

TruLifter Manual

for TruLifter URcap V2.0.2

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Safety Instructions

This TruLifter drive unit is a prototype that is intended for use in demonstrations and pre-tests.

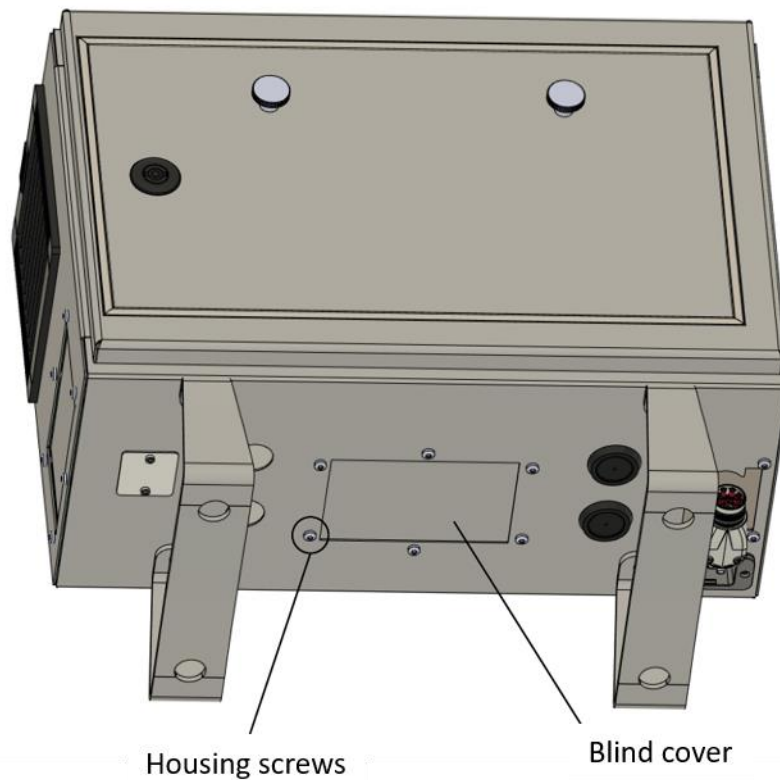
There are no safety and approval requirements for series production. After successful implementation, a risk and safety analysis according to the Machinery Directive 2006/42/EC must be performed. Liability is therefore excluded for this TruLifter drive unit. Excluded are personal injuries due to intent or gross negligence. Work around or on linear axes that have been equipped with the TruLifter drive unit may only be performed by trained personnel. For all work on the linear axis or the TruLifter drive unit, the latter must be disconnected from the power supply

1 TruLifter UR Kit – Assembly and Installation

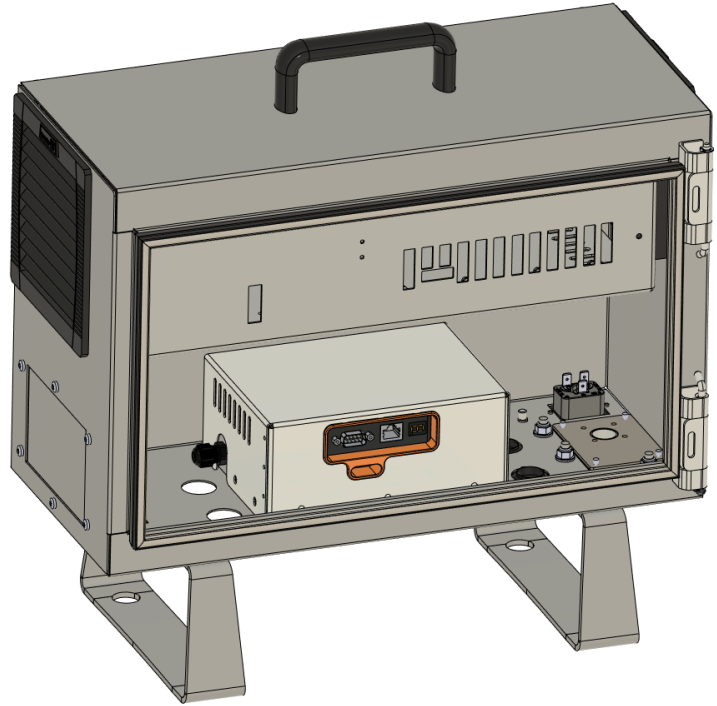
For quick and easy commissioning, TruPhysics offers a complete kit with pre-installed and pre-configured Dryve D1 motor controller, matching power supply and cable set.



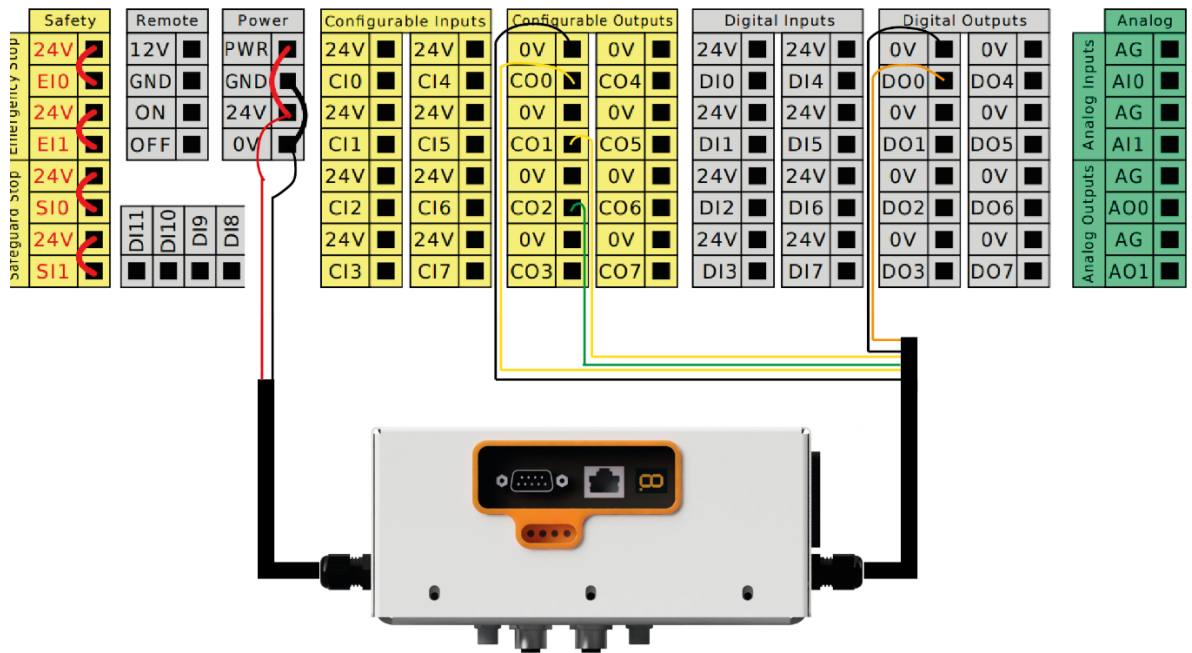
On the bottom of the UR-Controller there is a blind cover, which is mounted with 6 (e-series) or 4 screws (CB-series). Remove the screws and the blind cover.



