INNOVATELIA
Industrial Technologies

UWeld

User Manual
URCap Interface

INNOVATELIA SOLUCIONES
17/10/2024
Version 1.6

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1. ABOUT THIS DOCUMENT

1.1 Safety Indications

	The instruction manual is part of the equipment and must be handed over and kept along with it. Carefully read this manual, as well as those for each specific machine or component before performing any type of handling of the equipment. This manual must be read by all persons authorized to intervene in any way in the handling of the equipment.
	The operator has the following prior obligations: -Maintain safety prescriptions during the operation of the equipment (collaborative robots/welding machines). -Use the collaborative robot correctly in accordance with established safety regulations. -Maintain a level of safety and hygiene with respect to the equipment.
	The use of welding machines and collaborative robots under NOT PROVIDED and/or PROHIBITED conditions by this manual and the standards ISO 10218-1/-2 (safety in industrial robot systems) and NOM-027-STPS (safety and hygiene in cutting and welding work) can pose serious hazards to the user, other people, and other equipment around the machinery, as well as to the equipment itself.
	To ensure user's safety and comply with the standards established by NOM-027-STPS regarding workplace safety, it is essential to use appropriate protective equipment during welding applications. This equipment includes, but is not limited to, welding helmets, protective gloves, heat-resistant aprons, and safety glasses. Refrain from directly touching the torch, the workpiece, and/or the nests and fixtures in contact with the process after welding, as they may be at high temperatures and pose a risk of severe burns. Always remember to follow the safety regulations established in NOM-027-STPS to ensure a safe and protected working environments for all personnel involved in the operation.

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IN CASE OF ACCIDENT:

In the event of a collision, the collaborative robot will stop moving and cease welding (if it was welding at the time of the collision). Attend to any injury that may result from the collision.

In case of burns, fever, discomfort due to the welding process, or a severe robot collision, immediately call emergency medical services (phone 911) or the phone number assigned by the company's HSE department for such cases.

1.2 Disclaimer

The manufacturer, INNOVATELIA SOLUCIONES, is not responsible for equipment failures or damages caused by it in cases where its handling or maintenance does not comply with the instructions provided in this manual, as well as in cases where the equipment has been used for purposes other than those for which it was designed.

Under no circumstances may the user perform unauthorized interventions on any aspect of the equipment. Any attempt by the user or unauthorized personnel to disassemble or modify the equipment without prior validation from INNOVATELIA SOLUCIONES will exempt the latter from all responsibility for any damages to persons, other devices, or other affected properties.

1.3 General Manufacturer Information

INNOVATELIA SOLUCIONES is a company dedicated to the integration and commercialization of welding focused industrial solutions.

The software (UWeld URCAP) covered by this manual is developed by:

INNOVATELIA SOLUCIONES

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2. UWELD URCAP: GENERAL DESCRIPTION

2.1 Introduction to Interface Operating Principle

UWeld is a software designed for automated welding with a collaborative robot from Universal Robots, serving as a URCap interface that allows the robot controller to connect to Fronius welding machines (GMAW or GTAW) capable of remote control via I/O or Universal Robots digital communication protocols.

Since some Fronius welding power sources store 'jobs', which are welding parameters saved like a program, UWeld has the capability to utilize these jobs during welding applications to ensure the repeatability and quality of the weld beads.

UWeld also incorporates typical welding functions or techniques such as oscillatory motion (Weaving) and application of multiple weld passes (Multipass / Multilayer). Path trajectories can use variable waypoints, facilitating integration with external sensors like seam trackers.

The UTeach EOAT is an integral component of UWeld, designed to facilitate precise and efficient welding operations with Universal Robots. The tool features a robust design with the following key elements:

- EOAT Body including three buttons:
  1. Freedrive Button: This button activates the Freedrive function of the robot, allowing the operator to manually move the robot to the desired position with ease.
  2. Linear Waypoint Recording Button: Pressing this button records linear welding waypoints in the UWeld Trajectory node of UWeld, enabling the creation of straight welding paths.
  3. Circular Waypoint Recording Button: This button is used to record circular welding waypoints in the UWeld Trajectory node, facilitating the programming of circular welding paths.

Torch holding Arm: Attached securely to the EOAT body. The clamping arm's primary function is to hold the welding torch in place. This ensures stability and precision during the welding process.

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IMPORTANT NOTE:

This UTeach EOAT is specifically designed for the Fronius torch model mentioned in this document

By integrating these features, the UTeach EOAT allows operators to program welding paths quickly and accurately, enhancing the overall efficiency and quality of automated welding operations.

2.2 Identification of Key Elements

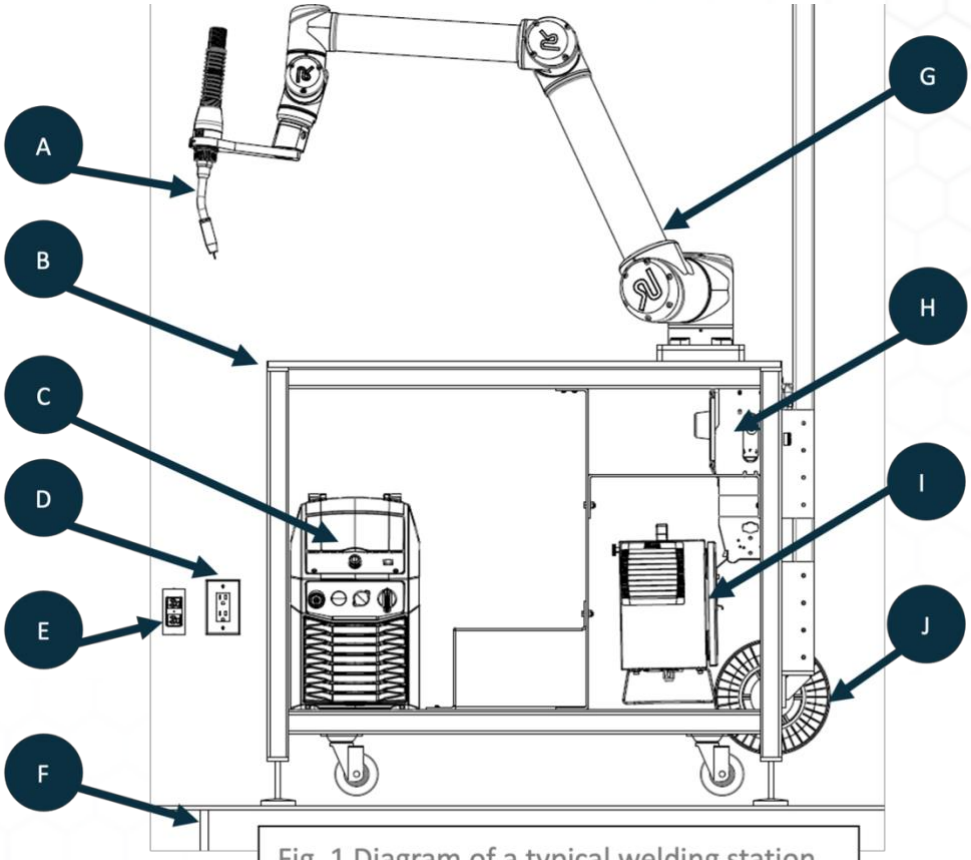

Fig. 1 Diagram of a typical welding station

IDENTIFIER	NAME	DESCRIPTION
A	EOAT UTeach	End-of-arm tooling for robot to mount torch and/or quick-action buttons.
B	Table	Welding application table.
C	Welding machine	Welding power source (any Brand capable of remote control), cab be GTAW or GMAW.
D	Single-phase socket outlet	Single-phase socket outlet (110 or 220 VAC) with a circuit breaker capacity of 10A for 220V or 15A for 110V, must include neutral and physical ground with impedance of 1 to 5 ohms.
E	Three-phase socket outlet	Three-phased socket outlet (220 or 440 VAC) with circuit breaker capacity depending on the welding power source

		capacity, must include physical ground with impedance of 1 to 5 ohms.
F	Grounding rod	Local physical grounding rod, at least 2 meters long, to ground the welding table.
G	Cobot	Universal Robots collaborative robot suitable for welding applications (UR10e, UR5e, UR10, etc.).
H	Feeder	Wire feeder (for GMAW or GTAW process with filler).
I	Control box	Robot control box, containing terminals and communication ports for welding power source control.
J	Spool	Welding wire spool.

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2.3 UTeach EOAT Parts

Below are the components of the end-of-arm tooling (EOAT) UTeach.

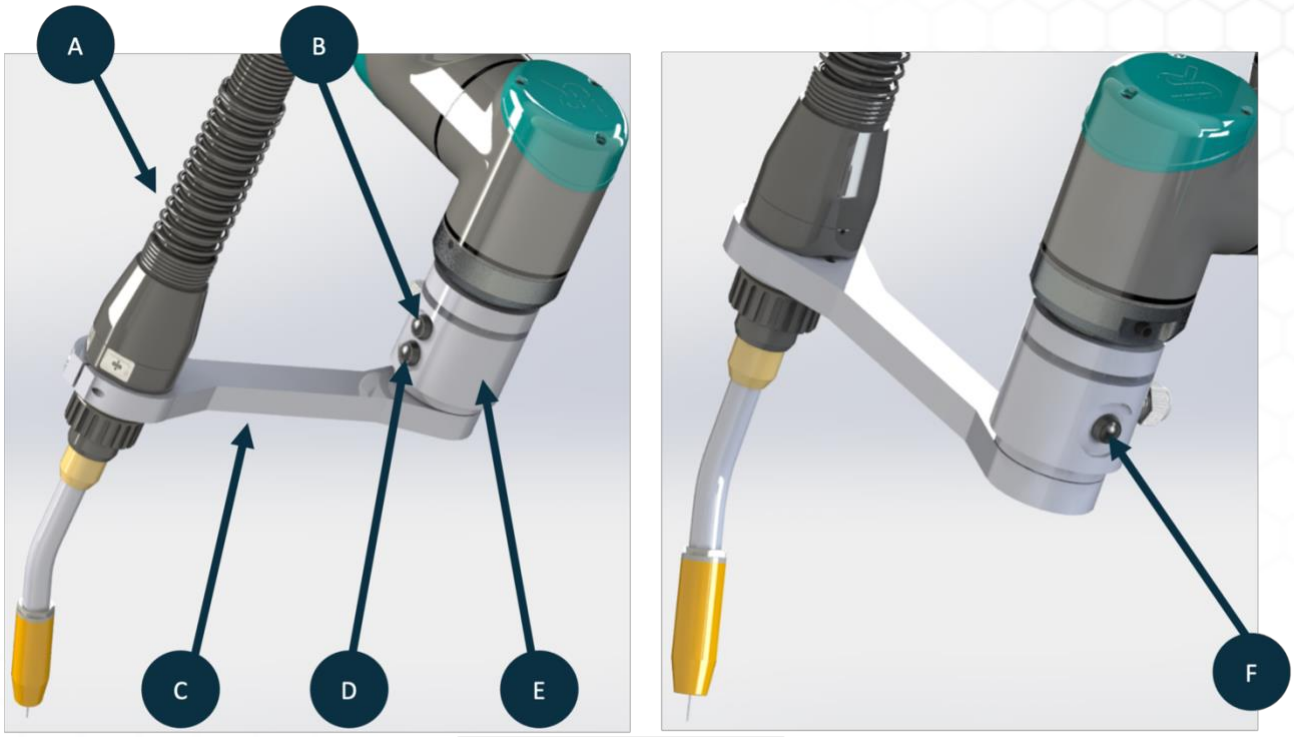

Fig. 2 UTeach EOAT

IDENTIFIER	NAME	DESCRIPTION
A	Torch	Welding torch for robotic application.
B	L Button	Push button for saving linear welding path waypoints (See *3.4 UTeach EOAT Assembly*)
C	Torch holding arm	Machined piece to hold the torch onto the UTeach body, this piece may differ in design depending on the torch used for the application.
D	C Button	Push button to save circular waypoints in welding path (See *3.4 UTeach EOAT Assembly*)
E	EOAT Body	Machined part for UTeach electronics, featuring the same drilling patterns as the Universal Robots tool flange, allowing any EOAT designed for a UR cobot to be mounted onto the UTeach body.
F	FreeDrive Button	Push button for activating FreeDrive mode on the robot.

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3. COMMISSIONING

3.1 Important Considerations for Assembly

If the user plans to place the collaborative robot on the welding table, make sure to mount it on a plate made of insulating material so that the robotic arm body is isolated from the welding current.

Ensure that the torch hose does not exert forces on the robotic arm that could alter its mass and center of gravity configuration. The most effective way to achieve this is by using a tool balancer, as shown in the following image:



Fig. 3 Typical setup in welding station

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3.2 Electrical Setup

Before proceeding with the configuration required to start using UWeld, ensure that the following key electrical installation considerations are addressed:

I. A stable AC voltage control is necessary to power both the robotic arm and the welding power source. Voltage spikes or drops can cause irreversible damage to the equipment.
II. For the collaborative robot, ensure that the single-phase socket voltage is within a range of 127 VAC +- 7 VAC or 220 VAC +- 8 VAC, according to the voltage regime at the site. It must include both neutral and physical ground with an impedance ranging from 1 to 5 ohms to ensure normal operation.
III. If the single-phase socket voltage does not fall within the allowed range, a voltage regulator with surge protection covering the appropriate voltage output range can be installed.
IV. For the welding power source, refer to the technical datasheet or consult with the manufacturer to ensure the voltage supply is appropriate. The three-phase socket must have a physical ground with an impedance ranging from 1 to 5 ohms.
V. A local grounding rod should be installed with a minimum length of 2 meters to ground the welding table/structure where the robot arm is mounted.

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Once these electrical installation considerations have been met, the tool connector voltage must be configured to output 24V to ensure proper functionality of UTeach as shown in the following image:

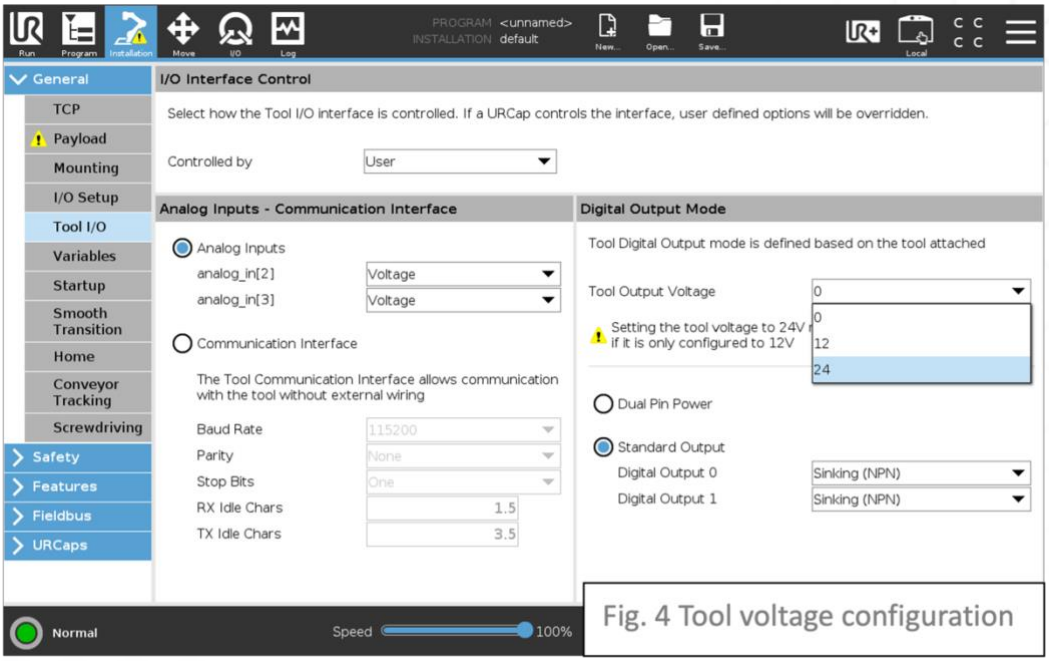

Fig. 4 Tool voltage configuration

After configuring the tool connector voltage to 24V, it will be necessary to set up the tool digital input 0, referred to as 'TI[0]', to activate the cobot's freedrive mode.

