



2F- 85

2F- 140

Original Notice

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Robotiq 2F-85 & 2F-140
for e-Series Universal Robots



Instruction Manual

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Revisions

Robotiq may modify this product without notice, when necessary, due to product improvements, modifications or changes in specifications. If such modification is made, the manual will also be revised, see revision information. See the latest version of this manual online at support.robotiq.com.

Revision 2018/11/07

New major revision of the Gripper hardware

- All external visual supports changed to reflect the hardware changes
- Updated Section 1
- Updated Section 3
- Updated Section 4
- Updated Section 6
- Updated Section 7
- Updated Section 8
- Updated Section 9

Revision 2018/09/11

- Updated Section 3 according to the robot used (CB-Series vs. e-Series)
- Updated Section 4
 - Input & Output Registers
 - Control over Universal Robots depending on the robot software used (PolyScope 3.6 and later version vs. PolyScope 5.0 and later versions)
 - Added LED and move functions to the list of available functions
- Updated Section 8 with new spare parts, kits and accessories

Revision 2018/05/23

- Major update following the release of UCG-1.2.0
 - New subsections in Section 4: Control
 - Gripper Dashboard
 - Gripper Calibration menu and Calibration wizard for object validation

Revision 2017/06/06

Added section:

- 4.8.2.1 Multiple Grippers

Revised sections:

- 3.8.1 Installation procedure for URCaps
- 4.8.1 Gripper Toolbar



Revision 2016/07/04

Major revision : Updated for URcaps release Section added :

- 3.8 URCaps Package
- 3.9 UR Package without URcaps
- 4.8 Control over Universal Robots with URcaps
- 4.9 Control over Universal Robots without URcaps

Revision 2015/09/15

Major revision : Updated for 2-Finger 140

Revision 2015/07/21

Section added :

- 4.5 Picking features : Force control, re-grasp and object detection.
- A. Harmonized standards, declarations and certificates

Minor modifications :

- Section 1. General Presentation
- Section 3.7 Universal Robots package

Revision 2014/11/05

Modification for Robotiq 2-Finger 85 Adaptive Robot Gripper version 3

Revision 2014/07/22

Modification for use on Robotiq Universal Controller

Minor modifications : User Interface section, maintenance section

Revision 2013/02/06

Section added : Couplings ISO models and Baxter robots Minor modifications

Revision 2013/02/06

Section added : Communication with UR robots Minor modifications

Revision 2012/10/18

Official release

Revision 2012/03/02

Beta release



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The information contained in this document is subject to change without notice.



1. General Presentation

The terms "Gripper", "Adaptive Gripper", "Robotiq Gripper", "Robotiq Adaptive Gripper", "2-Finger 85", "2-Finger 140", "2F-85" and "2F-140" used in the following manual all refer to the Robotiq 2-Finger Adaptive Robot Gripper. The Robotiq 2-Finger Adaptive Gripper has two versions, 85 and 140. The 2-Finger version will change finger opening dimensions, which will be 85 mm (2F-85) or 140 mm (2F-140). Both versions use the same base, installation and control will be exactly the same. The 2-Finger Gripper is a robotic peripheral that is designed for industrial applications. Its design makes it a unique robotic end-of-arm tool to quickly pick, place and handle a large range of objects of varying sizes and shapes.

Info

Unless specified, information in this manual applies to both the 85 and the 140 mm version of the 2-Finger Adaptive Robot Gripper.

Info

The following manual uses the metric system, unless specified, **all dimensions are in millimeters**.

Info

The following section presents the key features of the grasp-type gripper and must not be considered as appropriate to the gripper operation, each feature is detailed in the appropriate section of the manual. Safety guidelines must be read and understood before any operation is attempted with the grasp-type gripper.



1.1. Gripper nomenclature

The 2-Finger Gripper has two articulated fingers that each have two joints (two phalanxes per finger), as shown in the figure below. The grasp-type gripper can engage up to five points of contact with an object (two on each of the phalanges plus the palm). The fingers are under-actuated, meaning they have fewer motors than the total number of joints. This configuration allows the fingers to automatically adapt to the shape of the object they grasp and it also simplifies the control of the grasp-type gripper.



Fig. 1-1: Robotiq 2-Finger Adaptive Gripper.

Please refer to the for details on standard and optional parts.

The status LED presented in the figure above will be :

- solid blue/red when booting
- solid blue when powered with no errors (while communication is active)
- solid red if minor fault occurs, see status details in the **Control** section.
- blinking red/blue if major fault occurs, see status details in the **Control** section.



1.2. 2F-85 vs. 2F-140

The 2-Finger Gripper comes with either 85 mm opening (2-Finger 85) or 140 mm opening (2-Finger 140) according to the figure below. The chassis will remain the same, only the fingers will change. Please refer to the [Mechanical Installation](#) section for installation instructions. Finger kits are available in the Spare Parts and Accessories section.

Info

Details on the 2-Finger 85 and 2-Finger 140 (dimensions and specifications) can be found in the [Specifications](#) section.

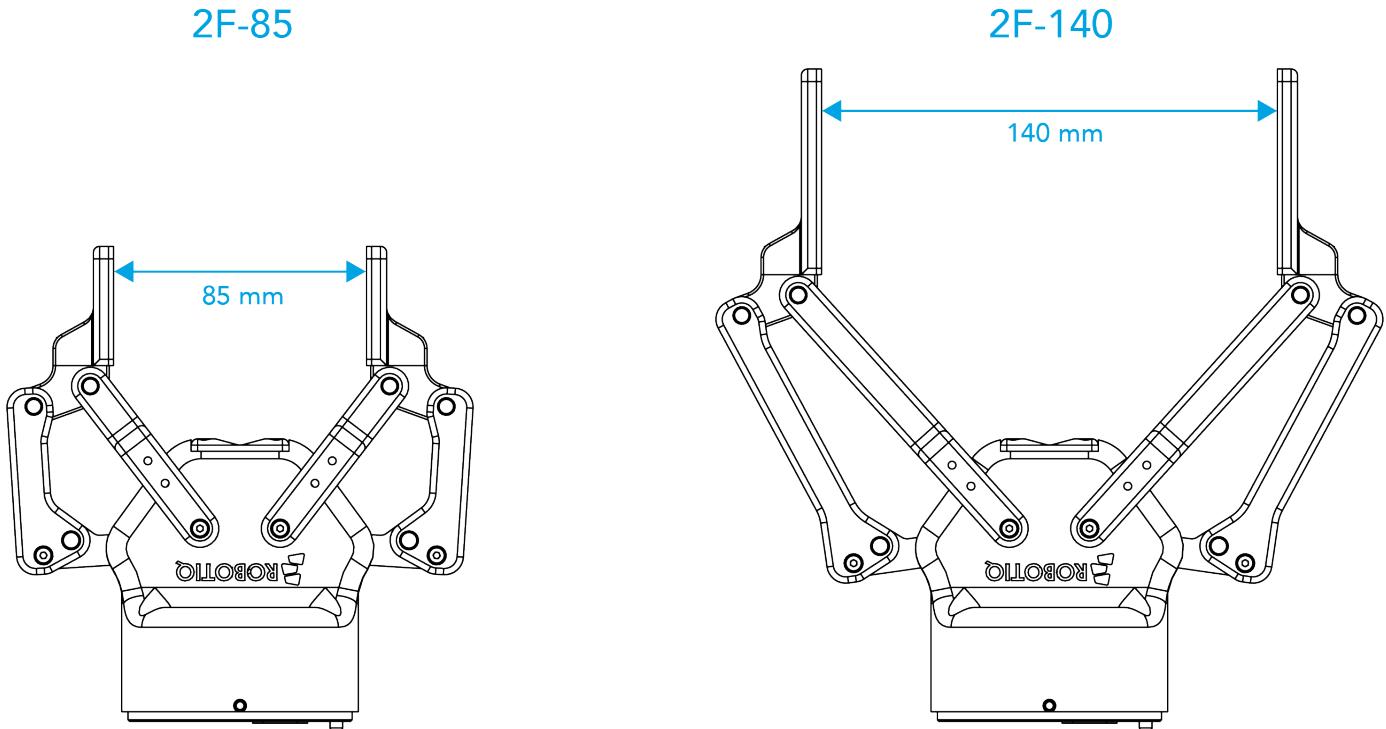


Fig. 1-2: The 2-Finger 85 and 140 mm versions.



1.3. Object picking

The 2-Finger Gripper has a single actuator for opening and closing the fingers, the fingers automatically adapt to the shape of the object manipulated.

Fingers will adopt either a parallel grasp or encompassing grasp as shown in the figure below.

Info

Closing or opening is done via the "Go to requested position" command and is input to the Gripper. **Whether the fingers close to produce an encompassing or fingertip grasp is decided at the Gripper level automatically.** It will depend on:

- The object's geometry;
- The relative position of the object with respect to the Gripper.

In other words, picking the same object could result in either an encompassing or fingertip grasp based on an object's position and geometry.

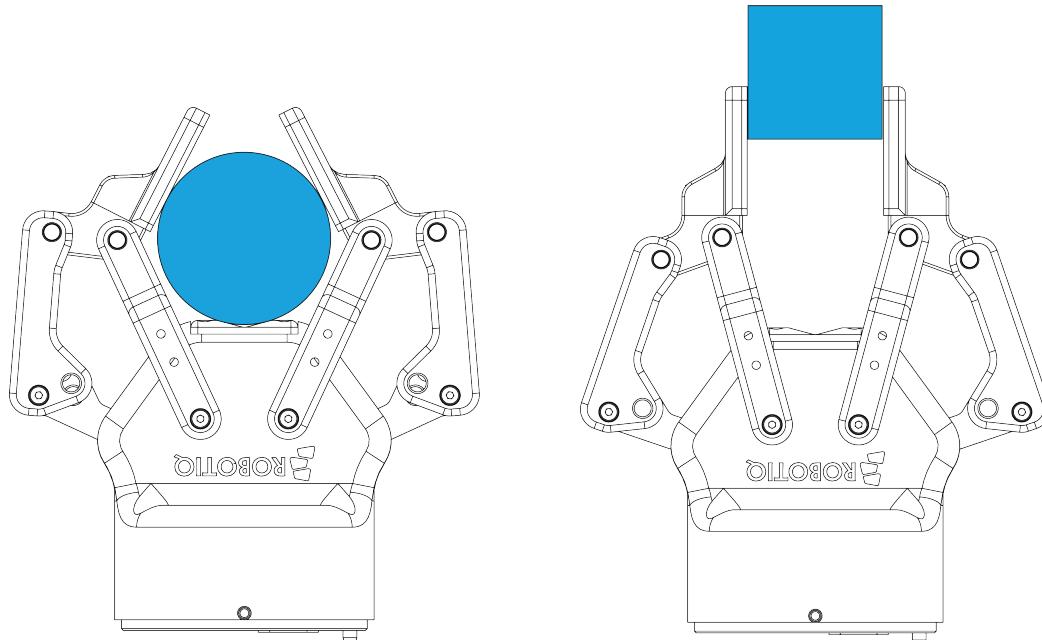


Fig. 1-3: 2-Finger parallel and encompassing grips.

Info

It is important to note that a fingertip grasp can only be performed when the fingers touch the object with the upper section of the distal phalanxes first. Inversely, for an encompassing grip, the fingers must touch the object with the proximal or the lower section of the distal phalanxes first. Also, to ensure stability, the object should be held against the Gripper palm while performing an encompassing grip. Refer to the figure below for a visual representation of the parallel and encompassing grasp regions on the distal phalanx of the 2-Finger Gripper.



The 2-Finger Adaptive Robot Gripper also allows for internal grasping. The fingers can pick hollow objects from the inside by applying pressure with the outside of the fingers. Refer to the figure below for a visual representation and to the **Picking Features** section for details on the possible position commands of your Gripper.

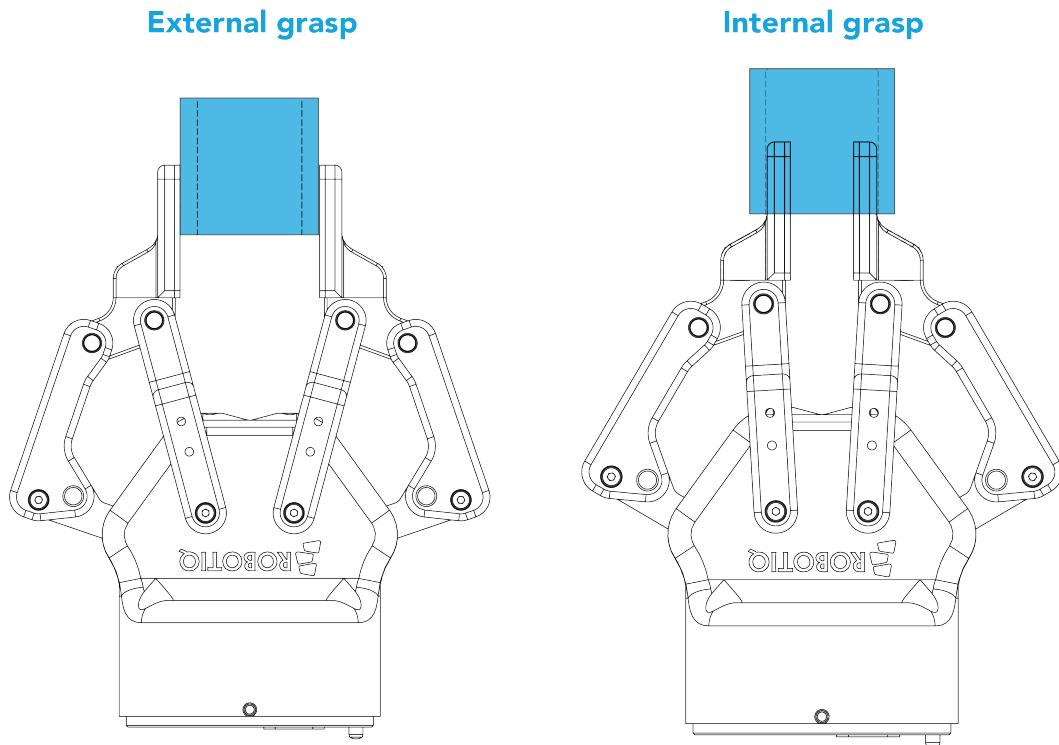


Fig. 1-4: Finger internal and external grasping.



The Gripper equilibrium line is the grasping region that separates the encompassing grasp from the parallel grip. When grasping an object close enough to the inside (palm) of the Gripper, the encompassing grasp will occur (unless the object size or shape is not adequate) and the fingers will close around the object.

If grasped above the equilibrium line, the same object will be picked up in a parallel grasp by the fingertips and the fingers will close with a parallel motion. The figure below shows the **encompassing grasp region**, the **equilibrium line**, and the **parallel grasp region** on the 2-Finger Adaptive Robot Gripper.

Info

The details of the equilibrium line relation between opening angle and the related position d can be found in the **Mechanical specifications** section.

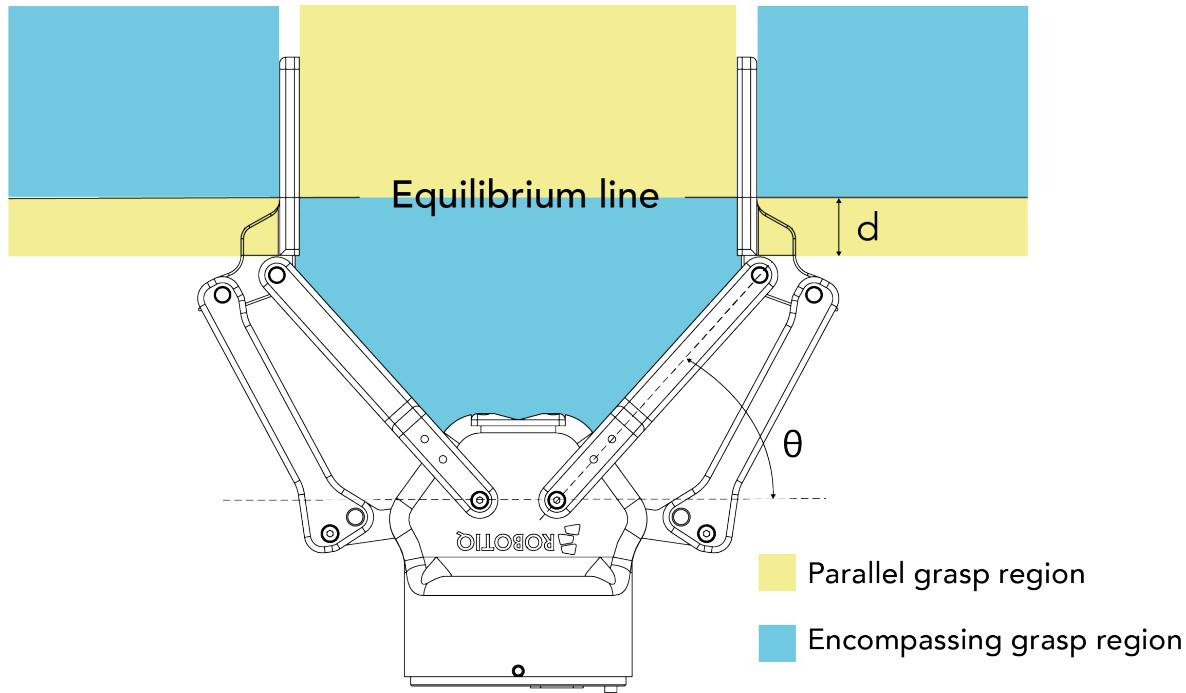


Fig. 1-5: Equilibrium line on the 2-Finger, shown with no fingertip pads.

Tip

Grasping an object that could be grasped by an encompassing grasp (a cylinder for example) on the equilibrium line is not recommended, as slight variations on the position will switch the grasp from parallel to encompassing and vice versa. Robot programming should be done so that the grasping mode will be predetermined.



1.4. Setup and control

The Gripper is powered and controlled directly via a single Device Cable that carries a 24V DC supply and Modbus RTU communication over RS-485, see Section 3.5 for wiring information and Section 4 for control of the Gripper (various software packages are available for control via various robot controllers).

Gripper Coupling is required for 2-Finger usage, the Coupling will provide mechanical and electrical connectivity. Please refer to the **Mechanical Installation** section for installation of the Coupling, to the **Specifications** section for technical drawings, and to the **Spare Parts, Kits and Accessories** section for available couplings.

The 2-Finger has an embedded object detection feature using indirect sensing methods. When picking an object via the "go to" command, the Gripper status will allow you to know if an object is picked or not via a simple object detection bit (0 or 1). When an object is detected, the Gripper will stop. If the object is being dropped, the Gripper will automatically close to keep the object until the "go to" command limit is attained. For details on object detection, see Control section.



2. Safety

Warning

The operator must have read and understood all of the instructions in the following manual before handling the Robotiq 2-Finger Adaptive Robot Gripper.

Caution

The term "operator" refers to anyone responsible for any of the following operations on the 2-Finger Adaptive Robot Gripper:

- Installation
- Control
- Maintenance
- Inspection
- Calibration
- Programming
- Decommissioning

This documentation explains the various components of the 2-Finger and general operations regarding the whole life-cycle of the product from installation to operation and decommissioning.

The drawings and photos in this documentation are representative examples and differences may exist between them and the delivered product.



2.1. Warning

Caution

Any use of the Gripper in noncompliance of these warnings is inappropriate and may cause injury or damage.

Warning

- The Gripper needs to be properly secured before operating the robot.
- Do not install or operate a Gripper that is damaged or lacking parts.
- Never supply the Gripper with an alternative current source.
- Make sure all cord sets are always secured at both ends, at the Gripper and at the robot.
- Always satisfy the recommended keying for electrical connections.
- Be sure no one is in the robot and/or Gripper path before initializing the robot's routine.
- Always satisfy the Gripper payload.
- Set the Gripper pinch force and speed accordingly, based on your application.
- Keep fingers and clothes away from the Gripper while the power is on.
- Do not use the Gripper on people or animals.
- For welding applications, make sure there are no Gripper parts on the ground path of the welding power source.

Any use of the Gripper in noncompliance of these warnings is inappropriate and may cause injury or damage.

2.1.1. Risk assessment and final application:

The Robotiq 2-Finger Adaptive Gripper is meant to be used on an industrial robot. The robot, Gripper and any other equipment used in the final application must be evaluated with a risk assessment. It is the robot integrator's duty to ensure that all local safety measures and regulations are respected. Depending on the application, there may be risks that need additional protection/safety measures, for example, the work-piece the Gripper is manipulating may be inherently dangerous to the operator.



2.2. Intended Use

The Gripper unit is designed for grasping and temporarily securing or holding objects.

Caution

The Gripper is NOT intended for applying force against objects or surfaces.

The product is intended for installation on a robot or other automated machinery and equipment.

Info

Always comply with local and/or national laws, regulations and directives on automation safety and general machine safety.

The unit may be used only within the range of its technical data. Any other use of the product is deemed improper and unintended use. Robotiq will not be liable for any damages resulting from any improper or unintended use.



3. Installation

The following subsections will guide you through the installation and general setup of your Robotiq 2-Finger Adaptive Robot Gripper.

- The **Scope of Delivery** section
- The **Required Tools and Equipment** section
- The **Environmental and Operating Conditions** section
- The **Mechanical Installation** section
- The **Electrical Setup** section
- The **Installation for Universal Robots** section
- The **URCap Package** section

Warning

Before installing:

- Read and understand the safety instructions related to the 2-Finger Adaptive Robot Gripper.
- Verify your package according to the Scope of delivery and your order.
- Have the required parts, equipment and tools listed in the requirements readily available

Warning

When installing:

- Satisfy the environmental conditions.
- Do not operate the Gripper, or even turn on the power supply, before it is firmly anchored and the danger zone is cleared.
The fingers of the Gripper may move and cause injury or damage.



3.1. Scope of Delivery

3.1.1. UR Kit

Robotiq 2-Finger Adaptive Gripper 85 (AGC-ES-UR-KIT-85)	Robotiq 2-Finger Adaptive Gripper 140 (AGC-ES-UR-KIT-140)
<p>Standard upon delivery:</p> <ul style="list-style-type: none"> Robotiq 2-Finger Adaptive Gripper 85 complete unit: AGC-GRP-2F85 <ul style="list-style-type: none"> 85 mm opening fingers without fingertips or pads (these are bought separately unless specified) 	<p>Standard upon delivery:</p> <ul style="list-style-type: none"> Robotiq 2-Finger Adaptive Gripper 140 complete unit: AGC-GRP-2F140 <ul style="list-style-type: none"> 140 mm opening fingers without fingertips or pads (these are bought separately unless specified)
<ul style="list-style-type: none"> Coupling according to your robot bolt pattern: GRP-ES-CPL-062 <div style="border: 1px solid #0072BD; padding: 5px; margin-top: 10px;"> Info Please refer to the Spare Parts, Kits and Accessories section for a list of available couplings. </div>	<ul style="list-style-type: none"> Coupling according to your robot bolt pattern: GRP-ES CPL-062 <div style="border: 1px solid #0072BD; padding: 5px; margin-top: 10px;"> Info Please refer to the Spare Parts, Kits and Accessories section for a list of available couplings. </div>

3.2. Required Tools and Equipment

The following tools are required to install the 2-Finger Adaptive Gripper:

- 4 mm hex key to mount the Gripper onto its coupling.
- Metric hex key according to your coupling to mount the coupling onto the robot.
- 3 mm hex key to mount the wrist connection protector

Optional tools if installing finger kits: **AGC-FIN-KIT-085** or **AGC-FIN-KIT-140**:

- 2 mm hex key

Optional tools if installing other fingertips: **AGC-TIP-204-085**, **AGC-TIP-205-085**, **AGC-TIP-420-140**, **AGC-TIP-420-140**

- 4 mm hex key

3.3. Environmental and Operating Conditions

CONDITION	VALUE
Minimum storage/transit temperature	-30°C [-22°F]
Maximum storage/transit temperature	60°C [140°F]
Minimum operating temperature	-10°C [14°F]
Maximum operating temperature	50°C [122°F]
Humidity (non-condensing)	20-80% RH



CONDITION	VALUE
Vibration	< 0.5G
Other	<ul style="list-style-type: none"> • Free from dust, soot or fluids • Free from corrosive liquids or gases • Free from explosive liquids or gases • Free from powerful electromagnetic interference

Table 3-1: Environmental and operating conditions of the 2-Finger Adaptive Gripper.

3.4. Mechanical Installation

3.4.1. Installing fingers on the Gripper

Depending on your order, you may or may not have fingers already mounted on the Gripper. The first step of installation should be to install the fingers. Refer to the figure below for finger placement. To do so :

1. Align fingers with chassis axes. To do so, the slot on the finger bar should be aligned correctly with the corresponding chassis axis.
2. Insert the finger shaft in the finger bar bracket hole and through the chassis axis (top hole is for parallel locking while bottom hole is for finger installation)..
3. Apply medium strength threadlocker on the provided screws, align the finger bar and fasten to the chassis/chassis axis.

PROVIDED PARTS:

	AGC-FIN-KIT-85	AGC-FIN-KIT-140
①	85 mm fingers	140 mm fingers
②	5 mm stainless steel finger shaft	
③	Optional parallel locking kit with one 5 mm stainless steel finger shaft and two M3 X 5 mm socket low head screw	
④	M3 X 5 mm socket low head screws	

TOOLS YOU NEED:

- 3 mm hex key
- Medium strength threadlocker

EXPLODED VIEW SHOWN WITH ONE 85 MM FINGER AND ONE 140 MM.

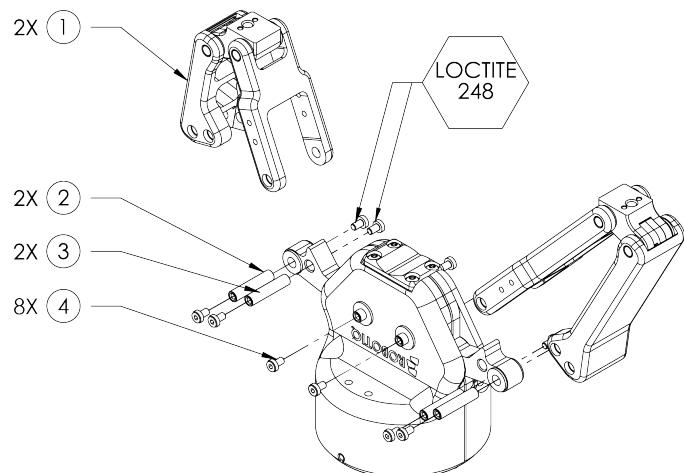


Fig. 3-1: 2-Finger Adaptive Gripper installation.



3.4.2. Installing the fingertips on the Gripper

Depending on your options, you may have fingertips to install. The second step of the installation should be to install the fingertips. To do so:

1. Align the fingertip indexing pins with the finger dowel holes.
2. Insert the M5 X 10 low head cap screws and screw on after applying low strength threadlocker.

PROVIDED PARTS:

	AGC-TIP-XXX-002	AGC-TIP-XXX-140
(1)	(85 mm fingertip option)	(140 mm fingertip option)
(2)	M5 X 10 mm head cap screw	
(3)	M2 X 6 mm indexing pins (M6 tolerance)	

TOOLS YOU NEED:

- 4 mm hex key
- Low strength threadlocker

Quantity shown for a single kit (1 pad)

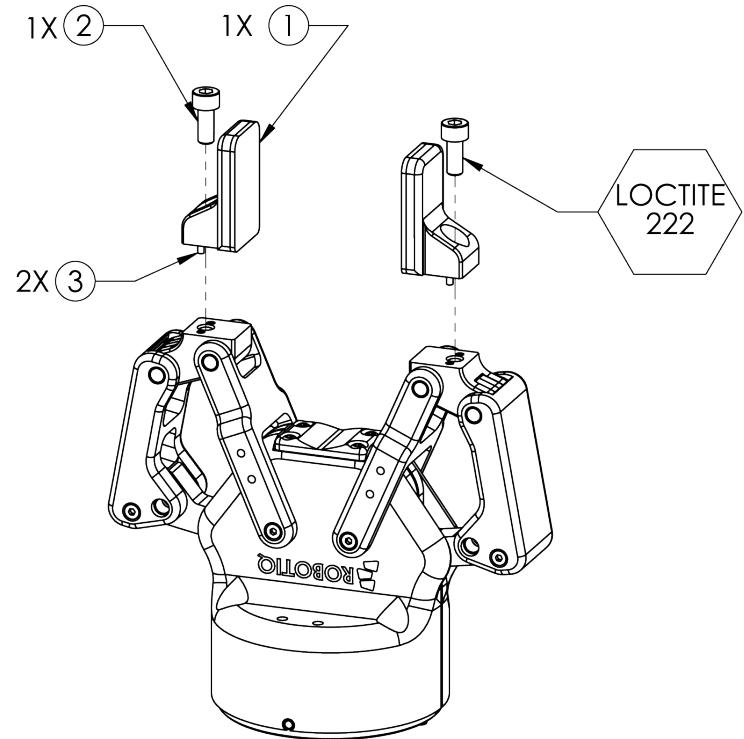


Fig. 3-2: Installing the fingertips on the Gripper



3.4.3. Installing a Protector Kit on the Gripper Fingers

An optional protector kit (AGC-PRO-KIT-V4) can be ordered to cover the fingers of the 2F-85 and therefore protect users and assets against pinch points.

You can install them using eight (8) M3 screws.

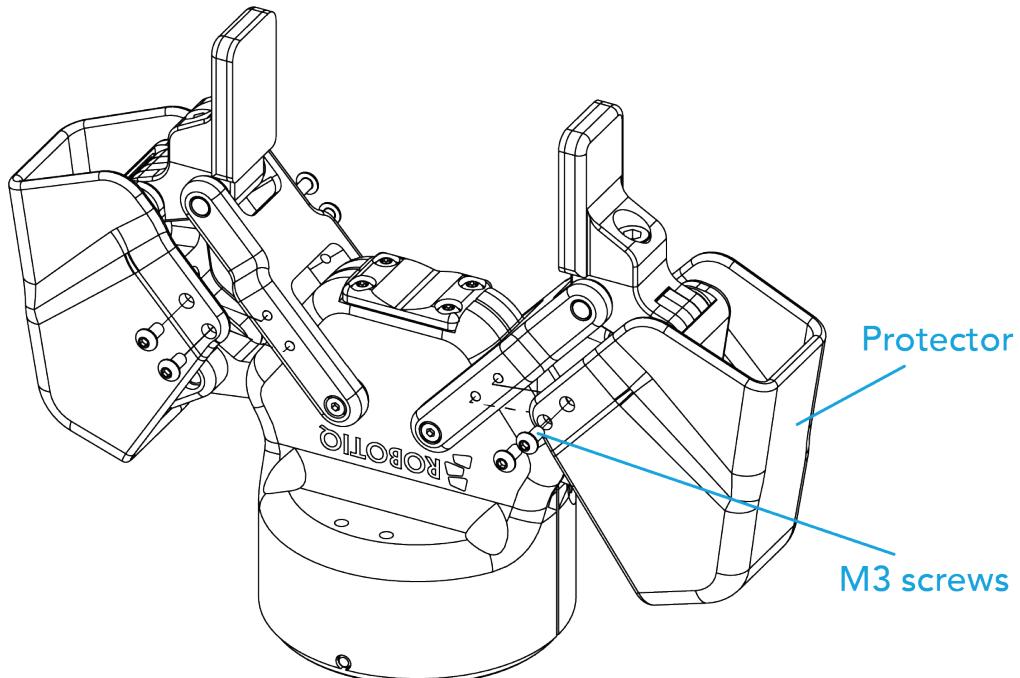


Fig. 3-3: Protector Kit Installation

3.4.4. Installing the Gripper onto the robot

Single Gripper

You must use a coupling to attach the Gripper to the robot.

Here are the steps to follow to mount the Gripper on the robot (exploded view in the figure below). Note that all screws must be locked in place using medium strength threadlocker.

