

Product Manual

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Symbols in this Manual

The symbols below define the captions specifying the danger levels used throughout this manual. Universal Robots use the same warning signs in their manual.

**DANGER:**

This indicates an imminently hazardous electrical situation which, if not avoided, could result in death or serious injury.

**DANGER:**

This indicates an imminently hazardous situation which, if not avoided, could result in death or serious injury.

**WARNING:**

This indicates a potentially hazardous electrical situation which, if not avoided, could result in injury or major damage to the equipment.

**WARNING:**

This indicates a potentially hazardous situation which, if not avoided, could result in injury or major damage to the equipment.

**WARNING:**

This indicates a potentially hazardous hot surface which, if touched, could result in injury.

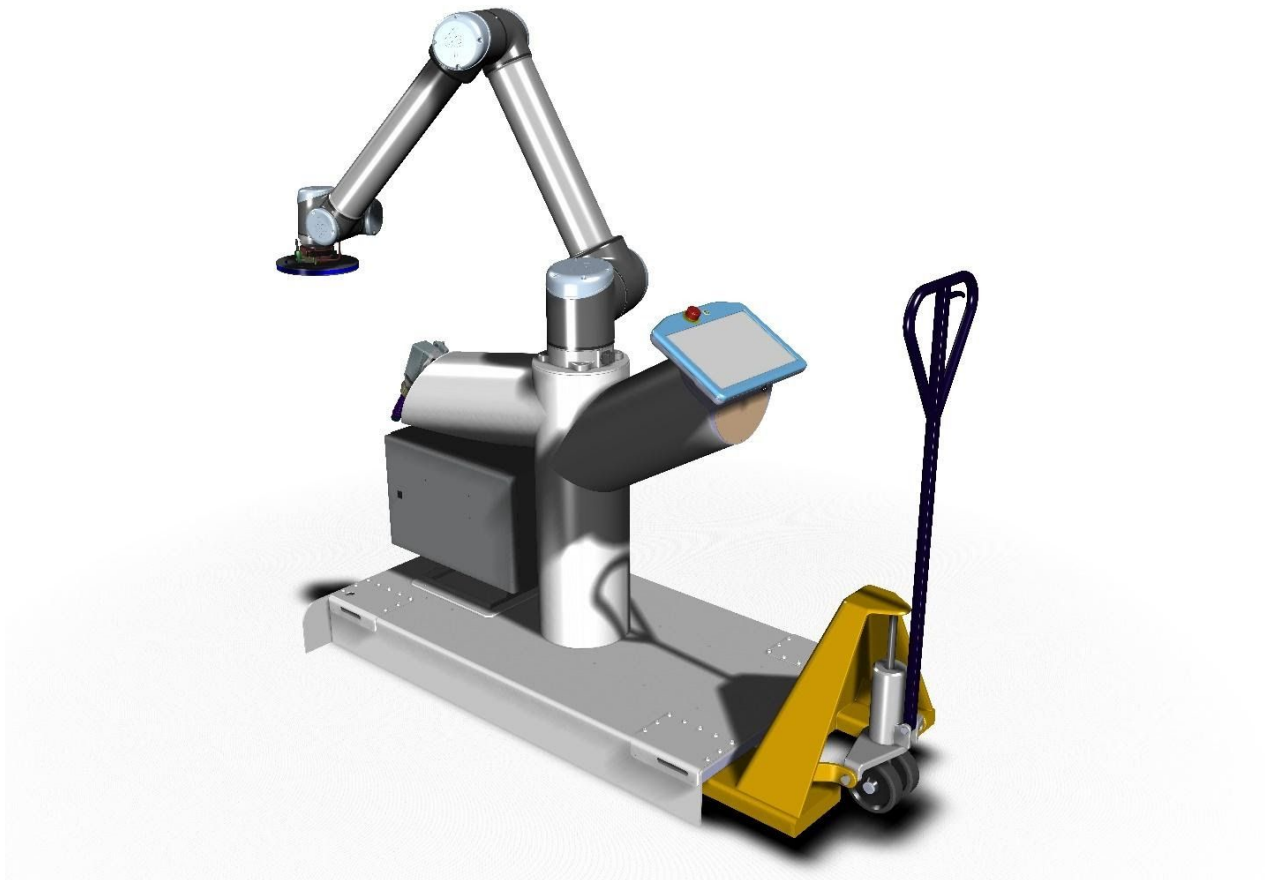
**CAUTION:**

This indicates a situation which, if not avoided, could result in damage to the equipment.

**NOTE:**

This indicates important information, if not applied, could result in loss of warranty.

Preface



General overview

Ovi is an out of the box multi-purpose collaborative robot mounted on a mobile frame specially designed to be transported with minimum effort using a manual forklift.

With its custom connector Ovi is able to recognize the station, where it is mounted and perform a specific application assigned to that station. In order to satisfy the client requirements, the cobot has a manual Tool changer for End Effectors designed for various applications. If installed as a collaborative application, there is no additional fencing required to work safely with and near the robot.

The product can be installed in only four steps:

1. Plug in the magic connector from the station into the bulkhead of Ovi;
2. 30 seconds of software setup;
3. Calibrate the robot using the Point Zero tool;
4. Change the tool with the one suitable for the application.

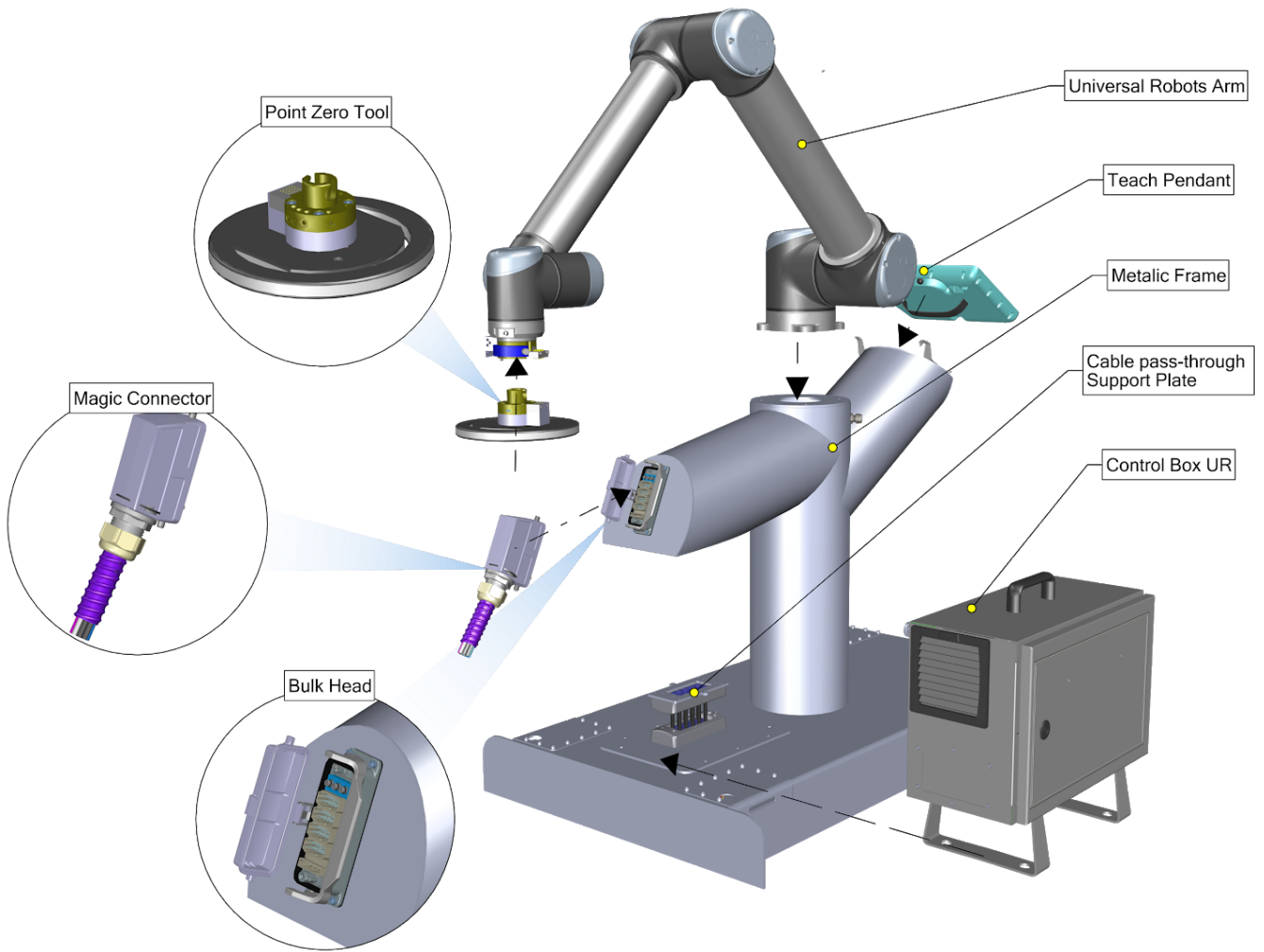
Ovi can perform multiple applications due to its built-in functional features:

- Magic connector (plug and play for multiple different applications);
- Point Zero calibration;
- Pallet detection (for palletizing applications);
- Stacker/Trolley/Cart detection (for machine tending);
- Light beacons (signaling in palletizing application);
- Pneumatic sensor for compressed air presence;
- Pneumatic direct-controlled valve (for applications that require pneumatic control);
- Adjustable feet for different floor surfaces;
- Manual tool changer with electrical and pneumatic connection;
- High mobility (manual forklift movement of the Ovi platform);
- Touch screen interface;
- Internet connection (cloud platform for monitoring individual or fleet of robots);
- Industry 4.0 ready.

Ovi delivery

When delivered, Ovi has the following modules:

1. UR10 (CB3 or E-series);
2. Metallic frame including control box;
3. Station box;
4. PointZERO Station;
5. PointZERO Tool.
6. Blank Tool holder



I. Introduction

I.1 Document identification

This manual is an appendix to the **Universal Robots User Manual** and shall be used only in conjunction with it. The product manual has been prepared by OVISO Robotics to offer essential information in the installation and operation of Ovi. It must be read and understood by the integrator/end client of Ovi before the system is powered on for the first time.

It is mandatory to follow all assembly instructions and guidance provided in this manual.

Increased attention shall be paid to text associated with warning symbols.

I.2 Scope and Purpose

The manual provides a general product overview and description of the design, functionality, and basic operation and instructions of Ovi.

This document is aimed at users with the following knowledge and skills:

- Basic knowledge of mechanical engineering;
- Basic knowledge of electrical and electronic systems;
- Knowledge of the Universal Robots programming concepts.

I.3 Intended use

Ovi is intended for multiple robot applications described further in this manual. Use is only permitted after performing a risk assessment for the complete robot system.

The complete system needs to be installed in accordance with the safety requirements specified in the standards and regulations of the country where it is installed.

Interfacing other machines is permitted only after the integrator eliminates any significant hazard that does not respect safety regulations.



NOTE:

Changing the structure of the product, e.g. by drilling holes, etc., can result in damage to the components. This is considered improper use and leads to loss of warranty.

II. Product Description

II.1 Overview of the product

Ovi comprises all the assemblies of a mobile industrial robot, including the manipulator (mechanical system and electrical installations), control cabinet, station cabinet, magic connector, teach pendant, calibration tool.

As the name suggests, it is easy to use and mobile. Therefore its length is the same as that of an EU pallet, namely 1200 mm.

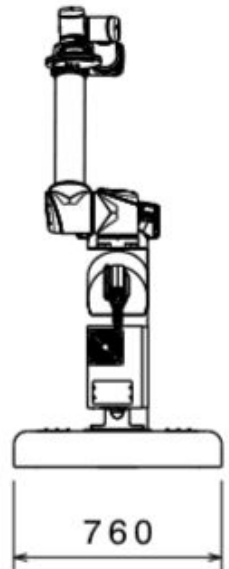
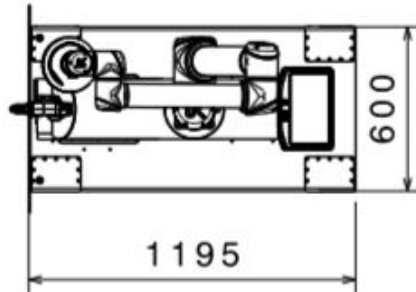
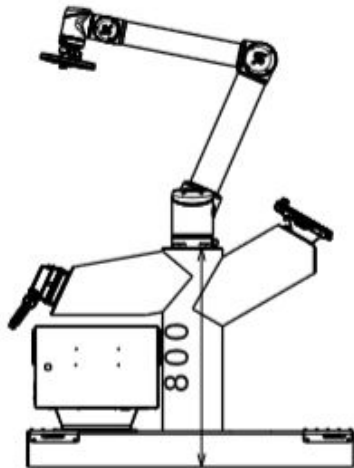
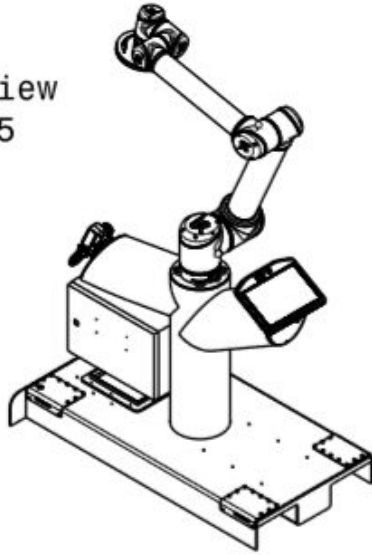
The width of the frame is 600 mm for the most part, allowing the operator to use the same forklift to move the robot as for moving the pallets. At the far end of the frame there are two flanges, one on either side, giving the frame a maximum width of 760 mm. These allow for an easy and precise placement of a pallet next to the frame.

The robots are also available in two versions (UR10 CB3 and UR10 e-series).

Ovi has the following functional modules:

1. Manipulator arm (UR 10);
2. Metallic frame;
3. Control Box;
4. Teach pendant;
5. Monitoring sensors (pallet sensors, pneumatic sensors, Teach pendant sensor);
6. Magic connector (power supply, pneumatic supply, ethernet connectivity etc.);
7. Software;
8. Manual tool changer;
9. Tools.

Isometric view
Scale: 1:25



II.2 Metallic frame

The metallic frame was designed with one clear idea. Namely, the robot must be able to reach its full workspace without affecting its mobility. Outlining this fact, the overall dimensions of the frame is designed to give the operator an ergonomic working space with the best possible reachability for the robot.

Considering the product is able to be used for different types of applications, the metallic frame encapsulates all air tubing, wires, and sensors specific to every application.

Material:	Painted Steel / Stainless steel	Unit
Thickness:		5 [mm]
Overall Dimensions:		
	- Length	1195 [mm]
	- Width	760 [mm]
	- Height	800 [mm]



NOTE:

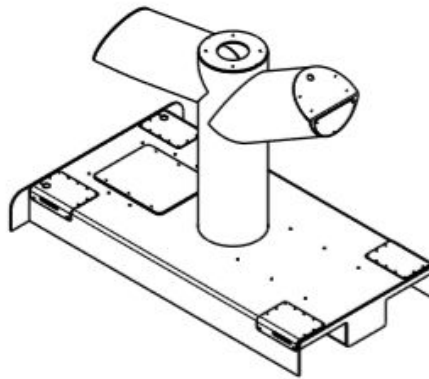
Any change to the metallic frame is strictly forbidden and leads to warranty loss.

The product has two adjustable industrial feet, placed on the opposite side from the user. It has been taken under consideration that the floor surface has irregularities and may not be perfectly flat. Therefore the user can make some fine adjustments using a hexagonal tool.

