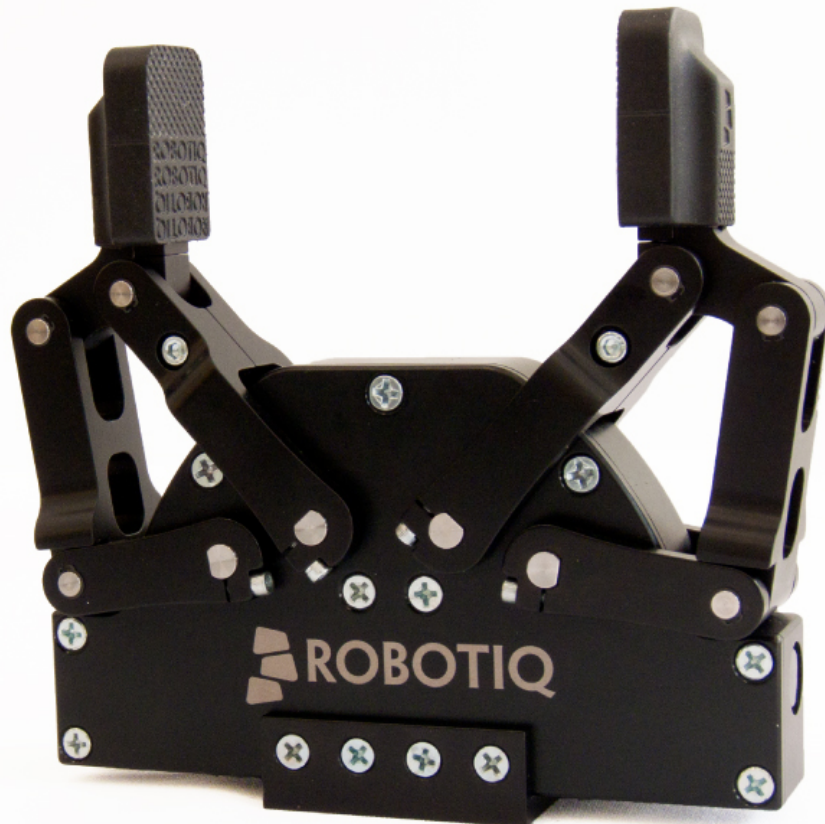

Robotiq Adaptive Gripper, C-Model Instruction Manual



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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 2013/02/06

Section added : Communication with UR robots
Minor modifications

Revision 2012/10/18

Official release

Revision 2012/03/02

Beta release

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

1. General Presentation

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

The C-Model has two articulated fingers, i.e. finger A in front of finger B, that each have two joints (two phalanges per finger), as shown in Figure 1.1. The Gripper can engage up to five points of contact with objects (two on each of the phalanges plus the palm). The fingers are under-actuated, meaning they have fewer motors than the total number of joints. This configuration allows the fingers to automatically adapt to the shape of the object they grip and it also simplifies the control of the Gripper.

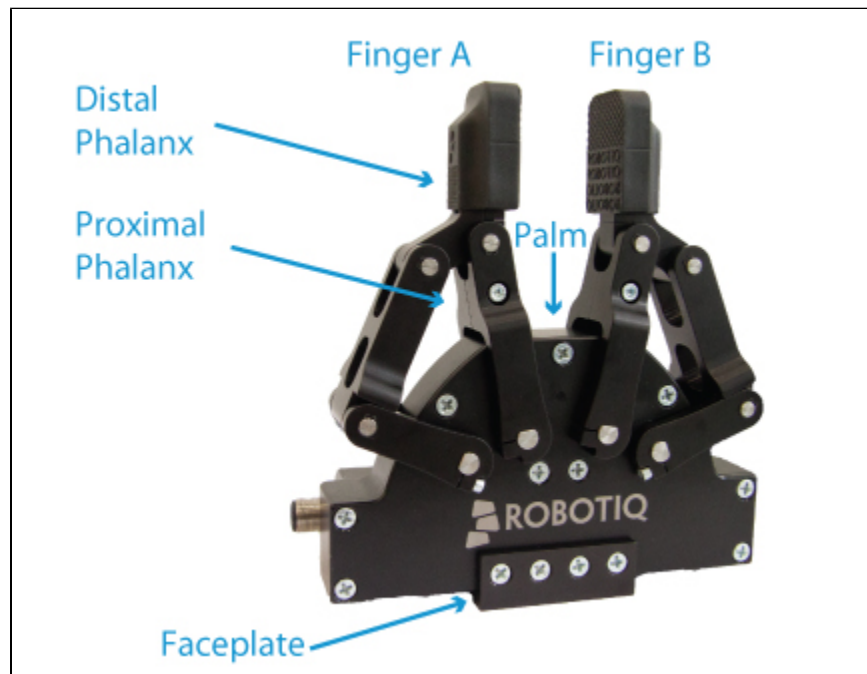


Figure 1.1 : The Adaptive Gripper C-Model.

