![ROBOTIQ logo]

Robotiq 3-Finger Adaptive Robot Gripper
Instruction Manual

Table of Contents

Revisions

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

Revision 2021-05-19

Updated section: Warranty Patent

Revision 2020-12-08

Section added: Setting Modbus Unit

Canopen legal mention added.

Revision 271118

Section added: Control over ROS subsection

Revision 180116

Section added: Installation for Universal Robots subsection
Section added: URCaps Package subsection
Section added: Setting the Gripper's IP address in the UR controller subsection
Section added: License Agreement subsection
Section added: Control over Universal Robots with URCaps subsection

Revision 140613

Update for Robotiq Adaptive Gripper S-7

Revision 130607

Annex added : EC incorporation
Section added : Maintenance subsection
Section added : Spare parts, Kits and Accessories
Section added : Design and customization

Revision 130206

Section added : Troubleshooting
Section added : Communication with UR robots
Minor modifications

Revision 121031

Update for Robotiq Adaptive Gripper S-6

Revision 120209

Update for Robotiq Adaptive Gripper S model 5.1

Revision 120118

Update for Robotiq Firmware 3.0

Revision 111031

Sections added: User Interface and MODBUS TCP communication protocol

Revision 110515

Manual release

Copyright

© 2008-2021 Robotiq Inc. All rights reserved.

This manual, and the product it describes, are protected by the Copyright Act of Canada, by laws of other countries, and by international treaties, and therefore may not be reproduced in whole or in part, whether for sale or not, without prior written consent from Robotiq. Under copyright law, copying includes translation into another language or format.

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.

Copyright

1. General Presentation

The terms "Gripper", "Adaptive Gripper", "Robotiq Gripper" , "S-Model", "3-Finger Gripper" and "Robotiq Adaptive Gripper" used in the following manual all refer to the Robotiq 3-Finger Adaptive Robot Gripper. The Robotiq 3-Finger Adaptive Robot Gripper is a robotic peripheral that is designed for industrial applications. Its design makes it a unique robotic end-of-arm tool to pick, place and handle a large range and volume of parts of varying sizes and shapes.

> **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 should not be considered as being related 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.

The Adaptive Gripper has three articulated fingers, i.e. Finger A in front of Finger B and Finger C, that each have three joints (three phalanxes per finger), as shown in Figure 1.1. The Gripper can engage up to ten points of contact with an object (three 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 object they grip and it also simplifies the control of the Gripper.
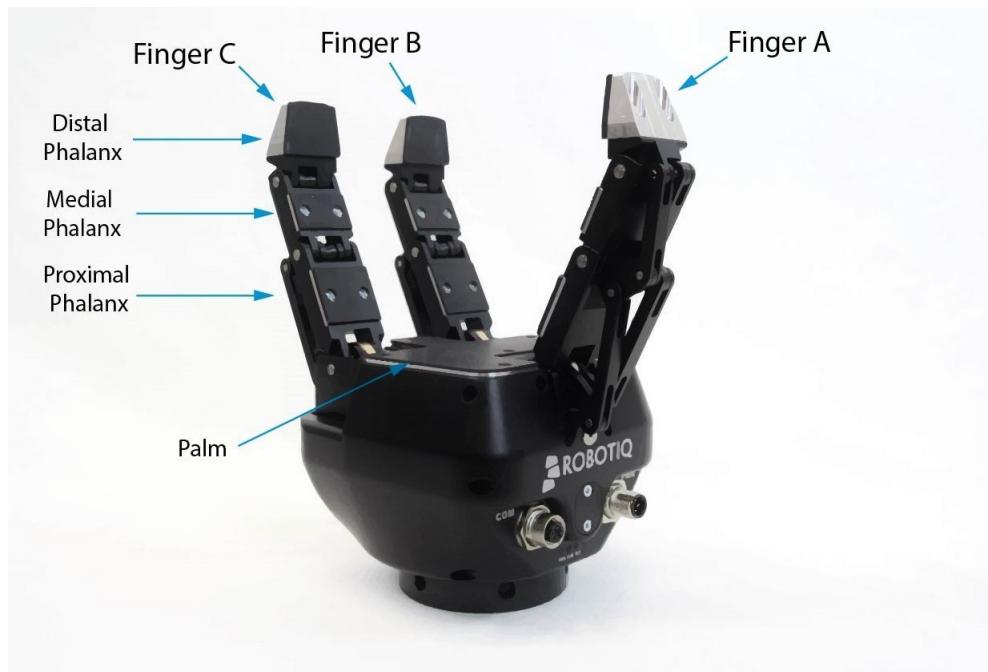
Figure 1.1 : The Robotiq 3-Finger Adaptive Robot Gripper.

Two different types of movements can be performed with the Gripper. The first determines the type of grip being used and simultaneously changes the orientation of Fingers B and C as shown in Figure 1.2. This movement is referred to as the 'Operation Mode'. The Operation Mode is determined by the user prior to the grip as a function of the size or shape of the object being gripped and for the task that has to be done.

Figure 1.2 : First type of movement for the 3-Finger Adaptive Robot Gripper: changing the Operation Mode.

Operation Modes:

1. The **basic mode** is the most versatile Operation Mode. It is best suited for objects that have one dimension longer than the other two. It can grip a large variety of objects.
2. The **wide mode** is optimal for gripping round or large objects.
3. The **pinch mode** is used for small objects that have to be picked precisely. This Operation Mode can only grip objects between the distal phalanxes of the fingers.
4. The **scissor mode** is used primarily for tiny objects. This mode is less powerful than the other three modes, but is precise. In scissor mode, it is not possible to surround an object. Here, Fingers B and C move laterally towards each other while Finger A remains still.

The four pre-set Operation Modes can be chosen by the user (see Figure 1.3).
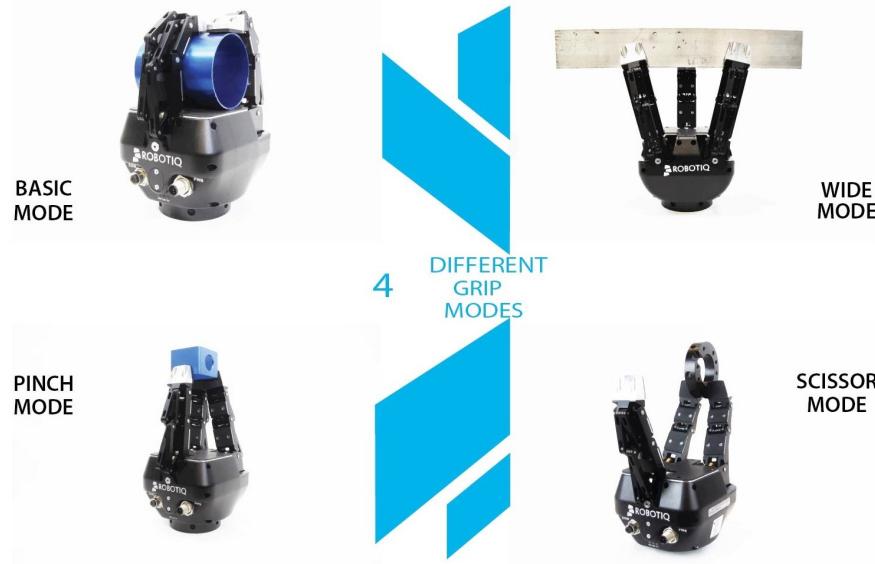
Figure 1.3 : The four Operation Modes of the 3-Finger Adaptive Robot Gripper.

The second movement of the Gripper is the closing and opening of the fingers as shown in Figure 1.4. This action is performed with a single input from the user. Each finger is not controlled independently; the Gripper itself closes each finger until it reaches a stable configuration, on an object or against the Gripper palm. Note that a user can specify the relative speed at which the fingers will close and the relative force that will be applied to an object.
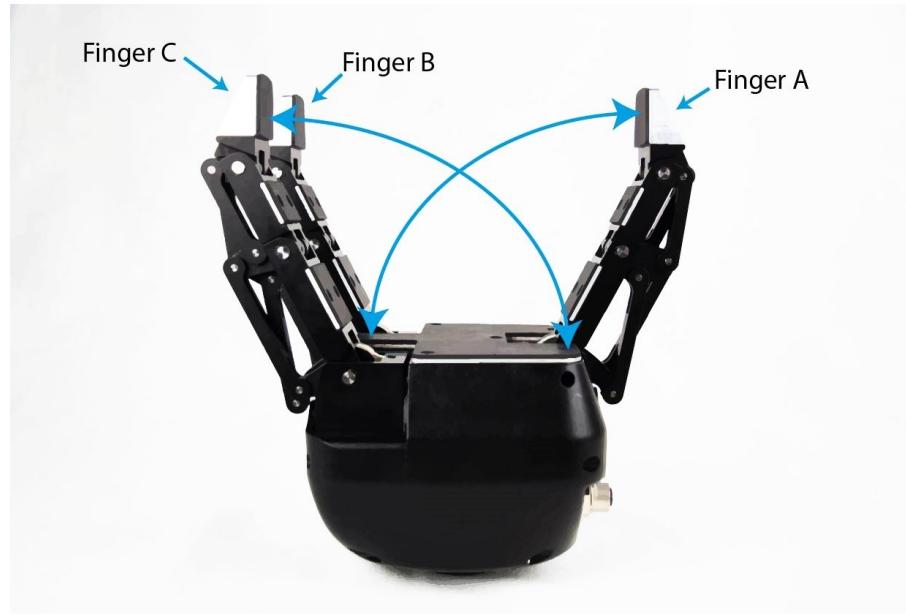
Figure 1.4 : Second movement of the 3-Finger Adaptive Robot Gripper: closing and opening the fingers.

Two types of grips occur when closing the 3-Finger Adaptive Robot Gripper on an object: Fingertip Grip or Encompassing Grip.

- The **Fingertip Grip** is when an object is only held by the distal phalanxes. This type of grip is similar to what is done with conventional industrial parallel grippers. In this situation, the stability of the grip is maintained because of the friction between the fingers and the object.
- The **Encompassing Grip** is when the fingers surround an object. The object is encompassed within the fingers and the stability of the grip is no longer related to friction. We suggest using the Encompassing Grip whenever possible to increase grip stability.

Figure 1.5 shows the two types of grips.
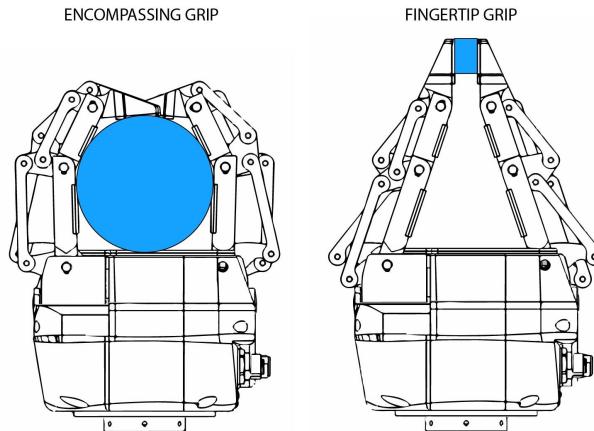
Figure 1.5 : The Two Types of Grip, Encompassing and Fingertip Grips.

Caution

It is important to note that a parallel grip can only be performed when the fingers touch the object with 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 when performing an encompassing grip.

Note that the Encompassing Grip cannot occur in all Operation Modes. For example, in Pinch and Scissor modes, it is only possible to do Fingertip Gripping. On the other hand, the Fingertip Grip can occur in all four Operation Modes. Figure 1.6 summarizes the Types of Grip possible for each Operation Mode.

Info

Operation Modes are inputs 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 Operation Mode;
- The part's geometry;
- The relative position of the part with respect to the Gripper.

In other words, picking the same part using the same Operation Mode could result in either an Encompassing or Fingertip Grip based on a part's position and geometry.

TYPES OF GRIP

	Fingertip Grip	Encompassing Grip
Basic		
Wide		
Pinch		N/A
Scissor		N/A

OPERATION MODES

Figure 1.6 : Operation Modes vs. Types of Grip.

2. Safety

<div>

Warning
The operator must have read and understood all of the instructions in the following manual before handling the Robotiq 3-Finger Adaptive Robot Gripper.

</div>

<div>

The term "operator" refers to anyone responsible for any of the following operations on the 3-Finger Adaptive Robot Gripper:

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

</div>

This documentation explains the various components of the 3-Finger Adaptive Robot Gripper and its general operation. Please read this documentation thoroughly and be sure to understand its contents before handling the 3-Finger Adaptive Robot Gripper.

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 respect the recommended keying for electrical connections.
> - Be sure no one is in the robot and Gripper path before initializing the robot's routine.
> - Always respect 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.
> - Inappropriate use of the Gripper may cause injury or damage.

> **Warning**
>
> Concerning Gripper use on a robot:
>
> - Make sure all cord sets are always secured at both ends, at the Gripper and at the robot.
> - Always handle the Gripper outside the robot danger zone for maintenance and inspection work or ensure complete shutdown of the robot.
> - For welding applications, make sure there are no Gripper parts on the ground path of the welding power source.
> - There is a risk that an object might be dropped or catapulted by the Gripper during use with a robot, precautions must be taken to prevent any possible injury.

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

> **Warning**
> Be sure to read and understand the safety instructions related to the 3-Finger Gripper prior to installation.

> **Warning**
> Do not operate the Gripper, or even turn on the power supply, before it is firmly anchored. The Gripper fingers may move and cause injury or damage.

3.1 Scope of delivery

Standard upon delivery:

- Robotiq 3-Finger Adaptive Robot Gripper (**AGS-001-XXXX**)
  - Replace **XXXX** by one of the following communication options :
    - **ENIP** - EtherNet / IP
    - **MTCP** - Modbus TCP
    - **M232** - Modbus RTU over serial 232
    - **M485** - Modbus RTU over serial 485
    - **ECAT** - EtherCAT
    - **DNET** - DeviceNet
    - **CANO** - CANopen[1]
    - **PNET** - PROFINET
- Default fingertip (see Technical dimensions).
- 5m Power cable for the 3-Finger Adaptive Gripper **CBL-PWR-2054**.
- USB cable **CBL-USB-2057** (for control via the Robotiq User Interface).
- 5m Communication cable according to your communication protocol option.
- Grease syringe **ACC-LUB-SHC1500** for maintenance.

> **Note**
>
> The following are not included with the delivery of the 3-Finger Adaptive Robot Gripper unless specified:
> - Hardware required for any of the communication options, accessories, faceplates or fixtures.
> - Power supply unit, power supply wiring or fuse.

See Spare Parts, Kits and Accessories section for a list of available parts.

3.2 Environmental and operating conditions

The Gripper is designed for industrial applications. Always respect the conditions specified for storage and operating environments:

SPECIFICATION	VALUE
Minimum storage/transit temperature	-22°F [-30°C]
Maximum storage/transit temperature	140°F [60°C]
Minimum operating temperature	14°F [-10°C]
Maximum operating temperature	122°F [50°C]
Humidity (non-condensing)	20-80% RH
Vibration	< 0.5G
Others	- Free from dust, soot or water - Free from corrosive gases, liquids or explosive gases - Free from powerful electromagnetic interference sources

[1]CANopen is a registered trademark of CiA.

> Cleanliness of the Gripper surface influences friction between parts and the Gripper, keep your Gripper clean and away from debris generators. Follow the specified maintenance intervals.

3.3 Mechanical connections

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 model or Robotiq can create a custom version based on blanks in section 6.6 for you or you can build one based on the dimensions in section 6.6.1.1. Please see Robotiq support Options and Spare Parts section for a list of available coupling and adapters.

Here are the steps to follow for the installation of the Gripper (see Figure 3.3.1). Note that all screws must be locked in place using medium strength thread locker (Loctite 248).

1. Screw the Coupling to your robot arm (if your cables are running through the robot, be sure to use a Coupling with a groove).
    a. If you are using an Adapter Plate, it must be mounted first on the robot arm, using the dowel pins for indexing and the screws to secure the adapter plate in place.
    b. Attach the Coupling to the robot arm using the correct dowel pins for indexing.
    c. Secure the Coupling with the coupling (robot) screws.
2. Insert the Gripper's Universal Wrist into the coupling and align the indexing dowel pin with the associated hole.
3. Secure the Gripper to the Coupling with the radial screws.
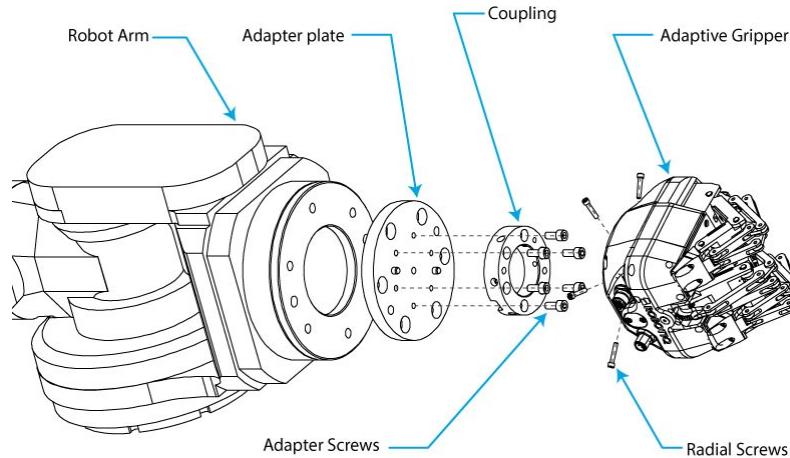
Figure 3.3.1 : Attaching the 3-Finger Gripper to a robot arm with the use of a Coupling.

3.4 Power supply specifications

The Gripper needs to be supplied by a DC voltage source. This power supply is not included with the Gripper. The following table shows the specifications regarding the power supply required to operate the Gripper properly.

SPECIFICATION	VALUE
Output voltage	24 V DC
Output current	2 A
Ripple	2-3 % peak-peak
Output regulation	10% maximum
Overcurrent	4 A fuse at 77°F [25°C]

SPECIFICATION	VALUE
Maximum fuse I2t factor	100 A2s at 77°F [25°C]
Overvoltage protection	Not required[1]

> **Warning**
>
> [1]Always respect the ripple and output regulation tolerances on the output voltage, exceeding these limits could damage the Gripper. If your power supply can exceed the specified regulation, overvoltage protection is required.

Robotiq recommends the use of the following power supply : TDK-Lambda DPP100 Series, 15-*100W Single Output DIN Rail Mount Power Supply*, **DDP100-24-1**

3.5 Wiring

Two connections are needed for the 3-Finger Gripper, one for power and one for communication. On the Gripper, both are located on the Connection Panel shown in Figure 3.5.1.
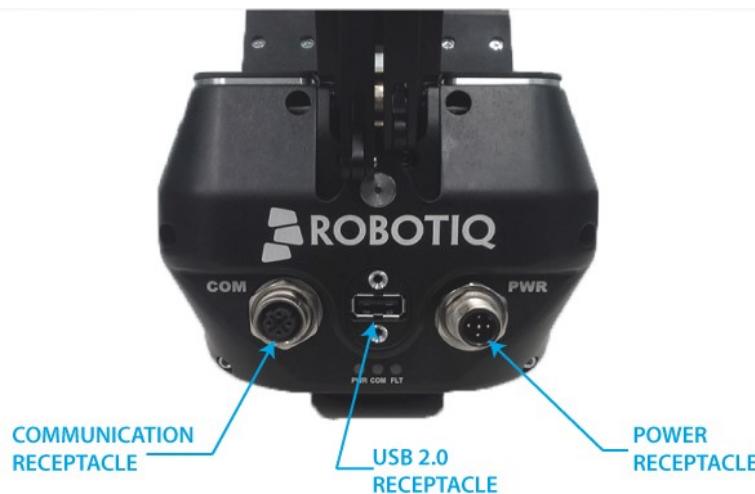
Figure 3.5.1 : Power, USB and communication receptacles shown with USB cover removed.

Connections are identified as:

- PWR for power connection.
- COM for communication connection (depends on your chosen protocol).
- USB for a standard USB male A jack (present on all products).

> **Info**
>
> Note that the communication connector (COM) shown in figure 3.5.1 will change according to the provided communication protocol. Status LED, USB 2.0 port and power connector (PWR) are standard on every Robotiq 3-Finger Adaptive Robot Gripper.

To access the USB panel:

1. Unscrew the two 4-40 FHMS (Flat Head Machine Screws) present on the cover.
2. Remove the cover.
3. Plug in your standard Male-A USB 2.0 connector.

> **Tip**
>
> When closing the panel, apply low strength (pink) Loctite to the screws to prevent loosening.

Standard cables for the 3-Finger Adaptive Robot Gripper are:

- 5 meters power cable
- 5 meters communication cable (according to your chosen communication protocol)

- 5 meters USB 2.0 cable A-A male

> **Info**
>
> All required cables are available from Robotiq, see the Spare Parts, Kits and Accessories section.

> **Warning**
>
> Use proper cabling management. Be sure to have enough forgiveness in the cabling to allow movement of the Gripper along all axes without putting tension on the cable or pulling out the connectors. Always protect the controller-side connector of the cable with a strain relief cable clamp.

3.5.1 Power connection

Here is the way the Gripper should be connected to a power source (Figure 3.5.1.1).
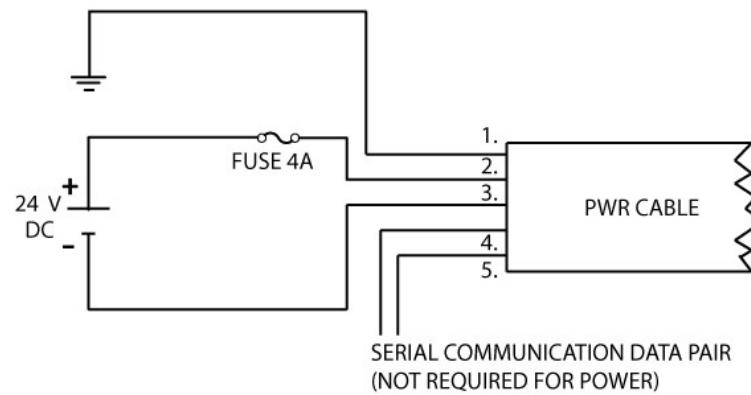
Figure 3.5.1.1 : Power connection diagram of the 3-Finger Adaptive Robot Gripper.

> **Caution**
>
> The 4A fuse is external to the Gripper. It is not provided by Robotiq and the user is responsible for proper installation.

The pin-out of the power connectors is detailed in Figure 3.5.1.2.

