WARNING

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

Hi5 Controller Maintenance Manual

- Hi5-C10/C20
- Hi5-N00/N30/N50

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Safety

1.1. Introduction

The main purpose of this chapter is to describe the safety precautions for users and operators who repair and manipulate the industrial robot.

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 10218-1:2006 and ANSI/RIA R15.06-1999.

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.

HHI 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.

Enable application and disable environment of robots are as follows.

Application

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
- MIG/MAG welding
- 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.)

1.2. Relevant Safety Regulations

The robot is designed as per ISO 10218-1:2006 safety standards for industrial robots, and furthermore in comply with ANSI/RIA 15.06-1999 regulations.

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 potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel and damage to equipment. The special attention must be paid to the operation and handling.
Mandatory		Indicate the compulsory measures that should be performed.
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 should be able to connect to the robot's safety chain circuit. The emergency stop function, which overrides all other robot controls, stops all moving parts by disconnecting power supply, and removes drive power to prevent the use of other dangerous functions controlled by the robot.

Safety Stop Function - EN ISO 10218-1:2006

When a safety stop circuit is provided, each robot must be delivered with the necessary connections for the safeguards and interlocks associated with this circuit. 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 10218-1:2006

In a manual mode, the speed of robot is strictly limited to 250 mm per second as maximum.
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/RIA R15.06-1999

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/RIA R15.06-1999

The robot must be operated either manually or automatically. In a manual mode, the robot must 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.

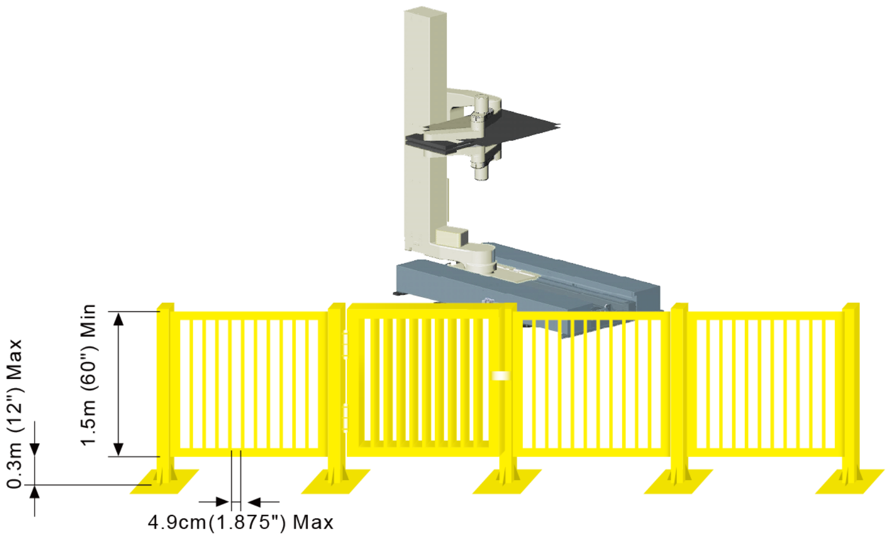


Figure 1.1 Recommended size for safety net and entrance gate (slot type entrance gate)

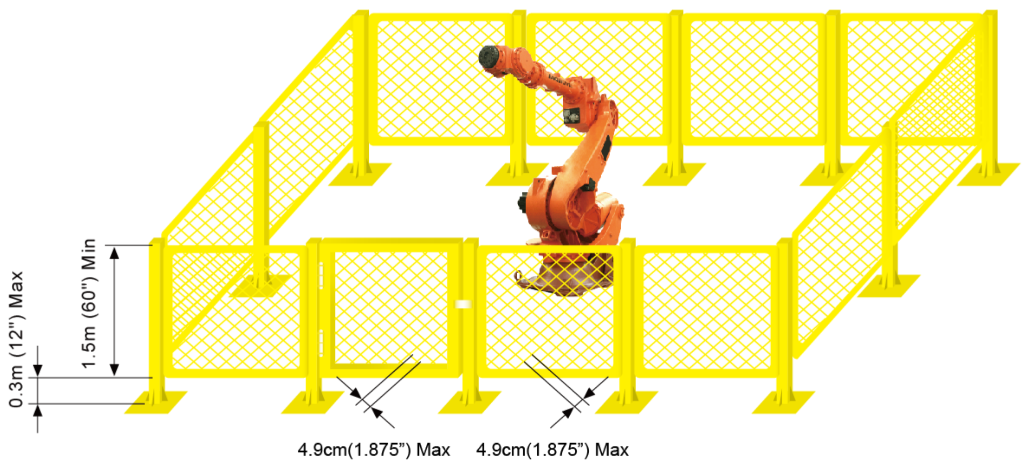


Figure 1.2 Recommended size for safety net and entrance gate (square type entrance gate)

(1) Enough space for safety net should be secured by covering robot operating area so as that workers would not have difficulty in teaching work or repairing work, and the safety net should have solid structure in order that it would not move easily and man cannot enter over easily.

(2) 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.

(3) 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. And, please make wiring with interlock so that robot would be operation ready OFF and motor OFF in the status that safety plug is pulled out or safety net is open.

(4) When intending to operate the robot with the safety plug pulled out, wire the robot as a low-speed play mode.

(5) For immediate emergency stop, install emergency stop button within operator’s easily accessible distance.

(6) In case of no safety net, please install photoelectric switch, mat switch and so on instead of safety plug in all range of robot operation, and make robot to stop automatically when man goes into.

(7) 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 the stand stops in an emergency wherever the robot is handled.

(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. The accident by falling down of work or wire cut can happen.

(6) Place the controller, interlock panel, and handling stand within the sight of robotic performance. It may cause a serious accident to operate the robot while the operator is working, or the robot is malfunctioning in an invisible sight.

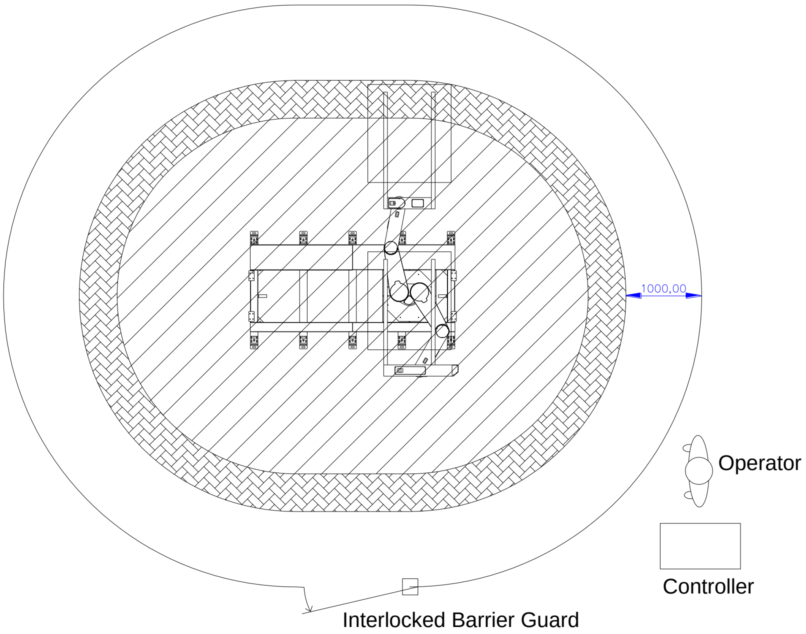
(7) Restrict the robot's working envelope by using soft limits and mechanical stopper if the necessary working envelope is narrower than the holding workable envelope. It is possible to stop the robot in advance when it moves beyond its normal working envelope due to an abnormal condition. (Refer to the 『Robot Manipulator Maintenance Manual』.)

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

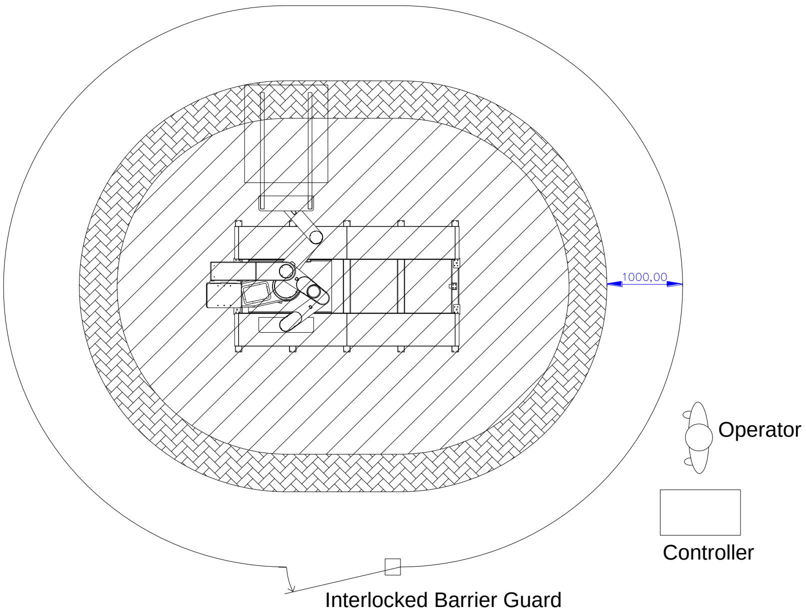
(9) Make sure that the device indicating the robot's running condition whether automatic or manual mode must be noticeable even in the far distance. In the case of automatic start-up, warning with a buzzer or warning lamp is also enable.

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

(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)

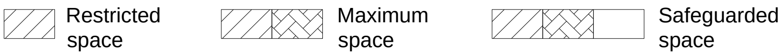


Figure 1.3 Arrangement of LCD robot peripheral devices and workers

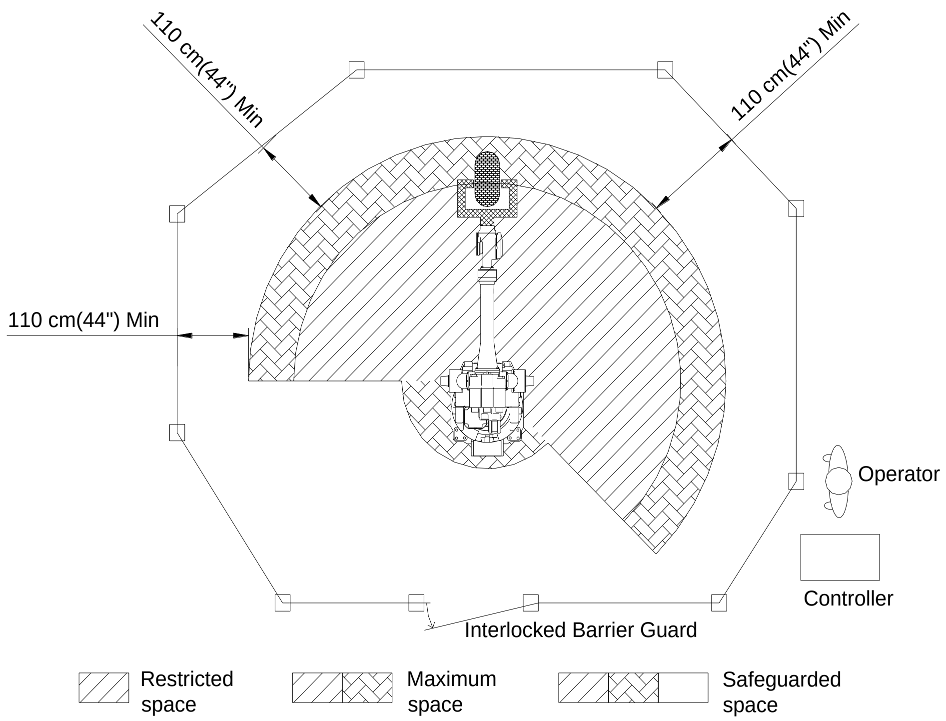


Figure 1.4 Arrangement of general robot peripheral devices and workers

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 0~45℃.

(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.

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 on operation of 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 1-2 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 entering into safeguard 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, take the teach pendant with you so that other people may not operate the robot. Make sure to post up the control panel a sign indicating the state of robot handling.

Read carefully and be aware of the follows when entering the 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.

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

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

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.)

1.9.3. Necessary Actions after Maintenance and Repair

Please observe following managing articles after the repair and check.

(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

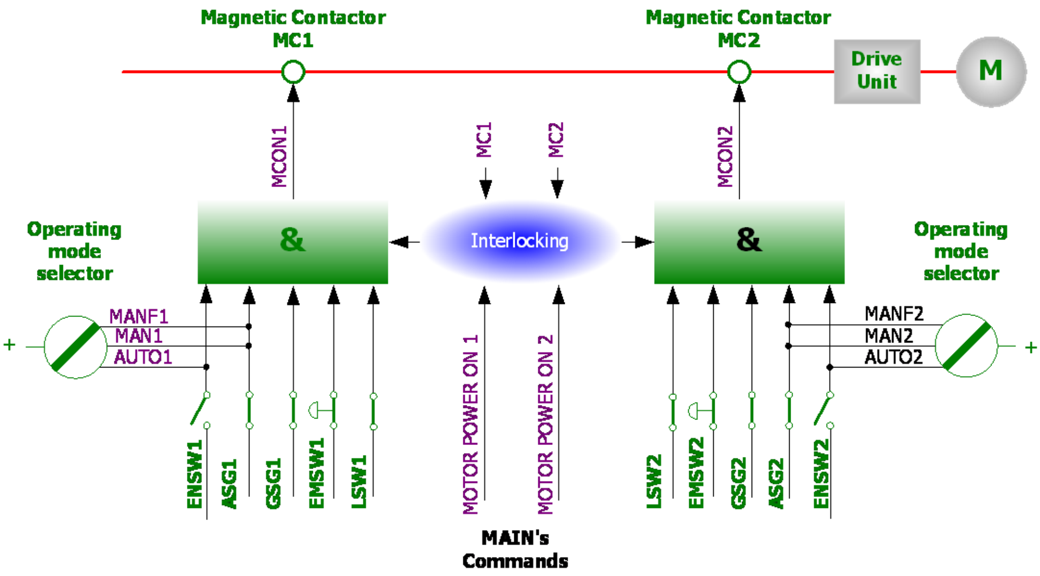


Figure 1.5 Configuration for safety chain

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 status in the menu: “『[F2]: System』 → 『3. Robot parameter』 → 『2. Axis constant』 / 『3. Soft limit』 / 『4. Encoder offset』”.)

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.

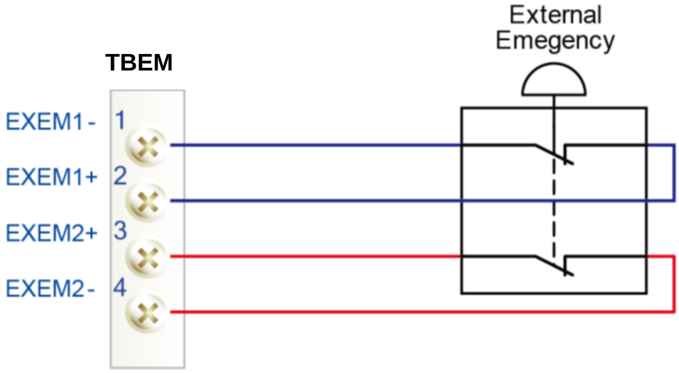


Figure 1.6 Connection with external emergency halt switch through system board terminal block TBEM

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/RIA R15.06-1999
  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 10218-1:2006
  Robots for industrial environments - Safety requirements - Part 1: Robot (ISO 10218-1:2006)

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 Hi5 Robot Controller

Table 2-1 shows the specifications of Hi5 robot controller.

Table 2-1 The specifications of Hi5 robot controller

<table>
<tr><th colspan="2">Model</th><th>Hi5-N**(Medium Size)</th><th>Hi5-C10 (Clean)</th><th>Hi5-C20 (Clean)</th></tr>
<tr><td colspan="2">CPU</td><td colspan="3">64 bit RISC (450MHz)</td></tr>
<tr><td colspan="2">Program Execution Method</td><td colspan="3">Teaching & Playback</td></tr>
<tr><td colspan="2">Operation Method</td><td colspan="3">Menu-Based Method</td></tr>
<tr><td colspan="2">Interpolation Type</td><td colspan="3">PTP, Linear, and Circular Interpolation</td></tr>
<tr><td colspan="2">Memory Back-Up Method</td><td colspan="3">Battery Back-UP IC Memory</td></tr>
<tr><td colspan="2">Encoder Type</td><td colspan="3">Absolute Encoder</td></tr>
<tr><td colspan="2">Servo Drive Unit</td><td colspan="3">6-Axis All-In-One Type, Digital Servo</td></tr>
<tr><td colspan="2">Max. No. of Axes</td><td colspan="3">Max. 16 Axes Simultaneously</td></tr>
<tr><td colspan="2">Step</td><td colspan="3">20,000 Points</td></tr>
<tr><td colspan="2">Program Selection</td><td colspan="3">255(Binary)/8(Discrete)</td></tr>
<tr><td colspan="2">Teach pendant Indication</td><td colspan="3">7” Color LCD(800x480)</td></tr>
<tr><td colspan="2">Digital I/O</td><td colspan="3">Input: 32 Points (Max. 256 Points) / Output: 32 Points (Max. 256 Points)</td></tr>
<tr><td colspan="2">Analog I/O (Option)</td><td colspan="3">Input: 8 Points / Output: 4 Points</td></tr>
<tr><td colspan="2">Conveyor Pulse Counter</td><td colspan="3">Line Driver/ Open Collector</td></tr>
<tr><td colspan="2">Communications Interface</td><td colspan="3">RS232C : 2 Ports(Also for RS485 1) / Ethernet : 2 Ports / CAN : 2 Ports</td></tr>
<tr><td colspan="2">Fieldbus Interface (Option)</td><td colspan="3">CC-Link, DeviceNet, Profibus-DP</td></tr>
<tr><td rowspan="10">Board</td><td>CPU</td><td colspan="3">BD510</td></tr>
<tr><td>DSP(Servo)</td><td colspan="3">BD542</td></tr>
<tr><td>Back Plane</td><td colspan="3">BD501</td></tr>
<tr><td>System</td><td colspan="3">BD530/531</td></tr>
<tr><td>Small Door</td><td colspan="3">BD5B1</td></tr>
<tr><td>Electrical Part</td><td colspan="3">BD5C0</td></tr>
<tr><td>CC-LINK</td><td>BD570</td><td rowspan="2">BD58A</td><td>BD570</td></tr>
<tr><td>Digital In/Out</td><td>BD580, BD581, BD582</td><td>BD580, BD581</td></tr>
<tr><td>Analog/Arc I/F</td><td>BD584</td><td>-</td><td>-</td></tr>
<tr><td>Conveyor I/F</td><td>BD585</td><td>-</td><td>-</td></tr>
</table>

Model		Hi5-N**(Medium Size)	Hi5-C10 (Clean)	Hi5-C20 (Clean)
Servo Amp	Drive Unit (6 Axis)	SA3X3Y	SA1L5X	SA4X2Z
	Drive Unit (1 Axis)	SA1X/SA1A	-	-
	Diode Module	SD1L2C		
Wire Harness		CMC1, CMC2, CEC1	CMC1, CMC2, CEC1, CIOC1	CMC1, CMC2, CEC1, AMC1, AEC1, CIOC1
Teach pendant		TP510		
Cooling Pan		10 ea	4 ea	5 ea
Air Conditioner		Hi5-A000	-	-
Rated Voltage		3-phase 220V(50/60Hz)±10% Options : 380 V, 400 V, 440 V	Power: Three-phase 220V (50/60 Hz) ±10%	Control: Single-phase 220V (50/60 Hz) ±10%
Max. Power Consumption		7.8 KVA	Power: 11.5 KVA Control: 1 KVA	Power : 10 KVA Control: 1 KVA
Protection Class		IP54	IP20	
Operating Temperature		0~45℃		
Noise Level		Max. 58dB	Max. 68dB	Max. 65dB
Operational Humidity		75%		
Exterior Dimensions (WxHxD)		650x1,100x600(mm)	600x1,100x500(mm)	500x500x1,100(mm)
Weight		225Kg (Including power supply transformer)	150 kg	

Table 2-2 Power Supply Requirements

Controller Type	Capacity*1) [KVA]	Input Voltage *2) [V]	Frequency [Hz]	Peak Current [A]
Hi5-N00	**Max. 7.8 KVA**	**220 V**	**50/60**	**30 A**
Hi5-N30	**Max. 4.4 KVA**	**220 V**	**50/60**	**15 A**
Hi5-C10	**Max. 12.5 KVA**	**220 V**	**50/60**	**30 A**
Hi5-C20	**Max. 11 KVA**	**220 V**	**50/60**	**30 A**

Note 1) Power capacity:

This refers to the capacity of the power supplied to the controller. Please refer to the “Repair Manual for the Robot Main Body” for the power capacity of each robot.

Note 2) Voltage Range : ±10% (The power terminal of Hi5-CH5 terminal)

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**

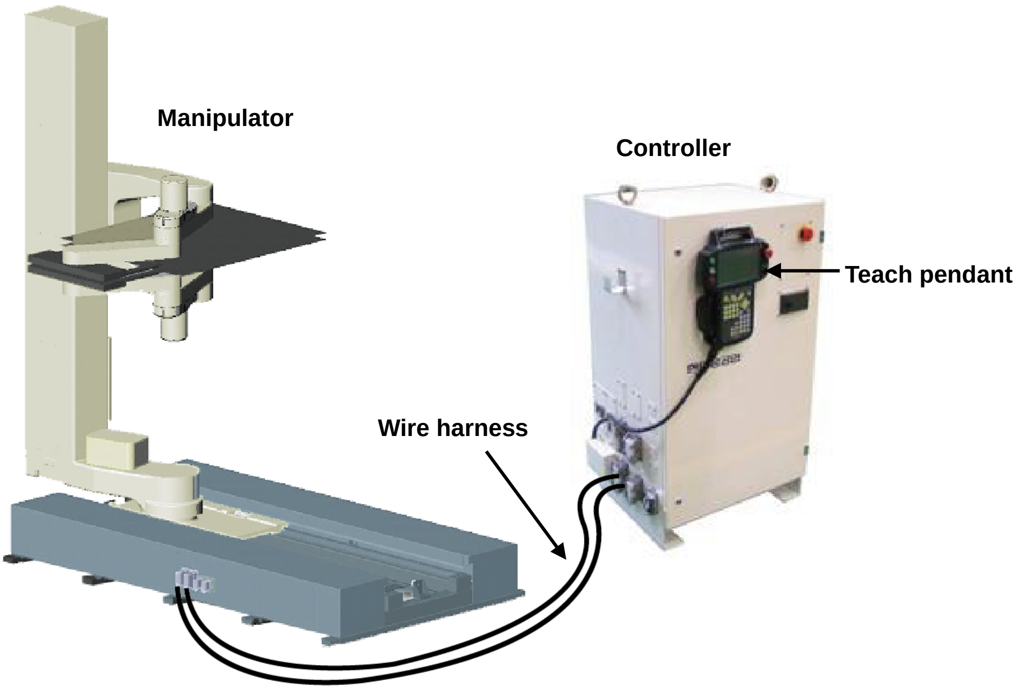


Figure 3.1 Basic Components of Manipulator and Controller (LCD Robot)

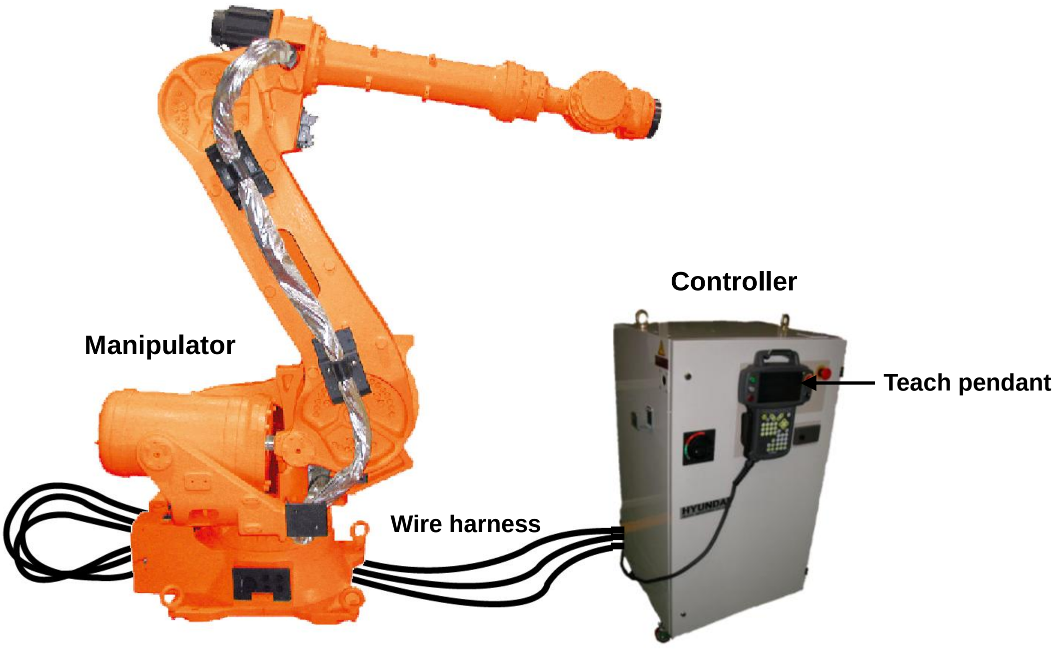


Figure 3.2 Basic Components of Manipulator and Controller (Vertical Articulated Robot)

3.1.2. Confirmation of Serial Number

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

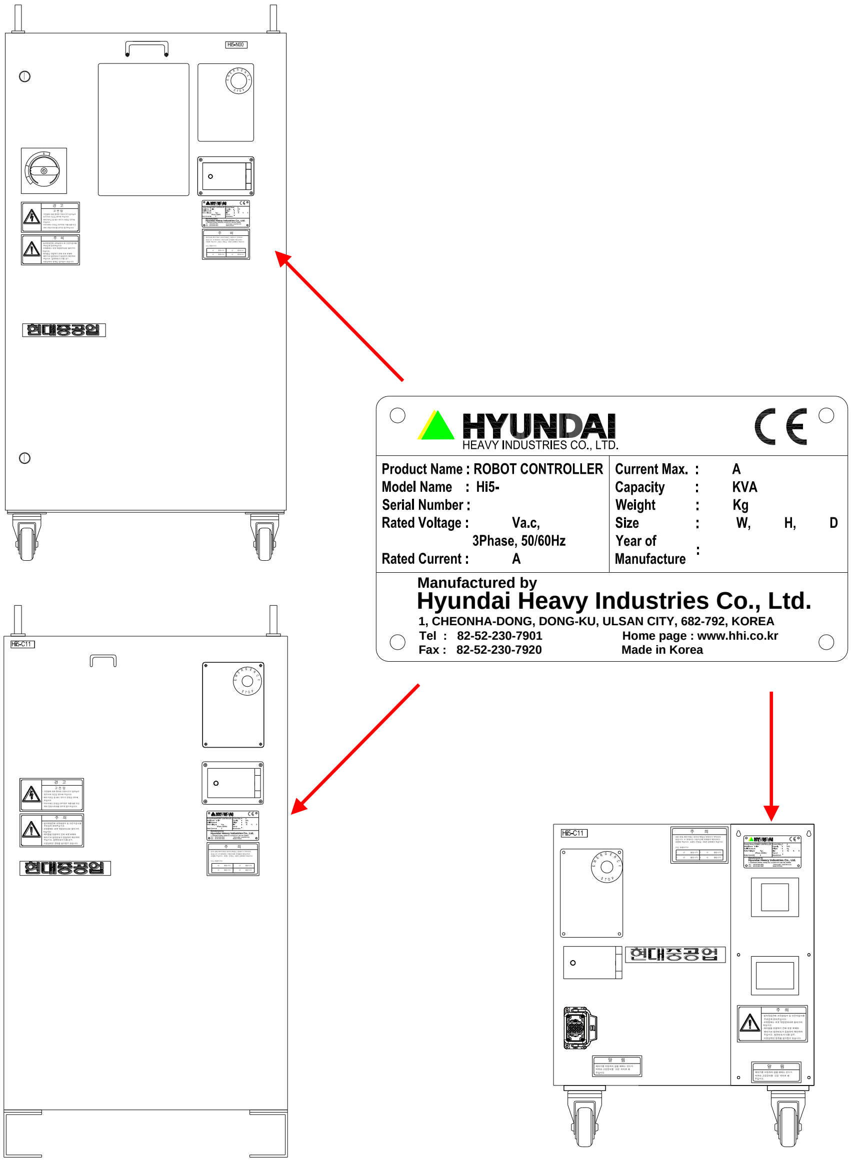


Figure 3.3 Location of Serial Number

3.1.3. Confirmation of Nameplates

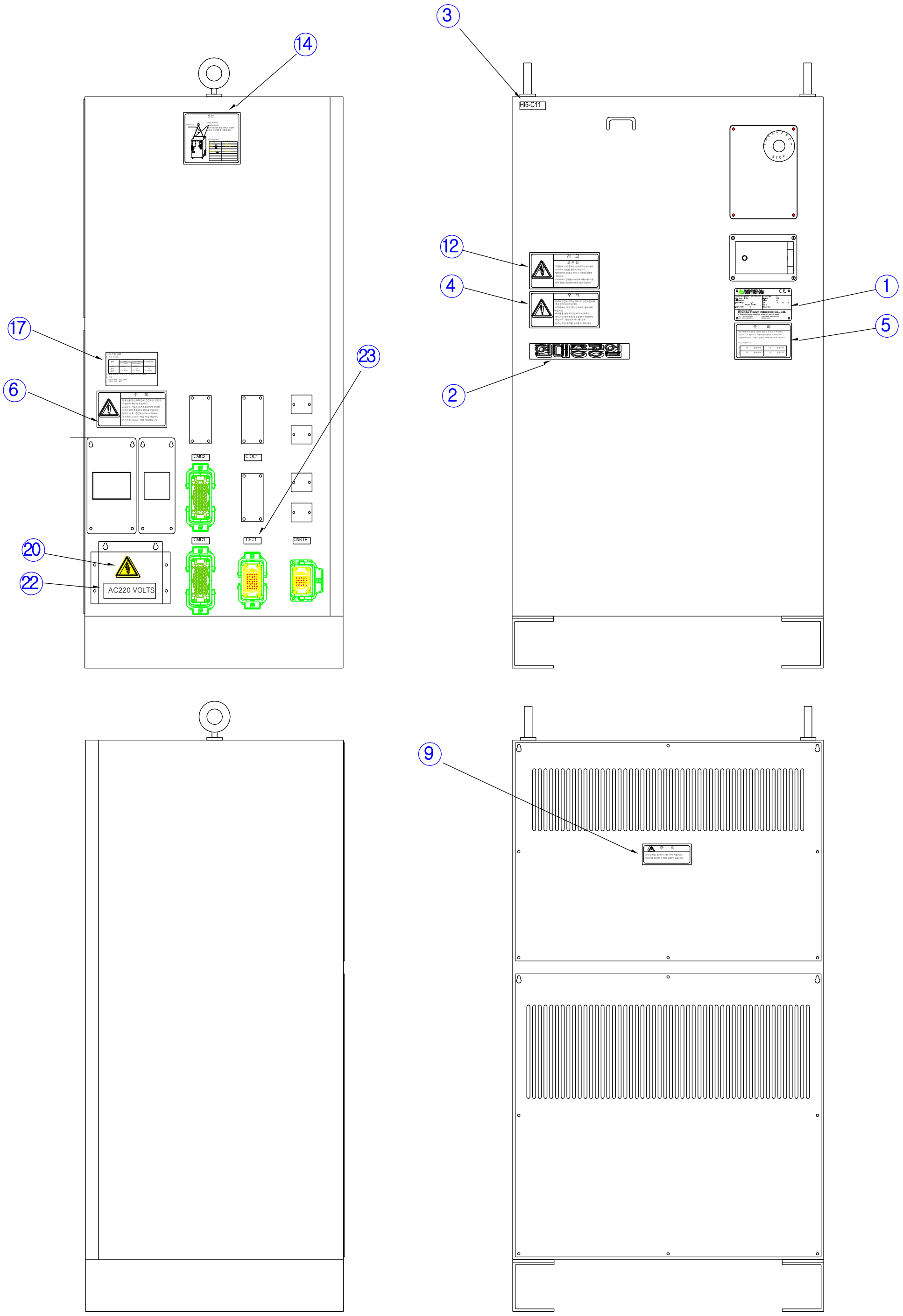


Figure 3.4 Hi5-C10 Location of Controller Nameplate 1

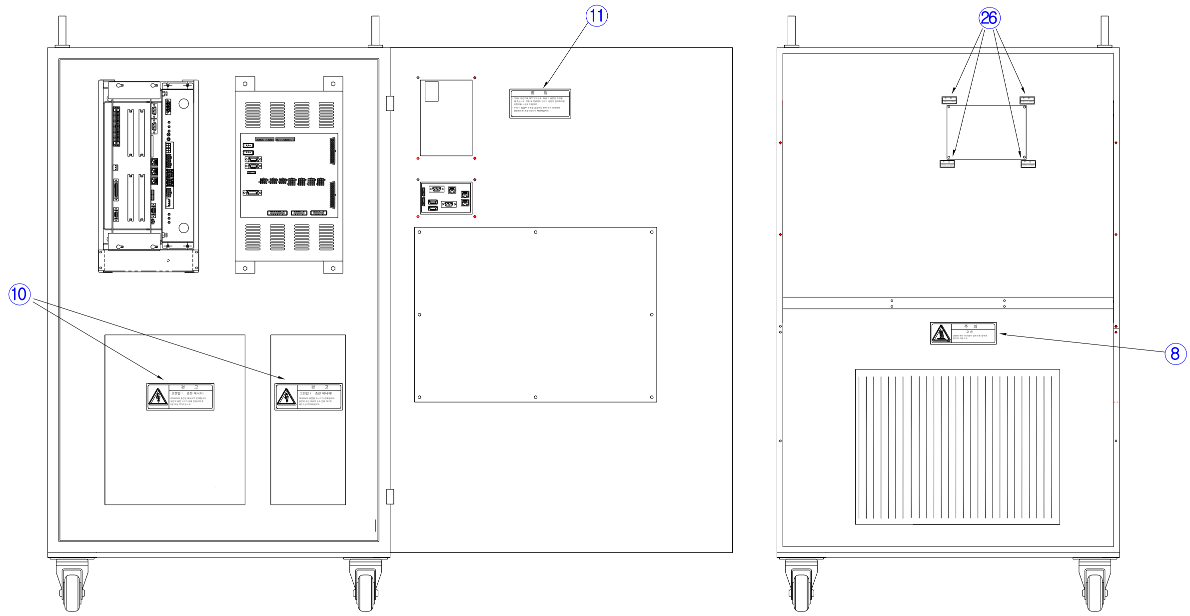


Figure 3.5 Hi5-C10 Location of Controller Nameplate 2

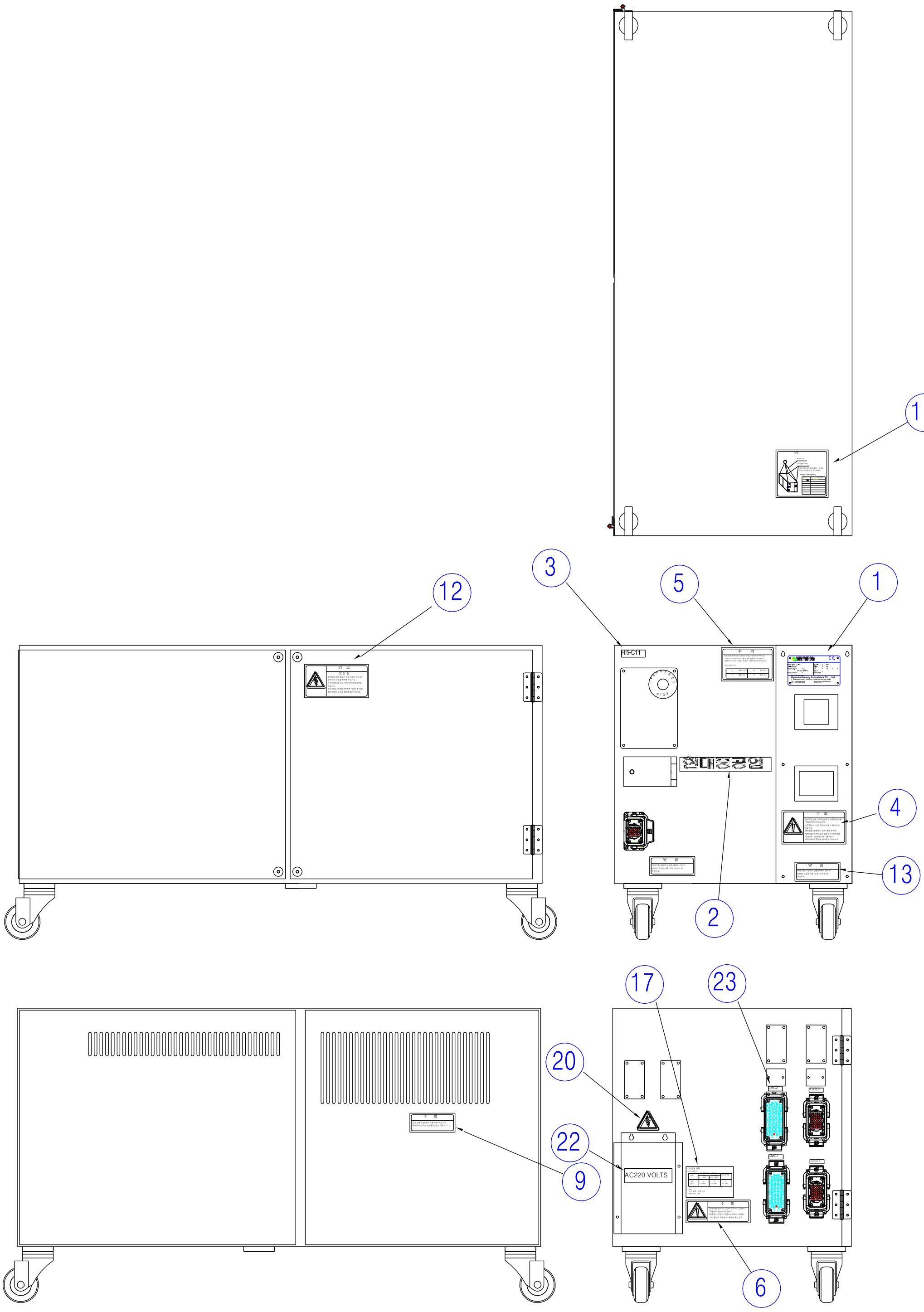


Figure 3.6 Hi5-C20 Location of Controller Nameplate 1

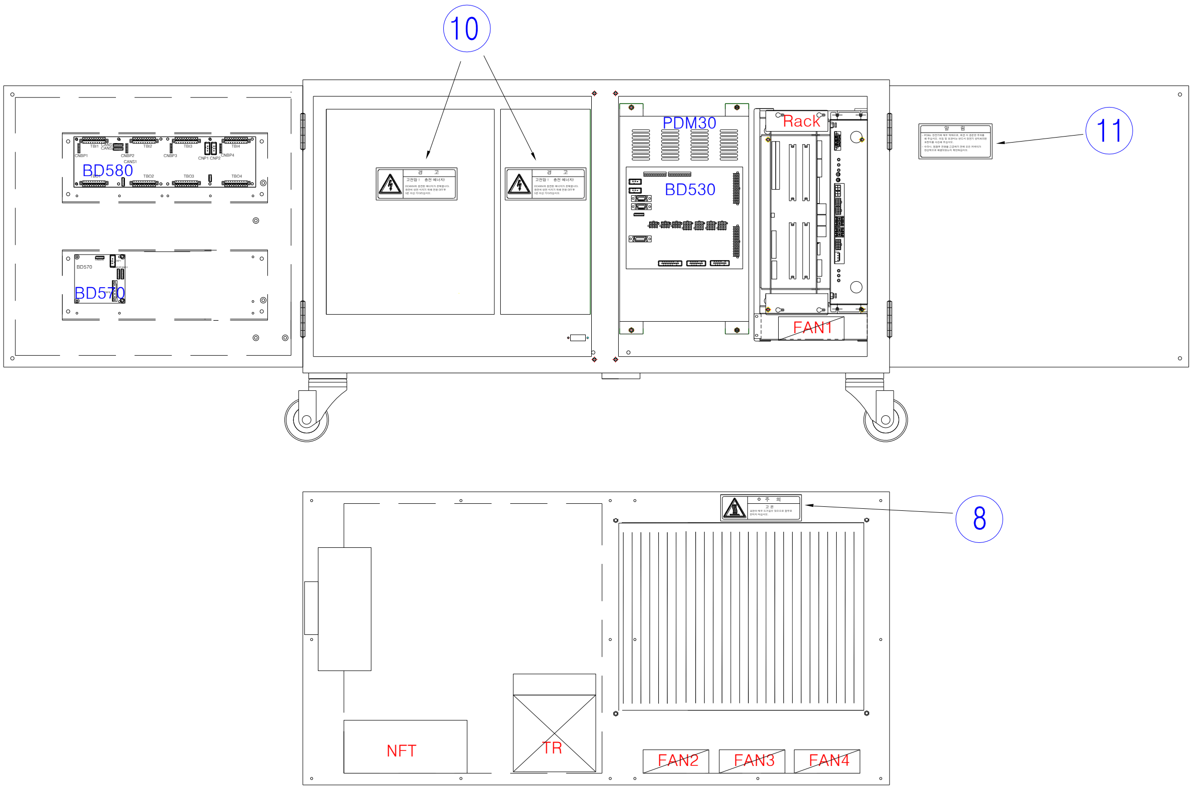


Figure 3.7 Hi5-C20 Location of Controller Nameplate 2

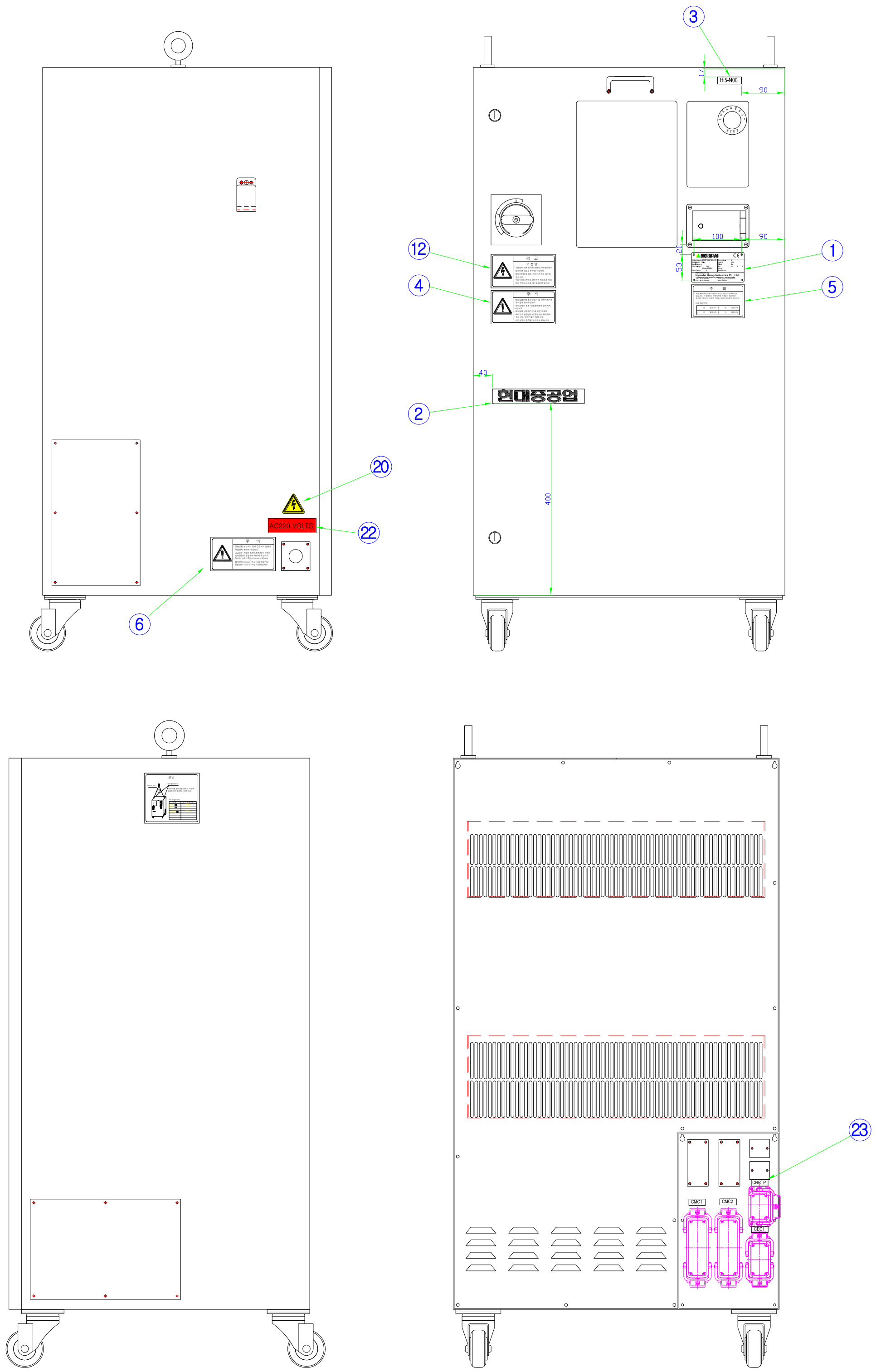


Figure 3.8 Hi5-N** Location of Controller Nameplate 1

HYUNDAI HEAVY INDUSTRIES CO.,LTD.

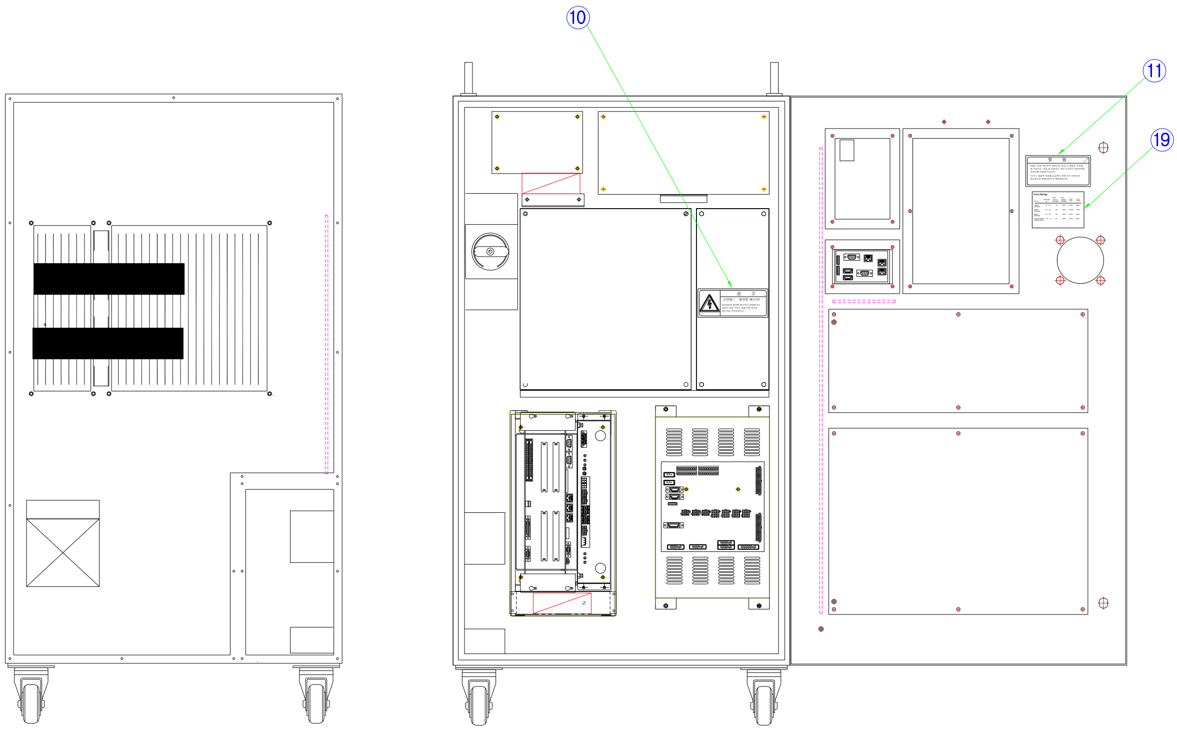
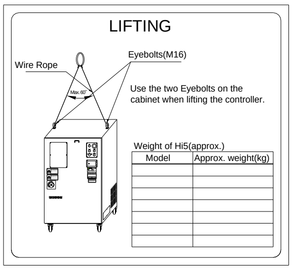
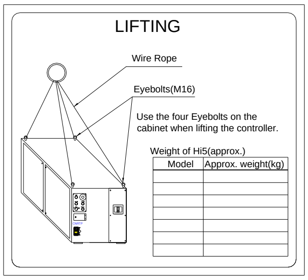
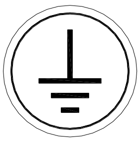


Figure 3.9 Hi5-N** Location of Controller Nameplate 2

No.	Name Plate	No.	Name Plate
1	HYUNDAI HEAVY INDUSTRIES CO., LTD. CE Product Name : ROBOT CONTROLLER Model Name : HI5 - Serial Number : Rated Voltage : Va.c, 3Phase, 50/60Hz Rated Current : A IEC NO : Max. Current : A Capacity : KVA Weight : Kg Size (W,H,D) : Manufacture Date : Subassembly ID : IP CLASS : Manufactured by Hyundai Heavy Industries Co., Ltd. 1, CHEONHA-DONG, DONG-KU, ULSAN CITY, 682-792, KOREA Tel : 82-52-202-5041 Home page : www.hhi.co.kr Fax : 82-52-202-7960 Made in Korea	2	HYUNDAI HEAVY INDUSTRIES CO.,LTD.
3	Hi5-C11	4	CAUTION - Carefully read the operation manual and the safety manual before installation and using application. - Do not enter the working range of the Robot system under operation. - Before cables connecting, check that the S/N is identical on the controller and on the manipulator. If the S/N is different, robot may be operated abnormally..
5	NOTICE Batteries for data backup are installed inside of both controller and manipulator. Batteries must be replaced in every 2 years regardless of operation hours. · Next date for replacement is 1 . . . 2 . . . 3 . . . 4 . . . . Battery type : ER6C(Lithium Battery, 3.6V) · Battery Maker : Hitachi Maxwell, Ltd.	6	CAUTION - Check appropriate supplied voltage before connection. - Check supplied voltage with setting voltage of transformer. - Make grounding which is 100Ω resistance or less for the robot independtly. - Use Grounding Cable more than 5.5mm² - Use power cable more than 5.5mm² (AWG10)
7	CAUTION Finger Injury Handling without care can cause fatal injury.	8	CAUTION High Temperature Do not touch! The temperature may be very high.
9	CAUTION Ensure no interference for air circulation of ventiduct. Interference may cause controller damage.	10	WARNING High Voltage ! Stored Energy! Be careful of stored energy of DC 400V. Wait more than 5 minutes for deenergizing after power off.
11	NOTICE - Make sure that PCB is handled with care in such a way that electrostatic does not occured. - Wrap treated with electrostatic-proof must be used for transportation and storage. - Be sure of normal power connection before supplying main power to control cabinet after repair or maintenance.	12	WARNING High Voltage - High voltage can cause injury or death. - Control cabinet must be turned to "OFF" before opening cabinet door. - The Robot System must be switched off before any maintenance, exchange, repair. - Padlock must be used to lock the power switch to "OFF" .

<table>
<tr><th>No.</th><th>Name Plate</th><th>No.</th><th>Name Plate</th></tr>
<tr><td>13</td><td>NOTICE
Lock the caster of control cabinet unless it needs to be moved.</td><td>14</td><td>
</td></tr>
<tr><td>15</td><td>
</td><td>16</td><td>-</td></tr>
<tr><td>17</td><td>Main Power Connection
1. Conductor size
<table>
<tr><td rowspan="2">Item</td><td colspan="2">Phase conductors(L1,L2,L3)</td><td rowspan="2">Protective Conductor(PE)</td></tr>
<tr><td>L= ~ 50m
L= ~ 160ft</td><td>L= 50 ~ 100m
L=160 ~ 320ft</td></tr>
<tr><td>Minimum Conductor Size</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. Tightening torque : 2.6 ~ 3.7 N·m(23.0~32.7 lb·in)
3. Terminal
- Terminal type : Ring terminal
- Bolt Size : M5</td><td>18</td><td>-</td></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>2A</td><td>250V</td><td>GP20</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>-</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 Hi5 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 fully 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 a qualified personnel

3.5.1. Weight of Controller

Table 3-1 Weight of Controller

Model	Power Supply Transformer	Weight	
		Kg	lb
Hi5-N00/N50	X/O(Option)	150/230	330/507
Hi5-N30	X/O(Option)	150/200	330/441
Hi5-C10	X	150	330
Hi5-C20	X	150	330

Table 3-2 Weight of Hi5 Controller by Models

Model	Weight	
	Kg	lb
Teach Pendant(7.5m, TP510)	4	9
Wire harness (5m, Hi5-N**)	15	33
wire harness (5m, Hi5-C10, Hi5-C20)	18	40

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.

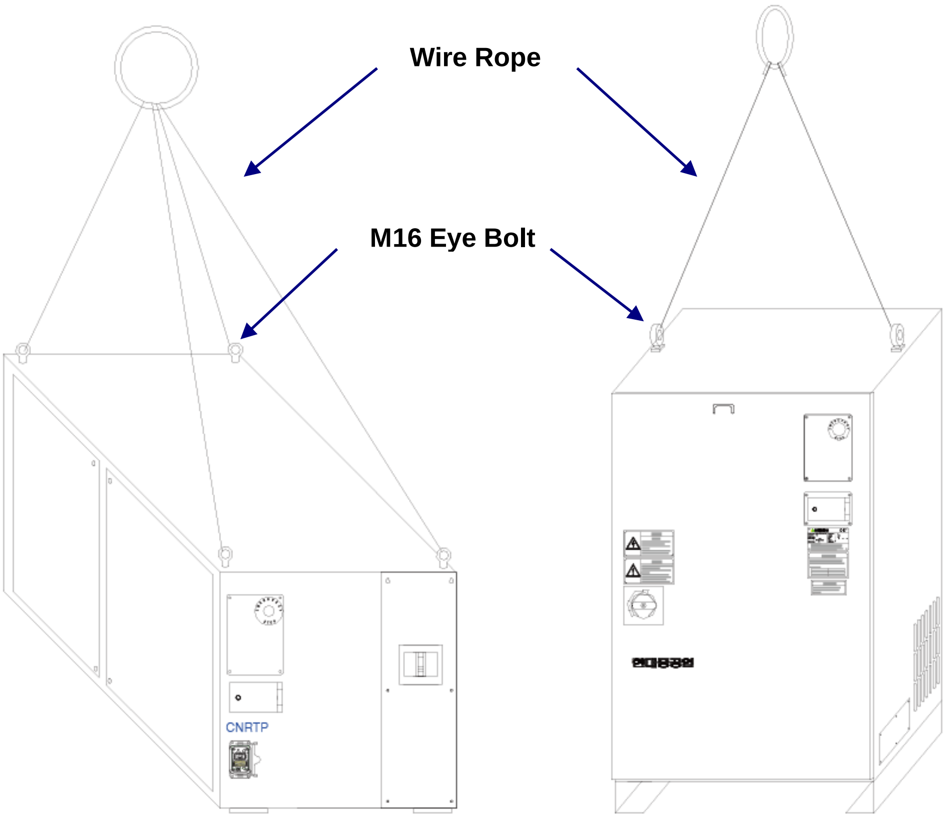


Figure 3.10Transportation of Controller Using Crane

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.

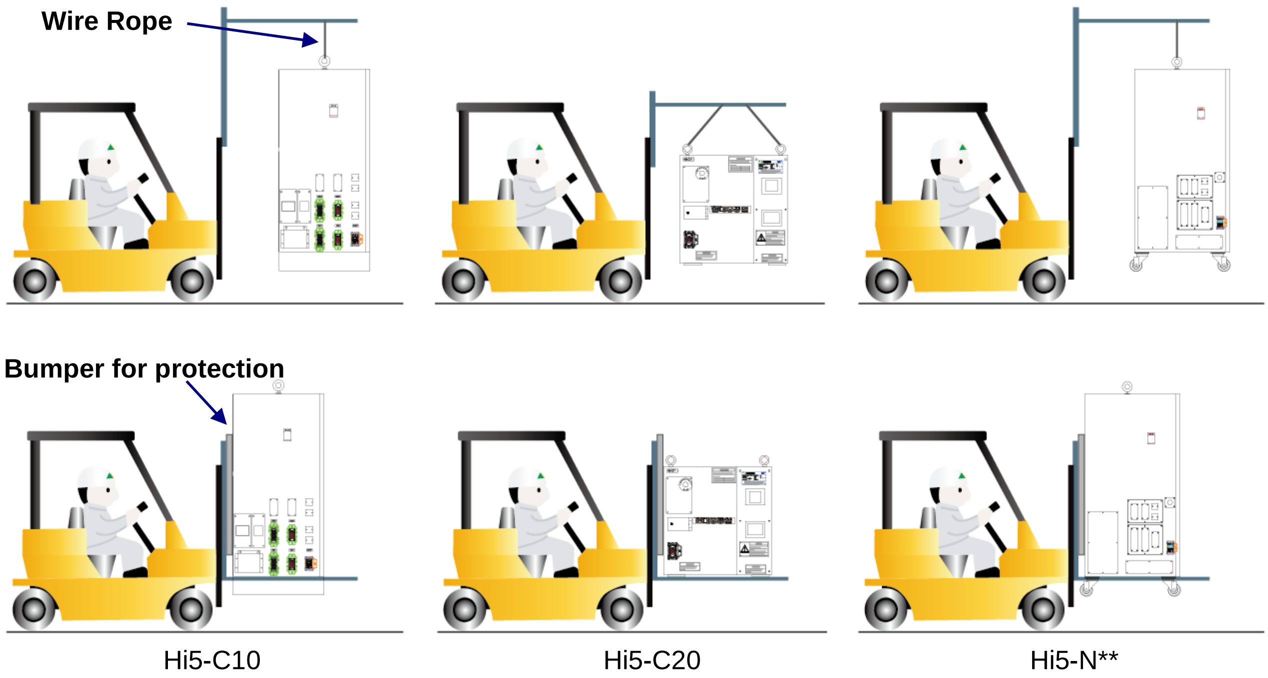


Figure 3.11 Transportation of Controller Using Forklift Truck

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.

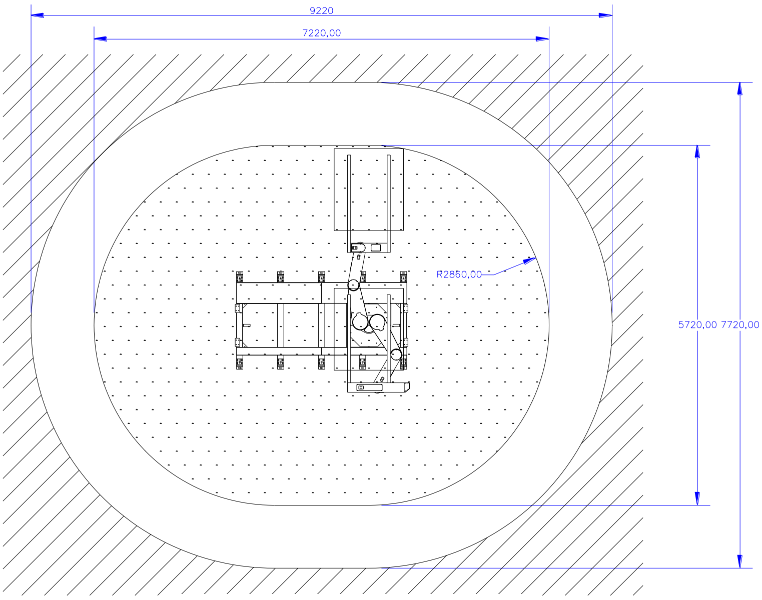
- Ambient Temperature ; 0°C ~ 45°C
- No dust, oil, or moisture.
- No flammable, corrosive liquid or gas.
- No impact and shaking.
- Far from electrical noise generator.
- No exposed direct to the sun

3.6.1. Installation of Controller

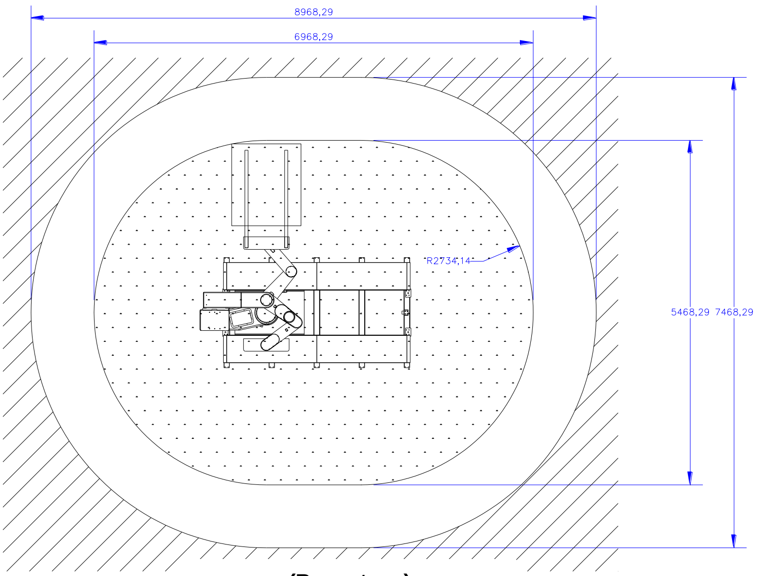
① Install the controller in a safe place outside of robot working envelope.
② If safety fence is located outside of robot working envelope, install the controller in a place where the robot's movement can be monitored from the outside of safety fence.
③ Open the front door and secure enough space for 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.



(Cylinder type)



(Beam type)

robot operation area

marginal space between operation area and safeguard area

safeguarded area

Figure 3.12 Installing space for LCD robot

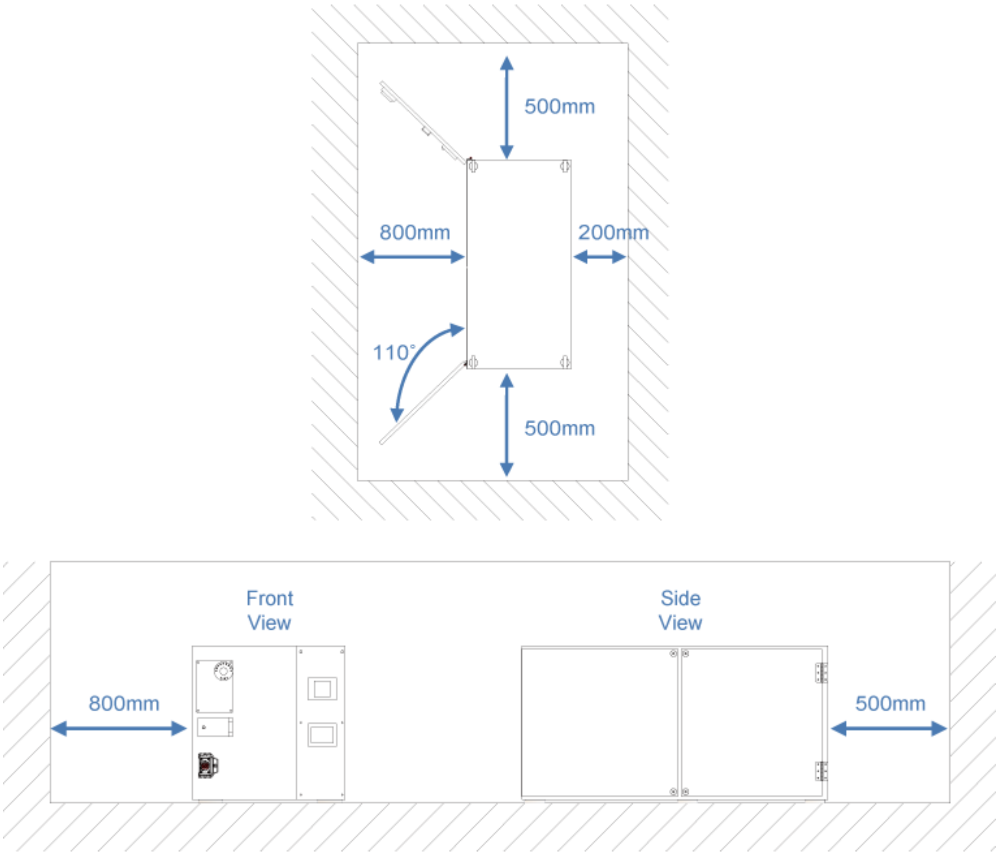


Figure 3.13 Installing space for Hi5-C20 controller

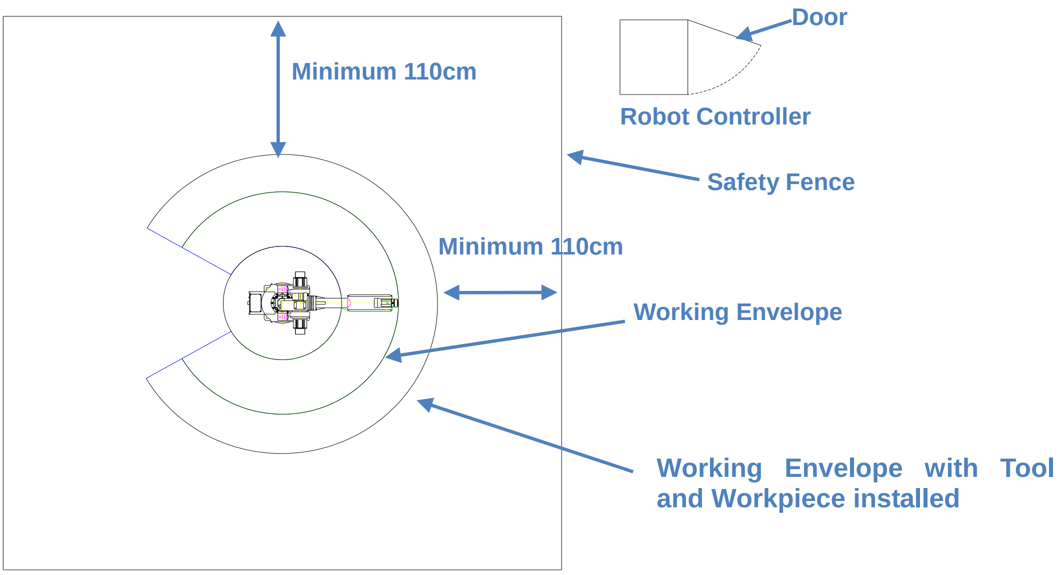


Figure 3.14 Install space for general type robot

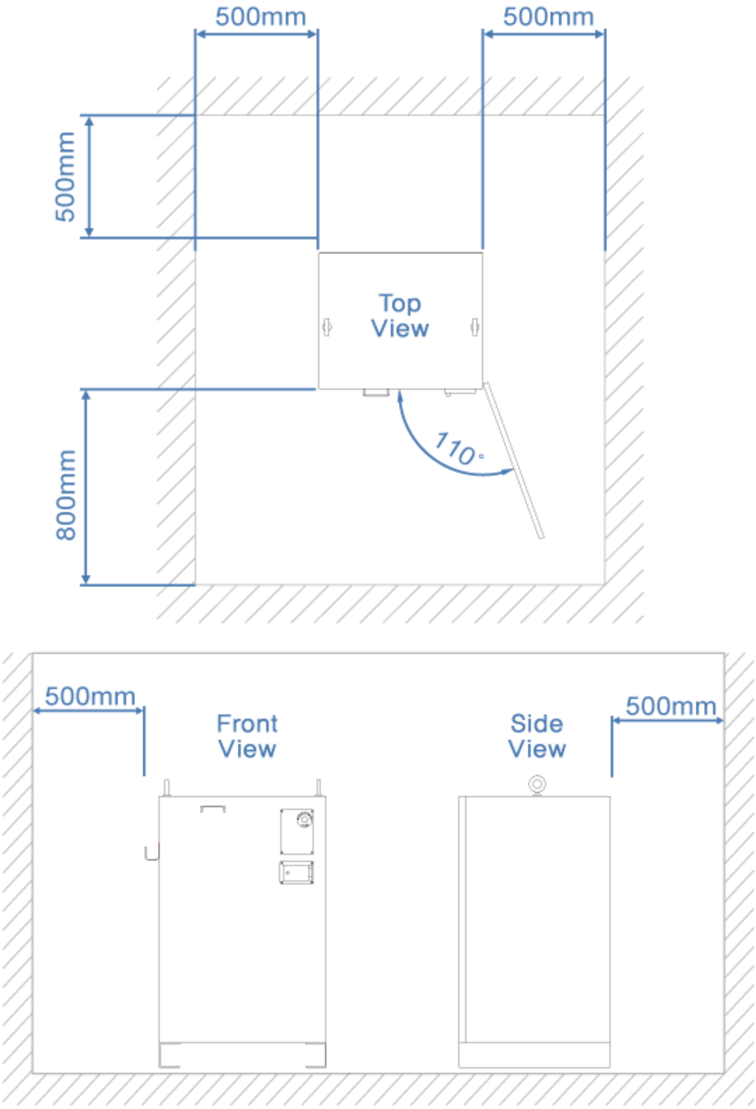


Figure 3.15 Installing space for Hi5-C10, Hi5-N** controller

3.6.3. Dimension of Controller

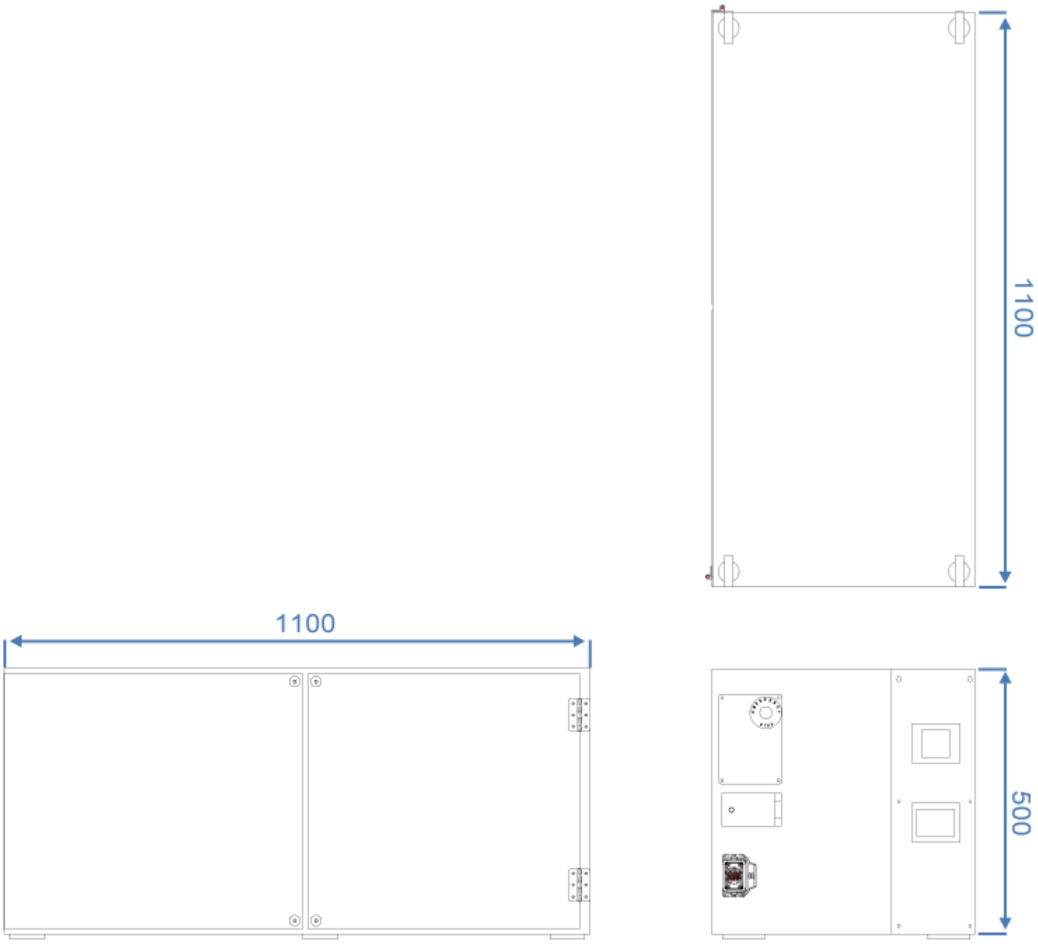


Figure 3.16 Dimension of Hi5-C20 (Unit:mm)

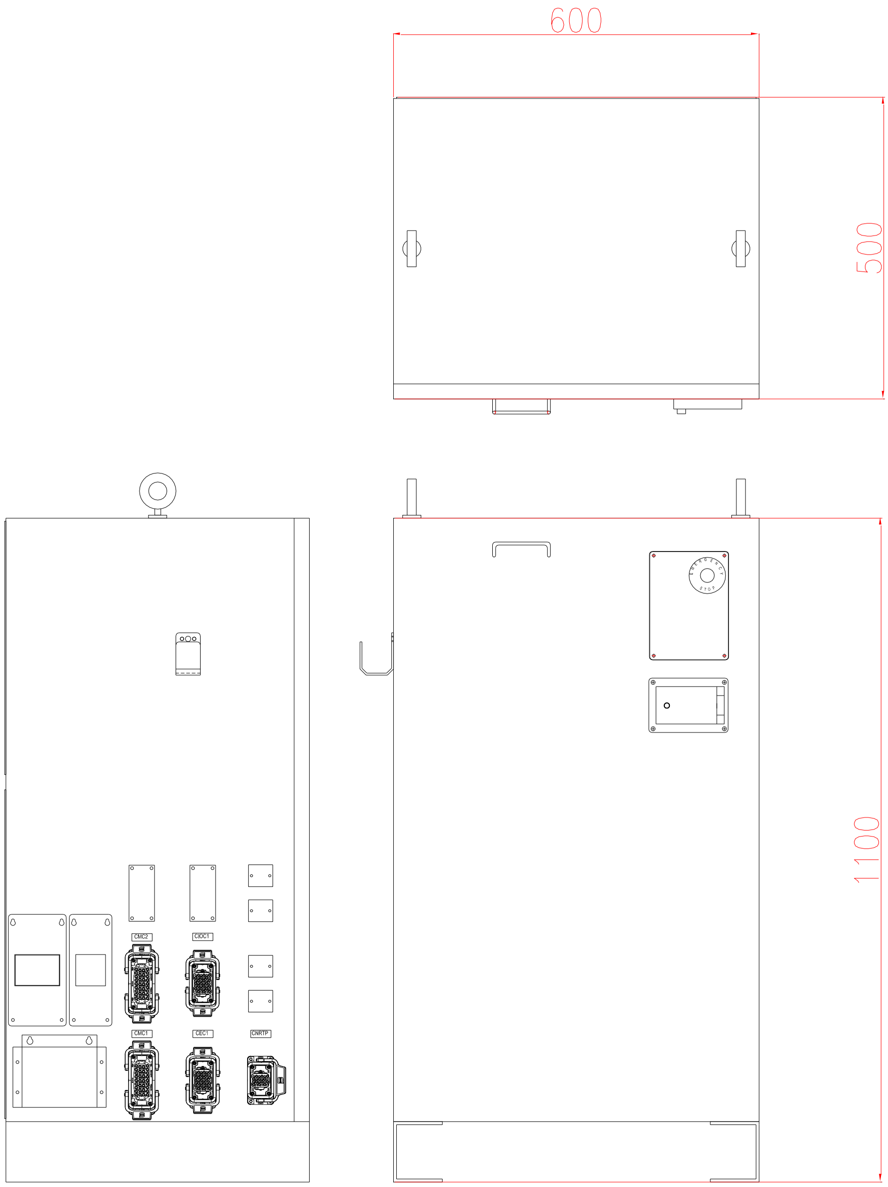


Figure 3.17 Dimension of Hi5-C10 Controller (Unit:mm)

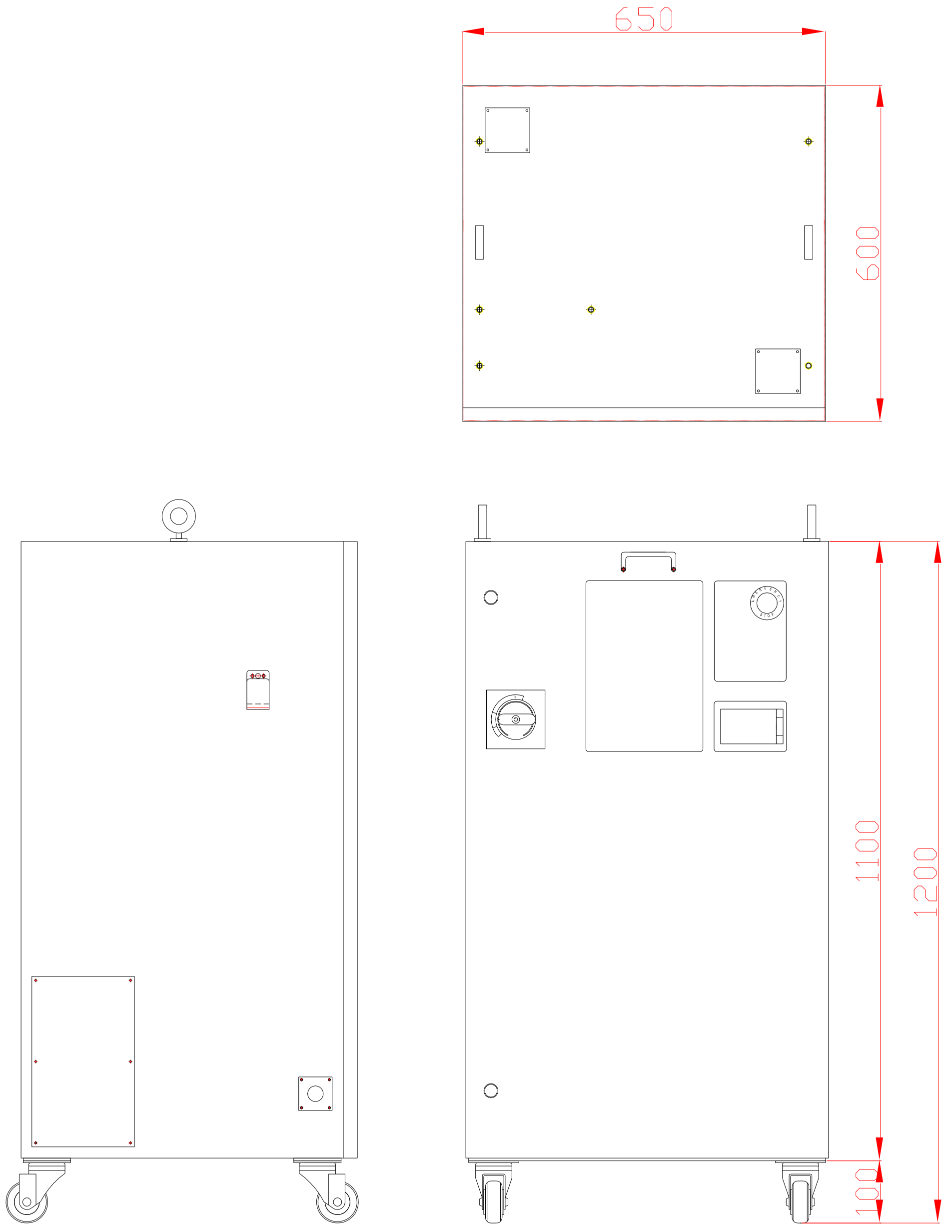


Figure 3.18 Dimension of Hi5-N** Controller (Unit:mm)

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 preformed by a qualified personnel.

3.7.1. Connection of Teach Pendant

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

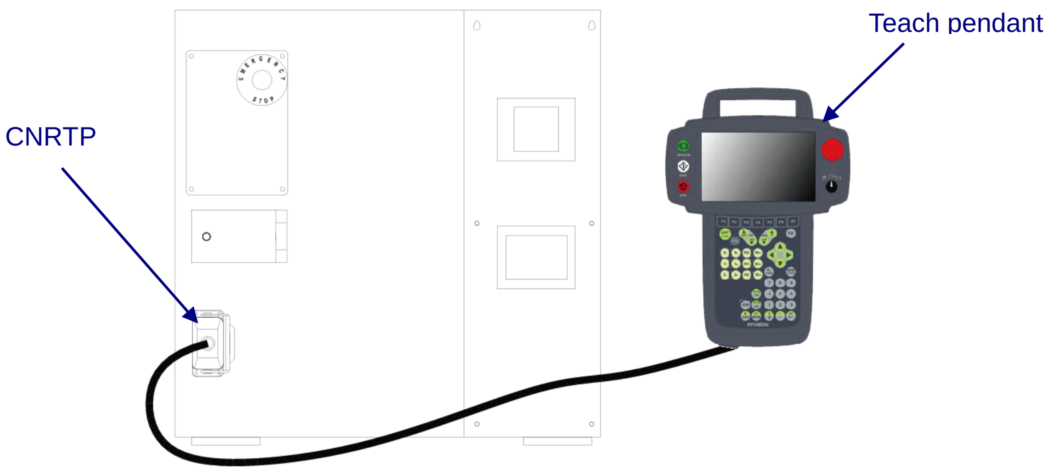


Figure 3.19 Hi5-C20 Connection of Teach Pendant

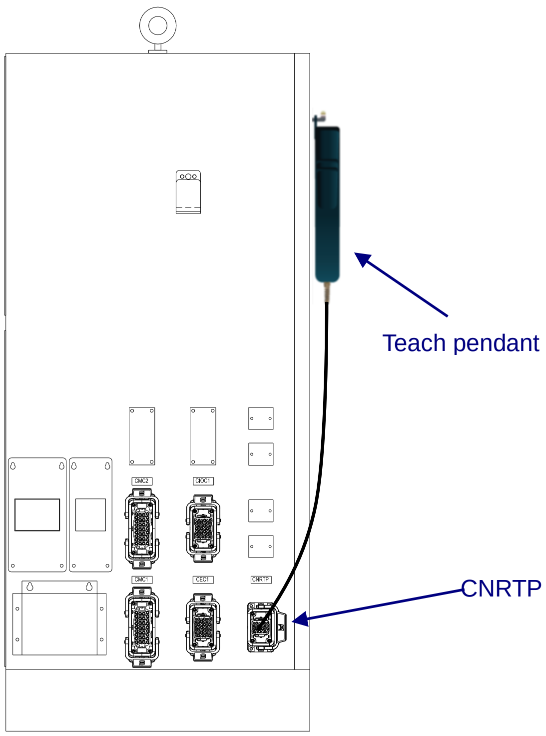


Figure 3.20 Hi5-C10 Connection of Teach Pendant

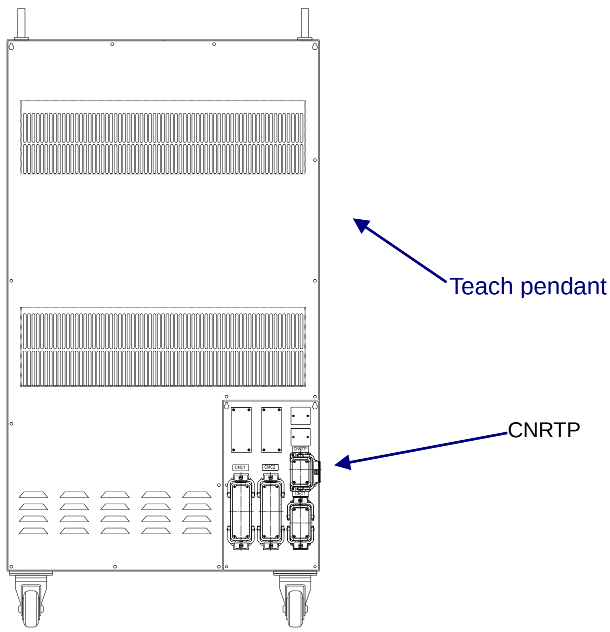


Figure 3.21 Hi5-N** Connection of Teach Pendant

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.

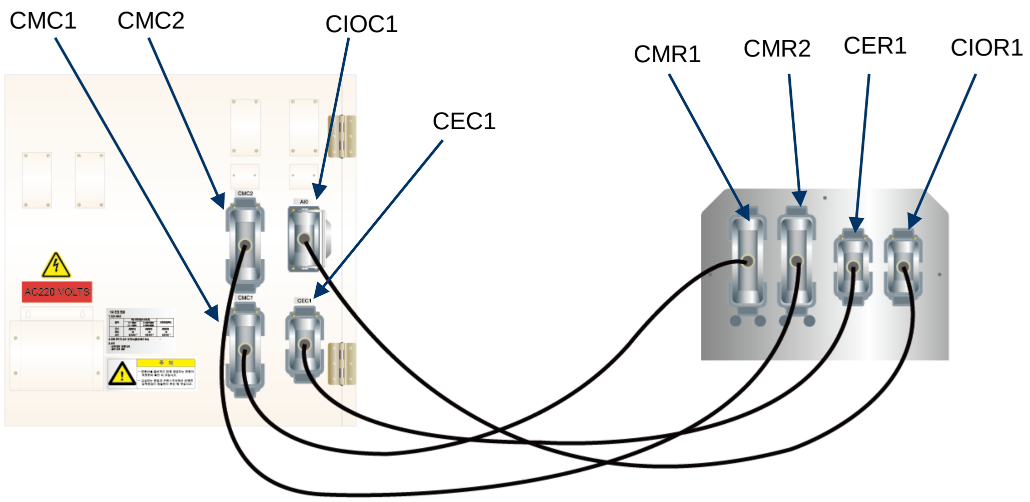


Figure 3.22 Connection of Robot Manipulator and Controller (Hi5-C20)

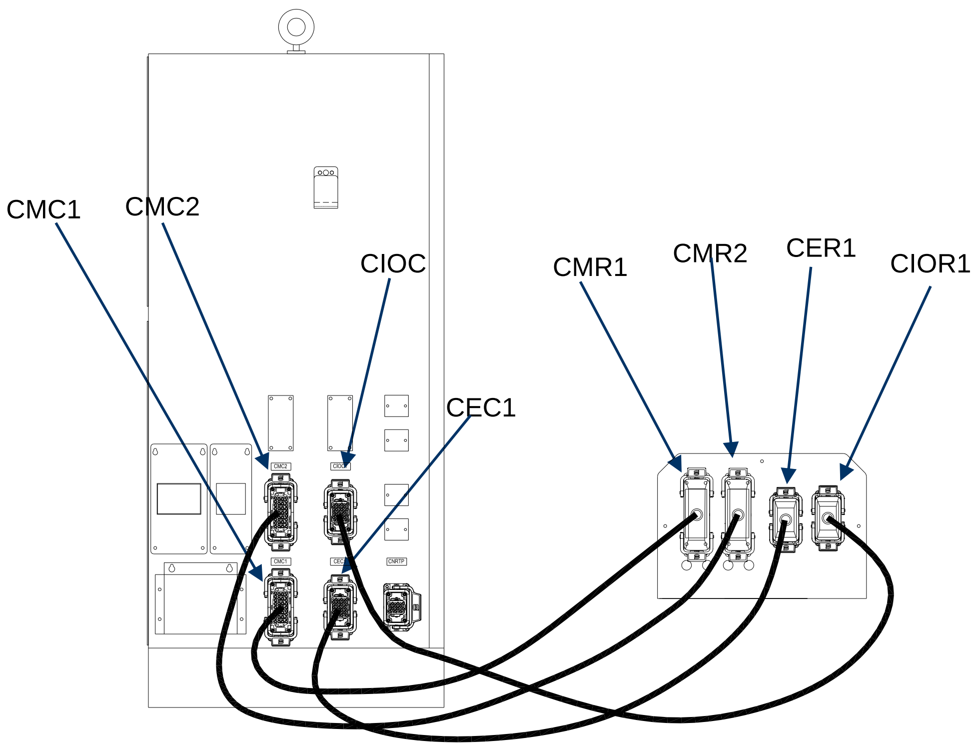


Figure 3.23 Connection of Robot Manipulator and Controller (Hi5-C10)

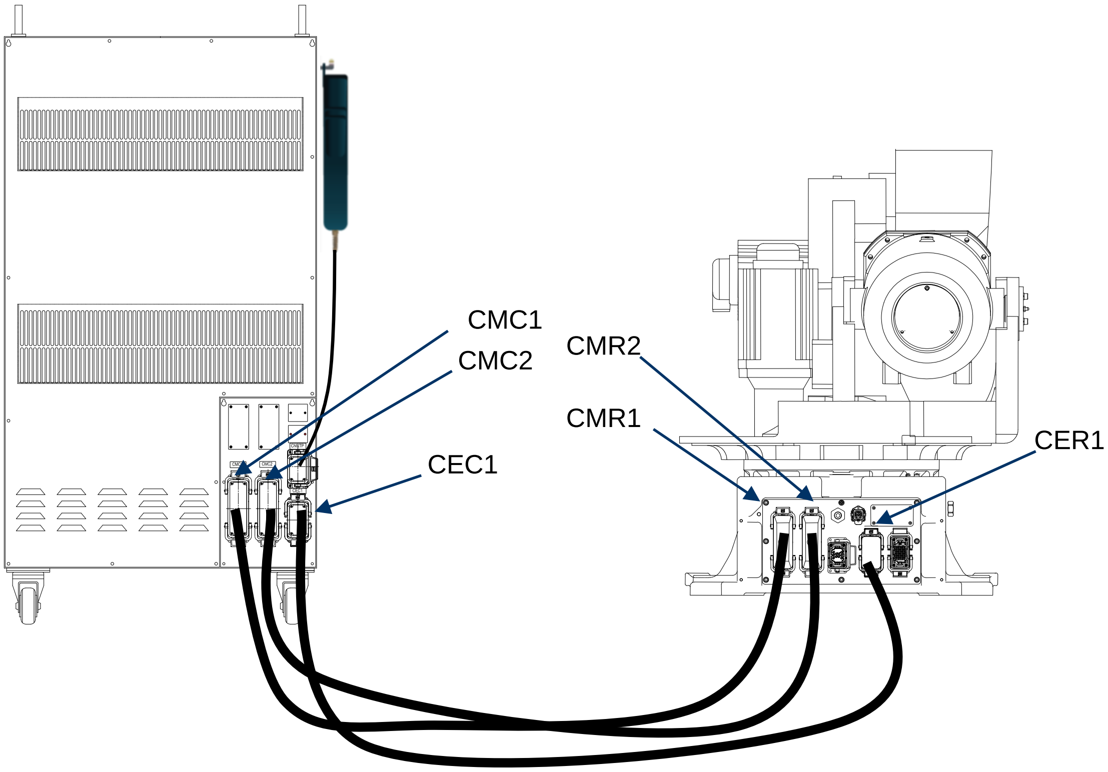


Figure 3.24 Connection of Robot Manipulator and Controller (Hi5-N00)

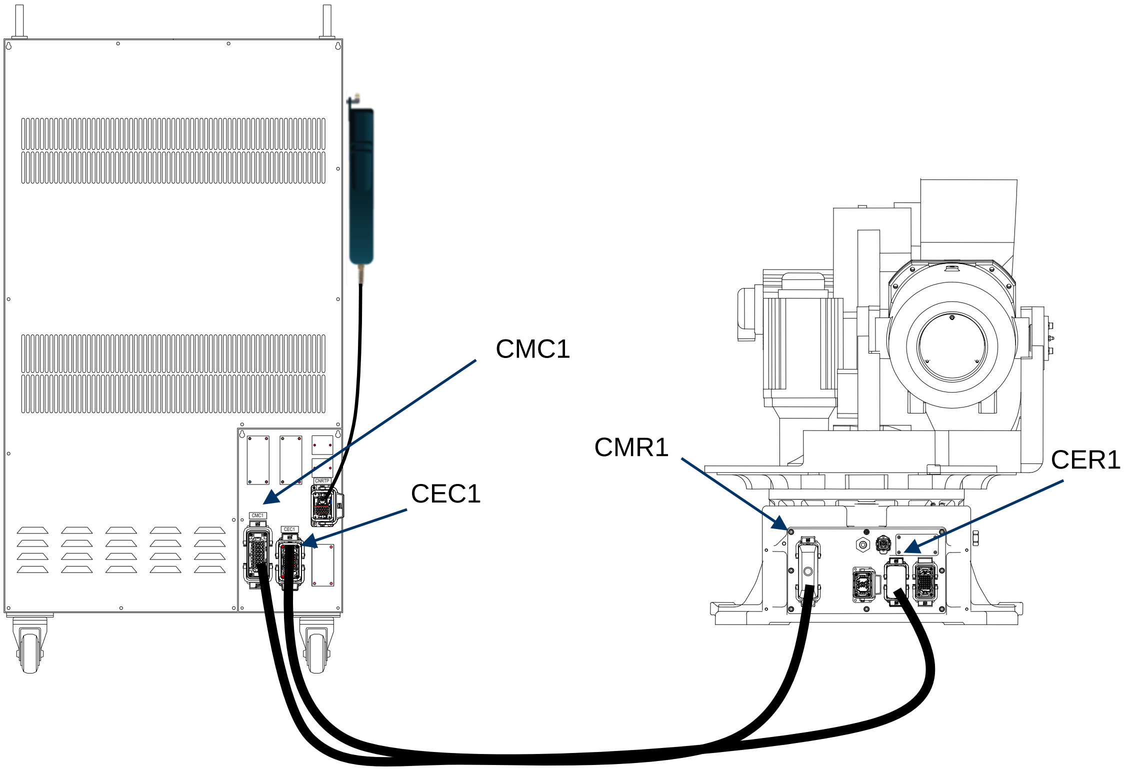


Figure 3.25 Connection of Robot Manipulator and Controller (Hi5-N30/N50)

3.7.3. Connection of Controller and Primary Power

Check if the power is removed from the primary power and braker(CB).
Connect the Hi5-C10 and C20 controllers to the terminal block (TBPW).
For the Hi5-N** 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

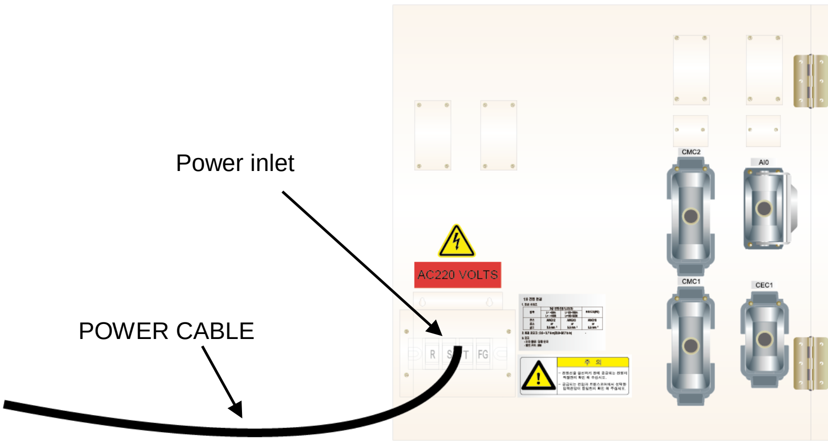


Figure 3.26 Hi5-C20 Connection of Primary Power to Controller

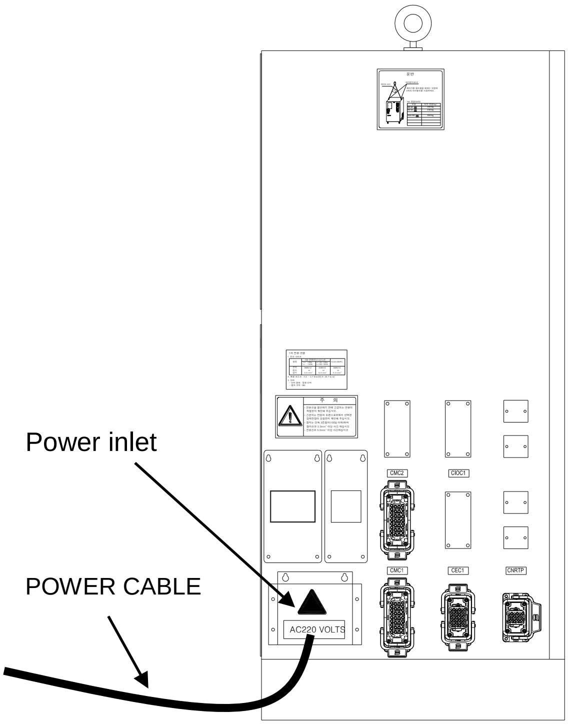


Figure 3.27 Hi5-C10 Connection of Primary Power to Controller

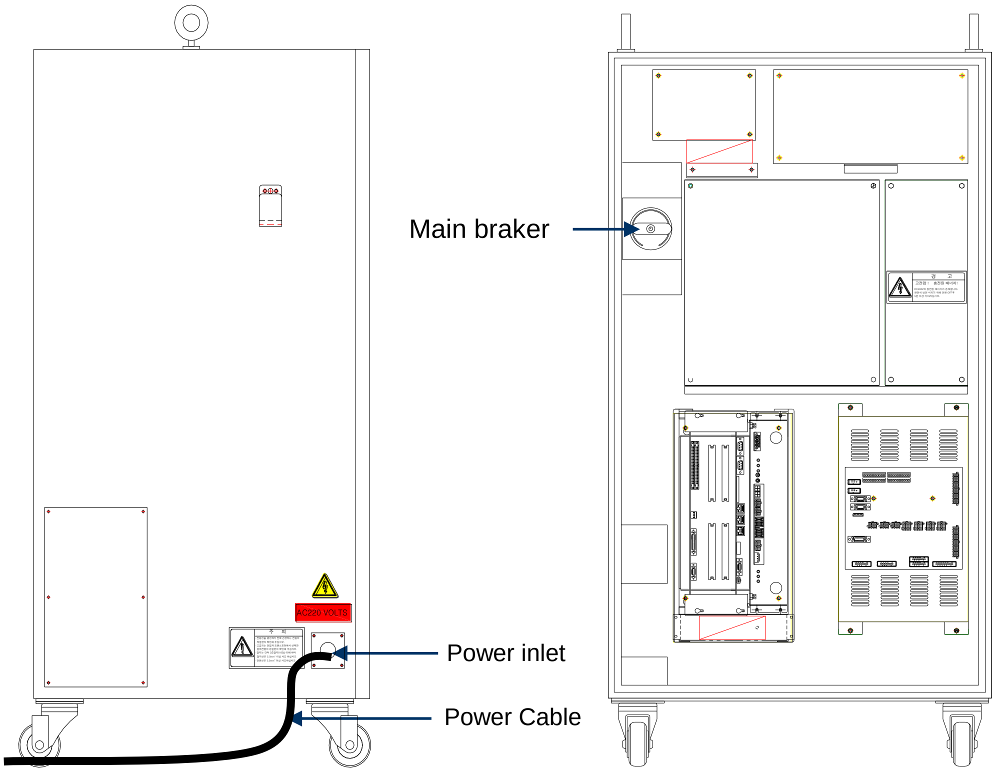


Figure 3.28 Hi5-N** Connection of Primary Power to Controller

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	Hi5-N00/N50	Max. 7.8KVA	220V/380V/400V/440V	50/60	30A
2	Hi5-N30	Max. 4.4KVA	220V/380V/400V/440V	50/60	15A
3	Hi5-C10	Max. 12.5KVA	220V	50/60	30A
4	Hi5-C20	Max. 11KVA	220V	50/60	30A

Note 1) Power capacity:
This refers to the capacity of the power supplied to the controller. Please refer to the "Maintenance Manual" for the Robot Main Body" 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 (Hi5-N00, Hi5-N50 Hi5-C10, Hi5-C20)		Thickness of Cable (Hi5-N30)	
		㎟	AWG	㎟	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

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)

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. RS232C & Ethernet access of Small Door

The small door sector is located on the OP panel in the front of the controller, and is composed of an RS232C and Ethernet port for external connection. Interconnecting to PC and Pin Description is as follows.

Table 3-5 Pin Descriptions (RS232 connector specifications; DSUB9S-M)

DSUB9S-M Pin No.	Name	Abbreviation	Direction
2	Receive Data	RX	In
3	Transmit Data	TX	Out
5	Signal Ground	GND	
7	Request to Send	RTS	Out
8	Clear to Send	CTS	In

Table 3-6 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 Hi5 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.