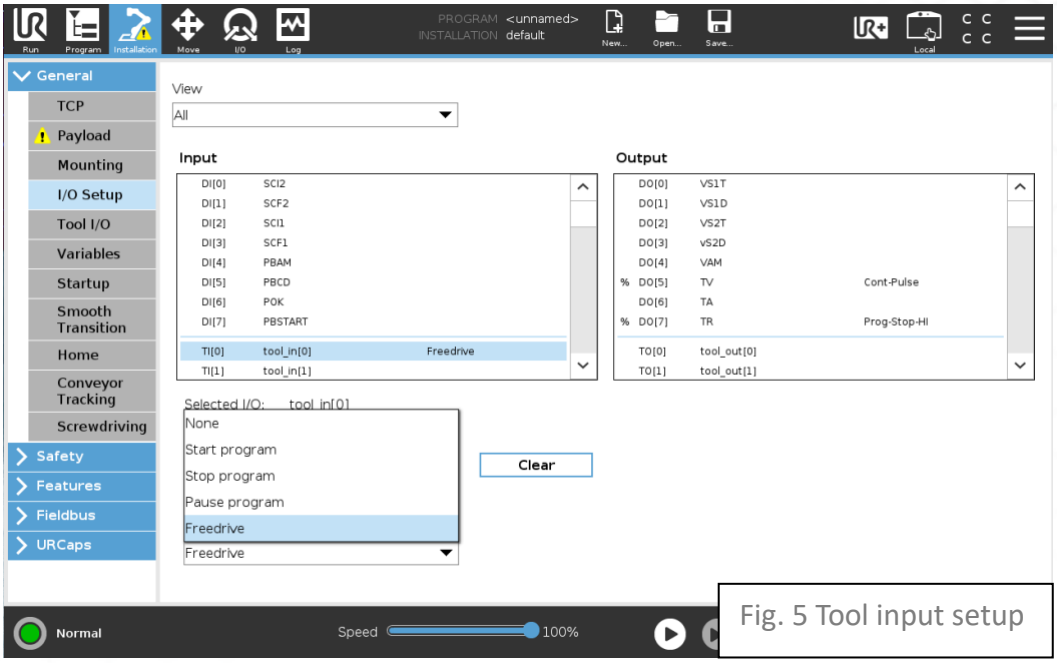

Fig. 5 Tool input setup

After completing the tool setup, it is recommended that the user save the installation as the default to maintain the UTeach functionality.

2.1 URCap Installation

This URCap interface does not require any special installation method. It should be saved on a USB storage device (formatted as FAT32) that the cobot can recognize. When this USB drive is connected to the cobot (Teach Pendant or Control Box), the user can select the URCap to install from the robot's configuration screen, as shown in the following figure:

IMPORTANT NOTE

The minimum required version of Polyscope to use UWeld is 5.13. Please note that this version of UWeld is only compatible with Polyscope 5 and does not work with Polyscope 3 or Polyscope X.

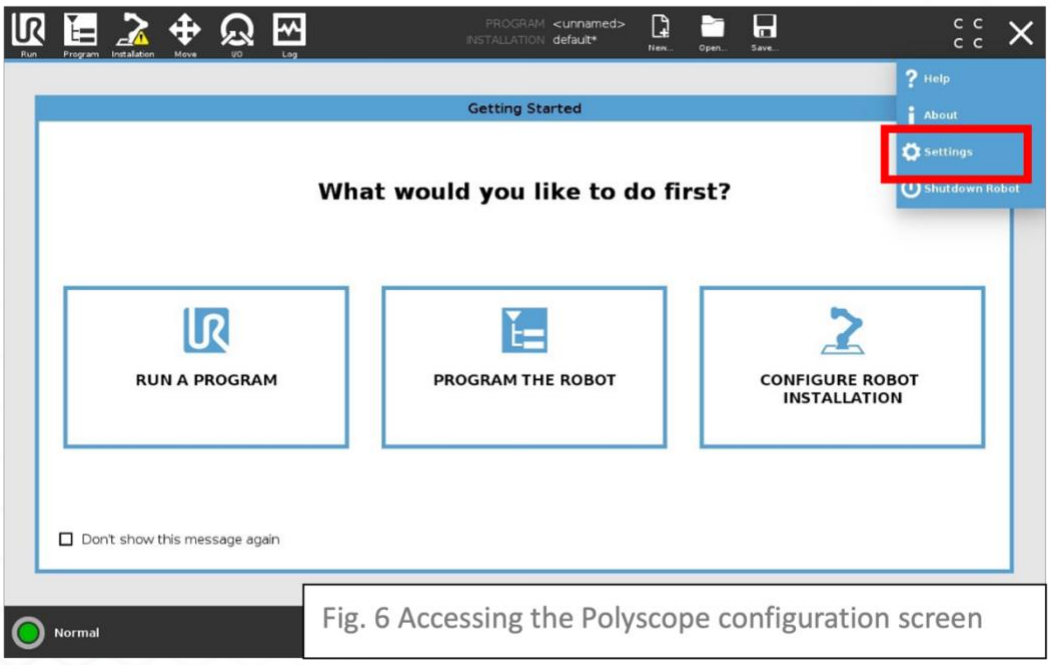

Fig. 6 Accessing the Polyscope configuration screen

Select the option System -> URCaps, then click on the '+' button to add the UWeld URCap.

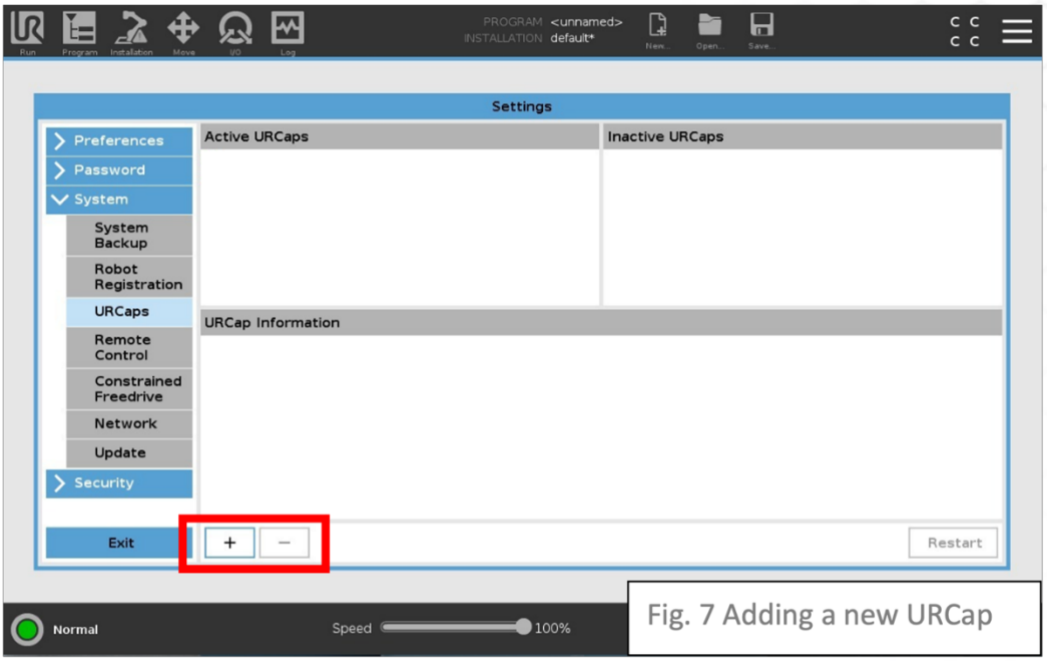

Fig. 7 Adding a new URCap

This window will appear, where we will need to select the best available version of UWeld.

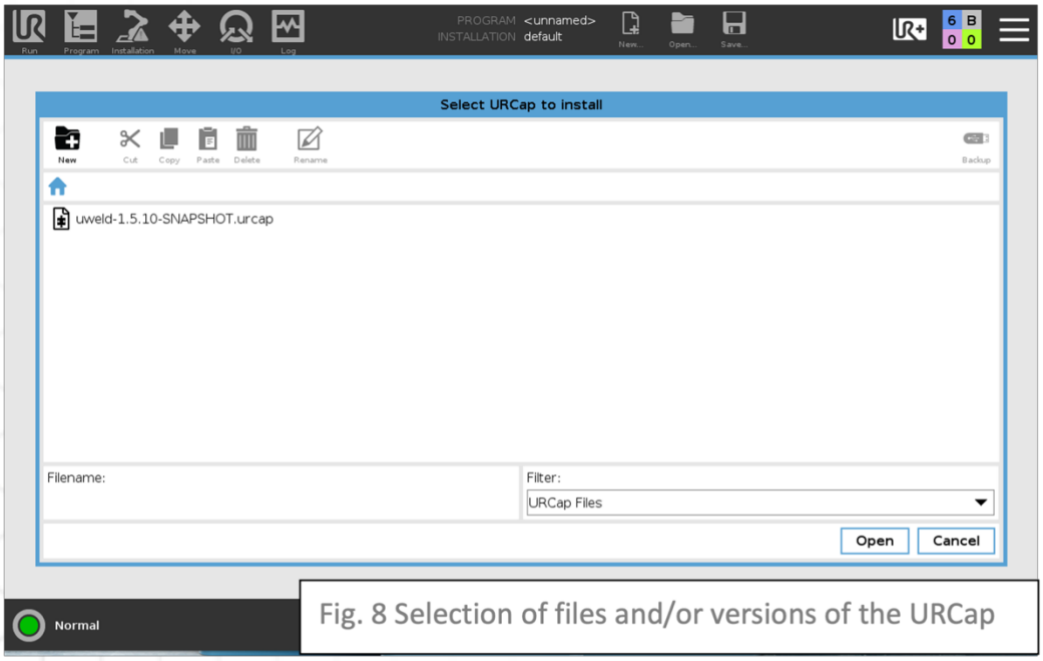

Fig. 8 Selection of files and/or versions of the URCap

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3.4 EOAT Assembly - UTeach

Here are the instructions for mounting and connecting the UTeach to the robot's tool flange.

1. The UTeach body (figure A) must be mounted onto the robot's tool flange (figure B). The user should tighten the cylindrical head M6x70 screws (figure C) with a torque value between 6 and 7.5 Nm. Additionally, the user must ensure that the faces of the 'L' and 'C' buttons are aligned in the same direction as the tool connector, as shown in the following image

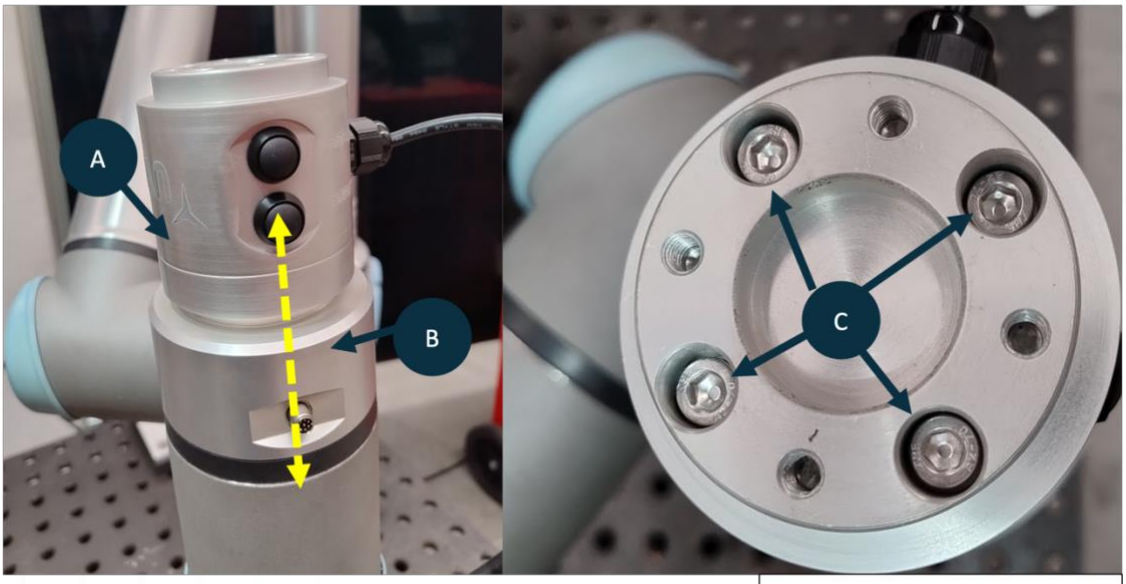

Fig. 9 UTeach assembly

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2. The torch holder arm (figure D) will be attached to the UTeach body. The screws should be tightened with a torque value of 5.5 to 6.5 Nm (figure E). This component must be positioned in the same orientation as shown in the following image. Please note that this piece is specifically designed for the Fronius MTB400i torch, and may be different depending on the type of torch and welding machine selected.

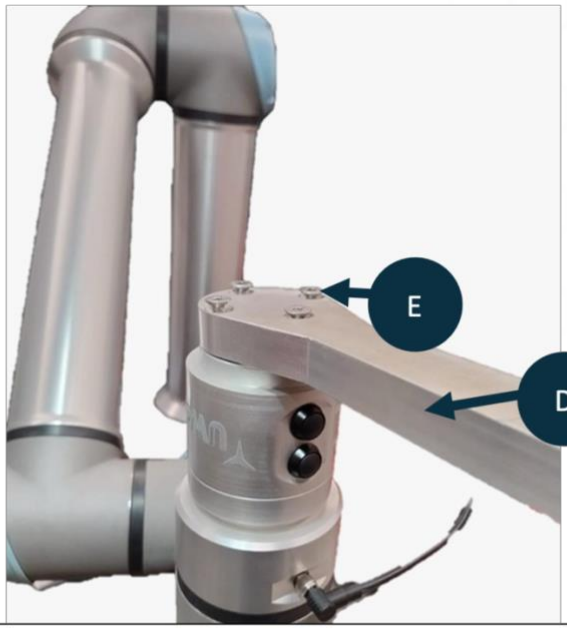

Fig. 10 Torch holding arm mounted onto the UTeach

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3. The torch (figure G) must be mounted onto the holder from the previous step. For reference, a Fronius torch and neck is used in this example. The torch holder arm should include a clamping screw for securing the torch body. Tighten the screw(s) (figure H) according to the design specifications.

