
ADAPTIVE ROBOT GRIPPER

2-FINGER (85 & 140)

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: <http://support.robotiq.com/>.

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

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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

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Official release

Revision 2012/03/02

Beta release

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Information provided by Robotiq in this document is believed to be accurate and reliable. However, no responsibility is assumed by Robotiq for its use. There may be some differences between the manual and the product if the product has been modified after the edition date.

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" and "2-Finger 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 (2-Finger 85 Adaptive Gripper) or 140 mm (2-Finger 140 Adaptive Gripper). 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 parts of varying sizes and shapes.

Note

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

Note

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

Note

The following section presents the key features of the Gripper and must not be considered as appropriate to 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 Gripper.

Gripper nomenclature :

The 2-Finger Gripper has two articulated fingers that each have two joints (two phalanges per finger), as shown in Figure 1.1. The 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 grip and it also simplifies the control of the Gripper.

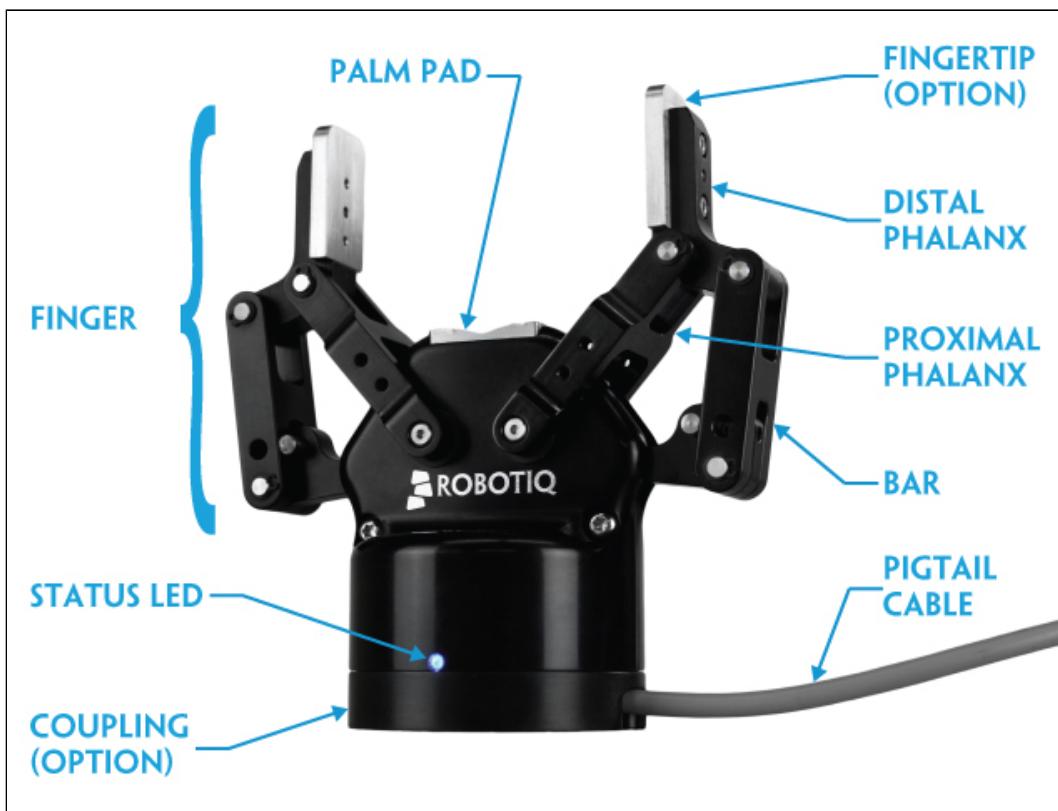


Figure 1.1 : The 2-Finger Adaptive Robot Gripper.

See section 3.1 Scope of delivery for details on standard and optional parts.

The status LED presented in Figure 1.1 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 [Section 4](#).
- blinking red/blue if major fault occurs, see status details in [Section 4](#).

2-Finger 85 vs 2-Finger 140 :

The 2-Finger Gripper comes with either 85 mm opening (2-Finger 85) or 140 mm opening (2-Finger 140) according to Figure 1.2. the Gripper chassis will remain the same, only the fingers will change, see [Section 3.4](#) for on the 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](#).

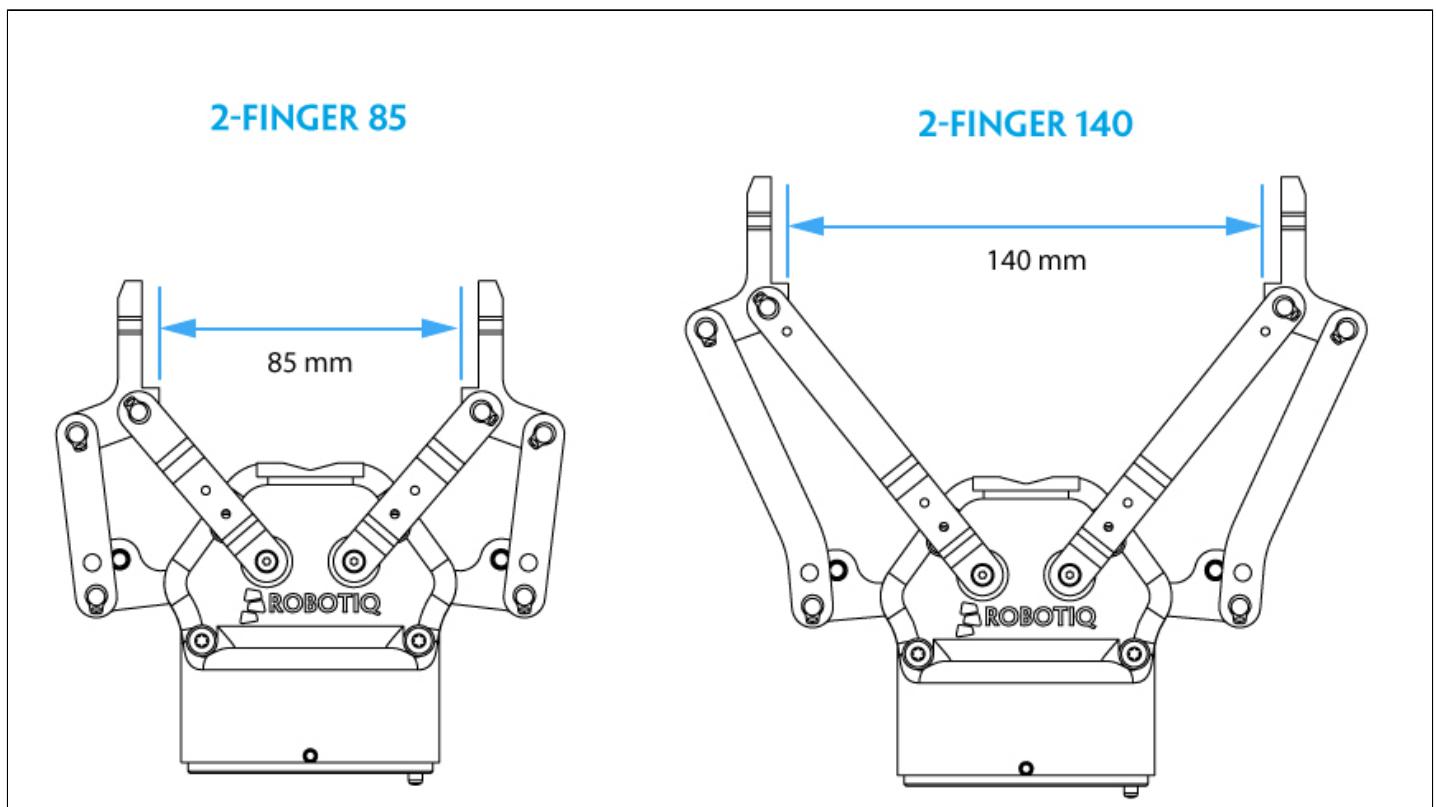


Figure 1.2 : The 2-Finger 85 and 140 mm versions.

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 grip or encompassing grip as shown in Figure 1.3.

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 grip is decided at the Gripper level automatically.** It will depend on:

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

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

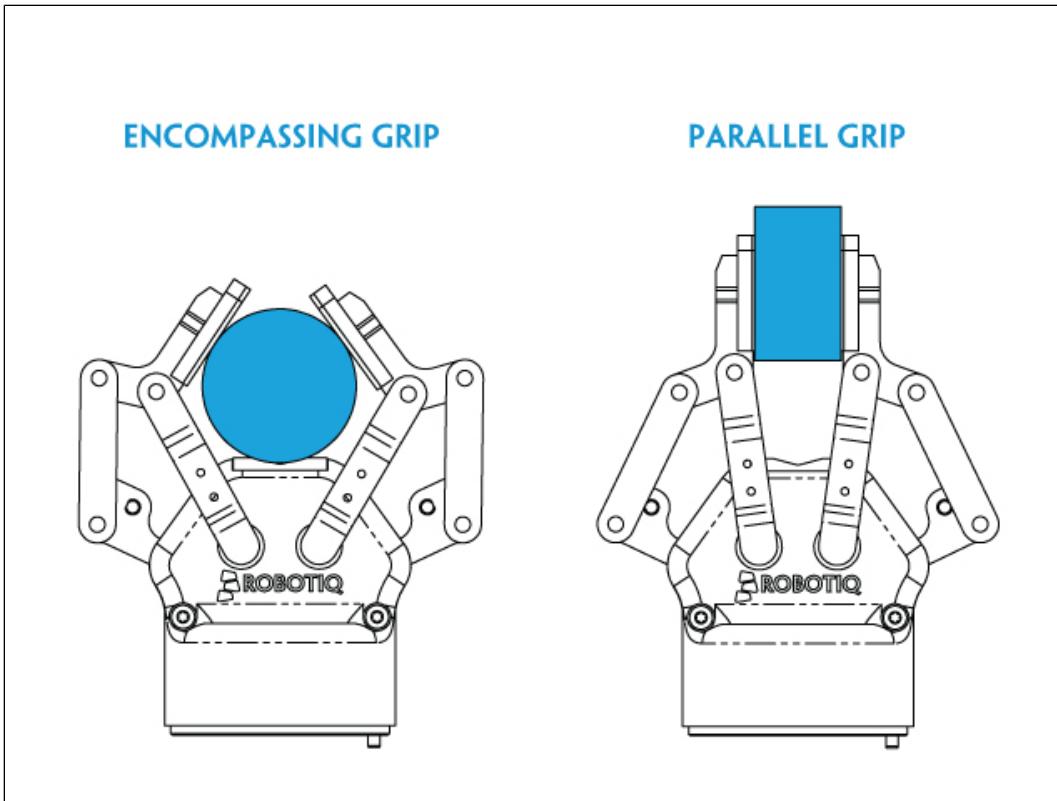


Figure 1.3 : 2-Finger parallel and encompassing grips.

Note

It is important to note that a fingertip grip 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. See Figure 1.4 below for a visual representation of the parallel and encompassing grip regions on the distal phalanx of the 2-Finger Gripper.

The 2-Finger Adaptive Robot Gripper also offers internal gripping. The fingers can pick hollow parts from the inside by applying pressure with the outside of the fingers. See Figure 1.4 for a representation and see [Section 4.5](#) for details on the possible position commands of your Gripper.

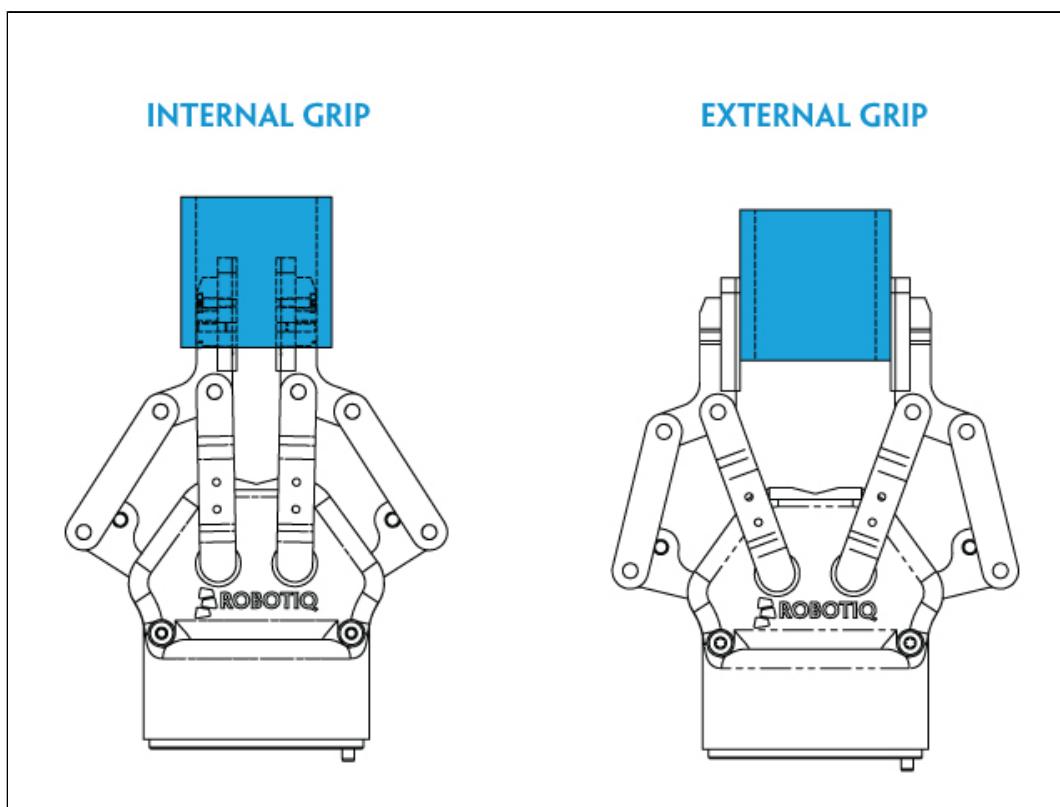


Figure 1.4 : 2-Finger internal and external gripping.

The Gripper equilibrium line is the gripping region that separates the encompassing grip from the parallel grip. When gripping an object close enough to the inside (palm) of the Gripper, the encompassing grip will occur (unless the object size or shape is not adequate) and the fingers will close around the object. If gripped above the equilibrium line, the same object will be picked up in a parallel grip by the fingertips and the fingers will close with a parallel motion. Figure 1.5 shows the **encompassing grip region**, the **equilibrium line**, and the **parallel grip region** on the 2-Finger Adaptive Robot Gripper.

Info

The details of the equilibrium line relation between opening angle θ and the related position d can be found in section 6.2 Mechanical Specifications.

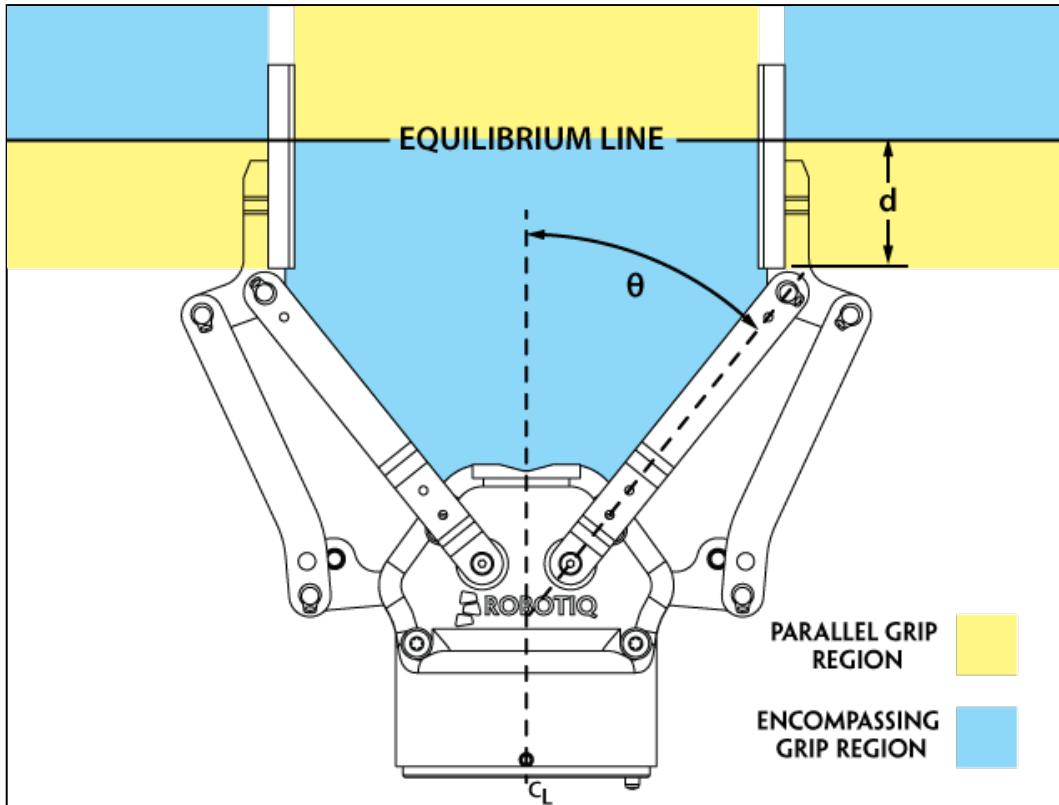


Figure 1.5 : Equilibrium line on the 2-Finger, shown with no fingertip pads.

Tip

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

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).

Info

[Robotiq Universal Controller](#) is available when industrial communication protocols are required (other than Modbus RTU over serial).

Gripper Coupling is required for 2-Finger usage, the Coupling will provide mechanical and electrical connectivity. See [Section 3.4](#) for installation of the Coupling, [Section 6.1](#) for tech drawings, [Section 8](#) 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.

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

Note

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.

Risk assessment and final application :

The Robotiq 2-Finger 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 gripping and temporarily securing or holding parts.

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.

Note

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.

- Section 3.1 details the scope of delivery for the 2-Finger, verify your package.
- Section 3.2 lists the required tools, parts and equipment for proper use of your Gripper.
- Section 3.3 explains the operating conditions that must be met for the 2-Finger to operate normally.
- Section 3.4 guides you through the mechanical installation using the 2-Finger Coupling and other optional parts.
- Section 3.5 describes the required electrical set up of the Gripper, its power source and communication wiring.
- Section 3.6 explains how to test the Gripper via the Robotiq User Interface.
- Finally, Section 3.7 explains how to get and install software packages meant to control your Gripper with Universal Robots

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

Robotiq 2-Finger Adaptive Robot Gripper 85 :

Standard upon delivery :

- Robotiq 2-Finger 85 Adaptive Gripper complete unit: **AGC-GRP-002**
 - 85 mm opening fingers without fingertips or pads (these are bought separately unless specified)
 - Palm pad
- USB to RS-485 signal converter: **ACC-ADT-USB-RS485**

Depending on your choice :

- Coupling according to your robot bolt pattern: **AGC-CPL-XXX-002**

Info

See [Spare Parts, Kits and Accessories](#) section for a list of available couplings.

- Robotiq device cable :
 - **CBL-COM-2065-05** for 5 meters cable
 - **CBL-COM-2065-10** for 10 meters cable

Robotiq 2-Finger Adaptive Robot Gripper 140 :

Standard upon delivery :

- Robotiq 2-Finger 140 Adaptive Gripper complete unit: **AGC-GRP-140**
 - 140 mm fingers without fingertips or pads (these are bought separately unless specified)
 - Palm pad
- USB to RS-485 signal converter: **ACC-ADT-USB-RS485**

Depending on your choice :

- Coupling according to your robot bolt pattern: **AGC-CPL-XXX-002**

Info

See [Spare Parts, Kits and Accessories](#) section for a list of available couplings.

- Robotiq device cable :
 - **CBL-COM-2065-05** for 5 meters cable
 - **CBL-COM-2065-10** for 10 meters cable

Note

The following are **not** included in standard delivery :

- Options such as adapter plates or couplings for mounting on various industrial robots, fingertips or finger pads.
- Hardware required for options; accessories or fixtures for the 2-Finger Adaptive Robot Gripper, unless specified.
- Power supply units, power supply wiring or fuses.

Info

When bought as a kit, the 2-Finger 85 or 140 will come in a package with the appropriate coupling, fingertips or finger pads and cabling. See [Spare Parts, Kits and Accessories](#) section

3.2 Required tools and equipment

The following tools are required to install the 2-Finger Adaptive Robot 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.

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

- 5 - 6 mm snap ring pliers
- 2 mm hex key

The following parts are required for setup :

- Power supply (see below).
- Fuse, see information below.
- Emergency stop is not provided, but its use is strongly advised.

The Gripper needs to be supplied by a DC voltage source. This power supply is not included with the Gripper. Required power supply must match the Robotiq device. The following table shows the specifications with regards to the power supply required to operate the Gripper and the optional Robotiq Controller.

SPECIFICATION	VALUE
Output voltage	24 V DC ±10%
Output current	1 A
Overcurrent	Recommended power supply with internal protection, otherwise fusing is required. 2 A fuse at 25°C [77°F] ¹

Table 3.2.1 : 2-Finger power supply requirements.

Info

¹ Suggested fuse is a: Phoenix Contact # 0916605 2 A thermal, use AWG #20 wiring.

Warning

If your power supply could exceed the specified regulation, over-voltage protection is required.

Robotiq recommends the use of the following power supplies :

- For the 1A output current: TDK-Lambda DPP Series, *100W Single Output DIN Rail Mount Power Supply: DPP30-24*.

Tip

Optional Robotiq Universal Controller can used the same power supply.

3.3 Environmental and operating conditions

The Gripper is designed for industrial applications. Always respect the following specified storage and operating environmental 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
Vibration	< 0.5G
Others	<ul style="list-style-type: none">• Free from dust, soot or water• Free from corrosive liquids or gases• Free from explosive liquids or gases• Free from powerful electromagnetic interference

Table 3.3.1 : Environmental and operating conditions of the 2-Finger.

3.4 Mechanical installation

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. View Figure 3.4.2 for finger placement. To do so :

1. Align fingers on chassis axes. To do so, the slot present on the finger bar must be aligned correctly to the corresponding chassis axis.
2. Insert finger shaft between finger bar bottom hole (top hole is for parallel locking) and corresponding chassis hole.
- a. Fix in place by inserting snap rings on both sides of the shaft using snap ring pliers.

Note

Use protective glasses when using snap ring and snap ring pliers.

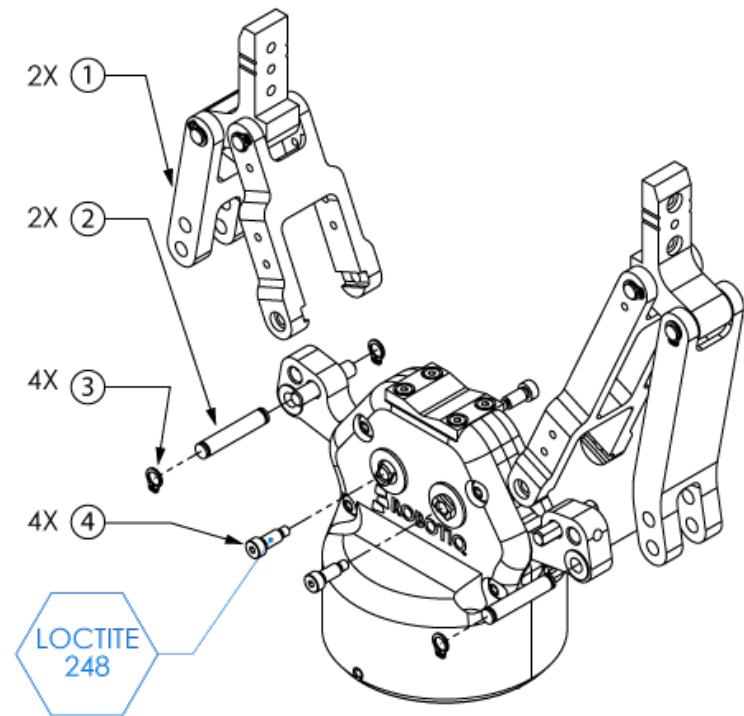
3. Apply medium strength thread-locker to the provided stainless steel shoulder screws, align the finger bar and screw into the chassis axis.

PROVIDED PARTS :

	AGC-FIN-KIT-85	AGC-FIN-KIT-140
①	85 mm fingers option	140 mm fingers option
②	5 mm stainless steel finger shaft	
③	5 mm black oxyde steel external snap ring	
④	4mm x 8 mm SHSS stainless steel shoulder screw with M3-0.5 thread	

TOOLS YOU NEED :

- 2 mm Allen key
- 5 - 6 mm snap ring pliers
- Medium strength Loctite



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

Figure 3.4.1 : 2-Finger Adaptive Gripper finger installation.