The C-Model has a single actuator for opening and closing the fingers, the fingers automatically adapt to the shape of the object manipulated. Fingers will adopt either a parallel grip or encompassing grip as shown in figure 1.2.

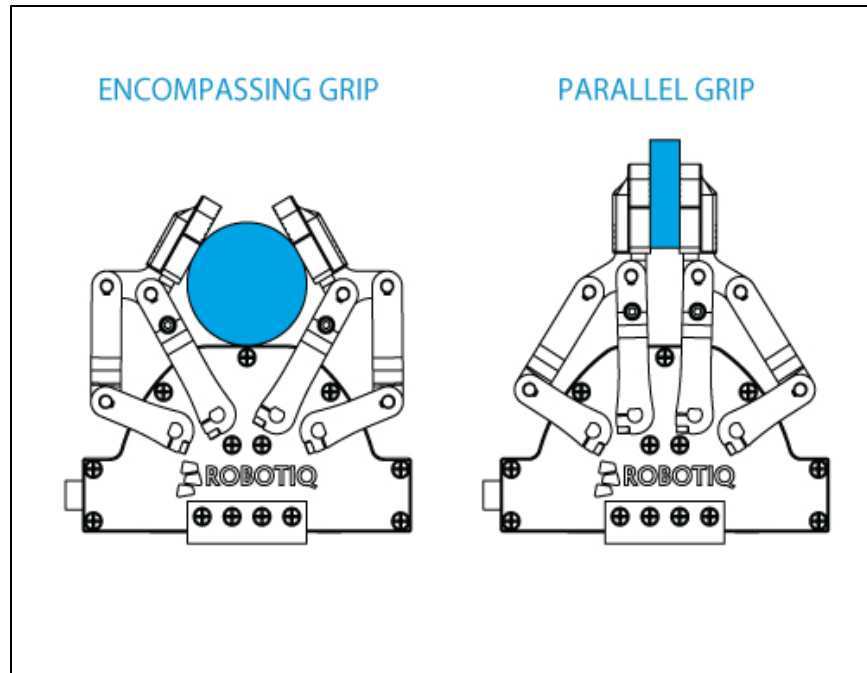


Figure 1.2 : The Adaptive Gripper C-Model.

It is important to note that a fingertip grip can only be performed when the fingers touch the object with the distal phalanges first. Inversely, for an encompassing grip, the fingers must touch the object with the proximal or the lower section of the distal phalanges first. Also, to ensure stability, the object should be held against the Gripper palm before performing an encompassing grip.

i Info

Closing or opening is done via "Go to requested position" command and is input to the Gripper.

Whether the fingers close to produce an encompassing or fingertip grip is decided at the Gripper level automatically. It will depend on:

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

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

The Adaptive Gripper C-Model also offers external gripping. The fingers can pick hollow parts by applying pressure with the outside of the fingers. See Figure 1.3 for representation and see [section 4.6](#) for details on the possible positions commands of your Gripper.

