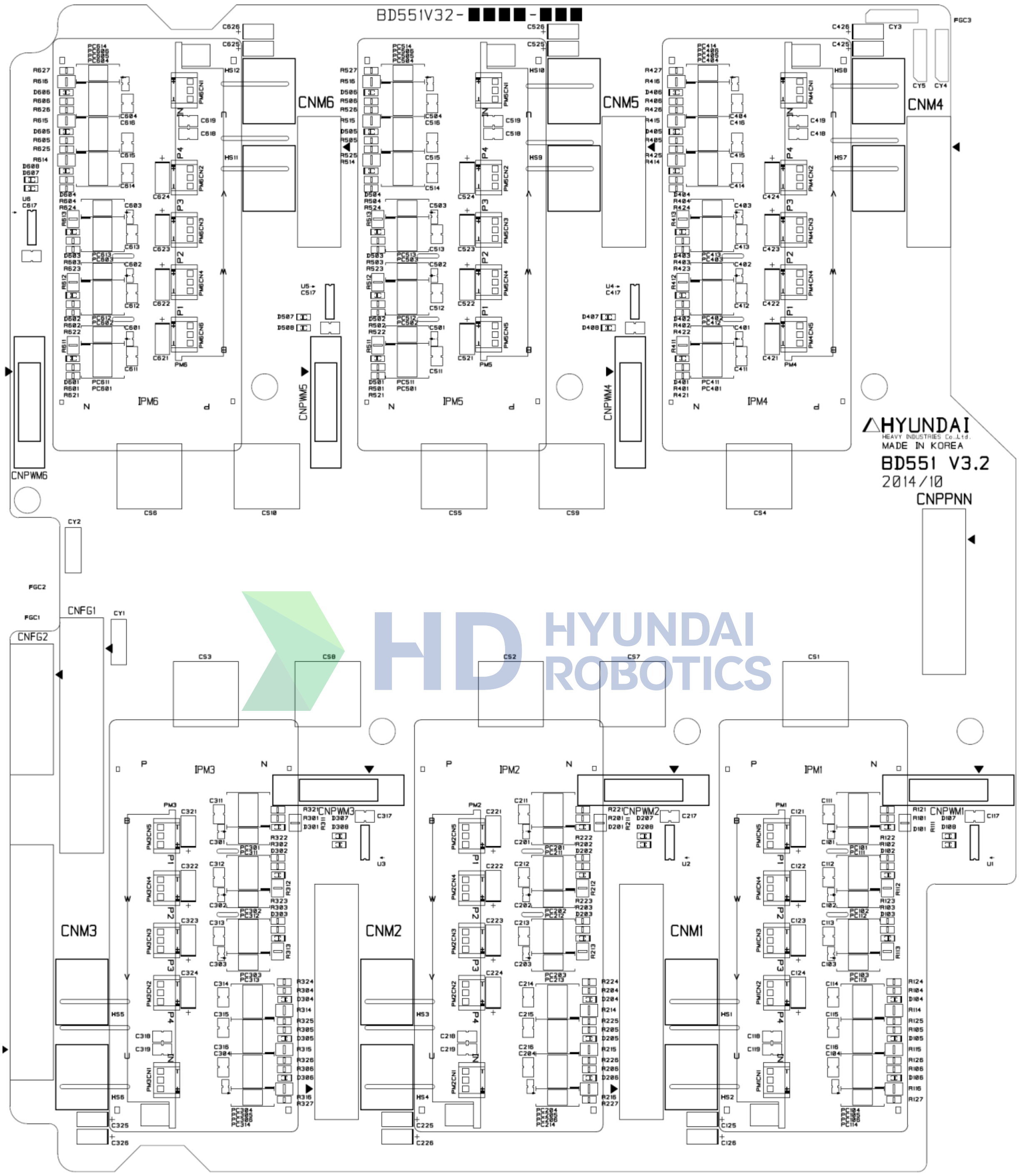


Figure 4.56 BD551 Component Layout

Table 4-43 BD552 Connector

Name	Use	External Device Connection
CNBS1, 2, 3	PWM Signal and Error Signal	Servo Board(BD544) CNBS1,2,3
CNSGA	/PWMON, SVERR, BRAKE	Sequence Board (BD530) CNSGA
CNPWM 1~6	PWM Signal and Error Signal	Servo Amp BD551 CNPWM1~6
CNPWM 7~8	Additional Axis PWM Signal and Error Signal	Option Board(BD554) CNPWM

Table 4-44 BD551 Connector

Name	Use	External Device Connection
CNM 1~6	Motor Connection	CMC1, CMC2
CNPWM 1~6	PWM signal and error signal	Servo Amp BD552 CNPWM1~6
CNPPNN	Power for motor drive	Drive Power Unit (BD561) CNPN1
CNFG1	The frame ground of the Main axis motor	CMC1
CNFG2	The frame ground of the Wrist Axis motor	CMC2

Table 4-45 BD552 LEDs

Name	Color	Status Display
SV	Yellow	ON if PWM is ON
POW	Green	OFF if current dip/sag occurs

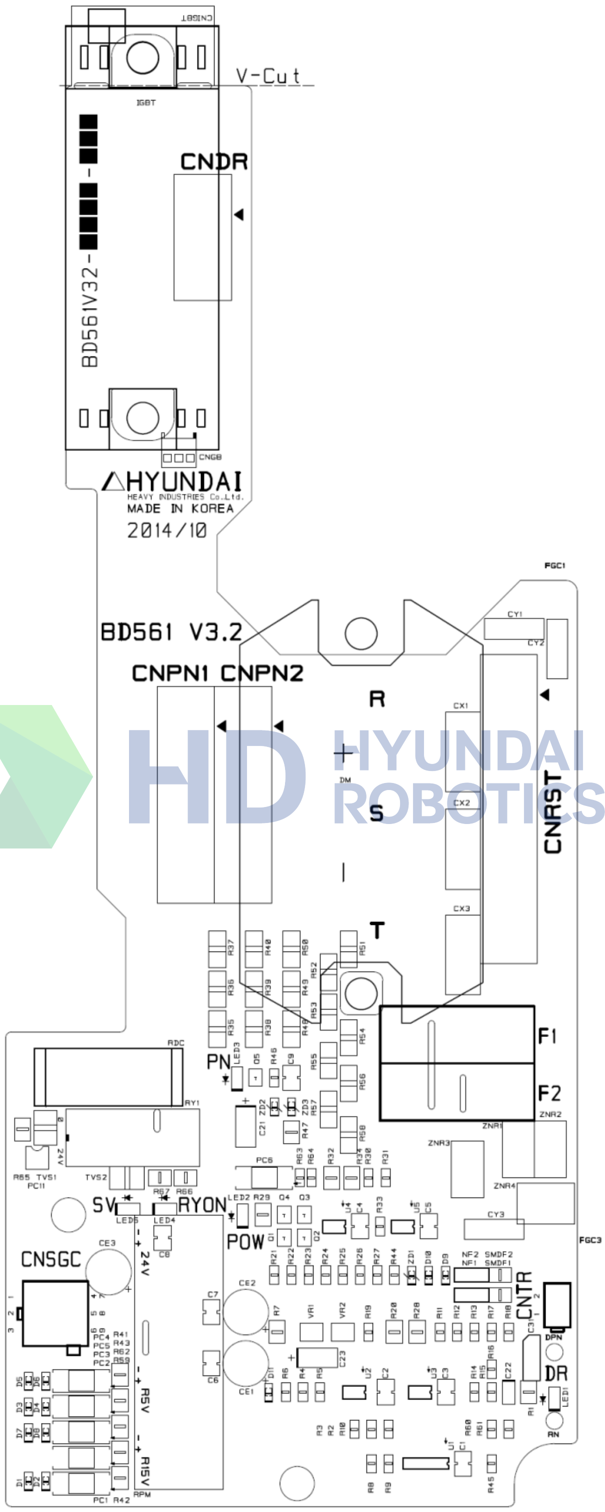


Figure 4.57 BD561 Component Layout

Table 4-46 Description of BD561 connector

Name	Use	External Device Connection
CNRST	3-Phase Power Input	Electrical Module CNRST
CNSGC	/PWMON, OV, FLT, FB	Sequence Board(BD530) CNSGC
CNDR	Regenerative Power Output	Regenerative Resistance
CNTR	Detection of Overheated Regenerative Resistance	Thermal Sensor of Regenerative Resistance
CNPN1	For Supply of PN Power	6-Axis Servo Amp CNPPNN, Additional Axis CNPN
CNPN2	For Supply of PN Power	Additional Axis Servo Amp

Table 4-47 Description of BD561 LED

Name	Color	Status Display
SV	Yellow	ON if PWN is ON
POW	Green	OFF if control voltage sag occurs
DR	Red	ON if regenerative power discharge operates
PN	Red	ON if PN voltage is over 42V
RYON	Red	OFF if PN power discharge operates

4.3.5.2. SD3A3D (Compact sized-6 axes integrated type-drive unit)

The drive unit plays a role of amplifying power by sending current to each motor according to the current command from the servo board. The 6 axis all-in-one drive unit can operate 6 motors at the same time, and the following Table shows its components.

Diode module converter is integrated with a compact servo amp, and the 3-phase current from the electric module is rectified with a diode module; converted to DC; and stored in the smoothing capacitor. When the speed of the robot is reduced, power generated from a motor is consumed through a transistor and resistance. The diode module converter is constructed as shown below.

Table 4-48 Construction of SD3A3D (Compact sized-6 axes integral type-drive unit)

Component		Function
BD553 (IPM board)	Gate Drive Module	Generation of IPM gate signals
	Gate Power Module	Generation of gate power
	Current Detection Unit	Detection of the current flowing into the motor
BD563 (Converter Board)	Rectifier Unit	Generation of DC power circuit provided from the AC input main power.
	Regenerative Control	Drive of IGBT if PN voltage increases
	Error Detection Unit	The detection of overvoltage, overheated regenerative resistance, and bibliographic data input errors
Other Parts	Heat Sink	Emits heat generated by power modules
	Capacitor	DC power smoothing
	Regenerative IGBT	Execution of regenerative control
	IPM	Switching Device

Caution:
As the drive unit varies depending on the robot, so please check out the form of it in replacing it.

■ **Type number system of compact 6-axis integrated drive unit**

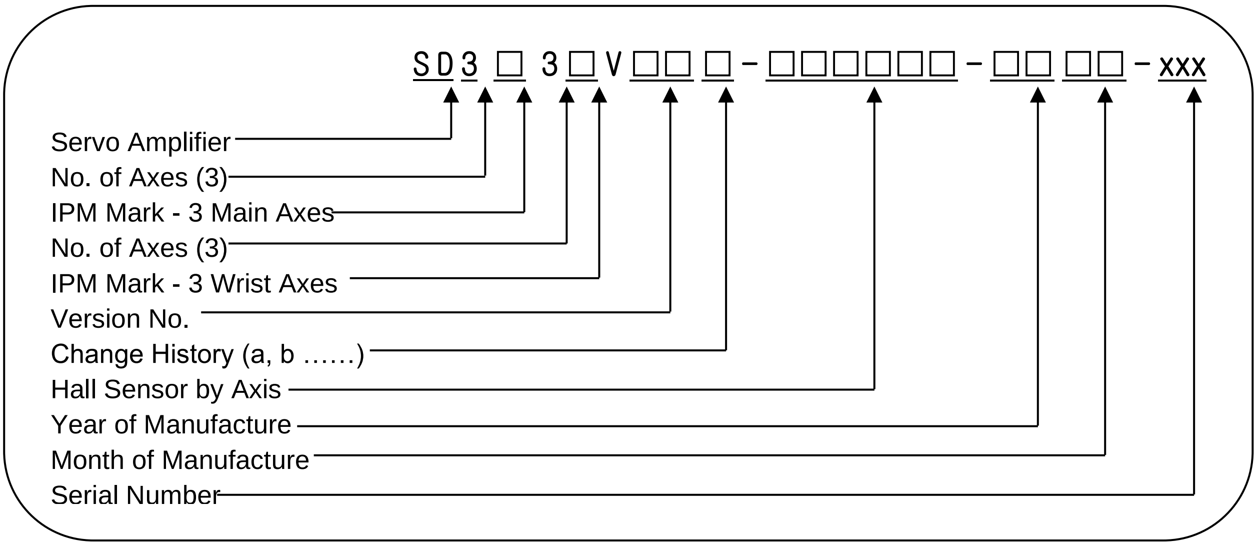


Table 4-49 Type code of compact 6-axis integrated drive unit

Classification	**Mark of Type**
Servo Drive	SD

Table 4-50 Specifications of compact 6-axis integrated drive unit

Item	**Classification**		**Application**	
IPM Capa.	3A	3D	HA006A, HH020	6-Axis integrated Type
Year	00 ~ 99		Year of Manufacture: 2000 ~ 2099	
Month	01 ~ 12		Month of Manufacture: 1 ~ 12	
Serial No.	001 ~ 999		No. of units manufactured per month: 1 ~ 999	

Table 4-51 Compact IPM Capacity

Compact Size	**A**	(IPM Rated Current) 30A, (Hall Sensor Rated Current) 4V/15A
	D	(IPM Rated Current) 10A, (Hall Sensor Rated Current) 4V/5A

Table 4-52 Hall sensor code for compact IPM

Drive Model	Hall Sensor Mark (Spec.)	Full-Scale Current (Im)	IPM Spec. (Rated Current)
Compact servo drive unit	3 (4V/15A)	27.27Apeak	PM30CSJ060(30A)
	4 (4V/10A)	18.18Apeak	
	5 (4V/5A)	9.19Apeak	PM10CSJ060(10A)
	6 (4V/3A)	5.45Apeak	
	7 (4V/6A)	10.91Apeak	PM30CSJ060(30A)
	8 (4V/2A)	3.64Apeak	PM10CSJ060(10A)
	9 (4V/1A)	1.82Apeak	

Table 4-53 Specifications of compact 6-axis regenerative IGBT

Regenerative IGBT	**Z**	50A, Regenerative Resistance: 15Ω 500W 1EA Applicable

Table 4-54 Specifications of compact 6-axis integrated electrolytic condenser

Chemical Condenser	**1C**	3300uF 1EA

Caution:
As the drive unit varies depending on the robot, so please check out the form of it in replacing it.

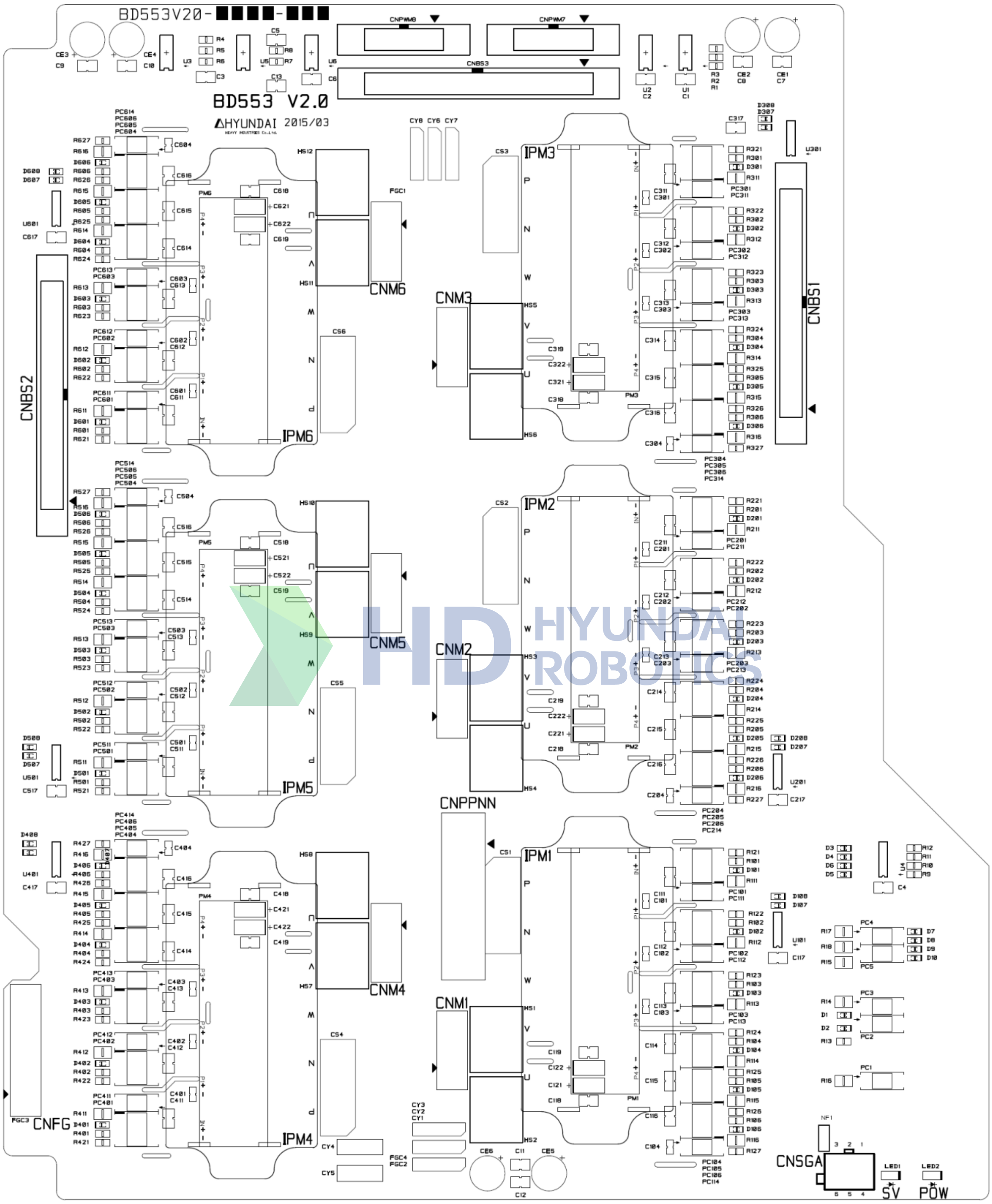


Figure 4.58 BD553 Component Layout

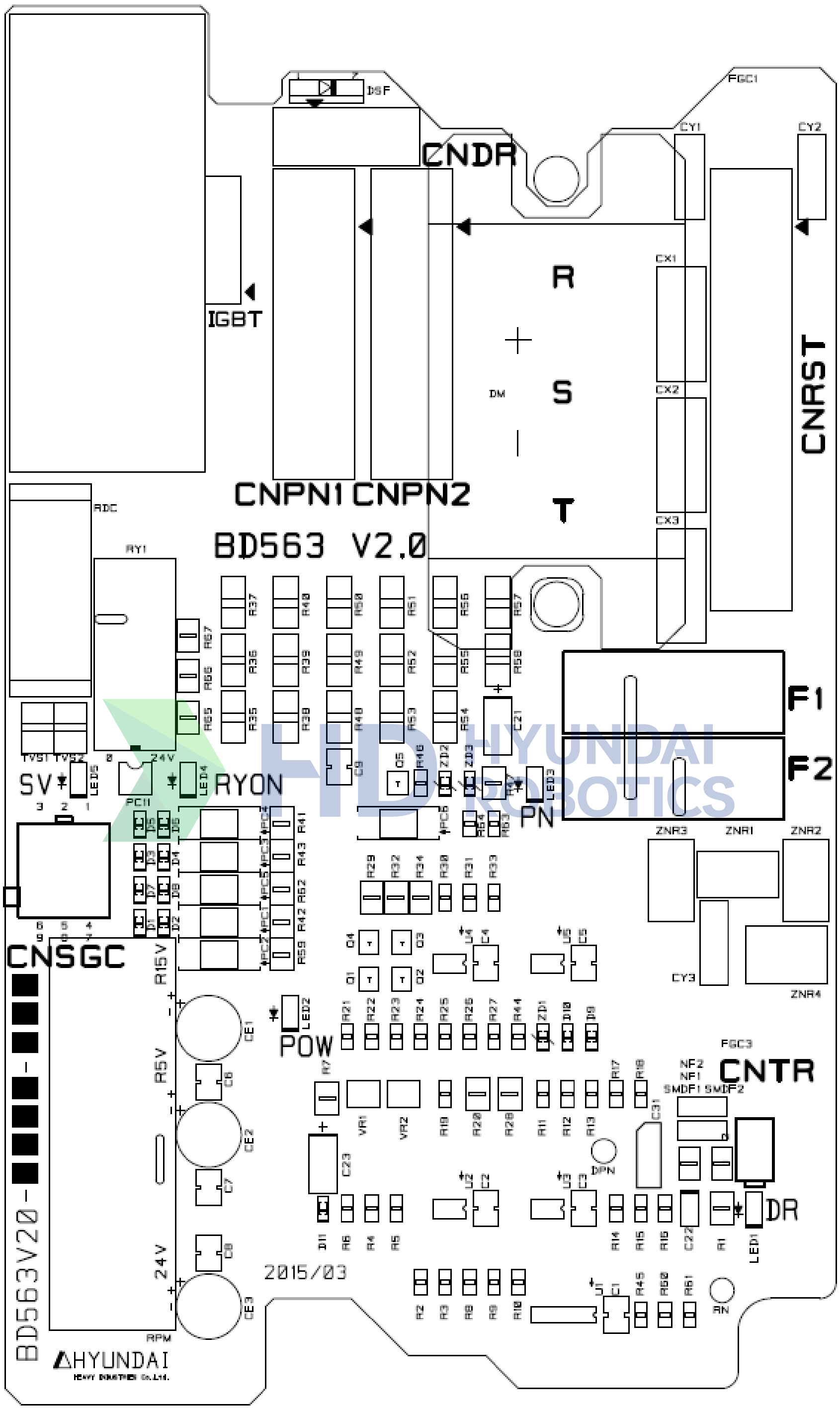


Figure 4.59 BD563 Component Layout

Table 4-55 Description of connector BD553

Name	Use	External Device Connection
CNBS1, 2, 3	PWM Signal and Error Signal	Servo Board (BD544) CNBS1,2,3
CNSGA	/PWMON, SVERR, BRAKE	Sequence Board (BD530) CNSGA
CNPWM7~8	Additional Axis PWM Signal and Error Signal	Option Board (BD554) CNPWM
CNM1~6	Motor Connection	CMC1
CNPPNN	Power for motor drive	Drive Power Unit (BD561) CNPN1
CNFG	The frame ground of the motor	CMC1

Table 4-56 Description of BD553 LED

Name	Color	Status Display
SV	Yellow	ON if PWM is ON
POW	Green	OFF with decreased control voltage

Table 4-57 Description of connector BD563

Name	Use	External Device Connection
CNRST	3-Phase Power Input	Electrical Module CNRST
CNSGC	/PWMON, OV, FLT, FB	Sequence Board(BD530) CNSGC
CNDR	Regenerative Power Output	Regenerative Resistance
CNTR	Detection of Overheated Regenerative Resistance	Thermal Sensor of Regenerative Resistance
CNPN1	For Supply of PN Power	6-Axis Servo Amp CNPPNN
CNPN2	For Supply of PN Power	Additional Axis Servo Amp CNPN

Table 4-58 Description of BD563 LED

Name	Color	Status Display
SV	Yellow	ON if PWN is ON
POW	Green	OFF if control voltage sag occurs
DR	Red	ON if regenerative power discharge operates
PN	Red	ON if PN voltage is over 42V
RYON	Red	OFF if PN power discharge operates

4.3.5.3. The Specifications of Option Drive Unit

■ Type number system of optional drive unit

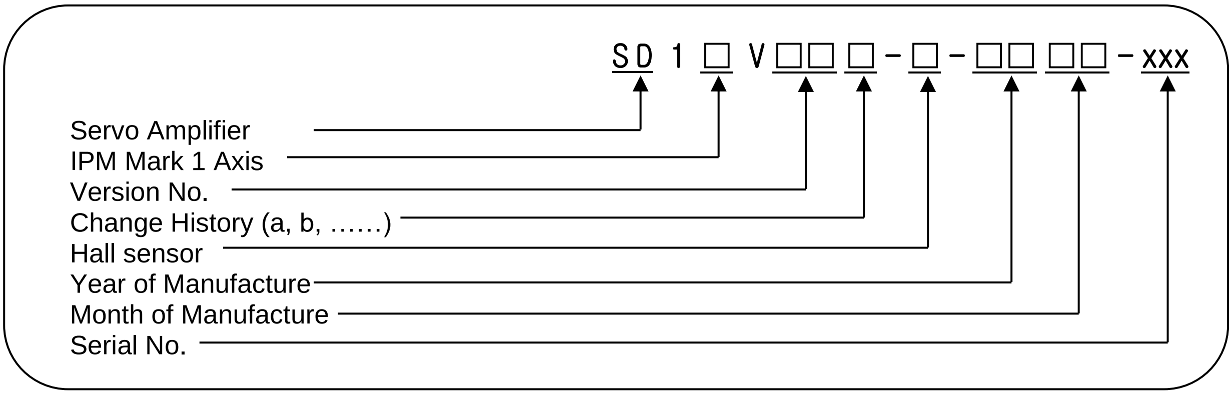


Table 4-59 Type code of optional drive unit

Classification	Mark of Type
Servo Drive	SD

Table 4-60 IPM capacity of optional drive unit

Large/Medium Size	**L**	(IPM Rated Current) 150A, (Hall Sensor Rated Current) 4V/75A
	X	(IPM Rated Current) 100A, (Hall Sensor Rated Current) 4V/50A
	Y	(IPM Rated Current) 75A, (Hall Sensor Rated Current) 4V/50A
	Z	(IPM Rated Current) 50A, (Hall Sensor Rated Current) 4V/25A

Table 4-61 Hall sensor code of optional drive unit

Drive Model	Hall Sensor Mark (Spec.)	Full-Scale Current (Im)	IPM Spec. (Rated Current)
Additional axis servo drive unit	0 (4V/75A)	140.62Apeak	**PM150CL1B060(150A)**
	1 (4V/50A)	93.75Apeak	**PM100CL1B060(100A) PM75CL1B060(75A) PM50CL1B060(50A)**
	2 (4V/25A)	46.87Apeak	
	3 (4V/15A)	28.12Apeak	
	4 (4V/10A)	18.75Apeak	
	5 (4V/5A)	9.37Apeak	

4.3.5.4. SD1X(Carriage drive unit: Option)

The drive unit plays a role of amplifying power by sending current to each motor according to the current command from the servo board. Carriage drive unit can operate 1 motor of 100A or lower and consists as follows.

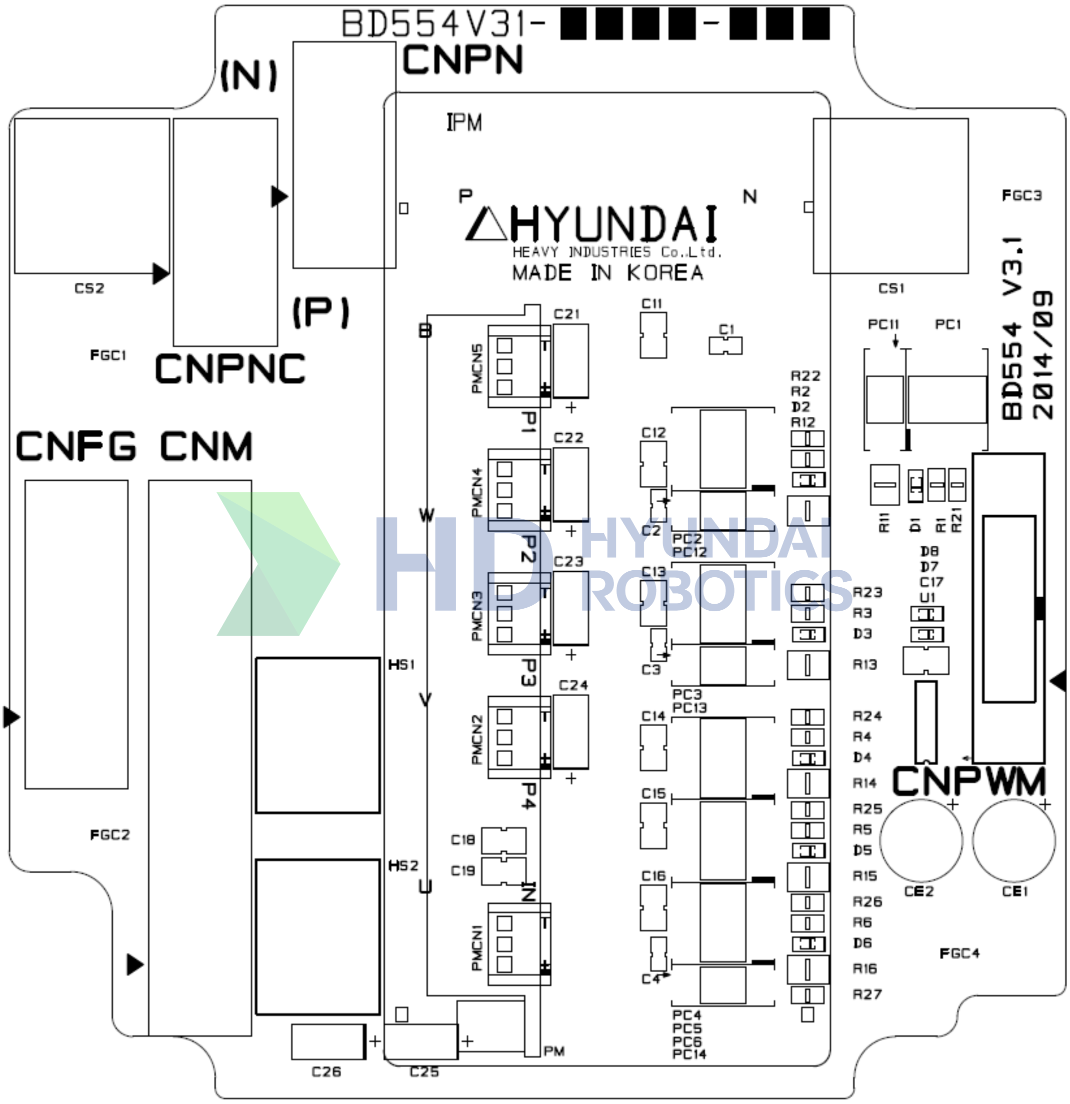


Figure 4.60 Carriage BD554 part layout

Table 4-62 The Components of SD1X

Components		Function
BD554 (IPM Board)	Logic Part	PWM signal from the 6-axis servo drive is converted to upper and lower drive signal of IPM, and the error is processed.
	Gate Power Module	Generation of gate power
	Current Detection Unit	Detection of the current flowing into the motor
Other Components	Heat Sink	Emission of heat generated from IPM
	IPM	100A Switching Device

Table 4-63 SD1X Connector

Name	Use	External Device Connection
CNPWM	PWM signal and error signal	CNPWM7 or CNPWM8 of 6-axis servo drive (BD552 or BD553)
CNM	Power for motor drive	AMC1 or AMC2
CNFG	Motor frame ground	AMC1 or AMC2
CNPN	Drive DC power input	CNPN2 of 6-axis servo drive (BD561 or BD563)
CNPNC	Drive DC power extension	Extended electrolytic condenser module

4.3.5.5. SD1Z(Servo gun drive unit; Option)

The drive unit plays a role of amplifying power by sending current to each motor according to the current command from the servo board. Servo gun drive unit can operate 1 motor of 50A or lower and consists as follows.

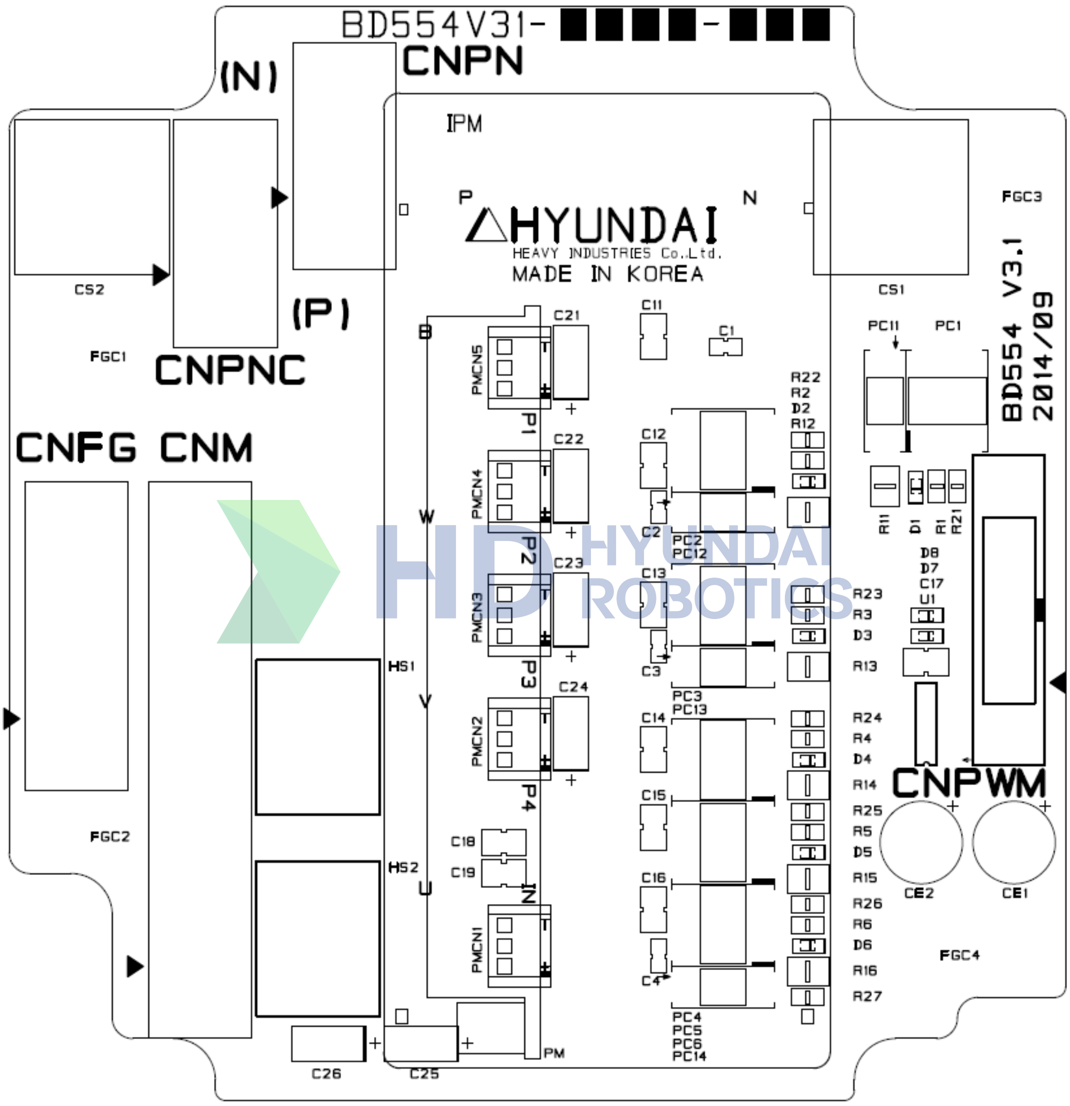


Figure 4.61 Servo gun BD554 part layout

Table 4-64 The Composition of SD1Z

Components		Function
BD554 (IPM Board)	Logic Section	PWM signal from the 6-axis servo drive is converted to upper and lower drive signal of IPM, and the error is processed.
	Gate Power Module	Generation of gate power
	Current Detection Unit	Detection of the current flowing into the motor
Other Components	Heat Sink	Emission of heat generated from IPM
	IPM	50A Switching Device

Table 4-65 SD1Z Connector

Name	Use	External Device Connection
CNPWM	PWM signal and error signal	CNPWM7 or CNPWM8 of 6-axis servo drive (BD552 or BD553)
CNM	Motor drive output, Frame Ground	AMC1 or AMC2
CNFG	Motor frame ground	AMC1 or AMC2
CNPN	Drive DC power input	CNPN2 of 6-axis servo drive (BD561 or BD563)
CNPNC	Drive DC power extension	Extended electrolytic condenser module

4.3.5.6. BD558T (Hi5a-T Controller Integrated Drive Unit)

The drive unit performs the power amplification function that allows the current to flow to each phase of the motor according to the current command from the servo board. The six-axis integrated drive unit can drive six motors at the same time and is configured, as shown below.

The diode module converter is integrated with the servo amp, rectifies and coverts the three-phase current supplied from the electric module into direct current using the diode module, and stores it into a smoothing capacitor. Then, the power generated from the motor when the robot decreases in speed is to be consumed through transistors and resistors. The converter is configured as follows.

