

CoBot SmartMagGrip E30 URCap Manual

Table of Contents

S. No.	Topic	Page Number
1	Magswitch Gripper URCap Installation	2
2	Powering Magswitch Gripper from the CoBot	3
3	Configuring Tool TCP	4
4	Magswitch Gripper URCap Installation Interface	6
5	Magswitch Gripper Calibration Fundamentals	10
6	Tool Orientation	11
7	Calibration Methods	12
8	Calibration Steps in Detail	13
9	Testing Calibration – Configuration 1 – Multi-Step Learn	21
10	Testing Calibration – Configuration 2 – Multi-Step Learn	23
11	Testing Calibration – Configuration 3 – Simple Learn/Multi-Step Learn	25
12	Using Magswitch Gripper and Magswitch Power Program Nodes	26

Magswitch Gripper URCap Installation

Open the settings menu and go to URCaps under the system tab.

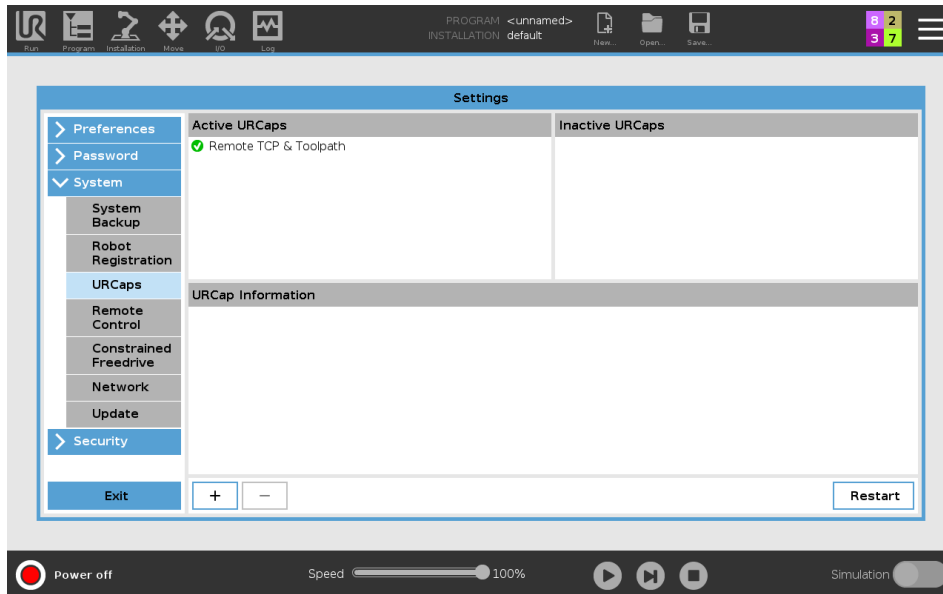


Fig 1: URCap Settings Menu

Select the "+" icon and load Magswitch Gripper URCap from the flash drive plugged into the cobot. Once the URCap is loaded, restart the system and verify that the Magswitch URCap is present under Active URCaps, this indicates successful installation.

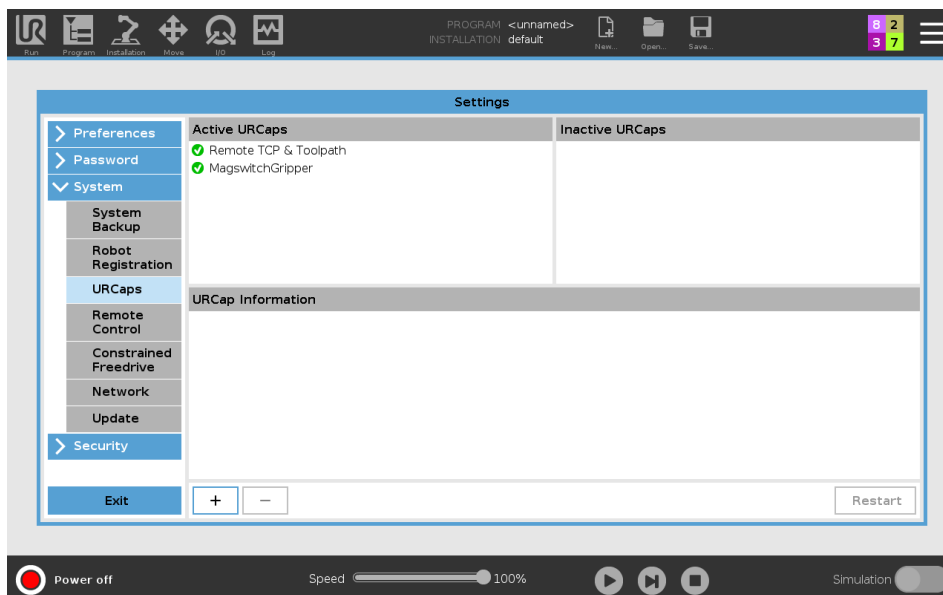


Fig 2: Successful Installation of Magswitch Gripper URCap

For more detailed steps please refer the following link: [Universal Robots ROS Driver/install_urcap_e_series.md at master · UniversalRobots/Universal Robots ROS Driver · GitHub](https://github.com/UniversalRobots/Universal_Robots_ROS_Driver/blob/master/install_urcap_e_series.md)

Powering Magswitch Gripper from the Cobot

To enable power and configure gripper using RS485 Modbus protocol, go to the installation tab, select Tool I/O and select MagswitchGripper from the Controlled by drop down menu.

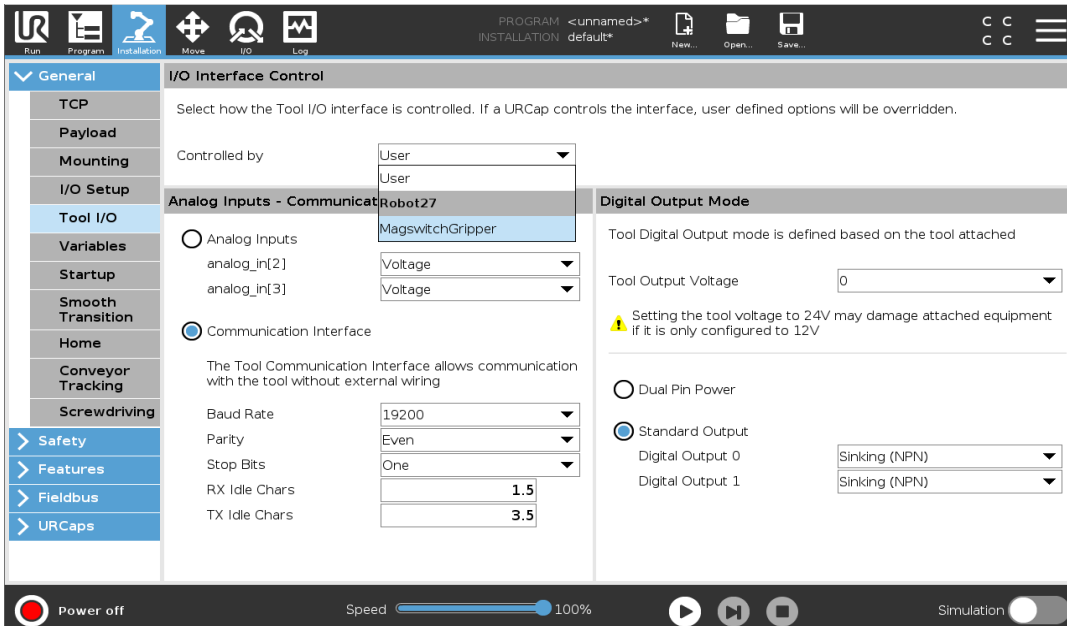


Fig 3: Selecting Magswitch Gripper from Tool I/O

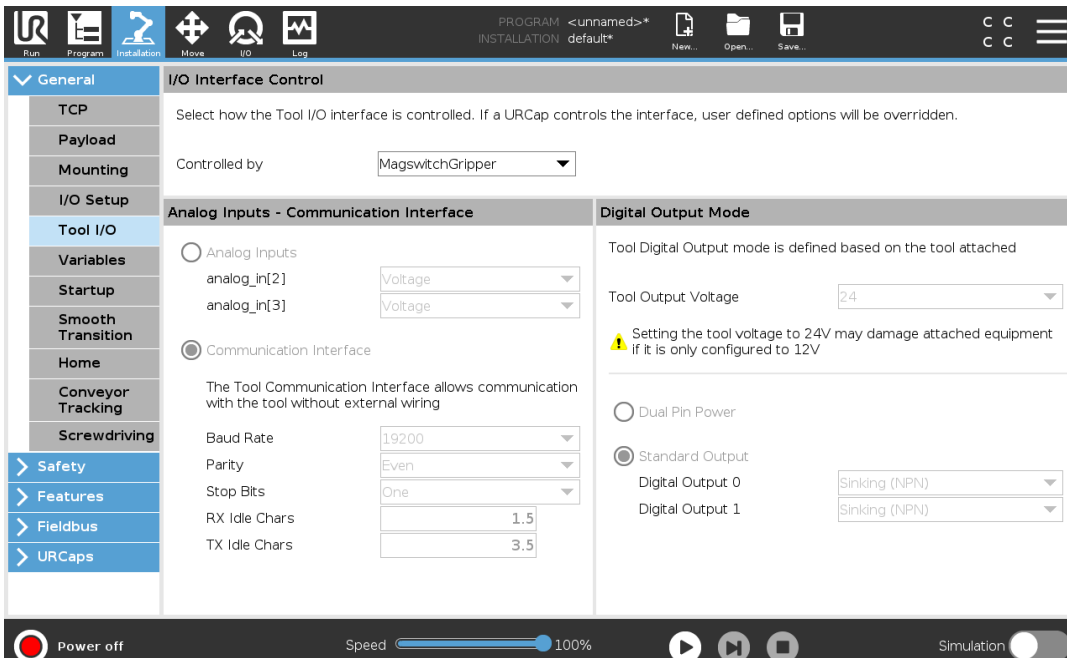


Fig 4: Magswitch Gripper Connected to Cobot

Configuring Tool Center Point (TCP)

Under the installation tab, select general and then TCP to configure the TCP (shown below in Figure 3). Under the drop-down menu, select the configuration that pertains to desired tool configuration.