Insert the kit into the controller and mount it in the same way as the cover (blind cover). The screws are reused.



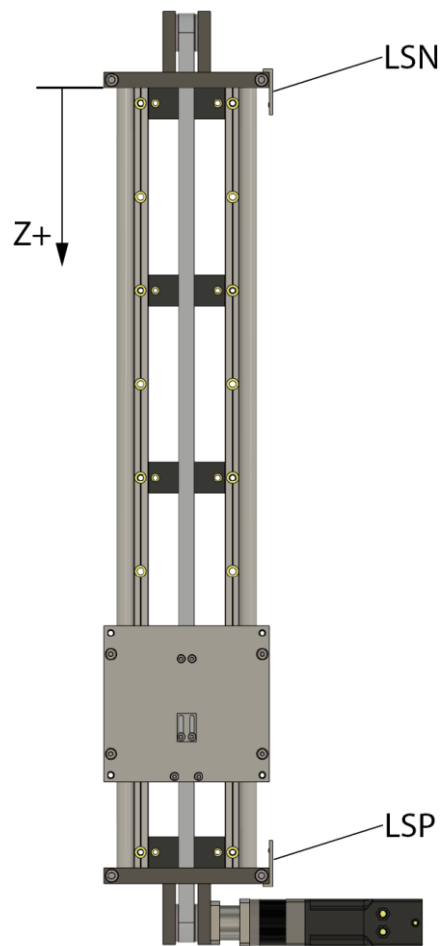
A cable harness is led out of the plug-and-play kit through the strain reliefs on the right and left side. Make the connections to the UR controller as shown in the following figure.



The connection between the kit and the linear axis is made with suitably assembled connecting cables. Plug the cable into the corresponding socket according to the labeling and secure the cable

by screwing in the knurled sleeve. This procedure must be repeated identically on the motor side. When plugging in the power supply unit, make sure that the connector is oriented correctly.

The arrangement of the drive motor and the limit switches on the toothed belt axis must correspond to the following illustration (top view of flange plate).



2 URcaps Installation and Setup

Note: The following descriptions refer to the English version of the user interface.

2.1 System Requirements

The URcap can be installed on all UR robots whose Polyscope version meets the minimum requirements, depending on whether it is an e-Series or a CB-Series UR:

- e-Series: **Polyscope V5.8.0** or higher
- CB-Series: **Polyscope V3.13.0** or higher

2.2 igus dryve Configuration

Before setting up the URcaps, the igus dryve configuration must be adjusted to the linear axis that is to be operated with the motor. For a complete description of the dryve configuration, please refer to the igus dryve motor control manual.

The configuration steps important for the TruLifter URcaps are summarized below.

2.3 igus dryve IP-Address

In order to configure the igus dryve motor controller, its current IP address must be known.

To determine the IP address, connect the igus dryve motor controller to a PC with an Ethernet cable, or to the UR. Then switch on the UR. As soon as the igus dryve motor control unit is supplied with power (which happens towards the end of the boot process), the status display on the front of the igus dryve first shows the letters "IP", followed by the current IP address.

If you want the IP address to be displayed again, simply disconnect the Ethernet cable briefly and reconnect it. The UR does not need to be switched off and on again for this purpose.

2.4 igus dryve Configuration

Connect the igus dryve motor controller to a PC with an Ethernet cable. Open a browser window (e.g. Firefox, Microsoft Edge or Google Chrome) and enter the IP address of the igus dryve motor control in the address line. Wait until the dryve configuration is loaded.

2.5 igus dryve Firmware Version

The firmware of the igus dryve motor controller must have the version **dryve-D1-1-20210510** (or newer). The installed firmware version is displayed in the igus dryve configuration in the "Start" menu item under "Firmware".

The latest dryve firmware can be downloaded from <http://www.igus.de/D1> under "Downloads". Alternatively, click the "Search" button in the dryve configuration under "Firmware" in the "Start" menu item. Unzip the downloaded .zip archive and follow the included instructions from igus to execute the update.

2.6 Configuration for linear Axis

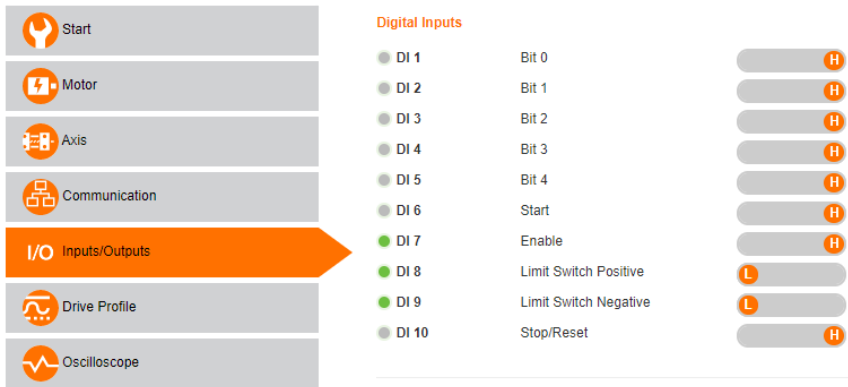
Select the menu item "Axis" on the left side. The options that are important there are marked in red in the following picture.

The screenshot shows the configuration interface for a linear axis. On the left, a vertical menu has 'Axis' highlighted. The main area is divided into sections: 'Axis' (with 'Available Stroke (mm)' and 'Feed Rate (mm)' input fields), 'Motion Limits' (with fields for Max. Velocity, Jog Velocity, Max. Acceleration, S-Curve, Quick-Stop, Following Error, Positioning Window, and Positioning Time), 'Limit Switch' (with a 'Position' dropdown), and 'Reference' (with 'Method' and 'Offset (mm)' fields). A status bar at the bottom displays 'Temperature dryve: 41.37 °C', 'Motor Current: 0.03 A', 'Actual Position: 400.00 mm', and 'Goal Position: 400.00 mm'.

In the upper part of the screen there are now two input fields for "Available Stroke" and "Feed Rate". Enter the values that match your linear axis here. Under "Method" the option "LSP (Limit Switch Positive)" must be selected. Also note down the entered values for **Available Stroke, Feed Rate, Max. Velocity and Max. Acceleration**.

Now select the "Motor" menu item on the left-hand side. The "Gear Ratio" option, which is important there, is marked in red in the image below. Note the number entered there that is not 1 (example: "5:1" is 5, "125:1" is 125, etc.).

