

# TruLifter Manual


for TruLifter URCap V2.0.2

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# Safety Instructions

The safety relay of the TruLifter motor control unit achieves Performance Level e according to EN ISO 13849. The motor control system is an incomplete machine. After successful implementation, a risk and safety analysis must be performed for the entire system consisting of drive, axis, robot with end effector, environment, etc. in accordance with the Machinery Directive 2006/42/EG. The liability for the overall system lies with the integrator. Personal injury due to intent or gross negligence is excluded. Work around or on linear axes that have been equipped with TruLifter motor controls may only be carried out by trained personnel. For all work on the linear axis or the TruLifter motor control unit, the latter must be de-energized.

**TruLifter** 

## Declaration of incorporation

according to EMC directive 2014/30/EU

**Hereby the manufacturer,**  
TruPhysics GmbH  
Seyfferstraße 34  
70197 Stuttgart

**Declares that the product**  
TruLifter-Kit

following basic requirements listed in Annex I of this directive are applied and observed.

**The following additional EC directives were applied:**  
2011/65/EU ROHS (including amendments up to 2019/178)

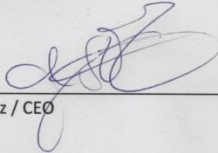
**The following harmonized standards (or parts thereof) were applied:**  
EN 61000-6-2 Immunity for industrial environments  
EN 61000-6-3 Emissions for residential areas, business and commercial areas, small businesses

**Function**  
The product serves as a motor control unit for stepper motors with a supply voltage of 48V DC and standard (metric) sensor/actuator cables.

**Forwarding of documents**  
We are committed to forward the special documents on the incomplete machine via regular mail to national authorities on reasoned request.

**Authorized representative for technical documentation:**  
Robert Buchelt  
Seyfferstraße 34  
70197 Stuttgart

Stuttgart, 15.12.2021

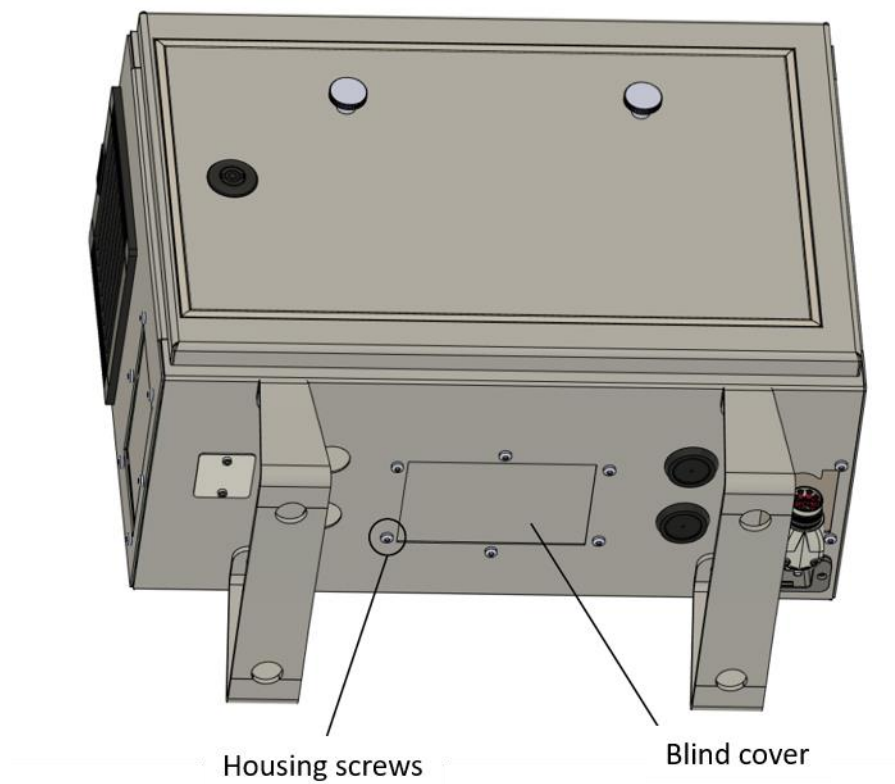
  
\_\_\_\_\_  
Albert Groz / CEO

# 1 TruLifter UR Kit – Assembly and Installation

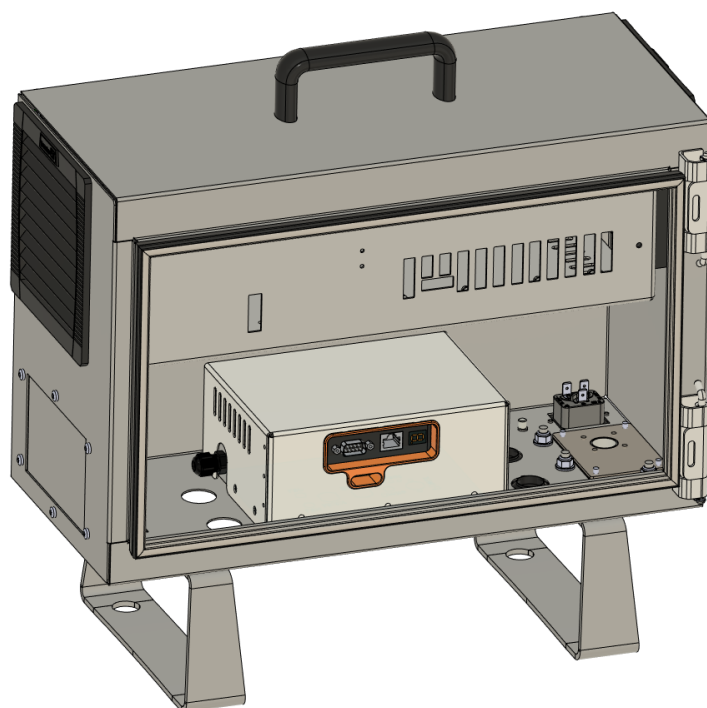
For quick and easy commissioning, TruPhysics offers a complete kit with pre-installed and pre-configured Dryve D1 motor controller, matching power supply and cable set.