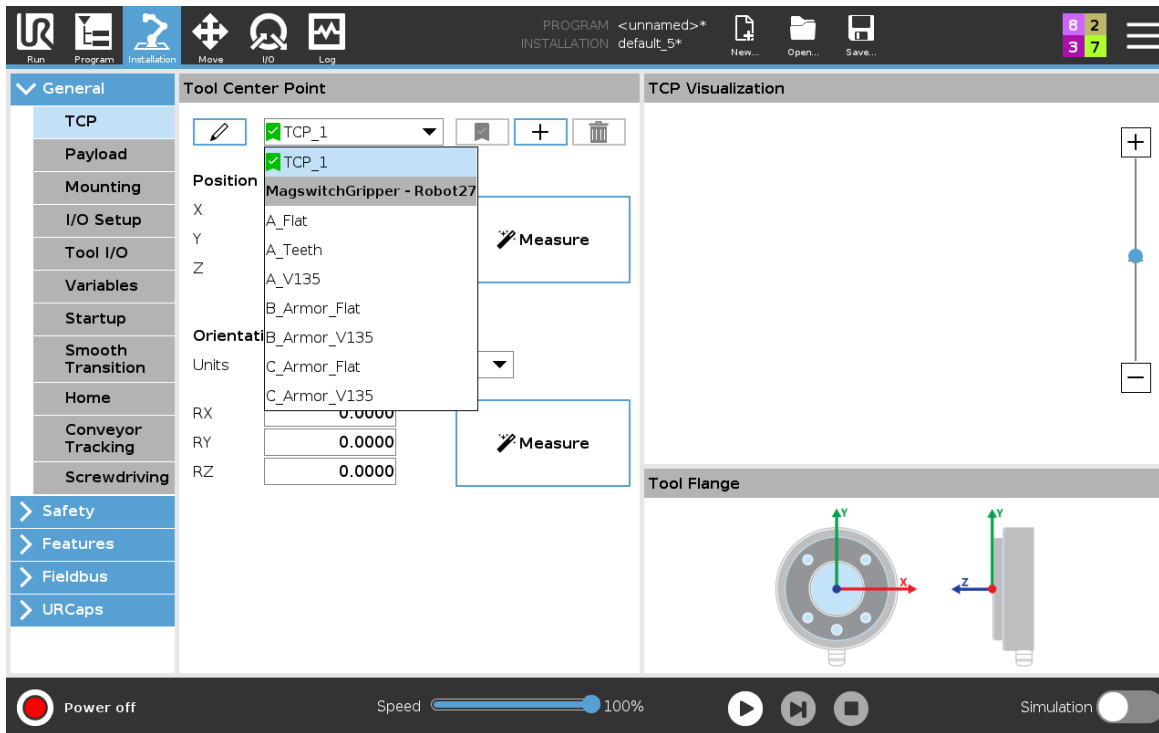


Fig 5: Dropdown menu for configuring TCP

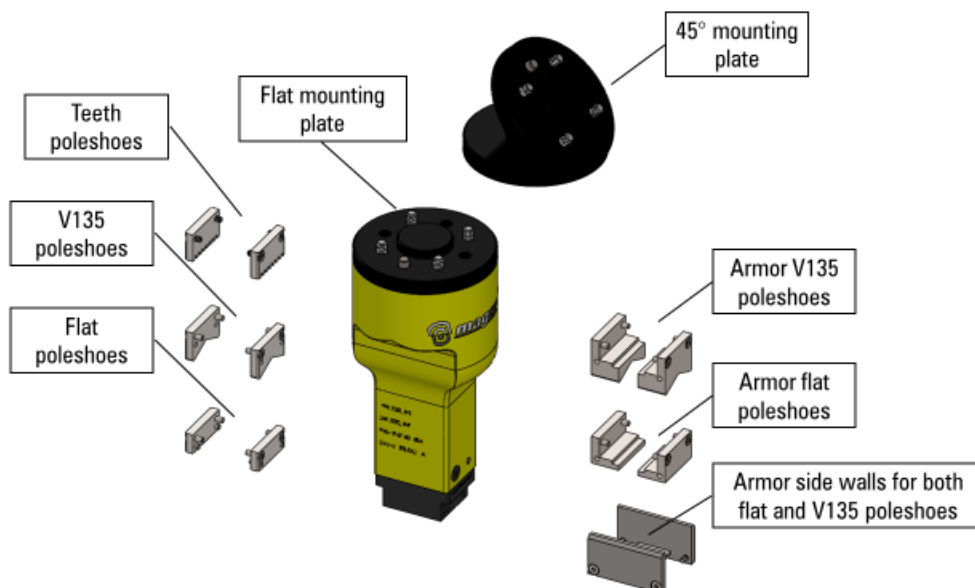


Fig 6: Magswitch gripper accessories

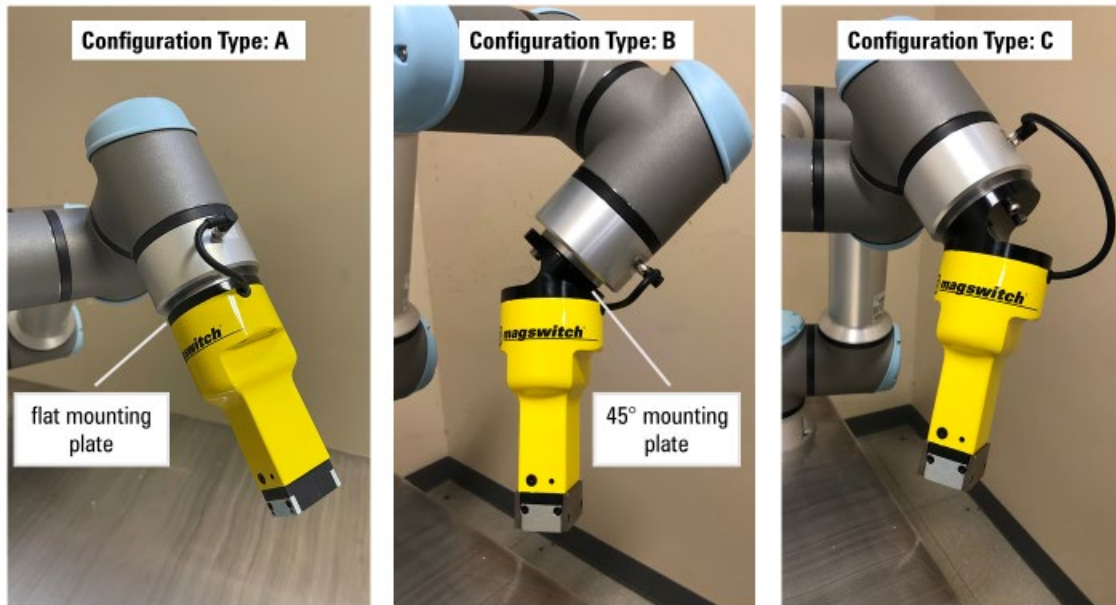


Fig 7: Configuration types for tool

Configuration Type A is when the eight-pinned connector on the wrist is aligned to the cable exit port on the CoBot SmartGrip E30 using the flat mount interface. Type B is when the 45° mounting plate is used and the cable exit port is closest to the eight-pinned connector. Type C also requires the 45° mounting plate but reversed tool mounting from type B.

Magswitch Gripper URCap Installation Interface

To enter the gripper URCap installation, go to URCaps and select Magswitch Gripper. When the gripper is powered off or there is an issue with the connection, all the buttons will be grayed out as shown in the image below.

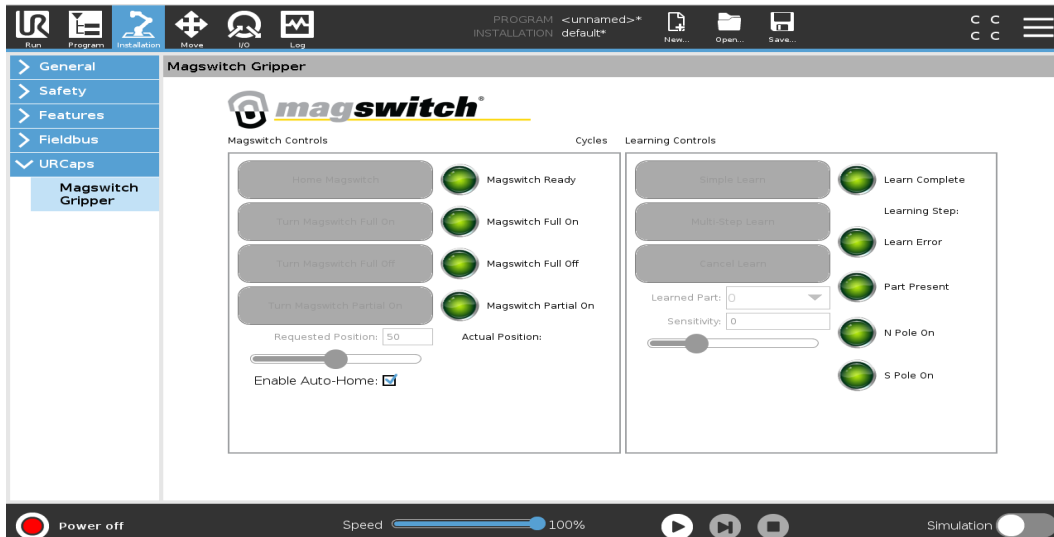


Fig 8: Magswitch Gripper Installation URCap when gripper is powered off

With the gripper powered on, the Home Magswitch button is active. The blue and green LEDs on the gripper will begin flashing to indicate that the gripper is not homed.

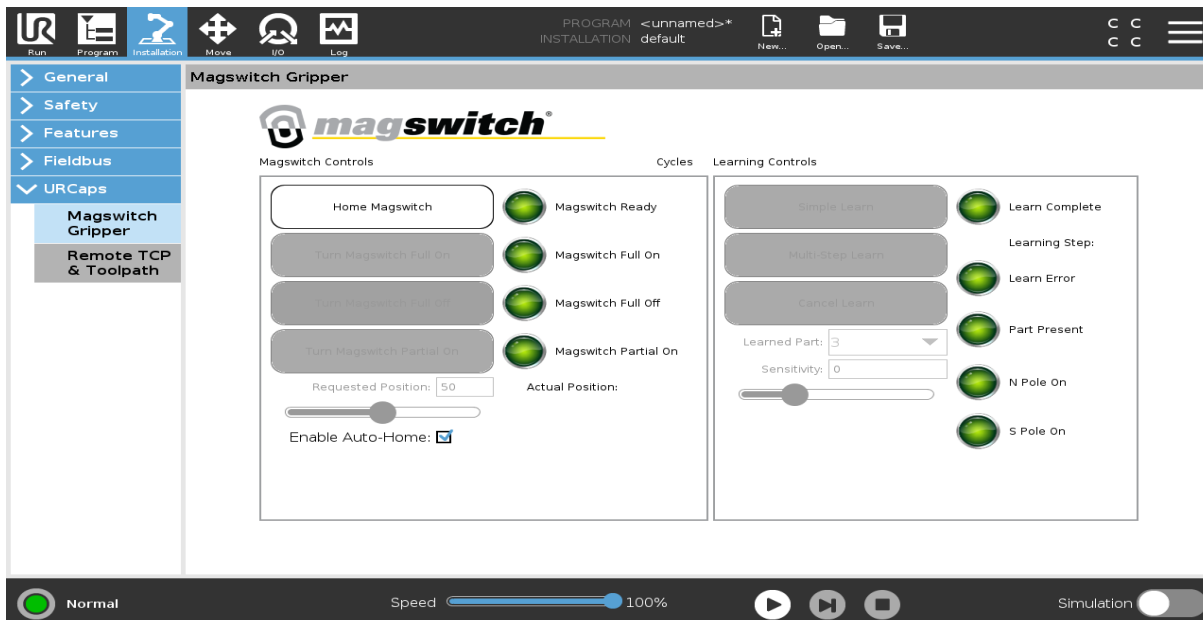


Fig 9: Magswitch Gripper Installation URCap when gripper is powered on

Once the gripper is homed, the rest of the buttons are no longer grayed out and the gripper can now be controlled from the buttons on the installation interface. The green indication LEDs indicate the various output signals sent by the gripper to the CoBot. The gripper can only be homed once after turning on. It needs to be rehomed if power to the tool is lost.

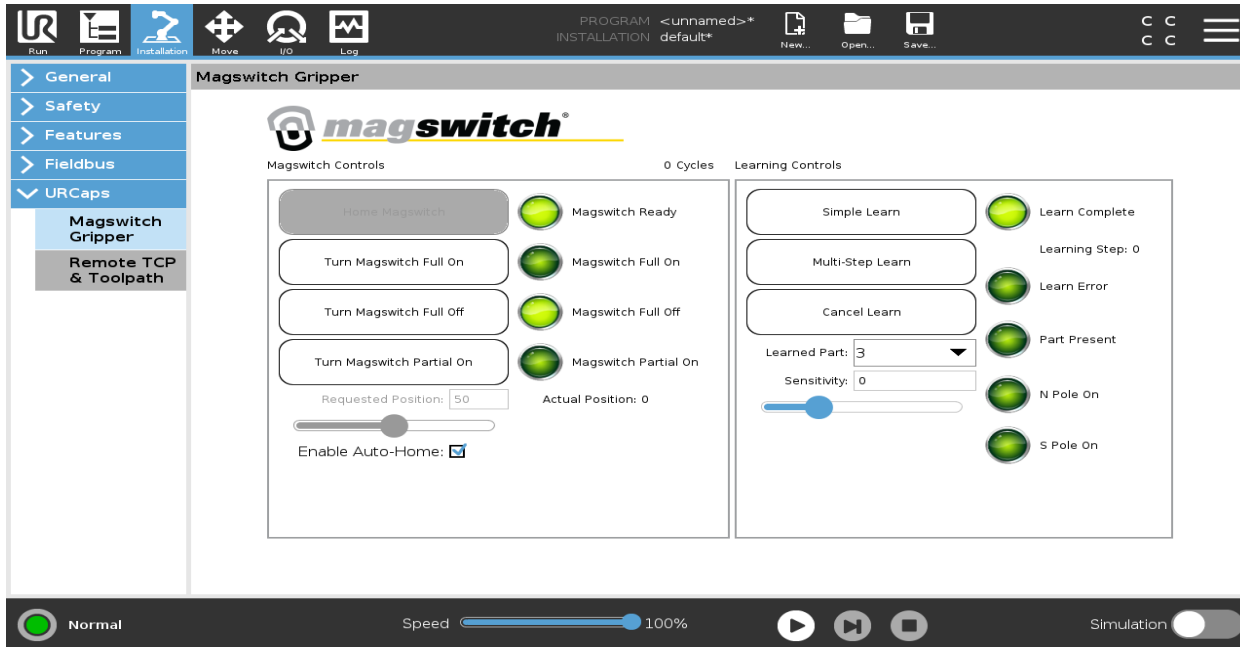


Fig 10: Magswitch Gripper Installation URCap after gripper is homed

The below table shows functionality of various buttons and signals on the Magswitch Gripper Installation UI.