M12 5 POLE MALE RECEPTACLE (GRIPPER SIDE)

M12 5 POLE FEMALE CONNECTOR (CABLE SIDE)

M12 5 POLE MALE AND FEMALE		
1.	RS485 GND	BARE
2.	24V	RED
3.	0V	BLACK
4.	RS485+ (UNUSED)	WHITE
5.	RS485- (UNUSED)	GREEN

POWER CONNECTIVITY
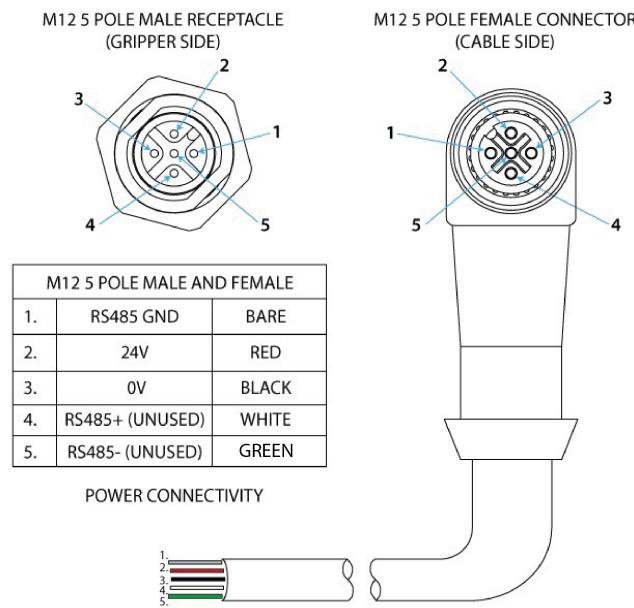
Figure 3.5.1.2 : Gripper Power Input and Power Connector.

> **Info**
>
> RS485 communication is standard on all 3-Finger Grippers, see the Serial Communication Protocol section. If not using RS485 communication, simply leave the two wires unconnected.

The 3-Finger Gripper should be supplied with cables that have the following specifications:

- Approximate length of 5 meters.
- DeviceNet standard cable.
- Power pair :
    - two (2) #22 AWG (black and red).
- Data pair :
    - two (2) #22 AWG (blue and white).
- Shield :
    - Foil (data only) #22 AWG.

3.5.2 Communication connection

By default, the power receptacle of the 3-Finger Adaptive Robot Gripper handles the communication via the MODBUS RTU protocol (RS232 or RS485). The following table summarizes the communication protocols available through the communication receptacle of the Gripper. Note that only one other protocol option is available in a given Gripper unit (MODBUS RTU protocol always being included). The Gripper that you have was configured before shipment with only one of the following protocols.

Family	Protocol
Real-Time-Ethernet	EtherNet/IP
	Modbus TCP/IP
	PROFINET
	EtherCAT
Fieldbus	DeviceNet
	CANopen[1]

The communication cable and connectors provided with the 3-Finger Gripper model vary with the communication protocol option choice. Each protocol has its own pin-out and cable. Provided cable has an approximate length of 5m. See details in the following sections for your communication pinout.

> **Warning**
>
> Be sure to use the appropriate cables and pin-outs for your communication protocol as any other setup may damage the Gripper.

DeviceNet communication protocol

Figure 3.5.2.1 shows the pin-out for the DeviceNet communication protocol for the receptacle (male) present on the 3-Finger Adaptive Robot Gripper and the cable (female) provided with your Gripper.

---

[1]CANopen is a registered trademark of CiA.
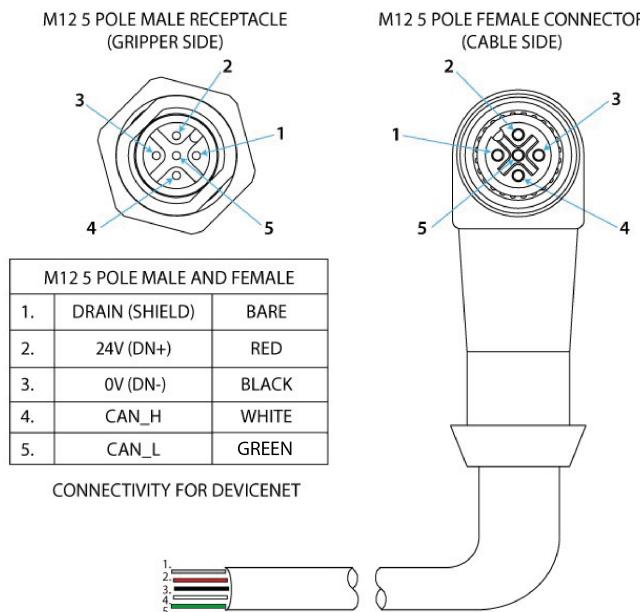
Figure 3.5.2.1 : DeviceNet communication pinout.

The DeviceNet communication and the 3-Finger Gripper use a 24 V supply. Robotiq suggests separating the power supplies as shown in Figure 3.5.2.2.

Caution

- There is no terminating resistor mounted in the Gripper.
- The shield of the cable must be grounded in the robot controller.
- Fusing must be respected.

Tips

DeviceNet standard requires a 120 Ohms resistor to be mounted at the beginning and at the end of the line. If the Gripper is the end of line, then a 120 Ohms resistor must be mounted between pin 4 and 5.
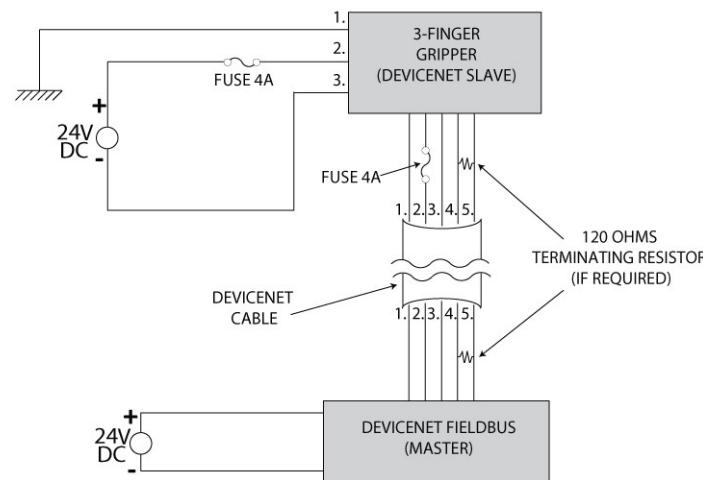
Figure 3.5.2.2 : Power connection diagram for the 3-Finger Gripper using DeviceNet Fieldbus.

Factory settings for DeviceNet protocol:

Identification Settings		
Info	**Decimal Value (base 10)**	**Hexadecimal Value (base 16)**
Vendor ID	283	0x0000011B
Product Code	35	0x00000023
Serial Number	0	0x00000000
Product Type	12	0x0000000C
Major Revision	1	
Minor Revision	1	
Product Name	AG-DNS	

BUS SETTINGS	
MAC ID	11
Baud Rate	250 KBaud

DATA SETTINGS	
Prod. Data Length	16
Cons. Data Length	16

CANopen communication protocol[1]

Figure 3.5.2.3 shows the pin-out for the CANopen communication protocol for the receptacle (male) present on the 3-Finger Adaptive Robot Gripper and the cable (female) provided with your Gripper.

M12 5 POLE MALE RECEPTACLE (GRIPPER SIDE)

M12 5 POLE FEMALE CONNECTOR (CABLE SIDE)

M12 5 POLE MALE AND FEMALE		
1.	DRAIN (SHIELD)	BARE
2.	UNUSED	RED
3.	UNUSED	BLACK
4.	CAN_H	WHITE
5.	CAN_L	GREEN

CONNECTIVITY FOR CANOPEN
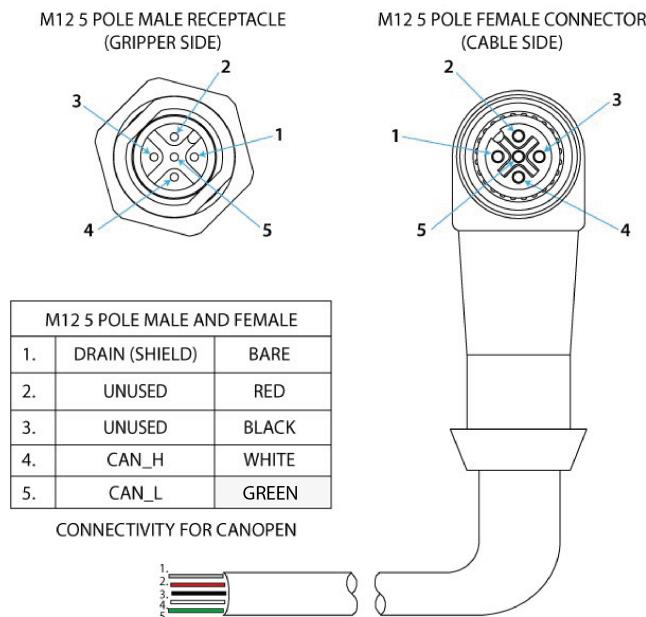
Figure 3.5.2.3 : CANopen communication pinout.

Caution

1CANopen is a registered trademark of CiA.

- There is no terminating resistor mounted in the Gripper.
- The shield of the cable must be grounded in the robot controller.
- Fusing must be respected.

Tip

CANopen standard requires a 120 Ohms resistor to be mounted at the beginning and at the end of the line. If Gripper is the end of line, then a 120 Ohms resistor must but mounted between pin 4 and 5.

Factory settings for CANopen[1] protocol:

Identification Settings		
Info	**Decimal Value (base 10)**	**Hexadecimal Value (base 16)**
Vendor ID	68	0x00000044
Product Code	1541540	0x001785A4
Revision Number	131072	0x00020000
Serial Number	0	0x00000000

BUS SETTINGS	
MAC ID	11
Baud Rate	250 KBaud

DATA SETTINGS		
	Index	**Size**
Send Object	0x2000	128
Receive Object	0x2200	128
Output Databytes		512
Input Databytes		512

Real-time Ethernet communication protocol

Real-time Ethernet communication includes Ethernet/IP, EtherCAT, PROFINET and Modbus TCP/IP protocols.

See the Real-Time Ethernet pin-out diagram below (Figure 3.5.2.5) for the receptacle (female) present on the 3-Finger Adaptive Robot Gripper and the cable (male) provided with your Gripper.

---

[1]CANopen is a registered trademark of CiA.
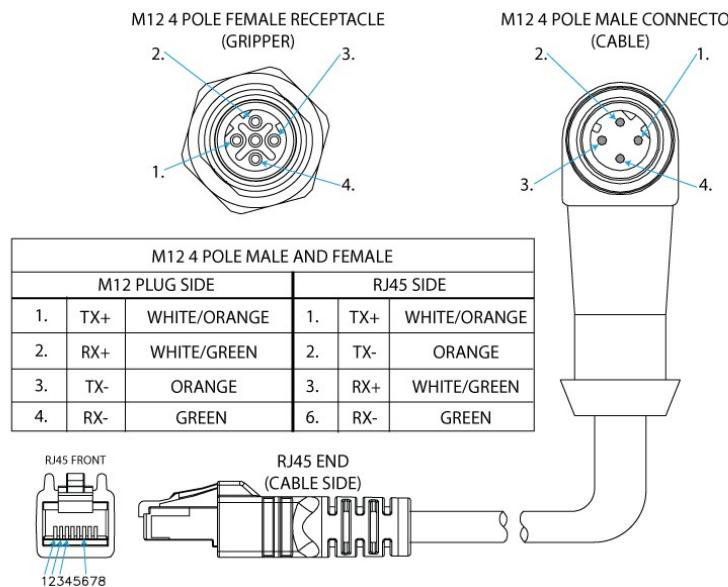
Figure 3.5.2.5 : Real-time Ethernet communication pin-out.

> **Tip**
>
> The 3-Finger Adaptive Robot Gripper features an auto-crossover, so there is no need to cross the RX/TX signals.

Factory settings for each Ethernet protocols:

IDENTIFICATION SETTINGS							
EtherCAT		**EtherNet/IP**		**PROFINET**		**Modbus TCP/IP**	
Vendor ID	0x0000FFFF	Vendor ID	0x0000011B	Vendor ID	0x0000011E	N/A	
Product Code	0x0000000B	Product Code	0x0000010D	Device ID	0x0000010A		
Serial Number	0x00000000	Product Type	0x0000000C	Device Type			
Revision Number	0x00000000	Major Revsision	1	Order ID	1541.110		
		Minor Revision	1	Name of station	nic50repns		
		Device Name	AG-EIS	Type of station	Default.Station.Type		
				Device Access Point			

BUS SETTINGS							
EtherCAT	**EtherNet/IP**		**PROFINET**		**Modbus TCP/IP**		
N/A (see info note)	IP Address	192.168.1.11	Bus Startup	Automatic	IP Address	192.168.1.11	
	Netmask	255.255.255.0	Watchdog Time	1000ms	Netmask	255.255.255.0	
	Gateway	Disabled			Gateway	Disabled	
	BootP	Disabled			BootP	Disabled	
	DHCP	Disabled			DHCP	Disabled	
	100Mbit	Enabled			100Mbit always on		
	Full Duplex	Enabled			Full Duplex always on		

BUS SETTINGS				
	Auto-neg	Enabled		Auto-neg always on
	Assembly Instance (input)	101		
	Assembly Instance (output)	100		
	Configuration Instance	1		
	Connection Type	Run/Idle Header		

DATA SETTINGS							
EtherCAT		EtherNet/IP		PROFINET		Modbus TCP/IP	
INput Data Bytes	16	Prod. Data length	20	Output Data Bytes (16)		N/A	
Output Data Bytes	16	Cons. Data Length	20	Module	1	N/A	
				Type	Byte		
				Count	16		
				Input Data Bytes (16)			
				Module	5		
				Type	Byte		
				Count	16		

> **Info**
>
> EtherCAT protocol uses inherent dynamic addressing, thus bus settings cannot be customized.

> **Info**
>
> Ethernet/IP uses 4 bytes of header which may be visible or not depending on the master.

Serial communication protocol

RS485 serial communication is standard on all 3-Finger Adaptive Robot Grippers, this communication is available through the power connector. Figure 3.5.2.6 shows the pin-out of the communication connectors when used in serial mode for the receptacle (male) present on the 3-Finger Adaptive Robot Gripper and the cable (female) provided with your Gripper.

> **Note**
>
> When using serial communication, power wiring must still respect the schematics described in the section on Power connection.

M12 5 POLE MALE AND FEMALE		
1.	RS485 GND	BARE
2.	24V	RED
3.	0V	BLACK
4.	RS485+	WHITE
5.	RS485-	GREEN

POWER WITH SERIAL COMMUNICATION
CONNECTIVITY
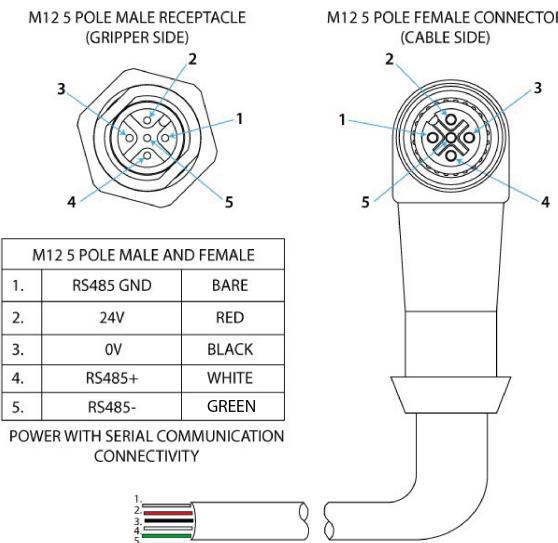
Figure 3.5.2.6 : Serial communication pin-out for RS485.

The RS485 communication can be converted to RS232 with an optional converter, see Figure 3.5.2.7 for schematics of the wiring. The converter is available in the Spare Parts, Kits and Accessories section. Note that the RS-232 converter ends with a female DB-9 plug for PC.

M12 5 POLE MALE AND FEMALE		
1.	RS485 GND	BARE
2.	24V	RED
3.	0V	BLACK
4.	RS485+	WHITE
5.	RS485-	GREEN

POWER WITH SERIAL COMMUNICATION
CONNECTIVITY AND RS-232 CONVERSION
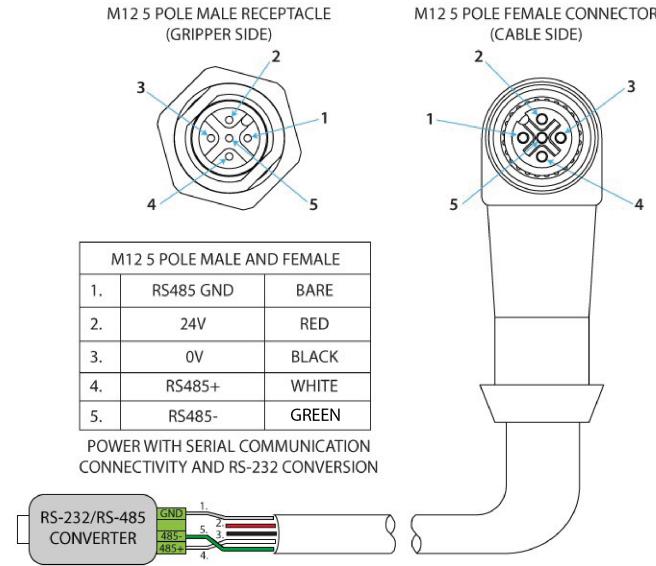
Figure 3.5.2.7 : Serial communication converted from RS485 to RS232.

Factory settings for Modbus RTU protocols:

IDENTIFICATION SETTINGS	
Slave ID	9

PROPRIETY	VALUE
Physical Interface	RS485-RS232
Baud Rate	115,200 bps

PROPRIETY	VALUE
Data Bits	8
Stop Bit	1
Parity	None
Number Notation	Hexadecimal
Supported Functions	Read Holding Registers (FC03) Preset Single Register (FC06) Preset Multiple Registers (FC16)
Exception Responses	Not supported
Slave ID	0x0009 (9)
Robot Output / Gripper Input First Register	0x03E8 (1000)
Robot Input / Gripper Output First Register	0x07D0 (2000)

See section 4.7.1 for details

DATA SETTINGS	
Number of Register	5000

3.6 Installation for Universal Robots

3.6.1 Communication
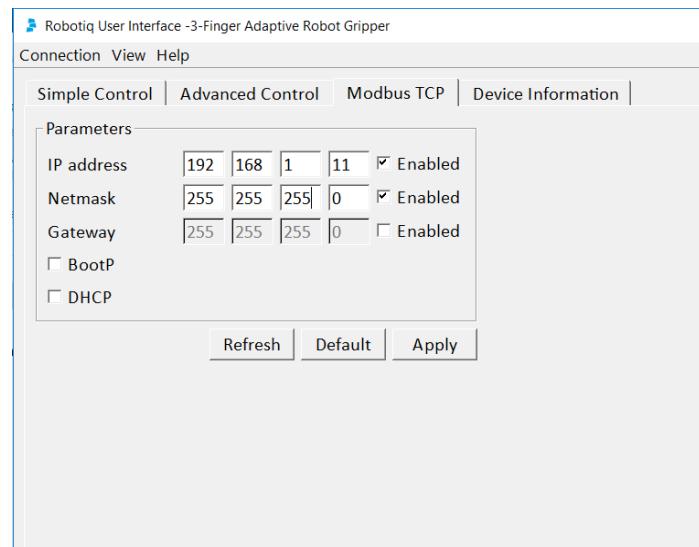
The 3-Finger Adaptive Robot Gripper uses the Modbus TCP communication protocol to communicate with the Universal Robots controller.

Info
If intended to be installed on Universal Robots, the 3-Finger Adaptive Robot Gripper must be ordered with the Modbus TCP communication protocol.

3.6.2 Configuring the IP address of the Gripper

Use the Robotiq User Interface to configure the IP address and subnet mask in the **Modbus TCP** tab. See the Robotiq User Interface Instruction Manual for details.

> **Info**
> The 3-Finger Gripper's factory default IP address is 192.168.1.11
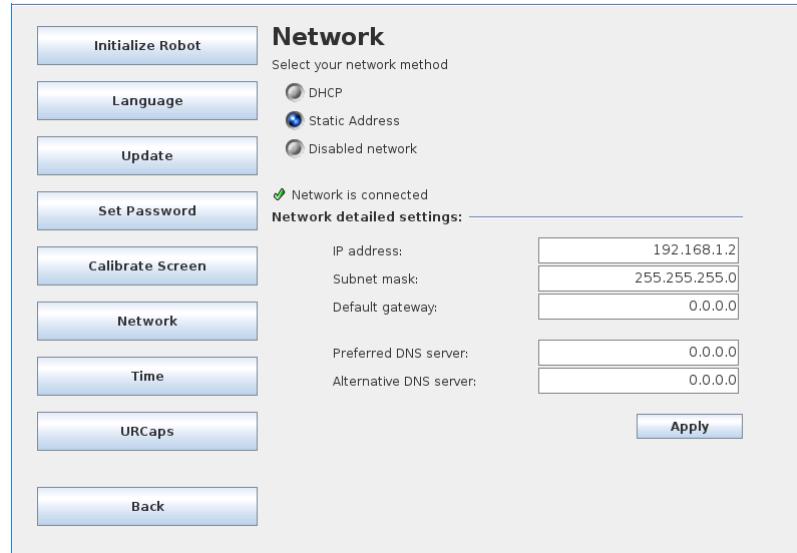
> **Caution**
> The IP address of the Gripper and that of the UR controller must be on the same subnetwork.
> For instance, if the Gripper's address is 192.168.1.11, the UR controller will follow the addressing sequence 192.168.1.x.

3.6.3 Configuring the UR controller network

When starting PolyScope, tap **Setup Robot** and then **Network**. Fill in the network settings applicable to the Gripper and tap the **Apply** button.

> **Info**
> If the robot is not connected to a network, the 3-Finger Gripper's Ethernet cable can be connected directly to the Ethernet port of the UR controller. The Gripper's IP address can be left 192.168.1.11 and the user can configure the robot with the above settings.

3.6.4 URCaps Package

Robotiq provides you with a Universal Robots URCaps package that enables Modbus TCP communication to your UR controller.

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

Make sure the 3-Finger Adaptive Robot Gripper is properly mounted to the robot arm. Refer to section 3.3 Mechanical connections for detailed information on the mechanical installation of the Gripper. Before proceeding with the installation of the URCaps package, make sure your Universal Robots controller is running PolyScope version 3.4 and higher.