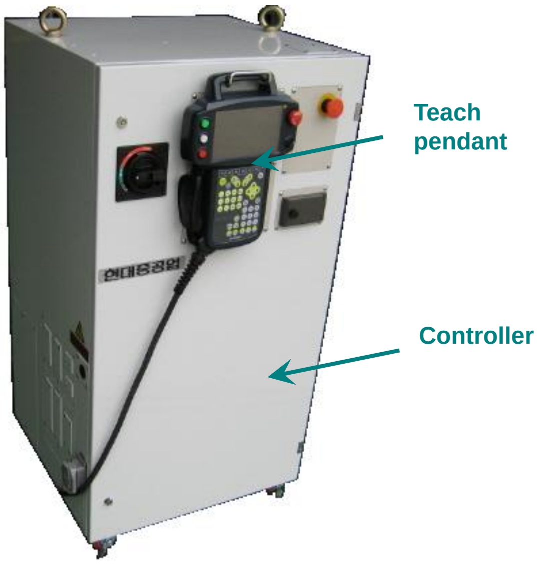


Figure 4.1 Hi5-N** Controller

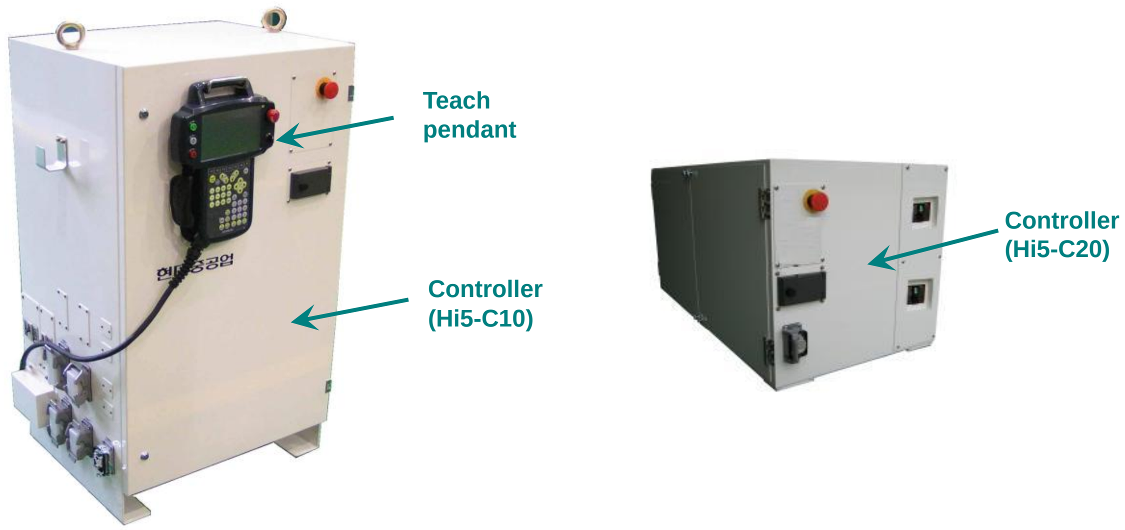


Figure 4.2 Hi5-C** Controller

Figure 4.3 Teach pendant (TP510)

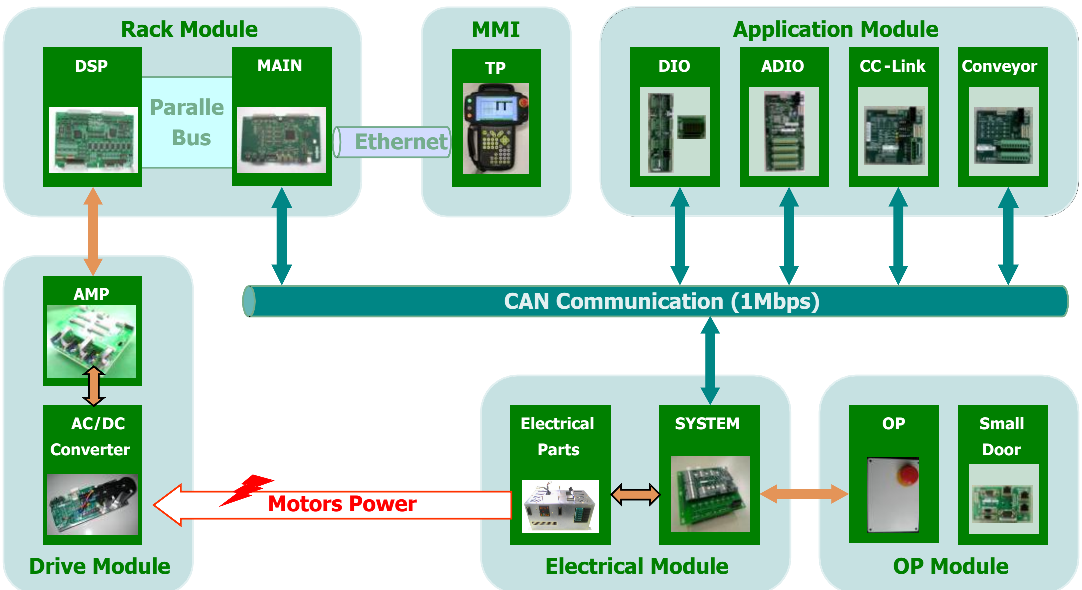


Figure 4.4 Internal Composition of Hi5 Controller

4.2. The Arrangement of Parts

Table 4-1 shows the main parts of Hi5-N00 controller and the name of each part, and Figure 4.5, 4.6 and 4.7 show the arrangement of them.

Table 4-1 The Name of Each Part of Hi5-N00 Controller

No.	Type	Item
1	RACK	Rack
2	BD501	Backplane Board
3	SR1	DC Multi Power Unit(SMPS : HDI-200)
4	BD510	Main Board
5	BD542	Servo Board
6	BD530/531	System Board
7	PDM30	Electrical Module
8	SD1L2C	Middle-Size Diode Module
9	SA3X3Y	Middle-Size 6-Axis Servo Drive Unit (Standard Specifications)
9-1	SA3A3D	Small-Size 6-Axis Servo Drive Unit (Standard Specifications, Including a DIOD module)
10	SA1X1X	Middle-Size 2-Axis Servo Drive Unit (Option)
10-1	SA1X1A	Middle-Size 1-Axis, Small-Size 1-Axis Servo Drive Unit (Option)
10-2	SA1A1A	Small-Size 2-Axis Servo Drive Unit (Option)
11	EM. SW	Emergency stop switch
12	BD5B1	Small Door Board
13	NFB	No Fuse Breaker
14	FAN1	Rack radiating fan
15	FAN2	Lower fan for upper circulation

No.	Type	Item
16~17	FAN3~5	Servo-drive unit radiating fan
18	NFT1	Line Noise Filter
19~20	DR1~2	Regeneration discharge resistance
21	TR1	Transformer
22	CMC1	Power Cable Lead-In Connector for Motor Drive 1
23	CMC1	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

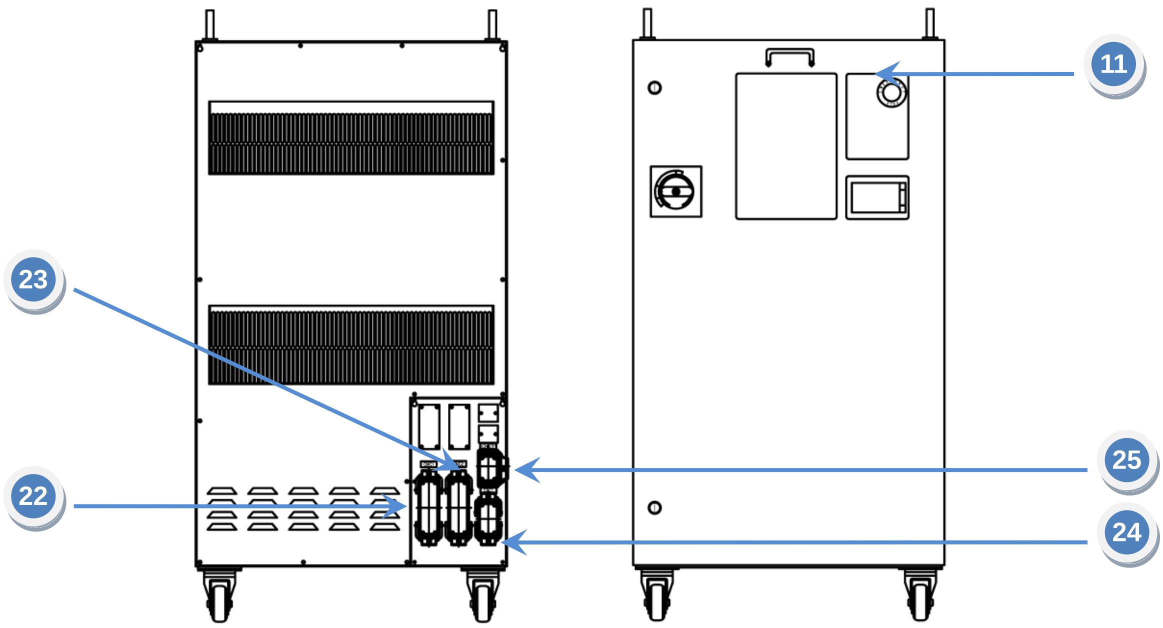


Figure 4.5 Hi5-N00 Part arrangement parts in the exterior of a controller

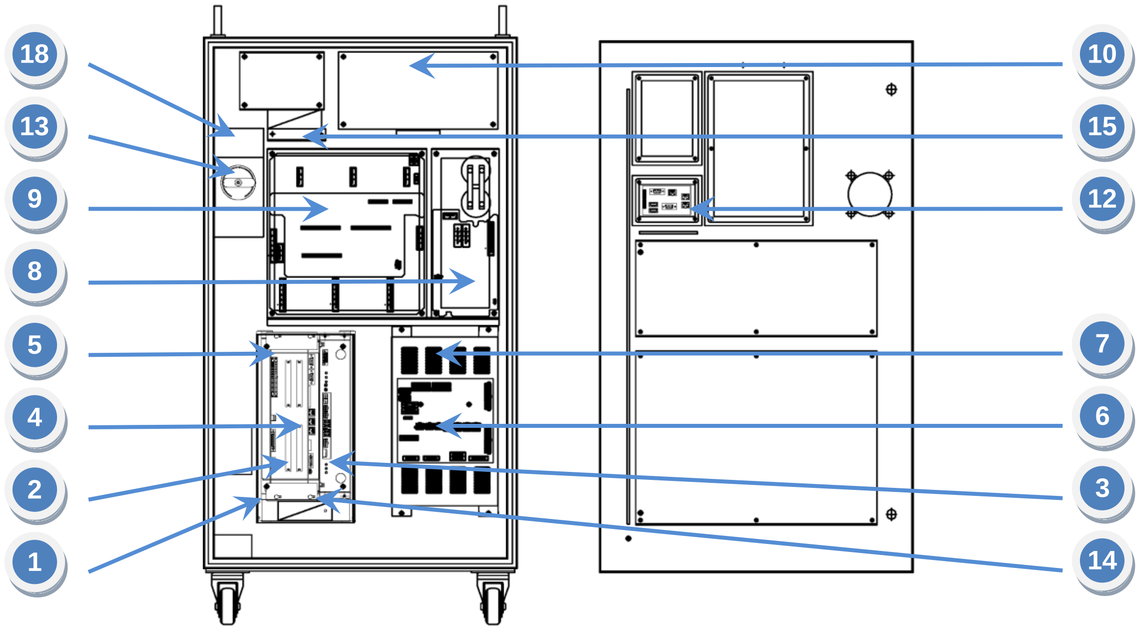


Figure 4.6 Part arrangement in the interior of the front surface of the Hi5-N00 controller

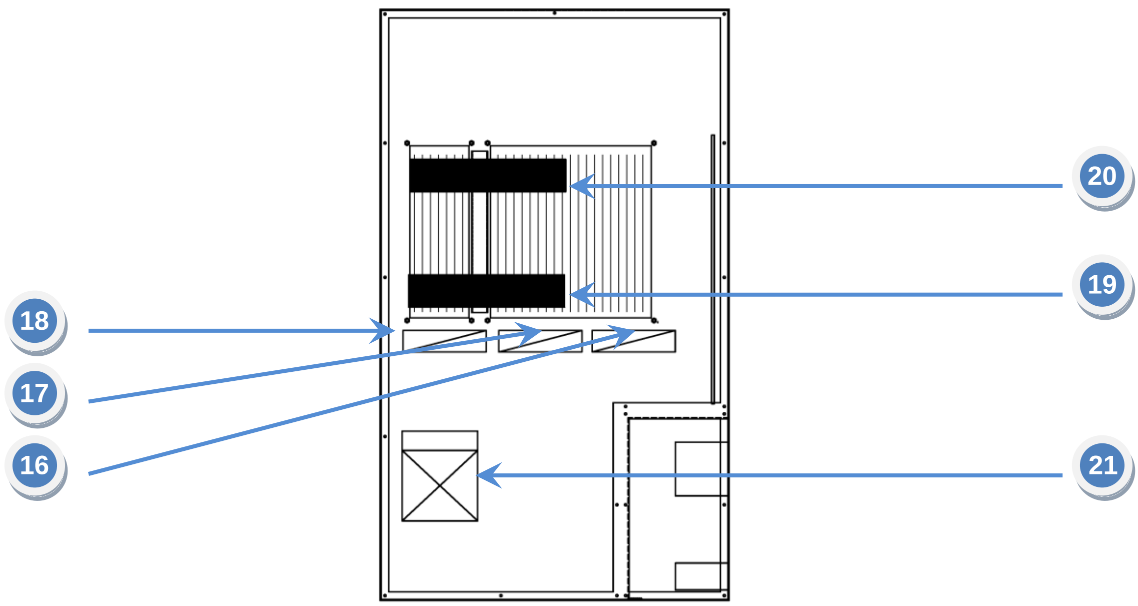


Figure 4.7 Part arrangement in the interior of the rear surface of the Hi5-N00 controller

Table 4-2 shows the main parts of Hi5-C10 controller and the name of each part, and Figure 4.8, 4.9 and 4.10 show the arrangement of them.

Table 4-2 The Name of Each Part of Hi5-C10 Controller

No.	Type	Item
1	RACK	Rack
2	BD501	Backplane Board
3	SR1	DC Multi Power Unit(SMPS : HDI-200)
4	BD510	Main Board
5	BD542	Servo Board
6	BD530/531	System Board
7	PDM30	Electrical Module
8	SD1L2C	Middle-Size Diode Module
9	SA3X3Y	Middle-Size 6-Axis Servo Drive Unit (Standard Specifications)
9-1	SA1L5X	Servo-drive apparatus for HC2500B2D-XXXX-10(optional specifications)
9-2,3	SA3X3Z	Servo-drive apparatus for HC2500B2D-XXXX-00(optional specifications) Servo-drive apparatus for HC2500B1-XXXX-10(optional specifications)
10	BD58A	LDIO board
11	BD58B	Safety relay board
12	BD5B1	Small Door Board
13	EM. SW	Emergency stop switch
14	SR2	DC power apparatus for a sensor
15	SR3	Elevation shaft fall prevention brake and DC power apparatus for a robot fan
16	NFB1	Breaker of driving device wiring (No Fuse Breaker)
17	NFB2	Breaker for control power wiring (No Fuse Breaker)

No.	Type	Item
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

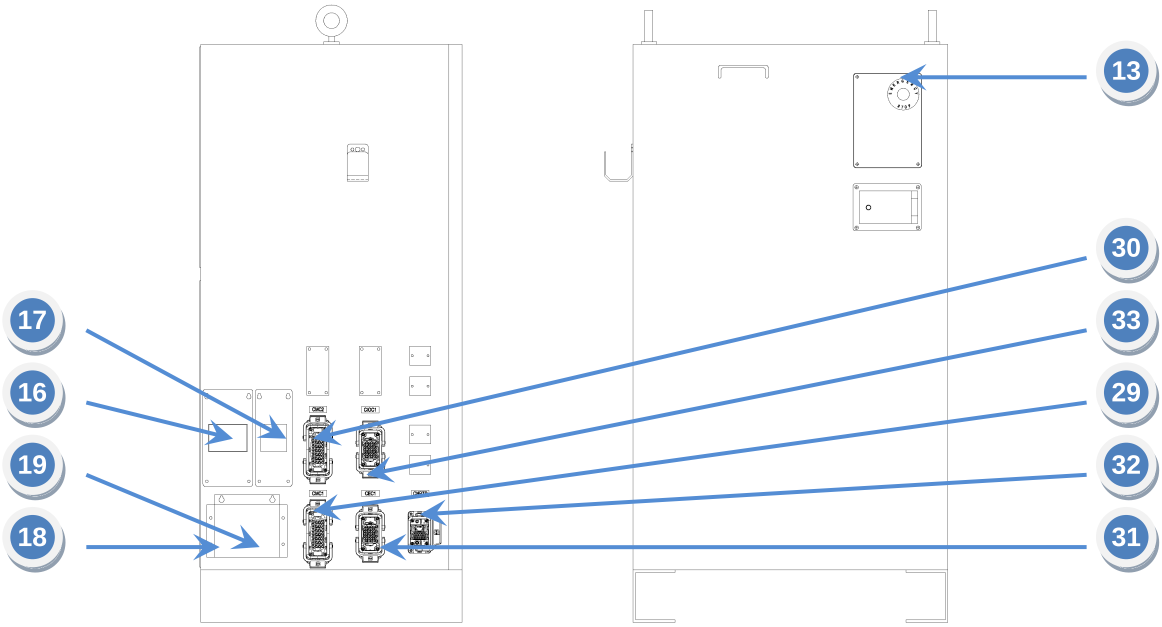


Figure 4.8 Hi5-C10 Part arrangement parts in the exterior of the controller

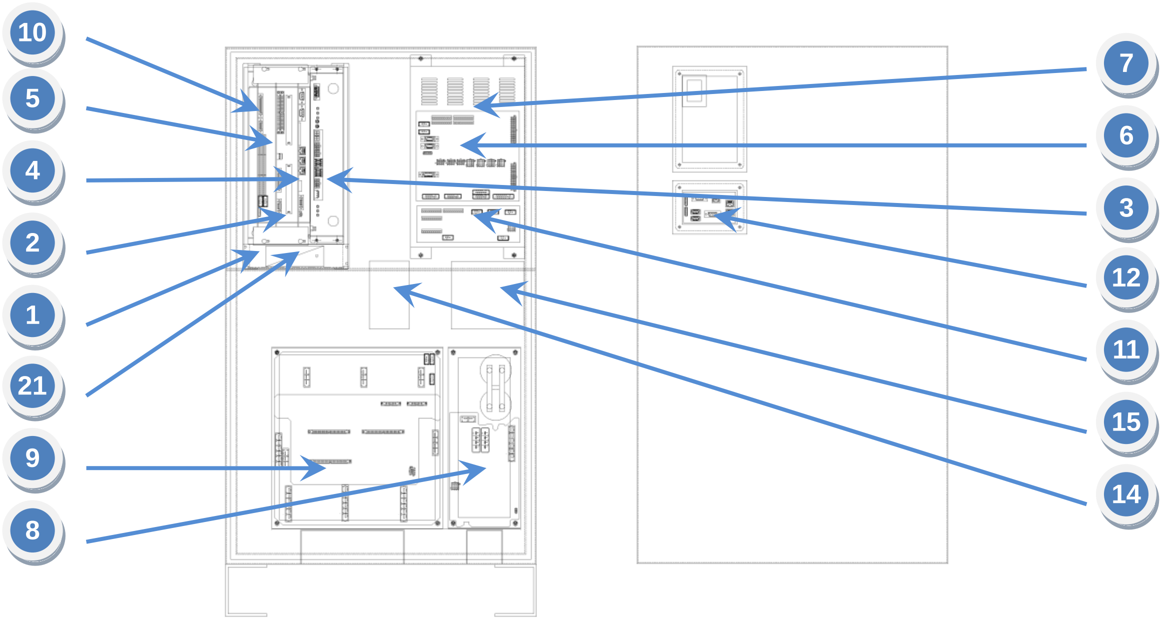


Figure 4.9 Part arrangement in the interior of the front surface of the Hi5-C10 controller

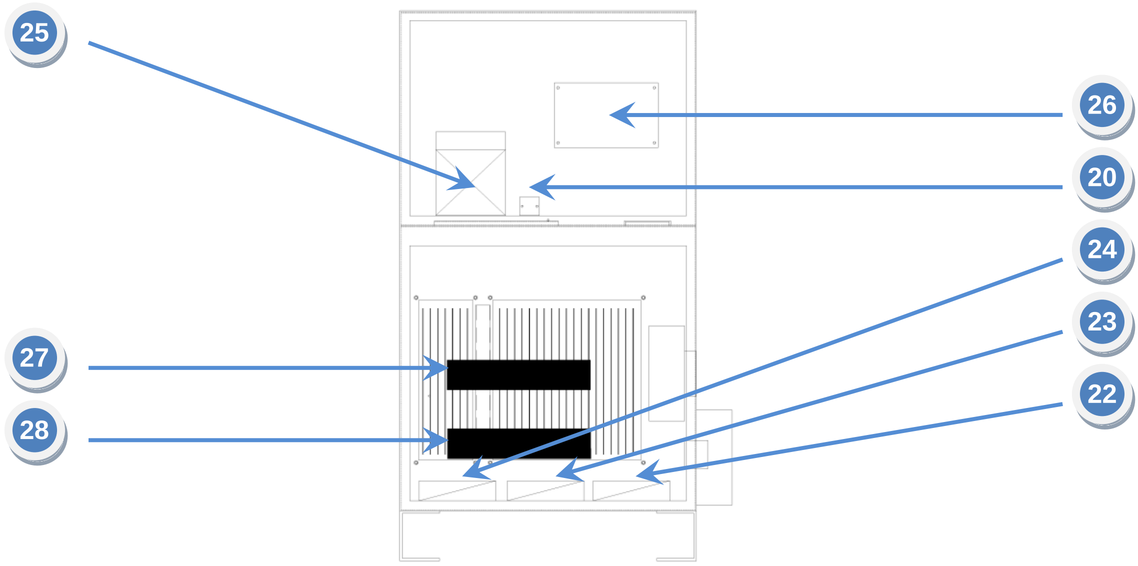


Figure 4.10 Part arrangement in the interior of the rear surface of the Hi5-C10 controller

Table 4-3 shows the main parts of Hi5-C20 controller and the name of each part, and Figure 4.11, 4.12 and 4.13 show the arrangement of them.

Table 4-3 The Name of Each Part of Hi5-C20 Controller

No.	Type	Item
1	RACK	Rack
2	BD501	Backplane Board
3	SR1	DC Multi Power Unit(SMPS : HDI-200)
4	BD510	Main Board
5	BD542	Servo Board
6	BD530/531	System Board
7	PDM30	Electrical Module
8	SD1L2C	Middle-Size Diode Module
9	SA3X3Y	Middle-Size 6-Axis Servo Drive Unit (Standard Specifications)
9-1	SA4X2Z	Servo-drive apparatus for HC2500IK-L0 (optional specifications) Servo-drive apparatus for HC2500IK-R0 (optional specifications)
10	BD580	DIO board
11	BD570	CC-Link board
12	BD5B1	Small Door Board
13	EM. SW	Emergency stop switch
14	SR2	DC power apparatus for a sensor
15	SR3	Elevation shaft fall prevention brake and DC power apparatus for a 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

No.	Type	Item
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	FAN5	Fan for front surface radiation
26	TR1	Transformer
27	NFT1	Line Noise Filter
28~29	DR1~2	Regeneration discharge resistance
30	CMC1	Power Cable Lead-In Connector for Motor Drive 1
31	CMC2	Power Cable Lead-In Connector for Motor Drive 2
32	CEC1	Motor Encoder Communications Cable Lead-In Connector
33	CNRTP	Teach pendant Cable Lead-In Connector
34	CIOC1	Sensor cable inserted in the connector 1
35	AMC1	Insertion connector 1 for the power cable to drive a motor in an added axis
36	AEC1	Insertion connector 1 for the communication cable of a motor encoder in an added axis

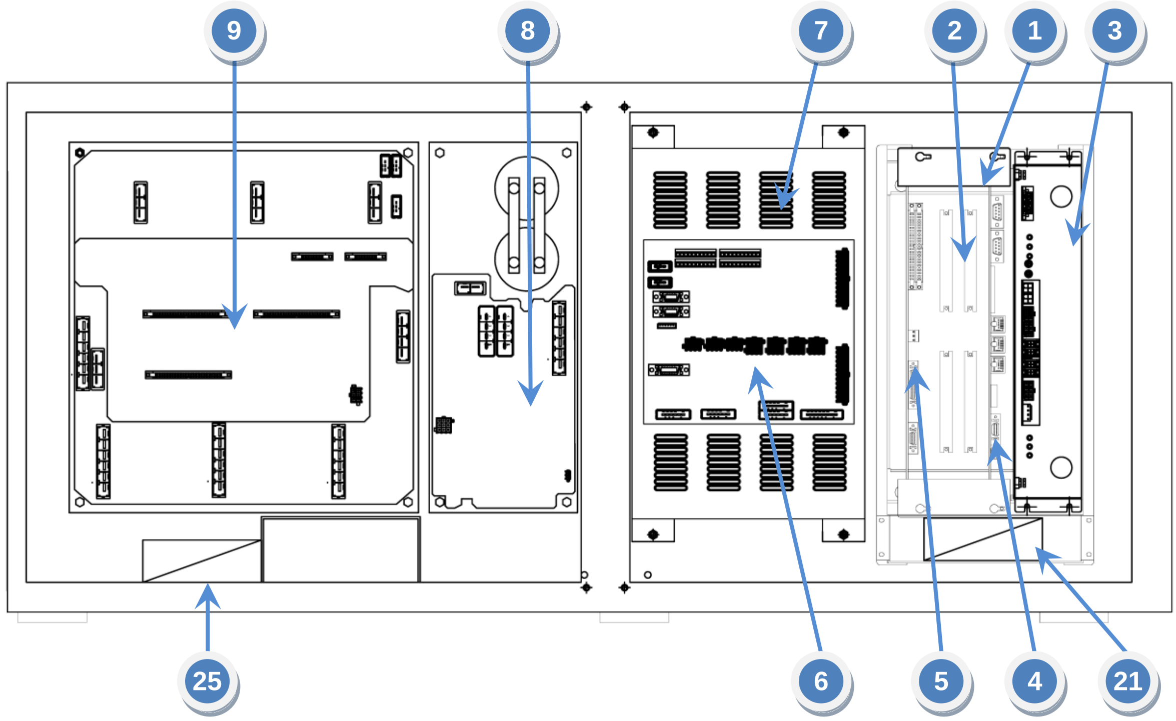


Figure 4.11 Part arrangement in the interior of the left side of the Hi5-C20 controller

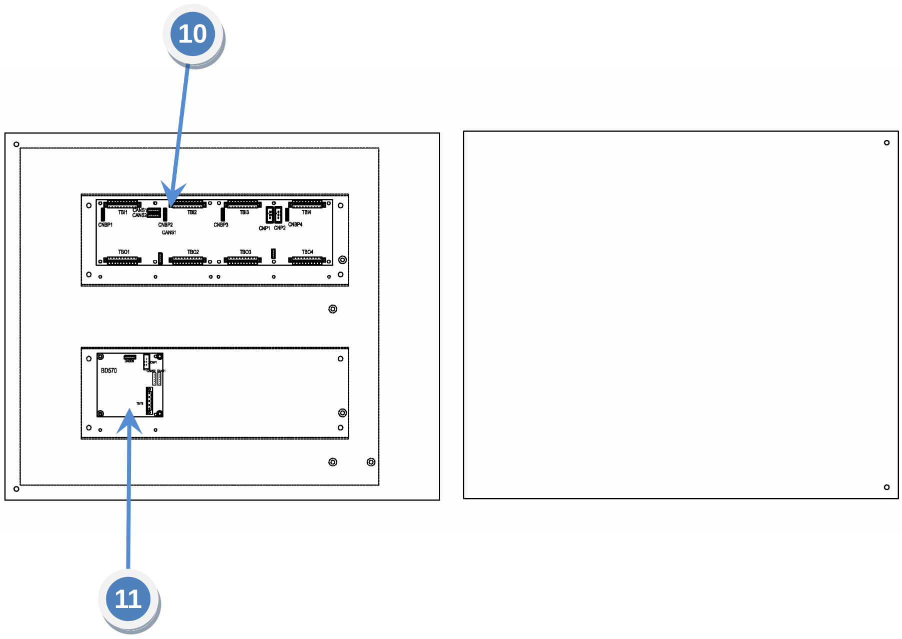


Figure 4.12 Part arrangement in the left side door of the Hi5-C20 controller

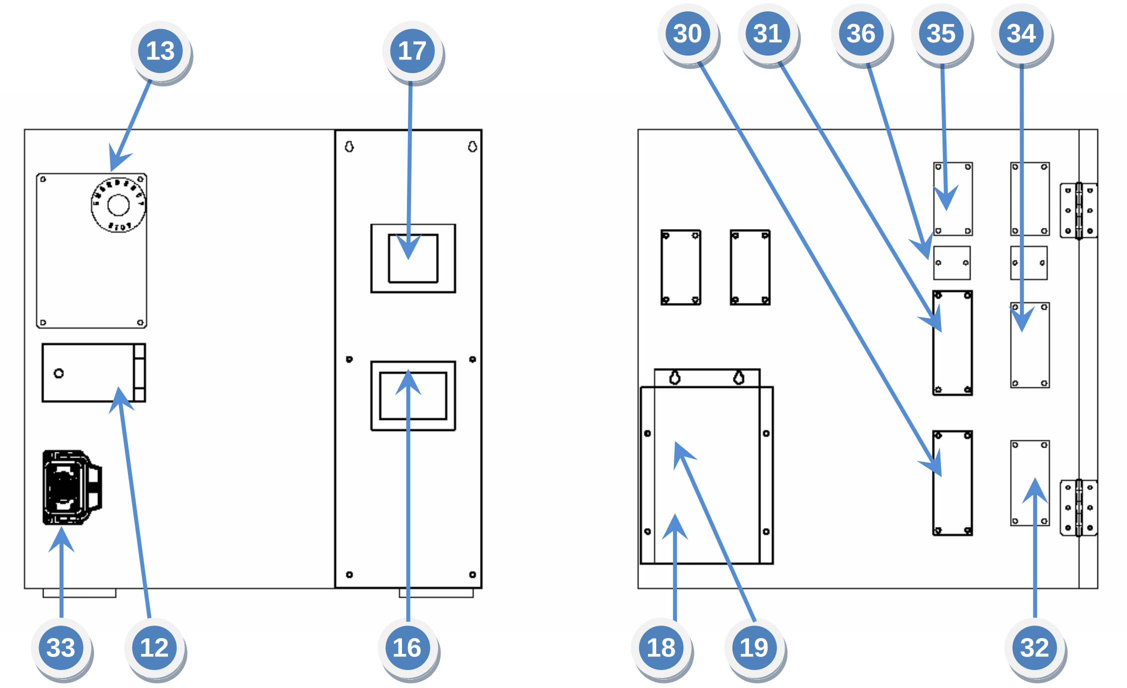


Figure 4.13 Part arrangement in the front and rear surfaces of the Hi5-C20 controller

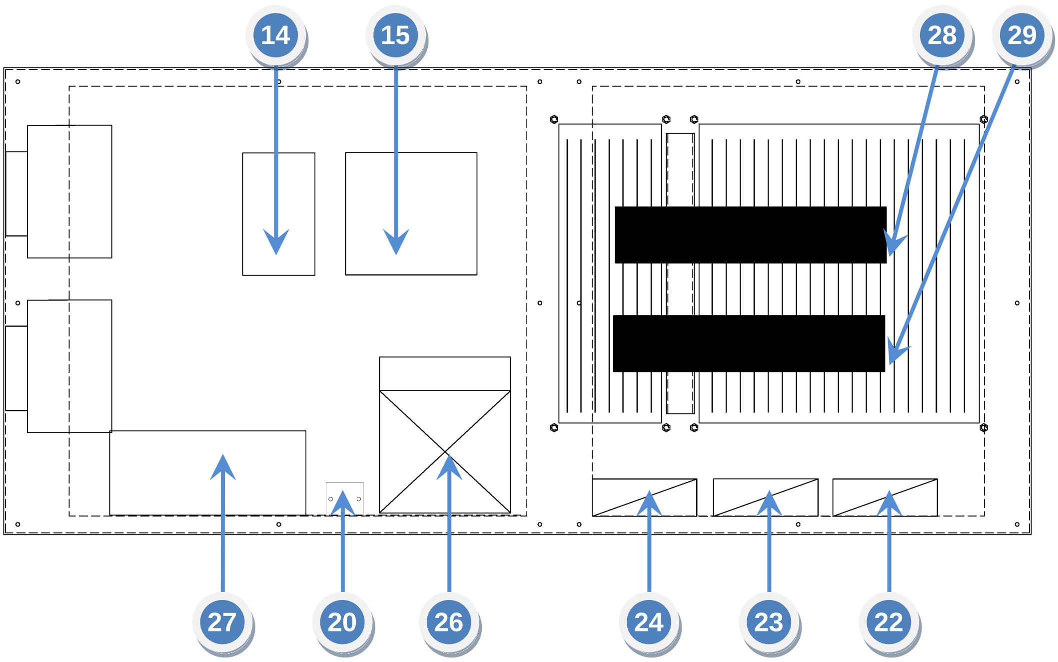


Figure 4.14 Part arrangement in the interior of the right side of the Hi5-C20 controller

4.3. The Function of Each Component

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

Component		Function
Board	Backplane Board (BD501)	● Bus for inter-board signal connection(4 Slots)
	Main Board (BD510)	● Save point saving and operational route calculation ● Program and robot constant preservation ● Teach pendant Communications ● PC, PC Card, and Serial Communications Connection
	Servo Board(BD542)	● CPU for Servo Control ● Encoder Connection (Serial I/F)
	System Board(BD530/531)	● 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	·Middle-Size 6 Axis ; SA3X3Y ·Small-Size 6 Axis ; SA3A3D	● Power generation for motor drive ● Regenerative power discharge ● Servo motor power amplifier circuit ● Various error reporting
DC Power Supply Unit (SMPS)	HDI-200 - Input power supply ; AC45~50V - 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) ● encoder power supply (DC+5V/4A)
T/P (Teach Pendant)	TP510	● 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

4.3.1. Rack and Backplane Board (BD501)

4.3.1.1. Outline

The rack has a structure as seen in Figure 4.15, 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 (BD501) as seen in Figure 4.16 should be installed at the back of the PCB rack.

Figure 4.15 PCB Rack

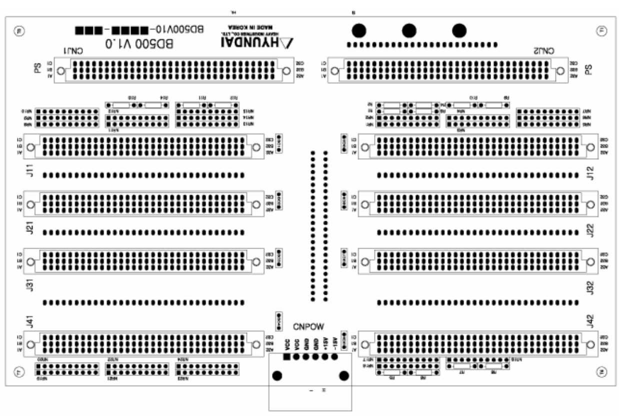


Figure 4.16 Backplane Board(BD501)

4.3.2. Mainboard(BD510)

4.3.2.1. Outline

The mainboard 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.

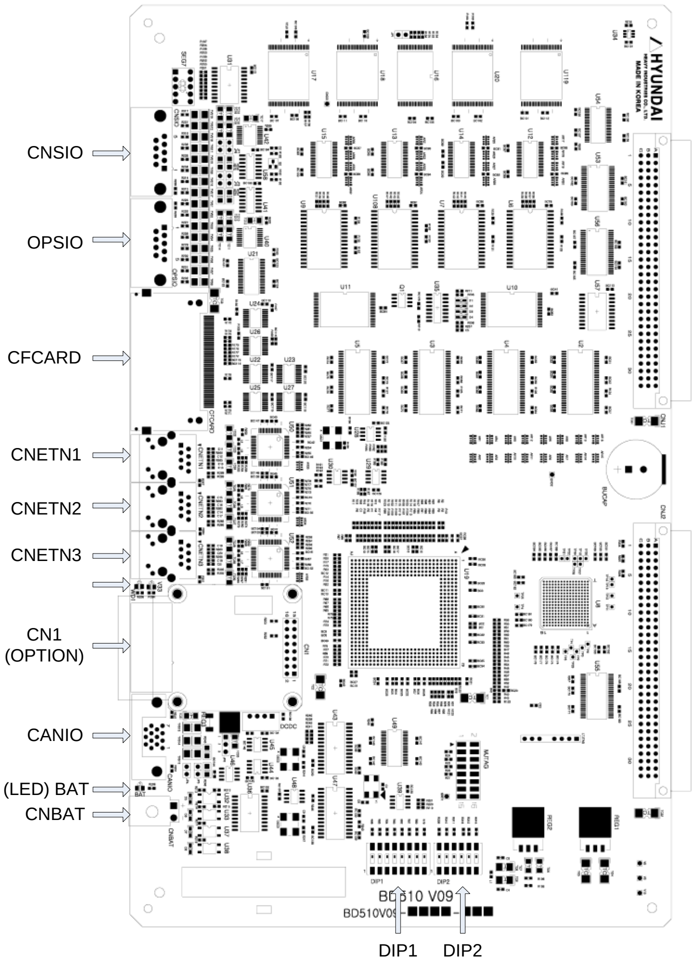


Figure 4.17 Mainboard (BD510)

4.3.2.2. Connector

Table 4-5 shows the use of connectors and external connecting devices.

Table 4-5 The Sorts and Uses of Mainboard (BD510)

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)	-
CFCARD	For system	-
CNETN1	Ethernet port: for cooperative control	-
CNETN2	Ethernet port: for communications between T/P	TP510 Connector (CNTP)
CNETN3	Ethernet port: for users (PC 1/F)	The small door of the front of the controller
CN1	CAN port: CAN3 (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 4-6 Mainboard (BD510) LED

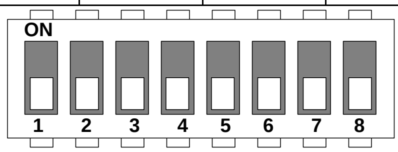
Status / Name	Color	Normal	Abnormal	Solution
V33	Green	On	Off	Check out REG1 of the board - DC 3.3V
WD1	Red	Off	On	Make a request for board repair
BAT	Yellow	On	Off	Replace the batteries for back up

4.3.2.4. Setting Unit

(1) DIP Switch Settings

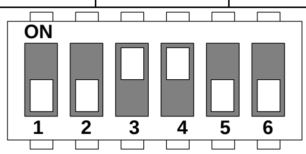
CAUTION : Users may not change the setting of DIP switch [DIP 1].

Table 4-7 The Method for Setting of the [DIP 1] Switch of the Mainboard (BD 510)

Switch No.		1	2	3	4	5	6	7	8
Content	**OFF**								
	ON								
Initial Setting		OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
The External Form of the Switch									

CAUTION: Users may not change the setting of DIP switch [DIP 2].

Table 4-8 The Method for Setting of the [DIP 2] Switch of the Mainboard (BD510)

Switch No.		1	2	3	4	5	6
Content	**OFF**	Not Changeable (For system)				Reserved	Mainboard BOOT
	ON						CF CARD BOOT
Initial Setting		OFF	OFF	ON	ON	OFF	OFF
The External Form of the Switch							

(2) Jumper Pin Settings

Caution: Users may not change the setting of the JP 1 set in production.

Table 4-9 The Method for Setting of the Serial Communications Jumper of the Mainboard (BD 510)

Jumper No.	JP1	JP2	JP3	JP7	JP8
Content	Not Changeable (For system)	[OPSIO] In using RS422/RS485 Termination		[CNSIO] In using RS422/RS485 Termination	
Initial Setting	SHORT	SHORT	SHORT	SHORT	SHORT

Table 4-10 The Method for Setting of CAN Communications Jumper of the Mainboard (BD510)

Jumper No.	JP4	JP5	JP6
Content	[CANIO] CAN2 Termination	[CANIO] CAN1 Termination	CAN2 External Power : No. 1-2 SHORT CAN2 Internal Power : No. 2-3 SHORT
Initial Setting	SHORT	SHORT	No. 2-3 SHORT

4.3.3. System Board(BD530/BD531)

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 ; BD531Board(In charge of system IO)

Figure 4.18 System Board (BD530/BD531)

4.3.3.2. Connector

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

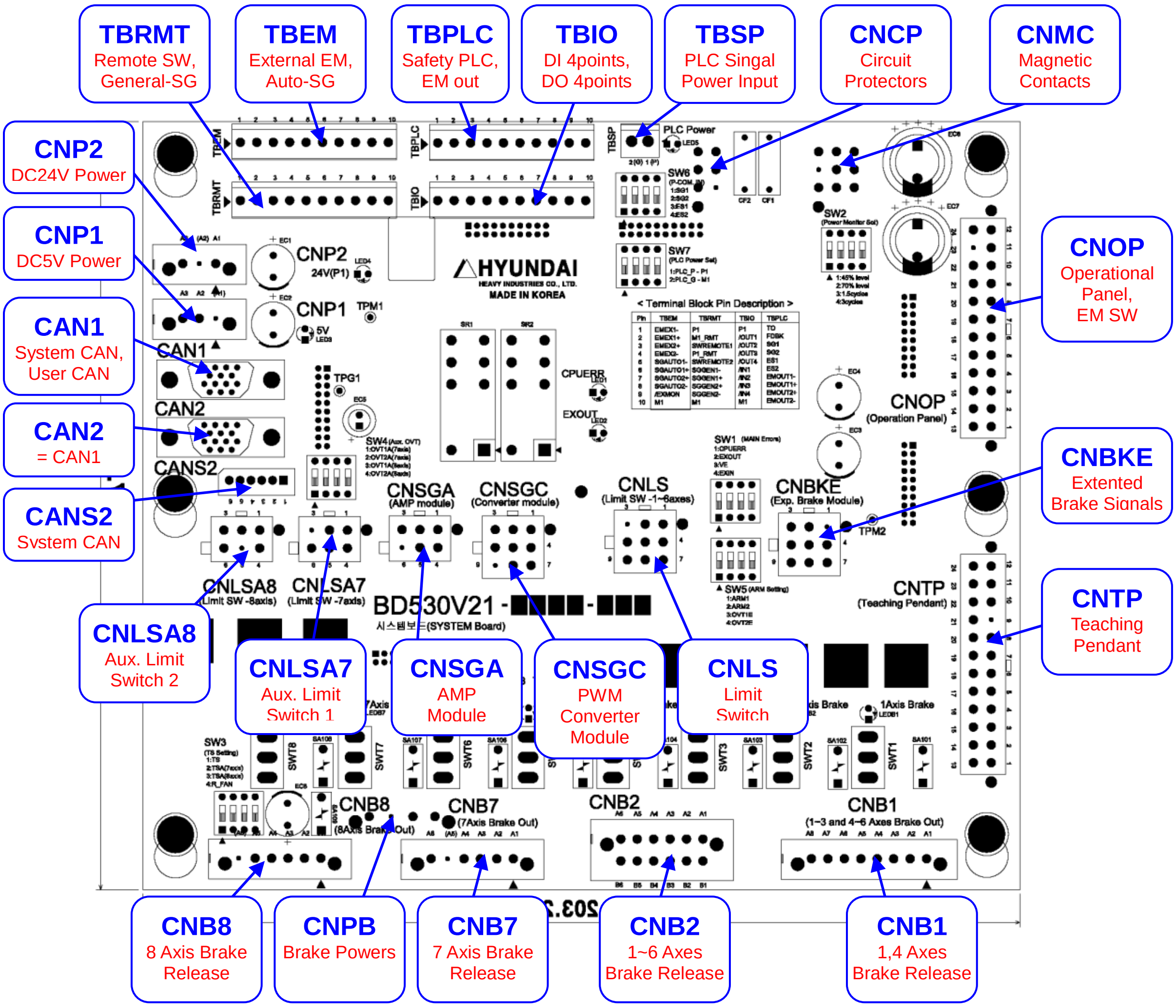


Figure 4.19 The Arrangement of the Connectors of the System Board (BD530)

Table 4-11 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
CNBKE	Safety signal I/F when brake output is extended	Brake extension board
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	CNMC 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

Name	Use	External Connecting Devices
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 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

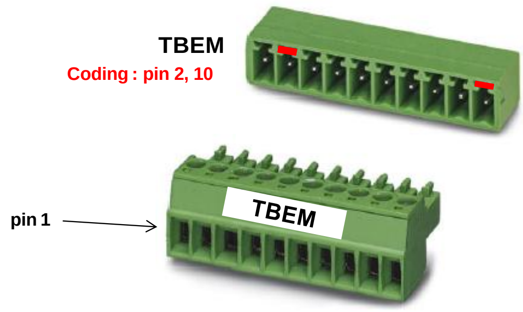


Figure 4.20 The Terminal Block of the System Board (BD530)

Table 4-12 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 (DC24V) ; TBIO

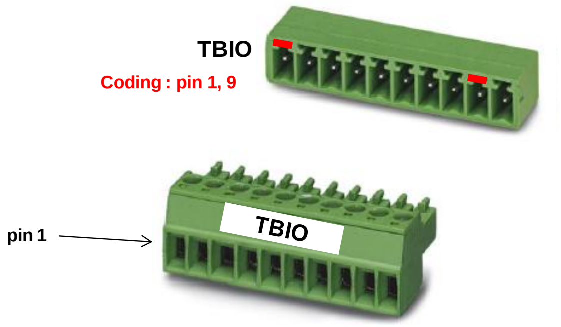


Figure 4.21 System board (BD530) terminal block TBIO

Table 4-13 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 (opened collector output)
3	DO2	Digital output signal 2for the system (opened collector output)
4	DO3	Digital output signal 3for the system (opened collector output)
5	DO4	Digital output signal 4for the system (opened collector output)
6	DI1	Digital input signal 1 for the system
7	DI2	Digital input signal 2for the system
8	DI3	Digital input signal 3for the system
9	DI4	Digital input signal 4for the system
10	M1	Digital input for the system (-) Common (DC24V GND)

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

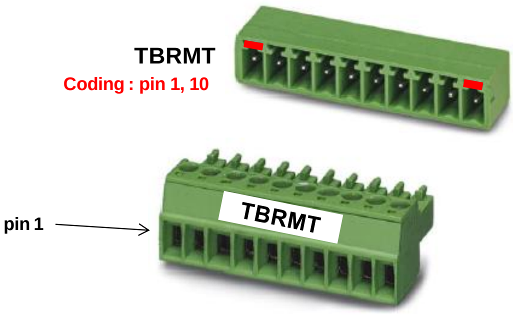


Figure 4.22 System board (BD530) terminal block TBRMT

Table 4-14 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>SWREMOTE1</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"><u>Providing shorting when general safety guard chain 1 is not used</u></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"><u>Providing shorting when general safety guard chain 2 is not used</u></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

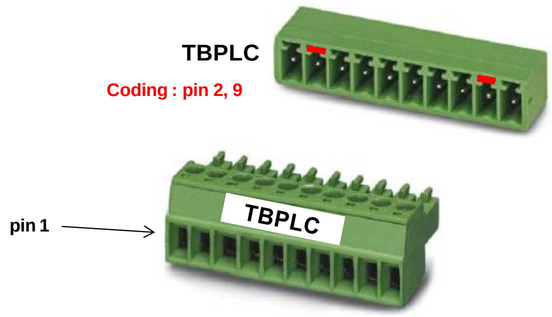


Figure 4.23 System board (BD530) terminal block TBPLC

Table 4-15 System board (BD530) terminal block TBPLC description

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

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

(5) Spare system CAN communication connector ; CANS2

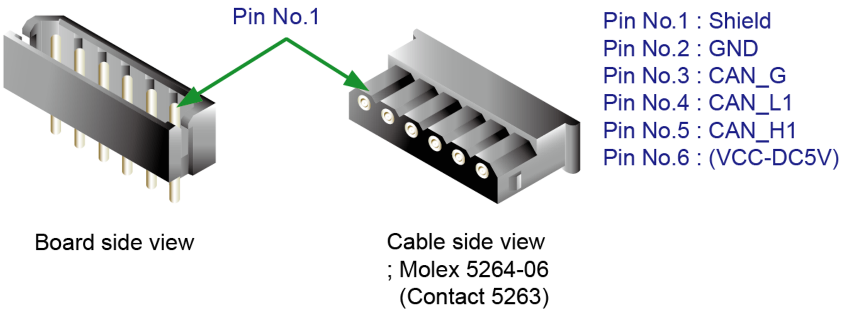


Figure 4.24 Pin arrangement in system CAN connector

4.3.3.3. Display Unit

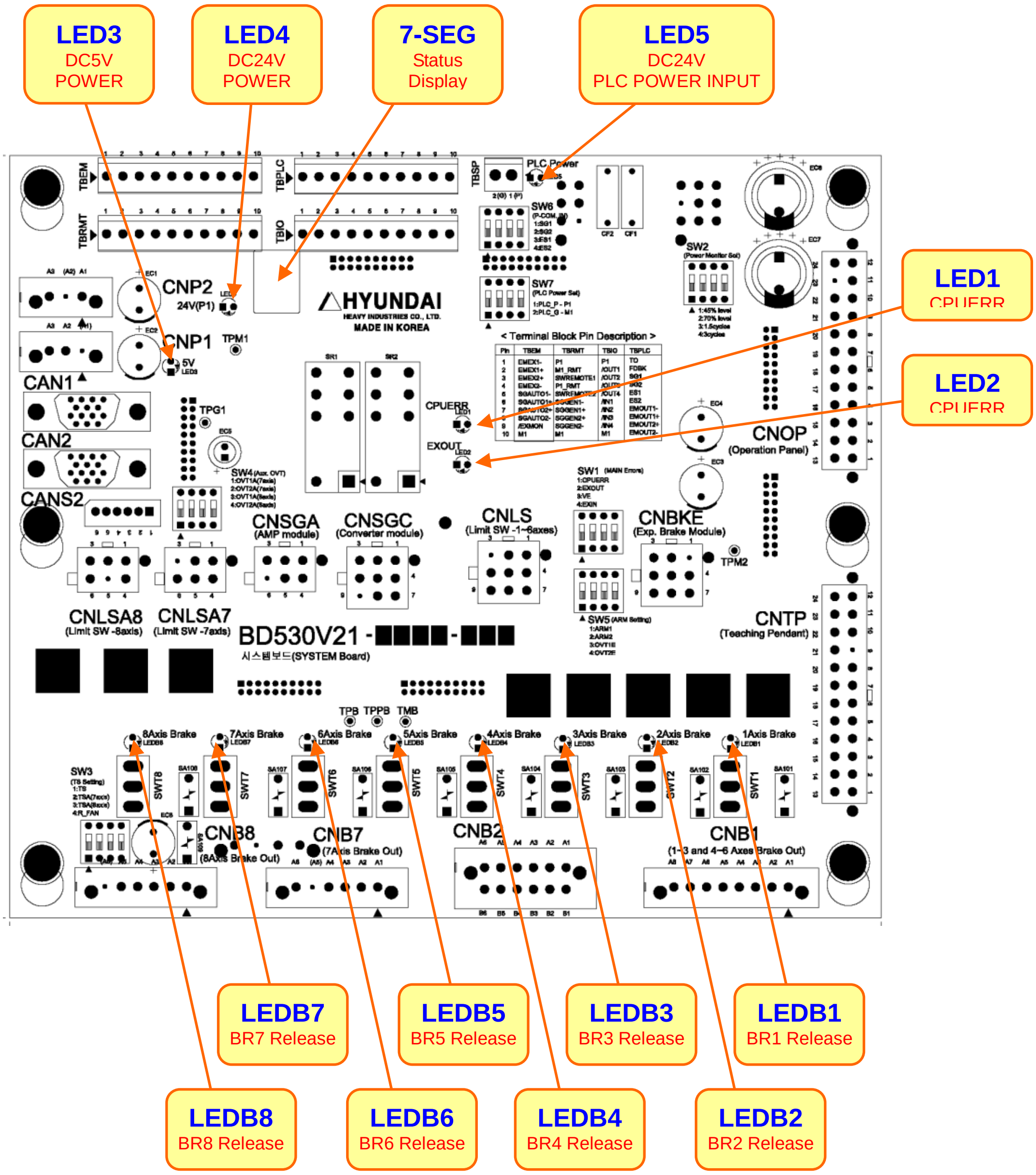


Figure 4.25 The Display Unit of the System Board (BD530)

Table 4-16 Description of the displaying device for the system board (BD530)

Name	Content	Color	In Normal Status	Solution
LED1	CPUERR	Green	On	1. Checking for errors in the MAIN board 2. Checking for the interruption of electric power 3. Checking the CNIO cable
LED2	EXOUT	Green	On	1. Checking for errors in the MAIN board 2. Checking the CNIO cable
LED3	5V POWER	Green	On	1. Checking 5V power within a board 2. Checking SMPS 5V power 3. Checking the power cable CNP1
LED4	24V POWER	Green	On	1. Checking 24V power within a board 2. Checking SMPS 24V power 3. Checking the power cable CNP2
LED5	PLC POWER (DC24V)	Green	On	1. Checking the input of PLC power 2.Checking SW7 when PLC power is not connected (internal power use setting)
LEDB1~8	1-8 Axes Brake Release	Green	Hold:OFF Release:ON	1. Checking “lowering brake voltage” monitoring (input signal for Teach pendant) 2. Checking the brake power (TPPB-TMB; 24V) 3. Checking the power in brake release
7-SEG	Status Information	Red Code	Display of status information	Repair work according to status information.

4.3.3.4. Setting and checking apparatus

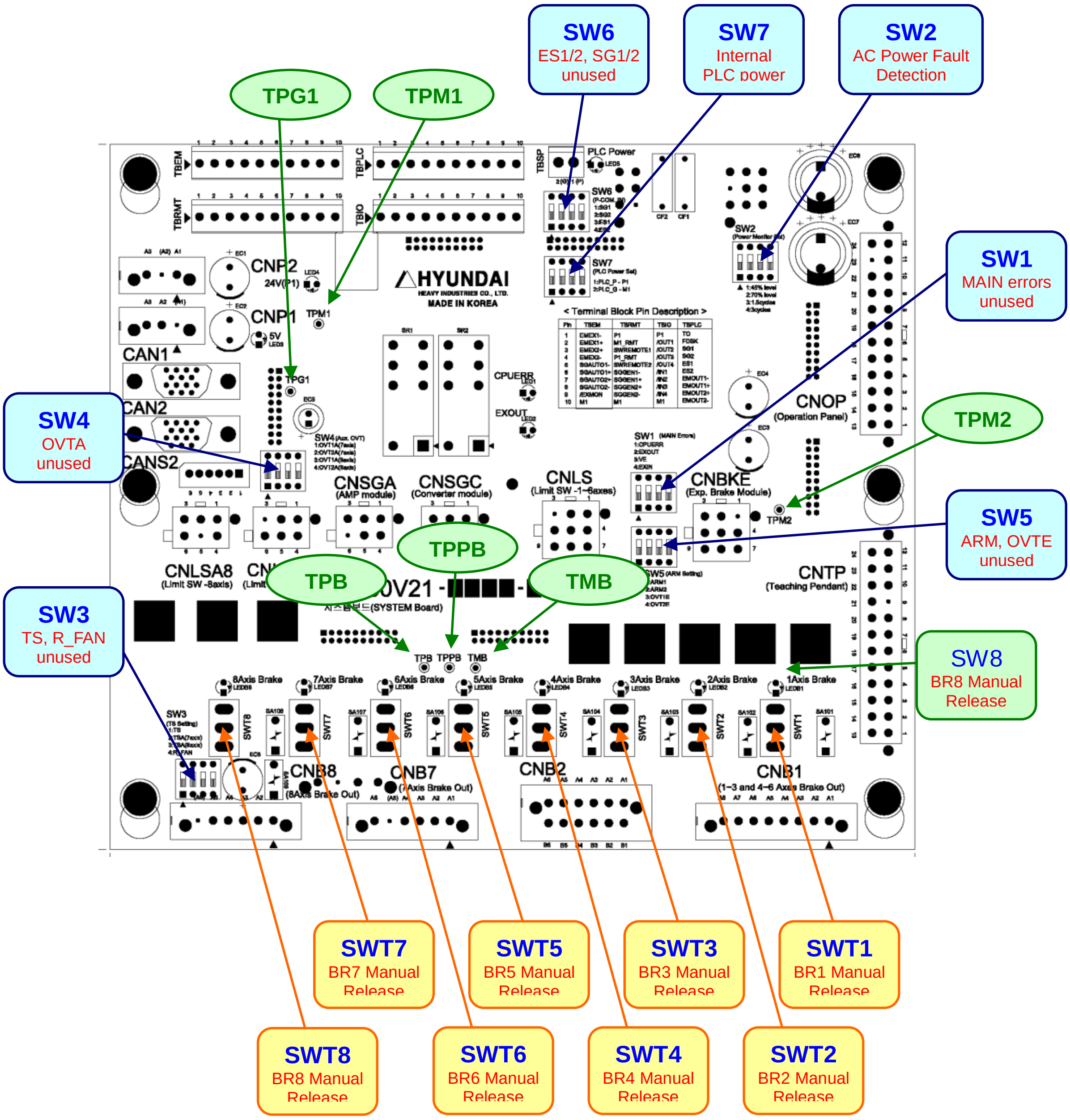


Figure 4.26 The Setting Unit of the System Board (BD530)

Table 4-17 System board (BD530) DIP switch SW1 (error monitoring) setting method

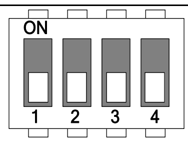
Switch No.		1	2	3	4
Use		CPUERR signal (MAIN → SYSTEM)	EXOUT signal (MAIN → SYSTEM)	Interruption detection (VE) (SYSTEM → MAIN)	EXIN signal (SYSTEM → MAIN)
Setting Content	OFF	Use	Use	Use	Use
	ON	Non-use	Non-use	Non-use	Non-use
Setting taking out time		OFF	OFF	OFF	OFF
Switch Appearance		 			

Table 4-18 System board (BD530) DIP switch SW2 (AC power monitoring) setting method

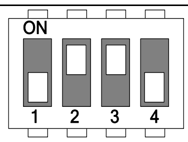
Switch No.		1	2	3	4
Use		AC power interruption detection level selection		AC power interruption detection cycle selection (based on 60Hz)	
Setting Content	OFF	-	-	-	-
	ON	Detection level: 70%	Detection level: 50%	1.5 cycles	3 cycles
Setting taking out time		OFF	ON	ON	OFF
Switch Appearance		 			

Table 4-19 System board (BD530) DIP switch SW3 (Motor temperature sensor monitoring) setting method

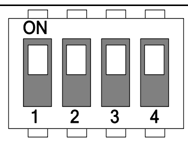
Switch No.		**1**	**2**	**3**	**4**
Use		TS detection (base axis)	TSA detection (7 axis)	TSA detection (8 axis)	R_FAN detection (FANs embedded in a robot)
Setting Content	**OFF**	Use	Use	Use	Use
	ON	Non-use	Non-use	Non-use	Non-use
Setting taking out time		ON	ON	ON	ON
Switch Appearance		 			

Table 4-20 System board (BD530) DIP switch SW4 (Added axis OVT limit switch) setting method

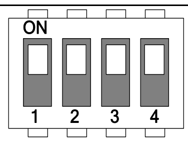
Switch No.		**1**	**2**	**3**	**4**
Use		Limit switch (chain 1) detection (7 axis)	Limit switch (chain 2) detection (7 axis)	Limit switch (chain 1) detection (8 axis)	Limit switch (chain 1) detection (8 axis)
Setting Content	**OFF**	Use	Use	Use	Use
	ON	Non-use	Non-use	Non-use	Non-use
Setting taking out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

Table 4-21 System board (BD530) DIP switch SW5 (Dark interference, extending axis limit switch) setting method

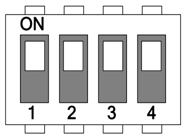
Switch No.		1	2	3	4
Use		Limit switch (chain 1) detection (dark interference)	Limit switch (chain 2) detection (dark interference)	Limit switch (chain 1) detection (Extending axis)	Limit switch (chain 1) detection (Extending axis)
Setting Content	OFF	Use	Use	Use	Use
	ON	Non-use	Non-use	Non-use	Non-use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

Table 4-22 System board (BD530) DIP switch SW6 (Safety IO safety signal monitoring) setting method

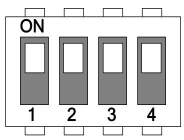
Switch No.		1	2	3	4
Use		Safety guard SG1 (chain 1) detection	Safety guard SG2 (chain 2) detection	Emergency stop ES1 (chain 1) detection	Emergency stop ES2 (chain 2) detection
Setting Content	OFF	Use	Use	Use	Use
	ON	Non-use	Non-use	Non-use	Non-use
Setting taking out time		ON	ON	ON	ON
Switch Appearance		 			

Table 4-23 System board (BD530) DIP switch SW7 (Power for Safety IO signal) setting method

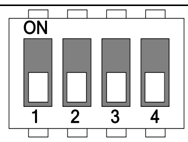
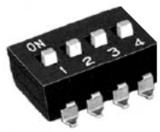
Switch No.		1	2	3	4
Use		Selecting power for Safety IO signal		-	-
Setting Content	OFF	Power of Safety IO (DC24V)	Power of Safety IO (DC24V GND)	-	-
	ON	Controller power (P1)	Controller power (M1)	-	-
Setting taking out time		OFF	OFF	OFF	OFF
Switch Appearance		 			

Table 4-24 Description of system board (BD530) toggle switch SWT1-8 operation

Switch NO.	Use
SWT1	Releasing robot basic axis 1 motor brake manually
SWT2	Releasing robot basic axis 2 motor brake manually
SWT3	Releasing robot basic axis 3 motor brake manually
SWT4	Releasing robot basic axis 4 motor brake manually
SWT5	Releasing robot basic axis 5 motor brake manually
SWT6	Releasing robot basic axis 6 motor brake manually
SWT7	Releasing added axis 7 motor brake manually
SWT8	Releasing added axis 8 motor brake manually

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, 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)

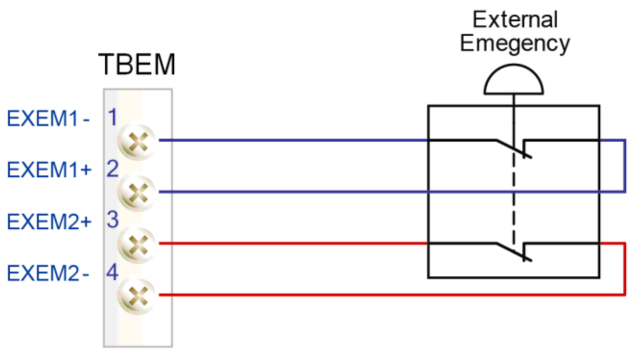


Figure 4.27 Method for connecting the external emergency stop switch to terminal block TBEM

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.

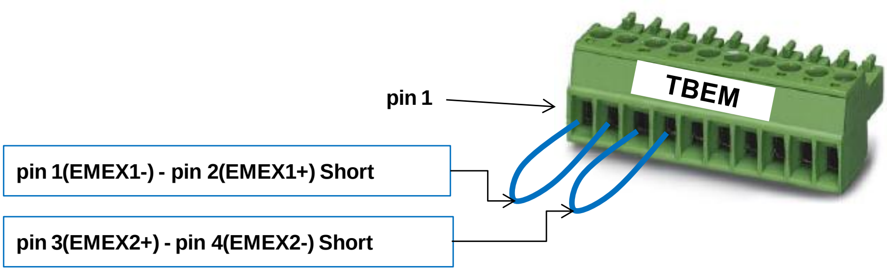


Figure 4.28 Management method when a contact point input type-external emergency stop is not used.

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 NPN output. The Figure below shows a connecting method through terminal block TBPLC in which the controller can receive NPN type output. (※ Reference: Description of the node of terminal block TBPLC)

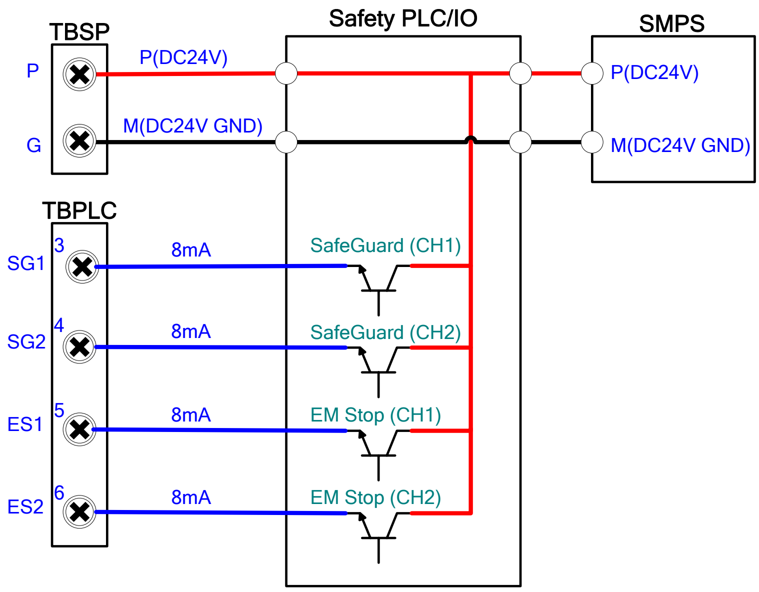


Figure 4.29 Method of connecting the automatic safety guard to an NPN output device

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)

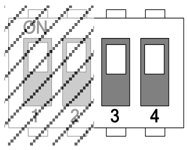


Figure 4.30 Management method in cases where the P-COM input external emergency stop is not used

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 TBEM.

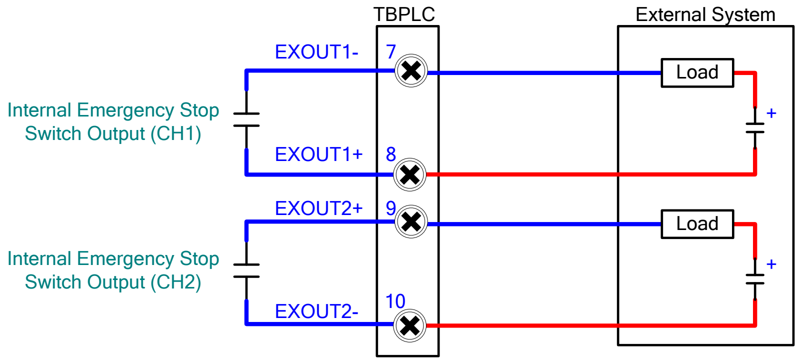


Figure 4.31 Output the internal emergency stop switch of terminal block TBPLC

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)

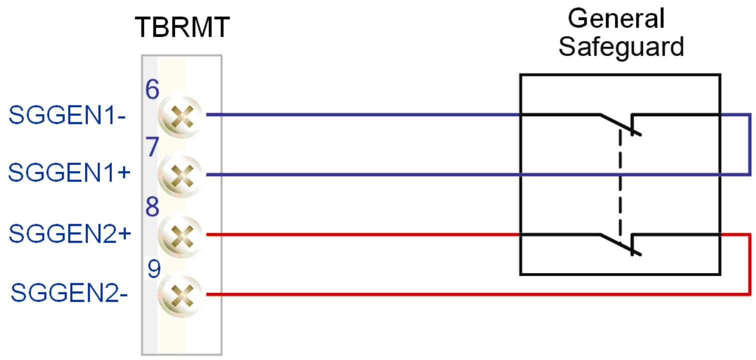


Figure 4.32 Method for connecting a typical safety guard to terminal block TBPLC

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.

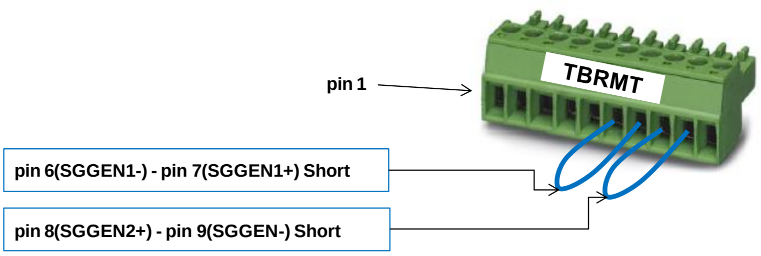


Figure 4.33 Management method in cases where a typical safety guard is not used

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)

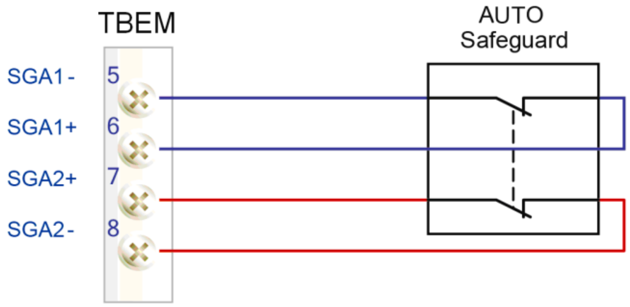


Figure 4.34 Method for connecting the contact point input automatic safety guard to terminal block TBEM

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.

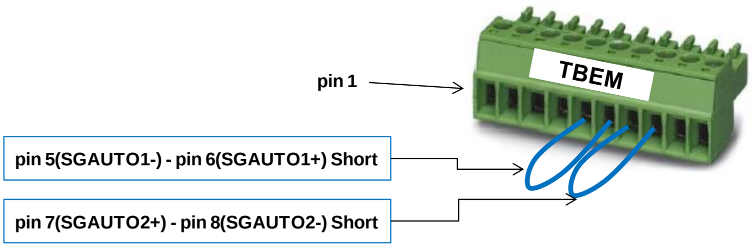


Figure 4.35 Management method in cases where a contact point input automatic safety guard is not used

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 NPN output. The Figure below shows a connecting method through terminal block TBPLC in which the controller can receive NPN type output. (※ Reference: Description of the node of terminal block TBPLC)

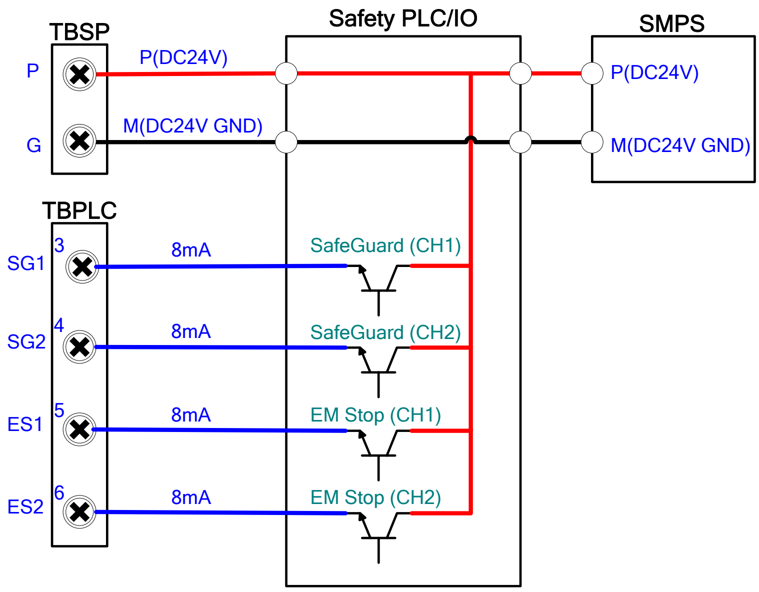


Figure 4.36 Connecting method of an automatic safety guard with respect to an NPN output device

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)

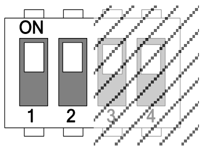


Figure 4.37 Management method in cases where P-COM input automatic safety guard is not used

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

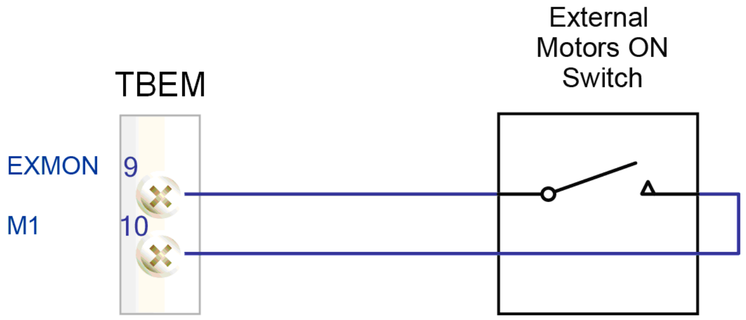


Figure 4.38 Method for inputting the external motor power ON signal into terminal block TBEM

(2) Remote switch input

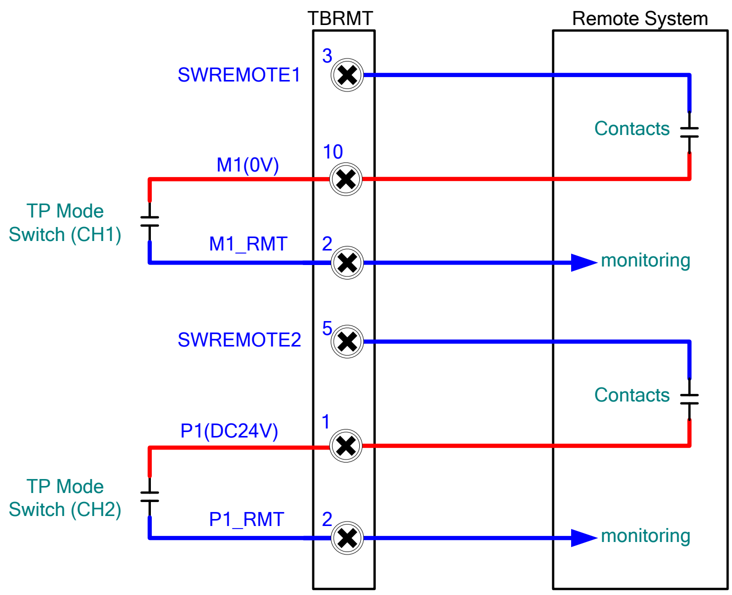


Figure 4.39 for inputting the remote switch signal into terminal block TBRMT

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

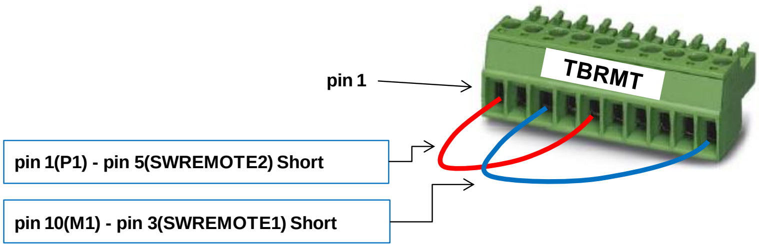


Figure 4.40 Management method in cases where remote switch input is not used

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.

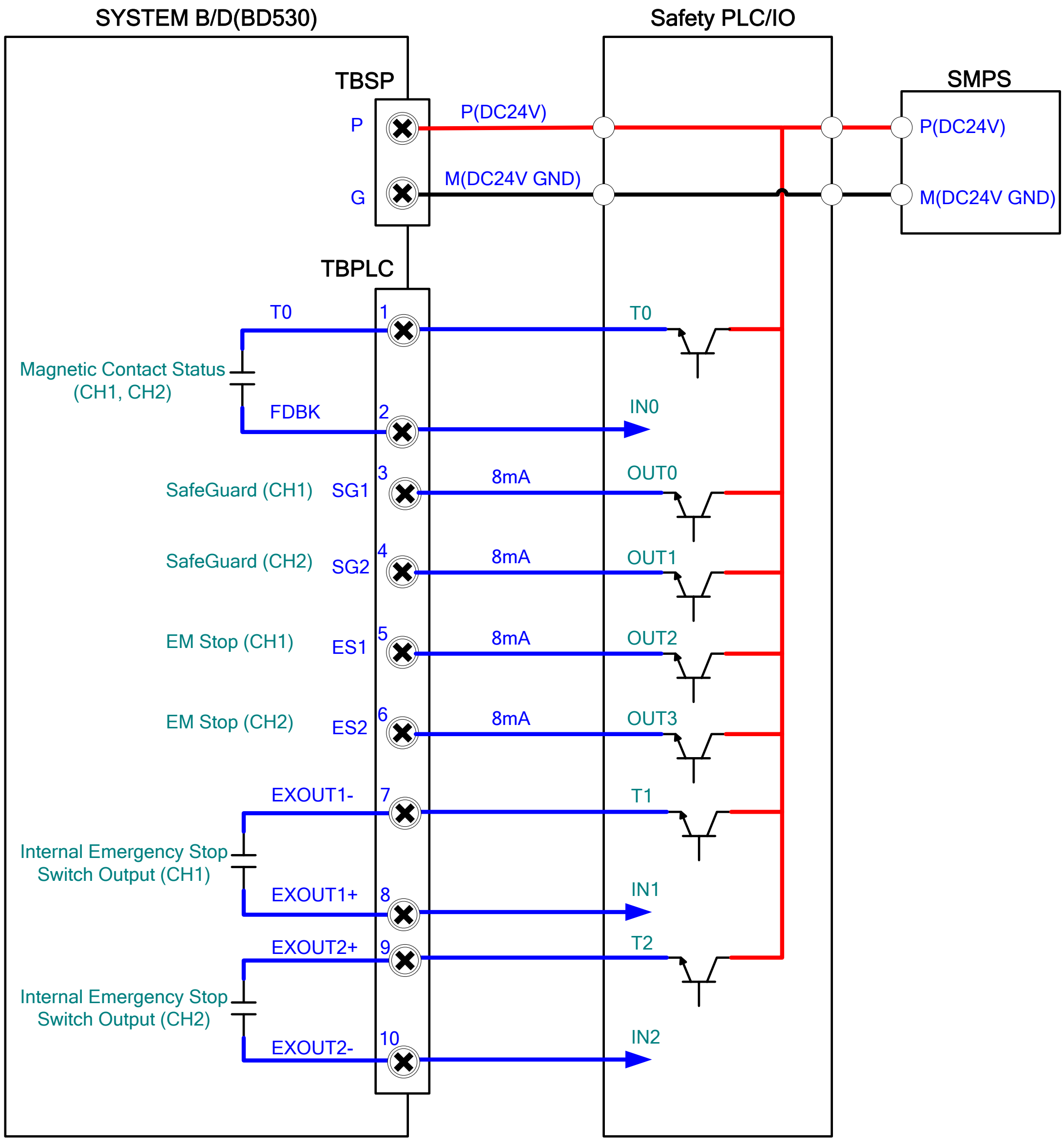


Figure 4.41 Connection method of Safety PLC/IO

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

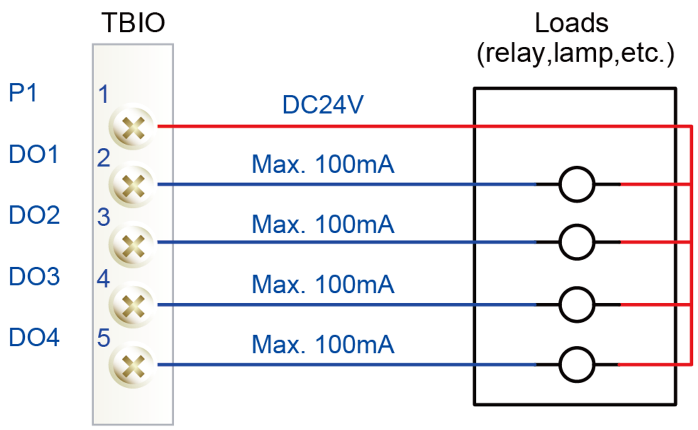


Figure 4.42 Method for connecting digital output for a system to terminal block TBIO

(2) Digital input

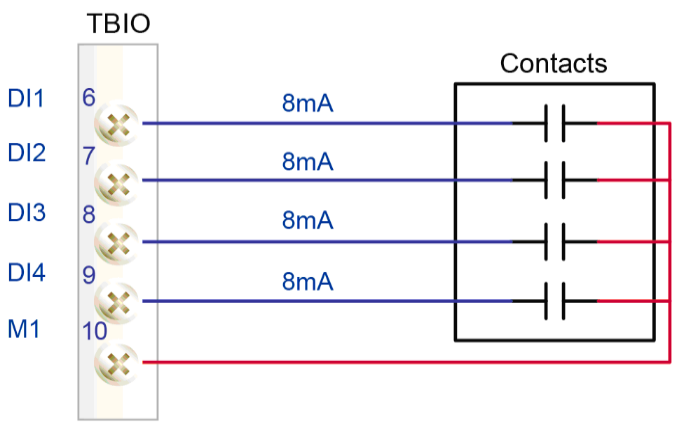


Figure 4.43 Method for connecting digital input for a system to terminal block

4.3.4. Servo Board (BD542)

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.

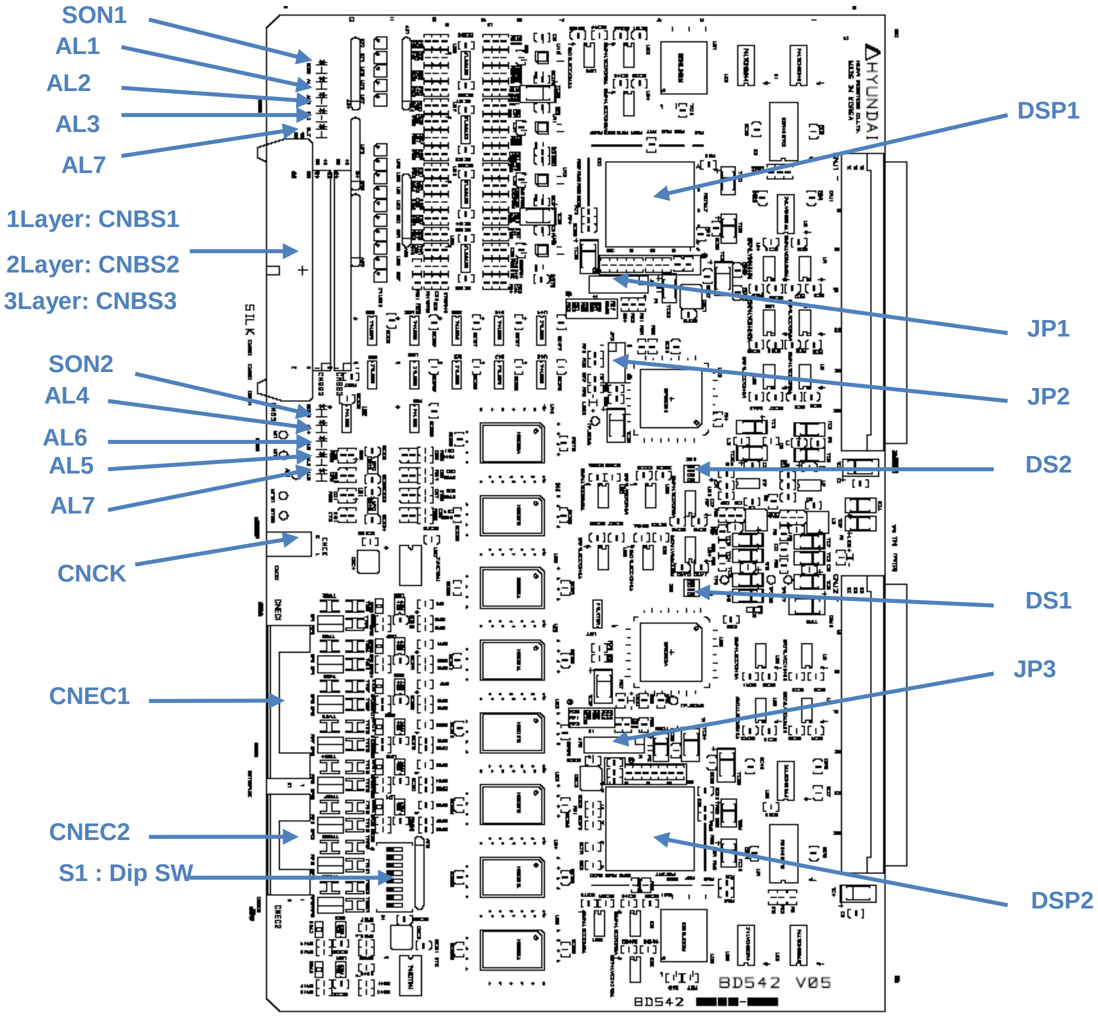


Figure 4.44 Servo Board (BD542)

4.3.4.2. Connector

Table 4-25 The Sorts and Uses of Servo Board (BD 542) 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
CNCK	PWM clock synchronization between servo boards in controlling over 9 axes	Additional Servo Board (BD542)CNCK
JP1,3	JTAG Emulator Port(DSP1, DSP2)	JTAG Emulator
JP2	EPLD program download port	EPLD Program Download Tool

4.3.4.3. Display Unit

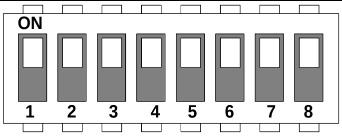
Table 4-26Servo Board (BD542) LED

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

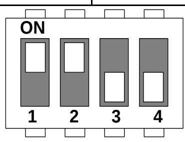
Caution: DIP switches are initially set as ON, and users may not change them.

Table 4-27 The Method for the Setting of DIP Switches (S1) of the Servo Board (BD542)

<table>
<tr><th>Switch No.</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th></tr>
<tr><td>Initial Setting</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td></tr>
<tr><td>External Form of Switch</td><td colspan="8"></td></tr>
</table>

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

Table 4-28 The Method for the Setting of DIP Switch (DS1) of the Servo Board (BD542)

<table>
<tr><th colspan="2">Switch No.</th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td rowspan="2">Content</td><td>OFF</td><td colspan="2" rowspan="2">Boot Mode Settings(Pin 1, 2)
ON, ON : HPI/EMU Boot
OFF, ON : 8Bit Flash Boot
ON, OFF : 16bit Flash Boot
OFF, OFF : 32Bit Flash Boot</td><td>Big Endian Mode</td><td>HPI Pin Enable
(Pin Functions Setting)</td></tr>
<tr><td>ON</td><td>Little Endian Mode</td><td>HPI Pin disable</td></tr>
<tr><td colspan="2">Initial Setting</td><td>ON</td><td>ON</td><td>OFF</td><td>OFF</td></tr>
<tr><td colspan="2">Exterior Form of Switch</td><td colspan="4"></td></tr>
</table>

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

Table 4-29 The DIP Switch (DS2: Pin 1 and 2)of the Servo Board (BD542)

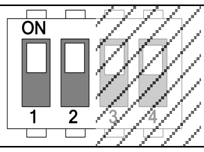
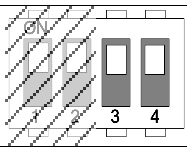
Content	Name	DS2	
		1	2
DSP1(U27), DSP2(U30) Setting	Designate 1DSP(U27) and 2DSP(U30)	ON	ON
	Designate 3DSP(U27) and 4DSP(U30)	OFF	ON
	Designate 5DSP(U27) and 6DSP(U30)	ON	OFF
	Designate 7DSP(U27) and 8DSP(U30)	OFF	OFF
Initial Settings		ON	ON

Table 4-30 The DIP Switch (DS2: Pin 3 and 4)of the Servo Board (BD542)

Contents	Name	DS2	
		3	4
Prohibition of Flash Write Function	Flash Write Prohibition	ON	X
	Flash Write Admission	OFF	X
DSP Reset	DSP's Own RESET + Admission of Main Reset Command	X	ON
	Use of DSP's Own Reset Only	X	OFF
Initial Setting		ON	ON

4.3.5. Drive Unit

4.3.5.1. SA3X3Y (Medium-Scale 6-Axis All-In-One 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.

Table 4-31 The Components of SA3X3Y(Medium-Scale 6-Axis All-In-One 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 (Strong Electric 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
	DB Control	Control of dynamic brake according to the signals from the servo board
Other Parts	**Heat Sink**	Emission of heat generated from IPM
	IPM	Switching Device

- The Reference Number of Servo Drive Unit

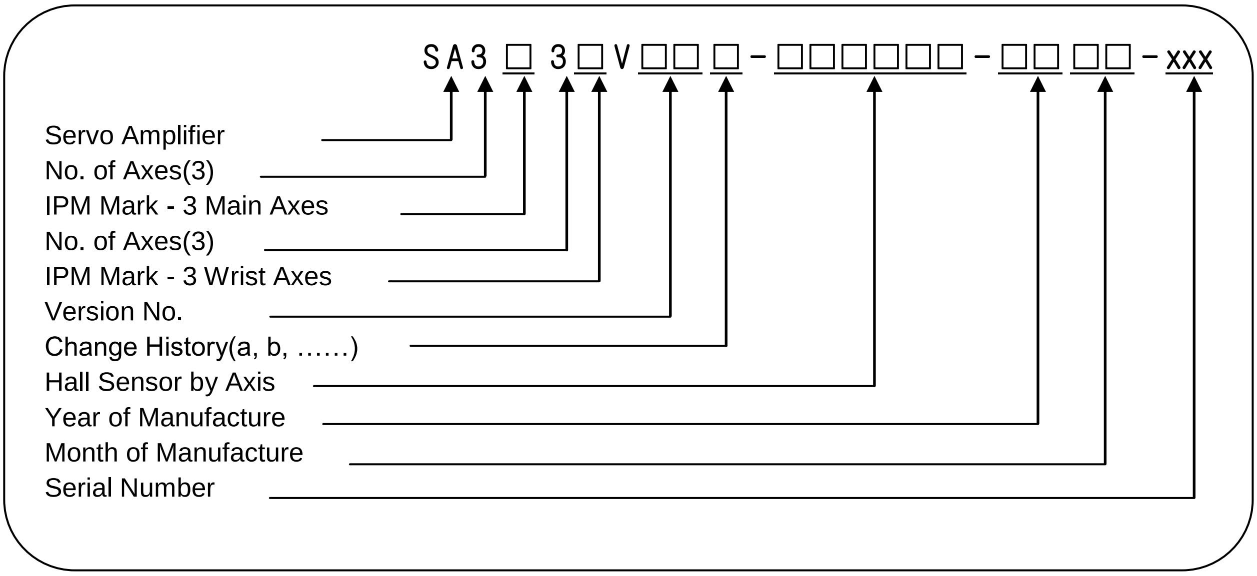


Table 4-32 The Mark of Type of Servo Driver Series

Classification	Mark of Type
Servo Amp	SA

Table 4-33 The Specifications of Drive Unit

Item	Classification		Application	
IPM Capa.	1L	4X	HC2500BD-10	6 Axis All-In-One Type
	3X	3Y	HS165 applied	
	3X	3Z	HC2500BD-00, HC2500IK	
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 4-34 IPM Capacity

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 4-35 Hall Sensor Marks

AMP Model	Hall Sensor Mark(Spec.)	Full-Scale Current(Im)	AMP Feedback Constant(Iv)
Large/Medium –Scale(6 Axis) Amp	0 (4V/75A)	140.62Apeak	**PM150CSD060(150A)**
	1 (4V/50A)	93.75Apeak	**PM150CSD060(150A) PM100CSD060(100A) PM75CSD060(75A) PM50CSD060(50A)**
	2 (4V/25A)	46.87Apeak	
	3 (4V/15A)	28.12Apeak	
	4 (4V/10A)	18.75Apeak	
	5 (4V/ 5A)	9.37Apeak	

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

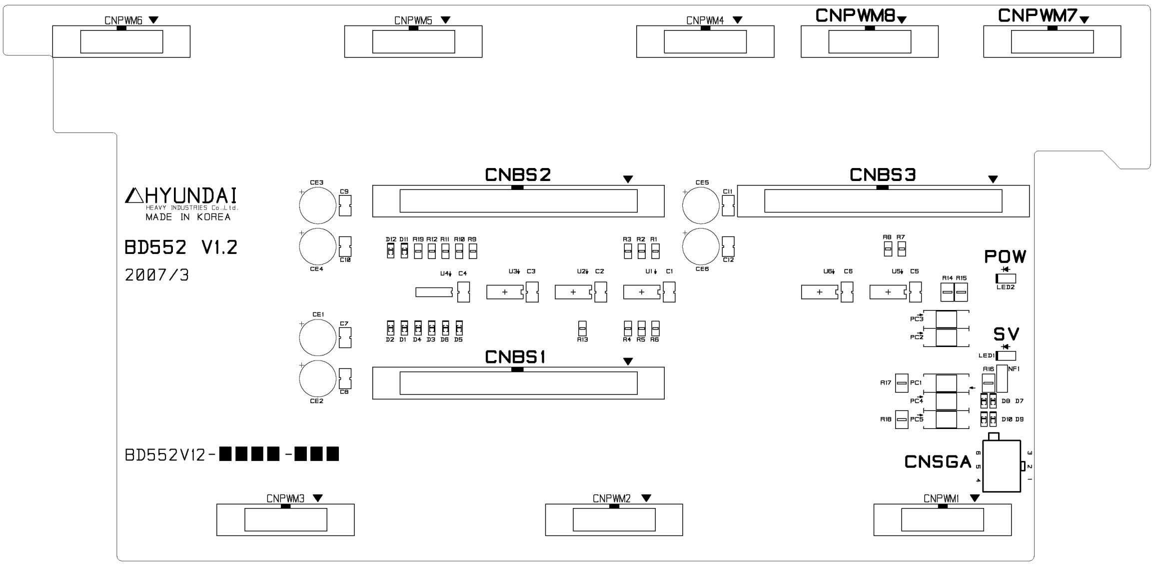


Figure 4.45 BD552 Component Layout

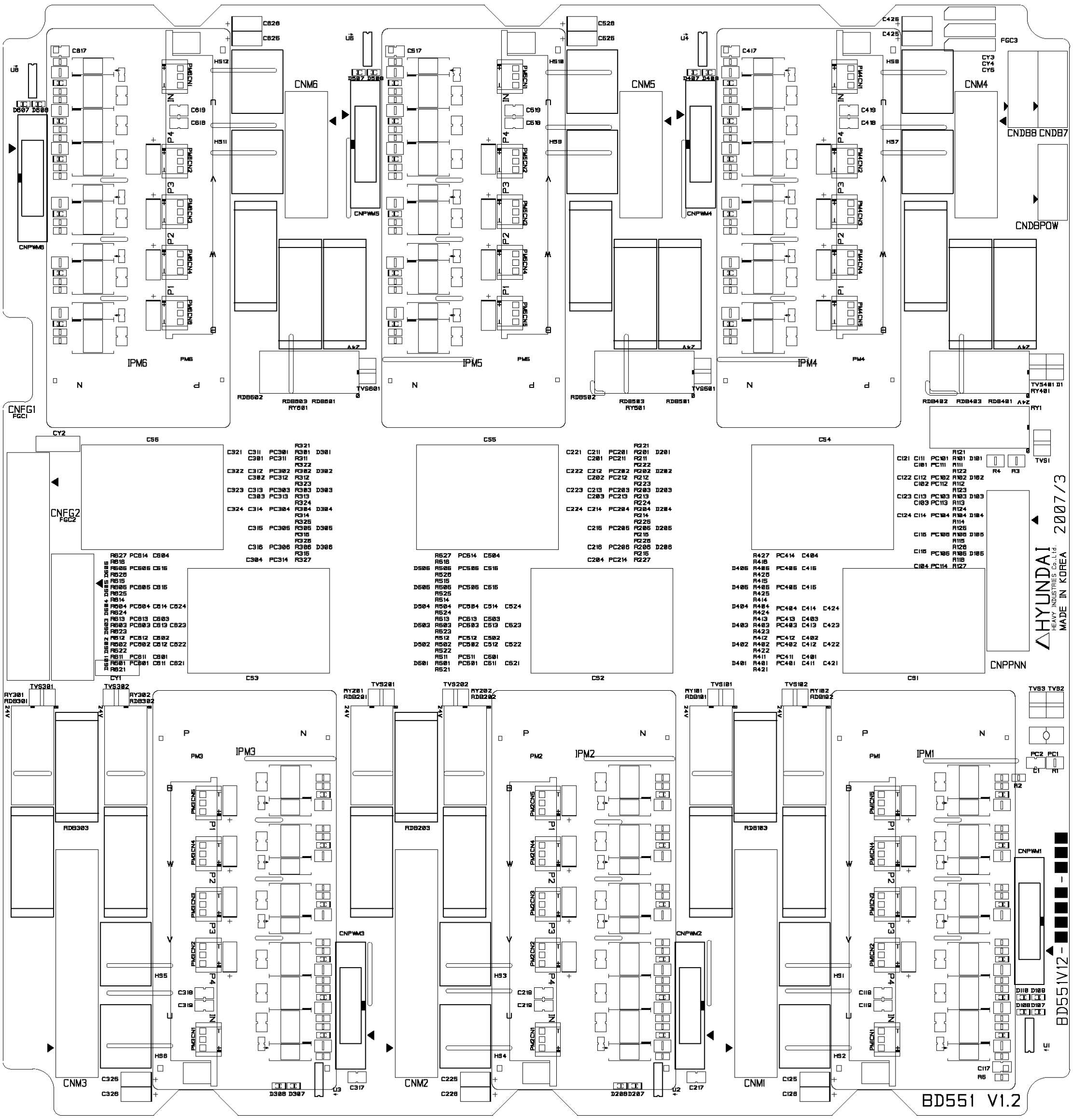


Figure 4.46 BD551 Component Layout

Table 4-36 BD552 Connector

Name	Use	External Device Connection
CNBS1, 2,3	PWM Signal and Error Signal	Servo Board(BD542) CNBS1,2,3
CNSGA	/PWMON, SVERR, BRAKE	Sequence Board (BD530) CNSGA
CNPWM1~6	PWM Signal and Error Signal	Servo Amp BD551 CNPWM1~6
CNPWM7~8	Additional Axis PWM Signal and Error Signal	Option Board(BD554, BD556) CNPWM

Table 4-37 BD551 Connector

Name	Use	External Device Connection
CNDBPOW	Power for DB control	CNPB of BD5C0
CNDB7,8	Additional Axis DB drive signal	Option board (BD554, BD555) CNDB
CNM1~6	Motor Connection	CMC1, CMC2
CNPWM1~6	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 4-38 BD552 LEDs

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

4.3.5.2. SD1L2C (Medium-Scale Diode Module Converter)

The medium-scale diode module converter changes the 3-phase current supplied from the electrical module into direct current by rectifying it through the diode module, and then store it in the electrolytic capacitor. The power generated from the motor in the robot slowing down is consumed through the transistor and resistance, and the following shows its components.

- The Specifications for Drive Power Unit

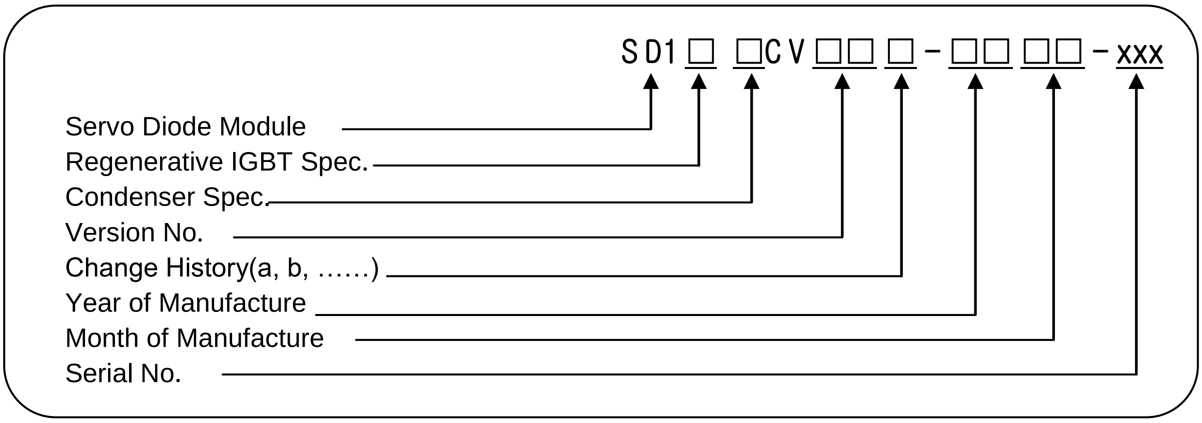


Table 4-39 The Mark of Type of Driver Series

Classification	Mark of Type
Servo Diode Module	SD

Table 4-40 The Specifications of Drive Power Unit

Item	Classification	Application
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 4-41 The Specifications of Regenerative IGBT

Regenerative IGBT	**L**	150A, Regenerative Resistance: 2Ω 800W 2EA Applicable

Table 4-42 Chemical Condenser Capacity

Chemical Condenser	**2C**	3300uF 2EA (HA165, HA020 + Carriage)

Table 4-43 SD1L2C (Medium-Scale Diode Module Converter)

Components		Function
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**	Emission of heat generated from the power device
	Capacitor	DC power smoothing
	Regenerative IGBT	Execution of regenerative control

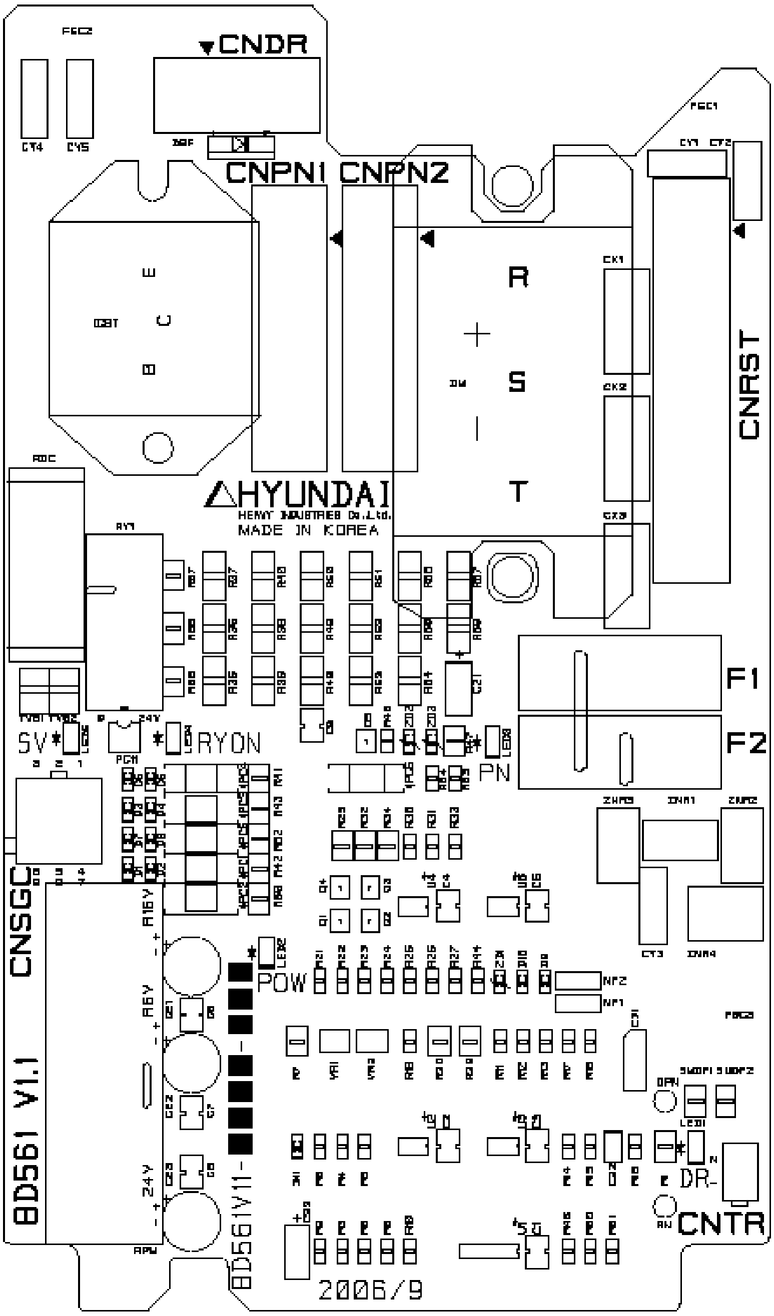


Figure 4.47BD561 Component Layout

Table 4-44 Medium-Scale Drive Power Unit (SD1L2C) 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
CNPN1,2	For Supply of PN Power	6-Axis Servo Amp CNPPNN, Additional Axis CNPN

Table 4-45 Medium-scale Drive Power Unit (SD1L2C) 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. SA3A3D (Small sized-6 axes integral type-driving apparatus)

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.