Installing the fingertips or finger pads 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 :

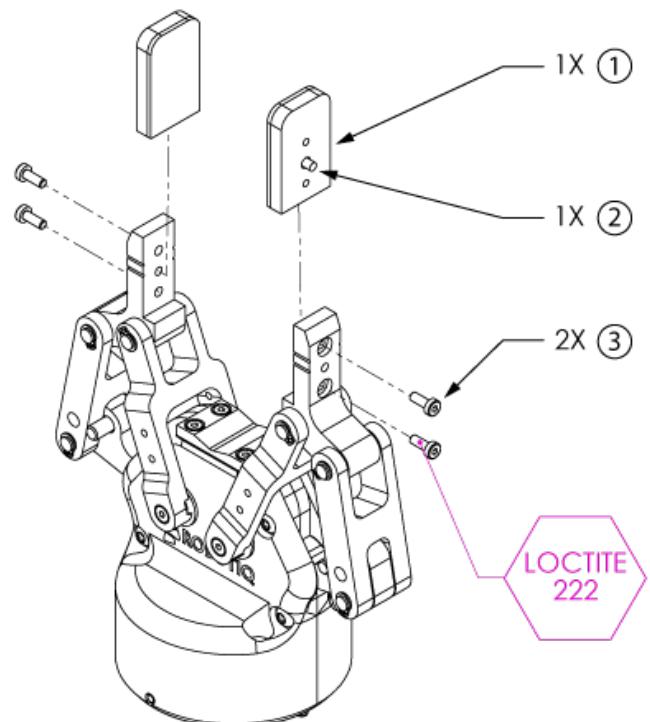
1. Align the fingertip indexing pin to the fingertip dowel hole.
2. Insert the two M3-0.5 x 8 low head cap screws and screw on after applying medium strength thread-locker.

PROVIDED PARTS :

	AGC-TIP-XXX-002	AGC-TIP-XXX-140
①	85 mm fingertip option	140 mm fingertip option
②	M3 x 10 mm indexing pins (m6 tolerance)	
③	M3 x 8 mm low head cap screws	

TOOLS YOU NEED :

- 2 mm Allen Key
- Medium strength Loctite



Quantity shown for a single kit (1 pad)

Figure 3.4.2 : Installing the fingertip (pads) onto the Gripper

Installing the Gripper onto the robot :

You must use a coupling to attach the Gripper to the robot. Be sure to use the coupling related to your robot model. If there is no coupling for your robot, you can modify a blank coupling or Robotiq can create a custom version for you. Some couplings may require an additional adapter plate. To create your own coupling or adapter plate you can refer to the [Coupling section](#). To see the details of the available couplings and adapter plates see the [Spare Parts, Kits and Accessories section](#).

Here are the steps to follow to mount the Gripper to your robot (exploded view in Figure 3.4.3 below). Note that all screws must be locked in place using medium strength thread-locker.

1. Screw the adapter plate or the coupling to the robot.
2. Screw the coupling to the adapter plate (if adapter plate is required).
3. Screw the Gripper onto it's coupling.

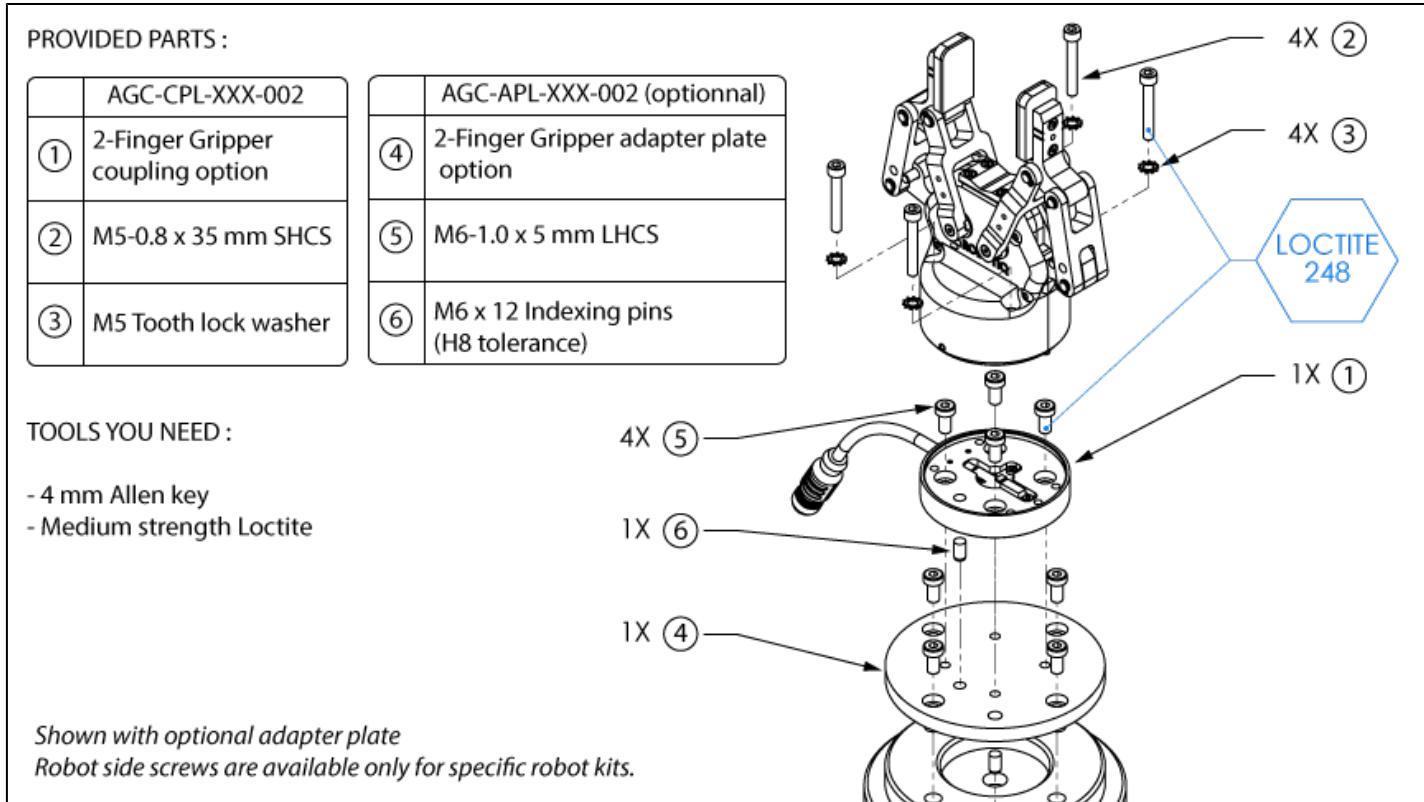


Figure 3.4.3 : Installing the Gripper to a robot using an adapter plate and coupling.

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 RS-485 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.

If a Robotiq Universal Controller is used, please consult the [Robotiq Universal Controller manual](#). Figure 3.5.1 below represents the wiring schematic of the 2-Finger with device cable, power supply, fuse (see Section 3.2) and grounding.

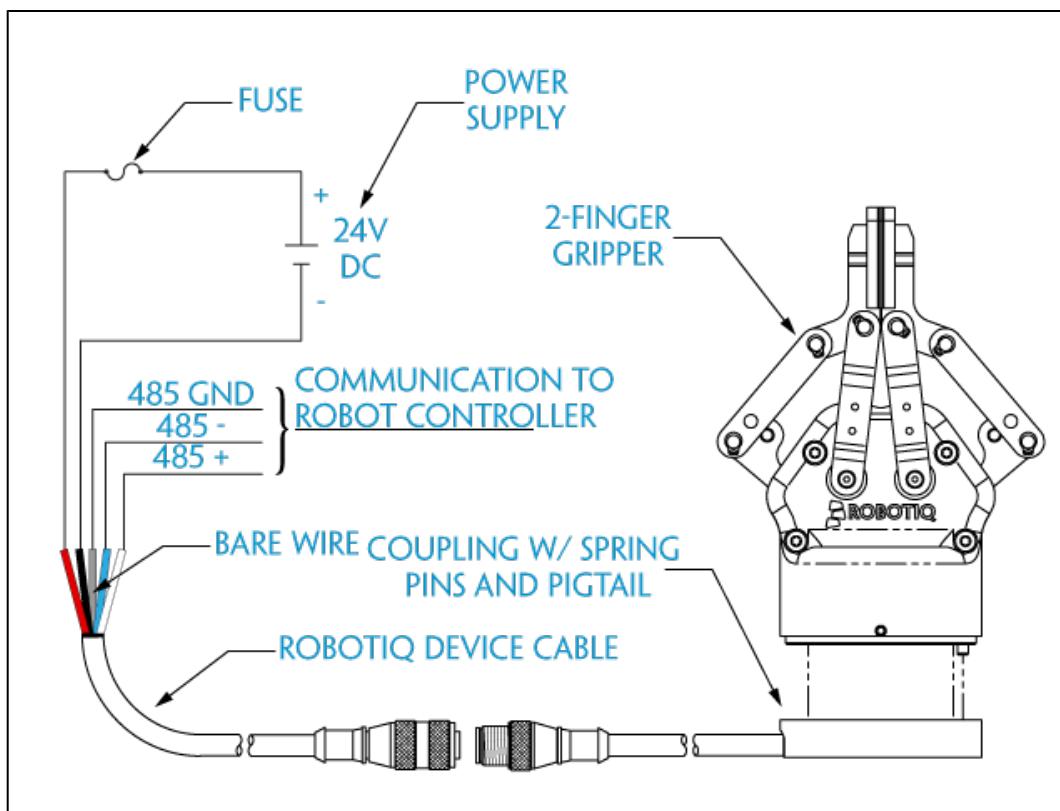


Figure 3.5.1 : Robotiq 2-Finger with pigtail cable and device cable wiring schematic.

Note

RS-485 signals (A, B and GND) are isolated from the main 24 V power supply. 4 GND can be connected to any other ground reference as long as the voltage potential between the grounds does not exceed 250 V. 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 Figure 3.5.2. They link through the coupling indexing pin to the robot ground. Proximal bars, distal phalanx, fingertip base and fingertips are isolated.

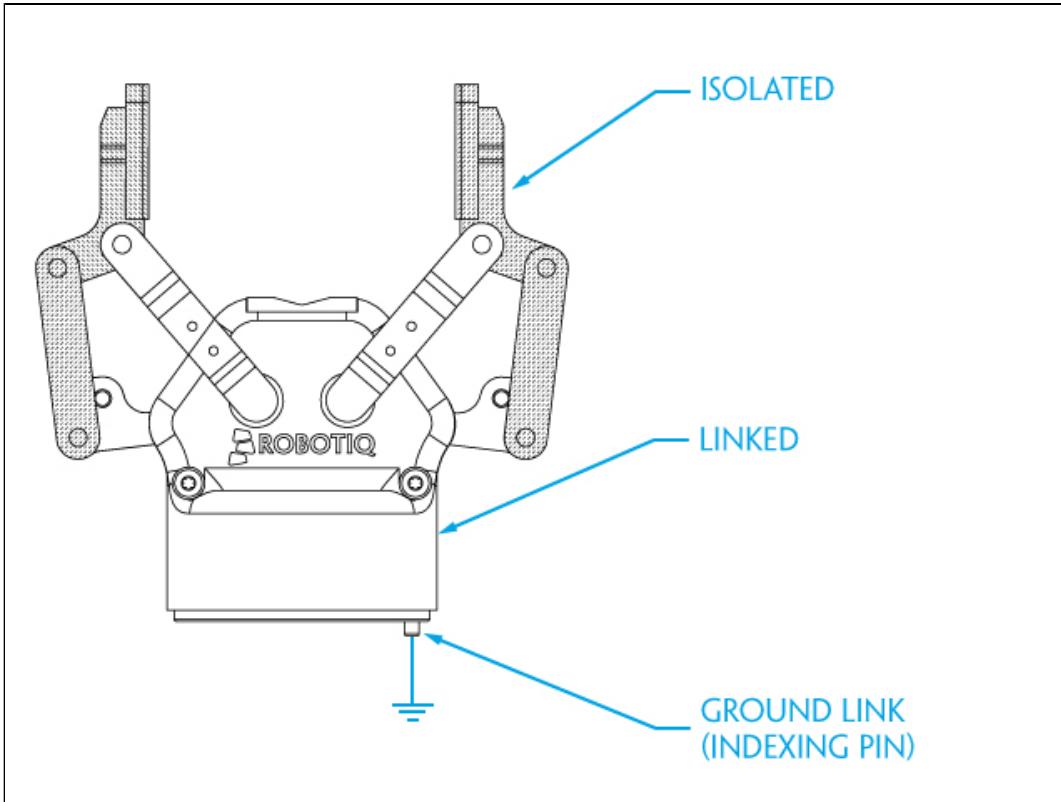


Figure 3.5.2 : Robotiq 2-Finger electrical isolation / grounding.

Warning

Use proper cabling management. Be sure to have enough forgiveness in the cabling to allow movement of the Gripper along all axes without pulling out the connectors. Always protect the controller-side (robot side) connector of the cable with a strain relief cable clamp.

Figure 3.5.3 represents the 2-Finger pigtail connector from the coupling (**AGC-CPL-XXX**), device cable - robot side (**CBL-C OM-2065-XX**) and their associated pinout.

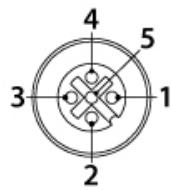
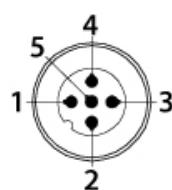
ROBOTIQ DEVICE CONNECTOR			
PIN	SIGNAL NAME	ROBOTIQ CABLE FEMALE END	COUPLING (PIGTAIL) MALE END
			
1	RS485 GND	SHIELD	SHIELD
2	24V	RED	RED
3	GND	BLACK	BLACK
4	RS485 + (A)	WHITE	WHITE
5	RS485 - (B)	BLUE	BLUE

Figure 3.5.3 : Pinout of the 2-Finger pigtail and device cable.

If additional cable is used, suggested cable specifications are as follow :

Power supply, fusing :

- minimum #22 AWG TEW, 300 V or 600 V

RS-485 signals :

- minimum #24 AWG TEW, 300 V or 600 V
- A and B signals must be balanced at 120 Ohms

3.6 Testing the Gripper

Once installed and properly secured, your Robotiq 2-Finger Adaptive Robot Gripper should be tested with the Robotiq User Interface test software using the provided USB converter. To do so :

1. Follow the instructions to [install the Robotiq User Interface](#).
Use the provided RS-485 to USB converter ACC-ADT-USB-RS485 (see the schematic in Figure 3.6.1 below) to plug into a PC with the Robotiq User Interface installed.
2. Power up your Gripper with the previously recommended power supply.
3. Execute the R.U.I. software and select "auto-connect" on the connection screen.
4. You are now connected to your Gripper, you can click "activate" to begin using the Gripper.

Note

The Activate command will initiate movement of the Gripper for auto-calibration procedures. Do not interfere with the Gripper. Be sure you have **satisfied robot safety measures**.

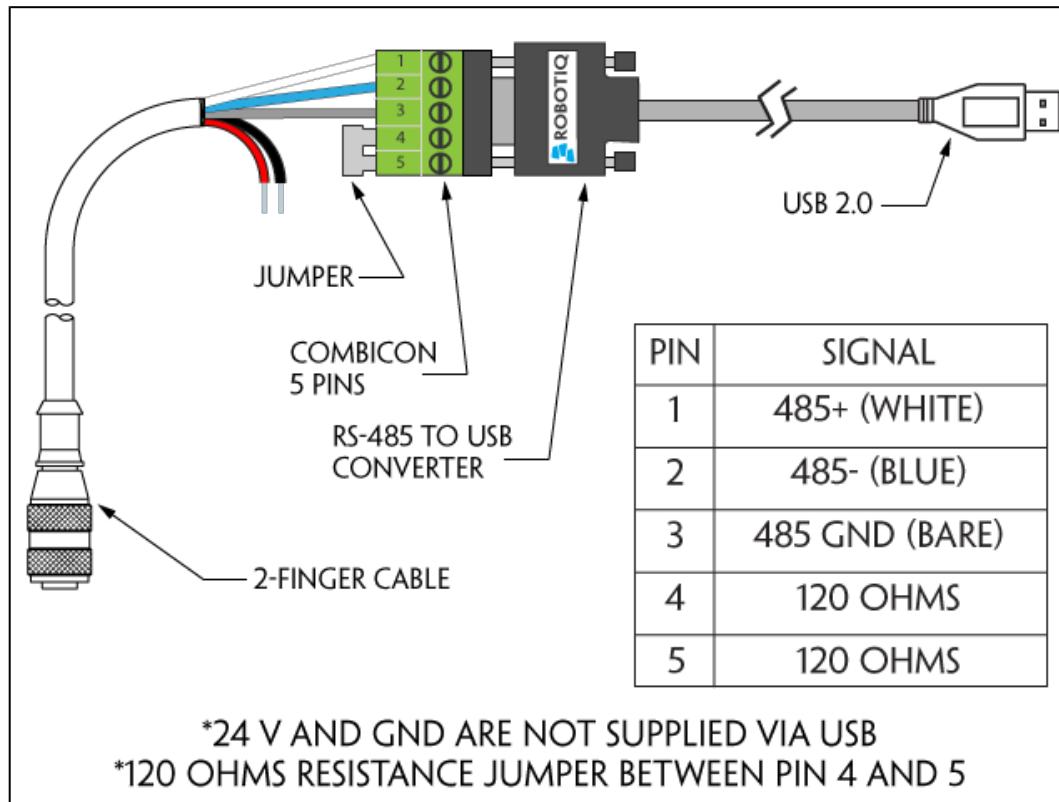


Figure 3.6.1 : RS-485 to USB converter **ACC-ADT-USB-RS485** pinout.

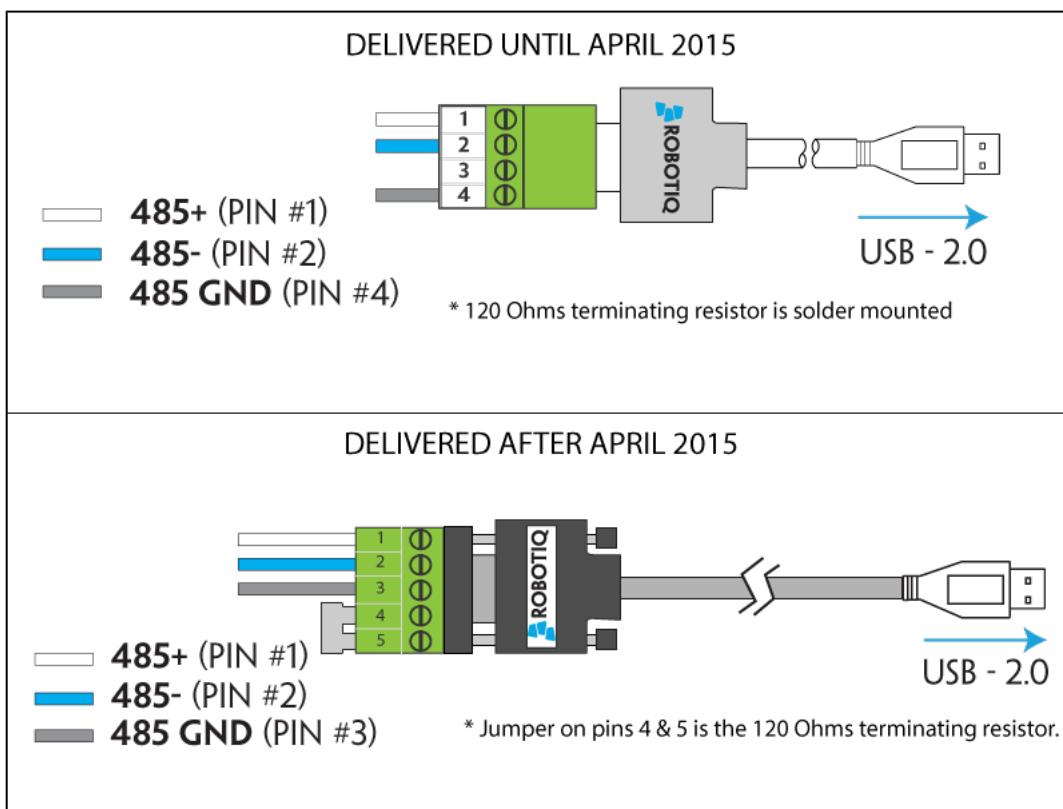


Figure 3.6.2 : Wiring possibilities of the USB to RS-485 converter.

Tip

With the R.U.I. controlling the Gripper, you can go to the "view" menu to see input and output register values to further your understanding on how to command the Gripper. You can also test gripping your parts with various speed and force settings. See Section 4. for Control details.

3.7 Installation for Universal Robots

The table below shows which Robotiq software to use with your Universal Robots' controller. If you are using a CB3 or CB3.1 controller, it is recommended to use the 2-Finger Gripper URCaps Package.

Robotiq software	Universal Robots' controller version			
	CB1	CB2	CB3	CB3.1
Driver Package (includes Gripper toolbar)	Incompatible	Compatible	Compatible	Compatible
2-Finger Gripper URCaps Package (includes Gripper toolbar and Gripper node)	Incompatible	Incompatible	Compatible	Compatible

Refer to the appropriate section depending on your controller version:

- Section 3.8 covers the installation of the 2-Finger Gripper URCaps Package.
- Section 3.9 covers the software installation when not using URCaps.

Prior to any software installation on Universal Robots, connect the white, blue and bare wires to the Robotiq RS-485 signal converter (ACC-ADT-RS485-USB) as shown in Figure 3.7.1. Also connect the red (24V) and black (0V) wires in the controller according to Figure 3.7.1.

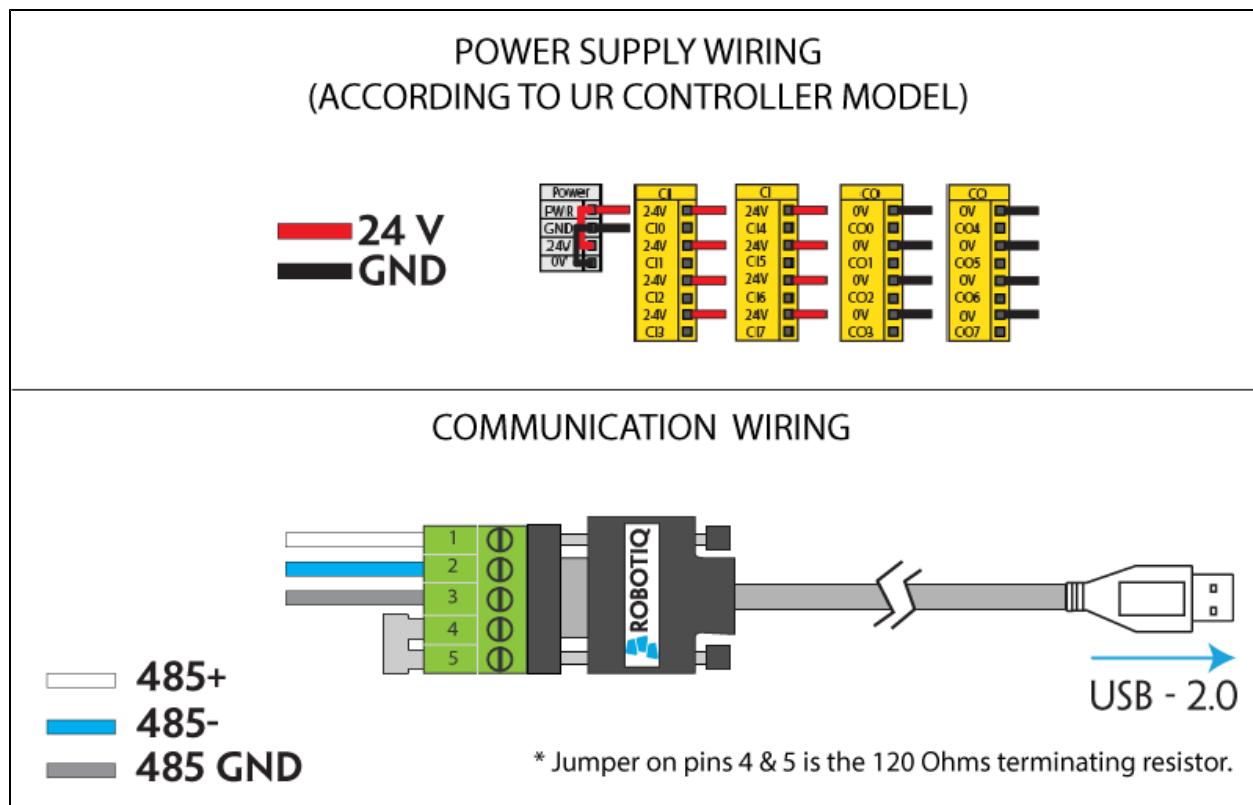


Figure 3.7.1 : 2-Finger Adaptive Robot Gripper wiring to Universal Robots' controller.

3.8 URCaps Package

Robotiq provides you with a *Universal Robots* URCaps package that enables direct serial communication (via USB) to your *UR* controller.

Info

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

Make sure the 2-Finger Gripper is properly mounted to the robot arm. Refer to Section 3.4 for detailed information on the mechanical installation. Before proceeding with the installation of the URCaps package, make sure your Universal Robots' controller is compatible with the package (refer to Section 3.7).

The Gripper's URCaps package contains :

- The URCaps for the Gripper;
- The Gripper toolbar;
- The Gripper node.

Tip

For other robots, where no driver package is available, we recommend the use of the Robotiq Universal Controller which allows fieldbus communication. Available communication protocols with this Universal Controller are :

- Modbus TCP
- EtherNet IP
- EtherCAT
- PROFINET
- DeviceNET
- CANopen

For details on controlling the Gripper, see Section 4.

Info

Visit support.robotiq.com for detailed information on how to program using the URCaps package (Section 4.2).

3.8.1 Installation

Make sure the 2-Finger Gripper is properly mounted to the robot arm. Refer to [Section 3.4](#) for detailed information on the mechanical installation. Before proceeding with the installation of the URCaps package, make sure your Universal Robots' controller is compatible with the package (refer to [Section 3.7](#)).