Table 4-66 Configuration of the BD558T (Hi5a-T 6-Axis Integrated Drive Unit)

Components		Functions
BD558T (Integrated board)	Logic unit	Separates the PWM signal from the servo board into the IPM upper/lower driving signals and performs error processing
	Gate drive module	Generates the IPM gate signal
	Gate power module	Generates the gate power
	Current detection unit	Detects the current that flows through the motor
	Rectifier	Generates the DC power from AC power that will be supplied to the motor
	Regenerative control	Drives IGBT when the PN voltage increases
	Error detection unit	Detects overvoltage, regenerative resistor overheating, and surge input errors
	Control power unit	Generates the control power (: 5 V, ± 15 V)
	Pre-charge unit	A power sequence unit that protects the DC power smoothing capacitor
Other parts	Heat sink	Dissipates the heat generated from the power devices
	IPM	Switching device
	Capacitor	Smoothens the DC power
	Regenerative IGBT	Performs regenerative control
	Regenerative resistor	Consumes regenerative power

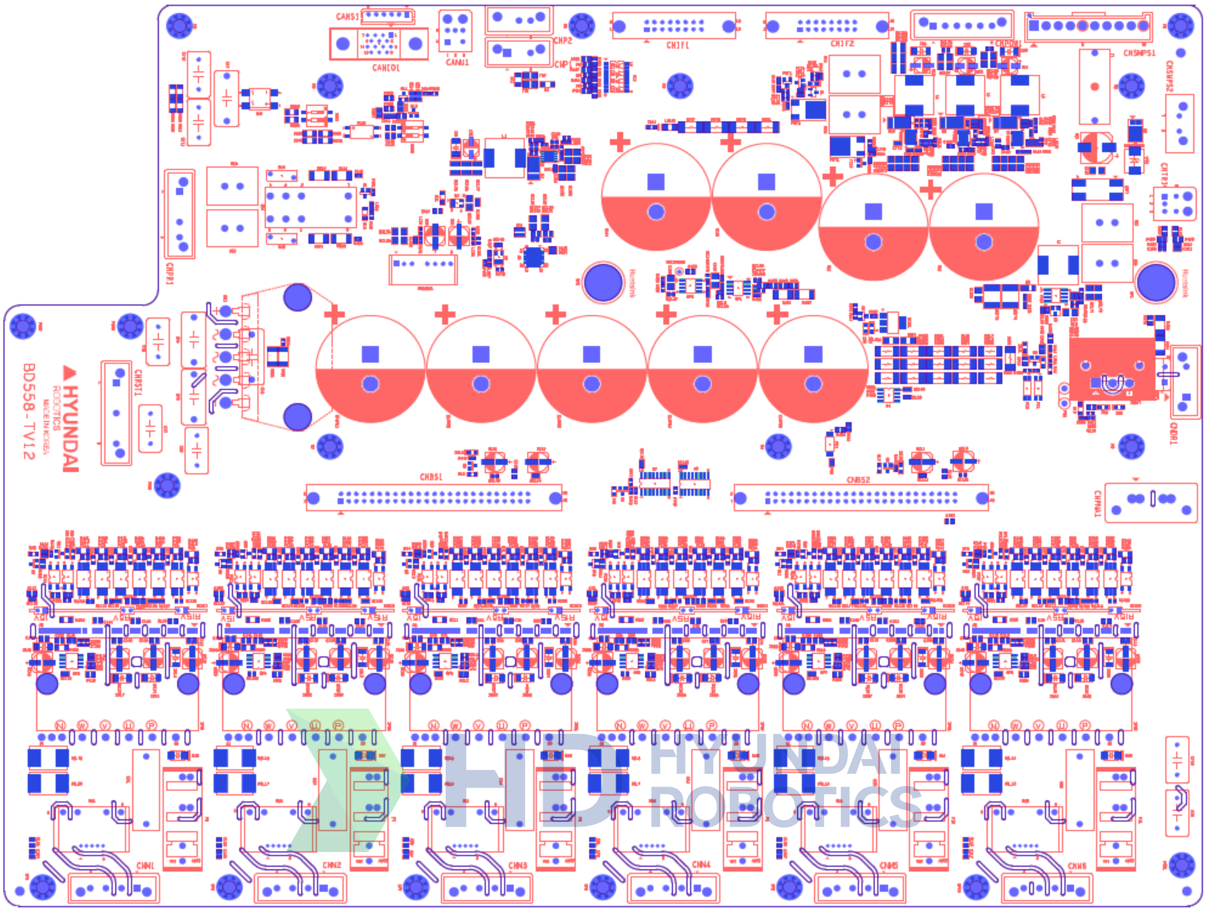


Figure 4.62 Parts Allocation Diagram of the BD558T

Table 4-67 Description of the Connectors for BD558T

Name	Usage	Connection of External Units
CNRST1	220 V Three-Phase (: R, S, T) Power Input	Magnetic Connector
CNPR1	220 V Single-Phase (: R, T) Power Input	Magnetic Connector
CNM1-6	Power PWM Output	Three Phases of Each Axis Motor
CNBS1-2	PWM Signal, Error Signal, Gate Power Supply	Servo Board (BD544) Interface
CNPNA1	Additional Axis Power Supply	Additional Axis AMP
CNDR1	Regenerative Resistor Connection	Regenerative Resistor
CNSMPS1	External SMPS Power Input	External SMPS
CNSMPS2	Sequence Board Power Supply	Sequence Board (BD567T)

CNP1	External Power Supply (24 V)	-
CNP2	External Power Supply (5 V)	-
CNPOW1	Control Power Supply (5 V, ±15 V)	Back Plane Board
CANIO1	CAN Communication 2PORT, Operation Sequence Signal	Mainboard (BD511)
CANS1	CAN Communication 1PORT	-
CANU1	External CAN Communication 1PORT	-
CNIF1	Operation Sequence Signal	Sequence Board (BD567T)
CNIF2	Operation Sequence Communication Signal	Sequence Board (BD567T)

Table 4-68 Type Symbol of the Hi5a-T 6-Axis Integrated Drive Unit

Classification	Type Symbol
Servo Drive	BD558T/BD558T-S

Table 4-69 Specification of the Hi5a-T 6-Axis Drive Unit

Item	Classification		Applicable	
IPM Capacity	3A	3B	HH4, HH4L, HH7, HH8	6-Axis Integrated
Year	00–99		Production Year: 2000–2099	
Month	01–12		Production Month: January–December	
Serial No.	001–999		Monthly Production Quantity: 1–999 Units	

Table 4-70 Capacity of the Hi5a-T IPM

Small	A	(IPM Current Rating) 50 A, (Hall Sensor Current Rating) 4 V / 15 A
	B	(IPM Current Rating) 20 A, (Hall Sensor Current Rating) 4 V / 5 A

Table 4-71 Hall Sensor Symbol for Hi5a-T IPMs

Drive Model	Hall Sensor Symbol (Specification)	Full-Scale Current (Im)	IPM Specification (Rated Current)
Small Servo Drive	3 (4 V / 15 A)	28.12 Apeak	PSS50S71F6 (50 A) PSS20S71F6 (20 A)
	5 (4 V / 5 A)	9.37 Apeak	

Table 4-72 Specification of Hi5a-T 6-Axis Integrated Regenerative IGBT

Regenerative IGBT	z	60 A Regenerative Resistor, 20 Ω 150 W 1 EA can be applied

Table 4-73 Specification of Hi5a-T 6-Axis Integrated Electrolytic Capacitor

Electrolytic Capacitor	5c	470 uF 5 EA

**** For IPM, hall sensors, IGBT, and electrolytic capacitors, the dedicated parts for the Hi5a-T controller should be used.**

Caution:
Because the drive unit differs depending on the robot, you must check the model when replacing it.

4.3.6. DC Multi Power Unit (SMPS: HDI-191)

The DC multi power unit supplies all the DC power within the controller. With the input voltage of AC48V, it is a multi-power supply device which generates various kinds of stabilized DC voltages and supplies them to many boards, drive unit, system IN/OUT, and teach pendant within the controller.

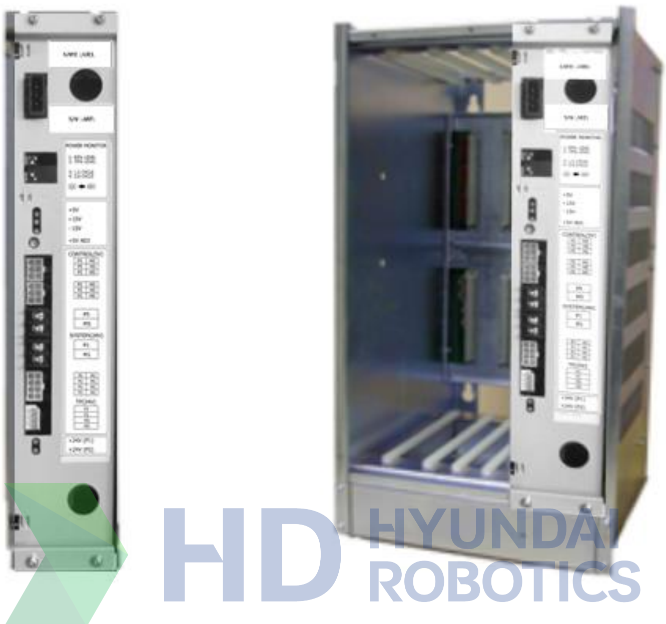


Figure 4.63 External appearance of SMPS SR1 and configuration mounted in Rack

Table 4-74 SMPS (SR1) Standards (Input Voltage: AC 220V, 50/60Hz)

Rated Output	Use	Connection
P5-M5	Board Power in Rack: DC5V	Backplane Board (BD502)
P1-M1	System I/O Power: DC24V	System board and other option boards
P2-M2	Teach pendant Power: DC24V	TP520/TP530 Connector (CNTP)
DC-15V	Drive Unit Control Power	Backplane Board (BD502)
DC+15V	The Control Power for Analog Section of the Servo Board	Backplane Board (BD502)

4.3.7. Electrical Module

4.3.7.1. PSM and electric board (BD5C2)

PSM(Hi5a-S controller electric module) controls the opening/closing and distribution of power supplied to the controller. Following figures show the interior/exterior of electric modules with different connectors and fuses.

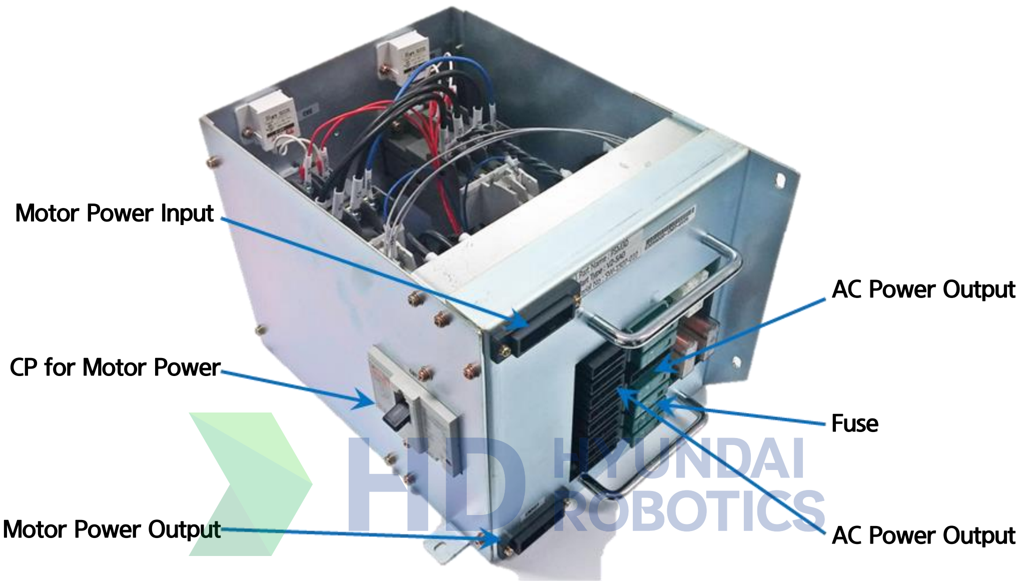


Figure 4.64 Exterior of PSM(Hi5a-S controller electric module)

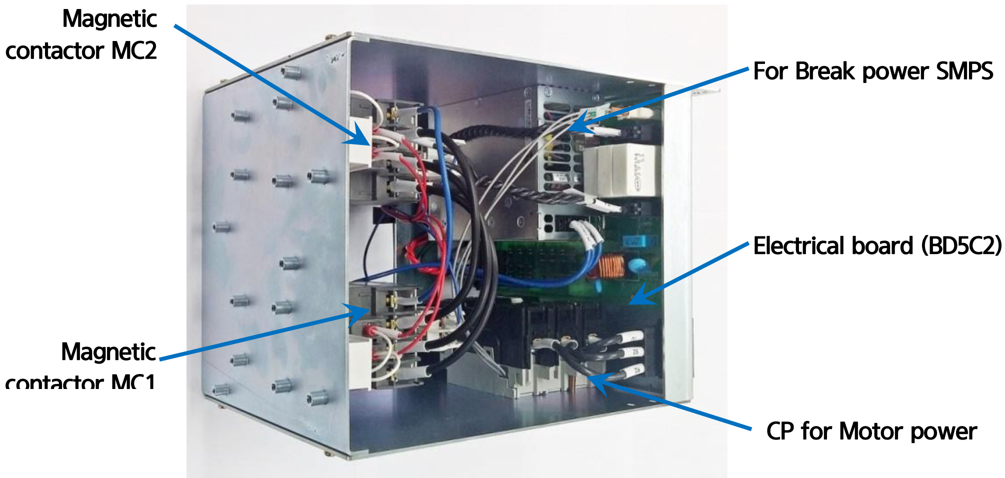


Figure 4.65 Interior of PSM(Hi5a-S controller electric module)

The following power flow chart shows the opening/closing of the 3-phase AC power for motor power supply, generation of brake power, AC control power such as fan operation, and the distribution of SMPS power for DC device power supply. Each power supply is equipped with a circuit breaker or fuse to protect components from over current. The electrical board (BD5C2) is used to minimize the use of the cables used for the distribution of power.

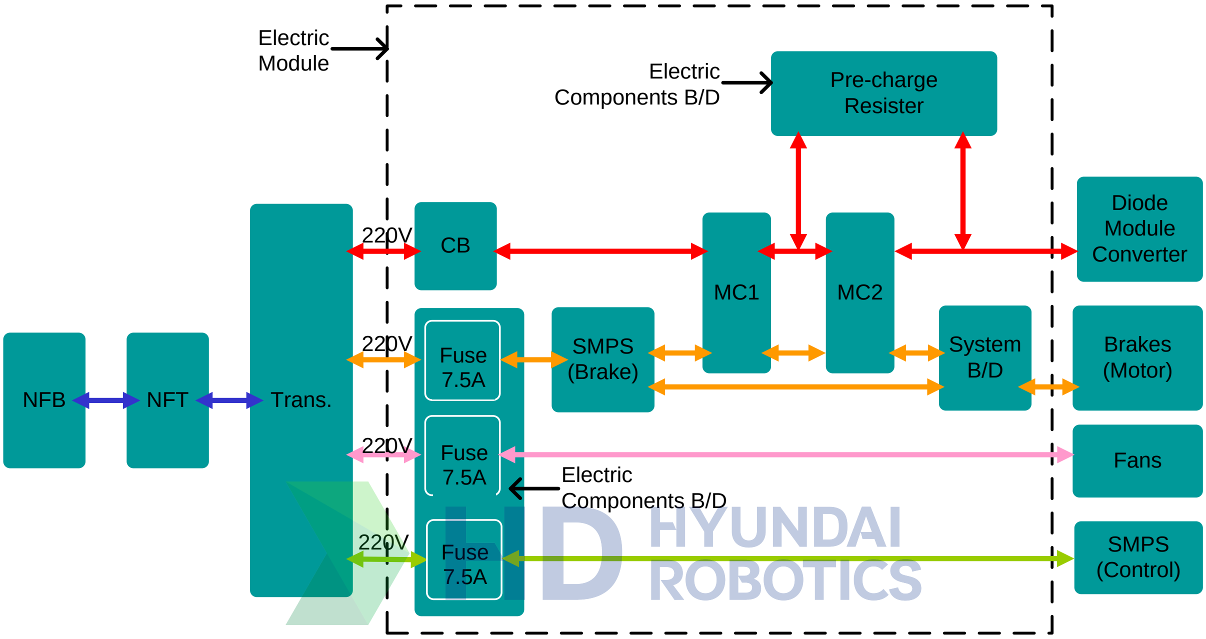


Figure 4.66 Power system of controller Hi5a-S

Table 4-75 The Sorts and Uses of Fuses in the Electrical Module

Name	Use	Spec.
F1, F2	Overcurrent Protection Fuse of the Electrical Control Power(AC220V)	AC220V 7.5A
F3, F4	Overcurrent Protection Fuse of the Rack SMPS Power (AC220V)	AC220V 7.5A
F5, F6	Overcurrent Protection Fuse of the Brake SMPS Power (AC220V)	AC220V 7.5A

※ BD5C2 : Application after May 2019

4.3.7.2. BD5C2 Connector

The following picture shows the layout of the electrical board (BD5C2)'s connectors and the table shows the uses of each connector and other connection devices.

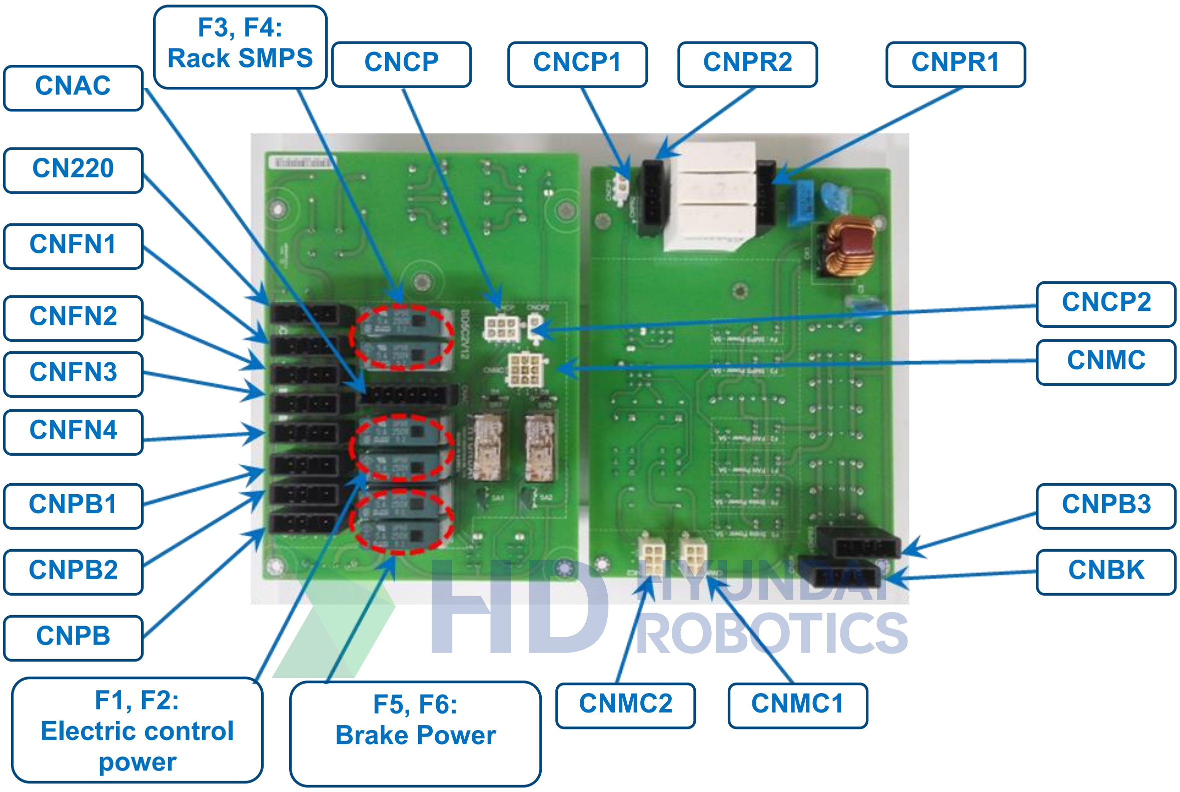


Figure 4.67 Connectors of the Electrical Board (BD5C2)

Table 4-76 Types and purposes of BD5C2 connectors

Name	Use	External Devices Connection
CNAC	Various AC power inputs	Transformer
CN220	SMPS Power Output (AC220V)	Rack SMPS
CNFN1~4	Electric control power output(AC220V)	FAN Module
CNPR1	Precharge Resistance Power Input	MC2 Input
CNPR2	Precharge Resistance Power Output	MC2 Output
CNBK	Brake Power Output (AC220V)	Brake Power SMPS Input
CNPB3	Brake Power Input (DC24V)	Brake Power SMPS Output
CNPB1,2	Brake Power Output (DC24V)	Servo Amp and Extended Brake Board
CNPB	Brake Power Output (DC24V)	System Board CNPB Input
CNCP1	Input of Motor Power Circuit Breaker Monitoring	Motor Power Circuit Breaker
CNCP	Output of the Monitoring of Circuit Breaker and Fuse	System Board CNCP Input
CNMC1,2	The Drive and Monitoring of Magnetic Contactor	Magnetic Contactor MC1, MC2
CNMC	Drive Signal and Monitoring Signal for Magnetic Contactor	System Board CNMC Input

4.3.7.3. PDM and Electrical Board (BD5C0)

PDM(Hi5a-C controller electric module) controls the opening/closing and distribution of power supplied to the controller. The following picture shows the interior and exterior of the electrical module equipped with various connectors and fuses.

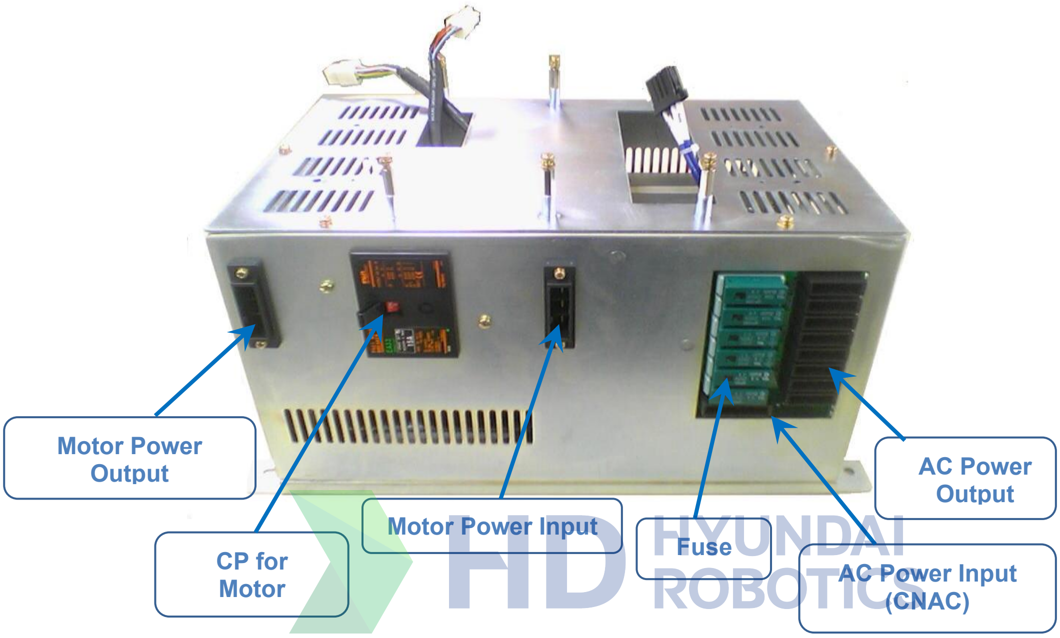


Figure 4.68 Electrical Module

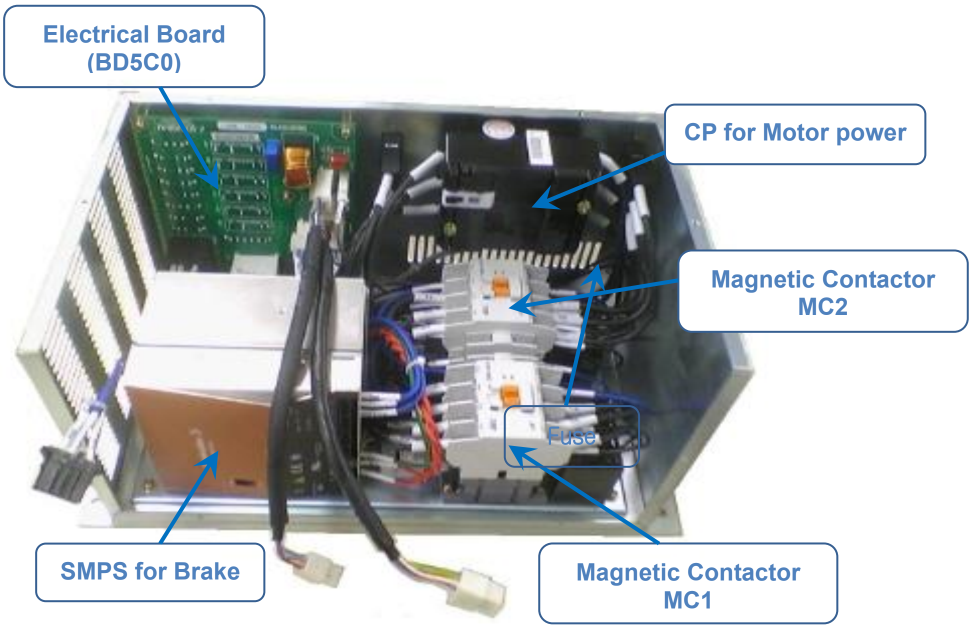


Figure 4.69 The Interior of Electrical Module

The following power flow chart shows the opening/closing of the 3-phase AC power for motor power supply, generation of brake power, AC control power such as fan operation, and the distribution of SMPS power for DC device power supply. Each power supply is equipped with a circuit breaker or fuse to protect components from over current. The electrical board (BD5C0) is used to minimize the use of the cables used for the distribution of power.

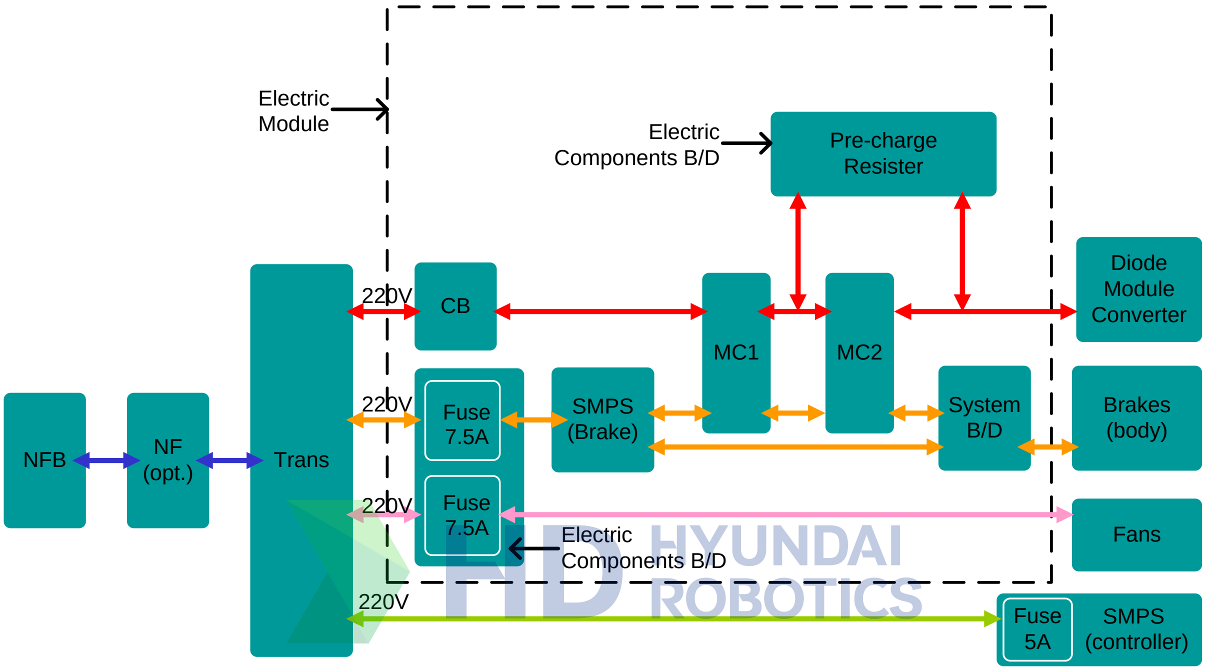


Figure 4.70 Power system of controller Hi5a

Table 4-77 The Sorts and Uses of Fuses in the Electrical Module

Name	Use	Spec.
F1, F2	Overcurrent Protection Fuse of the Electrical Control Power(AC220V)	AC220V 7.5A
F3, F4	Overcurrent Protection Fuse of the Rack SMPS Power (AC48V): Not used	AC48V 10A
F5, F6	Overcurrent Protection Fuse of the Brake SMPS Power (AC220V)	AC220V 7.5A

※ BD5C0 : Application after May 2019

4.3.7.4. BD5C0 Connector

The following picture shows the layout of the electrical board (BD5C0)'s connectors and the table shows the uses of each connector and other connection devices.

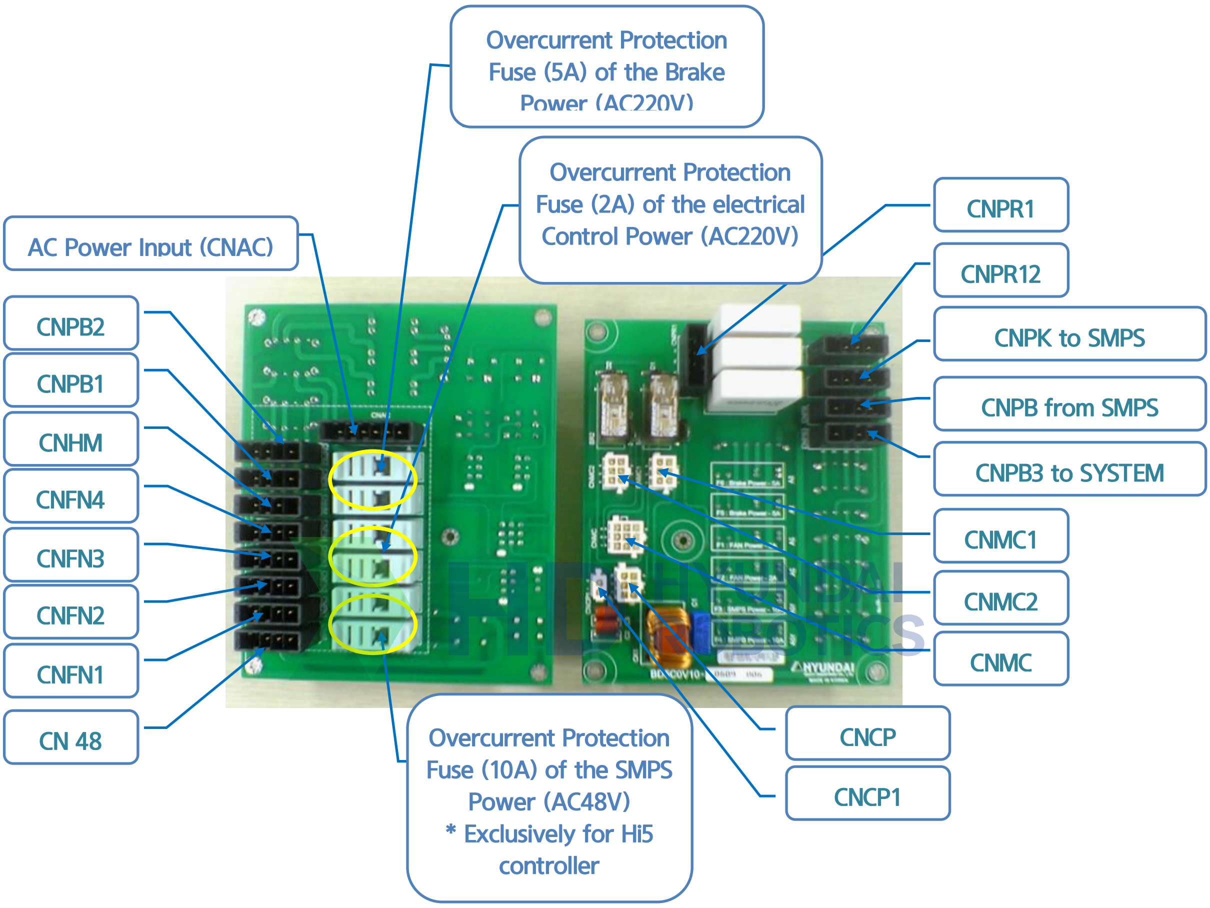


Figure 4.71 Connectors of the BD5C0

Table 4-78 Types and applications of fuses in the electronic control module

Name	Use	External Devices Connection
CNAC	Various AC power inputs	Transformer
CN48	SMPS power output(AC48V): Not used	Hi5a controller Rack SMPS
CNFN1~4	Electric control power output(AC220V)	FAN Module
CNHM	Power Output (AC220V) for Hour Meter	AC220V Hour Meter (Option)
CNPR1	Precharge Resistance Power Input	MC2 Input
CNPR2	Precharge Resistance Power Output	MC2 Output
CNBK	Brake Power Output (AC220V)	Brake Power SMPS Input
CNPB	Brake Power Input (DC24V)	Brake Power SMPS Output
CNPB1,2	Brake Power Output (DC24V)	Servo Amp
CNPB3	Brake Power Output (DC24V)	System Board CNPB Input
CNCP1	Input of Motor Power Circuit Breaker Monitoring	Motor Power Circuit Breaker
CNCP	Output of the Monitoring of Circuit Breaker and Fuse	System Board CNCP Input
CNMC1,2	The Drive and Monitoring of Magnetic Contactor	Magnetic Contactor MC1, MC2
CNMC	Drive Signal and Monitoring Signal for Magnetic Contactor	System Board CNMC Input

4.3.8. Teach pendant (TP520/TP530)

4.3.8.1. Outline

Teach pendant (TP520/TP530) performs communication through a main board (BD511) of a controller and Ethernet, allowing a user to perform many functions as detailed below.

- Monitoring: Work program / data of each axis / input*output signal / robot state, etc.
- History management: System version / operating time / error history / stop history, etc.
- File management: Version & teaching program up/down
- Setting various parameters:
  User environment / control/ robot / application / automatic integral number, etc.
- Robot teaching: Jog & teaching program registration
- Robot operation: MOTOR ON / START / STOP / MODE setting

Additionally, the teach pendant is equipped with a three-step enable switch, an emergency stop switch, etc. to ensure worker safety.
In addition, USB A type connector is installed under the rubber cover on the right side of teach pendant so a user can use a USB memory stick to up/download the versions of different versions as well as required files including data and teaching program.

Figure 4.72 Appearance of teach pendant TP520/TP530

4.3.8.2. USB cover

USB A type connector is installed under the rubber cover on the right side of teach pendant so a user can use a USB memory stick to up/download the versions of different versions as well as required files including data and teaching program.

Figure 4.73 USB cover of teach pendant TP520/TP530

Note) Keep the USB port closed with rubber cover when not in use.

4.3.9. Purge control board (BD5D0)

This board controls the valves of the pneumatic facilities for the pressurized explosion-proof function of the robot, and monitors pressure switch signals.

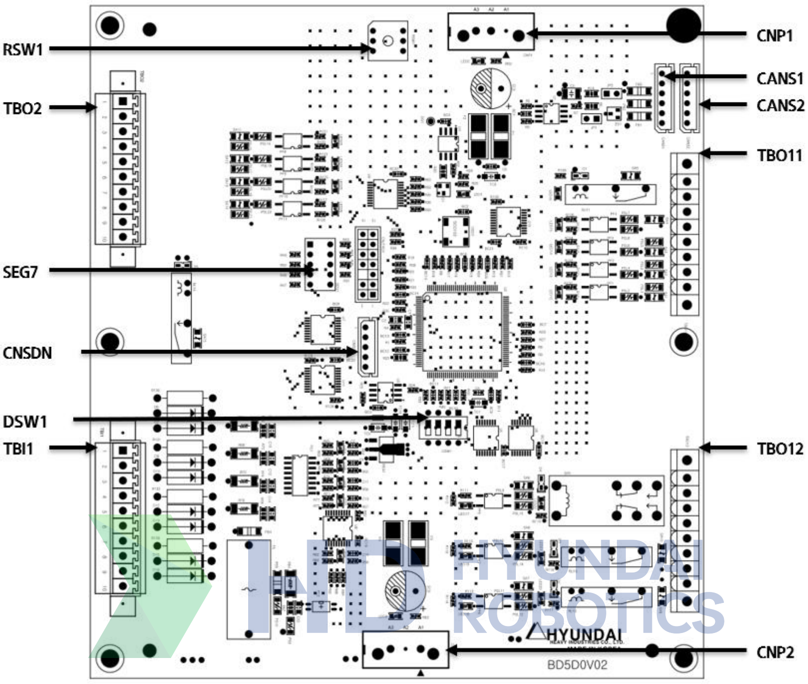


Figure 4.74 Parts diagram of the purge control board (BD5D0)

Table 4-79 Types and usage of BD5D0 connectors

Name	Usage	Spec.
CNP1	Control power	5V
CNP2	24V IO power	24V/5A SMPS
TBI1	Pressure switch connection	24V IO power
TBO11	Status indicator connection	24V IO power
TBO12	Air purge value control signal	24V IO power
TBO2	Purge status signal	BD530 TBIO

4.3.10. Encoder relay board (BD5D1)

After the air purging operation is normally performed, the encoder signal shall be connected through the operation of the relay.