Type (from Gripper perspective)	Magswitch Gripper Installation Controls	Description	Control Type
Input	Home Magswitch	Sends command to home Magswitch Gripper **The gripper can only be homed once after turning on	Button
Input	Turn Magswitch Full On	Turn on Magswitch to 100% ON	Button
Input	Turn Magswitch Full Off	Turn off Magswitch to 0% ON	Button
Input	Requested Position	Can be set to a position between 0 – 100.	Input Box
Input	Turn Magswitch Partial On	Sends command to turn magnet on to Requested Position	Button

Type (from Gripper perspective)	Magswitch Gripper Installation Controls	Description	Control Type
Input	Enable Auto Home	If checked the gripper will home automatically at the beginning of the program if it was not homed previously	Check Box
Input	Simple Learn	Send command to perform simple learn	Button
Input	Multi Step Learn	Send command to perform multi step learn	Button
Input	Cancel Learn	Sends command to cancel calibration	Button
Input	Learned Part	Sends command to change calibration storage option (Calibration 0-3)	Drop Down Box
Input	Sensitivity	Sends command to change magnet sensitivity of part present Default = 0 Accepts values from -20 to 50 as input. “–” is more sensitive and decreases the acceptable range. “+” is less sensitive and increases the acceptable range.	Input Box
Output	Magswitch Ready	Indicates if Magswitch is Homed	Indication LED
Output	Magswitch Full On	Indicates if Magswitch is turned on at 100% position	Indication LED
Output	Magswitch Full Off	Indicates if Magswitch is turned off at 0% position	Indication LED
Output	Magswitch Partial On	Indicates if Magnet is partially on – 2%-99% ON	Indication LED

Type (from Gripper perspective)	Magswitch Gripper Installation Controls	Description	Control Type
Output	Actual Position	Indicates actual position of the Magnet, value can be from 0 to 100%	Output Box
Output	Learn Complete	Indicates if gripper is calibrated	Indication LED
Output	Learn Step	Indicates calibration step, 0 = not in calibration 1 = waiting for best circuit 2 = waiting for worst circuit 3 = waiting for south pole 4 = waiting for north pole	Output Box
Output	Learn Error	Indicates error while performing calibration. Magnet was not fully on when trying to teach calibration step.	Indication LED
Output	Part Present	Indicates proper Part Present within range of selected learned part	Indication LED
Output	N Pole On	Indicates if North Pole is on	Indication LED
Output	S Pole On	Indicates if South Pole is on	Indication LED

Magswitch Gripper Calibration

Calibration Fundamentals

The gripper can be calibrated from the Magswitch Gripper Installation Interface, using Simple learn or Multi-Step learn. There are four calibration steps required to fully define magnetic field interaction between the tool and part and distinguish whether that interaction is sufficient or insufficient based on the user's configurations. Position of the tool's north and south poles relative to part edges and their proximity to the part during calibration steps govern whether poles are in adequate contact and whether the part is "present."

Learn complete indication LED will turn on when the tool is successfully calibrated for a particular calibration storage option (0-3).

North Pole indication LED will turn on only when the North Pole Position is in equal to or better contact than the stored North Pole Position.

South Pole indication LED will turn on only when the South Pole position is in equal to or better contact than the stored South Pole Position.

North Pole, South Pole and Part Present indication LEDs will turn on simultaneously only when the contact quality is between Limiting Position 1 and Limiting Position 2 *and* the North and South pole positions are in equal to or better contact than their respective stored positions.

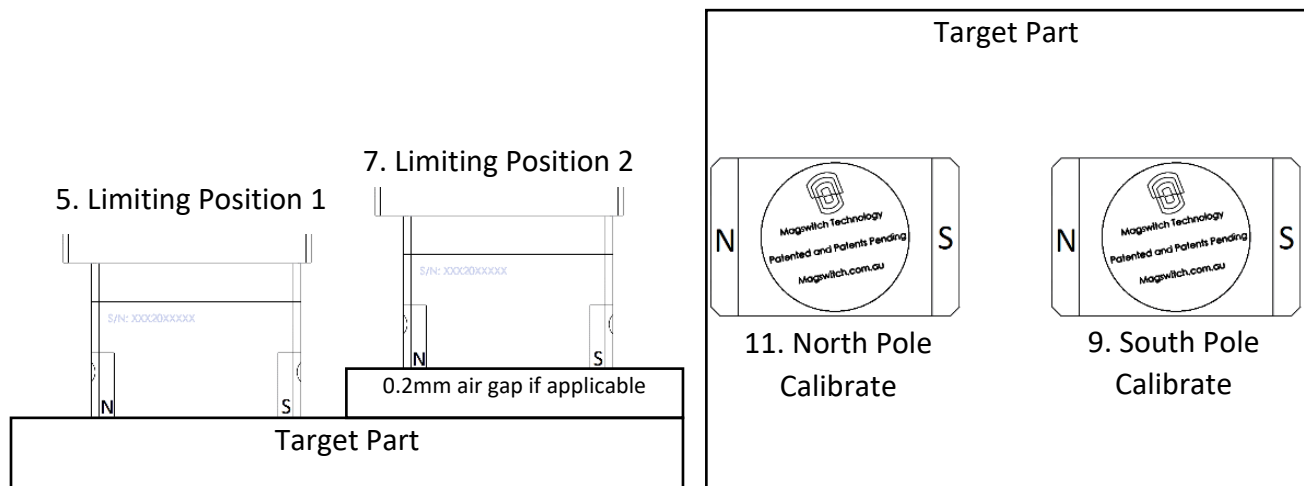


Figure 11: Step 1-4 Calibration Positions

There are four separate calibration profiles which can be configured by following the calibration instructions in the next steps. It is important to select the calibration profile from the Learned Part drop down menu to values 0, 1, 2, or 3 before entering calibration mode to ensure a different calibration profile is not overwritten.

Tool Orientation

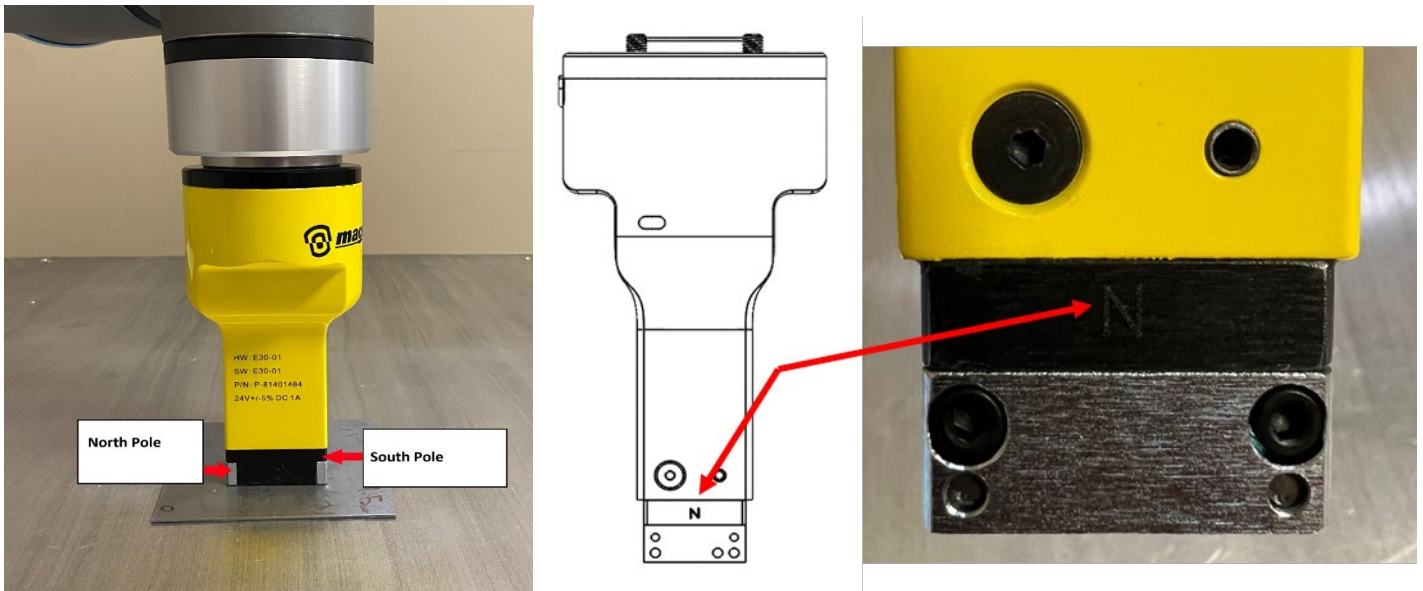


Fig 12: Tool Orientation for Magswitch CoBot SmartMagGrip E30

NOTE: Magnet Housing at the North Pole side of the tool has N marked on it

NOTE: North Pole side of the tool is on the same side as the LED

Calibration Methods

This section has a brief description of the two calibration/learning methods for the CoBot SmartMagGrip E30 tool. The next section contains detailed steps for these two methods. Below are a few simple steps. Detailed steps can be found in the next section of the manual.

Multi-Step Learn/Calibration

Select Learned Part from Drop Down Menu

1. Turn magnet "ON" fully and issue Multi-Step Learn command. The learning step will be set to 1.
2. Turn magnet "ON" fully on Limiting Position 1 and issue Multi-Step Learn command. The Learning step will be set to 2.
3. Turn magnet "ON" fully on Limiting Position 2 and issue Multi-Step Learn command. The Learning step will be set to 3.
4. Turn magnet "ON" fully on South Pole Position and issue Multi-Step Learn command. The learning step will be set to 4.
5. Turn magnet "ON" fully on North Pole Position and issue Multi-Step Learn command. The learning step will be sent to 0 and Learn Complete LED will turn on.
6. The Multi-step learn process is now complete.

Use Multi Step Learn/Calibration in the following scenarios:

1. Bin Picking Applications
2. Parts with different surface conditions. I.e., Increase/decrease in surface roughness to the part that causes to increase/decrease the airgap.
3. If your best and worst case scenario are on different parts, so that one calibration (Learned Part) can be used for the entire range of parts.

Simple Learn/Calibration

Steps to perform for Simple Learn:

1. Place tool on the location of the part that needs to be calibrated.
2. Turn magnet "ON" fully (100% ON)
3. Upon issuing Simple Learn Command, the tool will automatically go through four steps of the simple learn process.
4. Learned Complete LED should turn on if simple learn completed successfully else, Learn Error indication LED will turn on if the magnet was not fully on when starting the Simple Learn process.

Use Simple Learn in the following scenarios:

1. Double blank/multiple sheet detection
2. Handling parts where best and worse are nearly similar and surface conditions do not vary much between parts

Calibration Steps in Detail

Steps for Calibrating Gripper using Simple Learn

Step 1:

Select calibration storage option from the Learned Part drop down menu.

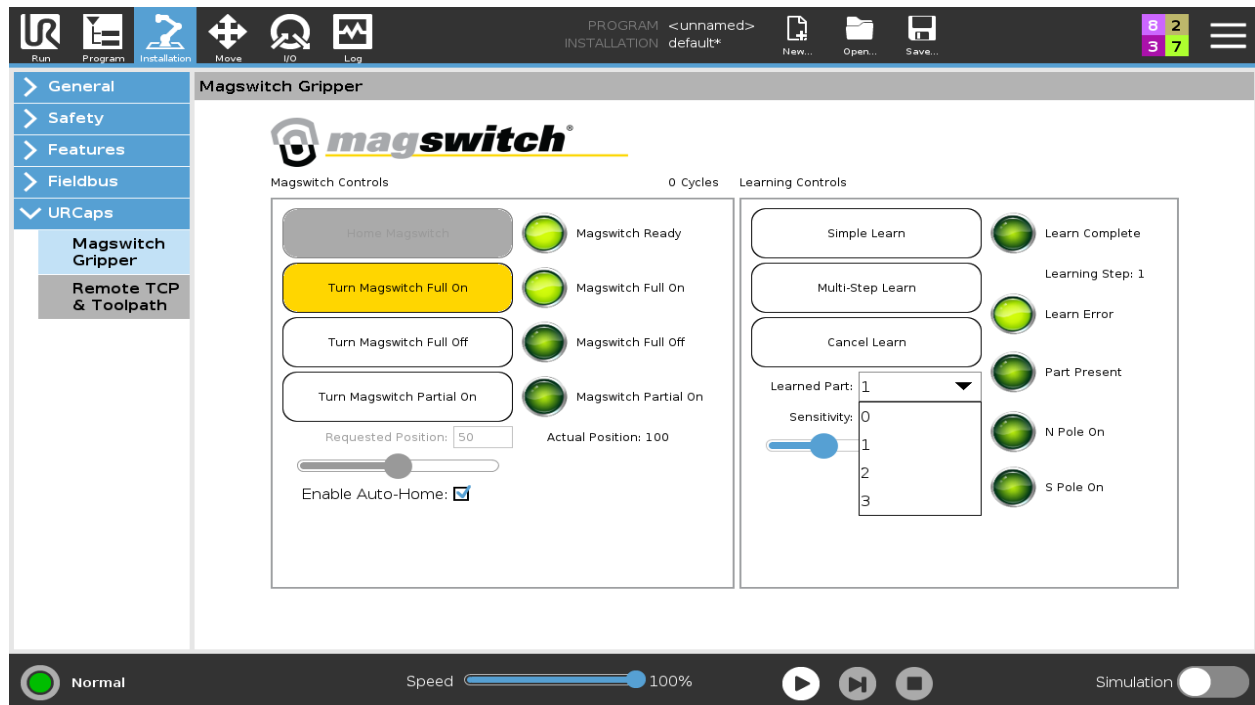


Fig 13: Selecting Calibration storage option

Step 2:

Ensure that Gripper is present on the target and turn magnet full on at 100% position.