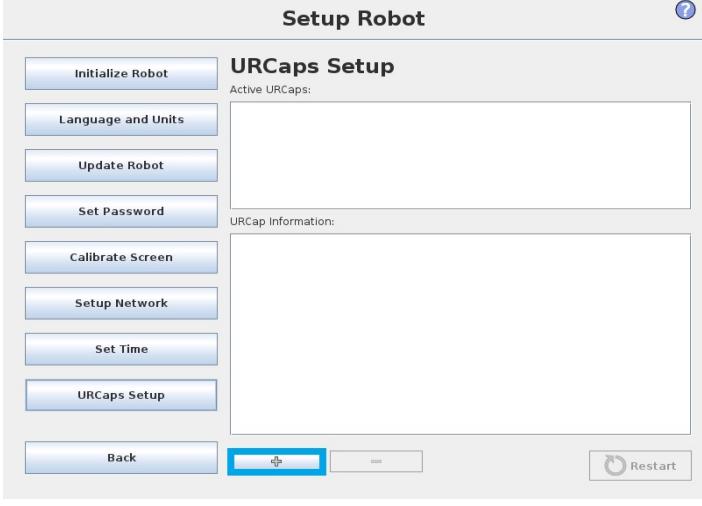
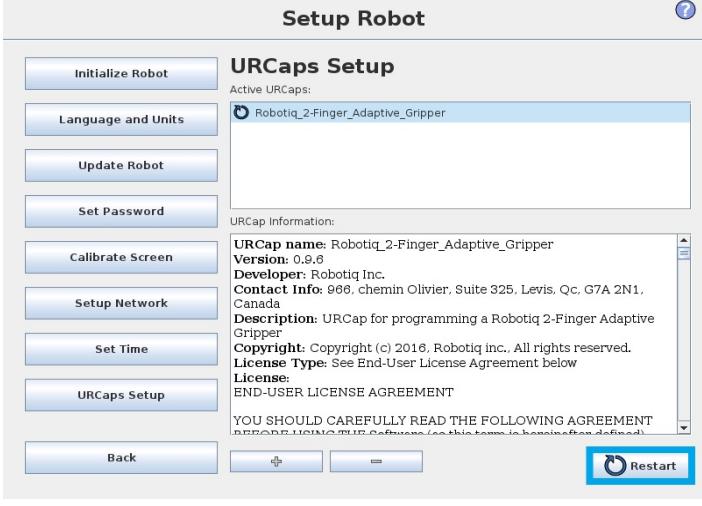
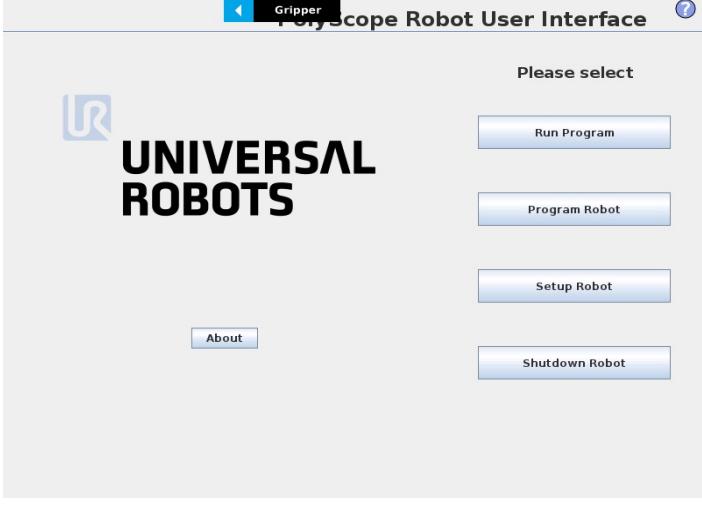
Follow this procedure to install the 2-Finger Gripper URCaps package :

The image consists of two screenshots of the Polyscope Robot User Interface. The top screenshot shows the main menu with the following buttons: 'Run Program', 'Program Robot', 'Setup Robot' (which is highlighted with a blue border), 'About', and 'Shutdown Robot'. The bottom screenshot shows the 'Setup Robot' page with the following buttons: 'Initialize Robot', 'Language and Units', 'Update Robot', 'Set Password', 'Calibrate Screen', 'Setup Network', 'Set Time', 'URCaps Setup' (which is highlighted with a blue border), and 'Back'. Both screenshots feature the Universal Robots logo and a wrench and screwdriver icon.

- Make sure that your Polyscope version is up-to-date and that your Universal Robots controller is compatible with the Gripper's URCaps package.
- Go to support.robotiq.com and click on the 2-Finger Gripper product page.
- Download the Robotiq_2-Finger_Adaptive_Gripper-X.X.X.urcap on a blank USB stick.
- Insert the USB stick in the UR teach pendant or controller.
- Go in Setup Robot.
- Tap URCaps Setup.

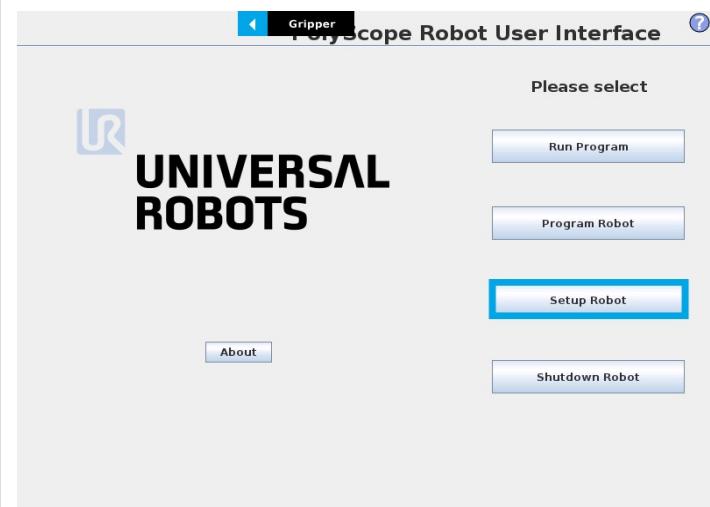
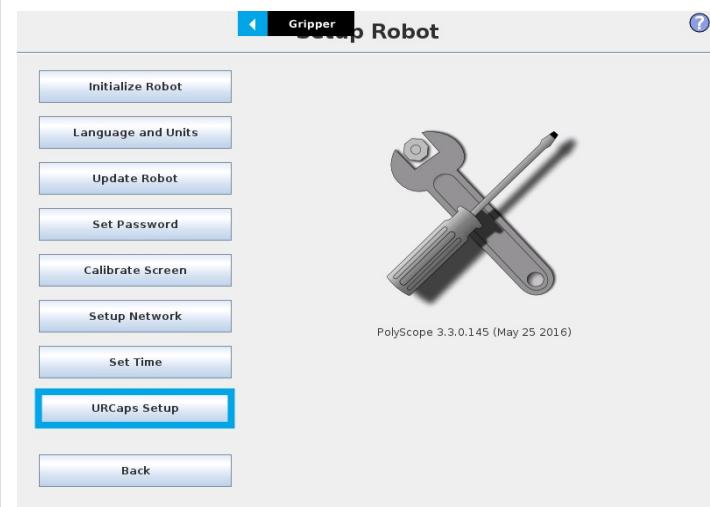
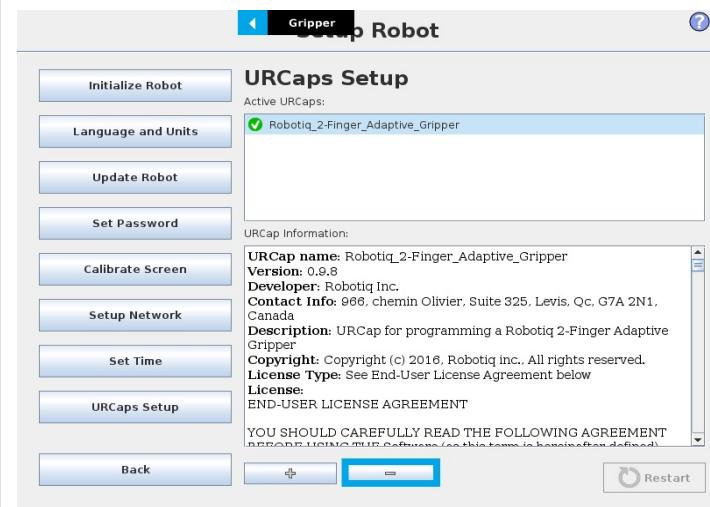
How to know your Polyscope version?

In Polyscope, go in the Home page and tap the About button. A window containing the Universal Robots software version will pop up.

	<ul style="list-style-type: none"> • Tap the plus button (+) to add the Gripper's URCaps package. • Open Robotiq_2-Finger_Adaptive_Gripper_Sensor-X.X.X.urcap.
	<ul style="list-style-type: none"> • Restart Polyscope to complete the URCaps installation. By doing so, you accept the License Agreement that is detailed in the URCap Information text box (see below for the License Agreement).
	<ul style="list-style-type: none"> • When Polyscope reopens, the Gripper toolbar will appear on the screen.

3.8.2 Uninstalling URCaps Package

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

	<ul style="list-style-type: none"> • Go in Setup Robot.
	<ul style="list-style-type: none"> • Tap URCaps Setup.
	<ul style="list-style-type: none"> • In the Active URCaps text box, tap the Gripper URCaps. • The Gripper URCaps should be highlighted. • Tap the minus button (-) to uninstall the URCaps. • Restart Polyscope to complete the uninstallation process.

3.8.3 License Agreement

END-USER LICENSE AGREEMENT

YOU SHOULD CAREFULLY READ THE FOLLOWING AGREEMENT BEFORE USING THE Software (as this term is hereinafter defined). Using the Software indicates your acceptance of the agreement. If you do not agree with it, you are not authorized to use the Software.

IMPORTANT-READ CAREFULLY: This End-User License Agreement (the "Agreement") is a legal agreement between you and the Licenser (as this term is hereinafter defined), the licensor of the Software. This Agreement covers the Software. The Software includes any "on-line" or electronic documentation and all modifications and upgrades related thereto. By installing, or otherwise using the Software, you agree to be bound by the terms of this Agreement. If you do not agree to the terms of this Agreement, the Licenser cannot and does not license the Software to you. In such event, you must not use or install the Software.

1. Definition.

1. "UR" means Universal Robots A/S, a corporation incorporated under the laws of Denmark, having its registered office at Energivej 25, DK-5260 Odense S, which specializes into the conception, advanced manufacturing and sale of robotic products (the "UR's Business");
 2. "Software" means any of the Licenser's softwares provided to its customers for the purposes mentioned in Sub-section 1.4 hereof including their modifications and upgrades and their related materials;
 3. "Licenser" means Robotiq inc., a corporation incorporated under the laws of Quebec, having its registered office at 325-966 chemin Olivier, Lévis, Québec, Canada, G7A 2N1, which specializes into the conception, advanced manufacturing and sale of robotic products (the "Licenser's Business");
 4. "End-User" means a customer authorized pursuant to this Agreement to install or use the Software in order to make a specific product from the Licenser's Products compatible and functional with a specific product of the UR's Product;
 5. "Licenser's Products" means those products developed by the Licenser in the course of the Licenser's Business;
 6. "UR's Products" means those products developed by UR in the course of the UR's Business;
 7. "Licenser's Authorized Representatives" means and includes the Licenser and Licenser's authorized vendors, resellers, distributors and licensors;
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3. Software and Documentation. The Licenser may provide, if applicable, all documentation containing the detailed specifications for operation and use of the Software, which Software shall be used in accordance with such documentation. This documentation, if applicable, will be provided, wholly or in part, within (i) this Agreement, (ii) the Licenser's Web site <http://robotiq.com/> (iii) the Licenser's Products and the Purchase Agreement therewith, or (iv) any other agreement, document, support, whatsoever decided by the Licenser.

The use of the Software requires the Licenser's Products, UR's Products, compatible systems and certain software (which may require some expenses), may require periodical updating and may be affected by such elements. Most equipment will be compatible with the Software. However, the Software may not function on certain types of equipment.

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12. Expiration and Termination. The Licensor may terminate this Agreement for default by the End-User. This Agreement will also be automatically terminated upon the election of such by the Licensor or the official launch of the Software, whichever event comes first. Upon termination of this Agreement for any reason, the End-User shall promptly uninstall the Software on any UR's Products and Licensor's Products, computer, or server on which it has been installed, deliver to the Licensor all CDs, DVDs, magnetic tapes, cards, and other tangible items and materials embodying the Software, and return to the Licensor all copies thereof or destroy such copies and warrant in writing that all copies thereof have been destroyed. In the event of termination of this Agreement, all obligations of the parties under this Agreement due for performance on the date of termination shall survive the termination, and the party terminating shall not be liable to the other party for any damages arising out of the termination.
13. Miscellaneous.
 1. This Agreement constitutes the entire understanding and agreement between the Licensor and the End-User and replaces any prior agreement relating to the same subject matter.
 2. This Agreement shall be governed and construed in accordance with the laws of the province of Quebec and the federal laws of Canada applicable therein. Any legal action or proceeding between the Licensor and the End-User for any purpose concerning this Agreement or the parties' obligations hereunder shall be brought exclusively in a court of competent jurisdiction sitting in the judicial district of Trois-Rivières, Quebec.
 3. The Licensor's failure to insist upon or enforce strict performance of any provision of this Agreement shall not be construed as a waiver of any provision or right. Neither the course of conduct between the parties nor trade practice shall act to modify any provision of this Agreement.
 4. The Licensor may assign its rights and duties under this Agreement to any party at any time without notice to the End-User. The End-User may not assign this Agreement without the prior written consent of the Licensor.
 5. If any part of this Agreement is null, illegal or non-enforceable, this Agreement shall be interpreted as if this part was never part of this Agreement.
 6. The provisions of this Agreement are for the benefit of the Licensor and its officers, directors, employees, agents, licensors and suppliers. Each of these individuals or entities shall have the right to assert and enforce those provisions directly against the End-User on its own behalf. This Agreement is also for the benefit of, and binds, the End-User and its heirs, successors, legal representatives and permitted assigns.
 7. Any rights not expressly granted herein are reserved.
 8. The parties confirm that they have agreed that this Agreement and all related documents be drafted in English only. Les parties aux présentes confirment qu'elles ont accepté que la présente convention et tous les documents y afférents soient rédigés en anglais seulement.

3.9 UR Package without URCaps

Robotiq provides you with a *Universal Robots* driver package that enables direct serial communication (via USB) to your *UR* controller.

Info

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

If your Universal Robots' controller is not compatible with the URCaps package (see [Section 3.7](#) for compatibility), 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.

Software Packages

The URCaps package also contains a driver package that is different from this section's. If you have already installed the URCaps, you do not need to install the driver package. This section applies to Robotiq's software excluding the URCaps package. If you wish to use the URCaps package, refer to [Sections 4.2.1](#) and [4.2.2](#).

Polyscope version

Make sure your Polyscope version is up-to-date and that your controller is compatible with the driver package for UR (see [Section 3.7](#) for controller compatibility). To view your Polyscope version, go in the Home page of the teach pendant and tap the About button. A window containing the Universal Robots software version will pop up.

Tip

For other robots, where no driver package is available, we recommend the use of the [Robotiq Universal Controller](#) which allows fieldbus communication. Available communication protocols with this Universal Controller are :

- Modbus TCP
- EtherNet IP
- EtherCAT
- PROFINET
- DeviceNET
- CANopen

For details on controlling the Gripper, see [Section 4](#).

3.9.1 Installation

To install the driver package, follow this procedure:

- Download the Robotiq 2-Finger Gripper software driver package (DCU-X.X.X) at support.robotiq.com.
- Extract the content of the .zip file onto a blank USB flash drive.
- Plug the flash drive into the robot controller or teach pendant.
- Installation is automatic. The pendant screen will show installation status. Do not unplug the flash drive until the operation is completed.
- When a green "USB" text is shown, unplug the USB drive.

Testing the Gripper:

- When the installation is completed, the Gripper toolbar button will appear on the teach pendant's screen after a short delay.
- Use the toolbar to jog and test the Gripper. Refer to [Section 4.3.1](#) to get detailed information on how to use the Gripper toolbar.

Removing the package

- Locate the uninstall.sh file provided in the driver package.
- Copy the file on a blank USB stick.
- Rename the file to urmagic_uninstall.sh.
- Plug the USB stick into the UR controller or teach pendant.
- Uninstallation is automatic.

4. Control

Info

Unless specified, all values in Section 4 are **hexadecimal** values.

4.1 Overview

The Robotiq 2-Finger Adaptive Gripper is controlled directly via Modbus RTU using a RS 485 signal. It can also be controlled via an optional [Robotiq Universal Controller](#) using an industrial protocol. The programming of the Gripper can be done with the Teach Pendant of the robot or by offline programming. Communication method used to control the 2-Finger Gripper does not change the control logic or the registers setup described in the following subsections.

Tip

Robotiq suggests using the Robotiq User Interface test software to explore the various features of the Gripper, like object detection and force control.

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 grip 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.

Section 4.2 will map the different registers used to control the Gripper or to read its status while Section 4.3 will detail the output (write) register functions and Section 4.4 will detail the input (read) register status. Figure 4.1.1 is a representation of the memory and the control logic of the Gripper.

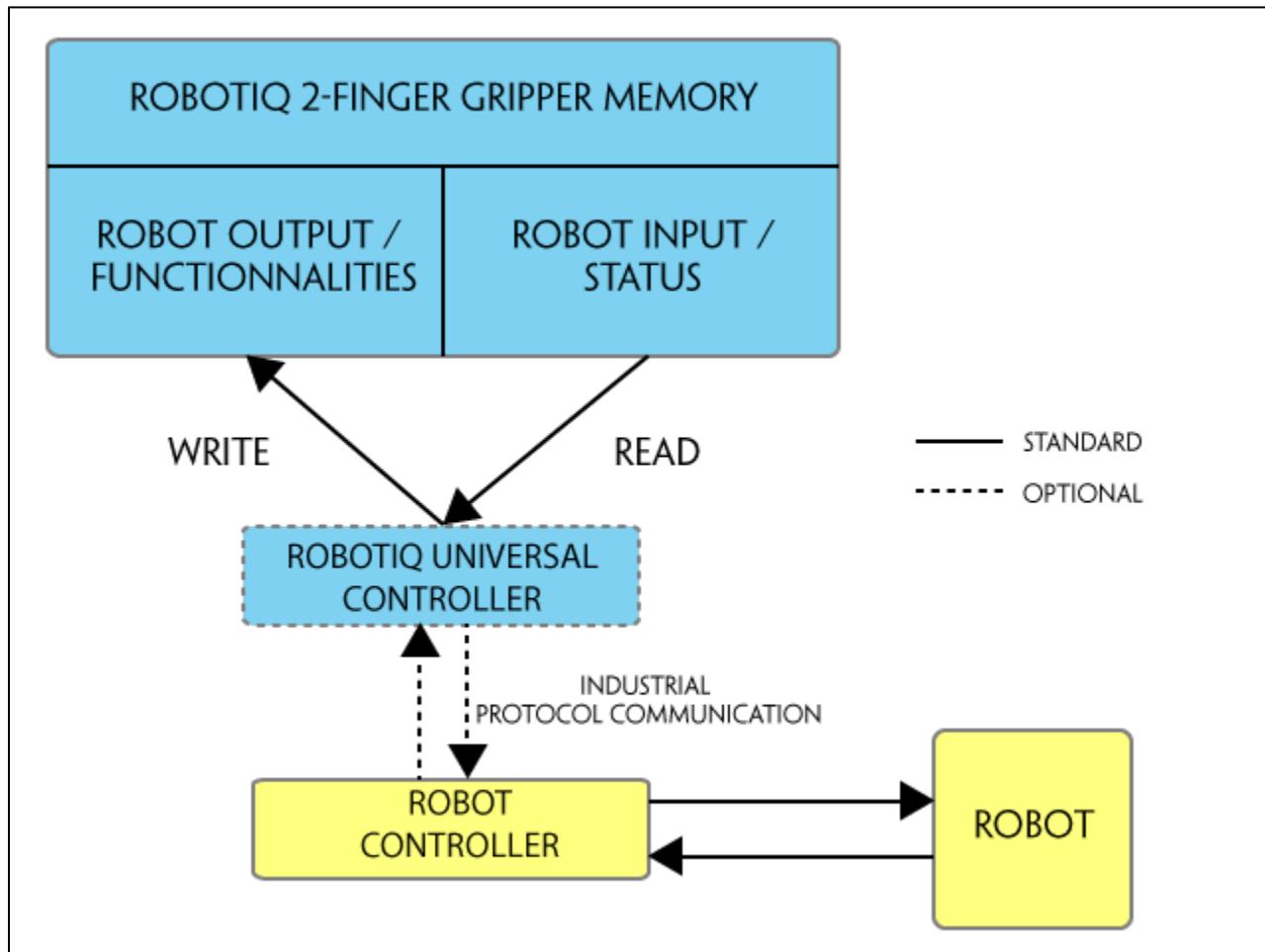


Figure 4.1.1 : 2-Finger control logic overview

Control using Universal Robots packages :

Robotiq provide *Universal Robots* packages to be used with either *URcaps* (require controller CB3 or higher) or using subprograms (for controller CB2).

See section 4.8 for instructions on how to use the *URcaps Gripper*, this method will provide you with a *Gripper Toolbar* to test and a *Gripper node* to program via the *URcaps* tabs.

See section 4.9 on how to use without *URcaps*, this method will provide you with a similar *Gripper Toolbar* but robot program will be done using *subprogram s and scripts*.

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 4.2.1 : 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 initialize the Adaptive 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 clear **rACT**, **rACT** bit must then be reset to one 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 reinitialized 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 reseted (**rACT == 0** then **rACT == 1**).

rADR : 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**

Bits	7	6	5	4	3	2	1	0
Symbol	Reserved							

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. Figure 4.3.1 represents the Position Request values and the corresponding distance between fingers (X axis). For detailed finger trajectory, see: [Specification 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

Robotiq Adaptive Gripper auto-calibration will allow the Gripper to adjust to any fingertips. No matter 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: SPEEDAddress: **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. See [Section 4.5](#) for details on force control.

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

Info

Register byte 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
Symbols	gOBJ	gSTA	gGTO	Reserved	gACT			

gACT : Initialization 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

The object detection is precise only to the order of a few mm. In some circumstances object detection may not detect an object even if it is successfully gripped. For example, picking up a thin object in a fingertip grip 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
Symbol	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 renewed 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.
- 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 processor fault.
 - 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: **FINGER 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 $10 * \text{value}$ 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 : Force control, Re-grasp and Object detection.

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, **rS**, **P** 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

Force control :

The 2-Finger Gripper gripping force is controlled via the **rFR** byte (see [Section 4.3](#), robot output registers & functionalities). 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

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 latest 2-Finger Gripper generation 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 Figure 4.5.1	15 - 120 Figure 4.5.1
Aluminium 6061 ¹	95 HV	Aluminium 6061	95 HV	25 - 220 Figure 4.5.2	15 - 120 Figure 4.5.2
Aluminium 6061 ¹	95 HV	Silicone (TIP-204) ²	60 A Durometer ⁴	25- 220 Figure 4.5.3	15- 120 Figure 4.5.3
Aluminium 6061 ¹	95 HV	Silicone rubber	40 A Durometer	25 - 155 Figure 4.5.4	15 - 100 Figure 4.5.4
Aluminium 6061 ¹	95 HV	Neoprene rubber	10 A Durometer	25 - 115 Figure 4.5.5	15 - 75 Figure 4.5.5
Aluminium 6061 ¹	95 HV	Polyurethane rubber	30 OO Durometer	15 - 65 Figure 4.5.6	10 - 40 Figure 4.5.6

¹ Available with blank fingertip AGC-TIP-203-002.

² Available with flat silicone fingertip AGC-TIP-204-002.

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)**

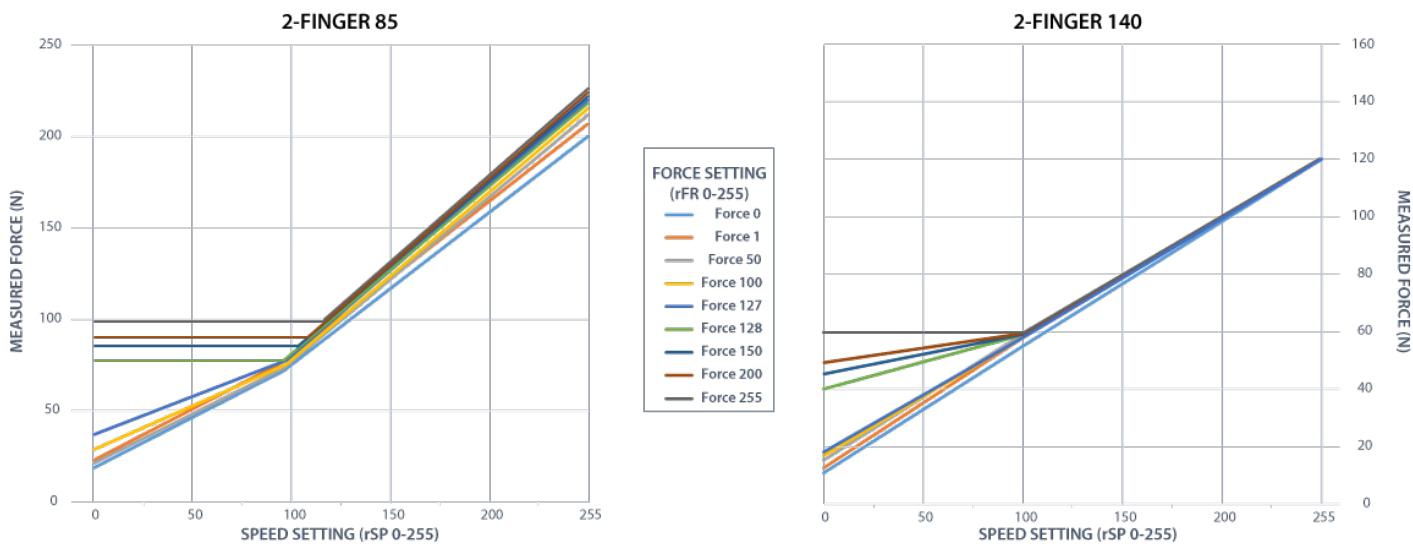


Figure 4.5.1 : Grip force on hardness 220 HV (4340 annealed carbon steel).

