



# Service Manual

TM5S / TM6S / TM7S / TM12S / TM14S / TM20S



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## 1. Handling components that are sensitive to electrostatic discharge (ESD)



To prevent ESD-sensitive components (e.g., printed circuit boards) from being damaged, please handle the components in the following steps:

- Wear an anti-static wrist strap before replacing ESD sensitive components and make sure the bracket is always connected to ground when replacing components.
- Hold the protective cover for the component's edge connect and avoid touching any exposed part.
- Drop the replaced component into an antistatic bag.

## 2. Safety information



### **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.



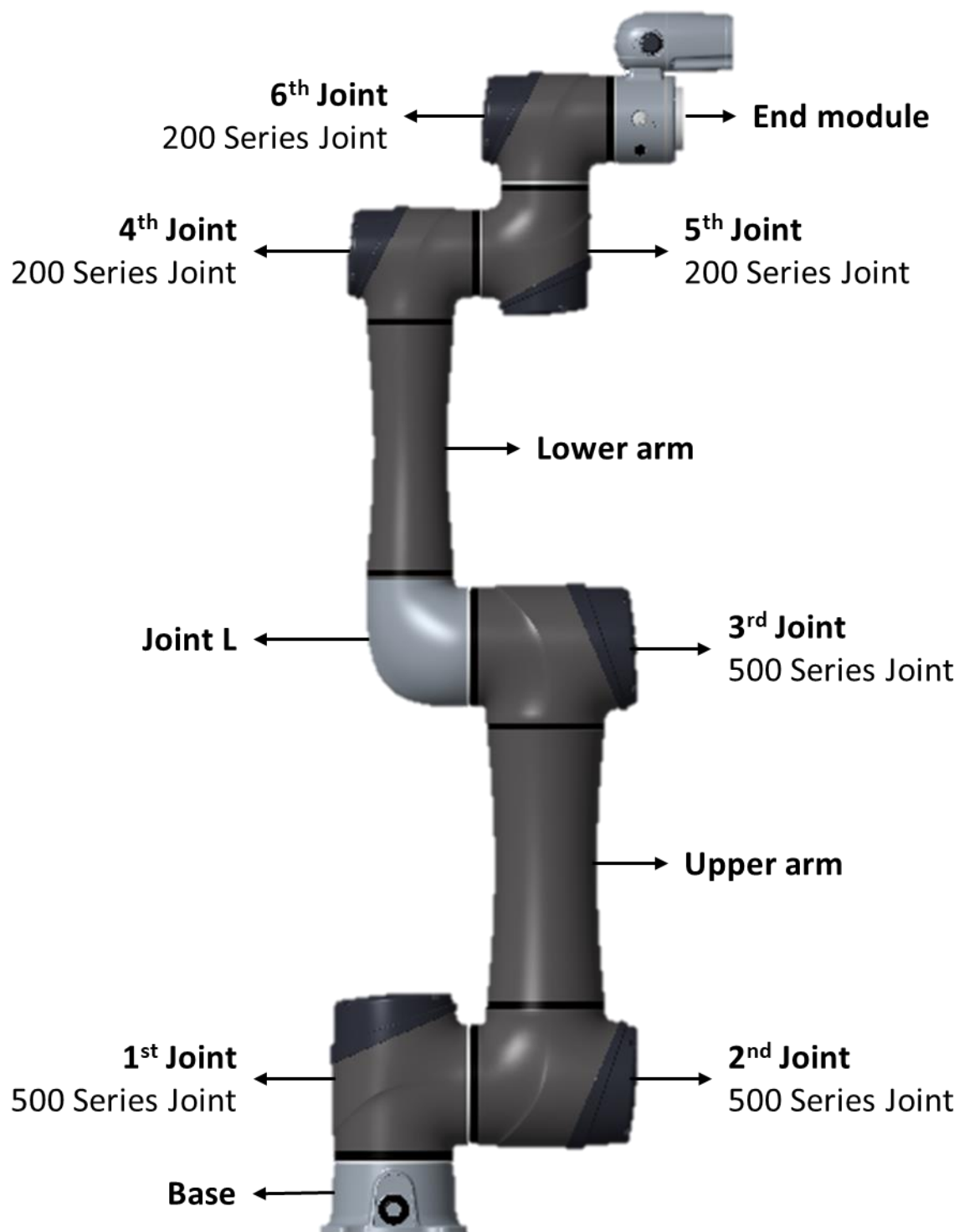
### **CAUTION:**

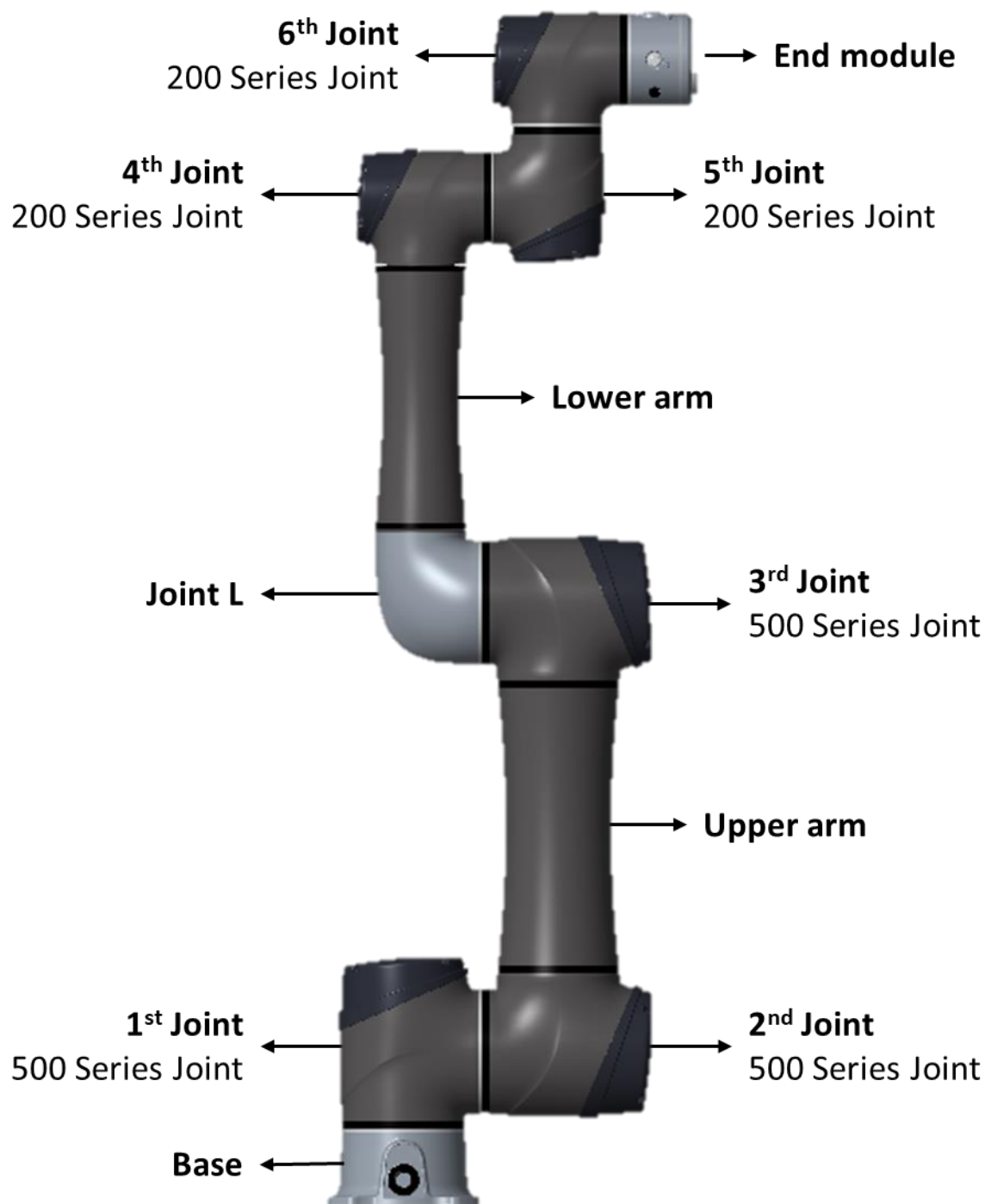
Identifies a potentially hazardous situation which, if not avoided, might result in minor injury, moderate injury, or property damage.

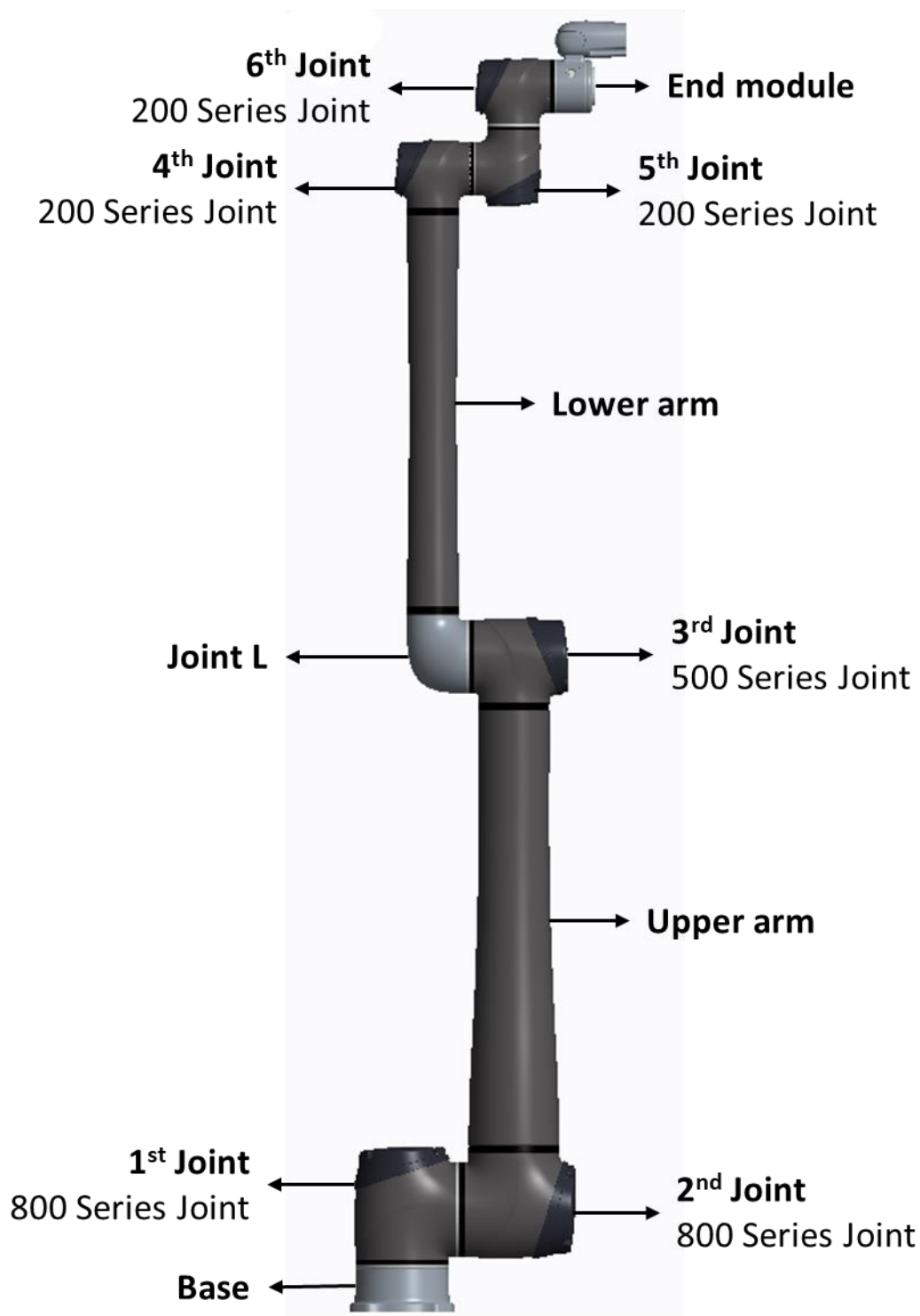


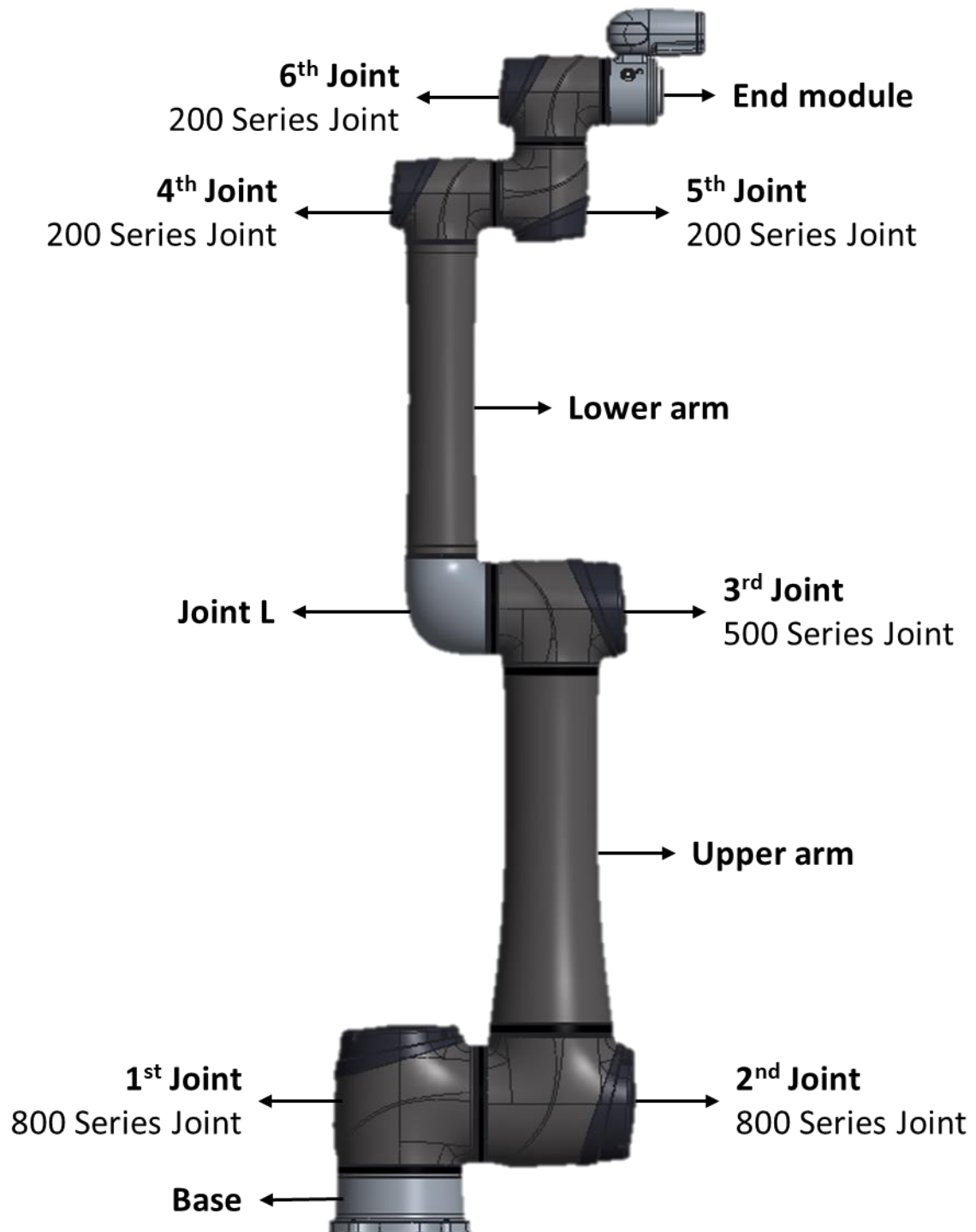
### 3. Description of arm and control box parts

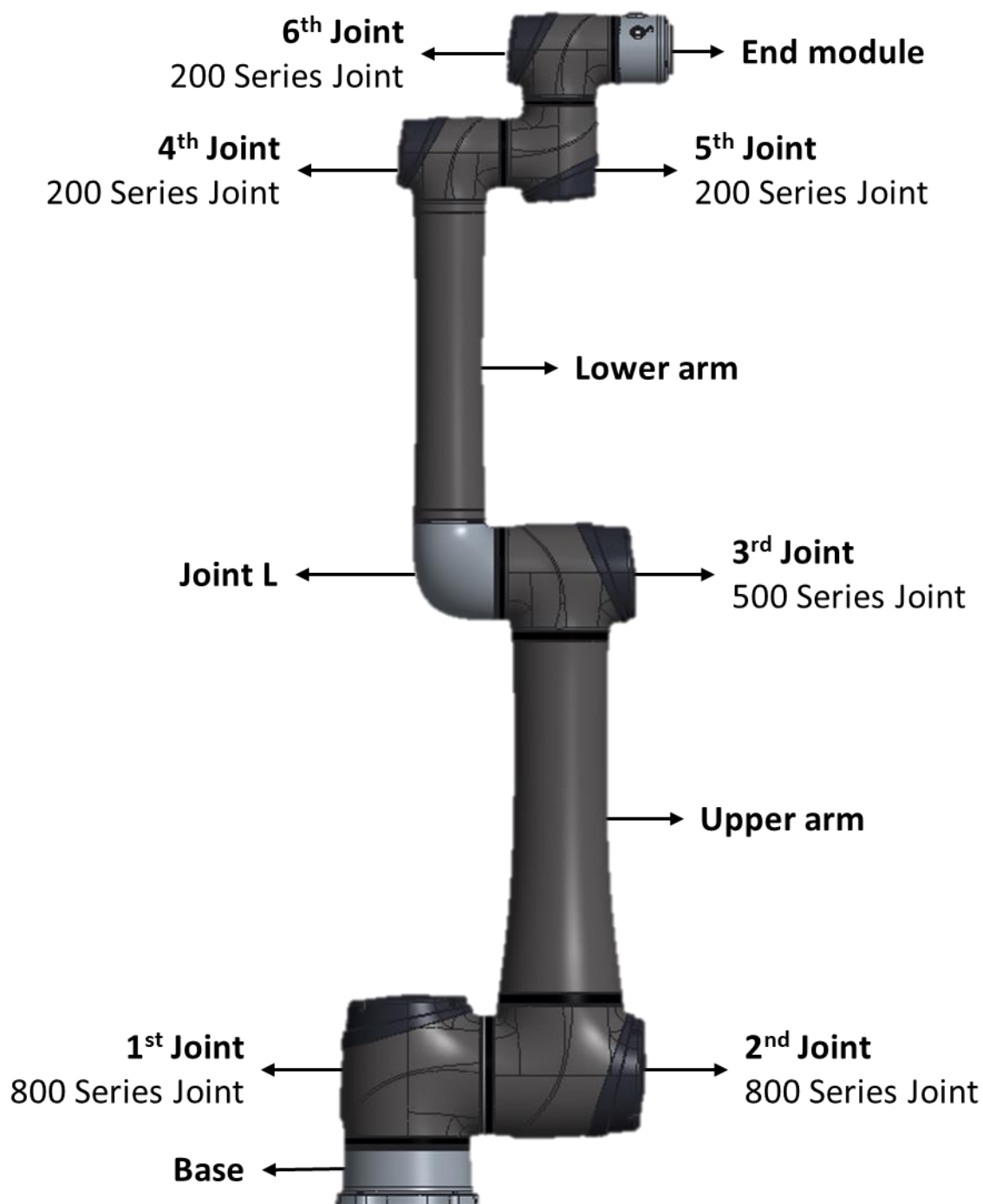
#### 3.1 TM5S 、TM7S



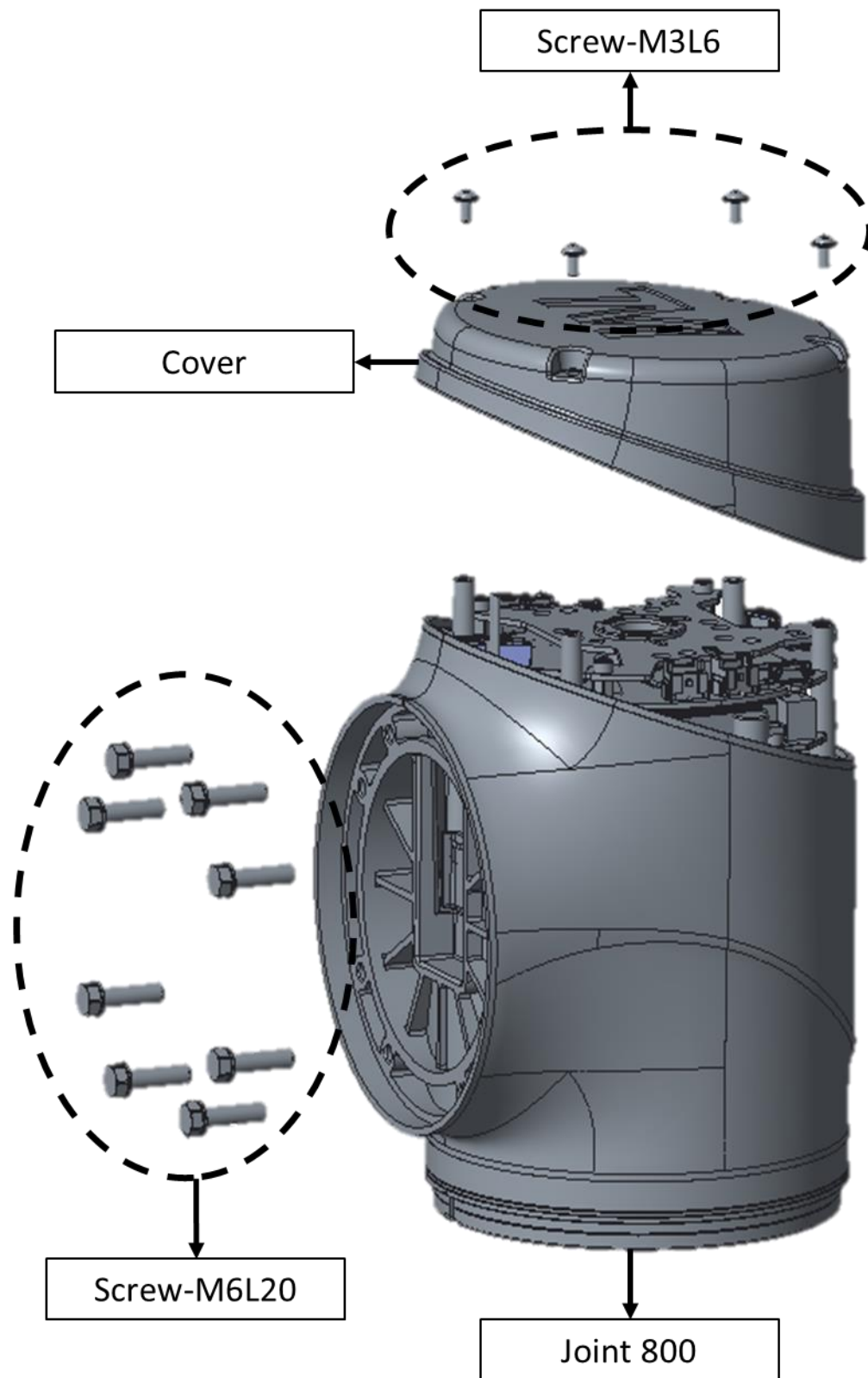




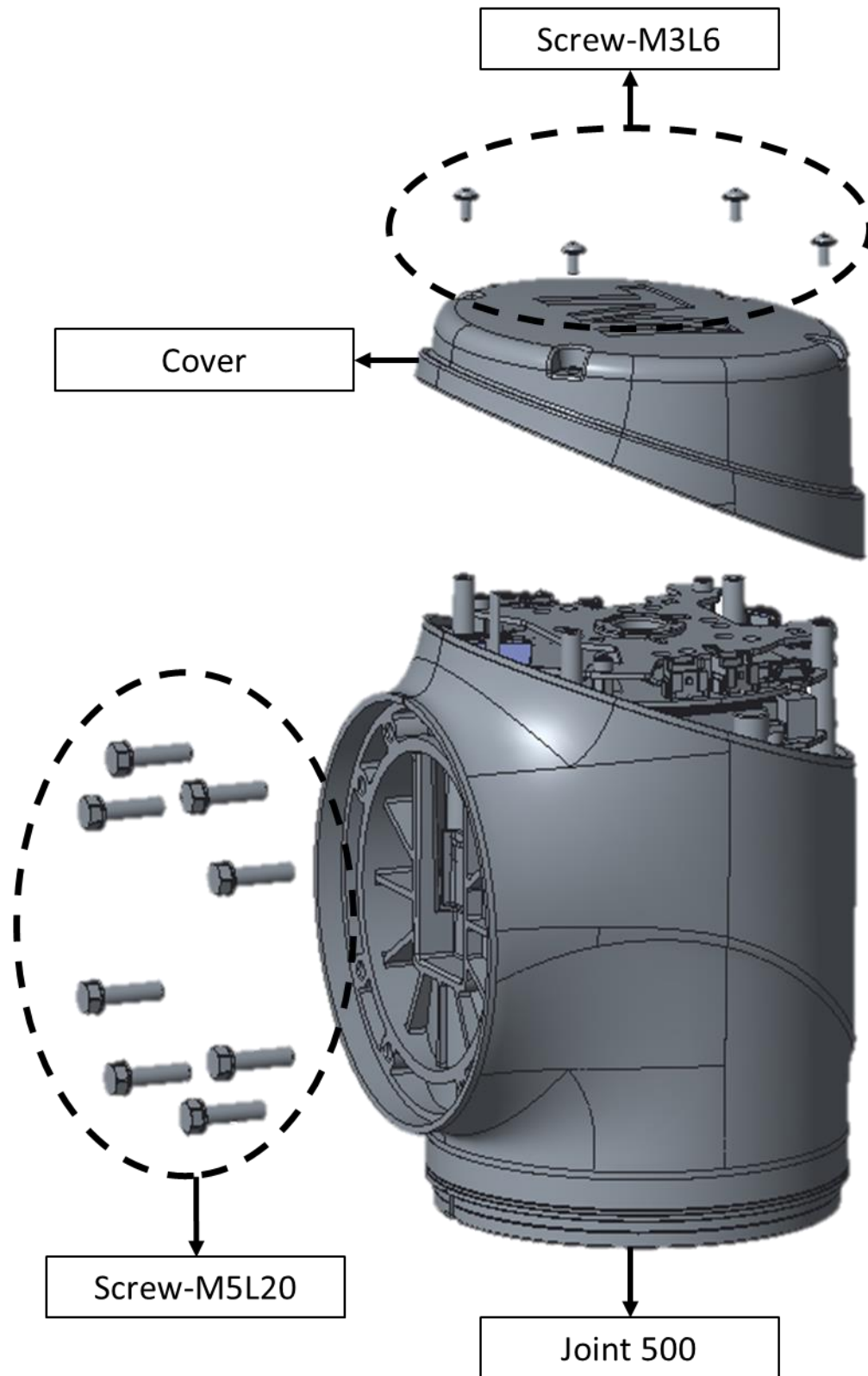




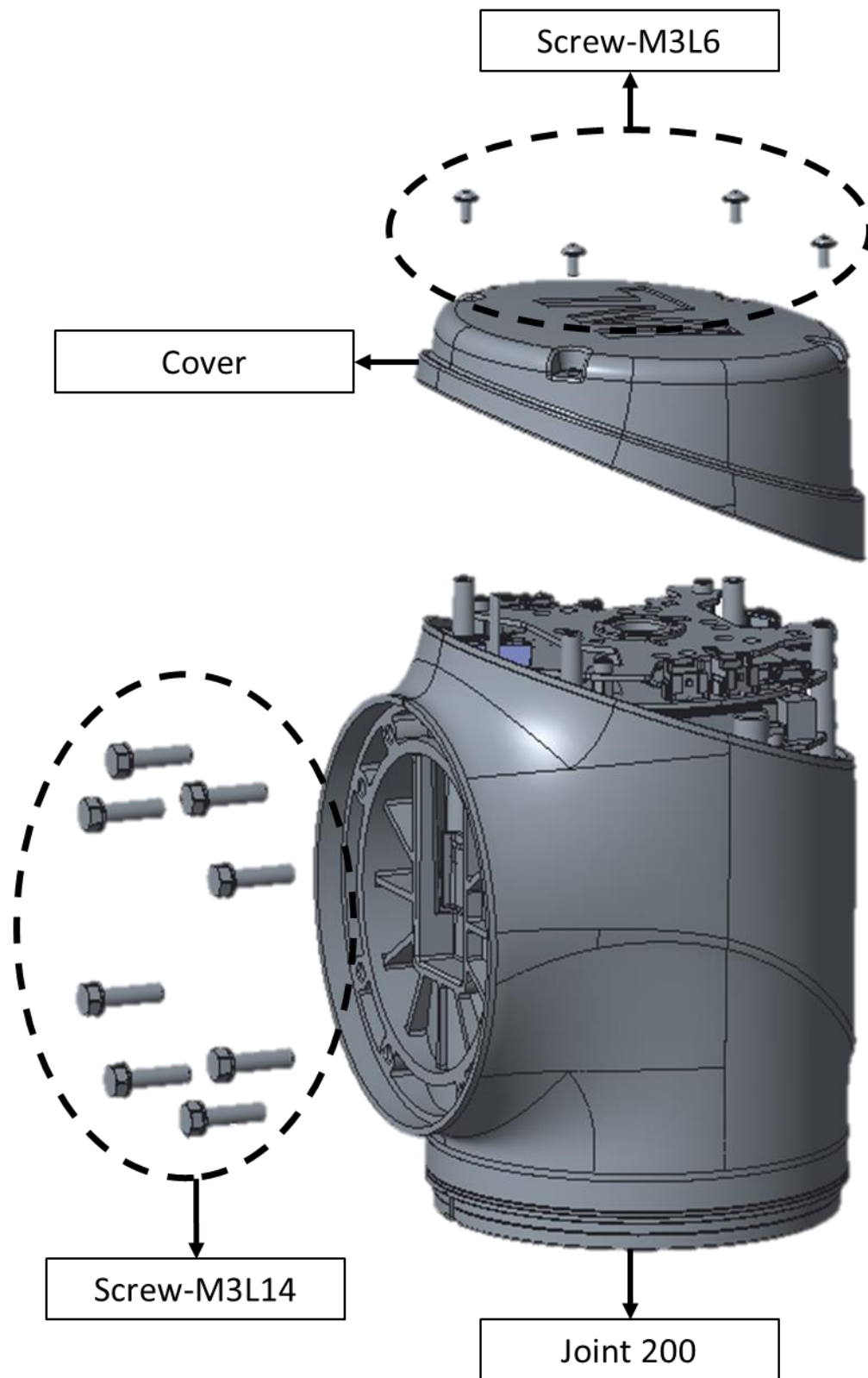
### 3.6 800 Series Joint



### 3.7 500 Series Joint

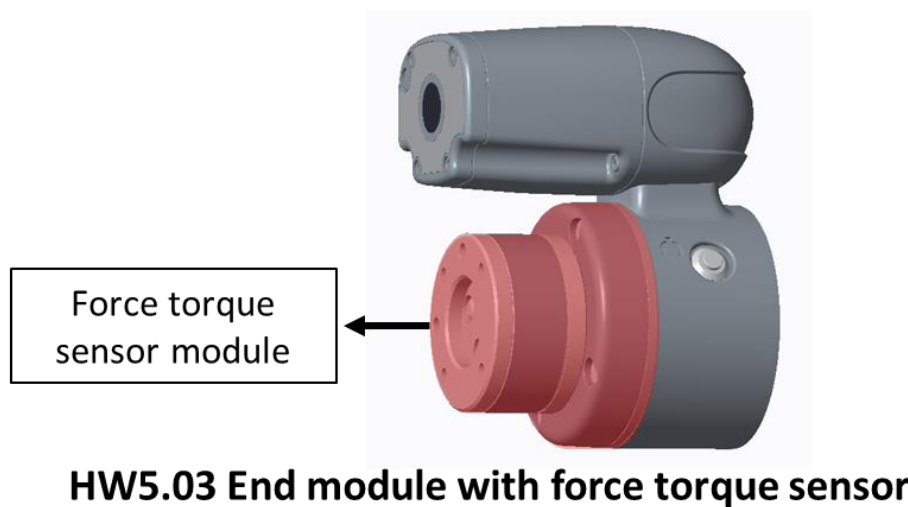
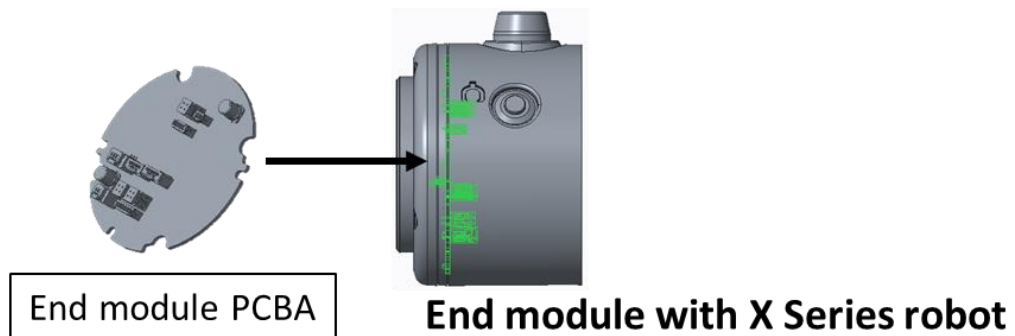
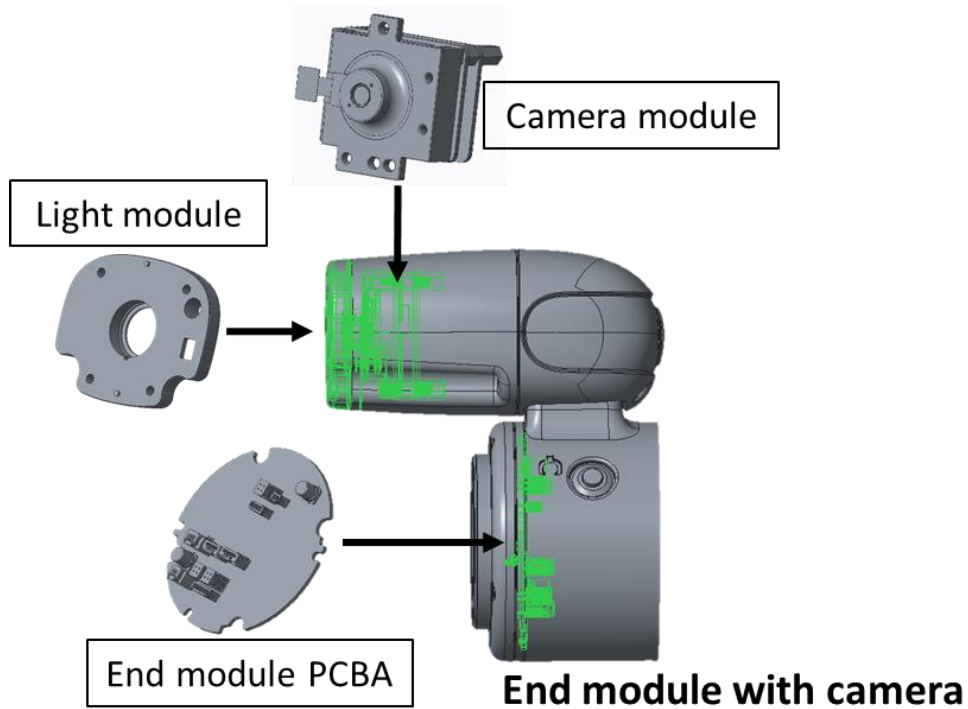