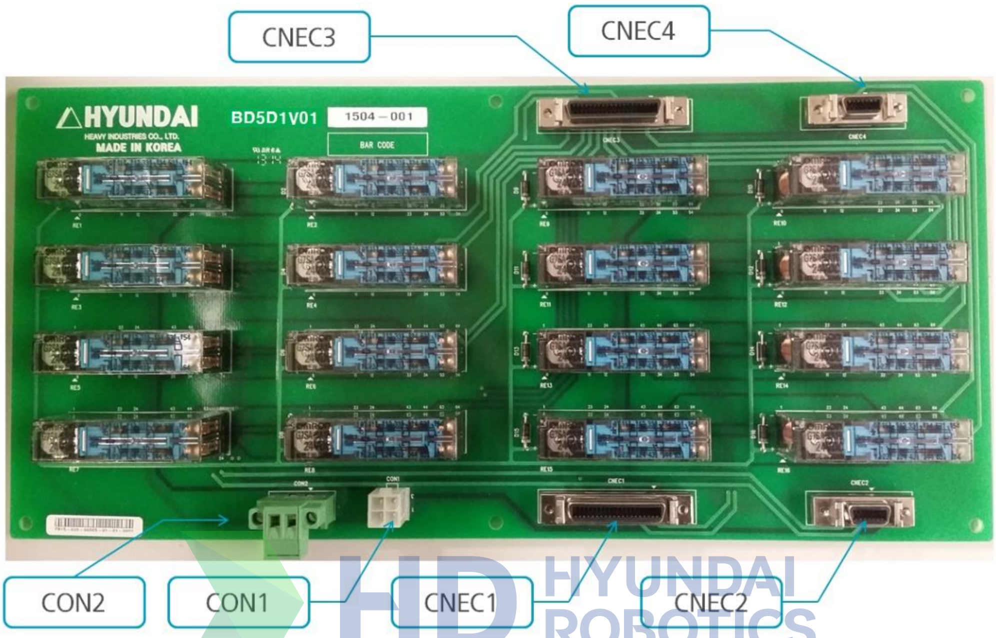


Figure 4.75 Parts diagram of the encoder relay board (BD5D1)

Table 4-80 Types and usage of BD5D1 connectors

Name	Usage	Spec.
CON1	-	OBSOLETE
CON2	Relay operation power	BD5D0 TBO12
CNEC1	Basic axis encoder	BD544 CNEC1
CNEC2	Additional axis encoder	BD544 CNEC2
CNEC3	Basic axis encoder	CEC1
CNEC4	Additional axis encoder	CEC2

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5

Controller Options

5.1. Public IO Board (BD580; Terminal Block)

5.1.1. Outline

Public DIO board can be used for interface or configuration with various devices through the digital input/output port. The specification of the basic board is as follows.

- Digital input (Photocoupler type): 32 points (4 ports)
- (+/-) Two-way digital output (Photo MOS type): 32 points (4 ports)
- 1Mbps CAN communication
- When relay contact point is required, the relay board can be installed

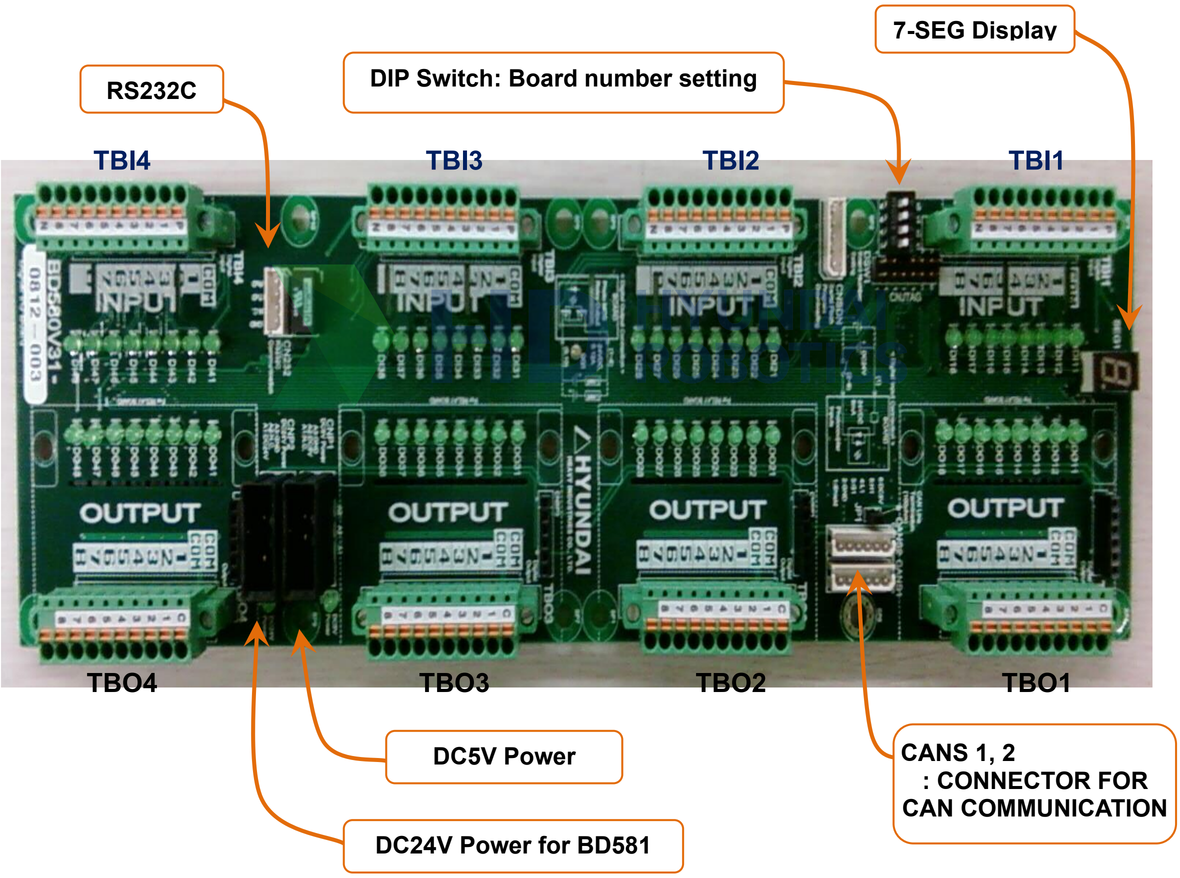


Figure 5.1 Public IO Board (BD580)

5.1.2. Connector

5.1.2.1. Digital Input

The following Figure and Table describe the pin composition of the terminal block (TBI1~4) for digital input. Each terminal block connects to 8 input signals, and different power can be used depending on the usage.

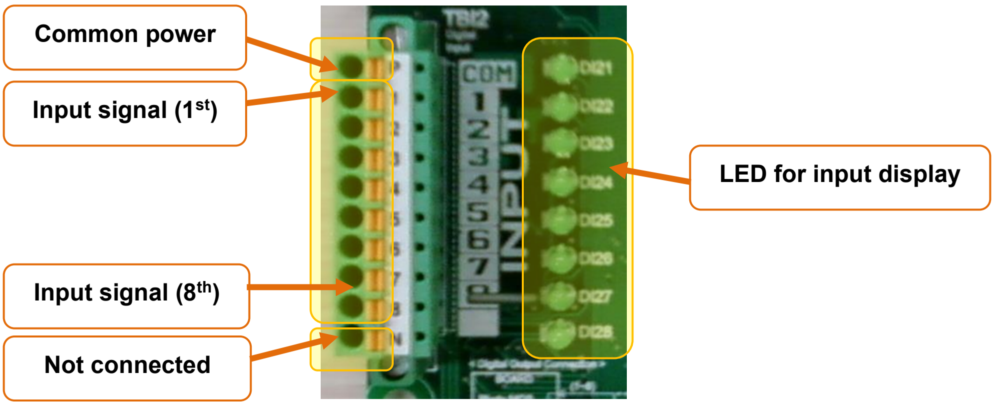


Figure 5.2 Pin Configuration of Digital Input Terminal Block of Public IO Board (BD580)

Table 5-1 Pin Configuration of Digital Input Terminal Block (TBIn*) of Public IO Board (BD580)

Pin Number	Signal Name	Signal Description
1	COMn*	COMMON power (Ground DC24V or DC24V)
2	DI n*1	1st input of nth public input signal port of user
3	DI n*2	2nd input of nth public input signal port of user
4	DI n*3	3rd input of nth public input signal port of user
5	DI n*4	4th input of nth public input signal port of user
6	DI n*5	5th input of nth public input signal port of user
7	DI n*6	6th input of nth public input signal port of user
8	DI n*7	7th input of nth public input signal port of user
9	DI n*8	8th input of nth public input signal port of user
10	N.C	No connection

Note *) Terminal block Number n = 1~4 (Ex, TBI1, TBI2, TBI3, TBI4)

The input specification of each port is as follows

- Input port component: AC input photocoupler
- Input impedance: 3 ㏀
- Common power: Ground 24VDC or 24VDC

The user connects the input signal through the method shown in Figure 5.3 below. First, connect the user power of +24V or the ground wire to the public IO board (BD580), and then connect each signal to the input pin according to the usage. For the power, 8 input ports can be composed as a unit, and can be used differently.

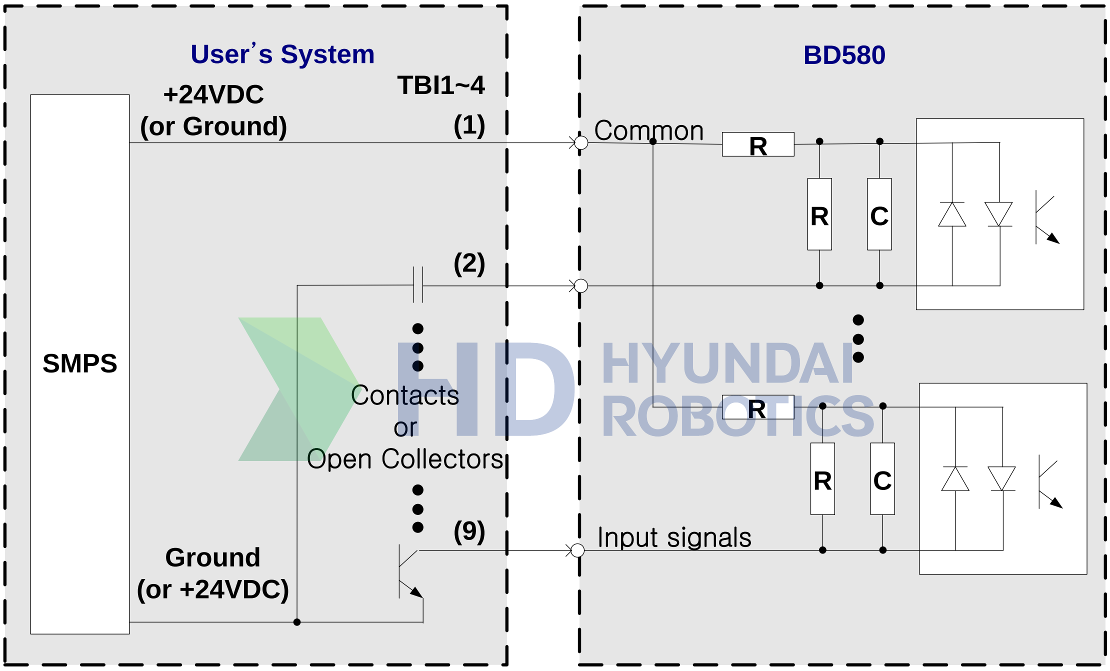


Figure 5.3 Wiring of Input Signals of the Public IO Board (BD580)

Caution:
Public IO Board V3.0 or lower does not support two-way digital input. For this reason, DC24V must be used for common power.

5.1.2.2. Digital Output

The following Figure and Table show the pin composition of terminal block (TB01~4) for digital output. Each terminal block can be connected to 8 output signals, and different power can be used depending on the usage.

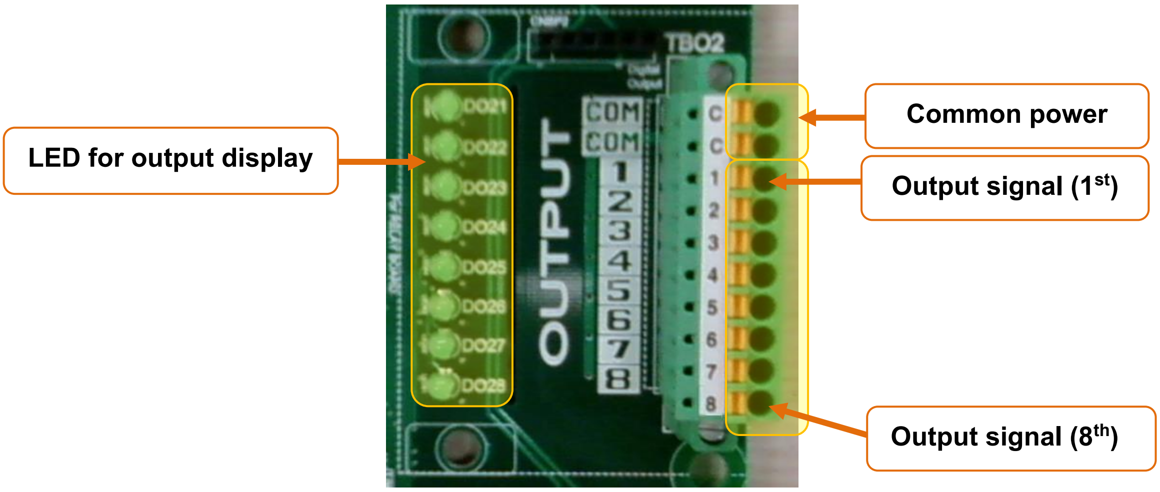


Figure 5.4 Pin Configuration of Digital Input/output Terminal Block of the Public IO Board (BD580)

Table 5-2 Pin Configuration of Digital Input/output Terminal Block (TBOn*) of the Public IO Board (BD580)

Pin Number	Signal Name	Signal Description
10	COMn*	COMMON power (Ground DC24V or DC24V)
9		
8	DOn*1	1st output of nth public output signal port of user
7	DOn*2	2nd output of nth public output signal port of user
6	DOn*3	3rd output of nth public output signal port of user
5	DOn*4	4th output of nth public output signal port of user
4	DOn*5	5th output of nth public output signal port of user
3	DOn*6	6th output of nth public output signal port of user
2	DOn*7	7th output of nth public output signal port of user
1	DOn*8	8th output of nth public output signal port of user

Note *) Terminal Block Number n = 1~4 (Ex, TBO1, TBO2, TBO3, TBO4)

The output specification of each port is as follows.

- Output component: Photo MOSFET output
- Rated output: 125mA (Continuous load current) / 24V DC
- Common power: Ground 24VDC or 24VDC

The user connects the output signal through the method shown in Figure 5.5 below. First, connect the common signal (COMMON) to the public IO board (BD580), and then connect each signal to the output pin according to the usage. For the power, 8 output signals can be composed as a unit and can be used differently.

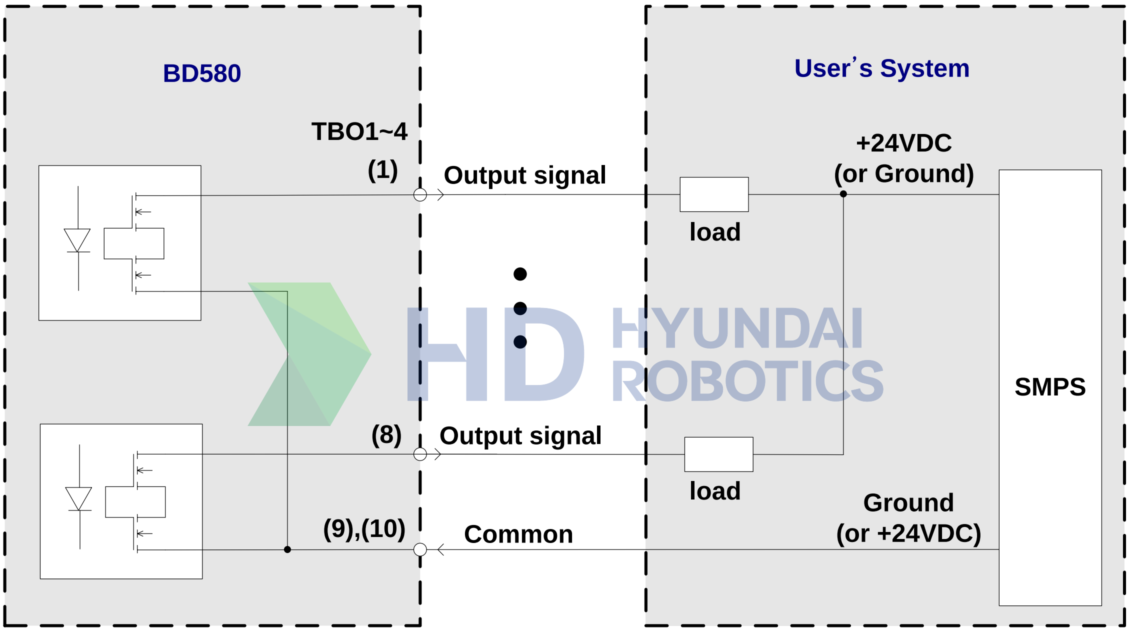
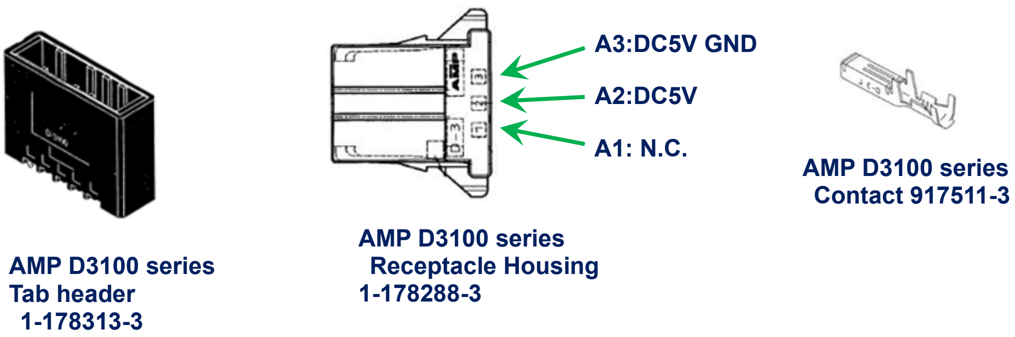


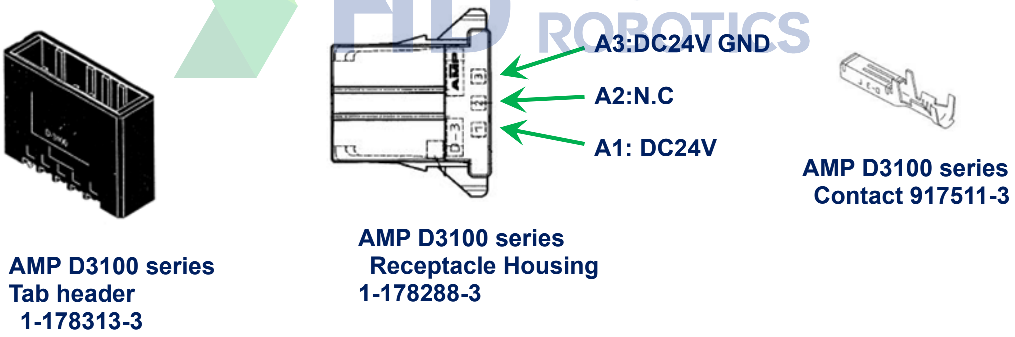
Figure 5.5 Method for the Connection of the Output Signals of the Public IO Board (BD580)

5.1.2.3. Power Connector: CNP1, CNP2

The Power Connector is the connector to supply the power to operate the public IO board (BD580), and is composed of connectors CNP1 for DC5V and CNP2 for DC24V, as shown in the Figure. As the power required for the basic operation of the board is DC5V, CNP1 must be connected. The connection of CNP2 for DC24V power can be made as required by the usage. The purpose of CNP2 is to operate the relay board that is additionally installed to the board. Therefore, CNP2 does not need to be connected for applications that do not require the relay board.



(a) CNP1 (DC5V power)



(b) CNP2 (DC24V power)

Figure 5.6 Power Connectors of the Public IO Board (BD580), CNP1 and CNP2

5.1.2.4. CAN Communications Connector: CANS1, CANS2

For the CAN Communications Connector, there are two identical connectors with the same pin specification, which are installed as shown in Figure 5.7 below. As CAN communication is conducted through cable, with a Daisy Chaining method, it therefore does not matter which side of the connector it is connected to, as it does not affect the operation.

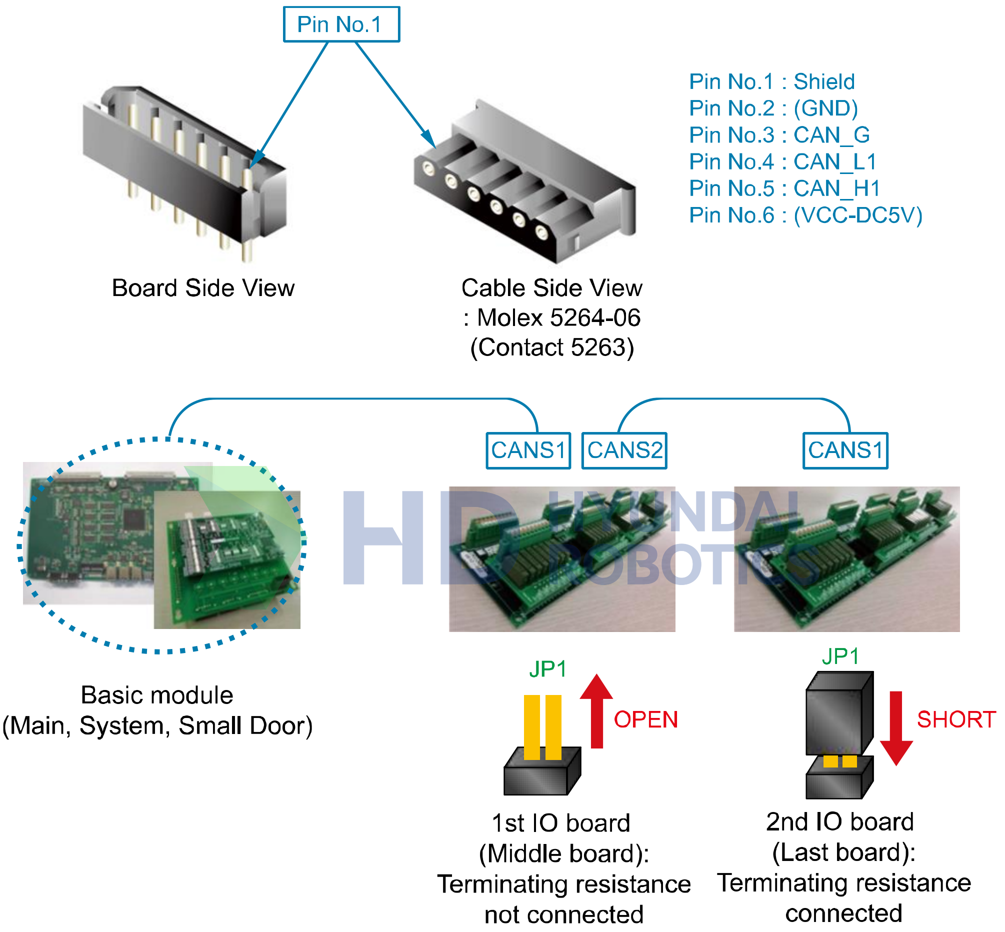


Figure 5.7 Method for the Connection of CAN Connectors of the Public IO Board (BD580)

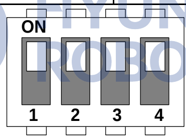
When connecting several boards, the terminating resistance must be processed precisely. CAN data communication uses the Daisy Chaining method. Therefore, only the board connecting the CAN communication cable at the end must be connected to the terminating resistance; all other boards must not be connected to the terminating resistance. For the connection of terminating resistance, use the JP1 jumper next to the CAN Connectors 1 and 2. When you short-circuit JP1, the terminating resistance is connected, and when opened, the terminating resistance is disconnected.

5.1.3. Setting Unit

5.1.3.1. DIP Switch Settings

DIP switch DSW1 sets the number of the board using a hexadecimal code. Based on the DIP switch settings, the number of the board is shown in Table 5-3 below.

Table 5-3 Settings of the DSW1 Switch of the Public IO Board (BD580)

Switch Number	4	3	2	1	Setting (Board Number)
Switch Condition	OFF	OFF	OFF	OFF	1
	OFF	OFF	OFF	ON	2
	OFF	OFF	ON	OFF	3
	OFF	OFF	ON	ON	4
Default setting	OFF	OFF	OFF	OFF	1
Switch exterior					

5.2. Relay Board (BD581)

5.2.1. Outline

The relay board is the board installed on the public IO board (BD580) to convert the semi-conductor output to contact point output in an 8-point unit.

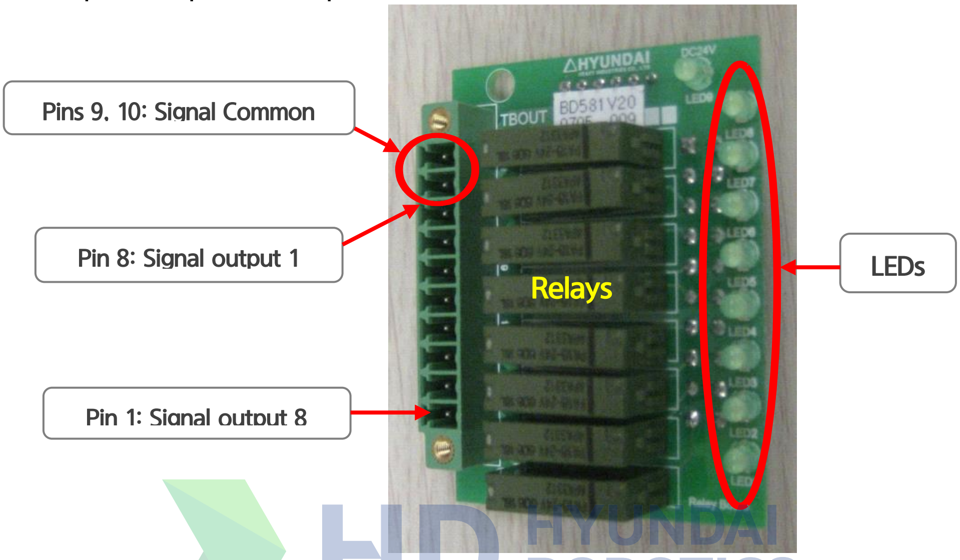


Figure 5.8 Relay Output Board of Public IO Board (BD581)

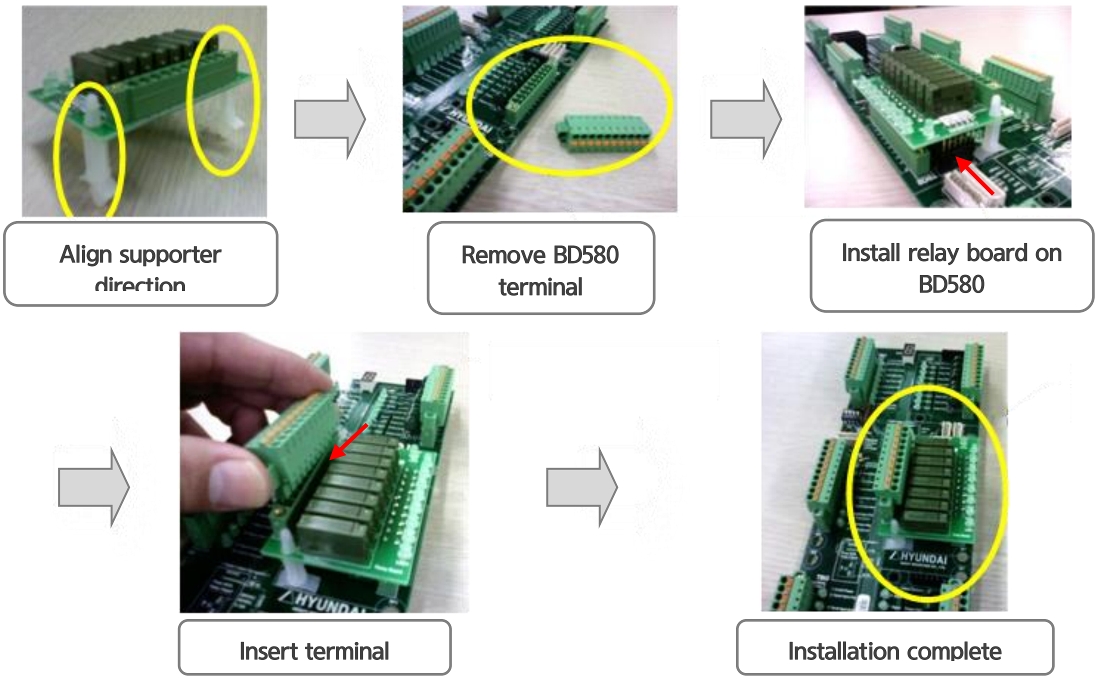


Figure 5.9 Method for the Installation of Relay Board

5.2.2. Connector

The output specification of the 8-point connector is as follows.

- Output component: Relay
- Rated output: 3A, 220VAC/24V DC

Table 5-4 Pin Configuration of the Digital Output Terminal Block (TBOUT) of the Relay Board (BD581)

Pin Number	Signal Name	Signal Description
10	COM	COMMON power (DC24V, DC24V ground, AC220V)
9		
8	DO1	1st user public relay output signal
7	DO2	2nd user public relay output signal
6	DO3	3rd user public relay output signal
5	DO4	4th user public relay output signal
4	DO5	5th user public relay output signal
3	DO6	6th user public relay output signal
2	DO7	7th user public relay output signal
1	DO8	8th user public relay output signal

5.3. Public IO Board (BD582: Connector Type)

5.3.1. Outline

The Public DIO board can be used for interface or configuration with various devices through the digital IO port. The specification of the basic board is as follows.

- Digital input (Photocoupler type) 32 points (4 ports)
- (+/-) Two-way digital output (Photo MOS type) 32 points (4 ports)
- 1Mbps CAN communication
- Input/Output connector: MDR-type connector (3M)

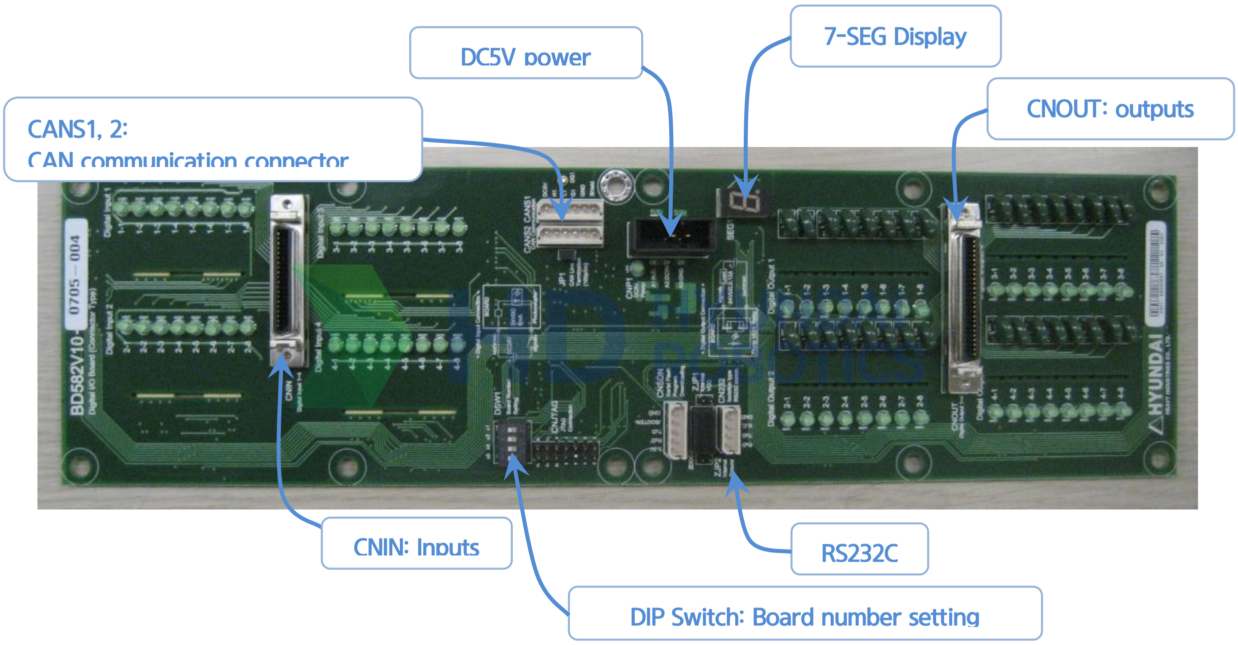


Figure 5.10 Public IO Board (BD582)

5.3.2. Connector

5.3.2.1. Digital Input

The following Figure and Table show the pin composition of connector CNIN for digital input. For the 32-point input pin, different power can be used for 8 input signals.

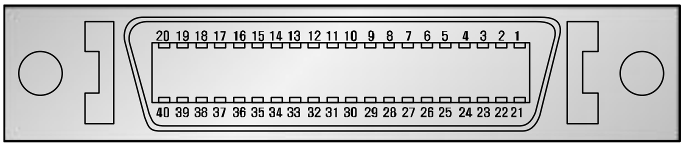


Figure 5.11 CNIN Connector (3M MDR 10240-52A2JL) of the Public IO Board (BD582)

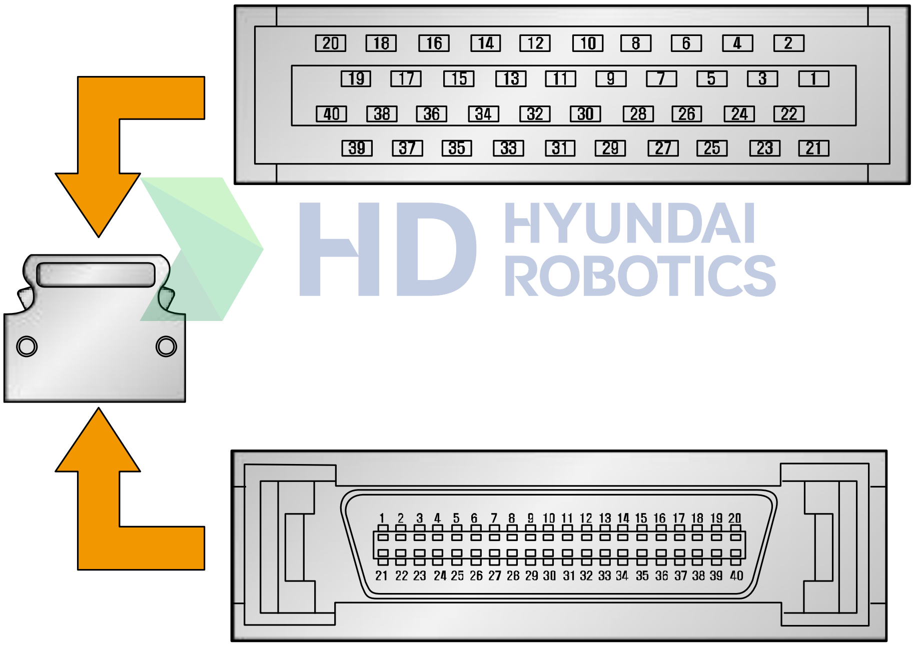


Figure 5.12 3M MDR 10140-3000VE of CNIN Connector Plug of the Public IO Board (BD582)

Table 5-5 Pin Configuration of Digital Input Connector CNIN of the Public IO Board (BD582)

Pin Number	Signal Name	Function Description (Expansion Board/Basic Board)
1	DI01	Public input 1
2	DI02	Public input 2
3	DI03	Public input 3
4	DI04	Public input 4
5	DI05	Public input 5
6	DI06	Public input 6
7	DI07	Public input 7
8	DI08	Public input 8
9	COMIN0	External power input (User power): +24 V (For DI01~DI08)
10		
11	DI09	Public input 9
12	DI10	Public input 10
13	DI11	Public input 11
14	DI12	Public input 12
15	DI13	Public input 13
16	DI14	Public input 14
17	DI15	Public input 15
18	DI16	Public input 16
19	COMIN1	External power input (User power): +24 V (For DI09~DI16)
20		
21	DI17	Public input 17

Pin Number	Signal Name	Function Description (Expansion Board/Basic Board)
22	DI18	Public input 18
23	DI19	Public input 19
24	DI20	Public input 20
25	DI21	Public input 21
26	DI22	Public input 22
27	DI23	Public input 23 (Signal for external operation)
28	DI24	Public input 24
29	COMIN2	External power input (User power): +24 V (For DI17~DI24)
30		
31	DI25	Public input 25
32	DI26	Public input 26
33	DI27	Public input 27
34	DI28	Public input 28
35	DI29	Public input 29
36	DI30	Public input 30
37	DI31	Public input 31
38	DI32	Public input 32
39	COMIN3	External power input (User power): +24 V (For DI25~DI32)
40		

The input specification of each port is as follows.

