Delta Articulated Robot System User Manual

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DELTA_IA-RA_DRV70L90L_UM_EN_20210811

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Module: DRV70/90L7D/E series
Applicable Controller Type: DCV-2J00-CA
Document No.: DRV70/90L7D/E series-System
Date of release: August 11, 2021

Articulated Robot series of standard coding guidelines:

Rule											
Example	DRV	90	L	7	D	6	2	1	3	1	-
Code	1	2	3	4	5	6	7	8	9	10	11

Definition			
Code	**Definition**	**Char**	**Description**
1	Series	3	DRV = Delta Robot Vertical (articulated robot)
2	Arm length	2	70 = 710 mm 90 = 900 mm
3	Level	1	L = Lite
4	Payload	1	7 = 7 kg
5	IP_rating+Certification	1	D = IP40/CE E = IP65/CE
6	Number_of_axis	1	6 = 6 axes
7	Generation	1	2 = Generation 2
8	Installation	1	1 = Standard
9	Power cable	1	cable length 3 = 3 m 5 = 5 m
10	Accessories (TP & cable)	1	1= with TP (5 m) 2= with TP (10 m) N = without TP

Appendix

IP40

Mark	Product p/n	Robot arm	Controller	Robot cable	TP (5 m cable)	TP (10 m cable)
CE	DRV70L7D62131	DRV70L7D621NA	DCV-2J00-CA	3 m	DTV-2FM	
CE	DRV70L7D62151			5 m		
CE	DRV70L7D62132			3 m		DTV-2GM
CE	DRV70L7D62152			5 m		
KCs, CE	DRV70L7D6213N		DCV-2J00-CA	3 m		
KCs, CE	DRV70L7D6215N			5 m		
CE	DRV70L7D621NA					
CE	DRV90L7D62131	DRV90L7D621NA	DCV-2J00-CA	3 m	DTV-2FM	
CE	DRV90L7D62151			5 m		
CE	DRV90L7D62132			3 m		DTV-2GM
CE	DRV90L7D62152			5 m		
KCs, CE	DRV90L7D6213N		DCV-2J00-CA	3 m		
KCs, CE	DRV90L7D6215N			5 m		
CE	DRV90L7D621NA					

IP65

Mark	Product p/n	Robot arm	Controller	Robot cable	TP (5 m cable)	TP (10 m cable)
CE	DRV70L7E62131	DRV70L7D621NA	DCV-2J00-CA	3 m	DTV-2FM	
CE	DRV70L7E62151			5 m		
CE	DRV70L7E62132			3 m		DTV-2GM
CE	DRV70L7E62152			5 m		
KCs, CE	DRV70L7E6213N			3 m		
KCs, CE	DRV70L7E6215N			5 m		
CE	DRV70L7E621NA					
CE	DRV90L7E62131	DRV90L7D621NA	DCV-2J00-CA	3 m	DTV-2FM	
CE	DRV90L7E62151			5 m		
CE	DRV90L7E62132			3 m		DTV-2GM
CE	DRV90L7E62152			5 m		
KCs, CE	DRV90L7E6213N			3 m		
KCs, CE	DRV90L7E6215N			5 m		
CE	DRV90L7E621NA					

Foreword

Thank you for using this product. This manual provides users with contents that must be followed in order to safely operate the robot. It contains information related to the Delta Vertical articulations industrial robot series. Before operating the robot, please read this manual carefully in order to ensure your safety and proper usage. In addition, please keep it at a safe location to read at any time.
This manual applies to robots DRV70/90L7D/E series robot system.
This manual applies to the robot controller DCV-2J00-CA.
The robot arm DRV70L7D/E621NA, DRV90L7D/E621NA can only work with our company's controller DCV-2J00-CA and DTV-2FM (or DTV-2GM) teach pendant. Please do not modify the robot and controller on your own or use it with other robots and controllers. Our company will not be held responsible for any injuries or fatalities caused by accidents that result from doing so.

The following are the robot models and document numbers and versions that this manual applies to.

Published by: Delta Electronics Inc.
Applicable robot system: DRV70/90L7D/E Series
Document number: DRV70L/90L7D/E-System

Contents of this manual include:

- Usage safety precautions.
- Transportation and installation.
- Safety protection.
- Robot and controller installation and operations.
- Operations and instructions.
- Testing and maintenance.

Due to operating environment and operator safety considerations, our company will provide dedicated training according to the different robot application staff; please contact your local dealer if related training courses are needed.
This operating manual is suitable as reference for the following users:

- System integrator and designer.
- Installation or wiring staff.
- Testing and tuning staff.
- Maintenance or inspection staff.

Please read this manual carefully before operating in order to ensure proper usage. In addition, keep this manual in a safe location to read at any time. The following items must be followed before you have finished reading this manual:

- Please set the robot in a safe and protected location such as a place with fences and gratings, etc. and do not operate the robot outside the safety protection, otherwise it may cause injuries to the operator.
- The installation environment must have no steam, corrosive gas or flammable gas or else it may cause accidents such as malfunctions or explosions.
- Please read this manual carefully before wiring, otherwise damage might be caused to the robot controller.
- Grounding works must be implemented properly.
- Do not disassemble or change the wiring while powered on, otherwise it may result in

electrical shocks.

- Please ensure that the emergency stop device can be enabled at any time before powering it on for operations.
- The power of the controller must be turned off before repairs or maintenance.
- Do not get close to the operating range of the robot before or after powering on for operations, and leave a warning at an obvious place to prevent injuries or fatalities to the staff.

If you still have questions concerning the usage, please contact a dealer or our company's customer service center.

No further notifications will be given for any changes in the contents or specifications of this manual. Please download the latest version from the Delta website.

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Safety Notice

This manual includes safety precautions on user safety and how to prevent the robot from getting damaged; warnings and notes are used in this manual to describe how important these safety precautions are. Warnings are used to describe supplementary explanations; users must read the items in the warning, danger and stop carefully in order to prevent accidents or causing injuries to the staff.
The installation and transportation of the robot should be executed by qualified personnel and should comply with the regional country and local laws and regulation requirements.
The integration of the robot and the robot's peripherals as well as the construction of the safety protection device should be executed by the final system integrator in order to ensure the overall safety of the system.
This robot was designed only as an accessory for specific applications. We strongly suggest that this robot should not be modified and/or used for any application processes other than what it was designed for. If you have any application problems, please do not use the robot until you have received detailed explanations from your dealer.

Definition of operators

The definition of robot operators is as follows.

Operator:
Able to perform operations such as powering the controller ON/OFF.
Able to start the robot from the final system integrated operation panel.

Program editor:
Performs the operations on the robot.
Uses manual mode to operate the robot or teach points, etc. outside the safety fences.

Repair or inspection personnel:
Perform simple operations of the robot.
Uses manual mode to operate the robot outside the safety fences.
Performs operations such as maintenance, repairs, adjustment and replacement, etc. to the robot and controller.

Product conforms to the Machinery Directive 2006/42/EC, Low Voltage Directive 2014/35/EU, EMC Directive 2014/30/EU and related standards EN ISO 12100, EN ISO 10218-1, EN ISO 13857, EN ISO 4414, EN ISO 13849-1, EN60204-1, EN 61000-6-2, EN 61000-6- 4, EN 61000-3-2, EN 61000-3-3.

Note: Please read the manual carefully before operating, maintaining or inspecting the robot and controller, and make sure to follow the safety regulations. Please contact our company for details if you have any questions.

Definitions of stop, danger and warning

For your safety, please read this manual before using the robot and have a clear understanding of all contents related to safety and warnings.
Robot operators must receive training, read and understand how to use the safety measures, also to follow and execute all the rules described in this manual.

Meanings of the symbols “Danger”, “Warning” and “Prohibited”.

“Danger”

- Means that danger is about to happen and may result in fatalities or severe injuries to the staff, if not prevented.

“Warning”

- Means that there is potential danger and may result in fatalities or severe injuries to the staff, if not prevented.

“Stop”

- Refers to activities that are absolutely prohibited; failure to comply may result in damage or malfunctions to the product causing the product to be unusable or it may result in injuries to the staff.

Noise prevention

- There is excessive noise that may affect the hearing when the robot is operating; operators should wear earmuffs if feeling any discomfort.

Installation safety

- Please read this manual carefully before installing in order to make sure that the robot and controller are installed at suitable usage locations and environments, to avoid affecting the mechanisms and usage life of the electronic components or encountering other safety problems.
- The robot arms DRV70/90L7D/E series can only be used with our company's controller DCV-2J00-CA. Please do not modify the machine or wiring by yourself or use with other controllers or robots. Our company will not be held responsible for any injuries or fatalities caused by accidents that result from doing so.
- Please follow the instructions in this manual properly to transport and install the robot and controller correctly, otherwise it might result in damage to the robot or controller.
- Related licenses are required to operate stackers or fork lifts etc.
- Please wear proper safety work clothes, helmets, gloves and shoes when installing the robot and controller in order to ensure the safety of personnel.
- On automated production lines, the operating range of multiple robots may overlap; please make sure they do not interfere with one another otherwise there might be impacts causing damages to the robots.
- Do not add additional cables or hoses etc. inside the robot. When installing the exterior cables of the robot, make sure to assess whether the cables and mechanisms will interfere with one another during operations.

- Only clean dry air (CDA) can be used for the installation of the air source at the input terminal of the robot air hose; oil or steam must not exist in the air source otherwise it may cause the mechanisms inside the robot to rust or get damaged
- DRV70/90L7D/E series are applicable for environment IP40 and is able to resist solid matters with diameters over 1mm but it is not protected against any liquid matter.
- Please follow the manual to install the safety protection devices such as fences, gratings, regional laser or pressure pads, etc. in order to prevent injuries or other dangers caused to the staff arising from impact by the robot within the operating range of the robot.
- Please install the final system integration of the user operating buttons and warning lights etc. outside the fences in order to ensure usage safety. The height of the operating interface should be a suitable (0.6m to 1.7m) range for operators to touch.
- Please do not turn the power on and off frequently as doing so may result in damage to the controller.
- The robot system should be installed under the specified conditions; in the foreseeable usage period, the robot cannot be tilted or moved with uncontrolled methods during transportation, assembly, dis-assembly, suspended or discarded periods.
- Please properly ground all robot systems; they should all be grounded before connecting the power.
- The final system integrator should install protection devices in order to prevent users from getting close to the danger area.

- Removing or changing the locations of any safety warning labels is strictly prohibited as doing so may cause danger to the staff and to cause injuries.
- Performing any unsafe actions at the safety warning locations is strictly prohibited as doing so may cause injuries to the staff.
- Personnel must not stand beneath when stackers or fork lifts, etc. are used to move the robot as doing so may result in injuries or other dangers.
- Stacking objects on top of the robot, controller or cables is strictly prohibited as doing so may cause damage to the robot, controller or cables.
- Changing or modifying the robot and controller is strictly prohibited as doing so may result in damages to the robot or controller and danger to the staff. Our company will not be held responsible for any work accidents.
- Installing and wiring of the robot by people without related professional knowledge or licenses is strictly prohibited.

Usage and operating safety

- Please read this manual carefully before usage in order to ensure proper usage and the safety of the maintenance staff.
- Due to operational environment and operator safety considerations, our company will provide dedicated training for the operators of different robot applications in order to ensure usage safety. Please contact our company or your local dealers if training is needed.
- Please perform wiring properly according to this manual; wiring must be performed by personnel with related professional knowledge or licenses.
- Please use our company's handheld teaching pendant (DTV-2FM or DTV-2GM) and install it on the controller DCV-2J00-CA to perform manual operations and edit programs.
- Cannot be used on production lines that are flammable, explosive, toxic or has the risk of being sprayed by liquids.
- Please select a suitable model according to the load capability; do not overuse specifications that exceed the machine model specifications.
- The robot is a partially completed machine; the assembly and construction of the protection and safety circuit should be the responsibility of the final system integrator.
- All children and visitors should keep a safe distance from the processing area.
- Do not wear loose clothes, ties, rings or bracelets and wear protective nets to protect long hair as these things can easily get caught in the machine by accident and cause injuries to the staff or cause other dangers during operation.

- Please turn off the power, isolate the power properly and wait for the robot to stop completely when the robot is no longer used before you leave.
- Please confirm that there is no one along the fences before operating the robot and performing operations.
- Do not laught or talk to other workers while operating the robot; such wrong behaviors may result in collision of the robot or injuries to other workers.
- Please use the two-stage key selection switch to change between T1 and Auto mode; the keys must be able to be unplugged in both directions.
- Please have the senior supervisor keep the T1/Auto mode selection switch key; do not place it randomly or leave it inserted on the selection switch as doing so may result in other personnel activating the robot accidentally, causing injuries to the workers.
- Please do not stand within the moving range of the robot when teaching the robot manually for the first time in order to prevent danger from occurring due to your being unfamiliar with theoperations.
- Please use slow speed operations when operating the robot manually for the first time, otherwise being unfamiliar with the operations may result in damage to the robot due to impact or cause injuries to other workers.
- Please do not turn the power on and off frequently as doing so may result in damage to the controller.
- Improper operations might damage the robot.
- When collisions happen to the robot, please first turn off the power of the robot and then check the components and cables of the robot to make sure they were not damaged before turning the power back on to perform

operations again.

- Please use a safety lock on the fences switch when entering the fences to operate the robot in order to prevent the fences from closing suddenly causing the robot to be activated accidentally.
- If the teaching pendant cable on the controller needs to be removed, please do so when power is completely cut, otherwise the teaching pendant might get damaged.
- The location of the interlock switch between the structure of the safety protection device and the protection device should comply with EN ISO 14120 and EN ISO 14119 standards, and the safety distance should be designed according to EN ISO 13857 standards.

- Do not randomly make any changes to any components on our company's handheld teaching pendant, including the emergency stop and Enable switch; doing so will lower the safety performance and level, even lose the safety protection.
- Short-circuiting of any safety protection signals on the controller is strictly prohibited, otherwise our company will not be held responsible for any work accidents that may occur.
- When operating the robot all personnel are prohibited from standing close or within the robot working range; doing so will cause injuries to the other workers.
- Do not unplug any cables on the controller while the robot is operating; doing so will cause damage to the controller.
- Do not open the protective cover or protection device while the machine and robot are operating.

Maintenance safety

- Please perform maintenance and inspection work properly according to the manual in order to prolong the usage life of the robot.
- Please add a safety lock on the power switch of the power box when performing maintenance or repair operations on the robot, and place a “Do not power on” safety warning at an obvious place.
- Make sure foreign objects do not get attached or enter the robot when performing maintenance or inspection.
- Making random oil changes during maintenance may result in damaging the performance of the robot or to the mechanical components.
- Protection devices and repair doors in the danger areas that need to be opened or removed regularly for the purpose of operations, maintenance, cleaning and configuration should be interlocking.
- Personnel performing maintenance or repairs on the robot or robot system should receive the necessary process training in order to execute the tasks required. Also use only genuine materials, or else it might cause grave danger to the users.
- The processing of waste materials should comply with local laws and regulations, and should be treated carefully.

- Random changes to the maintenance schedule of the robot and maintenance oil are strictly prohibited.
- Maintenance and inspection to the controller and robot are prohibited while power is being supplied or else it may cause electrical shocks or injuries to the workers.
- When a robot component is damaged, replacing with other brand components is prohibited as doing so many result in damaging the performance of the robot or the components.
- When internal components of the controller are damaged, replacing them with other brand components is prohibited; doing so may cause accidents or result in decreasing the safety performance levels.
- The controller must not be opened within 10 minutes of powering off because the residual voltage in the driver may cause electrical shocks.

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1. Warning label explanations

The description to the location and explanation of the safety warning stickers are as follows; operators should get familiar with the locations of the safety warning labels before use and know the meanings of each safety warning in order to prevent accidents from occurring.

- Please be aware of the locations of the safety warning labels during operations, or else it may result in workers sustaining injuries.
- Operators should get familiar with the locations of the safety warning labels before use and know the meanings of each safety warning in order to avoid risks.

- Removing or changing the locations of any safety warning labels is strictly prohibited as doing so may cause danger to the staff and cause injuries.
- Performing any unsafe actions at the safety warning locations is strictly prohibited as doing so may cause injuries to the staff.

1.1 Sticker labels on DRV70/90L7D/E

Figure 1.1 shows all warning sticker locations of DRV70/90L7D/E series Robot arm; Table 1.1 shows the contents of each warning sticker.

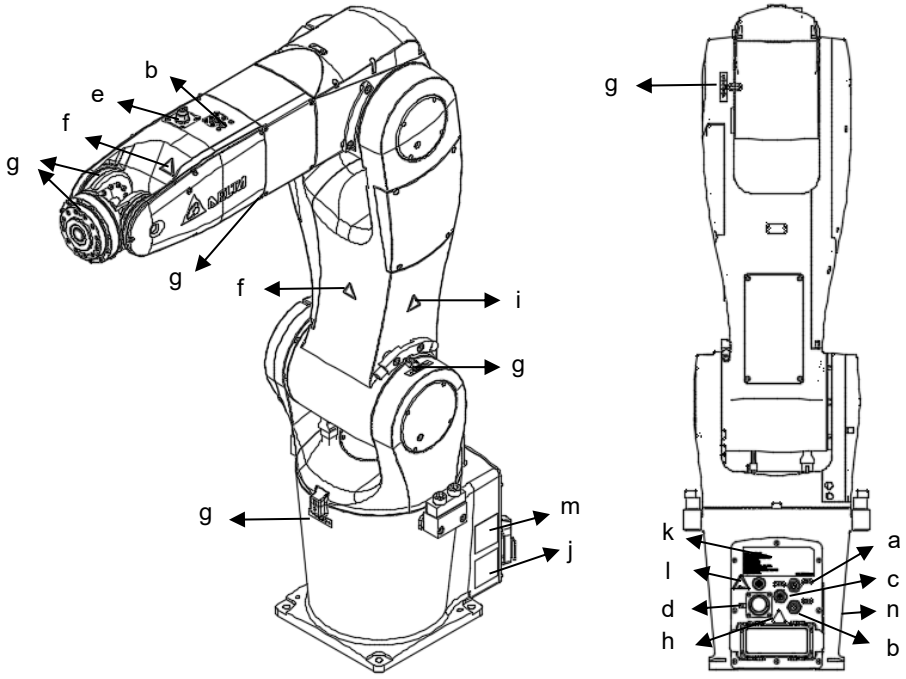
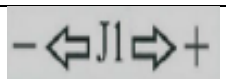
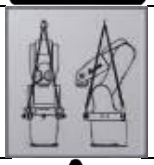


Figure 1.1 DRV70/90L7D/E series warning stickers

Table 1.1 DRV70/90L7D/E series sticker content descriptions

Item	Part No.	Name	Flag	Note	Qty
1	a	Air hose 1	AIR1	The first air hose provided inside the mechanical arm.	1
2	b	Air hose 2	AIR2	The second air hose provided inside the mechanical arm.	2
3	c	Air hose 3	Test	Signal and solenoid valve connector sticker; 24 pins in total.	1
4	d	Connector 1	X1	12 pins in total for user wiring.	1
5	e	Connector 2	X2	12 pins in total for user wiring.	1
6	f	Squeezing injuries warning		When the robot is operating, do no put your hands in dangerous area, or you might get squeezed and injured.	2
7	g	J1 to J6 axes moving direction		Moving directions of the axes.	6
8	h	Hazardous voltage		Hazardous voltage. Do not touch.	1
9	i	Crush warning		Do not enter the working range of the machine while the machine is operating or else workers might bump onto the robot; it may even cause fatalities when severe.	1

Item	Part No.	Name	Flag	Note	Qty
10	j	Read before use		Read the manual carefully before use in order to ensure proper usage; otherwise it may cause an accident.	1
11	k	Product nameplate		Product information such as model name and specifications.	1
12	l	Falling robot warning		The robot might fall down due to gravity when the brake release signal is activated. Watch out to prevent falling hazards.	1
13	m	Transporting		Transporting method of the robot.	1
14	n	Battery		Remove the cover and you can see the encoder Li-ion battery; please change the battery once a year.	1

1.2 Stickers on the controller

Figure 1.2 shows the DCV controller warning sticker location; Table 1.2 shows the contents of each warning sticker.

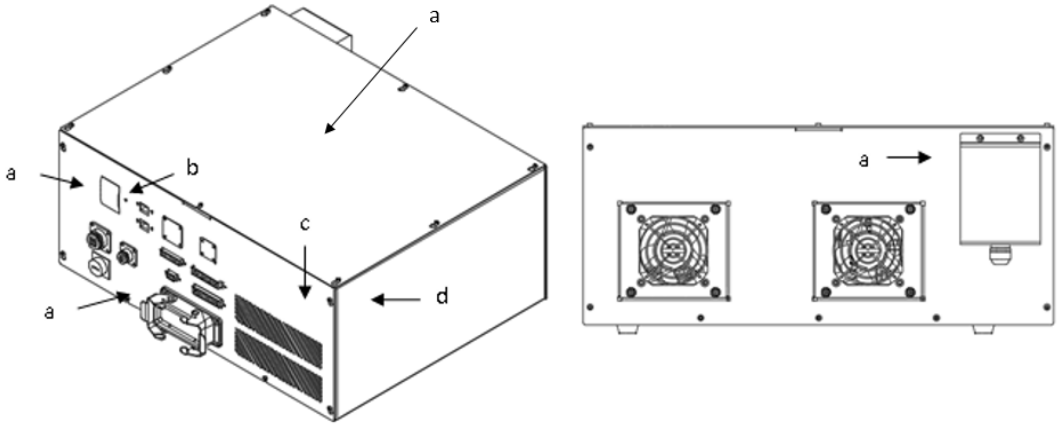


Figure 1.2 DCV controller warning stickers

Table 1.2 Warning sticker content explanation

Item	Part No.	Name	Flag	Note	Qty
1	a	Hazardous voltage		Electric shock hazardous. Do not touch it.	3
2	b	Lockout the energy		Turn power supply OFF before inspection, maintenance, adjustment and cleaning.	1
3	c	Read before use		Read manual before use	1
4	d	Product sticker		Product related model and specification explanations, etc.	1

1.3 Robot nameplate description

DRV70/90L7D/E series robot nameplate description contents are as shown in Figure 1.3 and Table 1.3 below.

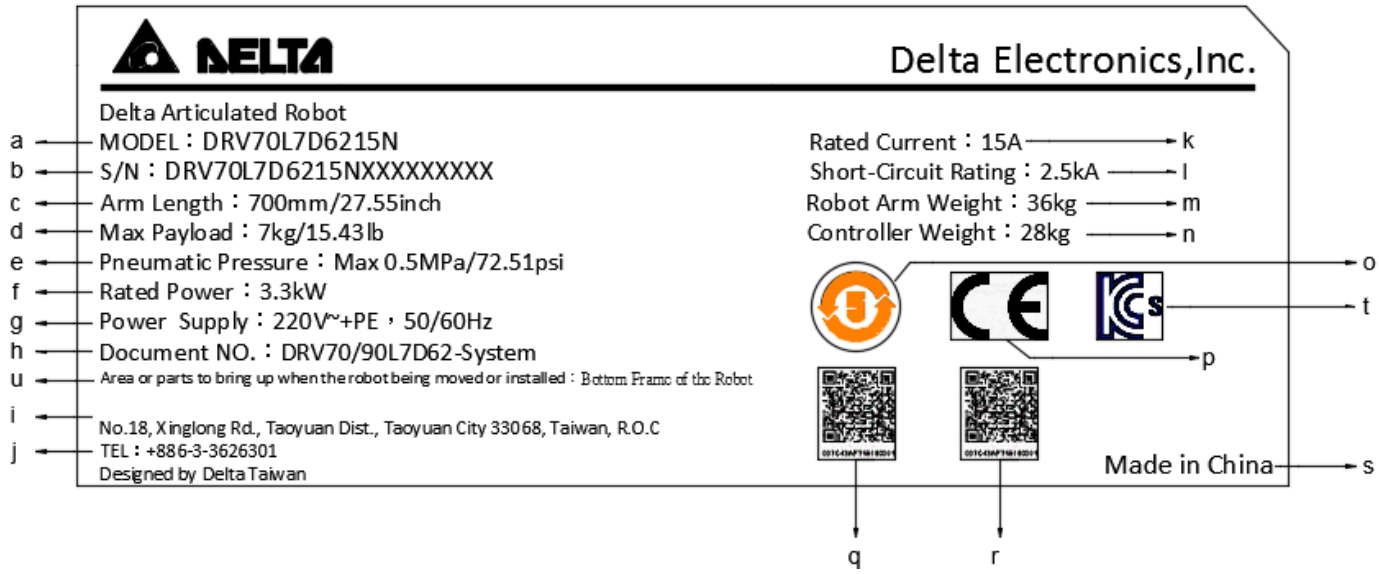


Figure 1.3 DRV70L/90L7D/E series nameplate

Table 1.3 DRV70/90L7D/E series nameplate description

Item	Part No	Note
1	a	Robot system model name
2	b	Product serial number, including manufacturing year, month, manufacturing origin and other related messages
3	c	Robot arm length
4	d	Max payload
5	e	Maximum pressure that can be tolerated by the air hose inside the robot
6	f	Total Power
7	g	Controller input power information, voltage and frequency
8	h	Robot user manual document number
9	i	Contact number and address of our company
10	j	Design factory area
11	k	Rated current
12	l	Short-Circuit Rating
13	m	Robot arm weight
14	n	Controller weight
15	o	Recycling years of battery inside the robot, 5 years
16	p	CE mark
17	q	Customer service information QR Code icon
18	r	Production information QR Code icon
19	s	Made factory area
20	t	KCs mark
21	u	Notice

2. Transport and Installation

Please execute the transportation and installation according to the instructions in the manual properly, otherwise it may result in the dropping and damaging of the robot etc.

- Related licenses are required to operate stackers and fork lifts etc. when transporting the robot.
- There are electronic components and precision components inside the robot device, therefore please be careful not to allow strong collisions to hit this device during the transport process.
- Workers must not stand below the transporting object when operating a lift; there must be workers directing from the side in addition to the lift operator in order to prevent accidents from occurring.
- Please be careful not to tilt the robot device when using the lift, otherwise it may result in injuries.
- Please remember to wear safety shoes and safety gloves when moving the controller manually in order to prevent getting crushed.

2.1 Transportation

There are 3 methods to transport the robot: using fork lift, stacker or lift, as shown in Figure 2.1 below.

Fork lift

Stacker

Lift

Figure 2.1 Transportation device type

Note: Operators must have related licenses when using fork lifts or stackers, or have equal number of training hours before performing operations and to ensure that no damage will be caused to the robot and no injuries will be caused to workers.

Transportation steps:

1. Please extend the fork lift under the wooden pallets properly, otherwise it may cause tilting injuries as shown in Figure 2.2 below.

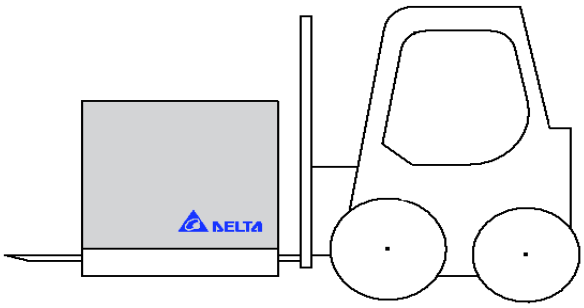


Figure 2.2 Fork lift transportation illustration

2. Elevate the fork lift or lift until it is off the ground and make sure they are not tilted, otherwise the product might drop during the transport process. When faced with uphill or downhill roads, please adjust the height or tilt angle of the fork lift accordingly so that the product will not tilt or tie down the product properly.

3. Confirm whether there is anyone close by during transport; there should be workers on the side responsible for guiding and directing in addition to the stacker operator. Please operate the stacker with the speed set according to the company rules; do not operate the stacker at a high speed.

4. Once the robot is transported to the installation location, please open the carton and remove the robot, controller, cables and handheld teaching pendant (optional) carefully, as shown in Figure 2.3 below.

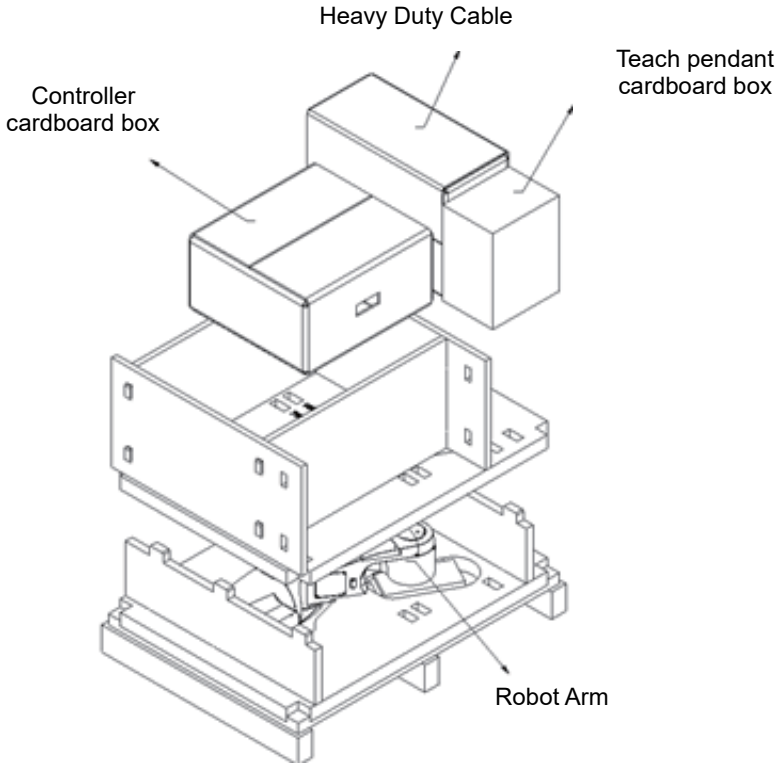


Figure 2.3 Package removal

5. When transporting the robot, please have at least 2 or more movers with professional training to perform the transportation operation. When implementing the transportation operation, connecting the power, or transporting while the arm is still in operation, are strictly prohibited in order to prevent worker casualties or damaging the arm. Hoisting transportation method is as described below figure 2.4.

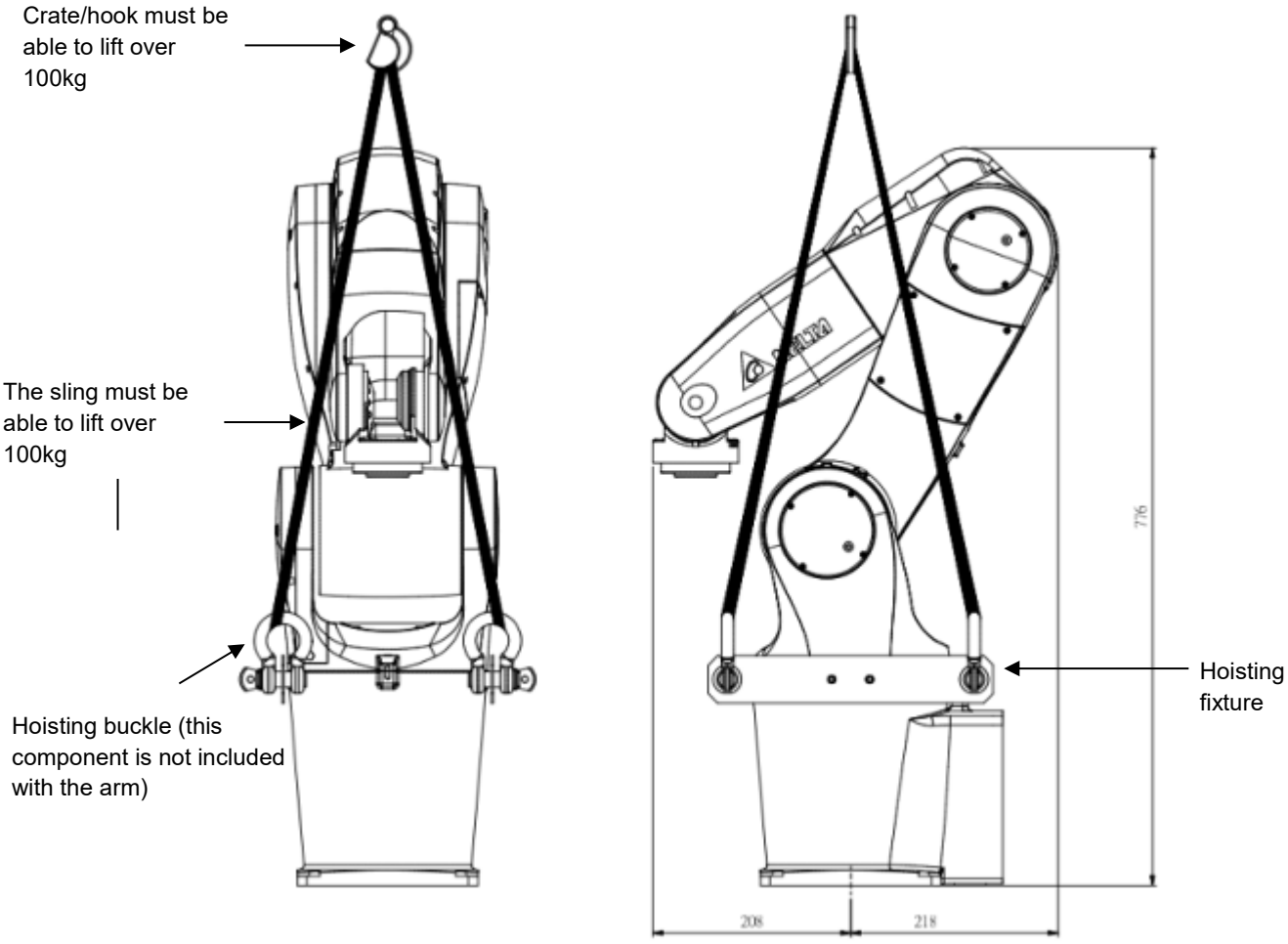


Figure 2.4 DRV70/90L7D/E series hoisting transportation description

6. Remove the controller and put both hands around the bottom of the controller to transport it.
Or, use a cart for transportation; please consider whether the road is bumpy when using a cart, or else the electronic components and precision components inside the controller device might get damaged.

2.2 Installation

- Please read this manual carefully before installing in order to make sure that the robot is installed at a suitable usage location and environment, avoid affecting the mechanisms and usage life of the electronic components, or encounter other safety problems.
- The robot arms DRV70/90L7D/E series can only be used with our company's controller DCV-2J00-CA; please do not modify the machine or wiring by yourself or use with other controllers. Our company will not be held responsible for any injuries or fatalities caused by accidents that result from doing so.
- The robot system should be installed under the specified conditions; in the foreseeable usage period, the robot cannot be tilted or moved with uncontrolled methods during transportation, assembly, dis-assembly, suspended or discarded periods.
- Please wear proper safety work clothes, helmets, gloves and shoes when installing the robot in order to ensure the safety of personnel.
- On automated production lines, the operating range of multiple robots may overlap; please make sure they do not interfere with one another otherwise there might be impacts causing damages to the robots.
- Please do not add additional cables or hoses etc. inside the mechanism. When installing cables outside the mechanism, make sure to assess whether the cables and mechanisms will interfere with one another during operations.
- When performing peripheral equipment adjustments, the power must first be cut off before performing adjustments.
- Only clean dry air (CDA) can be used for the installation of the air source at the input terminal of the robot air hose.
- Since the mechanical arm is a semi-finished product, if other operating modules are added or modifications are made, the original manufacturer will not be held responsible for any problems that result from them.
- Only the DRV70/90L7D series robot conforms to the IP40 specification and is able to resist solid matter with diameters over 1 mm, such as fingers; it is not protected against any liquid matter.
- The working range of the robot should be kept clean and ensure that it will not be used under environments affected by oil, water and dusts, etc.
- Please follow the manual to install the safety protection devices such as fences, gratings, regional laser or pressure pads, etc. in order to prevent injuries or other dangers caused to the staff arising from impact by the robot within the operating range of the robot.
- Please install the user operating buttons and alarm indicators outside the fences in order to ensure safe usage.
- Please properly ground all robot systems; they should all be grounded before connecting the power.
- The final system integrator should install protection devices in order to prevent users from getting close to the danger area.

- The robot does not have explosion-proof or splash-proof structures, so do not place it at locations that are too humid or can be easily splashed by liquids.
- Do not randomly stack objects on top of the robot and do not bump into the robot.
- Placing any objects on top of the cables connecting the controller and robot is prohibited, otherwise it may cause damage to the cables and result in injuries.

2.2.1 Articulated robot main body installation

The installation of the articulated robot should be as shown in Figure 2.5 below; the base should be locked on a flat surface and when locking it in place, M8 screws + flat gaskets should be used as shown in Table 2.1, then lock it in properly with the tightening torque.

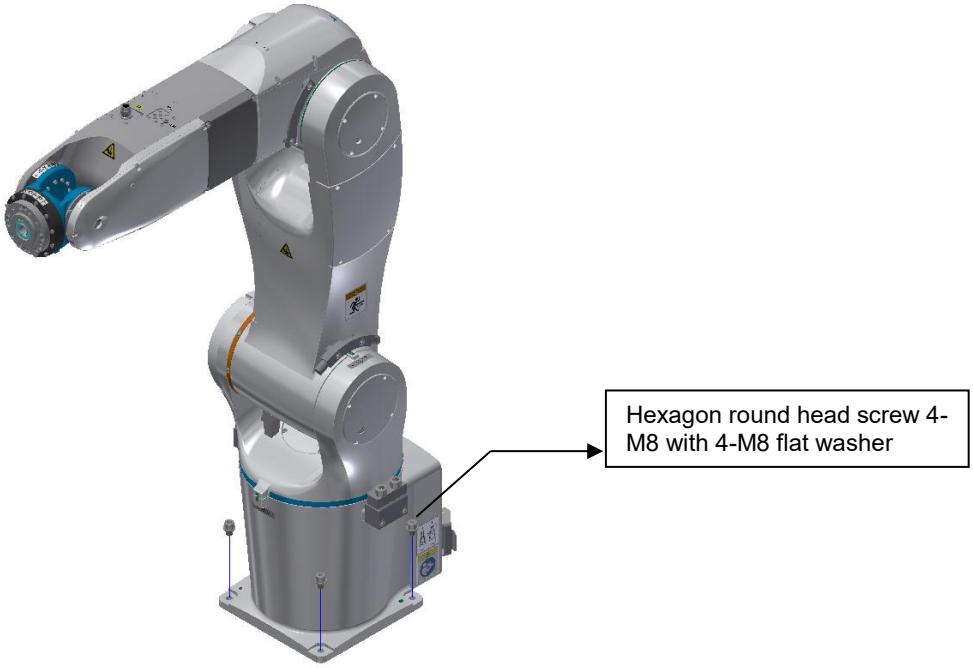


Figure 2.5 Robot installation screw lock position

Table 2.1 Robot installation tightening torque

	Tools	Screw type	Quantity	Screw torque
DRV70L/90L7D/E series	#6 hex wrench	M8 screw + M8 flat gasket	4	25N-m

2.2.2 Controller installation

1. The controller uses forced fan cooling; in order to keep the cooling cycle working well, when installingthe robot controller sufficient room must be left with neighboring objects and the baffle (wall), or else it may cause malfunctioning. Please refer to the controller installation space shown in Figure 2.6

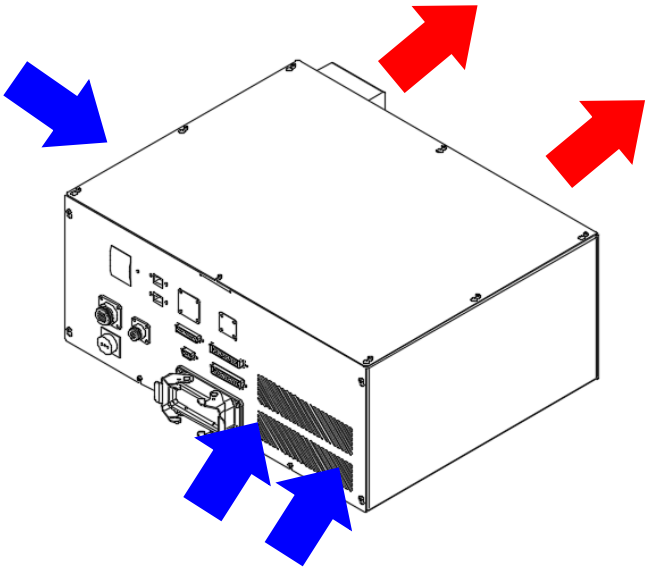


Figure 2.6 Controller cooling

2. The ventilation holes must not be blocked during installation; please keep 150mm distance or above in controller front. Please refer to the controller installation space shown in Figure 2.7.
3. Do not topple over the controller as doing so will cause it to malfunction.

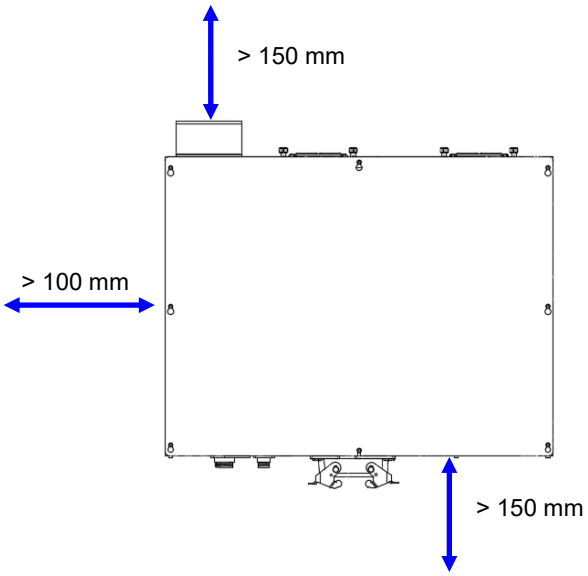


Figure 2.7 Controller installation distance

4. Controller power switch and other locations should be from the ground 0.6m to1.7m between to make it easier for users to operate. Please refer to the controller installation height requirement shown in Figure 2.7

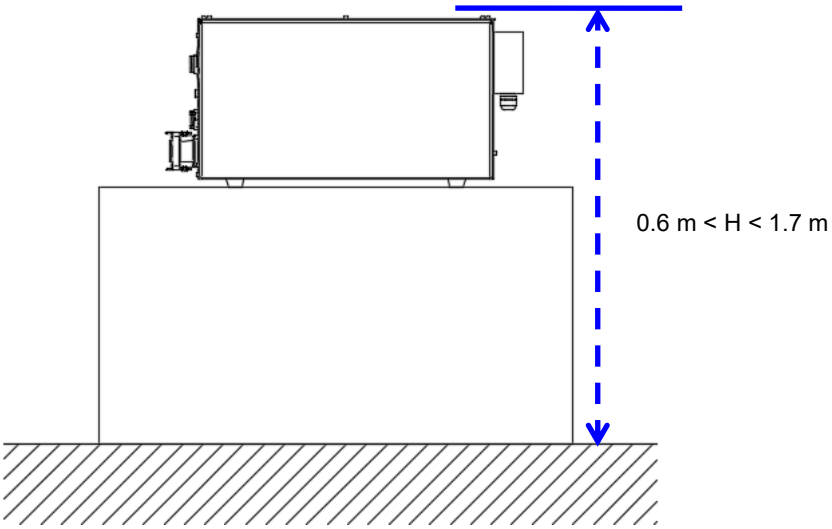


Figure 2.8 Controller installation height requirement

5. When fixing the controller in place, please do as shown in Figure 2.9 below and use 2 L-shaped plates to fix the controller tightly in place.

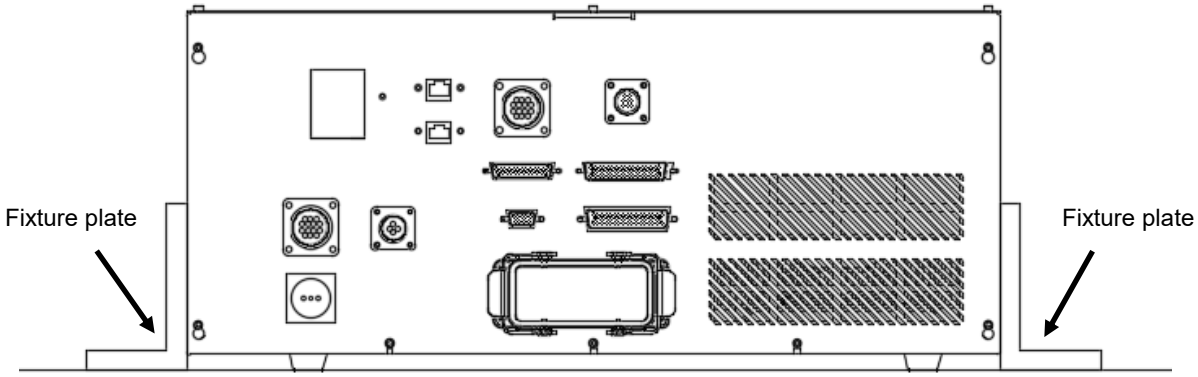


Figure 2.9 Controller fixture method

3. Robot safety protection

- The final system integrator must follow this manual properly to construct a safe overall protection system for the robot, otherwise it may result in injuries or fatalities to workers.
- Once the safety protection system and wiring are completed, then power can be connected to the controller and the robot can be operated.
- Please follow this manual to perform the construction of the safety protection and wiring, or else our company will not be held responsible for any injuries sustained by the workers.

- Do not perform any operations to the robot before the safety protection system construction is complete.
- Do not use any method to bypass the safety protection system; the safety protection system includes the emergency stop signal, fences, pressure pad, gratings, laser scanner and any safety device signals used to protect the workers.

3.1 Robot safety protection

The robot safety protection refers to the protection equipment set up around the robot; they are used to prevent workers from getting close while the robot is operating and causing an accident of getting hit.
The final system integrator should construct the safety protection device properly in order to ensure that the workers will not get hit by the robot and sustaining injuries.

Complete robot safety protection should include:

1. Emergency stop device
   Must be dual-channel NC contact mechanical type emergency stop device.
   This type of device can be an emergency stop button or pull-rope switch etc.

2. Fences, gratings, safety mats or laser scanners
   Use fences, gratings, safety mats or laser scanners within the working range of the robot to prevent workers from getting close and sustaining injuries.
   The maximum working range of the robot must be considered for the protection range.

3. Teaching pendant enable switch
   The 3-position switch on the back of the teaching pendant; this enable switch must be pressed when performing teaching point operations manually in order to teach. Releasing the switch or pressing the switch all the way to the bottom must be able to stop both robot operations.

3.2 Robot safety protection construction and installation

NOTE: The industrial robot applies for partly-completed machinery only. The end-gripper is not provided from this robot system. The related risk is responsible by end user or final system integrator. The safety-related control system provides interface for safety protections (e.g. fence interlocked switch, light curtain) for system integrator side, the related risk and safeguarding are responsible by employer or final system integrator.

3.2.1 Emergency stop device installation

This must be dual-channel NC contact mechanical type emergency stop device.
When the emergency stop button is used:
It must be a red type and has yellow background (the area of the yellow background must be greater than the red), as shown in Figure 3.1.

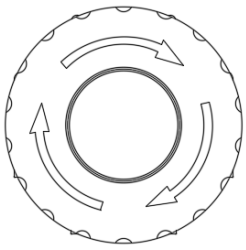


Figure 3.1 Emergency stop button

It must be equipped with a manual re-set function, as shown in Figure 3.2.

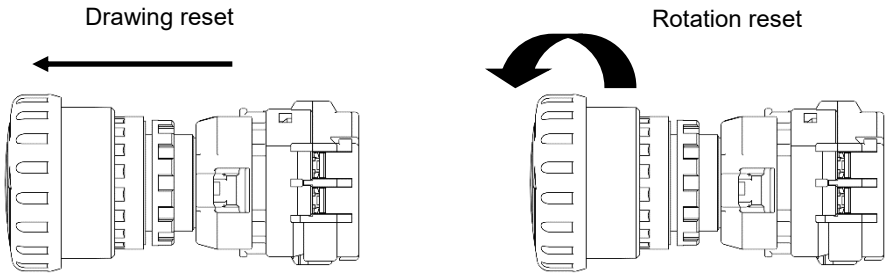


Figure 3.2 Emergency stop switch re-set method

It must be equipped with a disconnect function so that when the contacts are closed, the force used to press the button can be used to disconnect the closed contacts. This function symbol is as shown in Figure 3.3.

Figure 3.3 Emergency stop safety disconnect symbol

Please install multiple emergency stop devices according to the actual overall system, and take into consideration not to make the installation distance between each emergency stop too far in order to avoid not being able to press this button when emergency events occur.
Make sure the height of the emergency stop button installation is not too high or low; install it at a height that is accessible to workers.
The emergency stop buttons must be installed at obvious places and cannot be blocked by other devices.

3.2.2 Emergency pull-rope device installation

This must be dual-channel NC contact mechanical device, and must have a re-set button and the pull-rope must be able to be triggered at any position.
The installation height of the pull-rope must comply with average height and an accessible height; installing it too high will result in workers being unable to reach it.
The railing protection is still needed after you install the pull-rope switches. The pull-rope switches are there so that the emergency stop function can be triggered from any position.When installing emergency pull-rope devices, place them around the entire safety protection railing as shown in Figure 3.4 below.

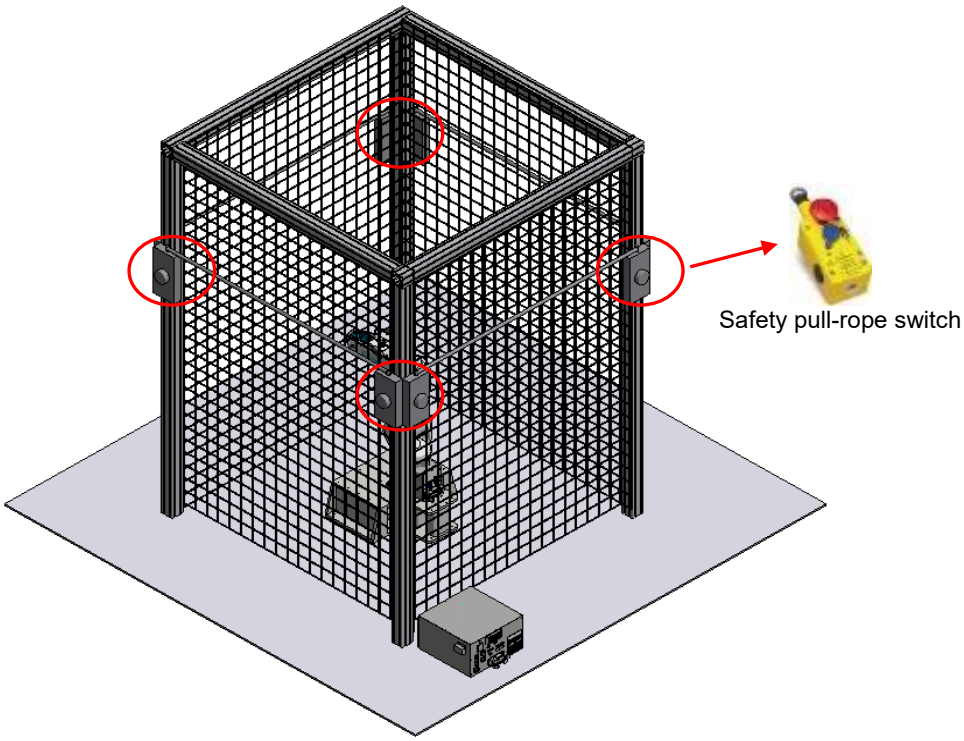


Figure 3.4 Safety pull-rope switch construction example

3.2.3 Fences installation

The power of the controller must be disconnected when performing adjustments to surrounding devices and confirm that the mechanical arm has stopped operating completely before performing adjustments, according to EN ISO 13857 (EN294 & EN811) safety distance for upper and lower limbs. Figure 3.5 below shows the installation height for the installation of the robot and fence protection; Table 3.1 shows the installation distance between the robot and the fences.