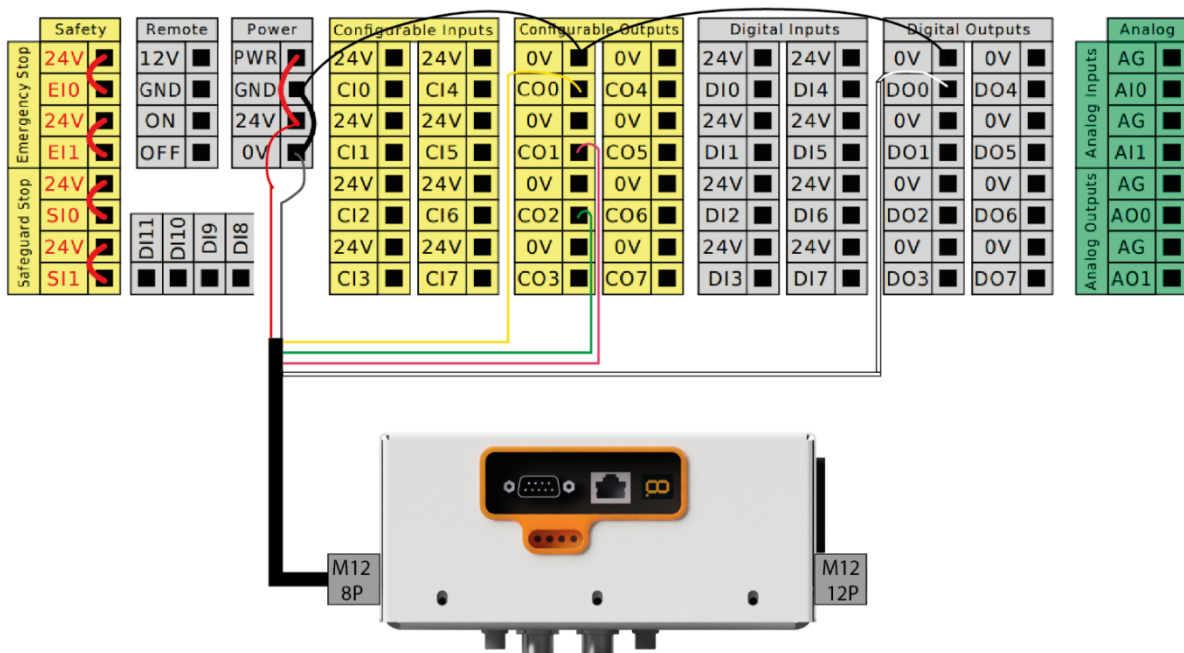
On the bottom of the UR-Controller there is a blind cover, which is mounted with 6 (e-series) or 4 screws (CB-series). Remove the screws and the blind cover.



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



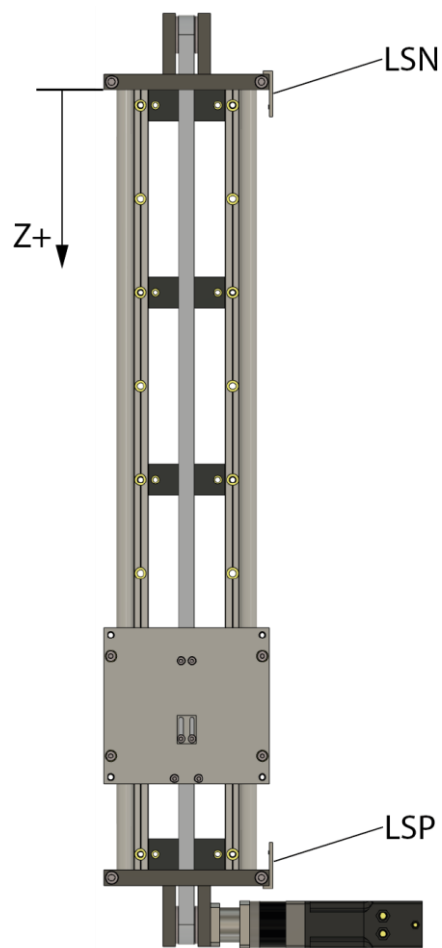
Connect the provided M12 8P cable to the connector on the left side of the kit and establish the wire connections to the UR-controller as shown below.



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.

