UNIVERSAL ROBOTS

Service Handbook

UR Series

Control box 5.5/5.6

Original instructions (en)

SW 5.26 / 10.12

Contents

1. Copyright and Disclaimers

NOTICE

Universal Robots continues to improve reliability and performance of its products, and therefore reserves the right to upgrade the product without prior warning. Universal Robots takes care that the content of this document is precise and correct, but takes no responsibility for any errors or missing information.

NOTICE

Universal Robots disclaims any liability, even if all guidelines in this document are followed.

2. Introduction

2.1. About This Document

Purpose

The purpose of this service manual is to help Universal Robots (UR) users and integrators to safely perform service-related operations and troubleshooting.

Universal Robots industrial robots are designed using high-quality components to ensure long product life cycle. However, improper use of a robot or robot parts will cause failures. If, for example, the robot is overloaded, dropped during relocation, damaged by collision or any other improper use, the warranty will be void.
Universal Robots recommends the user *not* to repair, adjust, or make other interventions in the mechanical or electrical systems of the robot without first consulting a UR-certified service engineer. Any unauthorized repair and/or troubleshooting work(s) voids the warranty. Service-related operations and troubleshooting should only be performed by qualified personnel.
Before performing service-related operations, stop the robot program and disconnect the main power to any potential dangerous tool on the robot or its surroundings.
In the event of a defect, Universal Robots recommends ordering new parts from the Universal Robot distributor where the robot was originally purchased. Alternately, parts can be ordered from the nearest distributor, details of which can be obtained from Universal Robots official website at www.universal-robots.com.

2.2. Company Details

Where we are

Universal Robots A/S
Energivej 51
DK-5260 Odense Denmark
Tel.: +45 89 93 89 89

2.3. Safety Message Types

Description

Safety messages are used to emphasize important information. Read all the messages to help ensure safety and to prevent injury to personnel and product damage.

WARNING

Indicates a hazardous situation that, if not avoided, can result in death or serious injury.

WARNING: ELECTRICITY

Indicates a hazardous electrical situation that, if not avoided, can result in death or serious injury.

WARNING: HOT SURFACE

Indicates a hazardous hot surface where injury can result from contact and non-contact proximity.

CAUTION

Indicates a hazardous situation that, if not avoided, can result in injury.

GROUND

Indicates grounding.

PROTECTIVE GROUND

Indicates protective grounding.

NOTICE

Indicates the risk of damage to equipment and/or information to be noted.

READ MANUAL

Indicates more detailed information that should be consulted in the manual.

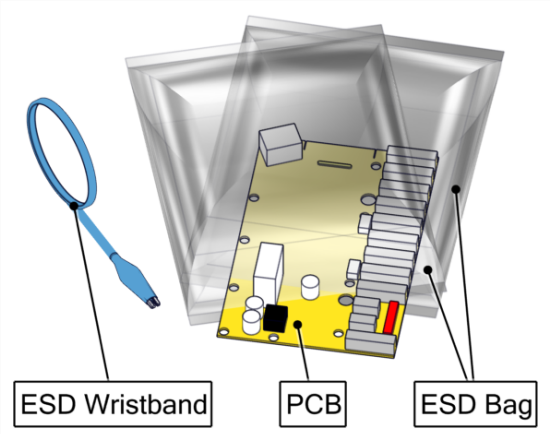
3. Handling Electrostatic Discharge (ESD)-Sensitive Parts

PCB, an ESD-sensitive part

To prevent damage to ESD-sensitive parts, that is, printed circuit board (PCB), follow the instructions below in addition to all the usual precautions, such as turning off the power before removing the PCB. See section Complete Rebooting Sequence.

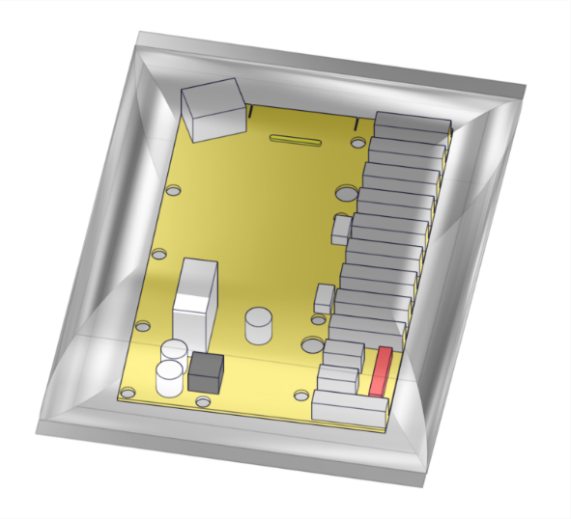
NOTICE

Be sure you have intact ESD wristband and a spare ESD bag before replacing any ESD-sensitive parts.



NOTICE

Keep the ESD-sensitive part in its original shipping container (a special "ESD bag") until the part is ready to be installed.

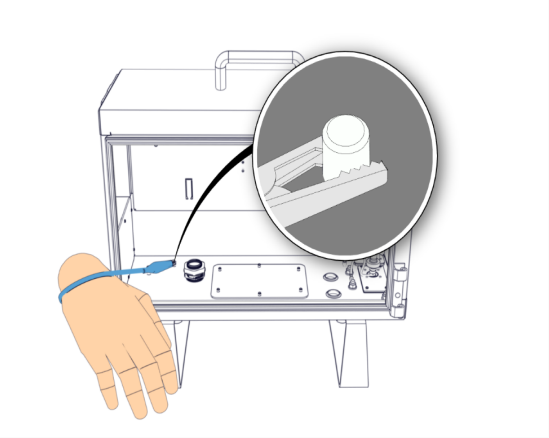


NOTICE

Put the ESD wristband on your wrist. Connect the wristband to the system ground point. It discharges any static electricity in your body to ground.

NOTICE

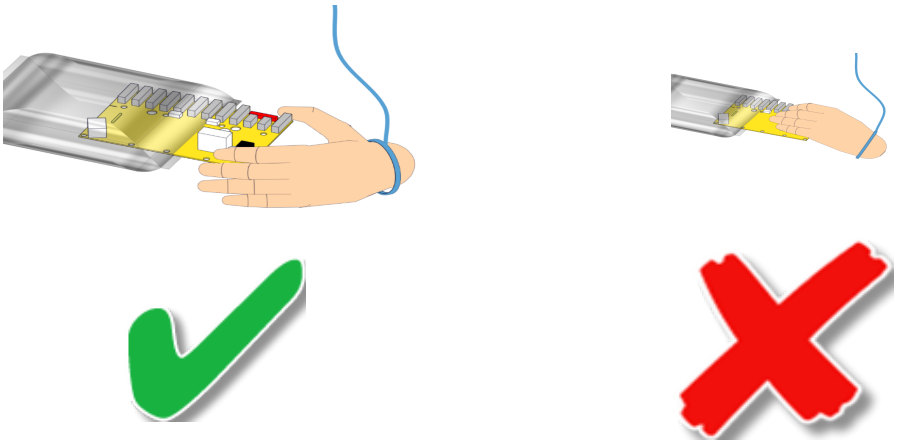
Replacing an ESD-sensitive part in a safe way is important to avoid damage to the part. It is important to take precautions when handling an ESD-sensitive part.



ESD wristband connection to the system ground

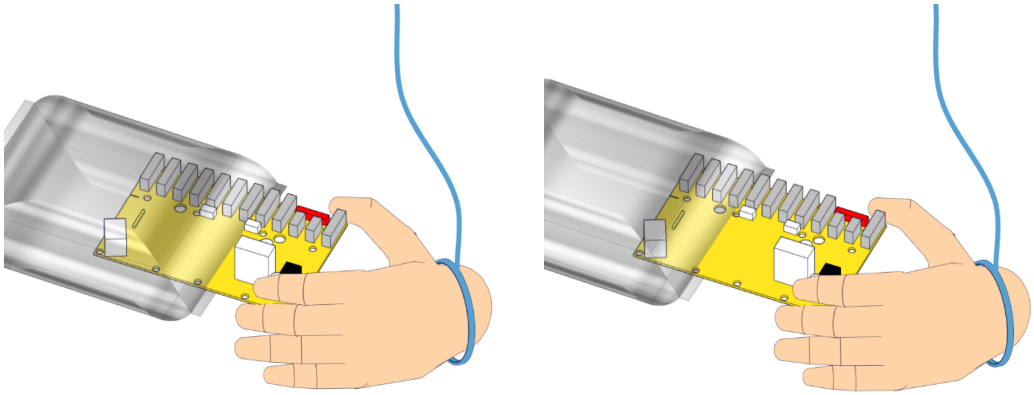
NOTICE

Hold the ESD-sensitive part by its edges. Do not touch its pins or hold directly on any exposed prints.



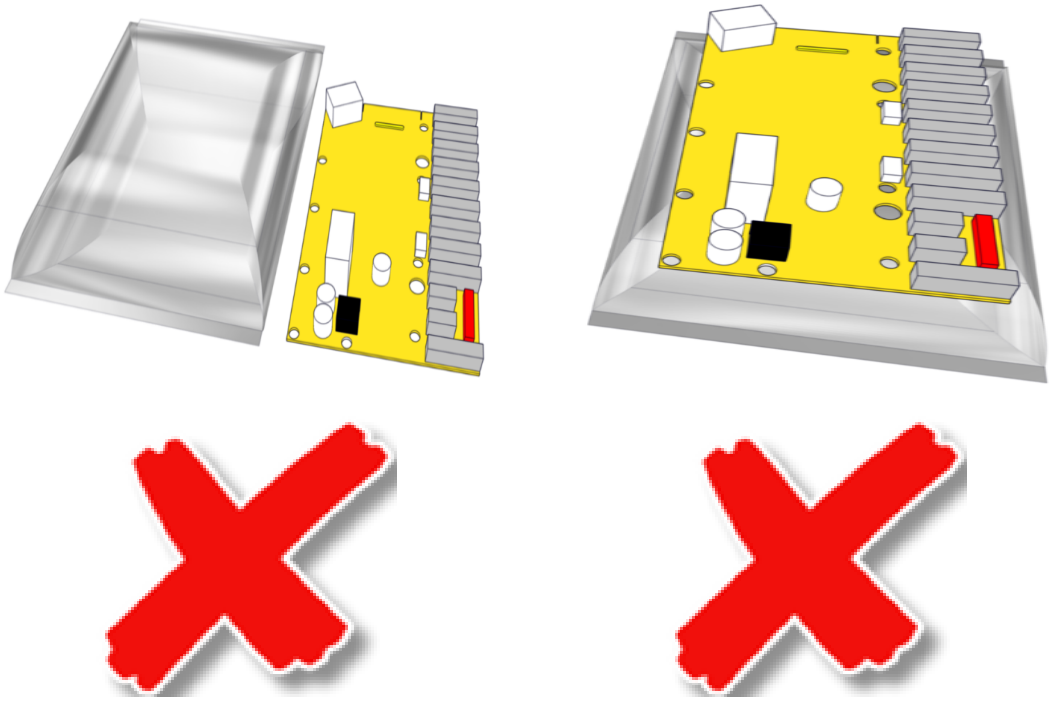
NOTICE

First place the OLD part in the spare ESD bag, then take out the NEW part of the ESD bag.



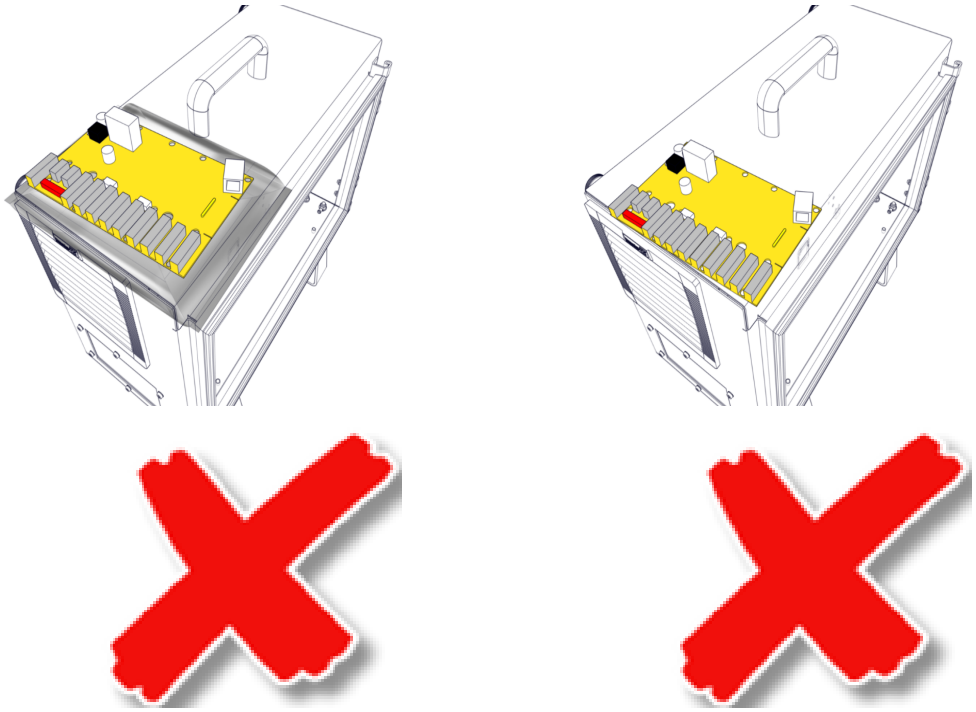
NOTICE

Do not place the ESD-sensitive part on nonconductive material or on metal tables/surfaces. If you must put down the ESD-sensitive part for any reason, then first place it into the ESD bag.



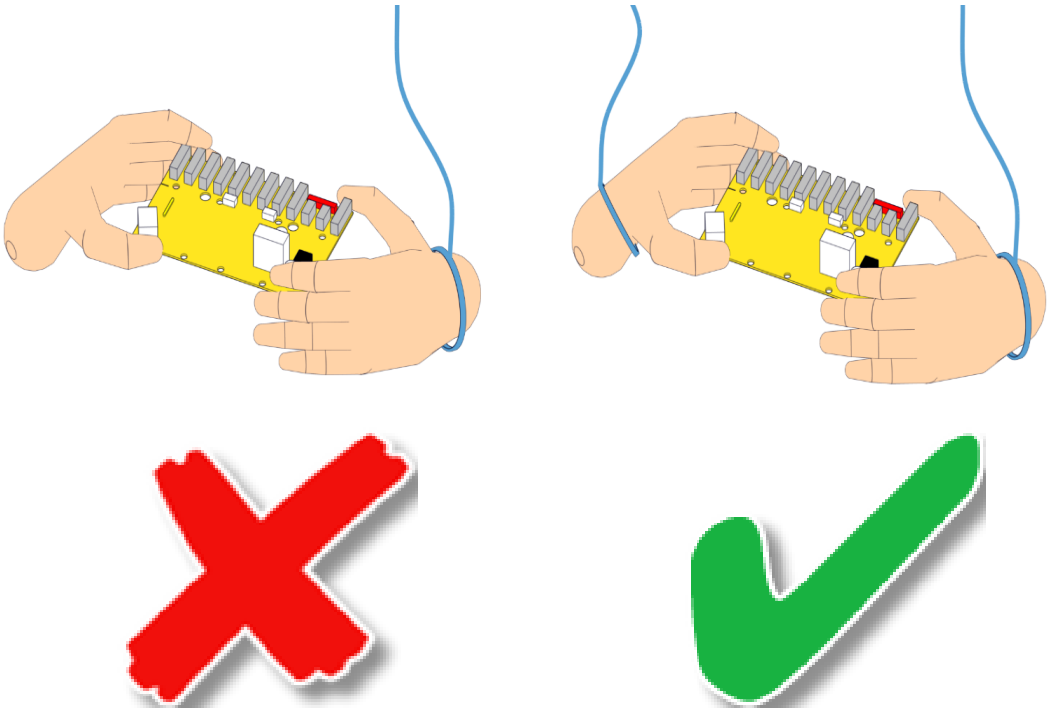
NOTICE

Machine covers and metal tables/surfaces are electrical grounds. They increase the risk of damage because they make a discharge path from your body through the ESD-sensitive part. (Large metal objects can be discharge paths without being grounded.)



NOTICE

If handing an ESD-sensitive part to another person, ensure both are wearing ESD wristband, attached to the system ground point.



NOTICE

Extra care is needed when working with ESD-sensitive parts during cold weather and when heating is used, because low air humidity increases accumulation of the static electricity.

4. Recommended Inspection Activities

Description

This chapter provides graphical and tabular information for UR robot inspection activities for:

- Robot arm
- Control box
- Teach pendant

4.1. Robot Arm

4.1.1. Inspection Plan

Inspection Plan

The table below is a checklist of the type of inspections recommended by Universal Robots. Perform inspections regularly as advised in the table. Any referenced parts found to be in an unacceptable state must be rectified or replaced.

See the following sections for detailed guidance:

- Visual Inspection: Robot Arm
- Pre-Use Assessment
- Robot Arm

Inspection action type			Timeframe		
			Monthly	Biannually	Annually
1	Check flat rings	V		✗	
2	Check robot cable	V		✗	
3	Check robot cable connection	V		✗	
4	Check Robot Arm mounting bolts *	F	✗		
5	Check Tool mounting bolts *	F	✗		
6	Round Sling	F			✗

V = Visual inspection F = Functional inspection * = Must also be checked after heavy collision

4.1.2. Visual Inspection: Robot Arm

NOTICE

Using compressed air to clean the robot arm can damage the robot arm components.

- Never use compressed air to clean the robot arm.

You can see the torque values and other technical data used to adjust the robot after the visual inspections here: 5.2.2 Connection Torque Values on page 23

1. Move the Robot Arm to ZERO position, if possible.
2. Turn off and disconnect the power cable from Control Box.
3. Inspect the cable between Control Box and Robot Arm for any damage.
4. Check the base mounting bolts are properly tightened.
5. Check the tool flange bolts are properly tightened.
6. Inspect the flat rings for wear and damage.
   - Replace the flat rings if they are worn out or damaged.

NOTICE

If any damage is observed on a robot within the warranty period, contact the distributor where the robot was purchased.

4.1.3. Functional Inspection

Do functional inspections to ensure the robot arm and its screws, bolts and tools are not loose.
Use a correctly calibrated torque wrench, specified in Torque Values to check the screws and bolts listed in the inspection plan.

4.1.4. Cleaning Your Robot

Cleaning Methods

To address the dust, dirt, or oil on the robot arm and/or Teach Pendant, simply use a cloth alongside one of the cleaning agents provided below.

Surface Preparation: Before applying the below solutions, surfaces may need to be prepared by removing any loose dirt or debris.

Cleaning agents:

- Water
- 70% Isopropyl alcohol
- 10% Ethanol alcohol
- 10% Naphtha (Use to remove grease.)

Application: The solution is typically applied to the surface that needs cleaning using a spray bottle, brush, sponge, or cloth. It can be applied directly or diluted further depending on the level of contamination and the type of surface being cleaned.
Agitation: For stubborn stains or heavily soiled areas, the solution may be agitated using a brush, scrubber, or other mechanical means to help loosen the contaminants.
Dwell Time: If necessary, the solution is allowed to dwell on the surface for a up to 5 minutes to penetrate and dissolve the contaminants effectively.
Rinsing: After the dwell time, the surface is typically rinsed thoroughly with water to remove the dissolved contaminants and any remaining cleaning agent residue. It's essential to ensure thorough rinsing to prevent any residue from causing damage or posing a safety hazard.
Drying: Finally, the cleaned surface may be left to air dry or dried using towels.

WARNING
DO NOT USE BLEACH in any diluted cleaning solution.

WARNING

Grease is an irritant and can cause an allergic reaction. Contact, inhalation or ingestion can cause illness or injury. To prevent illness or injury, adhere to the following:

- PREPARATION:
  - Ensure that the area is well ventilated.
  - Have no food or beverages around the robot and cleaning agents.
  - Ensure that an eye wash station is nearby.
  - Gather the required PPE (gloves, eye protection)
- WEAR :
  - Protective gloves: Oil resistant gloves (Nitrile) impermeable and resistant to product.
  - Eye protection is recommended to prevent accidental contact of grease with eyes.
- DO NOT INGEST.
- In the event of
  - contact with skin, wash with water and a mild cleaning agent
  - a skin reaction, get medical attention
  - contact with the eyes, use an eyewash station, get medical attention.
  - inhalation of vapors or ingestion of grease, get medical attention
- After grease work
  - clean contaminated work surfaces.
  - dispose responsibly of any used rags or paper used for cleaning.
- Contact with children and animals is prohibited.

In rare cases, very small amounts of grease can be visible from the joint. This does not affect the function, use, or durability of the joint.

4.2. Control Box and Teach Pendant

4.2.1. Inspection Plan

Description

Table below is a checklist of the type of inspections recommended by Universal Robots. Perform inspections regularly as stated in the table. Any referenced parts found to be in an unacceptable state must be corrected or replaced.

