

ESTIC



ESTIC PULSE



Cobot High-Torque Fastening Setup Guide

High-Torque Fastening setup guide

2021/08/08

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Revisions

Manual revision

Version	Date	Description
001	2021/08/08	Created

URcap revision

URcap version	Date	Description
EsticFastening-1.0.10.urcap	2021/7/16	UR testing version

Compatible Torque controller

Controller	Description
Estic Handy 2000 Touch	Firmware version: GA1452 or later

Annotation

- The URcap is only compatible with 5.9 or later for e-series, and 3.15 or later for CB3-series.
- This manual is consisting of 3 main sections:
 1. Hardware setup
 2. Torque Controller setup
 3. URcap setup

For URcap to work correctly, please read the manual thoroughly and complete the steps of each section.

Hardware setup

Mechanical Setup

Bill of Materials



End-of-arm tool mounting

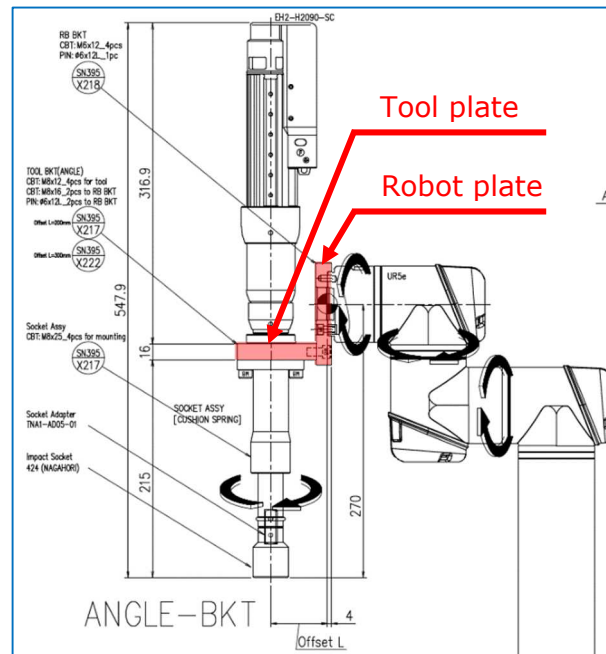
Parts Name	Description	Parts number	Vendor	QTY
Robot plate	UR tool flange mounting plate	SN395-X218	Estic	1
▪ Bolt	To secure Robot plate to tool flange.	NPN (M6X12)		4
▪ Pin	For Robot plate alignment.	NPN (Φ6x12L)		1
Tool plate	Nutrunner side mounting plate	SN395-X217	Estic	
▪ Bolt	To secure Nutrunner to the plate	NPN (M8X12)		4
▪ Bolt	To join Robot & Tool plate.	NPN (M8X16)		2
▪ Pin	For tool plate alignment.	NPN (Φ6x12L)		2

Floating Socket

Parts Name	Description	Parts number	Vendor	QTY
Socket assembly	Drive shaft, cushion spring, inner and outer tube assembly.	SN395-X217	Estic	1
Socket Adapter	To join Impact Socket and inner tube.	TNA1-AD05-01	Estic	1
Impact socket	For bolt fastening. (Varies according to bolt size)	NPN		1

EOAT Setup

Step 1: Assemble Tool-Robot Coupler



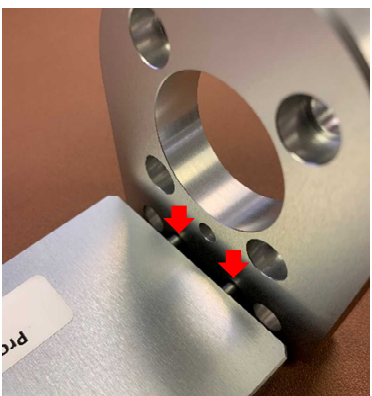
1. Insert two ($\Phi 6 \times 12L$) pins to the dowel holes on the Tool plate, as shown below.



2. Face this side of the Robot plate towards the tool plate.



3. Insert the pins to the Robot plate's dowel hole, as shown below.

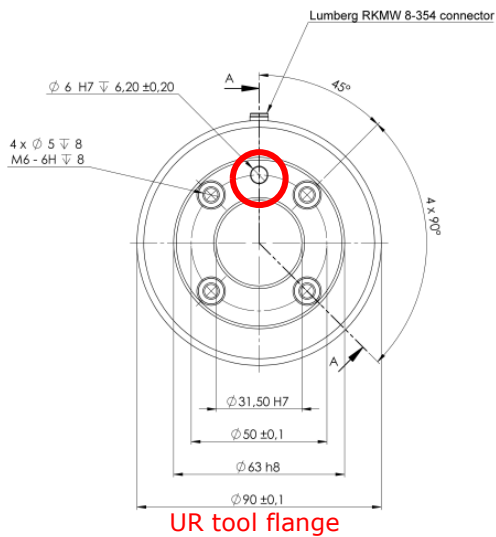


4. Secure the joint by fastening two M8x16 bolts.



Step 2: Mount the Coupler to the Robot tool flange

1. Insert one ($\Phi 6 \times 12L$) pin to the dowel hole on the UR Tool flange, as shown below.



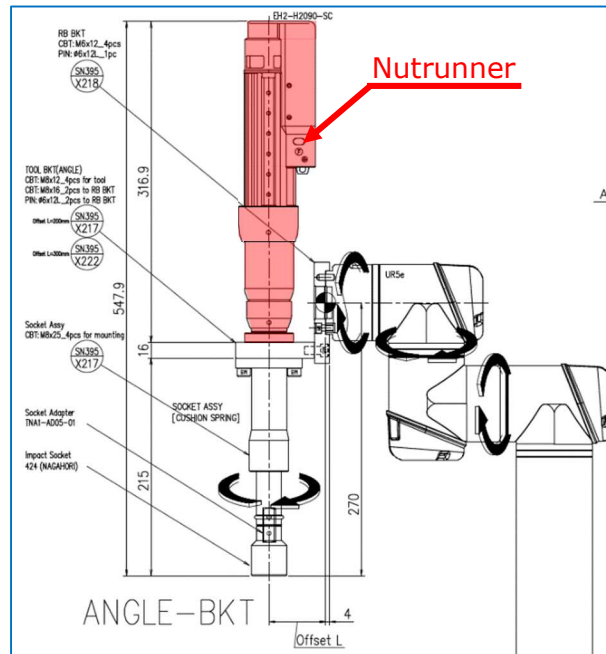
2. Face this side of the Robot plate towards UR tool flange.



3. Align plate's dowel hole to the pin and secure using M6x12 bolts after mounting it.



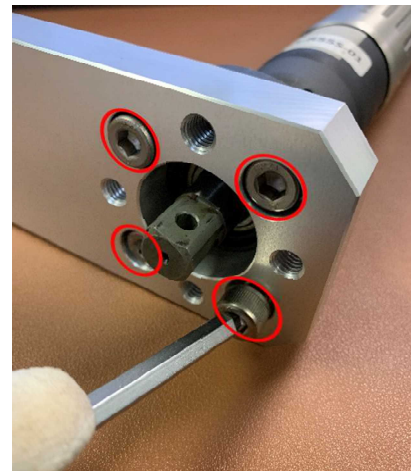
Step 3: Mount Nutrunner to the Coupler



1. Mount the Nutrunner and align the 4 threaded holes to Coupler's counterbore holes.



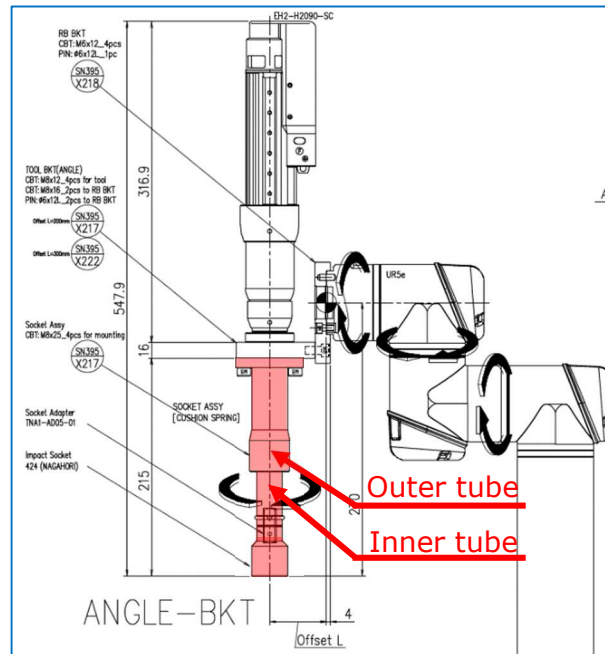
2. Insert M8x12 bolts from below. Fasten bolt so it will flush with bottom surface of the Coupler.



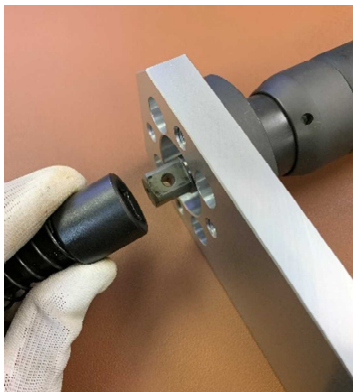
3. The bolts shown below should flush with the Nutrunner's flange if fastened correctly.



Step 4: Mount floating socket to the Coupler



1. Align floating socket's drive shaft with Nutrunner's output shaft.



2. Insert the drive shaft and the spring into the outer case. Then, align it with inner tube's drive shaft.

3. Once aligned, secure the Floating socket by fastening M8x25 bolts from below.



Electrical Setup

Bill of Materials

Estic fastening system				
Parts Name	Description	Parts number	Vendor	QTY
Handy2000 Touch Torque controller	Store torque programs. Touch screen.	EH2-HT50-000*** (* optional feature)	Estic	1
Nutrunner (High-Speed Pulse Drive)	Fastening tool.	See table below	Estic	1
Tool cable	Connect Controller and the tool	EH2-CVS0*-SS (* cable length. 5=5m)	Estic	1
Power cable	100V or 230V power cable	EH2-CP02-UL1 (100V) EH2-CP02-CE2 (240V)	Estic	1

Nutrunner			
Type	Description	Parts number	Vendor
Micro tools	Torque lower than 5Nm	EH2-RA1000-SNL/SNP/SRL- EH2-RA2000 -SNL/SNP/SRL EH2-RA5000 -SNL/SNP/SRL	Estic
Inline tools	Torque from 6 to 45Nm	EH2-H0025-SC EH2-H1045-SC	Estic
Right-angle tools	Torque from 46 Nm to 140Nm	EH2-H1070-A EH2-H2100-A EH2-H2140-A	Estic