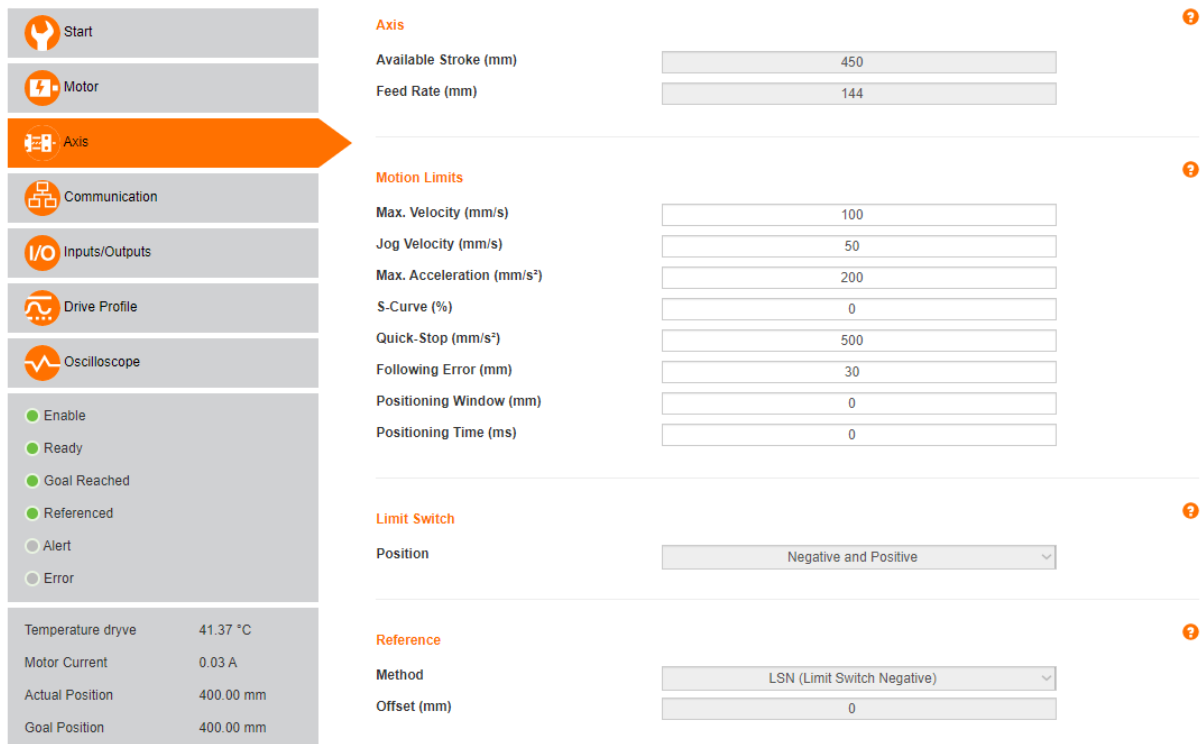
### 2.5 igus dryve Firmware Version

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.



**Start**

**Motor**

**Axis**

Communication

I/O Inputs/Outputs

Drive Profile

Oscilloscope

Enable

Ready

Goal Reached

Referenced

Alert

Error

Temperature dryve 41.37 °C

Motor Current 0.03 A

Actual Position 400.00 mm

Goal Position 400.00 mm

**Axis**

Available Stroke (mm) 450

Feed Rate (mm) 144

**Motion Limits**

Max. Velocity (mm/s) 100

Jog Velocity (mm/s) 50

Max. Acceleration (mm/s²) 200

S-Curve (%) 0

Quick-Stop (mm/s²) 500

Following Error (mm) 30

Positioning Window (mm) 0

Positioning Time (ms) 0

**Limit Switch**

Position Negative and Positive

**Reference**

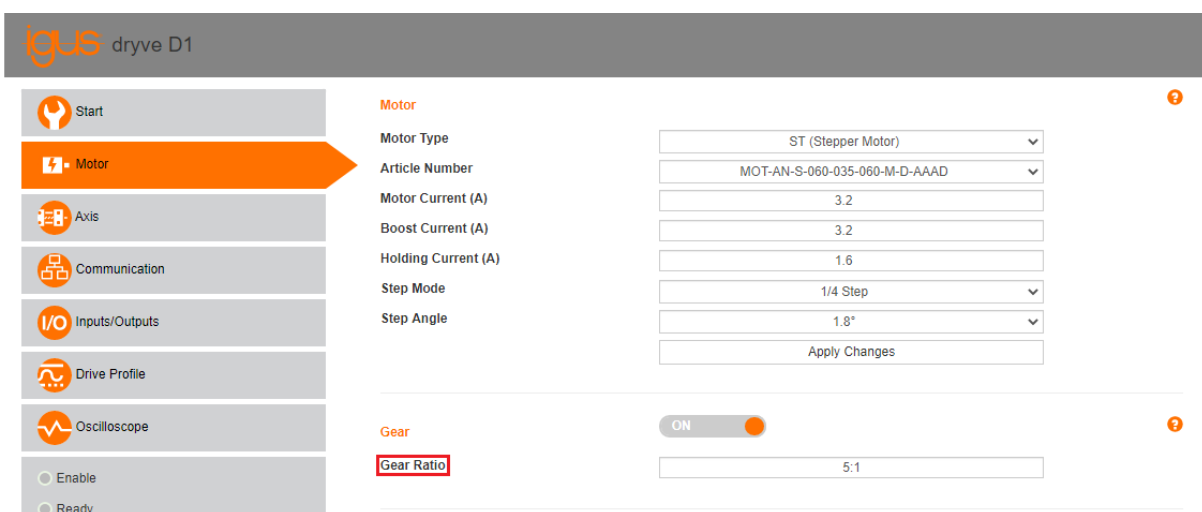
Method LSN (Limit Switch Negative)

Offset (mm) 0

**Gear Ratio** 5:1

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.).



