Reference Manual

URCap CAPTRON TCP – Version 1.2.0

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Reference Manual

Version 1.2.0

Contents

1 Introduction

The URCap CAPTRON TCP is a software extension for the UR robot (Universal Robots). It was developed to integrate the CAPTRON TCP sensors with minimal effort. With the CAPTRON TCP sensors, a TCP set up on the robot can be checked and adjusted during program runtime. Inaccuracies in the TCP, e.g. due to the replacement of an adhesive nozzle, can be easily corrected manually or automatically.

1.1 About this document

The reference manual contains an overview of all functions of the URCap. It was created for robotprogrammers, software developers and maintenance technicians.

1.2 Requirements and supported versions

E-Series robots (UR3, UR5, UR10 or UR16) from PolyScope 5.11. UR20/30 robots with PolyScope from version 5.11.

1.3 Update the URCap

Attention: Robot programs that were created with a previous version may no longer be used. The robot programs and the robot installation may have to be recreated or adapted. To install the URCap version 1.0.1 on a system where an earlier version is already installed.

- Uninstall the previous version
- Check the PolyScope version, if necessary, update to a newer version (version 5.11)
- To avoid configuration conflicts, create a new robot installation
- Install the new version of the URCap

2 Installation

2.1 Installing the URCap

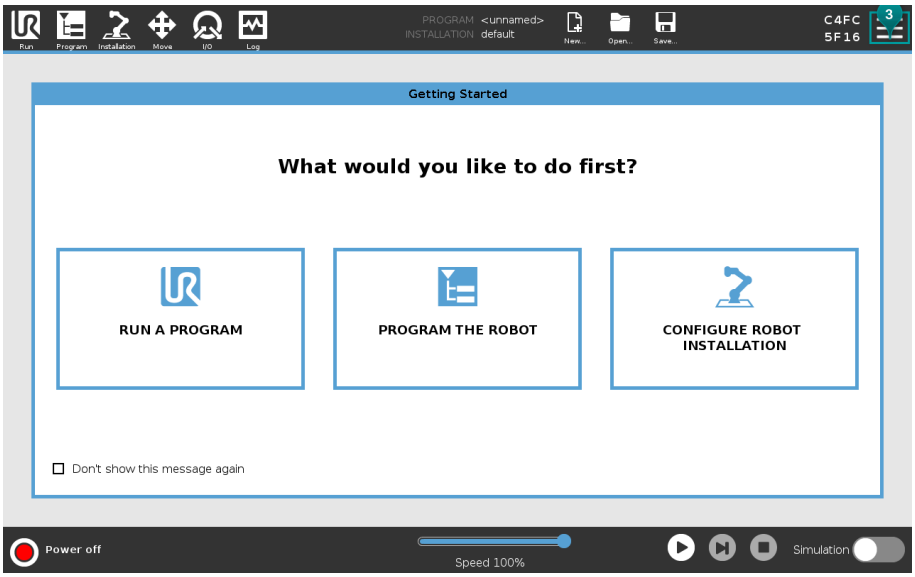


Abb. 1: Home screen

1. Start the robot
2. Insert the USB device with the URCap
3. Click the hamburger menu in the top right corner

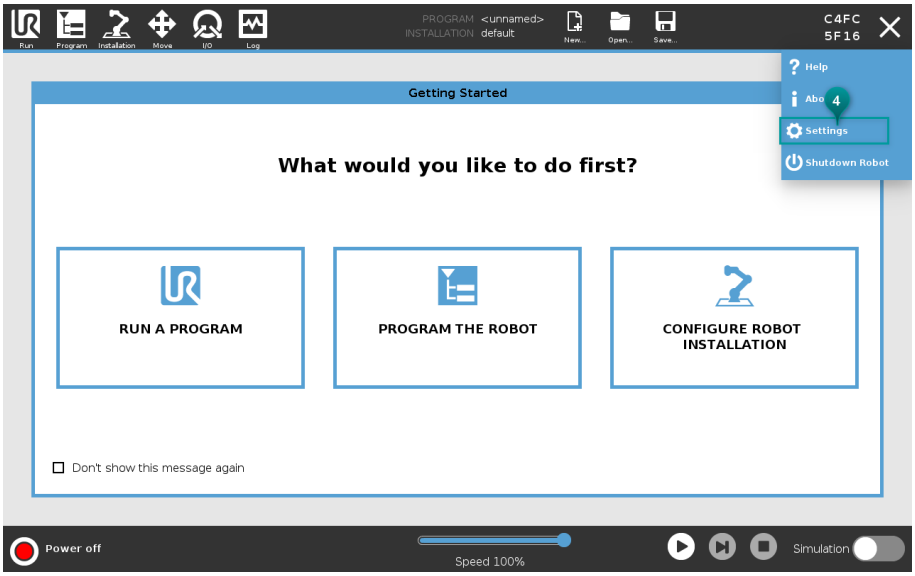


Abb. 2: Select Settings

4. Click “Settings”

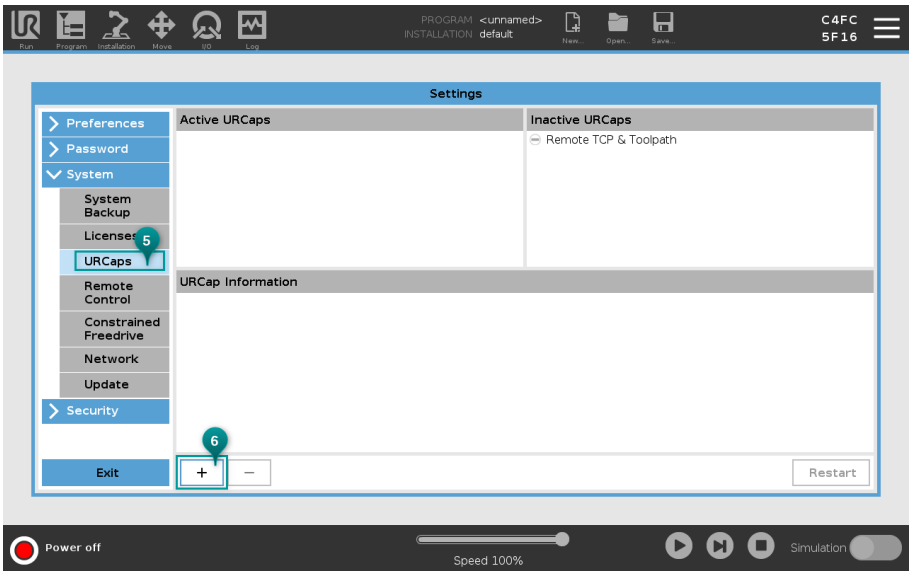


Abb. 3: Add URCap

5. Click on “URCaps”
6. Click “+”

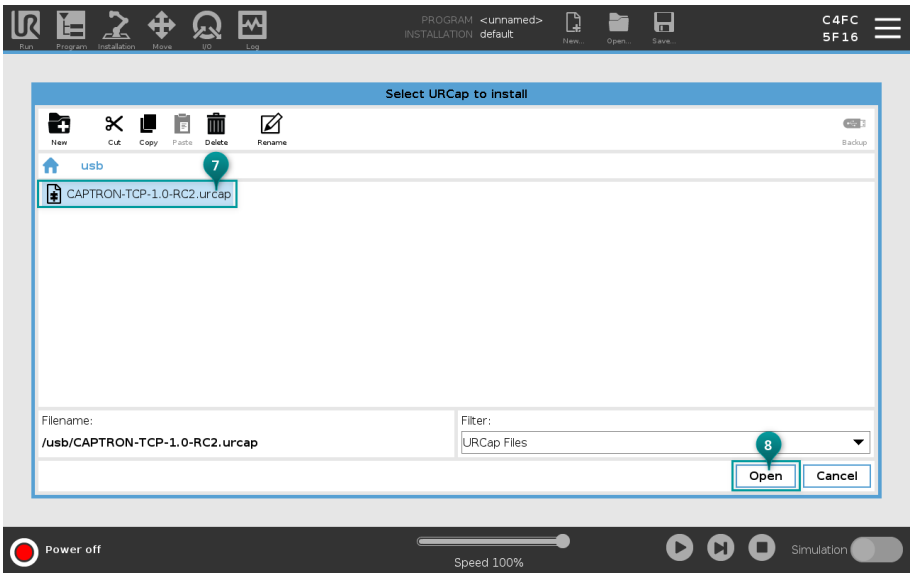