1. Screw the coupling to the robot wrist; align properly with the dowel pin
2. Fasten the Gripper to the coupling
3. Cover the connector by installing the wrist connection protector



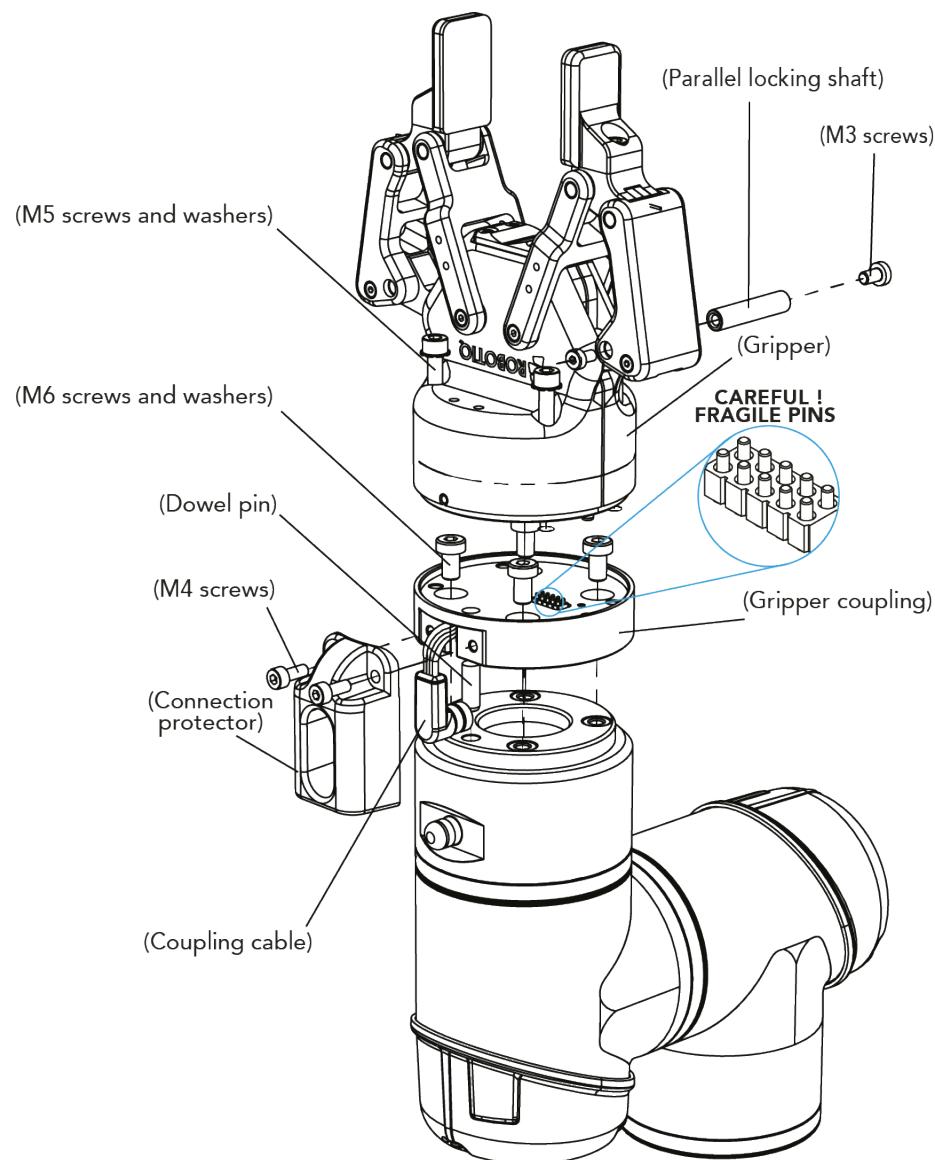


Fig. 3-4: Installing the Gripper onto the robot wrist

Multiple Grippers

When installing multiple grippers on one robot, every gripper must have its own coupling.

1. Fasten the M8 splitter (ACC-SPLIT-M8-2:1) to the dual gripper adapter plate (AGC-APL-159-002)
 - a. Make sure the splitter is fastened on the side of the adapter plate that receives the dowel pin.



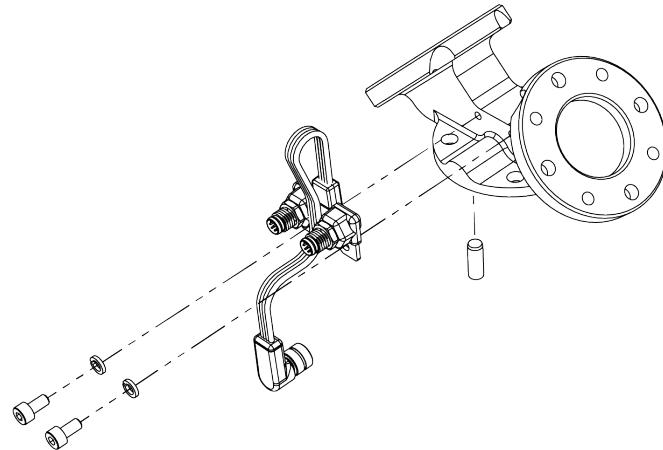


Fig. 3-5: Installation of the Wrist Connector Splitter for Mounting a Dual Gripper on e-Series

2. Mount the adapter plate on the robot wrist on the robot wrist.
3. Mount the gripper couplings on the adapter plate using the provided M6 screws.
4. Mount the grippers onto their coupling using the provided M5 screws.

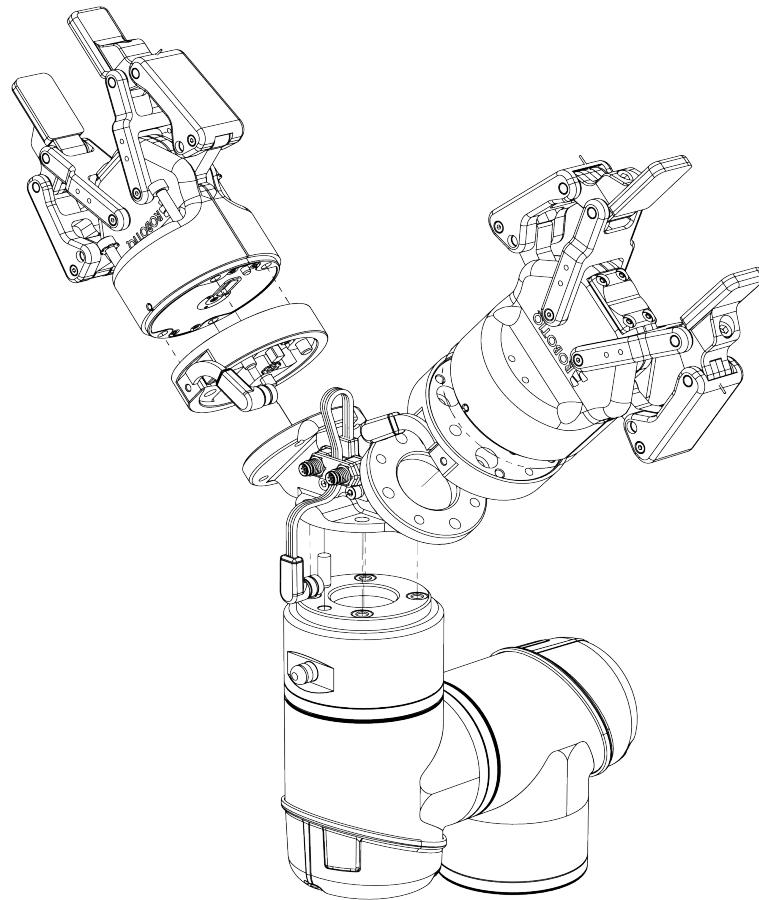


Fig. 3-6: Exploded view of a dual gripper setup



3.5. Electrical Setup

Power and communication are established with the 2-Finger Adaptive Robot Gripper via a single Device Cable. The Device Cable provides a 24V power supply to the Gripper and enables serial RS485 communication to the robot controller. An optional Robotiq Universal Controller may be used between the Gripper and the network / robot controller if fieldbus communication is required.

Info

RS485 signals (485+, 485- and 485 GND) are isolated from the main 24V power supply. 4 GND can be connected to any other ground reference as long as the voltage potential between the grounds does not exceed 250V. Grounding reference is at the user's discretion.

Gripper grounding is optional and is done via the robot ground. The coupling indexing pin (dowel) is the ground connector. Gripper coupling, chassis and proximal phalanx are linked as illustrated in the figure below. They link through the coupling indexing pin to the robot ground. Proximal bars, distal phalanx, fingertip base and fingertips are isolated.

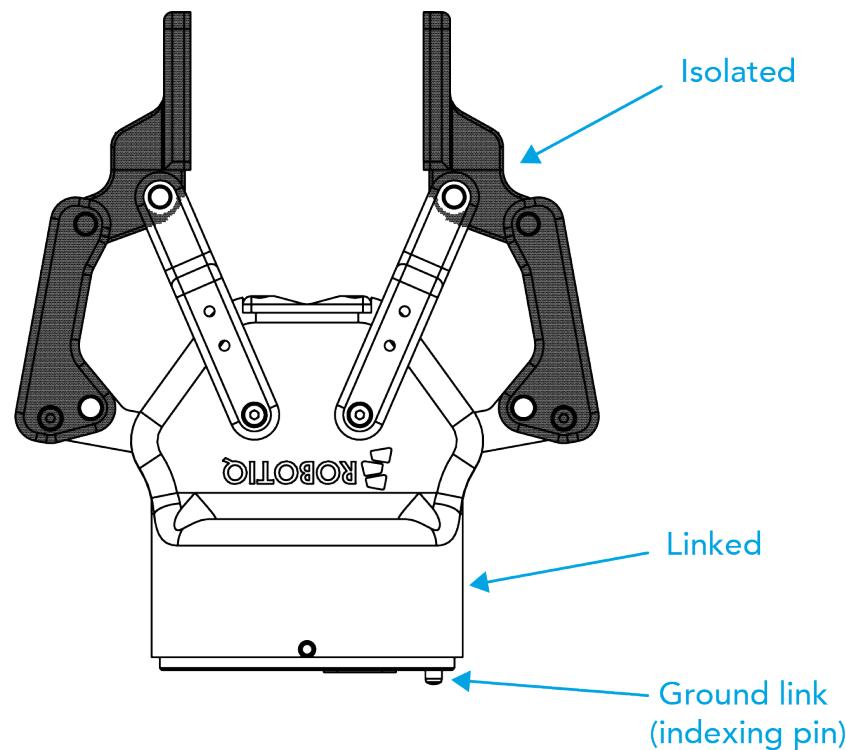
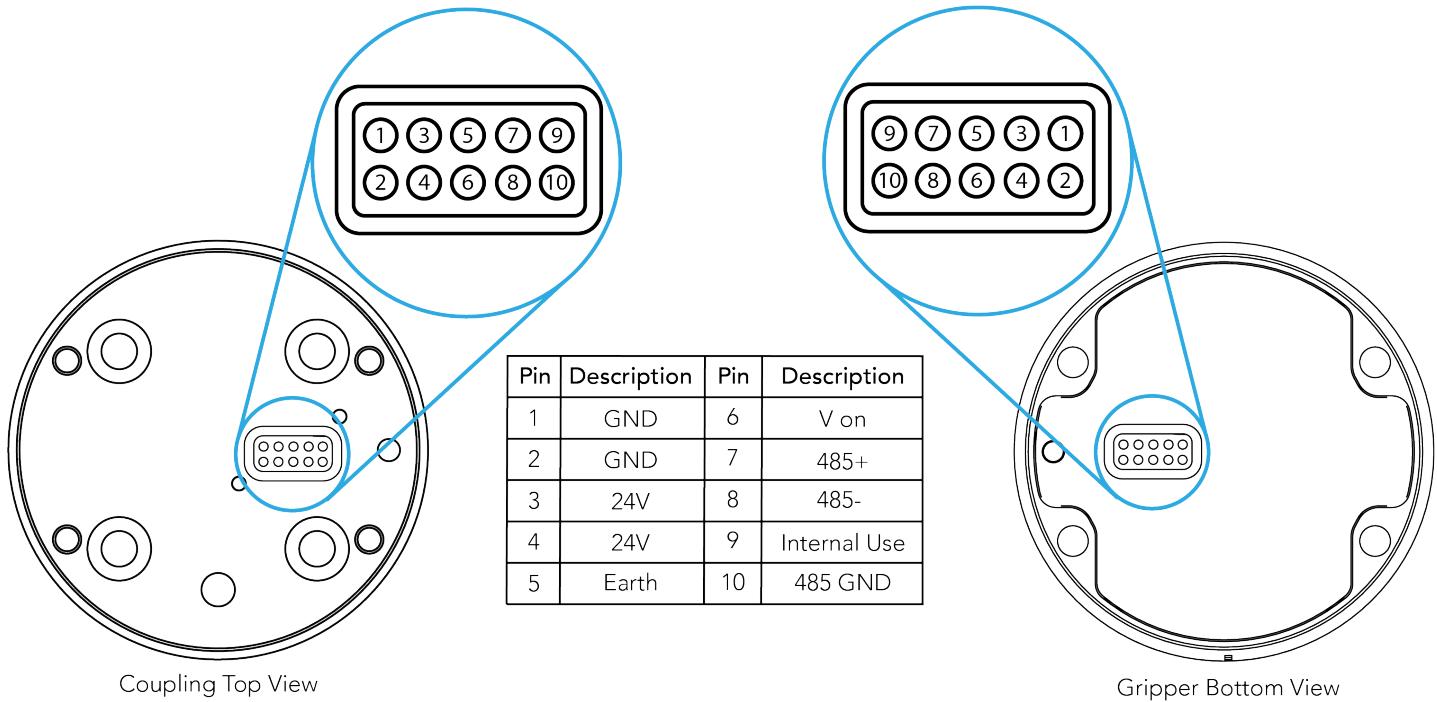


Fig. 3-7: Robotiq 2-Finger electrical isolation / grounding.



3.5.1. Pinout Interface

The Gripper interfaces with its coupling via a 10-spring pin connector located on its outer surface.



Info

The coupling used in the figure above is used for reference only and corresponds to bolt pattern ISO 9409-1-50-4-M6.

3.5.2. Coupling to controller

Tip

In order to connect the Gripper to the controller, please refer to the CB-Series instruction manual of this Gripper.

3.5.3. Coupling to wrist

Single Gripper

The figure below represents the wiring schematic of the 2-Finger with a coupling connecting directly to the robot wrist.



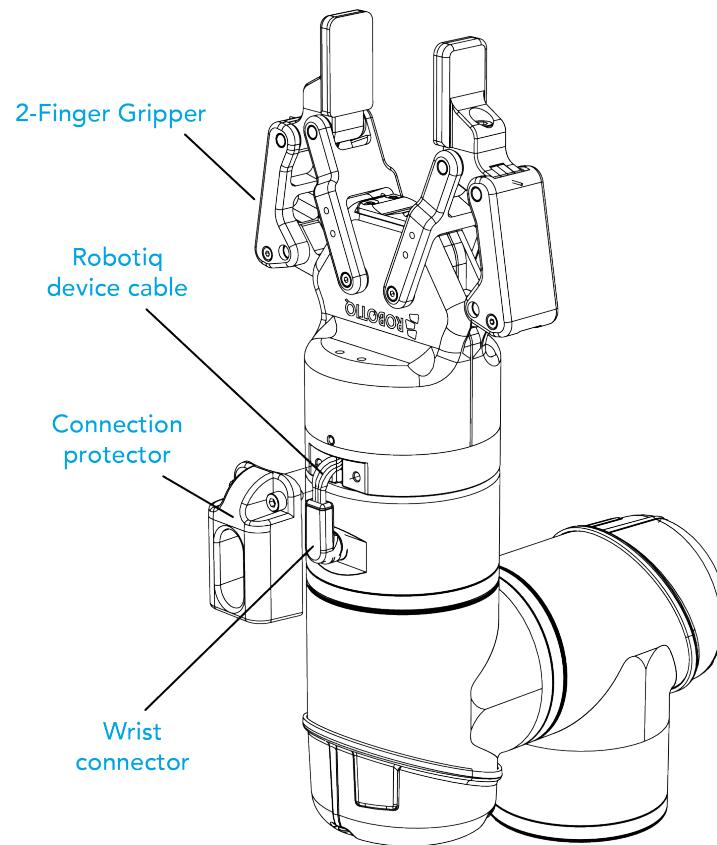


Fig. 3-8: Robotiq 2-Finger with cable and device cable wiring schematic.

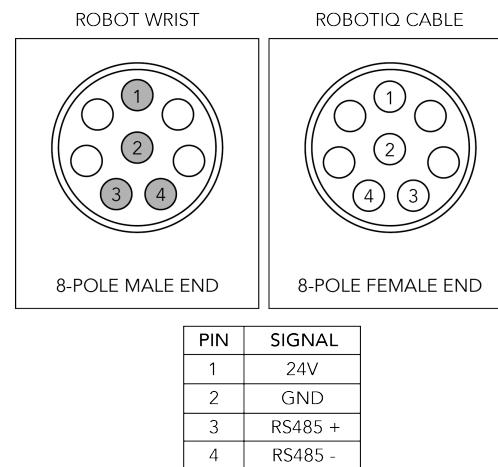


Fig. 3-9: Pinout of the 2-Finger cable-to-wrist coupling

Info

Power supply, communication signals, grounding, electrical resistance and fusing are managed by the robot itself.

Multiple Grippers

It is possible to connect more than one gripper to the wrist of the Universal Robot.



Refer to the **Installation** section for a visual representation of the two components to assemble in order to mount two grippers on the robot:

- M8 splitter (ACC-SPLIT-M8-2:1)
- Dual gripper adapter plate for Universal Robots (AGC-APL-159-002)

Caution

The M8 splitter and the adapter plate come unassembled.

The splitter must be fastened on the side of the adapter plate that receives the dowel pin.

3.6. Installation for Universal Robots

The table below shows which Robotiq software to use with your Universal Robots' controller. If you are using a CB3, CB3.1 or e-Series controller, it is recommended to use a Robotiq Grippers URCap Package.

Robotiq Software	Controller CB1	Controller CB2	Controller CB3	Controller CB3.1	e-Series Controller
Driver Package (includes Gripper toolbar)	Incompatible	Compatible	Compatible	Compatible	Incompatible
Robotiq Grippers URCap Package 1.2.1 and earlier versions	Incompatible	Incompatible	Compatible	Compatible	Incompatible
Robotiq Grippers URCap Package 1.3.0	Incompatible	Incompatible	Incompatible	Compatible	Incompatible
Robotiq Grippers URCap Package 1.3.1 and later versions	Incompatible	Incompatible	Incompatible	Compatible	Compatible

Table 3-2: Compatibility between Robotiq software and Universal Robots controller

Refer to the appropriate section depending on your controller version:

- Section 3.8 covers the installation of the Robotiq Grippers URCap Package.
- Section 3.9 covers the software installation when not using a URCap.

Caution

The robot's PolyScope version must be 3.5 and later in order to install the URCap.

Caution

Prior to use over Universal Robots, adjust the payload and the center of gravity from the Installation tab (refer to the **Mechanical specifications** section).

Caution



Make sure to refer to the [Installing URCap Package](#) section to configure the grippers properly before controlling and programming them.



3.7. URCap Package

Robotiq provides you with a Universal Robots URCap package that enables direct serial communication to your UR controller.

Info

To get the URCaps package for your UR controller, visit support.robotiq.com.

Make sure the 2-Finger Adaptive Gripper is properly mounted to the robot arm. Refer to the **Mechanical Installation** section for detailed information on the mechanical installation. Before proceeding with the installation of the URCap package, make sure your Universal Robots controller is compatible with the package (refer to the **Installation for Universal Robots** section).

Info

The robot's PolyScope version must be 3.5 and later in order to install the URCap.

The Gripper's URCap package contains:

- The URCap for the Gripper;
- The Gripper toolbar;
- The Gripper nodes.



3.7.1. Installing URCap Package

Single Gripper

Make sure the 2-Finger Adaptive Gripper is properly mounted to the robot arm. Refer to the **Mechanical Installation** section for detailed information on the mechanical installation. Before proceeding with the installation of the URCap package, make sure your Universal Robots' controller is compatible with the package (refer to the **Installation for Universal Robots** section).

Follow this procedure to install the 2-Finger Adaptive Gripper URCap package:

Tip

Tap the triple bar icon and select the **About** button to view the UR software version.

Multiple Grippers

It is possible to connect and control up to four grippers on the same UR robot.

When installing multiple grippers on one UR robot, their gripper ID must be set properly. To do so, perform the following steps for each gripper:

Caution

Connect only one gripper at a time using the M8 splitter (refer to the **Installing the Gripper onto the robot** section and the **Electrical Setup** section for detailed instructions); i. e. disconnect the gripper once it has been set up and identified by the software.

- On the teach pendant, tap the **Installation** button in the ribbon at the top of the screen.
- Select **URCaps** in the navigation pane on the left.
- Tap on **Gripper**.
- Select the **Dashboard** menu.
- Tap the **Scan** button to detect Grippers.

- Change the Gripper ID to the desired one.
- Make sure it is different from the other Gripper IDs.
- Gripper ID is saved to the Gripper's internal memory. ID will be kept at all time.
- Click on **Activate** to activate the Gripper.
- Perform the same routine for all grippers, if applicable, connecting only one at a time.

Caution

Make sure all grippers have different IDs. With their factory



settings, all grippers have Gripper ID set to 1. If you have more than one gripper connected with the same ID, communication issues will arise.

The screenshot shows the software interface with three main tabs at the top: Dashboard (selected), Calibration, and About. Below the tabs, there is a section titled 'Scan' with a 'Scan' button. Underneath are two entries for grippers:

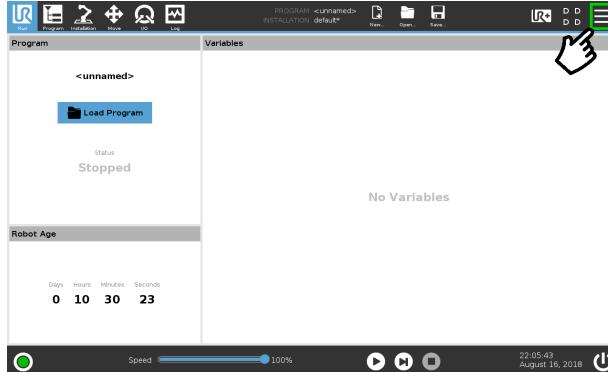
- Gripper 1:** Status: Not activated. Includes a 'Change ID' dropdown menu, an 'Activate' button, and 'E-Open' and 'E-Close' buttons.
- Gripper 2:** Status: Activated. Includes a 'Change ID' dropdown menu, a 'Reactivate' button, and 'E-Open' and 'E-Close' buttons.

- Once all grippers IDs have been set, connect them all to the M8 splitter.
- Go back to the **Dashboard** tab and confirm that all grippers are recognized and can be controlled.



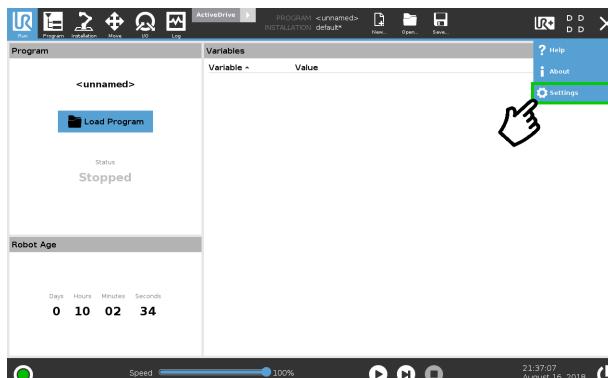
3.7.2. Uninstalling URCap Package

If you wish to uninstall the 2-Finger Gripper URCap, follow this procedure:

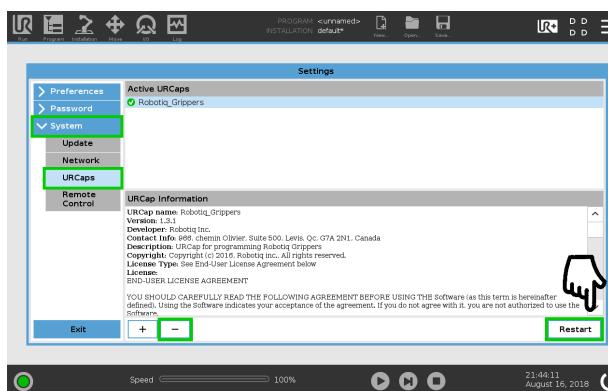


- On the teach pendant, tap the **triple bar icon** in the upper right corner of the screen.

- Tap **Settings**.



- Tap the **System** button in the navigation pane on the left.
- Select **URCaps** in the dropdown list.
- Select the URCap to uninstall.
- Press the minus (-) button to remove the URCap.
- Tap the **Restart** button to deactivate the URCap.



3.7.3. License Agreement

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4. Control

Info

Unless specified, all values in this section are hexadecimal values.

4.1. Overview

Since the Robotiq 2-Finger has its own embedded controller, high-level commands, such as "Go to requested position" are used to control it.

Info

The operator can:

- Control force, speed and position of the Gripper fingers.
- Finger movement is always synchronized, movement is initiated via a single "Go to requested position" command.
- Parallel or encompassing grasp is done automatically.
- A built in object detection feature is available, the user can be notified after an object is picked once the "Go to" command has been initiated. The feature also works for lost or dropped objects, and the user can be alerted if an object is dropped after being detected.
- Engage directional (open or close) auto-release for emergencies.

Control using registers

The Gripper has an internal memory that is shared with the robot controller. One part of the memory is for the robot output; **gripper functionalities**. The other part of the memory is for the robot input; **gripper status**. Two types of actions can then be done by the robot controller :

1. Write in the **robot output** registers to activate **functionalities**;
2. Read in the **robot input** registers to get the **status** of the Gripper.

The **Gripper Register Mapping** section will map the different registers used to control the Gripper or to read its status while the **Robot Output Registers & Functionalities** section will detail the output (write) register functions, and the **Robot Input Registers & Status** section will detail the input (read) register status. The figure below is a representation of the memory and the control logic of the Gripper.



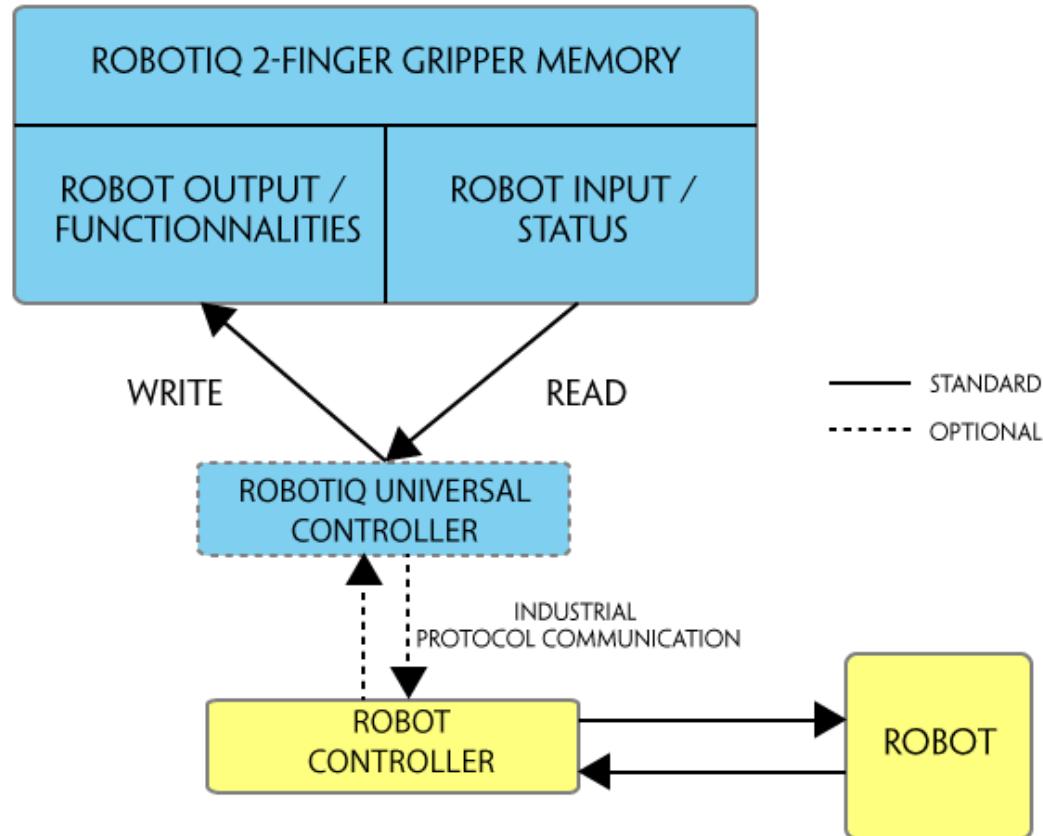


Fig. 4-1: 2-Finger control logic overview



4.2. Gripper Register Mapping

Register mapping

Caution

Byte numeration starts at zero and not at 1 for the functionalities and status registers.

Register	Robot Output / Functionalities	Robot Input / Status
Byte 0	ACTION REQUEST	GRIPPER STATUS
Byte 1	RESERVED	RESERVED
Byte 2	RESERVED	FAULT STATUS
Byte 3	POSITION REQUEST	POS REQUEST ECHO
Byte 4	SPEED	POSITION
Byte 5	FORCE	CURRENT
Byte 6 to 15	RESERVED	RESERVED

Table 4-1: Registers of the 2-Finger Gripper.



4.3. Robot Output Registers & Functionalities

Register: ACTION REQUEST

Address: Byte 0

Bits	7	6	5	4	3	2	1	0
Symbols	Reserved	rARD	rATR	rGTO	Reserved		rACT	

rACT: First action to be made prior to any other actions, **rACT** bit will activate the Gripper. Clear **rACT** to reset the Gripper and clear fault status.

- 0x0 - Deactivate Gripper.
- 0x1 - Activate Gripper (must stay on after activation routine is completed).

Warning

When setting **rACT** to one, the Gripper will begin movement to complete its auto-calibration feature.

Info

Power loss will set **rACT**; **rACT** bit must then be cleared, then set to allow operation of the Gripper.

Caution

rACT bit must stay on afterwards for any other action to be performed.

rGTO: The "Go To" action moves the Gripper fingers to the requested position using the configuration defined by the other registers, **rGTO** will engage motion while byte 3, 4 and 5 will determine aimed position, force and speed. The only motions performed without the **rGTO** bit are activation and automatic release routines.

- 0x0 - Stop.
- 0x1 - Go to requested position.

rATR: Automatic Release routine action slowly opens the Gripper fingers until all motion axes reach their mechanical limits. After all motion is completed, the Gripper sends a fault signal and needs to be reactivated before any other motion is performed. The **rATR** bit overrides all other commands excluding the activation bit (**rACT**).

- 0x0 - Normal.
- 0x1 - Emergency auto-release.

Caution

The automatic release is meant to disengage the Gripper after an emergency stop of the robot.

The automatic release is not intended to be used under normal operating conditions.

Automatic release will require **rACT** to be cleared (**rACT** == 0) then set (**rACT** == 1).



rARD: Auto-release direction. When auto-releasing, **rARD** commands the direction of the movement. The **rARD** bit should be set prior to or at the same time as the **rATR** bit, as the motion direction is set when the auto-release is initiated.

- 0x0 - Closing auto-release
- 0x1 - Opening auto-release

Register: **GRIPPER OPTIONS**

Address: **Byte 1**

Register: **GRIPPER OPTIONS 2**

Address: **Byte 2**

Bits	7	6	5	4	3	2	1	0
Symbol	Reserved							

Register: **POSITION REQUEST**

Address: **Byte 3**

Bits	7	6	5	4	3	2	1	0
Symbol	rPR							

This register is used to set the target position for the Gripper's fingers. The positions 0x00 and 0xFF correspond respectively to the fully opened and fully closed mechanical stops. For detailed finger trajectory, please refer to the [Specifications](#) section.