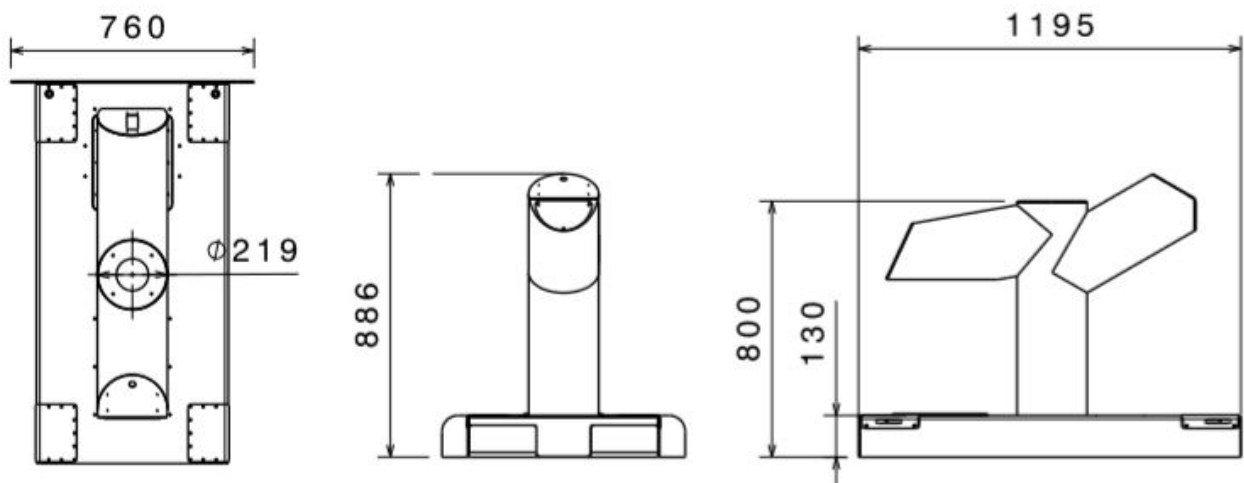
Technological openings make easy access to all wiring and connectivity inside the frame. Protection covers are used for pallet detection sensors and electrical modules.

**CAUTION:**

1. Ensure all the protective covers are in place, and the screws are tightened;
2. Before powering on the robot, make sure the feet are adjusted according to the floor surface so that the frame is stable.



Isometric view
Scale: 1:20



II.3 Magic Connector

The magic connector is a custom all-in-one built-in connector, which brings all the utilities to Ovi.

This connector has been custom designed and manufactured to be intuitive for users with minimal knowledge in robotics. Therefore there is no need for special training to use it. The mobile platform is plug and play with no room for error. Therefore it has one plug-in position featuring a poka-yoke system.

The connector is composed of two different parts distributed as follow:

1. Bulkhead (built-in Ovi);
2. Station connector .



DANGER:

1. Only supply voltages of 100-230 VAC, 50-60 Hz;
2. Make sure that all equipment remains dry. Electrical connectors are not rated for water exposure;
3. Use original cables supplied with Ovi only. Contact the supplier if longer or flexible cables are needed.

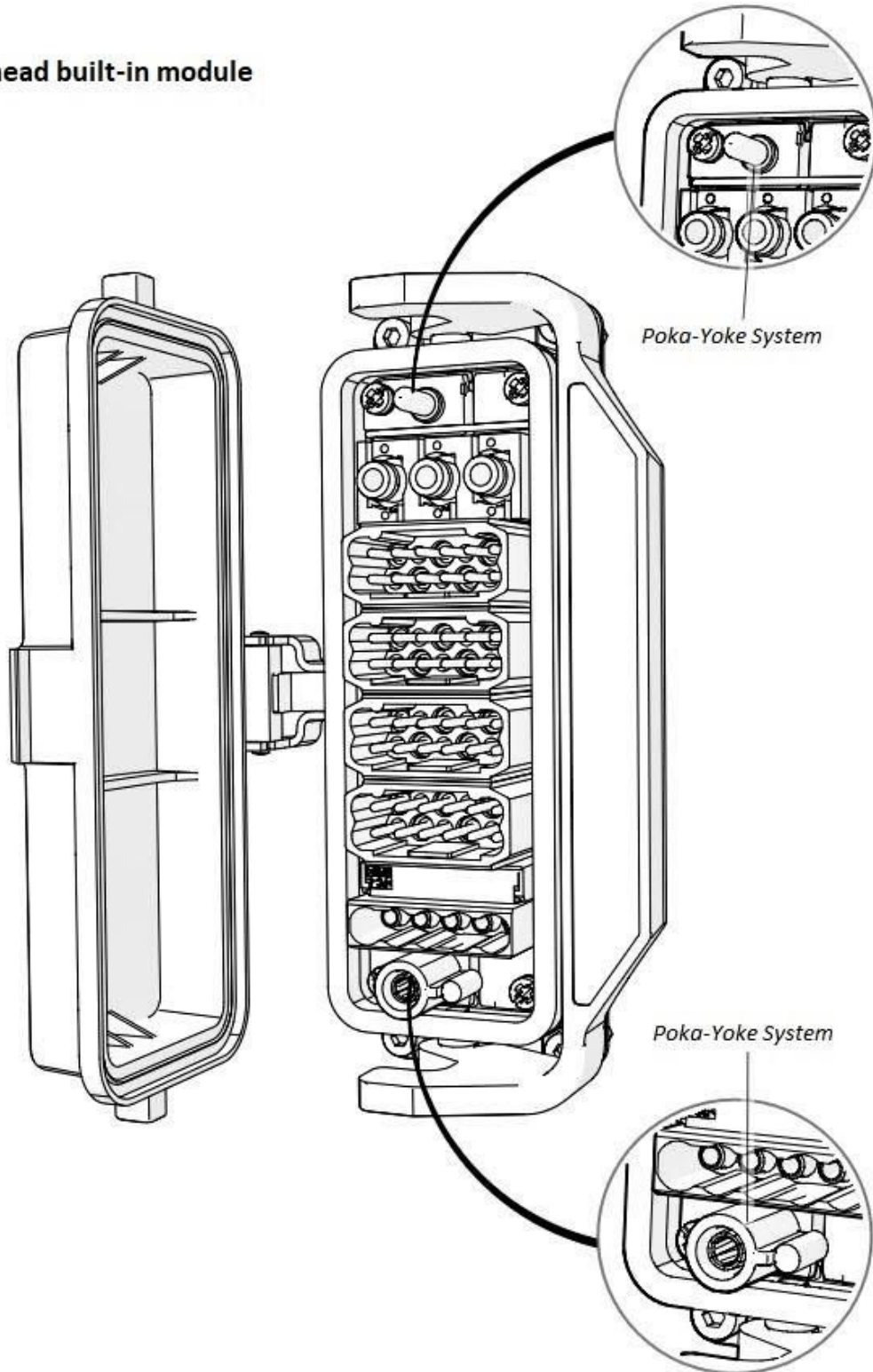


CAUTION:

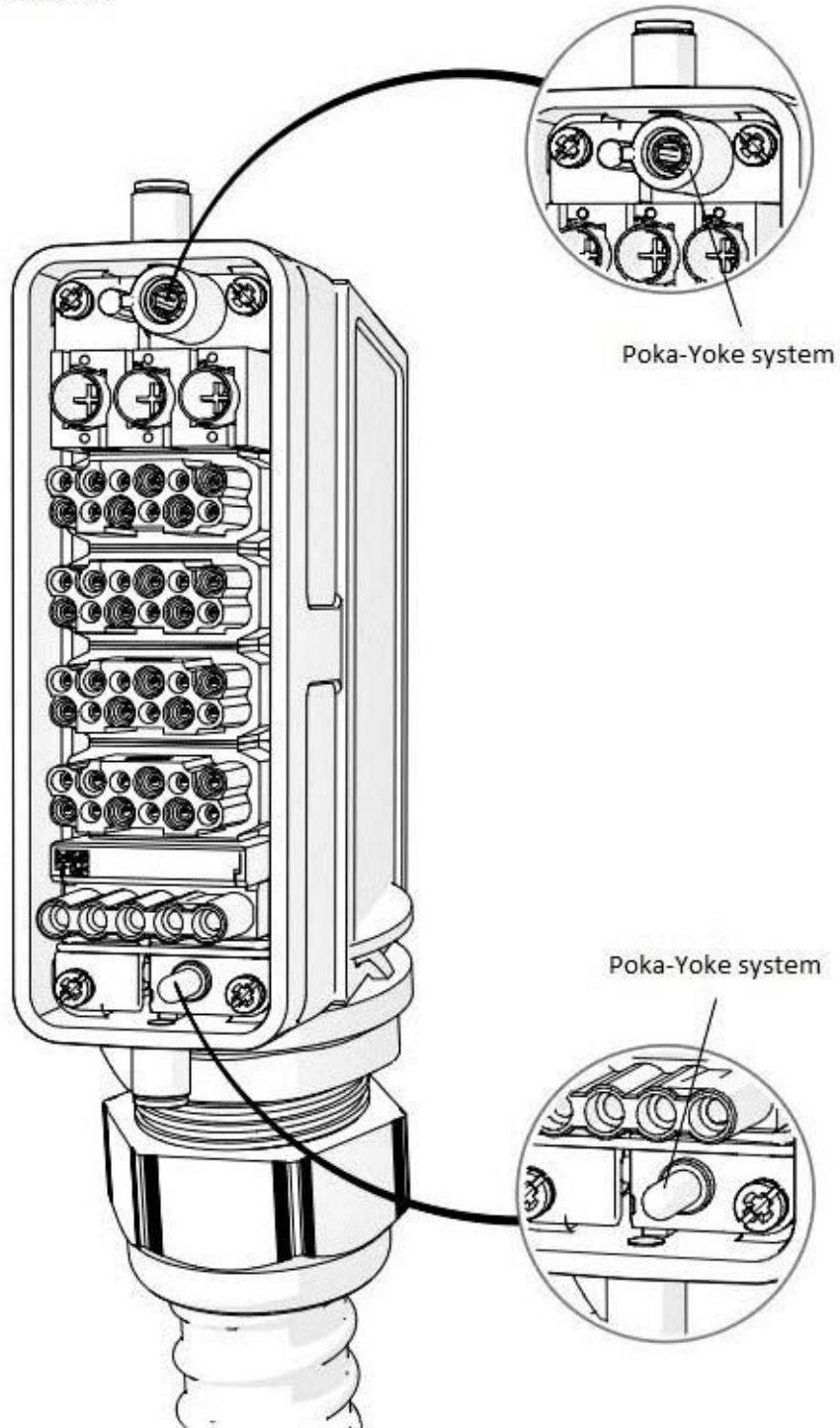
1. Make sure the bulkhead protection cover is closed every time Ovi is disconnected from the station or during transport;
2. Cables going from station to Ovi may not be longer than 3m unless extended tests are performed.

Every station can be configured as a specific application (palletizing, machine tending, sanding, etc.), or custom on client requirements.

Bulkhead built-in module



Station Connector



II.4 Built-in Pneumatics

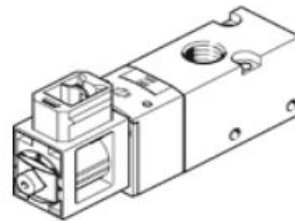
Ovi has been manufactured to perform multiple applications, including sanding, palletizing, painting, etc. All of these require air supply and pneumatic components.

The Magic connector provides 3 x 6mm tube with air supply from the station. When connected to the bulkhead, the air tubing will go into a triple input fitting with a single 10mm output, which will supply a pressure sensor and an air solenoid valve placed in the frame of Ovi.

The two pneumatic components allow the user to control and monitor the pneumatic supply required for end-effectors.

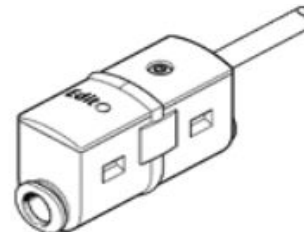
1. Air Solenoid Valve

FESTO VUVS-LK25-M32C-AD-G14-1B2-S



2. Pressure Sensor

FESTO SDE5



NOTE:

Once the robot makes an Emergency Stop, the air solenoid valve can be either open or closed, depending on the running application. (check applications manual)

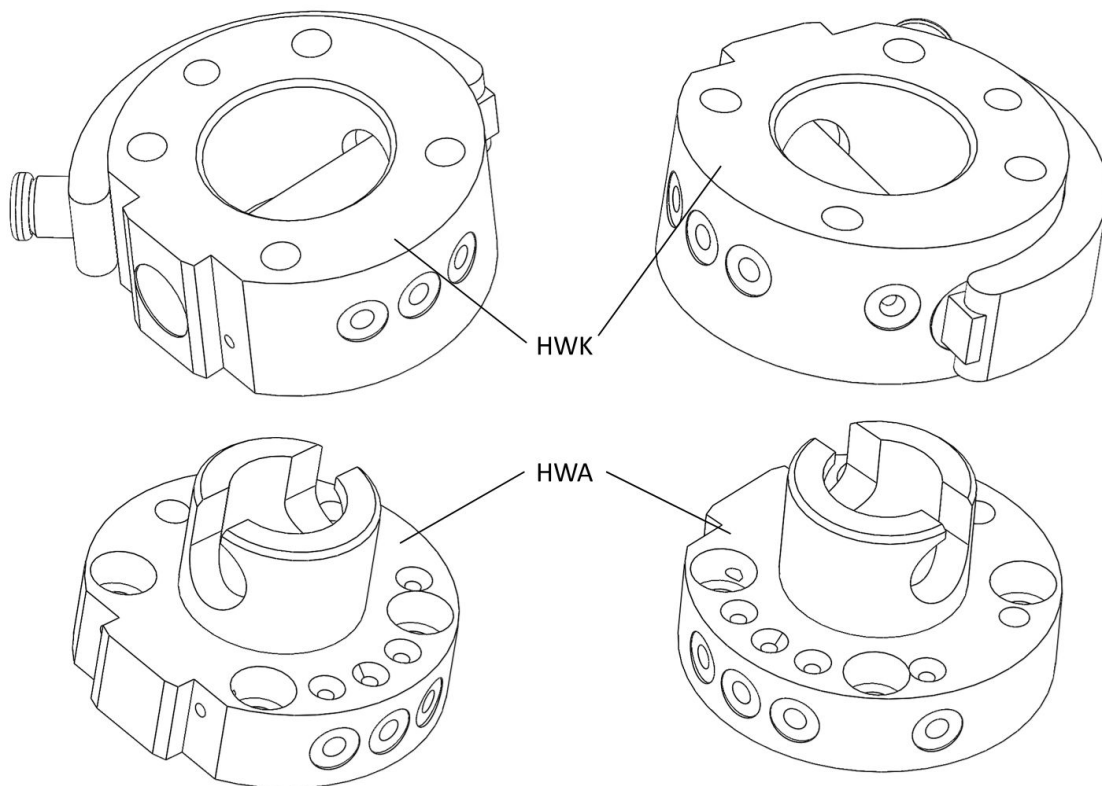
More details on the manufacturer's site: <https://www.festo.com/media/>

II.5 Manual Tool Changer

The robot is equipped with a manual tool changer **HWS 50** manufactured by **Shunk**. This type of tool changers are lightweight and low profile to maximize robot payload and fit into confined spaces.

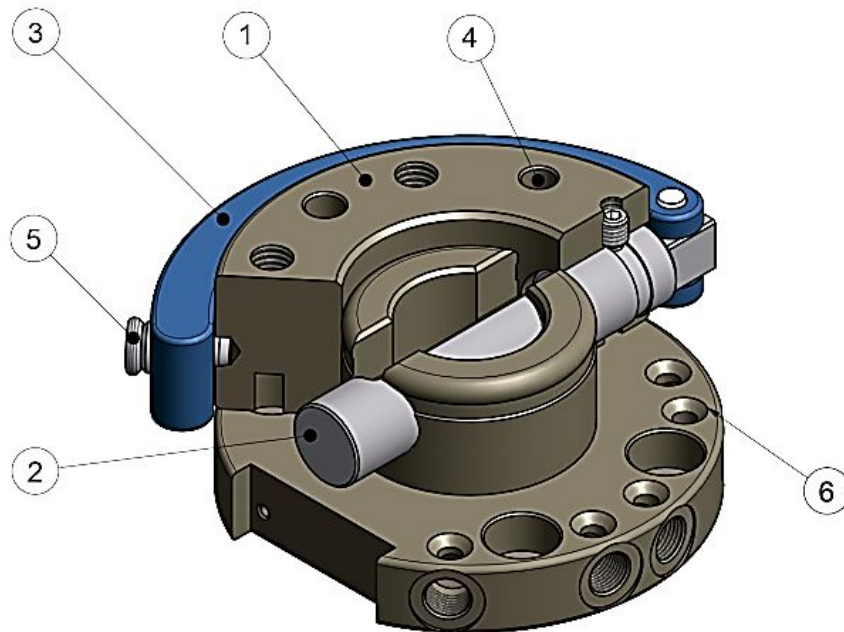
The tool changer contains two individual parts:

1. Manual quick change head **HWK** (robot side);
2. Manual quick change adapter **HWA** (tool side).



The locking bolt is operated via the hand lever to lock the HWK and HWA fast, positively and without play. Integrated pneumatic feed-throughs reliably supply the tool with compressed air.