Abb. 4: Select URCap on USB device

7. Select URCap on USB device
8. Click “Open” to install the URCap

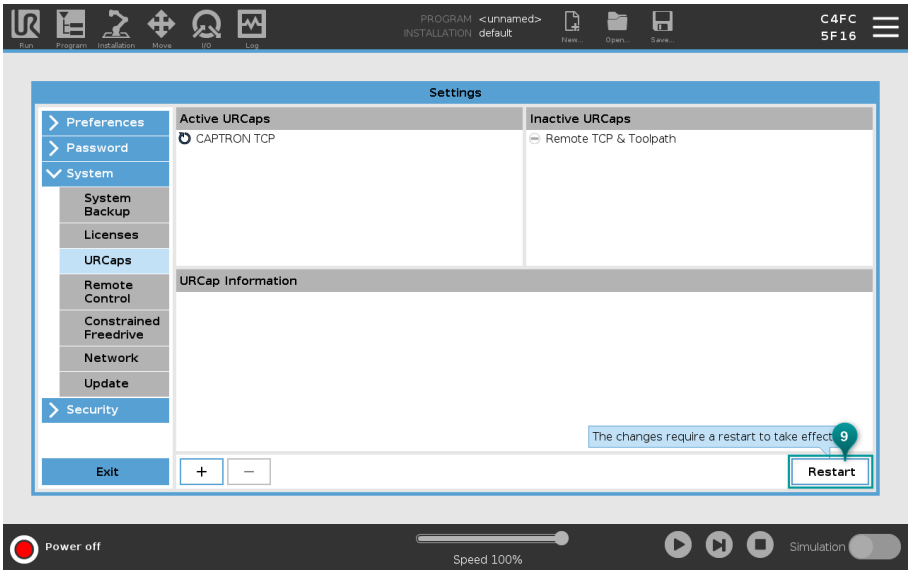


Abb. 5: Restart the robot

9. Agree to the end user license agreement by clicking on “Restart”. The robot is restarted to complete the installation

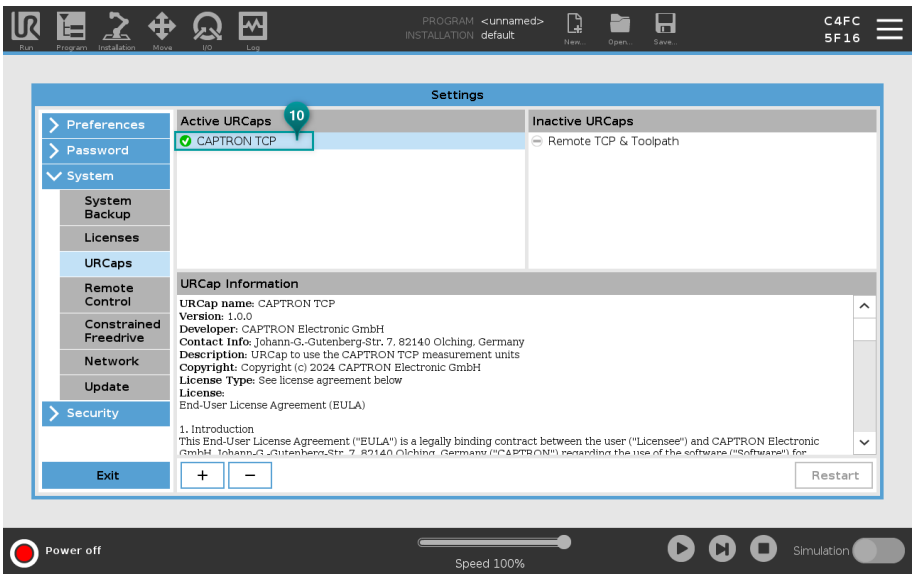


Abb. 6: URCap successfully installed

10. If the URCap has been successfully installed there is a green check mark next to the URCap name

2.2 Uninstall the URCap

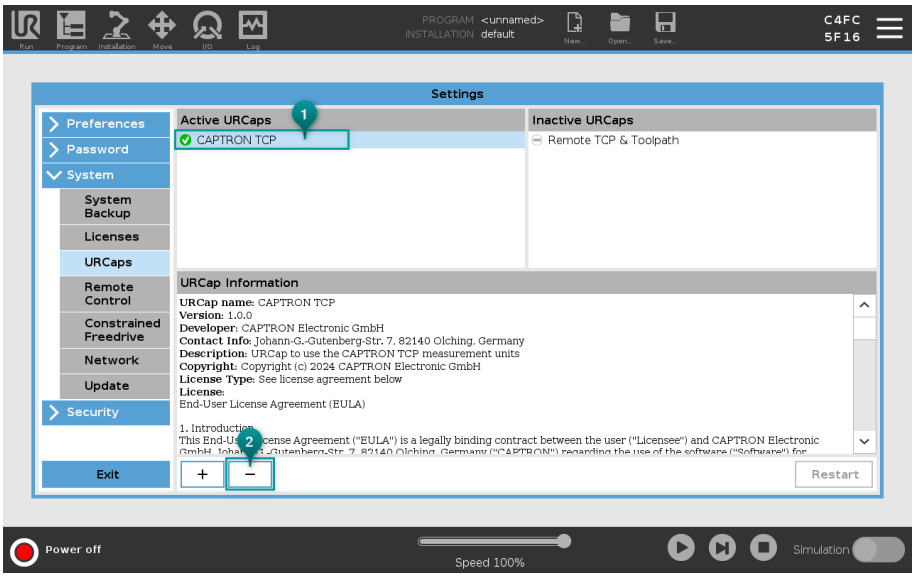


Abb. 7: Remove the URCap

1. Select the URCap to be uninstalled
2. Click “-“
3. Restart the robot

3 Installation Page

3.1 Licensing

To use the URCap, a valid license key must be purchased in advance. The license key must be entered and saved on the installation page. The license is a one-time purchase.

3.1.1 Enter license key on robot

The license key is generated using the robot ID displayed on the robot. To do this, open the installation page and follow steps 1-7.

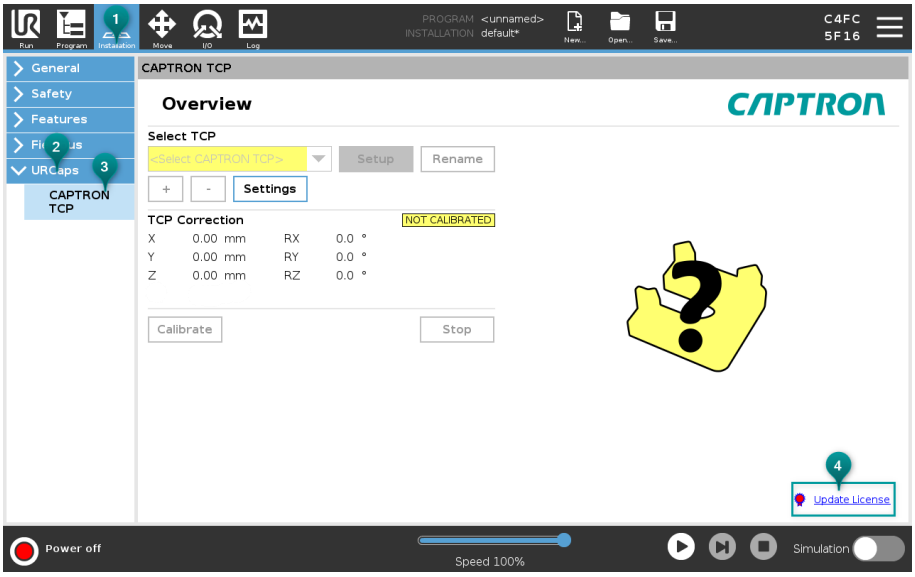


Abb. 8: Installation page

1. Open the installation page
2. Go to URCaps
3. Click on “CAPTRON TCP”
4. Click on “Update License”

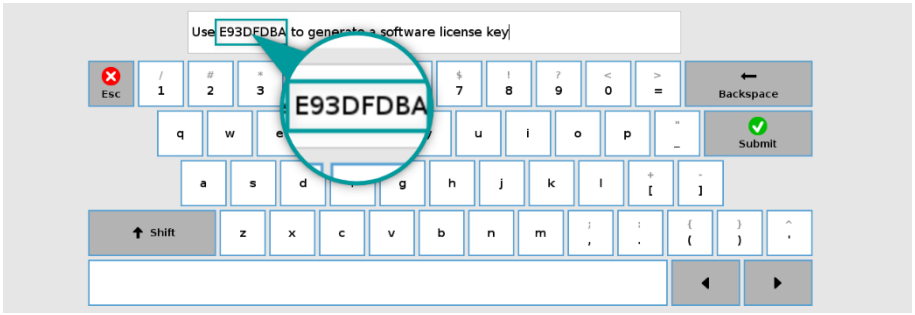


Abb. 9: Robot ID

5. Use the displayed robot ID to generate your software license key on https://www.captron.com/ur/.

Abb. 10: Enter license key

6. Enter your software license key in the input field instead of the message for the robot ID

Abb. 11: Valid license

7. You can recognize a successful activation by the green symbol

3.2 Setup and editing CAPTRON TCP

Up to 10 TCPs can be managed in a robot installation. The setup is done with the help of a setup wizard. To successfully set up a CAPTRON TCP, at least one configured TCP must be available, which can be used as a reference TCP.