The Gripper's URCaps package contains:
- The URCaps for the Gripper
- The Gripper nodes
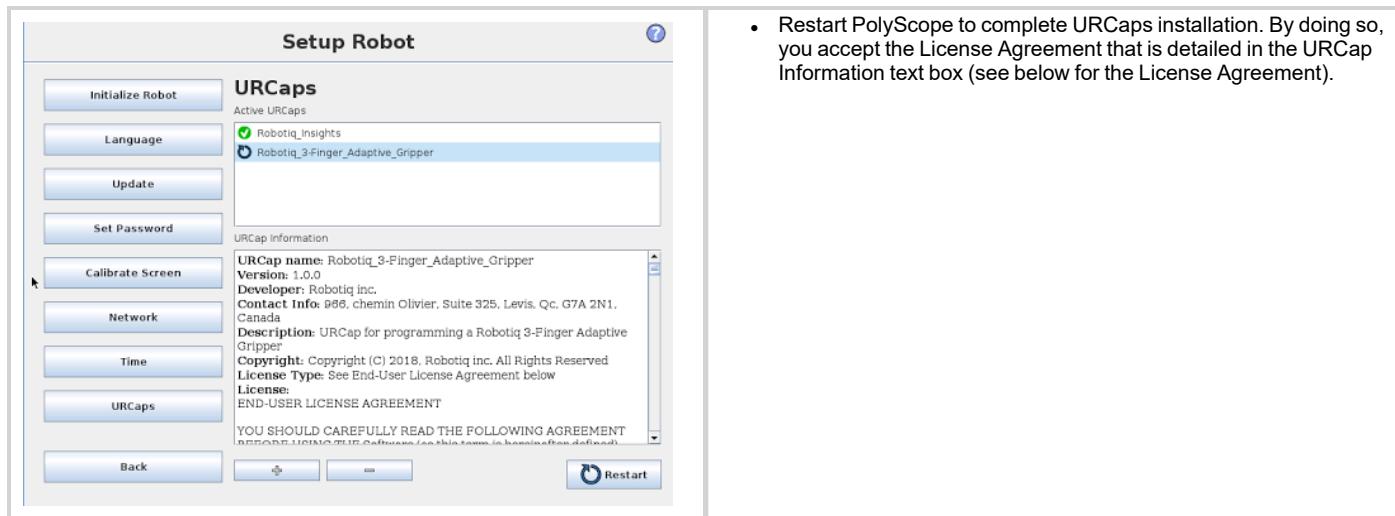
For details on controlling the Gripper, refer to section 4. Control

> **Info**
> Visit support.robotiq.com for detailed information on how to program using the URCaps package (section 4.9 Control over Universal Robots with URCaps)

Follow this procedure to install the 3-Finger Adaptive Robot Gripper URCaps package:
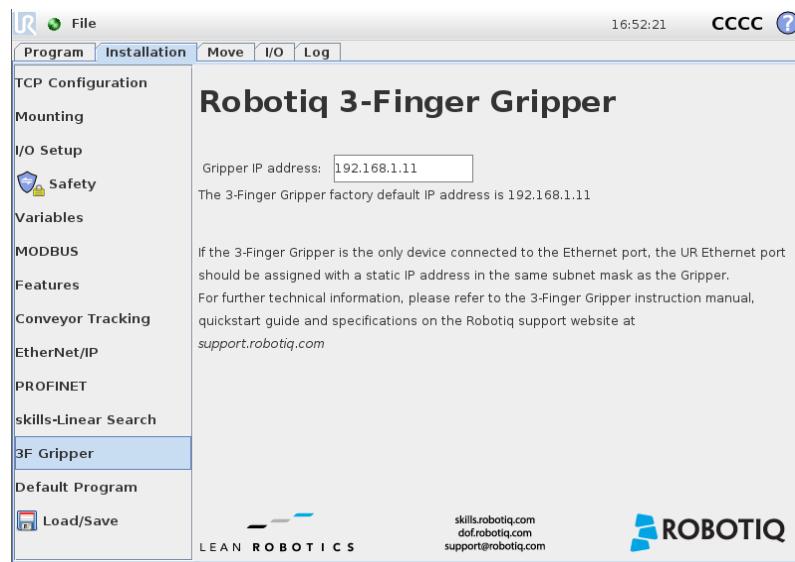
- Make sure that your PolyScope version is up-to-date and that your Universal Robots controller is compatible with the Gripper's URCaps package.
- Go to support.robotiq.com and click on the 3-Finger Adaptive Robot Gripper product page.
- Download the UC3-X.X.X file and extract it on the root of a blank US stick.
- Insert the USB stick in the UR teach pendant or controller.
- Go to Setup Robot.

- Tap URCaps Setup.

- Tap the plus button (+) to add the Gripper's URCaps package.
- Open Robotiq_3-Finger_Adaptive_Gripper-X.X.X.urcap.

- Restart PolyScope to complete 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).

3.6.5 Setting the Gripper's IP address in the UR controller
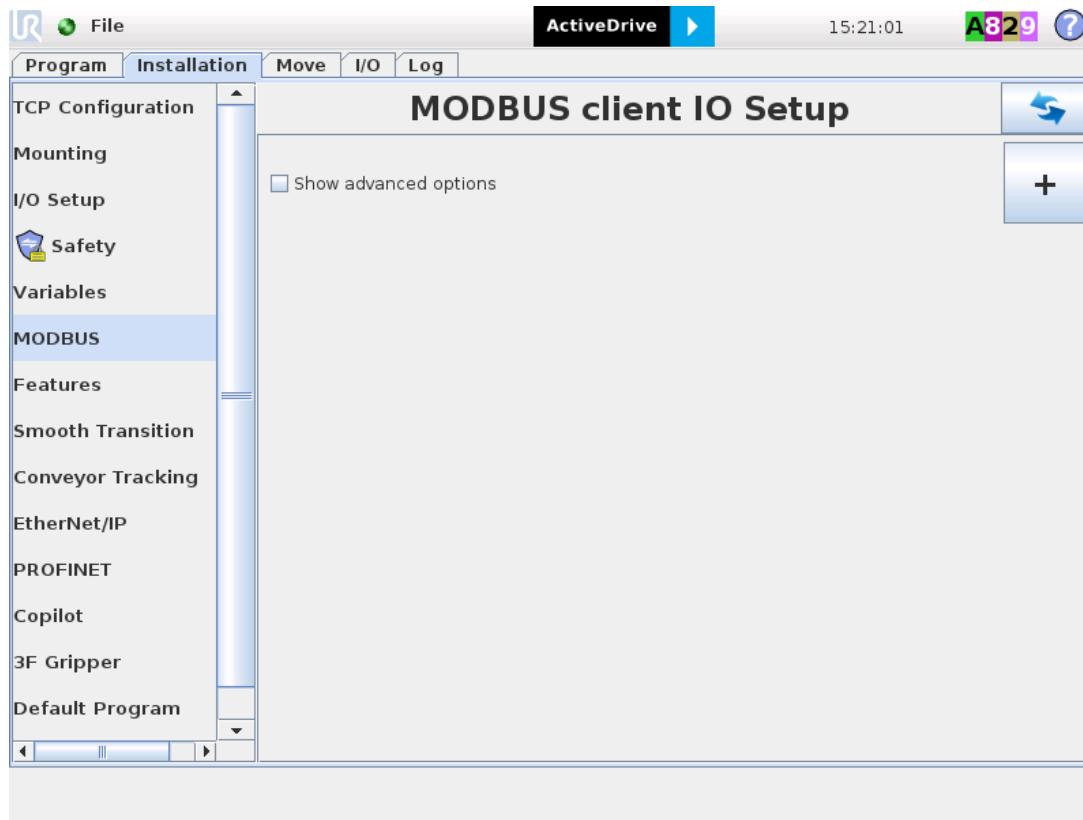
The 3-Finger Gripper URCap comprises a setting screen in the Installation tab of PolyScope.

The user can modify the 3-Finger Gripper's IP address here. Refer to section 3.6.2 to read how to configure the 3-Finger Gripper's IP address.
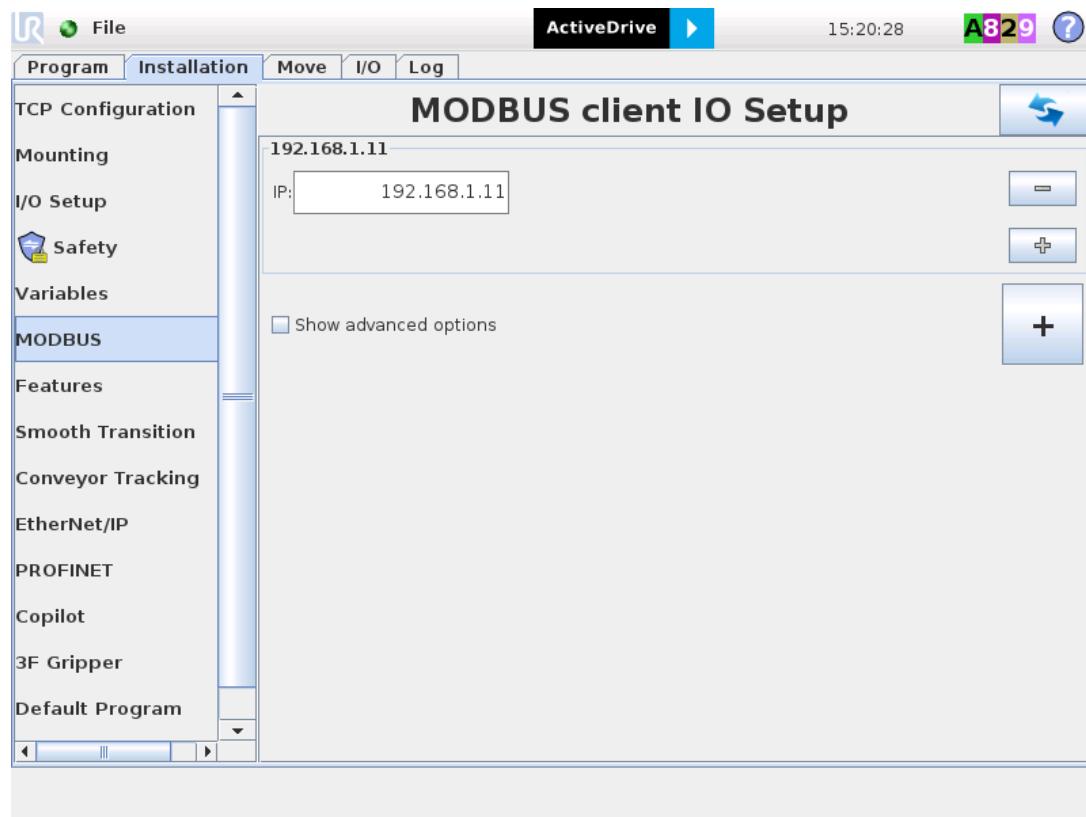
3.6.6 Setting Modbus Unit

1. Tap Installation → MODBUS → **PLUS** button.

2. Enter the 3F Gripper's IP address.

3.7 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 Licensor (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 Licensor 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 Licensor'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. "Licensor" 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 "Licensor'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 Licensor's Products compatible and functional with a specific product of the UR's Product;
    5. "Licensor's Products" means those products developed by the Licensor in the course of the Licensor's Business;
    6. "UR's Products" means those products developed by UR in the course of the UR's Business;
    7. "Licensor's Authorized Representatives" means and includes the Licensor and Licensor's authorized vendors, resellers, distributors and licensors;
    8. "Purchase Agreement" means an agreement between the End-User and the Licensor pursuant to which the End-User purchased one or more of the Licensor's Products.
2. License. Subject to the terms and conditions hereof, the Licensor grants to the End-User a personal, temporary, non-exclusive, non-assignable and non-transferable and revocable license to use the Software in accordance with the terms and conditions hereof.
3. Software and Documentation. The Licensor 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 Licensor's Web site http://robotiq.com/ (iii) the Licensor's Products and the Purchase Agreement therewith, or (iv) any other agreement, document, support, whatsoever decided by the Licensor.

   The use of the Software requires the Licensor'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..
4. Modifications and Upgrades. The Licensor shall be under no obligation to provide any upgrade or modification to the Software. However, the End-User shall be entitled to receive free of charge all modifications and upgrades of the Software provided by the Licensor if, at such time, the End-User is not in default in respect of any of its obligation contained herein. Such modifications and upgrades of the Software shall be installed by the End-User itself by consulting the Licensor's Website http://robotiq.com/ where a link to proceed to such installation will be made available thereof. A new version of the Software shall not be covered by this Section 4 but shall require that a new End-User Software License Agreement be entered into between the Licensor and the End-User.
5. Fees. The grant by Licensor to the End-User of the present license shall be free to the extent that the End-User agrees and complies to the term and conditions herein at all time.
6. Maintenance. During the term of this Agreement, the Licensor will maintain the Software in an operable condition and will make available anycorrections and improvements as are generally incorporated in the Software by the Licensor without additional charge to the End-User. The Licensor may temporarily and without notice suspend or limit access to the Software if necessary or desirable in order to maintain, restore, modify or repair any part of the Software or for any reason related to business. During such works, the Software will not be available but the Licensor undertakes to deploy its best efforts to perform such works at appropriate times and to limit any inconvenience arising therefrom.
7. Title to Software. The licensed Software is composed of confidential data and trade secrets and is proprietary to and constitutes trade secret information and intellectual property of the Licensor. Title and ownership rights to the Software, including the intellectual property rights related thereto, shall remain with the Licensor. The End-User agrees to maintain the confidential nature of the Software and related materials provided for the End-User's own internal use under this Agreement. The license granted herein does not include the right to sublicense to others, and may not be assigned to others, in whole or in part, without the prior written consent of the Licensor. The End-User may not or allow others to modify or prepare directive works, copy (except for normal backups for recovery purposes), reproduce, republish, reverse engineer, upload, post, transmit, or distribute, in any manner, the Software.
8. Restricted Use. The Software shall be used solely and exclusively by the End-User and its employees for the purpose mentioned in Sub-section 1.4 hereof. Any other use of the Software, including resell derivative modifications or extensions, is expressly prohibited.
9. Exclusion of Warranty on Software. The End-User expressly acknowledges and agrees that use of the Software is at the End-User sole risk. The Software is provided "AS IS" and without warranty of any kind. THE LICENSOR AND THE LICENSOR'S AUTHORIZED REPRESEN-TATIVES DO NOT WARRANT THAT Software WILL BE FREE OF ERRORS AND YOU ACKNOWLEDGE THAT THE EXISTENCE OF ANY SUCH ERRORS DOES NOT CONSTITUTE A BREACH OF THIS AGREEMENT. TO THE EXTENT PERMITTED BY LAW LICENSOR AND LICENSOR'S AUTHORIZED REPRESEN-TATIVES EXPRESSLY DISCLAIM ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING , BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTA-BILITY AND FITNESS FOR A PARTICULAR PURPOSE UNLESS OTHERWISE STATED HEREIN. LICENSOR AND LICENSOR'S AUTHORIZED REPRESENTATIVES DO NOT WARRANT THAT THE FUNCTIONS CONTAINED IN THE Software WILL MEET THE END-USER REQUIREMENTS OR THAT THE OPERATION OF THE Software WILL BE CORRECT. FURTHERMORE, LICENSOR AND LICENSOR'S AUTHORIZED REPRESEN-TATIVES DO NOT WARRANT OR MAKE

ANY REPRESENTATIONS REGARDING THE USE OR THE RESULTS OF THE USE OF THE Software IN TERMS OF ITS CORRECTNESS, ACCURACY, RELIABILITY, OR OTHERWISE. NO ORAL OR WRITTEN INFORMATION OR ADVICE GIVEN BY LICENSOR AND LICENSOR'S AUTHORIZED REPRESENTATIVE SHALL CREATE A WARRANTY OR IN ANY WAY INCREASE THE SCOPE OF THIS WARRANTY. SHOULD THE Software PROVE DEFECTIVE IN YOUR TECHNOLOGY ENVIRONMENT, YOU ASSUME THE ENTIRE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION TO YOUR OWN TECHNOLOGY ENVIRONMENT.

10. Limitation of liability. TO THE MAXIMUM EXTENT PERMITTED BY LAW, LICENSOR AND LICENSOR'S AUTHORIZED REPRESENTATIVES SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR BREACH OF ANY EXPRESS OR IMPLIED WARRANTY, BREACH OF CONTRACT, NEGLIGENCE, STRICT LIABILITY OR ANY OTHER LEGAL THEORY RELATED TO THE Software. SUCH DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, LOSS OF PROFITS, LOSS OF REVENUE, LOSS OF DATA, LOSS OF USE OF THE PRODUCT OR ANY ASSOCIATED EQUIPMENT, DOWN TIME AND USER'S TIME, EVEN IF THE LICENSOR HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. IN ANY CASE, LICENSOR ENTIRE LIABILITY UNDER ANY PROVISION OF THIS AGREEMENT SHALL BE LIMITED TO THE AMOUNT ACTUALLY PAID IN RESPECT OF THE LICENSOR'S PRODUCTS PURCHASED BY THE END-USER PURSUANT TO A PURCHASE AGREEMENT.

11. Training, Maintenance and Support There is no entitlement to training, maintenance and support under this license unless otherwise specified in the Purchase Agreement or any other written agreement between the End-User and the Licensor. The End-User may provide the Licensor with details regarding any bug, defect or failure in the Software promptly and with no delay from such event; the End-User shall comply with the Licensor's request for information regarding bugs, defects or failures and furnish him with information, screenshots and try to reproduce such bugs, defects or failures upon Licensor's demand.

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.

4. Control

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

> **Info**
> Register format is Little Endian (Intel format), namely from LSB (Less Significant Bit) to MSB (Most Significant Bit). Meaning that bytes are written with the least significant byte in the smallest address. If Big-endian would be writing from left to right, Little-endian would be writing from right to left.

4.1 Overview

> **Caution**
> This section applies to firmware 3.0 (Grippers delivered after November 2011). For prior versions please see the documentation archives.

The Robotiq 3-Finger Adaptive Robot Gripper is controlled from the robot controller (see Figure 4.1.1) using an industrial protocol (EtherNet/IP, DeviceNet, CANopen[1], EtherCat, etc.). The programming of the Gripper can be done with the Teach Pendant of the robot or by offline programming.

Since the Robotiq 3-Finger Gripper has its own internal controller, high-level commands such as "Go to requested position" are used to control it. The embedded Robotiq controller takes care of the regulation of the speed and the force prescribed, while the mechanical design of the fingers automatically adapts to the shape of object(s).
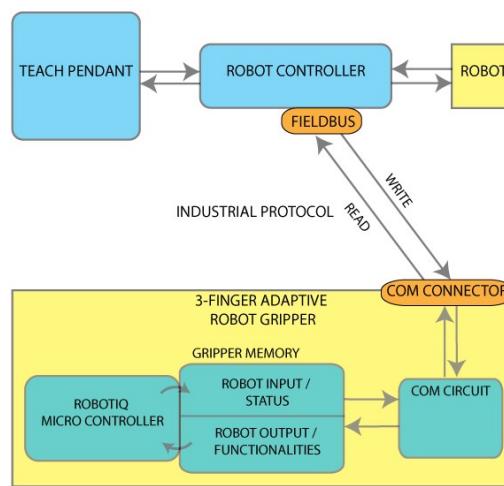
Figure 4.1.1 : 3-Finger Gripper connections.

The Gripper controller 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.

To control the 3-Finger Adaptive Robot Gripper, **Output Registers & Functionnalities** must be written, the following is a summary of the various registers, see Robot output registers & functionnalities for details:

- **Action Request** - Will command the Gripper to activate, switch operation mode, go to requested position or release its grip.
- **Gripper Options** - Contains optional modes of controls.
- **Position Request** - Sets the desired position of the grip (but does not activate movement).
- **Speed** - Sets the desired speed of the grip.
- **Force** - Sets the desired force of the grip.

---

[1]CANopen is a registered trademark of CiA.

> **Hint**
> - For each Operation Mode, the operator can control the force and the speed of the fingers.
> - Unless individual control is selected, the movement of the fingers is always synchronized, movement is done with a single "Go to requested position" command (the motion of each mechanical phalanx is done automatically).
> - The Gripper must be initialized (activation bit) at power on. This procedure takes a few seconds and allows the Gripper to be calibrated against internal mechanical stops.

The 3-Finger Gripper returns several registers of information to the robot controller to be read, this is called **Input Registers & Status**, see Robot input registers & status for details:

- **Global Gripper Status** - A global Gripper Status is available. This gives information such as which Operation Mode is currently active or if the Gripper is closed or open.
- **Object Status** - There is also an Object Status that let you know if there is an object in the Gripper and, in the affirmative, how many fingers are in contact with it.

> **Hint**
> - Object status is a built in feature that allows for object pick-up detection, see Robot input registers & status for details.

- **Fault Status** - The Fault Status gives additional details about the cause of a fault.
- **Position Request Echo** - The Gripper returns the position requested by the robot to make sure that the new command has been received correctly.
- **Motor Encoder Status** - Information on the encoders for the four motors is also available.
- **Current Status** - The current of the motors can also be known. Since the torque of the motor is a linear function of the current, this gives information about the force that is applied at the actuation linkage of the finger.

4.2 Status LEDs

Three status LED lights provide general information about the 3-Finger Adaptive Robot Gripper status. Figure 4.2.1 shows the LEDs and their locations.
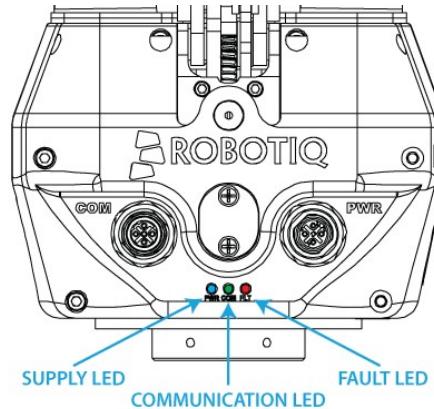
Figure 4.2.1 : Status LEDs.

4.2.1 Supply LED

COLOR	STATE	INFORMATION
Blue	Off	Gripper is not supplied with power
Blue	On	The Gripper is correctly supplied and the control board is running

4.2.2 Communication LED

COLOR	STATE	INFORMATION
Green	Off	Gripper is not supplied with power
Green	Blinking	The Gripper is correctly supplied and the control board is running
Green	On	A network has been detected and at least one connection is in the established state

4.2.3 Fault LED

COLOR	STATE	INFORMATION
Red	Off	No fault detected
Red	On	A minor fault occurred (or the Gripper is booting)
Red	Blinking	A network has been detected and at least one connection is in the established state

Info

A major fault refers to a situation where the Gripper must be reactivated.

4.3 Gripper register mapping

The 3-Finger Gripper firmware provides functionalities such as the direct position control of the fingers via "Go To" commands. There are also additional advanced options, such as the individual control of the fingers or the Scissor Mode.

A Simplified Control Mode is available for users which do not intend to use the advanced option. Otherwise a register mapping for the Advanced Control Mode containing all the Gripper functionalities is also provided. From the Gripper standpoint, there is no difference between the two modes. The Simple Control Mode is only intended to ease usage of the Gripper for users who are only interested in basic functionalities.

Warning

When using the Simplified Control Mode, it is important to fill the unused registers with zeros. Neglecting to do so will result in the unwanted triggering of control options and might lead to a hazardous behavior from the Gripper. Zero fill is 00 in hexadecimal or 00000000 in binary.