- 0x00 - Open position, with 85 mm or 140 mm opening respectively
- 0xFF - Closed
- Opening / count: 0.4 mm (for 85 mm stroke) and 0.65 mm (for 140 mm stroke)

Info

The activation feature of the Robotiq Adaptive Gripper will allow the Gripper to adjust to any fingertips. No matter what is the size and shape of the fingertips used, 0 will always be fully opened and 255 fully closed, with a quasi-linear relationship between 0 and 255.

Register: **SPEED**

Address: **Byte 4**



Bits	7	6	5	4	3	2	1	0
Symbol	rSP							

This register is used to set the Gripper closing or opening speed in real time, however, **setting a speed will not initiate a motion**.

- 0x00 - Minimum speed
- 0xFF - Maximum speed

Register: **FORCE**

Address: **Byte 5**

Bits	7	6	5	4	3	2	1	0
Symbol	rFR							

The force setting defines the final gripping force for the Gripper. The force will fix the maximum current sent to the motor while in motion. If the current limit is exceeded, the fingers stop and trigger an object detection notification. Please refer to the **Robot Input Registers & Status** section for details on force control.

- 0x00 - Minimum force
- 0xFF - Maximum force

Info

Register bytes 6 to 15 are reserved and should be set to zero.



4.4. Robot Input Registers & Status

Register: GRIPPER STATUS

Address: Byte 0

Bits	7	6	5	4	3	2	1	0
Symbol s	gOBJ	gSTA	gGTO	Reserved	gACT			

gACT: Activation status, echo of the **rACT** bit (activation bit).

- 0x0 - Gripper reset.
- 0x1 - Gripper activation.

gGTO: Action status, echo of the **rGTO** bit (go to bit).

- 0x0 - Stopped (or performing activation / automatic release).
- 0x1 - Go to Position Request.

gSTA: Gripper status, returns the current status & motion of the Gripper fingers.

- 0x00 - Gripper is in reset (or automatic release) state. See Fault Status if Gripper is activated.
- 0x01 - Activation in progress.
- 0x02 - Not used.
- 0x03 - Activation is completed.

gOBJ: Object detection status, is a built-in feature that provides information on possible object pick-up. Ignore if **gGTO == 0**.

- 0x00 - Fingers are in motion towards requested position. No object detected.
- 0x01 - Fingers have stopped due to a contact while opening before requested position. Object detected opening.
- 0x02 - Fingers have stopped due to a contact while closing before requested position. Object detected closing.
- 0x03 - Fingers are at requested position. No object detected or object has been loss / dropped.

Caution

In some circumstances object detection may not detect an object even if it is successfully grasped. For example, picking up a thin object in a fingertip grasp may be successful without object detection occurring. For such reasons, use this feature with caution. In these applications when the "Fingers are at requested position" status of register gOBJ, this is sufficient to proceed to the next step of the routine.

Tip

Checking for the correct position of the fingers (byte 4), **as well as** object detection (byte 0, bit 6 & 7) before proceeding to the next step of a routine is a more reliable method than object detection or finger position alone.



Register: **RESERVED**

Address: **Byte 1**

Bits	7	6	5	4	3	2	1	0
Symbol	Reserved							

Register: **FAULT STATUS**

Address: **Byte 2**

Bits	7	6	5	4	3	2	1	0
Symbols	kFLT				gFLT			

gFLT: Fault status returns general error messages that are useful for troubleshooting. Fault LED (red) is present on the Gripper chassis, LED can be blue, red or both and be solid or blinking.

- 0x00 - No fault (LED is blue)
- Priority faults (LED is blue)
 - 0x05 - Action delayed, activation (reactivation) must be completed prior to performing the action.
 - 0x07 - The activation bit must be set prior to action.

Minor faults (LED continuous red)

- 0x08 - Maximum operating temperature exceeded, wait for cool-down.
- 0x09 No communication during at least 1 second.

Major faults (LED blinking red/blue) - Reset is required (rising edge on activation bit rACT needed).

- 0x0A - Under minimum operating voltage.
- 0x0B - Automatic release in progress.
- 0x0C - Internal fault; contact support@robotiq.com.
- 0x0D - Activation fault, verify that no interference or other error occurred.
- 0x0E - Overcurrent triggered.
- 0x0F - Automatic release completed.

Info

While booting, status LED will be solid blue / red.

kFLT : See your optional Controller Manual (input registers & status).



Register: POSITION REQUEST ECHO

Address: Byte 3

Bits	7	6	5	4	3	2	1	0
Symbol	gPR							

gPR: Echo of the requested position for the Gripper, value between 0x00 and 0xFF.

- 0x00 - Full opening.
- 0xFF - Full closing.

Register: POSITION

Address: Byte 4

Bits	7	6	5	4	3	2	1	0
Symbol	gPO							

gPO: Actual position of the Gripper obtained via the encoders, value between 0x00 and 0xFF.

- 0x00 - Fully opened.
- 0xFF - Fully closed.

Register: CURRENT

Address: Byte 5

Bits	7	6	5	4	3	2	1	0
Symbol	gCU							

gCU: The current is read instantaneously from the motor drive, value between 0x00 and 0xFF, approximate current equivalent is 10 * value read in mA.

Tip

Built-in features like object detection and force control use the finger's electrical current readings. The user does not need to create these features.



4.5. Picking Features

As stated in previous sections, object picking is done via a simple "Go To" command, **rGTO** bit calls for movement, while **rPR** byte is the aimed position, **rSP** and **rFR** will be the desired speed and force settings respectively. This section describes key features in object picking applications:

- Force control
- Re-grasp
- Object detection

4.5.1. Force control

The 2-Finger Gripper gripping force is controlled via the **rFR** byte (refer to the [Gripper Register Mapping](#) section). The Gripper behavior will change according to the **rFR** force requested.

- **rFR = 0** : Very fragile objects or deformable objects mode
 - Lowest force
 - Re-grasp feature is off
- **1 rFR 127** : Solid & fragile objects
 - Low torque mode
 - Re-grasp feature is on
- **128 rFR 255** : Solid & strong objects
 - High torque mode
 - Re-grasp feature is on

The table below shows the expected applied force according to the payload material hardness, speed setting **rSP** and force setting **rFR**. All tests were done with the 2-Finger Gripper with firmware GC3-1.3.9. Data was obtained with a Load Cell from Phidget, S Type, model 3138.



FINGER PAD		PAYLOAD		MEASURED FORCE MIN / MAX (N)	
TYPE	HARDNESS	TYPE	HARDNESS	2-Finger 85	2-Finger 140
Steel 4340	220 HV	Steel 4340	220 HV ³	25 - 220	15 - 120
Aluminium 60611	95 HV	Aluminium 6061	95 HV	25 - 220	15 - 120
Aluminium 60611	95 HV	Silicone (TIP-204) ²	60 A Durometer	25 - 220	15 - 120
Aluminium 60611	95 HV	Silicone rubber	40 A Durometer ⁴	25 - 155	15 - 100
Aluminium 60611	95 HV	Neoprene rubber	10 A Durometer	25 - 115	15 - 75
Aluminium 60611	95 HV	Polyurethane rubber	30 OO Durometer	25 - 115	15 - 75

¹ Available with V-Groove fingertip AGC-TIP-205-0085 / AGC-TIP-421-140.

² Available with flat silicone fingertip AGC-TIP-204-085 / AGC-TIP-420-140.

³ HV refers to Vickers hardness test.

⁴ Durometer refers to Shore durometer hardness, scale A or scale OO.



**MEASURED GRIP FORCE ACCORDING TO SPEED & FORCE SETTING
FOR 220 HV HARDNESS MATERIAL (STEEL)**

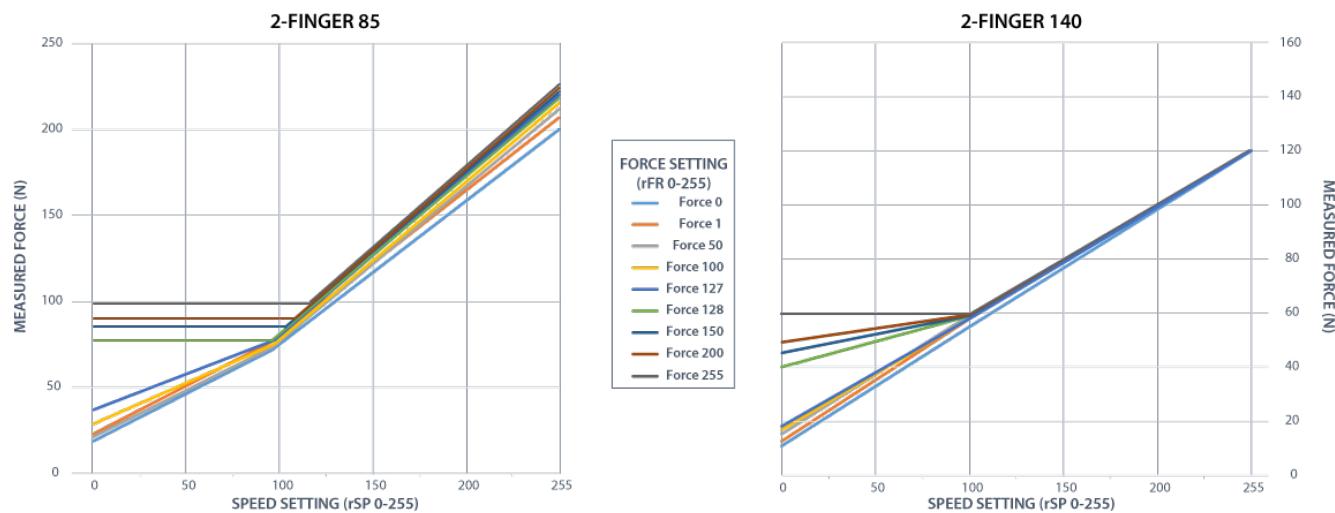


Fig. 4-2: grasp force on hardness 220 HV (4340 annealed carbon steel).

**MEASURED GRIP FORCE ACCORDING TO SPEED & FORCE SETTING
FOR 95 HV HARDNESS MATERIAL (ALUMINIUM)**

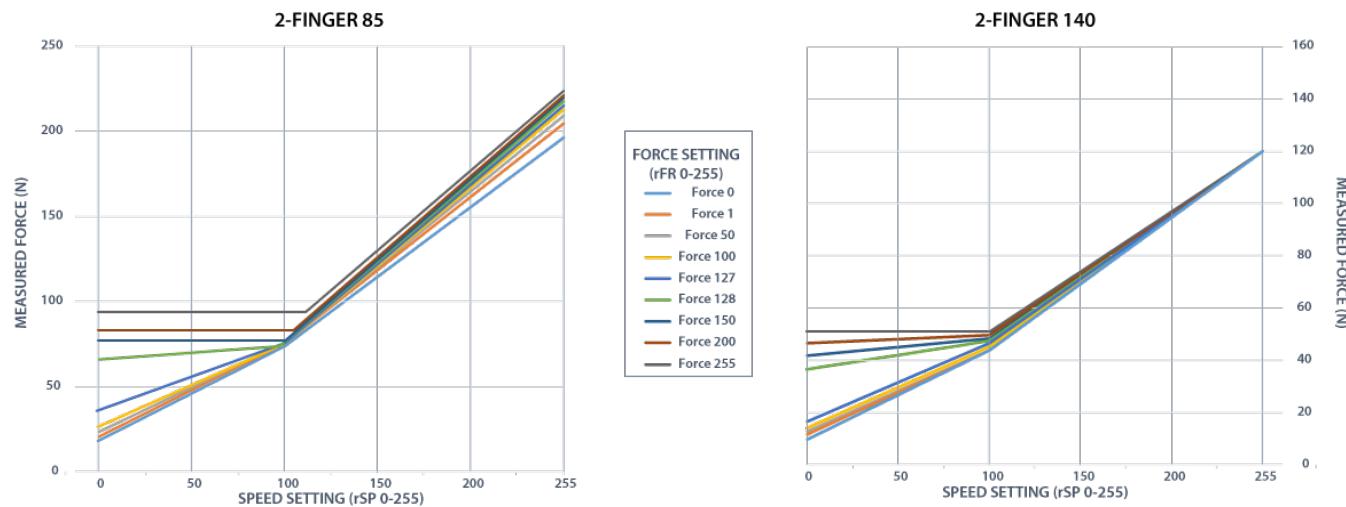


Fig. 4-3: grasp force on hardness 95 HV (6061-T6 aluminium).



**MEASURED GRIP FORCE ACCORDING TO SPEED & FORCE SETTING
FOR 60A DUROMETER MATERIAL**

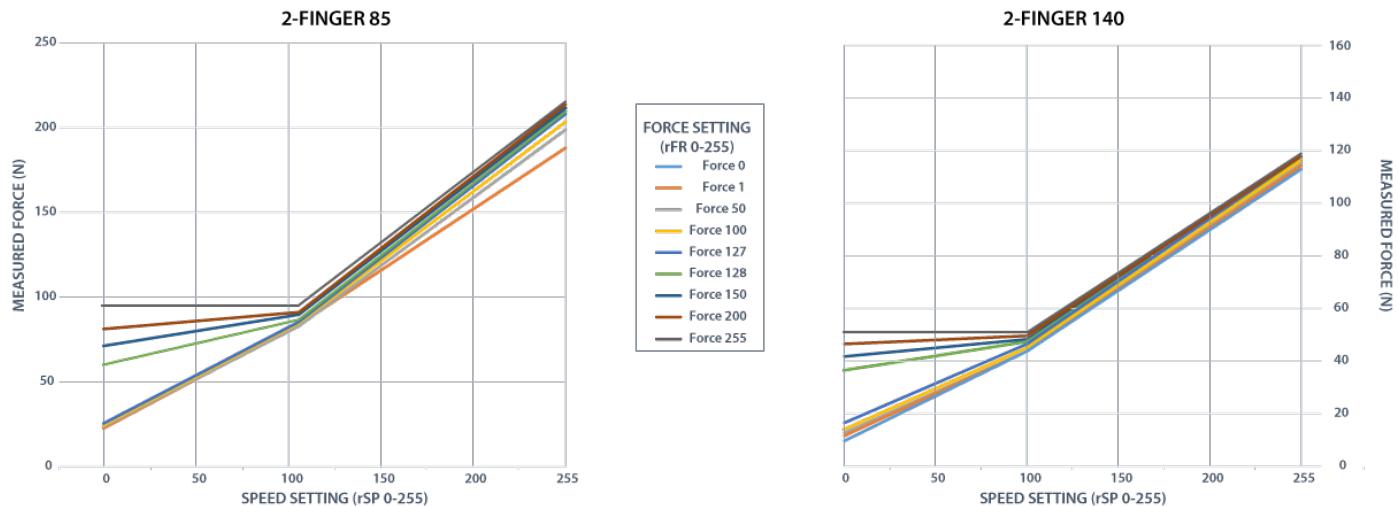


Fig. 4-4: grasp force on hardness 60A (silicone).

**MEASURED GRIP FORCE ACCORDING TO SPEED & FORCE SETTING
FOR 40A DUROMETER MATERIAL**

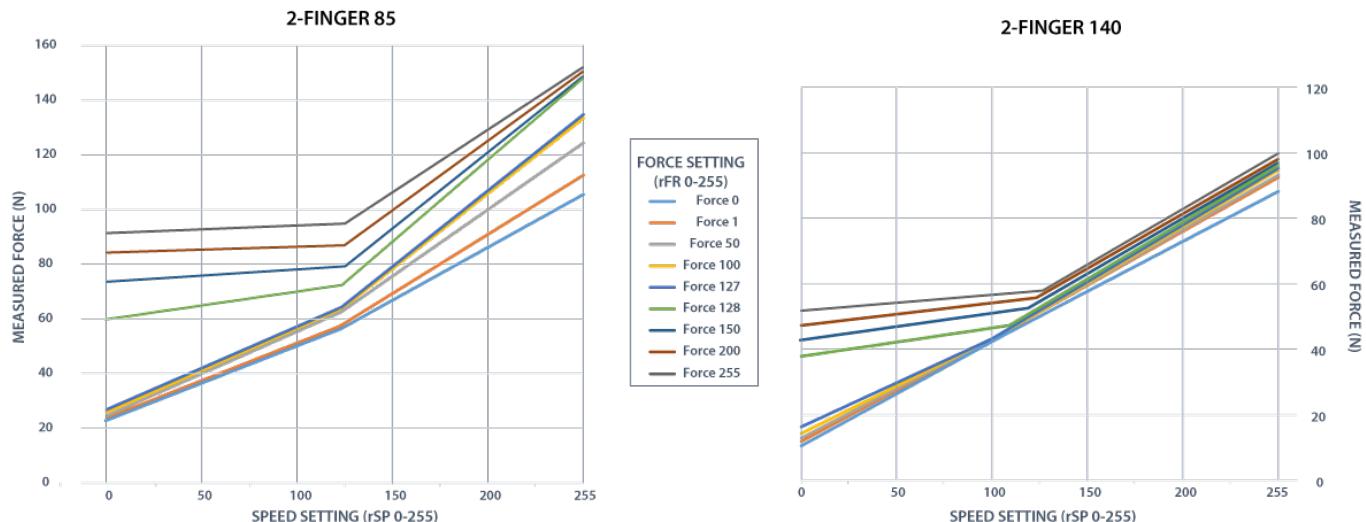


Fig. 4-5: grasp force on hardness 40 A (silicone).



**MEASURED GRIP FORCE ACCORDING TO SPEED & FORCE SETTING
FOR 10A DUROMETER MATERIAL**

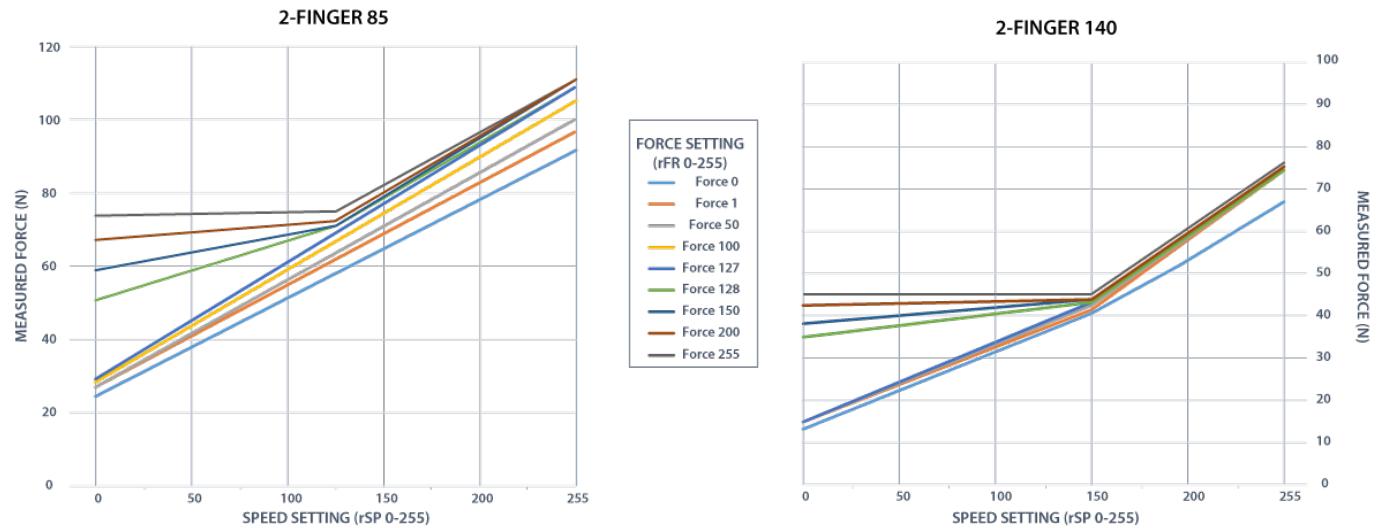


Fig. 4-6: grasp force on hardness 10 A (neoprene).

**MEASURED GRIP FORCE ACCORDING TO SPEED & FORCE SETTING
FOR 30OO DUROMETER MATERIAL**

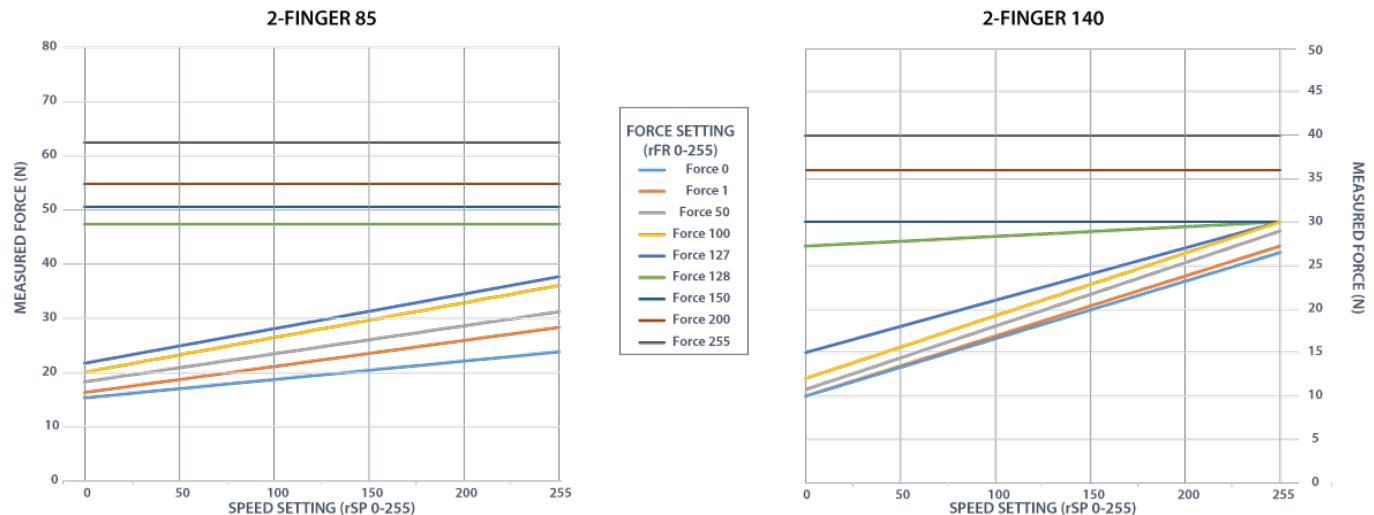


Fig. 4-7: grasp force on hardness 30 OO (polyurethane).



4.5.2. Re-Grasp

Re-grasp feature is a built-in feature meant to prevent object lost due to slipping or inaccurate initial grip. The Re-grasp feature will allow the Gripper to initiate movement when an object is slipping or dropped. When Re-grasping, the Gripper will attempt to close until it reaches the position (**rPR**) request.

- This feature is automatically set according to the force request **rFR**.

Info

Feature is off at force request **rFR** = 0, otherwise it is on.

- Re-grasp will keep the position setting:
 - Finger motion will stop when **rPR** position is reached, even if there is no object.
- Force and speed settings are not used, Re-grasp force and speed will automatically adjust to keep the object from being lost / dropped.

Info

While your initial settings for force and speed are not used for Re-grasp, they will never be exceeded to prevent damaging the object grasped.

Info

The **rOBJ** status is cleared when a motion is detected.



4.5.3. Object detection

When the Gripper grabs an object, **gOBJ** status will allow you to know if object retention was successful. This is a built-in feature for the 2-Finger Grippers meant to be used by the robot controller (or PLC) commanding the overall application. The Object detection feature will change the **gOBJ** status and can be used inside your robot program. As stated in the previous section:

gOBJ: Only valid if **gGTO** = 1.

- 0x00 - Fingers are in motion towards requested position. No object detected.
- 0x01 - Fingers have stopped due to a contact while opening before requested position. Object detected.
- 0x02 - Fingers have stopped due to a contact while closing before requested position. Object detected.
- 0x03 - Fingers are at requested position. No object detected or object has been lost / dropped.

Object detection exemple:

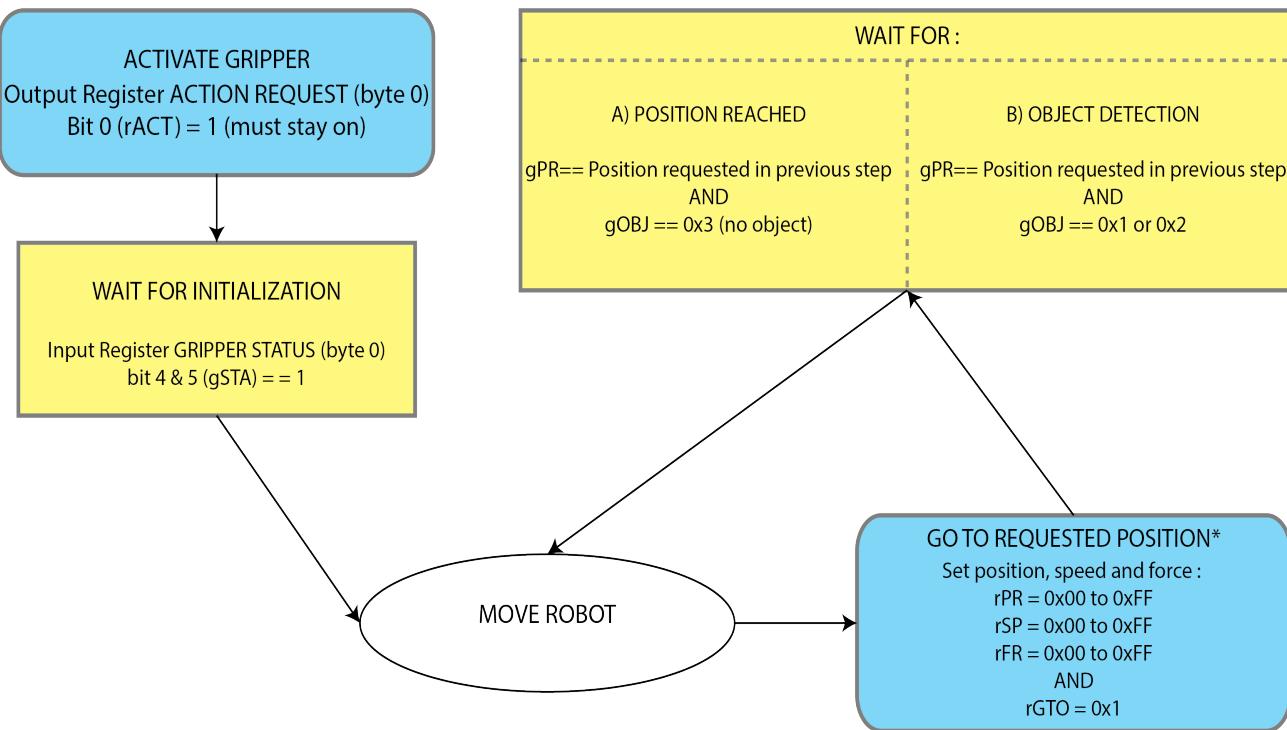
1. Set position, speed and force at maximum (full closing):
 - a. **rPR** == 0xFF, **rSP** == 0xFF, **rFR** == 0xFF,
2. Set "go to requested" will initiate movement :
 - a. **rGTO** == 0x01
3. Then object detection status will be "in motion"
 - a. **gOBJ** = 0x00
4. Until an object is picked, object detection status will then be "stopped due to contact while closing"
 - a. **gOBJ** = 0x02
5. The user can now assume it is holding the payload, and proceed to the next step.

Object lost example:

1. From previous example, after an object is picked, **gOBJ** = 0x02
2. If **gOBJ** = 0x03 after it was 0x02, user can assume the object as been lost.



4.6. Control Logic



* Go to requested position is used to open / close the Gripper until object is detected or requested position is reached.

Fig. 4-8: Example of the 2-Finger control logic with associated registers.



4.7. Modbus RTU Communication

The Gripper can be controlled by Modbus RTU directly with RS485-RS232 using the ACC-ADT-RS232-RS485, or over USB using the ACC-ADT-USB-RS485. This section is intended to provide guidelines for setting up a Modbus scanner that will adequately communicate with the Gripper.

For a general introduction to Modbus RTU and for details regarding the CRC algorithm, the reader is invited to read the Modbus over serial line specification and implementation guide available at: http://www.modbus.org/docs/Modbus_over_serial_line_V1_02.pdf.

For debugging purposes, the reader is also invited to download one of many free Modbus scanners such as the CAS Modbus Scanner from Chipkin Automation Systems available at: <http://www.store.chipkin.com/products/tools/cas-modbus-scanner>.

Info

Modbus RTU is a communication protocol based on a Big Endian byte order. Therefore, the 16-bit register addresses are transmitted with the most significant byte first. However, the data port is in the case of Robotiq products based on the Little Endian byte order. As such, the data parts of Modbus RTU messages are sent with the less significant byte first.

Tip

Modbus RTU specification and details can be found at www.modbus.org.



4.7.1. Connection Setup

The following table describes the connection requirements for controlling the Gripper using the Modbus RTU protocol.

PROPERTY	VALUE
Physical Interface	RS-485 ¹
Baud Rate ²	115,200 bps
Data Bits	8
Stop Bit ²	1
Parity ²	None
Supported Functions	Read Holding Register (FC03) Read Input Registers (FC04) Preset Single Register (FC06) Preset Multiple Register (FC16) Master read & write multiple registers (FC23)
Exception Responses	Not supported
Slave ID ²	0x0009 (9)
Robot Output / Gripper Input First Register	0x03E8 (1000)
Robot Input / Gripper Output First Register	0x07D0 (2000)

¹ Various converters are available in the Spare parts section.

² These parameters can be adjusted using the Robotiq User Interface.

Each register (word - 16 bits) of the Modbus RTU protocol is composed of 2 bytes (8 bits) from the Gripper. The first Gripper output Modbus register(0x07D0) is composed from the first 2 Robotiq Gripper bytes (byte 0 and byte 1).

Info

200 Hz is the usual speed when commanding / reading from the Robotiq Gripper. It is therefore recommended to send commands with a minimum delay of 5 ms between them.

Info

Maximum baud rate of ACC-ADT-USB-RS485 is 115200 bps.

120 Ohms termination resistor is already present on the converter.



4.7.2. Read holding registers (FC03)

Function code 03 (FC03) is used for reading the status of the Gripper (robot input). Examples of such data are Gripper status, object status, finger position, etc.

Example of FC03 Read function:

This message asks for register 0x07D0 (2000) and register 0x07D1 (2001) which contains Gripper Status, Object Detection, Fault Status and Position Request Echo.

Request is: 09 03 07 D0 00 02 C5 CE

Bits	Description
09	SlaveID
03	Function Code 03 (Read Holding Registers)
07D0	Address of the first requested register
0002	Number of registers requested (2)
C5CE	Cyclic Redundancy Check (CRC)

Response is: 09 03 04 E0 00 00 00 44 33

Bits	Description
09	SlaveID
03	Function Code 03 (Read Holding Registers)
04	Number of data bytes to follow (2 registers x 2 bytes/register = 4 bytes)
E000	Content of register 07D0
0000	Content of register 07D1
4433	Cyclic Redundancy Check (CRC)



4.7.3. Read input registers (FC04)

Function code 04 (FC04) is used for requesting the status of the Gripper's analog input register. Examples of such data are Gripper status, object status, finger position, etc.

Example of FC04 read function:

This message asks for register 0x07D0 (2000) and register 0x07D1 (2001) which contains Gripper Status, Object Detection, Fault Status and Position Request Echo.

Request is: 09 04 07 D0 00 02 C5 CE

Bits	Description
09	SlaveID
04	Function Code 03 (Read Holding Registers)
07D0	Address of the first requested register
0002	Number of registers requested (2)
700E	Cyclic Redundancy Check (CRC)

Response is: 09 04 04 E0 00 00 00 44 33

Bits	Description
09	SlaveID
04	Function Code 04 (Read Holding Registers)
04	Number of data bytes to follow (2 registers x 2 bytes/register = 4 bytes)
E000	Content of register 07D0
0000	Content of register 07D1
4584	Cyclic Redundancy Check (CRC)



4.7.4. Preset multiple registers (FC16)

Function code 16 (FC16) is used to activate functionalities of the Gripper (robot output). Examples of such data are action request, speed, force, etc.