**Start**

**Motor**

Axis

Communication

I/O Inputs/Outputs

Drive Profile

Oscilloscope

Enable

Ready

**Motor**

Motor Type ST (Stepper Motor)

Article Number MOT-AN-S-060-035-060-M-D-AAAD

Motor Current (A) 3.2

Boost Current (A) 3.2

Holding Current (A) 1.6

Step Mode 1/4 Step

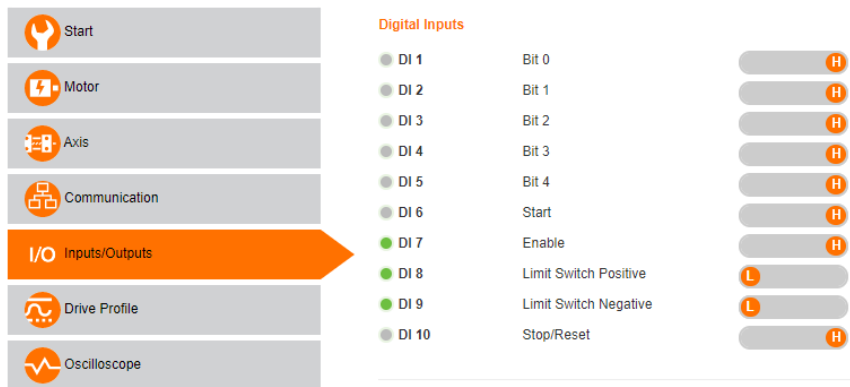
Step Angle 1.8°

Apply Changes

**Gear**

ON

**Gear Ratio** 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.

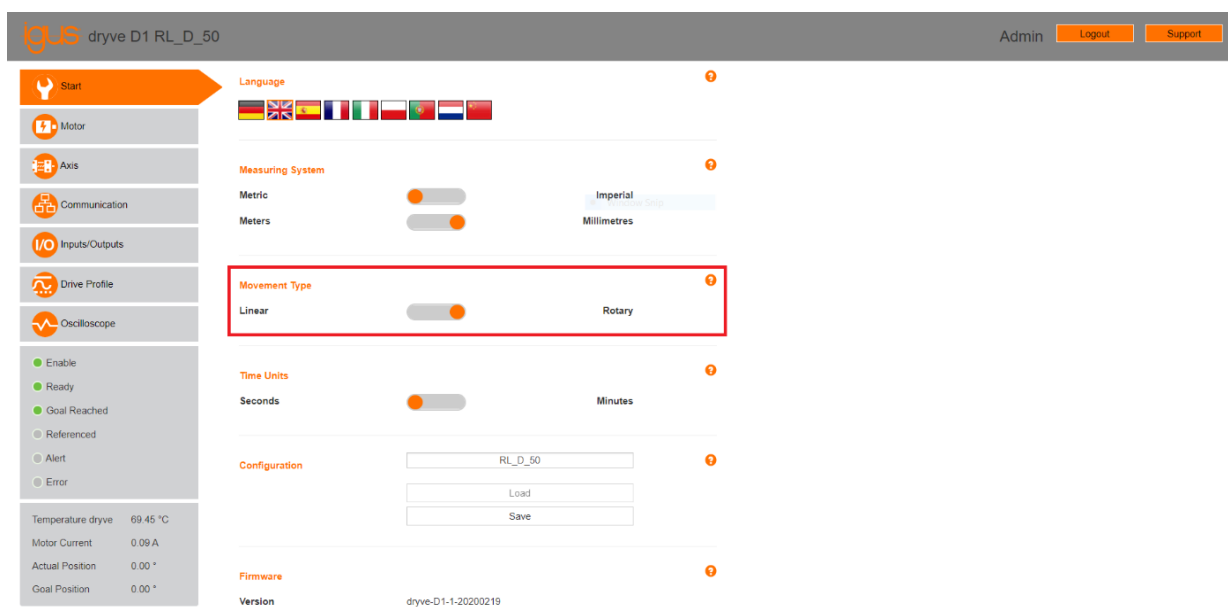
Finally, set in the Communication menu the switch next to Modbus TCP to ON.

