

Medium & Heavy Payload Series Hardware Installation Manual

Corresponding models : TM12 / TM14 Series

Original Instruction



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Revision History Table

Revision	Date	Revised Content
01	October 2018	Original release

1. Product Description

1.1 Product Description

The TM Robot is a high-performance, six-axis collaborative robot, which features simple programming, innovative integrated vision capabilities together with the latest safety functionality.

1.2 How Can I Get Help?

You can access information sources on the corporate website:

www.ia.omron.com

Related Manuals:

This manual covers the hardware installation, operation and user maintenance of the TM Robot. There are additional manuals that cover programming, safety information, and adding optional components. Please refer to the following table.

Manual Title	Description
Safety Manual	Contains safety information for TM Robots.
TMflow	Instructions for use of TMflow software.
TMvision	Instructions for use of TMvision software.




2. Safety Information

2.1 Overview

This chapter describes important safety information about the TM Robot. The users and system integrators of the TM Robot should carefully read and understand this chapter before using this robot. Moreover, before operating the robot, the users should read and abide by the Safety Manual in accordance with the software and hardware version of this robot.

2.2 Warning and Caution Symbols

The Table below shows the definitions of the warning and caution levels described in each paragraph of this Manual. Pay close attention to them when reading each paragraph, and observe them to avoid personal injuries or equipment damage.

	DANGER: Identifies an imminently hazardous situation which, if not avoided, is likely to result in serious injury, and might result in death or severe property damage.
	WARNING: Identifies a potentially hazardous situation which, if not avoided, will result in minor or moderate injury, and might result in serious injury, death, or significant property damage.
	CAUTION: Identifies a potentially hazardous situation which, if not avoided, might result in minor injury, moderate injury, or property damage.

2.3 Safety Precautions




DANGER:

This product can cause serious injury or death, or damage to itself and other equipment, if the following safety precautions are not observed.

- All personnel who install, operate, teach, program, or maintain the system must read the “Hardware installation Manual”, “Software Manual”, and “Safety Manual” according to the software and hardware version of this product, and complete a training course for their responsibilities in regard to the robot.



Read Manual and Impact Warning labels

- All personnel who design the robot system must read the “Hardware installation Manual”, “Software Manual”, and “Safety Manual” according to the software and hardware version of this product, and must comply with all local and national safety regulations for the location in which the robot is installed.
- Observing the “intended of Use” section in “Safety Manual”.
- If the installation and application does not observe human-robot collaboration regulations of the safety regulations, the user is responsible for providing safety barriers around the robot to prevent anyone from accidentally coming into contact with the robot when it is in motion.
- If any local or national electrical regulation requires, power to the robot and its power supply must be locked out and tagged out before any maintenance is performed.
-  Dispose of the product in accordance with the relevant rules and regulations of the country or area where the product is used.

2.4 Validation and Liability

The information contained herein neither includes how to design, install, and operate a complete robotic arm system, nor involves the peripherals which may affect the safety of the complete system. The integrators of the robot should understand the safety laws and regulations in their countries and prevent major hazards from occurring in the complete system.

This includes but is not limited to:

- Risk assessment of the whole system
- Adding other machines and additional safety mechanisms based on the results of the risk assessment

- Building appropriate safety mechanisms in the software
- Ensuring the user will not modify any safety-related measures
- Ensuring all systems are correctly designed and installed
- Clearly labeling user instructions
- Clearly marked symbols for installation of the robot arm and the integrator contact details
- Collecting all documents into the technology folder, including the risk assessment, and this Manual



CAUTION:

This product is a partly complete machine. The design and installation of the complete system must comply with the safety standards and regulations in the country of use. The user and integrators of the robot should understand the safety laws and regulations in their countries and prevent major hazards from occurring in the complete system.

2.5 Limitations on Liability

No safety-related information shall be considered a guarantee by the Corporation that TM Robot will not cause personnel injury or property damage.

2.6 General Safety Warning

1. The actual noise measured in a factory setting is about 49.3 dB under without production. (Condition: leave machine body 1m distance and at 1.6m height from the floor and 80% of maximum speed). If the sound pressure is over 80 dB(A) while operating, wear proper ear protection.
2. Environmental Conditions:
 - Ambient air temperature: 0°C ~ +50°C
 - Ambient relative humidity: < 85%
 - Transportation & Storage condition: -20°C ~ +60°C
 - Transportation & Storage humidity: < 75%
 - The robot needs to be protected from shock or vibration
 - Observe ESD precautions when installing or removing robot.

2.7 Risk Assessment

Before installing or using this product, the user must first carry out the necessary risk assessment based on the conditions of use; meanwhile please also closely study the potential remaining risk addressed by the Corporation. Refer to and abide by the relevant chapters in Safety Manual in accordance with its' software and hardware version.

2.8 Emergency Stop

If any accidents occur during the operation of the robot, the user can stop all movement by pressing the Emergency Switch. When the robot stops, the user must ensure that all fault conditions are eliminated before manually restarting the robot. The Emergency Switch is only used in critical conditions. To stop the robot during normal operations use the Stop Button on the system controller. When the user presses the emergency switch, the TM Robot product will disconnect the power of robot and activate the brake after the robot motion is stopped. The indication light ring of the robot will not display light, and the three lights from the robot stick will be constantly blinking.

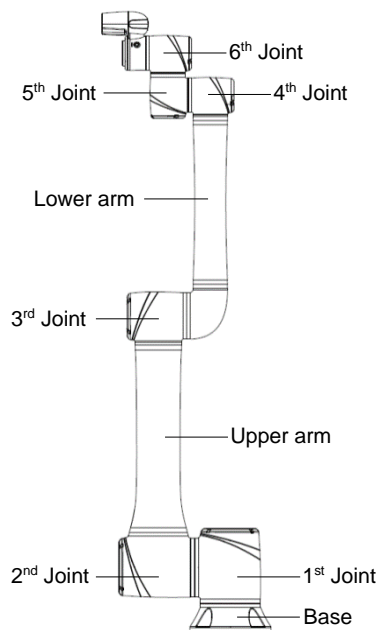
Once the risk assessment has been conducted, if an Emergency Switch needs to be installed then the selected device must comply with the requirements of ISO 60204-1. Emergency Stop act, factory reset and any other circumstances, please refer and abide by the relevant chapters in Safety Manual in accordance with its' software and hardware version.

2.9 Joint Rotation without Drive Power

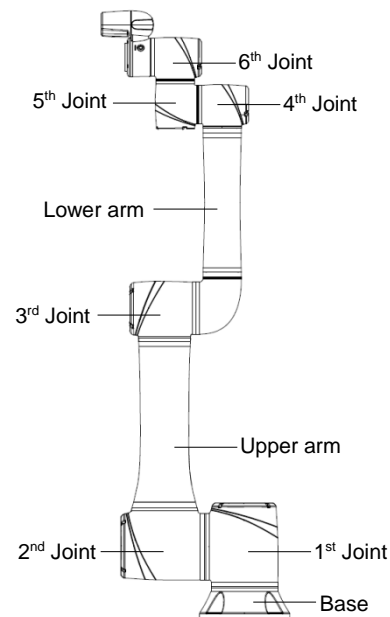
Robot without Drive Power could be found in three circumstances: Emergency stop, when disengaging packaging posture to initial booting, and power loss. The first two could enter Safe Start up Mode by means of releasing the Emergency Switch; the latter one is when robot loses external power. Regarding how to operate as well as safety precautions please refer and abide by the relevant chapters in the Safety Manual.

If the robot loses power, and joints need to be moved in order to clear error conditions, you will need to release the brake for each joint as follows:

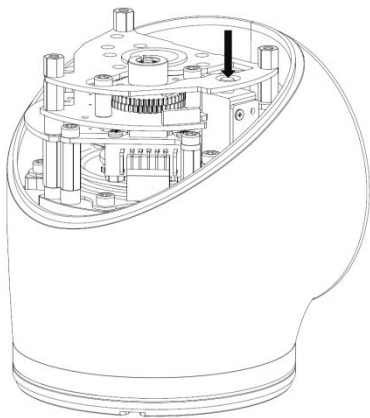
1. Remove joint cover screws (M3, Torx-T10) and joint cover.
2. Release the brake by pushing the pin on the brake solenoid shown in the following three figures.



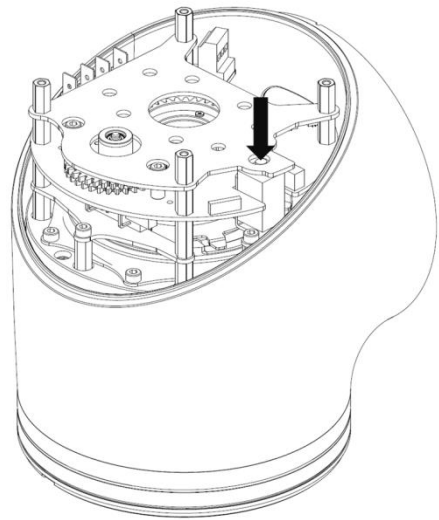
TM12 / TM12M



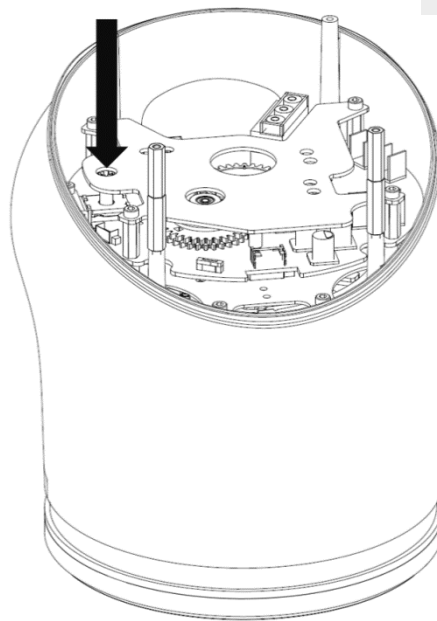
TM14 / TM14M



4th / 5th / 6th Joint



3rd Joint



1st / 2nd Joint




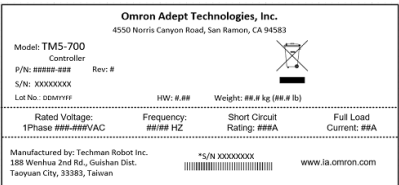


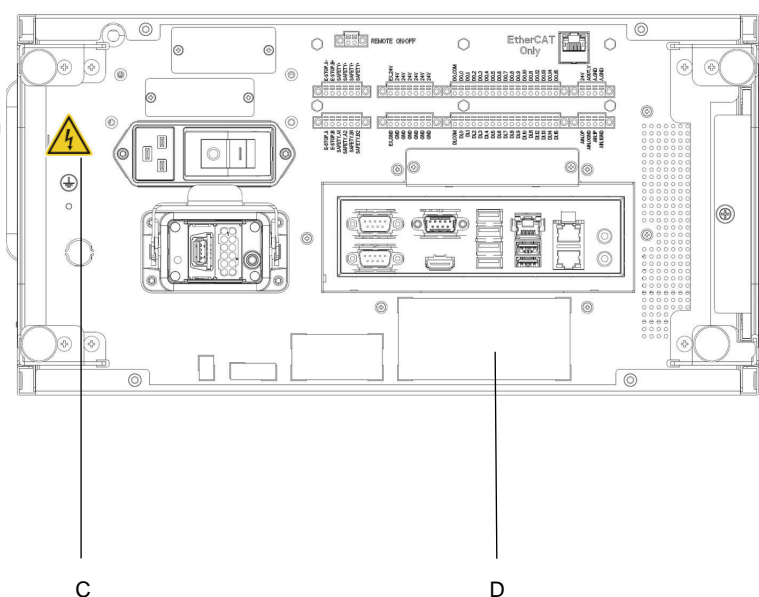
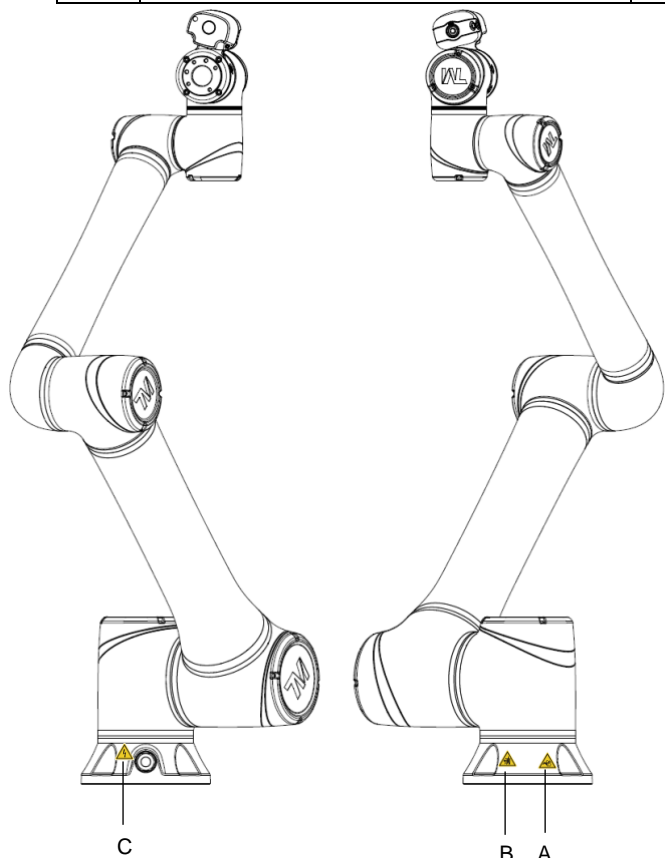
WARNING:

1. Robot Arm and End Effector should always be supported when manually releasing the brake to avoid falling due to gravity and causing damage. As the maximum payload of the medium and heavy payload series are relatively heavier, therefore, when manually releasing the brake, at least two people should hold on the Robot Arm and End Effector.
2. When manually moving each robot joint, the movement angle must be within a range of $\pm 45^\circ$.

2.10 Labels

The following labels, especially the warning ones, are attached to the locations where specific dangers may occur. Be sure to comply with description and warnings of the labels when operating to keep the manipulator safely. Do not tear, damage, or remove the labels. Be very careful if you need to handle the parts where the labels are attached.

A		Do not put your hand or fingers close to the moving parts
B		Be careful not to be close to the moving parts and nearby areas to avoid collision
C		Do not touch any internal electric parts to avoid electric shock
D		Product label



3. Transportation and Storage

Transport the TM Robot using its original packing materials. If you will need to transport the TM Robot after unpacking, store the packing materials in a dry place. Hold both arms of the TM Robot during transportation. Support the arms while tightening the base screws.

Lift the control box by its handles. Store the cables before transportation.



WARNING:

Pay attention to your posture when moving the arm and control box cartons to avoid back injury. The Corporation will not be liable for any injuries caused during transportation.



WARNING:

This product must be shipped and stored in a temperature-controlled environment, within the range -20°C to 60°C (-4°F to 140°F). The recommended humidity is up to 75 percent, non-condensing. It should be shipped and stored in the supplied package, which is designed to prevent damage from normal shock and vibration. You should protect the package from excessive shock and vibration.

The product must always be stored and shipped in an upright position in a clean, dry area that is free from condensation. Do not lay the package on its side or any other non-upright position: this could damage the product.

4. System Hardware

4.1 Overview

This chapter introduces the mechanical interface of the TM Robot System.

4.2 System Overview

TM Robot is made up of the robot arm and control box (including a robot stick).