Tool and Controller setup

1. Align and push the tool cable into the connector on the Nutrunner.



2. Secure the tool cable by screwing in the outer case.



3. Connect the other end of the tool cable to the controller.



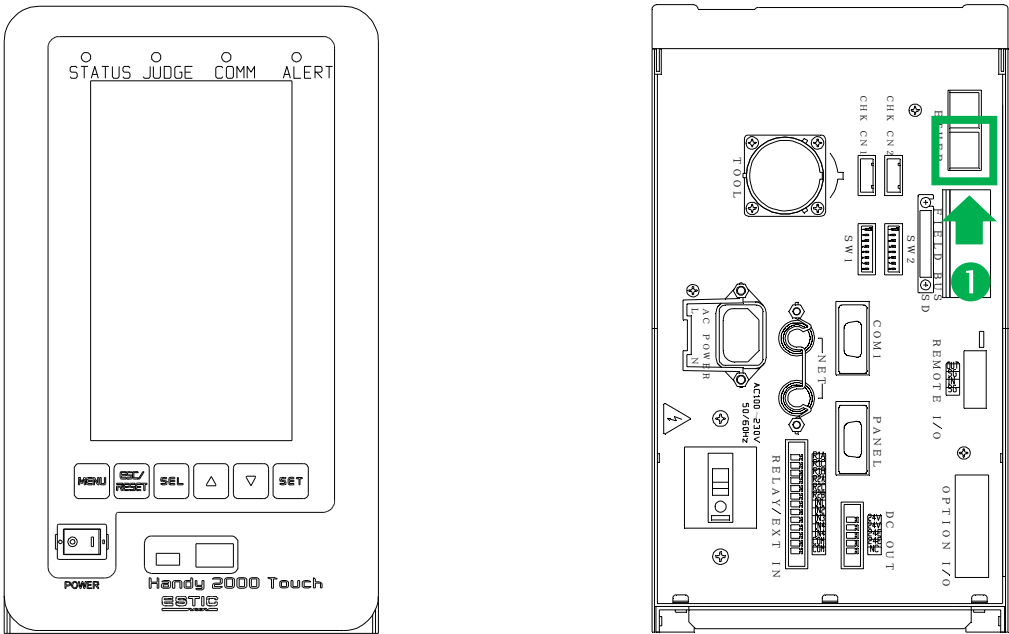
4. Connect power cable



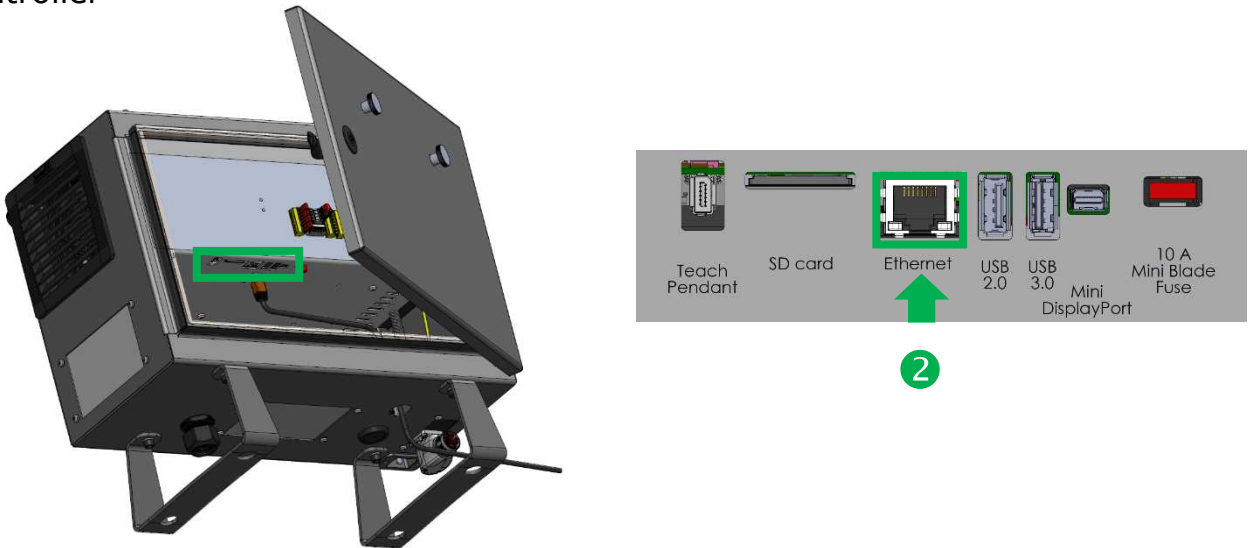
Modbus connection setup

Communication cable			
Parts Name	Description	Parts number	QTY
LAN cable	Cross-over or Straight LAN cable Cat.5e or above	NPN	1
Ethernet switch	Required if using straight LAN cable	NPN	1

Estic Torque Controller



UR Controller



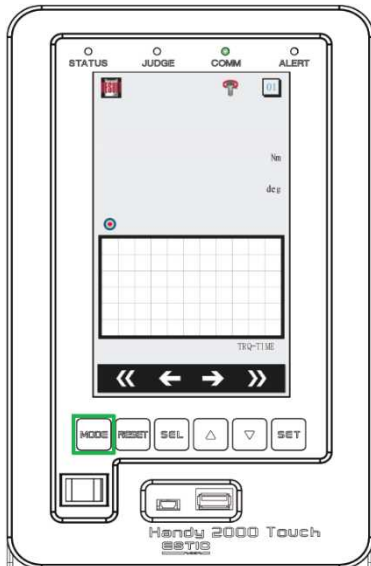
1. Connect the LAN cable (Cross-over, Cat.5e or above) to Estic controller's Ethernet port.
2. Connect the other end of the LAN cable to the UR Ethernet port.
3. For straight-through LAN cable, use industrial ethernet switch in between to connect.

Torque Controller setup

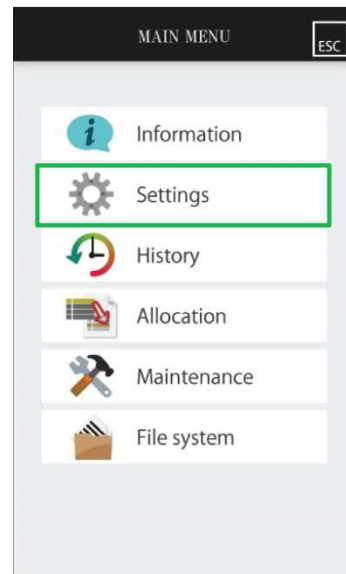
IP address configuration

Configure Torque controller's IP address through touch screen.

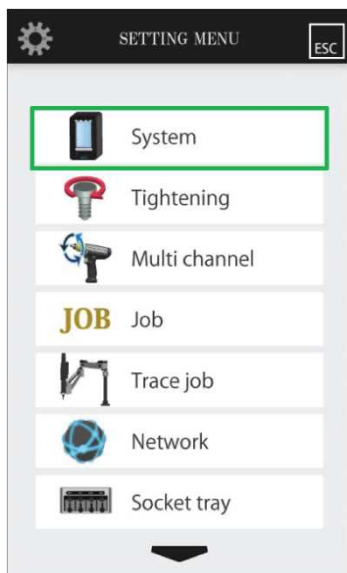
1. Push "MODE" button.



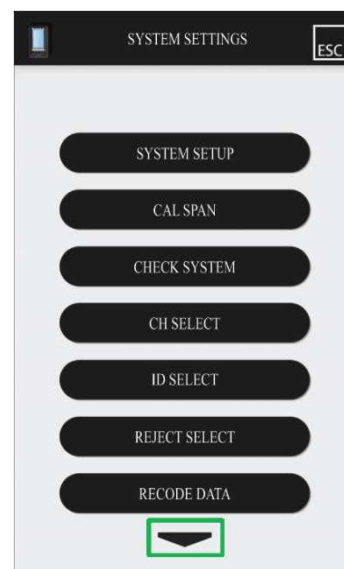
2. Select "Settings".



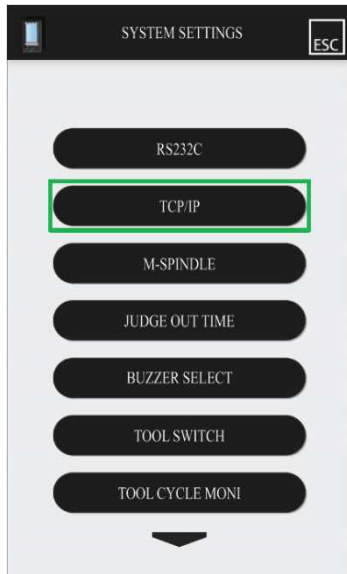
3. Select "System".



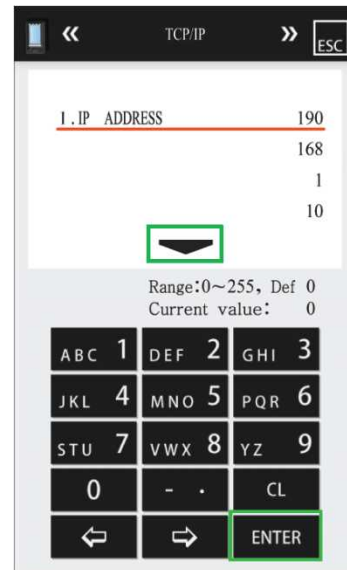
4. Scroll down.



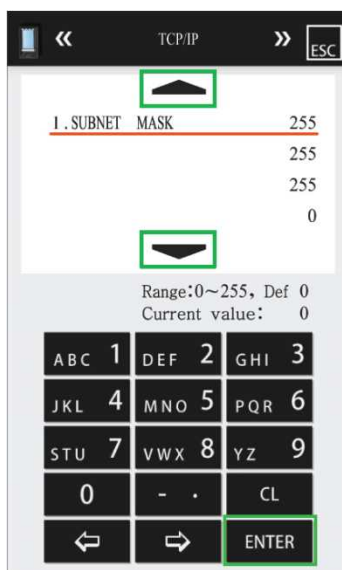
5. Select TCP/IP.



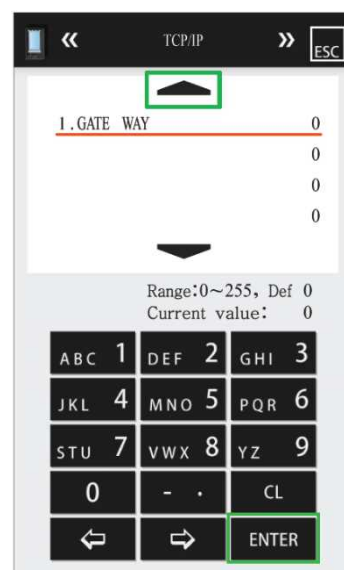
6. Specify Torque controller's IP address. Then, scroll down.



7. Specify subnet mask. Then, scroll down.



8. Specify gateway IP address.



Note:



COMM light on the panel will flash green when connected to a Modbus/TCP server.

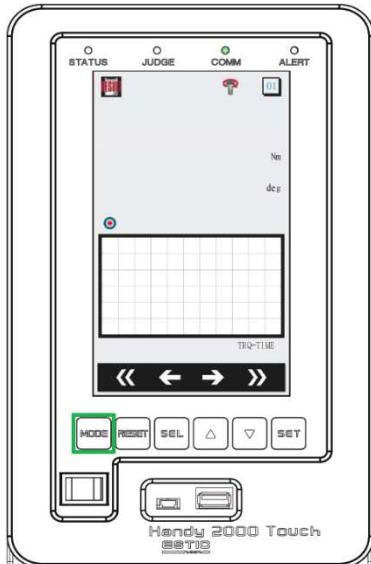


Use the on-screen keypad to change values in selected parameter. When adjustments are complete hit "ENTER" to change the value. Once all changes are complete hit "ENTER" again to register and upload changes to controller.

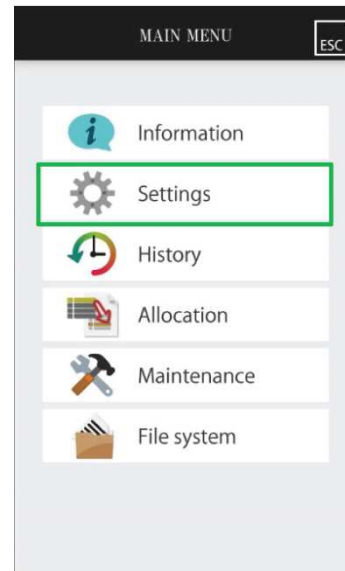
Channel External settings

For switching Channel selection mode to Channel external (CH-EX). This will allow Channel (Torque Program) selection by an external source, e.g., UR controller.

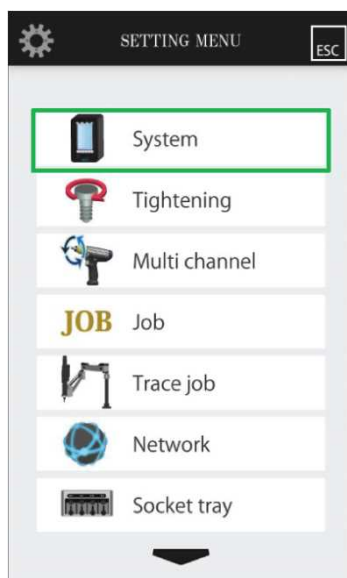
1. Push "MENU" button.