- Input port component: AC input photocoupler
- Input impedance= 3 ㏀
- (+) Common input voltage = 24 VDC
- (-) Common input voltage = 0 VDC

The user connects the input signal through the method shown in Figure 5.13 below. First, connect the user power +24 V and ground wire to the public IO board (BD582), and then connect each signal to the input pin, depending on the usage. The power can be differently used by the 8 input port units.

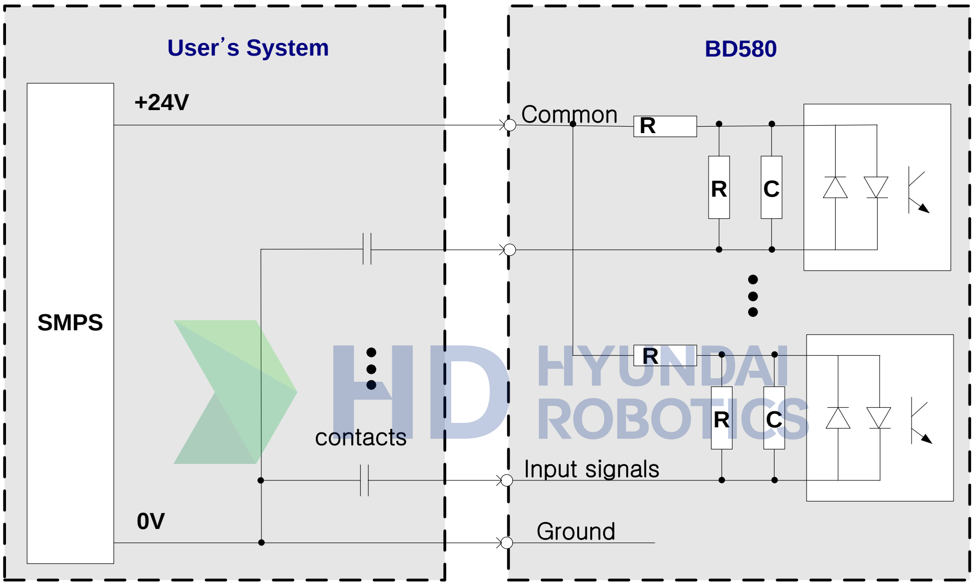


Figure 5.13 Method for Wiring Input Signals of the Public IO Board (BD582)

5.3.2.2. Digital Output

The following Figure and Table show the pin composition of connector CNOUT for digital output. For the 32-point output pin, different power can used for 8 output signals.

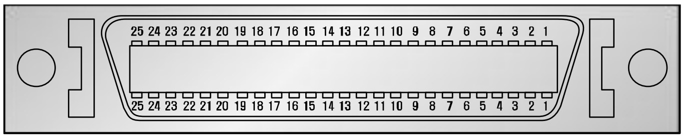


Figure 5.14 CNOUT Connector (3M MDR 10250-52A2JL) of the Public IO Board (BD582)

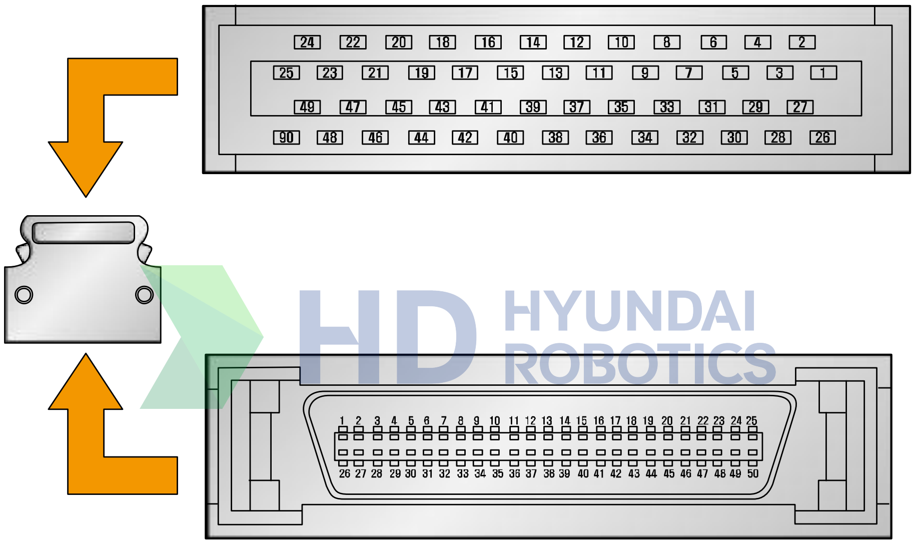


Figure 5.15 3M MDR 10150-3000VE of the CNOUT Connector Plug of the Public IO Board (BD582)

Table 5-6 Pin Configuration of the Digital Input Connector CNOUT of the Public IO Board (BD582)

Pin Number	Signal Name	Function Description (Expansion Board/Basic Board)
1	DO01	Public output 1
2	DO02	Public output 2
3	DO03	Public output 3
4	DO04	Public output 4
5	DO05	Public output 5
6	DO06	Public output 6
7	DO07	Public output 7
8	DO08	Public output 8
9	COMOUT0	External power input (User power): COMMON (For DO01~DO08)
10		
11	DO09	Public output 9
12	DO10	Public output 10
13	DO11	Public output 11
14	DO12	Public output 12
15	DO13	Public output 13
16	DO14	Public output 14
17	DO15	Public output 15
18	DO16	Public output 16
19	COMOUT1	External power input (User power): COMMON (For DO09~DO16)
20		
21	N.C	Not used
22	N.C	Not used
23	N.C	Not used
24	N.C	Not used
25	N.C	Not used
26	N.C	Not used

Pin Number	Signal Name	Function Description (Expansion Board/Basic Board)
27	N.C	Not used
28	N.C	Not used
29	N.C	Not used
30	N.C	Not used
31	DO17	Public output 17
32	DO18	Public output 18
33	DO19	Public output 19
34	DO20	Public output 20
35	DO21	Public output 21
36	DO22	Public output 22
37	DO23	Public output 23
38	DO24	Public output 24
39	COMOUT2	External power input (User power): COMMON (For DO17~DO24)
40		
41	DO25	Public output 25
42	DO26	Public output 26
43	DO27	Public output 27
44	DO28	Public output 28
45	DO29	Public output 29
46	DO30	Public output 30
47	DO31	Public output 31
48	DO32	Public output 32
49	COMOUT3	External power input (User power): COMMON (For DO25~DO32)
50		

The output specification of each port is as follows.

- Output component: Photo MOSFET output
- Rated output = 125mA (Continuous load current), 24V DC
- (-) Common output voltage = 0V DC (OPEN COLLECTOR)

The user connects the output signal through the method shown in Figure 5.16 below. First, connect the COMMON signal to the public IO board (BD582), and then connect each signal to the output pin depending on the usage. The power can be differently used by each 8-output port unit.

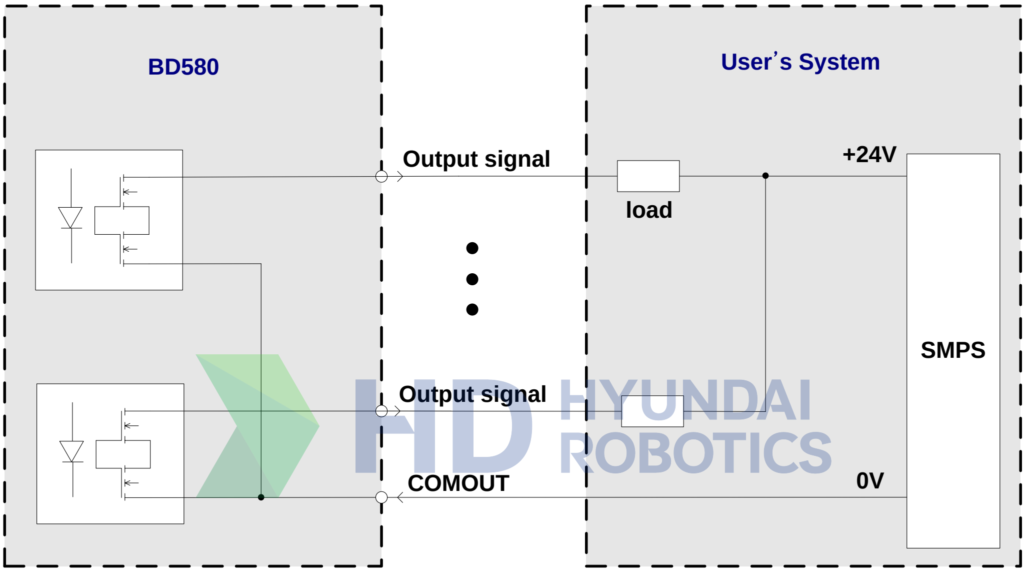


Figure 5.16 Method for Connection of Output Signals of the Public IO Board (BD582)

5.3.2.3. Power Connector: CNP1

Power Connector is the connector for DC5V power to operate the public IO board (BD582), and the pin specification is as shown in Figure 5.17 below.

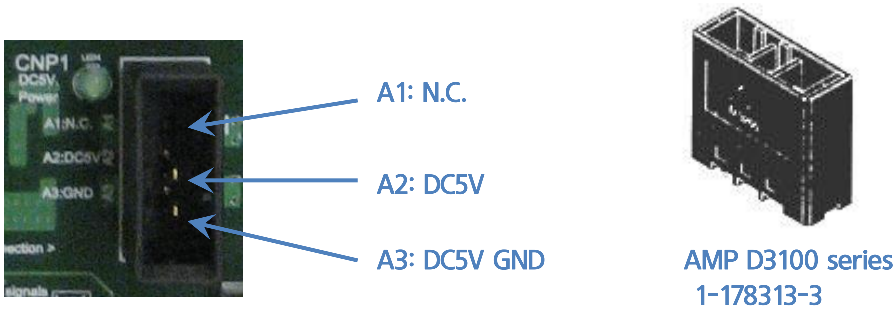


Figure 5.17 Power Connector CNP1 of the Public IO Board (BD582)

5.3.2.4. CAN Communications Connector: CANS1, CANS2

For the CAN Communications Connector, there are two identical connectors with the same pin specification, which are installed as shown in Figure 5.18 below. As CAN communication is conducted through cable, with a Daisy Chaining method, it therefore does not matter which side of the connector it is connected to, as it does not affect the operation.

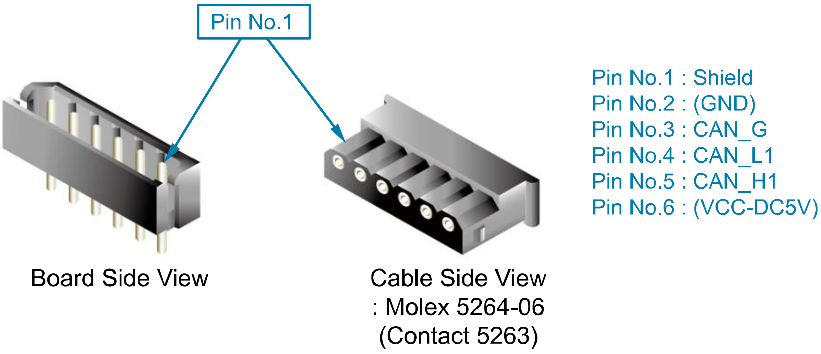


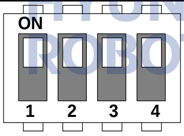
Figure 5.18 Method for Connection of the CAN Connector of the Public IO Board (BD582)

5.3.3. Setting Unit

5.3.3.1. DIP Switch Settings

DIP switch DSW1 sets the number of the board in hexadecimal code. Based on the setting of the switch, the number of the board is shown in the following Table.

Table 5-7 Method for Setting of the DSW1 Switch of the Public IO Board (BD582)

Switch Number	4	3	2	1	Setting (Board Number)
Switch Condition	OFF	OFF	OFF	OFF	1
	OFF	OFF	OFF	ON	2
	OFF	OFF	ON	OFF	3
	OFF	OFF	ON	ON	4
Default Setting	OFF	OFF	OFF	OFF	1
Switch Exterior					

5.4. CC-link Board (BD570)

5.4.1. Outline

To use the robot as the Slave from the field bus configured with CC-LINK communication, CC-LINK board (BD570) must be used, as shown in Figure below. To block various types of noise and surges from the external environment of the robot, various signals are insulated from the external side.

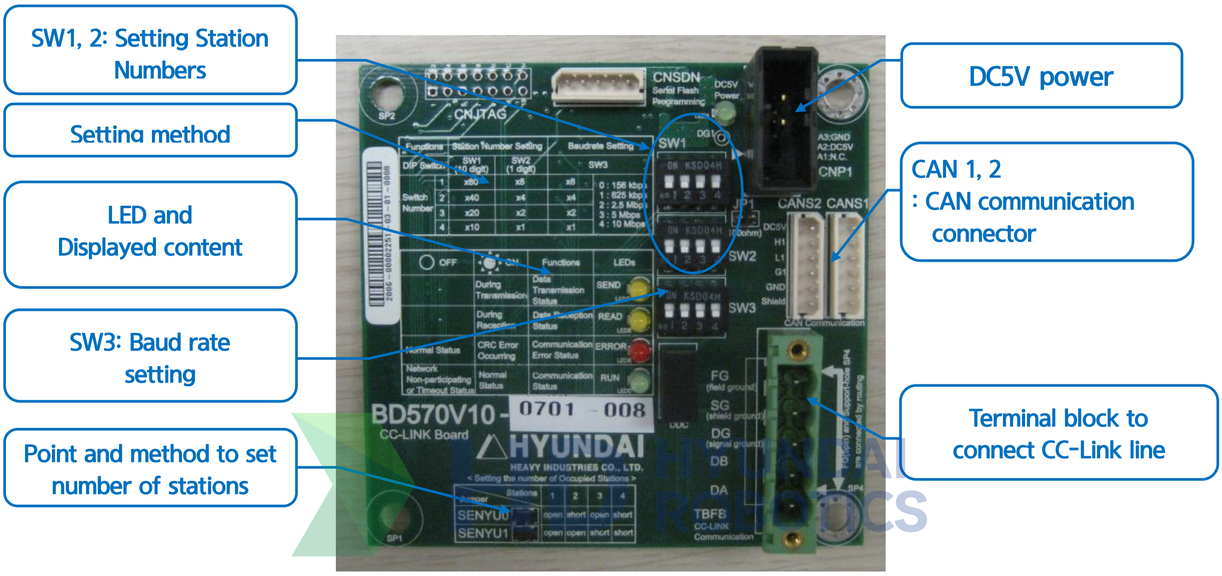


Figure 5.19 CC-LINK Board (BD570)

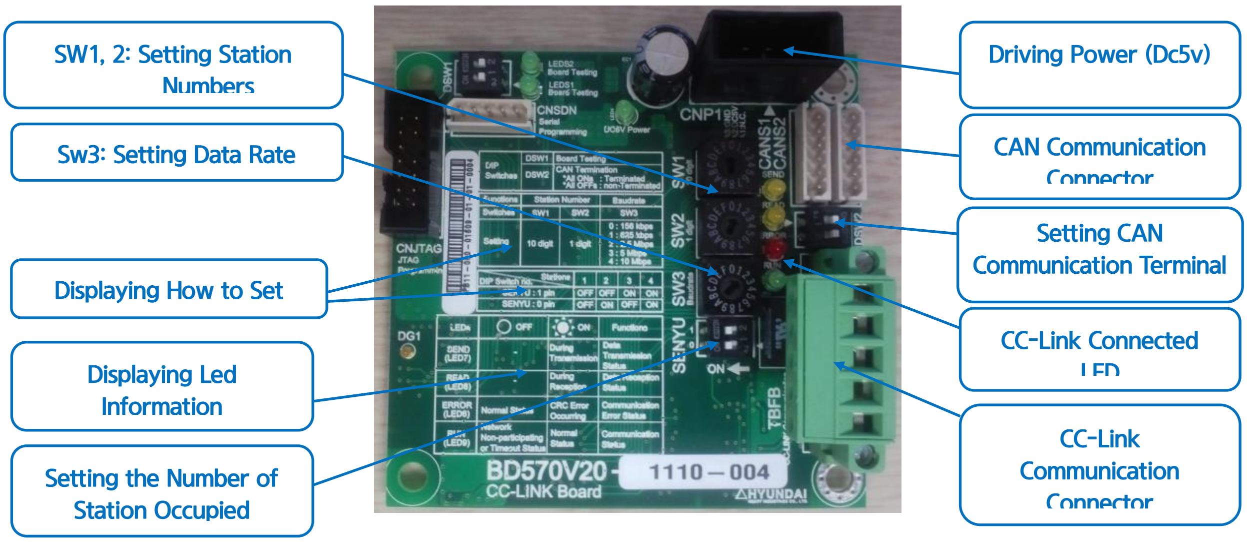


Figure 5.20 CC-LINK Board (BD570V20)

5.4.2. Connector

5.4.2.1. CC-link Communication Terminal Block: TBFB

Use the terminal block TBFB to connect to the CC-LINK communication line. Refer to the indicated properties of each pin, as shown in Figure 5.21 below.

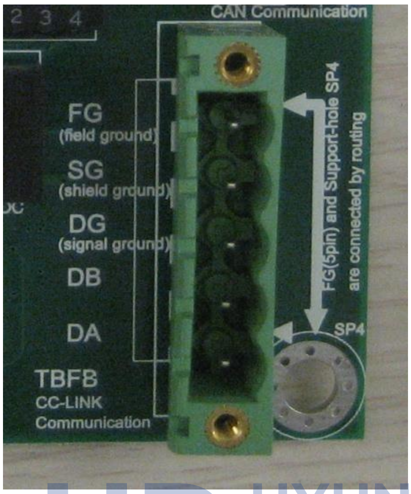


Figure 5.21 CC-LINK Communication Terminal Block of CC-LINK Board (BD570)

Table 5-8 Terminal Composition of the Terminal Block TBFB for the CC-link Communication of the CC-link Board (Bd570v20)

Name Of Terminal Block	Form	Terminal No.	Signal Name	Function
TBFB		5	FG	CC-link Cable Ground
		4	SG	CC-link Cable Shield
		3	DG	CC-link Ground
		2	DB	CC-link DB Line
		1	DA	CC-link DA Line

Name Of Terminal Block	Form	Terminal No.	Signal Name	Function
				

5.4.2.2. Power Connector: CNP1

The Power Connector is the connector for DC5V power to operate the CC-LINK board (BD570), and the pin specification is as shown in Figure 5.22 below.

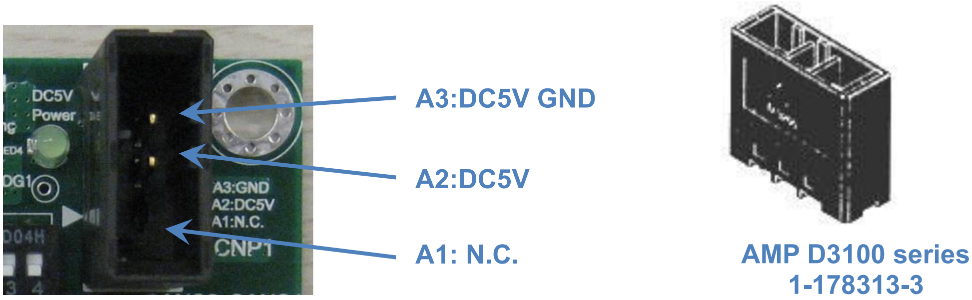
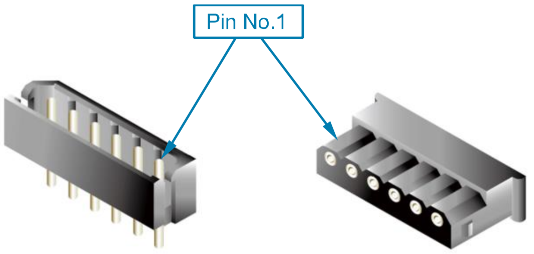


Figure 5.22 Power Connector CNP1 of CC-LINK Board (BD570)

5.4.2.3. CAN Communications Connector: CANS1, CANS2



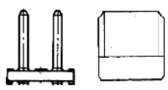
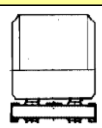
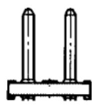
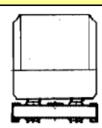
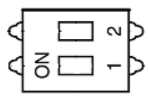
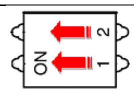
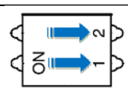
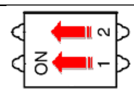
Pin No.1 : Shield
Pin No.2 : (GND)
Pin No.3 : CAN_G
Pin No.4 : CAN_L1
Pin No.5 : CAN_H1
Pin No.6 : (VCC-DC5V)

Figure 5.23 Method for the Connection of the CAN Connector of the CC-LINK Board (BD570)

For the CAN Communications Connector, there are two identical connectors with the same pin specification, which are installed as shown in Table 5-9 above. As CAN communication is conducted through cable, with a Daisy Chaining method, it therefore does not matter which side of the connector it is connected to, as it does not affect the operation.

When the board is installed in the terminal of the CAN communication system, the terminal shall be handled according to the following methods.

Table 5-9 How to Deal with the Can Communication Terminal of the CC-link Board (BD570)

Board Type	Terminating Equipment	Form	How To Set		Set During Forwarding
			Terminal	Non-Terminal	
BD570V10	Jumper JP1				
			SHORT	OPEN	SHORT
BD570V20	Dip switch DSW2				
			ALL ON	ALL OFF	ALL ON

5.4.3. Indication and Setting Units

Various LEDs are used to display the communication status of the CC-LINK line. The contents indicated by the LEDs are marked on the board as follows. In addition, for the station number and communication speed setting of the CC-link, DIP switches are used and the contents relevant to them are also marked on the board as follows.

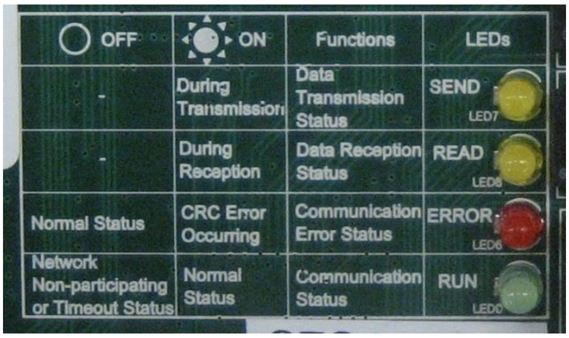


Figure 5.24 LED and Detail of Communication Status Indication of CC-LINK Board (BD570)

Figure 5. 5.25 Led For Displaying the Communication Conditions of the CC-link Board (Bd570v20) and the Information

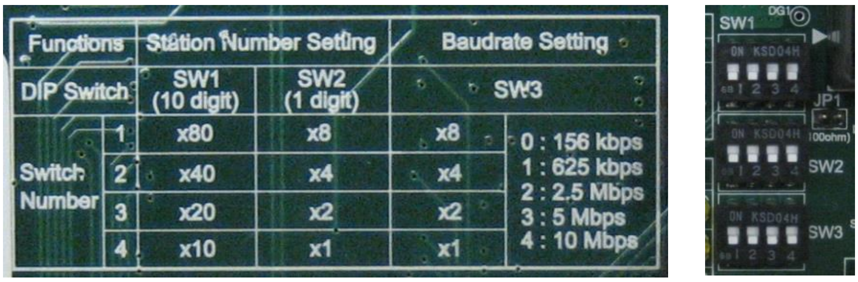
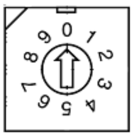
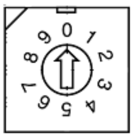
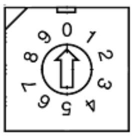


Figure 5.26 Setting Station Number and Communication Speed of the CC-LINK Board (BD570)

Table 5-10 How to Set the CC-link Station Numbers and the Data Rate (BD570V20)

Switch Name	Use	Form	How To Set	Set During Forwarding
Sw1	Station No. (10 Units)		Setting Station Number= (Set Value Of Swz1 X 10) + Set Value Of Swz2	"0"
Sw2	Station No. (1 Unit)			"1"
Sw3	Data Rate		0 : 125 Kbps 1 : 625 Kbps 2 : 2.5 Mbps 3 : 5.0 Mbps 4 : 10 Mbps	"4"

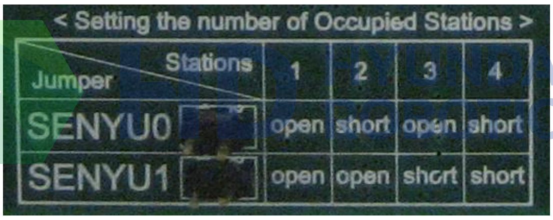
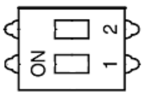


Figure 5.27 Method for Setting of the Number of Stations of the CC-LINK Board (BD570)

Table 5-11 How to Set the Number of the CC-link Station Occupied By the CC-link Board (Bd570v20)

Switch Name	Form	Switch No.	How To Set The No. Of Station Occupied				Set During Forwarding
			1	2	3	4	
SENYU		**2 (SENYU1)**	Off	Off	On	On	On
		1 (SENYU0)	OFF	ON	OFF	ON	ON

5.5. Conveyor I/F Board (BD585)

5.5.1. Outline

When configuring the robot system to synchronize with the conveyor, an interface board must be used to receive the encoder signal to detect the location of the conveyor Figure 5.28 below shows the configuration of the Conveyor Interface Board (BD585). There are two input ports, for which you can select the line receiver method or the open collector method.

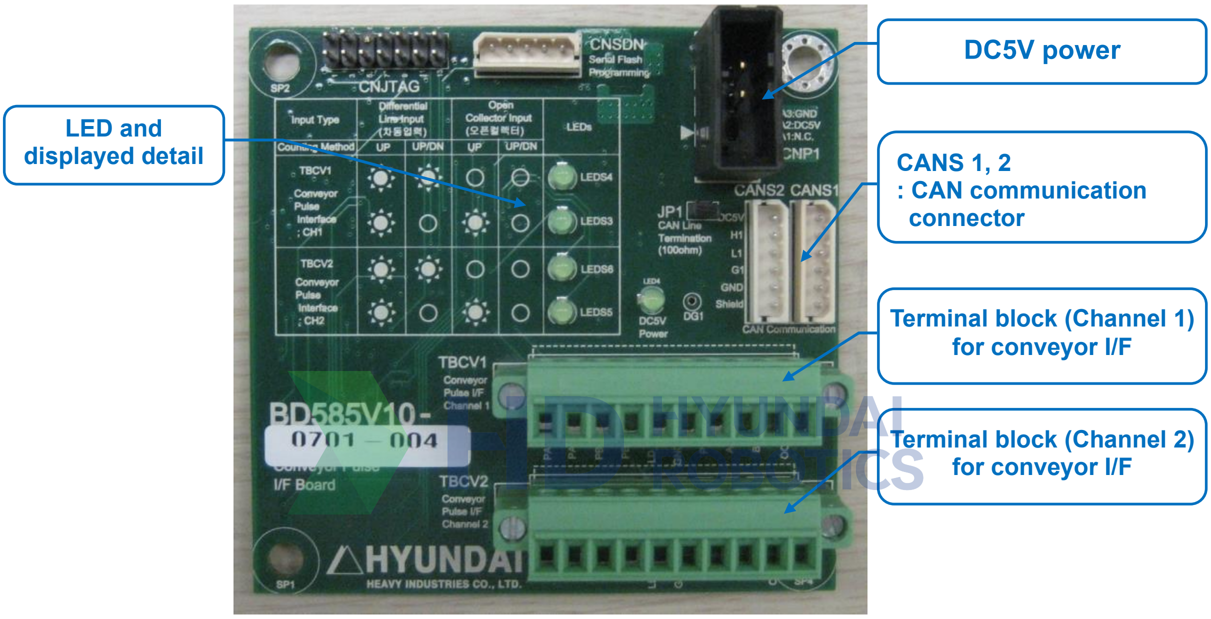


Figure 5.28 Conveyor I/F Board (BD585)

5.5.2. Connector

5.5.2.1. Conveyor I/F Terminal Block: TBCV1, TBCV2

The input of conveyor pulse can be connected to the two identical terminal blocks with the same pin specification, as shown in Figure 5.29 below. That is, two conveyors can be connected.

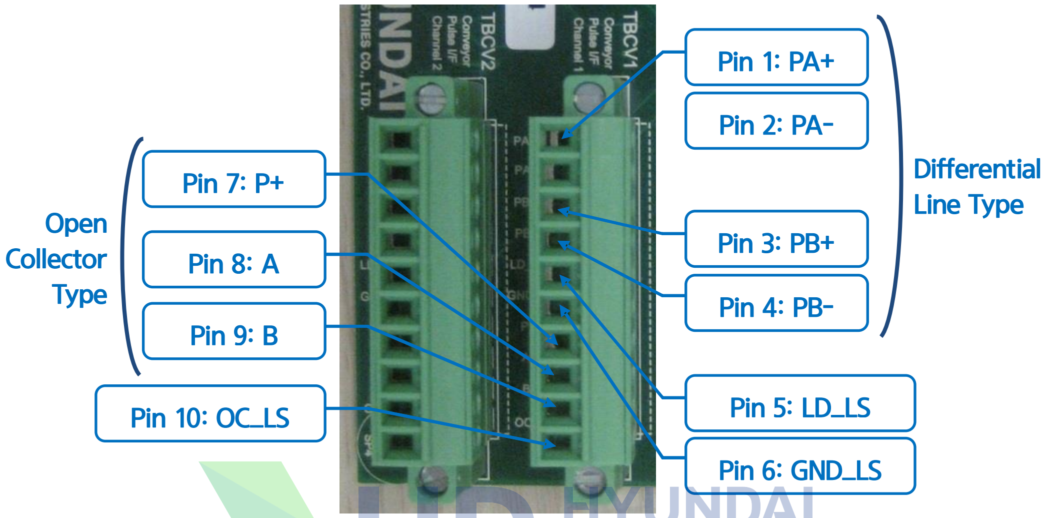


Figure 5.29 Conveyor Connection Terminal Block of the Conveyor I/F Board (BD585)

5.5.2.2. Power Connector: CNP1

The Power Connector is the connector for DV5V power to operate the Conveyor I/F Board (BD585), and the pin specification is as shown in Figure 5.30 below.

Figure 5.30 Power Connector CNP1 of Conveyor I/F Board (BD585)

5.5.2.3. CAN Communications Connector: CANS1, CANS2

For the CAN Communications Connector, there are two identical connectors with the same pin specification, which are installed as shown in Figure 5.31 below. As CAN communication is conducted through cable, with a Daisy Chaining method, it therefore does not matter which side of the connector it is connected to, as it does not affect the operation.

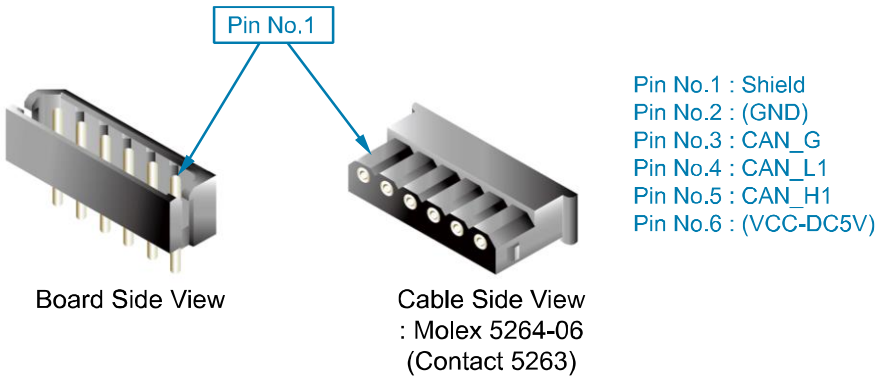


Figure 5.31 Method for the Connection of CAN Connector of the Conveyor I/F Board (BD585)

5.5.3. Display Unit

The method of counting the conveyor pulse that has been set is displayed with an LED, as shown in Figure 5.32 below. For each case, the description is shown on the board.

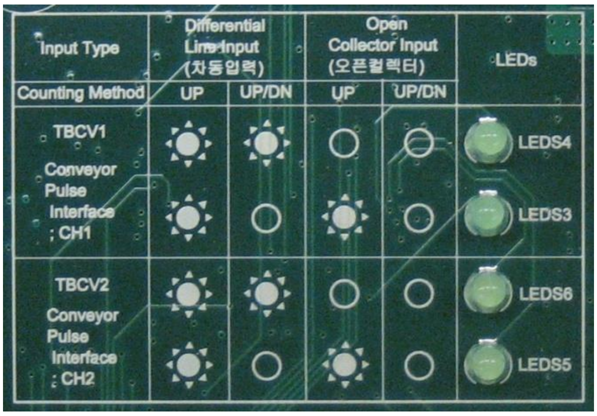


Figure 5.32 LED and Detail for Conveyor I/F Board (BD585) Status Indication

5.6. LDIO Board (BD58A; For LCD)

5.6.1. Outline

As a board exclusively for LCD, LDIO Board includes the DIO board and CC-LINK, and is installed on the RACK to ensure space inside the controller. The specification of the basic board is as follows.