### 3.8 200 Series Joint

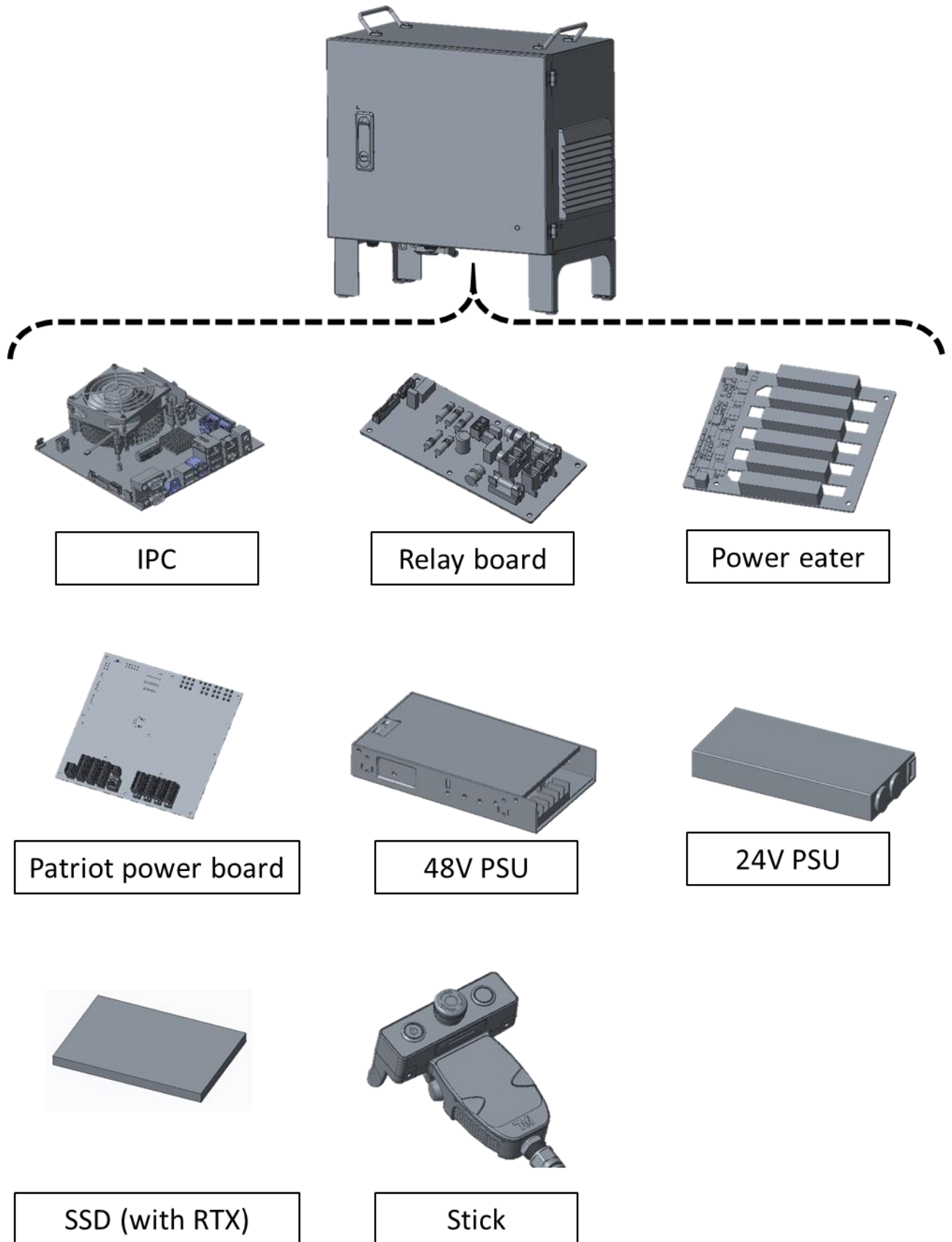




### 3.9 End module














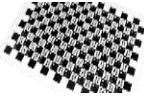
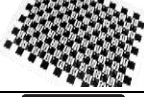





### 3.10 End module



## 4. Tool list

Name	Physical Reference	Specification	Model	Remarks
Open end wrench		5.5 mm		Used for 200 Series Joint
Open end wrench		8 mm		Used for 500 Series Joint
Open end wrench		10mm		Used for 800 Series Joint
Hex socket screwdriver		5.5 mm		Used for 200 Series Joint
Hex socket screwdriver		8 mm		Used for 500 Series Joint
Hex socket screwdriver		10mm		Used for 800 Series Joint
Torque wrench		5.5 mm 20 kgf·cm	TOHNICHI 50CL-MH	Used for 200 Series Joint
Torque wrench		8 mm 92 kgf·cm	TOHNICHI 150CL-MH	Used for 500 Series Joint
Torque wrench		10mm 250kgf·cm	TOHNICHI 225CL-MH	Used for 800 Series Joint
Wrench head		SH8D × 5.5 5.5 mm	TOHNICHI SH8D*5.5	Used for 200 Series Joint
Wrench head		SH8D × 8 8 mm	TOHNICHI SH8D*8	Used for 500 Series Joint
Wrench head		SH10D × 10 mm	TOHNICHI SH10D*10	Used for 800 Series Joint
Torque screw driver		6 - 10 kgf·cm	TOHNICHI 12 RTD	
Torx bit		T10		Used for Joint cover
Hex bit		2.5mm		Used for outer cover of camera module
Hex wrenches		M1.5-M10		Used for Base & Control box components
Extension bit Holder		1/4 inch At least 150mm		Used for internal box's fixed screws, magnet type is recommended.

Name	Physical Reference	Specification	Model	Remarks
Hex socket bit		M10		Used for internal box's fixed screws, magnet type is recommended.
Phillips screw driver				Used for control box components
Tweezer				Used for removing cables
Adjustable spanner		8 inch		Used for robot cable
Diagonal cutting plier				Used for cutting cable ties
Long nose plier				Used for removing cables
Cable tie		$120 \times 2.5 \text{ mm}^2$		Used for securing wires
Cable tie		$150 \times 3.6 \text{ mm}^2$		Used for securing wires
Multimeter				Used for checking voltage and circuit
Precision screwdriver set		T06151		Used for screws
Electrical tape		Width: 18mm		Used for wrapping around camera cable connectors
USB flash drive				Used for Windows recovery
Dongle key			Techman Robot	Must contain authorization key of maintenance
2-cm Plate calibration		40 cm $\times$ 30 cm	Techman Robot	Used for camera calibration
1-cm Plate calibration		20 cm $\times$ 15 cm	Techman Robot	Used for camera calibration
TM Landmark			Techman Robot	Used for Kinematic calibration and Hand-eye calibration
Torque screw driver		20 – 100 kgf.cm	KANON 100LTDK	Used for assembling A01 cover and end module flange
Torx bit		T10 x length at least 100mm		Used for outer cover of HW5.03 camera housing

## 5. Assembly and Disassembly Guide for Robot arm

### 5.1 Quick maintenance Guide

- 5.1.1 To ensure the safe operation, at least two people should work together to disassembly it.
- 5.1.2 Before disassembly, ensure that the robot is powered off completely and that the external power cord and robot cable have been removed.
- 5.1.3 Before disassembly, remove the robot from the platform and place it horizontally on a non-hard surface (e.g., blanket or sponge pad).
- 5.1.4 Before disassembly, take photos to record the status and wiring method when not disassembled for reference during reassembly process.
- 5.1.5 Follow the right-hand rule when disassembling and installing screws.

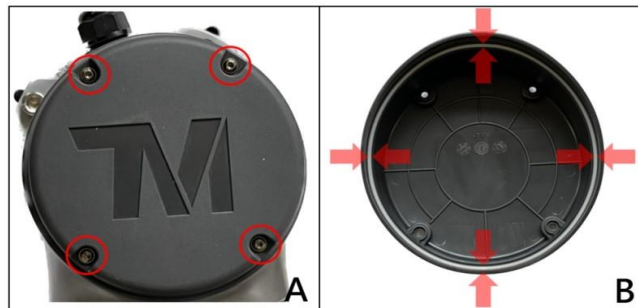
### 5.2 Joint model list

When replacing a joint, ensure that the joint specification model matches the one specified in the table below:

	TM5S / TM7S	TM6S / TM12S / TM14S	TM20S
1 <sup>st</sup> Joint	502	802	803
2 <sup>nd</sup> Joint	502	802	805
3 <sup>rd</sup> Joint	502	502	503
4 <sup>th</sup> Joint	204	204	205
5 <sup>th</sup> Joint	204	204	204*
6 <sup>th</sup> Joint	203	203	203
*The Joint 204 on the TM20S 5th joint cannot be used on any other robot model; it is intended solely for use on the TM20S 5th joint.			

### 5.3 Disassembly and assembly Joint cover and Joint rubber

- 5.3.1 Joint cover disassembly: To disassemble the joint cover, simply use a hex cap screwdriver to loosen the four hexagonal socket head cap screws (Fig. A). Then, gently remove the cover by hand, being careful to keep the O-ring in the groove.
- 5.3.2 Joint cover assembly: To assembly the joint cover, ensure that the O-ring is in the groove (Fig. B) and tighten the four socket head cap screws using a torque screwdriver and a socket head torque screwdriver.



- 5.3.3 Since the HW5.03 robot has an enhanced IP65 rating, the specifications for the joint cover screws have been updated. These leak-proofing screws can be reused for up to five disassembly cycles while maintaining the robot's IP65 protection level.



- 5.3.4 Since the HW5.03 robot has an enhanced IP65 rating, the specifications for the joint cover O-rings have been updated. The O-ring on the HW5.03 joint covers are thicker than those on the HW5.02



HW5.02 Joint cover O-ring



HW5.03 Joint cover O-ring



**CAUTION:**

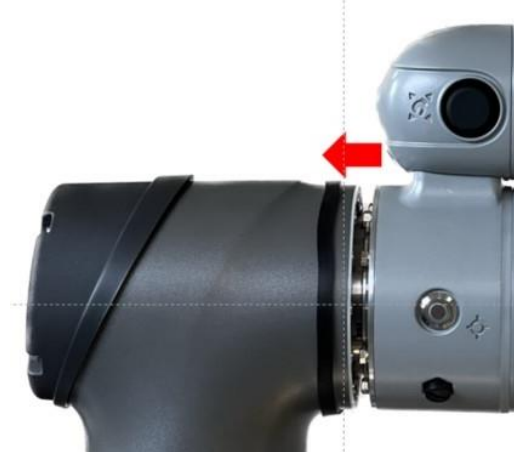
Use the correct torque to tighten the screws according to the table below. Insufficient torque may result in inadequate sealing of the joint cover. Excessive torque during screw tightening may cause damage to the joint cover.

**Torque specifications for covers**

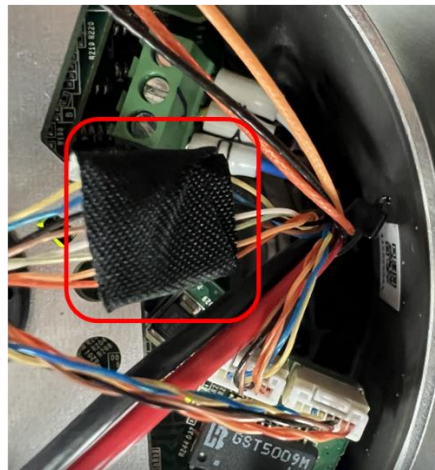
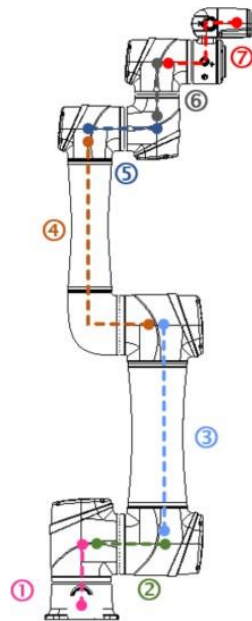
Joint Type	Screw Type	Torque Value (Kgf.cm)	Torque Value(Nm)	Total Screws
200 series	M3L6 Torx SOCKET HEAD CAP	6	0.6	4
500 series	M3L6 Torx SOCKET HEAD CAP	6	0.6	4
800 series	M3L6 Torx SOCKET HEAD CAP	6	0.6	4



5.3.5 Remove Joint Rubber: Remove the Rubber with tweezers and open the white anti-dust cover to reveal the 200 Series / 500 Series / 800 Series Joint Screws.  
Reverse the previous steps to install the dust cover and Rubber.

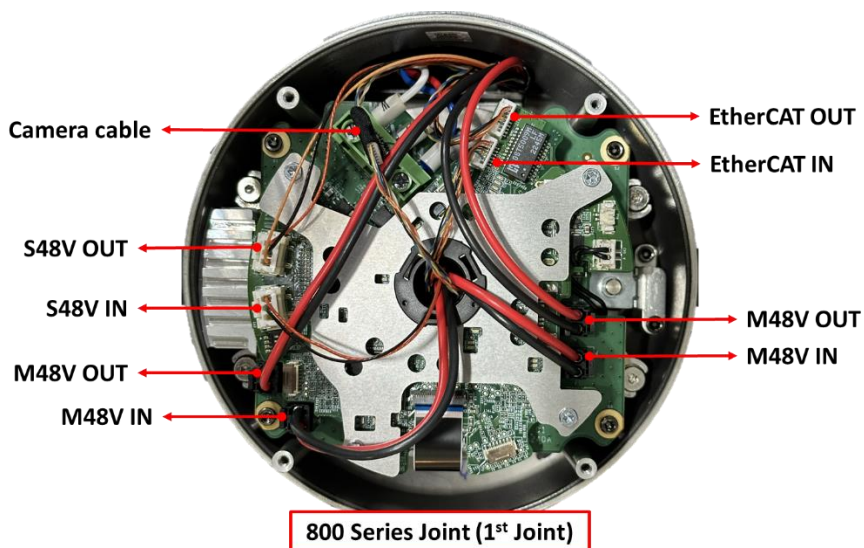
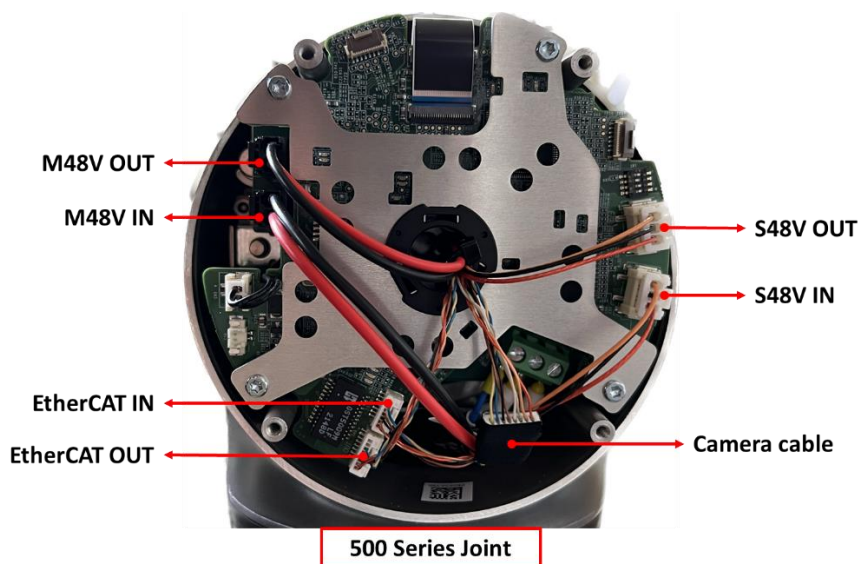
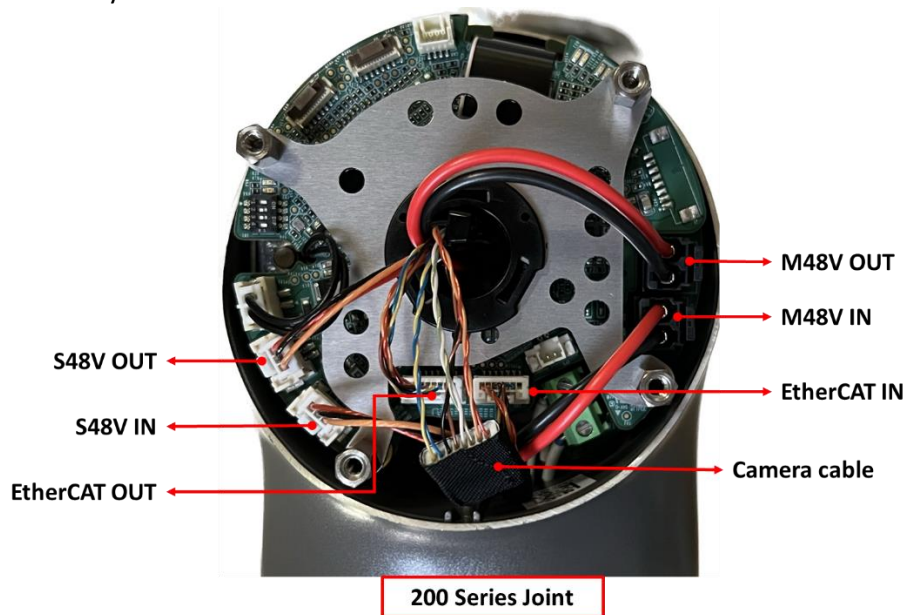


#### 5.4 Camera cable postion

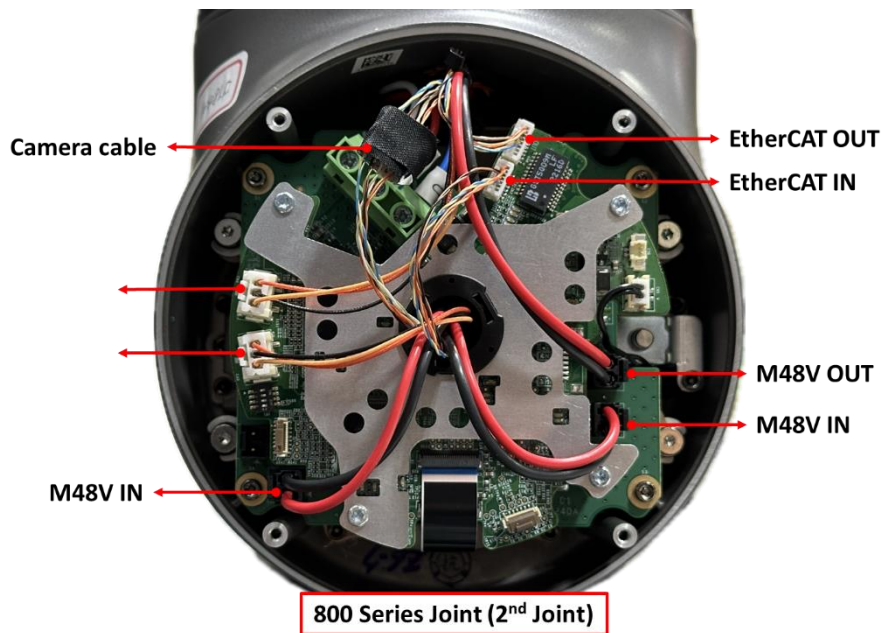


Remove the tape from the camera cable connector before disconnecting the cables.

## 5.5 Disassembly and assembly Joint cable







## 5.6 Disassembly and Assembly Joint screw



**CAUTION:** Before remove Joint screws, ensure the Joint cable and connectors are disconnected; failure to disconnect the cable may result in damage to the Joint cable or components due to pulling or interference when removing the Joint.

5.6.1 Before remove Joint screws, remove Joint Cover and Joint Rubber.

5.6.2 Using open end wrench to loosen the screw for Joint connecting screws.



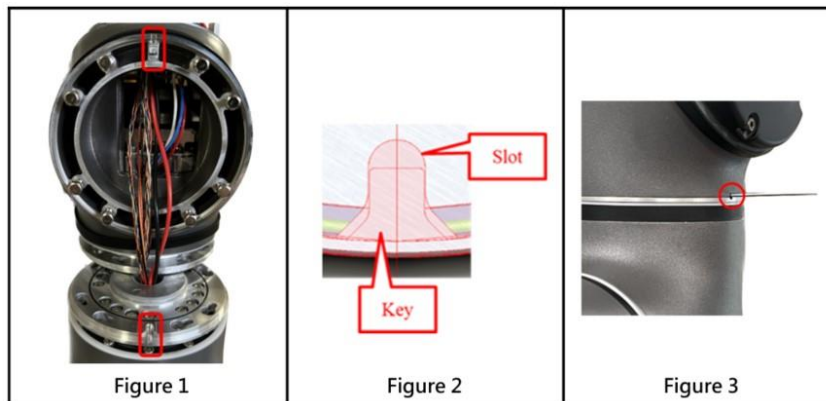
**DANGER:** Repeated use of disassembled screws is prohibited, as the screw adhesive on the screws will become ineffective, and the repeated use will increase unforeseen risks.



**DANGER:** Tighten the joint screws according to the specified torque value provided below.

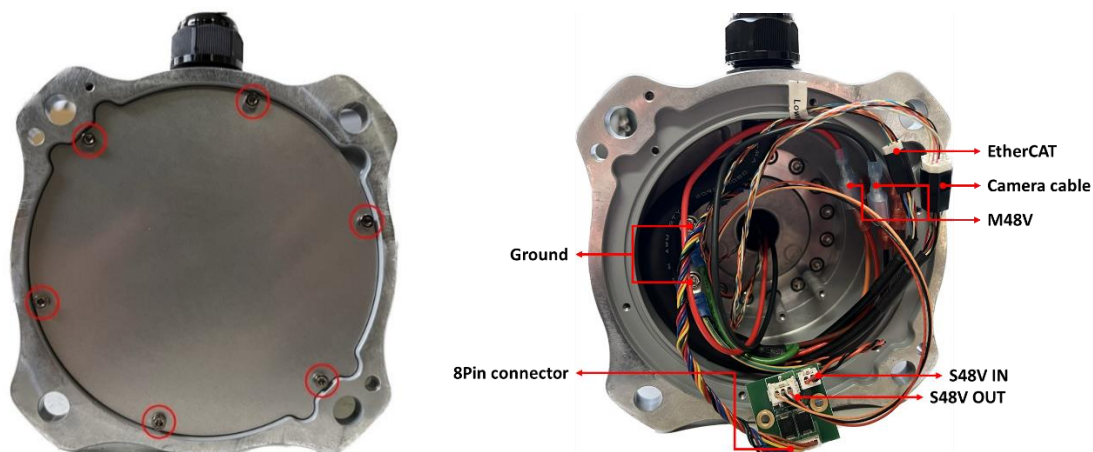
Torque specifications for Joint screws				
Joint Type	Screw Type	Torque Value (Kgf.cm)	Torque Value(Nm)	Total Screws
200 series	M3L14 HEX HEAD CAP	20	2.0	8
500 series	M5L20 HEX HEAD CAP	92	9.0	8
800 series	M6L20 HEX HEAD CAP	150	15	10

5.6.3 When assembling the joint, to ensure the correct installation orientation, it is necessary to interlock the key and slot between the joints (refer to Figure 1) (see Figure 2). Operators can visually align the holes or insert a  $\varnothing 1.9\text{mm}$  pin into the hole to verify proper installation (see Figure 3). If the hole of two joints are not in the same direction, or if misalignment prevents the insertion of the locating pin, do not proceed with further assembly.



## 5.7 Disassembly and Assembly of Base and Robot Cable

5.7.1 Before removing the Base cover, loosen the corresponding screws and disconnect the wiring between the Robot cable and Joint 1.



5.7.2 Use wrench to loosen the bottom connector, then carefully pull out the Robot cable.



5.7.3 When assembling the Base and Robot cable, please follow the reverse steps of the previous procedure.

## 5.8 Disassembly and assembly 800 Series Joint

5.8.1 Remove the Joint cover and Joint rubber.

5.8.2 Remove the Joint cable from the Joint °

5.8.3 Remove the screws connecting the Joint to other Joints or the Arm, then detach the Joint.

5.8.4 During assembly, follow the reverse steps of the previously mentioned procedure.

## 5.9 Disassembly and assembly 500 Series Joint

5.9.1 Remove the Joint cover and Joint rubber.

5.9.2 Remove the Joint cable from the Joint °

5.9.3 Remove the screws connecting the Joint to other Joints or the Arm, then detach the Joint.

5.9.4 During assembly, follow the reverse steps of the previously mentioned procedure.

## 5.10 Disassembly and assembly 200 Series Joint

5.10.1 Remove the Joint cover and Joint rubber.

5.10.2 Remove the Joint cable from the Joint °

5.10.3 Remove the screws connecting the Joint to other Joints, the Arm, or the End module, then detach the Joint.

5.10.4 During assembly, follow the reverse steps of the previously mentioned procedure.

## 5.11 Disassembly and assembly Upper arm

5.11.1 Remove Joint cover and Joint rubber which in Joint 2 & Joint 3

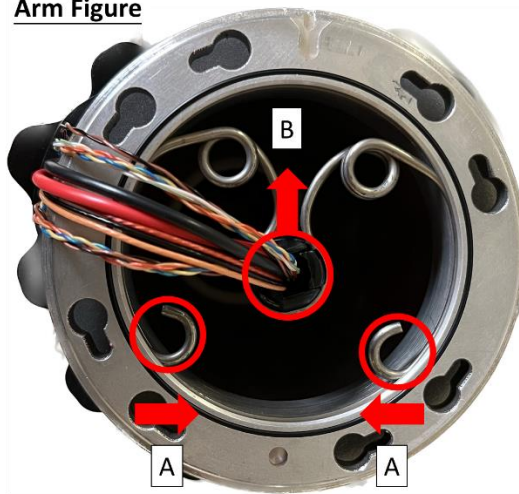
5.11.2 Remove Joint cable which in Joint 2 & Joint 3

5.11.3 Remove the screws connecting the Upper arm to Joint 2 and Joint 3, then detach the Upper arm.

5.11.4 During assembly, follow the reverse steps of the previously mentioned procedure.

5.11.5 (Please refer Arm figure below) After removing the Upper arm, use needle-nose pliers to compress the bracket at location A, then extract the bracket from the groove. Next, remove the wiring and plastic bushing at location B.

**Arm Figure**



## 5.12 Disassembly and assembly Lower arm

5.12.1 Remove Joint cover and Joint rubber which in Joint 3 & Joint 4

5.12.2 Remove Joint cable which in Joint 3 & Joint 4

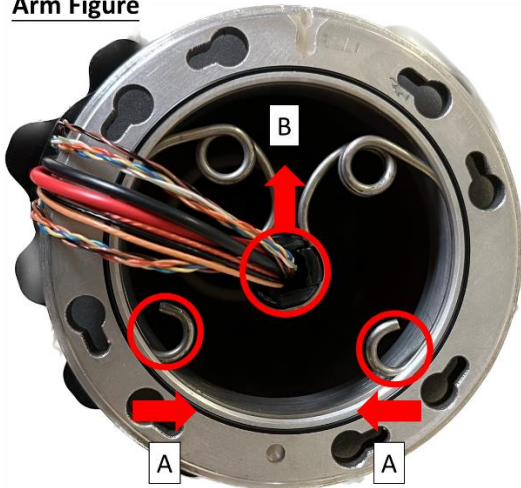
5.12.3 Remove the connecting screws between the Lower arm and Joint 4.

5.12.4 Remove the connecting screws between Joint L and Joint 3.

5.12.5 After removing the Lower arm, remove the screws connecting the Lower arm to Joint L, then remove the Lower arm.

5.12.6 (Please refer Arm figure below) After removing the Upper arm, use needle-nose pliers to compress the bracket at location A, then extract the bracket from the groove. Next, remove the wiring and plastic bushing at location B.

**Arm Figure**



#### 5.13 Disassembly and assembly End module

5.13.1 Remove Joint cover and Joint rubber which in Joint 6

5.13.2 Remove Joint cable which in Joint 6.

5.13.3 Remove the connecting screws between Joint 6 and the End module, then detach the End module.

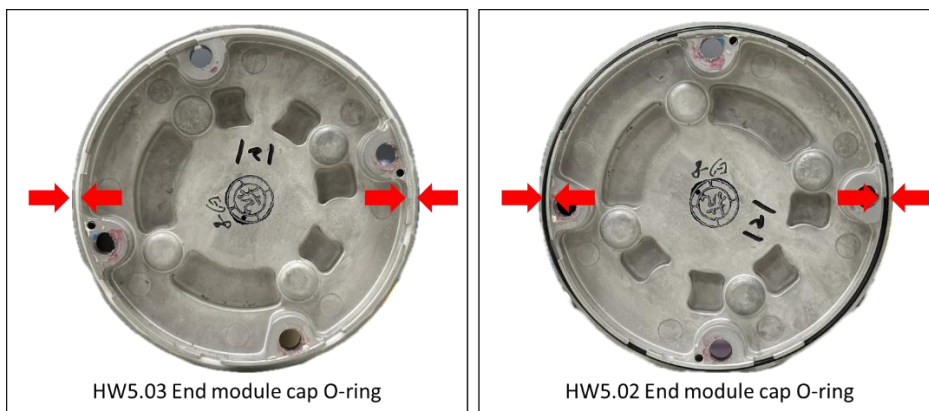
5.13.4 During assembly, follow the reverse steps of the previously mentioned procedure.

#### 5.14 Disassembly and assembly End module PCBA

5.14.1 Use a tool to loosen the 4 screws on the end module flange cover. A hex wrench, as shown below, is recommended.



5.14.2 Since the HW5.03 robot has an enhanced IP65 rating, the specifications for the screws and O-ring on the end-module cap have been revised. The original hex cap screws have been replaced with Torx cap screws, and the O-ring has been made thicker to enhance the IP protection level (see figure below).







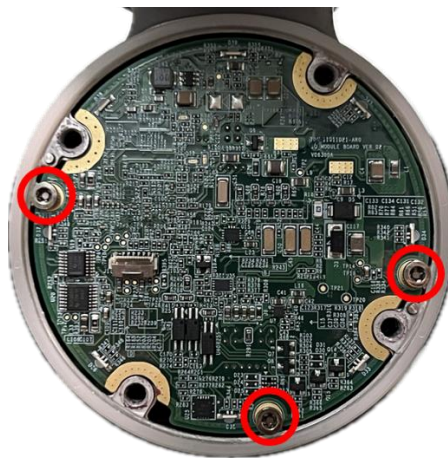
HW5.03 End module cap screws –  
T20 Torx socket screw



HW5.02 End module cap screws –  
T20 Hex socket cap screw

5.14.3 Remove the flange. If it is too tight and difficult to remove, insert a screw into the flange and gently pry it off.

5.14.4 Loosen the 3 screws on the end module PCBA.



Loosen the 3 screws

5.14.5 Beginning with HW5.03, the original hex cap screws on the end-module PCBA have been replaced with Torx cap screws.



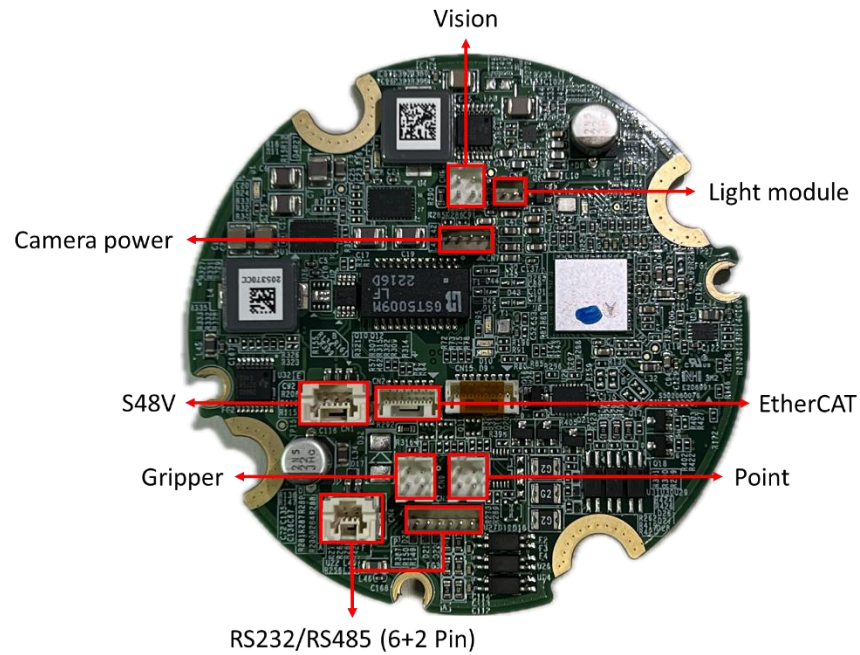
HW5.03 End module PCBA screws –  
T10 Torx socket screw



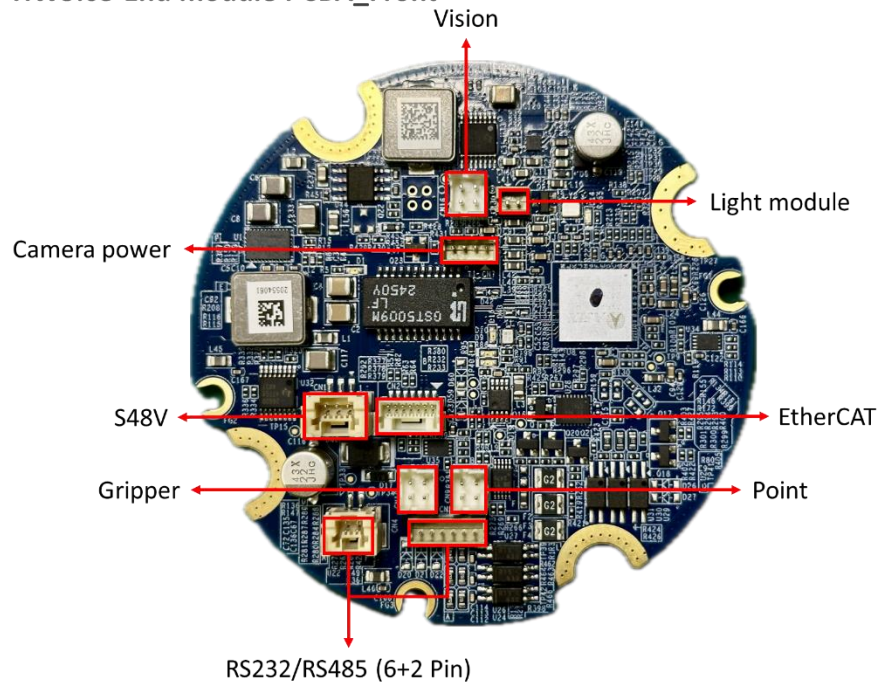
HW5.02 End module PCBA screws –  
T10 Hex socket cap screw

5.14.6 Disconnect all cables. It is strongly recommended to take a photo beforehand for reference.

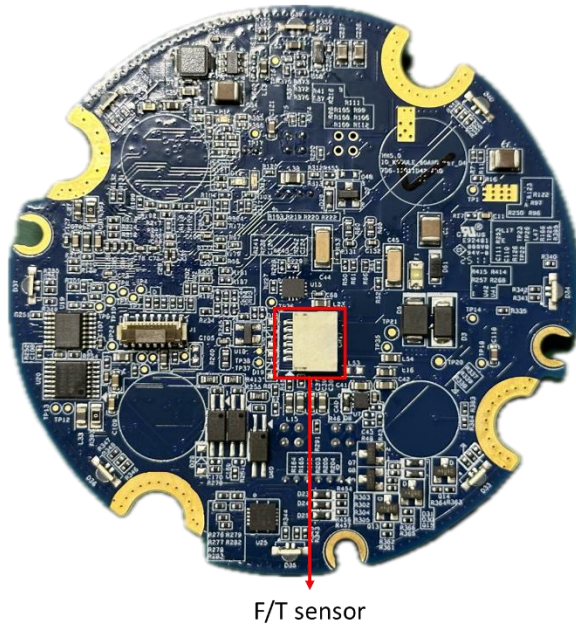
### HW5.02 End module PCBA



### HW5.03 End module PCBA\_Front



### HW5.03 End module PCBA\_Back



F/T sensor

5.14.7 Replace the PCBA with a new one. Reconnect all cables and tighten the 3 screws. The designated torque value for the PCBA screws is 10 kgf.cm.

