



## FLEXGRIP FOR UNIVERSAL ROBOTS

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# 1 Introduction

The GRIPKIT-Easy with activated FLEXGRIP interface (OPT-GKEASY-MB license required!) has an easy-to-use interface that enables flexible gripping with adjustable parameters. This means that complex robot applications can be realized in no time at all with minimal effort.



These instructions describe the functions of the FLEXGRIP plug-in. For information on installation, commissioning, and operation of the GRIPKIT-Easy gripping module, please refer to the operating instructions. These can be found online at [www.weiss-robotics.com/gripkit-easy/](http://www.weiss-robotics.com/gripkit-easy/).

## 1.1 Notation and Symbols

For a better overview, the following symbols are used in these instructions:



Functional or safety-relevant information. Non-compliance may endanger the safety of personnel and the system, damage the device, or impair the function of the device.



Additional information for a better understanding of the facts described.



Reference to further information.

## 1.2 Intended Use

The “FLEXGRIP plug-in” software is intended for communication between the gripping system GRIPKIT-Easy from WEISS ROBOTICS and a robot controller. The requirements of the applicable directives and the installation and operating instructions in this manual must be observed and complied with. Any other or additional use is considered improper use. The manufacturer is not liable for any resulting damage.

## 1.3 System Requirements

This plugin is compatible with GRIPKIT-Easy from firmware version 2.1.1. The license option “OPT-GKEASY-MB” must be activated on the gripping systems used. Contact our technical sales department for further information.

One of the following Universal Robots robot controllers is required for operation:

- UR e-Series with software revision 5.4 or later

## 1.4 Terms of License

The FLEXGRIP plug-in is protected by copyright. The applicable license terms are included with the software package. With the installation you accept these license terms.

## 1.5 Demo programs

The demo programs provided by the software package are demonstrating the usage of the plug-in only. They are meant for evaluation only!

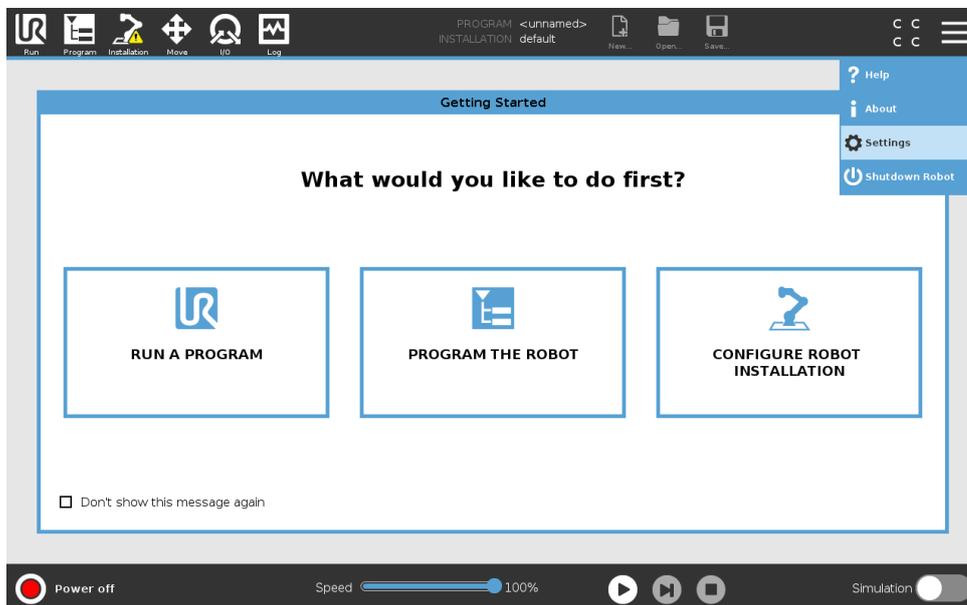
# 2 Installation

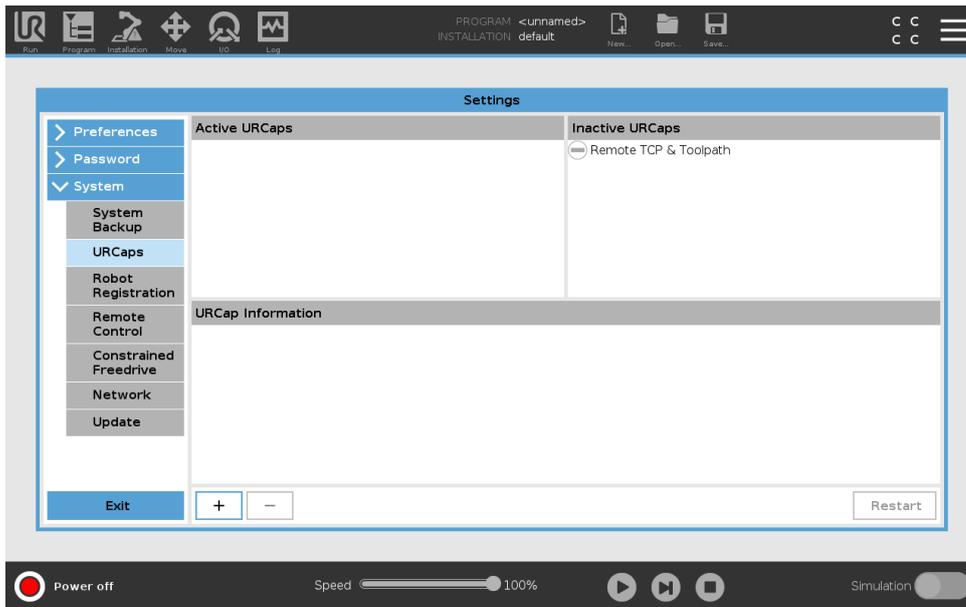
## 2.1 Software Installation



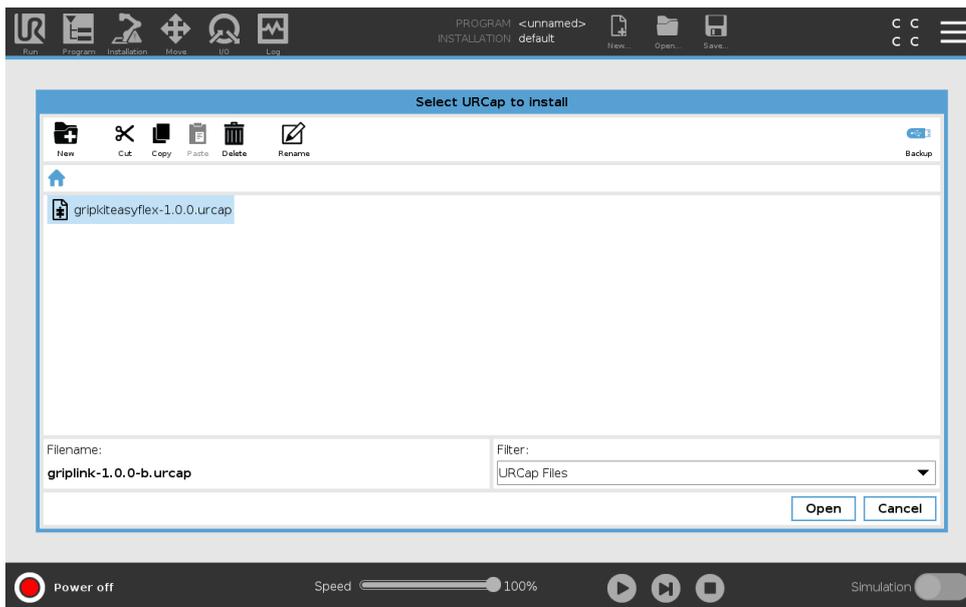
Make sure that you are using the latest version of the FLEXGRIP plug-in. The latest version can be found at [www.weiss-robotics.com/gripkit-easy/](http://www.weiss-robotics.com/gripkit-easy/).