A small sized-diode module converter is formed integrally with a small-sized servoamplifier, and converts three-phase current provided from an electronic field module to direct current through the rectification of a diode module so as to store it in a 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 4-46 Construction of SA3A3D (Small sized-6 axes integral type-driving apparatus)

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**	Emission of heat generated from IPM
	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.

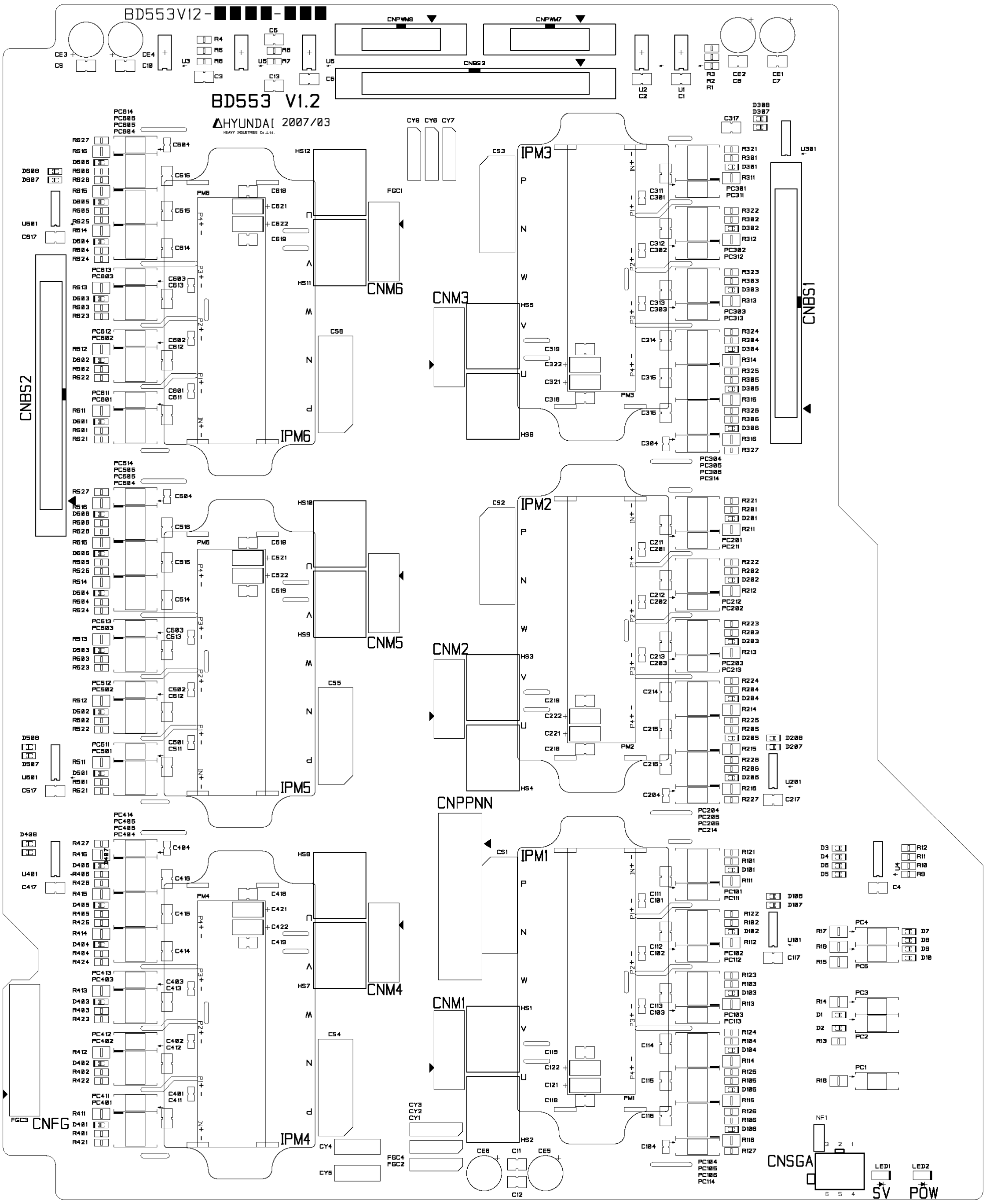


Figure 4.48 BD553 Component Layout

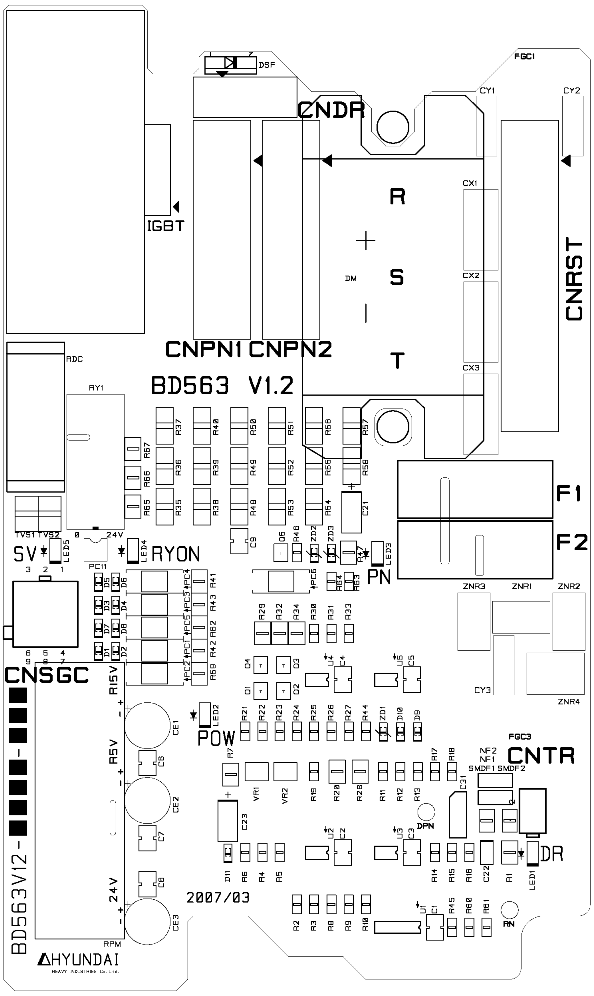


Figure 4.49 BD563 Component Layout

Table 4-47 Description of connector BD553

Name	Use	External Device Connection
CNBS1,2,3	PWM Signal and Error Signal	Servo Board(BD542) CNBS1,2,3
CNSGA	/PWMON, SVERR, BRAKE	Sequence Board (BD530) CNSGA
CNPWM7~8	Additional Axis PWM Signal and Error Signal	Option Board (BD554, BD556) CNPWM
CNM1~6	Motor Connection	CMC1
CNPPNN	Power for motor drive	Drive Power Unit (BD561) CNPN1
CNFG	The frame ground of the Main Axis motor	CMC1

Table 4-48 Description of BD553 LED

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

Table 4-49 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
CNPN1,2	For Supply of PN Power	6-Axis Servo Amp CNPPNN, Additional Axis CNPN

Table 4-50 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

4.3.5.4. The Specifications of Option Drive Unit

- AMP(DRIVER UNIT) type construction: When 2 axes are configured

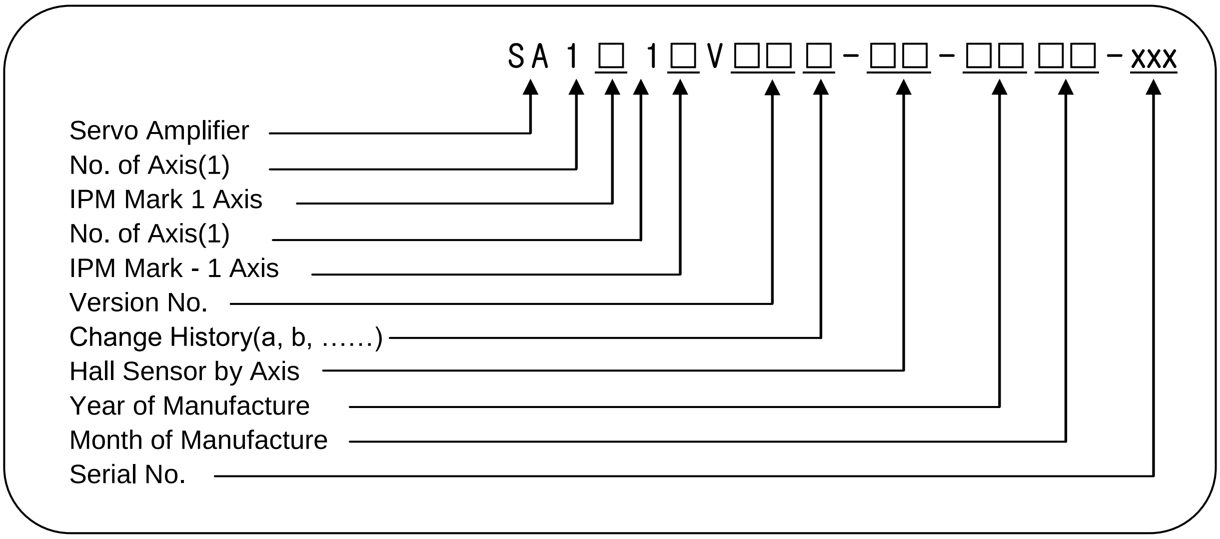


Table 4-51 The Mark of Type of Driver Series

Classification	Mark of Type
Servo AMP	SA

Table 4-52 IPM Capacity

<table>
<tr><td rowspan="2">Small Size</td><td>A</td><td>(IPM Rated Current) 30A, (Hall Sensor Rated Current) 4V/15A</td></tr>
<tr><td>D</td><td>(IPM Rated Current) 10A, (Hall Sensor Rated Current) 4V/5A</td></tr>
<tr><td rowspan="4">Large/Medium Size</td><td>L</td><td>(IPM Rated Current) 150A, (Hall Sensor Rated Current) 4V/75A</td></tr>
<tr><td>X</td><td>(IPM Rated Current) 100A, (Hall Sensor Rated Current) 4V/50A</td></tr>
<tr><td>Y</td><td>(IPM Rated Current) 75A, (Hall Sensor Rated Current) 4V/50A</td></tr>
<tr><td>Z</td><td>(IPM Rated Current) 50A, (Hall Sensor Rated Current) 4V/25A</td></tr>
</table>

Table 4-53 Hall Sensor Marks

<table>
<tr><th>AMP Model</th><th>Hall Sensor Mark (Spec.)</th><th>Full-Scale Current(Im)</th><th>AMP Feedback Constant(Iv)</th></tr>
<tr><td rowspan="6">Large/Medium –Scale(6 Axis) Additional axis Amp</td><td>0 (4V/75A)</td><td>140.62Apeak</td><td>PM150CLB060(150A)</td></tr>
<tr><td>1 (4V/50A)</td><td>93.75Apeak</td><td rowspan="5">PM150CLB060(150A)
PM100CLB060(100A)
PM75CLB060(75A)
PM50CLB060(50A)</td></tr>
<tr><td>2 (4V/25A)</td><td>46.87Apeak</td></tr>
<tr><td>3 (4V/15A)</td><td>28.12Apeak</td></tr>
<tr><td>4 (4V/10A)</td><td>18.75Apeak</td></tr>
<tr><td>5 (4V/5A)</td><td>9.37Apeak</td></tr>
<tr><td rowspan="3">Small –Scale (6 Axis) Additional axis Amp</td><td>3 (4V/15A)</td><td>28.12Apeak</td><td>PM30CSJ060(30A)</td></tr>
<tr><td>4 (4V/10A)</td><td>18.75Apeak</td><td>PM30CSJ060(30A)</td></tr>
<tr><td>5 (4V/5A)</td><td>9.37Apeak</td><td>PM30CSJ060(30A)
PM10CSJ060(10A)</td></tr>
</table>

4.3.5.5. SA1X (Medium-Scale 1 Axis 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. The medium-scale additional axis drive unit can drive one motor, and the following figure shows is components.

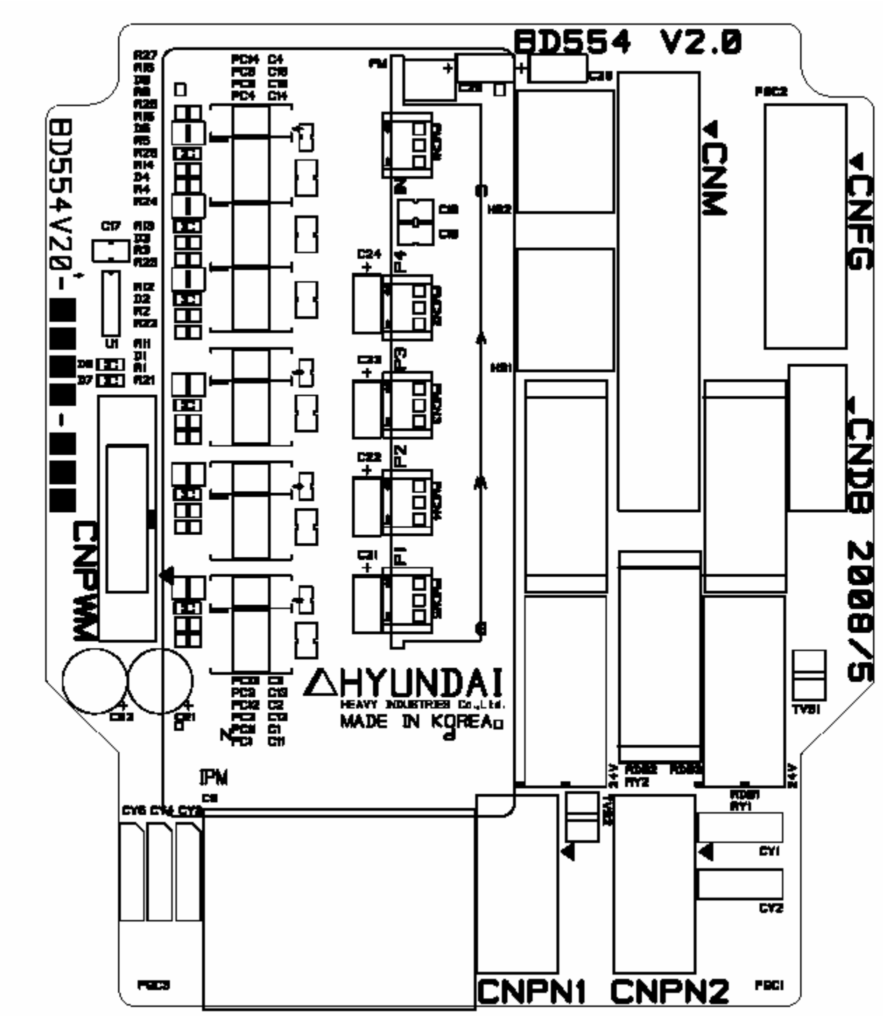


Figure 4.50 BD554 Component Layout

Table 4-54 The Components of SA1X(Medium-Scale 1 Axis Drive Unit ; Option)

Components		Function
BD554 (Amp Board)	**Logic Part**	Conversion of PWM signal from the 6 axis servo amp into upper and lower drive signals of IPM and execution of error processing and regenerative control
	Gate Power Module	Generation of gate power
	Current Detection Unit	Detection of the current flowing into the motor
	DB Control	Control of dynamic brake according to the signals from the 6 axis servo amp
Other Components	**Heat Sink**	Emission of heat generated from IPM
	IPM	Switching Device

Table 4-55 SA1X (Medium-Scale 1 Axis Drive Unit ; Option) Connector

Name	Use	External Device Connection
CNPWM	PWM signal and error signal	CNPWM7 or CNPWM8 of the 6-Axis Servo Amp (BD552 or BD553)
CNM	Power for motor drive	AMC1 or AMC2
CNFG	Motor frame ground	AMC1 or AMC2
CNPN1,2	PN voltage is inputted from the diode module	CNPN2 of the 6-Axis Servo Amp(BD561 or BD563)s
CNDB	DB drive of Additional Axis	6-Axis Servo Amp CNDB7, CNDB8

4.3.5.6. SA1A (Small-Scale 1 Axis 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. The small-scale additional axis drive unit can drive one motor, and the following figure shows is components.

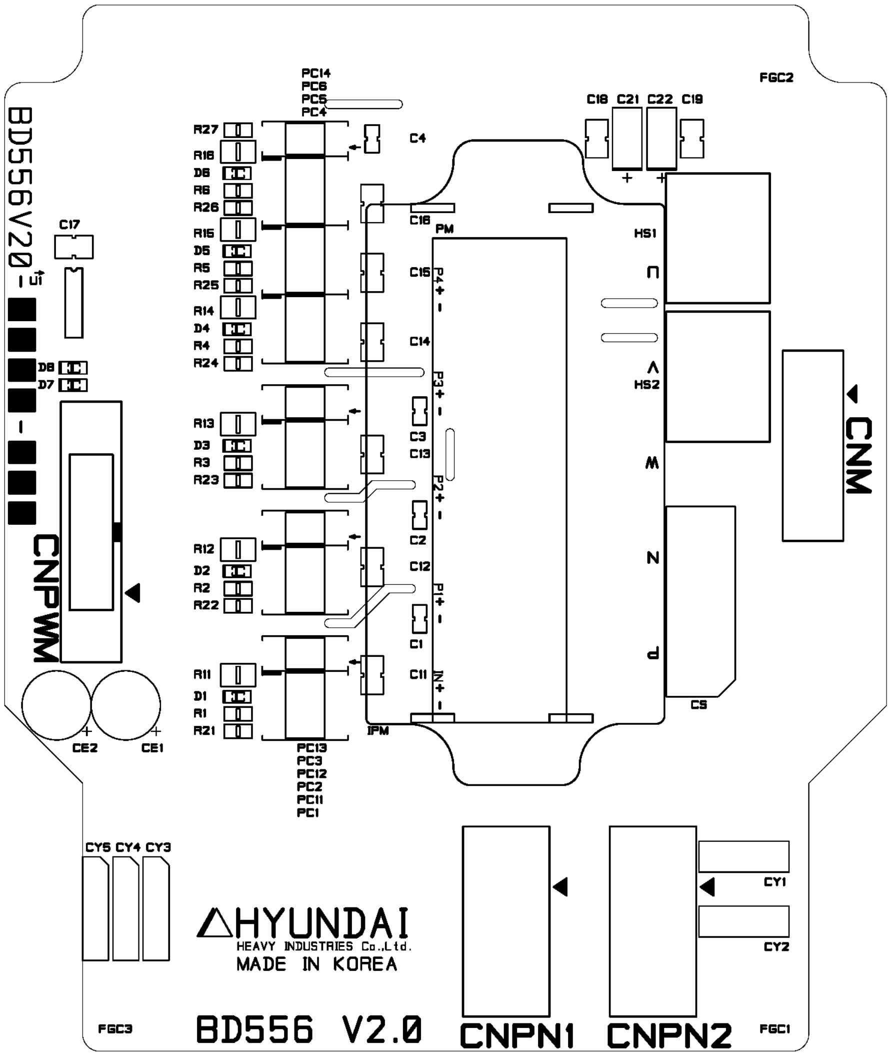


Figure 4.51 BD556 Component Layout

Table 4-56 The Composition of SA1A (Small-scale 1 Axis Drive Unit; Option)

Components		Function
BD556 (Amp Board)	**Logic Section**	Conversion of PWM signal from the 6 axis servo amp into upper and lower drive signals of IPM and execution of error processing and regenerative control
	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	Switching Device

Table 4-57 SA1A(Small-Scale 1 Axis Drive Unit ; Option) Connector

Name	Use	External Device Connection
CNPWM	PWM signal and error signal	CNPWM7 or CNPWM8 of the 6-Axis Servo Amp (BD552 or BD553)
CNM	Motor drive output, Frame Ground	AMC1 or AMC2
CNPN	For input of drive power	CNPN2 of the 6-Axis Servo Amp (BD561 or BD563)

4.3.6. DC Multi Power Unit (SMPS : HDI-200)

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 4.52 External appearance of SMPS SR1 and configuration mounted in Rack

Table 4-58 SMPS(SR1) Standards (Input Voltage ; AC 45V~50V, 50/60Hz)

Rated Output	Use	Connection
ENCODER(5V)	Motor Encoder Power: DC5V	W/H Connector(CNE1)
CONTROL(5V)	Board Power in Rack: DC5V	Backplane Board (BD501)
P1-M1	System I/O Power: DC24V	System board and other option boards
P2-M2	Teach pendant Power: DC24V	TP510 Connector (CNTP)
DC-15V	Drive Unit Control Power	Backplane Board (BD501)
DC+15V	The Control Power for Analog Section of the Servo Board	Backplane Board (BD501)

4.3.7. Electrical Module and Electrical Board(BD5C0)

4.3.7.1. Outline

The electrical module plays a role of opening/closing and distributing various electric powers supplied to the controller. The following picture shows the interior and exterior of the electrical module equipped with various connectors and fuses.

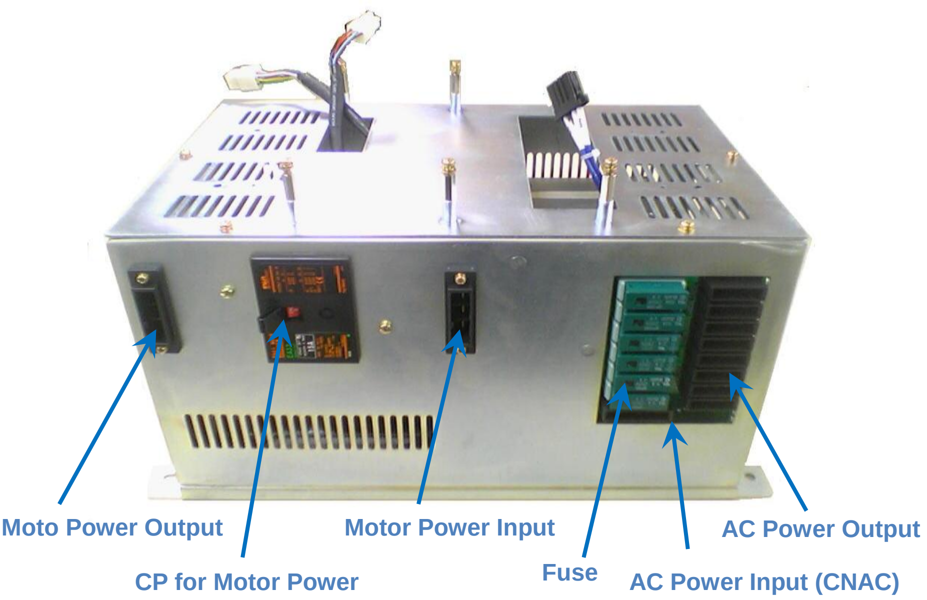


Figure 4.53 Electrical Module

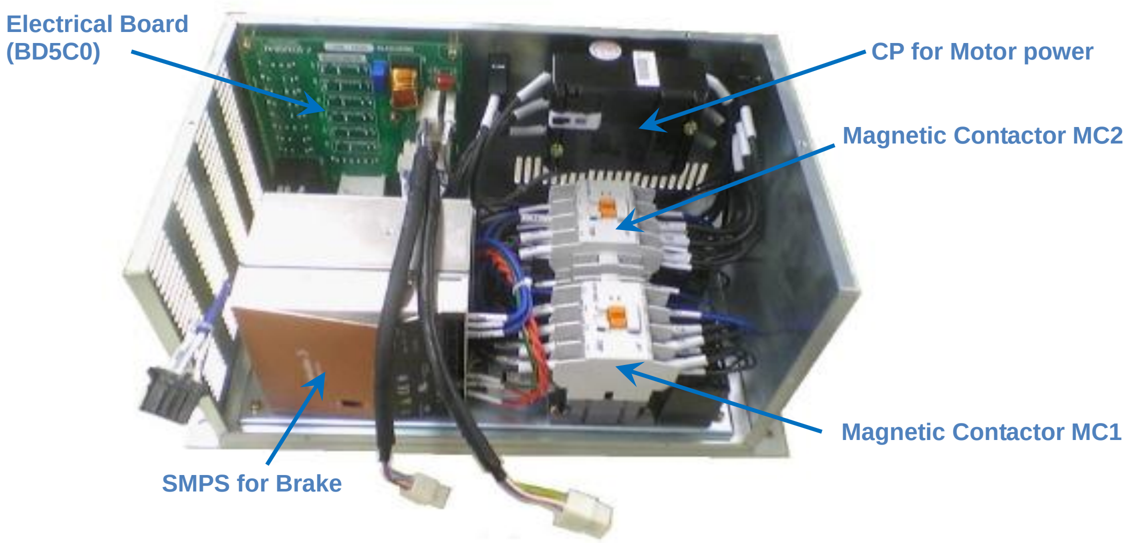


Figure 4.54 The Interior of Electrical Module

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 overcurrent. The electrical board (BD5C0) is used to minimize the use of the cables used for the distribution of power.

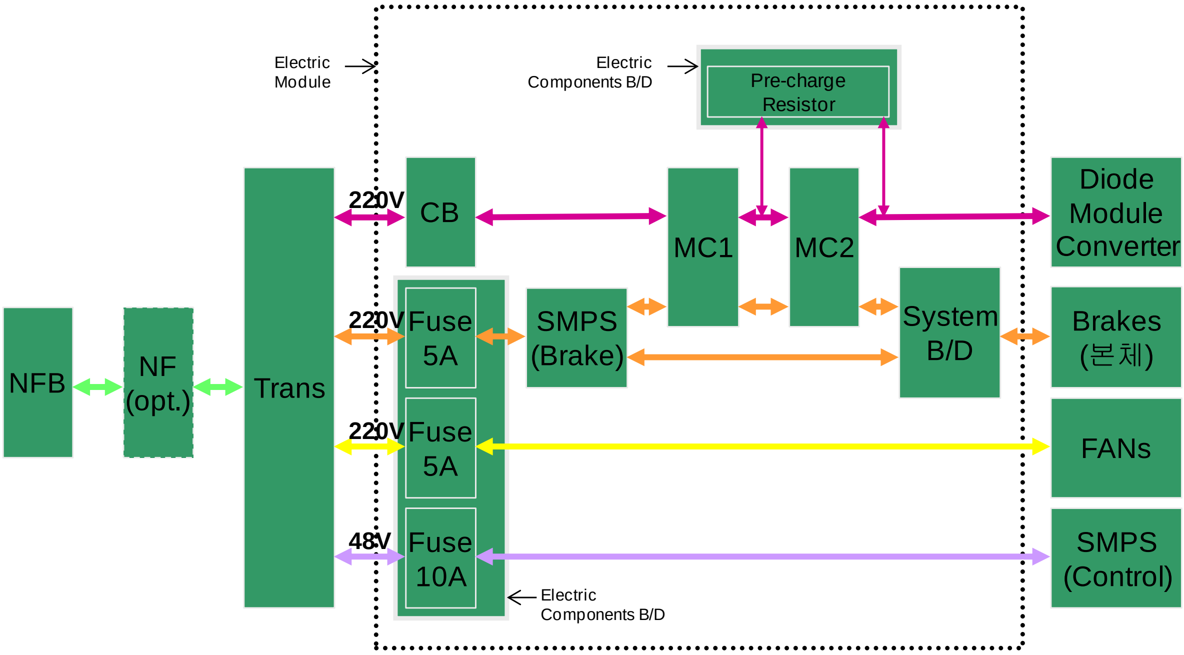


Figure 4.55 Power system of controller Hi5

Table 4-59 The Sorts and Uses of Fuses in the Electrical Module

Name	Use	Spec.
F1, F2	Overcurrent Protection Fuse of the Electrical Control Power(AC220)	AC220V 2A
F3, F4	Overcurrent Protection Fuse of the SMPS Power (AC48)	AC220V 10A
F5, F6	Overcurrent Protection Fuse of the Brake SMPS Power (AC220)	AC220V 5A

4.3.7.2. 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.

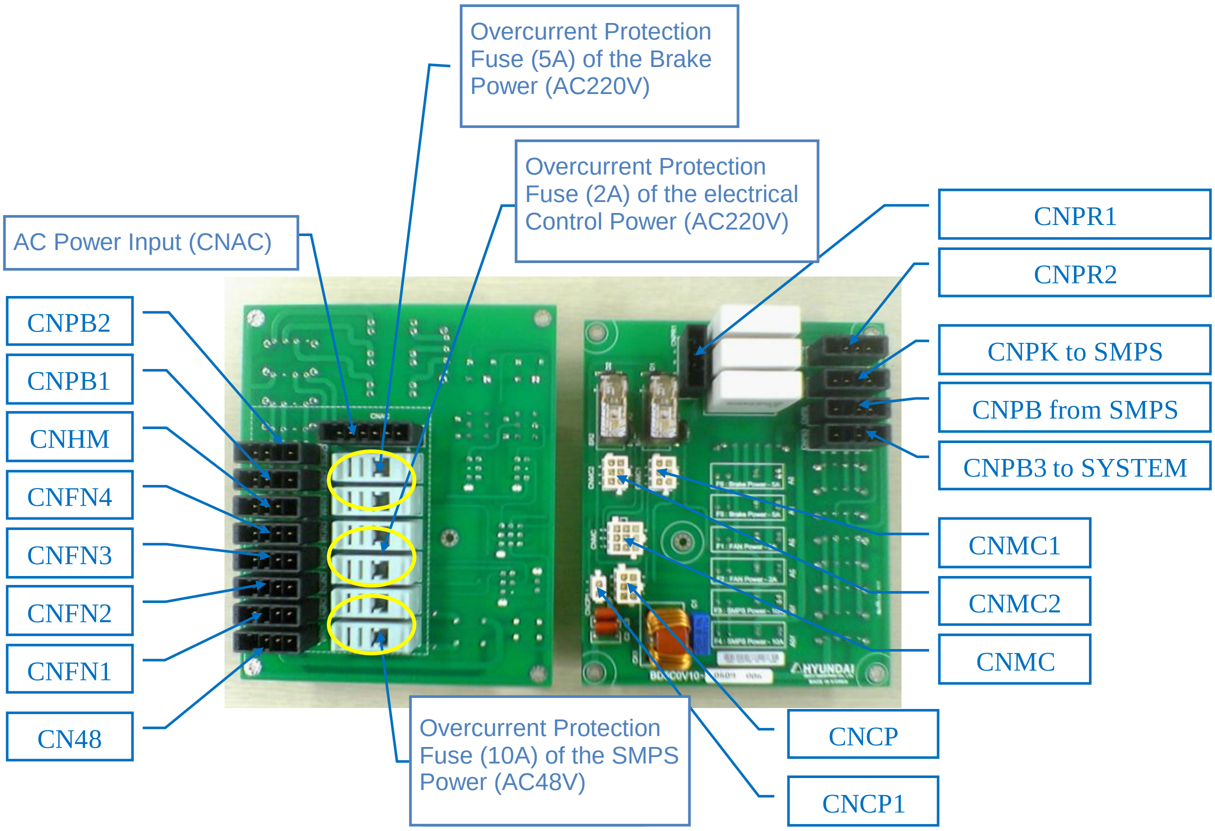


Figure 4.56 Connectors of the Electrical Board (BD5C0)

Table 4-60 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)	SMPS
CNFAN1~3	Power Output (AC220V) for Electrical Drive	FAN Module
CNHM	Power Output (AC220V) for Hour Meter	Hour Meter (Option)
CNPR1	Precharge Resistance Power Input	MC2 Input
CNPR2	Precharge Resistance Power Output	MC2 Output
CNPK	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 and Extended Brake Board
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

4.3.8. Small Door Board (BD5B1)

The small door board (BD5B1) is the board with various input/output connectors for users to connect the controller with various communication lines such as Ethernet, RS232, and CAN. It is located under the control panel in the front side of the controller. If you open the door, you can connect RS232 and Ethernet through their ports.

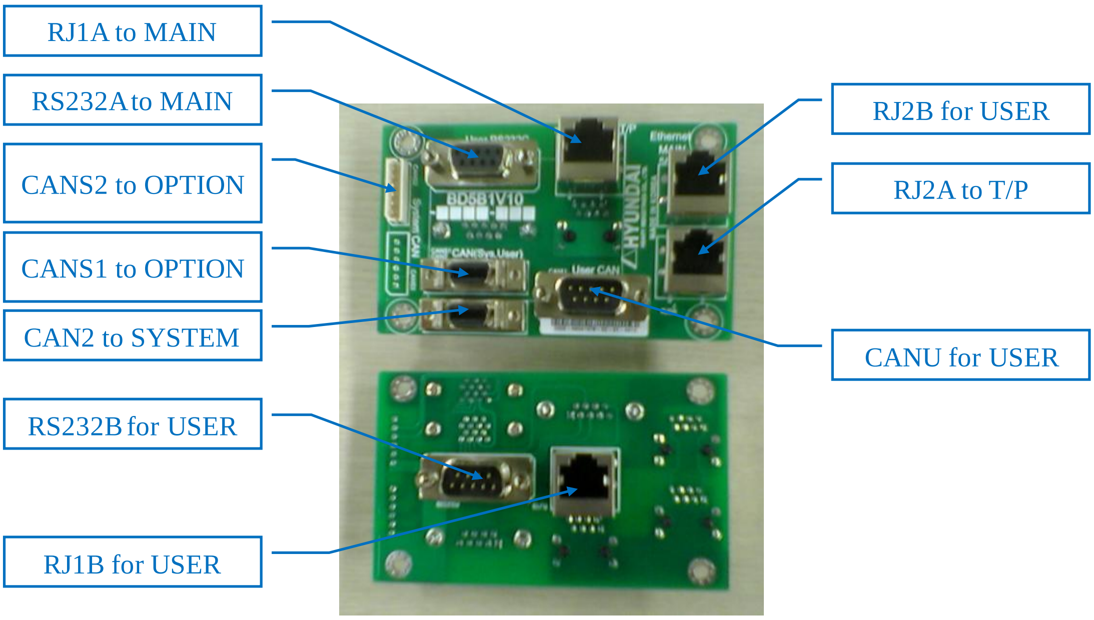


Figure 4.57 The Components of the Small Door Board (BD5B1)

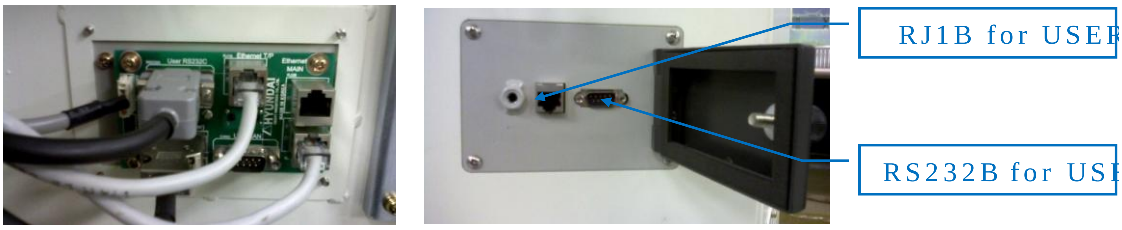


Figure 4.58 The Exterior and Interior of the Small Door Board (BD5B1)

4.3.9. Teach pendant (TP510)

4.3.9.1. Outline

TP510 (teach pendant) performs communication through a main board (BD510) 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.

Figure 4.59 Appearance of teach pendant TP510

4.3.9.2. USB cover

When you open a cover positioned at the lower side of the teach pendant, you can see the connectors such as those shown below. The meaning of each connector is the same as shown below.

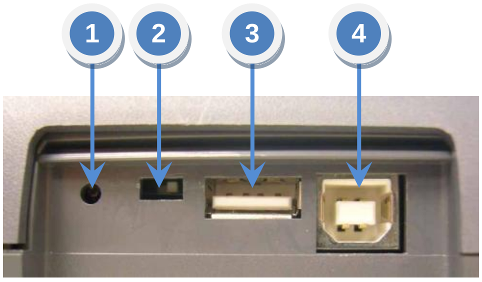


Figure 4.60 USB cover of teach pendant TP510

(1) RESET switch

When you want to re-operate the teach pendant, and not the controller, your can operate the RESET switch. However, do not operate this unnecessarily.

(2) Slide switch

When delivered, it is set on the right side (to the USB connector direction) as shown in the picture.

Notice: Slide switch is set when it is produced so that the user cannot change the position thereof.

(3) USB-A type connector

The user can up/down load necessary files, such as data and teaching programs, etc. as well as different versions of boards.

(4) USB-B type connector

This connector is not intended for use by a user

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

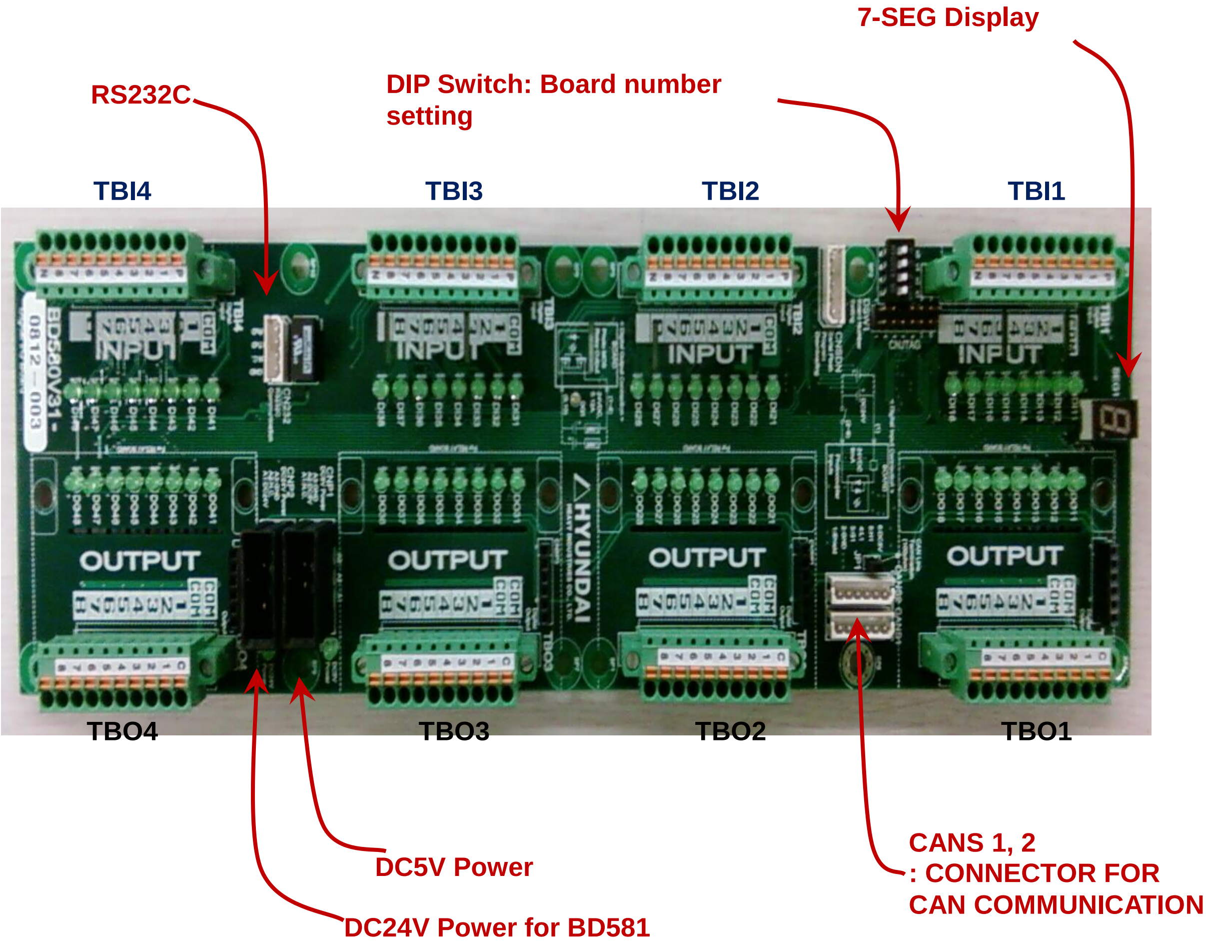


Figure 5.1 Public IO Board (BD580)

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.

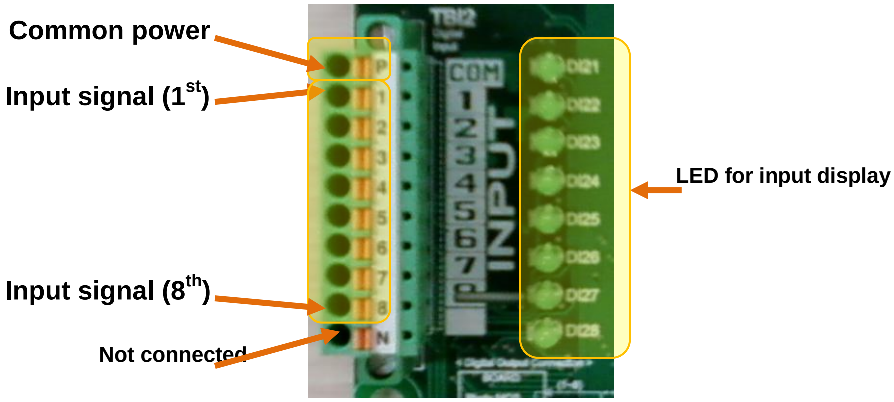


Figure 5.2 Pin Configuration of Digital Input Terminal Block of Public IO Board (BD580)

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.

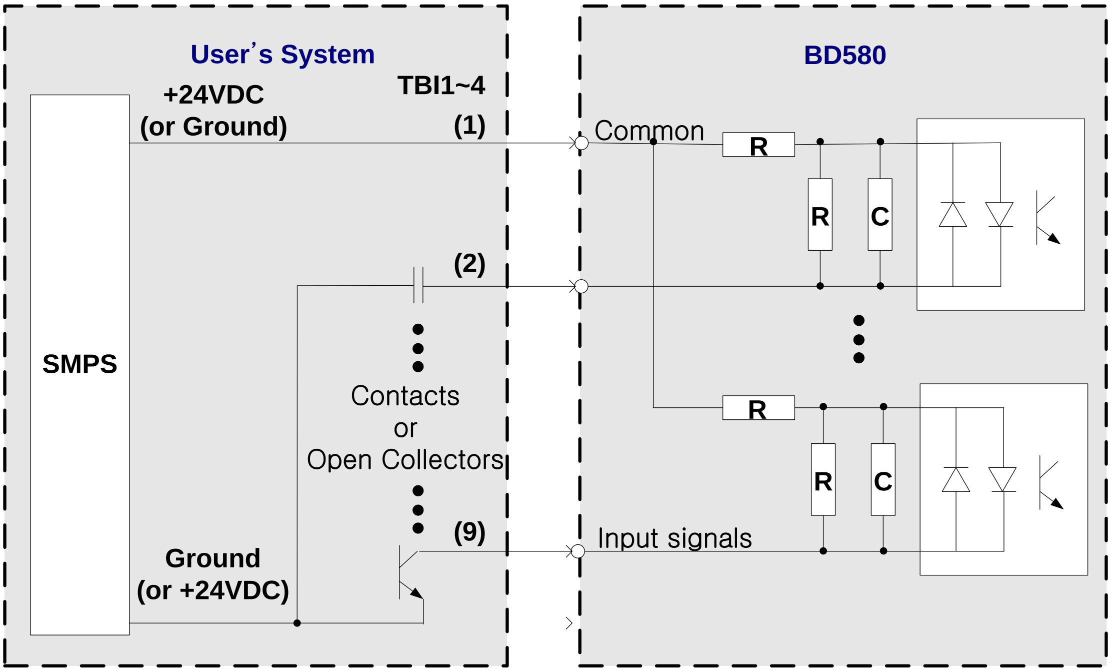


Figure 5.3 Wiring of Input Signals of the Public IO Board (BD580)

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.

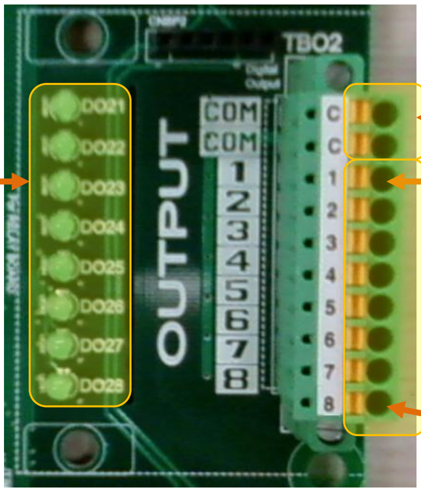


Figure 5.4 Pin Configuration of Digital Input/Output Terminal Block of the Public IO Board(BD580)

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.

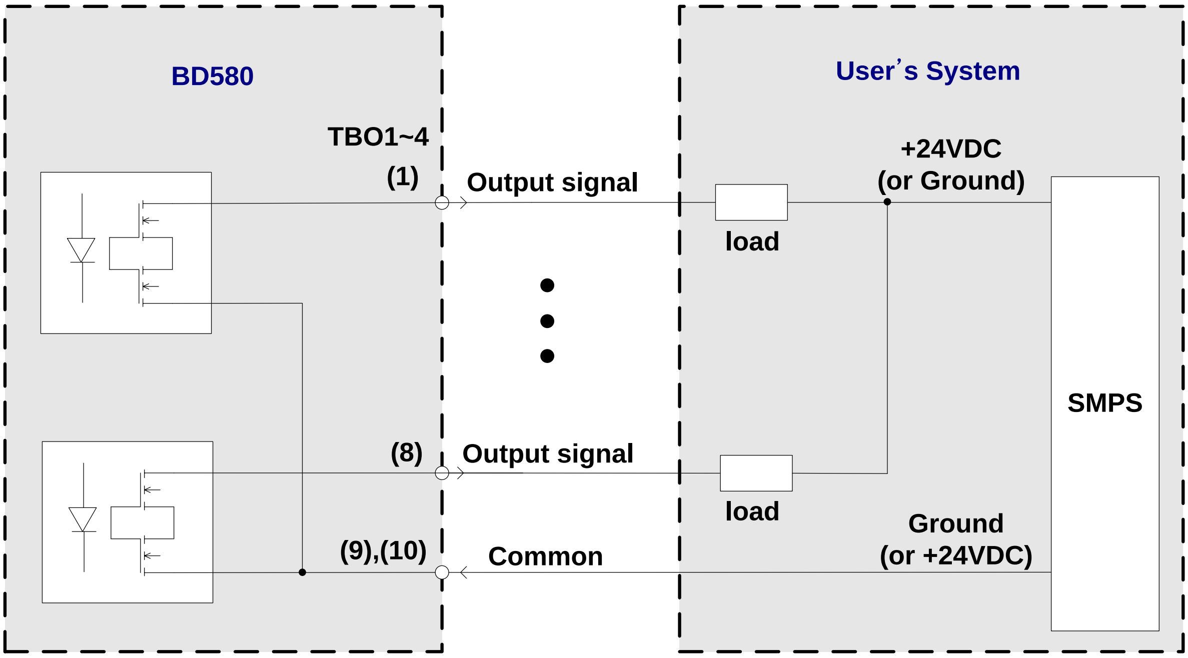
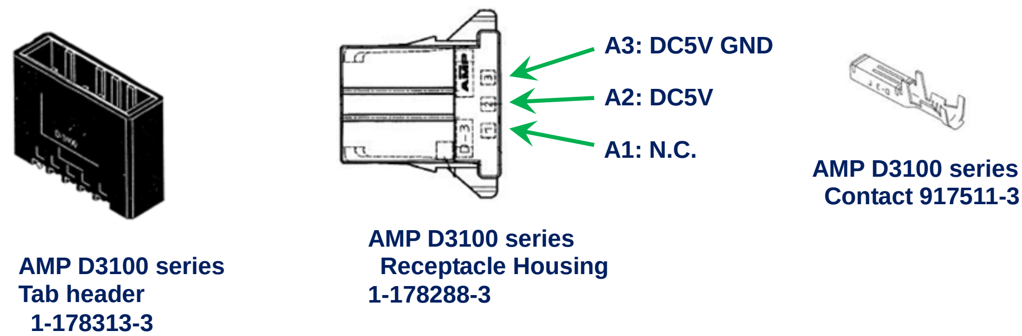


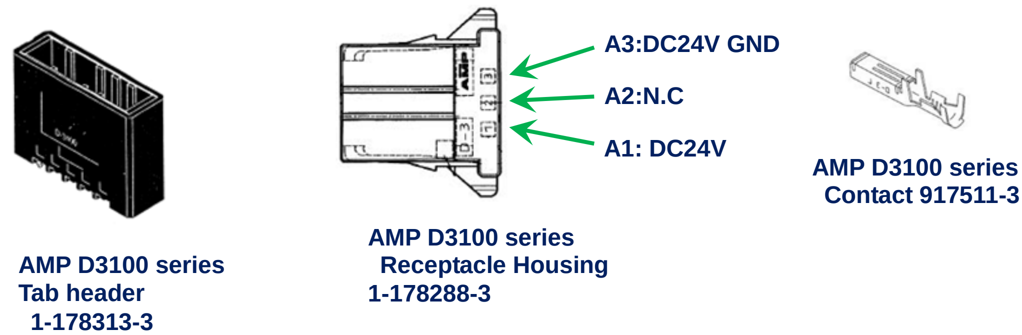
Figure 5.5 Method for the Connection of the Output Signals of the Public IO Board (BD580)

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.

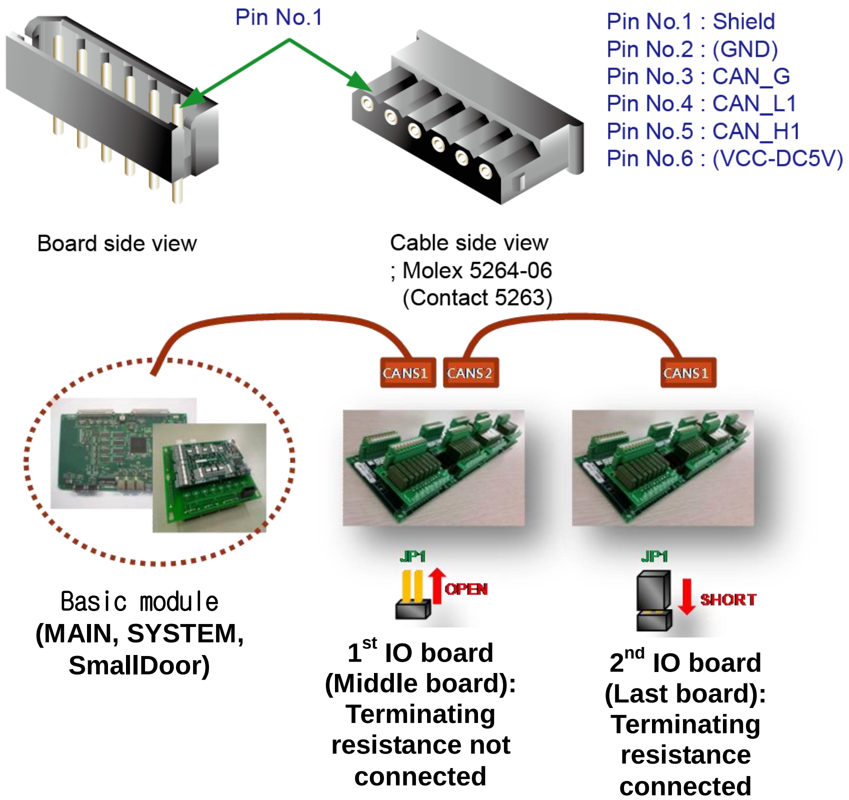


Figure 5.7 Method for the Connection of CAN Connectors of the Public IO Board (BD580)

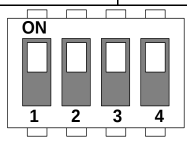
When connecting several boards, the terminating resistance must be processed precisely. CAN data communication uses the Daisy Chaining method. Therefore, only the board connecting the CAN communication cable at the end must be connected to the terminating resistance; all other boards must not be connected 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.

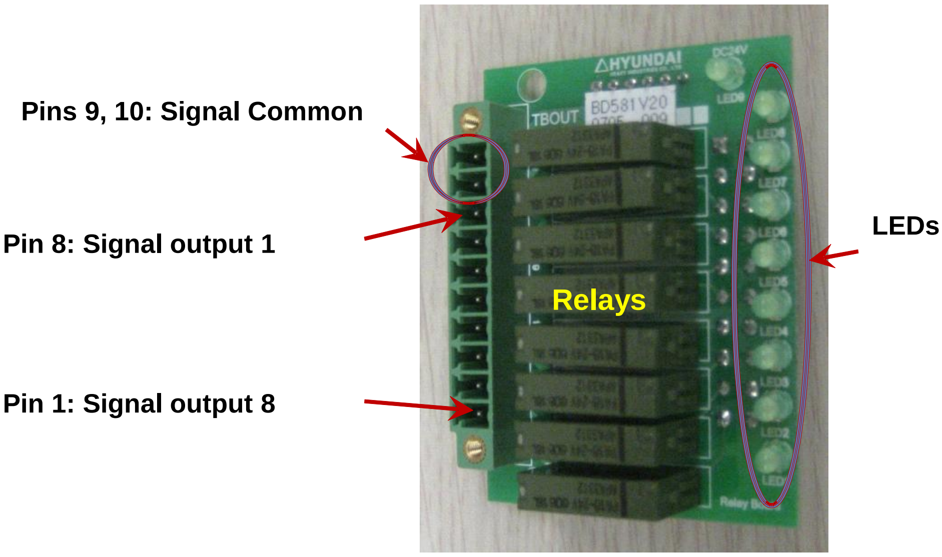


Figure 5.8 Relay Output Board of Public IO Board (BD581)

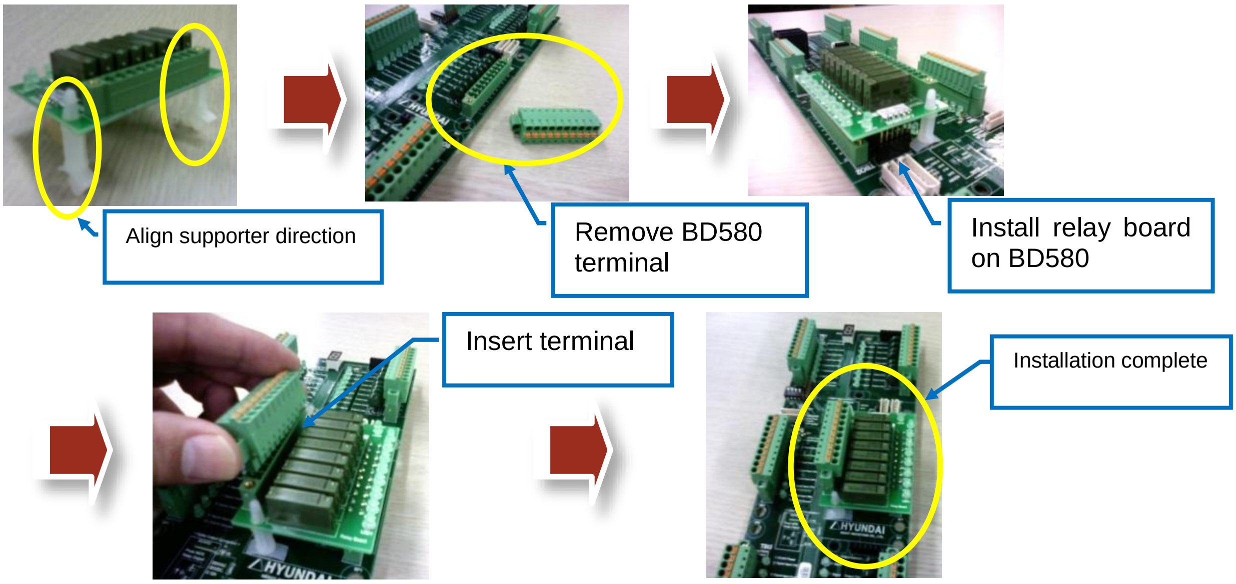


Figure 5.9 Method for the Installation of Relay Board

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)

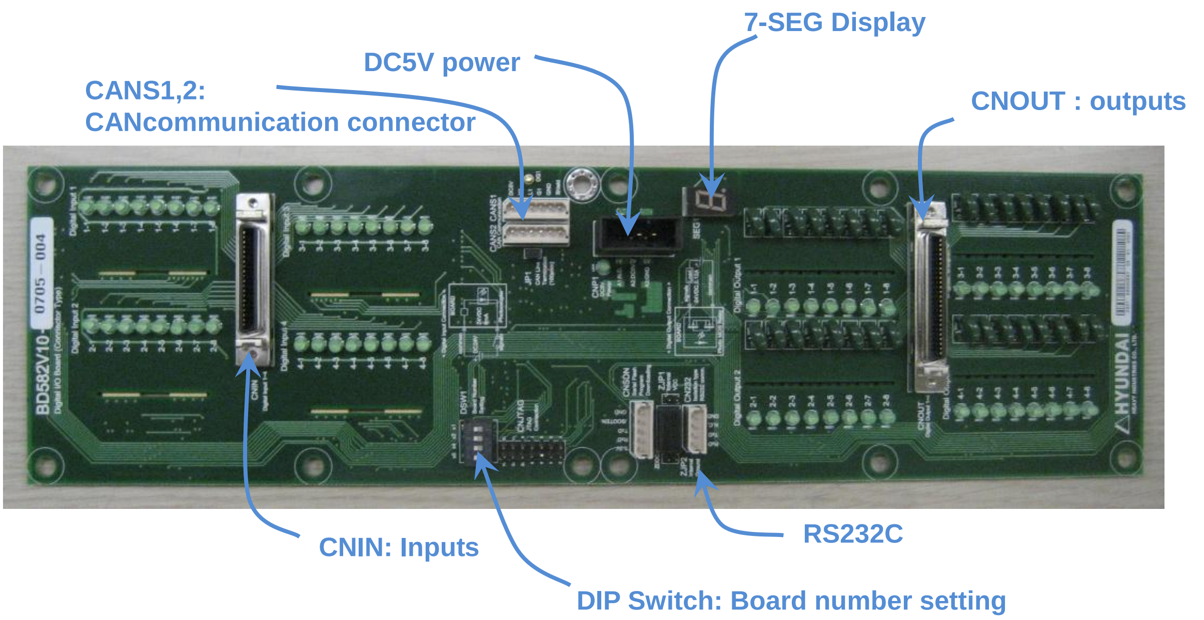


Figure 5.10 Public IO Board (BD582)

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.

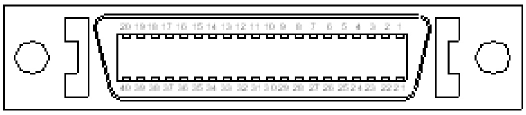


Figure 5.11 CNIN Connector (3M MDR 10240-52A2JL) of the Public IO Board (BD582)

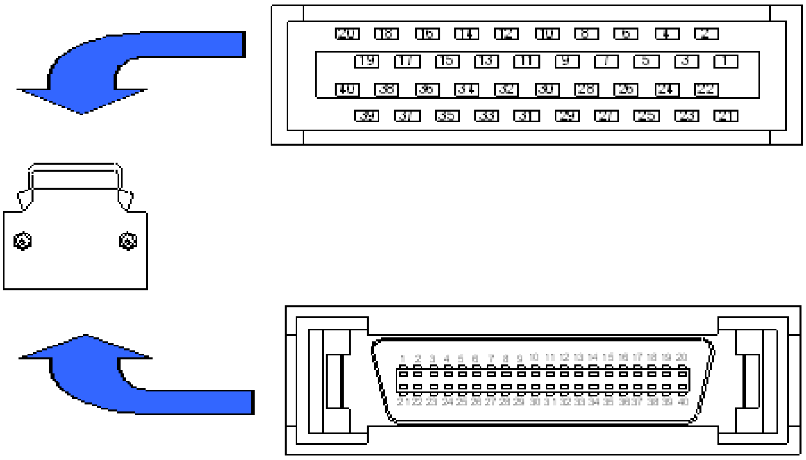


Figure 5.12 3M MDR 10140-3000VE (HOOD:1030-55F0-008) of CNIN Connector Plug of the Public IO Board (BD582)

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		

Pin Number	Signal Name	Function Description (Expansion Board/Basic Board)
21	DI17	Public input 17
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 kΩ
- (+) 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.

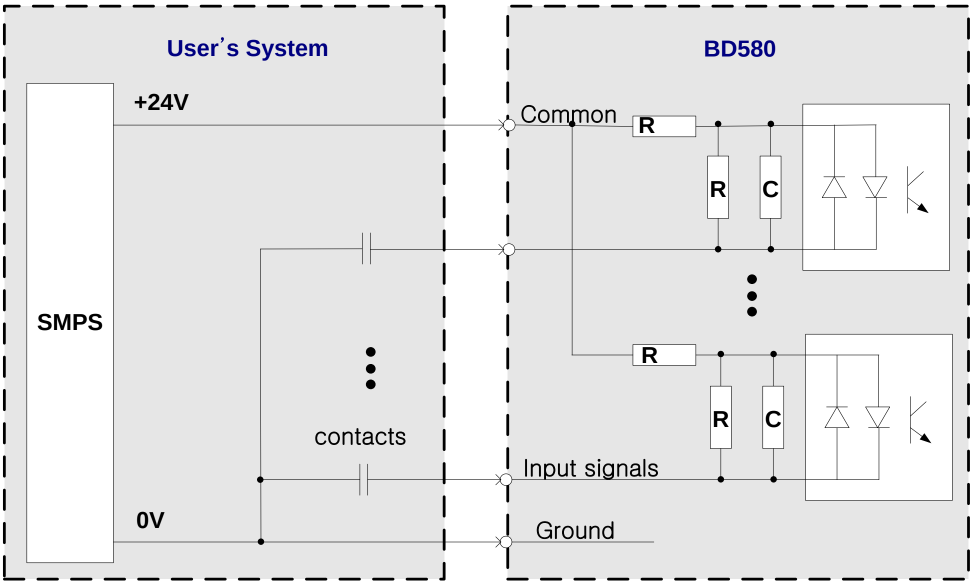


Figure 5.13 Method for Wiring Input Signals of the Public IO Board (BD582)

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.

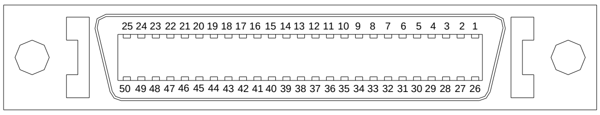


Figure 5.14 CNOUT Connector (3M MDR 10250-52A2JL) of the Public IO Board (BD582)

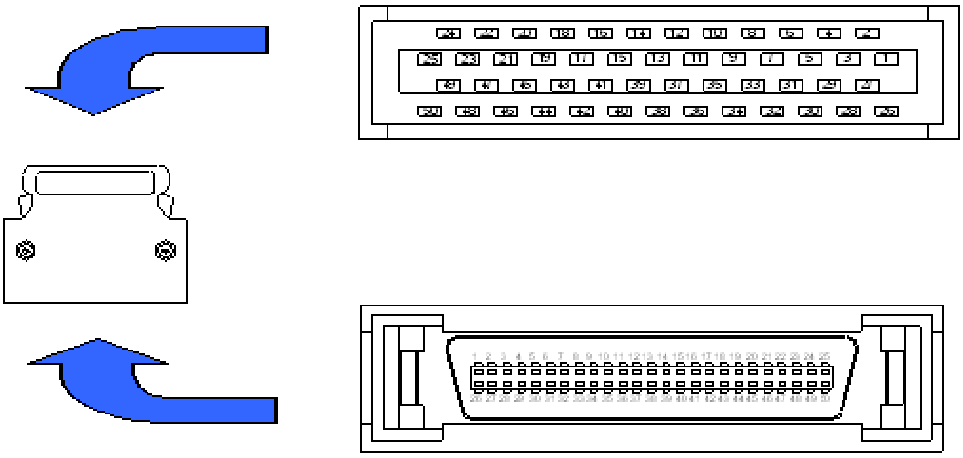


Figure 5.15 3M MDR 10150-3000VE (HOOD;10350-52F0-008) of the CNOUT Connector Plug of the Public IO Board (BD582)

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.

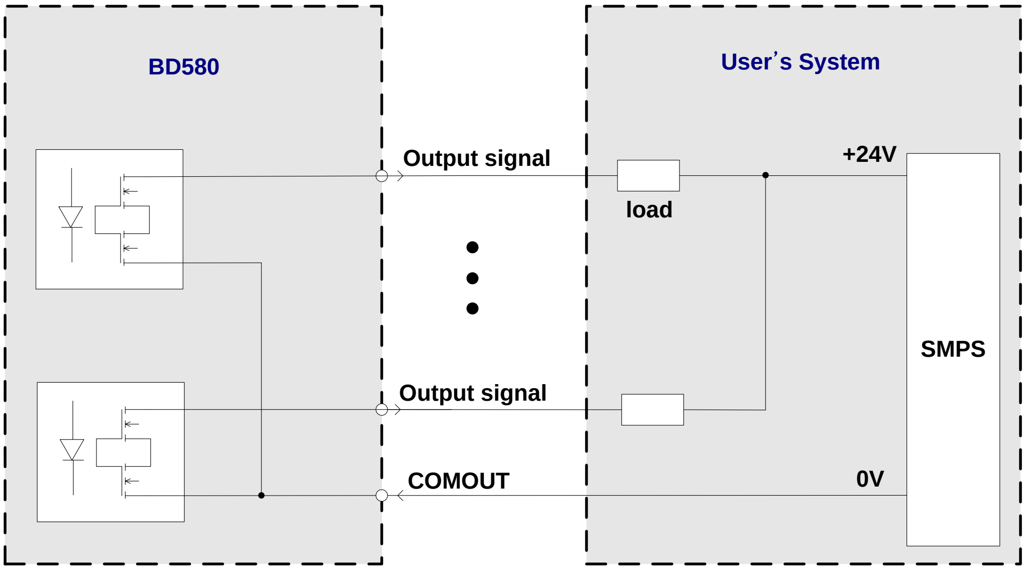


Figure 5.16 Method for Connection of Output Signals of the Public IO Board (BD582)

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.

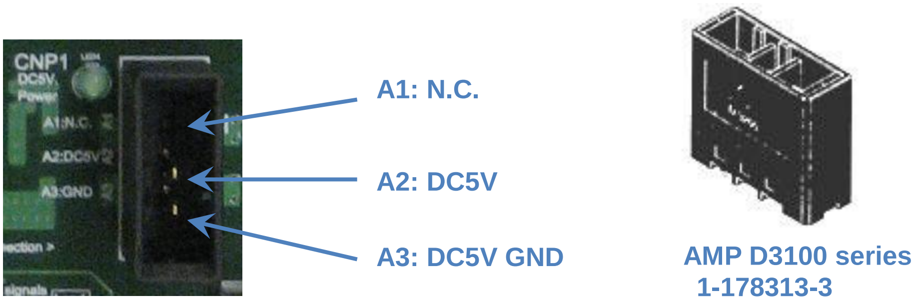


Figure 5.17 Power Connector CNP1 of the Public IO Board (BD582)

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.

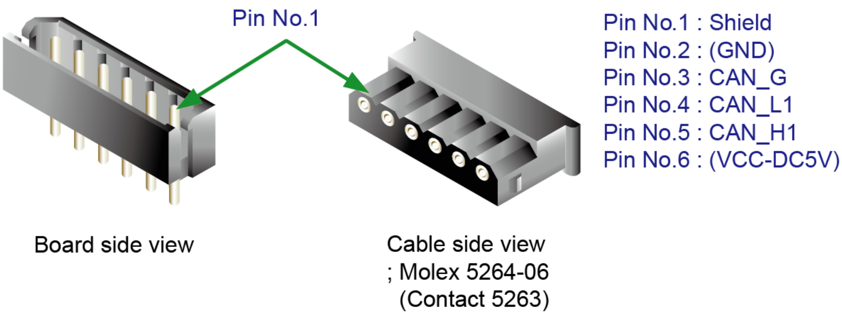


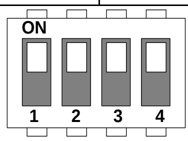
Figure 5.18 Method for Connection of the CAN Connector of the Public IO Board (BD582)

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 5.19 below. To block various types of noise and surges from the external environment of the robot, various signals are insulated from the external side.

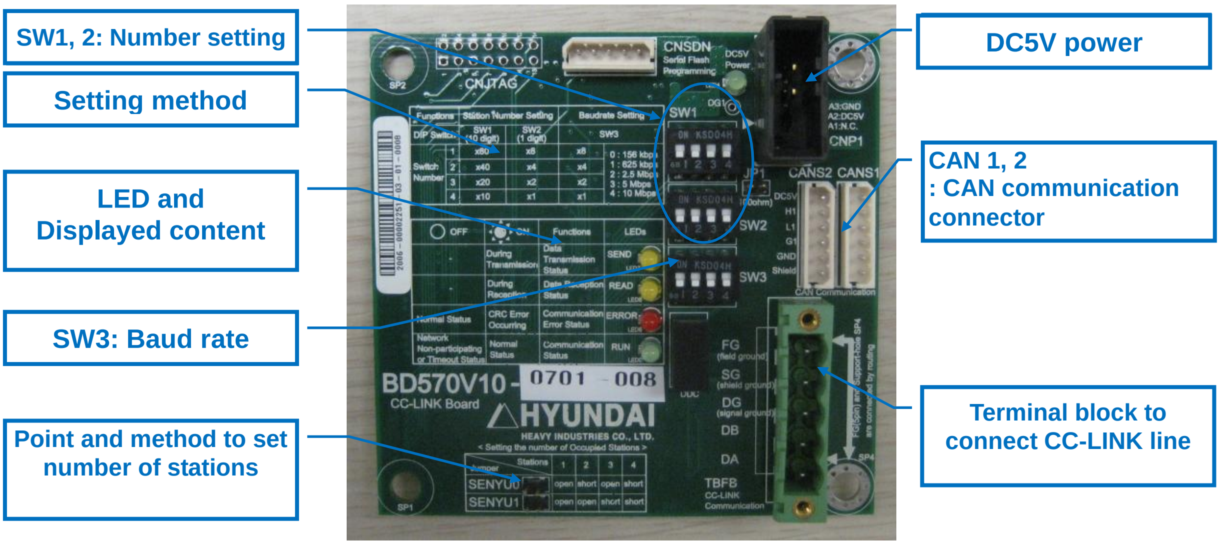


Figure 5.19 CC-LINK Board (BD570)

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 5.20 below.

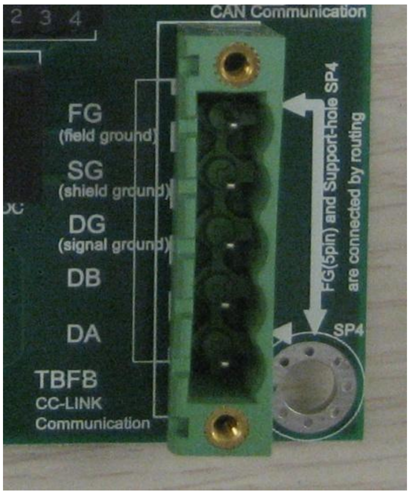


Figure 5.20 CC-LINK Communication Terminal Block of CC-LINK Board (BD570)

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 5.21 below.

Figure 5.21 Power Connector CNP1 of CC-LINK Board (BD570)

5.4.2.3. CAN Communications Connector: CANS1, CANS2

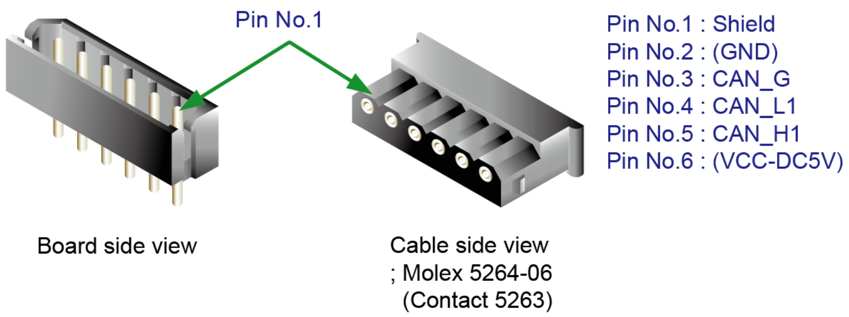


Figure 5.22 Method for the Connection of the CAN Connector of the CC-LINK Board (BD570)

For the CAN Communications Connector, there are two identical connectors with the same pin specification, which are installed as shown in Figure 5.22 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.

5.4.3. Indication and Setting Units

Various LEDs are used to display the communication status of the CC-LINK line. Indicated details of each LED are displayed on the board, as shown in Figure 5.23 below. You may also use the dip switch to set the number and communication speed of the CC-LINK board; relevant details are indicated on the board shown in Figures 5.24 and 5.25 below.

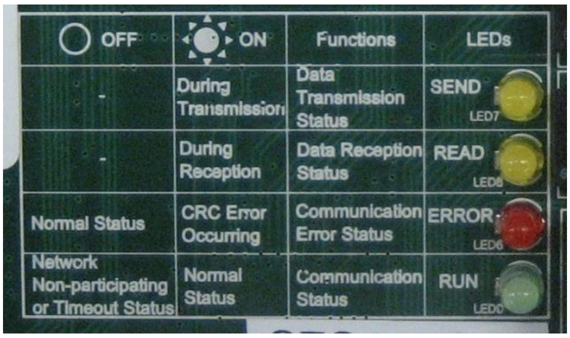


Figure 5.23 LED and Detail of Communication Status Indication of CC-LINK Board (BD570)

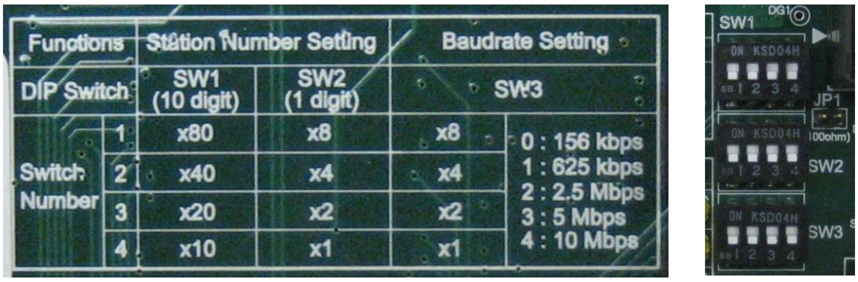


Figure 5.24 Setting Station Number and Communication Speed of the CC-LINK Board (BD570)

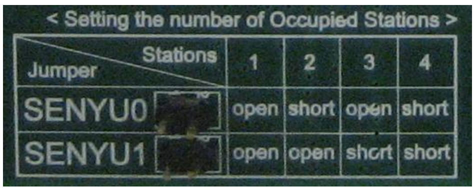


Figure 5.25 Method for Setting of the Number of Stations of the CC-LINK Board (BD570)

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 5.26 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.

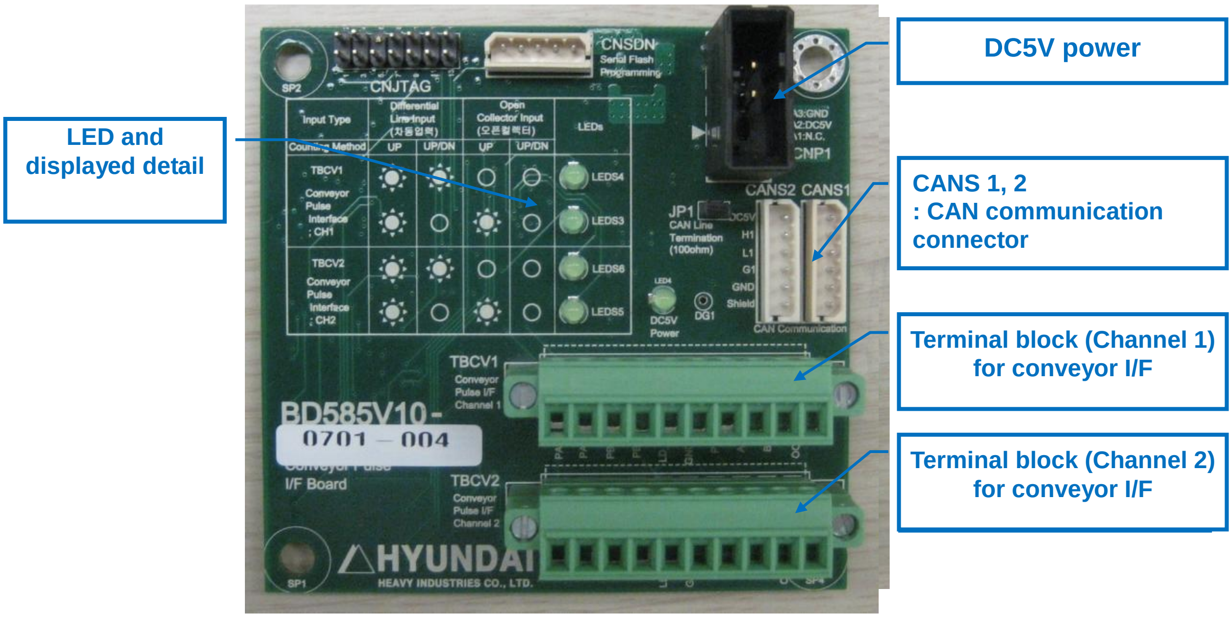


Figure 5.26 Conveyor I/F Board (BD585)

HYUNDAI HEAVY INDUSTRIES CO.,LTD.

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 5.27 below. That is, two conveyors can be connected.

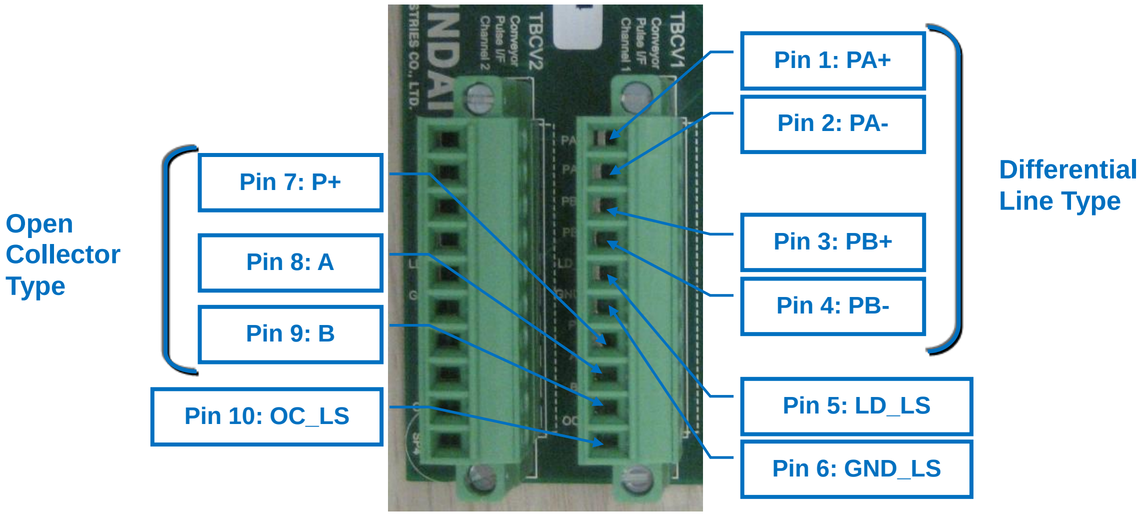


Figure 5.27 Conveyor Connection Terminal Block of the Conveyor I/F Board (BD585)

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 5.28 below.

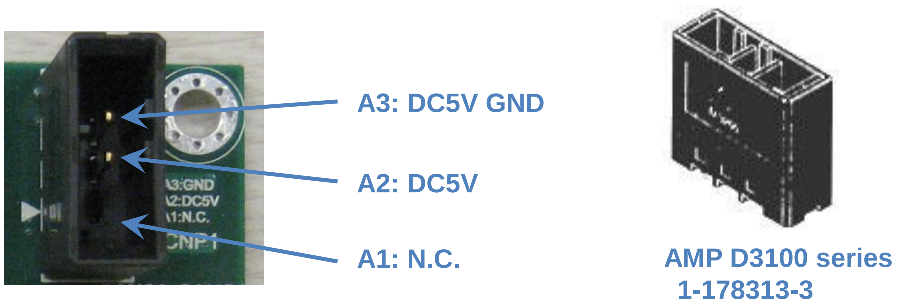


Figure 5.28 Power Connector CNP1 of Conveyor I/F Board (BD585)

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 5.29 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.

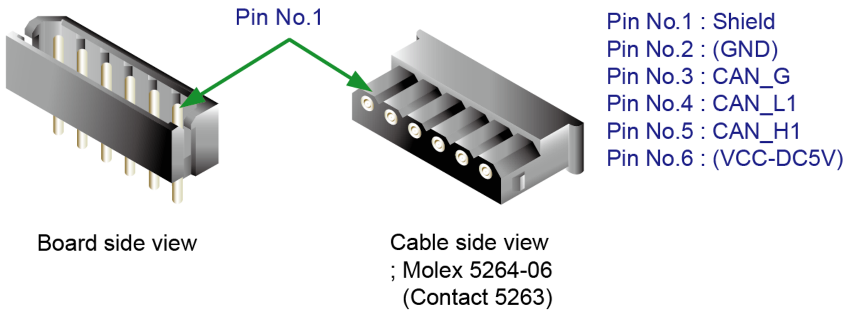


Figure 5.29 Method for the Connection of CAN Connector of the Conveyor I/F Board (BD585)

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 5.30 below. For each case, the description is shown on the board.

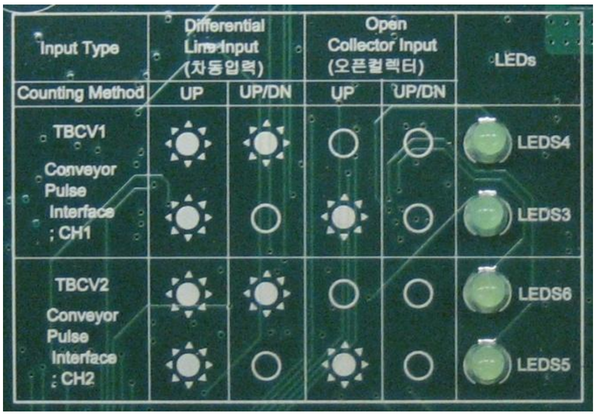


Figure 5.30 LED and Detail for Conveyor I/F Board (BD585) Status Indication

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
- Digital output (Photo MOS type): 24 points; Replay contact point: 8 points
- CC-LINK communication function included
- RS232 / RS485 select 1 channel
- Installation location: RACK
- 1 Mbps CAN communication

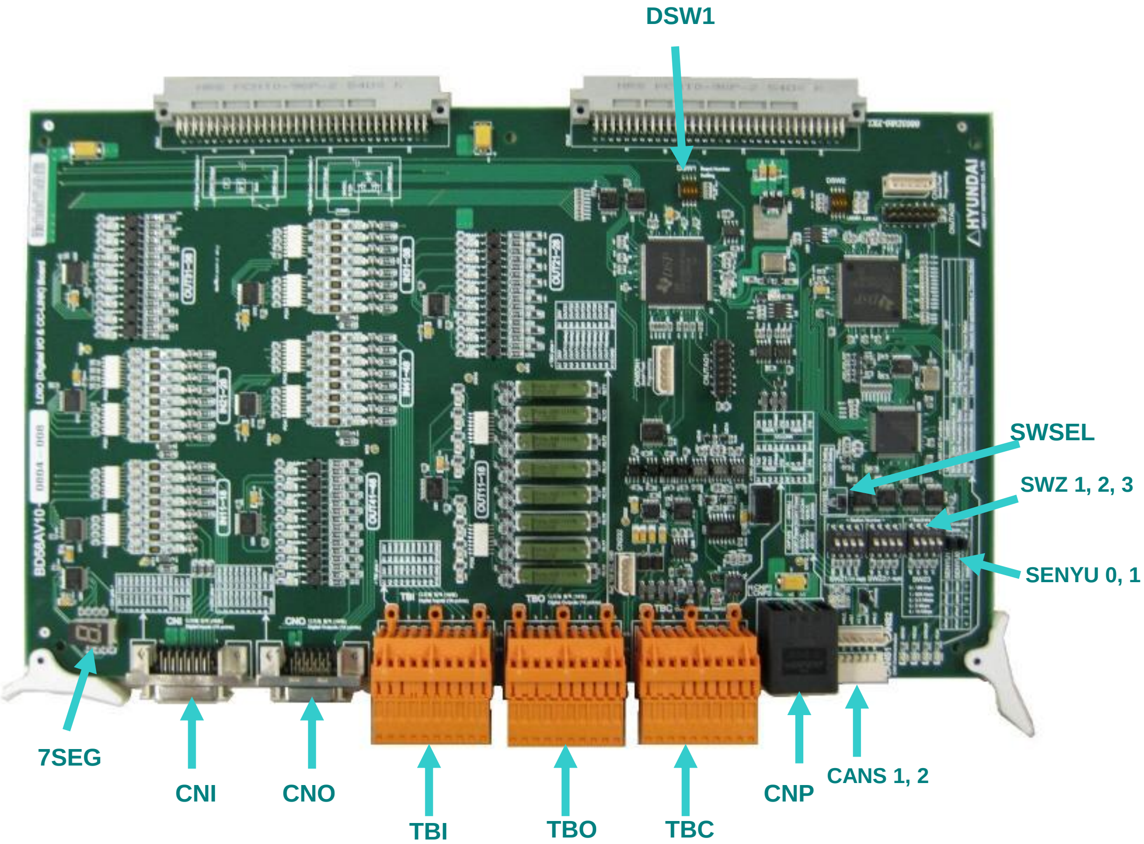


Figure 5.31 Appearance of the LDIO Board (BD58A)

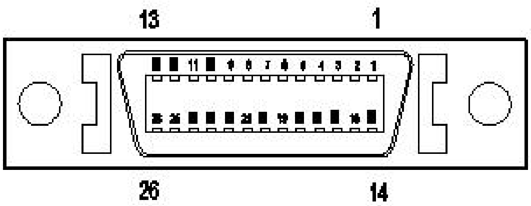
5.6.2. Connector

5.6.2.1. Digital Input

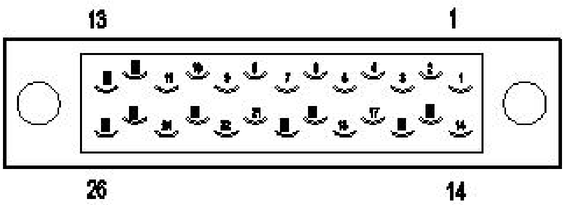
The photocoupler is used for digital input, and a total of 32 points are provided. The user can input each 16-point signal through the connector and terminal as required.

(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 5.32 Digital Input Connector CNI of LDIO Board (BD58A)

Table 5-8 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

Pin Number	Signal Name	Function Description
21	IN28	Digital input 28
22	M1	Power output: DC24V GND
23		
24	P1	Power output: DC24V
25		
26		

(2) Input through terminal block

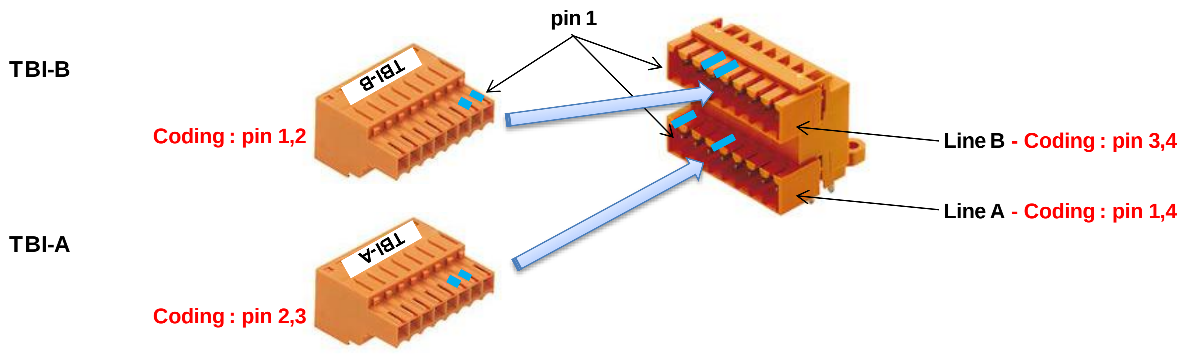


Figure 5.33 Digital Input Terminal Block TBI of LDIO Board (BD58A)

Table 5-9 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 photocoupler
- Input impedance= 3 kΩ
- (+) Common input voltage = 24 VDC
- (-) Common input voltage = 0 VDC

The user connects the input signal through the method shown in Figure 5.34 below.

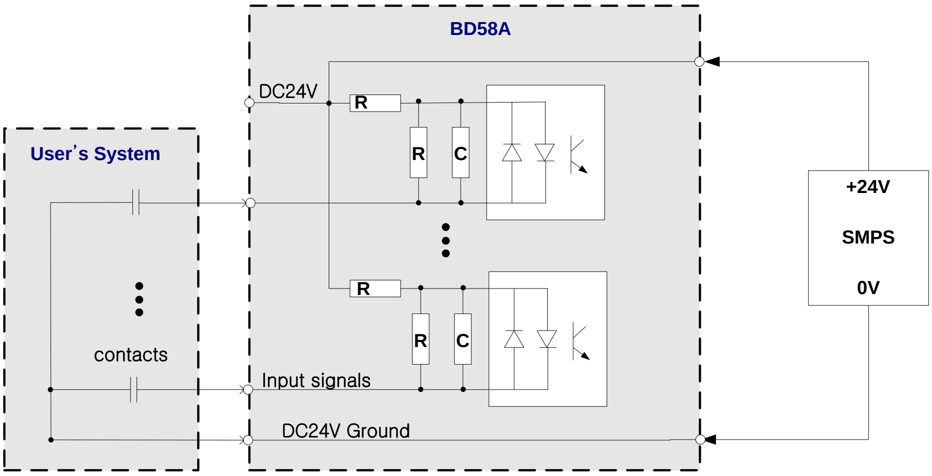


Figure 5.34 Method for Wiring the Input Signal of LDIO Board (BD58A)

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

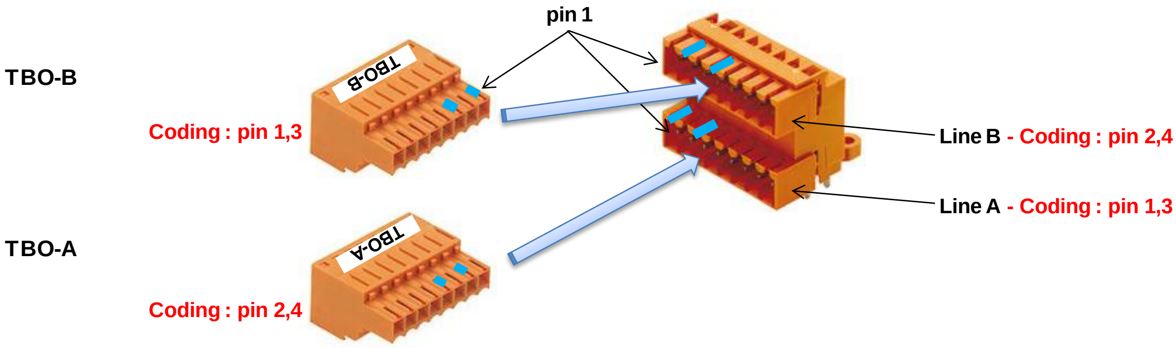


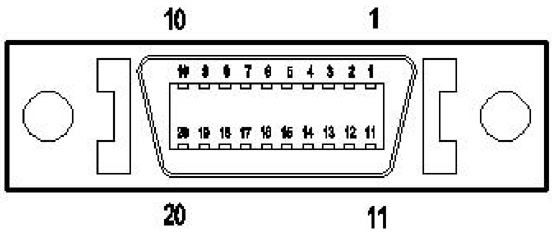
Figure 5.35 Digital Output Terminal Block TBO of LDIO Board (BD58A)

Table 5-10 Terminal Configuration of the Digital Output Terminal Block TBI of the LDIO Board (BD58A)

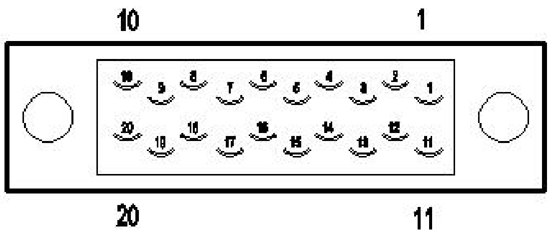
Terminal Block Name	Terminal Number	Signal Name	Function Description
TBO - A	1	P2	Power output: DC24V
	2	OUT11	Digital output 11 (Relay contact point output)
	3	OUT12	Digital output 12 (Relay contact point output)
	4	OUT13	Digital output 13 (Relay contact point output)
	5	OUT14	Digital output 14 (Relay 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
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

(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 5.36 CNO Connector of LDIO Board (BD58A)

Table 5-11 Pin Configuration of the Digital Input 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	IN41	Digital input 41
12	IN42	Digital input 42
13	IN43	Digital input 43
14	IN44	Digital input 44
15	IN45	Digital input 45
16	IN46	Digital input 46
17	IN47	Digital input 47
18	IN48	Digital input 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

In addition, the output specification of the relay contact point is as follows.

- Output component: Relay contact point output
- Rated output = 5 A / 24 VDC, 5A / 250 VAC
- (-) Common output voltage = 0V DC (OPEN COLLECTOR)

The user connects the output signal as shown in Figures 5.37 and 5.38 below.

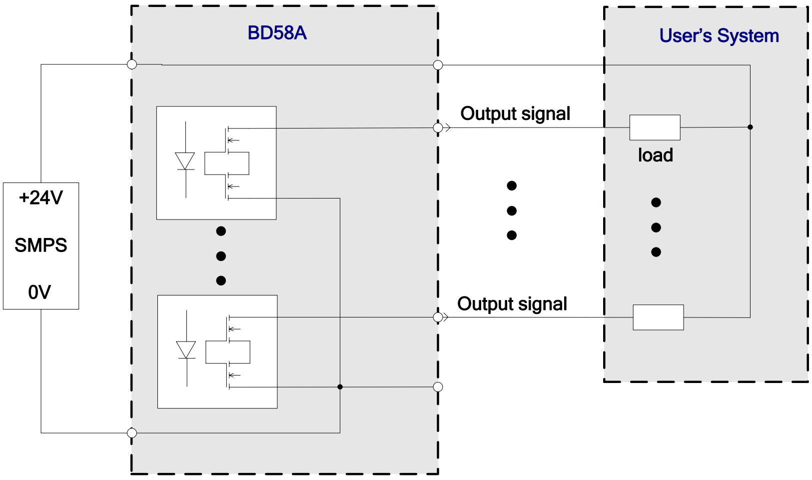


Figure 5.37 Method for Wiring the Output Signal of LDIO Board (BD58A) (Photo MOSFET)

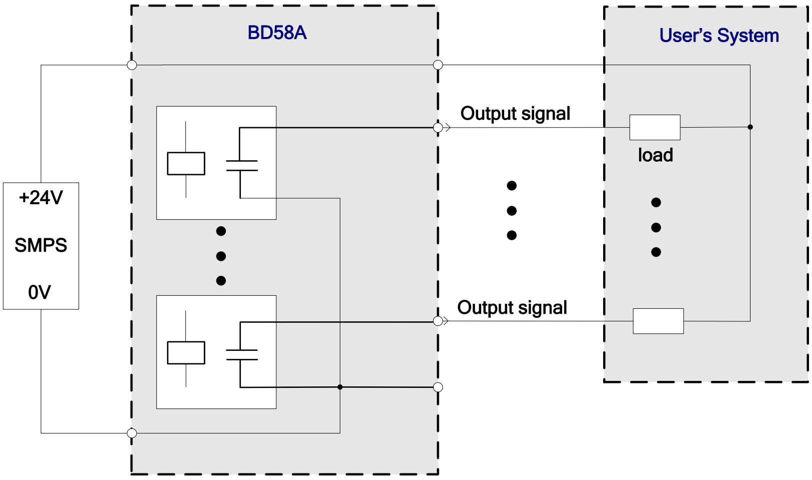


Figure 5.38 Method for Wiring the Output Signal of LDIO Board (BD58A) (Relay Contact Point)

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.

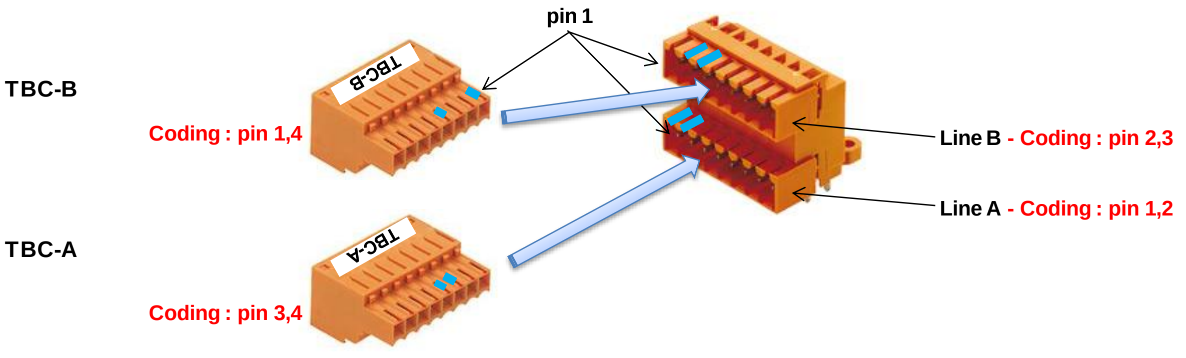


Figure 5.39 Serial Communication Terminal Block TBC of LDIO Board (BD58A)

Table 5-12 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 5.40 below.

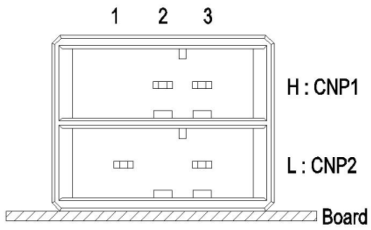


Figure 5.40 Power Connector CNP1 and CNP2 of LDIO Board (BD58A)

Table 5-13 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 5.41 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.

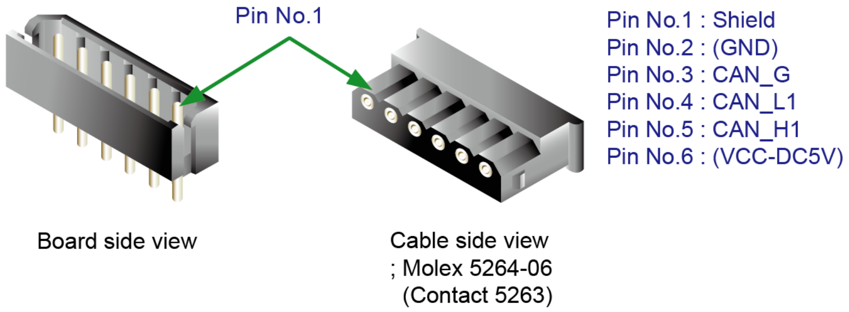


Figure 5.41 Method for Connecting the CAN Connector of LDIO Board (BD58A)

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 5-14 Method for Setting Station Number and Communication Speed of CC-LINK in the LDIO Board (BD58A)

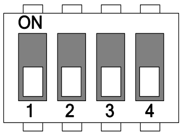
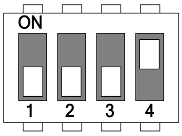
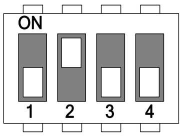
Switch Name	Usage	1	2	3	4	Remarks
SWZ1	**Station Number**	X80	X40	X20	X10	1
SWZ2		X8	X4	X2	X1	2
SWZ3	**Communication Speed**	X8	X4	X2	X1	0: 125 kbps 1: 625 kbps 2: 2.5 Mbps 3: 5.0 Mbps 4: 10 Mbps
Factory Default Setting	**SWZ1**	OFF	OFF	OFF	OFF	
	SWZ2	OFF	OFF	OFF	ON	
	SWZ3	OFF	ON	OFF	OFF	

Table 5-15 Method for Setting the Number of Stations of CC-LINK of the LDIO Board (BD58A)

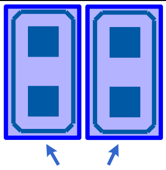
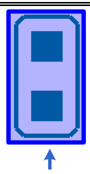
Jumper Name	Number of Stations			
	1	2	3	4
SENYU0	OPEN	SHORT	OPEN	SHORT
SENYU1	OPEN	OPEN	SHORT	SHORT
Factory Default Setting	 SHORT	SENYU0 : SHORT SENYU1 : SHORT		

Table 5-16 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

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 5.42 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.