3.2.1 Setup new CAPTRON TCP

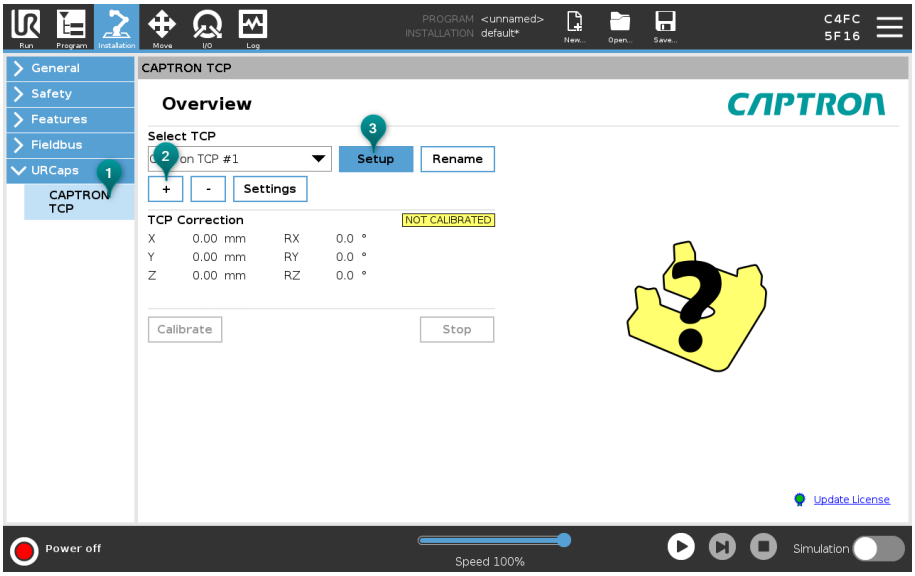


Abb. 12: Open setup wizard

1. Open the installation page
2. Click “+” (a new TCP will be created)
3. Click “Setup” to open the setup wizard

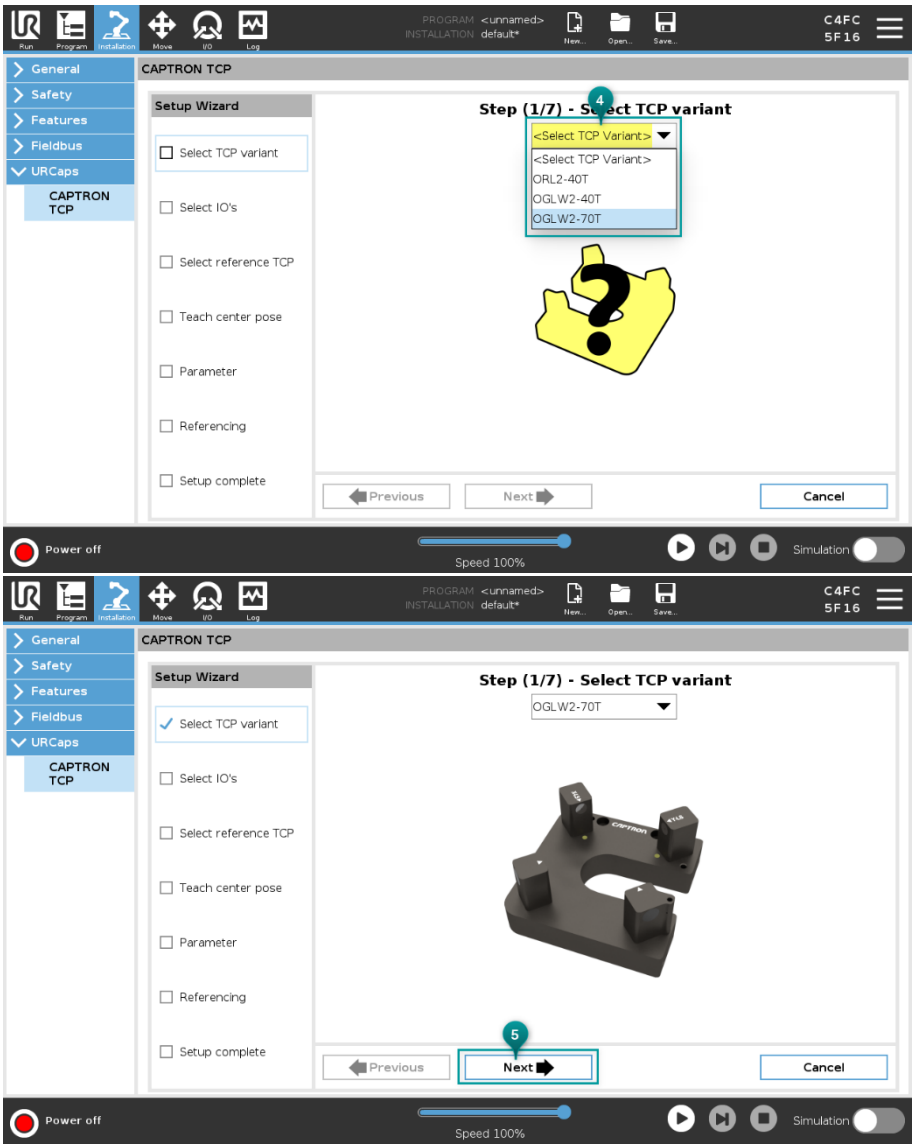


Abb. 13: Setup wizard step 1

4. Select the TCP variant used
5. Click on “Next”

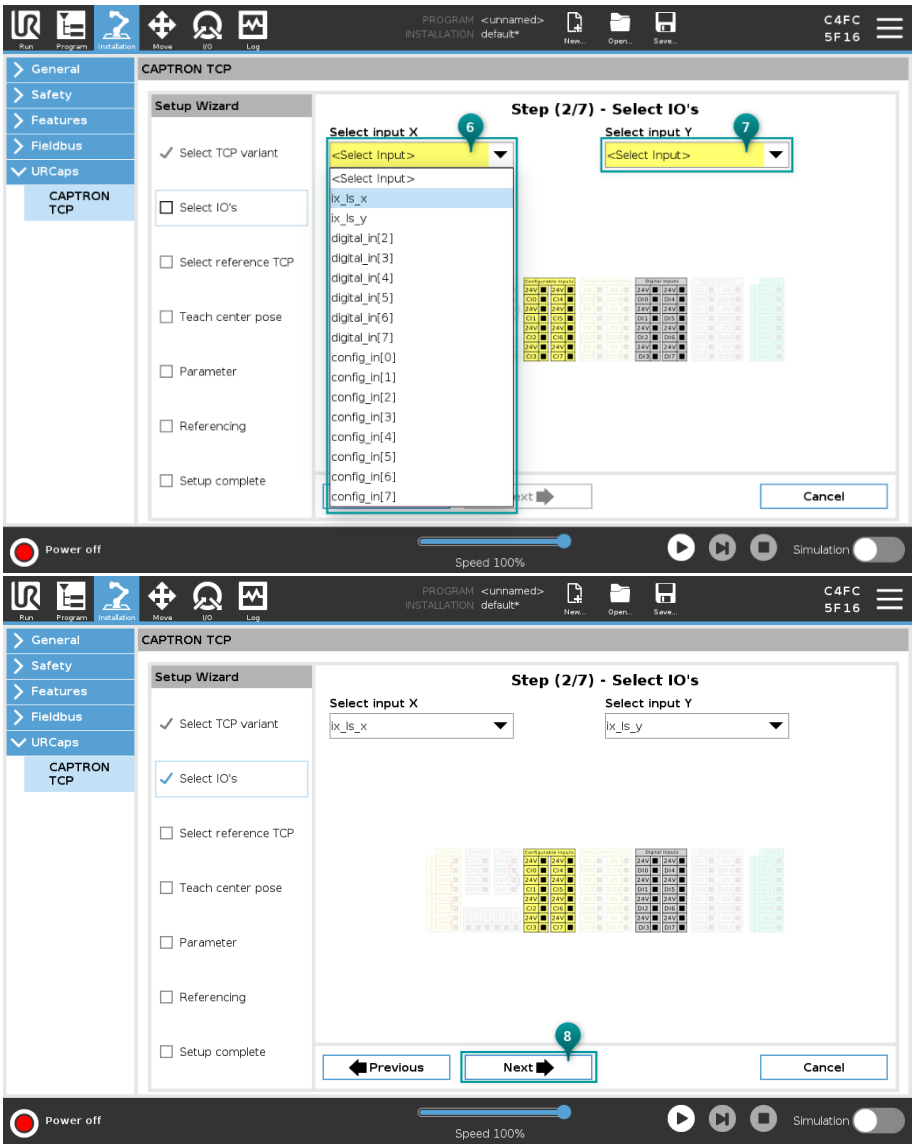


Abb. 14: Setup wizard step 2

6. Select input X-axis (white cable of the CAPTRON TCP sensor)
7. Select input Y-axis (black cable of the CAPTRON TCP sensor)
8. Click on “Next”

Note: Both digital and configurable inputs can be used. To identify the input used for the sensor, you can rename the IO in the robot's IO setup.

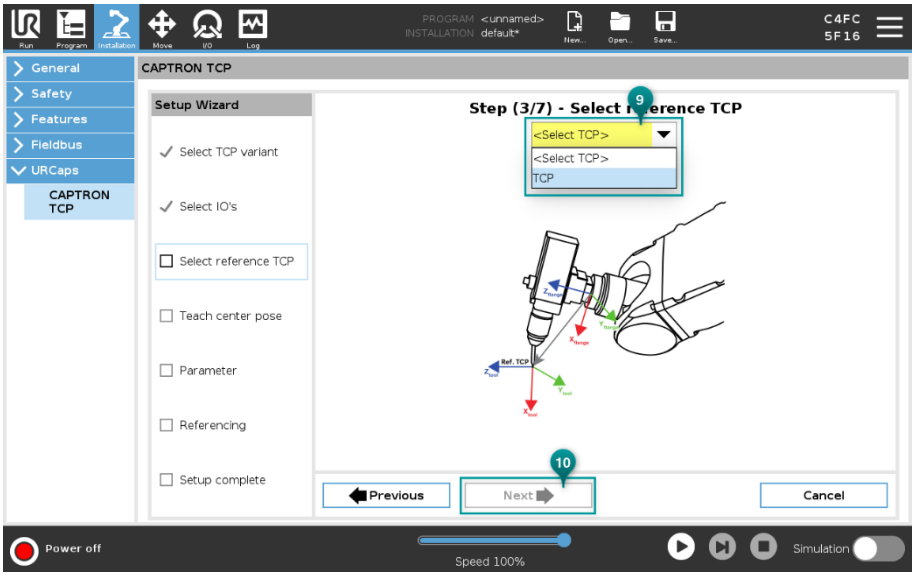
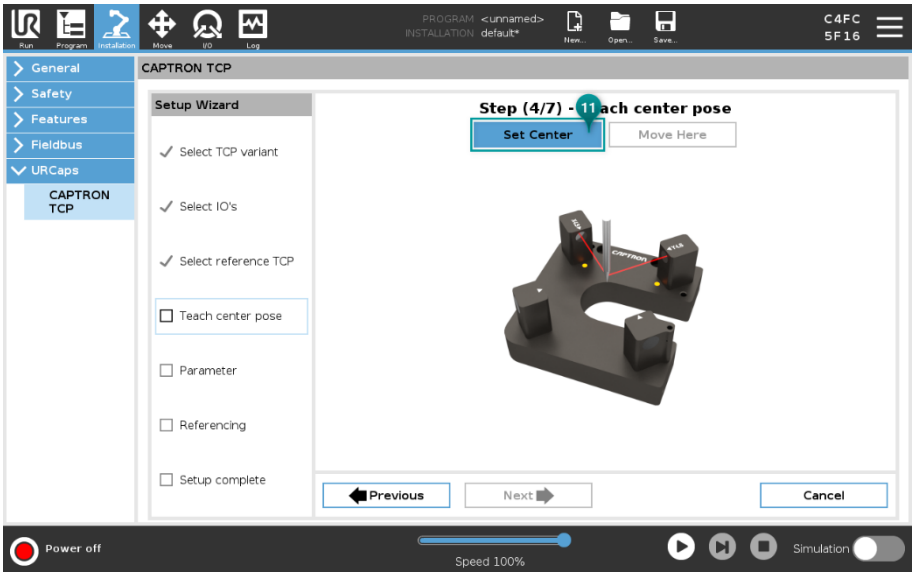


Abb. 15: Setup wizard step 3

9. Select reference TCP
10. Click on “Next”



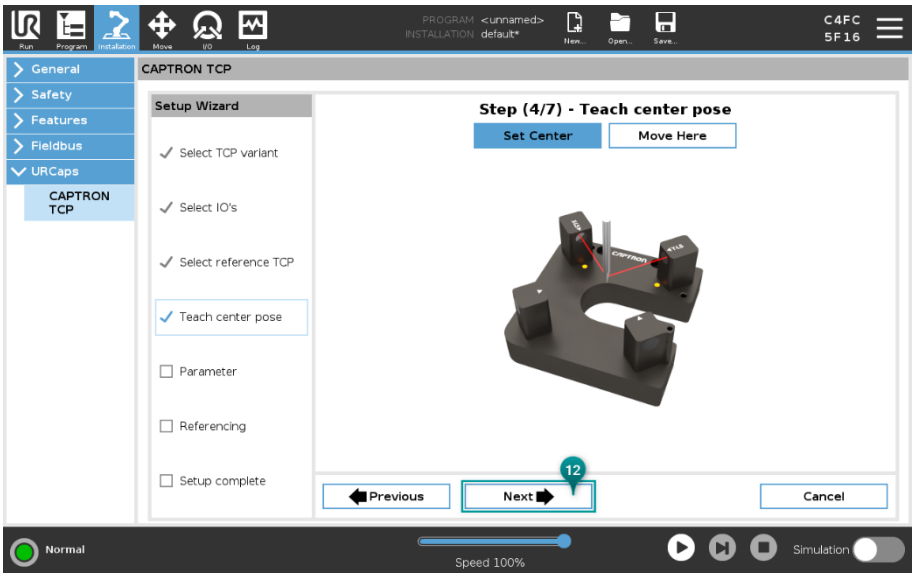


Abb. 16: Setup wizard step 4

11. Click on Set Center to teach the center position
    (The center position must be taught so that both light barriers are interrupted and both LEDs light up)
12. Click on “Next”