Example of setting multiple registers FC16:

This message requests to set position request, speed and force of the Gripper by setting register 0x03E9 (1002) and 0x03EA.

Request is: 09 10 03 E9 00 02 04 60 E6 3C C8 EC 7C

Bits	Description
09	SlaveID
10	Function Code 16 (Preset Multiple Registers)
03E9	Address of the first register
0002	Number of registers written to
04	Number of data bytes to follow (2 registers x 2 bytes/register = 4 bytes)
60E6	Value written to register 0x03E9
3CC8	Value written to register 0x03EA
EC7C	Cyclic Redundancy Check (CRC)

Response is: 09 10 03 E9 00 02 91 30

Bits	Description
09	SlaveID
10	Function Code 16 (Preset Multiple Registers)
03E9	Address of the first register
0002	Number of written registers
9130	Cyclic Redundancy Check (CRC)



4.7.5. Master read & write multiple registers FC23

Function code 23 (FC23) is used for reading the status of the Gripper (robot input) and activating functionalities of the Gripper (robot output) simultaneously. Examples of such data are Gripper status, object status, finger position, etc. Action requests are speed, force, etc.

Example of reading and writing multiple registers FC23:

This message reads registers 0x07D0 (2000) and 0x07D1 (2001), which contains Gripper Status, Object Detection, Fault Status and Position Request Echo. It also sets the position request, speed and force of the Gripper by writing to registers 0x03E9 (1001) and 0x03EA (1002).

Request is: 09 17 07 D0 00 02 03 E9 00 02 04 00 E6 3C C8 2D 0C

Bits	Description
09	SlaveID
17	Function Code 23 (read and write multiple registers)
07D0	Address of the first requested register, read
0002	Number of registers requested (2), read
03E9	Address of the first register written to
0002	Number of registers written to (3)
04	Number of data bytes to follow (2 registers X 2 bytes/register = 4 bytes)
00E6	Value written to register 0x03E9
3CC8	Value written to register 0x03EA
2D0C	Cyclic Redundancy Check (CRC)

Response is: 09 17 04 01 00 09 E6 F6 C1

Bits	Description
09	SlaveID
17	Function Code 23 (read and write multiple registers)
04	Number of data bytes to follow (2 registers x 2 bytes/register = 4 bytes)
1000	Content of register 07D0



Bits	Description
09E6	Content of register 07D1
F6C1	Cyclic Redundancy Check (CRC)

Note that the content of the response might change depending on the Gripper's status.



4.7.6. Modbus RTU example

This section depicts the example given in the **Control Logic** section when programmed using the Modbus RTU protocol. The example is typical of a pick and place application. After activating the Gripper, the robot is moved to a pick-up location to grasp an object. It moves again to a second location to release the grasped object.

Step 1: Activation Request (clear and set rACT)

Request is (clear rAct): 09 10 03 E8 00 03 06 00 00 00 00 00 73 30

Bits	Description
09	SlaveID
10	Function Code 16 (Preset Multiple Registers)
03E8	Address of the first register
0003	Number of registers written to
06	Number of data bytes to follow (3 registers x 2 bytes/register = 6 bytes)
0000	Value to write to register 0x03E9 (ACTION REQUEST = 0x01 and GRIPPER OPTIONS = 0x00): rACT = 1 for "Activate Gripper"
0000	Value written to register 0x03EA
0000	Value written to register 0x03EB
7330	Cyclic Redundancy Check (CRC)

Response is: 09 10 03 E8 00 03 01 30

Bits	Description
09	SlaveID
10	Function Code 16 (Preset Multiple Registers)
03E8	Address of the first register
0003	Number of written registers
0130	Cyclic Redundancy Check (CRC)



Request is (set rAct): 09 10 03 E8 00 03 06 01 00 00 00 00 00 72 E1

Bits	Description
09	SlaveID
10	Function Code 16 (Preset Multiple Registers)
03E8	Address of the first register
0003	Number of registers written to
06	Number of data bytes to follow (3 registers x 2 bytes/register = 6 bytes)
0100	Value to write to register 0x03E9 (ACTION REQUEST = 0x01 and GRIPPER OPTIONS = 0x00): rACT = 1 for "Activate Gripper"
0000	Value written to register 0x03EA
0000	Value written to register 0x03EB
72E1	Cyclic Redundancy Check (CRC)

Response is: 09 10 03 E8 00 03 01 30

Bits	Description
09	SlaveID
10	Function Code 16 (Preset Multiple Registers)
03E8	Address of the first register
0003	Number of written registers
0130	Cyclic Redundancy Check (CRC)



Step 2: Read Gripper status until the activation is completed

Request is: 09 03 07 D0 00 01 85 CF

Bits	Description
09	SlaveID
03	Function Code 03 (Read Holding Registers)
07D0	Address of the first requested register
0001	Number of registers requested (1)
85CF	Cyclic Redundancy Check (CRC)

Response (if the activation IS NOT completed): 09 03 02 11 00 55 D5

Bits	Description
09	SlaveID
03	Function Code 03 (Read Holding Registers)
02	Number of data bytes to follow (1 register x 2 bytes/register = 2 bytes)
1100	Content of register 07D0 (GRIPPER STATUS = 0x11, RESERVED = 0x00): gACT = 1 for "Gripper Activation", gSTA = 1 for "Activation in progress"
55D 5	Cyclic Redundancy Check (CRC)

Response (if the activation IS completed): 09 03 02 31 00 4C 15

Bits	Description
09	SlaveID
03	Function Code 03 (Read Holding Registers)
02	Number of data bytes to follow (1 register x 2 bytes/register = 2 bytes)
3100	Content of register 07D0 (GRIPPER STATUS = 0x31, RESERVED = 0x00): gACT = 1 for "Gripper Activation", gSTA = 3 for "Activation is completed"
4C15	Cyclic Redundancy Check (CRC)



Step 3: Move the robot to the pick-up location

Step 4: Close the Gripper at full speed and full force

Request is: 09 10 03 E8 00 03 06 09 00 00 FF FF FF 42 29

Bits	Description
09	SlaveID
10	Function Code 16 (Preset Multiple Registers)
03E8	Address of the first register
0003	Number of registers written to
06	Number of data bytes to follow (3 registers x 2 bytes/register = 6 bytes)
0900	Value written to register 0x03E8 (ACTION REQUEST = 0x09 and GRIPPER OPTIONS = 0x00): rACT = 1 for "Activate Gripper", rGTO = 1 for "Go to Requested Position"
00FF	Value written to register 0x03E9 (GRIPPER OPTIONS 2 = 0x00 and POSITION REQUEST = 0xFF): rPR = 255/255 for full closing of the Gripper
FFFF	Value written to register 0x03EA (SPEED = 0xFF and FORCE = 0xFF): full speed and full force
4229	Cyclic Redundancy Check (CRC)

Response is: 09 10 03 E8 00 03 01 30

Bits	Description
09	SlaveID
10	Function Code 16 (Preset Multiple Registers)
03E8	Address of the first register
0003	Number of written registers
0130	Cyclic Redundancy Check (CRC)



Step 5: Read Gripper status until the grasp is completed

Request is: 09 03 07 D0 00 03 04 0E

Bits	Description
09	SlaveID
03	Function Code 03 (Read Holding Registers)
07D0	Address of the first requested register
0003	Number of registers requested (3)
040E	Cyclic Redundancy Check (CRC)

Example of response if the grasp **is not completed**: 09 03 06 39 00 00 FF 0E 0A F7 8B

Bits	Description
09	SlaveID
03	Function Code 03 (Read Holding Registers)
06	Number of data bytes to follow (3 registers x 2 bytes/register = 6 bytes)
3900	Content of register 07D0 (GRIPPER STATUS = 0x39, RESERVED = 0x00): gACT = 1 for "Gripper Activation", gGTO = 1 for "Go to Position Request" and gOBJ = 0 for "Fingers are in motion"
00FF	Content of register 07D1 (FAULT STATUS = 0x00, POSITION REQUEST ECHO = 0xFF): the position request echo tells that the command was well received and that the GRIPPER STATUS is valid.
0E0A	Content of register 07D2 (POSITION = 0x0E, FINGER CURRENT = 0x0A): the position is 14/255 and the motor current is 100mA (these values will change during motion)
F78B	Cyclic Redundancy Check (CRC)



Example of response if the grasp is completed: 09 03 06 B9 00 00 FF BD 00 1D 7C

Bits	Description
09	SlaveID
03	Function Code 03 (Read Holding Registers)
06	Number of data bytes to follow (3 registers x 2 bytes/register = 6 bytes)
B900	Content of register 07D0 (GRIPPER STATUS = 0xB9, RESERVED = 0x00): gACT = 1 for "Gripper Activation", gGTO = 1 for "Go to Position Request" and gOBJ = 2 for "Fingers have stopped due to a contact while closing"
00FF	Content of register 07D1 (FAULT STATUS = 0x00, POSITION REQUEST ECHO = 0xFF): the position request echo tells that the command was well received and that the GRIPPER STATUS is valid.
BD00	Content of register 07D2 (POSITION = 0xBD, FINGER CURRENT = 0x00): the position is 189/255 (can be used to validate the size of the seized object)
1D7C	Cyclic Redundancy Check (CRC)



Step 6: Move the robot to the release location

Step 7: Open the Gripper at full speed and full force

Request is: 09 10 03 E8 00 03 06 09 00 00 00 FF FF 72 19

Bits	Description
09	SlaveID
10	Function Code 16 (Preset Multiple Registers)
03E8	Address of the first register
0003	Number of registers written to
06	Number of data bytes to follow (3 registers x 2 bytes/register = 6 bytes)
0900	Value written to register 0x03E8 (ACTION REQUEST = 0x09 and GRIPPER OPTIONS = 0x00): rACT = 1 for "Activate Gripper", rGTO = 1 for "Go to Requested Position"
0000	Value written to register 0x03E9 (GRIPPER OPTIONS 2 = 0x00 and POSITION REQUEST = 0x00): rPR = 0/255 for full opening of the Gripper (partial opening would also be possible)
FFFF	Value written to register 0x03EA (SPEED = 0xFF and FORCE = 0xFF): full speed and full force
7219	Cyclic Redundancy Check (CRC)

Response is: 09 10 03 E8 00 03 01 30

Bits	Description
09	SlaveID
10	Function Code 16 (Preset Multiple Registers)
03E8	Address of the first register
0003	Number of written registers
0130	Cyclic Redundancy Check (CRC)



Step 8: Read Gripper status until the opening is completed

Request is: 09 03 07 D0 00 03 04 0E

Bits	Description
09	SlaveID
03	Function Code 03 (Read Holding Registers)
07D0	Address of the first requested register
0003	Number of registers requested (3)
040E	Cyclic Redundancy Check (CRC)

Example of response if the opening is not completed: 09 03 06 39 00 00 00 BB 10 30 E0

Bits	Description
09	SlaveID
03	Function Code 03 (Read Holding Registers)
06	Number of data bytes to follow (3 registers x 2 bytes/register = 6 bytes)
3900	Content of register 07D0 (GRIPPER STATUS = 0x39, RESERVED = 0x00): gACT = 1 for "Gripper Activation", gGTO = 1 for "Go to Position Request" and gOBJ = 0 for "Fingers are in motion"
0000	Content of register 07D1 (FAULT STATUS = 0x00, POSITION REQUEST ECHO = 0x00): the position request echo tells that the command was well received and that the GRIPPER STATUS is valid.
BB10	Content of register 07D2 (POSITION = 0xBB, FINGER CURRENT = 0x10): the position is 187/255 and the motor current is 160mA (these values will change during motion)
30E0	Cyclic Redundancy Check (CRC)



Example of response if the opening is completed: 09 03 06 F9 00 00 00 0D 00 56 4C

Bits	Description
09	SlaveID
03	Function Code 03 (Read Holding Registers)
06	Number of data bytes to follow (3 registers x 2 bytes/register = 6 bytes)
F900	Content of register 07D0 (GRIPPER STATUS = 0xF9, RESERVED = 0x00): gACT = 1 for "Gripper Activation", gGTO = 1 for "Go to Position Request" and gOBJ = 3 for "Fingers are at requested position"
0000	Content of register 07D1 (FAULT STATUS = 0x00, POSITION REQUEST ECHO = 0x00): the position request echo tells that the command was well received and that the GRIPPER STATUS is valid.
0D00	Content of register 07D2 (POSITION = 0x0D, FINGER CURRENT = 0x00): the position is 13/255 (the fingers have reached their software limit)
564C	Cyclic Redundancy Check (CRC)

Step 9: Loop back to step 3 if other objects have to be grasped.



4.8. Control over Universal Robots with URCap

The URCap package contains many features to program and control the Gripper. The package provides:

- Gripper toolbar: The Gripper toolbar is automatically installed with the URCap package. It allows jogging and testing of the Gripper. It is a great tool to try grasps with the Gripper while programming.
- Gripper node: The URCap package adds a Gripper node that is used to add a Gripper command. A node can make the Gripper move to a specific opening, grasp an object and modify the speed and force applied by the Gripper.

Caution

Starting from Gripper URCap version 1.0.2, the gripper activation script command (`rq_activate()` or `rq_activate_and_wait()`) must be preceded by the reset command (`rq_reset()`). This will force the gripper's activation routine. Thus, if the gripper was already activated, it will activate again.



4.8.1. Gripper Dashboard

Overview

Single Gripper

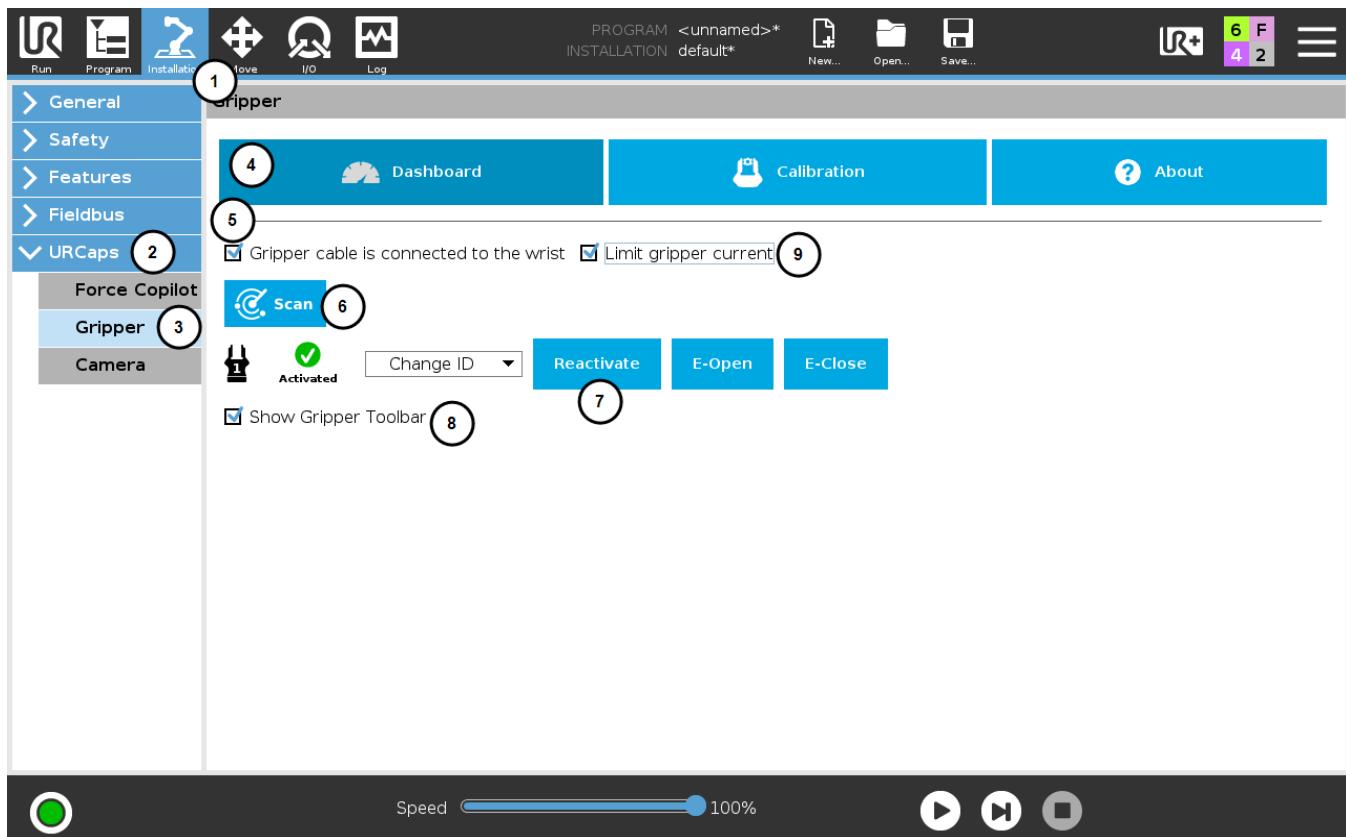


Fig. 4-9: Gripper Dashboard (steps highlighted)

- 1 On the teach pendant, tap the **Installation** button.
- 2 Select **URCaps** in the navigation pane on the left.
- 3 Tap the **Gripper** button.
- 4 Select the **Dashboard** tab.
- 5 If the Gripper is connected to the robot wrist (and not to the robot controller or via a Robotiq Wrist Camera), tick the **Gripper cable is connected to the wrist** box.
- 6 If no Gripper is found, tap the **Scan** button to detect any Gripper that might be connected to the robot.
- 7 Tap the **Activate/Reactivate** button.
- 8 In order to display the Gripper Tool+ menu in the top ribbon of PolyScope, tick the **Show Gripper Toolbar** box.
- 9 In order to prevent overcurrent conditions (for instance when grasping soft objects or using multiple Grippers at the same time), tick the **Limit gripper current** box.
 - a Limits the current at 600 mA for a single Gripper
 - b Limits the current at 450 mA for each Gripper connected in a multiple Gripper configuration



Multiple Grippers

Warning

In order to connect two or more Grippers at the same time on an e-Series robot, each Gripper must have **its own cable-to-controller coupling** (GRP-CPL-062 + CBL-COM-2065-10-HF) for the transmission of power and communication signals, dual gripper adapter plates (AGC-APL-159-002) to mechanically mount the Grippers on the robot arm, and M12 splitters (ACC-SPLIT-M12-2:1). Please refer to the **Spare Parts, Kits and Accessories** section for more details.

Info

The URCap allows the user to connect and control up to **4** Grippers at the same time.

Caution

If you wish to program using multiple grippers at the same time, connect them to the robot **one after the other**; each Gripper connection requiring its own **scan** and **activation** before going on to the next.

For each Gripper connected, follow steps 3 to 6 set out in the **Control** section.

Features

Icon	Functionality Name	Description
	Dashboard	After selecting Gripper in the left pane of the Installation tab, tap this button to access the Gripper Dashboard.
	Activate/Reactivate	The Activate and Reactivate buttons enables the corresponding Gripper.
	Not activated/Activated	Gripper status: One or the other of these icons is displayed next to the corresponding Gripper icon.
	Gripper	Label indicating the Gripper's ID, ranging from 1 to 4.
	Scan	Command allowing for a detection of connected Grippers. After tapping this button, the latter will display in the Gripper Dashboard.
	Change ID	Tap the arrow next to the textbox to expand a list of available Gripper IDs. Selecting an available number will allocate it to the corresponding Gripper.



Icon	Functionality Name	Description
E-Open	E-Open	Tapping this button sends an emergency open command to the corresponding Gripper, whether it is activated or not.
E-Close	E-Close	Tapping this button sends an emergency close command to the corresponding Gripper, whether it is activated or not.



4.8.2. Gripper Calibration menu and wizard

Depending on the fingers/fingertips used, the operator will calibrate the Gripper and measure the stroke by defining the fully open and fully closed positions.

Make sure the Gripper is activated.

- 1 On the teach pendant, tap the **Installation** button.
- 2 Select **URCaps** in the navigation pane on the left.
- 3 Tap the **Gripper** button.

Info

A gripper that has not been calibrated will display open and closed values in percentage.

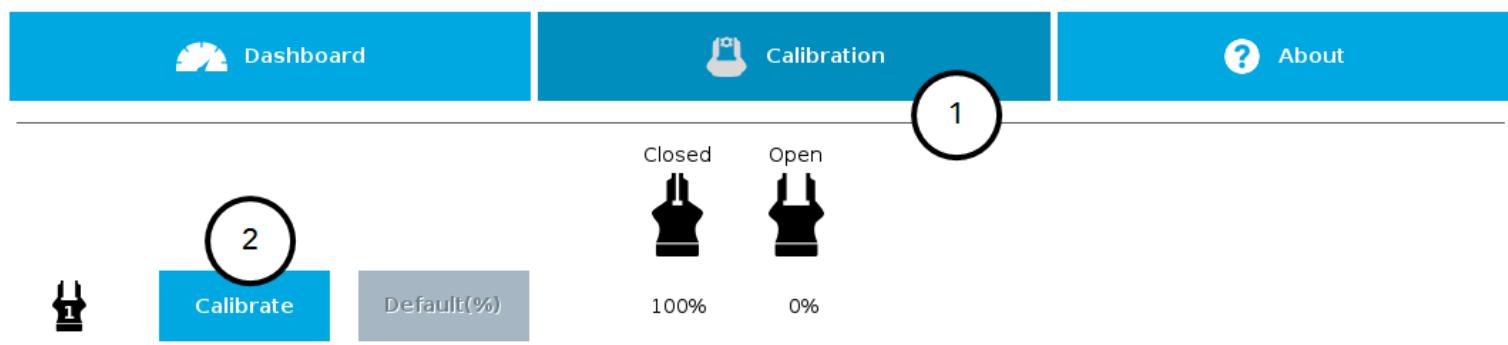


Fig. 4-10: Sequence toward calibration, single Gripper

- 1 Tap the Calibration tab
- 2 Tap the Calibrate button corresponding to the Gripper you want to calibrate

Tapping the **Calibrate** button in the Gripper Calibration menu launches the **Calibration wizard**.

Follow the instructions on the screen of the teach pendant.

Tip

Depending on the PolyScope settings defined by the user, the units of measurement can either display according to the metric or imperial system.



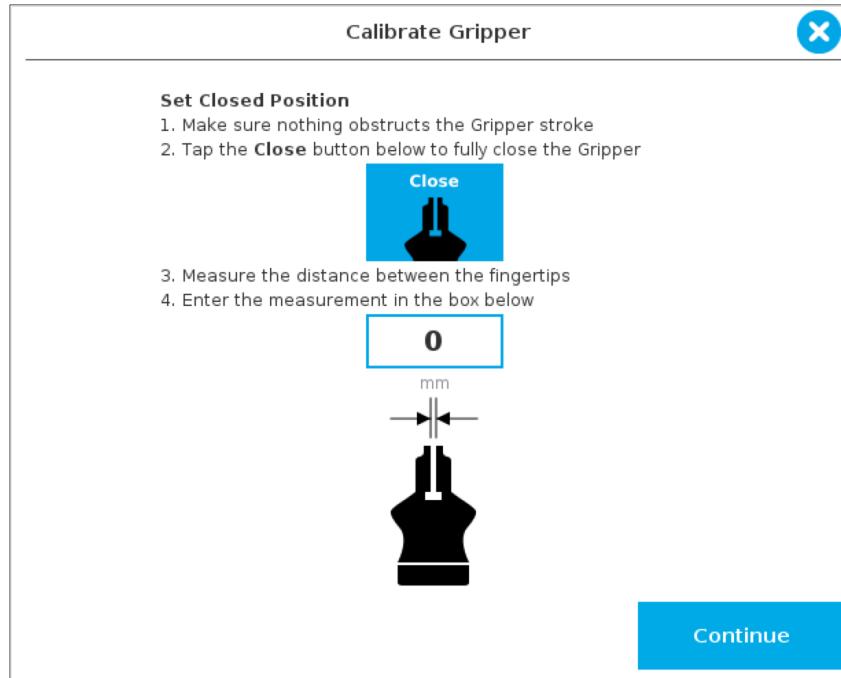


Fig. 4-11: First step of the calibration wizard

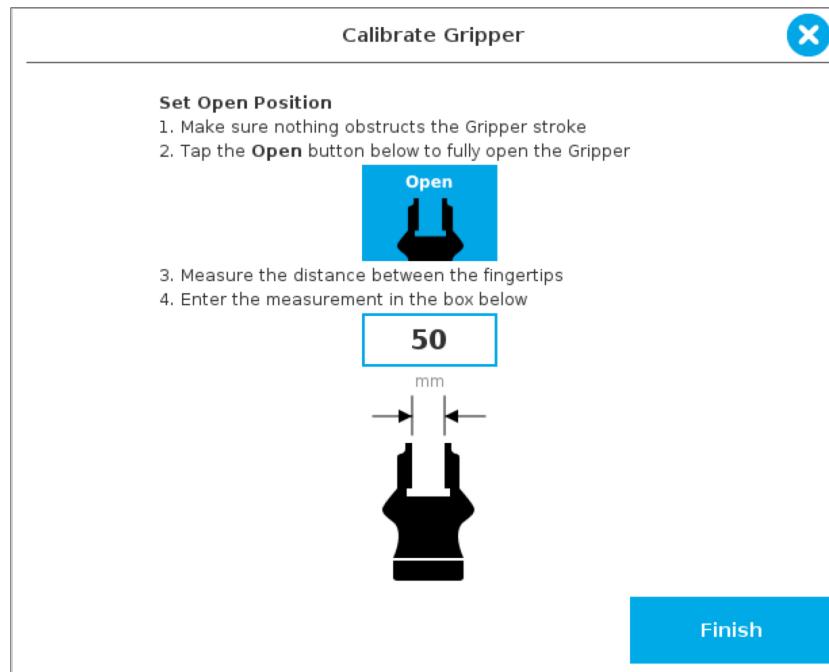


Fig. 4-12: Second step of the calibration wizard



Following their respective calibration, the Grippers will display their actual stroke, from the fully closed to the fully open position.

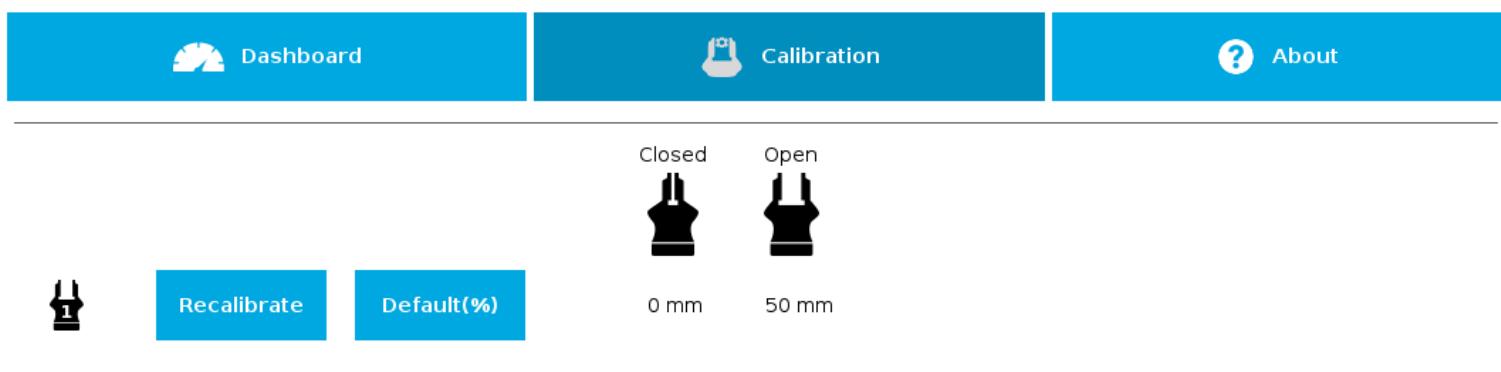
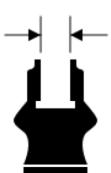


Fig. 4-13: Single Gripper, calibrated

Features

Icon	Functionality Name	Description
Calibration	Calibration	After selecting the Gripper in the left pane of the Installation tab, tap this button to access the Gripper Calibration menu.
Calibrate Recalibrate	Calibrate/Recalibrate	The Calibrate and Recalibrate buttons launch the Gripper Calibration wizard.
Default(%)	Default (%)	Following a calibration, tap this button to reset the calibration and return to the default percentage values. The button is greyed out if no calibration has been performed for the corresponding Gripper.
1	Gripper	Label indicating the Gripper's ID , ranging from 1 to 4.
Closed	Fully closed dimension table header	Visual aid above the fully closed dimensions in the Calibration menu.
Open	Fully open dimension table header	Visual aid above the fully open dimensions in the Calibration menu



Icon	Functionality Name	Description
	Close	Tap this button to close the Gripper in the Calibration wizard.
	Open	Tap this button to open the Gripper in the Calibration wizard.
	Fully closed	Visual aid for entering the fully closed dimension in the Calibration wizard.
	Fully open	Visual aid for entering the fully open dimension in the Calibration wizard.
	Continue	Tap this button at the end of the first step of the Calibration wizard in order to go to the next step.
	Finish	Tap this button at the end of the Calibration wizard to complete the calibration process for the corresponding Gripper.



4.8.3. Gripper Toolbar

The Gripper Toolbar is generally used to test and jog the Gripper, meaning it has no effect on the programming of the robot.

Info

The Gripper URCap package contains the Gripper toolbar. Therefore, the toolbar is automatically installed with the URCap package.

Overview

Prior to using the Gripper Toolbar, the user needs to go to the Gripper Dashboard and tick the Show Gripper Toolbar. Please refer to the **Gripper Dashboard** section for visual support.

Following the proper installation of the Gripper URCap, the user can tap the **UR+** button at the top of the screen to expand the Gripper Toolbar. Please refer to the figure below.



If the user has omitted to tick the **Show Gripper Toolbar** box in the Gripper Dashboard, tapping the **UR+** button will display this message:

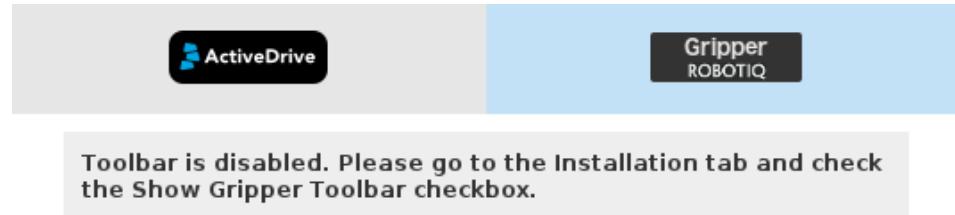


Fig. 4-14: Disabled Gripper Toolbar

An expanded Gripper Toolbar prior to the activation of the Gripper looks like the figure below:

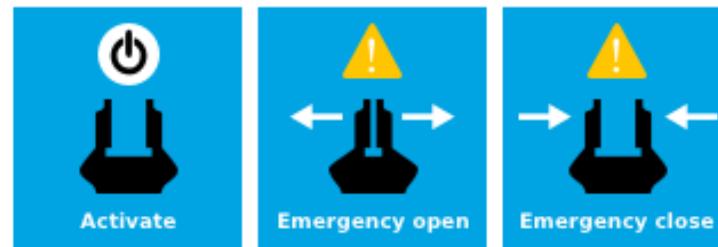


Fig. 4-15: Gripper toolbar before activation

Info

The **Emergency open** and **Emergency close** buttons allow the user to open and close the Gripper even if the latter is not activated.

The emergency commands use very low speed and force settings.

- Tap the **Activate** button to enable the Gripper



Single Gripper

Caution

If the Gripper has not been calibrated at this point, the Open and Close values will remain in percentage. Please refer to the Control section for instructions.