1. Download the plugin file “flexgrip\_plugin\_universalrobots\_<version>.zip”.
2. Unpack the previously downloaded ZIP archive with the GRIPLINK plug-in into the root directory of a USB stick and insert it into the USB slot of the Teach Pendant.
3. Open the settings and navigate to the “System/URCaps” menu

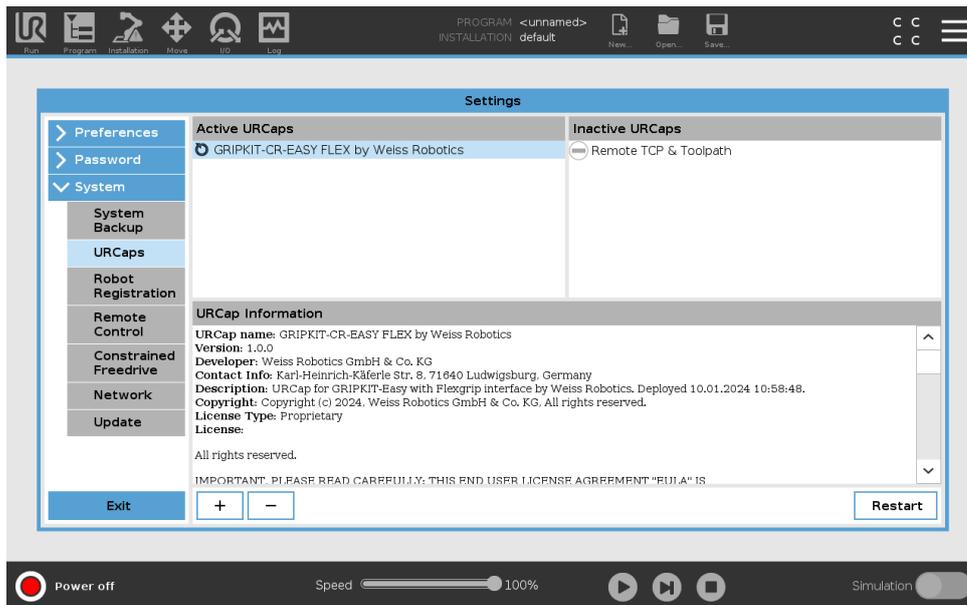




4. Press the “+” button and select the previously unzipped .urcap file

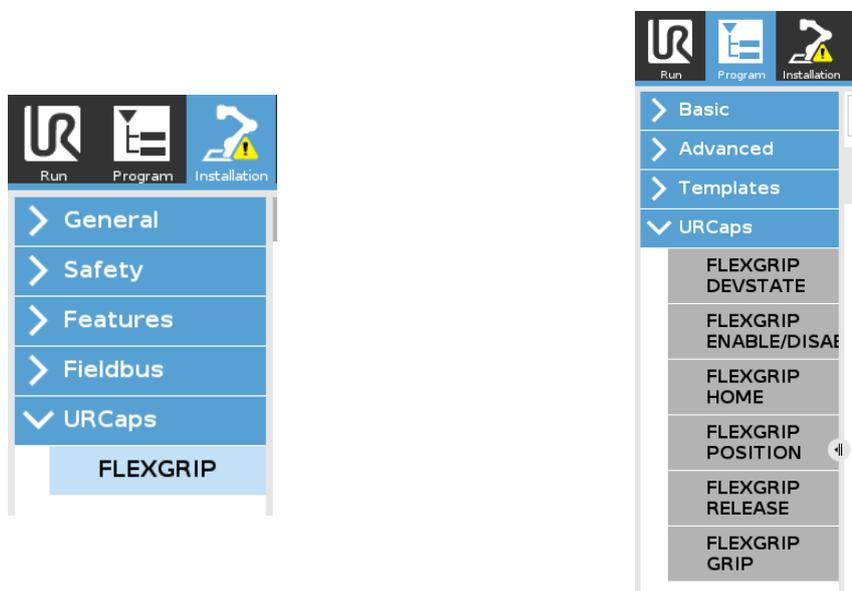


## 5. Restart the robot by pressing the “Restart” button



### 2.1.1 Verify Installation

After you have completed the installation process, the “FLEXGRIP” entry appears in the “Installation” main menu (left image), as well as various program nodes in the “Program” main menu under the “URCaps” menu item (right image).



## 2.2 Uninstall Software

To remove the GRIPKIT CR EASY FLEX plug-in from your robot, follow the instructions in the robot controller manual.

## 3 Hardware Setup

### 3.1 Mounting on Robot

Mounting on the robot flange is described in the operating instructions for the gripping module.



Only mount/unmount gripping modules when the power supply is switched off!

### 3.2 Power Supply

When using several gripping modules, the power supply must be dimensioned sufficiently high, otherwise the function of the gripping modules cannot be guaranteed.

A separate power supply must be routed to the gripping modules if the total power consumption of all gripping modules used exceeds the robot's limitations.



Follow the instructions in the operating instructions for your robot and the information in the operating instructions for the gripping module!

### 3.3 Data Connection

If several gripping modules are used, the termination of the data lines must only be activated on the gripping module that has the longest data line to the robot flange.

It can be activated/deactivated via two slide switches on the underside of the flange adapter.



Activating the termination for the data lines is described in the operating instructions for the gripping module.