The screenshot shows the configuration interface for a motor. On the left, a vertical menu has 'Motor' highlighted. The main area is divided into sections: 'Motor' (with fields for Motor Type, Article Number, Motor Current, Boost Current, Holding Current, Step Mode, and Step Angle) and 'Gear' (with an 'ON' toggle and a 'Gear Ratio' field). The 'Gear Ratio' field is highlighted with a red box and contains the value '5:1'.



In the "Inputs/Outputs" menu, set the digital inputs according to the figure above. Next, select "Modbus/TCP" from the drop-down box in the "Drive Profile" menu. Back at Inputs/Outputs, set the input "DI7 Enable" to L and then back to H again.

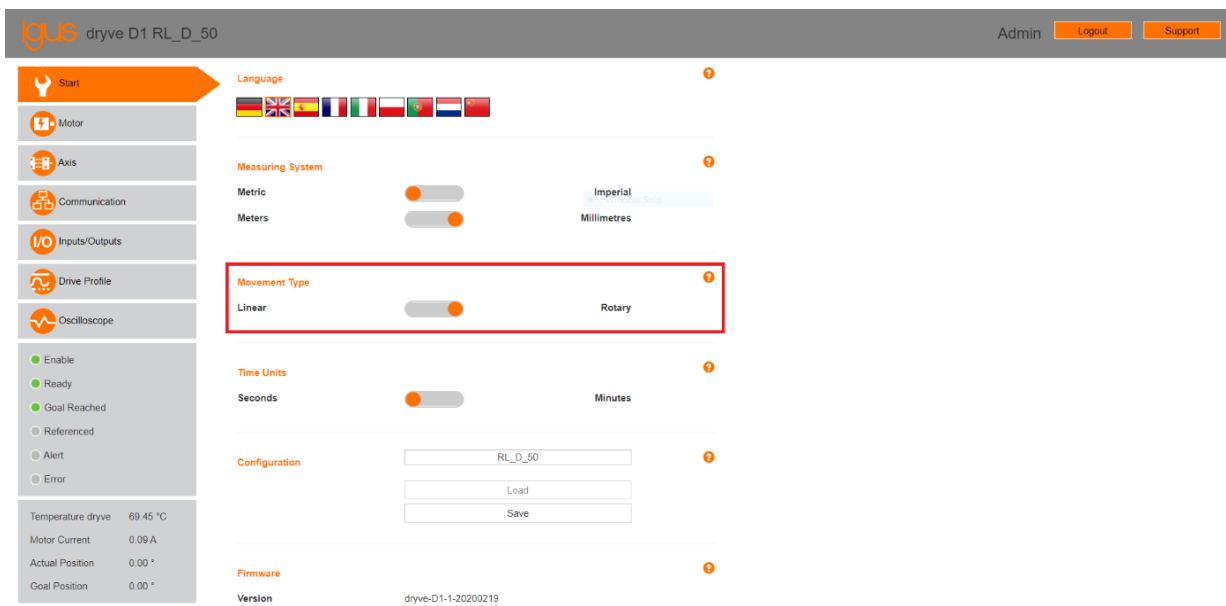
Finally, set in the Communication menu the switch next to Modbus TCP to ON.

2.7 igus dryve Motion of Rotational Axis

In the basic setting, the TruLifter URCaps supports the control of a linear movement. Alternatively, a rotatory movement can also be controlled with the TruLifter URCaps. The configuration required for this differs in a few points from the configuration of a linear movement.

2.8 igus dryve Configuration for Rotation

The igus dryve configuration must be changed in two places. Select the "Start" menu item on the left side. The "Movement Type" switch must be set from "Linear" to "Rotary" (marked red in the image below).



The **Available Stroke** option under the Axis menu item (see section "igus dryve axis configuration") must be configured based on the maximum desired revolutions. For each full revolution that is to be

possible, the number must be increased by 360. For example, for one revolution enter 360, for two revolutions 720, for 10 revolutions 3600, etc.

2.9 TruLifter Dongle

The TruLifter URCaps can only be used to its full extent with a TruLifter dongle. A TruLifter dongle is a USB device that looks like a very small USB stick.

As long as the dongle is not plugged into one of the USB ports of the UR, all functions where the motor is moved (e.g. homing or program execution) are not available. However, the TruLifter URCap can be configured without the dongle and programs can be created (but not executed) with the TruLifter program node.

The TruLifter dongle can be plugged into any available USB port on the UR, both on the teaching pendant and directly on the control computer. The dongle can be plugged in and unplugged at any time. When the dongle is unplugged, the functionality of the TruLifter URCaps is limited as described above.

2.10 URCaps Installation

The installation of the URCaps follows the normal installation process of a URCaps as described in the UR-Polyscope manual:

1. in the header bar: **Menu Icon** → **Settings**
2. **System** → **URCaps**
3. if not already done, insert the TruLifter USB stick into the USB slot of the teaching counterpart.
4. Tap the **+button** and select the .urcap file on the TruLifter USB stick.
5. Tap the **Restart** button. After the robot has restarted, the URCaps is completely installed.

2.11 URCaps Establishment

After the installation the URCap must be set up.

1. select the "**Installation**" tab in the header bar Under **URCaps**, select "**TruLifter Configuration**".
2. The following screen appears:

Run Program Installation Move I/O Log PROGRAM <unnamed> INSTALLATION default Next... Open... Save... Local C C C C

TruLifter Configuration

TRULIFTER CONFIGURATION
 TruLifter by: **tru physics**
 powered by: **igus** 1.6.6

Vertical Horizontal Rotation X

Available Stroke: 450 mm
 Max. Velocity: 100 mm/s
 Max. Acceleration: 200 mm/s²
 Feed Rate: 360 mm
 Gear Ratio: 5 :1
 IP-Address Dryve: 192.168.12.100
 Reference Pose (°): 0 -90 0 0 0 0
 Use Reference Pose in Program

Axis: 1
 Reset IO: config_out[0]
 Relais IO: digital_out[2]
 Connected: No
 Referenced: ---

REFERENCE LIFTER SET REFERENCE POSE SHOW LOGS RECONNECT

Power off Speed 100% Simulation

File 10:29:51 CCCC ?