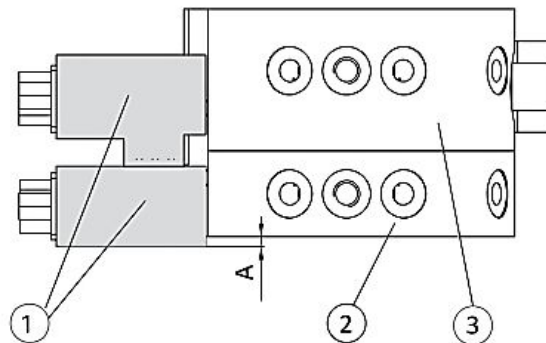
The **HWA** plate with pneumatic and electrical pass has been manufactured for fitting the tools found in the application package.



Structure - Mechanical Interface

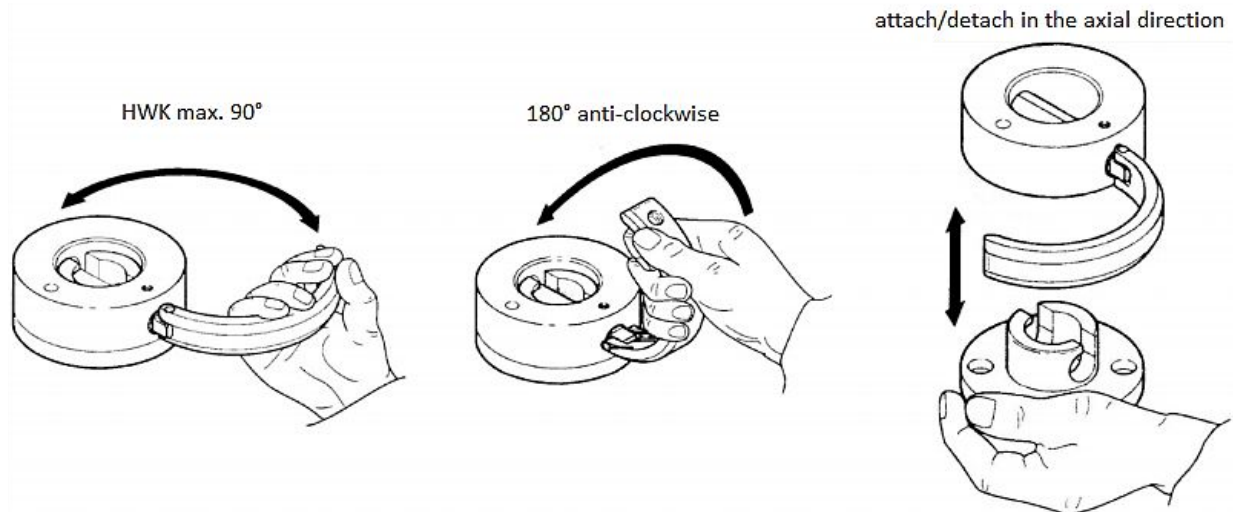
1	HWK manual quick change head (robot side)	4	Fitting for dowel pin
2	Semi-cylindrical locking bolt	5	Locking bolt
3	Hand lever	6	HWA manual quick change adapter (tool side)

Attachment option for electric modules



1	Electric module
2	HWA manual change adapter
3	HWK manual change head

The HWS manual change system is locked or unlocked as follows:



- Open the hand lever of the HWK max. 90°. Do not open the hand lever fully so that the semi-cylindrical shaft can be turned more easily (use greatest possible lever arm);
- Turn the hand lever of the HWK 180° counterclockwise until it stops (unlock). Now HWK and HWA can be pulled apart in the axial direction;
- Move the hand lever (3) to the "opened" position. It cannot snap in when in this position. The HWK and HWA parts can be pushed inside one another in this position;
- Turn the hand lever of the HWK 180° clockwise until it stops (lock). Locking becomes effective;
- Turn the hand lever of the HWK 90° and allow it to snap in.

**WARNING:**

1. Risk of injury due to unexpected movements;
2. Only open the tool changer if no load is gripped;
3. Make sure the tool will not fall out when unmounting it. This can be prevented by moving to Tool Change Position or a similar upside-down tool position.

**CAUTION:**

1. When mounting a tool, ensure that the lever is properly closed and the tool secured before continuing operations;
2. Before mounting a tool, make sure the lever is in its open position.

**NOTE:**

1. When attaching electrical modules, it can be that the module (1) does not connect flush with the manual change adapter (2). In this case, a corresponding adapter plate must be made that compensates for any projection "A";
2. Any change to the tool changer is strictly forbidden and leads to warranty loss. For adding additional applications or stations, please contact the supplier or integrator.
3. The pins from the electrical modules must not be touched with any metal object. Any contact with metal might harm the robot.

More details on the manufacturer's site:

<https://schunk.com/fileadmin/pim/docs/IM0014955.PDF>

II.6 Point ZERO feature

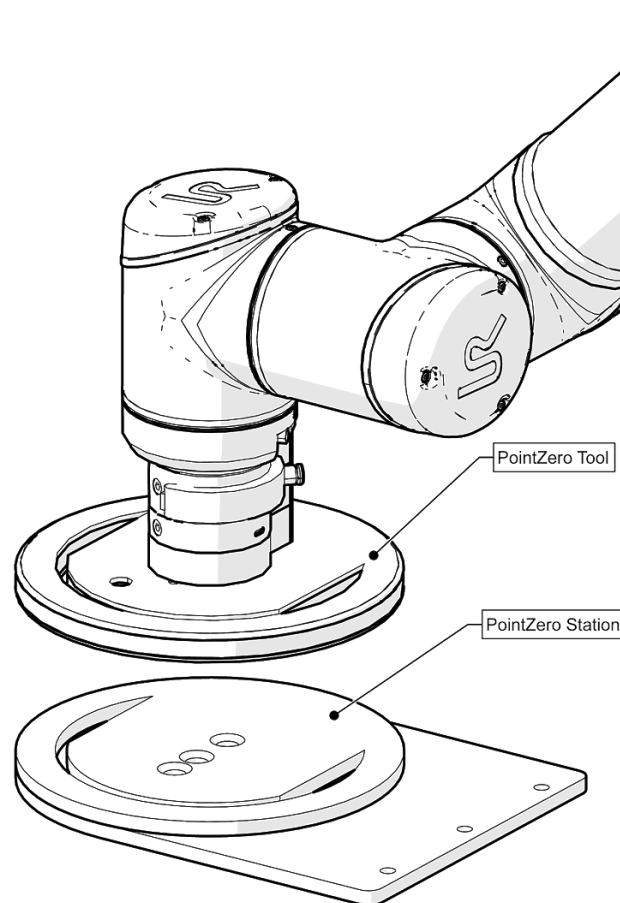
The “PointZERO” feature is a tool (software and hardware) that allows the user to place the mobile platform with a very high tolerance in position and orientation with respect to the station.

There is a specially designed tool that allows the software to properly calibrate the entire system before every application.

PointZERO hardware has two parts:

1. **PointZERO Station**, which is a fixed part of the station (conveyor, CNC, etc.) ;
2. **PointZERO Tool**, which is attached to the robot flange

Because of the special design characteristics of the tool, there is only one possible connection position between these two. The calibration can be performed after the two hardware parts are connected.



II.7 Transport Feature

Transport position feature must be used when the multipurpose mobile platform is moved from one station to another. Considering the robot is a rigid assembly when transporting the platform, vibrations that affect the robotic joints may occur.

The vibration dampening elements placed between the different sections of the arm and the position of the arm eliminates excessive movement of joints while transporting the platform.

II.8 Electrical interface

This section describes all the electrical interfaces of the robot arm and control box, including stations and all built-in sensors.

The list below are the different electrical interface groups:

- Station box;
- Built-in Sensors;
- The tool I/O;
- Ethernet;
- Status indicator;
- Main connection.

The term I/O refers to both digital and analog control signals going from or to an interface.

II.8.1 Station box

To supply Ovi with all utilities, there must be a fixed Station box for every application.

The Station box can be delivered either configured for a specific application (e.g., palletizing, machine-tending, sanding, etc.), or blank, which will be configured by the customer according to its industrial application.

On one side of the station box are located the following input modules:

- Power supply cable (100-230VAC, 50-60Hz);
- Pneumatic supply for the entire station (10mm quick connector);
- Ethernet connector (RJ-45).

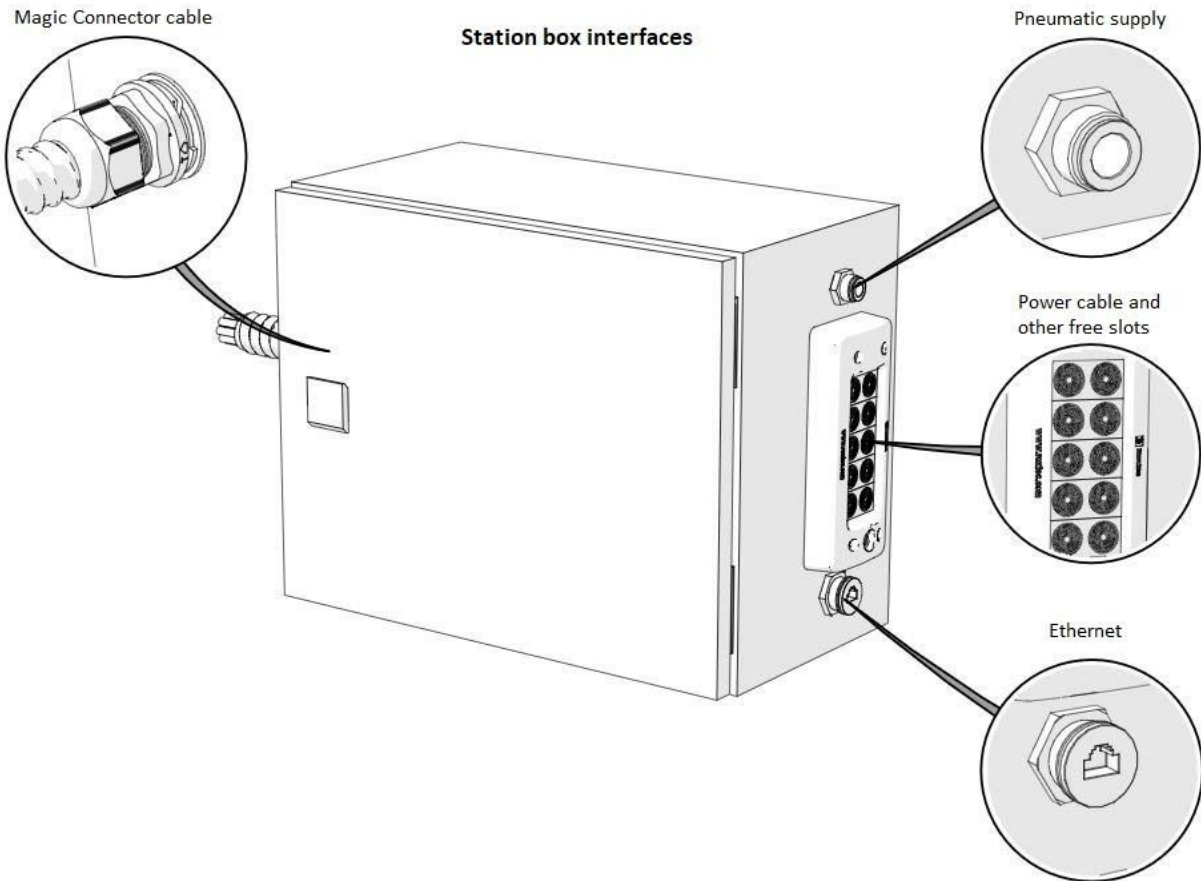
On the opposite side, there is a 3-meter utility cable, ending with the Magic Connector (presented in section ***“II.3 Magic Connector”***)

The configurable I/O from the robot control box and all built-in sensors of Ovi are connected inside the station box.



NOTE:

Any other industrial equipment that requires I/O communication with the robot must be configured from the station box **"IV.3 Electrical Procedures (I/O)"**.



**DANGER:**

1. Only supply voltages of 100-230 VAC, 50-60 Hz;
2. Make sure that all equipment remains dry. Electrical connectors are not rated for water exposure;
3. Use original cables supplied with Ovi only. Contact the supplier if longer or flexible cables are needed.

**CAUTION:**

1. Changes to the internal components of the station box are allowed for authorized personnel only;
2. Every station box configured for a specific application shall be used only for its designated application;
3. Station boxes can not be swapped. (e.g., the palletising station box can not be swapped with the sanding station box) If this happens, it will result in erroneous data or in data loss;
4. Use caution when manipulating the Magic Connector. Overbending or any other excessive external force directly applied can damage the utility cable.

**NOTE:**

All voltages and currents are in Direct Current (DC) unless otherwise specified.

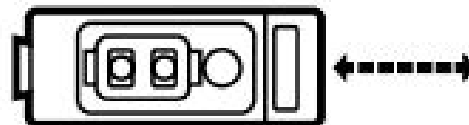
II.8.2 Built-in sensors

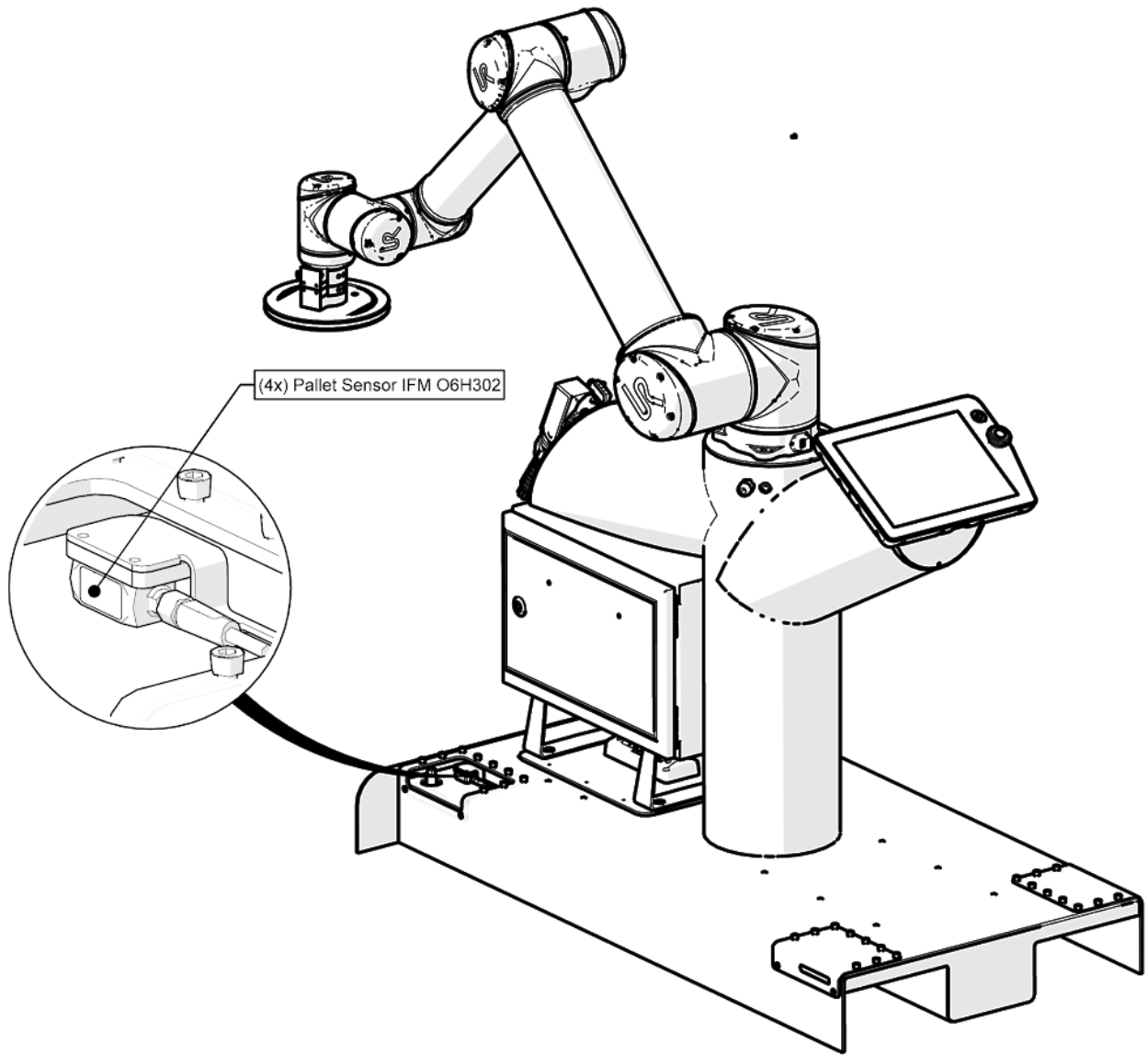
The product incorporates multiple capabilities and applications. Hence Ovi comes equipped with a multitude of sensors and signals.