- Digital input (Photocoupler type): 32 points
- BD58AV10 : Digital Output (Photo MOS Type) 24 Points, Relay Contact Output 8 Points
  BD58AV20 and Over: Digital Output (Photo MOS Type) 24 Points, FET (N Channel) Output 8 Points
- CC-LINK communication function included
- RS232 / RS485 select 1 channel
- Installation location: RACK
- 1 Mbps CAN communication

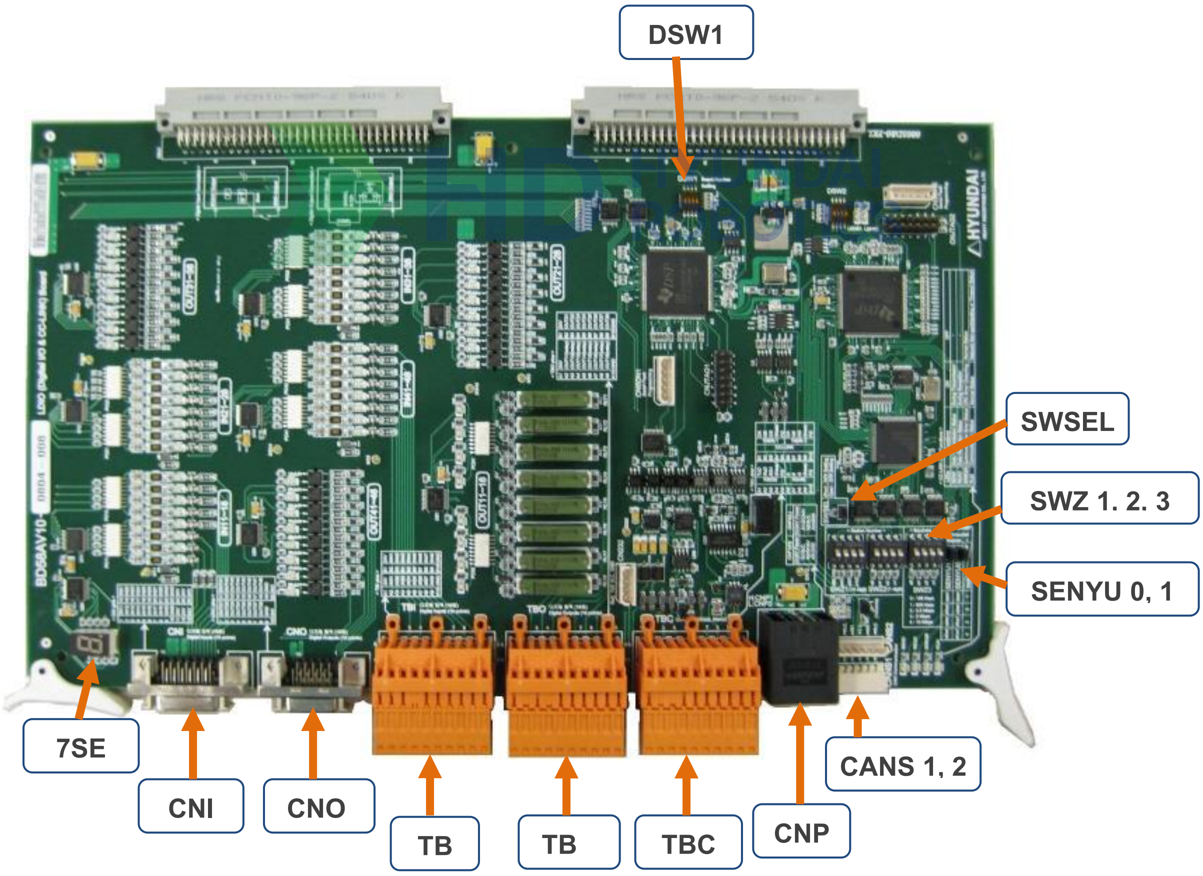


Figure 5.33 Appearance of the LDIO Board (BD58A)

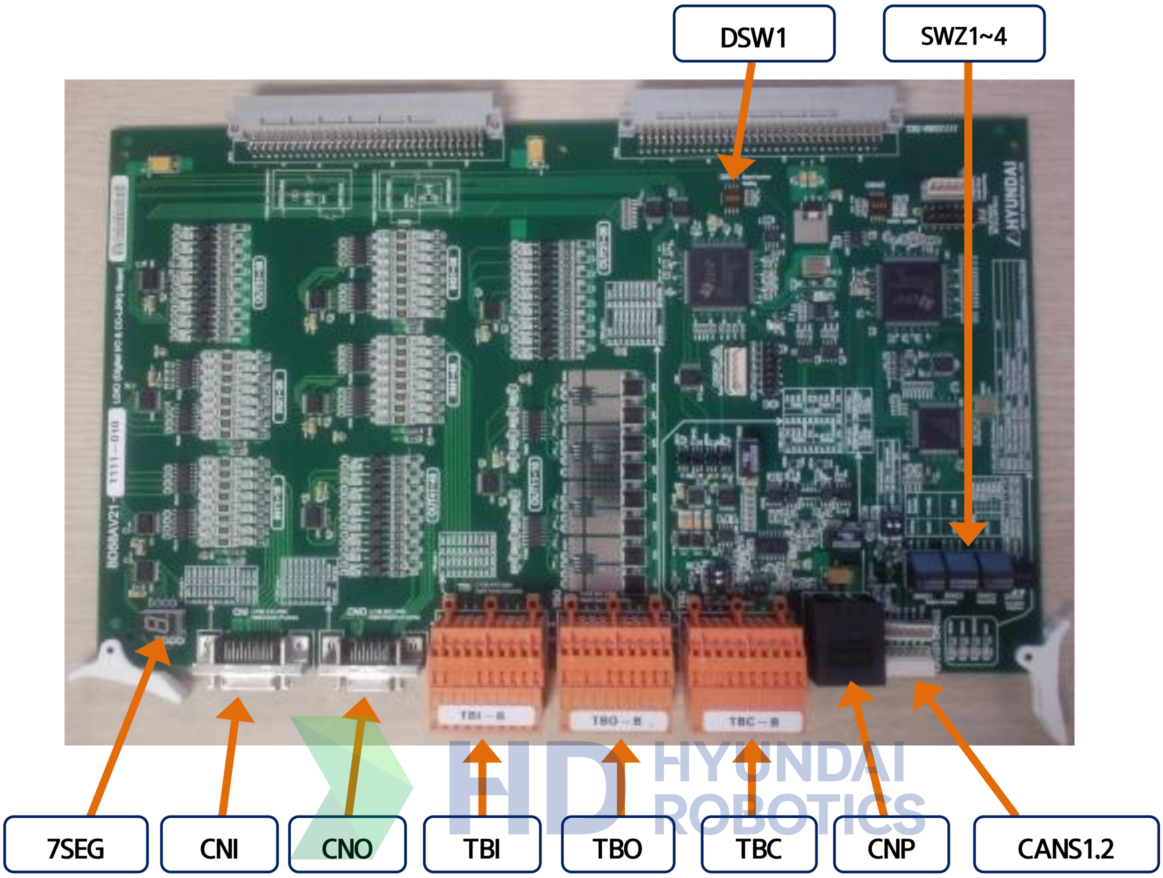


Figure 5.34 Appearance of the LDIO Board (BD58AV21)

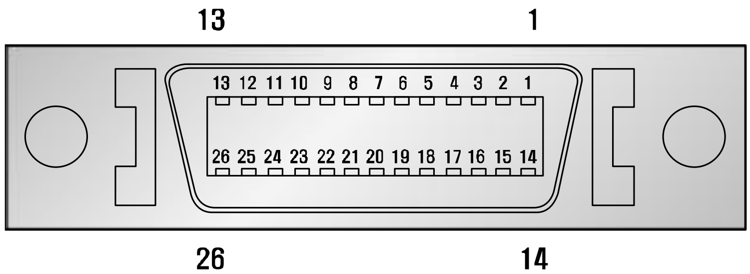
5.6.2. Connector

5.6.2.1. Digital Input

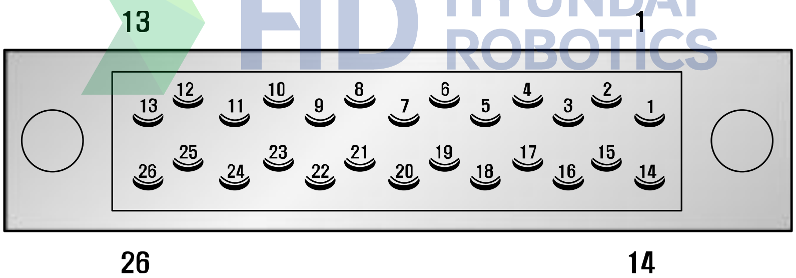
The photocoupler is used for digital input, and a total of 32 points are provided. The user can input each 16-point signal through the connector and terminal as required.

(1) Input through connector

The following Figure and Table show the pin composition of connector CN1 for digital input.



(a) Board side (3M MDR 10226-52A2JL)



(b) Plug side 3M MDR 10126-3000VE (HOOD: 10326-52F0-008)

Figure 5.35 Digital Input Connector CNI of LDIO Board (BD58A)

Table 5-12 Pin Configuration of the Digital Input Connector CNI of the LDIO Board (BD58A)

Pin Number	Signal Name	Function Description
1	IN11	Digital input 11
2	IN12	Digital input 12
3	IN13	Digital input 13
4	IN14	Digital input 14
5	IN15	Digital input 15
6	IN16	Digital input 16
7	IN17	Digital input 17
8	IN18	Digital input 18
9	M2	Power output: DC24V GND
10		
11	P2	Power output: DC24V
12		
13		
14	IN21	Digital input 21
15	IN22	Digital input 22
16	IN23	Digital input 23
17	IN24	Digital input 24
18	IN25	Digital input 25
19	IN26	Digital input 26
20	IN27	Digital input 27
21	IN28	Digital input 28

Pin Number	Signal Name	Function Description
22	M1	Power output: DC24V GND
23		
24	P1	Power output: DC24V
25		
26		

(2) Input through terminal block

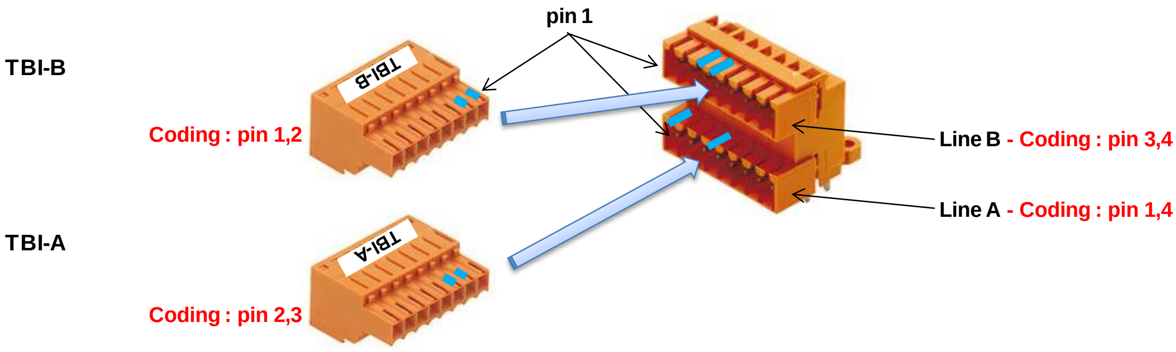


Figure 5.36 Digital Input Terminal Block TBI of LDIO Board (BD58A)

Table 5-13 Terminal Configuration of the Digital Input Terminal Block TBI of the LDIO Board (BD58A)

Terminal Block Name	Terminal Number	Signal Name	Function Description
TBI - A	1	P2	Power output: DC24V
	2	IN31	Digital input 31
	3	IN32	Digital input 32
	4	IN33	Digital input 33
	5	IN34	Digital input 34
	6	IN35	Digital input 35
	7	IN36	Digital input 36
	8	IN37	Digital input 37
	9	IN38	Digital input 38
	10	M2	Power output: DC24V GND
TBI - B	1	P2	Power output: DC24V
	2	IN41	Digital input 41
	3	IN42	Digital input 42
	4	IN43	Digital input 43
	5	IN44	Digital input 44
	6	IN45	Digital input 45
	7	IN46	Digital input 46
	8	IN47	Digital input 47
	9	IN48	Digital input 48
	10	M2	Power output: DC24V GND

The input specification of each port is as follows.

- Input port component: AC input photo coupler
- Input impedance= 3 ㏀
- (+) Common input voltage = 24 VDC
- (-) Common input voltage = 0 VDC

The user connects the input signal through the method shown in Figure 5.37 below.

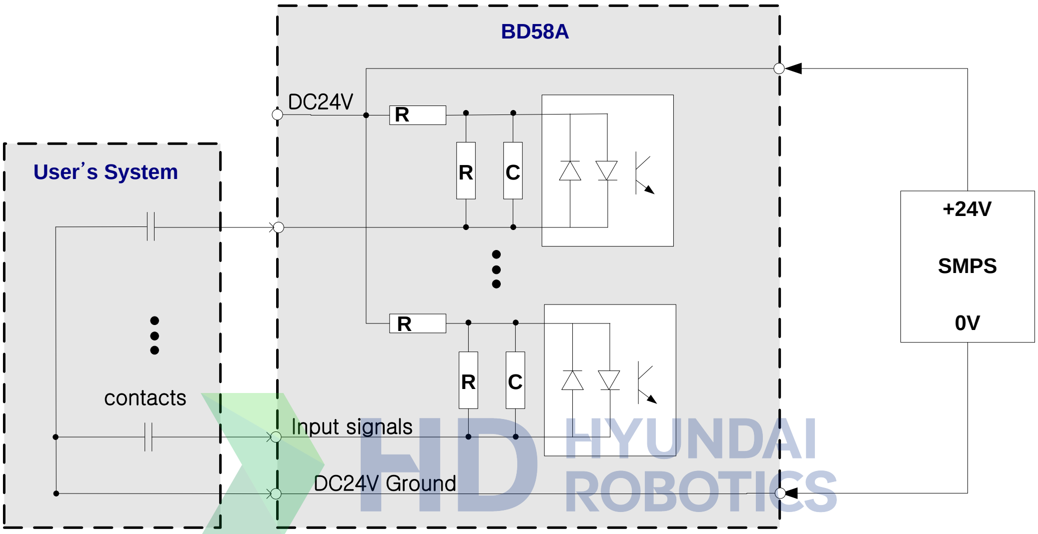


Figure 5.37 Method for Wiring the Input Signal of LDIO Board (BD58A)

5.6.2.2. Digital Output

Two-way output at 32 points using MOSFET is provided for the digital output. The user can output each 16-point signal through the connector and terminal as required, and the 8-point output is the relay contact point output.

(1) Output through terminal block

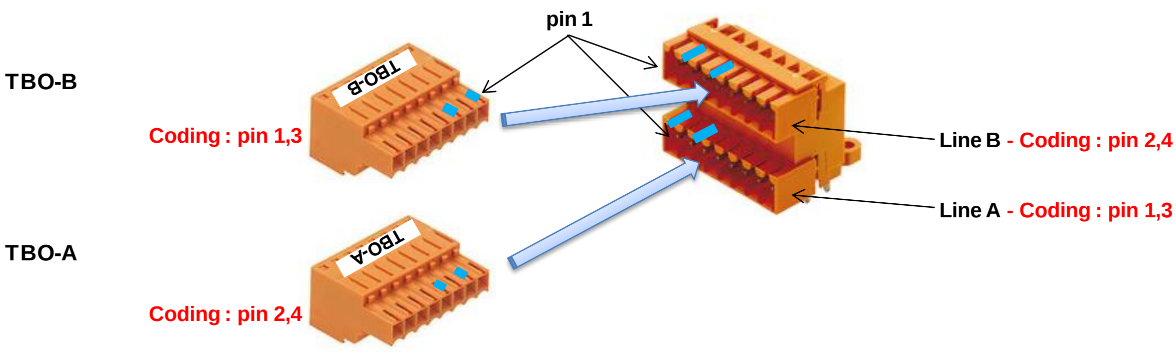


Figure 5.38 Digital Output Terminal Block TBO of LDIO Board (BD58A)

Table 5-14 Terminal Configuration of the Digital Output Terminal Block TBO of the LDIO Board (BD58A)

Terminal Block Name	Terminal Number	Signal Name	Function Description
TBO - A	1	P2	Power output: DC24V
	2	OUT11	Digital output 11 (Relay contact point output)
	3	OUT12	Digital output 12 (Relay contact point output)
	4	OUT13	Digital output 13 (Relay contact point output)
	5	OUT14	Digital output 14 (Relay contact point output)
	6	OUT15	Digital output 15 (Relay contact point output)
	7	OUT16	Digital output 16 (Relay contact point output)
	8	OUT17	Digital output 17 (Relay contact point output)
	9	OUT18	Digital output 18 (Relay contact point output)
	10	M2	Power output: DC24V GND

Terminal Block Name	Terminal Number	Signal Name	Function Description
TBO - B	1	P2	Power output: DC24V
	2	OUT21	Digital output 21
	3	OUT22	Digital output 22
	4	OUT23	Digital output 23
	5	OUT24	Digital output 24
	6	OUT25	Digital output 25
	7	OUT26	Digital output 26
	8	OUT27	Digital output 27
	9	OUT28	Digital output 28
	10	M2	Power output: DC24V GND

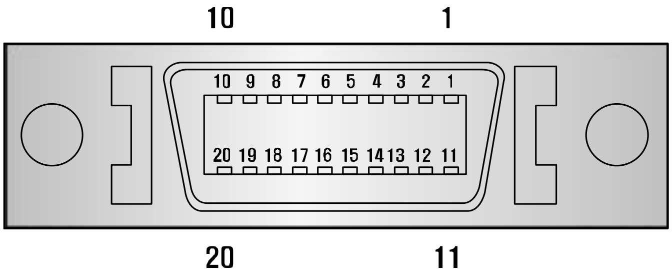
The versions of BD58AV20 board and over have changed the output from the 8-point relay contact provided by BD58AV10 to the N channel FET.

Table 5-15 Terminal Block LDIO Terminal Composition of the Digital Output for Each Version of the LDIO Board (BD58A)

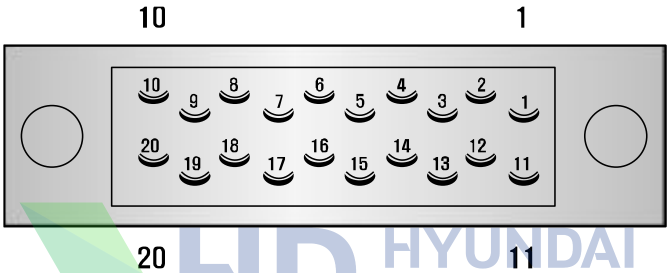
Board Name	Name Of Terminal Block	Terminal No.	Signal Name	Function
Common	TBO - A	1	P2	Power Output: DC24V
BD58AV10		2~9	OUT11~18	Digital Output 11~18 (Output Of Relay Contact)
Versions of BD58AV20 and Over				Digital Output 11~18 (Output Of N Channel FET)
Common		10	M2	Power Output: DC24V GND

(2) Output through connector

The following Figure and Table show the pin composition of the connector CNO for digital output.



(a) Board side (3M MDR 10220-52A2JL)



(b) Plug side 3M MDR 10120-3000VE (HOOD: 10320-52F0-008)

Figure 5.39 CNO Connector of LDIO Board (BD58A)

Table 5-16 Pin Configuration of the Digital Output Connector CNO of the LDIO Board (BD58A)

Pin Number	Signal Name	Function Description
1	OUT31	Digital output 31
2	OUT32	Digital output 32
3	OUT33	Digital output 33
4	OUT34	Digital output 34
5	OUT35	Digital output 35
6	OUT36	Digital output 36
7	OUT37	Digital output 37
8	OUT38	Digital output 38
9	M2	Power output: DC24V GND
10	P2	Power output: DC24V
11	OUT 41	Digital output 41
12	OUT 42	Digital output 42
13	OUT 43	Digital output 43
14	OUT 44	Digital output 44
15	OUT 45	Digital output 45
16	OUT 46	Digital output 46
17	OUT 47	Digital output 47
18	OUT 48	Digital output 48
19	M2	Power output: DC24V GND
20	P2	Power output: DC24V

The output specifications using photo MOSFET are as follows.

- Output component: Photo MOSFET output
- Rated output = 125 mA (Continuous load current), 24V DC

The relay contact output specifications are as follows:

- Output element: relay contact output
- Rated output = 5A/24VDC, 5A/250VAC

The FET output specifications of the versions of BD58AV20 and over are as follows:

- Output element: N channel FET output
- Rated output = 1A/24VDC

The user connects the output signal as shown in Figures 5.40, 5.41 and 5.42 below.

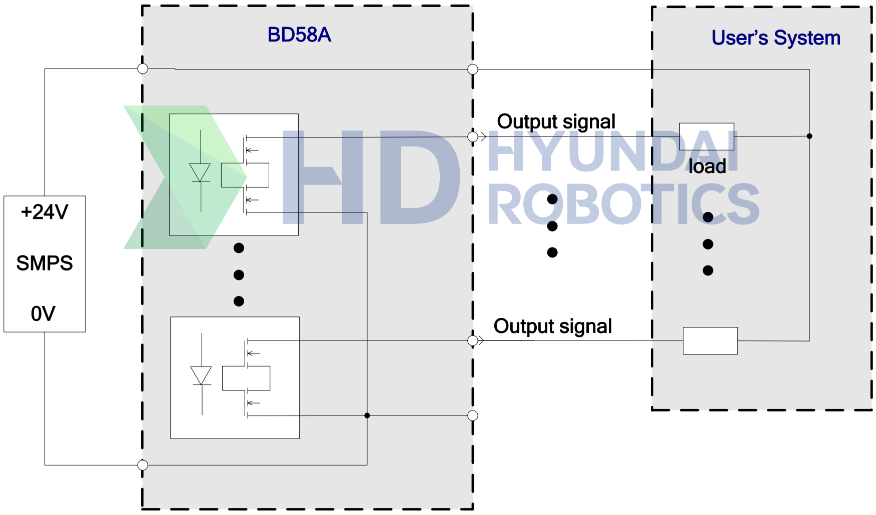


Figure 5.40 Method for Wiring the Output Signal of LDIO Board (BD58A) (Photo MOSFET)

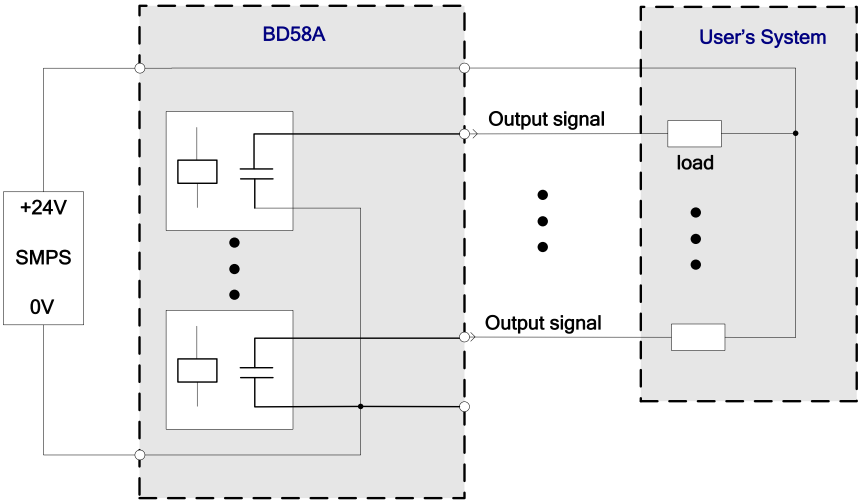


Figure 5.41 Method for Wiring the Output Signal of LDIO Board (BD58A) (Relay Contact Point)

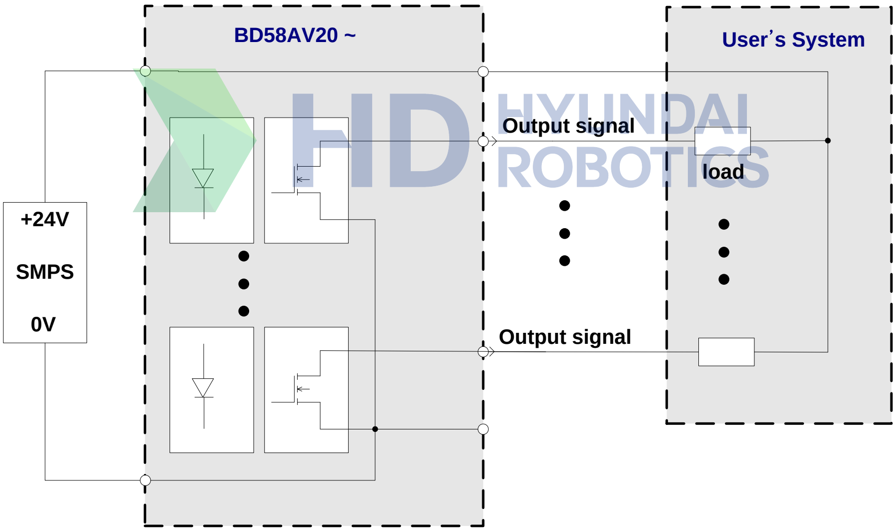


Figure 5.42 How to Connect the FET Output Signal with the Versions of the LDIO Board BD58AV20 and Over

5.6.2.3. Communication Connection

LDIO board supports serial communication RS232 and RS485 of beam sensor, and includes the CC-LINK function to facilitate information connections among the robots. Each communication is connected using the terminal block TBC.

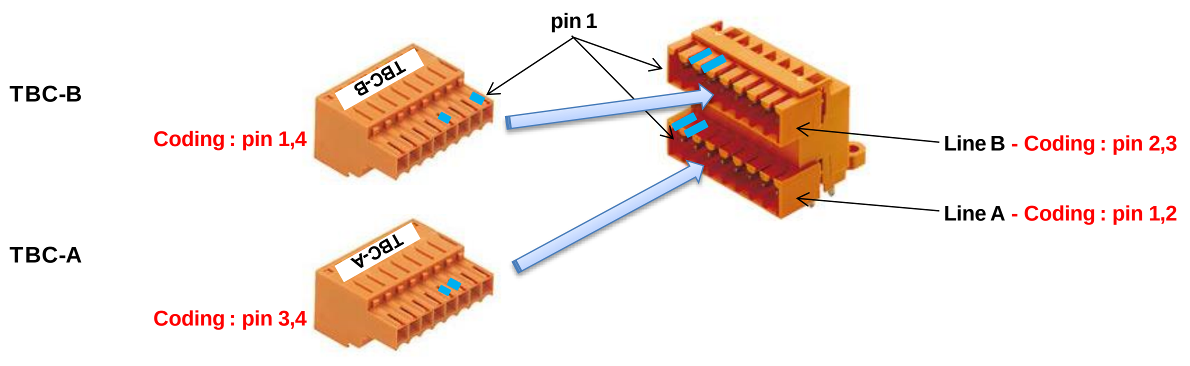


Figure 5.43 Serial Communication Terminal Block TBC of LDIO Board (BD58A)

Table 5-17 Terminal Configuration of Serial Communication Terminal Block TBC of LDIO Board (BD58A)

Terminal Block Name	Classification	Terminal Number	Signal Name	Function Description
TBC - A	RS232 (DSW1 #4 ON)	1	TxD	RS232 Transmission
		2	RxD	RS232 Receipt
		3	SG	RS232 Ground
		4	Shield1	RS232 Cable shield
		5	FG1	RS232 Cable ground
	RS485 (DSW1 #4 OFF)	6	A	RS485 + Side line
		7	B	RS485 – Side line
		8	G2	RS485 Ground
		9	Shield2	RS485 Cable shield
		10	FG2	RS485 Cable ground
TBC - B	CC-LINK	1	DA	CC-LINK DA line
		2	DB	CC-LINK DB line
		3	DG	CC-LINK Ground
		4	Shield3	CC-LINK Cable shield
		5	FG3	CC-LINK Cable ground
	CC-LINK	6	DA	CC-LINK DA line
		7	DB	CC-LINK DB line
		8	DG	CC-LINK Ground
		9	Shield3	CC-LINK Cable shield
		10	FG3	CC-LINK Cable ground

5.6.2.4. Power Connector: CNP1, CNP2

The Power Connector is the connector for DC 5 V power to operate the Conveyor I/F Board (BD585), and the pin specification is as shown in Figure 5.44 below.

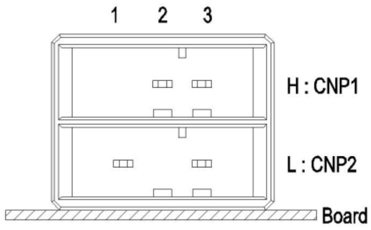


Figure 5.44 Power Connector CNP1 and CNP2 of LDIO Board (BD58A)

Table 5-18 Pin Configuration of the Power Connector of the LDIO Board (BD58A)

Connector Name	Terminal Number	Signal Name	Function Description
CNP1 (Upper level)	A1	-	N.C
	A2	P5	SMPS DC 5 V
	A3	M5	SMPS DC 5 V Ground
CNP2 (Bottom level)	A1	UP2	User power DC 24 V
	A2	-	N.C
	A3	UM2	User power DC 24 V Ground

5.6.2.5. CAN Communications Connector: CANS1, CANS2

For the CAN Communications Connector, there are two identical connectors with the same pin specification, which are installed as shown in Figure 5.45 below. As CAN communication is conducted through cable, with a Daisy Chaining method, it therefore does not matter which side of the connector it is connected to, as it does not affect the operation.

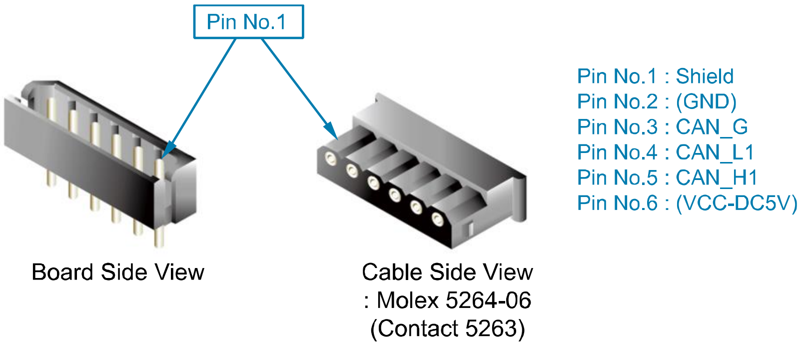
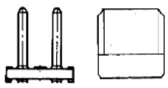
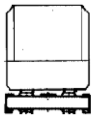
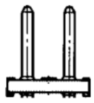
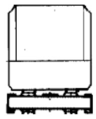
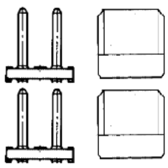
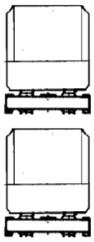
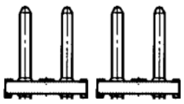
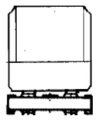
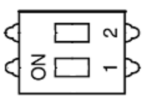
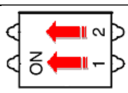
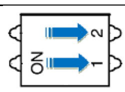
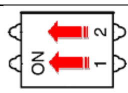


Figure 5.45 Method for Connecting the CAN Connector of LDIO Board (BD58A)

Table 5-19 How to Deal with the CAN Communication Terminal of the LDIO Board (BD58A)

Board Type	Terminating Equipment	Form	How To Set		Set During Forwarding
			Terminal	Non-Terminal	
BD58AV10	Jumper JP1		 SHORT	 OPEN	 SHORT
BD58AV20	Jumper JP1and JP3		 ALL SHORT	 ALL OPEN	 ALL SHORT
BD58AV21	DIP Switch SWC1		 ALL ON	 ALL OFF	 ALL ON

5.6.3. Setting Unit

5.6.3.1. DIP Switch Settings

The number and communication speed of the DIP switch SWZ1~3 related to CC-LINK are set in hexadecimal code, as shown in the Tables below.

Table 5-20 Method for Setting Station Number and Communication Speed of CC-LINK in the LDIO Board (BD58A)

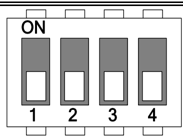
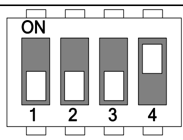
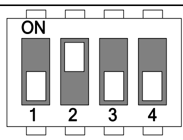
Switch Name	Use	1	2	3	4	Remarks
SWZ1	Station Number	X80	X40	X20	X10	1
SWZ2		X8	X4	X2	X1	2
SWZ3	Communication Speed	X8	X4	X2	X1	0: 125 kbps 1: 625 kbps 2: 2.5 Mbps 3: 5.0 Mbps 4: 10 Mbps
Factory Default Setting	SWZ1	OFF	OFF	OFF	OFF	
	SWZ2	OFF	OFF	OFF	ON	
	SWZ3	OFF	ON	OFF	OFF	

Table 5-21 How to Set the CC-LINK Station Numbers and the Data Rate of the LDIO Board (Bd58av21)

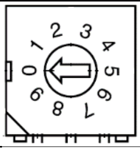
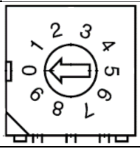
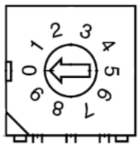
Switch Name	Use	Form	How To Set	Set During Forwarding
SWZ1	Station No. (10 Units)		Setting Station No. = (Set Value Of Swz1 X 10)+ Set Value Of Swz2	“0”
SWZ2	Station No. (1 Unit)			“1”
SWZ3	Data Rate		0 : 125 kbps 1 : 625 kbps 2 : 2.5 Mbps 3 : 5.0 Mbps 4 : 10 Mbps	“4”

Table 5-22 Method for Setting the Number of Stations of CC-LINK of the LDIO Board (BD58A)

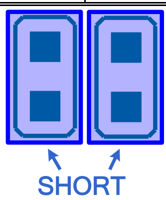
Jumper Name	Number of Stations			
	1	2	3	4
SENYU0	OPEN	SHORT	OPEN	SHORT
SENYU1	OPEN	OPEN	SHORT	SHORT
Factory Default Setting		SENYU0: SHORT SENYU1: SHORT		

Table 5-23 How to Set the Number of the CC-LINK Station Occupied of the LDIO Board (BD58AV21)

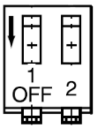
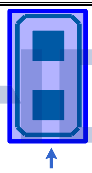
Switch Name	Form	Switch No.	How To Set The No. Of Station Occupied				Set During Forwarding
			1	2	3	4	
SWZ4		1 (SENYU0)	OFF	ON	OFF	ON	ON
		2 (SENYU1)	OFF	OFF	ON	ON	ON

Table 5-24 LDIO Jumper SWSEL for Selecting CC-LINK Set in the LDIO Board (BD58A)

Jumper Name	Number of channel	
	OPEN	SHORT
SWSEL	CC-LINK communication setting by DIP switch and jumper	CC-LINK communication setting by software
Factory default	 SHORT	SHORT

The BD58AV21 board does not have the option of setting the CC-LINK.

5.7. Safety Relay Board (BD58B)

5.7.1. Outline

To detect axis limit and power belt failure with an installed sensor on the robot, the sensor signal must be received and converted to a contact point format to use the Safety Relay Board (BD58B) connected to the system board. Figure 5.46 below shows the configuration of the Safety Relay Board (BD58B), which includes the control power connector, the terminal block to supply the power to the sensor and receive the signal, and the connector for the brake to prevent falling.

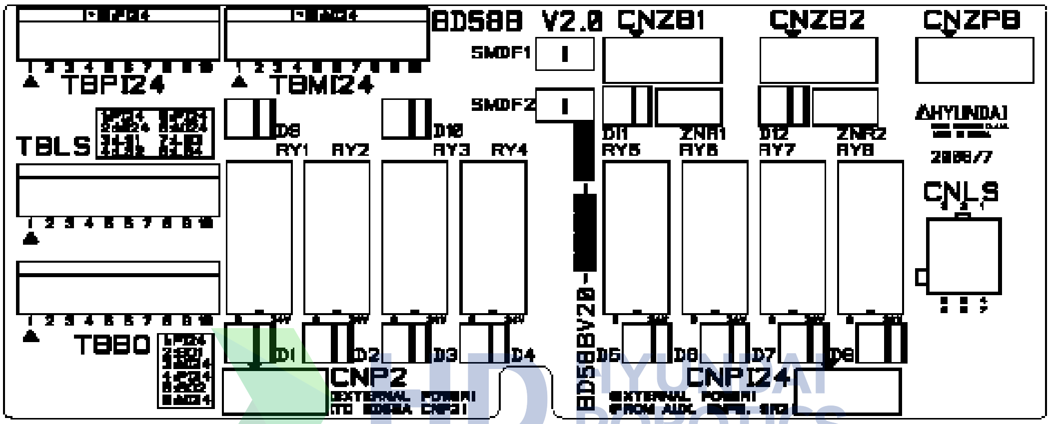


Figure 5.46 Safety Relay Board (BD58B)

5.7.2. Connector

Table 5-25 Pin Configuration of the Belt Sensor Terminal Block TBBO in the Safety Relay Board (BD58B)

Pin Number	Signal Name	Signal Description
1	PI24	24V power for belt sensor
2	BO1	Belt sensor output 1
3	MI24	GND power for belt sensor
4	PI24	24V power for belt sensor
5	BO1	Belt sensor output 2
6	MI24	GND power for belt sensor
7	NC	
8	NC	
9	NC	
10	NC	

Table 5-26 Pin Configuration of the Limit Sensor Terminal Block (TBLS) in the Safety Relay Board (BD58B)

Pin Number	Signal Name	Signal Description
1	PI24	24V power for limit sensor
2	MI24	GND power for limit sensor
3	LS1	Limit sensor output 1
4	LS2	Limit sensor output 2
5	PI24	24V power for limit sensor
6	MI24	GND power for limit sensor
7	LS3	Limit sensor output 3
8	LS4	Limit sensor output 4
9	NC	
10	NC	

Table 5-27 Pin Configuration of Power 24V Terminal Block (TBP124) in the Safety Relay Board (BD58B)

Pin Number	Signal Name	Signal Description
1-10	PI24	24V power

Table 5-28 Pin Configuration of Power GND Terminal Block (TBM124) in the Safety Relay Board (BD58B)

Pin Number	Signal Name	Signal Description
1-10	MI24	GND power

Table 5-29 Connector Type and Use of Safety Relay Board (BD58B)

Name	Use	External Device Connection
CNPI24	Power input for sensor	SR2
CNP2	Power output for BD58A	BD58A
CNZPB	Power input for fall preventive brake	SR3
CNZB1	Cancel fall preventive brake 1	CMC1
CNZB2	Cancel fall preventive brake 2	CMC2
CNLS	Transmit safety relay contact point status to system board	BD530

5.8. Expansion Public IO Board (BD583: 64-point I/O)

5.8.1. Outline

The Expansion Public DIO board can interface and be configured with various devices through the digital input/output port. The specification of the basic board is as follows.