Once the Gripper is activated, the toolbar can be expanded and used to test and jog the Gripper

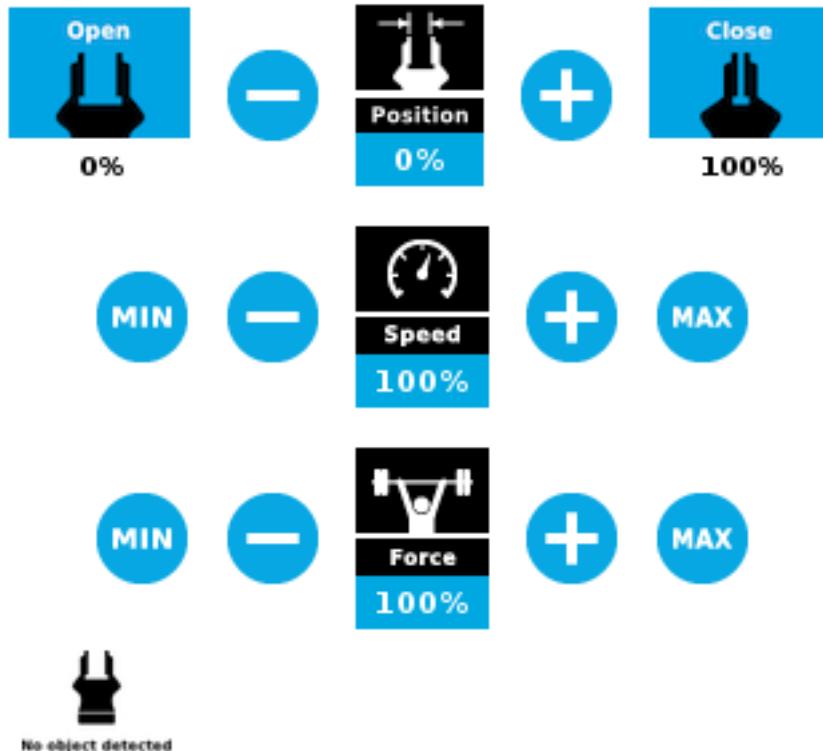


Fig. 4-16: Gripper toolbar after activation



Multiple Grippers

If multiple Grippers are used, check one or several Grippers and test their settings and features.

Tip

The first Gripper selected is the "master", meaning that its settings will be copied over to the others when they are selected. In order to modify each Gripper's settings individually, select a Gripper, edit it, uncheck its box and carry on to the next Gripper.

Info

For consistency, selecting multiple Grippers at the same time displays the open and close values in percentage since their stroke might be different.

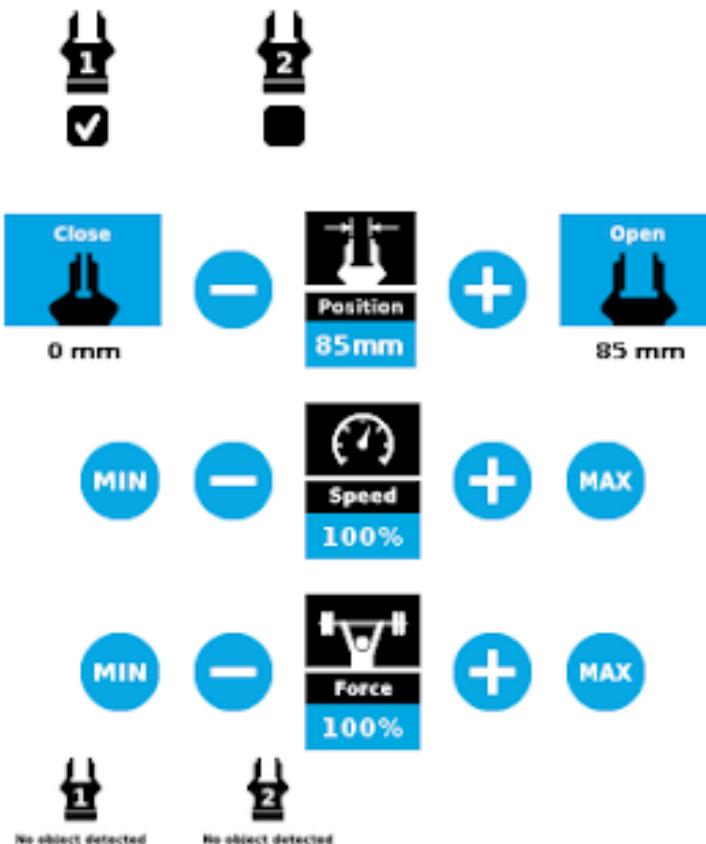
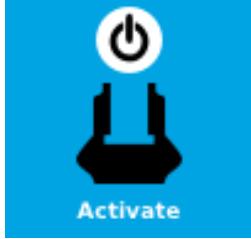


Fig. 4-17: Gripper toolbar (expanded, multiple Grippers)



Features

Gripper activation

Icon	Functionality Name	Description
	Gripper toolbar	Tap to toggle between the expanded and collapsed Gripper toolbar. When greyed out, the functionality is not available.
 	UR+ Menu (Gripper toolbar)	Tap to toggle between the expanded (blue) and collapsed (black) Gripper toolbar.
	Activate	Tap to activate the Gripper. The Gripper will fully open and close to set the zero of the position value.
	Emergency open	Slowly moves the Gripper to its fully closed position.
	Emergency close	Slowly moves the Gripper to its fully open position.



Gripper operation window

Primary Icon	Functionality Name	Description
	Gripper toolbar	Tap to toggle between expanded and collapsed Gripper toolbar. When greyed out, the functionality is not available.
	UR+ Menu (Gripper toolbar)	Tap to toggle between the expanded (blue) and collapsed (black) Gripper toolbar.
	Open	Tap to fully open the Gripper.
	Close	Tap to fully close the Gripper.
	Requested position	Shows the actual position of the Gripper according to the system of units defined in PolyScope (imperial vs. metric). If the Gripper is not calibrated, the values will display in percentage.
	Requested speed	Shows the actual speed set of the Gripper. <ul style="list-style-type: none"> • 0% = minimum speed • 100% = maximum speed
	Requested force	Shows the actual force set of the Gripper: <ul style="list-style-type: none"> • 0% : minimum force, regrasp feature disabled • 1% : minimum force, with regrasp feature enabled • 100% : maximum force, with regrasp feature enabled
	Plus	Tap to increase the corresponding parameter.



Primary Icon	Functionality Name	Description
	Minus	Tap to decrease the corresponding parameter.
	No object detected	Icon shown when no object is detected during a grasp.
	Object detected	The icon shows a green checkmark when an object is detected during a grasp.



4.8.4. Gripper Node

To add and edit a Gripper node inside your robot program, follow the steps below:

- 1 On the teach pendant, at the top of the screen, tap the **New** icon to create a program or the **Open** icon to load a program.
- 2 Select **Program**. The Program window will display.
- 3 Tap the **URCaps** menu in the navigation pane on the left.
- 4 Tap the **Gripper** button.
- 5 Select the node in the robot program and tap the **Command** tab.
- 6 Tap the **Edit** action button to edit the node's parameters.

Info

The Gripper needs to be activated before it can receive a command. To do so, use the `rq_activate_and_wait()` function script at the beginning of the program or activate with the Gripper toolbar. Starting from Gripper URCap version 1.0.2, the gripper activation script command (`rq_activate()` or `rq_activate_and_wait()`) must be preceded by the reset command (`rq_reset()`). This will force the gripper's activation routine. Thus, if the gripper was already activated, it will activate again.

Command window

The Command window shows the requested action parameters for the Gripper node. Depending on the position, speed and force parameters, warning messages may display.

To edit the Gripper node, tap **Edit action** (please refer to the **Edit action screen** section for more details).

Gripper

Gripper 1

Position
 Speed
 Force

Go to position
 Edit action

Complete gripper motion before next action

Gripper action undefined. Please edit action.

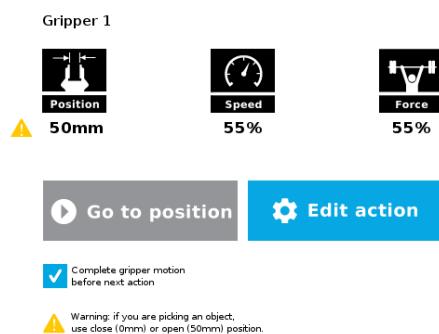
When the node is not defined, the Command window shows warning messages. Tap **Edit action** to modify the Gripper's action.

Caution

Tap the **Go to position** button prior to editing the action. Whereas the command window displays the command that the Gripper should execute in this particular node, the Edit action screen displays the current Gripper position.

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Gripper



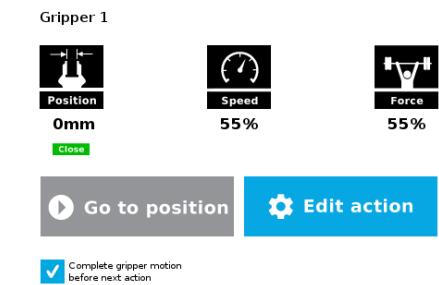
When the node requests the Gripper to close/open, the Command window warns that a partial opening/closing should not be performed for picking an object.

- For positioning and partial movement of the hand, moving to a specific position (between the fully open and fully close positions) is suitable.
- To pick an object, use the close (or open) actions along with the object detection feature (please refer to the **Edit action screen** section).

Info

When the action is set for multiple Grippers, the header lists the selected Grippers (e.g. Grippers 1,2,3,4)

Gripper



When the Gripper action is set to **close**, a green "Close" icon appears.

When the Gripper action is set to **open**, a green "Open" icon appears.



Features

Icon	Functionality Name	Description
	Requested position	Shows the position requested for the current Gripper node. Read only.
	Requested speed	Shows the speed requested for the selected Gripper node. Read only.
	Requested force	Shows the force requested for the selected Gripper node. Read only.
	Go to position	Sends all node parameters (position, force, speed) to the Gripper. Note: This button is disabled (grey) when the Gripper is already at the node position or when the Gripper is not powered/activated.
	Edit action	Opens the Edit action screen, where you can edit the Gripper's action parameters.
	Complete motion	Selected by default. Selected: The Gripper completes its motion before executing the next action on the PolyScope program tree. This is slower but safer.
	Do not complete motion	Selected by default. Unselected: As soon as the Gripper starts moving, PolyScope will execute the next action on the program tree. This allows you to move the Gripper and robot at the same time.
	Warning message section	
	Gripper not activated	"Warning, the Gripper is not powered or not activated. The Gripper will not move." Make sure that the Gripper is installed correctly and powered. You need to activate it using the Gripper toolbar before running Gripper commands.
	Gripper action undefined	"Gripper action undefined! Please edit action." When creating a new node, all action parameters are undefined. Tap the edit action button to define parameters.



Icon	Functionality Name	Description
	Object picking warning	<p>"Warning, if you are picking an object, use close (100%) or open (0%) position."</p> <p>It is highly recommended to only use 0% or 100% position when trying to pick an object.</p>
	Node name	<p>Node name is automatically set to:</p> <ul style="list-style-type: none"> • Gripper Open, when position = 0% or fully open value as defined in the Calibration wizard • Gripper Close, when position = 100% or fully closed value as defined in the Calibration wizard. • Gripper Move x%/mm/in, when position is between the fully open and fully closed values.
	Open request	When position requested is 0%, or the fully opened value defined in the Calibration wizard.
	Close request	When position request is 100%.



Edit action screen

Tap **Edit action** from the Command window and use the Edit action screen to edit the Gripper's parameters and adjust its position, speed and force. In normal usage conditions, the Gripper will move as soon as you change the position setting. The Gripper will not move if it is not properly powered, connected and activated.

Caution

The Gripper needs to be activated before it can receive a command. To do so, use the `rq_activate_and_wait()` function script at the beginning of the program or activate with the Gripper toolbar. Starting from Gripper URCap version 1.0.2, the gripper activation script command (`rq_activate()` or `rq_activate_and_wait()`) must be preceded by the reset command (`rq_reset()`). This will force the gripper's activation routine. Thus, if the gripper was already activated, it will activate again.

Single Gripper

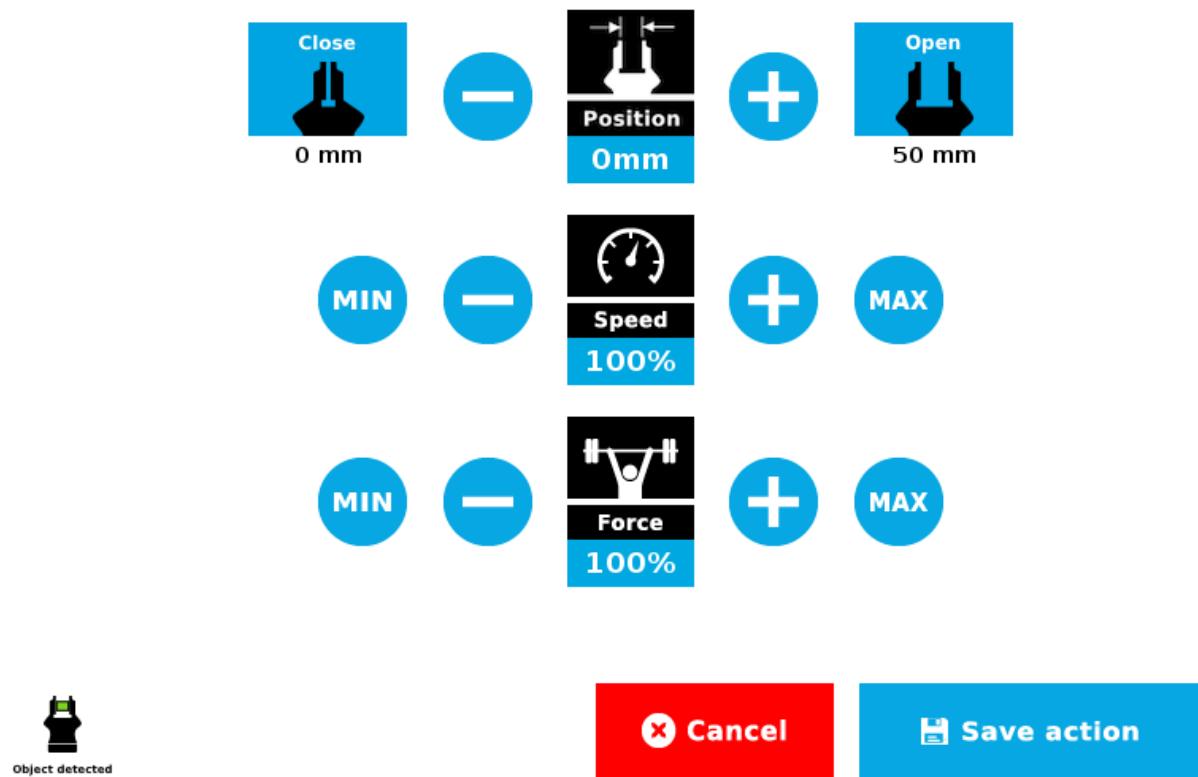
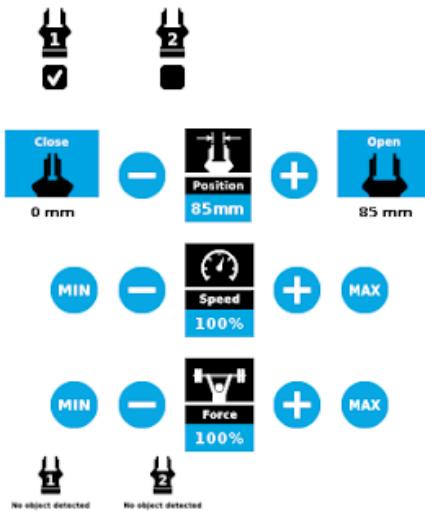


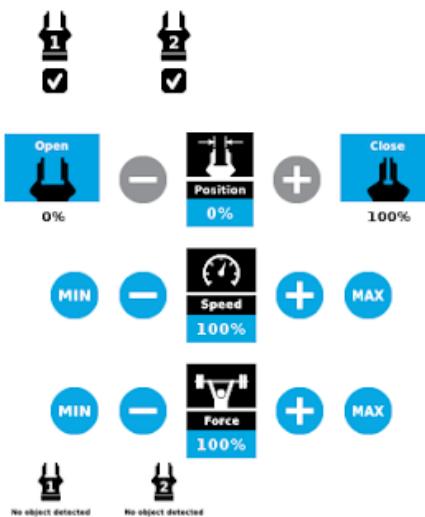
Fig. 4-18: Edit action screen



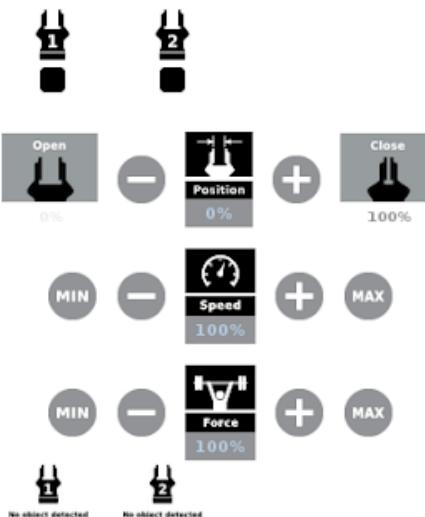
Multiple Grippers



- When selecting one gripper, all buttons are available. The action will apply to the selected gripper.
- When jogging the position, the selected gripper will move automatically.
- It is possible to jog the position (%).



- When selecting two or more grippers, it is not possible to jog the position.
- To jog the position, select only one gripper, jog the position and then select all grippers. The second gripper will move to the requested position.



- When no grippers are selected, the action cannot be edited.



Features

Primary Icon	Functionality Name	Description
	Open	Tap to fully open the Gripper. Use this when you want to grasp an object (internal grip), for example.
	Close	Tap to fully close the Gripper. Use this when you want to grasp an object (external grip), for example.
	Requested position	Shows the position request for the selected Gripper node.
	Requested speed	Shows the speed requested for the selected Gripper node. Use the Plus and Minus icons to modify.
	Requested force	Shows the force requested for the selected Gripper node. Use the Plus and Minus icons to modify.
	Plus	Tap to increase the corresponding parameter.
	Minus	Tap to decrease the corresponding parameter.
	Cancel	Cancels modifications and brings back the Gripper node command screen.
	Save action	Saves settings into the selected Gripper node and brings back the Gripper node command screen. Note: This functionality is not available (grey) when the Gripper has the same action parameters as the selected Gripper node.
	No object detected	Icon shown when no object is detected during a grasp.
	Object detected	Icon shows a green checkmark when an object is detected during a grasp.



Warning

If the Gripper is powered and initialized, it will move as soon as a change to the parameter is made (position, speed, force).

Tip

Change speed and force when grasping objects. In all other cases, it is recommended to use maximum speed and force.

Grip Check node

In order to add and edit a Grip Check node:

- 1 On the teach pendant, at the top of the screen, tap the **New** icon to create a program or the **Open** icon to load a program.
- 2 Select **Program**. The Program window will display.
- 3 Tap the **URCaps** menu in the navigation pane on the left.
- 4 Tap the **Grip Check** button.
- 5 Select the node in the robot program to edit it.

The Grip Check node is pre-packaged as an If statement that prompts the user to select between if the object **is** detected and if the object **is not** detected.

Selecting the former option allows the user to check a box and choose whether or not the grasp should be validated according to the object's dimension (in percentage if the Gripper is not calibrated, or in mm/in if the Gripper is calibrated—depending on the PolyScope configuration).

Grip Check

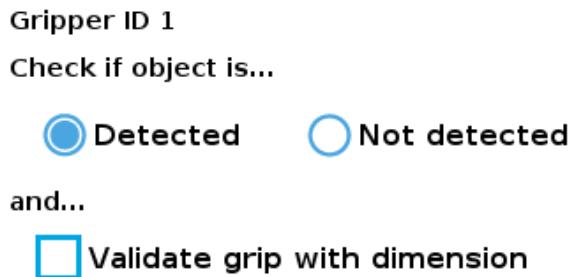


Fig. 4-19: Grip Check node interface



Grip Check

Gripper ID 1

Check if object is...

Detected Not detected

and...

Validate grip with dimension

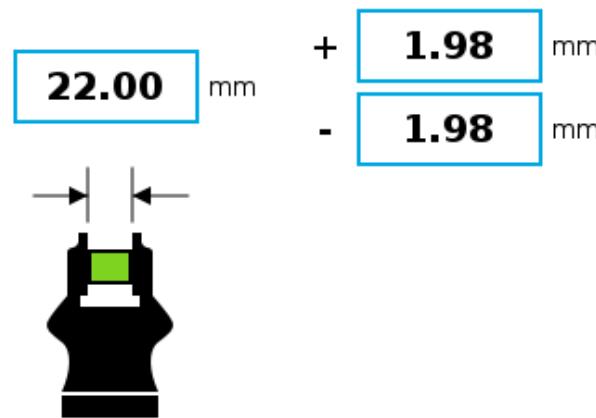


Fig. 4-20: Grip Check node interface with dimension validation

Given that the Grip Check node is an If statement, tapping the actual node in the Command tab brings up the option to add an Else instruction to the program tree.

About

In this window, the user can access information such as the Gripper's hardware, software and firmware versions, the number of cycles completed by the device and more.

- 1 Create or load a robot program
- 2 Tap the Installation tab
- 3 Select **Gripper** in the left pane
- 4 Tap the **About** submenu





URCap version: UCG-1.2.1
 PolyScope version: 3.5.4.10845
 Robot serial number: 2016352451

Gripper ID

2-Finger Gripper

Serial number: abc-1684348960
 Firmware version: GC3-1.4.1
 Number of cycles: 73873



Visit support.robotiq.com to get the latest instruction manual and further information on how to use your product.

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Error messages overview

If a program is running without the Gripper being activated, the program will stop at the execution of a Gripper node and the following message will be displayed in a popup. Tap Stop Program and activate the gripper with the toolbar to continue or add an activation command in the program (see Advanced Gripper Functions).



Caution

Starting from Gripper URCap version 1.0.2, the gripper activation script command (`rq_activate()` or `rq_activate_and_wait()`) must be preceded by the reset command (`rq_reset()`). This will force the gripper's activation routine. Thus, if the gripper was already activated, it will activate again.



Gripper Program Template

With the URCap package installation, a program template will automatically be installed in the program folder of PolyScope. It contains comments and pop up windows that explain Gripper nodes functions and advanced functions.

Load and open the gripperTutorial.urp program located in the root program folder. Make sure the Gripper is well connected to the UR controller. Run the program. You will see pop up windows with comments on the Gripper nodes and advanced functions.

Tip

Use the gripperTutorial.urp to know how to program the Gripper using nodes and advanced functions. You can copy the tutorial and start a new program based on it.



Advanced Gripper Functions

The use of Gripper URCaps nodes allows to move the Gripper and modify its speed and force. However, some advanced functions are only available through UR Script commands.

Info

The Gripper needs to be activated before it can receive a command. To do so, use the `rq_activate_and_wait()` function script at the beginning of the program or activate with the Gripper toolbar.

Single Gripper

Name	Description
<code>rq_activate()</code>	Sends the Gripper activation command. If it is already activated, nothing happens. Note that the Gripper must be activated to complete any other operation. Program execution continues before the end of activation.
<code>rq_activate_and_wait()</code>	Sends the Gripper activation command. If it is already activated, nothing happens. Note that the Gripper must be activated to complete any other operation. Program execution waits for the activation.
<code>rq_auto_release_close_and_wait()</code>	Slowly moves the Gripper to its maximum closed position. The Gripper must be activated after this command. Meant for emergency procedures.
<code>rq_auto_release_open_and_wait()</code>	Slowly moves the Gripper to its maximum opened position. The Gripper must be activated after this command. Meant for emergency procedures.
<code>rq_close()</code>	Moves the Gripper its fully closed position.
<code>rq_close_and_wait()</code>	Moves the Gripper to its fully closed position and waits until the motion is completed to execute the next command.
<code>rq_current_pos()</code>	Returns the current position of the fingers, from 0 to 255. Can be used to verify that the pick is successful, by comparing the finger position when the pick was taught with the similar-sized object.
<code>rq_current_pos_norm()</code>	Returns the current position of the fingers, normalized from 0% to 100%. Can be used to verify that the pick is successful, by comparing the finger position when the pick was taught with the similar-sized object.
<code>rq_current_pos_mm()</code>	Returns the current position of the fingers in millimeters, considering that the PolyScope configuration has been set to use the metric system as measurement system. Can be used to verify that the pick is successful, by comparing the finger position when the pick was taught with the similar-sized object.
<code>rq_current_pos_inches()</code>	Returns the current position of the fingers in inches, considering that the PolyScope configuration has been set to use the imperial system as measurement system. Can be used to verify that the pick is successful, by comparing the finger position when the pick was taught with the similar-sized object.
<code>rq_get_gripper_max_cur(gripperId)</code>	Returns the maximum supply current value of the appropriate Gripper in mA.
<code>rq_go_to()</code>	Sets the Go To bit to 1.
<code>rq_is_gripper_activated()</code>	Sets global variable <code>rq_gripper_act</code> to 1 if the Gripper is activated and returns True. Otherwise sets the variable to 0 and returns False.



Name	Description
rq_gripper_led_off()	Forces the LED to OFF status.
rq_gripper_led_on()	Allows the firmware to turn ON the LEDs when they have been forced to OFF status.
rq_is_motion_complete()	Returns True if the motion of the Gripper is complete and False otherwise. Can be useful to synchronize a program after a Gripper node is run without the option "Complete Gripper motion before next action".
rq_is_object_detected()	Returns True if the Gripper motion has stopped due to an object. Returns False if Gripper motion was not impeded by an object. Useful for verifying that an object has been picked correctly before going to the next step. Note: this function is not reliable for very small objects. Refer to the user manual for more details.
rq_move_and_wait("position")	Moves the Gripper to the position defined by the argument and waits until the motion is completed.
rq_move("position")	Moves the Gripper to the position defined by the argument.
rq_move_and_wait_norm ("position")	Moves the Gripper to the position defined by the argument, normalized from 0% to 100%. Waits until the motion is completed.
rq_move_mm()	Moves the Gripper to the position defined by the argument.
rq_move_and_wait_mm()	Moves the Gripper to the position defined by the argument.
rq_move_inches()	Moves the Gripper to the position defined by the argument.
rq_move_and_wait_inches()	Moves the Gripper to the position defined by the argument.
rq_move_norm("position")	Moves the Gripper to the position defined by the argument, normalized from 0% to 100%.
rq_open()	Moves the Gripper to its fully opened position.
rq_open_and_wait()	Moves the Gripper to its fully opened position and waits until the motion is completed.
rq_print_gripper_driver_state()	Prints the driver's state to the UR log window.
rq_print_gripper_driver_version()	Prints the driver version to the UR log window.
rq_print_gripper_fault_code()	Prints the Gripper's fault code in the UR log window.
rq_print_gripper_firmware_version()	Prints the Gripper's firmware version to the UR log window.
rq_print_gripper_num_cycles()	Prints the Gripper's number of cycles in the UR log window.
rq_print_gripper_serial_number	Prints the Gripper's serial number in the UR log window.
rq_reset()	Resets the Gripper's activation status. Use after an autorelease before activating the Gripper.
rq_set_force("force")	Sets the Gripper's force defined by the argument, from 0 to 255.
rq_set_force_norm("force")	Sets the Gripper's force defined by the argument, normalized from 0% to 100%.
rq_set_gripper_max_cur(current_mA, gripperId)	Sets the Gripper's maximum supply current in mA.
rq_set_speed("speed")	Sets the Gripper's speed defined by the argument, from 0 to 255.
rq_set_speed_norm("speed")	Sets the Gripper's speed defined by the argument, normalized from 0% to 100%.



Name	Description
rq_stop()	Stops the Gripper's motion. The Go To bit is set to 0.



Multiple Grippers

Warning

In order to connect two or more Grippers at the same time on an e-Series robot, each Gripper must have **its own cable-to-controller coupling** (GRP-CPL-062 + CBL-COM-2065-10-HF) for the transmission of power and communication signals, dual gripper adapter plates (AGC-APL-159-002) to mechanically mount the Grippers on the robot arm, and M12 splitters (ACC-SPLIT-M12-2:1). Please refer to the **Spare Parts, Kits and Accessories** section for more details.

Here is an example of how to use the script commands with more than one gripper.

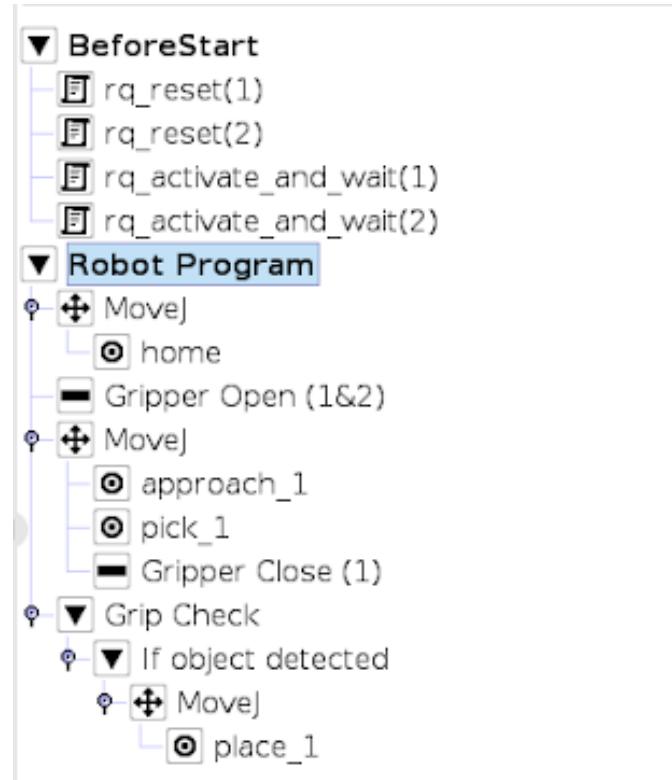


Fig. 4-21: Example of UR script commands with multiple Grippers



4.9. Control over Universal Robots without URCaps

If your Universal Robots' controller is not compatible with the URCap package (refer to the [Installation for Universal Robots](#) section), you can install the driver package. This package allows programming of the Gripper with scripts in a PolyScope program. It includes program templates and examples to help you get started with your own custom program. It also contains the Gripper toolbar for jogging and controlling the Gripper.

4.9.1. Gripper Toolbar

Overview

The Gripper toolbar is automatically installed with the driver package. The Gripper toolbar allows you to jog and test the Gripper. It is a great tool to try grasps with the Gripper while programming.

Features

Toolbar collapsed

When communication with the Gripper is not established, the expanded toolbar shows the driver version:

Fig. 4-22: Gripper toolbar expanded with driver version

4.9.2. Demo Scripts

The following section details the demo scripts provided with the driver package.



5. User Interface

Visit support.robotiq.com to get the latest installer of the Robotiq User Interface along with appropriate documentation.

See the [instruction manual of the Robotiq User Interface](#) for more details.



6. Specifications

Caution

The following manual uses the metric system, unless specified, **all dimensions are in millimeters.**

The following subsections provide data on the various specifications for the Robotiq 2-Finger 85 and 140 Adaptive Grippers.

- Section 6.1 lists the technical dimensions of the Grippers
 - Dimensions for custom (blank) coupling
 - Dimensions of all available couplings
 - Dimensions for custom fingertip
 - Dimensions of all available fingertips
- Section 6.2 presents the mechanical specifications of the Grippers.
- Section 6.3 gives electrical specifications for the Grippers.



6.1. Technical dimensions

The 2-Finger 85 and 2-Finger 140 share the same basic chassis and thus have the same technical dimensions for everything except the fingers. Figure 6-1 represents the Robotiq 2-Finger 85 Adaptive Robot Gripper's dimensions with axis X, Y, Z and origin referenced for finger motion. Figure 6-3 will show the equivalent with 140 mm fingers (2-Finger 140).

Info

All technical drawings in the present section are shown with silicone flat fingertip option: AGC-TIP-204-085 (2-Finger 85) or AGC-TIP-420-140 (2-Finger 140).

