Robotiq Adaptive Gripper, S Model Instruction Manual

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Revisions

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

Revision 111031
Sections added: User Interface and MODBUS TCP communication protocol

Revision 110515
Manual release

1. General Presentation

The Robotiq Adaptive 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.

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 objects (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.

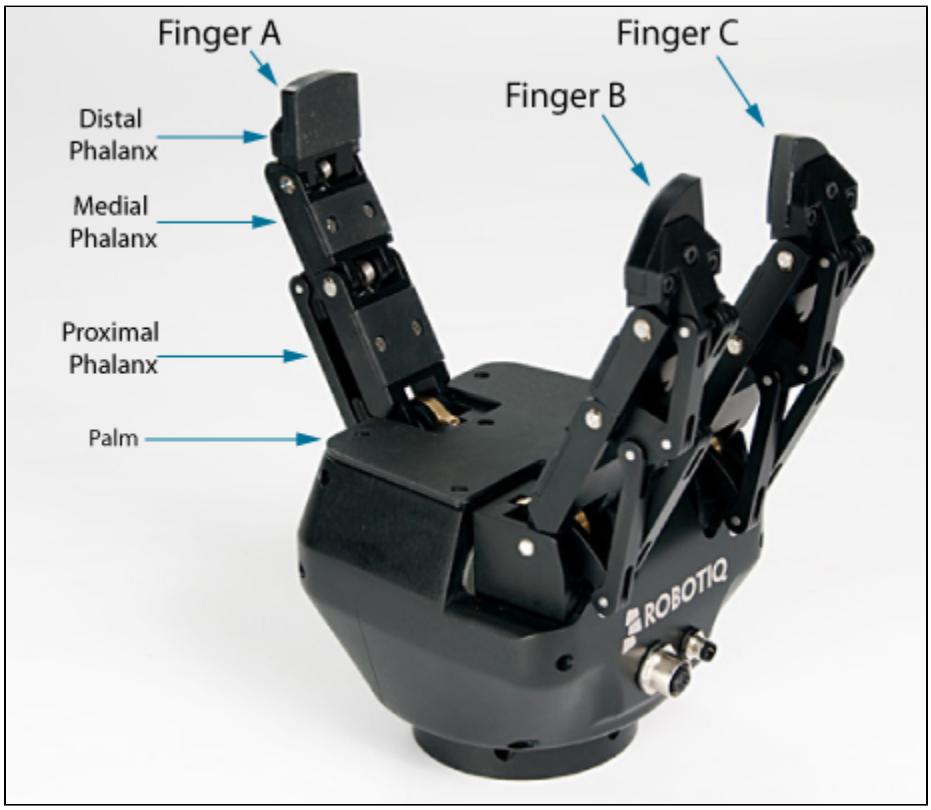


Figure 1.1 – The Adaptive Gripper.

Two different types of movements can be performed with the gripper. The first one simultaneously changes the orientation of fingers B and C as shown in Figure 1.2. That movement is referred to as changing Operation Modes. The Operation Mode is determined by the user prior to the grip in function of the size or the shape of the object and for the task that has to be done.

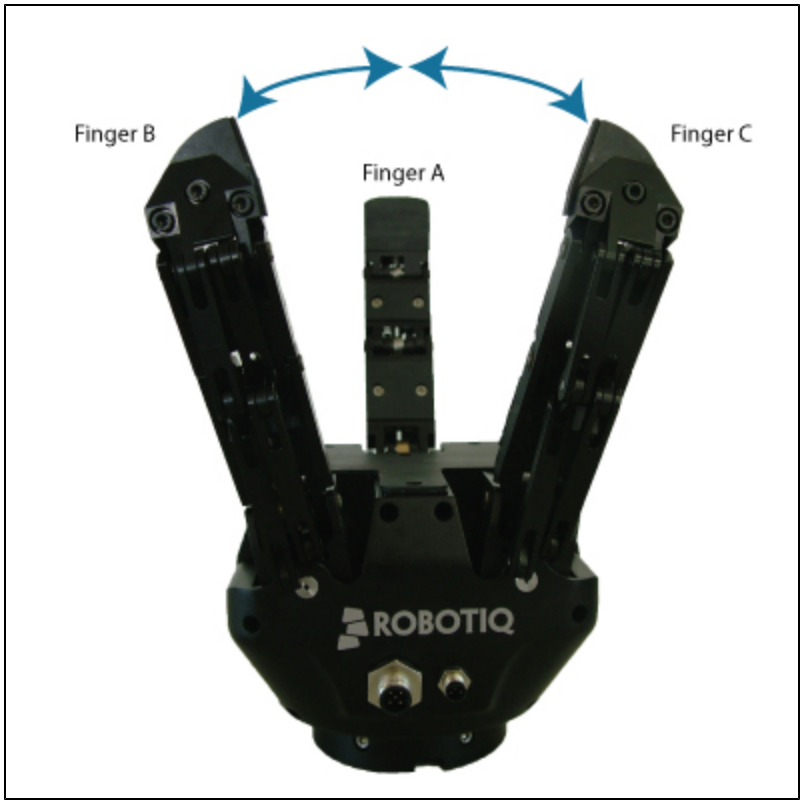


Figure 1.2 – First type of movement of the Adaptive Gripper: changing the Operation Mode

1. The ***basic mode*** is the most versatile Operation Mode. It is best suited for objects that have one dimension longer than the two others but 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 not very powerful 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 Adaptive 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 a 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.

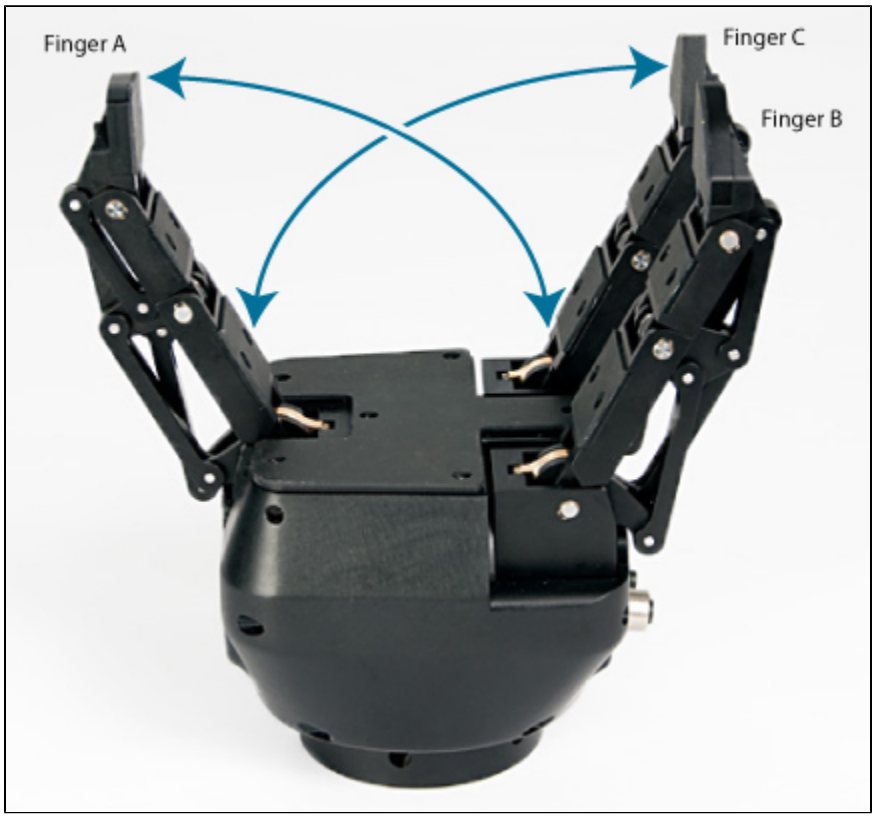


Figure 1.4 – Second movement of the Adaptive Gripper: closing and opening the fingers.

Two types of grips occur when closing the Adaptive 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 mainly related to 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.

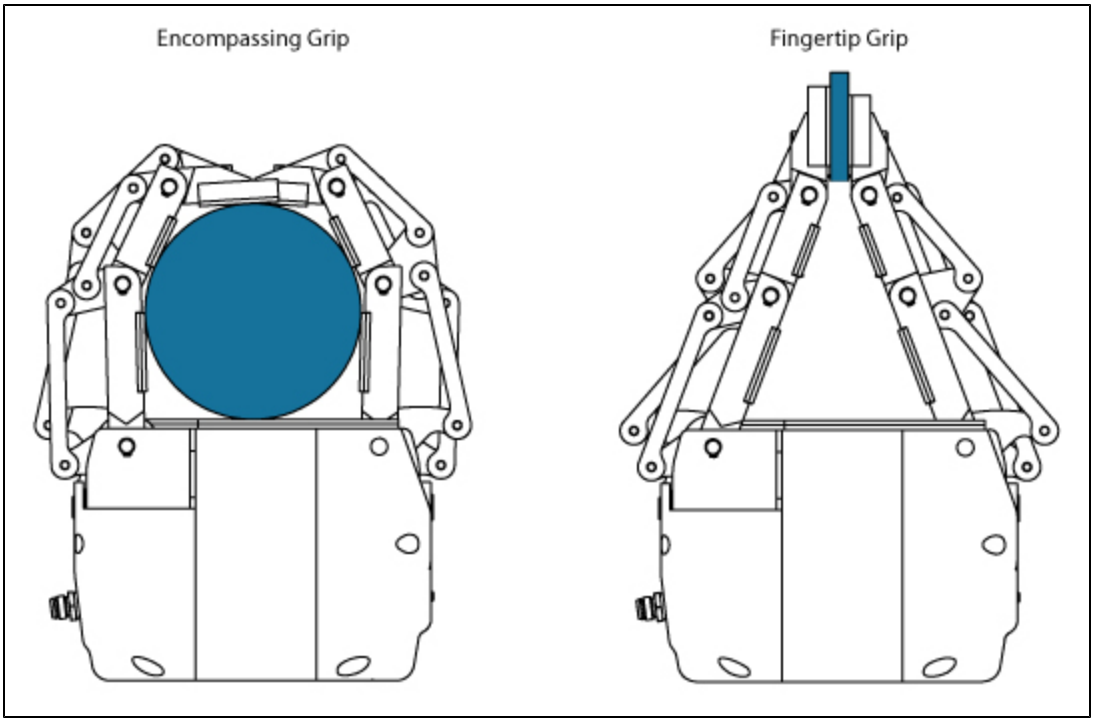


Figure 1.5 – The Two Types of Grip: Encompassing and Fingertip Grips.

It is important to note that a Fingertip 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 medial phalanxes first. Also, to ensure stability, the object should be held against the gripper palm before doing an Encompassing Grip.

Note that the Encompassing Grip cannot occur in all Operation Modes. Thereby, in Pinch and Scissor modes, it is only possible to do Fingertip Gripping. On the other side, 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.

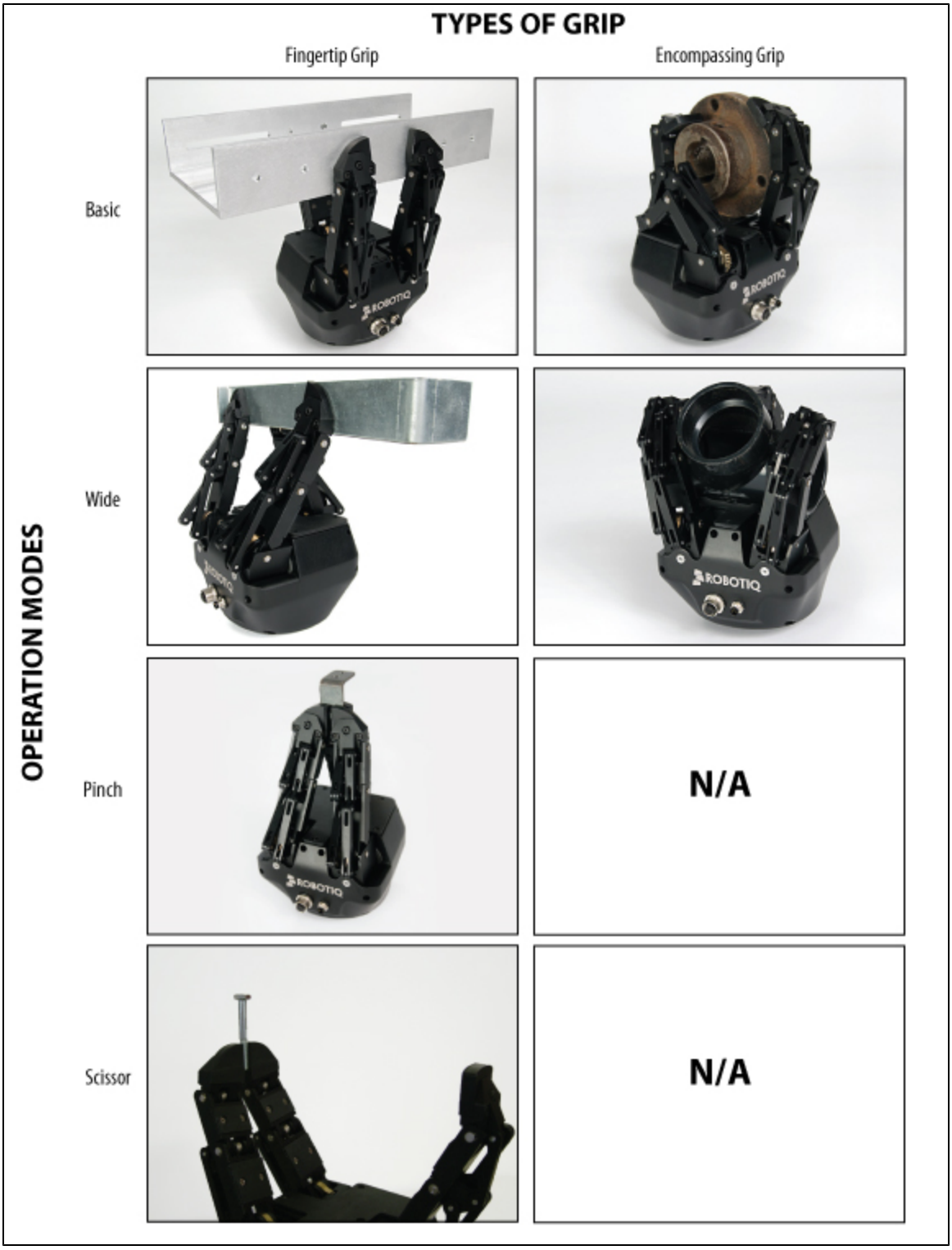


Figure 1.6 – Operation Modes vs. Types of Grip.

2. Safety

Warning
Read this section carefully before installation, operation, maintenance or inspection of the Robotiq Adaptive Gripper.

This documentation explains the various components of the Adaptive Gripper and general operation. Read this documentation and be sure to understand its contents before handling the Adaptive Gripper.

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

2.1 Warning

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.
  Any usage of the gripper beyond these definitions is inappropriate and may cause injury or damage.

2.2 Intended use

The gripper unit is designed for gripping and temporary secure holding of parts.

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

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 improper use.

3. Installation

Warning
Be sure to read and understand the safety instructions related to the Adaptive Griper 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 Environmental and operating conditions

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

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

3.2 Mechanical connections

You must use a faceplate to attach the gripper to the robot. Be sure to use the faceplate related to your robot model. If there is no faceplate for your robot, you can modify a blank faceplate model or Robotiq can create a custom version for you. (Please refer to the Faceplate Specification Section for details on different faceplate models)

Here are the steps to follow for the installation of the gripper (see Figure 3.1). Note that all screws must be locked in place (Loctite 248).