- 2-way digital input
  Photocoupler type input: 64 points (8 ports)

- 2-way digital output
  Photo MOS type at 32 points (4 ports)
  Relay contact point type at 32 points (4 ports)

- CAN communication between modules: 1Mbps

- Scan time: Maximum of 1msec

Figure 5.47 Expansion Public IO Board (BD583)

5.8.2. Connector

There are 4 types of connectors for Expansion Public IO Board (BD583), which are as follows.

- Digital input: TBI1~8
- Digital output: TBO1~8
- Power: CNP1, CNP2
- CAN communication: CANS 1, 2

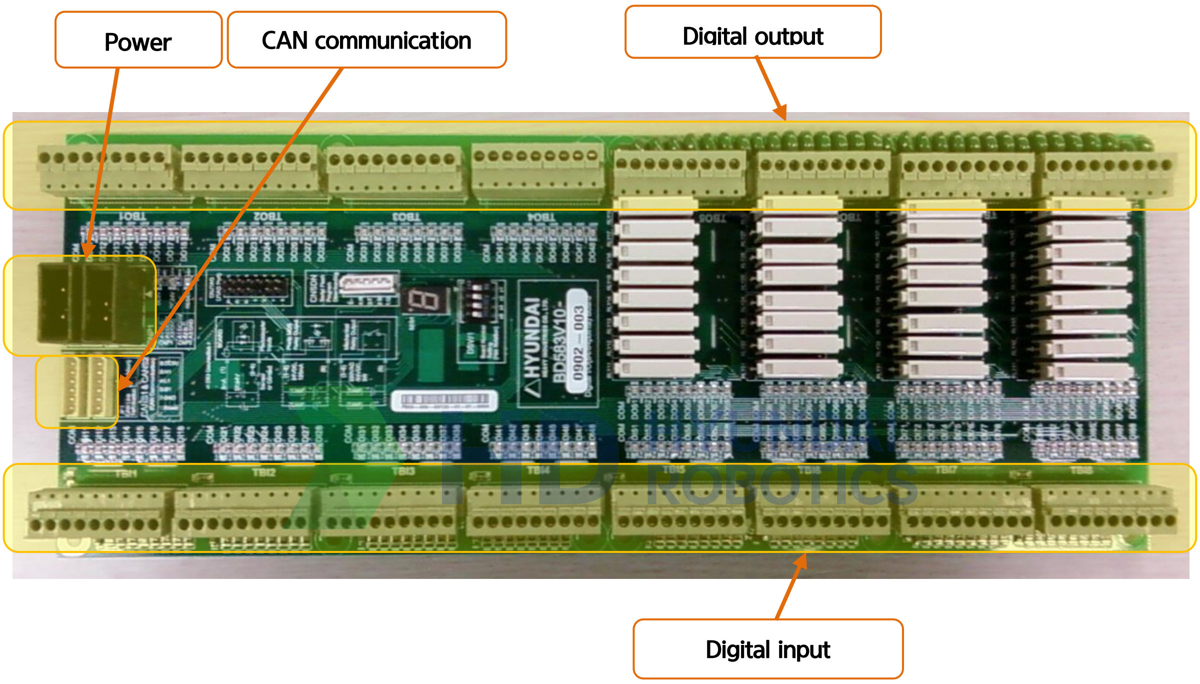


Figure 5.48 Connector Configuration for Expansion Public IO Board (BD583)

5.8.2.1. Digital Input

Figure 5.49 below shows the pin composition of the terminal block (TBI1~8) for digital input. Each terminal block can be connected to the common power for 8 input signals, and can use a different power supply than the common power of the terminal block for other input.

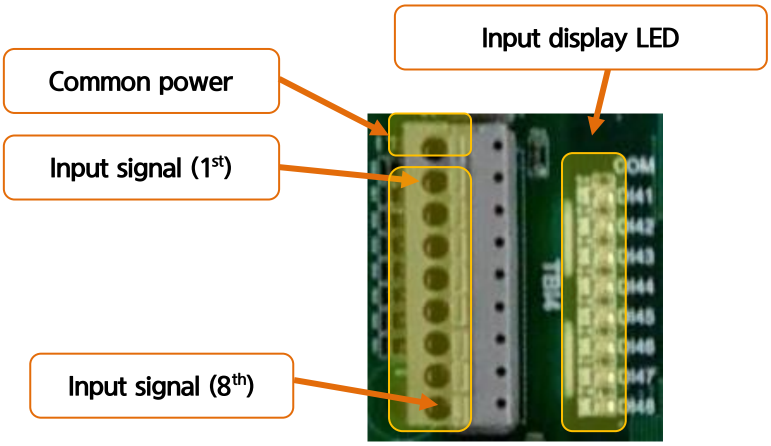


Figure 5.49 Pin Configuration of Digital Input Terminal Block on Expansion Public IO Board (BD583)

Table 5-30 Pin Configuration of Digital Input Terminal Block (TBIn*) of Expansion Public IO Board (BD583)

Pin Number	Signal Name	Signal Description
1	COMn*	COMMON power (Ground DC24V or DC24V)
2	DI n*1	1st input of nth public input signal port of user
3	DI n*2	2nd input of nth public input signal port of user
4	DI n*3	3rd input of nth public input signal port of user
5	DI n*4	4th input of nth public input signal port of user
6	DI n*5	5th input of nth public input signal port of user
7	DI n*6	6th input of nth public input signal port of user
8	DI n*7	7th input of nth public input signal port of user
9	DI n*8	8th input of nth public input signal port of user

Note *) Terminal Block Port Number n = 1~8 (Ex, TBI1, TBI2, TBI3, TBI4)

The electric specification of each input signal is as follows.

- Input terminal component: AC input photocoupler
- Input impedance: 3 KΩ
- Common power: Ground 24VDC or 24VDC

The user connects the input signal through the method shown in Figure 5.50 below. First, connect the user power +24V or the ground wire to the IO board (BD583), and then connect each signal to the input pin according to the usage. The power can be grouped by 8 input signals, and can be applied differently by port.

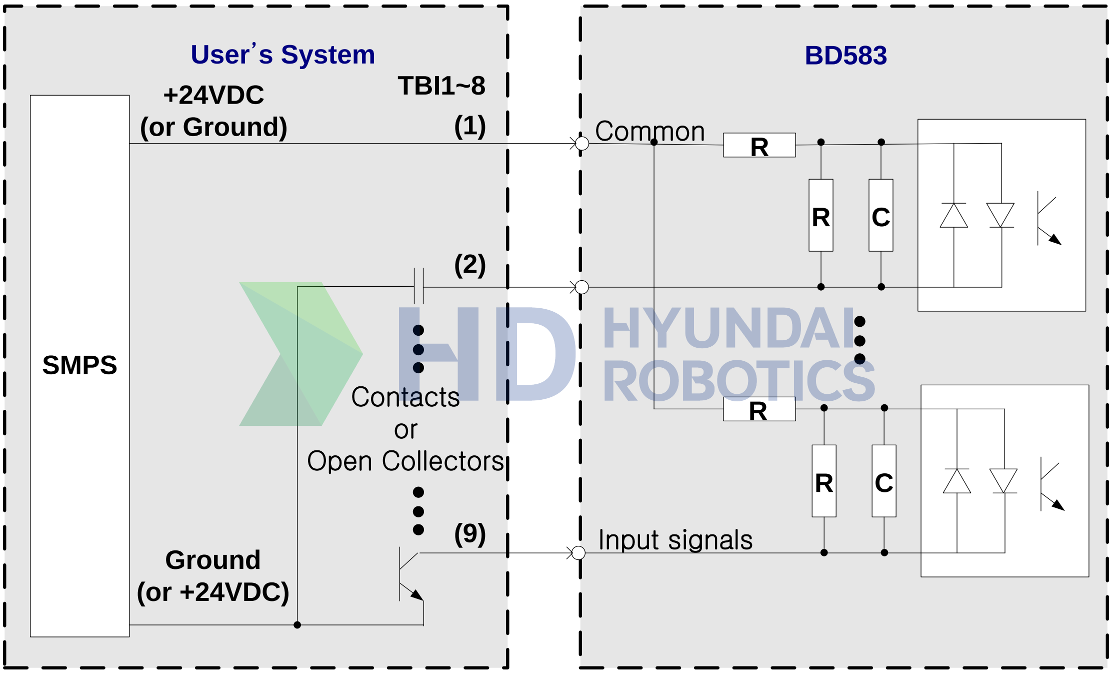


Figure 5.50 Method for Wiring Input Signal of Expansion Public IO Board (BD583)

5.8.2.2. Digital Output

Figure 5.51 below shows the pin composition of the terminal block (TBO1~8) for digital output. Each terminal block can be connected to the common power for 8 input signals, and can use a different power supply than the common power of the terminal block for other input.

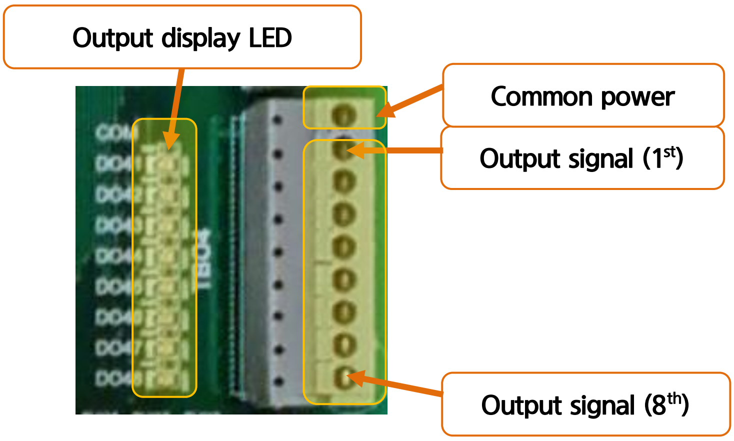


Figure 5.51 Pin Configuration of Digital Input/output Terminal Block on Expansion Public IO Board (BD583)

Table 5-31 Pin Configuration of Digital Output Terminal Block (TBOn*) on Expansion Public IO Board (BD583)

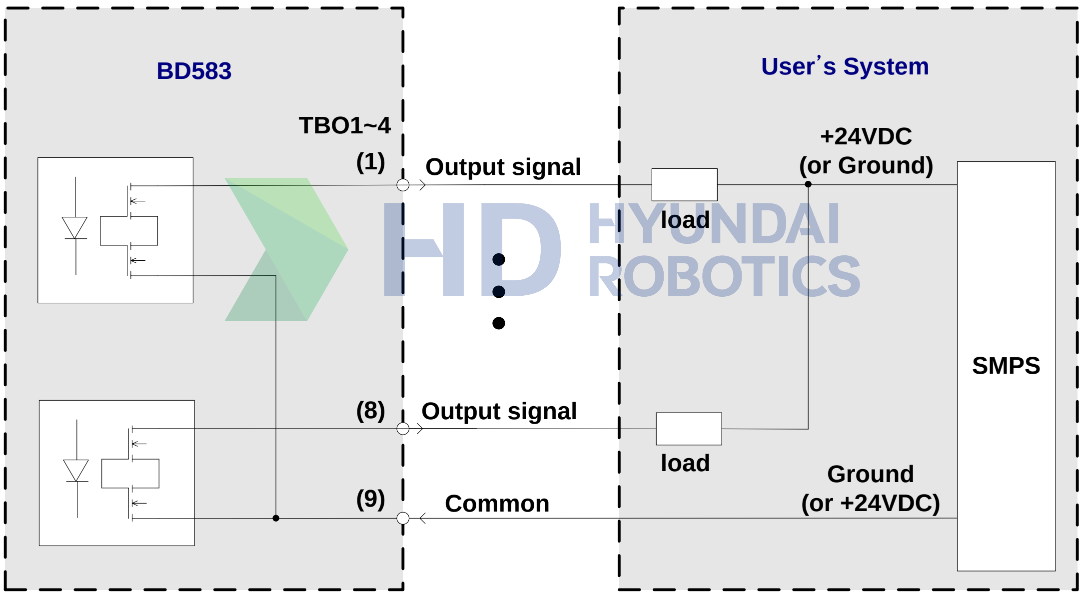
Pin Number	Signal Name	Signal Description
9	COMn*	COMMON power (Ground DC24V or DC24V)
8	DOn*1	1st output of nth public output signal port of user
7	DOn*2	2nd output of nth public output signal port of user
6	DOn*3	3rd output of nth public output signal port of user
5	DOn*4	4th output of nth public output signal port of user
4	DOn*5	5th output of nth public output signal port of user
3	DOn*6	6th output of nth public output signal port of user
2	DOn*7	7th output of nth public output signal port of user
1	DOn*8	8th output of nth public output signal port of user

Note *) Terminal Block Number n = 1~8 (Ex, TBO1, TBO2, TBO3, TBO4)

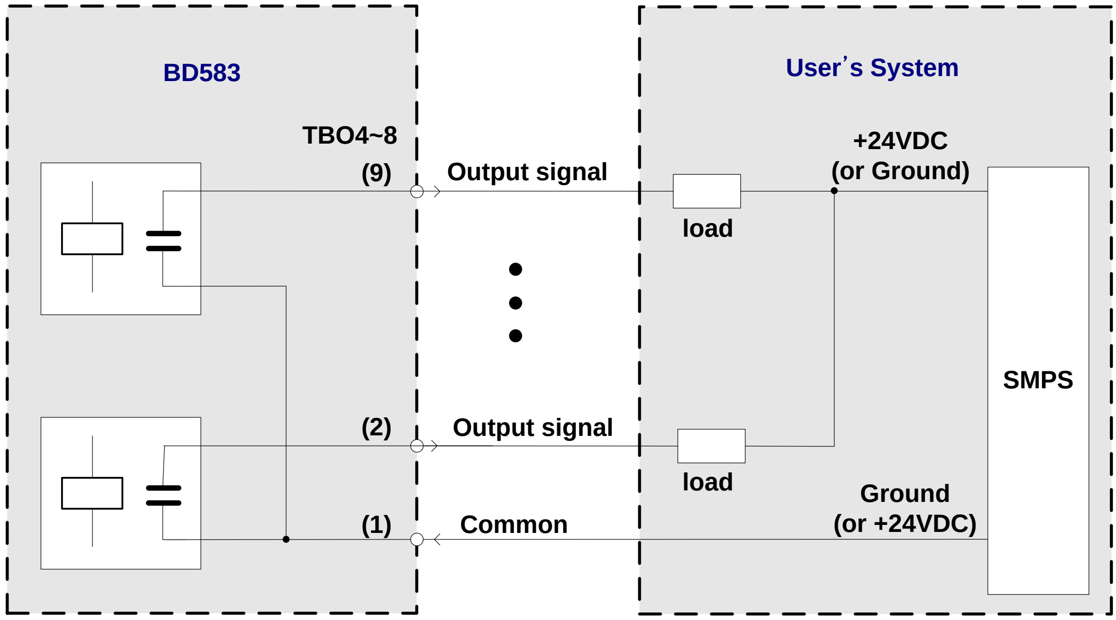
The electric specification of each output signal is as follows.

- Output component: Photo MOSFET (TBO1~4), relay (TBO5~8)
- Rated output
  Photo MOSFET 125mA (Continuous load current) / 24V DC
  Relay: 3A / DC 24V, AC250V
- Common power: Ground 24VDC or 24VDC

The user connects the output signal through the method shown in Figure 5.52 below. First, connect the common signal (COMMON) to the Expansion Public IO Board (BD583), and then connect each signal to the output pin according to the usage. The power can be grouped by 8 output signals, and can be applied differently by port.



(a) Photo MOSFET type output type

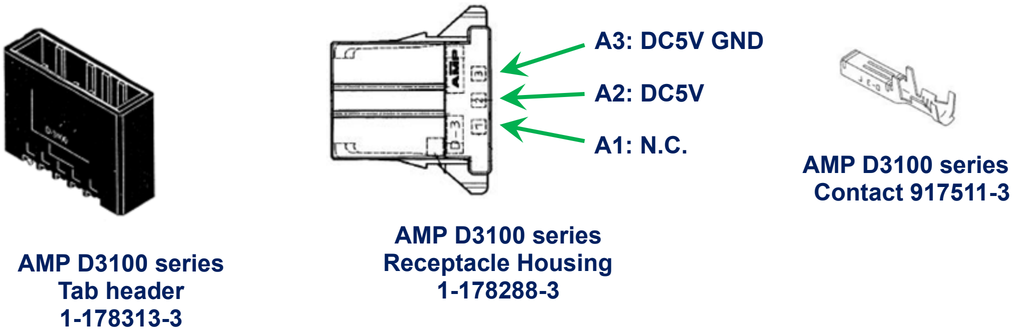


(b) Relay output type

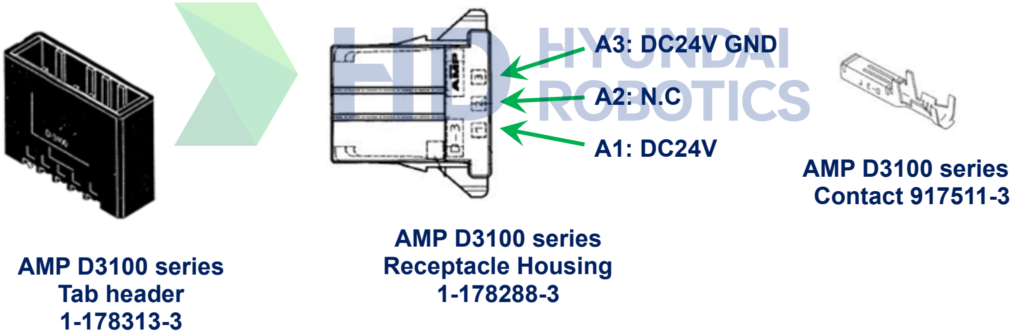
Figure 5.52 Method for Wiring Output Signal of Expansion Public IO Board (BD583)

5.8.2.3. Power Connector: CNP1, CNP2

The Power Connector is the connector to supply the power to operate the Expansion Public IO Board (BD583), and is composed of connector CNP1 for DC5V and CNP2 for DC24V, as shown in Figure 5.53 below. CNP1 supplies the power required for the basic operation of the board, and CNP2 supplies the power required to operate the 32-point output relay from the SMPS.



(a) CNP1 (DC5V power)



(b) CNP2 (DC24V power)

Figure 5.53 Power Connector CNP1 and CNP2 of Expansion Public IO Board (BD583)

5.8.2.4. CAN Communications Connector: CANS1, CANS2

For the CAN Communications Connector, there are two identical connectors with the same pin specification, which are installed as shown in Figure 5.54 below. As CAN communication is conducted through cable, with a Daisy Chaining method, it therefore does not matter which side of the connector it is connected to, as it does not affect the operation.

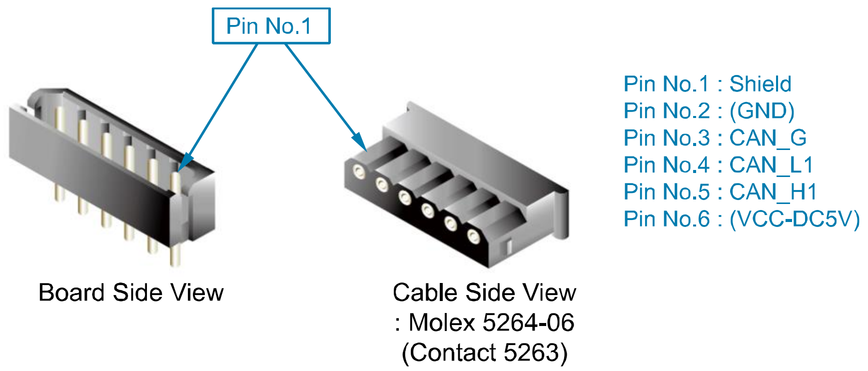


Figure 5.54 Method of Connecting the CAN Connector of Expansion Public IO Board (BD583)

When connecting several boards, the terminating resistance must be processed precisely. CAN data communication uses the Daisy Chaining method. Therefore, only the board connecting the CAN communication cable at the end must be connected to the terminating resistance; all other boards must not be connected to the terminating resistance. For the connection of terminating resistance, use the JP1 jumper next to CAN Connectors 1 and 2. When you short-circuit JP1, the terminating resistance is connected, and when opened, the terminating resistance is disconnected. Please refer to Figure 5.55 below.

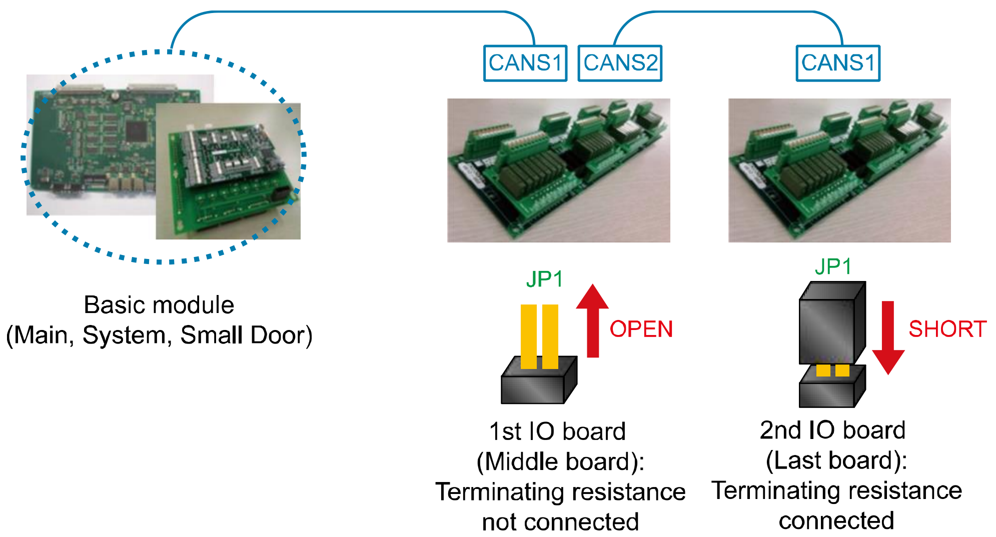


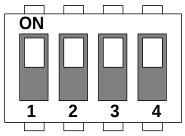
Figure 5.55 Method for Connecting Terminating Resistance

5.8.3. Setting Unit

5.8.3.1. DIP Switch Settings

The board number of the DIP switch DSW1 is set in hexadecimal code. Based on the setting condition of the switch, the board number is shown in Table 5-32 below.

Table 5-32 Method for Setting DSW1 Switch of Expansion Public IO Board (BD583)

Switch Number	4	3	2	1	Setting
Setting	Preliminary	Board Number (hex)			
		X4	X2	X1	
Example of Setting	OFF	OFF	OFF	OFF	1st board
	OFF	OFF	OFF	ON	2nd board
	OFF	OFF	ON	OFF	3rd board
	OFF	OFF	ON	ON	4th board
Factory Default Setting	OFF	OFF	OFF	OFF	1st board
Exterior of Switch					

5.9. Analog/Arc IF Board (BD584)

5.9.1. Outline

The Analog/Arc IF board provides the analog input/output and digital input/output required to connect with external devices. The specification of the basic board is as follows.

- Digital input: 8 points
- Digital output: 8 points (Photo MOS type)
- Analog input: 8 points (12-bit resolution)
- Analog output: 8 points (12-bit resolution)
- Analog stick check function

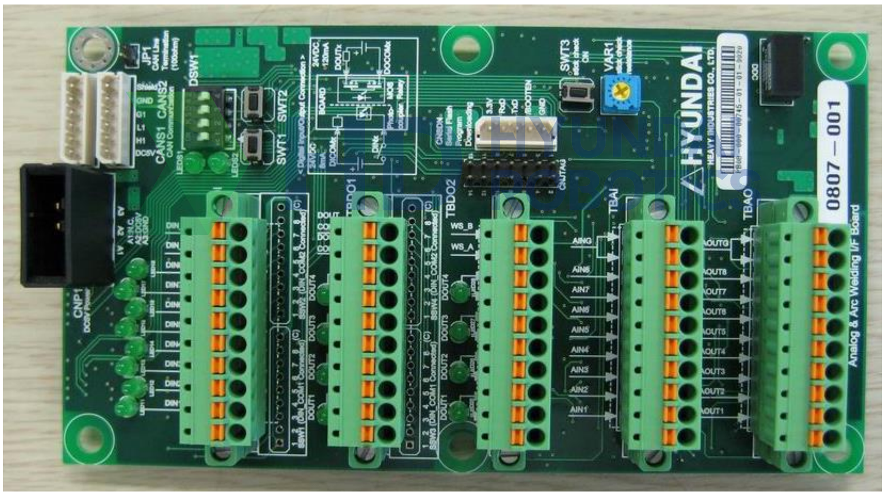


Figure 5.56 Analog/Arc IF Board (BD584)

The board is 86mm (L) x 156mm (H) in size, and has many functions, which are shown in Figure 5.57 below.

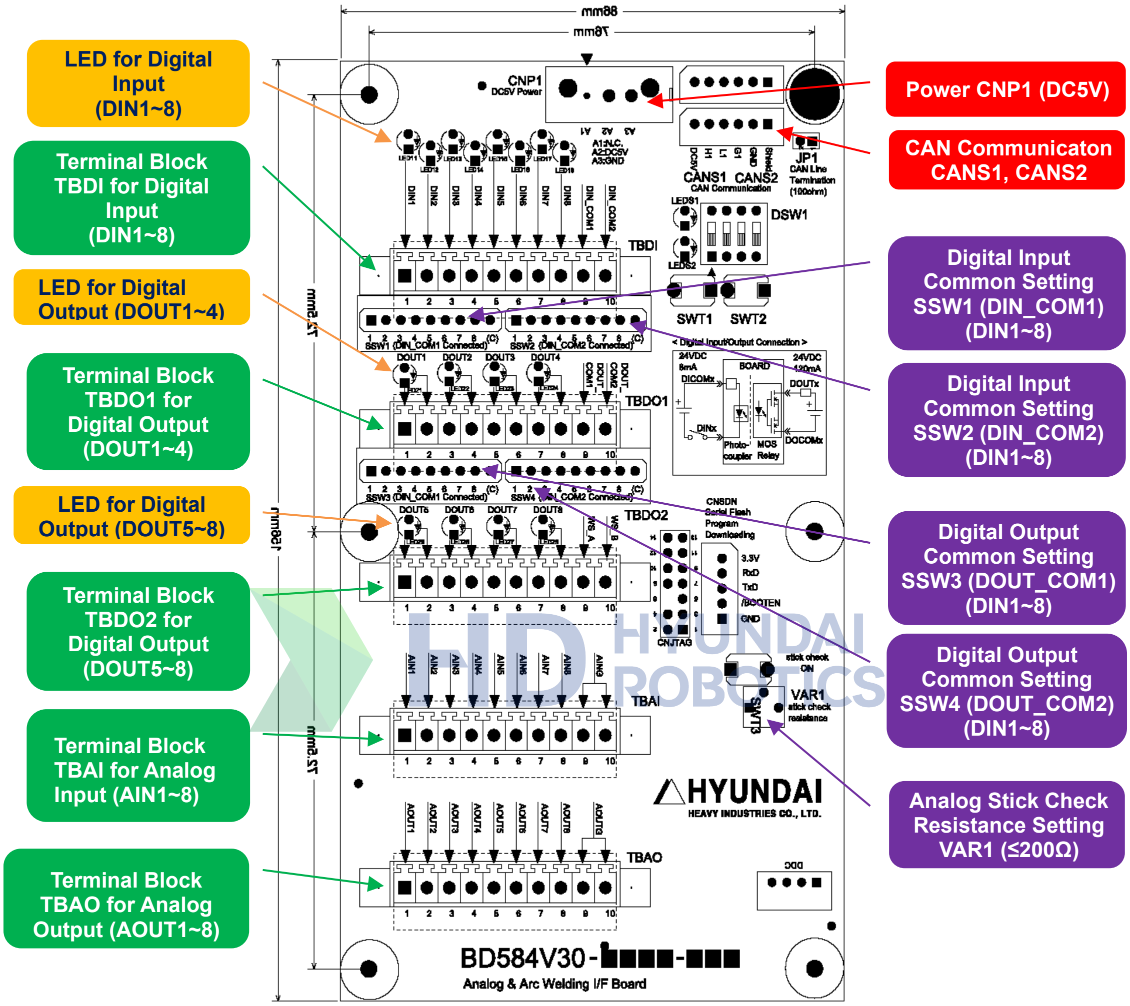


Figure 5.57 Configuration of Analog/Arc IF Board (BD584)

5.9.2. Connector

5.9.2.1. Digital Input

The board has 8 digital input ports that can receive ON/OFF input. The photocoupler is used to electrically insulate from the external device. To expand the applied scope, each input can select and use the common input signal of two types.

The current used in the unit input is 5mA at 24V voltage. Therefore, if all 8 inputs are used, a total of 40mA of current is consumed.

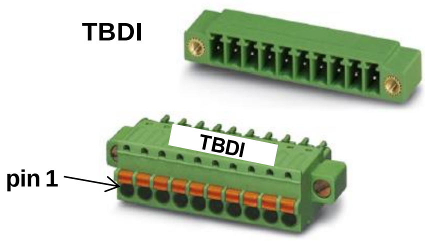


Figure 5.58 Terminal Block for Digital Input on Analog Board (BD584)

Use the assigned input to connect the arc welder. Details are shown in Table 5-33 below.

Table 5-33 Pin Configuration of Digital Input Terminal Block (TBDI) of Analog Board (BD584)

Number	Name	Name for Arc Welder Connection	Remarks
1	DIN1	WCR	
2	DIN2	SHOCK_SENSOR	
3	DIN3	WIRE_STICK	
4	DIN4	WELDER_ERR	
5	DIN5	WIRE_STATE	
6	DIN6	GAS_STATE	
7	DIN7	Reserved 1	
8	DIN8	Reserved 2	
9	DI_COM1	Signal Common 1	
10	DI_COM2	Signal Common 2	

The method of connecting the digital input port is shown in Figure 5.59 below. The example depicts the connection of 4 sensors with contact point or NPN-type output. Sensors 6 and 8 are configured with SMPS1 power, and Sensors 1 and 4 are configured with SMPS2 power. That is, two different types of power input can be used. This is set and classified by the SIP switches, SSW1 and SSW2 inside the board. For example, sensor 8 is connected to input port 8. Because this sensor uses SMPS1 power, the circuit must be configured through the COMMON power connected to 9. Therefore, turn on SSW1 switch 8, and then turn off SSW2 switch.

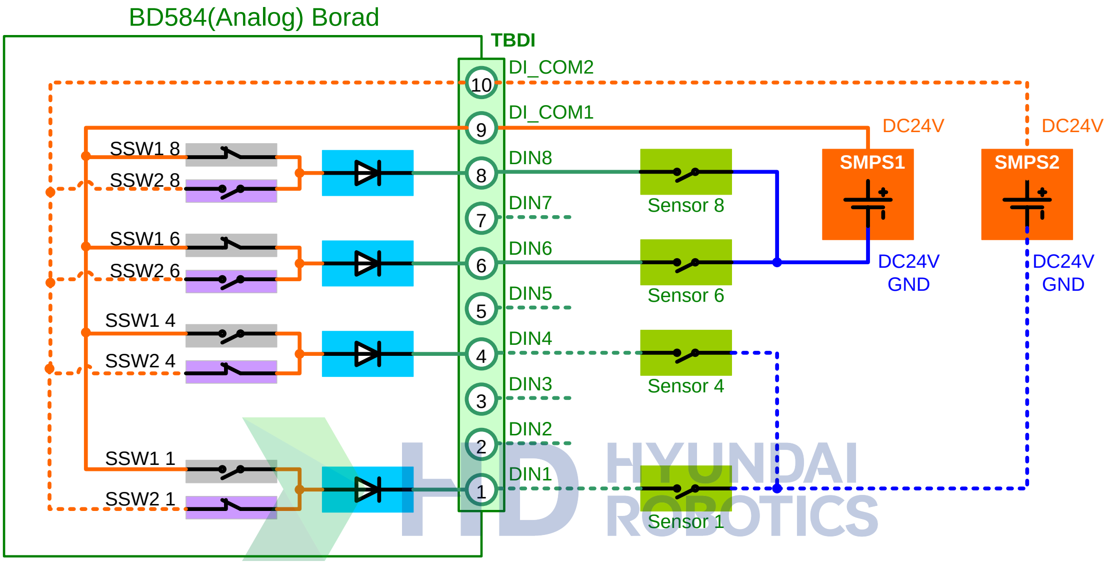


Figure 5.59 Method for Connecting Digital Input on Analog Board (BD584)

The installation order can be summarized as follows.

① First, turn off both SIP switches (SSW1 and SSW2).
② Connect the sensor and external power to the input terminal block TBDI.
③ SIP switch (SSW1 and SSW2) setting: For the power configuration, turn the SIP switches SSW1 and SSW2 ON or OFF according to the applicable sensor.

Caution:
You must not set the same switch number for SIP switches SSW1 and SSW2 to ON simultaneously. Doing so can short-circuit two different power supplies.

SIP switches SSW1 and SSW2 are connected within the board, as shown in Figure 5.60 below. Because the DI_COM1 (#9 pin) of digital input terminal block TBDI is connected to the common connecting pin (#9 pin) of SIP switch SS1, when you turn ON switches #1~#8 of SSW1, the same power as DI_COM1 is connected to the input signal processing circuit.
In addition, because the DI_COM2 (#10 pin) of TBDI is connected to the common connecting pin (#9) of SIP switch SSW2, when you turn ON switches #1~#8 of SSW2, the same power as DI_COM2 is connected to the input signal processing circuit.
Switches #1~#8 of SSW1 and SSW2 are connected to each other for each number. Therefore, if you turn ON both SSW1 and SSW2 for the input signal number, the common power will be short-circuited. For this reason, you must only turn ON one of the two.

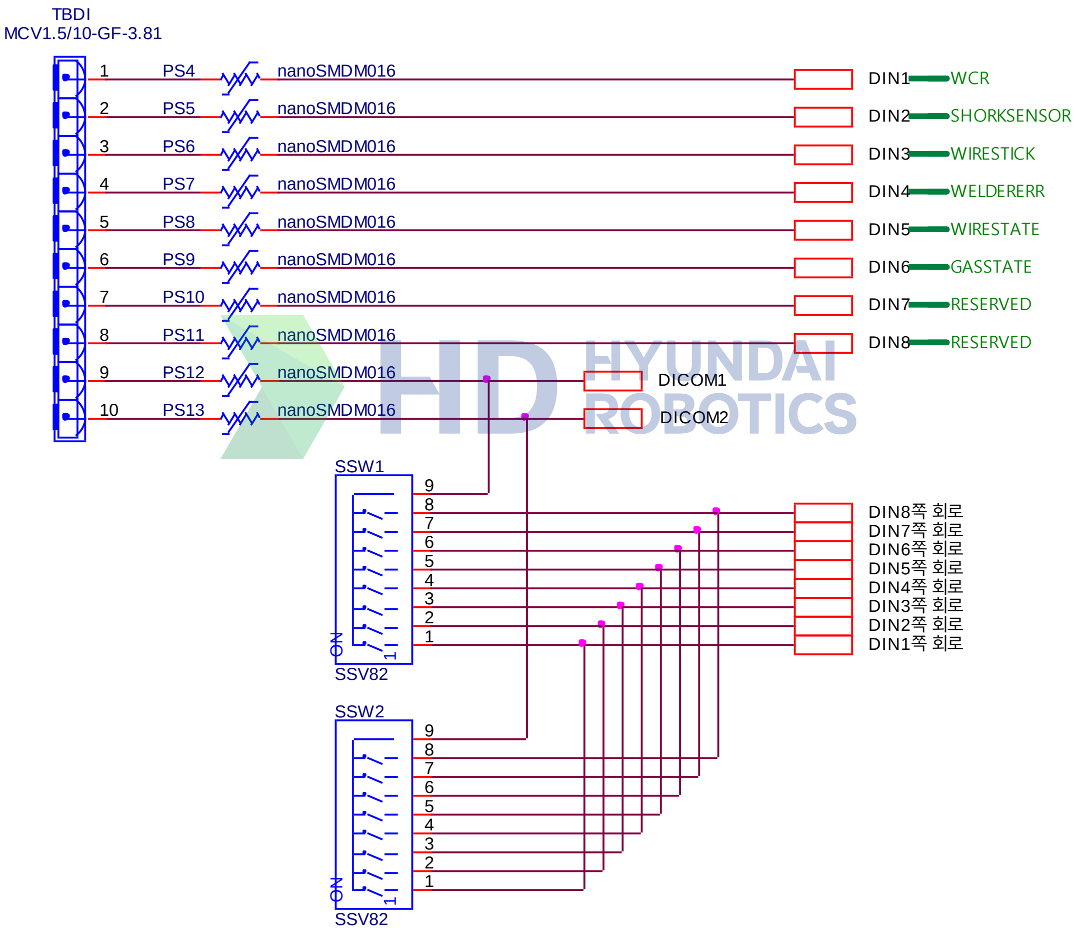


Figure 5.60 Common Circuit of Digital Input from Analog Board (BD584)

Caution:
You must not set the same switch number for SIP switches SSW1 and SSW2 to ON simultaneously. Doing so can short-circuit two different power supplies.