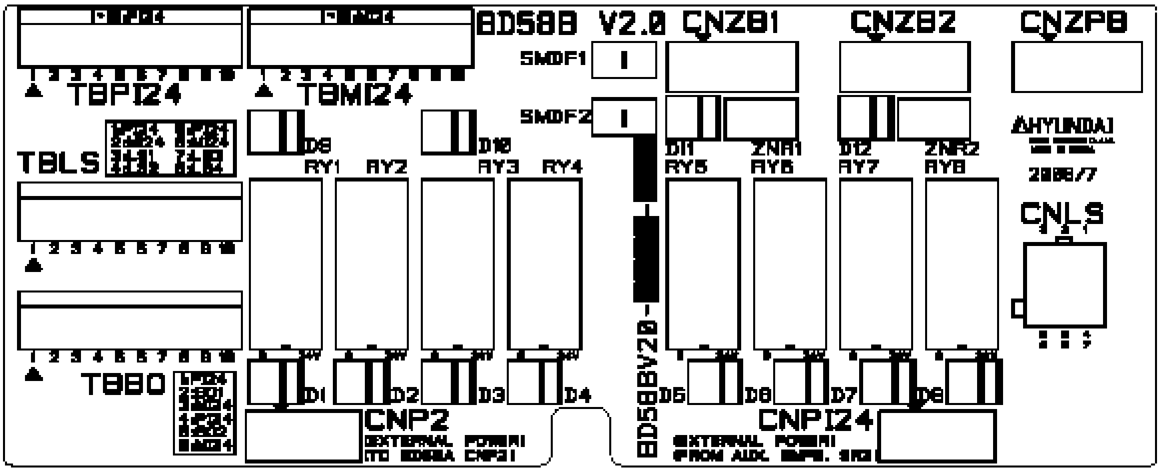


Figure 5.42 Safety Relay Board (BD58B)

5.7.2. Connector

Table 5-17 Pin Configuration of the Belt Sensor Terminal Block TTBO 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 5-18 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 5-19 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 5-20 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 5-21 Connector Type and Usage of Safety Relay Board (BD58B)

Name	Usage	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; 464-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

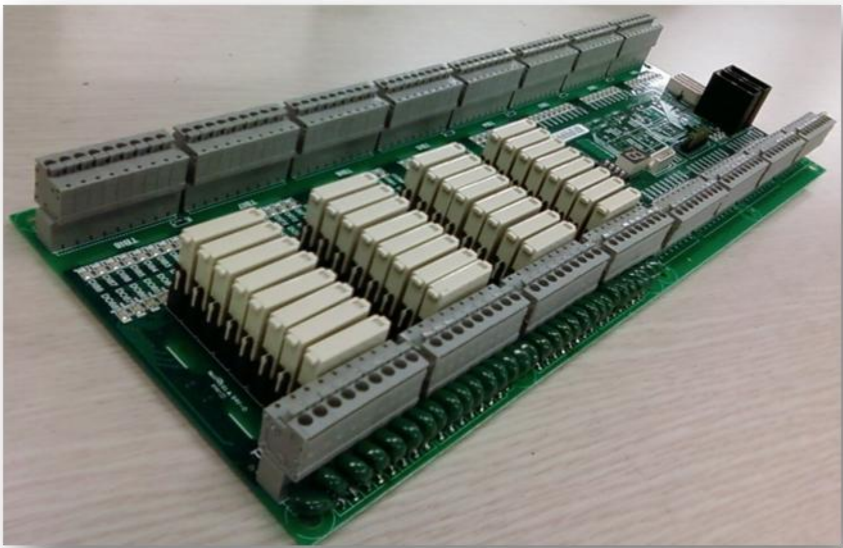


Figure 5.43 Expansion Public IO Board (BD583)

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

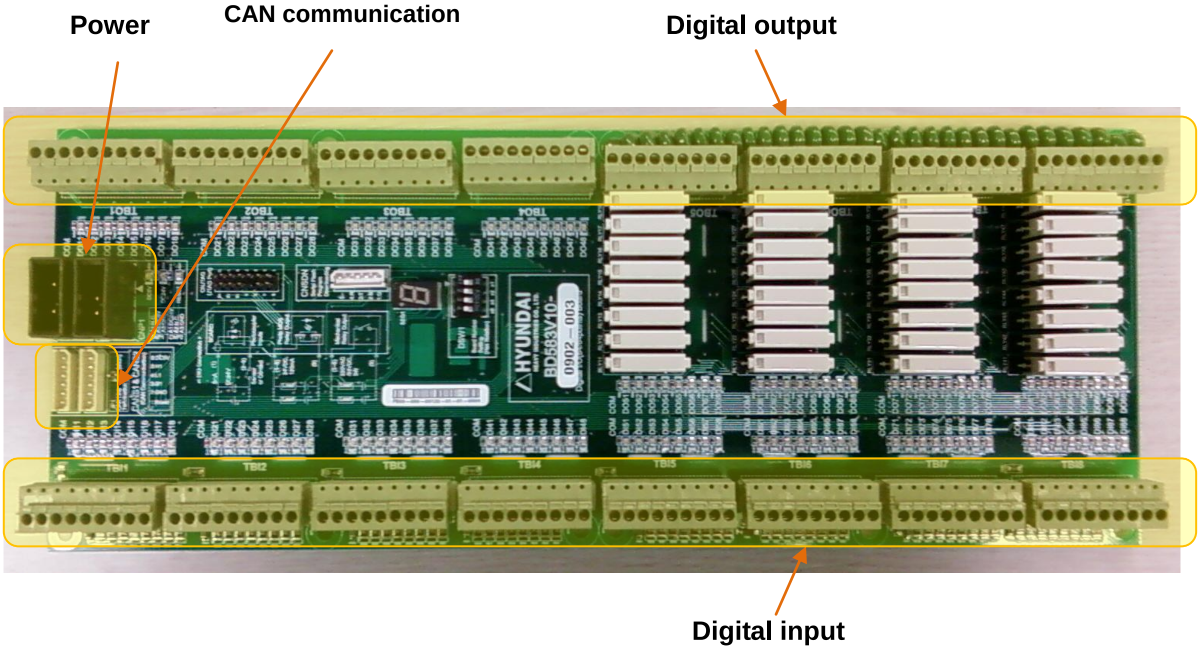


Figure 5.44 Connector Configuration for Expansion Public IO Board (BD583)

5.8.2.1. Digital Input

Figure 5.45 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.

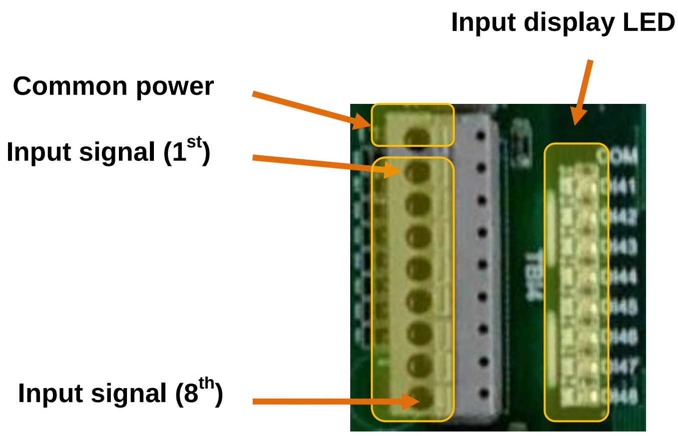


Figure 5.45 Pin Configuration of Digital Input Terminal Block on Expansion Public IO Board (BD583)

Table 5-22 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 ㏀
- Common power: Ground 24VDC or 24VDC

The user connects the input signal through the method shown in Figure 5.46 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.

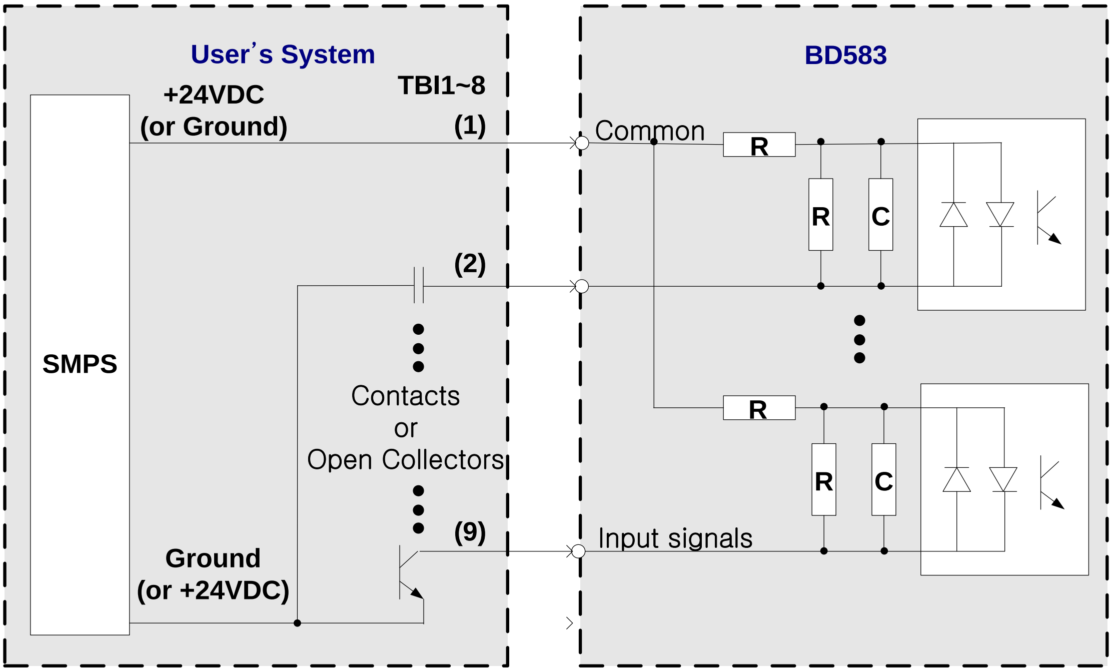


Figure 5.46 Method for Wiring Input Signal of Expansion Public IO Board (BD583)

5.8.2.2. Digital Output

Figure 5.47 below shows the pin composition of the terminal block (TBI1~8) 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.

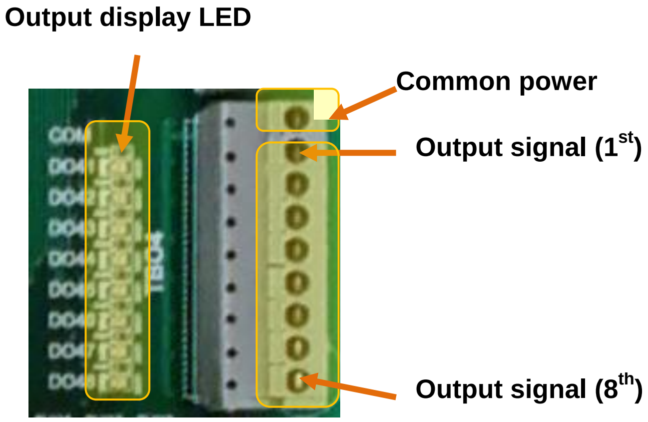


Figure 5.47 Pin Configuration of Digital Input/Output Terminal Block on Expansion Public IO Board (BD583)

Table 5-23 Pin Configuration of Digital Output Terminal Block (TBOn*) on Expansion Public IO Board (BD583)

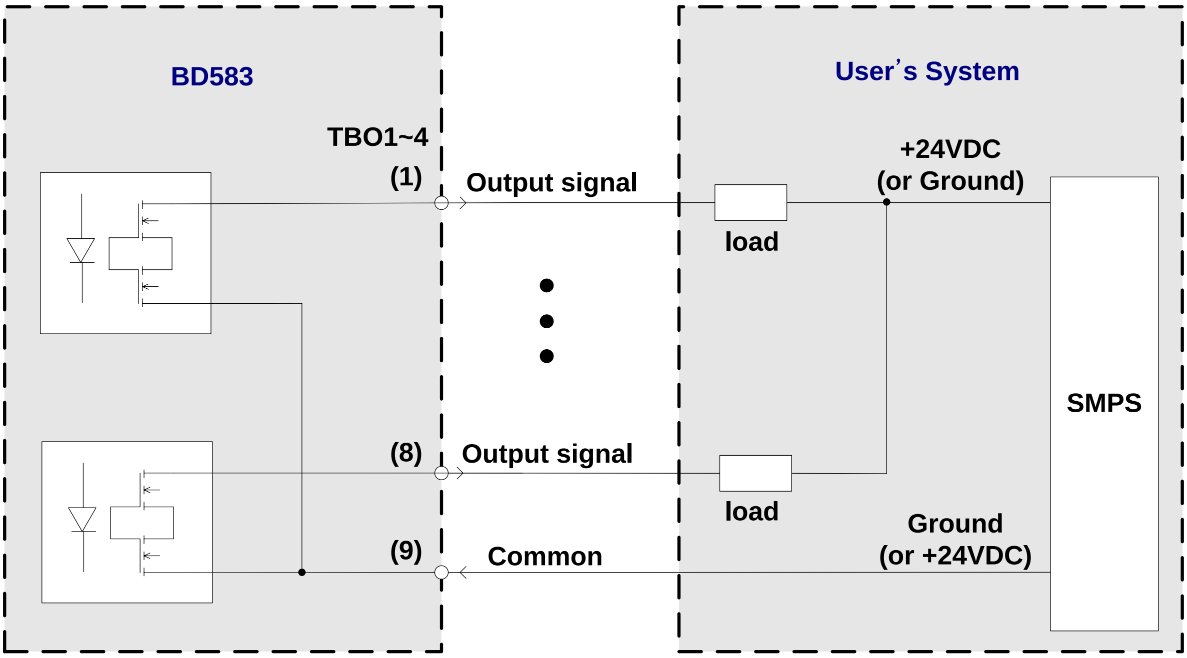
Pin Number	Signal Name	Signal Description
9	COMn*	COMMON power (Ground DC24V or DC24V)
8	DOn*1	1st output of nth public output signal port of user
7	DOn*2	2nd output of nth public output signal port of user
6	DOn*3	3rd output of nth public output signal port of user
5	DOn*4	4th output of nth public output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

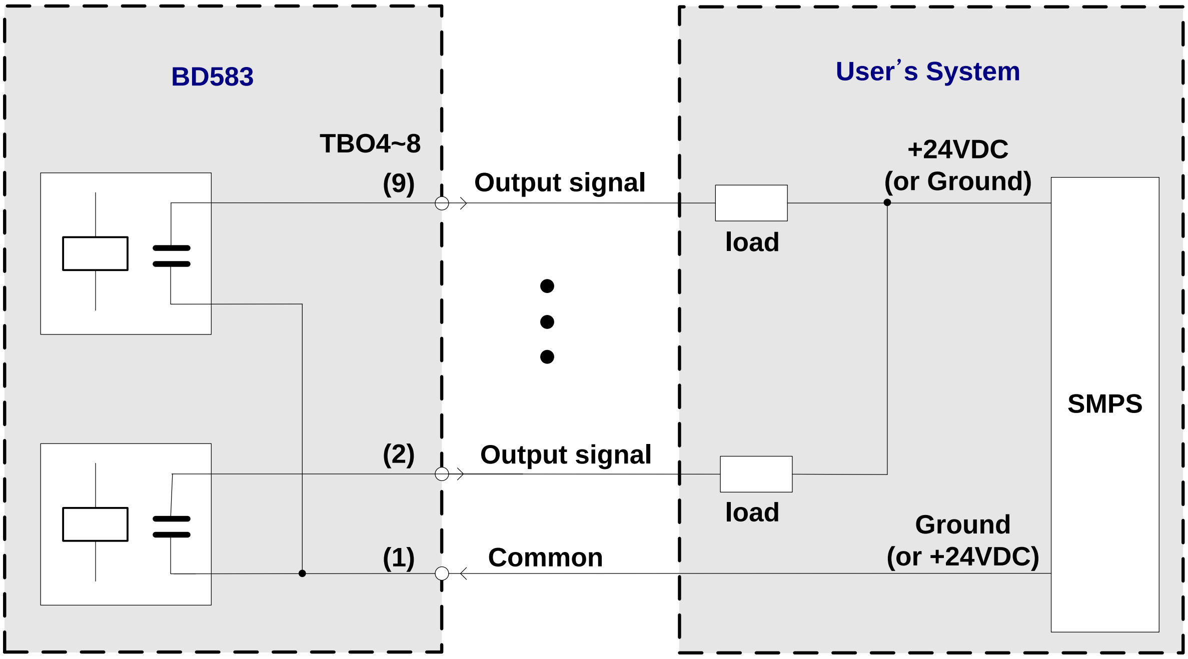
The electric specification of each output signal is as follows.

- 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 5.48 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

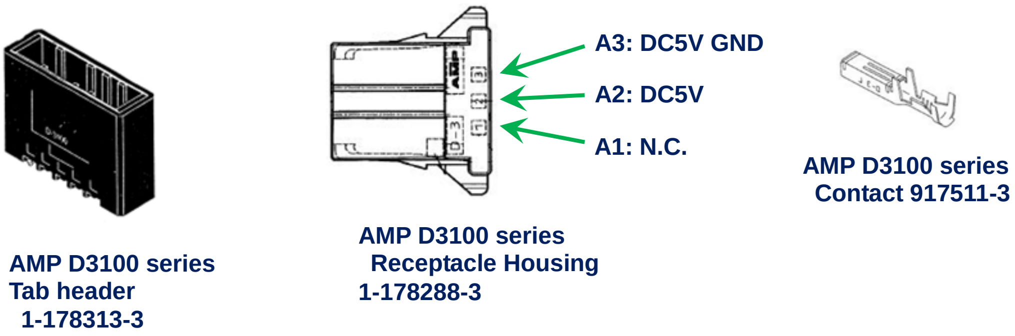


(b) Relay output type

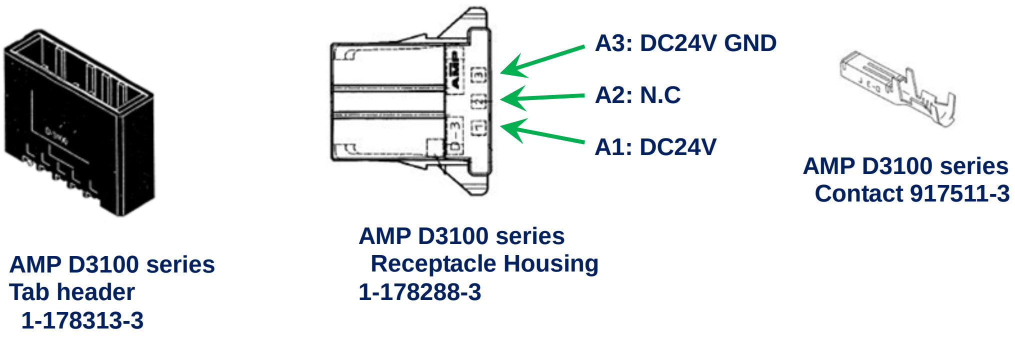
Figure 5.48 Method for Wiring Output Signal of Expansion Public IO Board (BD583)

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 5.49 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 5.49 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 5.50 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.

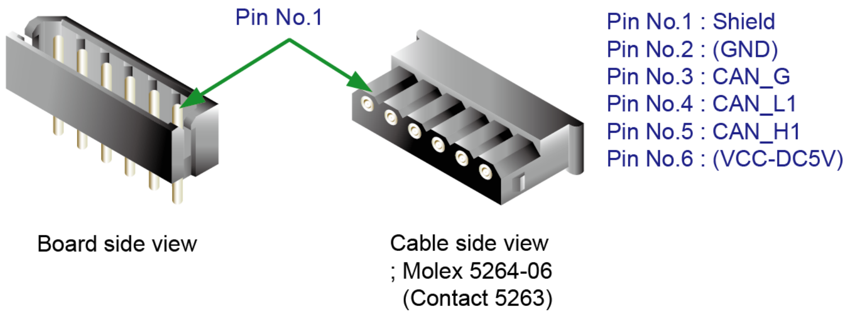


Figure 5.50 Method of Connecting the CAN Connector of Expansion Public IO Board (BD583)

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 5.51 below.

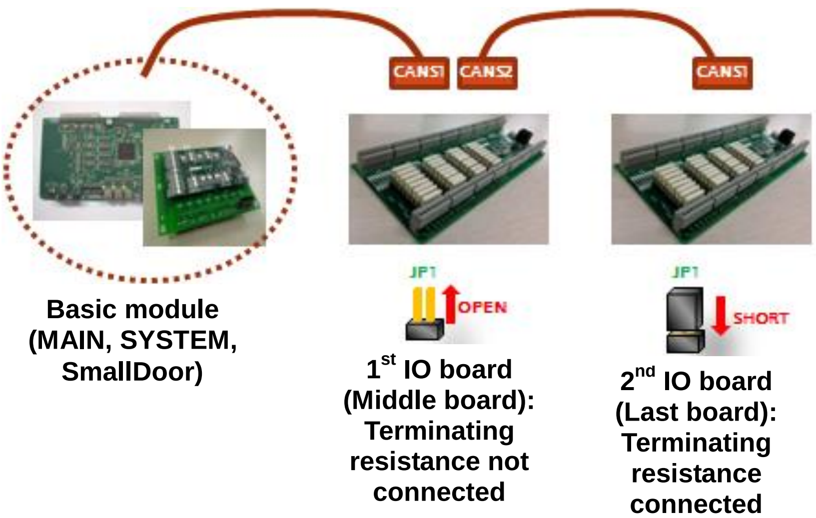


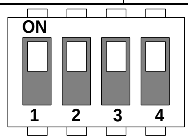
Figure 5.51 Method for Connecting Terminating Resistance

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 5-24 below.

Table 5-24 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

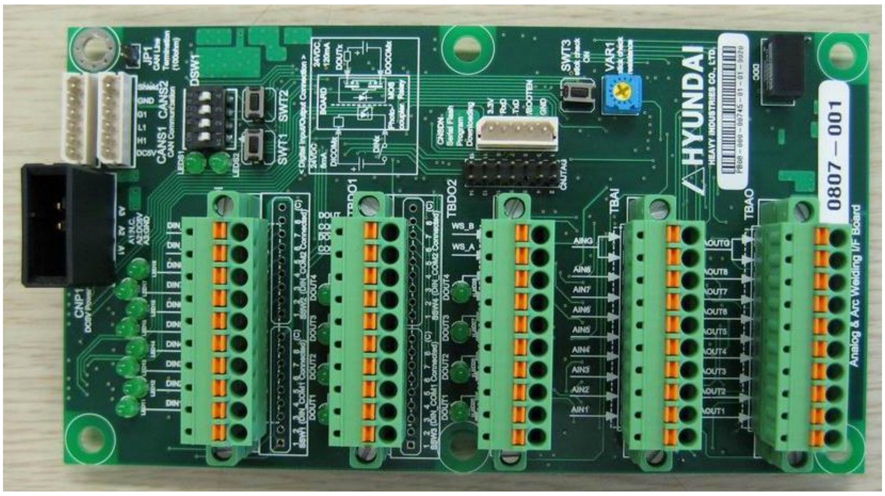


Figure 5.52 Analog/Arc IF Board (BD584)

The board is 86mm(L) x 156mm(H) in size, and has many functions, which are shown in Figure 5.53 below.

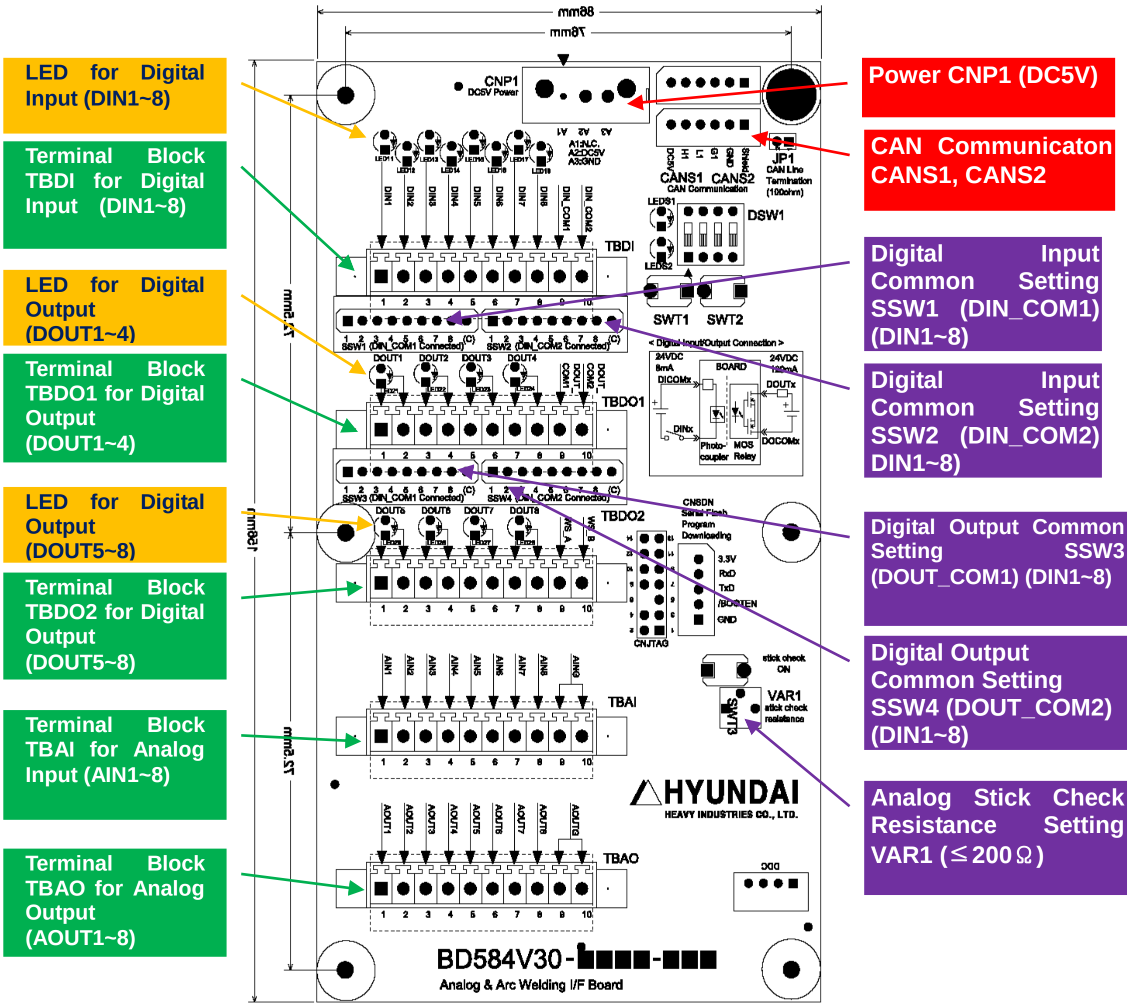


Figure 5.53 Configuration of Analog/Arc IF Board (BD584)

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.

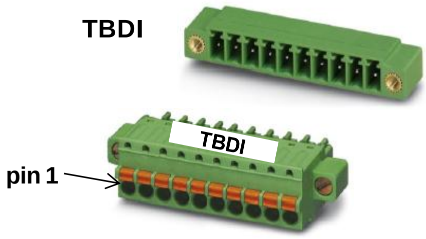


Figure 5.54 Terminal Block for Digital Input on Analog Board (BD584)

Use the assigned input to connect the arc welder. Details are shown in Table 5-25 below.

Table 5-25 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 5.55 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.

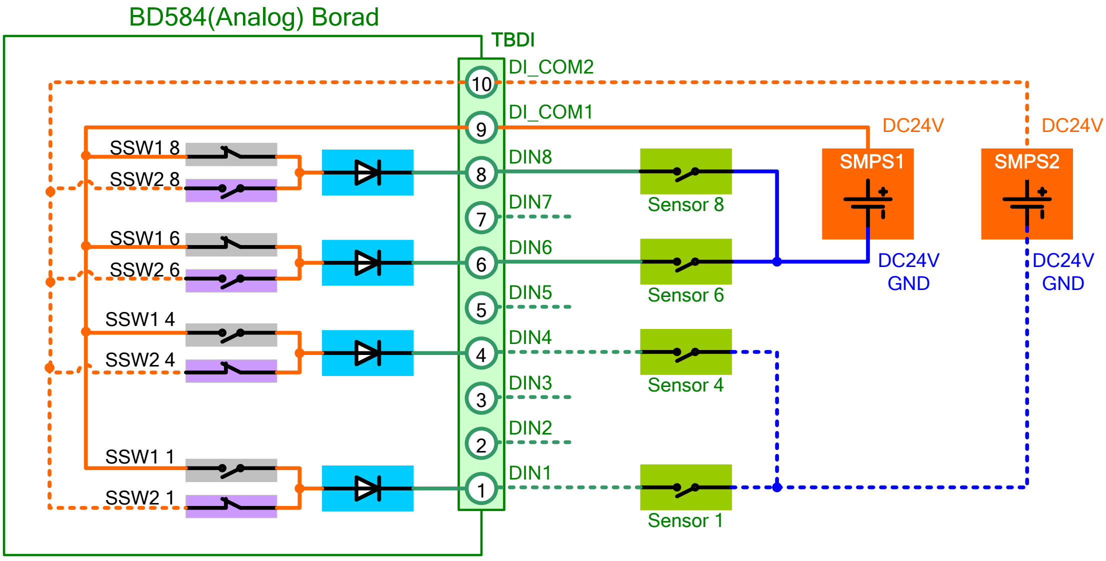


Figure 5.55 Method for Connecting Digital Input on Analog Board (BD584)

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 SSW3 and SSW4 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 5.56 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.

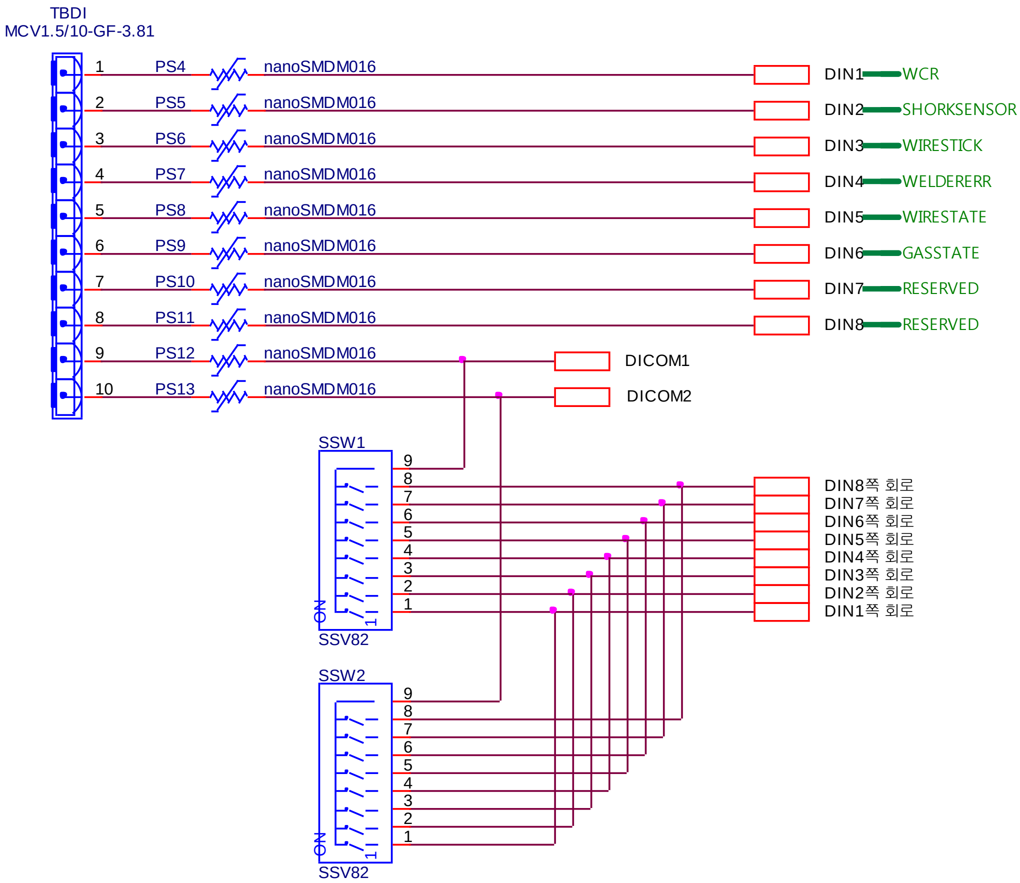


Figure 5.56 Common Circuit of Digital Input from Analog Board (BD584)

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.

5.9.2.2. 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.
Maxim3um 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.

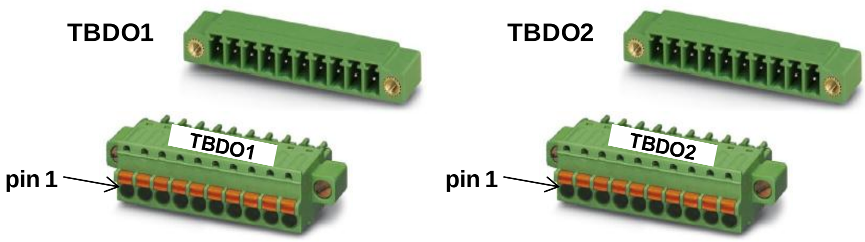


Figure 5.57 Terminal Block for Digital Output on Analog Board (BD584)

Use assigned output to connect the arc welder. Details are shown in Table 5-26 below.

Table 5-26 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 5-27 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 5.58. 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.

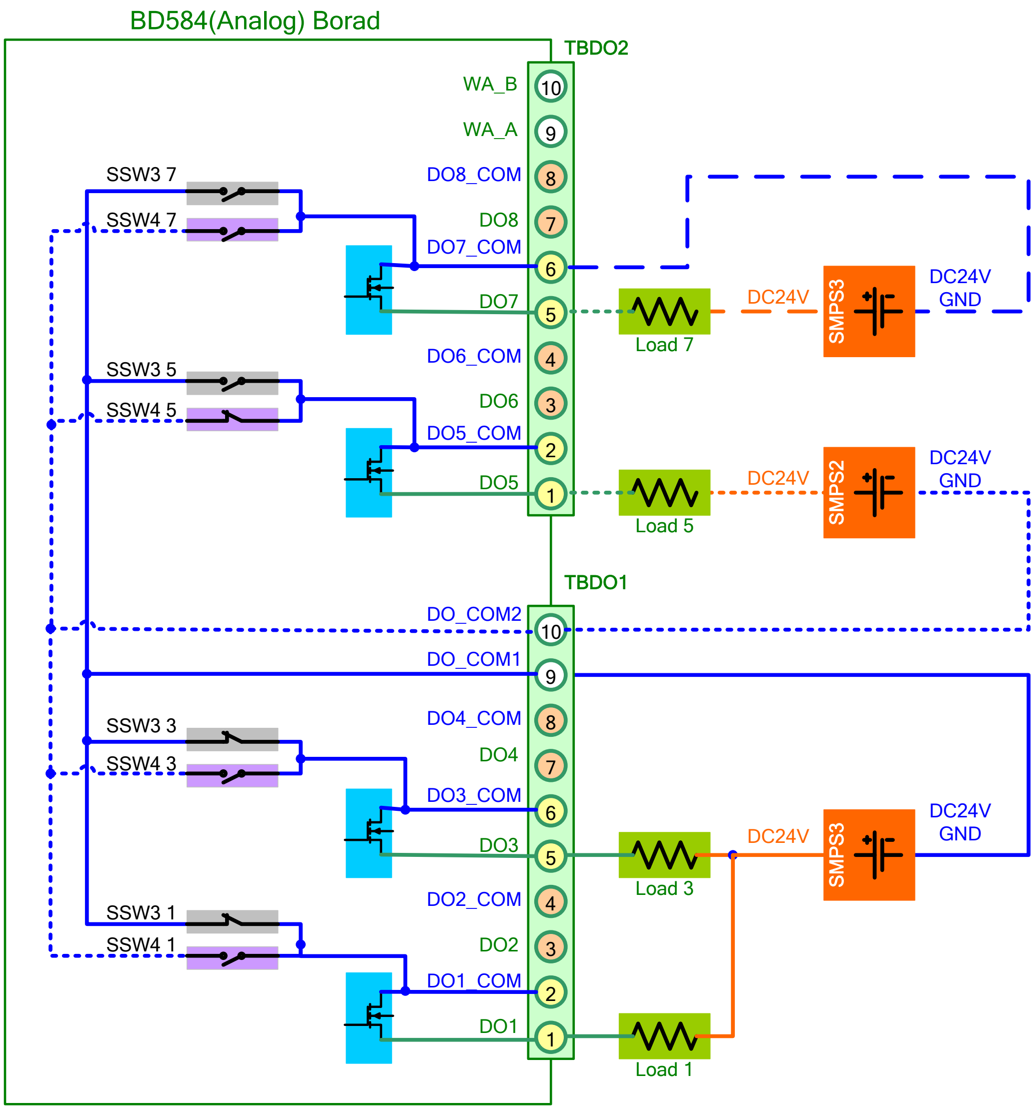


Figure 5.58 Method for Connecting the Digital Output on Analog Board (BD584)

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 5.59 below.

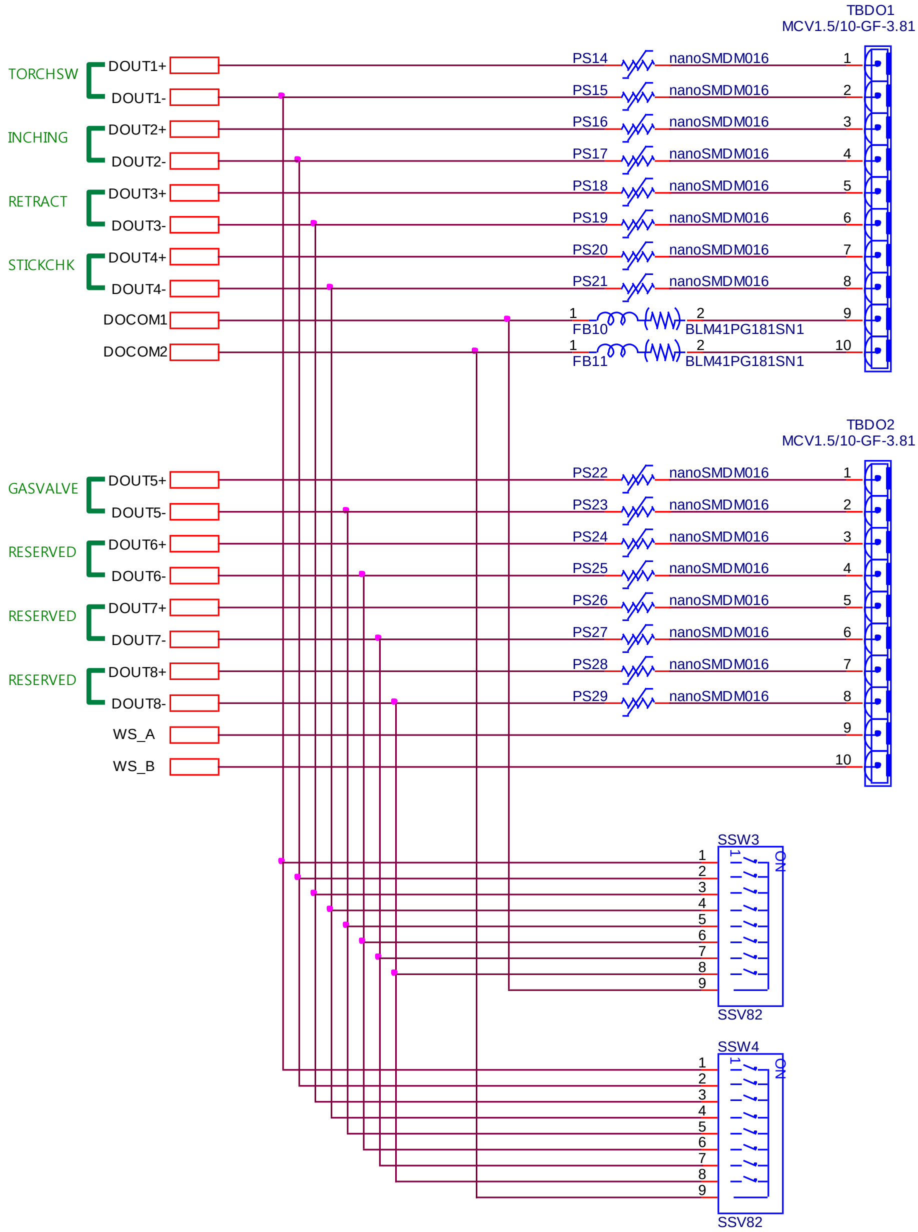


Figure 5.59 Common Circuit of Digital Output on Analog Board (BD584)

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.

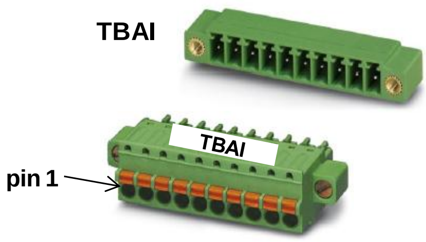


Figure 5.60 Terminal Block for Analog Input on Analog Board (BD584)

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

Table 5-28 Pin Configuration of Analog Input Terminal Block (TBAI) on Analog Board (BD584)

Number	Name	Usage	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 5.61 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.

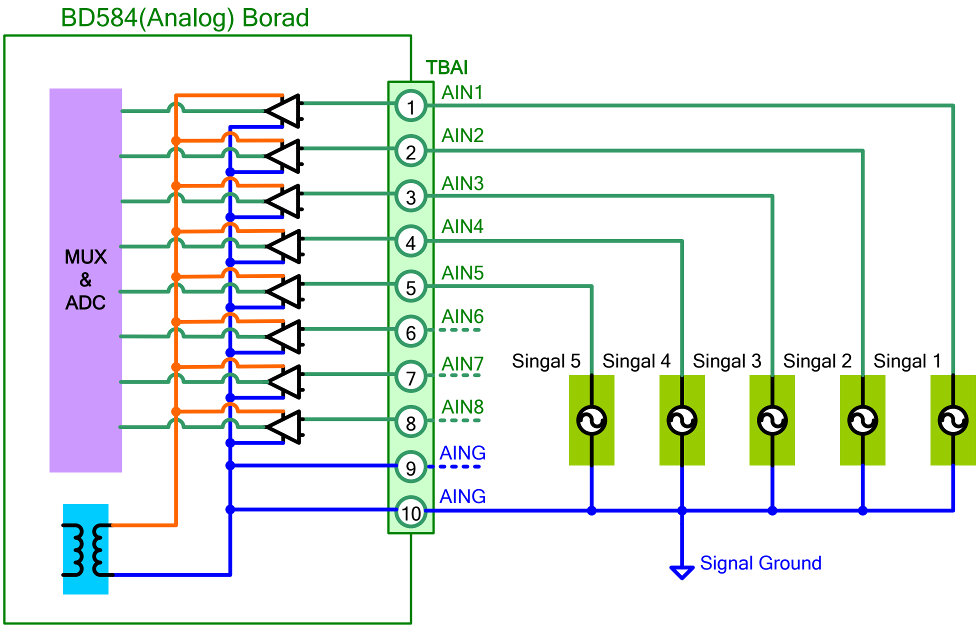


Figure 5.61 Method for Connecting Analog Input on Analog Board (BD584)

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.

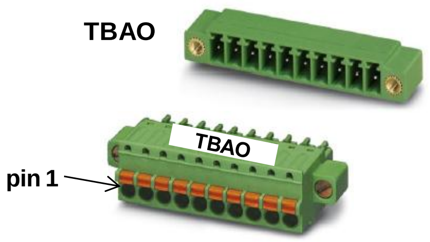


Figure 5.62 Analog Output Terminal Block on Analog Board (BD584)

The pin allocation of terminal block TBAO for analog output is shown in Table 5-29 below.

Table 5-29 Pin Configuration of Analog Output Terminal Block (TBAI) on Analog Board (BD584)

Number	Name	Usage	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 5.63 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.

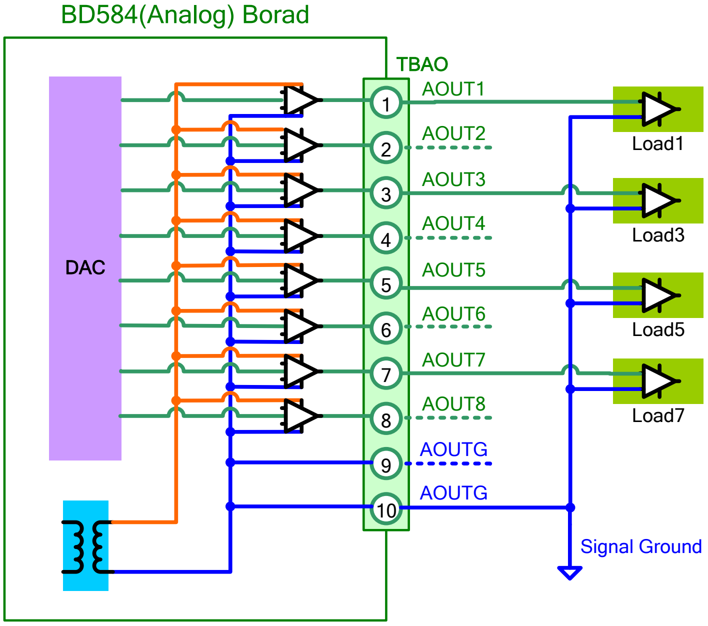


Figure 5.63 Method of Connecting Analog Output on Analog Board (BD584)

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 5.64 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.

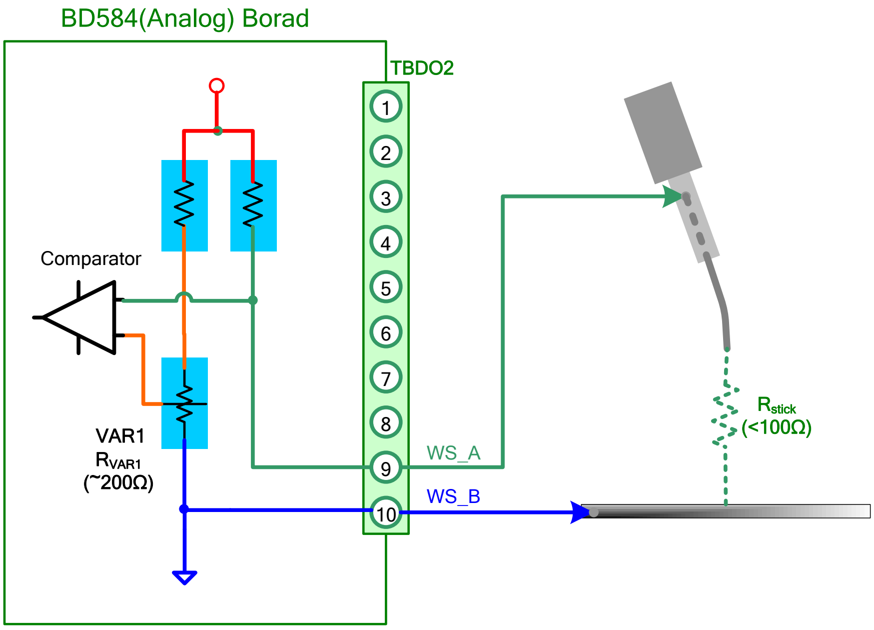
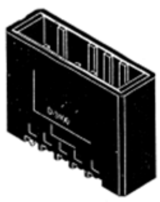


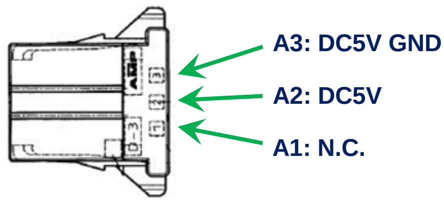
Figure 5.64 Analog Stick Check Function on Analog Board (BD584)

5.9.2.6. Power Connector: CNP1

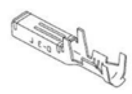
Power is supplied to the board through CNP1 connector. Figure 5.65 describes the exterior and pin allocation of CNP1.



AMP D3100 series
Tab header
1-178313-3



AMP D3100 series
Receptacle Housing
1-178288-3



AMP D3100 series
Contact 917511-3

Figure 5.65 Power Connector CNP1 of Analog Board (BD584)

Table 5-30Pin Configuration of Power Connector CNP1 on Analog Board (BD584)

Number	Name	Usage	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 5.66 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.

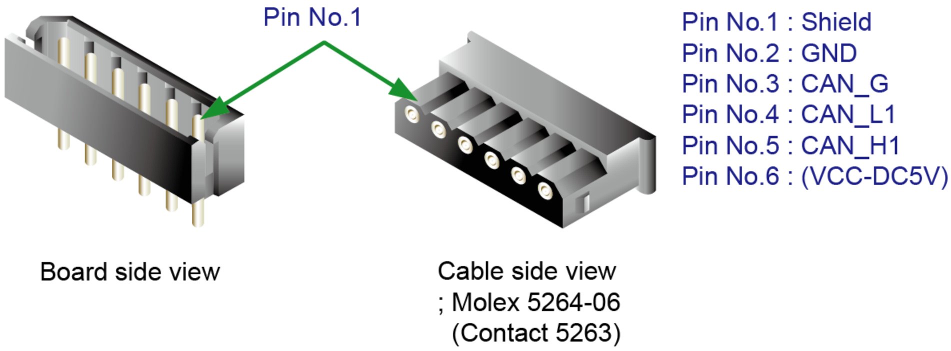


Figure 5.66 Method of Connecting CAN Connector on Analog Board (BD584)

Table 5-31 Pin Configuration of CAN Connector on Analog Board (BD584)

Number	Name	Usage	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

6
Troubleshooting

Hi5 controller emphasizes on high-precision and high-speed(promptness). So, it is designed to facilitate troubleshooting when troubles occur.
Please be fully aware of this MANUAL for troubleshooting.

6.1. Troubleshooting Solution

Troubleshooting cases are explained hereinafter.

6.1.1. E0002 Hardware limit switch operating

6.1.1.1. Outline

Limit switch that is installed at the end of operation area of Robot’s each axis has been activated. The Robot will be immobilized immediately for a safety reason and will not be operational until it is moved to a safe operation area by an appropriate method.

6.1.1.2. Causes and checking methods

(1) Please confirm if the Robot actually went out of operation area
- Actions to be taken when a Robot went out of operation area

(2) If an error occurs though a Robot is in the operation area
- Checking method from a System Board Connector(CNLS)
- Checking method from a Wire Harness(CER1 or CEC1)
- Checking method by examining a limit switch and internal wiring of main frame

(1) Please confirm if the Robot actually went out of operation area

Please confirm if the Robot actually went out of operation area. If a soft limit error has occurred simultaneously, the Robot did go out of operation area.

Please take an appropriate action to move the Robot back into the operation area.

Operation area may vary to the each Robot model, so as the installed location of limit switches. Please refer to the corresponding Robot's maintenance manual - "Limitations of Operation area"

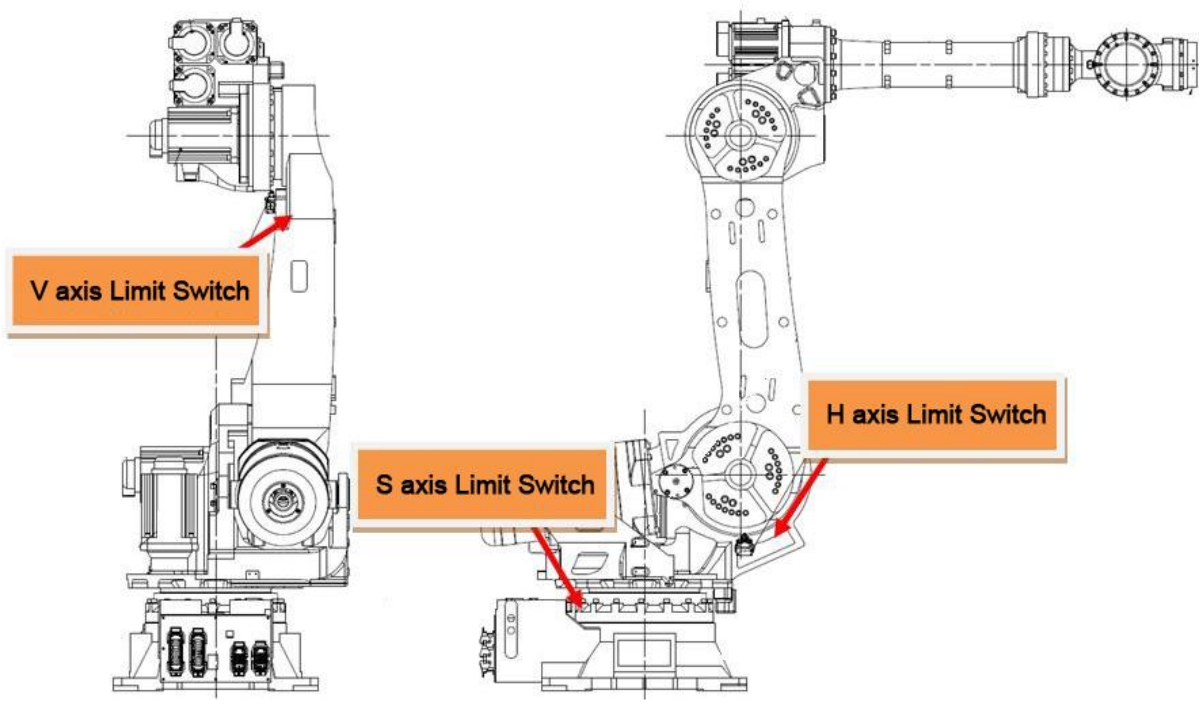


Figure 6.1 Installed Locations of Hardware Limit Switches for HS165/HS200 Robot

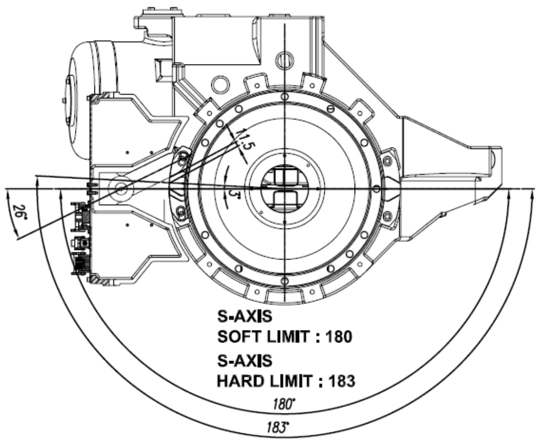


Figure 6.2 Operation Area for S-axis Limit Swith of HS165/HS200 Robot

- Actions to be taken when a Robot went out of operation area

  Please take following actions in order to move a Robot while a hardware limit switch is on. Firstly, enter the system with a manual mode and turn on the enabling switch of Teach Pendant.

  Manual Mode + System + Turn on the TP's enabling switch

  From this stage, execute the Motor On command and move the Robot back into the operation area by using a jog key

(2) If an error occurs though a Robot is in the operation area

Firstly, check if the limit (Over-Travel) is being entered consecutively from the Private input signal window of Teach Pendant

This window can be accessed by selecting “『[F1]: Service』 → 『1: Monitoring』 → 『2: Input/Output Signal』 → 『1: Private input signal』”

A yellow color status on limit (Over-travel) indicates an error status

- Cautions:
  On manual mode, a monitoring is enabled only when a Teach Pendant’s enabling switch is on
  On automatic mode, a monitoring is enabled regardless of a status of enabling switch

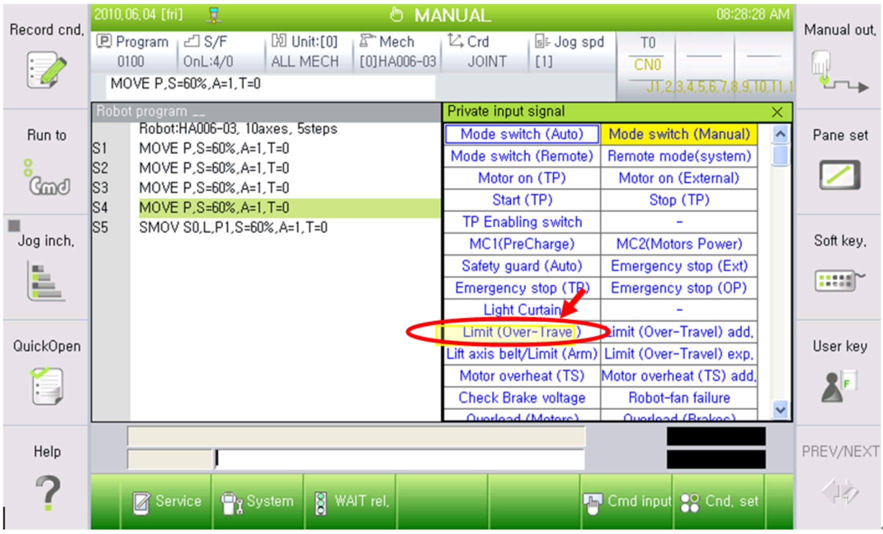


Figure 6.3 Limit (Over-Travel) Monitoring is Displayed from the Private input signal Window

In these cases, cause of this error can be found from the components that are related to the limit switch. As shown in the diagram below, the limit switch is connected to a controller’s System Board from a main frame by using “CER1 – CEC1” cables

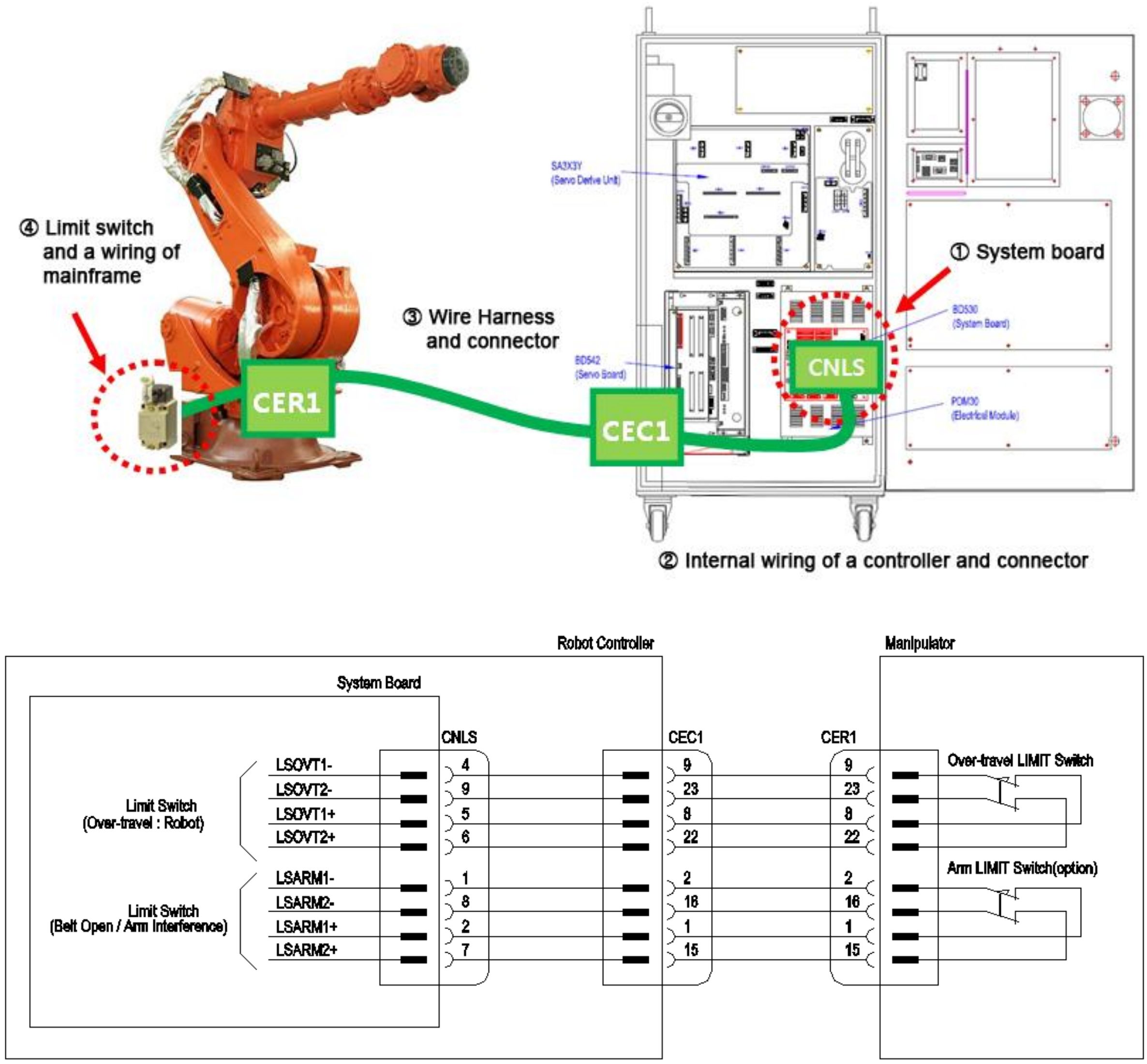


Figure 6.4 Wirings that are related to a Limit Switch Status Input

Main check points and their orders are

① System Board
② Internal wiring of a controller and connector
③ Wire harness and connector
④ Limit switch and a wiring of mainframe

and please jump the input line of limit switch at an appropriate point in order to check if a limit (Over-Travel) from a monitoring windows turns to white color.

Please proceed as follows.

■ **Checking method from a System Board Connector(CNLS)**

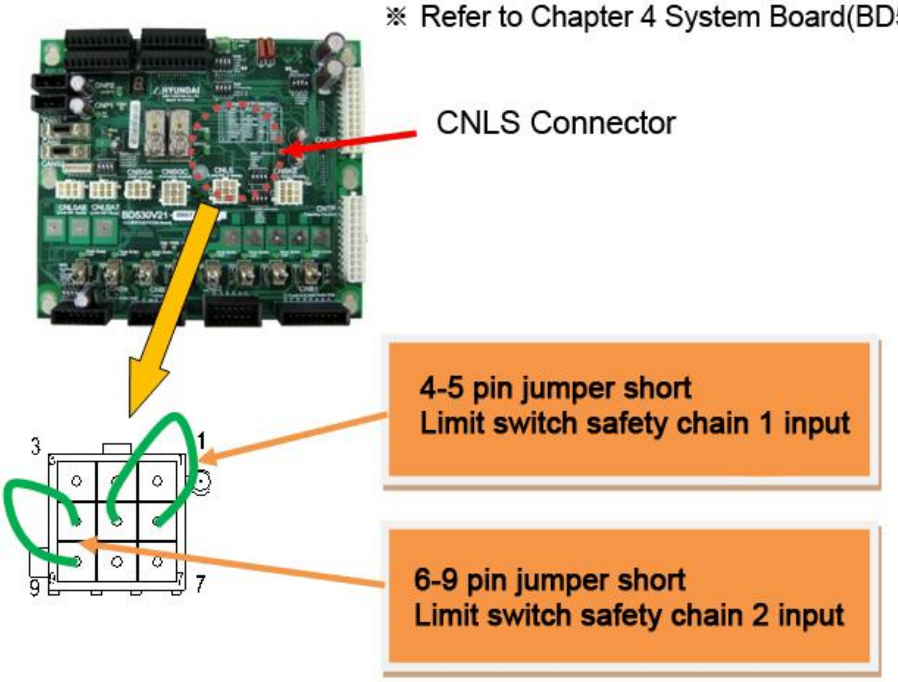
Warning
Please make sure the power of a controller has been completely turned off before you connect or remove any cables. Electrocution may cause personal injuries or a property damages

This method uses a CNLS connector of System Board to judge if the board malfunction caused this error.
Please jumper short the pins that are related to the limit switch's input from a CNLS connector as shown below. At this stage, please check the limit (Over-Travel) from the Private input signal monitoring windows.

① If it turned to a white color, System Board malfunction caused this error. Please replace the board.
② If it is still yellow which indicates that the error persists,

Please search a problem that caused this error in an area between the System Board and the limit switch of main frame.

※ Refer to Chapter 4 System Board(BD530)



■ **Checking method from a Wire Harness(CER1 or CEC1)**

Warning
Please make sure the power of a controller has been completely turned off before you connect or remove any cables. Electrocution may cause personal injuries or a property damages

This method uses a Wire Harness connector (CER1 or CEC1) to judge if the cable malfunction caused this error.
Please remove CEC1 Wire Harness, and jumper short the pins that are related to the limit switch from a CEC1 connector which is attached to a controller. At this stage, please check the limit (Over-Travel) from the Private input signal monitoring windows.

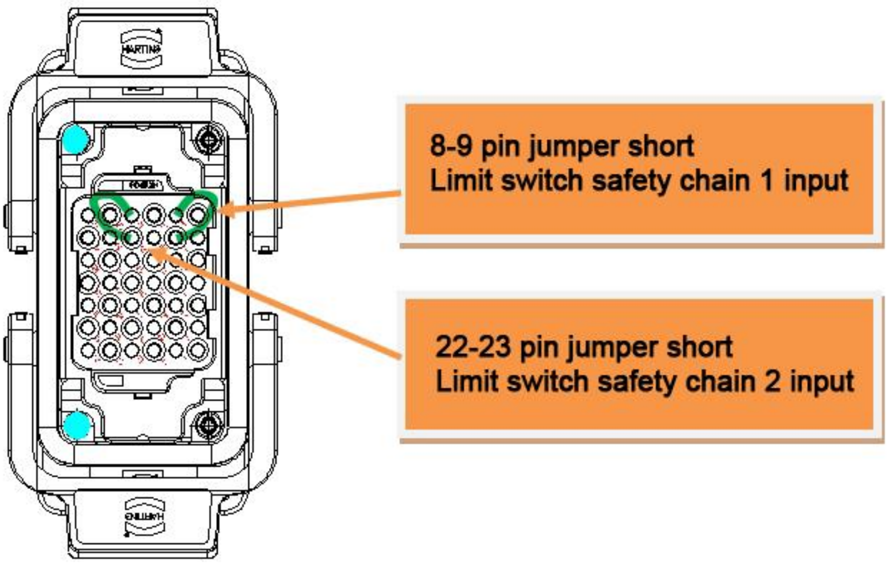
① If it turned to a white color, internal CEC1 Connector (of a controller) - System Board cable or a connector malfunction caused this error. Please examine them or replace them.

② If it is still yellow which indicates that the error persist, please search a problem that caused this error in an area between the CEC1 connector and the limit switch of main frame.

Please reconnect CEC1 Wire Harness, and remove the CER1 Wire Harness from a main frame. After that, please jumper short the pins that are related to a limit switch from a CER1 connector.
At this stage, please check a limit (Over-Travel) from the Private input signal monitoring windows.

① If it turned to a white color, Wire Harness cable between CER1 Connector-CEC1 Connector or a connector malfunction caused this error. Please examine them or replace them.

② If it is still yellow which indicates that the error persist, please search a problem that caused this error in an area between the mainframe side's CER1 connector and the limit switch.



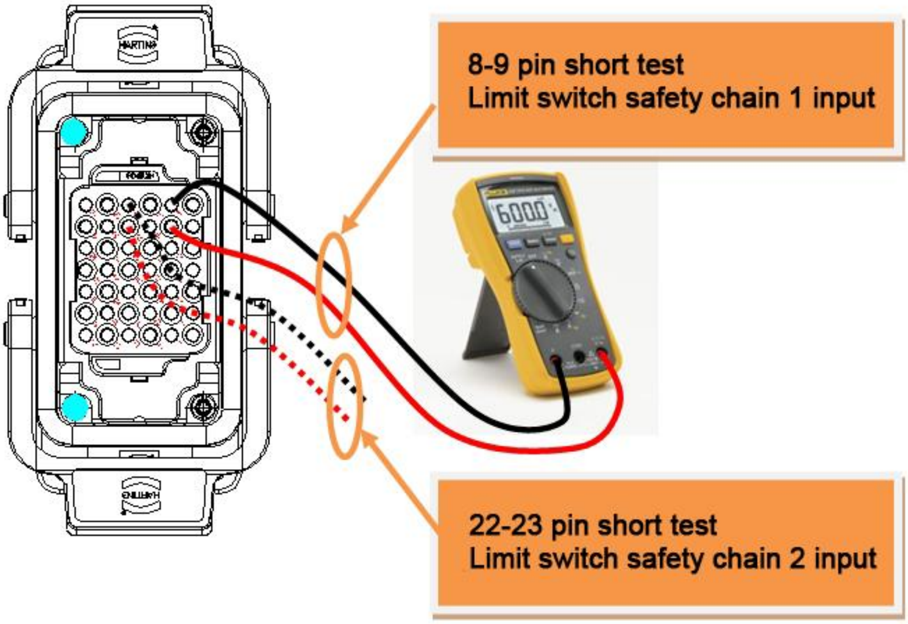
■ **Checking method by examining a limit switch and internal wiring of main frame**

Warning
Please make sure the power of a controller has been completely turned off before you connect or remove any cables. Electrocution may cause personal injuries or a property damages

Please remove the CER1 Wire Harness from a main frame, and use a multi meter to run a short (shortage) test to examine the lines that are related to the limit switch from a main frame's CER1 connector.

① If resistance is measures as open status, limit switch or a limit switch – CER1 connector, or a connector malfunction is suspected. Please examine or replace them.

② If resistance is measured as short (shortage) status, other parts need to be examined. Please make an enquiry to our office.



6.1.2. E0010 AMP recovery discharge resistance overheating

6.1.2.1. Outline

Recovery electric power that generated when Robot reduces a speed or moving toward to a gravity direction is discharged by resistance.
This error is related to an overheat that caused by the resistance.
This error may occurs due to a reduced performance of cooling fan, overheat detection sensor's circuit malfunction, disconnection of the resistor, overload of recovery discharge capacity that caused by momentary rapid movement or a continuous movement of robot.

6.1.2.2. Causes and checking methods

<Case : Error always occurs even when the motor is off>

(1) Please examine the components that are related to the overheat error detection
- Please examine the resistor of CNTR cable
- Please replace CNSGC cable and examine it
- Please replace BD530/BD531 board and examine it
- Please replace diode module and examine it

<Case : Error always occurs at the moment when the motor turns on>

(2) Please examine the components that are related to the power
- Please examine the resistance value of CNDR cable
- Please replace diode module and examine it
- Please examine the 3-phase voltage from the inside of controller
- Please examine the controller's 3-phase input voltage

<Case : Error occurs at a certain step according to the Robot's operation speed>

(3) Please make changes on a speed of Robot's operation in order to confirm the error
- Please reduce the speed of Robot's operation in order to confirm the error
- Please examine the recovery discharge resistance value

<Case : Error occurs after 5 minutes from the start up of Robot's operation>

(4) Please examine the controller's cooling system and recovery electric power level
- Please examine the operational status of each fan
- Please examine the power voltage of each fan
- Please reduce the speed of Robot's operation in order to confirm the error

(1) Please examine the components that are related to the overheat error detection
Recovery resistance overheat error is detected by Servo Drive Unit. Each end's On/Off status of overheat sensor that are attached to a recovery resistor is being monitored by CNTR connector. Detected error will be sent through CNSGC cable to be handled by software at the BD530/BD531 board.

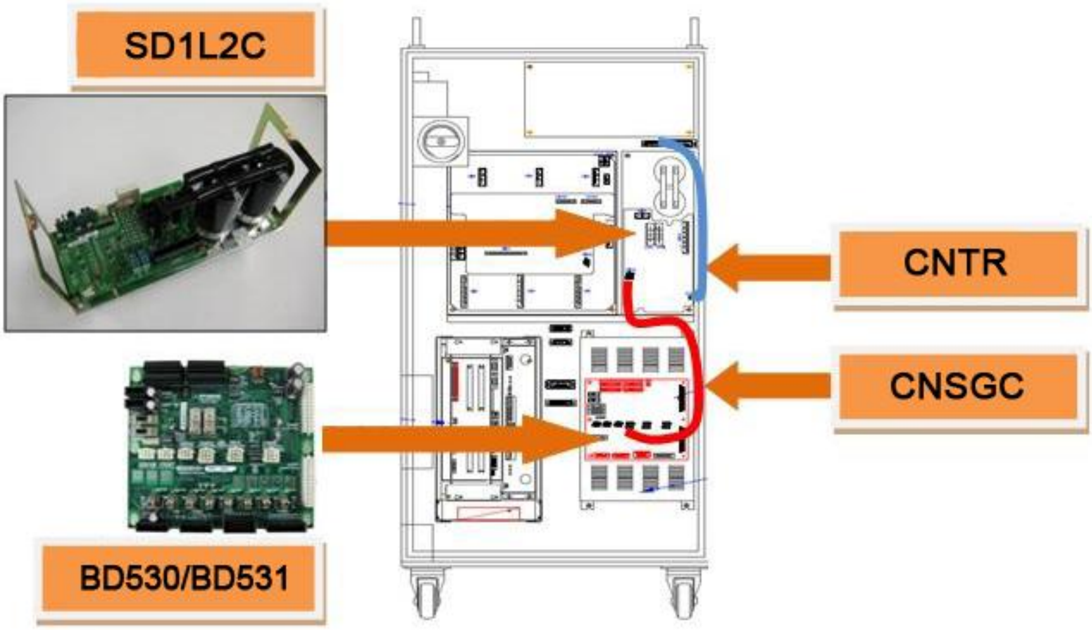


Figure 6.5 Locations of Components in Hi5-N00 Controller that are related to Recovery Resistance Overheat Error

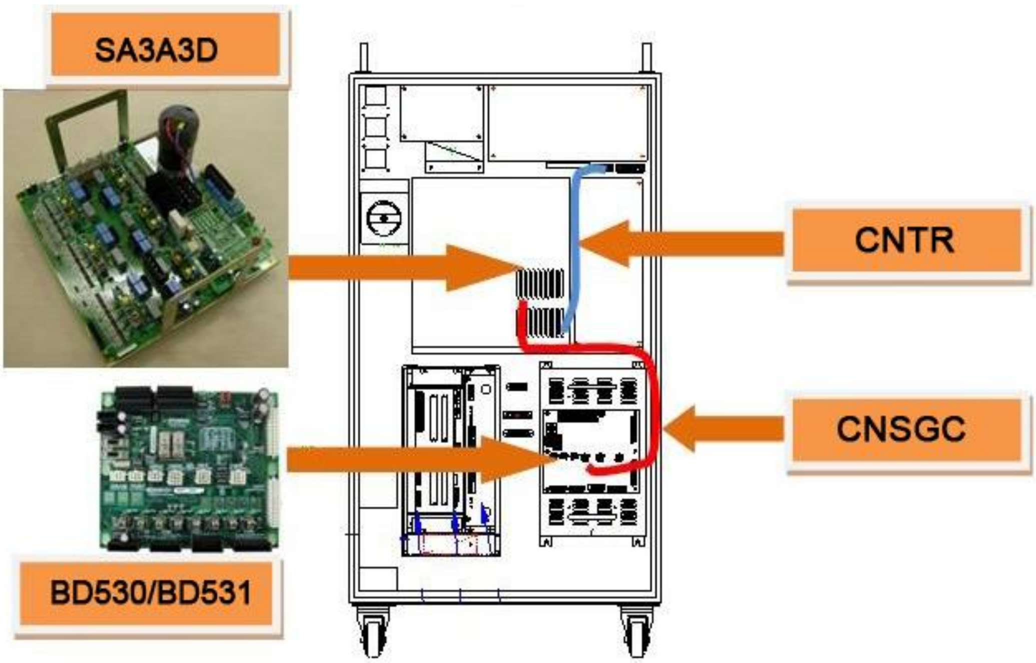


Figure 6.6 Locations of Components in Hi5-N30 Controller that are related to Recovery Resistance Overheat Error

- **Examining the CNTR cable**
  Please examine the sensor from a CNTR connector that connects the overhear detection sensors.
  In a normal status, sensor must be measured less or than 0.1 ohm

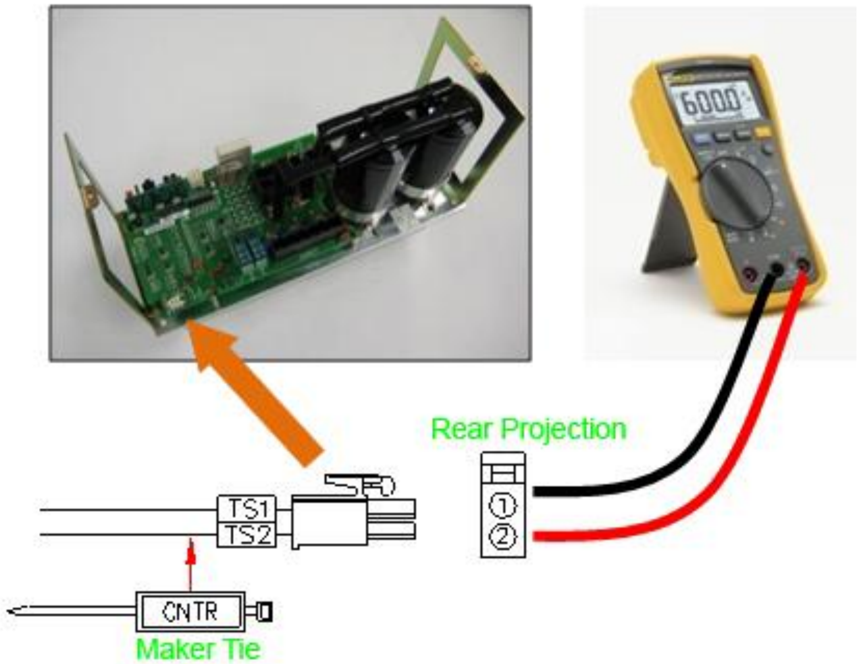


Figure 6.7 Measuring Resistance Value from Hi5-N00 Controller's CNTR

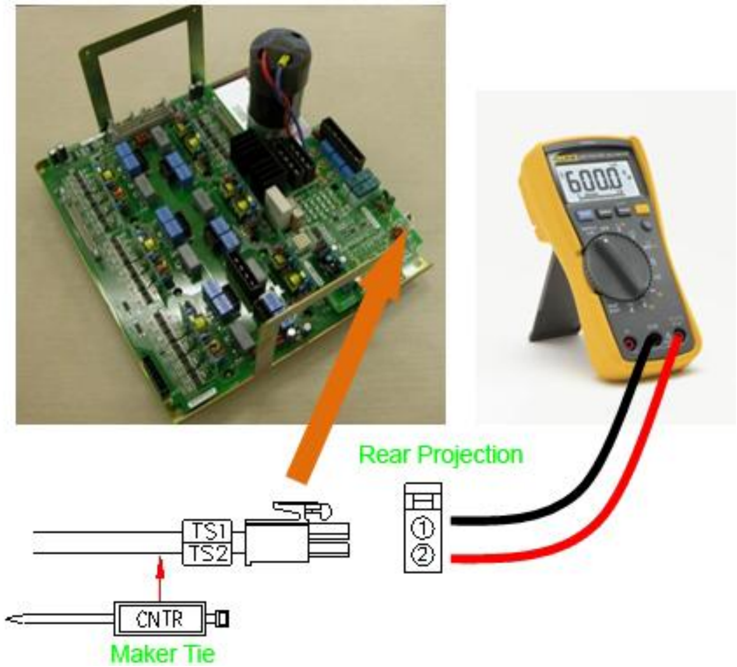


Figure 6.8 Measuring Resistance Value from Hi5-N30 Controller's CNTR

- Replacement and examining of CNSGC cable
  Replace the CNSGC cable with new one and test it. If the error does not persist, cable connection problem caused this error. Please replace the CNSGC cable with new one.

- Replacement and examining of BD530/BD531
  Replace the BD530/BD531 with new one and test it. If the error does not persist, the board malfunction caused this error. Please replace the BD530/BD531 with new one.

Figure 6.9 Replacement of BD530/BD531

- Replacement and examining of diode module
  Components that detects the recovery discharge resistance overheats error are SD1L2C (large size) and SA3A3D (small size). Please check the components in the controller that you are currently using and examine it. Please replace it with new one and see if the error persists.

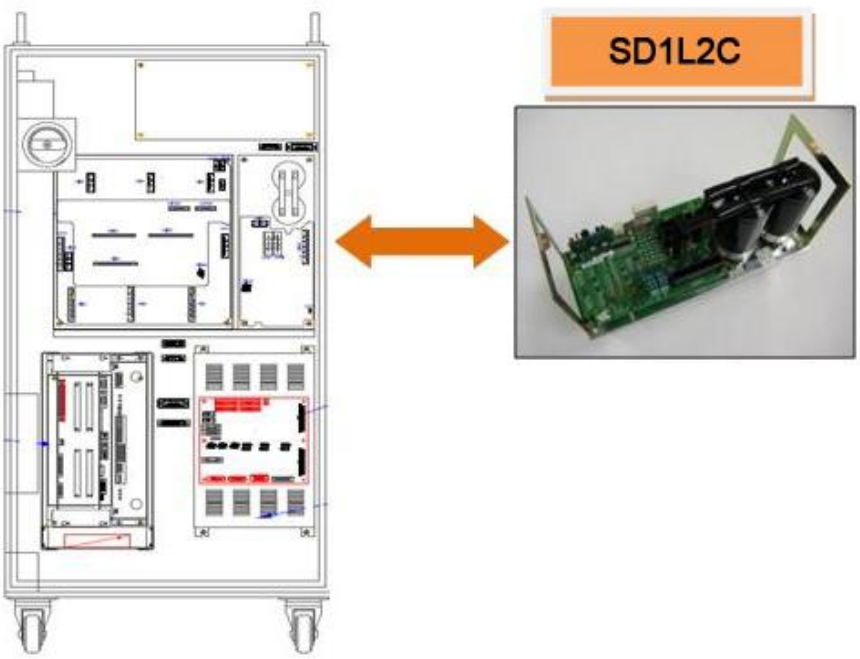


Figure 6.10 Replacement of SD1L2C in Hi5-N00 Controller when Recovery Discharge Resistance is Overheated

(2) Please examine the components that are related to the power

Overhear error may occurs in a case when resistor has disconnection or discharge control malfunction. It also can occur when recovery discharge resistance value and a 3-phase voltage increases.

- Examining recovery discharge resistor's disconnection
  If measured resistance value at the end of CNDR cable is many M ohm, the resistor's disconnection or connection problem of internal wiring caused this error. Please replace the recovery resistor with new one or repair the wiring.

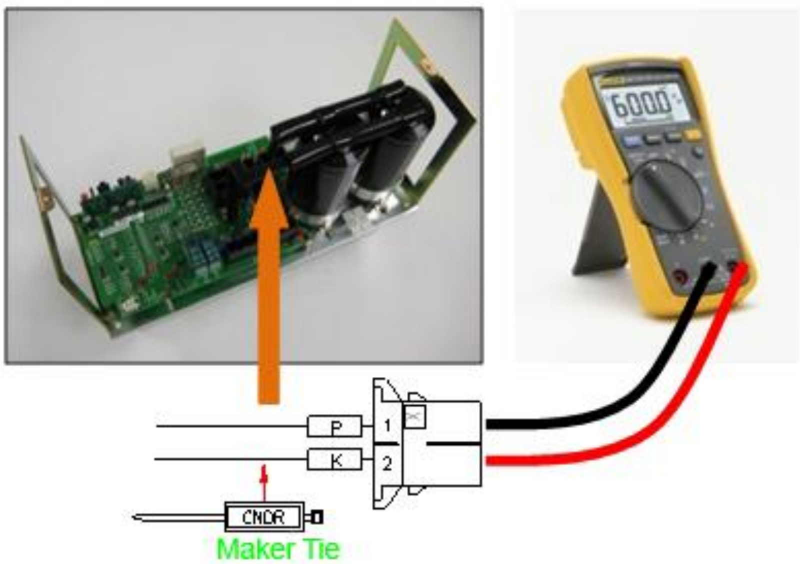


Figure 6.11 Measuring Resistance Value from CNDR of Hi5-N00 Controller

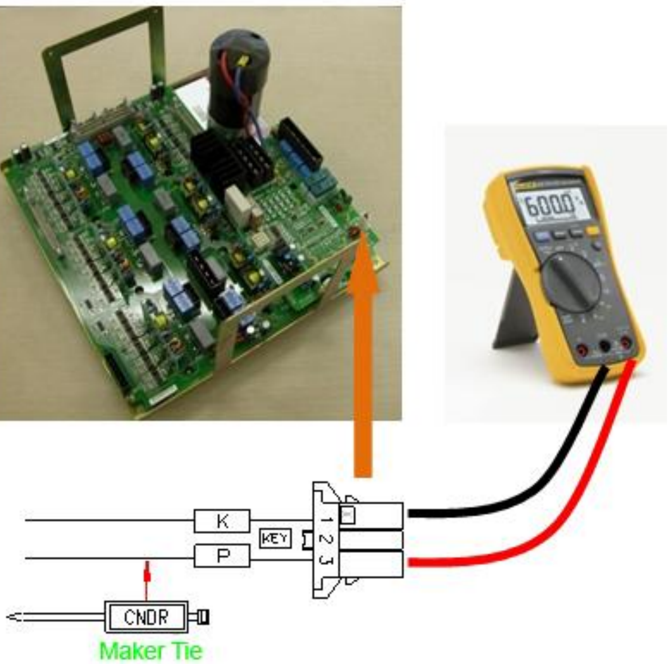


Figure 6.12 Measuring Resistance Value from CNDR of Hi5-N30 Controller

- Replacement and examining of diode module
  Please replace a module (SD1L2C for large size, SA3A3D for small size) that detects a recovery discharge resistance overheat error and check if an error persists. An error may occur continuously due to a module's internal circuit malfunction. For a large size controller, diode module is separated from the Servo Drive Unit, and for a small size controller, it is located inside of the Servo Drive Unit.

  - Large size Robot's diode module: SD1L2C
  - Small size Robot's Servo Drive Unit: SA3A3D

- Examine the 3-phase voltage (inside of the controller)
  Recovery discharge operation activates from approximately DC 375V
  If a voltage over AC242 V enters to the Servo Drive Unit, a recovery discharge resistance overheat error may occur when the motor turns on.
  If the input voltage exceeds the allowed range, please examine according to a controller's input voltage examination procedures and a controller's 3-phase internal voltage examination procedures.

  - Servo Drive Unit input voltage specification: 3-phase AC 220V
  - Allowed range when motor turns on: 198 V ~ 242 V

(3) Please make changes on a speed of Robot's operation in order to confirm the error

In case when a Robot's speed is reducing, or moving toward to gravity direction, direct current voltage of a Servo Drive Unit increases, and the voltage will be discharged with a recovery discharge resistance in order to prevent damages on components that may caused by voltage increase.
If a Robot reduces its speed rapidly, or make a high speed movement toward to gravity direction, it may cause this error. Please confirm if this error occurs according to the speed of Robot's operation.

- Make changes on a speed of Robot's operation
  If a recovery electric power that generated by Robot's operation exceeds the controller's designed specification, recovery resistance overheat error may occurs. Please reduce the speed of a step that the error occurs and re-operate in order to confirm if the error persists.

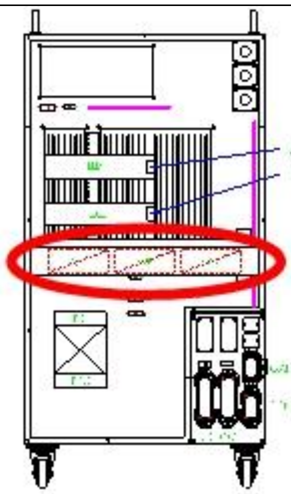
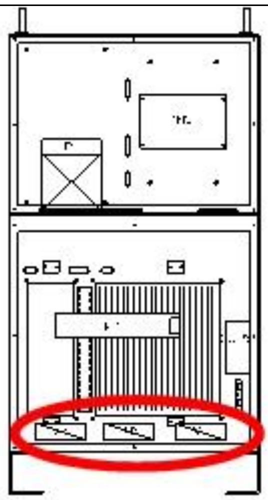
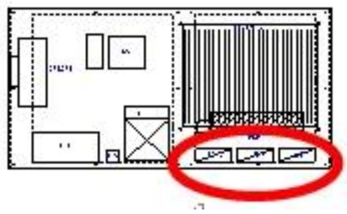
- Examining recovery discharge resistance value
  If a measured resistance value at the end of CNDR cable exceeds over 10% of the value described in the manual, the resistor malfunction is the cause of this error. Please replace the resistor. Please refer to the previous page for the measuring method.

  - Large size (SD1L2C) recovery discharge resistance value : 5 ohm
  - Small size (SA3A3D) recovery discharge resistance value : 15 ohm

(4) Please examine the controller's cooling system and recovery electric power level

If recovery resistance overheat error occurs after 5 minutes from the start up of Robot's activation, the cause would be either the controller's cooling system malfunction or a speed of Robot's operation exceeded the designed specification of the controller.
Fans are being used at rear of the controller in order to cool down the Servo Drive Unit's heat sink and the recovery discharge resistor

Table 6-1 Location of Fans for Each Controller

Hi5-N**	Hi5-C1*	Hi5-C0*
		

- Examining the operational status of each fan
  Please replace a fan if it does not spin, or the speed is abnormally slow. Lifetime of a fan may vary according to a operating environment or a amount of operated hours.

- Examining fan's power voltage
  Please check the input voltage of fans if all of them do not operate. Input voltage of a fan is set to AC220V and the allowed range is within 10% of the standard voltage. If voltage is lower than 10% of the standard voltage, the cooling effect will be reduced due to slow spinning speed of a fan. In case when the voltage is low, please check the input voltage for fan's power supply connector (CNFN2) and a controller.

- Please confirm an occurrence of an error according to the speed of Robot's operation
  If an overheat error occurs during a continuous operation over 5 minutes, it is because of the consecutive operation of Robot exceeded the cooling capacity of a controller.
  Please reduce the speed of Robot's operation and check if the error persists.
  In order to resolve this error, if you had to reduce the operation speed too much just to resolve this error, please enquire at our office

6.1.3. E0011 AMP overvoltage (P-N)

6.1.3.1. Outline

Direct current voltage (P-N) of Servo Drive Unit that drives the motor exceeded the set value

6.1.3.2. Causes and checking methods

<Case : Error always occurs even when the motor is off >

(1) Please examine the components that are related to the overvoltage error detection

- Please replace CNSGC cable and examine it CNSGC
- Please replace BD530/BD531 board and examine it BD530/BD531
- Please replace diode module and examine it

<Case : Error always occurs at the moment when the motor turns on>

(2) Please examine the components that are related to the power

- Please replace diode module and examine it
- Please examine the 3-phase voltage from the inside of controller
- Please examine the controller’s 3-phase input voltage

<Case : Error occurs at a certain step according to the Robot’s operation speed>

(3) make changes on a speed of Robot’s operation in order to confirm the error

- Please reduce the speed of Robot’s operation in order to confirm the error
- Please examine the recovery discharge resistance value

(1) Please examine the components that are related to the overheat error detection
AMP overvoltage occurrence error is detected by diode module when direct current voltage (P-N) that supplied to the Servo Drive Unit exceeds the configured level. Detected error will be sent through CNSGC cable to be handled by BD530/BD531 board.

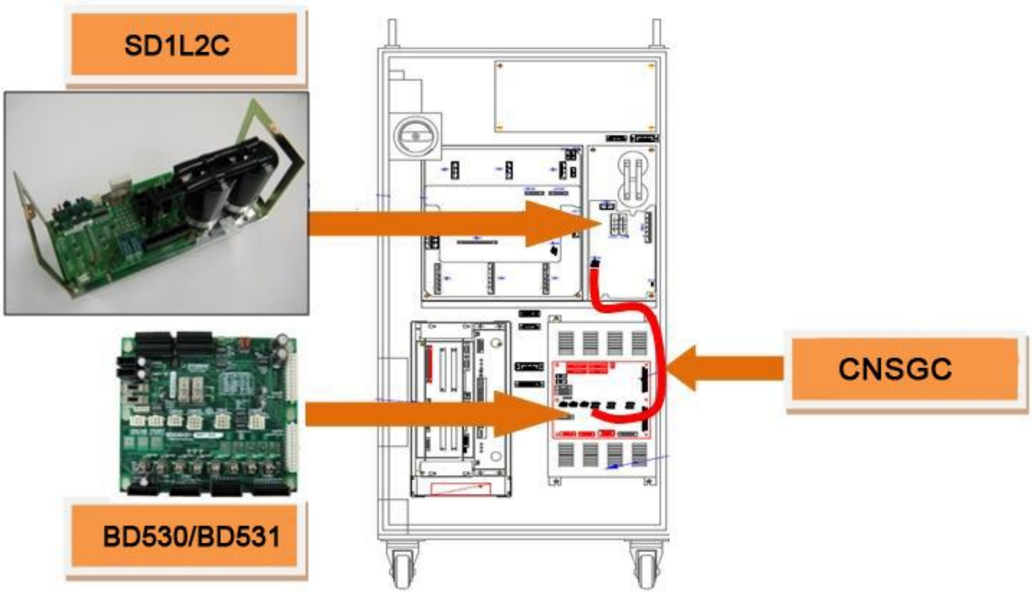


Figure 6.13 Locations of Components in Hi5-N00 Controller that are Related to Overvoltage Occurrence Error

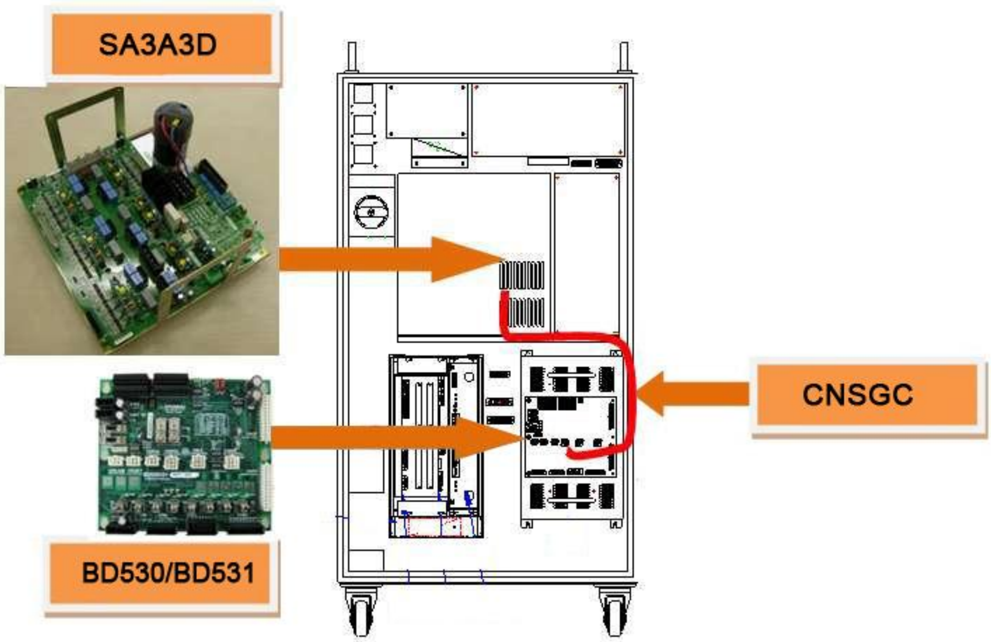


Figure 6.14 Locations of Components in Hi5-N30 Controller that are Related to Overvoltage Occurrence Error

- Replacement and examining of CNSGC cable
  Replace the CNSGC cable with new one and test it. If the error does not persist, cable connection problem caused this error. Please replace the CNSGC cable with new one.

- Replacement and examining of BD530/BD531 BD530/BD531
  Replace the BD530/BD531 with new one and test it. If the error does not persist, the board malfunction caused this error. Please replace the BD530/BD531 with new one.

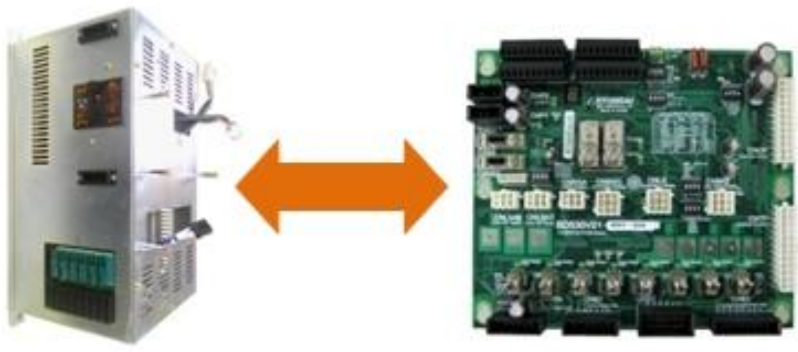


Figure 6.15 Replacement of BD530/BD531

- Replacement and examining of diode module
  Components that detects the AMP overvoltage occurrence error are SD1L2C (large size) and SA3A3D (small size). Please check the components in the controller that you are currently using and examine it. Please replace it with new one and see if the error persists.

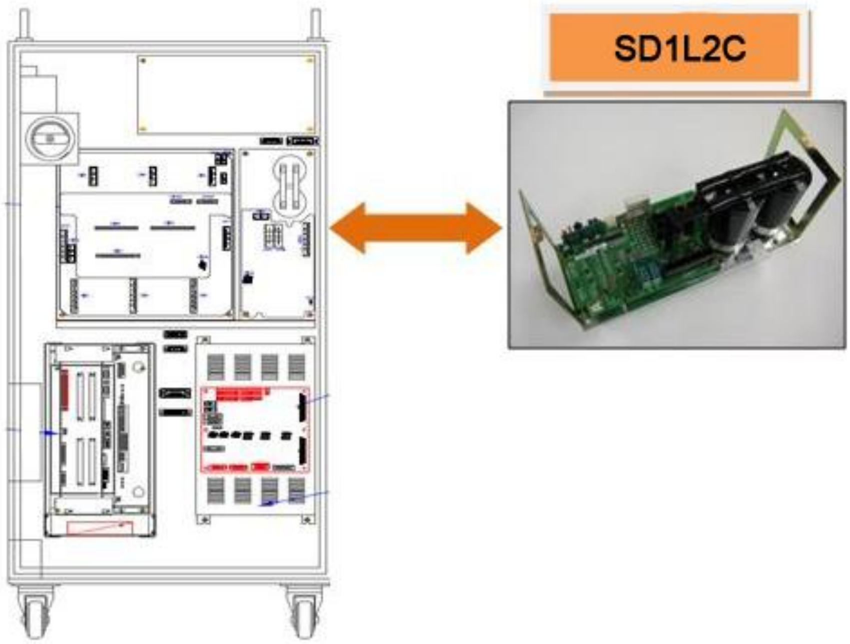


Figure 6.16 Replacement of SD1L2C in Hi5-N00 Controller when Overvoltage Occured

HYUNDAI HEAVY INDUSTRIES CO.,LTD.

(2) Please examine the components that are related to the power

Overvoltage error occurs when direct current voltage that exceeds DC395V due to 3-phase input voltage over AC 220V enters to the Servo Drive Unit.

- Replacement and examining of diode module
  Please replace a module (SD1L2C for large size, SA3A3D for small size) that detects AMP overvoltage error and check if the error persists. An error may occur continuously due to module's internal circuit malfunction.

  - Large size Robot's Servo Drive Unit : SD1L2C
  - Small size Robot's Servo Drive Unit : SA3A3D

- Examine the 3-phase voltage
  AMP overvoltage error is activated from approximately DC 395V
  If voltage over AC242 V enters to the Servo Drive Unit, a recovery discharge resistance overheat error may occur when the motor turns on.
  If the input voltage exceeds the allowed range, please examine according to a controller's input voltage examination procedures and a controller's 3-phase internal voltage examination procedures.

  - Servo Drive Unit input voltage specification : 3-phase AC 220V
  - Allowed range when motor turns on : 198V ~ 242V

(3) Please confirm the occurrence of error according to the speed of Robot's operation

If a robot reduce the speed rapidly, or make a high speed movement toward to gravity direction, it can cause an overvoltage error. Please confirm if an error occurred according to a speed of Robot's operation.
AMP overvoltage occurrence error also can be caused by an invalid recovery discharge resistance value or recovery discharge control malfunction.
In case when a Robot's speed is reducing, or moving toward to gravity direction, voltage of the Servo Drive Unit increases, and the voltage will be discharged with a recovery discharge resistance in order to prevent damages on components that may caused by an increased voltage.

- Make changes on a speed of Robot's operation
  If a recovery electric power that generated by Robot's operation exceeds the controller's designed specification, overvoltage error may occurs. Please reduce the speed of a step that the error occurs and re-operate in order to confirm if the error persists. If the error does not occur when the speed is reduced, please change the speed of step and use it.

- Examining the recovery discharge resistance value
  If a recovery resistance value is greater than the specification, recovery discharge does not perform well and it will cause the overvoltage error. Recovery resistance specifications are subject to be changed according to the controller's specification. Please refer to a manual and a controller check sheet that provided upon a purchase.
  If the resistance value exceeds 10 % of specification, please replace it.