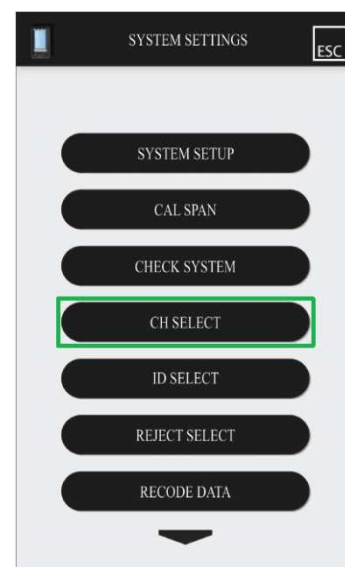
2. Select "Settings".



3. Select "System".



4. Select "CH-SELECT".

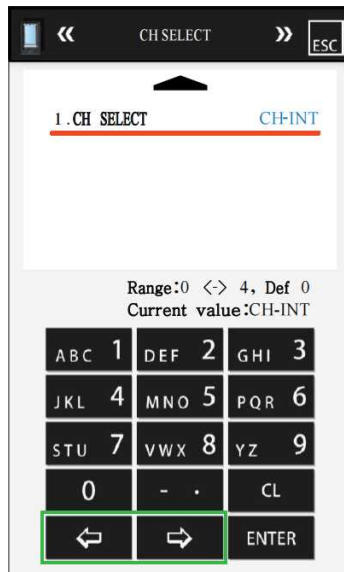


Note:

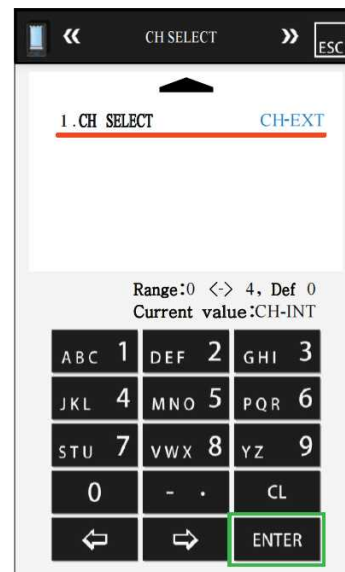


Channel Number = Program Number = Torque program = Pset

5. Navigate using left or right arrow.



6. Press Enter when "CH-EXT" is displayed.



Note:



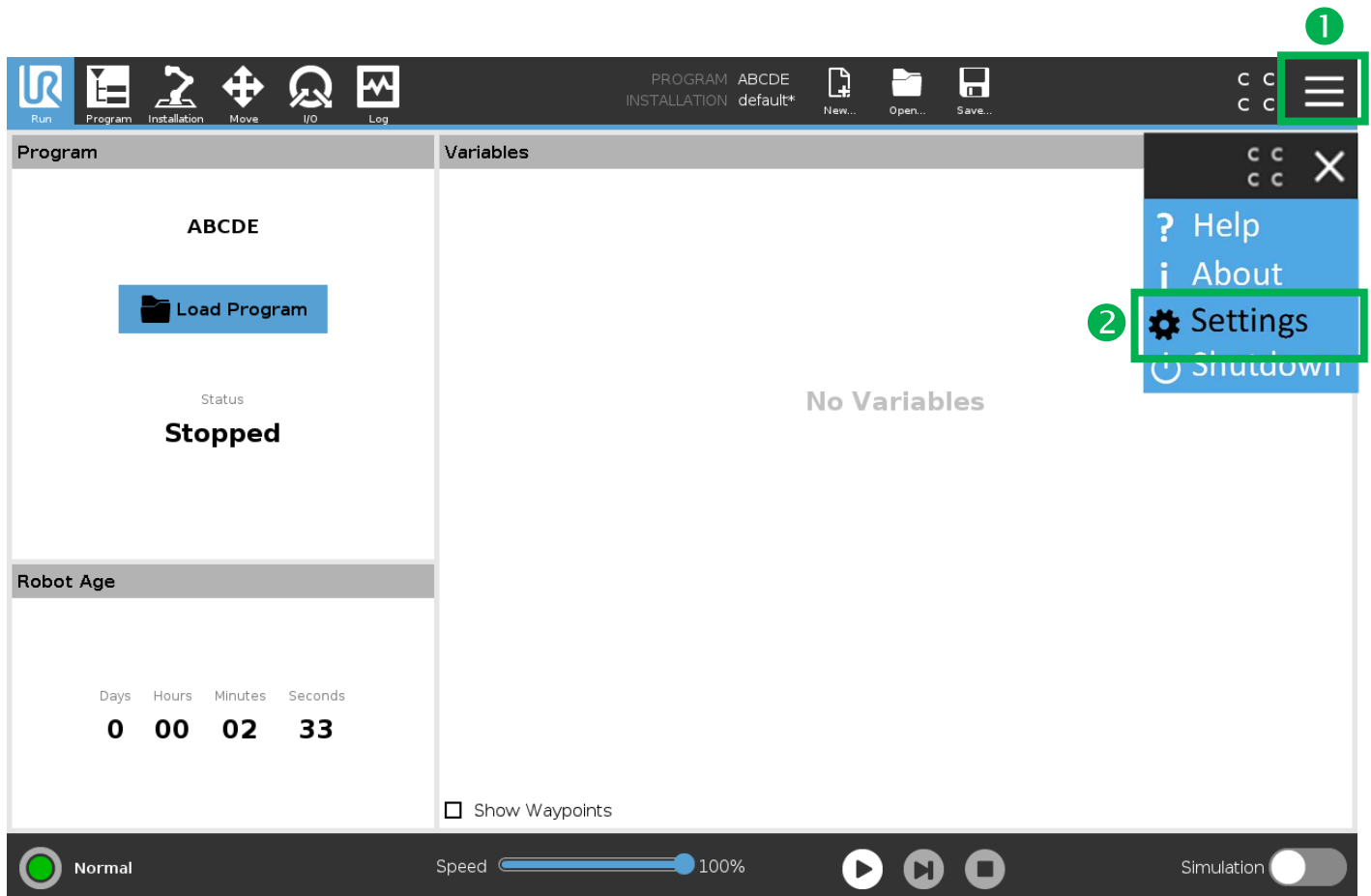
Use the on-screen keypad to change values in selected parameter. When adjustments are complete hit "ENTER" to change the value. Once all changes are complete hit "ENTER" again to register and upload changes to controller.

Refer to Handy2000 Touch Manual to program torque program/s for the Estic system.

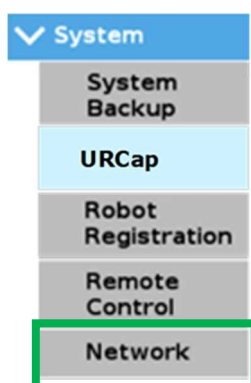
Go to <https://www.estic-global.com/> to download Manuals.

Installing URcap on Polyscope

UR IP address configuration

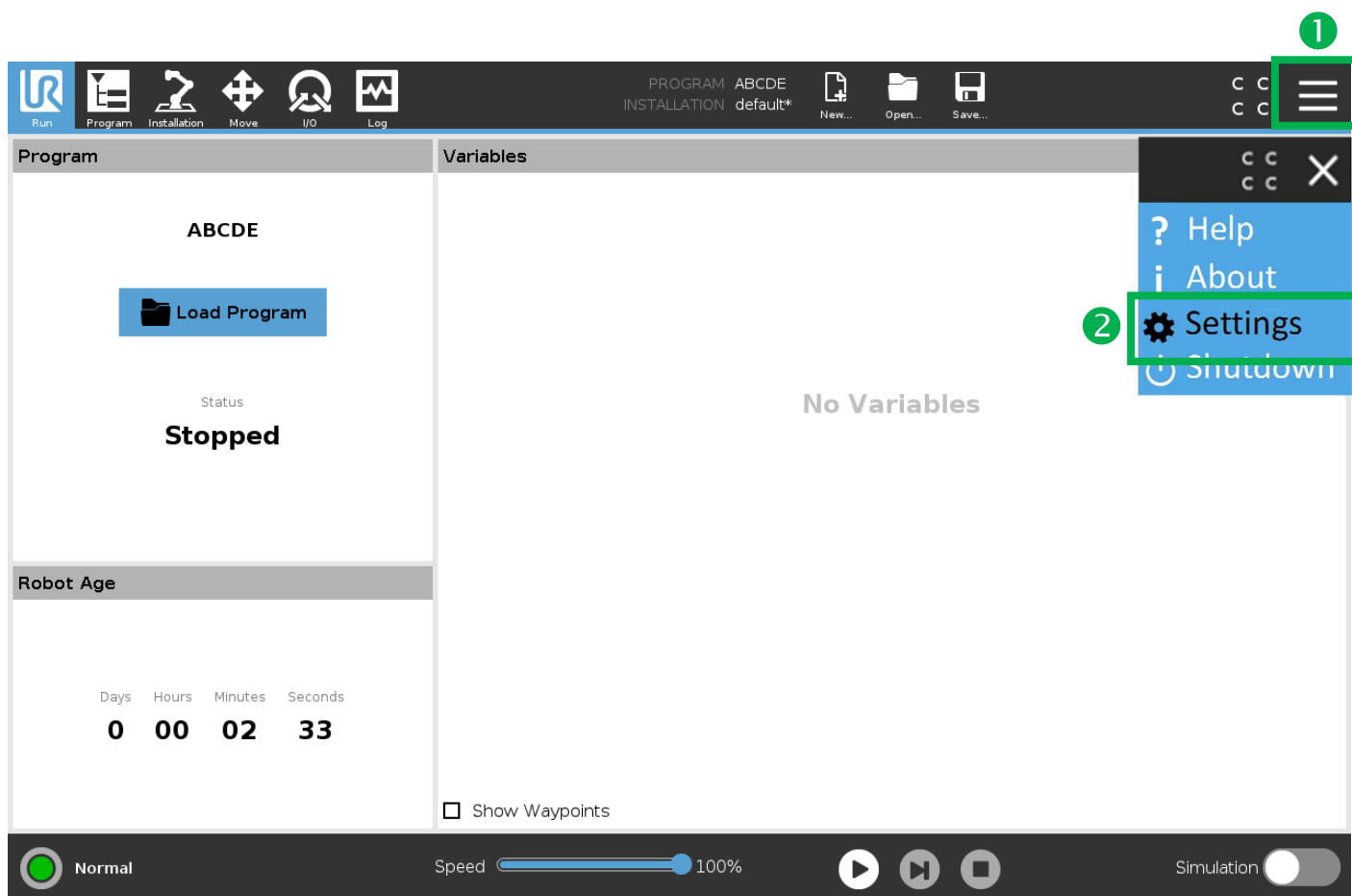


1. In the Header, press the Hamburger menu and select Settings.
2. Under System, select Network.

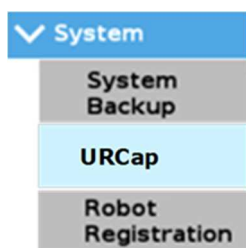


3. Select Static Address
4. Configure network settings accordingly. UR IP address must be different from the torque controller

Installing URcap on Polyscope



1. Insert Estic URcap USB drive into the UR teach pendant's USB port. The USB stick contains URcap file (.urcap) required by the UR setup assistant.
2. In the Header, press the Hamburger menu and select Settings.
3. Under System, select URcap.