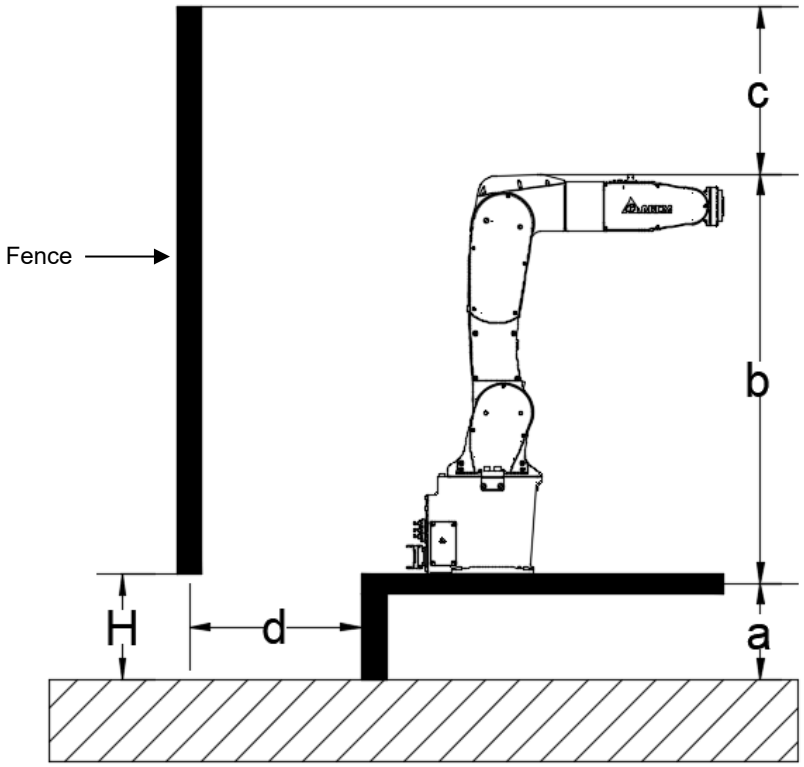


Figure 3.5 The installation height for fences around the robot

Table 3.1 Installation distance between the robot and fence

	a	b	c	d	H
	Machine installation height	Machine height	The fence should be higher than the machine height	The fence distance is higher than the table distance	Height under the fence
DRV70L7D/E series	30cm to 100cm		Refer to EN ISO 13857	Refer to EN ISO 13857	5cm to 20cm
DRV90L7D/E series	30cm to 100cm		Refer to EN ISO 13857	Refer to EN ISO 13857	5cm to 20cm

In addition, consider the length of the workers' arms so that the workers cannot touch the robot.Figure 3.6 shows an insufficient fences installation height; the worker's arm can still reach inside the railings.
Please construct the fences properly and take into consideration whether the worker's arm can reach inside the fences and touch the robot.

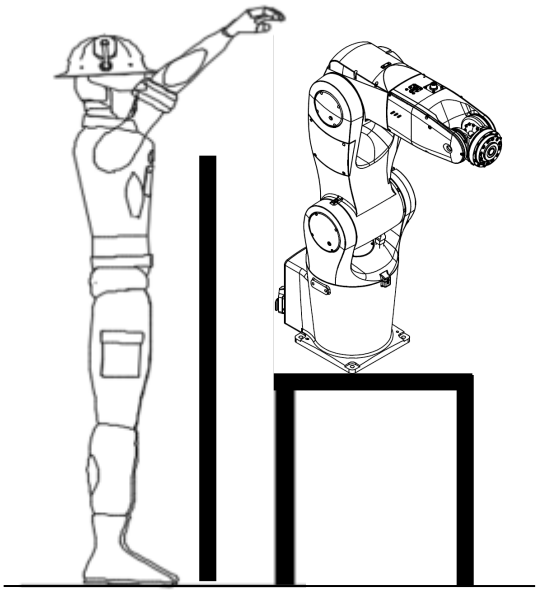


Figure 3.6 Insufficient fence installation height

3.2.4 Safety light curtain installation

The safety light curtain system shall comply with IEC 61496-1 and -2.
Improper installation and usage will also cause the risk of workers getting hit by the robot arm.
Please set up light curtain systems around the robot so that the light curtain system can detect workers no matter where they entered from.
The installing location of light curtain shall be considered the stopping time and calculated the safety distance accordance with EN ISO 13855.

DRV70/90L7D/E series safety light curtain protection area
Figure 3.7 shows the DRV70/90L7D/E series safety light curtain installation distance.

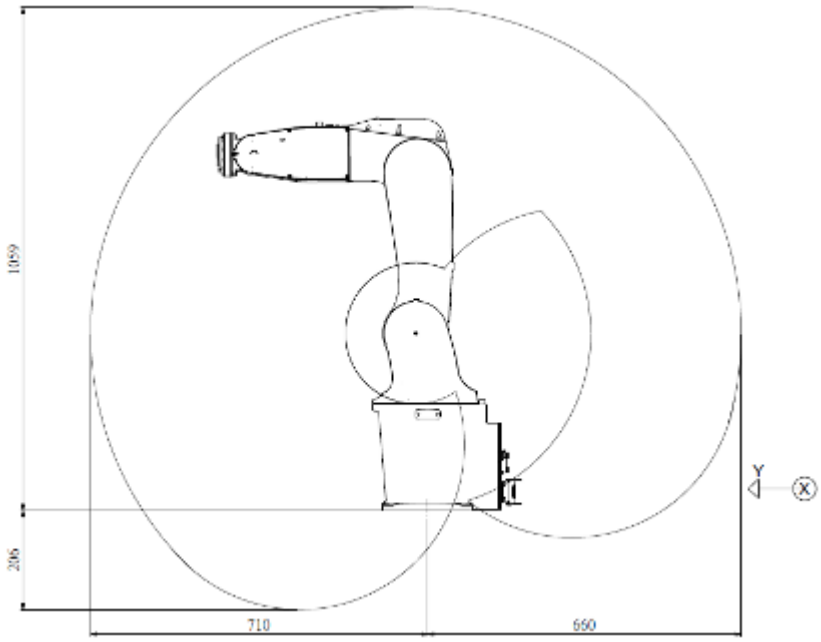


Figure 3.7 DRV70/90L7D/E series safety grating installation distance

Table 3.2 DRV70/90L7D/E series maximum working range

Maximum Working Range			
Item	Type	X	Y
1	DRV70L7D/E series	≥810	≥810
2	DRV90L7D/E series	≥1000	≥1000

3.2.5 Safety mat installation

The safety mat shall comply with EN 1760-1 (ISO 13856-1), and shall be able to detect operators over 35kg. Safety mat is another type of protection system around the robot. Since safety mats rest on the floor, it does not have height protection like railings. Calculate the size of the safety mats according to the total moving range of the robot arm.
Safety mats shall not be laid only around the robot when used; it shall be laid at the entire working area.

Figure 3.8 below shows the safety mat installation area for DRV70/90L7D/E series; in addition to calculating the maximum working range of the robot, an average of 1m (for reference only, the real safety mat laying range shall be considered the stopping time and calculated the safety distance accordance with EN ISO 13855) of worker arm length shall also be added in order to prevent the workers' arms from hitting the robot. So the actual installation shall take the arm length of most workers in that area into consideration.

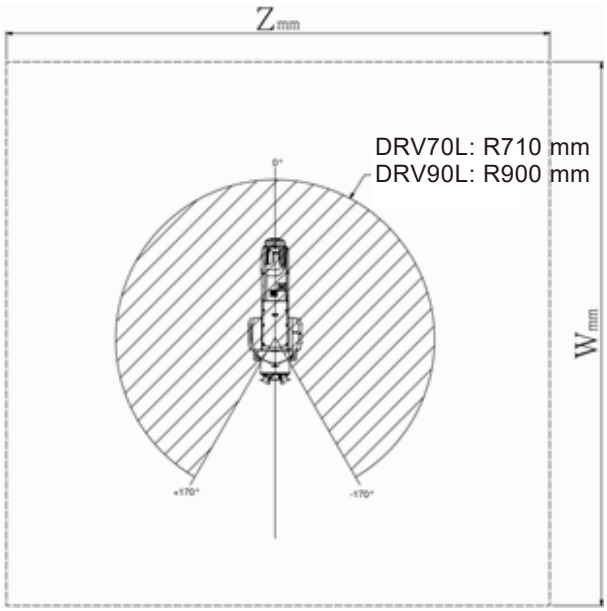


Figure 3.8 DRV70/90L7D/E series safety mat area

Table 3.3 DRV70/90L7D/E series safety mat distances

Safety mat distasnces			
Item	Type	W	Z
1	DRV70L7D/E series	≥2420	≥2420
2	DRV90L7D/E series	≥2800	≥2800

3.2.6 Laser scanner

The selected laser scanner shall comply with IEC 61496-1 & -3.

Laser scanner safety protection area
Consider the stopping time and calculate the safety distance in accordance with EN ISO 13855 when installing the laser scanner.

When installing the laser scanner, take into consideration both the operating range of the robot and the distance that the workers' arms reache into the robot.
The laser scanner shall not detect 360°, so please install another laser scanner for blind spots or where there is safety concerns. Figure 3.9 below is an illustration of laser scanner installation.

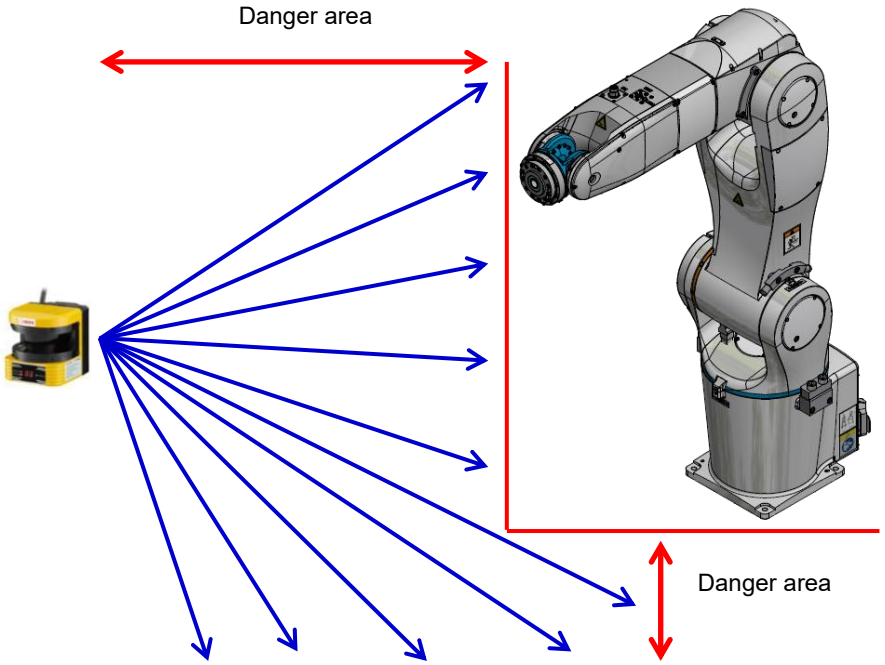


Figure 3.9 Laser scanner installation

3.2.7 Stopping distances and times

According to IEC 60204-1 Stop categories: Stop category 1 » STOP 1.

Table 3.4 Terms used

Term	Description
Stopping Distance(deg)	When stopping, the distance of robot from moving to hold still
Stopping Time(Sec)	When stopping, the time of robot from moving to hold still
Axes with the largest moving ranges	The three axes with the largest moving ranges are J1, J2, and J3 axes
Extension (l)	Distance (l in %) between axis 1 and the intersection of axes 4 and 5.
POV	Program override (%) = velocity of the robot motion
Payload 33	33% of the maximum load (7kg)
Payload 66	66% of the maximum load (7kg)
Payload 100	100% of the maximum load (7kg)

DRV90L Stopping distances and stopping times for STOP 1, J1

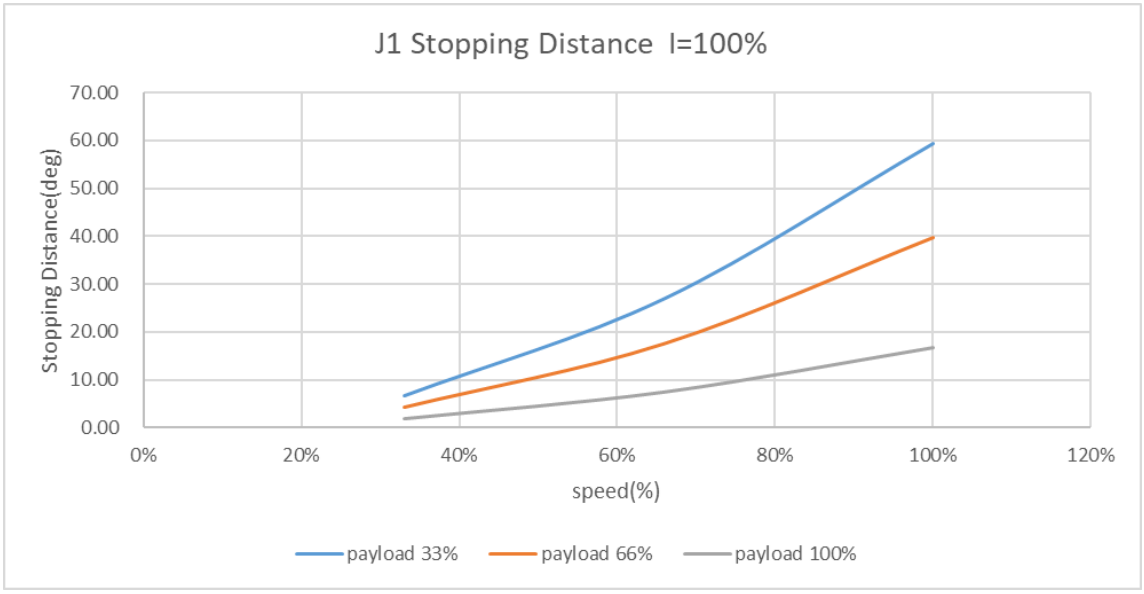


Figure 3.10 J1 Stopping Distance (DRV90L Extension 100%)

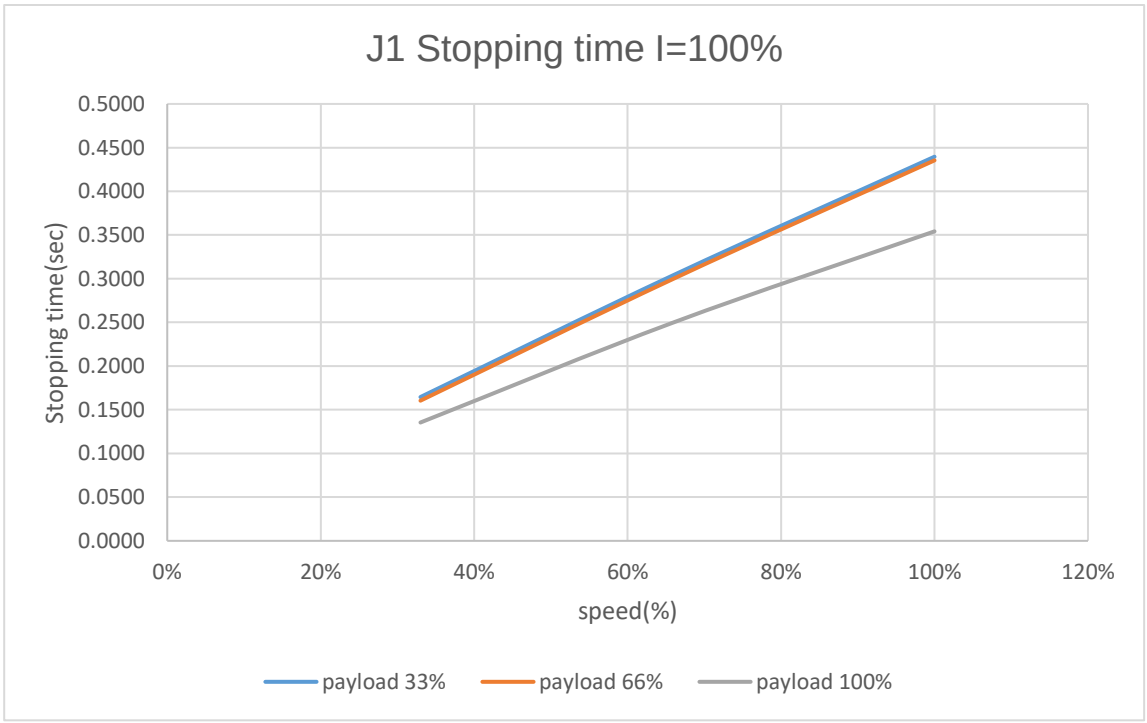


Figure 3.11 J1 Stopping time (DRV90L Extension 100%)

DRV90L Stopping distances and stopping times for STOP 1, J2

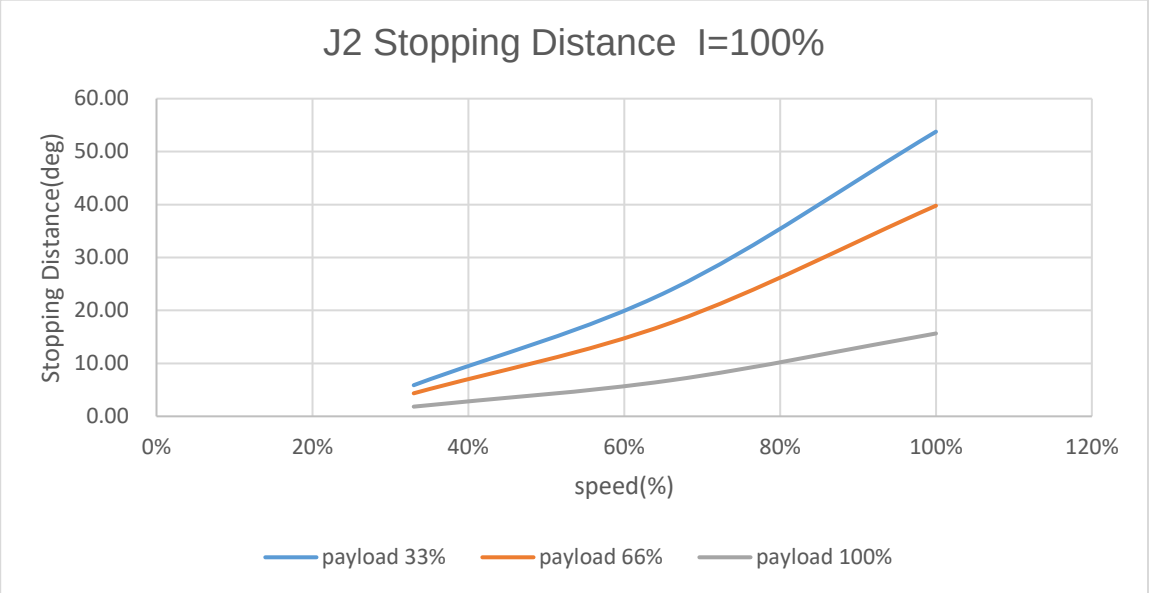


Figure 3.12 J2 Stopping Distance (DRV90L Extension 100%)

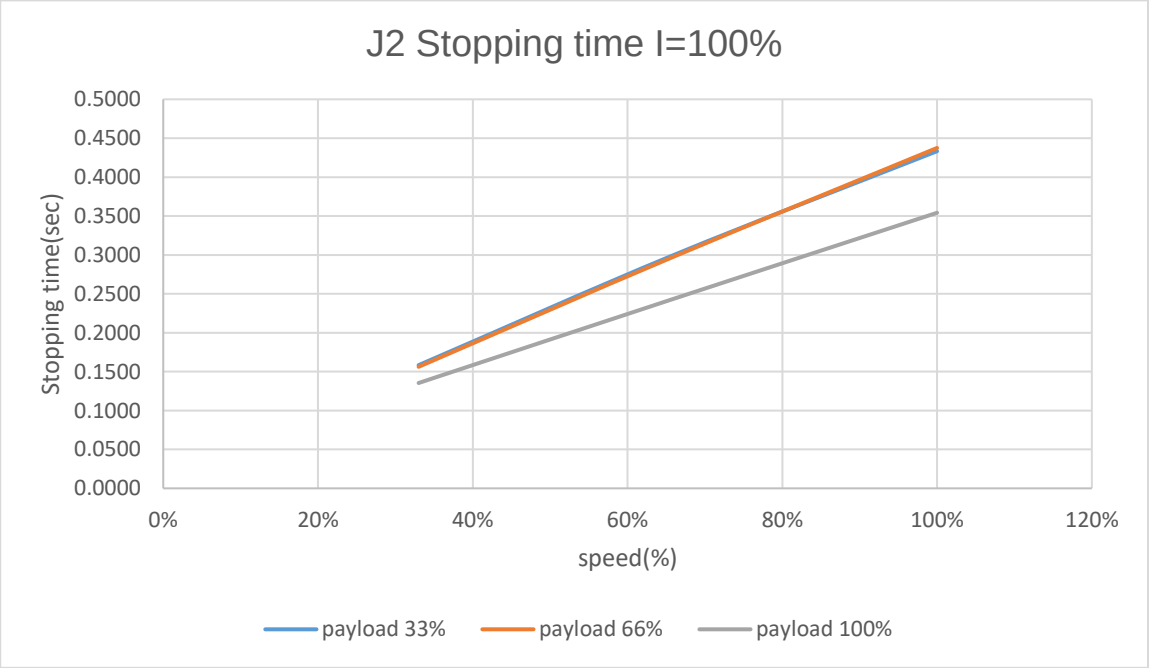


Figure 3.13 J2 Stopping time (DRV90L Extension 100%)

DRV90L Stopping distances and stopping times for STOP 1, J3

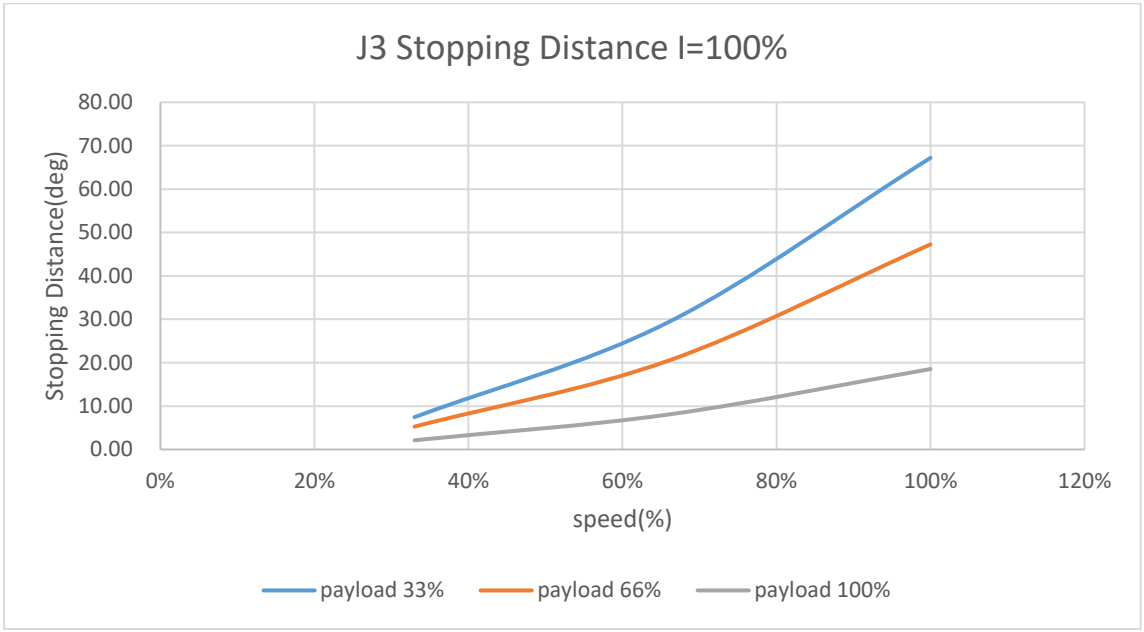


Figure 3.14 J3 Stopping Distance (DRV90L Extension 100%)

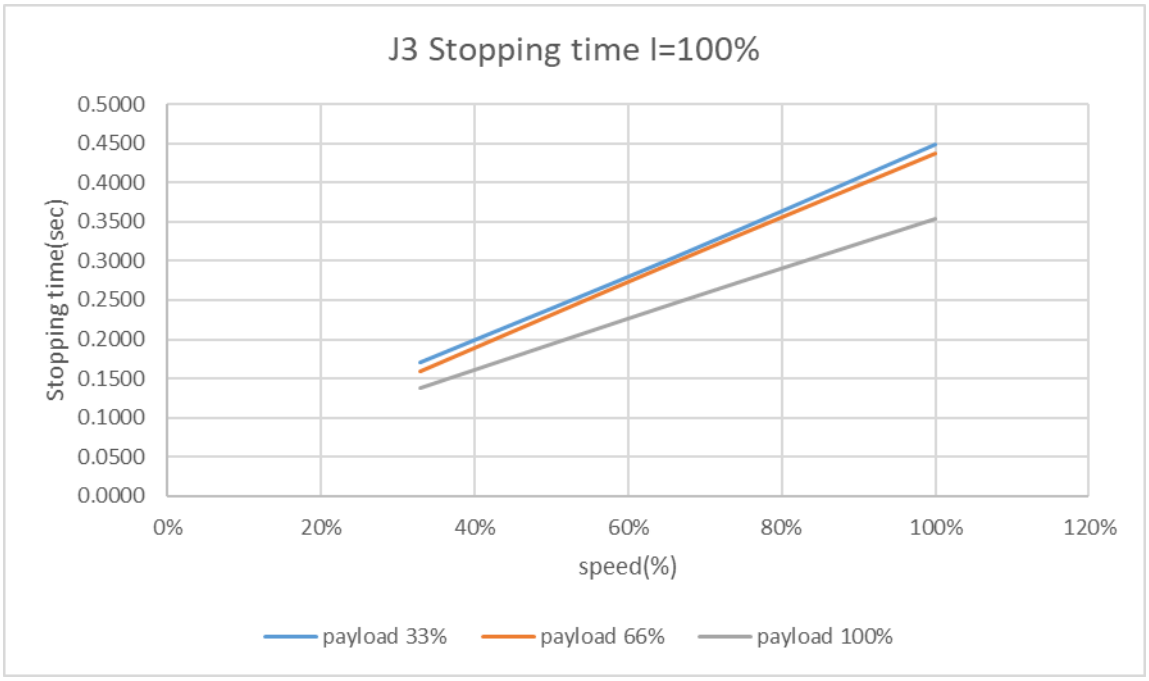


Figure 3.15 J3 Stopping time (DRV90L Extension 100%)

DRV90L Stopping distances and stopping times for STOP 1, J1

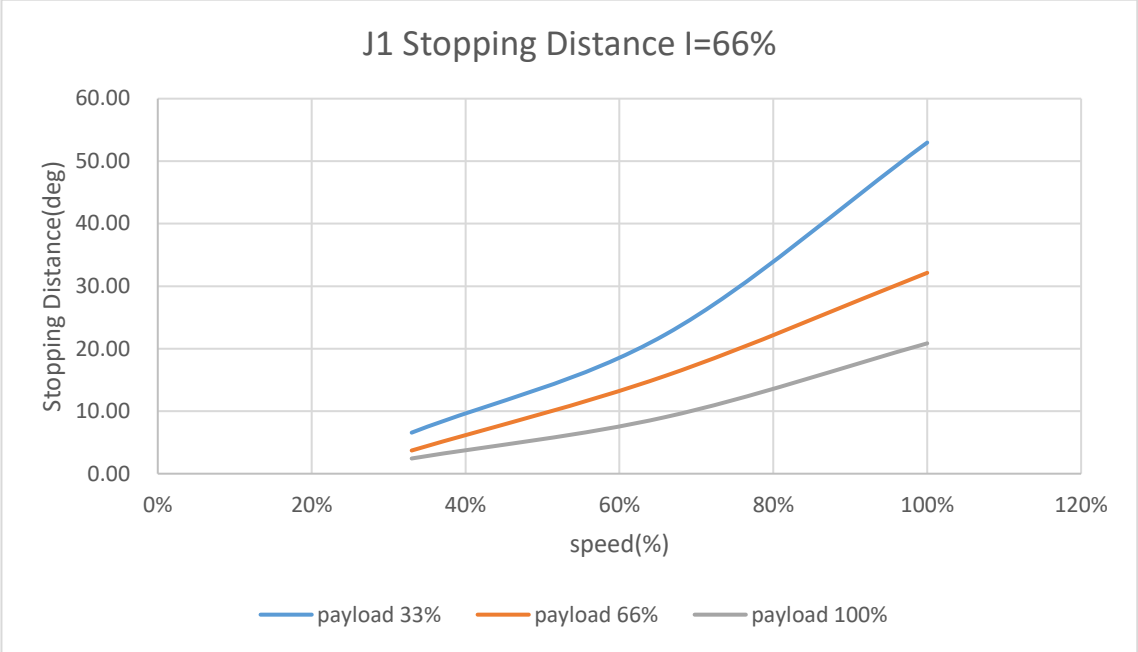


Figure 3.16 J1 Stopping Distance (DRV90L Extension 66%)

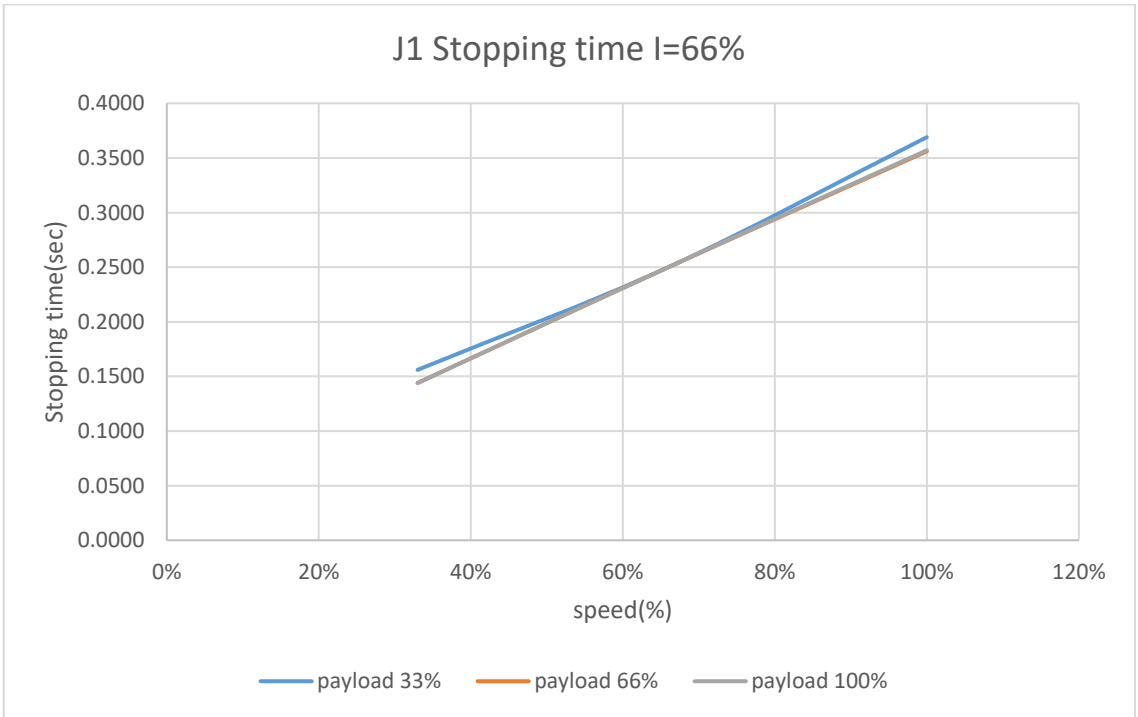


Figure 3.17 J1 Stopping time (DRV90L Extension 66%)

DRV90L Stopping distances and stopping times for STOP 1, J2

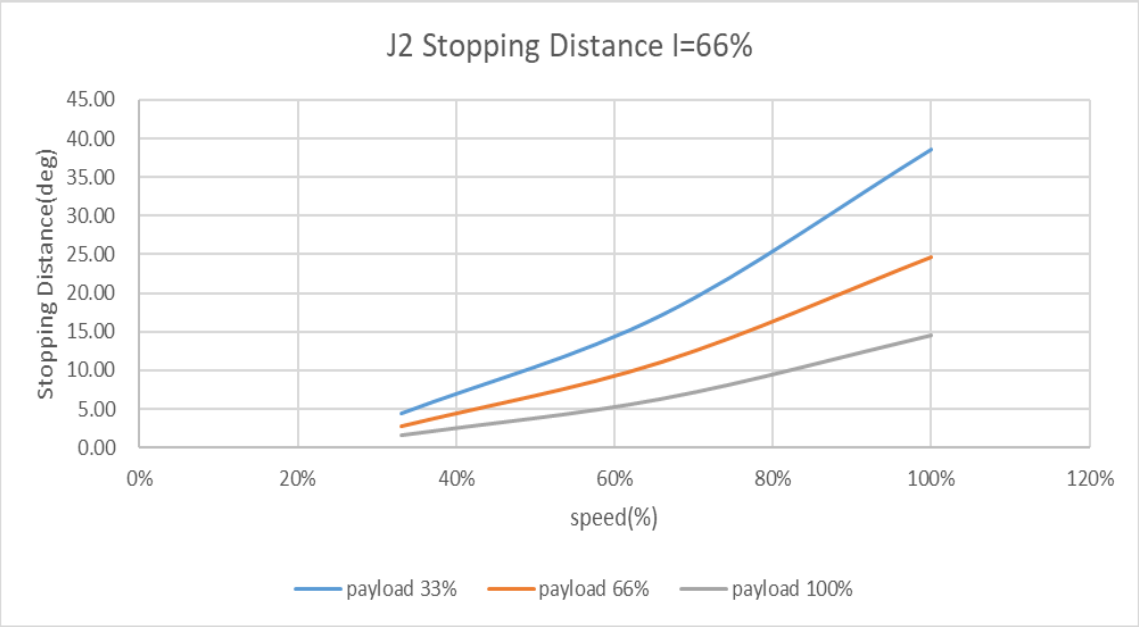


Figure 3.18 J2 Stopping Distance (DRV90L Extension 66%)

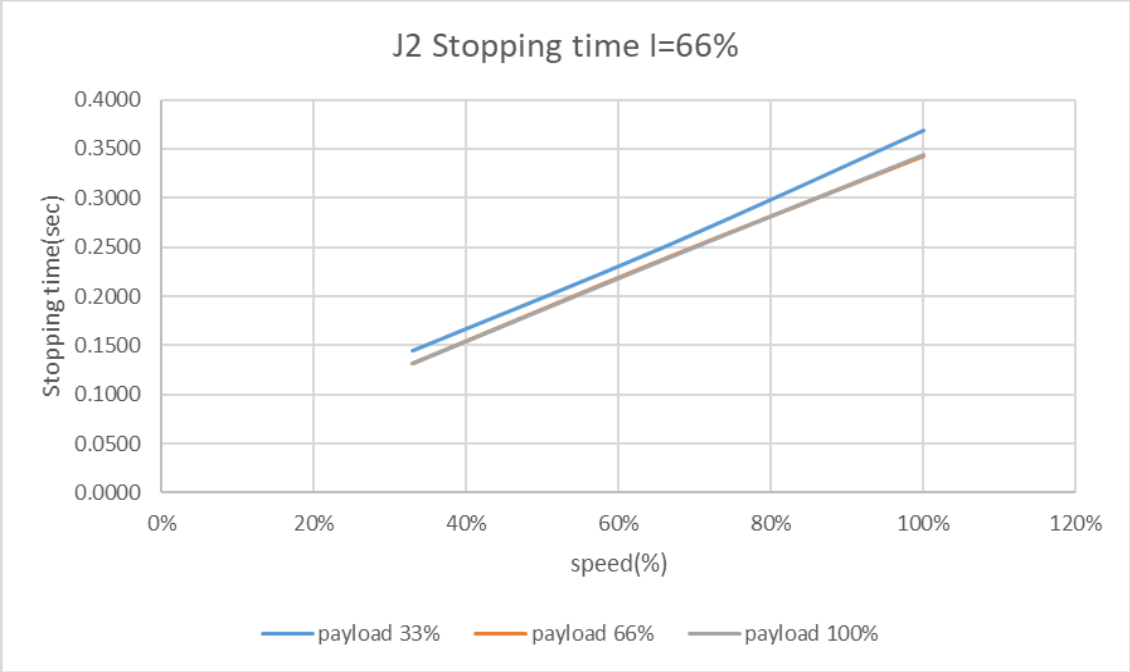


Figure 3.19 J2 Stopping time (DRV90L Extension 66%)

DRV90L Stopping distances and stopping times for STOP 1, J1

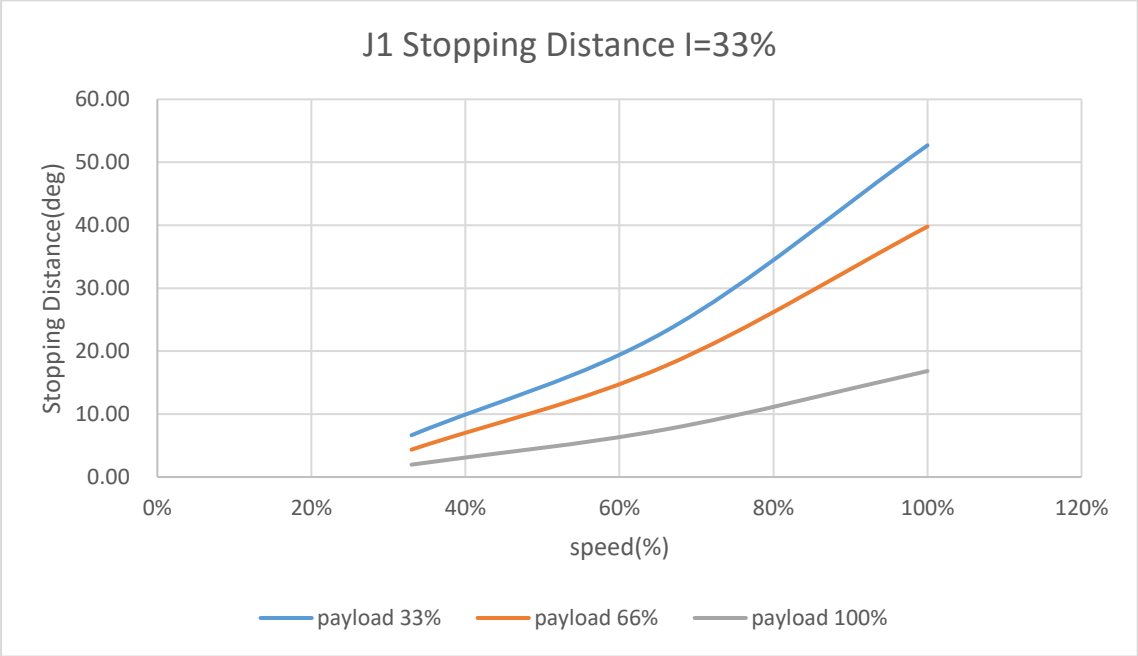


Figure 3.20 J1 Stopping Distance (DRV90L Extension 33%)

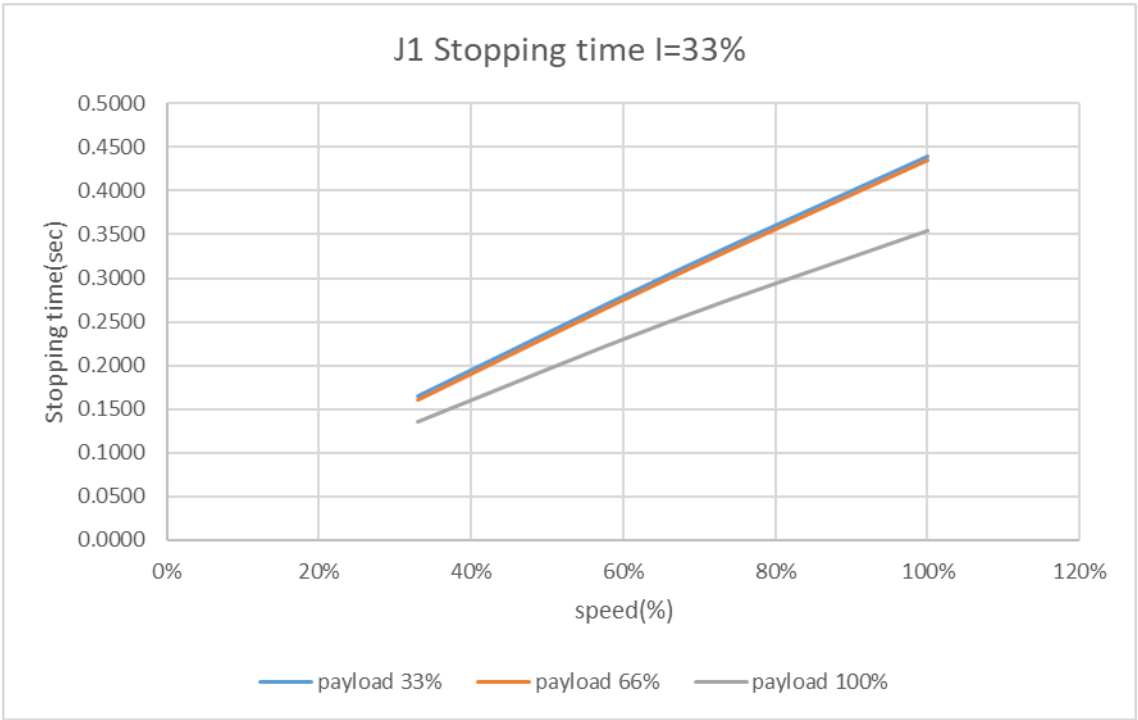


Figure 3.21 J1 Stopping time (DRV90L Extension 33%)

DRV90L Stopping distances and stopping times for STOP 1, J2

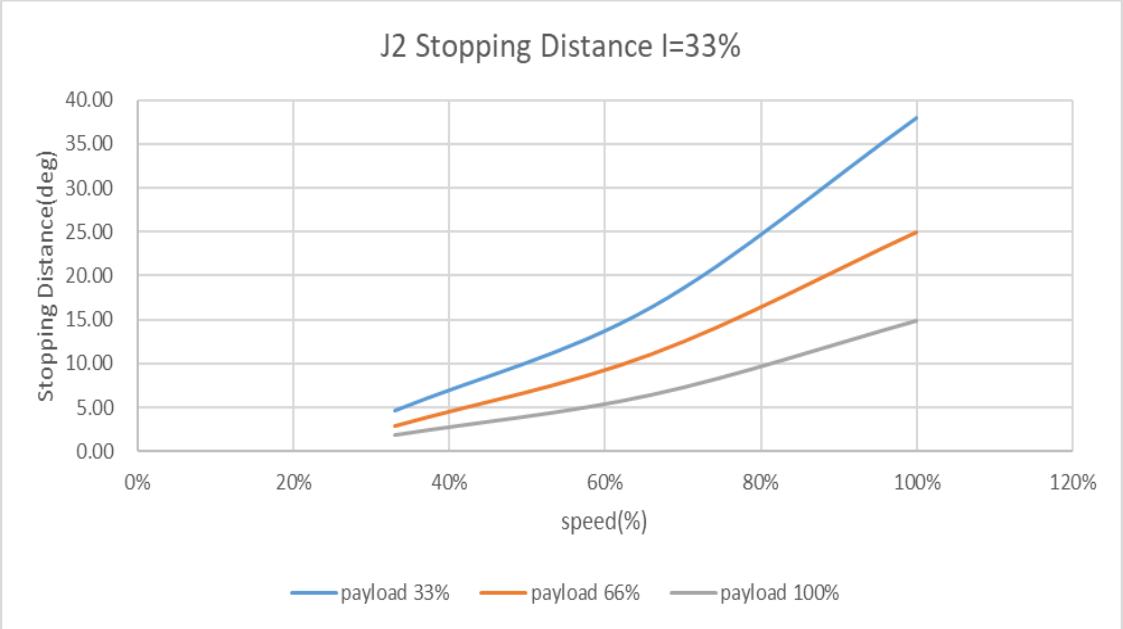


Figure 3.22 J2 Stopping Distance (DRV90L Extension 33%)

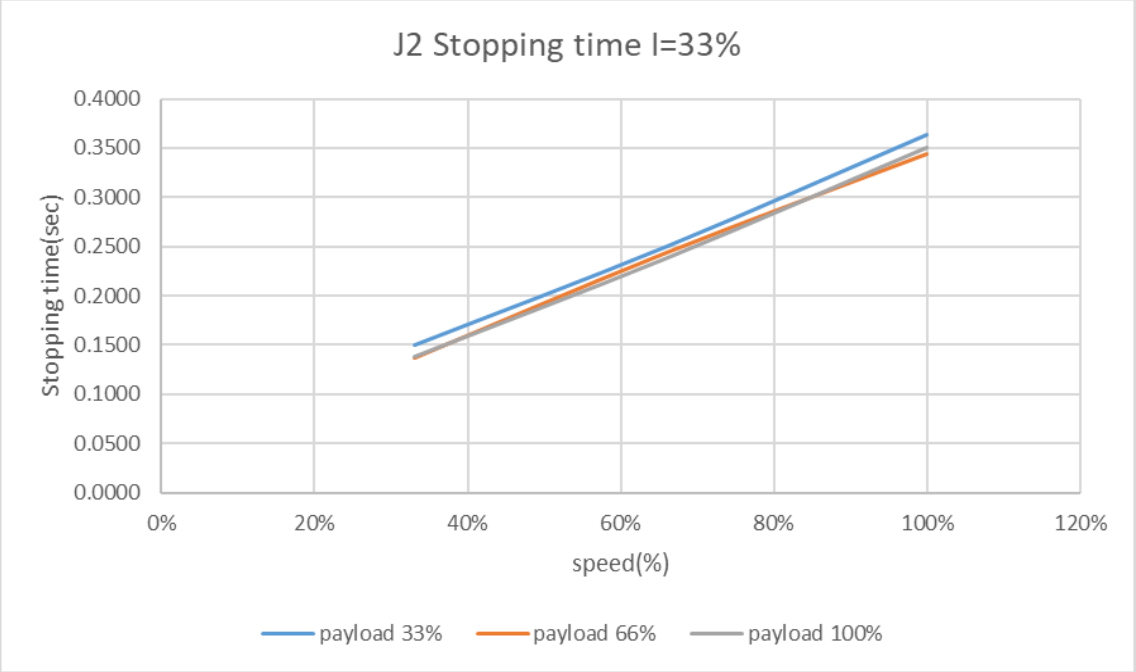


Figure 3.23 J2 Stopping time (DRV90L Extension 33%)

DRV70L Stopping distances and stopping times for STOP 1, J1

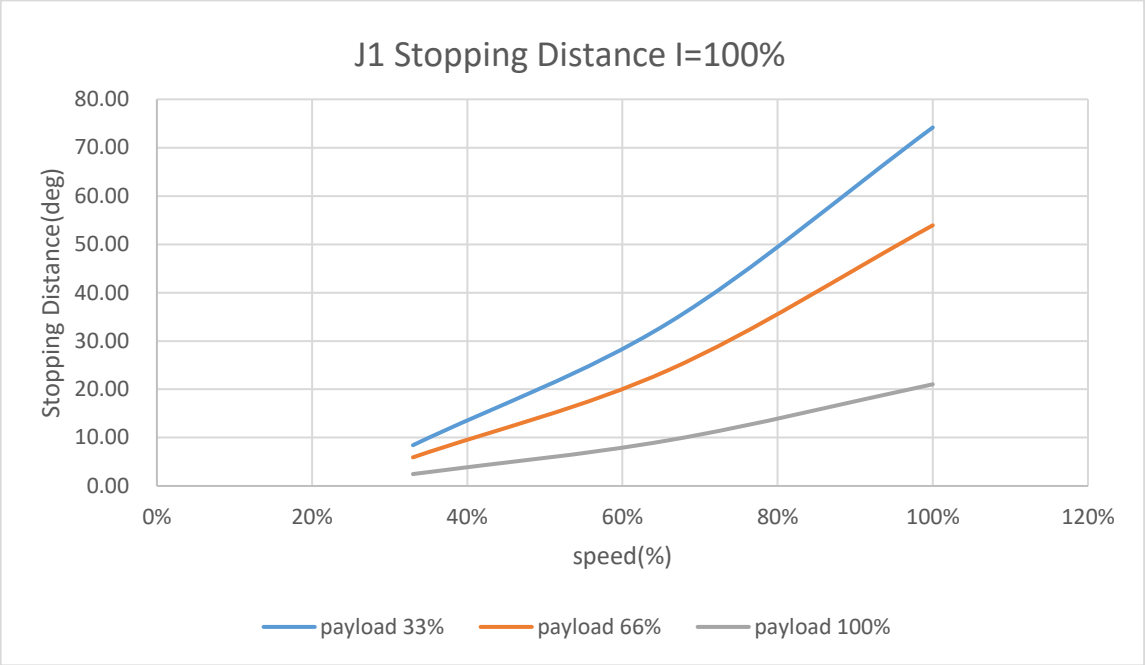


Figure 3.24 J1 Stopping Distance (DRV70L Extension 100%)

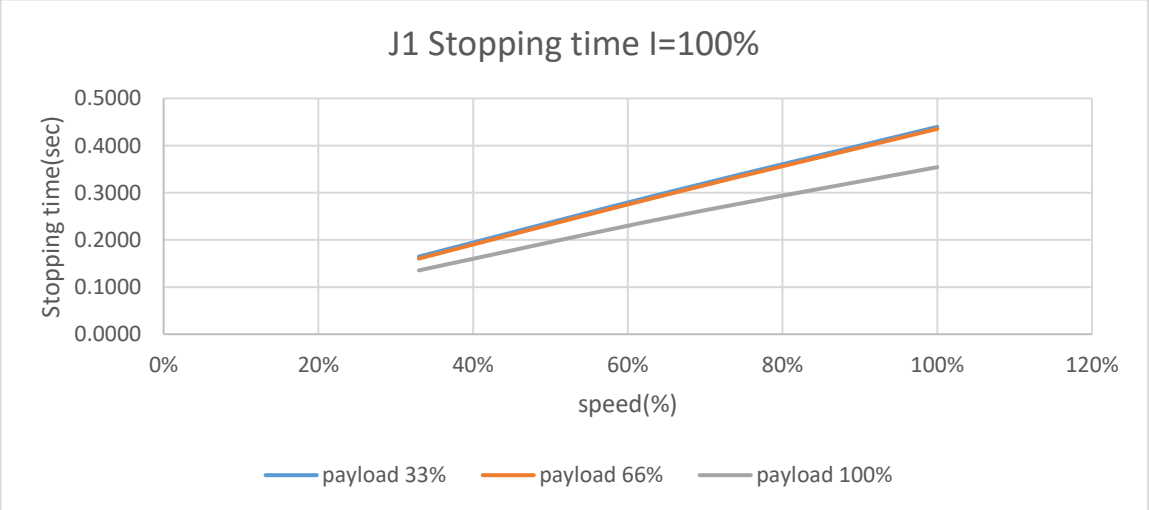


Figure 3.25 J1 Stopping time (DRV70L Extension 100%)

DRV70L Stopping distances and stopping times for STOP 1, J2

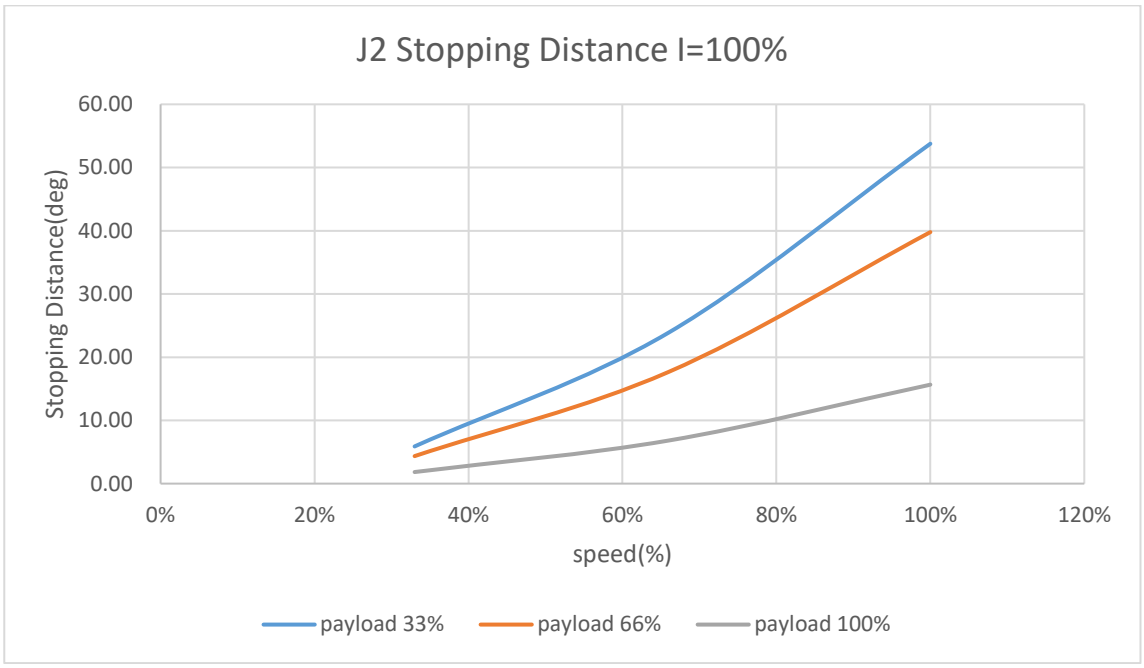


Figure 3.26 J2 Stopping Distance (DRV70L Extension 100%)