  - Large size (SD1L2C) recovery discharge resistance value : 5 ohm
  - Small size (SA3A3D) recovery discharge resistance value : 15 ohm

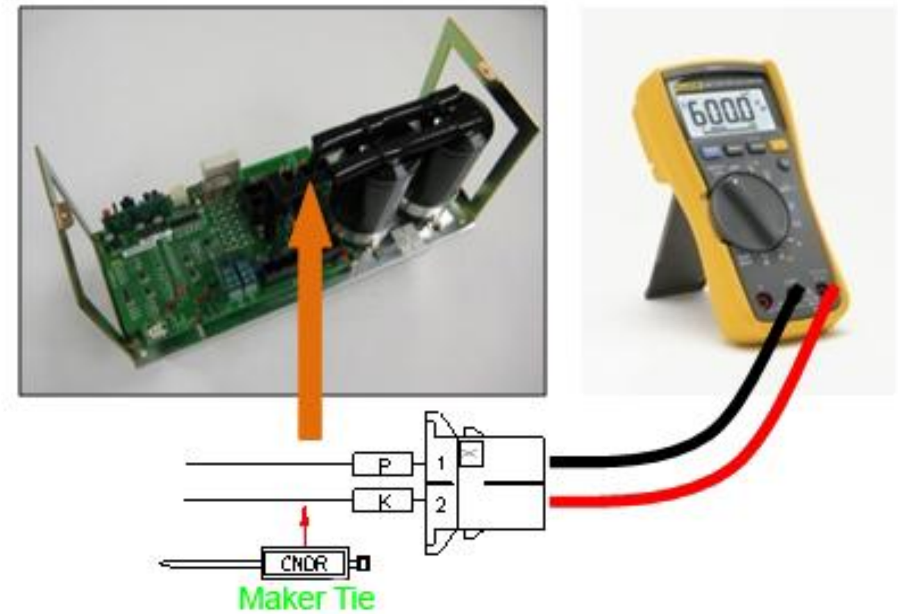


Figure 6.17 Measuring Resistance Value from CNDR of Hi5-N00 Controller

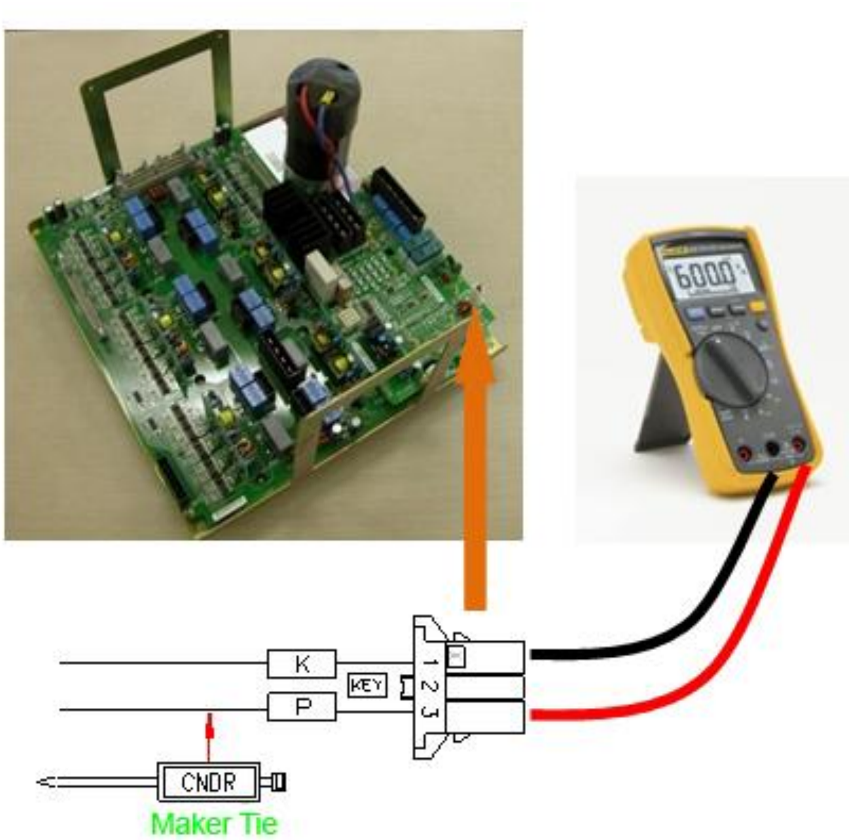


Figure 6.18 Measuring Resistance Value from CNDR of Hi5-N30 Controller

6.1.4. E0014 Instant contact of safety switch (EM, OTR, TS etc.)

6.1.4.1. Outline

For some reason the motor's power supply to AMP has been shut down. Main examines the safety signals in order find the reason of the motor's power shut down. If no reason is found, this message will be displayed

.
Following diagram shows compositions of various safety signals that can shut down the motor's power. Main periodically examines the ON/OFF status of those safety signals. If a momentary contact malfunction occurs between the periods, main will not be able to detect it and displays this message instead

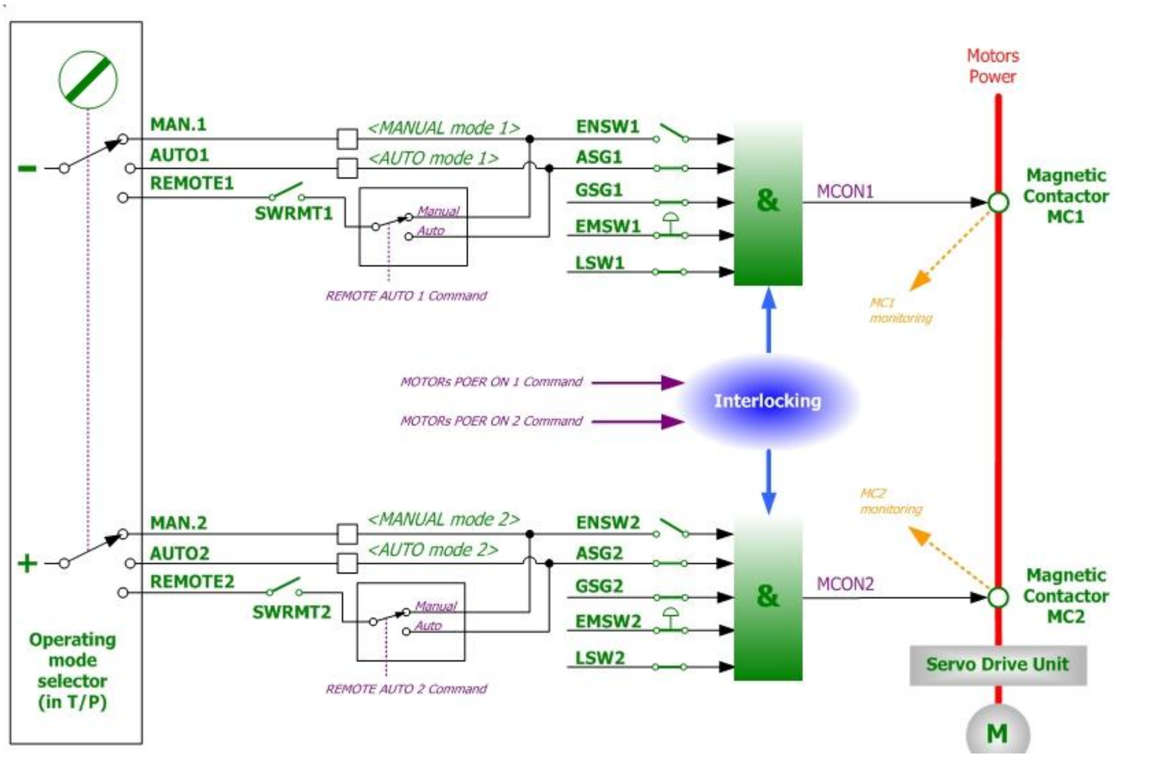


Figure 6.19 Concept Diagram of Safety Circuit for Motor's Power ON/OFF

6.1.4.2. Causes and checking methods

(1) Please check the status of DC 24V (P1-M1) power and cables (2) Please check if there is a problem with CPUERR, EXOUT signals (3) Please check the safety switch and signal wirings (4) Please check the System Board, Electrical Module

(1) Please check the status of DC 24V (P1-M1) power and cables

Please check if the System Board is being supplied with DC 24V control power (P1, M1) properly. This error can be caused if there is a problem with the power as it will effect the safety sequence of the System Board. Power is to be supplied by SMPS's CN6 Connector-System Board CNP2 Connector. Please check if the power level is varying or is there any problem with the cable.

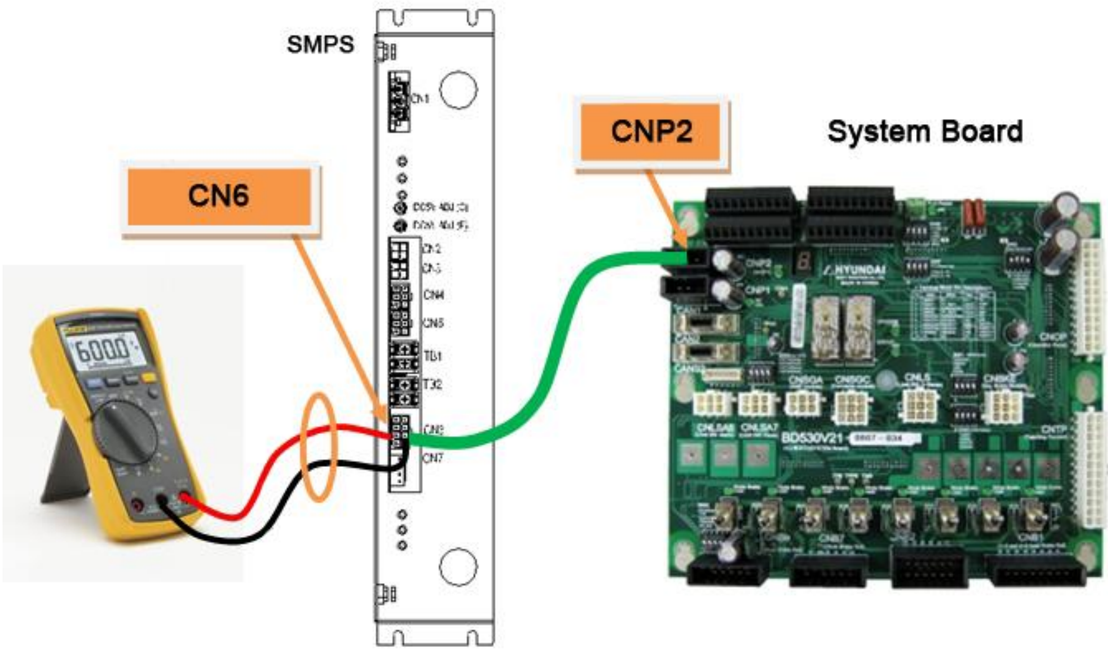


Figure 6.20 Method of Connecting DC24V Power and Measuring Voltage of the System Board (BD530)

(2) Please check if there is a problem with CPUERR, EXOUT signals

Mainboard generates CPUERR or EXOUT signals in a case when systemic error has occurred (e.g. power shut down, Servo error). This signal will be transferred to the System Board and block the motor on command in terms of hardware. Motor's power will be immediately shut down for a safety reason. However, these signals may be generated abnormally, and it will shut down the motor's power.

- How to judge:
  System Board's 7-segment index may give you an indication of the situation.7-segment displays "H" when CPUERR is being transmitted to the System Board. Also the CPUERR, EXOUT LED which located at the center of the System Board indicate the error situation (figure 6.21) These LED lights will be on if it is a normal status, and the lights will be off if it is not.

  However if the signal appears time to time for a very short moments, 7-segment and LED won't be able to indicate it. In such case, error occurrence must be observed while ignoring the two signals by using DIP switch SW1. Method to ignore the signal is to, as shown in the figure 6.21, turn on the No 1(to ignore CPUERR) and the No 2 (to ignore EXOUT) of the DIP switch SW1. At this point all LED lights will be on.

  If the error no longer persists after the system restart, mainboard generated these signals or CANS1 Connector/Cable malfunction is suspected.

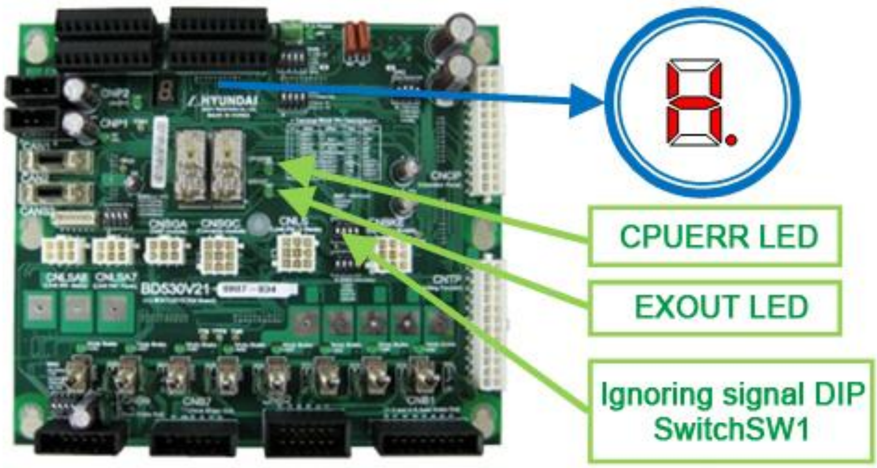


Figure 6.21 Location 7-SEG, LED and DIP Switch (CPUERR error related) on a System Board

- Actions :
  If a Main Board generating this signal without any other indication of errors, please check the PLD version of the Main Board. Over V0.7 is normal. If mainboard's PLD version is normal, please examine the CANS1 connector and cables.

Cautions : Please use only No 1(to ignore CPUERR) and No2(to ignore EXOUT) of the DIP switch SW1 for a testing purpose and please switch it back to normal after the test. This ignores the emergency safety related functions and it may cause safety related problems if operates while ignoring these functions.

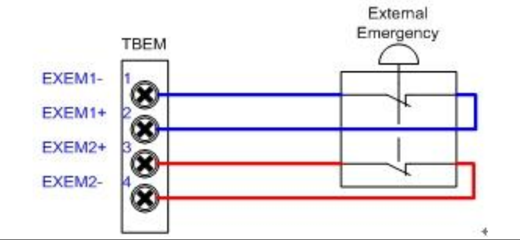
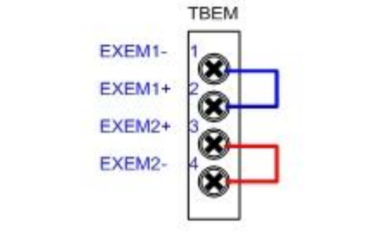
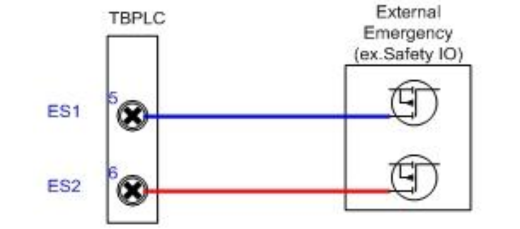
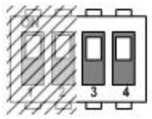
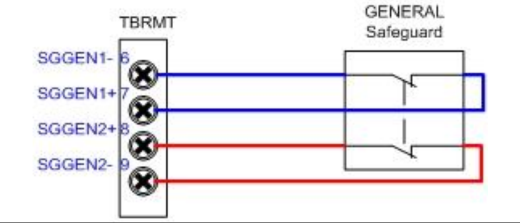
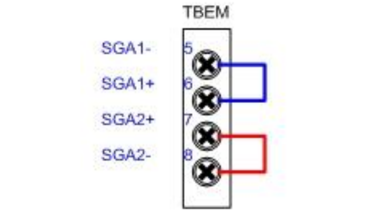
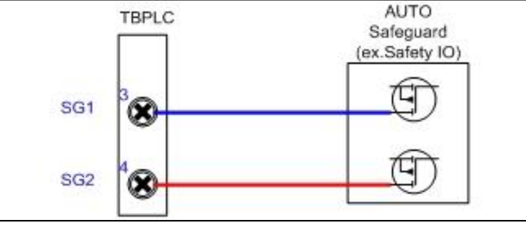
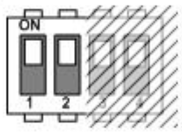
(3) Please check the safety switch and signal wirings

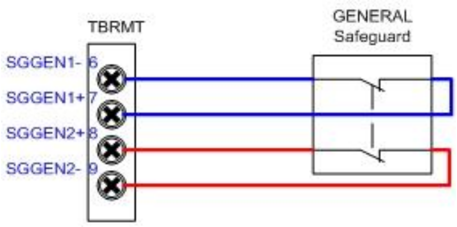
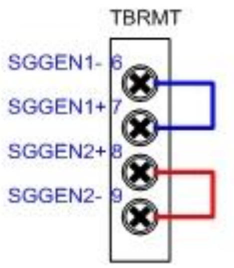
Safety switch input may goes OFF for a short moment which cannot be detected by the Main Board for following reasons

- Switch malfunction
- Wiring malfunction : Exposure or damage on a cable
- Wirings installation problem:
  Seperated distance between power lines, cables that consume a large amount of electric power must be greater than 10 CM. Alternatively electrical shielding by using a metal marital plates are required.

Cautions : Please use only for a testing purpose and please switch it back to normal after the test. This ignores the emergency safety related functions and it may cause safety related problems if operates while ignoring these functions.

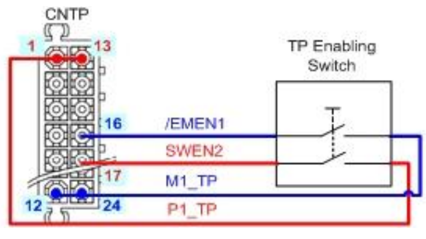
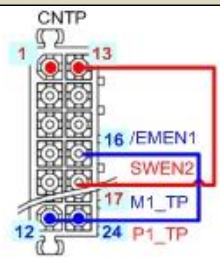
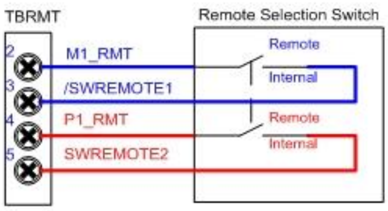
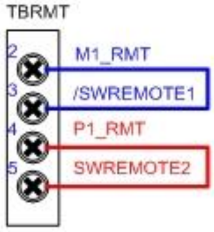
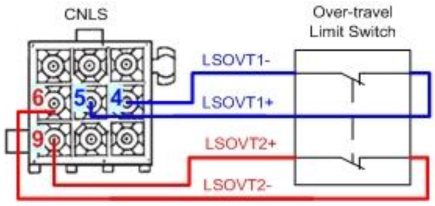
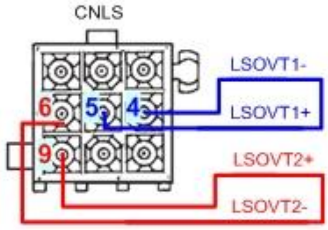
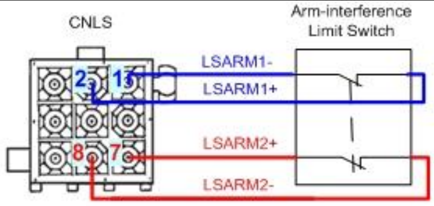
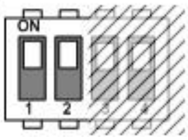
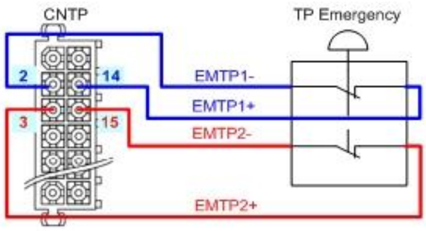
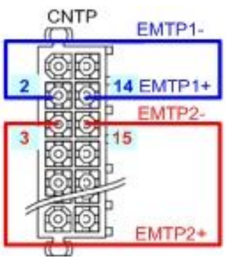
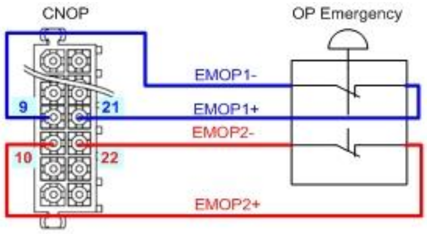
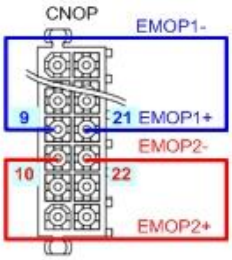
Available safety switches are as below, and they can be connected through a System Board. Please check the above for the safety switches that are being used.

Types	Connecting method	Disabling method
Emergency stop switch(External) –point of contact type		
Emergency stop switch(External)-semi conductor type		No3, No4 of SW6 is ON 
Safety guard (Auto)-point of contact type		
Safety guard (Auto)-semiconductor type		No1, No2 of SW6 is ON 

Types	Connecting method	Disabling method
Safety guard(General)		

Cautions :
Please use only for a testing purpose and please switch it back to normal after the test. This ignores the emergency safety related functions and it may cuase safety related problems if operates while ignoring these functions

Other switches that are related to a safety and system operation which may effect to this error are as below

<table>
<tr><th>Types</th><th>Connecting method</th><th>Disabling method</th></tr>
<tr><td>Enabling switch(TP)</td><td>
</td><td>
</td></tr>
<tr><td>Remote mode input</td><td>
</td><td>
</td></tr>
<tr><td>Limit switch</td><td>
</td><td>
</td></tr>
<tr><td>Arm interference switch</td><td>
</td><td>No1, No2 of SW5 is ON

</td></tr>
<tr><td>Emegerncy stop switch(TP)</td><td>System Board – Wiring between Teach Pendants

</td><td>
</td></tr>
<tr><td>Emergency stop switch(OP)</td><td>
</td><td>
</td></tr>
</table>

(4) Please check the System Board, Electirical Module

- Cabling (wires, connector etc) malfunction
  Please check the cabling between the Electrical Module (PDM30) that an electrical connector is installed and the System Board (BD530) that collects monitoring signals.
  The cable name is CNMS and it enters to the Electrical Module through the top rear of the System Board (figure 6.22). Please check the connection status of this cable's connector.

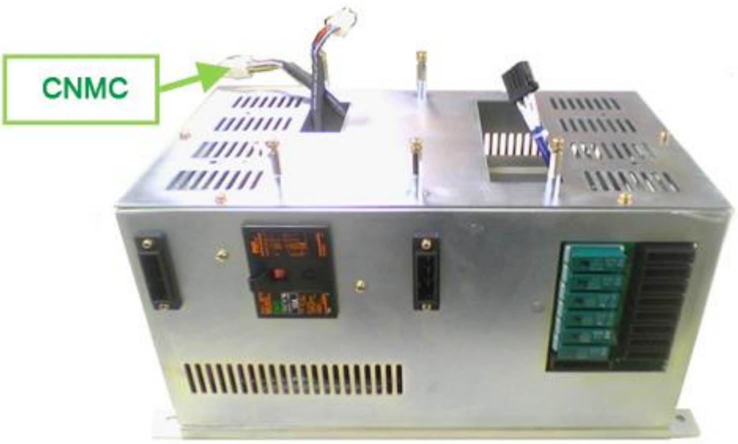


Figure 6.22 CNMC Cable on the Electrical Module

- System Board malfunction
  Input signal processing unit malfunction from the inside of System Board can be a cause of this error. Please replace the System Board and examine it.

- Electrical Module malfunction
  Internal electirical module malfunction can be categorized as a electrical board (BD5C0), Electrical connector (MC1, MC2), and wirings between the electrical board and the electrical connector (figure 6.23) However it is difficult to examine the inside of Electrical Module in a field where a Robot has already been installed, so alternatively please replace the Electrical Module.

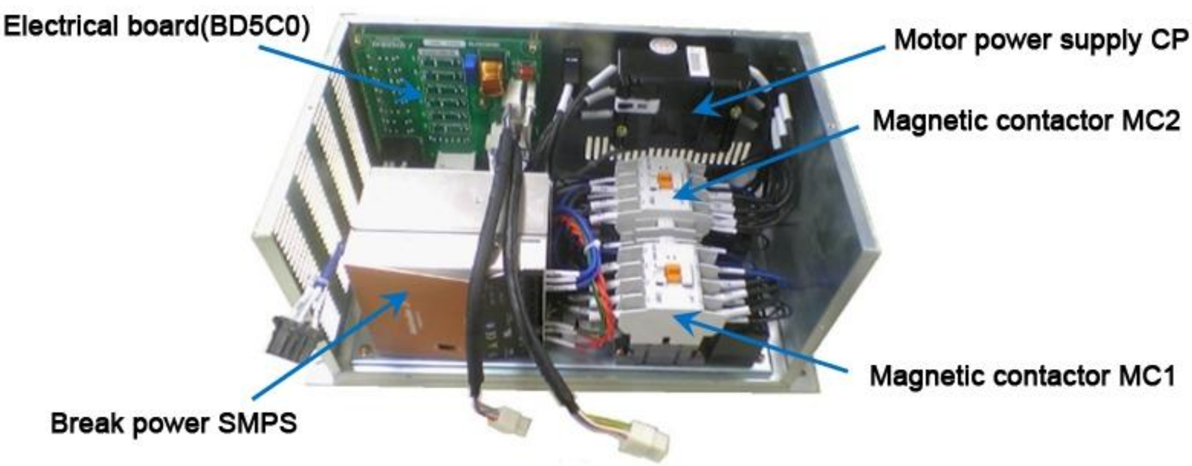


Figure 6.23 Inner Structure of Electrical Module

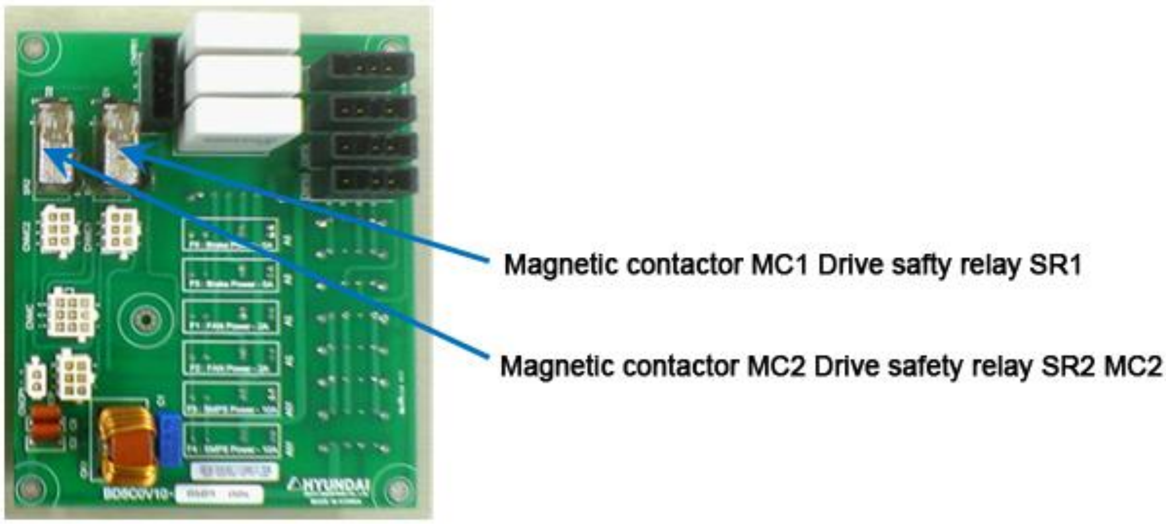


Figure 6.24 Electrical Board (BD5C0)

6.1.5. E0015 Teaching pendant operation error

6.1.5.1. Outline

This error occurs when communication between a Main Board (BD510) and a Teach Pendant (TP510) has been disconnected due to a bad communication status. If this error occurring during an operation (AUTO mode), a robot will be immobilized.

6.1.5.2. Causes and examine methods

(1) Please check if the Main Board inside of a controller is in a normal status

(2) Case : Status of 7-Segment from a Main Board is "." (normal)
- Case : TP communication status indicator icon is white
- Case : TP communication status indicator icon is x

(3) Case : Status of 7-Segment from a Main Board is "u"
- TP communication status indicator icon will be x

(4) Case : Status of 7-Segment from a Main Board is abnorma
- TP communication status indicator icon will be x

(1) Please check if the Main Board inside of a controller is in a normal status

Communication can be disconnected if a Main Board or a Teach Pendant is in a abnormal status for any reasons. Please see the 7-Segment from a Main Board to confirm if a Main Board's status is normal or abnormal.

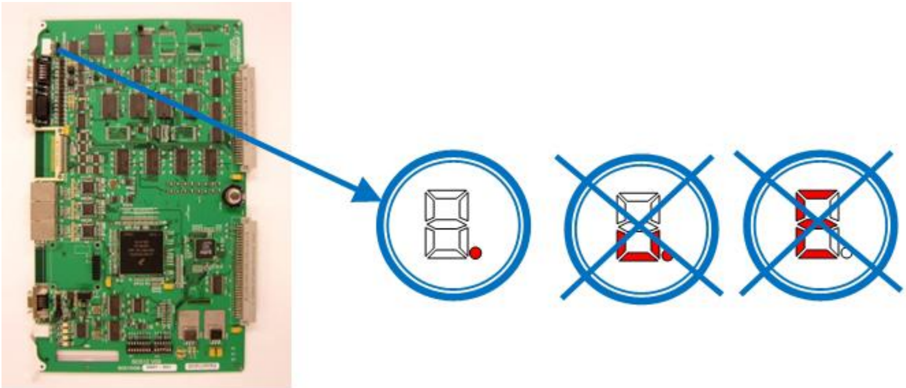
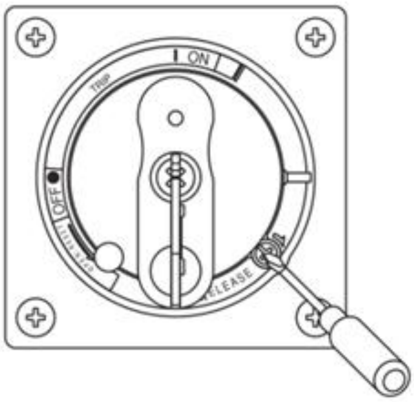


Figure 6.25 7-Segment is in a Normal Status. Others are Abnormal (see the above diagram)

If a controller's door is shut when the power is on, please refer to the below diatram in order to open the door to check.

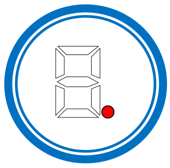


※ Turn the "release" screw that located at the below of external control handle on a controller's door to a clockwise.

How to open the door while the power is on

Caution
Once a controller is opened, please only check the main board's status and do not touch anything else for a safety reasons.
Please make sure to close it after you check the main board's status

(2) Case : Status of 7-Segment from a Main Board is "." (normal)



Please check the status of "TP communication indicator icon" that located on a left side of "Titles" from TP510.

- If a TP communication status indicator icon is blue, it is a normal status.

- If a TP communication status indicator icon is white,

➢ LAN cable between a Main Board and TP has a problem (not open) or an abnormal status of Teach Pendant is suspected.

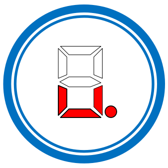
① Please download Main Board's application program as same version as a TP
② Please replace TP510 and test it.
③ Please replace a LAN cable between TP connector and Main Board in a controller and test it.
④ If a same status persists, please contact to our AS department.

- If a TP communication status indicator icon is x,

➢ Disconnection (open) of LAN cable between a Main Board and TP is suspected.

① Please replace TP and test it.
② Please replace a LAN cable between TP connector and Main Board in a controller and test it.
③ If a same status persists, please contact to our AS department.

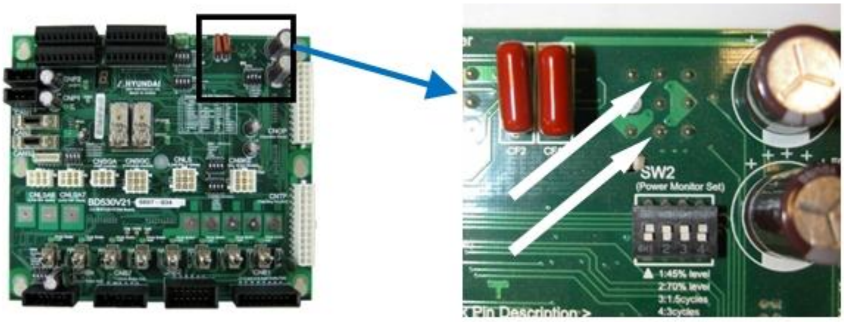
(3) Case : Status of 7-Segment from a Main Board is "u"



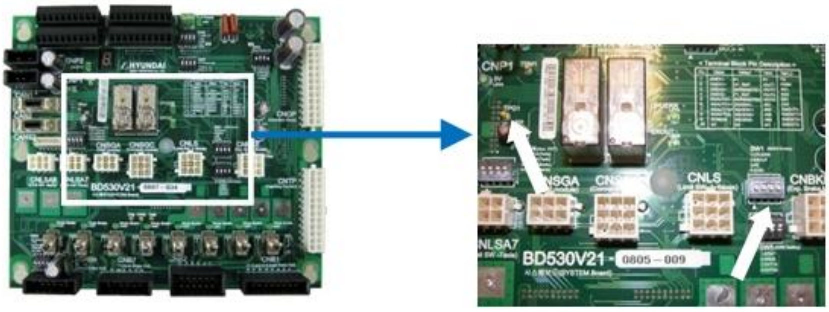
- TP communication status indicator icon will be x.

➢ Cable between a main and System Board, or a System Board is suspected.

① Please check if a connector at the both ends of cable have been plugged properly.
② Please check if a power for CNMC connector is AC48V.

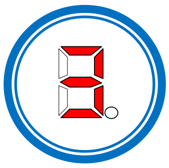


③ Please check if Ve(3pin) of SW1 is DC0V.



④ Please replace a (CANIO↔CAN1)Cable and test it.
⑤ Please replace a System Board and test it.
⑥ If a same status persists, please contact to our AS department.

(4) Case : Status of 7-Segment from a Main Board is abnormal



- TP communication status indicator icon will be x.

➢ The cause for this case is a Main Board malfunction.
① Please replace a Main Board and test it.
② If a same status persists, please contact to our AS department.

6.1.6. E0022 Communication error between internal modules

6.1.6.1. Outline

Internal modules of controller use CAN communication in order to transfer data. E0022 is an error code that indicates the Main Board has detected an error in a CAN communication between internal module System Boards. E0032 error code will be used for users board (BD58x) that uses a same CAN communication channel.

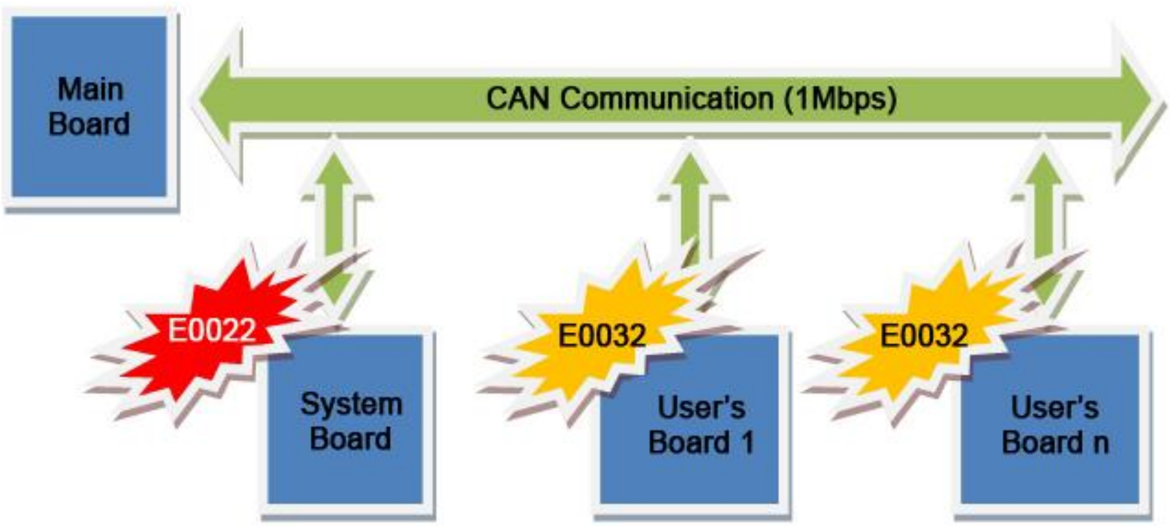


Figure 6.26 CAN Communication Structure of Hi5 Controller

System Board is a moduel that controls an input/output of controller's power sequence. Once this error occurs, all functions related to this will be stopped and main stops CAN communication. In order to re active all the functions, a controller must be restarted.

6.1.6.2. Causes and examine methods

(1) General examine
- Please check the connection staus of CAN communication cable
- Please check the power status (power voltage or connection status of cable)

(2) If an error persists even after a restart of contoller
- Please check a System Board malfunction
- Please replace a malfunction parts and test it (Main Board, System Board, cables)

(3) If an error occurs while a controller is normally operating
- Please observe a changes in surrounding environment
- Please examine the CAN communication line
  - Please examine the CAN communication connector for users module
  - Please examine the connection of termination resistor
  - Please examine the wiring structures.
  - Please examine if a communication cable uses a twist line.

(1) General examine

If this error occurred while a system is normally operating, please examine the following for a start

Reference

Once "E0022 Communication error between internal modules" occurs, mainboard will not establish a communication with system board even if a system board initiates communication. Controller must be restarted in order to reestablish a communication.

- Please check the connection status of CAN communication cable
  Please check if a CAN cable between Main Board and System Boards are well connected. Please remove and reconnect the CAN connectors of Main Board and System Board and check if an error persists, in order to check connector's connection status.

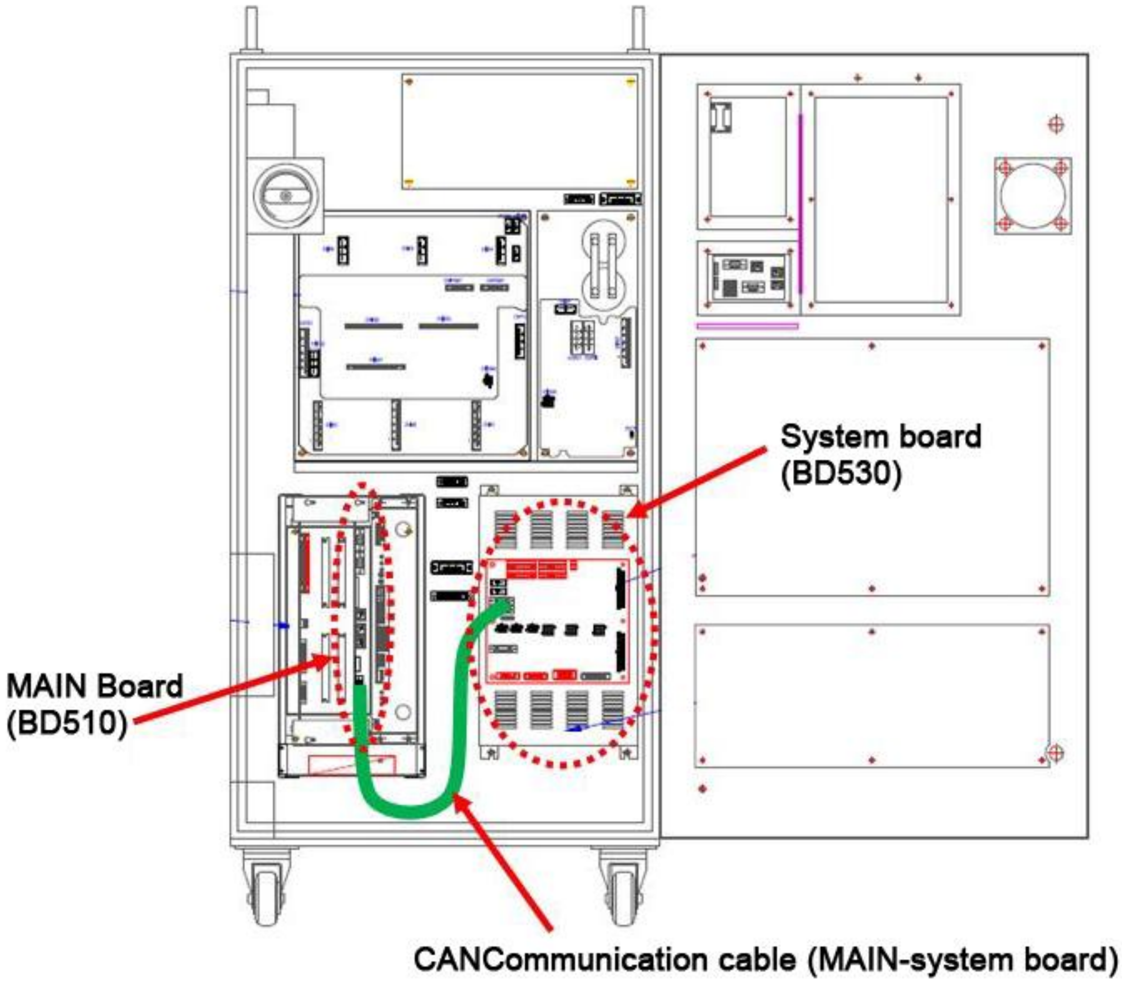


Figure 6.27 CAN Communication Cable Connection between a Main Board (BD510) and a System Board (BD530)

- Please check the power status (power voltage or connection status of cable).
  Please check if a DC 5V control power is being supplied to System Board properly. If there is a problem with a power, this error may occur as the System Board will not operate.
  Please check if a power is being supplied or not by using a simple method. As a below diagram, there are LED CNP1 that indicates DC 5V voltage and 7-segment that indicates the board operating status on an upper right side of System Board.

Table 6-2 Method to Check the whether the Rated Voltage on System Board is Normal or Not

Category	(LED) CNP1	7-SEG	Result
1	Off	Off	Power on a System Board is has not been authorized properly. Please examine the power related parts such as SMPS, Cable, Connector connections etc.
2	On	Off	Power of IO related board (BD531) that located at the rear of system is not authorized or malfunction.
3	On	On	Please check the power voltage.

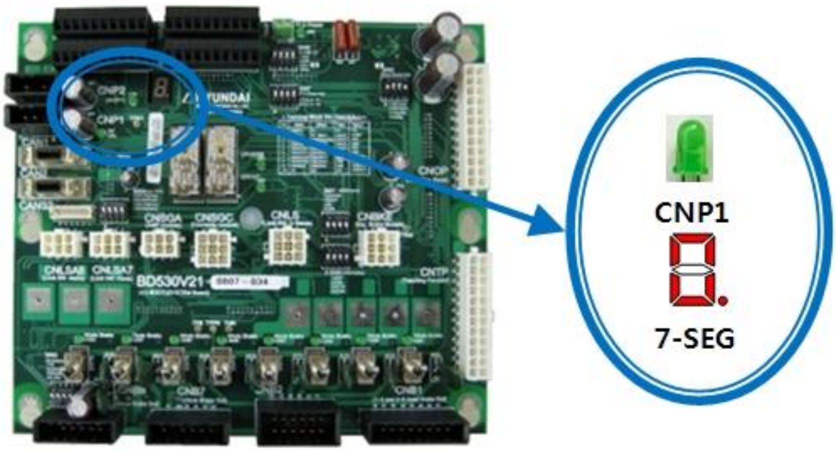


Figure 6.28 LED CNP1 for a Power Purpose DC5V of a System Board (BD530)

If the lights of LED CNP1 and 7-segment DC are all on as above table, please check if the DC 5V control power that authorized on a board is in a range of 5.0V~5.3V.
If the voltage is out of this range, it may effect to the communication. Check points are as below diagram and it the voltage is out of range, plase configure it to a range of 5.0V~5.3V from a SMPS.

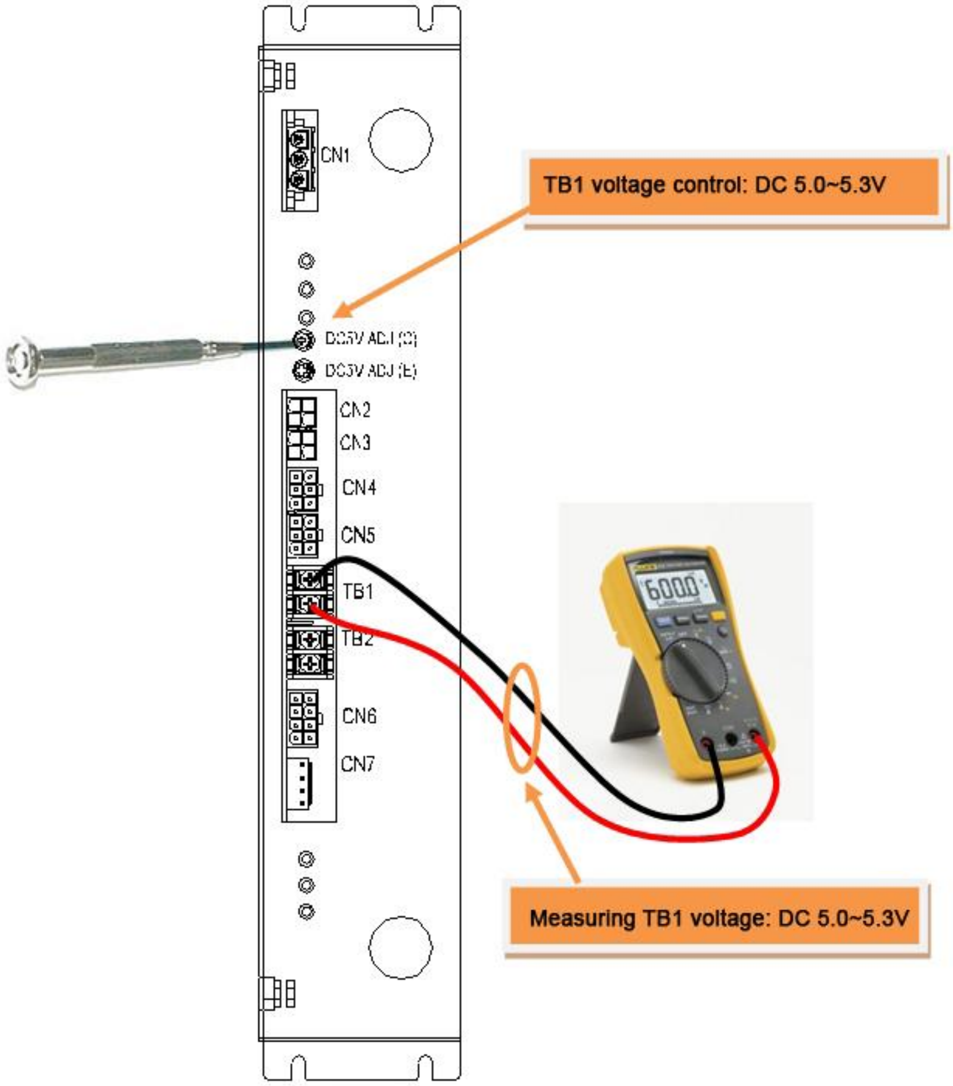


Figure 6.29 Measuring a Voltage of DC 5V and Controlling Method

(2) If an error persists even after a restart of controller

If a error message displayed because the error is already occurring even after the controller has been restarted, the faulty area can be identified by performing a series of examines.

Reference

If you are usings a user's module (BD58x), please remove a CAN cable that connected to this module before you perform this test. It is to eliminate possible elements that will effect to the test. If this error does not persists after a restart of a controller followed by a removal of user's module cable, the cause of an error is related to a user's module. Please refer to the following paragraph.

In order to remove a user's module CAN communication from a controller, please unplug the CAN2 and CANS2 connectors from a System Board as below diagram. If you restart the controller, only a Main Board and System Board will keep the CAN communication.

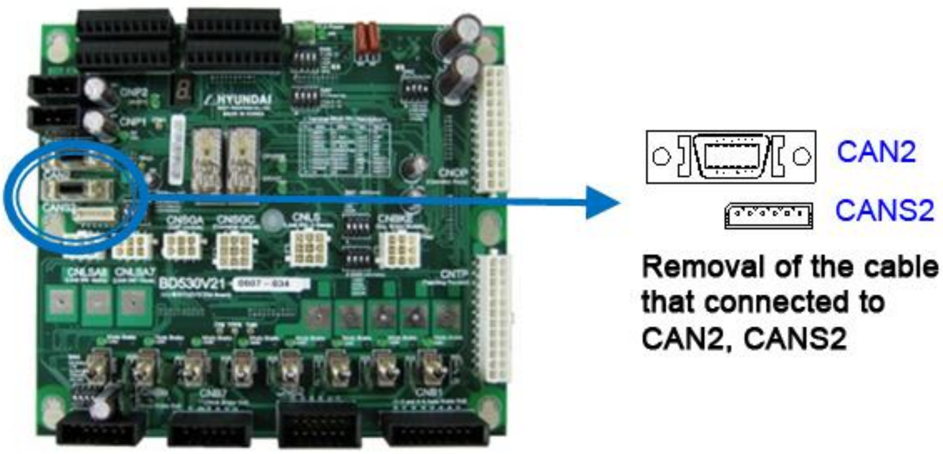


Figure 6.30 Method to Remove CAN Communication Connection from User's Module (BD58x)

- Please check the malfunction status of System Board
  System Board has a 7-segment that indicates a various status. By examining it, you may determine if a System Board is malfunctioning or not. After a controller has been restarted, if the indicator does not display the content in a rotation as below, System Board malfunction is suspected. Please replace it.

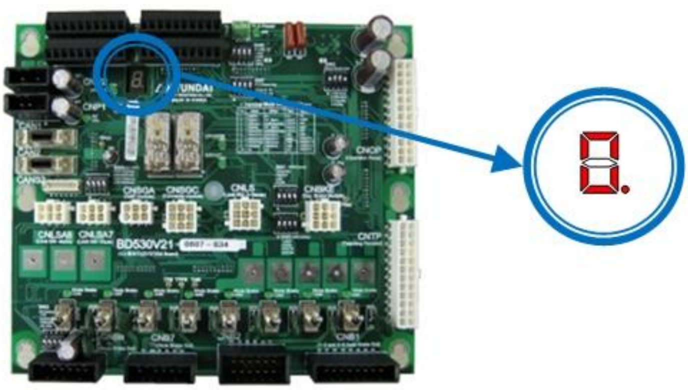


Figure 6.31 Location of 7-segment on a System Board (BD530)

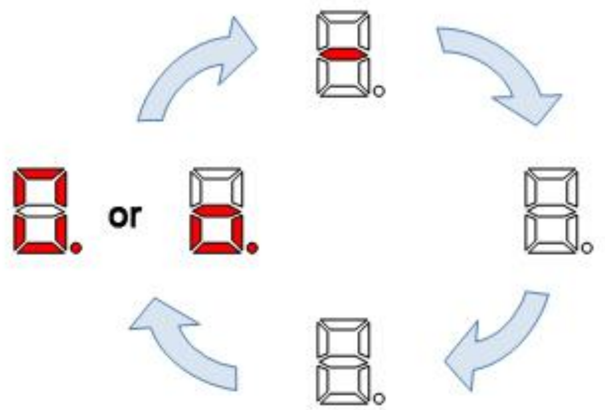


Figure 6.32 Normal Display of 7-segment on a System board when Restarted

- Please replace a malfunction part and test it.
  If above examines do not resolve an error, you will have to replace the parts that related to this error and test them. The cause might be a circuit malfunction that related to CAN communication inside of the board and it is difficult to be identified from an outside.
  There are 3 parts as below diagram – System Board (BD530), Main Board (BD510), Cable. (If a Main Board and other option module (BD58x) were having a CAN communication, the cause of an error is not likely from Main Board or cable. Please replace a System Board and test it).

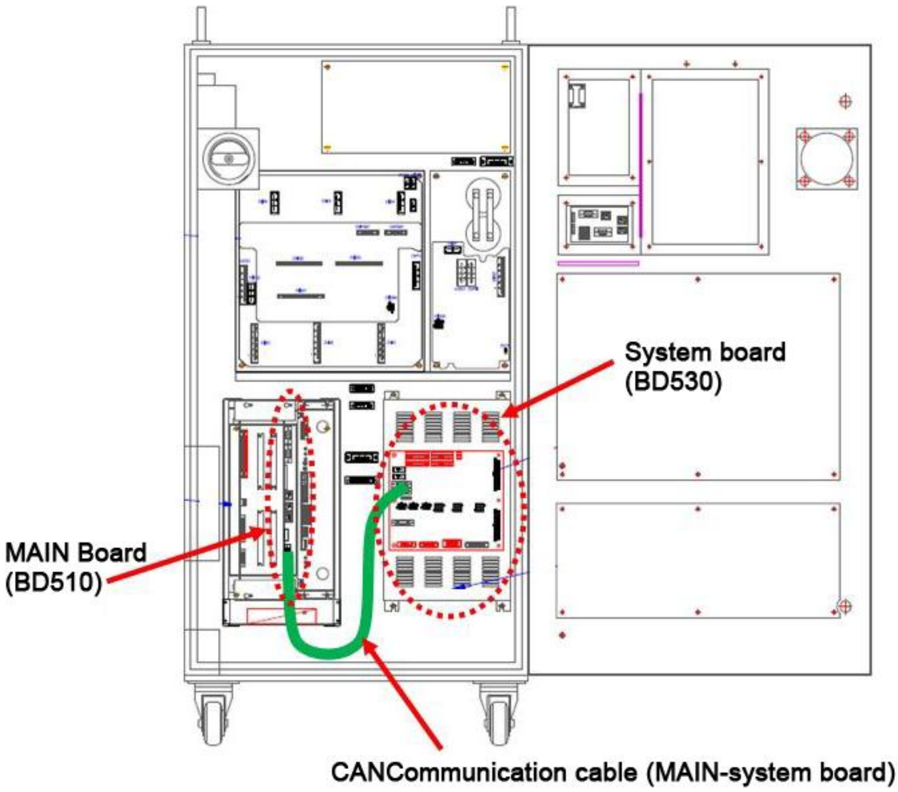


Figure 6.33 Location of CAN Communication Cable and a Main Board (BD510)

(3) Error occurring while a controller is operating normally

- Please observe changes in surrounding environment.
  Please observe if there have been any changes in the surrounding field. Check if a new large capacity electric power device has been installed. Quality of electric power and a shortage may effect to the communication and cause this error.

- Please examine a CAN communication line CAN.
  Property of matter CAN communication line may be connected with a users module (BD58x) as well as a System Board and this may cause an error due to a effect caused by a property of line's material. So, if a users module is being used, please run the following examines.

  - Please examine a CAN communication connector for user's module.
    Data communication with a Main Board uses a half duplex CAN. Sub modules of controllers are consists of a Daisy chain that uses CAN data communication. So the board has 2 CAN connectors that indicated as CANS1, CANS2. Please check if those connections are valid.

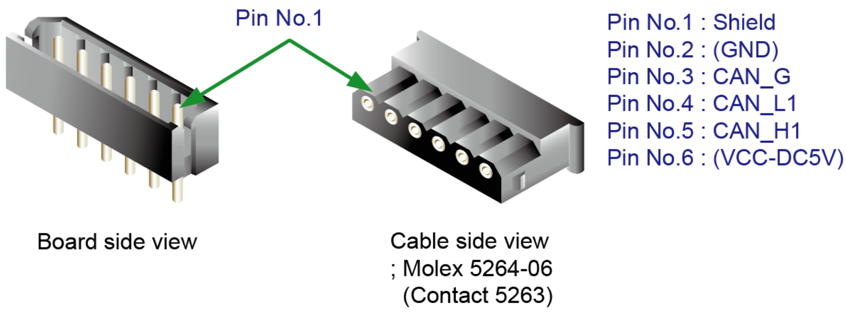


Figure 6.34 CAN Connector CANS1, CANS2 of User's Module

Table 6-3 Pin Locations for CAN Connector of User's Module

Number	Title	Usage
1	Shield	To connect the electric shield line of CAN cable
2	(DC5V GND)	To connect board power DC5V ground (Connection with CNP1 is recommended)
3	CAN_G	To connect a ground for CAN communication
4	CAN_L1	To connect L signal of CAN communication
5	CAN_H1	To connect H signal of CAN communication
6	(DC5V)	To connect board power DC 5V (Connection with CNP1 is recommended)

- Please examine the connection of terminal resistor.
  If numbers of boards are connected to each other, a terminal resistor must be handled clearly. CAN data communication uses daisy chain method. So the terminal resistor only should be connected to the last CAN communication cable and the terminal resistor must not be connected to any boards in between. Terminal resistor's connection uses a JP1 jumper that located next to the CANS1 and CANS2 connector on a board. If JP1 has been shorted it means that the terminal resistor is connected, and if JP1 has been opened, it eliminates the terminal resistor connection. Please refer to the following diagram.

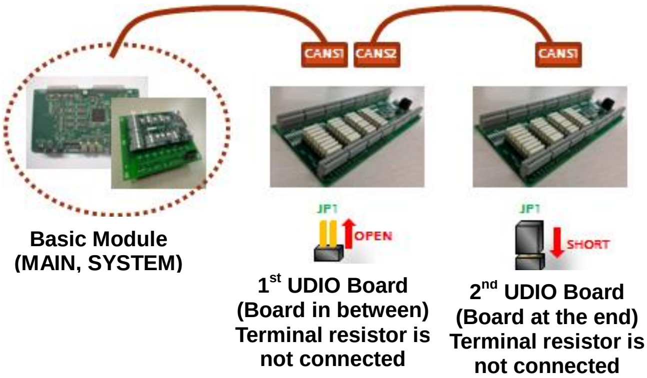


Figure 6.35 Connecting Method of Terminal Resistor on a CAN Communication Line

- Please examine the wiring structure
  CAN communication wiring must not have a branch wiring. All connections must have a series connection from one module to the next module. Following diagram describes a wrong wiring structure.

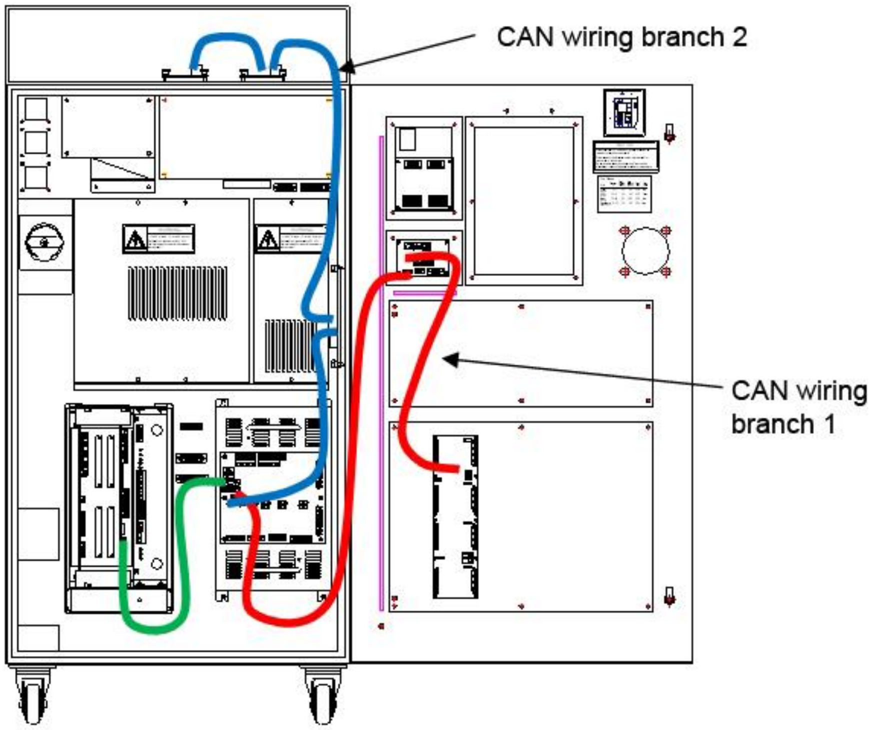


Figure 6.36 Bad example of CAN Communication Wiring Structure

In a diagram, CAN communication line that starts from a System Board has two branches.

- Branch 1:
  System Board CAN 2 Connector → Small Door Board → Controller door DIO board

- Branch 2 :
  System Board CNAS2 Connector → Analog board on Controller's side → DIO borads on a controller

These can have a negative effect on a quality of communication, so please change the wiring structure as below.

- Branch 1 :
  System Board CAN 2 Connector → Small Door Board → Controller door DIO board → Analog board on Controller's side → DIO boards on a controller
- Branch 2 : Eliminated

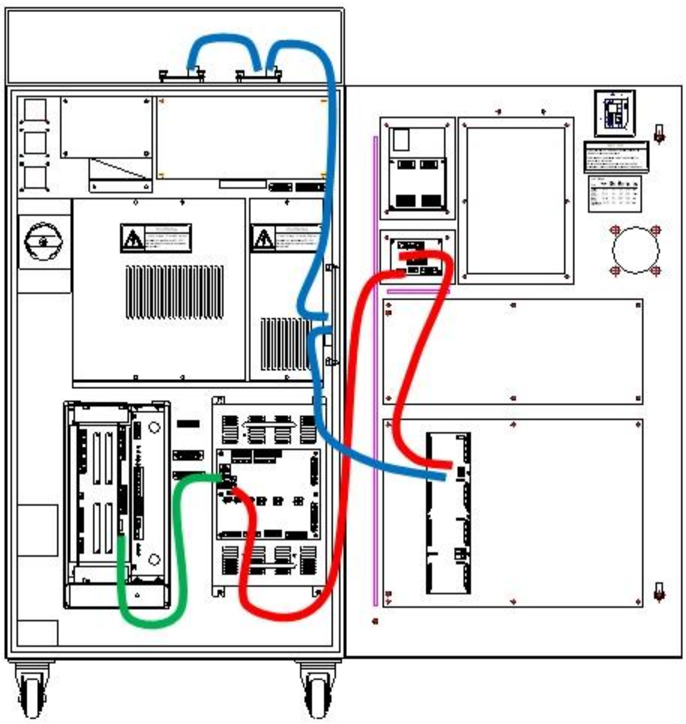


Figure 6.37 Good example of CAN communication wiring structure

If user module that used for a controller's door is not available, please remove the CAN cable that connects a System Board to a small door board as shown in a below diagram. Also making a wiring in order to keep the cable between modules at a minimum distance can increase a quality of communication

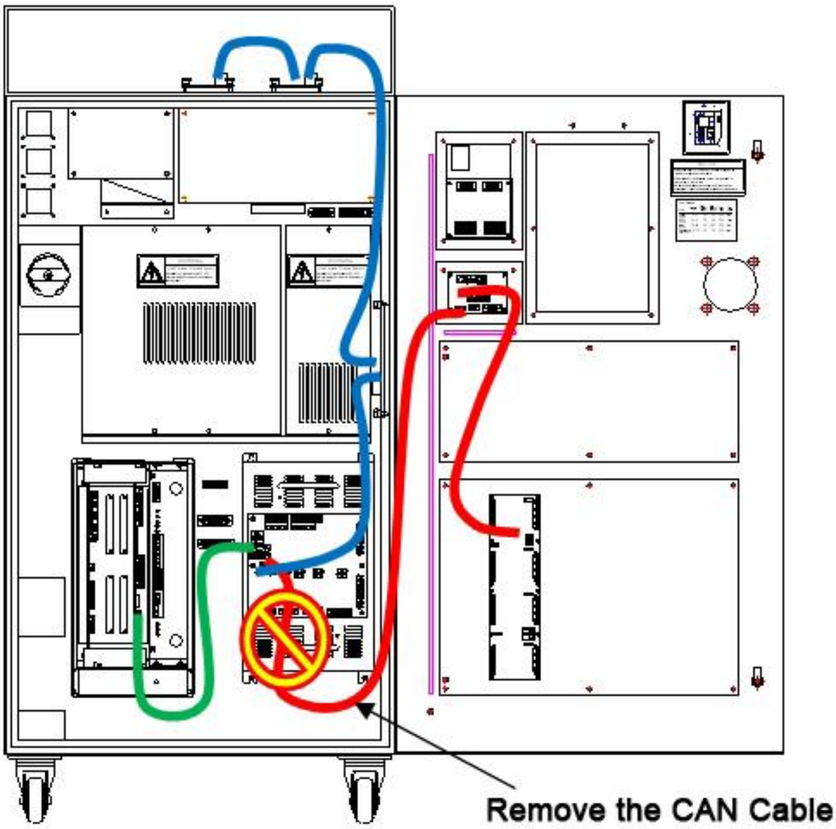


Figure 6.38 Remove the CAN Communication Cable that is Not in Use

(4) Please examine if a communication cable uses a twist line.
CAN communication uses twist pair wiring in order to ensure a high quality of communication against external noise. CAN_H1 and CAN_L1 signal line must be twisted to each other (please refer to figure 6.39).

Figure 6.39 Example of Twist pair

6.1.7. E0033 AMP under-voltage error

6.1.7.1. Outline

Direct current voltage (P-N) that activates a motor in a Servo activation device has been measured under the under-voltage set value.

6.1.7.2. Causes and examine methods

<Case : Error occurs even when the motor is off>

(1) Please examine the parts that related to an under-voltage error detection.
- Please replace CNSGC cable and test it CNSGC
- Please replace BD530/BD531 board and test it
- Please replace a diode module and test it

.

<Case : Error always at the moment when motor turns on>

(2) Please examine power related parts.
- Please replace a diode module and test it
- Please examine a 3-phase voltage inside of a controller
- Please examine a input 3-phase voltage of a controller

<Case : Error occurs at a certain step according to the robot’s operation speed>

(3) Please make changes on a speed of robot’s operation in order to confirm an error.
- Please reduce the speed of robot’s operation in order to confirm an error
- Please examine a input 3-phase voltage of a controller while a robot is in operation
- Please examine a internal 3-phase voltage if a input voltage is not 220V

(1) Please examine the parts that related to an under-voltage error detection

Occurrence of under-voltage at AMP error is detected by a diode module when a direct current voltage (P-N) that supplied to Servo activation device has been measured under the under-voltage set value. Generated error will be handled by a software at BD530/BD531 through a CNSGC cable

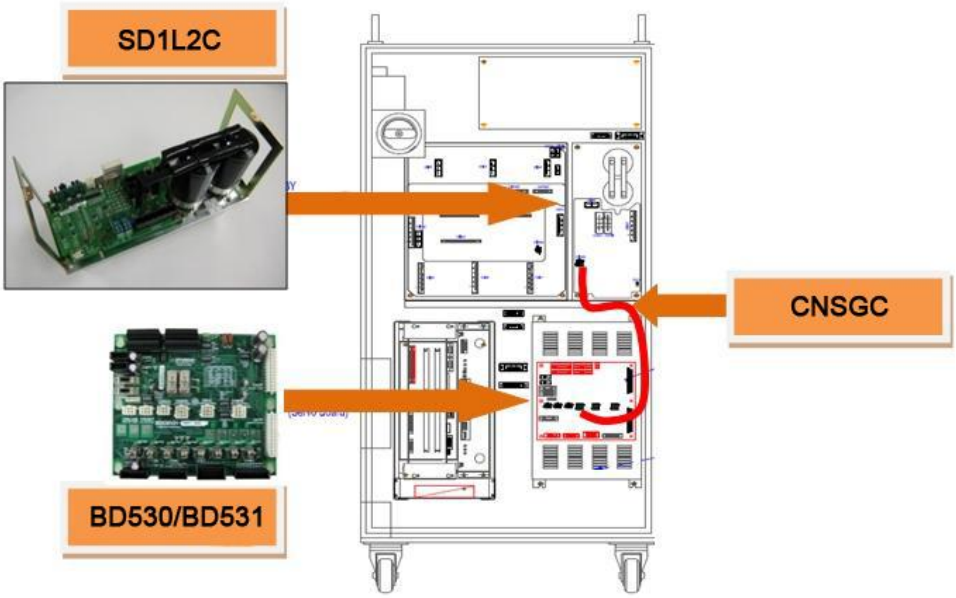


Figure 6.40 Locations of Hi5-N00 Controller’s Under-Voltage Occurrence Error Related Parts

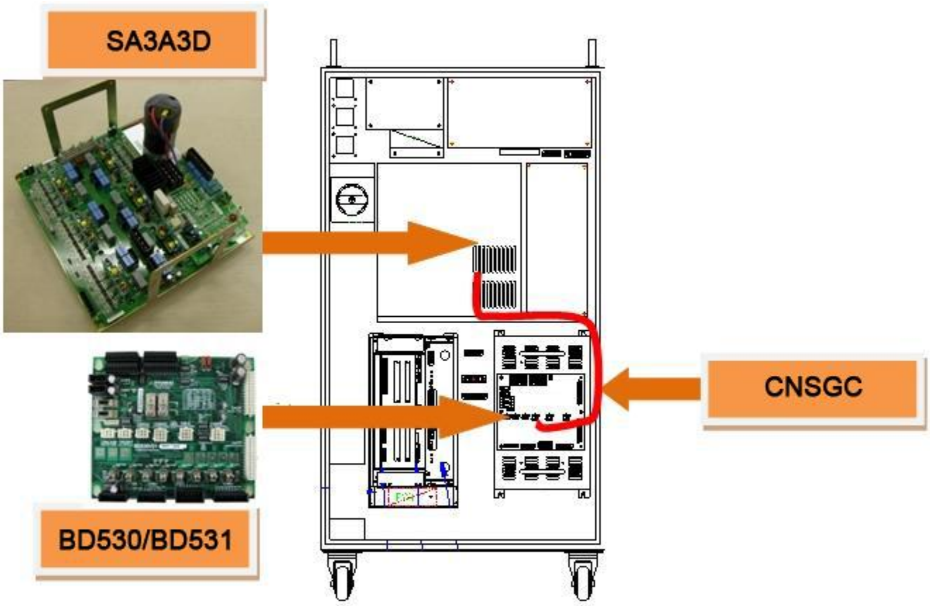


Figure 6.41 Locations of Hi5-N30 Controller’s Under-Voltage Occurrence Error Related Parts

- Replacement of CNGSC and examine CNSGC
  Please replace CNGSC cable with a proper one and if an error does not persist, cable connection fault caused an error. Please replace the CNGSC cable with new one and use.

- Replacement of BD530/BD531 and examine
  Please replace BD530/BD531 with a proper one and if an error does not persist, the board malfunction caused an error. Please replace the BD530/BD531 with new one and use.

Figure 6.42 Replacement of BD530/BD531

- Replacement of diode module and test
  A module that detects an under-voltage error of AMP is SD1L2C for a large size and SA3A3D for a small size. Please check the parts of a controller that currently used. Please replace it with new one to test the persistence of an error.

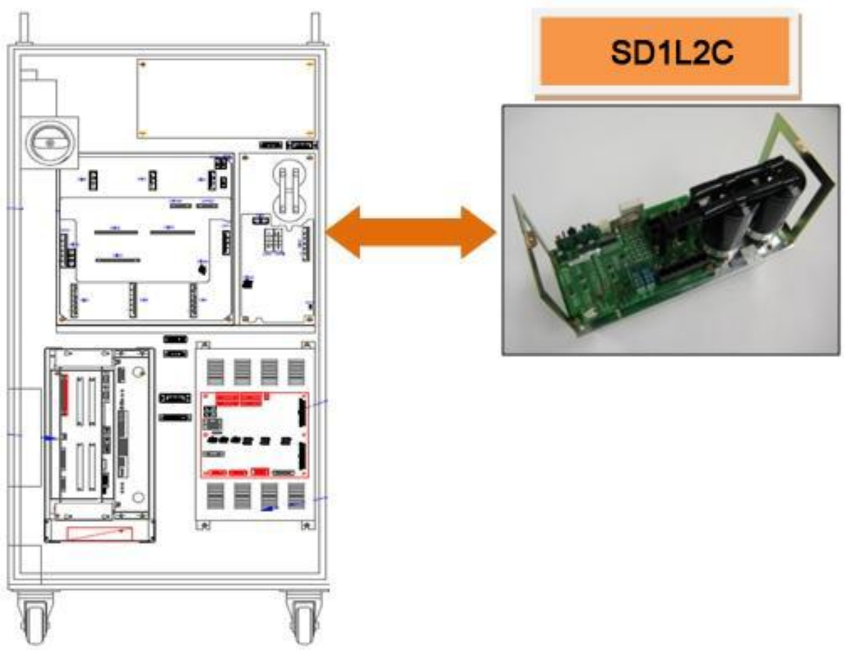


Figure 6.43 Replacement of DS1L2C when an Under-Voltage Occurs at Hi5-N00 Controller

(2) Please examine the components that are related to power
AMP under-voltage occurrence error occurs when the 3-phase AC 220V that enters to the Servo Drive Unit exceeds the allowed range. Also this error may occur when recovery discharge happens at a moment of motor turns on due recovery discharge control circuit malfunction.

- Replacement and examining of diode module
  Please replace a module (SD1L2C for large size, SA3A3D for small size) that detects AMP under-voltage error and check if an error persists. For a large size controller, diode module is separated from the Servo Drive Unit, and for a small size controller, it is located inside of the Servo Drive Unit.

  - Large size Robot’s diode module: SD1L2C
  - Small size Robot’s Servo Drive Unit: SA3A3D

- Examine the 3-phase voltage
  AMP under-voltage error starts from approximately DC 210V (or 148V)
  If a voltage under AC148V (or 100V) enters to the Servo Drive Unit, under-voltage error may occur when the motor turns on.
  If the input voltage exceeds the allowed range, please examine according to a controller’s input 3-phase voltage examination procedures and a controller’s 3-phase internal voltage examination procedures.

  - Servo Drive Unit input voltage specification: 3-phase AC 220V
  - Allowed range when motor turns on: 198V ~ 242V

(3) Please confirm the occurrence of error according to the speed of Robot’s operation
If a robot reduce the speed rapidly, or make a high speed movement toward to gravity direction, it can cause AMP under-voltage error. Please confirm if an error occurred, or the changes of input 3-voltage supplied to Servo Drive Unit according to a speed of Robot’s operation.

- Make changes on a speed of Robot’s operation
  If a recovery electric power that generated by Robot’s operation exceeds the controller’s designed specification, under-voltage error may occurs. Please reduce the speed of a step that the error occurs and re-operate in order to confirm if the error persists. If the error does not occur when the speed is reduced, please change the speed of step and use it.

- Examine the 3-phase voltage at the error occurrence step
  AMP under-voltage error starts from approximately DC 210V (or 148V)
  If a voltage under AC148V (or 100V) enters to the Servo Drive Unit at the error occurrence step, under-voltage error may occur when the motor turns on.
  If the input voltage exceeds the allowed range, please examine according to a controller’s input voltage examination procedures and a controller’s 3-phase internal voltage examination procedures.

  - Servo Drive Unit input voltage specification: 3-phase AC 220V
  - Allowed range when motor turns on: 198V ~ 242V

6.1.8. E0034 AMP over-current error

6.1.8.1. Outline

Over-current on the 3-phase voltage(R, S, T) that supplied to the diode module, or inflow of surge voltage generated the over-current on a surge protector and it caused a cut-off of safety fuse.

6.1.8.2. Causes and checking methods

(1) Please examine the diode module’s fuse
- Please examine if the diode module’s fuse has been cut-off

<Case : Fuse has not been cut-off>

(2) Please examine the components that are related to the over-current error detection error.
- Please replace CNSGC cable and examine it CNSGC
- Please replace BD530/BD531 and examine it
- Please replace diode module and examine it

<Case : Fuse has been cut-off>

(3) Please examine the components that are related to power
- Please examine the 3-phase voltage from the inside of controller
- Please examine the controller’s 3-phase input voltage
- Please replace diode module and examine it

(1) Please examine the fuse in the Servo Drive Unit

Occurrence of AMP over-current error is detected by a diode module when the input 3-phase voltage exceeds the specification. Generated error will be handled by the BD530/BD531 through a CNSGC cable.

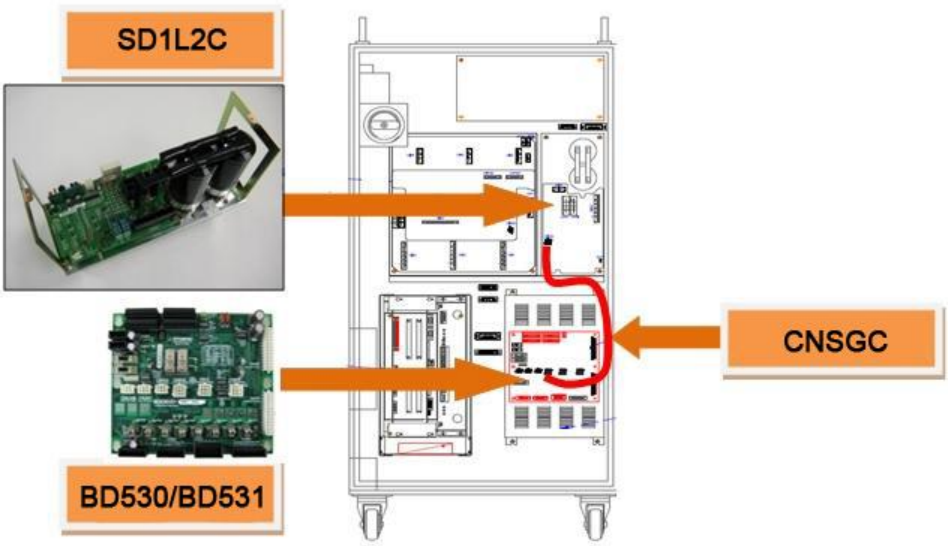


Figure 6.44 Locations of Hi5-N00 Controller’s AMP Over-Current Occurance Error Related Parts

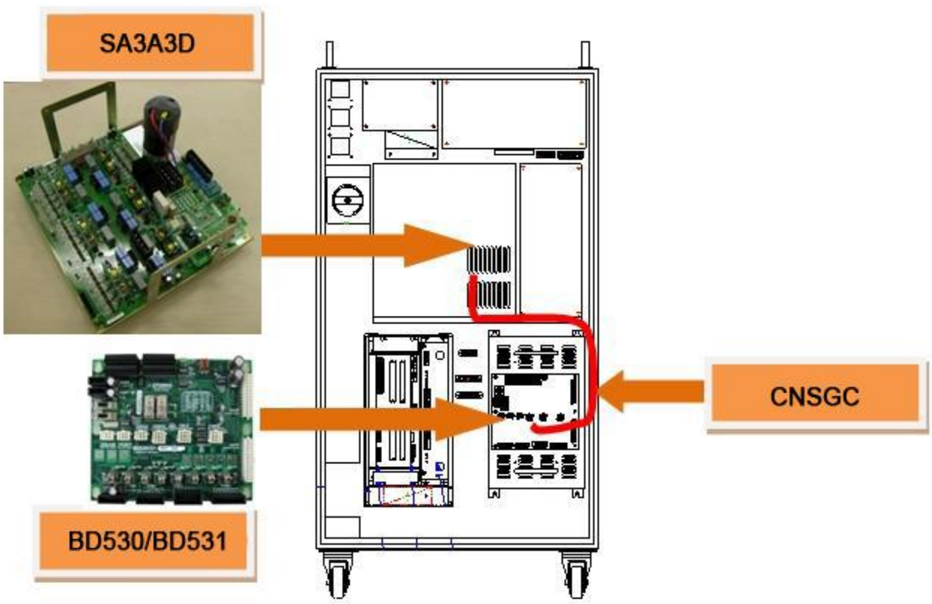


Figure 6.45 Locations of Hi5-N30 Controller’s AMP Over-Current Occurance Error Related Parts

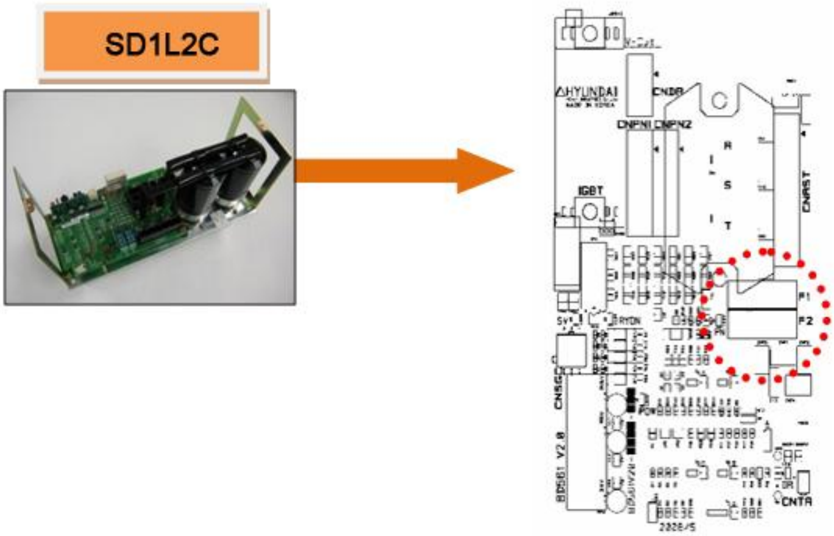


Figure 6.46 Locations of AMP Over-Current detection Fuse (in the SD1L2C)

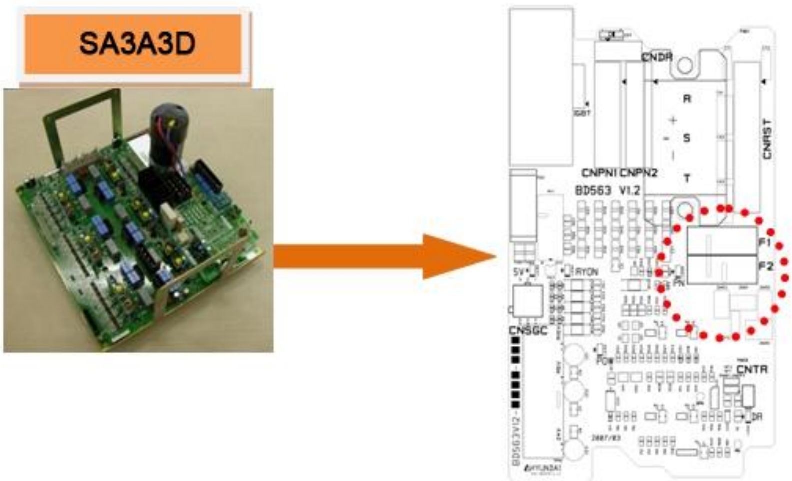


Figure 6.47 Locations of AMP Over-Current Detection Fuse (in the SA3A3D)

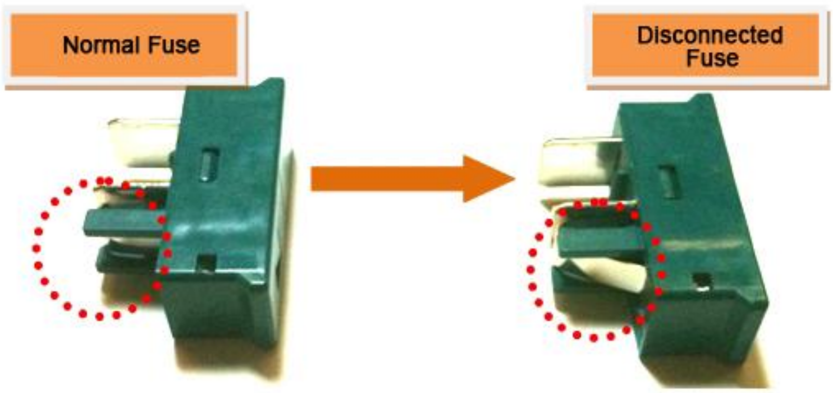


Figure 6.48 Appearance of Disconnected AMP Over-Current Detection Fuse

(2) Please examine the parts that are related to over-current error detection

If AMP over-current error occurs while the fuse has not been cut-off, CNSGC, BD530/BD531 or the Servo Drive Unit is faulty. Please refer to the compositions of controller from the manual and examine the each component.

- Replacement and examining of CNSGC cable CNSGC
  Replace the CNSGC cable with new one and test it. If the error does not persist, cable connection problem caused this error. Please replace the CNSGC cable with new one.

- Replacement and examining of BD530/BD531 BD530/BD531
  Replace the BD530/BD531 with new one and test it. If the error does not persist, the board malfunction caused this error. Please replace the BD530/BD531 with new one.

Figure 6.49 Replacement of BD530/BD531

- Replacement and examining of diode module
  Components that detects the AMP over-current error are SD1L2C (large size) and SA3A3D (small size). Please check the components in the controller that you are currently using and examine it. Please replace it with new one and see if the error persists.

  - Large size Robot’s diode module : SD1L2C
  - Small size Robot’s Servo Drive Unit : SA3A3D

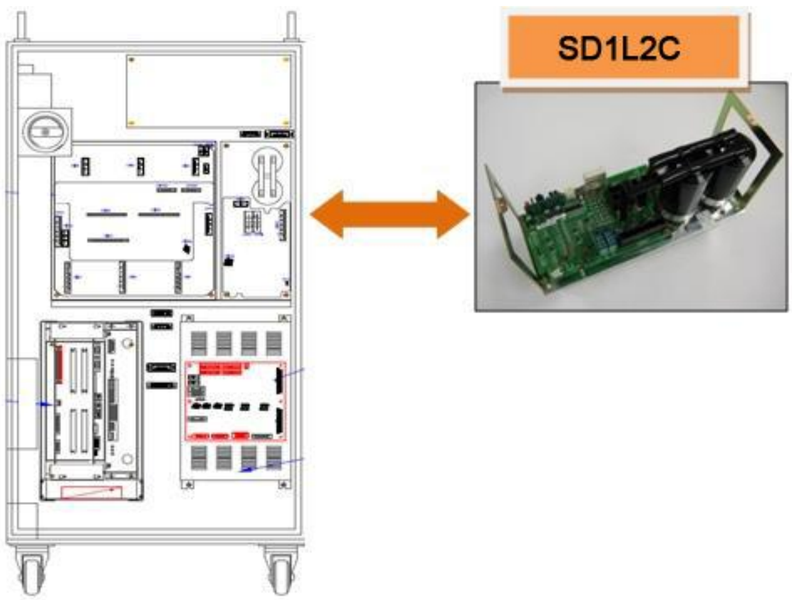


Figure 6.50 Replacement of SD1L2C in Hi5-N00 Controller when AMP Over-Current Error Occurs

(3) Please examine the components that are related to the power

Over-current error occurs when an over-voltage or surge voltage that exceeds 3-phase AC 220V enters to the Servo Drive Unit. Over-voltage will trigger the surge protector, and the serial connected fuse gets disconnected, so the error will occur.

- Examine the input voltage
  If a voltage over AC242 V enters to the Servo Drive Unit, over-current error may occur when the motor turns on.
  If the input voltage exceeds the allowed range, please examine according to a controller's input voltage examination procedures and a controller's 3-phase internal voltage examination procedures.

  - Servo Drive Unit input voltage specification: 3-phase AC 220V
  - Allowed range when motor turns on: 198V ~ 242V

- Replacement and examining of diode module
  Please replace a module (SD1L2C for large size, SA3A3D for small size) that detects AMP over-current error and check if an error persists. An error may occur continuously due to a module's internal circuit malfunction. For a large size controller, diode module is separated from the Servo Drive Unit, and for a small size controller, it is located inside of the Servo Drive Unit.

  - Large size Robot's diode module: SD1L2C
  - Small size Robot's Servo Drive Unit: SA3A3D

6.1.9. E0044 Lift axis belt disconnect sensor is operating

6.1.9.1. Outline

A sensor that is installed on an axis (one of Robot's operating axis) which transfers the power to the belt is determining whether the belt exists or not. This error will occur, if a belt does not exist in the detection range of the sensor as the belt is broken.
This error also can be caused by an abnormal connection between the sensor and the board that is installed on a controller.

6.1.9.2. Causes and examine methods

(1) Please check the status of the error
- Please check the Private input signal monitoring window.
- Please check the status of BD58B board's relay operation

<Error status on monitoring window, but replay is normal(ON)>

(2) Please examine the components that are related to the error detection
- Please replace CNSGC cable and examine it CNSGC
- Please replace BD530/BD531 board and examine it.

<Error status on monitoring window, and replay is abnormal(OFF)>

(3) Please examine the Robot
- Please check the status of belt in the Robot's drive unit
- Please check the operation of the sensor that detects the broken belt

(1) Please check the status of the error.

- Check the Private input signal from the monitoring window of TP510
  Firstly, check if the Lift axis belt/Limit (Arm) is being input. This window can be accessed from 『[F1]: Service』 → 『1: Monitoring』 → 『2: Input/Output signal』 → 『1: Private input signal』. If the Lift axis belt/Limit (Arm) is highlighted in yellow, it indicates an error status.

Figure 6.51 Checking the Lift axis belt from Private input signal

- Checking the status of BD58B board's relay operation
  Proximity sensor that attached at the Robot's operation part detects a break based on the light reflection from surface of the belt and transmits the ON/OFF signal to the controller. The received signal will be transferred to BD58B board for the fall prevention brake system and as well as to the BD530 (the System Board). Please check the sensor's operation status based on the relay operation status of BD58 board.

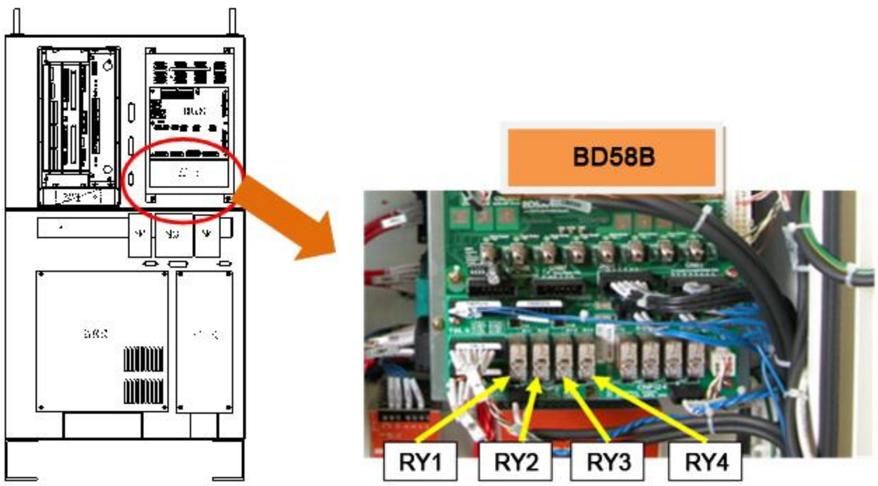


Figure 6.52 Checking the Relay Status of BD68B Board

Relay operation status of BD58B board can be checked as below diagram. Normal status relay operates the coil and can see the empty space at the center. .

Figure 6.53 Comparing the Normal and Error Status of BD58B Board’s Relay

You may confirm which (in the Robot) axis’s detection sensor is operating based on the status of BD58B board’s relay operation

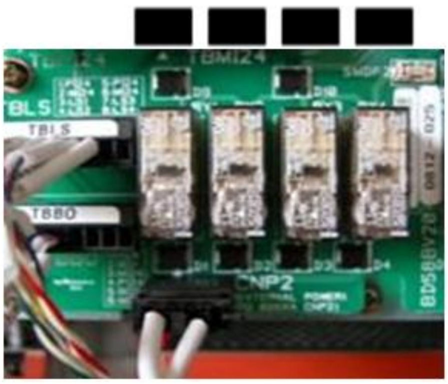
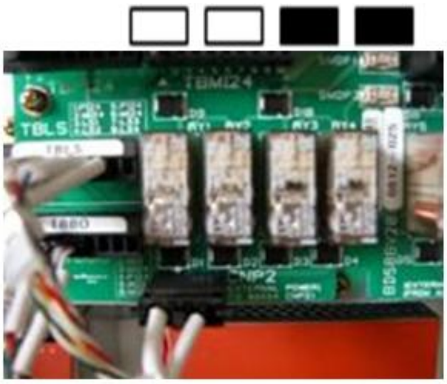
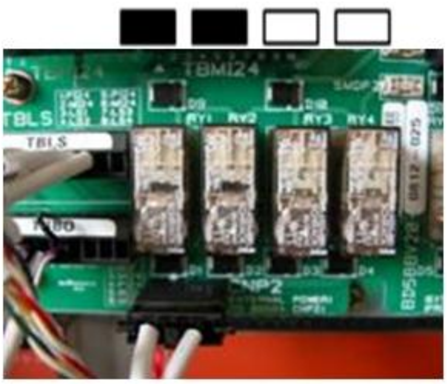
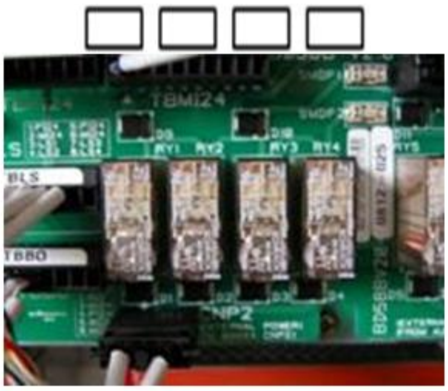
① Normal	② Z1 sensor is off (Z1 axis is broken)
	
③ Z2 sensor is off (Z2 axis is broken)	④ Both Z1/Z2 sensor are off (Z1/Z2 axis are broken)
	

Figure 6.54 Checking the Location of Error Based on BD58B Board’s Relay

(2) Please examine the components that are related to the error detection

If the Private input signal from the monitoring window and the relay status of BD58B board are different, CNLS cable that connects the BS58B and BD530/BD531, or the BD530/BD531 is faulty. Please refer to the compositions of controller from the manual and examine the each component

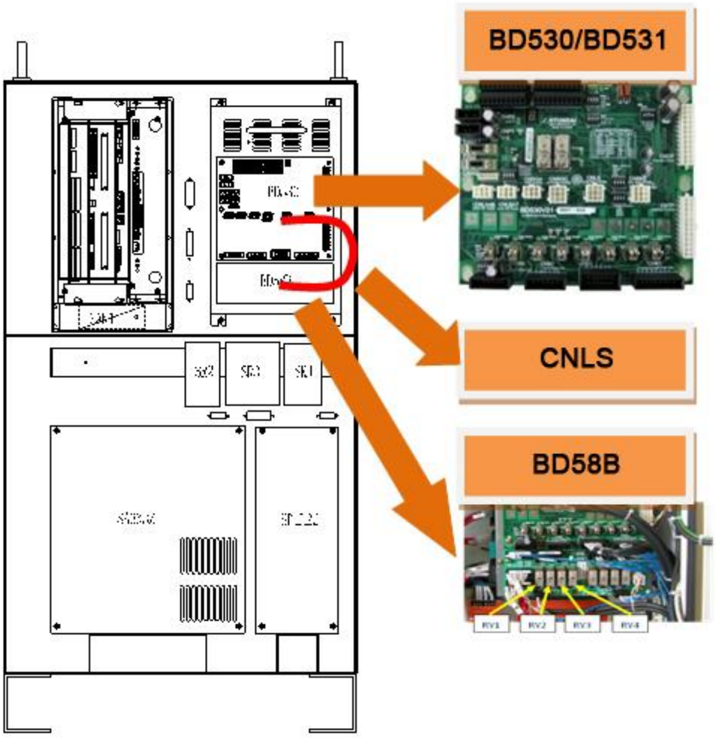


Figure 6.55 Replacement of BD530/BD531

- Replacement and examining of CNSGC cable
  Replace the CNSGC cable with new one and test it. If the error does not persist, cable connection problem caused this error. Please replace the CNSGC cable with new one

- Replacement and examining of BD530/BD531
  Replace the BD530/BD531 with new one and test it. If the error does not persist, the board malfunction caused this error. Please replace the BD530/BD531 with new one

Figure 6.56 Replacement of BD530/BD531

(3) Please examine the Robot

If the Private input signal from the monitoring window and the status of BD58B board's relay, BD58B actually acknowledged the error operation of the sensor. Robot's belt and detection sensor must to be checked. Please remove the CNZB1 and CNBZ2 connector of BB58B board in order to prevent a fall of lift axis that may caused by sensor malfunction during the examination of Robot

> **Warning**
> **Make sure the CNZB1 and CNBZ2 connectors of BD58B are removed while examining the Robot's belt and break detection sensors in order to prevent the fall of list axis**

- Check the belt's status of Robot's operation part
  Please check the belt of the axis that confirmed by a status of BD58B relay from the Robot. Applicability and location of the belt may be different to each Robot's model. Please check the status of belt according to the Robot's specification and maintenance manual

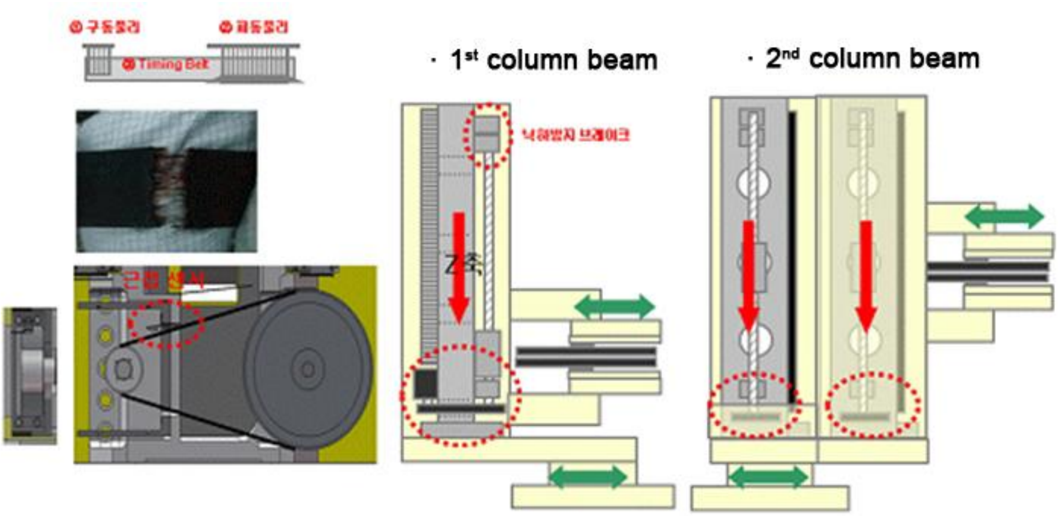


Figure 6.57 Lift Axis Belt and the Break Detection Sensor

- Checking the operation of belt break detection sensor
  Detection sensor is an optical type and it can only detect when the object is within a certain distance. If the object if out of the distance, it will process an error. Please change the distance to the object at the front of detection sensor and check the status of TP510's Private input signal. If the sensor's operation and the result of monitoring do not match, please check the connection of signal line between the sensor and the TBBO terminal block (inside of BD58B board) in the Robot. Sensor's LED green indicates normal status and red indicates error status.

6.1.10. E0108 (Axis ○) Encoder error: Encoder reset required

6.1.10.1. Outline

Power must be supplied to the encoder at all time for it to be able to store the motor's location data. Encoder's power will be supplied when the controller's power is on or from the encoder's back up battery. This error will occur, if the controller's power goes off while the encoder's back up battery is discharged (as it will cause the encoder to lose the location data)
The same error will also occur when the motor is being replaced, because the new motor's encoder is not supplied with power.
Please move the Robot to reference position by using an axis coordinate manual control to re-adjust the axis's encoder as encoder reset will change the reference position data of the axis.

6.1.10.2. Causes and examine methods

(1) Please check the voltage of encoder's battery

(2) Please examine the Encoder's battery connection status

(3) Please replace the motor and test it

(4) Re-adjustment of the encoder from Robot's reference position must be done after the encoder reset

(1) Please check the voltage of encoder's battery
Encoder's batter uses 3.6V. If the voltage decreases to 3.0V~3.2V, a message of "W0104 ○ Axis) Encoder battery voltage is low" will be displayed. Please replace the encoder's battery if this warning occurs. Replacement of encoder's battery must be done while the controller's power is on. If the encoder battery is replaced at this stage, Robot's operation will not be interrupted.

If you miss the time to replace the encoder's battery, and the battery voltage reaches to 2.5V~3.0V, and error of "E0108 ○ Axis) Encoder error: Encoder reset required" will occur.
At the point of this error occurs, the encoder already lost the location data.
Please move the Robot to reference position by using an axis coordinate manual control to re-adjust the axis's encoder followed by a replacement of encoder's battery and the reset of encoder.

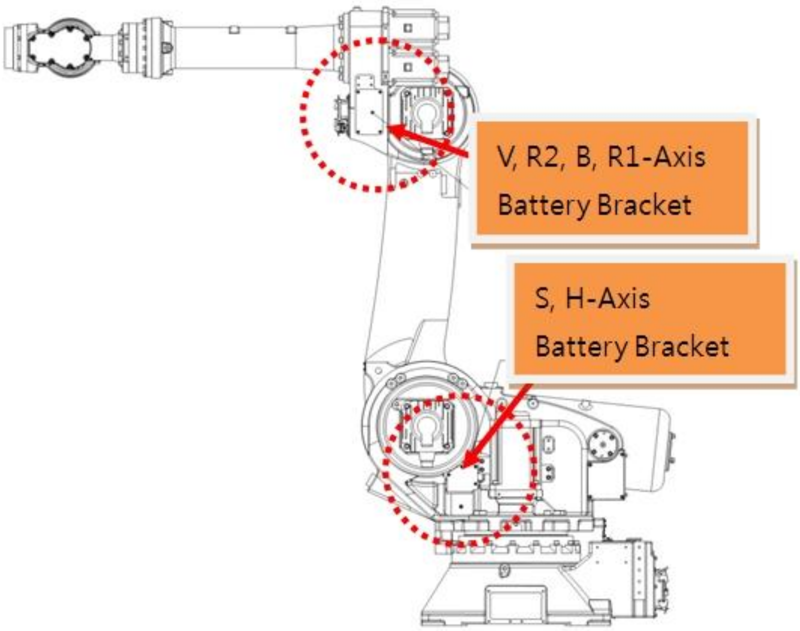
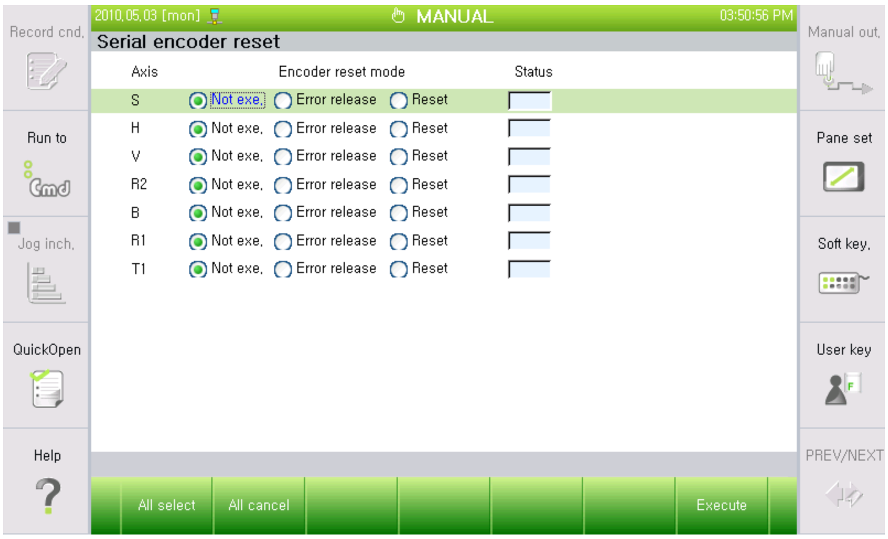


Figure 6.58 Location of Encoder's Battery Replacement

Encoder reset can be executed from the below menu.

- System
- 5. Initialize
- 4. Serial encoder reset



(2) Please examine the Encoder's battery connection status

Please examine the connection status from encoder's battery to the motor.