Register mapping for the Simplified Control Mode:

Caution

Byte numeration starts on 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	00	OBJECT DETECTION
Byte 2	00	FAULT STATUS
Byte 3	POSITION REQUEST	POS. REQUEST ECHO
Byte 4	SPEED	FINGER A POSITION

REGISTER	ROBOT OUTPUT/FUNCTIONALITIES	ROBOT INPUT/STATUS
Byte 5	FORCE	FINGER A CURRENT
Byte 6	00	NOT USED IN SIMPLE MODE
Byte 7	00	FINGER B POSITION
Byte 8	00	FINGER B CURRENT
Byte 9	00	NOT USED IN SIMPLE MODE
Bye 10	00	FINGER C POSITION
Byte 11	00	FINGER C CURRENT
Byte 12	00	NOT USED IN SIMPLE MODE
Byte 13	00	SCISSOR POSITION
Byte 14	00	SCISSOR CURRENT
Byte 15	RESERVED	RESERVED

Register mapping for the Advanced Control Mode:

REGISTER	ROBOT OUTPUT/FUNCTIONALITIES	ROBOT INPUT/STATUS
Byte 0	ACTION REQUEST	GRIPPER STATUS
Byte 1	GRIPPER OPTIONS	OBJECT DETECTION
Byte 2	GRIPPER OPTIONS #2 (EMPTY)	FAULT STATUS
Byte 3	POSITION REQUEST (FINGER A IN INDIVIDUAL MODE)	POS. REQUEST ECHO
Byte 4	SPEED (FINGER A IN INDIVIDUAL MODE)	FINGER A POSITION
Byte 5	FORCE (FINGER A IN INDIVIDUAL MODE)	FINGER A CURRENT
Byte 6	FINGER B POSITION REQUEST	FINGER B POS. REQUEST ECHO
Byte 7	FINGER B SPEED	FINGER B POSITION
Byte 8	FINGER B FORCE	FINGER B CURRENT
Byte 9	FINGER C POSITION REQUEST	FINGER C POS. REQUEST ECHO
Bye 10	FINGER C SPEED	FINGER C POSITION
Byte 11	FINGER C FORCE	FINGER C CURRENT
Byte 12	SCISSOR POSITION REQUEST	SCISSOR POS. REQUEST ECHO
Byte 13	SCISSOR SPEED	SCISSOR POSITION
Byte 14	SCISSOR FORCE	SCISSOR CURRENT
Byte 15	RESERVED	RESERVED

4.4 Robot output registers & functionalities

Register: **ACTION REQUEST**
Address: **Byte 0**

Bits	7	6	5	4	3	2	1	0
Symbols	Reserved			rATR	rGTO	rMOD		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.

> **Caution**
>
> **rACT** bit must remain on afterwards for any other action to be performed.

rMOD: Changes the Gripper Grasping Mode. When the Grasping Mode is changed, the Gripper first opens completely to avoid interference between the fingers, then goes to the selected mode. This option is ignored if the bit **rICS** is set (individual control of the scissor motion option).

- 0x0 – Go to Basic Mode.
- 0x1 – Go to Pinch Mode.
- 0x2 – Go to Wide Mode.
- 0x3 – Go to Scissor Mode.

rGTO: The "Go To" action moves the Gripper fingers to the requested position using the configuration defined by the other registers and the **rMOD** bits. The only motions performed without the **rGTO** bit are: activation, the mode change 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.

Register: **GRIPPER OPTION 1**
Address: **Byte 1**

rICF: In Individual Control of Fingers Mode each finger receives its own command (position request, speed and force) unless the Gripper is in the Scissor Grasping Mode and the Independent Control of Scissor (**rICS**) is not activated. Please refer to the **rPRA** (Position Request) register description for information about the reachable positions of the fingers.

- 0x0 - Normal.
- 0x1 - Enable Individual Control of Fingers A, B and C.

> **Caution**
>
> As soon as the **rICF** bit is set, the fingers will move towards the target defined by the position request bytes. To avoid unwanted motion of the fingers, it is preferable to define the position requests before setting the **rICF** bit. It is also possible to clear the **rGTO** bit, configure the registers according to the desired motion and then set the **rGTO** bit to start the motion.

Bits	7	6	5	4	3	2	1	0
Symbols	Reserved				rICS	rICF	Reserved	

rICS: In Individual Control of Scissor, the scissor axis moves independently from the Grasping Mode. When this option is selected, the **rMOD** bits (Grasping Mode) are ignored as the scissor axis position is defined by the **rPRS** (Position Request for the Scissor axis) register which takes priority.

- 0x0 - Normal.
- 0x1 - Enable Individual Control of Scissor. Disable Mode Selection.

> **Info**
>
> To avoid geometric interference between Fingers B and C, the reachable positions for the scissor axis is reduced if the Individual Control of Scissor option is selected. Please refer to the rPRA (Position Request) register description for more information about the reachable positions of the scissor axis.

Register: **GRIPPER OPTION 2**
Address: **Byte 2**

Bits	7	6	5	4	3	2	1	0
Symbols	Reserved							

Register: **POSITION REQUEST (FINGER A IN INDIVIDUAL MODE)**
Address: **Byte 3**

Bits	7	6	5	4	3	2	1	0
Symbols	rPRA							

This register is used to set the target position of the fingers for the Adaptive Gripper (or Finger A only if bit rICF is set). The positions 0x00 and 0xFF correspond respectively to the fully opened and fully closed mechanical stops.

Figure 4.4.1 represents the reachable workspace of the fingers and scissor axis. Note that the finger position on the figure represents the maximum value for the three fingers. Also, note that the fully opened and fully closed software limits are not shown on the figure for simplicity. The fully closed software limit of the scissor axis when the Individual Control of Scissor option is selected is also not shown for simplicity.

rPRA

- 0x00 minimum position (open)
- 0xFF maximum position (close)

> **Info**
>
> In order to protect the Gripper from geometric interferences, several software limits are implemented and therefore some positions are not reachable. When a finger reaches the software limit, the Gripper status will indicate that the requested position has been reached. This is because the requested position is internally replaced by the software limit. In figure 4.4.1, zone 1 is the never reachable space, while zone 2 is only reachable when requesting the scissor motion in individual mode.
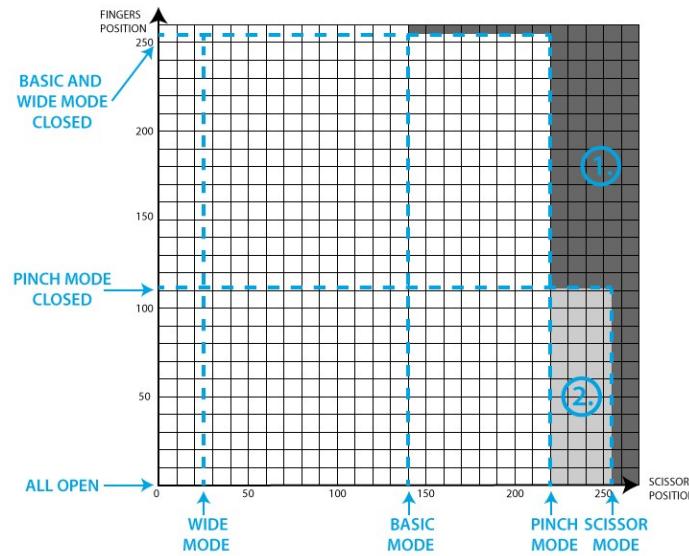
Figure 4.4.1 : Reachable workspace of the fingers and scissor axis, zone 1 is never reachable, zone 2 is only reachable in individual control of Scissor Mode.

Register: **SPEED (FINGER A IN INDIVIDUAL MODE)**
Address: **Byte 4**

Bits	7	6	5	4	3	2	1	0
Symbols	rSPA							

This register is used to set the Gripper closing or opening speed (or Finger A only if bit **rICF** is set) in real time, however, setting a speed will not initiate a motion.

rSPA

- 0x00 minimum speed
- 0xFF maximum speed

> **Info**
>
> 0x00 speed does not mean absolute zero speed. It is the minimum speed of the Gripper.
> Minimum speed: 22 mm/s
> Maximum speed: 110 mm/s
> Speed / count: 0.34 mm/s

Register: **FORCE (FINGER A IN INDIVIDUAL MODE)**
Address: **Byte 5**

Bits	7	6	5	4	3	2	1	0
Symbols				rFRA				

The force setting defines the final grasping force of the Adaptive Gripper (or Finger A only if bit **rICF** is set). The force will fix maximum current sent to the motors while in motion. For each finger, if the current limit is exceeded, the finger stops and triggers an object detection notification.

rFRA

- 0x00 minimum force
- 0xFF maximum force

> **Info**
>
> Force setting is overridden for a short period when the motion is initiated. Also, note that 0x00 force does not mean zero force; it is the minimum force that the Gripper can apply.
> Minimum force: 15 N
> Maximum force: 60 N
> Force / count: 0.175 N (approximate value, relation non-linear)

Register: **FINGER B POSITION REQUEST**
Address: **Byte 6**

Bits	7	6	5	4	3	2	1	0
Symbols				rPRB				

This register is used to set the Finger B target position. It is only available if the Individual Control of Finger option is selected (bit **rICF** is set). Please refer to **rPRA** (position request) register for more information.

Register: **FINGER B SPEED**
Address: **Byte 7**

Bits	7	6	5	4	3	2	1	0
Symbols				rSPB				

This register is used to set Finger B speed. It is only applied if the Individual Control of Finger option is selected (bit **rICF** is set). Please refer to **rSPA** (speed) register for more information.

Register: **FINGER B FORCE**
Address: **Byte 8**

Bits	7	6	5	4	3	2	1	0
Symbols				rFRB				

This register is used to set Finger B force. It is only applied if the Individual Control of Finger option is selected (bit **rICF** is set). Please refer to **rFRA** (force) register for more information.

Register: **FINGER C POSITION REQUEST**
Address: **Byte 9**

Bits	7	6	5	4	3	2	1	0
Symbols				rPRC				

This register is used to set the Finger C target position. It is only applied if the Individual Control of Finger option is selected (bit **rICF** is set). Please refer to **rPRA** (position request) register for more information.

Register: **FINGER C SPEED**
Address: **Byte 10**

Bits	7	6	5	4	3	2	1	0
Symbols				rSPC				

This register is used to set Finger C speed. It is only applied if the Individual Control of Finger option is selected (bit **rICF** is set). Please refer to **rSPA** (speed) register for more information.

Register: **FINGER C FORCE**
Address: **Byte 11**

Bits	7	6	5	4	3	2	1	0
Symbols				rFRC				

This register is used to set Finger C force. It is only applied if the Individual Control of Finger option is selected (bit **rICF** is set). Please refer to **rFRA** (force) register for more information.

Register: **SCISSOR POSITION REQUEST**
Address: **Byte 12**

Bits	7	6	5	4	3	2	1	0
Symbols				rPRS				

This register is used to set the scissor axis target position. It is only applied if the Individual Control of Scissor option is selected (bit **rICS** is set). Please refer to **rPRA** (position request) register for more information.

Register: **SCISSOR SPEED**
Address: **Byte 13**

Bits	7	6	5	4	3	2	1	0
Symbols				rSPS				

This register is used to set the scissor axis speed. It is only applied if the Individual Control of Scissor option is selected (bit **rICS** is set). Please refer to **rSPA** (speed) register for more information.

Register: **SCISSOR FORCE**
Address: **Byte 14**

Bits	7	6	5	4	3	2	1	0
Symbols				rFRS				

This register is used to set the scissor axis force. It is only applied if the Individual Control of Scissor option is selected (bit **rICS** is set). Please refer to **rFRA** (force) register for more information.

4.5 Robot input registers & status

Register: **GRIPPER STATUS**
Address: **Byte 0**

Bits	7	6	5	4	3	2	1	0
Symbols	gSTA		gIMC		gGTO		gMOD	gACT

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

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

gMOD: Operation Mode status, echo of the rMOD bits (grasping mode requested).

- 0x00 - Basic mode.
- 0x01 - Pinch mode.
- 0x02 - Wide mode.
- 0x03 - Scissor mode.

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

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

gIMC: Gripper status, returns the current status of the Gripper.

- 0x00 - Gripper is in reset (or automatic release) state. See Fault status if Gripper is activated.
- 0x01 - Activation is in progress.
- 0x02 - Mode change is in progress.
- 0x03 - Activation and Mode change are complete.

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

- 0x00 - Gripper is in motion towards requested position (only meaningful if gGTO = 1).
- 0x01 - Gripper is stopped. One or two fingers stopped before requested position.
- 0x02 - Gripper is stopped. All fingers stopped before requested position.
- 0x03 - Gripper is stopped. All fingers reached requested position.

> **Hint**
>
> Monitoring Motion status and Object status (in byte 1) are very useful for object pick-up routines.

Register: **OBJECT STATUS**
Address: **Byte 1**

Bits	7	6	5	4	3	2	1	0
Symbols	gDTS		gDTC		gDTB		gDTA	

> **Hint**
>
> Object status byte provides you with a built-in object detection feature that can replace very complex algorithms.

gDTA

- 0x00 - Finger A is in motion (only meaningful if gGTO = 1).
- 0x01 - Finger A has stopped due to a contact while opening.
- 0x02 - Finger A has stopped due to a contact while closing.
- 0x03 - Finger A is at the requested position.

gDTB: Finger B object detection status returns information on possible object contact from Finger B.

- 0x00 - Finger B is in motion (only meaningful if gGTO = 1).
- 0x01 - Finger B has stopped due to a contact while opening.
- 0x02 - Finger B has stopped due to a contact while closing.
- 0x03 - Finger B is at the requested position.

gDTC: Finger C object detection status returns information on possible object contact from Finger C.

- 0x00 - Finger C is in motion (only meaningful if gGTO = 1).
- 0x01 - Finger C has stopped due to a contact while opening.
- 0x02 - Finger C has stopped due to a contact while closing.
- 0x03 - Finger C is at the requested position.

gDTS: Scissor object detection status returns information on possible object contact from scissor maneuver.

- 0x00 - Scissor is in motion (only meaningful if gGTO = 1).
- 0x01 - Scissor has stopped due to a contact while opening.
- 0x02 - Scissor has stopped due to a contact while closing.
- 0x03 - Scissor is at the requested position.

When a contact is detected, the corresponding axis will stop unless one of these conditions is met: a new position command is requested in the opposite direction, the requested force level is increased or the rGTO bit is cleared and set again.

> **Warning**
>
> Resetting the contact detection repeatedly at high frequency using the rGTO bit may cause a major failure of the Gripper. This is not considered normal usage of the Gripper and it is not recommended by Robotiq.

> **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 grasped. For example, picking up a thin object in a Fingertip Grip may be successful without object detection occurring. For this reason, use this feature with caution. In these applications the "Gripper is stopped" status of register **gSTA** is sufficient to proceed to the next step of the routine.

Register: **FAULT STATUS**
Address: **Byte 2**

Bits	7	6	5	4	3	2	1	0
Symbols	Reserved (zeros)				gFLT			

gFLT: Fault status returns general error messages useful for troubleshooting.

- 0x00 - No fault (fault LED off)
- Priority faults (fault LED off)
    - 0x05 - Action delayed, activation (reactivation) must be completed prior to renewed action.
    - 0x06 - Action delayed, mode change must be completed prior to continuing action.
    - 0x07 - The activation bit must be set prior to action.
- Minor faults (fault LED continuous red)
    - 0x09 - The communication chip is not ready (may be booting).
    - 0x0A - Changing mode fault, interference detected on Scissor (for less than 20 sec).
    - 0x0B - Automatic release in progress.
- Major faults (fault LED blinking red) - Reset is required.
    - 0x0D - Activation fault, verify that no interference or other error occurred.
    - 0x0E - Changing mode fault, interference detected on Scissor (for more than 20 sec).
    - 0x0F - Automatic release completed. Reset and activation is required.

> **Caution**
>
> All major faults will require you to reset the Gripper (rACT bit == 0 then rACT bit == 1) which will initiate motion from the Gripper for the re-calibration procedure before recovering normal control of the Gripper. Beware of possible hazards caused by the Gripper motion.

Register: **POSITION REQUEST ECHO (FINGER A IN INDIVIDUAL MODE)**
Address: **Byte 3**

Bits	7	6	5	4	3	2	1	0
Symbols	gPRA							

gPRA: Echo of the requested position of the Gripper (rPRA), 0x00 is the minimum position (fully open) and 0xFF is the maximum position (fully closed). If commanding the Gripper in individual control mode, gPRA is the echo of Finger A, otherwise it is the general position requested to all fingers.

Register: **FINGER A POSITION)**
Address: **Byte 4**

Bits	7	6	5	4	3	2	1	0
Symbols				gPOA				

gPOA: Returns the actual position of the Gripper Finger A, 0x00 is the minimum position (fully open) and 0xFF is the maximum position (fully closed).

Register: **FINGER A CURRENT)**
Address: **Byte 5**

Bits	7	6	5	4	3	2	1	0
Symbols				gCUA				

gCUA: Returns a value that represents the Finger A with instantaneous current consumption from 0x00 to 0xFF.

> **Info**
> Current consumption is approximately equal to 0.1 * gCUA (in mA).

Register: **FINGER B POSITION REQUEST ECHO**
Address: **Byte 6**

Bits	7	6	5	4	3	2	1	0
Symbols				gPRB				

gPRB: Echo of the requested position of Finger B (rPRB), 0x00 is the minimum position (fully open) and 0xFF is the maximum position (fully closed).

Register: **FINGER B POSITION**
Address: **Byte 7**

Bits	7	6	5	4	3	2	1	0
Symbols				gPOB				

gPOB: Returns the actual position of the Gripper Finger B, 0x00 is the minimum position (fully open) and 0xFF is the maximum position (fully closed).

Register: **FINGER B CURRENT**
Address: **Byte 8**

Bits	7	6	5	4	3	2	1	0
Symbols				gCUB				

gCUB: Returns a value that represents the Finger B with instantaneous current consumption from 0x00 to 0xFF.

Register: **FINGER C POSITION REQUEST ECHO**
Address: **Byte 9**

Bits	7	6	5	4	3	2	1	0
Symbols				gPRC				

gPRC: Echo of the requested position of Finger C (rPRC), 0x00 is the minimum position (fully open) and 0xFF is the maximum position (fully closed).

Register: **FINGER C POSITION**
Address: **Byte 10**

Bits	7	6	5	4	3	2	1	0
Symbols	gPOC							

gPOC: Returns the actual position of the Gripper Finger C, 0x00 is the minimum position (fully open) and 0xFF is the maximum position (fully closed).

Register: **FINGER C CURRENT**
Address: **Byte 11**

Bits	7	6	5	4	3	2	1	0
Symbols	gCUC							

gCUC: Returns a value that represents the Finger C with instantaneous current consumption from 0x00 to 0xFF.

Register: **SCISSOR POSITION REQUEST ECHO**
Address: **Byte 12**

Bits	7	6	5	4	3	2	1	0
Symbols	gPRS							

gPRS: Echo of the requested position of the scissor action (rPRS), 0x00 is the minimum position (fully open) and 0xFF is the maximum position (fully closed).

Register: **SCISSOR POSITION**
Address: **Byte 13**

Bits	7	6	5	4	3	2	1	0
Symbols	gPOS							

gPOS: Returns the actual position of the Gripper scissor action, 0x00 is the minimum position (fully open) and 0xFF is the maximum position (fully closed).

Register: **SCISSOR CURRENT**
Address: **Byte 14**

Bits	7	6	5	4	3	2	1	0
Symbols	gCUS							

gCUS: Returns a value that represents the scissor action with instantaneous current consumption from 0x00 to 0xFF.

4.6 Control logic - example

Figure 4.6.1 represents the general structure and logic for control of the 3-Finger Adaptive Robot Gripper. See the following subsections for details on specific industrial communication protocol examples.
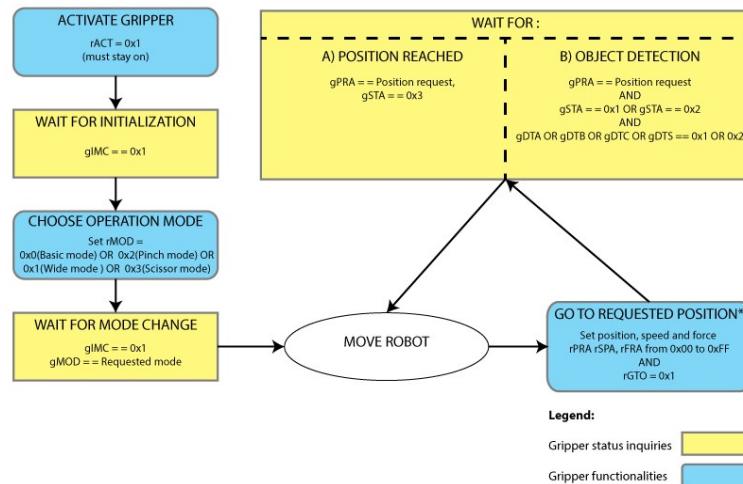
Figure 4.6.1 : Example of 3-Finger Adaptive Robot Gripper control logic.

4.7 MODBUS RTU communication protocol

The Robotiq 3-Finger Gripper can be controlled via RS485 or RS232 by using the Modbus RTU protocol. 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 invited to download one of many free Modbus scanners, such as the *CAS Modbus Scanner* from *Chipkin Automation Systems*, which is available at: http://www.chipkin.com/cas-modbus-scanner.

> **Caution**
>
> The Adaptive Gripper register values are updated at a 100Hz frequency. It is therefore recommended to send commands with a minimum interval delay of 10ms. Note that the updated frequency may drop under some conditions where the response time would be longer.

4.7.1 Connection setup

The following table describes the connection requirements for controlling the Robotiq 3-Finger Gripper using the Modbus RTU protocol.

PROPRIETY	VALUE
Physical Interface	RS485-RS232
Baud Rate	115,200 bps
Data Bits	8
Stop Bit	1
Parity	None
Number Notation	Hexadecimal
Supported Functions	Read Holding Registers (FC03) Preset Single Register (FC06) Preset Multiple Registers (FC16)
Exception Responses	Not supported
Slave ID	0x0009 (9)
Robot Output / Gripper Input First Register	0x03E8 (1000)

PROPRIETY	VALUE
Robot Input / Gripper Output First Register	0x07D0 (2000)

Each register (word - 16 bits) of the Modbus RTU protocol is composed of 2 registers (bytes – 8 bits) from the Robotiq 3-Finger Gripper. The first Gripper output Modbus register (0x07D0) is composed from the first 2 Robotiq 3-Finger Adaptive Robot Gripper registers (byte 0 and byte 1).

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.

Ex: 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

where

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 an echo:

09 03 04 E0 00 00 00 44 33

where

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 single register (FC06)

Function code 06 (FC06) is used to activate functionalities of the Gripper (robot output). Examples of such data are Action Request, Velocity, Force, etc.

Ex: This message requests the initialization of the Gripper by setting register 0x03E8 (1000), which contains an Action Request and Gripper Options, to 0x0100.