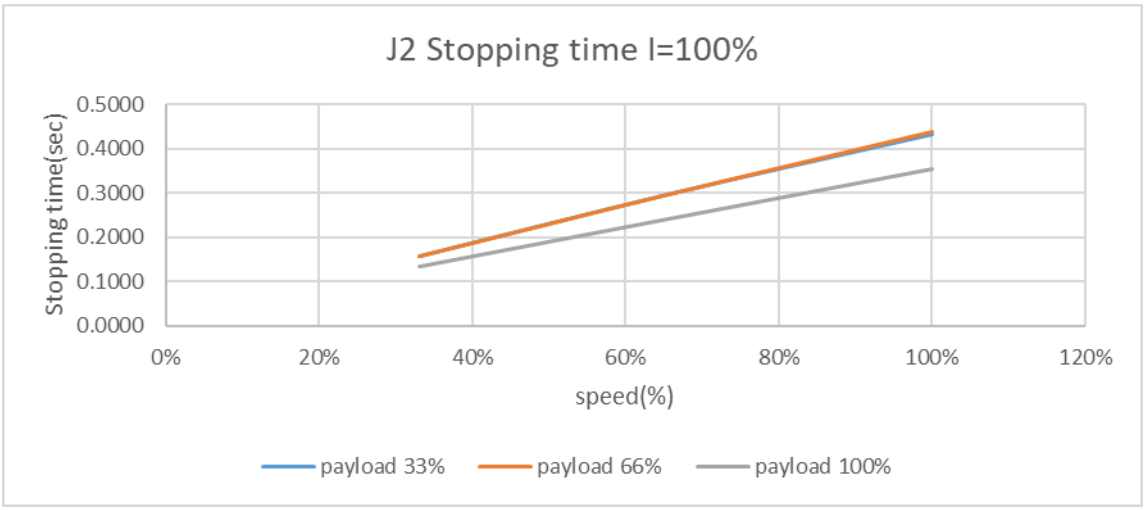


Figure 3.27 J2 Stopping time (DRV70L Extension 100%)

DRV70L Stopping distances and stopping times for STOP 1, J3

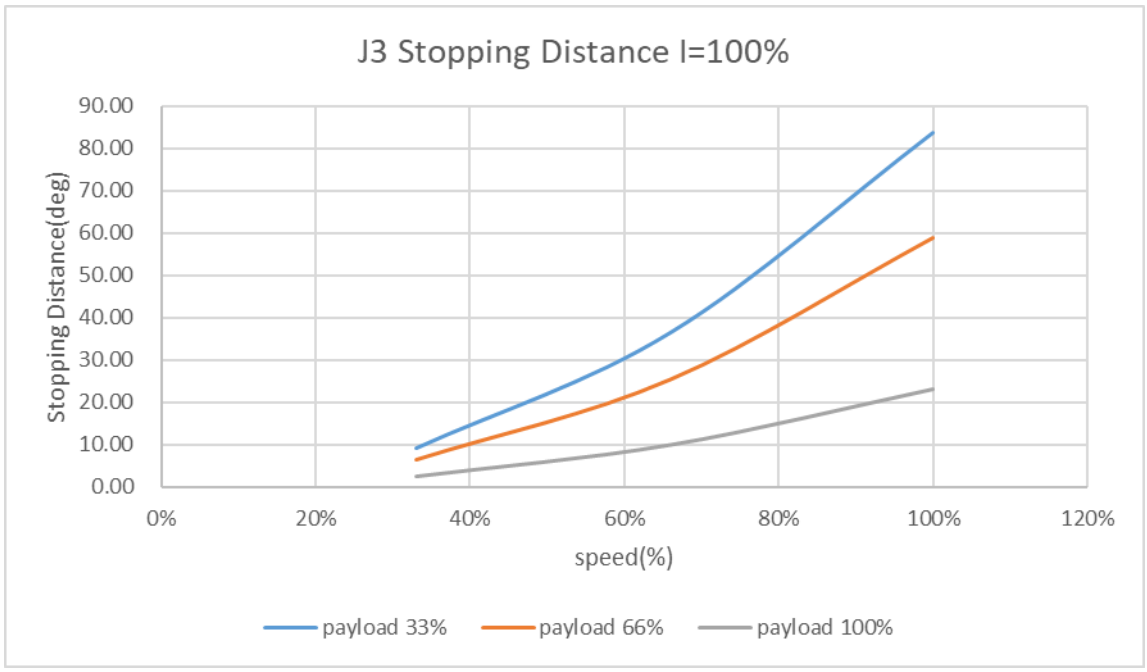


Figure 3.28 J3 Stopping Distance (DRV70L Extension 100%)

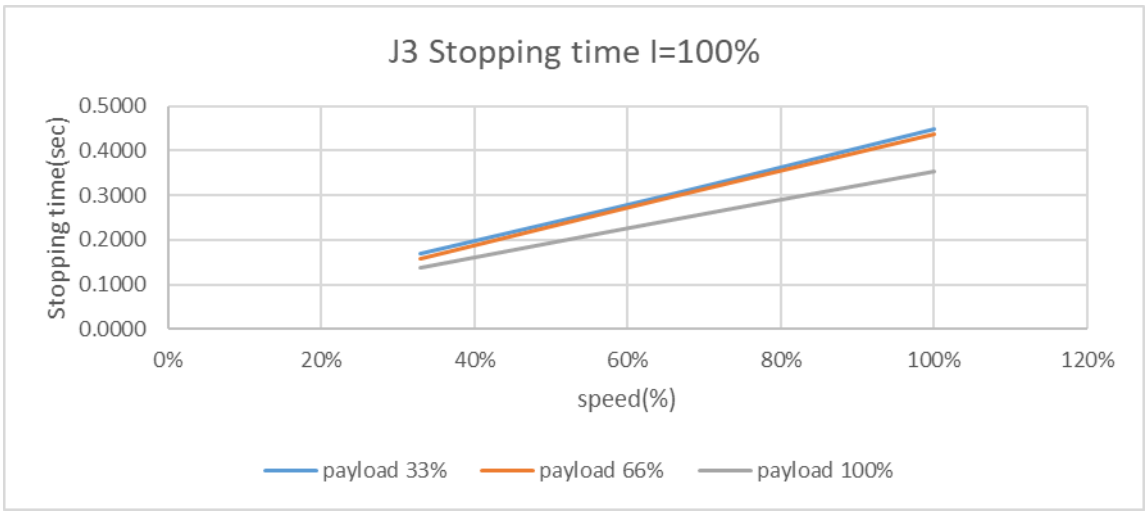


Figure 3.29 J3 Stopping time (DRV70L Extension 100%)

DRV70L Stopping distances and stopping times for STOP 1, J1

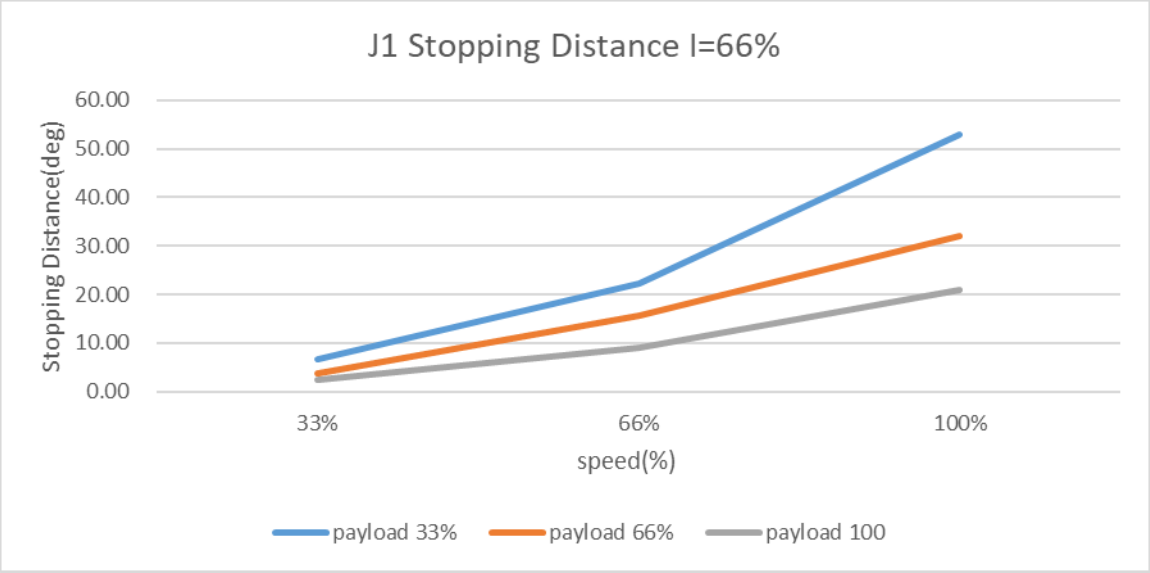


Figure 3.30 J1 Stopping Distance (DRV70L Extension 66%)

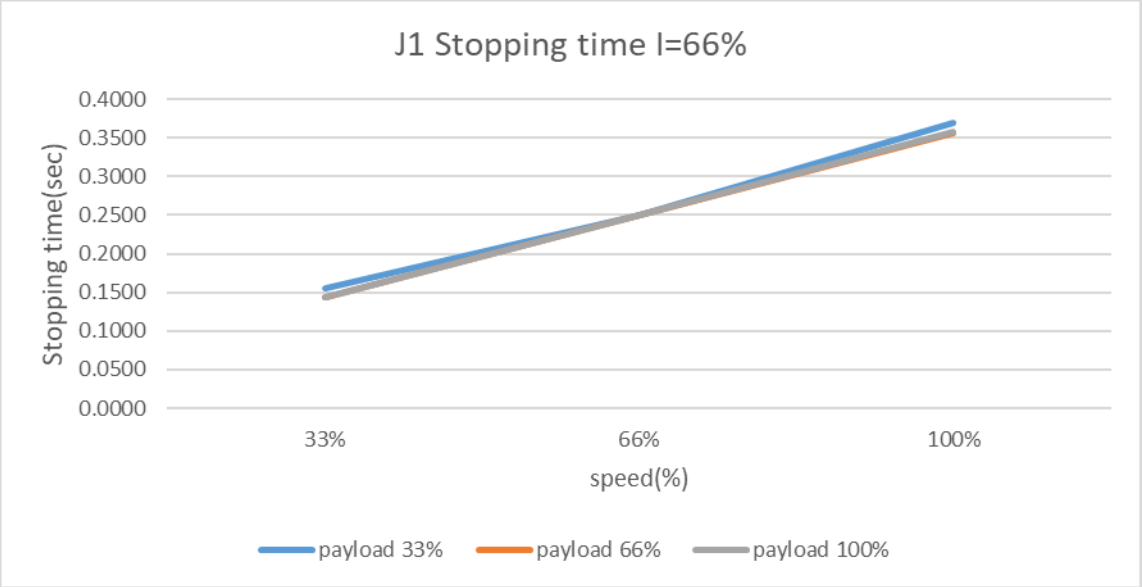


Figure 3.31 J1 Stopping time (DRV70L Extension 66%)

DRV70L Stopping distances and stopping times for STOP 1, J2

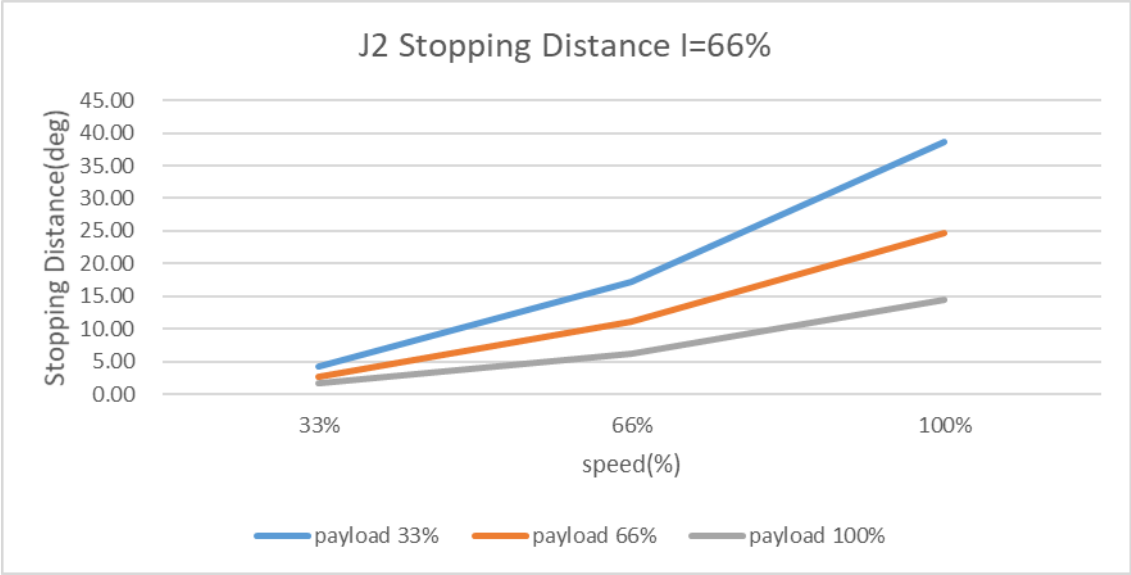


Figure 3.32 J2 Stopping Distance (DRV70L Extension 66%)

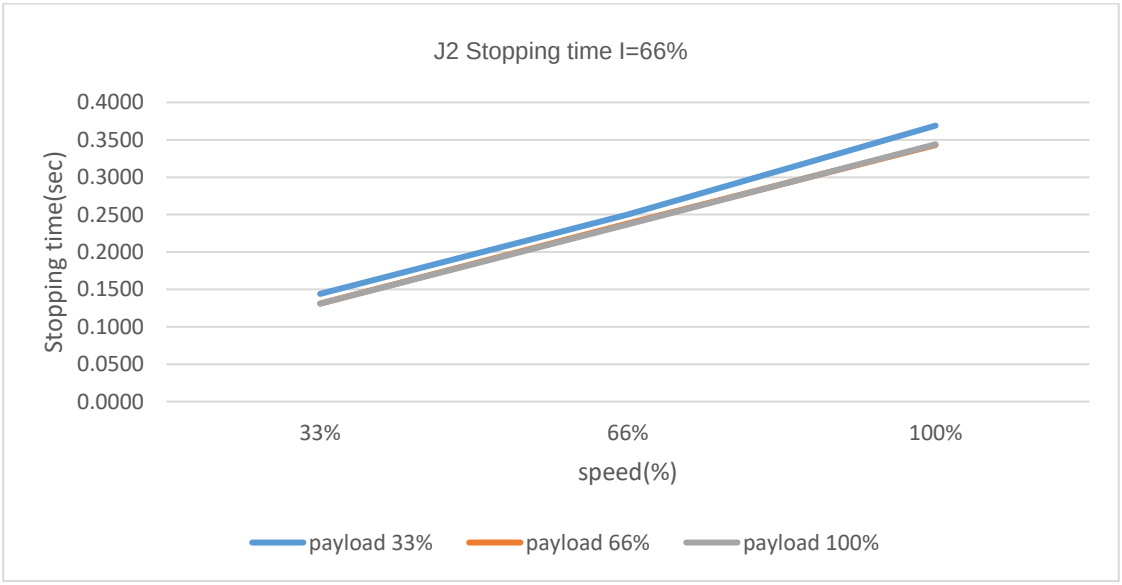


Figure 3.33 J2 Stopping time (DRV70L Extension 66%)

DRV70L Stopping distances and stopping times for STOP 1, J1

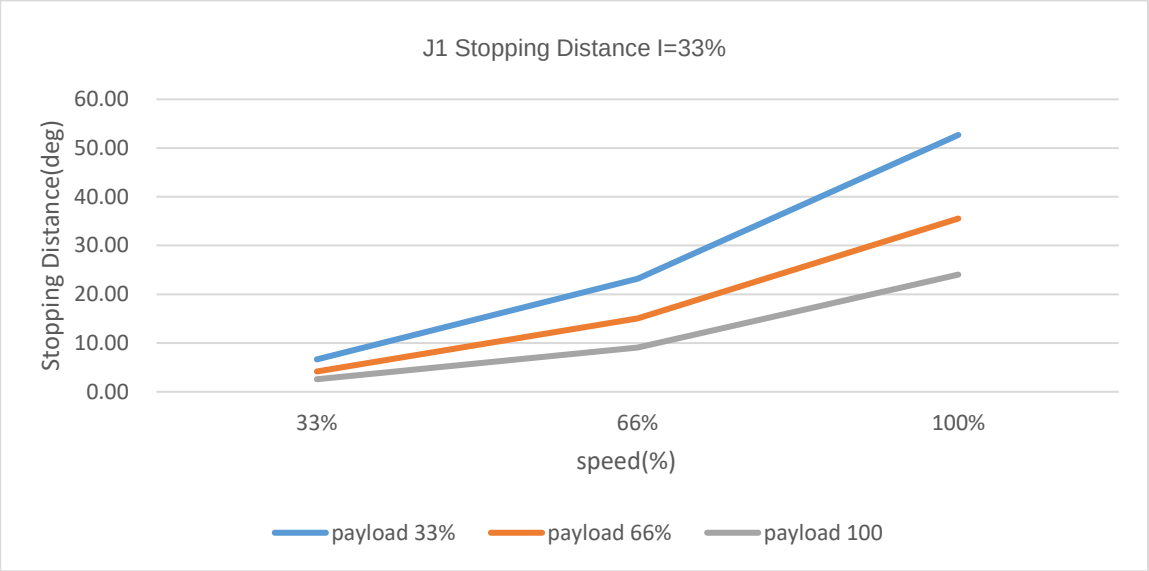


Figure 3.34 J1 Stopping Distance (DRV70L Extension 33%)

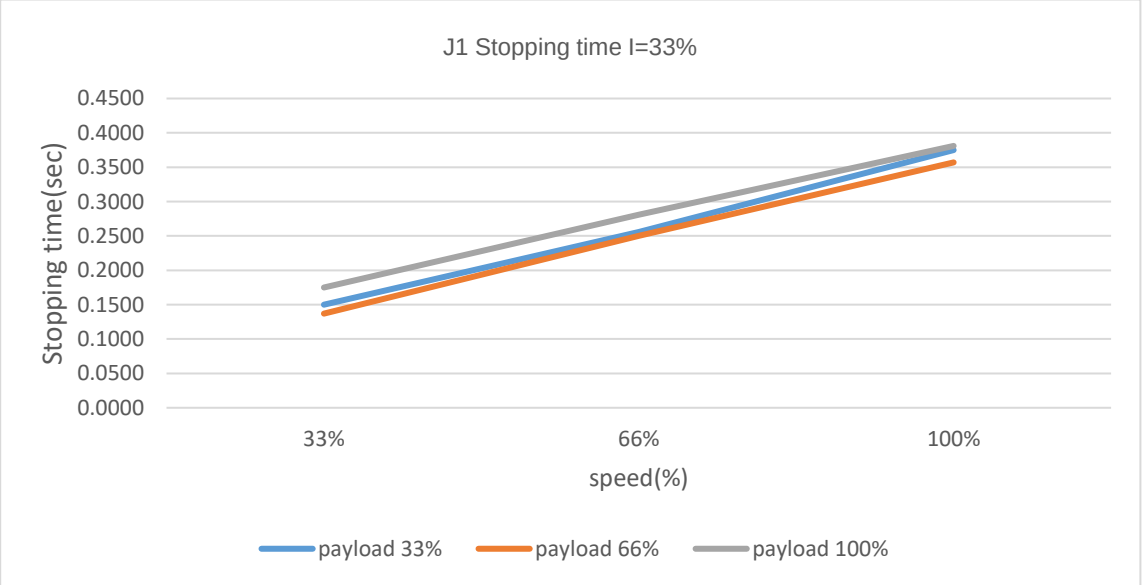


Figure 3.35 J1 Stopping time (DRV70L Extension 33%)

DRV70L Stopping distances and stopping times for STOP 1, J2

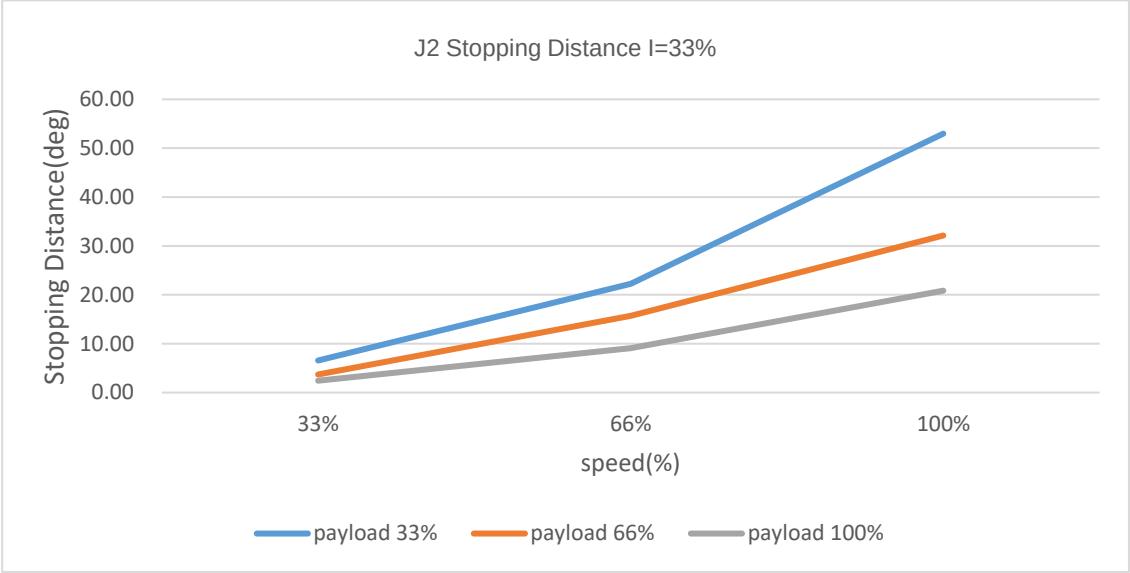


Figure 3.36 J2 Stopping Distance (DRV70L Extension 33%)

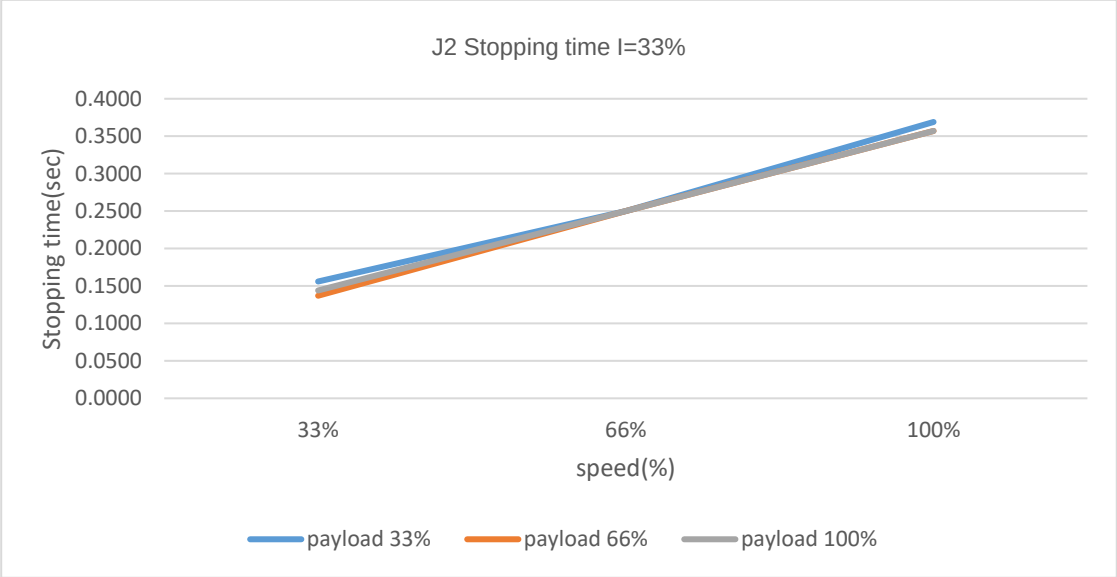


Figure 3.37 J2 Stopping time (DRV70L Extension 33%)

4. Specifications and dimensions

This chapter introduces the specifications and dimensions of the robots and controllers; please use according to the specifications properly.

- Please use the robot according to the specified methods, otherwise it may result in fire or equipment failures, even injuries or fatalities of workers and other dangers.
- Use this product at locations exposed to substances such as steam, corrosive gas and flammable gas etc. is prohibited, otherwise it may cause electrical shocks or fire.
- Please read this manual carefully before use in order to ensure the robot is used in suitable locations and environments in order to prevent affect the usage life of the mechanisms and electronic components, or get involved in other safety problems.
- The robots DRV70/90L7D/E series can only work with our company's controller DCV-2J00-CA; please do not modify the robot and wiring on your own, or use it with other controllers. Our company will not be responsible for any injuries or fatalities caused by accidents that resulted from doing so.
- DRV70/90L7D series itself are applicable for environment IP40 and is able to resist solid matters with diameters over 1mm, such as fingers; it is not protected against any liquid matters.
- The working range of the robot shall be kept clean and ensure that it will not be used under environments affected by oil, water and dust etc.
- Only clean dry air (CDA) can be used for the installation of the air source at the input terminal of the robot air hose.

- Use of this robot in non-specified environments is prohibited, otherwise it may cause damages to the robot or reduce the usage life of the robot.
- Random changes to the specification table of the robot is prohibited.
- Random changes or modifications of the robot is prohibited; our company will not be held responsible for any safety problems resulted from doing so. Please contact our company if other specifications are needed.

4.1 Specifications

Specifications of the DRV70/90L7D/E series robot are as shown in Table 4.1 below.

Table 4.1 Articulated robot specification table

Model		DRV70L7D/E Series	DRV90L7D/E Series
Number of axes		6	
Arm length		710 mm/27.55 in	900 mm/35.43 in
Rated / maximum payload		1 kg / 7 kg	1 kg / 7 kg
Operation range (°)	J1	±170	
	J2	+125 / -95	+125 / -95
	J3	+58 / -198	
	J4	±190	
	J5	±120	
	J6	±360	
Maximum speed (° / sec)	J1	450	370
	J2	340	260
	J3	510	410
	J4	550	550
	J5	550	550
	J6	820	820
Maximum Synthetic speed		11,000 mm/sec	10,060 mm/sec
Maximum allowable load inertia (kg*m^2)	J4	0.47	
	J5	0.47	
	J6	0.15	
Load torque (Nm)	J4	16.6	
	J5	16.6	
	J6	9.4	
Repeatability		±0.02 mm	±0.03 mm
Standard cycle time*1		0.32 sec	0.35 sec
Installation method		counter, hanging, wall mount*2	
The robot arm has the followings built-in		One 12 Pos connector for customers to connect sensors and 2 ø6 straight air pipes (one provided for the built-in 3 sets of solenoid valves and one for expansion)	
IP Level		IP40 for DRV70/90L7D series; IP65 for DRV70/90L7E series	
Environmental specifications	Temperature	0ºC to +40ºC	
	Humidity	20 to 85%RH	
Shock		0.5G	
Robot arm weight		36 kg	38 kg
Controller type		DCV-2J00-CA	
Phase / Voltage		220V~+PE · 15A · 50/60Hz	
Rated power		3.3 kW	

Note:

*1. 5mm-300mm-25mm & Payload: 1Kg, testing environmental temperature 25°C, environmental relative humidity 45% to 65%.

*2. Wall mount specifications: 0◦to 30◦If have any requirement, please contact your local dealer.

DCV controller specifications are as shown in Table 4.2 below.

Table 4.2 DCV-2J00-CA controller specification table

DCV-2J00-CA specification		
Power	Phase / Voltage	220V~+PE, 15A, 50/60Hz
	Rated power (kW)	3.3 kW
Dimensions W x H x D(mm)		529 x 232 x 409
Weight (kg)		28 (kg)
Cooling method		Fan cooling
Robot control	Program language	Delta Robot Language
	Movement mode	Point-to-point movement, linear interpolation, circular interpolation
	Memory capacity	20MB: For user to edit program and data 1K position points for global variable use (can be shared in different programs) 30K position points for all users to edit program
Input / output	Standard input/output	24DI/12DO
	System input/output	6DI/8DO
	Safety input	2 Point for Emergency Stop 2 Point for Protect stop device
Communication interface	Ethernet	1 channel
	RS-232 / RS-485	1 connection port (the 1 connection port can switch between two communication functions)
	DMCNET	1 channel
Environmental specifications	Installation location	Indoor (avoid exposure to direct sunlight), no corrosive fog (avoid fumes, flammable gas and dust)
	Altitude	up to 1000 m above mean sea level
	Atmospheric pressure	86 kPa to 106 kPa
	Environmental temperature	5°C to +40°C (if the environmental temperature exceeded 40°C, please force surrounding air circulation)
	Storage temperature	-20°C to +55°C
	Humidity	not exceed 50% at a maximum temperature of +40°C
	Vibration	9.80665m/s2 (1G) less than 20Hz, 5.88m/s2 (0.6G) 20 to 50Hz
	IP level	IP20
	Power system	*TN system

*TN system: The neutral point of the power system is connected to ground directly, metal components exposed outside are connected to ground through protective ground conductors.

4.2 Dimensions

4.2.1 DRV70/90L7D/E robot arm dimensions

Figure 4.1 below is the dimensions figure of DRV70/90L7D/E series; the unit is mm.

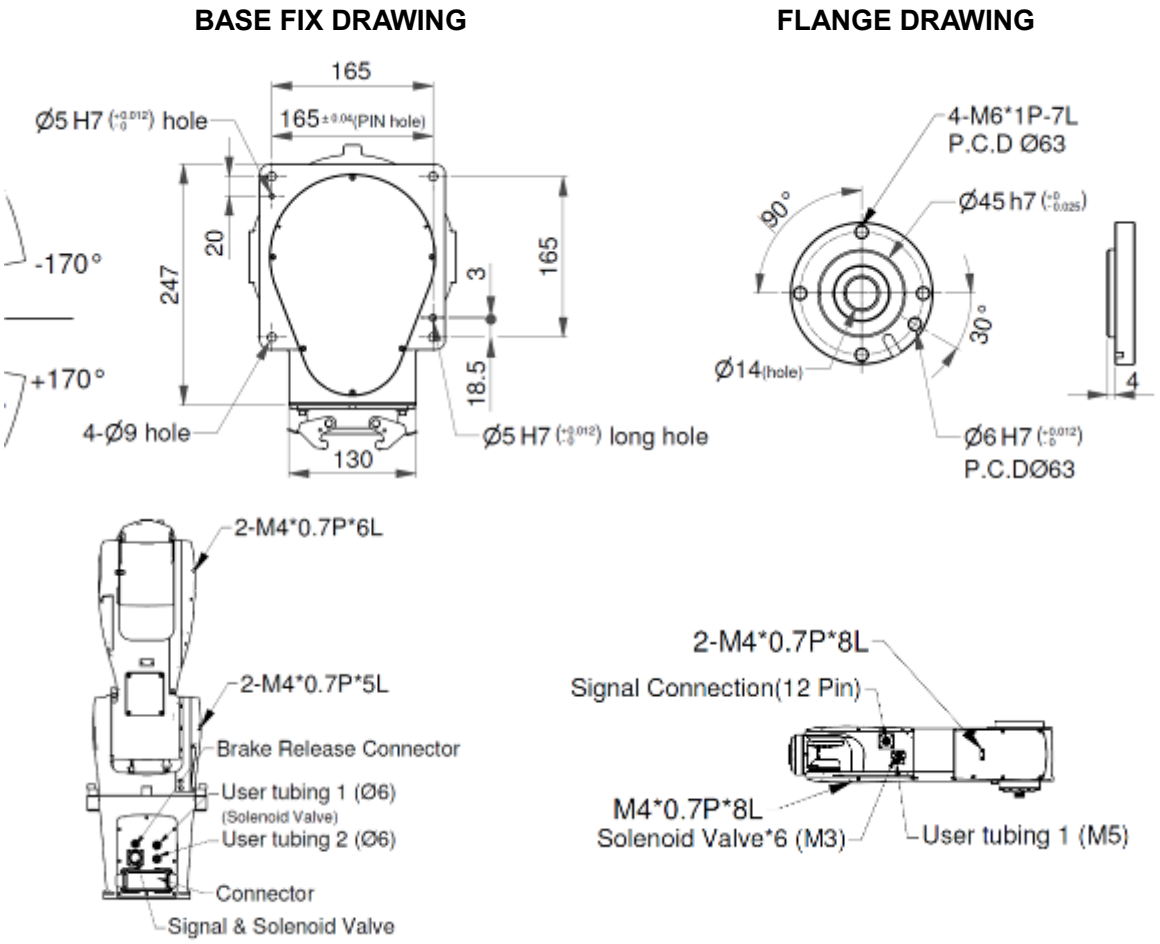


Figure 4.1 DRV70/90L7D/E series Appearance and Installation Hole Position Diagram

4.2.2 DCV-2J00-CA controller dimensions

DCV-2J00-CA controller dimensions are as shown in Figure 4.2 below.

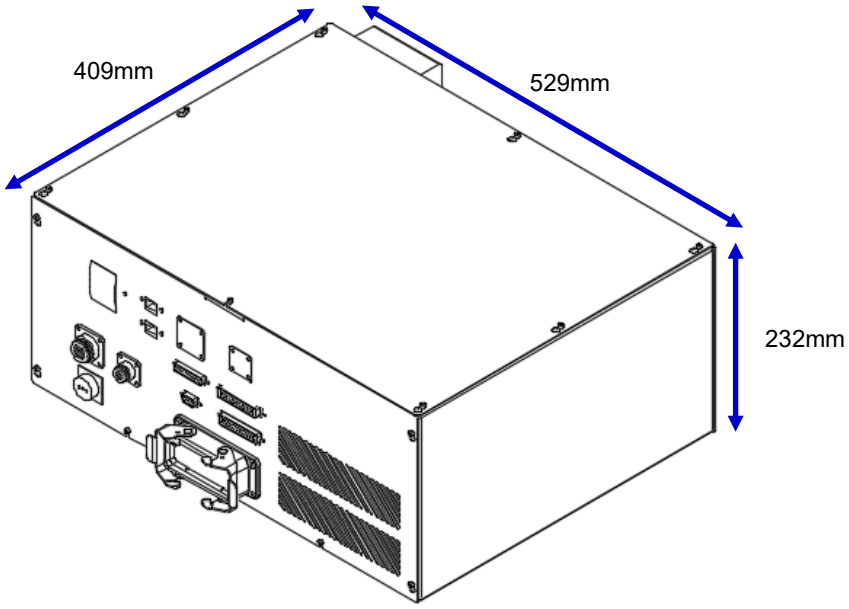


Figure 4.2 Controller dimensions

Controller installation notes :

- Do not put your finger or foreign matter into the heat-radiating fan of controller, or it may cause injury hazards.
- This controller does not have explosion-proof or splash-proof structures, so do not place it at locations that are too humid or can be easily splashed by liquids.
- Before moving, installing, wiring and using, please read this Manual carefully.
- Do not randomly stack objects on top of the controller, and do not bump into the controller.
- Do not install the controller in a location subjecting to excessive vibration.
- Do not plug or unplug the power while the power is on the ON status or while operating as doing so may cause damages to the internal components of the robot orcontroller.
- The input power of the controller is 220Vac, 50/60Hz; do not input non-specified voltages as doing so may cause the controller to burn or inaccurate robot movements.

5. Working range description

This chapter will introduce the point position and working range of the robot.
Since the robot is a semi-finished product system, please install and adjust the active point positions according to the actual system in order to prevent operational errors causing damages to the robot and surrounding devices due to impact.

- Please check the working area of the robot before installation, and plan the composition of the surrounding system properly.
- Please install safety protection devices around the working area of the robot, such as railings, safety gratings, pressure pads, or laser scanners etc. in order to guarantee the safety of the workers.
- Please adjust the active point positions of the robot properly according to the actual plan in order to prevent operational errors and damages to the robot and surrounding devices due to impact.
- After adjusting the active points, please lock in the screws properly or else the points might lose their functions.

- Adding any new point positions on your own is strictly prohibited; this will damage the rigidity of the mechanism. Our company will not be held responsible for any damages resulted from doing so.
- Changing the screen size of any point is prohibited.

5.1 DRV70L7D/E series working range

The rotatable angle ranges for each axis of DRV70L7D/E series are: J1 axis ±170 degrees, J2 axis +125 to -95 degrees, J3 axis +58 to -198 degrees, J4 axis +190 to -190 degrees, J5 axis +120 to -120 degrees, J6 axis +360 to -360 degrees. The figure 5.1 below is the working range of the DRV70L7D/E series robot.

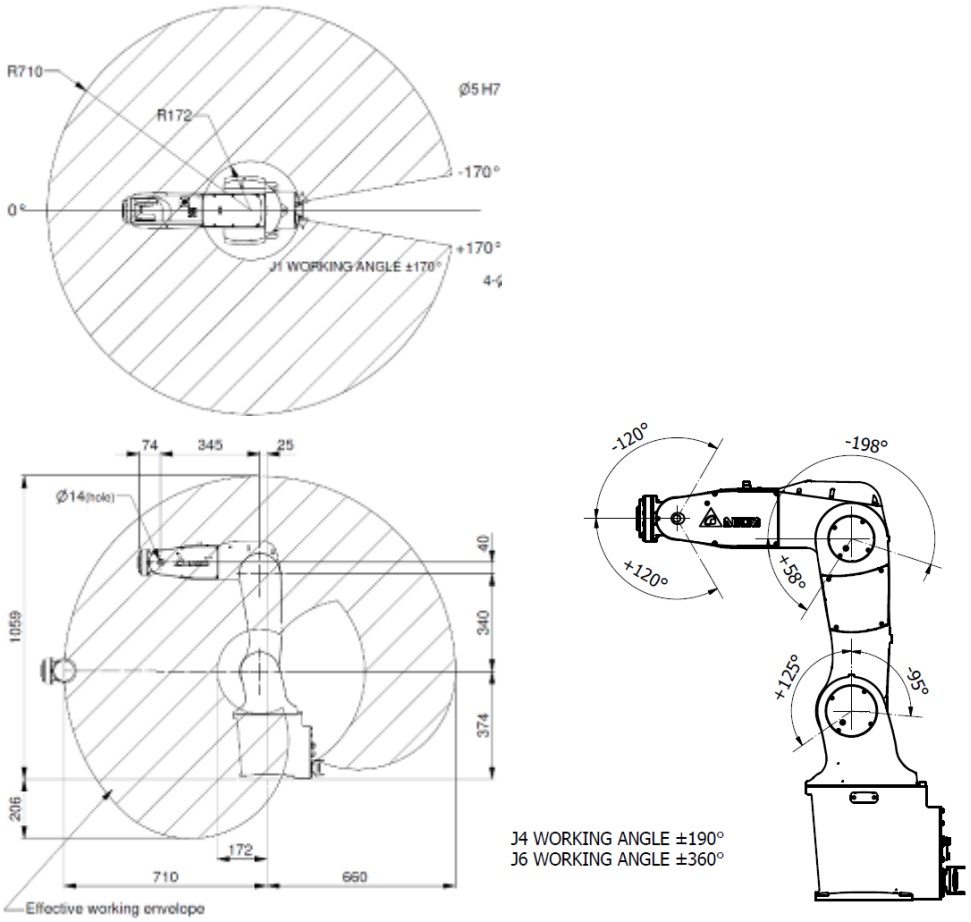


Figure 5.1 DRV70L7D/E series working range

The installation location of the DRV70L7D/E series-J1 axis limit point is as shown in the figure 5.2 below; the table 5.1 shows the limit point screw and tightening torque.

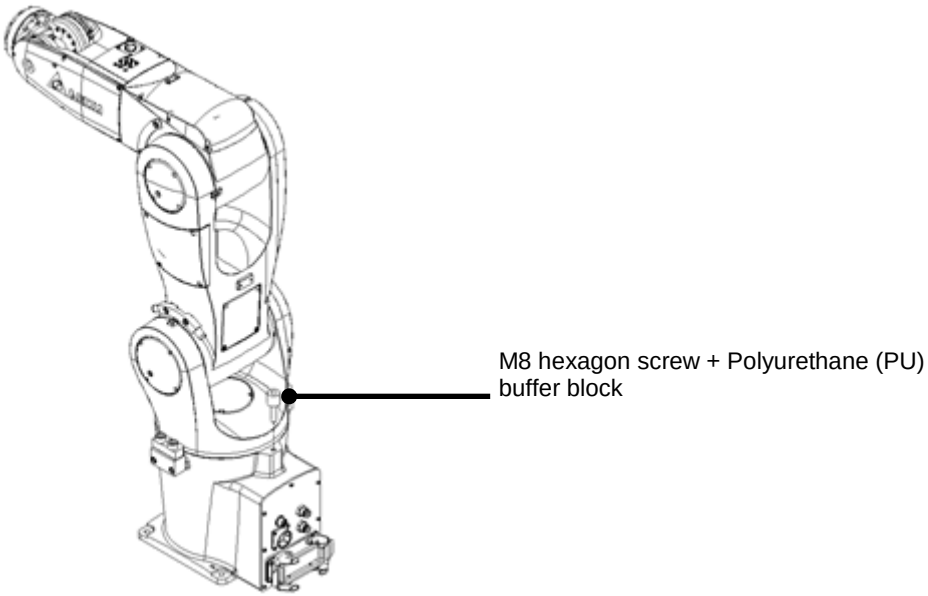


Figure 5.2 DRV70L7D/E series-J1 limit installation

Table 5.1 DRV70L7D/E series-J1 limit point tightening torque

	Name	Screw torque	Remark
Tools	#6 hex wrench	8 N-m	M8x12 hexagon screw + Polyurethane (PU) buffer block

5.2 DRV70L7D/E series adjustable hardware limit

When the working range of the articulated robot arm needs to restricted, adjustable hardware limits can be added to restrict the working range of the articulated robot arm. The rotation motion range of J1 is ±170, ±70 degrees; the rotation motion range of J2 is +105, +127, -77, -99 degrees and the rotation motion range of J3 is +48, +60, -177, -200 degrees.
The installation position of the J1 axis active point of DRV70L7D/E series and the working angle are as shown in the figure 5.3 below.

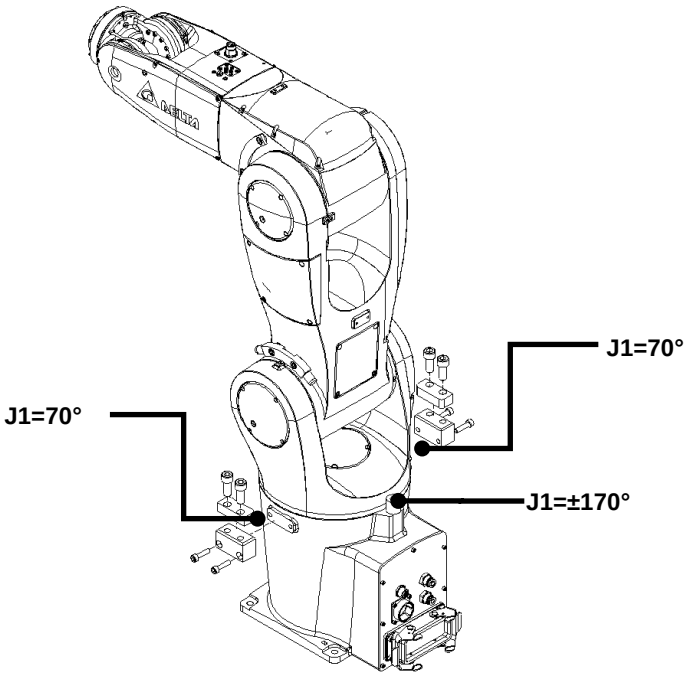


Figure 5.3 DRV70L7D/E series-J1 axis adjustable hardware limits and the working angle

Table 5.2 below is the screw and tightening torque for installing the hardware limits of J1 axis on DRV70L7D/E series.

Table 5.2 DRV70L7D/E series-J1 axis screw and tightening torque

	Name	Screw torque	Remark
Tools	#5 hex wrench	9.7N-m	M6x12 hex socket screws + M6 spring washer
	#8 hex wrench	12N-m	M10x25 hex socket screws

The installation position of the J2 axis adjustable hardware limits (+105°, +127°, -77°, -99°) of DRV70L7D/E series and the working angle are as shown in Figure 5.4 below.

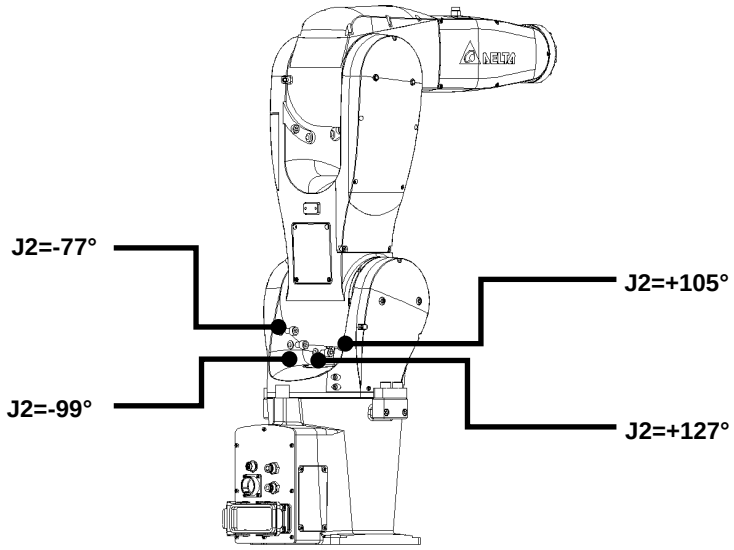


Figure 5.4 J2 axis adjustable hardware limits of DRV70L7D/E series and the working angle

Table 5.3 below is the screw and tightening torque for installing the hardware limits of J2 axis on DRV70L7D/E series.

Table 5.3 DRV70L7D/E series-J2 axis screw and tightening torque

	Name	Screw torque	Remark
Tool	#6 hex wrench	9.7 N-m	M8x12 hex socket screws

The installation position of the J3 axis adjustable hardware limits (+48°, +60°, -177°, -200°) of DRV70L7D/E series and the working angle are as shown in Figure 5.5 below.

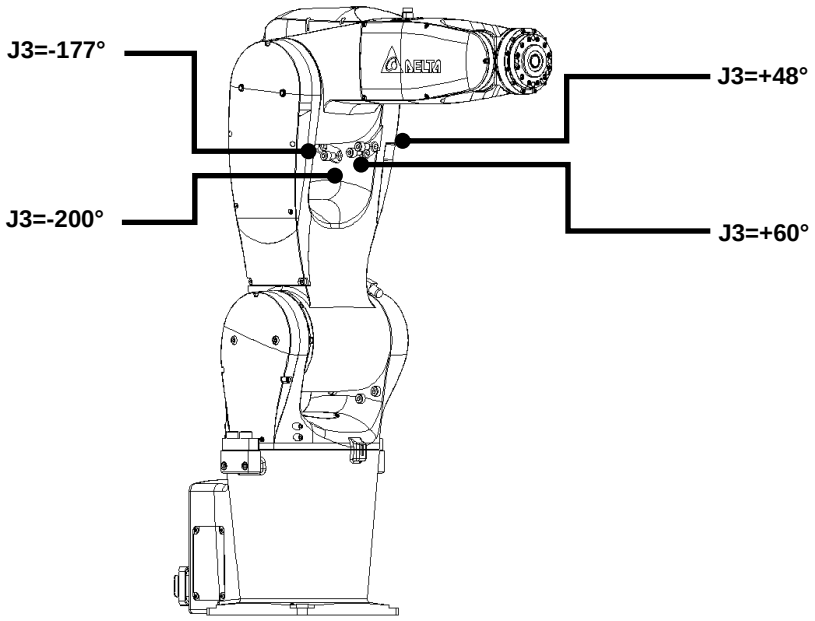


Figure 5.5 J3 axis adjustable hardware limits of DRV70L7D/E series and the working angle

Table 5.3 below is the screw and tightening torque for installing the hardware limits on J3 axis on DRV70L7D/E series.

Table 5.4 DRV70L7D/E series-J3 axis screw and tightening torque

	Name	Screw torque	Remark
Tool	#6 hex wrench	9.7 N-m	M8x12 hex socket screws

5.3 DRV90L7D/E series working range

The rotatable angle ranges for each axis of DRV90L7D/E series are: J1 axis ±170 degrees, J2 axis +125 to -95 degrees, J3 axis +58 to -198 degrees, J4 axis +190 to -190 degrees, J5 axis +120 to -120 degrees, J6 axis +360 to -360 degrees. The figure 5.6 below is the maximum working range of the DRV90L7D/E series robot.

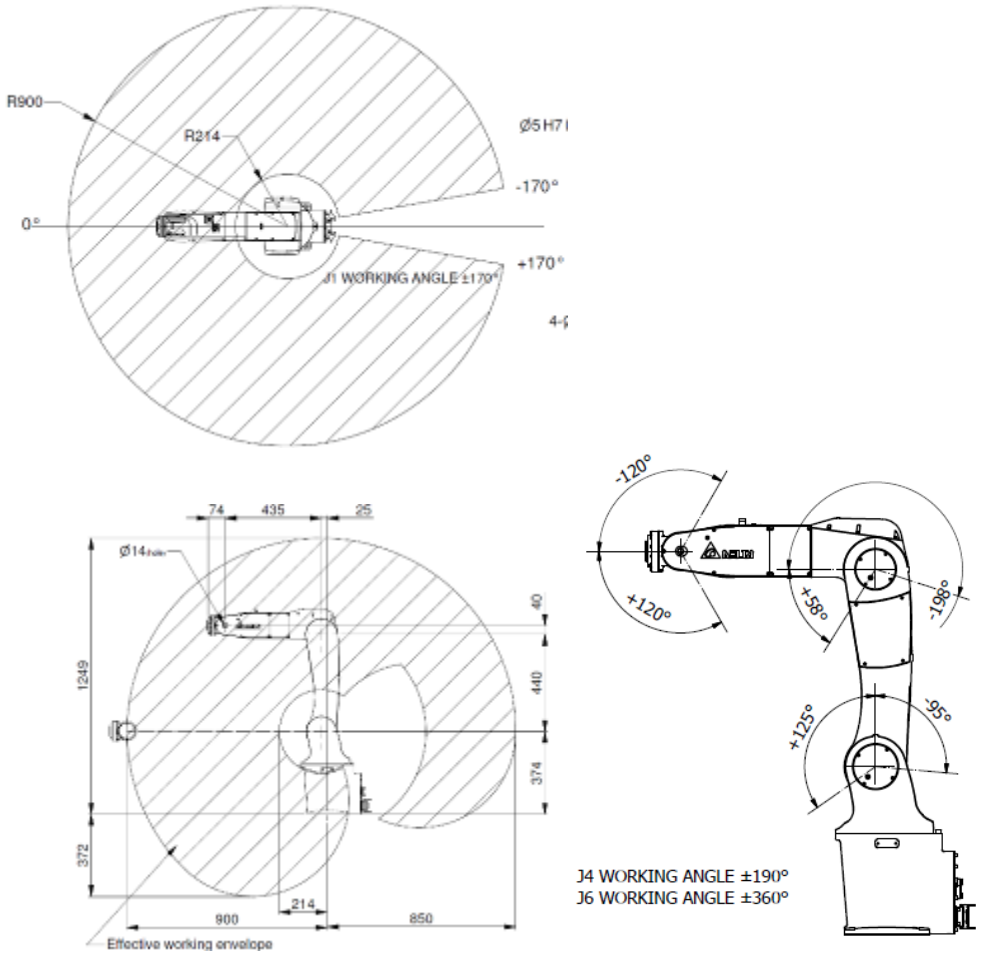


Figure 5.6 DRV90L7D/E series-working range

The installation position of the DRV90L7D/E series-J1 axis limit point is as shown in the figure 5.7; the table 5.5 shows the limit point screw and tightening torque.

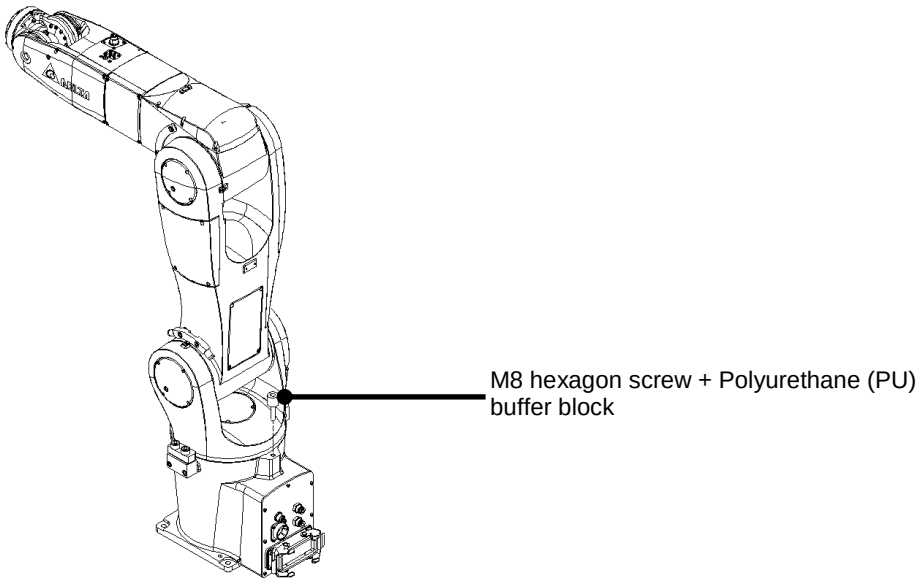


Figure 5.7 DRV90L7D/E series-J1 limit installation

Table 5.5 DRV90L7D/E series-J1 axis screw and tightening torque

	Name	Screw torque	Remark
Tool	#6 hex wrench	8 N-m	M8x12 hexagon screw + Polyurethane (PU) buffer block

5.4 DRV90L7D/E series adjustable hardware limit

When the working range of the articulated robot arm needs to restricted, adjustable hardware limits can be added to restrict the working range of the articulated robot arm. The rotation motion range of J1 is ±170; the rotation motion range of J2 is +105, +127, -77, -99 degrees and the rotation motion range of J3 is +48, +60, -177, -200 degrees.
The installation position of the J1 axis adjustable hardware limits of DRV90L7D/E series and the working angle are as shown in the figure 5.8 below.