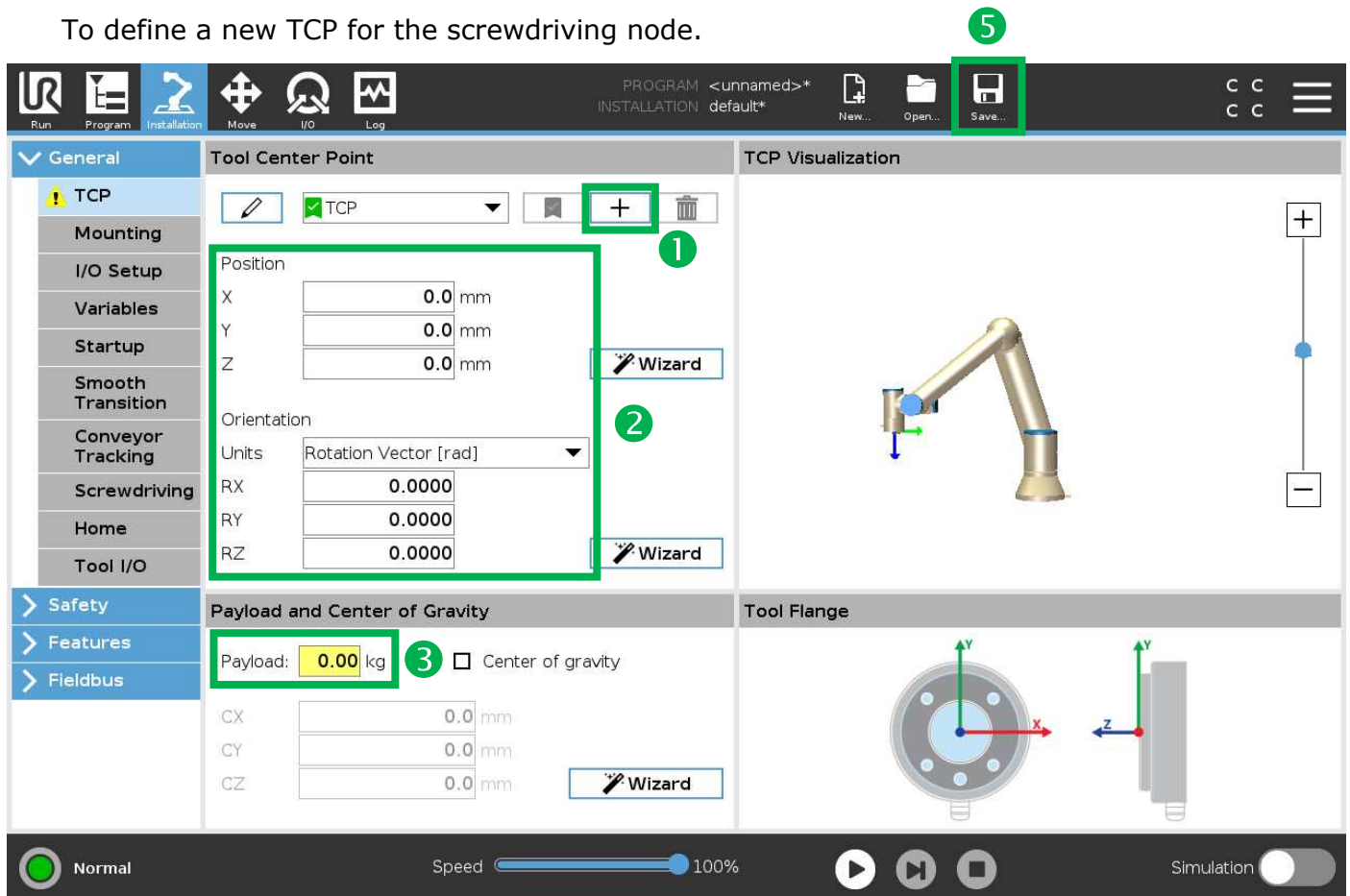


4. Tap the + button, select the .urcap file and press Open.
5. Press Restart to complete URcap installation.

Installation node

TCP configuration

To define a new TCP for the screwdriving node.

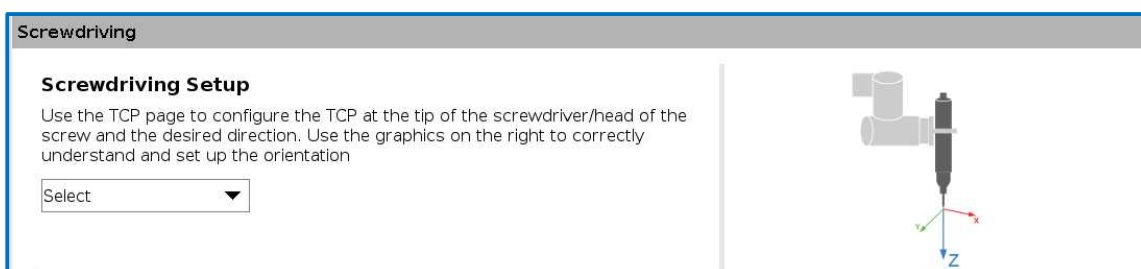


1. Tap the **+** to define screwdriving TCP. It is recommended to include "Screwdriver" in the TCP name to be easily recognizable in the screwdriving setup.
2. Enter the TCP value from "TCP value sheet" that came with the purchased tool.
3. Enter payload value from "Payload value sheet".
4. Make sure that the current TCP, which is displayed at "TCP Visualization" matches the picture below.
5. Push Save to apply the changes.

Note:

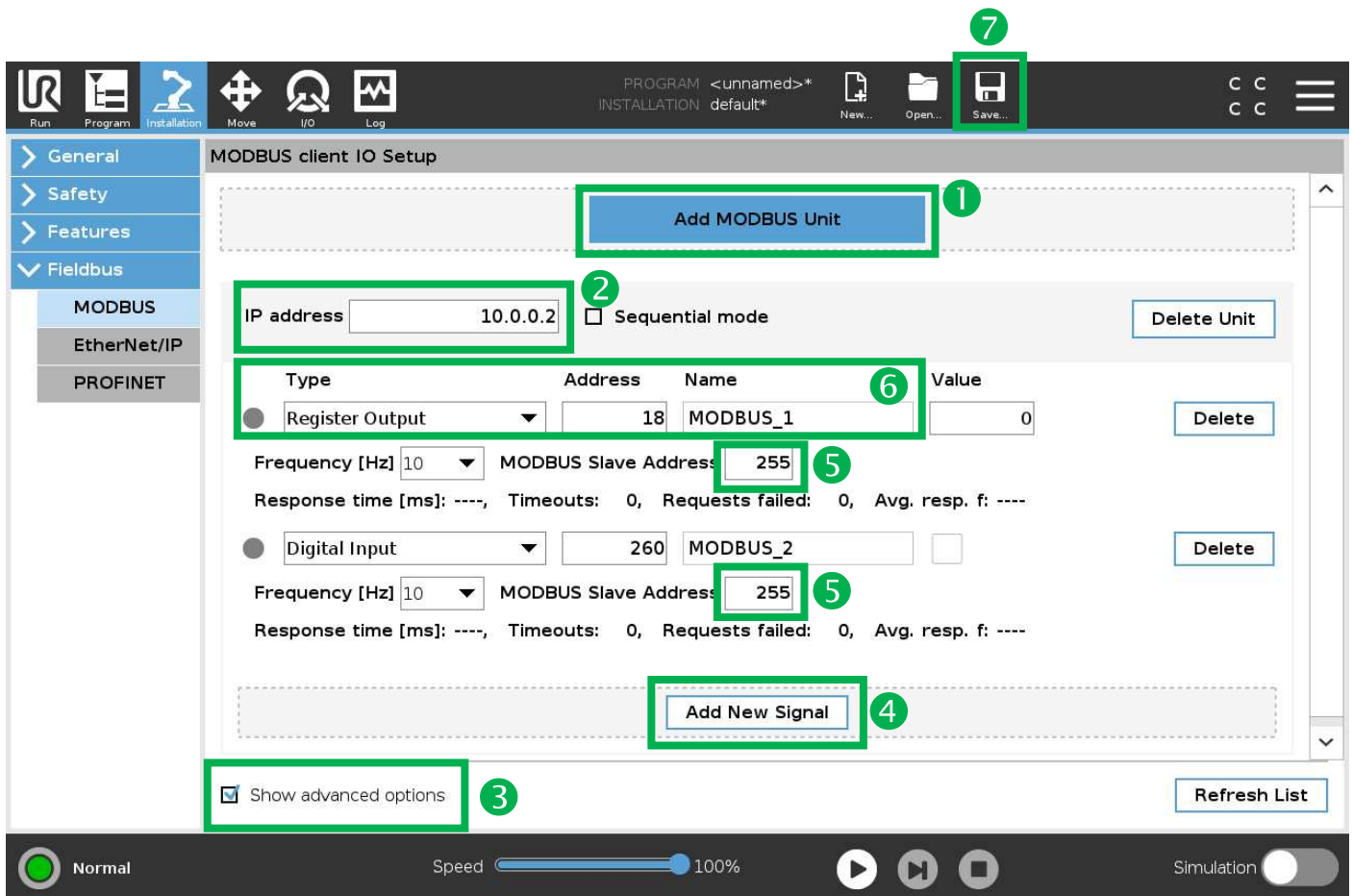


For screwdriving node to work correctly, the +ve direction of TCP's Z-axis should point downward.



MODBUS Client I/O Setup

To define Modbus signals (I/O) for screwdriving node on Polyscope.

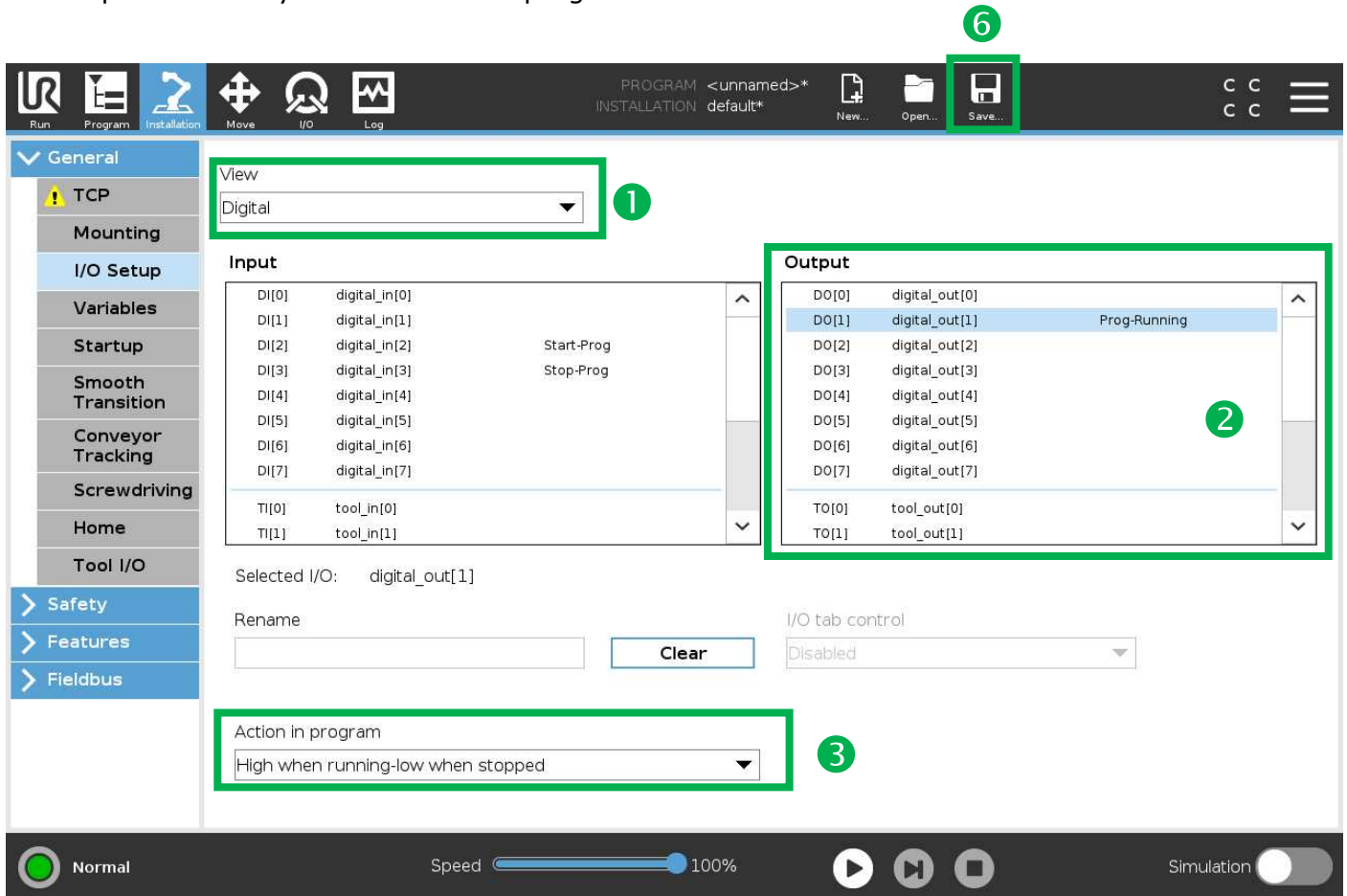


1. To add Estic controller, push "Add MODBUS Unit"
2. Enter Estic controller IP address. Configure the same IP address to URcap installation as well.
3. Check the "Show advanced options" box.
4. Push Add New Signal and create 6 Modbus signals.
5. Set Slave address to 1 for each signal. (Default: 255)
6. Change each signal's properties as shown below.
7. Push Save to apply the changes.