1. Screw the faceplate to your robot arm (if your cables are running through the robot, be sure to use a faceplate with a groove).
2. Insert the gripper in the faceplate and align the indexing dowel pin with the associated hole.
3. Secure the gripper with the radial screws.

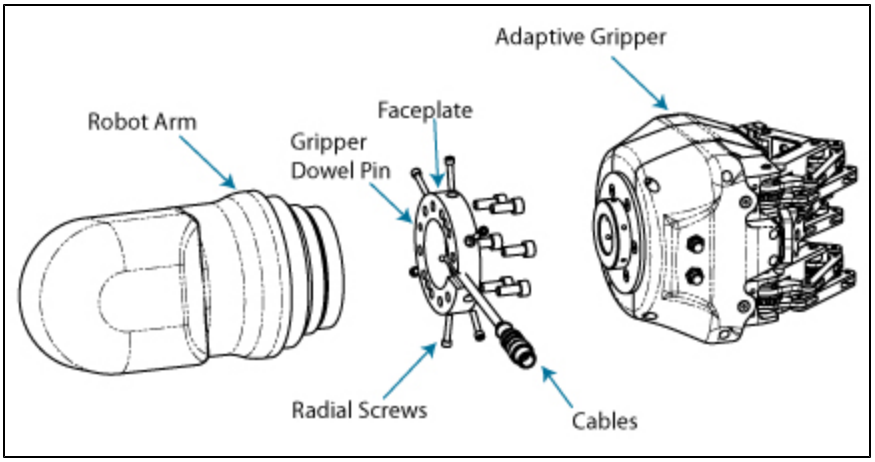


Figure 3.1 – Attaching the Adaptive Gripper to a robot arm with the Faceplate.

3.3 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.

Output voltage	24 V DC
Output current	2 A
Ripple	2-3 % peak-peak
Output regulation	2% maximum
Overcurrent	4 A fuse at 77°F [25°C]
Maximum fuse I^2t factor	100 A^2s at 77°F [25°C]
Overvoltage protection	Not required[1]

1 The gripper has built-in overvoltage protection.

3.4 Wiring

Two connections are needed for the Adaptive Gripper, one for the power and one for the communication. On the gripper, both are located on the Connection Panel shown in Figure 3.2.

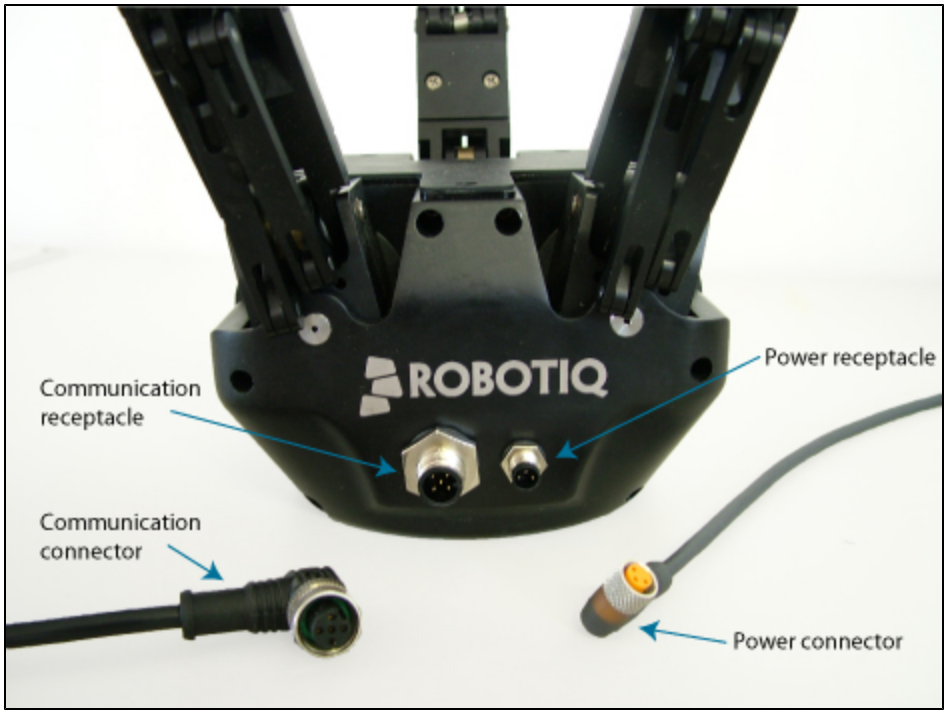


Figure 3.2 – Power and Communication receptacles and connectors.

Warning
Use proper cabling management. Be sure to have enough forgiveness in the cabling to allow movement of the gripper along all axes without pulling out the connectors.

3.4.1 Power connection

Here is the way the gripper should be connected to a power source (Figure 3.3).

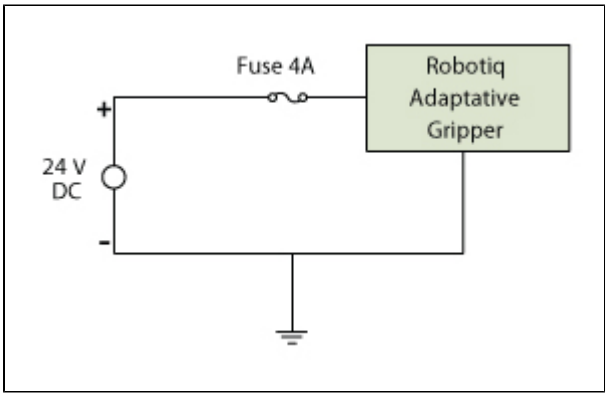
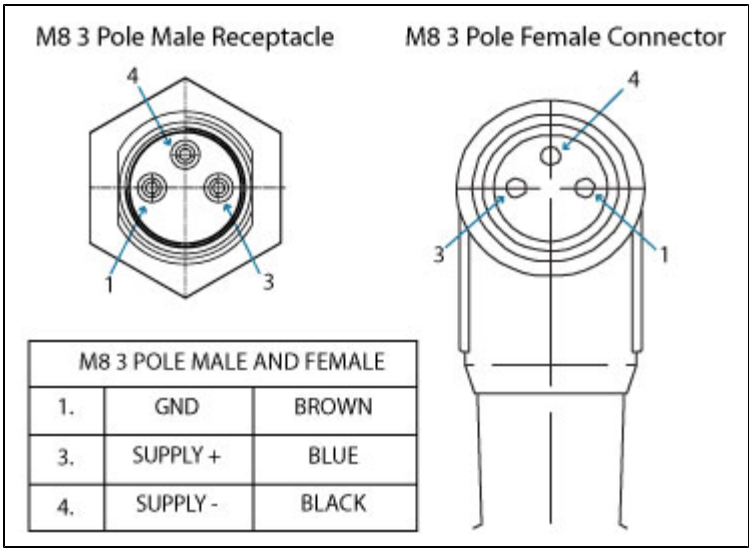


Figure 3.3 – Power connection diagram of the Adaptive Gripper.

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 3.4.



M8 3 POLE MALE AND FEMALE		
1.	GND	BROWN
3.	SUPPLY +	BLUE
4.	SUPPLY -	BLACK

Figure 3.4 – Gripper Power Inlet and Power Connector.

The gripper should be supplied with cables that have the following specifications:

- #22 AWG TEW, 300 V or 600 V.
- 3 Conductors, 2 for the supply and one for the protective ground.
- Shielding, depending on the application. Shield must be grounded in robot controller.

3.4.2 Communication connection

The following table summarizes the communication protocols available for the gripper. Note that only one protocol option is available in a given gripper unit. The gripper that you have was configured before shipment with only one of the following protocols.

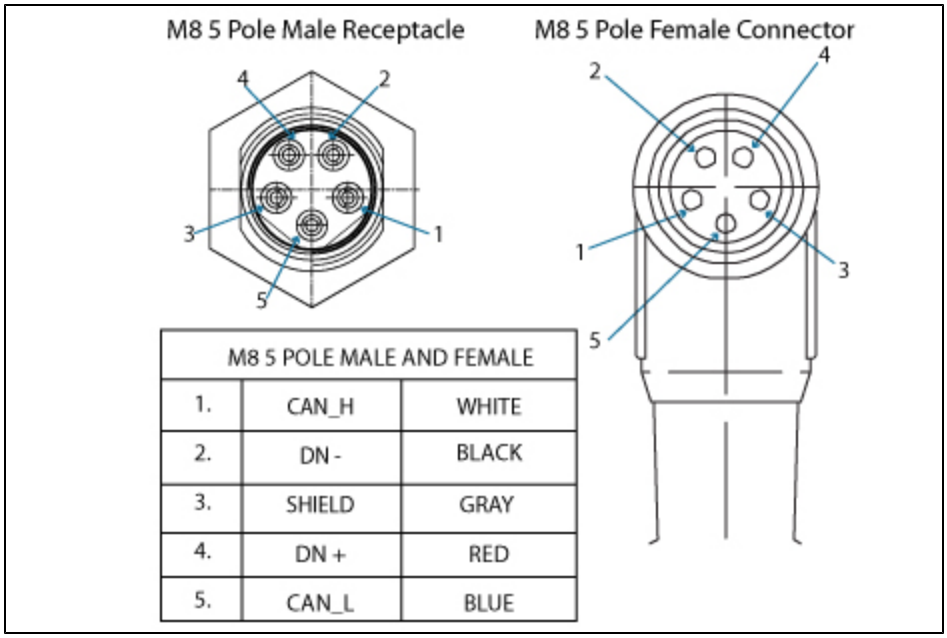
Family	Protocol
Real-Time-Ethernet	EtherNet/IP
	Modbus TCP/IP
	EtherCAT
Fieldbus	DeviceNet
Serial	Modbus RTU

The same communication cable and connectors are used for all the protocols but each protocol has its own pin-out.

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 shows the pin-out for the DeviceNet communication protocol.



M8 5 POLE MALE AND FEMALE		
1.	CAN_H	WHITE
2.	DN -	BLACK
3.	SHIELD	GRAY
4.	DN +	RED
5.	CAN_L	BLUE

Figure 3.5 – DeviceNet communication pinout.

Caution

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

The DeviceNet communication and the Adaptive Gripper use 24 V supply. Robotiq suggests to separate power supplies as shown in Figure 3.6.

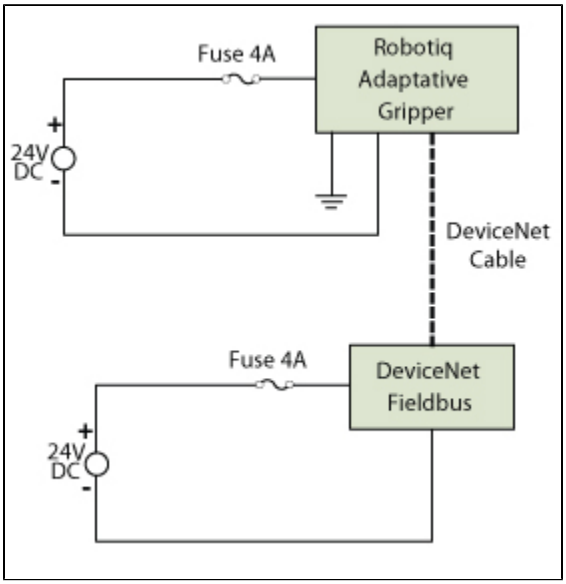


Figure 3.6 – Power connection diagram of the Adaptive Gripper using DeviceNet Fieldbus.

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	

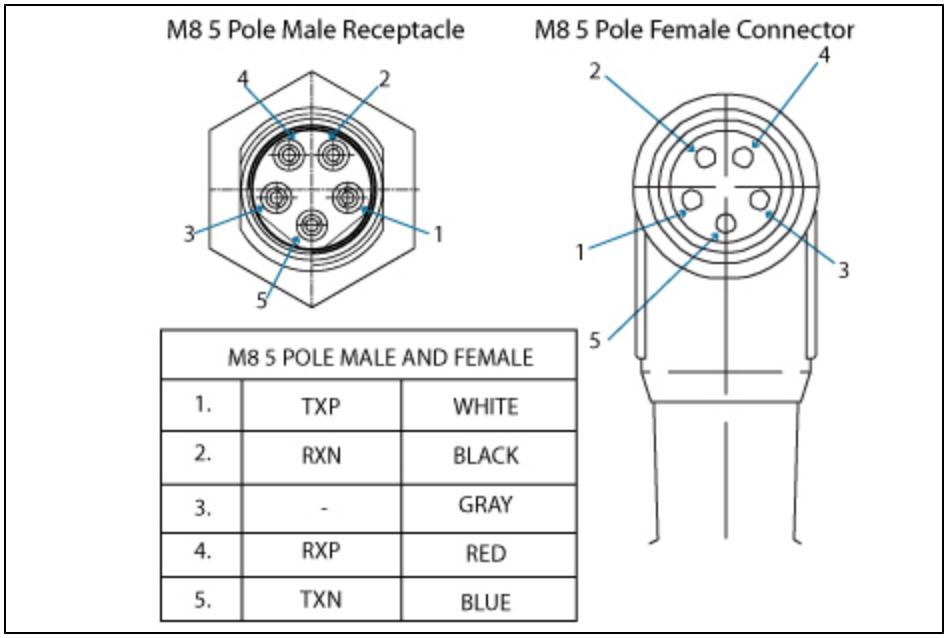
BUS SETTING	
MAC ID :	11
Baud Rate :	250 kBaud

DATA SETTINGS	
Prod. Data Length :	12
Cons. Data Length :	12

Real-time Ethernet communication protocol

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

See the Real-Time Ethernet pin-out diagram below (Figure 3.7).



M8 5 POLE MALE AND FEMALE		
1.	TXP	WHITE
2.	RXN	BLACK
3.	-	GRAY
4.	RXP	RED
5.	TXN	BLUE

Figure 3.7 – Real-time Ethernet communication pin-out.

Caution

The crossover on the RX/TX signals is made inside the gripper.

Factory settings for each Ethernet protocols:

EtherCat		EtherNet/IP		Modbus TCP/IP
IDENTIFICATION SETTINGS				
Vendor ID :	0xE0000044	Vendor ID :	0x0000011B	N / A
Product Code :	0x0000000B	Product Code :	0x0000010D	
Serial Number :	0x00000000	Product Type :	0x0000000C	
Revision Number :	0x00000000	Major Revision :	1	
		Minor Revision :	1	
		Device Name :	AG-EIS	

EtherCat	EtherNet/IP		Modbus TCP/IP	
BUS SETTING				
N / A (see info note)	IP Address :	192.168.1.11	IP Address :	192.168.1.11
	Netmask :	255.255.255.0	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	
	Auto-neg :	Enabled	Auto-neg always on	
	Assembly Instance (input) :	101		
	Assembly Instance (output) :	100		
	Configuraton Instance :	1		
	Connection Type :	Run/Idle Header		

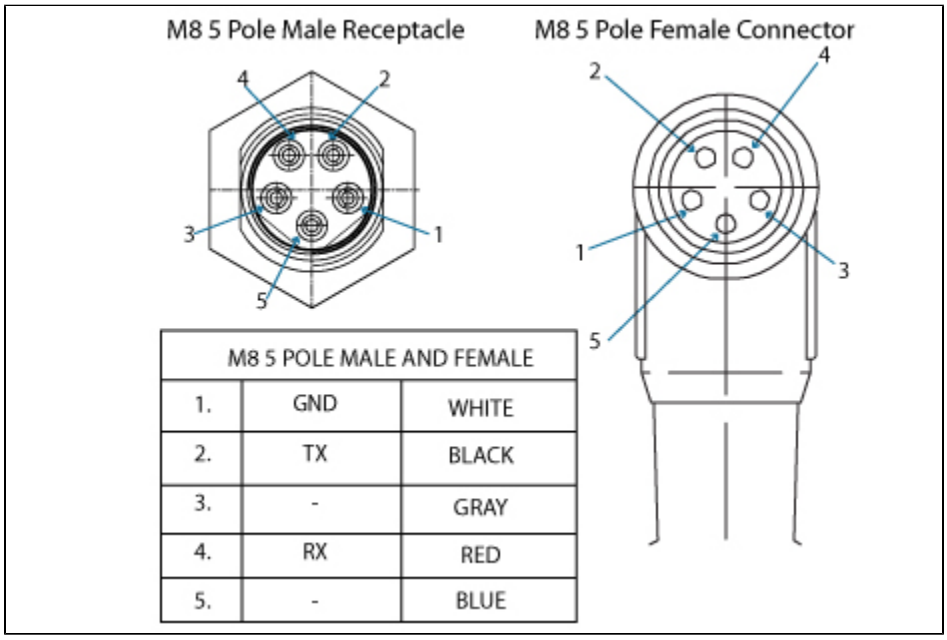
EtherCat		**EtherNet/IP**		**Modbus TCP/IP**
DATA SETTINGS				
Input Data Bytes :	12	Prod. Data Length :	16	N / A
Output Data Bytes :	12	Cons. Data Length :	16	N / A

Info

Ethercat protocol uses inherent dynamic addressing thus bus settings cannot be customized

Serial communication protocol

Figure 3.8 shows the pin-out of the communication connectors when used in serial mode.