5.14.8 Reinstall the flange cover. The designated torque value is 72 kgf.cm.

### 5.15 Disassembly and assembly Light module

5.15.1 Refer to the picture below to remove the four screws securing the camera light source module.



5.15.2 Unplug the power cable of the light source module and remove the light source module, being careful not to let the O-ring fall off.



5.15.3 During the assembly of the End module, please follow the reverse steps of the previously mentioned



procedure.

## 5.16 Disassembly and assembly Camera module

5.16.1 Loosen the three M3L10 screws on the camera module, separate the camera module casing from the End module. The torque during assembly is 10 kgf·cm.



5.16.2 Beginning with HW5.03, the original hex cap screws on the end-module PCBA have been replaced with Torx cap screws.

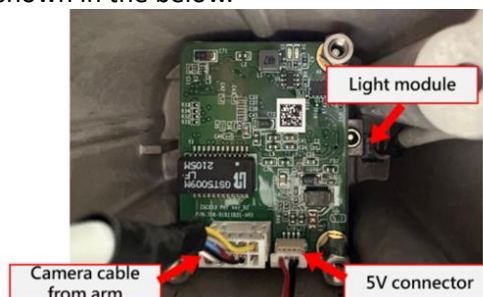


HW5.03 camera housing screws –  
T10 Torx socket screw



HW5.02 camera housing screws –  
T10 Hex socket cap screw

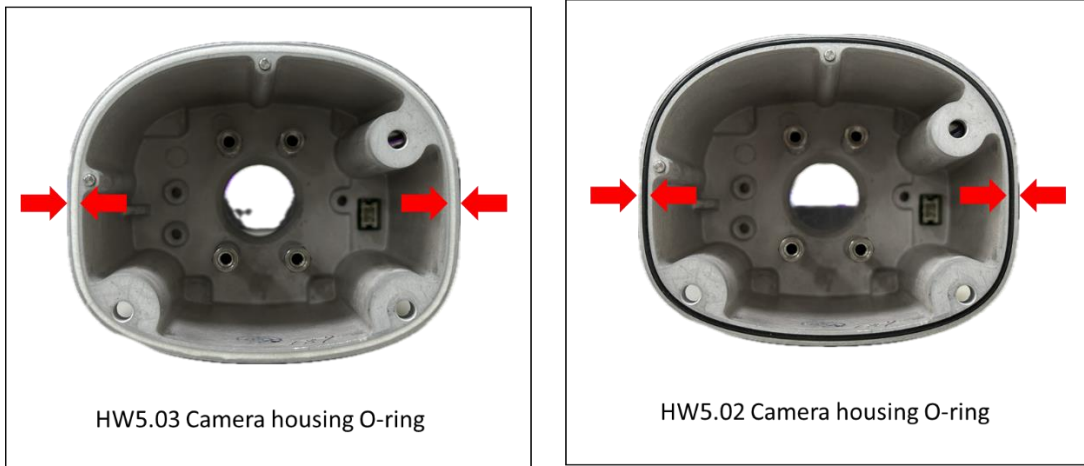
5.16.3 Disconnect the cables as shown in the below.



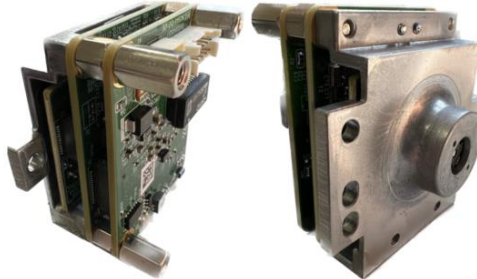
5.16.1 After removing the camera module, take off the three M3L6 screws securing the TRI camera. The torque during assembly is 10 kgf·cm.



5.16.2 Since the HW5.03 robot has an enhanced IP65 rating, the specifications for the O-ring on the camera housing has been revised. The O-ring has been made thicker to enhance the IP protection level (see figure below).



5.16.3 After removing the TRI camera unit (refer to the below picture), replace it directly with a new TRI camera. Do not perform any disassembly or modifications on the components of the unit.

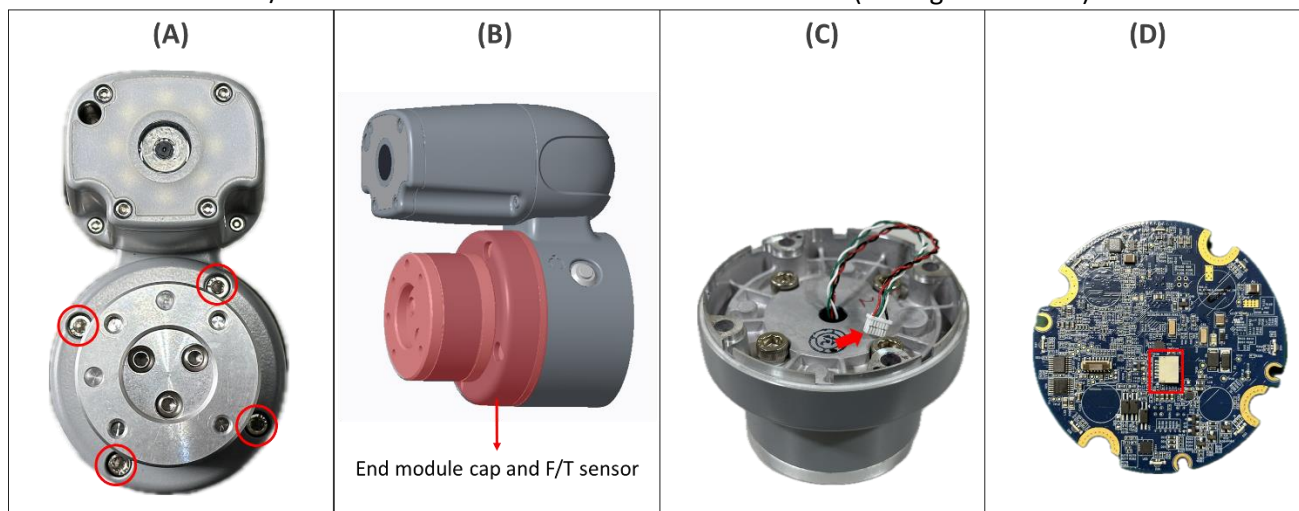


5.16.4 When assembling the camera, please follow the reverse steps of the previously mentioned procedure.

## 5.17 Disassembly and assembly Force/Torque (F/T) sensor

5.17.1 Loosen the 4 flange screws and remove the F/T sensor together with the end module cap. (see Figure A and B)

5.17.2 Disconnect the F/T sensor connector from the end module PCBA. (see Figure C and D)



5.17.3 Do not disassemble the F/T sensor itself or remove F/T sensor from end module cap.

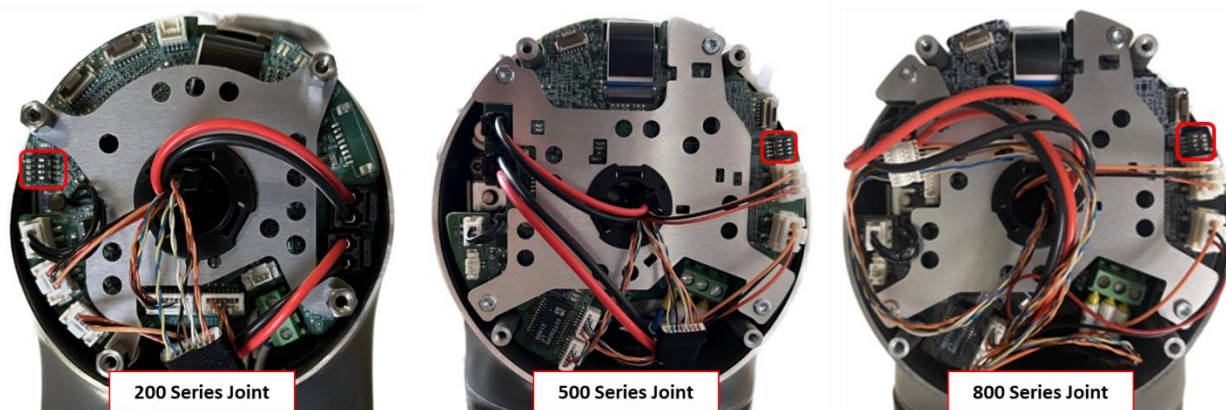
5.17.4 To install an F/T sensor on an HW5.02 robot, replace end module PCBA with the HW5.03 version and replace the old end module cap with the HW5.03 end module cap with F/T sensor.

5.17.5 To install an F/T sensor on an HW5.03 robot that was not originally equipped with one, replace the end module cap with the HW5.03 end module cap with F/T sensor.

5.17.6 The F/T sensor and end module cap are factory-assembled and pre-calibrated by Techman. No user calibration of the F/T sensor is required.

## 5.18 DIP Switch Setting

5.18.1 After replacing or rearranging Joints, use pliers to move the Joint DIP switch to the corresponding position according to the following specifications:



J1	H	ON				
	L					
		1	2	3	4	
J2	H	ON				
	L					
		1	2	3	4	
J3	H	ON				
	L					
		1	2	3	4	
J4	H	ON				
	L					
		1	2	3	4	
J5	H	ON				
	L					
		1	2	3	4	
J6	H	ON				
	L					
		1	2	3	4	



**CAUTION:** Failure to set the DIP switch on the Joint to the specified position may trigger Error Code 0x0000004E or other unexpected errors.

## 5.19 Software Update

### 5.19.1 Notes:

5.19.1.1 If **any** of the following components is replaced—Joints, Patriot power board, or End module (including the End module PCBA)—the user must update the ESI and firmware and run ReinstallRobotId to ensure the robot operates properly.

5.19.1.2 Follow the table below to update ReinstallrobotID, ESI and Firmware(FW) updates:

	ESI update	Firmware update	ReinstallRobotId
Replace Patriot power board	●	●	●
Replace End module (or End module PCBA)	●	●	●
Replace Joints	●	●	○
● Update required ○ Not required			

5.19.1.3 The Robot ID is stored in both patriot power board and end module PCBA. System may trigger error code 0x3C or others if it detects a discrepancy between the robot IDs of those two parts.

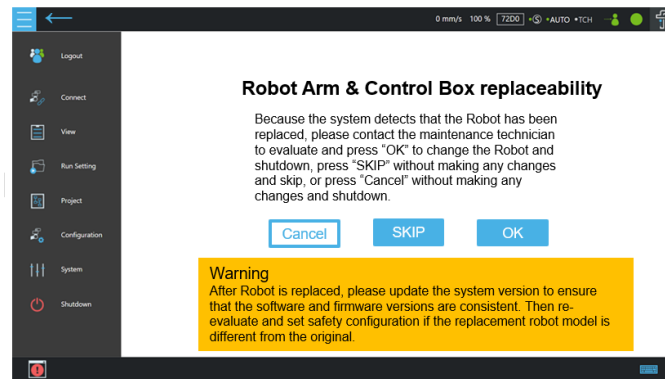
5.19.1.4 Replacing the above-mentioned components without updating the ESI and firmware as required will not trigger errors immediately. However, to prevent potential unforeseen errors caused by inconsistencies in ESI and firmware versions between components or mismatches with the current TM Flow version, it is essential to perform updates after replacing components. This ensures that the ESI and firmware of all components align with the current TM Flow version.

5.19.1.5 Two update methods are provided below. Refer to the table for appropriate applications:

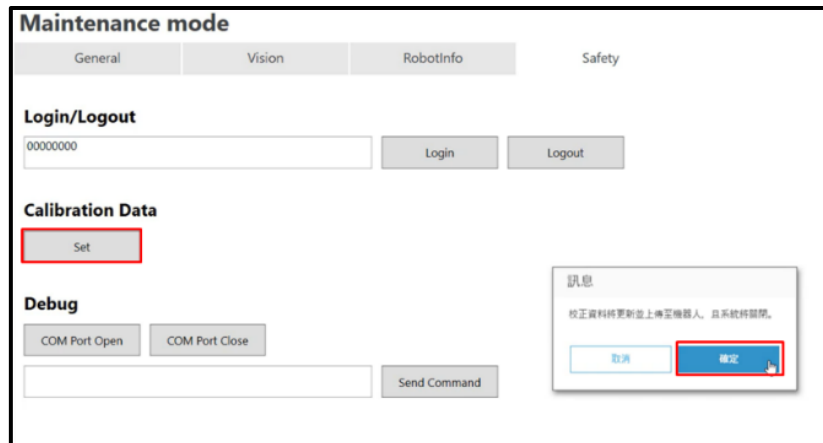
	TM Flow	Manually updating
Patriot power board (new)	●	●
Patriot power board (used)	○	●
End module (new)	●	●
End module (used)	○	●
Joint (new)	●	●
Joint (used)	●	●
● Applicable ○ Not Applicable Both methods require a maintenance dongle.		

#### 5.19.1.6 Restoring the calibration data:

- (a. )Replacing patriot power board: User may see the following screen upon startup after replacing a new patriot power board. Click 'OK' and enter the default password (default 00000000), the control box will reboot and synchronize the calibration data to the patriot power board.

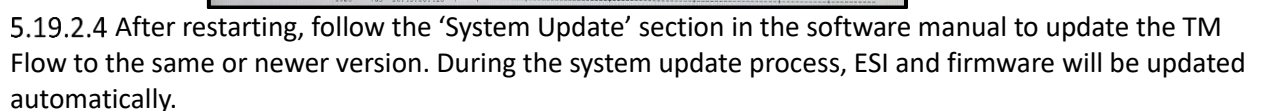
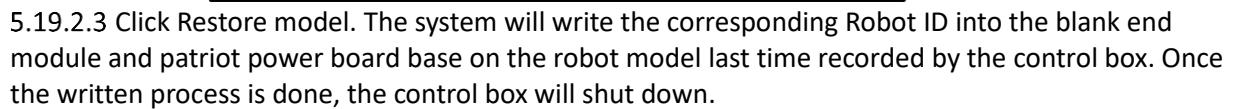


- (b. )Replacing end module: After replacing and new end module, user must enter the maintenance mode (firstly click SKIP on the page 'Robot Arm & Control Box replaceability') and type in the password (default 00000000) and log in. Then, click calibration data 'Set' to upload the calibration data to the end module PCBA.





5.19.2.2 After replacing brand-new end module or patriot power board, since these components do not initially have a Robot ID written into them, the system will display the following error screen (Error code 0x3C) when it detects that the Robot ID in these components does not match the robot model.




### 5.19.3 Manually updating Robot ID, ESI and Firmware:

#### 5.19.3.1 Enter Windows:

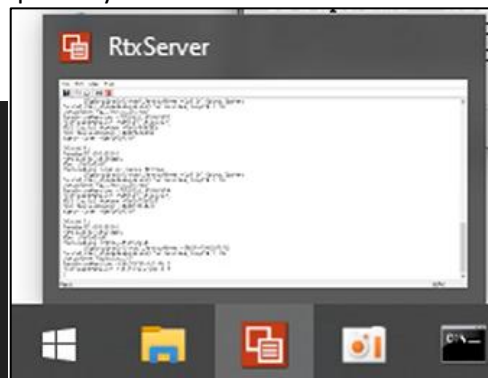
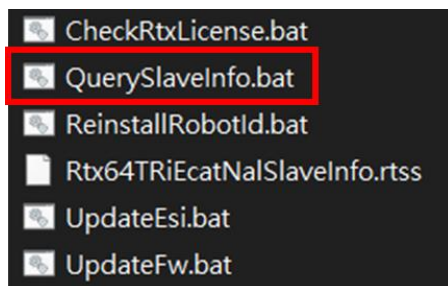
- (a.) While the control box is powered off, press the emergency stop button and insert the maintenance dongle to the control box. After powering on, TM Flow will display error codes due to the emergency stop cutting off the power between control box and the robot arm. Click 'Exit' at the bottom left of the screen to enter Windows.



**Warning:** After entering Windows, release the emergency stop button. Once released, check if the end module indicator light is blinking. If the light is not blinking, it indicates that the control box is not correctly connected to the robot arm. Do not proceed with the subsequent steps and prioritize troubleshooting the issue.

- (b.) Starting from TM Flow version 2.20, when the user inserts the maintenance dongle, a new option will appear in the left function bar. Clicking this option  allows the user to access the Windows operating system.

5.19.3.2 Before proceeding with the update process for the ESI and firmware, make sure that the number of slaves and the device sequence are correct. Click on QuerySlaveInfo.bat to verify the slave count. **Do not proceed** with the following steps if any errors are shown.

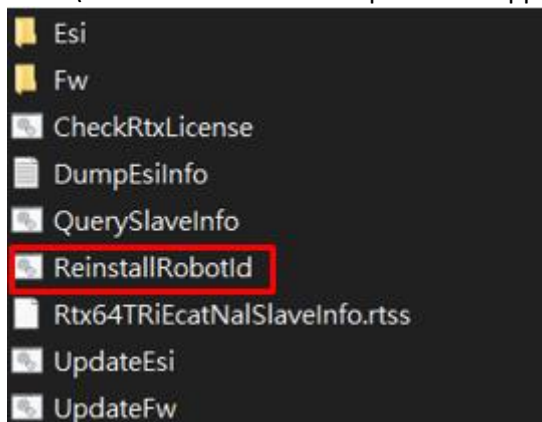


- (a.) Click QuerySlaveInfo.bat and click the red icon on the toolbar to show more details

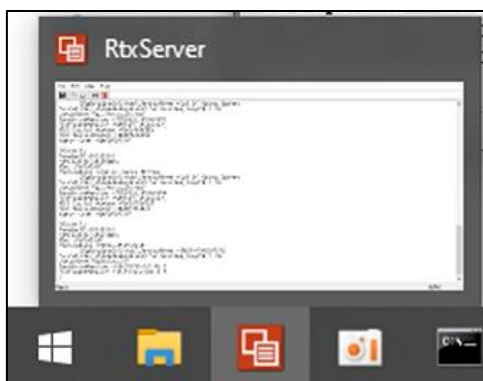


(b.) Check if any errors are shown. Under normal conditions, all slaves should be detected. The last one should be the EcatPatriotSafetyMonitor, with its sequence number as slave[8].

5.19.3.3 ReinstallrobotID: After replacing **Patriot power board** or **End module (or End module PCBA)**, the robot ID should be updated. Enter Windows, run the file 'ReinstallRobotID' located in the path: D:\Techman Robot\TM Flow\ModuleRelease. This step can be skipped if only joints were replaced.



(a.)Click ReinstallRobotId.bat

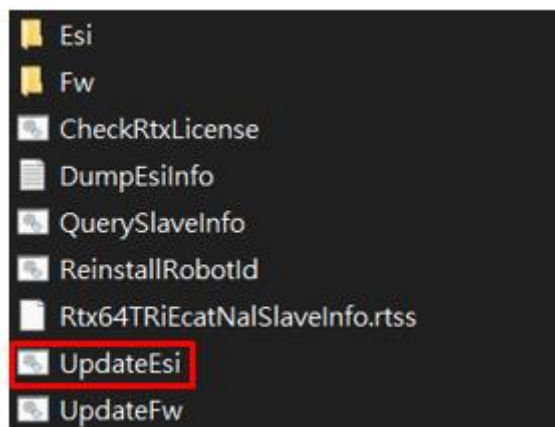


(b.)Click the red icon on the toolbar to show more details

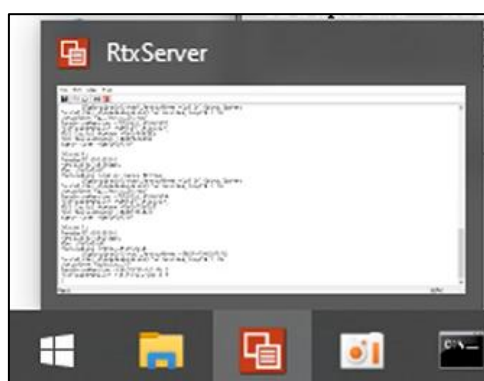


(c.) Close the window after viewing the result.

5.19.3.4 UpdateEsi: After entering Windows, run the file 'UpdateEsi' located in the path: D:\Techman Robot\TM Flow\ModuleRelease.



(a.) Click UpdateEsi.bat

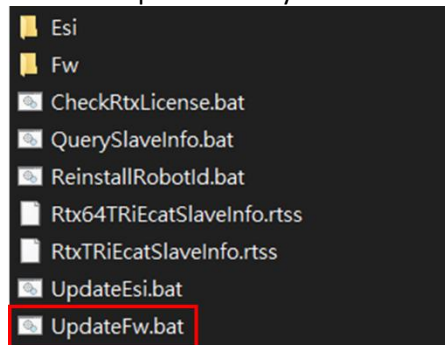


(b.) Click the red icon on the toolbar to show more details

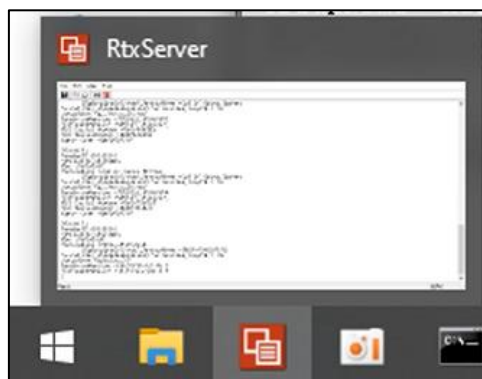


(c.) Close the window after viewing the result.

5.19.3.5 UpdateFW: After entering Windows, run the file 'UpdateFW' located in the path: D:\Techman Robot\TM Flow\ModuleRelease. **Once the firmware update is complete, completely power off the control box and robot arm.** It is recommended to unplug the external power cable after shutting down and then plug it back in to ensure the power is fully turned off before restarting.



(a.) Click UpdateFw.bat

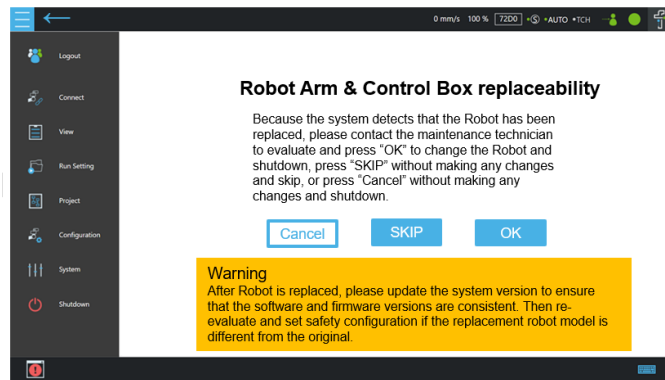


(b.) Click the red icon on the toolbar to show more details



(c.) Close the window after viewing the result.

5.19.3.6 When the ESI and FW update processes are complete, the user may encounter the replaceability screen after powering up (as shown below). Select **SKIP**, complete the designated calibration processes, and synchronize the calibration data.



## 6. Disassembly /Assembly Control Box

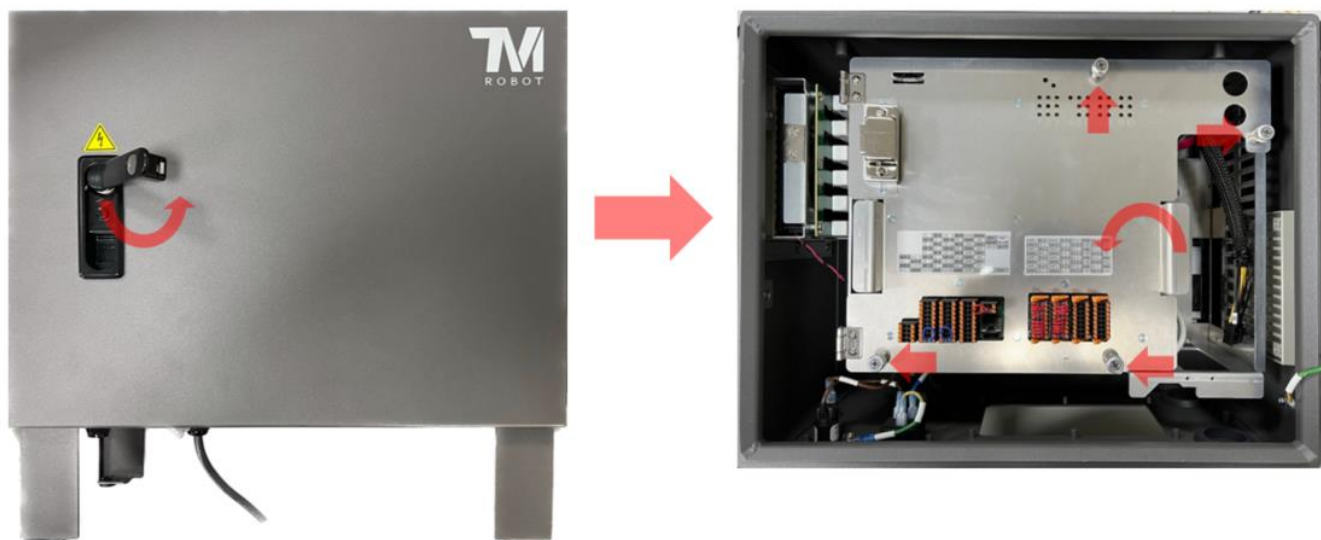
### 6.1 Quick maintenance guide

- 6.1.1 To ensure operational safety, at least two persons are required to collaborate in the disassembly process.
- 6.1.2 Before disassembly, place the control box on a soft surface (such as a blanket or sponge pad) for disassembly.
- 6.1.3 Before disassembly, take photos to record the status and wiring method when not disassembled.
- 6.1.4 Follow the right-hand rule when disassembling and installing screws.
- 6.1.5 When installing components, refer to the wiring photos or the wire photos taken before disassembly. Install the wires and ensure proper cable management.
- 6.1.6 When installing components, use a torque wrench to tighten the parts according to the torque specifications table below:

Torque specifications for Control board		
Item	torque value(Kgf.cm)	torque value(Nm)
IPC	6	0.6
Patriot power board	6	0.6
Relay board	6	0.6
Power eater board	6	0.6
PSU cable	10	0.98
PSU Bracket	14	1.37
SSD Bracket	14	1.37

### 6.2 Open the Control Box Outer Casing

- 6.2.1 Before opening the outer casing of the control box, ensure that the control box is completely powered off, and disconnect the external power cord and robot cable.
- 6.2.2 Open the outer casing cover of the control box, loosen the four inner casing screws, and open the inner casing cover.

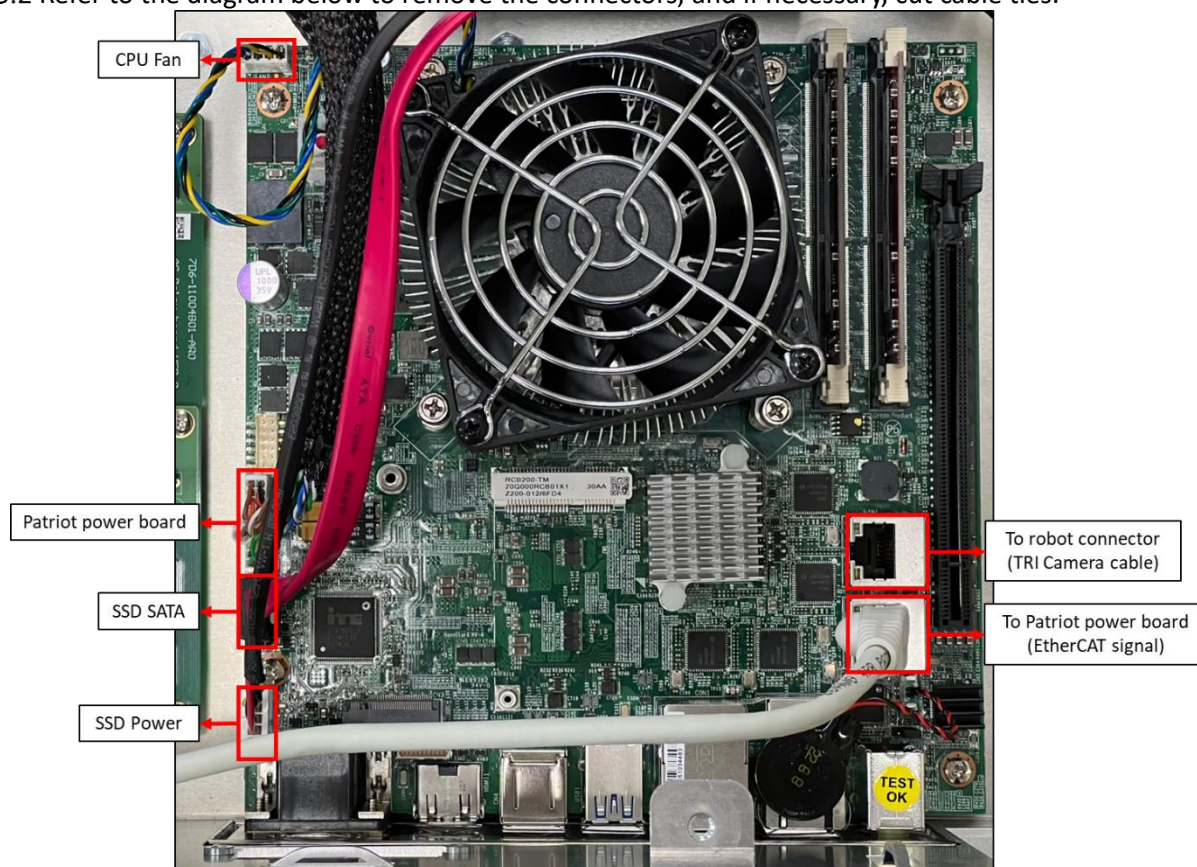




## 6.3 Disassembly/Assembly of IPC

6.3.1 Refer to "Open the Control Box Outer Casing" to open the outer casing cover and inner casing cover.

6.3.2 Refer to the diagram below to remove the connectors, and if necessary, cut cable ties.



6.3.3 Loosen the four screws securing the IPC.



6.3.4 During installation, follow the reverse steps of the above procedure. If cable ties were cut, secure the wires again in the original manner.



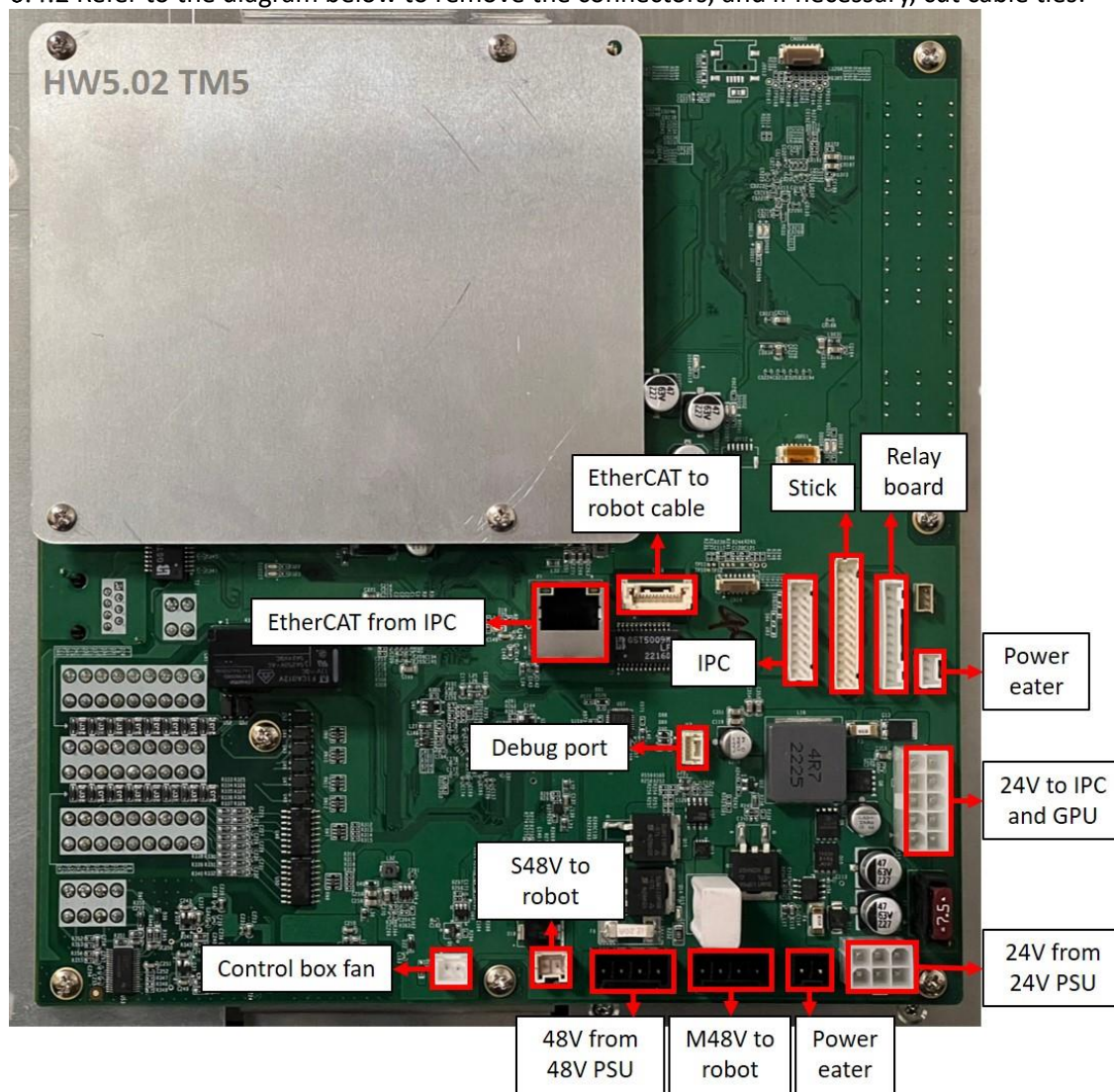
## 6.4 Disassembly/Assembly of the Patriot Power Board

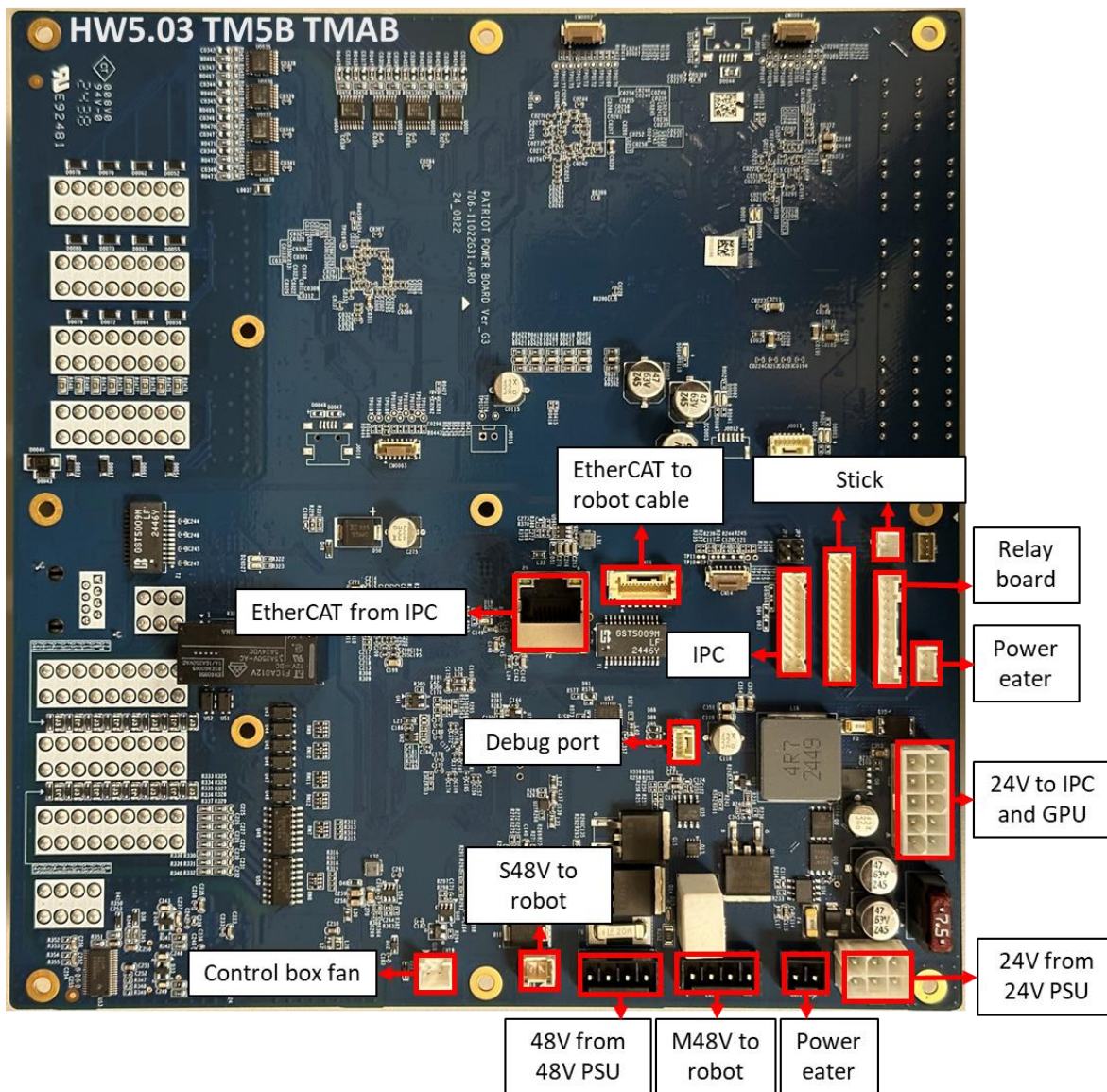


**Caution:** Replacing the Patriot power board will reset the Safety settings in the TM flow, please refer to the Safety settings section in the software manual for saving and recovery.