Robot arm



Control Box

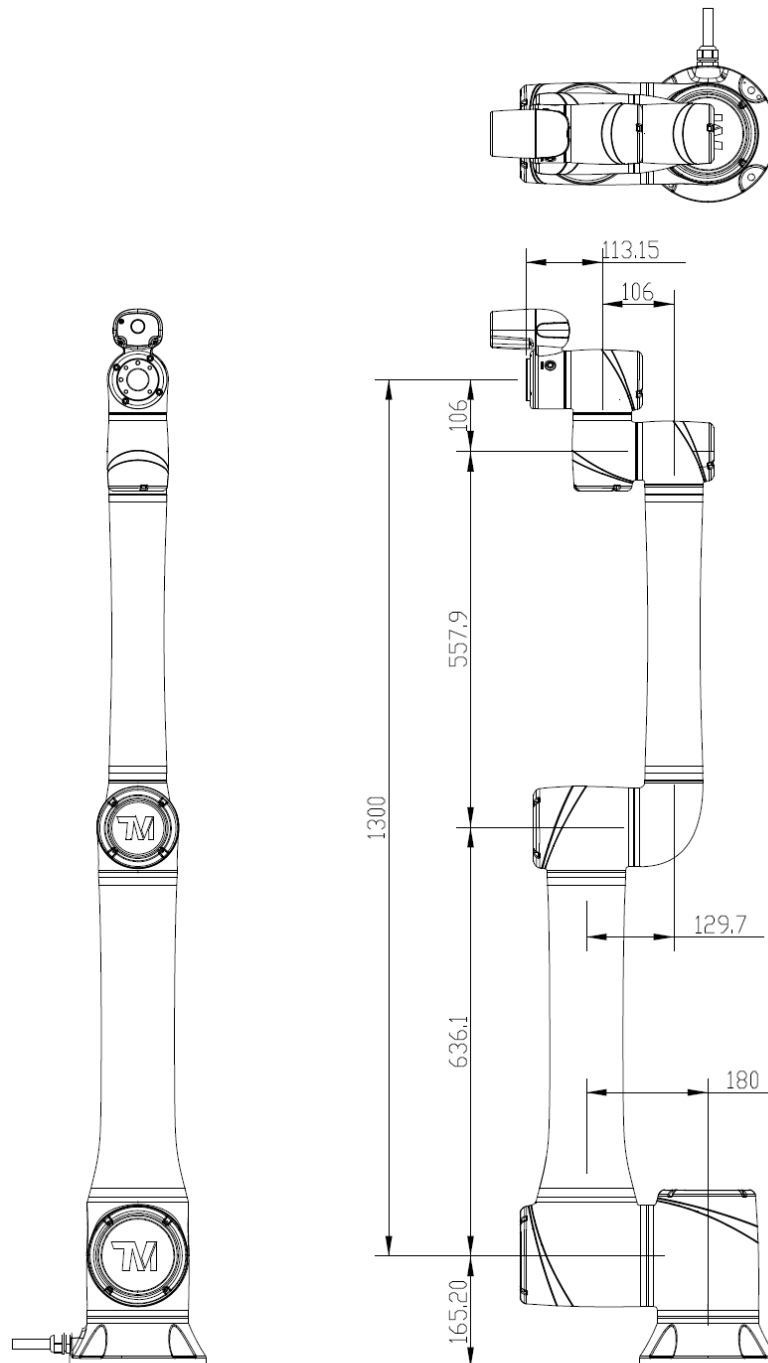


Robot Stick

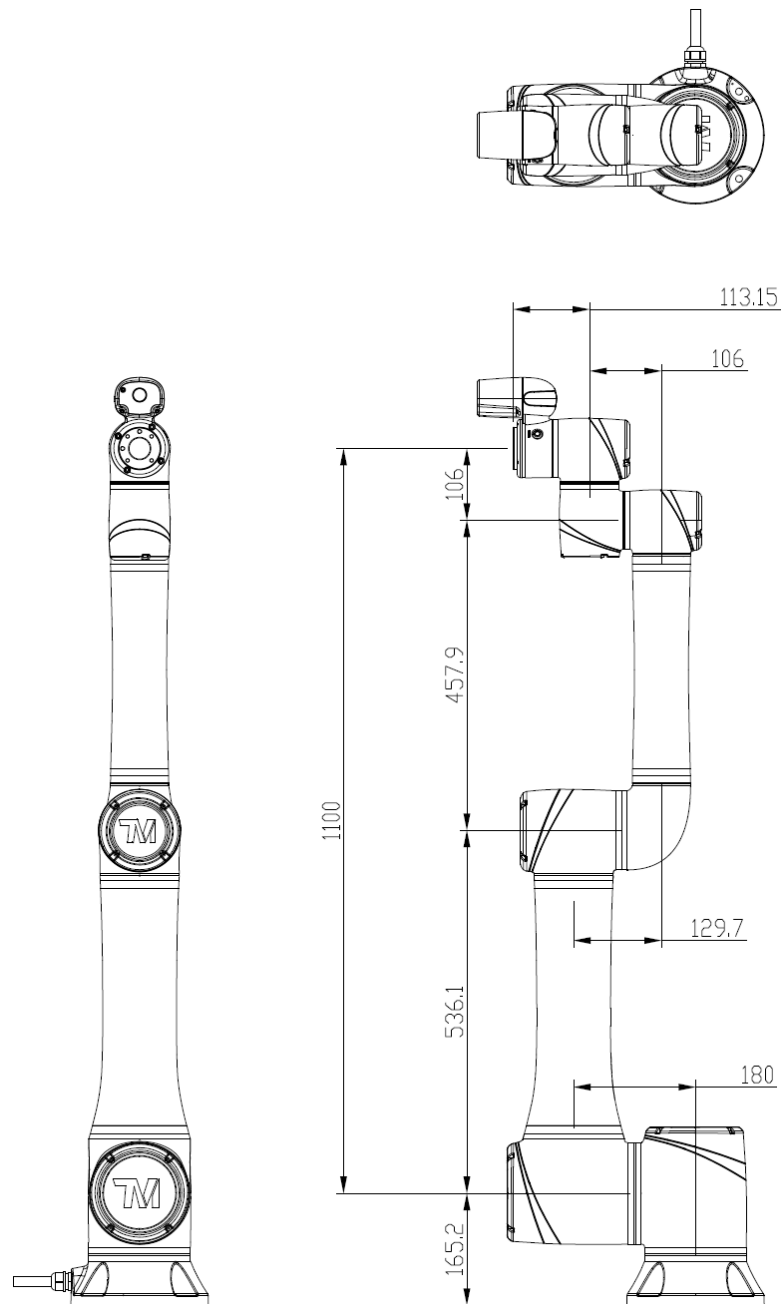
4.2.1 Robot Arm

4.2.1.1 Three-view Diagram of Robot

Shown below is the three-view diagram of the robot



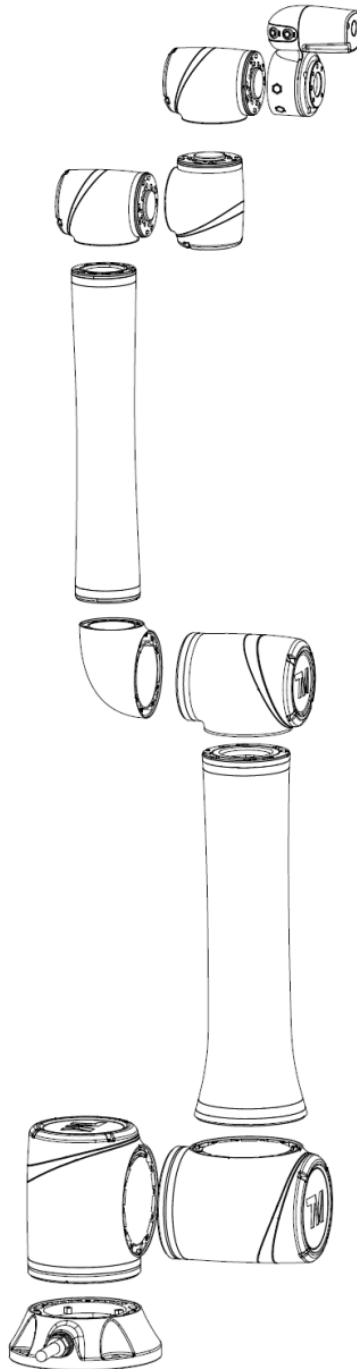
TM12 / TM12M



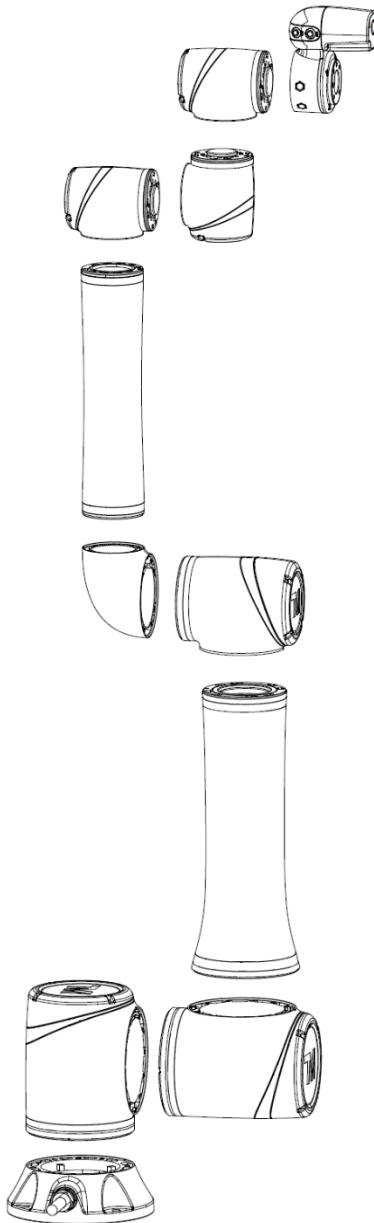
TM14 / TM14M

4.2.1.2 Robot Assembly Diagram

Shown below is an illustration of the robot components. To avoid safety risks, please do not attempt to disassemble any component on your own. Please contact your local corporation support for any service request.



TM12 / TM12M



TM14 / TM14M

4.2.1.3 Robot Range of Motion

TM12 series working range is a spherical space with a 1300 mm radius at the base (for TM14 series, it is a 1100 mm radius). Due to the limitations of configuration, try to avoid moving the center of the tool to the cylindrical space directly below and above the base.

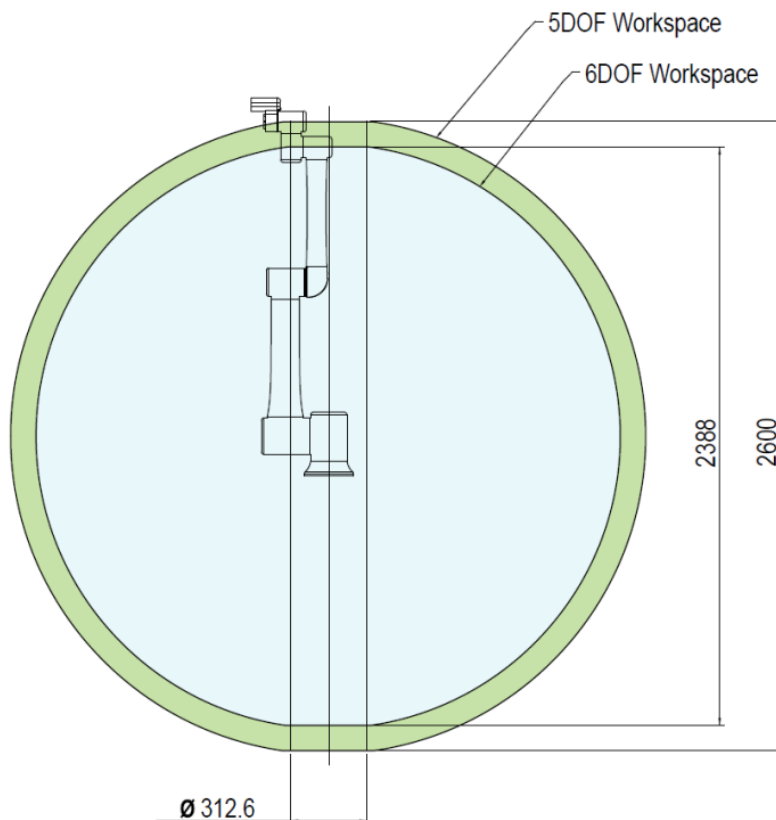


DANGER:

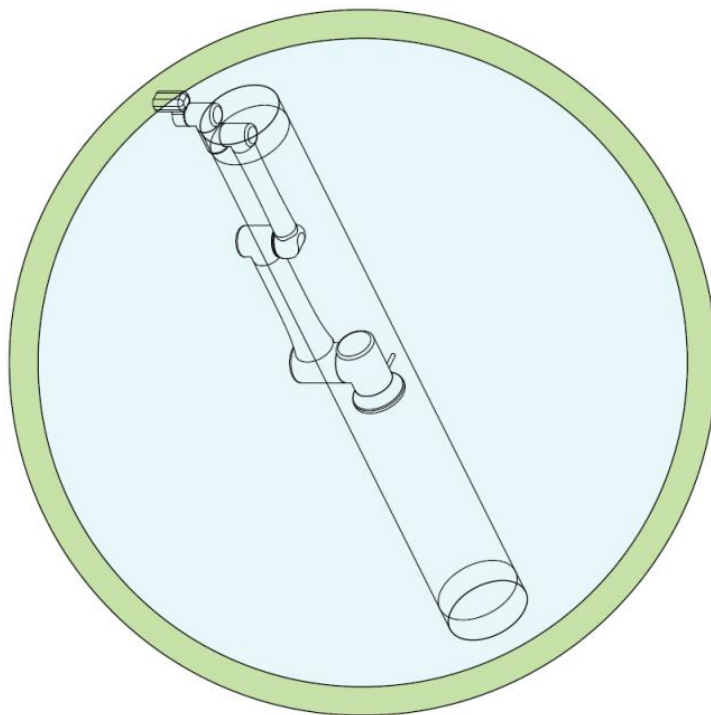
In addition to Hand Guide Mode, for correct operating positions, the user should stay outside of the motion range of the robot to perform operations. At least one emergency switch is installed outside of the motion range of the robot. When no motion limit is set for the robot, the motion range of the robot is equal to the maximum motion range of the robot arm. You can set a motion limit to avoid the situation whereby all operations have to be out of the maximum motion range of the robot arm.

The robot stick should be placed in an area that the robot cannot reach. The user should also make sure that the movement of the robot will not be within any area where personnel will enter to press any buttons on the robot stick.

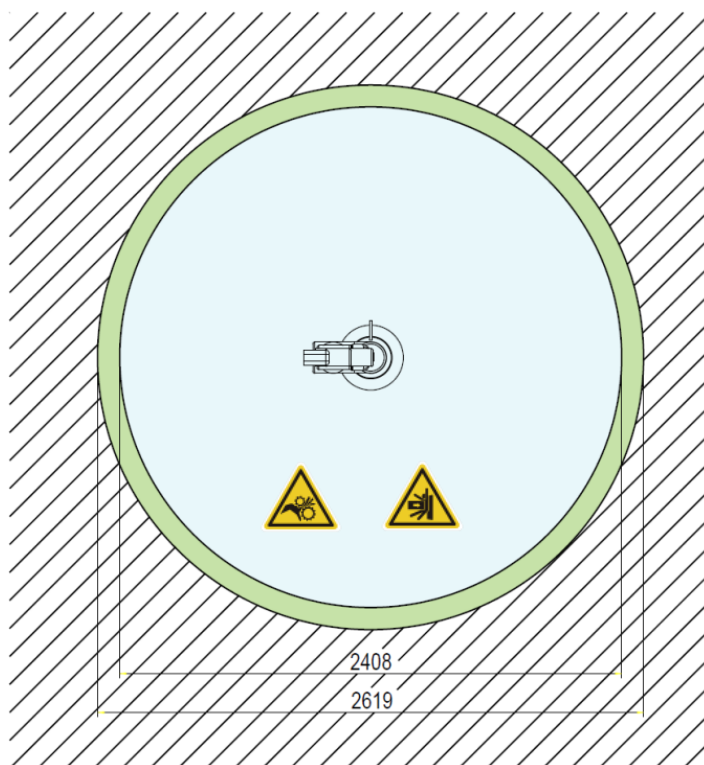
TM12 / TM12M Movement Range Diagram



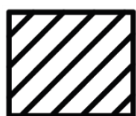
Side View



Pictorial view



Top View



Operator Position

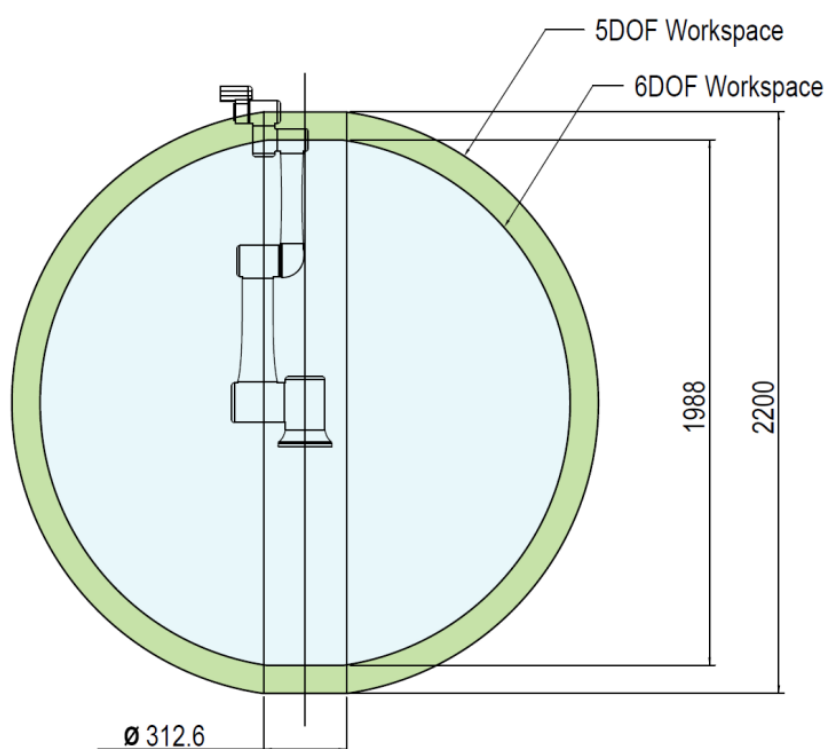


Warning: Risk of crushing within the operating area of the arm.

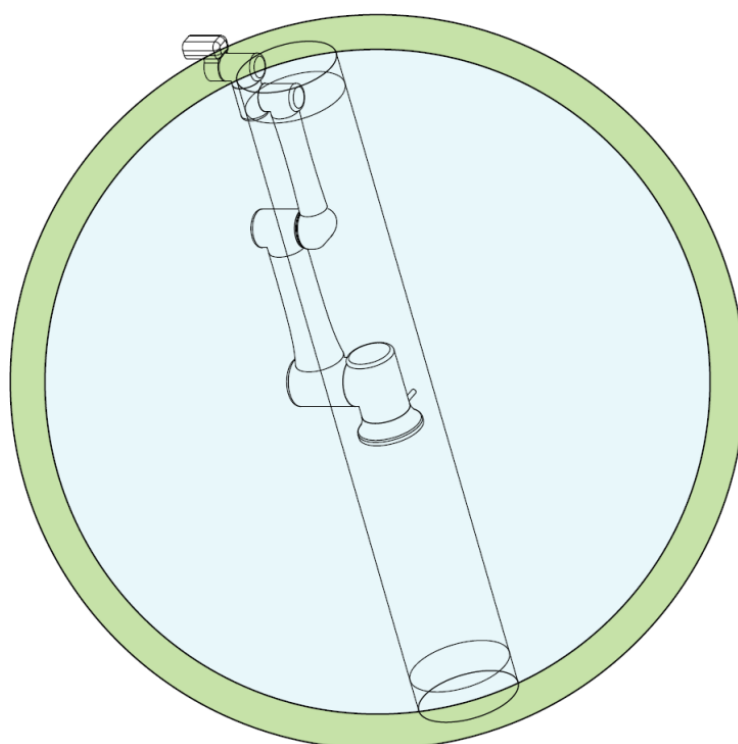


Warning: Risk of collision within the operating area of the arm.