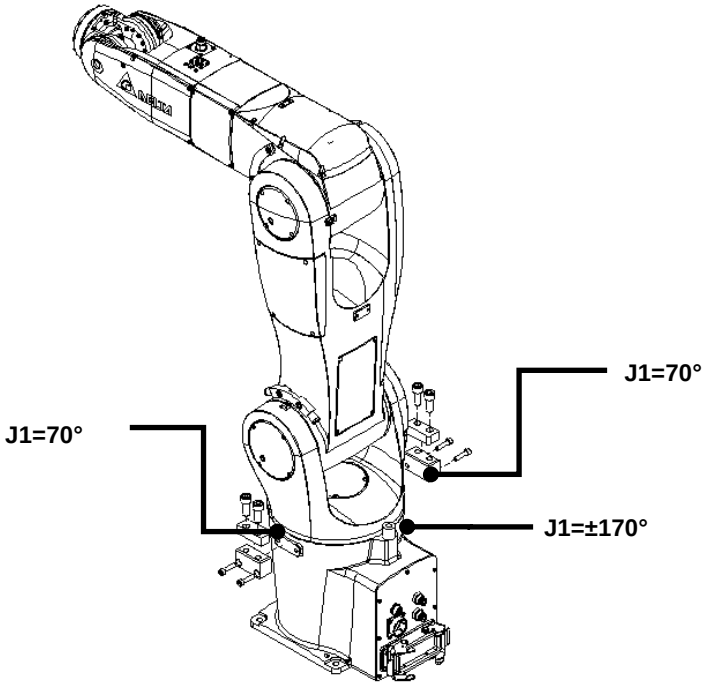


Figure 5.8 DRV90L7D/E series-J1 axis adjustable hardware limits and the working angle

Table 5.6 below is the screw and tightening torque for installing the hardware limits of J1 axis on DRV90L7D/E series.

Table 5.6 DRV90L7D/E series- J1 axis screw and tightening torque

	Name	Screw torque	Remark
Tools	#5 hex wrench	9.7 N-m	M6x12 hex socket screws + M6 spring washer
	#8 hex wrench	12 N-m	M10x25 hex socket screws

The installation position of the J2 axis adjustable hardware limits (+105°, +127°, -77°, -99°) of DRV90L7D/E series and the working angle are as shown in Figure 5.9.

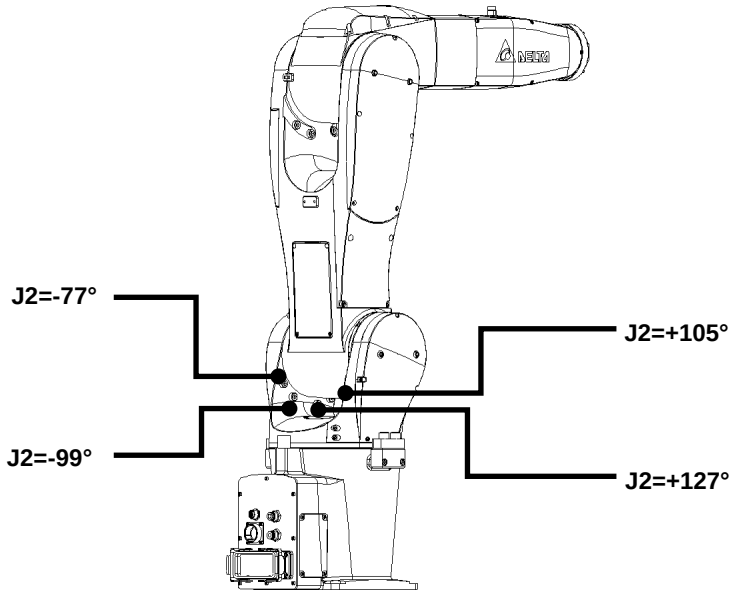


Figure 5.9 DRV90L7D/E series-J2 axis adjustable hardware limits and the working angle

Table 5.7 below is the screw and tightening torque for installing the hardware limits of J2 axis on DRV90L7D/E series.

Table 5.7 DRV90L7D/E series-J2 axis screw and tightening torque

	Name	Screw torque	Remark
Tool	#6 hex wrench	9.7 N-m	M8x12 hex socket screws

The installation position of the J3 axis adjustable hardware limits (+48°, +60°, -177°, -200°) of DRV90L7D/E series and the working angle are as shown in Figure 5.10 below.

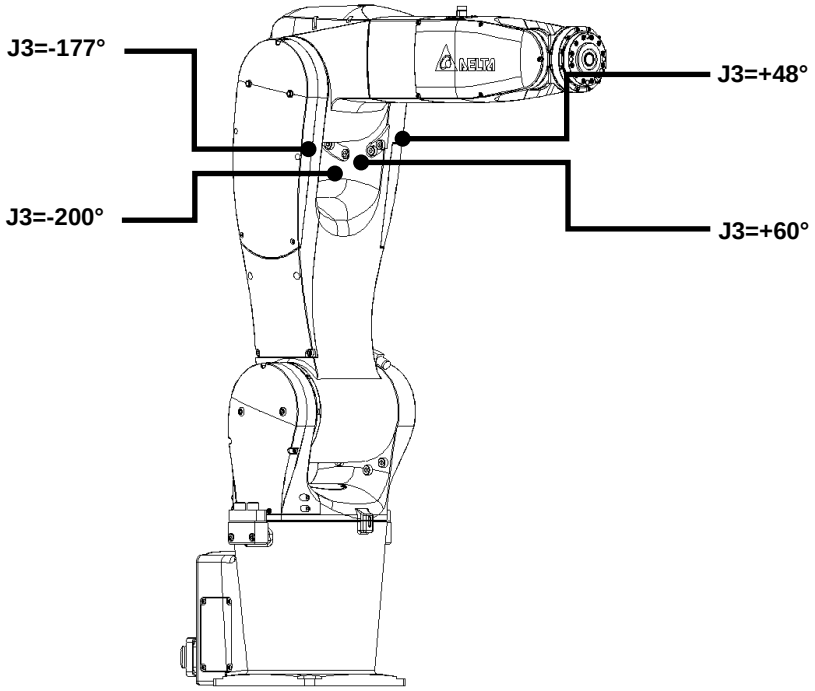


Figure 5.10 DRV90L7D/E series-J3 axis adjustable hardware limits and the working angle

Table 5.8 below is the screw and tightening torque for installing the hardware limits of J3 axis on DRV90L7D/E series.

Table 5.8 DRV90L7D/E series-J3 axis screw and tightening torque

	Name	Screw torque	Remark
Tool	#6 hex wrench	9.7 N-m	M8x12 hex socket screws

6. Robot parts descriptions

This chapter will introduce the names, functions, and operating directions of the various parts of the robot.

- Please install safety protection devices around the working area of the robot, such as railings, safety gratings, pressure pads or laser scanners etc. in order to guarantee the safety of the workers.
- Please read this manual carefully before operation in order to use the robot properly, which prevents impact and ensures the safety of workers.
- Please operate the robot outside the safety protection area in order to ensure worker safety.

- Adding any new point positions on your own is strictly prohibited; this will damage the rigidity of the mechanism. Our company will not be held responsible for any damages resulted from doing so.
- Changing the screw size of any point is prohibited.
- Random changes or modification of the robot is strictly prohibited; our company is not responsible for any problems resulted from doing so.

6.1 Robot parts descriptions

The appearance and parts of DRV70/90L7D/E series are as shown in Figure 6.1 below.

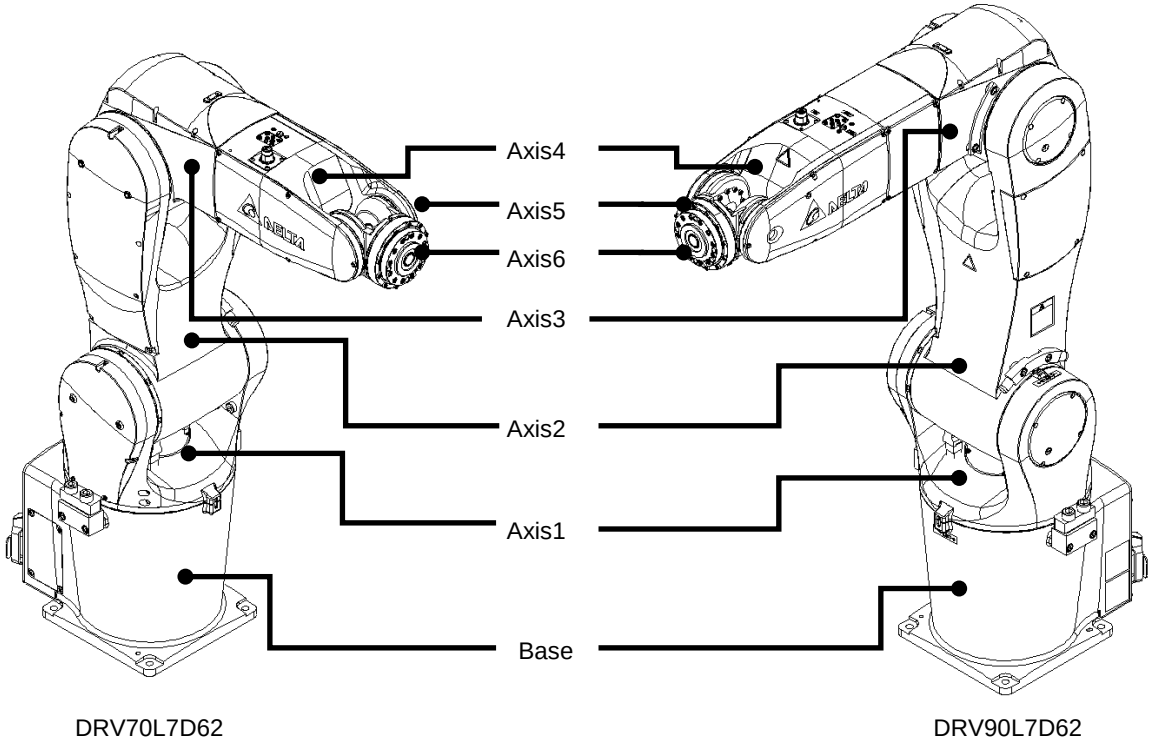


Figure 6.1 DRV70/90L7D/E series appearance

6.2 Operation directions

The DRV series are six-axis robots composed of J1 to J6; its motion direction is based on the joint coordinate, as shown by the motion direction of the robot in the figure below. The (+) and (-) shown in the figure 6.2 are actual motion directions of each axis.

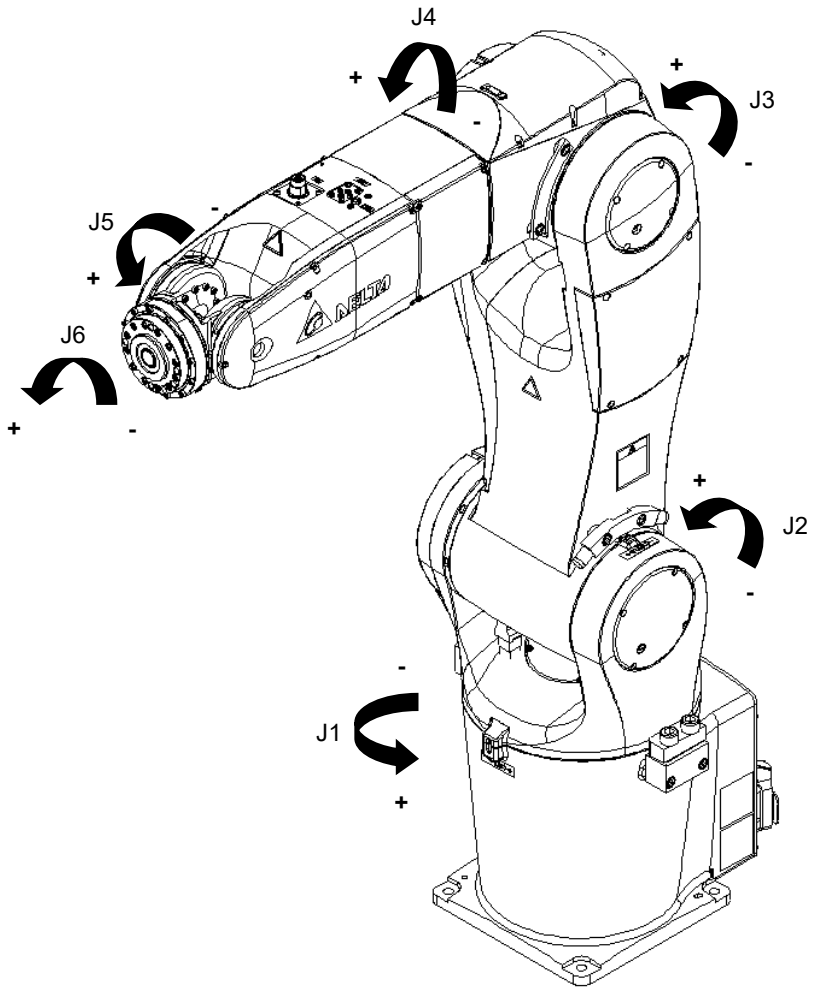


Figure 6.2 DRV series motion directions

6.3 Brake release connector

DRV70/90L7D/E series brake release connector function description:
The connector is located at the base of the robot; its location is as shown in Figure 6.7 below. This brake release connector can be used to create the brake button and release the brakes of the various axes.

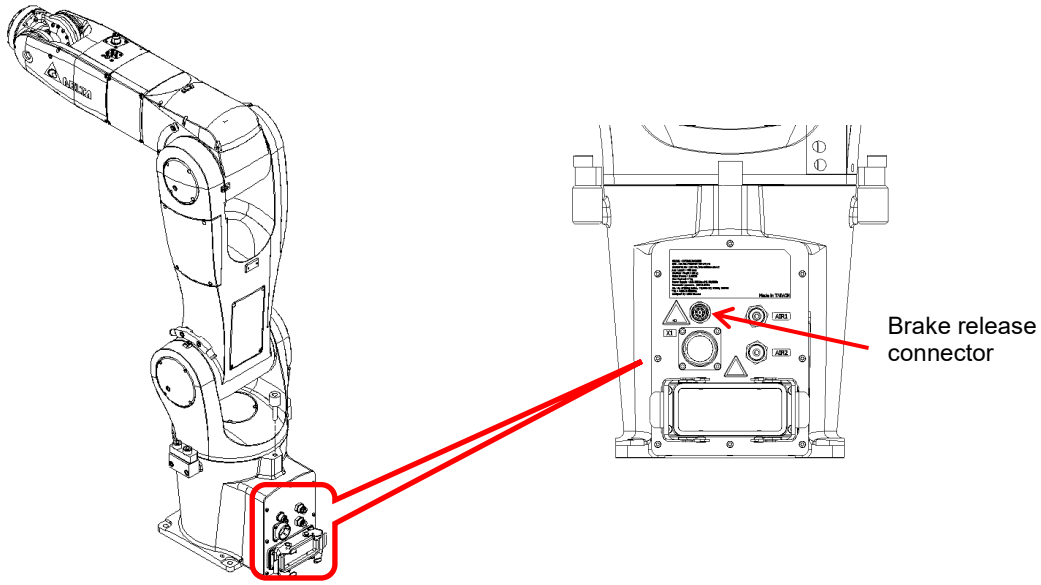


Figure 6.3 DRV70/90L7D/E series brake release connector

The figure and table below are the pin definitions and wire colors of the brake connector.

Table 6.1 Brake release connector pin definition and wire colors (Robot arm side)

Brake Connector Pin Definition-[Tyco]5-2271137-2								
PIN	NAME	Color	PIN	NAME	Color	PIN	NAME	Color
1	J1-Brake	White	2	J2-Brake	Brown	3	J3-Brake	Green
4	J4-Brake	Yellow	5	J5-Brake	Gray	6	J6-Brake	Pink
7	P24V	Blue	8	Space	Red			

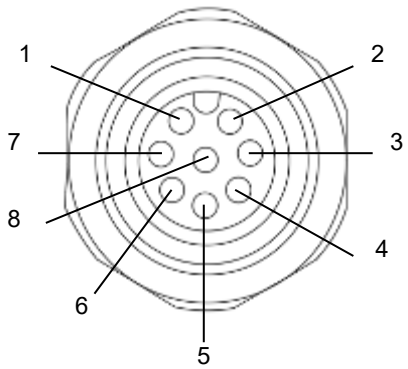


Figure 6.4 Brake release pin position (Robot arm)

The figure 6.5 below is a wiring example of the brake connector

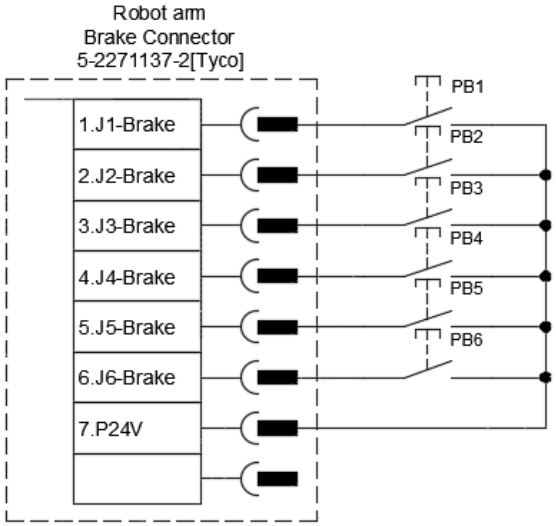


Figure 6.5 Brake connector wiring example

Notices:

1. The connector model on the side of the robot is: [Tyco]5-2271137-2.
2. The connector model connected to the robot is: [Tyco]T4111002081-000, and the external diameter of the applicable cable is 6 - 8 mm.
3. P24V power (Pin7) is already provided by the brake connector; please do not input other additional AC or DC power.
4. Do not use the power inside the brake connector for other purposes.
5. Please install the buttons to release the brakes of each axis inside the railing close to the robot; if accidently caught by the robot during operation, the brake can be released immediately so that the robot can be pushed away immediately in order to save oneself.
6. The power of the brake connector is provided by the controller; the power is not provided only when the controller is turned off or damaged, or the fuse is broken.
7. When the brake is released, due to the posture of the robot arm or load installed on the flange surface of the J6 axis, the various axes might slide downwards due to gravity.
8. When releasing the brake, do not place hand in gaps of the robot arm in order to avoid getting pinched.
9. Do not release the brakes of the six axes simultaneously; otherwise the robot arm might fall and cause damages or injuries to workers.
10. If the brake release button is installed far away from the robot, someone caught by the robot cannot rescue himself.
11. The brake release button must be installed at a location where the height is appropriate for workers to press the button; installing it too high makes it difficult for workers to press it when danger occurred.

The follow figure 6.6 shows the user end diagram and pin diagram of the brake connector [Tyco]T4111002081-000.

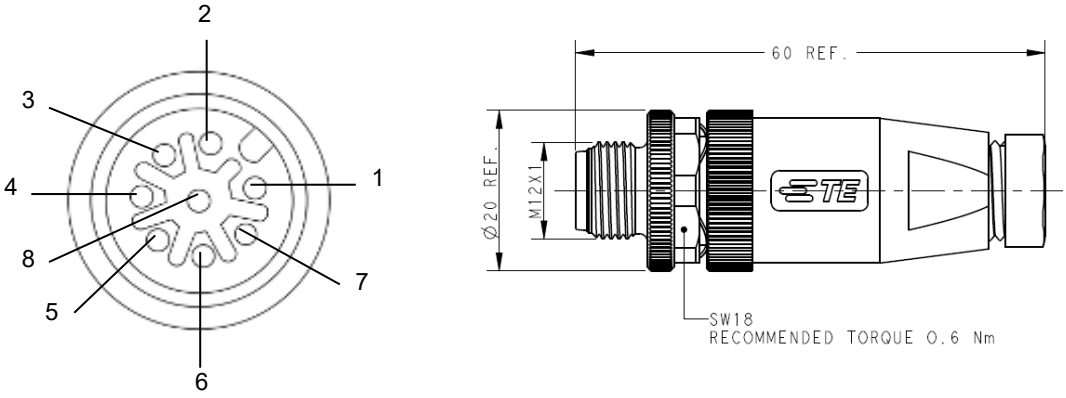


Figure 6.6 Brake release connector pin definition (User side)

6.4 Air pipe and signal connector configuration

Since customers will install various types of clamps and fixtures on the flange surface of the robot during actual applications, there is a 12Pos circular connector configured at the J4 wrist part of the robot arm for customers to connect signals. Customers can use this 12Pos connector to connect sensor signals.

Notices:

1. This 12Pos signal is for customers to use only when installing sensors on the TCP terminal; it cannot drive loads exceeding 0.5A current.
2. To use this signal cable to connect external indicators or use as an output signal, the maximum current allowed for each point of the 12Pos circular connector is 0.5A.
3. The 12Pos signal circuit has already completed configuration inside the robot; customers do not need to run cables from the J4 axis wrist 12Pos connector to the base.
4. The model of the 12Pos signal connector at the side of the robot is [HIROSE] LF10WBRB-12S, and the model of the signal connector connected on the other end is [HIROSE] LF10WBLP-12PA.

The 12Pos signal circuit enters from the robot's J4 axis wrist and connects to pins 1-12 of the 24Pos circular connector behind the base, as shown in the figure 6.7 below.

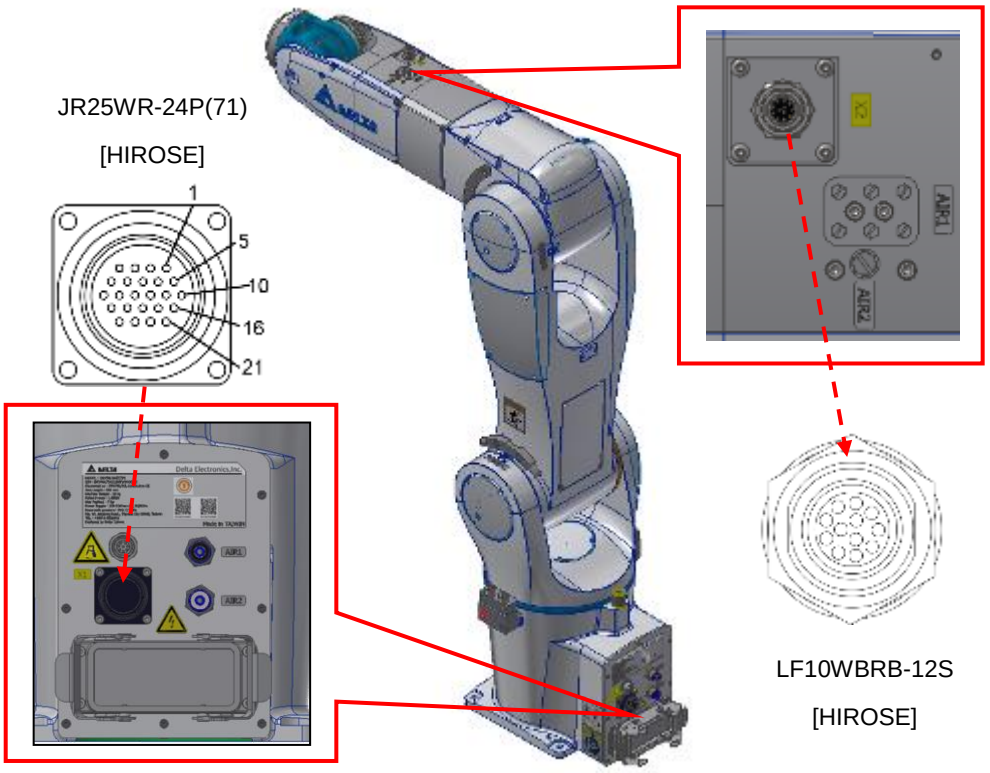


Figure 6.7 DRV70/90L7D/E series signal connector position

Please refer to Figure 6.8 below for the correlation curve between the burst pressure and temperature of the 2 air hoses provided inside the robot. Please consider the temperature effects on the air hose while in use.

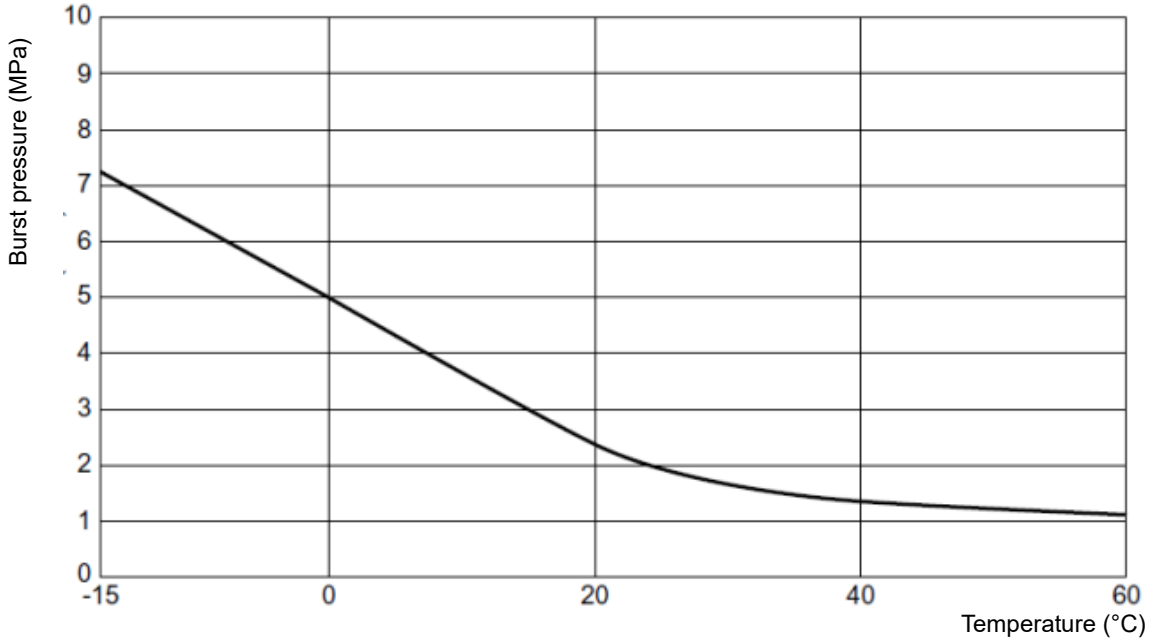


Figure 6.8 Air hose burst pressure table

3 five-port three-position central blocking solenoid valves are equipped inside the J4 axis of the DRV70/90L7D/E series robot arms for customers to quickly connect and use; the solenoid valve figure is as shown in the figure 6.9.

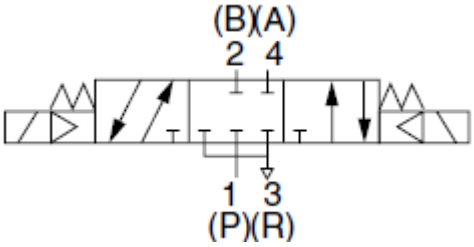


Figure 6.9 Solenoid- five-port three-position

The driving coils of these three sets of solenoid valves are DC 24V; the circuit enters from inside the robot's J5 axis and connects to pins 13-24 of the 24Pos circular connector behind the base, as shown in Figure 6.10 below. Notice:

1. The driving coils of these three sets of solenoid valves are DC 24V; AC power cannot be connected to pins 13-24 of the 24Pos connector at the base.
2. The power of the solenoid valve coil is only 0.35W; the current needed to drive one side of a single solenoid valve is 15mA.

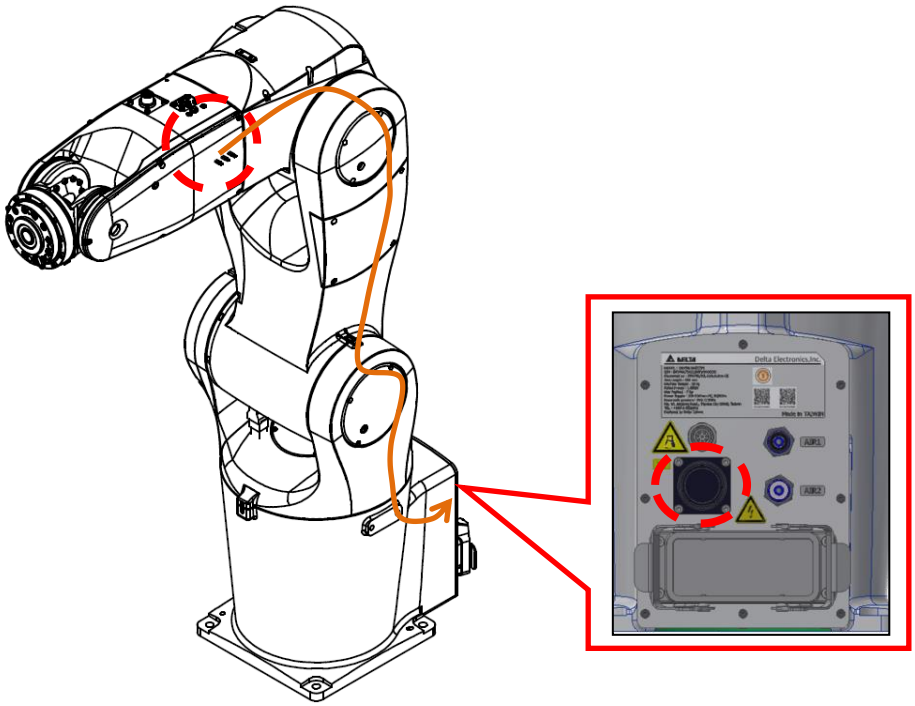


Figure 6.10 Wiring Diagram of the Robot's Built-in Solenoid Valve

2 ø6 air pipe connectors are provided at the base of the robot for customers to install and use on their own. One is connected to the solenoid valve inside the robot and the other is connected on top of the J4 axis for customers to use for expansion. The figure 6.11 below is the internal pipe laying location of the robot's first set of air pipes.

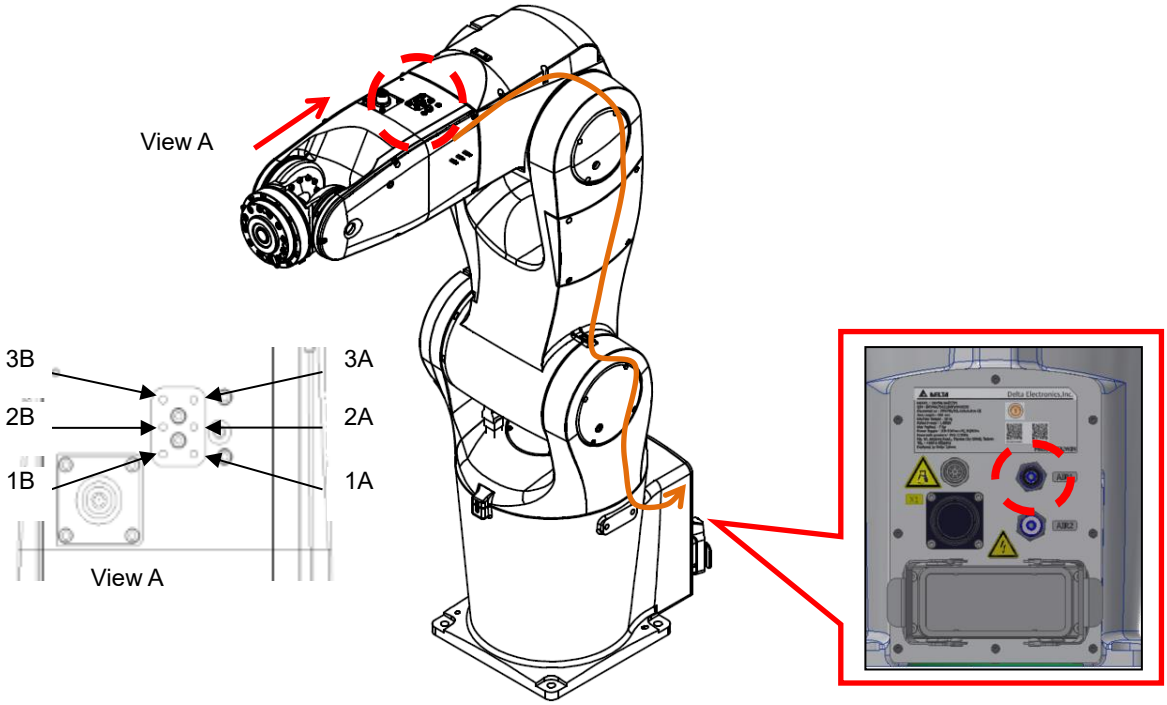


Figure 6.11 Air pipe path inside the robot

Table 6.2 Solenoid & Signal Pin Defininition on the Robot

Solenoid & Signal Pin Definition/Robot Side/JR25WR-24P(71)[HIROSE]					
PIN	NAME	PIN	NAME	PIN	NAME
1	12Pos-1	2	12Pos-2	3	12Pos3-
4	12Pos-4	5	12Pos-5	6	12Pos-6
7	12Pos-7	8	12Pos-8	9	12Pos-9
10	12Pos-11	11	12Pos-11	12	12Pos-12
13	Solenoid-1A+	14	Solenoid-1A-	15	Solenoid-2A+
16	Solenoid-2A-	17	Solenoid-3A+	18	Solenoid-3A-
19	Solenoid-1B+	20	Solenoid-1B-	21	Solenoid-2B+
22	Solenoid-2B-	23	Solenoid-3B+	24	Solenoid-3B-

Figure 6.12 below is the air pipe and sensor wiring example after installing a clamping jaw on the TCP terminal of the robot. The green cable is the sensor signal cable of the clasping jaw, and the red cable is the air pipe of the clasping jaw.
The air pipe and clasping jaw sensor cable can be run directly to the J4 arm using a hollow cable running from the TCP terminal of the robot; this way when the robot is in motion, the air pipe or cable will not rupture due to the rotation.

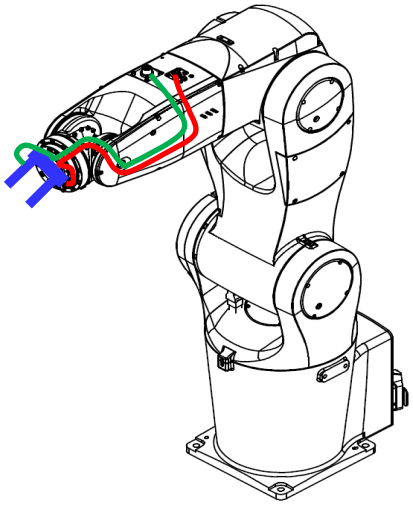


Figure 6.12 Air pipe and Sensor installing example

Customers can connect the factory terminal air source to the ø6 air pipe connector at the base of the robot to provide an air source for the solenoid valve inside the robot. And the clasping jaw sensor signal cable and solenoid valve coil signal cable can also be connected to the DCV controller's User .DI/O connector or the upper controller of the customer terminal using the 24Pos circular connector at the base of the robot, as shown in the figure 6.13 below.

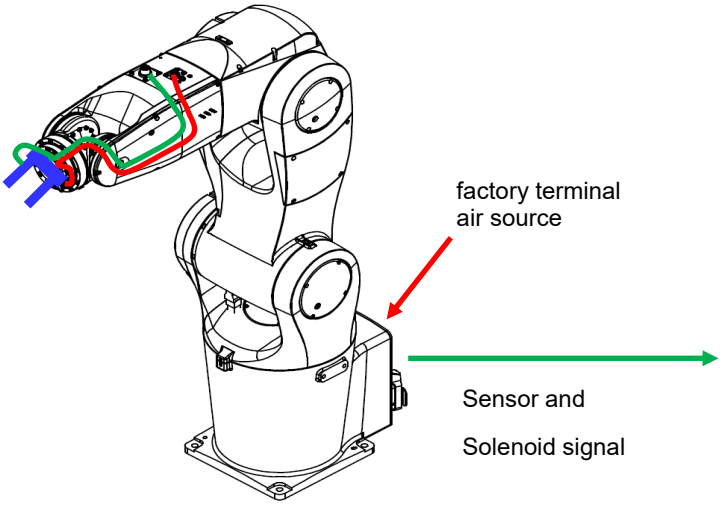


Figure 6.13 Robot clamp sensor and solenoid connector example

6.5 Heavy-duty connector

Mainly used to connect the motor and encoder cable signals between the robot and controller.
The locations of the robot connectors are as shown in the figure 6.14, and the cables are also as shown in the figure 6.15.
Please make sure the buckles are locked in properly before turning on the power.
Please note the connector directions; both ends of the connector have foolproof designs so forced connection will cause damages to the connector and the equipment.
The standard length of the cables between the robot and control box is 3m; customers shall not extend the cables on their own as doing so will cause problems such as weakening the signals and causing the equipment to malfunction.

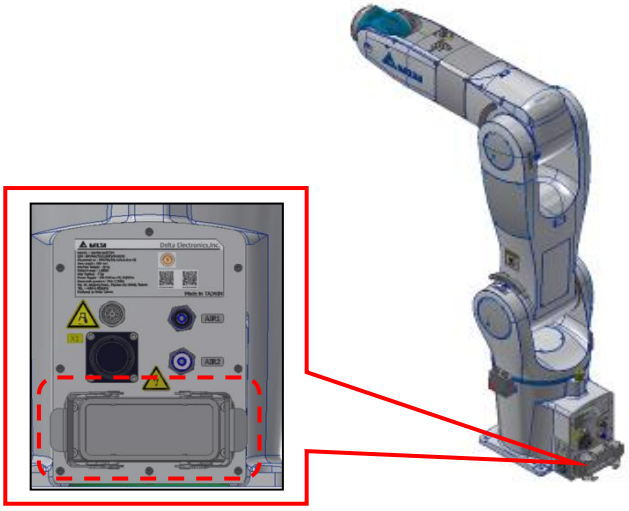


Figure 6.14 Heavy-duty connector position

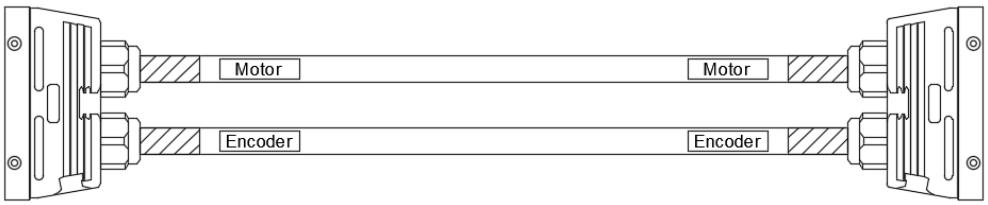


Figure 6.15 Heavy-duty cable

The heavy-duty connector pin definition is shown in the table 6.3.

Table 6.3 Heavy-duty connector pin definition

PIN	Module 1 12Pos	PIN	Module 2 12Pos	PIN	Module 3 17Pos	PIN	Module 4 25Pos	PIN	Module 4 25Pos
1	J1-U	1	J3-U	1	J5-U	1	J1-5V	13	J4-5V
2	J1-V	2	J3-V	2	J5-V	2	J1-0V	14	J4-0V
3	J1-W	3	J3-W	3	J5-W	3	J1-T+	15	J4-T+
4	J1-Ground	4	J3-Ground	4	J5-Ground	4	J1-T-	16	J4-T-
5	J1-Brk+	5	J3-Brk+	5	J5-Brk+	5	J2-5V	17	J5-5V
6	J1-Brk-	6	J3-Brk-	6	J5-Brk-	6	J2-0V	18	J5-0V
7	J2-U	7	J4-U	7	J6-U	7	J2-T+	19	J5-T+
8	J2-V	8	J4-V	8	J6-V	8	J2-T-	20	J5-T-
9	J2-W	9	J4-W	9	J6-W	9	J3-5V	21	J6-5V
10	J2-Ground	10	J4-Ground	10	J6-Ground	10	J3-0V	22	J6-0V
11	J2-Brk+	11	J4-Brk+	11	J6-Brk+	11	J3-T+	23	J6-T+
12	J2-Brk-	12	J4-Brk-	12	J6-Brk-	12	J3-T-	24	J6-T-
				17	P24V				

6.6 Battery location

Figure 6.16 below indicates the battery location of the DRV70/90L7D/E series robots. There are 3 batteries in the battery holder for memorizing the position of each axis of the robot.
Please execute battery-change operations properly according to the maintenance table (please refer to the maintenance chapter) in order to ensure that the encoder position of the robot can be properly stored.

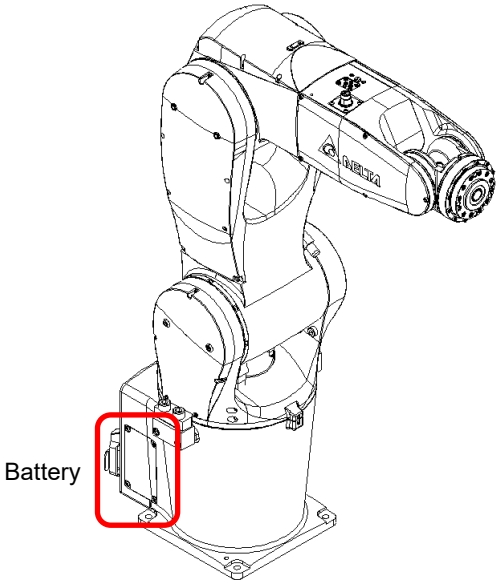


Figure 6.16 DRV70/90L7D/E series battery location

7. Wiring

Since the robot is a semi-finished product system, please construct safety protection systems, operation buttons, and lamps etc., around the robot according to the instructions in the manual properly in order to ensure the integrity and safety of the entire system.

- Please perform wiring according to the explanations in the manual properly.
- Please install safety protection devices around the robot, such as railings, safety gratings, pressure pads, or laser scanners etc., in order to guarantee the safety of the workers.
- Please turn off the power during wiring otherwise there is the danger of electrical shocks.
- Do not perform any wiring within 10 minutes after turning of the power because there is residue voltage in the driver that has not yet been fully discharged.
- Wiring operations shall be performed by personnel with related licenses; personnel without related licenses shall not perform wiring operations.

- Personnel without related licenses shall not perform wiring operations.
- Do not use any method to bypass the safety protection system; the safety protection system includes the emergency stop signal and railing signal.
- The emergency stop signal and railing signal are no-voltage contact signals; do not connect any AC or DC power otherwise it will cause damages to the controller.
- Modifications of any wiring inside the controller is prohibited; our company is not responsible for any controller malfunctions or damages resulted from doing so.

7.1 Controller peripheral interface

The robot controller is integrated with the driver control; this controller can be used with visual systems and teach pendants, and can be expanded with drivers or remote input/output modules to easily complete the integration with peripheral systems. Figure 7.1 is a schematic of the combination of controller interface peripherals.

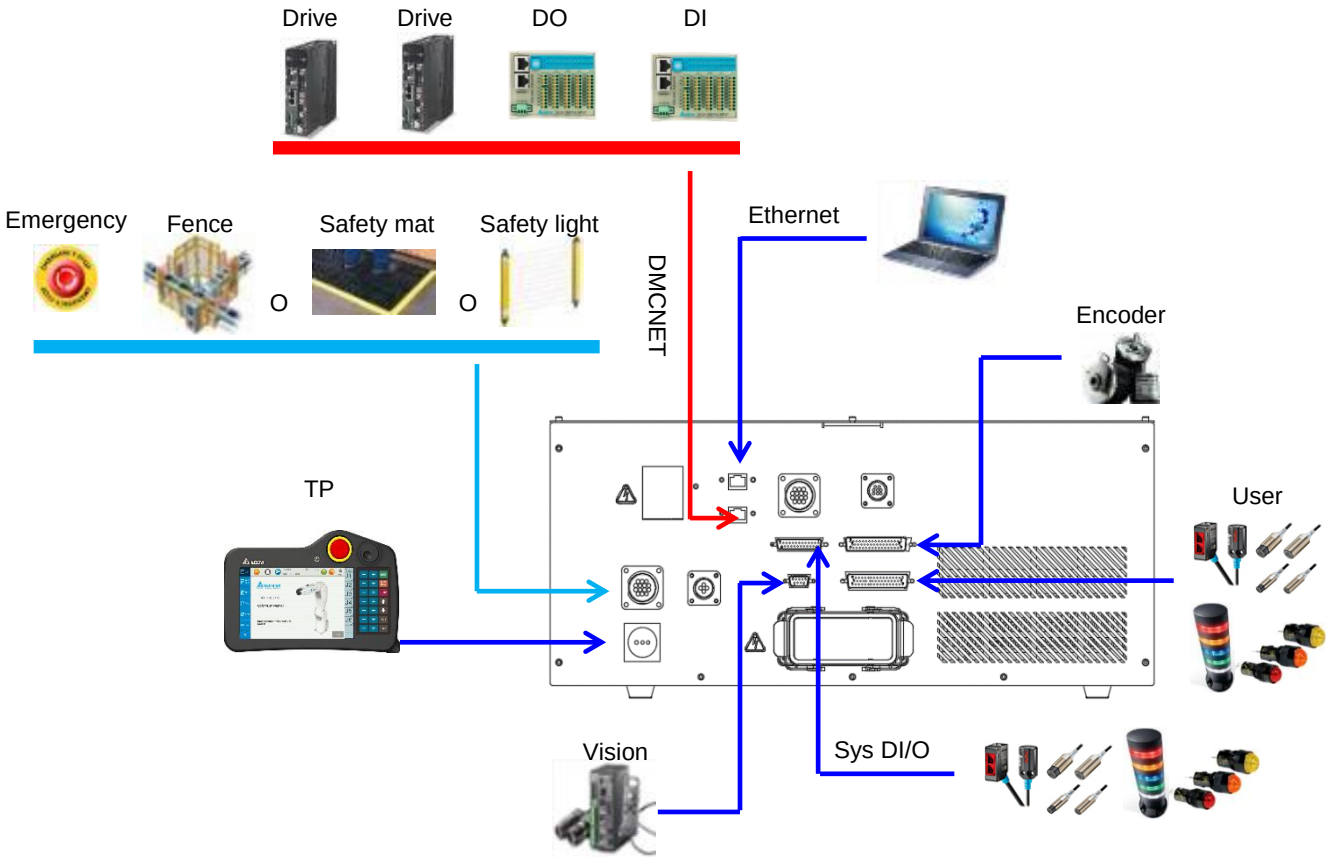


Figure 7.1 Controller interface peripheral combination

7.2 Introduction to the controller interface

Figure 7.2 below is the DCV power control box interface; the following are individual explanations of the controller interface, explaining the function of the interface and the wiring.

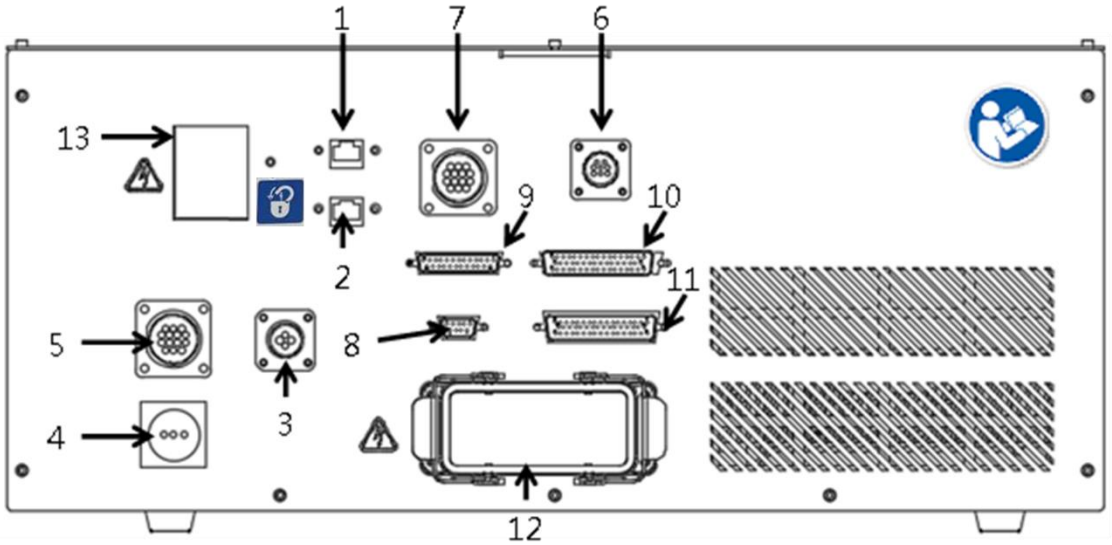


Figure 7.2 DCV-2J00-CA controller interface

1. Ethernet communication port.
2. DMCNET communication port.
3. Direct current output connector: Provides customers with DC24V (2A) for external connection.
4. Teach pendant connector: Location to connect handheld teach pendants (DTV).
5. Safety connector: Provided for customers to connect external safety protections.
6. External shaft motor connection (optional): Power connector for the seventh axis motor.
7. External shaft encoder connection (optional): Encoder connector for the seventh axis motor.
8. Serial communication connector: RS-232/RS485 communication connector.
9. System output / input connector: System I/O; provides customers with defined system input points and output points for external connections.
10. External encoder connector: Allows customers to connect and use 4 external encoders to finish close loop application or conveyor tracking.
11. User output / input connector: User I/O; a total of 24 sets of DI and 12 sets of DO.
12. Robot connector: Connects the motor and between the robot and the controller, and the encoder cable signal.
13. No Fuse Breaker: Overcurrent protection

7.2.1 Main circuit power connection

The input power specification of the Delta robot controller is 220Vac, single-phase, 50/60 Hz. Customers need to connect the main power manually and please use cables that comply with VW-1 flame resistance and UL758 wire diameter specifications, as well as cables with the specifications in Table 7.1 below：

Table 7.1 Main circuit power specification

Power control box main circuit power cable specifications	
Power cable diameter	2 mm², 105°C
Ground cable diameter	10 mm²

Installation:

1. There is a terminal interface on the controller for customers to install the cables for the main power circuit in figure 7.3.

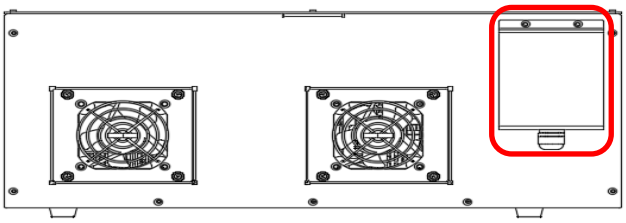


Figure 7.3 User side AC power in terminal

2. AC power cable connected to terminals L and N, and ⏚ is for grounding.
   Please use R type terminals to connect the power cable to the terminal block to avoid loose wire resulting in a short circuit.

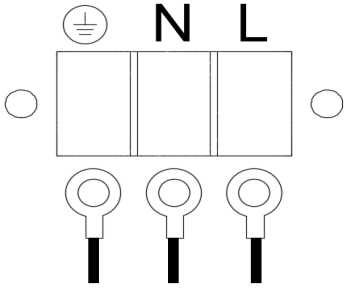


Figure 7.4 AC power cable connected to the terminal block

Note: Since the robot is a partly-completed robot system, add an isolated main power switch before controller and add an EMI filter, a reactor, and a ferrite core to the power cable connected to the controller in order to reduce the interference of noise and harmoniocs, as shown in Figure 7.5.

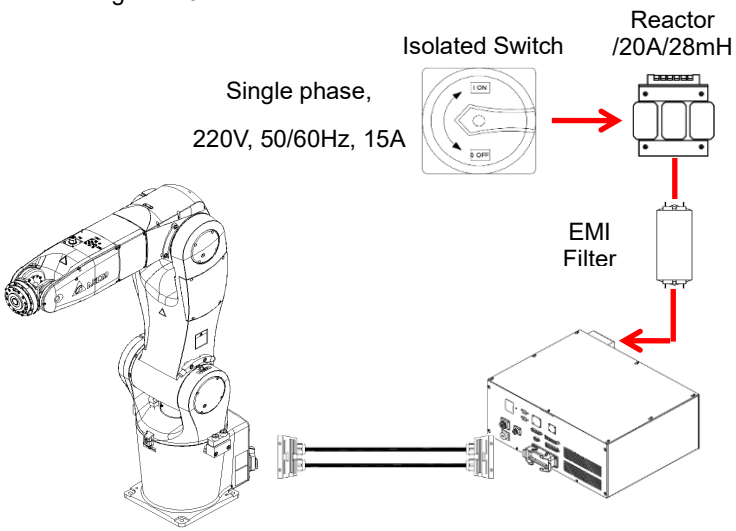


Figure 7.5 Add filter & reactor to the controller configuration

7.2.2 Robot connector

Detachable cables are used for the connection between the robot and the DCV robot control box; the two ends are connected with heavy load connectors. Please make sure the buckles are locked in properly before turning on the power. The installation of the power control box connector is as shown in Figure 7.6 and the standard connection cable is as shown in Figure 7.7.
Please note the connector directions; both ends of the connector have foolproof designs so forced connection will cause damages to the connector and the equipment.
The standard length of the cables between the robot and control box is 3 m; customers shall not extend the cables on their own as doing so will cause problems such as weakening the signals and causing the equipment to malfunction.