M8 5 POLE MALE AND FEMALE		
1.	GND	WHITE
2.	TX	BLACK
3.	-	GRAY
4.	RX	RED
5.	-	BLUE

Figure 3.8 – Serial communication pin-out.

Factory settings for Modbus RTU protocols:

IDENTIFICATION SETTINGS	
Device :	9

BUS SETTING
See section 4.9.1 Connection setup for details

DATA SETTINGS	
Number of Register :	5000

4. Control

4.1 Generalities

The Robotiq Adaptive Gripper is controlled from the robot controller (see Figure 4.1) using an industrial protocol (EtherNet/IP, DeviceNet, EtherCat, etc.). The programming of the gripper can be done with the *Teach Pendant* of the robot or by offline programming.

Info

- The three fingers always close/open at the same time with a single command (the motion of each mechanical phalanx is done automatically).
- For each Operation Mode, the operator can control the partial closing / opening position, the force and the speed of the fingers.

Since the Robotiq Adaptive Gripper has its own internal controller, high-level commands such as *Open* or *Close* 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 objects.

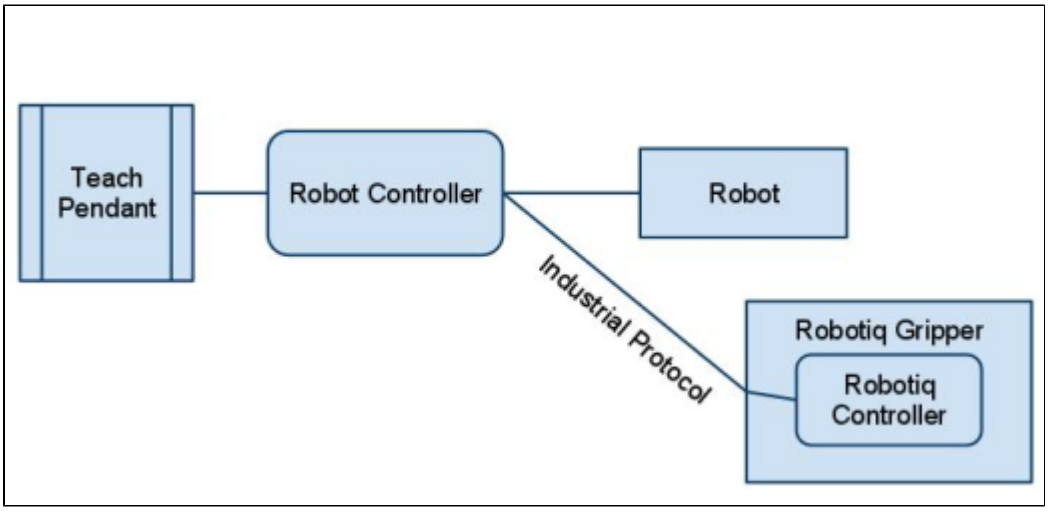


Figure 4.1 – Adaptive Gripper connections.

4.2 Status overview

- 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.
- Fault Status - The Fault Status gives additional details about the cause of a fault_._
- Motor Encoder Status - The information of the encoders of 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.

4.3 Control overview

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** (see Figure 4.2). 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.
   Note that the gripper must be initialized at power on. This procedure takes a few seconds and allows the gripper to be calibrated against internal mechanical stops.

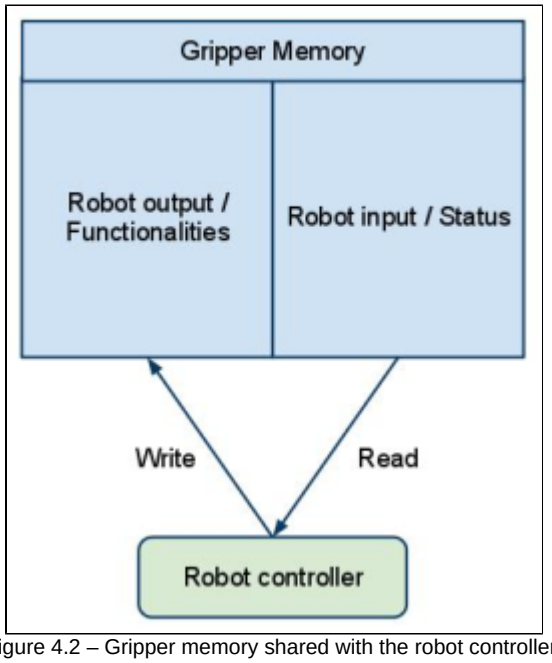


Figure 4.2 – Gripper memory shared with the robot controller.

4.4 Status LEDs

Three status LED lights provide general information about the Adaptive Gripper Status. Figure 4.3 shows the LEDs and their locations.

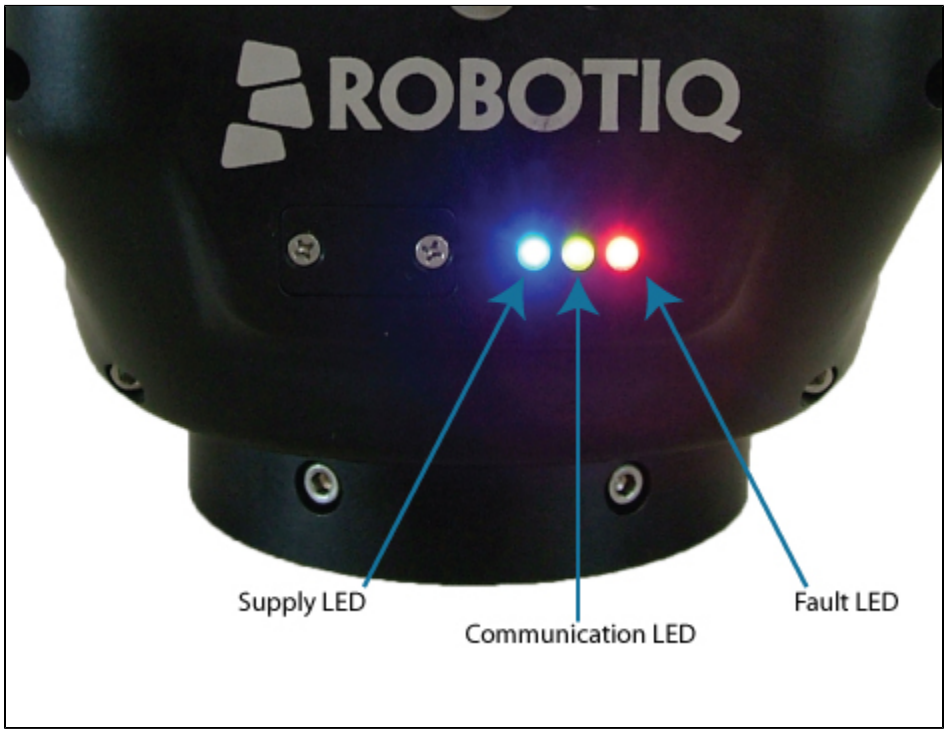


Figure 4.3 – Status LEDs.

4.4.1 Supply LED

Color	State	Information
Blue	Off	Gripper is not power supplied
Blue	On	The gripper is correctly supplied and the control board is running

4.4.2 Communication LED

Color	State	Information
Green	Off	No network detected
Green	Blinking	A network has been detected and no connection has been established
Green	On	A network has been detected and at least one connection is in the established state

4.4.3 Fault LED

Color	State	Information
Red	Off	No fault detected
Red	Blinking	Action and/or communication fault occurred
Red	On	A major fault occurred

Info
A major fault refers to a situation where the gripper must be reinitialized.

4.5 Gripper register mapping

The register mapping is valid for all communication protocols, unless specified.

Info
Register format is Little Endian (Intel format), namely from LSB (Less Significant Bit) to MSB (Most Significant Bit).

Register	Robot Output / Functionalities	Robot Input / Status
Byte 0	ACTION REQUEST	GRIPPER STATUS
Byte 1	SAFETY SHUTDOWN (RS232 Modbus RTU only)	OBJECT STATUS
Byte 2	SPEED	RESERVED
Byte 3	FORCE	FAULT STATUS
Byte 4	PARTIAL OPEN	FINGER A POSITION
Byte 5	PARTIAL CLOSE	FINGER B POSITION
Byte 6		FINGER C POSITION
Byte 7		SCISSOR POSITION
Byte 8		FINGER A CURRENT
Byte 9		FINGER B CURRENT
Byte 10		FINGER C CURRENT
Byte 11		SCISSOR CURRENT

4.5 Gripper register mapping (firmware version 3.0)

Info
Register format is Little Endian (Intel format), namely from LSB (Less Significant Bit) to MSB (Most Significant Bit).

Version 3 of the Adaptive Gripper firmware provides new functionalities such as the direct position control of the fingers via "go to" commands. There is also additional advanced options such as the individual control of the fingers and scissor, the glove mode (when using the Robotiq Glove) and the automatic centering of the fingers.

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 the usage of the gripper for users who are only interested in the basic functionalities.

Warning
When using the Simplified Control Mode, it is important to fill the unused registers with zeros. Neglecting to do so would result in the unwanted triggering of control options and could lead to a hazardous behavior of the gripper.

Register mapping for the Simplified Control Mode

Register	Robot Output / Functionalities	Robot Input / Status
Byte 0	ACTION REQUEST	GRIPPER STATUS
Byte 1	00000000	OBJECT DETECTION

Byte 2	00000000	FAULT STATUS
Byte 3	POSITION REQUEST	POS. REQUEST ECHO
Byte 4	SPEED	FINGER A POSITION
Byte 5	FORCE	FINGER A CURRENT
Byte 6	00000000	NOT USED IN SIMPLE MODE
Byte 7	00000000	FINGER B POSITION
Byte 8	00000000	FINGER B CURRENT
Byte 9	00000000	NOT USED IN SIMPLE MODE
Byte 10	00000000	FINGER C POSITION
Byte 11	00000000	FINGER C CURRENT
Byte 12	00000000	NOT USED IN SIMPLE MODE
Byte 13	00000000	SCISSOR POSITION
Byte 14	00000000	SCISSOR CURRENT

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
Byte 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

4.6 Robot output registers & functionalities

Info
Register format is Little Endian (Intel format), namely from LSB (Less Significant Bit) to MSB (Most Significant Bit).

Register: ACTION REQUEST
Address: Byte 0

Bit	Name	Description
0	rINI	0 – Reset Gripper 1 – Initialize Gripper (Must stay on after initialization is completed)
1 2	rMOD	00 – Go to Basic Mode 10 – Go to Pinch Mode 01 – Go to Wide Mode 11 – Go to Scissor Mode
3 4	rGRP	00 – Stop 10 – Open 01 – Close 11 – Stop
5	rPRO	0 – Set opening displacement to maximal opening 1 – Set opening displacement up to requested position (See Register PARTIAL OPEN)
6	rPRC	0 – Set closing displacement to maximal closing 1 – Set closing displacement up to requested position (See Register PARTIAL CLOSE)
7	rRS1	Reserved

rINI: First action to be made when the power is turned on. Prior to any other action the gripper **must be** initialized and **rINI bit must stay on afterwards for any other action to be performed**. Set **rINI** to 0 to reset gripper and fault status.

rMOD: The gripper has four different Grasping Modes to accommodate objects of different shapes. When the Grasping Mode is changed, the gripper automatically opens completely first to avoid interferences between the fingers.

rGRP: The gripper will close or open at a speed corresponding to the value set in register **rVEL**. 00 and 11 bits on the rGRP register have the same effect.

rPRO, **rPRC**: It is possible to determine the position at which the finger will stop while closing or opening. We call this a Partial Close or a Partial Open. This functionality is useful when you want to optimize the cycle time of the sequence of the gripper. These registers enable or disable that function. The gripper will open or close to a position corresponding relatively to the value set in the registers **rPPO** and **rPPC**.

Register: SAFETY SHUTDOWN (**RS232 Modbus only**)
Address: Byte 1

Bit	Name	Description
0 – 3	rRS2	Reserved
4 - 7	rSSH	Timeout between successive requests before shutdown 0x0 – No Shutdown 0x1 – 20ms 0x2 – 40ms 0x3 – 80ms 0x4 – 160ms 0x5 – 320ms 0x6 – 640ms 0x7 – 1280ms 0x8 – 2560ms 0x9 – 5120ms 0xA to 0xF – 10240ms

rSSH: Sets safety shutdown delay in ms. Safety shutdown delay is the maximum accepted delay between two successive commands. If the delay between two successive commands is higher than this value, the gripper will automatically shutdown. **Only active in Modbus RTU**. This function is automatically enabled for other communication protocols and depends on the connection status.
Register: SPEED
Address: Byte 2

Bit	Name	Description
0 – 7	rSPD	Set Grasping Speed 0x00 (Minimum velocity) to 0xFF (Maximum velocity)

This register is used to setup the gripper's closing or opening speed. Setting a speed will not initiate a motion. However, for motions that have already been initiated, changing the gripper speed will directly influence the gripper closing speed. Note that 0x00 speed does not mean absolute zero speed. It is the minimum speed of the gripper.
Register: FORCE
Address: Byte 3

Bit	Name	Description
0 – 7	rFOR	Set Gripping Force 0x00 (Minimum force) to 0xFF (Maximum force)

The user can change the final gripping force. Note that 0x00 force does not mean zero force; it is the minimum force that the gripper can apply.

Register: PARTIAL OPEN
Address: Byte 4

Bit	Name	Description
0 – 7	rPPO	Set position for partial opening 0x00 (Full opening) to 0xFF (No opening)

This register is used to setup the position for Partial Opening. Setting a Partial Opening will not initiate a motion. See Figure 4.4 and Figure 4.5 for the relationship between the Partial Opening value and the distance between the fingers.

Register: PARTIAL CLOSE
Address: Byte 5

Bit	Name	Description
0 – 7	rPPC	Set position for partial closing (0x00 – 0xFF) 0x00 (No closing) to 0xFF (Full closing)

This register is used to setup the position for partial closing. Setting a partial closing will not initiate a motion. See the following figures for a chart of the positions. See Figure 4.4 and Figure 4.5 for the relationship between the Partial Closing value and the distance between the fingers.