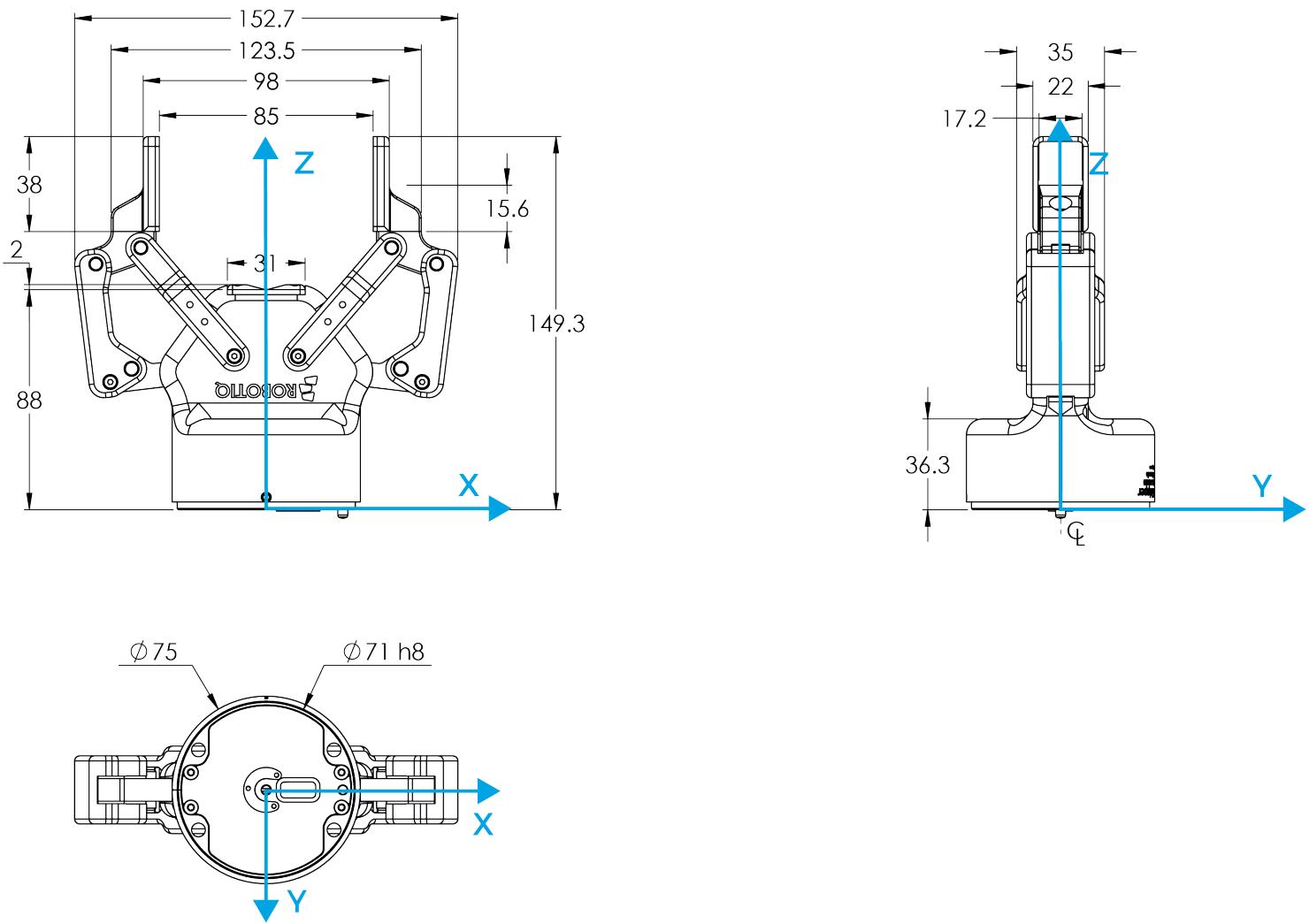


Fig. 6-1: 2F-85 general dimensions (opened).

As mentioned in the figure above, height and width of the fingers vary with opening position. Figure 6-1 represents the 2F-85 Gripper in the opened position (position request = 0), while Figure 6-2 represents the 2F-85 Gripper in the closed position (position request = 255).



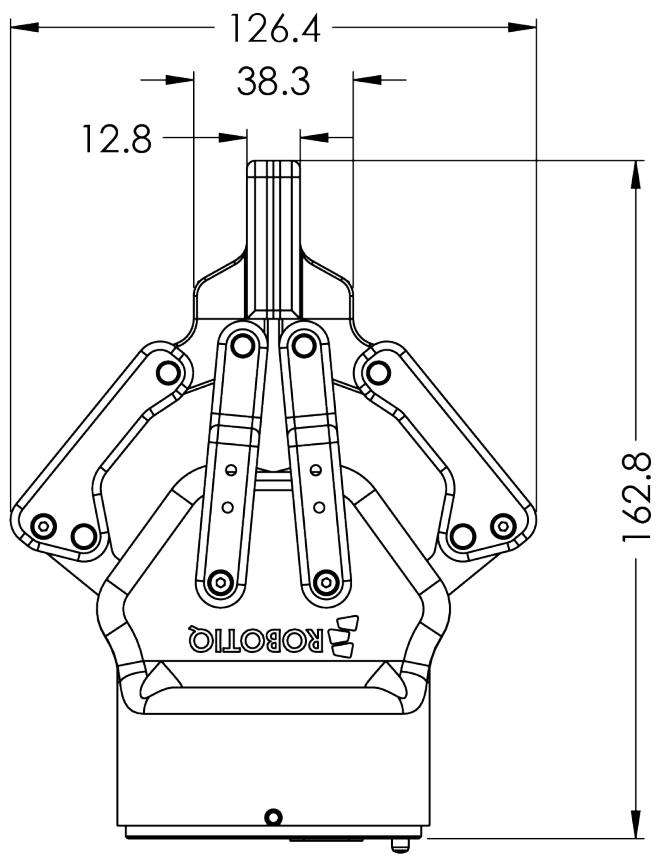


Fig. 6-2: 2F-85 dimensions (closed).



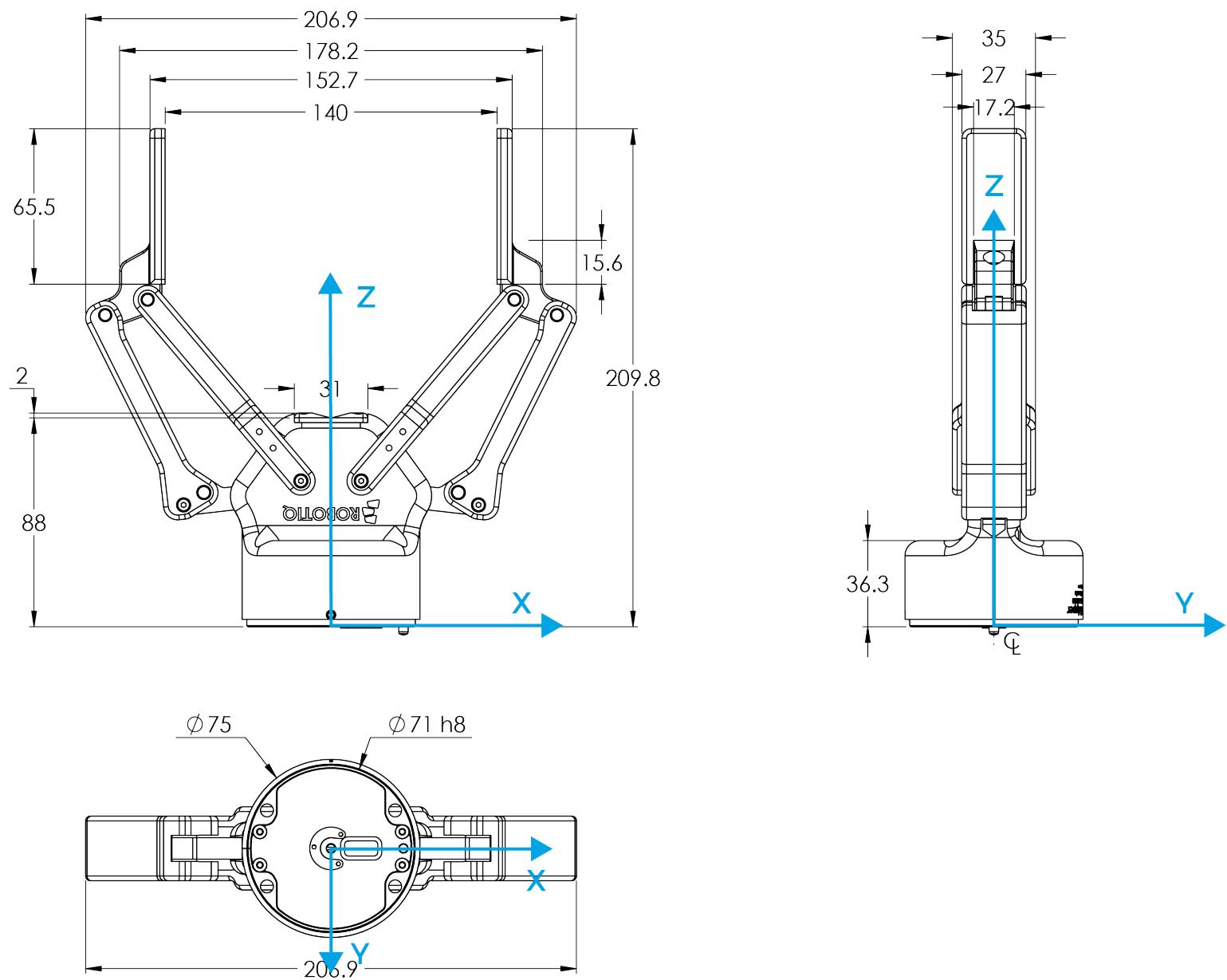


Fig. 6-3: 2F-140 general dimensions (opened).



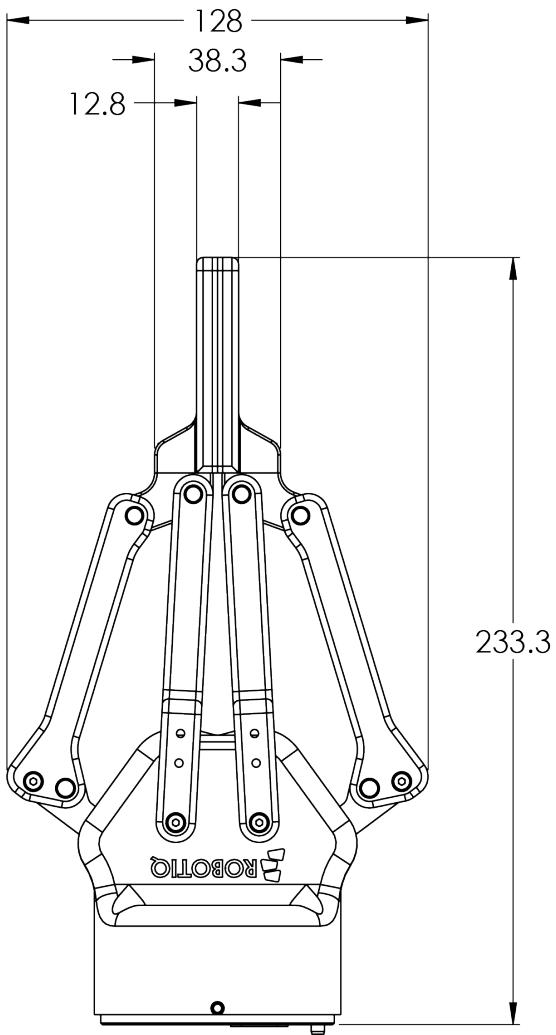


Fig. 6-4: 2F-140 dimensions (closed).

As mentioned in the figure above, the height and width of the fingers vary with opening position. Figure 6-3 represents the 2F-140 Gripper in the opened position (position request = 0), while Figure 6-4 represents the 2F-140 Gripper in the closed position (position request = 255).



6.1.1. Couplings

The Robotiq 2-Finger Adaptive Robot Gripper requires a coupling provided by Robotiq to operate. The coupling is mandatory since it integrates electronics and electrical contacts.

Info

The coupling is common to both the 2F-85 and the 2F-140.

Blank coupling

Below are the dimensions of the blank coupling, **AGC-CPL-BLANK-002** (refer to the **Spare Parts, Kits and Accessories** section), available to create a custom bolt pattern. Blue section can be fully customized (holes can be placed in any part of this section) while the grey section can only be worked to a depth of 3 mm.

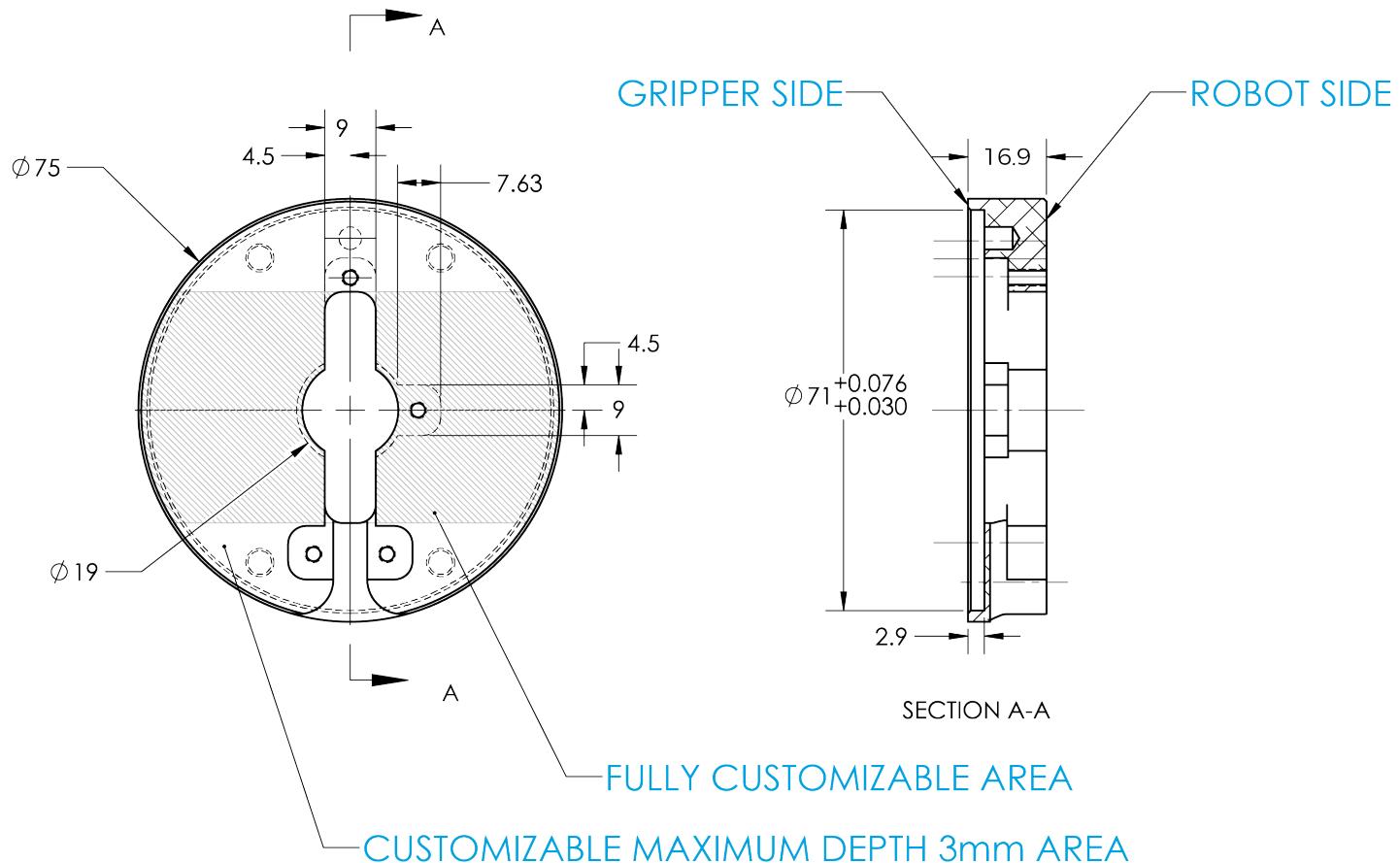


Fig. 6-5: Blank coupling AGC-CPL-BLANK-002 workable area dimensions.



Coupling for ISO 9409-1-50-4-M6

Bolt pattern for coupling AGC-CPL-062-002 (refer to the **Spare Parts, Kits and Accessories** section) is compatible with :

- 50 mm pitch circle diameter :
 - (4) M6-1.0 low head socket cap screw clearance
 - (1) M6 indexing pin
- ISO 9409-1 standard 50-4-M6

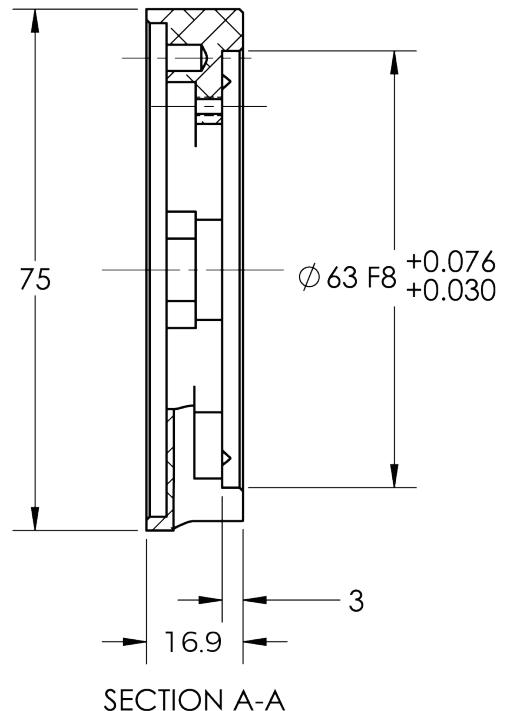
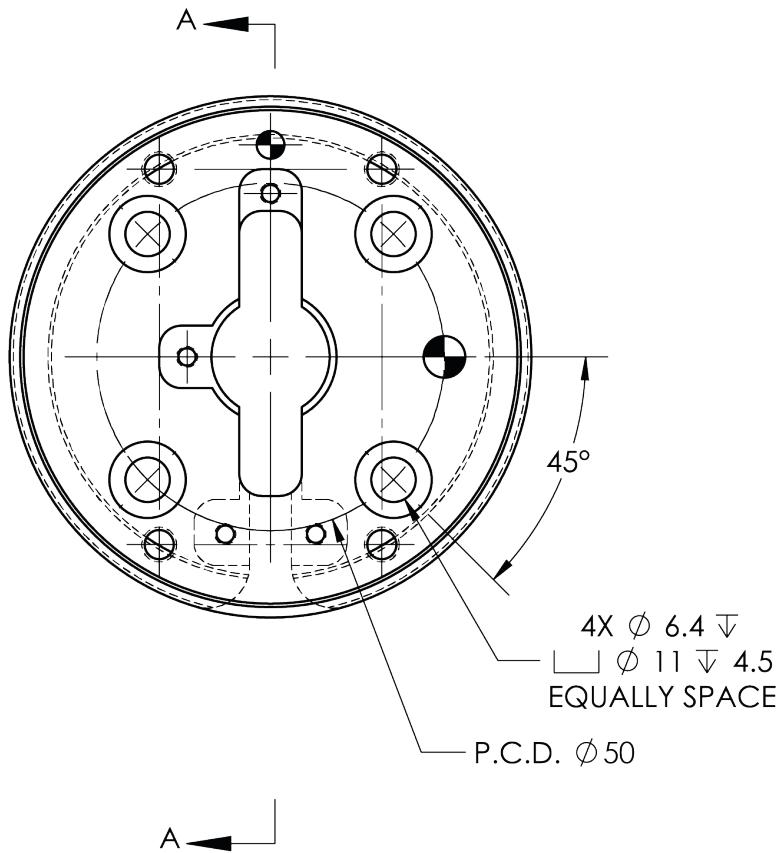


Fig. 6-6: Coupling for ISO 9409-1-50-4-M6.



Coupling for ISO 9409-1-31.5-4-M5

Bolt pattern for coupling AGC-CPL-063-002 (refer to the Spare Parts, Kits and Accessories section) is compatible with :

- 31.5 mm pitch circle diameter :
 - (4) M5-0.8 low head socket cap screw clearance
 - (1) M5 indexing pin
- ISO 9409-1 standard 31.5-4-M5

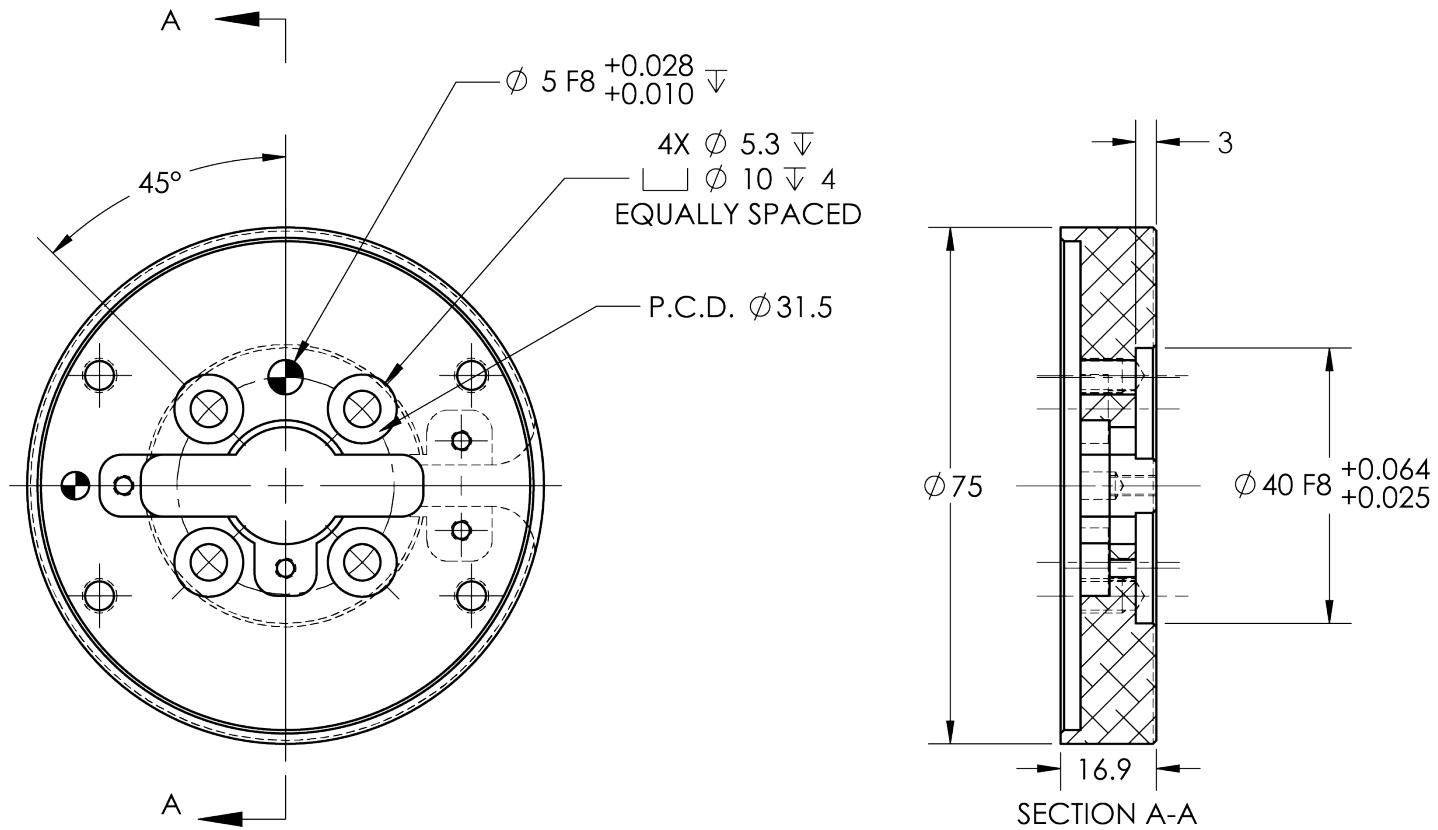


Fig. 6-7: Coupling for ISO 9409-1-31.5-4-M5.



Coupling for ISO 9409-1-40-4-M6

Bolt pattern for coupling AGC-CPL-064-002 (refer to the **Spare Parts, Kits and Accessories** section) is compatible with :

- 40 mm pitch circle diameter :
 - (4) M6-1.0 low head socket cap screw clearance
 - (1) M6 indexing pin
- ISO 9409-1 standard 40-4-M6

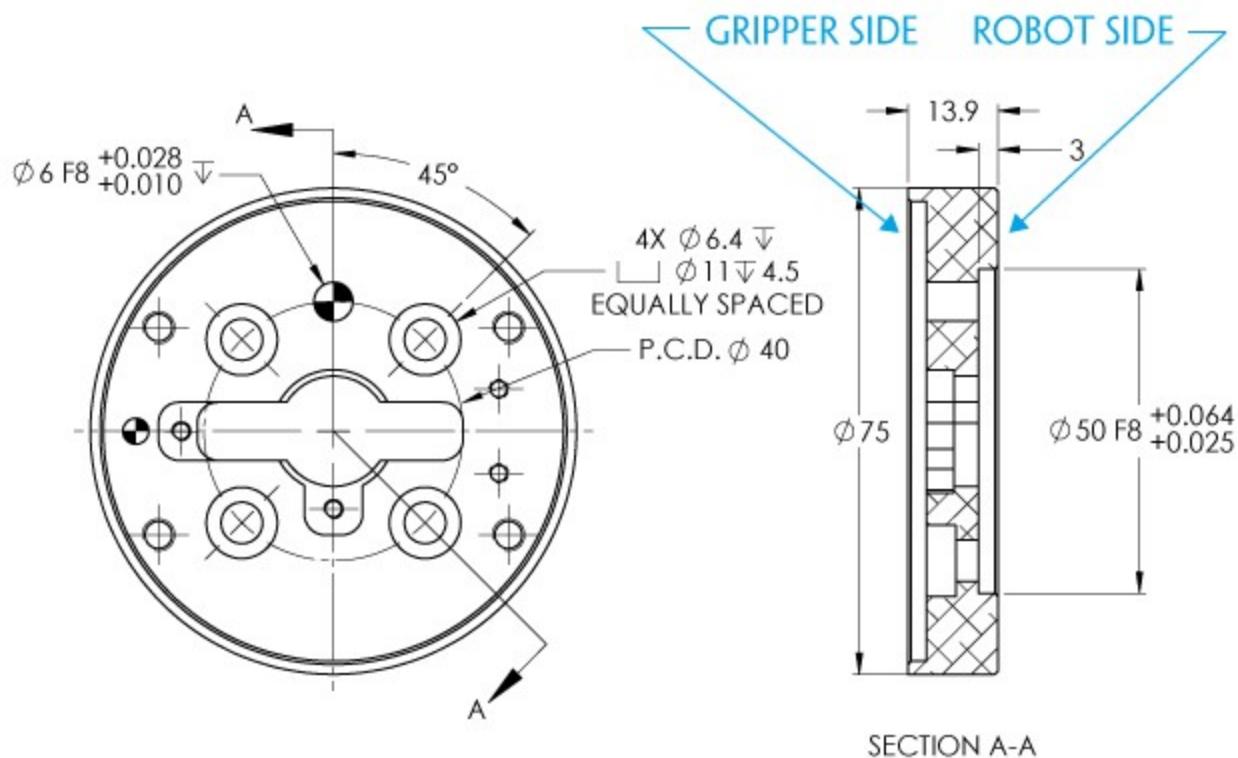


Fig. 6-8: Coupling for ISO 9409-1-40-4-M6.



Coupling for PCD 56 with 8 x M4

Bolt pattern for coupling AGC-CPL-065-002 (refer to the **Spare Parts, Kits and Accessories** section) is compatible with :

- 56 mm pitch circle diameter :
 - (8) M4-0.7 low head socket cap screw clearance
 - (1) M4 indexing pin
 - 62 mm diameter internal insert

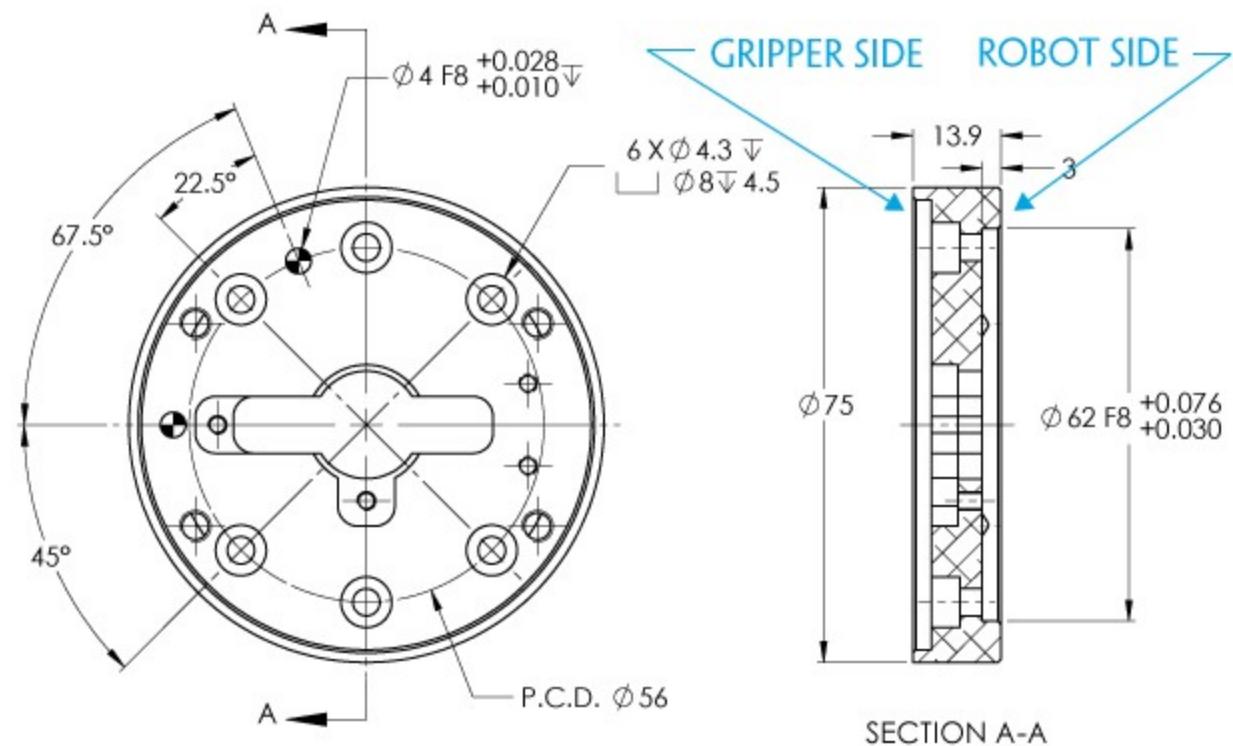


Fig. 6-9: Coupling for PCD 56 mm with 8 x M4 clearance.

Info

Although coupling AGC-CPL-065-002 is compatible with 8 x M4 threads on a 56 mm PCD it uses only 6 of the 8 normally present holes.