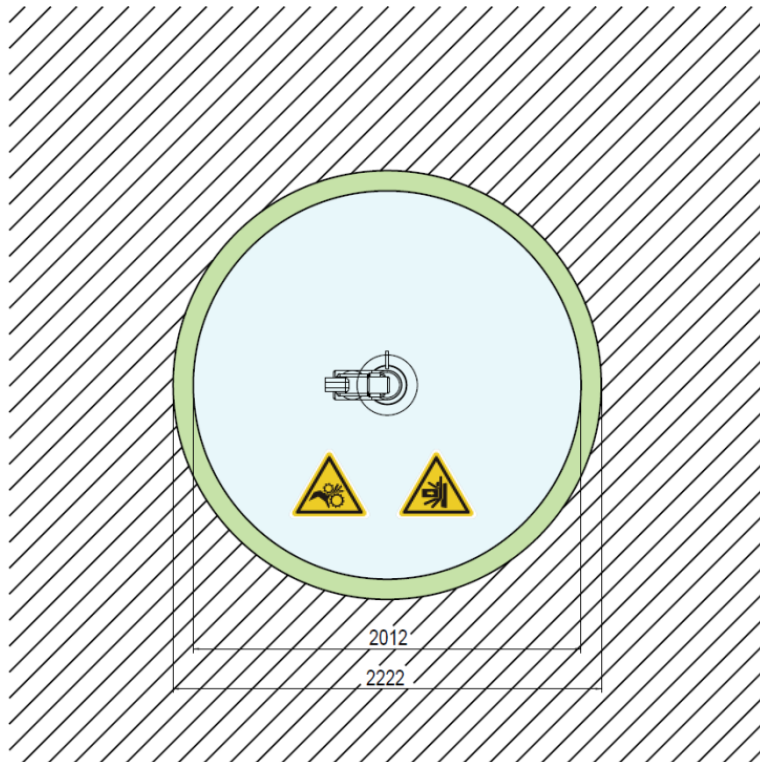
TM14 / TM14M Movement Range Diagram



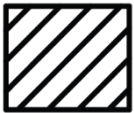
Side View



Pictorial view



Top View



Operator Position



Warning: Risk of crushing within the operating area of the arm.

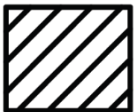
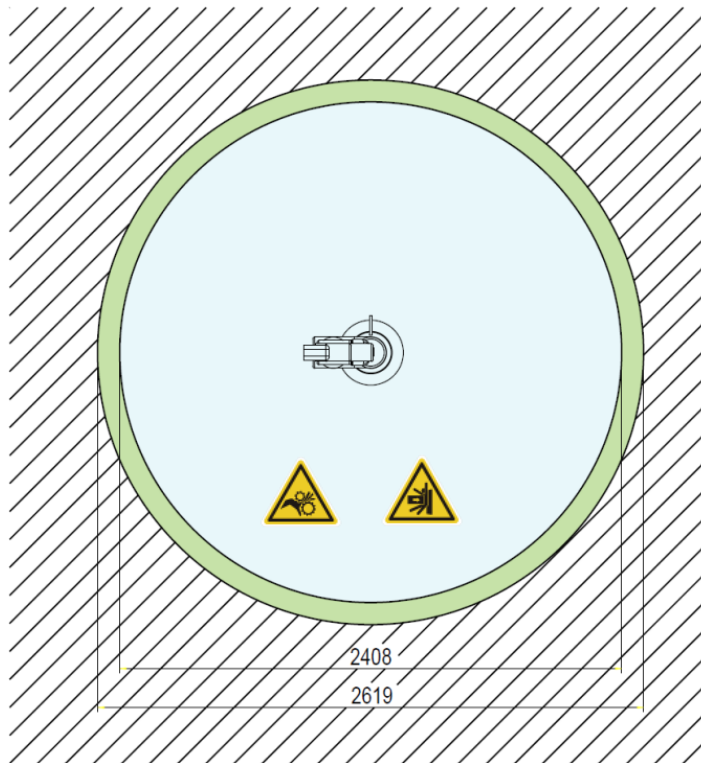


Warning: Risk of collision within the operating area of the arm.

4.2.1.4 Robot Hazard Zone Diagram and Operator Position Diagram

Shown below is an illustration of the robot hazard zone and operator position diagrams. Do not operate the robot while anyone is inside of the hazard zone to avoid safety risks.

TM12 / TM12M



Operator Position

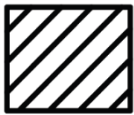
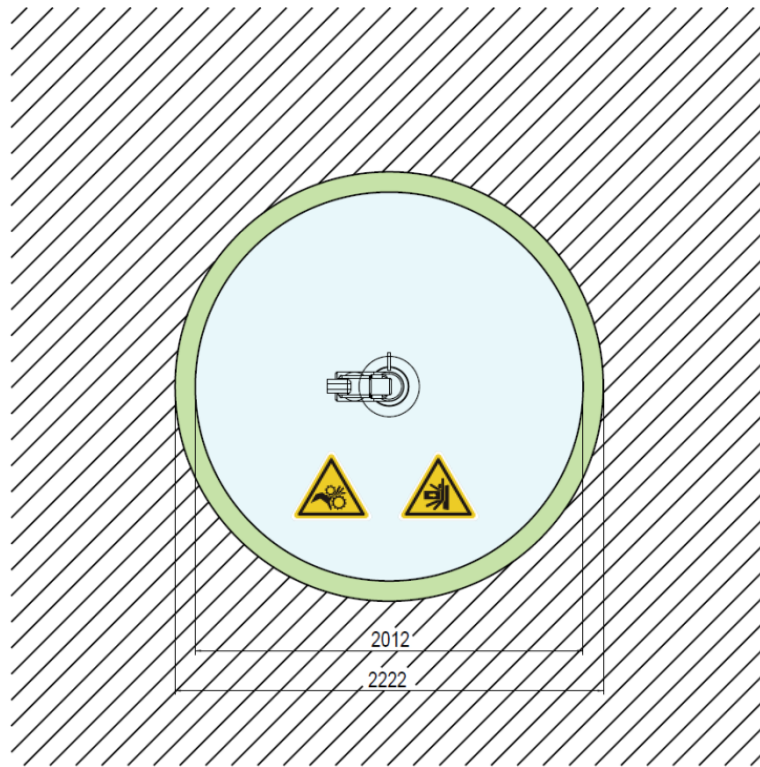


Warning: Risk of crushing within the operating area of the arm.



Warning: Risk of collision within the operating area of the arm.

TM14 / TM14M



Operator Position



Warning: Risk of crushing within the operating area of the arm.



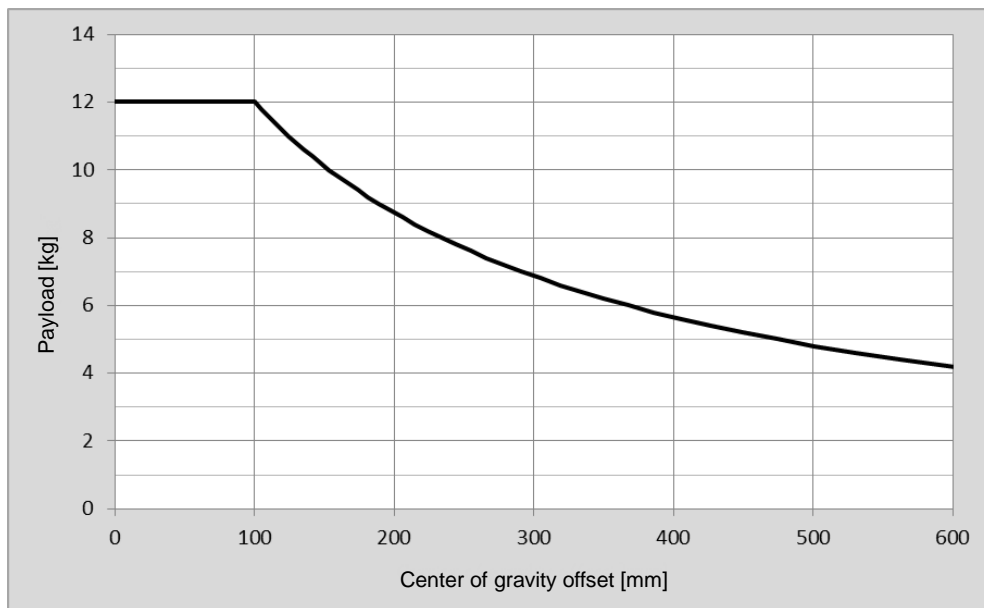
Warning: Risk of collision within the operating area of the arm.

4.2.1.5 Robot Arm Maximum Payload

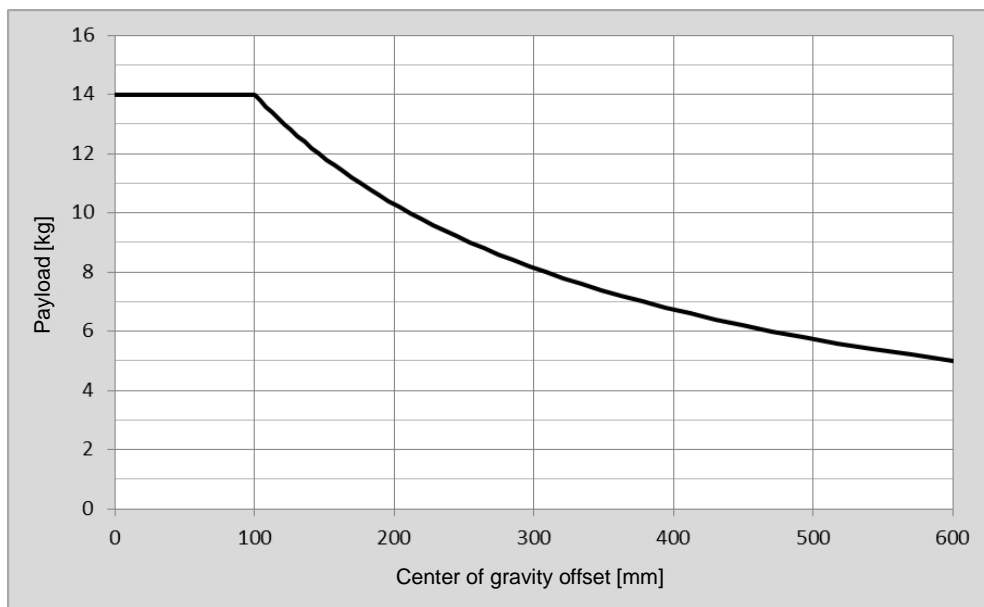
The maximum allowed payload of the robot arm is related to its center of gravity offset, which is defined as the distance from the center point of tool flange to the payload's center of gravity.

The following figure shows the relationship between payload and the center of gravity offset:

TM12 / TM12M



TM14 / TM14M



**WARNING:**

Use the total weight of the end-effector and the payload to stay within the payload rating of the robot. Ensure that the system never exceeds that maximum payload. You should perform a full risk assessment that includes the end-effector and payload samples, to ensure the safety of the entire system.

4.2.1.6 Robot Arm Installation

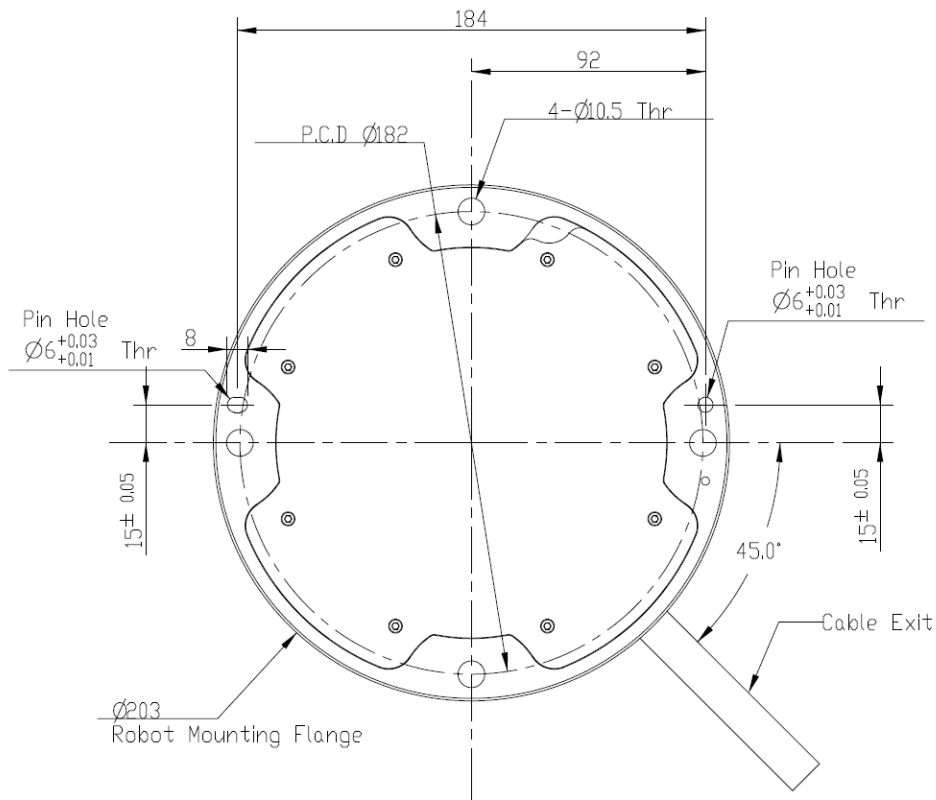
The TM12 / TM14 series is secured by four holes on the base and four M10 screws with washers. A tightening torque of 40 Nm (can be adjusted based on the strength of the screws used) is recommended. If your application requires more precision, you can use two positioning pins with a diameter of 6 mm for a more secure mounting.

**DANGER:**

1. The TM Robot must be securely and tightly screwed down before use. The strength of the mounting surface must be sufficient.

When operating at high speed, the robot can generate up to 710 N reaction force to the mounting surface and screws. In order to avoid decreased performance caused by robot slip or vibration, the recommended mounting surface should be a steel plate at least 25 mm thick, its flatness should be 0.1 mm or less, its surface roughness should be Rz25 or less. The recommended screw should be M10 x L35 mm, at least 8.8 strength.