Estic Modbus signals				
Signal type	Address	Signal Name	Description	Slave address
Digital Input	80	Ready	Tool Ready	1
Digital Input	84	OK	Good fastening	1
Digital Input	85	Not OK	Bad fastening	1
Digital Output	4096	Start	Start fastening	1
Digital Output	4097	Reverse	Start loosening	1
Digital Output	4101	Reset	Controller reset	1

I/O setup

To Change Modbus I/O properties to "Low on unscheduled stop". This will allow the tool to stop immediately when the Robot program is terminated.



1. Select Modbus from the drop-down list
2. Select Start signal from the Output list
3. Select "Low on unscheduled stop" from the drop-down list.
4. Select Reverse signal from the Output list.
5. Select "Low on unscheduled stop" from the drop-down list.
6. Push Save to apply the changes.

Note:

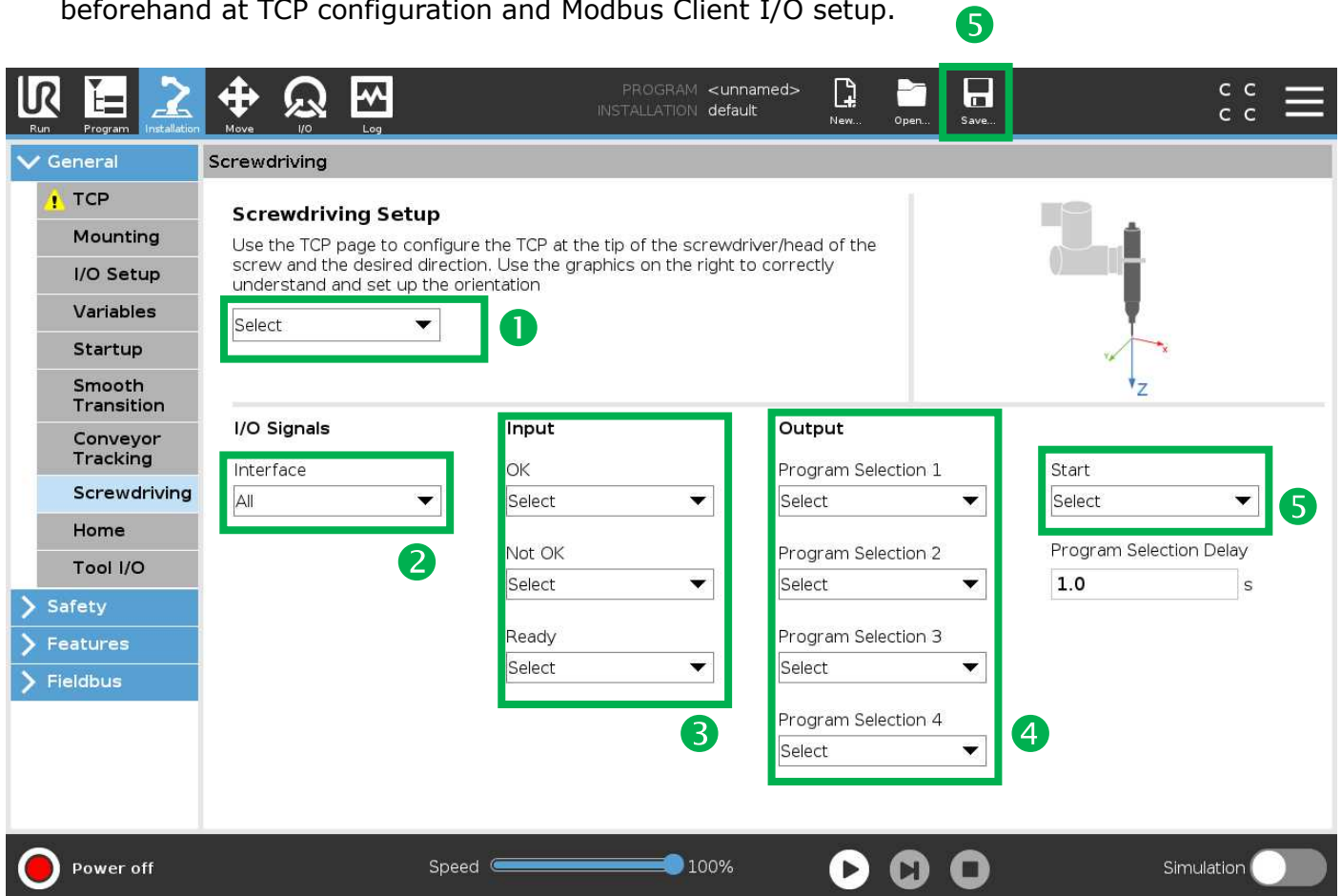


Robot program is terminated unscheduled if any of the following occur:

- **Protective stop**
- **Fault**
- **Violation**
- **Runtime Exception**

Screwdriving Setup

For configuring screwdriving node I/Os. The TCP and I/O signals selected here are defined beforehand at TCP configuration and Modbus Client I/O setup.



1. Select Screwdriving TCP defined at TCP configuration.
2. Select Modbus from the Interface drop-down list.
3. Select matching Modbus signals from the drop-down list for Inputs.
4. Leave Program selection as default. Torque program selection will be performed by URcap
5. Select "Start" from the drop-down list for box 5 for starting the tool.
6. Push Save to apply the changes.

Note:

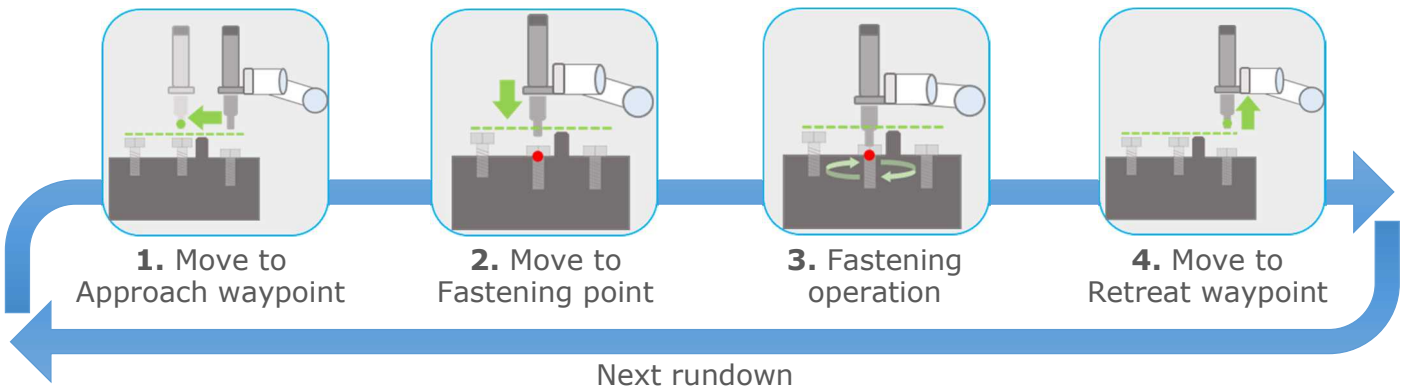


TCP configuration : pg. 18

Modbus Client I/O setup : pg. 19

Estic URcap Overview

Robot movement in a general tightening operation can be described as below.

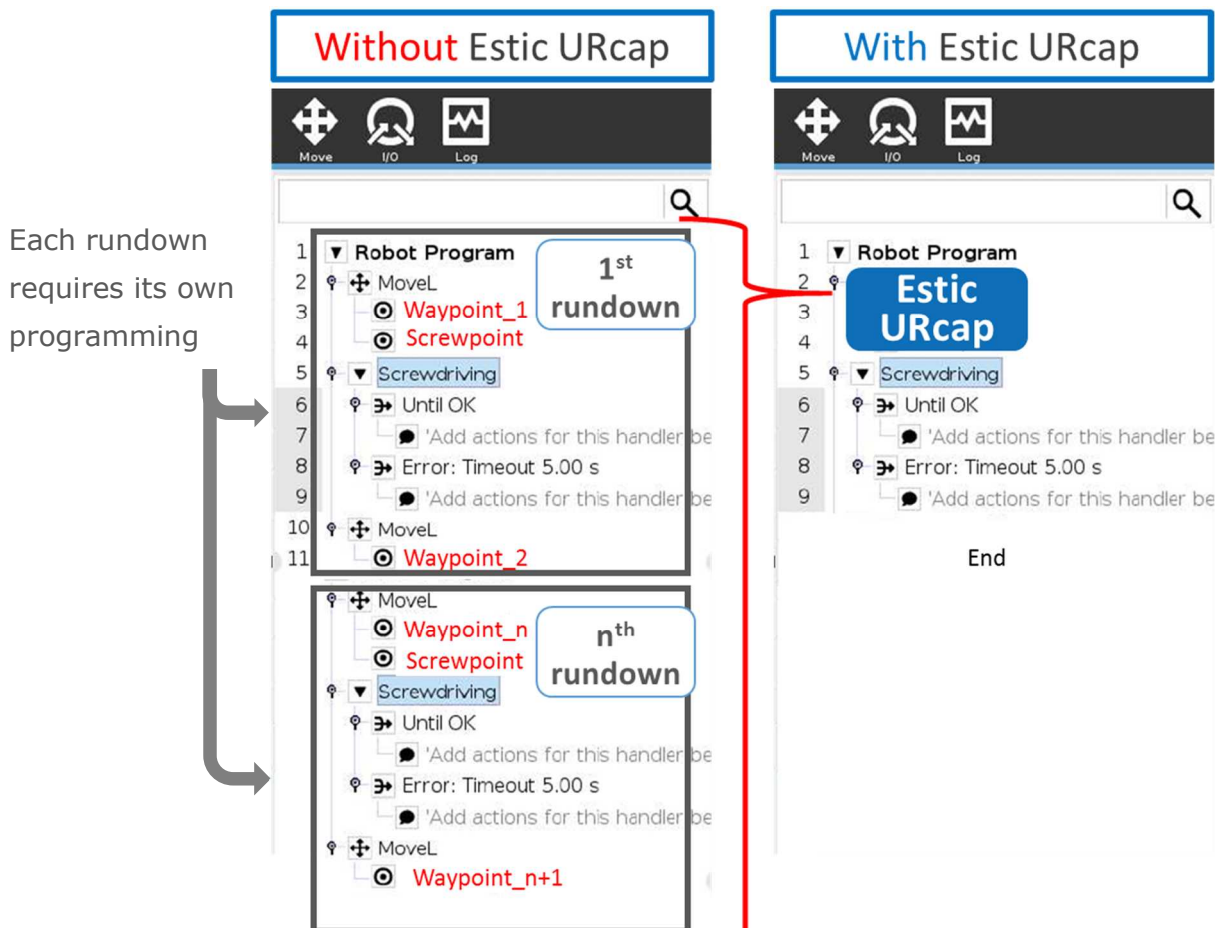


Typically, each step in the above sequence requires at least one line of robot programming, and the same has to be done for the n-number of fastening (sequence).