## 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

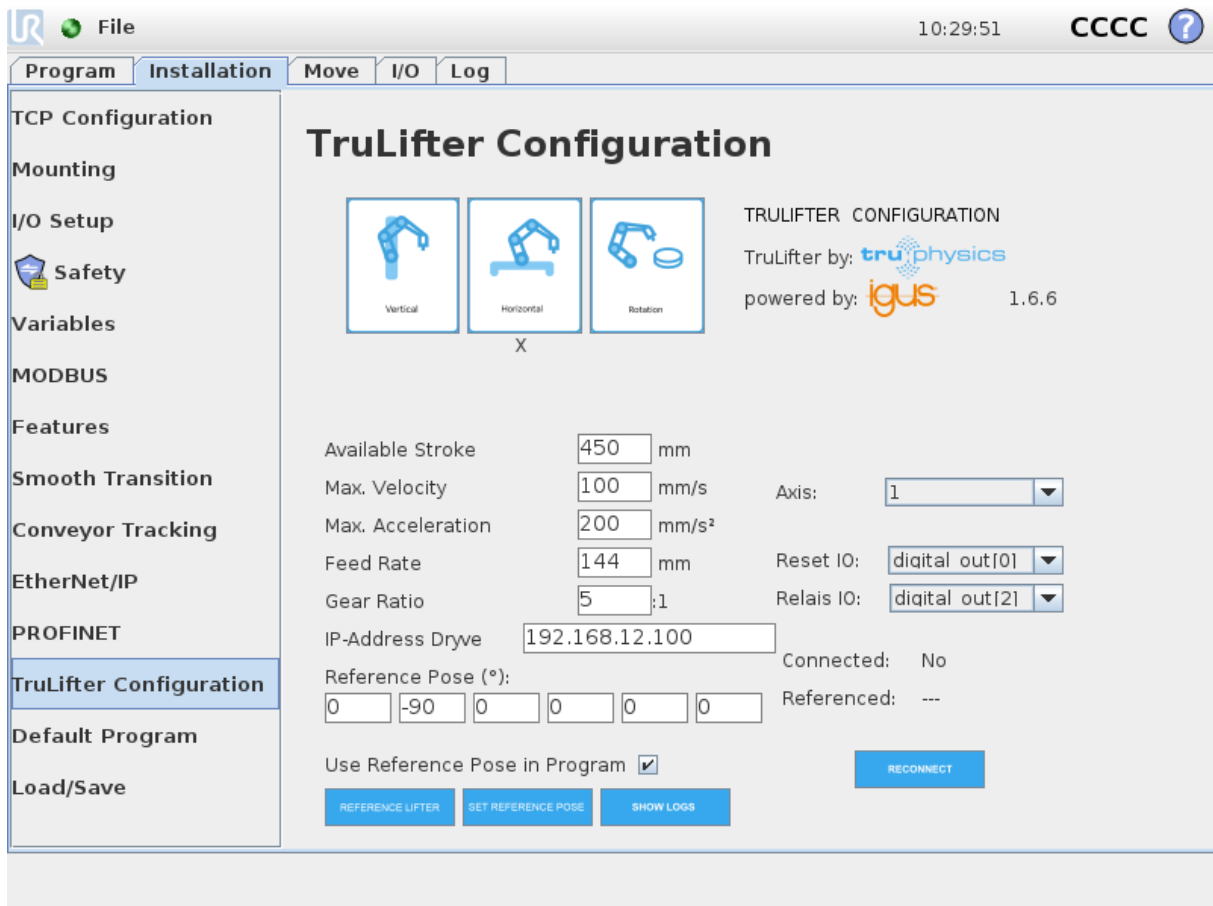
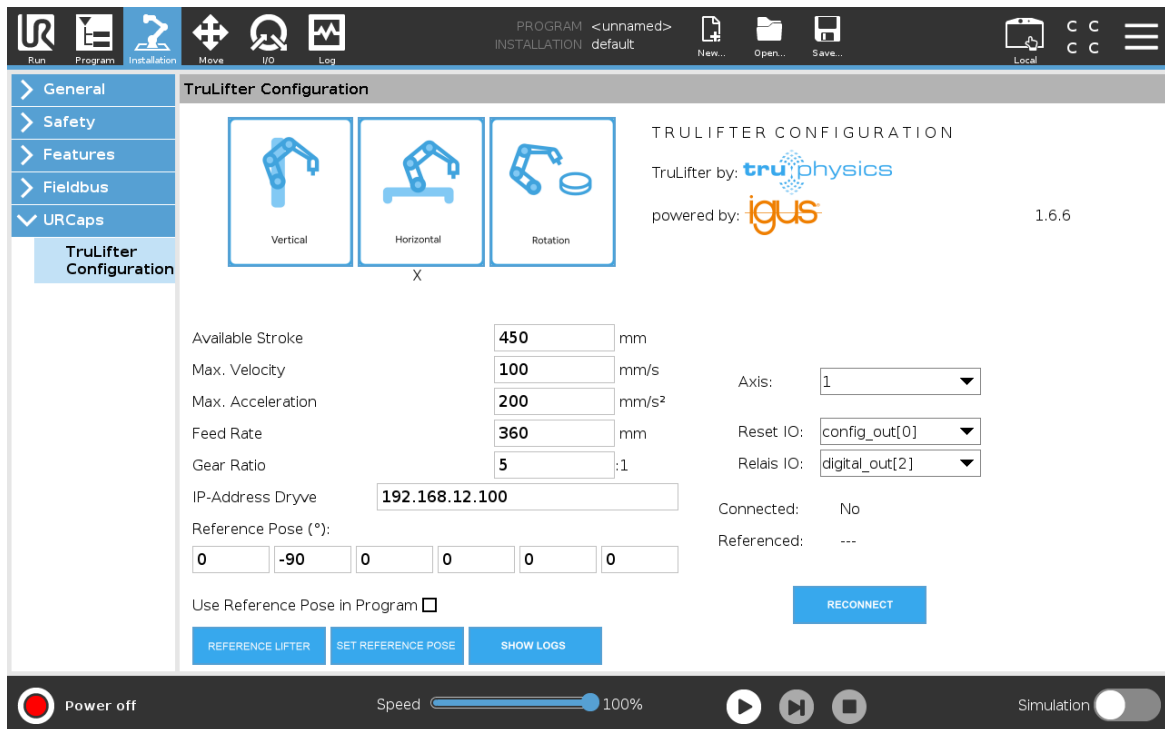
The installation of the URCaps follows the normal installation process of a URCaps as described in the UR-Polyscope manual:

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:



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.