## 4 Preparation of the Robot

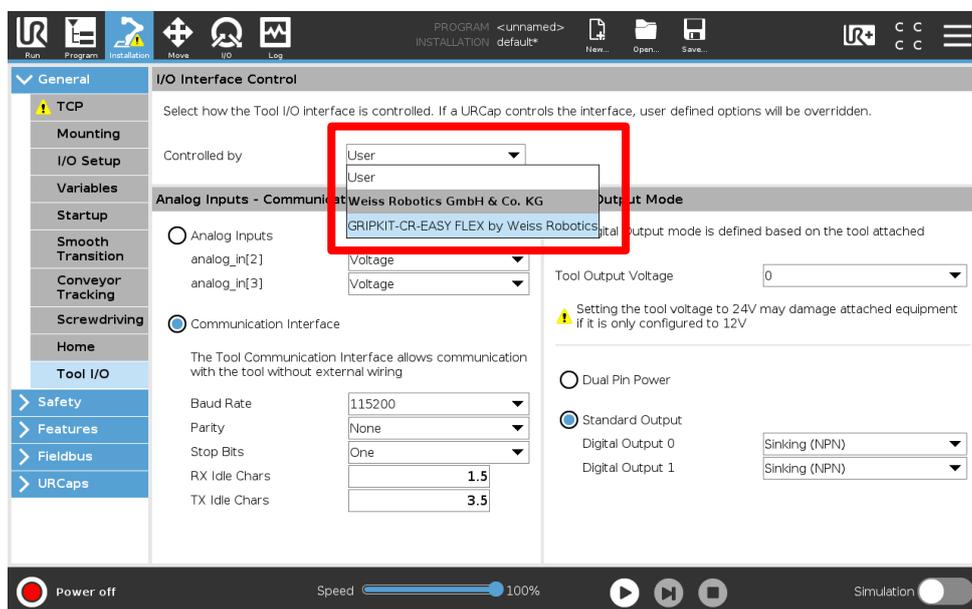
In order to use FLEXGRIP interface, the tool interface must be configured in the installation tab. To do this, select the “FLEXGRIP by Weiss Robotics” option in the “Control by” drop-down menu.



If the interface is not configured correctly, the connected gripping modules cannot be controlled via the program nodes!



Ensure that the communication interface on the connected gripping modules is configured appropriately (RS485: Baud Rate: 115200, Parity: none, Stop Bits: one)!



Ensure that only devices that support a 24 V power supply are connected to the tool connection! Risk of damage!

## 5 Preparation of the Plugin

The basic settings of the URCap must be made in the installation view.



The GRIPKIT EASY gripping modules are configured using the separately available “GRIPKIT EASY Configurator” software.



The “OPT-GKEASY-MB” license option is required to operate the gripping modules with the FLEXGRIP plug-in.

### 5.1 Overview

All currently available gripping modules are displayed in the overview.

In addition to the current device status, the available status data position of the fingers (in mm), set gripping force (in N), current supply voltage (in V) and current gripper temperature (in °C) are displayed.

The buttons on the right can be used to switch the state visualization of the respective gripping module to an identification mode, in order to identify it on the robot flange.

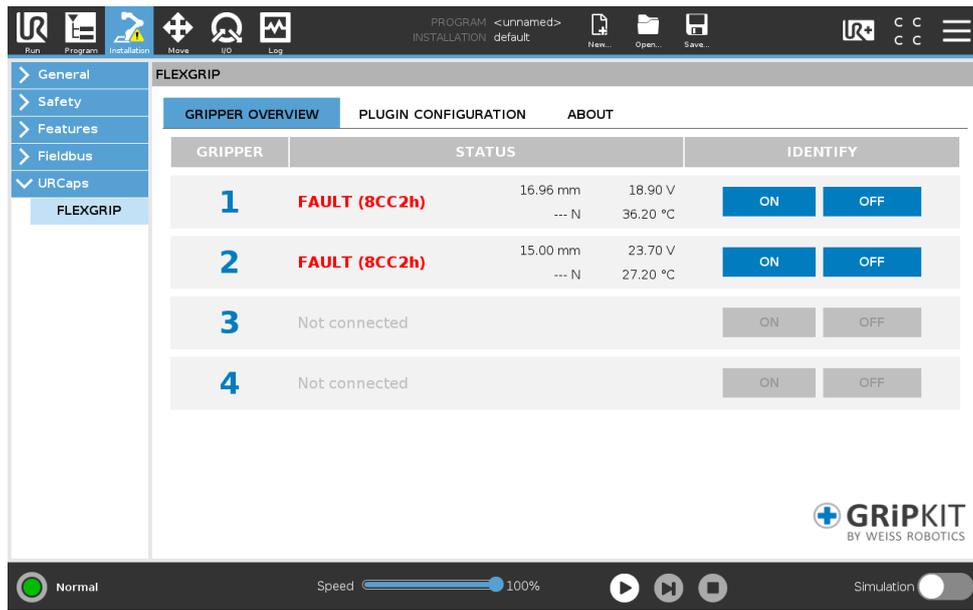
The screenshot displays the FLEXGRIP software interface. The main window is titled 'FLEXGRIP' and has a sidebar on the left with navigation options: General, Safety, Features, Fieldbus, URCaps, and FLEXGRIP. The main area shows a table with columns for GRIPPER, STATUS, and IDENTIFY. The table contains four rows of data for grippers 1 through 4. Gripper 1 is 'NOT INITIALIZED', Gripper 2 is 'HOLDING', Gripper 3 is 'RELEASED', and Gripper 4 is 'DISABLED'. Each row includes numerical data for position (mm) and force (N), and voltage (V) and temperature (°C). To the right of each row are 'ON' and 'OFF' buttons. The bottom of the interface shows a status bar with a green 'Normal' indicator, a speed slider at 100%, and a 'Simulation' toggle.

GRIPPER	STATUS	POSITION (mm)	FORCE (N)	VOLTAGE (V)	TEMPERATURE (°C)	ON	OFF
1	NOT INITIALIZED	---	---	23.70	36.00	ON	OFF
2	HOLDING	13.15	100.00	23.80	34.80	ON	OFF
3	RELEASED	28.90	---	23.80	34.80	ON	OFF
4	DISABLED	0.00	---	---	---	ON	OFF



To control the connected gripper modules, the robot must be in the “Idle” or “Normal” state (yellow or green status light at the bottom left).

If there are errors on the gripping modules, these are displayed in brackets after the device status.



The meaning of the error codes and the measures required to rectify the cause of the error can be found in the operating instructions for the gripping module.

## 5.2 Plugin Configuration

The global parameter “Release Acceleration Override Factor” can be used to reduce peak currents when moving the fingers quickly. This occurs in particular when pre-positioning or releasing with several grippers at the same time or over a long distance. Three settings can be specified for the parameter using the selection field:

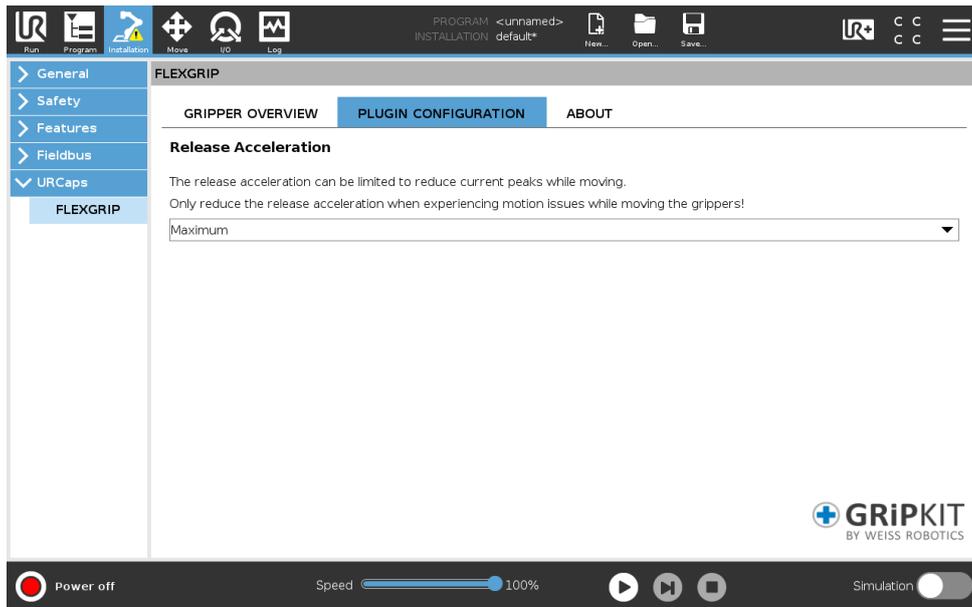
Value	Description
Minimum	Minimum acceleration
Reduced	Reduced acceleration, around 60 %
Maximum	Maximum acceleration



Only reduce the release acceleration if you experience problems when moving the gripping modules used. Please consult our technical support team!