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

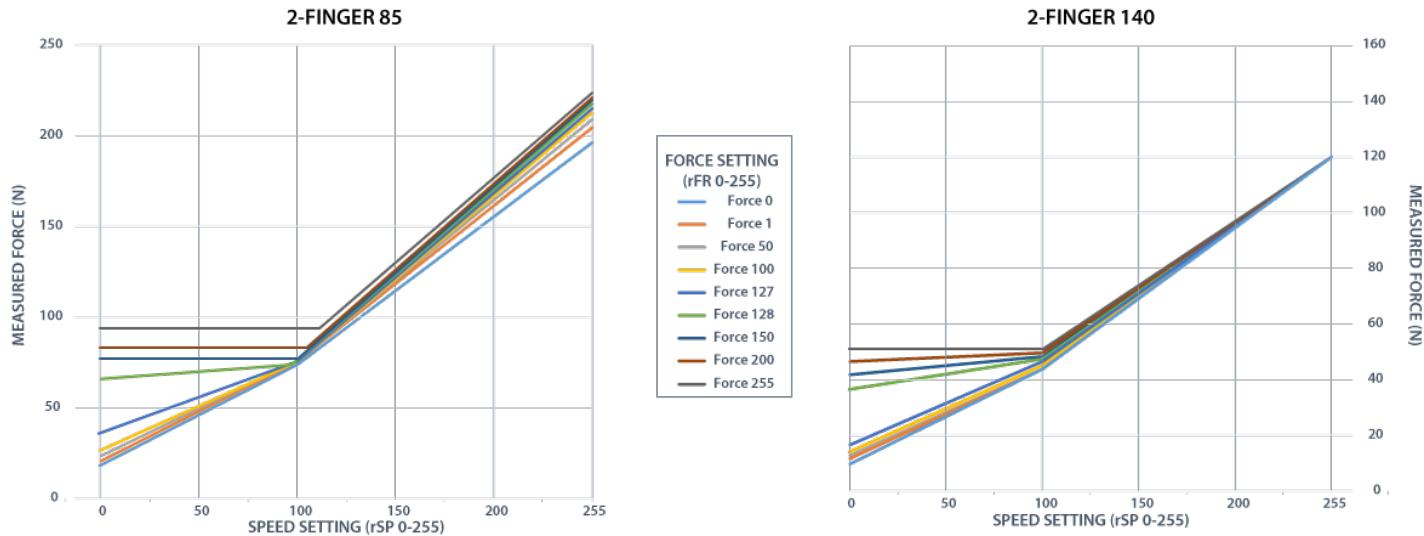


Figure 4.5.2 : Grip force on hardness 95 HV (6061-T6 aluminium).

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

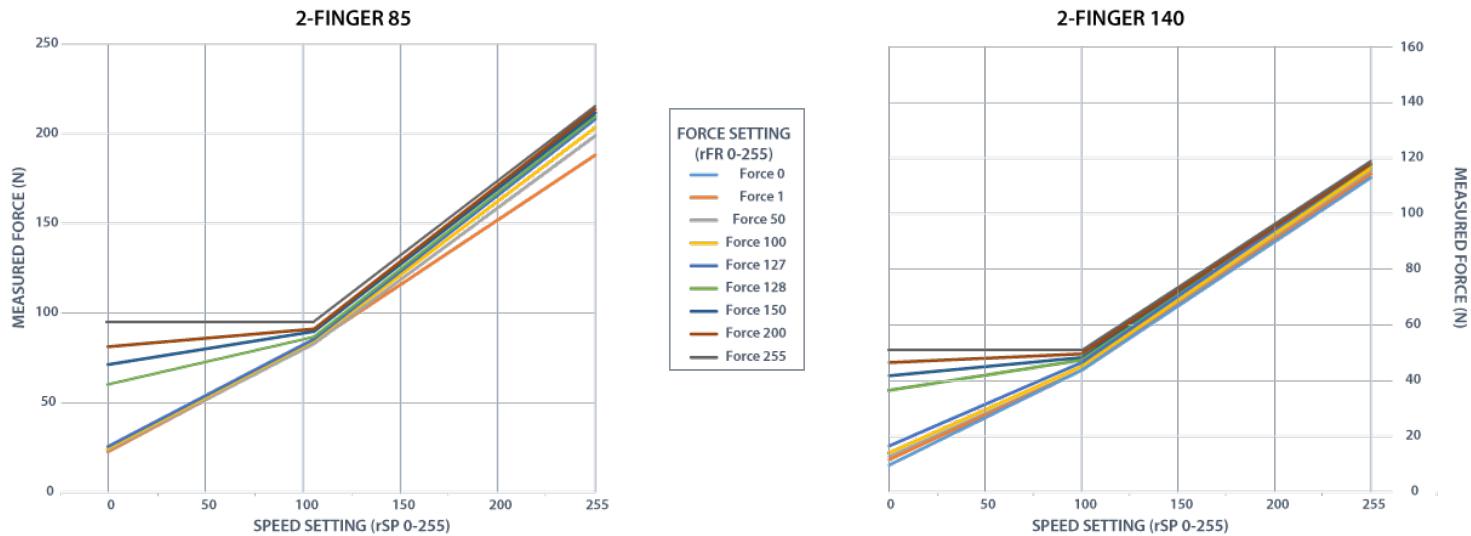


Figure 4.5.3 : Grip force on hardness 60A (silicone).

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

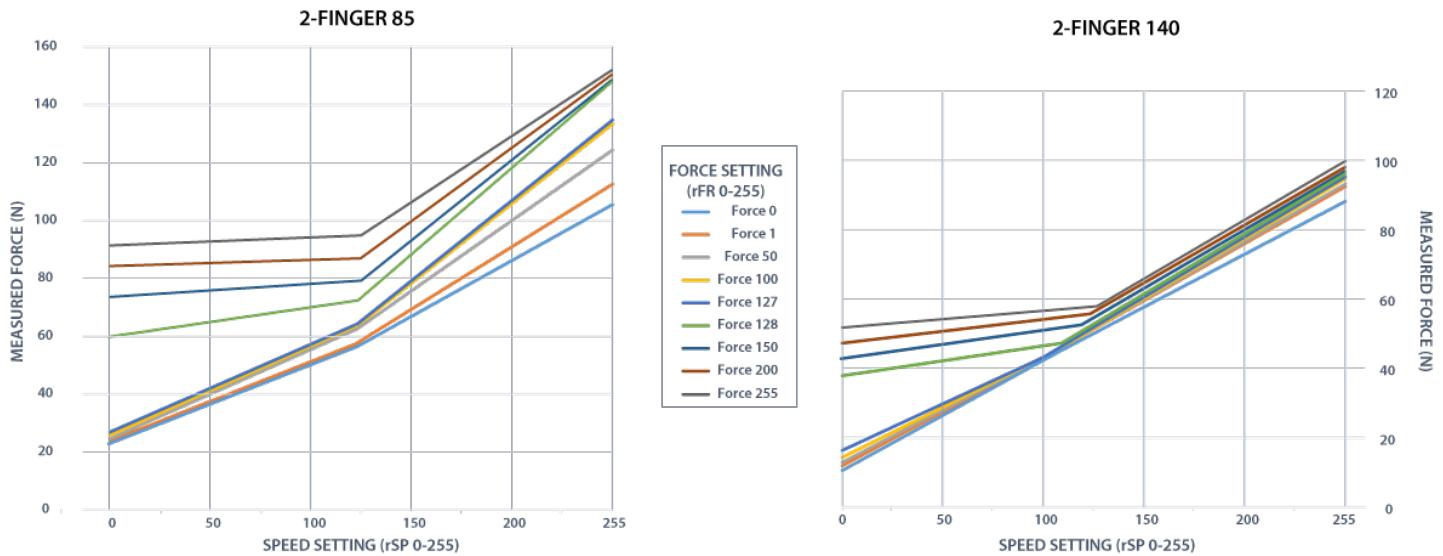


Figure 4.5.4 : Grip force on hardness 40 A (silicone).

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

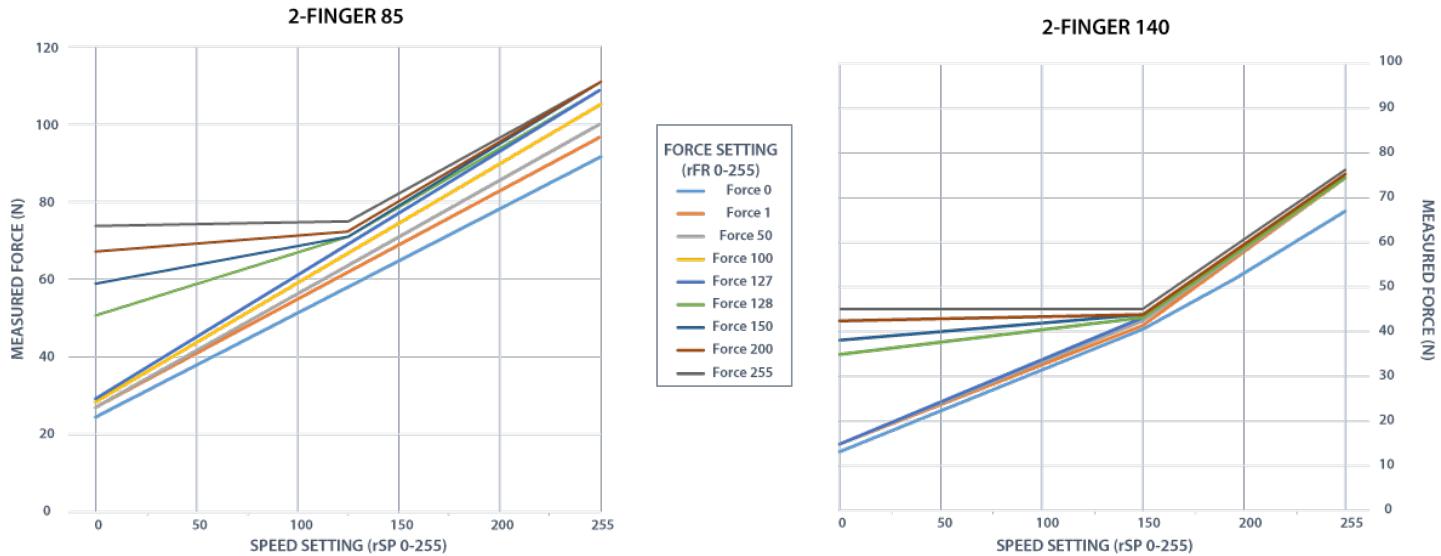


Figure 4.5.5 : Grip force on hardness 10 A (neoprene).

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

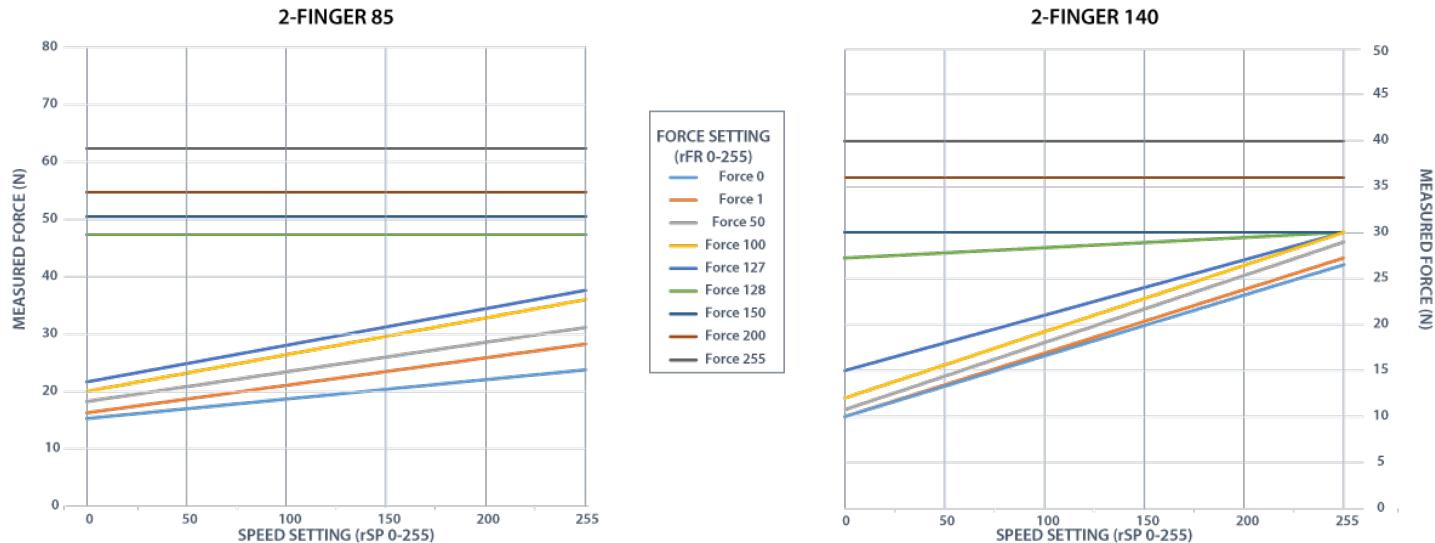


Figure 4.5.6 : Grip force on hardness 30 OO (polyurethane).

Re-grasp :

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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 part.

Object detection :

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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.

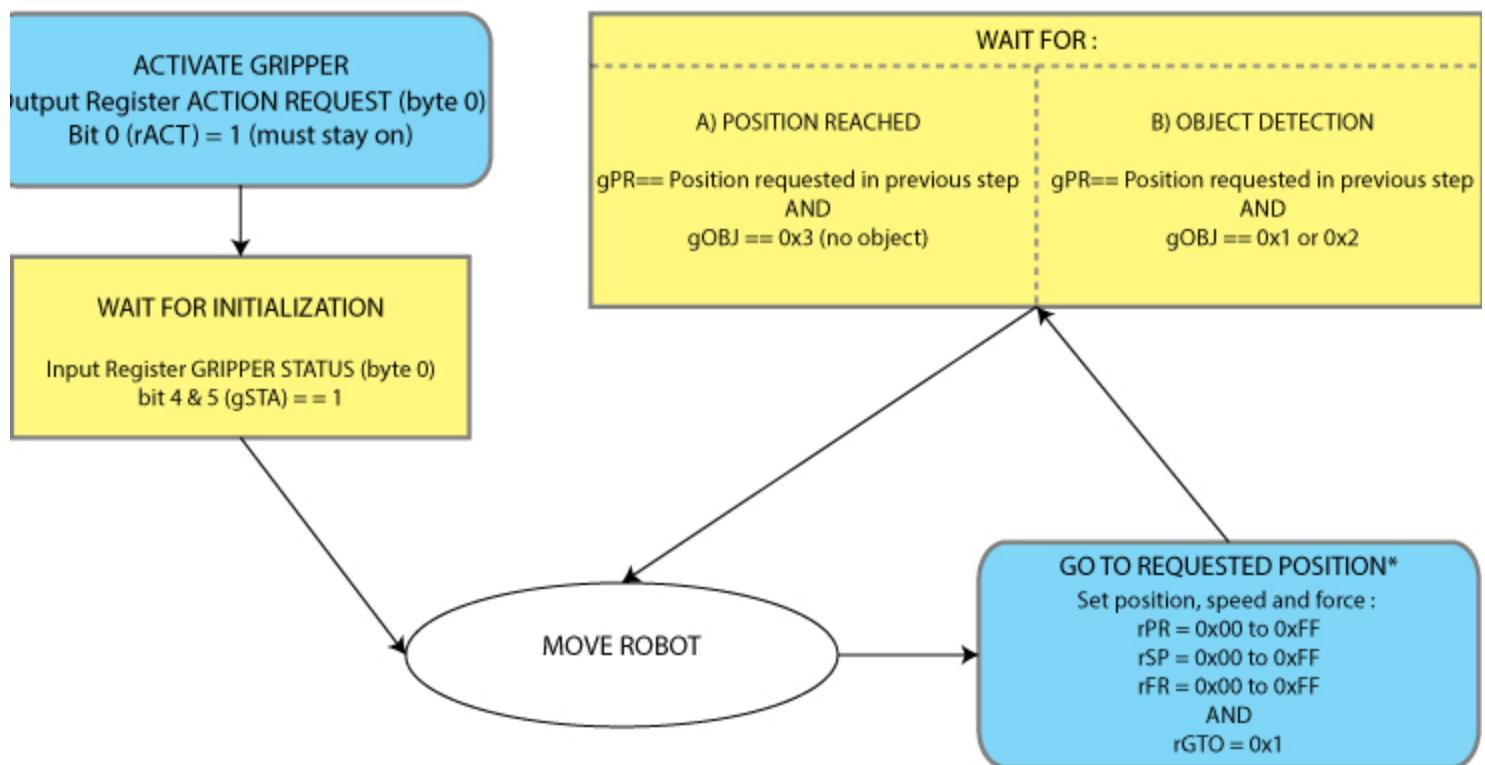
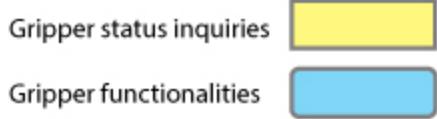
Object detection exemple :

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 - example


Legend:


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

Figure 4.6.1 : 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 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.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.chipkin.com/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) 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 Preset multiple registers (FC16)

Function code 06 (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 (1001) 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)
00E6	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)

4.7.4 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
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.

4.7.5 Modbus RTU example

This section depicts the example given in [Section 4.6](#) 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 grip an object. It moves again to a second location to release the gripped 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 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 registers 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"
55D5	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 registers 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 0x03E9 (ACTION REQUEST = 0x09 and GRIPPER OPTIONS = 0x00): rACT = 1 for "Activate Gripper", rGTO = 1 for "Go to Requested Position"
00FF	Value written to register 0x03EA (GRIPPER OPTIONS 2 = 0x00 and POSITION REQUEST = 0xFF): rPR = 255/255 for full closing of the Gripper
FFFF	Value written to register 0x03EB (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 grip is completed

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

Bits	Description
	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 grip **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 grip **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)
F78B	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 0x03E9 (ACTION REQUEST = 0x09 and GRIPPER OPTIONS = 0x00): rACT = 1 for "Activate Gripper", rGTO = 1 for "Go to Requested Position"
0000	Value written to register 0x03EA (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 0x03EB (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 gripped.

4.8 Control over Universal Robots with URCaps

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

- **Gripper toolbar:** The Gripper toolbar is automatically installed with the URCaps 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 URCaps 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.

4.8.1 Gripper Toolbar

Toolbar Installation

The Gripper URCaps package contains the Gripper toolbar. Therefore, the toolbar is automatically installed with the URCaps package. The Gripper toolbar can be installed and used without the URCaps package (see Section 4.1.3 for information on how to install the toolbar and the driver package without the URCaps).

Overview

Toolbar collapsed :

- Tap the Gripper button to expand the toolbar.

Toolbar expanded, Gripper activation window :

- When the Gripper is not activated, the toolbar shows this window.
 - You need to tap the Activate button to be able to jog the Gripper.
 - Emergency open and close allows you to control the Gripper without activating, this mode will use a very low speed and force setting

Toolbar expanded, Gripper operation window :

- Use the buttons of this window to jog and test the Gripper.

Features

Gripper activation window

Primary icon	Secondary icon	Functionality name	Description
		2-Finger Gripper toolbar	Tap to toggle between expand and collapse the 2-Finger Gripper toolbar. When grey, the functionality is not available.
		Activate	Tap to activate the 2-Finger 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.

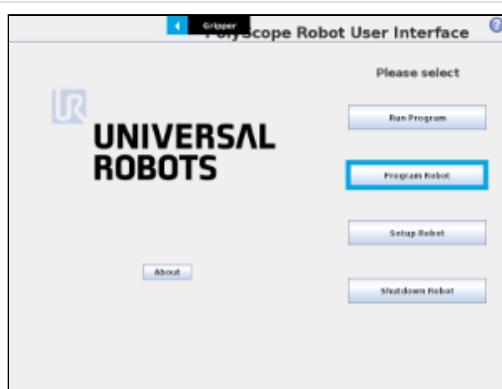
Gripper operation window

Primary icon	Secondary icon	Functionality name	Description
		2-Finger Gripper toolbar	Tap to toggle between expand and collapse the 2-Finger Gripper toolbar. When grey, the functionality is not available.
		Activate	Tap to fully open the Gripper.
		Emergency open	Tap to fully close the Gripper.
	(%)	Emergency close	Shows the actual position of the Gripper: <ul style="list-style-type: none">• 0% : fully open• 100% : fully closed
	(%)		Shows the actual speed set of the Gripper: <ul style="list-style-type: none">• 0% : minimum speed• 100% : maximum speed
	(%)		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
			Tap to increase the associated parameter.
			Tap to decrease the associated parameter.
			Icon shown when no object is detected during a grasp.
			The icon shows a green checkmark when an object is detected during a grasp.

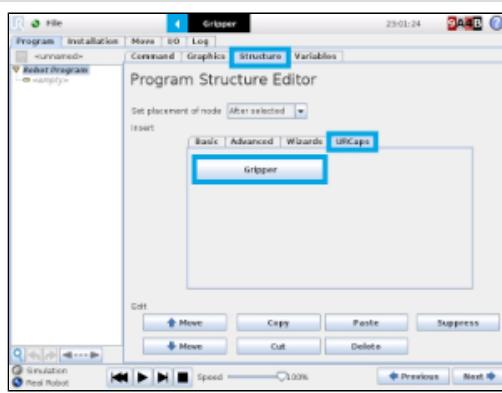
4.8.2 Gripper Node

Gripper Node :

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

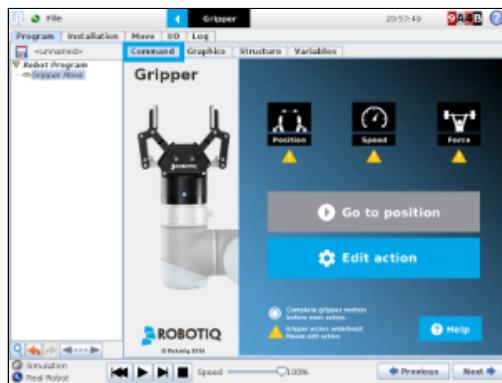


- Tap on Program Robot
- Open an empty program or load one.

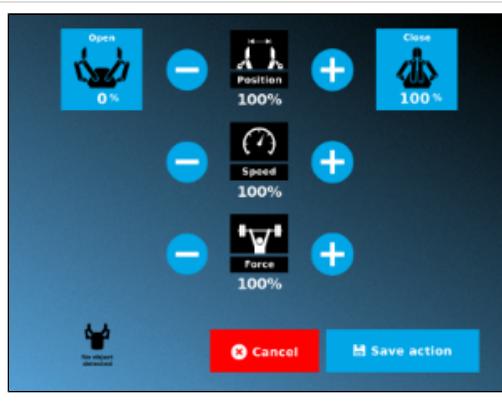


- Go in the Structure tab.
- Go in the URCaps tab.
- Tap the Gripper button.

After taping the Gripper button from URCaps, you have a Gripper node inserted in your robot program.



- Go in the Command tab to edit the Gripper node previously inserted.



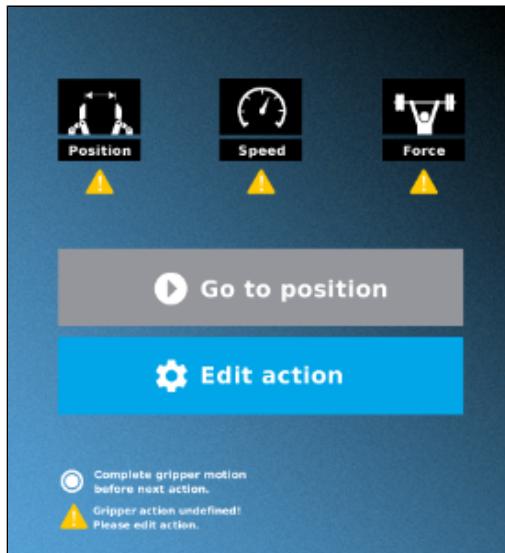
- To edit the node's parameters, tap Edit action. The edit action screen will appear.