Coupling for PCD 56 with 6 x M4

Bolt pattern for coupling AGC-CPL-066-002 (refer to the **Spare Parts, Kits and Accessories** section) is compatible with:

- 56 mm pitch circle diameter:
 - (6) M4-0.7 low head socket cap screw clearance
 - (1) M6 indexing pin
 - 42 mm diameter external insert

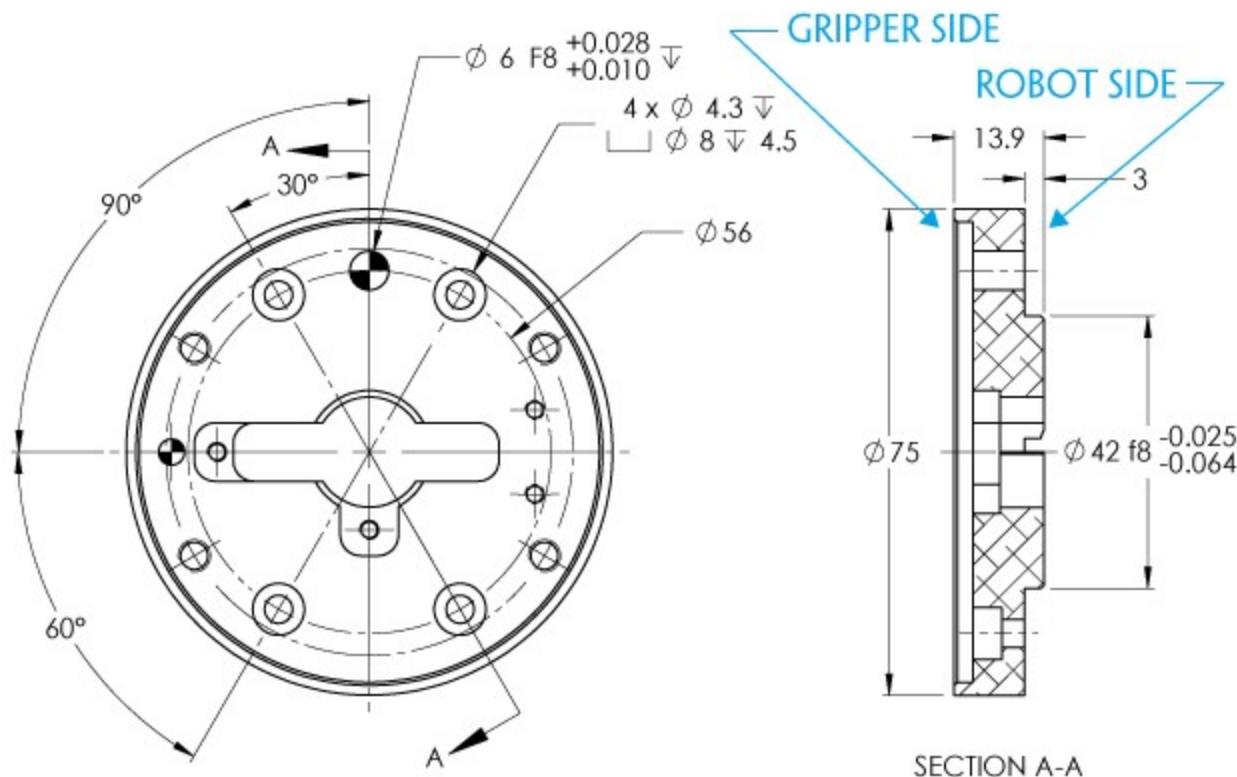


Fig. 6-10: Coupling for PCD 56 mm with 6 x M4 clearance.



Coupling for PCD 60 with 4 x M5

Bolt pattern for coupling AGC-CPL-067-002 (refer to the Spare Parts, Kits and Accessories section) is compatible with :

- 60 mm pitch circle diameter :
 - (4) M5-0.8 low head socket cap screw clearance
 - (1) M5 indexing pin
 - 34 mm diameter external insert

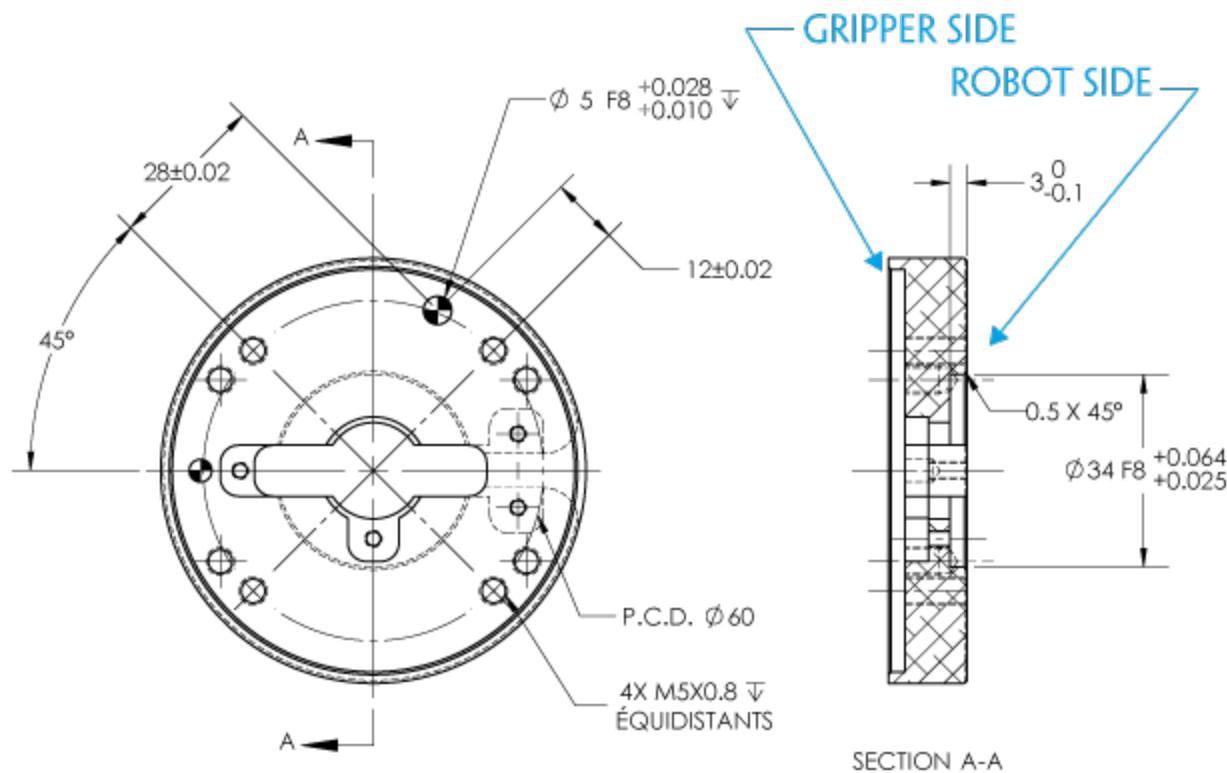


Fig. 6-11: Coupling for PCD 60 mm with 4 x M5 clearance.



Coupling for PCD 63 with 6 x M6

Bolt pattern for coupling AGC-CPL-068-002 (refer to the **Spare Parts, Kits and Accessories** section) is compatible with :

- 63 mm pitch circle diameter :
 - (6) M6-1.0 low head socket cap screw clearance
 - (2) M6 indexing pins

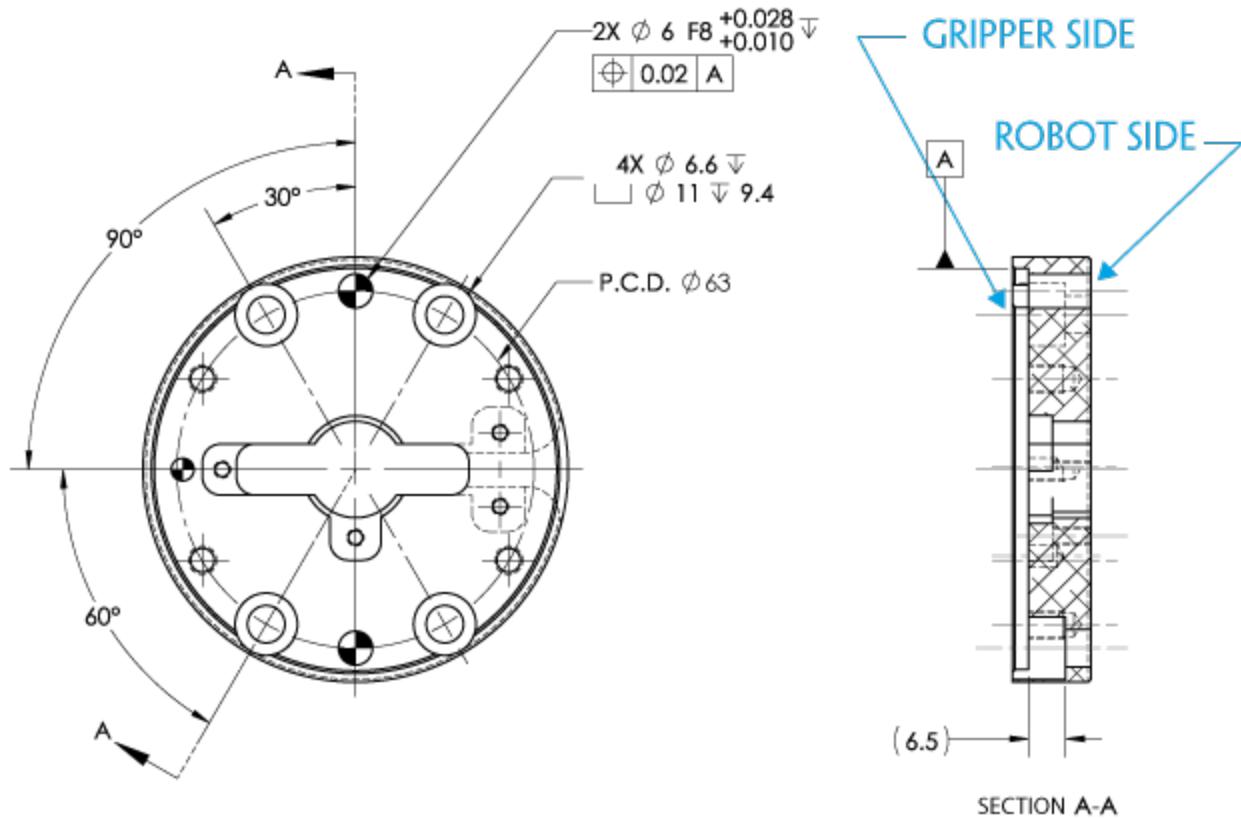


Fig. 6-12: Coupling for PCD 63 mm with 6 x M6 clearance.



6.1.2. Fingertips

The contact grasp points for the Robotiq 2-Finger Adaptive Robot Gripper are its two fingertip pads and palm pad. Many fingertips are available from Robotiq (refer to the **Spare Parts, Kits and Accessories** section). The user can customize their own fingertips from blanks or create them from scratch. The figure below represents the distal phalanx (which acts as the fingertip holder) the permanent, non customizable part of the Gripper finger on which the fingertip must be mounted.

Custom fingertip designs must abide by the following:

- Fingertip must not exceed 100 mm in height from the fingertip's base.
- Fingertip must not exceed 100 mm in width from the fingertip's base (refer to Y axis from figure 6-18).
- Refer to the **Mechanical specifications** section to evaluate the grasp force according to your fingertip design.
- Applied forces to the gripper must not exceed moment and force limits detailed in the **Moment and force limits** section.

Info

Both 2-Finger 85 and 2-Finger 140 use the same fingertips and finger holder.

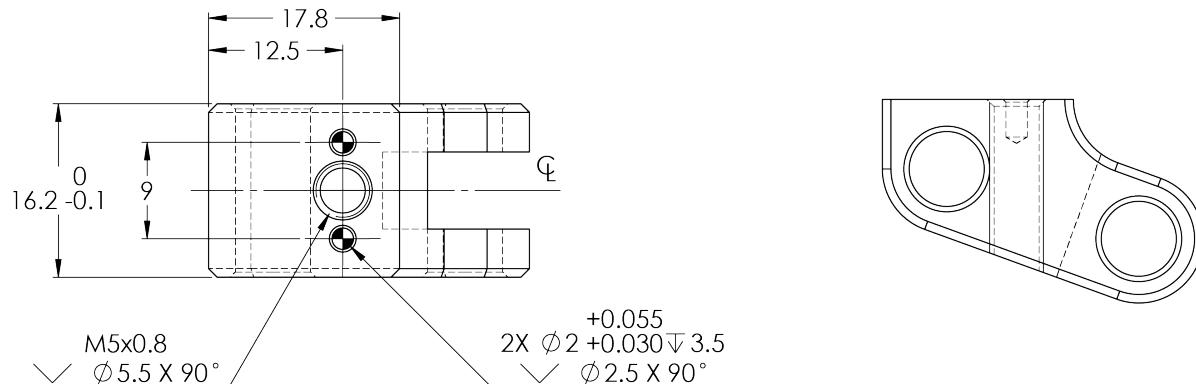


Fig. 6-13: Distal phalanx for holding standard or custom fingertips.

Tip

Custom fingertips will still be subject to the equilibrium line rule for proper actuation of the Gripper, see General Presentation section.



Flat silicone fingertip

The figure below represents a flat silicone fingertip AGC-TIP-204-085 (2F-85) and AGC-TIP-420-140 (2F-140); please refer to the **Spare Parts, Kits and Accessories** section. This fingertip has a flat silicone surface with an optimal friction coefficient for picking objects while the other surface will mount onto the fingertip holder shown in the **Fingertips** section.

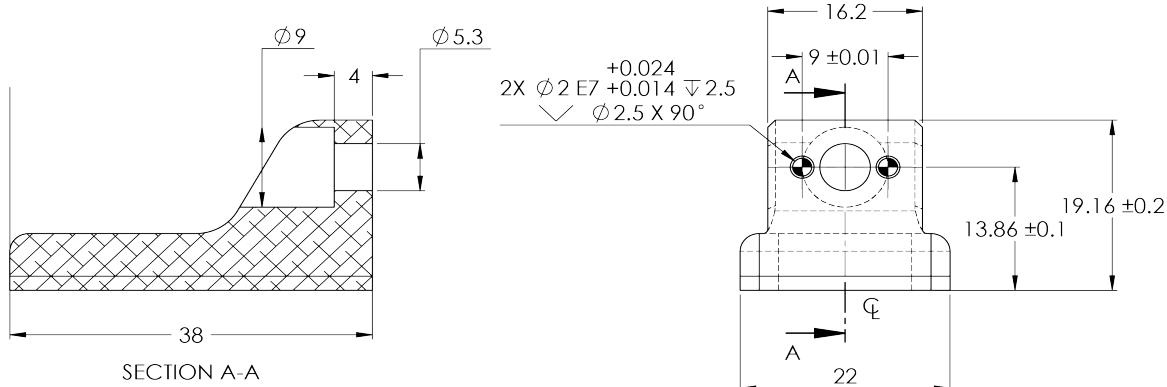


Fig. 6-14: Flat silicone fingertip AGC-TIP-204-085

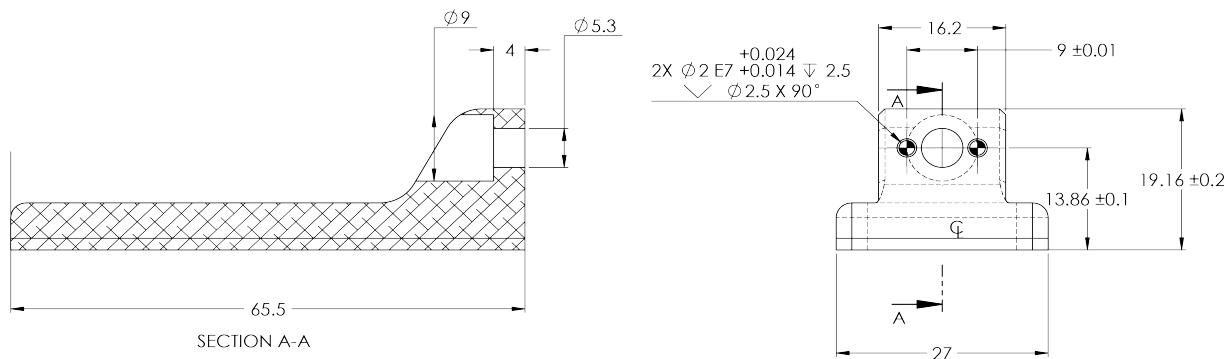


Fig. 6-15: Flat silicone fingertip AGC-TIP-420-140



Grooved fingertip

The figure below represents the available grooved fingertip **AGC-TIP-205-085** (2-Finger 85) and **AGC-TIP-421-140** (2-Finger 140); please refer to the **Spare Parts, Kits and Accessories** section. This fingertip has a grooved surface with an optimal shape for picking cylindrical objects (with its horizontal and vertical grooves) while the other surface will mount onto the fingertip holder shown in the **Fingertips** section.

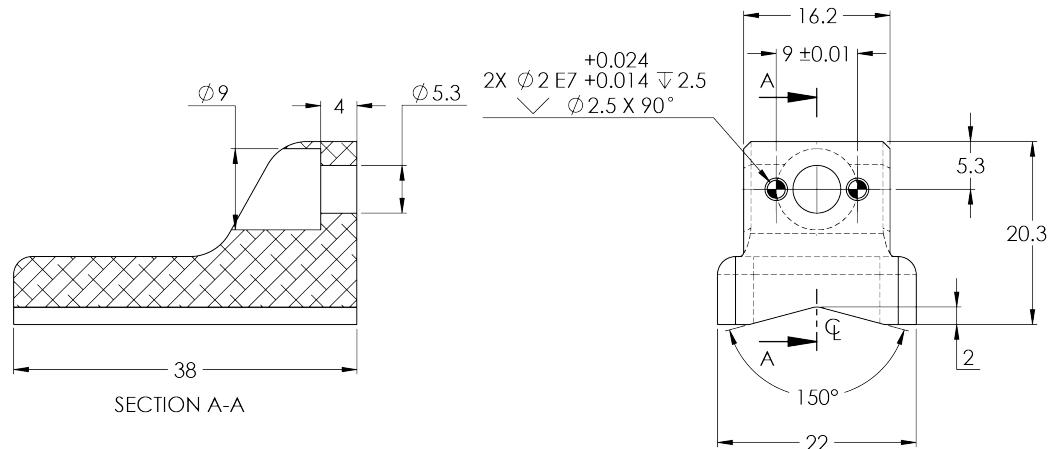


Fig. 6-16: Grooved fingertip AGC-TIP-205-085

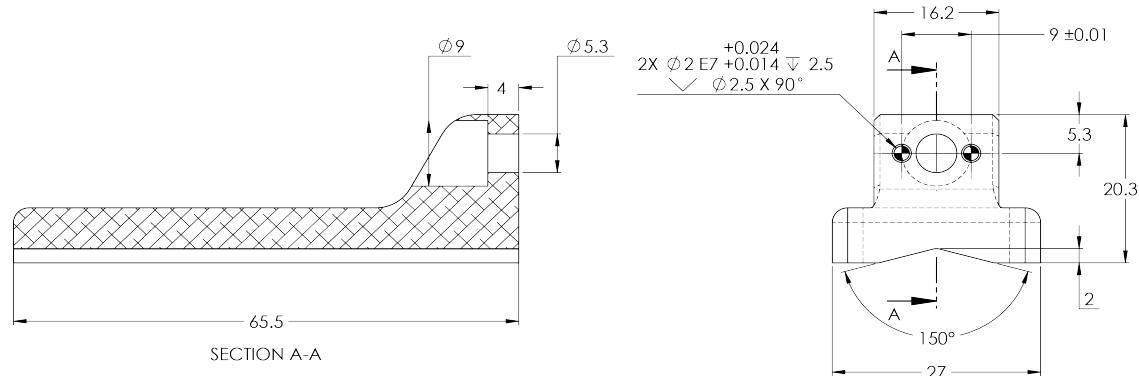


Fig. 6-17: Grooved fingertip AGC-TIP-421-140



6.2. Mechanical specifications

Specification	2-FINGER 85		2-FINGER 140	
	Metric Units	Imperial Units	Metric Units	Imperial Units
Gripper Opening	85 mm	3.35 in	140 mm	5.5 in
Minimum diameter for encompassing	43 mm	1.69 in	90 mm	3.5 in
Maximum height	162.8 mm	6.4 in	232.8 mm	9.15 mm
Maximum width	148.6 mm	5.85 in	202.1 mm	8.0 in
Weight	925 g	2.04 lbs	1,025 g	2.25 lbs
Grasp Force	20 to 235 N	4.49 to 52.83 lbf	10 to 125 N	2.25 to 28.10 lbf
Finger speed	20 to 150 mm/s	0.8 to 5.9 in/s	30 to 250 mm/s	1.2 to 9.8 in/s
Position repeatability ¹	0.05 mm	0.002 in	0.08 mm	0.003 in
Force repeatability	+/- 10%			
Position resolution ²	0.4 mm	0.016 in	0.6 mm	0.022 in
Grasp force resolution	Maximum force calculation below; refer to the Force control section			

Info

All specs are measured with coupling **GRP-CPL-062** and fingertip **AGC-TIP-204-085** (2-Finger 85) or **AGC-TIP-420-140** (2-Finger 140).

¹Repeatability is defined as the positional deviation resulting from the average displacement determined when picking an object with a parallel grasp using standard silicone fingertips. For more details see the [blog.robotiq.com article on repeatability](http://blog.robotiq.com/article/on-repeatability).

²Resolution is the increment modified from a 1 bit difference of position/speed/force request (from 0 to 255).



6.2.1. Payload and force

Actuation force model used to calculate recommended payload is described in the figure below, the user must not exceed the force and torque limits:

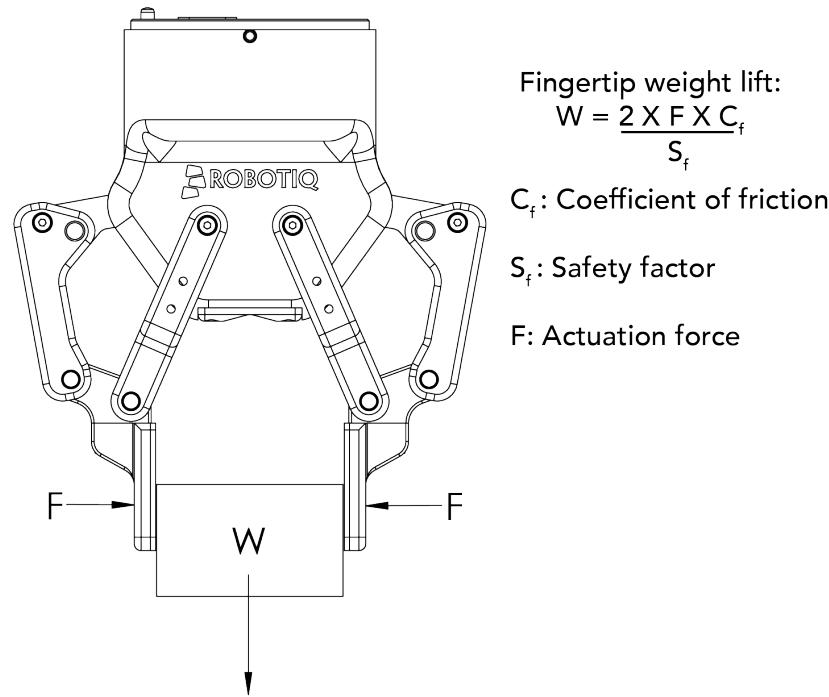


Fig. 6-18: Actuation force on the fingertip of the Adaptive Gripper 2-Finger (see charts below for 2-Finger 85 and 2-Finger 140 force).

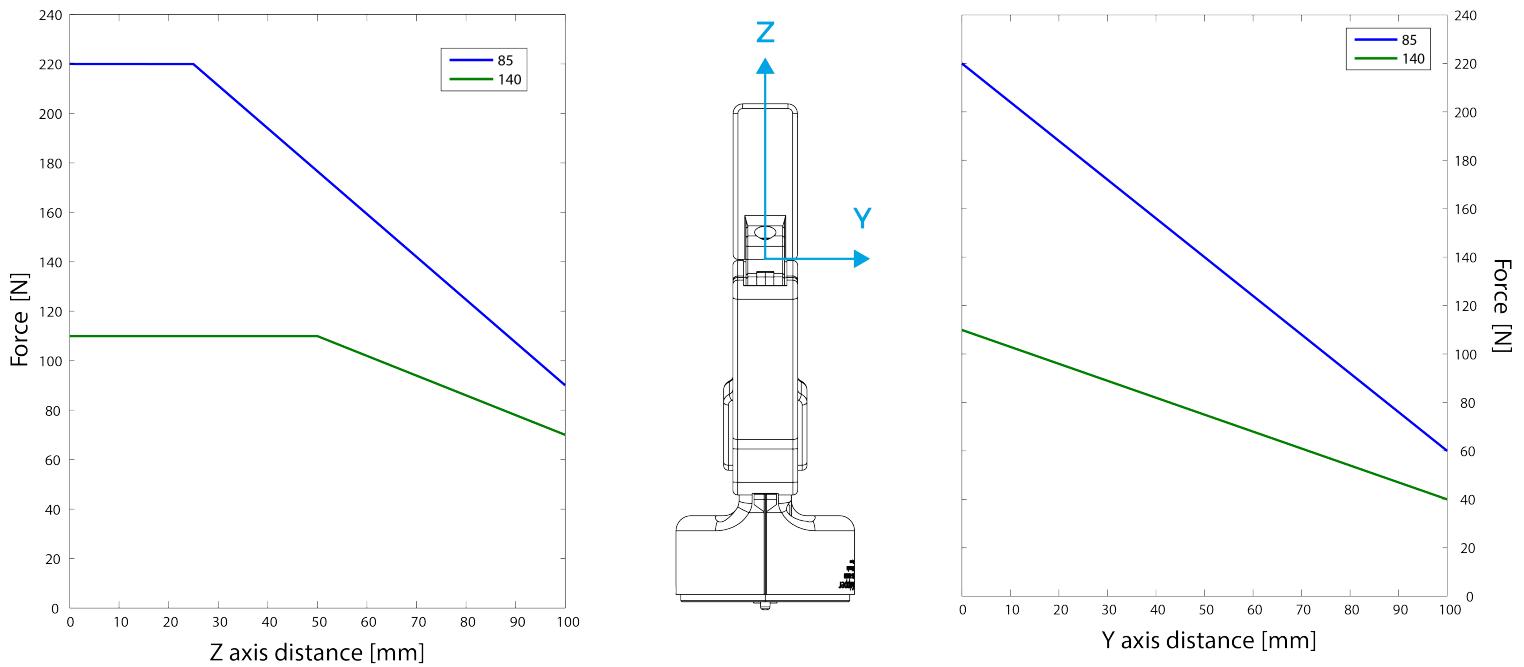


Fig. 6-19: Grasp force in the Y and Z axis for the 2-Finger 85 and 2-Finger 140.



Info

- The "Actuation Force" is the force that can be applied to an object by the motor of the Gripper.
- The Gripper is self-locking.

Info

The user of the Gripper must always ensure that the result of the forces against the finger is always lower than the maximum holding force as seen in figure 6-18.

As defined in figure 6-18, the weight that can be lifted is defined by :

- F is the force that is applied to the load by the Gripper.
- C_f is the friction coefficient between the fingertip and the object load.
- S_f is a safety factor to be determined by the robot integrator.

Info

For example, if the silicone fingertips **AGC-TIP-204** are used to lift a lubricated steel object (machine tending with cutting oils), the friction coefficient would be 0.3 (tested static coefficient of friction).

Maximum weight with a safety factor of 2.4 would be :

$$W = (2 \times 200 \text{ N} \times 0.3) / 2.4 = 50 \text{ N}$$

This calculation means that a 5 kg object will be held by the Gripper when not moving (standing still). When accelerating, the payload will decrease.

For example, if your robot accelerates at $2g$ then the 5 kg object would weigh 100 N and would therefore be dropped.

The biggest factor in such calculations will always be the friction coefficient, we recommend testing the coefficient.

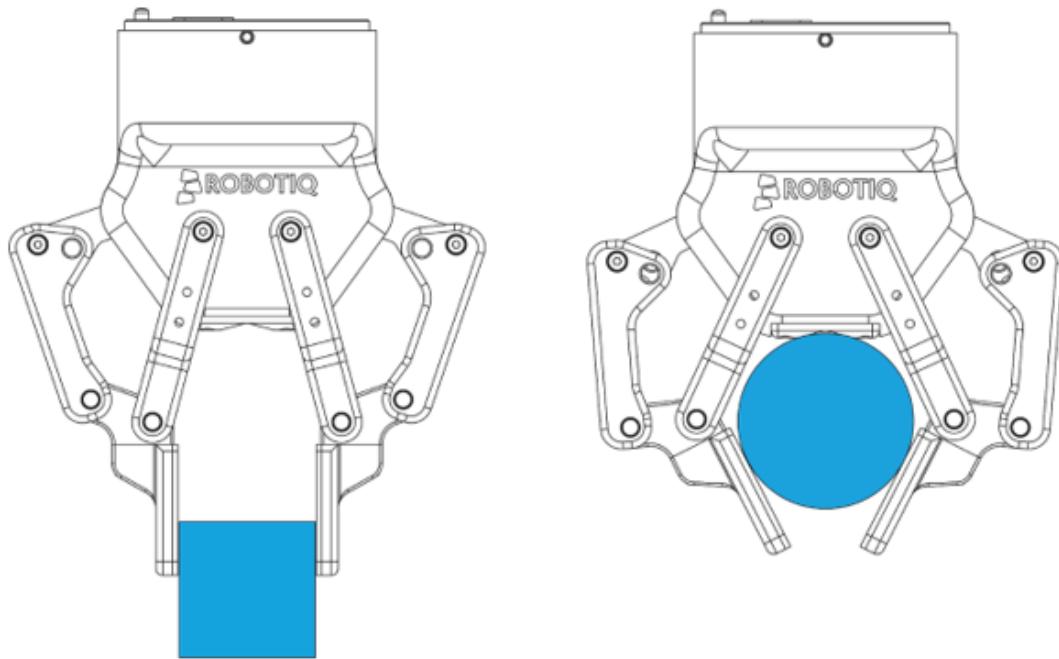
Warning

You must consider the **robot acceleration** in your payload calculations.

Robot emergency stops will lead to major deceleration velocities.



Friction grasp and form-fit grasp



Maximum payload by grasp type

Grasp Type	2F-85	2F-140
Friction grasp	5 kg	2.5 kg
Form-fit grasp	5 kg	2.5 kg



6.2.2. Equilibrium Line

Equilibrium line position (explained in the **General Presentation** section) is detailed in the figure below, where:

- θ is the opening angle between the Gripper proximal bar and center line
- d is the distance between the bottom of the finger pads and the equilibrium line as seen on the Z axis in figure 1-5.

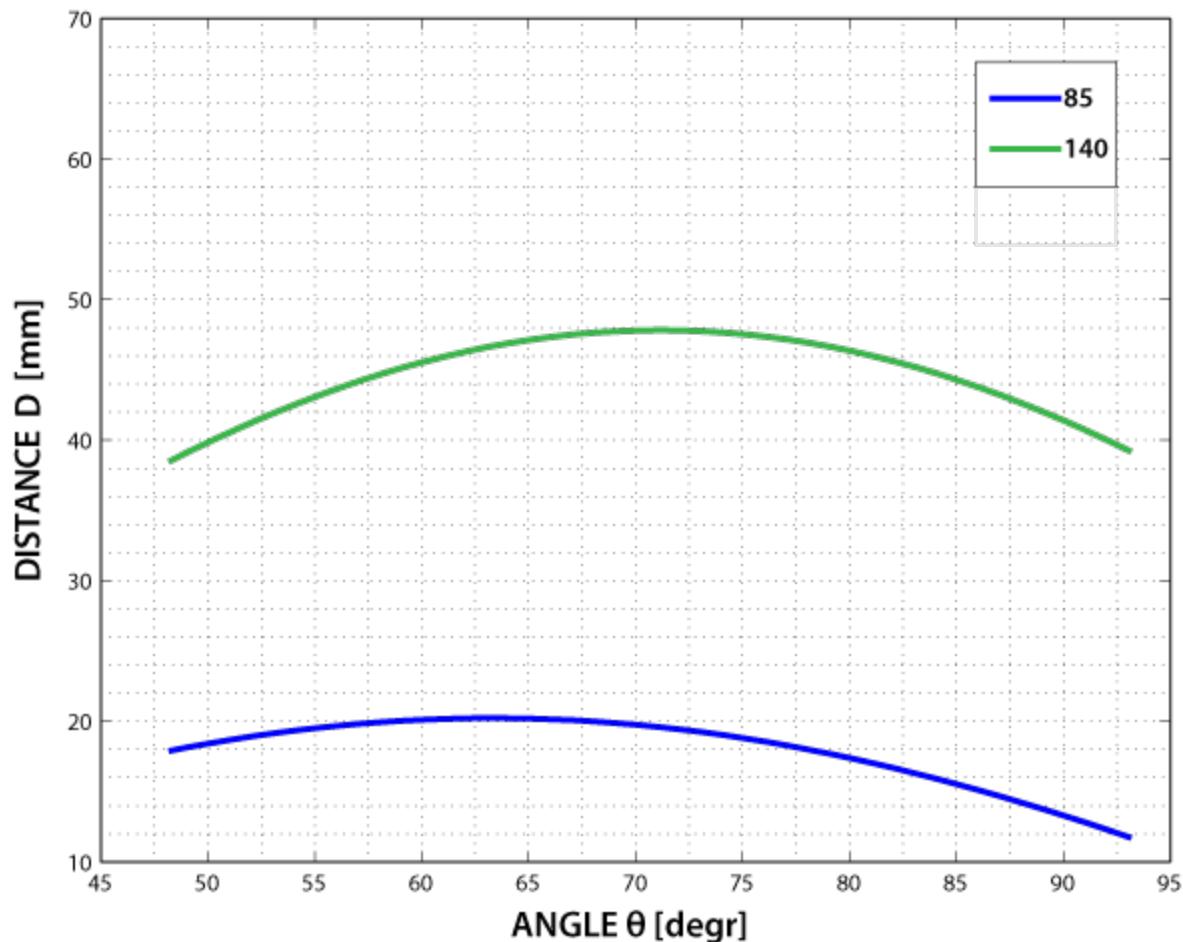


Fig. 6-20: Position of the Gripper equilibrium line according to the opening angle for 2-Finger 85 and 2-Finger 140 options.