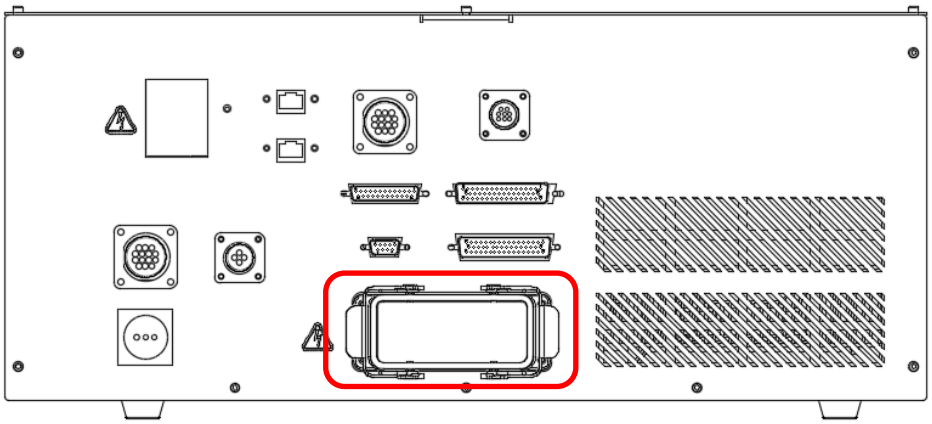


Figure 7.6 Robot cable connector

Figure 7.7 Robot standard connection cable

7.2.3 External encoder connector

A set of external optical ruler or encoder connector is provided for external optical rulers or encoders (A, B, Z); the connection of the controller into a fully closed loop can be applied for CVT functions. The location of the external encoder connector and definitions of the pins are as shown in Figure 7.8 and Table 7.2 below.

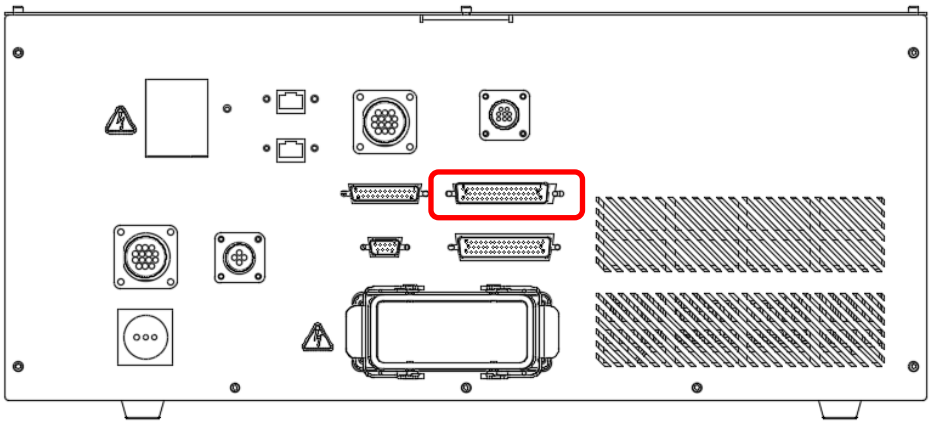


Figure 7.8 External encoder connector

Table 7.2 External encoder connector pin definition

Ext.Encoder Pin Defininition / D-Sub 37-in, Female							
Pin	**Name**	**Pin**	**Name**	**Pin**	**Name**	**Pin**	**Name**
1	1-Z	2	1-/Z	19	3-Z	20	3-/Z
3	1-B	4	1-/B	21	3-B	22	3-/B
5	1-A	6	1-/A	23	3-A	24	3-/A
7	1-5V	8	1-0V	25	3-5V	26	3-0V
9		10		27		28	
11	2-0V	12	2-5V	29	4-0V	30	4-5V
13	2-Z	14	2-/Z	31	4-Z	32	4-/Z
15	2-B	16	2-/B	33	4-B	34	4-/B
17	2-A	18	2-/A	35	4-A	36	4-/A

7.2.4 User DI/O

Standard D-SUB50P/Female/3 row connector; this connector defines the user output / input pins and provides 12 sets of output and 24 sets of input that can be planned freely. The location of the connector is as shown in Figure 7.9 and the definitions of the pins are as shown in Table 7.3 below.

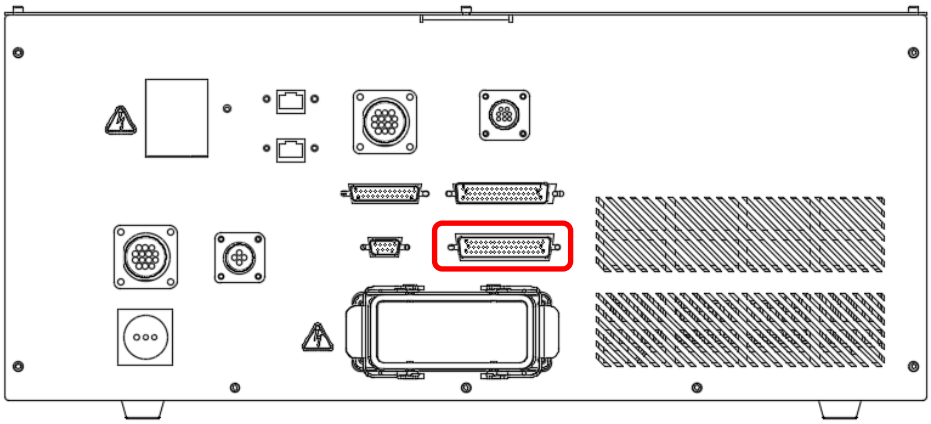


Figure 7.9 User DI/O Connector Position

Table 7.3 User digital output input connector pin definition

Pin	Name	Pin	Name	Pin	Name	Pin	Name
1	DI1	2	DI2	27	DO2+	28	DO2-
3	DI3	4	DI4	29	DO3+	30	DO3-
5	DI5	6	DI6	31	DO4+	32	DO4-
7	DI7	8	DI8	33	DO5+	34	DO5-
9	DI9	10	DI10	35	DO6+	36	DO6-
11	DI11	12	DI12	37	DO7+	38	DO7-
13	DI13	14	DI14	39	DO8+	40	DO8-
15	DI15	16	DI16	41	DO9+	42	DO9-
17	DI17	18	DI18	43	DO10+	44	DO10-
19	DI19	20	DI20	45	DO11+	46	DO11-
21	DI21	22	DI22	47	DO12+	48	DO12-
23	DI23	24	DI24	49	-	50	DI_COM
25	DO1+	26	DO1-	-	-	-	-

User digital input (User.DI) wiring example

User input signal D1 includes a total of 24 points from Pin1 to Pin24; users can freely select between NPN or PNP wiring.

When the power of the controller itself is going to be used for the input signal DI:

- The NPN wiring method is as shown in Figure 7.10 below; please connect DI COM (Pin50) of User.DI/O (D Sub-50P) to P24V (Pin1) of the DC output, and connect the output signals including buttons, switches, and sensors etc. to DI.

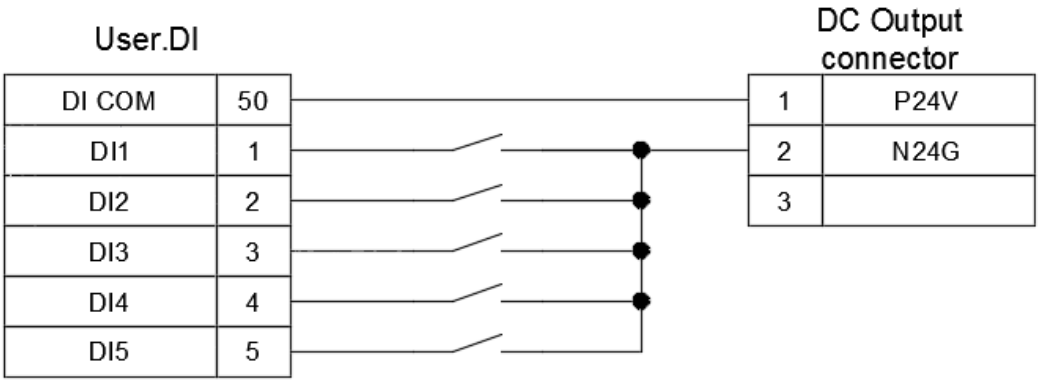


Figure 7.10 NPN wiring for when the input signal DI uses power of the controller

- The PNP wiring method is as shown in Figure 7.11 below; please connect DI COM (Pin50) of User.DI/O (D Sub-50P) to N24G (Pin2) of the DC output, and connect the output signals including buttons, switches, and sensors etc. to DI.

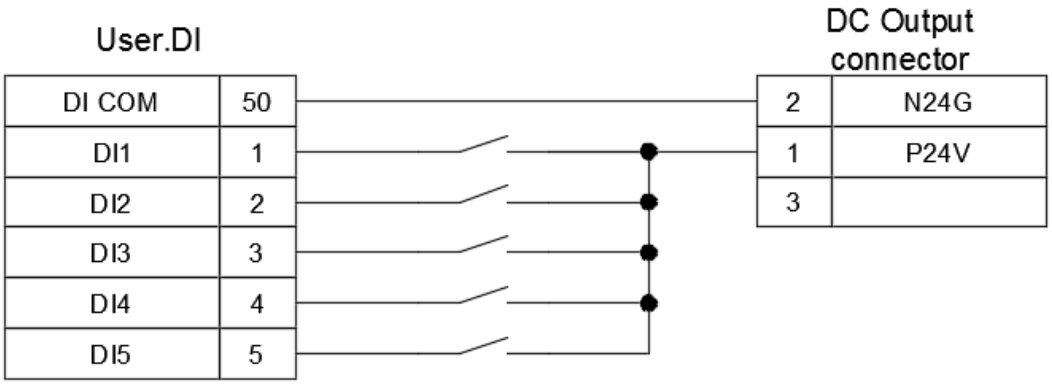


Figure 7.11 PNP wiring for when the input signal DI uses power of the controller

Note:
The power control box DC output connector already provides the N24G power; please do not connect the User.DI signal to other powers in order to prevent the signal from not being able to be sent or causing the DI contact to burn.

When the input signal DI is going to be connected directly with the controller and NPN wiring is used, the wiring method is as shown in Figure 7.12.

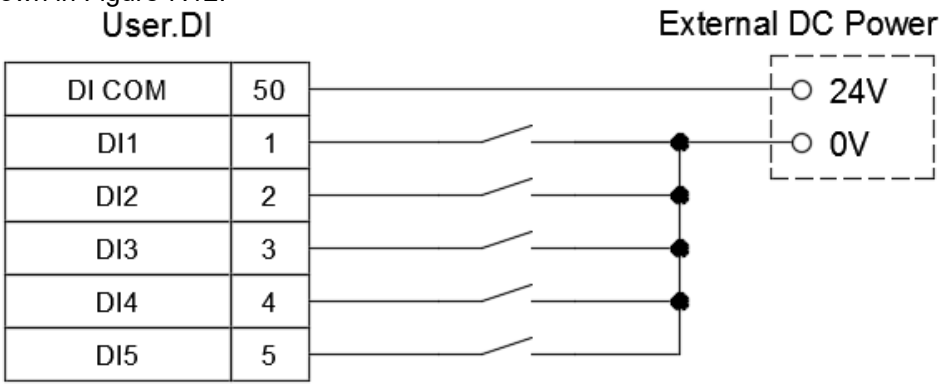


Figure 7.12 Input signal DI connected to the controller using NPN connection

When the input signal DI is going to be connected directly with the controller and PNP wiring is used, the wiring method is as shown in Figure 7.13.

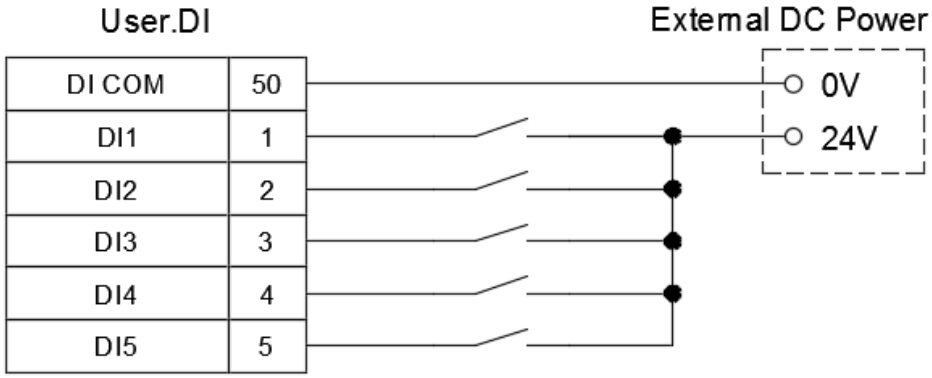


Figure 7.13 Input signal DI connected to the controller using PNP connection

The output signal DO includes a total of 24 points of output from Pin25 - Pin48; the output method can be NPN or PNP.
Customers can freely choose whether the output voltage signal will be the controller voltage output or the controller voltage output.

- When the selected output voltage signal is the controller voltage output
  The NPN wiring method is as shown in Figure 7.14 below:

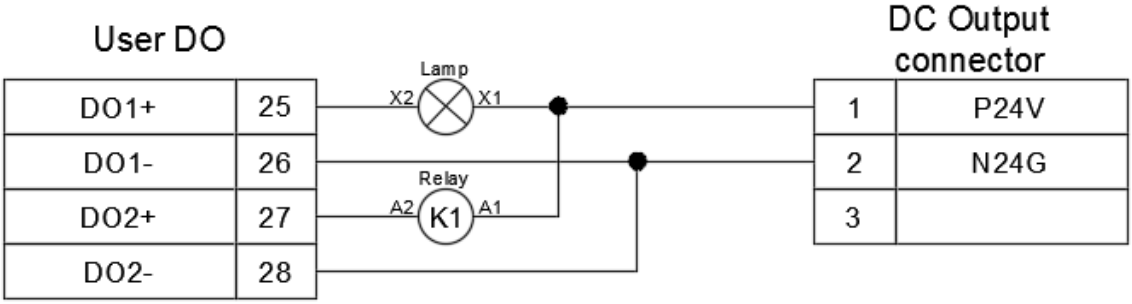


Figure 7.14 User DO controller voltage output NPN wiring

The PNP wiring method is as shown in Figure 7.15 below:

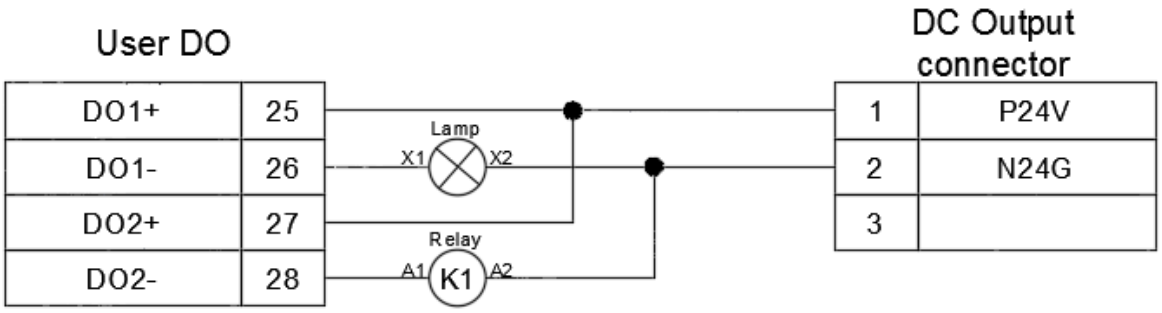


Figure 7.15 User DO controller voltage output NPN wiring

Mixed NPN and PNP wiring method is as shown in the figure below:
In Figure 7.16 below, PNP output wiring is used for the lamp and NPN output wiring is used for the relay.

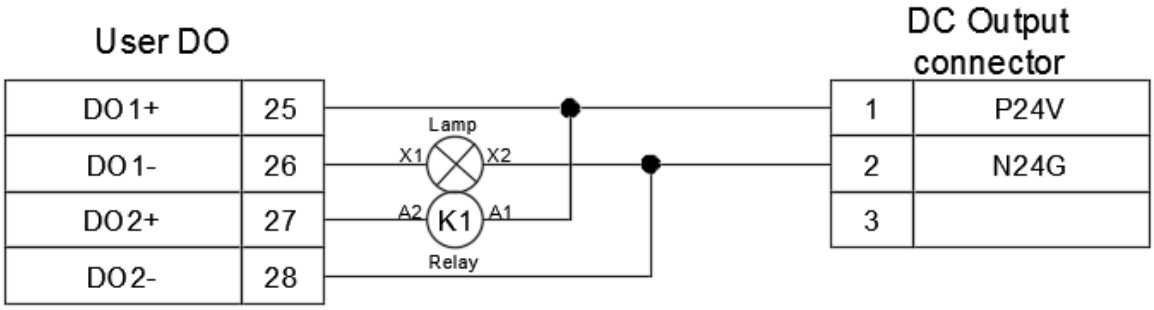


Figure 7.16 User DO controller voltage mixed output wiring

- When the selected output voltage signal is the controller voltage output
  The NPN wiring method is as shown in Figure 7.17 below:

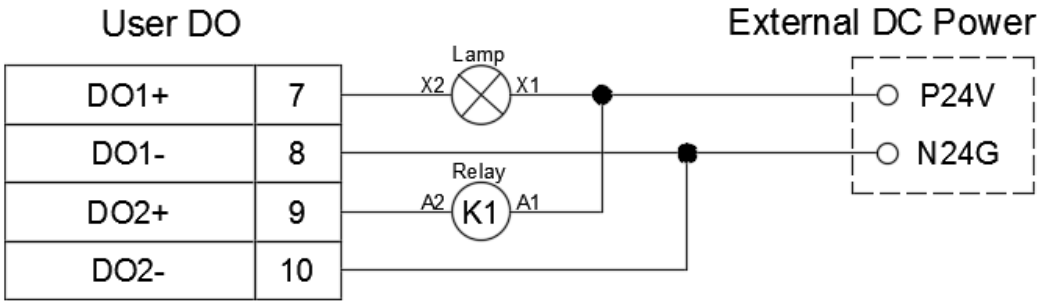


Figure 7.17 User DO controller voltage output NPN wiring

The PNP wiring method is as shown in Figure 7.18 below:

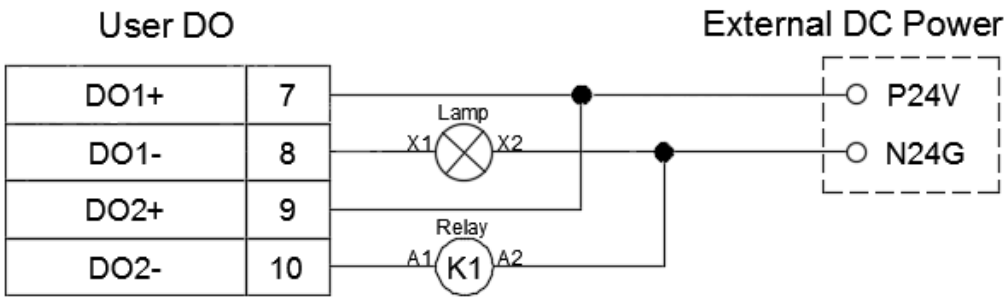


Figure 7.18 User DO controller voltage output PNP wiring

Upper controller mixed NPN and PNP wiring method is as shown in the figure below:
In Figure 7.19 below, PNP output wiring is used for the lamp and NPN output wiring is used for the relay.

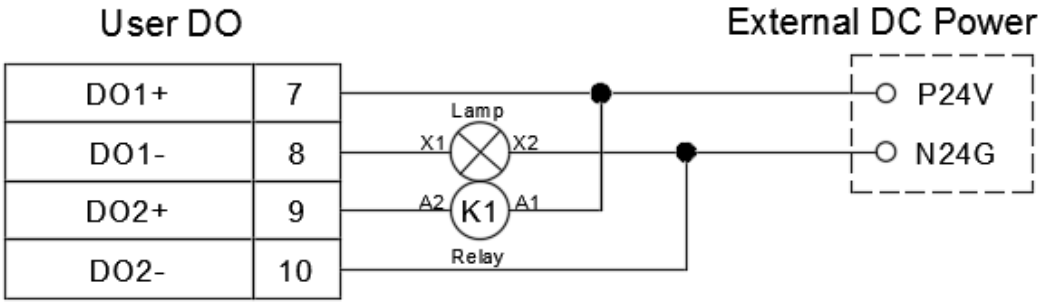


Figure 7.19 User DO controller voltage mixed output wiring

Note:

1. Each DO output point can supply 40 mA at most. To activate heavy current load, please execute through the relay.
2. Do not connect AC power to the DO output point; such wiring methods will damage the controller.

7.2.5 System digital output input connectors

Standard D-Sub25P/Female connector; System DI/O provides 5 point input and 7 point output to communicate with the controller. Pin definitions are as shown in Table 7.4, and the connector interface locations are as shown in Figure 7.20.

Table 7.4 System DI/O pin definition

Pin	Name	Function	Pin	Name	Function
1	DI3	Reserved	13	DO4+	Reserved
2	DI4	Mode selection 1	14	DO4-	
3	DI5	Mode selection 2	15	DO5+	Project run status
4	DI6	Project run 1	16	DO5-	
5	DI7	Project run 2	17	DO6+	
6	DI8	Abnormality alarm reset	18	DO6-	
7	DO1+	Abnormality alarm status	19	DO7+	Controller ready
8	DO1-		20	DO7-	
9	DO2+	Servo status	21	DO8+	Reserved
10	DO2-		22	DO8-	
11	DO3+	Robot movement status	23		
12	DO3-		24		

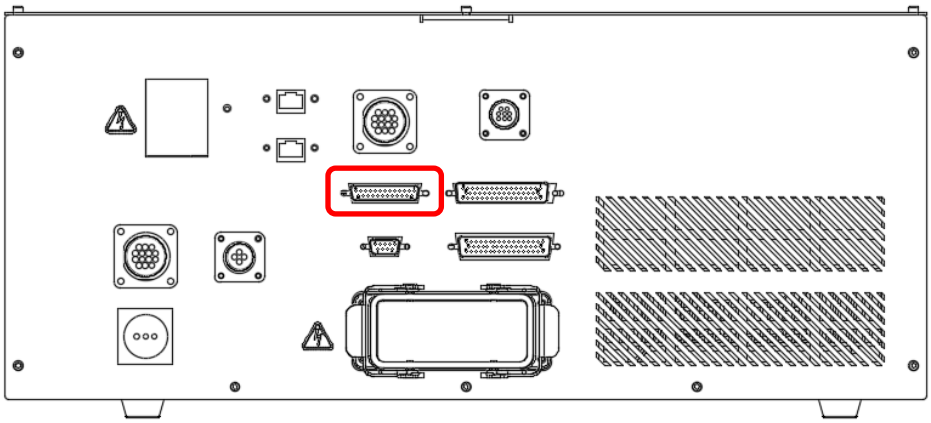


Figure 7.20 System output/input connector seat

Please connect Pin1 (P24V) and Pin2 (N24G) of the DC output connector in the power control box interface with the input signal DI by using a button or selection switch during wiring. The DC Output location is as shown in Figure 7.21.

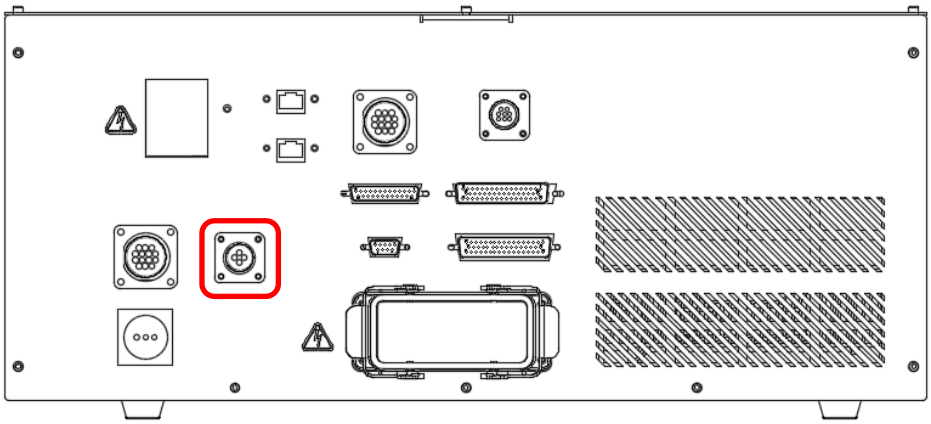


Figure 7.21 DC Output connector location

Note:
1. The DC output provides a maximum output of 1A, and can only be connected with small DI/O signals.
2. Do not connect too many DC signals otherwise it might cause the fuse to burn.

The wiring method for the input signal DI is as shown in Figure 7.22.

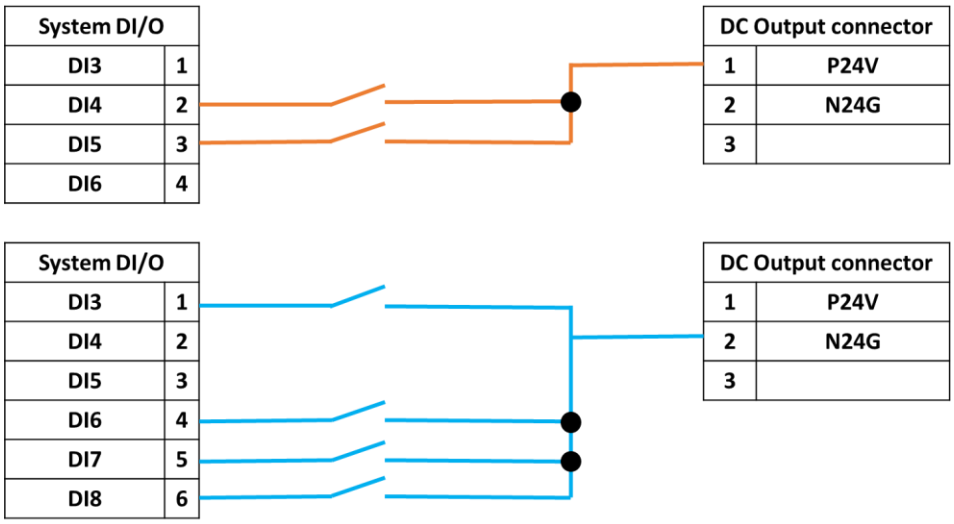


Figure 7.22 Input signal DI wiring

Note:
1. The power control box DC output connector already provides the P24V and the N24G power; please do not connect the System.DI signal to other powers in order to prevent the signal from not being able to be sent or causing the DI contact to burn.
2. When the transmitted DI signal is live or when transmitting the signal from upper controller to DI, please execute through the relay or optocoupler.

The output signal DO includes a total of 8 points of output from Pin7 to Pin22; the output method can be NPN or PNP.
Customers can freely choose whether the output voltage signal will be controller voltage output or upper controller voltage output.

- When the selected output voltage signal is the controller voltage output
  The NPN wiring method is as shown in Figure 7.23 below:

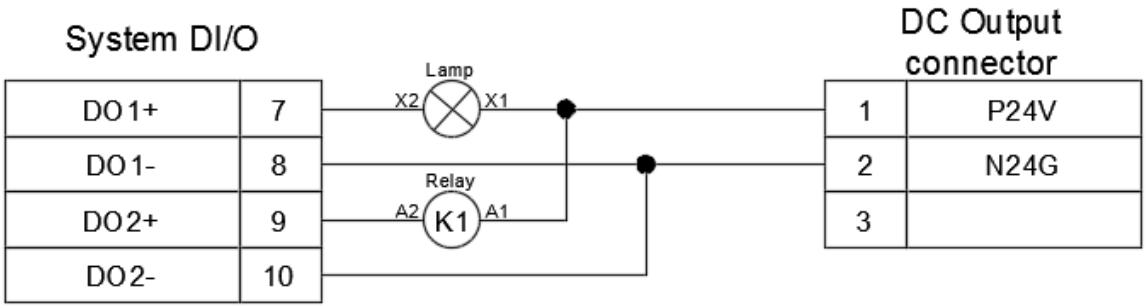


Figure 7.23 System DO controller voltage output NPN wiring

The PNP wiring method is as shown in Figure 7.24 below:

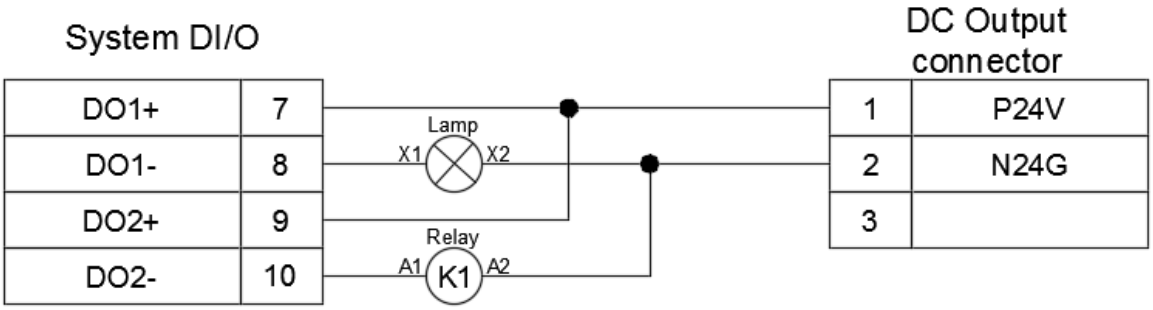


Figure 7.24 System DO controller voltage output PNP wiring

Mixed NPN and PNP wiring method is as shown in Figure 7.25 below:
In the figure below, PNP output wiring is used for the lamp and NPN output wiring is used for the relay.

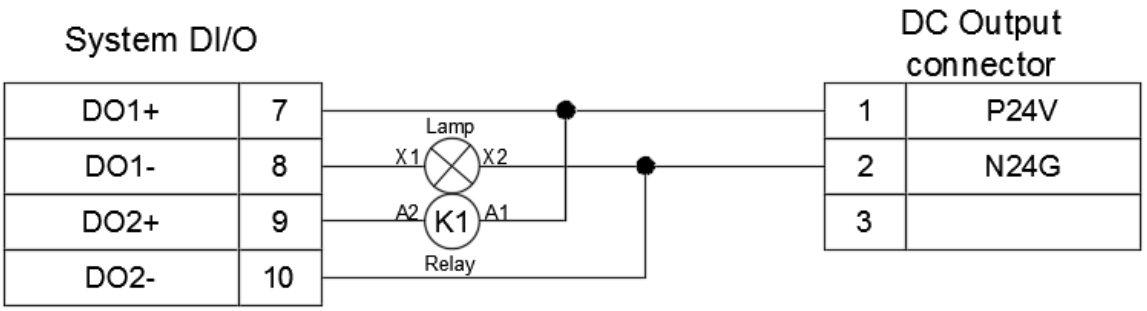


Figure 7.25 System DO controller voltage mixed output wiring

- When the selected output voltage signal is the controller voltage output, the NPN wiring method is as shown in Figure 7.26 below:

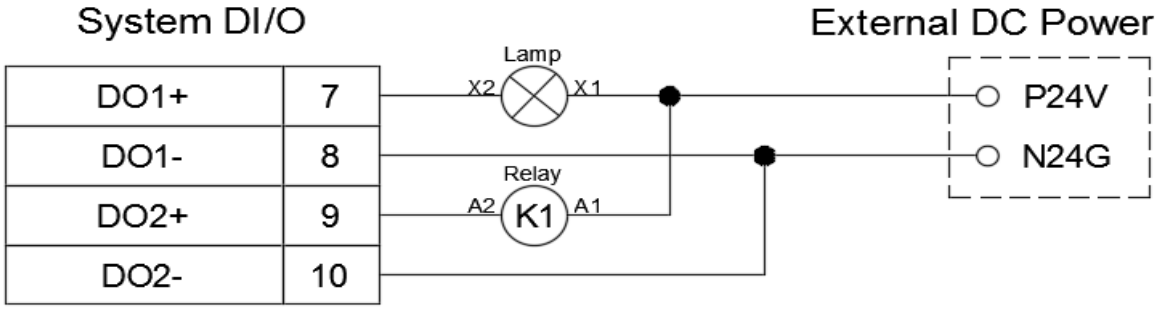


Figure 7.26 System DO controller voltage output NPN wiring

The PNP wiring method is as shown in Figure 7.27 below:

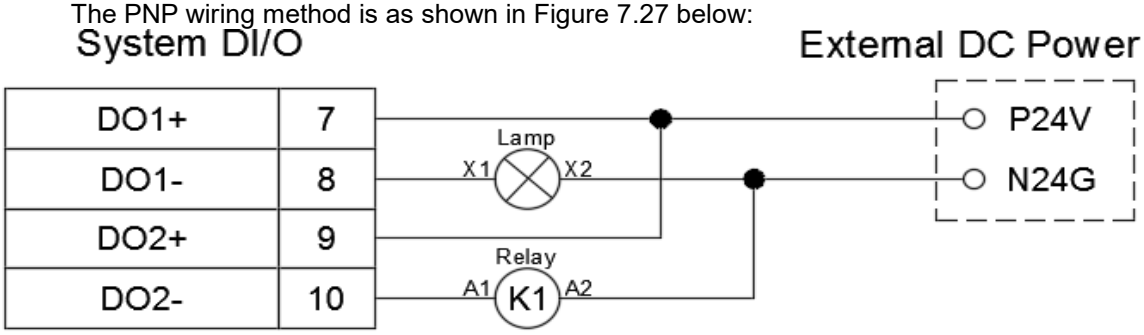


Figure 7.27 System DO controller voltage output PNP wiring

Upper controller mixed NPN and PNP wiring method is as shown in Figure 7.28 below:
In the figure below, PNP output wiring is used for the lamp and NPN output wiring is used for the relay.

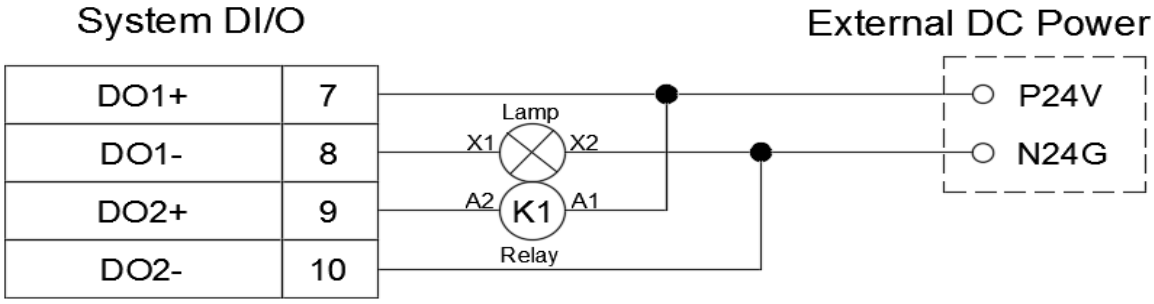


Figure 7.28 System DO controller voltage mixed output wiring

Note:
1. Each DO output point can supply 40mA at most. To activate heavy current load, please execute through the relay.
2. Do not connect AC power to the DO output point; such wiring methods will damage the controller.

7.2.5.1 System digital input (SYS.DI) usage

DI3 reserved
This function is temporarily reserved and does not have any meaning.

DI4, DI5 mode selection
Provides 2 point DI4 and DI5 signals. User then selects whether to perform manual teach or automatic operation mode.
Mode selection truth table is as shown in Table 7.5 below.

Table 7.5 DI4, DI5 mode selection truth table

Status command	DI4	DI5	Description
T1 mode	**1**	**0**	Under T1(Manual teach) mode, need to press the Enable switch of TP to JOG,the combined JOG speed of the robot will be lower than 250 mm/s.
Auto mode	**0**	**1**	Under Auto mode, the operating speed of the Robot is the speed being set in the program.

T1 mode:

- Under T1(Manual teach) mode, press the Enable switch of TP to JOG
- When shifting to T1 mode, the combined JOG speed of the Robot will be lower than 250 mm/s.
- Under this mode, TP/DRAStudio can execute the robot operation; but DI6 and DI7 cannot be used to execute the program Run/Pause/Stop.

Auto mode:

- To execute the program automatic running, please select Auto mode. Under this mode, it is impossible to use TP for executing T1 mode operations.
- Before executing the automatic operation under Auto mode, confirm that people are cleared of the Robot operation scope.
- When executing the automatic operation under Auto mode for the first time, please run the Robot at lower speed and then proceed with high-speed operation after confirming that the Robot is acting smoothly without any error.
- Under Auto mode, the operating speed of the Robot is the speed being set in the program.
- Under Auto mode, the user can only run the program currently selected by DRAStudio.

Note:

1. Please use the two-stage key switch (two a contact) in order to ensure that the operation mode cannot be changed randomly and prevent danger from happening. The key switch is as shown in Figure 7.29 below.

Figure 7.29 Two-stage key switch

2. The key must be able to be pulled out from any direction or else workers might activate the robot by accident and causing danger.

3. Please do not hang or place the keys randomly. It should be kept safely with authorized users in order to ensure safe usage.

4. Please differentiate between the two operation modes with the symbols in Figure 7.30 below:

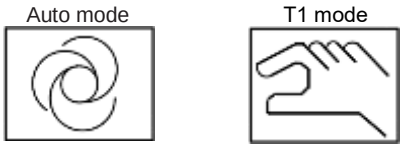


Figure 7.30 Mode selection symbol

5. The mode selection switch can be installed outside the railing together with the operation panel constructed by the user, as shown in Figure 7.31. Operation panel should be from the ground 0.6m to 1.7m between to make it easier for users to operate.

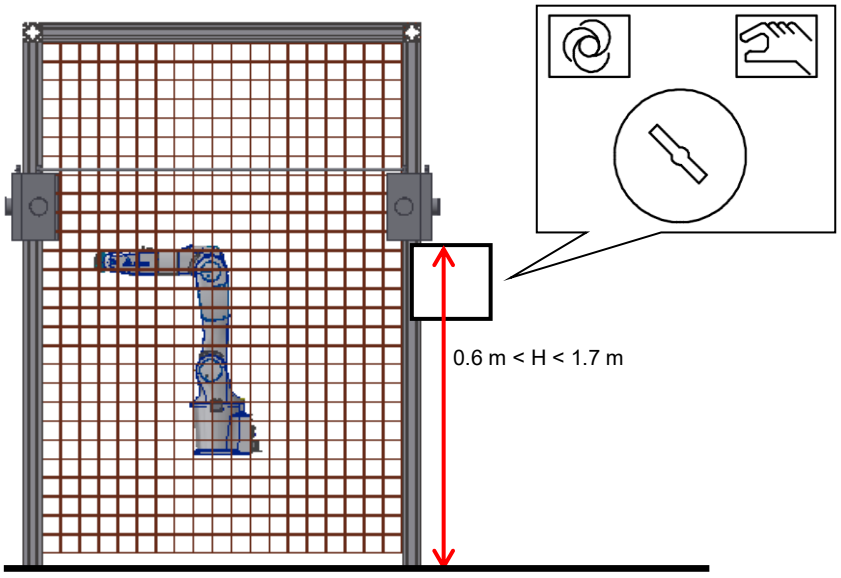


Figure 7.31 Mode selection switch installation location

6. When the operation mode is changed, controller will cut off the drive power. Press the reset button (safety connector Pins 5, 6 and Pins 7, 8) to reset alarm, and then you can switch to Auto or T1 mode again.

7. If DI4 and DI5 are not connected, then DI5 will be ON and AUTO mode is selected by default.

DI6, DI7 program execution

Provides the function for customers to run the program; the program can be paused, stopped, and ran by executing the functions from the external switch; its description is as shown in Table 7.6 below.

Table 7.6 Program execution signal truth table

Status command	DI6	DI7	Description
NO FUNCTION	**0**	**0**	No function.
PAUSE	**0**	**1**	The program pause function can be executed through external input signals, and will pause the current block; resuming it will start execution from the next action.
STOP	**1**	**0**	The program stop function can be executed through external input signals; resuming it will start execution from the first line of this process.
RUN	**1**	**1**	The program execute function can be executed through external input signals, but this is only valid for Auto mode.

DI8 abnormality warning reset

- If error occurs to the Robot or the Controller, the abnormal signal contact will be released.
- When eliminating the error, the signal must be maintained at ON status for 200 msec.
- For the error list and troubleshooting method, please refer to the software manual.

7.2.5.2. Digital output (DO) usage

DO1 robot abnormality alarm status display
The status descriptions of the system digital output SYS.DO1 is as shown in Table 7.7 below.

Table 7.7 SYS.DO1 status descriptions.

SYSDO status	ON	OFF
DO1	An alarm occurs	No alarm

DO2 robot servo status display
The status descriptions of the system digital output SYS.DO2 is as shown in Table 7.8 below.

Table 7.8 SYS.DO2 status descriptions

SYSDO status	ON	OFF
DO2	The servo for the robot is ON	The servo for the robot is OFF

DO3 robot in-place status display
The status descriptions of the system digital output SYS.DO3 is as shown in Table 7.9 below.

Table 7.9 SYS.DO3 status descriptions

SYSDO **status**	ON	OFF
DO3	The robot is moving	The robot is stopped

DO4 function pause function status display
The status descriptions of the system digital output SYS.DO4 is as shown in Table 7.10 below.

Table 7.10 SYS.DO4 status descriptions

SYSDO status	ON	OFF
DO4	The function is not triggered	The function is triggered

DO5, DO6 program run status display
The status descriptions of the system digital outputs SYS .DO5 and SYS.DO6 are as shown in Table 7.11 below.

Table 7.11 SYS.DO5.DO6 status descriptions

Function	DO5	DO6
Pause	0	1
Stop	1	0
Run	1	1

DO7 controller preparation complete status display
The status descriptions of the system digital output SYS.DO7 is as shown in Table 7.12 below.

Table 7.12 SYS.DO7 status descriptions

SYS.DO status	ON	OFF
SYS.DO7	The controller is ready	The controller is not ready

DO8 Reserved

7.2.6 Safety connector

The controller provides 12 point safety signals for users to connect; these 12 point safety signals can be used by the user to construct comprehensive robot safety protection. The location of the safety connector is as shown in Figure 7.32.

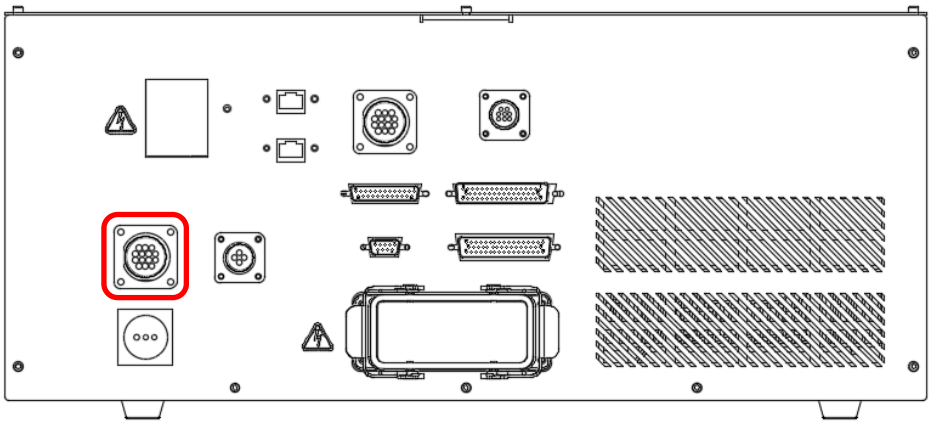


Figure 7.32 Safety connector seat

Connector pin definitions are as shown in Table 7.13 below.

Table 7.13 Safety connector pin definition

Pin	Name	Description
1	Emergency stop signal 1	Connects to the external emergency stop signal. Each emergency stop button corresponds to two NC contacts.
2		
3	Emergency stop signal 2	
4		
5	Protective stop signal 1	Connects to the external protective stop signal. Please connect to the NO or NC contact based on the type of the protective stop. Connect the fence to the NO contact. Connect the safety mats, light curtains, and laser scanners to the NC contacts.
6		
7	Protective stop signal 2	
8		
9	Emergency stop reset	After the emergency stop button is released, trigger the reset signal of the controller.
10		
11	Protective stop reset	After the protective stop device is released, trigger the reset signal of the controller.
12		

Notes for Connecting to the External Emergency Stop:

- The emergency stop is a dry contact (voltage-free contact) signal. Do not connect AC or DC voltage signal, or it may cause damage to the internal components of the controller.
- Short-circuiting the emergency stop signal is strictly prohibited; this ensures the safety of the overall robot system and workers.
- Emergency stop is a safety signal; please install the emergency stop button at a location where the button can be easily pressed.
- Please distribute the power properly according to the methods described in the wiring diagram. The emergency stop button must have 2 NC contacts. If only 1 NC contact is connected, the electrical control box will have emergency stop abnormalities continuously.
- Please do not connect one NC contact to Pin1 to Pin4 of the safety connector simultaneously; this will decrease the safety level of the system.
- Please construct according to the entire actual equipment and install one or more emergency stop buttons. When multiple emergency stops need to be connected, please use serial connection for the emergency stop NC signals; parallel connections cannot be used.
- When the emergency stop signal is triggered, the robot will stop the motion immediately and the AC power will be cut in order to reach type 1 safety stop. The entire process takes approximately 0.5 sec.

A correct wiring example of a single emergency stop button is as shown in Figure 7.33.

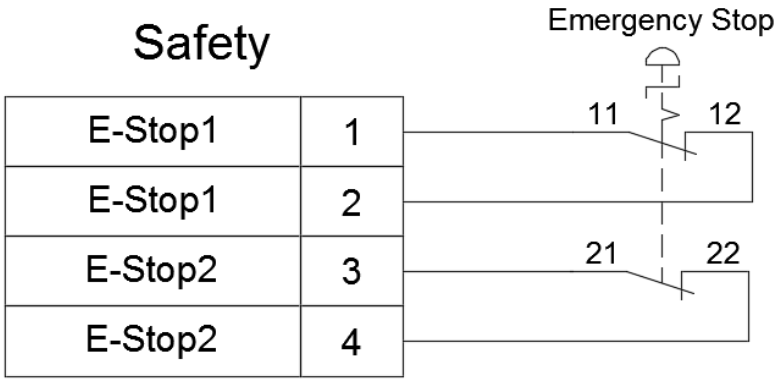


Figure 7.33 A correct wiring example of a single emergency stop

Figure 7.34 below shows the wiring method when only a single emergency stop button NC contact is used; this wiring method is wrong and such wiring will cause the system to become abnormal continuously.

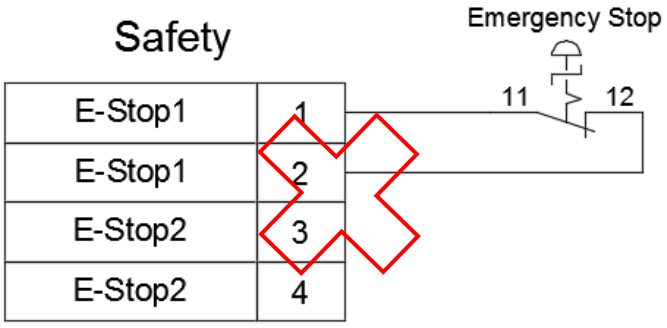


Figure 7.34 Wrong wiring of a single NC emergency stop

Figure 7.35 below shows when only a single emergency stop button NC is used and the safety signal is connected. This wiring method is wrong; do not use such a wiring method. Such connection will result in a decreased safety level of the entire system.

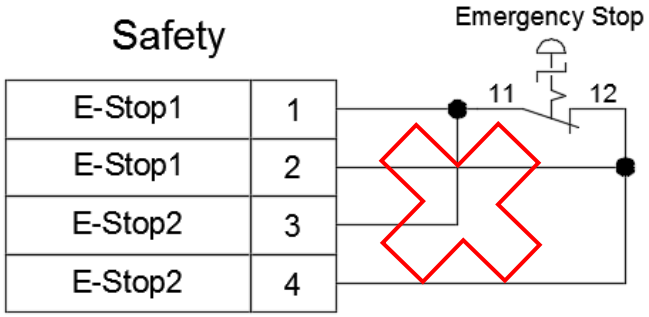


Figure 7.35 Incorrect wiring - only a single emergency stop NC is used

When multiple emergency stop buttons need to be connected, please perform wiring according to Figure 7.36 and distribute the locations of each emergency stop buttons appropriately so that when a dangerous situation occurs, the emergency stop buttons can be quickly pressed to stop the robot actions.

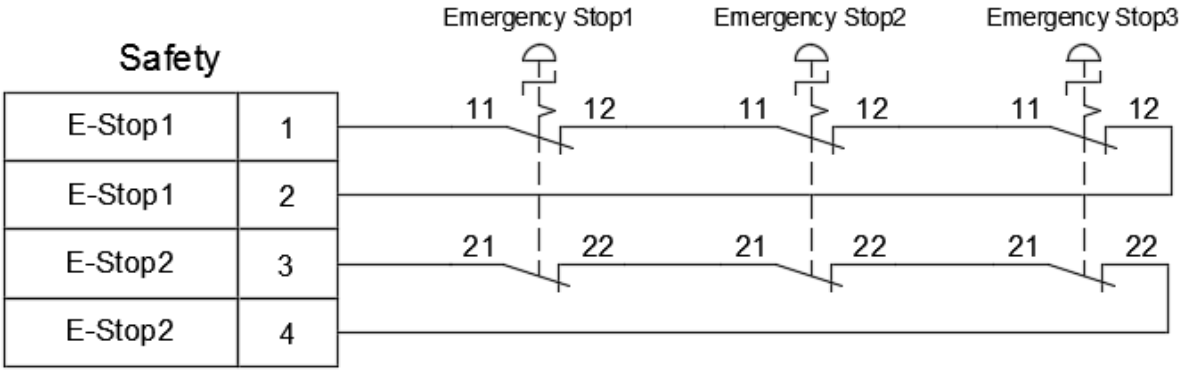


Figure 7.36 Example of connecting multiple emergency stops

Pin5 - Pin8 of the safety connector are the safety protection contacts; users can install railings, safety grating, pressure pad, or laser scanner etc. according to their needs. Please refer to descriptions in Chapter 3 Robot safety protection for the installation and requirements of the safety protection.

When the robot safety protection device is the fence, please use a contact (normal open) at the safety switch of the railing. Under normal usage status, A contact (normal open) will only change to B contact (close) when the railing is closed; only this allows the safety module to operate normally.

When workers open the fence and enter the railing, the railing safety switch will change from B contact (close) to A contact (open), and the safety module signal is disconnected. During this time, robots that are currently operating will quickly decelerate to a stop, and the robot's power source will be disconnected.

When the fence installed has multiple safety switches, the correct wiring method is as shown in Figure 7.37 below.

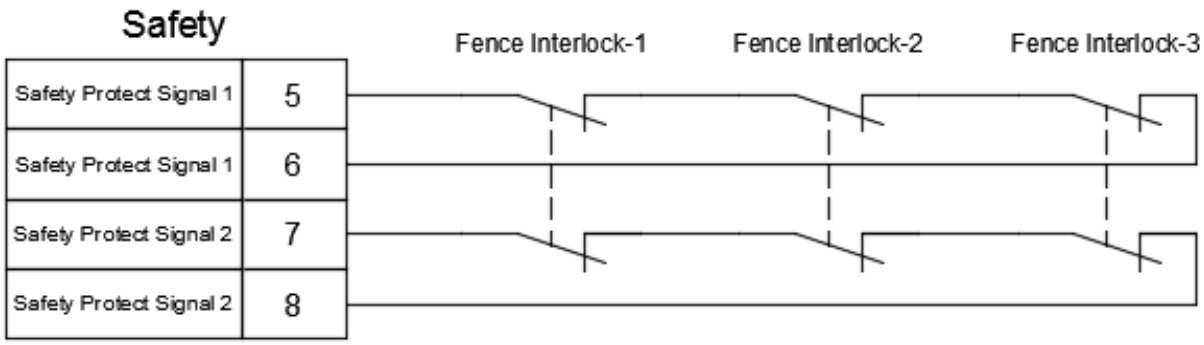


Figure 7.37 Multiple fences wiring example

For safety protection needs, users can install safety lock switches on the railings in order to ensure that the safety door can close properly, as shown in Figure 7.38 below.

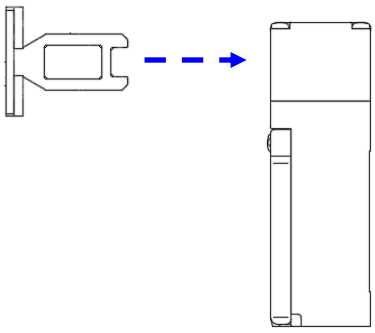


Figure 7.38 Safety door switch

A safer practice is to use the electromagnetic safety door switches so that when the safety door is closed, the safety switch will generate magnetic force to keep the door lock bolt securely in place and prevent users from accidentally opening the door and entering the railing, causing danger.
The power switch of the electromagnetic safety door lock can be installed inside the railing so that when workers are accidentally trapped inside the railing, they only need to turn off the power switch to release the electromagnetic safety door and save themselves. The installation method is as shown in Figure 7.39 below.