Considering that for palletizing applications, pallets must be detected, Ovi has four **IFM O6H302** - diffuse reflection sensors with background suppression.

For this type of sensor, the transmitter and receiver are integrated into one stainless steel housing. The reflection of the light beam detects the objects according to the energetic or triangulation principle.

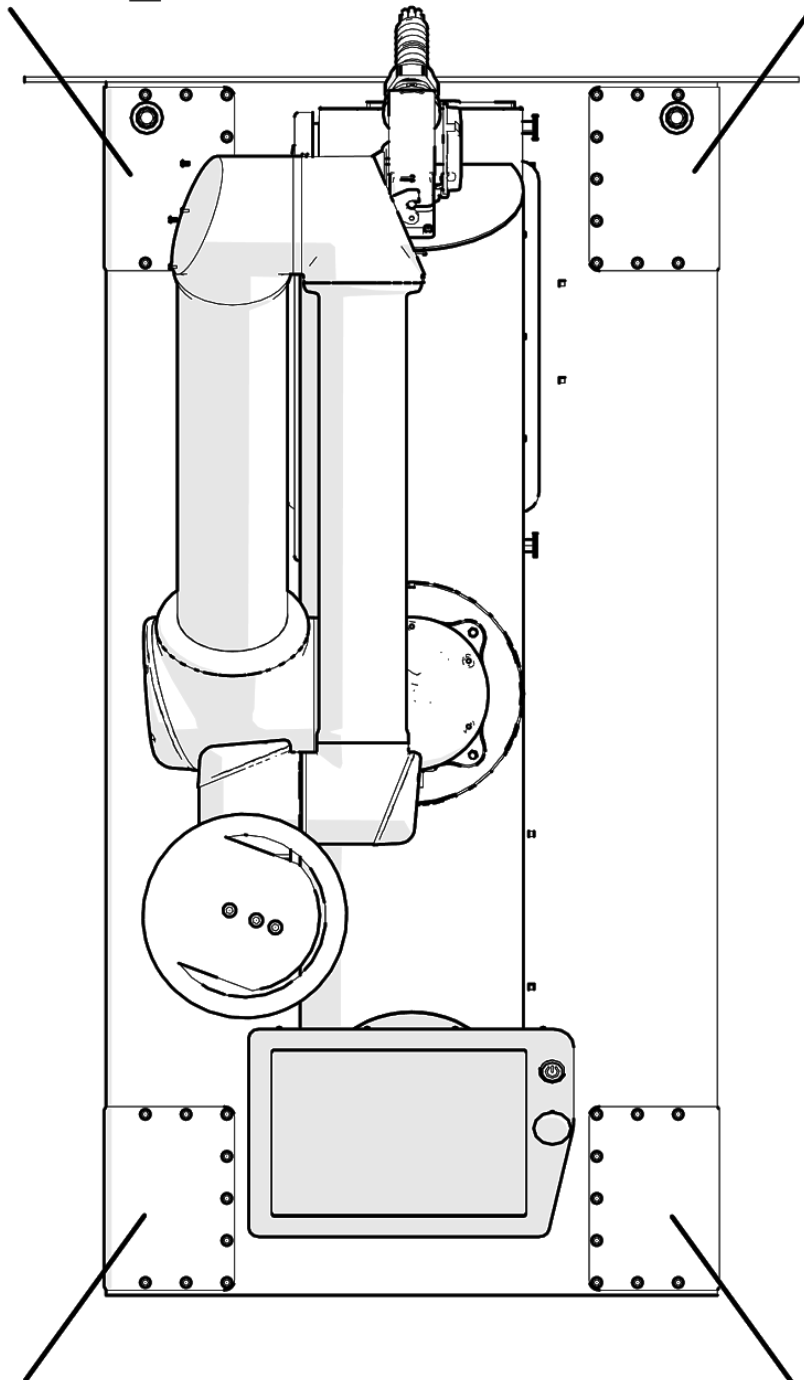
More details on the manufacturer's site: <https://www.ifm.com/us/en/product/O6H302>





Palletsensor_NW

Palletsensor_NE



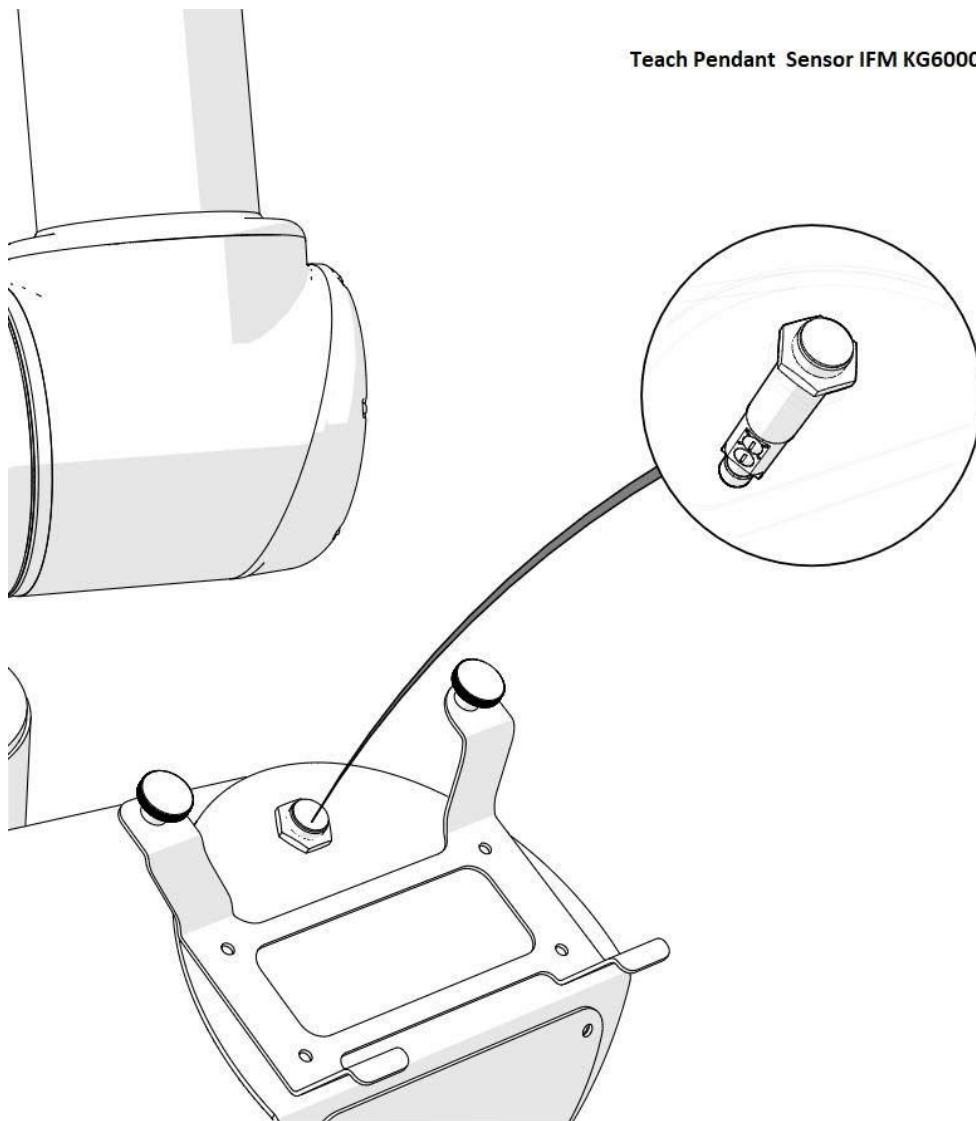
Palletsensor_SW

Palletsensor_SE

Ovi monitors the position of the teach pendant, which can be used by the operator as an extra safety feature.



An easily adjustable **IFM KG6000** capacitive sensor is used for identifying the Teach Pendant position.



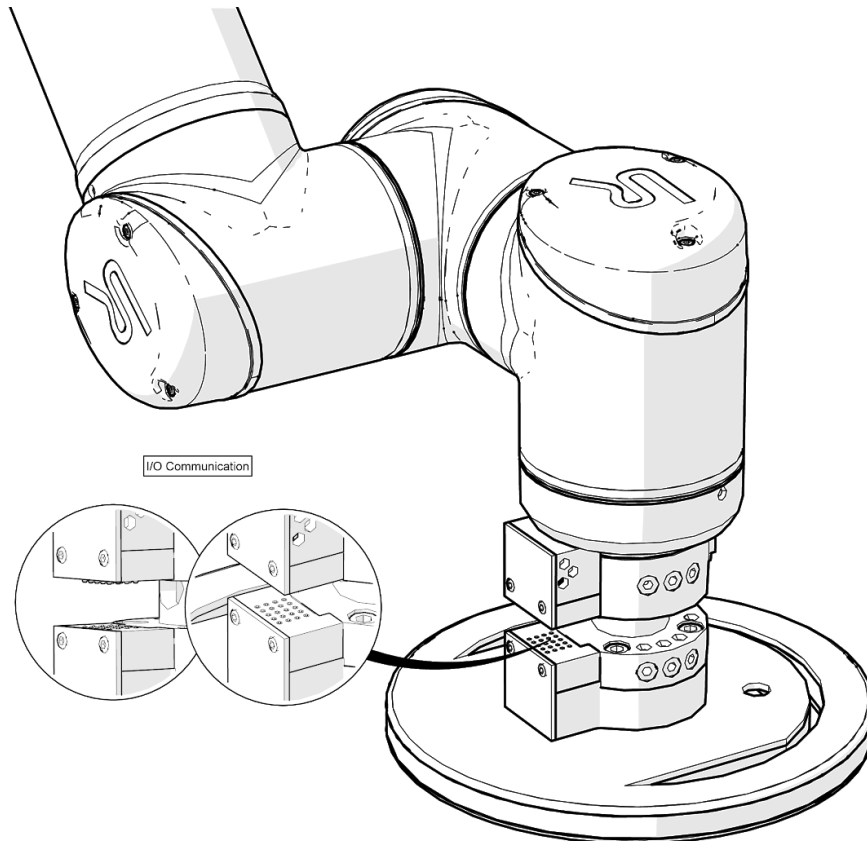
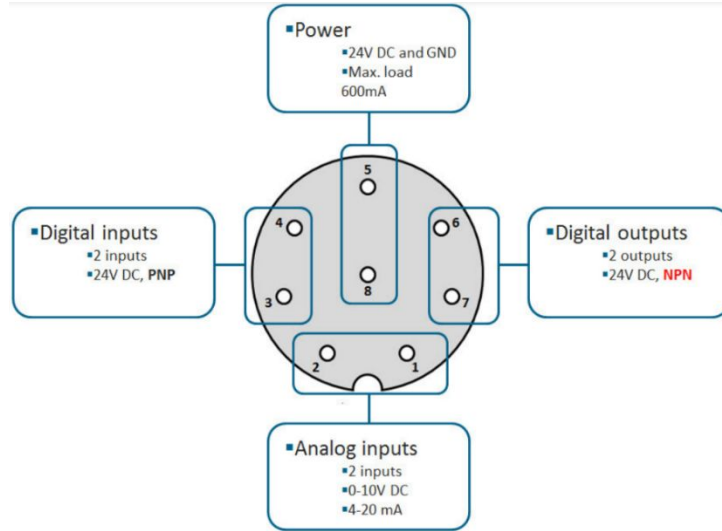
Teach Pendant Sensor IFM KG6000

More details on the manufacturer's site: <https://www.ifm.com/us/en/product/KG6000>

II.8.3 Tool I/O

The electrical cabling in the PointZero tool uses the pins that already exist on the UR10 flange; therefore, the tools that require I/O communication will use the same connector.

Tool pin layout:

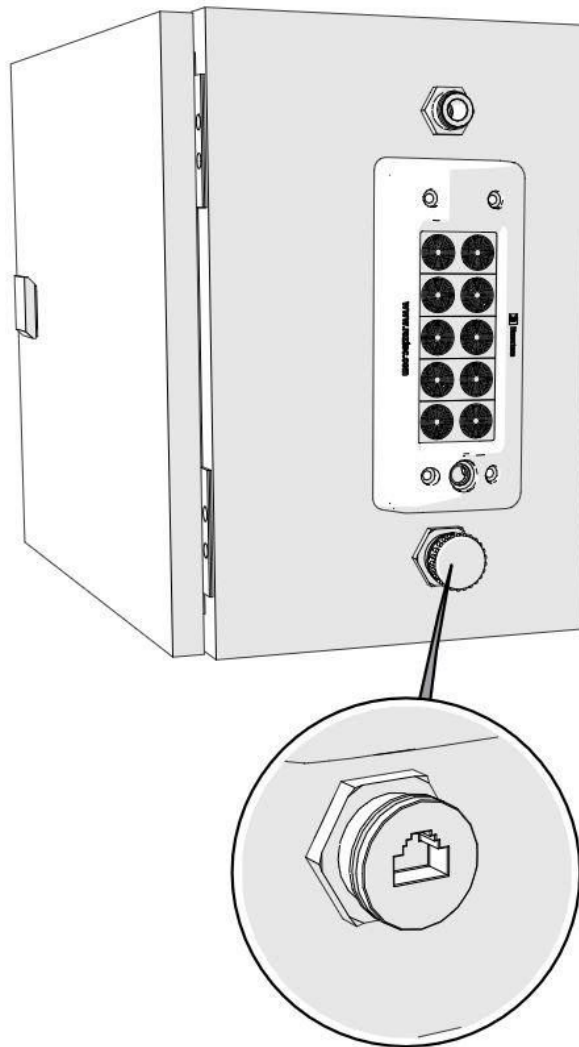


II.8.4 Ethernet

The Ethernet interface can be used for:

- MODBUS, EtherNet/IP and PROFINET (check UR manual);
- Remote access and control.

To connect the Ethernet cable plug it into the Ethernet port on the side of the Station Box.



The electrical specifications are shown in the table below:

Parameter	Min	Typ	Max	Unit
Communication speed	10	-	1000	Mb/s

II.8.5 Main connection

Main connections are represented by two interfaces:

1. Connection of the station box with all utilities;
2. Connection of the Magic connector to Ovi, see section "*IV.1.4 Connection procedure of Ovi to Station Box (Magic Connector)*".

The connection is considered to be complete when the two above mentioned procedures are done.

III. Software Interface

III.1 Introduction

The Ovi software package has been developed to run in PolyScope, which is the Graphical User Interface on the Teach Pendant that operates the Robot Arm, Control Box, and executes programs.