Step 3:

Press Simple Learn Button.

Step 4:

Wait for Learn Complete indication LED to turn on, which indicates that calibration is performed successfully. In the case that the calibration fails the Learn Error indication LED will turn on instead.

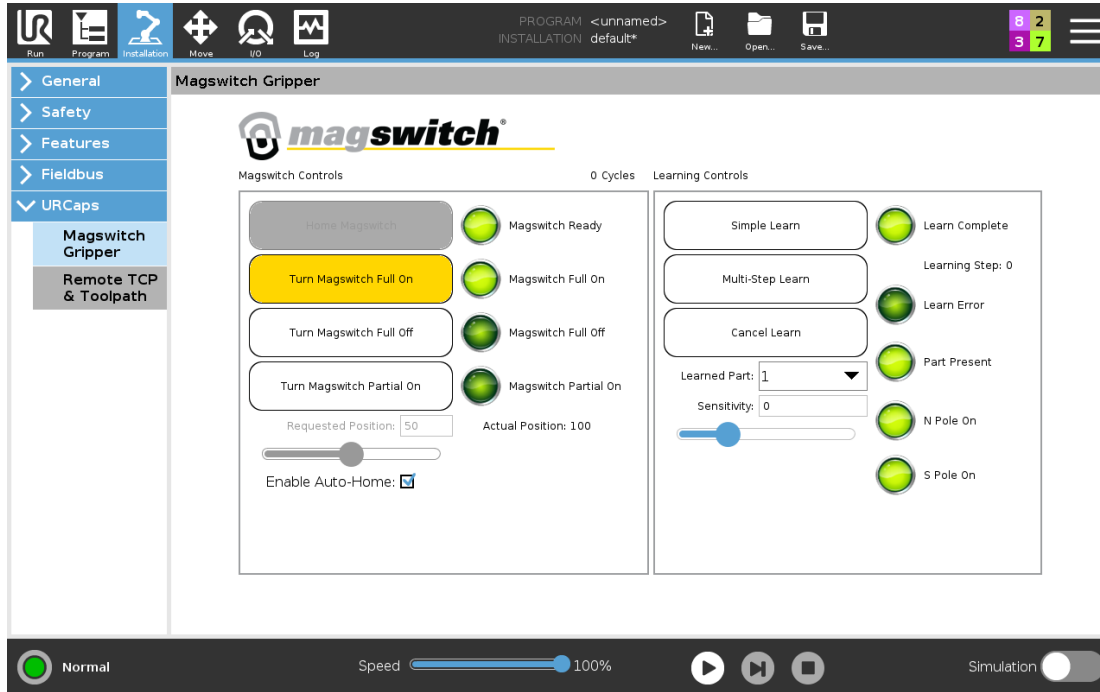


Fig 14: Simple Learn Complete

Steps for Calibrating Gripper using Multi-Step Learn

Step 1:

Select calibration storage option from the Learned Part drop down menu.

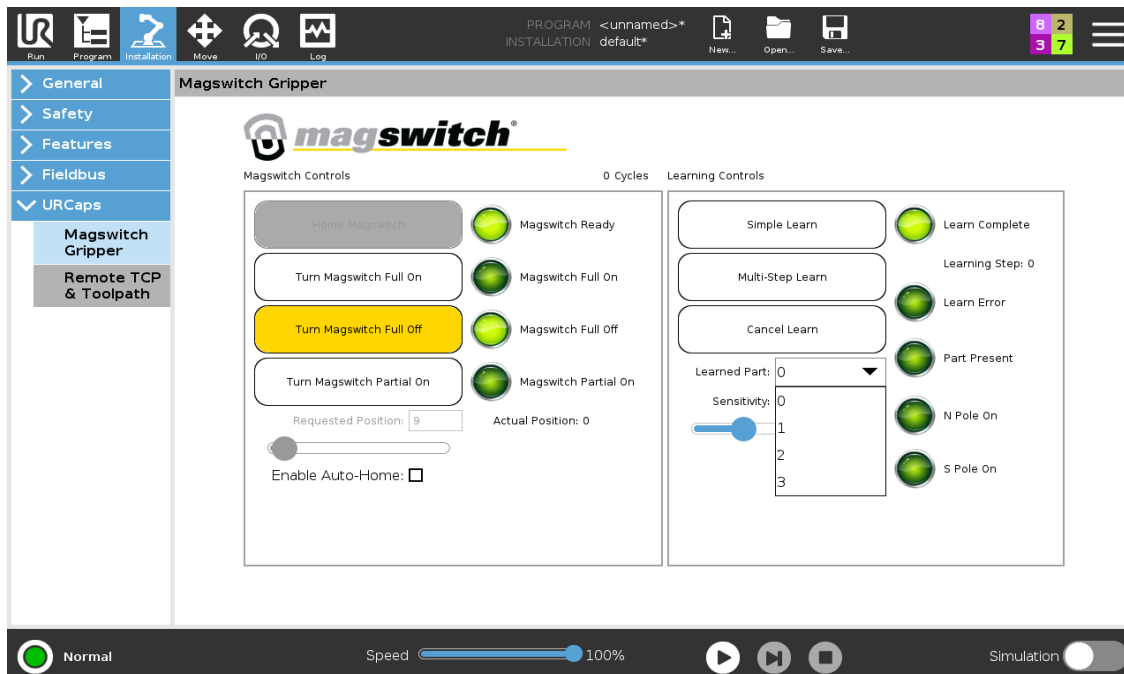


Fig 15: Selecting Calibration storage option

Step 2:

Ensure that gripper is present on the target in limiting position 1 and turn magnet full on. Some recommended positions are provided below.

- i. The maximum steel in vicinity (for complex or bin picking shapes)
- ii. The best contact
- iii. The least air gap
- iv. The maximum for one pole, but minimum for the other

NOTE: The unit is centered on the part with little to no air gap between the pole shoes and part.



Fig 16: Example of Limiting Position 1 for Calibrated Part Present Signal

Step 3:

Press Multi-Step Learn Button, the gripper blue LED will flash three times and Learning Step will display 1. This indicates Multi-Step Learn is initiated and is waiting for Limiting Position 1.

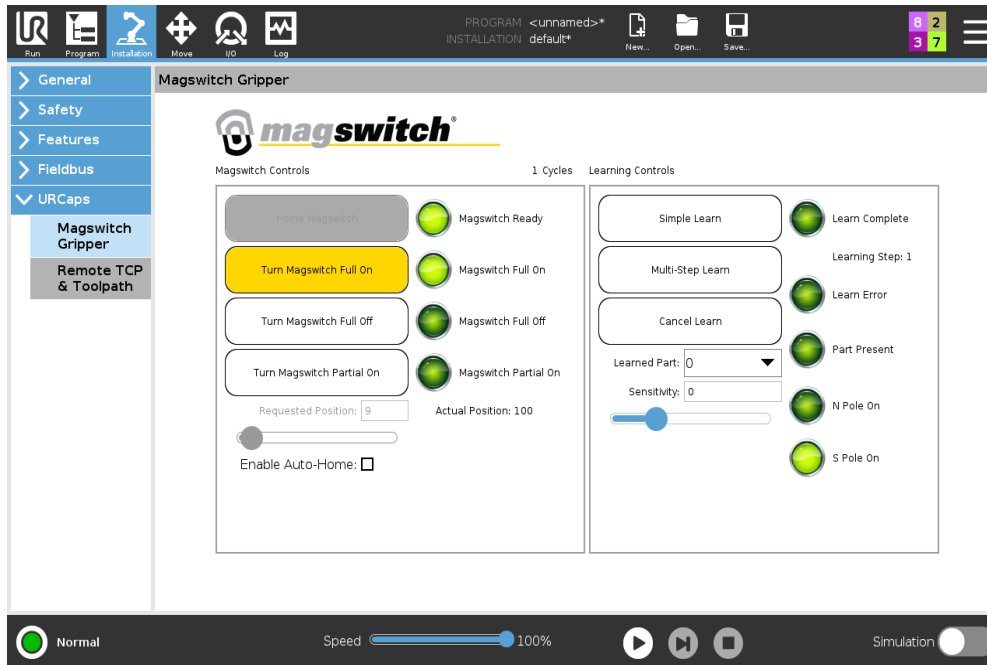


Fig 17: Multi-Step Learn initiated

Step 4:

Press Multi-Step Learn Button, the gripper blue LED will flash three times and Learning Step will display 2. This indicates that the gripper has stored Limiting Position 1 and is waiting for Limiting Position 2.

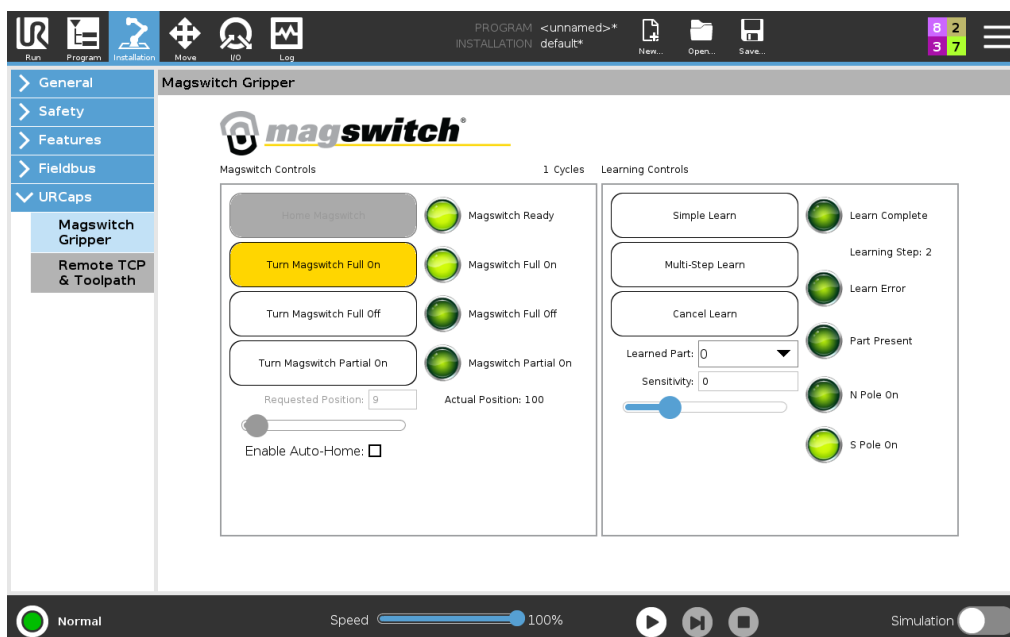


Fig 18: Mult-Step Learn tool is calibrated for Limiting Position 1

Step 5:

- a. Turn off magnet, place gripper on the target in Limiting Position 2 and turn magnet full on. Some recommended positions are provided below.
 - i. The minimum steel in vicinity (for complex or bin picking shapes)
 - ii. The worst contact.
 - iii. The maximum allowable air gap (coatings)
 - iv. The minimum for one pole, but the maximum for the other

NOTE: The unit is centered on the part but an air gap of 0.2mm approximately equal to 2 layers of standard copy paper is added between the pole shoes and part. Artificial air gaps can be used to simulate scale, paint, or debris on a part but it is preferable to use the authentic "worst-case" allowable part condition rather than nonferrous shims.