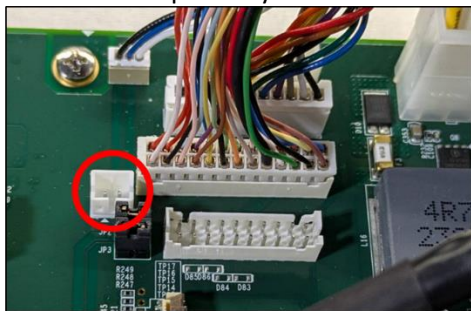
6.4.1 Refer to "Open the Control Box Outer Casing" to open the outer casing cover and inner casing cover.

6.4.2 Refer to the diagram below to remove the connectors, and if necessary, cut cable ties:



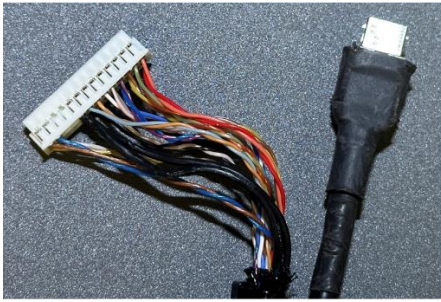


6.4.3 When an HW5.02 Stick is installed on an HW5.03 Patriot power board, the 2pins connectors socket shown below do not require any cable connections. (See Figure below)

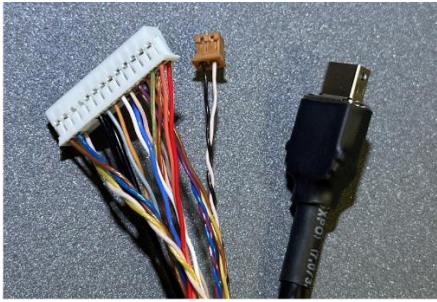


HW5.02 Stick + HW5.03 Patriot power board





HW5.02 Stick connector



HW5.03 Stick connector

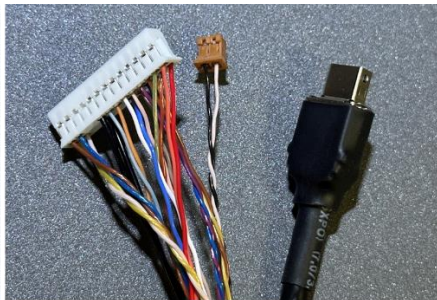
6.4.4 When an HW5.03 Stick is installed on an HW5.02 Patriot power board, the 2 pins do not require any connector connections. (See Figure below)



HW5.03 Stick + HW5.02 Patriot power board

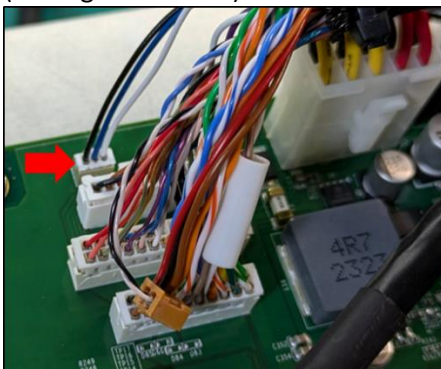


HW5.02 Stick connector

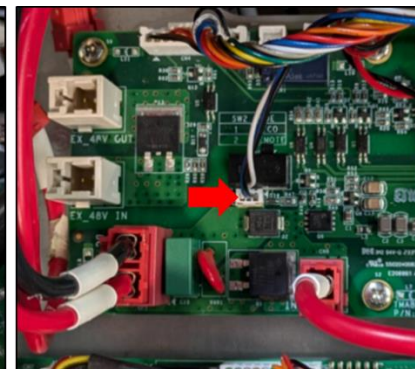


HW5.03 Stick connector

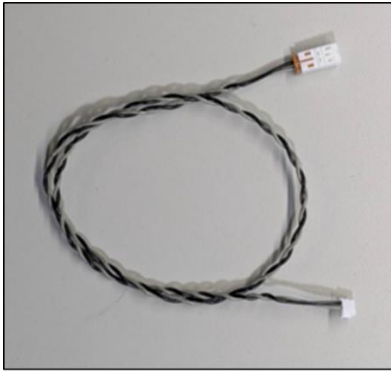
6.4.5 When using an HW5.03 Stick with an HW5.02 DC Patriot power board, the cable between the relay board (see Figure B) and the Patriot power board (see Figure A) must be replaced. Disconnect the existing cable from both the relay board and the Patriot power board, then connect the new cable from the Stick to the relay board. (see Figure C and D).



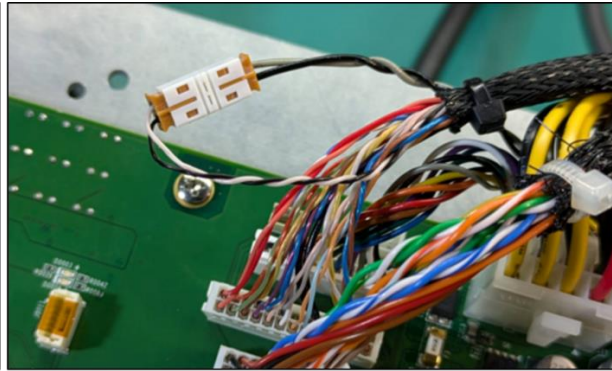
(A)



(B)

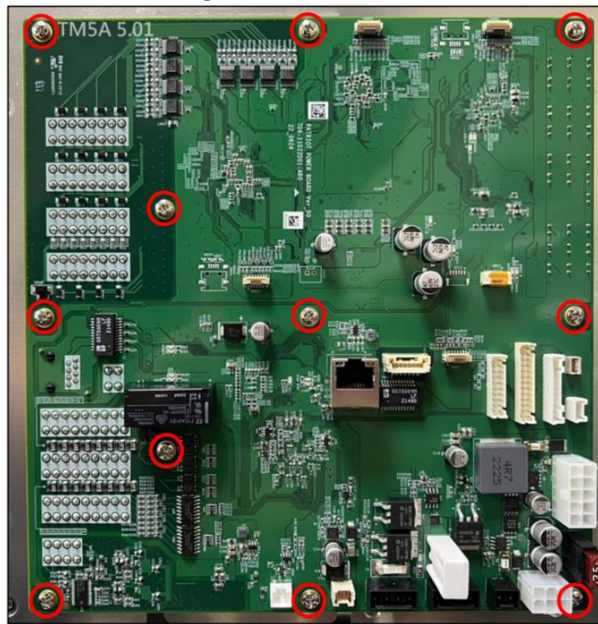


(C)



(D)

6.4.6 Loosen the 11 screws securing the Patriot Power Board.



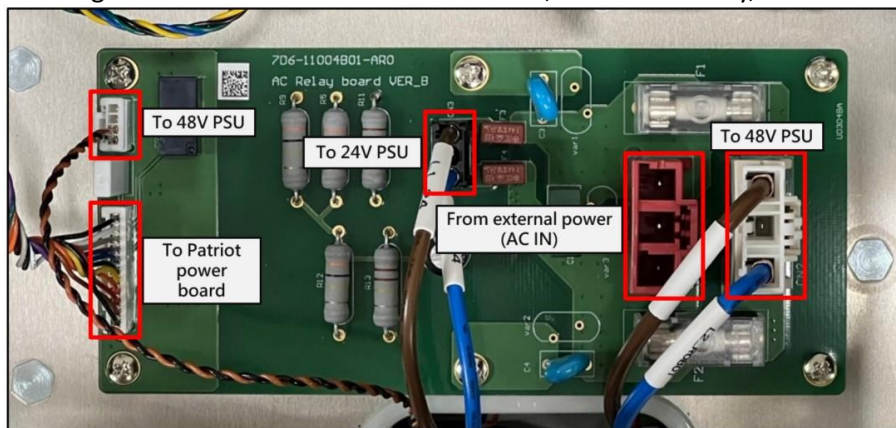
6.4.7 During installation, follow the reverse steps of the above procedure. If cable ties were cut, secure the wires again in the original manner



## 6.5 Disassembly/Assembly Relay board

6.5.1 Refer to "Open the Control Box Outer Casing" to open the outer casing cover and inner casing cover.

6.5.2 Refer to the diagram below to remove the connectors, and if necessary, cut cable ties



6.5.3 Loosen the 6 screws securing the Relay Board.



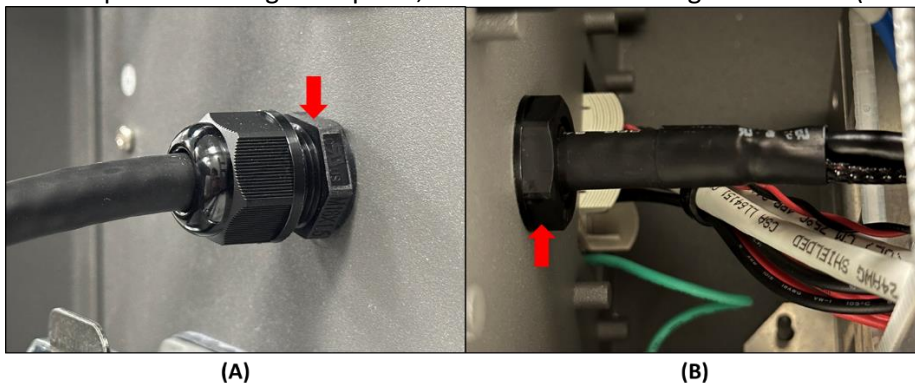
6.5.4 During installation, follow the reverse steps of the above procedure. If cable ties were cut, secure the wires again in the original manner

## 6.6 Disassembly/Assembly Stick

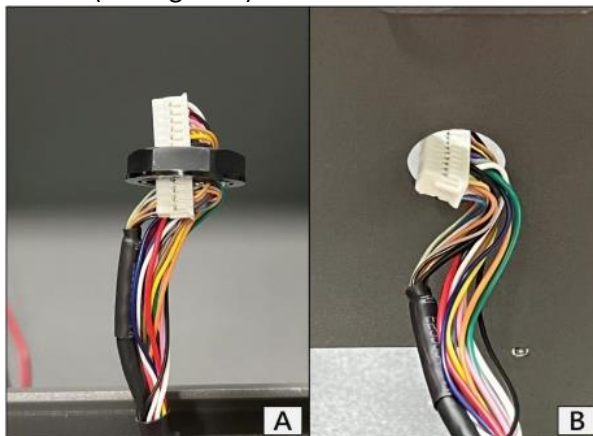
6.6.1 Refer to "Open the Control Box Outer Casing" to open the outer casing cover and inner casing cover

6.6.2 Disconnect the stick connector on patriot power board.

6.6.3 Using an adjustable spanner or long-nose pliers, hold the outer hexagonal locknut (see Figure A). With another adjustable spanner or long-nose pliers, loosen the inner hexagonal locknut (see Figure B).



6.6.4 Gently bend the Stick connector and carefully thread it, in sequence, through the hexagonal locknut (see Figure A) and then through the control box (see Figure B) to remove the Stick.



6.6.5 During installation, follow the reverse steps of the above procedure. If cable ties were cut, secure the wires again in the original manner



## 6.7 Disassembly/Assembly of Robot Connector and Internal Composite Cable

6.7.1 Refer to "Open the Control Box Outer Casing" to open the outer casing cover and inner casing cover

6.7.2 Refer to "Disassembly/Assembly of the Patriot Power Board" to remove the "To Robot connector (Servo 48V)" connector.

6.7.3 Refer to "Disassembly/Assembly of the Patriot Power Board" to remove the "To Robot connector (Motor 48V)" connector.

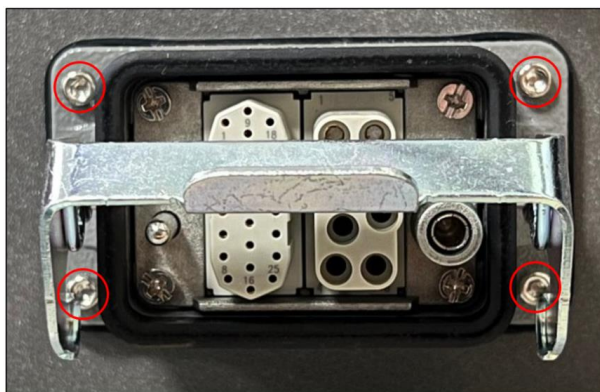
6.7.4 Refer to "Disassembly/Assembly of the Patriot Power Board" to remove the "To Robot connector (EtherCAT)" connector.

6.7.5 Refer to "Disassembly/Assembly of IPC" to remove the "To Robot connector (Camera)" connector.

6.7.6 Remove the grounding cable as shown in the diagram.



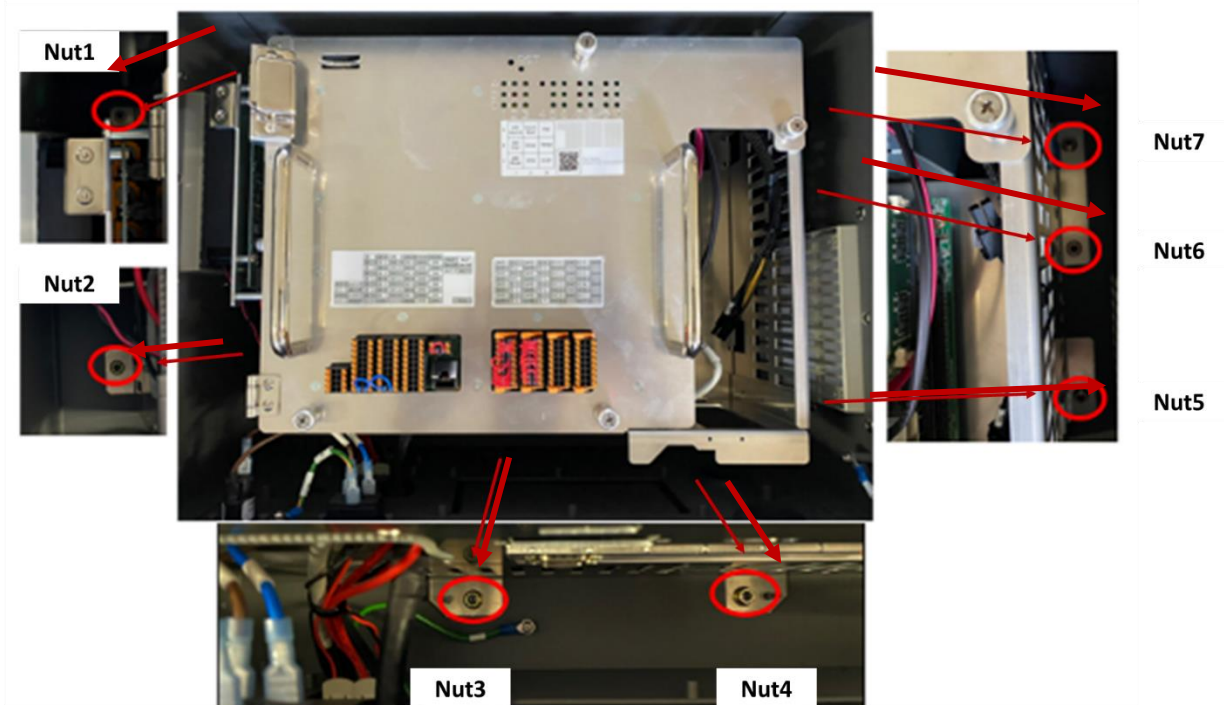
6.7.7 Remove the four Robot connector screws shown in the diagram and take out the internal composite cable.



6.7.8 During installation, follow the reverse steps of the above procedure. If cable ties were cut, secure the wires again in the original manner

## 6.8 Disassembly/Assembly of Inner Casing

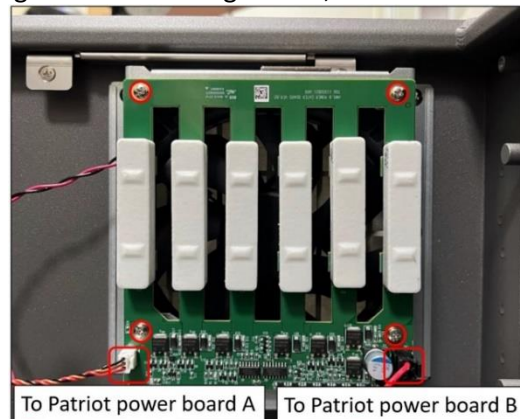
- 6.8.1 Refer to "Open the Control Box Outer Casing" to open the outer casing cover and inner casing cover
- 6.8.2 Refer to "Disassembly/Assembly of Robot Connector and Internal Composite Cable" to remove the Robot connector and internal composite cable.
- 6.8.3 Refer to "Disassembly/Assembly of the Patriot Power Board" to remove the "To Power eater board A" connector.
- 6.8.4 Refer to "Disassembly/Assembly of the Patriot Power Board" to remove the "To Power eater board B" connector.
- 6.8.5 Refer to "Disassembly/Assembly of the Patriot Power Board" to remove the "To Control box fan" connector.
- 6.8.6 Refer to "Disassembly/Assembly of the Relay Board" to remove the "From external power (AC IN)" connector.
- 6.8.7 Refer to the diagram below to remove the 7 inner casing securing nuts and take out the inner casing.
- 6.8.8 During installation, follow the reverse steps of the above procedure. If cable ties were cut, secure the wires again in the original manner



## 6.9 Disassembly/Assembly of Power Eater Board

6.9.1 Refer to "Disassembly/Assembly of Inner Casing" to remove the inner casing.

6.9.2 Refer to the diagram below to remove the connectors "To Patriot power board A" and "To Patriot power board B". After removing the four securing screws, take out the Power Eater Board.

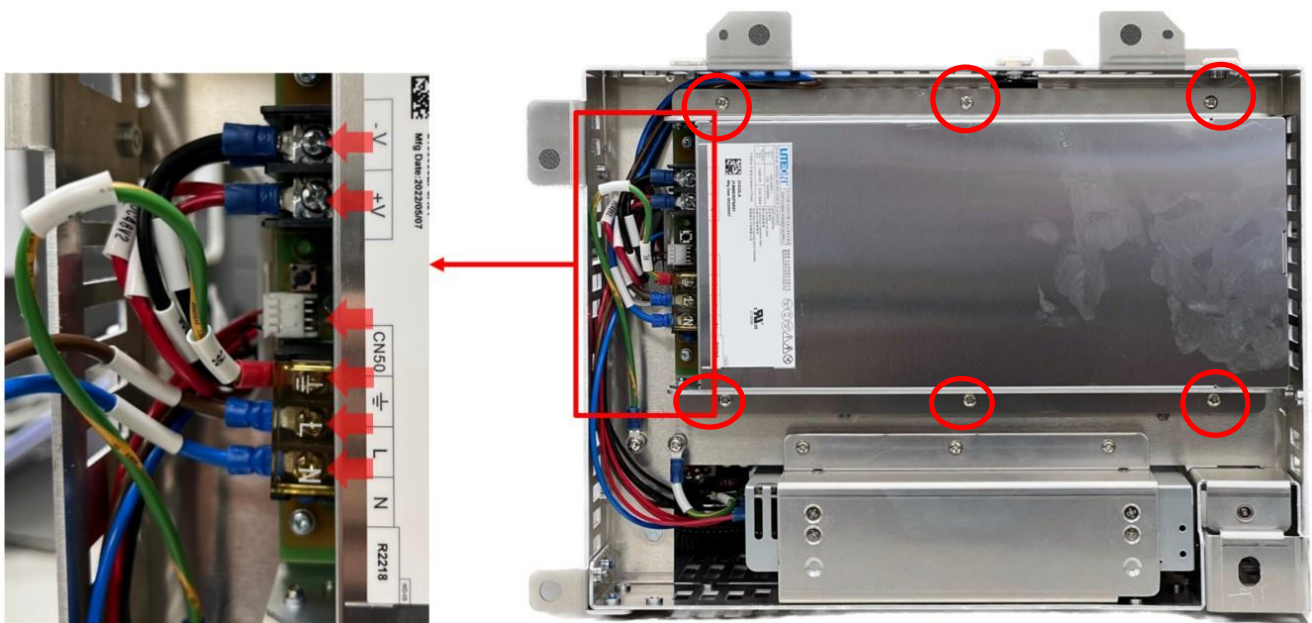


6.9.3 During installation, follow the reverse steps of the above procedure. If cable ties were cut, secure the wires again in the original manner.

## 6.10 Disassembly/Assembly of 48V PSU

6.10.1 Refer to "Disassembly/Assembly of Inner Casing" to remove the inner casing.

6.10.2 Refer to the diagram below to disconnect the wiring.



6.10.3 Refer to the diagram below to remove the six securing screws and take out the 48V PSU with the bracket.

6.10.4 Refer to the diagram below to remove the six securing screws and take out the 48V PSU.



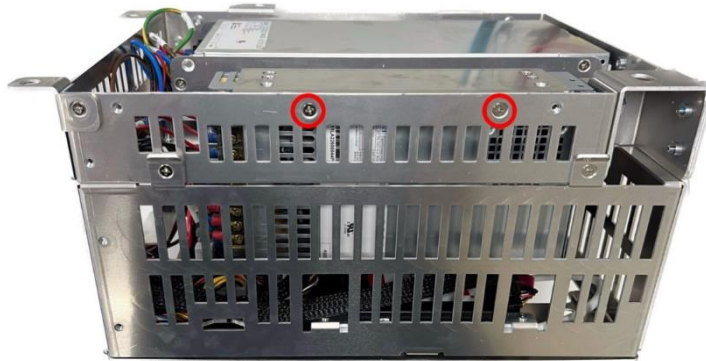
6.10.5 During installation, follow the reverse steps of the above procedure. If cable ties were cut, secure the wires again in the original manner



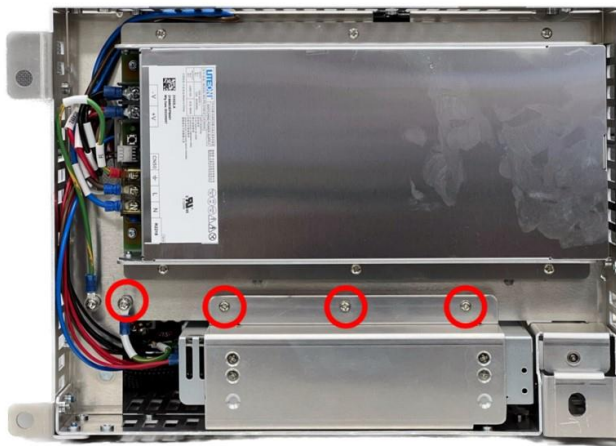
## 6.11 Disassembly/Assembly of 24V PSU

6.11.1 Refer to "Disassembly/Assembly of Inner Casing" to remove the inner casing.

6.11.2 Refer to the diagram below to remove the two securing screws.



6.11.3 Refer to the diagram below to remove the three securing screws and one grounding wire screw.



6.11.4 Refer to the diagram below to disconnect the wiring and take out the 24V PSU with the bracket.



6.11.5 Refer to the diagram below to remove the six bracket securing screws and take out the 24V PSU.



6.11.6 During installation, follow the reverse steps of the above procedure. If cable ties were cut, secure the wires again in the original manner

## 6.12 Disassembly/Assembly of Filter

6.12.1 Slide the tray upward along the tray slide to remove it

6.12.2 Remove the filter and replace it with a new one.



6.12.3 Reinstall the tray.

## 7. Light Indication

### 7.1 Power board Light Indication

#### LED Position



#### LED Position Corresponding Function

A	24V Source	Heart-beat	PW!
B	48V PSU	Error	Temp!
C	48V Mode	STO!	ECAT!
	1	2	3

LED Position	LED Name	LED Status Description
A1	24V Source	Off = External 24V
		On = Internal 24V
		100ms/100ms Rapid Blink = Internal 24V Error
		500ms/500ms Blink = Internal 24V Current Exceeded
B1	48V PSU	Off = PSU off
		On = (Reserved)
		500ms/500ms Blink = PSU on
C1	48V Mode	Off = 48V off
		On = Normal Mode
		500ms/500ms Blink = Limit Mode
A2	HeartBeart	Off = FW Stuck or Abnormal Protection Pause
		On = FW Stuck
		500ms/500ms Blink = Running
B2	Error	Off = Normal
		100ms/100ms Rapid Blink = ESC Not Ready
		500ms/500ms Blink = Abnormal Protection Pause
		Coding = Error code (Reserved)
C2	STO Alarm	Off = Normal
		On = STO (ESM<OP)
		100ms/100ms Rapid Blink = STO (Low Voltage)
		500ms/500ms Blink = STO (Patriot Act.)
A3	Power Alarm	Off = Normal
		On = 48V & 24V Warning
		100ms/100ms Rapid Blink = 48V Warning
		500ms/500ms Blink = 24V Warning
B3	Temperature Alarm	Off = Normal
		On = PCB & Eater Warning
		100ms/100ms Rapid Blink = PCB Warning
		500ms/500ms Blink = Eater Warning
C3	EtherCAT Alarm	Off = Normal
		On = Packet Loss Warning
		100ms/100ms Rapid Blink = InvalidFrame or RxErr or PUErr counted
		500ms/500ms Blink = PDIErr counted
		1000ms/1000ms Slow Blink = Forwarded RxERR counted



## 7.2 End module Indication Light Ring

### 7.2.1 Special Light Indication

Initializing:	Alternating between Red and Light Off equally
Power On with STO status:	Failed to finish booting up and Light Off (Buzzer no beep)
Power On with SOS status:	Finished booting up and the light indicated as the tables below.
Robot in STO status:	Light Off (Buzzer no beep)
Robot in SOS status:	Light indicated as the tables below.
Updating:	Alternating between Red and Light Off equally (at doubled speed)
Fatal Error(Need to re-boot):	Solid Red Light (Buzzer emits a long beep)

#### NOTE:

STO (Safe Torque Off)\* status condition includes:

1. Category 0 Stop.
2. Category 1 Stop.
3. Emergency Stop function input LOW signal.

SOS (Safe Operation Stop)\* status condition includes:

1. Safeguard function Input LOW signal.
2. Enabling Switch function at OFF Status.
3. Under safety configuration status of either safety-related parameters parameterization, Robot Stick MODE Switch function or Enable/Disable of Robot Stick function.

Refer to *Safety Manual* for details.

\*Both names come from IEC 61800-5-2.

#### NOTE:

The different Light Indication of HW3.2 here are:

AUTO Mode: Blue

Recovery Mode: (Not provided in HW3.2)

Maintenance Setting: White

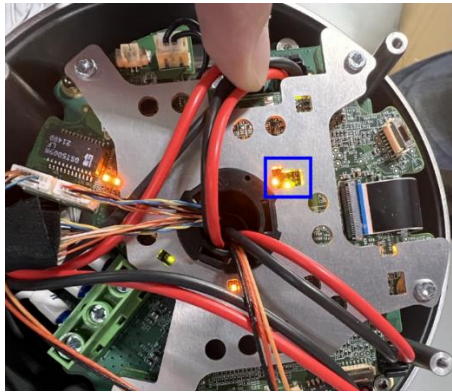
### 7.2.2 Regular Light Indication

The regular Light Indication alternates between 2 categories of light indication: Operation Mode Light Indication and Auxiliary Light Indication. The blinking ratio of the light indications indicates the various status of the robot. In addition, the display color of Auxiliary Light Indication prioritizes by conditions.

Operation Mode	Running status	Space/Status	Operation Mode Light Indication	Auxiliary Light Indication
MANUAL MODE	Hold to Run or Step Run	Normal	Green (100%)	-
		Error	Green (50%)	Red (50%)
		In Recovery Mode	Green (50%)	Yellow (50%)
		Trigger Maintenance Settings	Green (90%)	Blue (10%)
		Trigger Human-Machine Safety Settings	Green (90%)	Purple (10%)
	Project is running	Normal	Green (50%)	Light Off (50%)
		Error	Green (50%)	Red (50%)
		In Recovery Mode	Green (50%)	Yellow (50%)
Operation Mode	Running status	Space/Status	Operation Mode Light Indication	Auxiliary Light Indication

		Settings		
		Trigger Human-Machine Safety Settings	Green (50%)	Purple (50%)
	System under SOS status	Normal	Green (10%)	Light Off (90%)
		Error	Green (50%)	Red (50%)
		In Recovery Mode	Green (50%)	Yellow (50%)
		Trigger Maintenance Settings	Green (10%)	Blue (90%)
		Trigger Human-Machine Safety Settings	Green (10%)	Purple (90%)
AUTO MODE	Project is not running	Normal	White (100%)	-
		Error	White (50%)	Red (50%)
		In Recovery Mode	White (50%)	Yellow (50%)
		Trigger Maintenance Settings	White (90%)	Blue (10%)
		Trigger Human-Machine Safety Settings	White (90%)	Purple (10%)
	Project is running	Normal	White (50%)	Light Off (50%)
		Error	White (50%)	Red (50%)
		In Recovery Mode	White (50%)	Yellow (50%)
		Trigger Maintenance Settings	White (50%)	Blue (50%)
		Trigger Human-Machine Safety Settings	White (50%)	Purple (50%)
	Paused in Project or system under SOS status	Normal	White (10%)	Light Off (90%)
		Error	White (50%)	Red (50%)
		In Recovery Mode	White (50%)	Yellow (50%)
		Trigger Maintenance Settings	White (10%)	Blue (90%)
		Trigger Human-Machine Safety Settings	White (10%)	Purple (90%)

### 7.3 Joint LED Indication



LED Indicator Locations on the Arm Mainboard Assembly

Status		Servo LED (Green)	Error LED (Red)
MCU power on		NA	NA
Error		Error Slow Blink	Flashes with Error code
FW integrity Fail	Bootstrap	Flashes: Off/On (0.042/0.042 sec)	Always On
	Failsafe	Flashes: Off/On (0.168/0.168 sec)	Always On
Without FW		Never On	Never On
Servo on		Fast Blink	Never On
Servo off		Slow Blink	Never On

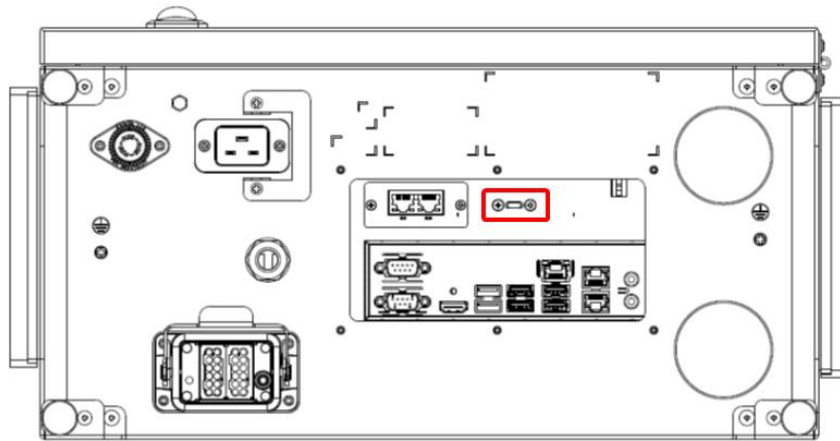
## 8. Other Software for support functions

### 8.1 Debug port

#### 8.1.1 Tool list

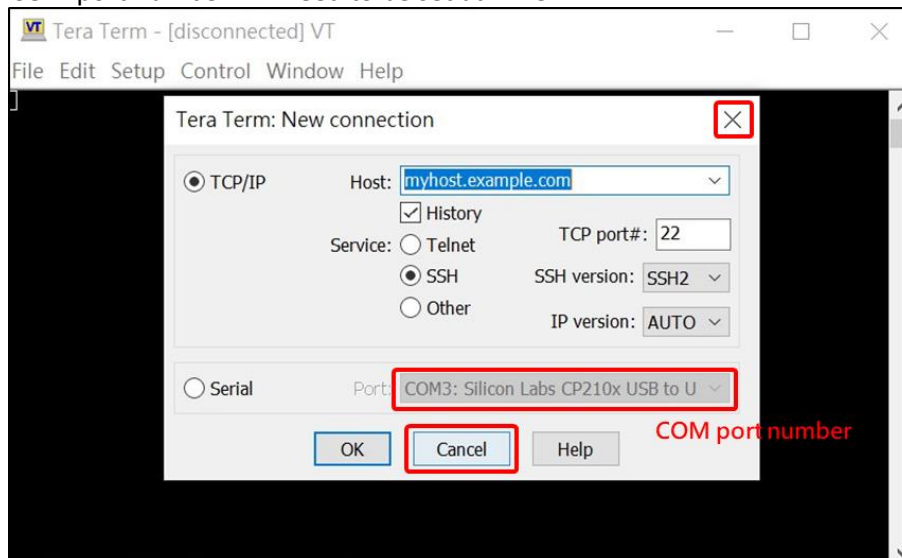
Item	Description
Laptop	Used for installing Tera term and CP2102 driver
USB cable	Used for connecting control box and laptop. <b>Type C to Type A</b> is recommended <b>*Need data transfer function</b>
CP2102 *Software	To ensure that the laptop correctly detects the debug port Recommended download link: <a href="https://www.silabs.com/developers/usb-to-uart-bridge-vcp-drivers?tab=downloads">https://www.silabs.com/developers/usb-to-uart-bridge-vcp-drivers?tab=downloads</a>
Tera term *Software	Used for establishing the connection and displaying the information Recommended download link: <a href="https://ttssh2.osdn.jp/index.html.en">https://ttssh2.osdn.jp/index.html.en</a>