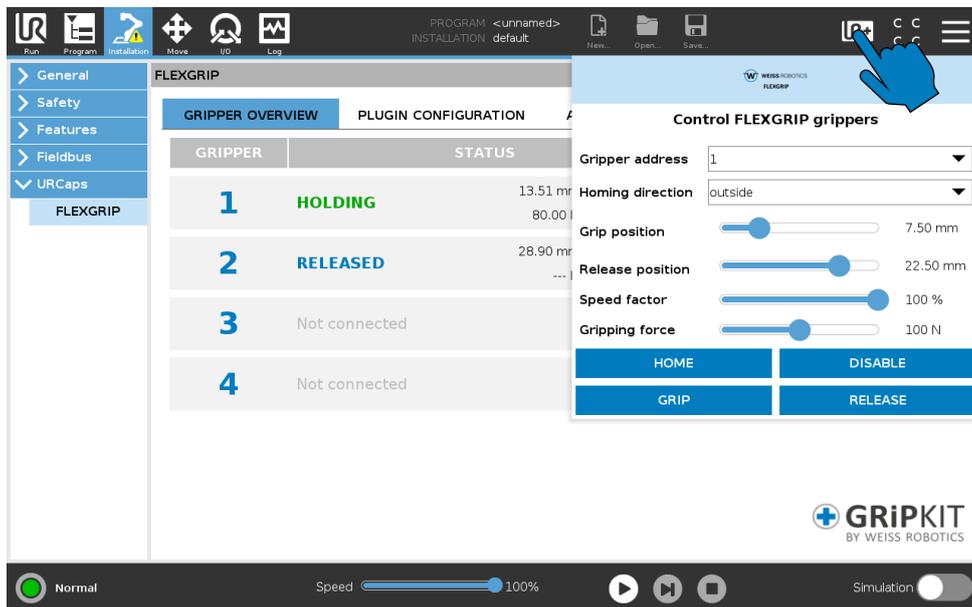


The release acceleration applies in every RELEASE instruction and also across programs!



## 6 Manual Control of connected Grippers via the Toolbar

All four grippers, if connected, can be controlled via the toolbar. Open/close the toolbar by clicking on the “UR+” symbol. The buttons below can be used to test the basic functions of the grippers. The toolbar is available on all pages of the user interface, i.e. also in the robot program view.



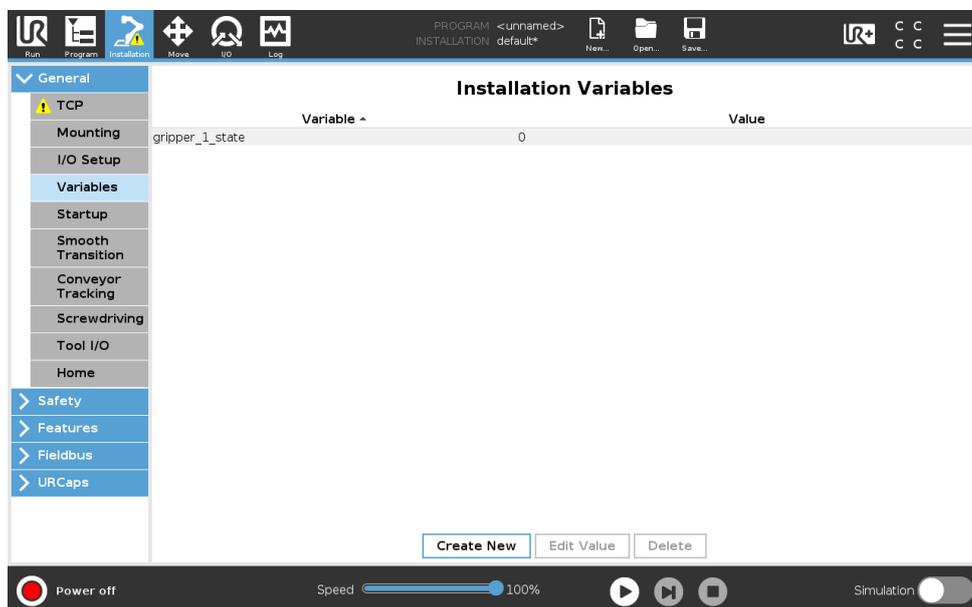
## 7 Program Nodes (Nodes)

### 7.1 Basic program sequence

When using the GRIPKIT CR Easy gripping modules, the following design guidelines should be followed.

#### 7.1.1 Global variables

Some program nodes return values and store them to user selectable variables. Those variables must be defined in advance. To add new variables, open the installation view and navigate to the menu “General”. Change to “Variables” and add the desired variable names. Initialize the variables with numeric values.



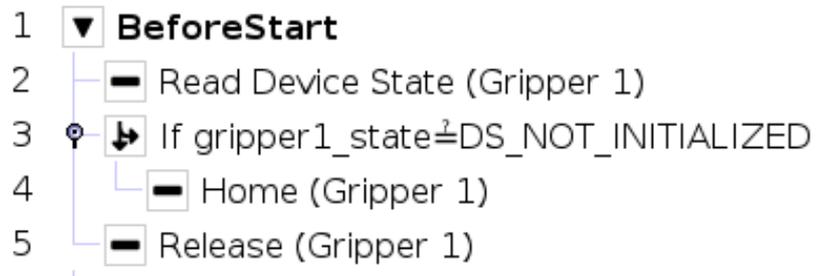
#### 7.1.2 Installation View

During installation, variables for device status and finger position should be created for each gripping module used. These can be used later in the robot program.