Fig 19: Example of Limiting Position 2 for Calibrated Part Present Signal

Step 6:

Press Multi-Step Learn Button, the gripper blue LED will flash three times and Learning Step will display 3. This indicates that the gripper has stored Limiting Position 2 and is now waiting for the South Pole Position. In case of an error, the Learn Error LED will turn on.

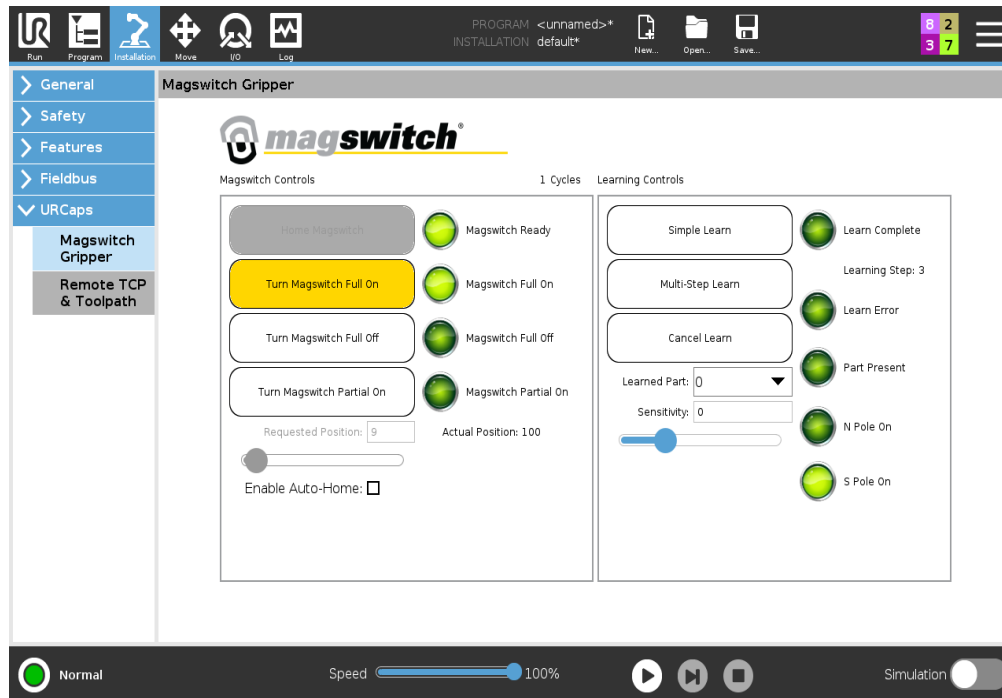


Fig 20: Mult-Step Learn tool is calibrated for Limiting Position 2

Step 7:

Turn off magnet, place gripper on the target in the desired position for South Pole Signal and turn magnet full on.

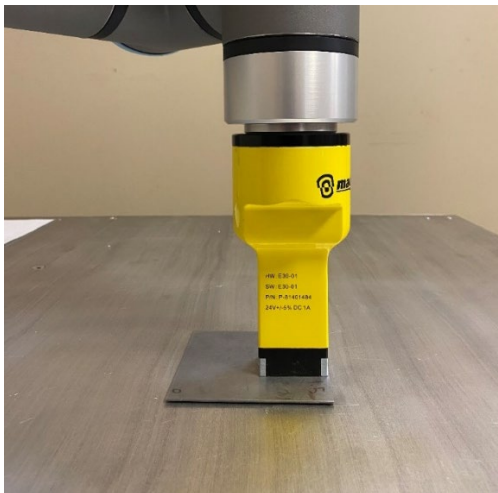


Fig 21: Example of South Pole Signal Position

Step 8:

Press Multi-Step Learn Button, the gripper blue LED will flash three times and Learning Step will display 4. This indicates that the gripper has stored the South Pole Position and is waiting for the North Pole Position. In case of an error, the Learn Error LED will turn on.

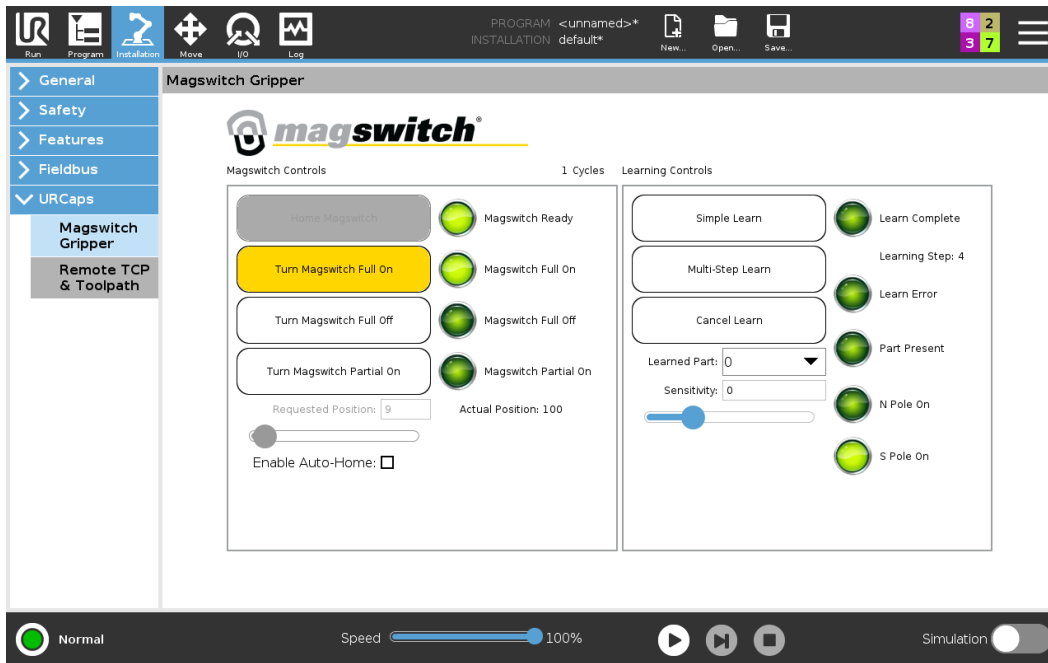


Fig 22: Multi-Step Learn tool is calibrated for Limiting Position 3

Step 9:

Turn off magnet, place gripper on the target in the desired position for the North Pole Signal and turn magnet full on.



Fig 23: Example of North Pole Signal Position

Step 10:

Press Multi-Step Learn Button, the gripper blue LED will flash three times, Learning Step will display 0, and Learn Complete LED will turn on when the process is finished. This indicates that the gripper has stored the North Pole Position and Multi-Step calibration is complete. In case of an error, the Learn Error LED will turn on.

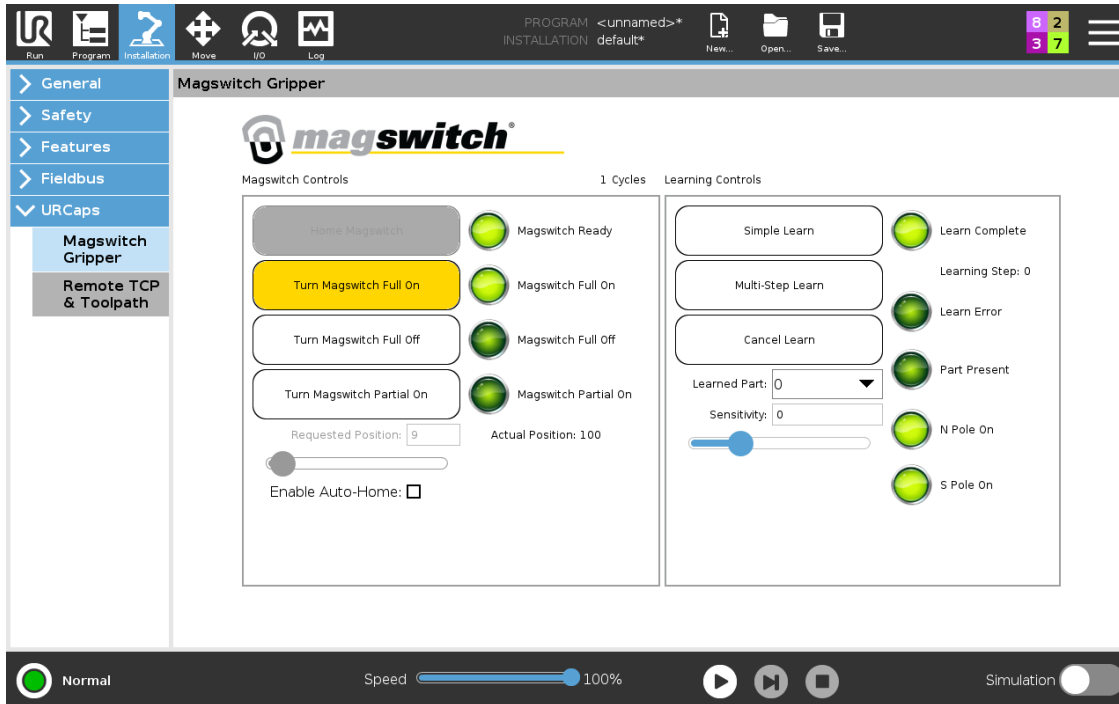


Fig 24: Multi-Step Learn complete

Testing Calibration – Configuration 1 – Multi-Step Learn

If the North Pole Signal and/or South Pole Signal Position are less than the minimum of the Calibrated Part Present signal range (this is the case for the calibration shown in this document):

1. Magnet is electrically de-actuated:
 - a. Magswitch Full On indication LED turns Off
 - b. Learning Step is shown as 0
2. Unit positioned within Calibrated Part Present signal range and the magnet is electrically actuated between 2% and 99%, by setting Requested Position as a value between 2 and 99 (Magnet 2%-99% ON):
 - a. Magswitch Partial On LED turns On
 - b. Check below table for the expected LED Indication values at this step

Indication LED	Value
S Pole On	Off
N Pole On	Off
Part Present	Off

3. Unit positioned within Calibrated Part Present signal range and the magnet is electrically actuated on (100%), by setting Requested Position = 100 (Magnet 100% ON) or issuing Turn Magswitch Full On command:
 - a. Magswitch Full On indication LED turns On
 - b. Check below table for the expected LED Indication values at this step

Indication LED	Value
S Pole On	On
N Pole On	On
Part Present	On

4. Unit positioned with South Pole outside of South Pole Signal range and the magnet is electrically actuated on (100%), by setting Requested Position = 100 (Magnet 100% ON) or issuing Turn Magswitch Full On command:
 - a. Magswitch Full On indication LED turns On
 - b. Check below table for the expected LED Indication values at this step

Indication LED	Value
S Pole On	Off
N Pole On	On
Part Present	Off

5. Unit positioned with North Pole outside of North Pole signal range and the magnet is electrically actuated on (100%), by setting Requested Position = 100 (Magnet 100% ON) or issuing Turn Magswitch Full On command:

- Magswitch Full On indication LED turns On
- Check below table for the expected LED Indication values at this step

Indication LED	Value
S Pole On	On
N Pole On	Off
Part Present	Off

6. Unit positioned with North/South Poles within South/North Pole Signal range and the magnet is electrically actuated on (100%), but not within Calibrated Part Present signal range, by setting Requested Position = 100 (Magnet 100% ON) or issuing Turn Magswitch Full On command:

- Magswitch Full On indication LED turns On
- Check below table for the expected LED Indication values at this step

Indication LED	Value
S Pole On	On
N Pole On	On
Part Present	Off

7. Unit positioned with neither pole within the Calibrated Part Present signal nor South/North Pole Signal range and the magnet is electrically actuated on (100%), by setting Requested Position = 100 (Magnet 100% ON) or issuing Turn Magswitch Full On command:

- Magswitch Full On indication LED turns On
- Check below table for the expected LED Indication values at this step

Indication LED	Value
S Pole On	Off
N Pole On	Off
Part Present	Off

Testing Calibration – Configuration 2 – Multi-Step Learn

If the South Pole Signal and North Pole Signal Position are equal to the minimum of the Calibrated Part Present signal range:

1. Magnet is electrically de-actuated, by issuing Magswitch Full Off command:
 - a. Magswitch Full Off indication LED turns On
 - b. Check below table for the expected LED Indication values at this step

Indication LED	Value
S Pole On	Off
N Pole On	Off
Part Present	Off

2. Unit positioned within Calibrated Part Present signal range and the magnet is electrically actuated between 2% and 99%, by setting Requested Position as any value between 2 and 99(Magnet 2%-99% ON):
 - a. Magswitch Partial On indication LED Turns On
 - b. Check below table for the expected LED Indication values at this step