See the following sections for detailed guidance:

- Functional and Safety Inspection
- Visual Inspection: Control Box
- Pre-Use Assessment
- Control Box

Inspection checklist

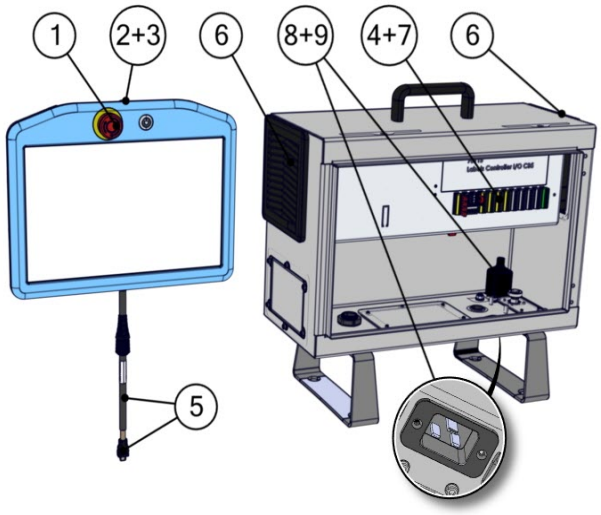
Inspection action type			Time Frame		
			Monthly	Biannually	Annually
1	Check emergency stop on teach pendant	F	✗		
2 & 3	On a standard TP: check the freedrive button by pressing it gently. On a 3PE TP: check the 3PE buttons pressing them gently.	F		✗	
	Check backdrive mode	F	✗		
	Check freedrive mode	F		✗	
4	Check safety inputs and outputs(if connected)	F	✗		
5	Check teach pendant cable and connector	V		✗	
6	Check and clean air filters on control box	V	✗		
7	Check terminals in control box	F		✗	
8 & 9	Check electrical grounding <1Ω to control box	F			✗
	Check main power to control box	F			✗

V = Visual inspection F = Functional inspection

4.2.2. Functional and Safety Inspection

NOTICE

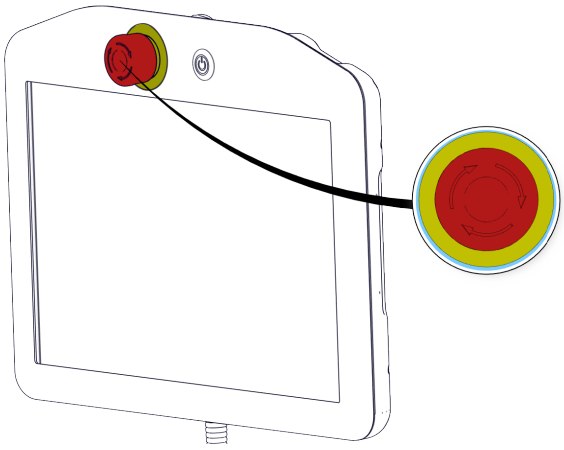
Robot safety functions is highly recommended to be tested monthly to ensure correct function.



Numbered instruction per parts of teach pendant

Emergency stop button on the teach pendant:

1. Press the emergency stop button of the teach pendant. See figure 3.2.
2. Observe the robot stops and shuts off power to the joints.
3. Power on robot again.



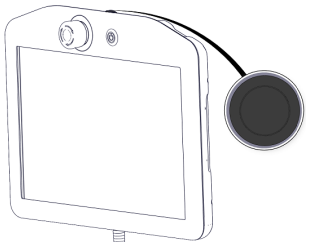
Emergency button of teach pendant

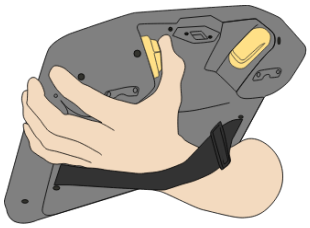
Freedrive

To test Freedrive

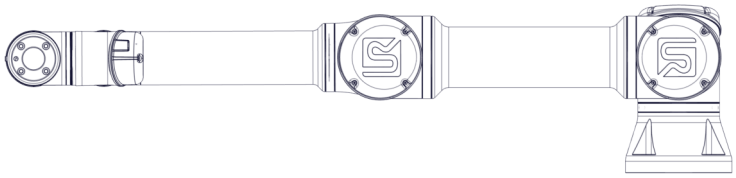
1. Unmount attachment or set TCP (tool center point)/payload/CoG (center of gravity) according to tool specifications.
2. To move the robot arm in freedrive, see figure below.

Standard TP	3PE TP
On a standard teach pendant (TP), press and hold the freedrive button.	On a 3PE TP, rapidly light-press, release, light-press again, and keep holding the 3PE button in this position.





3. Pull/Push the robot to a horizontally elongated position and release. See figure below.



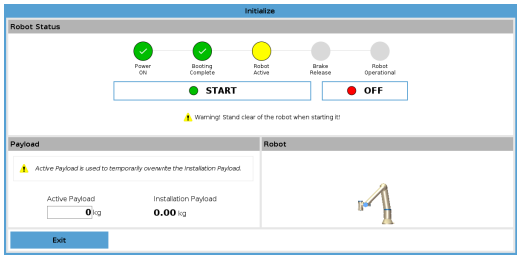
Elongated horizontal position of UR robot

4. Verify the robot arm can maintain the position without support and without pressing the freedrive or 3PE button.

Backdrive

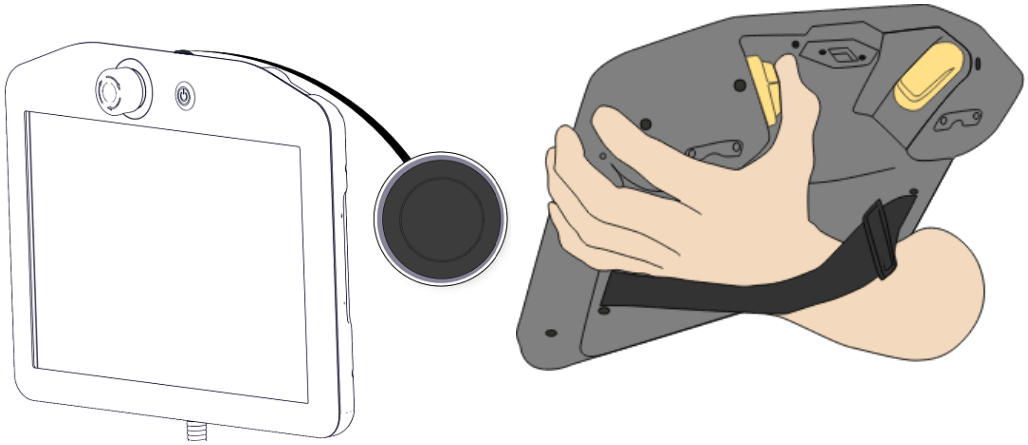
If the robot arm is close to colliding with something, you can use the backdrive function to move the robot arm to a safe position before (re)initializing it.

1. Press On to enable power. Status changes to *Robot Active*.



Robot status and payload information in the teach pendant.

2. Press and hold Freedrive. Status changes to *Backdrive*, as shown in figure 3.6.



Standard TP 3PE TP

Freedriving a standard TP and 3PE TP.

NOTICE

The robot arm is “heavy” to move around in Backdrive, so efort is required to move the joints.

MANDATORY ACTION

You must test Backdrive mode on all joints.

3. Move robot as in Freedrive. Joint brakes are released where needed once the Freedrive button is activated.

Safety settings
Verify the robot safety settings comply with the robot installation risk assessment.
Additional safety inputs and outputs are still functioning
Check which safety inputs and outputs are active and that they can be triggered via PolyScope or external devices.
Backup data See section Backup of Data

4.2.3. Visual Inspection: Control Box

1. Disconnect the power cable from the control box.
2. Check the control board terminals are properly inserted. Do not ignore loose wires.
3. Check for any dirt/dust inside the control box. Clean with ESD vacuum cleaner, if needed.

NOTICE
Using compressed air to clean the Control Box can cause damage to the Control Box components.

- Never use compressed air to clean the Control Box.

4.2.4. Cleaning TP and CB

Cleaning the Teach Pendant Touch Screen	Use a mild, industrial cleaning agent without thinning agents or any aggressive additives. Do not use an abrasive material to wipe down the screen. Universal Robots does not promote a specific cleaning agent.
Cleaning the Control Box	Wipe down the Control box with a damp cloth, if necessary. Use the cleaning recommendation listed in the user manual.

Replace he Control box Filters

There is a filter on either side of the control box.

1. Gently remove the outer plastic frame by pulling where the red arrows are, as shown in the images below in figure 3.7. The frame tilts outward.
2. Replace filters.

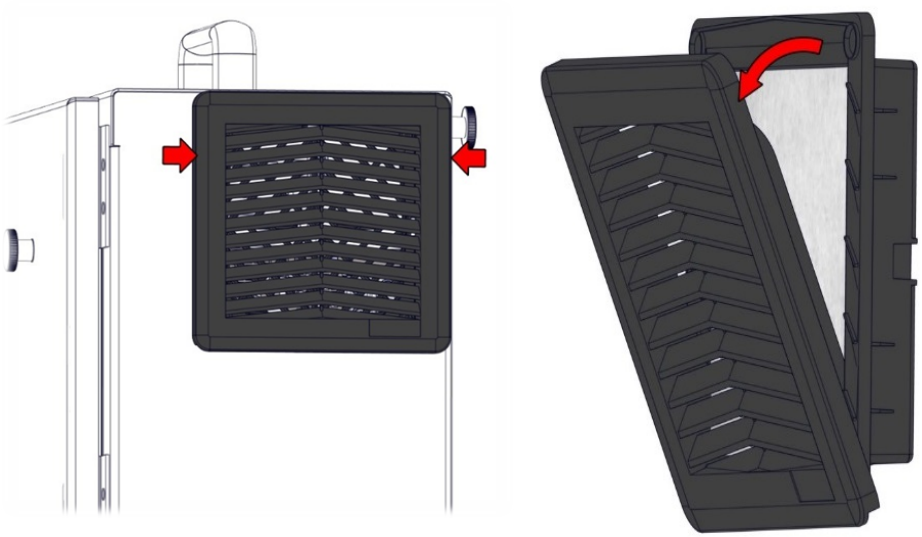


Figure 3.7. Replace the Control box filters.

5. Service and Replacement of Parts

Installation of a new spare part might require a software update to ensure full functionality. Universal Robots always recommends updating to the latest software release or the current long-term support software version.
See more here: Software Updates
In this chapter, information are provided for services and parts replacements for:

- Secure the Grounding Lead
- Pre-use assessment
- Robot arm
- Robot cable
- Control box

5.1. Pre-Use Assessment

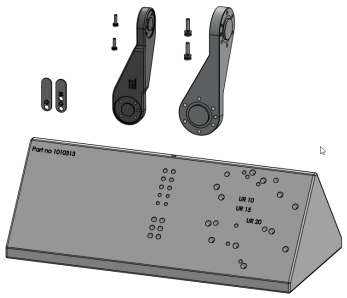
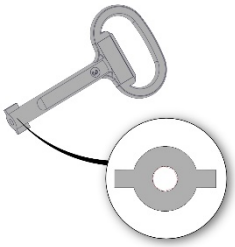
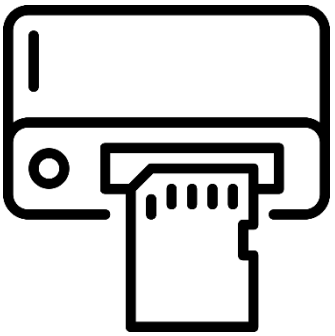
Tests before first use

The following tests must be conducted before using the robot for the first time or after any modifications are made. Verify all safety inputs and outputs are correctly connected. Test all connected safety inputs and outputs, including devices common to multiple machines or robots, are functioning.

- Test the emergency stop buttons. Check the robot is stopped and the brakes are engaged.
- Test the safeguard input stops the robot's motion. If a safeguard reset is configured, check that it must be activated before motion can resume.
- Test safety boundaries to ensure that Reduced Mode can switch the safety mode and back.
- Test the Operational Mode switches, if connected. See icon on top right corner of user interface to ensure the mode is changing.
- Test the Three-Position Enabling Device (3PE), if connected, to enable motion in manual mode and test that the robot is under reduced speed control.
- Test that the System Emergency Stop Outputs can bring the entire system to a safe state.
- Test that the system connected to Robot Moving Output, Robot Not Stopping Output, Reduced Mode Output, or Not Reduced Mode Output can detect the output changes.

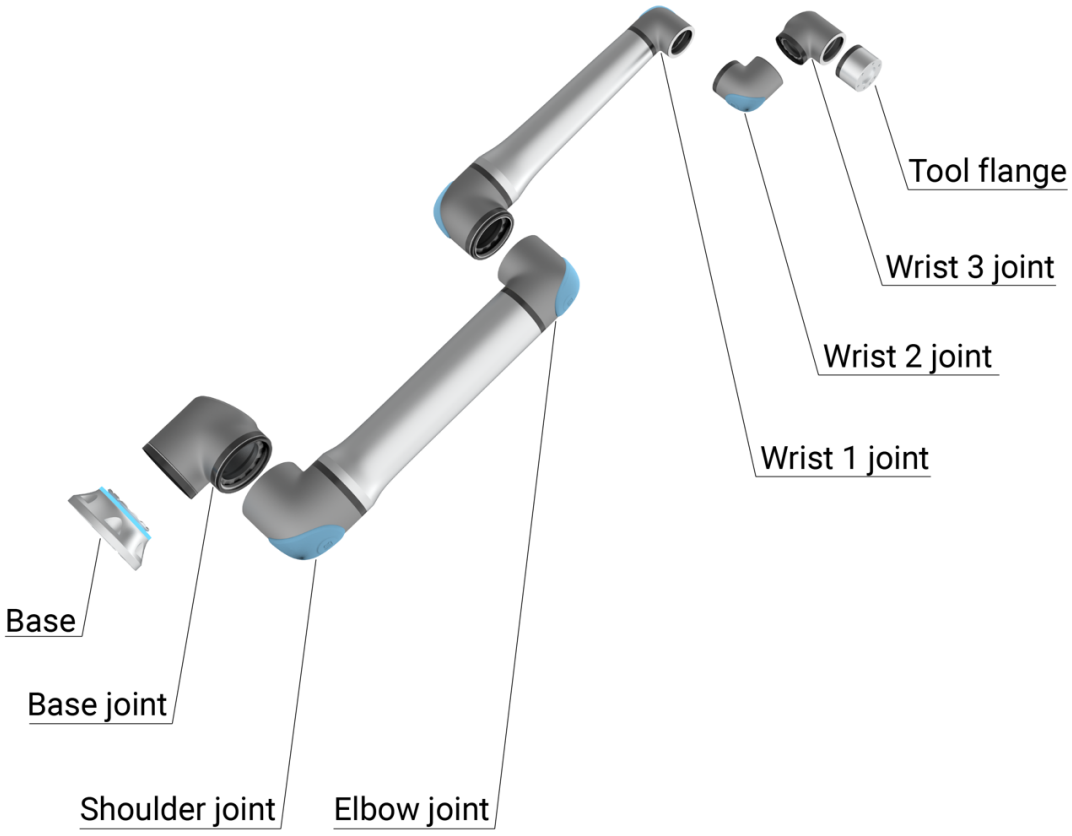
Read Section 9 to learn how to pack down and ship the robot and/or spare parts. Packing and Shipping of Robot/Spare Parts

5.1.1. Recommended Tools

Robot Arm	Control Box	
UR Series Arm Toolkit - part no.: 200121	General Service toolkit - part no.: 200119	
		
Dual Robot Calibration tooling part no.: 200977	Cabinet key (double-bit key)	SD card reader
		

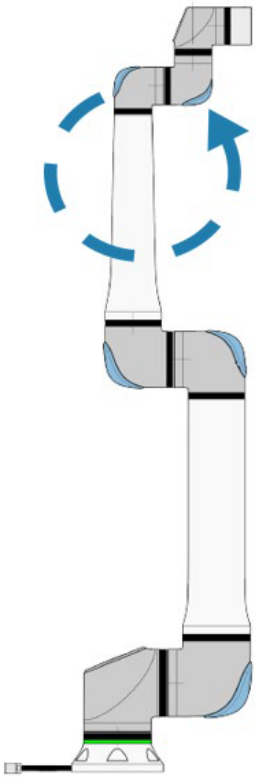
5.2. Robot Arm

Joint names



5.2.1. Joint Interchangeablilty

On the UR Series robot arms only wrist 1 and wrist 2 can be switched in service situations. Every other part has their own spare part number.

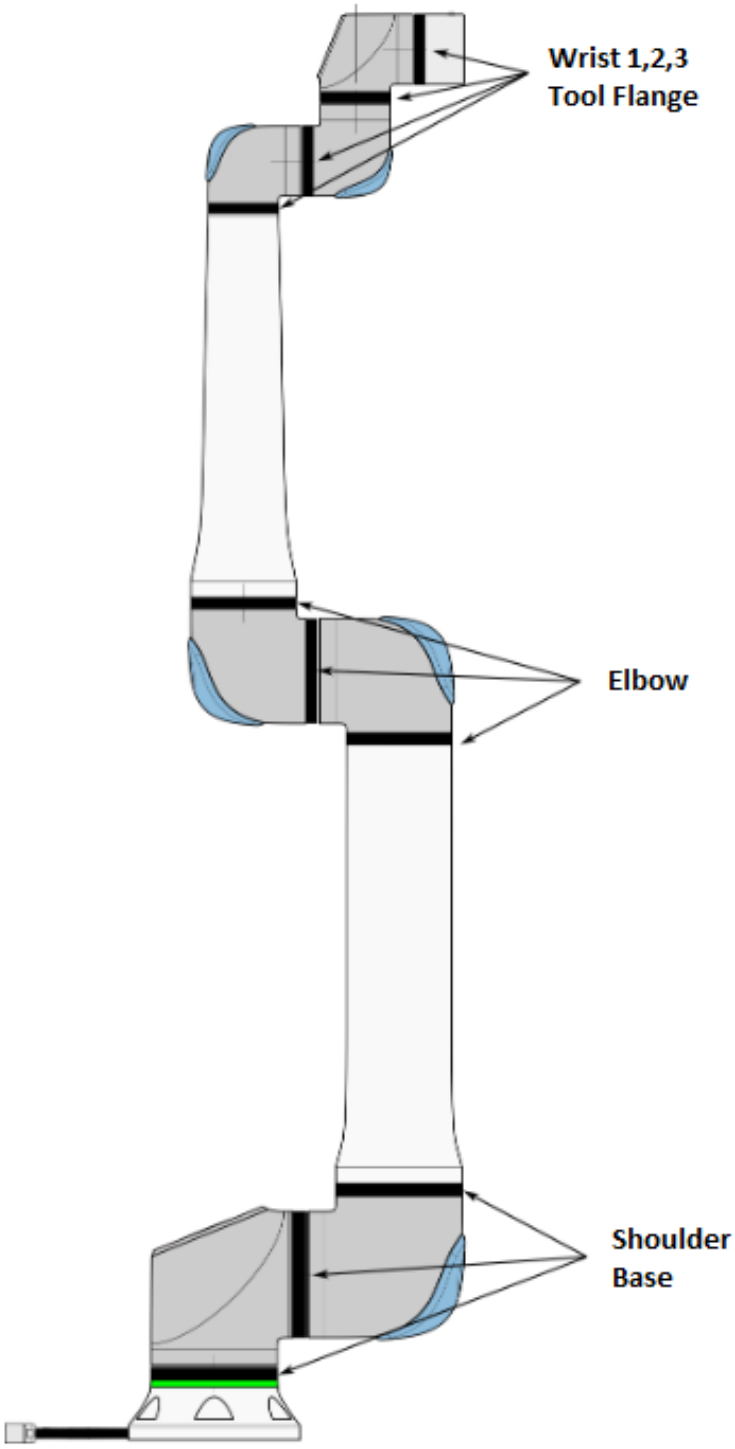


NOTICE

It is only possible the change joints between UR20 and UR30.
It is only possible the change joints between UR8 Long, UR15, and UR18.

5.2.2. Connection Torque Values

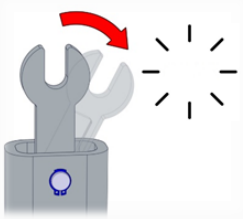
The clamp connection is present between all joint assemblies.

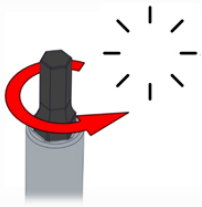


Size	Placement	Thread	Head Size	Torque	Tolerance
2	**UR18 / UR15 / UR8 Long** Wrist 1 Wrist 2 Wrist 3 Tool flange	M4	Hex key 3	2.5 Nm	±10%
2.5	**UR20 / UR30** Wrist 1 Wrist 2 Wrist 3 Tool flange	M5	Hex key 4	5.5 Nm	±10%
3	**UR18 / UR15 / UR8 Long** Elbow	M5	Hex key 4	4 Nm	±10%
4	**UR18 / UR15 / UR8 Long** Shoulder Base **UR20 / UR30** Elbow	M6	Hex key 5	7.5 Nm	±10%
5	**UR20 / UR30** Shoulder Elbow	M6	Hex key 5	7.5 Nm	±10%

NOTICE

Click the torque tool a minimum of three times before use, to get the correct calibrated torque.





5.2.3. Clamp Connection

The following two sections describe how to disassemble and assemble a joint with a clamp connection.

NOTICE

When handling joints, consider the weight of each individual joint and observe the relevant safety rules.

Joint Size	Joint Mass
Joint Size 5	15.8 Kg.
Joint Size 4	9.1 Kg.
Joint Size 3	5.0 Kg.
Joint Size 2.5	2.9 Kg.
Joint Size 2	2.2 Kg.

Clamp Connection: Disassembly

Description

WARNING

Unsupported joints can fall, or be dropped, resulting in injury.

- Support joints while clamps are being removed.

NOTICE

Failure to support the joint/s while clamps are removed can result in damage to equipment.