(3) Please replace the motor and test it

If the above do not solve the problem, there is a high possibility that the encoder itself is the cause. Please replace the motor and test it

6.1.11. E0112 (○ Axis) IPM fault signal detection

6.1.11.1. Outline

A fault output has occurred from an IPM (Intelligent Power Module) – a switch device inside of Servo Drive Unit that drives the motor. IPM fault may occur due to an increased temperature of heat sink, IPM's control voltage reduction or an over-current output

6.1.11.2. Causes and examine methods

<Error occurs non periodically when the motor turns on>

(1) Please examine the motor drive components.
- Please examine the output cable that connects to the Servo Drive Unit
- Please examine the terminal(socket) of switching device in the Servo Drive Unit
- Please replace CNBS1,2,3 cables and confirm the error
- Please replace the Servo Board(BD542) and confirm the error
- Please replace the Servo Drive Unit and confirm the error
- Please replace the Servo motor and confirm the error

<Error occurs at a certain step>

(2) Please examine the Robot at the step that an error occurs
- Please examine the Robot's wiring at the location where the error occurs
- Please reduce the speed of Robot's operation in order to confirm the error
- Please make changes on Teached step's interpolation and confirm the error

(1) Please examine the components that are related to the motor drive
Servo Drive Unit that drives the motor receives a command from the Servo Board (BD542) through CNBS cable, and the current output of internal amplification circuit will be transferred to the motor through wirings that connected to each connectors of axis

- Examine the output cable that connects to the Servo Drive Unit
  Examine the wirings that connect the Servo Drive Unit to the motor. Please turn off the power of controller, and remove the connector from the Servo Drive Unit and measure the resistance value between grounds to inspect the occurrence of short circuit

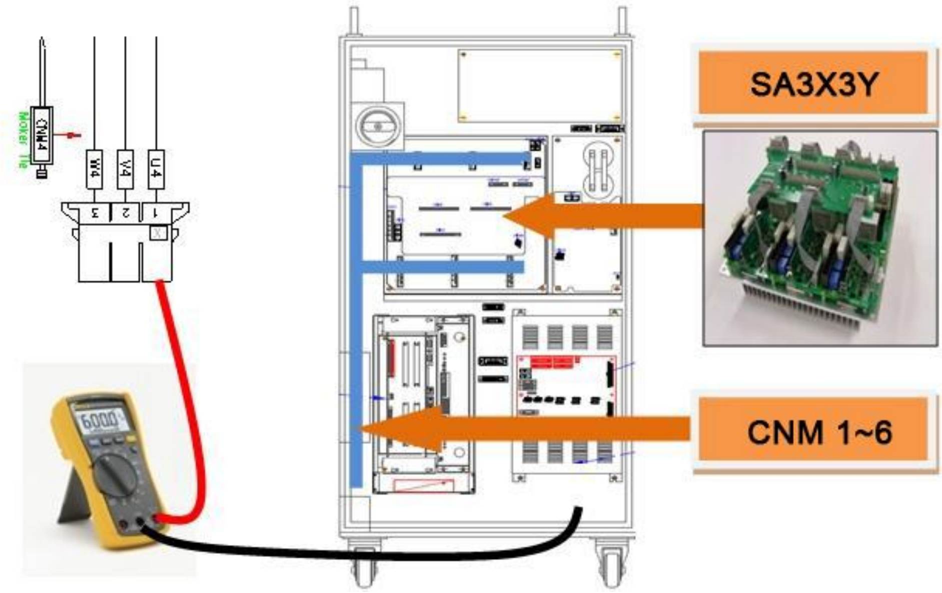


Figure 6.59 Examining the Output Cable of Servo Drive Unit (Hi5-N00 controller)

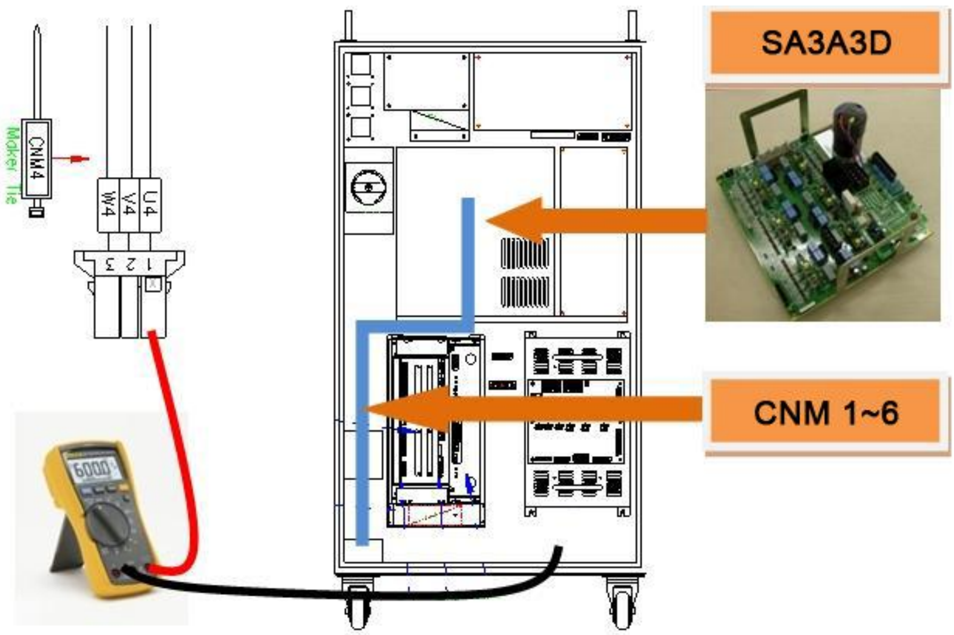


Figure 6.60 Examining the Output Cable of Servo Drive Unit (Hi5-N30 controller)

- Examine the switch device of Servo Drive Unit
  Switch device of Servo Drive Unit switches the direct current voltage that supplied from diode module and output the alternating current for each phases. If a short circuit occurs at the internal terminal of switch device, over-current flow and it will cause an IPM fault error. Please remove the connector and check if a short circuit has occurred between the output terminal in a switch device of Servo Drive Unit and the P (or N)
  If a short circuit exists, the Servo Drive Unit need to be replaced and also the cable that connects the Servo Drive Unit to the motor needs to be examined.

  - Large size Robot’s Servo Drive Unit: SA3X3Y
  - Small size Robot’s Servo Drive Unit: SA3A3D

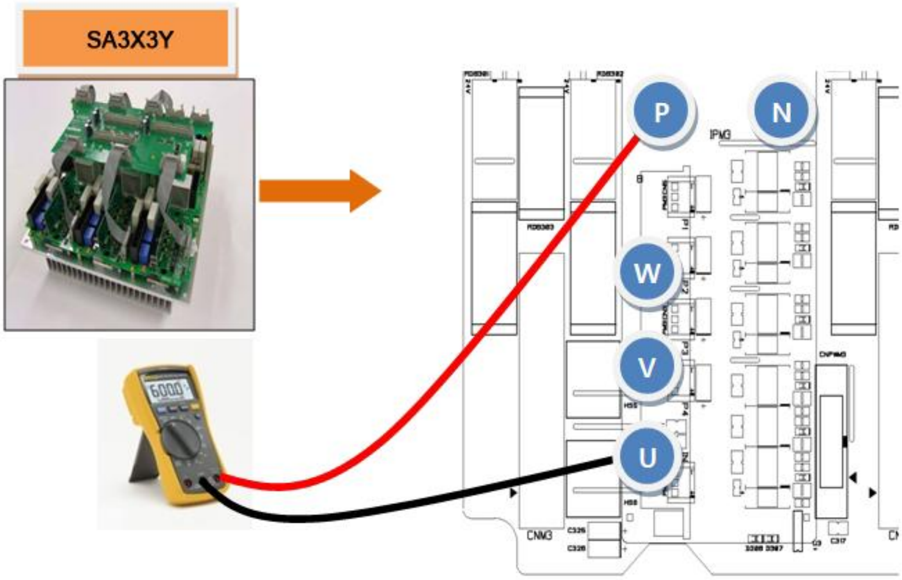


Figure 6.61 Short Circuit Test on Switching Device of SA3X3Y

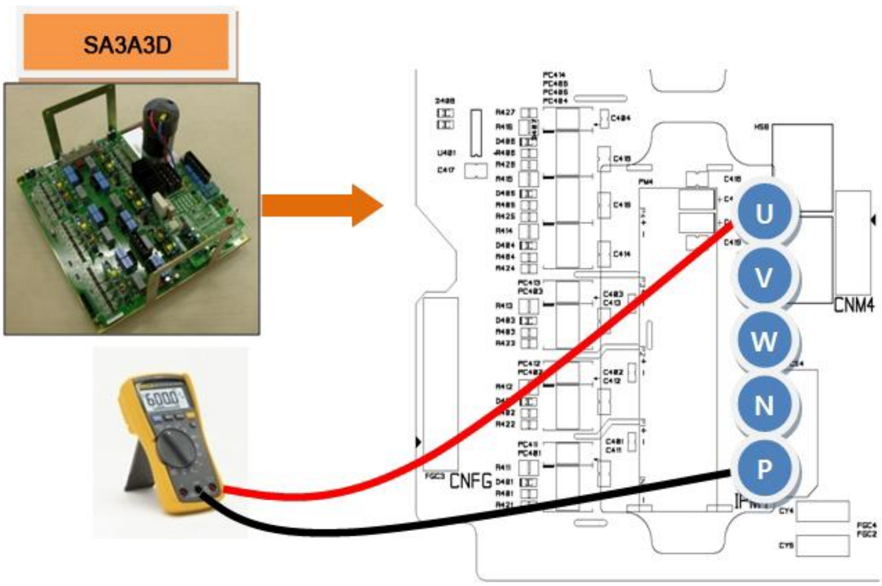


Figure 6.62 Short Circuit Test on Switching Device of SA3A3D

- Replacement of CNBS cable and examining the error CNBS
  Servo Drive Unit that drives the motor receives a command from the Servo Board (BD542) through CNBS cable, and the current output of internal amplification circuit will be transferred to the motor through wirings that connected to each connectors of axis.
  If the error does not persist after the replacement of cable, cable is faulty. Please replace the CNBS cable with new one.

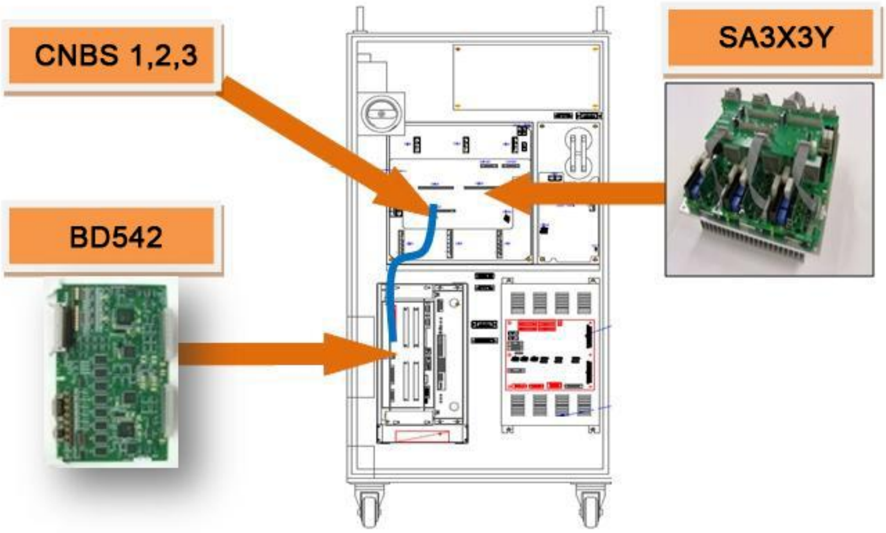


Figure 6.63 Locations of Components in Hi5-N00 Controller that are Related to Motor Drive

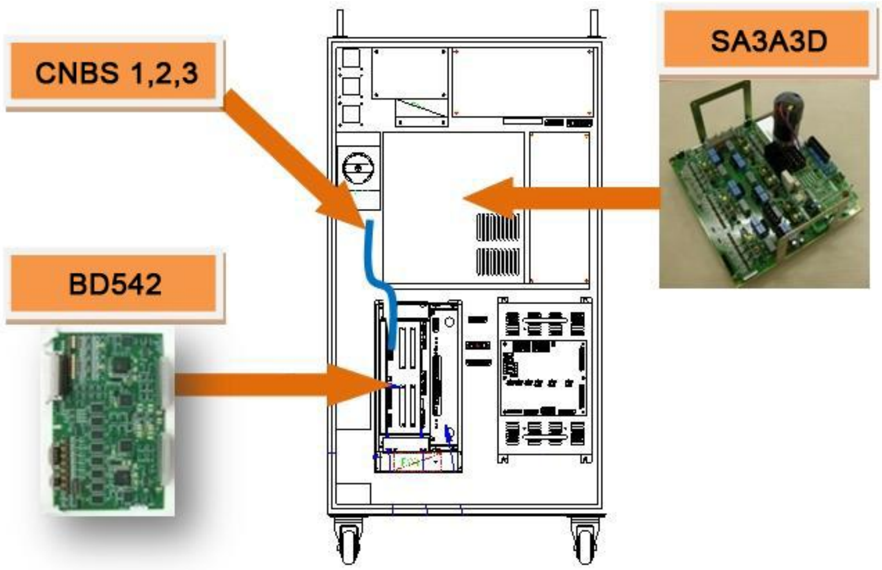


Figure 6.64 Locations of Components in Hi5-N30 Controller that are Related to Motor Drive

- Replacement of Servo Board (BD542) and examine it
  If the error does not persist after the replacement of Servo Board (BD542), Servo Board (BD542) is faulty. Please replace the Servo Board (BD542) with new one.

- Replacement of Servo Drive Unit and examine it
  If the error does not persist after the replacement of Servo Drive Unit, Servo Drive Unit is faulty. Please replace the Servo Drive Unit with new one.

  - Small size Robot’s Servo Drive Unit: SA3X3Y
  - Small size Robot’s Servo Drive Unit: SA3A3D

- Replacement of Servo Motor and examine it
  If the error does not persist after the replacement of Servo Motor, Servo Motor is faulty. Please replace the Servo Motor with new one. Below diagram describes the locations of each axis’s motor (HS165 Robot). For other Robot, please refer to the Robot’s maintenance manual to replace it.

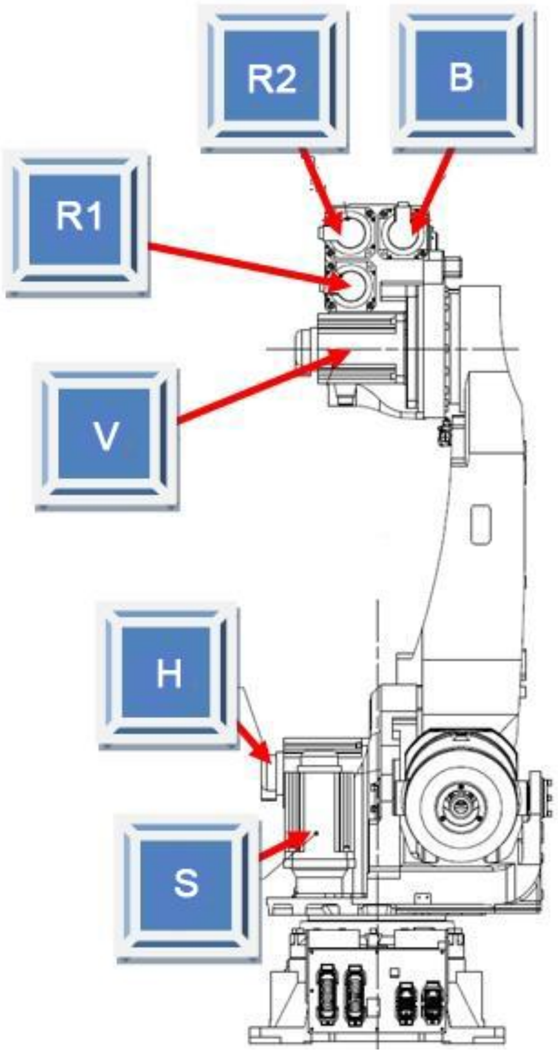


Figure 6.65 Locations of Each Axis’s Motor (HS165 Robot)

(2) Please examine the Robot at the step that an error occurs

If IPM fault error occurs at a certain step, it may occur when the device wiring has been damaged at Teached step or the axis speed changed greatly when the Teached program changes the position. ,

- Examine the internal wiring at the location of an error
  Examine the wiring status of corresponding axis that connected to the motor (inside of Robot). During the examination, please turn off the controller's power and remove the output connector from the Servo Drive Unit. After that please measure the resistance value between ground of each phases (cable side) to test a short circuit.

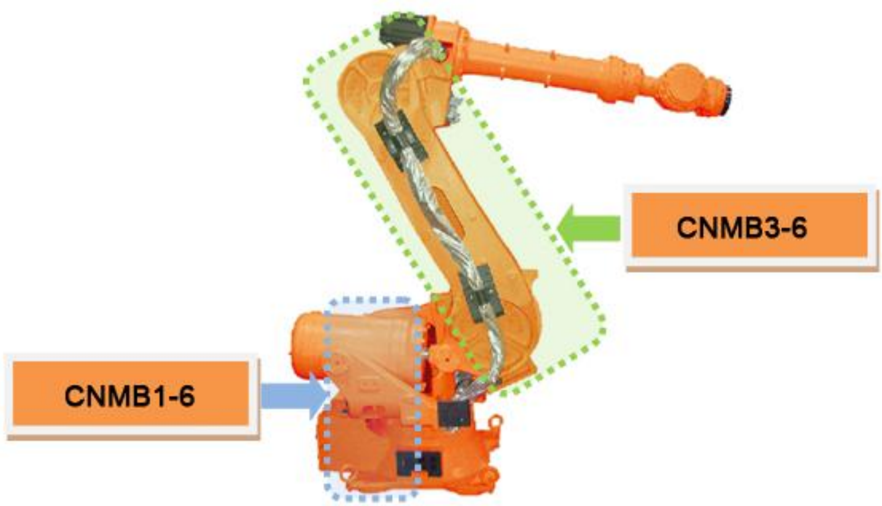


Figure 6.66 Location of Wiring Examination for Each Axis (HS165)

- Reduce the speed of Robot's operation in order to confirm the error
  If an error occurs at a step that generates rapid changes of axis speed which is caused by the position changes of Robot, reduce the operation speed to confirm the error. If the error does not persist after the speed is reduced, please change the Teach speed of corresponding step and record the job program to use.

- Change the Teached step's interpolation to confirm the error
  If the axis speed rapidly changes even after the operation speed is reduced by 75%, please change the Teached step's interpolation to 'P' and confirm the error. If the changes on interpolation resolve the error, (at the same operation speed) please modify the Teach.

6.1.12. E0113 (○ Axis) Over-current

6.1.12.1. Outline

Current that flows in the motor or the drive unit exceeds the allowed voltage range. When the current that generated by the Servo control to operate the Robot (or the drive unit) exceeds the allowed safe voltage range, the Servo Board will detect an error and immobilize the Robot

6.1.12.2. Causes and examine methods

(1) Check if the axis with an error has mechanical interference with other equipments.

(2) Examine the Motor power line.
- Check the wiring that connects the Robot and Controller.
- Check the Robot's internal wiring.
- Check the Controller's internal wiring.

(3) Examine the CNBS cable between the Controller's internal Servo Board and the Drive Unit

(4) Replace other components

(1) Check if the axis with an error has mechanical interference with other equipments
This error may occur if the Robot had a mechanical interference or collisions. If the Robot is out of the operation area, please move it back into the operation area by using a manual control.

(2) Examine the Motor power line
Please turn off the primary power and remove the U, V, W of drive unit for the corresponding axis and examine if short circuit exists in each phase. Please use an equipment such as the multi meter (tester) and examine each phase's wiring one by one.

Warning
Be cautious. Examination while the power is on may cause an electrocution

- Check the wiring that connects the Robot and Controller.
  Please remove the wirings that connect the controller, Robot or the drive unit to examine each phases (U, V, W) for ground, or a short circuit. If a short circuit is found, please replace the wire

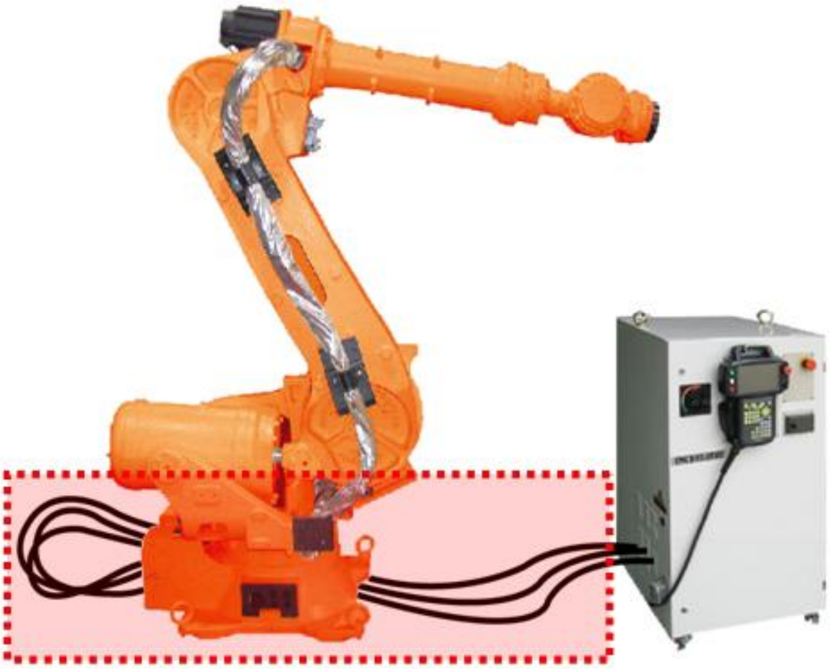


Figure 6.67 Basic Installation Diagram of the Robot and Control Period

- Check the Robot's internal wiring
  Examine for a short circuit, faulty on a wiring that connected to Robot's internal motor is required

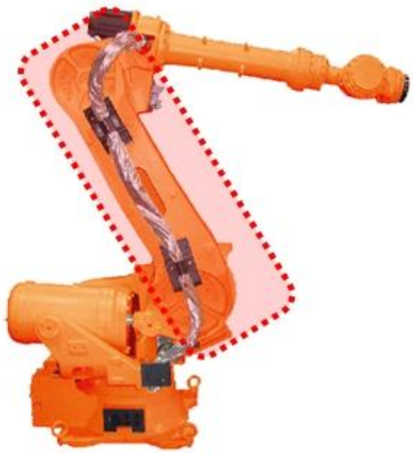


Figure 6.68 Robot's Internal Wiring

- Check the Controller's internal wiring.
  Examine on a controller's internal AMP and installed wiring is required

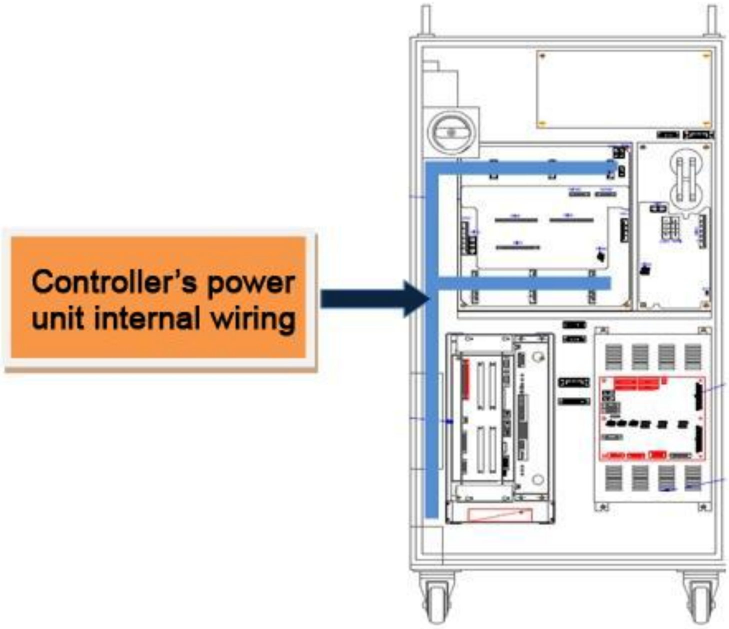


Figure 6.69 Controller's Internal Area (Power unit)

(3) Examine the CNBS cable between the Controller's internal Servo Board (DSP board) and the Drive Unit

Please examine if the CNBS cable is installed properly. If the cable is not installed properly, or the cable is faulty, this error may occur.

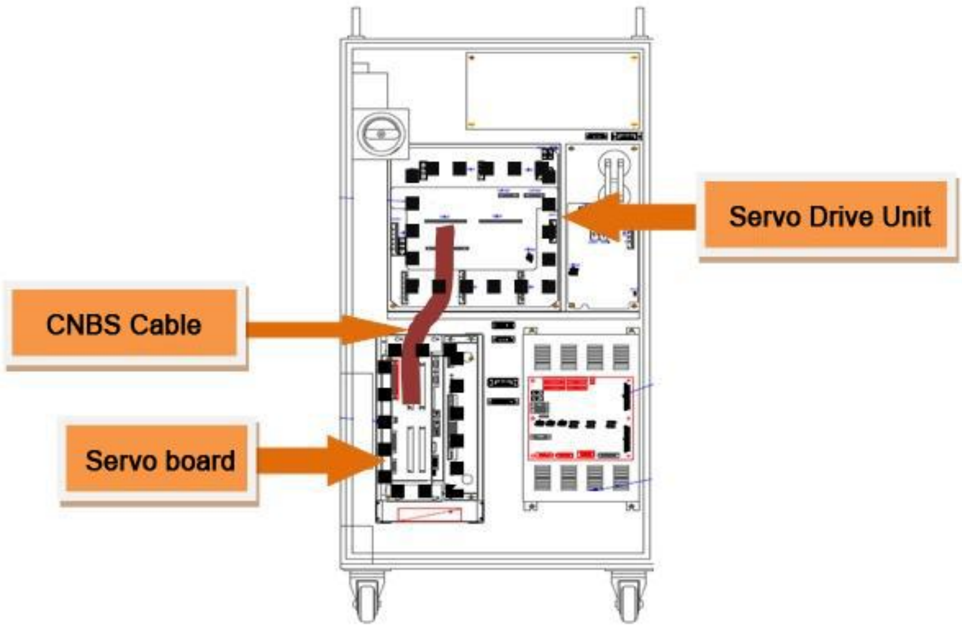
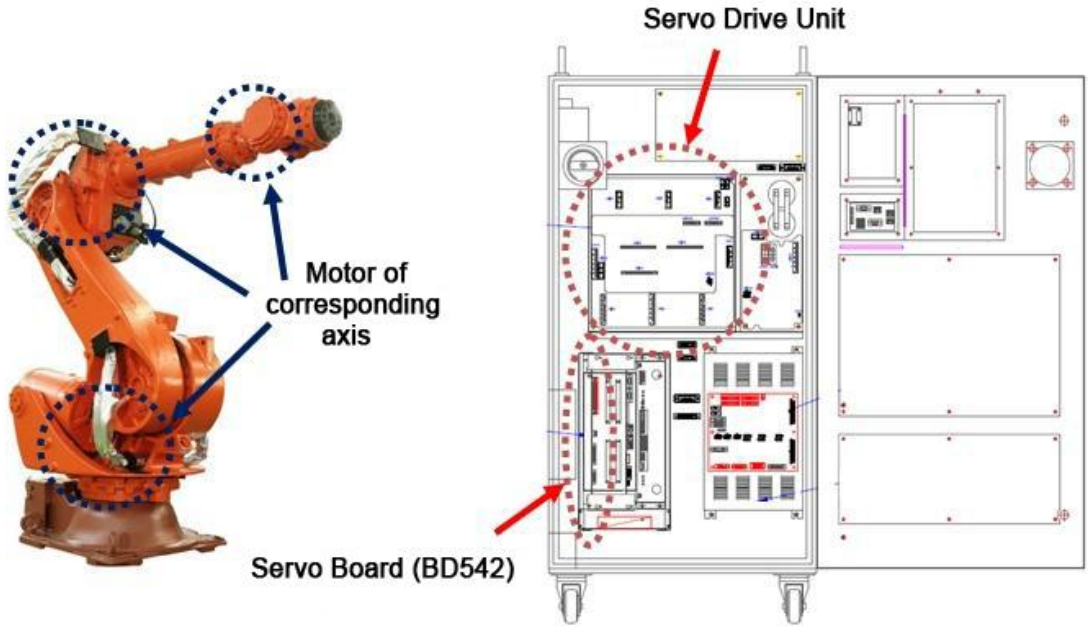


Figure 6.70 Controller's Internal Area (CNBS cable)

(4) Replace other components

Replace the component in order of Servo Board (BD542) → Servo Drive Unit → Motor to confirm the occurrence of an error.



6.1.13. E0114 Operating device control voltage reduction

6.1.13.1. Outline

Control power that supplied to the Servo Drive Unit +15V has been reduced. This error is detected by the Servo Drive Unit and transferred to the Servo Board through CNBS cable

6.1.13.2. Causes and examine methods

(1) Please check the power indicator LED
- Please check the ‘POW’ LED of Servo Drive Unit
- Please check the ‘+15V’ LED of SR1 (control power supply unit)

<Case: Both of module’s LED are OFF>

(2) Please check the output of SR1(control power supply unit)
- Please remove CNBS cable from BD542 and check the LED
- Please remove the Servo Board from the Rack and check the LED

(3) Please examine the SR1(control power supply unit)
- Please check the input voltage to SR1
- Please replace the SR1 and check the LED

<Case: Only the Servo Drive Unit’s ‘POW’ LED is OFF>

(4) Please replace the related components and check the power indicator LED
- Please replace CNBS cable and check the LED
- Please replace the Servo Board and check the LED
- Please replace the Servo Drive Unit and check the LED

(1) Please check the power indicator LED

Drive unit control voltage reduction error is caused by a reduction of control voltage +15V. This error will be detected by the Servo Drive Unit and transferred to the Servo Board (BD542) through CNBS1, 2, 3 cables to be handled.

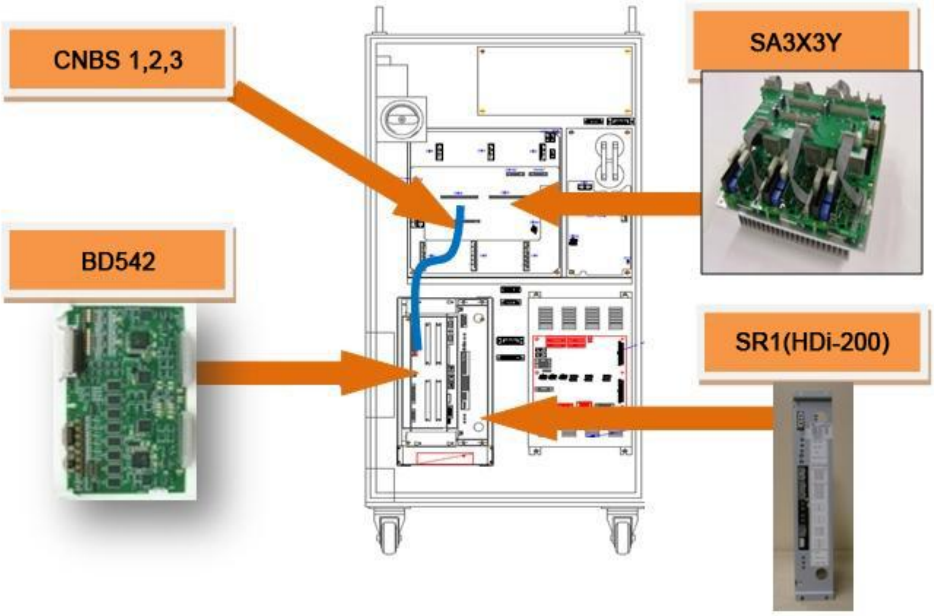


Figure 6.71 Locations of Components in Hi5-N00 Controller that are Related to Drive Unit Control Voltage Reduction

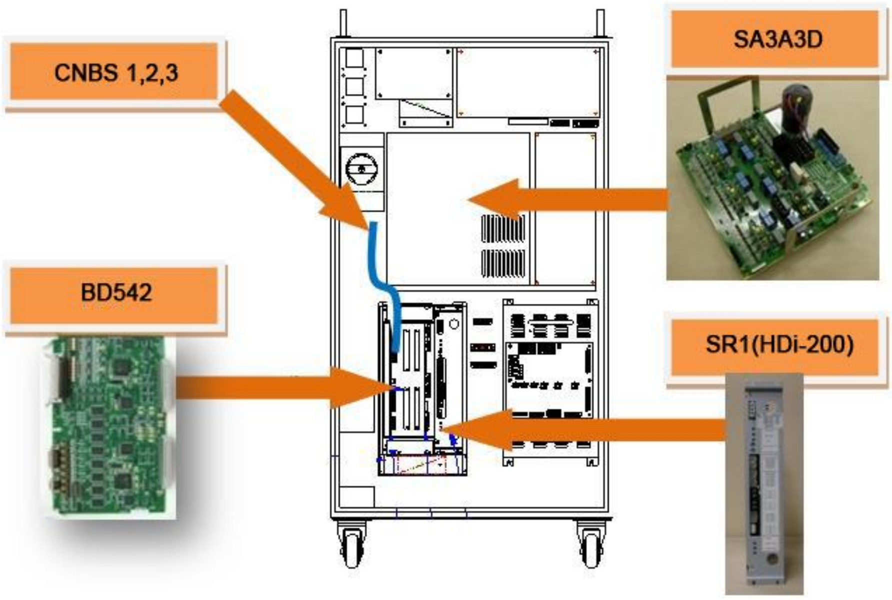


Figure 6.72 Locations of Components in Hi5-N30 Controller that are Related to Drive Unit Control Voltage Reduction

- Examine the ‘POW’ LED of Servo Drive Unit
  Please check the ‘POW’ of drive unit control voltage error detection module (SA3X3Y-large, and SA3A3D-small) If the power is being supplied normally, the LED light should be stays on

  - Large size Robot’s Servo Drive Unit : SA3X3Y
  - Small size Robot’s Servo Drive Unit : SA3A3D

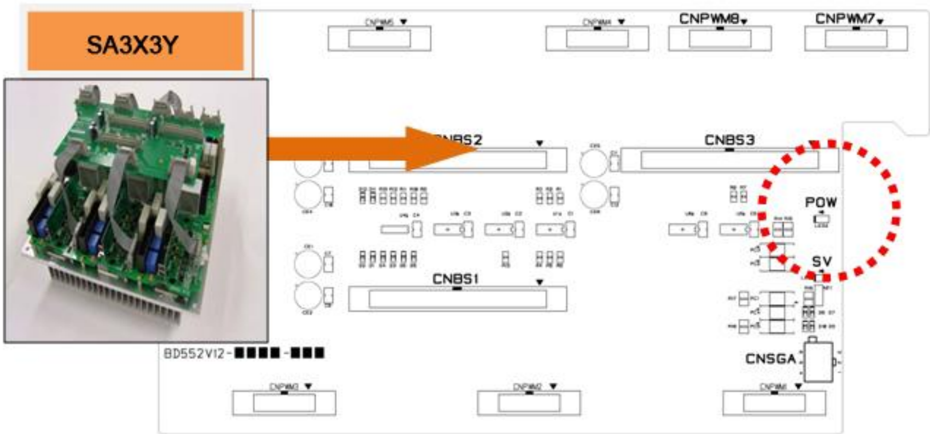


Figure 6.73 Locations of Components in SA3X3Y that are Related to ‘POW’ LED

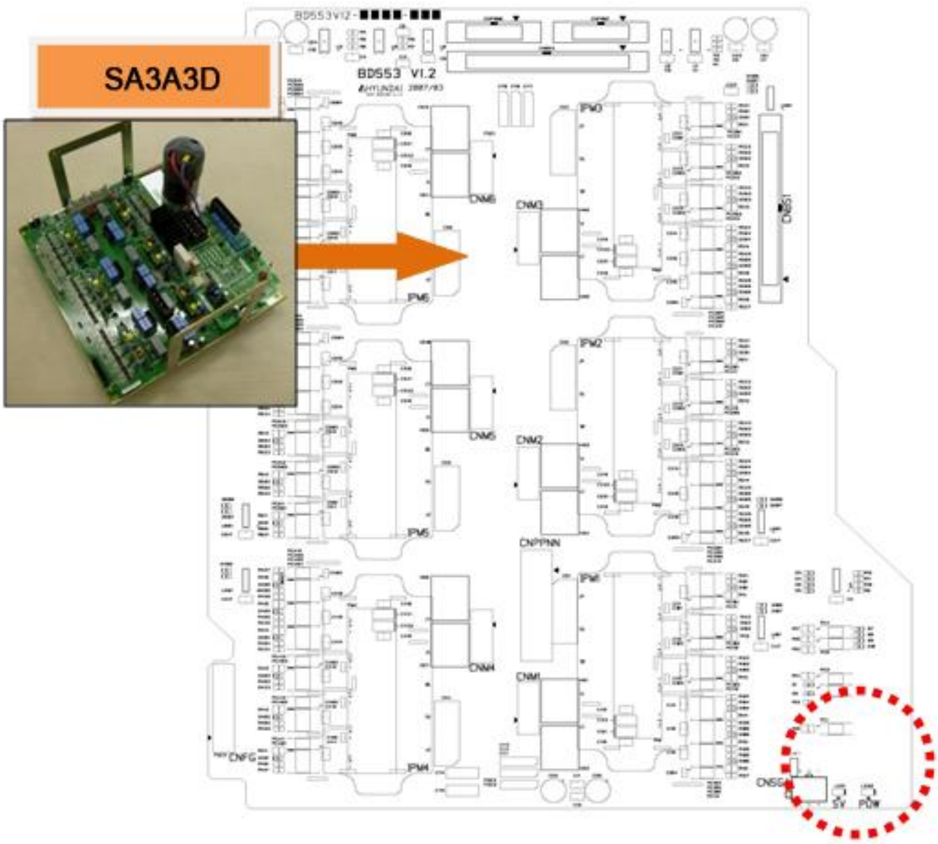


Figure 6.74 Locations of Components in SA3A3Dthat are Related to ‘POW’ LED

- Examine the '+15V' LED of SR1

  Please check the LED of SR1 if the Servo Drive Unit's 'POW' LED light is off.
  Please check if the LED of SR1 and the LED of Servo Drive Unit are both off at the same time.

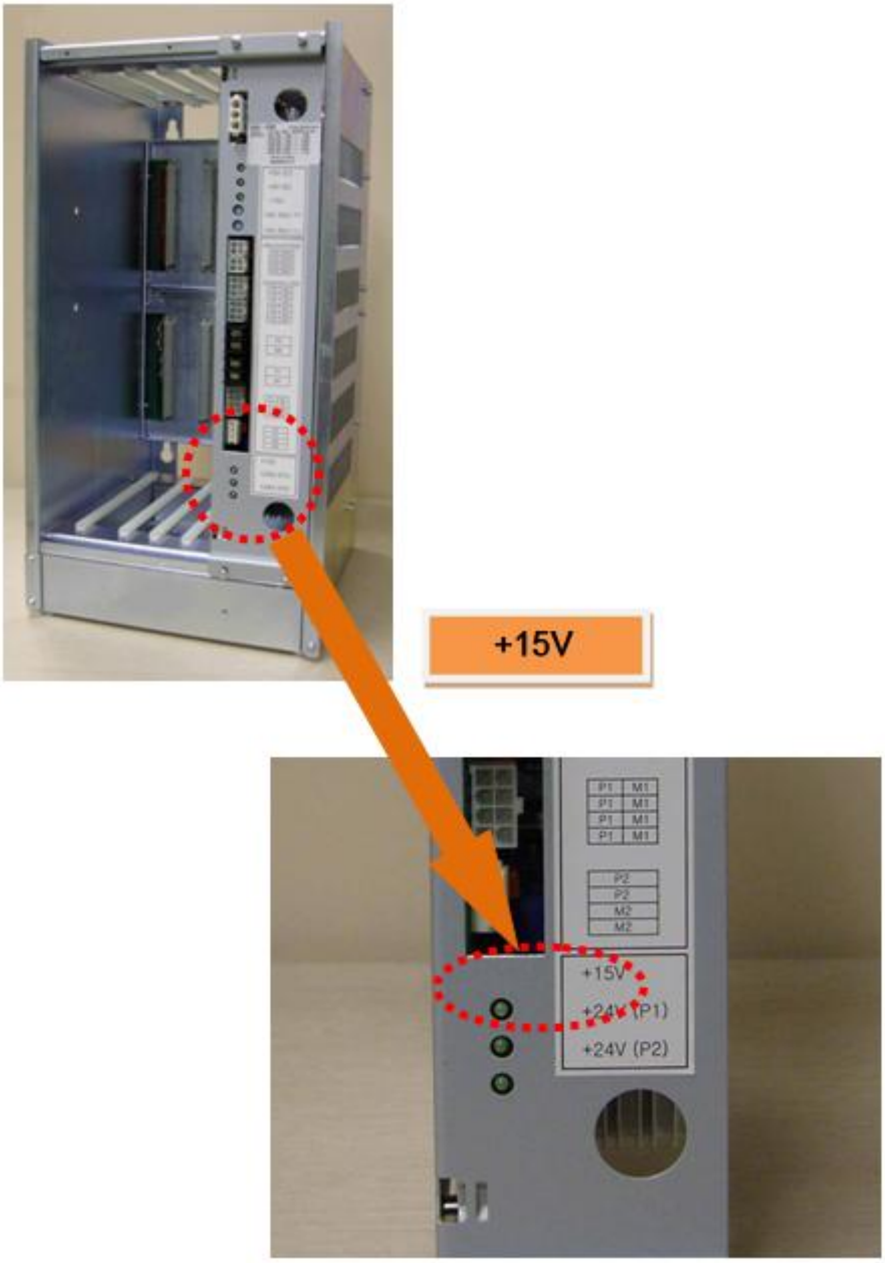


Figure 6.75 Locations of '+15V' LED Related Components of SR1

(2) Please check the output of SR1

Please remove the wirings and components that are connected to the Servo Drive Unit and examine the '+15V' LED in order to check the output of SR1 itself

- Remove CNBS cable and check the LED
  Please remove the CNBS1, CNBS2, CNBS3 that connect the Servo Drive Unit and the Servo Board. After the removal, please check the LED of SR1. If the '+15V LED' of SR1 turns to ON after the removal of cables, the Servo Drive Unit is faulty. Please replace the Servo Drive Unit with new one

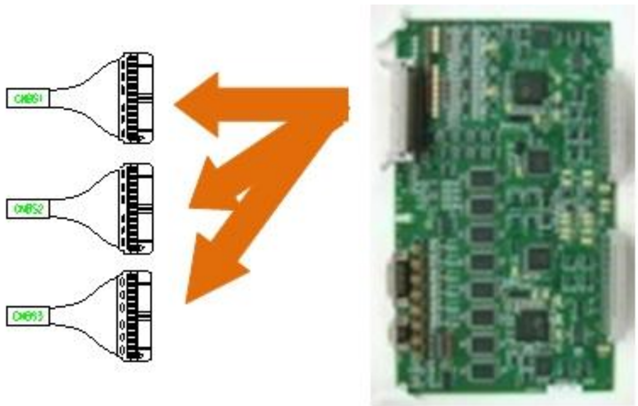


Figure 6.76 Removal of CNBS cable

- Remove the Servo Board (BD542) and examine the LED
  Please check the SR1's LED after you remove the Servo Board from a Rack. If the '+15V LED' of SR1 turns to ON after the removal of Servo Board, the Servo Board is faulty. Please replace the Servo Board with new one

Figure 6.77 Removal of Servo Board from the Rack

(3) Please examine the SR1(control power supply unit)
Control power supply unit received AC 48V (input) and output the necessary control power to each board from the internal circuit.

- Examine the input voltage of SR1
If the input voltage to SR1 exceeds the specification, the output of control power may have an error. If the input voltage exceeds the allowed range, please examine according to a controller's input voltage examination procedures and a controller's single-phase internal voltage examination procedures.

  - SR1 input voltage specification: single-phase AC 48V
  - Allowed range: 44V ~ 52V

- Replace the SR1 and check the LED
Please replace the SR1 with new one and check the '+15V' LED. If the LED is ON after the replacement, SR1 is faulty. Please replace it and use.

(4) Please replace the related components and check the power indicator(LED)
Please replace the Servo Drive Unit, Servo Board, CNBS cable and check the 'POW' LEF of the Servo Drive Unit.

- Replace the CNBS cable and check the 'POW' LED
Please replace the CNBS1, CNBS2, CNBS3 that connects the Servo Drive Unit and the Servo Board, and check the 'POW' LED. If the 'POW' LED is ON after the replacement, cable is faulty. Please replace it with new one.

- Replace the Servo Board and check the 'POW' LED
Please replace the Servo Board, and check the 'POW' LED. If the 'POW' LED is ON after the replacement, the Servo Board is faulty. Please replace it with new one.

- Replace the Servo Drive Unit and check the 'POW' LED
Please replace the Servo Drive Unit, and check the 'POW' LED. If the 'POW' LED is ON after the replacement, the Servo Drive Unit is faulty. Please replace it with new one.

  - Large size Robot's Servo Drive Unit: SA3X3Y
  - Small size Robot's Servo Drive Unit: SA3A3D

6.1.14. E0115 (Axis o) Received command code error

6.1.14.1. Outline

Main Board’s command code that received by the Servo Board does not meet the mutual regulation of Main Board and the Servo Board. This error may occur due to the communication error or the version differences between the Main Board and the Servo Board

6.1.14.2. Causes and examine methods

(1) Please examine if the Main Board and the Servo Board are installed properly.
- Examine if the board is installed properly.
- Examine if board is faulty

(2) Examine if the versions of the Main Board and the Servo Board matches

(1) Please examine if the Main Board and the Servo Board are installed properly

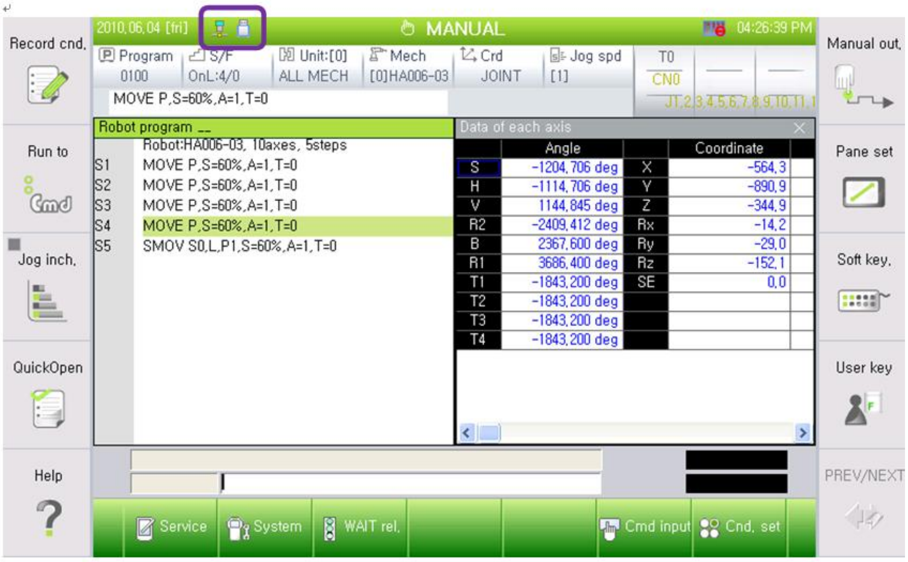
This error may be caused by a communication problem if the Main Board and the Servo Board is not installed properly on a rack, or the board has an error

Warning
In order to protect the previous job programs, please back up all the files of Main board to the USB memory before you remove the board from the Rack

Method to back up the files from Main Board to USB memory is as below

Figure 6.78 Inserting Method of USB to TP

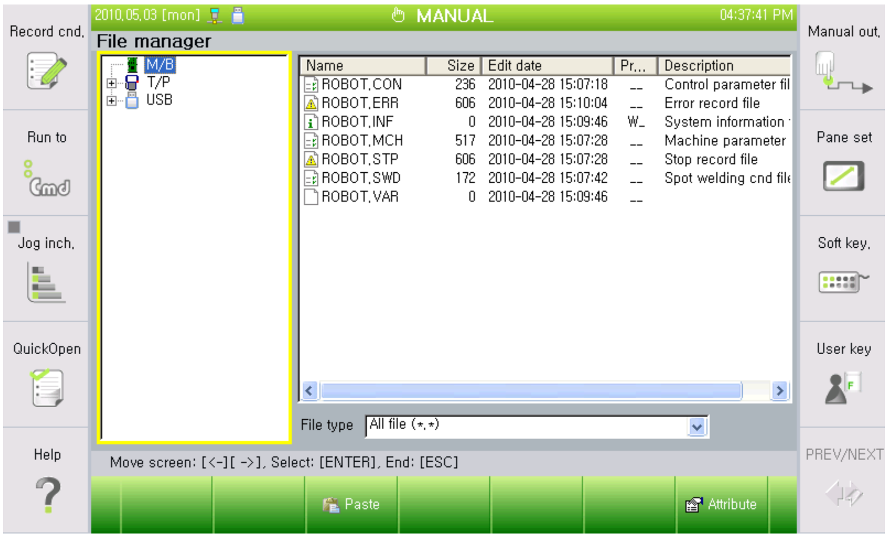
Once the USB is recognized by TP, the below icon will be displayed on a screen



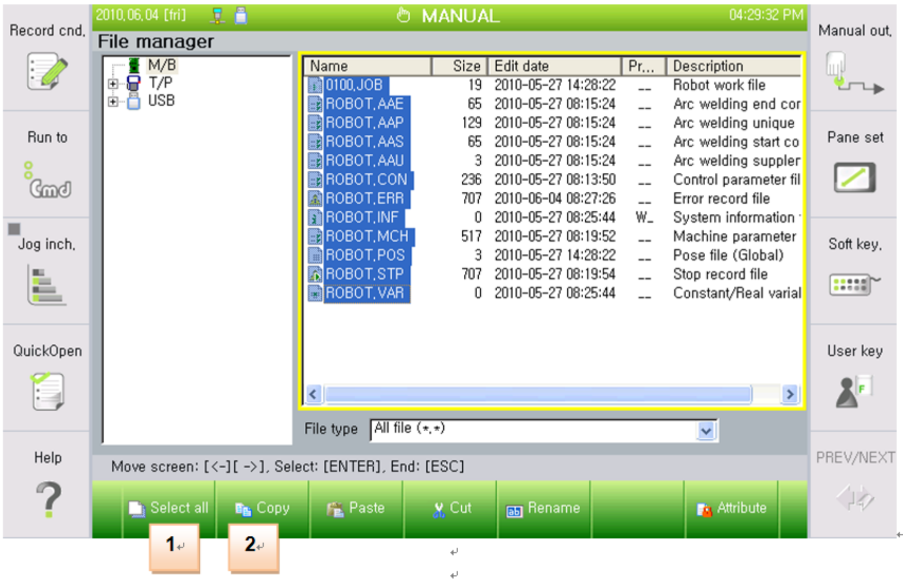
To back up the files enter to,

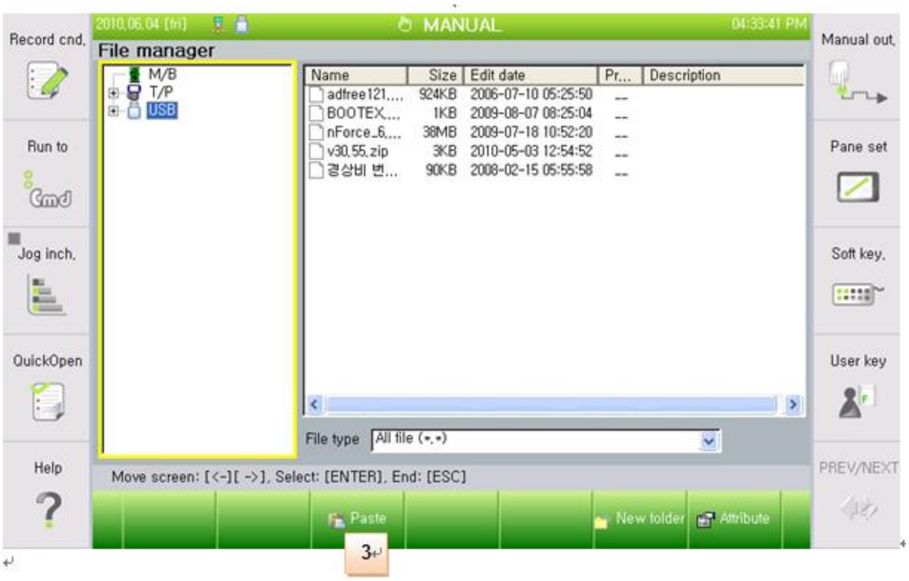
- Service
- 5. File manager

And the screen that is similar to windows explorer will be displayed.

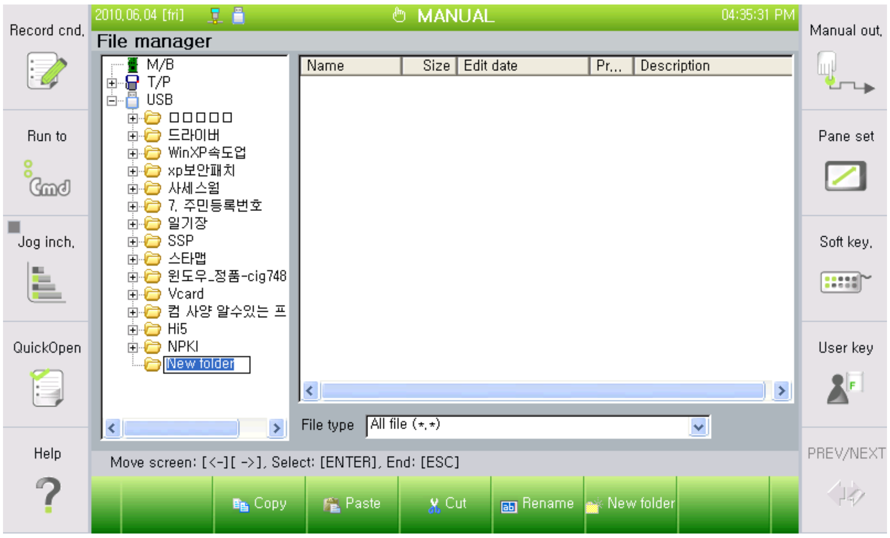


At this stage, please copy the files shown in M/B and move them to USB





You may create a new folder on USB, or can rename the folder by using the soft keyboard just like the windows explorer



- Examine if the board is installed properly
  Please remove the Main Board and the Servo Board from the Rack and re-install them again

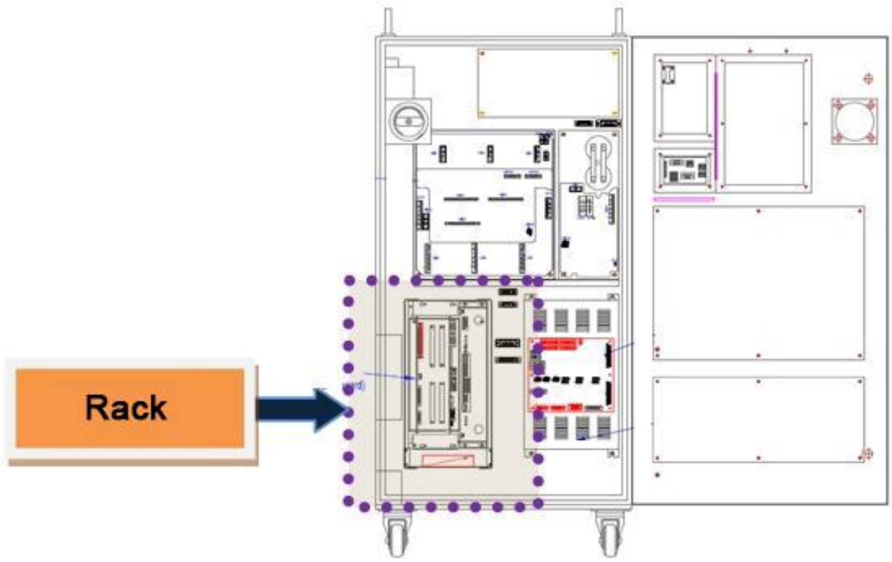


Figure 6.79 Location of Rack Inside of the Controller

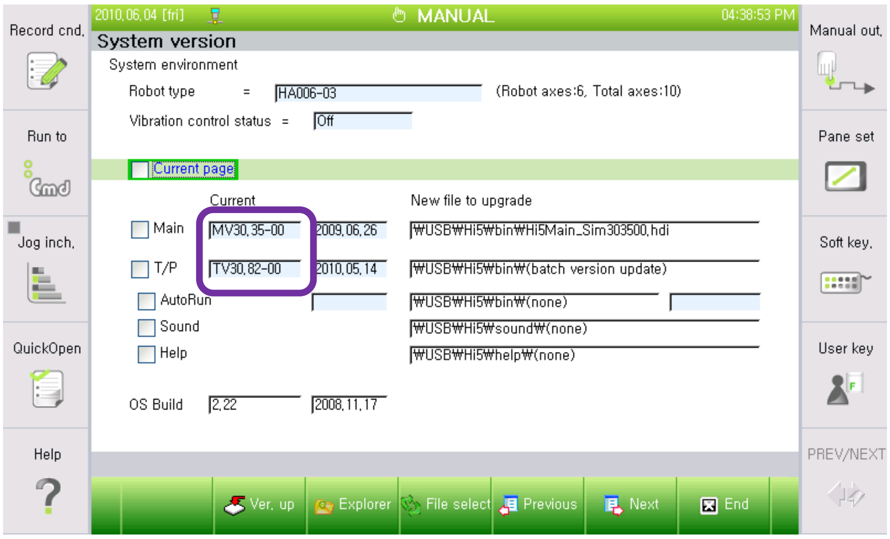
- Examine if the board is faulty.
  To examine if the board is faulty, please replace it with new one

(2) Examine if the versions of the Main Board and the Servo Board matches

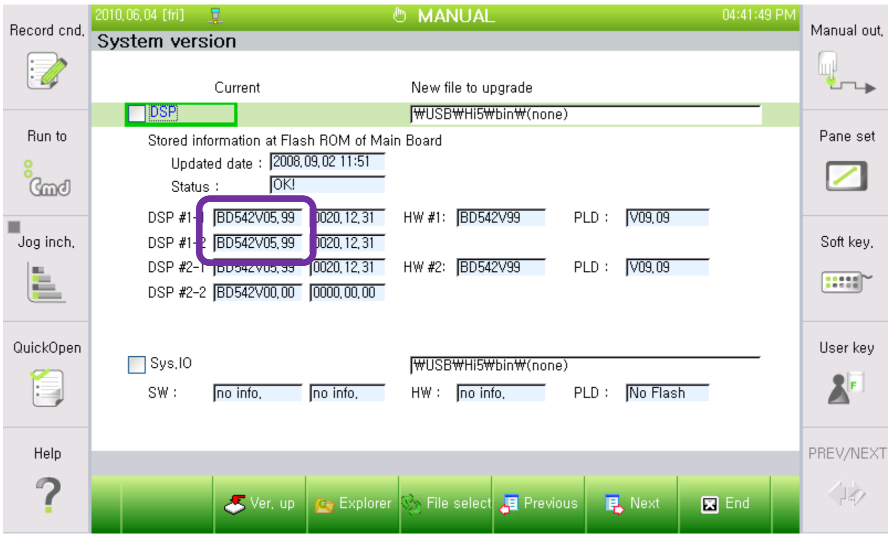
When the controller turns on, it will check the versions of Main Board and the Servo Board If the version does not match, an error of "E0179~E181 DSP version is old" will be displayed. Please contact to our A/S department in order to update the system with a proper version

Versions of the Main Board and the Servo Board can be checked from the below menu

- ➢ Service
- ➢ System diagnosis
- ➢ System version



Press F6[next page] to check the version of Servo Board



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6.1.15. E0117 (Axis ○) Location deviation set value exceeded

6.1.15.1. Ouline

Location (speed) deviation exceeds the set value. If the difference between the location of moving command and the actual location is too large during the operation of Robot that controlled by the Servo, the Servo Board will detect an error (during Servo operation) and immobilize the Robot .

6.1.15.2. Causes and examine methods

(1) Check if the axis with an error has mechanical interference with other equipments (2) Check if the brake release works properly ■ Examine if the brake release of each axis has an error ■ Examine the error on brake's power supply. (3) Examine the wiring status (4) Check if the rated load is used (5) Position deviation setting level error (6) Please replace other components

(1) Check if the axis with an error has mechanical interference with other equipments
This error may occur if the Robot had a mechanical interference or collisions. If the Robot is out of the operation area, please move it back into the operation area by using a manual control

(2) Check if the brake release works properly
Brake release function of the corresponding axis maybe have an error, or the releave voltage of the brake release may have problem

- Examine if the brake release of each axis has an error
  Please remove the motor's power supply (motor OFF) and check if you can release the brake of the axis with manual brake switch. You can confirm it with the sound of brake release from the motor

Warning
Please be cautious. The Robot's axis may fall once the brake is released

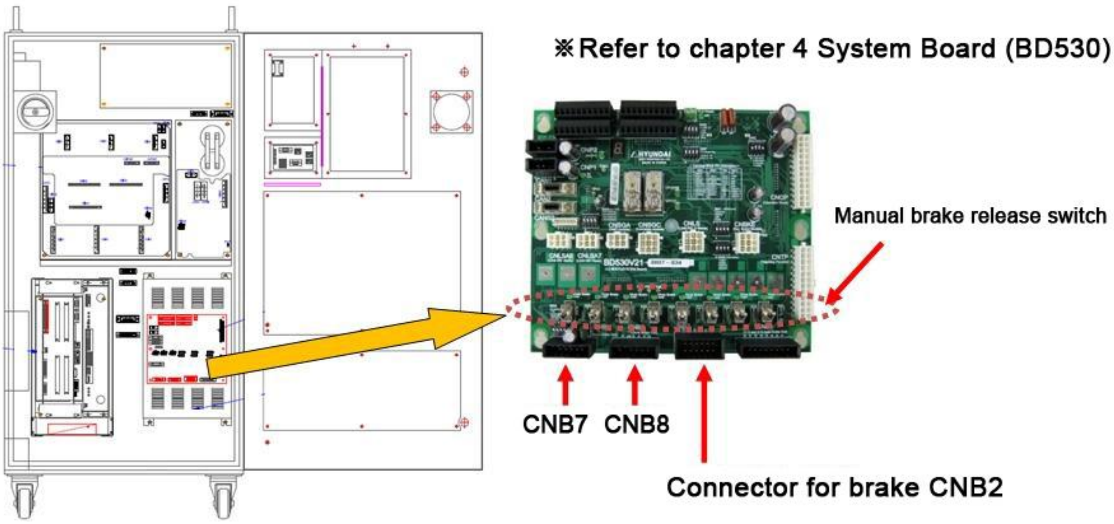
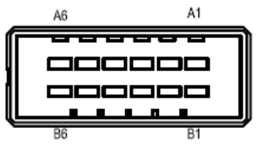


Figure 6.80 Location of the Manual Brake Release Switch

If the corresponding axis's brake cannot be released, output status of the brake release voltage in the System Board need to be examined. Please remove the brake wiring (CNB2, CNB7, CNB8 connector) and use the manual brake switch for the brake voltage's output.
Please measure the brake voltage of corresponding axix output (from the CNB2, CNB7, CNB8 connector) to check if it is over 20V. If there is an axis which has a voltage output under the 20V, System Board (BD530) is faulty. Please replace it



CNB2

PIN	DESCRIPTION	PIN	DESCRIPTION
A1	BA1	B1	MB
A2	BA2	B2	MB
A3	BA3	B3	/R_FAN
A4	BA4	B4	MONL
A5	BA5	B5	PREPB
A6	BA6	B6	/TS

CNB7

PIN	DESCRIPTION	PIN	DESCRIPTION
1	BA7	4	/TS1
2	PREPB	5	—> Key Pin
3	MB	6	/TS7

CNB8

PIN	DESCRIPTION	PIN	DESCRIPTION
1	BA8	4	/TS7
2	PREPB	5	/TS8
3	MB	6	—> Key Pin

Figure 6.81 Pin Locations of CNB2, CNB7 Connectors

- Examine the error on brake's power supply.
  If "E0012 Brake power supply error message is displayed at the same time, there is an error on Brake's power supply unit. From TP, please access 『[F1]:Service』→『1:Monitoring』→『2:I/O signals』→『1:Private input signal』→『Overload(Brake Power supply)』. If it is highlighted as yellow, the fuse for Brake (in the Electrical Module)'s power supply has been disconnected. Please replace the fuse.

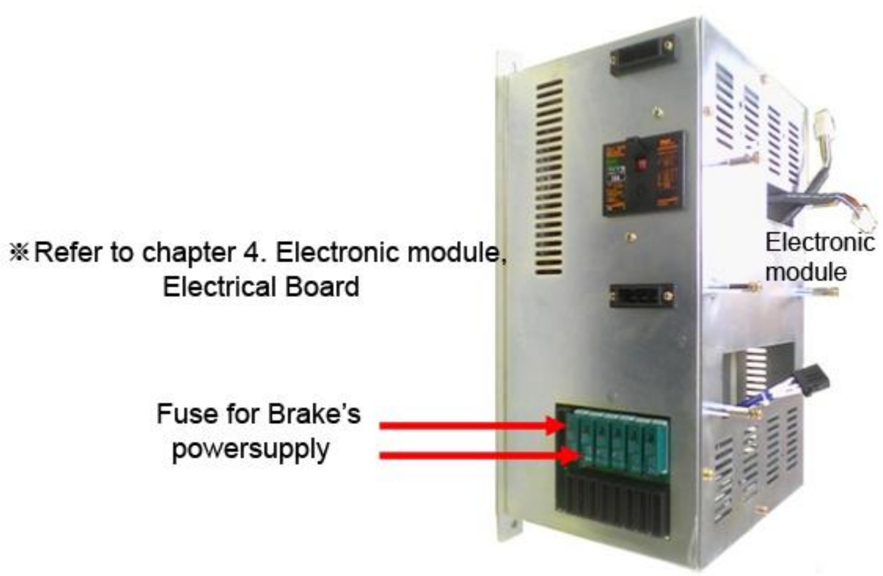


Figure 6.82 Electrical Module

If the fuse is normal, please measure the Brake power supply (DC24V) from the System Board. There are 3 test pins at the center of the board. Use the TMB as a reference terminal and the TPPB terminal value should be over DC20V. If it is below 20V, the power supply unit that generates the power for the brake has an error. Please replace the Electrical Module.

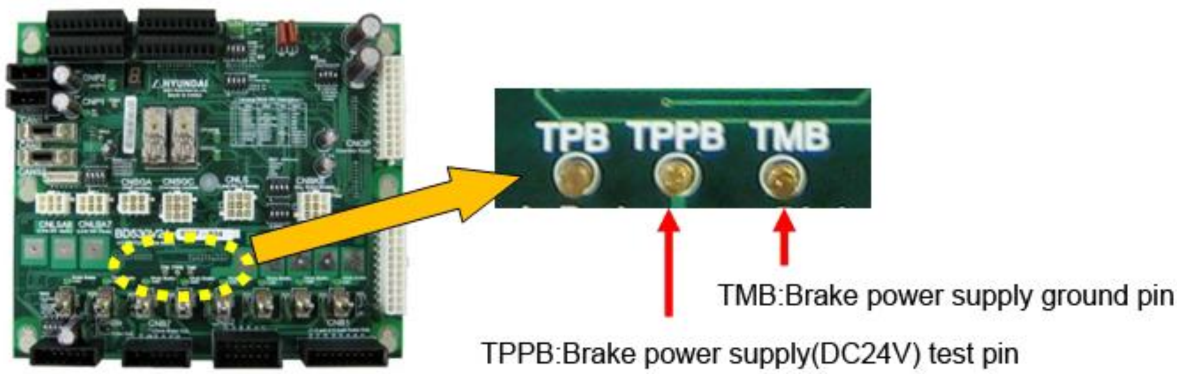


Figure 6.83 Brake Power Supply Test Pin

(3) Examine the wiring status
Check if the motor wiring (U, V, W phase) has been short-circuit from the other wiring or ground lines (FG)

(4) Check if the rated load is used
If the total weight exceeds the rated load, please refer to the Robot's specification and adjust the load to within the rated load.

(5) Position deviation setting level error

If the position deviation setting value is smaller than the below's maximum measured value, please increate the setting value

Maximum measured value of positon deviation after few cycles of operation x 1.5

Figure 6.84 Monitoring Screen of the Maximum Measured Position Deviation Value from TP

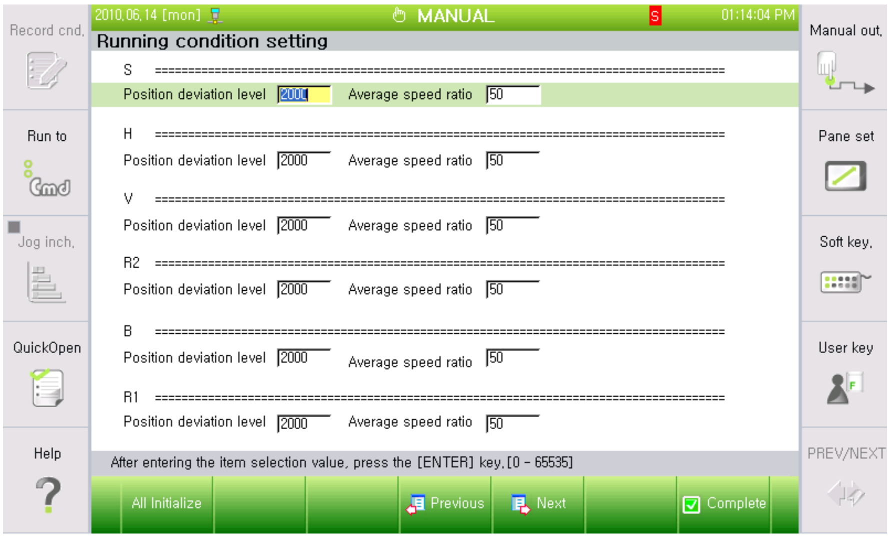
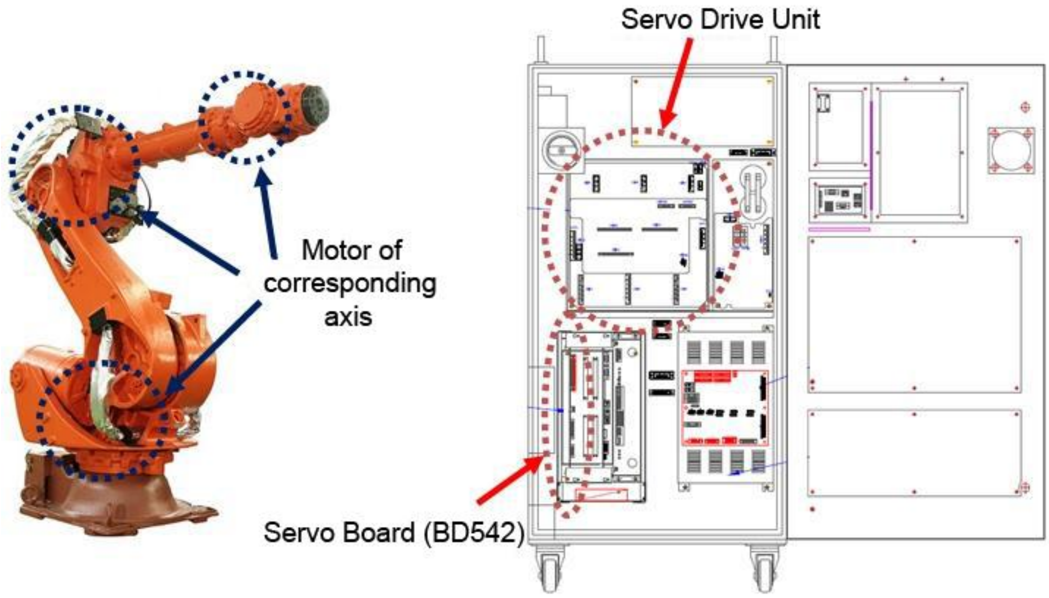


Figure 6.85 Modifying Screen of Position Deviation Value from TP

(6) Please replace other components.

Replace the component in order of Servo Board (BD542) →Servo Drive Unit→Motor to confirm the occurance of an error'



6.1.16. E0119 (Axis ○) Overload

6.1.16.1. Ouline

Motor or the drive unit is being overloaded. If motor or the drive unit is overloaded, the Servo Board detects an error and immobilizes the Robot

6.1.16.2. Causes and examine methods

(1) Please check if the Robot is loaded within its rated load (2) Please examine if there is a possible collision point during the Robot’s operation (3) Please check if the axis brake works properly (4) Please replace the Servo Board and examine an error (5) Please examine if the Drive Unit operates normally

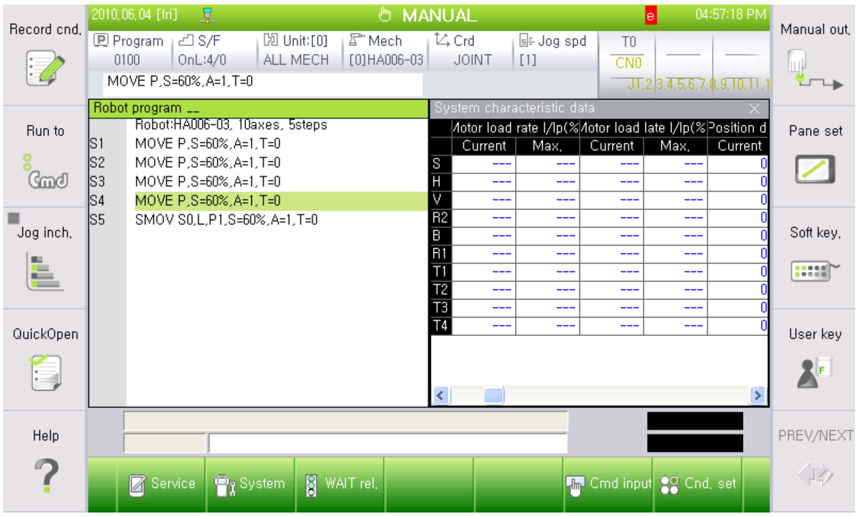
(1) Please check if the Robot is loaded within its rated load.
Please check if the Robot is loaded within its rated load. This error may occur if the load exceeds Robot’s specification (load does not only include the tools that can be attached at the end of Robot, but also include all the cables and other components that can be attached to the Robot

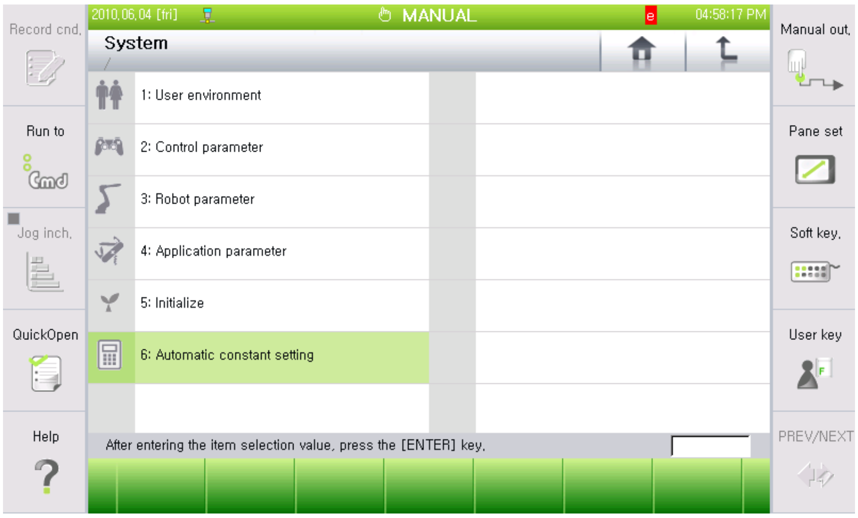
Using measuring equipment is recommended, but if it is not an option, load can be measured by using a ‘load estimation function’ from the controller. However this function only can measure the load of a tool that attached at the end of the Robot

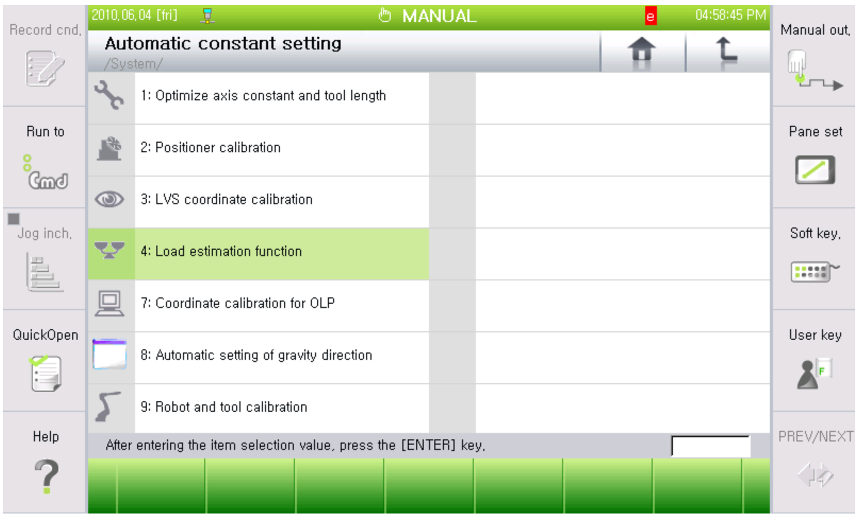
Method to estimate the load is as below

■ Enter to the load estimate function

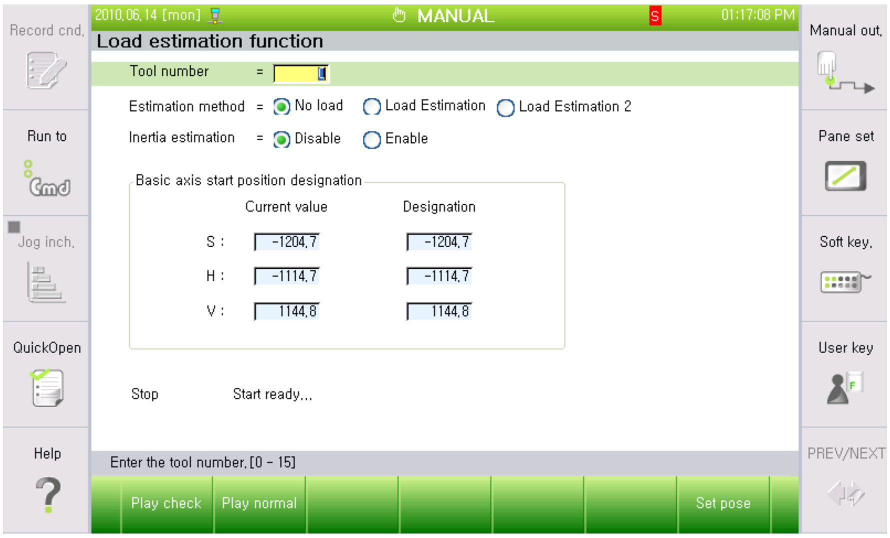
『[F2]: System』 → 『6: Automatic constant setting』 → 『4: Load estimation function』



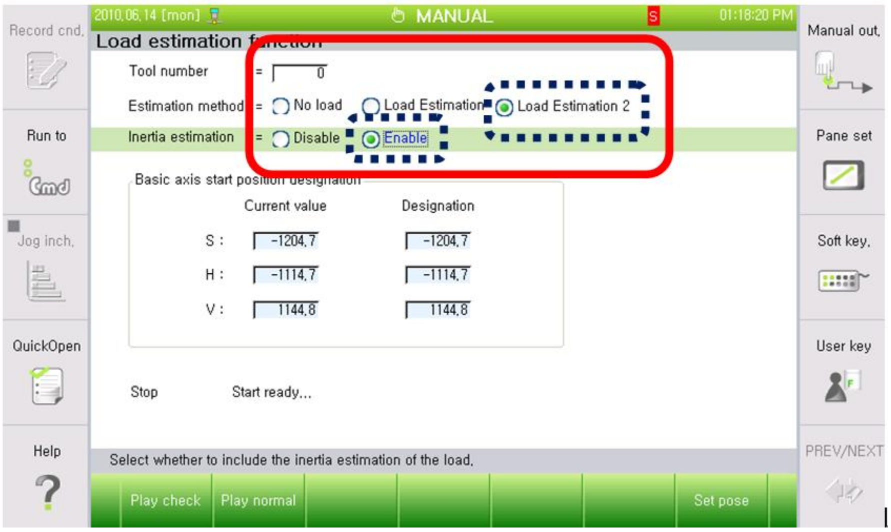




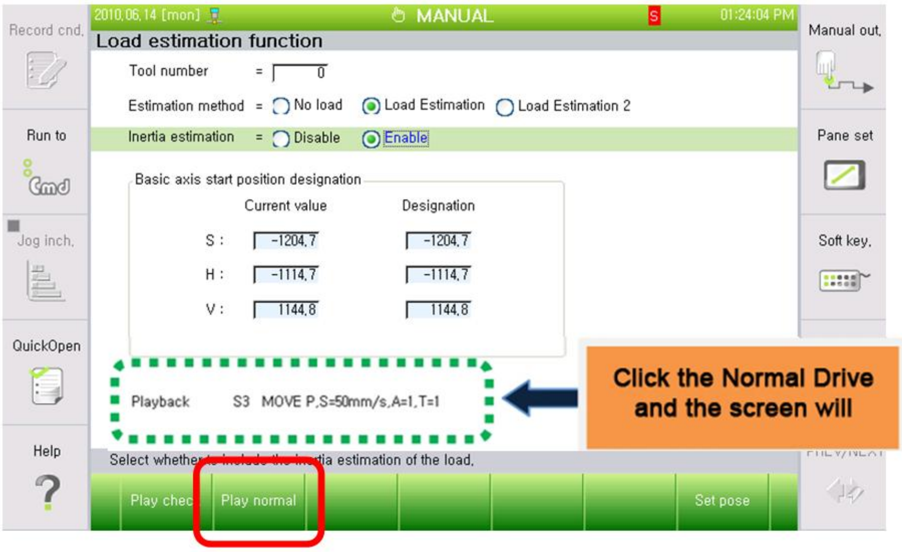
■ Select the tool number, estimation method, enable status of inertia estimation from the load estimation function



- ➢ Tool number to save after the load estimation
- ➢ Estimation method : Load estimation 2
- ➢ Inertia estimation : Enable



- Click Normal Drive to execute.
  Press the Motor On switch, and hold the deadman and click the Play Normal.



Decide if you want to register the result of load estimation

- Once the load estimation drive has completed, the estimated result will be displayed on the screen

If you press the close button, a message box will appear to ask you if you want to reflectthe result. If you click 'yes' it will be saved

(2) Please examine if there is a possible collision point during the Robot's operation
Please check if there is a point where the Robot may be interfered or have a collision in the operation area. This error may occur if the Robot is interfered by other equipments. In that case, please modify the job program so the interference will not occur

(3) Please check if the axis brake works properly
Brake release function of the corresponding axis maybe have an error, or the releave voltage of the brake release may have problem.

- Examine if the brake release of each axis has an error
  Please remove the motor's power supply (motor OFF) and check if you can release the brake of the axis with manual brake switch. You can confirm it with the sound of brake release from the motor .

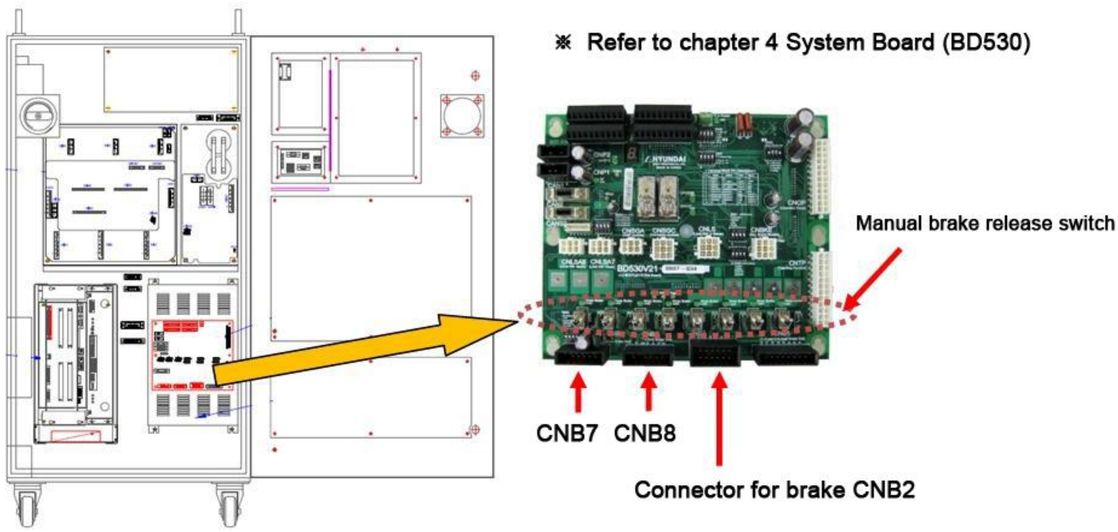
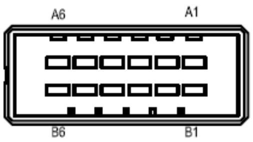


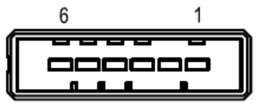
Figure 6.86 Location of the Manual Brake Release Switch

If the corresponding axis's brake cannot be released, output status of the brake release voltage in the System Board need to be examined. Please remove the brake wiring (CNB2, CNB7, CNB8 connector) and use the manual brake switch for the brake voltage's output.
Please measure the brake voltage of corresponding axix output (from the CNB2, CNB7, CNB8 connector) to check if it is over 20V. If there is an axis which has a voltage output under the 20V, System Board (BD530) is faulty. Please replace it



CNB2

PIN	DESCRIPTION	PIN	DESCRIPTION
A1	BA1	B1	MB
A2	BA2	B2	MB
A3	BA3	B3	/R_FAN
A4	BA4	B4	MONL
A5	BA5	B5	PREPB
A6	BA6	B6	/TS



CNB7

PIN	DESCRIPTION	PIN	DESCRIPTION
1	BA7	4	/TS1
2	PREPB	5	—> Key Pin
3	MB	6	/TS7

CNB8

PIN	DESCRIPTION	PIN	DESCRIPTION
1	BA8	4	/TS7
2	PREPB	5	/TS8
3	MB	6	—> Key Pin

Figure 6.87 Pin Locations of CNB2, CNB7 Connectors

- Examine the error on brake’s power supply.
  If “E0012 Brake power supply error message is displayed at the same time, there is an error on Brake’s power supply unit. From TP, please access 『[F1]:Service』→『1:Monitoring』→『2:I/O signals』→『1:Private input signal』→『Overload(Brake Power supply)』. If it is highlighted as yellow, the fuse for Brake (in the Electrical Module)’s power supply has been disconnected. Please replace the fuse.

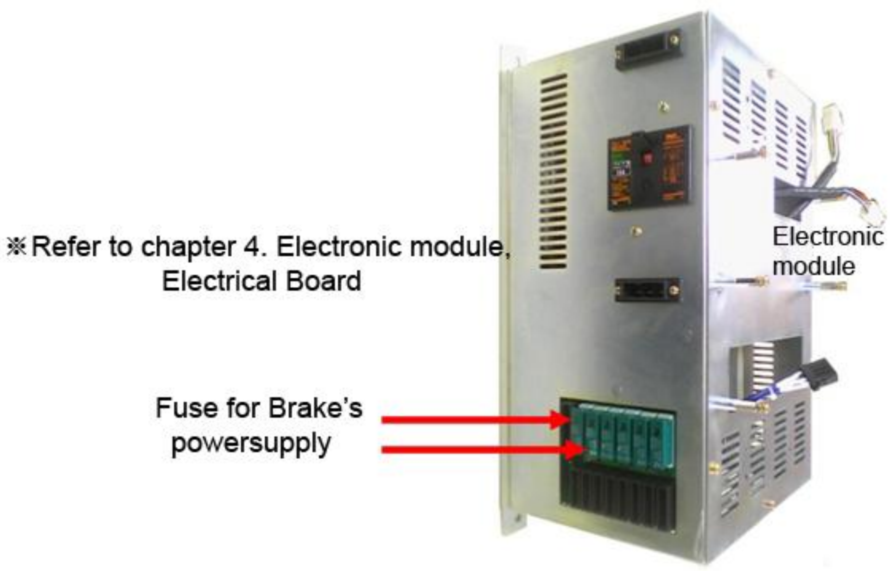


Figure 6.88 Electrical Module

If the fuse is normal, please measure the Brake power supply (DC24V) from the System Board. There are 3 test pins at the center of the board. Use the TMB as a reference terminal and the TPPB terminal value should be over DC20V. If it is below 20V, the power supply unit that generates the power for the brake has an error. Please replace the Electrical Module

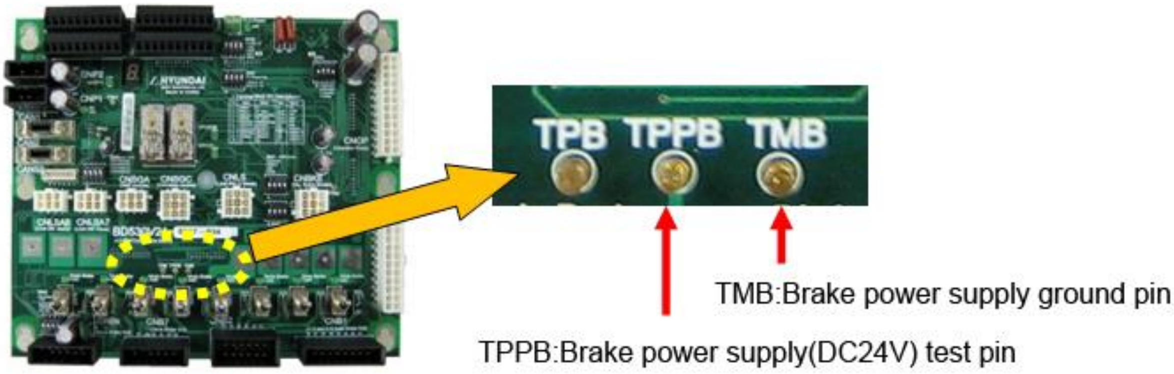
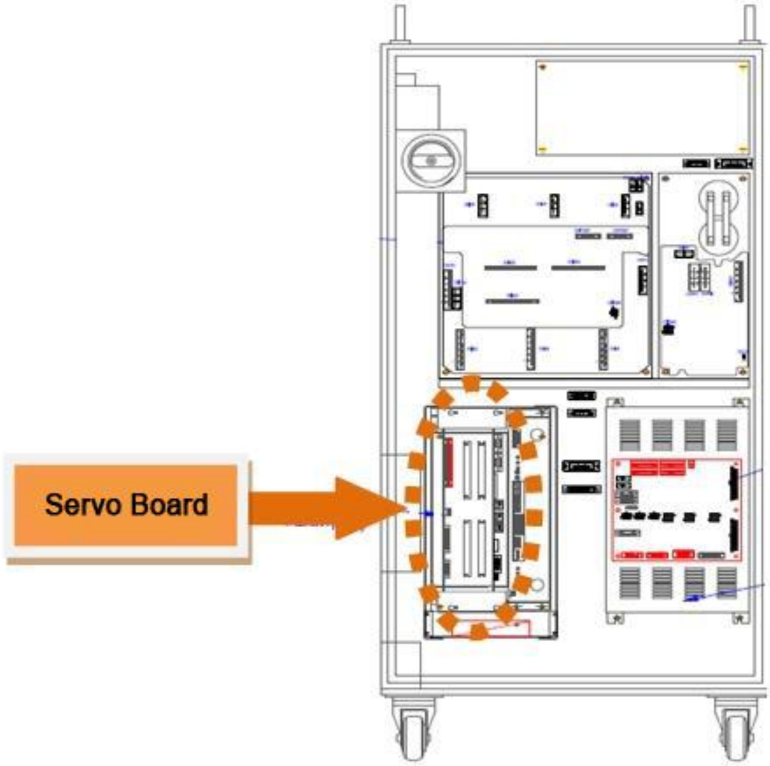
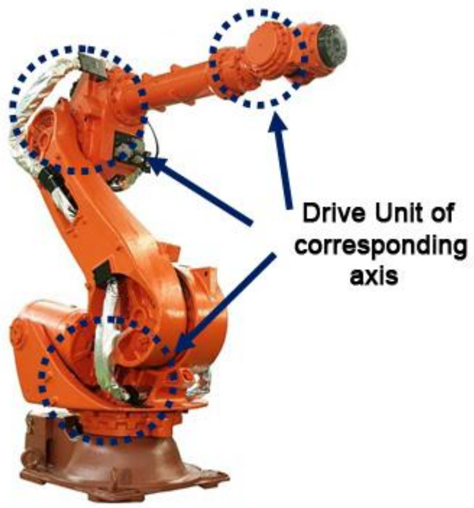


Figure 6.89 Brake Power Supply Test Pin

(4) Please replace the Servo Board and examine an error
This error may occur if there is an error on the Servo Board. Please replace the board to check



(5) Please examine if the Drive Unit operates normally
Please check if the Drive Unit of corresponding axis (Motor, Decelerator) works properly



6.1.17. E0122 Servo ON limit time exceeded

6.1.17.1. Ouline

This error occurs if the Servo motor does not turn on when the main send out the motor on command to the Servo. The cause might be a communication problem between the main and the Servo.
Main send Servo error clear command prior to sending motor on, and once the Servo error is cleared motor on command will be sent out. If the Servo error did not clear, the same error persists and motor on command will go out. In other words, if the communication between the main and the Servo does not have a problem, the motor on command will be received, or other Servo error will occur.

6.1.17.2. Causes and examine methods

(1) Please examine if the Main Board and the Servo Board are installed properly
- Examine if the board is installed properly.
- Examine if board is faulty

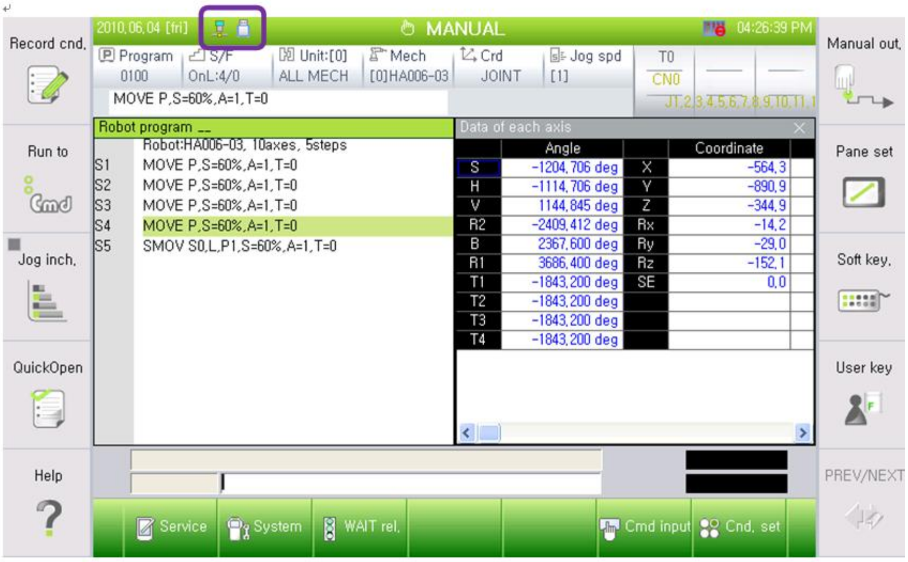
(1) Please examine if the Main Board and the Servo Board are installed properly
This error may be caused by a communication problem if the Main Board and the Servo Board is not installed properly on a rack, or the board has an error

Warning
In order to protect the previous job programs, please back up all the files of Main board to the USB memory before you remove the board from the Rack

Method to back up the files from Main Board to USB memory is as below

Figure 6.90 Inserting Method of USB to TP

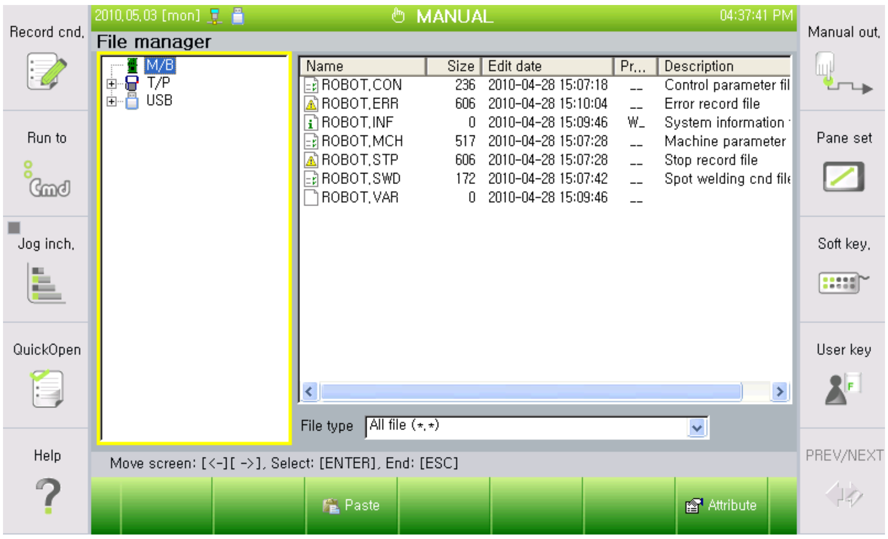
Once the USB is recognized by TP, the below icon will be displayed on a screen



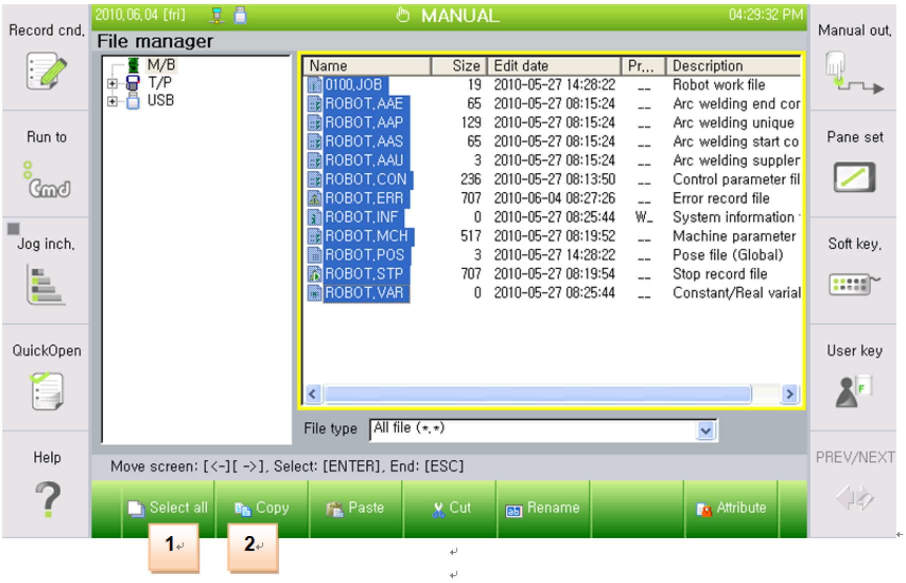
To back up the files enter to

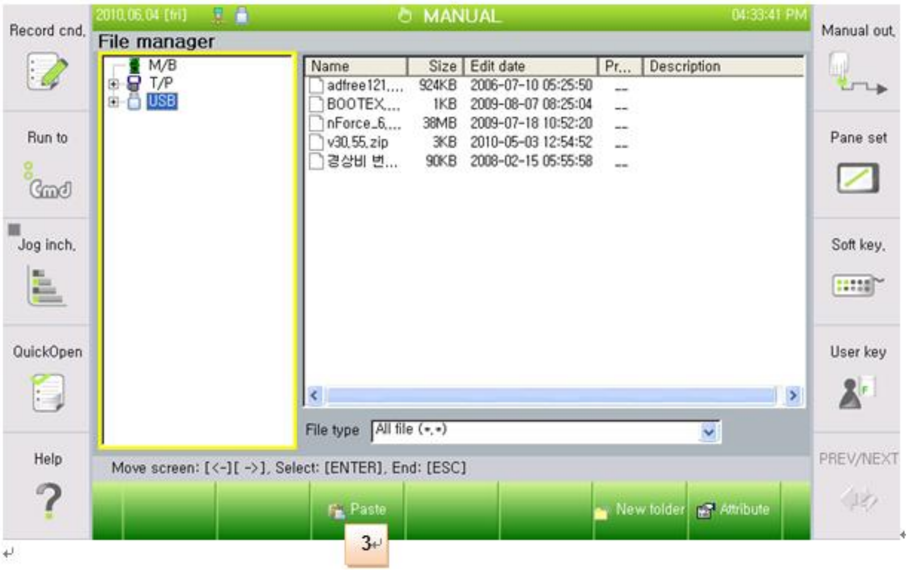
- Service
- 5. File manager

And the screen that is similar to windows explorer will be displayed

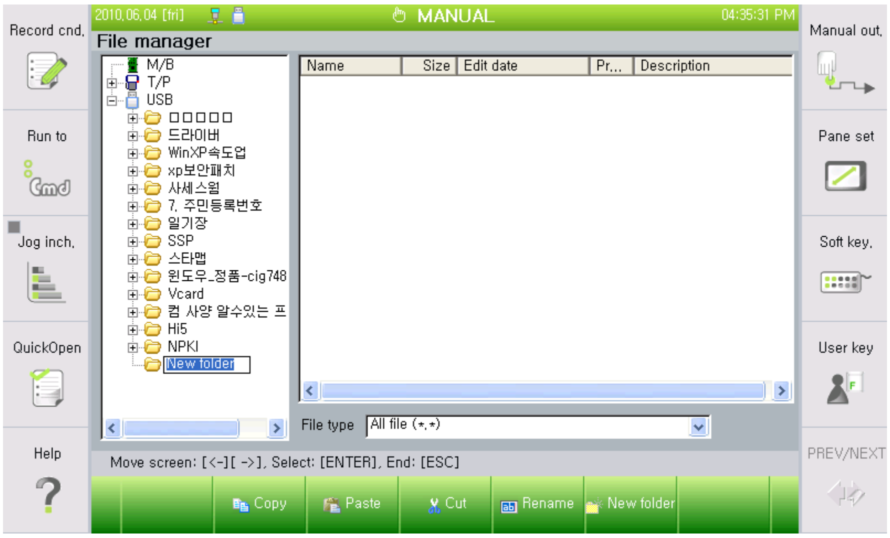


At this stage, please copy the files shown in M/B and move them to USB





You may create a new folder on USB, or can rename the folder by using the soft keyboard just like the windows explorer



- Examine if the board is installed properly
  Please remove the Main Board and the Servo Board from the Rack and re-install them again

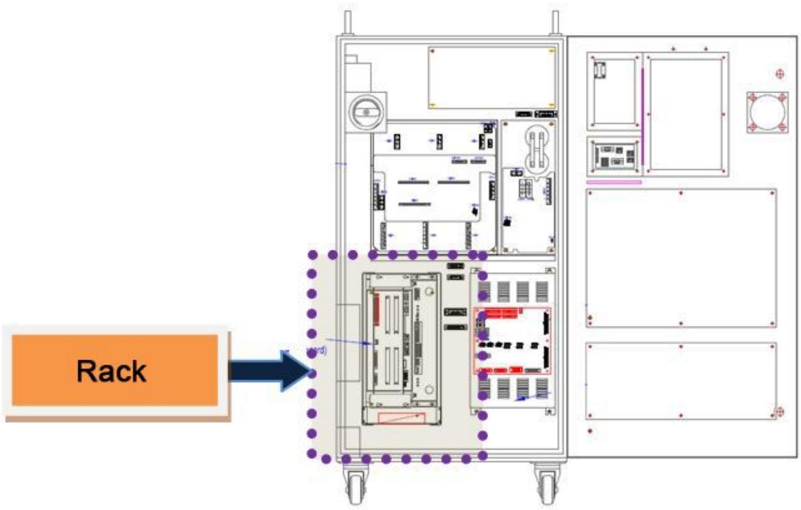


Figure 6.91 Location of Rack Inside of the Controller

- Examine if the board is faulty.
  To examine if the board is faulty, please replace it with new one

6.1.18. E0127 MSHP operation error
6.1.19. E0140 MSPR operation error

6.1.19.1. Ouline

Motor's power supply is suppied to the AMP according to the open/close status of Magnetic contactor MC1, and MC2
Status of MC1 and MC2 are being monitored by Main's conditions and E127 (MSHP operation error) or E140 (MSPR operaton error) will be generated when an abnormal operation is detected

(1) E0140 (MSPR operation error)
For a reason that cannot be identified by Main, the Magnetic contactor MC1
① Does not turn On while an attemption is made ,
② Turns off while it should stays on

(2) E0127 (MSHP operation error)
For a reason that cannot be identified by Main, the Magnetic contactor MC2
① Does not turn On while an attemption is made ,
② Turns off while it should stays on

In order for MC1 or MC2 to on, many conditions need to be satisfied, and even if when they are on, they can be off for some reasons. Main can identify the causes for Magnetic contctor's operation error if it is a case that provides a monitoring function such as safety signals. However if the main cannot identify the Magnetic contactor's operation error, a number of examines are required

6.1.19.2. Causes and examine methods

(1) Command system malfunction
- Error on receiving data from the Main
- CPUERR or EXOUT signal has occurred, or an error of the corresponding line
- Old system I/O Board (BD531V10) is used from the remote mode
- Error on the safety signal system
- Error that occurred due to the safety related unit's wiring malfunction
- System Board malfunction

(2) Monitoring system malfunction
- Cabling (Wire, Connector etc) malfunction
- Electrical Module malfunction
- System Board malfunction

(3) Other malfunction
- Case when E0043 and E0140 both occurs at the same time

To identify the cause of these two errors (MSPR operation error, and MSHP operation error), you must understand the Motor's power supply insertion system. Basic concept of Motor's power supply to the Amp (Drive Unit) is as below.