The software package has two different interfaces, as follows:

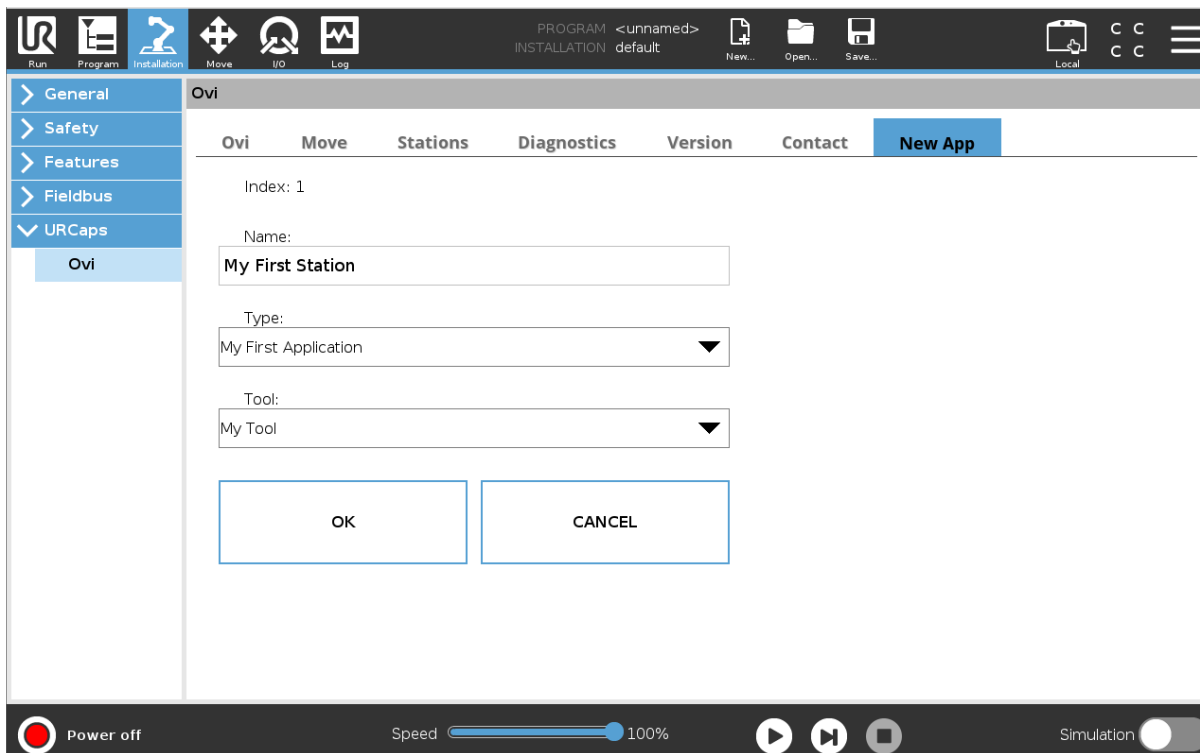
1. Ovi Installation node;
2. Ovi Program node.

III.2 Installation node

III.2.1 New App Tab

The installation node configures Ovi and contains multiple tabs. Before using the platform, a new application must be created and configured. New App Tab is shown automatically while no application has been configured for the station it is connected to.

In this tab, the user must input the station name and choose from the available station, application, and tools.

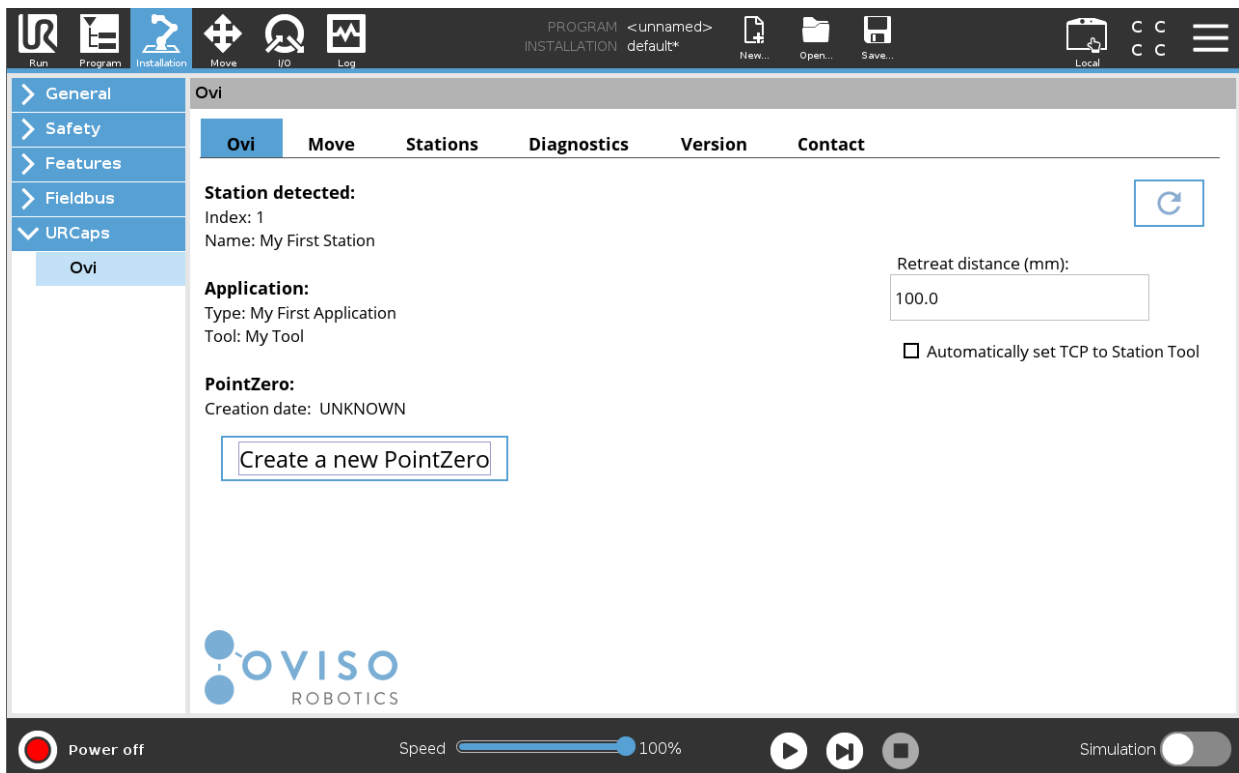


Once the application has been created and configured, the user can access the other tabs of the interface.

III.2.2 Ovi Tab

The Ovi tab contains all the information regarding station status with index and name, application type and tool, the button to create a new PointZero and the field to set the desired retreat distance that must be set by the user.

The procedure for creating a new PointZero is described in section **“IV.2 Software installation procedures/IV.2.1 New PointZero”**



III.2.3 Move Tab

The move Tab under Ovi installation node includes saved and predefined positions for quick use when needed.

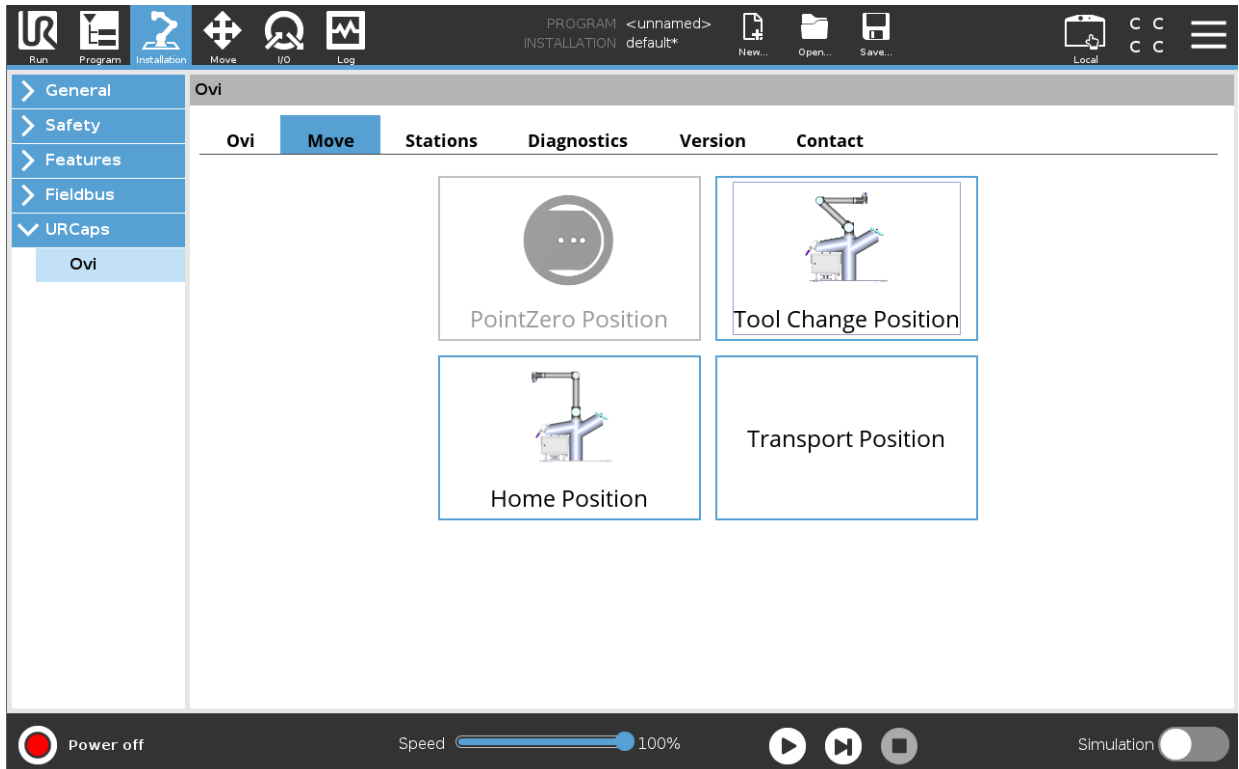
The following three positions are hardcoded and can not be changed by the user:

1. ToolChange Position;
2. Home Position;
3. Transport Position.

PointZero Position is the only one that varies depending on the station and previously saved Point Zero positions. Notice that PointZero Position button is inactive if the station is not registered and Point Zero has been created.

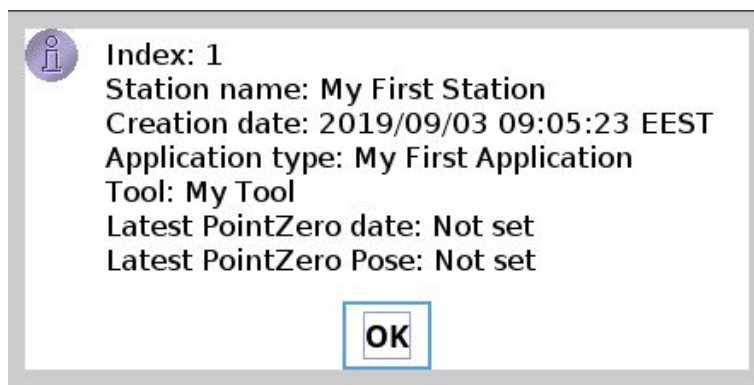
For calibration, follow the procedure described in section ***“IV.2 Software installation procedures/IV.2.1 New PointZero”***.

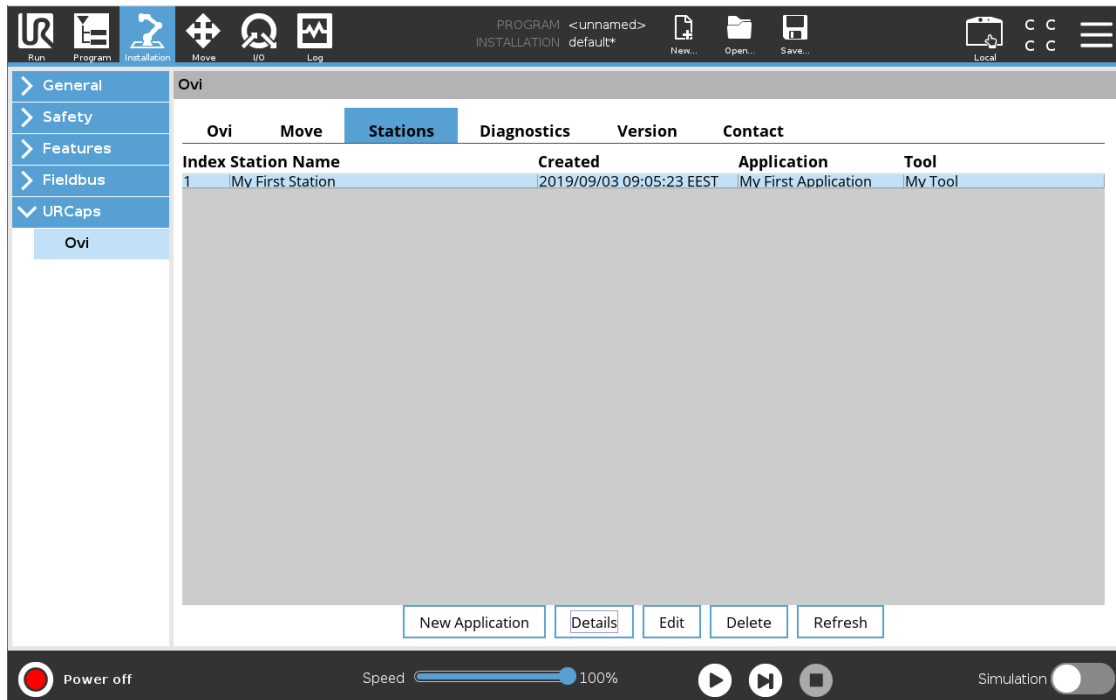
Once the PointZero calibration procedure is successfully completed, the position will turn active and ready for use.



III.2.4 Stations Tab

Under this tab, you can manage the stations already configured or create a new one. Information regarding Index, Station Name, PointZero timestamp, Application type, and tool are shown to keep track of stations. Stations are managed from the bottom menu by accessing the active buttons, namely: New Application, Details, Edit, Delete, and Refresh.





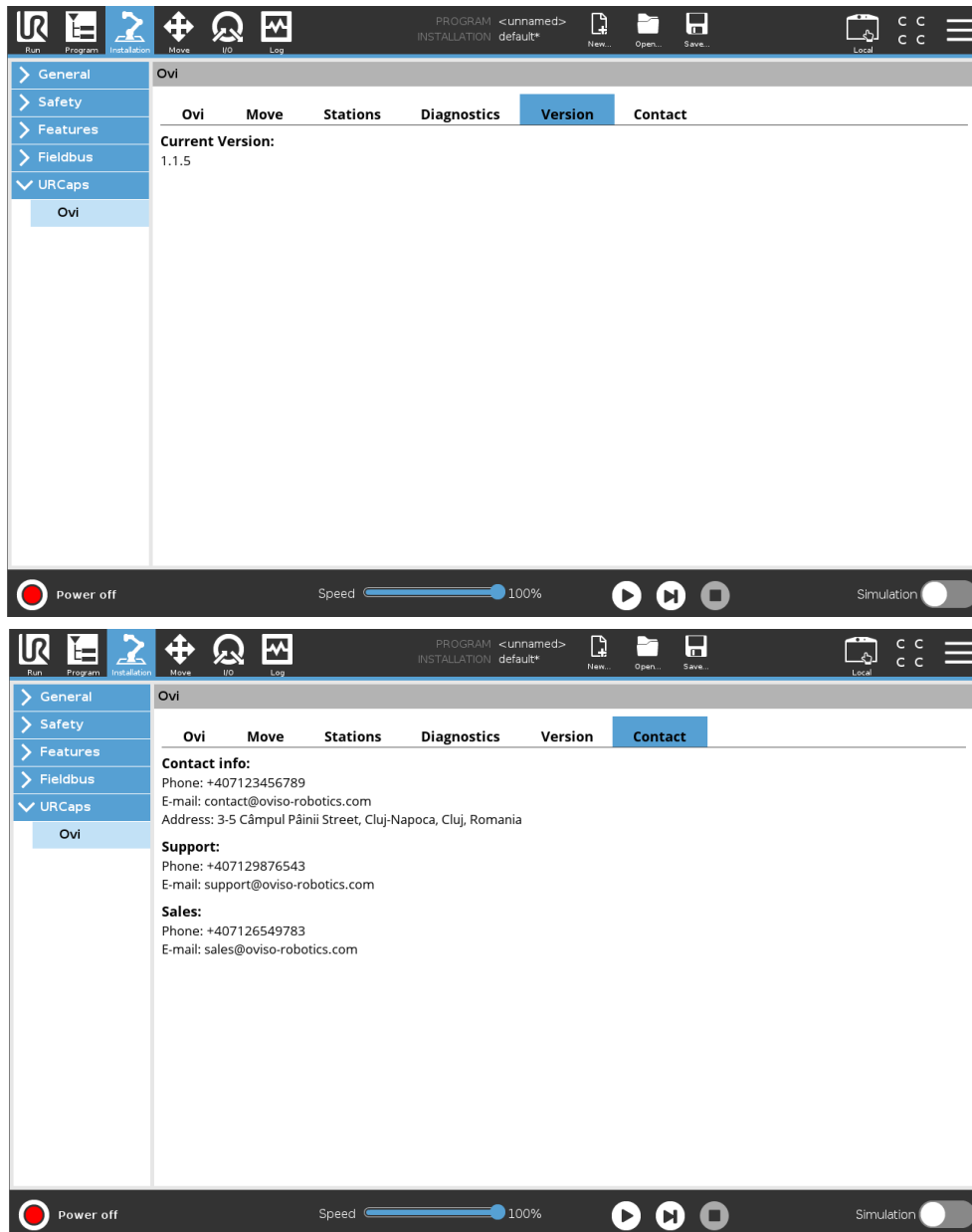
III.2.5 Diagnostics Tab

Under Diagnostics Tab, main data and utilities like Air Check, Internet Check, Tool Check, and Station Index are available to the operator.