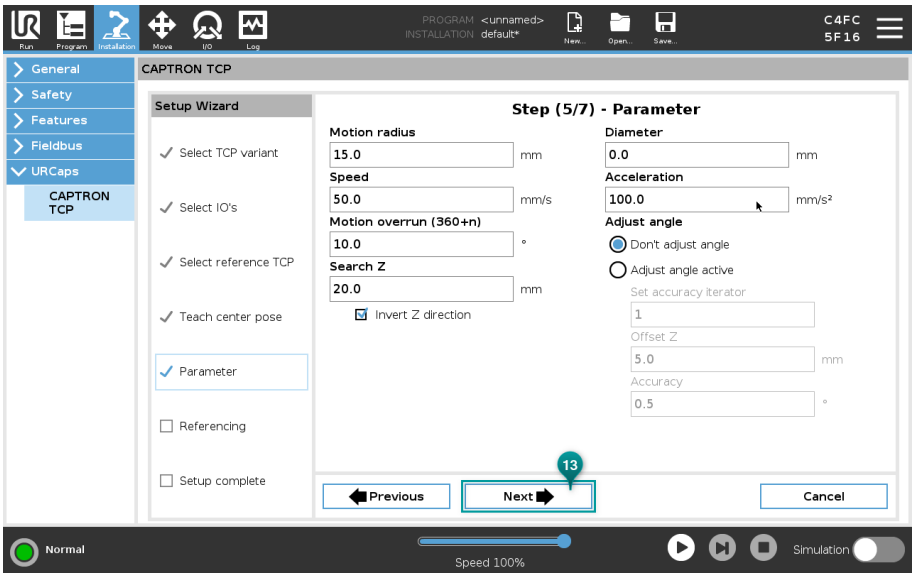


Abb. 17: Setup wizard step 5

13. Click on “Next”
    (If problems occur during referencing/calibration, the parameters might need to be adjusted, explanations in chapter 3.2.5 Setup wizard settings)

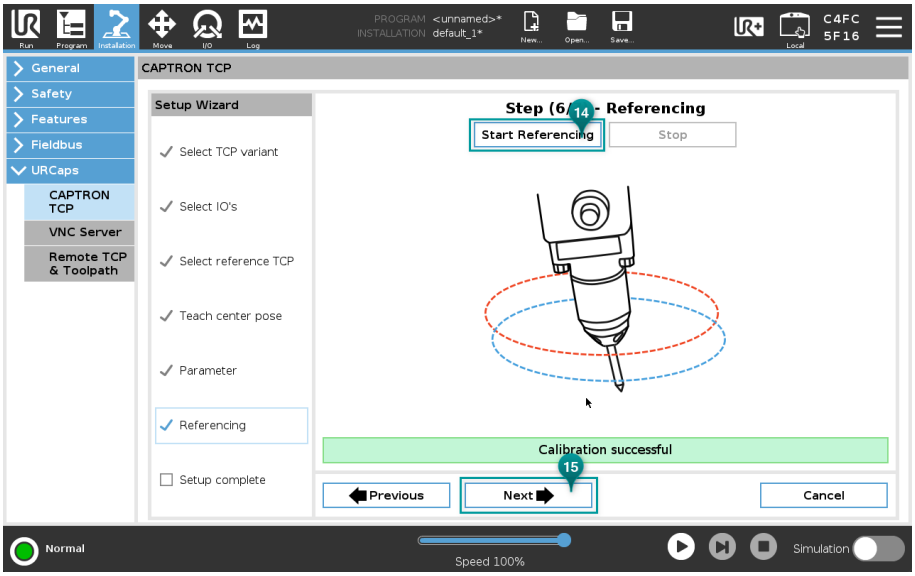


Abb. 18: Setup wizard step 6

14. Click on “Referencing” to start referencing
    (The robot then carries out its reference movement. This determines the intersection point of the two light barriers for the offset calculation)
15. Click on “Next”
    (If an error occurs during referencing, please check the parameter in the previous step)

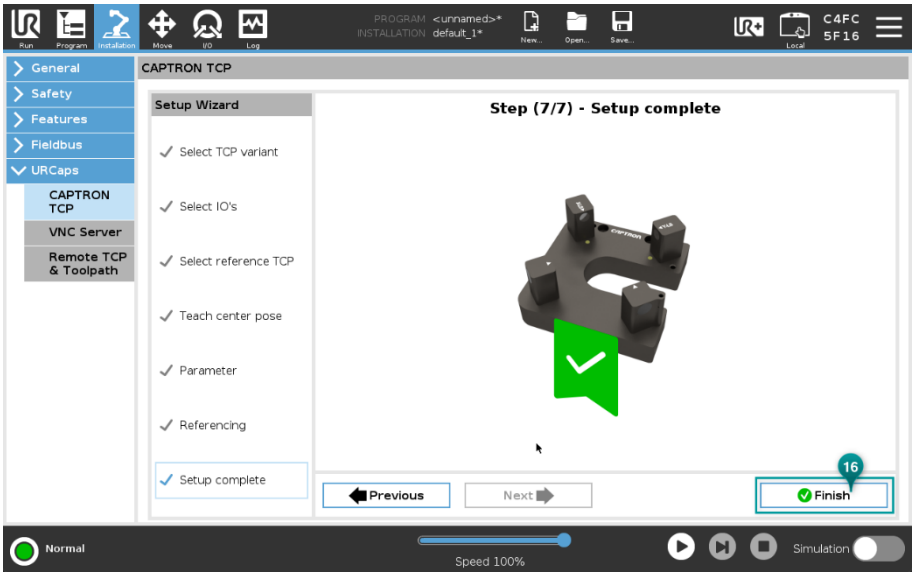


Abb. 19: Setup wizard step 7

16. Click “Finish” to complete the setup process

3.2.2 Edit existing CAPTRON TCP

To adjust basic settings such as the movement radius or similar after the initial setup, the setup wizard can be repeated at any time.

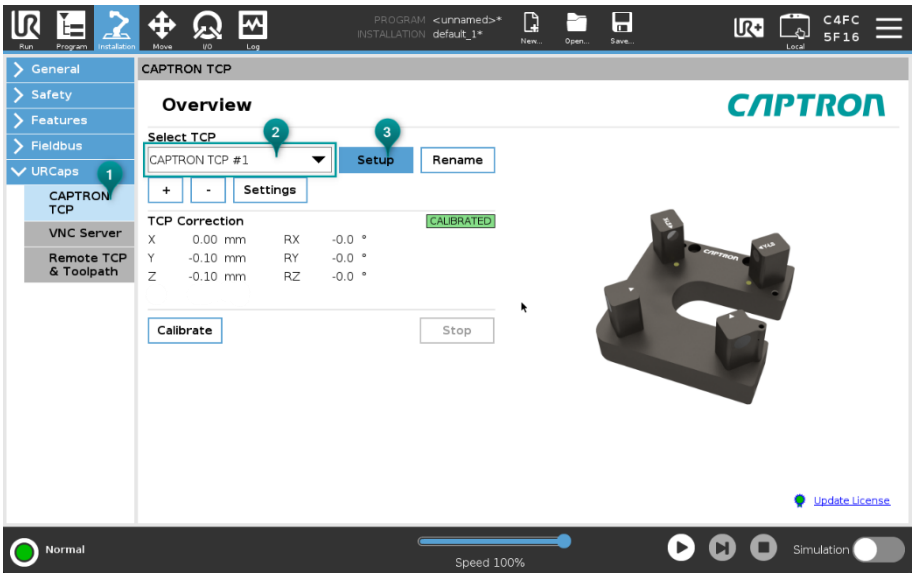


Abb. 20: Open Setup Wizard for editing

1. Open the installation page and click on “CAPTRON TCP”
2. Select the desired CAPTRON TCP from the selection
3. Click on “Setup” to open the setup wizard
4. Repeat steps 4-16 from the previous chapter (Setup new CAPTRON TCP)

3.2.3 Rename CAPTRON TCP

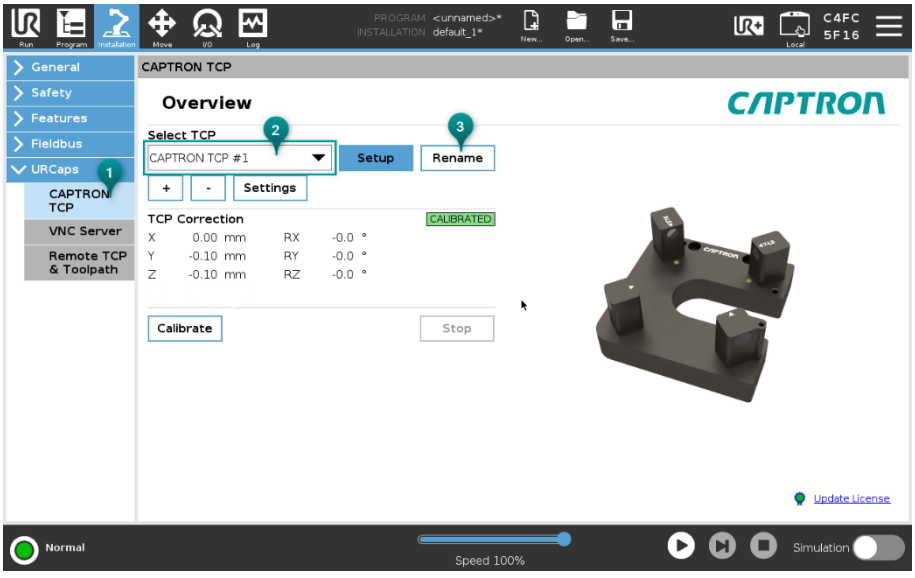


Abb. 21: Rename CAPTRON TCP

1. Open the installation page and click on “CAPTRON TCP”
2. Select the desired CAPTRON TCP from the selection
3. Click on “Rename” to open the input dialog