2. Do not immerse TM Robot in water. Installation in the water or a humid environment will permanently damage the robot.

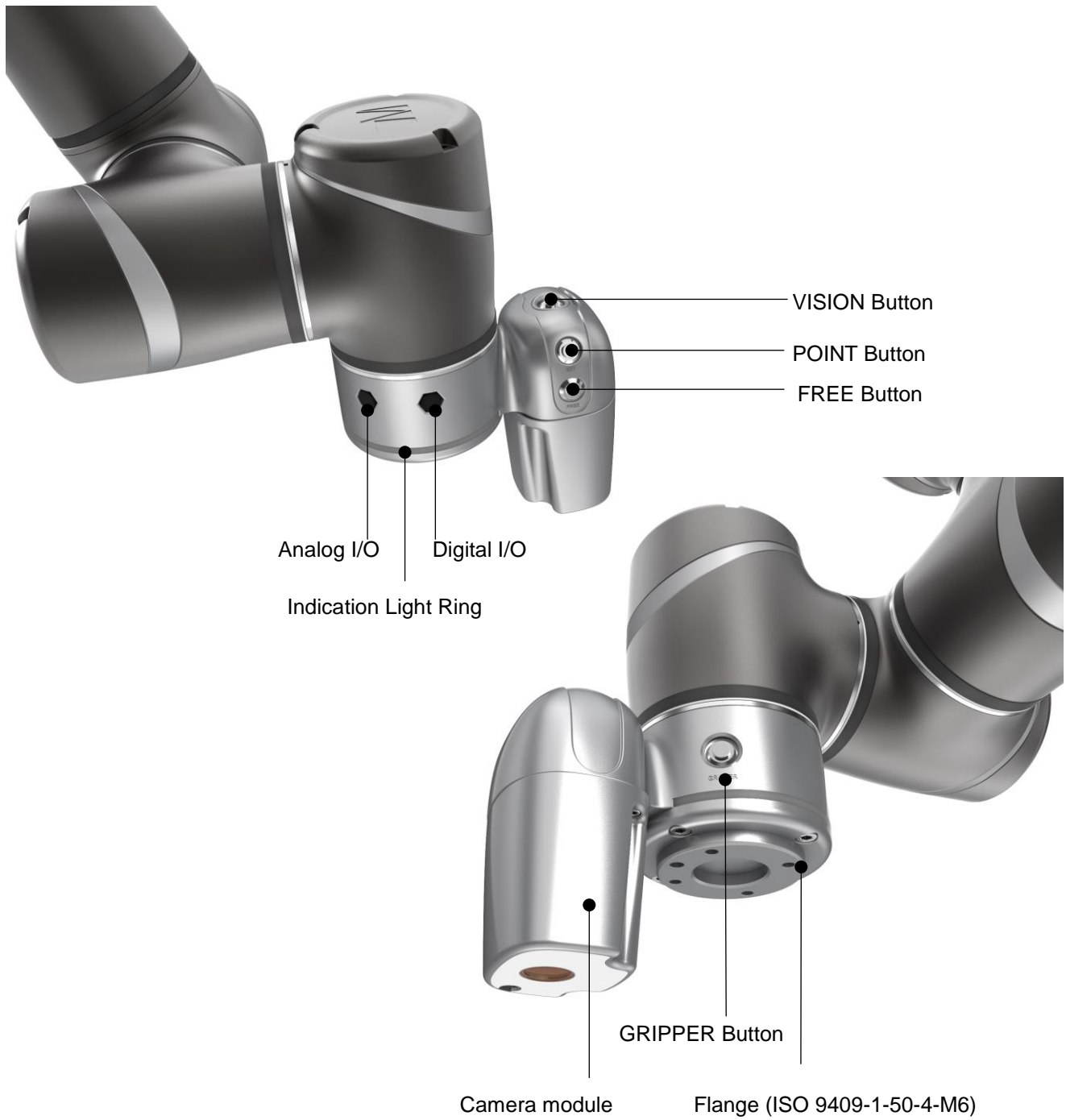


BOTTOM VIEW OF ROBOT BASE

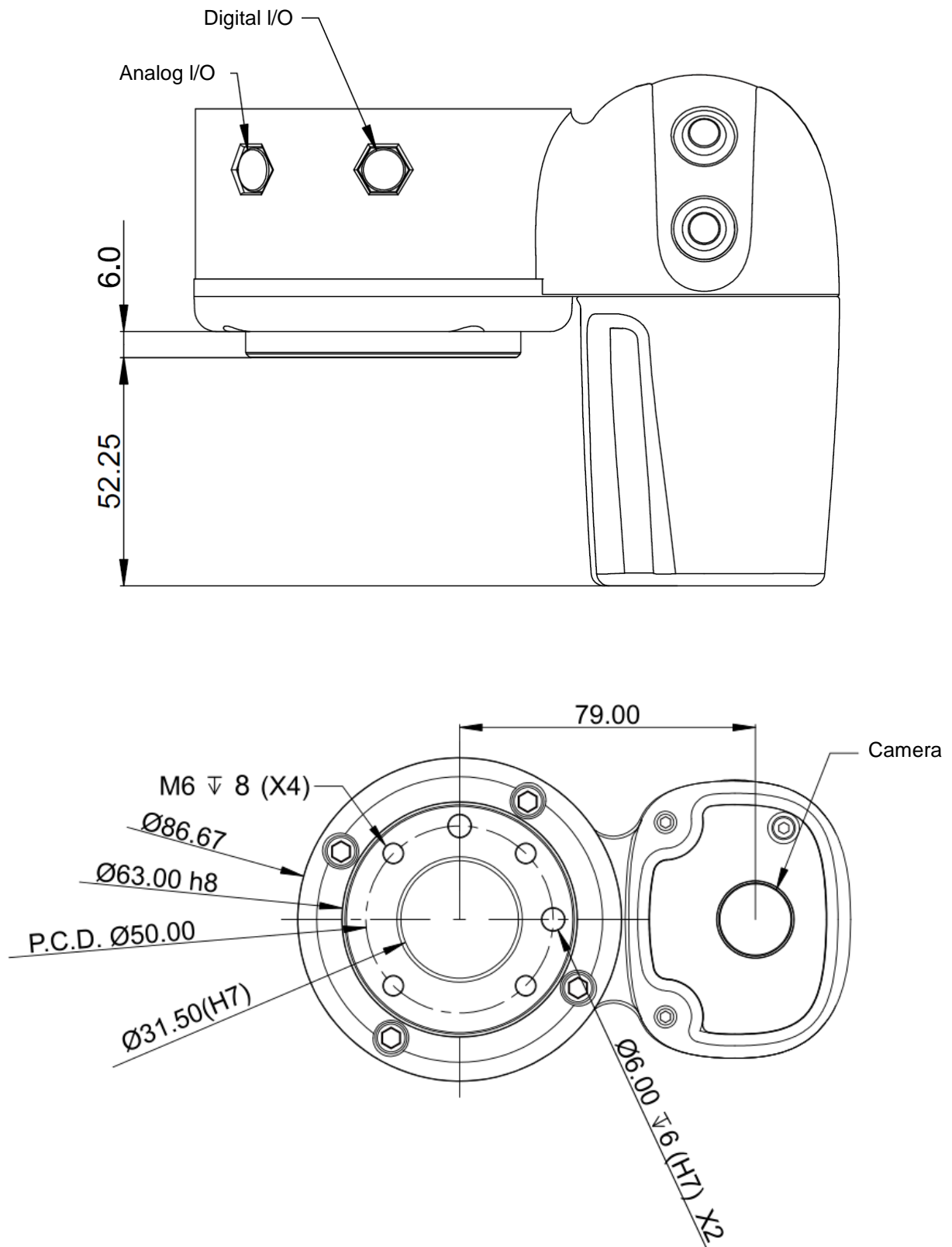
4.2.2 Robot End Module

4.2.2.1 End Module Components

TM12 / TM12M / TM14 / TM14M End Module Components



4.2.2.2 End Flange Surface



4.2.2.3 End Mounting Caution

The TM12 / TM14 series uses four M6 threaded holes on the end flange and four M6 screws for mounting tools. A tightening torque of 9 Nm is recommended. If your application requires higher precision, you can use two positioning pins with a diameter of 6 mm for a more secure mounting.

**DANGER:**

Tools must be properly tightened when using this product. Improper tightening may cause the tool or part to fall out, or even cause personal injury and death.

4.2.2.4 End Indication Light Ring Table

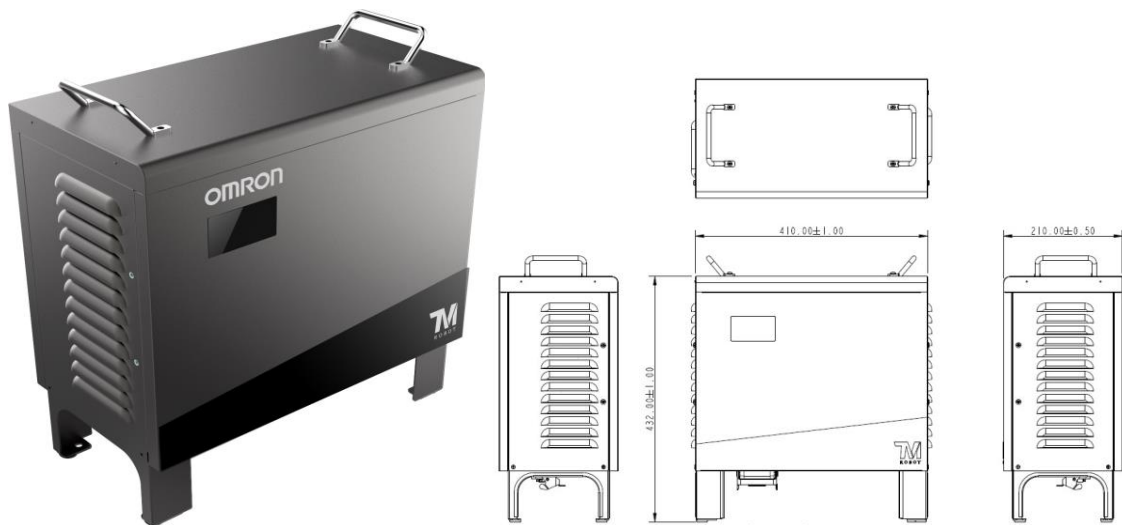
The Indication Light Ring of the TM Robot has several colors which represent different modes and error statuses. Refer to the following table:

Color/Blinking	Description	Troubleshooting
Solid green light	Standby status in Manual Mode (Manual Control mode)	Not Applicable
Flashing green light	Project running in Manual Mode (Trial Run mode)	Not Applicable
Short Flashing Green light	Project paused in Manual Mode.	Not Applicable
Alternating between Green/Red light (with 2 beeps from buzzer)	Manual Mode Error	Press the FREE Button to troubleshoot the error.
Solid blue light	Standby status in Auto Mode	Not Applicable
Flashing blue light	Project running in Auto Mode	Not Applicable
Short Flashing Blue light	Project paused in Auto Mode	Not Applicable
Alternating between Blue/Red light (with 2 beeps from buzzer)	Auto Mode Error	After switching to Manual Mode, press the FREE Button to troubleshoot.
Light blue light	Safe Start up Mode	Press Stop Button for 3 seconds to return to original Mode
Flashing red light	Robot is initializing.	Not Applicable
Light off	Emergency stop pressed	Release the Emergency Switch to turn to Safe Start up Mode
Solid red light Buzzer emits a long beep	Fatal error	Shutdown and Restart required

When the user sets the safety space and the robot moves into the safety space, the robot will enter the collaborative mode. At this time, the purple light will be added which represent different modes, Please refer to the following table for the definition of each status. When the collaborative mode triggers an error state, the indication light will return to the original mode. Please refer to the above table for troubleshooting.

Mode	Standby/Running	Space	Color/Blinking
Manual Mode	Standby status	Full speed Space	Solid green light
		Collaboration Space	Alternating between Green(9)/ Purple(1)
		Stop Space	Alternating between Green/ Red
	Project running	Full speed Space	Flash green light
		Collaboration Space	Alternating between Purple/ Red
		Stop Space	Alternating between Green/ Red
Auto Mode	Standby status	Full speed Space	Solid blue light
		Collaboration Space	Alternating between Blue(9)/ Purple(1)
		Stop Space	Alternating between Blue/ Red
	Project running	Full speed Space	Flash blue light
		Collaboration Space	Alternating between Purple/ Red
		Stop Space	Alternating between Blue/ Red

4.2.3 Control Box

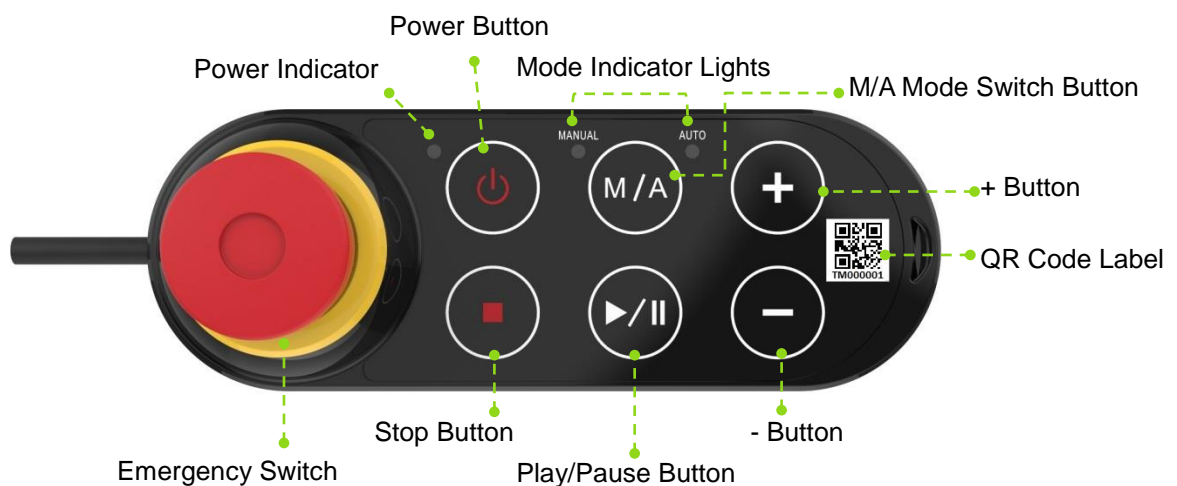


CAUTION:

The control box can be placed on the floor or in your working cell. Note that 5cm clearance should be left at both sides for air flow.

4.2.3.1 Robot Stick

The Robot Stick has 6 function buttons, 3 indicator lights, 1 Emergency Switch, and 1 QR-code. Their functions are as follow:



CAUTION:

When operating the robot stick, do not use other objects than fingers to press the robot stick.

Items	Basic Function
Emergency Switch	Default emergency button for the robot
Power Button	Bootup (single press)/ Shutdown (long press)
M/A Mode Switch Button	Toggle Manual/Auto Mode (single press). See Safety Manual for details.
Play/Pause Button	Play/Pause Project
Stop Button	Press this button to stop any project.
+ - Button	Adjust project speed (single press) under Manual Trial Run Mode. See Safety Manual for details.
Power Indicator	This indicator shows the robot's power status. Not on: Switched off Flashing: Booting Constant: Startup completed
Mode Indicator Lights	One is Manual Mode, the other one is Auto Mode. They show the robot's current operating mode. Once boot up is complete only one will always be on.
QR Code Label	The content of the SSID is also the robot's name in TCP/IP network.

Some of the function buttons offer the following advanced functions:

Items	Advanced Function
Emergency Switch	- Press and then release, wait for 3 seconds to enter Safe Start up mode. - Press and then release to enter Safe Start up mode while booting.
Play/Pause Button	Play/pause visual calibration operation (single press)
Stop Button	Stop visual calibration operation (single press)
+ - Button	- Hold to jog the robot at the HMI robot controller page (Hold to Run). See Safety Manual for details. - Lock/ Unlock: hold down both add and subtract until the mode indicator flashes, then follow the sequence "-", "+", "-", "+" to lock/unlock the Robot Stick (except the Power Button)

**CAUTION:**

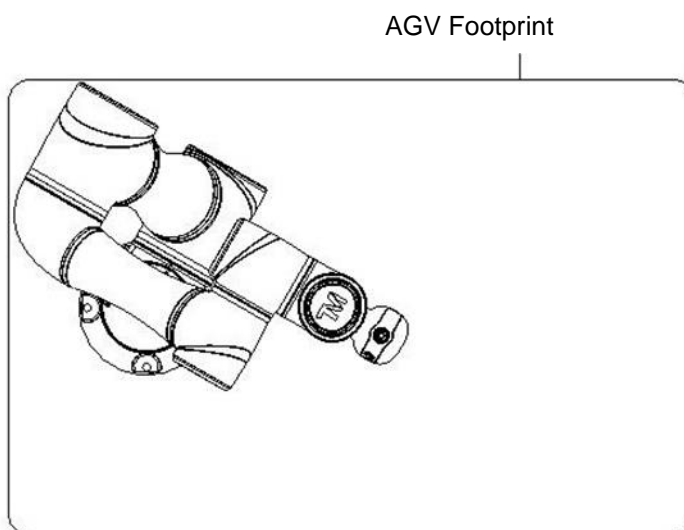
The robot stick is magnetic so that it can be attached to steel surfaces. However, the risk of falling or rotating caused by poor attachment should be taken into account. We recommend using the Techman Robot Stick Stand (official accessory) to secure the robot stick. The Robot Stick Stand should be fixed with screws. Always attach the robot stick when it is not in use. The robot stick should be placed in a way such that the signal cables are routed to avoid damage caused by pulling.

**DANGER:**

1. The control box, cables, power signal cables, and robot stick cannot be used when any of them is in contact with liquids. This may result in personal injury or death.
2. The control box has an IP32 rating but should still is not recommended to be used in dusty and humid environments. Particular attention should be paid to environments with conductive dust (such as metal particles).
3. Be noted that the control box can only be at standing pose to have IP32 rating.

4.3 Operating Position of TM Robot with AGV

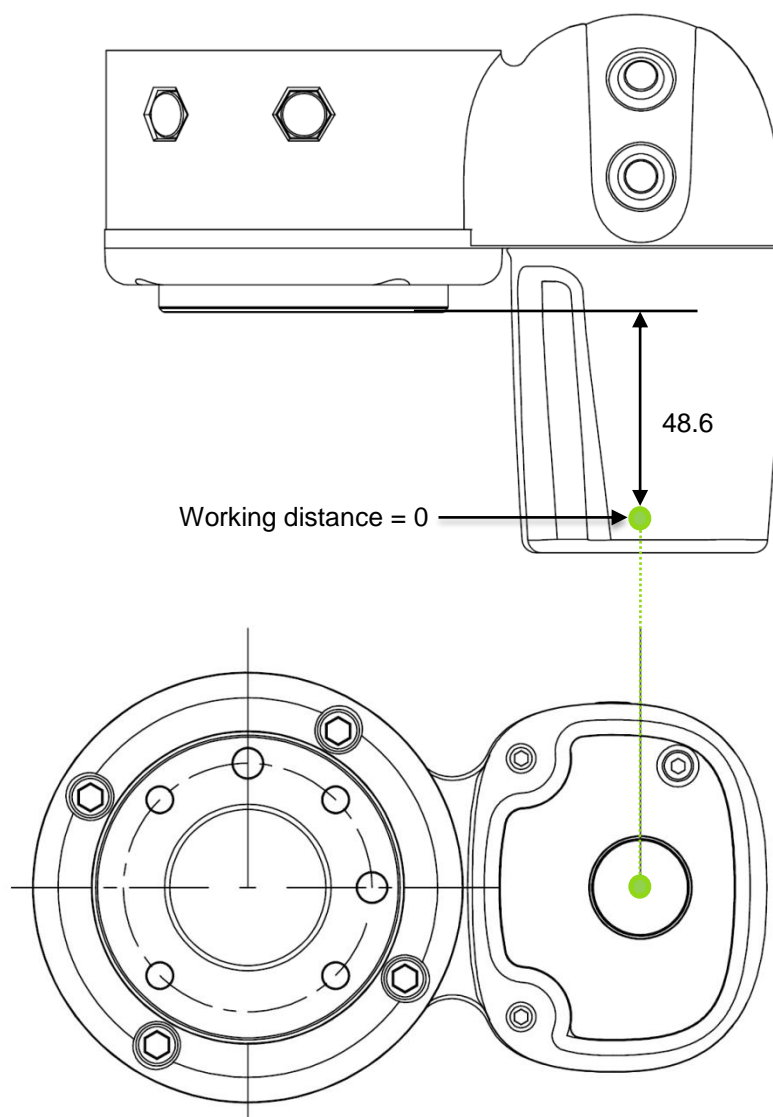
When TM Robot is placed on an AGV and while the AGV is in operation, the user should pause the TM Robot and the TM Robot itself should not exceed the footprint of the AGV.



Top view of TM Robot placed on the AGV

4.4 Working distance and field of view of TM Robot's EIH camera

The field of view of TM Robot's EIH camera varies linearly in accordance with the working distance. The minimum working distance is about 100 mm and the maximum working distance is about 300 mm. The zero working distance point is approximately 49 mm in front of the flange surface and right behind the center of the protection lens.



The relation between the working distance and the field of view is listed below,

Working distance(mm) Field of view(mm)	300	100
Width	281.6	96.9
Height	211.2	72.7

5. Electrical Interface

5.1 Overview

This chapter introduces all electrical interfaces of the robot arm and control box.

5.2 Electrical Warnings and Cautions

The application design and installation of the robot should comply with the following warnings.



DANGER:

1. Ensure all pieces of the equipment are kept dry. If water enters the equipment, disconnect the power and contact your supplier.
2. Only use the original cables included with the robot. If you need longer cables, contact your supplier.
3. Ensure that the robot is properly grounded. If the grounding is not correct, it may cause a fire or electric shock.



WARNING:

The I/O cables used for the link between the control box and other equipment should not be longer than 30 meters, unless testing shows that longer cables are feasible.