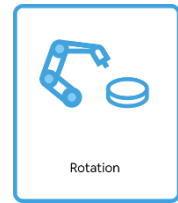
**CAUTION:** In the next step, the lift potentially moves along the entire length of the axis. Make sure that the robot attached to the lift cannot collide with anything.

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.

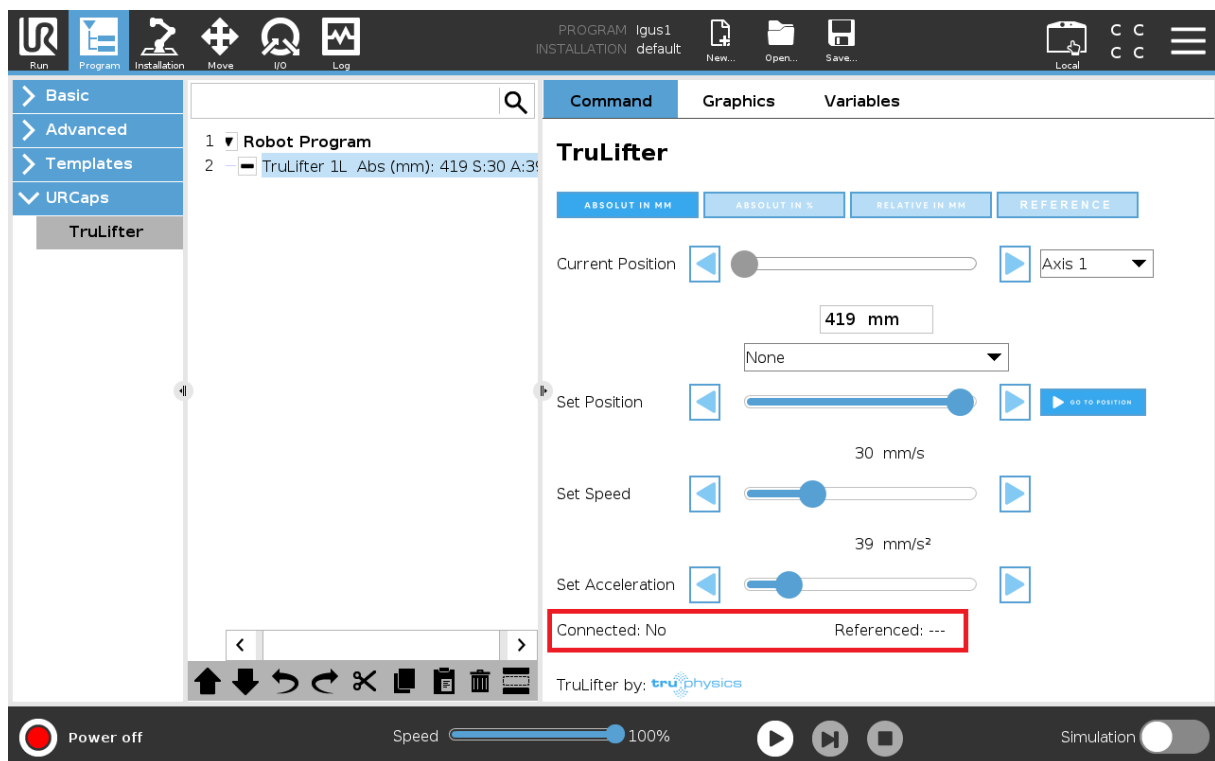
If no connection can be established, please restart the UR. If the problem persists, please contact TruPhysics Support for assistance.