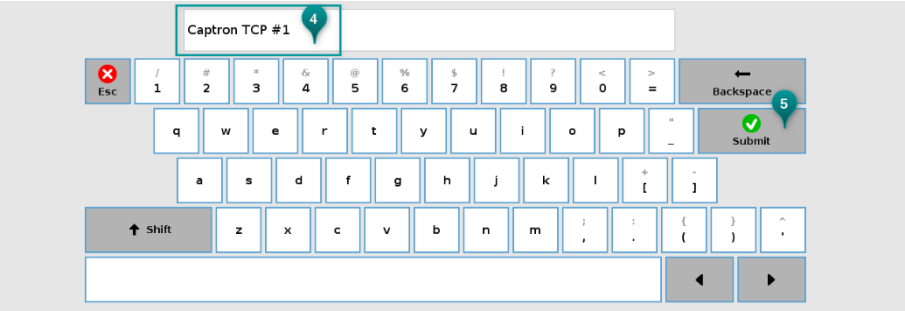


Abb. 22: Enter name for CAPTRON TCP

4. Enter the desired name in the input field
5. Click “OK” to confirm the change

3.2.4 Delete CAPTRON TCP

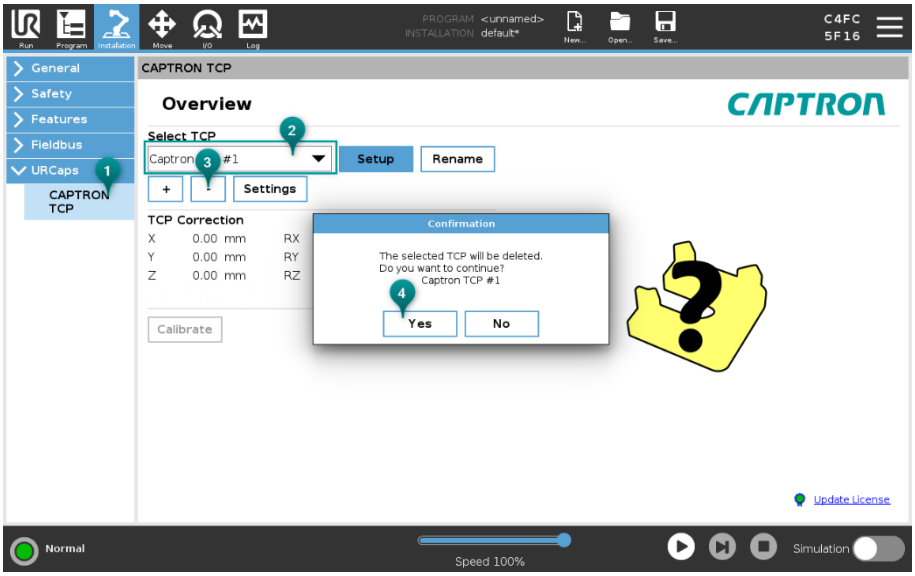


Abb. 23: Delete CAPTRON TCP

1. Open the installation page and click on “CAPTRON TCP”
2. Select the desired CAPTRON TCP from the selection
3. Click “-“
4. Click “Yes” to confirm deletion

3.2.5 Setup Wizard Parameters

The preset values are specific to the respective TCP sensor and may need to be adjusted, as tools can differ greatly.

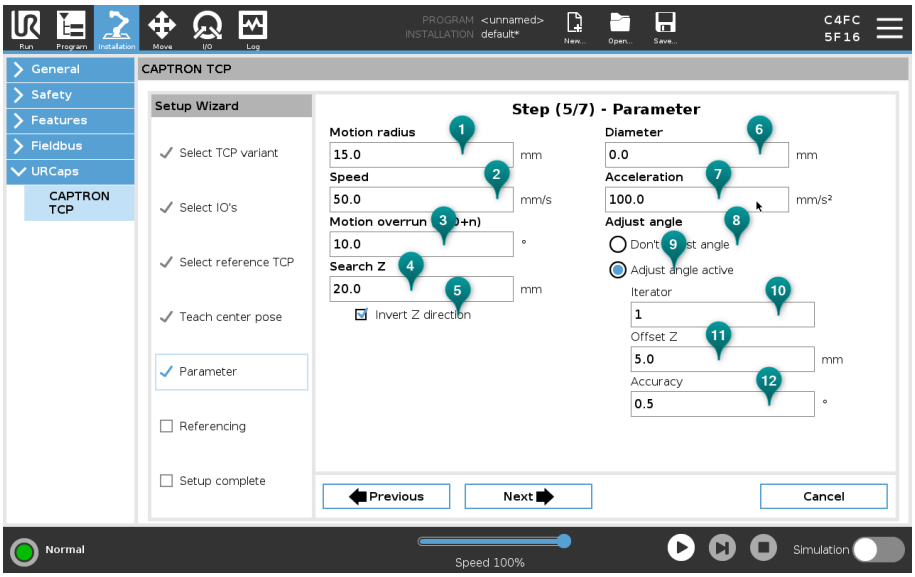


Abb. 24: Setup Wizard Parameters

1. Under “Motion radius“, the radius for the reference/calibration movement can be set
2. Under “Speed“, the speed of the reference/calibration movement can be set. The speed set here serves as the basis for the CAPTRON ACTION used in the program
3. Under “Motion overrun (360+n)“ you can set a number of degrees by which the complete circular movement for the reference/calibration movement is exceeded. This value must be adjusted if the reference/calibration movement ends exactly within a light barrier
4. Under “Search Z“, you can set the Z-stroke that is used to determine the Z-length of the TCP
5. Under “Invert Z direction”, the direction can be reversed
6. Under “TCP diameter”, the actual diameter of the tool can be entered
7. can be entered. This serves as a reference for checking the diameter
8. Under “Acceleration“, the acceleration of the reference/calibration movement can be set. The acceleration set here serves as the basis for the CAPTRON ACTION used in the program
9. If “Do not adjust angle“ is selected, no angle correction is performed
10. If “Adjust angle“ is active, the angle correction is carried out
11. Under “Iterator“ you can set how often the angle search is repeated to achieve the desired accuracy
12. Under “Offset Z“, the Z-stroke used for the angle search can be set. The TCP therefore immerses into the CAPTRON TCP sensor by the set value at the intersection point of the light barriers to determine the tilting of the TCP
13. Under “Accuracy“, you can enter a desired number of degrees for the angle correction. If the determined correction value is smaller than the input value, the angle search is terminated even if the iterator value is not reached

3.2.6 URCap Settings

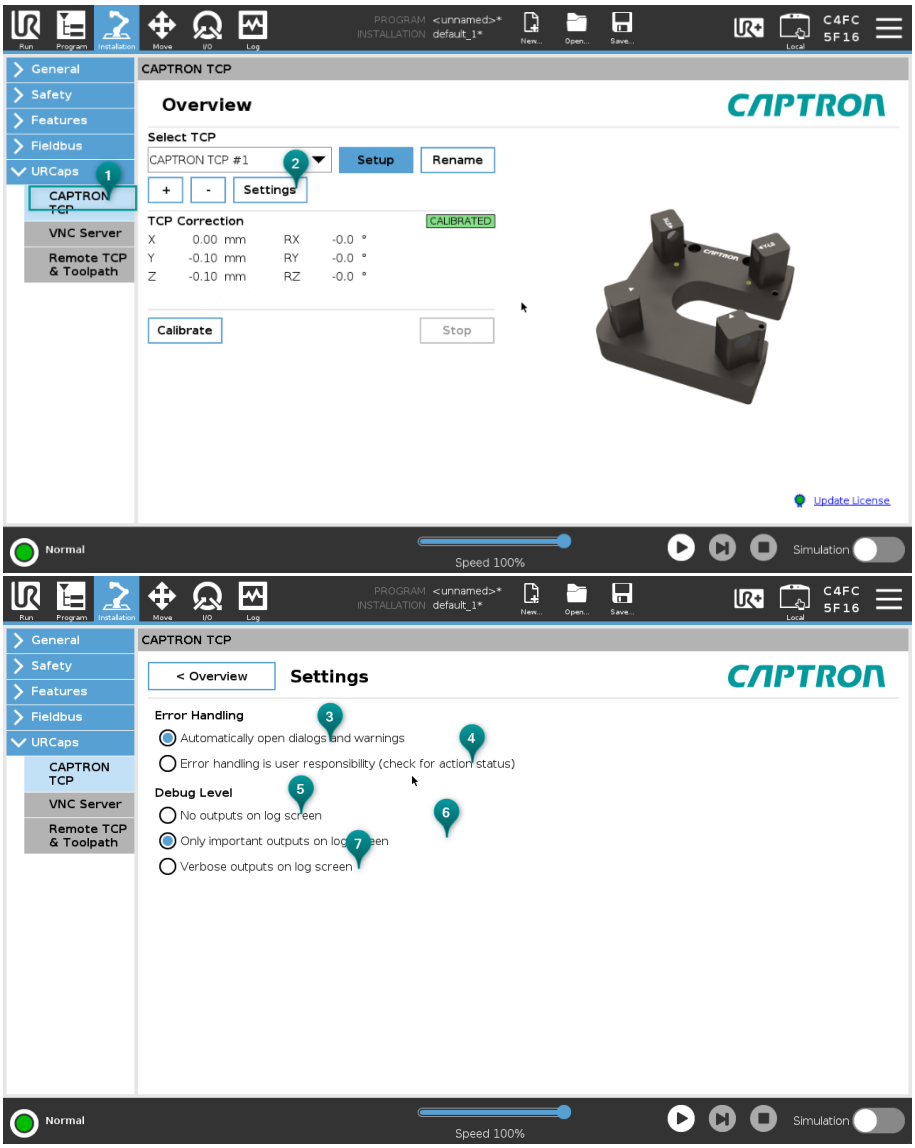


Abb. 25: URCap Settings

1. Open the installation page and click on CAPTRON TCP
2. Click on “Settings“
3. If this setting is active, process errors will be displayed via pop-ups
4. If this setting is active, process errors are not displayed
5. If this setting is active, no log entries are displayed on the log screen
6. If this setting is active, only important information and error messages are displayed on the log screen
7. If this setting is active, all messages are displayed on the log screen