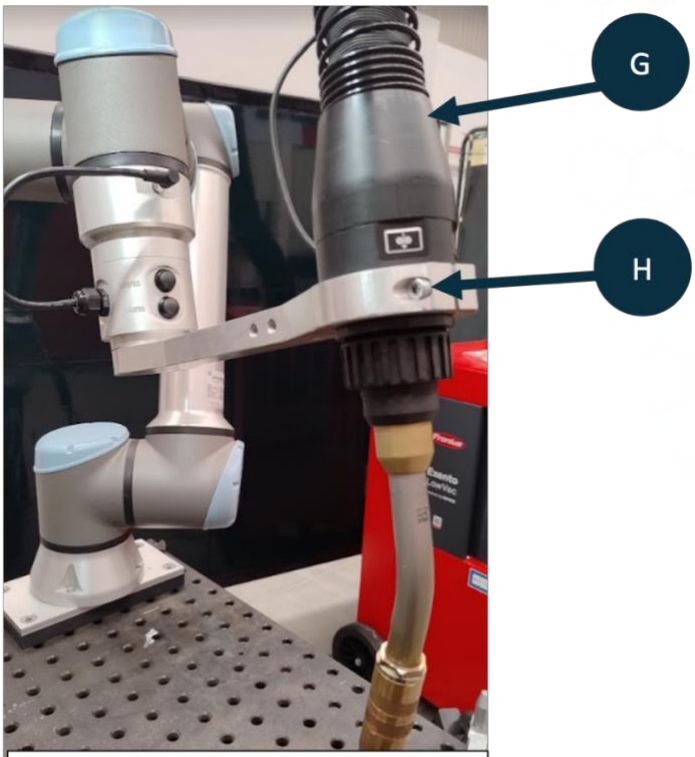

Fig. 10 Assembled UTeach

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4. The M8 8-pin cable from the UTeach (figure J) must be connected and screwed into the robot's tool connector (figure I). The user must ensure that it is done with the correct orientation to avoid damaging the connector.

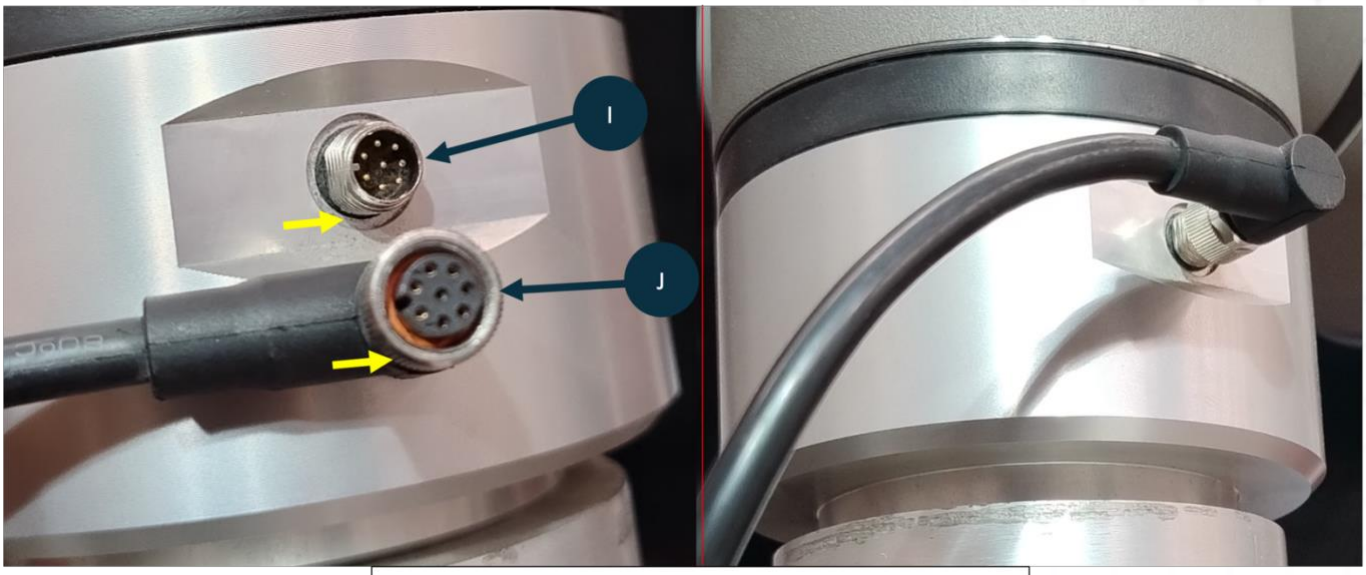

Fig. 11 UTeach cable orientation and connection

The dimensions and weight of the UTeach body are presented below.

Weight: 900 g

Front view:

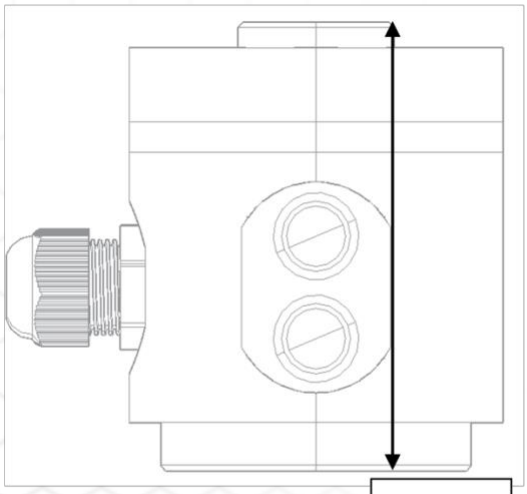

Fig. 12 UTeach body height

Top view:

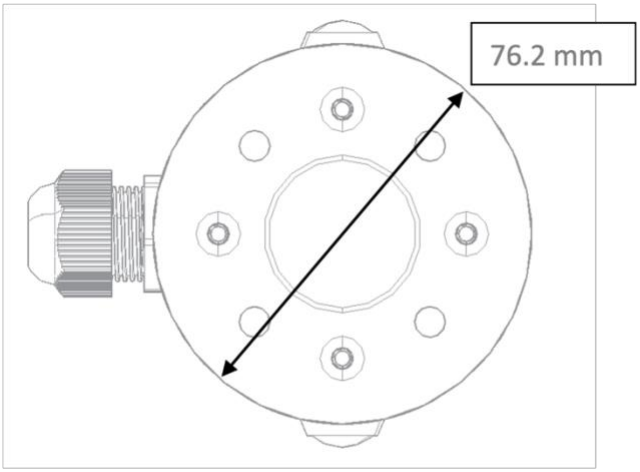

Fig. 13 UTeach body diameter

3.5 Uteach TCP and Playload

The user must calculate the TCP and payload according to the torch used for the application.

IMPORTANT NOTE:

The TCP, weight and center of gravity of this example is applicable to the torch model: MHP 400i R/GFSC and neck torch model: MTB 400i G R /22°/L241/H50, both manufactured by Fronius (this torch configuration is used on figure 10).

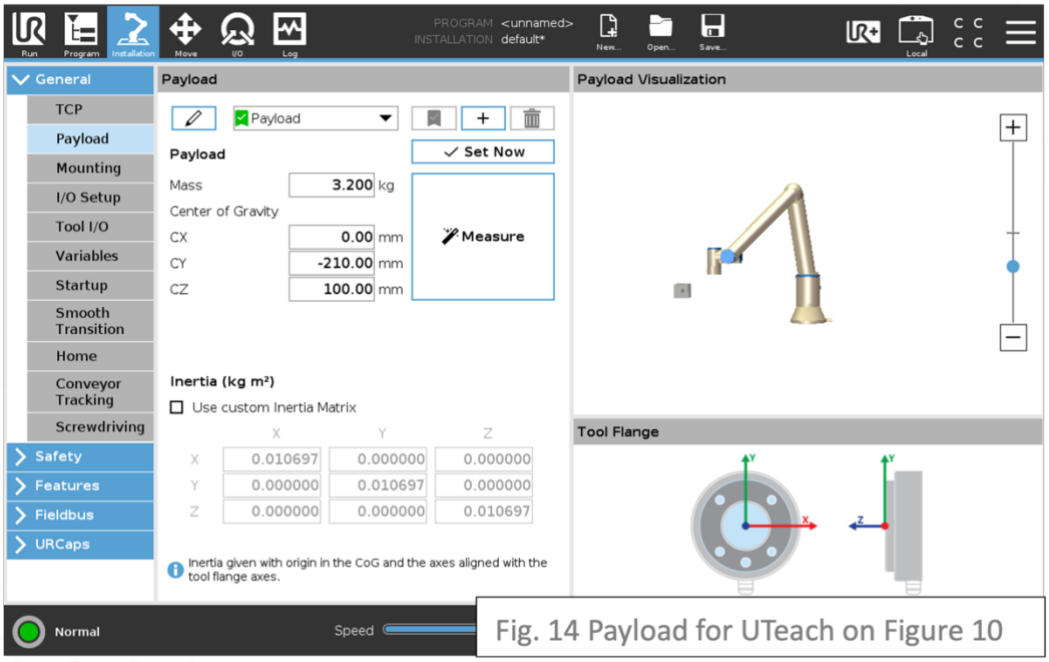

Fig. 14 Payload for UTeach on Figure 10

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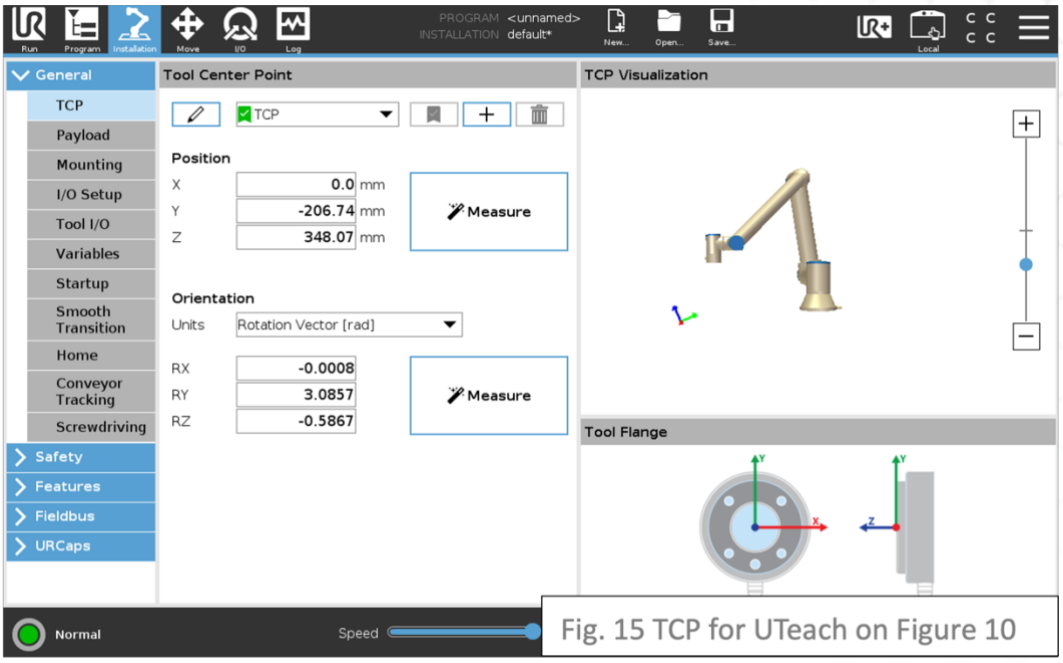

Fig. 15 TCP for UTeach on Figure 10

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4. UWELD POLYSCOPE INSTALLATION NODES

4.1 UWeld Installation Node Configuration

The installation node is the screen in Polyscope used to define the connection mode with the welding machine. By default, the UWeld URCap includes a trial license of 200 robot hours. This time counter (item B) decreases while the robot is powered on (even if no program is running). Once it reaches zero, UWeld can no longer be used until an activation key is purchased.

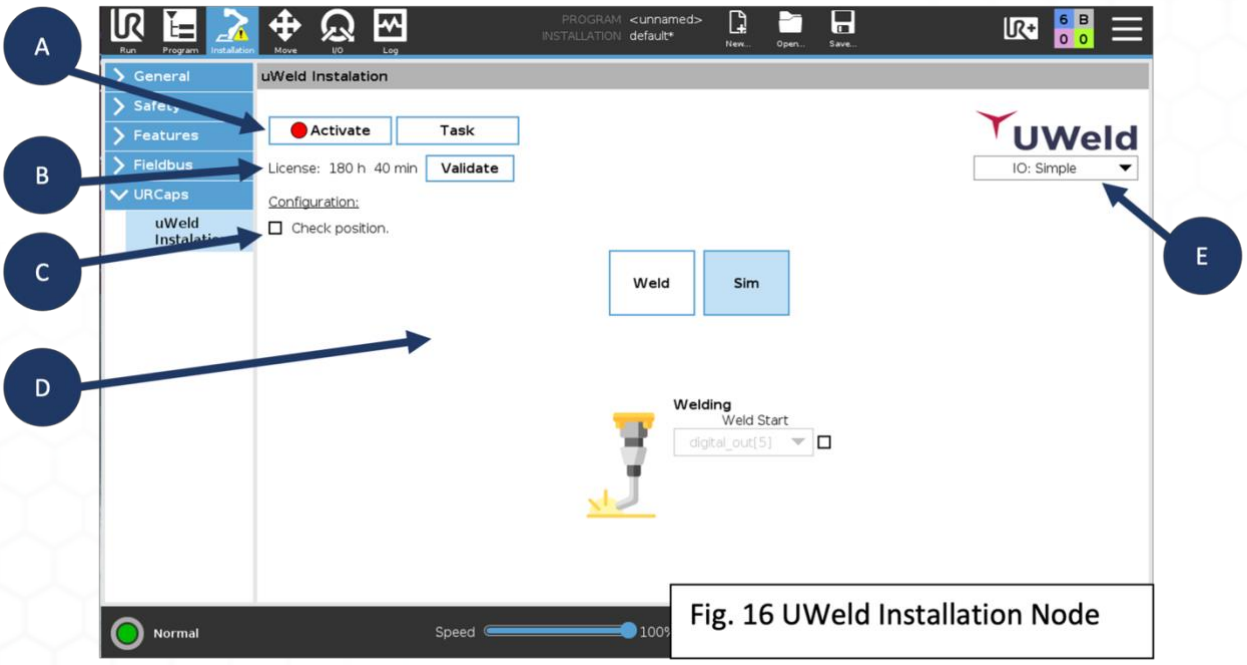

Fig. 16 UWeld Installation Node

On the right-hand side, there is a combo box (item E) that displays different connection options with the welding machine. The configuration panel (item D) changes depending on the selection made in the combo box. From the configuration panel, the user can define the signals present on the controller terminals and their mapping to perform various actions on the welding power source. Once configured according to the available welding machine, press the "Activate" button (item A) to use the program nodes.

To enable the permanent UWeld license, the user must press the "Validate" button (item B in Figure 16), and then a keyboard will be displayed (see Figure 17) on which the license key provided by the Innovatelia team should be entered.

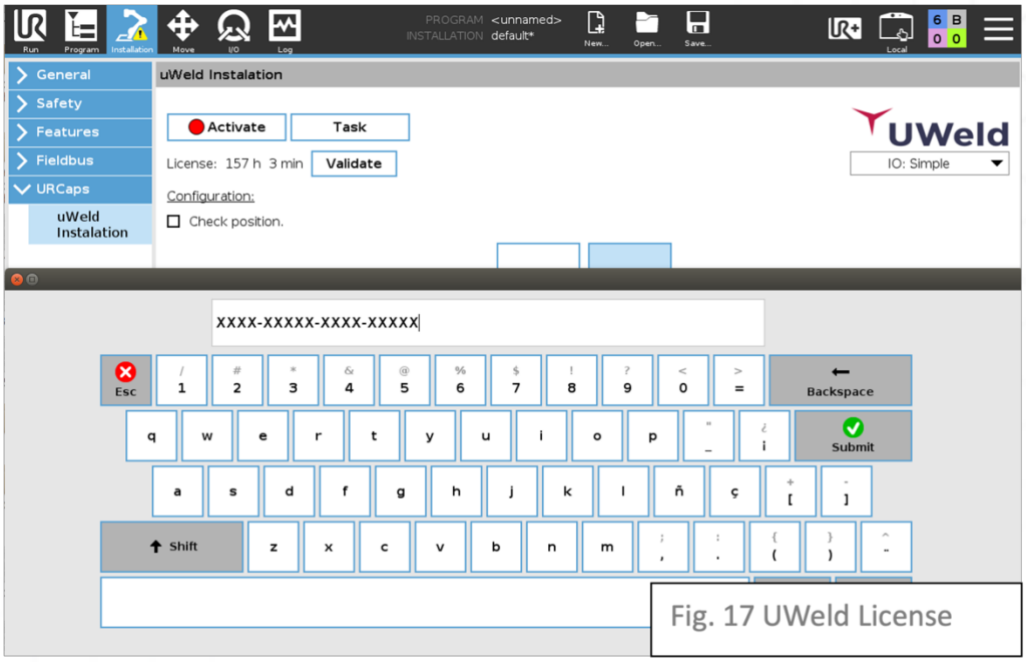

Fig. 17 UWeld License

Once the license key has been entered, the trial period timer will disappear, and item B in Figure 16 will display a "license enabled" message.