6.2.3. Center of mass, tool center point and moment of inertia

Coupling is included when Gripper is not mounted on the Camera. Dual Gripper adapter plate included where appropriate.

Products	Center of mass (mm)			TCP (mm)						Mass (g)	
	X	Y	Z	Gripper 1			Gripper 2				
				X	Y	Z	X	Y	Z		
FT Sensor	-3.0	0.0	17.0	0.0	0.0	37.5	-	-	-	300.0	
Camera	-3.0	4.5	9.0	0.0	0.0	23.5	-	-	-	245.0	
2F-85	0.0	0.0	58.0	0.0	0.0	174.0	-	-	-	925.0	
2F-140	0.0	0.0	73.0	0.0	0.0	244.0	-	-	-	1025.0	
Hand-E	0.0	0.0	57.5	0.0	0.0	157.0	-	-	-	1090.0	
Dual grippers plate	0.0	0.0	15.5	-	-	-	-	-	-	265.0	
FT Sensor + 2F-85	-0.7	0.0	76.3	0.0	0.0	211.5	-	-	-	1225.0	
FT Sensor + 2F-140	-0.7	0.0	89.3	0.0	0.0	281.5	-	-	-	1325.0	
FT Sensor + Hand-E	-0.6	0.0	78.2	0.0	0.0	194.5	-	-	-	1390.0	
Camera + 2F-85	-0.7	1.2	57.1	0.0	0.0	175.5	-	-	-	975.0	
Camera + 2F-140	-0.7	1.1	72.4	0.0	0.0	246.5	-	-	-	1075.0	
Camera + Hand-E	-0.6	1.0	57.4	0.0	0.0	159.5	-	-	-	1135.0	
FT Sensor + Camera + 2F-85	-1.3	0.9	76.3	0.0	0.0	213.0	-	-	-	1275.0	
FT Sensor + Camera + 2F-140	-1.2	0.8	89.6	0.0	0.0	284.0	-	-	-	1375.0	
FT Sensor + Camera + Hand-E	-1.1	0.8	78.6	0.0	0.0	197.0	-	-	-	1435.0	
Hand-E/Hand-E	0.0	0.0	62.0	154.0	0.0	138.0	-154.0	0.0	138.0	2445.0	
Hand-E/2F-85	5.9	0.0	61.7	154.0	0.0	138.0	-166.0	0.0	150.0	2280.0	
Hand-E/2F-140	-2.4	0.0	66.6	154.0	0.0	138.0	-215.5	0.0	199.5	2380.0	
2F-85/2F-85	0.0	0.0	61.4	166.0	0.0	150.0	-166.0	0.0	150.0	2115.0	
2F-85/2F-140	-8.7	0.0	66.6	166.0	0.0	150.0	-215.5	0.0	199.5	2215.0	
2F-140/2F-140	0.0	0.0	71.4	215.5	0.0	199.5	-215.5	0.0	199.5	2315.0	
Camera + Hand-E/Hand-E	-0.3	0.4	78.5	154.0	0.0	161.5	-154.0	0.0	161.5	2690.0	
Camera + Hand-E/2F-85	5.0	0.4	77.8	154.0	0.0	161.5	-166.0	0.0	173.5	2525.0	
Camera + Hand-E/2F-140	-2.5	0.4	82.5	154.0	0.0	161.5	-215.5	0.0	223.0	2625.0	
Camera + 2F-85/2F-85	-0.3	0.5	77.0	166.0	0.0	173.5	-166.0	0.0	173.5	2360.0	
Camera + 2F-85/2F-140	-8.1	0.4	82.1	166.0	0.0	173.5	-215.5	0.0	223.0	2460.0	
Camera + 2F-140/2F-140	-0.3	0.4	86.7	215.5	0.0	223.0	-215.5	0.0	223.0	2560.0	
FT Sensor + Hand-E/Hand-E	-0.3	0.0	90.5	154.0	0.0	175.5	-154.0	0.0	175.5	2745.0	
FT Sensor + Hand-E/2F-85	4.9	0.0	89.7	154.0	0.0	175.5	-166.0	0.0	187.5	2580.0	
FT Sensor + Hand-E/2F-140	-2.5	0.0	94.3	154.0	0.0	175.5	-215.5	0.0	237.0	2680.0	
FT Sensor + 2F-85/2F-85	-0.4	0.0	88.8	166.0	0.0	187.5	-166.0	0.0	187.5	2415.0	
FT Sensor + 2F-85/2F-140	-8.0	0.0	93.7	166.0	0.0	187.5	-215.5	0.0	237.0	2515.0	
FT Sensor + 2F-140/2F-140	-0.3	0.0	98.4	215.5	0.0	237.0	-215.5	0.0	237.0	2615.0	
FT Sensor + Camera + Hand-E/Hand-E	-0.5	0.4	106.1	154.0	0.0	199.0	-154.0	0.0	199.0	2990.0	
FT Sensor + Camera + Hand-E/2F-85	4.2	0.4	104.9	154.0	0.0	199.0	-166.0	0.0	211.0	2825.0	
FT Sensor + Camera + Hand-E/2F-140	-2.5	0.4	109.4	154.0	0.0	199.0	-215.5	0.0	260.5	2925.0	
FT Sensor + Camera + 2F-85/2F-85	-0.6	0.4	103.5	166.0	0.0	211.0	-166.0	0.0	211.0	2660.0	
FT Sensor + Camera + 2F-85/2F-140	-7.6	0.4	108.4	166.0	0.0	211.0	-215.5	0.0	260.5	2760.0	
FT Sensor + Camera + 2F-140/2F-140	-0.6	0.4	112.9	215.5	0.0	260.5	-215.5	0.0	260.5	2860.0	



Info

The angle to calculate the TCP for Grippers mounted on a dual gripper assembly is as follows:

- Rx = 0
- Ry+/Ry- = 0.7854
- Rz = 0

The moment of inertia are calculated for a configuration where the fingers are fully open. Here is the approximate moment of inertia matrix for the Gripper:

2-FINGER 85 OPTION

$$I = \begin{bmatrix} I_{XX} & I_{XY} & I_{XZ} \\ I_{YX} & I_{YY} & I_{YZ} \\ I_{ZX} & I_{ZY} & I_{ZZ} \end{bmatrix} = \begin{bmatrix} 4180 & 0 & 0 \\ 0 & 5080 & 0 \\ 0 & 0 & 1250 \end{bmatrix} = \begin{bmatrix} 14.3 & 0 & 0 \\ 0 & 17.4 & 0 \\ 0 & 0 & 4.3 \end{bmatrix}$$

$kg * mm^2$ $lb * in^2$

2-FINGER 140 OPTION

$$I = \begin{bmatrix} I_{XX} & I_{XY} & I_{XZ} \\ I_{YX} & I_{YY} & I_{YZ} \\ I_{ZX} & I_{ZY} & I_{ZZ} \end{bmatrix} = \begin{bmatrix} 7400 & 0 & 0 \\ 0 & 9320 & 0 \\ 0 & 0 & 2260 \end{bmatrix} = \begin{bmatrix} 25.3 & 0 & 0 \\ 0 & 31.8 & 0 \\ 0 & 0 & 7.7 \end{bmatrix}$$

$kg * mm^2$ $lb * in^2$

Fig. 6-21: Robotiq 2-Finger inertia matrix.



6.2.4. Moment and force limits

The 2-Finger Adaptive Gripper has maximum moments and force limit. The listed moments and forces are independent to the force applied by the Gripper itself on its payload. For payload calculation, refer to the [Mechanical specifications](#) section.

Warning

The following limits must be respected at all time. Calculation of maximum moment and force should include the robot acceleration and a safety factor.

Parameters	Finger Option	
	2-Finger 85	2-Finger 140
Fx, Fy, Fz	50 N	25 N
Mx*	5 Nm	5 Nm
My*	5 Nm	5 Nm
Mz	3 Nm	3 Nm

* Moments in x and y are calculated from the base of the fingertips as shown in figure 6-19.

Example usage of the listed limit :

- After picking its normal payload, the robot can use the 2-Finger 85 Gripper to apply up to 50 N of force in any direction. Applying more than 50 N could damage the Gripper or result in payload loss.
- The Gripper can pick a screwdriver and apply 3 Nm of torque to screw (such moment would be in the Z axis).



6.3. Electrical specifications

SPECIFICATION	VALUE
Operating supply voltage	24 V DC ±10%
Absolute maximum supply voltage	28 V DC
Quiescent power (minimum power consumption)	< 1 W
Peak current	1 A



7. Maintenance

The Adaptive Gripper requires only external maintenance with limited downtime. Maintenance for both 2-Finger Adaptive Robot Grippers is required after specified usage, measured in time (normal 40h week) or in cycles (requesting an open and closed movement from the Gripper).

Following the maintenance interval will ensure :

- Correct functioning of your Gripper.
- Validity of your warranty.
- Proper lifetime for your Gripper.

Please visit support.robotiq.com for details on the maintenance operation.

Warning

Unless specified, any **repairs** done on the Gripper will be done by Robotiq.

Info

A cycle is defined as a **go to requested position** command that results in grasp force being applied (picking an object while opening or closing or closing the fingers on themselves).



Operation	Daily	Weekly	Semiannually (or 1 M cycles)	Annually (or 2 M cycles)
Gripper Cleaning	Dirty conditions	Normal conditions		
Periodic Inspection			X	
Finger Pad Replacement ¹			X	
Overhaul ²				X

Table 7-1: Maintenance intervals for the 2-Finger Grippers

¹Replace pads before if wear is visible.

²Overhaul is recommended after 2M cycles and is done by Robotiq at the user's expense, please contact Robotiq support.

Caution

Maintenance operations are for the average normal usage of the Gripper, the maintenance intervals must be adjusted according to environmental conditions such as:

- Operating temperature
- Humidity
- Presence of chemical(s)
- Presence of physical objects (debris, scraps, dust, grease etc.)
- Interaction with operated parts (sharp or rough)
- Dynamics of the operation (accelerations)

7.1. Gripper cleaning

Maintenance Interval	Tools You Need	Parts You Need
Weekly or daily in dirty operating conditions	<ul style="list-style-type: none"> • Flat head precision 2 mm screwdriver • 4 mm hex key • Dry tissue or towel • Medium strength thread locker 	None

Caution

The Robotiq 2-Finger Adaptive Robot Gripper is not waterproof or water resistant without additional protection, only clean the Gripper with a dry towel.

Info

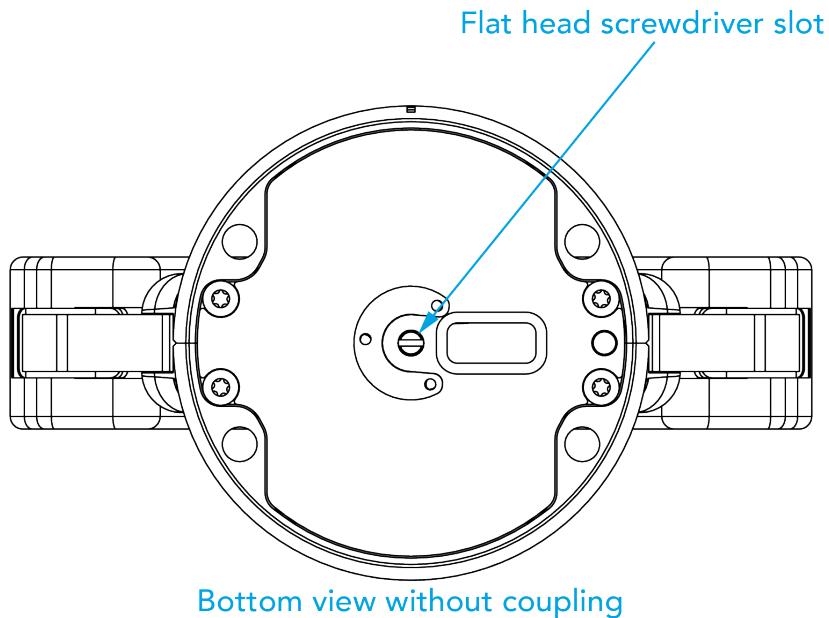


Always turn off the robot and Gripper power supply before performing any maintenance operations on the Gripper.

Caution

Maintenance operator must be grounded to prevent electrostatic discharge that could damage the Gripper electronics.

1. Remove the Gripper from its coupling using the 4 mm hex key to unscrew the four (4) M5-0.8 x 25mm socket head cap screws. Note that each screw uses a tooth lock washer, do not lose them.
2. Use the flat head precision screwdriver to open or close the Gripper by accessing the transmission shaft under the Gripper, where the coupling connects. Illustrated in the figure below.
 - a. Open or close to access the palm pad and other parts of the Gripper.
3. Clean the Gripper with a dry towel, remove all debris, dirt and dust from the surface of the Gripper, clean all pads, dry thoroughly.
4. Clean the coupling with a dry towel, pay particular attention to the electrical contact.
5. Visually inspect the Gripper and pay attention to any visible damage.
6. Put the coupling back on and fix it with the four (4) M5-0.8 x 25mm socket head cap screws, use the tooth lock washers, apply medium strength thread locker to the M5 screws.



Bottom view without coupling

Fig. 7-1: Flat head screwdriver slot for manual opening and closing of the Gripper.



7.2. Periodic inspection

Maintenance Interval	Tools You Need	Parts You Need
Monthly	<ul style="list-style-type: none"> • Flat head precision 2 mm screwdriver • 4 mm hex key • Dry tissue or towel • Medium strength thread locker 	None (unless damage is detected)

Info

Always turn off robot and Gripper power supply before doing maintenance operations on the Gripper.

1. Remove and clean the Gripper following instructions in the [Gripper cleaning](#) section.
2. Inspect the Gripper :
 - a. Finger movement must be symmetric and fluid:
 - i. Test the return movement by pushing fingers open, the fingers must come back to the initial starting position on its own.
 - ii. Test the general movement of the fingers by actuation using the screwdriver insertion hole in the chassis.
 - b. Finger pad wear must not affect grasping, if wear is visible and affects movement, change fingerpad(s).
 - c. Check for any collision damage, if damage is visible, contact support@robotiq.com.
 - d. Check for any sign of wear on the Gripper chassis, if wear is present and may affect the Gripper, contact support@robotiq.com.
3. Put back in place respecting instructions from the [Gripper cleaning](#) section.



7.3. Fingertip replacement

Maintenance Interval	Tools You Need	Parts You Need
1 Million cycles or when wear is visible	<ul style="list-style-type: none">• Flat head 2 mm precision screwdriver• 4 mm hex key• Dry tissue or towel• low strength thread locker• medium strength thread locker	2 x Robotiq 2-Finger Adaptive Robot Gripper fingertip (silicone pad or V-grooved).

Refer to the [Spare Parts, Kits and Accessories](#) section to order Robotiq 2-Finger Adaptive Robot Gripper replacement parts.

Info

Always turn off robot and Gripper power supply before doing maintenance operations on the Gripper.

1. Remove and clean the Gripper following instructions from the [Gripper cleaning](#) section.
2. Remove the worn fingertip by removing the M5 screws with the 4 mm hex key; make sure not to mislay the 2 mm indexing pins.
3. Clean the fingertip holder and dry thoroughly.
4. Insert the new fingertip by inserting the indexing pin in the fingertip holder.
5. Fix the fingertip using the provided M5-0.5 x 8 mm socket head cap screws, apply low strength threadlocker to the M5 screw threads.
6. Repeat for remaining finger.



7.4. Overhaul

Maintenance Interval	Tools You Need	Parts You Need
2 Million cycles or at warranty expiration	None	None

Gripper overhaul is necessary when the Gripper reaches 2 Million cycles or when warranty expires. Overhaul is done by Robotiq, please contact Robotiq support service.

Gripper overhaul includes, but is not limited to :

- Worn parts changed
 - Power transmission gearing mechanism
 - Plain bearings
 - Ball bearings
- Quality control
 - Specification test (force, speed, position)

Overhaul takes a maximum of 5 business days after reaching Robotiq, shipping is at customer's expense.

Tip

Loan units are available while your Gripper is under maintenance.



8. Spare Parts, Kits and Accessories

Spare parts, kits and accessories list:

Info

The following list is up to date at print time and is subject to change, check online for updates.

Info

Unless specified, screws, dowel pins and other hardware are included only for the Gripper side, never for the robot side.

Item	Description	Ordering Number (2-Finger 85)	Ordering Number (2-Finger 140)
Gripper basic unit	Adaptive Robot Gripper 2-Finger basic unit with fingers (no fingertips, no coupling)	AGC-GRP-2F85	AGC-GRP-2F140
Kit for Universal Robots (CB-Series)	Gripper basic unit, 10 m cable and coupling for Universal Robots with silicone fingertips	AGC-UR-KIT-002	AGC-UR-KIT-140
Kit for Universal Robots (e-Series)	Gripper basic unit, silicone fingertips, and cable-to-wrist coupling for Universal Robots	AGC-ES-UR-KIT-85	AGC-ES-UR-KIT-140
Controller	Optional controller for industrial communications see Robotiq Universal Controller Items	UNI-CTR-XXXX	
Finger Kit	Finger upgrade kit for 85 or 140 mm option. Included: <ul style="list-style-type: none">• 2 x Replacement finger• 2 x Hardware kit• 1 x hex key	AGC-FIN-KIT-85-V4	AGC-FIN-KIT-140-V4
Blank coupling	Blank coupling for Adaptive Robot Gripper 2-Finger, with screws for Gripper fixation and 1 m pigtail cable	AGC-CPL-BLANK-002	
ISO-9409-1-50-4-M6 coupling (coupling-to-wrist)	ISO 9409-1-50-4-M6 coupling for 2-Finger Robot Grippers, with screws for Gripper fixation	GRP-CPL-062	
ISO 9409-1-50-4-M6 coupling (coupling to controller)	ISO 9409-1-50-4-M6 coupling for 2-Finger Robot Grippers, with screws for Gripper fixation and 1 m pigtail cable	AGC-CPL-062-002	
ISO 9409-1-31.5-4-M5 coupling	ISO 9409-1-31.5-4-M5 coupling for Adaptive Robot Gripper 2-Finger, with screws for Gripper fixation and 1 m pigtail cable	AGC-CPL-063-002	



Item	Description	Ordering Number (2-Finger 85)	Ordering Number (2-Finger 140)
ISO 9409-1-40-4-M6 coupling	ISO 9409-1-40-4-M6 coupling for Adaptive Robot GripperGripper 2-Finger, with screws for Gripper fixation and 1 m pigtail cable	AGC-CPL-064-002	
56-8M4-1D4 coupling	Coupling for 56 mm PCD1 with (8) M4 and (1) 4mm indexing pin, with screws for 2-F Gripper fixation and 1 m pigtail cable	AGC-CPL-065-002	
56-6M4-1D6 coupling	Coupling for 56 mm PCD1 with (6) M4 and (1) 6mm indexing pin, with screws for 2-F Gripper fixation and 1 m pigtail cable	AGC-CPL-066-002	
60-405-1D5 coupling	Coupling for 60 mmPCD1 with (4) M5 thread and (1) 5mm indexing pin, with screws for 2-F Gripper fixation and 1 m pigtail cable	AGC-CPL-067-002	
63-6M6-2D6 coupling	Coupling for 63 mm PCD1 with (6) M6 and (2) 6mm indexing pins, with screws for 2-F Gripper fixation and 1 m pigtail cable	AGC-CPL-068-002	
40-4M5-1D3 coupling	Coupling for 40 mm PCD1 with (4) M5 and (1) 3mm indexing pins, with screws for 2-F Gripper fixation and 1 m pigtail cable	AGC-CPL-070-002	
31.5-4M4 coupling	Coupling for 31.5 mm PCD1 with (4) M4, with screws for 2-F Gripper fixation and 1 m pigtail cable	AGC-CPL-071-002	
Adapter plate to 63-4M6-71-2D3	Wrist adapter plate for use with AGC-CPL-064-002. Interface to 63 mm PCD1 with (4) M6 screws and 71 mm PCD1 with (2) M3 indexing pins	AGC-APL-151-002	
Adapter plate to 63-4M6-61_4-2D6	Wrist adapter plate for use with AGC-CPL-064-002. Interface to 63 mm PCD1 with (4) M6 screws and 61.4 mm PCD 1 with (2) M6 indexing pins	AGC-APL-152-002	
Adapter plate to 80-6M8-2D82D8	Wrist adapter plate for use with AGC-CPL-064-002. Interface to 80 mm PCD1 with (6) M8 screws and (2) M8 indexing pins	AGC-APL-153-002	
2-Finger Device Cable (5M)	5 m Robotiq device cable for power and communication. Straight M12 5-pins female on one side, single ended on the other, shielded	CBL-COM-2065-05	
2-Finger Device Cable (10M)	10 m Robotiq device cable for power and communication. Straight M12 5-pins female on one side, single ended on the other, shielded	CBL-COM-2065-10	
USB to RS485 adapter	USB to RS485 adapter, can be used with device cable for USB connection	ACC-ADT-USB-RS485	
Silicone fingertip ²	Flat silicone fingertip for 2-Finger Adaptive Gripper, included: <ul style="list-style-type: none">• one (1) silicone fingertip.• two (2) dowel pins (dia. 2 x 6 mm)	AGC-TIP-204-085	AGC-TIP-420-140



Item	Description	Ordering Number (2-Finger 85)	Ordering Number (2-Finger 140)
	<ul style="list-style-type: none"> two (2) screws (M5-0.5 x 12 mm SHCS) 		
Grooved fingertip ²	<p>Grooved aluminium fingertip for 2-Finger Adaptive Gripper, included:</p> <ul style="list-style-type: none"> one (1) V-grooved fingertip two (2) screws M5-0.5 x 12 mm SHCS two (2) dowel pins dia. 2 x 6 mm 	AGC-TIP-205-085	AGC-TIP-421-140
Replacement finger	<p>Replacement finger for 2-Finger Adaptive Gripper, included:</p> <ul style="list-style-type: none"> One (1) finger Four (4) screws M3-0.5 X 8 LHCS One (1) proximal locking shaft One (1) link/bar locking shaft 	AGC-FIN-085	AGC-FIN-140
Finger Protector ²	<p>Protector for 2-Finger Adaptive Gripper, included:</p> <ul style="list-style-type: none"> One (1) protector Four (4) M3 screws 	AGC-PRO-KIT-V4	N/A
Parallel locking shaft ²	<p>Parallel mechanism locking shaft for 2-Finger Adaptive Gripper, included :</p> <ul style="list-style-type: none"> One (1) parallel locking shaft Two (2) M3 screws 		AGC-PARA-KIT

¹Pitch Circle Diameter

²Part listed for two units, since two are required per Gripper.

Tip

For legacy part replacement visit the documentation archives and the appropriate manual or consult your Robotiq distributor.



9. Troubleshooting

When using 2-Finger with USB to RS485 serial converter:

Troubleshooting from the Gripper LED:

1. LED is not lit, Gripper not powered.
 - a. Check Gripper power supply and electrical setup
2. LED is solid blue and red, Gripper is in fault.
 - a. Disconnect the communication and power cycle the Gripper. The LED should turn solid red when powered.
 - b. While powered with red LED, connect the communication, LED should turn solid blue when connection is established.
3. Flashing blue and red LED, Gripper is in fault.
 - a. Gripper may be in auto-release, wait for auto-release to be completed, then turn off auto-release and initialize the Gripper.
 - b. Gripper may have a major fault, check the error from fault status and contact support.
4. Solid blue, no fault and communicating.
 - a. If you can control the Gripper from the GUI on the pendant, check your program structure.
 - b. If you can not control the Gripper from the pendant, contact support.
5. Solid red, no fault, but Gripper is not communicating.
 - a. USB-RS485 converter LEDs are :
 - Not lit, no USB communication.
 - i. Check USB connection.
 - ii. Re-install drivers.
 - iii. Contact support.
 - Red flashes at slow rate.
 - i. Check the DB-9 connector.
 - ii. Check the cable.
 - iii. Check the communication parameters from the Robotiq User Interface, see recovery procedure.
 - iv. Contact support.
 - Red and green flashing at high speed.
 - i. Check fault status, maximum operating temperature could be exceeded.
 - ii. Contact support.



When using 2-Finger with Universal Robots package:

Troubleshooting from the previous section (LED references) still applies.

From the UR teach pendant:

URCap install:

1. Verify that the latest URCap is installed by tapping the **triple bar icon** in the upper right corner, selecting **Settings**, then tapping the **System** menu and the **URCaps** button in the navigation pane on the left
 - a. URCaps installation instructions are in the **Installing URCap Package** section
 - b. Inside the URCaps menu, if you select the appropriate URCap file, you can see the current software version
 - c. The Gripper toolbar should appear if installed properly
2. URCap is installed but Gripper cannot be controlled :
 1. If Gripper LED is not blue, follow the steps in the first section above
 2. If Gripper LED is blue, URCap is installed with the latest available version, contact support@robotiq.com



Driver package install:

1. Driver checkup :
 - a. Use the latest driver version available at support.robotiq.com
 - Use the installation instruction from the **Installation** section
 - b. To check your driver version :
 - With the Gripper unplugged
 - From the UR teach pendant screen, click the "Gripper" button
 - i. Driver version will be shown
 - ii. If Gripper button is not displayed, driver package is not properly installed, see instruction from the **Control over Universal Robots without URCaps** section
2. Driver is installed but Gripper cannot be controlled :
 - a. If Gripper LED is not blue, follow the steps in the first section above
 - b. If Gripper LED is blue, driver is installed with the latest available version, contact support@robotiq.com



10. Warranty and Patent

Robotiq warrants the 2F-85 and 2F-140 Adaptive Robot Grippers against defects in material and workmanship for a period of one year from the date of reception when utilized as intended. Robotiq also warrants that this equipment will meet applicable specifications under normal use.

Warning

Warranty applies under the following conditions:

- Usage respects the operating and storage conditions specified in Section 3.3
- Proper installation of the Gripper specified in Section 3 and the following subsections.
- Usage under normal one-shift operation (40h a week)
 - Or until a 2 000 000 cycle count¹ has been reached.
- Usage respects maintenance specified in Section 7.
- Usage respects recommended payload and force specified in the **Payload and force** section.

¹Cycle count: One (1) cycle is defined as an object picking attempt, successful or not (open or closing onto an object, or closing on itself). It is calculated in the internal memory of the 2-Finger Adaptive Gripper and can be seen with the Robotiq User Interface.

During the warranty period, Robotiq will repair or replace any defective 2-Finger Adaptive Robot Gripper, as well as verify and adjust the Gripper free of charge if the equipment should need to be repaired or if the original adjustment is erroneous. If the equipment is sent back for verification during the warranty period and found to meet all published specifications, Robotiq will charge standard verification fees.

The unit is considered defective when at least one of the following conditions occurs :

- The Gripper fingers cannot close or open;
- The Gripper feedback necessary for the robot program is not accessible.

Parts that come into contact with the work piece and wearing parts such as the finger and palm pads are not covered by the warranty.

Caution

The warranty will become null and void if the :

- Unit has been tampered with, repaired or worked on by unauthorized individuals.
- Warranty sticker has been removed.
- Screws, other than as explained in this guide, have been removed.
- Unit has been opened other than as explained in this guide.
- Unit serial number has been altered, erased, or removed.
- Unit has been misused, neglected, or damaged by accident.



This warranty is in lieu of all other warranties expressed, implied, or statutory, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. In no event shall Robotiq be liable for special, incidental, or consequential damages.

Robotiq shall not be liable for damages resulting from the use of the Robotiq 2-Finger Adaptive Robot Gripper, nor shall Robotiq be responsible for any failure in the performance of other items to which the 2-Finger Adaptive Robot Gripper is connected or the operation of any system of which the Gripper may be a part.



Exclusions

This warranty excludes failure resulting from: improper use or installation, normal wear and tear, accident, abuse, neglect, fire, water, lightning or other acts of nature, causes external to the Gripper or other factors beyond Robotiq's control.

Robotiq reserves the right to make changes in the design or construction of any of its products at any time without incurring any obligation to make any changes whatsoever on units already purchased.

Patent

This product incorporates technology developed by Lionel Birglen, professor at Polytechnique Montreal, and is used under license of Polyvalor LP.



11. Contact

www.robotiq.com

Contact Us

Phone

1-888-ROBOTIQ (762-6847)
(01) 418-380-2788 Outside US and Canada

Fax

1-418-800-0046

Technical support and engineering

option 3

Sales

option 2

Head office

Robotiq:
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St-Nicolas, Québec
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Canada



Where automation Pros come to share their know-how and get answers.

dof.robotiq.com



12. Harmonized Standards, Declarations and Certificates

12.1. Translation of original EC declaration of incorporation



Translation of original declaration of incorporation

In terms of the Directive 2006/42/EC, Annex II, part B of the European Parliament and of the Council on machinery,

We, the manufacturer, **Robotiq Inc.**
966, Chemin Olivier, suite 325
Lévis, Québec, Canada, G7A 2N1

Hereby declare that the following product:

Robotiq 2-Finger Adaptive Gripper – 85 / 140

Meets the applicable basic requirements of the **Machinery Directive 2006/42/EC**

The incomplete machine may not be put into operation until conformity of the machine into which the incomplete machine is to be installed with the provisions of the Machinery Directive is confirmed. Compliance with all essential requirements of Machinery Directive relies on the specific robot application and overall risk assessment.

The manufacturer agrees to forward on demand of national authorities the relevant technical documents specified by Annex VII part B within the required time.

Additionally the product declares in conformity with the following directives, according to which the product is CE marked:

2004/108/EC Electromagnetic Compatibility Directive (EMC)

2011/65/EU Restriction of the use of certain hazardous substances (ROHS)

Person responsible for documentation: Mr. Étienne Samson, address: see manufacturer address

Lévis, September 2015
(place and date of emission)

Jean-Philippe Jobin
Chief Technical Officer
Robotiq Inc.



12.2. Applied standards

This section describes all applied harmonized standards for the design and production of the Robotiq 2-Finger Adaptive Gripper. Standards are applied where applicable, some points may not be applied if not applicable to this specific product. Conformity is not enforced by any laws, it is self-applied and the aim is to define normal safety and performance requirements for similar products.

Caution

Conformity of the product is only met if all instructions of the following manual are followed. Among others; installation, safety measure and normal usage must be respected.

The following standards have been applied:

NF EN ISO 14539	2000	Manipulating industrial robots — Object handling with grasp-type grippers — Vocabulary and presentation of characteristics
NF EN ISO 12100	2010	Safety of machinery — General principles for design — Risk assessment and risk reduction
NF EN IEC 60204-1	2006	Safety of machinery — Electrical equipment of machines — Part 1: General requirements