Main will send out the MC1 Motor power on 1 command (MCON1) and waits (while monitoring the sub point of contact) until the MC1 is activated. At this stage, if the MC1 does not activates within certain amount of time, E0140 (MSPR operation error) will occur. On the other hand, if MC1 sucessfully operated, Main will send out the MC2 Motor power on 2 command (MCON2) and waits (while monitoring the sub point of contact) until the MC2 is activated. Again, if the MC1 does not activates within certain amount of time, E0127 (MSHP operation error) will occur

If the Magetic contact MC1 and MC2 turns on according to the Main's command, AC220V R, S, T 3-phase power supply will be supplied to the Amp

While the motor is on, the Main will monitor if the MC1, and MC2's status is on at all time

If the Magnetic contact goes off for a reason that cannot be identified by the Main, these errors will occur

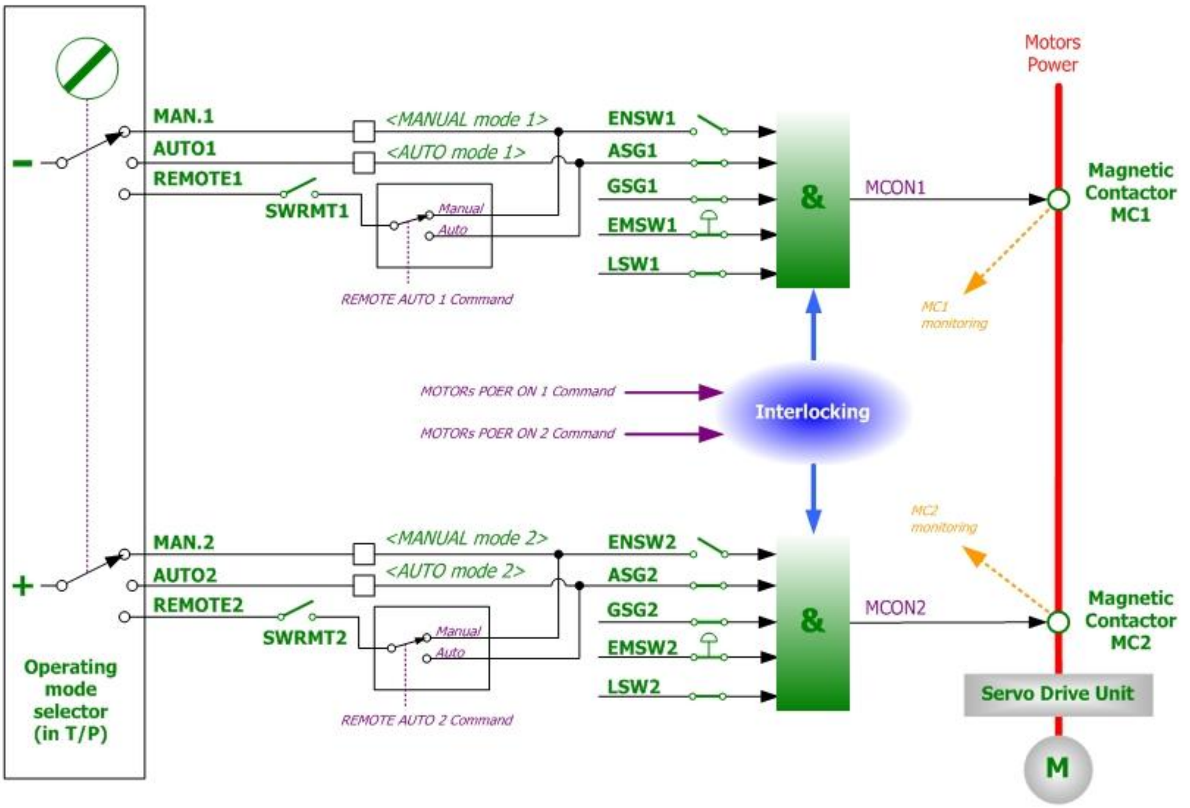


Figure 6.92 Concept Diagram of Safety Circuit for Motor Power's Opening/Closing

(1) Command system malfunction

Motor on command from the main has been blocked for some reason, if you do not hear any sound of operation and a message of ‘MSPR operation error’ is displayed while the motor on attemption is made,

- Error on receiving data from the Main

  If a communication error occurs between the Main Board and the System Board, the System Board will block the Motor On command for a safety reason. Generally the Main Board also detects the communication error at the same time, so the MSPR operation error or MSHP operation error will not occur. However if the Main cannot detect the communication error, these erros can be generated. This is a case when the control status of safety switch related components (Teach Pendant emergency stop switch input, OP panel’s emergency stop switch input) are being transmitted to the Main Board, but output from the Main Board (Motor ON) will not be transmitted to the System so the hardware wise Motor On command is cannot be executed.

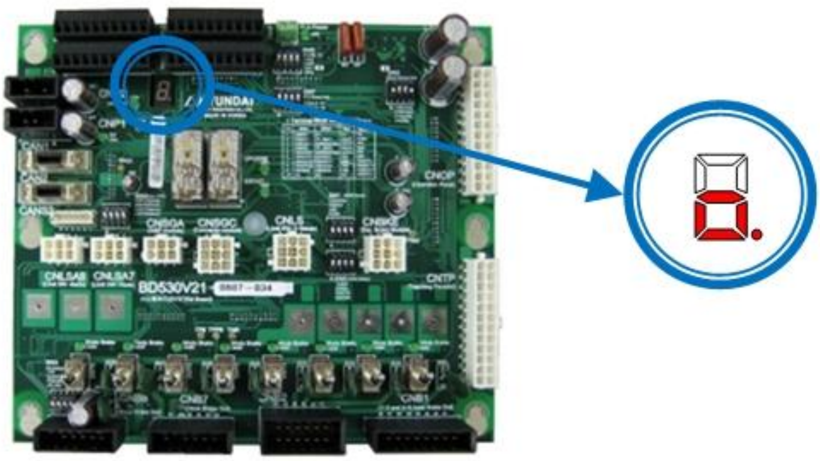


Figure 6.93 7-SEG Indicator of the System Board when a Communication Error Occurs

- How to judge :

  System Board’s 7-segment index may give you an indication of the situation. 7-segment displays “o” to indicate that the current communication with the Main Board is in abnormal status

- Actions :

  Firstly, please restart the controller and observe if the same error persists. If it does, the communication input unit of the System Board has an error. Please replace the System Board.

- CPUERR or EXOUT signal has occurred, or an error of the corresponding line
  Main Board generates CPUERR or EXOUT signals in a case when systemic error has occurred (e.g power shut down, Servo error). This signal will be transferred to the System Board and block the motor on command in terms of hardware. Motor's power will be immediately shut down for a safety reason. However, these signals may be generated abnormally, and it will shut down the motor's power

  - How to judge :
    System Board's 7-segment index may give you an indication of the situation.7-segment displays "H" when CPUERR is being transmitted to the System Board. Also the CPUERR, EXOUT LED which located at the center of the System Board indicate the error situation (Figure 6.93) These LED lights will be on if it is a normal status, and the lights will be off if it is not

  However if the signal appears time to time for a very short moments, 7-segment and LED won't be able to indicate it. In such case, error occurance must be observed while ignoring the two signals by using DIP switch SW1. Method to ignore the signal is to, as shown in the Figure 6.94, turn on the No 1(to ignore CPUERR) and the No 2 (to ignore EXOUT) of the DIP switch SW1. At this point all LED lights will be on

  If the error no longer persists after the system restart, Main Board generated these signals or CANS1 Connector/Cable malfunction is suspected

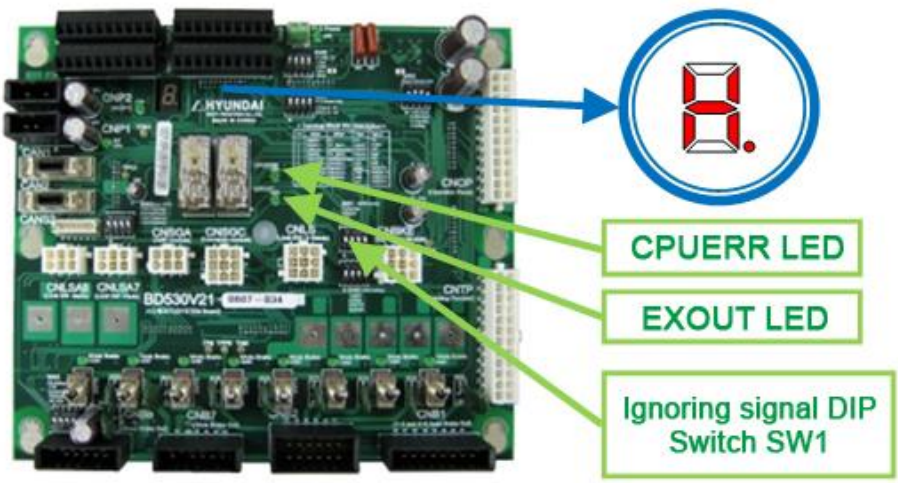


Figure 6.94 Indication of 7-SEG, LED (on System Board) when CPUERR Error is Occurred

  - Actions :
    If a Main Board generating this signal without any other indication of errors, please check the PLD version of the Main Board. Over V0.7 is normal. If Main Board's PLD version is normal, please examine the CANS1 connector and cables

Cautions : Please use only No 1(to ignore CPUERR) and No2(to ignore EXOUT) of the DIP switch SW1 for a testing purpose and please switch it back to normal after the test. This ignores the emergency safety related functions and it may cuase safety related problems if operates while ignoring these functions

- Old system I/O Board (BD531V10) is used from the remote mode
  If an old system IO board (BD531V10) is used on a remote mode, this error may occur. Motor on command will not be executed because this type of board does not have remote mode function

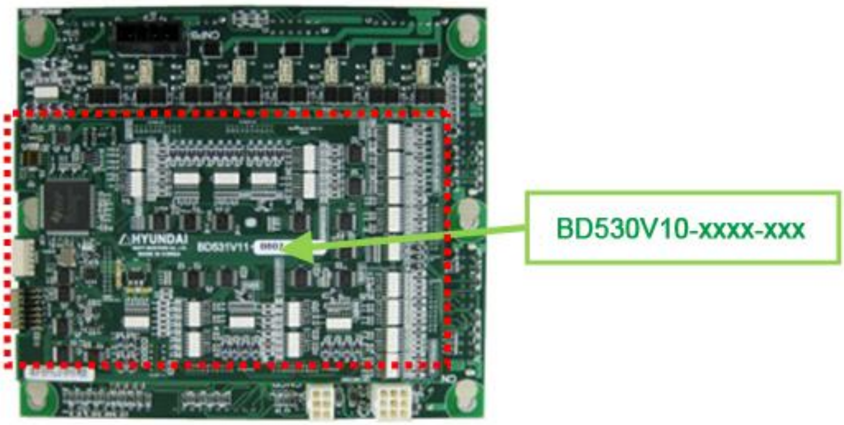


Figure 6.95 Checking Method of Old System I/O Board (BD531V10)

➢ How to judge :
This board is attatched at the back of the System Board. Please remove the System Board from Electrical Module and check the system I/O board number at the back (Figure 6.95)

➢ Actions :
If the installed board is “BD531V10”, please replace it with a board with the hardware version above “BD531V11”

- Error on the safety signal system
  Motor on command from the main has been blocked for some reason, if you do not hear any sound of operation and a message of 'MSPR operation error' is displayed while the motor on attemption is made without any other error messages

  The motor on command will not be executed if there is a problem on a safety signal system as explained earlier (Figure 6.92) Safety devices (Safety guard, emergency stop switch etc) are mechanically operating devices, but their monitoring is operated electronically. So a safety device malfunction, or any electronic shock (noise, surge), wiring error, short circuit can cause an error. To confirm, please remove the connected safety device's wiring and rewire them to ignore the input. (Figure 6.96, Figure 6.97, Figure 6.98, Figure 6.99, Figure 6.100)

Cautions : Please use only for a testing purpose and please switch it back to normal after the test. This ignores the emergency safety related functions and it may cuase safety related problems if operates while ignoring these functions

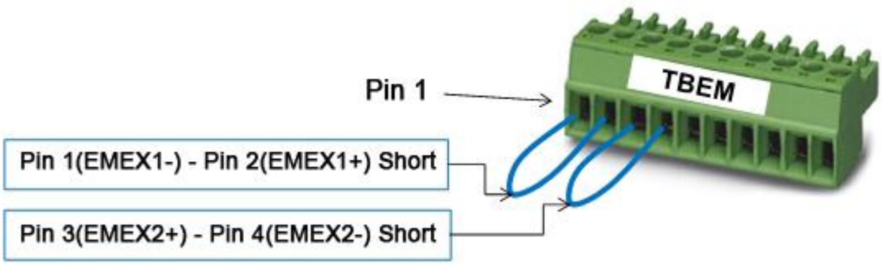


Figure 6.96 Method to Ignore the External Emergency Stop Input

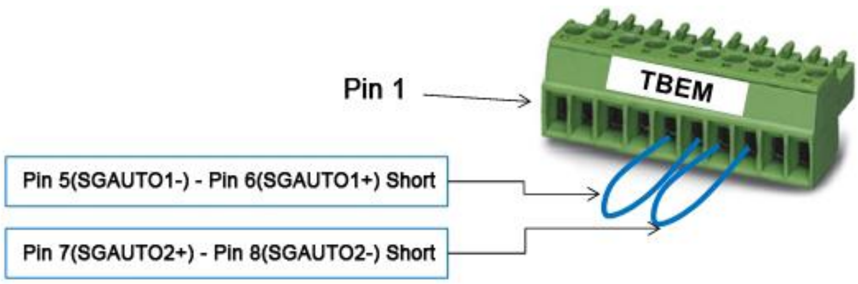


Figure 6.97 Method to Ignore the Safety Guard(Auto) Input

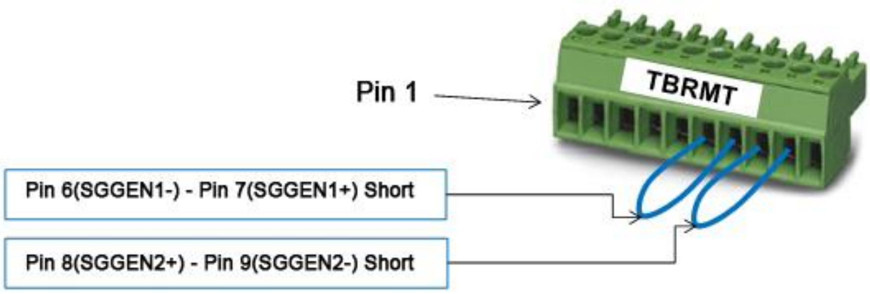


Figure 6.98 Method to Ignore the Safety Guard(General) Input

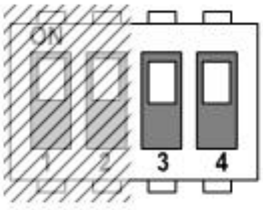


Figure 6.99 Method to Ignore the (P-COM input) Uuter External Emergency Stop(3,4 of SW6 is ON)

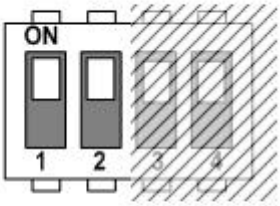


Figure 6.100 Method to Ignore the (P-COM) Safety Guard (Auto)(1,2 of SW6 is ON)

As explained, if the error does not persist when these safety switch inputs are ignored, the problem exists in the safety switches and wirings. Please check them

Cautions : Please use only for a testing purpose and please switch it back to normal after the test. This ignores the emergency safety related functions and it may cuase safety related problems if operates while ignoring these functions

- Error that occurred due to the safety related unit's wiring malfunction
If there is a problem in a wiring of devices that are related to the safety such as Safety guard(Auto), the error for a corresponding safety signal may not be detected and it will generate E0140 (MSPR operation error).
This error occurs from a waiting of manual mode drive prepration (Status that the Teach Pendant's motor on LED is flickering) switches to automatic mode, and motor on attempt is made on an automatic mode

For example, there is a case when the wiring of Safety guard (Auto) is faulty. There are two types of input method (point of contact input, P-common input) that enters safeguard to the System Board (BD530) and the point of contact input's wiring error may cause a problem. Proper wiring separates each safechain and connects the each end of point of contact (Figure 6.101) However if the chain's wiring is mixed and connected, the controller will not be able to detect the Safety guard's error due to an electronic error. (Figure 6.102). If the motor on is attempted at this time, not sufficient power supply for Magnetic contactor's saferelay operation will be supplied and it will generate E0140 (MSPR operation error)

➢ How to judge :
Phenomenon of Safety guard wiring malfunction is as below

- If a safechain connection is removed, (5,6 wiring or 7,8 wiring) Safety guard error will be detected in automatic mode and displays E0043 error

- However, if all chains are connected (5,6,7,8 wiring are all connected), Safety guard error will not be detected in automatic mode (E0043 error does not occur)

If the above phenomenon appears, please examine the Safety guard (Auto)'s wiring. Firstly, please remove the terminal block TBEM from the board, and perform a short circuit test from a removed terminal block connector's (TBEM) safeguard input terminal (socket) while activating the guard device

- If you close the guard device (point of contact – close status), 5, 6 terminal (socket) will be shorted. Also 7,8 terminal (socket) will be shorted

- If you open the guard device (point of contact – open status), 5,6 terminal (socket) will be open. Also the 7,8 terminal (socket) must be open status

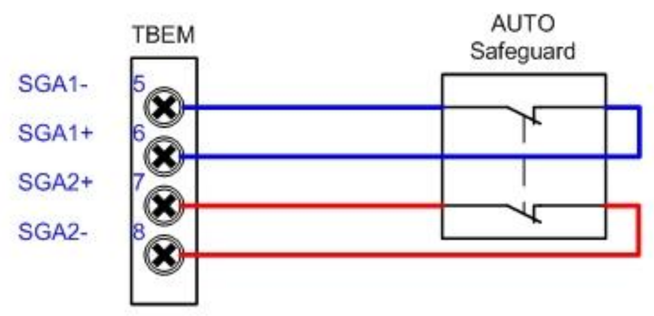


Figure 6.101 Good example of Safety Guard (Auto) wiring

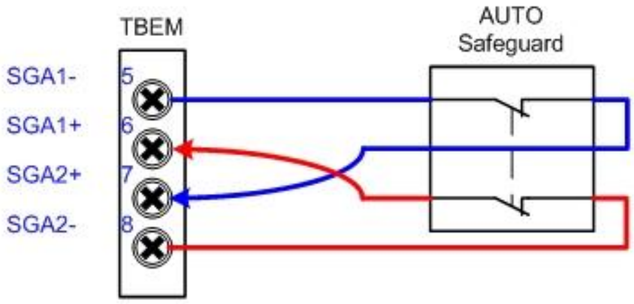
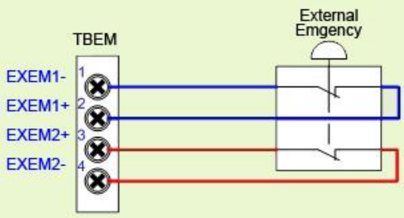
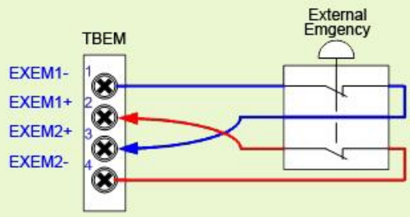
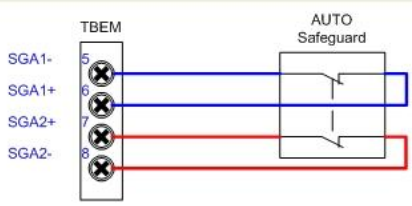
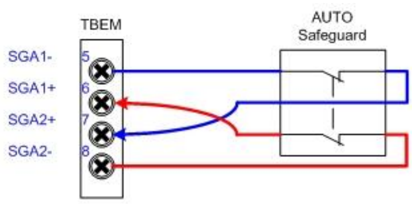
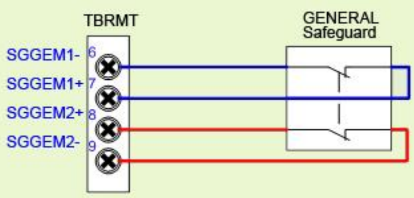
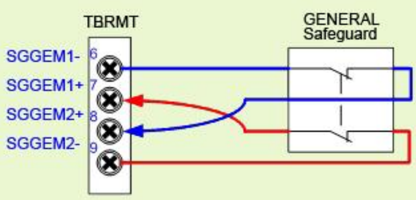


Figure 6.102 Bad example of Safety Guard (Auto) wiring

- Actions : Please modify the wiring of Safety guard (Auto) correctly (Figure 6.102)

  Error occurance caused by the wiring error of safeguard has been explained in above. This applies same to all safety related signals (Safety guard (General), Safety guard (Auto), external emergency stop switch, various limit switches), so please refer to (table 6-4) to compare the normal and abnormal wiring examples

Table 6-4 Error on safety related device's wiring

Classification	Normal wiring	Abnormal wiring
External emergency stop switch		
Safety guard (Auto)		
Safety Guard (General)		

- System Board malfunction
  When motor on is attempted, if you do not hear the activating sound of controller's internal Magnetic contactor (MC1) and a message of "MSPR operation error" is displayed, please examine all the above. If no problem is found from the above examinations and same error persists, System Board malfunction might be the cause. Please replace it

(2) Monitoring system malfunction

When motor on is attempted, if you do hear the activating sound of controller's internal Magnetic contactor (MC1) and a message of "MSPR operation error" or "MSHP operation error" is displayed, the cause of an error might be the Monitoring system malfunction. In order to confirm the Monitoring system malfunction, please do as below

The status of Magnetic contactor MC1 and MC2 is monitored by using the sub point of contact and can be accessed by the Teach Pendant. (Figure 6.103) From the Teach Pendant, MC1 (PreCharge) and MC2 (Motors Power) signal can be accessed by Private input signalmonitoring window. Motor off status will be displayed as a white color background and motor on status will be displayed as yellow color backround

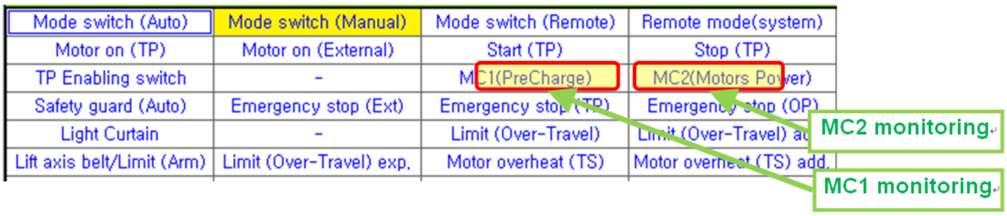


Figure 6.103 Method of Magnetic Contactor Monitoring

Please attempt the motor on in automatic or manual mode and confirm the activation sound of the Magnetic contactor as well as the displayed status of MC1, and MC2

- At first, if MC1 is displayed with a yellow color for a moment (with the sound of Magnetic contactor's acvitvation) and E0140(MSPR operation error) message is appears, it means that there is no error in MC1's sub point of contact and the monitoring system

- After the activation of MC1, if MC2 is displayed with a yellow color for a moment (with second sound of Magnetic contactor's acvitvation) and E0127(MSHP operation error) message is appears, it means that there is no error in MC1's sub point of contact and the monitoring system

With the above methods, if you confirmed that the monitoring of MC1 and MC2 is not working (Monitoring signal is not displayed in yellow while you can hear the sound of Magnetic contactor's activation), the following devices has to be examined (Figure 6.104)

① Cable CNMC
② Electrical Board relay SR1, SR2 (inside of Electrical Module)
③ Sub point of contact for MC1 and MC2 – Magnetic contactor (inside of Electrical Module)
④ Wiring between the Electrical Board and the Magnetic contactor (inside of Electrical Module)
⑤ System Board (input signal processing unit)

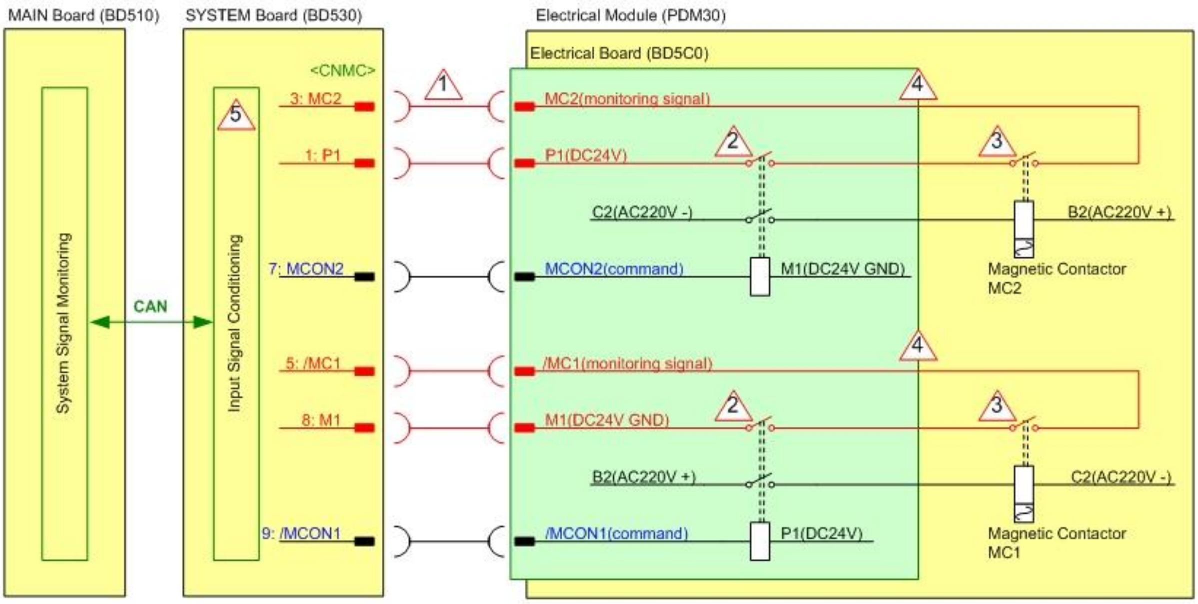


Figure 6.104 Diagram of the Monitoring System – Magnetic Contactor

- Cabling (wires, connector etc) malfunction
  Please check the cabling between the Electrical Module (PDM30) that an electrical connector is installed and the System Board (BD530) that collects monitoring signals.
  The cable name is CNMS and it enters to the Electrical Module through the top rear of the System Board (Figure 6.105). Please check the connection status of this cable's connector

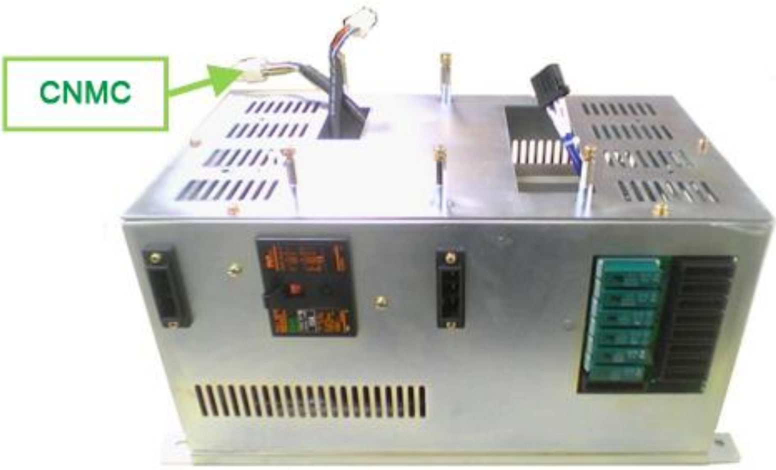


Figure 6.105 CNMC Cable on the Electrical Module

- Electrical Module malfunction
  Monitoring signal of the Magnetic contactor is transmitted to the System Board through many devices that are inside of the Electrical Module. So if one of those devices has an error, the Main will not be able to detect even if the Magnetic contator is operated. Internal electirical module malfunction can be categorized as a electrical board (BD5C0), Electrical connector (MC1, MC2), and wirings between the electrical board and the electrical connector (Figure 6.23) However it is difficult to examine the inside of Electrical Module in a field where a Robot has already been installed, so alternatively please replace the Electrical Module

Figure 6.106 Inner Structure of Electrical Module

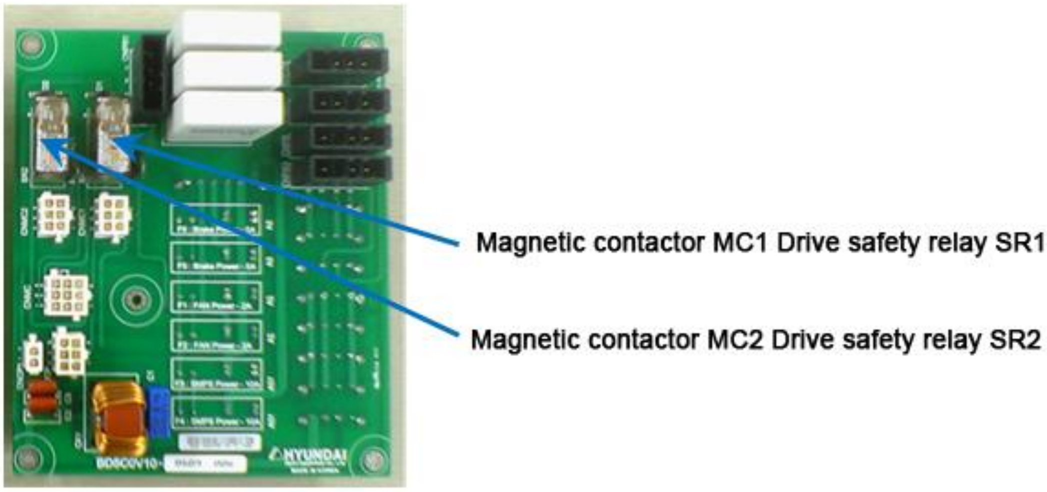


Figure 6.107 Electrical Board BD5C0)

- System Board malfunction
  Input signal process unit malfunction of the System Board can be the cause of this error. Please replace the System Board and check

(3) Other malfunction

- Case when E0043 and E0140 both occurs at the same time
  E0043(Safety Plug or Light Curtain) with the E0140(MSPR operation error) can occurs from a waiting of manual mode drive preparation (Status that the Teach Pendant's motor on LED is flickering) switches to automatic mode, and motor on attempt is made when the Safety guard (Auto) is open (and the Main software version is below V30.07-00). Please check the Main software version from the Teach Pendant and upgrad if the version is low

6.1.20. E0133 (Axis ○) Command value error

6.1.20.1. Ouline

This error may occur due to a communication error between the Main Board and the Servo Board, or a rapid chages of motion. When a communication error occurs, a valid command cannot be transferred from the Main Board to the Servo Board, so this error will occur and immobilize the Robot to prevent the Robot's abnormal operation based on an invalid command
Also this error will occur and immobilized the Robot because the drive unit may not follow the rapid changes of motion command

6.1.20.2. Causes and examine methods

(1) Please examine if the Main Board and the Servo Board are installed properly.
- Examine if the board is installed properly.
- Examine if board is faulty

(2) Examine if there is a job program that operates a Robot rapidly

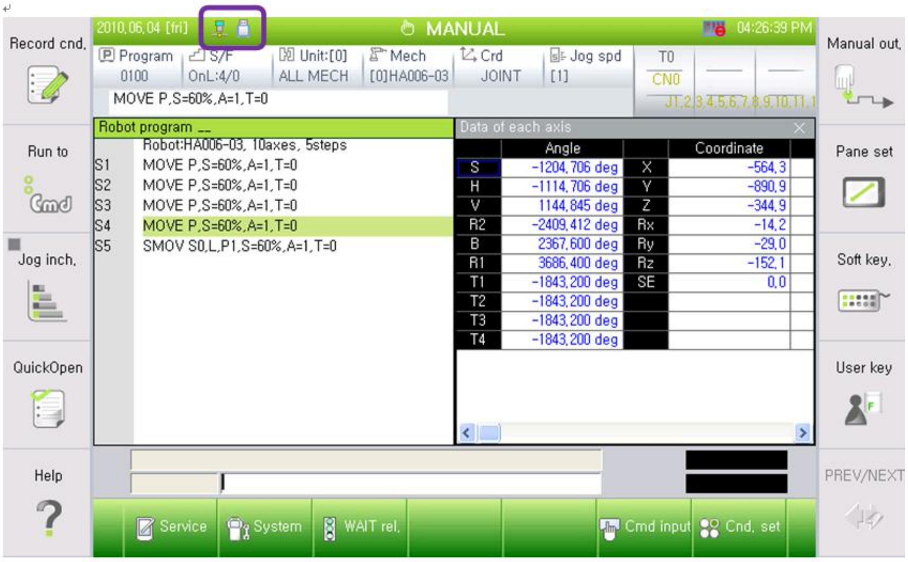
(1) Please examine if the Main Board and the Servo Board are installed properly
This error may be caused by a communication problem if the Main Board and the Servo Board is not installed properly on a rack, or the board has an error

Waring
In order to protect the previous job programs, please back up all the files of Main board to the USB memory before you remove the board from the Rack

Method to back up the files from Main Board to USB memory is as below

Figure 6.108 Inserting Method of USB to TP

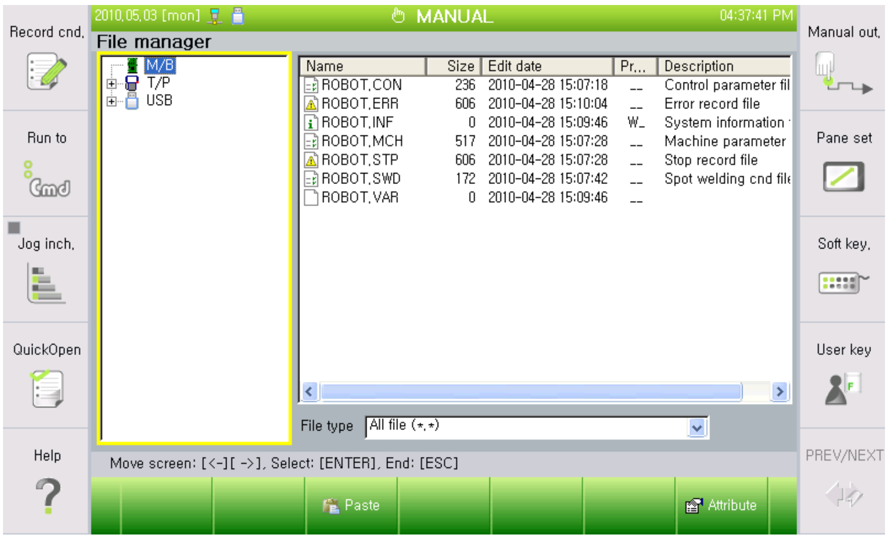
Once the USB is recognized by TP, the below icon will be displayed on a screen.



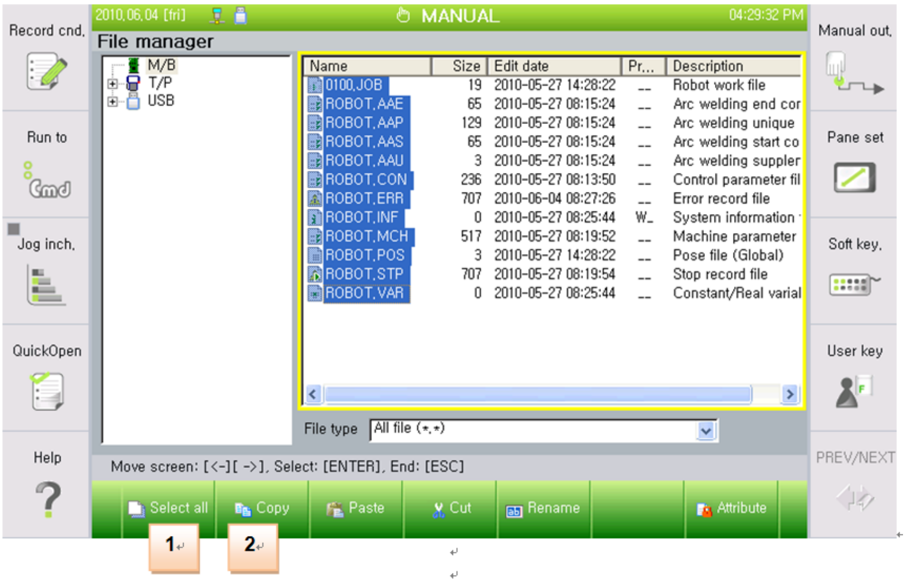
To back up the files enter to

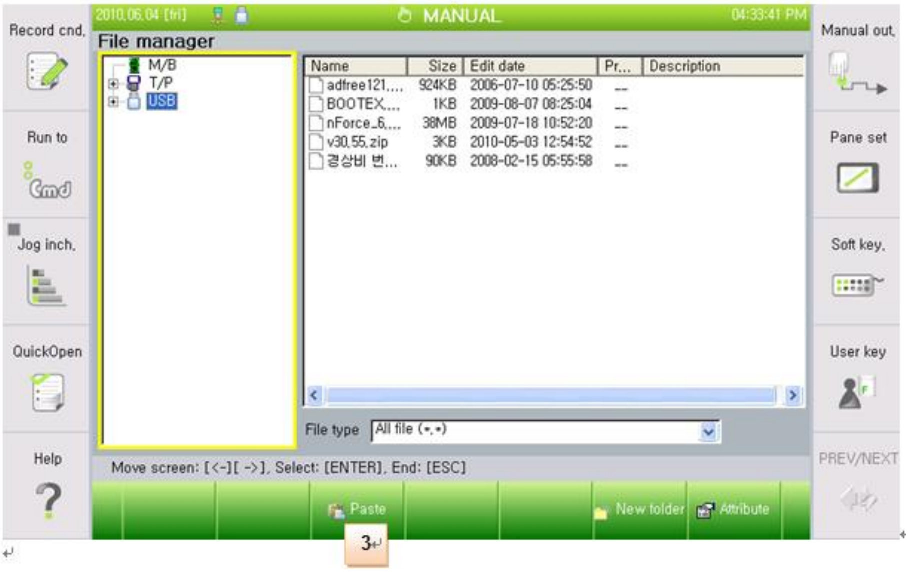
- Service
- 5. File manager

And the screen that is similar to windows explorer will be displayed

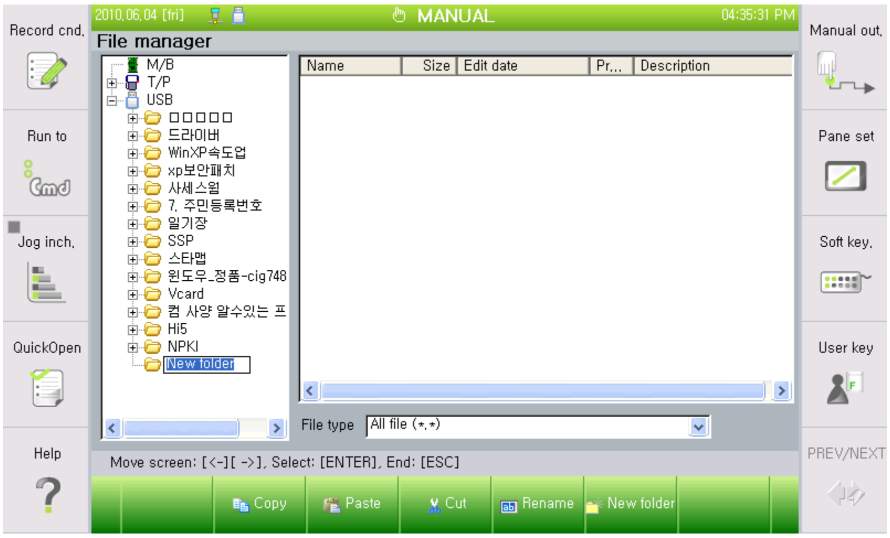


At this stage, please copy the files shown in M/B and move them to USB





You may create a new folder on USB, or can rename the folder by using the soft keyboard just like the windows explorer



- Examine if the board is installed properly.
  Please remove the Main Board and the Servo Board from the Rack and re-install them again

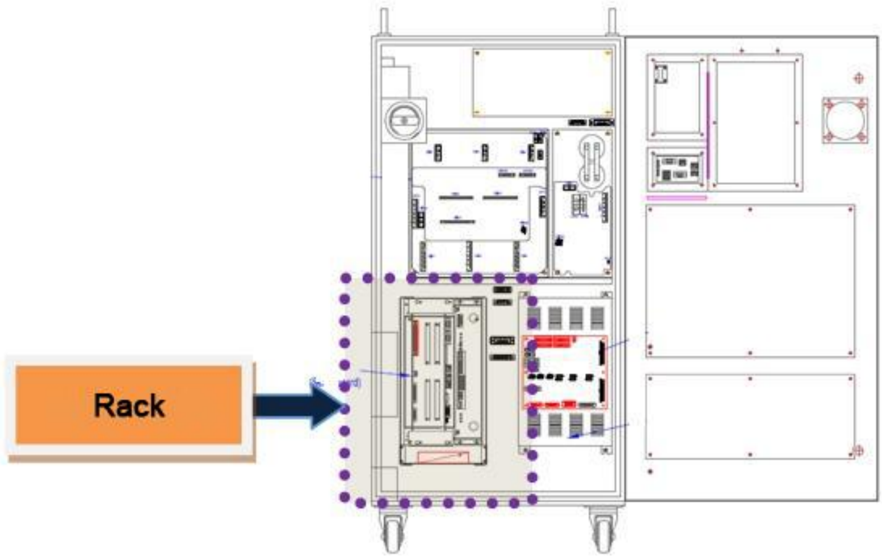


Figure 6.109 Location of Rack Inside of the Controller

- Examine if the board is faulty.
  To examine if the board is faulty, please replace it with new one

(2) Examine if there is a job program that operates a Robot rapidly

Please check if the error occurs at a point where the Robot's motion chages rapidly. If the error occurs during the rapid motion, modification of job program is required.

The reason that this error occurs during the rapid motion is as below. During the execution of job program, Robot's position may be twisted in order do move a short distance. At that point, the speed of Robot's axis suddenly increases, and the error may occur if the Servo Board follows the movement. In order to resolve this, please modity the Teaching point of the location (where the position changes rapidly) or make changes on the position of Robot.

6.1.21. E0134 (Axis ○) Maximum speed exceeded

6.1.21.1. Ouline

Speed of Robot’s axis exceeded the maximum speed limit while an operation. An error will be generated and the Robot will be immobilized since the Robot is not being controlled normally
When the Main Board sends a command to the Servo Board, it will send a limited command so that the Robot will not exceed the maximum speed limit. Maximum speed exceeded error may occurs if the Robot’s speed triggers an overshoot because the Robot could not follow the command

6.1.21.2. Causes and examine methods

(1) Please check if the tool data has entered correctly

(2) Please check if the position of Robot is close to the singular point

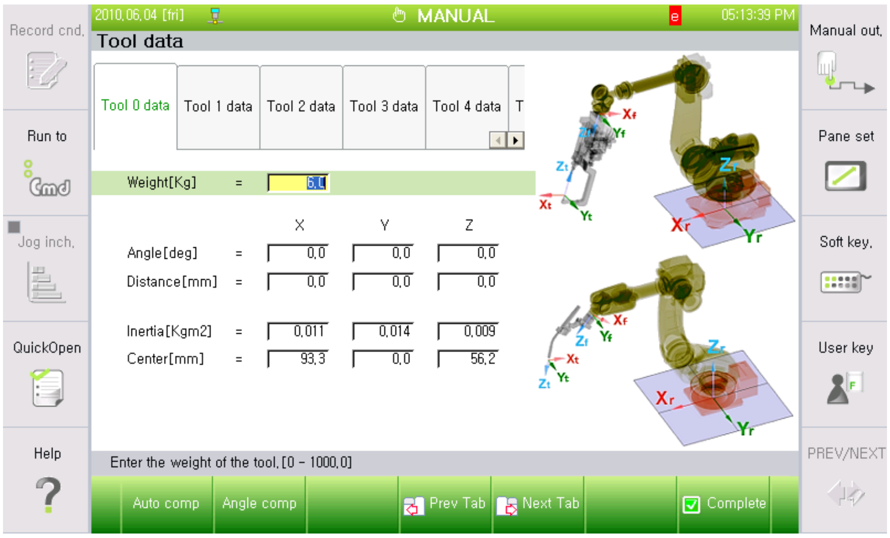
(3) Please check the setting value of condensation acceleration/deceleration parameter and the load factor

(4) Please adjust the job program

(1) Please check if the tool data has entered correctly

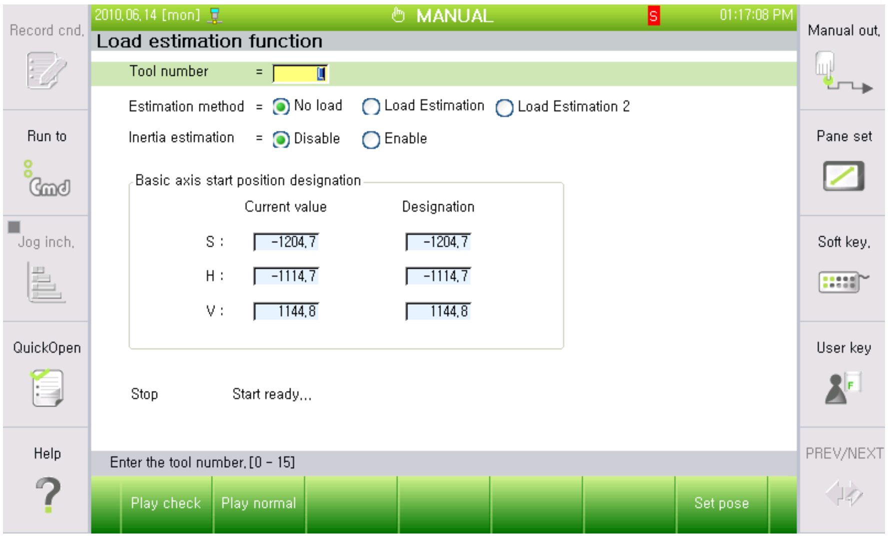
If the weight or the inertia of tool is different from the registered value at the controller, Robot's control performance will be reduced and the maximum speed limit exceeded error can occur. Tool's weight and the inertia can be registered from the below menu according to the number of tools.

- ➢ System
- ➢ 3. Robot Parameter
- ➢ Tool data



You may use the load estimation function in order to set the weight of tool or the inertia automatically.

- ➢ System
- ➢ Automatic constant setting
- ➢ 4. Load estimation function



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(2) Please check if the position of Robot is close to the singular point

This error may occur, if you execute L interpolation or C interpolation instead of PtP interpolation near the position of singular point

Singular point occurs when the B axis is close to 0 deg, or the center of wrist part is close to the spin centural axis of S axis. When passing near the singular point is required, please change the corresponding step to PtP interpolation

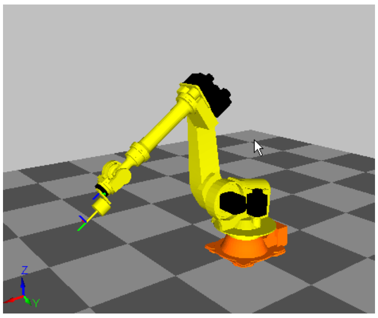


Figure 6.110 Axis B Singular Point

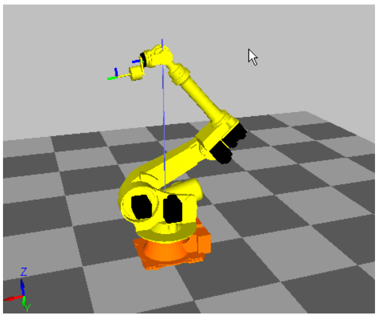


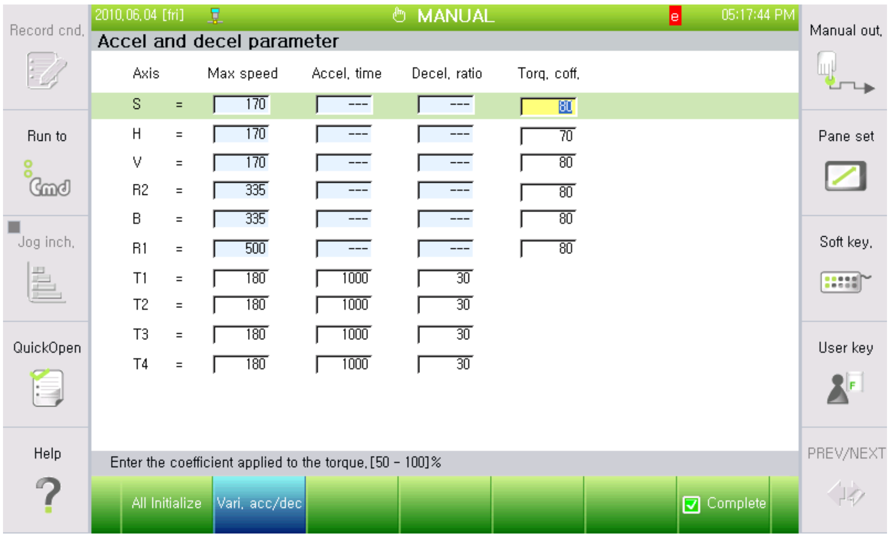
Figure 6.111 Axis S Singular Point

(3) Please check the setting value of condensation acceleration/deceleration parameter and the load factor

Motor torque is insufficient, because maximum speed of condensation acceleration/deceleration parameter is too high or the acceleration time is too short. I/lp maximum speed had to be reduced with an observation of load factor (while the Robot’s operation) or increase the acceleration time

- ➤ System
- ➤ 3. Robot Parameter
- ➤ 34. Acceleration /Deceleration Parameter

Acceleration /Deceleration Parameter of condensation can be modified from the above



(4) Please adjust the job program

Please make changes of conditions (from the job program) on a corresponding step, or the one step prior to it. Firstly, try “Acc=0”, secondly, reduce the step speed, and thirdly, add one more step on a movement routine.

6.1.22. E0165 (Axis o) Servo lock cannot be maintained

6.1.22.1. Ouline

Power for the drive of Motor or the drive unit is not being supplied. The current that generated by a Servo control for the Robot or drive unit's operation is not being supplied. For such cases, the Servo Board detects an error and the controller will stop the release of brake and block the current that supplied to the motor or the drive unit

6.1.22.2. Causes and examine methods

(1) Examine the Motor power line.
- Check the wiring that connects the Robot and Controller
- Check the Robot's internal wiring.
- Check the Controller's internal wiring.

(2) Examine the CNBS cable between the Controller's internal Servo Board and the Servo AMP .

(3) Replace other components.

(1) Examine the power line

Please turn off the primary power and remove the U, V, W of drive unit for the corresponding axis and examine if short circuit exists in each phase. Please use an equipment such as the multi meter (tester) and examine each phase's wiring one by one

Warning

Be cautious. Examination while the power is on may cause an electrocution

- Check the wiring that connects the Robot and Controller
  Please remove the wirings that connect the controller, Robot or the drive unit to examine each phases (U, V, W) for ground, or a short circuit. If a short circuit is found, please replace the wire

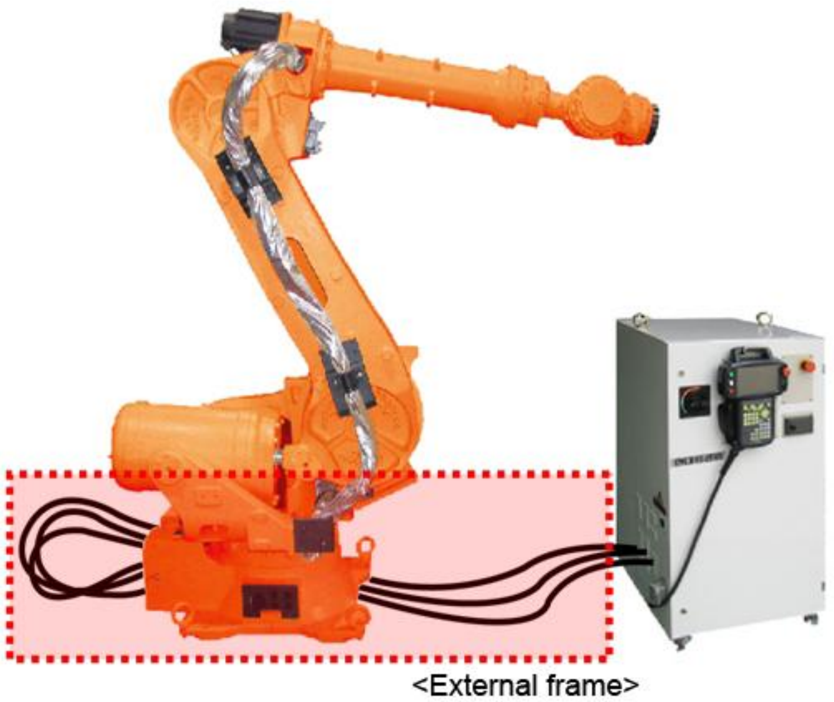


Figure 6.112 Basic Installation Diagram of the Robot and Control Period

- Check the Robot’s internal wiring.
  Examine for a short circuit, faulty on a wiring that connected to Robot’s internal motor is required

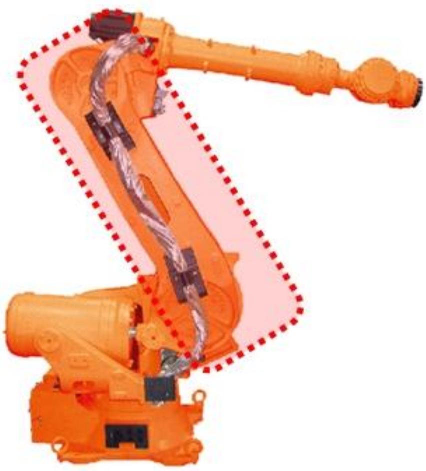


Figure 6.113 Robot’s Internal Wiring

- Check the Controller’s internal wiring
  Examine on a controller’s internal AMP and installed wiring is required

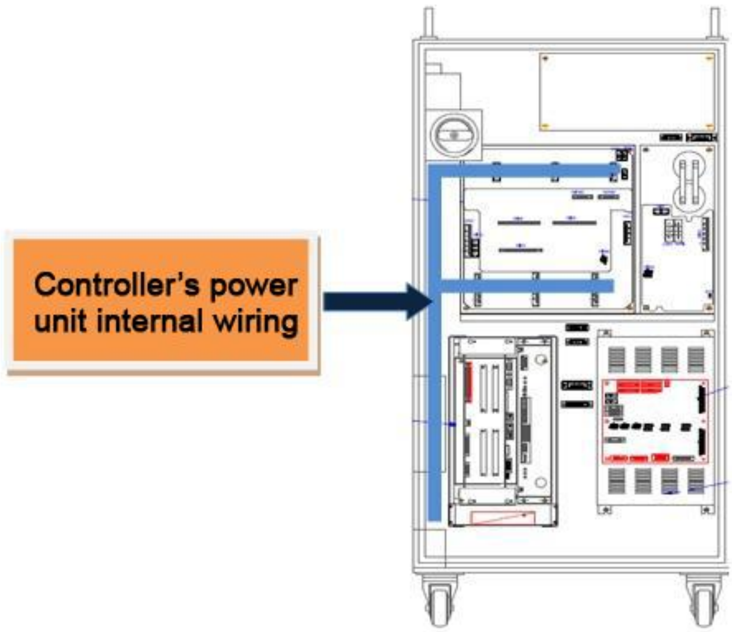


Figure 6.114 Controller’s Internal Area (Power Unit)

(2) Examine the CNBS cable between the Controller's internal Servo Board (DSP board) and the Drive Unit

Please examine if the CNBS cable is installed properly. If the cable is not installed properly, or the cable is faulty, this error may occur

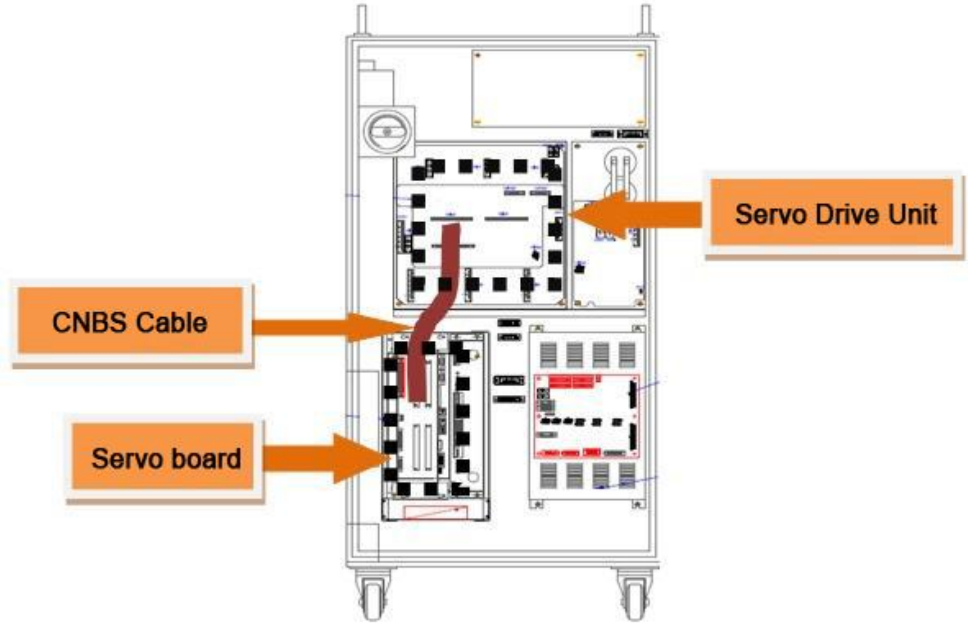
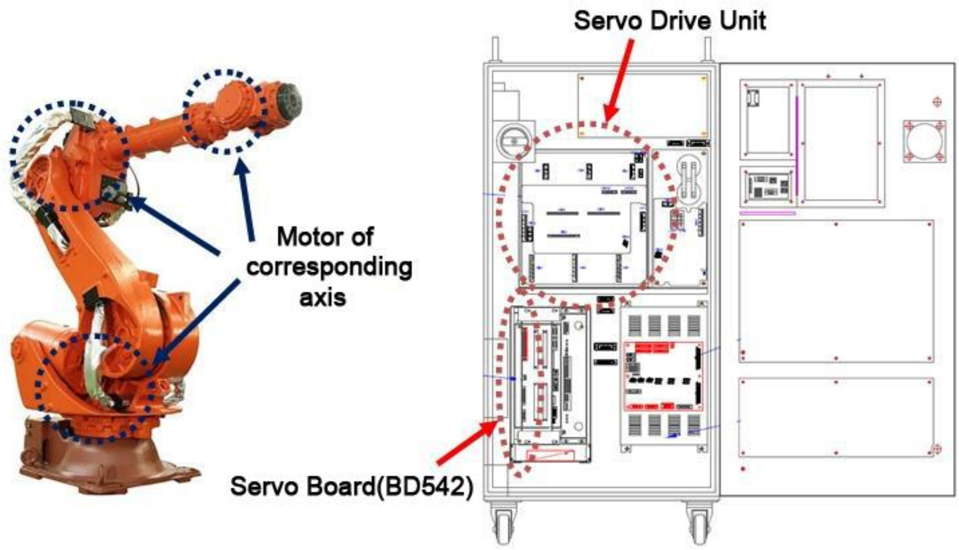


Figure 6.115 Controller's Internal Area (CNBS Cable)

(3) Replace other components

Replace the component in order of Servo Board (BD542) →Servo Drive Unit→Motor to confirm the occurance of an error'.



6.1.23. E0223 (Axis o) Encoder cut-off or communication failure

6.1.23.1. Ouline

Servo Board receives data from the encoder periodically through a serial communication in order to perform a Servo control on the motor. This error occurs if the received data from the encoder violates the communication protocol.

This error may occurs due to a fault of components that received the data from the encoder, or the problems in a encoder shield lines or the wiring,

6.1.23.2. Causes and examine methods

(1) Please check the supply voltage to the Encoder

(2) Please replace the Servo Board and test it

(3) Please replace the Motor and test it

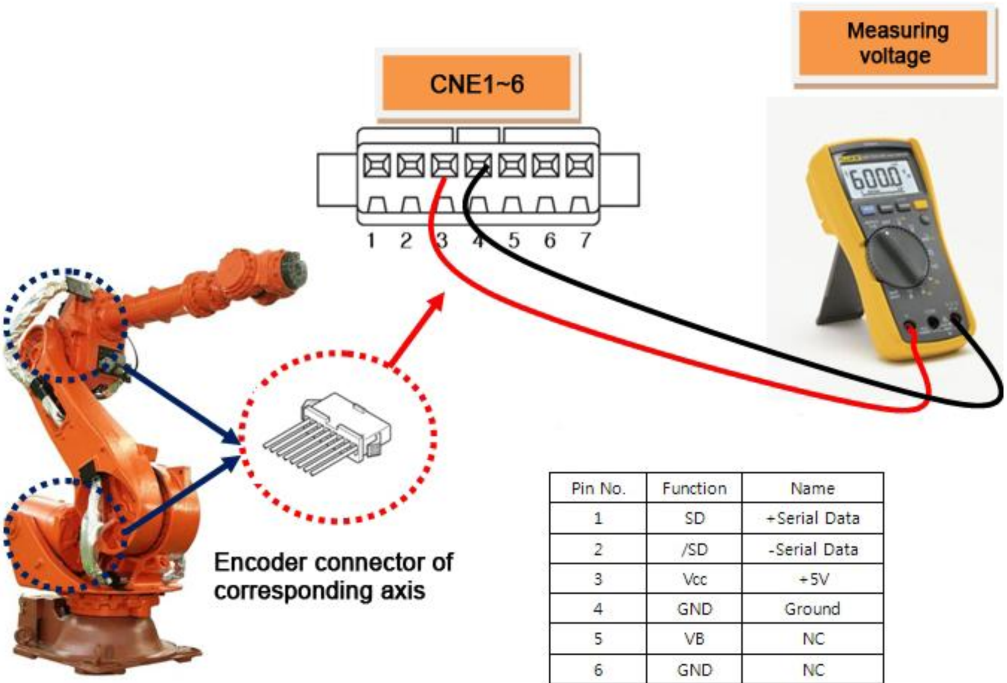
(4) Please examine the wiring

(5) Please examine the communication status of wiring after the repair

(1) Please check the supply voltage to the Encoder

Power supply voltage to the encoder must be in a range of 5V±5% (4.75V ~ 5.25V)-(encoder side connector's supply voltage). If the voltage is reduced below 4.75V, encoder may not operate normally and it will cause this error

Please measure the voltage of encoder side's connector-pin(3-4)

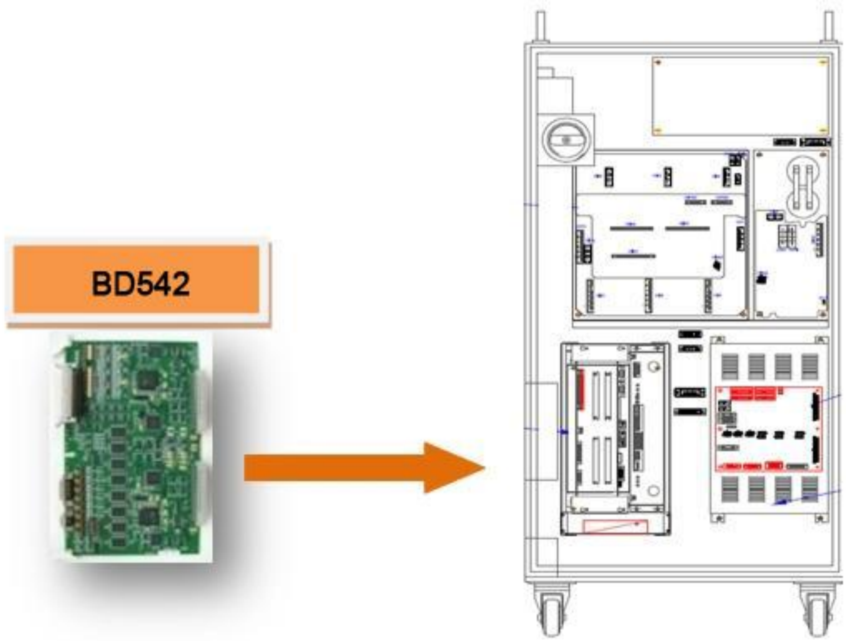


Pin No.	Function	Name
1	SD	+Serial Data
2	/SD	-Serial Data
3	Vcc	+5V
4	GND	Ground
5	VB	NC
6	GND	NC
7	Shield	Shield

If the measured voltage is below the standard voltage, please adjust the +5V ADJ(E) voltage control terminal (socket) in the encoder's power supply unit, so that the encoder side's connector voltage can be adjusted according to the standard

(2) Please replace the Servo Board and test it

After the replacement of the Servo Board, if the error does not persis, the Servo Board is faulty. Please replace the Servo Board with new one



(3) Please replace the Servo Motor and test it.
If the error does not persist after the replacement of Servo Motor, Servo Motor is faulty. Please replace the Servo Motor with new one. Below diagram describes the locations of each axis's motor (HS165 Robot). For other Robot, please refer to the Robot's maintenance manual to replace it

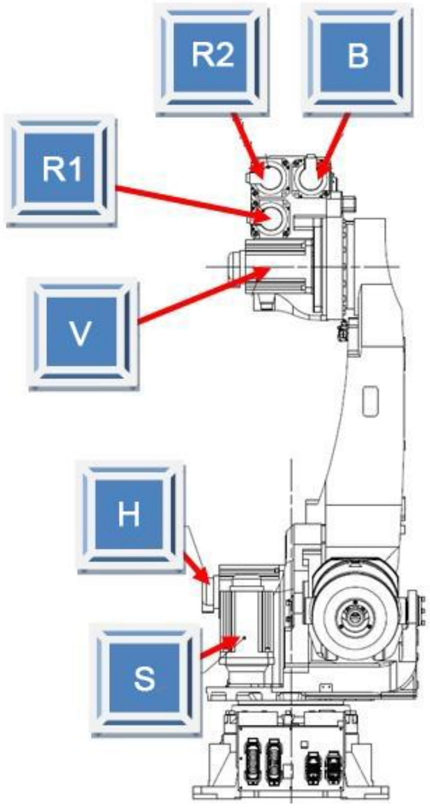


Figure 6.116 HS165 Locations of Each Axis's Motor (HS165 Robot).

(4) Please examine the wiring.

Encoder’s wiring examination orders are asl below

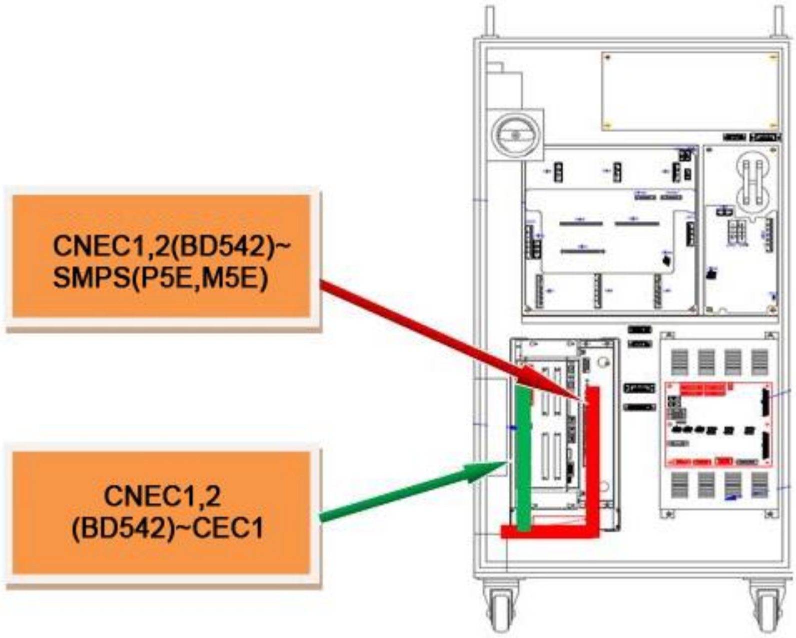
Firstly, Examine the loose contact of the connectors that are related to the Encoder’s wiring

Secondly, Examine the short-circuit of encoder’s wiring. Please use equipment such as the multi meter (tester) and examine each phase’s wiring one by one

Thirdly, replace the encoder’s wiring and test it

If the encoder’s wiring has not been disconnected and if the error caused by certain problems (loose contact of shield line, contact between the encoder’s signal line and other electric power line, or a contact with the metal part of Robot’s main frame) it cannot be detected by short-circuit test. So please replace the wiring and test it

- Please examine the internal wiring of the Controller
  Please examine the wiring between the CNEC1,2(DB542) connector and the SMPS(P5E,M5E)
  Please examine the wiring between the CNEC1,2(BD542) connector and the CEC1.



- Please examine the wiring between the Controller and the Robot.
  Please examine the wiring bêtween the CNEC1 and the CER1

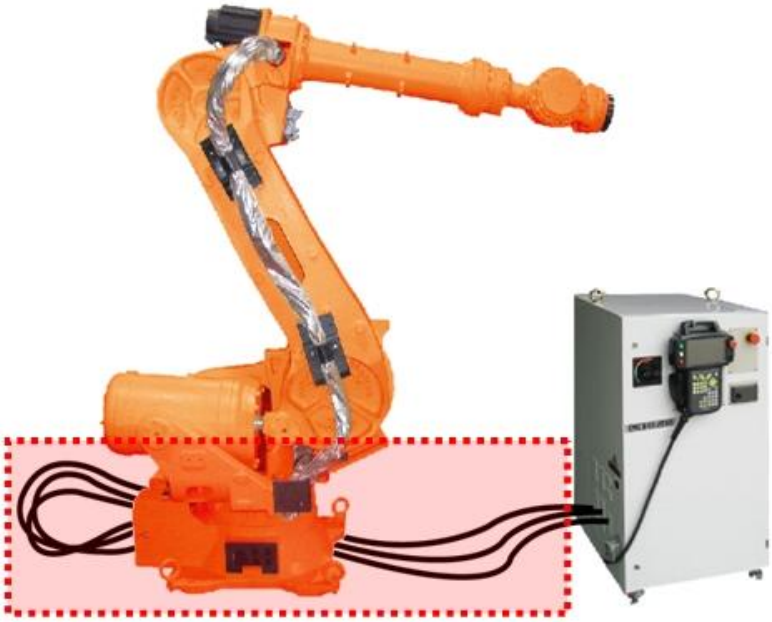


Figure 6.117 Basic Installation Diagram of the Robot and Control Period

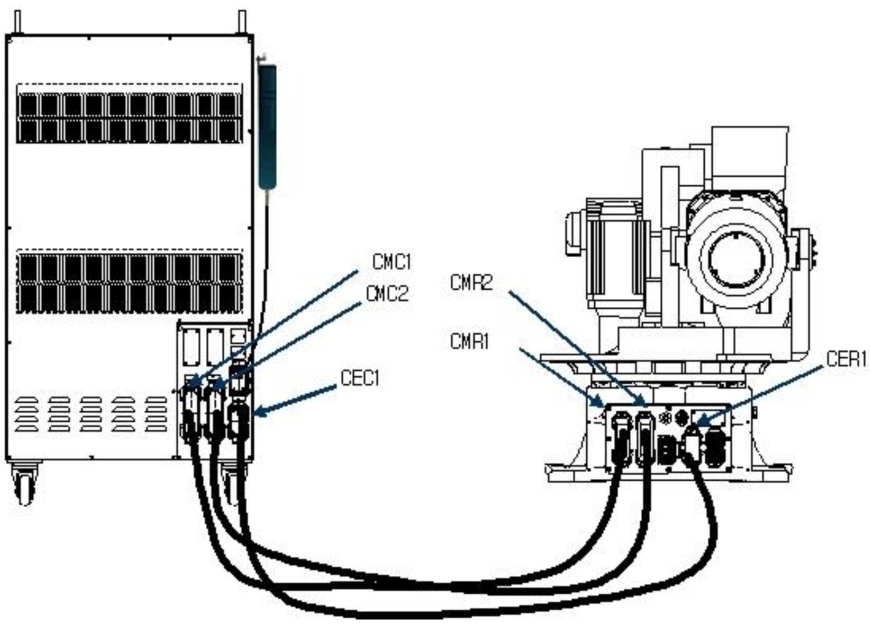


Figure 6.118 Connection Between the Robot’s Mainframe and the Controller

- Please examine the wiring of the mainframe.
  Please examine the wring between the CER1 and CNE1~6(Encoder side’s connector)
  Please refer to the wiring diagram of Robot’s maintainance manual

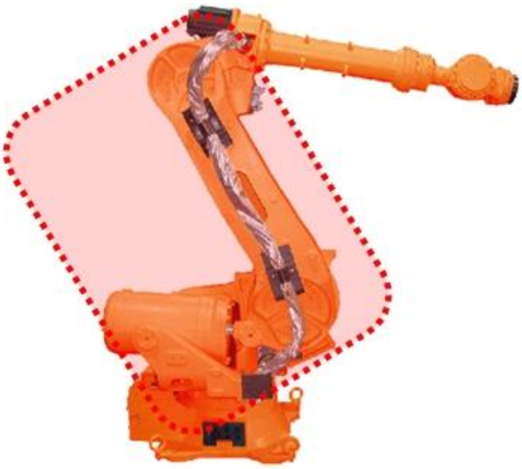
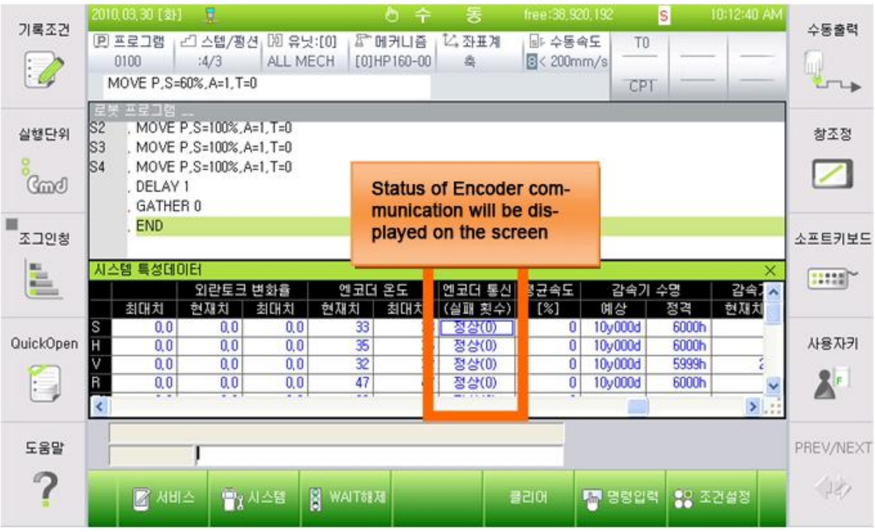


Figure 6.119 Robot’s Internal Wiring

(5) Please examine the communication status of wiring after the repair

Once actions for the problem are taken, please refer to [Count of encoder communication failure display function manual] to check the communication status



Count of communication failure	Encoder's status	Content
0~2	Normal	Normal status
3~5	Examine required	Wiring, encoder or the board need to be examined
6~8	Warning	Dangerous status. Robot may be immobilized

6.1.24. E0224 (Axis o) Encoder status error

6.1.24.1. Ouline

Servo Board receives data from the encoder periodically through a serial communication in order to perform a Servo control on the motor. This error occurs when the data that received from the encorder is normal, but the result of encoder's self status check shows an error

6.1.24.2. Causes and examine methods

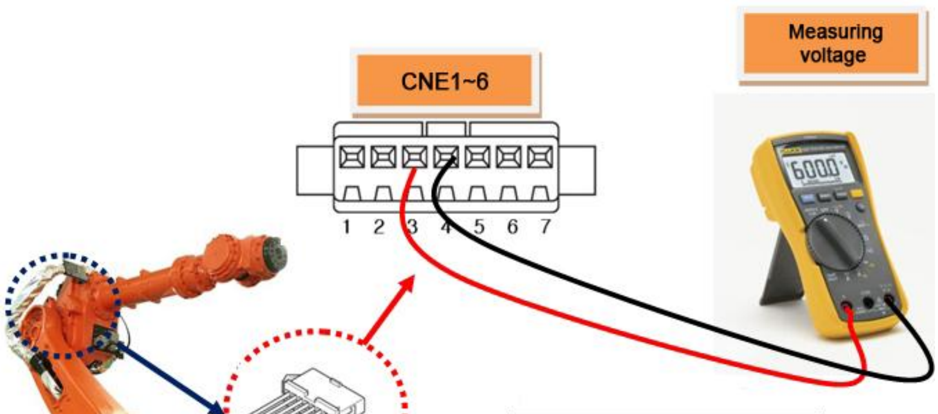
(1) Please check the supply voltage to the Encoder.

(2) Please replace the Motor and test it.

(1) Please check the supply voltage to the Encoder.

Power supply voltage to the encoder must be in a range of 5V±5% (4.75V ~ 5.25V)-(encoder side connector's supply voltage). If the voltage is reduced below 4.75V, encoder may not operate normally and it will cause this error

Please measure the voltage of encoder side's connector-pin(3-4)



Pin No.	Function	Name
1	SD	+Serial Data
2	/SD	-Serial Data
3	Vcc	+5V
4	GND	Ground
5	VB	NC
6	GND	NC
7	Shield	Shield

If the measured voltage is below the standard voltage, please adjust the +5V ADJ(E) voltage control terminal (socket) in the encoder's power supply unit, so that the encoder side's connector voltage can be adjusted according to the standard

(2) Replacement of Servo Motor and examine it

If the error does not persist after the replacement of Servo Motor, Servo Motor is faulty. Please replace the Servo Motor with new one. Below diagram describes the locations of each axis's motor (HS165 Robot). For other Robot, please refer to the Robot's maintenance manual to replace it

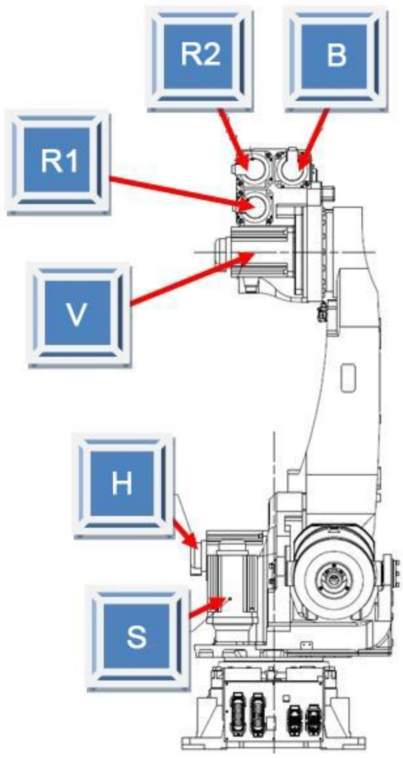


Figure 6.120 Locations of Each Axis's Motor (HS165 Robot)

6.1.25. Instructions in examining the Controller's input voltage (Single-phase)

(1) Please check the voltage on the rating plate and the actual input voltage

Please check if the voltage of controller's power supply is within the allowed voltage range as described on the rating plate. Allowed reange of input voltage is within the 10% of describe value on the raing plate, and it should be over 198V (AC220V standard). Below describes how to measure the input volate of controller. If the measured voltage is out of the allowed range, please examine the power supply units

Warning

Please be cautious. Short-circuit between phases or with surrounding components can occur while measuring the high voltage

- Hi5-C1X Controller : Measuring the Side terminal block's single-phase terminal (socket)

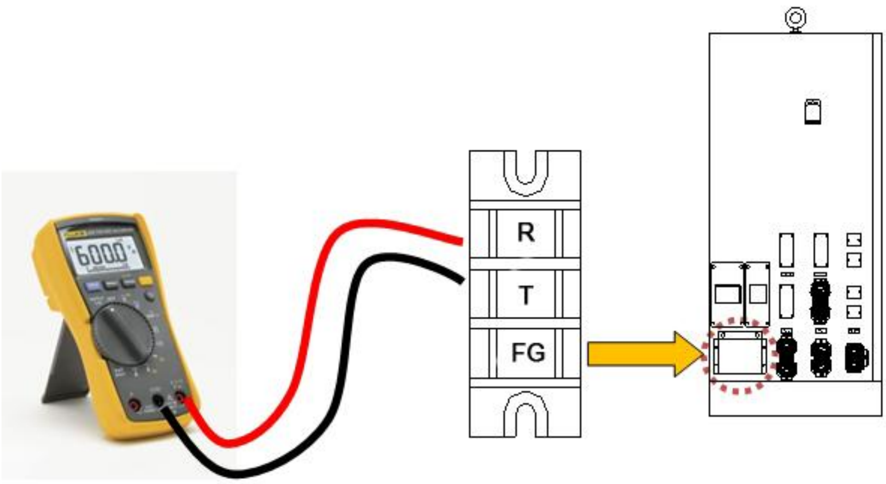


Figure 6.121 Hi-5-C1X Controller's Single-Phase Power Terminal Block

- Hi5-C0X Controller : Measuring the Side Terminal Block's Single-Phase Terminal (Socket)

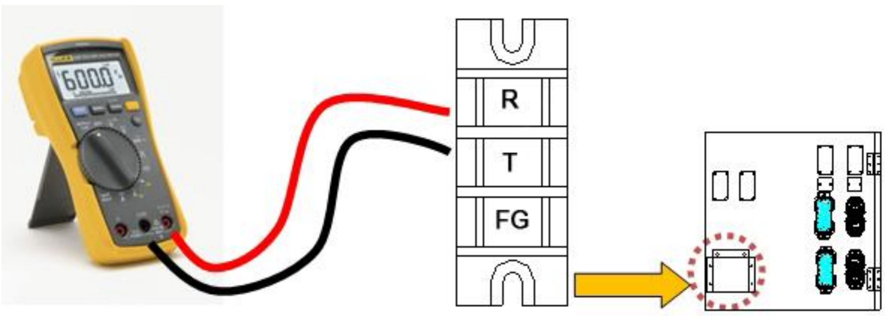


Figure 6.122 Hi-5-C0X Controller's Single-Phase Power Terminal Block

6.1.26. Instructions in examining the Controller’s input voltage(3-phase)

(1) Please check the voltage on the rating plate and the actual input voltage

Please check if the voltage of controller’s power supply is within the allowed voltage range as described on the rating plate. Allowed reange of input voltage is within the 10% of describe value on the raing plate, and it should be over 198V (AC220V standard). Below describes how to measure the input volate of controller. If the measured voltage is out of the allowed range, please examine the power supply units

- Hi5-N Controller : Measuring the power line of front switch

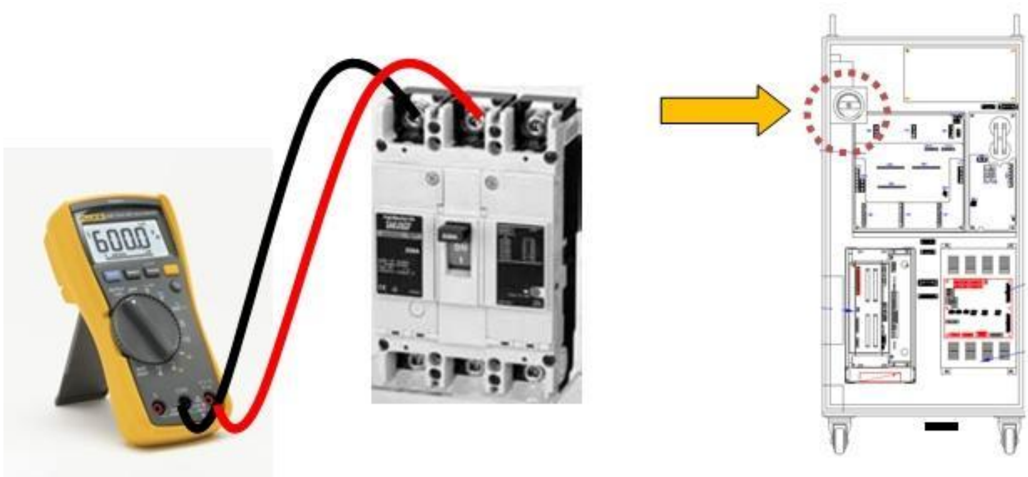


Figure 6.123 Location of Hi5-N Controller’s Power Switch

Warning
Please be cautious. Short-circuit between phases or with surrounding components can occur while measuring the high voltage

1) Hi5-C1X Controller : Measuring the Side terminal block’s 3-phsae terminal (socket)

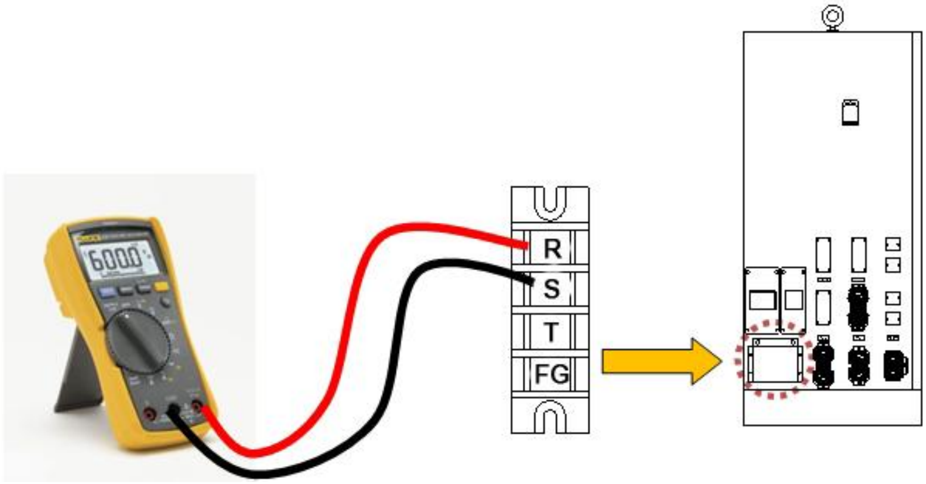


Figure 6.124 Hi-5-C1X Controller’s 3-Phase Power Terminal Block

2) Hi5-C0X Controller : Measuring the Side terminal block’s 3-phase terminal (socket)

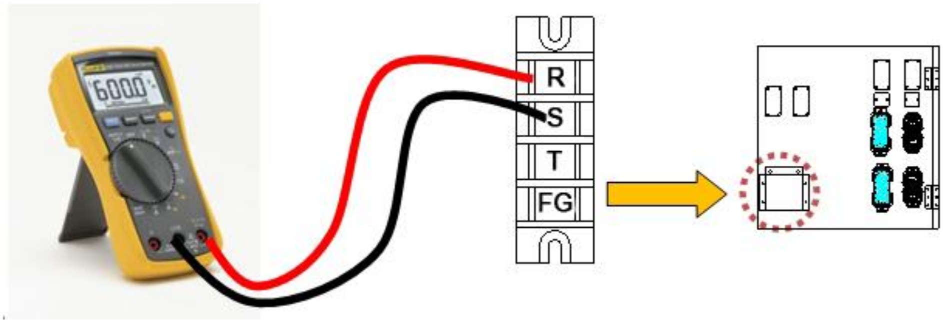


Figure 6.125 Hi-5-C0X Controller’s 3-Phase Power Terminal Block

6.1.27. Instructions in examining the Controller's internal voltage(3-phase)

(1) Please check the Controller's internal 3-phase power voltage

Electrical Module(PDM) that attached at the front of controller is in charge of the distribution and replay of each power supplies, and the 3-phase power supply wii be turned on/off by a Magnet switch in the Electrical Module. Please exmine if the input voltage to the Electrical Module is within the 10% error range of AC220V standard. If the measured voltage is out of the allowed range, please examine as below

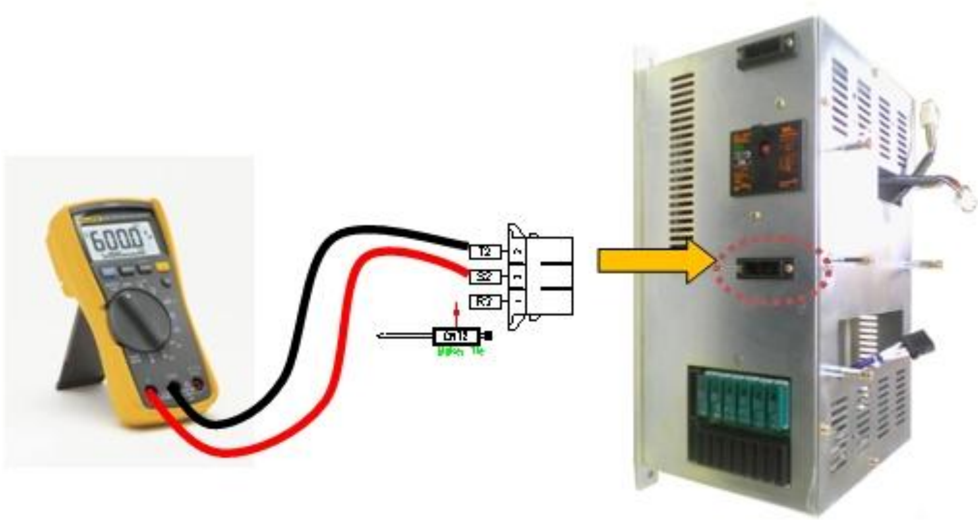


Figure 6.126 3-Phase Power Input to the Electrical Module

Warning
Please be cautious. Short-circuit between phases or with surrounding components can occur while measuring the high voltage

1) If the input voltage to the controller is AC220V
   If the input voltage to the controller is AC220V, input voltage from external to the power switch or terminal block must be same as the measured voltage from the internal Electrical Module. If there is a difference, please examine the 3-phase power supply wiring

2) If the input voltage to the controller is not AC220V
   If the input voltage specification to the controller is not AC220V, please use the internally installed transformer to conver the 3-phase voltage into AC220V and it will be connected to the Electrical Module. Please exmine if the voltage of the Electrical Module is within the 10% error range of AC220V standard. Also examine if the voltage is maintaining.
   If the measured voltage is out of allowed range, please examine the input of internally installed transformer and the connection status of output terminal (socket). Primary column of the internally installed transformer must be connected with the voltage as it is displayed on a rating panel. Secondary column of the transformer must be set to AC3-phase 220V at all time. If the output from the output terminal (socket) is not AC 3-phase 220V even when the input and output terminals (socket) are connected properly, the transformer is faulty. At this stage the output voltage of transformer's error rate must be within 5 %

6.2. Instructions in Parts Replacement

This instruction shows how to replace the parts and boards during troubleshooting.

6.2.1. Instructions in Substrate Replacement

Pay attention to the followings during boards replacement.

① Be sure to turn power off before working.

② Keep your hands clean to prevent boards from being stained with oils or water. If y ou need to grasp the board, please hold around the board. Be sure not to touch th e contacting surface of electric parts or pattern, and especially connector.

③ Align the electric potential between the body(hand) of the user and the controller.

④ Each board has a number of connectors. Be sure to insert completely to prevent fa lse inserting, omission, or looseness when replacing. Match the printed names on th e nameplate of connector and on the one of boards.

Separation of Boards

Please take the followings actions before taking out mainboard.

① If you intend to replace mainboard, you need to back up the necessary program/constant data by using HR-VIEW S/W or SRAM CARD of (Notebook) PC before replacement.

② Since the teaching-program / constant data is stored in SRAM of BD510 board, the previous program / constant data you want is not existed after replacement. After replacement, load the backup contents to the new board before using.

③ Program/constant data remains in SRAM by the battery for backup even when power is removed.

④ Besides, in case that connectors of battery for backup is separated by mistake or by board replacement, capacitor for backup maintains program /constant data up to 1 hour. The battery for backup must be connected to keep the board for long period of time because program/constant data may be deleted afterwards.

Please be aware of the above cautions, and make a replacement of board following the below instructions.

① First, remove input power from power unit.

② Loosen slightly the screw upholding the supporting stand which is above and below of Rack, move the supporting stand to the left, and pull it out.

③ Take all the connectors out of board. Here, for the connector connected by screws, loosen them by using a suitable screwdriver. And be careful of excessive force to connector.

④ Pull out the Ejector mounted on the upper and lower front side of board, and the board will be taken out along the guide rail of Rack.

Insert of Board

① First, turn off the input power of power unit.

② Push inward the Ejector mounted on the upper and lower front side of board along the guide rail of Rack. Here, push it hard until you feel that the connector is inserted into backplane board which is located in the back side of Rack.

③ Connect all the connectors of the board. Here, for the connector connected by screws, tighten it again by using a suitable screwdriver.

④ Move the supporting stand to the right, hooking up to the screw on the upper and lower part of Rack, and then tighten the screw.

Pay attention to the followings after inserting mainboard.

Make a copy of the program/constant data which is copied prior to the replacement of main in mainboard memory by using (Notebook) PC or SRAM CARD. And make sure that the battery connector for backup is connected.
If the battery connector is not connected, it is safe while controller power is ON. However, if power is OFF for more than 1 hour, program/constant data will be all deleted.

6.2.2. Instructions in Servo AMP Replacement

Pay attention to the followings during servo AMP replacement.

Check the nameplate in the front side of panel in case that it would not have compatibility with other types of servo AMP.

Separation of Servo AMP

① First, turn off the input power of power unit.
② Loosen the fixed bolt in servo AMP protection cover to take off.
③ Take off wires tightened to terminal block with screws.
④ Take off all the connected connectors.
⑤ Take off the screws tightening the servo AMP.
⑥ Take out the servo AMP.
Be careful when taking out the servo AMP because it is very heavy. And make sure not to damage wires around it.

Connection of Servo AMP

① First, turn off input power of power unit.
② Lift the servo AMP carefully and push it in.
Be careful when pushing in the servo AMP because it is very heavy. And make sure not to damage wires around it.
③ Screw on the servo AMP.
④ Screw on the wires to terminal block.
⑤ Connect all the connectors.
⑥ Tighten the servo AMP protection cover with bolts.

6.2.3. Instructions in Battery Replacement

This controller is a backup battery for SRAM, and uses 3.6V Lithium battery.
Replace the battery every 2 years on a regular basis.
To prevent a damage of SRAM data, back up SRAM data first by using HRVIEW or SRAM CARD.
When replacing the battery, it can be done with the primary power is ON.

① Prepare a new Lithium battery.

② Disconnect the primary power of controller.

③ Replace Lithium battery with a new one.

④ Supply the primary power to controller.

[Warning]

① Do not litter the spent battery.

② Dispose of the spent battery as an industrial waste under the relevant regulations or rules.

③ Do not recharge the used-up battery. It involves a danger of explosion.

④ Use the specified battery only.

⑤ Do not make a short circuit of positive and negative poles.

⑥ Do not burn the spent battery, nor leave it in a high temperature.

6.2.4. Instructions in SMPS Replacement

This SMPS is a complex power unit which is used as a primary control power. Pay close attention to this sophisticated device.

Separation of SMPS

① First, turn off input power of power unit.

② Unscrew the terminal stand of SMPS to take off the attached wires.

③ Loosen 4 screws tightened to the board Rack.

④ Insert your index finger into the hole in upper and lower side of SMPS, and pull it out. Then SMPS will be taken out of the Rack. Here, if pulling too hard, you may involve an injury, so be careful. And make sure not to damage the wires around it.

Connection of SMPS

① First, turn off input power of power unit.

② Grasp the SMPS with the right hand and push it into the first guide rail of Rack, while clearing the surrounding wires away. Here, make sure not to damage the wires around it.

③ Screw it to the Rack.

④ Screw on the wires to terminal stand.

6.3. Instructions in Adjustment

This controller does not require extra adjustment because it has been fully adjusted when delivered from warehouse. However, in case of parts replacement, an adjustment may be needed to some extent. This instructions shows how to adjust and where to adjust. Do not make an adjustment, except that it is needed, unless the cause of trouble is confirmed.

6.3.1. Adjustment of Power System

In case of power system errors or power change, take a measurement of each power voltage, and adjust any voltage below the standard(use a digital voltmeter for measurement).

Table 6-5 Power Standard

Power	Measuring Location	Standard	Adjustment
Primary Power	CB1 input terminal	**AC220V ± 10%**	Define the primary tab of transformer TR1 as AC220V
R6,S6,T6	Servo AMP R, S, T	**AC220V ± 10%**	Check the input voltage of CB1 - AC220V
B2-C2	TB1 B2-C2	**AC220V ± 10%**	Secondary Tab turnover of transformer TR1
P1-M1	SR1 +24V-G2	**DC24V ± 2.0V**	(Note 1)
P5-M0	SR1 +5V-G1	**DC5.1V ± 0.1V**	Volume resistance in SR1
P15-M0	SR1 +15V-G1	**DC15V ± 0.5V**	(Note 1)
N15-M0	SR1 -15V-G1	**DC-15V ± 0.5V**	(Note 1)
P5E-M5E	SR1 +5V-GND	**DC5.4V ± 0.1V**	Volume resistance in SR1 (Note 2)
	Terminal block for Robot external wiring Connectors Pin P5E-M5E	**DC5.1V ± 0.1V**	Volume resistance in SR1 (Note 2)

(Note 1) Replace the SR1 if it is not within the standard.
(Note 2) First, check the standard in the measuring location, and then make a measurement in the nearest terminal stand from robot encoder and between connector Pins. Here, the standard must be DC5.1V±0.1V.

6.3.2. Transformer (TR1)

AC 220V 3-phase must be used for primary power of transformer(TR1).
Do not adjust the secondary terminal because it is connected to power suitable for the internal parts specifications.

AC 220V 3-phase must be used for input power of this controller.
Tab must not be changed without permission of our staff because this controller has been completed in adjusting when delivered from warehouse.

6.4. Error Code and Warning

Errors are classified into general errors and handling errors. General errors are to call user's attentions, and handling errors indicates that operator made a mistake or trouble.

Hi5 controller, with its built-in self-diagnostic function, displays the details of errors on LCD screen of Teach pendant. Thus, you may check error code, and confirm it in the error code Table for troubleshooting.

In case of troubleshooting, read carefully 『troubleshooting cases』 & 『Instructions in Parts Replacement』, and be fully understood on your working details before getting down to work. In addition, fully inform us of the followings when contacting with our A/S office.

① Robot type name on robot specification plate and controller type of specification plate

② Happened date

③ Symptoms & error code

④ Details conducted by user's company

⑤ Software version of robot controller (Main, I/O, DSP, T/P)

⑥ Environment conditions in the occurrence of errors(power failure, collision with Jig, etc.)

6.4.1. System Error

Code	Message	Cause	Remedy
E0001	Power down detected	A power was cut after motor ON or CB(Circuit Breaker) was OFF.	Just to store a power outage to the error list, Any action is not demanded.
E0002	H/W LMT switch on	Limit Switch was actuated at the end of work range for each axis.	On the motor from system menu (press motor on button while holding the Enable switch), and move it back to operation area by using jog key. Refer to error repair manual
E0003	Overload of brake power	Fuse was cut off due to overcurrent at AC220V power line to create brake power.	Replace the brake power suppy fuse in Electrical Module
E0004	Axis Z break sensor is on working	Axis Z break sensor is on working	1)Examine the Axis Z belt. 2)Examine the safety board(BD58B) 3)Examine the System Board
E0005	No DSP version on flash ROM of main board.	It happens when stored performing code does not exist even though DSP performing code, which has been stored to flash ROM of main board, is being dispatched to servo board in power on.	Please make version up DSP with system version up function (R286).
E0006	Collision sensor is on working.	Collision sensor has worked.	Please check whether tool of robot end-effector was deformed. Please start after removing all error causes.
E0007	Sticking of weld detected	Sticking of welds signal is detected in completion of welding sequence.	1)Check the sticking of welds signal. 2) Remove the cause of weld stick.
E0008	Motor temperature is risen (Hard-wiring)	Excessive raising of motor temperature was sensed through temperature sensor wired to each axis of robot.	If overdrived, reduce the operation speed. If the temperature is too high, stop the operation until the motor cools down
E0009	Verify error after the #(%d) DSP version download	Data dispatching performing code through HPI port of servo board is wrong.	1) Please check whether servo board is mounted. 2) Please check DIP switch of servo board referring to trouble shooting.