#### 8.1.2 Power up the control box and connect it to the laptop by using a USB cable.

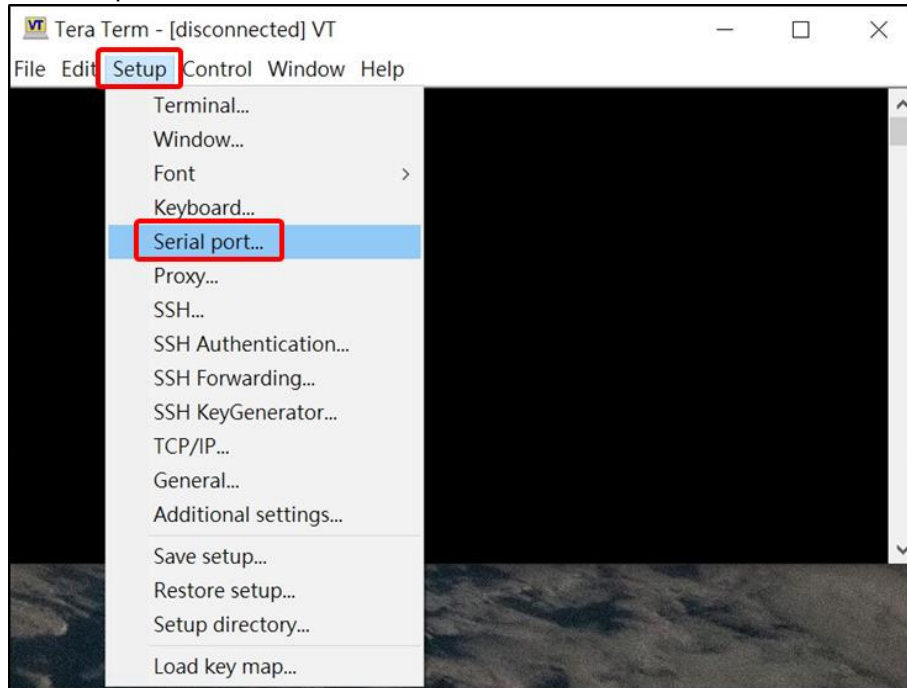


#### 8.1.3 Activate Tera Term and then close the pop-up window by selecting "Cancel" or "Close"

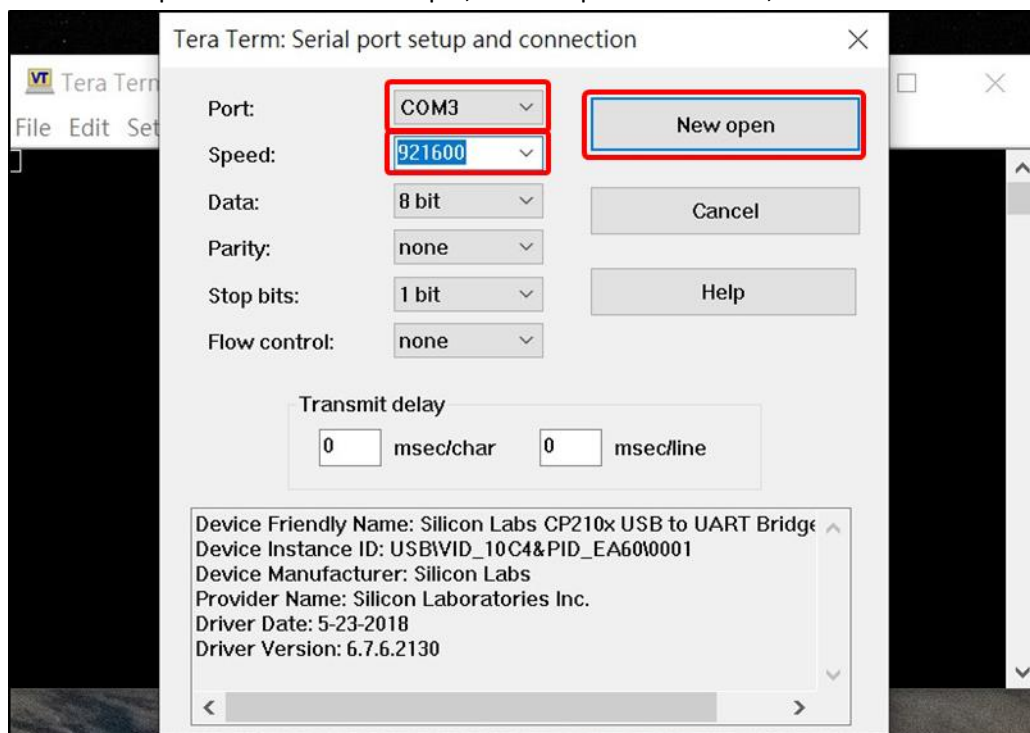
\*The COM port number will need to be set at 7.1.5



#### 8.1.4 Choose "Setup" and then select "Serial Port"



#### 8.1.5 Choose the port as indicated in step 2; set the speed to 921600, and then click on "New open"



#### 8.1.6 Following screen indicates a successful connection.



```
VT COM3 - Tera Term VT
File Edit Setup Control Window Help

=== Techman Robot status console ===
Model = TMB (0x02) AC 220V (max 80.000000A)
H/W = 20230301-G5.Hx.0 PID = 0x02081E20
F/W = 20230717-040.0.0 Date = Jul 17 2023
ESC Status :----P0-P1-P2-P3-----FSW-----
          IF 00 00 00 00 | PU      Init
          RxE 00 00 00 00 | 00     Pre-OP
          FRxE 00 00 00 00 | PDI   Safe-OP
          LL 00 00 00 00 | 00      OP

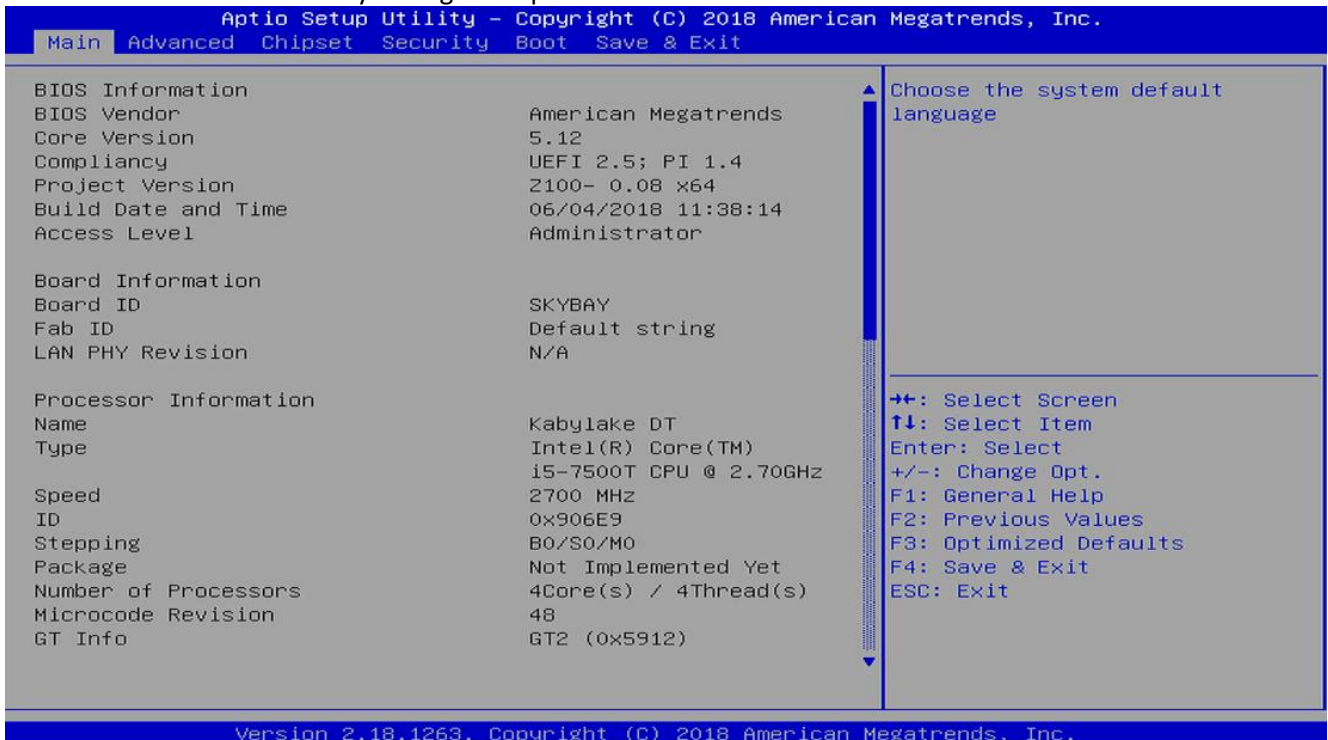
POWER key : OFF ON
Peripheral Comm. Status : ESC ADC DAC1 DAC2 EEPROM
FAN state : OFF ON
48V Power Status : +exPSU PSU on Limited Full
PSU voltage = 48.252895 V(1st), 47.871837 V(2nd)
ST0 voltage = 0.084678 V Patriot not ready
m48 voltage = 0.155244 V
m48 current = -0.166500 A
s48 voltage = 48.000000 V
s48 current = 0.032351 A
24V Power Status : Internal External
IPC voltage = 24.232601 V
i24 current = 0.030689 A
s24 current = 1.647949 A
Temperature = 34.413806 C
Configurable Digital I/O : Normal Configured Mask = 00000000
Digital Output[15..0] = 0000 (....) enabled
Digital Input[15..0] = 0000 (....) Input filter : disabled
Analog Output[0] = 0000 ( 0.000000 V) enabled ----+
Analog Output[1] = 0000 ( 0.000000 V) enabled ----+
Analog Input[0] = 7FF8 (-0.002656 V)
Analog Input[1] = 8000 (-0.000156 V)
Analog Input[2] = 8001 (-0.000781 V) <-----+
Analog Input[3] = 8000 ( 0.000156 V) <-----+

--- INFORMATION list ---
--- CAUTION list ---
--- WARNING list ---
=== End ===
```

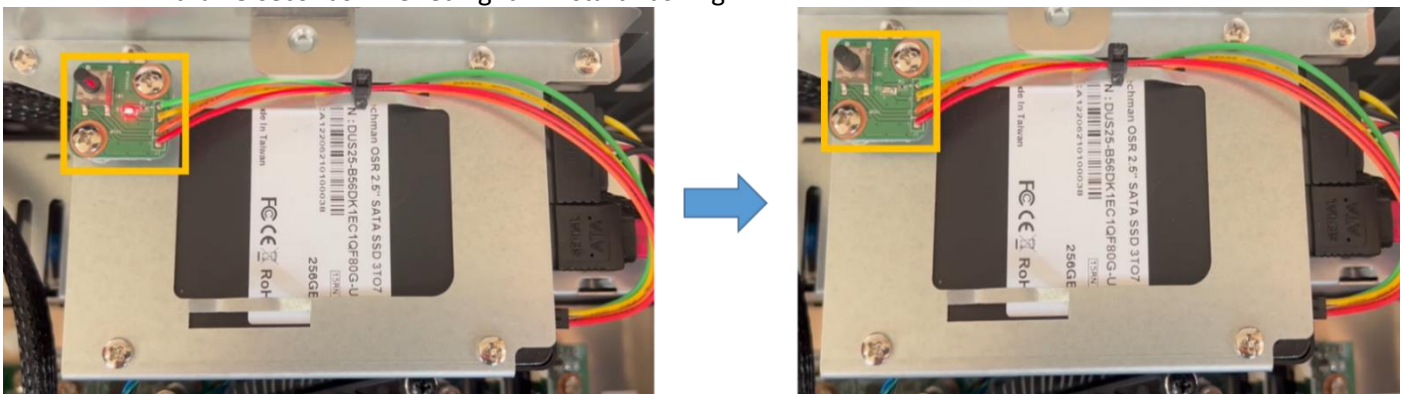
## 8.2 System recovery

8.2.1 This function is used to restore Disk C to the factory settings, while Disk D (e.g., projects, HMI configurations, etc.) will remain unchanged.

8.2.2 Press the Del key during startup to enter the BIOS.



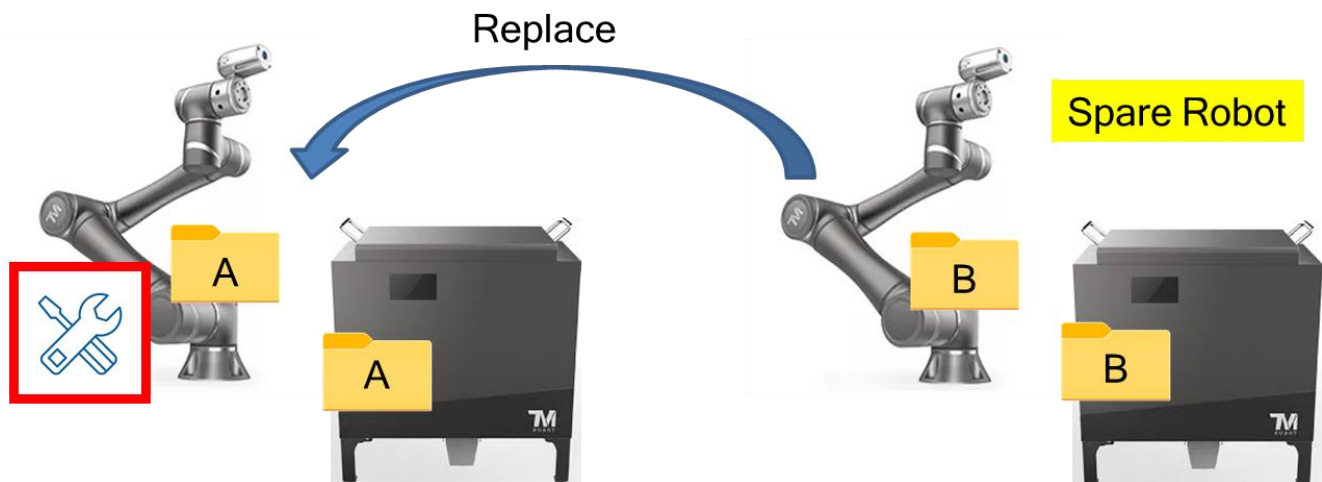
8.2.3 Open the outer casing of the control box, and press and hold the black button on the SSD for more than 5 seconds. The red light will start flashing



8.2.4 After waiting for 15 minutes, the system will complete the restoration, and the red light will become steady. Once the red light is steady, you can exit the BIOS, restart the system, and Disk C will be restored to its factory state.

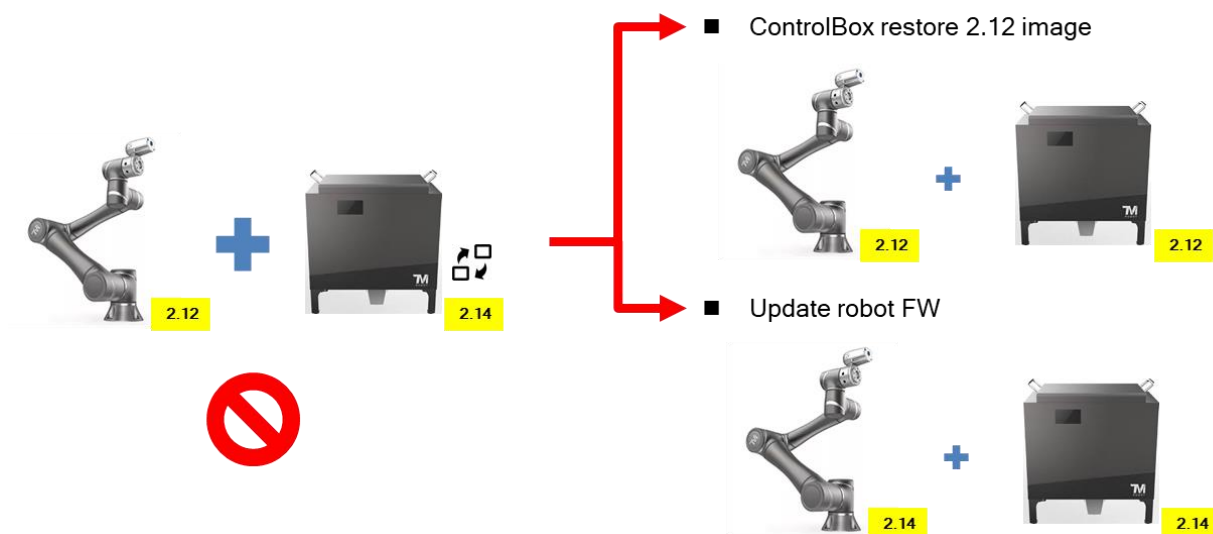


**8.3 Arm Exchange:** This function is designed for situations where either the arm or the control box experiences abnormalities. In cases of urgency, where the customer needs to quickly resume production on the assembly line, arm exchange can be performed to avoid production line downtime. As illustrated below, if Arm A is damaged, this feature facilitates the exchange of Arm A with the available Arm B in stock, enabling the production line to continue operations.

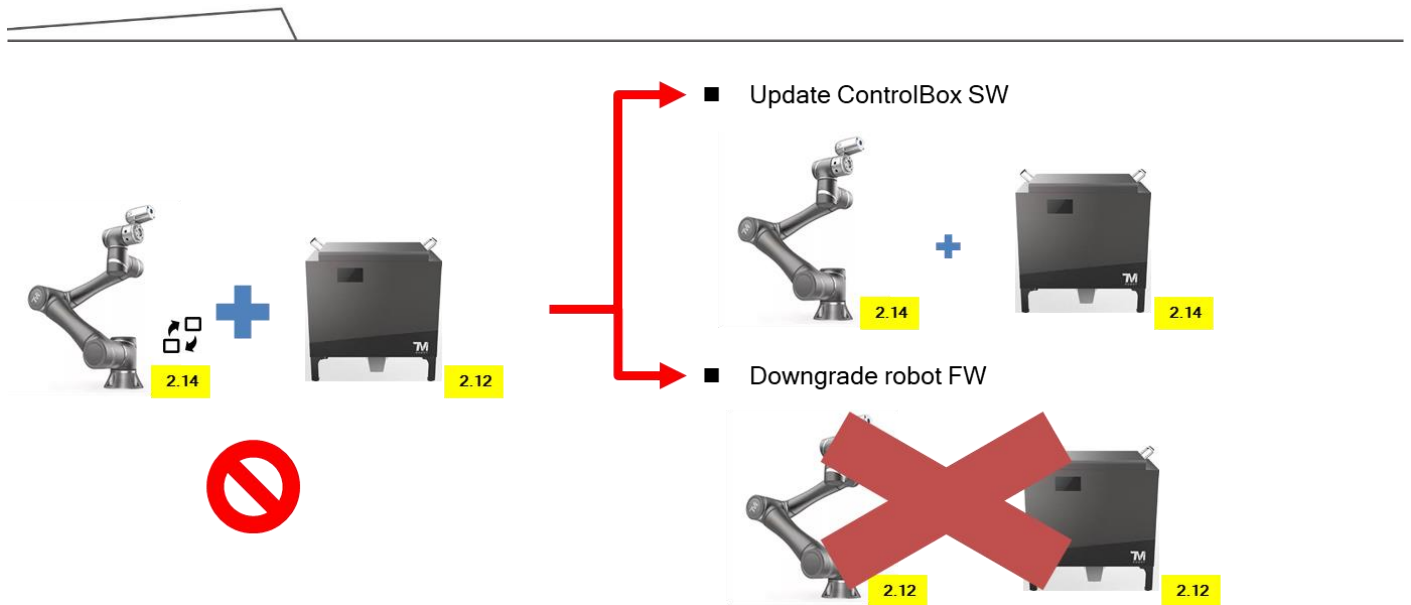


**8.3.1** Remove the malfunctioning arm and directly connect the spare arm to the original control box. The calibration data stored in the arm's IO board will overwrite the data in the original control box, so it's crucial to back up the files in the original control box. The software will check whether the data between the arm and control box matches. The following scenarios will explain the handling when the arm firmware (FW) does not match the control box HMI.

**8.3.2** If the arm FW is version 2.12 but the spare control box's HMI version is 2.14, the user can choose to restore the control box's HMI image to version 2.12 or upgrade the arm FW to version 2.14.

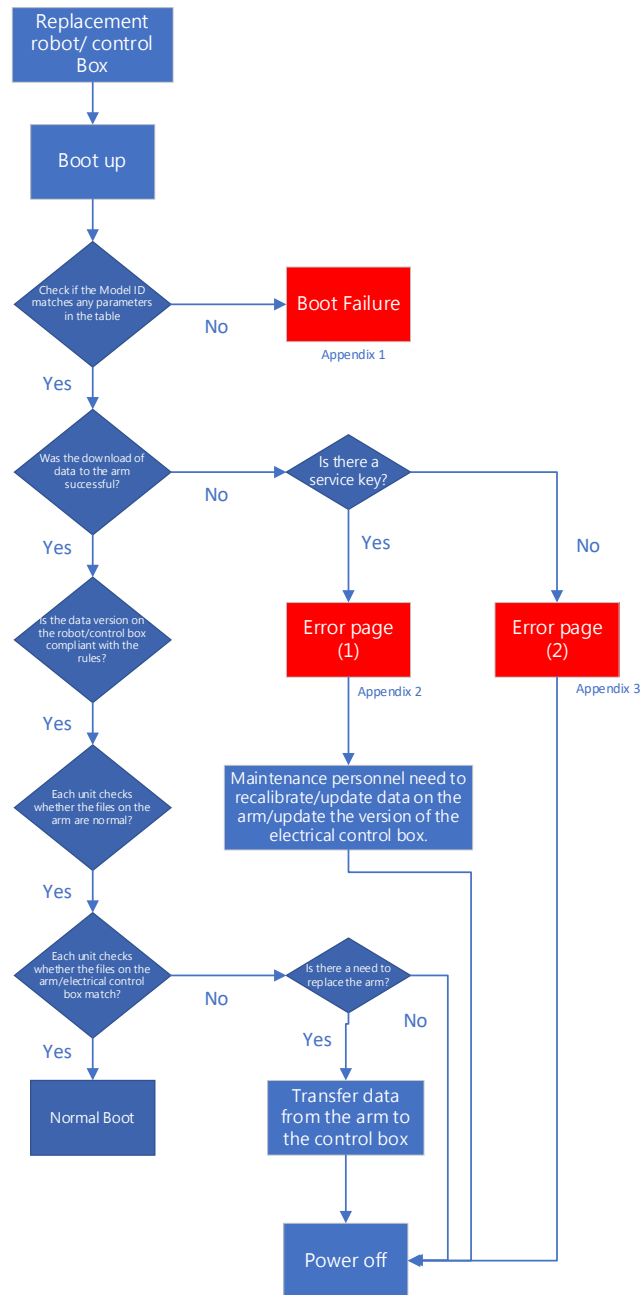


**8.3.3** When the arm FW is version 2.14, but the spare control box's HMI version is 2.12, the user can only upgrade the control box's HMI to match the FW. The main reason is that older versions of software or firmware may not recognize the new Joint type.



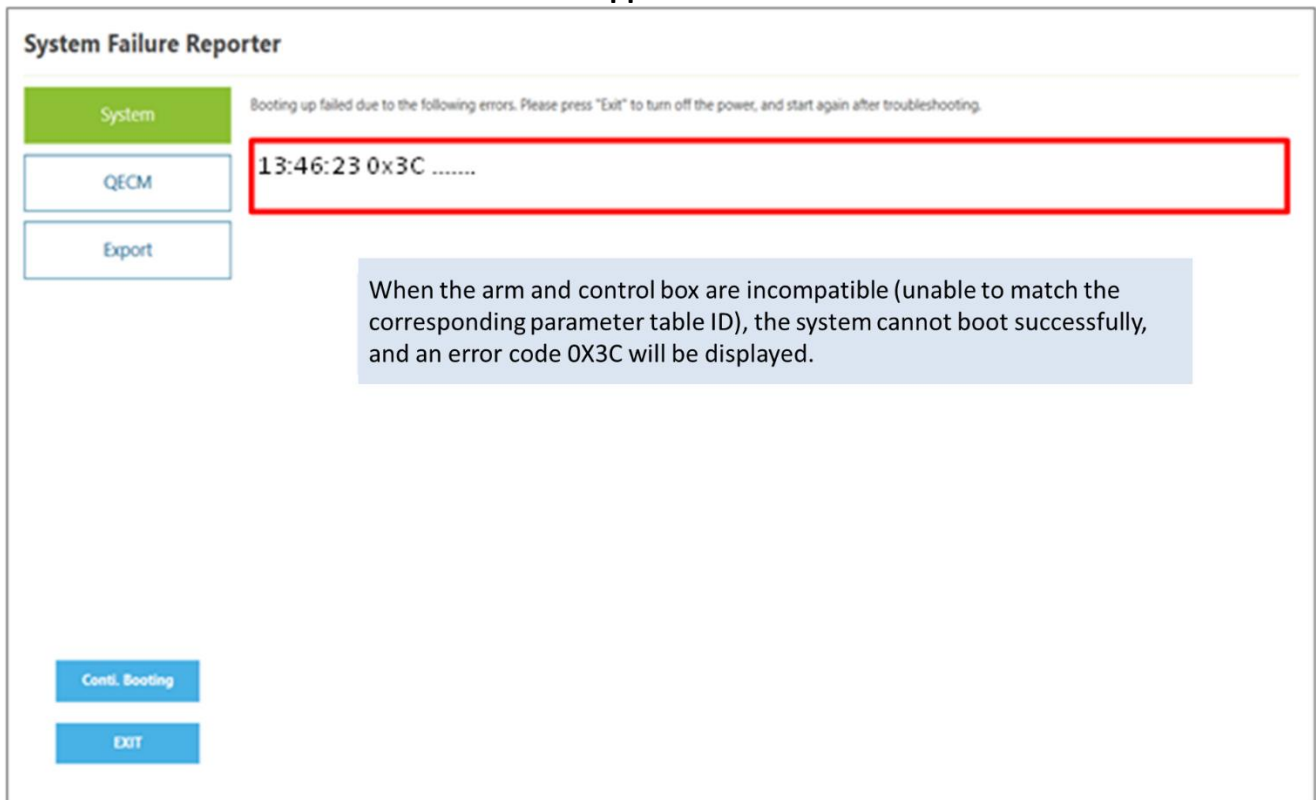
- 8.3.4 Not every arm and control box can support interchangeability. Exchange can only occur when Arm Model and Control Box Model are mutually compatible. The **Compatibility List** table below summarizes all compatible combinations. Only the Arm model and Control box model appearing simultaneously in the same column of the table can be interchanged.
- 8.3.5 Example: TM5B-070050000 and CAL0500000 both appear in the same column, so this arm and this control box can be interchanged.

8.3.6 The flowchart below showing the process that the system will follow in the background after swapping the arm with the control box. If there are no errors or anomalies during the process, it is considered a successful interchange. For troubleshooting in case of abnormal situations, please refer to the Appendix.



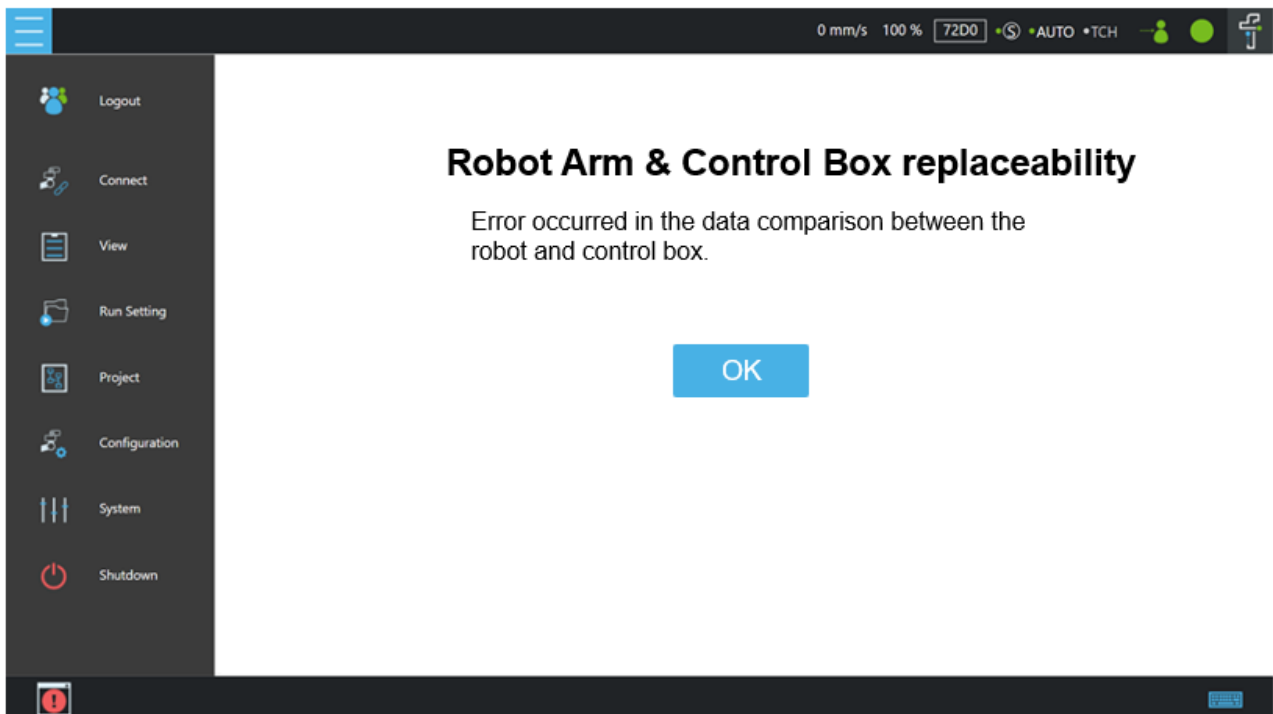


## Appendix 1



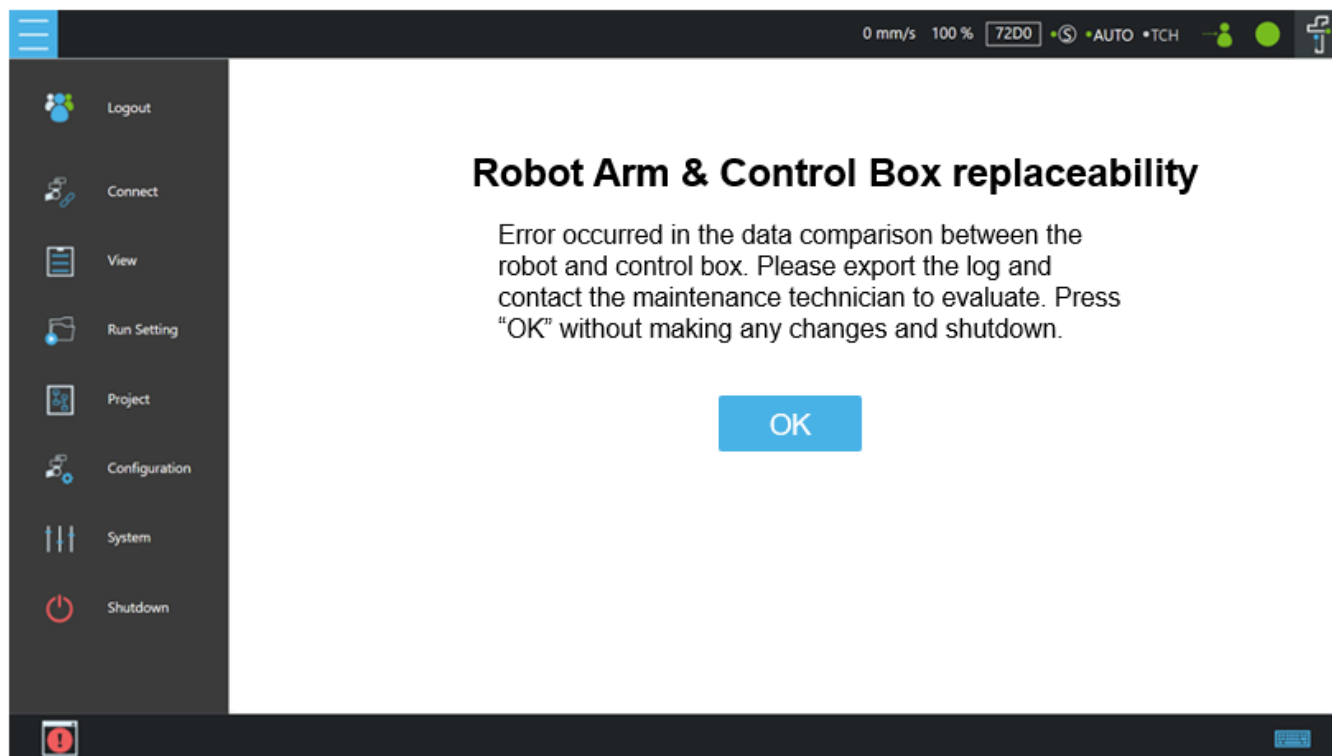
- This issue indicates that the arm and control box combination may not support interchangeability. Please double-check the compatibility list to ensure that the combination is valid. If it is a valid combination and you still encounter this problem, it is recommended to contact the headquarters' engineers for further assistance.