3.2.7 Calibrate CAPTRON TCP manually

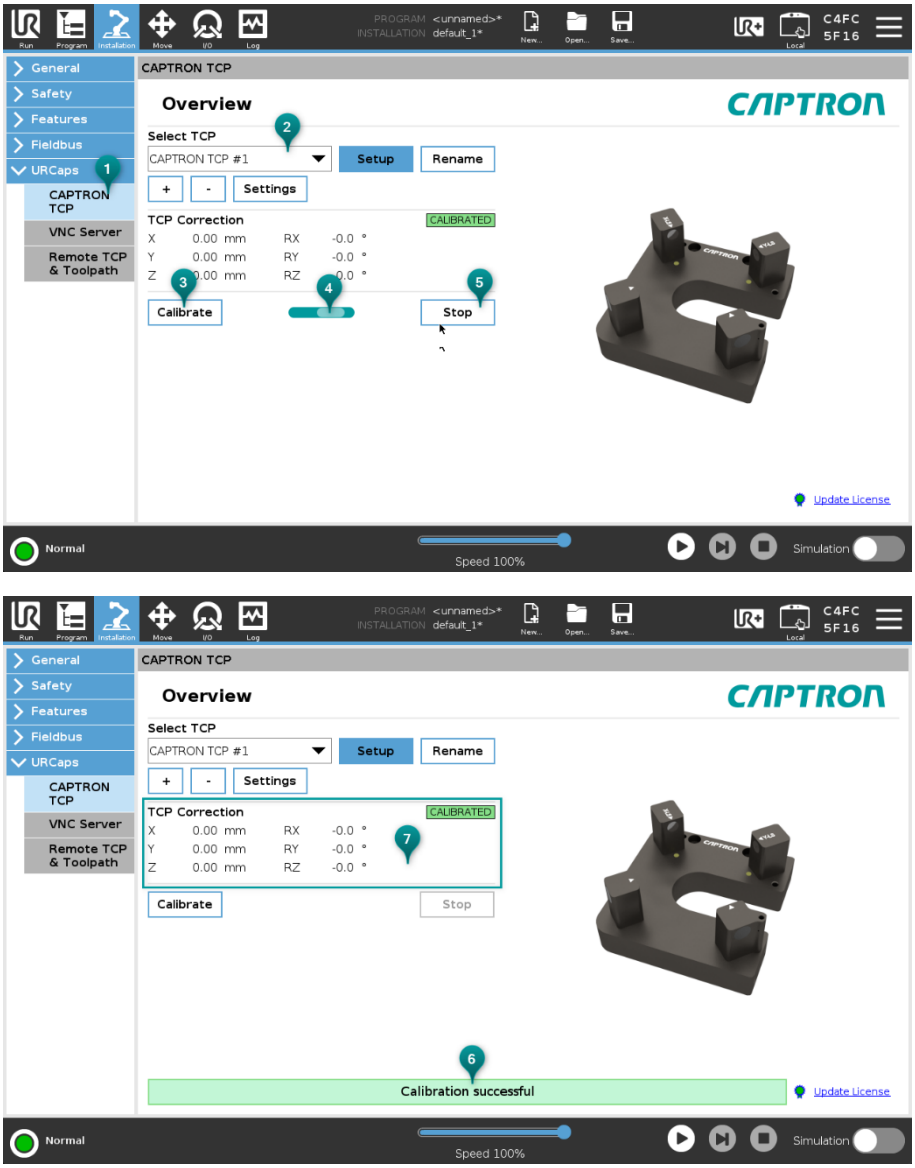


Abb. 26: Calibrate CAPTRON TCP manually

1. Open the installation page and click on CAPTRON TCP
2. Select the desired CAPTRON TCP from the selection
3. Click “Calibrate“ to start calibration
4. The progress bar is displayed while the calibration is running
5. Click “Stop“ to interrupt/end the calibration prematurely
6. The status is displayed in the lower part of the screen after calibration has been completed
7. The correction values in relation to the reference TCP are displayed here. Use the corresponding TCP “CAPTRON TCP #No.“ in the program

Note: After setup, no additional manual calibration is required to use the CAPTRON TCP in the program sequence

4 Program Node CAPTRON ACTION

With the CAPTRON ACTION, all available functions can be used. The TCP can be checked, validated or recalibrated.

4.1 Insert CAPTRON ACTION

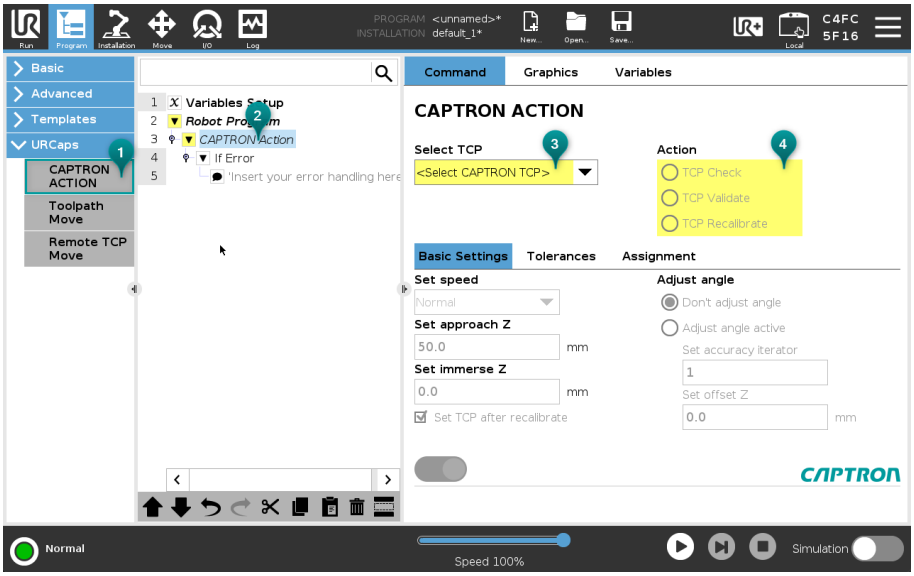


Abb. 27: Insert CAPTRON ACTION

1. Insert CAPTRON ACTION to the program tree by clicking on CAPTRON ACTION
2. Activate the Program Node
3. Select the desired CAPTRON TCP from the selection
4. Select the action to be performed

4.1.1 TCP Check

During TCP Check, the robot moves with the selected CAPTRON TCP to the intersection point of the CAPTRON TCP sensor. For the check to be successful, both light barriers must be interrupted. If this is not the case, an immersion movement is carried out (immersion parameter Z) to check for minimal wear. If the light barriers still do not respond after immersion, the check has failed and error handling is called, otherwise the program flow continues.

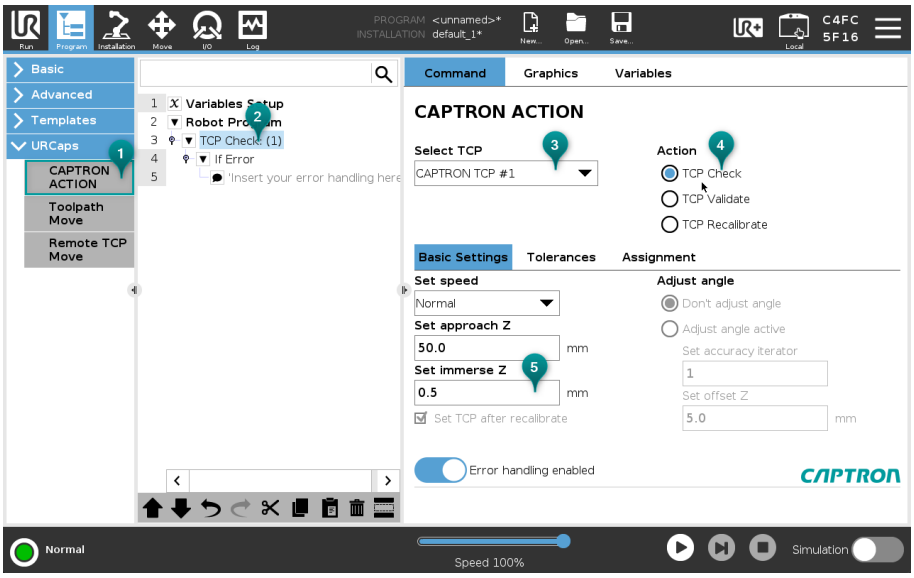


Abb. 28: CAPTRON ACTION TCP Check

1. Insert CAPTRON ACTION to the program tree by clicking on CAPTRON ACTION
2. Activate the Program Node
3. Select the desired CAPTRON TCP from the selection
4. Select “TCP Check“
5. If necessary, adjust “Set immerse Z“

4.1.2 TCP Validate

During TCP validation, the robot performs the calibration movement of the CAPTRON TCP sensor. However, the TCP is not corrected, but merely validated to ensure that the deviation is not outside the set tolerance values. If successful, the program continues, otherwise error handling is called.

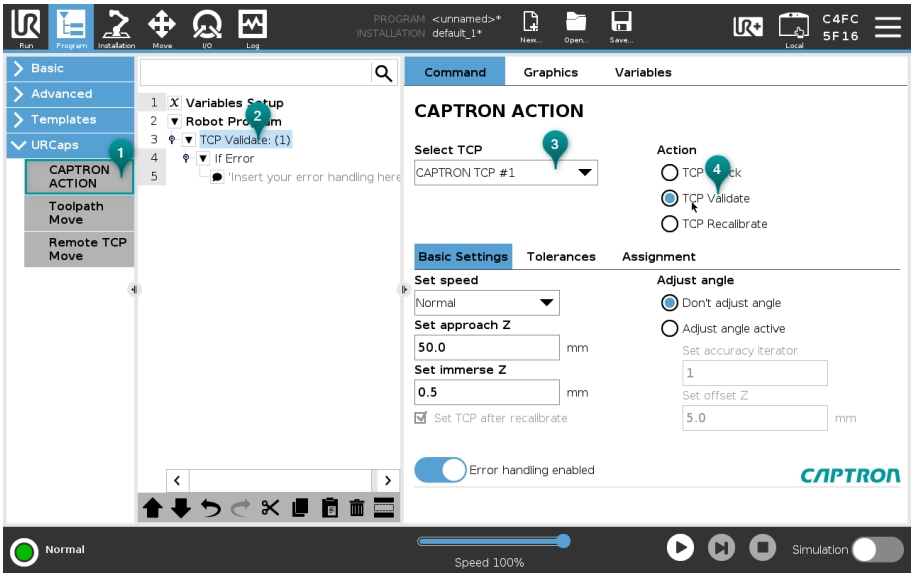


Abb. 29: CAPTRON ACTION TCP Validate

1. Insert CAPTRON ACTION to the program tree by clicking on CAPTRON ACTION
2. Activate the Program Node
3. Select the desired CAPTRON TCP from the selection
4. Select “TCP Validate“

4.1.3 TCP Recalibrate

During TCP recalibration, the selected CAPTRON TCP is calibrated with the calibration movement of the CAPTRON TCP sensor, taking into account the set tolerances. The determined TCP correction value is assigned to the program node variable, but a user-defined position variable can also be used alternatively. If successful, the program run is continued, otherwise error handling is called.