When the tool is connected, it appears in the Diagnostics Tab with its name. In General -> TCP Tab the tool will appear with TCP position and orientation values. The user must check the payload and the center of gravity. The payload of the tool can be seen in the Initialize Tab and must be set for each tool.

III.2.6 Version and Contact Tab

These two tabs provide information about software version and contact details of Oviso Robotics.

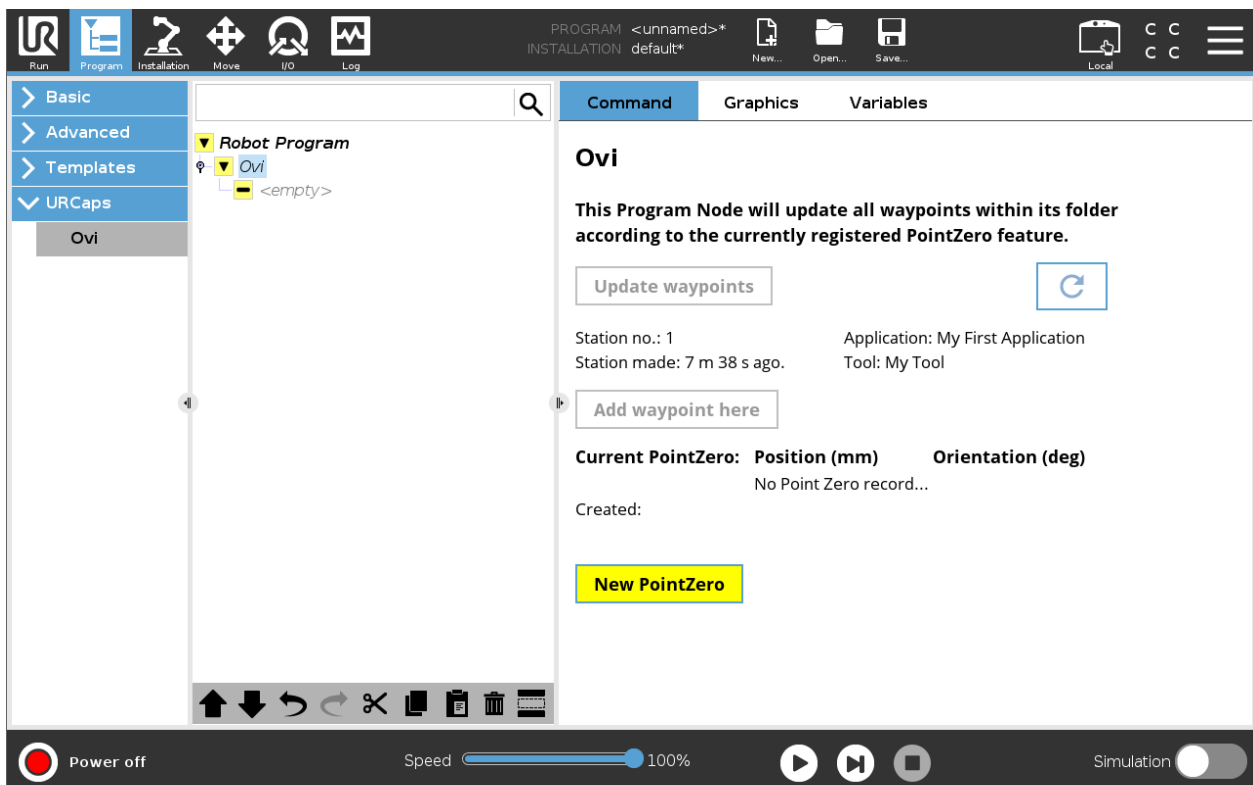


III.3 Ovi Program node URCap

The Program node will allow update of all waypoints within its folder structure according to the currently registered PointZero feature.

An empty Program Tree is not allowed to run. Improperly defined Program Nodes are highlighted in yellow to indicate what should be fixed before the program is allowed to run.

You must first create a PointZero in order to properly add waypoints. The procedure to create waypoints and how to update them is described in the section **“IV.2.2 Create & Update waypoints”**.



IV. Installation Procedures

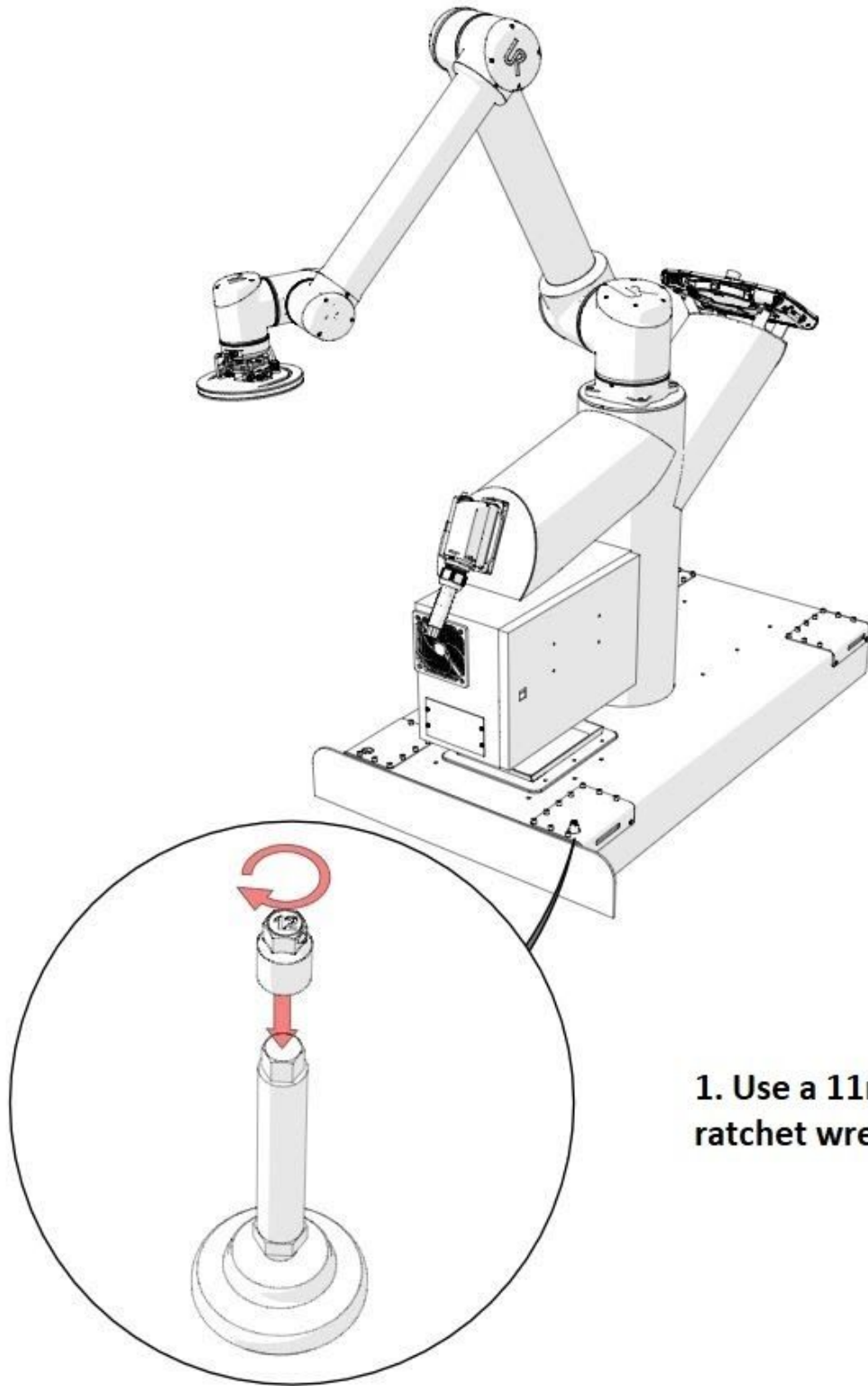
IV.1 Hardware Installation Procedures

The hardware installation is designed to be intuitive and straightforward for users with minimal knowledge in robotics.

When delivered, Ovi has the following individual modules:

1. UR10 (CB3 or E-series);
2. Metallic frame including control box;
3. Station box;
4. PointZERO Station;
5. PointZERO Tool.
6. Blank Tool Holder

IV.1.1 Metallic Frame adjustment

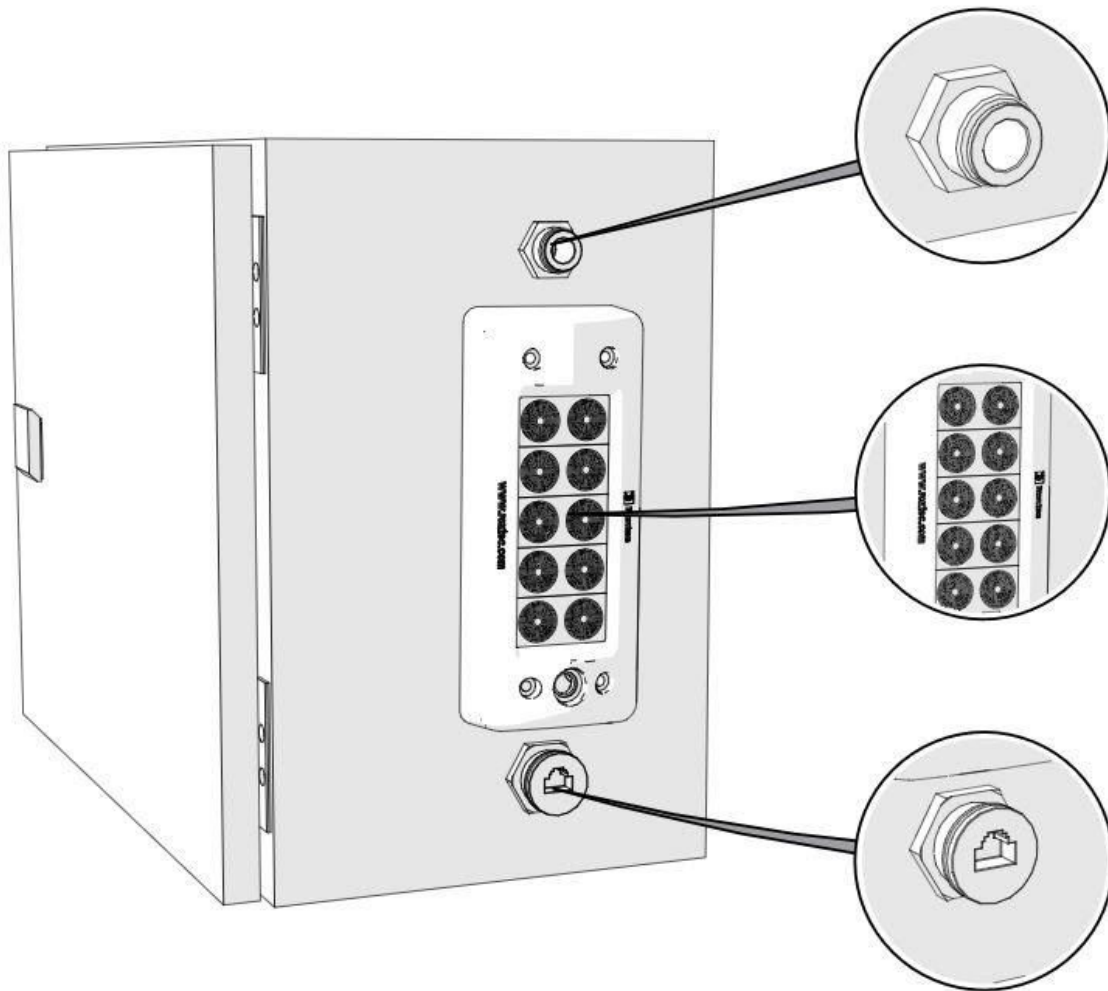


1. Use a 11mm ratchet wrench

IV.1.2 Installation procedure for Station Box

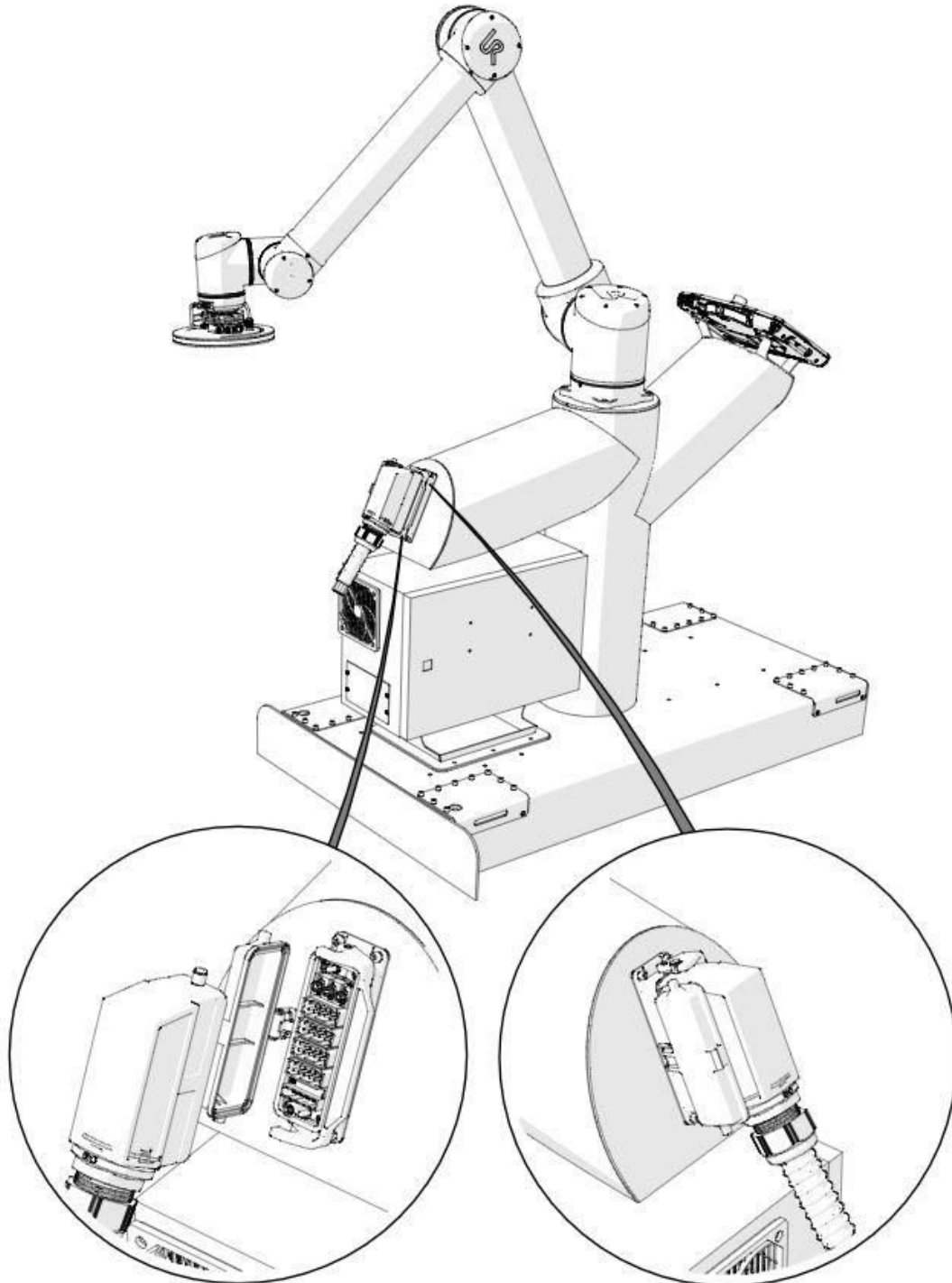
When installing the Ovi Station box, you must first connect the utilities: pneumatic supply, power, and ethernet.