Estic URcap is designed to:

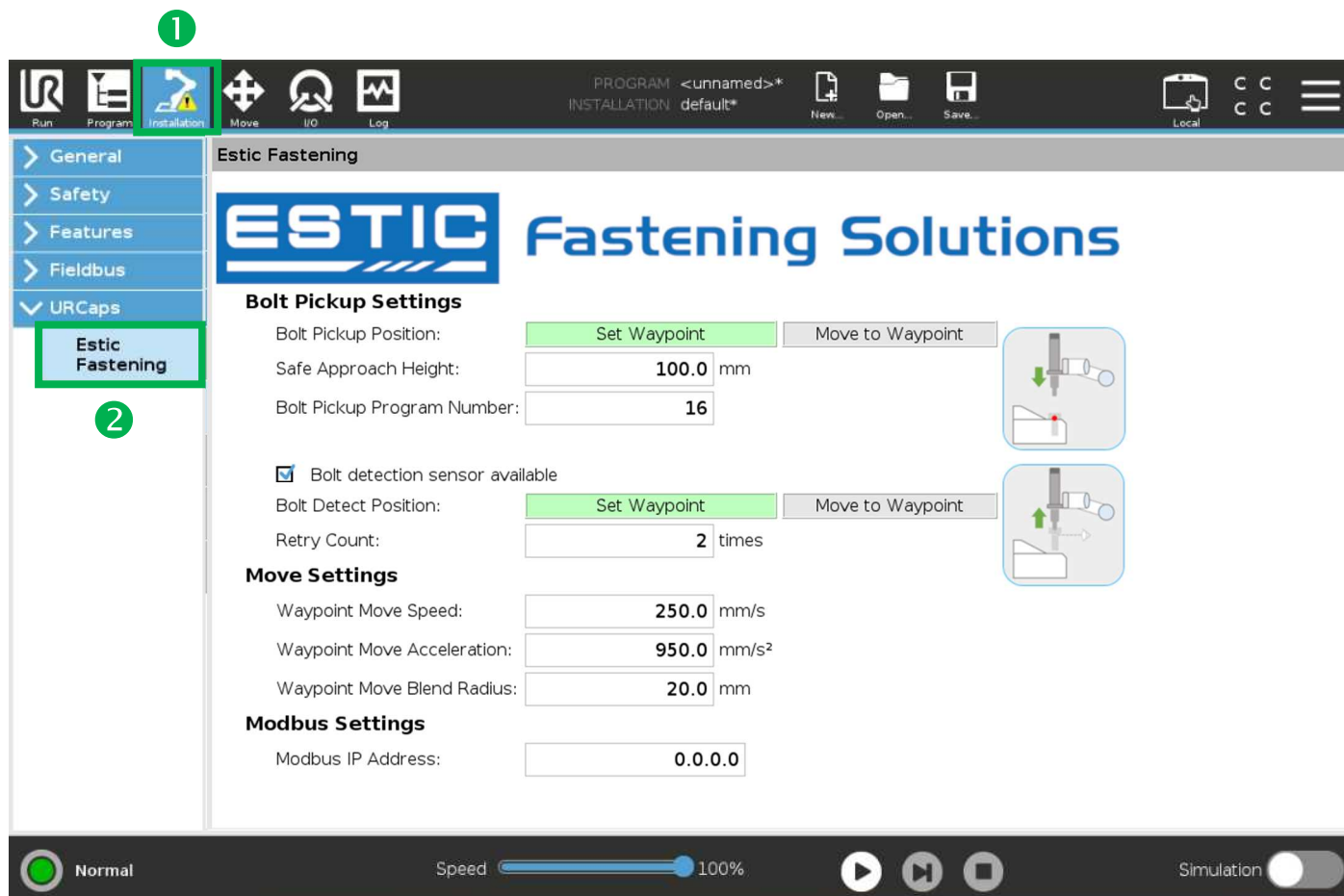
- 1) Minimize robot programming for fastening process.
- 2) Allows the user to individually assign a torque program for each fastening/rundown/bolt.

As shown below, a single Estic URcap node can accommodate robot programming and fastening operations for as many as n (=30) rundowns.



Installation Node (URcap)

To configure common parameters in tightening applications. Common parameters such as Bolt pickup position (if applicable) and Move Command parameters are configured here.



Parameter list (Bolt pickup)

Parameters	Description
Set waypoint	Set (teach) waypoint for Bolt pickup.
Safe approach height	Set safe height when approaching Bolt pickup.
Bolt pickup program number	Specify bolt pickup program number. Needs to match the preset channel number in Estic controller
Bolt detection sensor available	Enable bolt pick up detection if the detection sensor is available in the system.
Set waypoint	Set (teach) waypoint for bolt detection.
Retry count	Specify retry count for a failed bolt pickup.

Parameter list (Robot movement)

Parameters	Description
Waypoint move speed	Specify speed for MoveL Command.
Waypoint move acceleration	Specify acceleration for MoveL Command.
Waypoint move Blend radius	Specify blend radius for MoveP Command

Parameter list (Modbus)

Parameters	Description
IP address	Specify Torque controller's IP address for URcap (Refer note below)

Screen function

Functions	Description
Move to waypoint	Move robot to the preset bolt pickup or bolt detection position. Caution : Robot will move directly to the waypoint without retreating to the safe height.

Note:



To ensure URcap works properly, please use IP address from the Modbus Client I/O setup. (Torque controller IP address)

Program Node (URcap)

How to create Program

After installing Estic URcap, tap the "Estic Fastening" tab under URcap menu to create **Fasten Bolt** node. Then, go to Templates menu and add **Screwdriving** node under **Fasten Bolt**.

1) Fasten Bolt node

Consists of 4 steps that enables users to configure:

- a) Number of fastening points (Max 30)
- b) Approach, Fastening, and Retreat points
- c) Torque program number
- d) Bolt pickup (If applicable)

2) Screwdriving node

Screwdriving is a UR built-in node that enables users to configure:

- a) Screwdriving rotational direction
- b) "Follow the screw" parameters
- c) "Until" condition

The yellow down arrow  indicates an incomplete configuration of the node beside it. The program cannot be executed unless the configuration is complete. A white down arrow indicates a complete node.

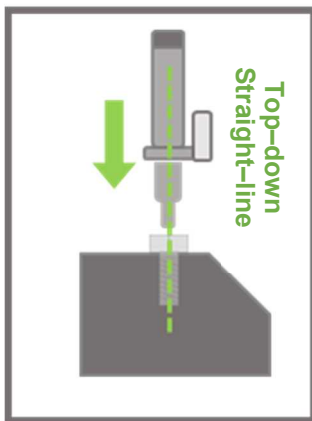


Before configuring

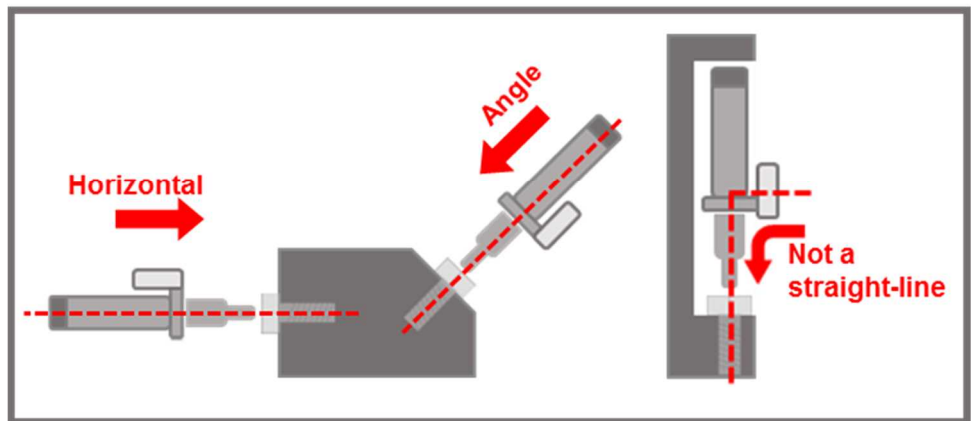
Programming using Estic URcap can be significantly easier if you can identify what type of robot movement is involved in the process beforehand. Depending on the process, robot programming (excluding robot teaching) can be performed in under 2 minutes. Consider clearing the questions below before starting Estic URcap configuration.

Is the process a top-down, straight-line fastening?

Yes

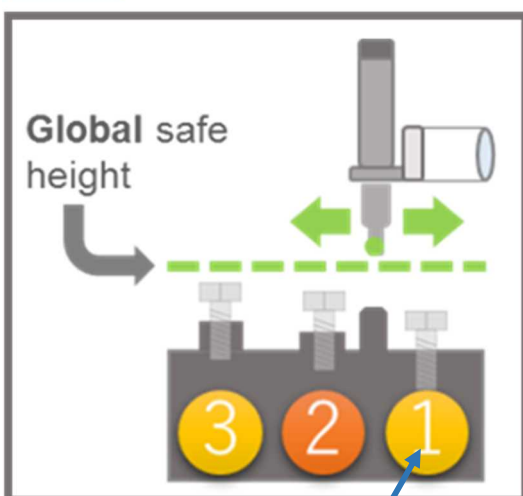


No



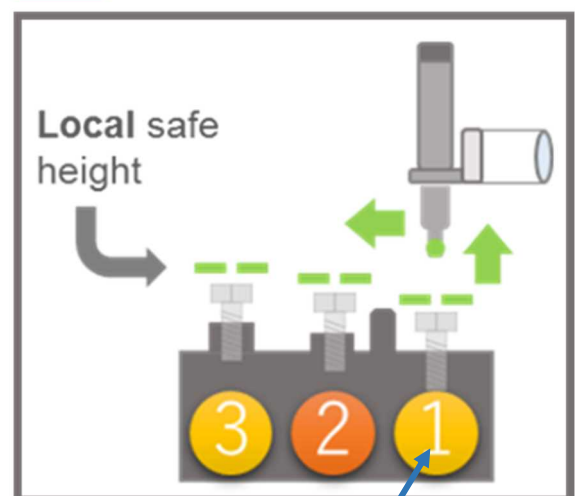
Does Global safe height work for all bolts?

Yes



Fastening point 1 /
Bolt 1

No



Fastening point 1 /
Bolt 1

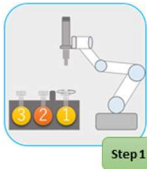
Fasten Bolt - Step 1 Number of Fastening Points



Parameter list

Parameters	Description
Step 1 How many fastening points?	Specify how many rundowns/bolts/fastening points are in the process. A maximum 30 fastening points can be selected from the drop-down list.

Note:



The value configured here will be linked to the following steps. The “Step 1” box at the bottom will turn from grey to green when configuration in this step is complete. This is the same for other steps as well.

Fasten Bolt - Step 2a Assign Approach Waypoints

Specify waypoints when approaching each fastening point.

The screenshot shows the 'Estic Fastening' software interface. On the left, a tree view shows the program structure: 1 Robot Program, 2 Fasten Bolt, 3 Screwdriving, 4 Until, and 5 Add actions for this handler. The 'Estic Fastening' tab is selected. The main panel is titled 'Approach Waypoints' and contains the following settings:

- Step 2a-2:** Use global safe approach height? ☐ Yes ☒ No Specify safe global approach height: 100.0 mm
- Step 2a-4:** Top-down, straight line approach? ☐ Yes ☒ No Specify safe local approach height: 100.0 mm
- Move Type:** MoveL
- Waypoint Configuration:**

Set Waypoint	Move to Waypoint
Set Waypoint 1	Move to Waypoint 1
Set Waypoint 2	Move to Waypoint 2
Set Waypoint 3	Move to Waypoint 3
Set Waypoint 4	Move to Waypoint 4
Set Waypoint 5	Move to Waypoint 5

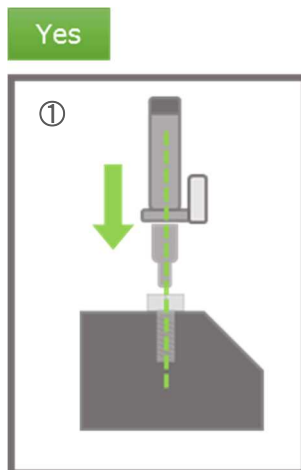
The bottom status bar shows 'Normal' mode, 'Speed' at 100%, and a 'Simulation' toggle.