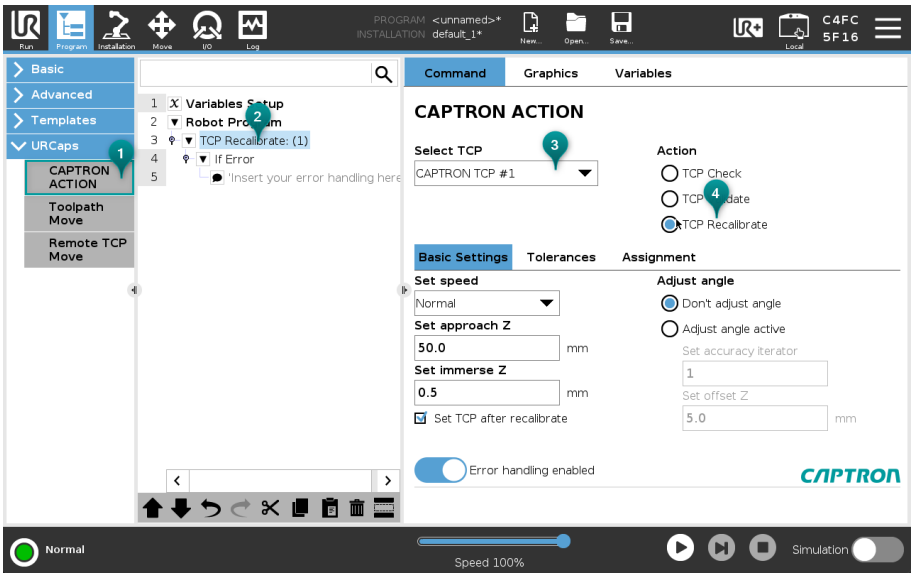


Abb. 30: CAPTRON ACTION TCP Recalibrate

1. Insert CAPTRON ACTION to the program tree by clicking on CAPTRON ACTION
2. Activate the Program Node
3. Select the desired CAPTRON TCP from the selection
4. Select “TCP Recalibrate“

4.2 Basic Settings

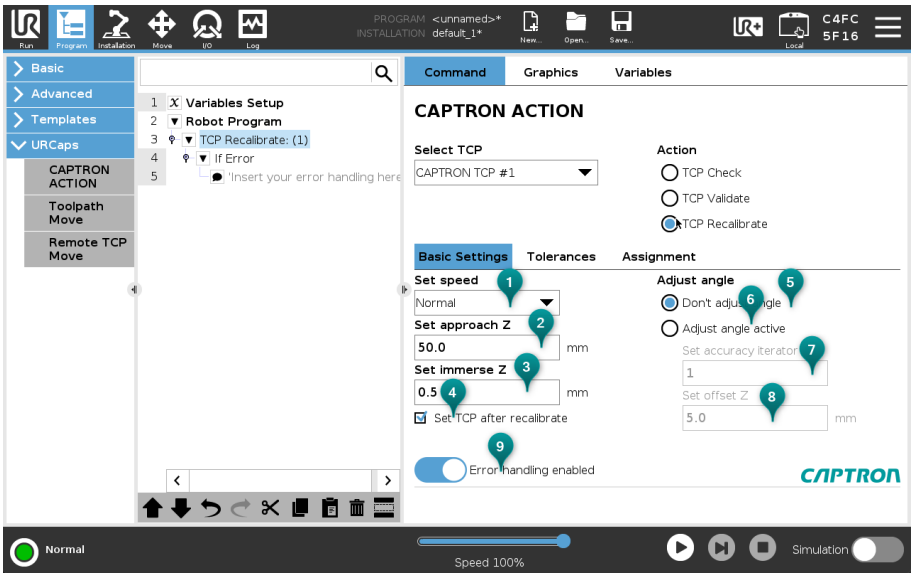


Abb. 31: CAPTRON ACTION Basic Settings

1. Under “Speed“, the robot speed for the selected action can be changed. You can choose between Normal, Fast and Slow. The base speed for this is set in the setup wizard
2. Under “Approach Z“, the Z offset used for the movement to the CAPTRON TCP sensor can be set
3. Under “Set immerse Z“, the Z offset used in the “TCP Check“ and “TCP Validate“ actions to immerse into the CAPTRON TCP Sensors in the intersection point of the light barriers can be set
4. Checkbox to activate the TCP correction value automatically on successful recalibration
5. If “Do not adjust angle“ is selected, the angle deviation is not checked in the „TCP Validate“ action and is neither checked nor corrected in “TCP Recalibrate“
6. If “Adjust angle“ is active, the angle deviation is checked in the “TCP Validate“ action and is checked and corrected in „TCP Recalibrate“
7. Under “Accuracy iterator“, the accuracy of the angle correction can be increased if necessary. To achieve this, the angle search is repeated until the entered value is reached or until the accuracy from the setup wizard is achieved
8. Under “Offset Z“, the Z stroke used for the angle search can be set. The TCP therefore immerses into the CAPTRON TCP sensor by the set value at the intersection point of the light barriers to determine the tilting of the TCP
9. Error handling can be activated or deactivated using the slider

4.3 Tolerances

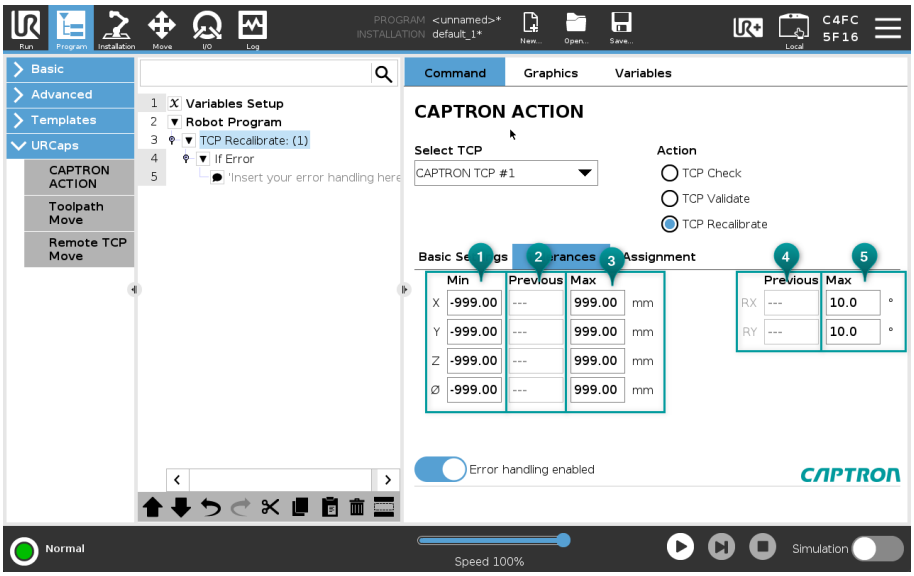


Abb. 32: CAPTRON ACTION Tolerances

1. Under “Min“, the minimum deviation tolerance for the „TCP Validate“ and TCP Recalibrate actions can be set (XYZ offset and diameter). The deviation determined must therefore not be less than this value
2. Under Previous, the most recently determined deviation is displayed. For this, the robot program must have run through the CAPTRON ACTION at least once
3. Under Max, the maximum deviation tolerance for the “TCP Validate” and “TCP Recalibration“ actions can be set (XYZ offset and diameter). The deviation determined must therefore not exceed this value
4. Under Previous, the most recently determined value of the angle correction is displayed. For this, the angle adjustment must be active, and the robot program must have run through the CAPTRON ACTION at least once
5. Under “Max“, the maximum correction value for the angle adjustment can be set (RX and RY). The angle determined must therefore not exceed this value

4.4 Assignment

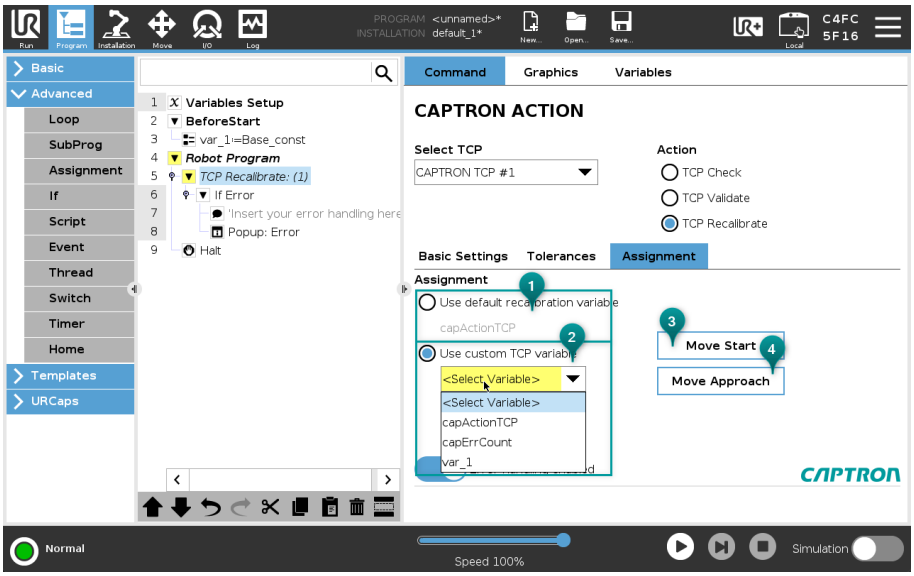


Abb. 33: CAPTRON ACTION Assignment

1. If “Use default recalibration variable“ is active, the determined TCP correction value, which is determined during TCP recalibration, is assigned to this variable
2. If “Use custom TCP variable“ is active, the determined TCP correction value, which is determined during TCP recalibration, is assigned to the selected position variable
3. The “Move Start“ button can be used to move the robot to the start position in the CAPTRON TCP sensor. The start position depends on the selected action. With “TCP Check“ and “TCP Validate“, the intersection point with the currently calibrated correction value is approached. With “TCP Recalibration“, the center position from the setup wizard is approached with the reference TCP
4. The “Move Approach“ button can be used to move the robot to the start position including the set approach Z value in the CAPTRON TCP sensor

4.5 Error Handling

Error handling is enabled by default, so that the logic to be executed in the event of an error must be programmed in the “If Error” program node in the program tree.