Program Installation Move I/O Log

TruLifter Configuration

TRULIFTER CONFIGURATION
 TruLifter by: **tru physics**
 powered by: **igus** 1.6.6

Vertical Horizontal Rotation X

Available Stroke: 450 mm
 Max. Velocity: 100 mm/s
 Max. Acceleration: 200 mm/s²
 Feed Rate: 144 mm
 Gear Ratio: 5 :1
 IP-Address Dryve: 192.168.12.100
 Reference Pose (°): 0 -90 0 0 0 0
 Use Reference Pose in Program

Axis: 1
 Reset IO: digital out[0]
 Relais IO: digital out[2]
 Connected: No
 Referenced: ---

REFERENCE LIFTER SET REFERENCE POSE SHOW LOGS RECONNECT

TCP Configuration
 Mounting
 I/O Setup
 Safety
 Variables
 MODBUS
 Features
 Smooth Transition
 Conveyor Tracking
 EtherNet/IP
 PROFINET
 TruLifter Configuration
 Default Program
 Load/Save

3. Enter the IP address of the igus dryve motor control unit under "**IP Address TruLifter**" and save the installation with **Save... → Save Installation As...**

Note: By default, the IP of Dryve is: 192.168.12.100. The UR must have an IP address in the same subnet as the igus dryve motor control unit so that UR and TruLifter can communicate with each other. For example, if the dryve motor controller has the IP 192.168.1.150, the UR must have an IP address of the form 192.168.1.X, where X must not be 150.

The network configuration of the UR is described in the UR-Polyscope manual.

4. In the drop-down box labeled "**Relay IO**", select the digital output of the UR that is connected to the **safety relay**.
5. Configure the following input fields using the values you noted down during the Dryve configuration (see section "igus dryve axis configuration"). The table shows which value from the Dryve configuration has to be entered in which input field in the URCaps.

| Value in Dryve configuration | Must be entered in URCaps in |
|-------------------------------------|-------------------------------------|
| Available Stroke | → Length |
| Feed Rate | → Feed Rate |
| Max. Velocity | → Maximum Speed |
| Max. Acceleration | → Maximum Acceleration |
| Gear Ratio | → Shaft Revolutions |

Note that for **Shaft Revolutions**, only the number that is not 1 in the Dryve configuration will be entered. This means that if **Gear Ratio** is configured with the value X:1, **Shaft Revolutions** must be set to X.

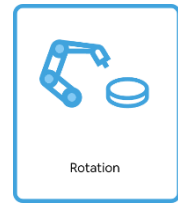
6. If not already done, plug the TruLifter dongle (see section 2.7) into one of the USB ports of the UR.

CAUTION: In the next step, the lift potentially moves along the entire length of the axis. Make sure that the robot attached to the lift cannot collide with anything.
7. Touch the "**REFERENCE LIFTER**" button. The lift then moves up until it triggers the upper limit switch **Limit Switch Positive**.

The TruLifter is now ready for use.

2.12 URCaps configuration for rotation

The TruLifter URCaps is configured for rotatory movement by tapping the button labeled "Rotation" (see the adjacent image). For rotatory movements the setting Shaft Revolutions (motor revolutions) does not have to be set, therefore the corresponding input field is hidden when a rotatory movement is selected. The rest of the URCap configuration does not differ from the configuration for linear movements.



2.13 Multiple Axis

TruLifter URCaps supports the control of multiple axes with the same UR program. The prerequisite for this is a corresponding license code. When ordering the license, you must specify how many axes you want to control with TruLifter URCaps. By entering the license code, the URCap is then configured accordingly.

The configuration of multiple axes works in the same way as the configuration of a single axis. Which of the available axes should be configured can be selected from the drop-down box labeled "Axis" in the upper right corner.

2.14 Changing the Number of Axis

Since the number of controllable axes depends on the license code entered, it can only be changed by entering a new license code. To do this, the current license must first be removed.

To remove the current license, touch the "**REMOVE LICENSE**" button. A security prompt will appear asking if the license should really be removed. After confirming this prompt, the license will be removed and a new license code can be entered (see step 2 in section "**URCaps Setup**").

2.15 Transfer Pose

In TruLifter, a so-called **Transfer Pose** can be configured. The transfer position is given by six joint angles that define a pose in which the robot must be before a reference run in the program node (see below) is possible. The six input fields stand for from left to right: Base, shoulder, elbow, wrist 1, wrist 2, wrist 3.

- As of V1.1.7, the transfer pose can be deactivated, so when creating a control program, special care should be taken that the robot does not move in an undesired position on the axis.
- The transfer pose has no influence on the execution of a reference run from the installation screen, with the button "**REFERENCE LIFTER**". It refers exclusively to the reference run in the program node.

2.16 Resetting an Error Condition

In certain cases, the igus dryve motor control sets an error state for safety reasons and no longer accepts movement commands. An example is the triggering of one of the limit switches. A list of all possible error states can be found in the igus dryve motor control manual.

If an error state is set, the TruLifter URCaps cannot be used anymore until the error state is cleared. Therefore, in this case the connection state is displayed as "ERROR" (instead of "Yes" or "No").

In order to bring the igus dryve motor control unit and the TruLifter URCaps back into a usable state, the cause of the error must first be eliminated. Once this has been done, the error condition in the motor control unit must be reset. There are two ways to do this.

First, the configuration of the motor control unit can be called up in a browser (see section "**igus dryve configuration**"). If an error state is set, the configuration will display a "Reset" button in the lower left corner of the screen. Clicking this button resets the error state. If this button has no effect, the cause of the error still exists.

It is also possible to reset the error state directly in TruLifter URCaps. To do this, one of the digital outputs of the UR must be connected to the digital input 2X.10 of the igus dryve motor control (for details, see the manuals of UR and motor control). Once this has been done, the corresponding digital output of the UR must be selected in the dropdown box labeled "Error IO". Afterwards, an error state can be reset by pressing the "RESET ERROR" button.

2.17 Restoring the Connection when the Connection is interrupted

The TruLifter URCaps will not work if no connection can be established between UR and igus dryve motor control. Possible reasons can be a loose network cable between TruLifter and UR or a faulty network configuration of the UR (see point 3 in the section "URCaps").

Once a connection problem has been solved, the TruLifter URCaps will in most cases automatically reconnect to the igus dryve motor control unit. However, sometimes it is necessary to manually trigger a reconnection. To do this, touch the "**RECONNECT**" button.