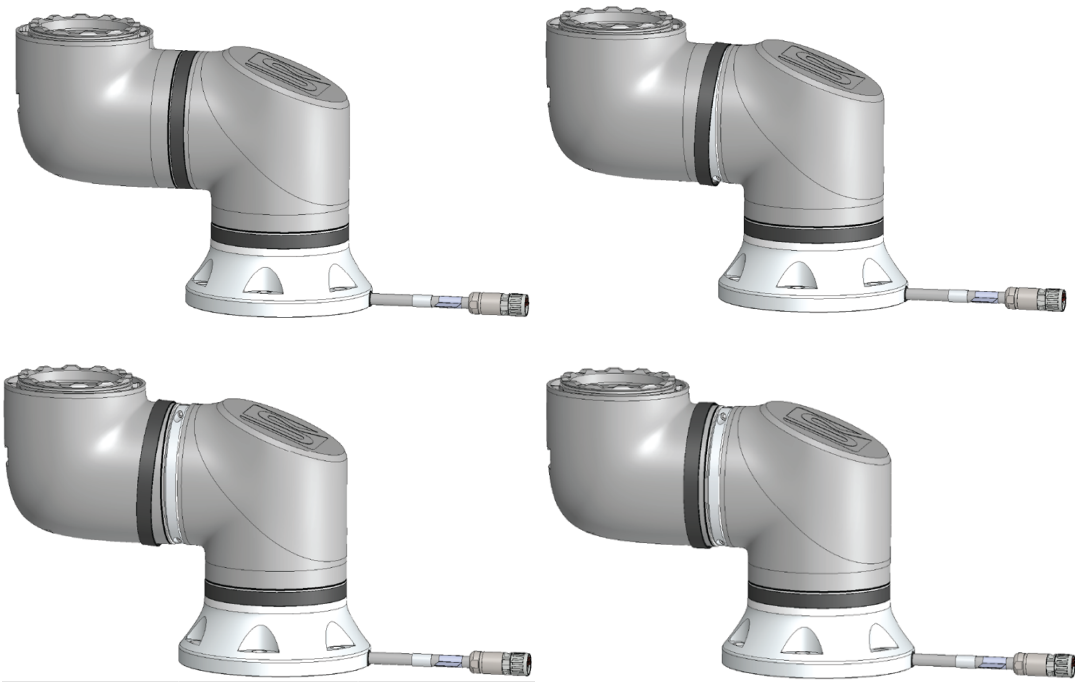
- Prevent the joint/s from falling while removing the clamp/s by doing any of the following:
  - Use something to support underneath the part that is coming off.
  - Disassemble the joint while it is laying down.
  - Support with lifting equipment.

Failure to test the old joint before replacing it, can lead to damage to property and/or equipment.

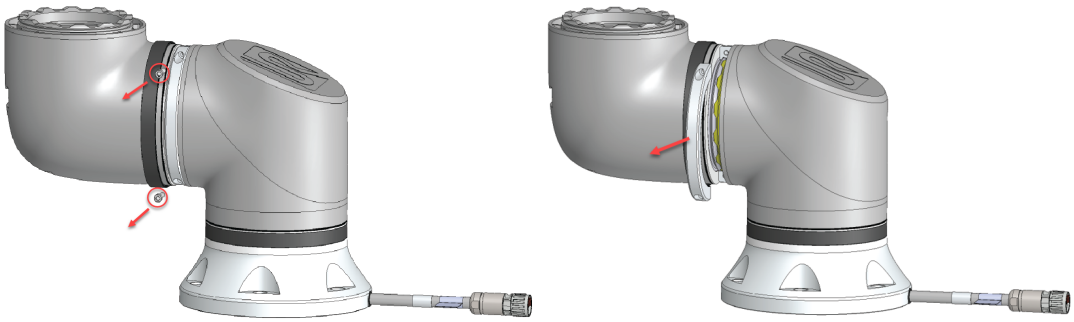
Always perform a joint verification test before replacing a joint. See the Joint Verification section in the Service Manual for more information.

To Disassemble

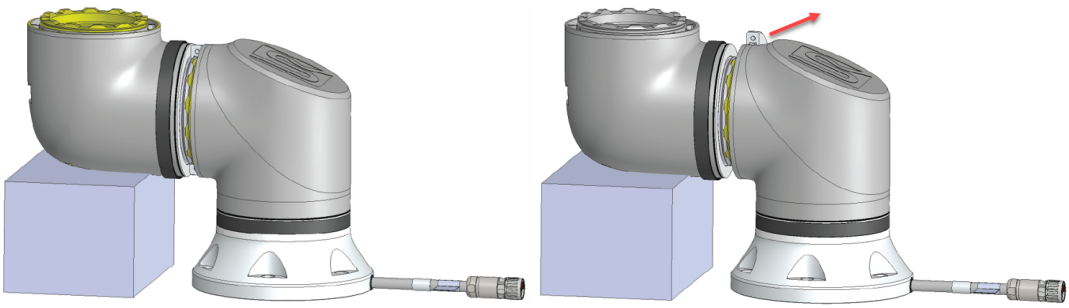
1. Attach the ESD wristband from the spare part package or tool kit to an electrical grounded surface.
2. Remove the black flat-ring.
   You can use a pair of pointy tweezers or a small flathead screwdriver.



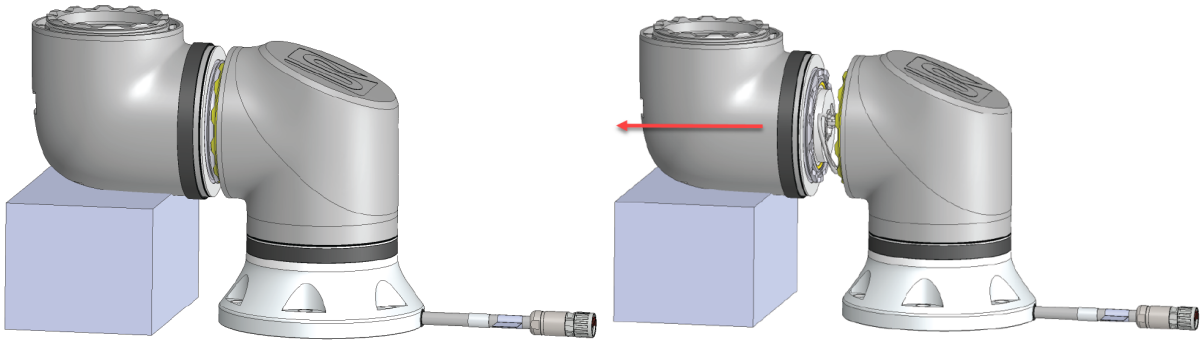
3. Remove the screws and the clamp on one side.



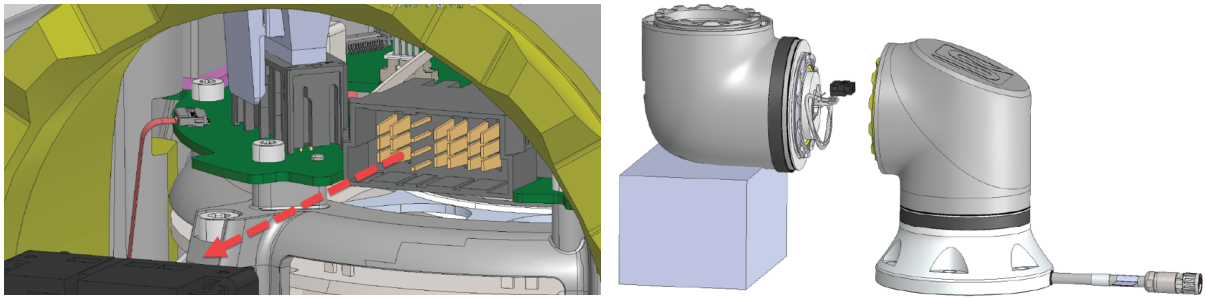
4. Support the joint as you remove the second side of the clamp.



5. The joint is now loose and can be removed.



6. Gently unplug the connector from the PCB on joint.



7. The joint has now been dismounted.

Clamp Connection: Assembly

Description

You can now reassemble the clamp connection with the new joint in reverse of the disassembly. However, be aware of the following before you start reassembling the clamp connection.

NOTICE

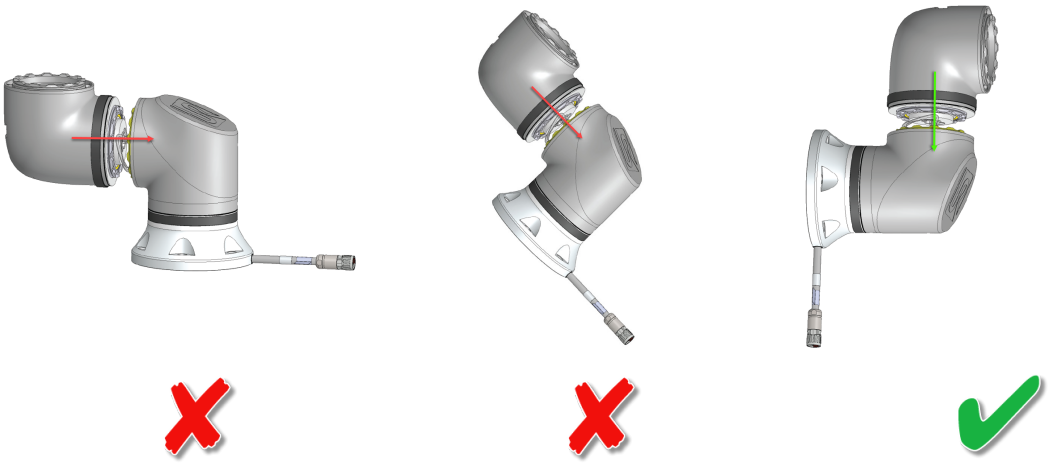
Failure to replace the black flat ring can lower the IP classification and cause damage to property and/or equipment.

- Always replace the flat ring with a new one to maintain the IP classification.
  The dots must be aligned otherwise the connection cannot be made.

NOTICE

Failure to test the new joint after replacement can lead to damage to property and/or equipment.

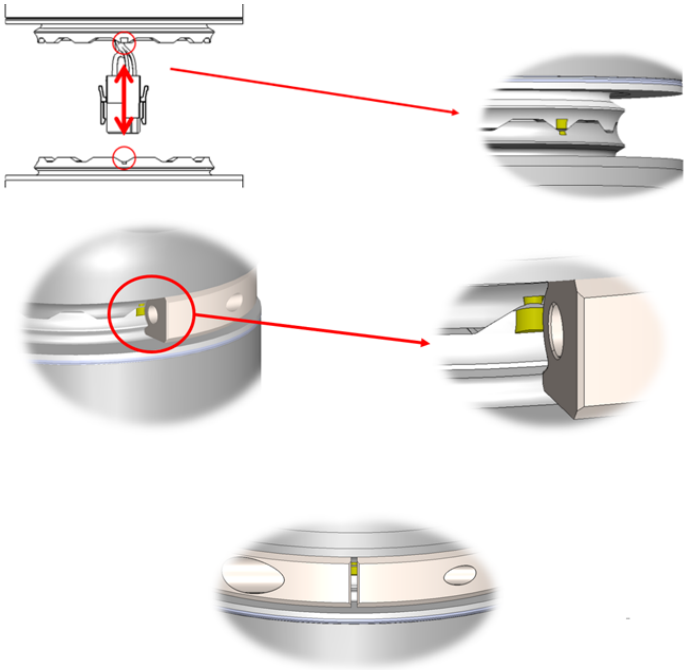
- Always perform a joint replacement test before using a new joint. See the Joint Verification section in the Service Manual for more information.
- Joints should be assembled in a vertical position to ensure proper mating between the joints.



NOTICE

Improper connection between the joints can lead to damage to property and/or equipment

- Assemble the joints in a vertical position to ensure proper connection.
- Ensure that the index marks are vertically aligned.
- The clamps must be assembled at the index marks as illustrated below.

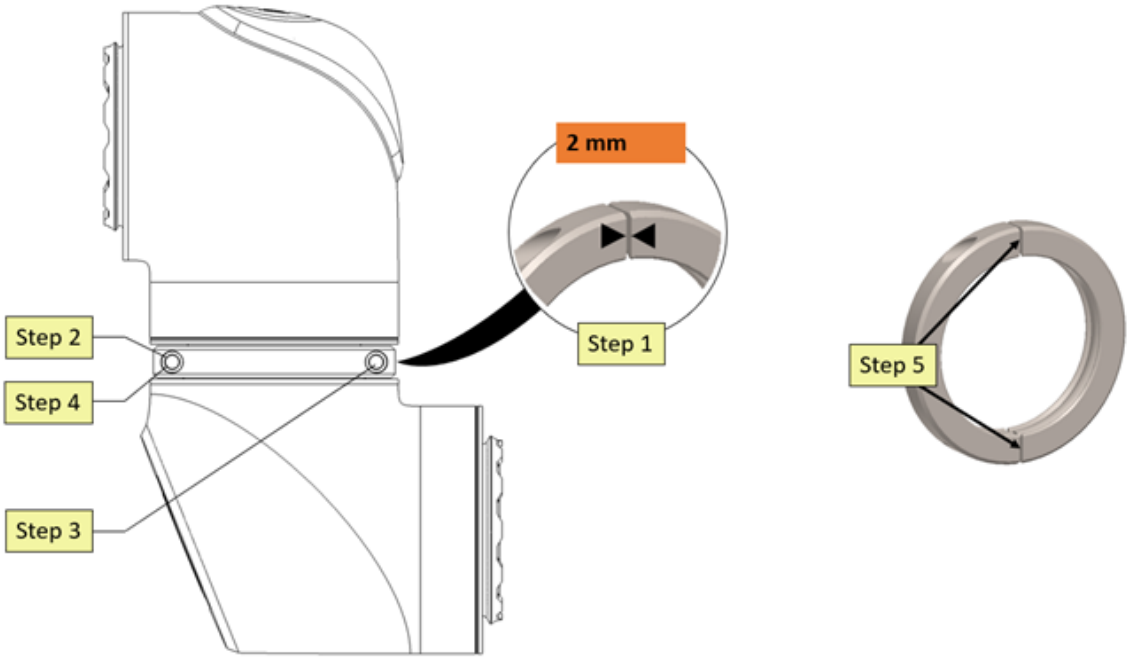


> **CAUTION**
> Ensure the screws are inserted in the correct clamp.

When tightening the clamp must be done in steps. Do not exceed recommended torque.

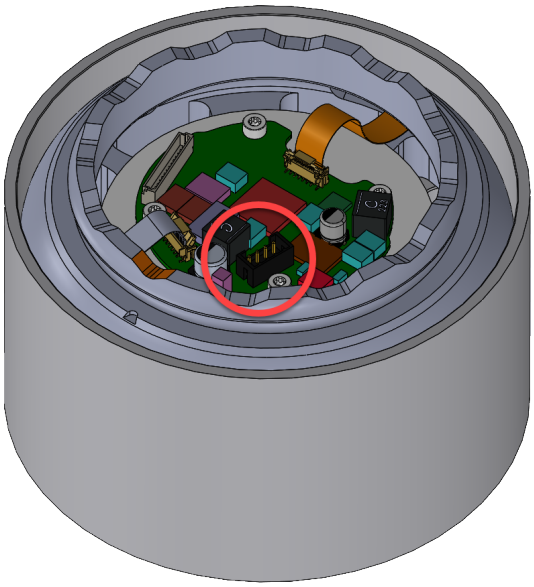
To assemble:

1. Tighten the bolt at one side so there is a 2 mm gap between the clamp ends.
2. Tighten the bolt at the other side with half the specified moment.
3. Tighten the bolt from step 1 with full moment.
4. Tighten the bolt from step 2 with full moment.
5. Ensure same gap at both ends.



5.2.4. Tool Flange

The tool flange is a clamp connection and is disassembled like a joint with this connection.
See section: Clamp Connection
Power and communication plug is in the same plug.

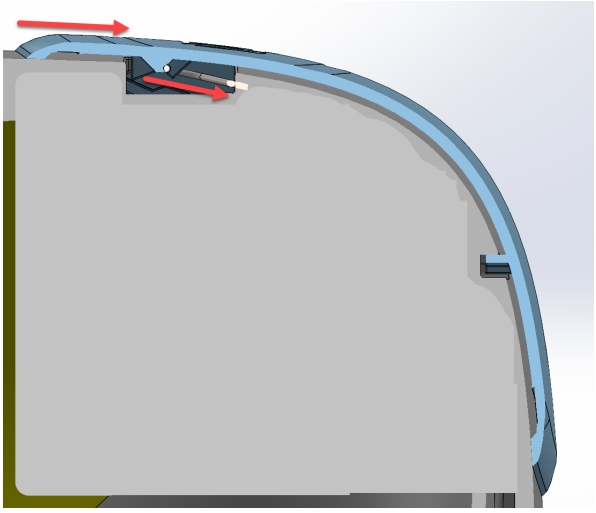


5.2.5. Replacement of Trim Plates Size 2.5, 4, and 5

Description The trim plates on are mounted in a slightly different way depending on the joint size. By applying pressure correctly on the trim plates, it is possible to remove them without any tools.

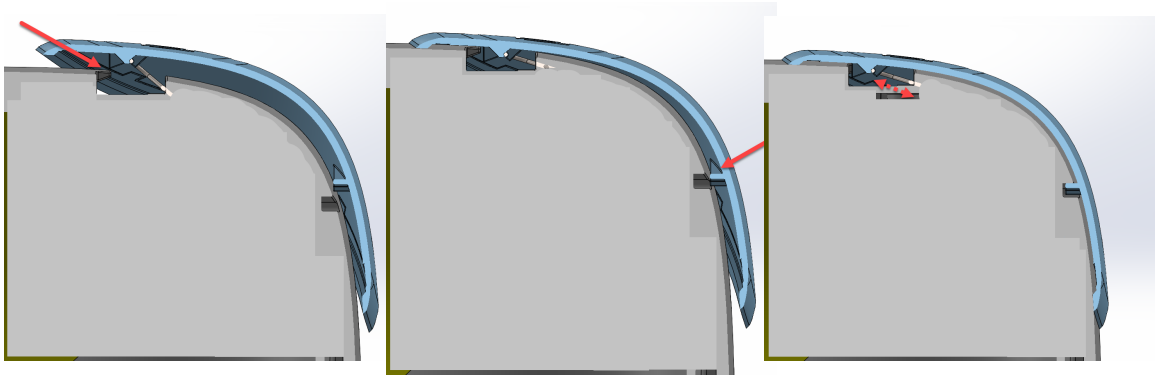
Dismounting Trim Plates

By pushing the front of the cover you compress the spring so the hooks can be disengaged



Mounting Trim Plates

By pushing the front of the cover you compress the spring so the hooks can be engaged. The force of the spring will keep the cover in place.



Compress the spring by applying pressure in the direction of the arrow.

When the spring is compressed the hook can catch the housing.

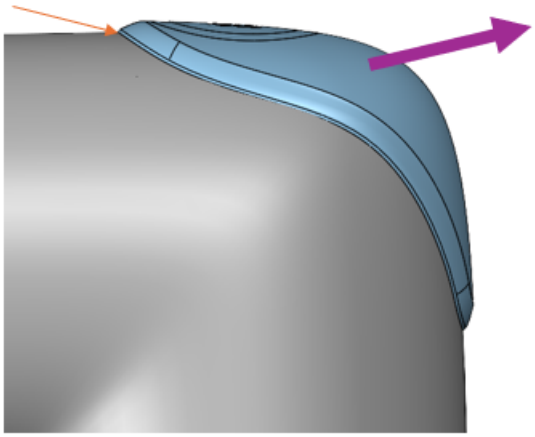
The force of the spring will keep the cover in place.

5.2.6. Replacement of Trim Plates Size 2 and 3

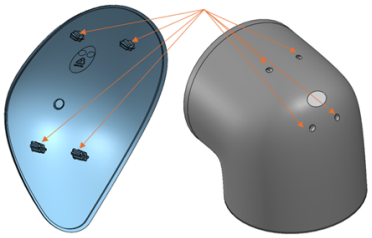
Description The trim plates are attached with a different method than what is used on the e-Series robots.

Dismounting Trim Plates

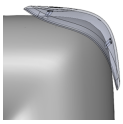
Use a non-scratch tool to lift the cover off the house. Push the cover to compress and lift the cover off the house.



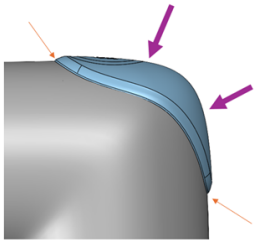
Mounting Trim Plates



To mount size 2 and 3 covers to the house, the four guiding pins need to be pushed into the four holes of the house.



Align the four pins of the cover with the edges of the four holes of the house.



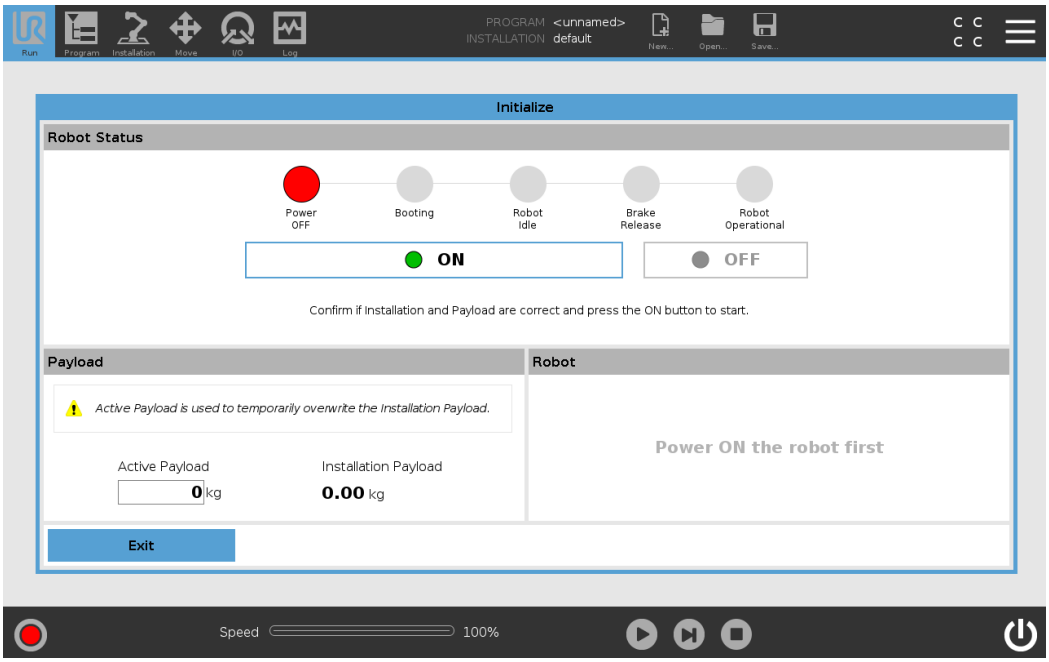
Firmly push the pins into the holes until the cover is fully aligned with the house in each end.