Quick setup 1

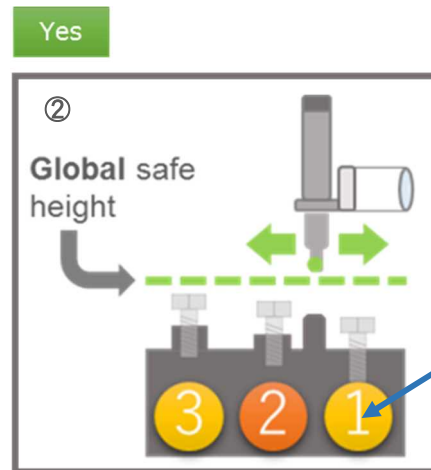
Select Yes in **Step 2a-2** if:

Both illustrations are true for all fastening points/bolts. In this case, only Global safe approach and retreat height needs to be configured for **Step 2a** and **Step 2c**.

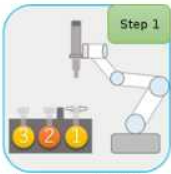
Safe height specified here is common for all fastening points.



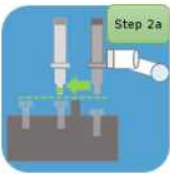
Top-down,
Straight-line
approach



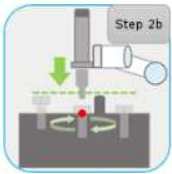
Fastening point 1 /
Bolt 1



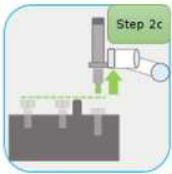
Step 1



Step 2a



Step 2b



Step 2c

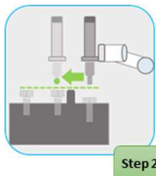
Approach Waypoints

Fastening Point: 1

Step 2a-2 → Use global safe approach height? ☒ Yes ☐ No ?

Specify global safe approach height: mm

Note:



Safe height is where robot can move horizontally in any direction without the risk of collision.

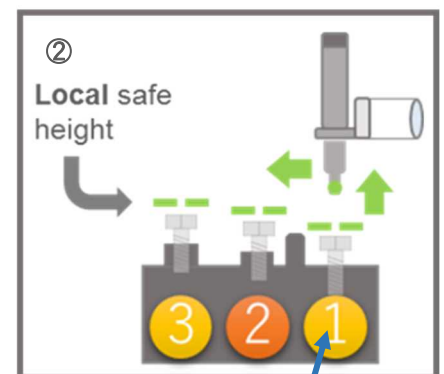
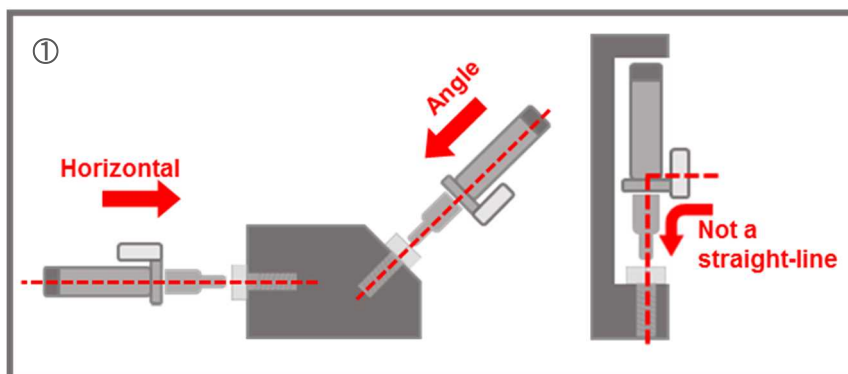
A common safe height for all fastening points/bolts is called Global safe height while safe height for an individual bolt is called Local safe height.

Quick setup 2

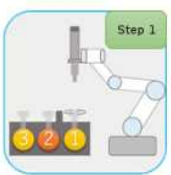
Select No in **Step 2a-2** if:

Illustration ① is true for at least one fastening point/bolt. Select Yes in **Step 2a-4** if the specified fastening point is a top-down, straight-line approach.

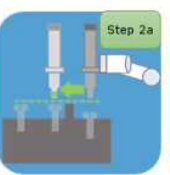
In this case, a local safe approach and retreat height needs to be configured for the specified fastening point.



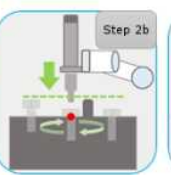
Fastening point 1 / Bolt 1



Step 1



Step 2a



Step 2b



Step 2c

Approach Waypoints

Fastening Point: 1

Step 2a-2 → Use global safe approach height? ☐ Yes ☒ No ?

Specify global safe approach height: mm

Step 2a-4 → Specify individual approach waypoints and settings below to avoid collision

Top-down, straight line fastening? ☒ Yes ☐ No ?

Specify safe approach height: mm

Parameter list

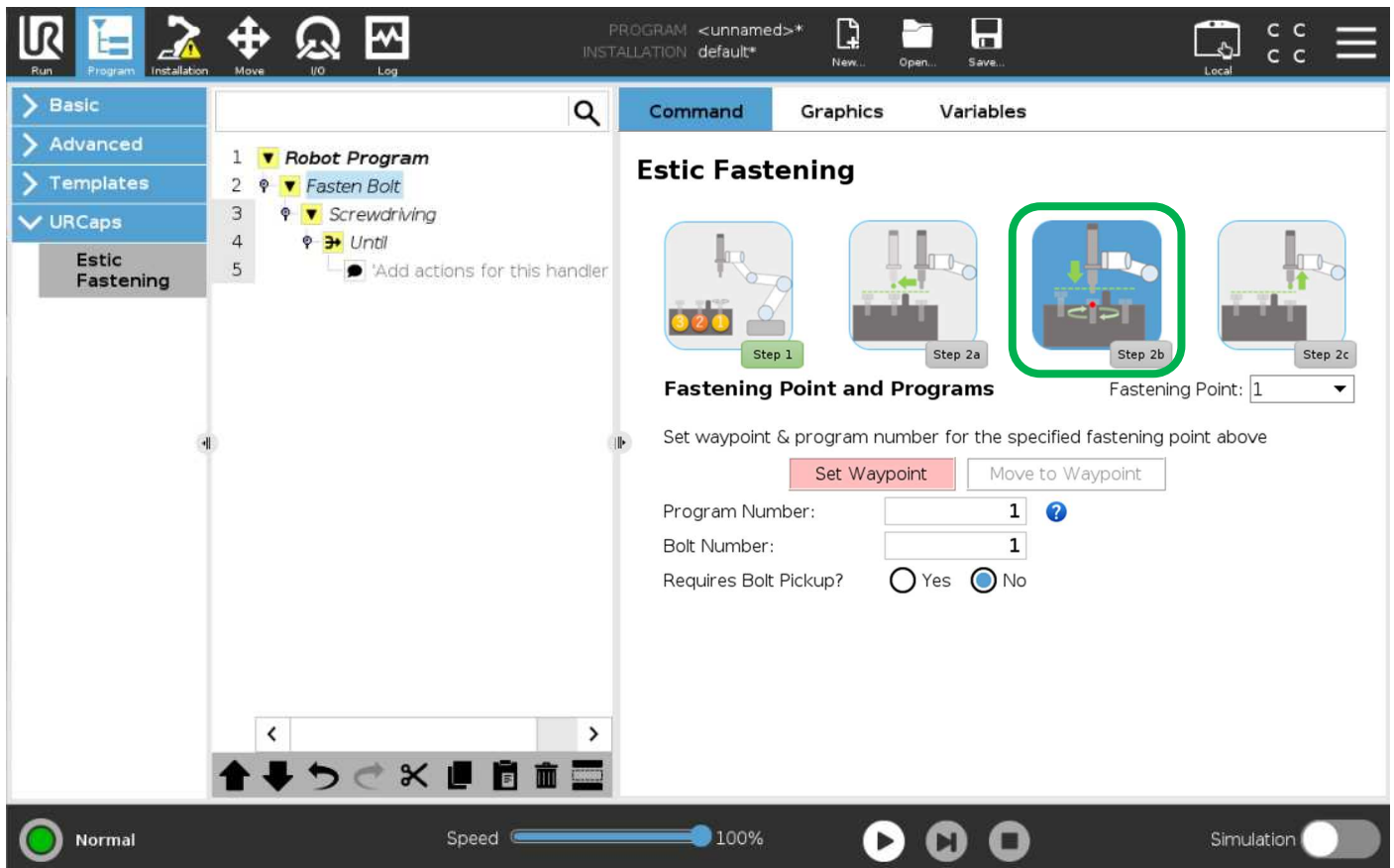
Parameters	Description
Step 2a-1 Fastening point:	Specify the fastening point or bolt that needs to be configured on this screen. This parameter is linked to the settings in Step 1: Number of Fastening points.
Step 2a-2 Use global safe approach height?	<u>Select Yes</u> if: Top-down, straight-line approach is true for all bolts/screws, AND <u>Global</u> safe approach height can be used. <u>Select No</u> if: Top-down, straight-line approach is NOT true for all bolts/screws, OR <u>Global</u> safe approach height can NOT be used. Note: Safe height is where robot can move horizontally in any direction without the risk of collision, and a common safe height for all fastening points/bolts is called <u>Global safe height</u> .
Step 2a-3 Specify global safe approach height:	Specify a <u>Global</u> safe height for the robot when approaching the fastening point/bolt.
Step 2a-4 Top-down, straight-line approach?	<u>Select Yes</u> if: Top-down, straight-line approach is true for the fastening point specified at Step 2a-1. <u>Select No</u> if: Top-down, straight-line approach is NOT true for the fastening point specified at Step 2a-1.
Step 2a-5 Specify local safe approach height	Specify a <u>local</u> safe height for the robot when approaching the fastening point/bolt specified at Step 2a-1. Note: Safe height for an individual bolt is called <u>Local safe height</u> .
Step 2a-6 Move Type:	Select Move type for the robot. (MoveL, MoveP) Note: MoveL moves the Tool Center Point (TCP) linearly between waypoints. MoveP moves the tool linearly with constant speed with circular blends.
Step 2a-7 Add Waypoint	Add waypoints if more waypoints are required to safely approach the fastening point without collision.
Step 2a-8 Set Waypoint 1~5	Set (teach) approach waypoints. The Polyscope screen will jump to Move Screen  .
Step 2a-9 Remove Waypoint	Remove approach waypoints.

Screen function

Functions	Description
Step 2a-9 Help button	Display Help screen containing illustrations for the corresponding parameter.
Step 2a-10 Move to waypoint	Move robot to the preset approach waypoint Caution : Robot will move directly to the waypoint without retreating to the safe height.

Fasten Bolt - Step 2b Assign Fastening Point and Torque Program Number

Teach fastening point and assigning Torque program for each bolt/screw.



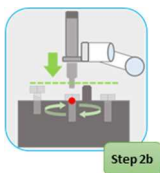
Parameter list

Parameters	Description
Step 2b-1 Fastening point:	Specify the fastening point or bolt that needs to be configured in this step. This parameter is linked to the settings in Step 1: Number of Fastening points.
Step 2b-2 Set Waypoint	Set (teach) fastening points. The Polyscope screen will jump to Move Screen  .
Step 2b-3 Program number	Assign a Torque program number for the fastening point specified at Step 2b-1.
Step 2b-4 Bolt Number	Assign a Bolt number for the fastening point specified at Step 2b-1. Bolt number will be displayed on Estic Fastening results as VIN. Refer to Estic Handy2000 manual for details.
Step 2b-5 Requires Bolt Pickup? (If applicable)	Assign bolt pickup for fastening point specified at Step 2b-1. If bolt pickup is assigned to one of the fastening points, users must set Bolt pickup point at the Installation Tab.

Screen function

Functions	Description
Step 2b-6 Help button	Display Help screen containing illustrations for the corresponding parameter.
Step 2b-7 Move to waypoint	Move robot to the preset fastening point Caution : Robot will move directly to the waypoint without retreating to the safe height.