Gripper activation

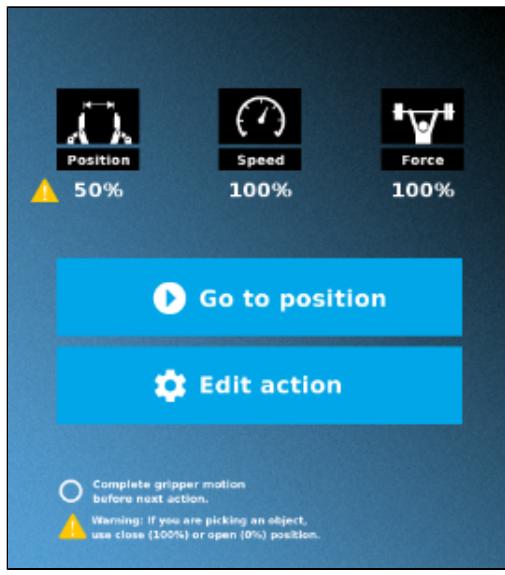
The Gripper needs to be activated before it can receive a command. To do so, use the rq_activate_and_wait() function script at the beginning of the program or activate with the Gripper toolbar.

Command window

The Command window shows the requested action parameters for the Gripper node. Depending on the position, speed and force parameters, some warning messages will appear. To edit the Gripper node, tap Edit action.

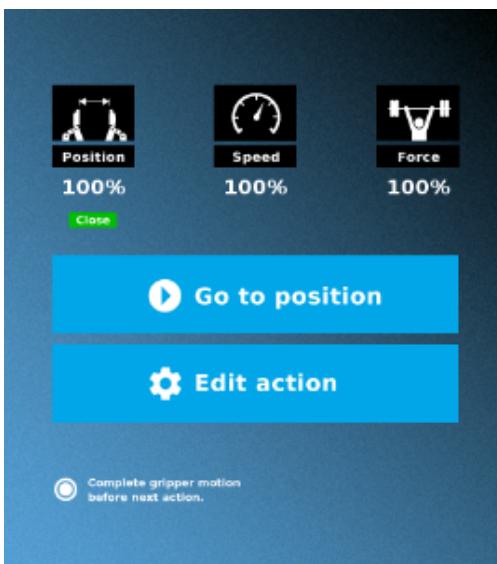


When the node is undefined, the Command window shows warning messages. Tap Edit action to modify the Gripper's action.

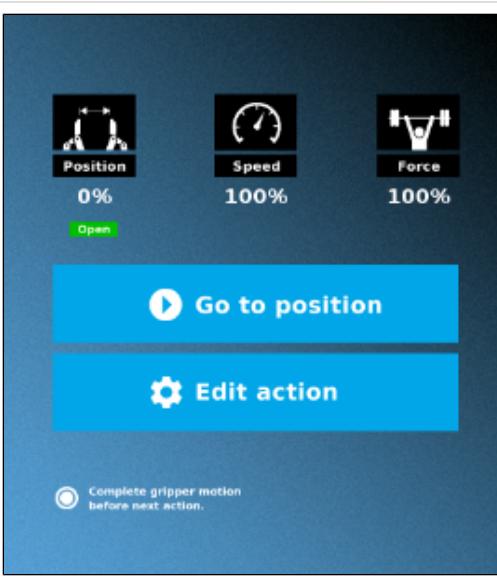


When the node requests the Gripper to move to a specific position, the Command window warns that this should not be performed to pick an object.

- For positioning and partial movement of the hand, moving to a position is correct.
- To pick an object, use the close (or open) actions along with the object detection feature.

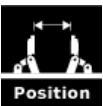
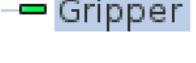


When the Gripper action is to close, a green "Close" icon appears.



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

Features

Primary icon	Secondary 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 Gripper 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.
		Object picking warning	"Warning, if you are picking an object, use close (100%) or open (0%) position." It is highly recommended to only use 0% or 100% position when trying to pick an object.
		Node name	Node name is automatically set to: <ul style="list-style-type: none">• Gripper Open, when position = 0%• Gripper Close, when position = 100%• Gripper Move x%, when position is between 0% and 100%.
		Open request	When position request is 0%.
		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 by adjusting its position, speed and force. In normal usage, the Gripper will move as soon as you change the position setting. The Gripper will not move if it is not powered, connected and activated.

Gripper activation

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.



Features

Primary icon	Secondary icon	Functionality name	Description
		Open	Tap to fully open the Gripper. Use this when you want to grip an object (internal grip).
		Close	Tap to fully close the Gripper. Use this when you want to grip an object (external grip).
	(%)	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 associated parameter.
		Minus	Tap to decrease the associated parameter.
		Cancel	Cancels modifications and brings back to the Gripper node command screen.
		Save action	Saves settings into the selected Gripper node and brings back to the Gripper node command screen. <small>Note: This functionality is not available (grey) when the Gripper has the same action parameters as the selected Gripper node.</small>
		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).

Info

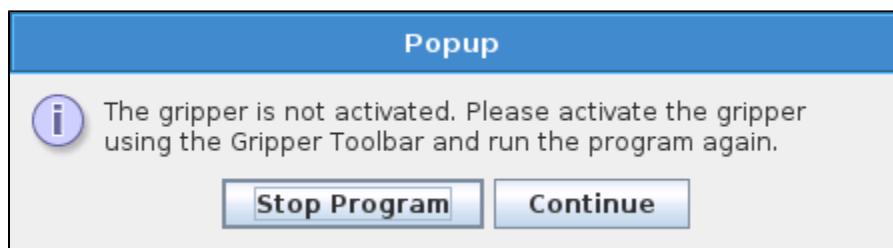
For detailed force and speed control, see [Section 4.5 Force Control](#).

Hint

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

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](#)).

**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 gripper_tutorial.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.

Use the gripper_tutorial.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 URCap nodes allows to move the Gripper and modify its speed and force. However, some advanced functions are only available through UR Script commands:

- `rq_activate_and_wait()`: This function activates the Gripper and waits for the completion of the procedure before going to the next command. If the Gripper is already activated, nothing happens and the program continues.
- `rq_auto_release_open_and_wait()`: This function can be used to completely open the Gripper at low speed even when it is not activated. This is useful in the case of a safe recovery after an emergency stop.
- `rq_auto_release_close_and_wait()`: Same as `rq_auto_release_open_and_wait()` but for closing the Gripper (useful in case of internal grip).
- `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_current_pos_norm()`: 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.
- `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".

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.

4.9 Control over Universal Robots without URCaps

If your Universal Robots' controller is not compatible with the URCaps package (see Section 3.7 for compatibility), 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

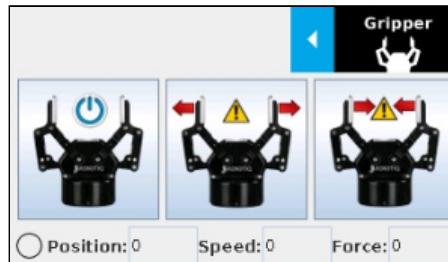
The Gripper toolbar is automatically installed with the driver package. The Gripper toolbar allows you to jog and test the Gripper. It is a great tool to try grasps with the Gripper while programming.

Toolbar collapsed :



- Tap the Gripper button to expand the toolbar.

Toolbar expanded, Gripper activation window :



- When the Gripper is not activated, the toolbar shows this window.
 - You need to tap the Activate button to be able to jog the Gripper.
 - Emergency open and close allows you to control the Gripper without activating, this mode will use a very low speed and force setting

Toolbar expanded, Gripper operation window :



- Use the buttons of this window to jog and test the Gripper.

Features

Gripper activation window

Primary icon	Secondary icon	Functionality name	Description
		2-Finger Gripper toolbar	Tap to expand and collapse the 2-Finger Gripper UR toolbar. When grey, the functionality is not available.
		Activate	Tap to activate the 2-Finger 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	Secondary icon	Functionality name	Description
		2-Finger Gripper toolbar	Tap to expand and collapse the 2-Finger Gripper UR toolbar. When grey, the functionality is not available.
		Open	Tap to fully open the Gripper.
		Close	Tap to fully close the Gripper.
Position:		Requested position	Shows the actual position of the Gripper: <ul style="list-style-type: none">• 0% : fully open• 100% : fully closed
Speed:		Requested speed	Shows the actual speed set of the Gripper: <ul style="list-style-type: none">• 0% : minimum speed• 100% : maximum speed
Force:		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• 100% : maximum force, with regrasp feature
		Increase force	Tap to increase the force request.
		Decrease force	Tap to decrease the force request.
		Increase speed	Tap to increase the speed request.
		Decrease speed	Tap to decrease the speed request.
		No object detected	Icon shown when no object is detected during a grasp.
		Object detected	Icon shown when an object is detected during a grasp.

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

The driver state "RQ_STATE_INIT" means the driver is attempting to connect to a Robotiq Gripper. When connection is established, the normal toolbar detailed above will appear.

Tip

If you see the following toolbar with communication not established, check if your Gripper is powered first, then check if the RS-485 to USB converter is properly wired.

4.9.2 Demo Scripts

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

pick_and_place_demo_with_subprograms.script is a demo script for pick and place applications using provided subprograms. The script uses subprograms included in the package such as **rq_set_force**, **rq_set_speed**, etc.

All provided subprograms are identified with the prefix **rq_**.

The script uses **rq_speed** and **rq_force** as speed and force parameters to be used during the program. They can be modified using values from 0 to 255 (see section XX).

The script does the following actions in sequence :

- Assign initial values to the global variables in the **Init Variables** section.
- Initiate the communication with the Gripper in the **Before Start** section.
- The **Robot Program** section contains the commands sent to the Gripper:
 - Activate the Gripper with **SubP_rq_activate_and_wait**.

Remember that all **_and_wait** subprograms will wait for the action to be completed before going to the next step.

- Move the robot to a predetermined position

Run with Universal Robots simulator first or make sure that the UR robot work area is totally cleared before running the script, as it will move the robot.

- Close the Gripper with **rq_close_and_wait**.
- Watch for object detection status :
 - If an object is detected, the script moves the robot and opens the Gripper.
 - If no object is detected, the script prompts a warning.

pick_and_place_demo_async_partial_opening_without_subprograms.script is similar to the previous demo, but without using subprograms. This demo uses asynchronous commands so that the robot and the Gripper will move at the same time (the previous example had the Gripper and the robot move separately).

4.9.3 Custom Programs

You can create your own program that commands the Gripper with the provided templates :

- Open **basic_template.script** in the list of provided templates;
- Push **play** to test the Gripper. The program will activate the Gripper and then do a loop of closing and opening the Gripper;
- Add your instructions under the robot program section. Program instructions can be added with Polyscope.

When programming an object pick up, use the **rq_is_object_detected subprogram** and **rq_object_detect** variable to know if an object has been picked. The subprogram sets the **rq_object_detect** variable to 1 if an object is detected, 0 otherwise.

Subprograms with the **_and_wait** will wait for the instruction to be completed before going to the next step. For example, **rq_close_and_wait** will wait for the motion to be completed before continuing to the next step, while **rq_close** will initiate motion and go to the next programmed step.

As shown in Figure 4.3.3.1, the basic_template program will execute these instructions in a sequence:

- Assign initial values to the global variables with the **Init Variables** section.
- Initiate communication with the Gripper with the **Before Start** section.
- The **Robot Program** section contains the commands sent to the Gripper:
 - Activate the Gripper with **SubP_rq_activate_and_wait**.
 - Close the Gripper with **rq_close_and_wait**.
 - Open the Gripper with **rq_open_and_wait**.

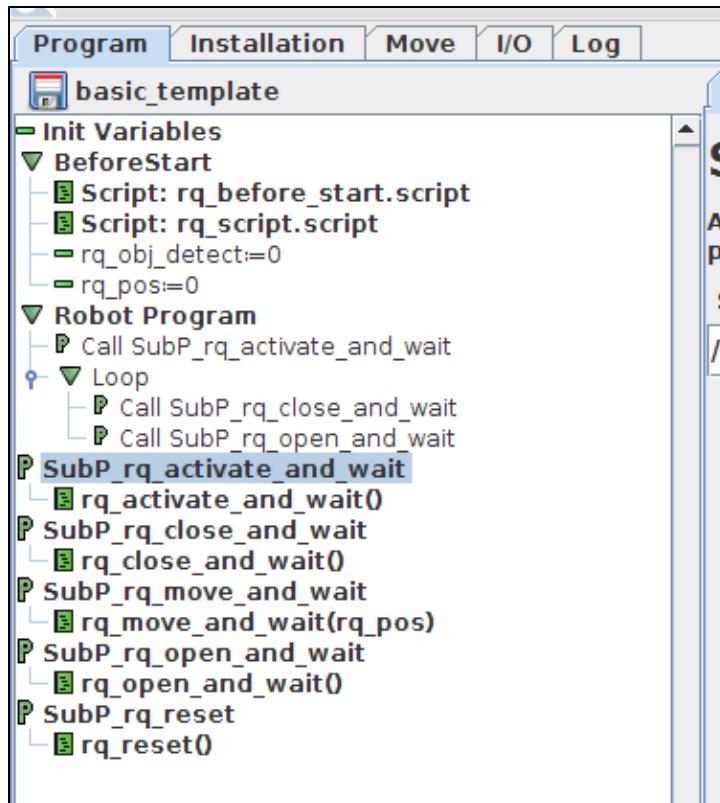


Figure 4.3.3.1: Basic template as shown in UR Polyscope.

When using the **advanced_template**, you have access to all of the subprograms listed in Section 3.7.4. Unused subprograms can be removed from the list. You must use global variables to pass information, not arguments.

4.9.4 Provided Variables and Functions

The file **rq_script.script** contains function definitions and variables that enhance the programming of the Gripper. Here is the list of these variables and functions.

Variables are used when programming the Gripper using subprograms. Since it is not possible to pass arguments to subprograms, the global variables listed below must be used.

Name	Range	Description
rq_force	[0-255]	Force set point. Change this variable by calling the subprogram SubP_rq_set_force .
rq_gripper_act	[0-1]	1 if the Gripper is activated. This variable is updated by calling either SubP_rq_is_gripper_activated or SubP_rq_activate_and_wait .
rq_move_complete	[0-1]	1 if the motion is complete. This variable is updated by calling one of the following: <ul style="list-style-type: none"> • SubP_rq_move_and_wait; • SubP_rq_open_and_wait; • SubP_rq_close_and_wait; • SubP_rq_is_motion_complete.
rq_object_detect	[0-1]	1 if an object is detected. This variable is updated by calling one of the following: <ul style="list-style-type: none"> • SubP_rq_move_and_wait; • SubP_rq_open_and_wait; • SubP_rq_close_and_wait; • SubP_rq_is_object_detected.
rq_pos	[0-255]	Position set point. This variable is updated by calling SubP_rq_current_pos .
rq_speed	[0-255]	Speed set point. Change this variable by calling the subprogram SubP_rq_set_speed .

The functions listed below can be called using subprograms in Polyscope or with a script. Functions with the suffix **_and_wait** will wait for the Gripper to complete its operation before going to the next step.

Name	Description
rq_activate	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.
rq_activate_and_wait	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.
rq_auto_release_close_and_wait	Slowly moves the Gripper to its maximum closed position. The Gripper must be activated after this command. Meant for emergency procedures.
rq_auto_release_open_and_wait	Slowly moves the Gripper to its maximum opened position. The Gripper must be activated after this command. Meant for emergency procedures.
rq_close	Moves the Gripper its fully closed position.
rq_close_and_wait	Moves the Gripper to its fully closed position and waits until the motion is completed to execute the next command.
rq_current_pos	Sets global variable rq_pos to the current Gripper position and returns this value.
rq_is_gripper_activated	Sets global variable rq_gripper_act to 1 if the Gripper is activated and returns True. Otherwise sets the variable to 0 and returns False.
rq_is_motion_complete	Sets global variable rq_mov_complete to 1 if the Gripper motion is complete and returns True. Otherwise sets the variable to 0 and returns False.
rq_is_object_detected	Sets global variable rq_obj_detect to 1 if the Gripper has detected an object and returns True. Otherwise, sets the variable to 0 and returns False.
rq_move_and_wait	Moves the Gripper to the position defined by the argument and waits until the motion is completed.
rq_move	Moves the Gripper to the position defined by the argument.
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_driver_state	Prints the driver's state to the UR log window.
rq_print_driver_version	Prints the driver version to the UR log window.
rq_print_fault_code	Prints the Gripper's fault code in the UR log window.
rq_print_firmware_version	Prints the Gripper's firmware version to the UR log window.
rq_print_num_cycles	Prints the Gripper's number of cycles in the UR log window.

5. User Interface

Visit <http://support.robotiq.com> to get the latest installer of the Robotiq User Interface along with appropriate documentation.

See the [Robotiq User Interface Instruction Manual](#) for details on usage of the Robotiq User Interface.

6. Specifications

Reminder

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

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

- [Section 6.1](#) 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 6.1.1 represents the Robotiq 2-Finger 85 Adaptive Robot Gripper's dimensions with axis X, Y, Z and origin referenced for finger motion. Figure 6.1.3 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-204-002** (2-Finger 85) or **AGC-TIP-220-140** (2-Finger 140).

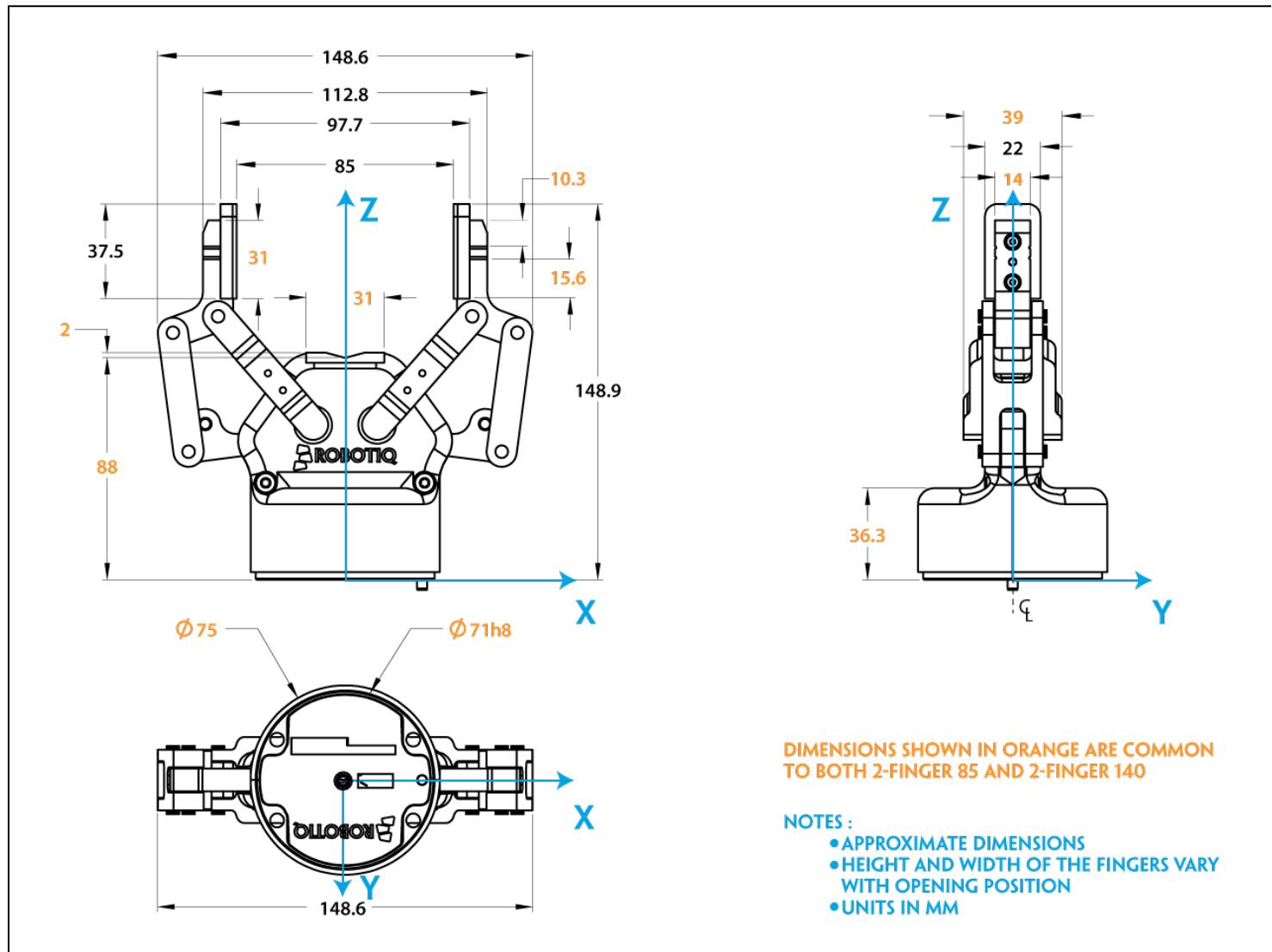


Figure 6.1.1 : 2-Finger 85 general dimensions (opened).

As mentioned in Figure 6.1.1, height and width of the fingers vary with opening position. Figure 6.1.1 represents the 2F85 Gripper in the opened position (position request = 0), while Figure 6.1.2 represents the 2F85 Gripper in the closed position (position request = 255).

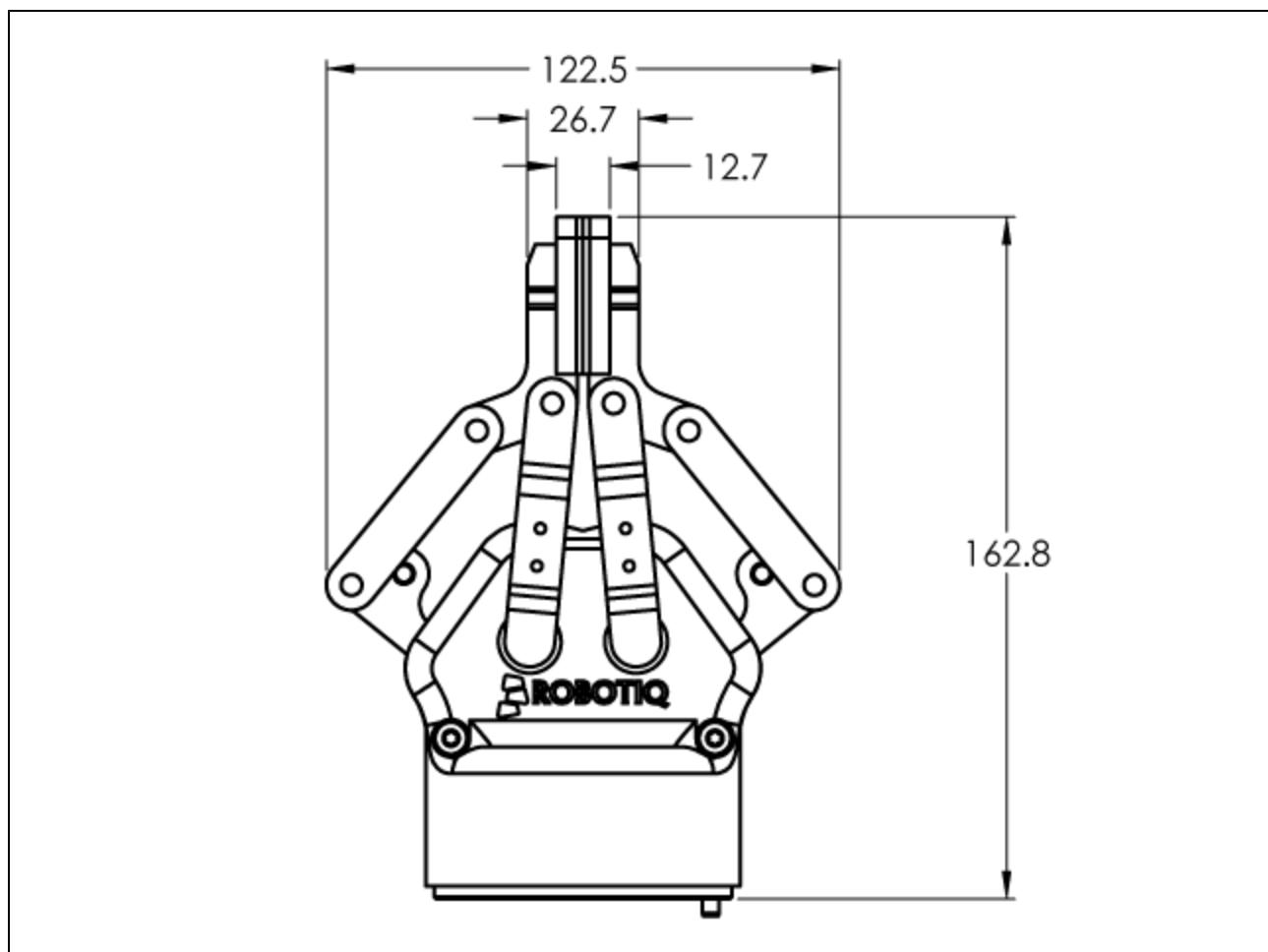


Figure 6.1.2 : 2-Finger 85 dimensions (closed).