5.2.7. Joint Verification PolyScope 5

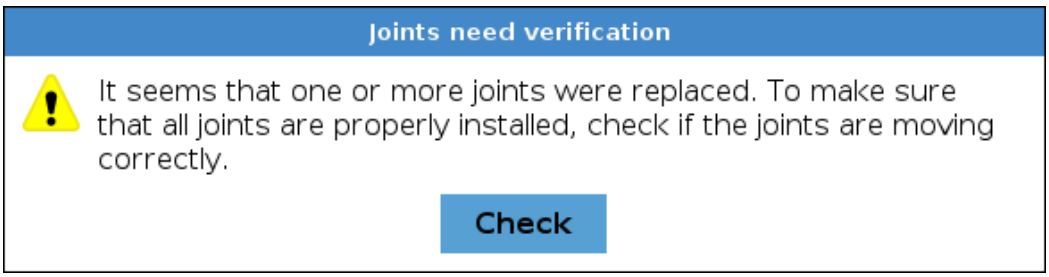
Verification steps

When a joint is replaced, it needs to be verified by the controller to be assigned the correct ID. The screen below appear automatically when the robot arm is powered on for the first time. Follow the steps.

1. Go to **Initialize** screen and press **On**.

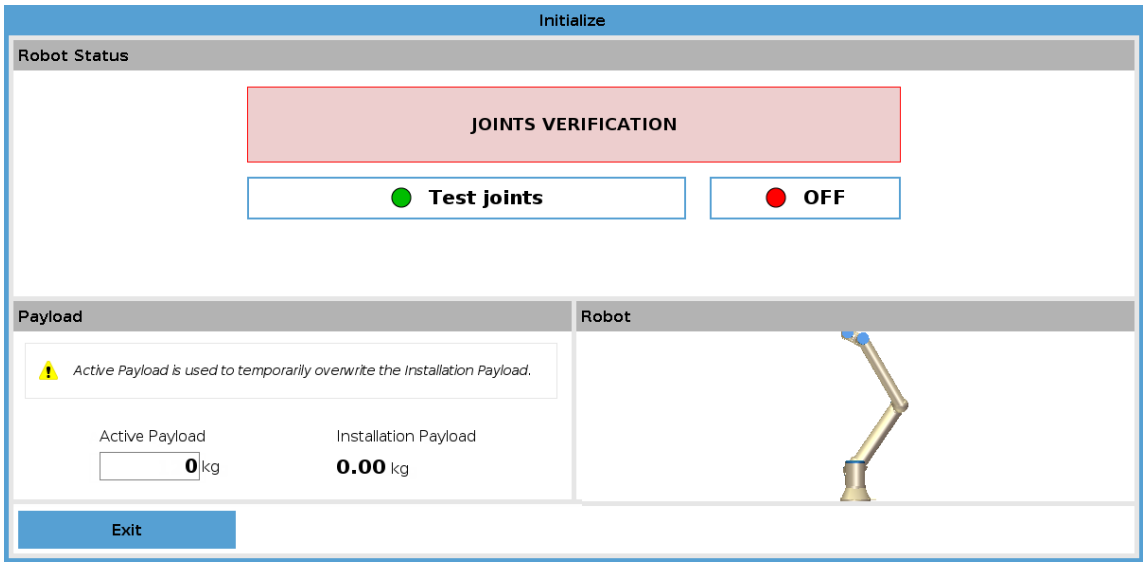


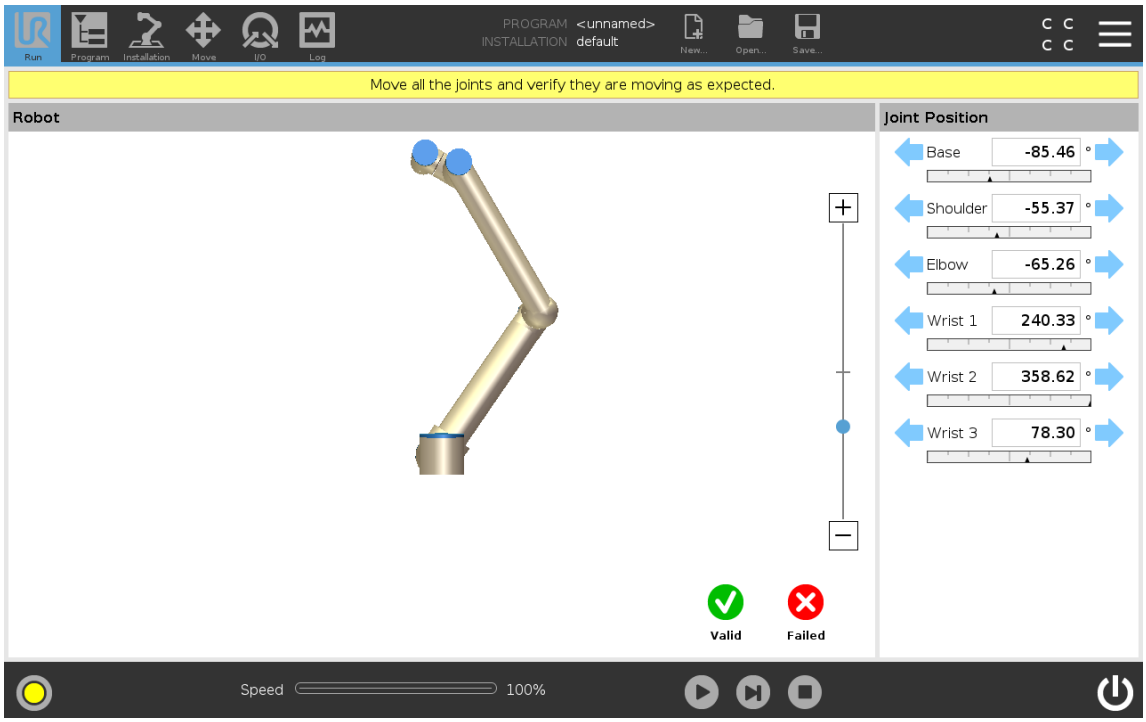
2. A pop-up appears saying that joints need verification. Confirm the pop-up message by pressing **Check**.



3. Press **Test joints** to start joint verification.

4. Move all joints with the arrows respective to each joint.
   - If joints move as expected, press **Valid**, and a pop-up appears. Follow the pop-up instructions.
   - If joints do not move as expected, i.e., wrong joint moves or incorrect direction), press **Failed** and a pop-up appears. Follow the pop-up instructions.



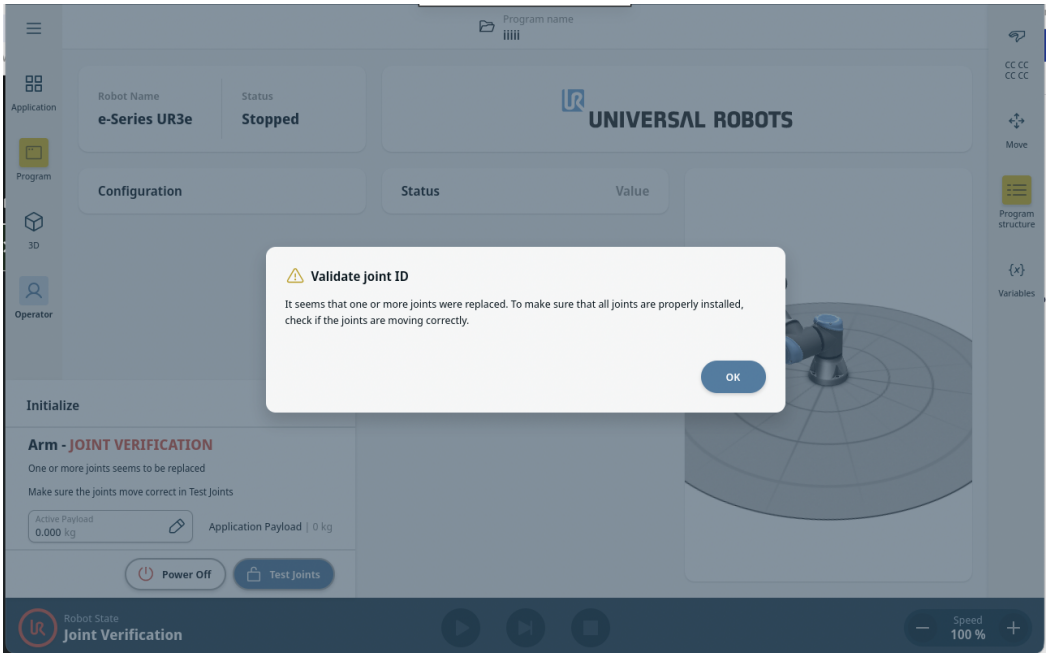


5.2.8. Joint Verification PolyScope X

Verification steps

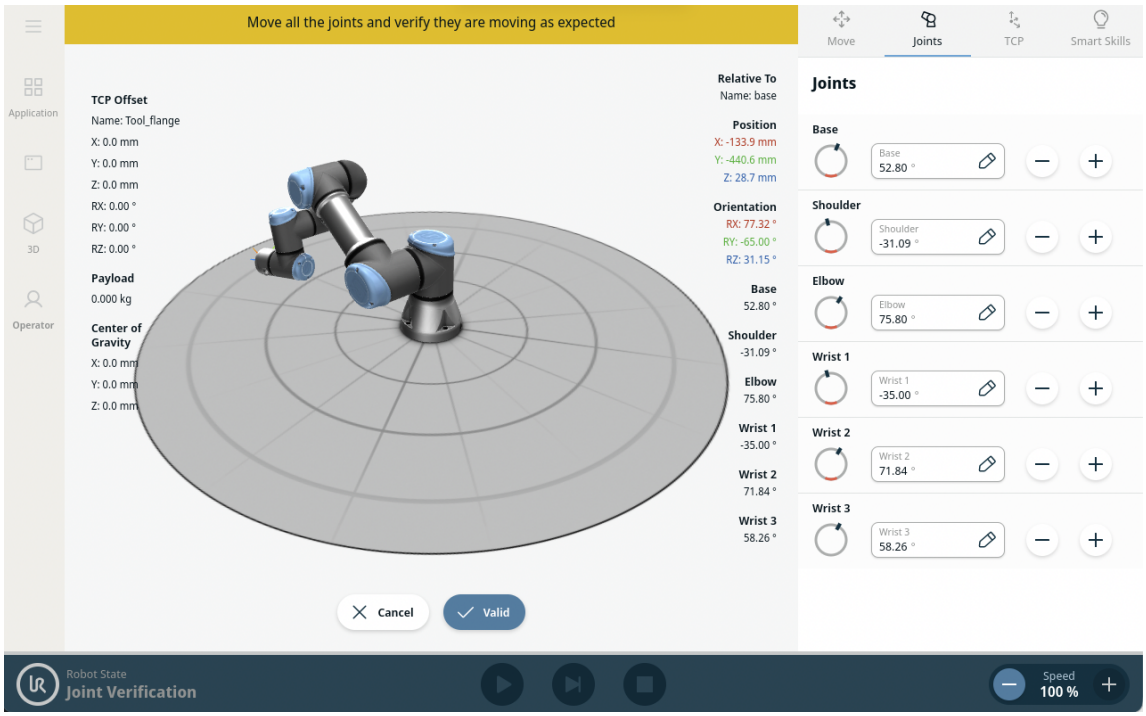
After replacing any joint on a robot, the controller requires a Joint Verification process. This procedure ensures that each joint is correctly identified in the system. The process now appears automatically during the first power on after a joint replacement.

1. Power on the robot.
2. A pop-up appears saying that joints need verification. Confirm the pop-up message by pressing **Ok**.



3. Press **Test joints** to start joint verification.

4. Move all joints with the arrows respective to each joint.
   - If joints move as expected, press **Valid**.
   - If joints do not move as expected, i.e., wrong joint moves or incorrect direction), press **Failed**.



5.2.9. Robot Type Validation

Description

To prevent accidentally using a robot arm together with a control box configured for another type, e.g. using a UR20 with a UR30 configuration, a robot type is stored in the robot joints during production.

Validation after Joint Replacement

Description

If replacing one or more robot joints with joints that have previously been in a different robot type, the joints can have a conflicting type stored, resulting in the following error when attempting to release the robot brakes:
C364A1: Robot validation : Robot type disagreement in the joints.

This issue can be corrected by first ensuring that the configured robot type is indeed the correct one, and afterwards issuing a command to restore the robot type in the joints.

Use the steps below to correct the issue:

1. In the initialize tab on the Teach Pendant, click once on the **Power On** button until you can see a Yellow indicator in the bottom left corner with the **Idle** state. If using Polyscope X, the state is called "Locked" instead of "idle" .
2. Ensure you know which type your robot is, e.g. if it is a UR3e, UR16e, UR20, UR15 etc. If in doubt, the robot type will be written on the serial number label on the robot arm.
3. Validate that the robot box is configured for the correct robot type:
   a. Attach a keyboard to the USB port in the teach pendant or in the control box.
   b. Use the keyboard to change to a "Virtual Terminal" by pressing CTRL-ALT-F1.
   c. Login to the terminal using root as username and the configured root password. (easybot is the default password).
   d. Check the current configuration by running the command below

      Polyscope 5:

      ```
      ls -la /root/.urcontrol/urcontrol.conf
      ```

      Resulting in a line being printed like this:

      ```
      lrwxrwxrwx 1 root root 35 Apr 24 13:14 /root/.urcontrol/urcontrol.conf ->
      /root/.urcontrol/urcontrol.conf.UR5
      ```

      Polyscope X:

      ```
      ls -la /ur/etc/urcontrol/urcontrol.conf
      ```

      Resulting in a line being printed like this:

      ```
      lrwxrwxrwx 1 root root 36 Nov 18 2024 /ur/etc/urcontrol/urcontrol.conf ->
      /ur/etc/urcontrol/urcontrol.conf.UR5
      ```

The output of the command will indicate which robot type is currently configured. In the example above, the ending of the line indicates the configuration as a UR5. Other robot types will show e.g. UR20, UR15, UR16 etc.

1. If the configuration does not match the actual robot type, ensure that you are using the original SD-card or control box for the robot.

   If these are not available, a clean SD-card image downloaded from the UR Support Site can be flashed to the SD card, and the correct configuration will be used after entering the robot serial number on the serial number screen.

2. After ensuring that the correct robot type is configured, and with the robot still powered on but the brakes not released. enter the command shown below to restore the robot type to all joints:

   ```
   echo "upload robottype" | nc 127.0.0.1 30001 -q0
   ```

3. Change back to polyscope by pressing CTRL-ALT-F7
4. Press the **Start** button on the TP and continue with the booting process. If using Polyscope X, the button is called **Unlock** instead of start.

Validation after Configuration

When powering on the robot arm, prior to releasing the brakes, the robot type stored in the arm is validated against the robot configuration, and the arm will be prevented from releasing the brakes if the types do not match.

If there is a mismatch between the stored and configured type, it will result in the following error when attempting to brake release:

C365:A0: Robot validation : Robot type mismatch between configuration and arm

The error indicates that the control box is configured for a different robot type than the attached arm.

If the SD-card has been moved between different control boxes, or the control box used for the robot arm has been changed, this can be the cause for the configuration mismatch.

Correct the issue by changing back to the original SD-card or control box.

If these are not available, a clean SD-card image downloaded from the UR Support Site can be flashed to the SD card, and the correct configuration will be used after entering the robot serial number on the serial number screen.

5.2.10. Dual Robot Calibration

Dual Robot Calibration calibrates the robot in the full work space. Each new robot is Dual Robot Calibrated as part of final assembly.

Performing a Dual Robot Calibration after replacement of a joint allows the robot to continue in the production line without modifying waypoints in the robot program.

To perform a Dual Robot Calibration, you need:

- 2 robots (same size and same generation)
- Dual Robot Calibration Tooling Complete (Part no: **TBD**)

You can download the Calibration Manual from the Universal Robots Support site www.universal-robots.com/support/

5.2.11. Program Correction by Key Waypoints

Program Correction by Key Waypoints helps adjusting programs waypoints when a program is moved from an uncalibrated robot to another. The technique can also be used to make programs work after replacements of joints.

Please refer to the Calibration Manual from the Universal Robots Support site www.universal-robots.com/support/ for detailed description on how to use this feature.

NOTICE

Program Correction by Key Waypoints does not currently support the following:
- Other types of waypoints with the exception fixed waypoints.
- Move node with Use Joint Angles selected.

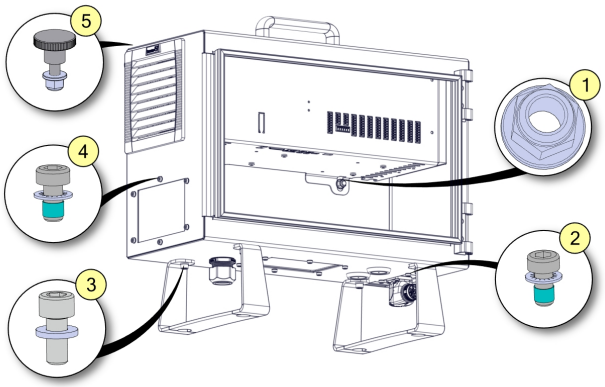
The unsupported program nodes above may need to be corrected manually after the Program Correction by Key Waypoints process is complete.

5.3. Control Box

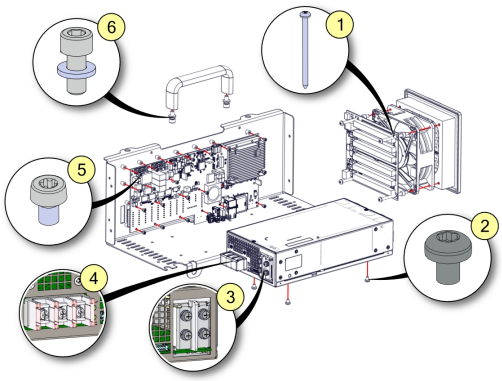
5.3.1. Torque Values

Torque Values and Notes for Control Box

Below are the torque values used in the Control Box.



NO.	DESCRIPTION	Tool size	Torque
1	Nut for internal CB bracket	10mm	2.25Nm
2	Robot connector screw	Torx T20	1.5Nm
3	Screw for feet bracket	Hex key 5	4.0Nm
4	Screw and washer for cover plate	Torx T20	1.5Nm
5	Control Box and Teach pendant mounting nut	10mm	2.25Nm



NO.	DESCRIPTION	Tool size	Torque
1	Screw for fan and energy eater assembly	Torx T20	0.6Nm
2	Screw for mounting power supply	Torx T20	1.0Nm
3	Internal power terminal screws	PZ2	1.2Nm
4	External power terminal screws	PZ2	1.2Nm
5	Control Board mounting screws	Torx T10	0.6Nm
6	Bolt for Control Box handle	Hex key 5	4.0Nm

5.3.2. Replacing the 3PE Teach Pendant

Description

This section describes how to replace a Standard Teach Pendant with a 3PE Teach Pendant. For information on how to remove and replace a Standard Teach Pendant, see Replacing the Teach Pendant: Standard TP.

WARNING

When the Teach Pendant is replaced, test the function of the 3PE buttons.

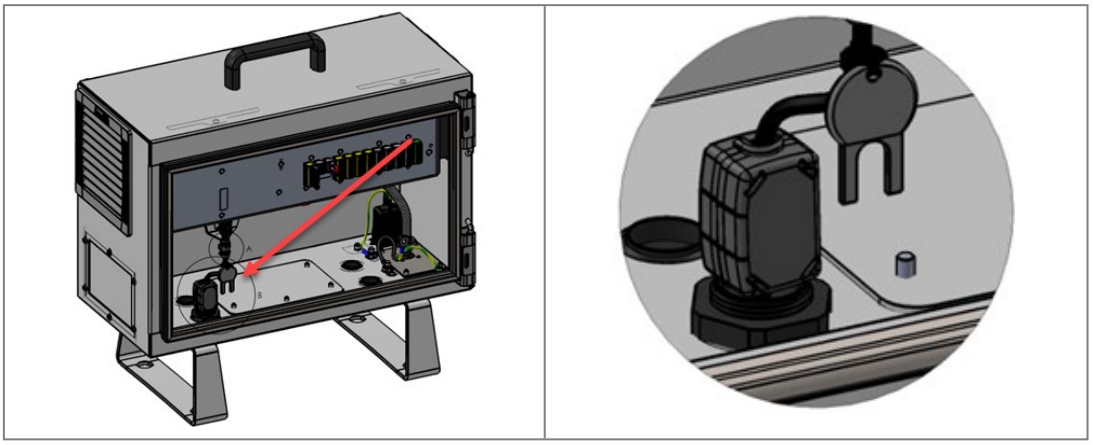
NOTICE

Replacing the Teach Pendant can result in the system reporting a fault on start-up.

- Always select the correct configuration for the type of Teach Pendant.

To remove

1. Power down the control box and disconnect the main power cable from the power source.
2. If mounted, remove the ferrite core with snap lock from the teach pendant cable by cutting the cable ties of key.

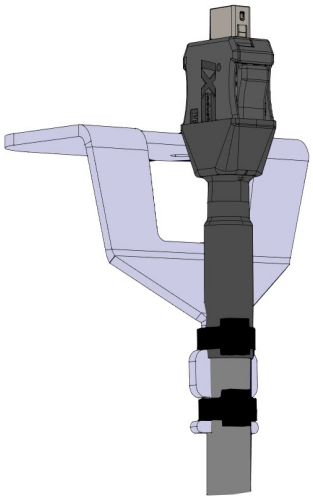


3. Insert the key into the ferrite core with snap lock to unlock it and remove it.

4. Remove and discard the two cable ties used for mounting the Teach Pendant cables.
5. Press in the clips on both sides of the Teach Pendant plug, as illustrated, and pull down to disconnect from the Teach Pendant port.
6. Fully open/loosen the plastic grommet at the bottom of the Control Box and remove the Teach Pendant plug and cable.
7. Gently remove the Teach Pendant cable and Teach Pendant.

To replace

1. Place the 3PE Teach Pendant plug and cable in through the bottom of the control box and fully close/tighten the plastic grommet.
2. Push the 3PE Teach Pendant plug into the Teach Pendant port to connect.
3. Use two new cable ties to mount the 3PE Teach Pendant cables.
4. Connect the main power cable to the power source and power on the Control Box.