Please note that there are free cable slots for interfacing multiple industrial types of equipment.



IV.1.3 Connection procedure of Ovi to Station Box (Magic Connector)

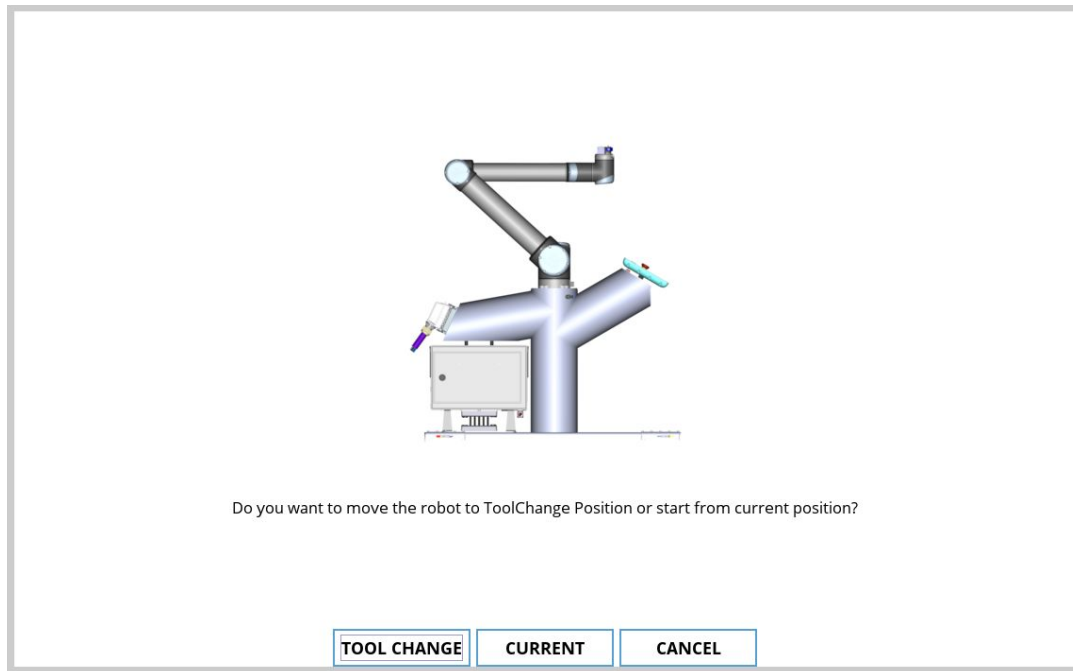
Plug the Magic Connector into the metallic frame's bulkhead and secure with the lever.



IV.2 Software Usage Procedures

IV.2.1 New PointZero

When creating a new PointZero, a popup message will ask you to choose if you want to “MOVE TO TOOLCHANGE POSITION” or “CONTINUE FROM HERE”.



CAUTION:



The robot movement is performed either Automatic or Manual. Check the UR Manual; section ***“14.4 Move Robot into Position.”***

NOTE:

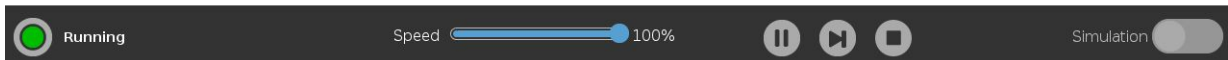
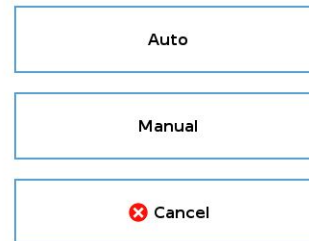
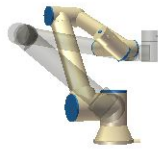


The Tool change position is a default position predefined by the manufacturer and can not be changed.

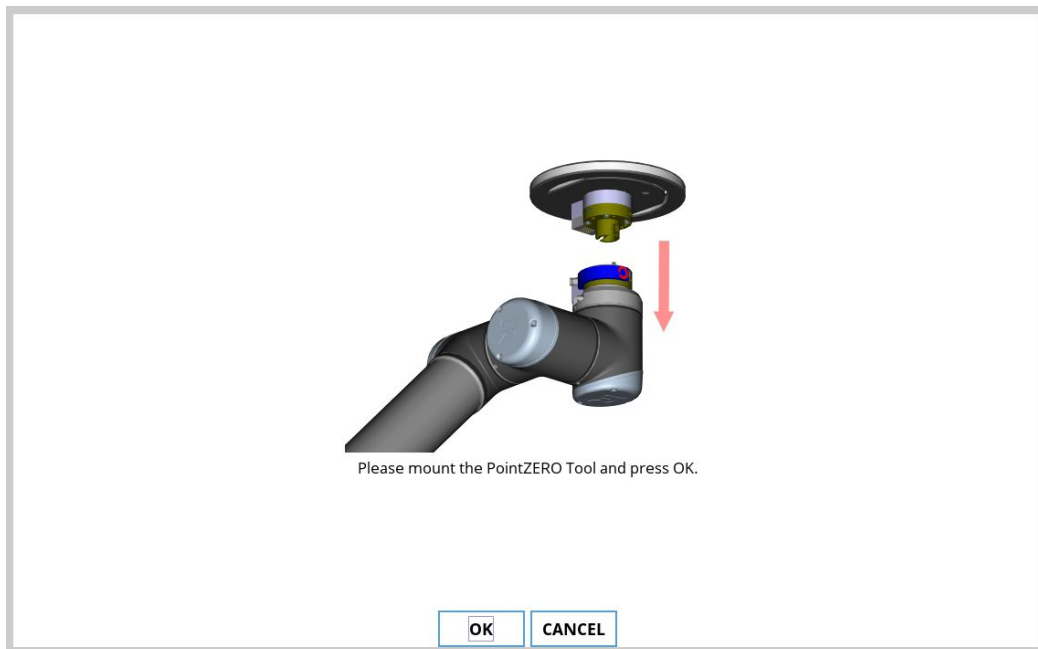


Move Robot into Position.

Hold down 'Auto' to perform the movement shown. Release the button to abort.
Push 'Manual' to move the robot into position manually.

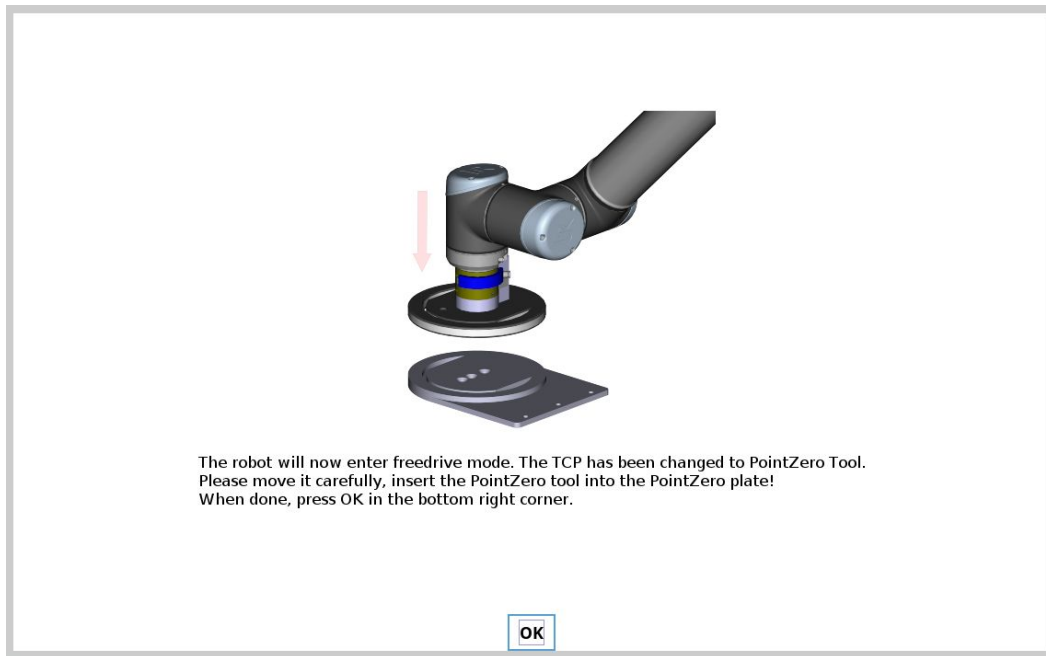


After performing the movement, a popup message will ask the user to *“mount the PointZero Tool and press OK.”*

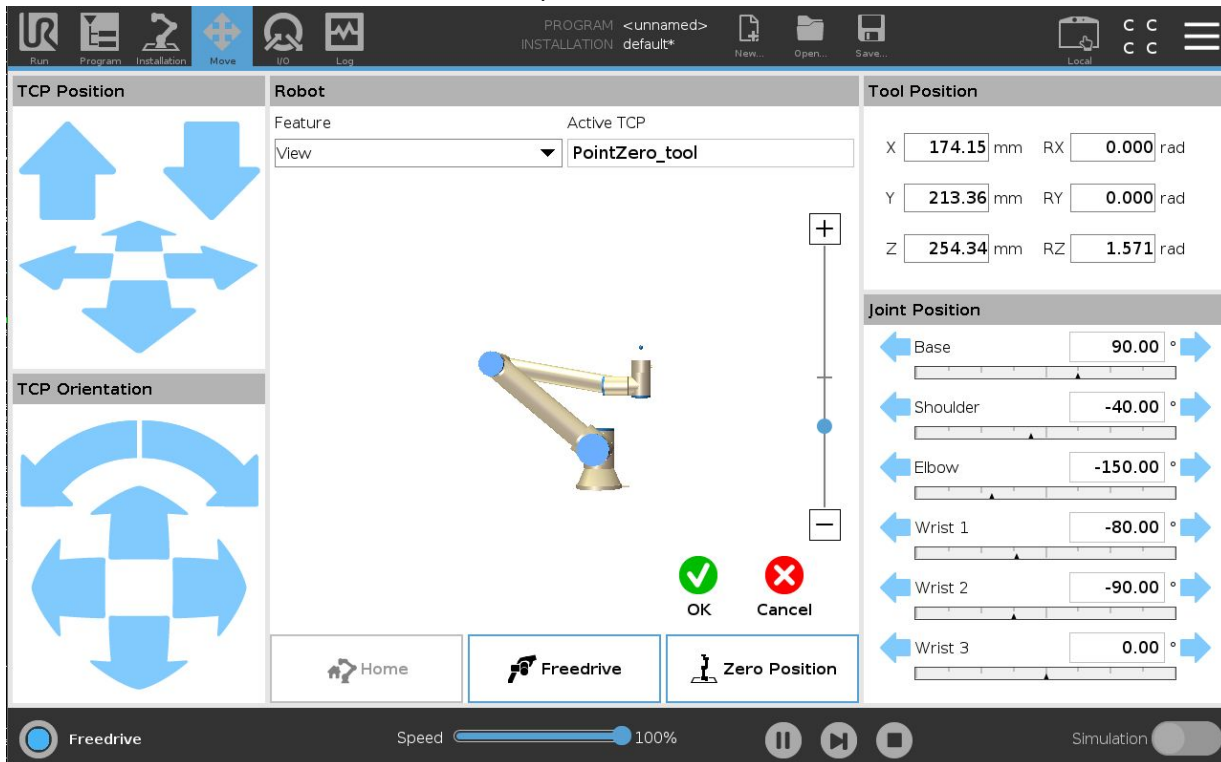


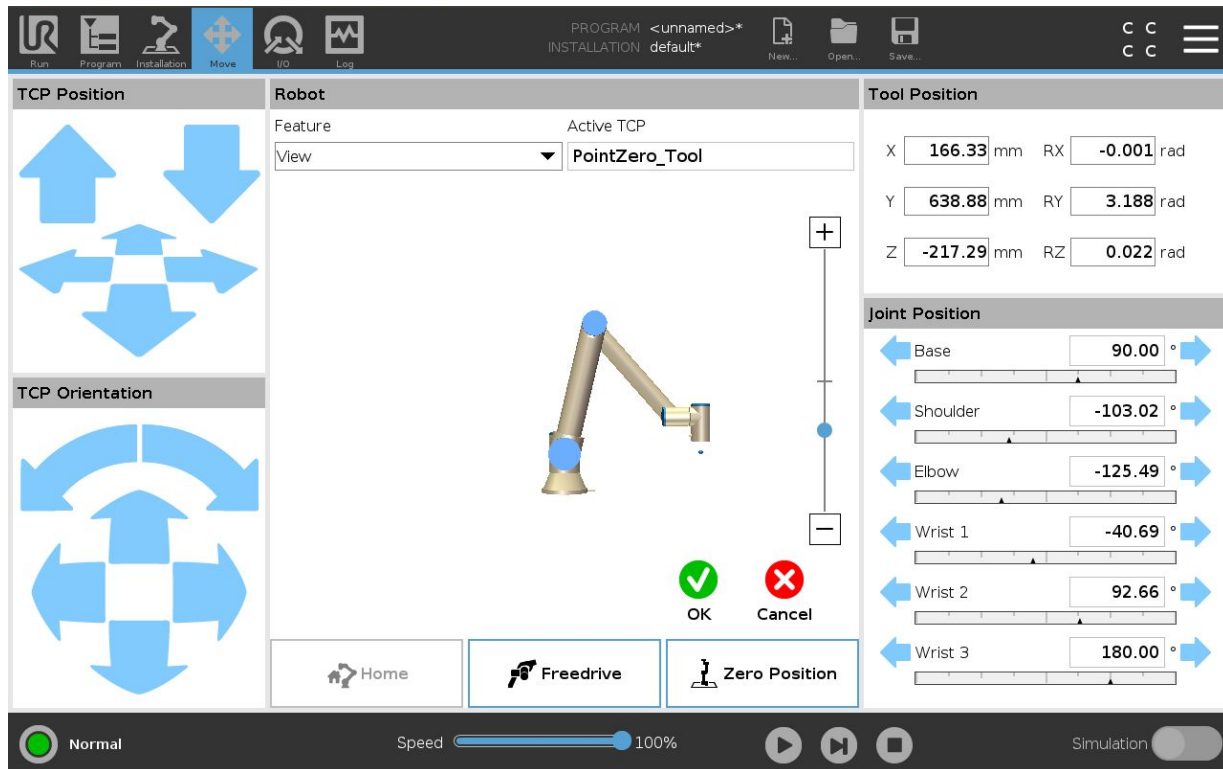
The tool is mounted using the QuickChange Shunk presented in section *“11.5 Manual Tool Changer.”*

An acknowledgment message will pop up on the Teach Pendant, informing the user that the robot will enter freedrive mode.