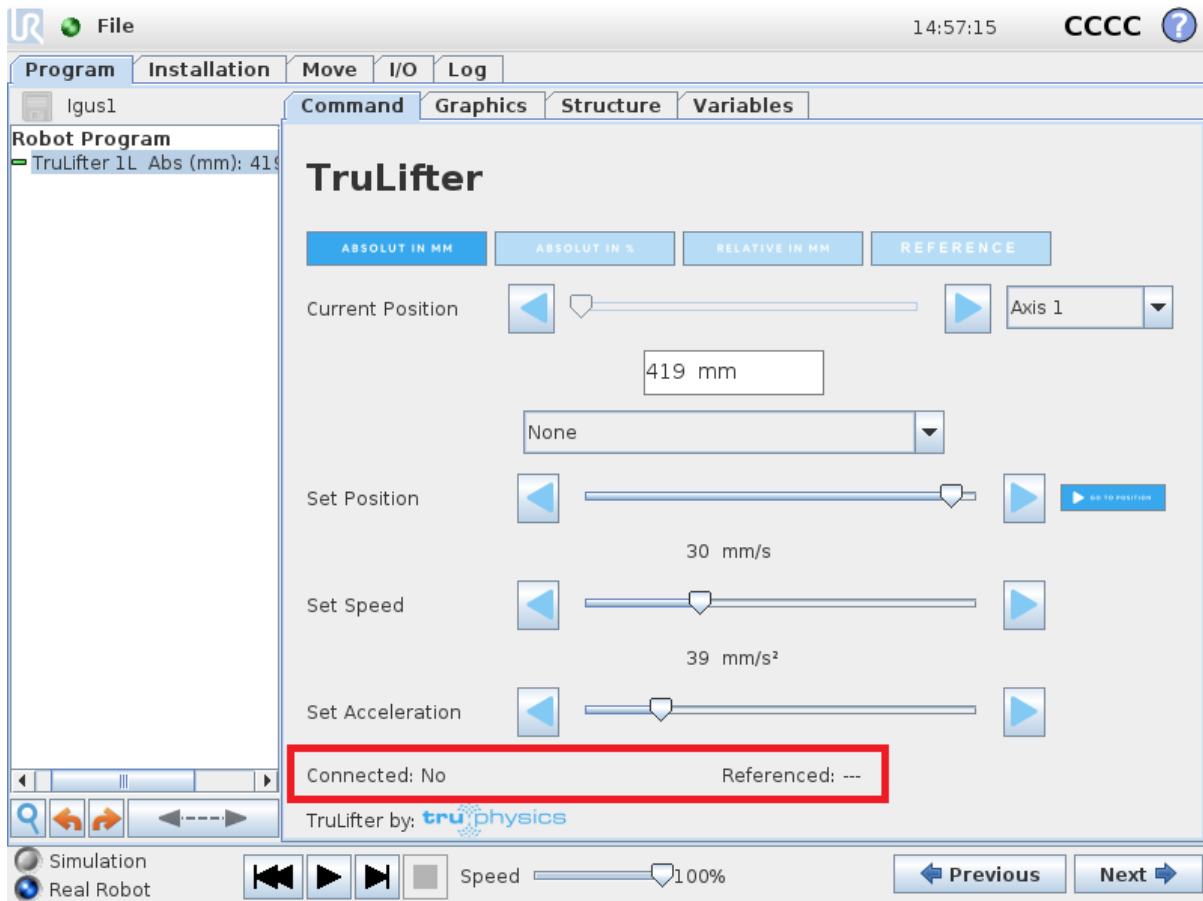
## 3 Lifter Programming

### 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

The image displays two screenshots of the TruLifter software interface, illustrating the configuration of the Reference node.

**Top Screenshot:** The interface shows the 'Command' tab. The 'TruLifter' section has four buttons: 'ABSOLUT IN MM', 'ABSOLUT IN %', 'RELATIVE IN MM', and 'REFERENCE'. The 'REFERENCE' button is highlighted with a red box. Below these buttons, the 'Reference' checkbox is checked and highlighted with a red box. The status 'Connected: No' and 'Referenced: ---' are displayed.

**Bottom Screenshot:** The interface shows the 'Structure' tab. The 'TruLifter' section has the same four buttons, with 'REFERENCE' highlighted by a red box. The 'Reference' checkbox is checked and highlighted by a red box. The status 'Connected: No' and 'Referenced: ---' are displayed.

Both screenshots show the 'TruLifter by: tru physics' logo at the bottom.



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.