5.9.2.2. Digital Output

The board has 8 digital output ports that can output ON/OFF. These are electrically insulated from the external device using the photo MOSFET. To expand the applied scope, each input can select and use common output signal and individual contact point output of two types.
Maximum permitted current of unit output is 125mA at 24V voltage. Therefore, when all 8 of the outputs are used, the total current consumption is about 1000mA.

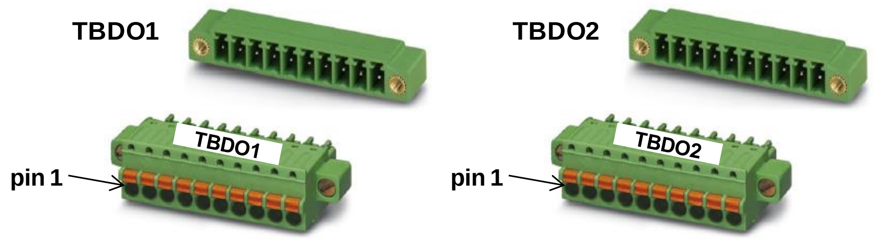


Figure 5.61 Terminal Block for Digital Output on Analog Board (BD584)

Use assigned output to connect the arc welder. Details are shown in Table 5-34 below.

Table 5-34 Pin Configuration of Digital Output Terminal Block (TBD01) on Analog Board (BD584)

Number	Name	Name for Arc Welder Connection	Remarks
TBDO1 1	DOUT 1	TORCH_SW	
TBDO1 2	DOUT 1 COM		
TBDO1 3	DOUT 2	INCHING	
TBDO1 4	DOUT 2 COM		
TBDO1 5	DOUT 3	RETRACT	
TBDO1 6	DOUT 3 COM		
TBDO1 7	DOUT 4	STICK_CHECK	
TBDO1 8	DOUT 4 COM		
TBDO1 9	DO_COM1	Signal Common 1	
TBDO1 10	DO_COM2	Signal Common 2	

Table 5-35 Pin Configuration of Digital Output Terminal Block (TBD02) on Analog Board (BD584)

Number	Name	Name for Arc Welder Connection	Remarks
TBDO2 1	DOUT 1	GAS_VALVE	
TBDO2 2	DOUT 1 COM		
TBDO2 3	DOUT 2	Reserved 1	
TBDO2 4	DOUT 2 COM		
TBDO2 5	DOUT 3	Reserved 2	
TBDO2 6	DOUT 3 COM		
TBDO2 7	DOUT 4	Reserved 3	
TBDO2 8	DOUT 4 COM		
TBDO2 9	WS_A	Check connecting terminal A of Analog Wire Stick	
TBDO2 10	WS_B	Check connecting terminal B of Analog Wire Stick	

The connecting method for the digital output port is shown in Figure 5.62. The example shows how to connect 4 loads in 3 formats. Loads 1 and 3 are connected to SMPS1 power, load 5 is connected to SMPS3 power and load 7 is connected to SMPS3 power. That is, you can use 3 different power supplies for the output. This can be set and classified by SIP switches SSW3 and SSW4 inside the board.

For example, load 1 is connected to output port #1. Because this sensor uses SMPS1 power, the circuit must be configured through the COMMON power connected through #9. Therefore, turn #1 of SSW3 switch ON, and then #1 of SSW4 switch OFF.

For load 7, the COMMON power is not used, and SMPS3 is separately used to use the output port independently. Turn both SIP switches SSW3 and SSW4 OFF, and connect the Ground wire from SMPS3 directly to the terminal block.

Caution:
You must not set the same switch number for SIP switches SSW3 and SSW4 to ON simultaneously. Doing so can short-circuit two different power supplies.

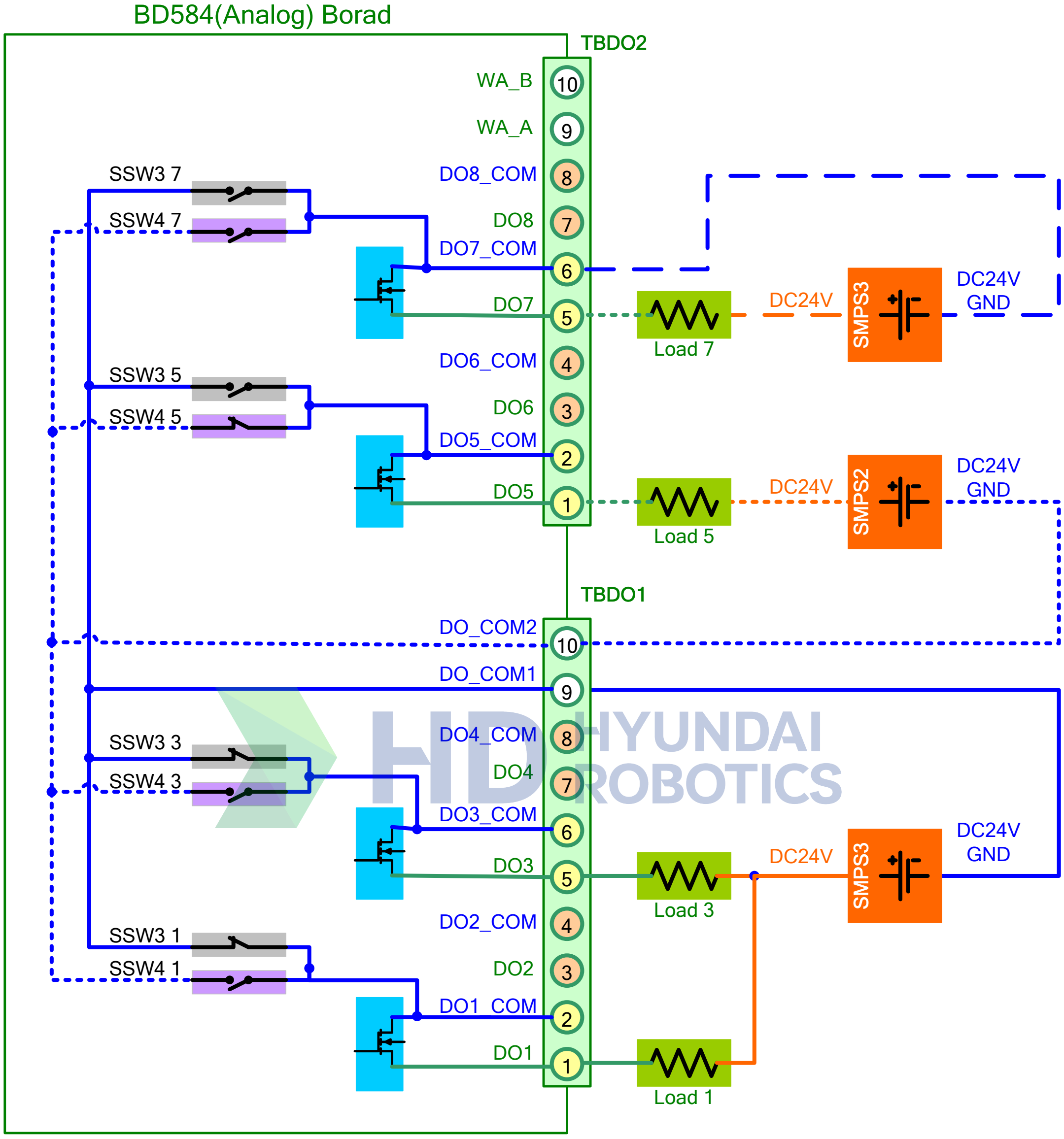


Figure 5.62 Method for Connecting the Digital Output on Analog Board (BD584)

The installation order can be summarized as follows.

① First, turn off both SIP switches (SSW3 and SSW4).
② Connect the load and external power to the output terminal blocks TBDO1 and TBDO2.
③ SIP switch SSW3 and SSW4 setting: For the power configuration, turn the SIP switches SSW3 and SSW4 ON or OFF according to the applicable load.

Caution:
You must not set the same switch number for SIP switches SSW3 and SSW4 to ON simultaneously. Doing so can short-circuit two different power supplies.

Similarly to the input, the SIP switches SSW3 and SSW4 are connected inside the board, as shown in Figure 5.63 below.

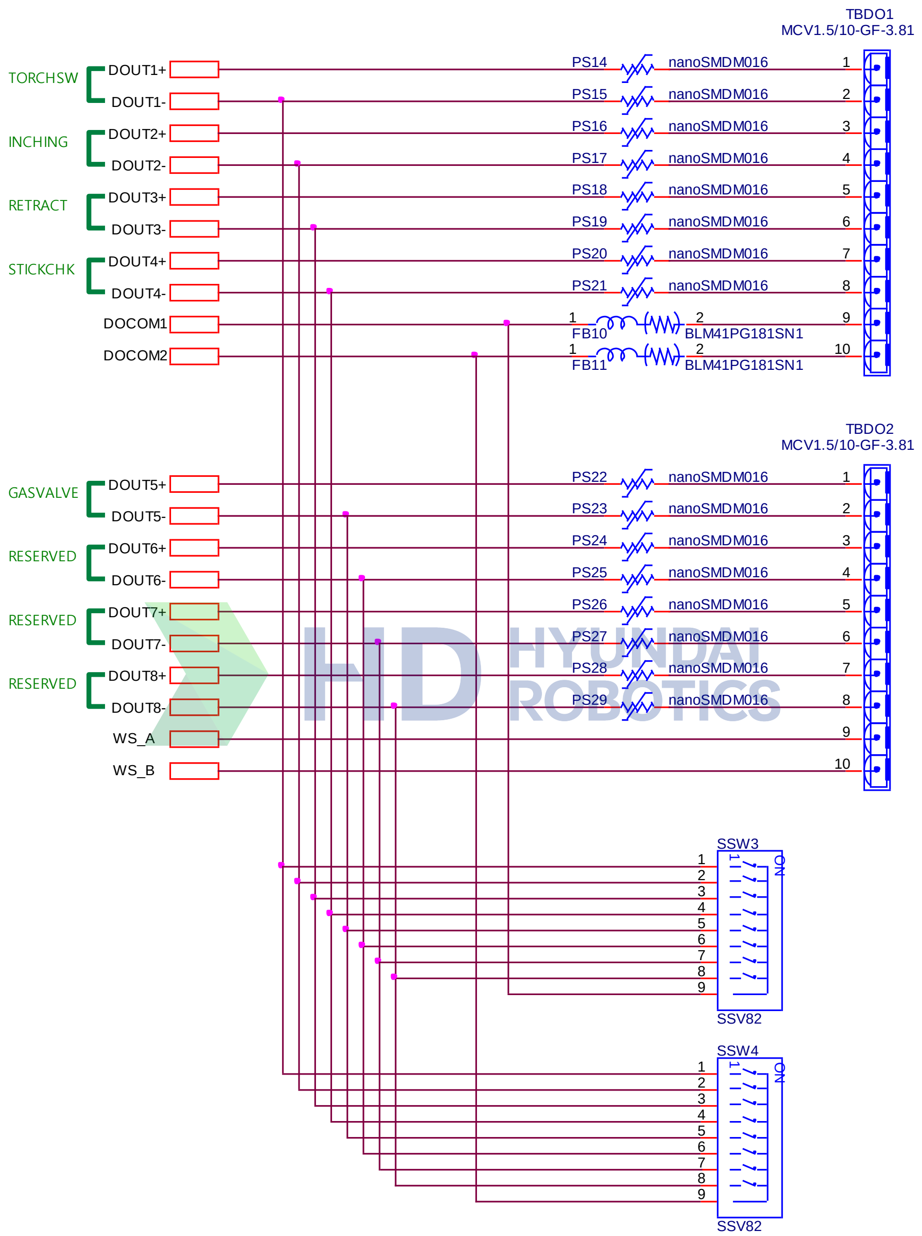


Figure 5.63 Common Circuit of Digital Output on Analog Board (BD584)

Caution:
You must not set the same switch number for SIP switches SSW3 and SSW4 to ON simultaneously. Doing so can short-circuit two different power supplies.

5.9.2.3. Analog Input

The board can receive analog voltage input of 8 channels. Each channel has 12-bit resolving power in the range of -12V~+12V. The input impedance is 20kΩ, and output impedance of the connected device should ideally be infinite. As the analog value of all 8 channels is transmitted to the MAIN board every 1msec, the scan time is 1msec.

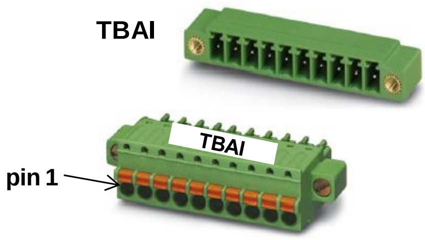


Figure 5.64 Terminal Block for Analog Input on Analog Board (BD584)

The pin allocation of terminal block TBAI for analog input is shown in the following Table.

Table 5-36 Pin Configuration of Analog Input Terminal Block (TBAI) on Analog Board (BD584)

Number	Name	Use	Remarks
1	AIN1	Analog Input Channel 1	
2	AIN 2	Analog Input Channel 2	
3	AIN 3	Analog Input Channel 3	
4	AIN 4	Analog Input Channel 4	
5	AIN 5	Analog Input Channel 5	
6	AIN 6	Analog Input Channel 6	
7	AIN 7	Analog Input Channel 7	
8	AIN 8	Analog Input Channel 8	
9	AING	Analog Input Ground	
10	AING	Analog Input Ground	

The method of connecting the analog input port is shown in Figure 5.65 below. This example shows the method of connecting 5 analog signals. Each signal sends input to AIN1~ AIN5 and the ground is connected to AING pin #9 or #10. The input signal is AD converted through the signal control circuit inside the board. The power used in the analog input circuit uses the insulation separated type DC/DC converter, and is separated from the internal power of the controller.

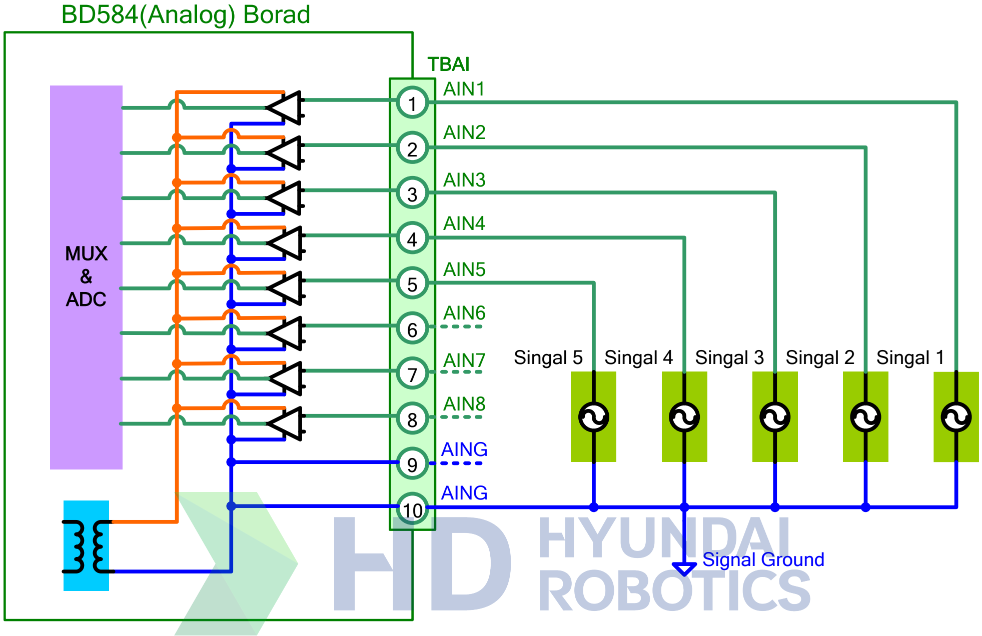


Figure 5.65 Method for Connecting Analog Input on Analog Board (BD584)

5.9.2.4. Analog Output

The board can output analog voltage on 8 channels. Each channel has 12-bit resolving power in the range of -12V~+12V. The analog voltage value of all 8 channels is transmitted from the MAIN board every 5msec, to renew the output voltage.

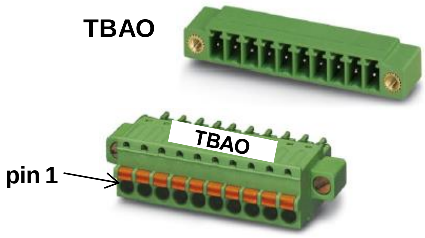


Figure 5.66 Analog Output Terminal Block on Analog Board (BD584)

The pin allocation of terminal block TBAO for analog output is shown in Table 5-37 below.

Table 5-37 Pin Configuration of Analog Output Terminal Block (TBAO) on Analog Board (BD584)

Number	Name	Use	Remarks
1	AOUT 1	Analog Output Channel 1	
2	AOUT 2	Analog Output Channel 2	
3	AOUT 3	Analog Output Channel 3	
4	AOUT 4	Analog Output Channel 4	
5	AOUT 5	Analog Output Channel 5	
6	AOUT 6	Analog Output Channel 6	
7	AOUT 7	Analog Output Channel 7	
8	AOUT 8	Analog Output Channel 8	
9	AOUTG	Analog Output Ground	
10	AOUTG	Analog Output Ground	

The method of connecting the analog output port is shown in Figure 5.67 below. The example shows the method of connecting to use 4 analog voltage outputs, AOUT1, AOUT3, AOUT5 and AOUT7. Ground of voltage is connected to AOUTG pin #9 or #10. The power used in the analog output circuit uses the insulation separation type DC/DC converter to separate from the internal power of the controller.

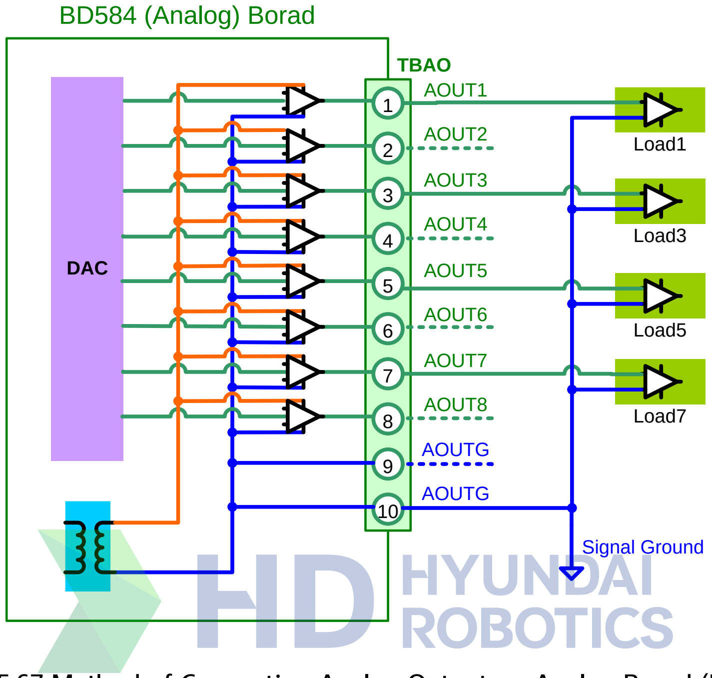


Figure 5.67 Method of Connecting Analog Output on Analog Board (BD584)

5.9.2.5. Analog Stick Check

The board includes a function to check the wire stick of the arc plate through an analog method. As shown in the Figure 5.68 below, connect to #9 (WS_A) and #10 (WS_B) of TBD02 to check the stick. The criteria for checking the stick can be set up to 200Ω by using the variable resistance VAR1 of the board.

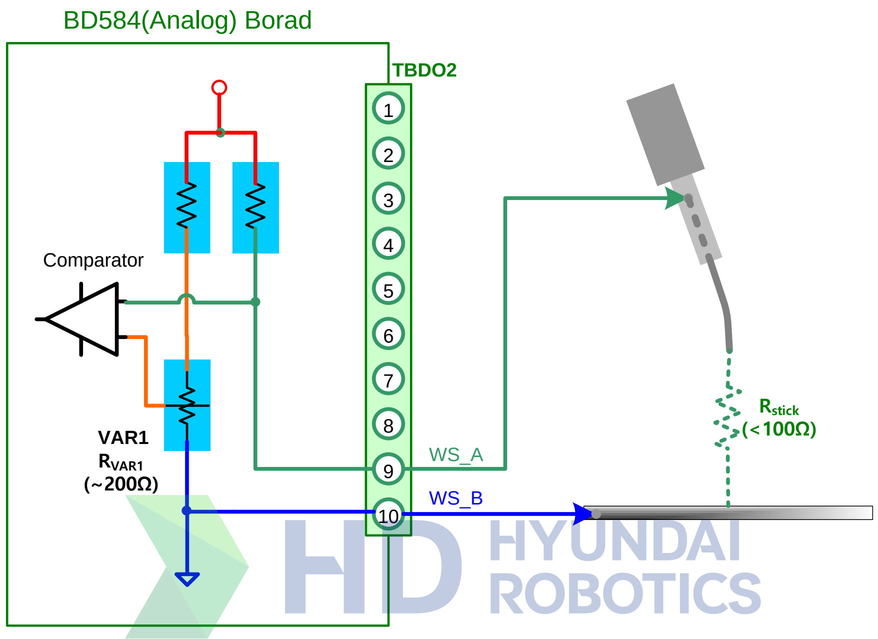


Figure 5.68 Analog Stick Check Function on Analog Board (BD584)

5.9.2.6. Power Connector: CNP1

Power is supplied to the board through CNP1 connector. Figure 5.69 describes the exterior and pin allocation of CNP1.

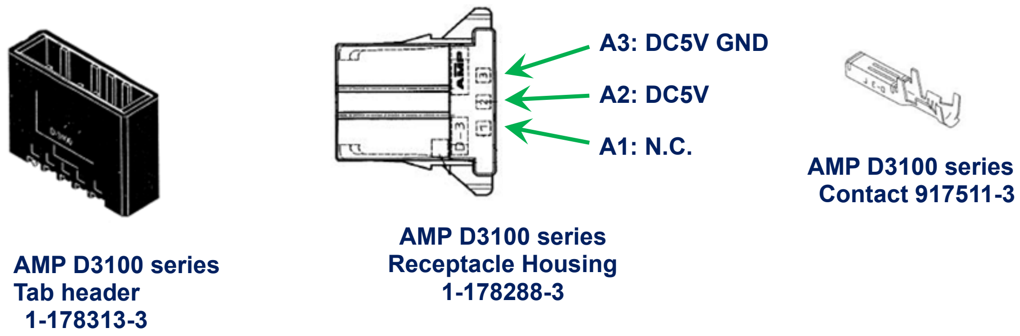


Figure 5.69 Power Connector CNP1 of Analog Board (BD584)

Table 5-38 Pin Configuration of Power Connector CNP1 on Analog Board (BD584)

Number	Name	Use	Remarks
A1	N.C.	No connection	
A2	DC5V	DC 5V power	
A3	DC5V GND	DC 5V power ground	

5.9.2.7. CAN Communications Connector: CANS1, CANS2

Data communication with the MAIN board uses the CAN of Half Duplex method. Bottom modules of the controller are configured for CAN data communication using a Daisy Chain method. Therefore, there are two CAN connectors on the board. Figure 5.70, Table 5-39 below describes the CAN connector exterior and pin allocation. Even though you can connect the power through #6 (VCC-DC5V) and #2 (VCC Ground) to the board, it is recommended to use the CNP1 power connector.

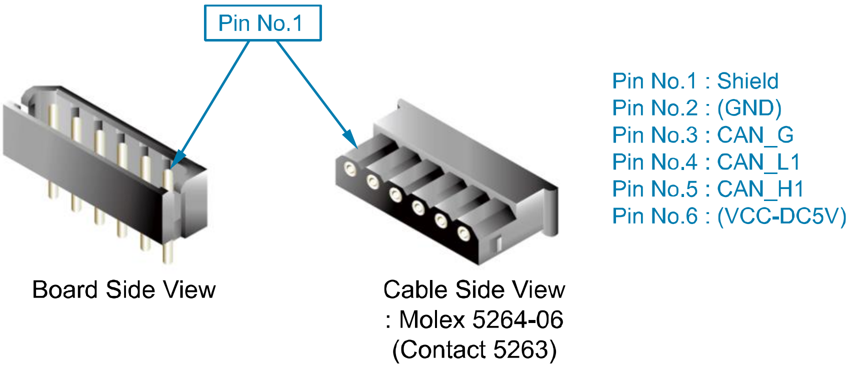


Figure 5.70 Method of Connecting CAN Connector on Analog Board (BD584)

Table 5-39 Pin Configuration of CAN Connector on Analog Board (BD584)

Number	Name	Use	Remarks
1	Shield	Connect shield of CAN cable	
2	DC5V GND	Connect board power DC5V ground (Recommended to connect through CNP1)	
3	CAN_G	Connect ground for CAN communication	
4	CAN_L1	Connect L signal of CAN communication	
5	CAN_H1	Connect H signal of CAN communication	
6	DC5V	Connect board power DC5V ground (Recommended to connect through CNP1)	

When connecting several boards, the terminating resistance must be processed precisely. CAN data communication uses the Daisy Chaining method. For this reason, only the board connecting the CAN communication cable at the end must be connected to the terminating resistance; all other boards must not be connected to the terminating resistance. For the connection of the terminating resistance, use the JP1 jumper next to CANS connectors 1 and 2. When you short-circuit JP1, the terminating resistance is connected, and when opened, the terminating resistance is disconnected.

5.10. Terminal board (BD5B2)

The terminal board combines all the input and output connectors for the user to the CAN communication connection. When opening the door of the controller, the user can see the board located on a plate on the right side.

Figure 5.71 Terminal Board (BD5B2) Configuration

Figure 5.72 Terminal Board (BD5B2) Connection

5.11. Fieldbus communication board (BD525)

5.11.1. Outline

The robot controller doesn't work alone, and HW and interface are required for different fieldbus communication protocols when it is a sub device of process control PLC or superior device to control a robot tool, positioner, or I/O.
Our robot controller fieldbus communication board supports the Ethernet-based fieldbus master and/or slave channel, and CC-Link IE slave and legacy communication based fieldbus(ProfiBus-DP, CC-Link) when an optional board is installed.
Channel parts and optional boards can be partially assembled and supplied according to the requirements.

- **Support for Ethernet-based fieldbus**

  PROFINET IO-Controller (Master), IO-Device (Slave)
  Ethernet/IP Scanner (Master), Adapter (Slave)
  CC-Link IE Slave (When an optional board is installed)

- **Support for legacy communication based fieldbus**

  PROFIBUS-DP (When a BD525SUBP optional board is installed)
  CC-Link (C When a BD525SUB optional board is installed)

- **3 channels in total**

  - Ethernet/IP Scanner or ProfiNet IO-Controller or Legacy Fieldbus
  - Ethernet/IP Adapter or ProfiNet IO-Device or Legacy Fieldbus
  - CC-Link IE Slave

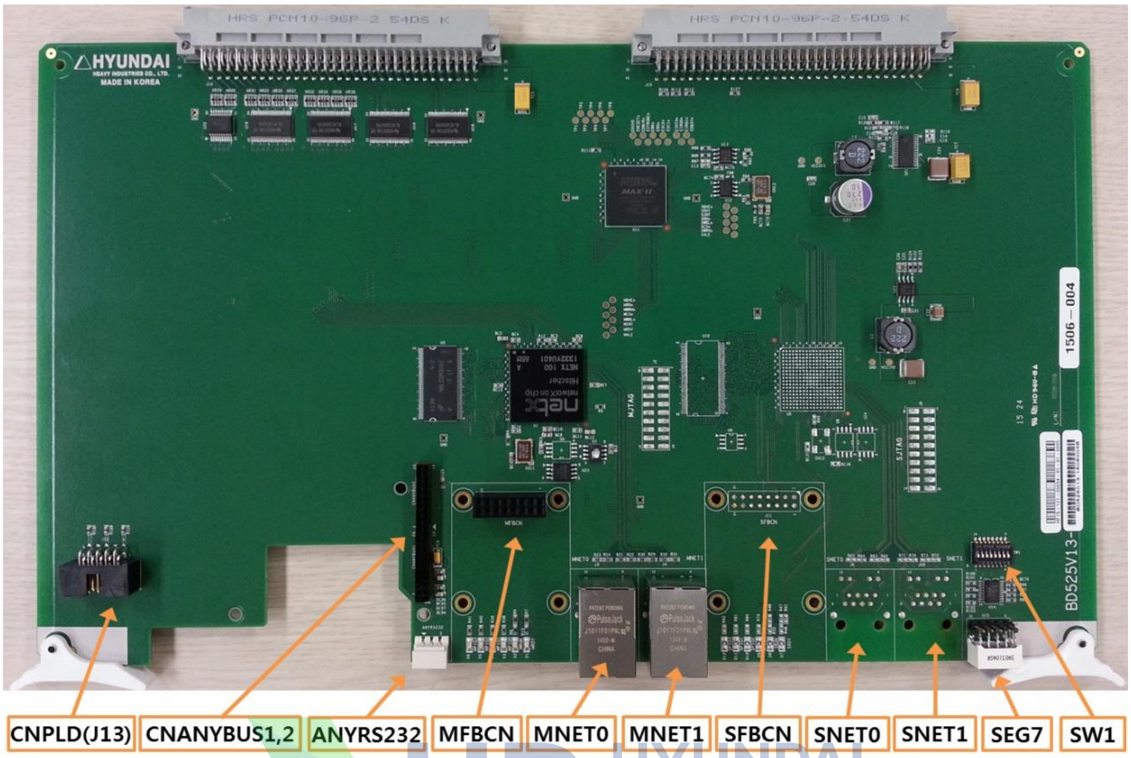


Figure 5.73 Exterior (top) of fieldbus communication board(BD525)

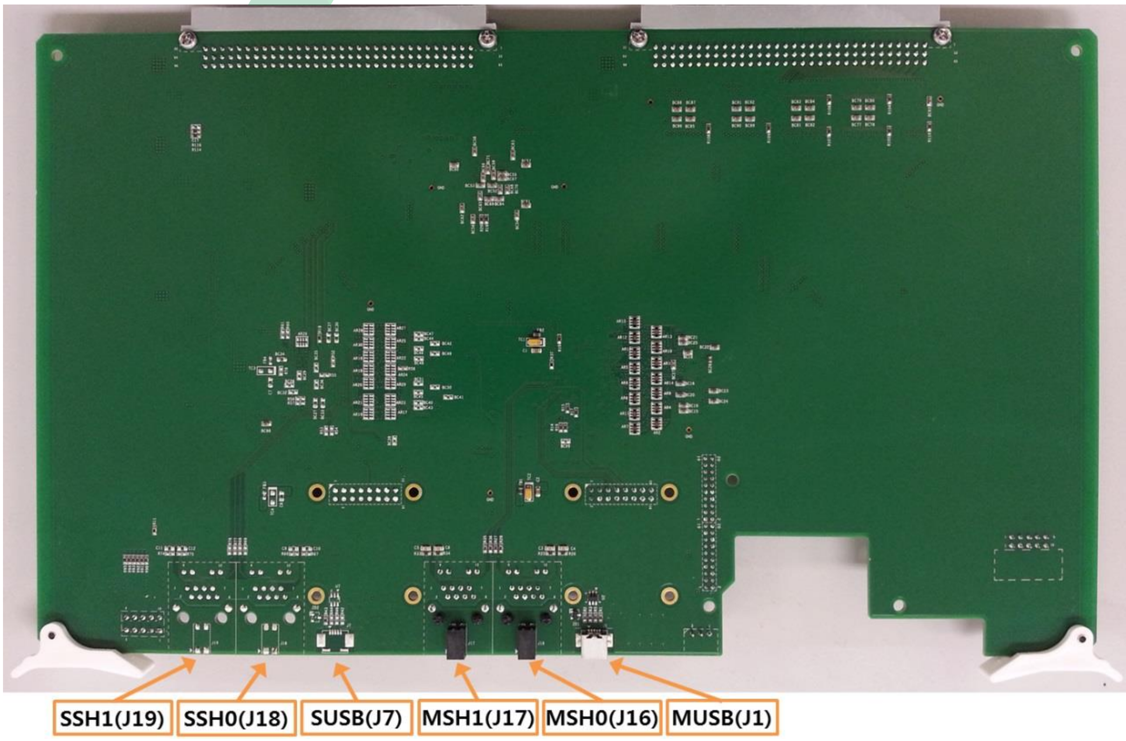


Figure 5.74 Exterior (bottom) of fieldbus communication board(BD525V13)

5.11.2. Connector & I/O device

5.11.2.1. Ethernet connector

Connector for Ethernet-based fieldbus

- Master channel connector: MNET0, MNET1
- Slave channel connector: SNET0, SNET1

Figure 5.75 Exterior of Ethernet connector

When setting up Ethernet-based fieldbus network connection topology, terminal blocks are assigned for individual Ethernet connectors to separate the ground wire if it is necessary to ground the shield of Ethernet cable from the fieldbus communication board of robot controller. Ethernet connector housings are not connected to each other but respectively connected to corresponding terminal blocks. Therefore, individual Ethernet lines can be grounded by inserting the ground lines to terminal blocks and connecting them to the enclosure grounds of controllers if necessary. The terminal blocks can be connected with 18 - 24 AWG single/stranded lines.

- MNET0 <-> MSH0(J16)
- MNET1 <-> MSH1(J17)
- SNET0 <-> SSH0(J18)
- SNET1 <-> SSH1(J19)

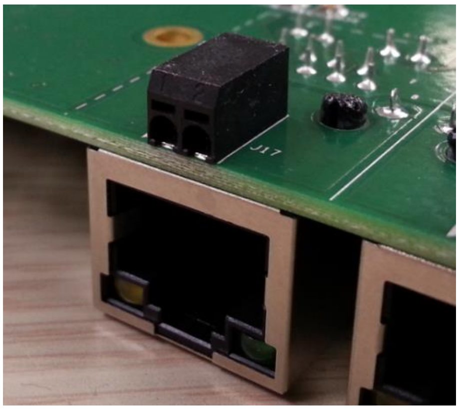


Figure 5.76 Terminal block on the back of Ethernet connector

5.11.2.2. Optional module connector

There are connectors to insert optional 3 types of modules on the fieldbus communication board.
The CC-Link IE Slave Module needs to be aligned with the pin No. 1 and device hole of CNANYBUS1 connector, and then inserted.

- CNANYBUS1,2: CC-Link IE Slave Module (ANYBUS AB4788-B)
- MFBCN: Legacy Fieldbus Module (BD525SUBC, BD525SUBD)
- SFBCN: Legacy Fieldbus Module (BD525SUBC, BD525SUBD)

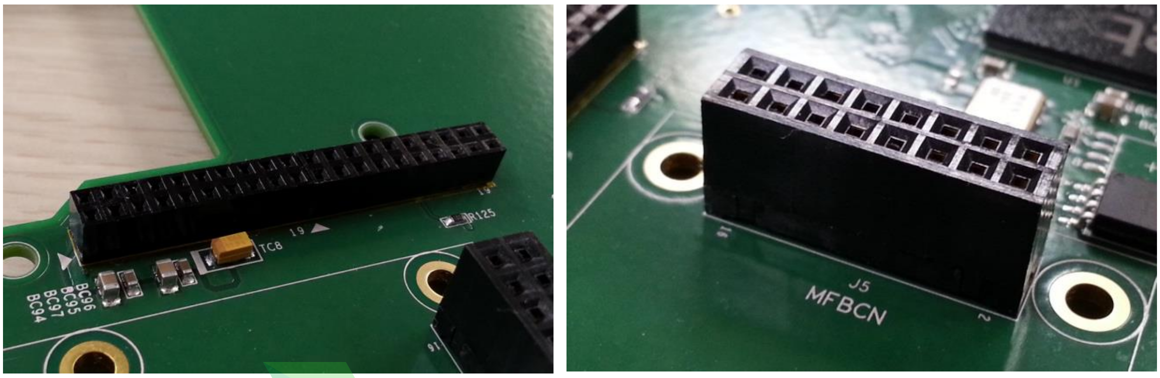


Figure 5.77 Exterior of CNANYBUS1,2 (left) and MFBCN(same as SFBCN, right) connectors

5.11.2.3. In/output device

On the fieldbus communication board, there is a DIP SW to enter external setting value and seven segment LED to indicate the version and state of PLD.