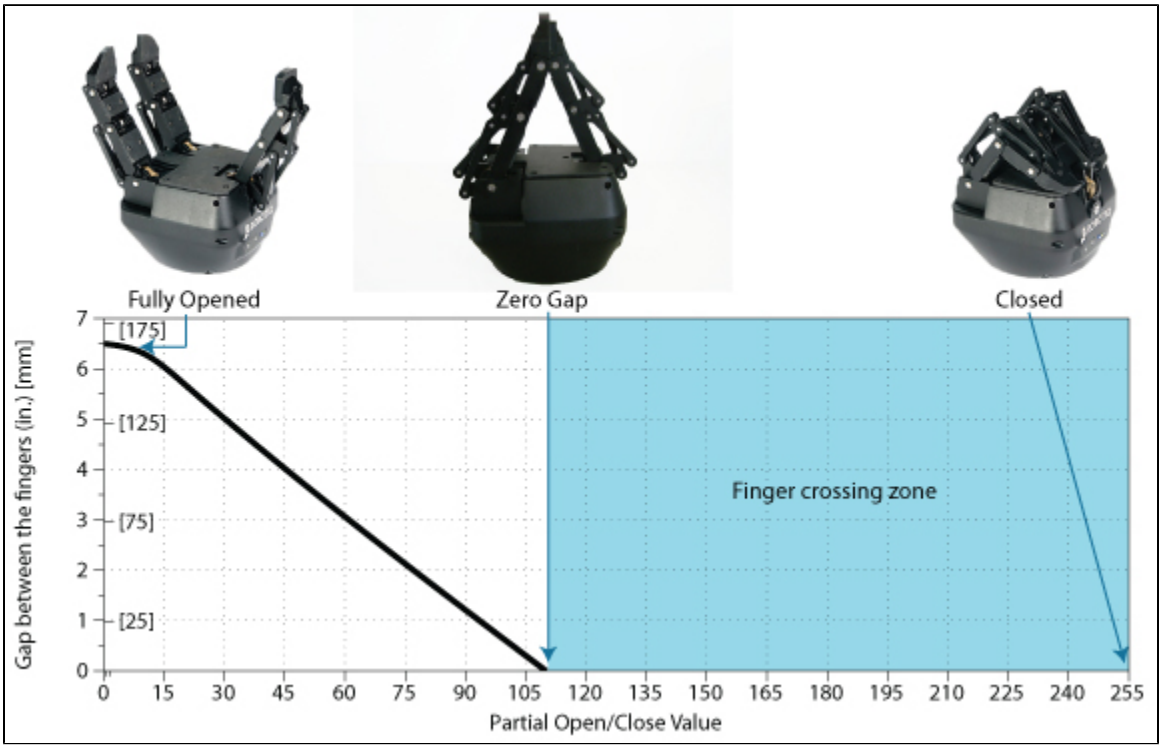


Figure 4.4 – Partial Close graph for Wide, Basic and Pinch Modes.

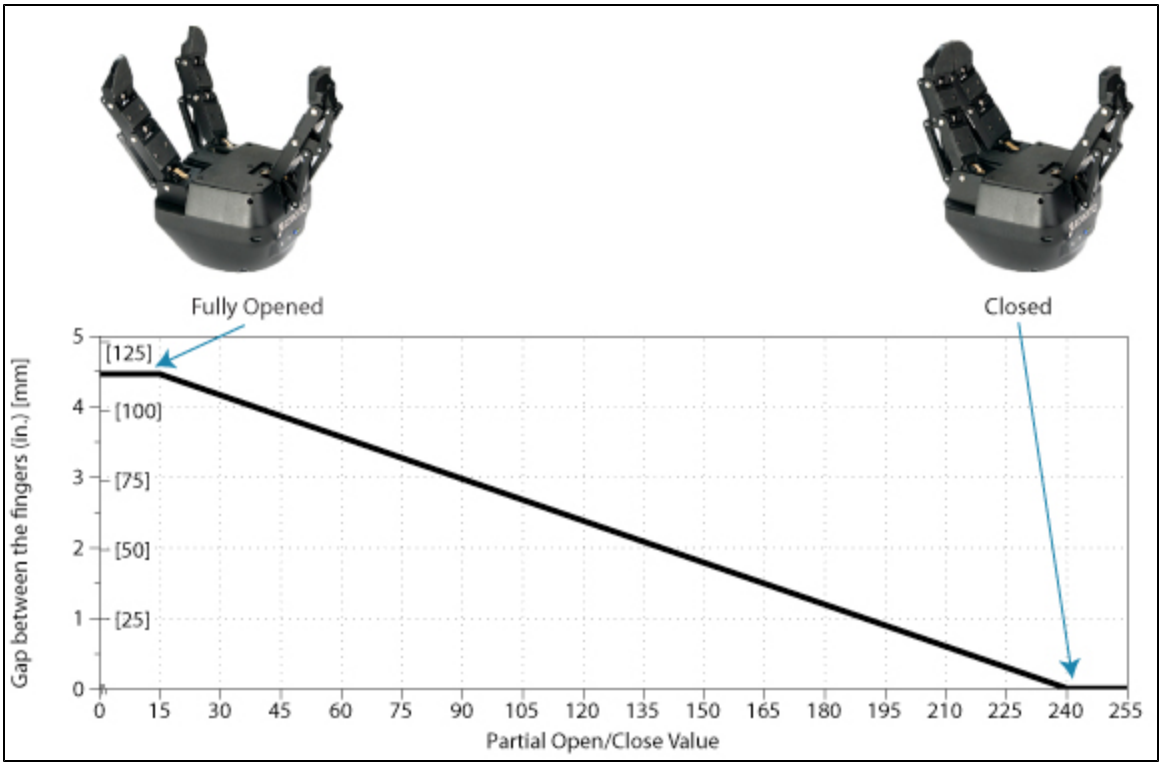


Figure 4.5 – Partial Close graph for Scissor Mode.

4.7 Robot input registers & status

Info
Register format is Little Endian (Intel format), namely from LSB (Less Significant Bit) to MSB (Most Significant Bit).

Register: GRIPPER STATUS
Address: Byte 0

Bit	Name	Description
0	gINI	0 – Gripper Reset 1 – Initialization completed
1 2	gMOD	00 – Basic Mode 10 – Pinch Mode 01 – Wide Mode 11 – Scissor Mode
3 4	gGRP	00 – Stop 10 – Open 01 – Close 11 – Mode Change, Initialization
5 6	gSTA	00 – Requested action has faulted (see Register FAULT STATUS) 10 – Requested action is in progress 01 – Invalid/Undefined 11 – Requested action was successfully completed
7	gRS1	Reserved. Set to 1

Register: OBJECT STATUS
Address: Byte 1

Bit	Name	Description
0	gOBJ	00 – No part detected 10 – One finger detected a part (Invalid for Scissor mode) 01 – Two fingers detected a part (Invalid for Scissor mode) 11 – All fingers (or Scissor fingers in Scissor modes) detected a part
1		
2	gOBA	0 – No part was detected by Finger A 1 – A part was detected by Finger A
3	gOBB	0 – No part was detected by Finger B 1 – A part was detected by Finger B
4	gOBC	0 – No part was detected by Finger C 1 – A part was detected by Finger C
5	gOBS	0 – No part was detected by Scissors 1 – A part was detected by Scissors
6	gRS2	Reserved. Set to 0
7		

Caution
The object detection is precise only to the order of a few mm. Therefore in some circumstances, object detection may not be accurate and it is possible that it won't detect an object. A good example of this is when picking up a thin object in a fingertip grip. For this reason, we suggest to use this feature with caution. In fact, in most applications the "action successfully completed" status of register gSTA is sufficient to proceed to the next step of the routine.

Register: RESERVED
Address: Byte 2

Bit	Name	Description
0	gRS3	Reserved. Set to 0

Register: FAULT STATUS
Address: Byte 3

Bit	Name	Description
0 – 7	gFLT	0x00 – No Fault Priority Fault 0x11 – Action delayed, initialization must be completed prior to action 0x12 – Action delayed, mode change must be completed prior to action Communication Fault 0x21 – Communication timeout, Gripper is stopped 0x22 – Insufficient supply voltage, Gripper is stopped Action Fault 0x31 – Changing mode fault, interferences detected on Scissor 0x32 – Gripper opening fault, interferences detected on Fingers 0x33 – Gripper opening fault, interferences detected on Scissor 0x34 – Gripper closing fault, abnormal displacement of Fingers 0x35 – Gripper closing fault, abnormal displacement of Scissor fingers Major Fault. Reset is required 0x41 – Initialization fault, insufficient Scissor displacement 0x42 – Initialization fault, insufficient Finger(s) displacement

Register: FINGER A POSITION
Address: Byte 4

Bit	Name	Description
0	gPOA	Position of Finger A 0x00 (Fully opened) to 0xFF (Fully closed)

Register: FINGER B POSITION
Address: Byte 5

Bit	Name	Description
0	gPOB	Position of Finger B 0x00 (Fully opened) to 0xFF (Fully closed)

Register: FINGER C POSITION
Address: Byte 6

Bit	Name	Description
0	gPOC	Position of Finger C 0x00 (Fully opened) to 0xFF (Fully closed)

Register: SCISSOR POSITION
Address: Byte 7

Bit	Name	Description
0	gPOS	Position of the Scissor 0x00 (Fully opened) to 0xFF (Fully closed)

Register: FINGER A CURRENT
Address: Byte 8

Bit	Name	Description
0	gCUA	Current of Finger A 0.1 * Current (in mA)

Register: FINGER B CURRENT
Address: Byte 9

Bit	Name	Description
0	gCUB	Current of Finger B 0.1 * Current (in mA)

Register: FINGER C CURRENT
Address: Byte 10

Bit	Name	Description
0	gCUC	Current of Finger C 0.1 * Current (in mA)

Register: SCISSOR CURRENT
Address: Byte 11

Bit	Name	Description
0	gCUS	Current of the Scissor 0.1 * Current (in mA)

4.8 Example

Figure 4.6 shows how the gripper should be controlled with a robot. Note that all the "Wait for" blocks are request status operations intended for security reasons and are therefore, in some cases, optional.

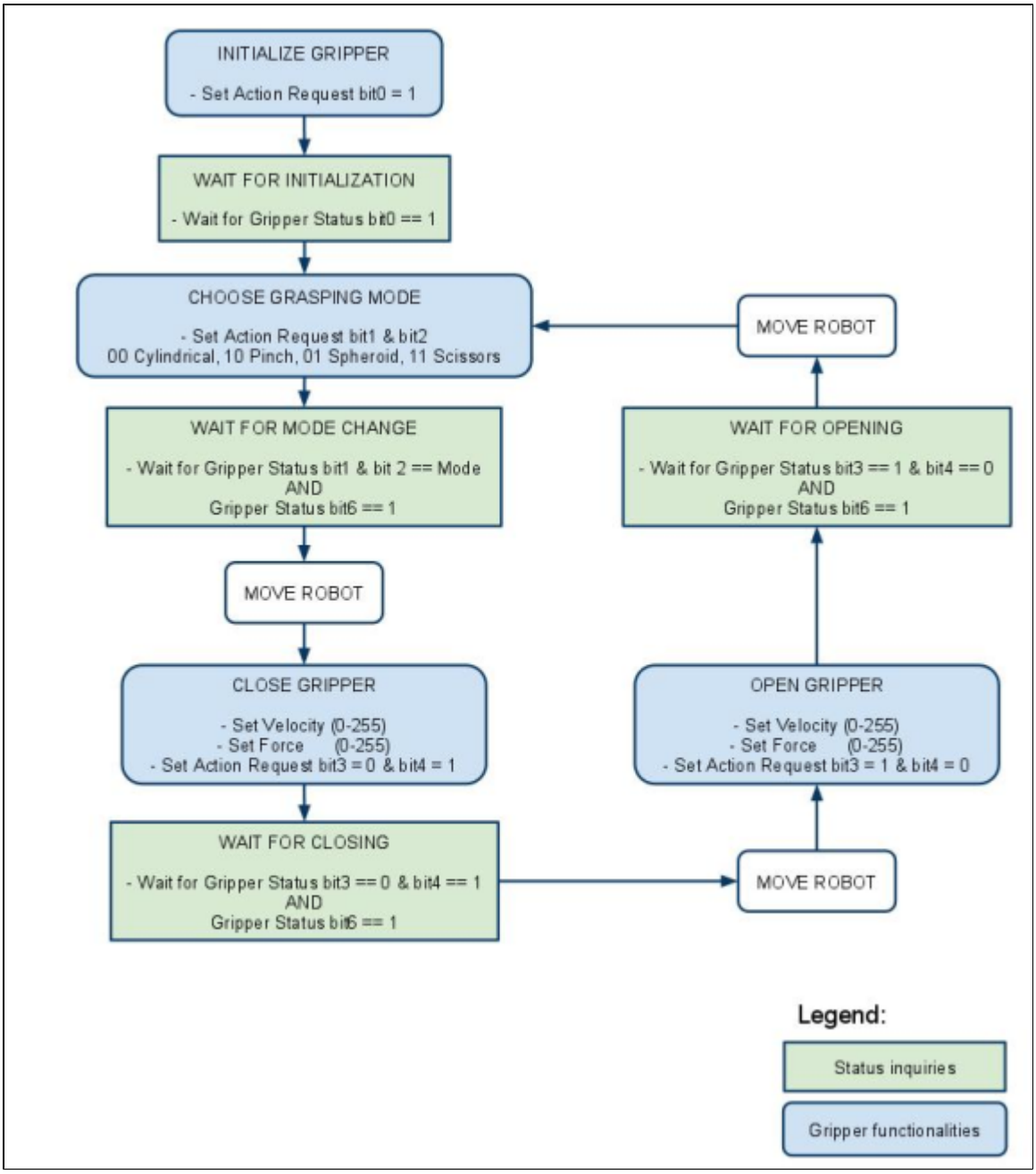


Figure 4.6 – Robotiq Gripper flow chart.

4.9 MODBUS RTU communication protocol

The Robotiq Adaptive Gripper can be controlled over RS232 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 http://www.modbus.org/docs/Modbus_over_serial_line_V1.pdf.

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

4.9.1 Connection setup

The following table describes the connection requirement for controlling the Robotiq Adaptive Gripper using the Modbus RTU protocol.

Physical Interface	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)
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 Adaptive Gripper. The first gripper output Modbus register (0x07D0) is composed from the first **2** Robotiq Adaptive Gripper registers (byte 0 and byte 1).

4.9.2 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 Status, Reserved and Fault Status.

Request is:

09 03 07 D0 00 02 C5 CE

where

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

Response is:

09 03 04 E0 00 00 00 44 33

where

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)

Note
The Adaptive Gripper register values are updated at a 200Hz frequency. It is therefore recommanded to send FC03 commands with a minimum delay of 5ms between them.

4.9.3 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 to initialize the gripper by setting register 0x03E8 (1000), which contains Action Request and Safety Shutdown registers, to 0x0100.
Request is:

09 06 03 E8 01 00 09 62

where

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

Response is an echo:

09 06 03 E8 01 00 09 62

where

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

4.9.4 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, velocity, force, etc.

Ex: This message requests to set speed, force and partial closing/opening positions 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

09	SlaveID
10	Function Code 16 (Preset Multiple Registers)
03E9	Address of the first register
0002	Number of registers to write
04	Number of data bytes to follow (2 registers x 2 bytes/register = 4 bytes)
60E6	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

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

4.10 MODBUS TCP communication protocol

The Robotiq Adaptive Gripper can be controlled using the Modbus TCP protocol. This section is intended to provide guidelines for setting up a Modbus TCP communication to adequately send commands 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 read the information provided on the following website: http://www.simplymodbus.ca/TCP.htm.

4.10.1 Connection Setup

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

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 Adaptive Gripper. The first gripper output Modbus register (0x0000) is composed from the first **2** Robotiq Adaptive Gripper registers (byte 0 and byte 1).

4.10.2 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.