The “Check position” selector (item C) allows the user to confirm a robot waypoint after it has been recorded using either UTeach or the teach pendant.

In the case of Figure 16, the "Simple" mode has been selected, which is suitable for welding power sources that only allow remote start and stop of welding arcs. Therefore, in the configuration panel, the user only needs to select the robot's digital output connected to the welding machine. Additionally, the control panel offers a "Sim" mode, which makes the robot simulate the program without applying welding, or a "Weld" mode to perform welding. Below, an electrical diagram is provided as an example to illustrate the connection.

It is important to consult the technical manual of the welding power source you intend to use, as the connection will differ depending on the manufacturer.

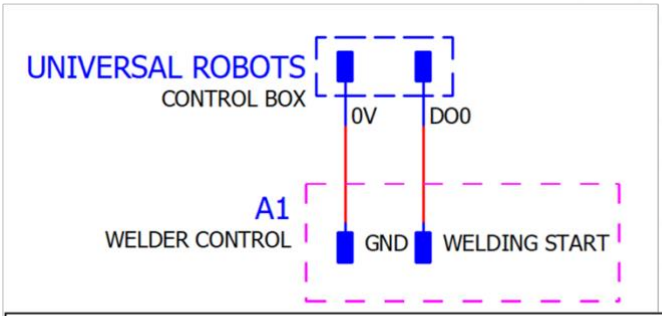

Fig. 18 Example diagram for simple welder connection

The next connection option with welding machines is through digital inputs and outputs, where from the configuration panel, the user can select which signals are connected to the welding machine and to which digital input or output of the robot (Figure 19).

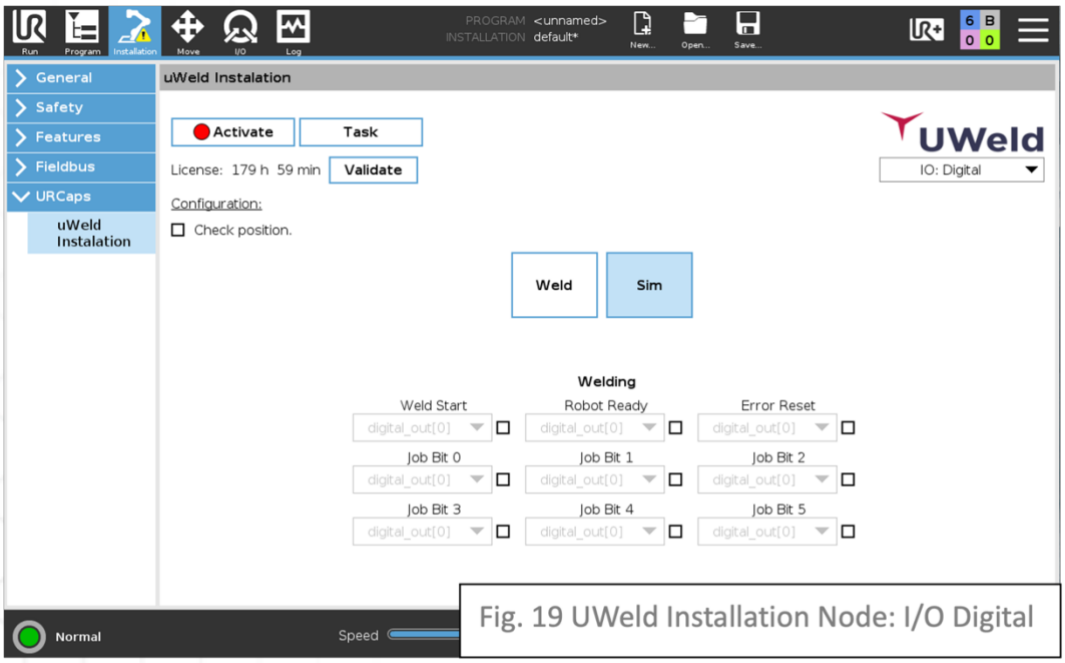

Fig. 19 UWeld Installation Node: I/O Digital

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The following diagram is provided as an example for making the electrical connection for a welding power source controlled by digital I/O, as shown in Figure 19.



Fig. 20 Diagram for IO Digital connection

This diagram is only an example of the connection. The user must refer to the technical manual of the selected welding power source for the application, as connections change depending on the manufacturer.

For Modbus TCP communication, a network cable connection is required (minimum recommended category 6a). An example diagram is presented below.

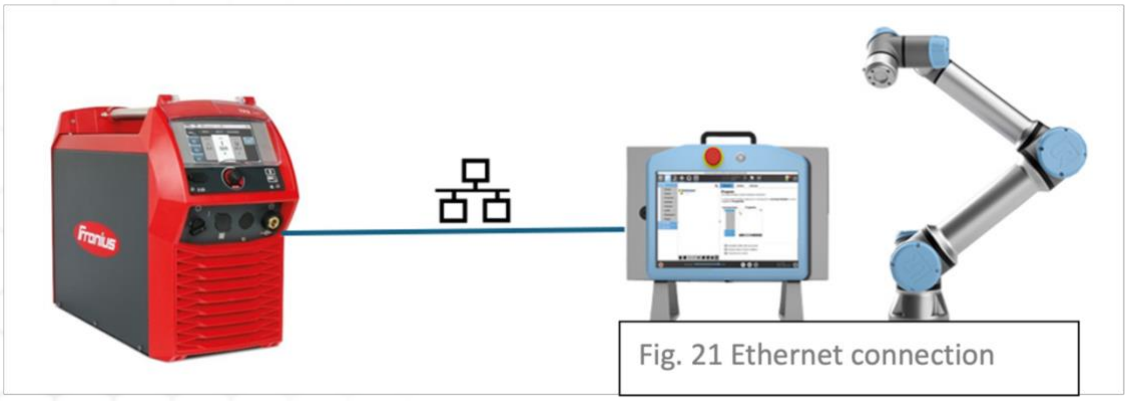

Fig. 21 Ethernet connection

The robot controller's Ethernet port must be connected to the communication port of the welding power source, and both devices must be on the same network segment.

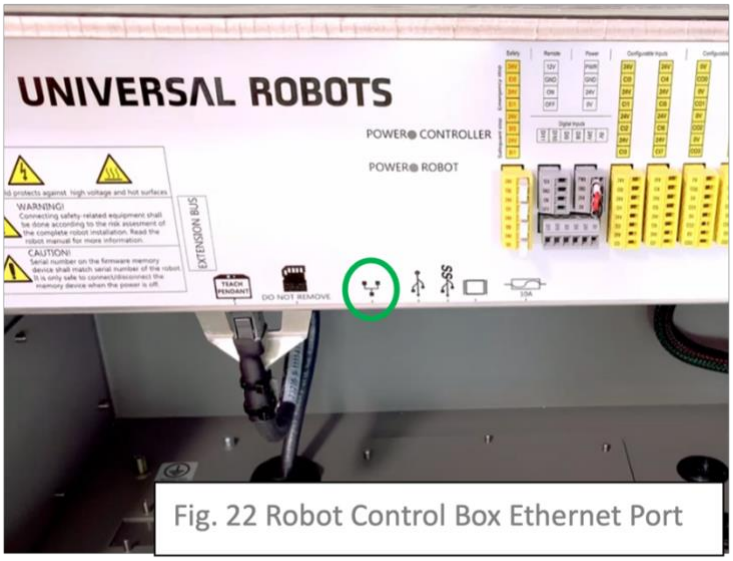

Fig. 22 Robot Control Box Ethernet Port

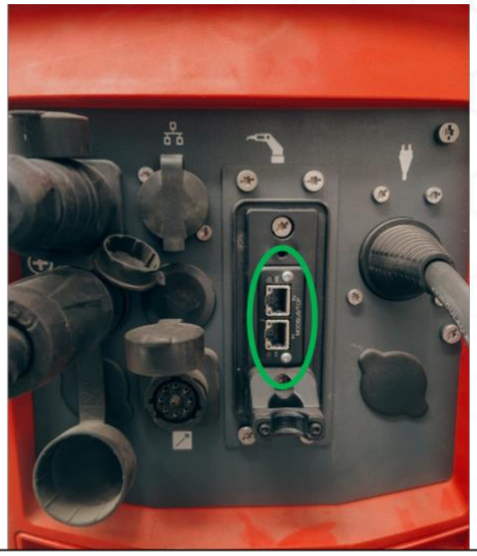

Fig. 23 TPSi (Rear Side) Ethernet Port

In the case of selecting the Fronius configuration, a third button is included in the configuration panel, which activates the "Teach Mode" for TPSi welding machines. This mode is very useful for simulating and teaching welding paths (Figure 24).

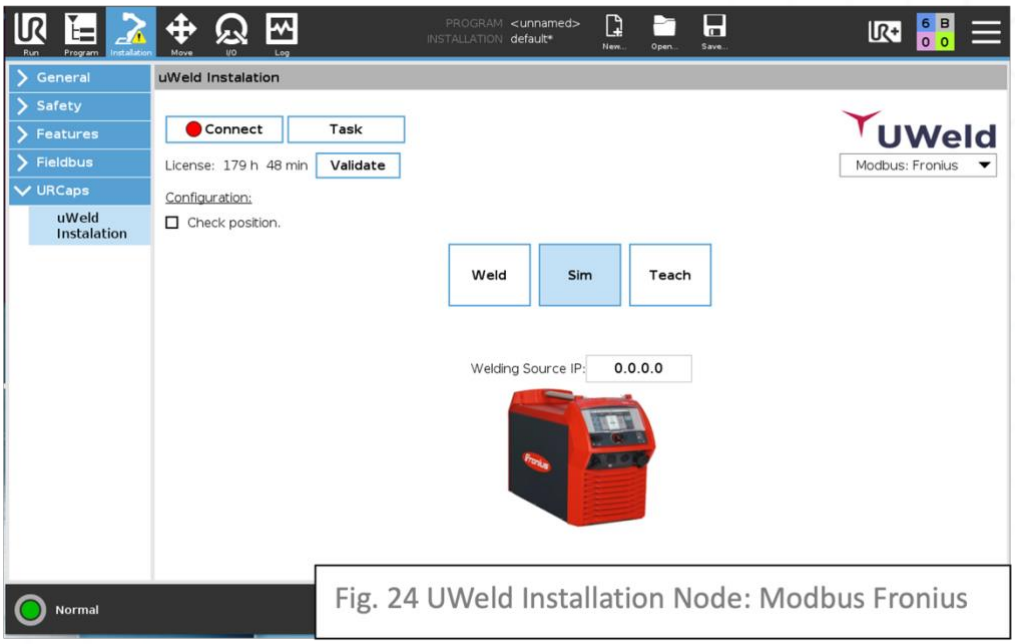

Fig. 24 UWeld Installation Node: Modbus Fronius

5. UWELD POLYSCOPE PROGRAM NODES

5.1 UWeld Trajectory

The UWeld trajectory program node is designed to build welding paths quickly and easily. It also offers the ability to configure oscillatory movement (weaving) or the application of multiple welding passes (multipass). Each function has its own tab, with the main tab being the Trajectory section.

If the button to activate in the installation node has not been pressed or the IP address of a welding power source has not been properly configured, the UWeld trajectory node will display a status called "Not Active" (Figure 25). It is important to have properly configured the installation node before starting to apply welding.

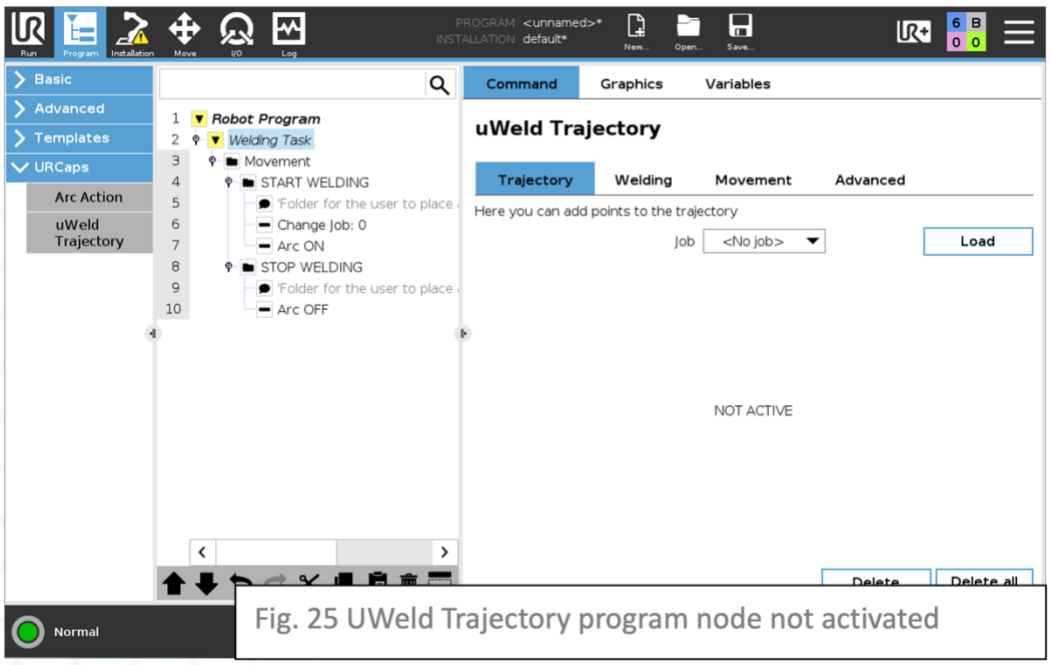

Fig. 25 UWeld Trajectory program node not activated

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If the UWeld installation node has been properly configured, the trajectory program node will display an icon related to a welding path.

A typical welding path should consist of 5 stages: an approach point, a start welding point, various waypoints for the bead geometry (linear or circular), a stop welding point, and finally an exit point.