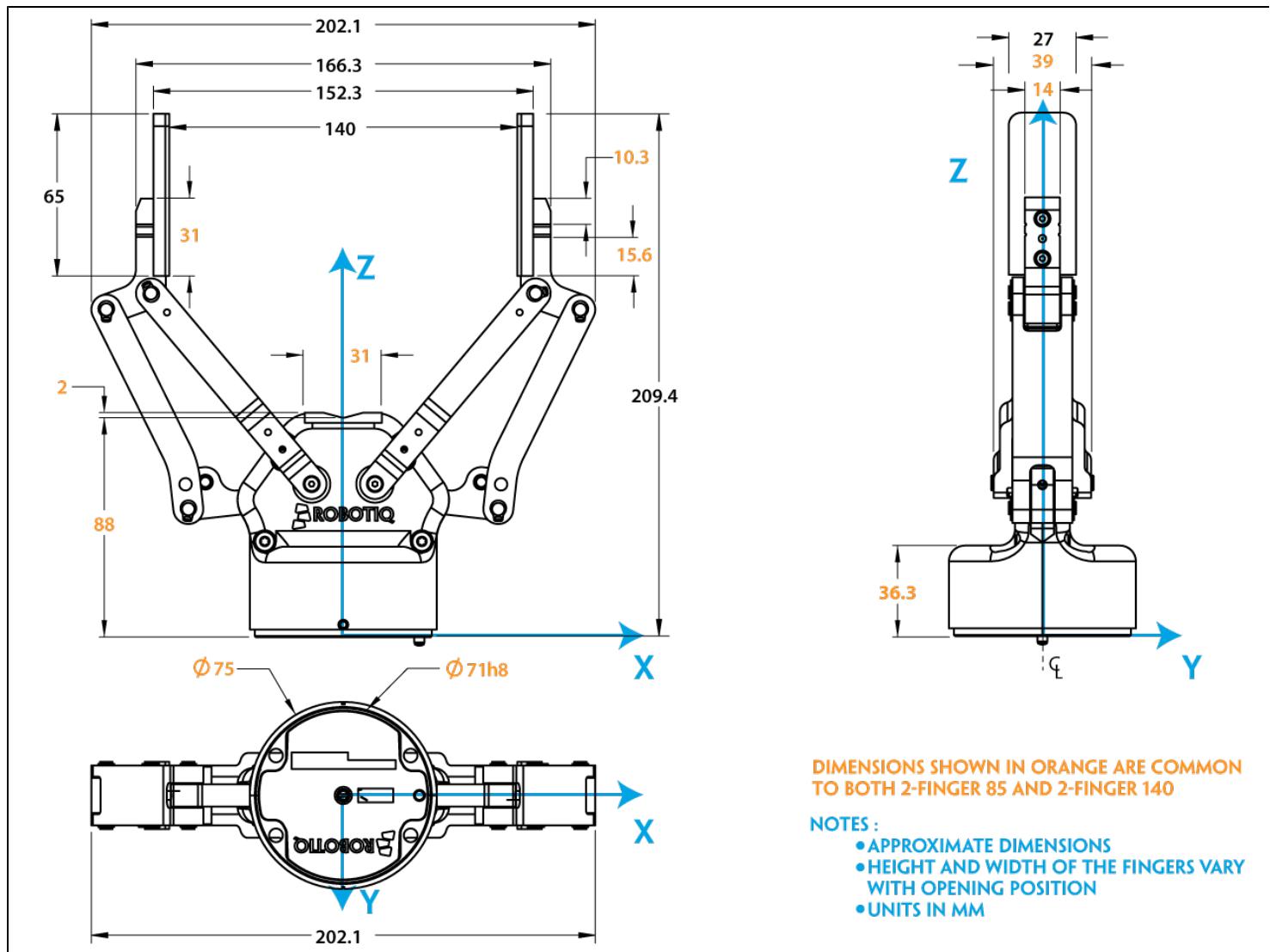


Figure 6.1.3 : 2-Finger 140 general dimensions (opened).

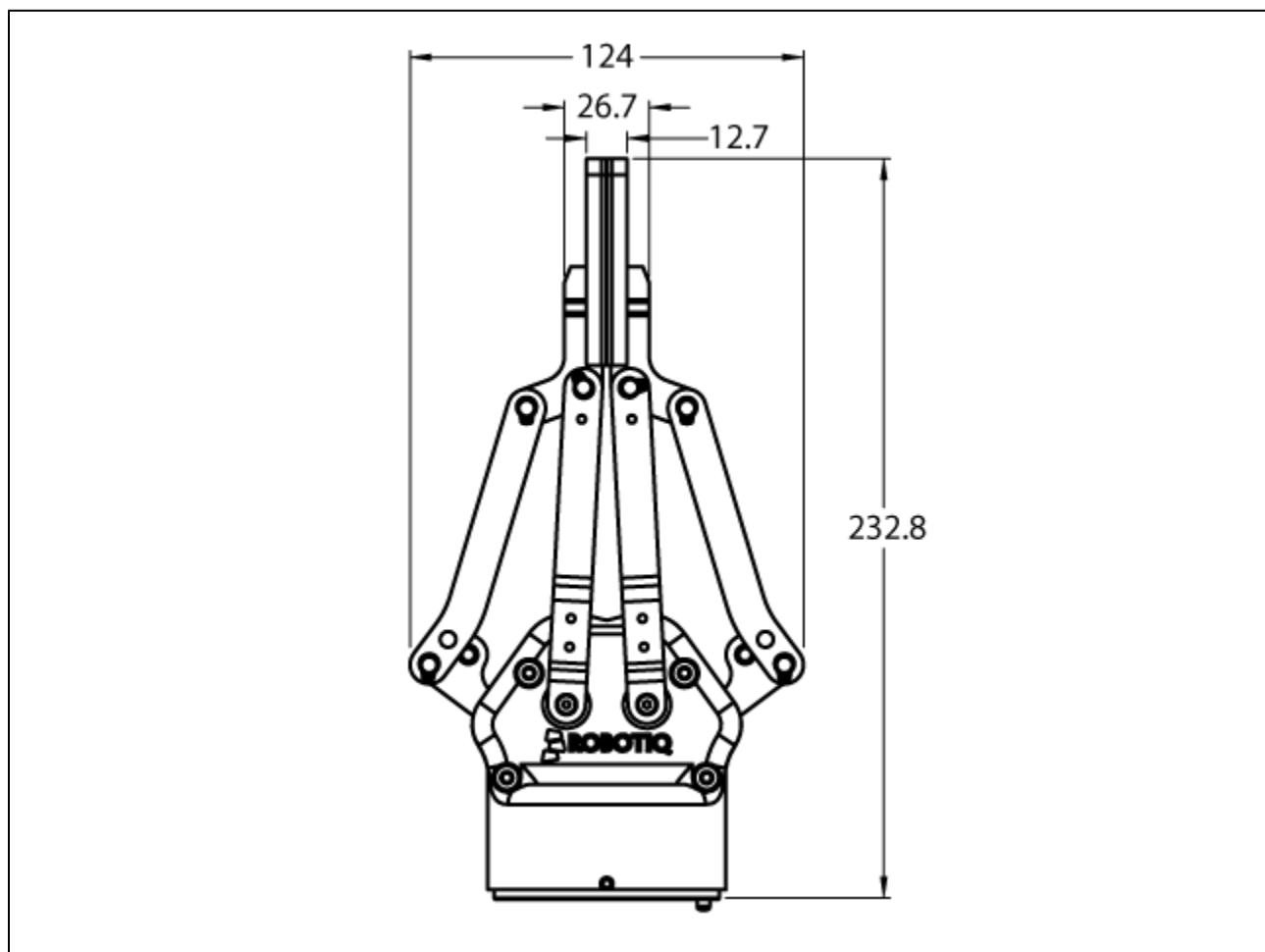


Figure 6.1.4 : 2-Finger 140 dimensions (closed).

As mentioned above Figure 6.1.3, height and width of the fingers vary with opening position. Figure 6.1.3 represents the 2F140 Gripper in the opened position (position request = 0), while Figure 6.1.4 represents the 2F140 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 2-Finger 85 and the 2-Finger 140.

Below are the dimensions of the blank coupling, **AGC-CPL-061-002** (see [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.

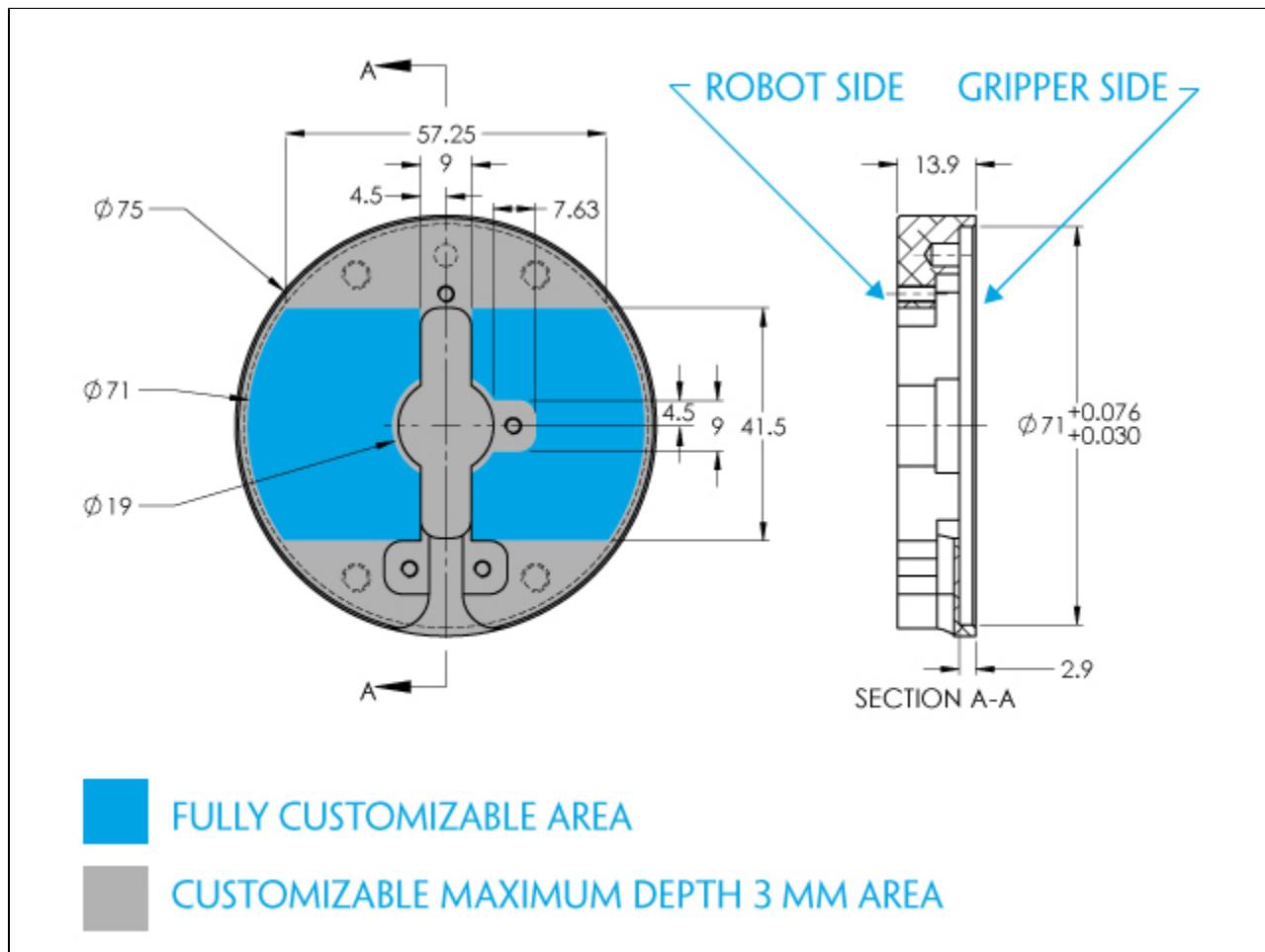


Figure 6.1.1.1 : Blank coupling AGC-CPL-061-002 workable area dimensions.

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

Bolt pattern for coupling **AGC-CPL-062-002** (see 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

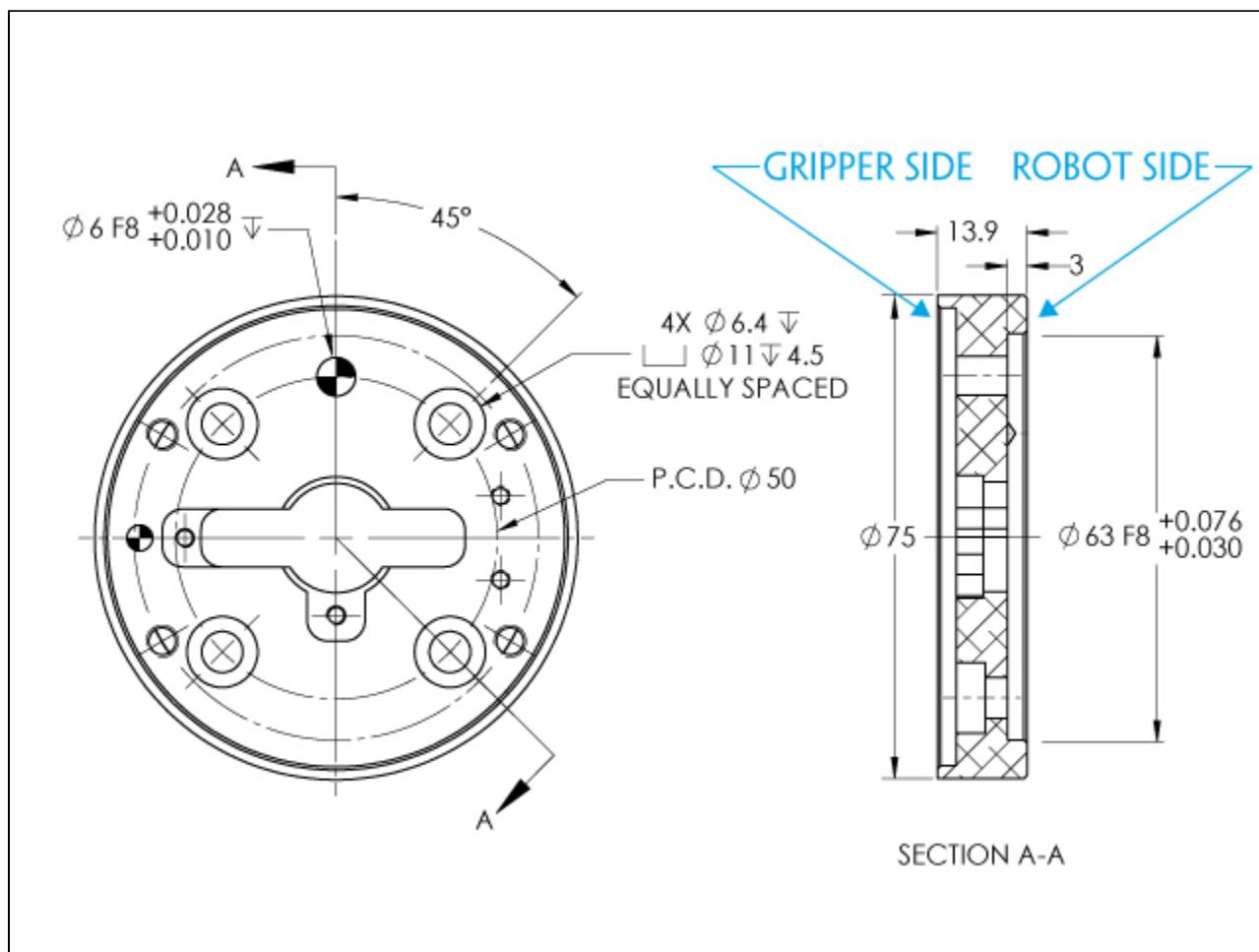


Figure 6.1.1.2 : Coupling for ISO 9409-1-50-4-M6.

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

Bolt pattern for coupling **AGC-CPL-063-002** (see 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

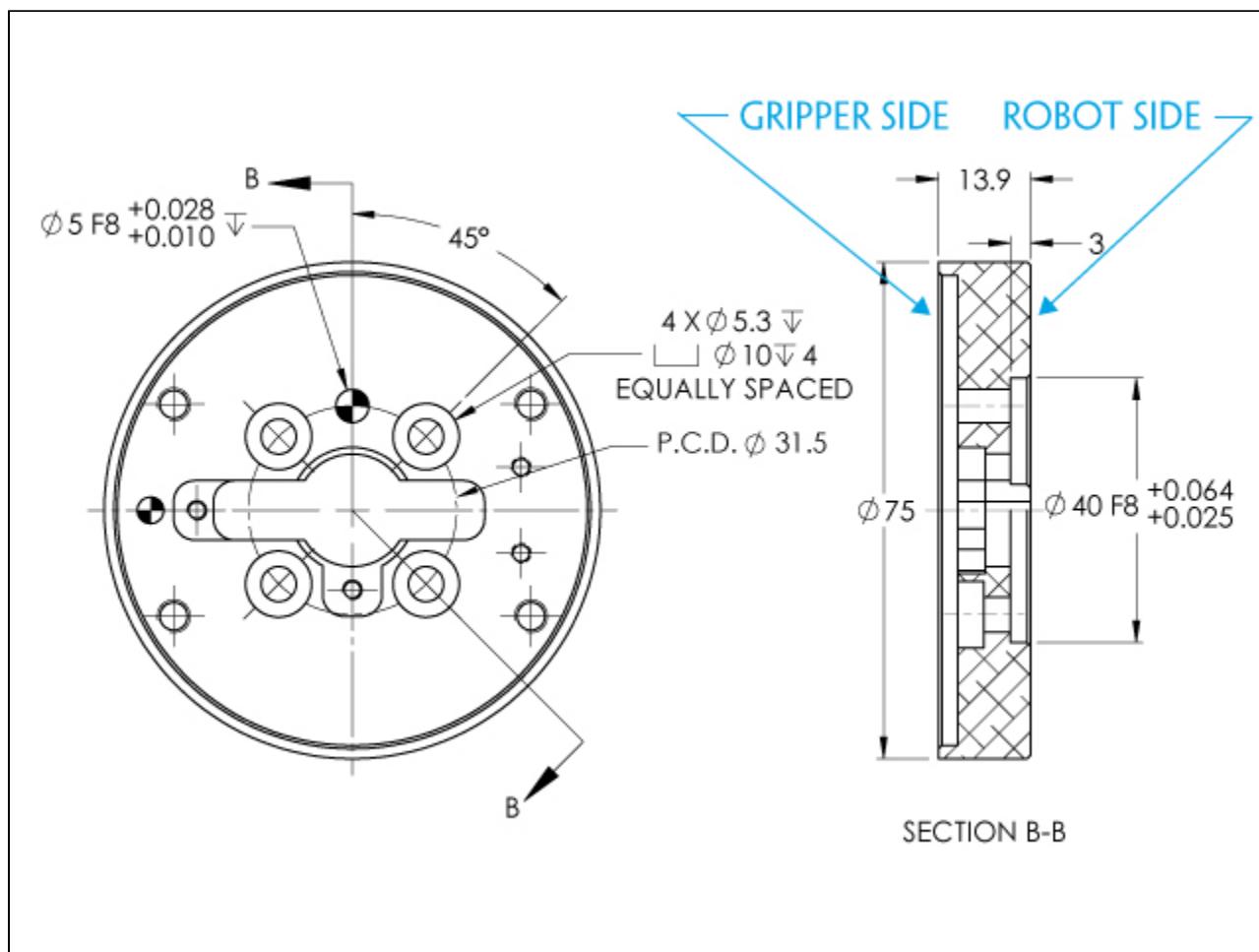


Figure 6.1.1.3 : Coupling for ISO 9409-1-31.5-4-M5.

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

Bolt pattern for coupling **AGC-CPL-064-002** (see 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

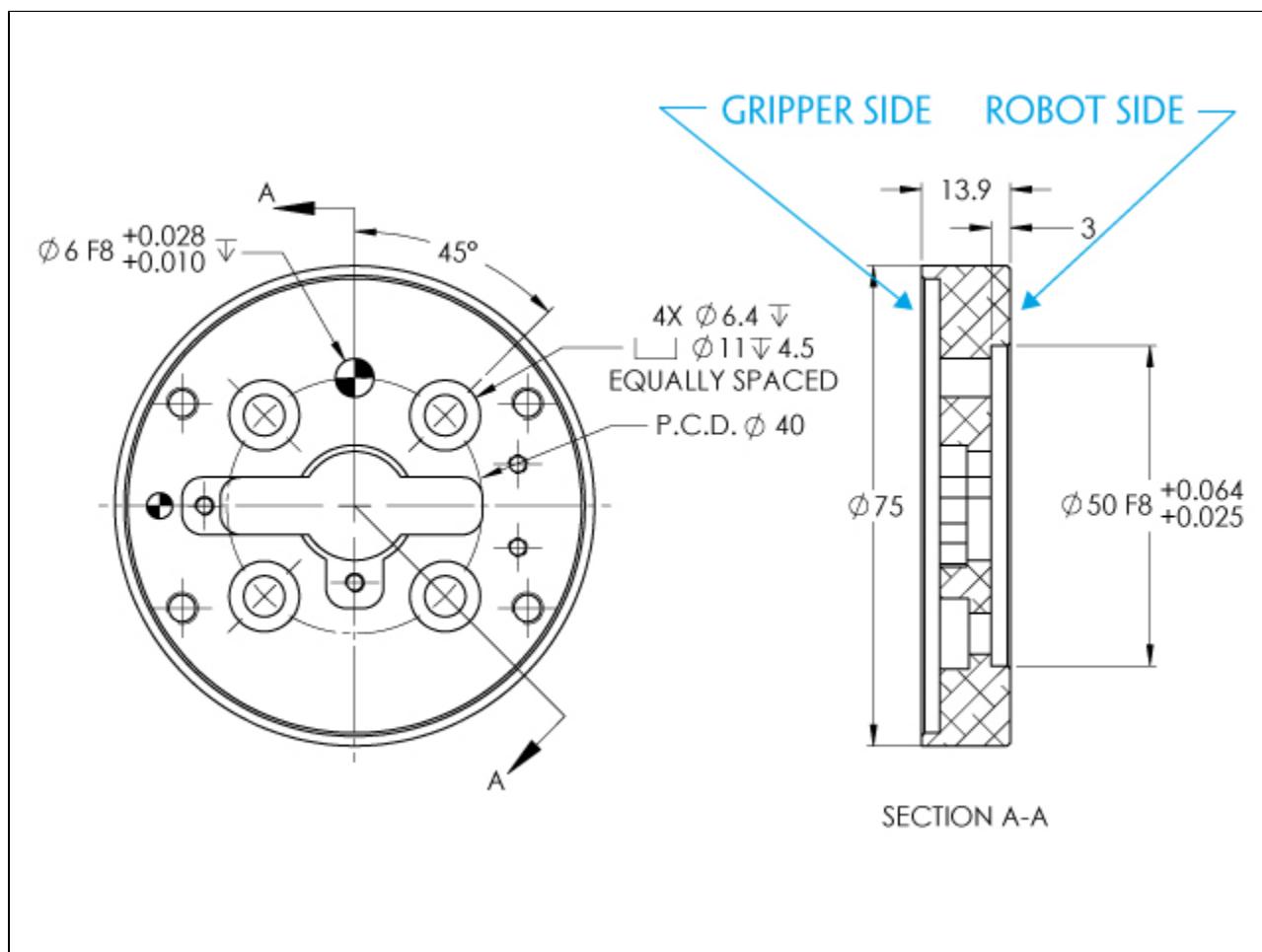


Figure 6.1.1.4 : Coupling for ISO 9409-1-40-4-M6.

Coupling for PCD 56 with 8 x M4

Bolt pattern for coupling **AGC-CPL-065-002** (see 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

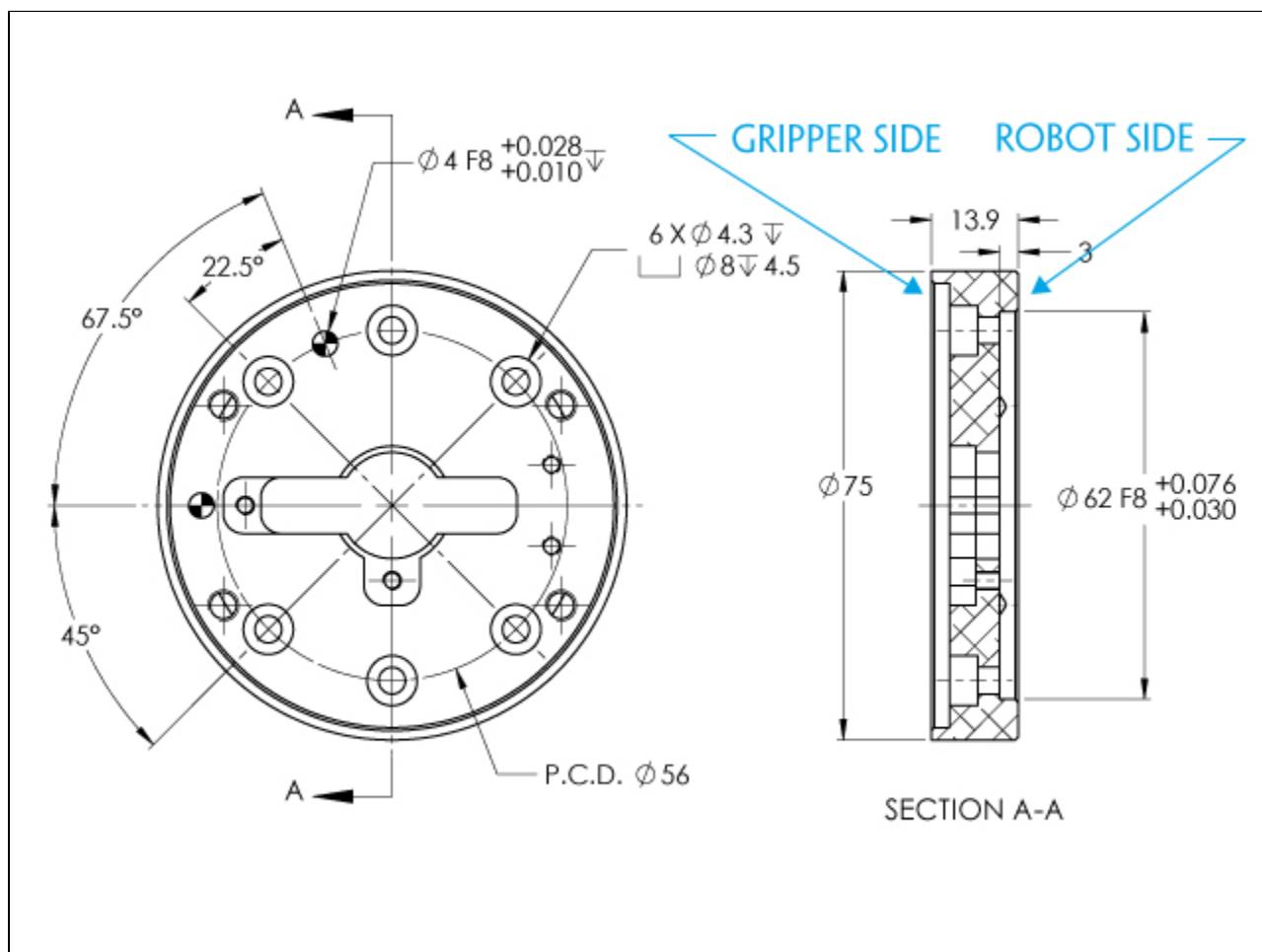


Figure 6.1.1.5 : Coupling for PCD 56 mm with 8 x M4 clearance.