5.3 Control Box



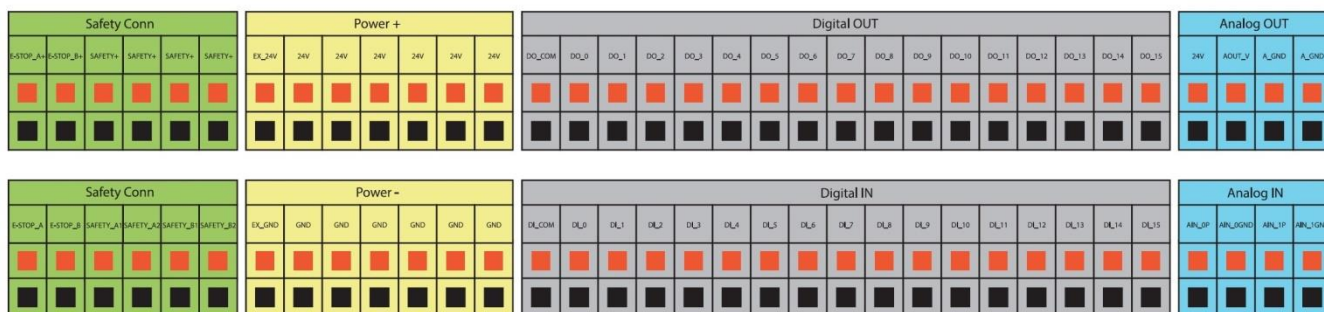
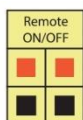
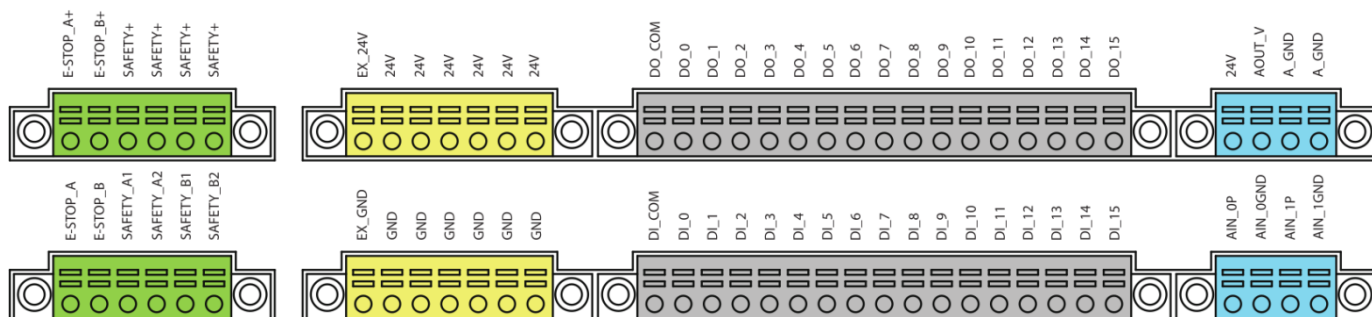
WARNING:

Except for USB ports, other interfaces have to be installed while arm is powered off. Do not install while arm is on to avoid abnormal shutdown.

Control Box I/O configuration



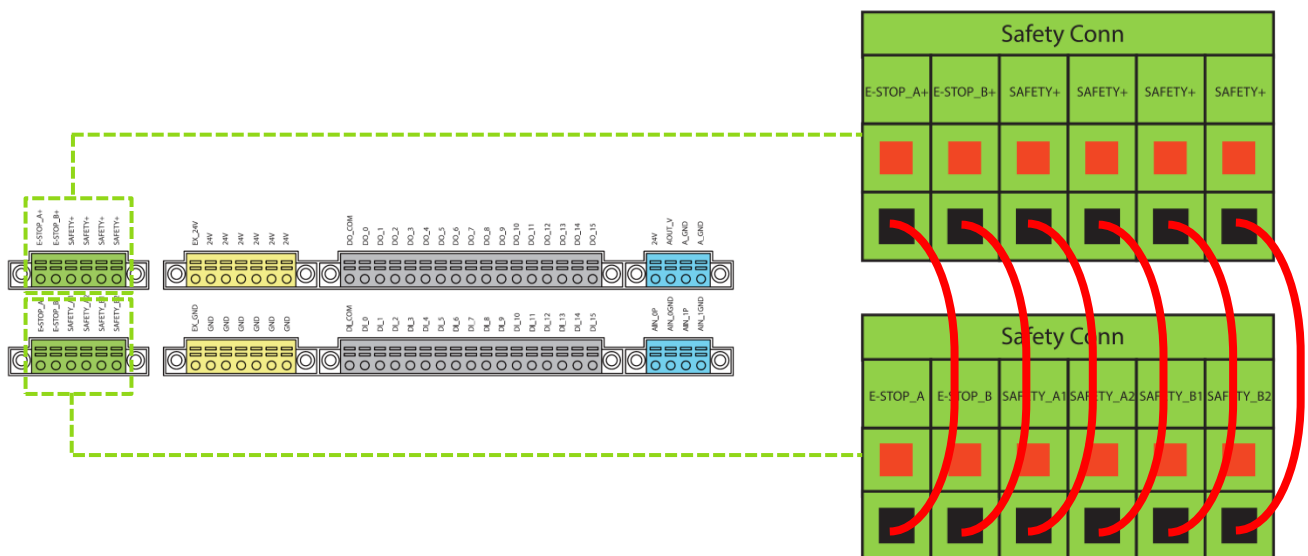
REMOTE ON/OFF



5.3.1 Safety Connector

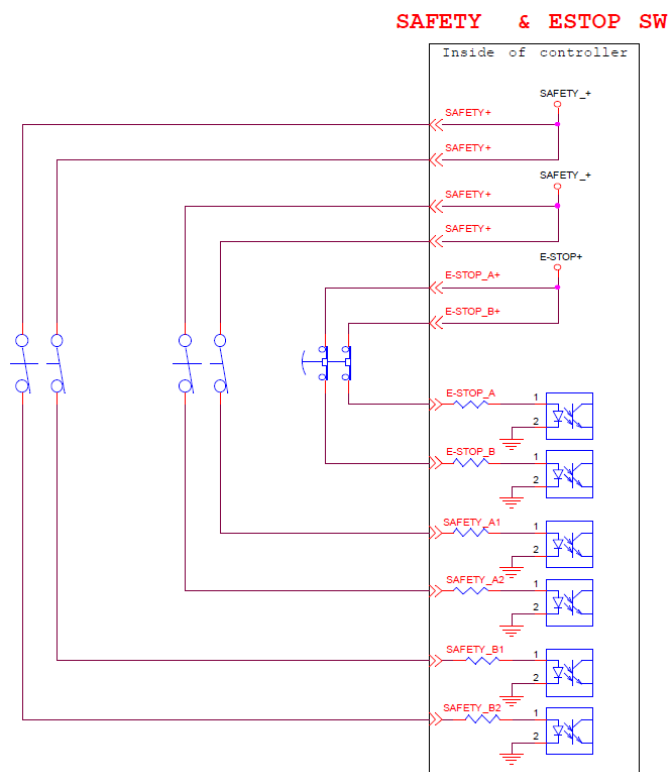
Provides extension ports for Emergency Stop (ESTOP) & Safeguard Port.

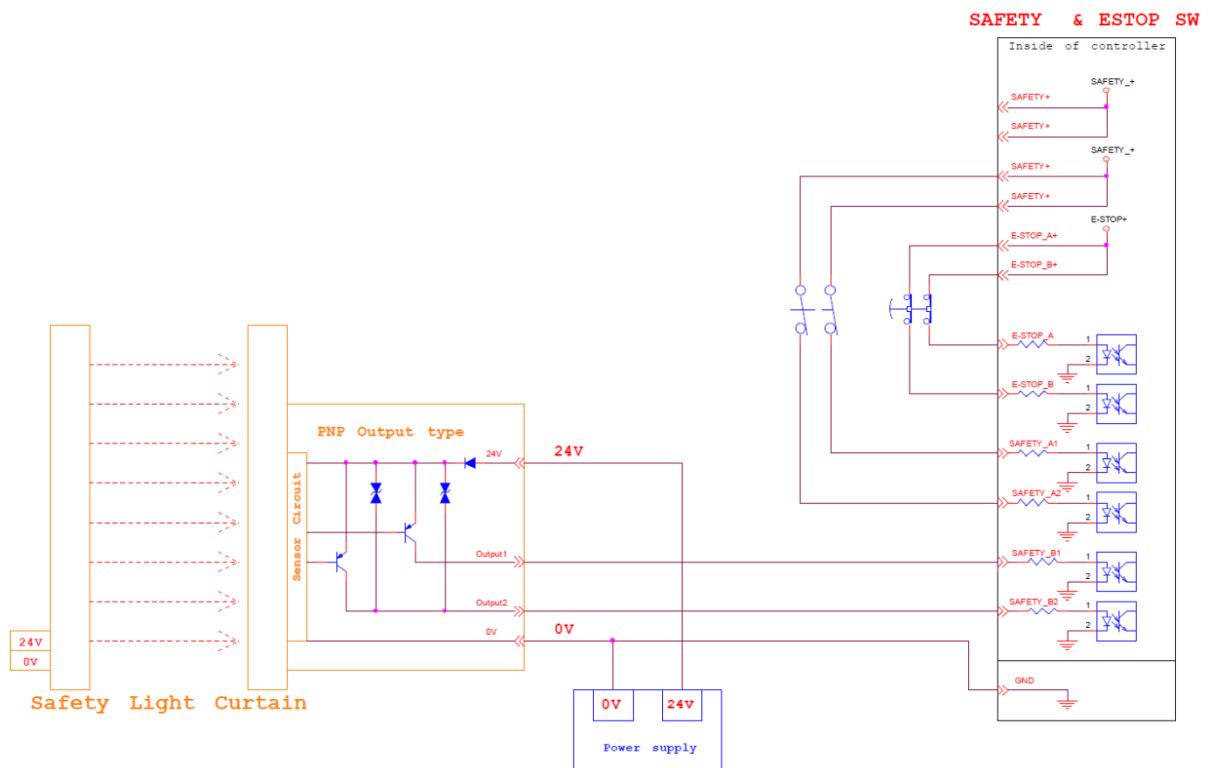
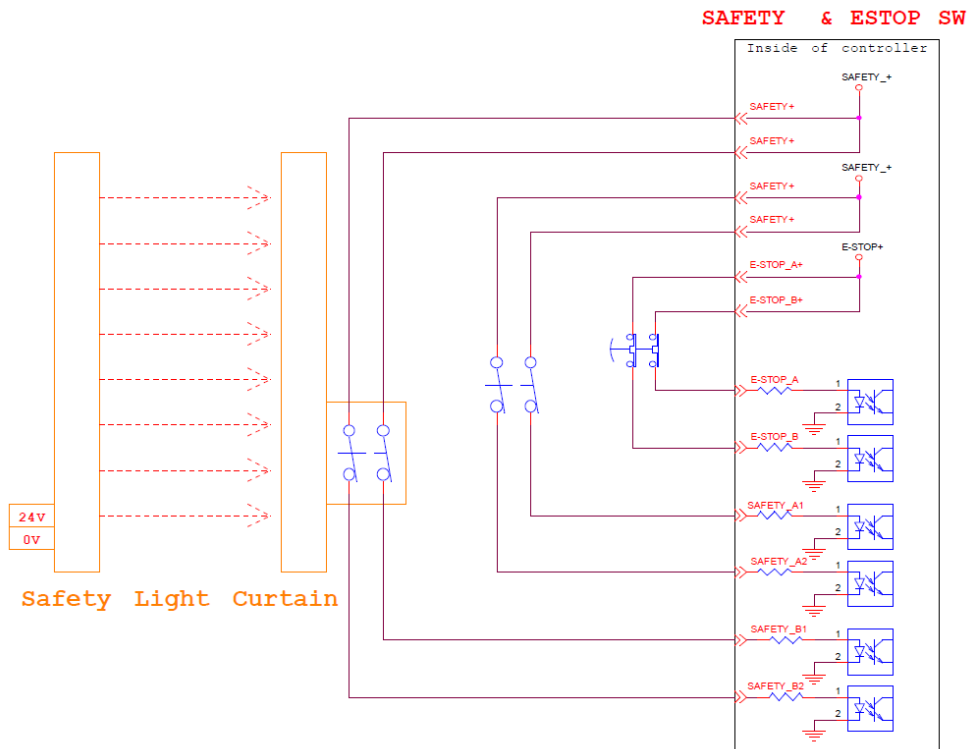
1. ESTOP is a N.C. contact (Normally closed). When any connected ESTOP switch is OPEN, the robot enters the Emergency STOP state.
2. Safeguard A Port is a N.C. contact (Normally closed). When Safety A switch is OPEN, the robot enters the Safeguard Pause state.
3. Safeguard B Port is a N.C. contact (Normally closed). When Safety B switch is OPEN, the robot enters the Safeguard Collaborative Mode state.



Application settings of the arm safety device

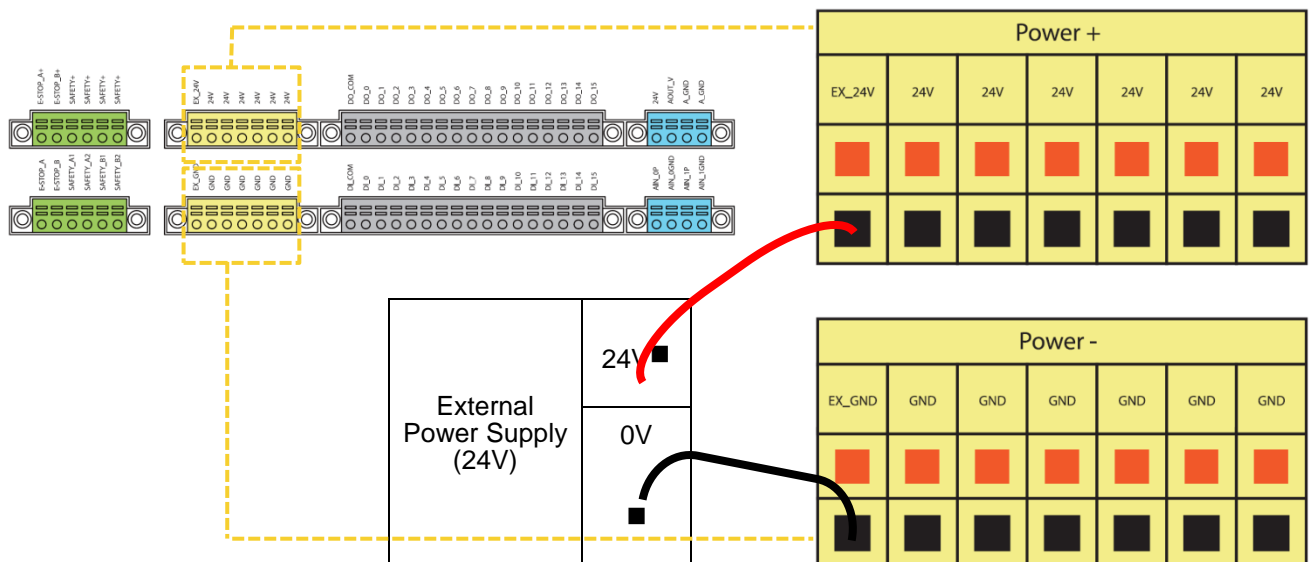
If the safety device is used to work with the safety connectors on the TM Robot, the safety relay can be connected to the safety connector to work as the normally closed switch triggered by the safety device. If direct connection between safety device and safety connector on the TM Robot is preferred, use a safety device with PNP outputs. The PNP outputs can be connected to either “SAFETY_A1 and SAFETY_A2” or “SAFETY_B1 and SAFETY_B2” to trigger the collaborative mode or pause the robot motion. The PNP outputs can also be connected to “ESTOP_A and ESTOP_B” to trigger the emergency stop. The example circuit wiring diagram can be found below.





5.3.2 Power Connector

1. During boot, the control box will check for an external 24V input. If none is found then it will switch to the internal 24V supply.
2. The control box itself offers a 24V1.5A output (24_EX). If the 24V load exceeds 1.5A, it enters Safe Mode and disables the 24V output.
3. EX24V provides an external 24V input port. If the load exceeds 1.5A an external power supply can be used instead. The load on EX24V must not exceed 3.5A.

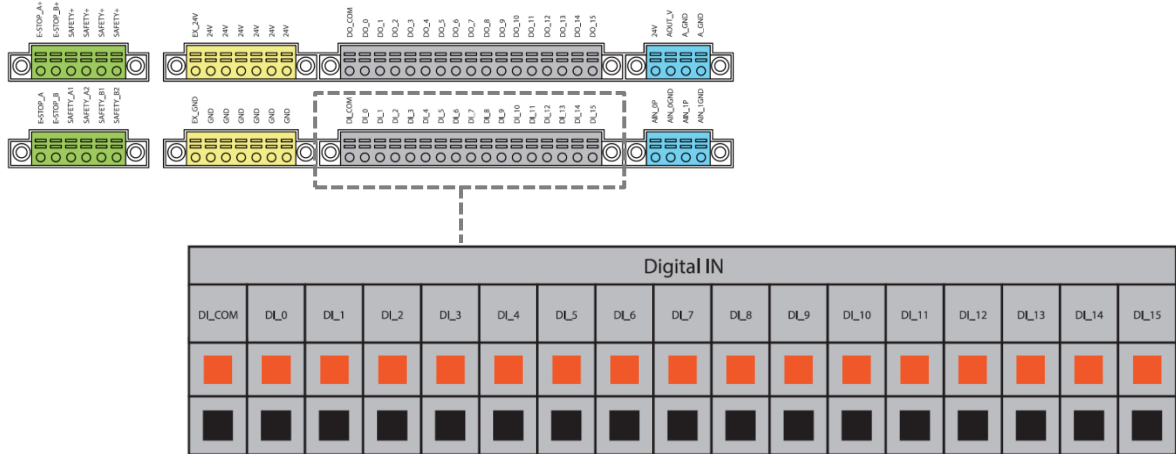


5.3.3 Digital In/Out

Digital input/output each has 16 channels, and its application is connected to the following sections.