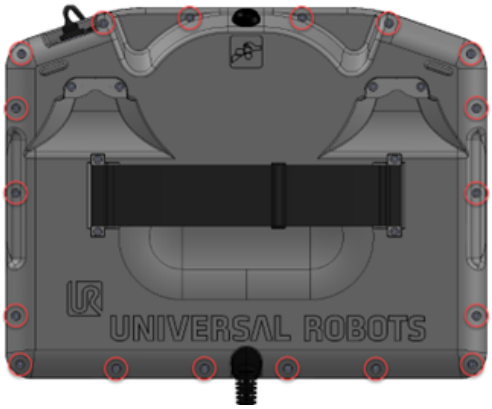
5.3.3. Replacement of Teach Pendant Cable

Use the teach pendant cable repair kit

The teach pendant cable can be replaced with a teach pendant cable repair kit.
Note: Read thoroughly the disclaimer in the kit before installing.

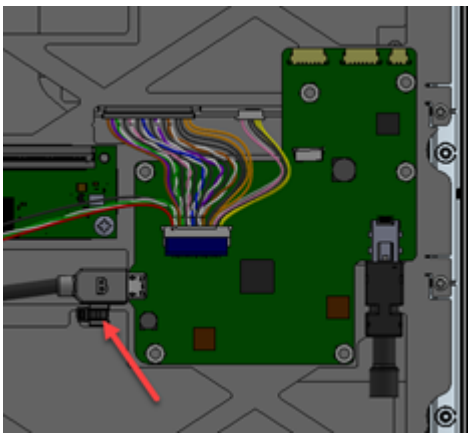
13-step process

1. Turn the teach pendant around and place it screen down on a soft surface. Be careful not to damage the E-stop button.
2. Remove the eighteen (18) bolts connecting the front frame to the back plate using a T8 torx screwdriver.

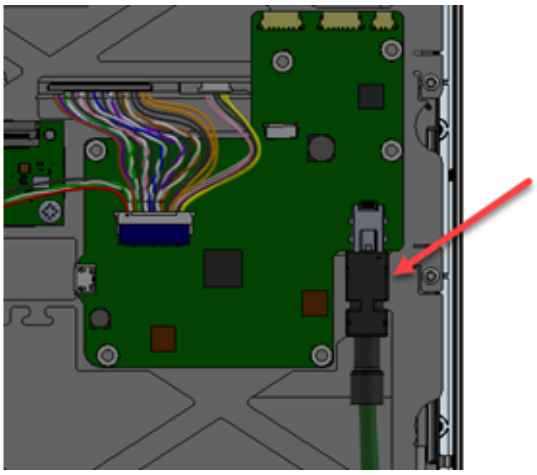


3. Pull the front frame and back plate apart. This will, in some cases, require some force, but note that there is a cable connecting the two parts. Be careful that this cable or connectors do not get damaged.

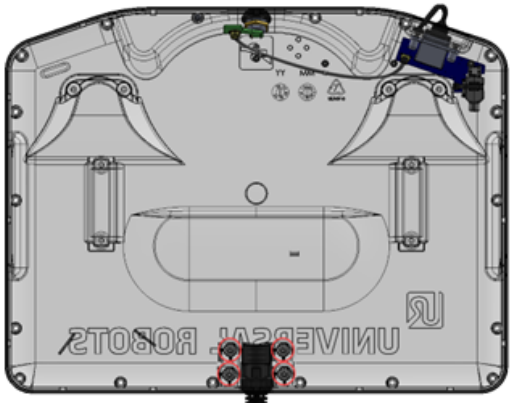
4. On the front frame, cut the cable tie and unplug the cable that connects the front frame and back plate.



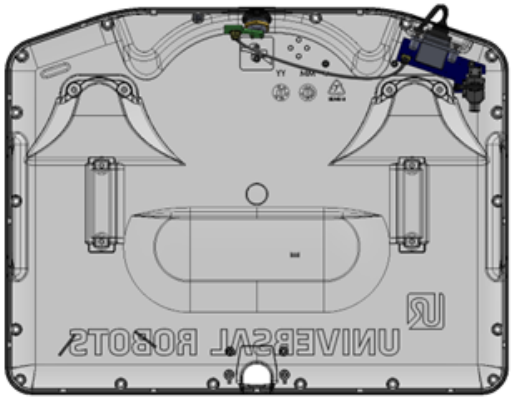
5. Unplug the teach pendant cable.



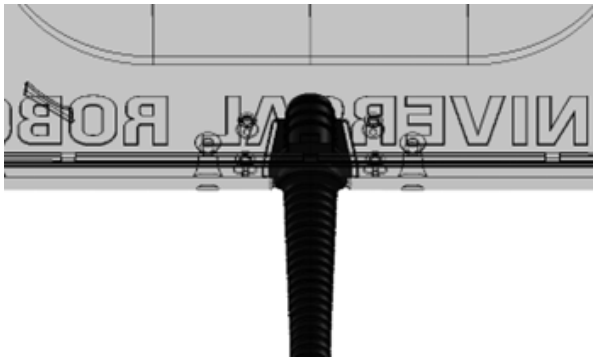
6. On the back plate, remove the four bolts on the teach pendant cable bracket using a T8 torx screwdriver, and remove the bracket.



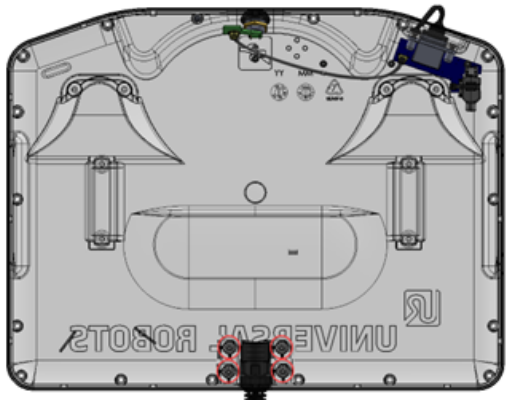
7. Teach pendant cable can now be removed.



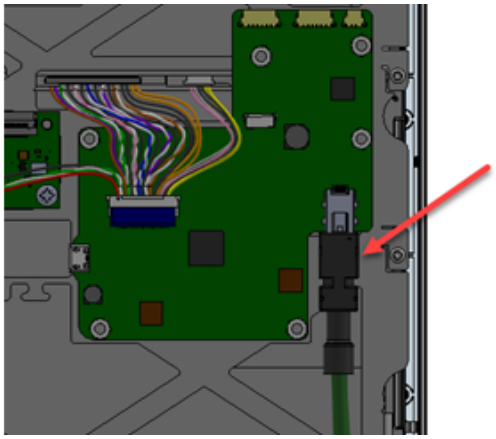
8. Find the new teach pendant cable from the kit. Pull it through the hole of the back plate. Make sure that the rubber cable collar is mounted correctly at the hole.



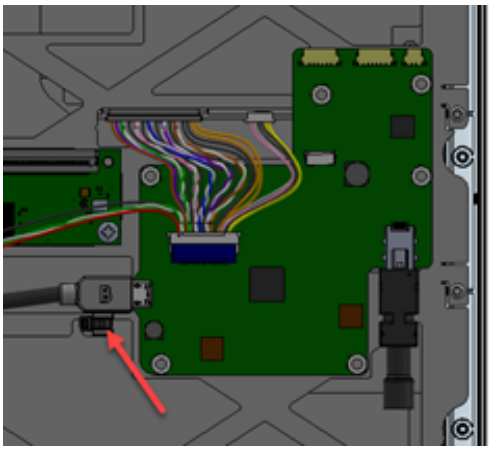
9. Mount the teach pendant cable bracket again and mount the four bolts with 0.3 Nm using a T8 torx screwdriver.



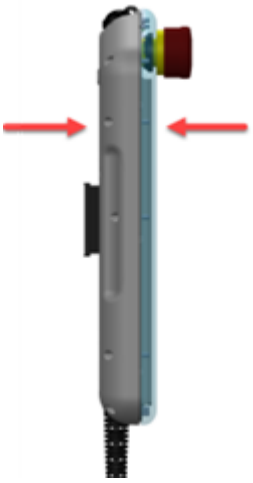
10. On the front frame, reconnect the teach pendant cable on the PCB connector.



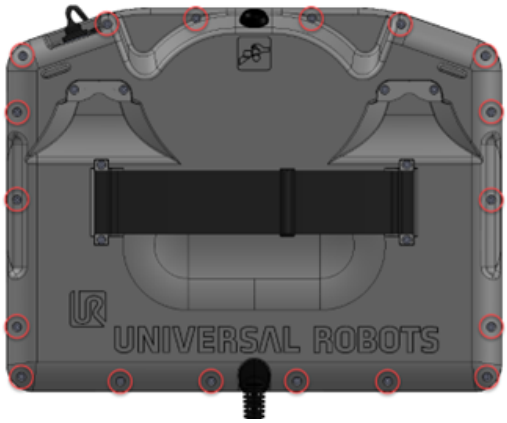
11. Connect the cable between the front frame and back plate on the other PCB and mount the new cable tie from the kit.



12. Connect the front frame and back plate again.



13. Mount the eighteen (18) bolts connecting the front frame to the back plate with 0.3 Nm, using a T8 torx screwdriver.



6. Software

Polyscope

Universal Robots does not recommend or support downgrading of Polyscope software. Downgrading can, in some cases, break hardware compatibility or corrupt program functionality. When in doubt, reach out to Universal Robots.

6.1. Long Term Support

Software support PolyScope 5

Since PolyScope software release 5.26, UR has introduced a long-term support strategy to ensure hardware compatibility with requiring updating to latest software version. The long-term supported software version does not introduce new features but will ensure hardware compatibility due to product changes. Please note that it is the major software release that will be long-term supported. The minor releases are continuously updated (e.g. 5.26.x is long-term supported, the minor releases, stated with x, will be subject for changes)
See which PolyScope version is currently long-term supported on Universal Robot's website: https://www.universal-robots.com/support/

6.2. Software Updates

Universal Robots software is called PolyScope.

CAUTION

Read these instructions and the instructions on our support website (www.universal-robots.com/support) completely prior to updating your software. Universal Robots assumes no responsibility for failed updates caused by improper operation.
Control Box power MUST NOT be turned off during the software update process. Failure to meet this demand is likely to cause loss of data and malfunction.
Keeping the robot software up to date is required to ensure safe operation. Also, the latest software provides more features and a better performance.
Read the Release Notes of the software you install. Release Notes hold notes about the software changes which in some cases are relevant for safe operation of the robot.
Updating the software may cause changes to functionality. Robot motions might change or be subjected to different restrictions.
In case of questions or concerns related to your application please contact your supplier for advice and assistance.

PolyScope 5

Not all combinations of updates are possible. These are the rules to observe:

- If running **PolyScope 5.5.0 and above**:
  Update directly to PolyScope 5.8.0 or any later version.
- If running **PolyScope 5.4.3 and below**:
  Updates must be done incrementally in steps of one minor version.
  E.g. PolyScope 5.2.1 à 5.3.1 à 5.4.3 à 5.5.1.
  When PolyScope 5.5.0 is reached, software can be updated directly to the latest version.

Therefore, when updating your robot software care must be taken to select a proper update path. Several update steps will be necessary until reaching a version of 5.5.0. Downgrading software is not supported. In PolyScope 5.5.0 backup and restore functionality is added and this is the recommended way to go back to any prior version installed. We strongly recommend that you precede any update cycle with a backup to counter the situation of a failing update. Please contact your supplier if updating causes any trouble.

6.2.1. Update Procedure

Prerequisites

This procedure requires a USB storage device that is detectable by Windows and is FAT32 formatted.

If the storage device is not FAT32 formatted, perform the following procedures:

NOTICE

- You might need admin privileges to perform the procedure.
- Back up any important data on the USB storage device before formatting. The process will erase all existing information.

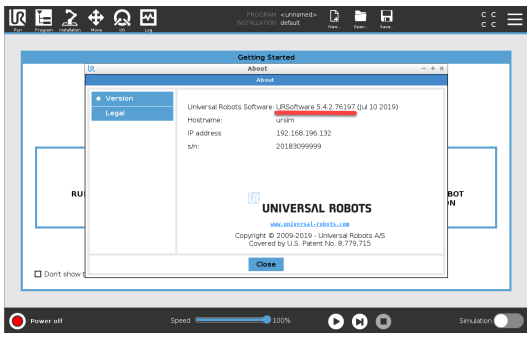
1. Connect the USB to your computer.
2. Open **File Explorer**.
3. Right-click on the USB drive and select **Format**.
4. In the format window, select **Restore device defaults**.
5. In the **Volume label**, specify the robot's product line as shown in the following table.

e-Series and UR Series	Generation 3
Standard	G3
UR20	CB3

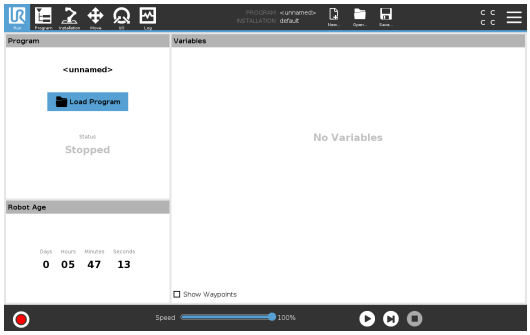
6. Select **Start** to begin formatting.
7. Confirm any warning messages.

PolyScope 5

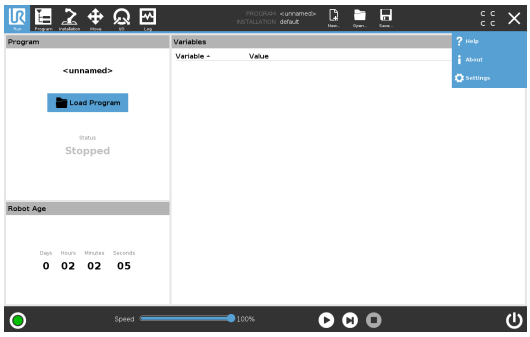
1. On your robot, go to **About** and check your current software version.



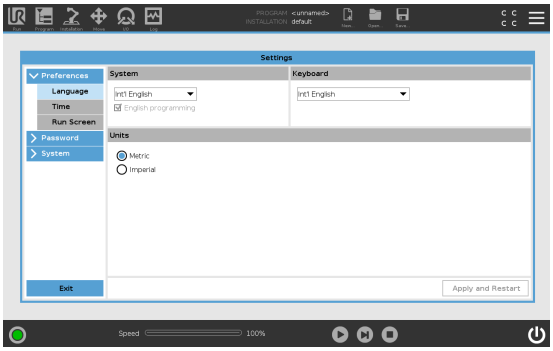
2. Download to your computer the software versions needed to be installed, you can download from Universal Robot's website (www.universal-robots.com/support).
   - If your SW is below 5.5 (E.g.: 5.3), you will need to incrementally update until you reach 5.5 (E.g.: 5.3 to 5.4, then 5.4 to 5.5), after updating to software 5.5 you can download the most up to date software and go straight from 5.5 to this last update (E.g.: 5.5 to 5.8).
   - If your SW is equal or above 5.5, just download the most updated software version file and install it straight from your current software version (E.g: 5.5 to 5.8).
3. Download the software version(s) needed to update your software and save file(s) in the root of a USB stick on your computer.
4. Insert the USB stick into the USB slot in the Control Box.
5. On teach pendant screen, press the right top corner icon  to access the settings menu.



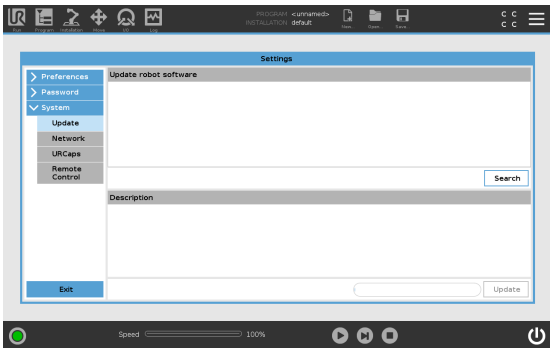
6. Press **Settings** to access the settings menu.



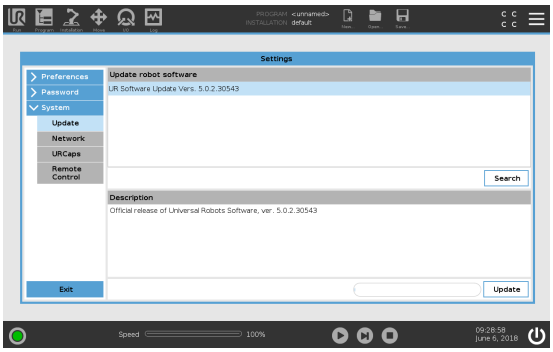
7. On the left side menu, select **System**.



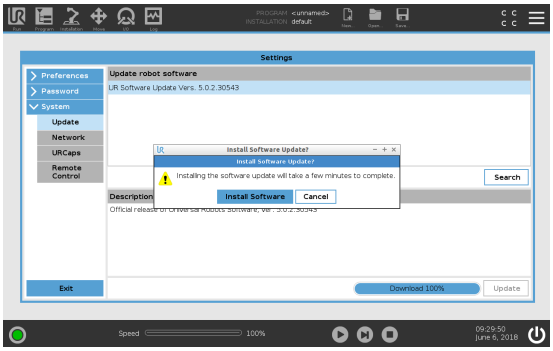
8. Press **Update**, then **Search** to locate software update on USB stick.



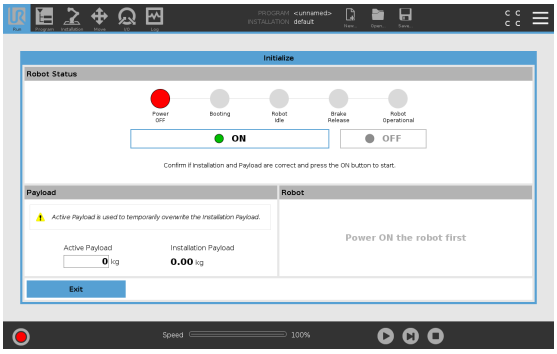
9. Select the desired software update and press **Update**.



10. Press **Install Software** to update the software.



11. The robot will power off and power on again. Once the update is complete, the Control Box automatically reboots. **Do not power off or unplug the robot from the outlet during startup.**
12. Wait until the reboot is complete. Firmware for the control Box and Tech Pendant is updated.
13. When complete, go to the Initialize screen and press **ON**, if available joint firmware is going to update.



14. Remove the USB stick.
15. Repeat steps 4 to 14, if your installed software is earlier than 5.5.

NOTICE

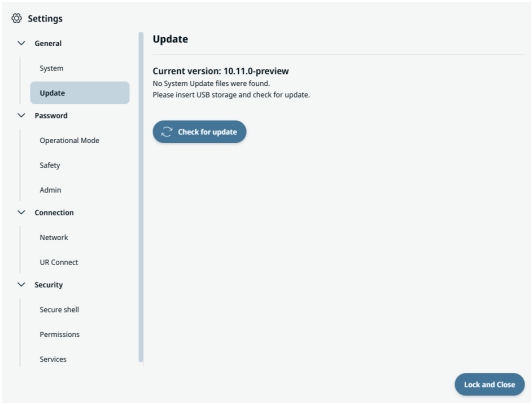
From software version 5.5 beyond, the most updated version available in UR's website can be installed direct, no need to incrementally install updates.

More info is displayed on release notes on support site. Read it for new features releases and improvements.

PolyScope X

Update the software as follows:

1. Tap the hamburger menu in the main navigation.
2. Go to **Update** in the **general settings**.
3. Insert the USB drive with the software update.
4. Tap the **Check for update** button.



6.2.2. Downgrading vs. Restoring System Backup

Description

Do *not* downgrade the robot software to a version earlier than the robot's manufacturing date. All changes made after the upgrade will be lost. Back up all data before upgrading.

NOTICE

The system backup requires about 4 GB of free space. Use a USB drive with 4 GB or more capacity.

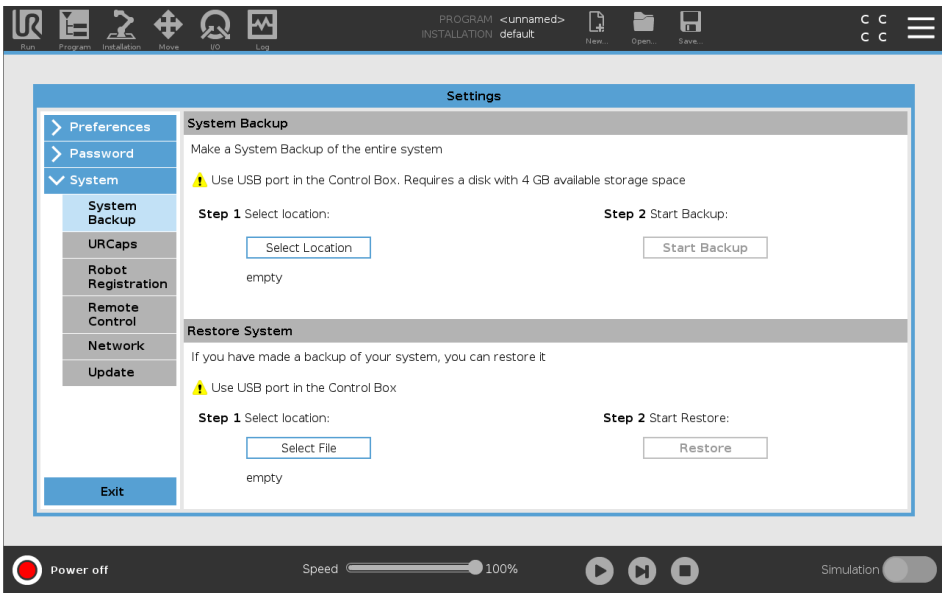
NOTICE

Always back up program and installation files before updating the software.

PolyScope 5

Do *not* downgrade

Do not revert your robot software using older update packages if you have installed 5.8 or above software version. If, for any reason, you need to downgrade below PolyScope version 5.8, you can do so by restoring your old system backup (system backup was implemented from Polyscope version 5.5 ahead).