#### 7.1.3 Program

##### The BeforeStart-Sequence

1. Loads the current device state into the corresponding global variable for each gripping module used with the “Read Device State” node.
2. References each gripping module used with the “Home” node, provided the previously loaded state is “NOT INITIALIZED”.
3. Optional: use the “Release” node to move the fingers to the desired starting position



### The Robot Program-Sequence

1. Contains the commands for gripping and releasing
2. Processes variables that are described by nodes, e.g. for status and position queries

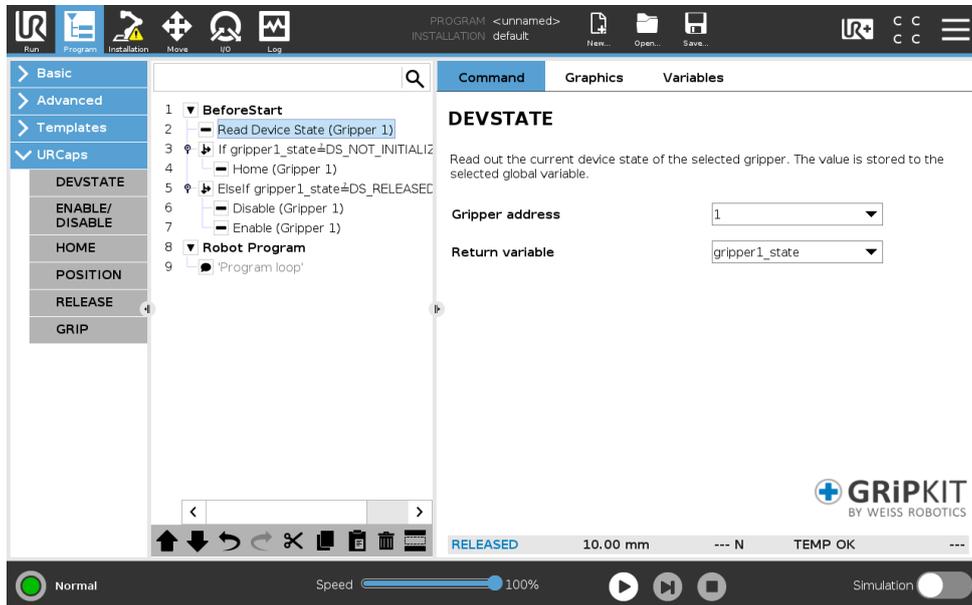


Correct functioning can only be guaranteed if this basic procedure is followed.

The available commands of the plugin are described in the following sections. Each command can be used both as a graphical node and as a URScript implementation.

## 7.2 Device State Query – DEVSTATE

The “DEVSTATE” node is used to query the status of a gripping module. This is written to the selected global variable.



Available device states can be found in Appendix A.



The return variable must be defined in the global variables (see section 7.1.1).

### 7.2.1 Calling the Command using Script Code

```
<return_variable_name> = flexgrip_devstate (
    <GRIPPER_ADDRESS>
)
```

Parameter	Type	Meaning
<GRIPPER_ADDRESS>	Int	Gripper address Value range: [1 .. 4]

Type of return value	Meaning
Int	Current device state (refer to Appendix A)

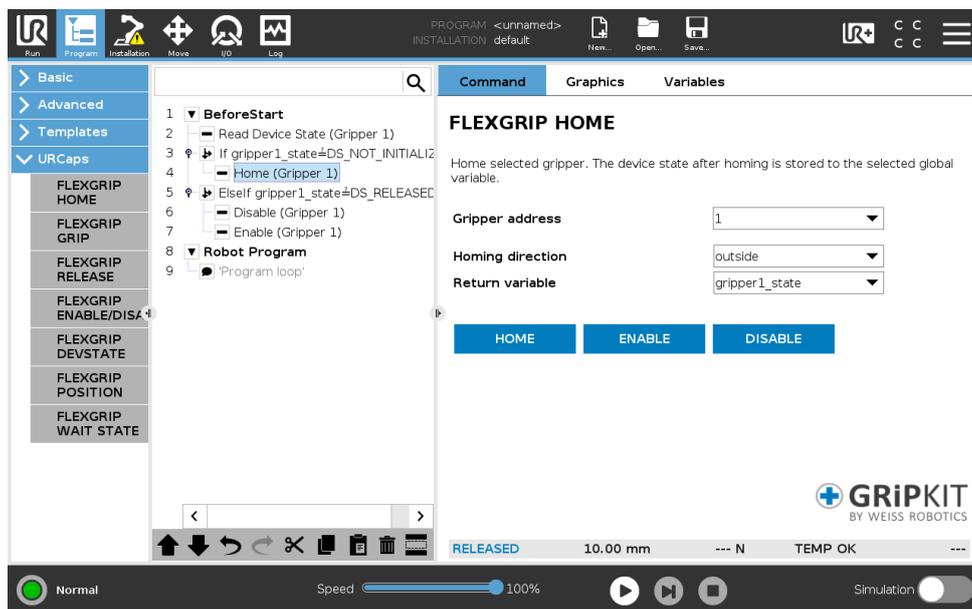
### 7.3 Referencing – HOME

Before gripping commands can be executed, the position measuring system must be initialized. The “HOME” node is used for this purpose.

When referencing, the base jaws of the fingers must reach the physical end positions. The finger design must allow the outer or inner end stop to be reached.



Select the referencing direction so that the base jaws of the fingers reach an end stop when referencing.



The return variable must be defined in the global variables (see section 7.1.1).

The command blocks until either a state change or a time overflow occurs. The state reached after the command is executed is saved in the selected global variable. In the event of a time overflow, an error message is displayed and the program is interrupted.

### 7.3.1 Calling the Command using Script Code

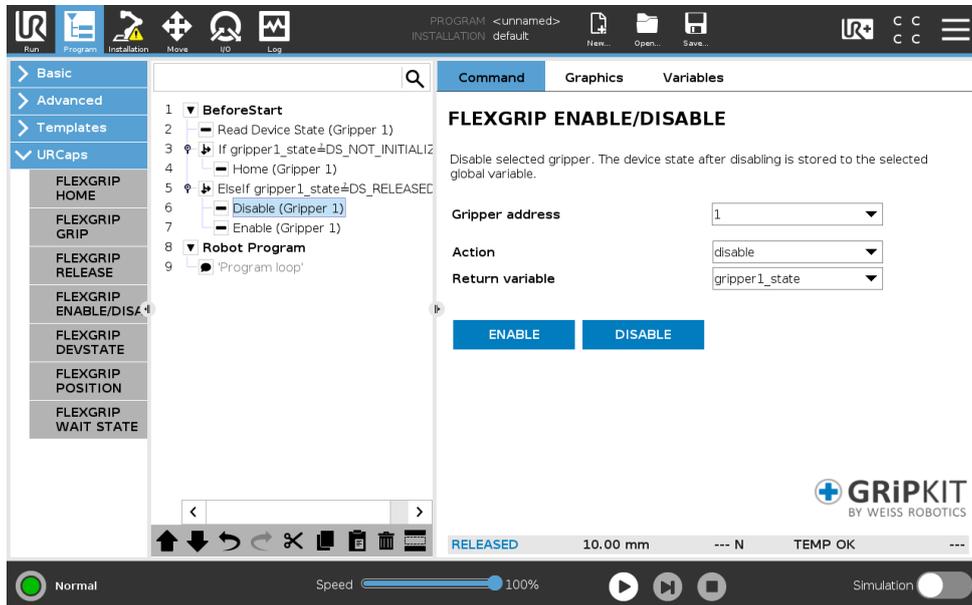
```
<return_variable_name> = flexgrip_home(  
    <GRIPPER_ADDRESS>,  
    <HOMING_DIRECTION>  
)
```