Note

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** (see 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

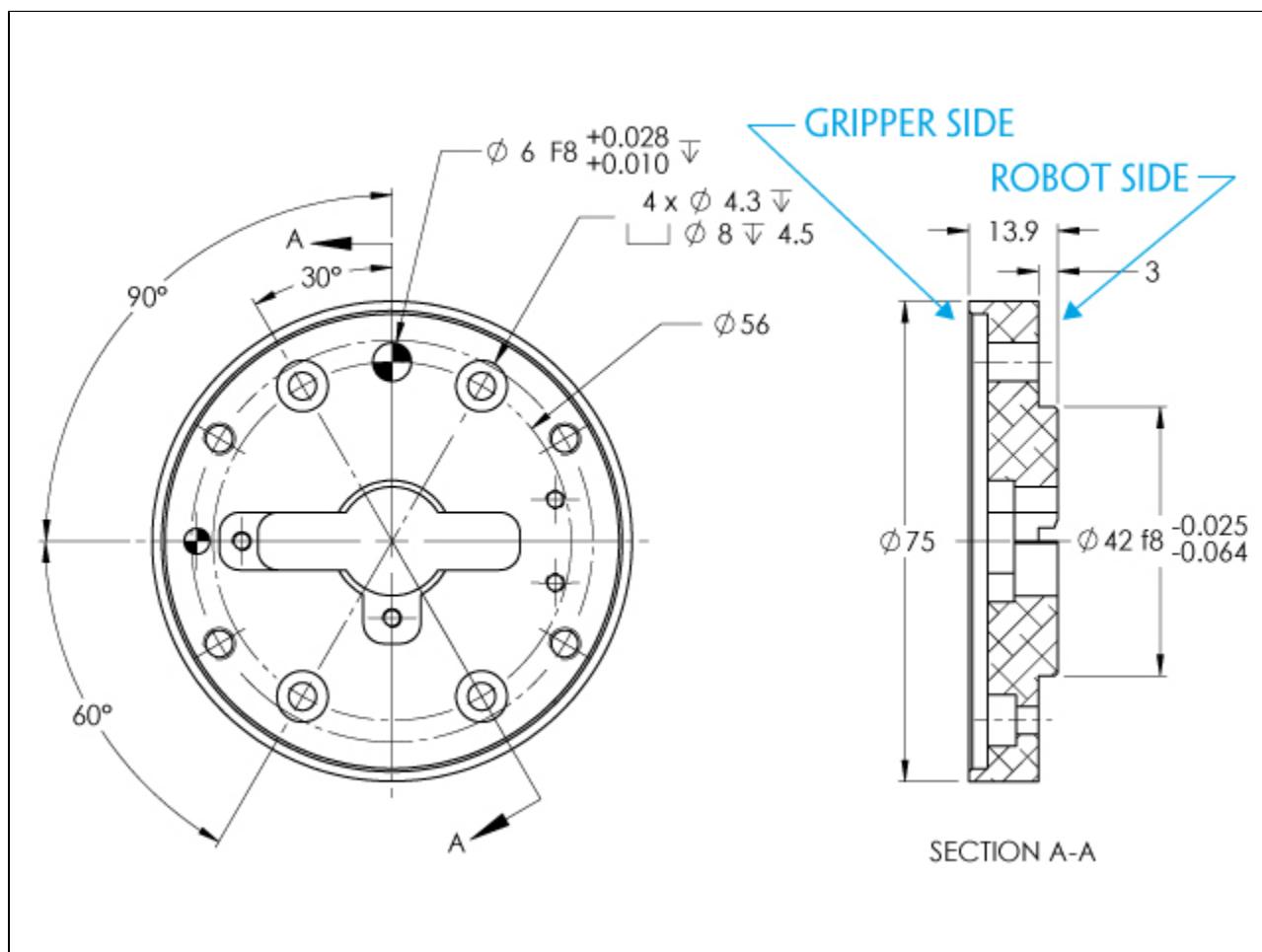


Figure 6.1.1.6 : Coupling for PCD 56 mm with 6 x M4 clearance.

Coupling for PCD 60 with 4 x M5

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

- 60 mm pitch circle diameter :
 - (4) M5x0.8 low head socket cap screw clearance
 - (1) M5 indexing pin
 - 34 mm diameter external insert

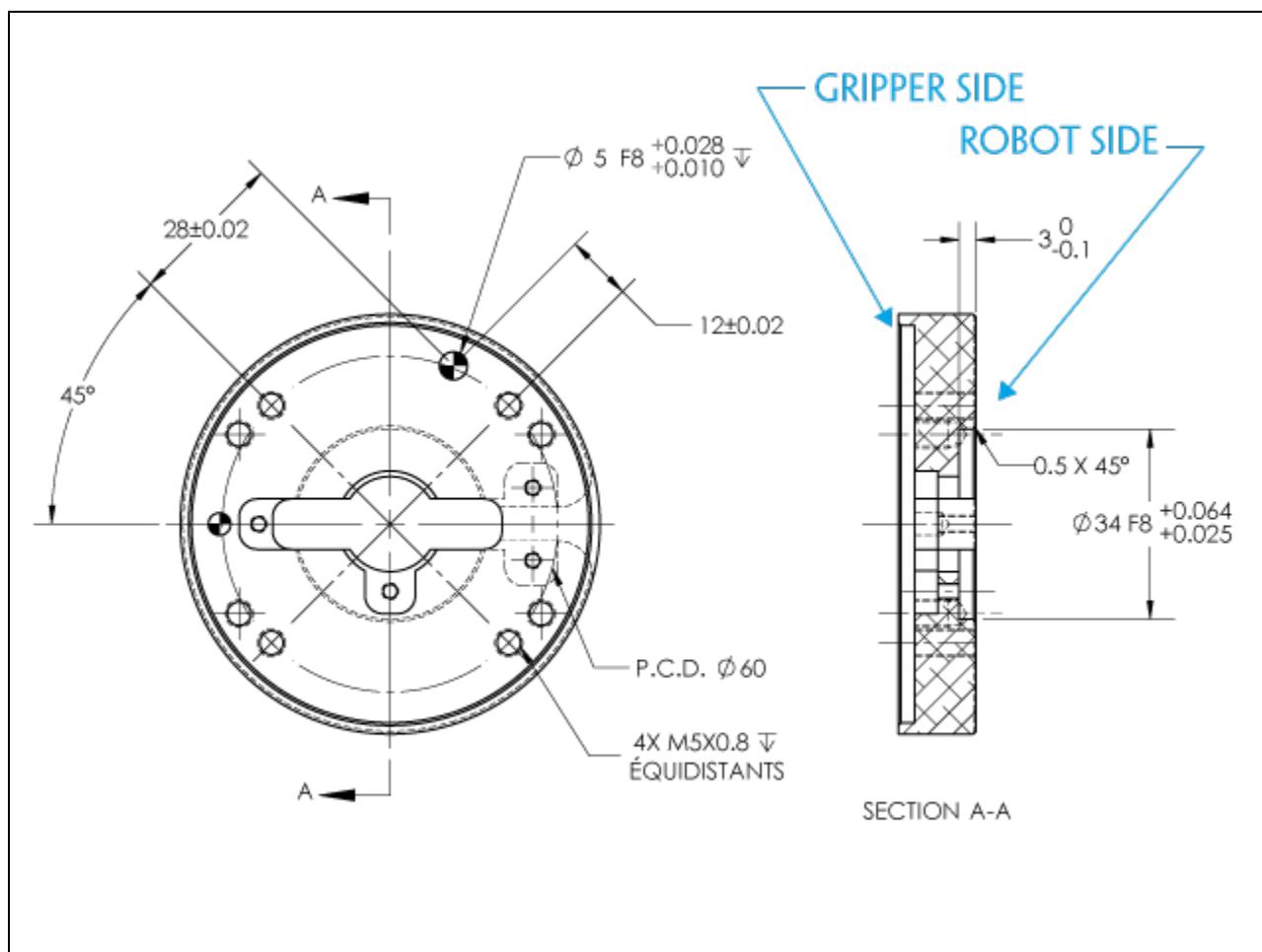


Figure 6.1.1.7 : Coupling for PCD 60 mm with 4 x M5 clearance.

Coupling for PCD 63 with 6 x M6

Bolt pattern for coupling **AGC-CPL-068-002** (see 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

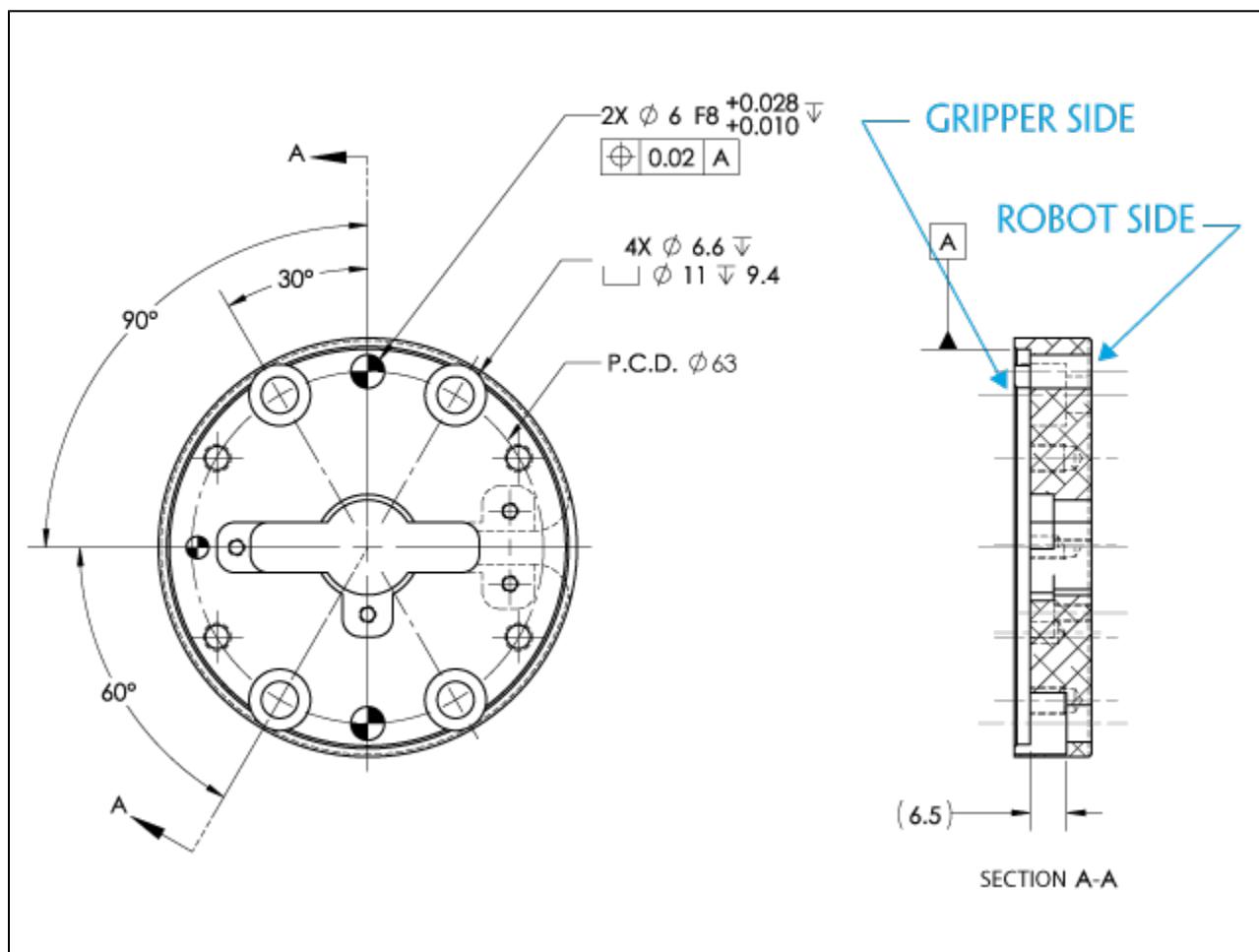


Figure 6.1.1.8 : Coupling for PCD 63 mm with 6 x M6 clearance.

6.1.2 Fingertips

The contact grip points for the Robotiq 2-Finger Adaptive Robot Gripper are its two fingertip pads and the palm pad. Many fingertips are available from Robotiq (see [Spare Parts, Kits and Accessories section](#)). The user can customize their own fingertips from blanks or create them from scratch. Figure 6.1.2.1 below represents the fingertip holder, the permanent, non customizable part of the Gripper finger on which the fingertip must be mounted.

Info

The 2-Finger 85 and the 2-Finger 140 both use the same fingertips.

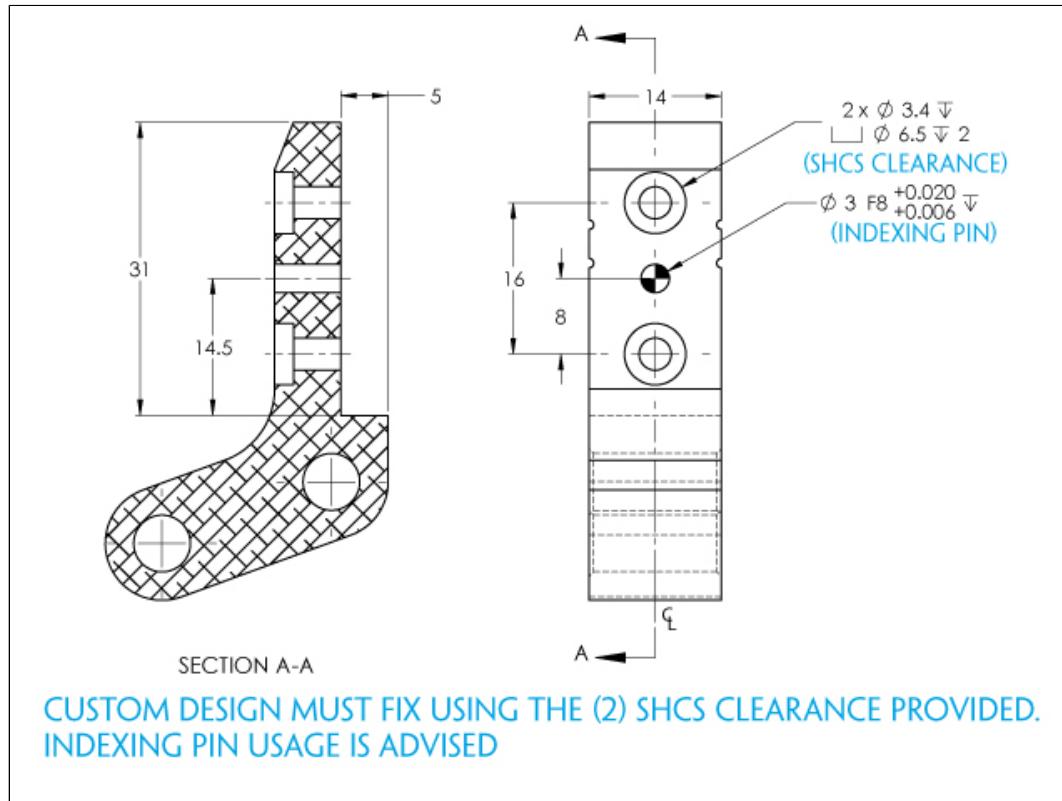


Figure 6.1.2.1 : Finger holder for standard or custom designed fingertips.

Info

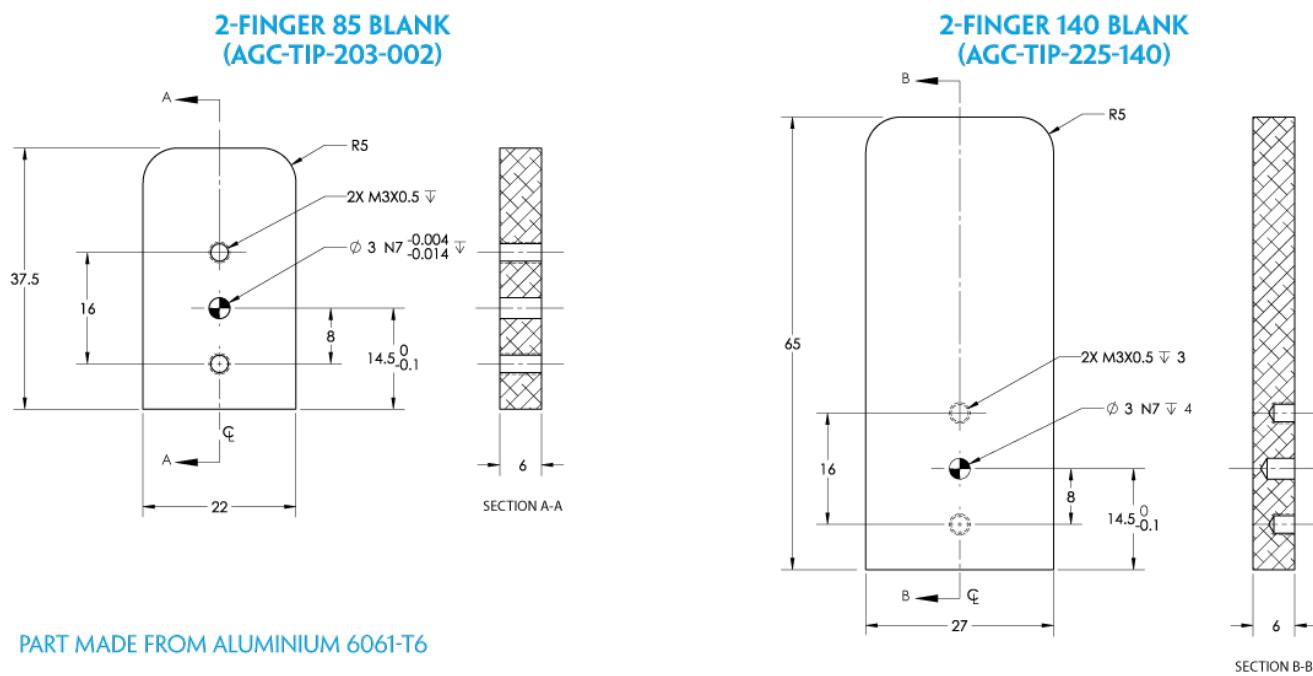
Socket head cap screw clearance will need low head cap screws if you intend to perform an internal grip, otherwise the screw head won't be recessed into the fingertip holder.

Tip

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

Blank fingertip

Figure 6.1.2.2 represents a blank fingertip **AGC-TIP-203-002** (2-Finger 85) and **AGC-TIP-225-140** (2-Finger 140), see Spare Parts, Kits and Accessories section. This fingertip is meant for the customization of one surface (it is symmetric) while the other surface will mount onto the fingertip holder shown in Section 6.1.2.



PART MADE FROM ALUMINIUM 6061-T6

* FINGERTIP IS SYMETRIC, ANY SIDE CAN BE CHOOSEN FOR CUSTOMIZATION, OTHER SIDE MUST BE LEFT AS IS

Figure 6.1.2.2 : Blank fingertip AGC-TIP-203-002 and AGC-TIP-225-140.

Flat silicone fingertip

Figure 6.1.2.3 represents a flat silicone fingertip **AGC-TIP-204-002** (2-Finger 85) and **AGC-TIP-220-140** (2-Finger 140), see Spare Parts, Kits and Accessories section. This fingertip has a flat silicone surface with an optimal friction coefficient for picking parts while the other surface will mount onto the fingertip holder shown in Section 6.1.2.

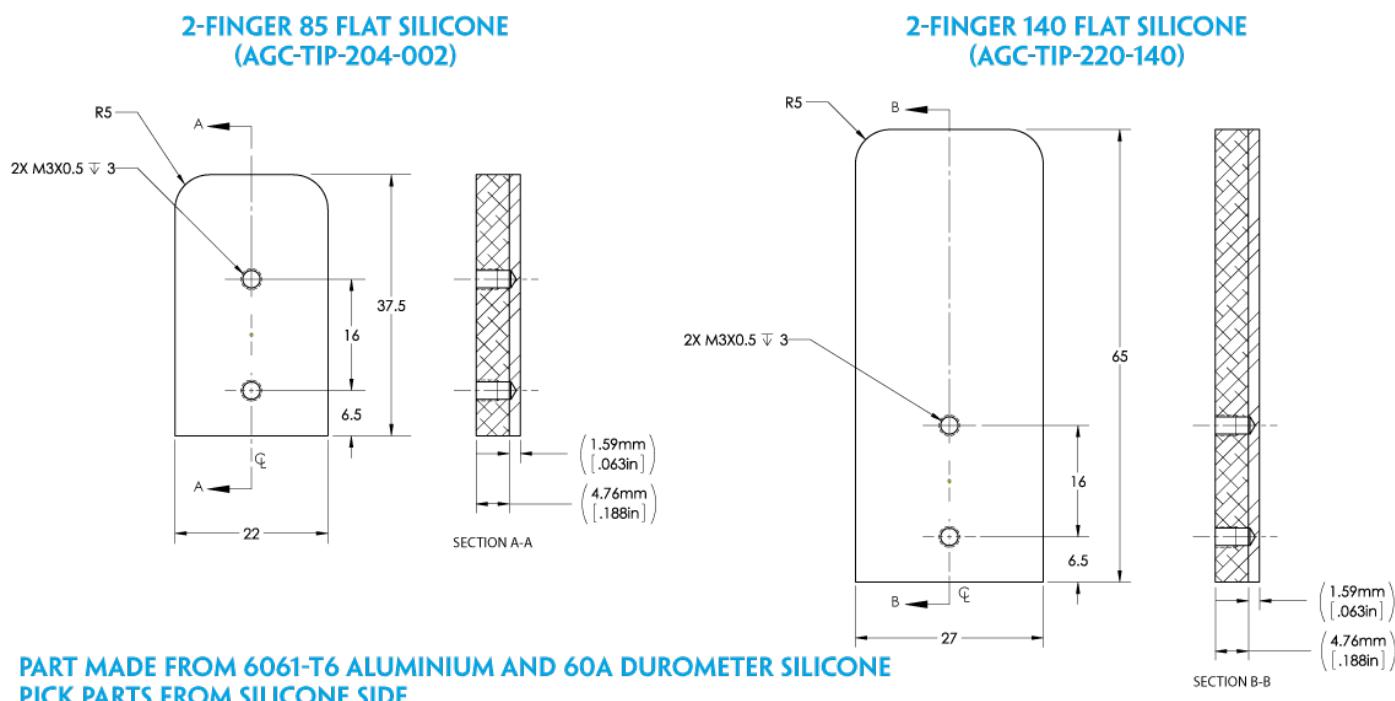


Figure 6.1.2.3 : Flat silicone fingertip AGC-TIP-204-002 and AGC-TIP-220-140

Grooved fingertip

Figure 6.1.2.4 represents the available grooved fingertip **AGC-TIP-205-002** (2-Finger 85) and **AGC-TIP-221-140** (2-Finger 140), see Spare Parts, Kits and Accessories section. This fingertip has a grooved surface with an optimal shape for picking cylindrical parts (by its horizontal and vertical grooves) while the other surface will mount onto the fingertip holder shown in Section 6.1.2.