## Appendix 2



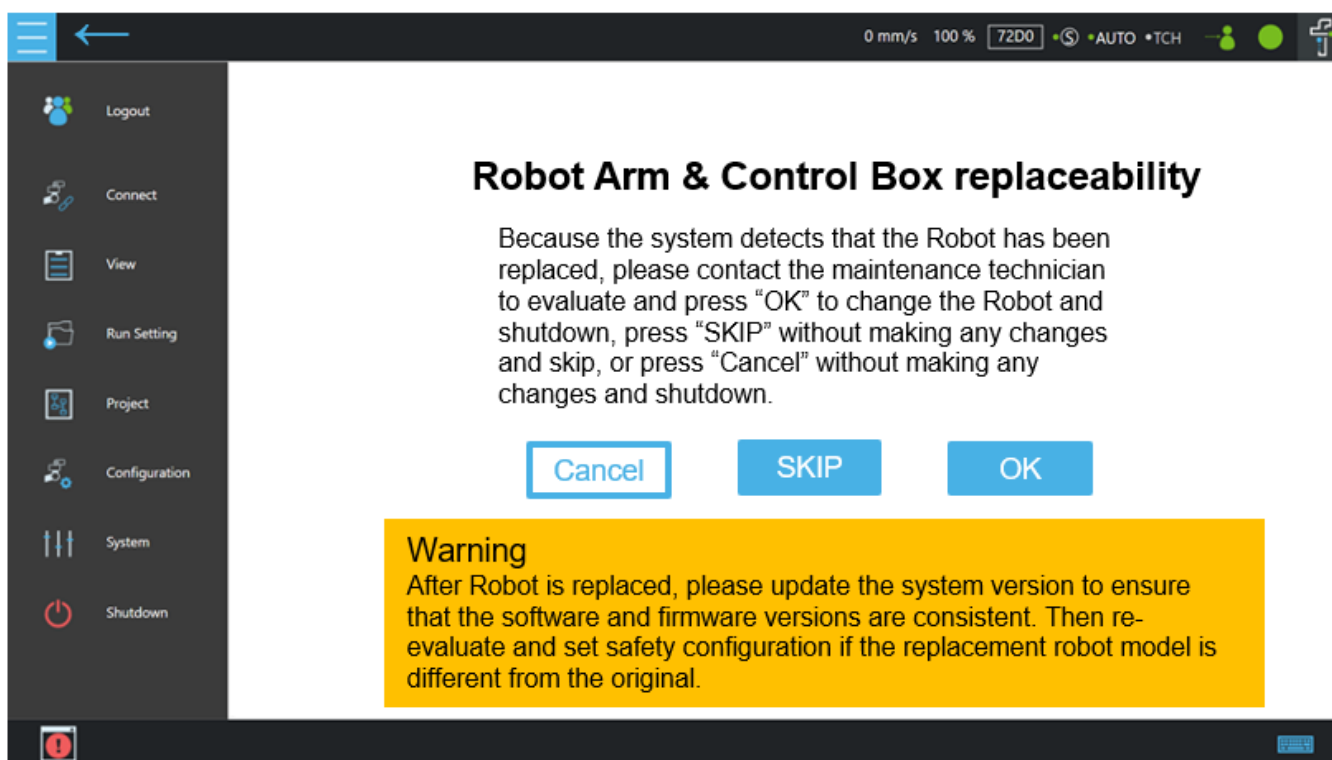
- This error indicates a data comparison issue, and it may trigger a special page with log entries such as 0x00045240 (download failed or data error) or 0xF0000180 (version comparison failed).
- The maintenance personnel need to recalibrate/update arm-end data/update control box version.

## Appendix 3



- The error message "Data comparison error prompts a special page and logs 0x00045240 (download failed or data error) or 0xF0000180 (version comparison failed). Please export the logs and contact the headquarters maintenance personnel for assistance

#### Appendix 4




If all the above criteria are met, but the data on the arm side differs from the data on the control box side, switch to this special page after turning on the machine.

**Cancel** : Do not make any changes. Click to initiate the shutdown procedure.

**SKIP** : No changes needed. Click to exit this special page. If there is no service key, the button will be greyed out and

Hardware Version: 5.02 Document Version: 0

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cannot be clicked.

**OK** : Overwrite the data of the arm side to the control box side, and switch off the machine, if there is no Service key, the button will be greyed out and cannot be clicked.

**Note:** The visual connection camera check takes approximately 60 seconds. During Normal power on, the page may jump to this special page after a period of time. The check will first go to the Normal condition, and then jump to this special page when any unit is checked to a different condition.

Please click 'OK' and enter the Safety Password to confirm the arm change. This password is the same as the Safety Configuration Tool Password.

After replacing the arm, update the system version to ensure the firmware version remains the same. If the arm model has been changed, conduct a new safety assessment and modify the safety function settings

## 9. Calibration guide

Reference the order of images in the following sections for calibration.

### Contents

1. [Tools and space](#)
2. [Settings for calibration \(HW5 ONLY\)](#)
3. [Dynamic calibration and Hand-guide calibration](#)
4. [Initial calibration position](#)
5. [Camera calibration](#)
6. [Kinematic calibration](#)
7. [Hand-eye calibration and Verification](#)
8. [Barcode setting](#)
9. [Save the calibration data \(HW5 ONLY\)](#)
10. [Snake dance](#)

### Important notes:

1. To avoid collisions, the gripper, external cables, and external equipment must be removed before performing calibration.
2. Before calibration, ensure the robot is securely mounted to the platform, and that the platform remains stable without any shaking during arm movement.
3. Move the robot to the **Home Pose** while powered on and confirm there is no backlash or misalignment in any joint.
4. During calibration, use standard indoor lighting as the primary light source. Additional lighting is unnecessary unless in special environments with insufficient or unstable lighting.
5. To maintain stability in the relative position between the robot and the calibration plate, both must be mounted on the same platform.

#### □ When to Perform Maintenance Calibration

The maintenance calibration items listed in this document **do not need to be performed periodically** while the robot is operating normally. However, maintenance calibration **must be carried out** when replacing or dismantling parts in any of the following situations:

Robot with camera	Joint	End module	End module PCBA	Camera unit	Flange and F/T sensor
Dynamic & Hand-guide	Need	Need	Not need	Not need	Not need
Camera	Not need	Need	Not need	Need	Not need
Kinematic	Need	Need	Need	Need	Need
Handeye and Verification	Need	Need	Need	Need	Need
Barcode Setting	Need	Need	Not need	Need	Not need


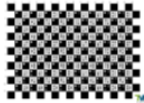
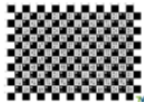

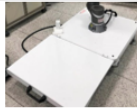
X-type robot (without camera)	Joint	End module	End module PCBA	Flange and F/T sensor
Dynamic & Hand-guide	Need	Need	Not need	Not need
Camera	Not need	Not need	Not need	Not need
Kinematic	Need	Not need	Not need	Not need
Handeye and Verification	Need	Not need	Not need	Not need
Barcode Setting	Need	Not need	Not need	Not need

Note: (a.) For X-type robots (without a camera), when replacing or dismantling a joint or end module or end module PCBA, only Dynamic Calibration and Hand-Guide Calibration need to be performed.

(b.) In this context, replacing the 'end module PCBA' refers to opening the end-module flange to perform the replacement directly, rather than separating Joint 6 from the end module.

## 9.1 Tools and space

### Tools and space

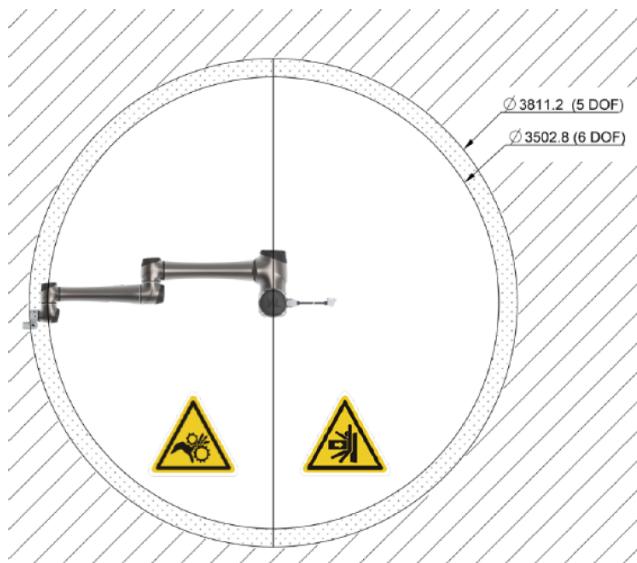
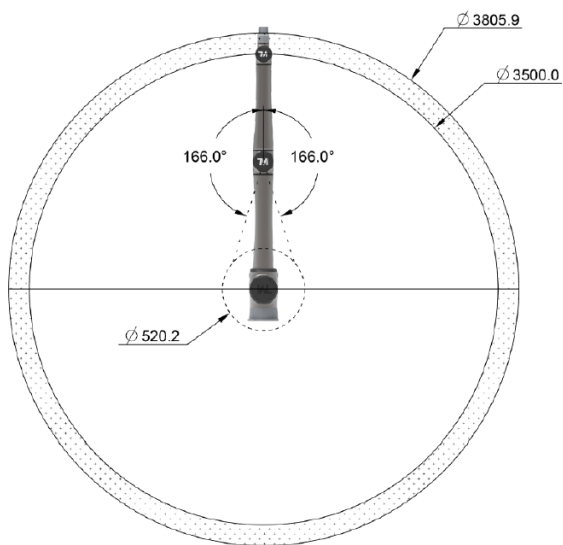
1	Maintenance dongle	
2	1cm calibration plate (small dice board) *Only the new calibration plate can be used (the new version has a smooth touch, whereas the old version has noticeable printed texture when touched).	
3	2cm calibration plate (big dice board) *Only the new calibration plate can be used (the new version has a smooth touch, whereas the old version has noticeable printed texture when touched).	
4	TM Landmark 2.0 *Peel the protective wrap off before use.	
5	Calibration platform	



## Tools and space

Ensure that there is enough space to perform the calibration.

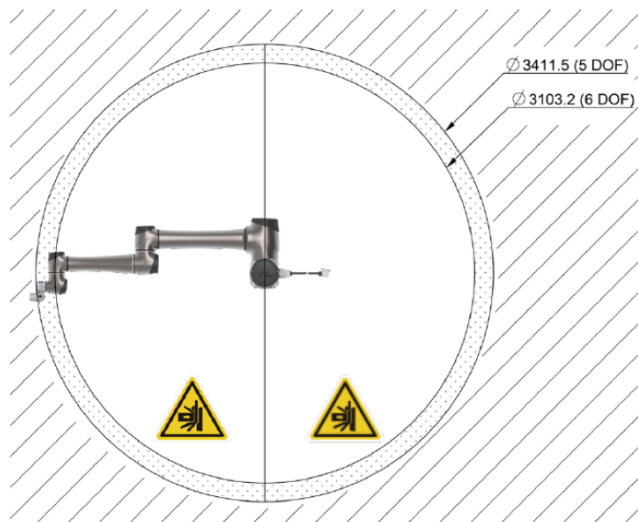
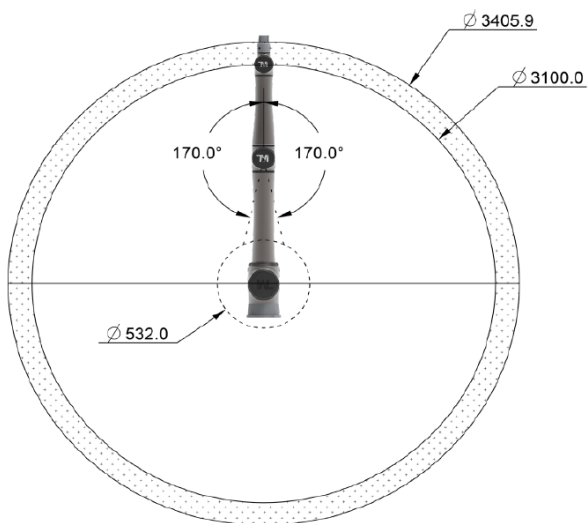
### TM25S



## Tools and space

Ensure that there is enough space to perform the calibration.

### TM30S



## 9.2 Settings for calibration

## Settings for calibration

\*Please restore the following settings after the calibration process is completed.

\*Insert the maintenance dongle before perform following steps and calibration.

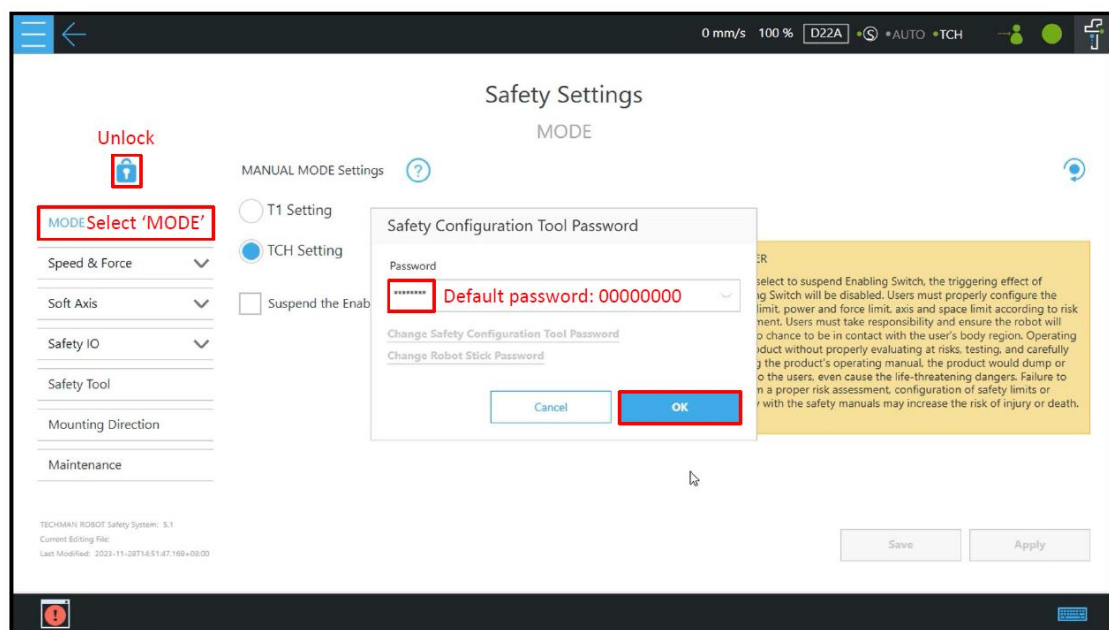
1. Select menu



3. Select Safety

2. Select

## Settings for calibration



## Settings for calibration

### Safety Settings

MODE

MANUAL MODE Settings ?

☐ T1 Setting

☒ TCH Setting

☒ Suspend the Enabling Switch

**DANGER**

When select to suspend Enabling Switch, the triggering effect of Enabling Switch will be disabled. Users must properly configure the speed limit, power and force limit, axis and space limit according to risk assessment. Users must take responsibility and ensure the robot will have no chance to be in contact with the user's body region. Operating the product without properly evaluating at risks, testing, and carefully reading the product's operating manual, the product would dump or pinch to the users, even cause the life-threatening dangers. Failure to perform a proper risk assessment, configuration of safety limits or comply with the safety manuals may increase the risk of injury or death.

Save
Apply

TECHMAN ROBOT Safety System: 5.1

Current Editing File:

Last Modified: 2023-11-28T14:51:47.169+08:00

## Settings for calibration

0 mm/s 100 % D22A
• AUTO • TCH

MODE

Speed & Force

Soft Axis

Safety IO

Safety Tool

Mounting Direction

Maintenance

Apply Safety Configuration

Last modified time: 2023-12-26T14:06:47.924+08:00  
 Safety System version: 5.1  
 Safety Checksum: D22A  
 Robot Name: CC2324034  
 Robot model: TMSS

Mode Settings  
 MANUAL MODE Settings: TCH Setting  
 Suspend the Enabling Switch: True

Speed & Force Setting  
 General Setting  
   Hand Guide TCP Speed  
     T1 Hand Guide TCP Speed Limit: 250 mm/sec  
     TCH Hand Guide TCP Speed Limit: 450 mm/sec  
   End-Point Reduced Speed  
     End-Point Reduced Speed Limit: 250 mm/sec  
 Force & Torque Limit function  
   Robot in the fenceless workspace  
 Human-Machine Safety

☒ I have confirmed all the safety parameters according to my settings.

Cancel
OK

TECHMAN ROBOT Safety System: 5.1

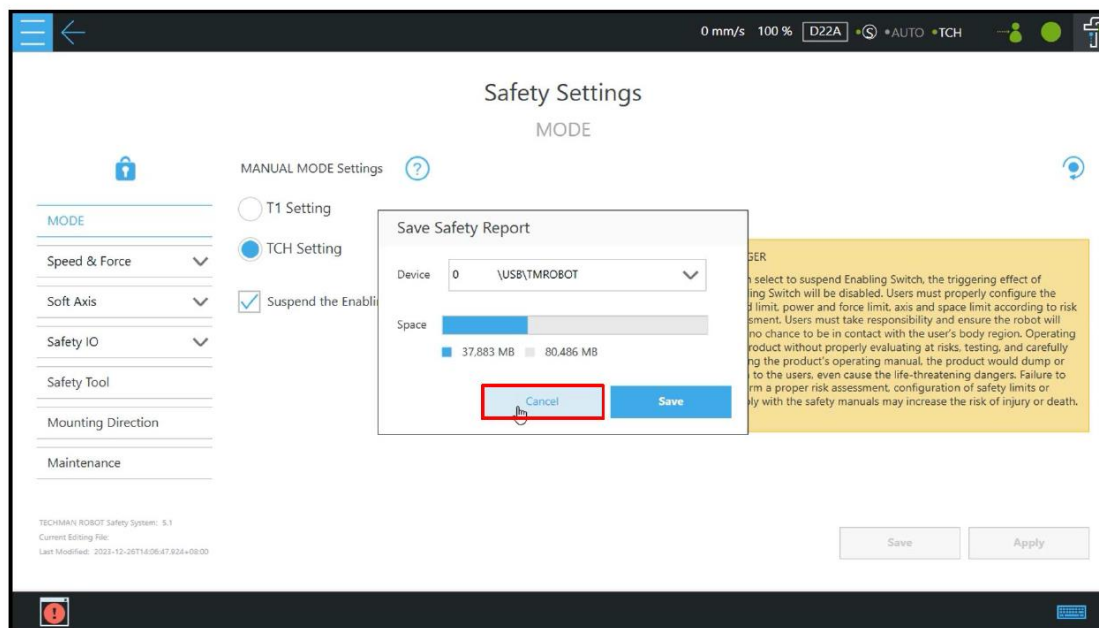
Current Editing File:

Last Modified: 2023-11-28T14:51:47

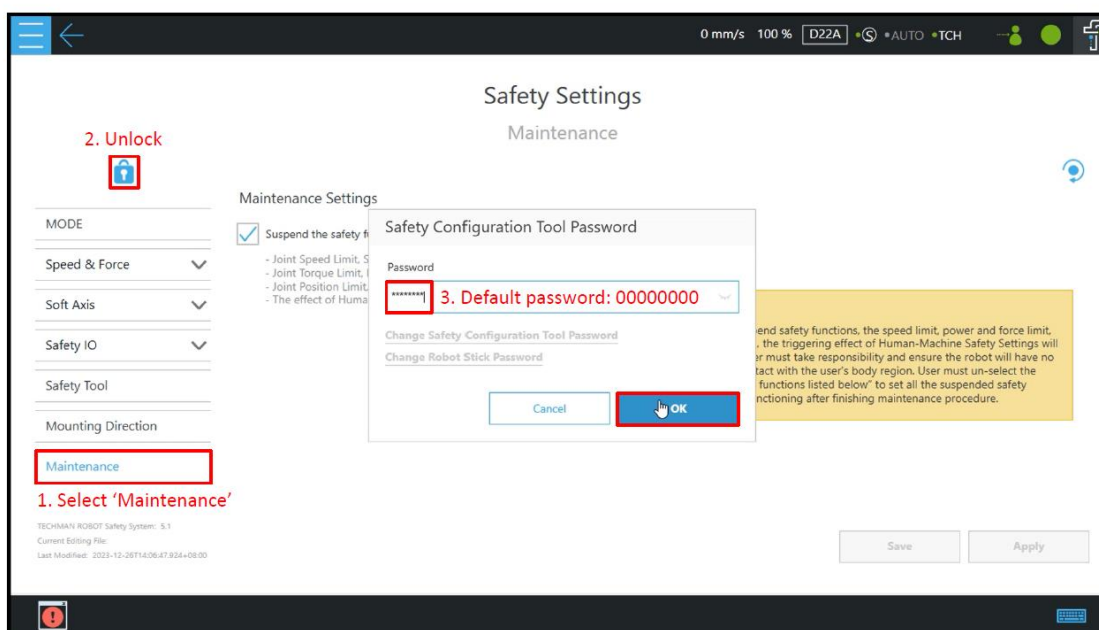
When select to suspend Enabling Switch, the triggering effect of Enabling Switch will be disabled. Users must properly configure the speed limit, power and force limit, axis and space limit according to risk assessment. Users must take responsibility and ensure the robot will have no chance to be in contact with the user's body region. Operating the product without properly evaluating at risks, testing, and carefully reading the product's operating manual, the product would dump or pinch to the users, even cause the life-threatening dangers. Failure to perform a proper risk assessment, configuration of safety limits or comply with the safety manuals may increase the risk of injury or death.

Apply

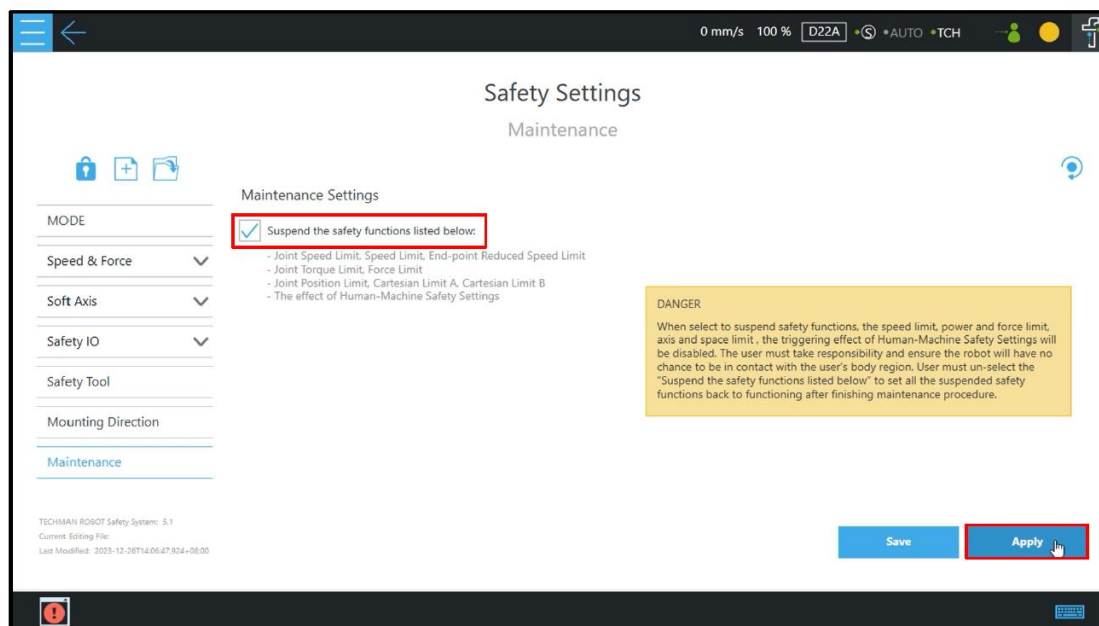
## Settings for calibration



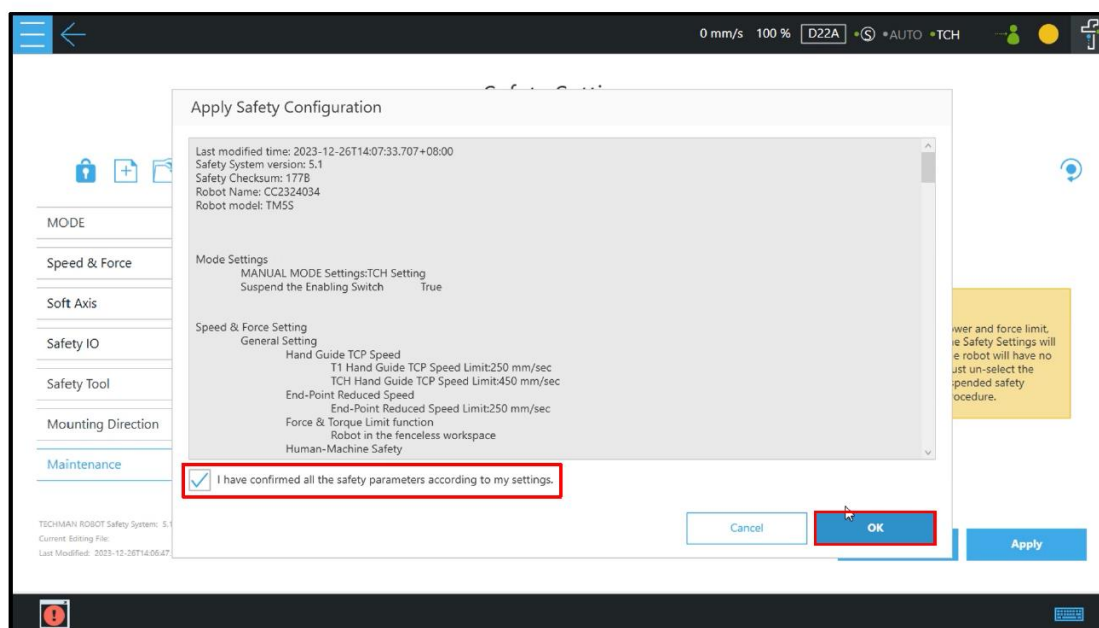
## Settings for calibration



## Settings for calibration



## Settings for calibration

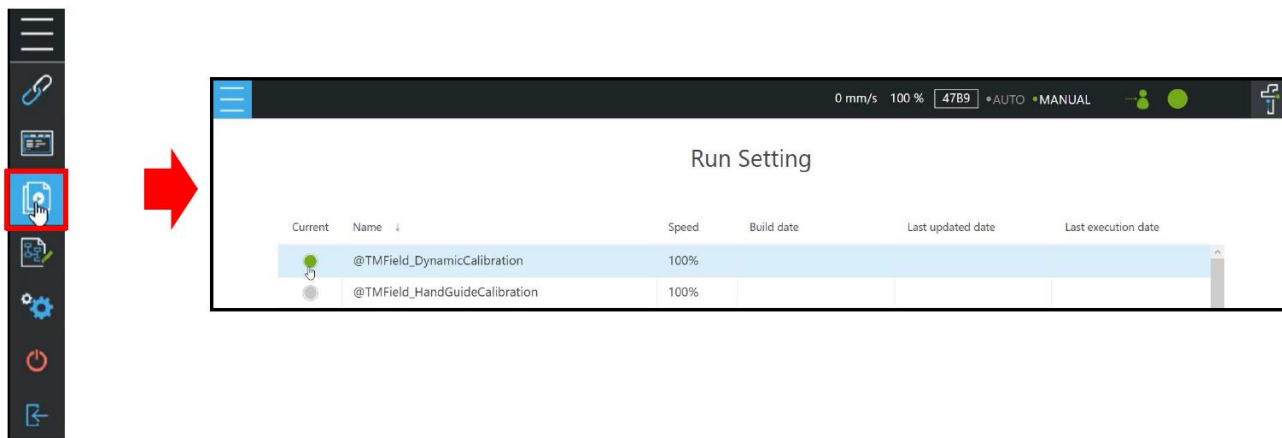


### 9.3 Dynamic calibration and Hand-guide calibration



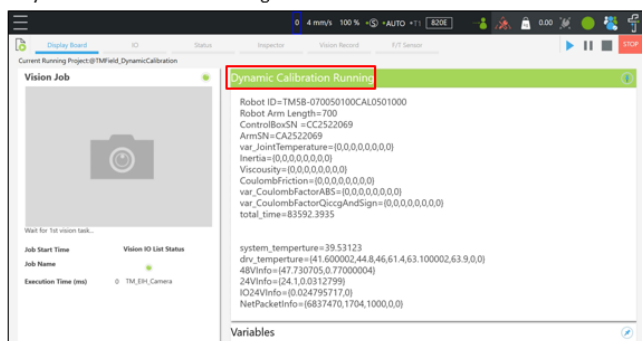
## Dynamic calibration and Hand-guide calibration – Dynamic calibration

1. Select the @TMField\_DynamicCalibration
2. Switch the robot into auto mode and run the project.

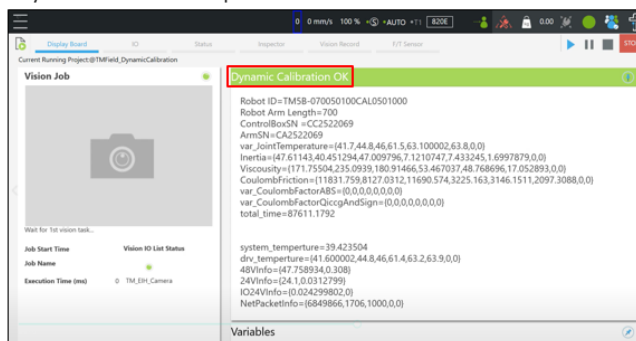


## Dynamic calibration and Hand-guide calibration – Dynamic calibration

Dynamic calibration is running

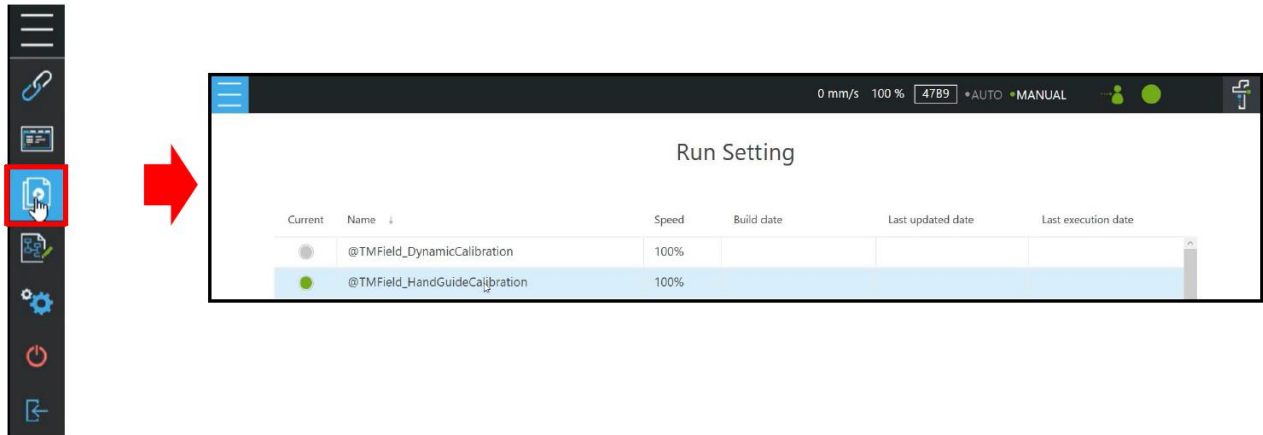


Dynamic calibration completed



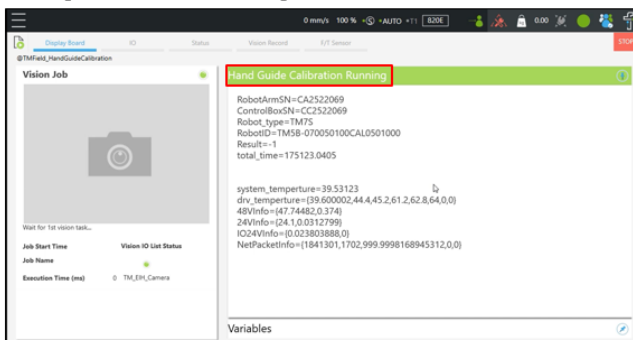
## Dynamic calibration and Hand-guide calibration – Hand-guide calibration

1. Select the @TMField\_HandGuideCalibration
2. Switch the robot into auto mode and run the project.

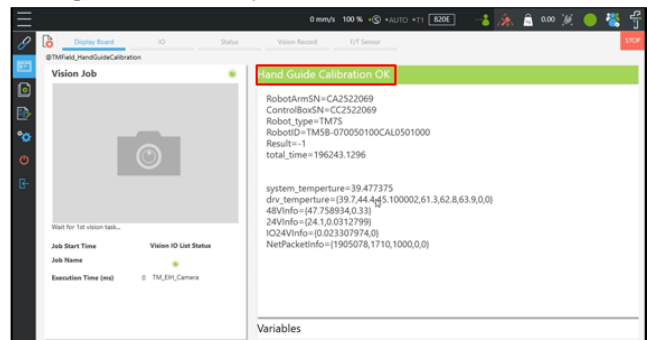


## Dynamic calibration and Hand-guide calibration – Hand-guide calibration

Hand-guide calibration is running



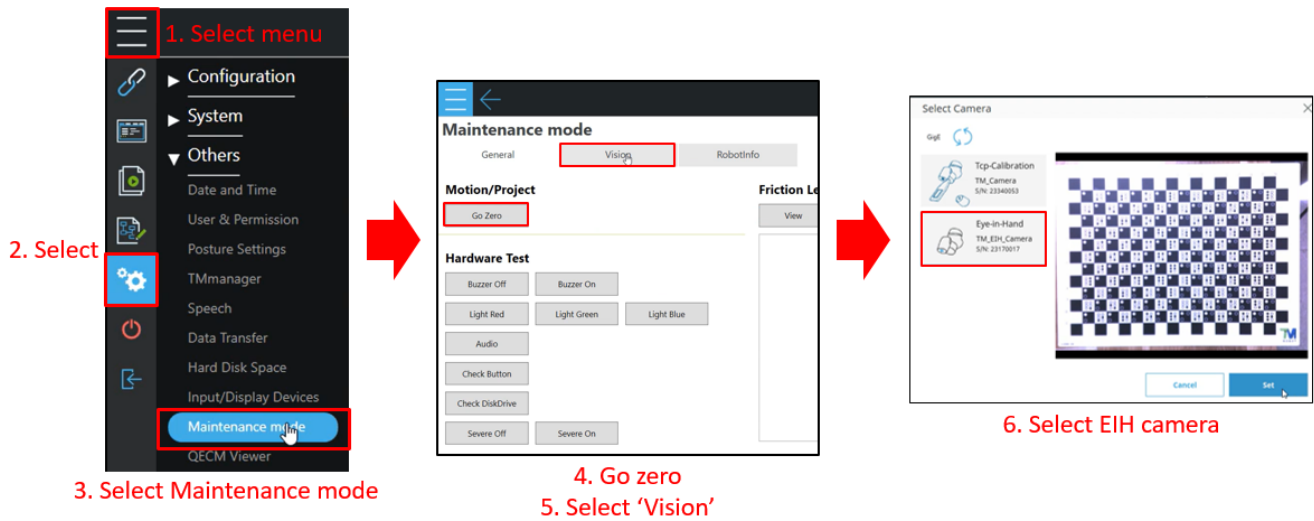
Hand-guide calibration completed



## 9.4 Initial calibration position

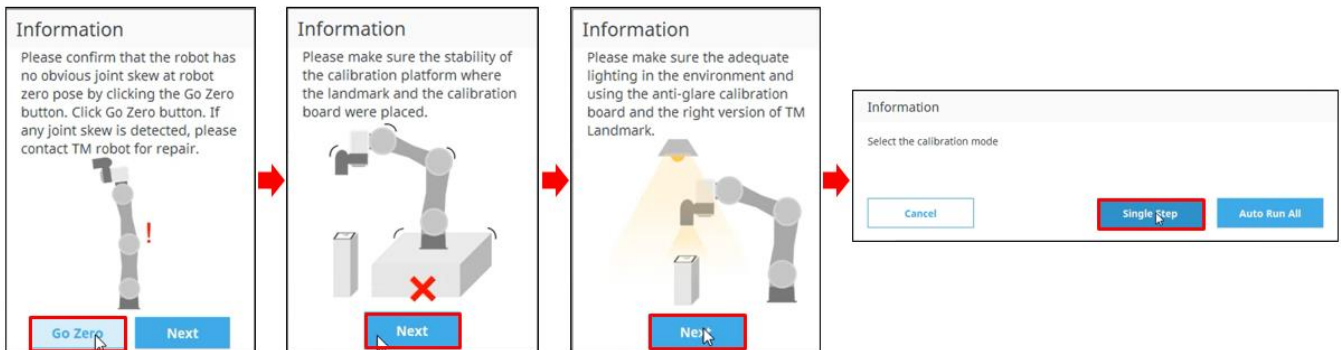
## Initial calibration position

1. Starting from HMI 2.20, the initial calibration positions have been adjusted. However, they can still be modified. Follow the steps below to set the initial position and select the calibration.
2. This function only applies to *Vision Calibration*, *Kinematic Calibration*, *Hand-Eye Calibration*, and *Verify*.