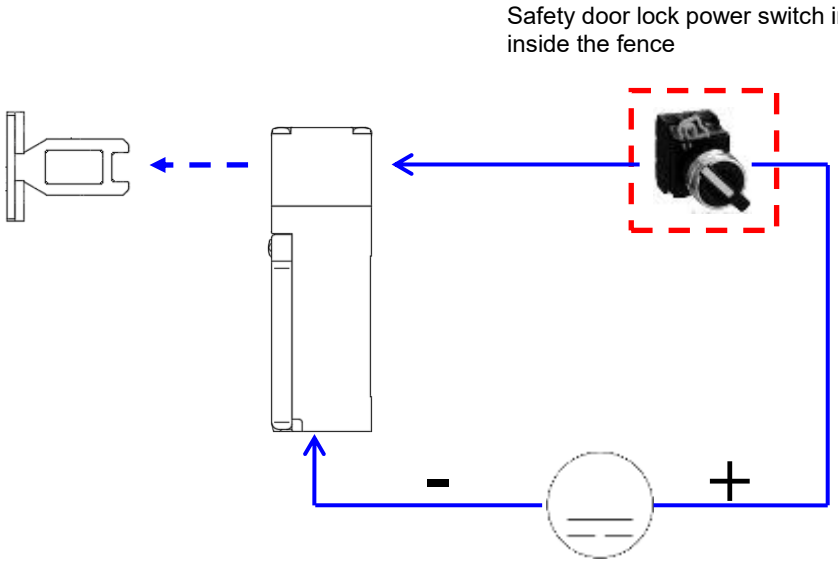


Figure 7.39 Electromagnetic safety switch wiring

When the robot's safety protection device is the safety mat, grating, or laser scanner, please use B contact (normal close). During normal usage and no one has entered or touched these safety protection devices, it will remain at B contact (close) signal and allow the safety module to operate normally.

When workers step on the pressure pad, touch the grating signal, or enter the laser scanner scanning area, the safety signal will change from B contact (close) to A contact (open), and the safety module signal is disconnected. During this time, robots that are currently operating will quickly decelerate to stop, and the robot's power source will be disconnected.

When the installed safety protection device is pressure pad, grating, or laser scanner, the correct wiring method is as shown in the figure 7.40 below.

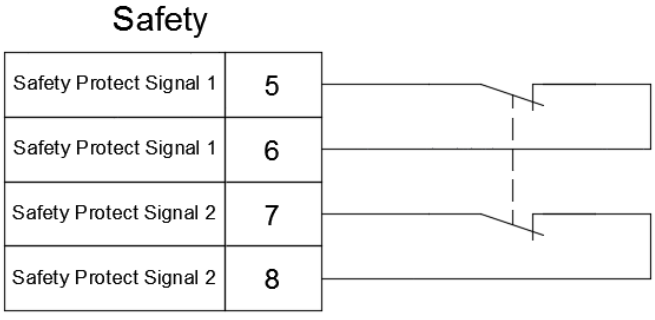


Figure 7.40 Safety mat, grating, or laser scanner wiring example

Pin9 - Pin12 of the safety connector are the safety abnormality reset signal inside the connector; please note the following items when using them:

1. Please use a 2 NO contacts (normal open) button switch as the abnormality reset signal for the safety controller.
2. Do not input any AC or DC power into Pin9 to Pin12 of the safety connector as such actions will cause damages to the safety module inside the controller.
3. When the system integrator has finished installing safety protection devices around the robot and turns on the controller power, the controller will not output power to the drive at this time. Users must first reset the abnormality reset signal of the safety controller once. The purpose of this action is to allow users to first check whether there are workers inside the safety protection devices when turning on the controller power; after confirming there is no one around the robot, press this abnormality reset signal and then the power will be transmitted to the drive and allow the robot to prepare for operation.
4. This safety abnormality reset signal is the reset signal for safety abnormality when the emergency stop button of the user terminal or TP is pressed or when the safety protection device signal is triggered or the Auto/T1 mode is selected; it is different from the warning reset signal of system DI8.
5. For the wiring diagram of the system connector's safety abnormality reset signal, please refer to the figure 7.41 below.

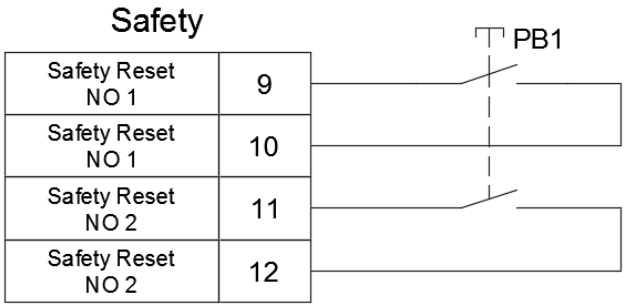


Figure7. 41 Safety signal error reset wiring example

6. The safety signal timing chart of the controller under Auto mode is as shown in the figure 7.42 below.

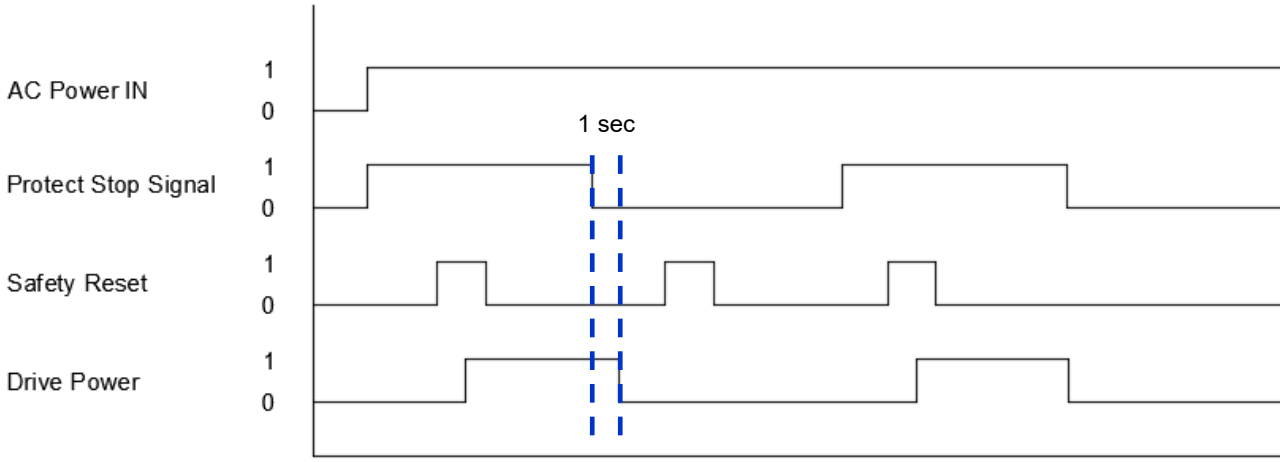


Figure 7.42 Auto mode safety signal timing chart

7. Under T1 mode, the middle position of the enable switch on the back of the TP must be pressed for the power to be sent to the drive and thus allows the robot to perform JOG operation. When the enable switch is released or pressed all the way down, the power of the drive will be disconnected in order to ensure safety.
8. The safety signal timing chart of the controller under T1 mode is as shown in the figure 7.43 below.

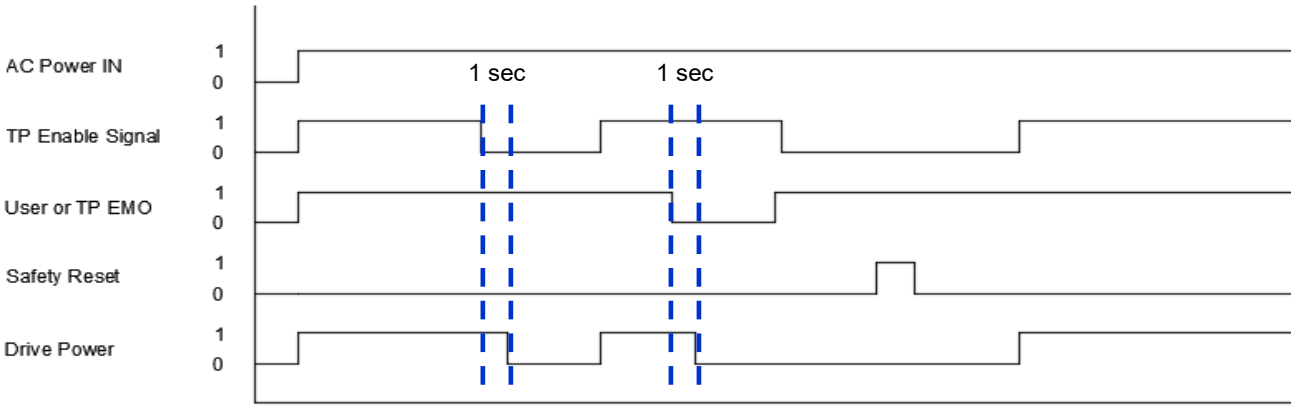


Figure 7.43 T1 mode safety signal timing chart

7.2.7 DC output connector

There is a DC output connector on the controller interface for customers to connect DI/O signals.
The connector location is as shown in Figure 7.44 and the pin definitions are as shown in Table 7.15.

Note:

1. The power provided by the DC output connector is DC24V/1A. Do not use this connector with other DC power or else it will cause the fuse to burn.
2. Do not randomly change the fuse of this DC output connector or else it might result in burning of the cable.

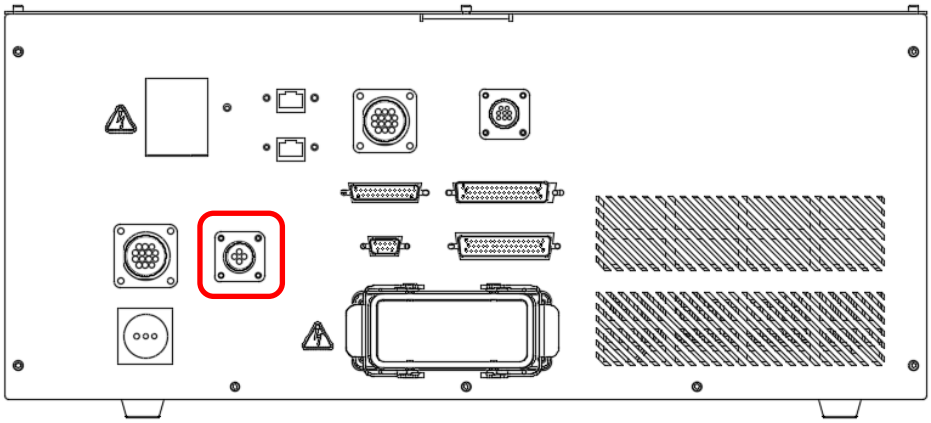


Figure 7.44 DC output connector location

Table 7.14 DC output pin definition

Pin	Name	Description
1	DC24V	Connect to the positive potential
2	DC24G	Connect to the negative potential
3	-	-

7.2.8 Handheld teach pendant connector

Users can use the handheld teach pendant to operate the robot, teach points, edit robot program, and perform I/O monitoring easily. The connection method is as shown in Figure 7.45.

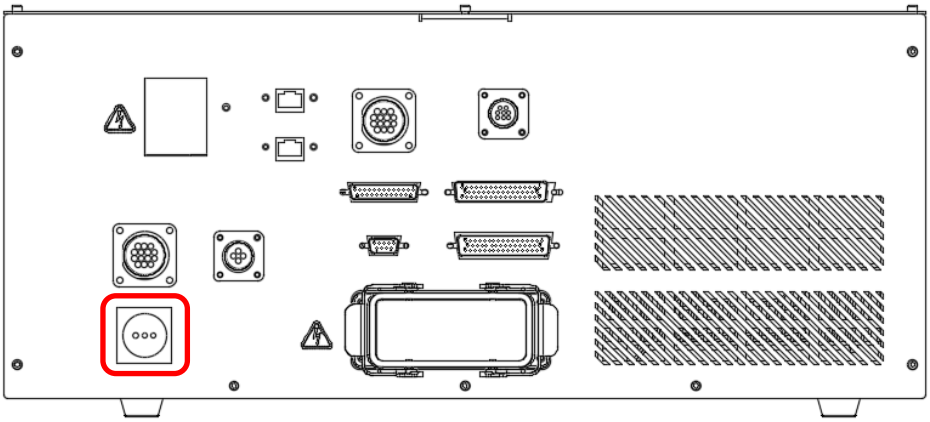


Figure 7.45 Teach pendant connector location

Cautions for operating TP:

- The DRV70/90L7D/E621NA series robot can only work with our company's controller DCV-2J00-CA and DTV serial Teach pendant. Please do not modify the robot and controller on your own or use them with other robots and controllers. Our company will not be held responsible for any injuries or fatalities caused by accidents that result from doing so.
- TP can only execute T1 mode (JOG teaching).
- The JOG speed will be limited to 250 mm/sec when TP is in T1 mode.
- When using TP to operate the Robot, do not stand within the working scope of the Robot to avoid getting hit by the Robot.
- When using TP to operate the robot with the job function, the left hand must press the enable switch located on the back of the TP to the second position. Pressing the switch to other positions will cut all drive AC power. The enable switch on the back of the TP is as shown in Figure 7.46.

Figure 7.46 TP Enable switch icon

- During an emergency, press the Emergency Stop on TP or release the enable switch, and the Robot will decelerate and stop operating immediately, and then disconnect the power of the driver in order to ensure user safety.
  Do not press the screen of the TP with a sharp object or a pen, or it may cause the damage to the screen.
- Please refer to the TP manual for detailed operations, or download it from the official Delta website.

Cautions for assembling/disassembling TP:

- Install the TP to the electrical control box when the power is disconnected.
- When TP is not in use, if TP needs to be disassembled from the electrical control box, set the Electrical Control Box to OFF position and then perform the disassembling. After disassembling the TP, please install the TP bypass connector included in the accessory pack onto the electrical control box, or else abnormalities will occur and the controller cannot be operated.

When teaching the robot using TP, please press the enable switch located at the left-back side of TP with your left hand, making the enable switch stay in the middle position, and your right hand can operate the physical buttons on TP or the touch screen. Figure 7.47 shows the correct way to hold the TP.

Figure 7.47 Correct way to hold the TP

TP interface: it is mainly divided into the touch screen, physical buttons, emergency stop button, and selection/adjustment knob, as shown in Figure 7.48 below.

Figure 7.48 DTV serial teach pendant

Since the cable length of TP is too long, please hang the TP next to the safety fence when not in use, and select a suitable location that is not too high so that it can be easily accessed, as shown in Figure 7.49 below. Please put away the TP cable properly; placing it on the floor might result in damages to the cable from being stepped on by workers.

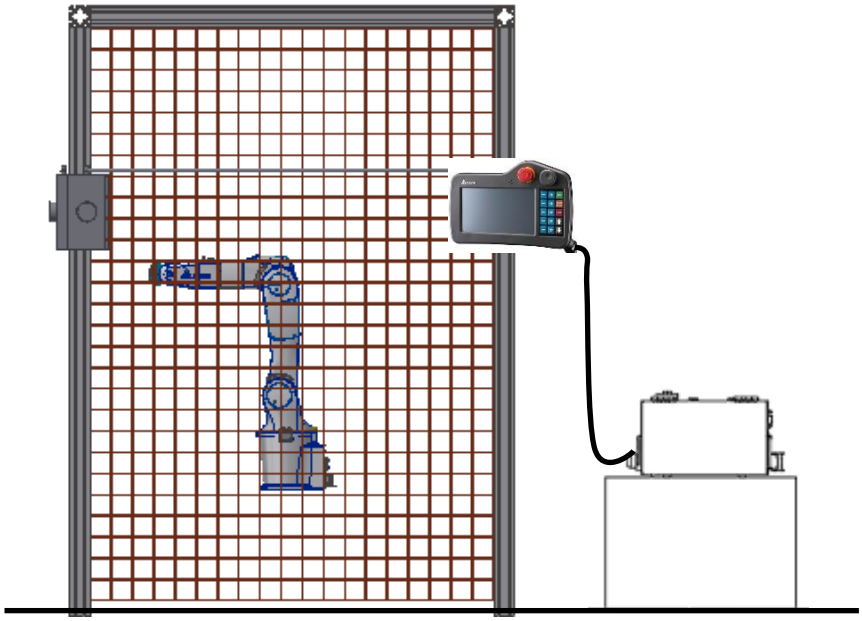


Figure 7.49 TP installation location

7.2.9 Serial transmission (RS-232, RS-485)

A standard D-Sub 9P/Female Connector. With controllers such as a PC, PLC, or HMI, etc. that feature the RS-232/485 function, users may carry out the communication with the power control box controller through such connector to read the Robot data or control the Robot. In addition, controllers equipped with RS-232/485 functions can also be connected to perform data reading or writing to the controller.
The location of the RS-232/485 connector is as shown in Figure 7.50.

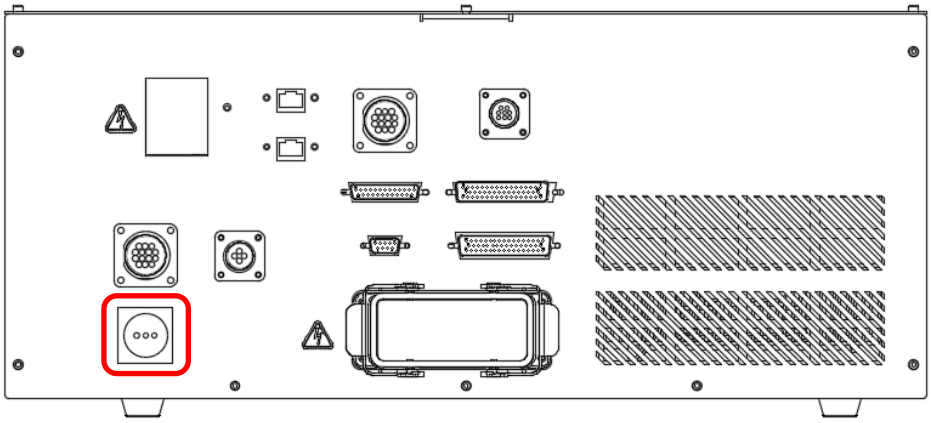


Figure 7.50 RS-232/485 connector location

In order to ensure that there is no interference with the data transmission, please use shielded twistedpair cables for the connections. The RS-232/485 pin definitions are as shown in Table 7.15.

Table 7.15 Serial transmission (RS-232, RS-485) connector function definition

Pin	Name	Description
1	RS485+	Drive end data transmission differential + end
2	RS232_RX	Drive end data receiver connected to the RS-232 transmitter end of the PC.
3	RS232_TX	Drive end data transmitter connected to the RS-232 receiver end of the PC. Connected to the RS-232 receiver end of the PC
4	-	Reserved
5	GND	+5V and signal end grounding
6	RS485-	Drive end data transmission differential - end
7	-	Reserved
8	-	Reserved
9	-	Reserved

7.2.10 Communication port (ETHERNET)

By connecting the network cable to the Ethernet connector, the PC can perform communication connection with the controller. In addition, the following can be performed through the Delta DRAStudio software:

- Edit robot language and save the program into the controller to perform project management.
- Jog the robot, set the origin, and reset the origin etc.
- Servo and robot related parameter settings.
- Execute I/O monitoring.
- Alarm, troubleshooting.

For detailed operation of DRAStudio software, please refer to the description contained in Delta DRAStudio Operation Manual.
The connection method of the connector is as shown in Figure 7.51.

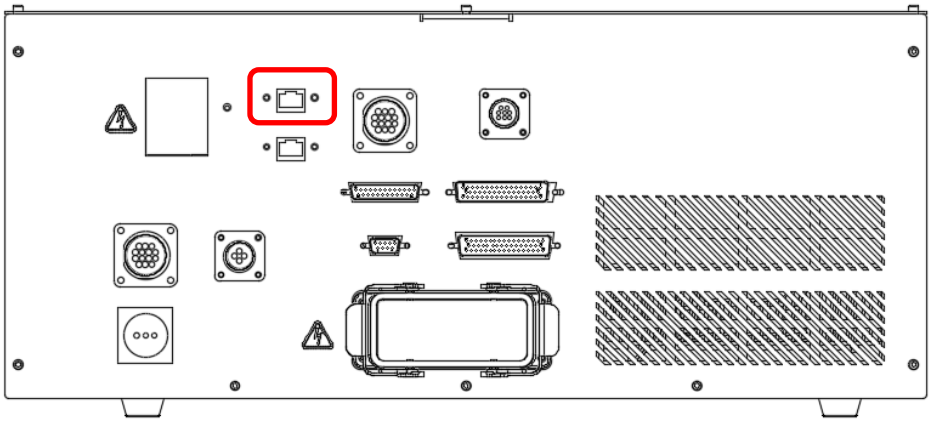


Figure 7.51 Communication port

7.2.11 Communication port (DMCNET)

Diverse Delta products can be connected through the Delta high speed communication network DMCNET; for example, drives or remote DI/O modules. Connect one side of a standard RJ45 to the power control box interface and connect the other end to the Delta DMCNET product as shown in Figure 7.52.

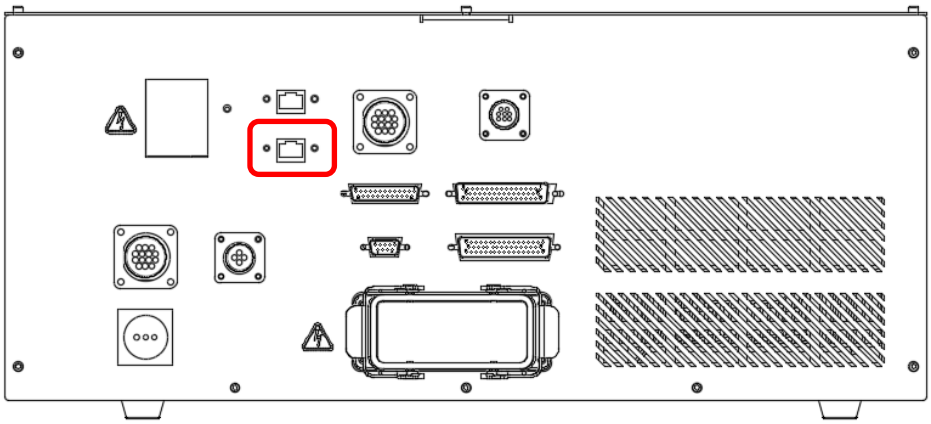


Figure 7.52 DMCNET communication port

A maximum of 12 Delta product workstations equipped with the DMCNET function can be connected through DMCNET connection, as shown in Figure 7.53.

Note: When an external drive is connected to the DMCNET connector, if the power control box is a 6-axes power control box, a maximum of 4-axes external drive can be connected; if the power control box is a 7-axes power control box, a maximum of 3-axes external driver can be connected. If there is no drive connected to the DMCNET connector, a maximum of 12 DI/O module units can be connected.

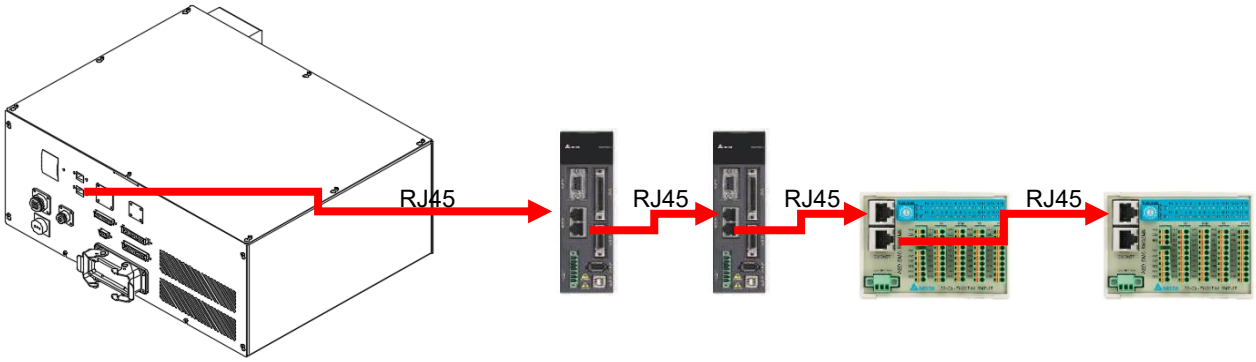
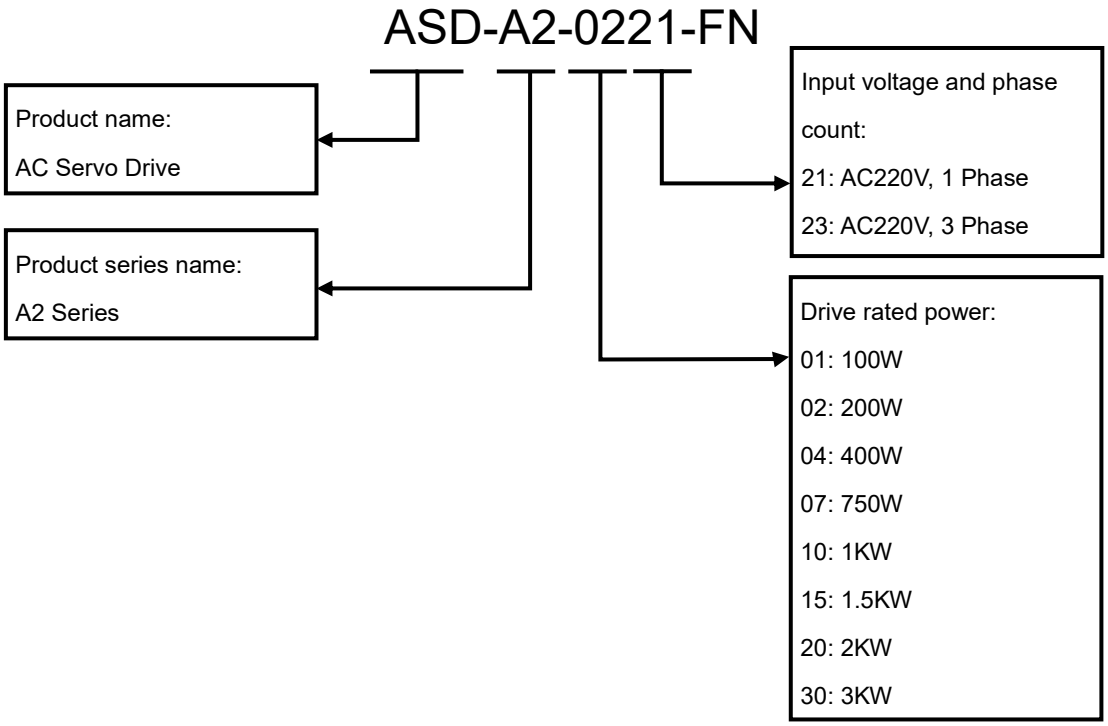


Figure 7.53 DMCNET connection illustration

Drive models that can be connected through DMCNET are as follows:



When connecting an external expansion axis drive, please add an electromagnetic contactor in front of the drive; the control of the electromagnetic contactor is done by using the controller or emergency stop to cut off the AC power supplied to the driver, as shown in Figure 7.54 below.

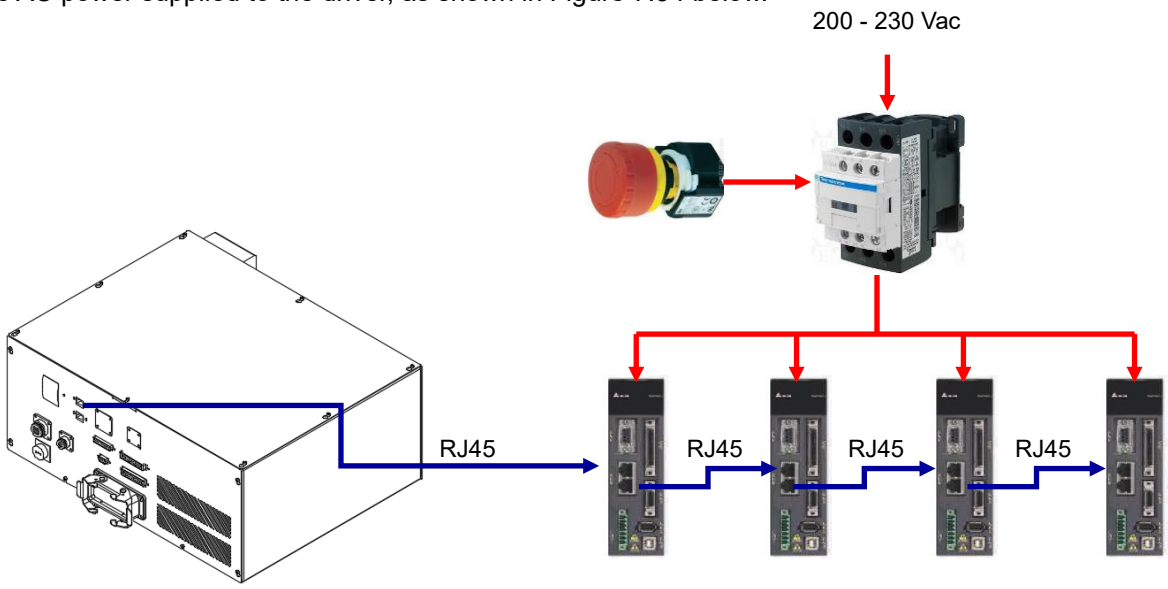


Figure 7.54 Power control box with external drive system architecture

Listed below is the model numbers of DI/O module those can be connected:
Input Module:

- ASD-DMC-RM32MN
  32-point Input Module.
  Input signal: By connecting to COM point, the user may select input signal as PNP or NPN.

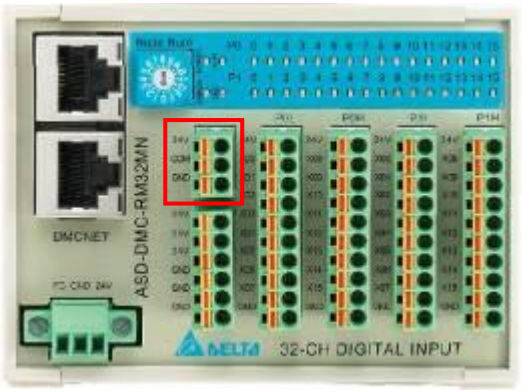


Figure 7.55 ASD-DMC-RM32MN

Short-circuit COM and 24V: Common point of input signal is GND.
Short-circuit COM and GND: Common point of input signal is 24V.

Output Module:

- ASD-DMC-RM32NT
  32-point Output Module
  Type of output signal: NPN
  Rating of output current: 100mA/1 point
  Type of output circuit: Transistor

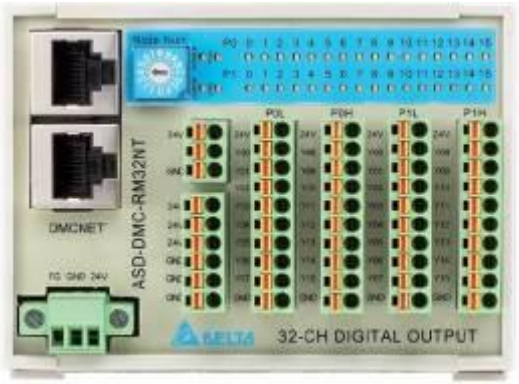


Figure 7.56 ASD-DMC-RM32NT

8. Installation and operation

This chapter will introduce how to install, wire, and connect the robot, and the execution method for initial operation.

- Please read this manual carefully before usage in order to ensure proper usage and the safety of the maintenance staff.
- Due to operational environment and operator safety considerations, our company will provide dedicated training for the operators of different robot applications in order to ensure usage safety. Please contact our company or your local dealers if training is needed.
- Only workers with related professional knowledge or qualified engineers can perform the installation and wiring of the robot.
- This DR70/90L7D/E series robot can only be used with our company's controller DCV-2J00-CA. Please do not modify the machine or wire by yourself or use the robot with other controllers. Our company will not be held responsible for any injuries or fatalities caused by accidents that resulted from doing so.
- Please use our company's handheld teach pendant and install it on the controller DCV-2J00-CA to perform manual operations and edit programs.
- Do not use this product on flammable or toxic processing lines.
- Carefully select the model according to the loading quality; do not try to expand to the specified capacity.
- The robot is a partially completed machine; the assembly and construction of the protection and safety circuits should be conducted by the final system integrator.
- All children and visitors should keep a safe distance from the processing area.
- Do not wear loose clothes, ties, rings, or bracelets, and wear protection cases to protect long hairs. These things can be easily caught in the machine by accident and cause injuries to the staff or other dangers during operation.
- Please turn off the power, isolate the power properly, and wait for the robot to stop completely when the robot is no longer used before you leave.
- Please follow the manual to install the safety protection devices such as fences, light curtain, regional laser, or pressure pads in order to prevent workers from getting inside the working range of the robot and avoid injuries or other dangers due to impact by the robot.
- Please confirm there is no one in the railing before operating the robot and performing operations.
- Do not laugh or talk to other workers while operating the robot; such wrong behaviors may result in collision of the robot or injuries to other workers.
- Please install the final system integration of user operation buttons and warning lights etc. outside the railing in order to ensure usage safety. And the height of the operating interface should be a suitable (0.6 m to 1.7 m) range for operators to touch.
- Please use the two-stage key selection switch to change between T1 and Auto modes; the keys must be able to be unplugged in both directions.
- Please have the senior supervisor keep the T1/Auto mode selection switch key. Do not place it randomly or leave it inserted on the selection switch, or the personnel might activate the robot accidentally, causing injuries to the workers.
- Please do not stand within the moving range of the robot when teaching the robot manually for the first time in order to prevent danger from occurring due to being unfamiliar with the operations.
- Please operate the robot manually at a low speed for the first time, otherwise being unfamiliar with the operations may result in damages to the robot due to impact or cause injuries to other workers.
- Please do not turn the power on and off frequently as doing so may result in damages to the controller.
- Improper operations might damage the robot.
- When collisions occurred to the robot, please first turn off the power of the robot and then check the components and cables of the robot to make sure they are not damaged before turning the power back on to perform operations again.
- Please use a safety lock on the railing switch when entering the railing to operate the robot in order to prevent the railing from closing suddenly causing the robot to activate accidentally.
- If the teaching pendant cable on the controller needs to be removed, please do so when power is completely cut, otherwise the teaching pendant might get damaged.

- The location of the interlock switch between the structure of the safety protection device and the protection device should comply with EN ISO 14120 and EN ISO 14119 standards, and the safety distance should be designed according to EN ISO 13857 standards.

- Do not randomly make any changes to any components on our company's handheld teach pendant, including the emergency stop and Enable switch. Doing so will lower the safety performance and level and even lose the safety protection.
- Short-circuiting of any safety protection signals on the controller is strictly prohibited, otherwise our company will not be held responsible for any accidents that occurred.
- When operating the robot, all personnel are prohibited to stand close or within the robot working range; doing so will cause injuries to the workers.
- Do not unplug any cables on the controller while the robot is operating; doing so will cause damages to the controller.
- Do not open the protective cover or protection device while the machine and robot are operating.

8.1 Robot and controller installation

8.1.1 Robot installation

The installation of the robot is as shown in Figure 8.1 below; lock the base on a flat surface using M8 screws and flat gaskets, and fasten them with the specified tightening torque (25 N-m).

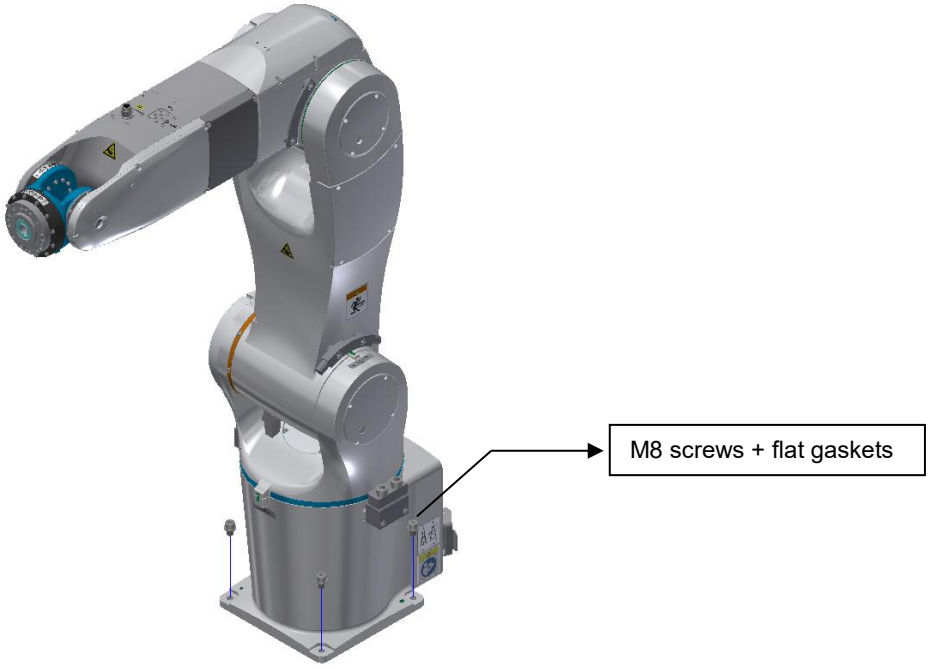


Figure 8.1 Robot installation - screw locking position

8.1.2 Controller installation

Controller installation notes:

1. The controller uses forced fan cooling, so sufficient space must be left in the front, back, and left sides of the controller or else it will cause malfunctions. Figure 8.2 shows the cooling illustration of the controller.

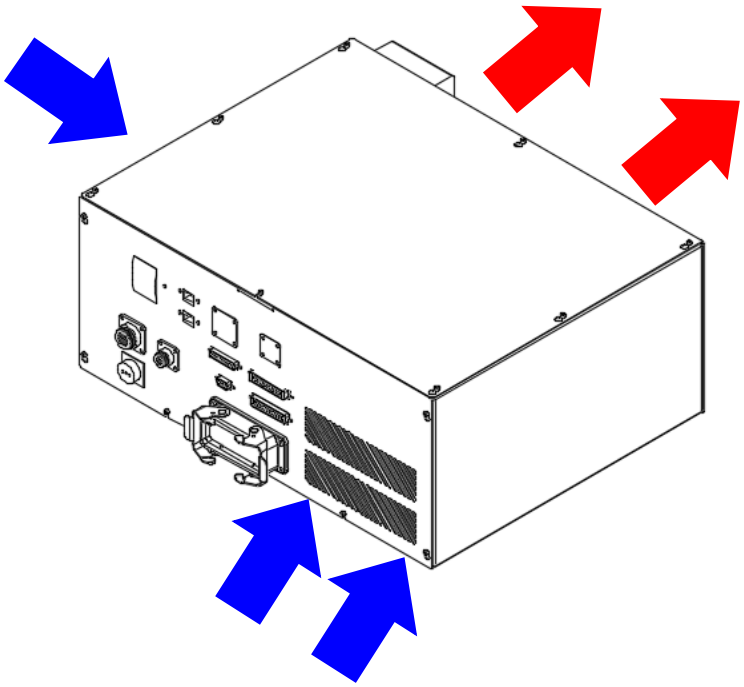


Figure 8.2 Controller cooling

2. When installing the controller, in order to make the cooling cycle work well, please keep a distance of at least 150 mm in the front and back of the controller, and reserve at least a 100 mm space on the left side of the controller. Figure 8.3 shows the cooling distance and space requirements for the installation of the power control box.

3. Do not tilt the power control box as doing so will cause malfunction.

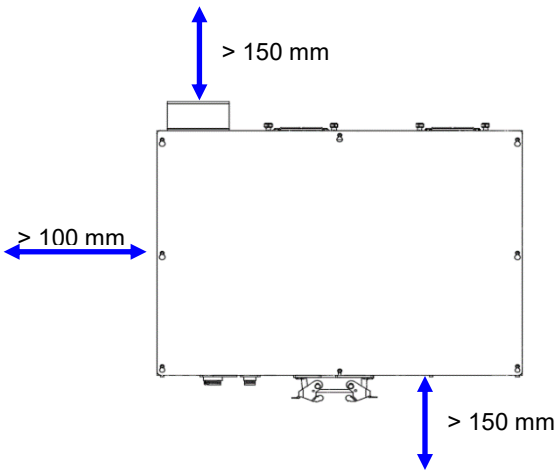


Figure 8.3 Controller installation cooling distance

4. When the controller is installed outside the equipment of the final system integrator, please make sure that the height of the power control box is between 0.6 m and 1.7 m. This height makes it easier for users to operate the controller and turn the controller power on and off. Figure 8.4 below shows the height requirement for the installation of the controller.

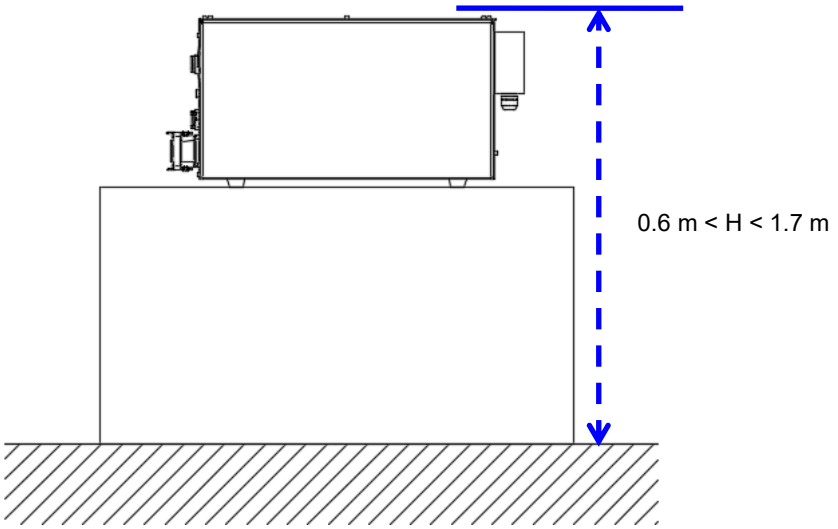


Figure 8.4 Controller installation height

5. When installing the controller, please beware to reserve space for opening the controller door, or else it will be difficult to perform repairs.

6. When fixing the power control box in place, please do as shown in Figure 8.5 below and use 2 L-shaped plates to keep the two sides of the controller tightly together and fixed in place.

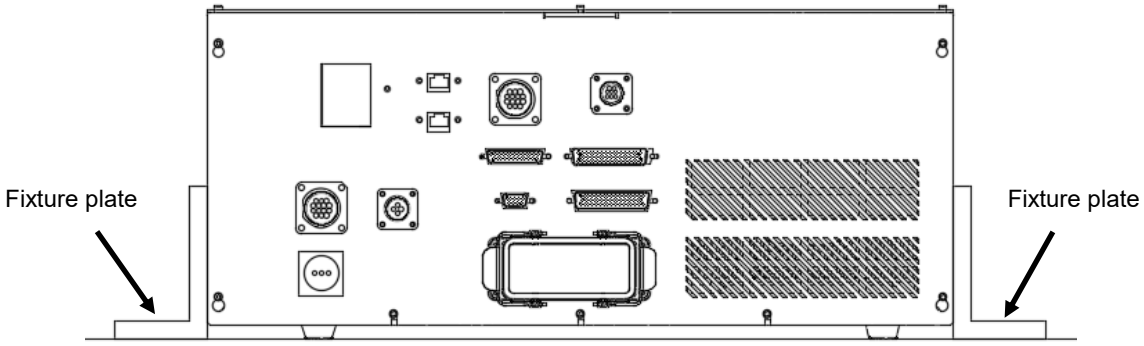


Figure 8.5 Controller installation fixture method

8.2 Safety protection device construction

8.2.1 Fence construction notes

The final system integrator must construct safety protection devices around the robot properly, such as railings, pressure pads, and gratings etc.
Please refer to Chapter 3 for the construction of safety protection devices.

The use of the safety switch with key attached as shown in Figure 8.6 below is recommended for the installation of the safety lock for the railing.

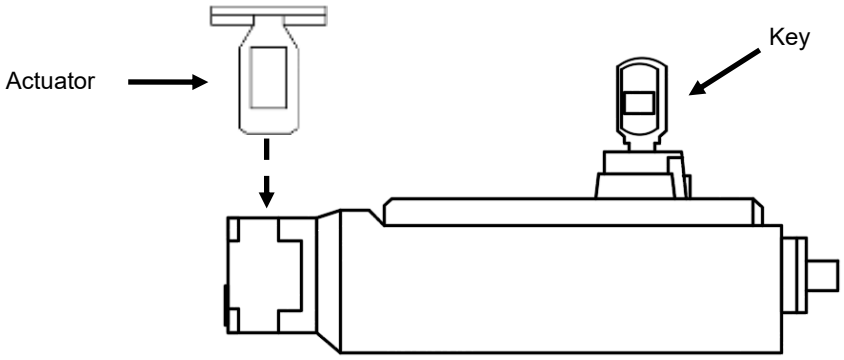


Figure 8.6 Key safety switch

Workers entering the railing should have the keys with them; this can effectively prevent the door from being close and accidentally starting the robot.
Even if the railing is closed, the safety switch will not be activated without the key to switch the safety switch to Lock mode.
When the safety switch with the attached key is selected, please select so that the key can be removed at any position; otherwise, there will be the risk of anyone can switch the safety mode randomly.

Please also install one or more safety switches or key switches inside the railing, and use serial connection to connect it with the safety switch signal of the railing so that if the railing was accidentally closed, the workers trapped inside the railing can turn off the safety switch signal and make the controller cut the power supplied to the robot. This ensures the safety of the workers trapped inside. Please refer to Figure 8.7 below for the installation example.

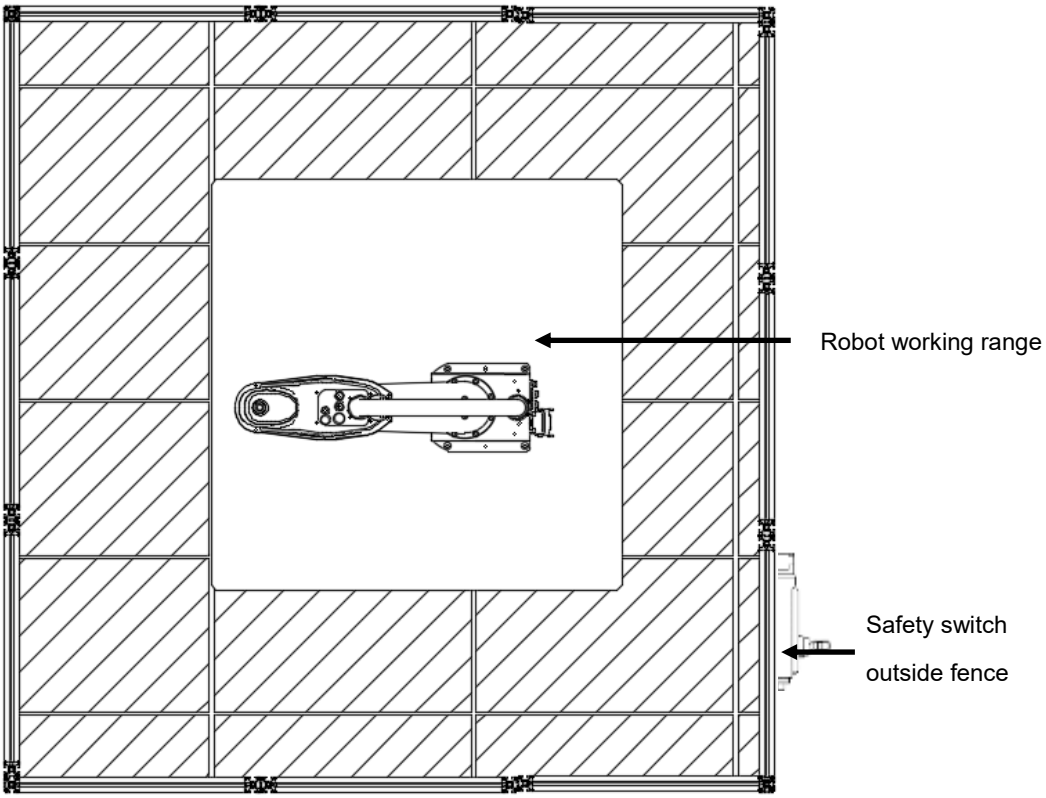


Figure 8.7 Safety fence signal installation example

The wiring method of the safety railing signal is as shown in Figure 8.8 below. The safety signal contact on the controller must be a voltage-free contact; the use of live signal will cause damages to the components inside the controller.

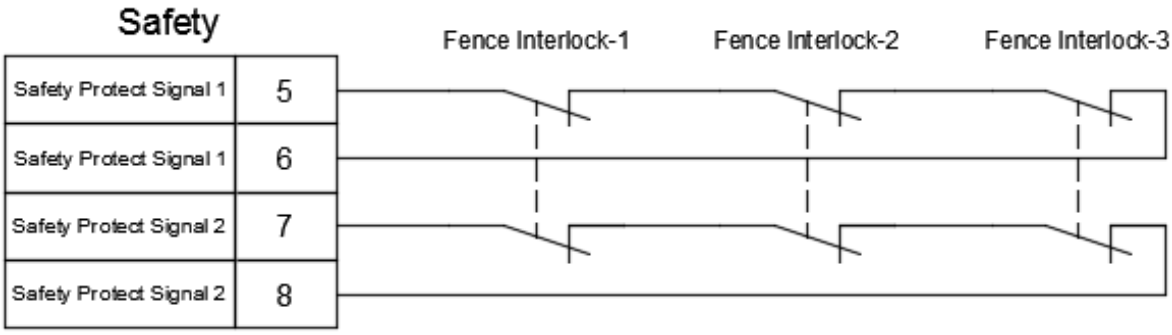


Figure 8.8 Wiring example of multiple safety railing signals

8.2.2 Emergency stop installation notes

Please refer to Chapter 3.2.1 for details on items related to the installation of the emergency stop button.
The installation of the emergency stop button must be at an obvious place and cannot be blocked by other equipment or objects.
Please install the emergency stop button at an appropriate height; it cannot be too high or too low or else it will be difficult to operate during emergencies.
Please install more than one emergency stop buttons according to the actual length of the equipment; the distance between the emergency stop buttons must not exceed the length of the two arms of a person in order to ensure that the emergency stop button can quickly be pressed during an emergency situation. Please refer to the installation example in Figure 8.9 below for the installation of emergency stop buttons.

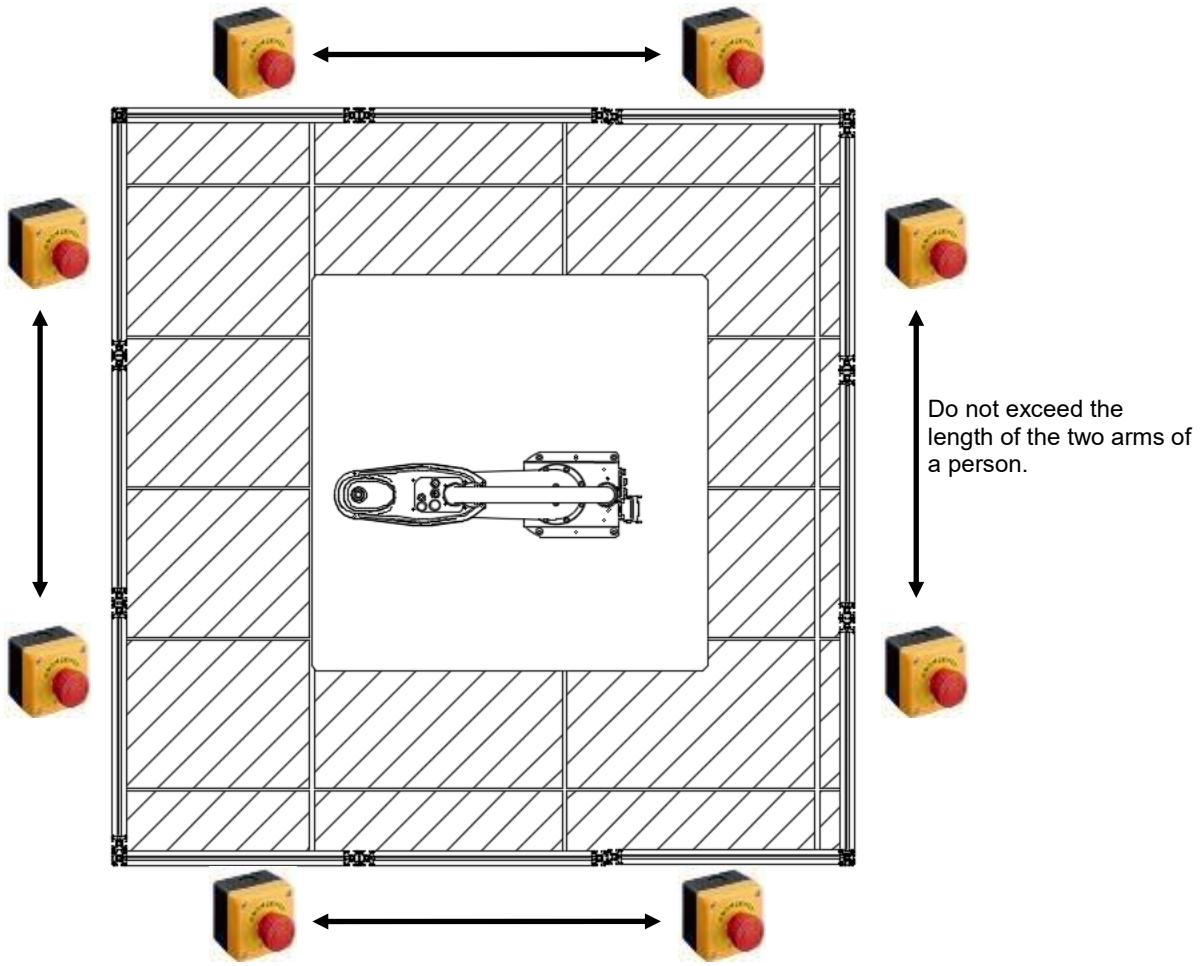


Figure 8.9 Example of installing multiple emergency stop buttons outside the fence

Please also install one or more emergency stop buttons inside the fence so that if workers are trapped inside the fence, they can press the emergency stop button inside the railing and the controller will remove the power from the robot in order to ensure the safety of the workers trapped inside the railing. Figure 8.10 below is an example of installing emergency stop buttons inside the fence.