Request is:

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

where

01 00	Transaction identifier
00 00	Protocol identifier
00 06	Length
02	UnitID
04	Function 04 (Read input registers)
00 00	Address of the first register
00 06	Word count

Response is:

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

where

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

Note
The Adaptive Gripper register values are updated at a 200Hz frequency. It is therefore recommanded to send FC04 commands with a minimum delay of 5ms between them.

4.10.3 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, velocity, force, etc.

Ex: This message requests to set all options of the gripper by setting registers from 0x0000 (0000) to 0x0003.

Request is:

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

where

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 64 64 00 ff	Data

Response is:

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

where

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	The number of registers written

5. User Interface

The following section describes the Robotiq User Interface software provided with the Adaptive Gripper.
The User Interface is designed to allow Adaptive Gripper:

- Testing.
- Demo mode.
- Xbox Remote control mode.
- Communication options configuration.

Note
Robotiq User Interface Software is designed for the testing and demo control of the Adaptive Gripper. It is not a production control software.

Figure 5.1 Main screen of the Robotiq User Interface.

5.1 Requirements

To use this version of the Robotiq User Interface, you will need:

- The Adaptive Gripper and its power cable (see Wiring section)
- A computer with
  - Windows XP or newer
  - At least 50MB of main memory
  - A USB port and/or an Ethernet port
- A 24V power source for the Gripper
- A small Phillips screwdriver
- A USB 2.0 Micro-B or a USB 2.0 Micro-A cable. (Connection via the USB use Modbus RTU)
- Optional: An Ethernet communication connector for Modbus TCP provided by Robotiq. (Connection via Ethernet uses Modbus TCP)

Info
The USB cable that is needed for the configuration of the communication protocol is provided with the Adaptive Gripper.

Note
Ethernet Option: You will only have the Ethernet communication connector provided with your Gripper if you have the Modbus TCP option.

5.2 Installation

To install the Robotiq User Interface software:

1. Launch the Robotiq User Interface installer from "Robotiq User Interface Setup.exe" provided by Robotiq.
2. Choose the installer language and click "Ok".
3. Follow the setup steps until you can click "Install".

> **Tip**
> You can leave the settings on default or choose an installation directory of your own.

4. After installation is completed you can launch the Robotiq User Interface, if you do not have the required drivers for the USB connection of the Gripper, please select the box shown in figure 5.2.1.

> **Warning**
> To use the Modbus RTU communication via the USB port, you need to select the driver installation shown in figure 5.2.1

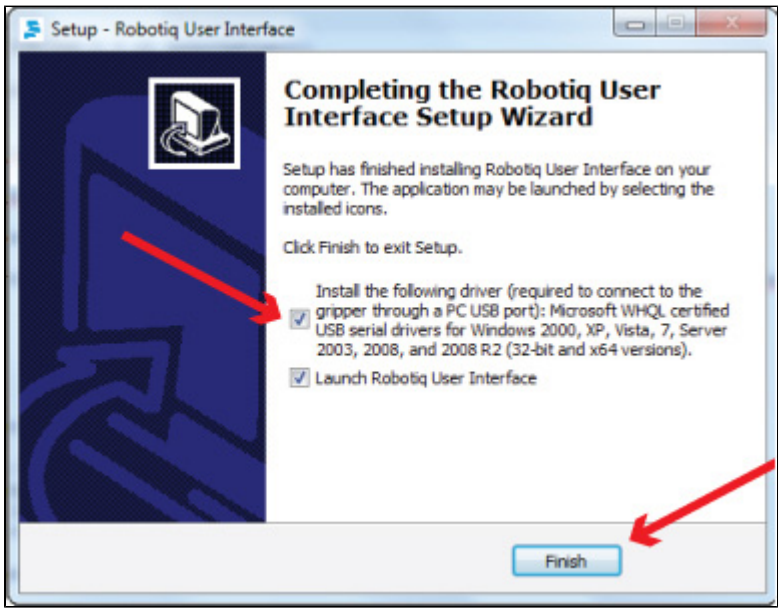


Figure 5.2.1 Completing the installation of Robotiq User Interface

In order to connect the Adaptive Gripper via USB for Modbus RTU:

1. Unplug the Gripper from the power source by disconnecting the power cable from the Gripper.
2. Remove the USB port panel by unscrewing the two screws (shown in Figure 5.2.2). A Phillips screwdriver is needed.
3. Connect the gripper to your computer with a USB 2.0 Micro-B or a USB 2.0 Micro-A cable.

> **Info**
> The USB cable needed is provided with the Adaptive Gripper.

4. Reconnect the power connector to the power receptacle and power up the Gripper with a 24V power source (not included) as described in the Wiring section .

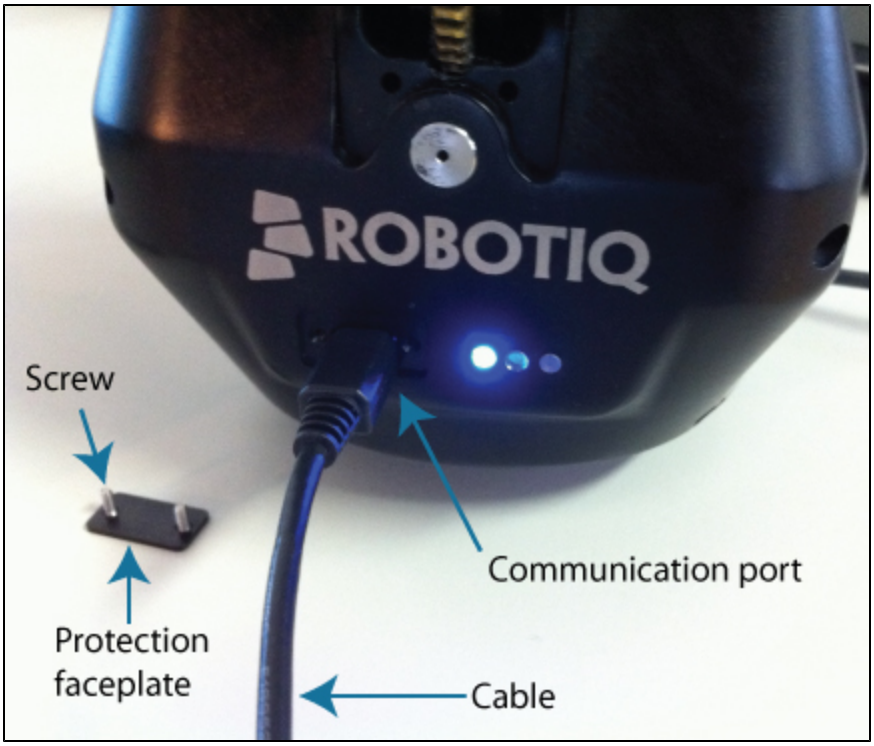


Figure 5.2.2: Unscrewing the USB port panel and connecting the USB 2.0 Micro cable.

To connect the Adaptive Gripper via Ethernet port for Modbus TCP or Modbus RTU:

1. Unplug the Gripper from the power source by disconnecting the power cable from the Gripper.
2. Connect the Gripper to your computer with the Ethernet communication connector.

> **Info**
> The Ethernet or Serial cable needed is provided with the Adaptive Gripper if the Gripper has the Modbus TCP or Modbus RTU communication option.

3. Reconnect the power connector to the power receptacle and power up the Gripper with a 24V power source (not included) as described in the Wiring section.

See the following sections for a description of the User Interface and its usage.

If you are connected through the USB port and the configuration is finished, follow these steps to acess the normal usage of the Gripper:

1. Disconnect the Gripper with the **Disconnect** button found in the User Interface menu or simply quit the program.
2. Unplug the Gripper from the power source by disconnecting the power cable from the Gripper.
3. Unplug the Gripper from your PC by removing the USB cable.
4. Replace the USB port panel by screwing back the two screws (shown in figure 5.2.2). A phillips screwdriver is needed.
5. Reconnect the power and communication cables to the Gripper as described in the Wiring section.

5.3 UI Description

When you first start the Robotiq User Interface you need to set the connection mode you will use (see Figure 5.3.1). Choose between Modbus RTU or Modbus TCP according to your connection options. If you do not know what connection you will be using simply close the pop-up window (you can connect later).

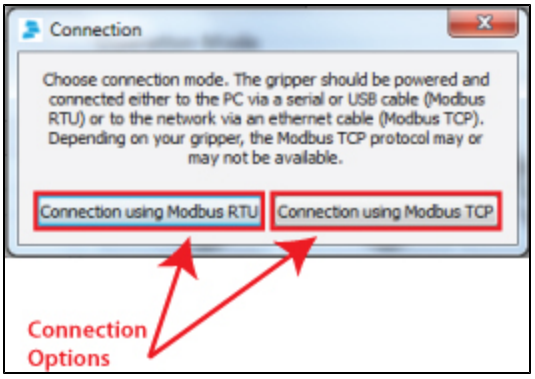


Figure 5.3.1 Connection options available on start-up of the Robotiq User Interface.

Once you choose the connection mode, the first tab becomes activated (see Figure 5.3.2).
The first tab is the Gripper Control tab (detailed in section 5.5), it can be split into the following:

- Initialization and Gripper Status
- Interface Options
- Operation Mode and Action
- Control Parameters
- Gripper Feedback
- Connection, View and Help menus

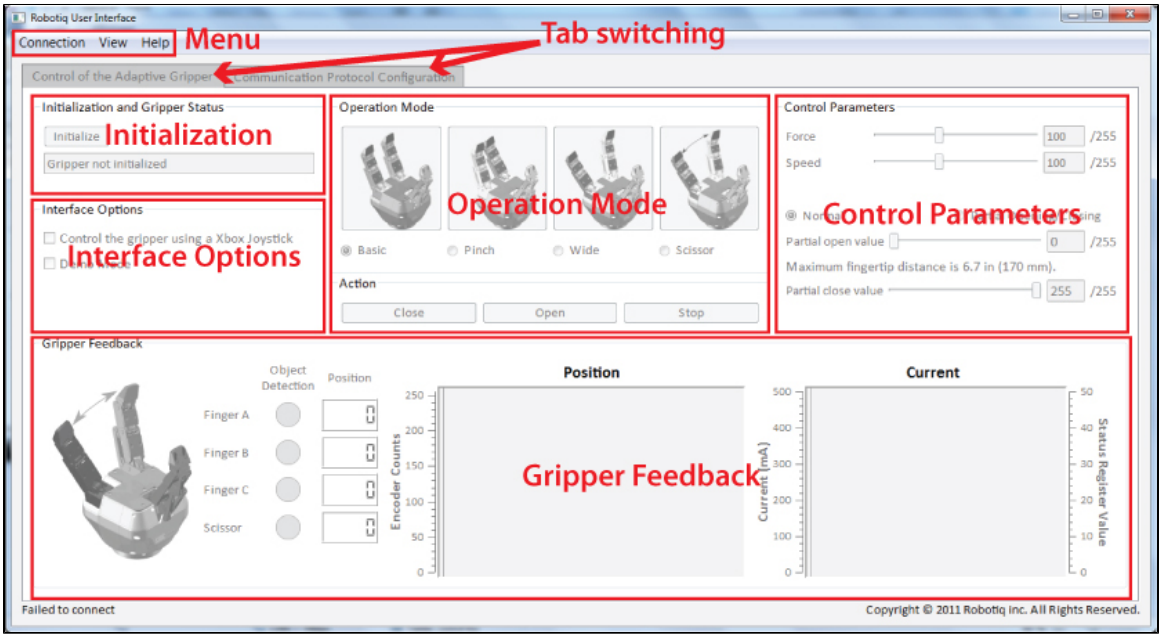


Figure 5.3.2 Gripper Control tab description.

The Communication Protocol Configuration tab (detailed in section 5.6) will be split into :

- Device Identity
- Protocol
- Data

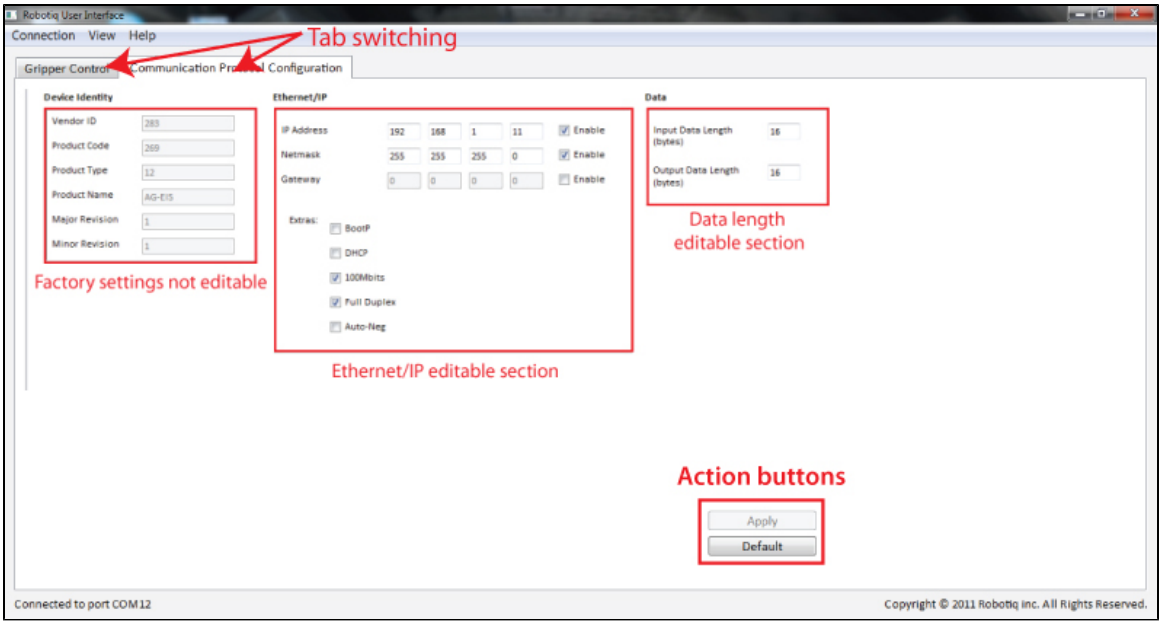


Figure 5.3.3 Communication Protocol Control configuration tab (shown with Ethernet/IP)

5.4 Connection

If the connection protocol was properly chosen using the pop-up window, the connection will be automatically established unless the status label (lower left part of the main window) displays "Connection failed".
If a connection has not been established yet, you can manually connect to the Gripper via the connection menu.

The connection menu allows you to :

- Connect via Modbus RTU
- Connect via Modbus TCP
- Disconnect

> ⚠ Note that you must choose the right connection option (see section 5.2) for your Gripper.

5.4.1 Modbus RTU

A connection via Modbus RTU can be established with all Robotic Adaptive Grippers via the USB port panel or via the communication connector for grippers with Modbus RTU communication option.

To establish a connection simply select "**Connect using modbus RTU**" from the connection menu.

> ℹ The Robotic User Interface is programmed to automatically detect the port being used.

5.4.2 Modbus TCP

A connection via Modbus TCP can only be established via the communication connector for grippers with Modbus TCP communication option.

To establish the connection simply select **Connect using modbus TCP** from the connection menu.

> ℹ The Robotic User Interface is programmed to automatically detect the Gripper address comprised in the range 192.168.1.11 to 192.168.1.13.

The Modbus TCP does not allow Communication Protocol Configuration. A connection using the Modbus RTU protocol is required to perform the reconfiguration of the communication protocol.

5.5 Control of the Adaptive Gripper

This section guides you through the control of the Adaptive Gripper via the Gripper Control tab.

5.5.1 Initialization & Gripper Status

Once a connection to the Gripper has been established (see section 5.4), the Adaptive Gripper needs to be initialized before being used. Simply click the "Initialize" button in the Initialization and Gripper Status section. The Gripper will start its initialization procedure and once completed the Gripper status text box located under the "Initialize" button will display "Gripper initialized".