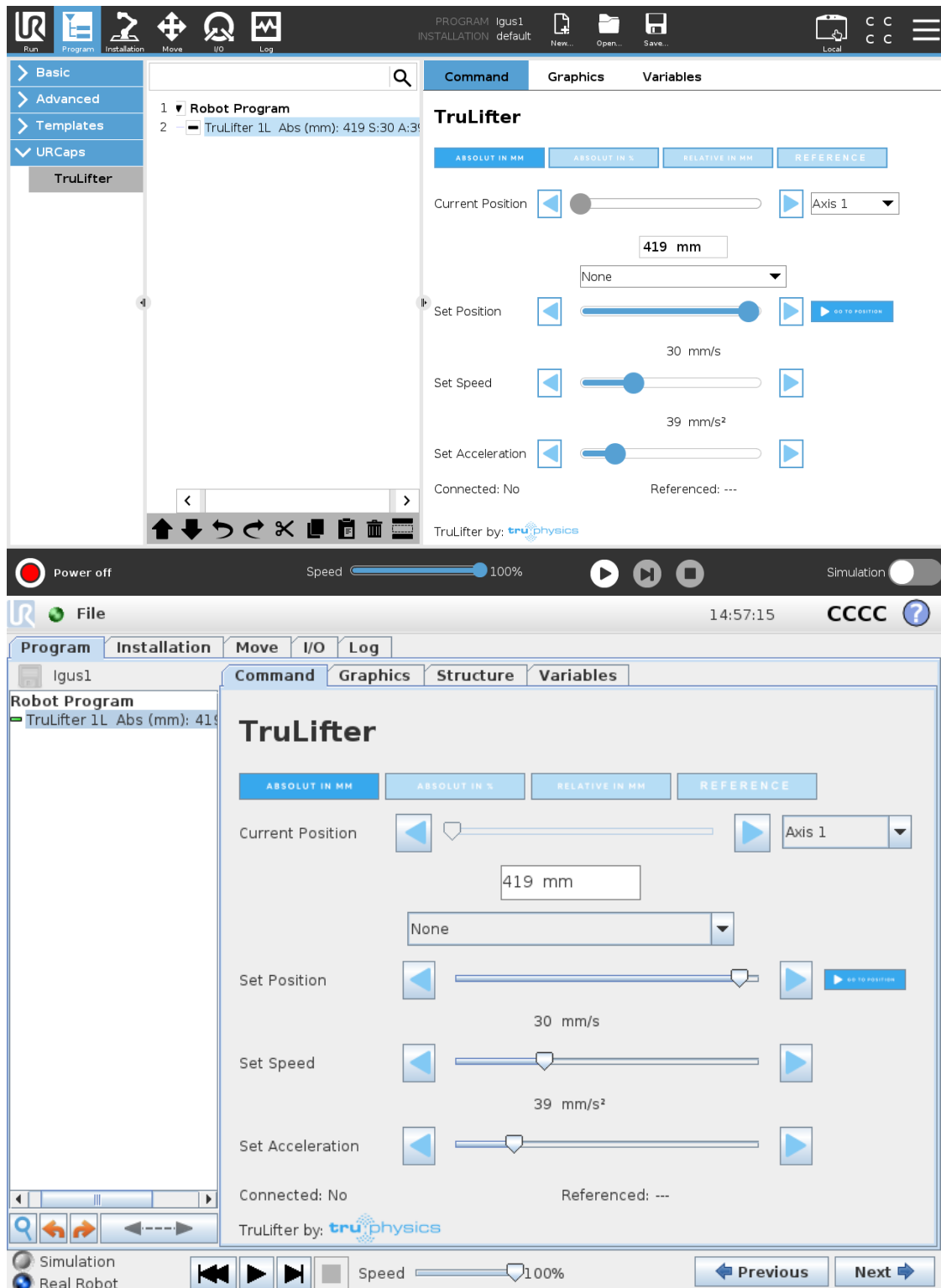
When inserting a reference node, please note that the robot must be in the "**Reference Pose**" for the reference run. (Reference Position), which is configured in the Installation tab (see section "Other Configuration"). If a reference node is reached in the program flow and the robot is not in the 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, showing the configuration for absolute movement with a target in percent (linear axis).

**Top Screenshot:**

- Command Tab:** Shows the configuration for the TruLifter command.
- Set Position in %:** Slider set to 70%.
- Set Speed:** Slider set to 30 mm/s.
- Set Acceleration:** Slider set to 39 mm/s<sup>2</sup>.
- Buttons:** "GO TO POSITION" button is visible.
- Status:** "Connected: No", "Referenced: ---".
- Bottom Bar:** "Power off" button, "Speed" slider (100%), "Simulation" toggle (off).

**Bottom Screenshot:**

- Command Tab:** Shows the configuration for the TruLifter command.
- Set Position in %:** Slider set to approximately 50%.
- Set Speed:** Slider set to 30 mm/s.
- Set Acceleration:** Slider set to 39 mm/s<sup>2</sup>.
- Buttons:** "GO TO POSITION" button is visible.
- Status:** "Connected: No", "Referenced: ---".
- Bottom Bar:** "Simulation" and "Real Robot" buttons, "Speed" slider (100%), "Previous" and "Next" buttons.

Motion relative to current position (linear axis):

The image displays two screenshots of the TruLifter software interface, showing the configuration for a linear axis motion.

**Top Screenshot:** The 'TruLifter' window is open, showing the 'Command' tab. The 'Set Relative Move' is set to 24. The 'Set Speed' is 30 mm/s, and the 'Set Acceleration' is 39 mm/s². The 'Connected' status is 'No', and the 'Referenced' status is '---'. The 'TruLifter by: tru physics' logo is visible at the bottom.

**Bottom Screenshot:** The 'TruLifter' window is open, showing the 'Command' tab. The 'Set Relative Move' is set to 24. The 'Set Speed' is 30 mm/s, and the 'Set Acceleration' is 39 mm/s². The 'Connected' status is 'No', and the 'Referenced' status is '---'. The 'TruLifter by: tru physics' logo is visible at the bottom.

Rotatory movement:

The image displays two screenshots of the TruLifter software interface, which is used for controlling a robot's rotatory movement.

**Top Screenshot:** The interface shows the 'Command' tab. The 'TruLifter' section includes sliders for 'Current Position' (set to 419°), 'Set Position', 'Set Speed' (set to 30°/s), and 'Set Acceleration' (set to 39°/s²). The 'Connected' status is 'No' and 'Referenced' is '---'. The 'Simulation' button is visible at the bottom right.

**Bottom Screenshot:** The interface shows the 'Structure' tab. The 'TruLifter' section includes sliders for 'Current Position' (set to 419°), 'Set Position', 'Set Speed' (set to 30°/s), and 'Set Acceleration' (set to 39°/s²). The 'Connected' status is 'No' and 'Referenced' is '---'. The 'Simulation' button is visible at the bottom left.

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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