Indication LED	Value
S Pole On	Off
N Pole On	Off
Part Present	Off

3. Unit positioned within Calibrated Part Present signal range and the magnet is electrically actuated on (100%), by setting Requested Position = 100 (Magnet 100% ON) or issuing Turn Magswitch Full On command:
 - a. Magswitch Full On indication LED Turns On
 - b. Check below table for the expected LED Indication values at this step

Indication LED	Value
S Pole On	On
N Pole On	On
Part Present	On

4. Unit positioned with South Pole outside of Calibrated Part Present signal range and the magnet is electrically actuated on (100%), by setting Requested Position = 100 (Magnet 100% ON) or issuing Turn Magswitch Full On command:
 - a. Magswitch Full On indication LED Turns On
 - b. Check below table for the expected LED Indication values at this step

LED Indication	Value
S Pole On	Off
N Pole On	On
Part Present	Off

5. Unit positioned with North Pole outside of Calibrated Part Present signal range and the magnet is electrically actuated on (100%), by setting Requested Position = 100 (Magnet 100% ON) or issuing Turn Magswitch Full On command:

- Magswitch Full On indication LED Turns On
- Check below table for the expected LED Indication values at this step

LED Indication	Value
Input Word 2: Bit 9 (S Pole On)	On
Input Word 2: Bit 8 (N Pole On)	Off
Part Present	Off

6. Unit position with neither pole within the Calibrated Part Present signal range and the magnet is electrically actuated on (100%), by setting Requested Position = 100 (Magnet 100% ON) or issuing Turn Magswitch Full On command:

- Magswitch Full On indication LED Turns On
- Check below table for the expected LED Indication values at this step

Bit Number (Short Name)	Bit Return Value
S Pole On	Off
N Pole On	Off
Part Present	Off

Testing Calibration – Configuration 3 – Simple Learn/Multi-Step Learn

If Simple learn is used or Multi-Step Learn is done in such a way that all the steps were calibrated in a single position:

1. Magnet is electrically de-actuated:
 - a. Magswitch Full On indication LED turns Off
 - b. Learning Step returns 0
2. Unit positioned within Calibrated Part Present signal range and the magnet is electrically actuated between 2% and 99%, by setting Requested Position as a value between 2 and 99 (Magnet 2%-99% ON):
 - a. Magswitch Partial On indication LED turns On
 - b. Check below table for the expected LED Indication values at this step

LED Indication	Value
S Pole On	Off
N Pole On	Off
Part Present	Off

3. Unit positioned within Calibrated Part Present signal range and the magnet is electrically actuated on (100%), by setting Requested Position = 100 (Magnet 100% ON) or issuing Turn Magswitch Full On command:
 - a. Magswitch Full On indication LED turns On
 - b. Check below table for the expected LED Indication values at this step

LED Indication	Value
S Pole On	On
N Pole On	On
Part Present	On

4. Unit positioned with North/South Poles within South/North Pole Signal range and the magnet is electrically actuated on (100%), but not within Calibrated Part Present signal range %, by setting Requested Position = 100 (Magnet 100% ON) or issue Turn Magswitch Full On command
 - a. Magswitch Full On indication LED turns On
 - b. Check below table for the expected LED Indication values at this step

LED Indication	Value
S Pole On	On
N Pole On	On
Part Present	Off

Using Magswitch Gripper and Magswitch Power Program Nodes

Under the program tab select URCaps, the Magswitch gripper and Magswitch Power URCap should be visible.

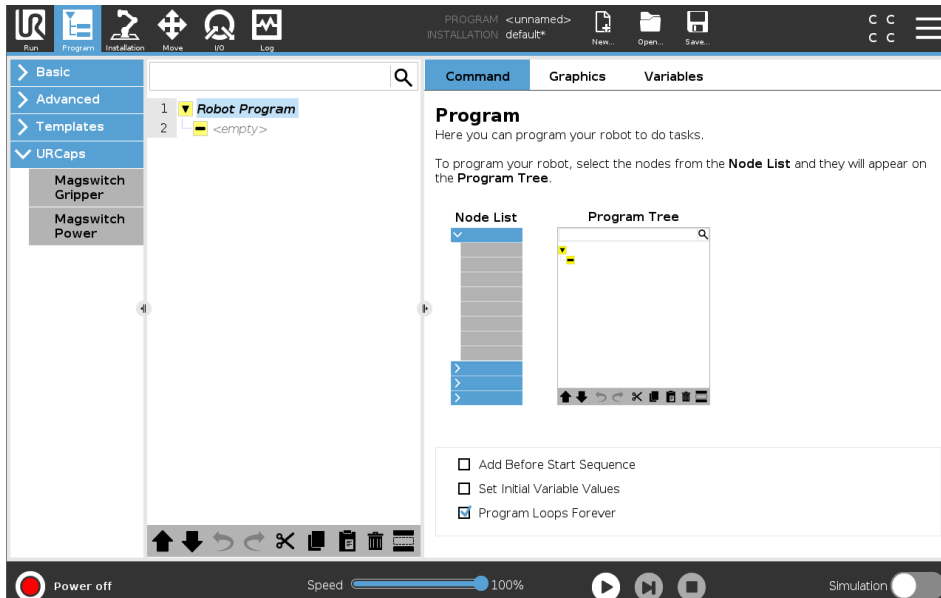


Fig 25: Both URCaps should be visible under program tab

Magswitch Power:

Selecting this URCap turns the gripper on or off in the program as shown below. It is recommended to use the Magswitch power URCap only if the gripper is used with a tool changer. After switching the gripper off and turning it back on, it is recommended to provide a delay of at least 2 seconds before issuing the Magswitch Gripper URCap command to home the tool.

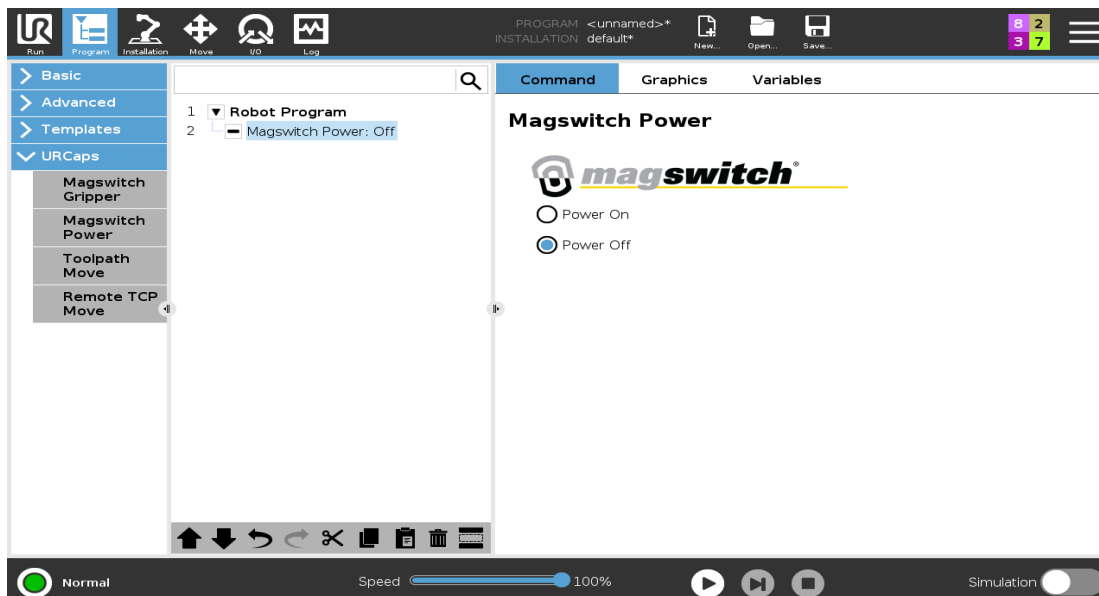


Fig 26: Magswitch Power Program Node URCap

Magswitch Gripper:

The Magswitch gripper URCap can be used to send commands to the gripper as well read the state of the gripper. The commands are summarized in the table below.

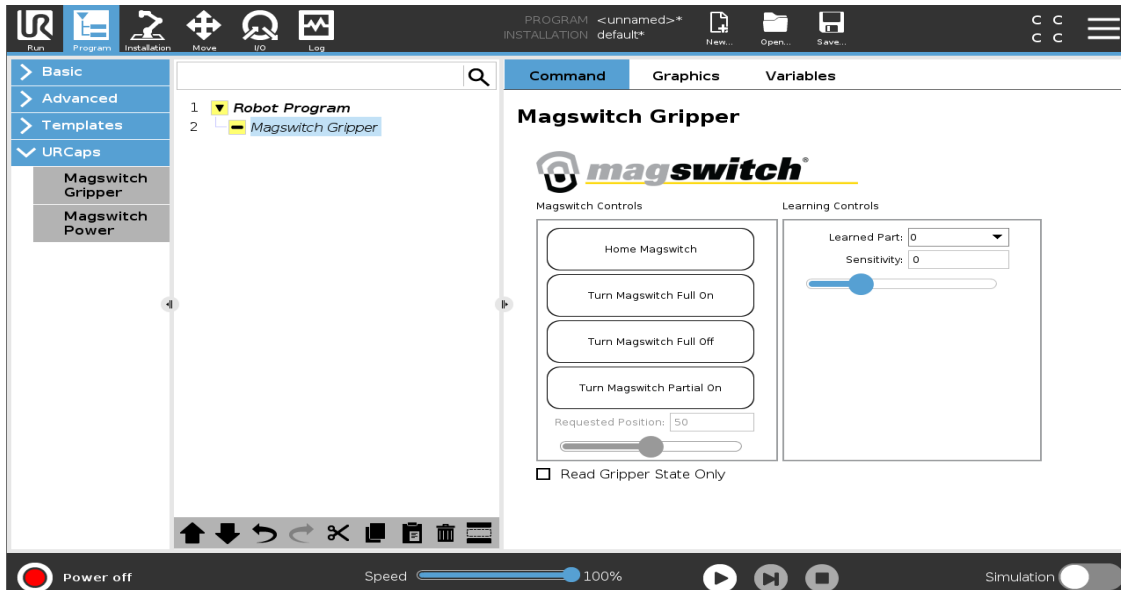


Fig 27: Magswitch Gripper Program Node URCap

Magswitch Gripper URCap Program Node Command	Description
Home Magswitch	Sends Command to Home Magswitch Gripper (It is recommended to use the Auto Home feature instead of the Home Magswitch command if the gripper is not used with a tool changer)
Turn Magswitch Full On	Turn on Magswitch to 100% ON
Turn Magswitch Full Off	Turn off Magswitch to 0% ON
Requested Position	Can be set to a position between 0 – 100 %.
Turn Magswitch Partial On	Sends command to turn magnet on at requested position

Magswitch Gripper URCap Program Node Command	Description
Learned Part	Sends command to change calibration storage option (Calibration 0-3)
Sensitivity	Sends command to change magnet sensitivity Default = 0 Takes values from -20 to 50 as input
Read Gripper State Only	Reads the state of one or more variables associated with the gripper

List of variables that can be read using the read gripper state command is shown in the table below.

Variable	Description
ACTUAL_POS	Indicates actual position of the magnet, value can be from 0 to 100%
FULL_OFF	True if magnet is at 0% off position, else False
FULL_ON	True if magnet is at 100% on position, else False
HOMED	True if gripper is Homed, else False
N_POLE	True if North Pole on, else False
PARTIAL_ON	True if magnet is partial on, else False
PART_PRESENT	True if part present detected, else False
S_POLE	True if South Pole on, else False

Example Demonstrating Turn Magswitch Full On:

Commands can be sent to the gripper from the Magswitch Gripper URCap in the program. The below program example shows how to send command to turn the magnet on at 100% position.