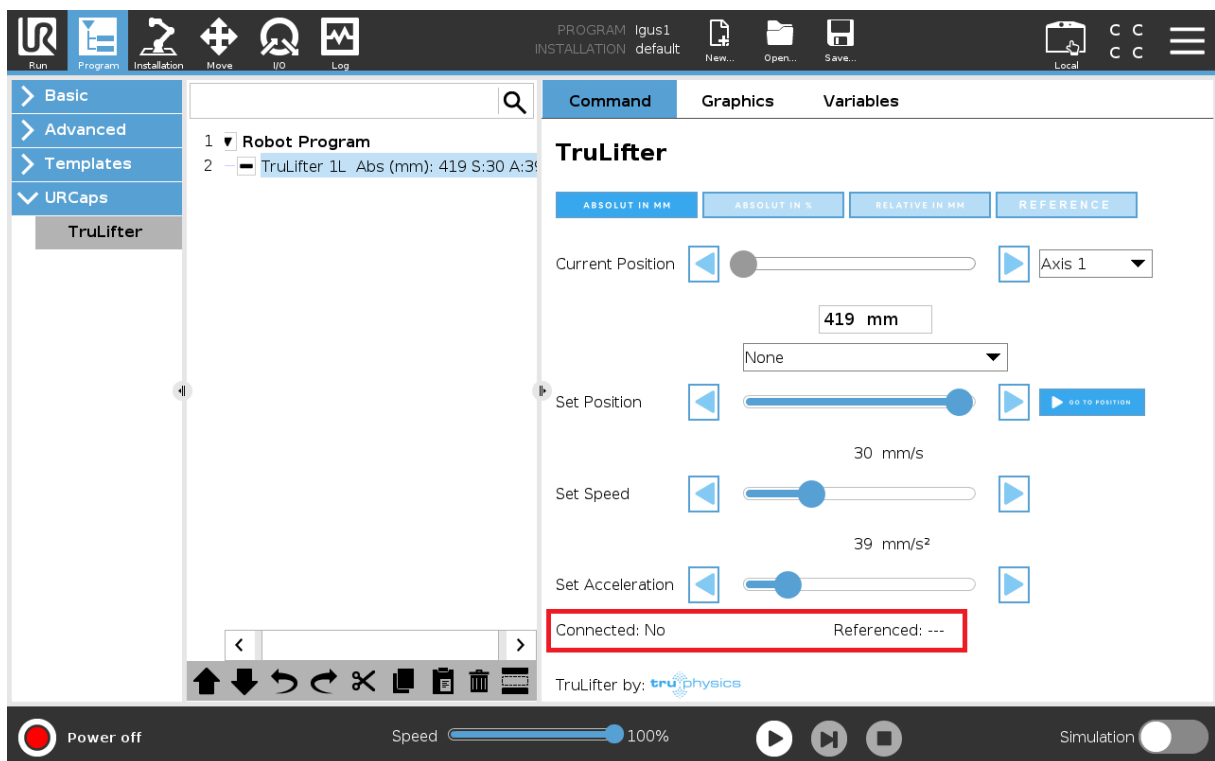
If no connection can be established, please restart the UR. If the problem persists, please contact TruPhysics Support for assistance.

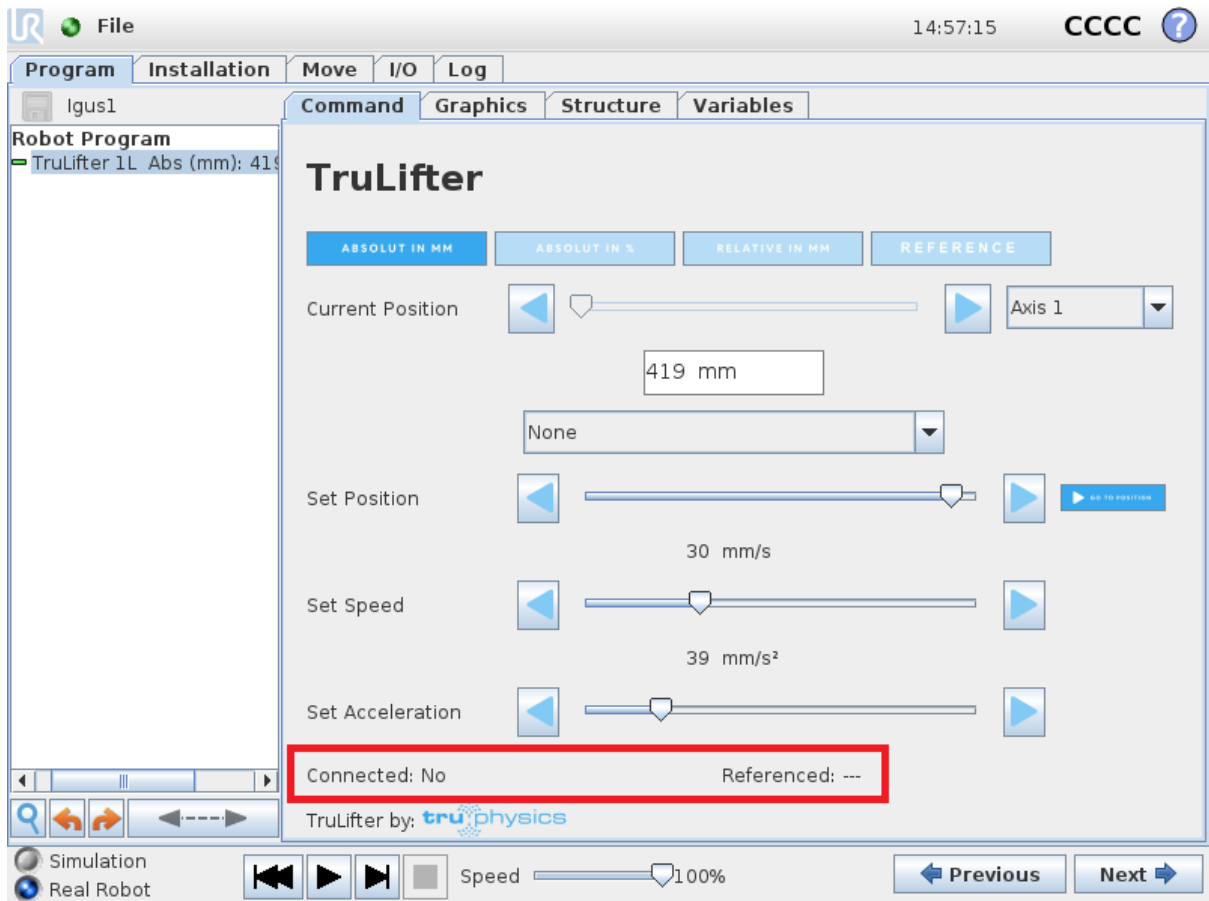
3 Lifter Programming

3.1 TruLifter Program Node

The TruLifter program node can be inserted into a control program like any other Polyscope program node. It is located below the standard UR commands in the "URCaps" menu.

With the TruLifter program node, movement commands can be sent to the lift. For this to work, there must be a connection to the lift and the lift must be referenced. The current status of these two conditions is indicated in the TruLifter program node in the bottom line, marked in red in the following picture:





Connection setup and referencing are described in section URCap setup.