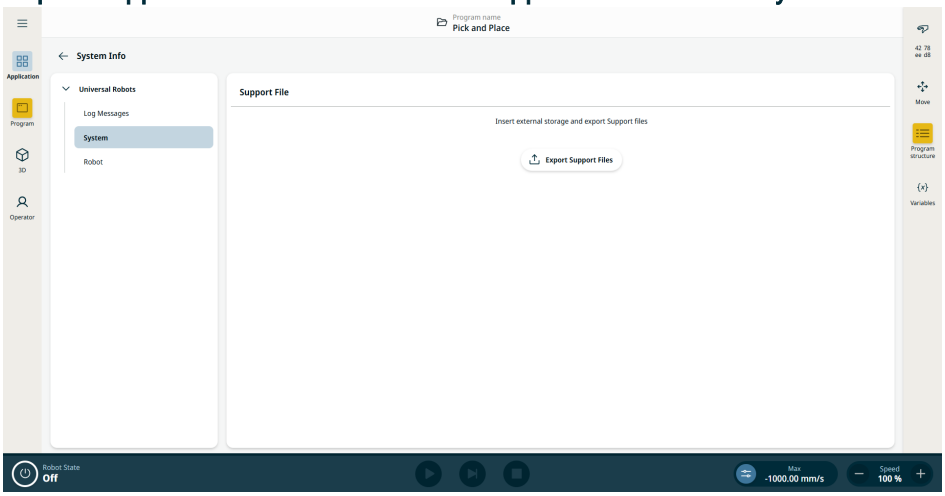


PolyScope X

Do *not* downgrade

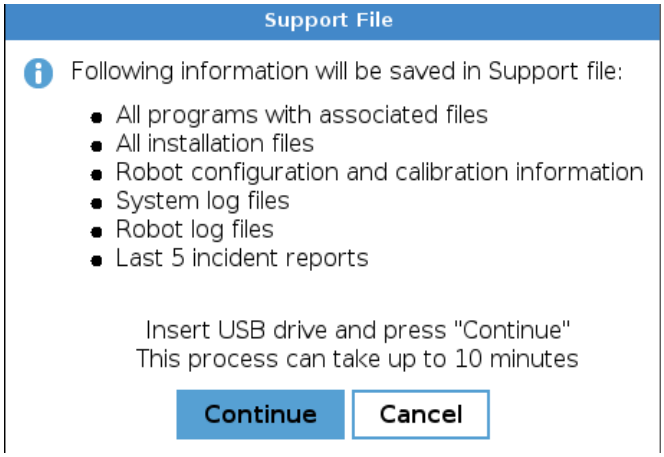
Polyscope X does not have a backup feature but it has an export feature that will export all programs to a USB drive before updating.

Export Support Files is accessible under **Application** tab on the **System Info** section.

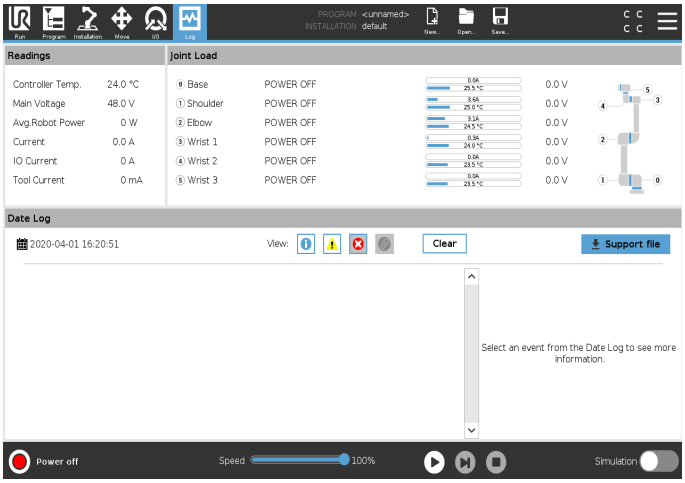


6.3. Using Support File

6.3.1. PolyScope 5



1. Go to Log tab, insert a USB stick, and click on Support File.



NOTICE

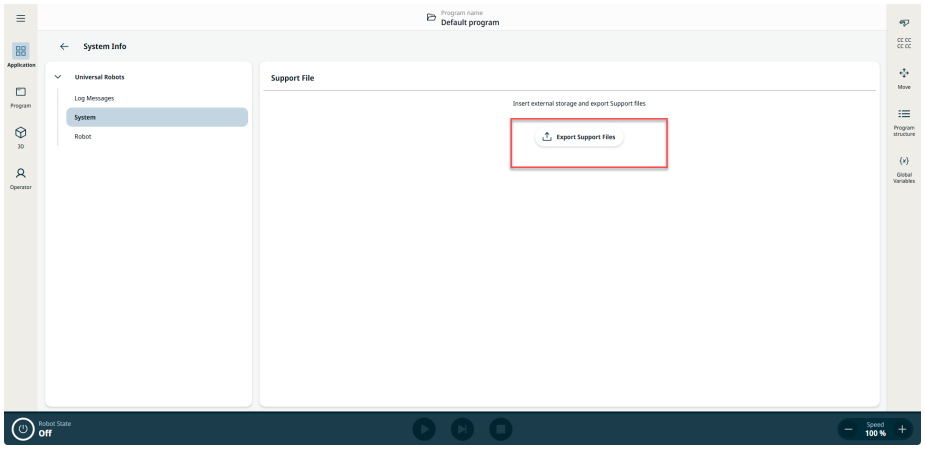
This backup requires around 1Gb memory, please use a USB stick of 2Gb or more capacity.

NOTICE

Always perform program and installation files backup before updating the software.

6.3.2. PolyScope X

1. On the Main Navigation, tap **Application** > **System Info** > **System**.



2. Insert a USB drive and tap **Export Support Files**. The controller creates a zip-compressed file that contains:
   - all previous flight reports
   - entire robot log
   - individual log files for all software components
   - operating system log files, memory consumption, and available disk space
   - configuration files
   - calibration file
   - robot arm statistics
   - software metrics

NOTICE

This backup requires about 1 GB of free space. Use a USB drive with at least 2 GB of capacity.

NOTICE

Always back up program and installation files before updating the software.

6.4. Using Magic Files

Description

For easy backup, Universal Robots provides magic files to automatically copy data from the control box to USB stick. Magic files back up works with all software versions, but starting with version 5.11, execution of magic files could be disabled in general security settings.

NOTICE

Always perform program and installation files backup before updating the software.

You can download magic files at: www.universal-robots.com/support
The magic file creates a folder on the USB stick named with the serial number of the robot.

PolyScope 5

Available File	Function
URmagic log file	Copies the entire log history file to USB stick
URmagic backup programs	Copies all programs and installation files to USB stick
URmagic configuration files	Copies all configuration files to USB stick
URmagic upload programs	Copies all programs and installation files **from** a USB stick to the robot
URmagic screenshot	Generates a screenshot of GUI when USB stick is inserted

PolyScope X

Available File	Function
urmagic_upload_programs.sh	Upload all programs from USB to Robot
urmagic_backup_programs.sh, urmagic_configuration_files.sh und urmagic_log_file.sh	Backup all programs
urmagic_rm_safetyPW.sh	Delete Safety password
urmagic_rm_modePW.sh	Delete mode password
urmagic_data_capture_v0_6_9.sh	Performance check
urmagic_rm_everything.sh	Delete all

How to Download

You can download magic files at: www.universal-robots.com/support

1. Download and save magic files to the root folder on a USB stick. If more than one magic file is on the USB stick, they run in sequence. Warnings appear for each file. Do not remove the USB stick until the last file is finished. Multiple folders are created and named with serial number as well as a sequence number (e.g., 201855xxxx_0, 201855xxxx_1).
2. Insert the USB stick into the USB slot in the Control Box.
3. A red **!USB!**-sign appears on the screen. Do not remove the USB stick.
4. Wait for a green **<-USB**-sign to appear. If more than one magic file is on the USB stick, proceed to step 3.
   Note: Large files (e.g., history log) may take up to two minutes to download.
5. After the last magic file is completed, the USB stick can be safely removed.

The magic file creates a folder on the USB stick named with the serial number of the robot.

6.5. Backup of Data

Data backup

NOTICE

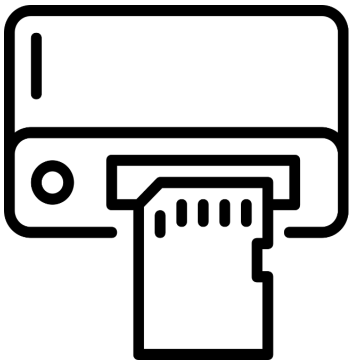
When copying/moving files and folders, incorrect use might corrupt the file system.
Contact your IT professional for assistance if you are not comfortable with this procedure.

This section explains the process of moving required files during a robot backup.

6.5.1. Hardware Requirements

The following hardware is needed:

- SD card (Universal Robots 4GB industrial grade SD card)
- A standard SD card reader



6.5.2. Software Requirements

When using Windows operation system, a software file system driver is required to read a Linux partition. In this example, we are using “Linux File Systems for Windows” by Paragon, but other Windows Linux reader can be used as well (these are, however, not tested by Universal Robots).

NOTICE

"Linux File Systems for Windows” by Paragon software is a third-party software.
Universal Robot takes no responsibility for this software.

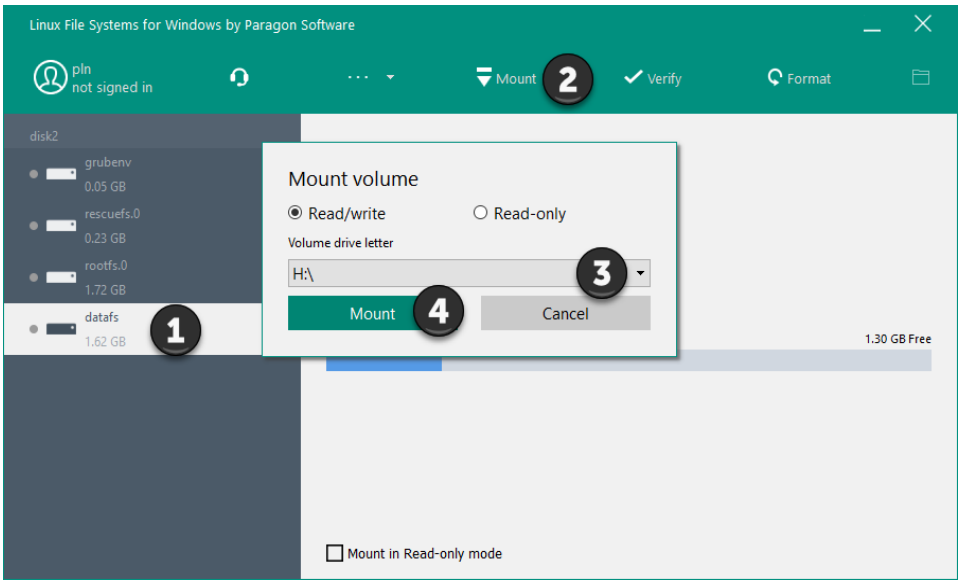
6.5.3. How to Access Linux Partition from Windows

Linux partition

With the software from Paragon, you can access all partitions on the SD card. The files needed are located on the partition called **datafs**

If the partition is not shown, it could be that it is not mounted automatically. To correct this:

1. open the Paragon software,
2. select the partition,
3. select the mount icon,
4. select the volume drive letter, and
5. mount.



6.5.4. Copy the Data from SD Card

Datafs

Navigate to the SD card partition called **datafs** and copy the listed files/folders below.

NOTICE
Do not alter any files. You must only take backup copies as needed.

- programs/ [all of the following files: .urp, .txt, .script, .installation, .variable, .old]
- root/ur-serial
- root/log_history.txt
- root/log_history.bak [if existing]
- root/histogram.properties
- root/flightreports [Complete folder if existing]
- root/.urcontrol/calibration.conf
- root/.urcontrol/calibration.log
- root/.urcontrol/robot_calibration_summary.txt

6.6. Installation of Robot Image

Data backup

NOTICE
When copying/moving files and folders, incorrect use might corrupt the file system.
Contact your IT professional for assistance if you are not comfortable with this procedure.

This section explains the process of moving required files during a robot backup.

6.6.1. Create a Bootable Storage Device

Description

The creation of a bootable storage device system enables users to boot a control box with a new robot image in either Polyscope version. This is a practical and useful user action for recovery in case of emergency situation when a robot's internal storage gets damaged.

Download and install balenaEtcher

Here we use an open-source flashing tool called balenaEtcher to create our storage device with PolyScope installed. Other programs can be used as well, such as Rufus. Follow the instructions found in balenaEtcher's own website to install the program. Click https://etcher.balena.io/.

NOTICE

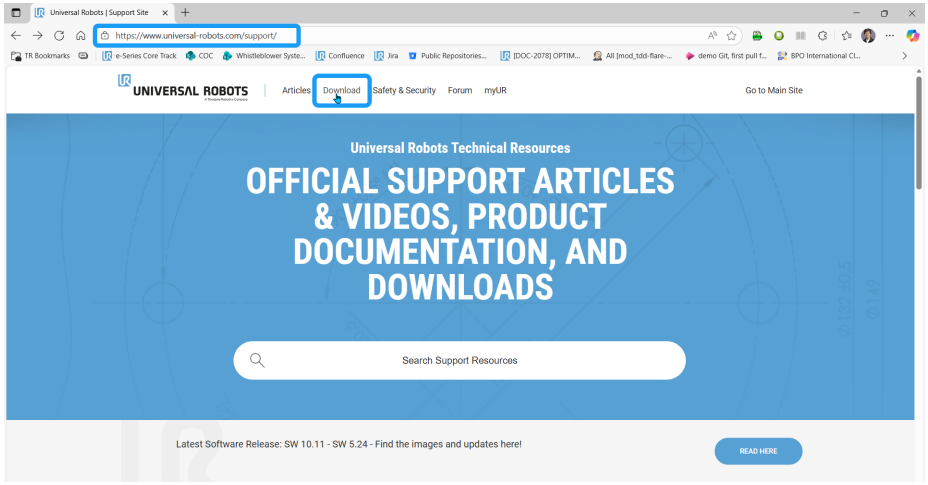
BalenaEtcher is a third-party software and not associated with Universal Robots A/S. Universal Robot takes no responsibility for this software.

When you successfully install balenaEtcher in your computer, its icon is visible in your desktop, along with the other programs installed in your computer.

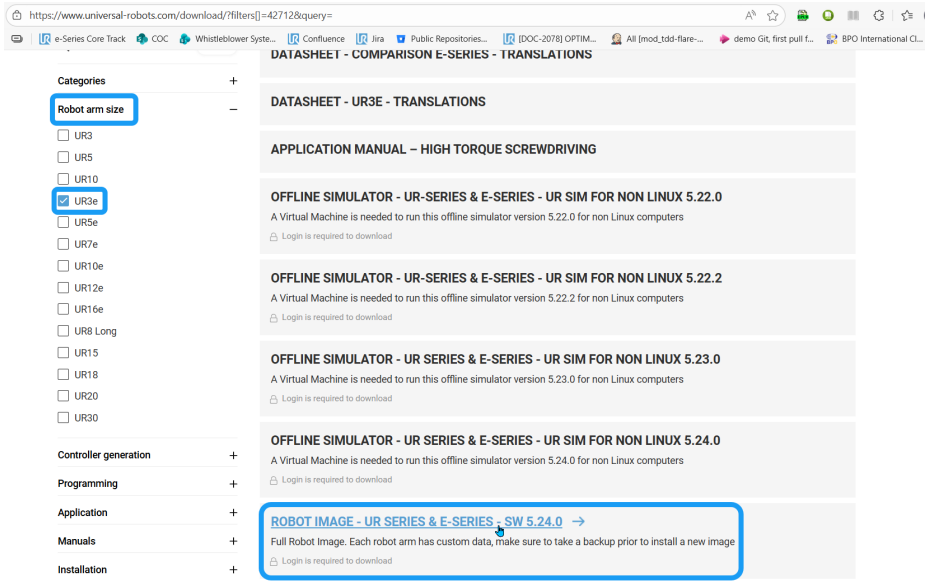
6.6.2. Download Robot Image

To download a robot image:

1. Go to https://www.universal-robots.com/support/.
2. In the header, click the download section.



3. Click **Robot arm size** and tick the checkbox of your robot type. Click the **Load More Results** button and scroll down to locate the **Robot Image** section.



4. Enter your log-in credentials to download.

NOTICE

Before you download, make sure to back up prior to installation of a new image. Each robot arm has custom data.

6.6.3. Install Image and Re-image into USB

Description

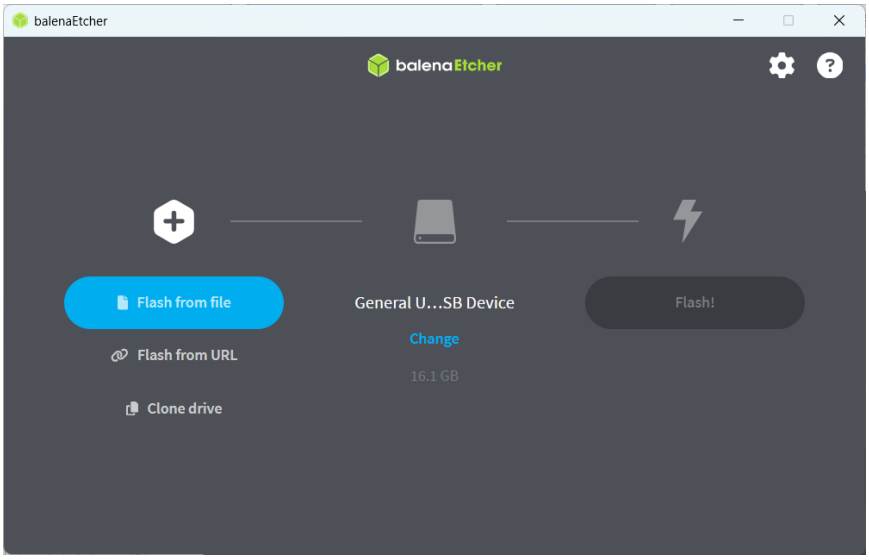
A bootable USB enables users to boot a control box with a new robot image in either Polyscope 5 or Polyscope X software version, in case of emergency situation when a robot's internal storage gets damaged.

Installing image using balenaEtcher

NOTICE

If your USB flash drive was previously formatted as Windows partition, it will be fully erased, and partition type is changed to ext3 and ext4 making it unreadable for Windows. If Linux file system support is not installed, you have no way to access the USB flash drive.

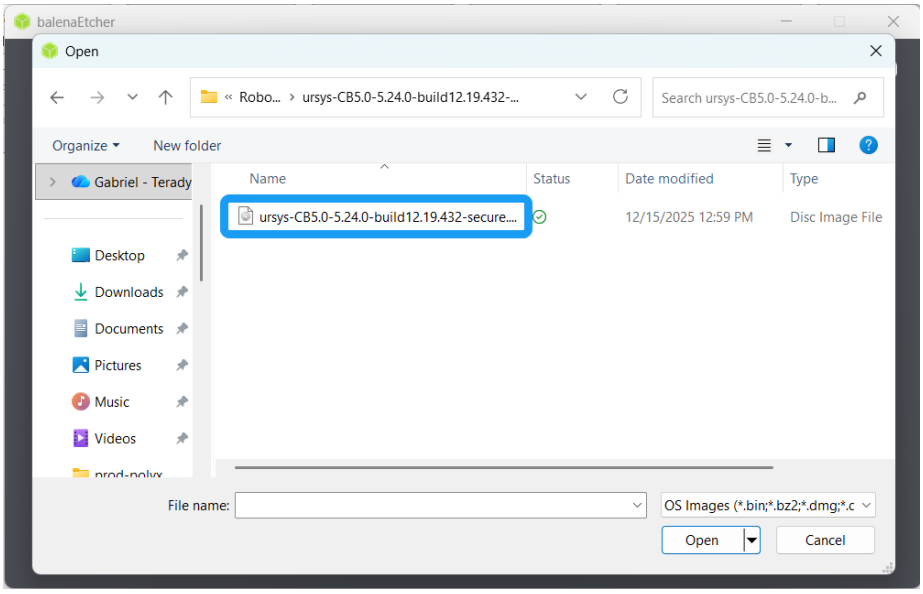
1. In your desktop, double click to open balenaEtcher in your computer.



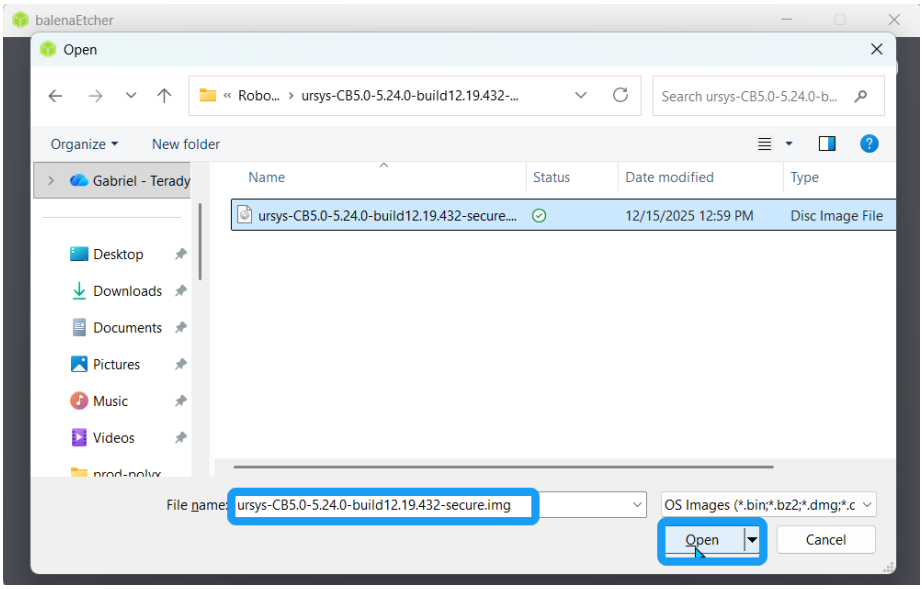
2. Insert a USB flash drive in your computer if it is not yet inserted.