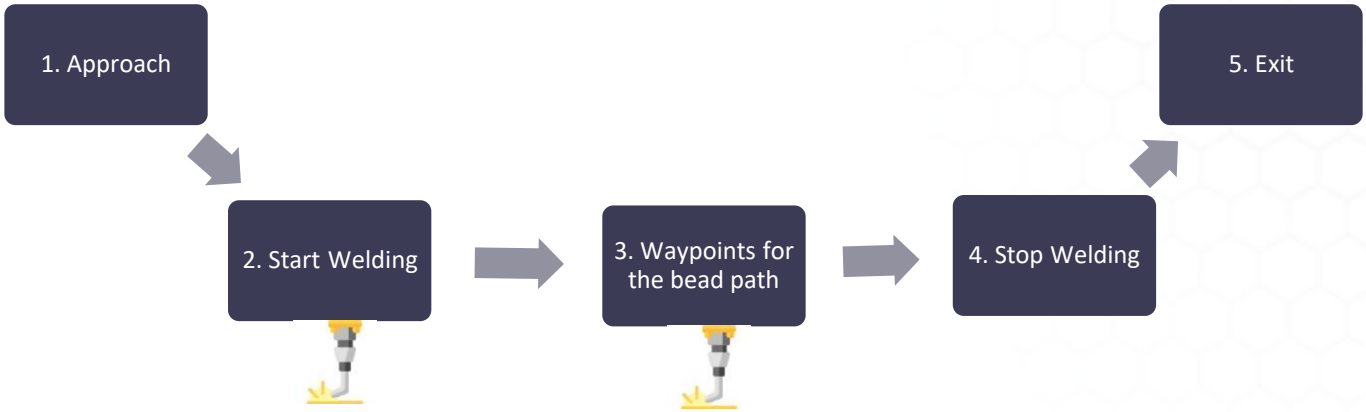

Fig. 26 Typical welding path

Note that where the icon of the torch with an arc is found, there is where welding is being applied.

The UWeld trajectory program node is the appropriate tool to build the entire welding path, from the approach to the exit, and it includes a visual guide to help the user know which step of the path they are on.

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To save waypoints in UWeld Trajectory, simply move the robot to the desired position (with freedrive or coordinated movement) and press the icon corresponding to the current stage (1, 2, 3, 4, or 5 in Figure 26). The icon of a welding torch will be displayed as the user proceed, saving the waypoints of the path.

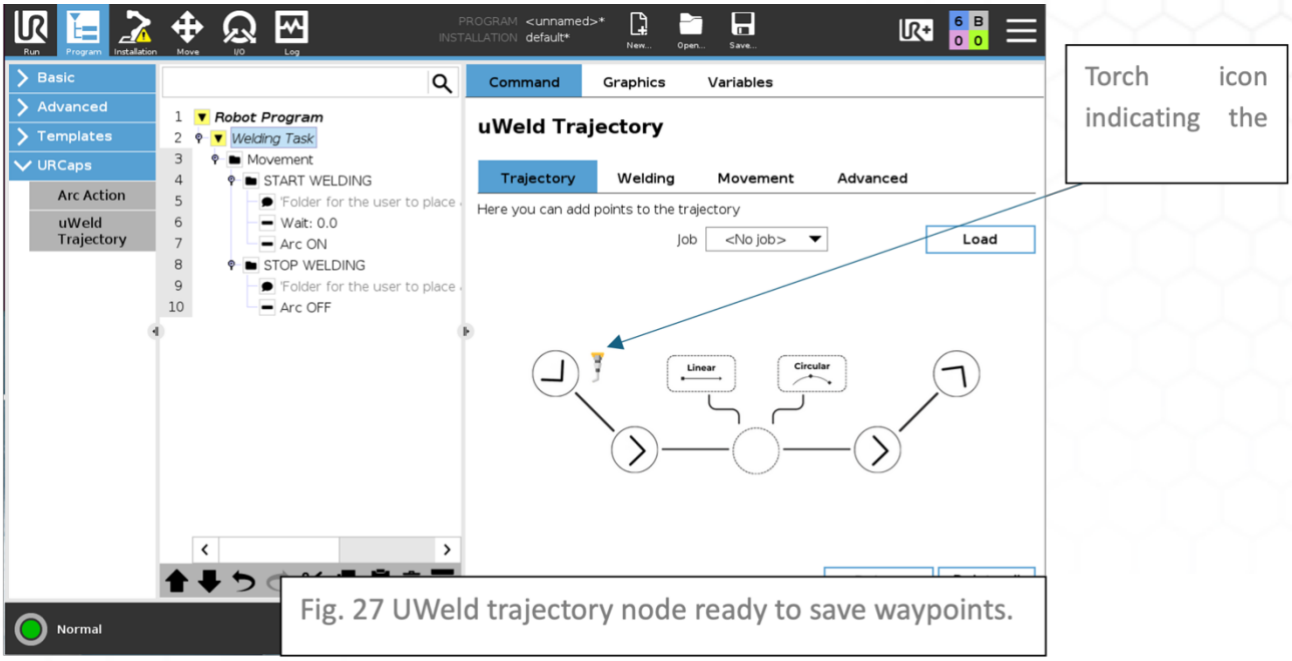

Fig. 27 UWeld trajectory node ready to save waypoints.

According to the image in Figure 26, it is evident that no waypoints have been taught yet. Therefore, the first waypoint corresponds to the approach stage. It is important to note that to save any waypoint at any stage, the user should perform the following steps:

I. Identify the current stage of the trajectory.
II. Move the robot to the desired position.
III. Save the waypoint.

UWeld allows saving waypoints in two ways:

a) By pressing the icon of the current stage.
b) Using the push buttons on UTeach.

To save waypoints using the push buttons on UTeach, the user needs to reach the screen shown in Figure 27, and this should be done without switching to another screen in Polyscope.

The approach waypoint (stage 1) is saved as follows:

I. Move the robot to the desired approach position.
II. Navigate to the Polyscope screen as shown in Figure 27.
III. Press the "L" button on the UTeach EOAT for 3 to 4 seconds or click on the trajectory figure icon where the welding torch icon is located.

If the “Check Position” selector in the UWeld Installation node is activated, a waypoint editor screen will appear after the user presses a UTeach button or taps the trajectory icons to save any waypoint.

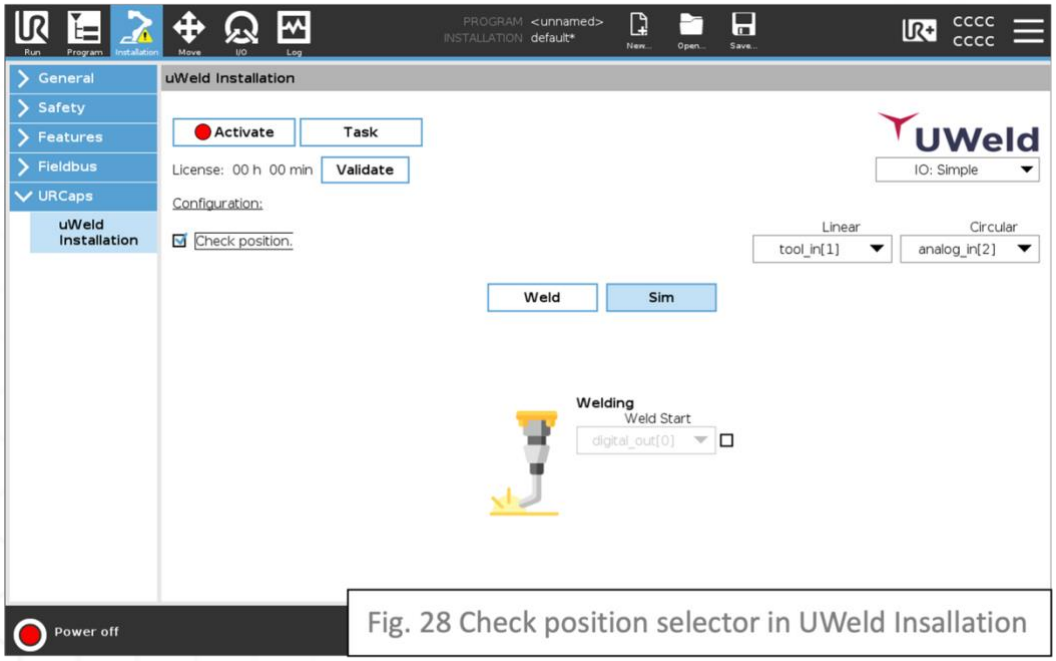

Fig. 28 Check position selector in UWeld Insallation

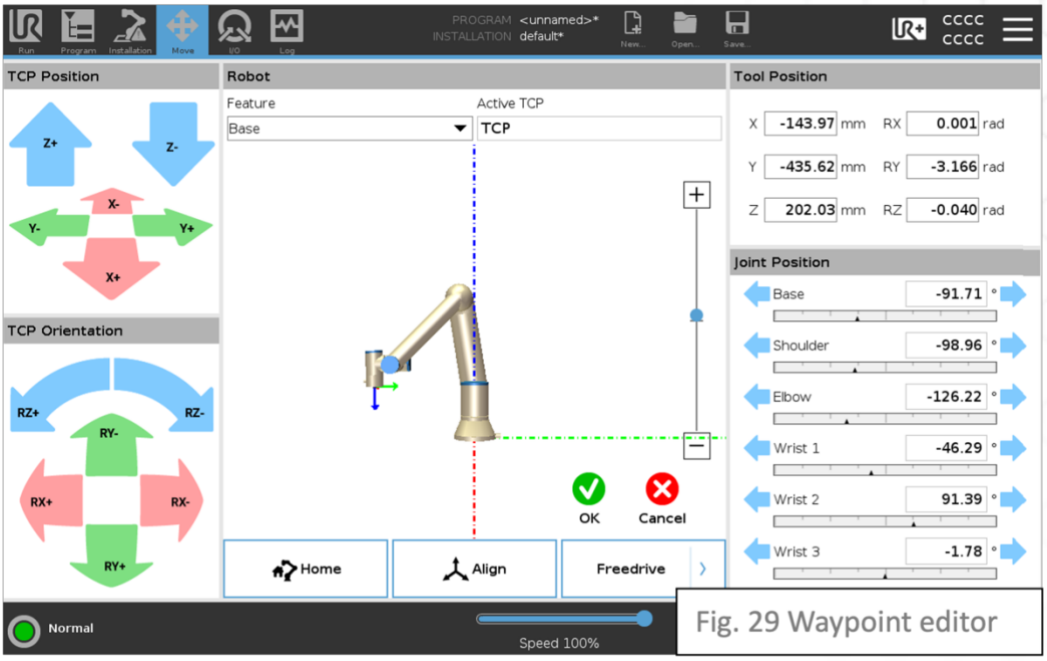

Fig. 29 Waypoint editor

Once the approach waypoint has been saved (either with UTeach or directly with the trajectory figure icons), the trajectory figure will change to the next stage.

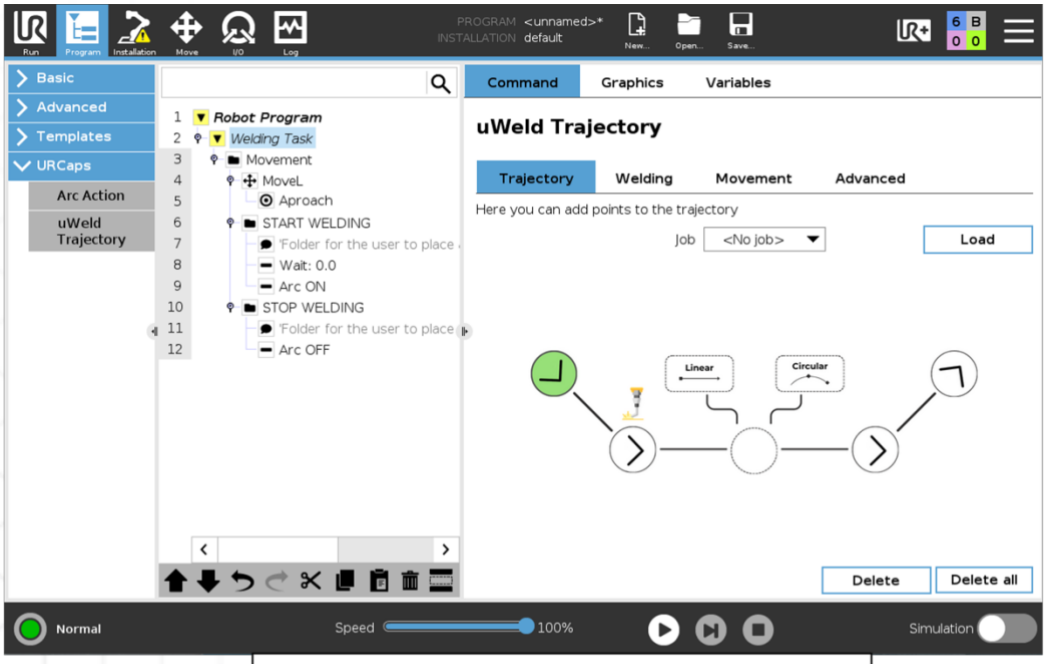

Fig. 30 UWeld trajectory node after Stage 1

Note that a Linear Movement has been added to the robot program tree with a waypoint named "Approach." Additionally, the icon corresponding to stage 1 has turned green, and the welding torch icon has moved to stage 2, which marks the start of welding and shows a "spark," indicating that welding arc will begin from this point onward.

The start welding waypoint can be saved as follows:

I. Keep Polyscope on the screen shown in Figure 30.
II. Move the robot to the desired start welding pose start applying welding.
III. Press the "L" button on UTeach for 1 second or click on the trajectory figure icon where the welding torch icon is located.

This way, the user has instructed the robot where to begin the welding bead, and the UWeld Trajectory figure will progress to the next stage:

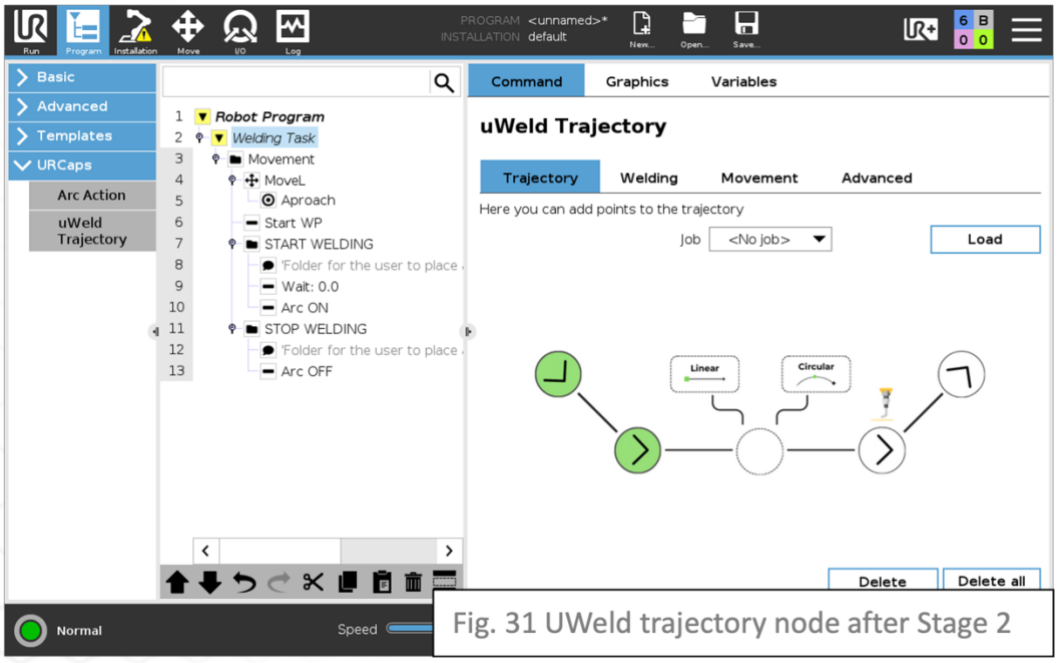

Fig. 31 UWeld trajectory node after Stage 2

A waypoint named "Start WP" has been added where the start welding position is saved.

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The welding torch icon has been placed in the circle corresponding to stage 4. If the welding is a single linear bead, the user could save the final waypoint. However, if the welding bead has a different geometry, the user will need to define all necessary waypoints, corresponding to stage 3.