4.5.1 Enable Error Handling

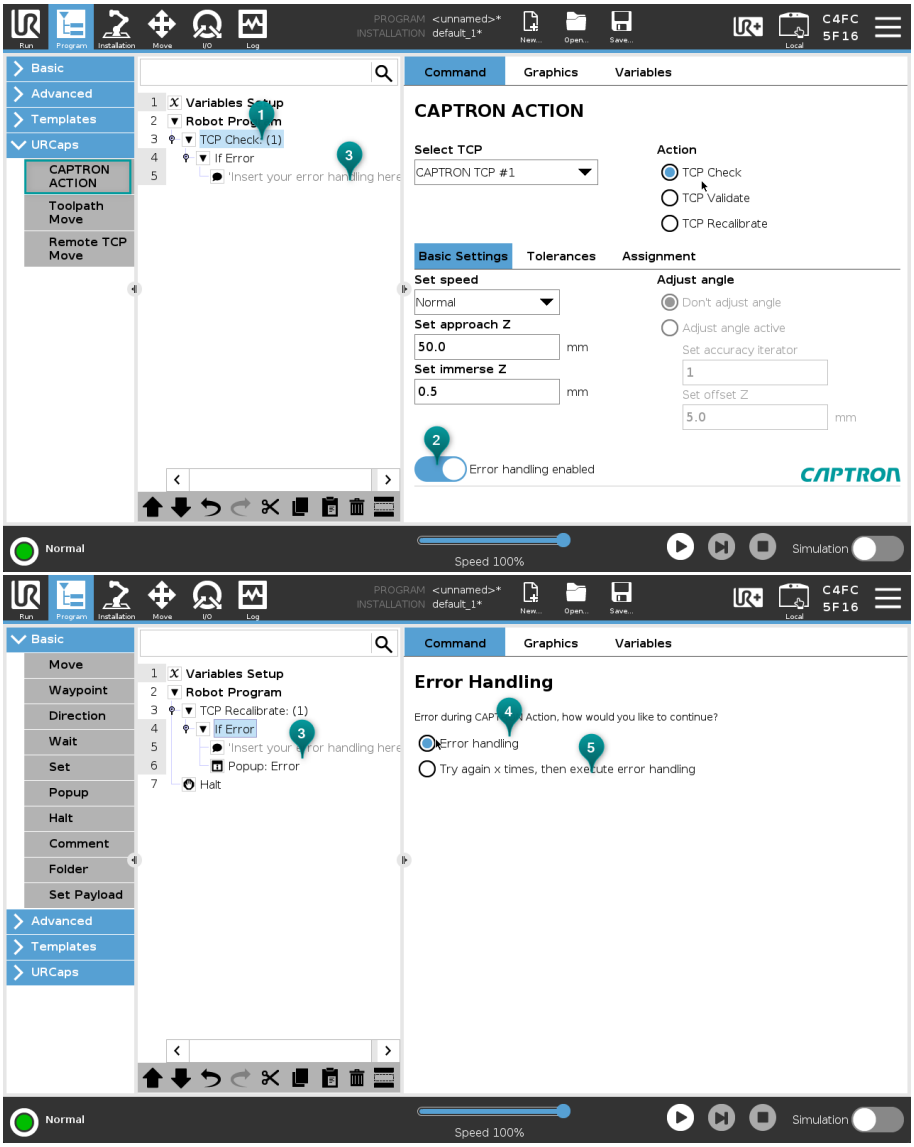


Abb. 34: CAPTRON ACTION Enable Error Handling

1. Activate the Program Node
2. Activate error handling
3. Program the logic for error handling at this point in the program tree
4. If the “Error Handling“ selection is active, error handling is called immediately after the error occurs
5. If the “Try again x times...“ is selected, error handling is only called if the CAPTRON ACTION is still faulty after the entered number of repetitions

4.5.2 Disable Error Handling

If error handling is disabled, after executing the CAPTRON ACTION, the script function cap_isActionOk() must be used to check whether the check, validation or recalibration was successful.

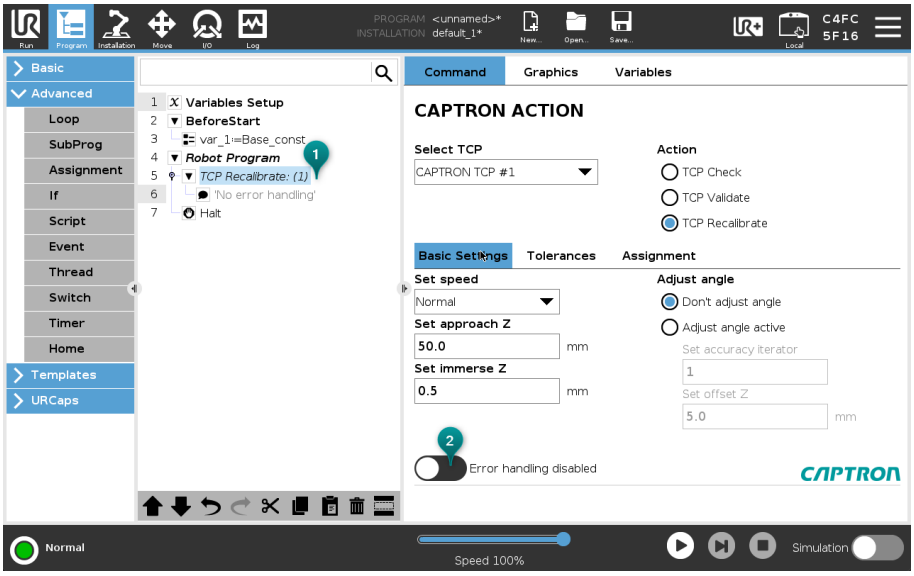


Abb. 35: CAPTRON ACTION Disable Error Handling

1. Activate the Program Node
2. **Disable Error Handling**

4.6 Script Functions

In addition to the CAPTRON ACTION, various script functions are available. Among other things, there is a function to query the status of the CAPTRON ACTION when error handling is deactivated. In addition, the correction value can be called up, for example, or the determined TCP can be set.

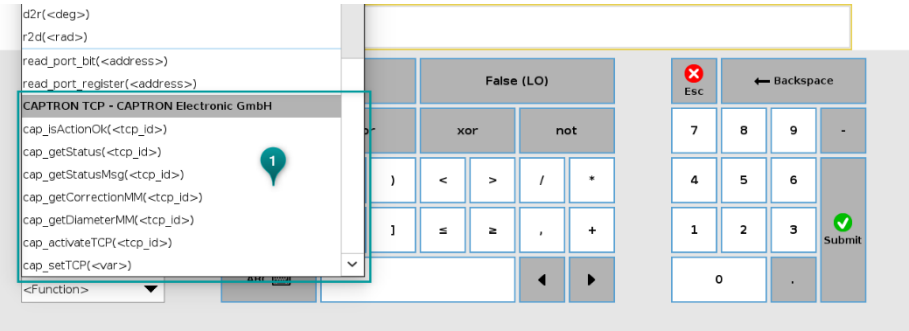


Abb. 36: Script Functions

1. List of available script functions

Script Function	Description	Passing parameter	Return Value
cap_isActionOk()	Query whether the last CAPTRON ACTION execution was successful	<tcp_id> = CAPTRON TCP 1-10	True | False
cap_getStatus()	Status query of the last CAPTRON ACTION execution	<tcp_id> = CAPTRON TCP 1-10	No. of status message, 0 = OK
cap_getStatusMsg()	Status message of the last CAPTRON ACTION execution	<tcp_id> = CAPTRON TCP 1-10	Status message
cap_getCorrectionMM()	Correction value of the last CAPTRON ACTION execution	<tcp_id> = CAPTRON TCP 1-10	Position variable with correction values
cap_getDiameterMM()	Diameter of the last CAPTRON ACTION execution	<tcp_id> = CAPTRON TCP 1-10	Diameter value
cap_activateTCP()	Activate recalibrated TCP (CAPTRON ACTION)	<tcp_id> = CAPTRON TCP 1-10	No return value
cap_setTCP()	Set TCP offset with variable	<var> = Position variable with TCP values	No return value

5 Troubleshooting

5.1 Error Messages Installation

No.	Description	Suggested solution
1	At least one input sensor is low.	- Check the electrical wiring - Check the center point position, both light barriers must be interrupted
2	Wrong number of interrupt points.	- Check the electrical wiring - Check the calibration movement, both light barriers must be interrupted exactly 2 times. If necessary, correct the center point position or adjust the motion overrun parameter - Increase the speed if necessary
3	Unable to calculate diameter.	- Repeat the process - If necessary, use a different angle for the center point position
4	Unable to calculate center points.	- Repeat the process - If necessary, use a different angle for the center point position
5	Unable to calculate intersect point.	- Repeat the process - If necessary, use a different angle for the center point position
6	Failed to convert intersect position.	- Repeat the process - If necessary, use a different angle for the center point position
7	Failed to move to intersect position.	- Check that the robot is enabled to move
8	Input low on intersect position.	- Check the electrical wiring - If necessary, use a different angle for the center point position
9	Search motion Z failed, input not low.	- Check the electrical wiring - Adjust the center point position so that the TCP only immerses about 1-2 mm into the light barriers - Increase the Z Search parameter
10	Unable to calculate correction/ tcp.	- Repeat the process - If necessary, use a different angle for the center point position
11	Adjust angle, wrong number of interrupt points.	- Check the electrical wiring - Check the calibration movement, both light barriers must be interrupted exactly 2 times. If necessary, correct the center point position or adjust the motion overrun parameter
12	Adjust angle, Unable to calculate intersect point.	- Repeat the process - If necessary, use a different angle for the center point position
13	Adjust angle, angle correction to large.	- Reduce the tilting of the TCP

5.2 Status Messages CAPTRON ACTION

No.	Description	Suggested solution

0	Success	
1	Wrong number of interrupt points	- Check the electrical wiring - Check if the CAPTRON TCP is correctly set up and calibrated
2	Unable to calculate intersect point	- Repeat the process - Check if the CAPTRON TCP is correctly set up and calibrated
3	Invalid intersect point	- Repeat the process - Check if the CAPTRON TCP is correctly set up and calibrated
4	Input low on intersect position	- Check if the TCP is correct - Check the electrical wiring
5	Search motion Z failed, input not low	- Check if the TCP is correct - Check the electrical wiring - Check if the CAPTRON TCP is correctly set up and calibrated
6	TCP correction outside tolerance	- Check if the TCP is correct - Adjust the tolerances accordingly
7	TCP diameter outside tolerance	- Check if the TCP is correct - Adjust the tolerances accordingly
11	Wrong number of interrupt points (adjust angle)	- Repeat the process - Check if the CAPTRON TCP is correctly set up and calibrated
12	Unable to calculate intersect point (adjust angle)	- Repeat the process - Check if the CAPTRON TCP is correctly set up and calibrated
13	Invalid intersect point (adjust angle)	- Repeat the process - Check if the CAPTRON TCP is correctly set up and calibrated
14	Adjust angle outside tolerance	- Check if the TCP is correct - Adjust the tolerances accordingly
21	Input low on reference position (check)	- Check if the TCP is correct - Check the electrical wiring - Check if the CAPTRON TCP is correctly set up and calibrated
31	Immerse motion Z failed, inputs not high	- Check if the TCP is correct - Check the electrical wiring - Check if the CAPTRON TCP is correctly set up and calibrated
999	Unknown	

6 Index

6.1 List of Figures