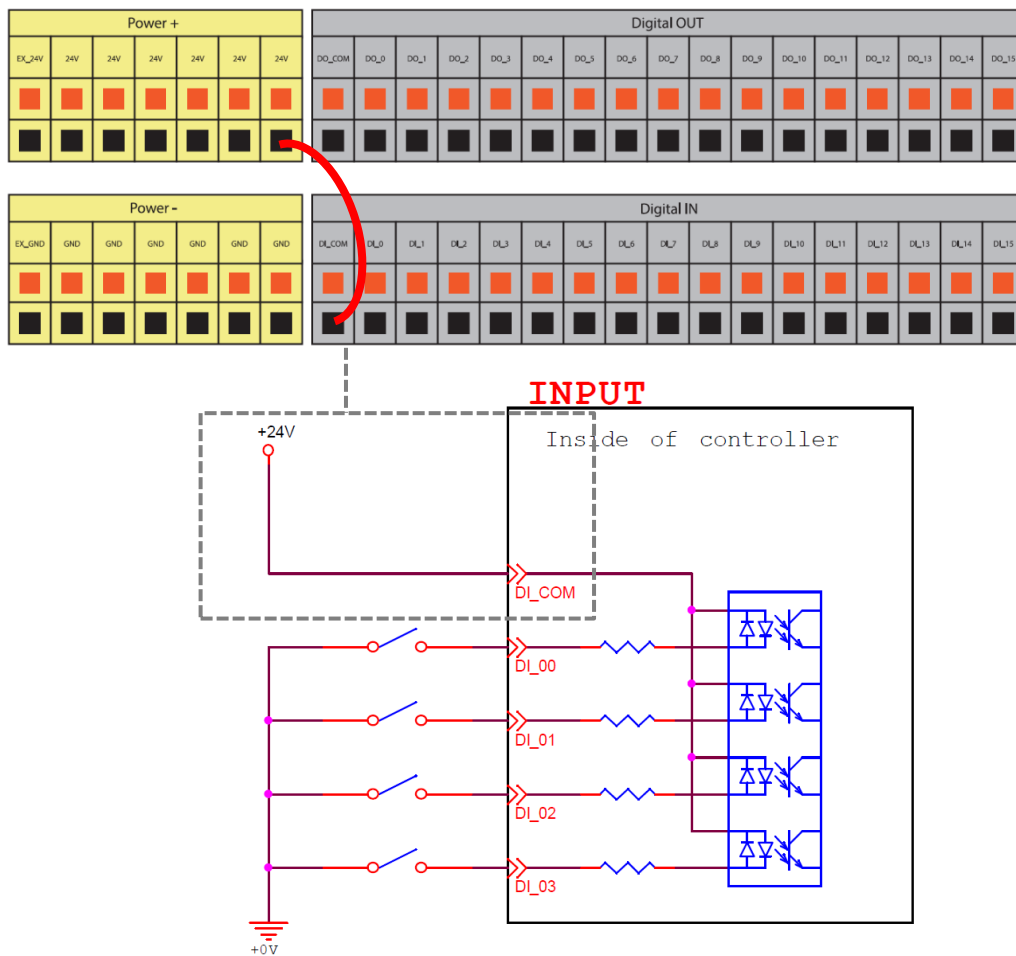
5.3.3.1 Digital Input

Inputs can be set to either sink input or source input by selection.



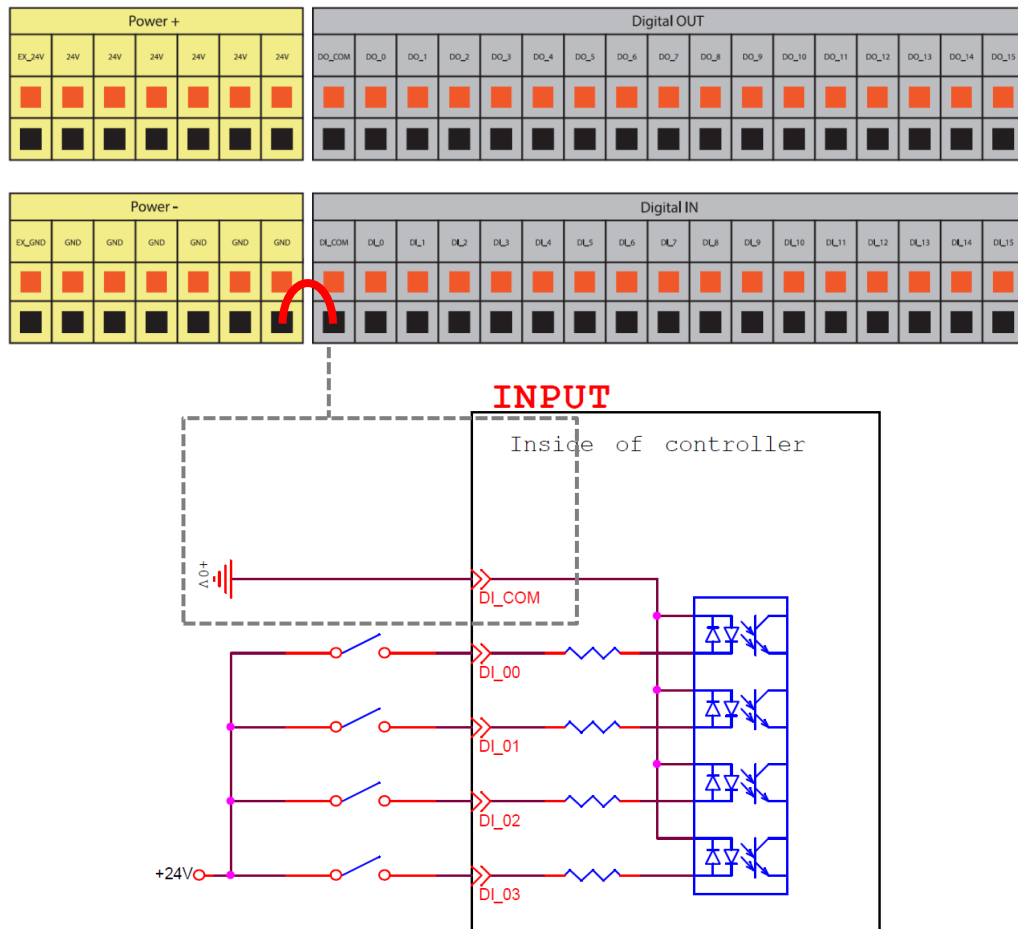
- Set to sink input type

When a device such as a transistor output type sensor is connected, NPN open collector transistor output can be used.



- Set to Source input type

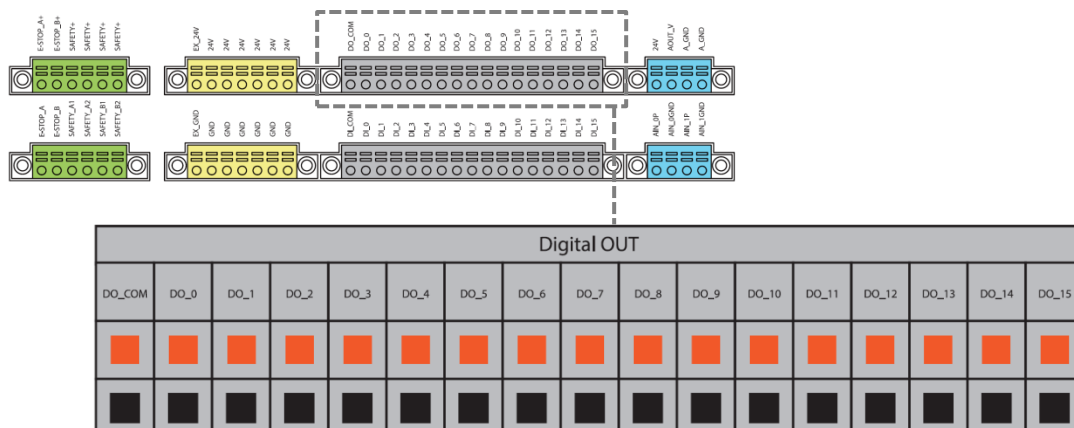
When a device such as a transistor output type sensor is connected, PNP open collector transistor output can be used.



5.3.3.2 Digital Output:

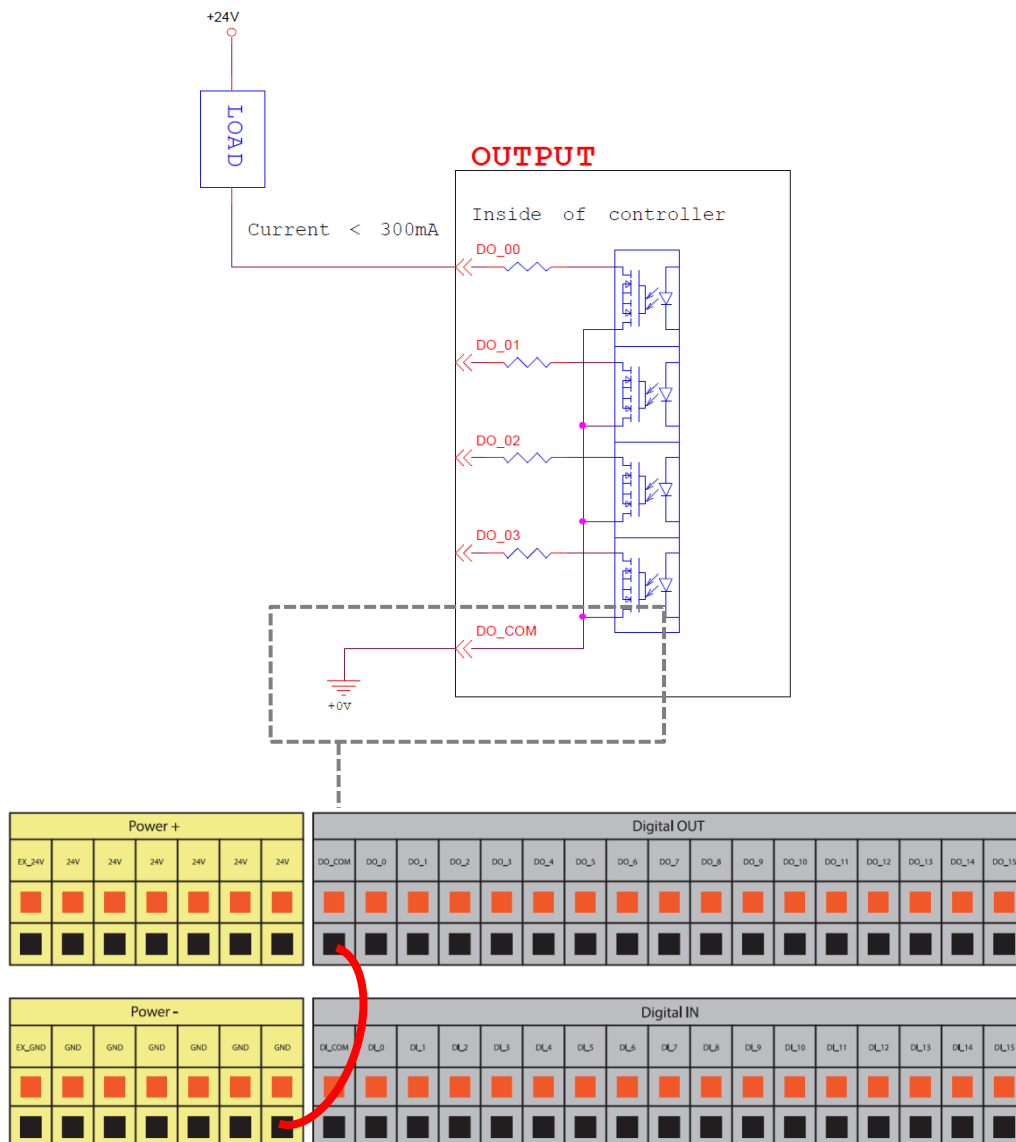
Outputs can be set to either sink output or source output by selection.

The maximum drive current is 300mA per channel. If the load exceeds 300mA, a relay should be used to drive it.



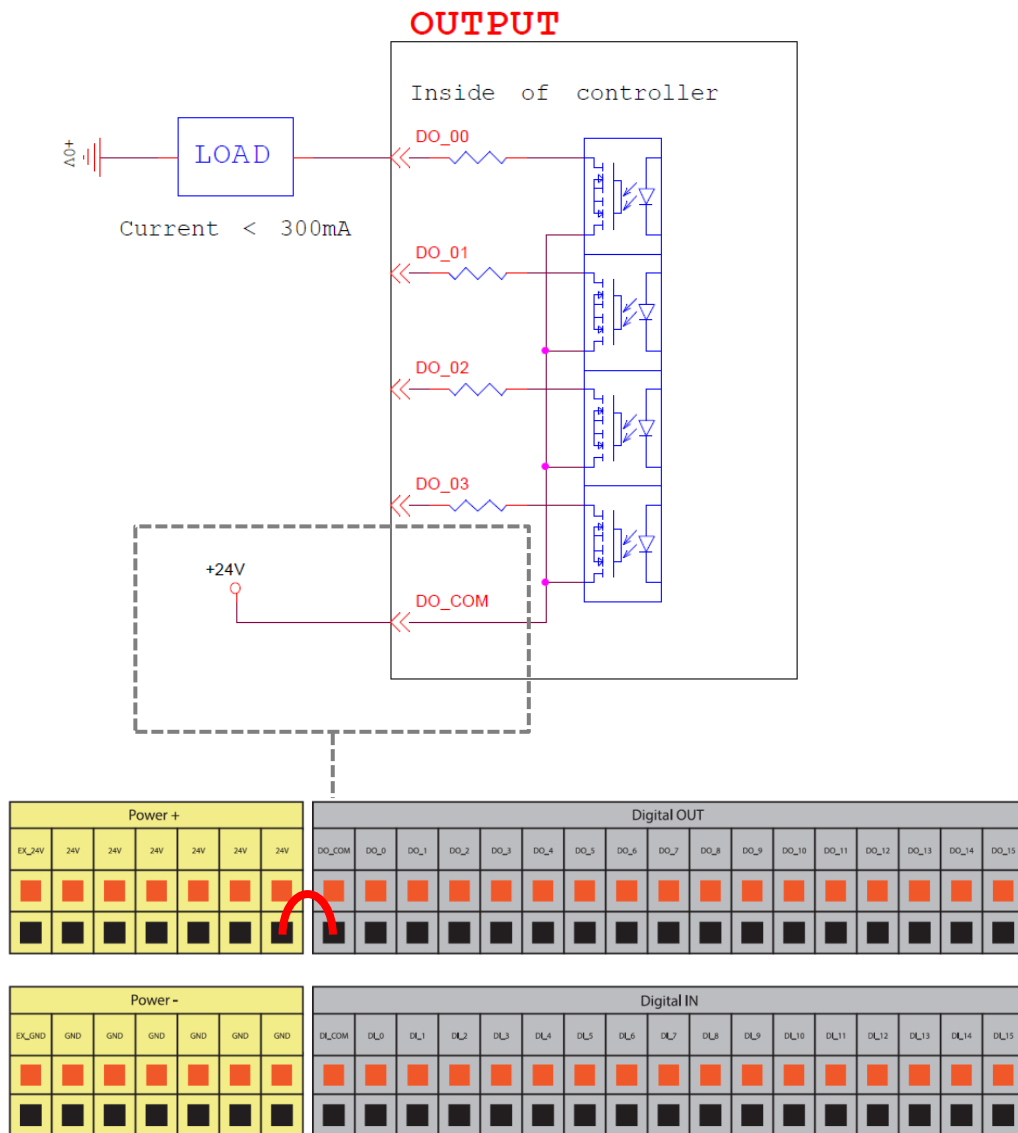
- Set to sink output type.

Connect DO_COM terminal to the minus side of the power supply.



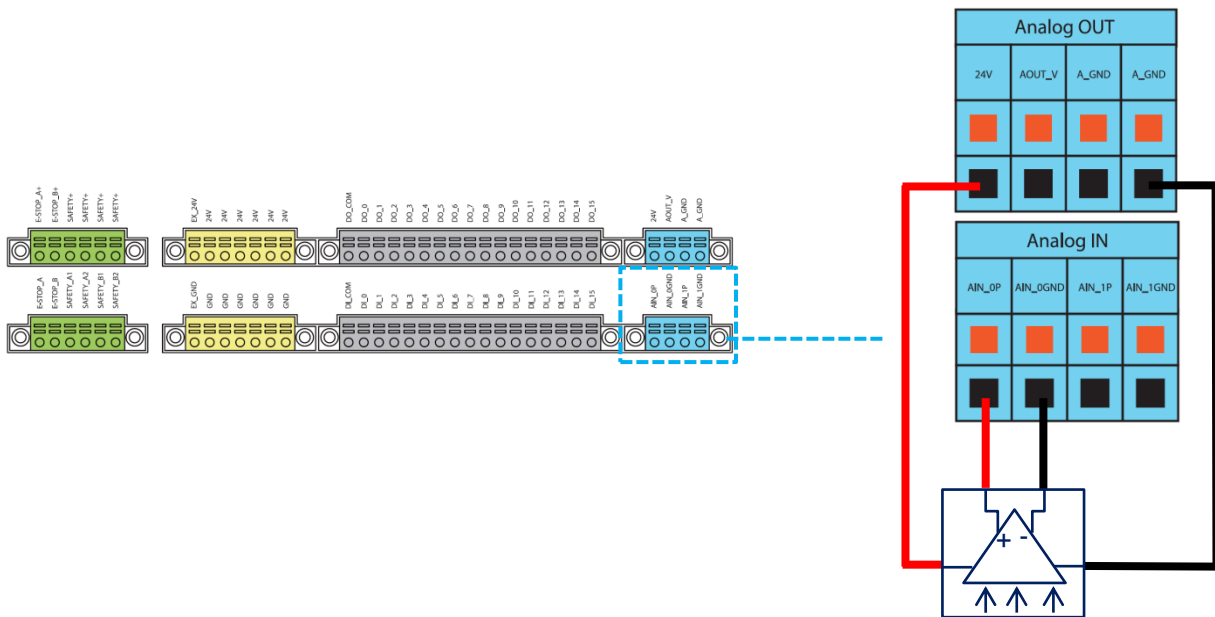
- Set to source output type.

Connect DO_COM terminal to the plus side of the power supply.



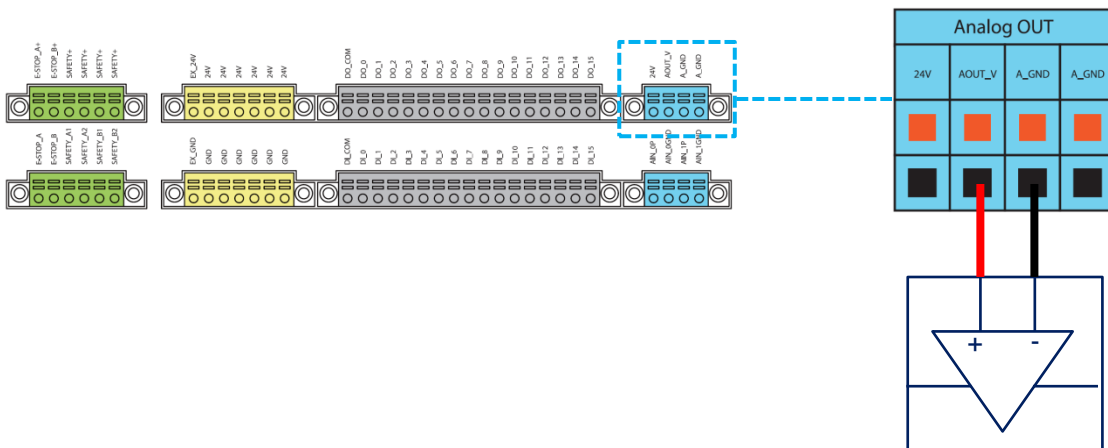
5.3.4 Analog In

Analog In only supports a voltage mode and detection range of -10.00 V ~ +10.00 V.