To save waypoints for a piece with linear geometries, follow these steps:

I. Keep Polyscope on the screen shown in Figure 30.
II. Move the robot to the desired position for the next waypoint.
III. Press the "L" button on UTeach for 1 second or click on the square icon labeled "Linear."

The user can add as many linear waypoints as necessary to create the welding trajectory according to the workpiece. Each waypoint will be added to the robot's program tree.

If the user selects any of the linear waypoints that have been added to the tree, the user can individually configure them with offsets (position and/or angular), change the position where they were saved, or adjust the robot's travel speed to reach the selected waypoint.

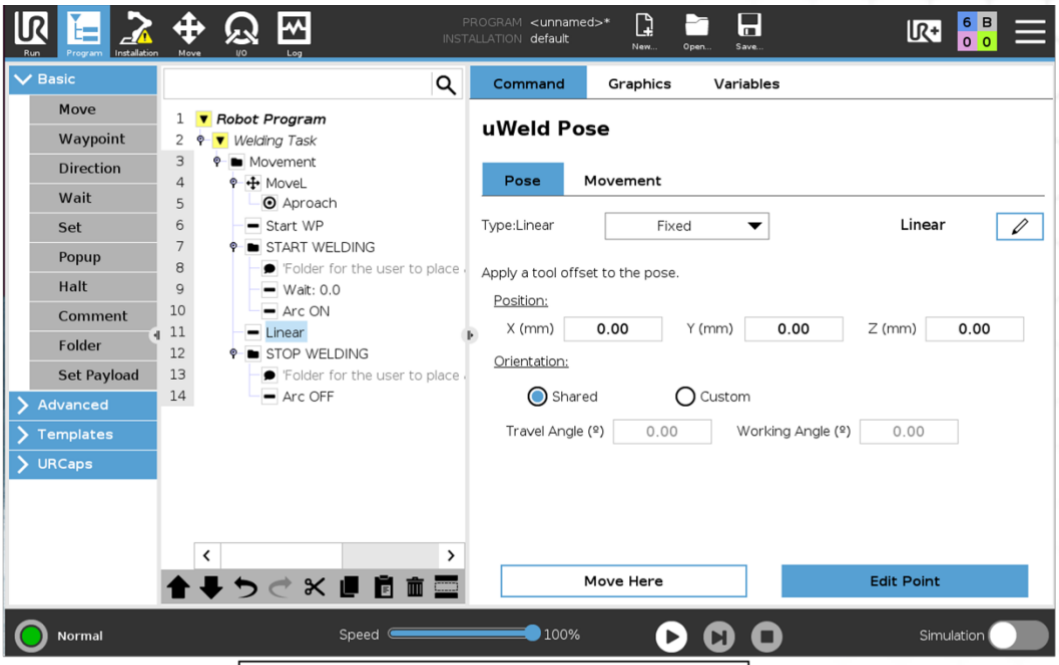

Fig. 32 UWeld Linear program node

A workpiece may have both linear and circular sections. It is important to note that circular motions are composed of 3 waypoints:

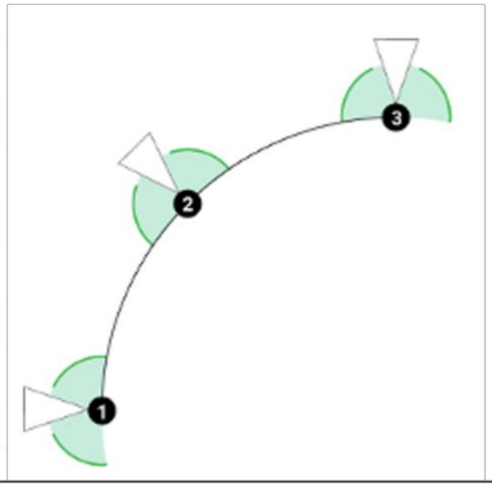

Fig. 33 Construction of a circular motion

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When adding a circular movement in Universal Robots, the user is required to save only 2 out of the 3 necessary waypoints. The second point is commonly known as the ViaPoint, and the third point is the EndPoint. The first point is derived from the preceding waypoint immediately before the circular movement instruction.

Therefore, Waypoint 1 is taken from the start welding point or any linear waypoint that immediately precedes the circular movement in the program tree. (Reference: Circle Move in Universal Robots CoreTrack training).

To save waypoints for circular motion on parts with circular geometries:

I. Keep the polyscope on the screen shown in figure 31.
II. Move the robot to the Via Point position (Free motion or coordinated motion).
III. Press and hold UTeach Button C for 1 second or tap the square icon labeled "circular" in the path figure (see figure 31).

The user will notice that when adding the circular waypoint, the instruction is added to the program tree, and the path figure will change as follows:

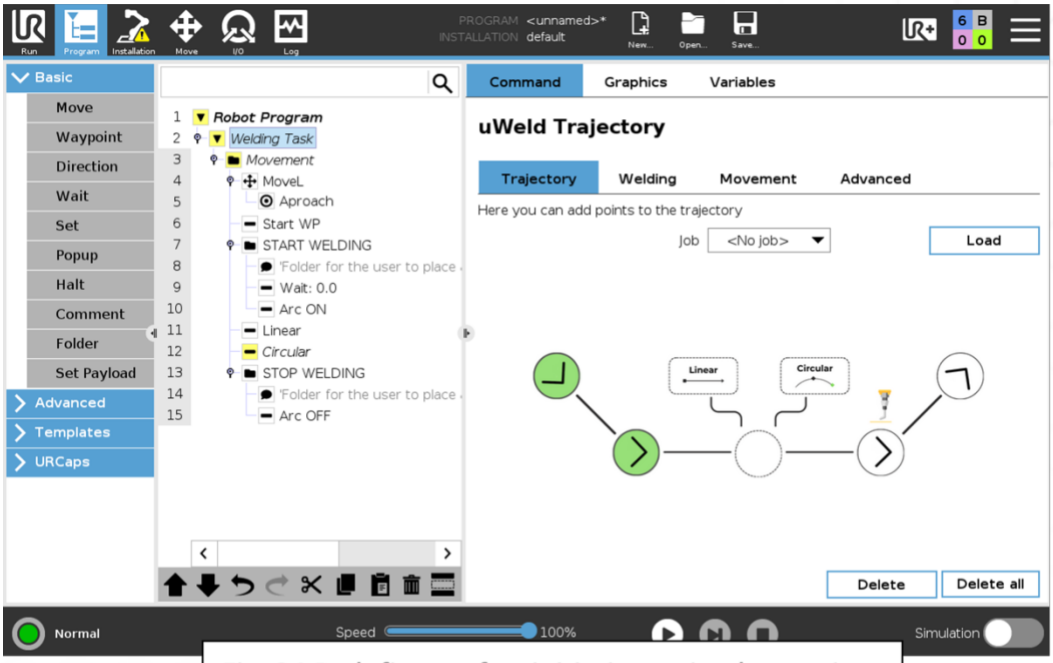

Fig. 34 Path figure after initiating a circular motion

When initiating a circular motion, UWeld will disable the option to add linear movement because the arc in figure 34 has not been fully defined. Therefore, follow these steps:

I. Keep the polyscope on the screen shown in figure 34.
II. Move the robot to the End Point position (Freedrive or coordinated motion).
III. Press and hold UTeach Button C for 1 second or tap the square icon labeled "circular" in the path figure (see figure 34).

After fully defining the circular trajectory, the user can proceed to create a linear path or start a new circular trajectory. In cases where welding involves drawing a circle, this circle must be created using at least 2 consecutive circular paths.

Like linear waypoints, the user can edit the positions of the Via Point and End Point, as well as specify a specific travel speed for executing the circular motion.

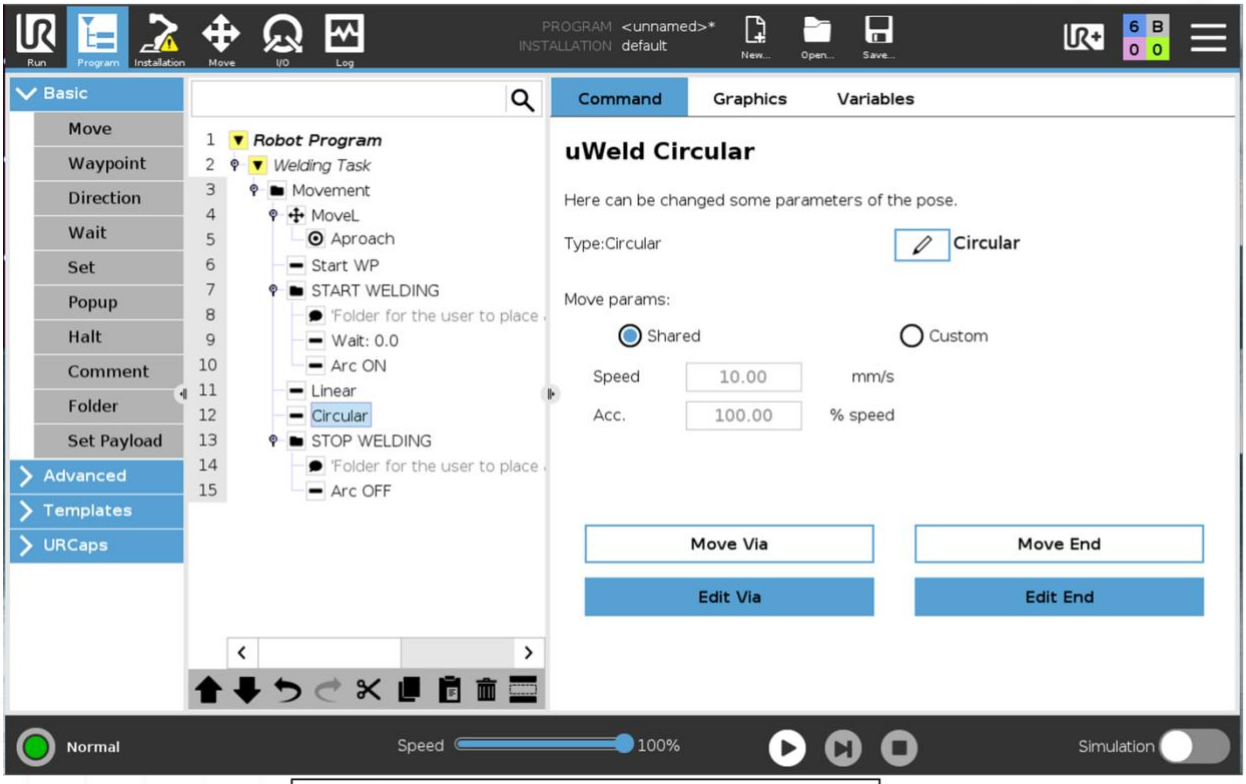

Fig. 35 UWeld Circular program node

All waypoints saved with UWeld Trajectory (whether linear or circular) will maintain the same torch orientation (lead angle and work angle) to ensure consistent application throughout the weld bead.

To finish the welding application trajectory, follow these steps:

I. Keep the polyscope on the screen shown in figure 34 or figure 31 (depending on the case).
II. Move the robot to the final welding position (Freedrive or coordinated motion).

Press and hold UTeach Button L for more than 5 or tap the icon corresponding to stage 4, where the icon of the non-sparking welding torch is in figures 31 and 34.

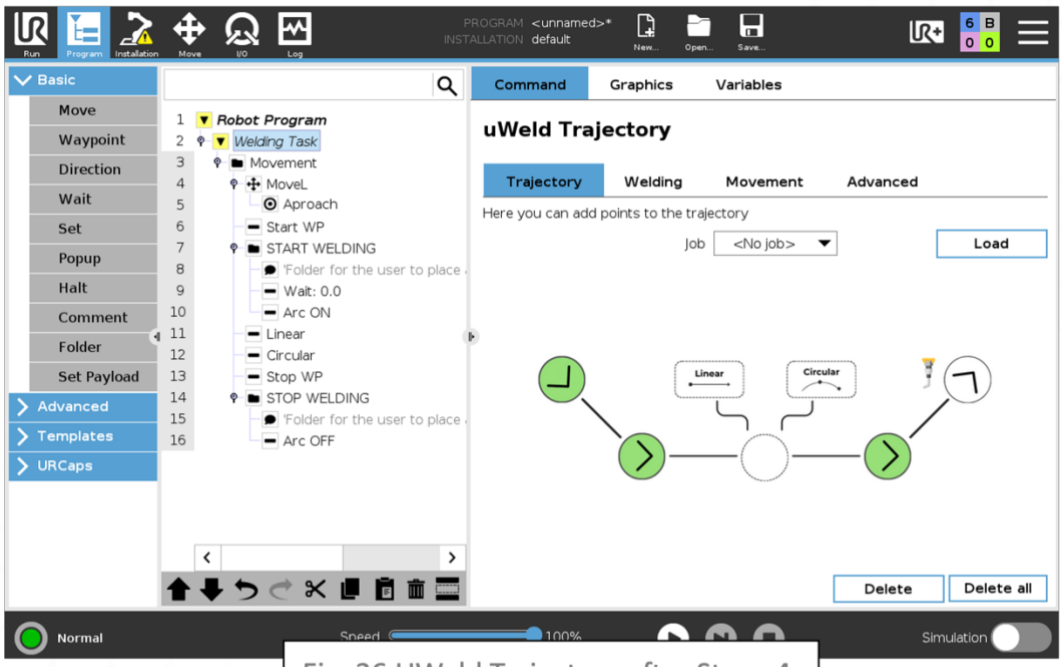

Fig. 36 UWeld Trajectory after Stage 4

After recording the welding endpoint, the only remaining step is to save the exit waypoint corresponding to stage 5.

The user will notice that in the program tree there are 2 folders: one called START WELDING and another named STOP WELDING. Inside these folders are instructions to initiate and terminate the welding arc, respectively.

If the user has automatic clamps or other devices that need to be activated in the welding program, the user can add the respective polyscope instructions within these folders. To delete any waypoint from the trajectory, simply select it and press the Delete button (trash can icon).

To save the exit waypoint position, follow these steps:

I. Keep the polyscope on the screen shown in figure 36.
II. Move the robot to the exit position (Freedrive or coordinated motion).
III. Press and hold UTeach Button L for 1 second or tap the final icon in the UWeld path figure.

Once the welding trajectory has been fully defined, the path figure will change as follows:

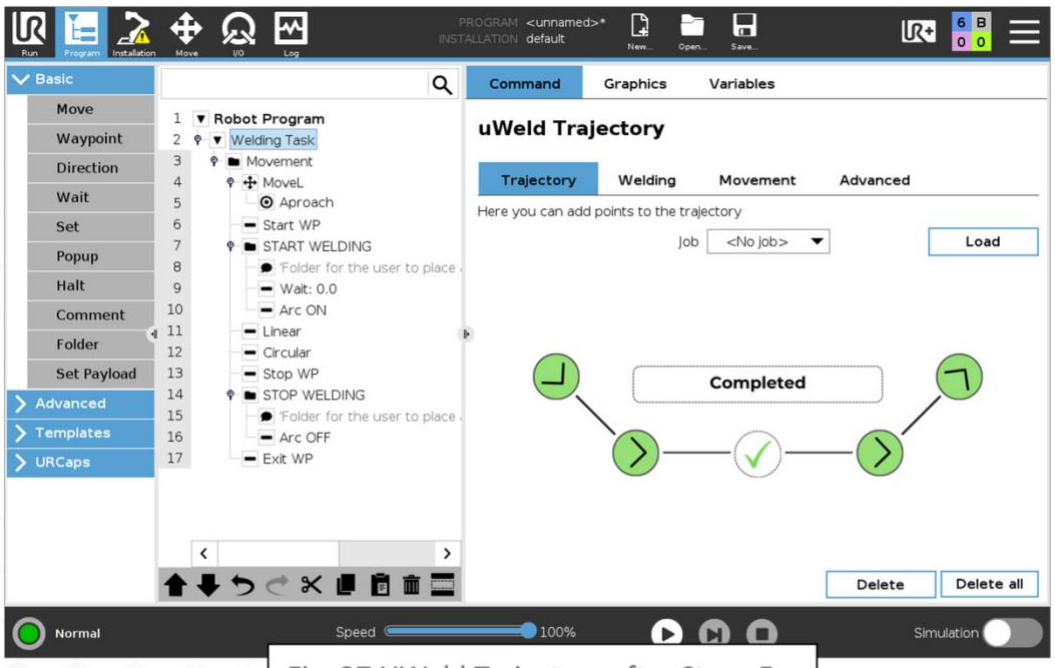

Fig. 37 UWeld Trajectory after Stage 5

Note that this indicates the trajectory has been completed and all program nodes in the tree have been defined (none remain yellow). At this point, the user could start the program to validate the trajectory.