Warning
Do not interfere with the Gripper during the initialization process.

After the initialization process is completed the Gripper is ready to be used.

5.5.2 Interface Options

"Interface Options" allows you to choose between two options:

- **Xbox Joystick control** allows control of the Gripper using a remote Xbox controller (see Figure 5.5.2.1 for a summary of the available controls).
- **Demo Mode** command the Gripper to cycle through its operation modes with pauses after every move.

To disable any of the options simply uncheck the corresponding box.

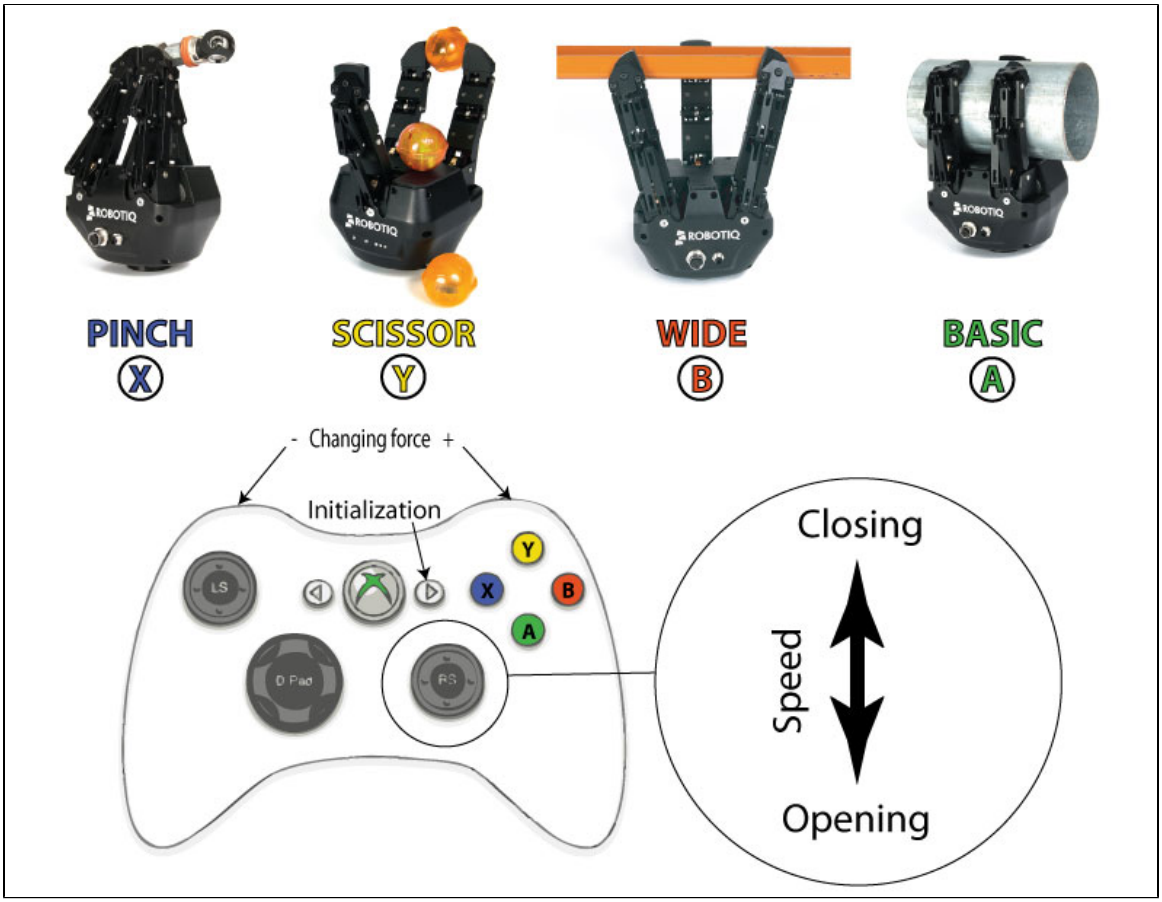


Figure 5.5.2.1 Xbox Controls for the Adaptive Gripper

5.5.3 Operation Mode

You can select the operation mode of your Gripper in the "Operation Mode" section of the Robotic User Interface. Simply check the corresponding radio button or click on the corresponding picture to activate any mode.

For a description of the operation modes see the general presentation in section 1.

5.5.4 Action

The "Action" section of the User Interface allows you to command the Gripper in real-time:

- **Close** command will close the grip of the Gripper completely or until an object is detected unless you have chosen partial closing in the Control Parameters (see section 5.5.5).
- **Open** command will open the grip of the Gripper completely or until an object is detected unless you have chosen partial closing in the Control Parameters (see section 5.5.5).
- **Stop** command will stop the Gripper movement and hold the current position.

5.5.5 Control Parameters

The "Control Parameters" section of the UI can customize every parameter of the Gripper:

- **Force** slider will control the grasping force limit of the Gripper. The value can be set anywhere between 0 and 255 with 255 being the maximum strength.
- **Speed** slider will control the closing or opening speed of the Gripper. The value can be set anywhere between 0 and 255 with 255 being the maximum speed.
- **Normal** mode is selected by default. This option will command the Gripper to open or close completely or until an object is grasped.
- **Partial Opening/Closing** mode will disable **Normal** mode and allow you to set the position reached when opening or closing the gripper
  - **Partial open value** will fix the position value the Gripper attempts to reach when opening.
  - **Partial close value** will fix the position value the Gripper attempts to reach when closing.

Hint
You can fix the desired position with the slider or the numeric values.

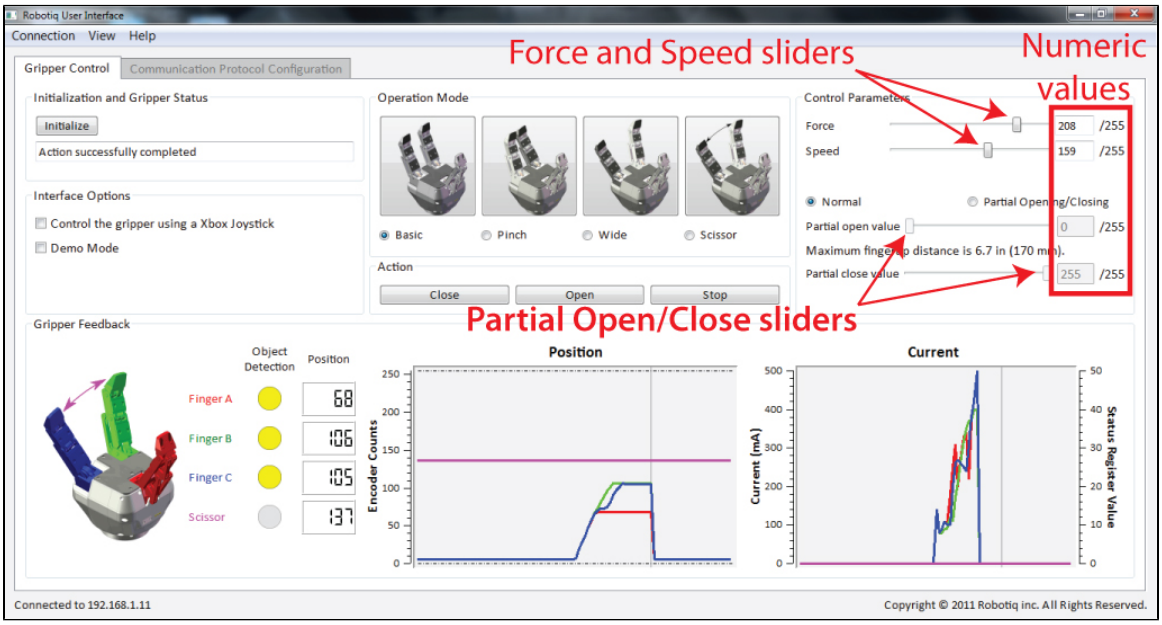


Figure 5.5.4.1 Changing the control parameters of the Gripper

5.5.6 Gripper Feedback

The "Gripper Feedback" section provides you with information concerning the current status of the Adaptive Gripper.

- **Object Detection**: If the Gripper detects a contact with an object when closing, the "Object Detection" display turns yellow on the corresponding finger. Object detections are displayed independently for each of the three fingers and the scissor axis.

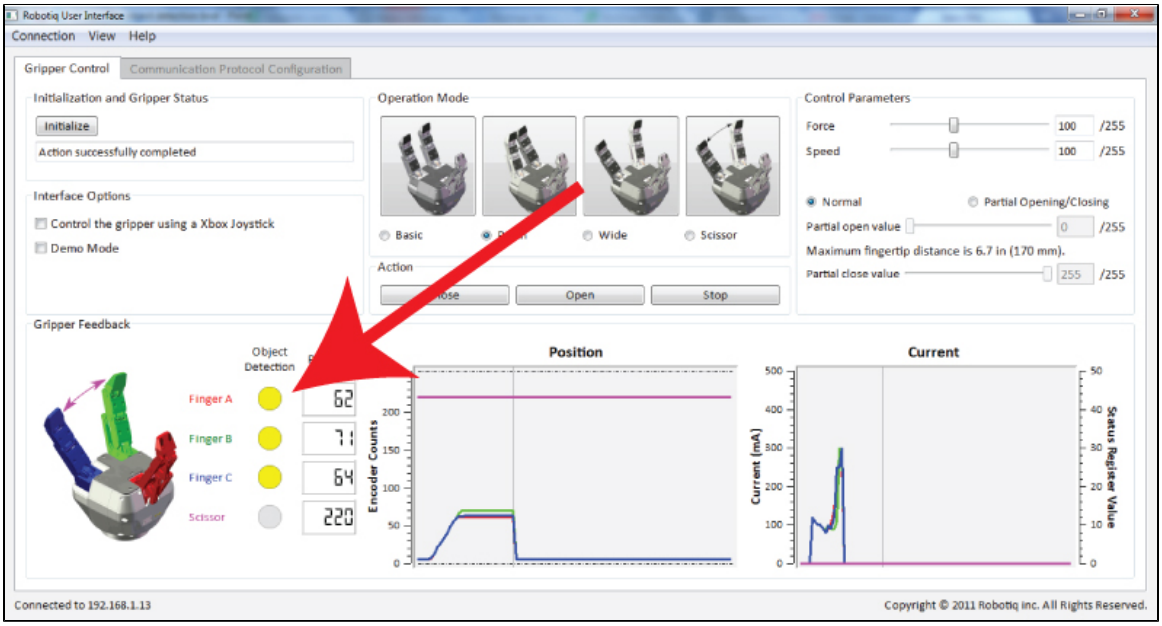


Figure 5.5.6.1 Positive object detection is registered when the object detection dot turns yellow.

- **Position** (numeric): The digital display of "Position" shows the position of the associated finger as designated on a scale of 0 to 255 (see section 4.6 for details).
- **Position** (graphic): The visual display of "Position" shows the real-time position of each finger graphically. Each axis has an associated

color.

- **Current** (graphic): The "Current" graph shows the amount of current going through each motor. Each axis has an associated color.

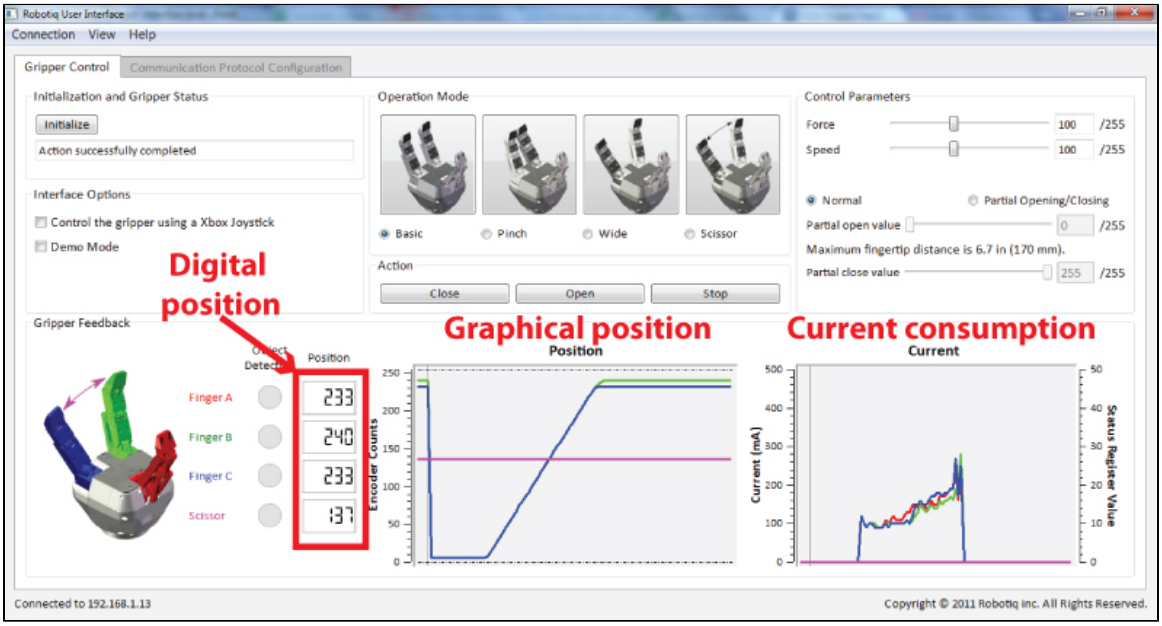


Figure 5.5.6.2 Digital and visual displays of the finger positions and electrical current usage.

5.6 Configuration of the Adaptive Gripper

The **configuration tab** allows access to the configuration information of the Gripper, it can only be accessed via Modbus RTU. To access the **configuration tab** click this tab in the main Robotiq User Interface screen as shown in figure 5.3.2.

The configuration tab display depends on the communication protocol option of your Gripper, each communication protocol being displayed in one of the following sections:

- Ethernet/IP section
- Modbus TCP section
- DeviceNet section

5.6.1 Ethernet IP

If your Gripper has the **Ethernet/IP** communication protocol option, you should see the screen shown in figure 5.6.1.1, when a connection is established with the Gripper.

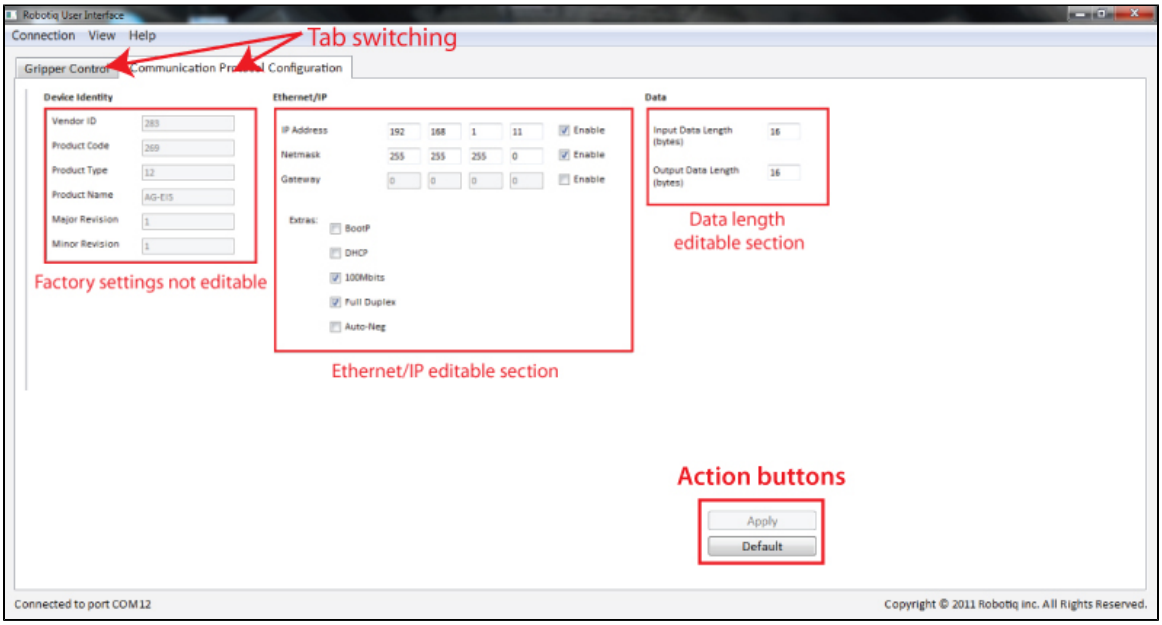


Figure 5.6.1.1: Default screen of the Configuration Tool with Ethernet/IP

The Configuration Tool with Ethernet/IP screen is described below:

- **Device Identity** section shows the factory settings of your Gripper, these settings are fixed.