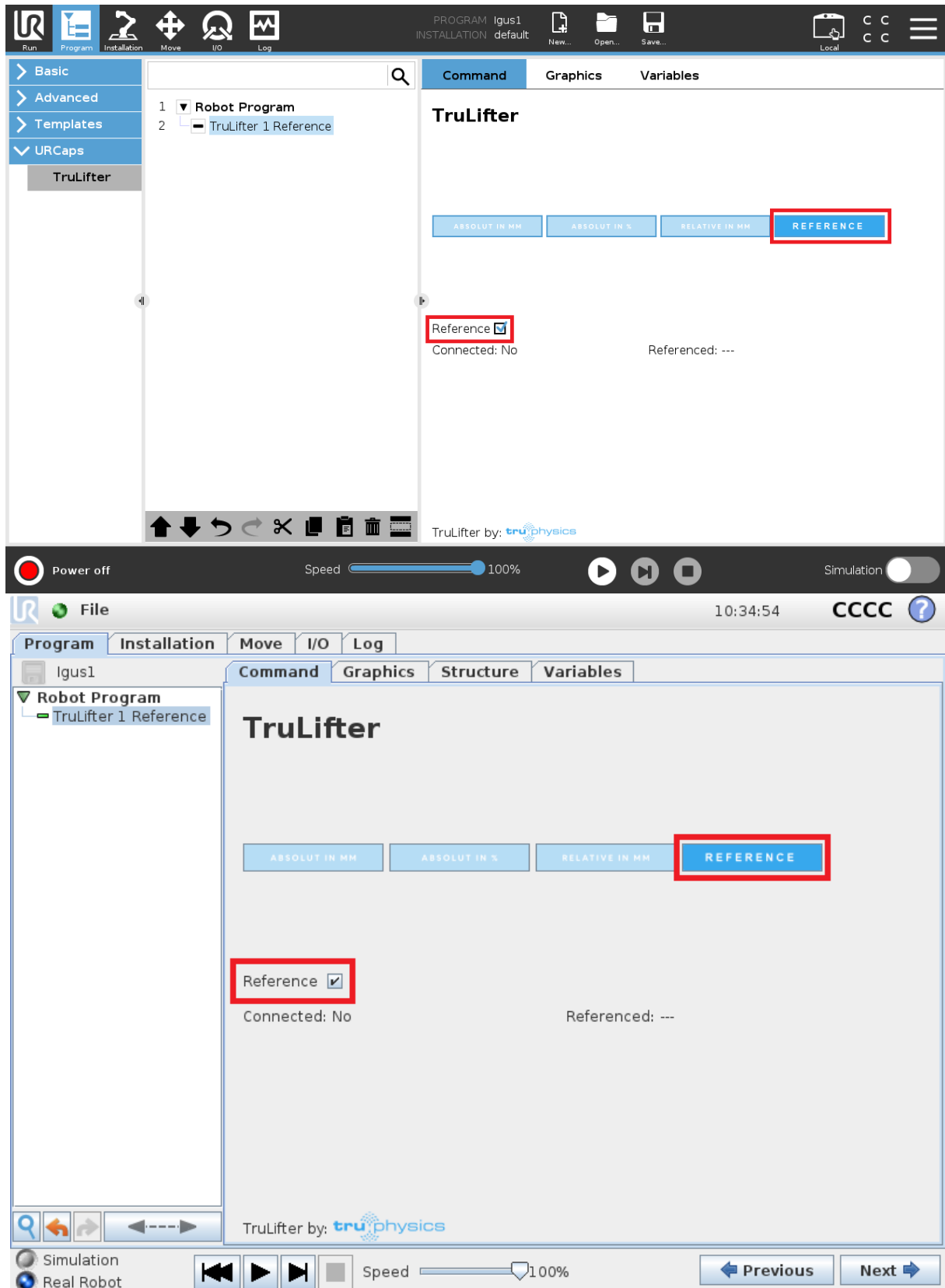
3.2 Referencing in the program node

To be able to execute movement commands, the TruLifter must be referenced. The lift is referenced by performing a reference run. The lift moves upwards until it triggers the upper limit switch **Limit Switch Positive**.

A reference run can be initiated in two ways.

1. by tapping the "**REFERENCE LIFTER**" button on the TruLifter installation tab.
2. by inserting a reference node into a Polyscope program.

Reference node



A reference node is inserted into a Polyscope program by adding a TruLifter program node to the program. Then the "**REFERENCE**" tab must be selected and the "**Reference**" checkbox must be marked. The tab and the checkbox are marked red in the following image.

If a reference node is reached in the program flow and TruLifter is not already referenced, TruLifter performs a reference run and then continues with the remaining program flow.

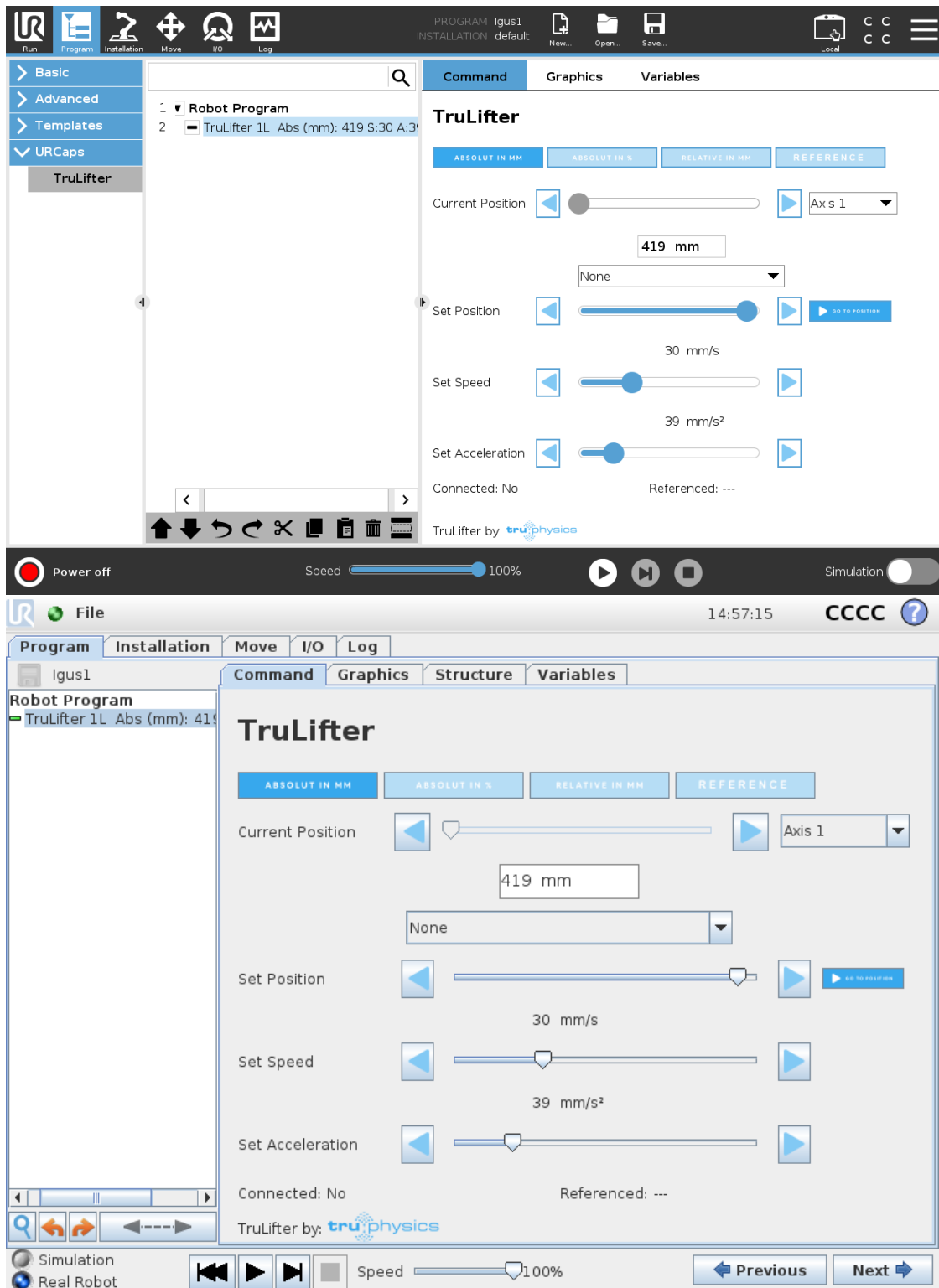
When inserting a reference node, please note that the robot must be in the "**Reference Pose**" for the reference run. (Reference Position), which is configured in the Installation tab (see section "Other Configuration"). If a reference node is reached in the program flow and the robot is not in the reference pose, the program flow will abort with an error message. This ensures that the lift never moves while the UR is in an undefined position.