Request is:

09 06 03 E8 01 00 09 62

where

BITS	DESCRIPTION
09	SlaveID
06	Function Code 06 (Preset Single Register)
03E8	Address of the register
0100	Written Value
0962	Cyclic Redundancy Check (CRC)

Response is an echo:

09 06 03 E8 01 00 09 62

where

BITS	DESCRIPTION
09	SlaveID
06	Function Code 06 (Preset Single Register)
03E8	Address of the register
0100	Written Value
0962	Cyclic Redundancy Check (CRC)

4.7.4 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.

Ex: 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

where

BITS	DESCRIPTION
09	SlaveID
10	Function Code 16 (Preset Multiple Register)
03E9	Address of the first register
0002	Number of written registers
04	Number of data bytes to follow (2 registers x 2 bytes/register = 4 bytes)
00E6	Value to write to register 0x03E9
3CC8	Value to write to register 0x03EA
EC7C	Cyclic Redundancy Check (CRC)

Response is:

09 10 03 E9 00 02 91 30

where

BITS	DESCRIPTION
09	SlaveID
10	Function Code 16 (Preset Multiple Register)
03E9	Address of the firstregister
0002	Number of written registers
9130	Number of data bytes to follow (2 registers x 2 bytes/register = 4 bytes)

4.7.5 Master read&write multiple registers (FC23)

Function code 23 (FC23) is used for reading the status of the Gripper (robot input) and activating functionalities of the Gripper (robot output) simultaneously. Examples of such data are Gripper Status, Object Status, Finger Position, etc. Action Requests are Speed, Force, etc.

Ex: This message asks for register 0x07D0 (2000) and register 0x07D1 (2001) which contains Gripper Status, Object Detection, Fault Status and Position Request Echo while setting Position Request, Speed and Force of the Gripper is done by setting registers 0x03E9 (1001) and 0x03EA (1002).

Request is:

09 23 07 D0 00 02 03 E9 00 02 04 00 E6 3C C8 00 FF

where

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 written register
0002	Number of registers to **write** (3) 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
00FF	Cyclic Redundancy Check (CRC)

Response is:

09 17 04 E0 00 00 00 47 27

where

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)
E000	Content of register 07D0
0000	Content of register 07D1
4727	Cyclic Redundancy Check (CRC)

Caution

ROBOTIQ

> The 3 Finger Adaptive Gripper register values are updated at a 200Hz frequency. It is therefore recommended to send FC23 commands with a minimum interval delay of 5ms.

4.7.6 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

Request is:

<p style="text-align:center">09 10 03 E8 00 03 06 01 00 00 00 00 00 72 E1</p>

where

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

Response is:

<p style="text-align:center">09 10 03 E8 00 03 01 30</p>

where

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:

<p style="text-align:center">09 03 07 D0 00 01 85 CF</p>

where

BITS	DESCRIPTION
09	SlaveID
03	Function Code 03 (Read Holding Registers)

BITS	DESCRIPTION
07D0	Address of the first 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

where

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, OBJECT STATUS = 0x00): gACT = 1 for "Gripper Activation", **gIMC = 1 for "Activation in progress"**
55D5	Cyclic Redundancy Check (CRC)

Response (if the activation IS completed):

09 03 02 31 00 4C 15

where

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, OBJECT STATUS = 0x00): gACT = 1 for "Gripper Activation", **gIMC = 3 for "Activation and mode change are 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

where

BITS	DESCRIPTION
09	SlaveID
10	Function Code 16 (Preset Multiple Registers)
03E8	Address of the first register
0003	Number of registers to write to
06	Number of data bytes to follow (3 registers x 2 bytes/register = 6 bytes)

BITS	DESCRIPTION
0900	Value written to register 0x03E9 (ACTION REQUEST = 0x09 and GRIPPER OPTIONS = 0x00): **rACT = 1 for "Activate Gripper", rMOD=0 for "Go to Basic Mode" , rGTO = 1 for "Go to Requested Position"**
00FF	Value written to register 0x03EA (GRIPPER OPTIONS 2 = 0x00 and POSITION REQUEST = 0xFF): **rPRA = 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

where

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 08 45 C9

where

BITS	DESCRIPTION
09	SlaveID
03	Function Code 03 (Read Holding Registers)
07D0	Address of the first requested register
0008	Number of registers requested (8)
45C9	Cyclic Redundancy Check (CRC)

Example of response if the grip **is not completed**:

09 03 10 39 C0 00 FF 08 0F 00 08 10 00 08 0F 00 89 00 00 73 70

where

BITS	DESCRIPTION
09	SlaveID
03	Function Code 03 (Read Holding Registers)
10	Number of data bytes to follow (8 registers x 2 bytes/register = 16 bytes)
39C0	Content of register 0x07D0 (GRIPPER STATUS = 0x39, OBJECT STATUS = 0xC0): **gSTA = 0 for "Gripper is in motion towards requested position"**

BITS	DESCRIPTION
00FF	Content of register 0x07D1 (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.
080F	Content of register 0x07D2 (FINGER A POSITION = 0x08, FINGER A CURRENT = 0x0F): the position of finger A is 8/255 and the motor current is 150mA (these values will change during motion)
0008	Content of register 0x07D3 (FINGER B POSITION REQUEST ECHO = 0x00, FINGER B POSITION = 0x08)
1000	Content of register 0x07D4 (FINGER B CURRENT = 0x10, FINGER C POSITION REQUEST ECHO = 0x00)
080F	Content of register 0x07D5 (FINGER C POSITION = 0x08, FINGER C CURRENT = 0x0F)
0089	Content of register 0x07D6 (SCISSOR POSITION REQUEST ECHO = 0x00, SCISSOR POSITION = 0x89)
0000	Content of register 0x07D7 (SCISSOR CURRENT = 0x00)
7370	Cyclic Redundancy Check (CRC)

Example of response if the grip **is completed**:

09 03 10 B9 EA 00 FF BC 00 00 C1 00 00 BD 00 00 89 00 00 4E 17

where

BITS	DESCRIPTION
09	SlaveID
03	Function Code 03 (Read Holding Registers)
10	Number of data bytes to follow (8 registers x 2 bytes/register = 16 bytes)
B9EA	Content of register 0x07D0 (GRIPPER STATUS = 0xB9, OBJECT STATUS = 0xEA): **gSTA = 2 for "Gripper is stopped. All fingers stopped before requested position", gDTA = gDTB = gDTC = 2 for "Finger X has stopped due to a contact while closing"**
00FF	Content of register 0x07D1 (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.
BC00	Content of register 0x07D2 (FINGER A POSITION = 0xBC, FINGER A CURRENT = 0x00): the position of finger A is 188/255 and the motor current is 0mA
00C1	Content of register 0x07D3 (FINGER B POSITION REQUEST ECHO = 0x00, FINGER B POSITION = 0xC1)
0000	Content of register 0x07D4 (FINGER B CURRENT = 0x00, FINGER C POSITION REQUEST ECHO = 0x00)
BD00	Content of register 0x07D5 (FINGER C POSITION = 0xBD, FINGER C CURRENT = 0x00)
0089	Content of register 0x07D6 (SCISSOR POSITION REQUEST ECHO = 0x00, SCISSOR POSITION = 0x89)
0000	Content of register 0x07D7 (SCISSOR CURRENT = 0x00)
4E17	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

where

BITS	DESCRIPTION
09	SlaveID
10	Function Code 16 (Preset Multiple Registers)
03E8	Address of the first register
0003	Number of registers to write 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", rMOD=0 for "Go to Basic Mode" , 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

where

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 08 45 C9

where

BITS	DESCRIPTION
09	SlaveID
03	Function Code 03 (Read Holding Registers)
07D0	Address of the first requested register
0008	Number of registers requested (8)
45C9	Cyclic Redundancy Check (CRC)

Example of response if the opening **is not completed**:

09 03 10 39 C0 00 00 B8 0B 00 BD 0E 00 BA 0B 00 89 00 00 10 85

where

BITS	DESCRIPTION
09	SlaveID
03	Function Code 03 (Read Holding Registers)
10	Number of data bytes to follow (8 registers x 2 bytes/register = 16 bytes)
39C0	Content of register 0x07D0 (GRIPPER STATUS = 0x39, OBJECT STATUS = 0xC0): **gSTA = 0 for "Gripper is in motion towards requested position"**
0000	Content of register 0x07D1 (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.
B80B	Content of register 0x07D2 (FINGER A POSITION = 0xB8, FINGER A CURRENT = 0x0B): the position of finger A is 184/255 and the motor current is 170mA (these values will change during motion)
00BD	Content of register 0x07D3 (FINGER B POSITION REQUEST ECHO = 0x00, FINGER B POSITION = 0xBD)
00E0	Content of register 0x07D4 (FINGER B CURRENT = 0x0E, FINGER C POSITION REQUEST ECHO = 0x00)
BA0B	Content of register 0x07D5 (FINGER C POSITION = 0xBA, FINGER C CURRENT = 0x0B)
0089	Content of register 0x07D6 (SCISSOR POSITION REQUEST ECHO = 0x00, SCISSOR POSITION = 0x89)
0000	Content of register 0x07D7 (SCISSOR CURRENT = 0x00)
1085	Cyclic Redundancy Check (CRC)

Example of response if the opening **is completed**:

09 03 10 F9 FF 00 00 07 00 00 06 00 00 06 00 00 89 00 00 34 8D

where

BITS	DESCRIPTION
09	SlaveID
03	Function Code 03 (Read Holding Registers)
10	Number of data bytes to follow (8 registers x 2 bytes/register = 16 bytes)
F9FF	Content of register 0x07D0 (GRIPPER STATUS = 0xF9, OBJECT STATUS = 0xFF): **gSTA = 3 for "Gripper is stopped. All fingers reached requested position"**
0000	Content of register 0x07D1 (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.
0700	Content of register 0x07D2 (FINGER A POSITION = 0x07, FINGER A CURRENT = 0x00): the position of finger A is 7/255 and the motor current is 0mA
0006	Content of register 0x07D3 (FINGER B POSITION REQUEST ECHO = 0x00, FINGER B POSITION = 0x06)
0000	Content of register 0x07D4 (FINGER B CURRENT = 0x00, FINGER C POSITION REQUEST ECHO = 0x00)
0600	Content of register 0x07D5 (FINGER C POSITION = 0x06, FINGER C CURRENT = 0x00)
0089	Content of register 0x07D6 (SCISSOR POSITION REQUEST ECHO =

BITS	DESCRIPTION
	0x00, SCISSOR POSITION = 0x89)
0000	Content of register 0x07D7 (SCISSOR CURRENT = 0x00)
384D	Cyclic Redundancy Check (CRC)

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

4.8 MODBUS TCP communication protocol

The Robotiq 3-Finger Gripper can be controlled using the Modbus TCP protocol. This section is intended to provide guidelines for setting up a Modbus TCP communication link to adequately send commands to and read inputs from the Gripper.

For a general introduction to Modbus TCP and to understand its differences from Modbus RTU, the reader is invited to review the information provided on the following website:

http://www.simplymodbus.ca/TCP.htm.

> **Caution**
>
> The Adaptive Gripper register values are updated at a 100Hz frequency. It is therefore recommended to send commands with a minimum interval delay of 10ms. Note that the updated frequency may drop under some conditions where the response time would be longer.

4.8.1 Connection Setup

The following table describes the connection requirement for controlling the Robotiq 3-Finger Gripper using the Modbus TCP protocol.

CONNECTION REQUIREMENT	VALUE
Required protocol	TCP/IP
Port	502
Gripper IP address	Configurable (most Grippers are shipped with the 192.168.1.11 address)
Supported Functions	Read Input Registers (FC04) Preset Multiple Registers (FC16)
UnitID	0x0002 (2)
Robot Output / Gripper Input First Register	0x0000 (0000)
Robot Input / Gripper Output First Register	0x0000 (0000)

Each register (word - 16 bits) of the Modbus TCP protocol is composed of 2 registers (bytes – 8 bits) from the Robotiq 3-Finger Gripper. The first Gripper output Modbus register (0x0000) is composed from the first 2 Robotiq 3-Finger Adaptive Robot Gripper registers (byte 0 and byte 1).

4.8.2 Read Input Registers (FC04)

Function code 04 (FC04) is used for reading the status of the Gripper (robot input). Examples of such data are Gripper Status, Object Status, Finger Position, etc.

Ex: This message asks for registers 0x0000 (0000) to 0x0006 (0006) which contain all the robot input statuses except for the scissor axis.

Request is:

<div align="center">

01 00 00 00 00 06 02 04 00 00 00 06

</div>

where

BITS	DESCRIPTION
01 00	Transaction identifier
00 00	Protocol identifier

BITS	DESCRIPTION
00 06	Length
02	UnitID
04	Function 04 (Read input registers)
00 00	Address of the first register
00 06	Word count

Response is:

<div align="center">

01 00 00 00 00 0f 02 04 0c e9 00 00 00 06 06 06 8a 00 00 00 00

</div>

where

BITS	DESCRIPTION
01 00	Transaction identifier
00 00	Protocol identifier
00 0f	Length
02	UnitID
04	Function 04 (Read input registers)
0c	The number of data bytes to follow
e9 00 00 00 06 06 06 8a 00 00 00 00	Data

4.8.3 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, Position Request, Speed, Force, etc.

Ex: This message requests to set several options for the Gripper by setting registers from 0x0000 (0000) to 0x0003.

Request is:

<div align="center">

01 00 00 00 00 0d 02 10 00 00 00 03 06 09 00 64 64 00 ff

</div>

where

BITS	DESCRIPTION
01 00	Transaction identifier
00 00	Protocol identifier
00 0d	Length
02	UnitID
10	Function 16 (Preset multiple registers)
00 00	Address of the first register
00 03	The number of registers to write
06	The number of data bytes to follow
09 00 00 64 00 ff	Data

Response is:

<div align="center">

01 00 00 00 00 06 02 10 00 00 00 03

</div>

where

BITS	DESCRIPTION
01 00	Transaction identifier
00 00	Protocol identifier
00 06	Length
02	UnitID
10	Function 16 (Preset multiple registers)
00 00	Address of the first register
00 03	Number of written registers

4.8.4 Modbus TCP example

This section depicts the example given in section 4.6 when programmed using the Modbus TCP 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

Request is:

33 9A 00 00 00 0D 02 10 00 00 00 03 06 01 00 00 00 00 00

where

BITS	DESCRIPTION
339A	Unique transaction identifier (chosen randomly)
0000	Protocol Identifier (Modbus)
000D	Length
02	SlaveID
10	Function 16 (Preset Multiple Registers)
0000	Address of the first register
0003	The number of registers to write to
06	Number of data bytes to follow (3 registers x 2 bytes/register = 6 bytes)
0100	Value written to register 0x0000 (ACTION REQUEST = 0x01 and GRIPPER OPTIONS = 0x00): **rACT = 1 for "Activate Gripper"**
0000	Value written to register 0x0001
0000	Value written to register 0x0002

Response is:

33 9A 00 00 00 06 02 10 00 00 00 03

where

BITS	DESCRIPTION
339A	Unique transaction identifier (chosen randomly)
0000	Protocol Identifier (Modbus)
0006	Length
02	SlaveID
10	Function 16 (Preset Multiple Registers)

BITS	DESCRIPTION
0000	Address of the first register
0003	Number of written

Step 2: Read Gripper status until the activation is completed

Request is:

<div align="center">

45 33 00 00 00 06 02 03 00 00 00 01

</div>

where

BITS	DESCRIPTION
4533	Unique transaction identifier (chosen randomly)
0000	Protocol Identifier (Modbus)
0006	Length
02	SlaveID
04	Function 04 (Read Input Registers)
0000	Address of the first requested register
0001	Number of registers requested (1)

Response (if the activation **is not completed**):

<div align="center">

45 33 00 00 00 05 02 04 02 11 00

</div>

where

BITS	DESCRIPTION
4533	Unique transaction identifier (chosen randomly)
0000	Protocol Identifier (Modbus)
0005	Length
02	SlaveID
04	Function 04 (Read Input Registers)
02	Number of data bytes to follow (1 registers x 2 bytes/register = 2 bytes)
1100	Content of register 0x0000 (GRIPPER STATUS = 0x11, OBJECT STATUS = 0x00): gACT = 1 for "Gripper Activation", **gIMC = 1 for "Activation in progress"**

Response (if the activation **is completed**):

<div align="center">

45 33 00 00 00 05 02 04 02 31 00

</div>

where

BITS	DESCRIPTION
4533	Unique transaction identifier (chosen randomly)
0000	Protocol Identifier (Modbus)
0005	Length
02	SlaveID

BITS	DESCRIPTION
04	Function 04 (Read Input Registers)
02	Number of data bytes to follow (1 registers x 2 bytes/register = 2 bytes)
3100	Content of register 0x0000 (GRIPPER STATUS = 0x31, OBJECT STATUS = 0x00): gACT = 1 for "Gripper Activation", **gIMC = 3 for "Activation and mode change are completed"**

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

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

Request is:

71 EE 00 00 00 0D 02 10 00 00 00 03 06 09 00 00 FF FF FF

where

BITS	DESCRIPTION
71EE	Unique transaction identifier (chosen randomly)
0000	Protocol Identifier (Modbus)
000D	Length
02	SlaveID
10	Function Code 16 (Preset Multiple Registers)
0000	Address of the first register
0003	Number of registers to write 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", rMOD=0 for "Go to Basic Mode" , rGTO = 1 for "Go to Requested Position"**
00FF	Value written to register 0x03EA (GRIPPER OPTIONS 2 = 0x00 and POSITION REQUEST = 0xFF): **rPRA = 255/255 for full closing of the Gripper**
FFFF	Value written to register 0x03EB (SPEED = 0xFF and FORCE = 0xFF): full speed and full force

Response is:

71 EE 00 00 00 06 02 10 00 00 00 03

where

BITS	DESCRIPTION
71EE	Unique transaction identifier (chosen randomly)
0000	Protocol Identifier (Modbus)
0006	Length
02	SlaveID
10	Function 16 (Preset Multiple Registers)
0000	Address of the first register
0003	Number of written registers

Step 5: Read Gripper status until the grip is completed

Request is:

<div align="center">

77 6B 00 00 00 06 02 04 00 00 00 08

</div>

where

BITS	DESCRIPTION
776B	Unique transaction identifier (chosen randomly)
0000	Protocol Identifier (Modbus)
0006	Length
02	SlaveID
04	Function 04 (Read Input Registers)
0000	Address of the first requested register
0008	Number of registers requested (8)

Example of response if the grip **is not completed**:

<div align="center">

77 6B 00 00 00 13 02 04 10 39 C0 00 FF 08 0F 00 08 10 00 08 0F 00 89 00 00

</div>

where

BITS	DESCRIPTION
776B	Unique transaction identifier (chosen randomly)
0000	Protocol Identifier (Modbus)
0013	Length
02	SlaveID
04	Function Code 04 (Read Input Registers)
10	Number of data bytes to follow (8 registers x 2 bytes/register = 16 bytes)
39C0	Content of register 0x0000 (GRIPPER STATUS = 0x39, OBJECT STATUS = 0xC0): **gSTA = 0 for "Gripper is in motion towards requested position"**
00FF	Content of register 0x0001 (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.
080F	Content of register 0x0002 (FINGER A POSITION = 0x08, FINGER A CURRENT = 0x0F): the position of finger A is 8/255 and the motor current is 150mA (these values will change during motion)
0008	Content of register 0x0003 (FINGER B POSITION REQUEST ECHO = 0x00, FINGER B POSITION = 0x08)
1000	Content of register 0x0004 (FINGER B CURRENT = 0x10, FINGER C POSITION REQUEST ECHO = 0x00)
080F	Content of register 0x0005 (FINGER C POSITION = 0x08, FINGER C CURRENT = 0x0F)
0089	Content of register 0x0006 (SCISSOR POSITION REQUEST ECHO = 0x00, SCISSOR POSITION = 0x89)
0000	Content of register 0x0007 (SCISSOR CURRENT = 0x00)

Example of response if the grip is completed:

<div align="center">

77 6B 00 00 00 13 02 04 10 B9 EA 00 FF BC 00 00 C1 00 00 BD 00 00 89 00 00

</div>

where

BITS	DESCRIPTION
76B	Unique transaction identifier (chosen randomly)
0000	Protocol Identifier (Modbus)
0013	Length
02	SlaveID
04	Function Code 04 (Read Input Registers)
10	Number of data bytes to follow (8 registers x 2 bytes/register = 16 bytes)
B9EA	Content of register 0x07D0 (GRIPPER STATUS = 0xB9, OBJECT STATUS = 0xEA): **gSTA = 2 for "Gripper is stopped. All fingers stopped before requested position", gDTA = gDTB = gDTC = 2 for "Finger X has stopped due to a contact while closing"**
00FF	Content of register 0x07D1 (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.
BC00	Content of register 0x07D2 (FINGER A POSITION = 0xBC, FINGER A CURRENT = 0x00): the position of finger A is 188/255 and the motor current is 0mA
00C1	Content of register 0x07D3 (FINGER B POSITION REQUEST ECHO = 0x00, FINGER B POSITION = 0xC1)
0000	Content of register 0x07D4 (FINGER B CURRENT = 0x00, FINGER C POSITION REQUEST ECHO = 0x00)
BD00	Content of register 0x07D5 (FINGER C POSITION = 0xBD, FINGER C CURRENT = 0x00)
0089	Content of register 0x07D6 (SCISSOR POSITION REQUEST ECHO = 0x00, SCISSOR POSITION = 0x89)
0000	Content of register 0x07D7 (SCISSOR CURRENT = 0x00)

Step 6: Move the robot to the release location

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

Request is:

<p align="center">34 AB 00 00 00 0D 02 10 03 E8 00 03 06 09 00 00 00 FF FF</p>

where

BITS	DESCRIPTION
34AB	Unique transaction identifier (chosen randomly)
0000	Protocol Identifier (Modbus)
000D	Length
02	SlaveID
10	Function Code 16 (Preset Multiple Registers)
03E8	Address of the first register
0003	Number of registers to write 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",**

BITS	DESCRIPTION
	rMOD=0 for "Go to Basic Mode" , 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

Response is:

34 AB 00 00 00 06 02 10 03 E8 00 03

where

BITS	DESCRIPTION
34AB	Unique transaction identifier (chosen randomly)
0000	Protocol Identifier (Modbus)
0006	Length
02	SlaveID
10	Function Code 16 (Preset Multiple Registers)
03E8	Address of the first register
0003	Number of written registers

Step 8: Read Gripper status until the opening is completed

Request is:

D6 05 00 00 00 06 02 04 07 D0 00 08

where

BITS	DESCRIPTION
D605	Unique transaction identifier (chosen randomly)
0000	Protocol Identifier (Modbus)
0006	Length
02	SlaveID
04	Function Code 04 (Read Input Registers)
07D0	Address of the first requested register
0008	Number of registers requested (8)

Example of response if the opening **is not completed**:

D6 05 00 00 00 0D 02 04 10 39 C0 00 00 B8 0B 00 BD 0E 00 BA 0B 00 89 00 00

where

BITS	DESCRIPTION
D605	Unique transaction identifier (chosen randomly)
0000	Protocol Identifier (Modbus)

BITS	DESCRIPTION
000D	Length
02	SlaveID
04	Function Code 04 (Read Input Registers)
10	Number of data bytes to follow (8 registers x 2 bytes/register = 16 bytes)
39C0	Content of register 0x07D0 (GRIPPER STATUS = 0x39, OBJECT STATUS = 0xC0): **gSTA = 0 for "Gripper is in motion towards requested position"**
0000	Content of register 0x07D1 (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.
B80B	Content of register 0x07D2 (FINGER A POSITION = 0xB8, FINGER A CURRENT = 0x0B): the position of finger A is 184/255 and the motor current is 170mA (these values will change during motion)
00BD	Content of register 0x07D3 (FINGER B POSITION REQUEST ECHO = 0x00, FINGER B POSITION = 0xBD)
0E00	Content of register 0x07D4 (FINGER B CURRENT = 0x0E, FINGER C POSITION REQUEST ECHO = 0x00)
BA0B	Content of register 0x07D5 (FINGER C POSITION = 0xBA, FINGER C CURRENT = 0x0B)
0089	Content of register 0x07D6 (SCISSOR POSITION REQUEST ECHO = 0x00, SCISSOR POSITION = 0x89)
0000	Content of register 0x07D7 (SCISSOR CURRENT = 0x00)

Example of response if the opening **is completed**:

D6 05 00 00 00 0D 02 04 10 F9 FF 00 00 07 00 00 06 00 00 06 00 00 89 00 00

where

BITS	DESCRIPTION
D605	Unique transaction identifier (chosen randomly)
0000	Protocol Identifier (Modbus)
000D	Length
02	SlaveID
04	Function Code 04 (Read Input Registers)
10	Number of data bytes to follow (8 registers x 2 bytes/register = 16 bytes)
F9FF	Content of register 0x07D0 (GRIPPER STATUS = 0x39, OBJECT STATUS = 0xC0): **gSTA = 0 for "Gripper is in motion towards requested position"**
0000	Content of register 0x07D1 (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.
0700	Content of register 0x07D2 (FINGER A POSITION = 0x07, FINGER A CURRENT = 0x00): the position of finger A is 7/255 and the motor current is 0mA
0006	Content of register 0x07D3 (FINGER B POSITION REQUEST ECHO = 0x00, FINGER B POSITION = 0x06)
0000	Content of register 0x07D4 (FINGER B CURRENT = 0x00, FINGER C POSITION REQUEST ECHO = 0x00)
0600	Content of register 0x07D5 (FINGER C POSITION = 0x06, FINGER C

BITS	DESCRIPTION
	CURRENT = 0x00)
0089	Content of register 0x07D6 (SCISSOR POSITION REQUEST ECHO = 0x00, SCISSOR POSITION = 0x89)
0000	Content of register 0x07D7 (SCISSOR CURRENT = 0x00)

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

4.8.5 Application with Universal Robots

This section contains some additional information relative to the communication between the Gripper and the *Universal Robots* model *UR-5* and *UR-10* using the *Modbus TCP* protocol.