- **Ethernet/IP** section shows the current address and options of your Gripper. You can change any option by enabling or disabling it and changing the values indicated in the fields.
  - **IP address** is the networking address used for communication with your Gripper. (IPv4 protocol)
  - **Netmask** is the networking subnet address used for communication with your Gripper.
  - **Gateway** is the gateway address used within your network. By default this option is disabled.
  - **Extras:**
    - **BootP** option for Bootstrap Protocol, a network protocol used to obtain an IP address from a configuration server. By default BootP is disabled.
    - **DHCP** option for Dynamic Host Configuration Protocol is an automatic configuration protocol used on IP networks. By default DHCP is enabled.
    - **100Mbits** option for the standard speed of Fast Ethernet (100 Mbit/s). By default it is enabled. If disabled the standard speed goes to 10 Mbit/s.
    - **Full Duplex** option allows full duplex communication (simultaneous two way communication); by default the Full Duplex is enabled. If disabled it goes to half duplex (not simultaneous two way communication).
    - **Auto-Neg** option allows the two connected devices to choose common transmission parameters such as speed, duplex mode, and flow control. The highest performance parameters will be chosen. By default the Auto-Neg is disabled.

- **Data** section shows the current data length used in input and output during communication.
  - **Input Data Length** sets the number of bytes allocated to input data communication.

- **Output Data Length** sets the number of bytes allocated to output data communication.

> **Hint**
> You should match the Input and Output data length to the robot I/O on which the Gripper is mounted.

- The support section buttons :
  - **Help** will pop-up the link to Robotiq support, where you can navigate the Adaptive Gripper manual for help or post comments for help. You can also access the Robotiq User Interface version you are using via the **About Robotiq User Interface** button.
- **Quit** or the "X" on the top-right corner will leave the program.

The action buttons function in the following manner:

- To apply the changes made in the editable section, click on **Apply** button.

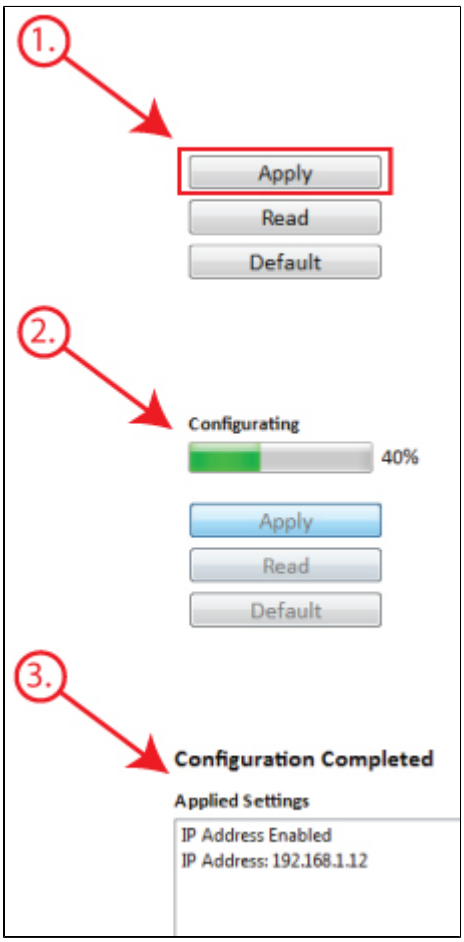


Figure 5.6.1.2: Applying the changes, this example changed the default IP of the Adaptive Gripper.

- To read the current settings of the Gripper, click on the **Read** button.
- To apply the default settings, click on the **Default** button and then click on the **Apply** button.

5.6.2 Modbus TCP

If your Gripper has the **Modbus TCP** communication protocol option, you should see the screen shown in figure 5.6.2.1, when the connection is established with the Gripper.

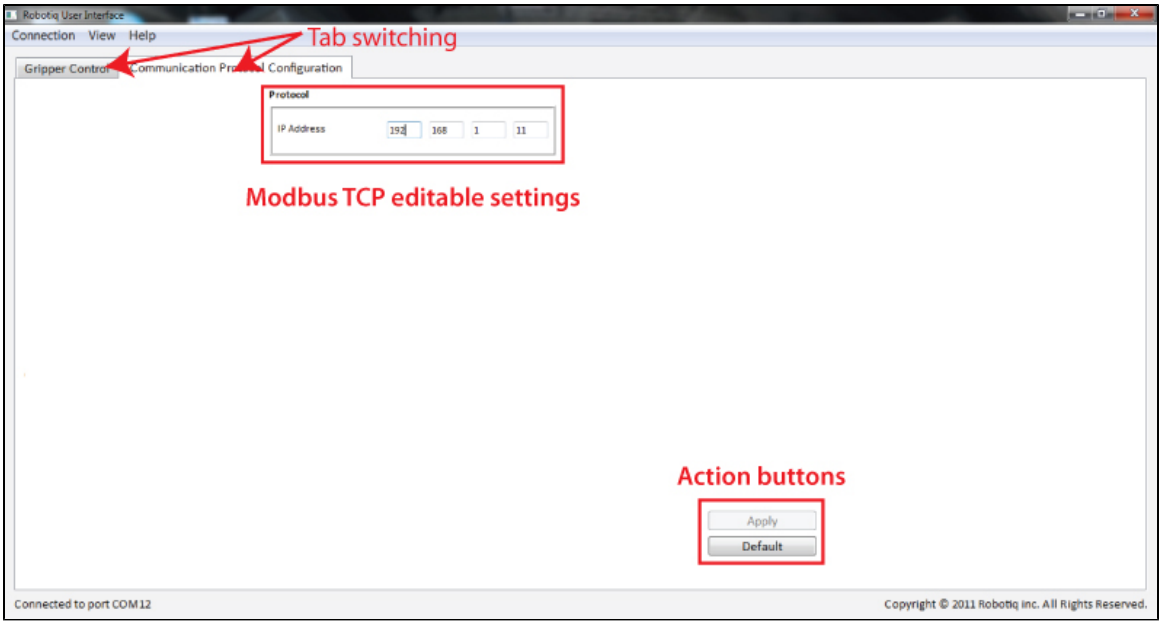


Figure 5.6.2.1: Default screen for the Configuration Tool with Modbus TCP

The Configuration Tool with Modbus TCP screen is described below:

- **Device Identity** case shows the factory settings of your Gripper, these are fixed.
- **Modbus TCP** case shows the current address and options of your Gripper, you can change any option by enabling or disabling it or by changing the values indicated in the fields.
    - **IP address** shows the current networking address used for communication with your Gripper.(IPv4 protocol)
- The support section buttons :
    - **Help** will pop-up the link to Robotiq support, where you can navigate the Adaptive Gripper manual for help or post comments for help. You can also access the Robotiq User Interface version you are using via the **About Robotiq User Interface** button.
- **Quit** or the "X" on the top-right corner will leave the program.

The action buttons are used in the following manner:

- To apply the changes made in the editable section, click on the **Apply** button.

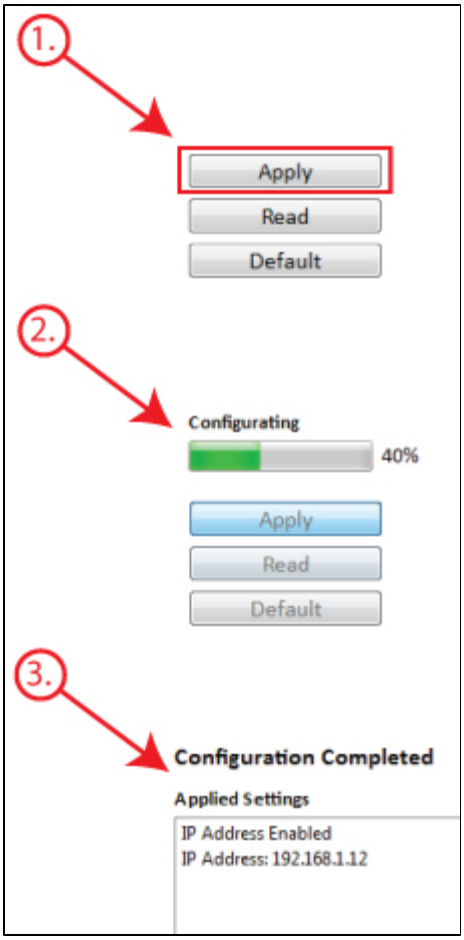


Figure 5.6.2.2: Applying the changes, this example changed the default IP of the Adaptive Gripper.

- To read the current settings of the Gripper, click on the **Read** button.
- To apply the default settings, click on the **Default** button and then click on the **Apply** button.

5.6.3 DeviceNet

If your Gripper has the **DeviceNet** communication protocol option, you should see the screen shown in figure 5.6.3.1, when a connection is established with the Gripper.

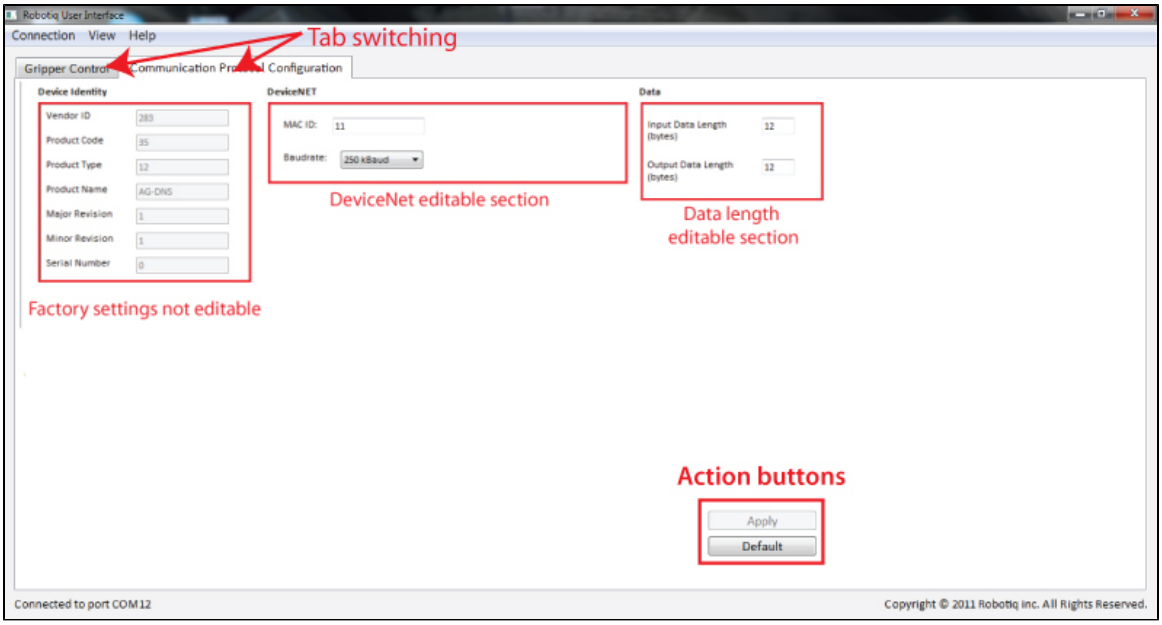


Figure 5.6.3.1: Default screen of the Configuration Tool with DeviceNet

The Configuration Tool with the DeviceNet screen is described below:

- **Device Identity** case shows the factory settings of your Gripper, these are fixed.
- **DeviceNET** section shows the current address and options of your Gripper. You can change any option by enabling or disabling it and by changing the values indicated in the fields.
  - **MAC ID** is the physical address used for communication with the Gripper. Default is set to 11.
  - **Baudrate** is the number of pulse/seconds for communications. The default is set to 250 Kbaud, you can adjust this to 125 Kbaud or 500 Kbaud.
- The support section buttons :
  - **Help** will pop-up the link to Robotiq support, where you can navigate the manual for help or post comments for help.
  - **Language** will change the language of the Configuration Tool interface.
    - **Français** will change the Configuration Tool interface to French.
    - **English** will change the Configuration Tool interface to English.
- **Quit** or the "X" on the top-right corner will leave the program.

The action buttons are used in the following manner:

- To apply the changes made in the editable section, click on the **Apply** button.

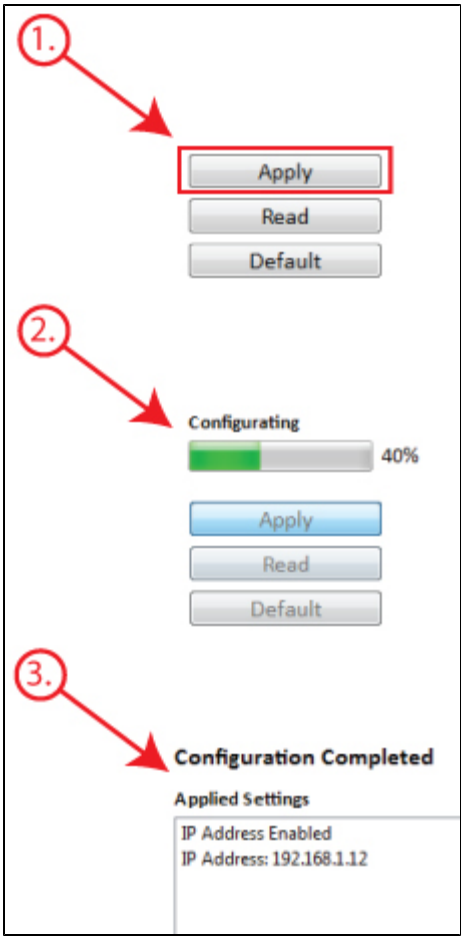


Figure 5.6.3.2: Applying the changes, this example changed the default IP of the Adaptive Gripper.

- To read the current settings of the Gripper, click on the **Read** button.
- To apply the default settings, click on the **Default** button and then click on the **Apply** button.

5.7 Menu Options

Connection menu:

- **Connect using Modbus RTU**: Robotiq User Interface will attempt to connect to the Gripper via Modbus RTU.
- **Connect using Modbus TCP**: Robotiq User Interface will attempt to connect to the Gripper via Modbus TCP.
- **Disconnect**: Will disconnect the connection to the Gripper without leaving the program.
- **Quit**: Will disconnect the connection to the Gripper and close the program.

View menu:

- **Xbox controls**: Will pop-up the Xbox Joystick Control diagram.
- **Input registers**: Will pop-up the Input registers tables, you can refer to section 4.7 for details
- **Output registers**: Will pop-up the Output registers tables, you can refer to section 4.6 for details

> You can close the pop-up of the "view" menu at anytime, the Robotiq User Interface will stay open.

Help menu:

- **Support**: Will link you to Robotiq support services.
- **About Robotiq User Interface**: Will display the Robotiq User Interface version you are using.