However, there are still functions to address with the UWeld trajectory program node.

The next tab involves adjusting welding parameters, which varies depending on the configuration set in the installation node.

For example, in figure 38, we notice that Fronius Modbus has been selected in the UWeld setup. Therefore, changing the welding source simply involves selecting the job.

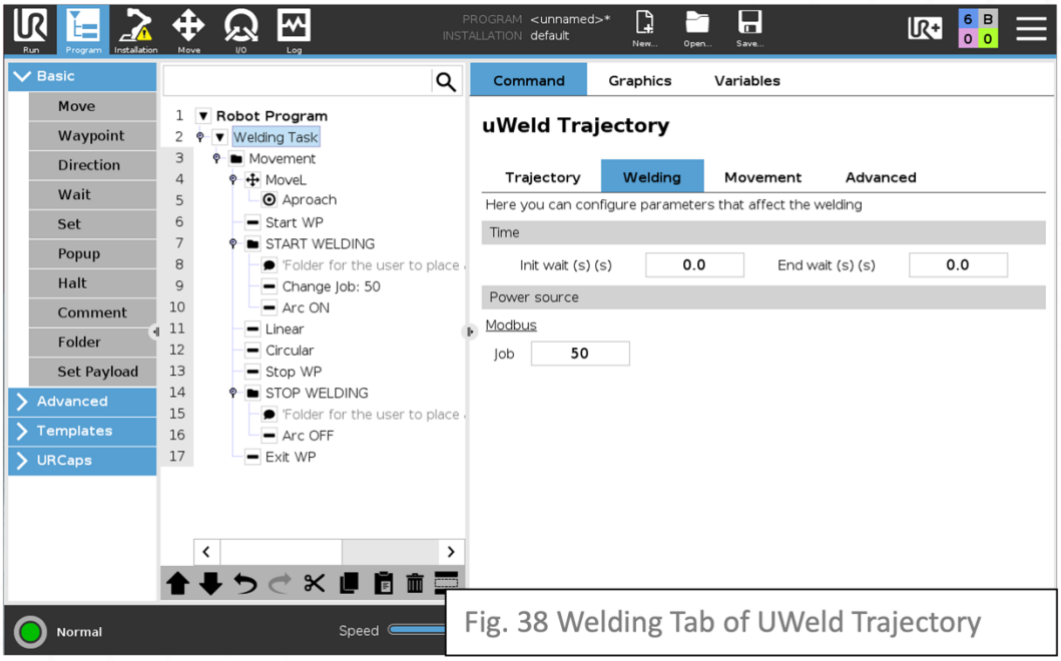

Fig. 38 Welding Tab of UWeld Trajectory

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The "Time" tab refers to the wait times for the robot when initiating and terminating the welding arc, respectively. If set to 0, the robot will advance immediately after sending the instruction to open the welding arc to the welding source. Therefore, it is necessary to configure a wait time for Init and End as follows:

- Init Wait: Time to wait after sending the instruction to open the welding arc to the welding source.
- End Wait: Time to wait after sending the instruction to close the welding arc to the welding source.
- Job: Selection of the job on the welding machine.

These settings ensure proper synchronization and control over the welding process with the robot.

The "Movement" tab contains everything related to motion control along the trajectory. From this tab, the user can define the welding travel speed and torch angles.

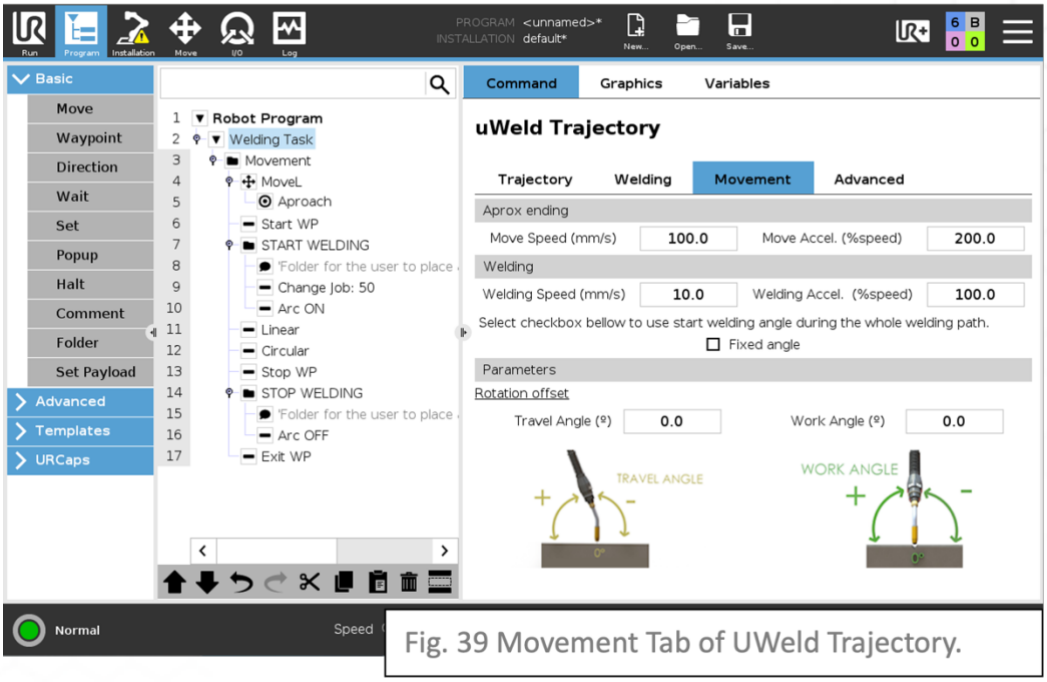

Fig. 39 Movement Tab of UWeld Trajectory.

- Move Speed: Magnitude of movement speed when the robot is not welding, given in mm/s.
- Move Accel.: Magnitude of acceleration when the robot is not welding, given as a percentage of Move Speed.
- Welding Speed: Magnitude of movement speed during welding application, given in mm/s.
- Welding Accel.: Magnitude of acceleration during welding application, given as a percentage of Welding Speed.

There is a checkbox that enables the option to force the robot to maintain the same work angle and travel angle throughout the weld bead. If activated, the starting welding waypoint will be used as the reference, and the entire trajectory will maintain the same work angle and travel angle.

- Travel angle: Angular value to change the travel angle of the welding application. If the value is zero, the travel angle will not be modified.
- Work angle: Angular value to change the work angle of the welding application. If the value is zero, the work angle will not be modified.

This tab includes two images showing that both the work angle and the travel angle originate from the perpendicular orientation of the torch.

The “Advanced” tab of UWeld Trajectory contains advanced welding functions: Oscillatory Motion (Weaving) and Multiple Passes (Multilayer or Multipass).

First, the user must select which technique to use to enable it. Figure 26 displays the screen related to oscillatory motion (Weaving).

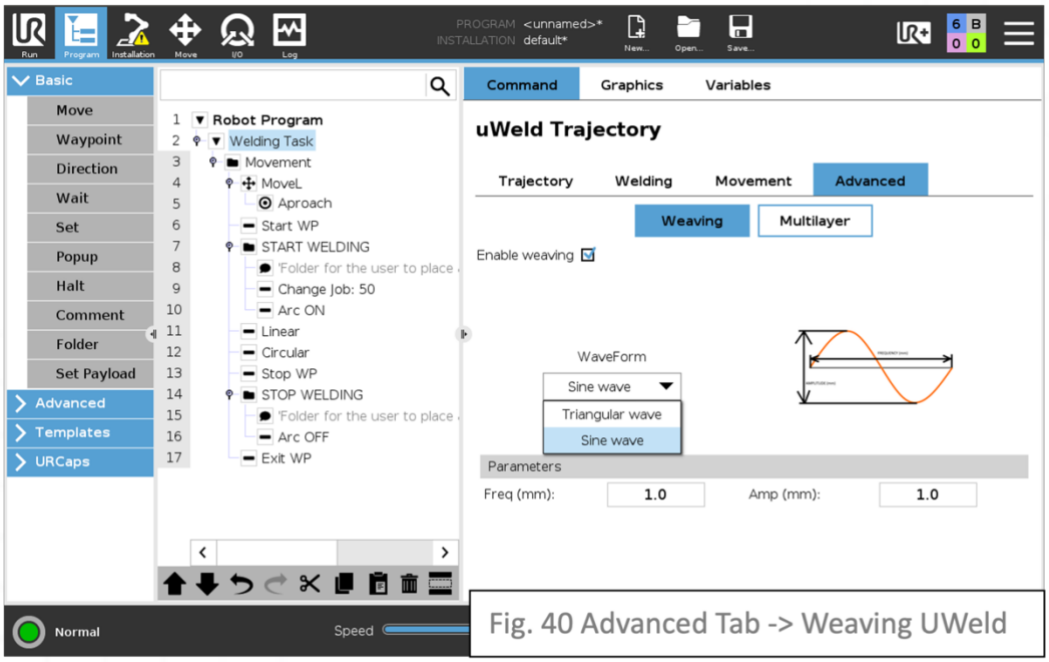

Fig. 40 Advanced Tab -> Weaving UWeld

The user should check the checkbox to enable Weaving and configure the oscillatory motion.

Under the WaveForm option, the user can select two types of movements: triangular or sine. The triangular movement pauses for 100 ms at each end of the wave, whereas the sine movement is continuous.

At the bottom of this screen, the user will find the wave parameters:

- Freq: Length of one complete cycle of the wave in mm.
- Amp: Amplitude between peak and valley of the wave in mm.

The function to perform multiple passes can be enabled similarly as Weaving function. The user needs to check the checkbox for "Multilayer" to configure the welding passes and layers.

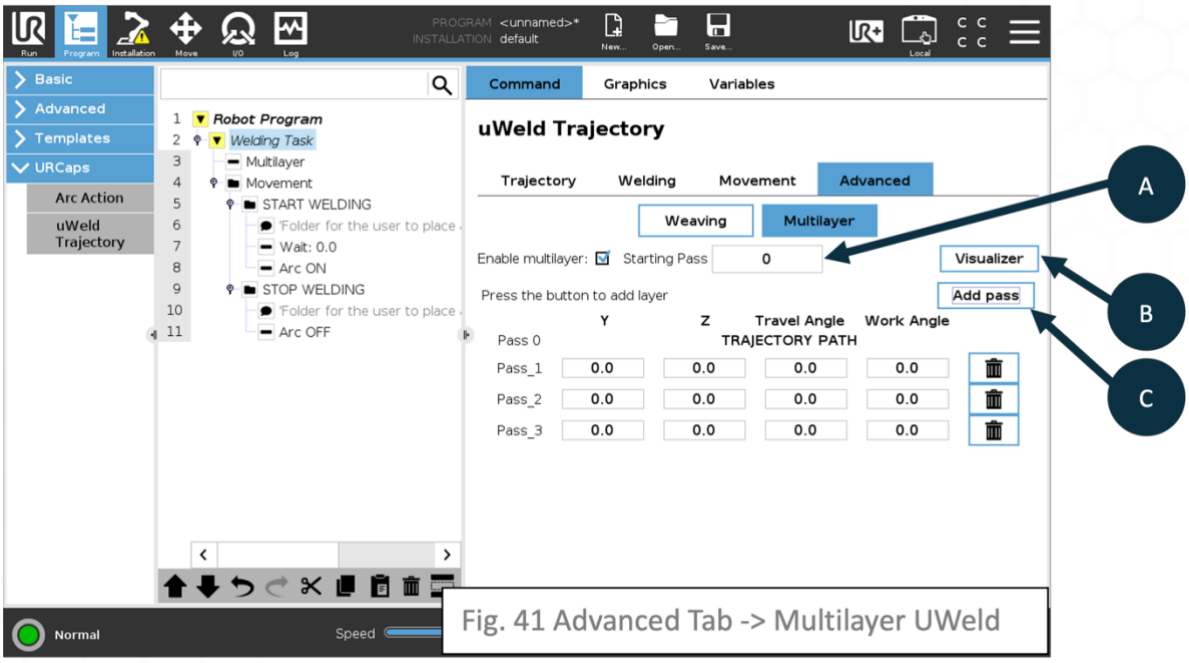

Fig. 41 Advanced Tab -> Multilayer UWeld

The user can add different passes or "layers" for welding using UWeld. These passes are added one by one using the "Add layer" button (item C). Each pass can be configured with a displacement in Y and Z directions relative to the TCP frame, as well as modifying the work angle and travel angle.

Layer 0 corresponds to the welding trajectory defined in the Trajectory tab, so any differences in Y and Z of the TCP will be relative to the initial trajectory.

Additionally, UWeld allows the programmer to select which pass to execute, which facilitates the testing stage for multiple passes. The programmer should enter the pass number they wish to execute in the "Starting Layer" input box (item A).

During program execution, the robot will start from the selected pass without executing the trajectories of previous passes, saving time for the programmer during testing.

IMPORTANT NOTE:

Once testing is complete and the program starts running cyclically, ensure that the desired pass is selected in the "Starting Layer" input box.

The "Visualizer" button (item B) opens a window to a visualizer that allows the user to see graphically where the different welding layers will be executed.

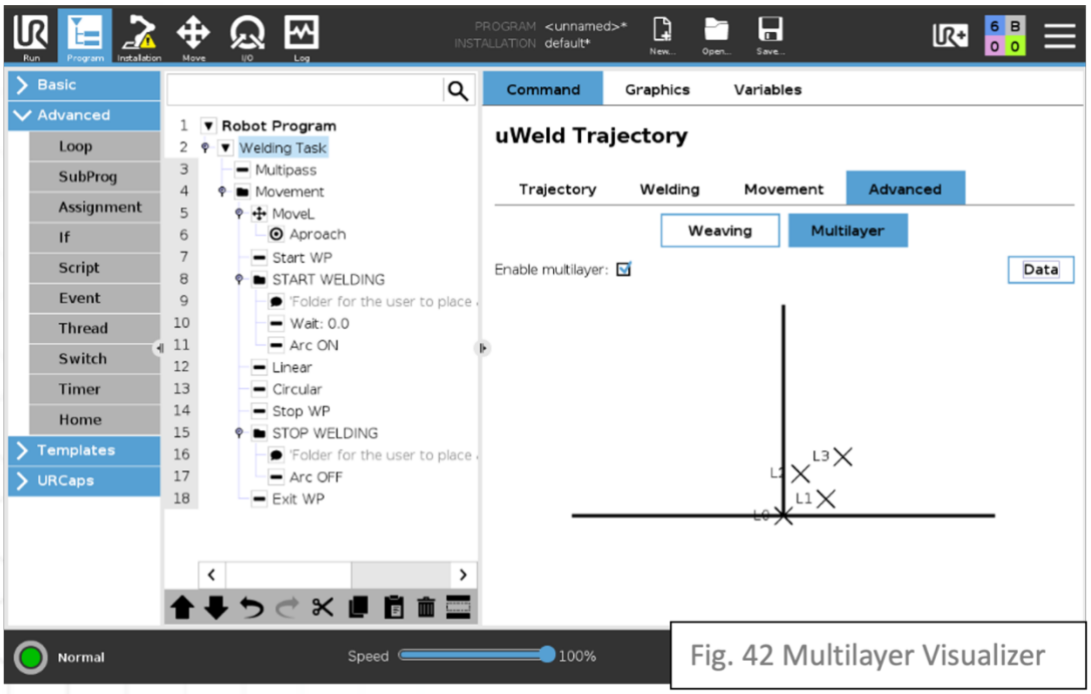

Fig. 42 Multilayer Visualizer

5.2 Arc Action

The "Arc Action" program node is useful for sending three different instructions to the welding machine: Arc On, Arc Off, and parameters change (if supported by the welding machine).