## Initial calibration position

1. When selecting the EIH, the Information window will pop up. Select 'Go Zero' to move the robot to its home pose, then follow the on-screen instructions to check the platform's stability, the robot's condition, and the light source.
2. After checking these items, select 'Single Step' to proceed with the calibration process. Do not select 'Auto Run All', as this option is intended for Techman factory use only.



### Initial calibration position \_ Default initial position

To calibrate the robot using the **default initial position**:

1. Choose '**① All Use Default Position**'.
2. Select the desired calibration item.
3. Click '**② Move**' and follow the guidance to move the robot.
4. Ensure the camera can detect the dice board or landmark.
5. Click '**③ Action**' to proceed.

[Click here for more information.](#)

Decide robot's initial position

Customized initial position  
70.5, 2.7, 117, -30, 90, 25.5

Default initial position  
70.5, 2.7, 117, -30, 90, 25.5

☒ All Use Default Position ①

☒ Calibration Plate 10cm/ Verify

☐ Calibration Plate 20cm

☐ Kinematics

☐ Handeye

Score: 0.00; SquareNum:33

Buttons: Move ②, Reset, Record, Auto Camera, Import, Export, Cancel, Action ③

### Initial calibration position \_ Customized initial position

To calibrate the robot using the Customized initial position:

1. Uncheck '**① All Use Default Position**'
2. Select the desired calibration item.
3. Use the controller to move the robot to the preferred position and ensure the camera can detect the dice board or landmark.
4. Click '**② Record**' to use the current posture as the initial posture for calibration.
5. Click '**③ Action**' to proceed.

[Click here for more information.](#)

Decide robot's initial position

Customized initial position  
16.36, -21.17, 132.48, -21.41, 90.09, 16.49

Default initial position  
70.5, 2.7, 117, -30, 90, 25.5

☐ All Use Default Position ①

☒ Calibration Plate 10cm/ Verify

☐ Calibration Plate 20cm

☐ Kinematics

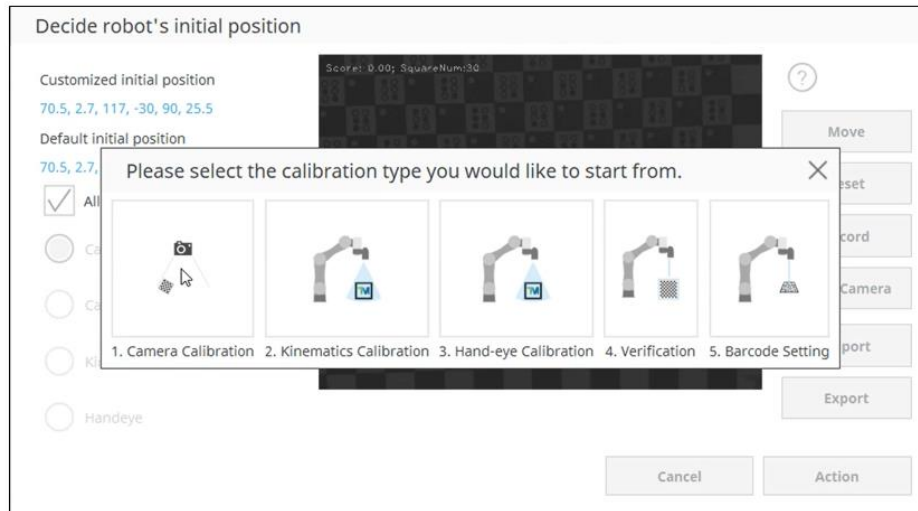
☐ Handeye

Score: 0.00; SquareNum:0

Buttons: Move, Reset, Record ②, Auto Camera, Import, Export, Cancel, Action ③

## Initial calibration position

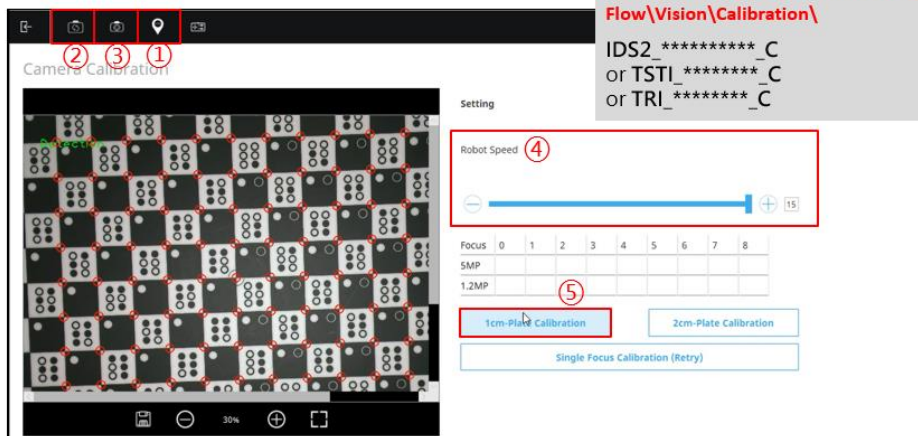
Choose the calibration process after completing initial position setup.



## 9.5 Camera calibration

### Camera calibration

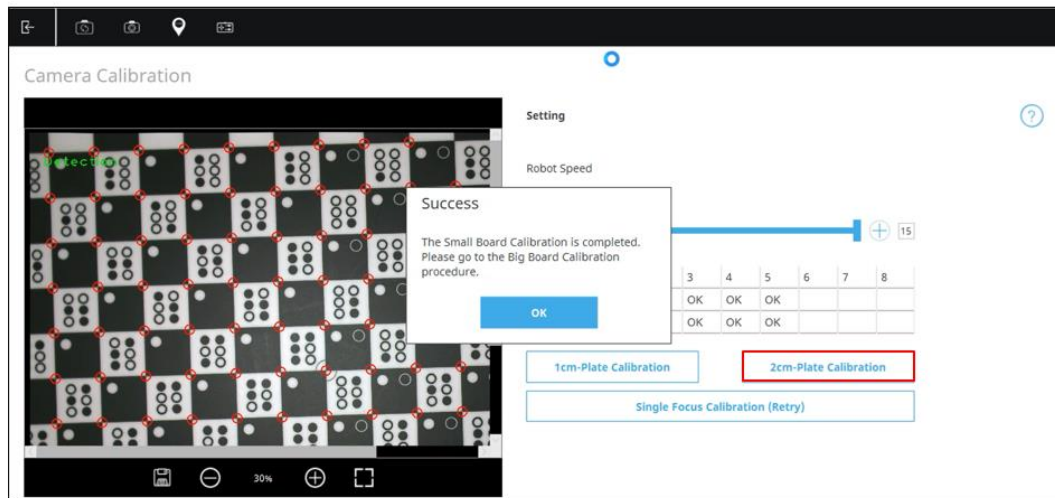
1. Click ① to move the robot to the initial position, then place the small dice board within the camera's field of view (FOV).
2. Click ② to automatically set the camera parameters, or ③ to adjust them manually. (Recommended settings: enable the built-in light, set shutter time to 5000, gain to 0, and leave other settings on Auto.)
3. Make sure the camera can clearly detect the dice board.
4. Set the desired ④ Robot Speed.
5. Click ⑤ '1 cm-plate calibration' to begin the calibration process.





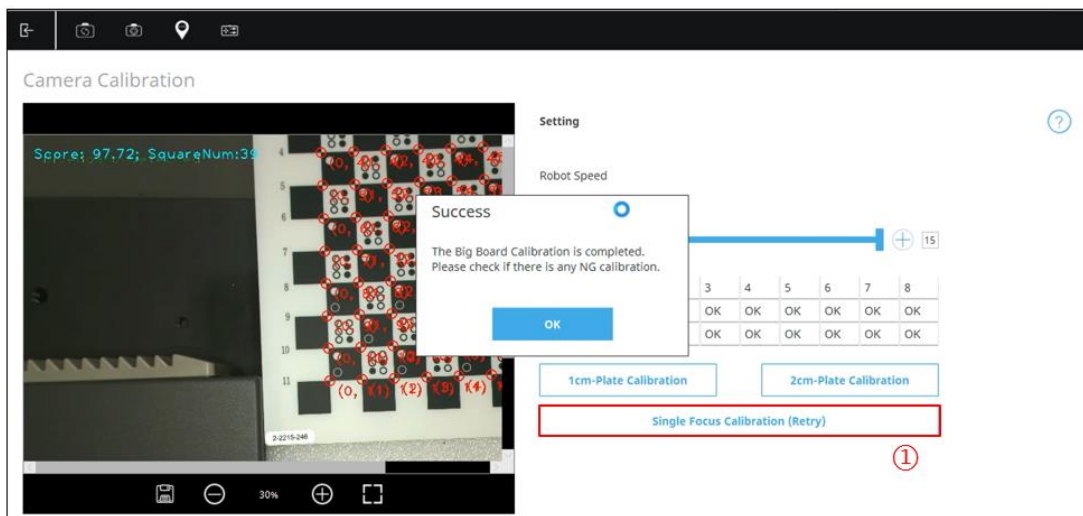
## Camera calibration

1. Setting up the big dice board properly after 1-cm Plate Calibration(small dice board) is completed.
2. Run 2-cm Plate Calibration.



## Camera calibration

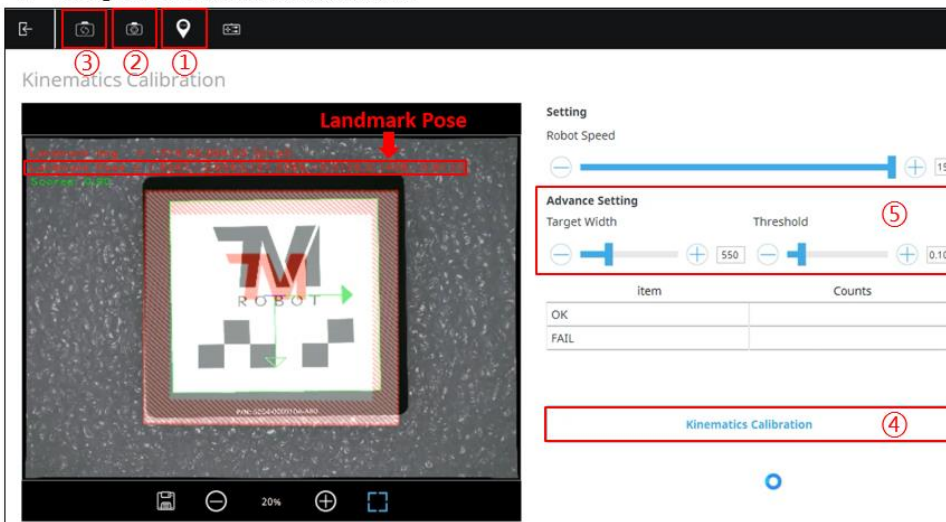
1. The screenshot below shows that the calibration has been completed.
2. If any status is still marked 'Not Finished' after completing the 2 cm Plate Calibration, run a ① Single Focus Calibration to re-calibrate.



## 9.6 Kinematic calibration

## Kinematic calibration

1. Click ① to move the robot to its initial position.
2. Place the landmark at the center of the FOV and make sure the distance between the landmark and the camera lens is close to 100 mm (Landmark pose = 0, 0, 100, ...). Then remove the landmark and place the small dice board, and click ② or ③ to adjust the camera parameters.
3. After the parameter setup, remove small dice board and put the Landmark back at position. (Landmark Pose = 0, 0, 100, ...)
4. Click ④ to begin the Kinematics Calibration.



**DO NOT ALTER ⑤ ADVANCED SETTINGS WHICH ARE FOR TECHMAN FACTORY USE ONLY**

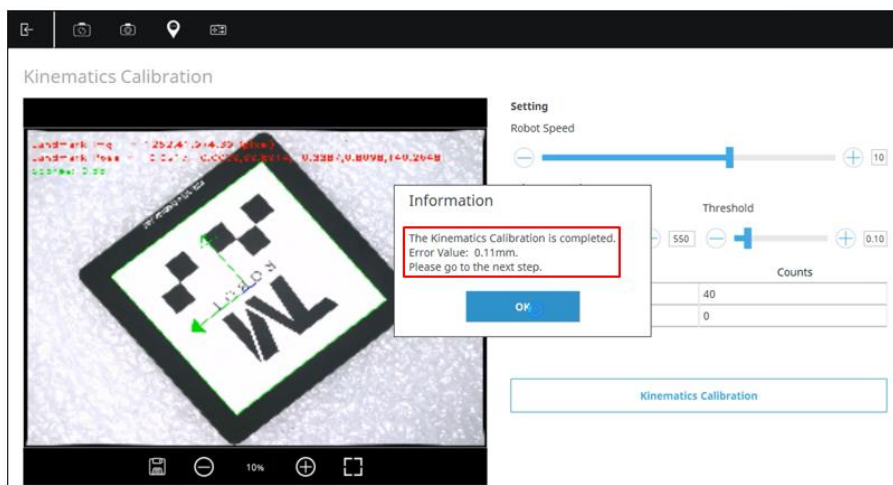
Changing the Target Width or Threshold values may change the robot's posture and cause unexpected errors or collisions.

### Recommended camera parameter

1. Built-in lighting: Enable and set the value to 255
2. Shutter Time: Set to 5000. Increase the value only if the light source is unstable or insufficient.
3. Gain: Set to 0
4. White balance: Press "Auto" once
5. Focus: Set to 3

## Kinematic calibration

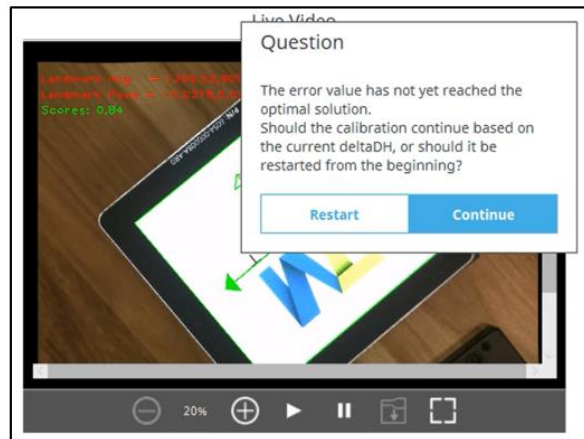
1. Calibration will terminate after completing 40 successful calibrations (OK) or 15 failed calibrations (FAIL).
2. After calibration, if the error value is below 0.3, the calibration is considered successful. If the error value exceeds 0.3 or the calibration fails, provide the following to Techman: **Camera view images, photos of the environment, video of the calibration process, Logs from the same day.**



## Kinematic calibration

When Kinematic Calibration reaches 40 'FinishTimes' but still fails at the final stage, the following message may appear. Users can choose one of the following options to retry the calibration:

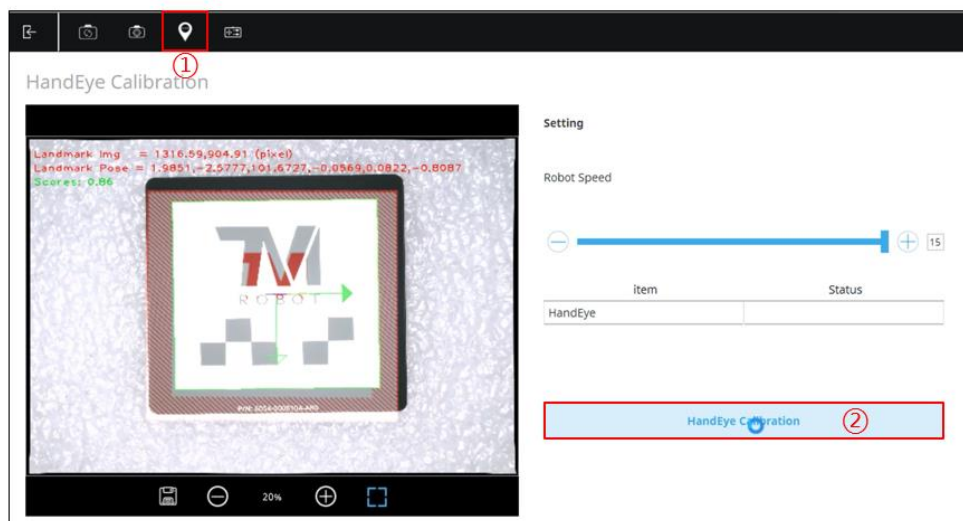
- ◆ **Restart:** Deletes the collected 40 positions and restarts Kinematic Calibration.
- ◆ **Continue (Recommended):** Retains the collected 40 positions and reattempts Kinematic Calibration. If the calibration still fails after selecting 'Continue', provide the following to Techman: Camera view images, photos of the environment, video of the calibration process, Logs from the same day.



## 9.7 Hand-eye calibration and verification

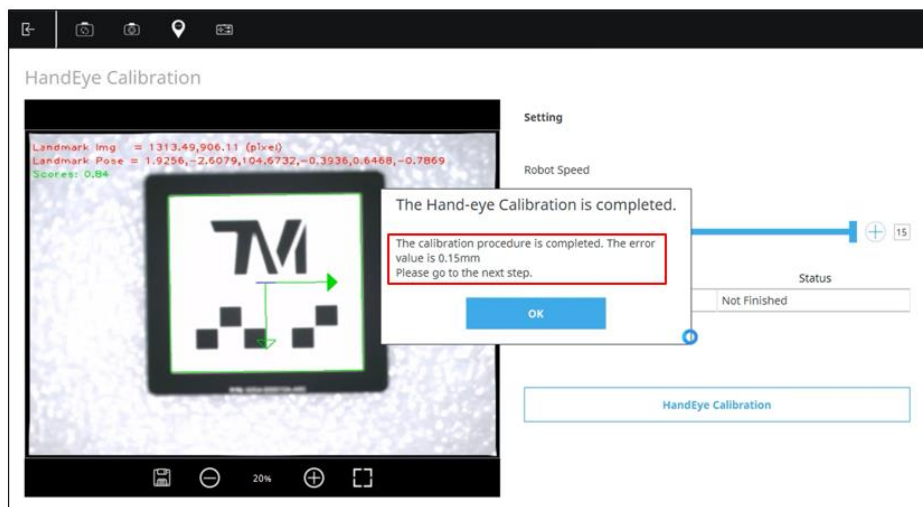
### Hand-eye calibration & Verification

1. Click ① to move the robot to its initial position.
2. Continue using camera parameters from the Kinematic Calibration.
3. Click ② to begin the HandEye Calibration.



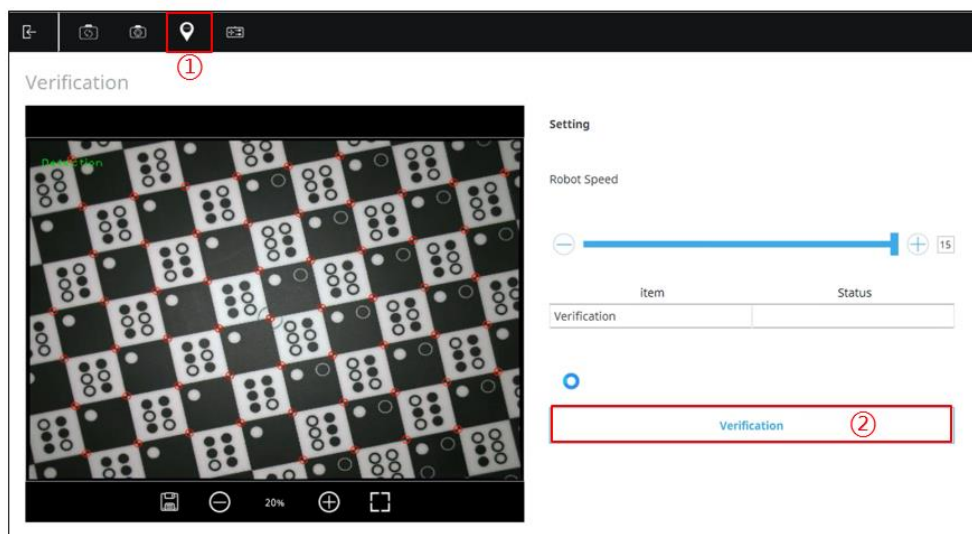
## Hand-eye calibration & Verification

1. After completing the calibration, if the error value is below 0.3, the calibration is considered successful.
2. If the error value exceeds 0.3 or the calibration fails, send the following to Techman: **Camera view images, photos of the environment, video of the calibration process, Logs from the same day**



## Hand-eye calibration & Verification

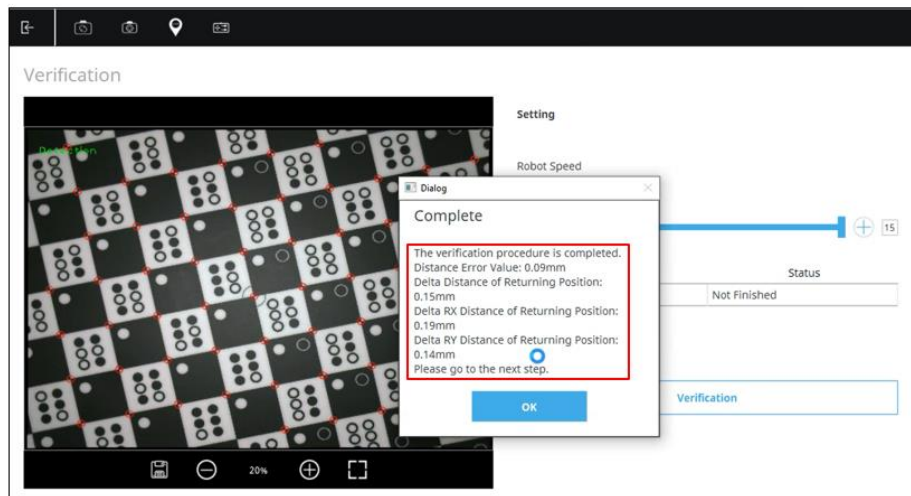
1. Click ① to move the robot to its initial position after completing the handeye calibration.
2. Place the **small dice board**, turn on the camera light, and adjust camera parameters to ensure the small dice board can be detected. Click ② to begin the Verification.





## Hand-eye calibration & Verification

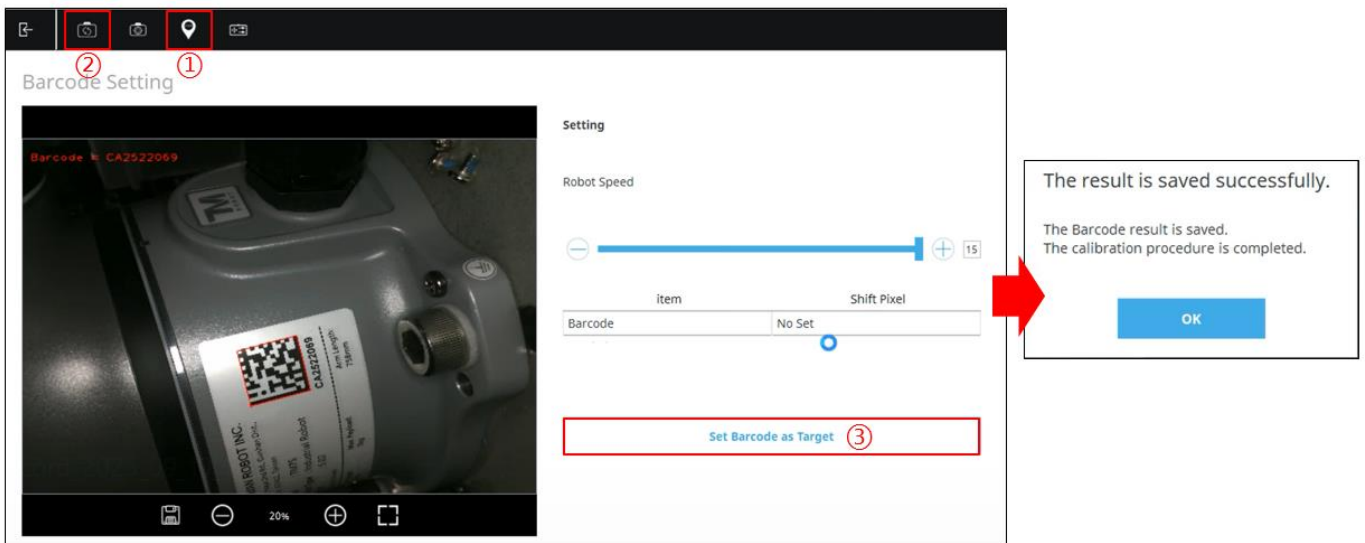
1. After calibration is complete, ensure that the first and second values are below 0.5, and the third and fourth values are below 1.
2. If any value exceeds these limits, repeat the Handeye calibration and Verification.
3. If the error value exceeds stipulated value or the calibration fails, send the following to Techman: **Camera view images, photos of the environment, video of the calibration process, Logs from the same day**



## 9.8 Barcode setting

### Barcode setting

1. Click ① to move the robot to its initial position.
2. Click ② to set the camera parameter automatically if needed.
3. Click ③ to begin the Set Barcode as Target. When the window pops up, it means the process is completed.

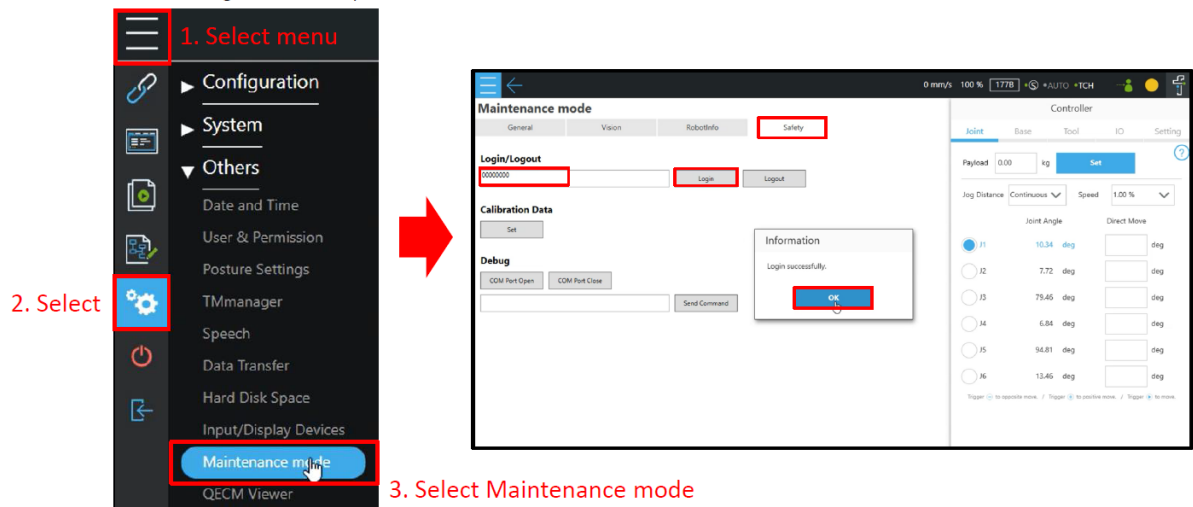


## 9.9 Save the calibration data



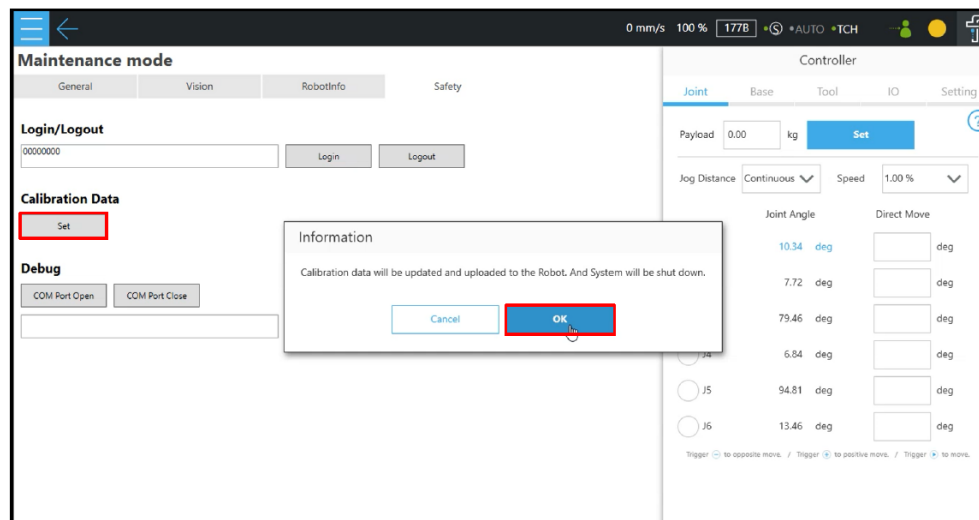
## Save the calibration data

1. Go to 'Maintenance mode', select 'Safety'
2. Enter 00000000 and select Login, and then press 'OK'



## Save the calibration data

1. Press 'Set' to upload the calibration data from control box to arm
2. Press 'OK' and the TMflow will shut down automatically



## 9.10 Snake dance

## Snake dance

Method 1\_For robot type: TM5A, TM5S, TM6S, TM7S, TM12, TM12S, TM14, TM14S, TM16, TM20, TM20S


1. Create 2 nodes, each with following joint angles:

	Node 1	Node 2
J1	260	-260
J2	90	-90
J3	-150	150
J4	90	-90
J5	170	-170
J6	110	-110

2. Make the 2 nodes run in a loop, run at 60% speed for 30 minutes.
3. If there is no abnormality after the test, the robot is ready for use.

Method 2\_For robot type: TM5A, TM5S, TM6S, TM7S, TM12, TM12S, TM14, TM14S, TM16, TM20, TM20S, TM25S, TM30S

1. Run the TrialRun from Run setting for 30 minutes.

	@TMField_TrialRun	100%
---	-------------------	------

2. If there is no abnormality after the test, the robot is ready for use.

## 10. Trouble shooting

### 10.1 Camera disconnection

#### Symptom description

EIH camera disconnected while using / EIH camera can not be detected

#### Possible causes

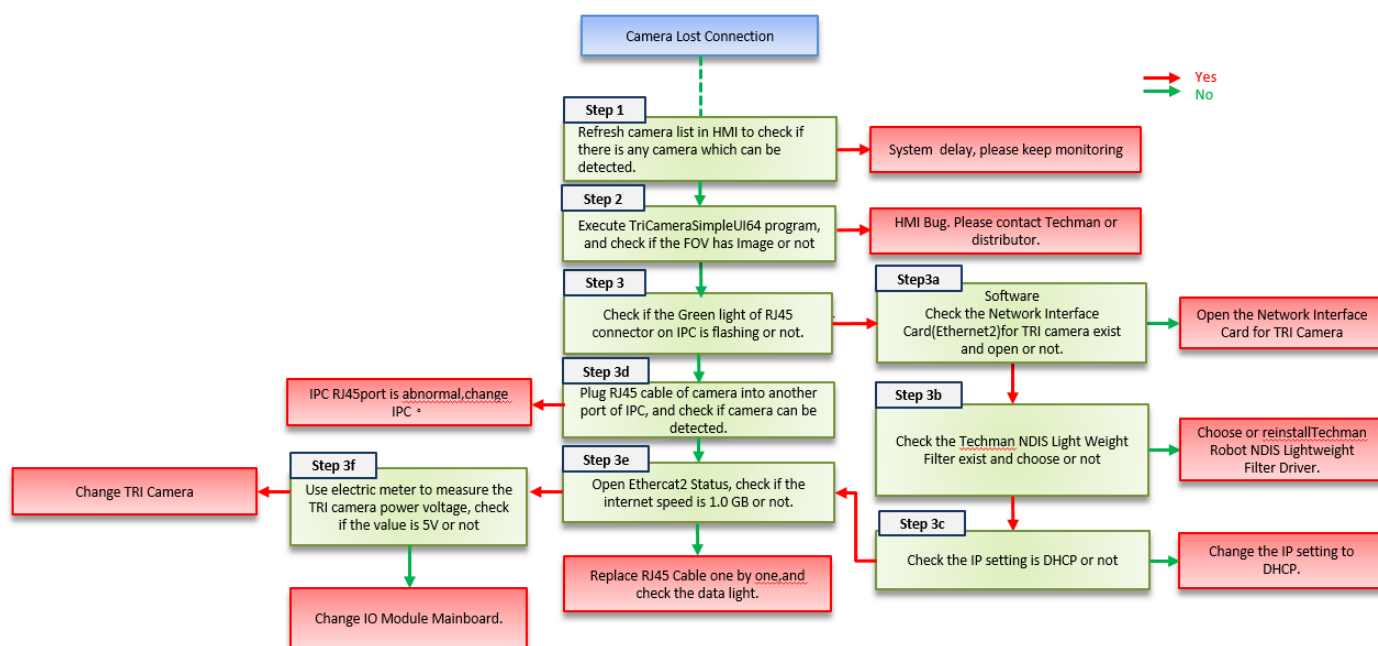
This issue may be caused by following reasons/components:

1. IPC
2. Internal complex cables
3. Robot cable
4. Camera cables inside the robot arm
5. TRI camera
6. System or driver

#### Symptom photos Or Error codes

0x00020000  
0x00020003

#### Notices



## TriCameraSimpleUI64

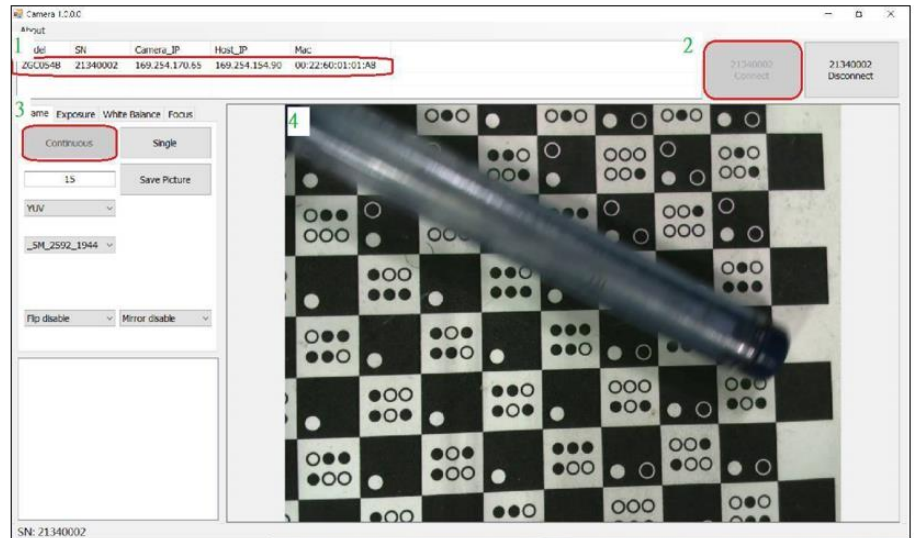
The TriCameraSimpleUI64 executable file is on the Control Box above HMI Vesion2.0.