Note:



Torque program numbers specified in this step need to match the preset channel number in Estic controller, as shown below. Specifying program number which is not defined in the controller will cause an error.

Estic Management software

The screenshot shows the 'Estic Management software' interface. At the top, there are tabs for 'Individual Settings' and 'Advanced Setting'. Below these is a 'ProgramParameter CH List' table with columns: CH, Name, Fastening Method, Target TRQ [Nm], Target ANG [deg], Target T/R, and Mode. The table contains three rows of torque programs. A green box highlights the 'CH' column, and an arrow points to it with the text 'Channel number'. To the right, a 'URcap' dialog box is open, showing a sequence of four steps (Step 1, Step 2a, Step 2b, Step 2c) with corresponding illustrations. Below the steps, there are input fields for 'Program Number' (set to 1), 'Bolt Number' (set to 1), and a 'Requires Bolt Pickup?' checkbox (set to No). Buttons for 'Set Waypoint' and 'Move to Waypoint' are also visible.

Note:



See Handy 2000 Touch Manuals to create torque program in the controller.

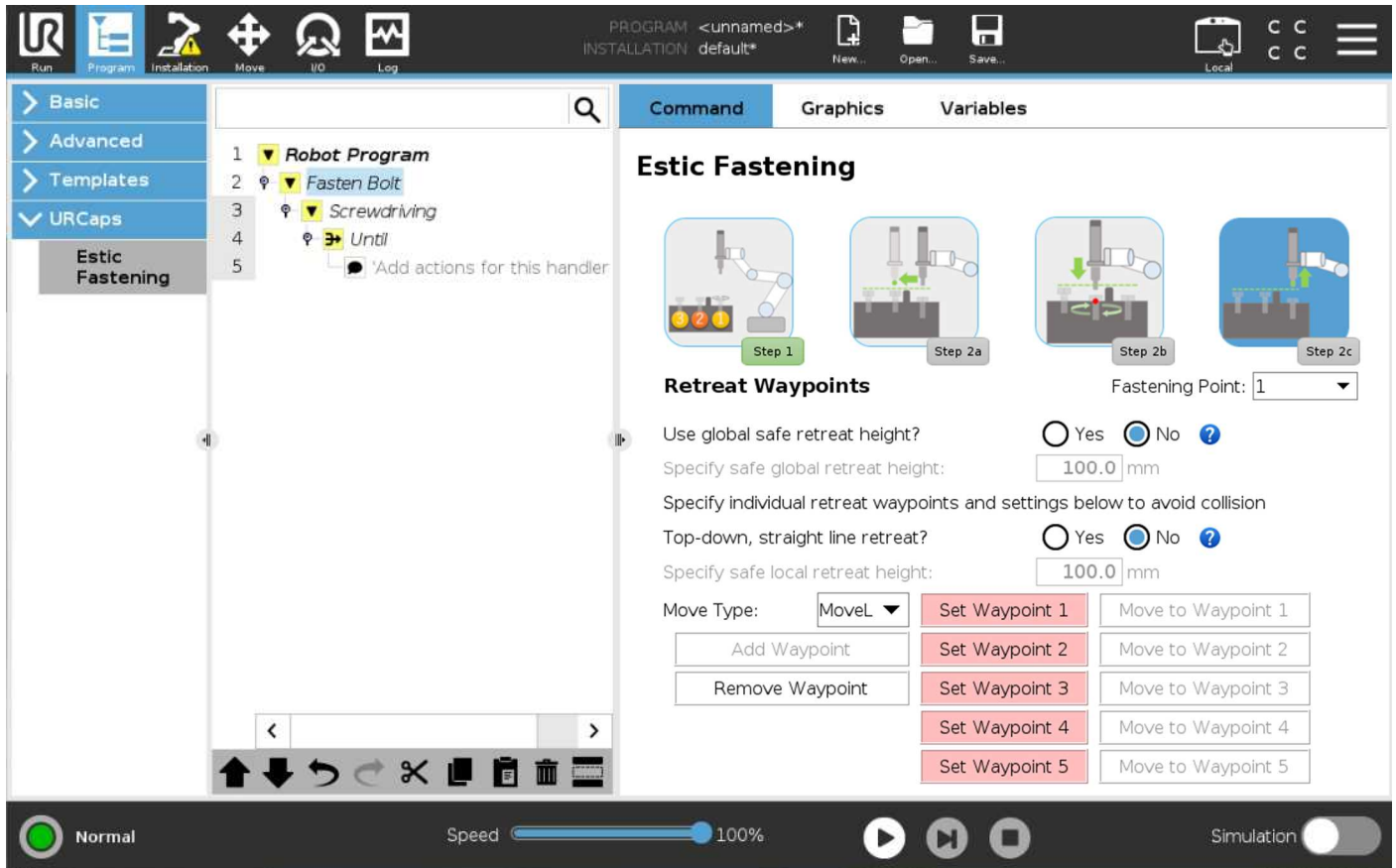
Go to <https://www.estic-global.com/> to download Manuals.



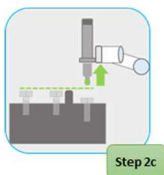
Channel Number = Program Number = Torque program = Pset

Fasten Bolt-Step 2c Assign Retreat waypoints

Specify waypoints when retreating (moving away) from each fastening point. This step has identical parameters as Step 2a-Approach waypoints. Please refer to Step 2a for details.



Note:

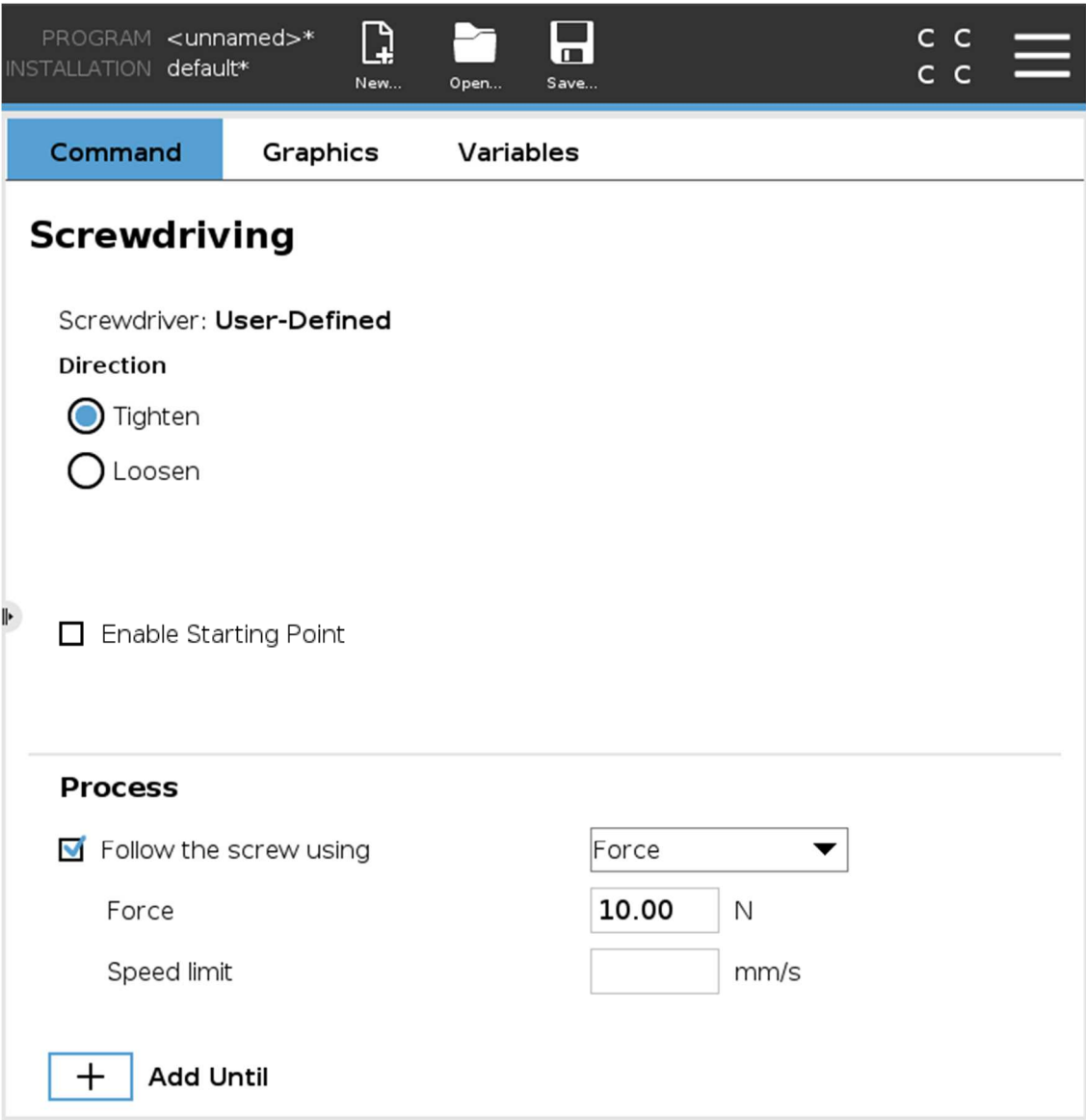


Safe height is where robot can move horizontally in any direction without risk of collision.

A common safe height for all fastening points/bolts is called Global safe height while safe height for one individual bolt is called Local safe height.

Screwdriving

The Screwdriving program is a UR built-in node that provides an easy way to add a screwdriving application for an attached screwdriver/nutrunner. Configuring the screwdriver and its connections to the robot are defined in the Installation Tab. (See 24.1 General in UR user manual_99405)



Parameter list (Screwdriving)

Parameters	Description
Tighten/Loosen	Select Tighten to follow the screw in a tightening direction (in), or select Loosen to follow the screw in a loosening direction (out). This selection only impacts the motion of the robot to follow the screw and its measuring calculations.
Enable starting point	Select Enable Starting Point, to add a MoveL to the Program Tree that is executed when the screwdriver/nutrunner is already running.
Follow the screw using	Define robot operation during screwdriving. Force: Select Force to define how much force is exerted on a screw. Then

	select Speed Limit, so the robot moves at this speed as long as it does not come into contact with the screw. • Speed: Select a fixed Tool Speed and Acceleration for the robot to follow the screw. • Expression: Similar to the If command (see 23.11.2. If on page 168), select Expression to describe the condition under which the robot follows the screw.
+ Add until	Refer next section.

Screwdrive Until

The Screwdriving program node includes a mandatory until success Until node that defines stop criteria for the screwdriving process.

1) Until- Success

Screwdriving continues until completion is detected using your selected option. You can only add one success condition.

2) Until- Error

Screwdriving continues until an error is detected using your selected option/s. You can add more than one error condition.

PROGRAM <unnamed>*

INSTALLATION default*

New...

Open...

Save...

C C

C C

Command

Graphics

Variables

Until

Specify the **Until** condition. The robot will follow the process **Until** the specified condition is met.

Success

OK

Time

Distance

Expression

Error

Not OK

Distance

Timeout

+ Add Until

Parameters list (Until)

Parameters	Description
Success-OK	Screwdriving continues until an OK signal from the screwdriver is detected.
Success-Time	Screwdriving continues up to a defined time.
Success-Distance	Screwdriving continues up to a defined distance.
Success-Expression	Screwdriving continues until a custom expression condition is met.
Error-Not OK	Screwdriving stops when a NOT OK signal from the screwdriver is detected.
Error-Distance	Screwdriving stops when the defined distance is exceeded.
Error-Timeout	Screwdriving stops when the defined time is exceeded.

Note:

Screwdriving

Screwdriver: **User-Defined**

⚠ A Start I/O and TCP must be defined in the installation

Direction

☒ Tighten

☐ Loosen

A Caution sign as shown on Screwdriving node indicates incomplete installation setup. Refer Installation Node and complete the setup according to the instructions.



See Handy 2000 Touch Manual to create torque program in the controller.

Go to <https://www.estic-global.com/> to download Manuals.