Robot Image into USB

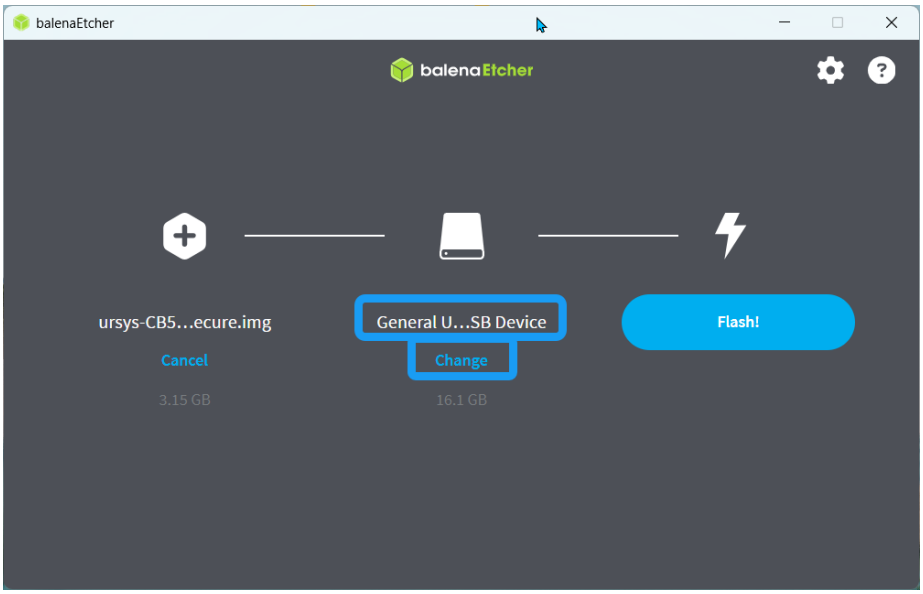
3. Click the blue **Flash from file** button. A pop-up dialogue box appears where you can locate the folder that contains the downloaded robot image file.



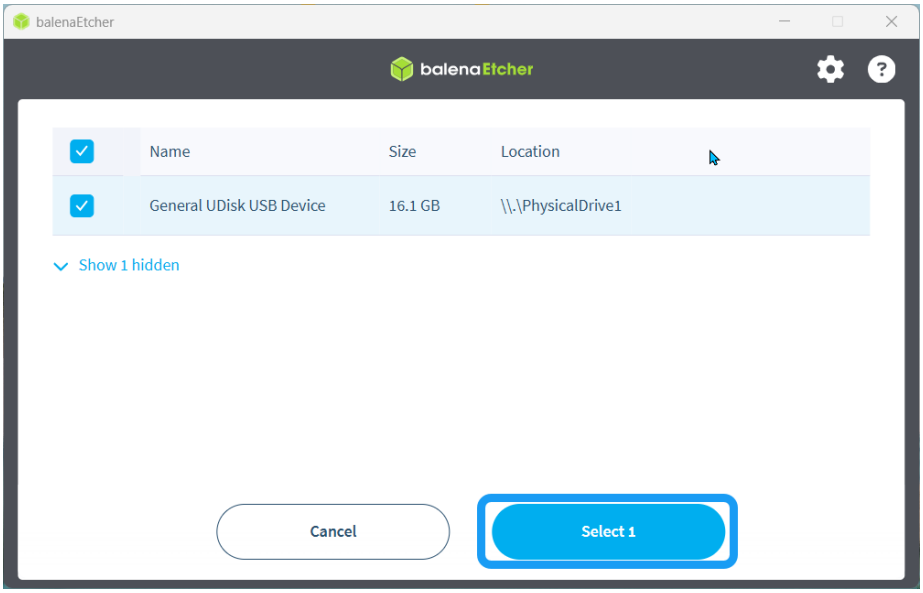
4. Choose the pertinent robot image (**.dmg**) file. Click **Open**.



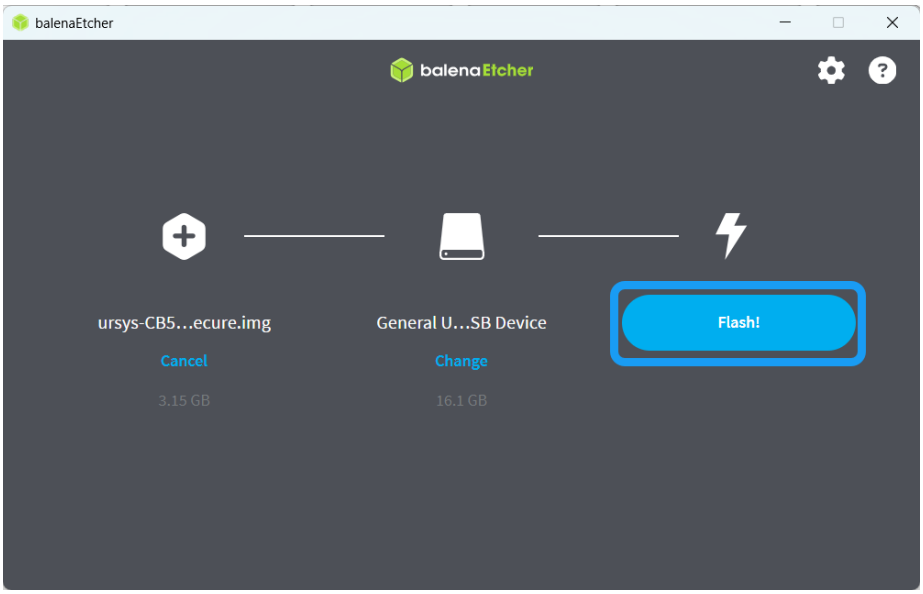
5. The partitioned USB flash drive is automatically selected as target.



6. To confirm that the partitioned USB flash drive is selected, click **Change** under it. A pop-up dialogue box appears that shows your inserted USB flash drive checked and selected. Click the **Select** button.



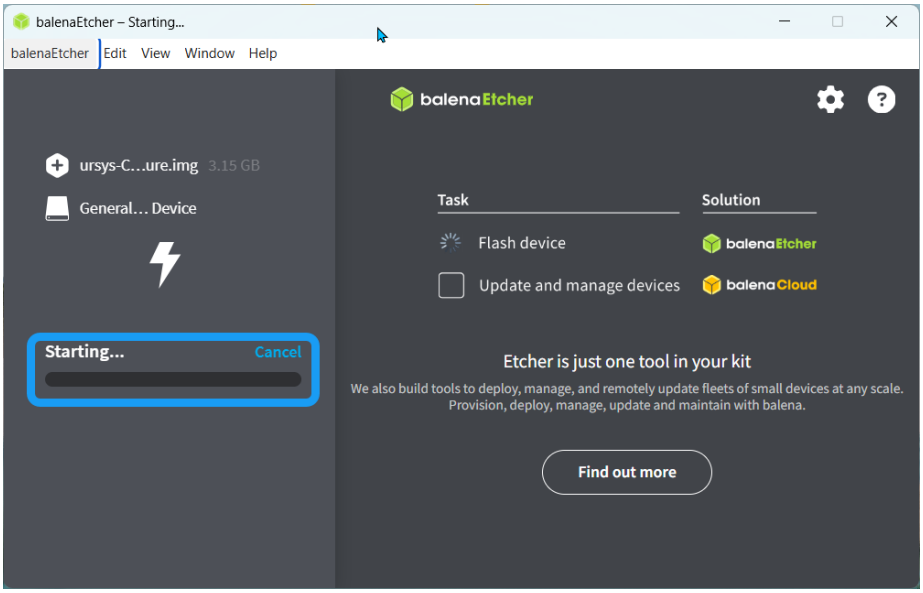
7. Click the activated blue **Flash!** button.



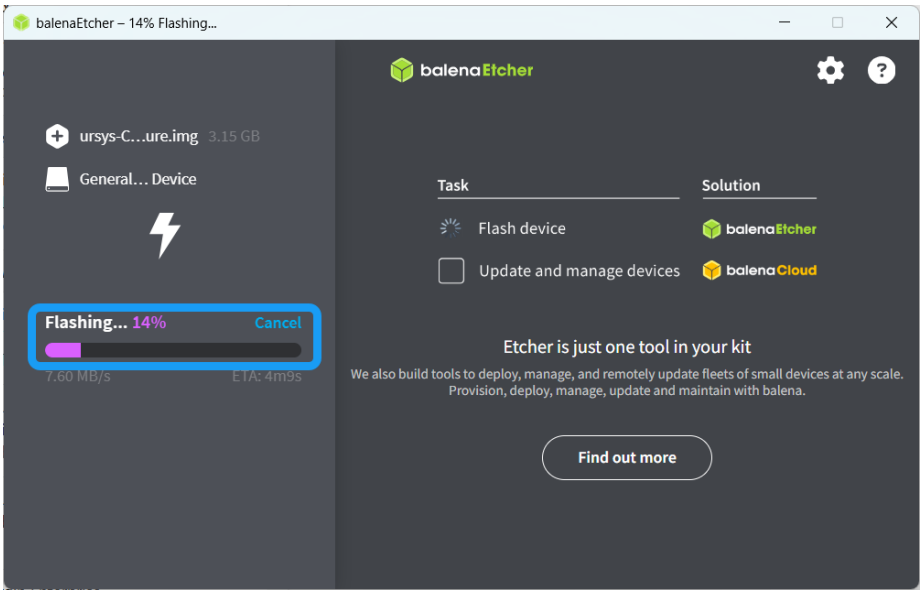
WARNING

Do not remove the USB while flashing and avoid unnecessary movements in your computer to stabilize the USB in its port.

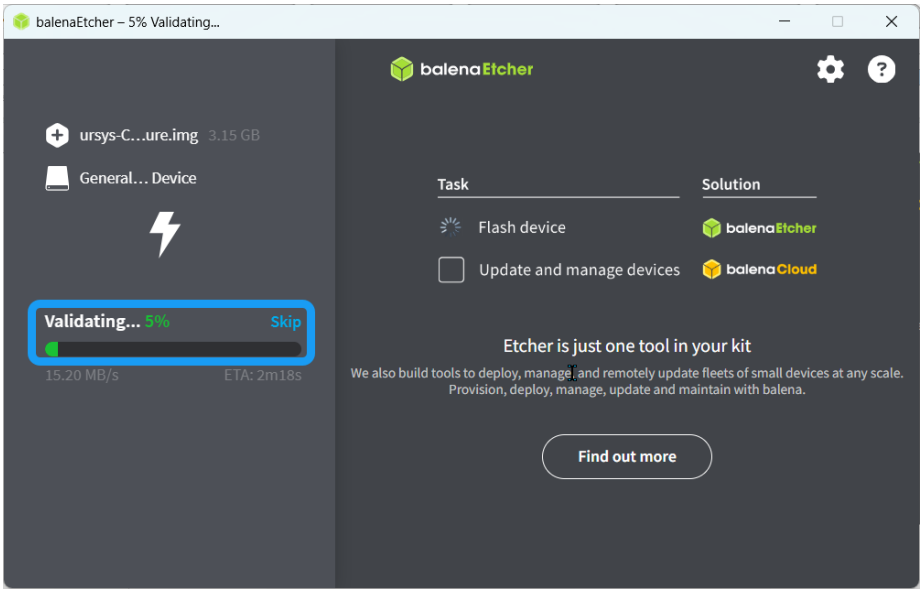
8. A pop-up screen shows Flashing process is starting.



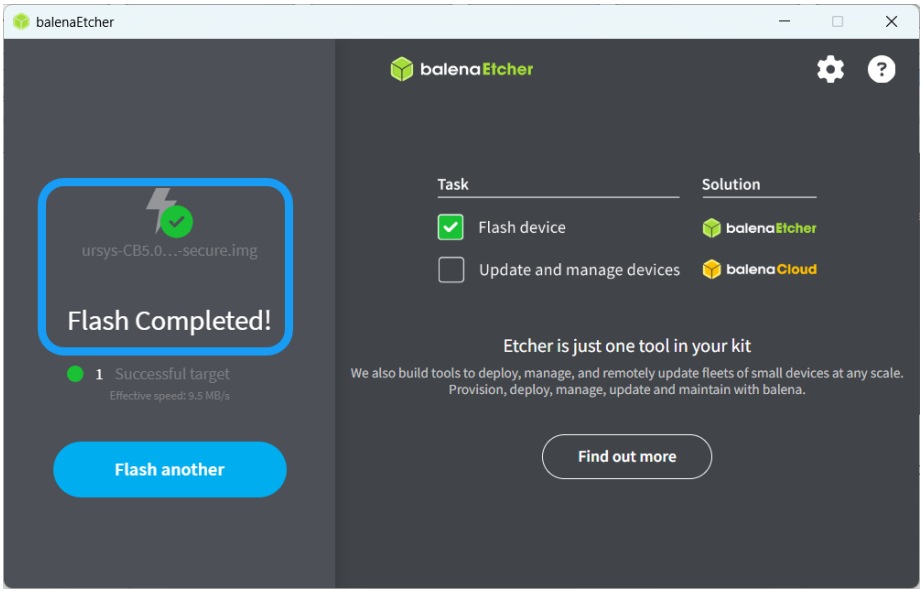
9. After, the Flashing process screen appears. Wait until flashing is at 100 percent.



10. When flashing is done, a screen appears that shows the percentage of the validation process. Wait until completed.



11. When validation is completed, a screen appears confirming that USB flash is completed. A Windows Explorer notification pops up with the information that balenaEtcher has successfully flashed a file into the USB.



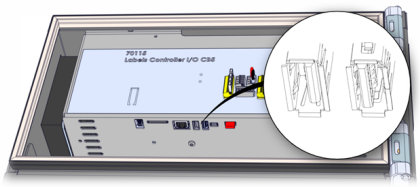
12. You can close the program and remove the USB flash drive.

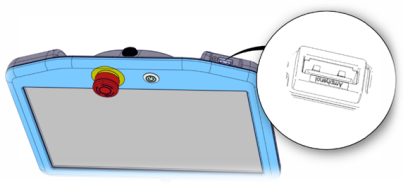
7. Troubleshooting

7.1. Adding External Equipment for Troubleshooting Purpose

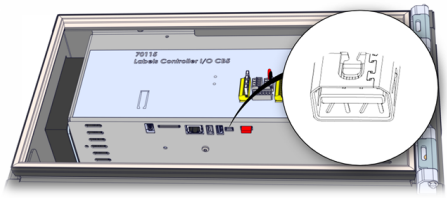
Add External Equipment

For troubleshooting, it can be useful to add a mouse, keyboard, or monitor.
Most USB mouse and keyboards are supported. Plug in the mouse or keyboard in one of the available USB ports. A restart of the the control box may be required for it to work.





In the control box, a mini display port is available. When a monitor is connected, it will display the same content as the teach pendant and can be connected at the same time as the teach pendant. A restart of the control box may be required for it to work.



7.2. UR Log Viewer

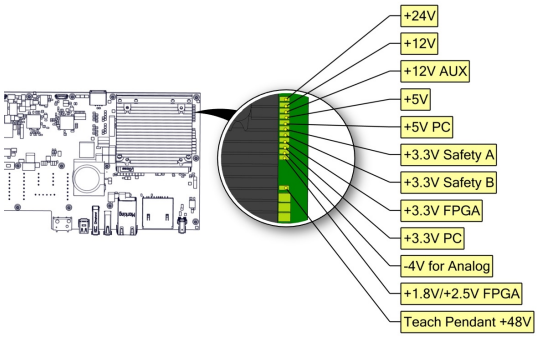
The UR Log Viewer is a software intended for reading and viewing the support file from the UR robot/s. Support files are generated automatically inside each robot, and contain the log files, programs and flight reports. This software is a support tool for the user to troubleshoot as needed. It is a tool for understanding the robot behavior and have data analysis, as well to do improvements, based on this data, to your application and programming.

Go to www.universal-robots.com/support to download the UR log viewer and find the full instruction.

7.3. LED indicators and Fuse on Safety Control Board

7.3.1. LED Indicators on Safety Control Board

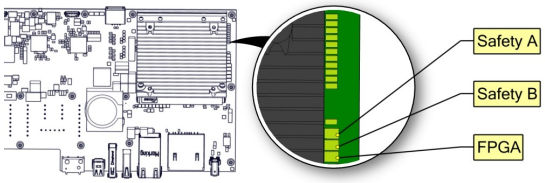
The below LEDs are “power” LEDs. They are either on or off.



LED for power

- Green color permanent = Power on
- No color permanent = Error or no power

Below are “communication” LEDs. They flash in different patterns, depending on the status.

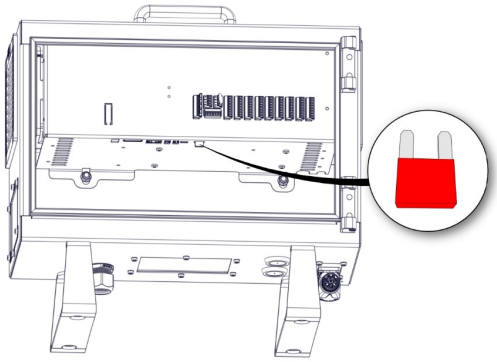


LED for Safety A and Safety B
Green fast flash = Bootloader
Green slow flash = Normal communication
Red permanent = Error (Red flash can happen during bootup/power on, this is normal.)
LED for FPGA
Green/Red permanent = Normal communication
Green slow flash = No communication/trying to establish communication

7.3.2. Fuse

Fuse is a 10A fast-acting mini blade fuse.

WARNING
Never use a different fuse than specified. Only use high grade components.



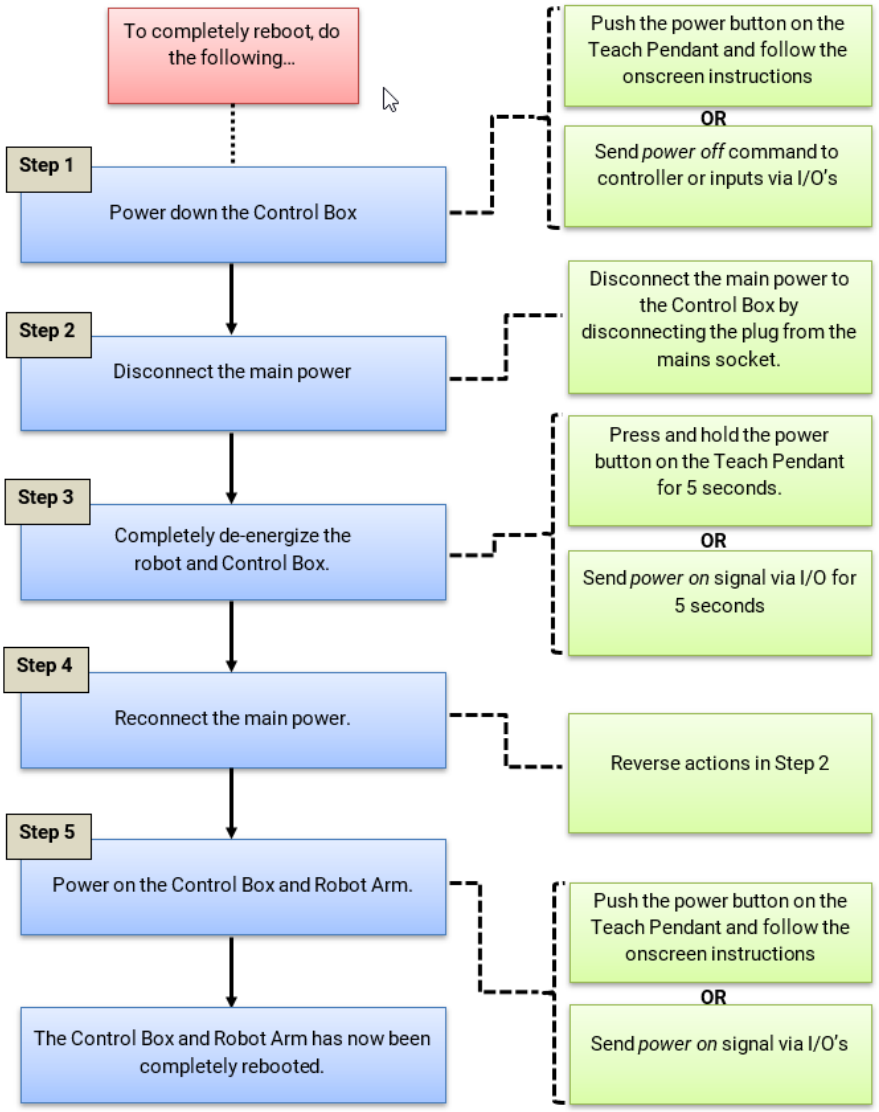
Fuse specifications:

- Interrupting Rating: 1000A @ 32 VDC
- Voltage Rating: 32 VDC
- Component Level Temperature Range: -40˚C to +125˚C
- System Level Temperature Range: -40˚C to +105˚C
- Terminals: Ag plated zinc alloy
- Housing Material: PA66
- Complies with: SAE J2077, ISO 8820-3
- UL 248 Special Purpose Fuses

7.4. Complete Rebooting Sequence

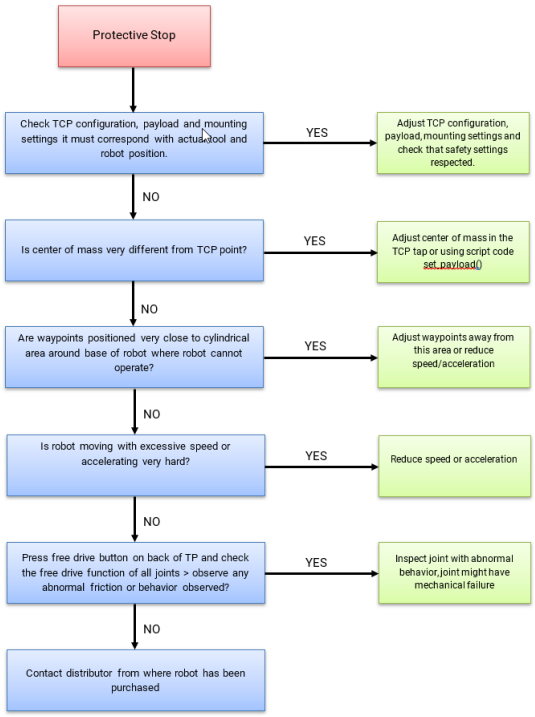
Diagram showing rebooting steps

To completely reboot the robot system, follow the following steps:



7.5. Robot Stop

Read also article 18939 on the support site www.universal-robots.com/support



7.5.1. Preventive Measures

Ignoring Robot stops is considered abuse of the robot which voids the warranty.
These faults can be hidden from view under the following two circumstances:

1. Personnel simply resetting a fault without review of why the fault has happened.

WARNING

Ignoring robot stops masks fault detection, which can increase the risk of injury.