5.3.5 Analog Out

Analog Out only supports a voltage mode and detection range of -10.00 V ~ +10.00 V.

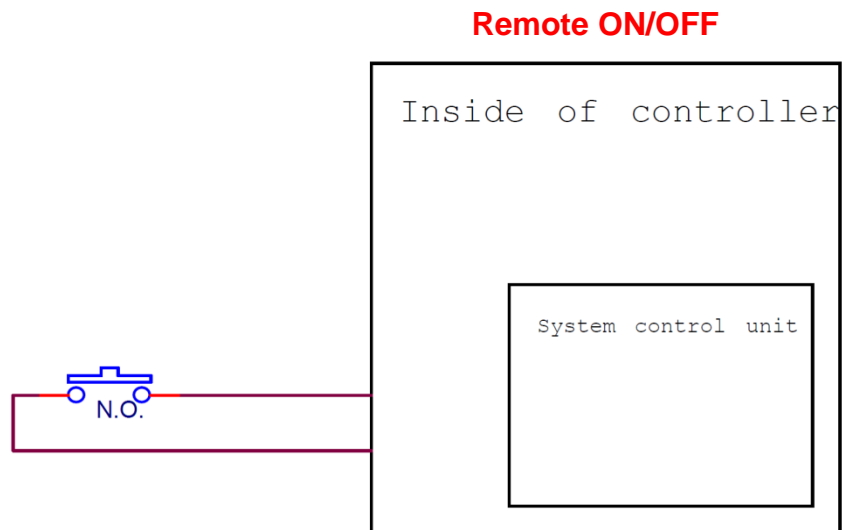


5.3.6 System Remote Power ON/OFF

The function of Remote ON/OFF shares the same functionality of the Robot Stick Power Button.



REMOTE ON/OFF



5.3.7 EtherCAT: For EtherCAT Slave I/O Expansion



WARNING:

The robot must be powered off when installing the EtherCAT Slave. Do not plug or unplug the connector while the robot is on.

5.3.8 USB Port

The USB port of the control box is used for connecting the keyboard, mouse and external storage devices. External storage devices should only be used for the import/export functions of TM Flow. No other device than those listed above should be connected. Please be noted that the external storage device should be named "TMROBT".

5.4 Tool End I/O Interface

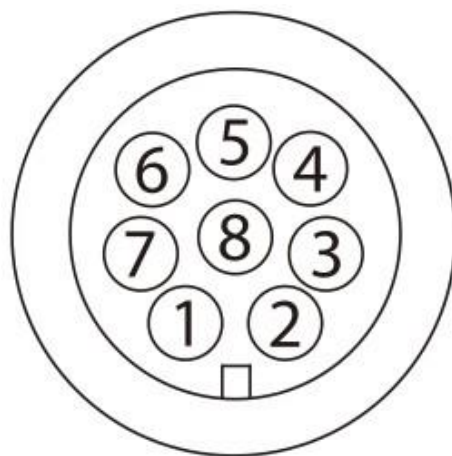
There are two small connectors on the tool end of the robot: a 8-pin connector and a 5-pin connector. The 8-pin connector is for digital I/O. The 5-pin connector is for analog I/O.

5.4.1 I/O Terminals

The tool end 24V has a maximum output current of 1.5A. If overloading, overload protection is activated and the robot will turn off the 24V output power.

8-pin digital I/O connector of Cable

Pin	Wire color	Pin define	
1	Brown	+24v	24V output
2	Red	DI_0	Digital Input0
3	Orange	DI_1	Digital Input1
4	Yellow	DI_2	Digital Input2
5	Green	DO_0	Digital Output0
6	Blue	DO_1	Digital Output1
7	Purple	DO_2	Digital Output2
8	Black	+0V	+0v



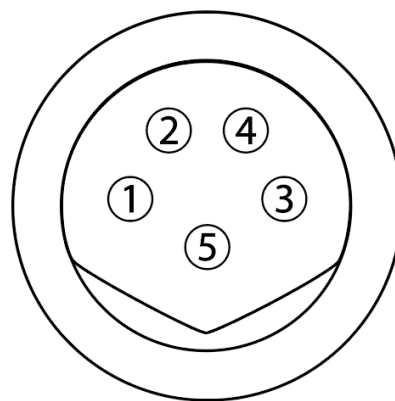
8-pin digital I/O connector of Robot

Pin	Wire Color	Pin Define	
1	Brown	+24v	24V output
2	Red	DI_0	Digital input0
3	Orange	DI_1	Digital input1
4	Yellow	DI_2	Digital input2
5	Green	DO_0	Digital output0
6	Blue	DO_1	Digital output1
7	Purple	DO_2	Digital output2
8	Black	+0V	+0V



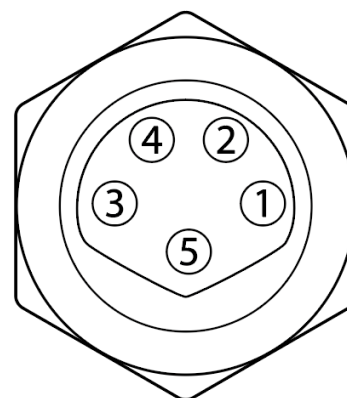
5-pin analog I/O connector of Cable

Pin	Wire Color	Pin Define	
1	Black	+24V	24V output
2	Brown	DI_3	Digital Input3
3	Red	DO_3	Digital Output3
4	Orange	AI Analog	Input
5	Yellow	+0V	GND



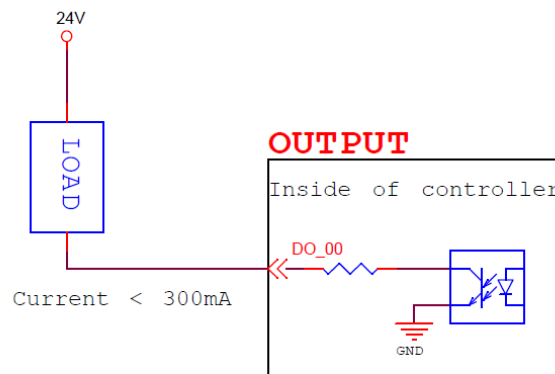
5-pin analog I/O connector of Robot

Pin	Wire Color	Pin Define	
1	Black	+24V	24V output
2	Brown	DI_3	Digital Input3
3	Red	DO_3	Digital Output3
4	Orange	AI Analog	Input
5	Yellow	+0V	GND



5.4.2 Connecting Tool End Digital Output

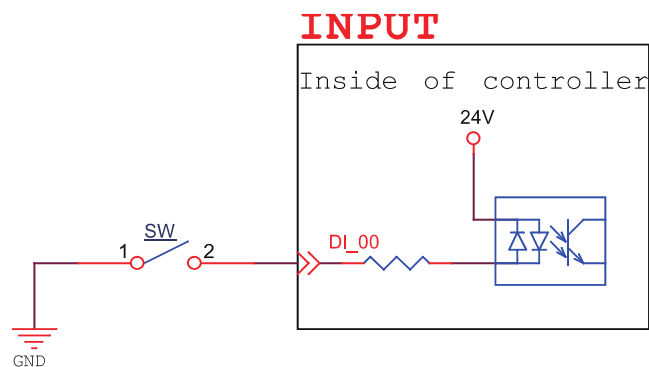
The following figure shows how to connect the tool end digital output:



5.4.3 Connecting Tool End Digital Input

The following figure shows how to connect the tool end digital input:

NOTE: If sensors are connected directly then they should be of the NPN type.

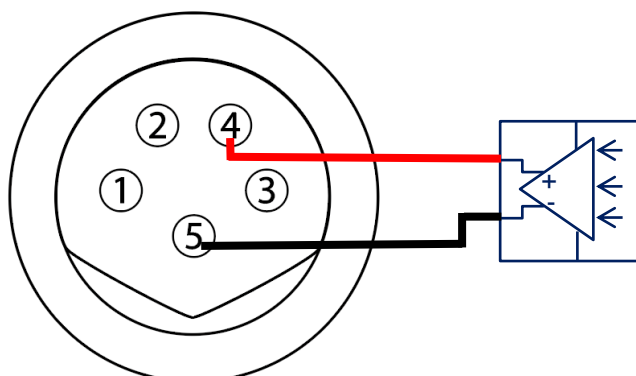


5.4.4 Connecting Tool End Analog Input

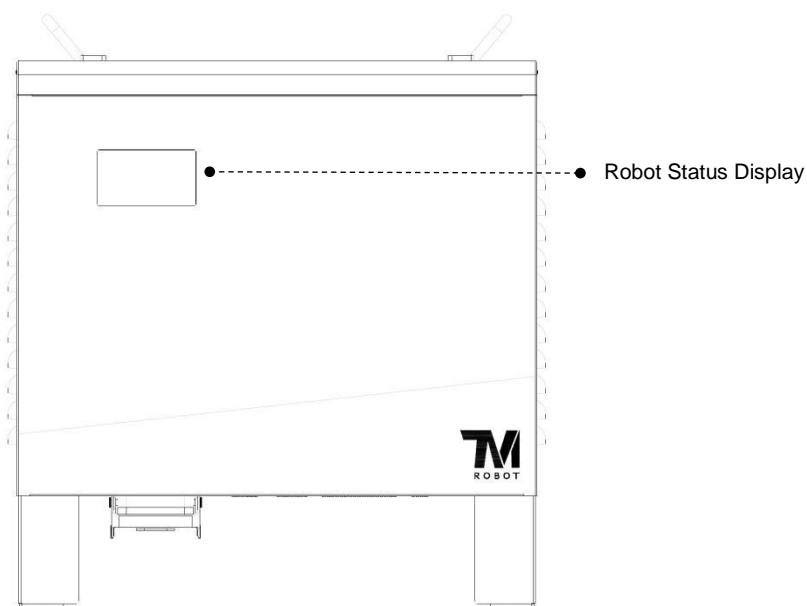
Input range of -10.00 V ~ +10.00 V.

The following figure shows how to connect the tool end Analog input:

(Because AIN_GND is connected to ground, when AIN is a dead contact, a pressure difference will occur, which is a normal phenomenon.)

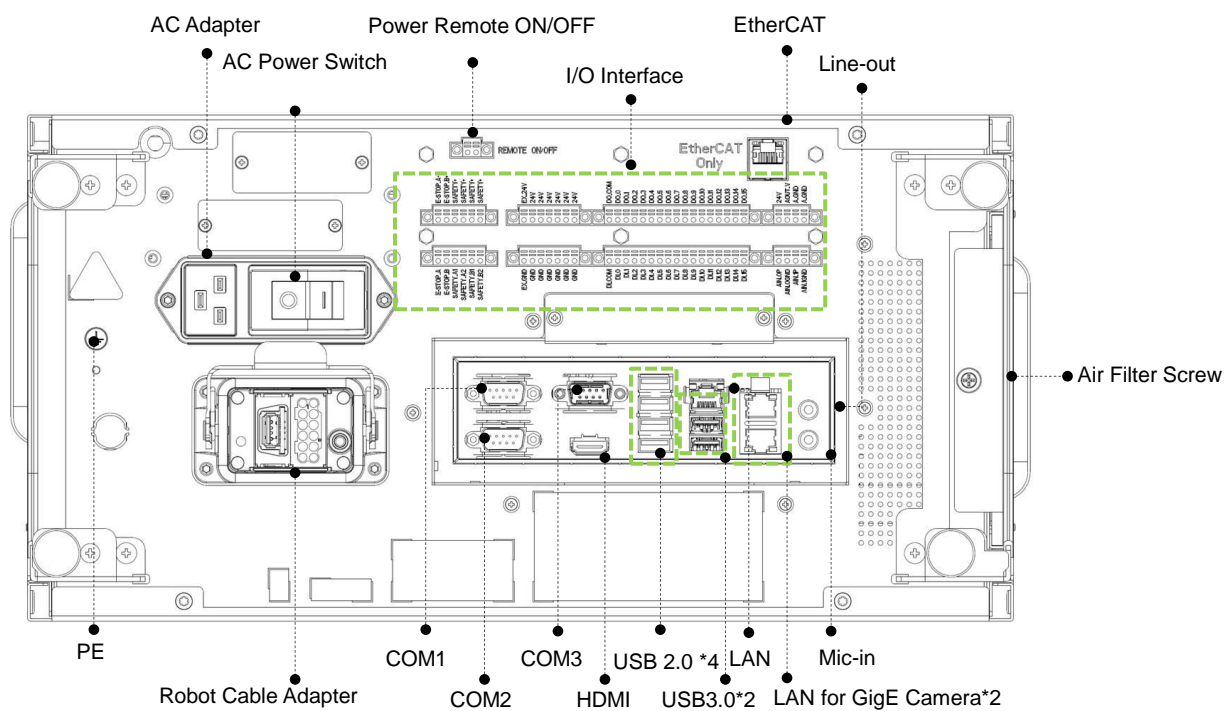


5.5 Control Box Interfaces

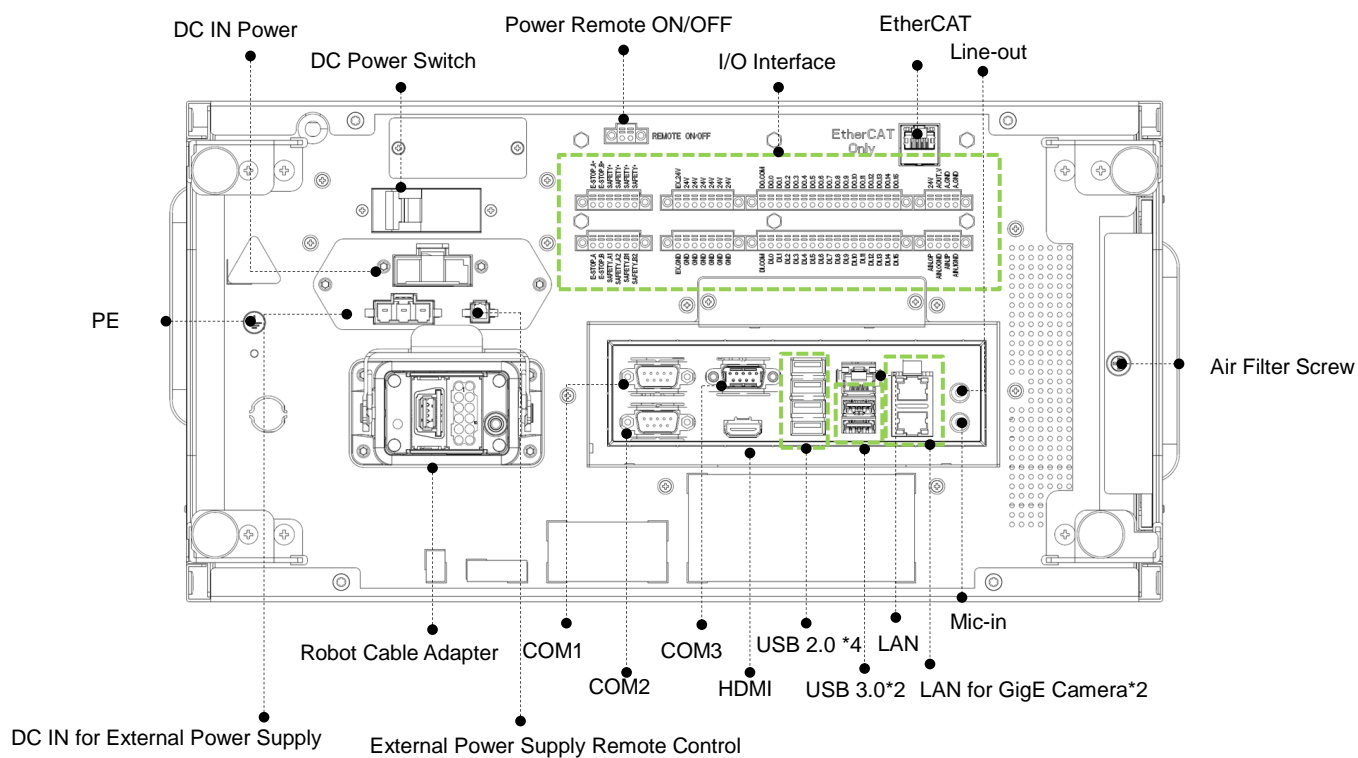


CAUTION:

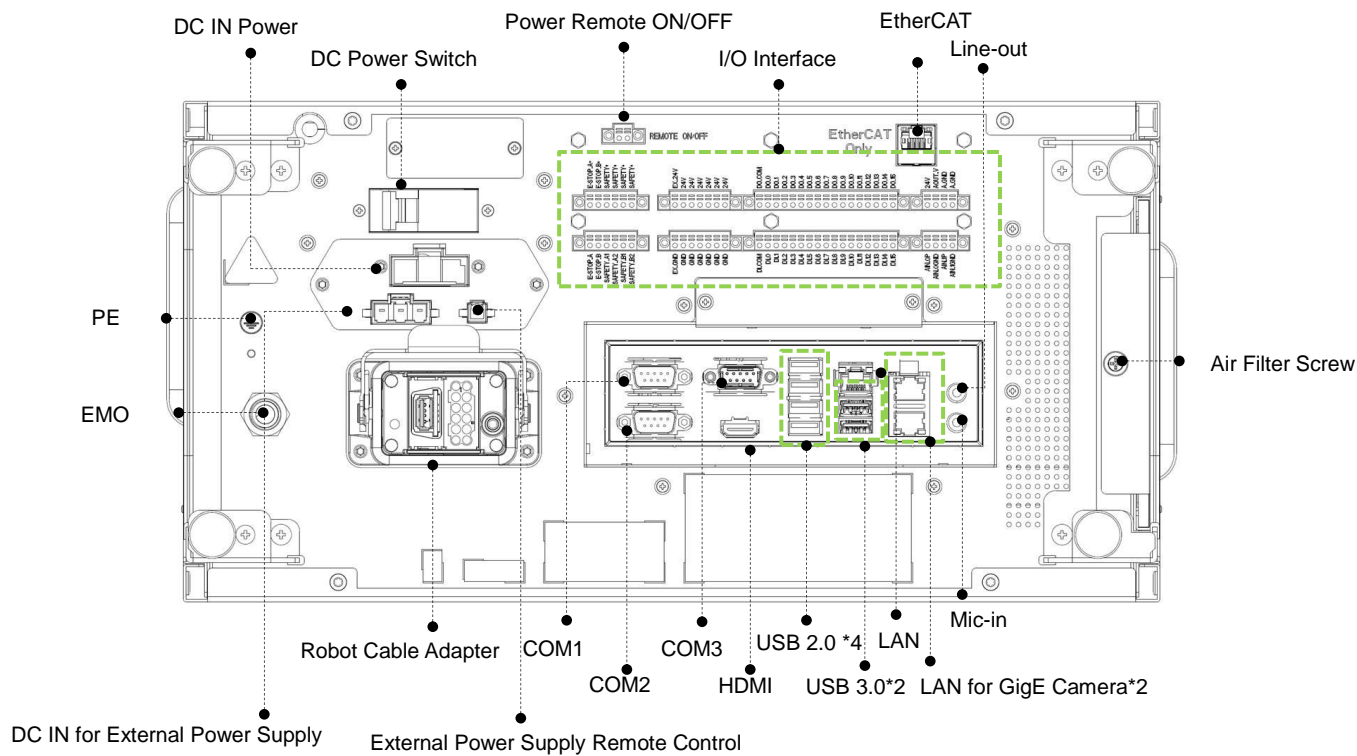
The ETHERCAT interface can only be used to connect ETHERCAT devices. Improper connection may cause the robot to stop.