Modbus TCP works with 16-bit registers, whereas the Adaptive Gripper is configured using 8-bit bytes. Therefore, you must compute the value for each 16-bit register using two bytes. Also, the endianness is different for the Gripper than for the *UR* robots. This means that the first register is built using the following formula:

REGISTER0 = BYTE1 + 256 * BYTE0

> **Tip**
>
> One thing to try first is to send the value 256 to REGISTER0. This command (1 on the activate bit) will trigger the initialization routine and therefore you should see the Gripper open and close to reach its mechanical stops.

Writing and reading other registers will be based on similar computations. Also, please note that theread/write registers are not the same.

As an example, writing to REGISTER0 will send a command to the Gripper, whereas reading REGISTER0 will give you the status of the Gripper.

4.9 Control over Universal Robots with URCaps

The URCaps package contains many features allowing to program and control the 3-Finger Adaptive Robot Gripper.

- **3F Gripper Activate node**
  This node is used to add a Gripper Activate command. The command will initiate the activation sequence of the Gripper.
- **3F Gripper Move node**
  This node is used to add a Gripper Move command. The node can make the Gripper move to a specific opening distance in a specific mode, and modify the speed and force applied by the Gripper.
- **3F Object Detected node**
  This node is used to add a command sequence if an object is detected/not detected by the Gripper.
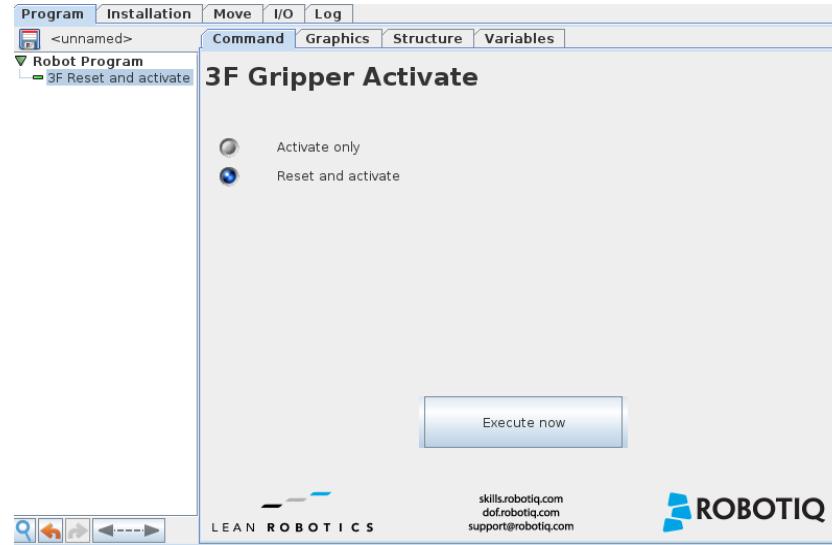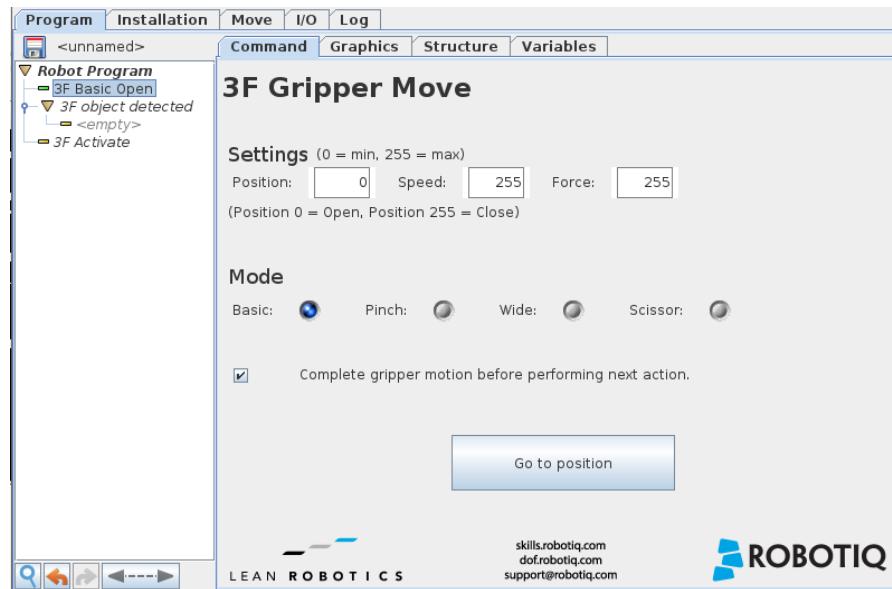
4.9.1 3F Gripper Activate node

This node commands the activation sequence of the 3-Finger Adaptive Robot Gripper. If the user selects the **Reset and activate** radio button, the Gripper will initiate the activation sequence everytime the command is executed. If the user selects the **Activate only** radio button, the activation sequence will be executed only if the Gripper is not already activated.
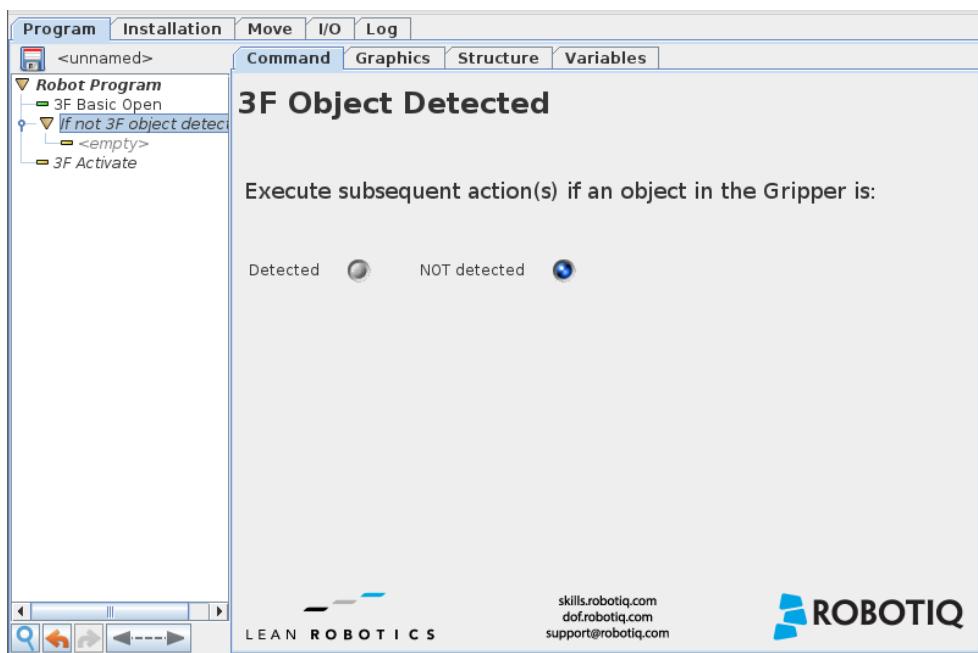
4.9.2 3F Gripper Move node

Features

Feature	Description	User input
Position	Gripper position requested	Integer value from 0 to 255 • 0 = Open • 255 = Close
Speed	Gripper speed requested	Integer value from 0 to 255 • 0 = minimum • 255 = maximum
Force	Gripper force applied by the Gripper	Integer value from 0 to 255 • 0 = minimum • 255 = maximum
Basic	Operation mode in which all fingers of the Gripper close, with fingers B and C remaining parallel.	Radio button
Pinch	Operation mode in which all fingers of the Gripper close, with fingers B and C travelling one towards the other.	Radio button
Wide	Operation mode in which all fingers of the Gripper close, with fingers B and C travelling away one from the other.	Radio button
Scissor	Operation mode consisting in the lateral move of fingers B and C, each one towards the other, while finger A remains still.	Radio button
Complete gripper motion before performing next action	If selected, the Gripper completes its motion prior to executing the next action in the PolyScope program tree. Slower but safer action. If NOT selected, as soon as the Gripper starts moving, PolyScope executes the next action in the program tree. This allows the user to move the Gripper and robot at the same time.	Checkbox
Go to position	Sends all node parameters (position, force and speed) to the Gripper; the instruction is executed immediately.	Button

4.9.3 3F Object Detected node

The **3F Object Detected** node is prepackaged in an **If** statement. Selecting the **Detected** radio button will affect the node's name in the program tree and perform the actions following said node if an object is detected in the Gripper.

On the other hand, selecting the **NOT detected** radio button will also affect the node's name accordingly and perform the actions following the program node if no object has been detected in the Gripper.

4.9.4 Script functions

Below is the list of functions defined in the URCap. These functions interface with the Modbus client in order to facilitate the control of the Gripper.

There are two types of functions: **blocking** and **non-blocking**.

Blocking functions will send commands to the Gripper and wait for their completion.

Non-blocking functions will send commands to the Gripper and allow the program to carry on with the execution of the subsequent instructions.

The **_and_wait** suffix differentiates both types of functions.

> **Info**
> Note that the majority of the following functions can be used by calling their respective subprograms (except **rq_is_motion_complete**, **rq_is_gripper_activated** and **rq_is_object_detected**)

Function Name	Function Description
rq_activate	Sends the gripper activation command. If it is already activated, nothing happens. Program execution continues before the end of the activation.
rq_activate_and_wait	Activates the gripper and wait until the motion is over. If it is already activated, nothing happens.
rq_stop	Stops the current motion (has no effect on activation/auto-release commands)
rq_reset	Resets the activation bit. To move the gripper will need to be activated again.
rq_auto_release_and_wait	Slowly moves the gripper to its maximum opened position. The gripper must be activated after this command.
rq_set_force	Uses the argument as the force set point.
rq_set_speed	Uses the argument as the speed set point
rq_open	Requests the gripper to move to its fully opened position
rq_open_and_wait	Moves the gripper to its fully opened position and wait until the motion is over
rq_close	Requests the gripper to move to its fully closed position
rq_close_and_wait	Moves the gripper to its fully closed position and wait until the motion is over
rq_move	Requests the gripper to move to the position defined by the argument
rq_move_and_wait	Moves the gripper to the position defined by the argument and wait until the motion is over
rq_set_basic_mode	Sets the gripper in the basic mode. Refer to the gripper's manual.
rq_set_pinch_mode	Sets the gripper in the pinch mode. Refer to the gripper's manual.
rq_set_wide_mode	Sets the gripper in the wide mode. Refer to the gripper's manual.
rq_set_scissor_mode	Sets the gripper in the scissor mode. Refer to the gripper's manual.
rq_is_motion_complete	Returns True if the gripper motion is complete .Otherwise it returns False.
rq_is_gripper_activated	Returns True if the gripper is activated. Otherwise it returns False.
rq_is_object_detected	Returns True if the gripper has detected an object. Otherwise it returns False.
rq_print_fault_code	Prints the gripper's fault code in the UR log window

4.10 Control over ROS

The Robotiq 3-Finger Adaptive Gripper is supported on ROS Kinetic.

Please visit our ROS wiki page to learn more.

The package stack (also including support for the other Adaptive Grippers as well as the FT 300 Force Torque Sensor), can be downloaded via Robotiq's Github repository, provided by ros-industrial.

You can use Gazebo to visualize and simulate the 3-Finger Adaptive Gripper.

Contact ros@robotiq.com for support or further information.
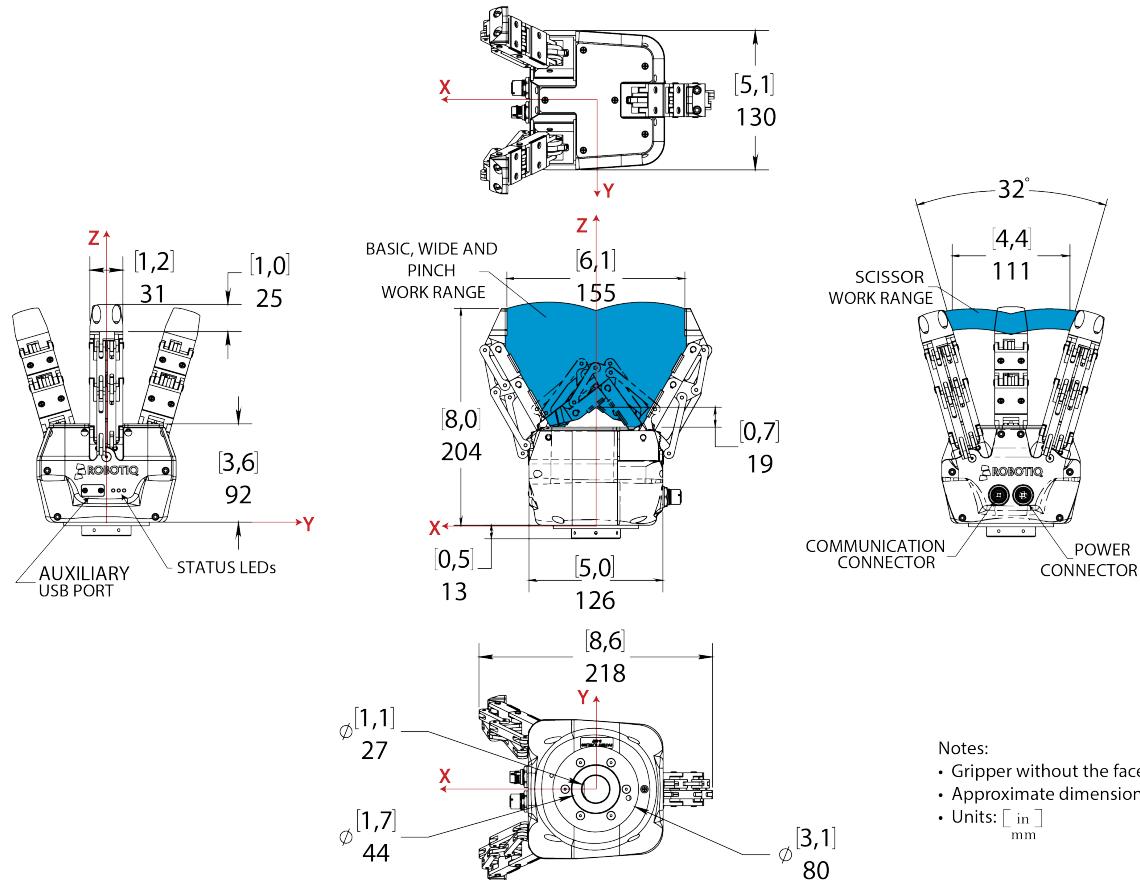
5. User Interface

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

See the Robotiq User Interface Instruction Manualfor details on usage of the Robotiq User Interface.

6. Specifications

6.1 Technical dimensions

Figure 6.1.1 : Robotiq 3-Finger Adaptive Robot Gripper technical dimensions.

6.2 Mechanical specifications

Specification	Imperial Units	Metric Units
Gripper Opening (see Pad design and customization section)	0-6.6 in	[0-167 mm]
Maximum encompassing diameter	6.1 in	[155 mm]
Gripper Approximate Weight	5 lbs	[2.3 kg]
Recommended Payload (Encompassing Grip)	22 lbs	[10 kg]
Recommended Payload (Fingertip Grip)[1]	5.5 lbs	[2.5 kg]
Maximum Grip Force (Fingertip Grip)	13.5 lbf	[70 N]
Maximum Break Away Force	2 lbf	[100 N]
Maximum Closing Speed (Fingertip Grip)	4.3in/sec	[110mm/sec]

[1]0.6 friction coefficient between finger silicone and steel part, safety factor of 2.
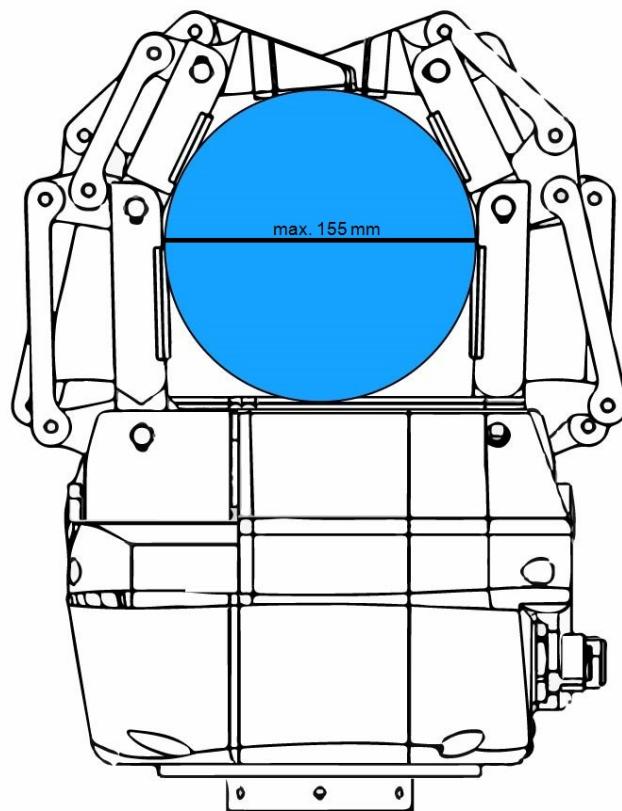
Figure 6.2.1 : Maximum encompassing diameter
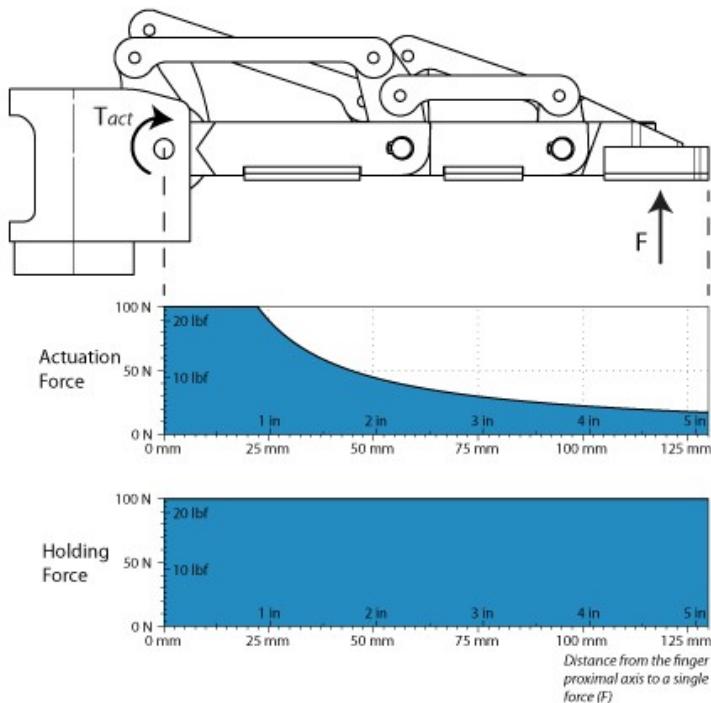
Figure 6.2.2 : Actuation and Holding Forces available in a single finger.

> **Info**
>
> - The "Actuation Force" is the force that can be applied to an object by the motors of the Gripper while the "Break Away Force" is the force that the Gripper can sustain.
> - Because the Gripper is self-locking, the Break Away Force is higher than the Actuation Force (see Figure 6.2.1).
> - In Pinch Mode, Fingers B and C will force against Finger A. As Finger A is locked, the pinch Actuation Force is the sum of the Actuation Force from Fingers B and C, 20+20 = 40 N.

The user of the Gripper must always ensure that the result of the forces against the finger is always lower than the maximum Break Away Force.

When doing a Fingertip Grip, the weight that can be lifted is defined by:

$$W = \frac{2 * F * C_f}{S_f}$$

Where

- F is the force that is applied to the load by the Gripper. Note that at the fingertips, the maximum force that can be applied is when Fingers B and C force against Finger A. In this case, the force can be up to twice the Maximum Actuation Force, so 40N.
- C_f is the coefficient of friction between the fingertip pads and the load.
- S_f is a safety factor to be determined by the robot integrator.