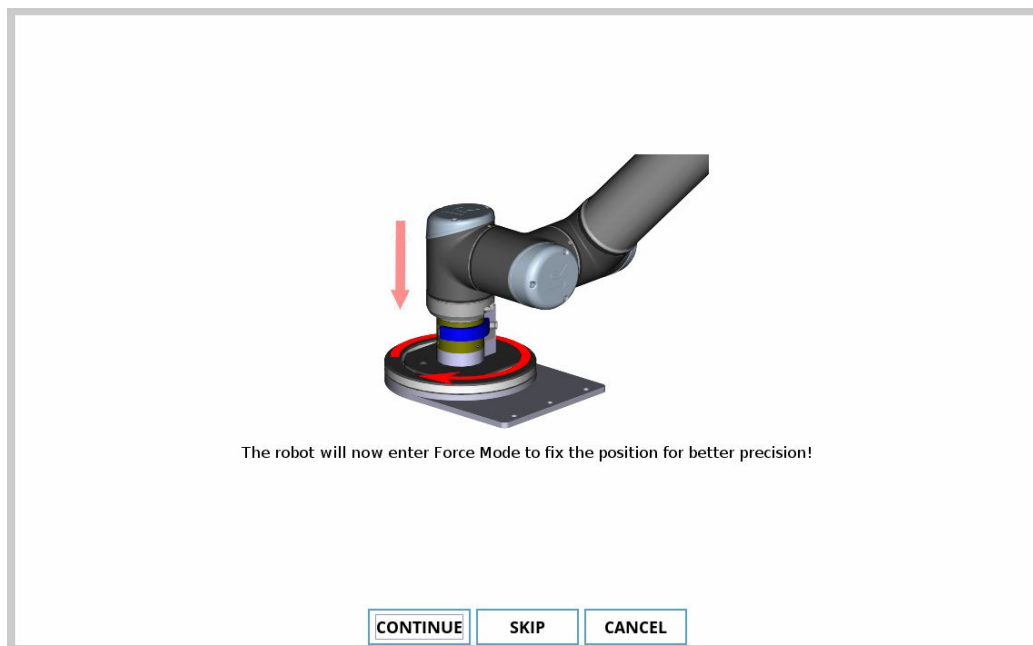
When entering Freedrive mode, the main screen will switch to **Move Tab**, and the user can move the robot arm into the PointZero plate.



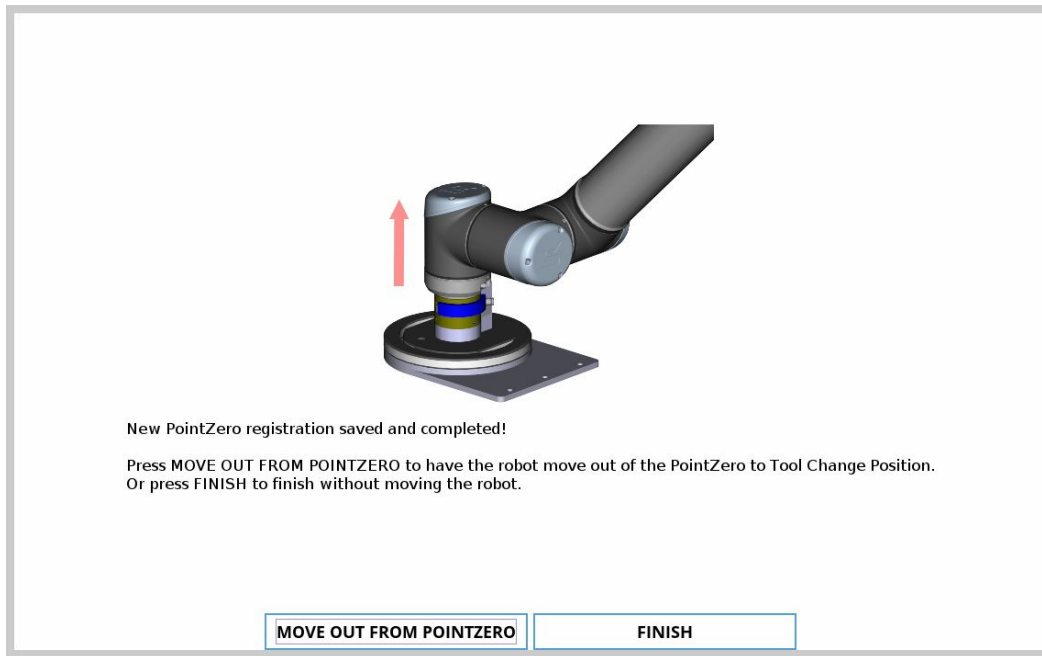


After the PointZero tool is connected with the PointZero plate, press OK, and the following pop-up message will appear on the Teach Pendant.

You can also skip this step, but it may affect the recalculation of waypoints, resulting in low precision.



When the procedure is complete, the new PointZero is saved, and you can move the robot to the predefined tool-change position, or finish the procedure and manually move the robot from Point Zero plate.



IV.2.2 Create & Update waypoints

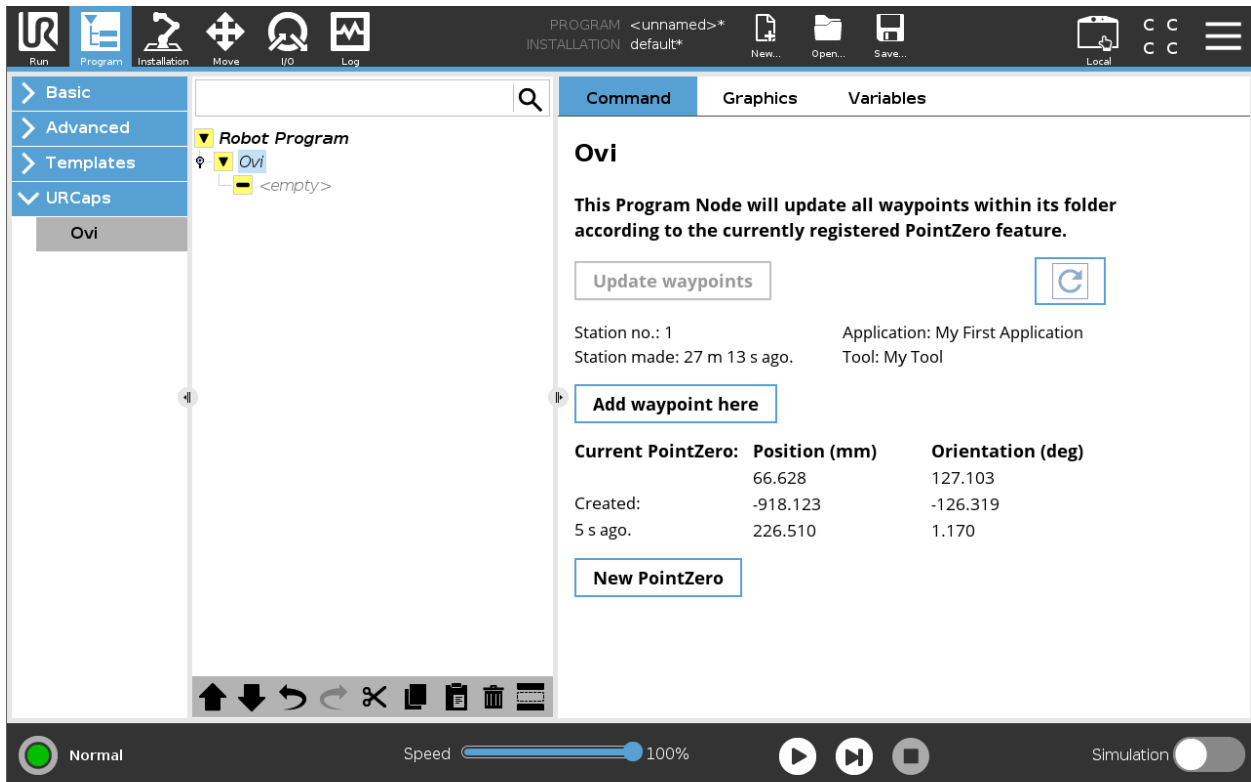
CAUTION:



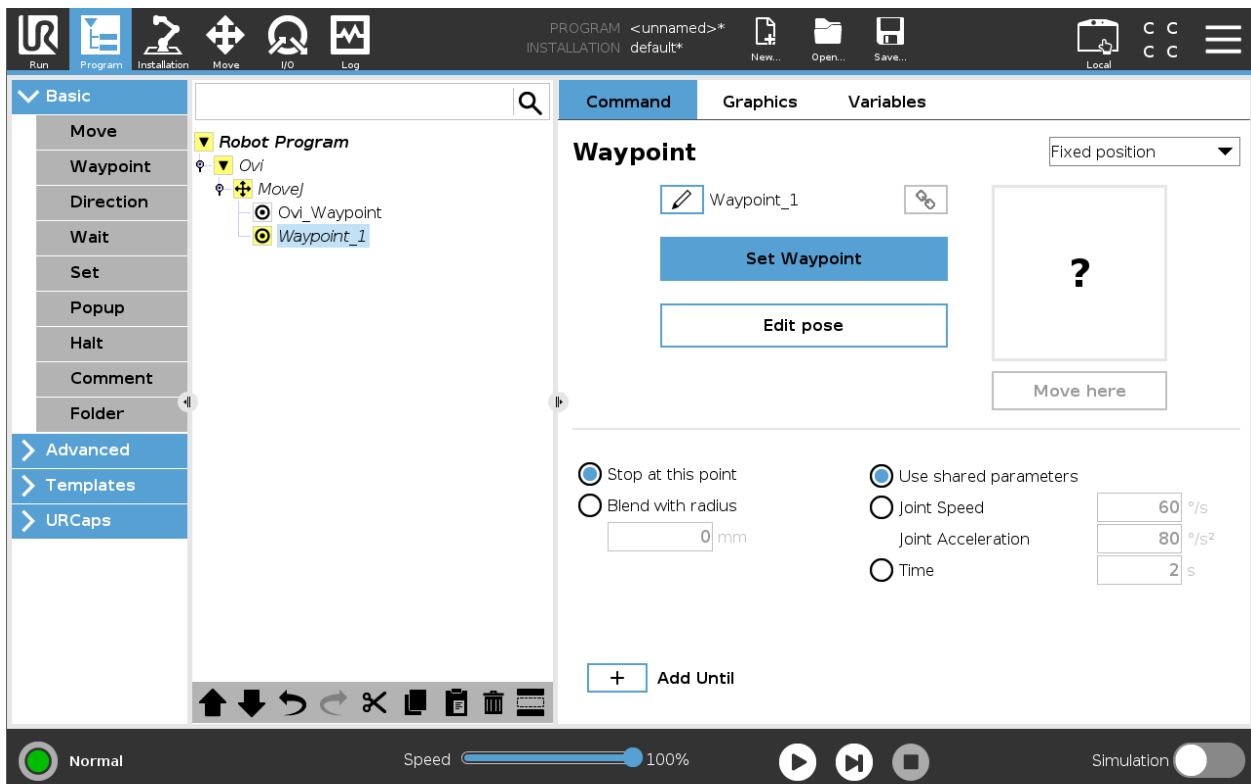
Ovi can only update Waypoints that are Fixed or created as Variable waypoints from the Ovi ProgramNode window.

They are transformed based on the recorded PointZero configurations. This means that 2 positions that are rotated 360 degrees from each other will result in them having the same Joint Positions.

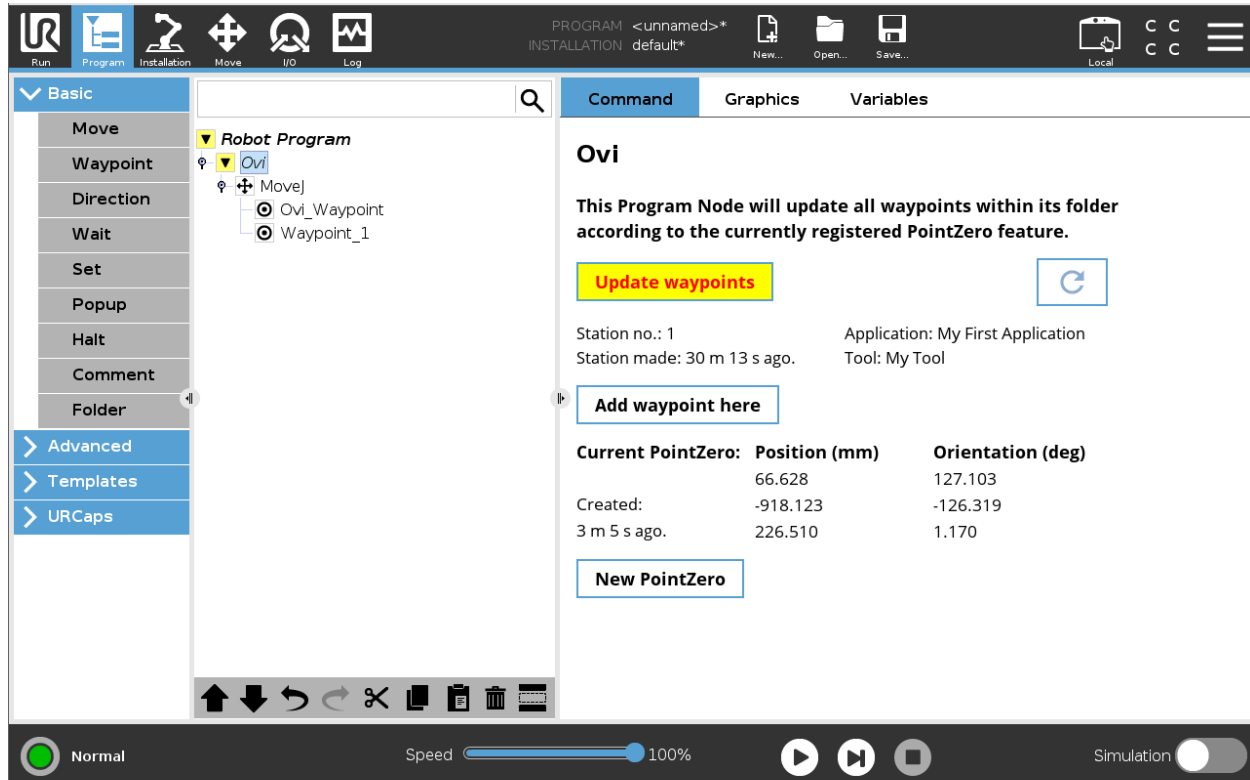
To create a waypoint, you should first create a new PointZero. Afterwards, the user can press the "Add waypoint here" button or add a fixed waypoint from the polyscope interface.



Selecting the newly created waypoint will show the waypoint configuration screen and the waypoint can be set.



When the robot is moved to a different station, running a different application, and then brought back to the initial one, a new PointZero must be created. Only afterward the program will enable the feature to Update waypoints.



On pressing the Update waypoints button, the waypoints will be transformed according to the new PointZero and the operator can start the program once all Ovi Nodes have been updated.



Although the updated waypoint poses may all be reachable, the new positioning of the robot may determine it to move from one waypoint to another through an area of singularity. This may cause unexpected movements and behavior. Therefore we recommend first operating the robot at a reduced speed in order to verify that all the movements are safe and that the program runs safely before starting normal operation.

IV.3 Electrical Procedures (I/O)

You can use the I/O inside the Station Box for a wide range of equipment including sensors, relays, PLCs, and emergency stop buttons.



CAUTION:

All I/O must be connected in the Station Box due to the Magic Connector built-in communication.



NOTE:

Check the UR manual for a detailed description of Control Box I/O setup, section **“5.4 Controller I/O”**.

The illustration below shows the layout of electrical interface groups inside the Control Box of the robot.

Please note inside the Station Box are the associated I/O electrical interface groups as in the illustration below.

Safety		Remote		Power		Configurable Inputs				Configurable Outputs				Digital Inputs				Digital Outputs				Analog			
Emergency Stop	24V	■	12V	■	PWR	■	24V	■	24V	■	0V	■	0V	■	24V	■	24V	■	0V	■	0V	■	Analog Inputs	AG	■
	EI0	■	GND	■	GND	■	CI0	■	CI4	■	CO0	■	CO4	■	DI0	■	DI4	■	DO0	■	DO4	■		AI0	■
	24V	■	ON	■	24V	■	24V	■	24V	■	0V	■	0V	■	24V	■	24V	■	0V	■	0V	■		AI1	■
Safeguard Stop	EI1	■	OFF	■	0V	■	CI1	■	CI5	■	CO1	■	CO5	■	DI1	■	DI5	■	DO1	■	DO5	■	Analog Outputs	AG	■
	24V	■					24V	■	24V	■	0V	■	0V	■	24V	■	24V	■	0V	■	0V	■		AG	■
	SI0	■					CI2	■	CI6	■	CO2	■	CO6	■	DI2	■	DI6	■	DO2	■	DO6	■		AG	■
	24V	■					24V	■	24V	■	0V	■	0V	■	24V	■	24V	■	0V	■	0V	■		AG	■
	SI1	■					CI3	■	CI7	■	CO3	■	CO7	■	DI3	■	DI7	■	DO3	■	DO7	■	AO0	■	
																							AO1	■	