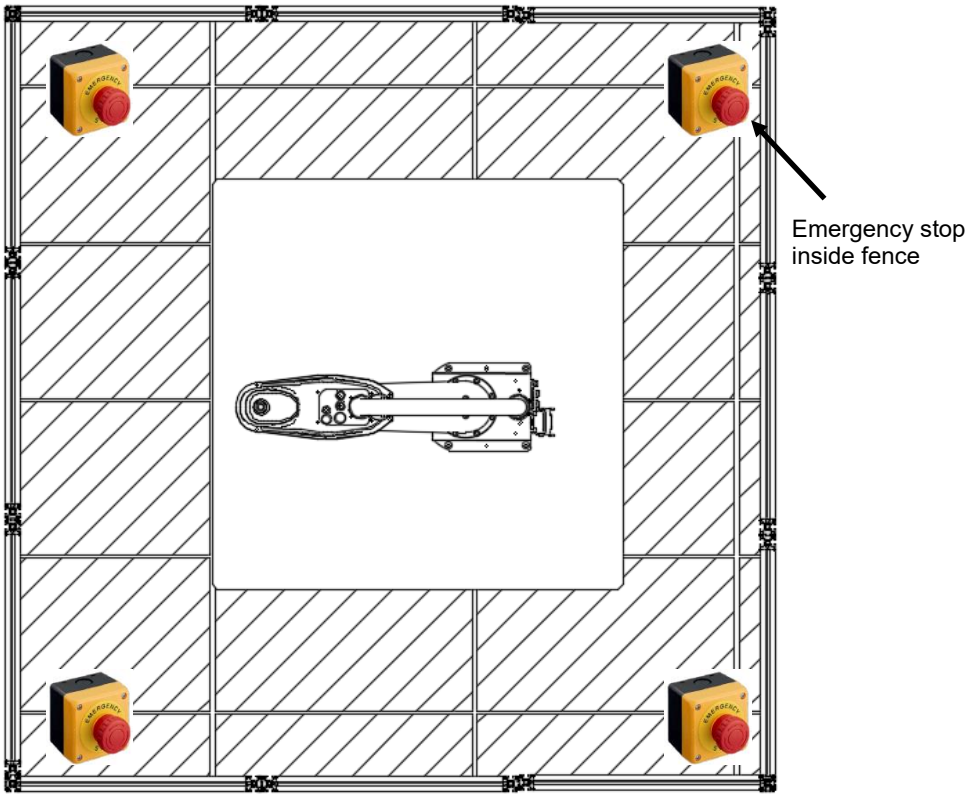


Figure 8.10 Example of installing multiple emergency stop buttons inside the fence

If the final system integrator installed additional emergency stop signals, they must be connected to the emergency stop signal of the robot using serial connection in order to ensure the safety of the entire system. The wiring method of multiple emergency stop buttons is as shown in Figure 8.11. The emergency stop signal contacts on the entire system must be voltage-free contacts; the use of live signals will cause damages to the components inside the controller.

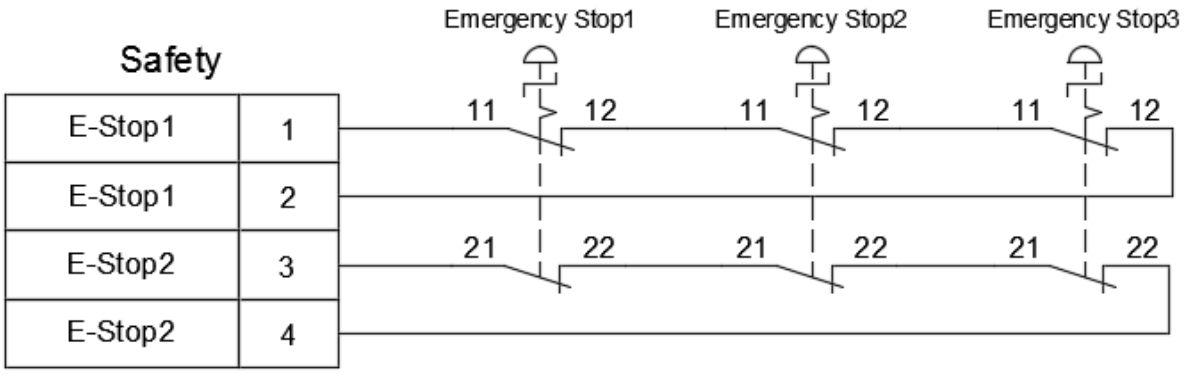


Figure 8.11 Wiring example of multiple emergency stop buttons

8.3 Wiring

Please have workers with related wiring knowledge responsible for the wiring, otherwise, it can easily cause danger.
Please implement the grounding properly in order to ensure the safety.
Please refer to Chapter 7 for details on related wiring for the controller; please have the final system integrator to perform wiring according to your actual needs.
Please install the user interface at an appropriate height (between 0.6 m and 1.7 m) so that it is easier for users to operate. Improper operation interface height can easily cause risks to exist in terms of usage.
Please install the user interface outside the railing in order to ensure the safety. Please refer to Figure 8.12 below for an example on operation interface installation.

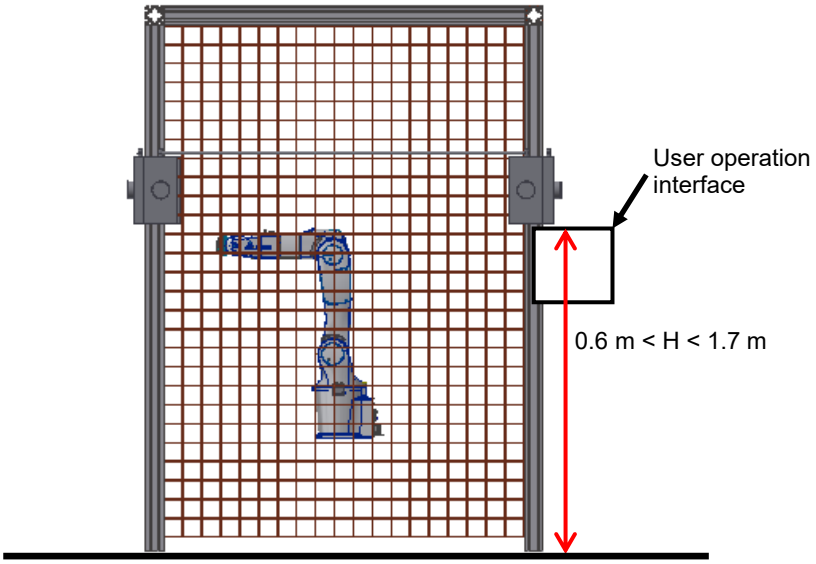


Figure 8.12 User interface installation height

Please use the robot cables from our company to connect the robot and controller, as shown in Figure 8.13 below.

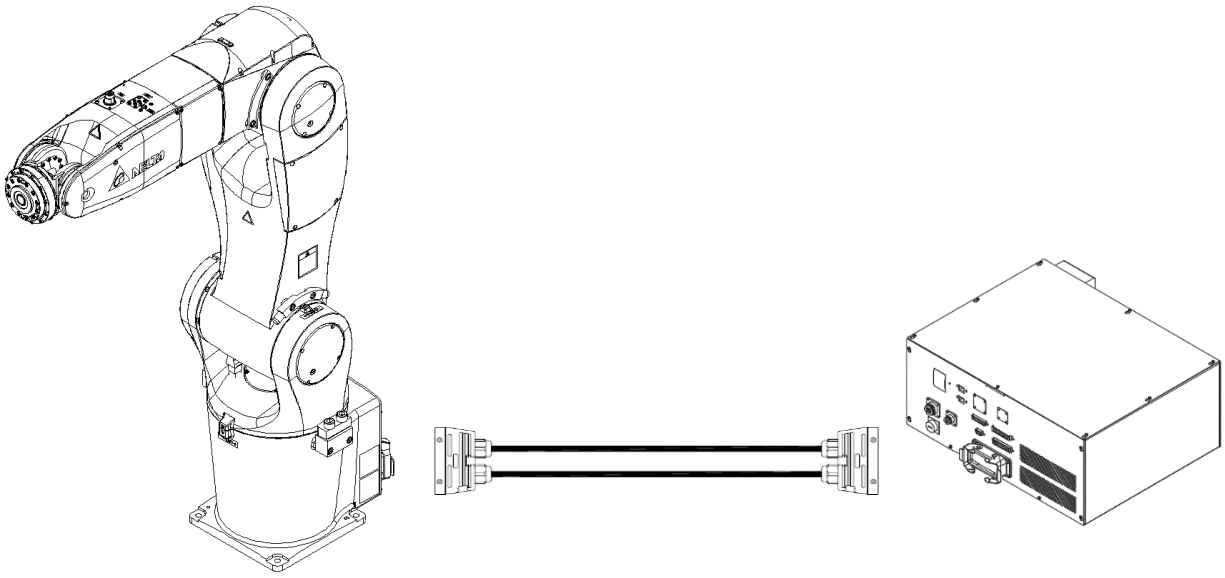


Figure 8.13 Robot cable connection

When installing the robot cable on the robot and controller, please lock the connector and fixture seat properly in place, otherwise it can easily cause poor signal contact and other dangers. As shown in Figure 8.14 below.

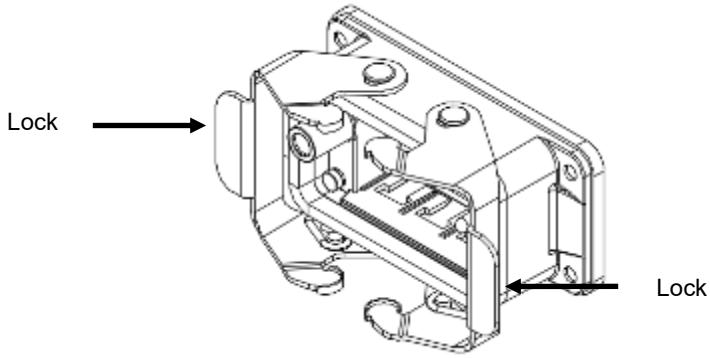


Figure 8.14 Locking the connector fixture seat

8.4 Inspection before power transmission

Please check whether the wiring of the entire system is correct before connecting the power; the following sections are items to check for the robot and controller systems.
The final system integrator not only should check the items in the following sections one by one, they should also perform detailed inspection of the entire system.

8.4.1 Emergency stop signal check

1. Unplug the safety connector, take a multimeter, and set the Ω gear to the lowest gear.
2. Reset all emergency stop buttons.
3. Measure Pin 1 and Pin 2 of the safety connector; the reading on the multimeter must be < 0.5 Ω, as shown in Figure 8.15 below.

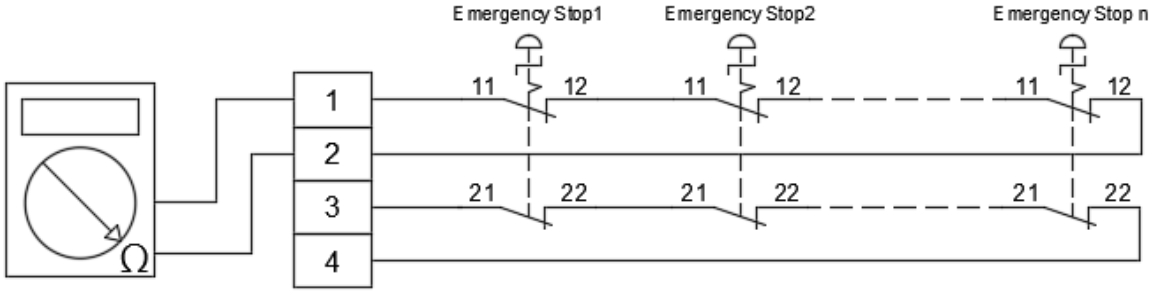


Figure 8.15 Reset emergency stop signal and measure Pin 1 and Pin 2

4. Measure Pin 3 and Pin 4 of the safety connector; the reading on the multimeter must be < 0.5 Ω, as shown in Figure 8.16 below.

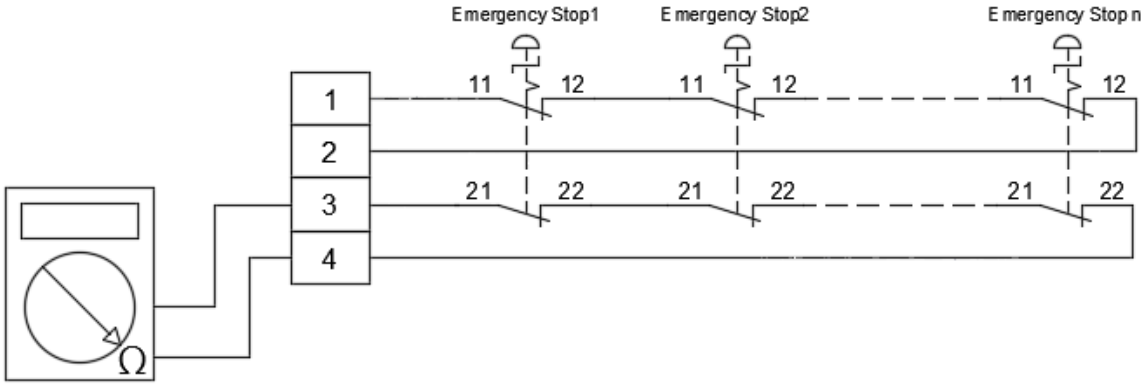


Figure 8.16 Reset emergency stop signal and measure Pin3 and 4

5. Press one of the emergency stop buttons.
6. Measure Pin 1 and Pin 2 of the safety connector; the reading on the multimeter must be ∞, as shown in Figure 8.17 below.

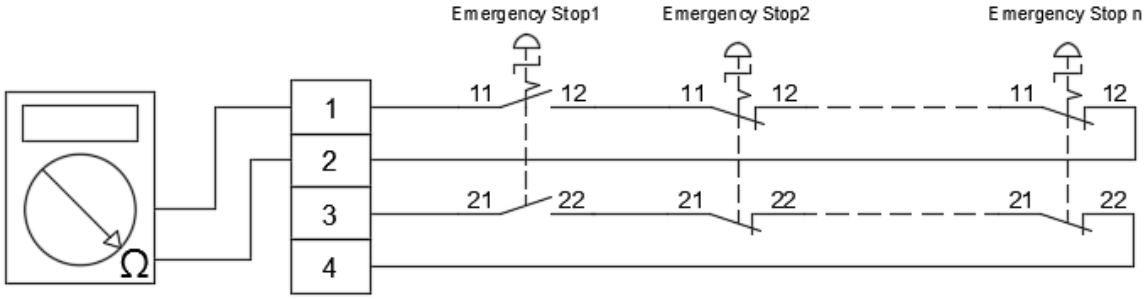


Figure 8.17 Press the emergency stop signal and measure Pin 1 and Pin 2

7. Measure Pin 3 and Pin 4 of the safety connector; the reading on the multimeter must be ∞, as shown in Figure 8.18 below.

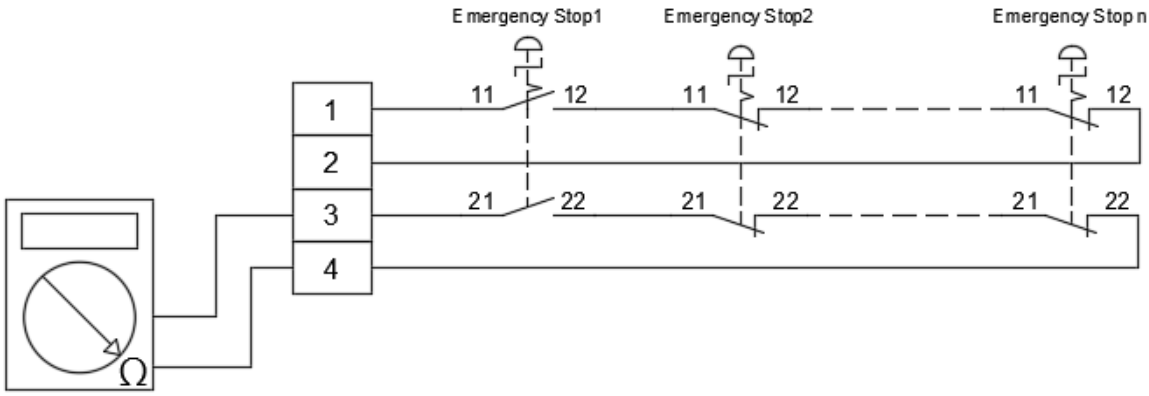


Figure 8.18 Press the emergency stop signal and measure Pin 3 and Pin 4

8. Reset the pressed emergency stop button.
9. Press another emergency stop button, and repeat steps 5, 6, and 7 until all emergency stop button signals have been checked.

8.4.2 Fence safety signal check

1. Unplug the safety connector, take a multimeter, and set the Ω gear to the lowest gear.
2. Turn off all fence safety signals.
3. Measure Pin 5 and Pin 6 of the safety connector; the reading on the multimeter must be < 0.5 Ω, as shown in Figure 8.19 below.

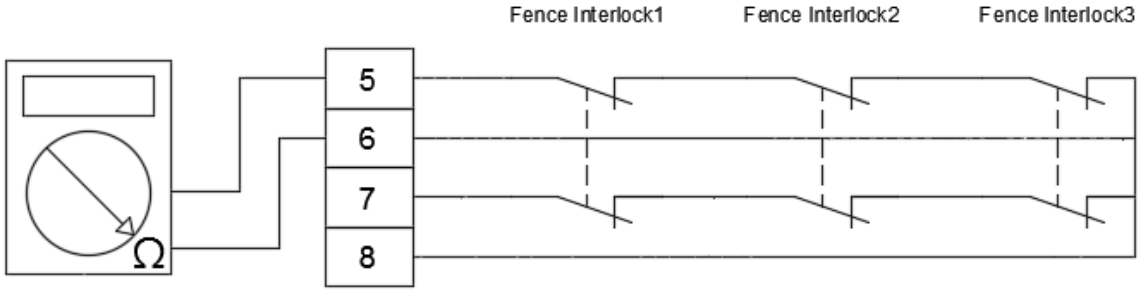


Figure 8.19 Turn off fence safety signal and measure Pin 5 and Pin 6

4. Measure Pin 7 and Pin 8 of the safety connector; the reading on the multimeter must be < 0.5 Ω, as shown in Figure 8.20 below.

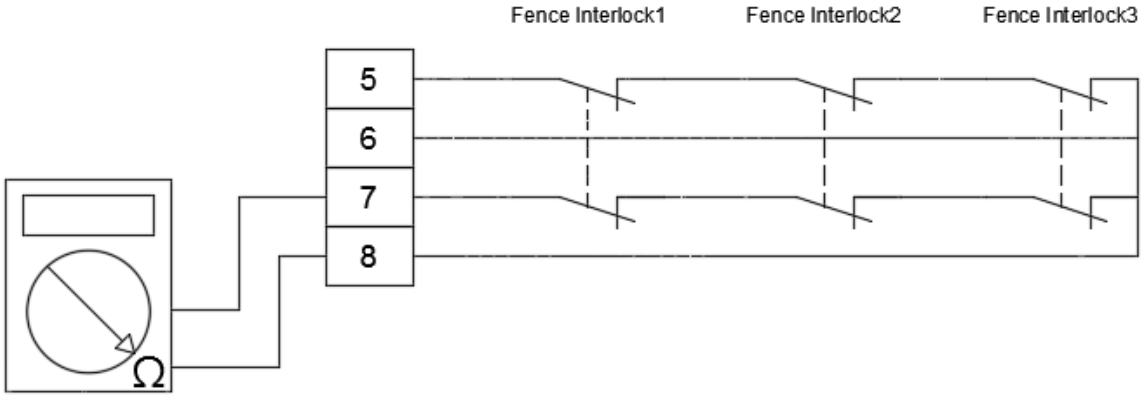


Figure 8.20 Turn off fence safety signal and measure Pin 7 and Pin 8

5. Turn on one of the fences.
6. Measure Pin 5 and Pin 6 of the safety connector; the reading on the multimeter must be ∞, as shown in Figure 8.21 below.

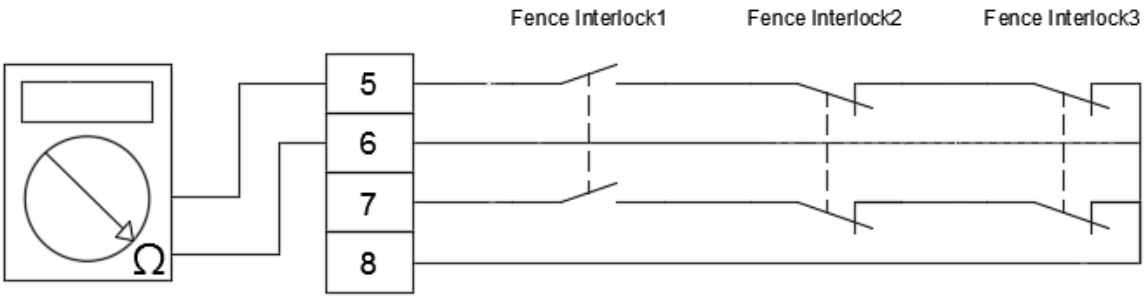


Figure 8.21 Turn on fence safety signal and measure Pin 5 and Pin 6

7. Measure Pin 7 and Pin 8 of the safety connector; the reading on the multimeter must be ∞, as shown in Figure 8.22 below.

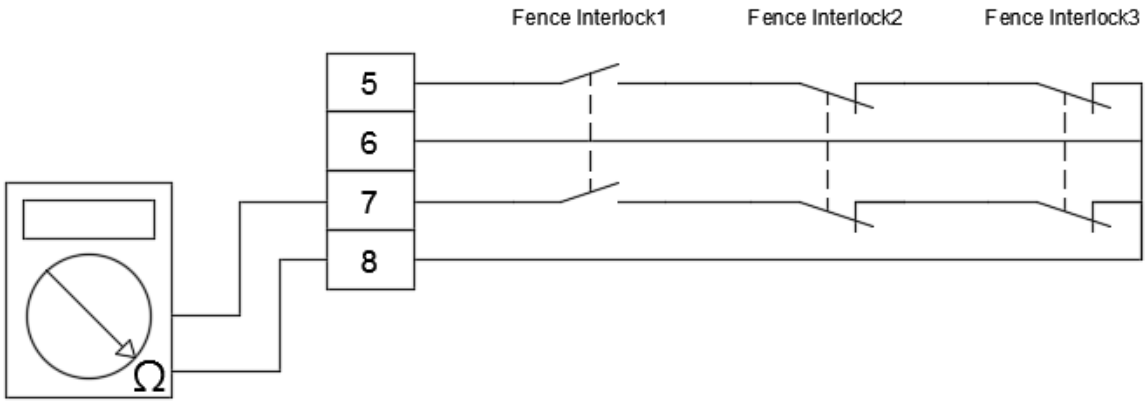


Figure 8.22 Turn on fence safety signal and measure Pin 7 and Pin 8

8. Reset the fences signal.
9. Repeat steps 5 - 8 and until all fences signal are checked.
10. The Safety connector pin 9 - pin 12 are safety alarm reset signal in controller.
    The Safety connector pin 9 - pin 12 are safety alarm reset signal on controller, please use two A (normal open) contact push buttons for alarm reset signal.
11. Please do not input any AC or DC power into safety connector pin 9 - pin 12, as this will make safety module broken in the controller.
    Safety alarm reset signals of the Safety connector are shown in Figure 8.23. See Figure 8.24 for the Intact Safety circuit.

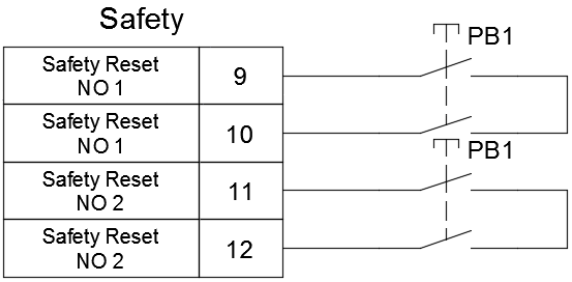


Figure 8.23 Safety alarm reset drawing

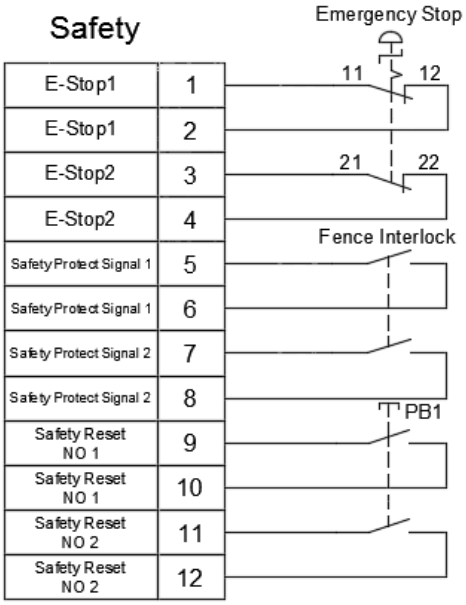


Figure 8.24 Intact Safety circuit

8.4.3 System DI important signal

DI4 and DI5 are the mode selection signal for switching between T1 and Auto modes. Please use the two-stage key switch in order to ensure that the operation mode cannot be changed randomly and prevent danger from happening.
The key must be able to be removed in any direction or else workers might activate the robot by accident and cause danger.
Please do not hang or place the keys randomly. It should be kept safely with authorized users in order to ensure safe usage.
The mode selection switch can be installed outside the railing together with the operation panel constructed by the user, as shown in Figure 8.25.
The operation panel should be installed at the location which is 0.6 m - 1.7 m from the ground to make it easier for users to operate.

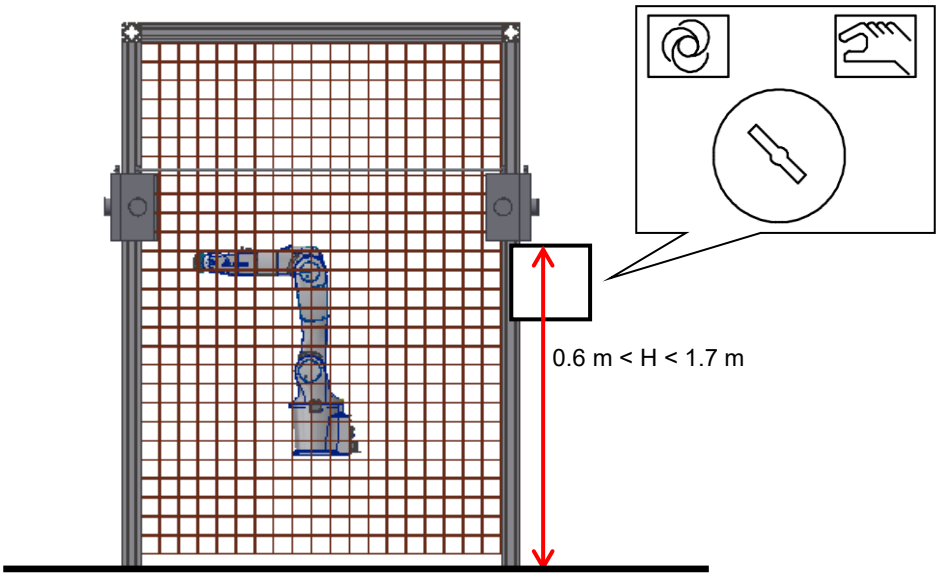


Figure 8.25 Mode selection switch installation location

DI6, DI7 program execution
Provides the function for customers to perform program run; the program can be paused, stopped, and ran by executing the functions from the external switch; its description is as shown in Table 8.1 below.

Table 8.1 Program execution signal truth table

Status command	DI4	DI5	Description
NO FUNCTION	**0**	**0**	No function.
PAUSE	**0**	**1**	The program pause function can be executed through external input signals to pause the current block; resuming it will start execution from the next action.
STOP	**1**	**0**	The program stop function can be executed through external input signals; resuming it will start execution from the first line of this process.
RUN	**1**	**1**	The program execute function can be executed through external input signals, but this is only valid for Auto mode.

DI8 abnormality warning reset

- If error occurs to the Robot or the Controller, the abnormal signal contact will be released.
- When eliminating the error, the signal must be maintained at ON status for 200 msec.
- For the error list and troubleshooting method, please refer to software manual.

8.4.4 Heavy-duty connector check

When installing the robot cable on the robot and controller, please lock the connector and fixture seat properly in place, otherwise it can easily cause poor signal contact and other dangers. As shown in Figure 8.26 below.

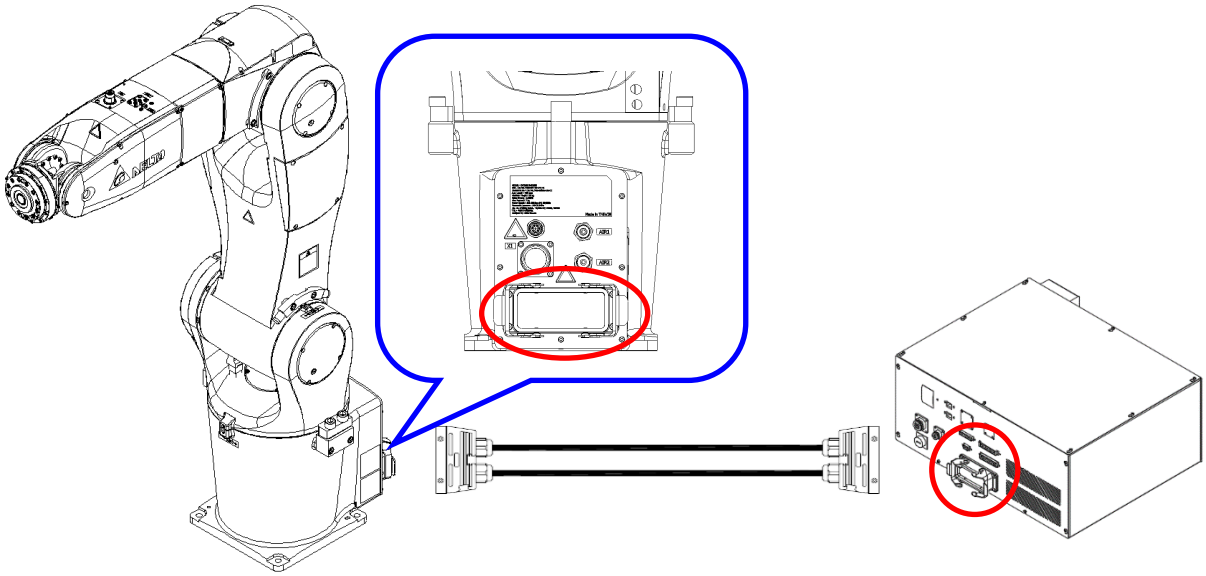


Figure 8.26 Heavy-duty connector position

8.5 Initial operation

8.5.1 Initial operation risk notification

Since users are unfamiliar with the operations when executing operations for the first time, it is possible that workers might get hit by the robot.
If any abnormal noises, vibrations, or leakages were detected, please turn off the controller power immediately and recheck the robot and surrounding integrated systems.
Please read Chapter 6.2 Robot operation direction carefully before performing operations.
When executing operations manually, please be careful not to place hands on the hole on the head of the robot because the worker's hand might get caught, as shown warning label in Figure 8.27 below.

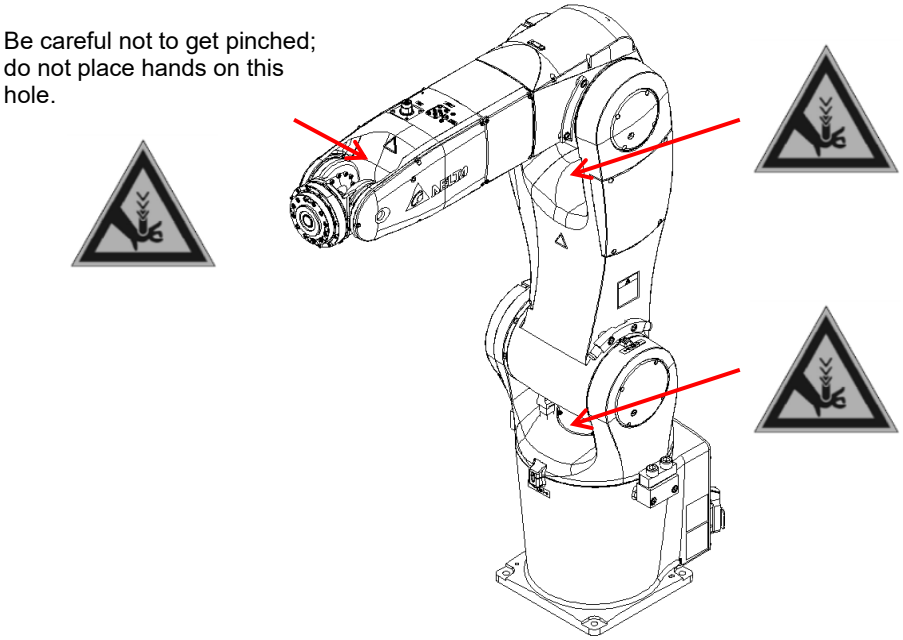


Figure 8.27 Location of robot to be careful not to get pinched

Please teach the points from outside of the railing when operating for the first time. If it has to be taught inside the railing, please stand at the safe area inside the railing in order to avoid getting hit by the robot during operation, as shown in Figure 8.28 below.
Please be careful not to extend arms and legs into the operation range of the robot during operation.

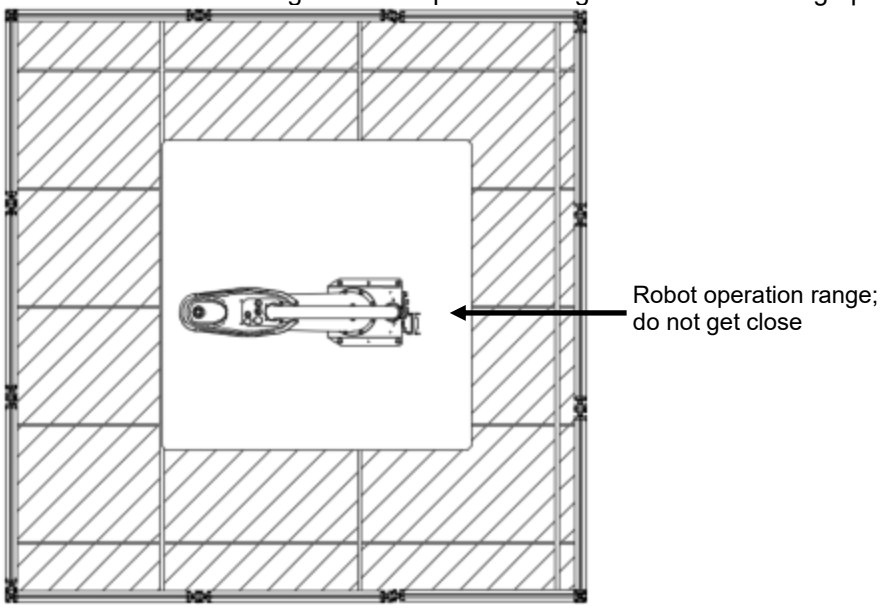


Figure 8.28 Working area and safe area of the robot inside the railing

8.5.2 When operating TP for the first time

Please use our company's handheld teaching pendant (DTV-2FM and DTV-2GM) and install it on the controller DCV-2J00-CA to perform manual operations and edit programs.
Our company will not be held responsible for any injuries or fatalities caused by accidents that result from using TPs of other brands.

1. When teach pendant is used to operate the robot, please connect the teach pendant connector onto the controller. Please disconnect the power before connecting; the location for connection is as shown in Figure 8.29.

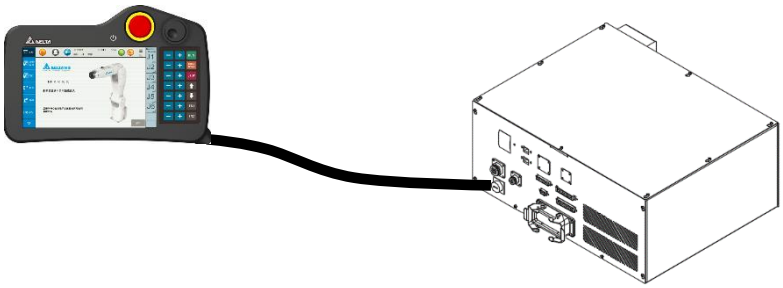


Figure 8.29 Teach pendant connection location

2. During an emergency situation, pressing the emergency stop button on the teach pendant can cut the power outputted to the robot from the controller; Figure 8.36 below is the emergency stop button on the teach pendant.

Figure 8.30 Location of the emergency stop button on the teach pendant

3. The enable switch at the back of the teach pendant is a 3-position button; the robot can only be operated when pressed at the middle position. When the enable switch is released or pressed all the way down, it will cut the power outputted to the robot from the controller. Figure 8.31 below is the location of the enable switch on the teach pendant.

Figure 8.31 Location of the enable switch on the teach pendant

4. Please switch the operation mode to manual (T1 mode) mode. At this time the status display on the teach pendant screen will change to  ; press the enable switch on the TP at the middle position and then press the  button on the teach pendant screen to Servo ON the robot. Figure 8.38 below is the position on the teach pendant screen.

Figure 8.32 Servo button position on teach pendant screen

5. To Servo off the robot, just press the  button again to Servo off the robot. At this time the icon will change to  .

6. When Servo on the robot, pressing the physical + and - buttons on the right of the teach pendant can operate the robot. The location of the physical buttons on the right of the teach pendant is as shown in Figure 8.33 below.

Figure 8.33 Location of teach pendant physical buttons

7. When T1 mode is used to operate the robot, the controller will automatically limit the moving speed of the robot to 250 mm/sec; users cannot change this speed.
8. Please refer to the software manual for details on teach pendant operations.

9. When TP is no longer used, please install the TP short-circuiting connector included in the accessory pack onto the controller, as shown in Figure 8.34.

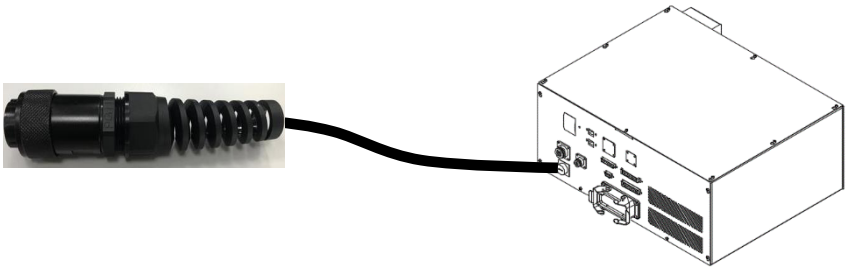


Figure 8.34 TP short-circuit connector figure

10. When operation in Auto mode, use the bypass connector included in the accessory pack, or else abnormalities will occur and it cannot be operated. Bypass connector is as shown in Figure 8.35.

Figure 8.35 Teach pendant bypass connector

8.6 Abnormal condition disposal

When faced with abnormal conditions, we recommend users to dispose of them using the following methods

1. Press the emergency stop button outside the railing.

2. Switch the mode selection to manual (T1 mode) status. This action ensures that workers will not accidentally press start operation again and restart the robot before the abnormal condition was eliminated.

3. Make sure the robot motion has come to a complete stop before opening the railing. Place the safety switch lock on after opening the railing in order to prevent the railing from accidentally being closed, causing the repair personnel to get trapped. Please remember to always carry the key when key switch is used; do not leave the key on the safety switch of the railing.

4. Press the emergency stop button inside the railing again to ensure the safety of the repair personnel inside the railing.

5. Check the robot and eliminate the problem. (Please refer to the abnormality message and troubleshooting chapters for related abnormality troubleshooting methods)

6. Reset the emergency stop button inside the railing.

7. Remove the lock on the railing safety switch.

8. Reset the emergency stop button outside the railing.

9. After resetting the abnormal signal, switch the model selection switch back to Auto mode, and execute program operation again.

10. If the abnormal condition cannot be eliminated or if you don’t know how to troubleshoot the abnormal condition, please contact your local dealer.

8.7 How to save injured workers

If workers were accidentally hit and injured, or got caught by the robot, please save them using the following steps.

1. Press the emergency stop button to cut off the power sent to the robot from the controller, as shown in Figure 8.36.

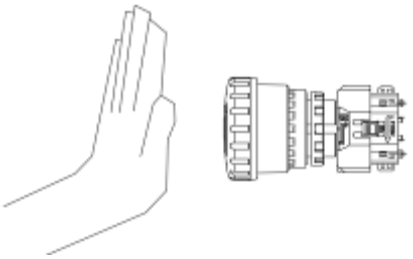


Figure 8.36 Press the emergency stop button

2. Press brake release push button and push robot to the front or back as shown in Figure 8.37.

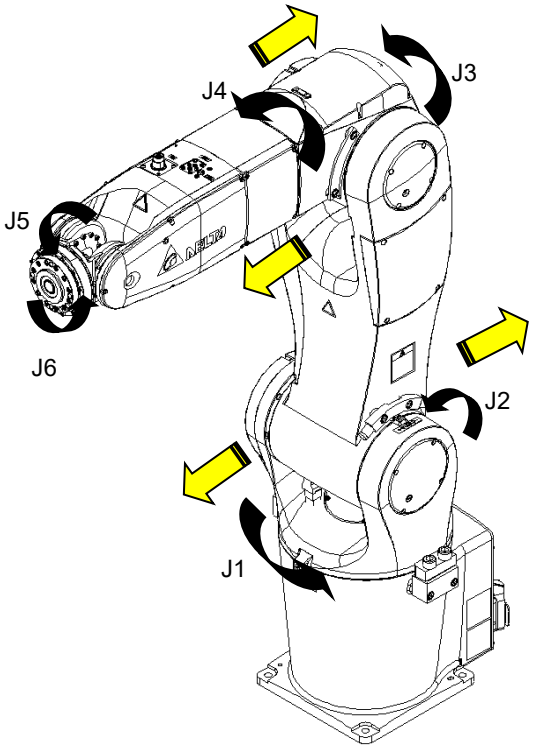


Figure 8.37 Push the robot

3. Carry, pull, or drag the injured worker away from the equipment and send them to the hospital as soon as possible. Carrying the injured worker is not suitable for all injuries; choose the most appropriate way to help the injured worker break away.

8.8 How to turn off the power

When the robot is not in use, please turn of the power of the controller properly and confirm that the robot has come to a complete stop before leaving.

The following steps is the correct way to turn off the power:

1. Press the emergency stop button
   Please press the emergency stop button around the railing; this action can ensure that the controller will not send power to the robot the next time the power is turned on, and it also ensures that the robot is in the power off status and the safety of the worker.

2. Turn off the controller power
   Please turn the controller power switch to the left to turn off the power of the controller properly, as shown in Figure 8.38.

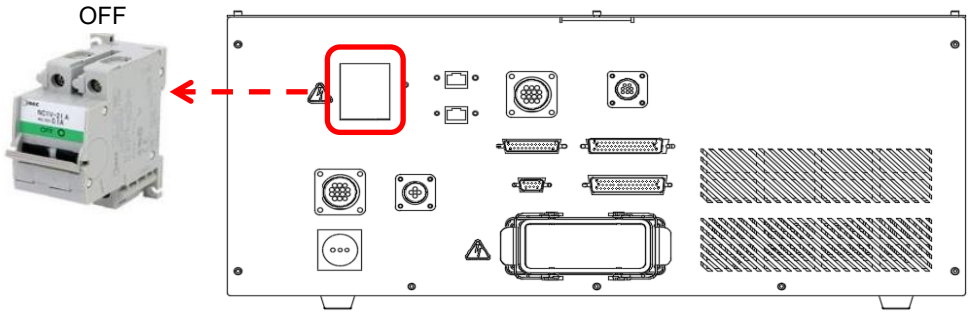


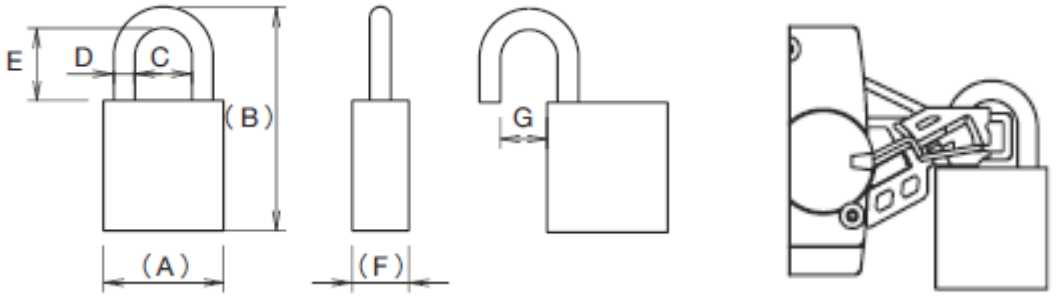
Figure 8.38 Turn off the controller power

3. Confirm that the robot has come to a complete stop before leaving.

4. User can also place a lock on the power switch of the controller in order to prevent operators from randomly turning on the power, as shown in figure 8.39.

Figure 8.39 Circuit breaker lockout device

5. Lock size. See figure 8.40.



Lock size (mm)						
(A)	(B)	C	D	E	(F)	G
19~25	35~42	9~11.5	4~4.5	11~15	8~10	7.5~9.0

Figure 8.40 Suggest size of lock

9. Maintenance

In order to prolong the usage life of the robot and to ensure accuracy for usage and reduce malfunctions, maintenance and inspections must be performed properly according to the maintenance table.

- Please perform maintenance and inspection properly according to the manual in order to prolong the usage life of the robot.
- Please add a safety lock on the power switch of the power box when performing maintenance or repairing operations to the robot, and place a “Do not power on” safety warning.
- When internal components of the controller are damaged, replacing the damaged ones with other brand’s components is prohibited; doing so may cause safety dangers or result in decrease of safety performance levels.
- Make sure foreign objects do not attach to or enter the robot when performing maintenance or inspection.
- Making random oil changes during maintenance may affect the performance of the robot or cause damage to the mechanical components.
- Protection devices and repair doors in the danger areas that need to be opened or removed regularly for the purpose of operations, maintenance, cleaning, and configuration should be interlocking.
- Personnel performing maintenance or repairs to the robot or robot system should receive the necessary process training in order to execute the tasks required. And also use original manufacturing parts, or else it might cause great danger to users.
- The processing of wasted material should comply with local laws and regulations, and should be treated carefully.

- Random changes to the maintenance schedule of the robot and maintenance oil are strictly prohibited.
- Maintenance and inspection to the controller and robot are prohibited while power is being supplied, or else it may cause electrical shocks or injuries to the workers.
- When a controller component is damaged, replacing the component with other brand’s components is prohibited; doing so many affect the performance of the controller or the components.
- The power control box must not be opened within 10 minutes after powering off because the residual voltage in the driver may cause electrical shocks.

9.1 DRV70/90L7D/E series inspection table

Table 9.1 below is the inspection table of the DRV70/90L7D/E series robots.
Please turn off the power switch properly during inspection and press the emergency stop button to ensure worker safety, otherwise dangers might occur.
When power is needed to check the motion range and reproducibility of the robot, please be careful not to stand in the motion range of the robot in order to avoid dangers from happening.

Table 9.1 DRV70/90L7D/E series inspection table

DRV 70/90L7D/E series inspection table							
Inspection item	Location	Power	Daily	Monthly	Quarterly	Every six months	Yearly
Make sure that the screws are fully tightened	Flange fixture screw	OFF	◆	◆	◆	◆	◆
	Robot base fixture screw		◆	◆	◆	◆	◆
Ensure the connector is completely in place	Heavy load connector		◆	◆	◆	◆	◆
Check appearance defects	Robot appearance		◆	◆	◆	◆	◆
	External cable		◆	◆	◆	◆	◆
Confirm each timing belt tension and abrasion	Base internals					◆	◆
	Fourth arm internals					◆	◆
	Fifth arm internals					◆	◆
Confirm that the cables and air pipes are not improperly bent	Each cable and air pipe		◆	◆	◆	◆	◆
Battery	Robot base						◆
Check the motion range of every axis	Every axis	ON					◆
Confirm there are no abnormal vibrations or noises	Entire robot		◆	◆	◆	◆	◆
Check reproducibility	Entire robot					◆	

The table below is the oil table for each DRV axis part that requires oil change during maintenance. Please use the oils described in the table or similar quality oils to perform maintenance in order to ensure normal use of each component.

Table 9.2 Oil table of the maintenance oil for each axis part

Part	Lubrication component	Lubrication interval	Lubricant
1	J1 reducer	Change motor	MP No.2 (Sumico Lubricant)
2	J2 reducer	Change motor	MP No.2 (Sumico Lubricant)
3	J3 reducer	Change motor	MP No.2 (Sumico Lubricant)
4	J4 reducer	Change motor	MP No.2 (Sumico Lubricant)
5	J5 reducer	Change motor	MP No.2 (Sumico Lubricant)
6	J6 reducer	Change motor	MP No.2 (Sumico Lubricant)

9.2 Robot battery maintenance and replacement

Please change the battery once a year, otherwise it will cause the robot to lose positions.

1. When the battery voltage is less than 3.1V, the controller will display the abnormality warning Ed061; please change a new battery within 15 days.
2. Please confirm that the voltage of the replaced battery is higher than 3.1V.
3. When the battery voltage is less than 2.7V, it will result in absolute position data loss.
4. Please perform battery replacement while the controller is powered on in order to prevent absolute position data loss.
5. When the battery is removed, do not turn off the power in order to prevent absolute position data loss.
6. When the absolute position data is lost, the origin reset process must be performed again.
7. Please use batteries with specifications that comply with Delta specifications; otherwise, it might cause damages to the machine. Please refer to the battery specifications shown in Table 9.3.

Table 9.3 Battery specification table

Name	Li/SOCl2 Cylindrical Battery
Type	ER14505
Delta model number	ASD-CLBT0100
International standard size	AA
Standard voltage	3.6V
Standard capacity	2700 mAh
Maximum continuous discharge current	100 mA
Maximum pulse current	200 mA
Dimensions (D x H)	14.5 mm x 50.5 mm
Operating temperature	-40 to +85°C

The battery location of the DRV70/90L7D/E series is shown in Figure 9.1.

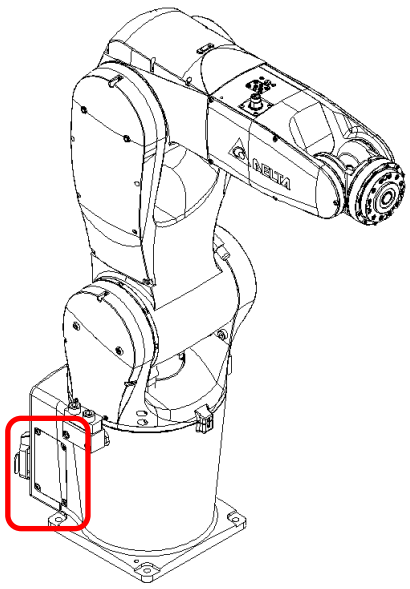


Figure 9.1 Battery location

9.3 Fan cleaning

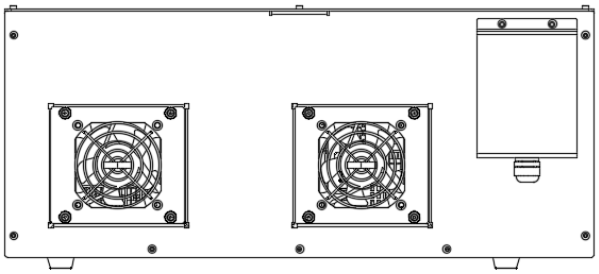
There are two cooling fans on the back of the controller.
Clean the fans within the specified time in order to prevent dust from blocking the fan which causes high temperature inside the electrical box and thus causes the power control box unable to operate normally.

- Frequency of cleaning the fan: once a month.

*The cleaning cycle is defined at general locations with no severe dust. Please refer to the description in the installation environment conditions; if environmental conditions are poor, the cleaning cycle needs to be shortened.

The sequence of cleaning processis as shown in Table 9.4 below:

Table 9.4 Controller fan cleaning sequence

1. The fans are located on the back of the controller; both fans need to be cleaned.	2. Remove the fan covers.
	
3. There is a connector connecting the fan and the wire. Remove the connector.	4. Place the fan back once cleaning is complete and secure the cover.
	

10. Bill of materials

This chapter lists some important components; please purchase components with same specifications if the component is damaged and needs to be replaced.

- Randomly replacing components with different specification is prohibited; our company is not responsible if problems occurred.
- Randomly replacing components with different specification is prohibited; doing so may affect the performance of the controller.

10.1 DCV controller bill of materials

Figure 10.1 below shows the locations of the components inside the DCV-2J00-CA controller.