Execute the following path file

D:\TRI\_Camera\TriCameraSimpleUI64.exe

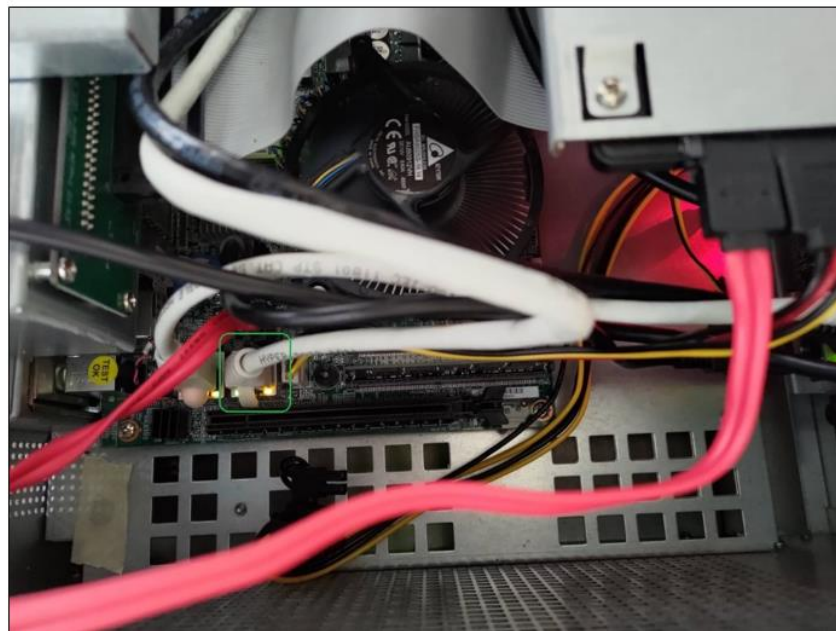
Step

1. Showing the camera
2. Connect (click)
3. Continuous(click)
4. Check if there is image on FOV

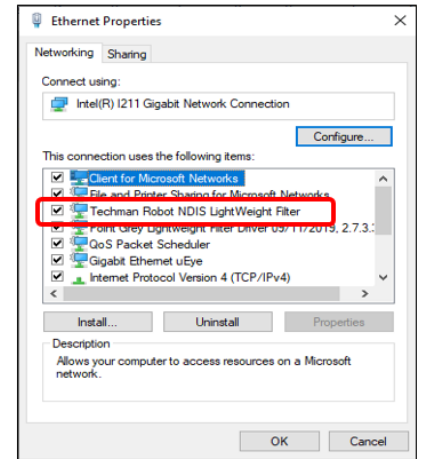


## Check camera port on IPC

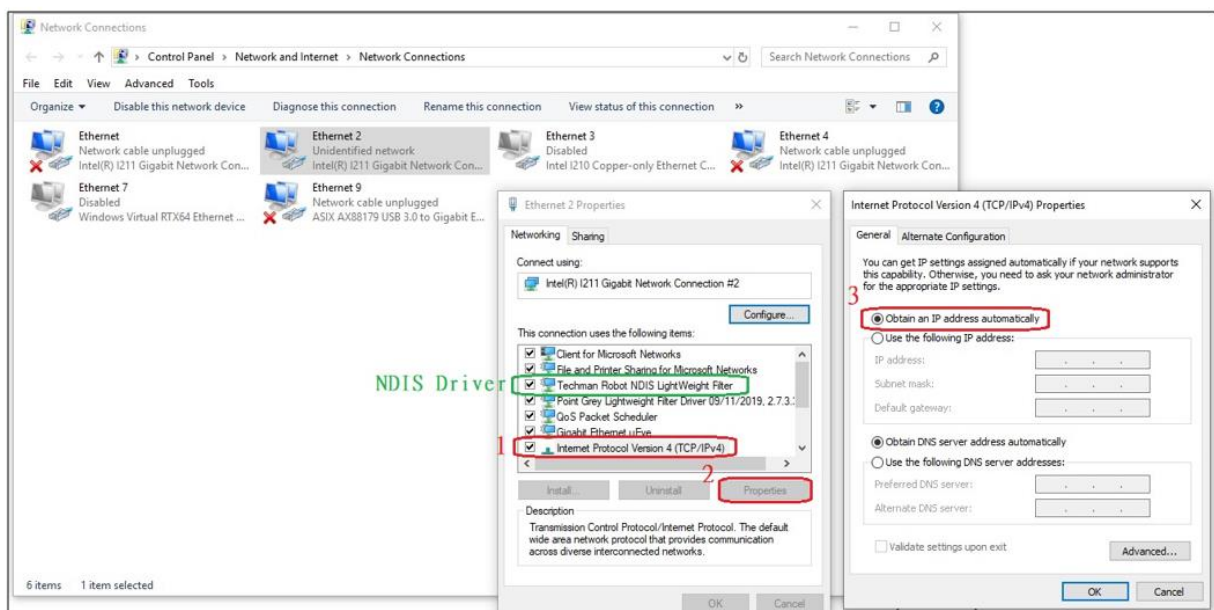
Check if the RJ45 Cable port on IPC flashes or not



1. Go to Control Pane -> Network and Internet -> Network and Sharing Center -> Change adapter settings
2. Check whether the Network Interface Card(Ethernet2)for TRI camera exists or not, and it should be activated.



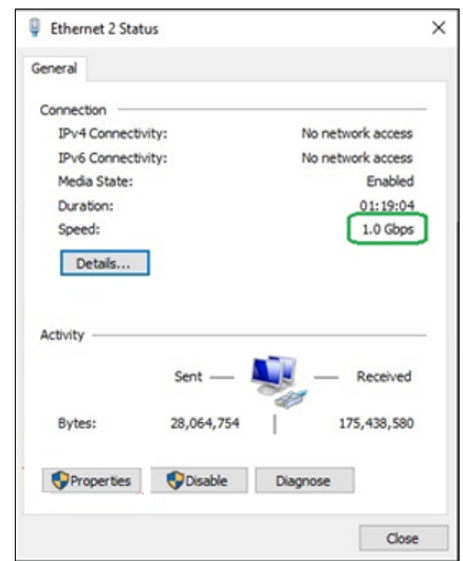
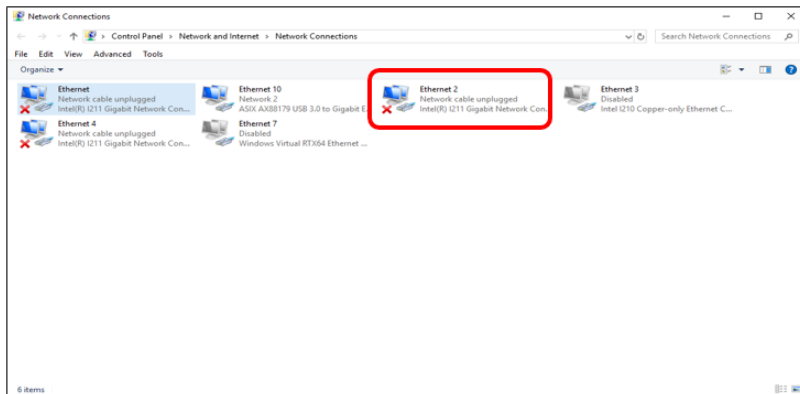
1. Choose Internet Protocol version4 and then choose properties. Check whether the IP setting is DHCP, set it as DHCP.





## Check Network setting\_3

1. Choose Ethernet2, and check whether the Ethernet Speed is 1.0 Gbps or not; if not, it means the problem could be caused by hard ware components.



## Check TRI camera

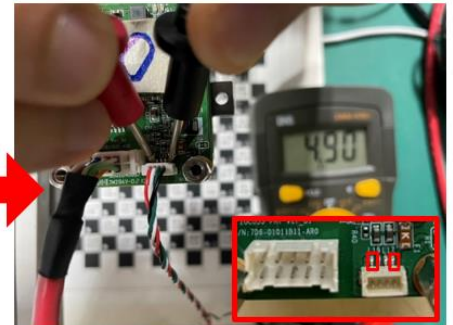
1. Follow Picture 1 to remove the Camera housing.
2. Use multi-meter to measure the TRI camera power voltage, check if the value is 5V or not as picture 2 & 3



Picture 1 - Remove camera housing screw



Picture 2 - Measure TRI camera Power



Picture 3 - Measure pins

## Check TRI Camera\_LED indicators

1. The orange light on the left indicates link status, signifying that the RJ45 signals on both sides (IPC and TRI camera) are connected.
2. The yellow light on the right represents data, and it illuminates when data is being transmitted.
3. When capturing a picture, the blinking frequency will be faster. In principle, please use the data light to verify whether the TRI camera Ethernet is active or not.



## 10.2 Camera won't focus

### Symptom description

EIH camera can not focus by HMI adjustment

### Possible causes

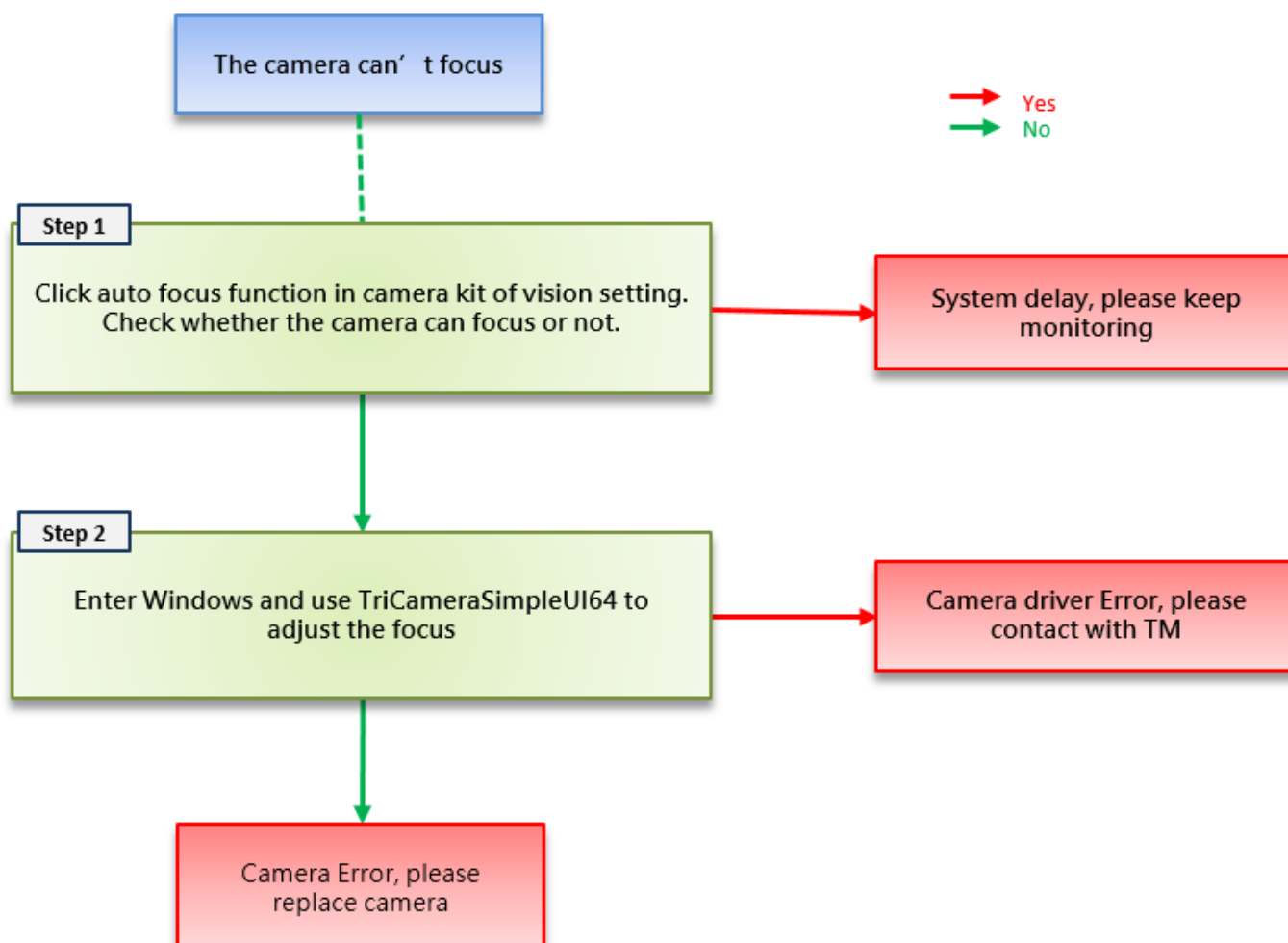
This issue may be caused by following reasons/components:

1. HMI
2. Camera

### Symptom photos Or Error codes

N/A

### Notices



### 10.3 Point offset

#### Symptom description

The robot cannot reach the previous position after a collision or for an unknown reason. This issue typically arises following a collision or relocation.

#### Possible causes

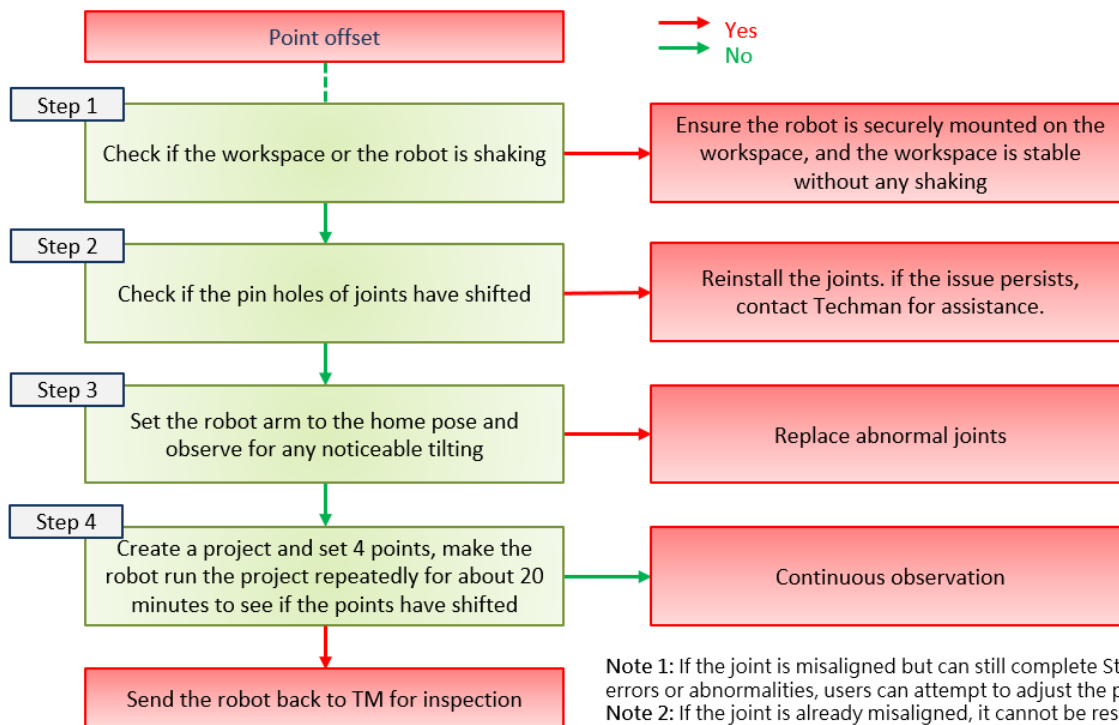
This issue may be caused by following reasons/components:

1. Joint
2. End module
3. Surrounding equipment

#### Symptom photos Or Error codes

N/A

#### Notices



## 10.4 Control box fails to boot up

### Symptom description

Control box fails to boot up after pressing the power key on the stick

### Possible causes

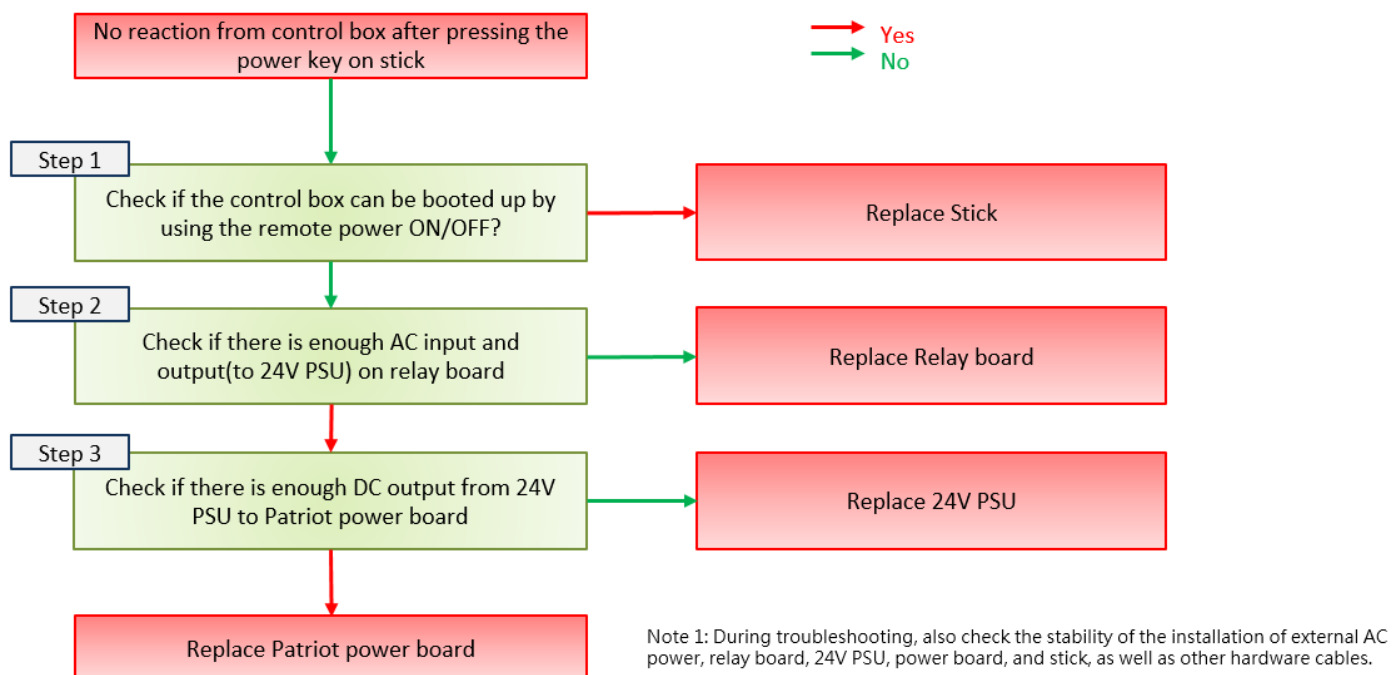
This issue may be caused by following reasons/components:

1. Stick
2. Relay board
3. 24V PSU
4. Patriot power board

### Symptom photos Or Error codes

N/A

### Notices





## 10.5 Encoder error

<b>Symptom description</b>	TMflow shows messages relating to encoder error or encoder compensation error
<b>Possible causes</b>	This issue may be caused by following reasons/components: 1. Joint
<b>Symptom photos Or Error codes</b>	0xFFCE / 0xFFED / 0xFFE4
<b>Notices</b>	When encountering Encoder-related anomalies, determine which joint is causing the issue based on the Error code displayed in TMFlow, and request replacement for the affected joint.

## 10.6 Robot arm does not activate

### Symptom description

There is no power supply from the control box to the robot arm, and the indicator light ring on the end module does not illuminate even after the control box has been booted up.

### Possible causes

This issue may be caused by following reasons/components:

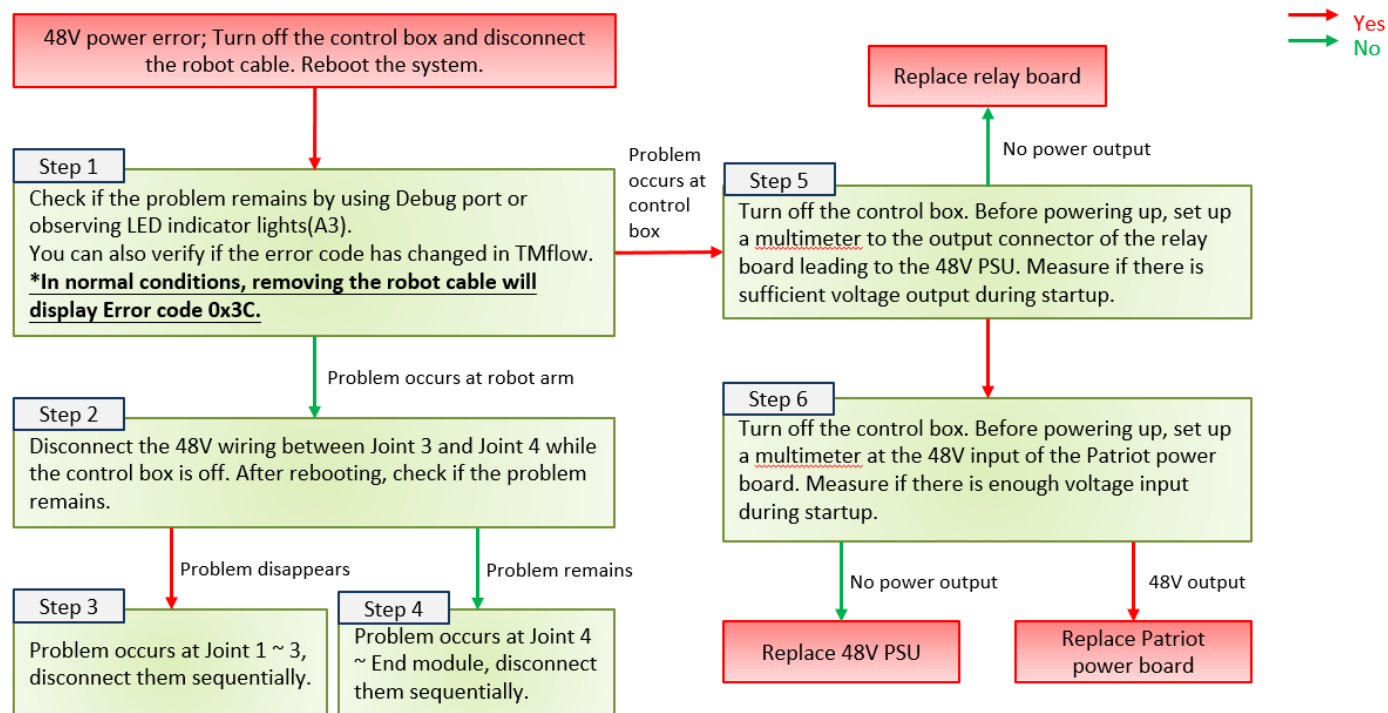
1. Power relay board
2. 48V PSU(Power supply)
3. Patriot power board
4. Power eater
5. Joints
6. End module

### Symptom photos Or Error codes

0x3E / 0x53 ...

### Notices

When addressing this 48V circuit issue, we recommend starting by disconnecting the robot and control box. This step will help you identify and narrow down the range of components that need to be checked.



## 10.7 TM Safe error

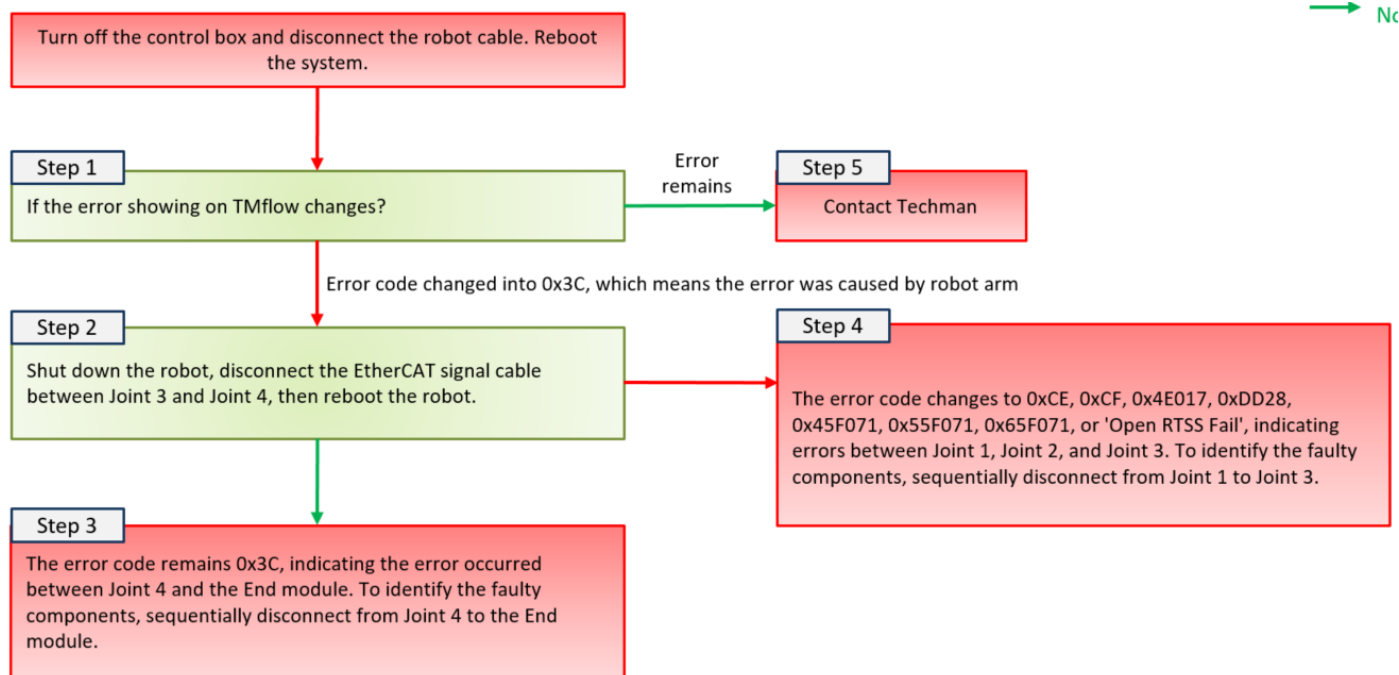
**Symptom description** Can not access TMflow normally, showing error codes below.

**Possible causes** The error may be caused by following reasons/components:

1. Joint
2. Patriot power board

**Symptom photos Or Error codes** 0xCE, 0xCF, 0x4E017, 0xDD28, 0x45F071, 0x55F071, 0x65F071, Open RTSS Fail

**Notices** When addressing this trouble shooting, we recommend starting by disconnecting the robot and control box, and check if the error code changes. This step will help you identify and narrow down the range of components that need to be checked.



## 10.8 Torque error

### Symptom description

During robot operation, it displays that torque limits exceed the standard.

### Possible causes

The error may be caused by following reasons/components:

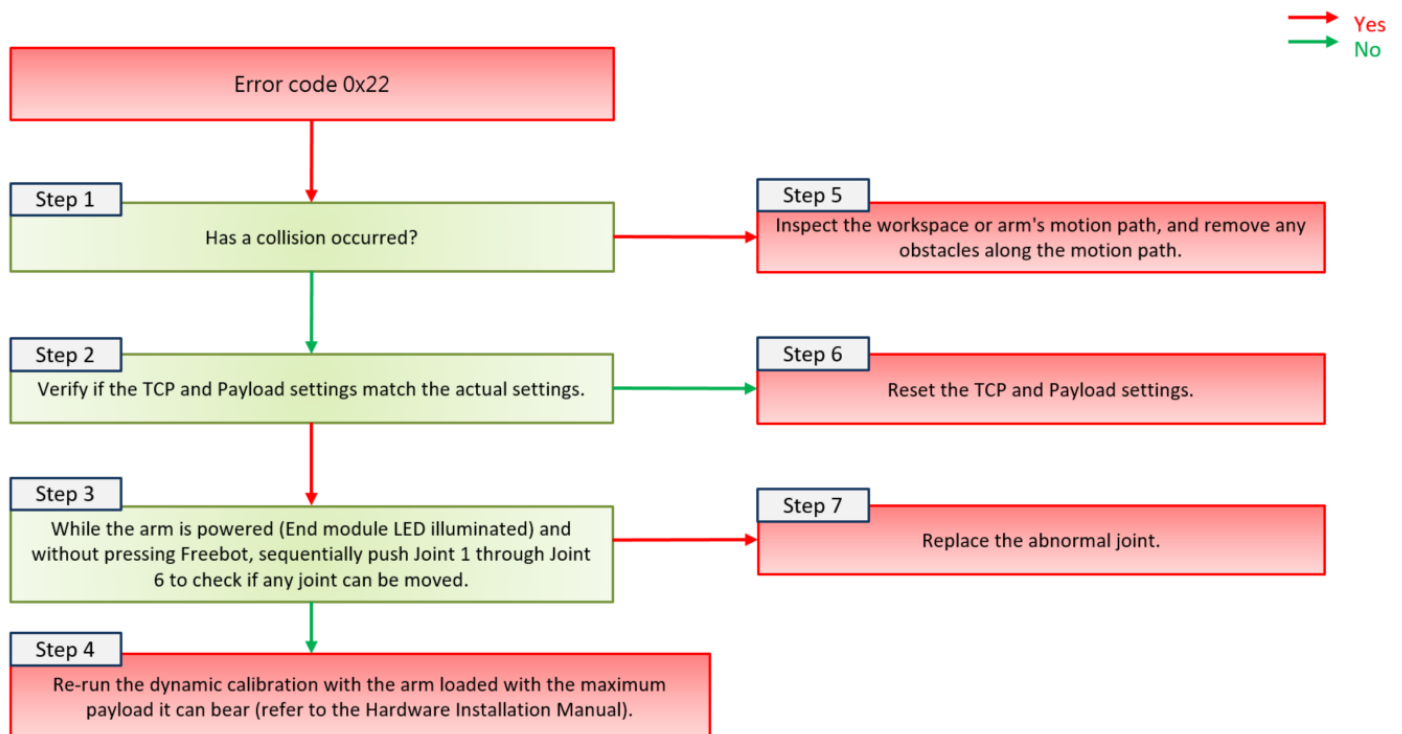
1. TCP settings do not match reality
2. Obstacle or interference detected along the arm's motion path
3. Abnormality in joint
4. Safety parameter abnormality

### Symptom photos Or Error codes

0x22, 0xFF08, 0xFF0B, 0xFF0E, 0xFF11, 0xFF14, 0xFF17, 0xFFCF

### Notices

When addressing this trouble shooting, it is recommended to first check whether there is any interference with other objects along the arm's motion path. Prolonged interference or collisions may lead to a shortened lifespan of the Harmonic Drive within the joint."



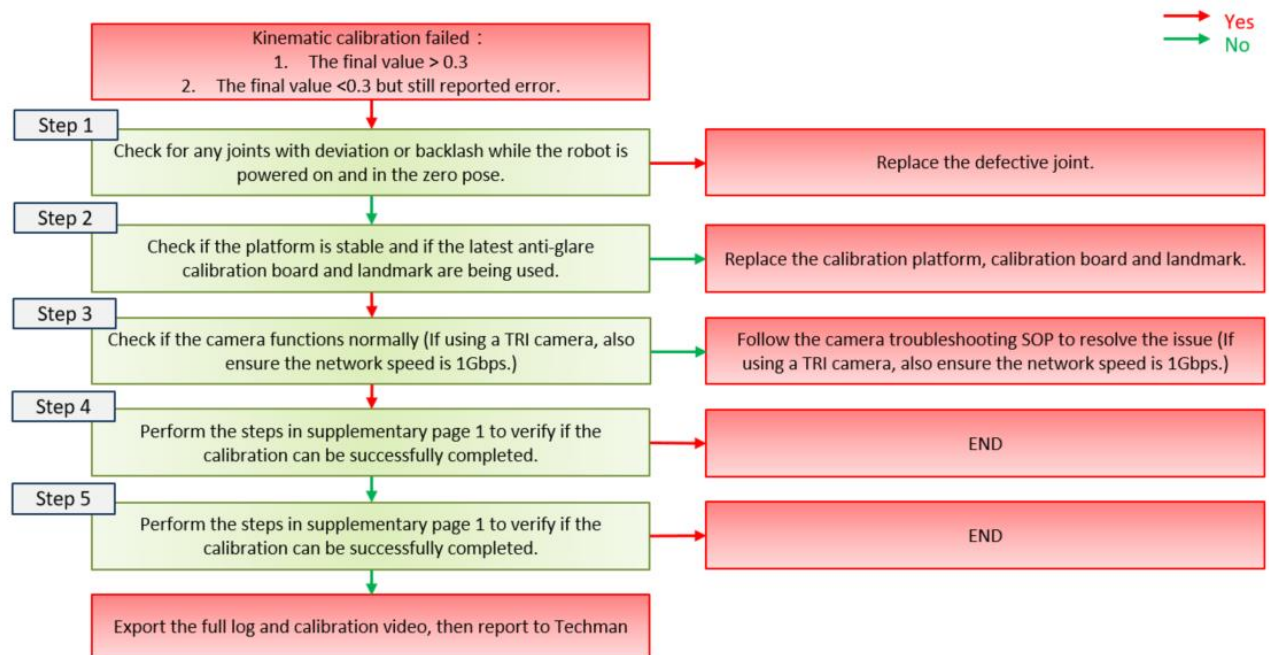
## 10.9 Kinematic calibration failed

**Description** Kinematic calibration failed

**Possible causes**

1. Camera malfunction.
2. Landmark abnormality.
3. Joint malfunction or incorrect joint assembly.

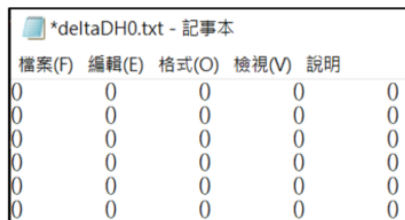
**Error code** NA





## 9. Kinematic calibration failed \_ supplementary page 1

1. Navigate to the path: D:\Robotfile
2. Back up the following files and delete them: deltaDH0.bin, deltaDH0.txt, Driveroffset0.bin, Driveroffset0.txt
3. In the D:\Robotfile directory, create the following files: EEPROMUPDATE1.txt & EEPROMUPDATE0.txt
4. Create a new file named DeltaDH0.txt, and enter the required values:

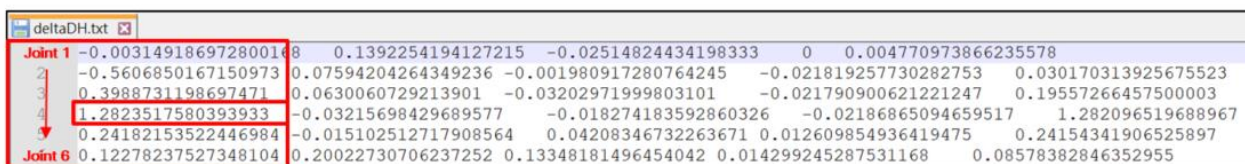


檔案(F)	編輯(E)	格式(O)	檢視(V)	說明
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

5. Create a new Driveroffset0.txt and input the following values:  
HW1 – HW3.2: -45.00000000,0.00000000,0.00000000,0.00000000,0.00000000,0.00000000  
HW5: 90.00000000,0.00000000,0.00000000,0.00000000,0.00000000,0.00000000,
6. Reboot the system and perform the calibration again.

## 9. Kinematic calibration failed \_ supplementary page 2

1. Navigate to the path: D:\CalibrationData
2. Open deltaDH.txt and check if any values are greater than 1. If any values are greater than 1, reassemble the corresponding joint. (For example, in the case of following image, Joint 4 needs to be reassembled.)



Joint 1	-0.003149186972800168	0.1392254194127215	-0.02514824434198333	0	0.004770973866235578
2	-0.5606850167150973	0.07594204264349236	-0.001980917280764245	-0.021819257730282753	0.030170313925675523
3	0.3988731198697471	0.0630060729213901	-0.03202971999803101	-0.021790900621221247	0.19557266457500003
4	1.2823517580393933	-0.03215698429689577	-0.018274183592860326	-0.02186865094659517	1.282096519688967
5	0.24182153522446984	-0.015102512717908564	0.04208346732263671	0.012609854936419475	0.24154341906525897
Joint 6	0.12278237527348104	0.20022730706237252	0.13348181496454042	0.014299245287531168	0.08578382846352955

1. If the calibration still fails after reassembling, and the value at that position is still greater than 1, replace the joint.

### 10.10 Hand-eye calibration failed

**Description**

Hand-eye calibration failed

**Possible causes**

1. Landmark abnormality.
2. Camera parameter abnormality

**Error code**

NA