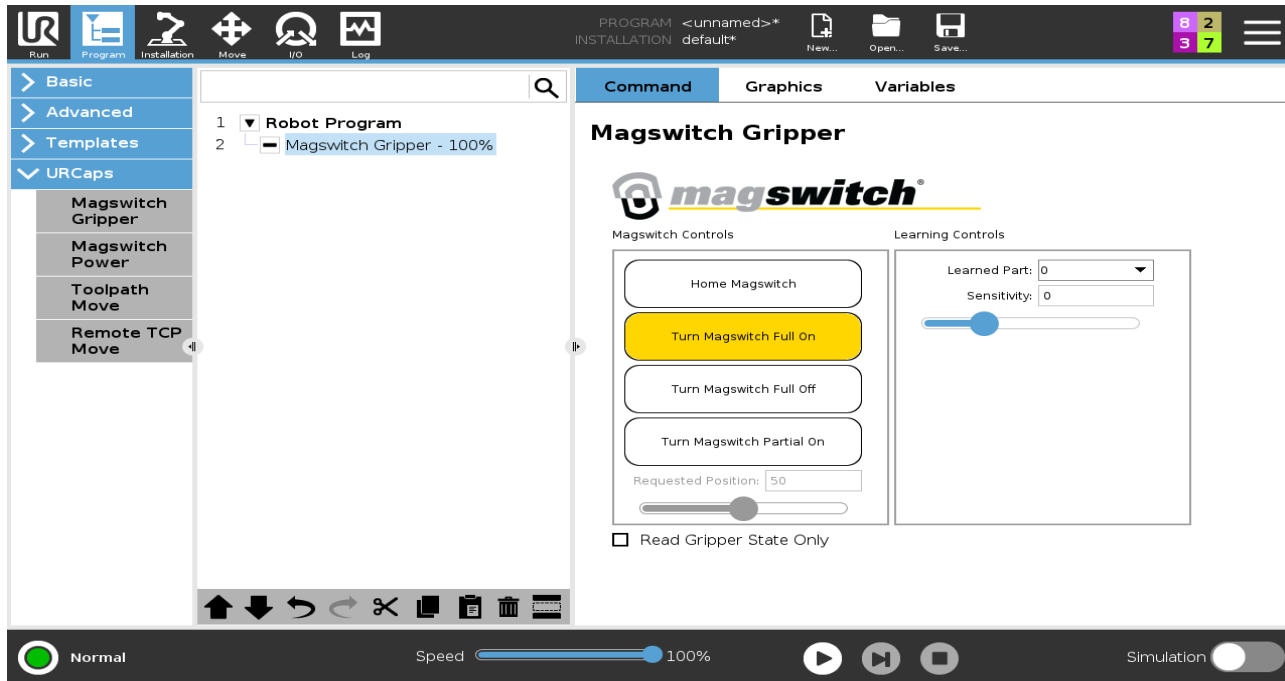


Fig 28: Example program to turn Magswitch Full On

Example Demonstrating Magswitch Gripper Read:

The state of one or more variables can be checked by placing the Read Gripper State command inside a loop. The below program example shows how to continuously check the state of the FULL_ON variable to verify that the magnet is turned on after sending the Turn Magswitch Full On command.

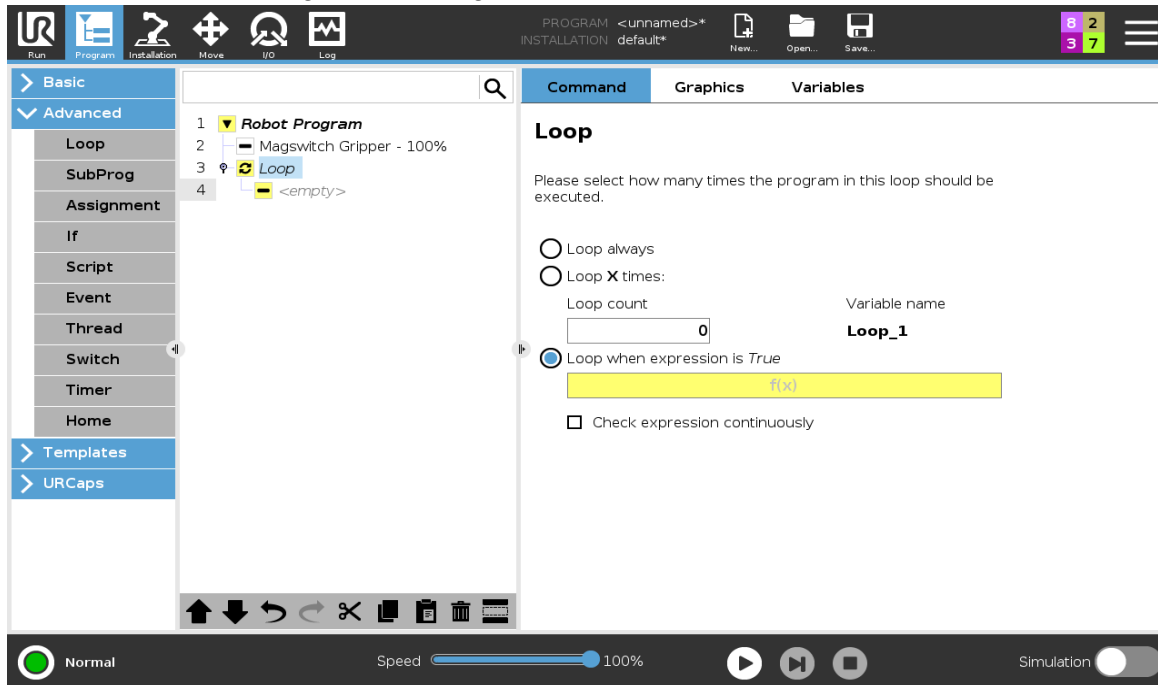


Fig 29: Using Loop to check the state of FULL_ON variable

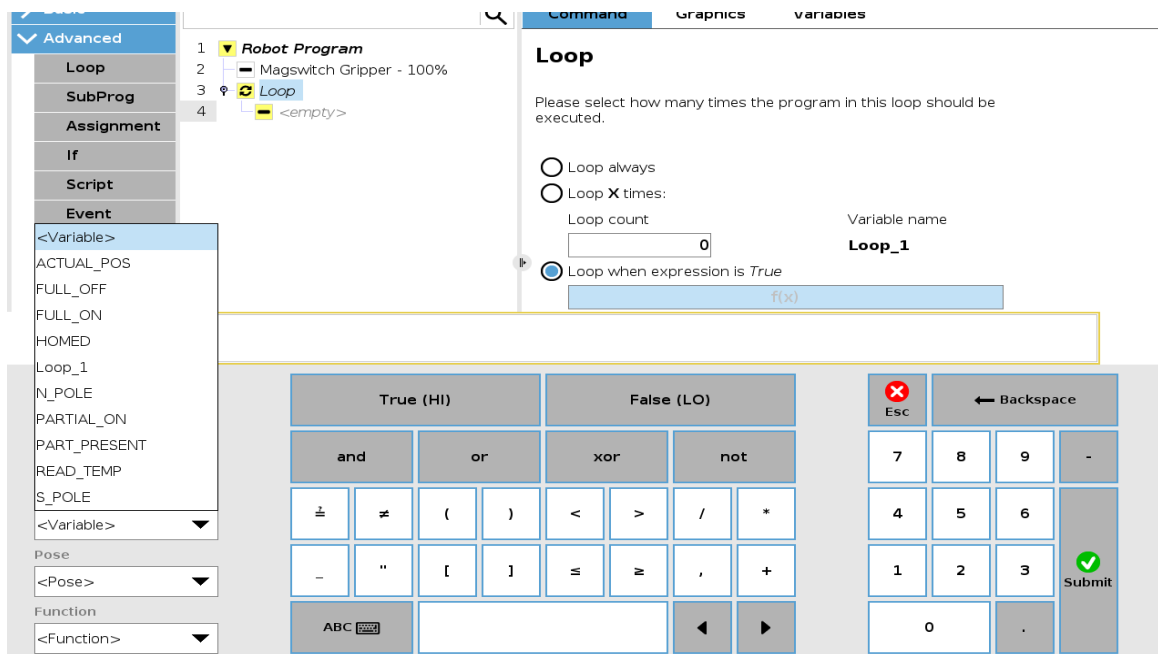


Fig 30: Selecting FULL_ON variable from the list of variables

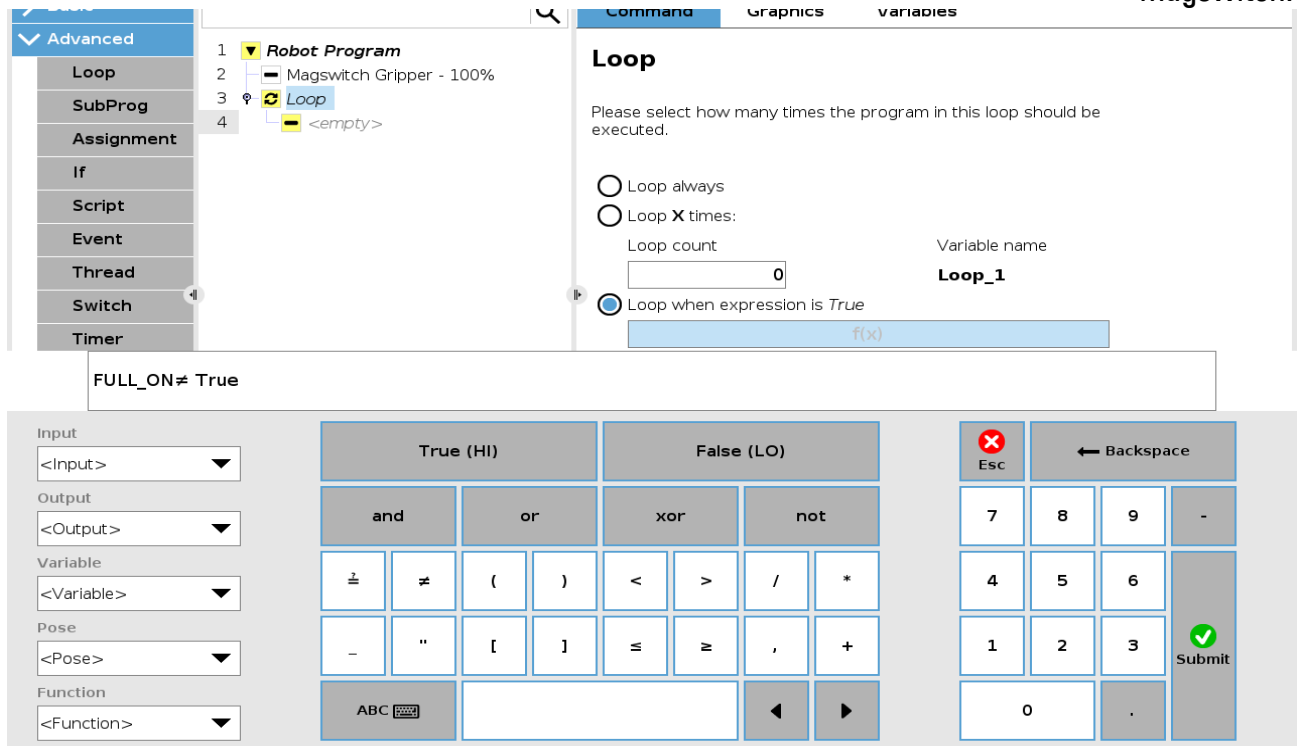


Fig 31: Loop until magnet is magnet is fully on

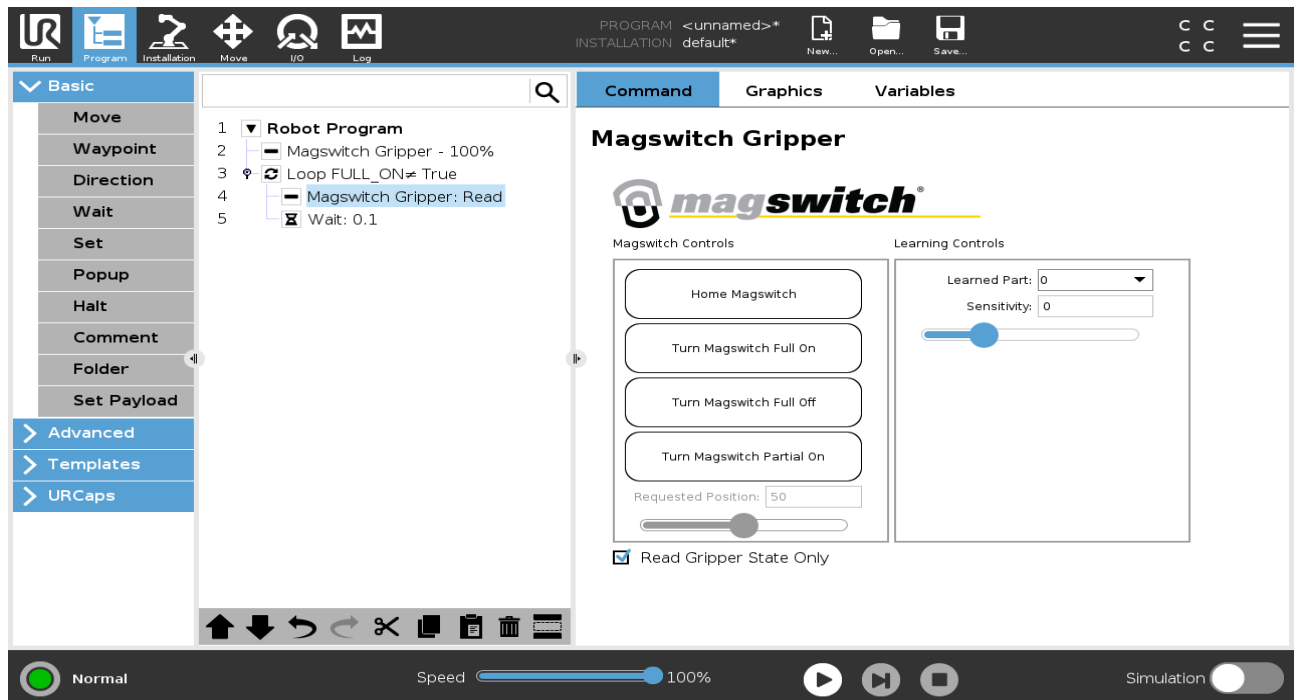


Fig 32: Read the state of the FULL_ON variable until True

Example Demonstrating Partial Magnet On:

The following program example turns on the magnet at 50% position and checks if the ACTUAL_POSITION variable returns a value of 50.