It is useful to have a reference node directly follow an UR movement command that brings the robot into the reference pose.

3.3 Motion Commands

The TruLifter program node offers four different ways to move the lifter. Three of them are suitable for linear axes, and the fourth for rotational movements. The following images show all available motion commands.

Absolute movement with target in millimeters (linear axis):



Absolute movement with target in percent (linear axis):

The image displays two screenshots of the TruLifter software interface. The top screenshot shows the main control panel with the following elements:

- Top Bar:** Includes icons for Run, Program, Installation, Move, I/O, and Log. It also shows 'PROGRAM Icus1' and 'INSTALLATION default'.
- Left Panel:** A tree view showing 'Robot Program' and 'TruLifter 1L Abs (%) : 70 S:30 A:39'.
- Main Panel:** Titled 'TruLifter', it features four tabs: 'ABSOLUTE IN MM', 'ABSOLUTE IN %' (selected), 'RELATIVE IN MM', and 'REFERENCE'.
 - Set Position in %:** A slider set to 70% with a speed of 30 mm/s.
 - Set Speed:** A slider set to 39 mm/s².
 - Set Acceleration:** A slider.
 - Buttons:** 'GO TO POSITION' and 'Connected: No'.
 - Status:** 'Referenced: ---'.
- Bottom Bar:** Shows 'Power off', a 'Speed' slider at 100%, and a 'Simulation' toggle.

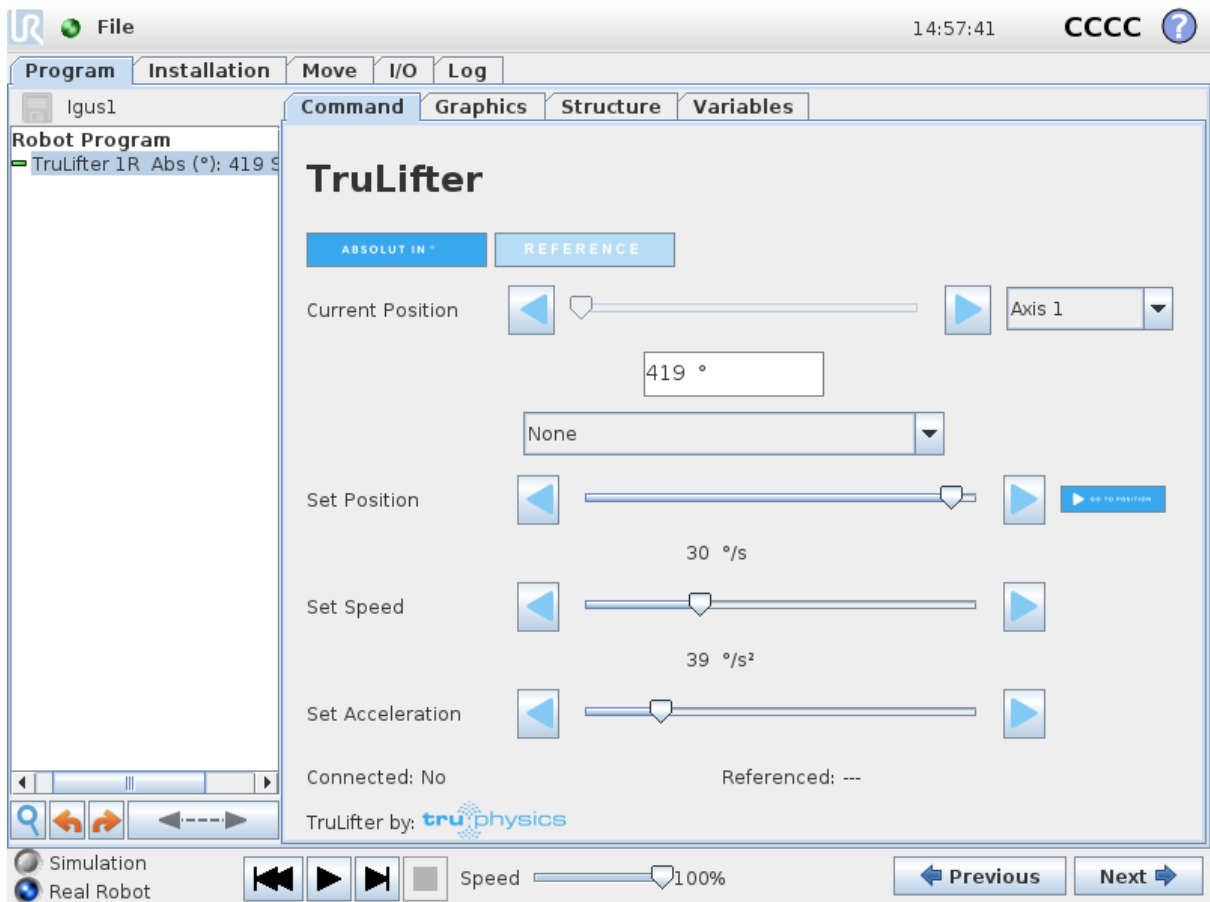
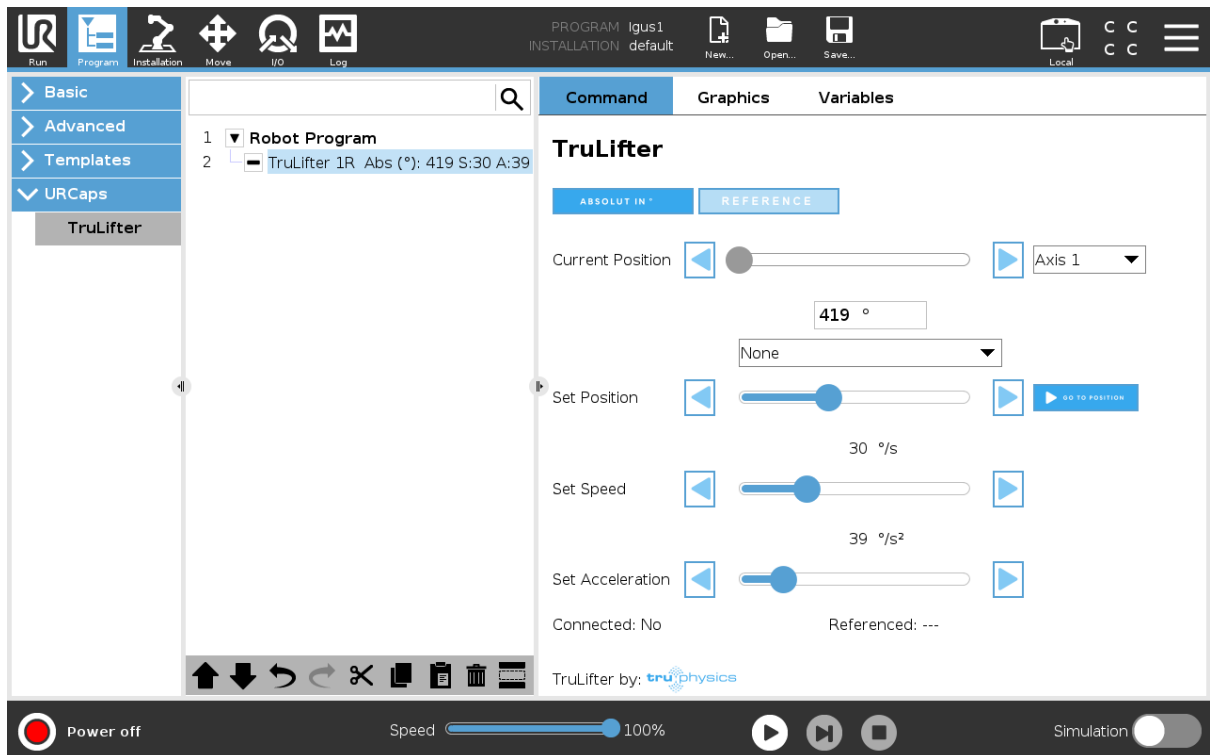
The bottom screenshot shows a more detailed view of the 'TruLifter' control panel with the following elements:

- Top Bar:** Includes 'File', 'Program', 'Installation', 'Move', 'I/O', and 'Log' tabs. It shows 'Icus1' and '10:34:09'.
- Left Panel:** A tree view showing 'Robot Program' and 'TruLifter 1L Abs (%) : 70 S'.
- Main Panel:** Titled 'TruLifter', it features four tabs: 'ABSOLUTE IN MM', 'ABSOLUTE IN %' (selected), 'RELATIVE IN MM', and 'REFERENCE'.
 - Set Position in %:** A slider set to 70% with a speed of 30 mm/s.
 - Set Speed:** A slider set to 39 mm/s².
 - Set Acceleration:** A slider.
 - Buttons:** 'GO TO POSITION' and 'Connected: No'.
 - Status:** 'Referenced: ---'.
- Bottom Bar:** Shows 'Simulation' and 'Real Robot' modes, a 'Speed' slider at 100%, and 'Previous' and 'Next' navigation buttons.

Motion relative to current position (linear axis):

The image shows two screenshots of the UR robot control interface. The top screenshot shows the 'TruLifter' configuration window with the 'RELATIVE IN MM' mode selected. The 'Set Relative Move' is set to 24 mm, 'Set Speed' is 30 mm/s, and 'Set Acceleration' is 39 mm/s². The 'Connected' status is 'No' and 'Referenced' is '---'. The bottom screenshot shows the same configuration window, but with the 'ABSOLUTE IN MM' mode selected. The 'Set Relative Move' is still 24 mm, but the 'Set Speed' and 'Set Acceleration' sliders are now disabled. The 'Connected' status is 'No' and 'Referenced' is '---'. The interface includes a top toolbar with icons for Run, Program, Installation, Move, I/O, and Log. The bottom toolbar includes a Power off button, a Speed slider set to 100%, and buttons for Simulation and Real Robot. The status bar at the bottom shows the time 10:34:42 and the CCCC logo.

Rotatory movement:



All four commands allow you to configure the speed and acceleration of the TruLifter movement, taking into account the maxima defined in the installation tab.

All four commands also have a button that causes the command to be executed immediately without a program running, provided the lift is referenced.

Otherwise, the following special features apply.

3.4 Absolute movement with target in millimeters

This command makes the lift move to a certain position, indicated in millimeters. The position 0mm is the lower **Limit Switch Negative**.

In the second line, the target position to which the lift moves when this node is reached in the program sequence is defined.

This command has a display of the current lift position in the top line. With the arrows to the left and right of this display, the lift can be moved directly in the corresponding direction as long as no program is running and the lift is referenced.

Multiple axes

If TruLifter URcaps is configured for the controllers of multiple axes, each movement command always refers to exactly one specific axis. The axis can be selected with the **upper drop-down box** next to the display of the current position.

Direct specification of the target position

The target position for a move command can be selected using the "Set Position" slider.

Target position from program variable

Alternatively, to the "Set Position" slider, the target position can also be read from a program variable. The variable must be defined before the movement command and must contain an integer.

To read the target position from a variable, the name of the variable must be selected in the **lower drop-down box** next to the display of the current position. If the "Set Position" slider is to be used instead, the entry "None" must be selected in this dropdown box.

3.5 Absolute Movement with Target in Percent

This command makes the lift move to a certain position, expressed as a percentage of the axis length. The 0% position is at the lower limit switch **Limit Switch Negative**.

Motion Relative to Current Position

This command moves the TruLifter a certain distance up or down, relative to the current position.

Rotatory Movement

This movement command works like the "absolute movement with target position in millimeters" command, with the only difference that the target position is specified in degrees. The command offers the same settings regarding multiple axes and specification of the target position.

Contact Information

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