6. Specifications

6.1 Technical dimensions

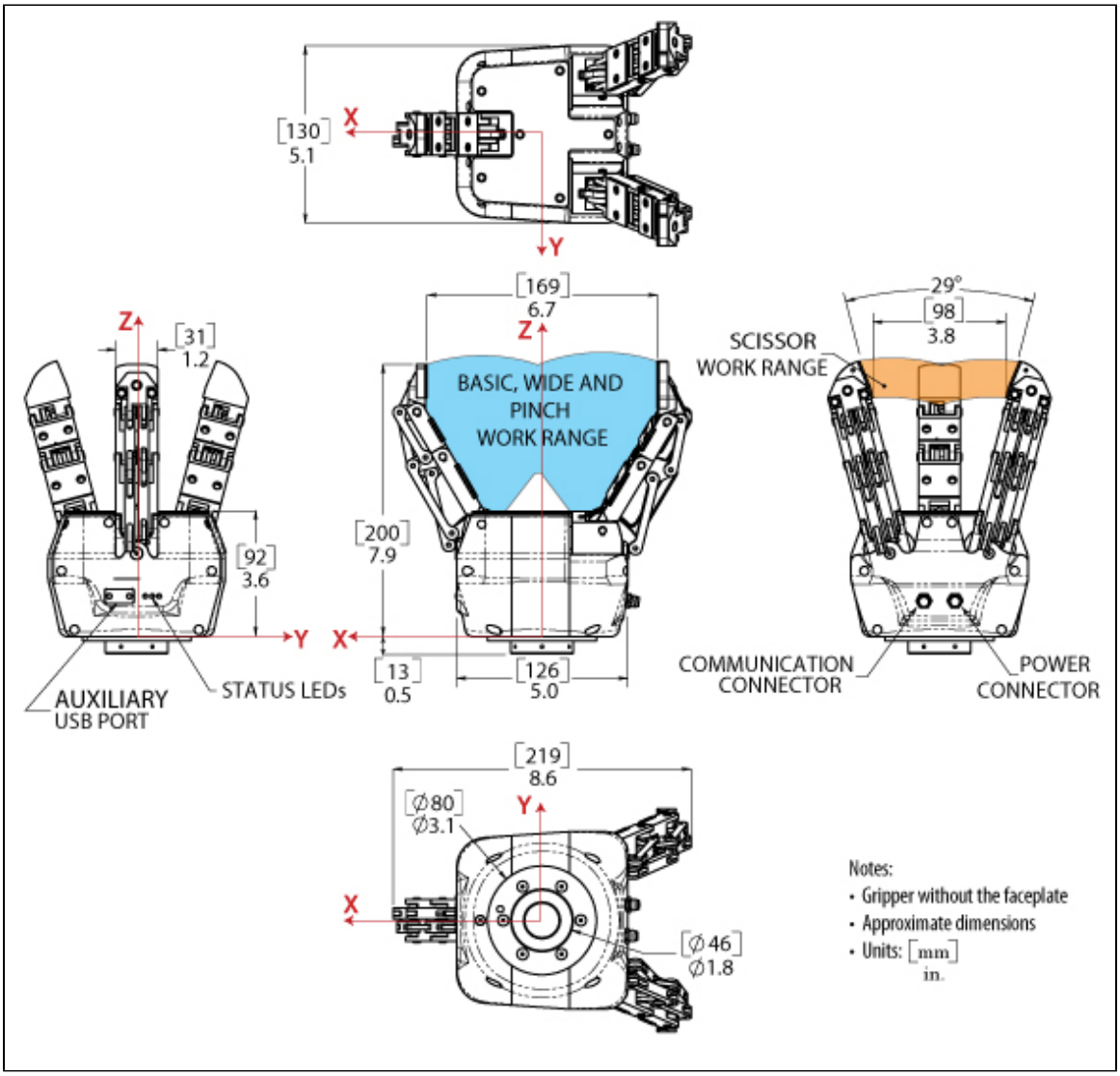


Figure 5.1 – Robotiq Gripper technical dimensions.

6.2 Mechanical specifications

Gripper Opening (see Figure 5.1)	0-6.7 in	[0-169 mm]
Gripper Approximate Weight	5 lbs	[2.3 kg]
Recommended Payload (Encompassing Grip)	22 lbs	[10 kg]
Recommended Payload (Fingertip Grip)	6.6 lbs	[3 kg]
Maximum Grip Force (Fingertip Grip)	10 lbf	[40 N]
Maximum Break Away Force	22 lbf	[100 N]
Maximum Closing Speed (Fingertip Grip)	4.3in/sec	[110mm/sec]

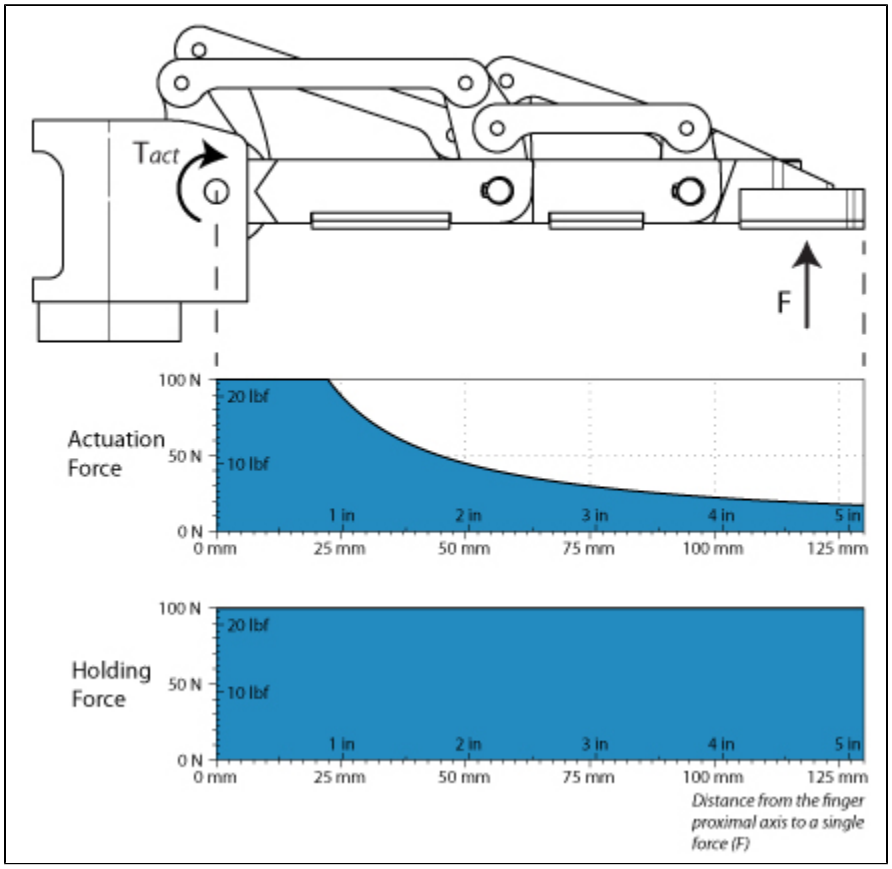


Figure 5.2 – Action and Holding Forces allowed in a single finger.

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 5.2).
- 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.

7. Maintance and service

6.3 Moment of inertia and center of mass

The coordinate system used for calculating the moment of inertia and center of mass of the gripper is shown in Figure 5.1. We consider a configuration where the fingers are fully open in Wide Mode.

Here is the approximate moment of inertia matrix of the 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:

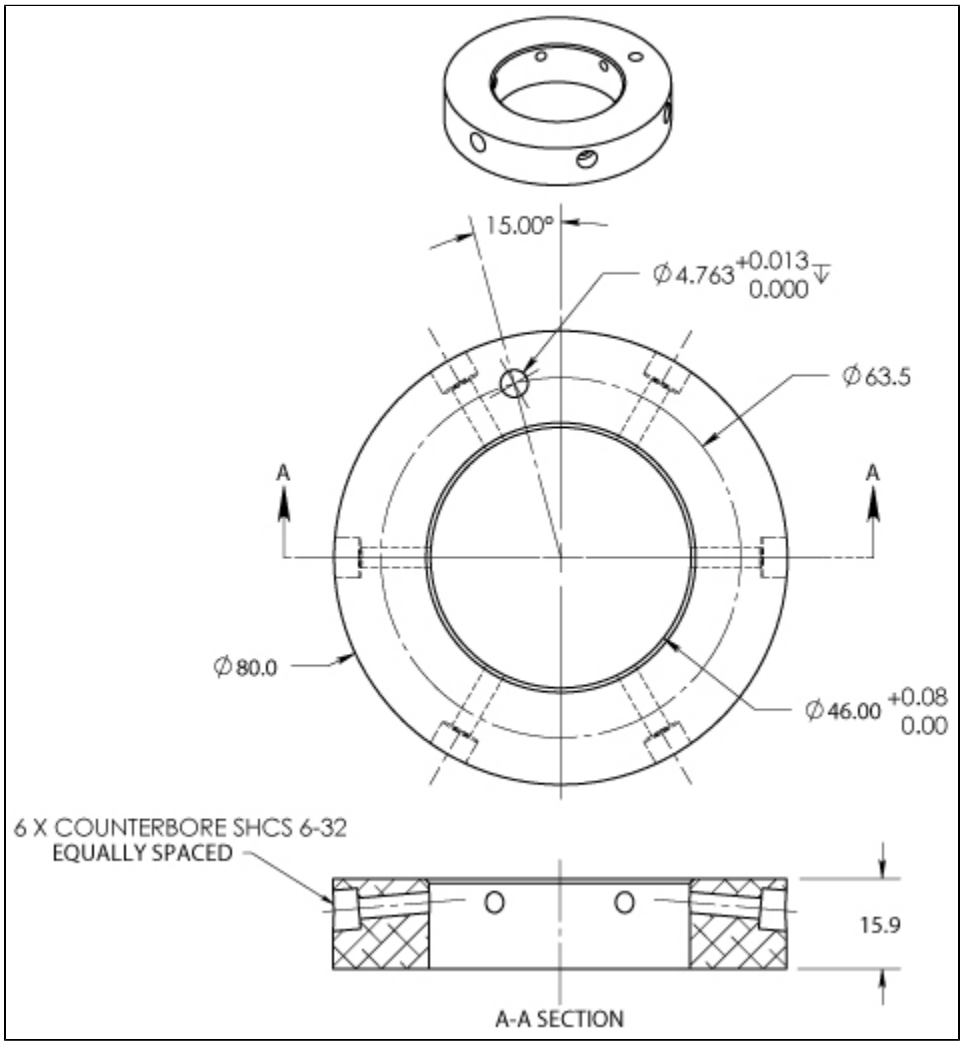
$$G = \begin{bmatrix} G_x \\ G_y \\ G_z \end{bmatrix} = \begin{bmatrix} -8 \\ 0 \\ 65 \end{bmatrix} mm = \begin{bmatrix} -0.031 \\ 0 \\ 2.560 \end{bmatrix} in$$

6.4 Electrical ratings

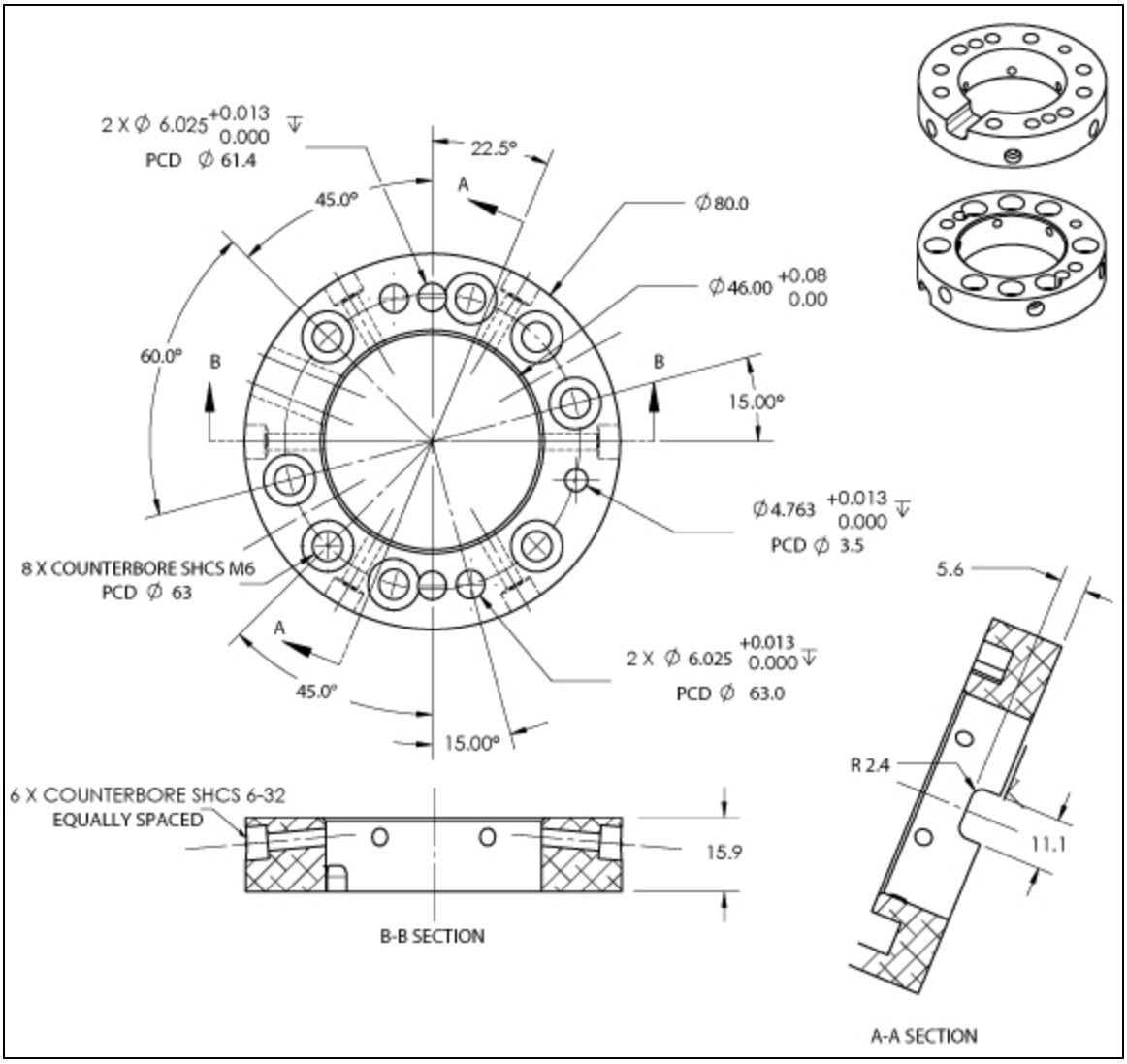
Nominal Supply Voltage	24 V
Quiescent Power (minimum power consumption)	4.1 W
Peak Power (at maximum gripping force)	35 W
Maximum RMS Supply Current (supply voltage at 24V)	1.4 A

6.5 Faceplates

6.5.1 Blank faceplate



6.5.2 Yaskawa SDA-5D_10D faceplate


2 X Ø 6.025 +0.013 0.000
PCD Ø 61.4
22.5°
45.0°
A
Ø80.0
Ø46.00 +0.08 0.00
60.0°
B
B
15.00°
Ø4.763 +0.013 0.000
PCD Ø 3.5
8 X COUNTERBORE SHCS M6
PCD Ø 63
A
2 X Ø 6.025 +0.013 0.000
PCD Ø 63.0
45.0°
15.00°
6 X COUNTERBORE SHCS 6-32
EQUALLY SPACED
15.9
B-B SECTION
5.6
R 2.4
11.1
A-A SECTION

7. Warranty

Robotiq warrants this equipment 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.

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 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.

8. Contact

www.robotiq.com

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