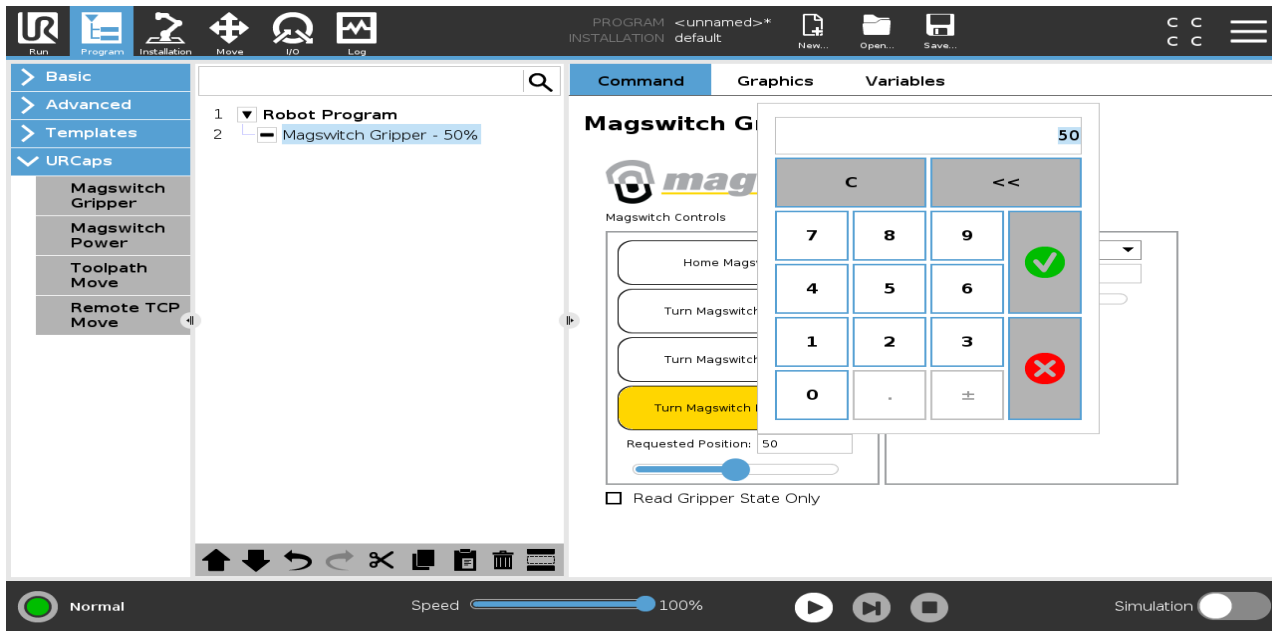


Fig 33: Actuate Magnet at 50% On position

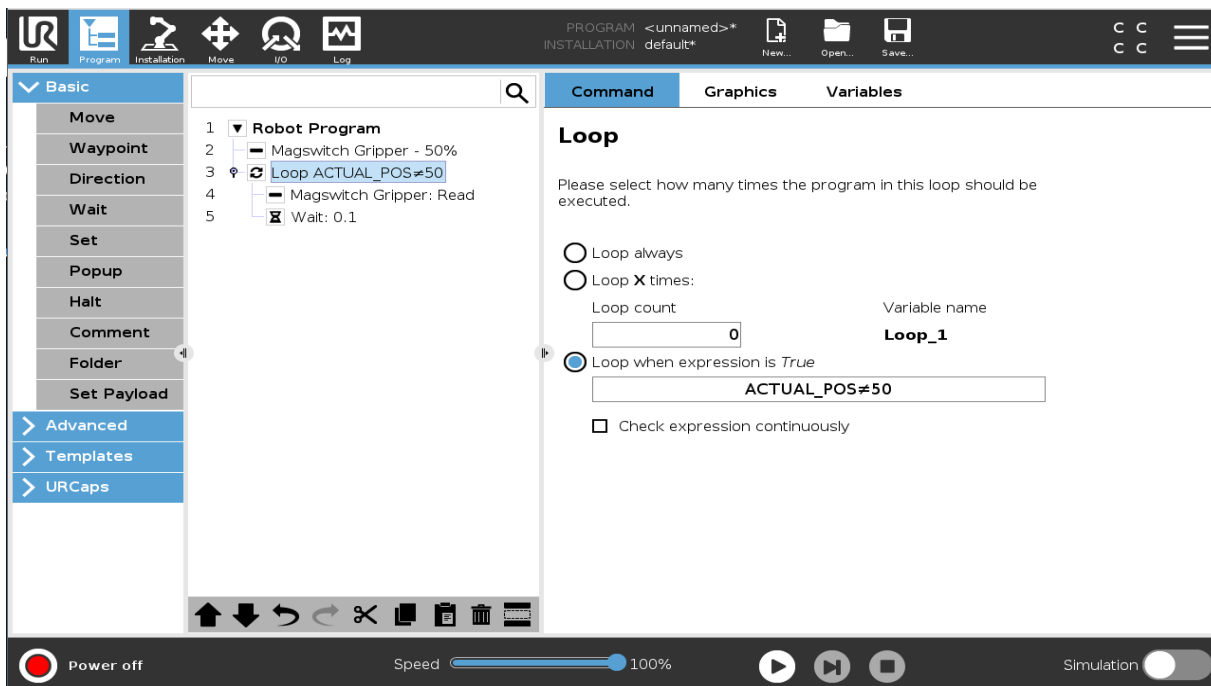


Fig 34: Loop until ACTUAL_POS variable equals 50

Example Demonstrating Part Present:

The below program example demonstrates reading the part present signal inside a loop. While issuing the Magswitch Gripper read command ensure that the appropriate Learned part is selected from the drop-down menu.

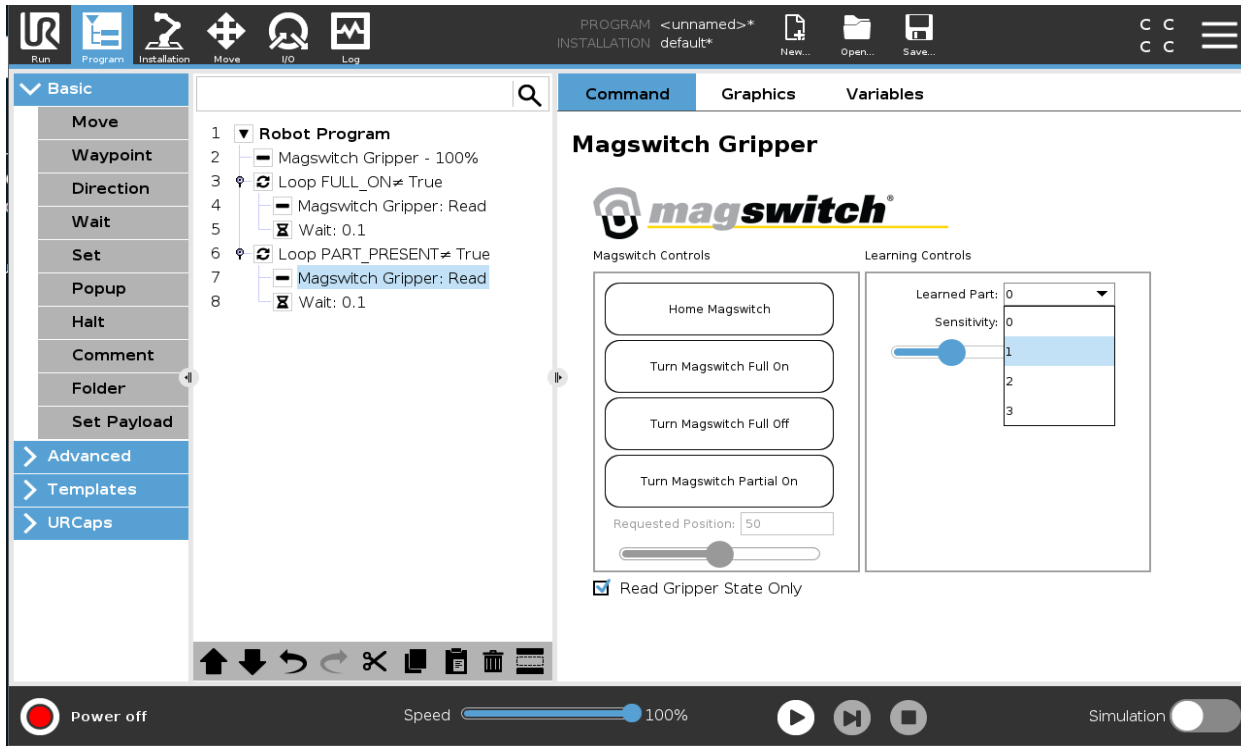


Fig 35: Selecting Calibration profile for checking the status of PART_PRESENT variable

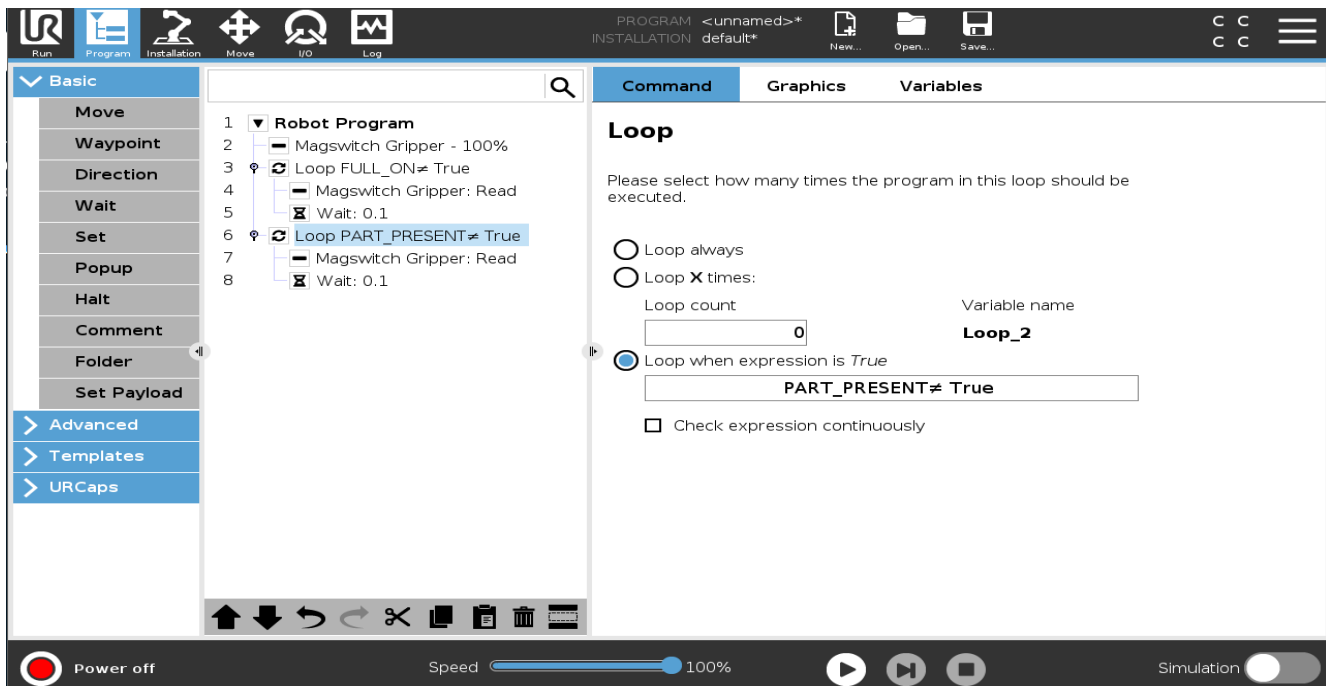


Fig 36: Loop until PART_PRESENT variable equals True