6.3 Design and customization

Pads and Fingertips for the Robotiq 3-Finger Adaptive Robot Gripper can be customized to fit your gripping application. The following subsection details the design of standard Finger Pads, Palm Pads and Fingertips, information for custom designs are also provided. For a list of available parts to replace the various pads see section 8. Spare Parts, Kits and Accessories.

6.3.1 Finger pad replacement and customization

The Robotiq 3-Finger Adaptive Robot Gripper Finger Pads are a usable part meant for frequent change (after a maximum of 1 Mio. cycles) that can be customized. The Finger Pad S-013 and Finger Pad S-014 are fixed to the Gripper Finger as shown in figure 6.3.1.1. For a list of available parts, see section 8. Spare Parts, Kits and accessories.

To assemble standard or custom Finger Pad :

1. Align the Pad on the correct emplacement, Proximal and Median Pads are of the same width, but not of the same height.
2. Fix each Pad with two (2) 4-40 x 1/4 , Z-200425 Flat Head Machine Screws, use low strength Loctite 222 on the screws.
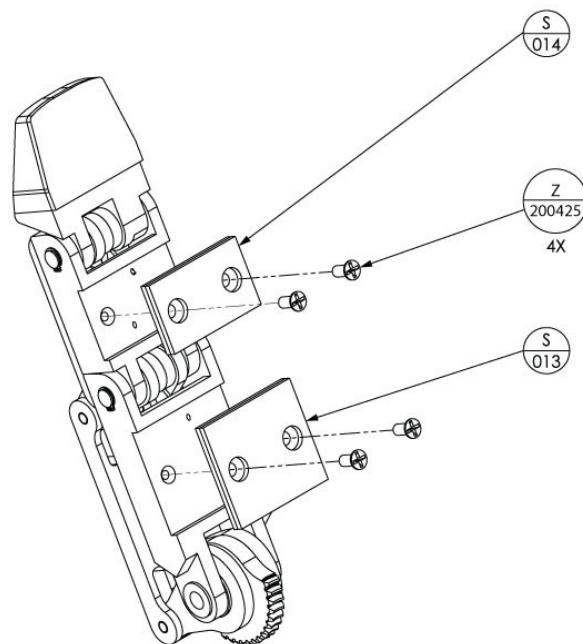
Figure 6.3.1.1 : Assembly of the Median and Proximal Finger Pad (S-013 and S-014) to the Robotiq 3-Finger Adaptive Robot Gripper.

See figure 6.3.1.2 for the Proximal and Median Pads thread pattern for custom design.

> **Note**
>
> Custom pads must be fixed with both available thread patterns, never modify the Fingers without Robotiq's consent first.
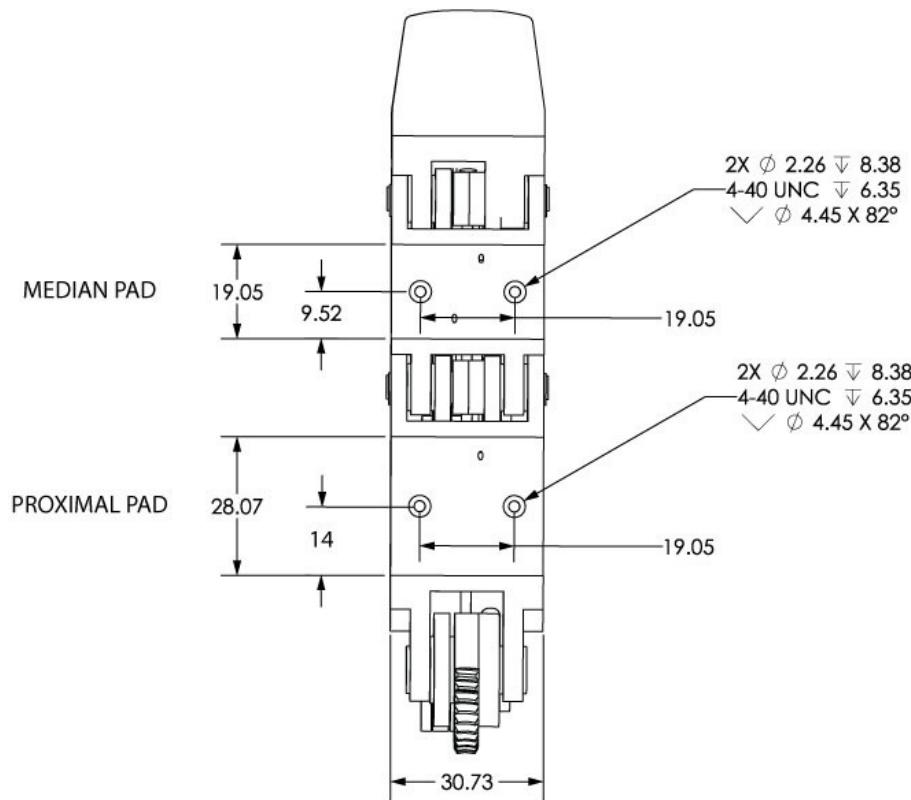

Figure 6.3.1.2 : Bolt pattern of the Proximal and Median Pads of the 3-Finger Adaptive Robot Gripper

6.3.2 Palm pad replacement and customization

The Robotiq 3-Finger Adaptive Robot Gripper Palm Pad is a usable part meant for frequent change (maximum 1 Mio. cycles) that can be customized. The Palm Pad S-071 is fixed to the Gripper as shown in figure 6.3.2.1. For a list of available parts see section 8. Spare Parts, Kits and accessories.

To assemble standard or custom Palm Pad:

1. Align the Palm Pad S-071 with the correct emplacement.
2. Fix the Palm Pad with four (4) 4-40 x 1/4, Z-200425 Flat Head Machine Screws and two (2) 4-40 x 3/8, Z-200431 Flat Head Machine Screws, use low strength *Loctite 222* on the screws.
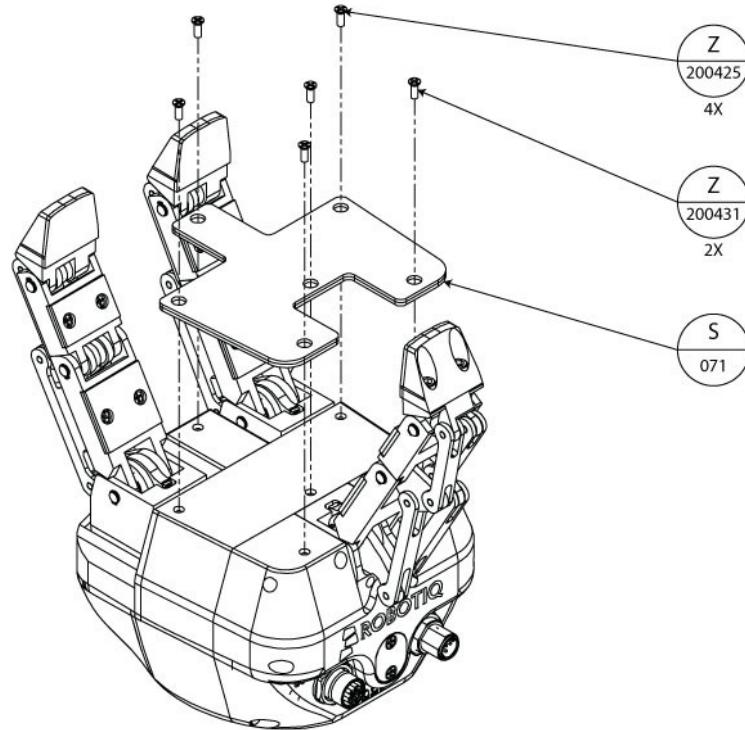
Figure 6.3.2.1 : Assembly of the Palm Pad (S-071) to the Robotiq 3-Finger Adaptive Robot Gripper.

See figure 6.3.2.2 for the Palm Pad thread pattern for custom design.

> **Caution**
>
> Custom pads must be fixed with the illustrated thread pattern, never modify the Gripper without Robotiq's consent first.
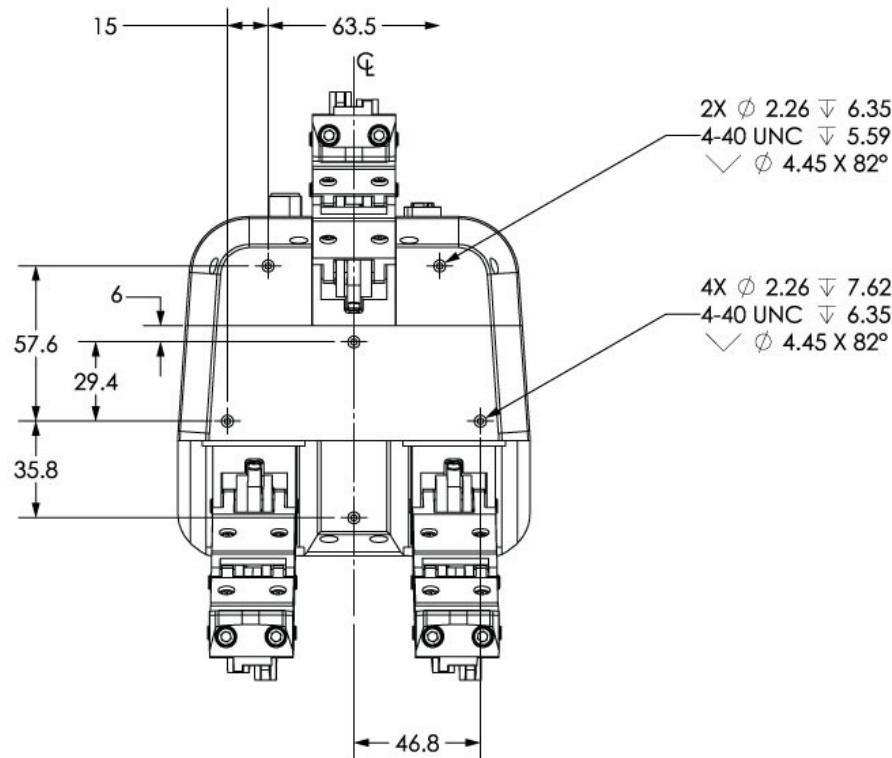
Figure 6.3.2.2 : Bolt pattern of the Palm Pad for the 3-Finger Adaptive Robot Gripper.

6.3.3 Fingertip replacement and customization

The Robotiq 3-Finger Adaptive Robot Gripper Fingertip is a usable part meant for frequent change (maximum 1 Mio. cycles) that can be customized. The Fingertip S-016 is fixed to the Gripper Finger as shown in figure 6.3.3.1. For a list of available parts see section 8. Spare Parts, Kits and accessories.

To assemble standard or custom Fingertip:

1. Align the Fingertip S-016 with the correct emplacement.
2. Fix each Fingertip with two (2) 8-32 x 3/8 socket head cap screw (SHCS Y-812), use medium strength *Loctite248* on the screws.
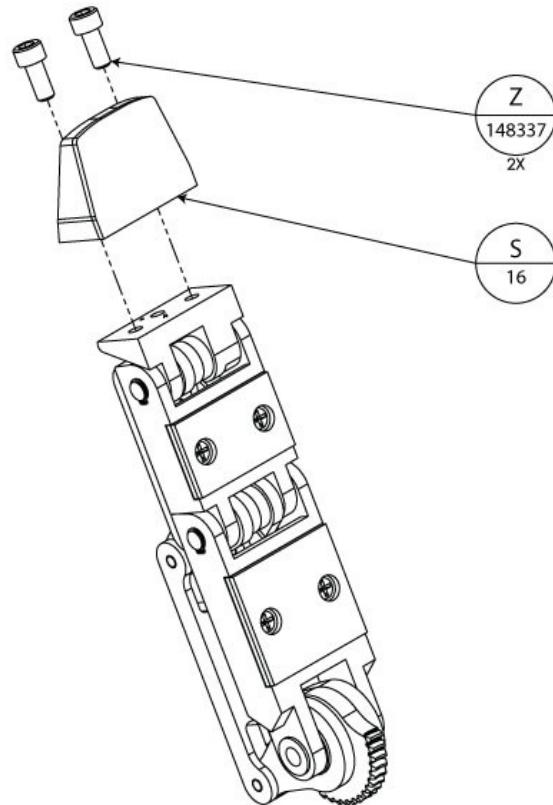
Figure 6.3.3.1 : Assembly of the Fingertip (S-016) to the Robotiq 3-Finger Adaptive Robot Gripper Finger.

See figure 6.3.3.2 for the Fingertip thread pattern for custom design.

> **Caution**
>
> Custom fingertips must be fixed with the thread pattern illustrated (a minimum of two SHCS are required), never modify the Gripper without Robotiq's consent first.
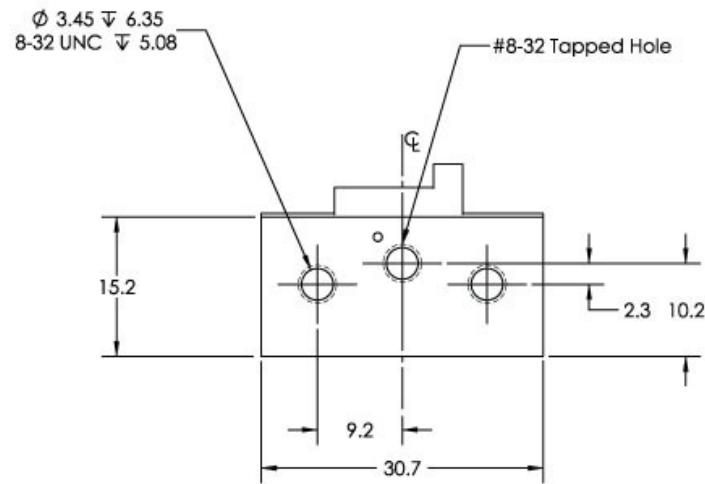

Figure 6.3.3.2 : Bolt pattern of the Fingertip for the 3-Finger Adaptive Robot Gripper Fingers.

6.4 Moment of inertia and center of mass

The coordinate system used for calculating the moment of inertia and center of mass for the 3-Finger Adaptive Gripper is shown in Figure 6.1.1. This represents a configuration where the fingers are fully open in Wide Mode.

> **Info**
>
> All values are approximate. Actual coordinates may vary according to fingertip type and various options present on the Gripper.

Here is the approximate moment of inertia matrix for the 3-Finger Adaptive Gripper:

$$I = \begin{bmatrix} I_{xx} & I_{xy} & I_{zz} \\ I_{yz} & I_y & I_{yz} \\ I_{zx} & I_{zy} & I_{zz} \end{bmatrix} = \begin{bmatrix} 7300 & 0 & -650 \\ 0 & 8800 & 0 \\ -650 & 0 & 7000 \end{bmatrix} kg * mm^2 = \begin{bmatrix} 24.8 & 0 & -2.2 \\ 0 & 29.9 & 0 \\ -2.2 & 0 & 23.8 \end{bmatrix} lb * in^2$$

Here is the approximate position of the center of mass for the 3-Finger Adaptive Gripper:

$$G = \begin{bmatrix} G_x \\ G_y \\ G_z \end{bmatrix} = \begin{bmatrix} -8 \\ 0 \\ 65 \end{bmatrix} mm = \begin{bmatrix} -0.031 \\ 0 \\ 2.560 \end{bmatrix} in$$

6.5 Electrical ratings

SPECIFICATION	VALUE
Operating Supply Voltage	24 V
Absolute Maximum Supply Voltage	28 V
Quiescent Power (minimum power consumption)	4.1 W
Peak Power (at maximum gripping force)	36 W
Maximum RMS Supply Current (supply voltage at 24V)	1.5 A

6.6 Couplings

6.6.1 Blank coupling

The 3-Finger Adaptive Robot Gripper blank coupling can be used to create a custom coupling between the Gripper Universal Wrist and your robot. Provided screw clearance and dowel pin hole are meant for installation on the Universal Wrist. Top face shown in figure 6.6.1.1 is meant to be on the wrist side while bottom face is meant to be on the robot side.
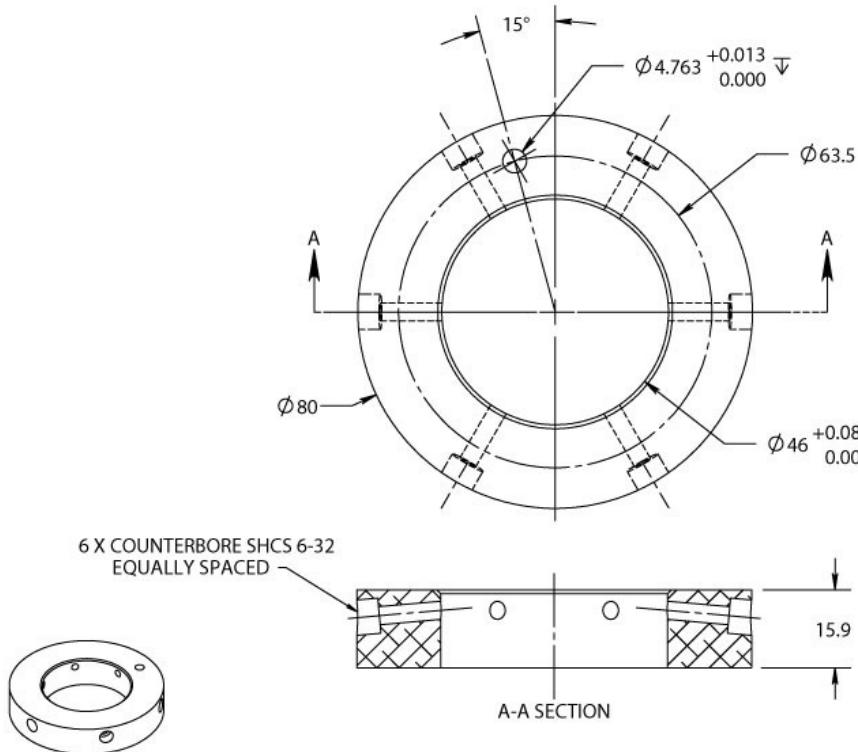

Figure 6.6.1.1 : Blank faceplate for the 3-Finger Gripper.

6.6.2 Yaskawa SDA-5D_10D coupling

The 3-Finger Adaptive Robot Gripper Yaskawa coupling is meant for coupling between the Gripper Universal Wrist and Yaskawa SDA-5D or Yaskawa SDA-10D robots. Provided screw clearance and dowel pin hole are meant for installation on the Universal Wrist. Top face shown in figure 6.6.2.1 is meant to be on the wrist side while bottom face is meant to be on the robot side.
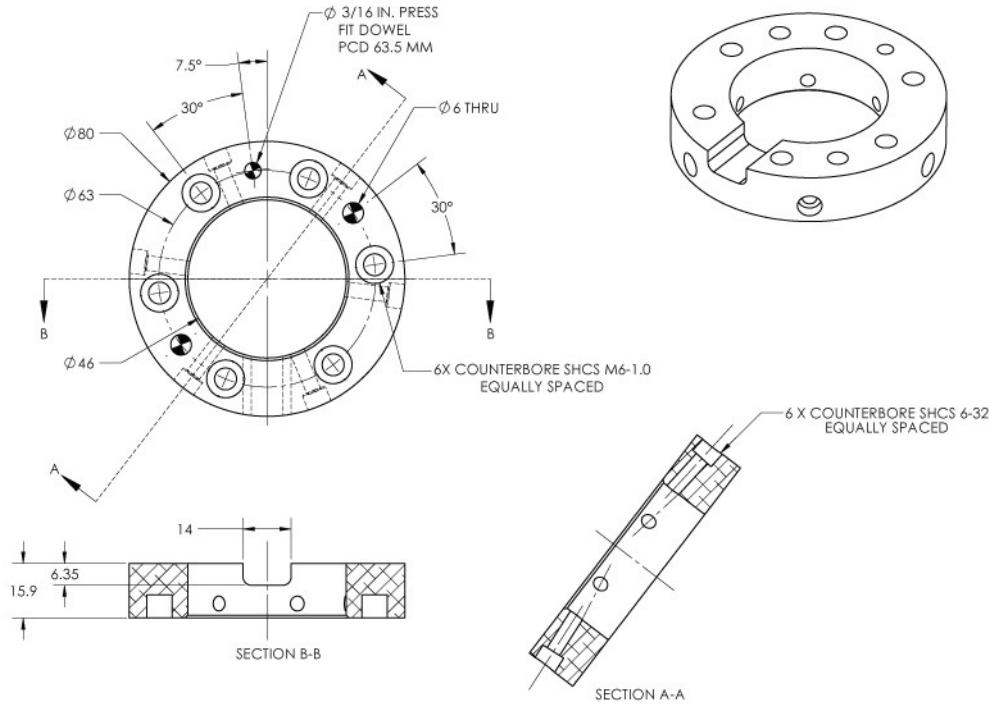

Figure 6.6.2.1 : Yaskawa SDA 5D/10D faceplate for the 3-Finger Gripper.

6.6.3 Dimensions for custom coupling

Figure 6.6.3.1 shown below describes the standard wrist present on all 3-Finger Adaptive Robot Grippers. Your custom coupling must be designed for fixation on the provided wrist.
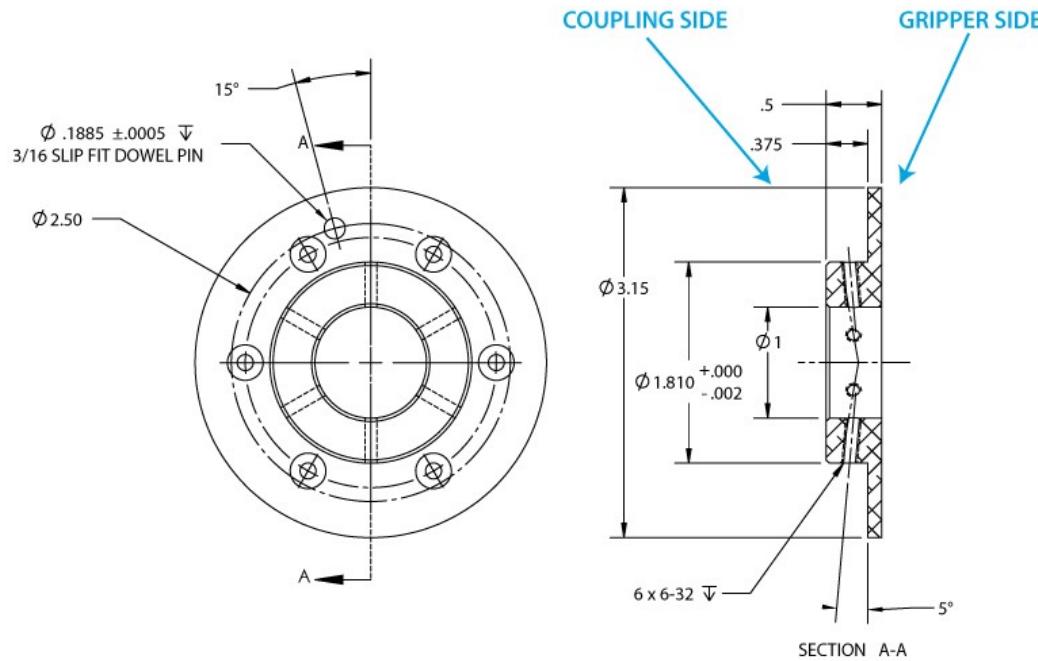

Figure 6.6.3.1 : 3-Finger Adaptive Robot Gripper dimensions for custom coupling.