Parameter	Typ	Meaning
<GRIPPER_ADDRESS>	Int	Gripper address Value range: [1 .. 4]
<HOMING_DIRECTION>	Int	Homing direction Values $\leq 0$ : Homing inside Values $\geq 1$ : Homing outside

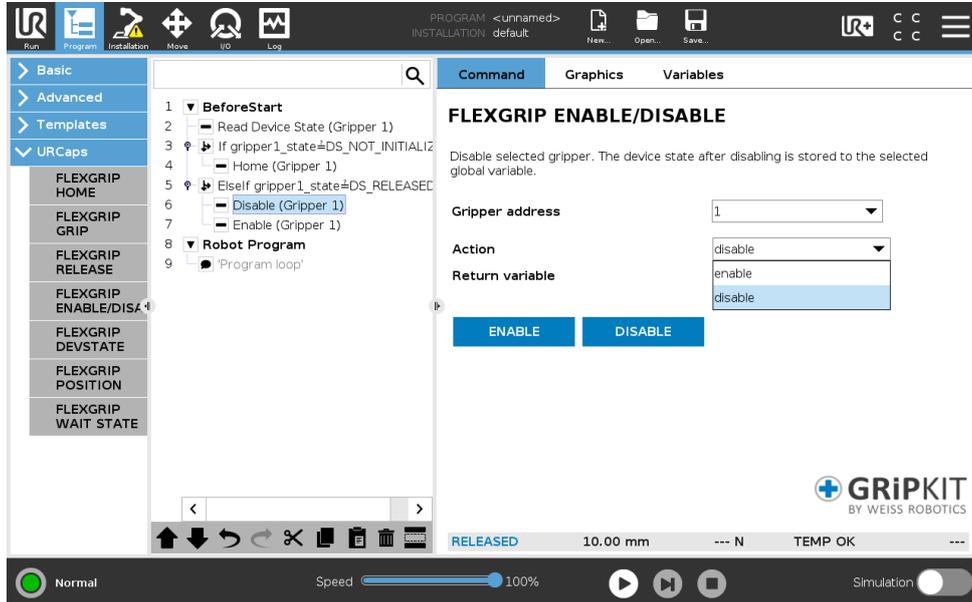
Type of return value	Meaning
Int	Device state after command execution (refer to Appendix A)

## 7.4 Enable and Disable – ENABLE/DISABLE

Grippers can be activated and deactivated during operation, for example to operate them on a changeover contact.



Select the appropriate command from the combo box:



The command blocks until either a state change or a time overflow occurs. The state reached after the command is executed is saved in the selected global variable. In the event of a time overflow, an error message is displayed and the program is interrupted.



The return variable must be defined in the global variables (see section 7.1.1).

### 7.4.1 Calling the Command using Script Code

```
<return_variable_name> = flexgrip_enable(  
    <GRIPPER_ADDRESS>  
)
```

```
<return_variable_name> = flexgrip_disble(  
    <GRIPPER_ADDRESS>  
)
```

Parameter	Type	Meaning
<GRIPPER_ADDRESS>	Int	Gripper address Value range: [1 .. 4]

Type of return value	Meaning
Int	Device state after command execution (refer to Appendix A)

## 7.5 Gripping – GRIP

The GRIPKIT-Easy can execute gripping commands based on the set movement parameters. The gripping position determines how far the fingers move together. If they block before reaching this position, the set gripping force is built up and the gripping module switches to the “HOLDING” state. If the position is reached without a workpiece being gripped, the gripping module switches to the “NO PART” state.

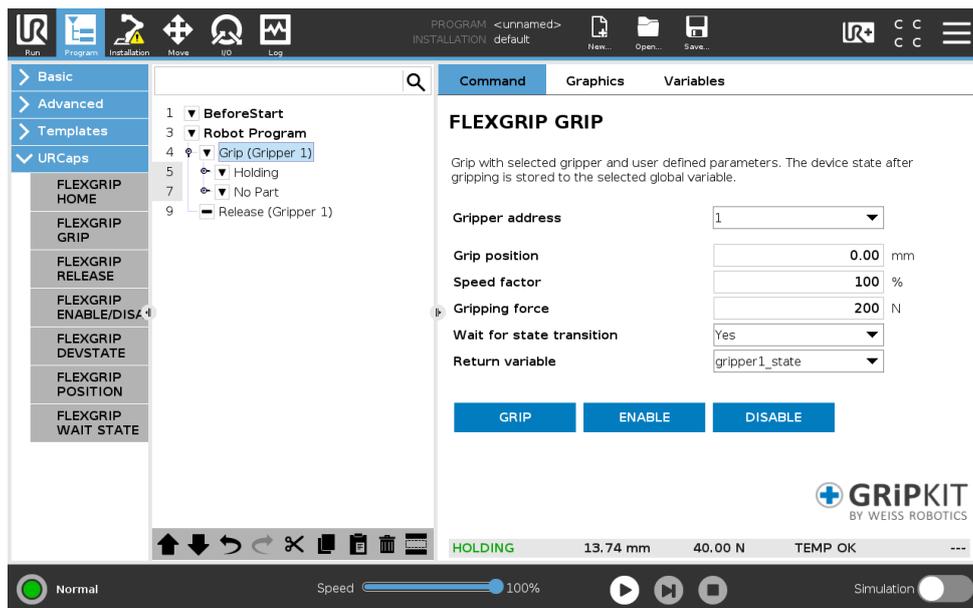
The gripping force-dependent speed can be scaled using the speed factor. This allows sensitive parts to be gripped particularly gently (values <100%). For robust gripping parts, higher scaling (values >100%) can be used to get lower cycle times.



Speed factors > 100% with high gripping forces can shorten the service life of the gripper mechanism!



Further information on the movement parameters can be found in the operating instructions for the gripping module.



The “Wait for state change” selection field can be used to control whether the robot program waits until the gripper has detected the workpiece (change to HOLDING state) or the target position has been reached (change to NO PART state).



When waiting for a state change, the state reached is saved in the selected global variable after the command has been executed.

If a time overflow occurs, an error message is displayed and the program is interrupted.