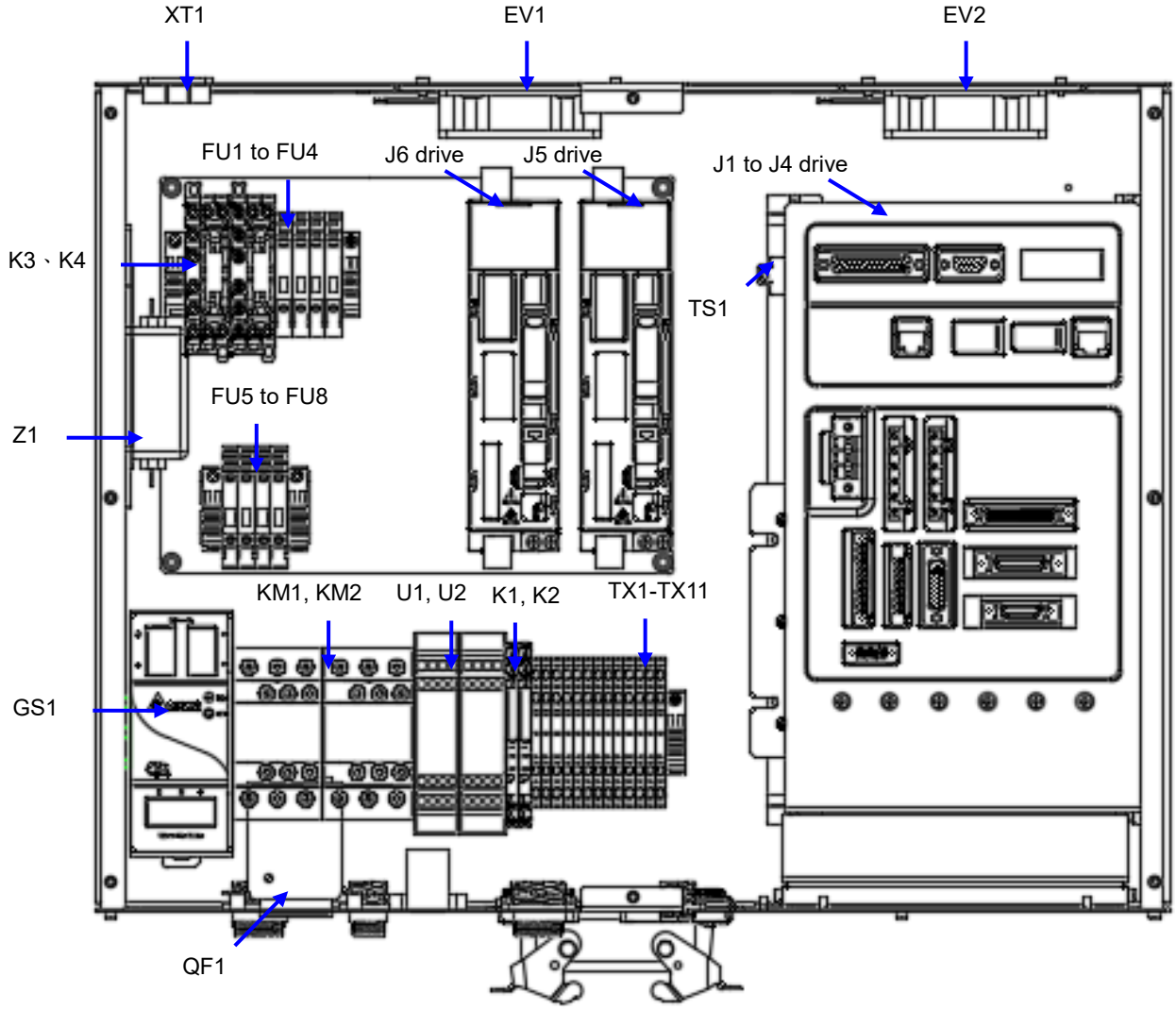


Figure 10.1 Controller internal parts layout

Table 10.1 below is the bill of materials for the DCV controller; please replace the damaged components according to the specification table below.
Please replace components with the same model number, otherwise it might cause more damages or danger, or affect the performance of the controller and robot.
Our company will not be responsible for any damages to the controller or problems resulted from replacing the components with different model numbers.

Table 10.1 DCV controller bill of materials

Item	Description	Manufacturer	Model number	Specification information
XT1	AC power in terminal block	DINKLE	0168-4003	Ith=76A AC1000V
Z1	Line Filter	DELTA	16DPCG5C	Ith=16A, AC115V/250V
J1 to J4 drive	Drive	DELTA	ASD-MS-0721-F	750W*4, 1PH/3PH, AC200-230V
J5, J6 drive	Drive	DELTA	ASD-A2-0221-FN	200W, 1PH/3PH, AC200-230V
QF1	No fuse break	IDEC	NC1V-2100-15M	Ui=250Vac Ith=15A Uimp 2.5kA
FU1	Fuse for MS drive	Cooper	S501-10-R	10A×1P, 250V~
FU2, FU3	Fuse for A2 drive AC power	Cooper	S501-3.15-R	3.15A×1P, 250V~
FU4	Fuse for A2 drive control power	Cooper	S501-2-R	2A×1P, 250V~
FU5	Fuse for DC power supply	Cooper	S505-2-R	2A×1P, 250V~
FU6	Fuse for MS, Brk	Cooper	S501-3.15-R	3.15A×1P, 250V~
FU7	Fuse for FAN, Parts coil	Cooper	S501-2-R	2A×1P, 250V~
FU8	Fuse for DC output	Cooper	S501-1-R	1A×1P, 250V~
FU-Holder	Fuse holder	DINKLE	DK4-TFL(5x20)	300V/16A
KM1, KM2	Magnetic contactor	FUJI	SC-0/G	24Vdc Ith=13A
GS1	Switch Power Supply	DELTA	DRP024V120W1AA	Input AC220V Output DC24V 120W
U1, U2	Safety module	PHOENIX	PSR-SCP-24DC/ESD/4X1/30	DC24V
XT1-XT11	Terminal block	DINKLE	AK2.5-TR	800V/24A
EV1, EV2	Cooling fan	DELTA	AFB0824SH-SM37	16-26VDC
TS1	Temperature Switch	Sensata	YS11A45B	7A/250Vac
K1, K2	Relay for J5 , J6 brake	IDEC	RV8H-L-AD24	Coil: 24Vdc Contacts: 6A/250Vac 6A/30Vdc
K3, K4	Relay for Auto/T1 mode select switch	IDEC	RF1V-2A2BL-D24	Coil: 24Vdc Contacts: 6A/250Vac 6A/30Vdc
FC1	Ferrite core for RJ45 Ethernet	DELTA	T60006L2050W565	13.5μH - 26.1μH at 10 kHz 7.5μH - 14.5 μH at 100 kHz
FC2	Ferrite core for RJ45 DMCnet	DELTA	T60006L2050W565	13.5μH - 26.1μH at 10 kHz 7.5μH - 14.5 μH at 100 kHz
FC3	Ferrite core for J1 motor power in controller	KGS	KRFC-13	>=105Ω at 100 MHz
FC4	Ferrite core for J2 motor power in controller	KGS	KRFC-13	>=105Ω at 100 MHz
FC5	Ferrite core for J3 motor power in controller	KGS	KRFC-13	>=105Ω at 100 MHz

Item	Description	Manufacturer	Model number	Specification information
FC6	Ferrite core for J4 motor power in controller	KGS	KRFC-13	>=105Ω at 100 MHz
FC7	Ferrite core for J5, J6 motor power in controller	KGS	KRFC-13	>=105Ω at 100 MHz
FC12	Ferrite core for J1 - J4 Encoder cable in controller	TDK	ZCAT3035-1330	80Ω at 10 - 100 MHz 150Ω at 100 - 500 MHz
FC13	Ferrite core for J5 Encoder cable in controller	TDK	ZCAT3035-1330	80Ω at 10 - 100 MHz 150Ω at 100 - 500 MHz
FC14	Ferrite core for J6 Encoder cable in controller	TDK	ZCAT3035-1330	80Ω at 10 - 100 MHz 150Ω at 100 - 500 MHz
FC15	Ferrite core for J5 Encoder cable in controller	TDK	ZCAT2017-0930	20Ω at 10 - 100 MHz 50Ω at 100 - 500 MHz
FC16	Ferrite core for J6 Encoder cable in controller	TDK	ZCAT2017-0930	20Ω at 10 - 100 MHz 50Ω at 100 - 500 MHz

11. Simple troubleshooting

This chapter introduces some simple troubleshooting methods and abnormality messages and contents of the controller.

- Please perform troubleshooting properly according to the descriptions in the manual.
- Do not perform any troubleshooting within 10 minutes after turning off the power because there is residue voltage in the drive that has not yet been fully discharged.
- Troubleshooting tasks must be performed by personnel with related licenses in order to guarantee the safety properly.

- Personnel without related licenses must not perform troubleshooting tasks.
- Randomly replacing components inside the controller is prohibited because components that do not comply with the specifications might result in damages to the controller or danger. Our company will not be held responsible if this occurs.
- Modification of any wiring inside the power control box to troubleshoot the malfunction is prohibited because doing so might result in damages to the controller or danger. Our company will not be held responsible if this occurs.

11.1 Fuse replacement

In order to protect the various components inside the power control box, fuses are used for each power circuit to protect its electrical circuit. If the corresponding fuse is burnt, the corresponding circuit will not be able to operate normally. The corresponding fuses of each circuit are as shown in Table 11.1 below:

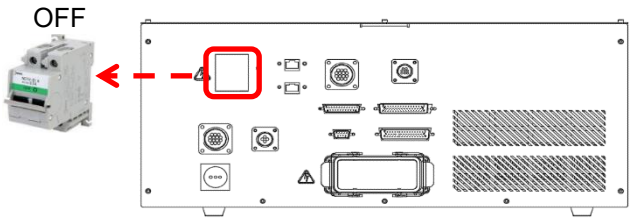
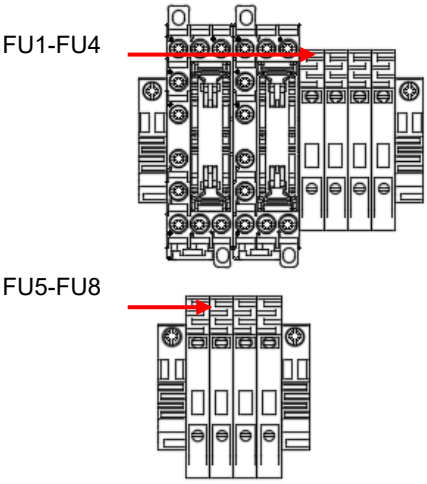
Table11.1 Fuse specifications and corresponding fault status list

Component	Corresponding circuit	Fault status	Fuse specifications
FU1	Fuse for J1 - J4 drive AC power	● Operator interface displays E?003´or E?013 or E?021 ● Robot system unable to Servo on	[Bussmann] S501-10-R/10A
FU2	Fuse for J5 drive AC power	● Operator interface displays E?003´or E?013 or E?021 ● Robot system unable to Servo on	[Bussmann] S501-3.15-R/3.15A
FU3	Fuse for J6 drive AC power	● Operator interface displays E?003´or E?013 or E?021 ● Robot system unable to Servo on	[Bussmann] S501-3.15-R/3.15A
FU4	Fuse for J5 and J6 drive control power	● J5 and J6 drive unable to turn on	[Bussmann] S501-2-R/2A
FU5	Fuse for DC power supply AC power	● Controller unable to turn on ● Controller fan unable to run ● Safety module unable to turn on ● Handheld teach pendant unable to turn on	[Bussmann] S505-2-R/2A
FU6	Fuse for J1 - J4 motor brake	● Motor brake can not be released ● Controller alarm AL006 when running	[Bussmann] S501-3.15-R/3.15A
FU7	Fuse for controller cooling fan	● Cooling fan not run	[Bussmann] S501-2-R/2A
FU8	Fuse for DC optput	● Controller interface DC output not output DC 24V	[Bussmann] S501-1-R/1A

Note: when replacing the fuse, replace it with products with specifications listed in the table above, or use products with same specifications which complies with the safety regulations.

Solution:
If the malfunction status above occurred, it might be due to the corresponding fuse being burnt. Please open the power control box door to check the fuse circuit and perform replacement if necessary. Please make sure to wait for 10 minutes after the power has been turned off before opening the power control box door to perform replacement operations in order to avoid residue voltages and getting electrical shocks. Please refer to the processes in Table 11.2 below to perform the replacement.

Table11.2 Fuse replacement steps

<table>
<tr><td>1. Turn off controller circuit breaker then remove the controller upper cover.</td><td>2. Please use the ohm gear of a multimeter to perform measurement of the fuse; if it has an open circuit, it means that the fuse has been burnt and needs to be replaced.</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>3. Remove the fuse cover when replacing the fuse, then install a fuse that corresponds to the specifications listed in Table 11.1.</td><td>4. Fit the cover for the fuse and controller then turn on the circuit breaker.</td></tr>
<tr><td> 
</td><td> 
</td></tr>
</table>

11.2 Troubleshooting temperature of power control box being too high

If the cooling fan of the box body malfunctioned or the installation space does not conform to the distance specified in the manual, the temperature inside the power control box will become too high, causing components inside the power control box to get damaged due to the high temperature. In response to such situations, there is a temperature sensing component installed inside the power control box. This component will monitor the temperature inside the power control box and if the temperature exceeds the component specification of 45°C, then protection actions will be performed to the safety circuit and the E?013 emergency stop abnormality alarm will occur.

Solution:

1. Check if the cooling fan malfunctioned and replace it with a fan with the specifications listed in the specification table.
2. Check if the installation environment complies with the distance specified in the manual.
3. To deal with Conditions 1 and 2, please open the box door for cooling. Once confirmed that the temperature inside the power control box is less than 40°C, power can be connected again.
4. Table 11.3 below shows how the temperature sensing component blocks and automatically resets the temperature.

Table 11.3 Temperature sensor component specifications

Temperature sensor component specifications	
Blocking circuit temperature	> 45°C
Reset circuit temperature	< 40°C

11.3 Abnormality warning list

When an abnormality occurs, the abnormality code number can be received through the handheld teach pendant. Table 11.4 below shows the abnormality alarms according to their group categories.

Table 11.4 Group abnormality warning codes

Abnormality warning display	Abnormality warning name	Abnormality type		Servo status	
		ALM	WARN	ON	OFF
E?801	Origin not set for all axes	○		E?801	Origin not set for all axes
E?803	Motion instruction not compatible	○		E?803	Motion instruction not compatible
E?80A	Motion instruction not ready	○		E?80A	Motion instruction not ready
E?80B	Unknown motion instruction	○		E?80B	Unknown motion instruction
E?80C	Motion instruction buffer error	○		E?80C	Motion instruction buffer error
E?813	Error occurred during axis command explanation process	○		E?813	Error occurred during axis command explanation process
E?814	Error occurred during axis motion instruction execution process	○		E?814	Error occurred during axis motion instruction execution process
E?815	Single axis exceeded software limit	○		E?815	Single axis exceeded software limit
E?821	Robot stance does not match	○		E?821	Robot stance does not match
E?822	Point-to-point motion instruction target position exceeded working range of robot	○		E?822	Point-to-point motion instruction target position exceeded working range of robot
E?823	Line continuous path instruction target position exceeded working range of robot	○		E?823	Line continuous path instruction target position exceeded working range of robot
E?824	Space motion exceeded working range	○		E?824	Space motion exceeded working range
E?825	Forward kinematics conversion error	○		E?825	Forward kinematics conversion error
E?827	Group does not exist	○		E?827	Group does not exist
E?829	Coordinates switch error	○		E?829	Coordinates switch error
E?82A	User coordinates switch error	○		E?82A	User coordinates switch error
E?82B	Tool coordinates switch error	○		E?82B	Tool coordinates switch error
E?832	Internal communication packet lost	○		E?832	Internal communication packet lost
E?833	Internal communication checksum error	○		E?833	Internal communication checksum error
E?841	Arc instruction out of bounds	○		E?841	Arc instruction out of bounds
E?842	Cannot form arc	○		E?842	Cannot form arc

Abnormality warning display	Abnormality warning name	Abnormality type		Servo status	
		ALM	WARN	ON	OFF
E?843	Arc mode error	○		E?843	Arc mode error
E?851	Conveyor belt tacking visual parameter transmission timeout	○		E?851	Conveyor belt tacking visual parameter transmission timeout
E?852	Conveyor belt tracking speed exceeded limit	○		E?852	Conveyor belt tracking speed exceeded limit
E?853	Conveyor belt tacking visual parameter transmission timeout	○		E?853	Conveyor belt tacking visual parameter transmission timeout

Note:
1. When an abnormality message which is different from the ones in the list above appears, please contact your local dealer or technical personnel.
2. “?” represents the group category abnormality warning numbers “1 to 2”.

Table 11.5 below is the axis abnormality warning table according to each axis category.

Table 11.5 Axis category abnormality warning code number

Abnormality warning display	Abnormality warning name	Abnormality type		Servo status	
		ALM	WARN	ON	OFF
E?001	Over-current	○		E?001	Over-current
E?002	Over-voltage	○		E?002	Over-voltage
E?003	Under-voltage		○	E?003	Under-voltage
E?004	Motor match error	○		E?004	Motor match error
E?005	Regeneration error	○		E?005	Regeneration error
E?006	Overload	○		E?006	Overload
E?007	Over-speed	○		E?007	Over-speed
E?009	Position control error too large	○		E?009	Position control error too large
E?011	Encoder abnormal	○		E?011	Encoder abnormal
E?012	Correction abnormal	○		E?012	Correction abnormal
E?014	Reverse limit abnormal		○	E?014	Reverse limit abnormal
E?015	Positive limit abnormal		○	E?015	Positive limit abnormal
E?016	IGBT overheated	○		E?016	IGBT overheated
E?017	Memory abnormal	○		E?017	Memory abnormal
E?018	Detector output abnormal	○		E?018	Detector output abnormal
E?019	Serial communication between controller and driver abnormal	○		E?019	Serial communication between controller and driver abnormal
E?020	Serial communication between controller and driver timeout		○	E?020	Serial communication between controller and driver timeout
E?022	Main circuit power abnormal		○	E?022	Main circuit power abnormal
E?023	Advanced overload warning		○	E?023	Advanced overload warning
E?024	Internal encoder initialization magnetic field error	○		E?024	Internal encoder initialization magnetic field error
E?025	Encoder internal error	○		E?025	Encoder internal error
E?026	Encoder internal data reliability error	○		E?026	Encoder internal data reliability error
E?027	Encoder internal reset error	○		E?027	Encoder internal reset error
E?028	Encoder high voltage error or encoder internal error	○		E?028	Encoder high voltage error or encoder internal error
E?029	Gray code error	○		E?029	Gray code error
E?030	Motor collision error	○		E?030	Motor collision error
E?031	Motor power cable break detection	○		E?031	Motor power cable break detection
E?034	Encoder internal communication abnormal	○		E?034	Encoder internal communication abnormal
E?044	Driver function usage rate warning		○	E?044	Driver function usage rate warning
E?060	Absolute position lost		○	E?060	Absolute position lost
E?061	Encoder voltage too low		○	E?061	Encoder voltage too low

Abnormality warning display	Anormality warning name	Abnormality type		Servo status	
		ALM	WARN	ON	OFF
E?062	Absolute position loop overflow		◯	E?062	Absolute position loop overflow
E?067	Encoder temperature warning		◯	E?067	Encoder temperature warning
E?069	Motor type error	◯		E?069	Motor type error
E?06A	Absolute position lost			E?06A	Absolute position lost
E?3CF	Emergency stop	○		E?3CF	Emergency stop
E?940	Protective stop	○		E?940	Protective stop
E?070	Encoder processing not complete warning		○	E?070	Encoder processing not complete warning
E?072	Encoder over-speed		○	E?072	Encoder over-speed
E?099	EEPROM needs upgrading	○		E?099	EEPROM needs upgrading
E?111	DMCNET packet receive overflow	○		E?111	DMCNET packet receive overflow
E?185	DMCNET Bus hardware abnormal	○		E?185	DMCNET Bus hardware abnormal
E?201	DMCNET data initialization error	○		E?201	DMCNET data initialization error
E?235	Position command overflow	○		E?235	Position command overflow
E?245	Positioning timeout	○		E?245	Positioning timeout
E?283	Driver positive limit		○	E?283	Driver positive limit
E?285	Driver reverse limit		○	E?285	Driver reverse limit
E?289	Position counter overflow	○		E?289	Position counter overflow
E?301	DMCNET synchronization failed	○		E?301	DMCNET synchronization failed
E?302	DMCNET synchronization signal too fast	○		E?302	DMCNET synchronization signal too fast
E?303	DMCNET synchronization signal timeout	○		E?303	DMCNET synchronization signal timeout
E?304	DMCNET IP command failed	○		E?304	DMCNET IP command failed
E?500	STO function activated	○		E?500	STO function activated
E?501	STO_A lost (signal lost or error)	○		E?501	STO_A lost (signal lost or error)
E?502	STO_B lost (signal lost or error)	○		E?502	STO_B lost (signal lost or error)
E?503	STO_error	○		E?503	STO_error
E?555	Driver malfunction	○		E?555	Driver malfunction

Note：

1. “?” represents axis category abnormality warning number “1 - 6” and letters “D - I”.

11.4 Abnormality warning cause and disposal method

The following are the causes of each abnormality warning and their troubleshooting methods.

Group category:

E?801 origin not set for all axes	
Cause	Cause
Inspection and disposal method	Inspection and disposal method
Solution	Solution

E?803 motion instruction incompatible	
Cause	Cause
Inspection and disposal method	Inspection and disposal method
Solution	Solution

E?80A motion instruction not ready	
Cause	Cause
Inspection and disposal method	Inspection and disposal method
Solution	Solution

E?841 arc instruction out of bounds	
Cause	The target position of the instruction given exceeded the working range.
Inspection and disposal method	Please check whether the target position of each axis' motion instruction is within the software limit range set.
Solution	Abnormality warning reset.

E?842 cannot form arc	
Cause	Entered condition unable to form arc.
Inspection and disposal method	Check whether the conditions entered to form the arc are correct; if 3 points are collinear, the radius is 0, or the center of the circle is on the circumference etc., an arc cannot be formed. Please resend the command position according to the arc-forming conditions.
Solution	Abnormality warning reset.

E?843 arc mode error	
Cause	Arc mode error.
Inspection and disposal method	Please return it to the dealer or original manufacturer for repairs.
Solution	Abnormality warning reset.

E?851 conveyor belt tacking visual parameter transmission timeout	
Cause	1. Data transmission error. 2. Visual system not yet triggered.
Inspection and disposal method	1. Make sure that the visual system was triggered before activating the robot. 2. Check whether the configurations and settings of the visual system are correct.
Solution	Abnormality warning reset.

E?852 conveyor belt tracking speed exceeded limit	
Cause	Conveyor belt speed too fast.
Inspection and disposal method	Lower the speed of the conveyor belt.
Solution	Abnormality warning reset.

E?853 conveyor belt tacking visual parameter transmission timeout	
Cause	Setting error in the user coordinates code number used for the conveyor belt tracking application.
Inspection and disposal method	Check whether the user coordinate code number used in the conveyor belt tracking application meets the user coordinate usage specifications (cannot be 0 and greater than 5).
Solution	Abnormality warning reset.

Axis category:

E?001 over-current	
Cause	1. Driver output short-circuited. 2. Motor connection error. 3. IGBT is abnormal.
Inspection and disposal method	1. Check whether the wiring between the motor and the driver is short-circuited; if short-circuited, please eliminate the short circuit status and prevent the wiring from being exposed. 2. Please refer to the wiring order in the manual and check the wiring order for connecting the motor to the driver, and then wire it again. Please send this product back to the dealer or original manufacturer for repairs if problems still exist.
Solution	Abnormality warning reset.

E?002 over-voltage	
Cause	1. Main circuit input voltage too high. 2. Driver hardware malfunction.
Inspection and disposal method	1. Check whether the input voltage of the main circuit is within the rated voltage value; if not, please use the correct voltage component or connect a stabilizer to convert the voltage for it tobe within the rated range. 2. Check whether the input voltage of the main circuit is within the rated voltage range; if this error still occurs, please send the driver back to the dealer or original manufacturer for repairs.
Solution	Abnormality warning reset.

E?003 under-voltage	
Cause	1. Main circuit input voltage too low. 2. Main circuit has no input voltage source. 3. Power input error.
Inspectionand disposal method	1. Use an ammeter to measure the voltage to see whether the voltage of the main circuit is normal. 2. Please refer to the wiring order in the manual to check whether the wiring of the main circuit input voltage is normal; if there is wiring error, please re-wire. 3. Check whether the power system complies with the specification definition; please use the correct voltage component or connect a stabilizer to convert the voltage for it to be within the rated range.
Solution	Voltage recovery and clear.

E?004 motor match error	
Cause	1. Encoder loose. 2. Motor match error.
Inspection and disposal method	Please return it to the dealer or original manufacturer for repairs.
Solution	Reconnect the power and clear.

E?005 regeneration error	
Cause	1. Use of regenerative resistance error or no external regenerative resistance connected. 2. Parameter setting error.
Inspection and disposal method	Please return it to the dealer or original manufacturer for repairs.
Solution	Abnormality warning reset.

E?006 overload	
Cause	1. Continual use while exceeding the rated load of the driver. 2. Wiring error between the motor and encoder. 3. Defective motor encoder.
Inspection and disposal method	1. Check the wiring between U, V, W and the encoder; if error is discovered, please re-wire it correctly. 2. Please return the motor to the dealer or original manufacturer for repairs.
Solution	Abnormality warning reset.

E?007 over-speed	
Cause	Improper settings for parameter P2-34 (over-speed warning conditions).
Inspection and disposal method	Please return it to the dealer or original manufacturer for repairs.
Solution	Abnormality warning reset.

E?009 position control error too large	
Cause	External load too great.
Inspection and disposal method	Please use a value within the maximum PayLoad range or adjust the PayLoad value.
Solution	Abnormality warning reset.

E?011 encoder abnormal	
Cause	1. Encoder wiring error. 2. Encoder loose or poor contact. 3. Encoder damaged.
Inspection and disposal method	1. Confirm whether the wiring was done properly according to the instructions in the manual. 2. Check the MotorENC. on the driver and whether the wiring on the both ends of the servo motor is loose. If the connector is loose, reconnect the driver MotorENC. and the wiring of the position detector.
Solution	Reconnect the power and clear.

E?012 correction abnormal	
Cause	Current calibration abnormal.
Inspection and disposal method	Please return it to the dealer or original manufacturer for repairs.
Solution	Reconnect the power and clear.

E?014 reverse limit abnormal	
Cause	1. Reverse limit switch activated. 2. Insufficient servo server stability.
Inspection and disposal method	Please return it to the dealer or original manufacturer for repairs.
Solution	Abnormality warning reset.

E?015 positive limit abnormal	
Cause	1. Positive limit switch activated. 2. Insufficient servo server stability.
Inspection and disposal method	Please return it to the dealer or original manufacturer for repairs.
Solution	Abnormality warning reset.

E?016 IGBT overheated	
Cause	1. Continual use of driver while overloaded. 2. Driver output short-circuited.
Inspection and disposal method	1. Check whether the load is too great and please use a value within the maximum PayLoad range or adjust the PayLoad value. 2. Check the output wiring of the driver and make sure the wiring is correct.
Solution	Abnormality warning reset.

E?017 memory abnormal	
Cause	1. Parameter data writing abnormal or parameter abnormal; this happens during factory parameter reset or when there is driver model setting error. 2. Driver memory abnormal. 3. Data in ROM damaged; this happens when power is connected. Usually data in the ROM is damaged or that there is no data in the ROM; please send it back to the dealer.
Inspection and disposal method	Please return it to the dealer or original manufacturer for repairs.
Solution	Abnormality warning reset.

E?018 detector output abnormal	
Cause	1. Encoder error. 2. Output pulse wave exceeded the allowable range by the hardware.
Inspection and disposal method	Please return it to the dealer or original manufacturer for repairs.
Solution	Abnormality warning reset.

E?019 serial communication between controller and driver abnormal	
Cause	1. Improper communication parameter settings. 2. Incorrect communication addresses. 3. Incorrect communication values.
Inspection and disposal method	1. Reset to the default factory values. 2. Please return it to the dealer or original manufacturer for repairs.
Solution	Abnormality warning reset.

E?020 serial communication between controller and driver timeout	
Cause	Driver did not receive communication commands for an extended period of time.
Inspection and disposal method	Check whether the communication cable is loose or disconnected and make sure the wiring is correct.
Solution	Abnormality warning reset.

E?022 main circuit power abnormal	
Cause	Main circuit power abnormal.
Inspection and disposal method	1. Check whether the RS power cable is loose or there is no input power. 2. Please connect the power properly; if the power is normal and this abnormality warning still cannot be eliminated, please send the driver back to the dealer or original manufacturer for
Solution	Abnormality warning reset.

E?023 advanced overload warning	
Cause	Advanced overload warning.
Inspection and disposal method	Confirm whether it is used while overload and please refer to the disposal method of abnormal warning E?006.
Solution	Abnormality warning reset.

E?024 internal encoder initialization magnetic field error	
Cause	Encoder initialization magnetic field error. (Magnetic field position U, V, W error).
Inspection and disposal method	Please return it to the dealer or original manufacturer for repairs.
Solution	Reconnect the power and clear.

E?025 encoder internal error	
Cause	1. Encoder internal error (internal memory abnormal and internal counter abnormal). 2. When power is connected, the motor started due to mechanical inertia or other elements.
Inspection and disposal method	Please return it to the dealer or original manufacturer for repairs.
Solution	Reconnect the power and clear.

E?026 encoder internal data reliability error	
Cause	Encoder error (internal data abnormal occurs three consecutive times).
Inspection and disposal method	Please return it to the dealer or original manufacturer for repairs.
Solution	Reconnect the power and clear.

E?027 encoder internal reset error	
Cause	Encoder chip reset.
Inspection and disposal method	Please return it to the dealer or original manufacturer for repairs.
Solution	Reconnect the power and clear.

E?028 encoder high voltage error or encoder internal error	
Cause	1. Battery voltage too high. 2. Encoder internal error.
Inspection and disposal method	Check the driver to see whether the charging circuit and battery installation are abnormal (voltage >3.8 V); please use an ammeter to measure whether the battery voltage is more than 3.8 V.
Solution	Reconnect the power and clear.

E?029 Gray code error	
Cause	A circle of absolute position error.
Inspection and disposal method	Reconnect the power for the motor to operate and confirm whether the abnormality warning recurs; if it does, please return it to the dealer or original manufacturer for repairs.
Solution	Reconnect the power and clear.

E?030 motor collision error	
Cause	1. Confirm whether the anti-collision function of the motor is activated. 2. Please return it to the dealer or original manufacturer for repairs.
Inspection and disposal method	Reconnect the power for the motor to operate and confirm whether the abnormality warning recurs; if it does, the encoder needs to be replaced.
Solution	Reconnect the power and clear.

E?031 motor power cable break detection	
Cause	Motor power cable broke.
Inspection and disposal method	Check whether the power cable (U, V, W, GND) of the motor is broken, and wire and ground it properly according to the manual.
Solution	Reconnect the power and clear.

E?034 encoder internal communication abnormal	
Cause	Encoder internal communication abnormal.
Inspection and disposal method	Check whether the battery wiring is loose; if it is, please rewire the battery and reconnect the power once confirmed wired properly.
Solution	Reconnect the power and clear.

E?044 driver function usage rate warning	
Cause	Driver function usage rate warning.
Inspection and disposal method	Please return it to the dealer or original manufacturer for repairs.
Solution	Reconnect the power and clear.

E?060 absolute position lost	
Cause	1. Battery voltage too low. 2. Replaced battery while the driver control power is off. 3. Absolute position coordinate initialization was not completed after the absolute function was enabled. 4. Battery power supply circuit has poor contact or disconnected. 5. Electronic gear ratio changed.
Inspection and disposal method	1. Check whether the battery voltage is under 2.8 V. 2. Do not replace or remove the battery while the driver control power is Off. 3. Complete absolute coordinate initialization and the origin reset function, and perform absolute position coordinate reconstruction. 4. (1) Check whether the battery was installed properly and whether its wiring is correct. (2) Check the encoder wiring. (3) Check the wiring between the external battery box and the driver. Disposal method: Perform the origin reset process again.
Solution	Reconnect the power and clear.

E?061 encoder voltage too low	
Cause	Battery voltage too low.
Inspection and disposal method	1. Check whether the panel battery voltage is under 3.1 V (tentative specification). 2. Measure whether the battery voltage is under 3.1 V (tentative specification); if the voltage is too low, please replace the battery while the driver control power is ON.
Solution	Automatically clears.

E?062 absolute position loop overflow	
Cause	Stroke exceeded range.
Inspection and disposal method	Please return it to the dealer or original manufacturer for repairs.
Solution	Reconnect the power and clear.

E?067 encoder temperature warning	
Cause	Encoder temperature too high warning (85 - 100°C).
Inspection and disposal method	Please return it to the dealer or original manufacturer for repairs.
Solution	Reconnect the power and clear.

E?069 motor type error	
Cause	Absolute functions not allowed to be activated for incremental motors.
Inspection and disposal method	Check whether the motor has an incremental type or an absolute type encoder.
Solution	Reconnect the power and clear.

E?06A absolute position lost	
Cause	Absolute position coordinate initialization was not completed after the absolute function was enabled.
Inspection and disposal method	1. Complete absolute coordinate initialization and the origin reset function, and perform absolute position coordinate reconstruction. 2. Please return it to the dealer or original manufacturer for repairs.
Solution	Reconnect the power and clear.

E?070 encoder processing not complete warning	
Cause	Related instructions were not completed when performing encoder barcode writing or related actions.
Inspection and disposal method	Please return it to the dealer or original manufacturer for repairs.
Solution	Reconnect the power and clear.

E?072 encoder over-speed	
Cause	While power is supplied by the driver: rotation speed exceeded 8800rpm; while power is supplied by the battery: rotation speed exceeded 10000rpm.
Inspection and disposal method	1. Check whether the motor ground terminal is properly grounded. 2. Check whether the encoder signal cable is separated from the power or large current circuits in order to prevent interference. 3. Check whether the isolation net is used for the cable of the position detector. 4. Check whether the speed is within the specifications.
Solution	1. Please connect the ground terminal of the UVW connector with the cooling part of the driver. 2. Please check whether the encoder signal cable is separated from the power or large current circuits properly. 3. Please use cables that include isolation nets. 4. Please use within specifications. 5. If there are no improvements after the disposal methods above, please return it to the dealer or manufacturer for repairs.

E?099 EEPROM needs upgrading	
Cause	EEPROM needs upgrading.
Inspection and disposal method	Please return it to the dealer or original manufacturer for repairs.
Solution	Reconnect the power and clear.

E?111 DMCNET packet receive overflow	
Cause	Two or more packets were received within 1 ms.
Inspection and disposal method	Please return it to the dealer or original manufacturer for repairs.
Solution	Reconnect the power and clear.

E?185 DMCNET Bus hardware abnormal	
Cause	DMCNET Bus hardware abnormal or communication packet lost.
Inspection and disposal method	Please return it to the dealer or original manufacturer for repairs.
Solution	Reconnect the power and clear.

E?201 DMCNET data initialization error	
Cause	DMCNET data initialization error.
Inspection and disposal method	Please return it to the dealer or original manufacturer for repairs.
Solution	Reconnect the power and clear.

E?235 position command overflow	
Cause	1. When the feedback position register overflows. 2. When return to origin was triggered but the return to origin process was not yet completed. 3. When E?060 or E?062 occurs.
Inspection and disposal method	Perform the origin reset process.
Solution	Reconnect the power and clear.

E?245 positioning timeout	
Cause	Position mode positioning timeout.
Inspection and disposal method	Please return it to the dealer or original manufacturer for repairs.
Solution	None.

E?3CF emergency stop	
Cause	Press the emergency stop switch.
Inspection and disposal method	Confirm whether the emergency switch was activated. The emergency switch is usually a NC button; if accidentally activated, please release the emergency stop button.
Solution	Abnormality warning reset.

E?940 Protective stop	
Cause	Protective stop is triggered.
Inspection and disposal method	Check whether the robot status is in T1 or AUTO mode If in T1 mode, you need to chech whether the enable switch is triggered or not. If in AUTO mode, you need to check whether the protective stop is triggered or not.
Solution	T1 mode: 1.Press Enable Switch 2. Reset TP/DRAStudio Alarm Auto mode: 1. User restart protective stop 2. Press Alaem reset manually 3. Reset TP/DRAStudio Alarm

12. Accessories for the controller (optional purchase)

The following accessories are required when you connect the peripheral devices to the robot controller. You can purchase these accessories based on the needs.

12.1 EMI filter

To protect the controller from the interference of the peripheral circuits and power supply, it is suggested to purchase an applicable EMI filter. The mounting dimensions and specification are as follows.

Table12.1 Specification of the EMI filter

Item	Name	Specification	Function	Part number for ordering
1	EMI filter	**Input:** 1PH 100 - 240V 48/63 Hz 22.9A **Drive rating:** 1PH 90 - 127V 0.75 - 1.1 kW (1.0 - 1.5 HP) 1PH 170 - 264V 1.5 - 2.2 kW (2.0 - 3.0 HP)	Noise filtering	EMF023A21A

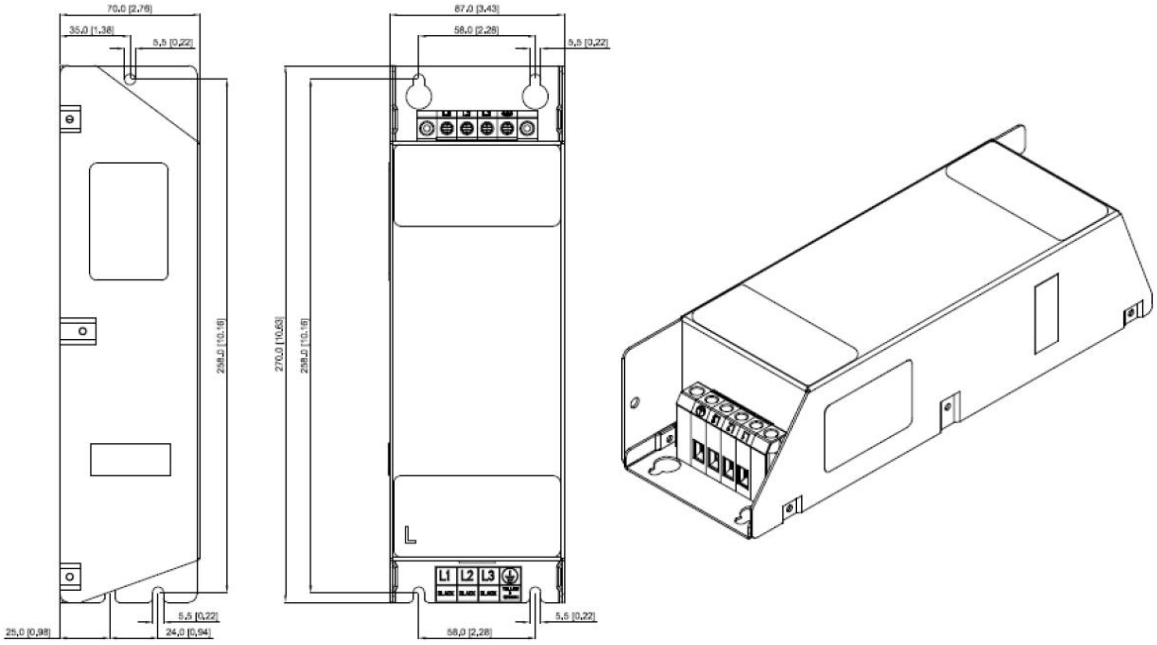


Figure12.1 Dimensions of Delta's EMI filter EMF023A21A

12.2 Handheld teach pendant

If you need to purchase a handheld teach pendant, teach pendants with a 5 or 10 meter cable are available.

Figure12.2 Handheld teach pendant

Table12.2 Specifications and part numbers of the handheld teach pendant

Item	Name	Specification	Part number for ordering
1	Handheld teach pendant	7” display, 15 keys, 5 meter cable	DTV-2FM
2	Handheld teach pendant	7” display, 15 keys, 10 meter cable	DTV-GM

12.3 Modules and cables

For easier wiring, the modules and cables are available for purchase which you can use to replace the damaged ones. Refer to Table 12.3 for descriptions.

Table12.3 Specifications and part numbers of the modules and cables

Item	Name	Specification	Part number for ordering
1	Robot cable	3 m, non-flexible	Refer to Section 12.3.1
2	System digital input / output (SYS.DI/O) conversion module	A module simplifying the wiring and a signal extension cable	Refer to Section 12.3.2
3	Standard digital input / output (STD.DI/O) conversion module	A module simplifying the wiring and a signal extension cable	Refer to Section 12.3.3
4	External encoder conversion module	A module simplifying the wiring and a signal extension cable	Refer to Section 12.3.4
5	Signal extension cable for robot	Signal extension cable	Refer to Section 12.3.5
6	DMCNET cable	Communication cable	Refer to Section 12.3.6
7	DMCNET module	DMCNET module	Refer to Section 12.3.7

12.3.1 Robot cable

You can connect the robot to the controller with the robot cable. 3 meter and 5 meter cables are available for purchase.

Table 12.4 Specifications and part numbers of the robot cables

Item	Name	Specification	Part number for ordering
1	Robot cable	3 meter, no cable carrier	3082296801
2	Robot cable	5 meter, no cable carrier	3082296701

Figure 12.3 Robot cable

Table 12.5 Pin definition of the robot cable

Pin	Module 1 12Pos	Pin	Module 2 12Pos	Pin	Module 3 12Pos	Pin	Module 4 12Pos	Pin	Module 4 12Pos
1	J1-U	**1**	J3-U	**1**	J5-U	**1**	J1-5V	**13**	J4-5V
2	J1-V	**2**	J3-V	**2**	J5-V	**2**	J1-0V	**14**	J4-0V
3	J1-W	**3**	J3-W	**3**	J5-W	**3**	J1-T+	**15**	J4-T+
4	J1-Ground	**4**	J3-Ground	**4**	J5-Ground	**4**	J1-T-	**16**	J4-T-
5	J1-Brk+	**5**	J3-Brk+	**5**	J5-Brk+	**5**	J2-5V	**17**	J5-5V
6	J1-Brk-	**6**	J3-Brk-	**6**	J5-Brk-	**6**	J2-0V	**18**	J5-0V
7	J2-U	**7**	J4-U	**7**	J6-U	**7**	J2-T+	**19**	J5-T+
8	J2-V	**8**	J4-V	**8**	J6-V	**8**	J2-T-	**20**	J5-T-
9	J2-W	**9**	J4-W	**9**	J6-W	**9**	J3-5V	**21**	J6-5V
10	J2-Ground	**10**	J4-Ground	**10**	J6-Ground	**10**	J3-0V	**22**	J6-0V
11	J2-Brk+	**11**	J4-Brk+	**11**	J6-Brk+	**11**	J3-T+	**23**	J6-T+
12	J2-Brk-	**12**	J4-Brk-	**12**	J6-Brk-	**12**	J3-T-	**24**	J6-T-

12.3.2 System DI/O conversion module

You can connect the system DI/O module to the system DI/O connector on the controller with the system DI/O conversion module and cable.

Table 12.6 Specifications and part numbers of the system DI/O conversion module

Item	Product name	Specification	Part number for ordering
1	System DI/O conversion module	D-SUB 25-pin	3073281546
2	Connection cable for system DI/O conversion module	1 m, no cable carrier	3081461600
3		1.5 m, no cable carrier	3081463100
4		2 m, no cable carrier	3081463200
5		2.5 m, no cable carrier	3081463300
6		3 m, no cable carrier	3081463400
7		3.5 m, no cable carrier	3081463500
8		4 m, no cable carrier	3081463600
9		4.5 m, no cable carrier	3081463700
10		5 m, no cable carrier	3081463800
11		6 m, no cable carrier	3081464000
12		7 m, no cable carrier	3081464200
13		8 m, no cable carrier	3081465600
14		9 m, no cable carrier	3081465500
15		10 m, no cable carrier	3081465400

Figure 12.4 System DI/O conversion module

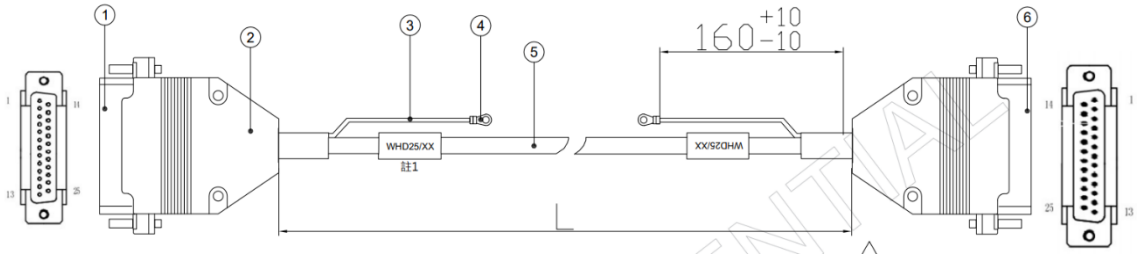


Figure 12.5 System DI/O conversion module connection cable

12.3.3 Standard digital input / output (STD.DI/O) conversion module

You can connect the standard DI/O module to the STD.DI/O connector on the controller with the standard DI/O conversion module and cable.

Table12.7 Specifications and part numbers of the standard DI/O conversion module

Item	Name	Specification	Part number for ordering
1	Standard DI/O conversion module	D-SUB 50-pin	3073281746
2	Connection cable for standard DI/O conversion module	1 m, no cable carrier	3081461700
3		1.5 m, no cable carrier	3081463900
4		2 m, no cable carrier	3081465200
5		2.5 m, no cable carrier	3081464900
6		3 m, no cable carrier	3081465300
7		3.5 m, no cable carrier	3081465000
8		4 m, no cable carrier	3081465100
9		4.5 m, no cable carrier	3081464800
10		5 m, no cable carrier	3081464700
11		6 m, no cable carrier	3081464500
12		7 m, no cable carrier	3081464600
13		8 m, no cable carrier	3081464400
14		9 m, no cable carrier	3081464300
15		10 m, no cable carrier	3081464100

Figure 12.4 Standard DI/O conversion module

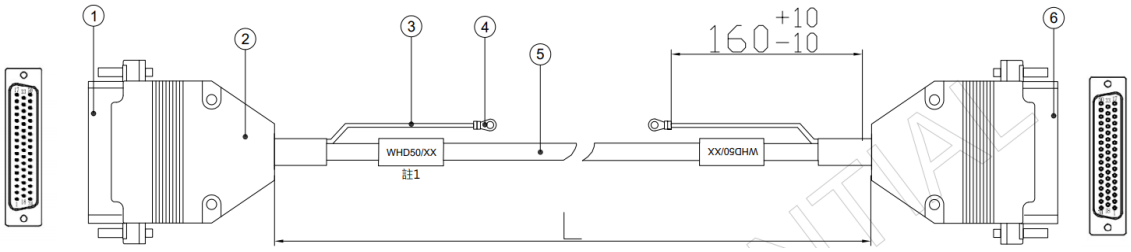


Figure 12.7 Standard DI/O conversion module connection cable

12.3.4 External encoder conversion module

You can connect the external encoder to the Ext.Encoder connector on the controller with the external encoder conversion module and cable.

Table12.8 Specifications and part numbers of the external.encoder module

Item	Name	Specification	Part number for ordering
1	External encoder conversion module	D-SUB 37-pin	3073281646
2	Connection cable for External encoder conversion module	1 m, no cable carrier	3081461500
3		1.5 m, no cable carrier	3081461800
4		2 m, no cable carrier	3081461900
5		2.5 m, no cable carrier	3081462000
6		3 m, no cable carrier	3081462200
7		3.5 m, no cable carrier	3081462100
8		4 m, no cable carrier	3081462300
9		4.5 m, no cable carrier	3081462400
10		5 m, no cable carrier	3081462600
11		6 m, no cable carrier	3081462500
12		7 m, no cable carrier	3081462800
13		8 m, no cable carrier	3081462700
14		9 m, no cable carrier	3081462900
15		10 m, no cable carrier	3081463000

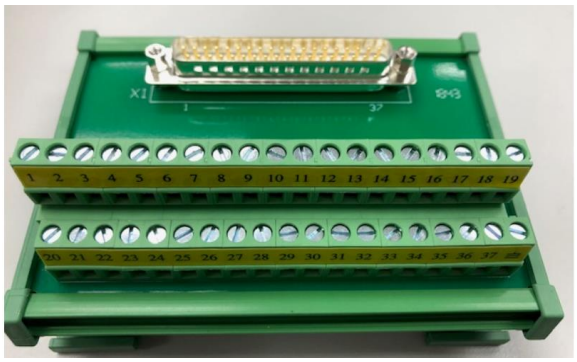


Figure 12.8 External encoder conversion module

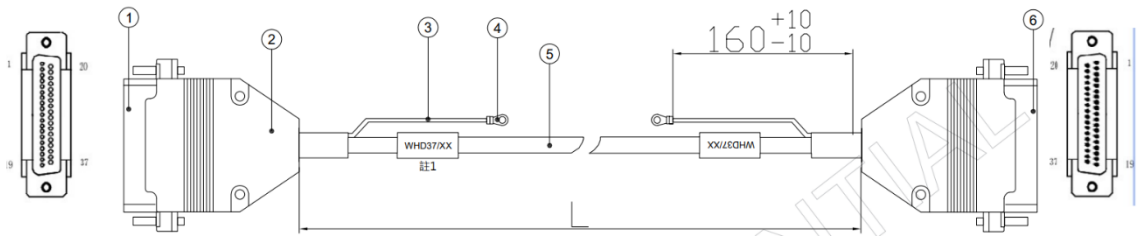


Figure 12.9 External encoder conversion module connection cable

12.3.5 Robot signal extension cable

You can transmit the 12 signals of the robot J4 axis and the 3 sets of built-in solenoid valve signals to this robot controller (DCV-2J00-CA) or other controllers for controlling.

Table12.9 Specifications and part numbers of the signal extension cable for the robot

Item	Name	Specification	Part number for ordering
1	Signal extension cable for robot	5 m, no cable carrier	3081734700
2	Signal extension cable for robot	7 m, no cable carrier	3081734800
3	Signal extension cable for robot	12 m, no cable carrier	3081734900

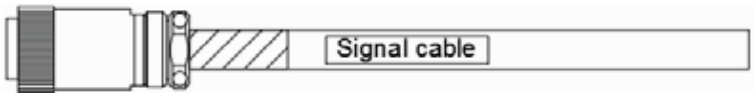


Figure12.10 Robot signal extension cable

Table12.10 Pin definition of the signal extension cable for the robot

Pin	Name	Color	Pin	Name	Color	Pin	Name	Color
1	12Pos-1	Black	2	12Pos-2	Brown	3	12Pos-3	Black
4	12Pos-4	Red	5	12Pos-5	Black	6	12Pos-6	Orange
7	12Pos-7	Black	8	12Pos-8	Yellow	9	12Pos-9	Black
10	12Pos-10	Green	11	12Pos-11	Black	12	12Pos-12	Blue
13	Sol-1A+	Black	14	Sol-1A-	Purple	15	Sol-2A+	Black
16	Sol-2A-	Gray	17	Sol-3A+	Black	18	Sol-3A-	White
19	Sol-1B+	Brown	20	Sol-1B-	Red	21	Sol-2B+	Brown
22	Sol-2B-	Orange	23	Sol-3B+	Brown	24	Sol-3B-	White

12.3.6 DMCNET cable

You can connect Delta DMCNET communication devices to the robot controller through the DMCNET connector on the controller with this cable.

Table12.11 Specifications and part numbers of the DMCNET cables

Item	Name	Specification	Part number for ordering
1	DMCNET cable	3 meter, no cable carrier	3864699800
2	DMCNET cable	5 meter, no cable carrier	3864266900
3	DMCNET cable	10 meter, no cable carrier	3864267000

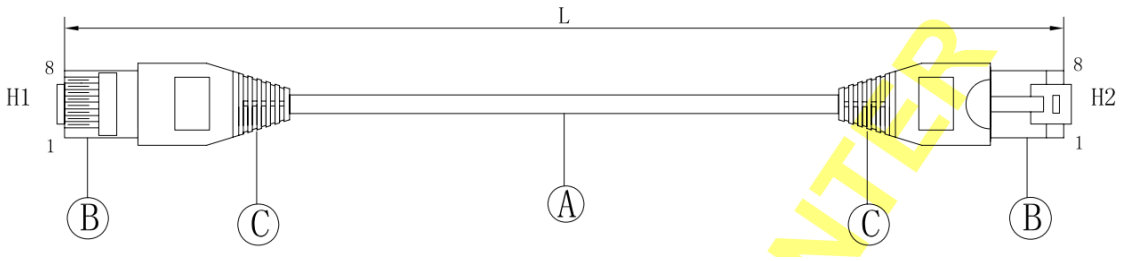


Figure12.11 DMCNET cable

12.3.7 DMCNET module

Specifications of the Delta DMCNET communication modules are as follows.

Table 12.12 DMCNET modules

Item	Name	Specification	Part number for ordering
1	Remote digital input extension module	32 input points, 24 V_{DC} / Sink / Source	ASD-DMC-RM32MN
2	Remote digital output extension module	32 output points, 24 V_{DC} / Sink	ASD-DMC-RM32NT
3	Remote digital output extension module	64 output points, 24 V_{DC} / Sink	ASD-DMC-RM64NT
4	Remote digital input / output extension module	16 input points / 16 transistor output points	ASD-DMC-RM32PT

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