Info

The Gripper must be secured with all six (6) of the # 6-32 UNC screws. Use the 3/16 Dowel pin for indexing, pin must be press fit in the custom coupling, it is slip fit on the Gripper Universal Wrist side.

7. Maintenance

The Adaptive Gripper requires only external maintenance with limited downtime. Maintenance of the 3-Finger Adaptive Robot Gripper is required after specified usage, measured in time (normal 40h week) or in cycles (requesting an open and close 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 maintenance operations.

Warning

Unless specified, any repairs done on the Gripper or its controller will be done by Robotiq.

Operation	Daily	Weekly	Monthly	Semiannually (or 1 M cycles)	Annually (or 2 M cycles)
Gripper Cleaning	Dirty conditions	Normal conditions			
Applying Grease		Dirty conditions	Normal conditions		
Periodic Inspection			X		
Finger Pad Replacement[1]				X	
Gripper Palm Replacement[1]				X	
Fingertipe Replacement[1]				X	
Gear Replacement					X
Overhaul[2]					X

[1]Replace pads before if wear is visible.

[2]Overhaul is done by Robotiq, please contact Robotiq Support.

Maintenance operations are for 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.)
- Contact resulting from 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	• 2.0 mm flat head precision screwdriver • Dry tissue or towel	None

Info

The Robotiq 3-Finger Adaptive Robot Gripper is not waterproof, clean the Gripper with a dry towel.

Caution

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

Procedure

1. Insert the 2.0 mm precision screwdriver into the hole under the finger to open.
2. Rotate the screwdriver counter clockwise to open the finger.
3. Clean the Gripper with a dry towel, remove all debris, dirt and dust from the surface of the Gripper.
4. Visually inspect the Gripper and pay attention to any visible wear or damage.
5. Check Gripper Coupling to ensure a tight fit.

7.2 Applying Grease

Maintenance interval	Tools you need	Parts you need
Monthly or weekly in dirty operating conditions	• 2.0 mm flat head precision screwdriver • Dry tissue or towel	None

Warning

Only apply grease on the gearing at the base of each finger, the finger medial and distal axes must never be greased.

Note

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

1. Fully close the Robotiq Adaptive Gripper finger manually (see Manual Opening of Fingers for details) or by using the Robotiq User Interface (see the User Interface section for details).
2. When the finger is closed the finger base cogs are visible, clean excess grease with a dry tissue or towel, then apply grease between the gear cogs (use the Mobilith SHC grease syringe provided by Robotiq).
3. Completely open the finger and then completely close the finger, this will allow the grease to spread.
4. Repeat opening and closing of the finger until the grease is spread evenly on the gearing, remove any excess grease. Excess grease may appear on the sides of the cogs.
5. Repeat operations 1 through 4 for every finger of the Adaptive Gripper.

7.3 Periodic Inspection

Maintenance interval	Tools you need	Parts you need
Monthly	• 2.0 mm flat head precision screwdriver • Dry tissue or towel	None (unless damage is detected)

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

Procedure

1. Remove the Gripper from the robot following schematics in section 3.3 Mechanical connections.
2. Clean the Gripper following instructions in 7.1 Gripper cleaning.
3. Inspect the Gripper :
    a. Finger movement must be symmetric and fluid:
        i. Test the return movement by pushing open the fingers, the fingers must come back to their initial position on their own.
        ii. Test the general movement of the fingers by actuation via the screwdriver insertion hole in the chassis.
    b. Finger pad wear must not affect gripping, if wear is visible and affects movement, change finger pad(s). See section 7.4 Finger Pad Replacement.
    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 Gripper performance, contact Robotiq Support.
4. Put the Gripper back in place, make sure to maintain the initial orientation of your Gripper.

7.4 Finger Pad Replacement

Maintenance interval	Tools you need	Parts you need
1 M cycles or when wear is visible	• 2.0mm precision flat head screwdriver. • Dry tissue or towel. • Philips screwdriver.	(To change pads on all 3 fingers) • Three (3) Robotiq 3-Finger Adaptive Robot Gripper Finger Median Pads. • Three (3) Robotiq 3-Finger Adaptive Robot Gripper Finger Proximal Pads. • Twelve (12) 4-40 X 1/4 Flat Head Machine Screws (Philips, zinc coated).

See Spare Parts, Kits and Accessories section to order Robotiq 3-Finger Adaptive Robot Gripper replacement parts.

> **Note**
>
> Always turn off robot and Gripper power supply before performing maintenance operations on the Gripper.

Procedure

1. Remove the Gripper from the robot following schematics in section 3.3 Mechanical connections.
2. Clean the Gripper following instructions in 7.1 Gripper cleaning.
3. Remove the Finger Pads as described in section 6.3.1 Finger Pad.
4. Clean the fingers of any debris or residue.
5. Fix the new Finger Pads (custom or standard) as instructed in section 6.3.1 Finger Pad.

7.5 Gripper Palm Replacement

Maintenance interval	Tools you need	Parts you need
1 M cycles or when wear is visible	• 2.0mm precision flat head screwdriver. • Dry tissue or towel. • Philips screwdriver.	• Palm pad S-071 (from Robotiq). • Six (6) 4-40 X 1/4 Flat Head Machine Screws (Philips, zinc coated). • Low strength thread-locker (*Loctite 220*)

See Spare Parts, Kits and Accessories section to order Robotiq 3-Finger Adaptive Robot Gripper replacement parts.

> **Note**
>
> Always turn off robot and Gripper power supply before performing maintenance operations on the Gripper.

Procedure

1. Remove the Gripper from the robot following schematics in section 3.3 Mechanical connections.
2. Clean the Gripper following instructions in 7.1 Gripper cleaning.
3. Remove the Palm Pad as described in section 6.3.2 Palm Pad.
4. Clean the Palm, especially the space under the Palm Pad of any debris or residue.
5. Fix the new Palm Pad (custom or standard) as illustrated in section 6.3.2 Palm Pad. Use low strength Loctite 222 on the screws.

ROBOTIQ

7.6 Fingertip Replacement

Maintenance interval	Tools you need	Parts you need
1 M cycles or when wear is visible	• 2.0mm precision flat head screwdriver. • Dry tissue or towel. • 9/64 hex (Allen) key.	• Finger tip S-016 (from Robotiq). • Two (2) 8-32 X 3/8 Socket Head Cap Screws. • Medium strength thread-locker (*Loctite 248*).

See Spare Parts, Kits and Accessories section to order Robotiq 3-Finger Adaptive Robot Gripper replacement parts.

> **Caution**
>
> Always turn off robot and Gripper power supply before performing maintenance operations on the Gripper.

Procedure

1. Remove the Gripper from the robot following schematics in section 3.3 Mechanical connections.
2. Clean the Gripper following instructions in 7.1 Gripper cleaning.
3. Remove the Fingertip as described in section 6.3.3 Fingertip.
4. Clean the finger, including the space under the Fingertip of any debris or residue.
5. Fix the new Fingertip (custom or standard) as illustrated in section 6.3.3 Fingertip. Use medium strength *Loctite 248* on the screws.

7.7 Gear replacement

Maintenance interval	Tools you need	Parts you need
2 M cycles or 1 year	• 2.0mm precision flat head screwdriver • Dry tissue or towel • Retaining ring (snap ring) pliers • Philips screwdriver	• Replacement gear kit provided by Robotiq (one kit for each Finger Gear to be replaced) • Heavy strength thread-locker (*Loctite 263*)

See Spare Parts, Kits and Accessories section to order Robotiq 3-Finger Adaptive Robot Gripper replacement parts.

> **Note**
>
> Always turn off robot and Gripper power supply before performing maintenance operations on the Gripper.

> **Warning**
>
> Always wear protective glasses when doing maintenance work on the 3-Finger Adaptive Robot Gripper, especially when manipulating snap rings.

Procedure

1. Remove the Gripper from the robot following schematics in section 3.3 Mechanical connections.
2. Clean the Gripper following instructions in 7.1 Gripper cleaning.
3. Remove the Fingers B and C by :
    a. Removing the snap rings at the base of the fingers using the snap ring pliers.
    b. Gently pull the finger base axis, beware the finger will come off.
4. Remove Finger A by :
    a. Removing the two (2) Palm Pad screws on each side of Finger A.
    b. Then remove the proximal axis by holding Finger A and inserting a screwdriver or Allen key in the hole on either side of the Finger A, beware the finger will come off.
5. On each Finger requiring replacement, remove the gear by unscrewing the three (3) 4-40 screws (note the gear orientation), discard the 4-40 screws and gear.
6. Place the new gear in the previous position with exact orientation.
7. Screw in the new gear using the new 4-40 screws, applying heavy strength *Loctite 263*.

7.8 Overhaul

Maintenance interval	Tools you need	Parts you need
2 M cycles, 1 year or at warranty expiration	• None	• None

Gripper overhaul is necessary when the Gripper reaches 2 M cycles or at warranty expiration. Overhaul is done by Robotiq, please contact Robotiq Support Service.

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.

Item	Description	Ordering Number
Standard Gripper	3-Finger Adaptive Robot Gripper with black silicone finger pads, right angle 5m communication cable, right angle 5 m power cable, USB configuration cable. Replace XXXX by one of the following communication protocol options : • **ENIP** - EtherNet IP • **MTCP** - Modbus TCP/IP • **ECAT** - EtherCAT • **DNET** - Device Net • **CANO** - CANopen[1] • **M232** - Modbus RTU over 232 • **M485** - Modbus RTU over 485 • **PNET** - PROFINET	AGS-001-XXXX
Blank Coupling	Blank Coupling to fix on 3-Finger Adaptive Gripper Universal Wrist	AGS-CPL-S175
Motoman Coupling	Coupling for use between 3-Finger Adaptive Gripper Universal Wrist and Motoman SDA5D / SIA5D robots	AGS-CPL-S101
Schunk Coupling	Coupling for use between 3-Finger Adaptive Gripper Universal Wrist and Schunk FWA Tool Changer	AGS-CPL-S102
ATI Coupling	Coupling for use between 3-Finger Adaptive Gripper Universal Wrist and ATI QC-21 Tool Changer	AGS-CPL-S103
New	Design of your custom coupling if not listed	AGS-CPL-NEW
S-151	Adapter plate for 31.5 mm PCD[1], four (4) M5 screws, one (1) 5 mm M6 dowel pin. Meant for use on S-101 Coupling.	AGS-APL-151
S-152	Adapter plate for 56 mm PCD[1], eight (8) M5 screws, one (1) 4 mm M6 dowel pin. Meant for use on S-101 Coupling.	AGS-APL-152
S-153	Adapter plate for 40 mm PCD[1], five (5) M6 screws, one (1) 6 mm M6 dowel pin. Meant for use on S-101 Coupling.	AGS-APL-153
S-155	Adapter plate for 40 mm PCD[1], four (4) M6 screws, one (1) 6 mm M6 dowel pin. Meant for use on S-101 Coupling.	AGS-APL-155
S-156	Adapter plate for 80 mm PCD[1], six (6) M8 screws, two (2) 8 mm M6 dowel pin. Meant for use on S-101 Coupling.	AGS-APL-156

---

[1]CANopen is a registered trademark of CiA.

Item	Description	Ordering Number
S-157	Adapter plate for 50 mm PCD[1], seven (7) M6 screws, one (1) 6 mm M6 dowel pin. Meant for use on S-101 Coupling.	AGS-APL-157
S-158	Adapter plate for 50 mm PCD[1], four (4) M6 screws. Meant for use on S-101 Coupling.	AGS-APL-158
S-159	Adapter plate for 100 mm PCD[1], ten (10) M8 screws, two (2) 8 mm M6 dowel pin. Meant for use on S-101 Coupling.	AGS-APL-159
S-160	Adapter plate for 55 mm PCD[1], four (4) M4 screws, two (2) 6 mm M6 dowel pin. Meant for use on S-101 Coupling.	AGS-APL-160
S-161	Adapter plate for four (4) M6 screws on 63 mm PCD[1], two (2) 6 mm M6 dowel pin on 61.4 mm PCD[1]. Meant for use on S-101 Coupling.	AGS-APL-161
S-163	Adapter plate for seven (7) M5 screws on 31.5 mm PCD[1], one (1) 5 mm M6 dowel pin. Meant for use on S-101 Coupling.	AGS-APL-163
S-164	Adapter plate for eight (8) M5 screws on 31.33 mm PCD[1], one (1) 5 mm M6 dowel pin.	AGS-APL-164
S-165	Adapter plate for three (3) M3 screws on 33 mm PCD[1], two (2) 3 mm M6 dowel pin.	AGS-APL-165
S-166	Adapter plate for six (6) M5 screws on 39 mm PCD[1], two (2) 4 mm slip fit dowel holes.	AGS-APL-166
S-167	Adapter plate for six (6) M5 screws on 35 mm square pattern, one 20 mm passing hole (center).	AGS-APL-167
New	Design of your new custom adapter plate.	AGS-APL-NEW
Power & serial cable	5 m power cable for 3-Finger Adaptive Robot Gripper, right angle, M12 5-pins female, single ended. Also used for serial communication via RS232 or RS485.	CBL-PWR-2054
DeviceNet cable	5m Fieldbus cable for 3-Finger Adaptive Robot Gripper, right angle, M12 5-pins female, 5-pins Combicon. Meant for use with DeviceNet.	CBL-COM-2056-CB5
CANopen cable	5m Fieldbus cable for 3-Finger Adaptive Robot Gripper, right angle, M12 5-pins female, Female DB9. Meant for use with CANopen.	CBL-COM-2056-DB9
Ethernet cable	5 m Real-Time Ethernet communication cable for 3-Finger Adaptive Robot Gripper, right angle, M12 4-pins male RJ45. Meant for use with EtherNet/IP, EtherCAT, Modbus TCP and PROFINET.	CBL-COM-2055
USB cable	5 m USB 2.0 cable, USB A - A male. Meant for configuration of the 3-Finger Adaptive Robot Gripper communication parameters and control via the Robotiq User Interface.	CBL-USB-2057
Finger Pads	includes :	AGS-PAD-S013/14

Item	Description	Ordering Number
	• one (1) Proximal Pad S-013, 6061 aluminium body with black silicone cover. • one (1) Median Pad S-014, 6061 aluminium body with black silicone cover. • four (4) 4-40 X 1/4 Flat Head Machine Screws (Philips, zinc coated)	
Palm Pad	includes : • one (1) Palm Pad S-071, 6061 aluminium body with black silicone cover. • six (6) 4-40 X 1/4 Flat Head Machine Screws (Philips, zinc coated)	AGS-PAD-S071
Finger Tip	includes : • one (1) Finger Tip S-016, 6061 aluminium body with black silicone cover. • two (2) 8-32 X 3/8 Socket Head Cap Screws	AGS-PAD-S016
Finger	includes : • one (1) replacement Finger for the 3-Finger Adaptive Robot Gripper, pads and gear included.	AGS-FIN-S/A09
Rotating Finger Tip[2]	includes : • one (1) distal pivot • three (3) bushings • one (1) spring casing • one (1) torsion spring • two (2) 3/16" x 3/4" Socket Head Cap Screws	AGS-FIN-002
Gear	includes : • one (1) replacement bronze worm gear S-200. • one (1) worm bushing Y-413. • three (3) 4-40 x 5/16 Flat Head Machine Screws Y-902. • two (2) snap rings Y-942 • grease syringe.	AGS-GEAR-001
Grease syringe	includes : • 1g high viscosity grease syringe for worm gears of the 3-Finger Adaptive Gripper	ACC-LUB-SHC1500

[1]Pitch Circle Diameter

[2]One 3-Finger Gripper requires two (2) rotating fingertips to work properly.

9. Troubleshooting

If your Gripper is not working, check the following:

1. **Check the blue LED on the Gripper**:
   a. It's ON: Check communication (step 2)
   b. It's OFF: Gripper not supplied, check power supply cable integrity and check power supply (see specification in section 3.3),

2. **Check the green LED on the Gripper**:
   a. It's OFF: No network detected, check communication cables and network infrastructure (see specific protocol in section 3.4.2 and step 4 below).
   b. It's BLINKING: Network detected, no communication established, go to step 4.

   > EtherNet family protocol must be connected via RJ45 while CanOpen[1] and DeviceNet must be connected via their own connectors.

   c. It's ON : Network detected and communication is established, go to step 3.

3. **Check the red LED on the Gripper**:
   a. It's OFF : No fault, go to step 5.
   b. It's BLINKING : Major fault occurred, reset (activate) the Gripper (see section 5.4.1).
   c. It's ON : Automatic release or booting in process, wait until it's off, if blinking, reset is needed.

4. **Communication & Networking issues**:
   a. Only use one connection at a time, either USB or the industrial protocol.
   b. Ethernet family : Use the proper Ethernet options, Modbus TCP/IP and EtherNet IP require fixed IP, EtherCAT requires DHCP.
   c. DeviceNet: Requires a separate power supply (see DeviceNet section).

   > Master communication device must use the same protocol and the same option settings as the controller for the Gripper.

   d. After reprogramming communication options, wait until the red LED stops blinking to update the configuration.

5. **Other problems**:
   a. If the system shuts down (blue LED goes off) when the Gripper activates, check the power supply, the power supply must meet the following requirements.
   b. When attempting to move the Gripper, make sure "go to requested position" (rGTO) is active (set to 1), in the User Interface, the Go to Requested Position case must stay checked for the Gripper to move.

---

[1]CANopen is a registered trademark of CiA.

Possible troubleshooting issues:

1. Grippers shut down or does not power up.
2. Gripper does not move under User Interface.
3. Cannot establish connection (Ethernet family).
4. Cannot establish connection (CAN bus family).
5. Finger movement is erratic.
6. Gripping force changed.

Q: Grippers shut down when working or does not power up when connected.

A: Check the power supply specification in section 3.3. Your power supply must meet the minimum requirements (36 W at 24 V) and the maximum operational voltage must not exceed 26 V.

Q: Gripper is not responding to commands (move) in the User Interface.

A: Make sure your Gripper is activated and that the Activate button is selected before sending move request, when sending position request make sure the Go To Requested Position button is selected. For details please consult the User Interface section.

Q: Cannot establish connection under EtherNet / IP or Modbus TCP/IP.

A: Default settings for EtherNet / IP and Modbus TCP/IP use fixed addresses, you must:

1. Check Gripper address using the Robotiq User Interface via USB. Communication protocol panel will show current address, default IP address for Robotiq Grippers are IP 192.168.1.11 with Gateway 255.255.255.0.
2. Use the same protocol options (fixed IP, auto-neg, full duplex, etc.) as shown in the Communication protocol panel. Set your Ethernet network card to use fixed addresses other than the Gripper address.
3. Set your master Ethernet network card to use fixed addresses other than the Gripper address (for example use 192.168.1.10 if Gripper address is 192.168.1.11).

Q: Cannot establish connection under DeviceNet or CANopen.

A: Both protocols will use the CAN bus, but make sure that DeviceNet is supplied with the adequate 24v supply as specified in DeviceNet communication protocol. Both protocols will use default address node 11. CANopen default baud rate is set to 1 Mbaud while DeviceNet is set to 250 kBaud.

Q: Finger movement is erratic or not fluid.

A: Finger movement can be altered by debris, clean the Gripper and make sure no debris or fluid is present betweenthe finger phalanx and bar (repeat for each finger).

Q: Gripping force changed since first usage.

A: Make sure the finger pads are clean of any lubricant and are in good condition. Note that gripping force varies with the grip type, encompassing grip will always be stronger than fingertip grip.

10. Warranty

Robotiq warrants the 3-Finger Adaptive Robot Gripper against defects in material and workmanship for a period of one year from the date of reception when utilized as intended with the specified maintenance. Robotiq also warrants that this equipment will meet applicable specifications under normal use.

> **Caution**
>
> - Usage respects the operating and storage conditions specified in section 3.2
> - Usage under normal one-shift operation (40h a week)
> - Usage respect maintenance specified in section 7.

During the warranty period, Robotiq will repair or replace any defective product, as well as verify and adjust the product 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 can't be switched among Operation Modes;
- 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 product, nor shall be responsible for any failure in the performance of other items to which the product is connected or the operation of any system of which the product may be a part.

Exclusion

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

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 product or other factors beyond Robotiq's control. It also excludes all consumable parts, such as fingertips and their normal wear.

11. Contact

www.robotiq.com

Contact Us

Phone

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

Technical support and Engineering

extension 207

Sales

extension 122

Head office

Robotiq:
966, chemin Olivier
Suite 325
St-Nicolas, Québec
G7A 2N1
Canada

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

dof.robotiq.com

EC Declaration of Conformity

Déclaration de conformité – Declaration of conformity

Nous,
we,

Robotiq inc.
966, Chemin Olivier, suite 325
St-Nicolas, Québec, Canada, G7A 1N1
(fournisseur, supplier)

déclarons sous notre seule responsabilité, que les produits:
declare under our sole responsibility that the products:

Main Robotiq à 3 doigts (Pince S, RAG, S)
3-Finger Adaptive Robot Gripper (Gripper S, RAG, S)

Main Robotiq à 2 doigts - 85 (Pince C, C)
2-Finger Adaptive Robot Gripper - 85 (Gripper C, C)

auxquels se réfère cette déclaration satisfont aux dispositions de la Directive du Conseil
to which this declaration relates satisfy the provisions of Directives

2006/42/CE	2006	Directive européenne relative aux machines

et sont conformes aux normes ou autres documents normatifs:
and are in conformity with the following standards or other normative documents:

NF EN ISO 14539	2000	Robots manipulateurs industriels Manipulation des objets par préhenseurs à pince Vocabulaire et présentation des caractéristiques
NF EN ISO 12100	2012	Sécurité des machines Principes généraux de conception Appréciation du risque et réduction du risque

Cette quasi-machine ne doit pas être mise en service avant que la machine finale dans laquelle elle doit être incorporée ait été déclarée conforme aux dispositions pertinentes de la Directive 2006/42/CE.
This partly completed machinery must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of the Directive 2006/42/EC.

St-Nicolas, le 15 décembre 2012
(lieu et date d'émission / place and date of issue)

Jean-Philippe Jobin
Vice-Président aux opérations
Robotiq inc.

Robotiq inc. © 2012   Déclaration de conformité – Declaration of conformity   Page 1/1
Version 2012-12-15