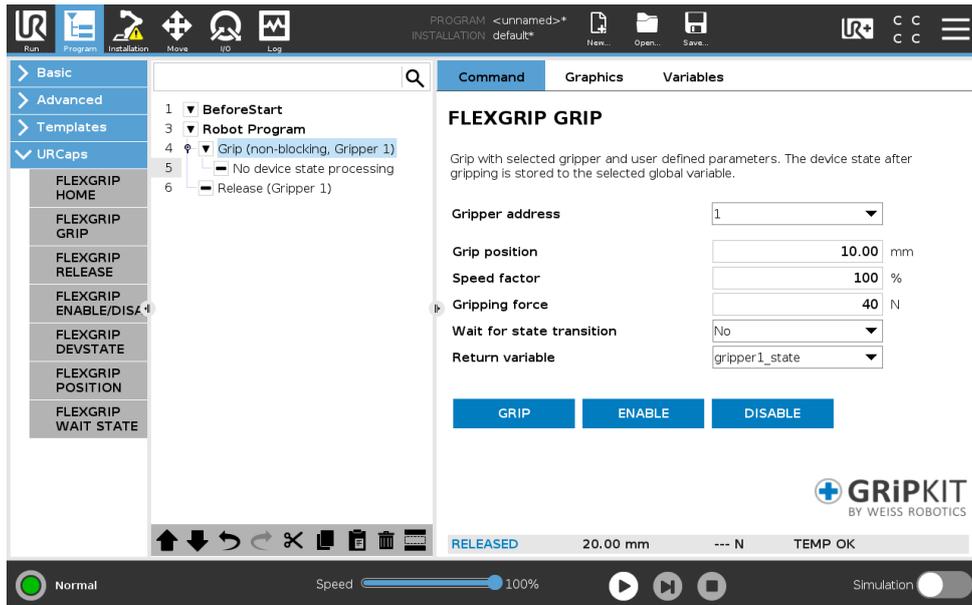


The return variable must be defined in the global variables (refer to section 7.1.1).



If you do not want to wait for a state change, the selected global variable is assigned the value 0!

Before evaluating the device state, it must be queried either with the DEVSTATE node or with the WAIT STATE node (refer to section 7.2).



### 7.5.1 Evaluation of the Device State

After executing the gripping command, the robot program automatically detects whether the gripper has gripped a part or not. The child nodes are then executed accordingly under “HOLDING” (component was gripped) or under “NO PART” (component was not gripped).



If you do not wait for a state change, the program continues without executing the child nodes.

## 7.5.2 Calling the Command using Script Code

```

<return_variable_name> = flexgrip_grip(
    <GRIPPER_ADDRESS>,
    <POSITION>,
    <SPEED_OVERRIDE>,
    <FORCE>,
    <WAIT_FOR_STATE_TRANSITION>
)

```

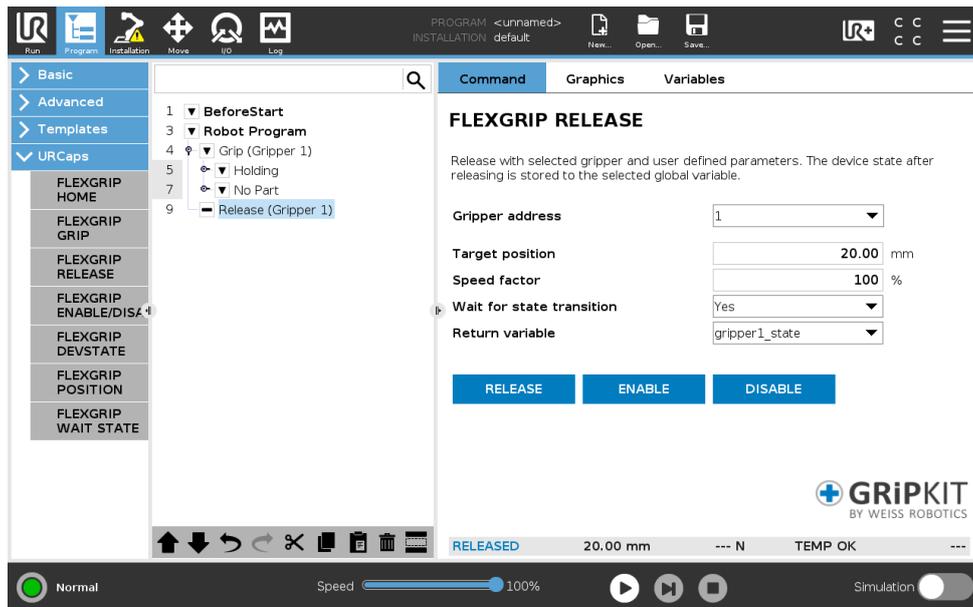
Parameter	Type	Meaning
<GRIPPER_ADDRESS>	Int	Gripper address Value range: [1 .. 4]
<POSITION>	Float	Target position in mm Value range: [0 .. 30]
<SPEED_OVERRIDE>	Int	Speed override factor in % Value range: [0 .. 200]
<FORCE>	Int	Gripping force in N Value range: [0 .. 200]
<WAIT_FOR_STATE_TRANSITION>	Bool	True: Command waits for device state transition False: Command does not wait for device state transition

Type of return value	Meaning
Int	Device state after command execution (refer to Appendix A)  If the value False is passed for the parameter <WAIT_FOR_STATE_TRANSITION>, the function returns the value 0

## 7.6 Releasing and Pre-Positioning – RELEASE

The “RELEASE” node can be used to release gripped workpieces or to pre-position the fingers. The target position determines the position to which the fingers move.

The traversing speed can be scaled using the speed factor. For example, it is possible to pre-position at a high speed and then grip with a low gripping force. This shortens cycle times and protects sensitive gripping parts.



Further information on the movement parameters can be found in the operating instructions for the gripping module.

The “Wait for state transition” selection field can be used to control whether the robot program waits until the target position has been reached or continues directly after the command has been executed. This is helpful if the command is started, and a movement of the robot arm is then to be executed directly.



When waiting for a state change, the state reached is saved in the selected global variable after the command has been executed.

If a time overflow occurs, an error message is displayed and the program is interrupted.



The return variable must be defined in the global variables (refer to section 7.1.1).



If you do not want to wait for a state change, the release node writes the value of the “NOT CONNECTED” state to the selected variable!

Before evaluating the device status, it must be queried again with the DEVSTATE node (refer to section 7.2).

If activated, the command blocks until either a state change or a time overflow occurs. The state reached after the command is executed is saved in the selected global variable. In the event of a time overflow, an error message is displayed and the program is interrupted.

### 7.6.1 Calling the Command using Script Code

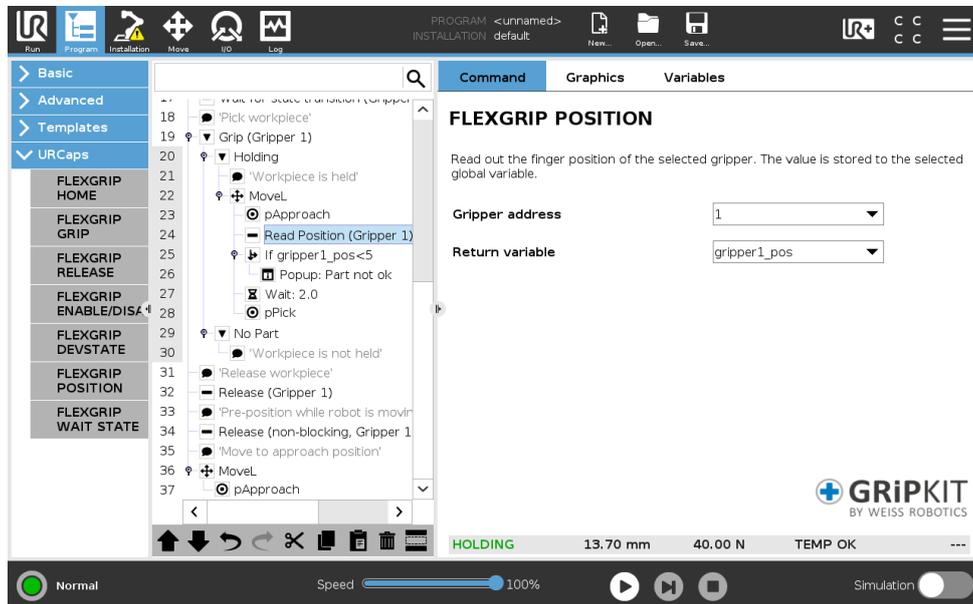
```
<return_variable_name> = flexgrip_release(  
    <GRIPPER_ADDRESS>,  
    <POSITION>,  
    <SPEED_OVERRIDE>,  
    <RELEASE_ACC_OVERRIDE>,  
    <WAIT_FOR_STATE_TRANSITION>  
)
```