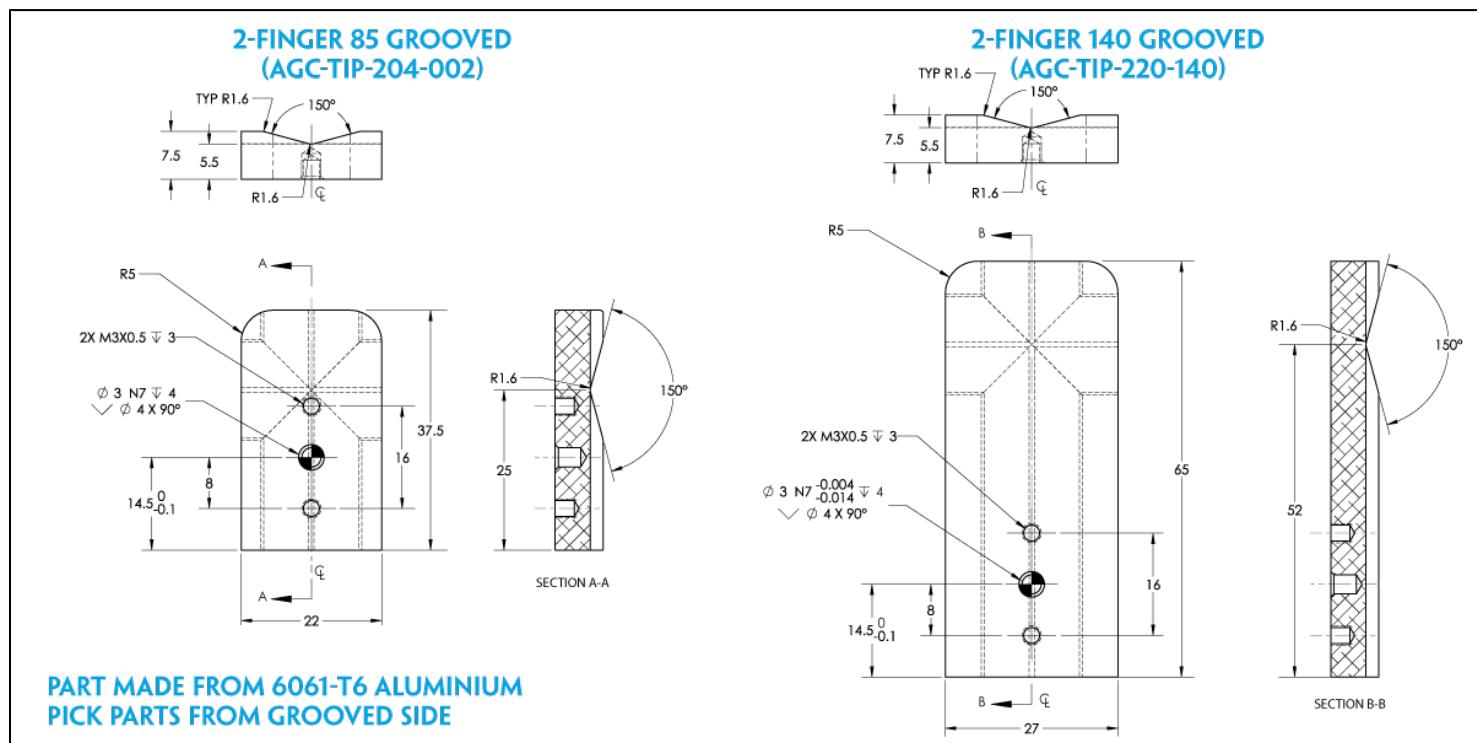


Figure 6.1.2.4 : Grooved fingertip AGC-TIP-205-002 and AGC-TIP-221-140.

6.2 Mechanical specifications

Specifications :

Specification	2-FINGER 85		2-FINGER 140	
	Metric units	Imperial Units	Metric units	Imperial Units
Gripper Opening (see Figure 6.1.1)	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	850 g	1.9 lbs	897 g	2 lbs
Grip force	Maximum force calculation below, see Section 4.5 for force control			
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
Grip force resolution	Maximum force calculation below, see Section 4.5 for force control			

Info

All specs are measured with coupling **AGC-CPL-062-002** and fingertip **AGC-TIP-204-002** (2-Finger 85) or **AGC-TIP-220-140** (2-Finger 140).

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

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

Payload and force :

Actuation force model used to calculate recommended payload is described in Figure 6.3.1, the user must not exceed the force (F) and torque (T) limits :

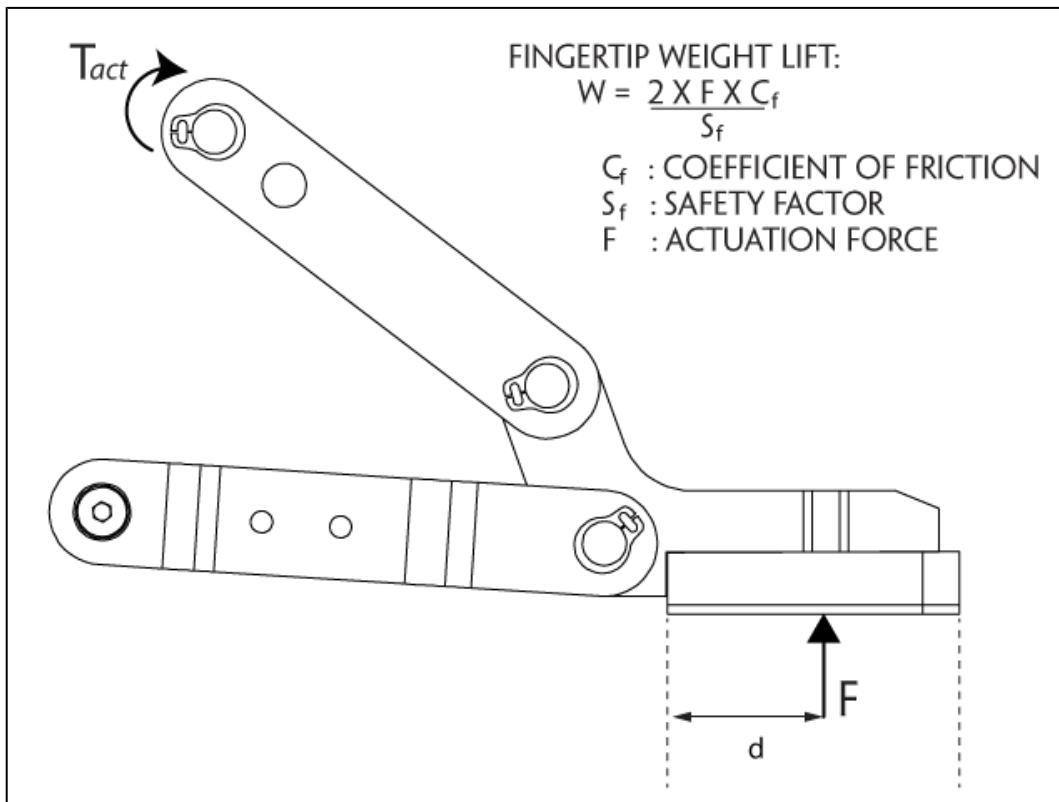


Figure 6.2.1 : Actuation force on the fingertip of the Adaptive Gripper 2-Finger (see charts below for 2-Finger 85 and 2-Finger 140 force).

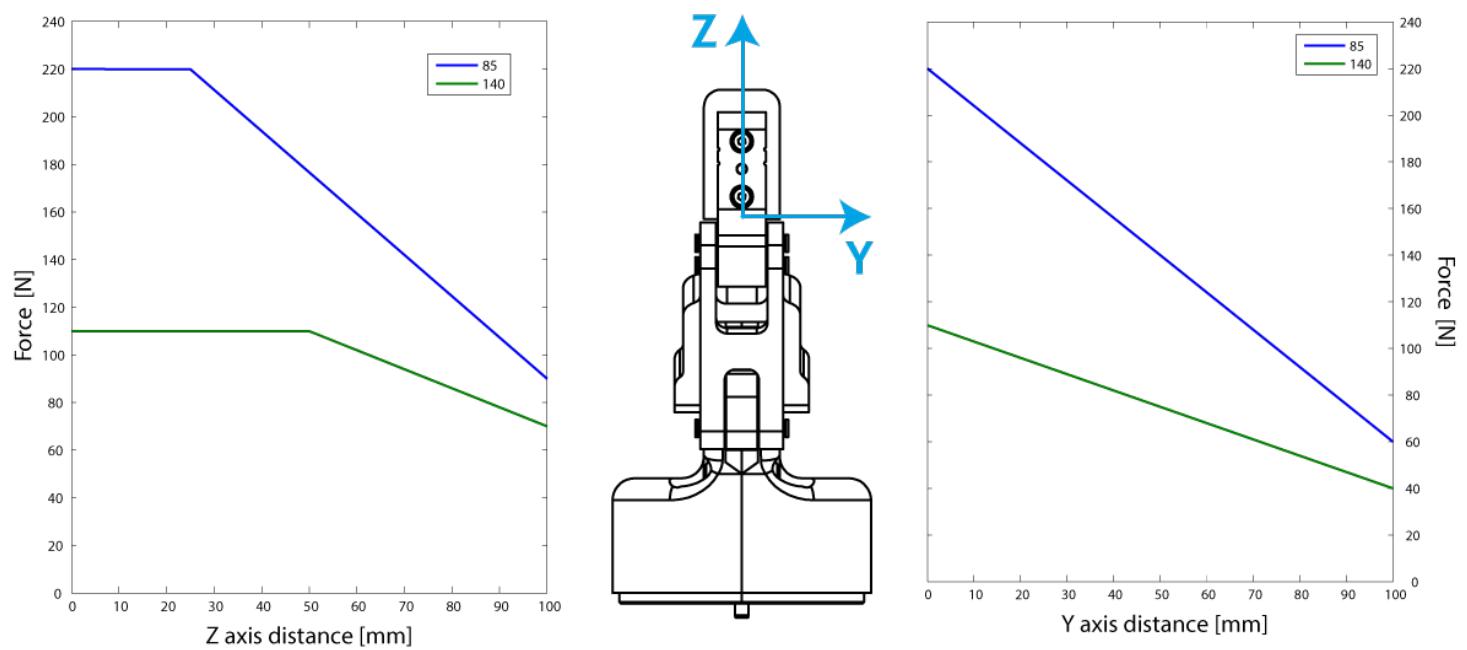


Figure 6.2.2 : Grip force in the Y and Z axis for the 2-Finger 85 and 2-Finger 140.

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.

Note

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 6.2.2.

As defined in Figure 6.2.1, 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 part 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 part (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 part 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 part would weight 100 N and would 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.

Equilibrium Line :

Equilibrium line position (explained in section 1. General Presentation) is detailed in Figure 6.2.3 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 6.2.2.

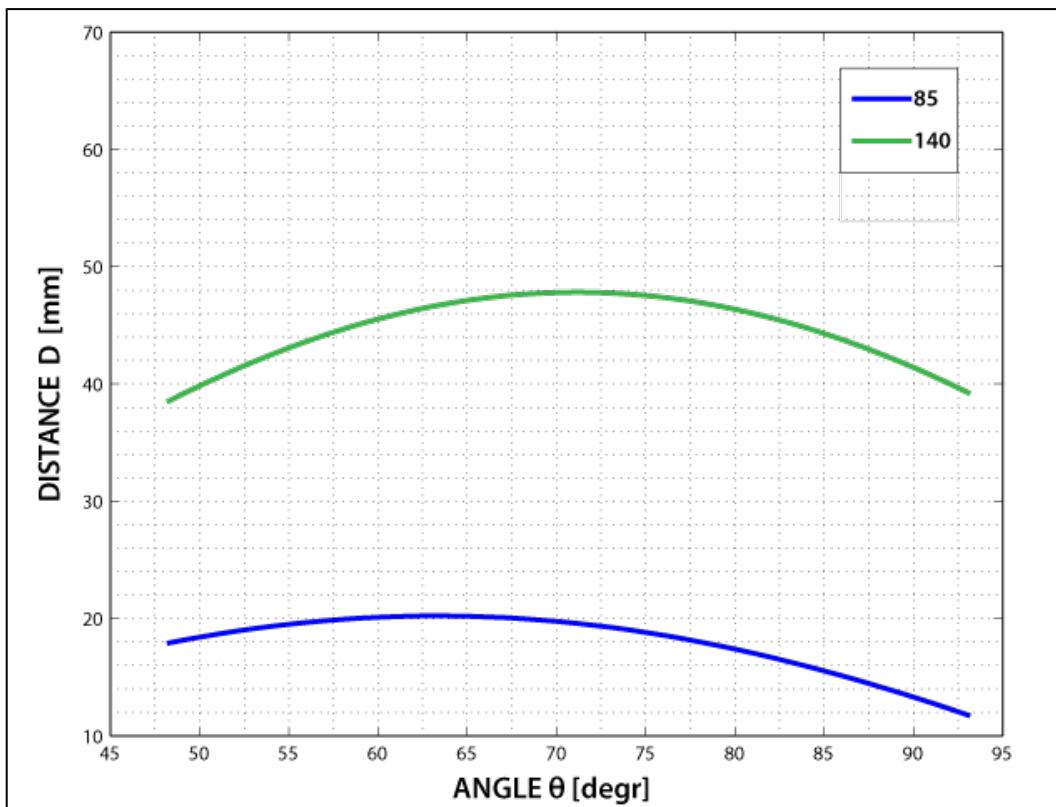


Figure 6.2.3 : Position of the Gripper equilibrium line according to the opening angle for 2-Finger 85 and 2-Finger 140 options.

6.2.1 Center of mass and moment of inertia

The coordinate system used to calculate the moment of inertia and center of mass of the Gripper is shown in Figure 6.1.1. The center of mass and moment of inertia are calculated for a configuration where the fingers are fully open.

Here is the approximate position for the center of mass:

2-FINGER 85 OPTION	
$G = \begin{bmatrix} G_x \\ G_y \\ G_z \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 58.4 \end{bmatrix} \text{mm} = \begin{bmatrix} 0 \\ 0 \\ 2.30 \end{bmatrix} \text{in}$	
2-FINGER 140 OPTION	
$G = \begin{bmatrix} G_x \\ G_y \\ G_z \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 69.1 \end{bmatrix} \text{mm} = \begin{bmatrix} 0 \\ 0 \\ 2.72 \end{bmatrix} \text{in}$	

Figure 6.2.1.1 : Robotiq 2-Finger center of mass.

Here is the approximate moment of inertia matrix for the Gripper:

2-FINGER 85 OPTION		
$I = \begin{bmatrix} I_{xx} & I_{xy} & I_{xz} \\ I_{yx} & I_{yy} & I_{yz} \\ I_{zx} & I_{zy} & I_{zz} \end{bmatrix}$	$= \begin{bmatrix} 2768 & 0 & 0 \\ 0 & 3149 & 0 \\ 0 & 0 & 564 \end{bmatrix}$	$= \begin{bmatrix} 9.5 & 0 & 0 \\ 0 & 10.8 & 0 \\ 0 & 0 & 1.9 \end{bmatrix}$
kg * mm^2 lb * in^2		
2-FINGER 140 OPTION		
$I = \begin{bmatrix} I_{xx} & I_{xy} & I_{xz} \\ I_{yx} & I_{yy} & I_{yz} \\ I_{zx} & I_{zy} & I_{zz} \end{bmatrix}$	$= \begin{bmatrix} 5755 & 0 & 0 \\ 0 & 7378 & 0 \\ 0 & 0 & 1844 \end{bmatrix}$	$= \begin{bmatrix} 19.7 & 0 & 0 \\ 0 & 25.2 & 0 \\ 0 & 0 & 6.3 \end{bmatrix}$
kg * mm^2 lb * in^2		

Figure 6.2.1.2 : Robotiq 2-Finger inertia matrix.

6.2.2 Moments and force limit

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, see [section 6.2](#).

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 finger tips as shown in [figure 6.2.2](#)

Example usage of the listed limit :

- After picking it's 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 grip force being applied (picking an object while opening or closing or closing the fingers on themselves).

Maintenance Intervals :

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

¹ Replace pads before if wear is visible.

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

Visit support.robotiq.com for details on the required maintenance operations.

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 parts (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

Reminder

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

Note

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

Note

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 35mm 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 Figure 7.1.1 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 35mm socket head cap screws, use the tooth lock washers, apply medium strength thread locker to the M5 screws.

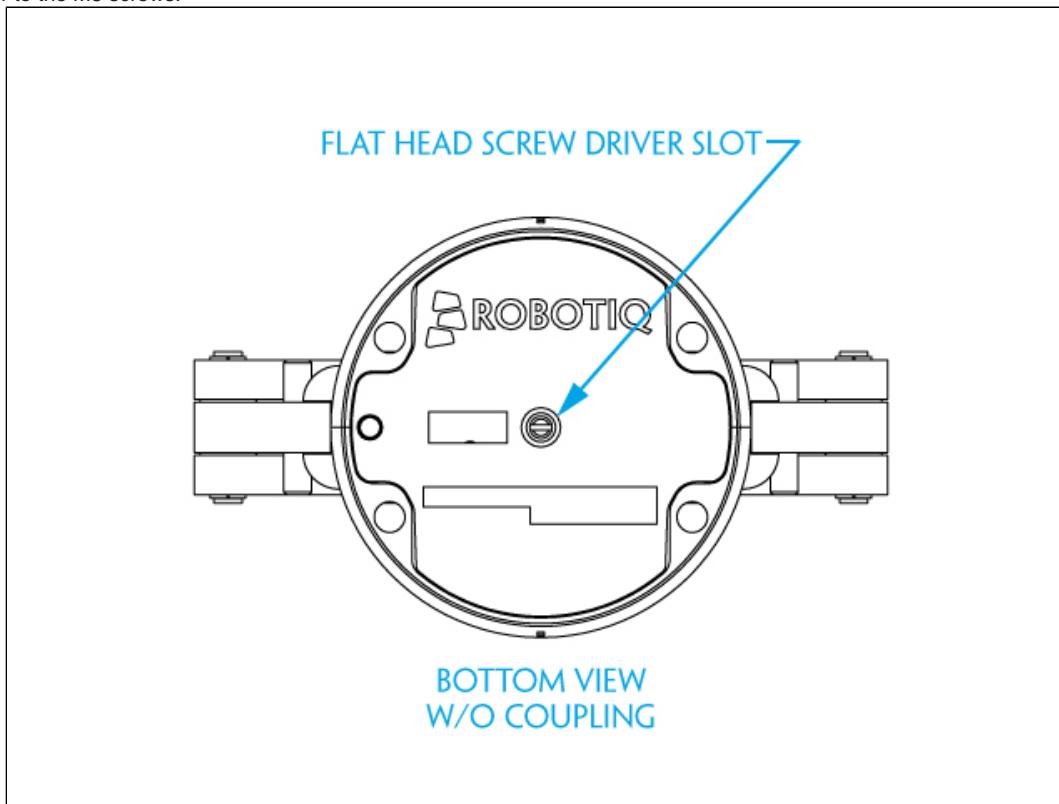


Figure 7.1.1 : Flat head screwdriver slot for manual opening and closing of the Gripper.

7.2 Periodic inspection

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

Note

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

1. Remove and clean the Gripper following instructions in [7.1 Gripper cleaning](#).
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 gripping, if wear is visible and affects movement, change fingerpad(s).
 - c. Check for any collision damage, if damage is visible, contact Robotiq support.
 - d. Check for any sign of wear on the Gripper chassis, if wear is present and may affect the Gripper, contact Robotiq support.
3. Put back in place respecting instructions from section 7.1.

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• 2 mm hex key• Dry tissue or towel• low strength thread locker• medium strength thread locker	<ul style="list-style-type: none">• 2x Robotiq 2-Finger Adaptive Robot Gripper fingertip (with or without silicone pad).

See Spare parts and accessories section to order Robotiq 2-Finger Adaptive Robot Gripper replacement parts.

Note

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

1. Remove and clean the Gripper following instructions in [7.1 Gripper cleaning](#).
2. Remove the worn fingertip by removing the M3 screws with the 2 mm hex key.
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 M3-0.5 x 8 mm socket head cap screws (low head), apply low strength thread locker to the M3 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 :

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-002	AGC-GRP-140
Kit for <i>Universal Robot</i>	Gripper basic unit, 10 m cables and couplings for <i>Universal Robots</i> with silicone fingertips	AGC-UR-KIT-002	AGC-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 : - 2 x Replacement finger - 2 x Hardware kit - 1 x Allen key	AGC-FIN-KIT-85	AGC-FIN-KIT-140
<hr/>			
Coupling kit for FT-150	Coupling Kit for FT-150 sensor Included: - 1 x 2-Finger coupling with 1 m pigtail - All required hardware (for FT-150 mounting)	AGC-CPL-FTSENSOR	
Blank coupling	Blank coupling for Adaptive Robot Gripper 2-Finger, with screws for Gripper fixation and 1 m pigtail cable	AGC-CPL-061-002	
ISO 9409-1-50-4-M6 coupling	ISO 9409-1-50-4-M6 coupling for Adaptive Robot Gripper 2-Finger, 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	
ISO 9409-1-40-4-M6 coupling	ISO 9409-1-40-4-M6 coupling for Adaptive Robot Gripper 2-Finger, with screws for Gripper fixation and 1 m pigtail cable	AGC-CPL-064-002	
56-8M4-1D4 coupling	Coupling for 56 mm PCD ¹ 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 PCD ¹ 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 mm PCD ¹ 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 PCD ¹ 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 PCD ¹ 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 PCD ¹ with (4) M4, with screws for 2-F Gripper fixation and 1 m pigtail cable	AGC-CPL-071-002	
<hr/>			
Adapter plate to 63-4M6-71-2D3	Wrist adapter plate for use with AGC-CPL-064-002. Interface to 63 mm PCD ¹ with (4) M6 screws and 71 mm PCD ¹ 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 PCD ¹ with (4) M6 screws and 61.4 mm PCD ¹ with (2) M6 indexing pins	AGC-APL-152-002	
Adapter plate to 80-6M8-2D8	Wrist adapter plate for use with AGC-CPL-064-002. Interface to 80 mm PCD ¹ with (6) M8 screws and (2) M8 indexing pins	AGC-APL-153-002	
<hr/>			
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	
<hr/>			
Blank fingertip ²	Blank aluminium fingertip for 2-Finger Adaptive Gripper, included : <ul style="list-style-type: none">• one (1) C-203 or C-225 Fingertip.• two (2) screws M3-0.5 x 8 mm LHCS• one (1) dowel pin 3 x 10 m6	AGC-TIP-203-002	AGC-TIP-225-140
Silicone fingertip ²	Flat silicone fingertip for 2-Finger Adaptive Gripper, included : <ul style="list-style-type: none">• one (1) C-204 or C-220 Fingertip.• two (2) screws M3-0.5 x 8 mm LHCS• one (1) dowel pin 3 x 10 m6	AGC-TIP-204-002	AGC-TIP-220-140
Grooved fingertip ²	Grooved aluminium fingertip for 2-Finger Adaptive Gripper, meant to pick cylindrical objects in both Y and Z axis, included : <ul style="list-style-type: none">• one (1) C-205 or C-221 Fingertip.• two (2) screws M3-0.5 x 8 mm LHCS• one (1) dowel pin 3 x 10 m6	AGC-TIP-205-002	AGC-TIP-221-140
Replacement palm pad	Replacement palm pad for the 2-Finger Adaptive Gripper, included : <ul style="list-style-type: none">• one (1) Palm pad C-010• four (4) screws M3-0.5 x 8 mm LHCS	AGC-PAD-010-002	
Replacement finger	Replacement finger for 2-Finger Adaptive Gripper, included : <ul style="list-style-type: none">• one (1) finger• two (2) replacement screws M4 x 8 SSCS• three (3) replacement snap rings (5 mm external)	AGC-FIN-002	AGC-FIN-140
Parallel locking pin ²	Parallel mechanism locking pin for 2-Finger Adaptive Gripper, included : <ul style="list-style-type: none">• one (1) locking pin C-020• three (3) snap rings (5 mm external)	AGC-PARA-KIT-002	

¹ Pitch Circle Diameter

² Part listed for a single unit, 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, see [Section 3.5](#).
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 establish.
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 :
 - i. Not lit, no USB communication.
 1. Check USB connection.
 2. Re-install drivers.
 3. Contact support.
 - ii. Red flashes at slow rate.
 1. Check the DB-9 connector.
 2. Check the cable.
 3. Check the communication parameters from the Robotiq User Interface, see recovery procedure.
 4. Contact support.
 - iii. Red and green flashing at high speed.
 1. Check [fault status](#), maximum operating temperature could be exceeded.
 2. Contact support.

When using 2-Finger with *Universal Robots* package :

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

From the UR teach pendant :

URcaps install :

1. Verify that the latest URCaps is installed from the "Robot Setup" menu, inside the "URCaps" tab
 - a. URCaps installation instructions are in [Section 3.8.1](#)
 - b. Inside the URCaps tab, if you select the appropriate URCaps file, you can see the
 - c. Gripper toolbar should appear if installed properly
2. URCaps is installed but Gripper cannot be controlled :
 - i. If Gripper LED is not blue, follow the steps in the first section above
 - ii. If Gripper LED is blue, URCaps 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
 - i. Use the installation instruction from Section 3.7.1
 - b. To check your driver version :
 - i. With the Gripper unplugged
 - ii. From the UR teach pendant screen, click the "Gripper" button
 1. Driver version will be shown
 2. If Gripper button is not displayed, driver package is not properly installed, see instruction from [Section 4.9](#)
 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 & patent

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

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 forces specified in [Section 6.2](#).

¹ Cycle 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 Robot 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 from 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

extension 207

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Robotiq:

966, chemin Olivier

Suite 325

St-Nicolas, Québec

G7A 2N1

Canada

A. Harmonized standards, declarations and certificates

A1. 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

Identified C-3001 and over

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.

A2. Applied standards

This section describes all applied harmonized standards for the design and production of the Robotiq 2-Finger Adaptive Gripper. Standards are applied were 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.

Note

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