Code	Message	Cause	Remedy
E0010	Discharge resister overheated(AMP)	In the case that temperature of Discharge resister risen for base value, overheated detect sensor error.	Please refer to trouble shooting.
E0011	Overvoltage of AMP	In the case of excess establish value of the motor voltage(P-N)	Check the AC input voltage in the controller. Check the connection of discharge resistor.
E0012	Brake power error	Brake voltage is lowered.	Examine the brake power(24V) 1)If it is normal, replace System Board. 2)If it is abnormal, replace Electrical Module
E0013	PWM error !!, contact failure of sequence line.	Due to contact failure of PWM off line between AMP and system board, PWM command is not inserted to drive unit.	Please check CNSG cable of drive unit. Please make an inquiry to HHI if the error happens again even after the above articles has been managed.
E0014	Instant contact of safety switch (EM,OTR,TS etc) has happened.	Instant contact of safety switch (emergency halt, motor overheat, limit switch etc) has happened.	1) Check the Emergency Switch. If an error occurs after taking above steps, contact the Robot A/S team. 2)Refer to error repair manual
E0015	Teach pendant does not work	Communication halt between teach pendant and main board was sensed.	1. Has this error happened after T/P version up? => You may ignore it. 2. Has this error happened after being reperformed after T/P failure occurrence => Please make an inquiry to HHI about T/P fallacy. 3. Other cases? => Teach pendant error or communication failure. Please make an inquiry to HHI.
E0016	Servo drive unit error	You pushed [Motors-on] button in the state that Servo Drive Unit is abnormal.	Take a measure to the error in system initialization and push [Motors on] button.
E0017	Conveyor pulse line trouble	Failing in conveyor pulse generating or a break in pulse lines.	1)Check up the conveyor encoder power and connections of pulse line 2) Please replace conveyer I/F board.

Code	Message	Cause	Remedy
E0018	Connecting error of arc board.	There is a trouble on connecting with arc board.	Please check communication path and power supply line between arc board and main board.
E0019	Conveyor pulse count changed a lot	Bigger value than fixed allowable frequency on conveyer pulse number was input.	1) Check the frequency range on SYSTEM/ APPLICATION PARAMETER/ CONVEYOR/ CONVEYOR CONSTANT SETTING 2) Check if noise signal exists in the pulse line
E0021	Conveyor speed is too high	Conveyor permission speed is high	1) Please check the fixed value of conveyer allowable speed. 2) Check if noise signal exists in pulse line.
E0022	Communication error among inner modules.	The error on communication between main board and each inner modules has happened.	Please refer to trouble shooting.
E0031	The mode switch is failure	Manual/automatic mode switch of operating panel (OP) has failed or connected status is strange.	Check the mode switch or connected line status.
E0032	Communication error on user IO board.	Communication trouble between user IO board and main board has happened.	Please refer to trouble shooting E0022.
E0033	under-voltage error of AMP	PN voltage of servo AMP became low.	Please check input power of recovery discharging status and servo AMP.
E0034	over-current error of AMP	F1 or F2 was cut off owing to surge voltage at servo AMP.	Please check power connecting status inside and outside of controller.
E0035	Hardware limit (auxiliary axis)	Limit switch, which is installed at end of operation area of auxiliary axis (running axis etc), operated.	On the motor from system menu (press motor on button while holding the Enable switch), and move it back to operation area by using jog key. Refer to error repair manual-E0002
E0036	Hardware limit (expansion 16 axes)	Limit switch, which is installed at end of operation area of expansion, operated.	On the motor from system menu (press motor on button while holding the Enable switch), and move it back to operation area by using jog

Code	Message	Cause	Remedy
			key. Refer to error repair manual-E0002
E0037	Overload occurred on a Control power supply	Fuse has been cut-off due to an overcurrent that occurred on control power (AC220V) supply line	After removing the cause of fuse off, please replace the fuse.
E0038	Overload of motor power	CP was tripped owing to over-current at RST line of motor power.	After removing the cause of CP trip, please return CP switch.
E0039	Overload of SMPS power	Fuse was cut off because power line of SMPS power AC48V has been overloaded.	After removing the cause of fuse off, please replace the fuse.
E0041	Motor temperature raising of auxiliary axis (Hard-wiring)	Motor temperature of auxiliary axis escalated excessively.	Please refer to trouble shooting E0008.
E0042	Connecting error of general guard switch	Error happned on connection of general safety guard.	Please check the connecting status of general safety guard or line.
E0043	Connecting error of safety plug	Connecting error of safety plug (auto guard) switch at automatic mode happened.	Please check the of safety guard switch or connecting status line.
E0044	A sensor for detecting any breakage of an elevation axis- belt is operating.	The belt of the elevation axis-motor driving part was cut off, or a sensor cable within the robot was cut off.	Replace the belt of the motor driving part or check the sensor cable inside the robot.
E0045	A change from remote mode to automatic mode is requested.	Despite the manual mode of the controller, a change from remote mode to automatic mode is requested.	Change the controller's mode to automatic mode.
E0046	The remote automatic mode is changed to a manual mode.	The controller's mode was changed from remote automatic mode to manual mode.	Try to operate the controller after changing the remote mode to manual mode.
E0047	Exceeding motion control time.	Robot motion calculation has not been completed within the reference time.	Where too much allocation time for the embedded PLC is set, ask our engineers for a reduction of the allocation time.
E0048	Remode mode(system) signal is not entered	1) Motor on has been attempted from a remote mode while remote mode signal is not entered 2) Mode switch has been	Examine the remote mode(system) signal from the Private input signal monitoring, and make sure the signal is being entered

Code	Message	Cause	Remedy
		controlled in remote mode while remote mode(system) signal is not entered	
E0049	External start is possible after joystick mode release	External start of LCD examining Robot is possible after joystick mode release	1) Release joystick mode 2) If external start is not possible even after the release of joystick mode, please check if the joystick signal is normal
E0050	Light Curtain dectection signal has been input	Light Curtain dectection signal has been input	Check the connection status of Light Curtain detection signal
E0101	Need more DSP boards	The number of motors to control is larger then the number of controllable motors on servo board	1) Check up the number to control motors on the menu SERVICE/ SYSTEM DIAGNOSTIC/ SYSTEM VERSION 2) Add the servo board
E0102	Different arm type!	No supported robot type was set	Check up setup robot type on the menu SERVICE/ SYSTEM DIAGNOSTIC/ SYSTEM VERSION
E0107	Enc Err: Bad bit sequence	Encoder’s data receving status is bad when controller’s power transfer	Refer to E0223, E0224 of error repair manual
E0108	Enc Err: Encoder reset needed	Encoder data gets out of the range to apply the offset function.	Please refer to trouble shooting.
E0112	Fuse blown or IPM fault(6Amp)	The fuse in the amplifier was blown or IPM fault happened.	Please refer to trouble shooting.
E0113	Overcurrent	Overcurrent flows through the Motor or amplifier.	Please refer to trouble shooting.
E0115	Command Error	Received packet data from main board was wrong.	Please refer to trouble shooting.
E0117	Too large position drift	Position Error exceeded the set value.	Please refer to trouble shooting.
E0119	Overload	Motors were operated overly.	Please refer to trouble shooting.
E0122	Servo On limit time exceeded	Servo On does not work within the limit time when the	Refer to error repair manual

Code	Message	Cause	Remedy
		control of Servo On, or release of power saving mode	
E0123	Cannot make servo off	When executing Servo Off or releasing power saving mode, Servo Off was not executed within the set time.	1) Replace the servo board. 2) if the same error occurs, contact with our service department.
E0124	Cannot clear servo error	Motor ON was not available because of servo error	Clear the servo error
E0125	Accuracy not satisfied	Despite that 10 sec passed after command was output, real position was not accorded with the command	Please contact to our office
E0126	Trial to go out of workspace	You tried to move the robot to the position where tool-end can not arrive.	Check whether the workpiece and the robot was located properly.
E0127	MSHP not work	MSHP doesn't work.	Please refer to trouble shooting.
E0131	Bit jump error (high level)	In High Speed Mode (playback), the speed exceeds High Speed Detecting Level (Bit Jump High Level -BJH).	1) Check the connection of CNEC for BD440 2) Check the connection of CNR4 and CNR5 3) Check whether BJH is set to 1.5 times of the maximum speed.
E0132	Bit jump error (low level)	In Low Speed Mode(Jog, Step forward/ backward, Allocation input signals, Teach mode), The speed exceeds Low Speed Detecting Level(Bit Jump Low Level-BJL).	1) Check the connection of CNEC for BD440. 2) Check the connection of CNR4. 3) Check whether BJL is set to 1.5 times of the minimum speed.
E0133	Command error	The position command to the servo board BD440 is abnormal.	Please refer to trouble shooting.
E0134	Overspeed	The position command on the packet data to the servo board exceeds the maximum speed.	Please refer to trouble shooting.
E0135	(Axis 0) PWM OFF at Servo On	PWM error!! Loose contact on sequence line. PWM	Examine the CNSG cable of drive unit. If the error persists,

Code	Message	Cause	Remedy
		command is not being input to drive unit due to loose contact on PWM off line between AMP and sequence board	please contact to our office
E0136	Control voltage down of Servo AMP	Control voltage +15V reduction. Error on a recovery control SMPS in drive unit	Refer to error repair manual
E0137	Encoder pulse setting error	In the servo parameters, Encoder Pulse Setting Value ('PUL') is unusable.	Check 'PUL' of servo parameters.
E0138	Can't return to previous position	The distance for returning to the previous position exceeded the set value.	1) Check servo gain. 2) Check encoder power. 3) Check encoder wiring.
E0139	Can't clean up DSP Filters	Communication from the main board to servo board was unable.	1) Check the insertion of main board and servo board. 2) Replace the main board or servo board.
E0140	MSPR does not work	The MSPR relay for precharging the capacitor did not work.	Refer to error repair manual
E0151	Improper step command	Robot can't work because of unprofiTable step information	Contact with out service department.
E0154	(0 gun)Tip consumption exceeded maximum.	Total tip consumption detected by gun search excess maximum tip consumption setted servo gun parameter.	1) Check maximum tip consumption at servo gun parameter 2) Replace electrodes.
E0155	(0 gun) Move-tip consumption exceeded max	Maximum abrasion of the moving electrode which was set in servo gun parameter setting was excessed by gun search.	1) Check up maximum abrasion of the moving electrode which was set in servo gun parameter setting 2) Replace electrodes.
E0156	(0 gun) Fix-tip consumption exceeded max	Wear of static electrode detected by gun search exceeded the wear of maximum mobile electrode to be set at servo gun parameter.	1) Check up maximum abrasion of the fixed electrode which was set in servo gun parameter setting 2) Replace electrodes.
E0157	Too large skew error	This error occurs in the synchronizing 2 axes function of gantry robots. Torsion angle to traveling axis	Adjust torsion parameter of the synchronizing 2 axes function of servo parameter.

Code	Message	Cause	Remedy
		was larger then set parameter of the synchronizing 2 axes function	
E0158	Skew error compensation Timeout	This error occurs in the synchronizing 2 axes function of gantry robots. Returning torsion angle to traveling axis exceeded set 5 seconds after motor on.	1) Put out obstacles of the moving way 2) Check up encoder powers and lines 3) Replace motors
E0159	(0 axis) exceeding limit value of axis speed	Angular velocity of an axis is high on interpolation operation of this position	1) Decrease the speed on this step. 2) Adjust the position made this error
E0160	(0 axis) collision detect	Disturbance torque is over excessed collision detection level	1) If collision is occurred, remove the problems 2) Adjust collision detection level
E0161	(0 axis) shock detect	Disturbance torque ratio is over excessed collision detection level	1) If collision is occured, remove the problems 2) Adjust collision detection level
E0162	(0 axis) current sensor error	In the drive unit, large current feedback offset is detected	1) Check +/-15V voltage in the SMPS 2) Change the servo board 3) Change the drive unit
E0163	Axis drifted during power saving	In power saving mode it happens that the brake is slipped.	Replace system I/O board
E0164	Dynamic brake error	An error happened to dynamic brake of AMP.	1) Please check CNBS cable linked to AMP at servo board. 2) Please replace AMP.
E0165	(0 axis) impossible to maintain servo lock	Current supply to motor is impossible.	Refer to error repair manual
E0170	MotStopWait(5Sec) TimeOut	To decrease speed and stop on working exceed 5 seconds after stop signal input	Decrease sum of times within 5 seconds after converting acceleration time and reduction ratio of acceleration and deceleration parameter into time Refer to acceleration and deceleration parameter of operation manual

Code	Message	Cause	Remedy
E0171	Gun open time is over	Opening time was exceeded 5 seconds after pressurization of spot welding or gun-search function.	Check the Gun was welded to the object or interference to the gun occurred.
E0172	Improper Endless rotation	Difference the encoder value of endless axis which was backuped from the encoder value of initializing read out exceeds 0X20000 in hex decimal	1) Compensate the encoder offset value of endless axis again. 2) Reset the encoder offset value of endless axis and compensate it.
E0173	Endless rotation overflow	The encoder value of endless axis to record exceeded max. encoder value	Execute R350 code to reset the recorded endless position manually, adjust the position.
E0174	1st servo CPU initialize error	Initialization response of DSP1 in first board was not received	1) Check up insertion the servo board. 2) Examine if the DS1, DS2, S1 switch of servo Board is working 3) Replace the servo board
E0175	2nd servo CPU initialize error	Initialization response of DSP2 in first board was not received	1) Check up insertion the servo board. 2) Examine if the DS1, DS2, S1 switch of servo board is working 3) Replace the servo board
E0176	3rd servo CPU initialize error	Initialization response of DSP1 in second board was not received	1) Check up insertion the servo board. 2) Examine if the DS1, DS2, S1 switch of servo board is working 3) Replace the servo board
E0177	4th servo CPU initialize error	Initialization response of DSP2 in second board was not received	1) Check up insertion the servo board. 2) Examine if the DS1, DS2, S1 switch of servo board is working 3) Replace the servo board
E0178	Incorrect 1st servo CPU version	The ROM version of DSP1 in first board is so low that set robot can't use.	Contact with out service department.
E0179	Incorrect 2nd servo CPU version	The ROM version of DSP2 in first board is so low that set robot can't use.	Contact with out service department.
E0180	Incorrect 3rd servo CPU version	The ROM version of DSP1 in second servo board is so low	Contact with out service department.

Code	Message	Cause	Remedy
		that set robot can't use.	
E0181	Incorrect 4th servo CPU version	The ROM version of DSP2 in second servo board is so low that set robot can't use.	Contact with out service department.
E0182	1st servo CPU communication error	Communication between main CPU board and the DSP1 of the first servo board was not work.	1) Check up insertion the servo board. 2) Replace the servo board
E0183	2nd servo CPU communication error	Communication between main CPU board and the DSP2 of the first servo board was not work.	1) Check up insertion the servo board. 2) Replace the servo board
E0184	3rd servo CPU communication error	Communication between main CPU board and the DSP1 of the second servo board was not work.	1) Check up insertion the servo board. 2) Replace the servo board
E0185	4th servo CPU communication error	Communication between main CPU board and the DSP2 of the second servo board was not work.	1) Check up insertion the servo 2) Replace the servo board.
E0186	1st servo CPU found main CPU error	Watch dog error of main board was detected in the DSP1 of the first servo board.	1) Please check and decrease PLC execution time. Contact with our service department. 2) Check up insertion the main or servo board. 3) Replace the main board or servo board
E0187	2nd servo CPU found main CPU error	Watch dog error of main board was detected in the DSP2 of the first servo board.	1) Please check and decrease PLC execution time. Contact with our service department. 2) Check up insertion the main or servo board. 3) Replace the main board or servo board
E0188	3rd servo CPU found main CPU error	Watch dog error of main board was detected in the DSP2 of the second servo board.	1) Please check and decrease PLC execution time. Contact with our service department. 2) Check up insertion the main or servo board. 3) Replace the main board or servo board

Code	Message	Cause	Remedy
E0189	4th servo CPU found main CPU error	Watch dog error of main board was detected in the DSP2 of the second servo board.	1) Please check and decrease PLC execution time. Contact with our service department. 2) Check up insertion the main or servo board. 3) Replace the main board or servo board
E0190	(0 axis) Improper encoder reception	Unexpected error was occupied from the servo board in receiving initial values of the absolute encoder.	1) Please check and decrease PLC execution time. Contact with our service department. 2) Check up insertion the main or servo board. 3) Replace the main board or servo board.
E0191	Not defined servo error found	Unexpected error was occulted from the servo board on working.	1) Please check and decrease PLC execution time. Contact with our service department. 2) Check up insertion the main or servo board. 3) Replace the main board or servo board.
E0192	AUX amp number error	The drive number of auxiliary axis has assigned as same number	Check up the number of BD, DSP, AXIS of auxiliary parameter set up assigned as same number
E0193	(0 axis) Improper Encoder for Endless	The number of pulses a rotation from the endless encoder was wrong.	Check up the number of pulses on the menu, SERVO PARAMETER/ MOTORS, ENCODERS as 1024,2048,4096 or 8192
E0194	Load weight is too heavy	Load weight is over 120% of normal capacitance	1) Check the weight value in the tool data 2) Reduce tool load weight
E0195	Sync Axes must use only 1 DSP	In order to control the sync axes you should conFigure the system as only 1 DSP controls both of sync axes	Change the system configuration so that only 1 DSP controls both of sync axes. If under 5 axes robot is used, 1 DSP in BD440 servo board can handle 2auxiliay axes. but over 6 axes robot is used, 1 DSP in BD440 servo board can't handle them, so you should use extra BD440 servo board.

Code	Message	Cause	Remedy
E0200	(0 axis) Speed over while cooperating	Command exceeds own axis speed while cooperative following.	Change Orientation of the Slave at a reference position of COWORK or modify recorded speed slowly
E0201	Cooperative Start time mismatch	Read of Sync. communication signal is wrong among cooperative robots, or running mode is not same each other.	Check communication status. check the running mode. adjust the mode status of robots in same, and run.
E0203	Partner robot is in emergency	Partner robots is stopped by motors off. My robot also is stopped by motors off	Check the status of partner robot. and fix the cause of error.
E0204	Rbt#0 Communication is not working	Communication connection is lost with corresponding robot.	Check connection of line and LAN card. HiNet check can find the unusual part of HiNet.
E0205	HiNet is not working	HiNet for cooperative control is not working.	Check connection of line and LAN card. you can find the unusual part of HiNet as using HiNet Check
E0210	Fail of Init. of SVG Connection	Fail of SVG connecting initialization is occurred.	Check the DSP version over 4.13 Check ATC connecting status and encoder power is inputted
E0211	Servo-gun / Servo ON / Time limit exceeded	Servo of servo-gun was not turned ON within the time limit.	
E0212	SVG's Servo filter clear is failed	Clear of SVG Filter is failed while trying to connect SVG axis	Communication between Main board and Servo board is bad. Check the connecting status, or another try after changing board(servo, main)
E0213	SVG Servo Off fail in time limit	Servo off is failed within limit time, while SVG disconnecting process	Check if ATC is connect well. Or another try after changing servo board.
E0214	SVG Encoder power is not connected	Failure of encoder power on is occurred as SVG connecting.	Examine error on Servo gun encoder's power control system and replace if necessary
E0215	SVG Encoder power off is failed	Failure of encoder power off is occurred as SVG disconnecting.	Examine error on Servo gun encoder's power control system and replace if

Code	Message	Cause	Remedy
			necessary
E0216	SVG Encoder data error	Encoder receiving result of the SVG axis is abnormal while trying to connect.	Check if battery is useless, and do another try after encoder try after encoder reset. and then encoder offset should be re-adjusted.
E0217	Error on speed increasing and decreasing parameter of motive axis	Motive control can be possible only if maximum speed, accelerating time and speed deceasing rate of 2 motive axes are same, however, the parameter is set by different value.	Please set speed increasing and decreasing parameter of motive axis to be same by checking speed increasing and decreasing parameter of robot parameter.
E0218	(0 axis) is overload.	Overload of the Axis is detected. Current has lasted over rated current to harm the motor of axis.	Check if rated current is set correctly, and check servo gun mechanism. Don't take a pressurization over rated current for a long time.
E0219	Couldn't execute SMOV W/O SELSTN	You could not execute positioner sync. command(SMOV) without selecting station in a SELSTN command	Chose the station # you want to sync. Correctly or Change the number of station of SMOV command to the same # in a SELSTN command.
E0220	(0 axis) Encoder noise	Robot current position is not the same as encoder data. There is noise in encoder pulse.	Check encoder voltage, connection of lines and frame grounds at controller and robot.
E0221	(0 axis) failed to receive encoder	It is failed to receive absolute encoder data to check if there is encoder noise.	Check encoder voltage, connection of lines and frame grounds at controller and robot.
E0222	Coincident entrance to same cube	Robot's TCP enter the cube area on which other robot is working. You can't playback in status of deadlock.	Turn to manual mode, and jog the robot to cube outside. And you can modify the robot program which can be run without deadlock status.
E0223	(0 axis) encoder line cut or comm. err	It is failed to receive absolute encoder data from serial encoder.	1)Examine encoder voltage, connection status of cable, controller, contact status of Robot 2) Refer to error repair manual

Code	Message	Cause	Remedy
E0224	(0 axis) encoder status error occurred	Error status is received from encoder such as overflow, overspeed, inner capacitor voltage drop, LED fail.	1)If an error persists after error reset function is executed(from encoder reset function), replace the encoder(motor) 2) Refer to error repair manual
E0225	(0 axis) Softlimit exceed encoder limit	The current softlimit range of the axis exceeds the range which can be used by encoder.	In case that machine integer file is loaded on controller newly, please make initialization in accordance with the order of encoder offset calibration, axis integer setting and soft limit setting after encoder reset of the corresponding axis. If not, please set at an appropriate position by checking the limit.
E0226	(0 axis) exceed encoder limit	Robot axis can't reach the position which exceed the limit of encoder usable range.	Turn to the manual mode, and jog the axis to internal direction with system setting mode. If the limit is short abnormally, you should initialize the encoder.
E0227	Seq. error of Cooperative control	Commands sequence between the master and the slave make a difference while cooperative robot control.	Check the network connection for cooperative robot control. And check whether the slave is doing power saving. The function should be disabled at the slave side.
E0228	Step target is out of range	Current step or next step target is out of range.	Find the error step by step go process. Check the all shift registers. And change the step target position.
E0229	(0 axis) encoder overheated	Encoder room temperature is increased to limit level.	Check the motor temperature and change the robot speed.
E0230	Encoder status error on connecting	Error status is received from encoder such as overflow, overspeed, inner capacitor voltage drop, LED fail on the connecting servo gun	Reset the encoder in encoder reset menu after connecting the encoder power with R359. If it is still in error state, the encoder(motor) should be changed

Code	Message	Cause	Remedy
E0231	Encoder comm. error on connecting	It is failed to receive absolute encoder data from serial encoder on the connecting servo gun.	Check encoder voltage, connection of lines and frame grounds at controller and robot.
E0232	(0 axis) Change encoder battery & reset	Because encoder battery may be disconnected or voltage drop, the encoder alarm is occured.	Check encoder battery voltage, connection cables, and change the battery and reset the encoder.
E0233	Step target position is interpreted into the collision position.	Step target position is interpreted into the collision position.	Change step position. It is required to program the step to be capable of avoiding collision in cases where the step is programmed for calculation.
E0234	0axis) Exceeding average speed limitation value	The robot is being operated while exceeding average speed limitations.	If the robot is operated while exceeding average speeds set in each axis of the robot, the life of the robot may decline rapidly. Low operating robot speeds must be secured.
E0235	Re-Start failed. Cautions on locus when restart	Restarting after controls such as backward step and stop	Be cautious as the newly calculated locus may be different from the precious one. In order to maintain a same route, please re-start the program from first step.
E0236	Motion planning failed	Robot is immobilized as motion planning has failed	Please contac to the labrotary. Please change the speed or location of steps as temporary solution

6.4.2. Operation Error

Code	Message	Cause	Remedy
E1001	Program not found	The program to execute was not exist.	Check if the program exists.
E1002	Step not found	You selected the step number was bigger than the total number of all steps.	Check the step number and select
E1003	Too many files(It's more than 703)	Total file number is limited by 703	Delete unnecessary files and make it.
E1004	The number of axis not match	Number of axes of the selected program was different with the number of the robot.	You select the program of other robot. Check it.
E1005	Main body of program and machine integer is different.	The selected program is different from the robot type registered at machine integer.	You seem to select different type of robot. Please check.
E1006	Memory full	The capacity of file memory is deficient.	Delete unnecessary files and make it.
E1007	Brake slipped!(Excess of 50mm)	It happens when the slippage of a brake by pressing during stud welding is over 50mm.	1) Check up the pressure. 2) Check up the slippage of the motor of every axis and change the motor with which slippage is bigger than any others'
E1008	Excessive brake slip count!	Number of brake slip excess by compression of stud welding exceeded detecting number of installed deviation error.	1) Check up the pressure. 2) Check up the slippage of the motor of every axis and change the motor with which slippage is bigger than any others'
E1009	Simultaneous file access confined	You can not copy same file, external → internal and internal → external, simultaneously. (RS-232C, Ethernet, SRAM card)	Wait a while until other people's copying is completed. And try again.
E1010	More teach points required	Insufficient recoded steps to tune conveyer angle automatically or to define user coordinate.	1) To tune linear conveyer angle automatically need 2 steps 2) To tune circular conveyer angle automatically need 3 steps

Code	Message	Cause	Remedy
			3) To define user coordinate need 3 steps
E1011	Points too close to one another	Recoded position is so close that calculation is impossible to tune conveyer angle automatically	Try to record positions as possible as wide
E1012	Recorded points are linear	3 steps to define user coordinate are in a line so calculation is impossible.	Refer to operation manual, locate 3 steps in a plane except 3 steps in a line.
E1013	Function not found	The selected function was not exist	Check the function number of the step.
E1014	Failed in allocating file handle	More than 4 copying operating is tried via several channel. (RS-232C, Ethernet, SRAM card)	Wait a while until other people's copying is completed. And try again
E1015	Protected program can not be edited.	Protected program can not be edited by step unit.	Please execute it after releasing the protection of the file.
E1016	Can't modify (No parameters)	You tried to edit the function of no modifiable parameter.	Check the function to edit.
E1017	No contents	You tried to delete or edit unmade program.	Check the selected program.
E1018	Program has no step data	Selected step is not exist.	Check the step number.
E1021	Unassigned weld condition signal	Number of welding condition output was bigger than the assigned number	Check assigned welding condition signals in System/ Control parameter/ I/O signal
E1023	Checksum error at the step	Check Sum of the taught step was changed.	Delete the selected step and add it.
E1024	Palletizing program changed	You changed the program in palletizing and tried to operate again	Initialize the palletizing counter and set again.
E1026	More steps than 4 are needed	Min.4 recoded steps need to estimate auto setup constants	Make 6 steps at least to estimate auto setup constants and try to make variety position
E1027	Program damaged.	Recoded auto step constants are broken because of failure	Initialize the memory by assistant of A/S member in

Code	Message	Cause	Remedy
		of the back up battery.	HHI.
E1028	It is not the same tool	The number of tool to estimate auto setup constants is different from the number of estimated tool	Consist tool number.
E1029	Robot type not applicable	Estimation of auto set up constants is do on only 6 axes manipulator.	1) Check up robot type on SERVICE / SYSTEM CHECKING/ SYSTEM VERSION/ ROBOT TYPE 2) Input measured constants.
E1030	Additional axes not applicable	Auxiliary axes should not move to estimate auto set up constants	Record positions only to move main 6 axes.
E1031	Pose data not good	Processing auto set up constants is not possible because steps are similar to each other.	Let robot pose different, teach hand axes to pose as differently as possible above all.
E1032	Axis Const out of soft limit	Compensation values of processing auto set up constants is so big that operating robot make a danger.	1) Check selected robot be correct. 2) Move to reference position to calibrate encoders, initialize axes parameters, try to process auto setup constants. 3) Make steps again to minimize position error between steps and try it again.
E1033	Error on automatic integer setting	The calculation for automatic integer setting is wrong.	Please make an inquiry to HHI.
E1034	Collision sensor on	Collision happened.	1) Check if the shape of the tool is ok. 2) Get the robot started again if there is no cause of the error more. 3) If collision was happed, check up collision signal logic in System/users.
E1035	Works over permitted No. entered	If conveyer parameter in SYSTEM/ APPLICATION PARAMETER/ CONVEYER is set to APPROACH OBJECTS = PERMISSION, robot approach objects is	Stop the system, clear process, run again.

Code	Message	Cause	Remedy
		permitted in conveyer synchronized operation. sum of approached objects is more then 10	
E1036	Welding wait time is over	Welding completion signal is not inputted within waiting time of WI in SYSTEM/ APPLICATION PARAMETER/ SPOT&STUD/ DATA FOR SERVO GUN WELDDING (CONDITION, SEQUENCE) / WELDING SEQUENCE in welding by servo gun	1) Check up circuit diagram in FLOW SIGNAL/ WELDING CONDITION SIGNAL/ COMPLETION SIGNAL OF WELDING and surrounding equipments. 2) Refer to SYSTEM/ APPLICATION PARAMETER/ SPOT&STUD/ DATA FOR SERVO GUN WELDDING (CONDITION,SEQUENCE)/ COMMON DATA whether wait for welding completion signal(WI) or stop the robot when error occurs
E1038	Can't record tip consump. position	Robot position was not posed to compensate the length of abraded electrode to record the position to compensate the length of abraded electrode.	Arrange robot position of length compensating of abraded electrode not to break away operation region.
E1039	Tolerance of sync. exceeded range	In operation of synchronized 2axes torsion angle to traveling two axes was larger then set parameter of the synchronizing 2 axes function	1) Set the same gain to each axis. 2) Increase Kp gain of delayed axis.
E1040	In this robot type can't provide	Robot of synchronized traveling 2 axes can not use interpolation(linear, circular).	Edit interpolation off on the step, run the robot.
E1041	Axes over at this positioner Group	Number of axes in positioner group exceeds 2	Set the value equal or less then 2 on the group in SYSTEM/ INITIALIZATION/ POSITIONER GROUP
E1042	Not support REFP step for calibr.	Reference point(REFP) was not recorded in the calibration program for the positioner	Record reference point(REFP) in the step for calibration program
E1043	Cannot calculated : Modify Steps	Floating point calculation error occurs in calibration processing.	1) Edit recorded steps for calibration program. 2) Tilt the direction between points by more then 30

Code	Message	Cause	Remedy
			degree to calibrate exactly.
E1044	Can't motor ON without Enc. Compen	No calibrate encoder offsets after selection of the robot type in SYSTEM/ INITIALIZE, not to try MOTOR ON.	Calibrate encoder offsets after selection of the robot type in SYSTEM/ INITIALIZE and try to operate MOTOR ON.
E1045	Not input freq/palletize count	When setting frequency or palletize count to external signal after selected register doesn't input setting count before 800ms.	Input count number to external signal after selected register before 800ms.
E1046	Gun is opening by external signal	During the servo gun moving by external signal, the auto-run signal was inputted.	After the servo gun moving is over, operate the auto-run.
E1047	FIFO Registers number is over 20	Program tries to register over 20EA from the state of FIFO function's (1)application at system/ user parameter menu.	Check reserved program count at service/ register/ FIFO register.
E1048	Welding gun connection number selection signal is abnormal	When spot gun manual/ auto connect for external input signal, the value of gun no has an error.	Check external input signal for Gun connection no.
E1049	Welding gun already connected	Impossible to execute because reconnection(GUNCHNG ON or manual connection) is attempted while welding gun is already connected to the system	Check spot gun connection stats.
E1050	Welding gun already separated	Manual separation (GUNCHNG ON or manual connection) is attempted while welding gun is already separated to the system	Check gun connection status.
E1051	Inappropriate change circumstance for spot gun.	It is a case that CUNCHNG command or manual gun connection or disconnection was performed at no spot gun changing conditions.	Please reinstall the controller into spot gun changing conditions.
E1052	Gun change time by manual is over	After gun connection on/off was manually execute, within 5 second this function doesn't complete.	Contact the Robot A/S team.

Code	Message	Cause	Remedy
E1053	The measured thickness is minus.	Panel thickness = in case that negative vale comes out from the calculation ; (axis integer poison – servo gun current position – worn quantity)	Please check axis integer installation or worn quantity value.
E1054	The thickness isn't been setting.	It happens if panel thickness is not set when welding position is recorded by opening servo gun.	Please install “panel thickness” at the menu of the spot welding conditions.
E1055	The panel thickness exceeded range	It happened when it is bigger than “maximum allowable thickness of panel” of servo parameter menu.	Please change “maximum allowable thickness of panel” at servo parameter menu.
E1101	(0 axis) Soft limit	It is a case that each axes encoder data of robot has arrived at installed soft limit on teaching or automatic operation.	Please move the robot within the installed range.
E1102	Motor on under axis operation!	MOTOR can't be turned on under axis operation	Don't hold the key of AXIS OPERATION in the operation of MOTOR ON
E1105	Step for jump not found	Number of steps to run Is bigger than the total number of all steps	Check the final step number of the program.
E1106	Function for jump not found	Number of functions to run is bigger than the total number of all functions.	Check the final function number of the program.
E1107	Shelter step not found	Step to shelter in timer condition function, etc. doesn't exist.	Check the number of the step to shelter.
E1108	Jumping to shelter step occurred	Condition is improper in conditional function execution.	Check the received data status of the program.
E1109	Interpolation impossible	Interpolation was tried in pose where the interpolation was impossible.	Change the pose by single axis movement and operate.
E1110	Out of workspace!	You tried to move tool-end to the position where it can't reach.	Check whether the work piece and the robot was located properly.
E1111	Too large angle between arms	The 1st Arm and 2nd Arm got into interference state.	Operate the robot to avoid interference.

Code	Message	Cause	Remedy
E1112	Too small angle between arms	The 1st Arm and 2nd Arm got into interference state.	Operate the robot to avoid interference.
E1113	Step for jump not found	There is no target step for step-jump function at playback.	Check the parameter of the made program.
E1114	Step for call not found	There is no target step for step-call function at playback.	Check the parameter of the made program.
E1115	Too many step-calls without return	Step-call was executed than 9 times without return.	Don't execute step-call than 9 times without return.
E1116	Can't return without step-call	Return exists without step call.	Use step-return and step-return together.
E1117	Can't return to another program!	The number of the program to step-return is different from the number of the program in executing.	Check whether step-call exists before step-return in the
E1118	Step for return not found	There is no target step of step-return function at playback.	Check the parameter of the made program.
E1119	Program for jump not found	There is no target program of program-jump function at playback	Check whether the program exists and the parameter of the made program.
E1120	The number of axes mismatch: Jump	The axes number of the program in program-jump function is different from the axes number of the robot.	Check the program to jump for.
E1121	Program for call not found	There is no target program of program-call function at playback	Check whether the program exists and the parameter of the made program.
E1122	The number of axes mismatch: Call	The axes number of the program in program-call function is different from the axes number of the robot.	Check the program to call.
E1123	Too many Prog-calls without return	Program-call is executed than 9 times without return.	Don't execute step-call than 9 times without return.
E1124	Program for return not found	There is no target program of program-return function when playback.	Check whether the program exists and the parameter of the made program.
E1125	The number of axes mismatch: Return	Axes number of the target program in program-return	Check whether the program exists and the parameter of

Code	Message	Cause	Remedy
		function was different from the axes number of the robot.	the made program.
E1126	A pose unable to take Cir-Interpol	Steps are too close or linear to make a Cir-Interpolation	Modify the recorded position of step.
E1127	Undefined Playback Error.		
E1128	Unusable output(DO) signal	You specified Signal which can't be output in playback, this error occurs.	Check the number for the output signal.
E1129	Undefined speed unit	You tried to playback with other unit except for [%] and mm/sec.	Check the condition of the present step.
E1130	END step not found	You tried to playback the program of no END step.	Check the parameter of the made program.
E1133	InexecuTable function	You designated inexecuTable function in playback.	Check the parameter of the made program.
E1135	End relay output error	END Relay Time exceeds 15 sec. Usually, because the END Relay Time is less than 10 sec in Constant Setting Mode, this error doesn't occur.	Constant Parameter is abnormal. Check the constant file.
E1136	Recovery protected program	1) It is impossible to playback from step 0. 2) It is impossible to execute step go/back.	Please perfom after releasing automatic operation protection ot the program.
E1139	Improper GI signal No	Number of Timer Conditional IB signal is wrong.	Check the parameter of the made program and change it.
E1140	Improper port number	A port for T/P was set in Shift Data Request Function.	Set port designation as general in Shift Data Request Function.
E1141	Improper use of serial port #1	Use of serial port(RS232C) was wrong.	Check the use for port in SYSTEM/ CONTROL PARAMETER in Condition Setting.
E1142	Repeated requests for shift data	Shift Data Request Function was executed again, before Shift Data was input, in	1) Check whether Shift Data Function is used delicately. 2) Check the connection for

HYUNDAI
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Code	Message	Cause	Remedy
		executing the function.	the external sensor.
E1143	Function M88 needed	You executed function-jump function without completion function in playing back.	Check the parameter of the made program.
E1144	Function M86 or M87 needed	You executed completion function without function-jump function in playing back.	Check the parameter of the function jump.
E1145	Out of range for function jump	Jumping range exceeds the calculated value.	Check the parameter of the made program and change it.
E1146	Use function M78 only 4 times	There are palletizing functions more than 5 in the program to be executed.	Reduce the number of palletizing function used.
E1147	Palletize start was not executed	There is END only without palletize start.	Check the contents of the made program.
E1148	Palletizing already executed	There is palletize start in executing palletizing functions.	Check the contents of the made program.
E1149	Start after palletizing stopped	You selected other program in executing palletizing functions and start from step 0.	Reset the palletizing function and start.
E1150	Can't use during palletizing	P reset was executed in executing palletizing functions.	End the palletizing function and execute.
E1151	Function for jump not found	There is no function number to jump in executing palletizing functions.	Check the parameter of the made program and change it.
E1152	Check search function M59(on/off)	Search On and Off are not accorded.	Check the parameter of the made program and change it.
E1153	Set search reference Pt. record on	When executed search function without setting standard position for search.	Set search reference position data record to 'on' in condition setting, and record in 1-Cycle Playback, execute.
E1154	Only in the 1 cycle at AUTO mode	You can record standard position data for search in 1 Cycle at AUTO Mode. Excepting for this case, error	Set AUTO Mode to 1-Cycle, and execute.

Code	Message	Cause	Remedy
		occurs.	
E1155	Out of the search range	Robot Interrupt doesn't occur despite search range exceeds setting value.	Check the searching object and search range setting of condition setting.
E1156	3 points are on the same line	Transformation calculation can't be made because 3 taught points are on the same line in the coordinate transfer function.	Check the teaching points.
E1157	No data in the shift register	In On-line Shift or On-line Coordinate Transformation Function, if the function is executed even when data are not input through RS232C port, this error occurs.	Modify the program to input data through RS232C before On-line Shift or On-line Coordinate Transformation.
E1158	Transfer reference step not found	There is no standard step number in Coordinate Transformation Function.	Check the parameter for the Coordinates Transformation in the program.
E1159	Can't take transferred pose	Transferred pose is out of Robot's Reach.	Modify the recorded position of step.
E1161	Interpolation impossible	Interpolation was executed in pose that interpolation is impossible.	Change the pose of robot and teach.
E1162	Three points too close	Transformation calculation can't be made because 3 taught points are too close each other in the coordinate transfer function.	Check the teaching points.
E1163	Shift makes robot leave workspace	Shift position is out of work range.	Check the shift amount and working procedure.
E1164	Improper coordinate frame:XYZshift	Setting of the standard coordinate system was not corrective in XYZ shift function.	Check the parameter for the XYZ shift function in the program.
E1165	Improper coordinate frame :Search	Setting of the standard coordinate system was not corrective in search function.	Check the parameter for the search function in the program.
E1166	Improper coordinate frame :Pallet	Setting of the standard coordinate system is not corrective in palletizing	Check the parameter for the palletize function in the program.

Code	Message	Cause	Remedy
		function.	
E1167	Search target is out of workspace	Search range got out of work range.	Reduce search range in condition setting.
E1168	Search available in linear INPLTN	Step where search function is to be executed is not in 'Interpolation On'.	Modify the step as Interpolation On.
E1169	Playback errors in fetching steps	Error in step data which were fetched to execute a program.	Delete the step and make the step again.
E1171	Transfer makes robot leave WRKSPC	In transformation of the coordinate between on-line and off-line transfomated data was out of robot operation space.	Change the robot pose, robot installation or location of the work piece and try it again.
E1189	Not inputs WCR at arc start	Fail to generate arc at start point.(The number of retrial was exceeded)	Check the power supply to the welder system.
E1192	Arc sensing error([A] range over)	The welding current is out of the abnormal margin for the abnormal time.	1) Check the feedback circuit of welding current. 2) If the work end, set the abnormal processisng method=<END>. 3) Other case, adjust the margin/t
E1193	Arc sens'g error(Too unsTable [A])	While the arc sensing function with the curve fitting algorithm, this is out of the Allowed error weav'g cycle because of unsTable welding current.	1) Check the feedback circuit of welding current. 2) Adjust the coef. curve to small 3) When you use bead detecting function, plase install as “bead detecting exisitence = valid”.
E1194	Arc sens'g error(Side range over)	The side tracking range over.	Adjust the side coef. of Ampere or/and the max. Distance limit.
E1195	Arc sens'g error(Height range ov.)	The height tracking range over.	Adjust the height coef. of ampere or/and the max. distance limit.
E1196	Shift limit over	Shift level exceeded the installed shift limit value.	Decrease shift length or reassign shift limit.

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E1197	Invalid step for Cir-Interpolation	2 steps at least are required for completing circular interpolation	Add step(s) for circular move.
E1198	Not exist approach step	Cannot execute a weaving motion without approach step or 'REFP 2'	Add approach step or 'REFP 2'.
E1199	Read error of current step	Fails in motion planning during the retry or restart function.	Add step(s) before the step including 'ARCON' function.
E1200	Read error of preview step	Fails in motion planning during the retry or restart function.	Add step(s) before the step including 'ARCON' function.
E1202	Syntax error	It is general syntax error.	Check the syntax.
E1203	Length of identifier exceeded	An identifier's length is longer then 8 characters.	Decrease the identifier's length to be equal or fewer then 8 characters.
E1204	The number of element fault	The number of elements in pose constant or shift constant is not matched with setting.	1) Check the number of elements of pose constants or shift constants. 2) In case of pose, it should include the additive axes. 3) Shift constant is the sum of basic axes number and additional axes number. 4) Pose constant is the sum of basic axes number, additional axes number and one(config).
E1205	Misusage of Parenthesis	In arithmetic expression, function, or pose/shift constant, there is no parenthesis at its required position.	Check whether the parenthesis is used properly.
E1206	Misusage of type postposition	An postposition of V variable has been used badly.	Use '%', '!', or '$' as postposition.
E1207	'[' missed	In variable, there is no index or '['.	Check whether the index is missed, or '[' and ']' is paired properly in variable.
E1208	'[' missed	In variable, there is no index or '['.	Check whether the index is missed, or '[' and ']' is paired properly in variable.

Code	Message	Cause	Remedy
E1209	Index exceeded its range	An index value exceeds its limit.	Make the index doesn't exceeds the variable type's index limit.
E1210	Misusage of index	The syntax of a constant or expression used as variable index is wrong.	Check the syntax of variable index.
E1211	Must be separated by space	Commend and parameter was sticked	Separate command and parameter with a space.
E1212	Shift operating fault	Syntax of shift calculation was wrong or shift parameter was not described properly.	Check syntax of shift calculation or shift parameter.
E1213	Interpolation parameter fault	The syntax of a interpolation in move statement is wrong.	Use 'P', 'L', or 'C' as interpolation.
E1214	',' missed	',' was missed in command statement or function statement.	Check the separation with ',' properly.
E1215	Pose expression fault	In MOVE statement, the pose expression is not proper.	Check the pose statement syntax. In case of hidden-pose MOVE, check the syntax of speed.
E1216	Speed parameter fault	In MOVE statement, speed is not proper.	Check the syntax of speed. S={Speed}
E1217	'=' missed	There is no '=' at its required position.	Check whether a '=' is used properly in assignment or statements.
E1218	Unit fault	In MOVE statement, the syntax of speed unit is wrong.	Use 'cm/min', 'mm/sec', 'sec', or '%' as speed unit. It must be small letters.
E1219	Accuracy parameter fault	In MOVE statement, the syntax of accuracy is wrong.	Check the syntax of accuracy. A={0-3}
E1220	Tool no. parameter fault	In MOVE statement, the syntax of tool is wrong.	Check the syntax of tool. T={0-3}
E1221	Too many output options	In MOVE statement, there is more than 5 output options(MX,MX2,G1,G2,BM).	Make output options don't be duplicated.
E1222	Value exceeded its range	In certain statement, some parameter values exceed their limit.	Make parameter values don't exceed their limit.

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E1223	Input/Output direction fault	Output direction of PRINT, or input direction of INPUT is wrong	Use '#0', '#1' or '#2' as input/output direction.
E1224	Step number exceeded its range	Step no. value exceeds its limit.	Use the value of 0 - 999 as step no.
E1225	Line number exceeded its range	Line no. value exceeds its limit.	Use the value of 1-9999 as line no.
E1226	Address parameter fault	The syntax of address is wrong, or it's attempted to branch to an address not existed.	Check the syntax of address, and whether the address actually exist.
E1227	Failed in getting hidden pose	Because of broken working file, it was failed to get hidden pose of the step.	Delete the step, record new step.
E1228	Incorrect element	An incorrect pose element or shift element is used.	Check the syntax of pose element or shift element.(refer to the operational manual.)
E1229	String fault	The syntax of string constant is wrong.	Check the syntax of string constant.
E1230	Program number parameter fault	The syntax of program no. is wrong.	Check the syntax of program no. Program no. must be a constant, not variable or arithmetic expression.
E1231	Voltage parameter fault	The syntax of voltage parameter value is wrong, or the value exceeds its limit.	Check the syntax of voltage parameter value, and the value is within its limit.
E1232	Current parameter fault	The syntax of current parameter value is wrong, or the value exceeds its limit.	Check the syntax of current parameter value, and the value is within its limit.
E1233	Time parameter fault	The syntax of time parameter value is wrong, or the value exceeds its limit.	Check the syntax of time parameter value, and the value is within its limit.
E1234	File parameter fault	The syntax of file no. parameter value is wrong, or the value exceeds its limit.	Check the syntax of file no. parameter value, and the value is within its limit.
E1235	Divided by zero	Divided by zero in arithmetic expression.	Make the result of expression used as divisor don't be zero in any case.

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E1236	Mathematical Error	Fault occurred in arithmetic calculation.	Check whether the expression is valid form. Infinity value shouldn't occurred.
E1237	Checksum Error	Checksum of the encoder value of the step was wrong.	Deleted the step and record a step.
E1238	Job header fault	The string syntax of working header was wrong.	Refer to other working file, edit the string syntax of working header.
E1239	Job format version is different	Because of upper version file, loading would not execute.	Increase the version of the controller, revise the working file as present version.
E1240	Too many addresses	On GOTO statement, there are too many addresses.	Use address parameters not more 10ea.
E1241	Code number fault	In M code or I code statement, the code no. not existed is used.	Use valid code no.(refer to the operation manual.)
E1242	Assign. fault	Because the left side of substitute is read only variable, substitution was not possible.	Check the error in working file, use substitutional variables.
E1243	Fault of Jig number to sync	In SMOV statement. the syntax or the extend of the parameter of the jig number was wrong.	Use the parameter of jig number in 0 to 3 by SMOV statement syntax
E1244	There is no registered jig	Jig number was inputted without a registration of jig.	Execute jig registration first.
E1245	Block stack overflow	GOSUB - RETURN, IF - ENDIF, FOR - NEXT of robot language have too many blocks. or because of mismatched flow control GOSUB, IF, FOR executed repeatedly without RETURN, ENDIF, NEXT.	Reduce inner block number about GOSUB, IF and FOR. or repair the mismatched flow control.
E1246	Designation of coordinate system is wrong	Grammar designating coordinate system of integer for pose or shift is wrong.	Please find the wrong points on grammar, and correct them.
E1249	Fallacy of block Table	Error happened during execution of controlling sentence of robot language.	Please make an inquiry to HHI.

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E1250	Block containing structure is wrong.	Containing structure of flow controlling sentence such as IF/ELSEIF/ELSE/ENDIF, FOR/EXIT FOR/NEXT etc in robot language is wrong.	Please find out wrong commanding sentence order or containing structure among flow controlling sentences, and revised it in accordance with purpose.
E1252	Reading Un initialized variable value	Attempt to read a pose that has no value or shift variable	Please supply the JOB variable with valid value. Or place copy a pose/shift file that contains a valid value to main board
E1260	Invalid position move conditions	Fails in motion planning during the retry or restart function.	Welding segment and approach step must be interpolated, PTP move is not allowed.
E1261	Incorrect number of REFP	REFP number can get its value of 1 to 4.	Correct the REFP number.(Refer to the operational manual.)
E1262	Detected wire stick	Wire is sticked to the workpiece. or 'Auto Stick Recovery' has failed in repetition.	1) Check the welder power source. 2) Remove wire stick to the workpiece.
E1263	Cannot read WEAV CONDITIONS	Cannot find the weaving condition file.	Move the cursor to the WEAVON statement, press [Quick Open] to create the file.
E1264	Cannot read ARC START CONDITIONS	Cannot find the arc start condition file.	Move the cursor to the ARCON statement, press [Quick Open] to create the file.
E1265	Cannot read ARC END CONDITIONS	Cannot find the arc end condition file.	Move the cursor to the ARCOF statement, press [Quick Open] to create the file.
E1266	Cannot read ARC AUX CONDITIONS	Cannot find the arc end condition file.	Move the cursor to the ARCON or ARCOF statement, press [Quick-Open] to create the file.
E1267	Cannot read ARC START CONDITIONS	Cannot find the arc end condition file.	Move the cursor to the ARCON or ARCOF statement, press [Quick-Open]. Then press [PF2] 'Welder' to create the file.

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E1268	Incorrect reference pose(REFP 3)	In steady weaving reference point(REFP3) was not exist or in normal weaving it was occurred to coincide direction to reference point with the direction to the object point.	1) In case of steady weaving (1) Record REFP3 point. (2) There was not agreed between start step and object step(try to copy the step) 2) In case of normal weaving (1) Adjust the REFP3 position.
E1269	Incorrect reference pose(REFP 1)	Distance between welding path and REFP 1 is smaller than 0.1mm.	Change the position of REFP 1 to the proper one.
E1270	Wall and target pose are linear	Forward direction and wall point are linear. if wall point does not exist, z-axis is assumed.	Add REFP 1 or reposition it.
E1271	Incorrect reference pose(REFP 2)	Forward direction and approach step(or REFP 2) are linear.	Add REFP 2 or reposition the approach step.
E1272	Too small weaving width	Weaving pattern length is smaller than 0.1mm.	Enlarge the pattern length
E1273	Too small number of weaving seq.	Number of sequence is equal to or less than 1 in user-defined pattern.	Enter weaving sequence more than 2.
E1274	Out of restart number on weld line	Restart repeats more than given value.	1) Check the welder power source 2) Adjust the 'ARC OFF DETECT TIME' in welder conditions
E1275	An insufficiency of shield gas	Shield gas pressure is low.	1) Charge the shield gas 2) Set gas-off signal 0 to ignore the low pressure.
E1276	A shortage of weld wire	Welding wire is run short of.	1) Replace wire roll. 2) Set wire-off signal 0 to ignore the wire shortage.
E1277	Cannot overlap pose of cir-interp	Unable to plan an overlap motion on the circular welding path.	Increase overlap length or use the overlap prohibition option.
E1278	Cannot retry pose of cir-interp.	Unable to plan an retry motion on the circular welding path.	Do it again. if error occurs, increase retry distance or change operation mode in the welding time & condition file.

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E1280	Check VOL CONFIRM of conditions	If 'Power Supply' in welder condition has changed, 'Voltage Confirm' altered to 'NOT DONE'.	Confirm the output voltage in ASF or AEf. And then set 'Vol Confirm' 'DONE'.
E1281	Detected welder error signal	Welder error signal is detected.	1) Check welding power device. 2) To ignore the signal reset the signal in 'arc application'.
E1282	ARCOF ASF# command language is unusable on setting of analogue arc.	It happens when ARCOF ASF# command is used if arc setting is analogue.	Please change the command format of ARCOF into 'ARCOF AEF#=_' or 'ARCOF C=_,V=_' format.
E1283	Arc board is necessary for arc welding.	Option board was not installed. So, the arc welding does not support.	Please check whether arc board is loaded.
E1285	Improper use of serial port #2	the object of serial port in 'SYSTEM/CONTROL PARAMETER/SERIAL PORT' was not 'SENS'	Set the object of serial port in 'SYSTEM/CONTROL PARAMETER/SERIAL PORT'as'SENS' to use the serial port as sense.
E1286	Different from Power Control Mode	Voltage output mode was not correspond to voltage control mode in welder character file.	In individual power control mode voltage out was selected as 'voltage', in one source or pulse voltage output was selected as '%'
E1287	Undefined Station(PositionerGroup)	In execution of 'SMOV' no defined station was appointed.	Adjust selected station in 'SYSTEM/INITIALIZATION/POSITIONER GROUP CONFIGURATION'
E1288	Not executed Calibration of S(?)	In execution of 'SMOV' it was selected that the station was not calibrated.	Do the calibration of the station in 'SYSTEM/ AUTO CONSTANT SETUP/ POSITIONER CALIBRATION'
E1289	Detected Arc Off in arc welding.	When WCR signal was not inputted in set time, arc off signal was detected in arc welding. Arc off detection time was adjusted in welding character file.	1) Adjust time of WCR signal and arc off detection. 2) To ignore the signal, select the ignore in 'Aux. welding config. file/restart condition'
E1290	Don't detect the start point.	Don't detect the start point within the search range.	Adjust the search range in the tracking conditions, or modify the step's pose.

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E1291	No responding of LVS.	The laser vision sensor does not reply.	1) Check the serial port usage. 2) Check the laser vision sensor. 3) Check the communication cable.
E1292	Do modify search start length.	When search a start pose with the laser vision sensor, at start pose correct with conditions even if the robot doesn't move.	1) Modify the search range in condition. 2) Modify the step pose.
E1293	Error detect at Laser sensor.	The laser vision sensor sends a error number, refer to HISTORY frame.	Refer to the error number in HISTORY frame, and the sensor manuals. 1 : PC setup comms error - serial connection fault to PC 2 : Sensor camera fault - no video from the sensor head 3 : Sensor link fault - no comms to sensor head. Camera cable faulty? 4 : No sensor connection - no video or comms. Sensor not plugged in? 5 : Sensor at wrong temp - too hot or too cold 6 : Sensor power failing - 24v supply to sensor head out of range. Camera cable faulty? 7 : Lasers disabled - check the laser enable keyswitch, and the laser warning lamps 8 : No sensor calibration - sensor calibration data faulty. Try a different sensor head 9 : Seam out of range - no stripe in picture 10: Analysis could not see the seam. Hit data ok, but analysis failed, only in search 11: Not used in this interface 12: Seam has not been setup. Incorrect seam number? 13: No seam in image in tracking 14: Esc pressed in tools program while robot communicating with the sensor 15: Control unit memory

Code	Message	Cause	Remedy
			corrupt, reformat and reload memory from backup. 16: Reading system data fail 17: Error reading seam from FLASH memory - corrupted? 18: Error reading seam from FLASH memory - corrupted? 19: Fault in the analogue I/O circuitry(POST) 20: Error in video acquisition hardware 21: Error in the on board timer hardware 22: FLASH memory dead - needs replacing 23: Data FLASH memory full 24: FLASH memory bad sector - warning only 25: Error in the error log 26: Power to the I/O on the SAPEII board missing 27: ESTOP active - check the ESTOP link or connections 28: Within 5 degrees of the temperature limits
E1294	Cannot read LVS CONDITIONS.	Cannot read the laser vision sensor condition file, ROBOT.LVS.	Move cursor on the LVSON/ CHGLVS command and, press [Quick Open]. If not be solved, backup all file and execute the system format
E1295	Set Weav'g mode=single for Track'g	When the mode of weaving condition is not the single, it's detect	Set the mode of weaving condition to the single.
E1296	Assign InPORT of weld [A] for TRK.	When unassigned the analog input port for tracking, it's detect.	Assign a number of port to the analog input port for tracking at {system>4:>2:>13:}.
E1297	Not correct the license key.	This function requires the license key.	Please purchase its function at HYUNDAI ROBOT marketer. Refer to {Sys}>{2:}>{19:Licens-}
E1298	A seam data doesn't exist with LVS	Laser vision sensor doesn't detect a seam pose.	If a joint type is no problem, please adjust the allowed value in LVS condition, or adjust the extend length for

Code	Message	Cause	Remedy
			search target.
E1299	The Search Start supports only LIN	The step's interpolation method is not linear for the moving search start function.	Please change next and next step interpolation method to linear.
E1302	Conveyor interpolation error	During conveyor tracking, interpolation off step was executed.	Change interpolation of step.
E1304	Conveyor running signal is given	Conveyor running signal is input. in case of conveyor operation mode was set Test or Simulat. in synchronization on.	Either turn conveyor running signal off or set conveyor operation mode to Normal.
E1305	Create Robot.CO1 file for conveyor	It is a case that corresponding command is performed at off status of conveyer motive.	Please check the conveyer motive status.
E1306	Standard position for gun search was not recorded.	After configuring mechanical constant file, playing gun search", function or spot welding function was executed without record gun search reference position.	Record gun search reference position with new electrodes
E1307	Gun search program is abnormal	Playing of spot welding function was occurred without termination of gun search normally or gun search 2 was executed without execution of gun search 1.	Do the work after detection of tip consumption with execution gun search 1 and 2.
E1308	Tool No. of selected step is wrong	The tool number to servo gun number was not selected correctly when the step was executed with spot welding function and gun search function.	Correspond tool number(G1 →T0, G2→T1) in the step with spot welding function and gun search function.
E1310	Squeeze force exceeded current LMT	Current limit(IP) of the servo amp was exceed to current limit of calculation by commanding pressure.	Lower conFigured pressure or increase capacity of the servo motor.
E1311	Squeeze force exceeded overload	Command pressure was exceeded over load detection level.	Lower command pressure not to make over load error.

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E1312	Squeeze target is out of workspace	Out of robot work space was occurred when pressure position(Object position) of servo gun calculation.	Change the pose of robot, record the position.
E1313	Squeeze data out of range in Table	The pressure in the welding condition data of spot welding parameter(M72) was exceeded conFigured pressure extend of pressure Table of servo gun parameter.	Lower conFigured pressure.
E1314	Squeeze force delay time is over	Electrode abrasion detected was exceeded max. electrode abrasion of servo parameter.	Change electrodes, adjust max. electrode abrasion value of servo parameter as preferable value.
E1315	Gun number for servo gun is wrong	To work with gun is not servo gun	Check the work is with whether servo gun in addition axis configuration
E1316	A robot search or C/V is operating	When gun search function was executed, the function of robot searching or conveyer was running	Do not use robot search function or conveyer function in gun search operation.
E1317	HRView is going to load program	When a program was downloaded by HRView, Run command was executed.	After downloading the program, do the program.
E1318	The result value was overfloor	The result of addition or subtraction with count register was exceed 255.	Max value of count register is 255, check the program.
E1319	The result value was underfloor	The result of addition or subtraction with count register was exceed 255.	Check the program
E1320	Sensor doesn't search operation	This error occurs when the sensor does not work though the robot approach the object in searching of fixed electrode abrasion by servo gun search function or robot equalize function	1) When electrodes approach sensor check the sensor work 2) Check connection of connectors. 3) check the kind of sensor contact
E1321	The pallet entry number is wrong	Use same palette number on a palette such as PAL and PALEND command or make this error.	1) Check palette number on a palette with command of TIERST, PALPU, PAL, PALEND and PALRST 2) Input same pallet number on the pallet

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E1322	Unusable pattern resister.	1) Palletizing pattern registers were inputted to palletize. 2) If invalid pattern register in 16 pattern registers was used, this error was occurred	1) Check pattern register number that was set up. 2) Check used/unused items of palletize pattern register.
E1323	Equalizerless environment is wrong	The condition to be execute robot equalizer function was not enough	Select 'SERVICE' as 'SPOT' in 'SYSTEM/ INITIALIZATION/ SERVICE SELECTION' after selection of air gun1, air gun2, etc as EQ'less
E1324	Palletizing environment is wrong	There was not selected 'SERVICE' as 'SPOT' in 'SYSTEM/ INITIALIZATION/ SERVICE SELECTION' after selection of air gun1, air gun2, etc as EQ'less	Set GUN2 as 'palletize' in 'SYSTEM/ INITIALIZATION/ SERVICE SELECTION'
E1325	Palletize pick'g up function fault	Shift quantity of 'PAL'was needed to use shift quantity of PALPU. PALPU is to be on between PAL and PALEND or make this error.	PALPU put on between PAL and PALEND in the program.
E1326	Invalid environment of GUN search2	Controller is conFigured to compensate consumption of gun by gun search method 1 only.	Change the compensate method to use gun search method 1,2 either by set the value 0 to 'Move tip consumption rate(%)'
E1327	Servo hand opening limit over	Open position of servo hand open step excess maximum open position of system/ application parameter/ palletizing/ servo hand parameter setting.	reduce length of the offset of servo hand open step or increase maximum open position of servo hand parameter menu.
E1328	Servo hand squeezing limit over	Squeeze position of servo hand squeeze step is smaller then Maximum squeeze position of system/ application parameter/ palletizing/ servo hand parameter menu.	Increase the length of servo hand squeeze step's offset or decrease maximum squeeze position of servo hand parameter menu.
E1329	Servo hand squeezing time over	While squeezing at servo hand squeezing step, squeeze force doesn't come in setting range in spite of passing system/ application	1) Settle servo hand squeeze position. 2) Setting the Squeeze-Current Table of system/ application

Code	Message	Cause	Remedy
		parameter/ palletizing / servo hand parameter menu's Squeeze fault check Tm.	parameter/ palletizing/ servo hand parameter 3) Settle squeeze force. 4) Settle squeeze fault check Tm.
E1330	Can't load .LD? file while PLC RUN	You tried to load ladder file(.LAD) while embedded PLS RUN or Remote-RUN mode	Turn the embedded PLC to STOP or Remote-STOP mode, and try again.
E1331	Reserved program exe. Is possible at remote mode	Reserved program exe. function has been attempted while currently mode is not a remote mode	Check the current mode
E1332	Confirm program strobe signal use	You tried to start in case of system/ user parameter menu's FIFO function (2)Program is <Ext-Sel> & (1)Application No. is <20EA> or <1EA> & program strobe signal use <DSBL>.	Confirm the setting of program strobe signal use at system/ user parameter menu.
E1333	Cannot found selected program	Reserved program is not exist on the internal memory when execute FIFO register's reserved program	Confirm selected program on the internal memory.
E1334	Free-fall! start after step SETg	When motor off for return to previous posi is enable, fall length excess limit for error detect. if error isn't occur in the case of robot restart because of stopped step is out of normal trace this error inform to user warning.	1) In spite of restart at current position interference isn't occur start after set again current step. 2) If interference expects when step execute at current posi, exchange robot posi at manual mode. 3) If error detect length is unsuiTable, adjust limit for error detect at system/ 2:control parameter/return to the previous posi menu.
E1335	Cannot use continue play at FIFO	When execute program at FIFO application, in case of cycle type of the cond set menu is continu input start.	When apply FIFO Function, please use after select 1cycle cycle type of the cond set menu
E1336	Undefined User-coordinate number.	When execute/input User-coordinate without setting User-coordinate	The first select a program and record 3 steps, the origin, the X-direction, and pose on XY-plan for User-coordinate. Sets System>2:>12:>1:User-coor

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			d. If you want it in program, refer to the MKUCRD command.
E1337	SOFT Instruction execute fail	When execute SOFT instruction While setting time(5sec) command and current encoder's difference is over 384Bit	Please set to 0 Accuracy for step before SOFT instruction.
E1338	Soft floating error distance over	When SOFT instruction executed, position difference is over error detection level.	Adjust error detection level.
E1340	Invalid condition for co-work run	Invalid condition of controller to do COWORK function	Verify communication status, common coordinate was set, same between manual cooperation role and COWORK's role of robot.
E1341	Cooperation wait time is over	All of cooperative robot are not ready to cooperate by COWORK wait time.	Considerate wait time of COWORK must be set, considering the other robots. or you can set the time as 0, waiting until agreement
E1342	Invailded COWORK or common coordi.	COWORK can not be executed as in validity of cooperative control, or as no common coordinate.	Cooperate control is set as enable at System setting/ Cooperation control parameter and common coordinate must be set.
E1343	COWORK execution mismatch	Duplicated COWORK is used, or program encounter END without COWORK END	COWORK function is programmed with pairing COWORK and COWORK END. It is prohibited from repetition of running COWORK caused by step change.
E1344	COWORK Para.(M/S,robot No.) error	COWORK's partner robot number is wrong set as my robot number.	Change robot number used in COWORK M(S),S(M)=robot number, my robot number can not be set as partner robot number.
E1345	The slave already executed COWORK.	Cursor position of Slave is at COWORK END.	Don't go to the trouble to change step to operate Master and Slave normally.
E1346	Excess of P* repeat limit (10x)	You can't repeat steps including P* over 10 times. (for limit of calculation load)	Insert a hidden pose step within preceding 10 steps.

Code	Message	Cause	Remedy
E1347	Coord. system not supporting shift	You can only add <base/robot/tool/user coord. system shift> to <base/robot/ encoder/user coord. system pose>. The shift operation of other coord. system is not permitted. Shift of base or tool coordinate system can be added, and shift calculation for other coordination is not permitted.	Check the pose or shift variable/ constant and convert it to permitted coord.system.[Quick Open]
E1348	Time out of connection complete.	For marked time gun connection doesn't complete.	If connection complete at ATC, send spot gun connection complete signal to controller. GUNCHNG ON, commend execute after connection between gun and ATC.(automatic tool changer)
E1349	SVG Disconnect error in limit time	After GUNCHNG OFF instruction execute, within 5sec spot gun doesn't disconnect.	Contact the Robot A/S team.
E1350	Don't set an user-coord. number.	Don't set user-coordinate number in the [Condi Set].	Please input user-coordi. Number with T/P, or execute SELUCRD command with teaching program
E1351	Interrupt defined duplicated.	For pre-defined interrupt number redefine without delete.	Define not used interrupt number or after execution interrupt delete.
E1352	Pre-execute interrupt definition.	Private interrupt enable instruction executes without defined number interrupt execution.	After pre-execution for interrupt define instruction executes private interrupt enable instruction.
E1353	Over allowed max. dist. deviation.	The distance deviation by the seam tracking is over.	Modify step's pose or the allowed max. deviation in TRK condi.
E1354	Over allowed max. angle deviation.	The angle deviation by the seam tracking is over.	Modify step's pose or the allowed max. deviation in LVS cond.
E1355	Partner robot is in abnormal stop	Partner robots aren't ready to cooperate. one of them is stop status.	Check the running status mode. If you want to rerun after stopping playback of

Code	Message	Cause	Remedy
			cooperation, you will run Master ahead after running Slave.
E1356	Duplicated robot number is set	Cooperation control is impossible because duplicated robot number can't be identified the robot	Inspect robot number of robot connected in HiNet, and change overlapped robot number. After this action, you must repower the controller.
E1357	Detected coolant error signal	Coolant circulation error signal is detected.	Check the cooling system. If there is no error, check the setting of input signal port in controller. And restart welding step after removing error state.
E1358	Interrupt enable at continue path.	When Interrupt Define or Enable instruction executes, continuous path function has been executed.	Cannot use interrupt & continuous path function at the same time
E1359	Set continuous path at Int enable.	When continuous path set, Interrupt function already executes.	Cannot use interrupt & continuous path function at the same time
E1360	File of control integer was damaged.	Structure of control integer file was damaged.	Initialize the memory by assistant of A/S member in HHI.
E1361	File of machie integer was damaged.	Structure of machine integer file was damaged.	Initialize the memory by assistant of A/S member in HHI.
E1362	File of control integer has property that writing is prohibited.	Data cannot be recorded at file of control integer.	Please change the file property of control integer.
E1363	File of machine integer has property that writing is prohibited.	Data cannot be recorded at file of machine integer.	Please change the file property of machine integer.
E1364	Duplicated setting of master.	The number of controllers which are set as masters of manual mode is more than 2EA.	Use R351 or F key for turning the roles such as master/slave. Only one should be selected as a master.
E1365	A cooperative status is not ready.	A master of manual mode is not selected.	Select a master for cooperative robots of manual mode.

Code	Message	Cause	Remedy
E1366	Master number of slave is wrong.	The master number selected by the slave is not coincident with the master number.	This message will be ready.
E1367	Can't be Shifted in CMOV	Shift function is applied, but the shift coordinate is not supported	You should apply the robot coordinate for CMOV shift.
E1368	Not select Master for Crd. trans.	The coordinate of step data is the master end effector Crd.<M>, but the master robot is not selected.	Select the master coincident with the master of current CMOV step
E1369	Invalided master number,ID in CMOV	The master number from COWORK S, M=#1,ID=#2 is not coincident with the master number from CMOV R#1#2	You should record the CMOV position, after the same master of COWORK is selected.
E1370	H axis, V axis motion limit	Combination angle of H axis and V axis reached the limit	You should move H axis or V axis within the limit
E1371	Conveyor run signal isn't input.	Conveyor run signal isn't input.	Check signal input state.
E1372	WCR can't be off in limit time.	WCR did not fall in limit time.	Check signal input state.
E1373	No use ARCONC=.. on digital welding	This ARC command is not valid in digital welding.	You should use ARCON ASF#=command.
E1374	Push remote button of ESAB welder.	When analog active is selected remote button must be pushed.	Push the 4th button(Rem) in measured screen of U8. If Rem is disappeared, mode is remote.
E1375	Can't receive Welder CAN message.	When a digital welding machine is selected any CAN message is received for some time.	Check CAN cable and power of the digital machine.
E1376	Welding machine (E00): no program for welding set	no welding parameters available for selected material-wire-gas combination (no reasonable combination)	Select other material-wire-gas combination.
E1377	Welding machine (E01): overheat on power device of welding machine	thermal sensor of power unit measures a too high temperature	let machine cool down in standby

Code	Message	Cause	Remedy
E1378	Welding machine (E02): Overvoltage error on main power	main voltage too high (24V supply > 36V)	check mains voltage and control transformer
E1379	Welding machine (E03): too high welding current	welding current is too high	check pc-board LSW
E1380	Welding machine (E04): error in air-cooling system	Temp. sensor of the power unit detects that the unit heats up too fast	check fan and air hardening lime
E1381	Welding machine (E05): error in water-cooling system	flowrate of the cooling liquid is too low (0.3 l/min) pump is not working	check connectors of flow-meter, level of cooling liquid and flowrate check fuse S17 (2.5A) on pc-board DP-MAPRO
E1382	Welding machine (E06): overvoltage error in secondary power	Master detects output voltage is too high (112V or more)	exchange power unit
E1383	Welding machine (E07): EEProm chksum error	No welding program stored or error during reading from memory	transfer welding programs to machine again
E1384	Welding machine (E08): Error on wire supply device	power consumption of wire feed motor too high no tacho signal no CAN-Bus connection between MAPRO and DMR	blow out torch package with
E1385	Welding machine (E09): measuring value error of current / voltage.	measuring difference between Master and Process	check wiring of pc-board LSW and pc-board DK-UFI
E1386	Welding machine (E10): error of torch socket / cable	short circuit of torch control cables or between torch switch wires and welding potential	check torch control cables and torch interface
E1387	Welding machine (E11): connecting error of remote device	short circuit between remote control cables	check remote control and wiring of remote control socket
E1388	Welding machine (E12): Process does not respond	Process is not responding to Master.	switch the machine off and on again optionally exchange pc-board DP-MAPRO
E1389	Welding machine (E13): temperature sensor error	Temp. sensor is defective	check resistor value and wiring of the sensor
E1390	Welding machine (E14): too low supply voltage	supply voltage is too low (<17V)	check mains voltage and control

Code	Message	Cause	Remedy
E1391	Welding machine (E14): too low supply voltage	It is an error (E15)of undesignated welding machine.	If the trouble is repeated, please contact to A/S staff of HHI.
E1392	Welding machine (E16): working of overcurrent protection of primary power	power consumption of power unit 1 is too high	exchange power unit
E1393	Welding machine (E17): error number of undesignated welding machine	undefined welder error(E17)	If same problem was repeated, contact A/S member in HHI.
E1394	Welding machine (E18): working of overload protection of secondary power	safety shutdown to protect electrical components temp. sensor is disconnected	let machine cool down in standby check temp. sensor
E1395	Welding machine (E19): error number of undesignated welding machine	undefined welder error(E19)	If same problem was repeated, contact A/S member in HHI.
E1396	Welding machine (E20): too high output voltage	Process reports a too high output voltage	exchange power unit
E1397	Welding machine (E21): measuring error of output current / voltage	external current/voltage or measure-difference between Master and Process	exchange power unit
E1398	Welding machine (E22): too low voltage of main power	power unit 1 reports mains voltage too low	check mains voltage and mains rectifier
E1399	Welding machine (E23): too high voltage of main power	power unit reports mains voltage too high	check mains voltage
E1400	Welding machine (E24): working of overcurrent protection of secondary power.	power consumption of power unit 2 is too high	exchange power unit
E1401	Welding machine (E25): DK-DCDRV jumper setting error	Jumper on pc-board DK-DCDRV have been set wrong	check jumper J1, J2 on pc-board DK-DCDRV
E1402	Welding machine (E26): error number of undesignated welding machine	undefined welder error(E26)	If same problem was repeated, contact A/S member in HHI.
E1403	Welding machine (E07): no welding program (DSP)	welding programs faulty or not available	select other material-wire-gas combination transfer welding

Code	Message	Cause	Remedy
			programs to machine again
E1404	Welding machine (E28): error number of undesignated welding machine	undefined welder error(E28)	If same problem was repeated, contact A/S member in HHI.
E1405	Welding machine (E29): error number of undesignated welding machine	RS232C port in welder is fault	If same problem was repeated, contact A/S member in HHI.
E1406	Welding machine (E30): secondary power voltage is too low.	power unit 2 reports mains voltage too low	check mains voltage and mains rectifier
E1407	Welding machine (E31): Master does not respond.	Master is not responding to Process	Switch the machine off and on again optionally exchange pc-board DP-MAPRO
E1408	Can't stop GAS ACTIVE status.	When welding finished, GAS ACTIVE signal is not disabled within assigned time.	Check the CAN cable and welding machine
E1409	(0 gun) failure of record for gun search standard position!	If gun search standard position recode performs GUNSEA sentence at ON status, standard position is stored at file. The error happened at this time.	Please check the file.
E1410	Mismatched multi gun type!!	Gun number VS gun type mismatched at command for multi gun sync welding.	Check gun number VS gun type.
E1411	Gun number setup was wrong.	gun number setup error at command	Check gun number.
E1412	Deviation of stop pose is too long	Deviation of stored stop pose vs. welding path is large then 2[cm].	Move the robot at welding stop pose by Jog, and start execution
E1413	Entrance/progressing step for arc welding is interpolation OFF.	Entrance/progressing step for arc welding is interpolation OFF.	Please set the entrance / progressing step for arc welding into linear or arc interpolation.
E1414	ARCON is not usable at step 0.	ARCON command is recorded at program step 0.	ARCON command should be recorded other steps beside command 0.

Code	Message	Cause	Remedy
E1415	Arc welding machine does not work.	Communication ready for arc welding machine is not input.	1) Please check communication cable connected to welding machine (A07→X7) 2) Please check performing status of inner PLC (X7 → DI111).
E1416	Restricted value is exceeded during arc welding.	Restricted value installed at condition file is exceeded during arc welding.	1) Please check welding tip or supply system. 2) Please adjust the restricted value of welding condition file.
E1417	The robot passes an operating limitation cubic.	The robot is soon to pass a designated operation limitation area.	Check the operating limitation cubic and move the robot to the inside of the operation limitation area.
E1418	The robot collided with a mirror axis.	The robot is soon to collide with a mirror axis.	Check the mirror position setting value and move the robot so as not to collide with the mirror.
E1419	The robot collided with the main body.	The robot is soon to collide with the main body.	Check the collision detection area of the main body and move the robot so as not to collide with the main body.
E1420	The robot link collided with an operation limitation area.	The robot link is soon to pass the operation limitation area designated by the user.	Check the operation limitation cubic and move the robot to the inside of the operation area.
E1421	Controller is not arc-welding set	Arc command has been executed while arc-welding function is disabled in the controller setting	Select appropriate setting between analog, digital from the dialog 'System→Initialization→controller setting'
E1422	No reponse from GB2 welder	Communication error to GB2 welder 1) Welder's power may be off 2) Error on communication cable 3) Error on 24 V power supply of communication cable 4) Error on controller's serial communication setting	1) Check welder's power. 2) Check the communication status between controller and welder 3) Check power terminal (socket) of cable 4) Check if controller's serial communication setting is for GB2
E1423	Command are transmitted to GB2 welder 3 times, but the welder did not respond	Communication error to GB2 welderGB2 .	1) Check welder's power 2) Check the communication status between controller

Code	Message	Cause	Remedy
			and welder 3) Check power terminal (socket) of cable 4) Check if controller's serial communication setting is for GB2
E1427	GB2 error(B06) encoder error detection	Wire supply motor is not spinning normally, or disconnection of encoder signal is expected. Try to spin the motor and if it spins (even a little), encoder damage or disconnection on wiring is suspected	Replace feeder unit
E1428	GB2 error(B07) motor error detection	Detected the wire supply motor's spinning without the spin command. If the motor is actually spinning, error on PCB of wire supply device is suspected	Replace feeder unit
E1430	GB2 error(B09) secondary over-current detection	Current that exceeds the maximum rated voltage flows because of short-circuit occurred on secondary side circuit	Turn off the power switch and remove the cause of short-circuit and over-current
E1431	GB2 error(B10) temperature increase error detection	Internal temperature of welder has increased over the rated value	1) Turn off the power until the internal temperature goes down 2) Remove the cause of increased internal temperature(exceeded rated operation, blockage of ventilation system of front and side)
E1432	GB2 error(B11) primary overvoltage detection	Input voltage exceeds the allowed range	Turn off the power switch and adjust the input voltage to be within +10% range of rated voltage
E1433	GB2 error(B12) primary low voltage detection.	Input voltage is lower than the allowed range	Turn off the power switch and adjust the input voltage to be within -10% range of rated voltage
E1434	GB2 error(B12) torch switch error detection.	Welding has started within 3 seconds from the power on. Welding is only possible after 3 seconds for safety reason	Turn off the power switch and try it again

Code	Message	Cause	Remedy
E1435	GB2 error(B14) CT offset error detection	Ouput current or output voltage is detected when the power switch turned on. Product malfunction or a current, voltage may be supplied to welder's secondary side from external area.	1) Check if power is supplied to welder's secondary side 2) Replace the welder
E1439	GB2 error(B18) emergency stop error detection	Emergency stop signal is being input to Jig terminal (socket)	Turn off the power switch and examine the cause of emergency stop signal of Jig terminal (socket)
E1440	GB2 error(B19) outer input 1 error detection	Signal that connected to EXT1 of Jig terminal (socket) is being input	Examine the cause of EXT1 signal of Jig terminal (socket)
E1441	GB2 error(B20) outer input 2 error detection	Signal that connected to EXT2 of Jig terminal (socket) is being input	Examine the cause of EXT2 signal of Jig terminal (socket).
E1444	GB2 error(B23) Arc start error detection	Arc start did not activated within 4 seconds from the input of welding activation signal	Check if the voltage detection line is disconnected, loose contact
E1445	GB2 Welding environment not supported by GB2 welder	Synergic welding setting that GB2 welder does not support is selected	Select synergic welding setting that GB2 welder supports
E1446	Robot link crashed to the operation limit area	Robot link exceeds the limited value and going to crash	Move the Robot link into the operation area or adjust the operation limit setting
E1447	No license for arc-sensing function	No license for arc-sensing function	Please contact to our office for a license
E1448	No license for LVS function	No license for LVS function.	Please contact to our office for a license
E1449	No license for cooperation control(CWORK) function	No license for cooperation control(CWORK) function	Please contact to our office for a license
E1450	No license for automatic calibration function	No license for automatic calibration function	Please contact to our office for a license
E1451	No license for embedded Fieldbus function	No license for embedded Fieldbus function.	Please contact to our office for a license

Code	Message	Cause	Remedy
E1452	Servo hand environment setting error	Servo hand related command has been executed while the status is not Servo hand environment	Check the setting status.
E1453	Gun type setting error	Spot welding related command is executed by independent drive. Guntype for the gun number is not set to stationary	Use it after set the gun type to stationary
E1454	(Axis 0) control status error	Case when a spot welding related command (recorded in program) is executed, if the control status of the axis for corresponding gun number is off. Or, case when a spot welding related command (by independent drive) is executed, if the control status of the axis for corresponding gun number is on .	Adjust the control status of corresponding axis when a spot welding related command is executed
E1455	(Axis 0) Independent drive is not terminated	AXISCTRL ON command try to control the designated axis, and the axis is already in independent drive	Adjust the location so that the AXISCTRL ON command can be executed after the termination of the axis's independent drive
E1456	Cannot find program XXXX.JOB	Started while the selected number's job program does not exist	1. Auto mode- Select the correct program (or copy it correctly) and start 2.Outer mode-Copy the correct job program into it and start
E1457	Start failed, because outer stop is entered	Outer stop signal has entered at the time of start (Check from the T/P input signal monitoring window)	1. Auto mode-Outer stop input signal must be off. Set outer stop as 0 from the assigned input signal to disable the outer stop 2.Outer mode- Please adjust the I/O sequence so that the outer start is activated after the outer stop is released. Or check if the signal connection is normal
E1458	Start failed, because door switch signal is entered	Door switch signal has entered at the time of start	Start after the door is closed. Or check if the signal connection is normal

Code	Message	Cause	Remedy
E1459	External program selection input signal is unstable	Assignment value for input signal of program selection has changed momentarily when remote mode started. (Check from the T/P input signal monitoring window)	Please adjust the I/O sequence so that the start signal is entered after the program number signal has entered. Or check if the signal connection is normal
E1460	Program Strobe signal is not entered	Program Strobe signal has not been activated when the remote mode started	Please adjust the I/O sequence so that the external start is activated after the program Strobe signal has entered. Or check if the signal connection is normal
E1461	Program selection signal input is 0	0 has entered as program selection signal value when the remote mode started	Please adjust the I/O sequence so that the external start is activated after the program selection signal value has entered. Or check if the signal connection is normal
E1462	Plasma welder is not responding	Communication error occurred between the Hi5 controller and Plasma welder	1) Check the connection status of communication line between the controller and welder 2)Check the status of controller communication setting from 'System>>Control Parameter>>Serial Port' 3) Check the status of communication with the 'Communication testing' function from the dialog
E1463	Plasma welder error(E01) Pilot ARC ignition has not started	Pilot ARC ignition has not started within 2 seconds from the activaton of Pilot.	Check the cause of trouble and fix it. Release the error status of welder, and try to ignitiate the Pilot
E1464	Plasma welder error(E02) Main ARC ignition has not started	Main ARC ignition has not started within 2 seconds from the activaton of Main ARC	Check the cause of trouble and fix it. Release the error status of welder, and try to ignitiate the Main ARC while Pilot ARC is ignitiated.
E1465	Plasma welder error(E03) Device overheat	Trance, reactor, semiconductor is overheated due to an operation over-load	Wait for the internal temperature of power supply unit cools down by the internal fan, and release the error status of welder. Once the error code that displayed

Code	Message	Cause	Remedy
			at the front of welder is gone, continue with the operation
E1466	Plasma welder error(E04) Primary over-current	Error is detected from the IGBT of welder's main	Check the cause and fix it. Restart and try to run the operation. If the problem persists, stop the operation and please contact to the welder's manufacturer
E1467	Plasma welder error(E06) Shield Gas pressure reduction	Pressure of Shield gas has reduced to below 0.15MPa	Check the pressure of Shield gas. If the gas valve is closed, open it and release the error status of welder. Once the error code that displayed at the front of welder is gone, continue with the operation
E1468	Plasma welder error(E07) Pilot Gas pressure reduction	1) Pressure of Pilot gas has reduced to below 0.15MPa. Pilot gas flux has decreased below 0.08L/min while welding operation	1) Check the pressure of Pilot gas. If the gas valve is closed, open it and release the error status of welder. Once the error code that displayed at the front of welder is gone, continue with the operation 2) Check the cause to fix the error, and release the error status of welder. Once the error code that displayed at the front of welder is gone, continue with the operation
E1469	Plasma welder error(E06) Insuffienct flux of coolant	Insuffienct flux of coolant Plasma	Check the cause (Blockage of Torch waterway, reduced pump performance, flux sensor malfunction) to fix the error, and release the error status of welder. Once the error code that displayed at the front of welder is gone, continue with the operation
E1470	Plasma welder error(E09) Emergency stop	Emergency stop signal is entered	After the release of emergency stop, release the error status of welder. Once the error code that displayed at the front of welder is gone, continue with the operation
E1471	Plasma welder error(E11) Chiller error	Error occurred from the Chiller's embedded coolant	Check the Chiller's embedded coolant circulating

Code	Message	Cause	Remedy
		circulating system, or when unit cooler is connected	system to fix the problem and release the error status of welder. Once the error code that displayed at the front of welder is gone, continue with the operation
E1472	Plasma welder error(E20) Input over-voltage	Power voltage over 240V has entered	Check the power voltage to fix the problem and release the error status of welder. Once the error code that displayed at the front of welder is gone, continue with the operation
E1473	Plasma welder error(E21) Input under-voltage	Power voltage under 180V has entered	Check the power voltage to fix the problem and release the error status of welder. Once the error code that displayed at the front of welder is gone, continue with the operation
E1474	Plasma welder error(E81) Over-voltage input	400V voltage has entered at 200V setting status, or 200V voltage has entered at 400V setting status	Check the power voltage to fix the problem and release the error status of welder. Once the error code that displayed at the front of welder is gone, continue with the operation
E1475	Plasma welder error(E85) Activation failed	Power activation has failed	Restart and try to run the operation. If the problem persists, please contact to the welder's manufacturer
E1476	Plasma welder error(E94) Memory error	Error occurred on a memory that stores the parameter	Restart and try to run the operation. If the problem persists, please contact to the welder's manufacturer
E1477	Execute on motor on status	Attempted while the motor is not On	Check the motor on status and try it
E1478	Execute on auto mode	Attemped while it is not on auto mode	Check the auto mode status and try it
E1479	Number of independant executable commands (4) exceeded	Maximum number of independent executable commands is four. Independent executable command that exceeds the limit has been requested	Please contact to our office

Code	Message	Cause	Remedy
E1480	Axis related to the independent executable command is already in operation	The correspoinding axis to the independent executable command is already in operation	Check the contro stats of the axis for the operation Please contact to our office
E1481	Servo gun related command is already executed	Servo gun related command cannot be executed at the same time	Please contact to our office

6.4.3. Warning

Code	Message	Cause	Remedy
W0001	Backup memory damaged	It occurs when damage is found in all kinds of files.	Initialize the internal memory, and load all kinds of files backed up in a diskette.
W0002	Controller temperature risen	It occurs when the controller temperature is above 65.	Refer to Troubleshooting Manual.
W0003	Damaged program. Delete it	Program to execute is damaged.	Delete the program, and reload a backup program.
W0004	Emergency stop is entered	It occurs when [Motor ON] in an emergency.	Release emergency stop and execute
W0005	Backup battery voltage dropped	Backup battery voltage connected to Main board BATCN connector is below the standard.	Replace the backup battery.
W0009	Brake slip!(Excess of set value)	It happens when brake slip by compression during stud welding exceeds the installed value.	Please check the axis having the largest slip at brake slip count. Replace the motor where axis has the largest slip.
W0010	Fieldbus power is not supplied	Field bus power is not supplied.	In case of DeviceNet, check if +24V of power supply line is correctly connected, and measure the voltage with multimeter. Take necessary actions to correctly supply +24V power to DeviceNet cable.
W0011	Fieldbus network connection error	Field bus network connection is not normal.	Check if field bus connector is taken off. Check if field bus network cables are all in comply with each field bus regulation.
W0012	Fieldbus IDLE state (PLC STOP)	Master stops I/O operating.	If PLC is in a program mode, change it to RUN mode.
W0013	Field bus module is not sensed.	Field bus module is not sensed.	If you want not to use filed bus, please install field bus use invalid.
W0014	Fieldbus setting error	Parameter setting for field bus master is not identical with that of slave.	Check if parameter setting is correctly done for filed bus master and slave. If any errors, then correct them

Code	Message	Cause	Remedy
W0015	Fieldbus general error	BD420 board field bus has an error.	Check if there is any error in BD420 field bus setting and field bus master setting, and cabling.
W0016	Improper use of GE or DE signal No	The specified values for GE or DE variable are incorrect. The values are out of range.	- It is different from coworking robot number. - GE: Min.=(robot #-1)*4+1, Max.=(robot #-1)*4+4 - DE: Min.=(robot #-1)*32+1, Max.=(robot #-1)*32+32
W0017	External emergency stop on	It happens when [motor ON] is done at the status that external emergency halt is inserted.	Please check the status and manage at monitoring of Private input signal.
W0018	#n node connection of embedded Fieldbus is disconnected	Occurs if the response is lost after a normal operation	Check the cable status
W0019	#n node input size of embedded Fieldbus does not match	Occurs if the input size of corresponding node has been changed	Check the input module of corresponding node, or execute [Re scan] function
W0020	#n node output size of embedded Fieldbus does not match	Occurs if the output size of corresponding node has been changed	Check the output module of corresponding node, or execute [Re scan] function
W0021	#n node I/O size of embedded Fieldbus is too large	Occurs if the I/O size of each node exceeds 16 bytes	Distribute input/output by adding a Fieldbus adaptor
W0022	#n node of embedded Fieldbus does not respond	Occurs if there is no response after the power on	Check the cable status of corresponding node
W0023	Master Mac(0) of embedded Fieldbus is crashing	Occurs if one of the node has Mac as same as Master Mac(0)	Turn off the power and change the Mac of a node with Mac=0
W0104	(0 axis) Encoder battery voltage drop	Battery voltage is too low in axis (○) encoder.	Follow the controller MANUAL to check the encoder battery in corresponding axis. Check the Battery connection of corresponding axis encoder.
W0105	(0 gun) Tip consumption exceeded limit!	It occurs when total tip consumption detected with gun search is in excess of tip exchange wear set in servo gun parameter.	Inspect the unfixed tip and fixed tip consumption, and replace the tip.

Code	Message	Cause	Remedy
W0106	(0 gun) Move-tip consumption exceeded LMT.	It occurs when total tip consumption detected with gun search is in excess of tip exchange wear set in servo gun parameter.	Inspect the unfixed tip and fixed tip consumption, and replace the tip.
W0107	(0 gun) Static electrode exceeded exchange wear level.	It occurs when fixed tip consumption detected with gun search is in excess of unfixed tip exchange wear set in servo gun parameter.	Inspect the fixed tip, and replace the tip.
W0108	In jog moving, Pressure exceeded!	It occurs when actual value of pressure is in excess of set value in manual pressurizing. Here operate the servo gun axis in the opposite direction.	Check if force is sufficiently set for the axis you intend to operate. Make contact with servo gun manufacturer because mechanical problem is anticipated in servo gun.
W0109	Change gun No. to jog this SVG	The servo gun you intend to operate is different from the selected servo gun number.	Servo gun should be operated by manual jog after being selected. Select the servo gun you intend to operate with R210 code before operating.
W0110	Set to condition of not detecting pressurization force.	This occurs when the pressurization force level of the servo gun parameter menu or the pressurization force error detection delay time is not set.	Check whether the pressurization force level of the servo gun parameter menu or the pressurization force error detection delay time.
W0111	Previous position return detection	This warning occurs when the returning distance simultaneously with motor ON input is larger than the set value of error detecting distance in case of enable returning function in [Motor ON].	Please expand error detecting distance of previous position recovery. Please make recovery function for previous positin invalid. Please contact to A/S of HHI..
W0112	Previous position return distance	This occurs when the returning distance simultaneously with motor ON input is larger than the set value in case of enable returning function in [Motor ON].	Set the returning distance setting to be larger than the existing set value.
W0116	Impossible to maintain weaving movement used previously.	It happens weaving movement, which is made when WEAVON command is performed, cannot be maintained.	1) Please start again from step having WEAVON command. 2) If welding, after starting from command that WEAVON command is recorded by OFF status and moving to the point

Code	Message	Cause	Remedy
			where weld is cut off, please change into weld ON status and make progress on.
W0117	Jog will make overspeed CMMD.	Robot is in a posture of high speed while manually operated in rectangular coordinate system or tool coordinate system.	Change the robot's posture by manipulating with articulation coordinate before operating it manually.
W0118	1st servo CPU version is Old	The robot may be used, but it has problems in the use of some functions due to the old version of 1st servo board CPU.	You may use the existing functions as they are, but for the use of new functions, please make contact with our A/S to update the version.
W0119	2nd servo CPU version is Old	The robot may be used, but it has problems in the use of some functions due to the old version of 1st servo board CPU.	You may use the existing functions as they are, but for the use of new functions, please make contact with our A/S to update the version.
W0120	3rd servo CPU version is Old	The robot may be used, but it has problems in the use of some functions due to the old CPU version of 1st servo in the 2nd servo board.	You may use the existing functions as they are, but for the use of new functions, please make contact with our A/S to update the version.
W0121	4th servo CPU version is Old	The robot may be used, but it has problems in the use of some functions due to the old CPU version of 2nd servo in the 2nd servo board.	You may use the existing functions as they are, but for the use of new functions, please make contact with our A/S to update the version.
W0123	Stop input from partner robot	Stop instruction is received from the partner robot during cowork control operation. In this case, the above message is output, and the robot stops.	Start running a master to resume a program after starting the robot on the part of slave.
W0124	Slave is Impossible to jog	It is set as salve in the condition of manual cowork control. The robot set as slave is impossible to operate separately.	To operate each robot individually in a manual mode, change the condition of manual cowork. To change the condition of manual cowork, users need to use F key or R351 code.
W0125	Invalid position of connected SVG	The position of servo gun attached by GUNCHNG ON instruction or instruction for manual gun connection is different from the one remained in its memory when separating.	It is normal if it occurs when servo gun is initially connected. If it occurs other than the initial connection, check the followings. It may occur if an incorrect

Code	Message	Cause	Remedy
			servo gun is selected. Thus, check this out. And check if encoder battery of servo gun is sufficient.
W0131	Jog Prohibited - Master overlapped	Among robots connected to HiNet are more than two robots set as Master in their manual cowork.	Only one Master for manual cowork is possible to set. Change the setting.
W0132	Jog Prohibited - No slave selected	Jog operation is attempted for Master robot without setting the Slave robot to be available to cowork.	Check if Slave robot is selected, and get it ready to be available to cowork before operating(Jog Off/Enabling Switch On).
W0133	Slave jog status are changed-Stop	A robot chaged its manual cowork is detected among the coworking Slave robots Master during cowork jog operation with robot.	Doublecheck the cowork condition of Slave before operating.
W0134	Master Tool Coord. isn't selected	It occurs when attempting to operate jog for Slave robot in a CMOV recording mode(R351,3). Master robot is not specified. Or it may occur when using forwarding function of CMOV step. The currently set number of Master is different from the recorded Master number in CMOV.	Set a correct master robot for manual cowork Master.
W0137	Manual operation generated by a high speed - order from a tool end.	During the manual operation of a cross coordinate and a tool coordinate, the speed of the tool end of the robot exceeded safety speed limits.	Check if axis B is near 0deg. An axial coordinate must be operated in a manual manner when axis B is near 0deg.
W0138	N axis] The remaining rated life of a decelerator of N axis is less than 10%.	The remaining rated life of the decelerator of the corresponding axis is calculated into a value of less than 10% of the initial specification value.	Under current operational conditions, the user is requested to prepare a replacement of the decelerator with reference to the expected life of the decelerator of the corresponding axis.
W0139	Tool is in excess of permissible value for tool weight error	Tool's weight is too small compare to the actual value. Robot's excessive operation is expected	Check the tool's weight/center of weight value, gravity direction or base position

Code	Message	Cause	Remedy
W0140	The expected life span of the reduction gear: less than 40,000 hours	Based on current operating condition, the expected life span of reduction gear for the axis is less than 40,000 hours. Earliy break of reduction gear is predicted	Check if the property of material rate for the tool has been entered correctly. If it is, please enquire to the engineer
W0143	Safe restart mode activated	Activating in safe speed as the location corresponding step has been changed from the restart	If operation requires the recorded speed rather than safe speed, please turn off the motor and restart

7

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.

7.1. 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.

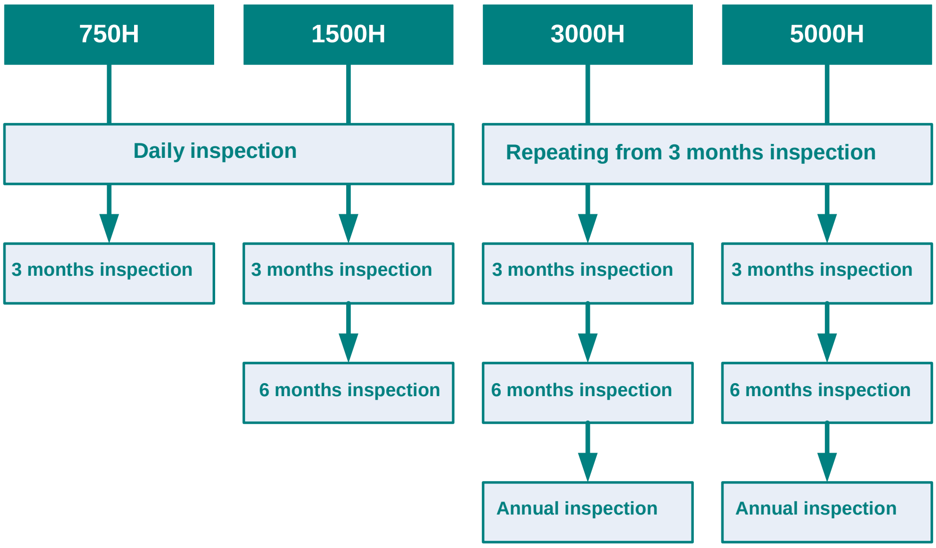

Figure 7.1 Inspection Schedule

7.2. General Instructions for Regular Inspection

① Inspection working should be performed by a 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 normal operation.

7.3. Daily Inspection

Table 7-1 Daily Inspection

No.	Inspection Part	Inspection Details	Remarks
1	Controller	Is display lamp working (normal)?	Check with the naked eye
2	Robot Manipulator	Is door completely closed?	Check with the naked eye
		Are there any errors in Teach Pendant screen?	Check with the naked eye
		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 a 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

7.4. First Inspection (750 hours inspection)

Table 7-2 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

7.5. Daily Inspection

Table 7-3 Daily Inspection

No.	Cycle (months)			Inspection Part	Inspection Details	Remarks
	3	6	12			
1		◎	◎	Packing of door	· Transformed & torn part	
2	◎	◎	◎	Back side	· Dust & rotation in cooling fan wings of heat exchanger	
					· Damage & dust in regenerative discharge resistance	
					· Check a heating of Transformer Room by touch, and clean the room.	
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”
					· R1, S1, T1	
					· C2, B2	
					· SMPS (HDI-200)	
					· BKSMPS (CP SNT 250W) : Brake power	
10		◎	◎	Grounding	· Check a loose & removed terminal	
11		◎	◎	Battery	· Voltage inspection & regular replacement	Main LED
12	◎	◎	◎	Teach Pendant	· Exterior inspection, and damage & joint part of connector checking	
					· Check LCD Display	
					· Check LED Display	
13	◎	◎	◎	Safety related parts	· Check emergency stop switching (operating panel, teach pendant)	
	◎	◎	◎		· Check primary power disconnecting switch(DS1)	
	◎	◎	◎		· Check enabling device of teach pendant	
	◎	◎	◎		· Check circuit protector (CP1,CP2)	
	◎	◎	◎		· Check magnet connector (MSHP,MSPB,MSDB)	

No.	Cycle (months)			Inspection Part	Inspection Details	Remarks
	3	6	12			
14	◎	◎	◎	Safety related PCB	· Check for BD530 board (connector, exterior relay of board)	

7.6. Inspection for Long-Term Idleness

In case of long-term idleness, inspect the followings before turning off power.

(1) Check if LED for battery discharge detection is normal in mainboard. If there is an error in battery, LED is turned OFF. In this case, replace it with a rated battery. If turning off a primary power with errors in battery, all program/constant data in a board will be deleted after about 7 days. Thus be sure to back up the program data by using HRView, etc.

(2) Check if controller door is completely closed.

7.7. 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 7-4 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 7-5 Maintenance Parts A-1 (Standard accessory parts to prepare)

No.	Product Name	Type	Maker	Quantity(EA)	Remarks
1	Fuse (F1,F2)	GP50	Daito	2	250V, 5A
2	Fuse (F3,F4)	GP100	Daito	2	250V, 10A
3	Fuse (F5,F6)	GP50	Daito	2	250V, 5A
4	Fuse (Servo AMP)	GP20	Daito	2	250V, 2A

Table 7-6 Maintenance Parts A-2 (Major Backup Parts)

No.	Product Name	Type	Maker	Quantity(EA)	Remarks
1	Servo AMP	Middle size / Small size	HHI	1	
2	Complex Power Unit	HDI-200	HHI	1	SMPS
3	Teach Pendant	TP510	HHI	1	
4	Electronic module	PDM30/PDM15	HHI	1	
5	Board	BD501	HHI	1	Back plain board
		BD510	HHI	1	Main board
		BD542	HHI	2	Servo board
		BD530/531	HHI	1	System board

Table 7-7 Maintenance Parts A-3 (Regular Replacement Parts)

No.	Product Name	Type	Maker	Quantity(EA)	Remarks
1	Battery(3.6V AA size)	ER6C	Hitachi Maxwell (JAPAN)	1	Replacement required every 2 years

Maintenance Parts B

To many maintain a normal operation parts.

Table 7-8 Maintenance Parts Inspection B

Type	Details	Remarks (reference)
Maintenance Parts B-1	Parts to purchase from HHI, Ltd.	
Maintenance Parts B-2	Purchasable Parts from Maker	

Table 7-9 Maintenance Parts B-1 (Parts to purchase from HHI (Co.,Ltd.))

No.	Product Name	Type	Maker	Quantity(EA)	Remarks
1	Wire harness	CMC1	HHI (Co.,Ltd.)	1	Controller ⇔ Robot Manipulator
		CMC2	HHI (Co.,Ltd.)	1	
		CEC1	HHI (Co.,Ltd.)	1	

Table 7-10 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℃ ~ +45℃

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 particulas, 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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