Parameter	Type	Meaning
<GRIPPER_ADDRESS>	Int	Gripper address Value range: [1 .. 4]
<POSITION>	Float	Target position in mm
<SPEED_OVERRIDE>	Int	Speed override factor in % Value range: [0 .. 100]
<RELEASE_ACC_OVERRIDE>	Int	Release acceleration override factor in % Value range: [0 .. 100]  Is set on the plugin installation (refer to section 5.2)
<WAIT_FOR_STATE_TRANSITION>	Bool	True: Command waits for device state transition False: Command does not wait for device state transition

Type of return value	Meaning
Int	Device state after command execution (refer to Appendix A)  If the value False is passed for the parameter <WAIT_FOR_STATE_TRANSITION>, the function returns the value 0

## 7.7 Evaluating the Finger Position – POSITION

The “POSITION” node can be used to read out the position of the finger jaws, for example to check the gripped component based on its size. This writes the current position of the finger jaws of the selected gripping module in millimeters to a global variable.



The return variable must be defined in the global variables (see section 7.1.1).

### 7.7.1 Calling the Command using Script Code

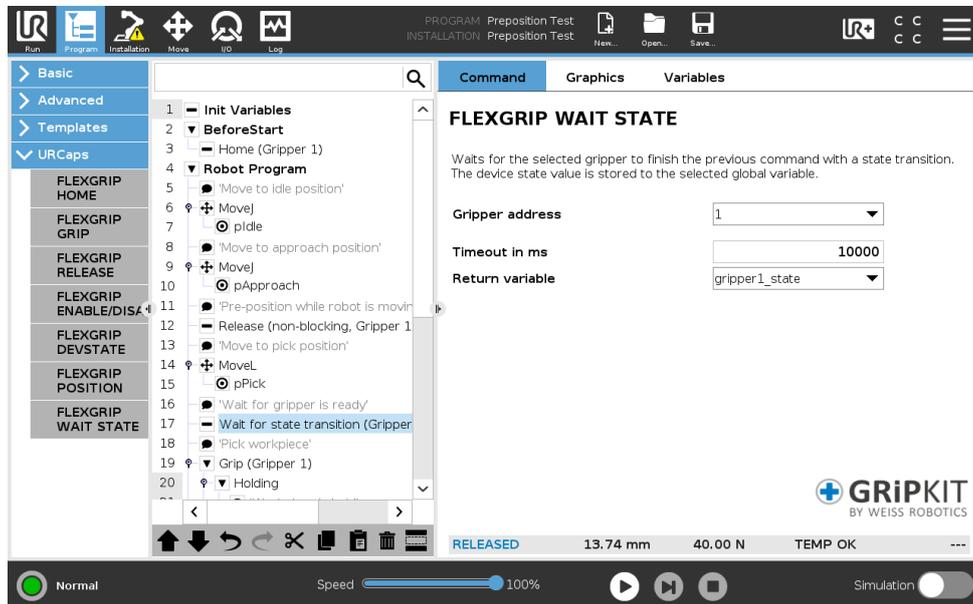
```
<return_variable_name> = flexgrip_position(  
    <GRIPPER_ADDRESS>  
)
```

Parameter	Type	Meaning
<GRIPPER_ADDRESS>	Int	Gripper address Value range: [1 .. 4]

Type of return value	Meaning
Float	Current finger position in mm

## 7.8 Wait for state transition – WAIT STATE

The “WAIT STATE” node is used to wait after a non-blocking command (e.g. GRIP or RELEASE) until the selected gripper has processed the command. The command blocks as long as the gripper has not changed its state or the time specified with the “Timeout in ms” parameter has passed.



The state reached is saved in the selected global variable after the command has been executed.

If a time overflow occurs, an error message is displayed and the program is interrupted.



The return variable must be defined in the global variables (see section 7.1.1).

### 7.8.1 Calling the Command using Script Code

```
<return_variable_name> = flexgrip_wait_state_transition(
    <GRIPPER_ADDRESS>,
    <TIMEOUT_MS>
)
```

Parameter	Type	Meaning
<GRIPPER_ADDRESS>	Int	Gripper address Value range: [1 .. 4]
<TIMEOUT_MS>	Int	Time in milliseconds, until timeout occurs Value range: [1 .. max]

Type of return value	Meaning
Int	Current device state (refer to Appendix A)

## 8 Troubleshooting

### 8.1 One or more grippers are not reachable

One or more grippers are connected, the status light(s) show a white light, but the grippers are not displayed on the overview page and cannot be controlled.

Possible cause	Remedy
Robot state is neither "IDLE" nor "NORMAL"	<ul style="list-style-type: none"><li>• Switch the robot controller to states "IDLE" or "NORMAL"</li></ul>
Invalid data line termination	<ul style="list-style-type: none"><li>• Refer to the notes in section 3.3 for further details regarding the termination settings</li></ul>
Invalid tool I/O configuration	<ul style="list-style-type: none"><li>• Check the tool I/O configuration and refer to section 4 for further details</li></ul>
Invalid interface selected in the gripping module	<ul style="list-style-type: none"><li>• Use the configuration software to select the "FLEXGRIP" command interface</li></ul>
Invalid gripper address	<ul style="list-style-type: none"><li>• Check gripper address in gripping module and robot program</li></ul>

## Appendix A Device State

The following table lists the possible status values of connected GRIPKIT CR EASY gripping modules. The constants specified in the rear column can be used in the robot program (refer to section 7.1).

Device State	Value	Meaning	Name of the UR-Script Constant
NOT CONNECTED	0	Gripping module not connected	DS_NOT_CONNECTED
NOT INITIALIZED	1	Gripping module not initialized	DS_NOT_INITIALIZED
IDLE	2	Drive inactive Fingers can be moved manually	DS_DISABLED
RELEASED	3	Workpiece released	DS_RELEASED
NO PART	4	No workpiece gripped	DS_NO_PART
HOLDING	5	Workpiece gripped	DS_HOLDING
ENABLED	6	Drive active Finger position is held	DS_OPERATING
FAULT	7	Fault state	DS_FAULT



Do not assign any values to the UR-Script constants other than those listed in the table, as otherwise the function of the URcap will be impaired and malfunctions may occur!

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