The default action of the Arc Action node is "Arc On," which is used to send to the welding machine the instruction to start the welding arc.

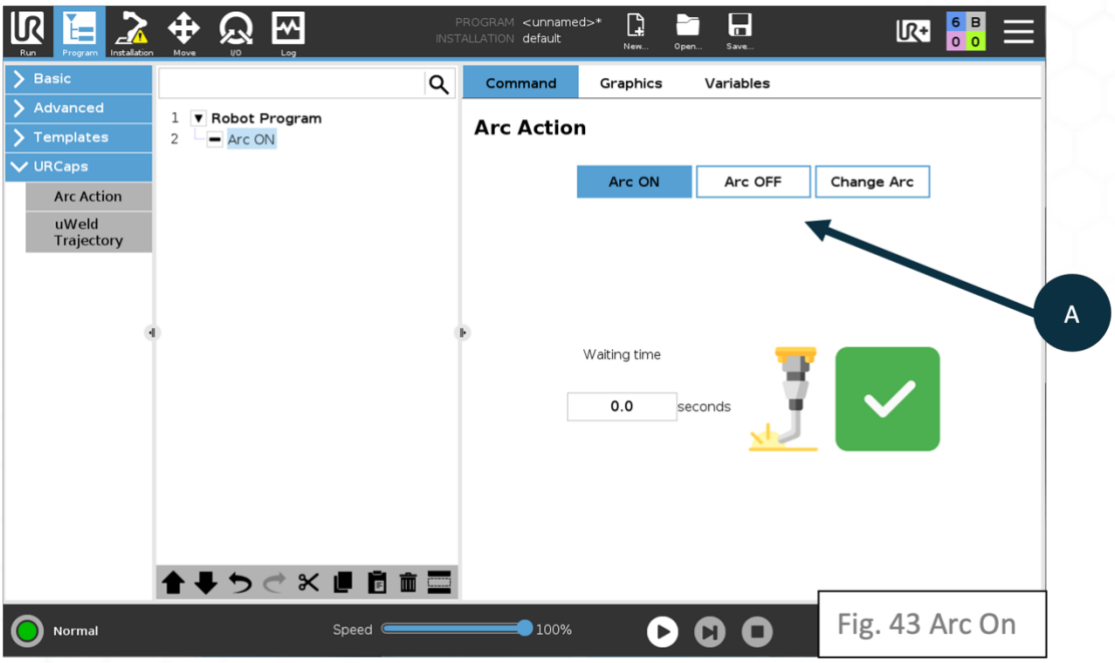

Fig. 43 Arc On

To change the action in the "Arc Action" program node, simply select one of the three available buttons (refer to item A in figure 29) to choose "Arc Off," "Change Arc," or to revert to "Arc On." Only one action can be performed per Arc Action node. For instance, selecting Arc On will disable the Change Arc button, requiring another Arc Action node to modify welding parameters.

Every configuration of the "Arc Action" node includes a numerical input labeled "Waiting Time." This allows the user to define a waiting period after executing an action. For example:

I. Arc On (Send instruction to the welding source to start the arc)
II. Wait for the configured time in "Waiting Time"
III. Continue with the next program node on the robot

If the user selects "Arc Off," the screen of the Arc Action node will change as follows:

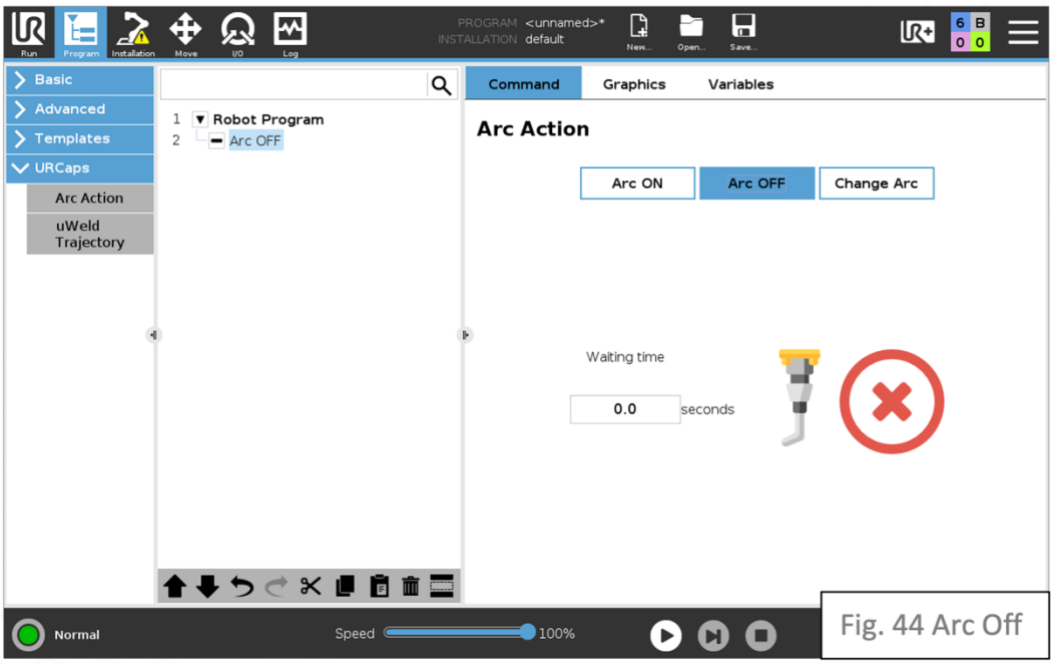

Fig. 44 Arc Off

If the user selects "Arc Off," its function will be:

I. Arc Off (Send the instruction to the welding source to turn off the arc)
II. Wait for the configured time in "Waiting Time"
III. Continue with the next program node on the robot

Regarding "Change Arc," the screen of the node will change as follows:

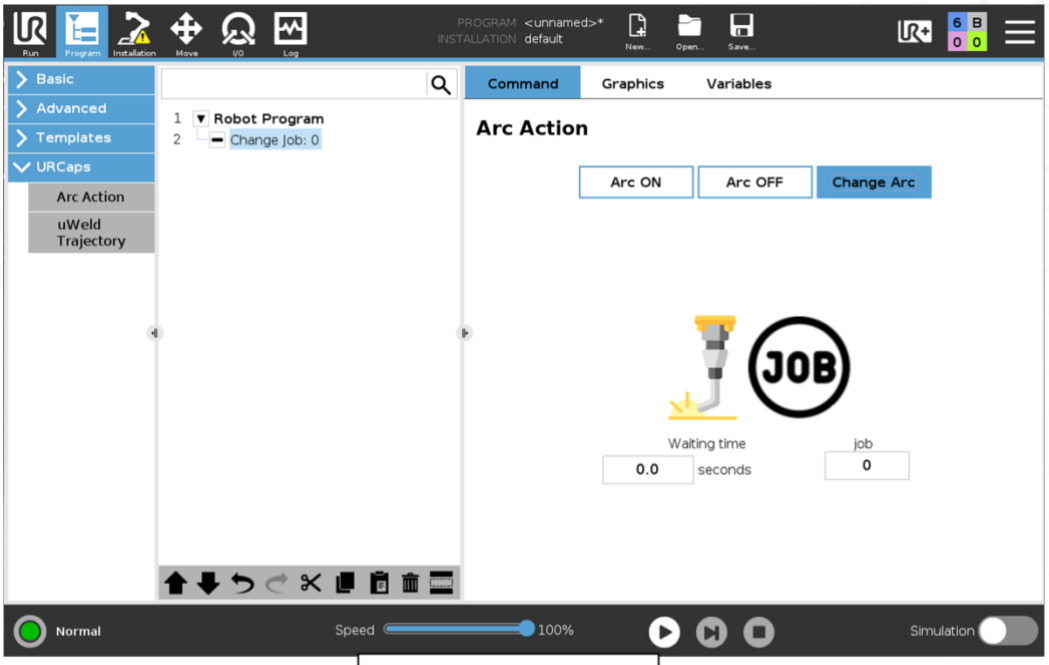

Fig. 45 Change Arc

And its function will be:

I. Change welding parameters - If a welding machine is configured to allow changing Jobs from the installation node, the user can select the job to use here. For welding machines that permit changing individual parameters, the user can adjust them on this screen.
II. Wait for the configured time in "Waiting Time".
III. Continue with the next program node.

This allows the user to add instructions to control the welding source at any point in the program tree. For example, a workpiece may require specific parameter settings for one part of the weld bead, while another part of the same weld bead (such as transitioning from linear to circular motion) may require different settings.

Refer to figure 46, where within the program tree created with UWeld Trajectory, a Job change has been added at line 12.

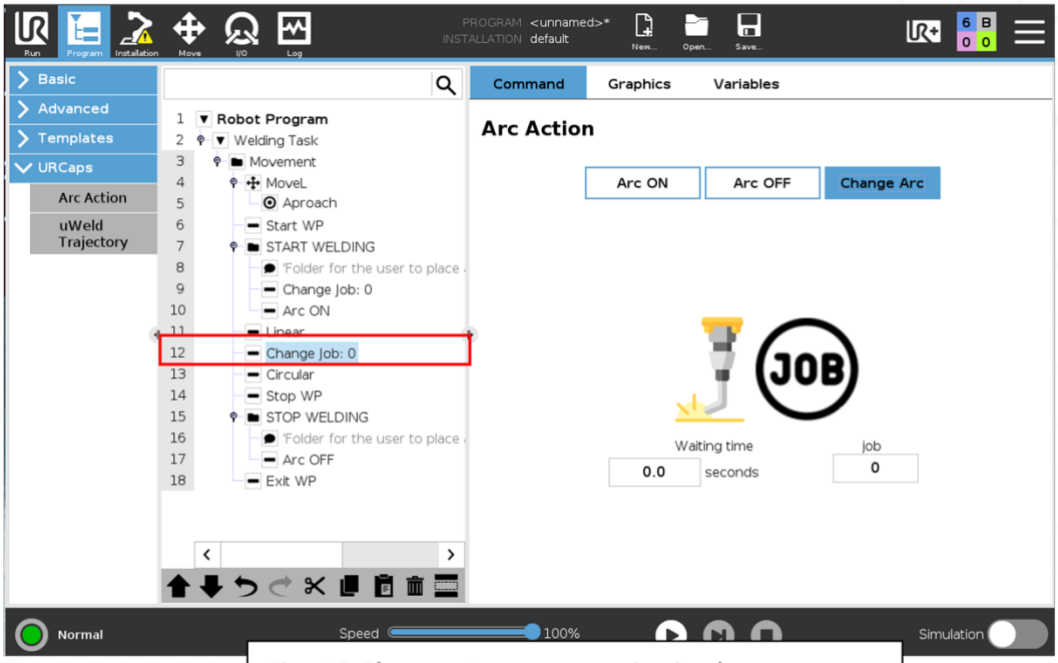

Fig. 46 Change Arc at any point in the program

The Arc Action program node can be used in any program involving trajectories created by the user with various methods, including:

- Typical Universal Robots motion instructions (MoveJ, MoveL, MoveP).
- Motion instructions executed with URScript.
- Coordinated motion with UR Toolpath.
- Any type of motion that allows adding program nodes for tool instruction (e.g., UR Palletizing template).

6. UWELD POLYSCOPE TOOLBAR

6.1 Operation of the UWeld Toolbar

To perform a simulation or test of the welding program, the user will use the UWeld node located in the Polyscope Toolbar at the top right corner, identified by the UR+ symbol.

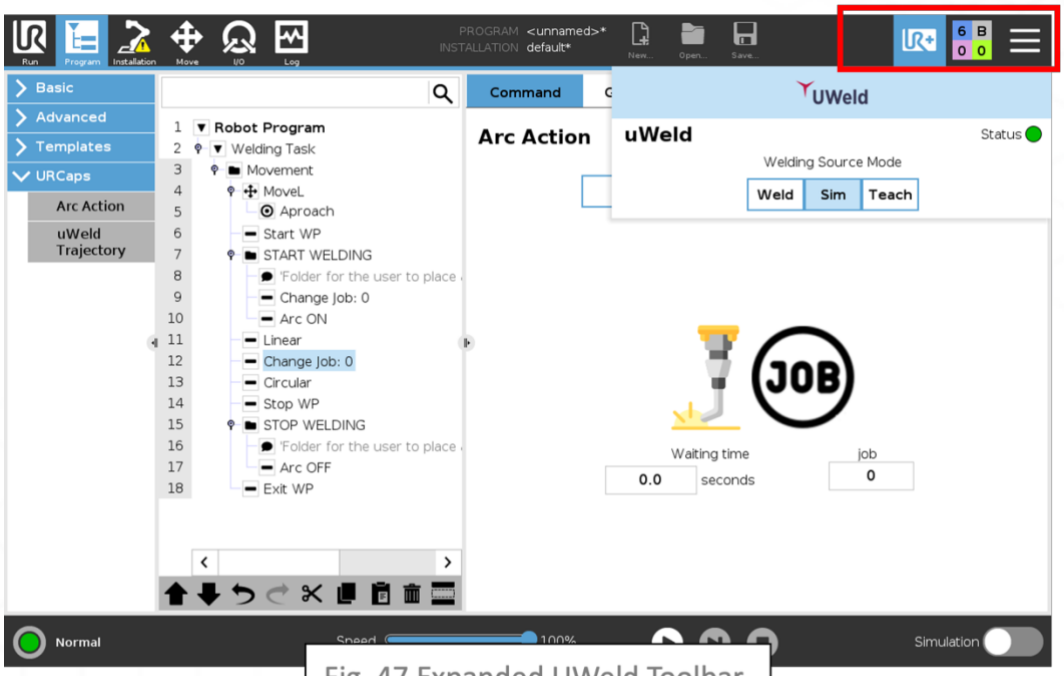

Fig. 47 Expanded UWeld Toolbar

From the UWeld Toolbar node, the user can select the mode for the welding machine:

- Weld: If this option is selected, the robot will execute the program and apply welding.
- Sim: Selecting this option will cause the robot to execute the trajectories but will not send the instruction to start the welding arc to the welding machine. This mode is used purely for simulating or testing the robot program.

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- Teach: This option is only available if a Fronius Modbus welding machine has been selected from the installation node. If any other welding machine is selected, the Teach option will not appear. Selecting Teach will execute the robot trajectories in Fronius "Teach" mode.