- Pay careful attention to robot stops.
  Learn why they happen to improve your programs and preserve fault detection.

Robot stops must never be acknowledged and reset automatically, it must always be a deliberate action by a user to resume after a robot stop.
In general, robot stops are designed to inform the user that the robot has stopped due to an external event such as hitting an obstacle or similar. In case the robots are pushed close to the limits, the robots can generate robot stops to indicate that they are not capable of following the desired trajectory. After a robot stop, the following must be done before resuming operation:

i. **If there has been a collision or similar:**
   Remove the obstacle and ensure that operators are out of the way before resuming operation. See Section 2 of Service Manual (see link below).

ii. **If there has been NO collision or similar:**
   The robot is operating too close to the limits, the application should be adjusted to reduce the load on the robot, for instance by reducing accelerations, by correct use of blends or similar measures.

Robot stops are indications of issues, including program or production issues – not only safety issues. An application which results in daily robot stops is not designed correctly and needs to be modified.

2. If an automatic acknowledgment and reset of a robot stop has been programmed – no one will see the robot stop.

NOTICE

Automatic acknowledgment and reset of robot stops masks faults that will lead to a failure condition.

- When there is a robot stop, verify the cause.
  If there is no collision, adjust the program

If an integrator has set-up the application program to do automatic acknowledgement and reset of robot stops, the customer should contact the integrator change the program immediately, as such override voids the product warranty and masks fault detection.

7.6. Safe Brake System

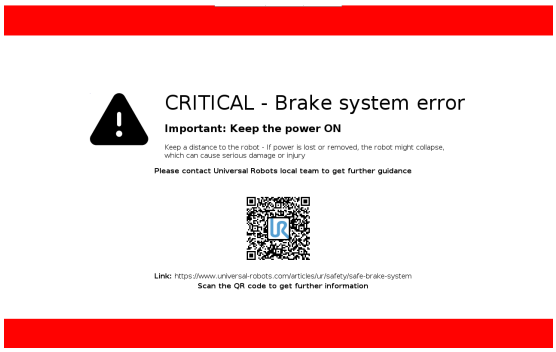
UR Series robots will perform a procedure prior to powering off the motors during shutdown, violation or E-stop where it will detect whether or not the brake system in the robot arm engaged successfully.

In the event that it is detected that the brake system did not engage, then power to the joint motors will be kept on. The arm will be kept at standstill until an operator powers off the arm in a controlled way.

NOTICE

The robot will also perform this detection during when leaving backdrive, although in this case, it will keep the motors powered off.

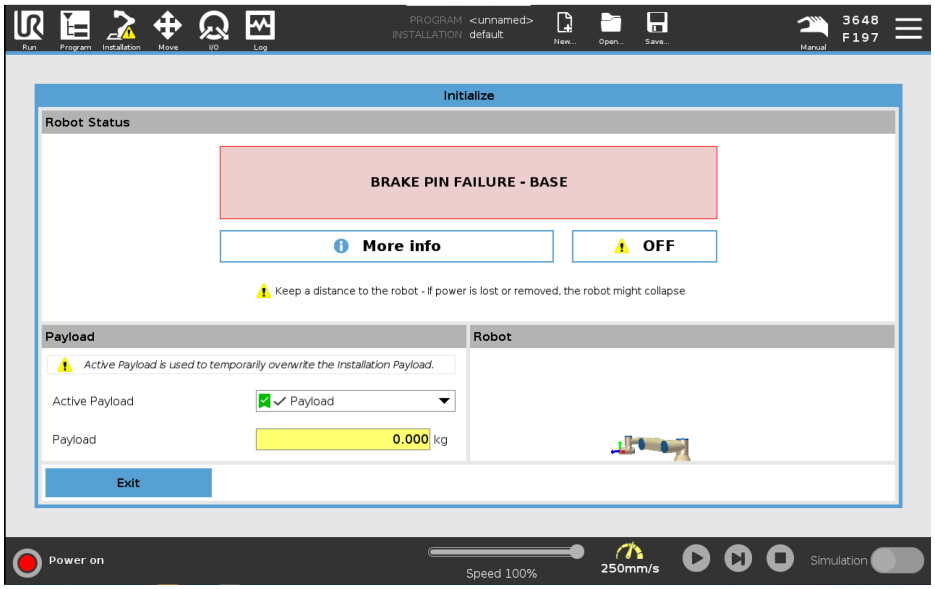
When the system enters this state, the following screen will appear in the PolyScope user interface:
Long-pressing the exclamation mark icon will bring up a special power off screen.



7.6.1. Finding the Faulty Joint

Here the operator can see which joint detected a faulty brake.

An entry will also be added to the log where it can be seen which joint detected a faulty brake.



When the robot is in this state, the dashboard server will not respond normally when queried. It will respond to all requests with information about that the robot encountered a brake system error and a link where further information can be found.

Before powering the robot off in this scenario, the operator needs to ensure that it will not cause any harm to personnel or damage to equipment beneath the robot, as it is likely that the brake will not be engaged, and thus the affected joint will not be able to keep the arm from sliding downwards once the power is removed.

Further operation of the robot will be prevented as the robot will be unable to brake release until the robot has been inspected to ensure the brake is operating properly.
The operator or a service technician need to validate that the brake of the previously reported joint is able to engage before proceeding with the steps in the section Clearing a brake system error.

If the brake is faulty, the brake failure should only be cleared in the case that it is necessary for getting the robot in a position where it can be shipped to a service facility.

To repair the faulty brake system, a service technician should first attempt to replace the brake solenoid in the joint. If that does not resolve the issue, it is likely to be a problem with the friction brake.

7.6.2. Validate Joint Brake System

If it is suspected that the detection of a faulty brake system was due to a false detection, and that there is not anything wrong with the brake system, a manual inspection can be done.

In that case, the operator should note which joint is reported to have a faulty brake system. If in doubt, powering up the robot again after the control box is restarted will show the brake system error popup screen again and make the user interface show which joint is faulty.

To inspect the brake, move the part of the robot arm connected to the faulty joint in both directions to evaluate if it hits the brake pin or not. If the brake is correctly engaged only very limited motion of the joint (1-2 degrees) will be possible before hitting the brake pin.

7.6.3. Clearing the Brake System Error

Description

Using this method to make the robot continue operating should only be done if the operator or service technician is sure that the brake system error was due to a false detection and the brake is actually working correctly.

CAUTION

If the robot arm slid downwards towards the ground after the initial detection when it was first powered off, the robot brake system is faulty and should be serviced.

If repeated brake system errors occurs, the robot should be serviced even if it seems like it is a false detection as it could be a sporadic issue if e.g. the brake solenoid is binding and slow to engage. If it is necessary to brake release the robot to get it in a position suitable for shipping to a service center, this procedure can be used.

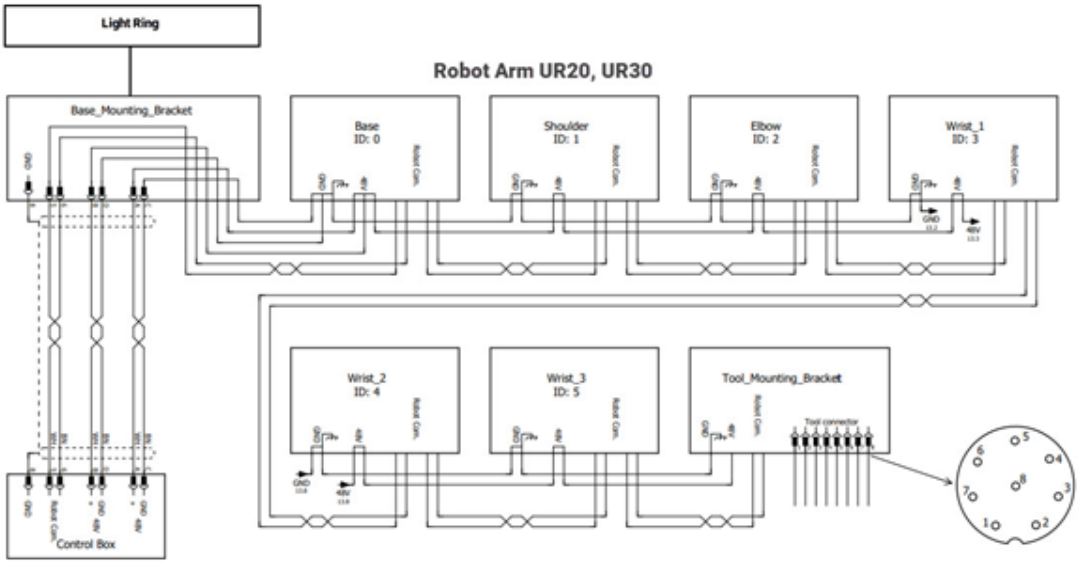
Use the steps below to clear a brake system error:

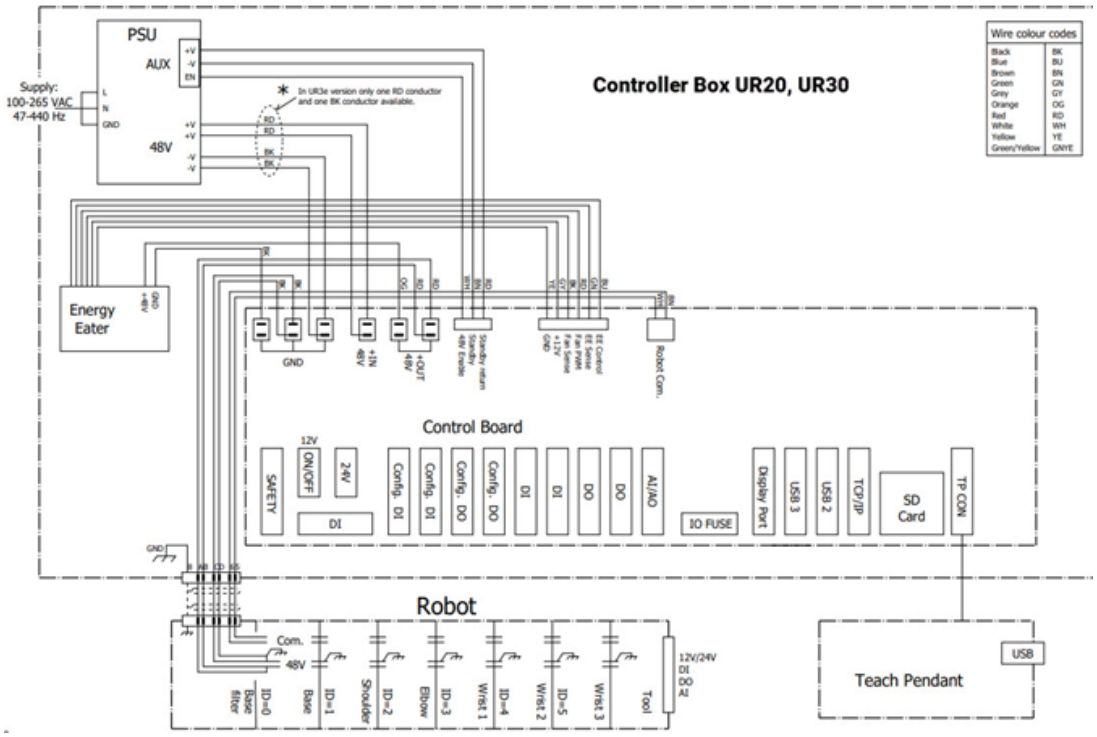
1. Attach an USB keyboard.
2. Make sure that there is power to the robot arm. If the system is in the brake failure state and powered off, it is necessary to restart the control box to power on the robot arm again. When powering on the robot arm, it will go to the brake failure state.
3. Use the USB keyboard to change to a "Virtual Terminal" by pressing CTRL-ALT-F1
4. Login in the terminal using `root` as username and the configured root password. (`easybot` is the default password).
5. Enter the following command and press enter

   ```
   echo "clear failed brake <joint>" | nc 127.0.0.1 30001 -q0
   ```

   where <`joint`> should be replaced with a number 0-5 corresponding to which joint should clear the failed brake state. e.g. for clearing it on the shoulder joint, enter `echo "clear failed brake 1" | nc 127.0.0.1 30001 -q0`
6. Change back to polyscope by pressing CTRL-ALT-F7
7. Power off the robot arm and restart the control box.
8. It is now possible to brake release the robot.

8. Electrical Drawings





9. Spare Parts

See Support Section of UR website

NOTICE

Ensure you have the correct part numbers when ordering spare parts.

The full list of spare parts have been moved to the support section on Universal Robot's website: https://www.universal-robots.com/support/

10. Packing and Shipping of Robot/Spare Parts

Description

Before shipping any robots or spare parts back to Universal Robots, note the following:

NOTICE

Remove external tools and electrical connections before shipment. Universal Robots may reject the shipment if third-party products cannot be unmounted safely or if they prevent required post-repair tests. Universal Robots assumes no responsibility for returning third-party goods.
Pack the robot, Control Box, and Teach Pendant securely. Universal Robots returns its products in original Universal Robots packaging.

NOTICE

Repairs include updating the robot software and firmware. New parts ship with the latest hardware and software versions. Updating PolyScope may be necessary after installing new parts.

MANDATORY ACTION

If the robot or parts have been in contact with, or used where dangerous chemicals or materials are present, clean them before shipment. If cleaning is not possible, include a Material Safety Data Sheet (MSDS) in English with cleaning instructions. Cleaning labor is billed at the standard rate.
If Universal Robots finds the robot or parts unsafe to service, UR may have them cleaned or decline the case and return the parts at the customer's expense.

Packing Down the Robot and Control Box for Shipment

1. Download the put_in_box program at: www.universal-robots.com/support
2. Upload the put_in_box program. See Section 5.2 Using Magic Files on how to do this.
3. Load the program and follow the instructions when running the program.
4. Power down, disconnect main power, and disconnect the Robot Arm from controller.
5. Pack the Robot Arm and Control Box in designated boxes. Ensure the Robot Arm is orientated correctly in the box.

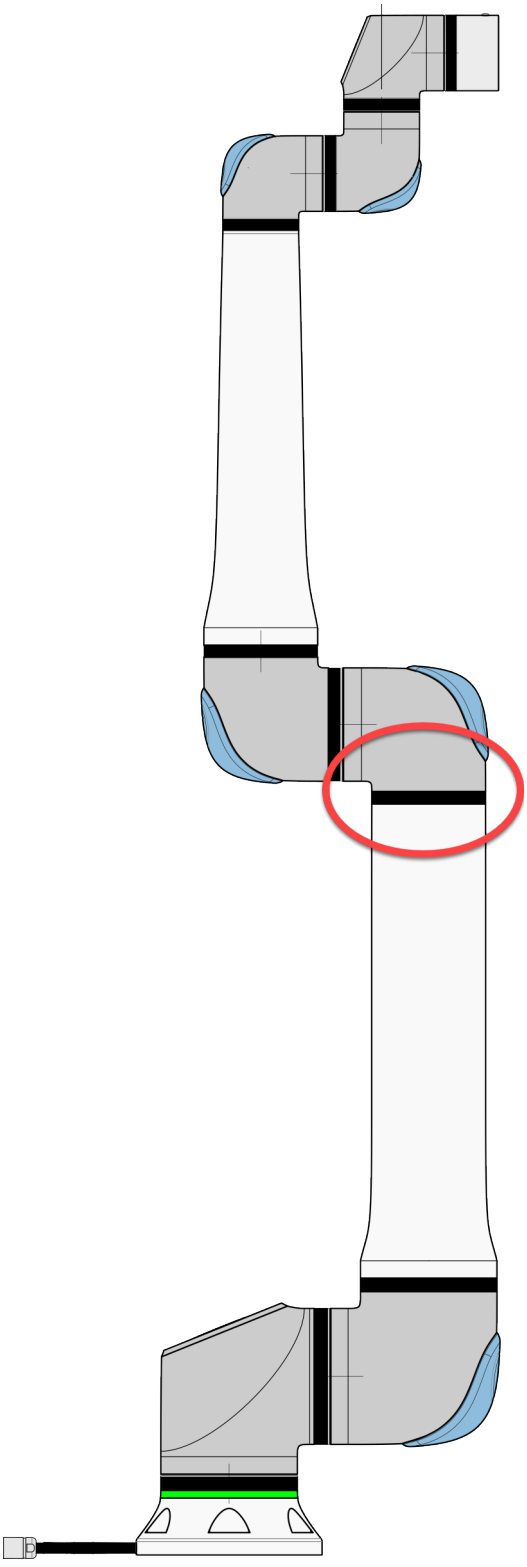
NOTICE

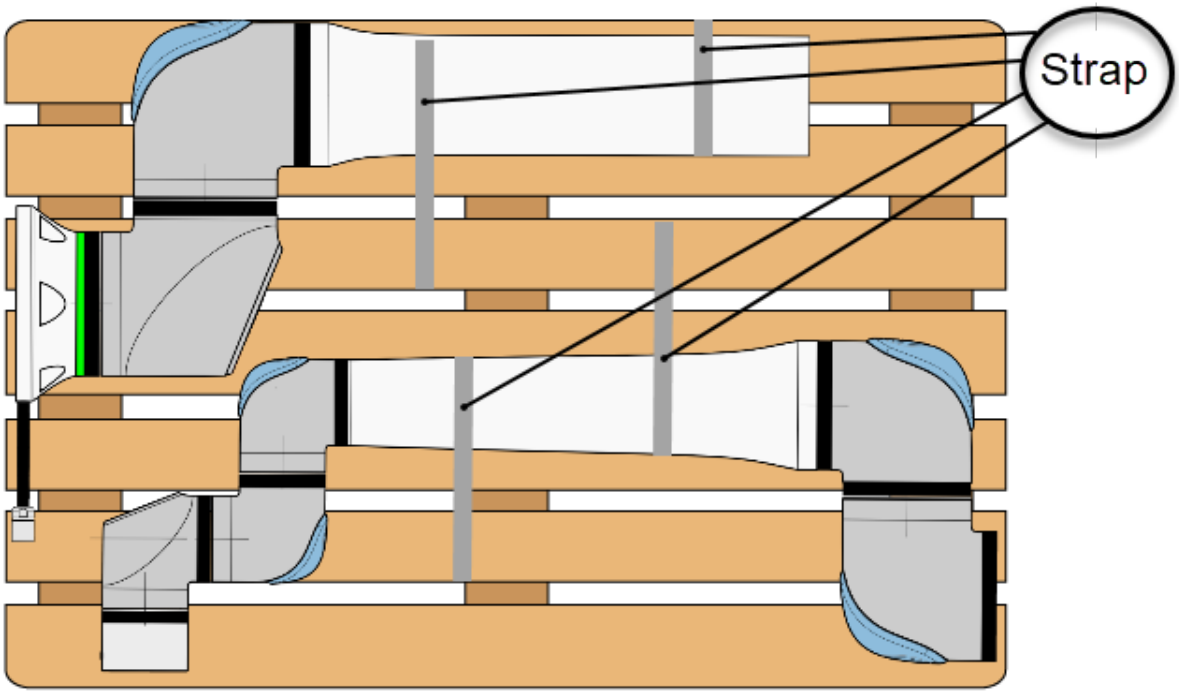
If the robot is attached to 3rd third-party application/ installation during transport, please refer to the following:

- Transporting the robot without its original packaging will void all warranties provided by Universal Robots A/S.
- If the robot is transported as part of a prefabricated solution, securely mounted, and in full compliance with the recommendations outlined below, it is not considered a breach of warranty.

You can see the recommendations for transportation without packaging on help.universal-robots.com/

If the robot arm cannot be moved, due to faults preventing the robot arm from releasing brakes. It may be necessary to disassemble the arm into two parts between the elbow joint and upper arm tube, and strap it securely to a pallet with two straps on the each tube before shipping. This will not void the warranty.





10.1. Transport Without Packaging

Description

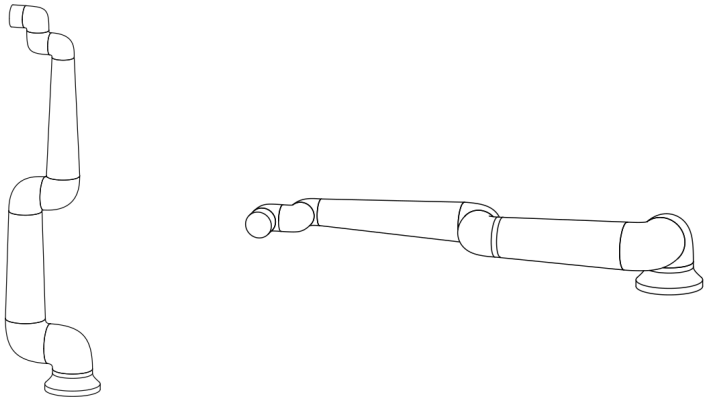
Universal Robots always recommends transporting the robot in its original packaging. These recommendations are written to reduce unwanted vibrations in joints and brake systems and reduce joint rotation.
If the robot is transported without its original packaging, then please refer to the following guidelines:

- Fold the robot as much as possible – do not transport the robot in the singularity position.
- Move the center of gravity in the robot as close to the base as possible.
- Secure each tube to a solid surface on two different points on the tube.
- Secure any attached end effector rigidly in 3 axes.

Trans port

Fold the robot as much as possible.

Do not transport extended. (singularity position)



Secure the tubes to a solid surface. Secure attached end effector in 3 axes.

Software Name: PolyScope 5/X
Software Version: 5.26 / 10.12
Document Version: 10.17.145