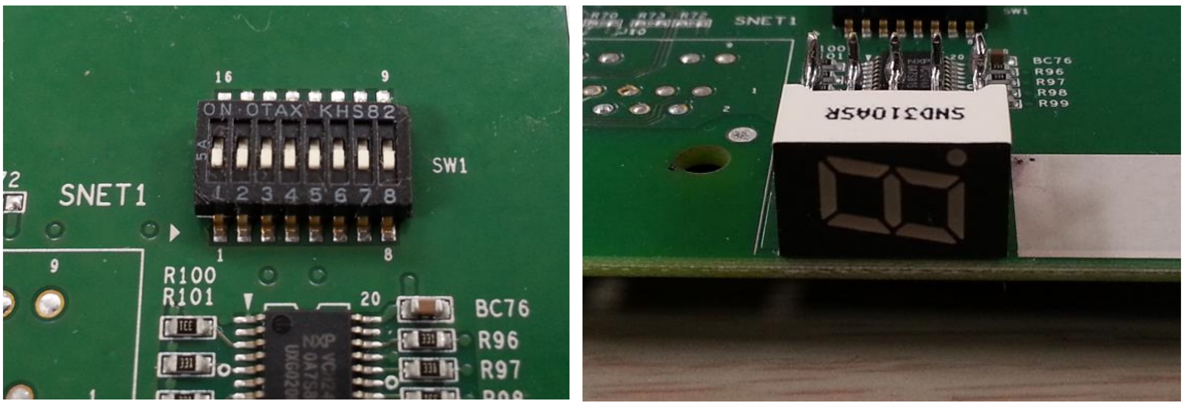
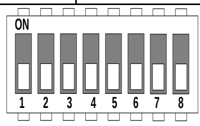


Figure 5.78 Exterior of DIP SW(SW1, left) and Seven Segment LED(SEG7, right)

(1) Switch Settings

CAUTION: Users may not change the setting of DIP switch [SW1].

Table 5-40 How to set fieldbus communication board(BD525) [SW1] switch

Switch No.		1	2	3	4	5	6	7	8
Content	OFF	Reserved							
	ON								
Initial Setting		OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
The External Form of the Switch									

(2) Seven segment state

Seven segments are all ON with the board reset and then repeatedly blinks every 15 seconds with 1 second interval. Segment indicates the followings.

- V1.V2 : Hardware version of BD525 board (ex. 1 3 ➔ board version 1.3)
- V3.V4 : PLD version of BD525 board (ex. 1 1 ➔ pld version 1.1)
- S1.S2 : Hexa code of pin No. 3 - 8 of DIP SW(SW1) (ex. 0x00 ~ 0x3F)
- R1.R2.R3 : Reserved for S/W

Table 5-41 State of fieldbus communication board (BD525) [7-SEG]

Seq.	First 1 time	1	2	3	4	5	6	7
Mark								
Meaning	**Reset**	**B**	**d**	**5**	**2**	**5**	**V1**	**V2 + Dot**
Seq.	8	9	10	11	12	13	14	15
Mark								
Meaning	**V3**	**V4 + Dot**	**S1**	**S2 + Dot**	**R1**	**R2**	**R3**	**Dot**

5.12. CAN extension board (BD574)

5.12.1. Outline

The main board (BD511) of robot controller is equipped with 2 CAN ports for the system and user. If an additional CAN port is required, a CAN extension board (BD574) can be inserted into the mainboard as a sub module.

- **Support for max 2 extended CAN ports**

  BD574: CAN 1 port extension for a user
  BD574E: CAN 2 port extension for a user

Figure 5.79 Exterior of CAN extension board BD574(left) and BD574E(right)

5.12.2. Connector pin map & terminating resister setting

5.12.2.1. Connector pin map

Pin sequence and signal names of terminal blocks and connectors are as follows.

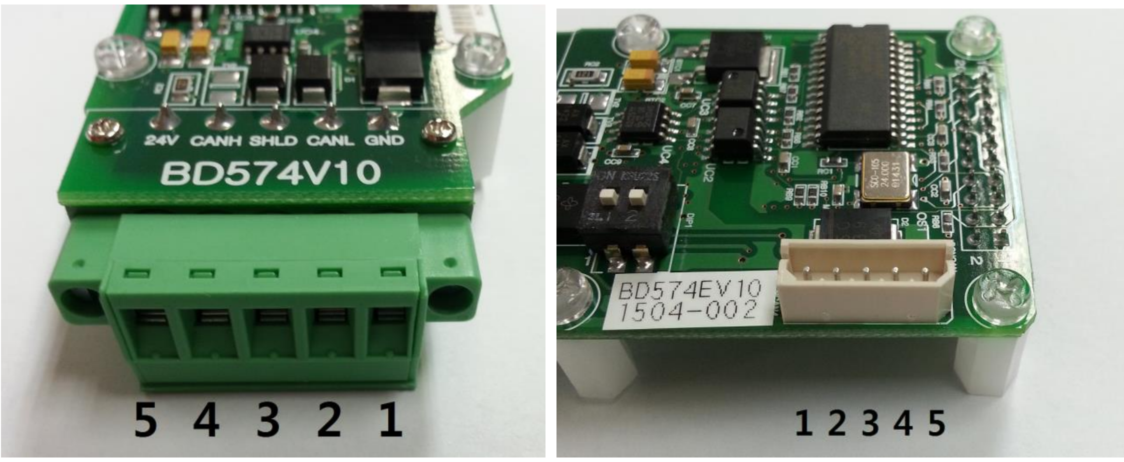


Figure 5.80 Terminal block and connector pin map of CAN extension board BD574 (left) and BD574E (right)

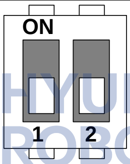
Table 5-42 Terminal block and connector of CAN extension board (BD574, BD575E)

Types	Number	Name	Use	Remarks
Terminal block	1	GND	Extension port1 Ground	Common for BD574 and BD574E
	2	CANL	Extension port1 CAN_L	
	3	SHLD	Extension port1 Shield	
	4	CANH	Extension port1 CAN_H	
	5	24V	Extension port1 24V power input	
CNCAN4 connector	1	GND	Extension por2 Ground	BD574E
	2	CANL	Extension por2CAN_L	
	3	SHLD	Extension por2 Shield	
	4	CANH	Extension por2CAN_H	
	5	24V	Extension port2 24V power input	

5.12.2.2. Terminating resister

When connecting several boards, it is necessary to precisely terminate the resister. CAN data communication uses the daisy chain method. So the terminating resister needs to be connected only to the board to which the last CAN communication cable is connected. Use the DIP switch (DIP1) of CAN extension board in order to connect the terminating resister. For the settings, refer to the following table.

Table 5-43 How to terminate the CAN communication of extension board (BD574)

Switch No.		1	2
Content	OFF	Extension port 1 terminating resister not connected	Extension port 2 terminating resister not connected
	ON	Extension port 1 terminating resister connected	Extension port 2 terminating resister connected
Initial Setting		OFF	OFF
Remarks		Common for BD574 and BD574E	BD574E
The External Form of the Switch			

5.13. Public IO Board (BD587; 8-Point IO)

5.13.1. Outline

The Public IO board can be used for interface or configuration with various devices through the digital input and output ports. The basic specification of the board is as follows.

- Two-way digital input
  Photocoupler input: 8 points (1 port)

- Two-way digital output
  Relay contact point output: 8 points (1 port)

- CAN communication between modules: 1 mbps

- Scan time: Max. 5 msec

Figure 5.81 Public 8-Point IO Board (BD587)

5.13.2. Connectors

There are mainly four different types of connectors of the public 8-point IO board (BD587).

- Digital input: TBI
- Digital output: TBO
- Power (Preparatory): TBPOW
- CAN communication: CANS1,2

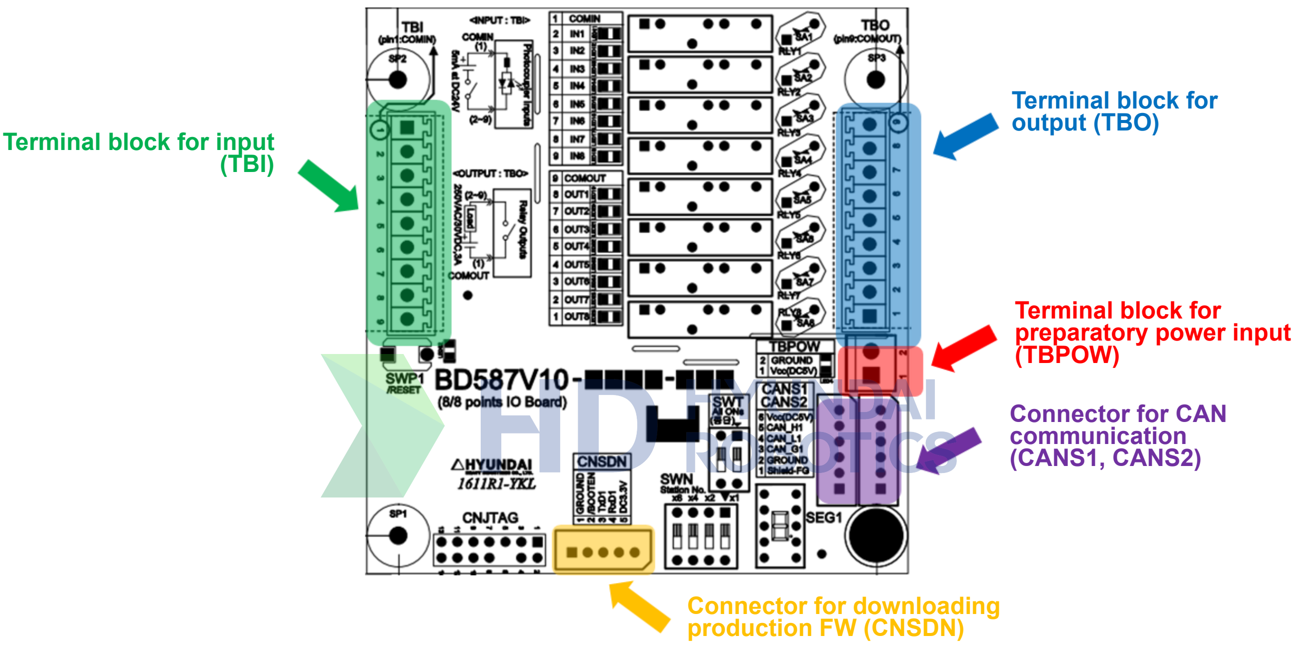


Figure 5.82 Placement of the Public 8-Point IO Board (BD587) Connectors

5.13.2.1. Digital Input

The following figure and table describe the pin configuration of the digital TBI. Each terminal block makes it possible to connect eight different input signals to the same common power.

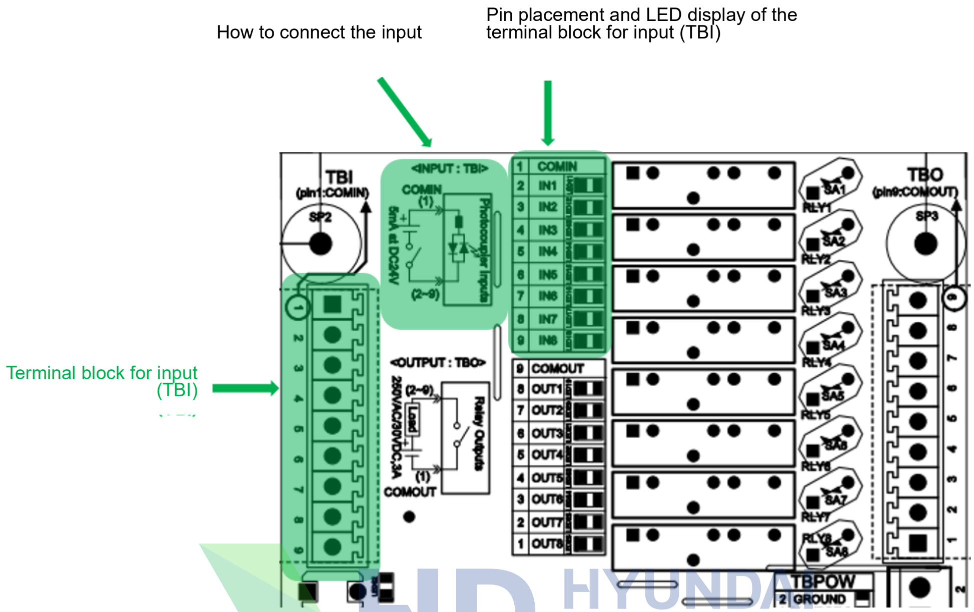


Figure 5.83 Pin Configuration of the Digital Input Terminal Block of the Public 8-Point IO Board (BD587)

Table 5-44 Pin Configuration of the Digital TBI of the Expansion Public IO Board (BD583)

Pin No.	Signal Name	Signal Description
1	COMIN	COMMON power (Ground DC24V or DC24V)
2	DI1	1st input of the 1st public input signal port * of the user
3	DI2	2nd input of the 1st public input signal port * of the user
4	DI3	3rd input of the 1st public input signal port * of the user
5	DI4	4th input of the 1st public input signal port * of the user
6	DI5	5th input of the 1st public input signal port * of the user
7	DI6	6th input of the 1st public input signal port * of the user
8	DI7	7th input of the 1st public input signal port * of the user
9	DI8	8th input of the 1st public input signal port * of the user

Note *) The 8-point input port of the BD587 board is fixed as the port #1.

The electrical specification of each input signal is as follows.

- Input terminal component: AC input photocoupler
- Rated input signal: DC24V / 5 mA for each point
- Common power: 24VDC or 24VDC Ground / 40 mA

The user is required to connect the input signal according to the method, as shown in the figure below. First, connect the user power +24 V or the ground to the IO board (BD587. Then, connect each signal to the input pin according to the purpose.

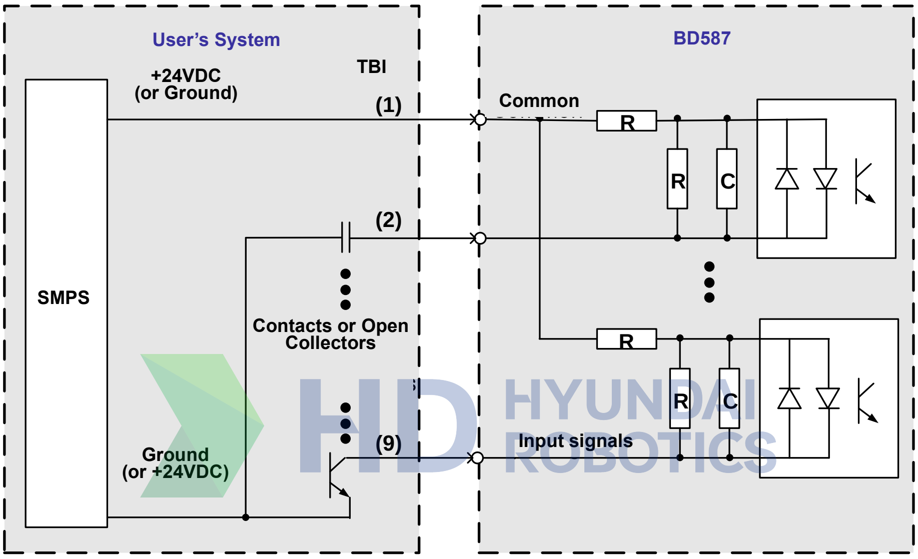


Figure 5.84 Method for the Connection of the Input Signal of the Public 8-Point IO Board (BD587)

5.13.2.2. Digital Output

The following figure and table describe the pin configuration of the digital TBO. Each terminal block makes it possible to connect eight different output signals to the same common power.

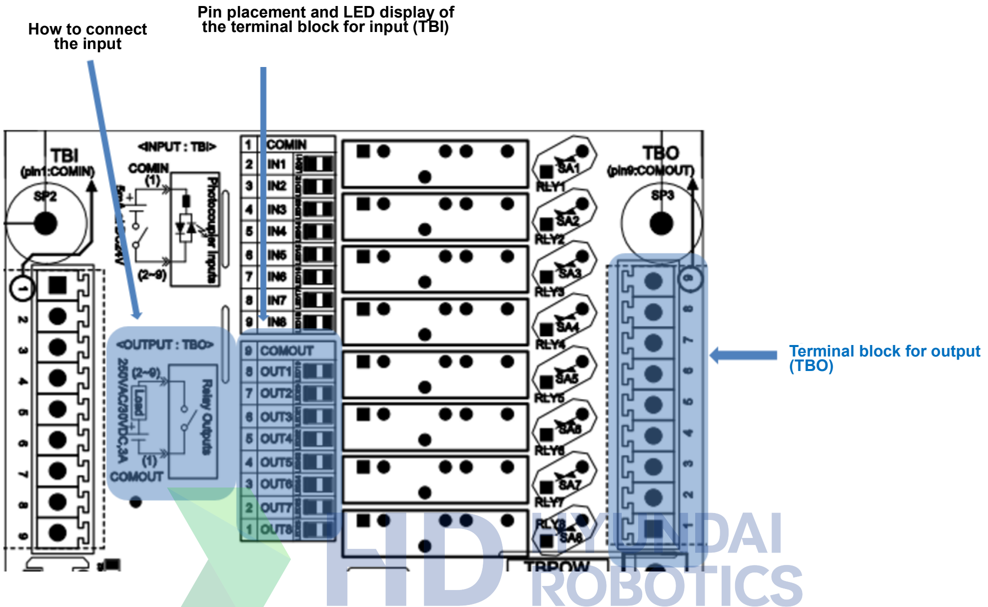


Figure 5.85 Pin Configuration of the Digital Output Terminal Block of the Public 8-Point IO Board (BD587)

Table 5-45 Pin Configuration of the Digital TBO of the Public 8-Point IO Board (BD587)

Pin No.	Signal Name	Signal Description
9	COMOUT	COMMON power (Ground DC24V or DC24V)
8	DO1	1st output of the 1st public output signal port * of the user
7	DO2	2nd output of the 1st public output signal port * of the user
6	DO3	3rd output of the 1st public output signal port * of the user
5	DO4	4th output of the 1st public output signal port * of the user
4	DO5	5th output of the 1st public output signal port * of the user
3	DO6	6th output of the 1st public output signal port * of the user
2	DO7	7th output of the 1st public output signal port * of the user
1	DO8	8th output of the 1st public output signal port * of the user

Note *) The 8-point output port of the BD587 board is fixed as the port #1.

The electrical specification of each output signal is as follows

- Output terminal component: Relay (AC220V, 5 A)
- Rated output signal: DC24V and AC250V / 1 A for each point
- Common power: 24VDC or 24VDC Ground / Max. 3 A

The user is required to connect the output signal, as shown in the following figure. First, connect the common signal to the expansion public IO board (BD583). Then, connect each signal to the output pin according to the purpose. For power, eight output signals can be configured as a unit and used differently for each port.

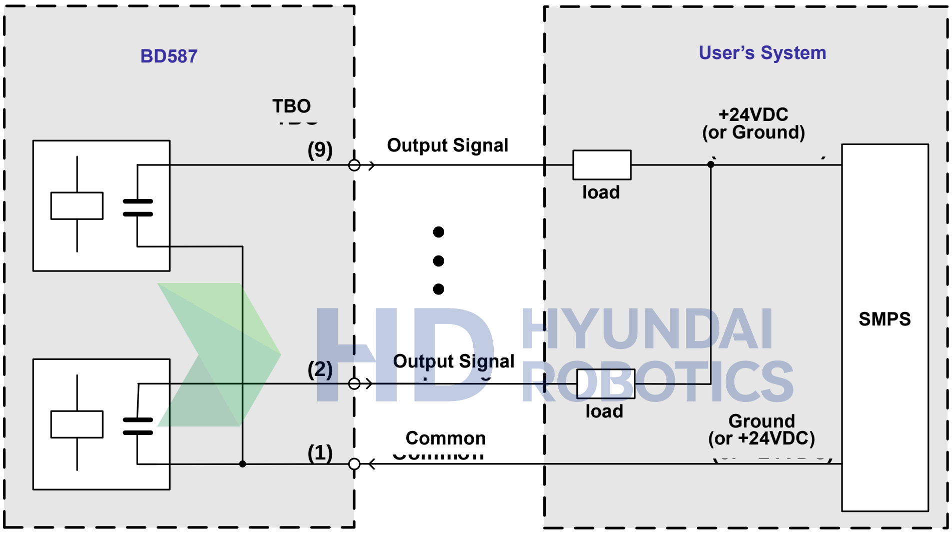


Figure 5.86 Method for the Connection of the Output Signal of the Public 8-Point IO Board (BD587)

5.13.2.3. Preparatory Power Connector : TBPOW

For power, DC5V is needed and is to be supplied through the power pin of the CAN communication connector CANS1 or CANS2. If the power cannot be supplied through the CAN cable in a situation or if the power is insufficient, the power should be supplied through the TBPOW.

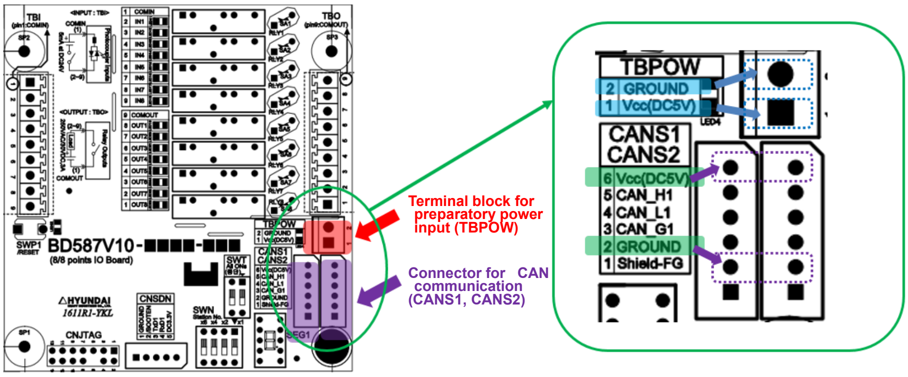


Figure 5.87 Connection of the Power of the Public 8-Point IO Board (BD587)

5.13.2.4. CAN Communication Connector : CANS1, CANS2

When it comes to the CAN communication connector, two connectors of the identical pin specification, as shown below, are installed. This is because the cables are configured according to the Daisy Chaining method. Therefore, there will be no problem in the operation when connecting to any one of the two connectors.

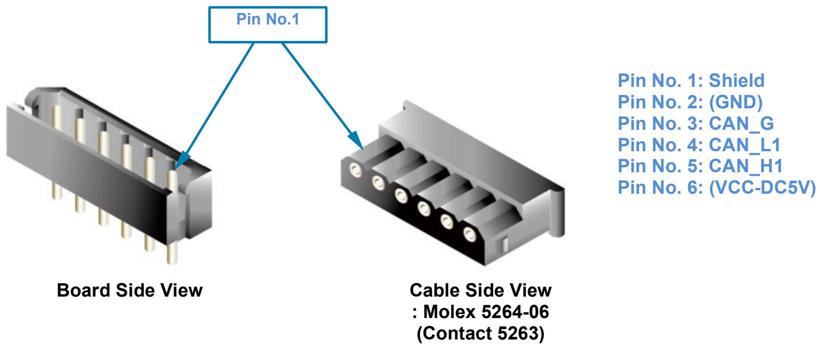


Figure 5.88 Method for the Connection of the CAN Connector of the Public 8-Point IO Board (BD587)

When connecting multiple boards, the terminating resistance should be processed precisely. CAN data communication uses the Daisy Chaining method. Therefore, only the board that is to be connected to the CAN communication cable at the end must be connected to the terminating resistance, while other boards must not be connected to the terminating resistance. For the connection of terminating resistance, use the dip switches SWT next to the CAN1 and CAN2 connectors. When all pins of the dip switch are turned on, the terminating resistance is connected. On the other hand, when all pins of the dip switch are turned off, the terminating resistance is disconnected. Refer to the following figure.

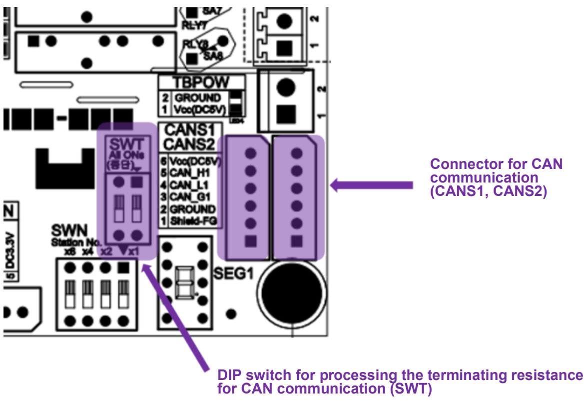


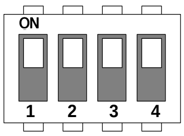
Figure 5.89 Method for the Connection of the Terminating Resistance of the Public 8-Point IO Board (BD587)

5.13.3. Setting the Unit

5.13.3.1. DIP Switch Settings

The DIP switch SWN makes it possible to set the board number in hexadecimal. The following table shows the board numbers according to the switch settings.

Table 5-46 Method for the Setting of the SWN Switch of the Public 8-Point IO Board (BD587)

Switch No.	4	3	2	1	Content of Setting
Content of Setting	Preparatory	Board Number (Hex)			
		X4	X2	X1	
Example of Setting	OFF	OFF	OFF	OFF	1st Board
	OFF	OFF	OFF	ON	2nd Board
	OFF	OFF	ON	OFF	3rd Board
	OFF	OFF	ON	ON	4th Board
Default Setting	OFF	OFF	OFF	OFF	1st Board
Switch Exterior					

HD HYUNDAI ROBOTICS

6

Regular inspection

6. Regular inspection

Regular inspection of controller is to minimize robot failures, and to maintain its efficiency. Instructions and working details for regular inspection are explained here.

6.1. Inspection Schedule

The check is conducted basically according to following review. Regular inspection is to prevent robot failures, and to secure and maintain its stability even for a long employment of robot and controller. Regular inspection is a requisite for the use of robot, and even for a normal condition.

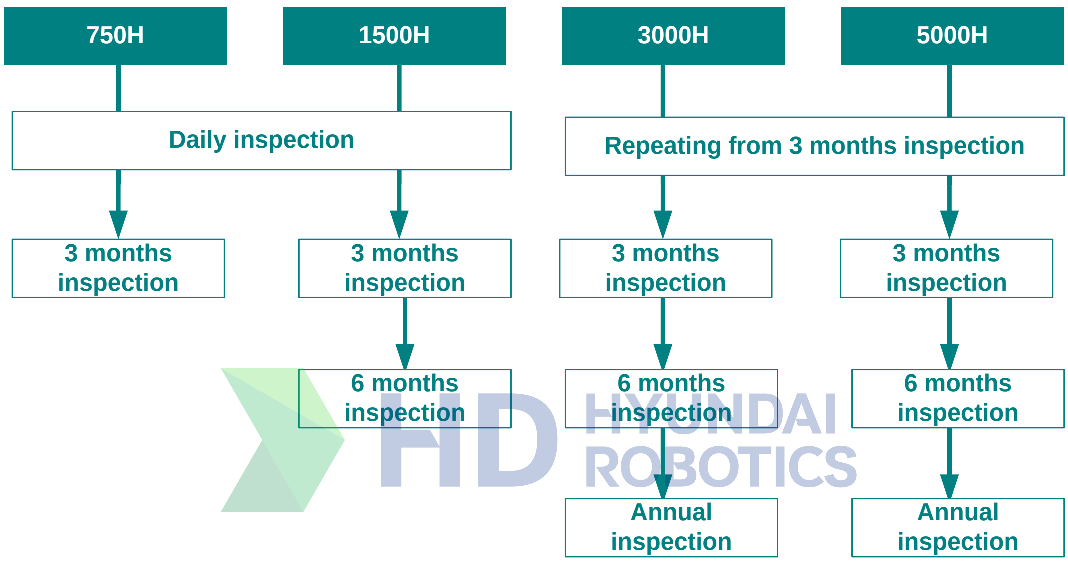


Figure 6.1 Inspection Schedule

6.2. General Instructions for Regular Inspection

① Inspection working should be performed by personnel who completed our training course in robot school.
② Check the necessary parts & tools, and drawings before inspection work.
③ Be sure to use special replacement parts specified by our company.
④ Be sure to turn power OFF when inspecting robot manipulator.
⑤ Turn primary power OFF when working with controller door open. Prevent dust or other things from entering the working area.
⑥ Pay close attention to IC breaking by static electricity if you need to touch the parts of controller. (Beware of it when touching a connector)
⑦ Be sure to forbid anyone to enter robot's working envelope when performing an inspection with robot manipulator operated.
⑧ Perform a voltage measurement in a specified place, and be careful of electric shock and short circuit.
⑨ Do not inspect robot and controller at the same time.
⑩ Be sure to perform a test operation after inspection to check robot's movement before

6.3. Daily Inspection

Table 6-1 Daily Inspection

No.	Inspection Part	Inspection Details	Remarks
1	Controller	Is display lamp working (normal)?	Check with the naked eye
		Is door completely closed?	Check with the naked eye
		Are there any errors in Teach Pendant screen?	Check with the naked eye
2	Robot Manipulator	Is there a noise during operation?	Listen out
		Is a tip joint unscrewed?	Fasten
		Are there any scratch, stain, and damage in a wiring and Wire harness of manipulator?	Check with the naked eye
		Are there any other impediments such as dust soil causing damage to manipulator?	Check with the naked eye & clean
3	Others	Are there any obstacles around controller and robot manipulator?	Check with the naked eye

6.4. First Inspection (750 hours inspection)

Table 6-2 First Inspection

No.	Inspection Part	Inspection Details	Remarks
1	External, major screws	Unscrewed	Fasten
2	Manipulator wiring connector & Wire harness	Loose connector	Fasten
3	Dog & limit switch screws	Unscrewed	Fasten

6.5. Daily Inspection

Table 6-3 Daily Inspection

No.	Cycle (months)			Inspection Part	Inspection Details	Remarks
	3	6	12			
1		◎	◎	Packing of door	·Transformed & torn part	
2	◎	◎	◎	Back side	·Dust and rotation of cooling fan blade	
					·Damage & dust in regenerative discharge resistance	
					·Check a heating of Transformer Room by touch, and clean the room.	
					·Loosening and damage of terminal block of transformer	
3	◎	◎	◎	Wire harness	·Loose & damaged connector	
4		◎	◎	Drive Unit	·Loose & damaged connector	
5		◎	◎	Connectors of each board	·Check a loose connector by touch	
6	◎	◎	◎	Operating panel	·Check Button switch & LED	
7		◎	◎	Overall Controller	·Dust cleaning	
8	◎	◎	◎	Nameplate	·Inspect all kinds of nameplates	
9		◎	◎	Voltage measurement	·Primary power voltage	Refer to “6.3.1 Adjustment of Power System”
					·CNFN1 B2-C2	
					·CN220 B3-C3	
					·SR1 P5-M5, P1-M1	
10		◎	◎	Grounding	·Check a loose & removed terminal	
11		◎	◎	Battery	·Voltage inspection & regular replacement	Main board LED
12	◎	◎	◎	Teach Pendant	·Visual inspection and checking of connections of connectors	
					·Check LCD Display	
					·Check LED Display	
					·Check the status of LED and button switch	

No.	Cycle (months)			Inspection Part	Inspection Details	Remarks
	3	6	12			
13	◎	◎	◎	Safety related parts	·Check emergency stop switching (Controller, teach pendant)	
	◎	◎	◎		·Check primary power disconnecting switch (NFB1)	
	◎	◎	◎		·Check enabling device of teach pendant	
	◎	◎	◎		·Check circuit protector (CP1)	
	◎	◎	◎		·Check magnet connector (MC1, MC2)	
14	◎	◎	◎	Safety related PCB	·Check for BD530 board (connector, exterior relay)	

6.6. Inspection for Long-Term Idleness

In case of long-term idleness, inspect the followings before turning off power.

(1) Check whether a yellow LED (BATLOW), which is located on the main board and used for the detection of the battery discharge, is turned on. If there is a problem with the battery, the yellow LED will be turned on, meaning it is required to replace the battery with a new rated one. While there is still a problem with the battery, if the power is shut off, various program/constant data of the board will be deleted after about seven days. Users must make backup files by using HRView or a USB memory.

(2) Check if controller door is completely closed.

6.7. Parts List for Maintenance

It explains the characteristics of parts.

Maintenance Parts A

Major maintenance parts to prepare in daily inspection.

To maintain a normal operation, parts A-2 and A-3 is a minimum of essential parts, and prepare more than 1 set of these parts.

Table 6-4 Maintenance Parts Inspection A

Type	Details	Remarks
Maintenance Parts A-1	Standard accessory parts to prepare	
Maintenance Parts A-2	Major backup parts	
Maintenance Parts A-3	Regular replacement parts	

Table 6-5 Maintenance Parts A-1 (Standard accessory parts to prepare)

No.	Product Name	Type	Maker	Quantity (EA)	Remarks
1	Fuse (F1,F2)	GP50(250V, 7.5A)	Daito	2	BD5C2, BD5C0
2	Fuse (F3,F4)	GP50(250V, 7.5A)	Daito	2	BD5C2
3	Fuse (F5,F6)	GP50(250V, 7.5A)	Daito	2	BD5C2, BD5C0
4	Fuse (F1,F2)	GP20(250V, 2A)	Daito	2	BD561, BD563

※ BD5C2 : Application after March 2019
※ BD5C0 : Application after May 2019

Table 6-6 Maintenance Parts A-2 (Major Backup Parts)

No.	Product Name	Type	Maker	Quantity (EA)	Remarks
1	Servo AMP	For Large/Medium/Small size	Hyundai Robotics	1	Specifications of robots
2	Complex Power Unit	HDI-191	Hyundai Robotics	1	SMPS
3	Teach Pendant	TP520/TP530	Hyundai Robotics	1	
4	Electronic module	PSM50 PSM30 PSM15 PDM30 PDM15	Hyundai Robotics	1	Large robot Medium robot Compact robot Medium clean robot Compact clean robot
5	Board	BD502	Hyundai Robotics	1	Back plain board
		BD511	Hyundai Robotics	1	Main board
		BD544	Hyundai Robotics	2	Servo board
		BD530/531	Hyundai Robotics	1	System board

Table 6-7 Maintenance Parts A-3 (Regular Replacement Parts)

No.	Product Name	Type	Maker	Quantity (EA)	Remarks
1	Battery (3.6V AA size)	ER6V-T1	TOSHIBA (JAPAN)	1	Replacement required every 2 years

Maintenance Parts B

To many maintain a normal operation parts.

Table 6-8 Maintenance Parts Inspection B

Type	Details	Remarks (reference)
Maintenance Parts B-1	Parts to purchase from Hyundai Robotics	
Maintenance Parts B-2	Parts directly available from the part makers	

Table 6-9 Maintenance Parts B-1 (Parts to purchase from Hyundai Robotics)

No.	Product Name	Type	Maker	Quantity (EA)	Remarks
1	Wire harness	CMC1	Hyundai Robotics	1	Medium/Compact/Large/ Painting
		CMC2	Hyundai Robotics	1	Medium/Large/ Painting
		CEC1	Hyundai Robotics	1	Medium/Compact/Large/ Painting
		CEC2	Hyundai Robotics	1	Painting
		CPC	Hyundai Robotics	1	Painting
		ASC1	Hyundai Robotics	1	Painting
		ASC2	Hyundai Robotics	1	Painting

Table 6-10 Maintenance Parts B-2 (Purchasable Parts from Maker)

No.	Product Name	Type	Maker	Quantity (EA)	Remarks
1	Circuit Breaker for wiring (NFB)	-	-	1	
2	Magnetic Contactor (MC1, MC2)	-	-	2	
3	Circuit protector (CP1)	-	-	1	

Caution: Pay attention to the followings for maintenance because high-performance parts are mounted on board.

Storage Temperature 0℃ ~ +40℃

To store for a long period of time and maintain high-reliability, keep temperature ranged 25±10℃ and avoid sudden change of temperature (±10℃/time).

Storage Humidity 20% ~ 80%

To store for a long period of time and maintain high-reliability, keep humidity ranged 45%~65%, and in particular, be careful of dew condensation.

Electric Shock Prevention

If extremes are kept dry, static electricity is likely to be charged. Here, semiconductor is likely to be ruined when the charged static electricity is discharged. Thus, when keeping the board separately, use an antistatic treated packing materials.

Others

Please keep at the place where noxious gas, dust and load do not exist

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