TM12 / TM14 Series



TM12M / TM14M Series



TM12M SEMI / TM14M SEMI Series

5.6 Control Box Power Interface and Robot Interface

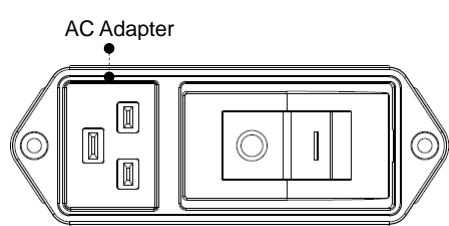
5.6.1 Control Box Power Interface

TM12 / TM14:

The power cable of the control box has an IEC plug. The local power plug is connected to the IEC plug.

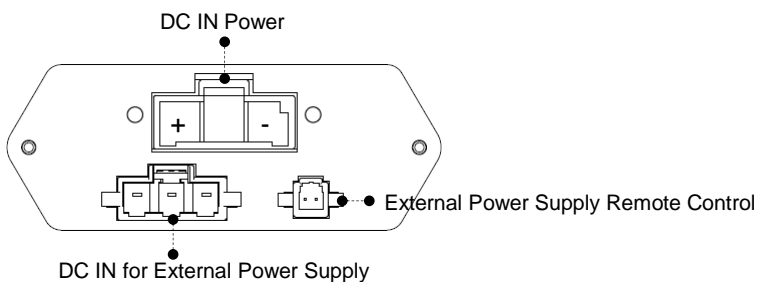
TM12M / TM14M:

The power cable of the control box has Hirose (HRS) DF60 series connector.



TM12 / TM14

AC Adapter : IEC plug



TM12M / TM14M

DC IN Power Connector : (HRS) DF60-3EP-10.16C

DC IN for External Power Supply Connector : Please contact with the Corporation for purchasing

External Power Supply Remote Control Connector : Please contact with the Corporation for purchasing

The power supply should be equipped with the following:

- Ground
- Main fuse
- Residual current device (RCD)

We recommend that you install a master switch on the equipment power supply for robot applications for servicing and inspection.

TM12 / TM14 Series electrical specifications:

Parameters	Minimum value	Typical value	Maximum value	Unit
Input voltage	100	-	240	VAC
External mains fuse (100V~120V)	-	-	15	A
External mains fuse (220V~240V)	-	-	10	A
Input frequency	43	-	63	Hz

*If using AC100V~AC199V power supply, the Robot will automatically limit the total output power

TM12M / TM14M Series electrical specifications:

Parameters	Minimum Value	Typical value	Maximum value	Unit
Input voltage	22	-	60	V (DC)
Power consumption		300	1500	W

*If using DC22~47V power supply, the Robot will automatically limit the total output power

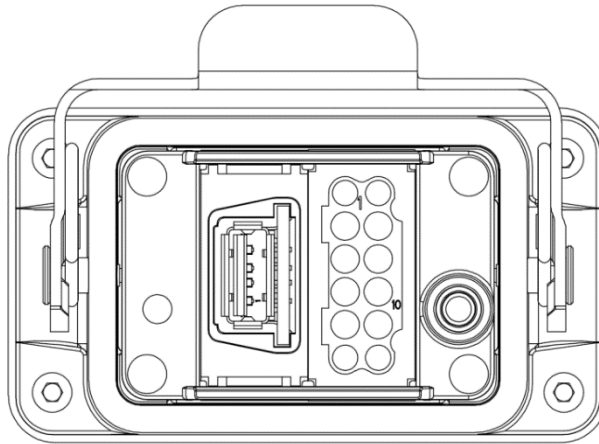


DANGER:

1. Ensure that the robot is correctly grounded (electrical grounding).
2. Ensure that the input current of the control box is protected by the Residual Current Device (RCD) and appropriate fuses.
3. Ensure that all cables are correctly connected before the control box is energized. Always use genuine power cables correctly.

5.6.2 Robot Interface

The following figure shows the connection interface of the robot. The cables of the robot are connected to the control box through the interface.



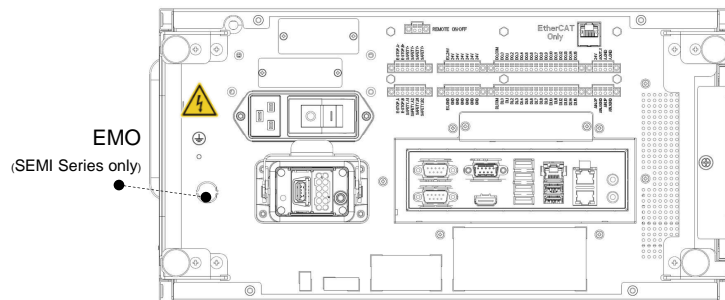
WARNING:



1. When the robot is turned on, do not disconnect cables of the robot. When cables of the robot are not connected to the connection interface, do not turn on the robot.
2. Do not extend or modify the original cables of the robot.
3. The cables of the robot are only suitable for a fixed installation. If you require a flexible installation, contact the Corporation.

5.6.3 Control Box EMO (Emergency Off) Interface

Control Box EMO (SEMI Series only) interface is as below: SEMI Emergency Off Switch is connected with control box through EMO interface.



CAUTION:



For SEMI Series, when SEMI Emergency Off Switch is not connected with EMO, the TM Robot cannot be booted.

WARNING:



When SEMI Emergency Off Switch is pressed, all power will be cut off immediately.

6. Unboxing & Installation

6.1 Overview

These instructions guide the user of the TM Robot through the first set up. The user must thoroughly read and understand this Guide before performing the operations of this Chapter. Fail to do so may cause serious danger.



WARNING:

If this is your first time using the TM Robot, please follow instructions in this chapter to perform installation and initial set up. If the robot has been implemented in the working environment, please note the following:

1. To avoid potential hazards after changing the original environment setting, verify with current responsible operator and to back up all necessary software settings and hardware wirings scheme.
2. Remove all of the control box's external I/O connections including the analog I/O, EtherCAT port and network port. Remove all air lines or external power lines connected to the optional equipment before Commissioning.
3. Remove all of the control box's connections to external devices / external storage devices through USB interface, Serial port, and network interface.
4. Unload any object/end effector attached to the end flange, and any electrical connection between the end effector and end module / control box of the robot.
5. Unload any hardware attached to the robot arm.

6.2 Inspecting the Equipment

6.2.1 Before Unpacking

Carefully inspect all shipping crates for evidence of damage during transit. If any damage is indicated, request that the carrier's agent be present at the time the container is unpacked

6.2.2 Upon Unpacking

Before signing the carrier's delivery sheet, compare the actual items received (not just the packing slip) with your equipment purchase order and verify that all items are present and that the shipment is correct and free of visible damage,

If the items received do not match the packing slip. or are damaged, do not sign the receipt. Contact your corporation support as soon as possible.

If the items received do not match your order, contact your corporation support immediately.

Inspect each item for external damage as it is removed from its container. If any damage is evident, contact your corporation support (see HOW Can I Get Help? on 1.2)

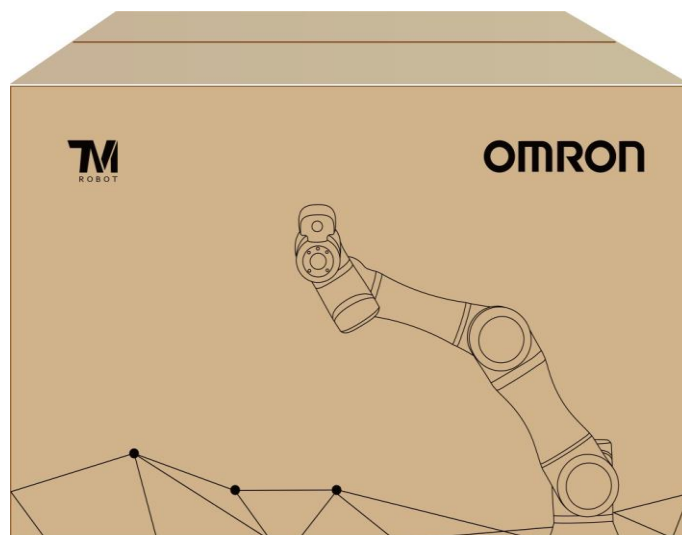
Retain all shipping containers and packaging materials. These items may be necessary to settle claims or at a later date, to relocate equipment.

6.3 Unboxing

6.3.1 Carton Types

The TM Robot product is packed in 2 cartons: the robot arm carton and the control box carton, as shown below:

Robot arm carton:



Control box carton:



6.3.2 Contents of Each Carton

Each carton has the following contents. Check them when you unpack the cartons for the first time. If any item is missing, contact your vendor.

The robot arm carton contains:

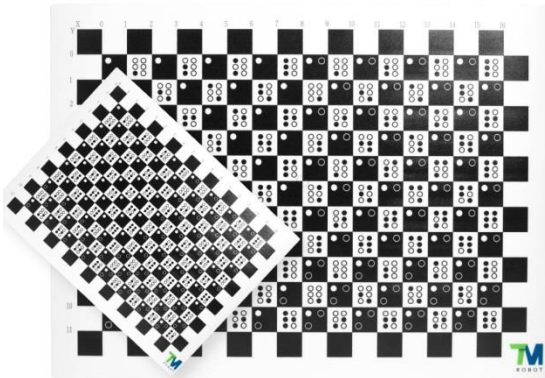


Robot arm

The control box carton contains:



Control box



Calibration Plates

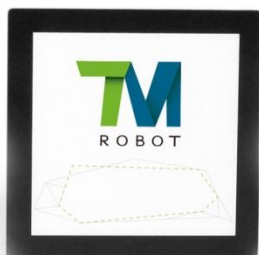
(Contains one large and one small calibration plate)



IO cables

(2 packs)

8-pin digital I/O, 5-pin analog I/O



TM Landmark

(Contains two TM Landmark)



Power cable of the control box
(TM12 / TM14)

(4 cables, Type B, I, G, F)



Power cable of the control box
(TM12M / TM14M)

(1 cable)



Ground Wire

(1 pack)



SEMI Emergency OFF Switch
(SEMI Series only)

(1 pack)

6.4 Installing Your Robot

The TM Robot arm cannot stand independently after being removed from the carton. Therefore, prepare the mounting base with the corresponding holes as described in Subsection 4.2.1.6 "Robot Arm Installation" in this Guide in advance. Then follow these instructions to install the robot.



WARNING:

At the installation site, at least two people should simultaneously perform installation of the robot, otherwise you risk robot arm damage or personal injury. Do not install the robot alone.



WARNING:

Do not attempt to move any robot links until the robot has been secured in position. Failure to comply could result in the robot falling and causing either personnel injury or equipment damage.

6.4.1 Remove the Control Box

After checking the contents, remove the contents in order and perform installation.

Control box carton:

- Remove the calibration plates and land mark
- Remove the power cable of the control box
- Remove the control box (At least two people should remove the control box from the carton. For the correct holding positions, as shown below)
- Connect the power cable to the control box
- Place the control box near the robot base



The control box should be carried by at least two people. One should hold on to the control box handles, while the other should carry the foot stands. Before handling, the cable of the robot stick should not be pulled to avoid any performance degradation.



WARNING:

At this stage, do not connect the power cable of the control box to any electrical outlet, or it may cause equipment damage.

6.4.2 Verification Before Removal of the Robot Arm

The TM Robot arm cannot stand independently after being removed from the carton. Prepare four screws (M10 *4) that used to attach the robot to the base near the robot base in advance. If the base is designed with corresponding pinholes, mount them to the base.

6.4.3 Removal of the Robot Arm and Tightening

At least two people should remove the robot arm from the carton. For the correct holding positions, see the figure shown below. Place the robot on the mounting base. If it is designed with connection pins, align the pinholes of the robot base module. Tighten two locking screws with washers for the robot base that are diagonally across from each other, then tighten the other two locking screws.

Follow the tightening torque recommended in Subsection 4.2.1.6 "Robot Arm Installation" in this Guide.



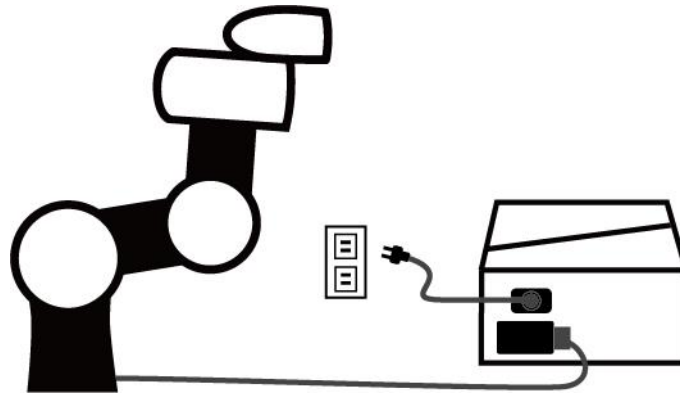
The Robot Arm itself should be handled with at least two people. One person should carry the Lower arm and Upper arm, and the other should hold on to the position between the base and 1st Joint as well as the 6th Joint. Before the Robot Base is fastened with screws tightly, the Robot Arm should always be supported to avoid tipping.

**WARNING:**

When the robot is installed to the base, make sure two people work together to install it. If it is designed with pinholes, pay attention to your safety to avoid pinching. If you do not have connection parts at hand, such as the connecting pins, screws, do not leave the robot without completely tightening it (with the 4 screws completely tightened). One person should continuously support the robot arm while the other person goes to get required parts. Otherwise, the robot arm may tip, result in equipment damage or personal injury.

6.4.4 Connect the Robot and Control Box

Connect the power cable from the control box to the robot, and then connect the power cable from AC power to the control box to boot up the controller.



WARNING:

1. Ensure that all cables are correctly connected before the control box is energized. Always use genuine power cables correctly.
2. When the robot is turned on, do not disconnect cables of the robot. When cables of the robot are not connected to the connection interface, do not turn on the robot.
3. Do not extend or modify the original cables of the robot.

7. Maintenance and Repair

The following table gives a summary of the preventive maintenance procedures and guidelines:

Item	Period	Remark
Warning, Safety labels	1 week	Ensure labels are present and legible. Replace them if necessary.
Check Filter	1 month	Please replace every 3 months.
Check Emergency Switch	1 month	Press the Emergency Switch and the IO E-Stop in open-loop status. Verify that each shuts off power.
Check Safeguard ports(A, B)	1 month	When the Safeguard A Port is in the open-loop state, the indication light of current mode will be constantly flashing. When the Safeguard B Port is in the open-loop state, the purple light will be alternating between the indication light of the current mode.
Check Robot Mounting screws	3 months	Follow "4.2.1.6 Robot Arm Installation"
EMO button (SEMI version only)	6 months	Press the EMO button. Verify that power shuts off.

Only the legal distributor or authorized service center should repair the TM Robot. The user should not repair it himself or herself.



DANGER:

Before performing maintenance or service, record the details of each setting for the robot for normal operation. When maintenance or service is complete, make sure that each setting satisfies the original conditions before resuming status, including but not limited to:

- Safety Software Settings
- Safety I/O
- Preset operation project
- TCP Settings
- I/O Settings
- I/O Wiring

Appendix A. Technical Specifications

Model		TM14	TM12	TM14M	TM12M
Weight		32.6 Kg	33.3 Kg	32.6 Kg	33.3 Kg
Payload		14 kg	12 kg	14 kg	12 kg
Reach		1100 mm	1300 mm	1100 mm	1300 mm
Typical Speed		1.1m/s	1.3m/s	1.1m/s	1.3m/s
Joint ranges	J1,J6	+/- 270°			
	J2,J4,J5	+/- 180°			
	J3	+/- 163°	+/- 166°	+/- 163°	+/- 166°
Speed	J1~J2	120°/s			
	J3	180°/s			
	J4~J5	150°/s	180°/s	150°/s	180°/s
	J6	180°/s			
Repeatability		+/- 0.1 mm			
Degrees of freedom		6 rotating joints			
I/O ports		Control box		Tool conn.	
	Digital in	16		4	
	Digital out	16		4	
	Analog in	2		1	
	Analog out	1		0	
I/O power supply		24V 1.5A for control box and 24V 1.5A for tool			
IP classification		Robot Arm: IP54 ; Control Box: IP32			
Power consumption		Typical 300 watts			
Temperature		The robot can work in a temperature range of 0-50°C			
Power supply		100-240 VAC, 50-60 Hz		DC22~60VDC	
I/O Interface		3×COM, 1×HDMI, 3×LAN, 4×USB2.0, 2×USB3.0			
Certification		CE, SEMI S2 (optional)			
Robot Vision					
Eye in Hand (Built in)		1.2M/5M pixels, color camera		1.2M/5M pixels, color camera	
Eye to Hand (Optional)		Support Maximum 2 GigE cameras			



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