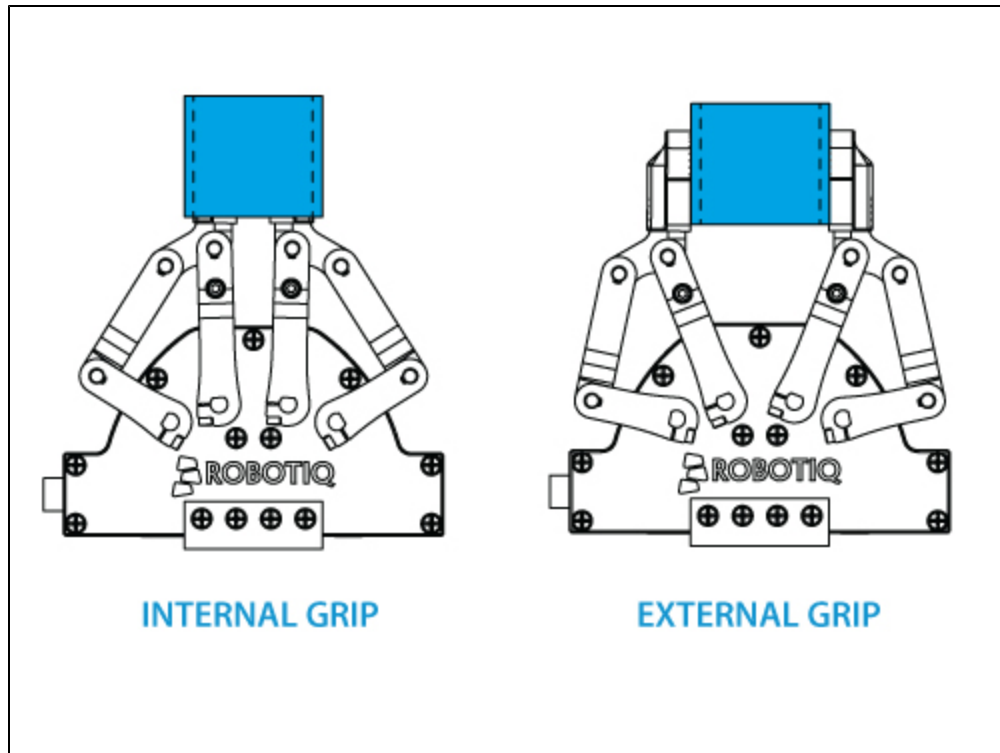


Figure 1.3 : The Adaptive Gripper C-Model internal and external gripping.

The Gripper is powered and controlled via the Robotiq Controller (Adaptive Gripper C-Model Controller). Upon delivery your controller will be set with the adequate communication option and ready to use. The details on the controller wiring and usage are described in [section 3](#) and [section 4](#).

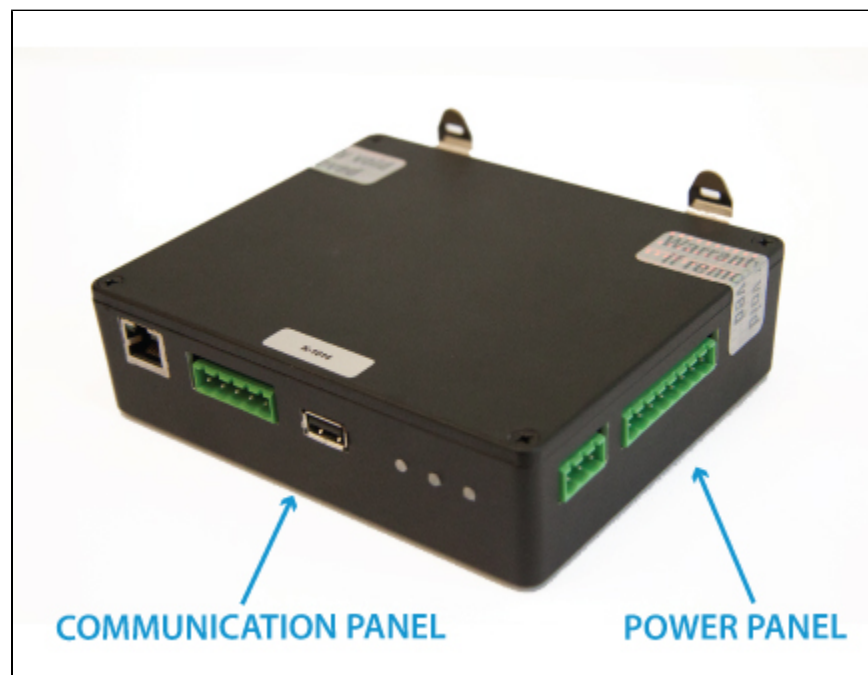


Figure 1.4 : The Adaptive Gripper C-Model Controller.

The Robotiq C-Model equilibrium line is the gripping region that separates the encompassing grip from the parallel

grip. When gripping an object close enough to the inside (palm) of the Gripper, the encompassing grip will occur (unless the object size or shape is not adequate) and the fingers will close around the object. If gripped above the equilibrium line, the same object will be picked up in a parallel grip and the fingers will close with a parallel motion.

Info

The same pattern applies for an inside grip.

The following figure shows the **encompassing grip region**, the **equilibrium line**, and the **parallel grip region** on the C-Model finger pad:

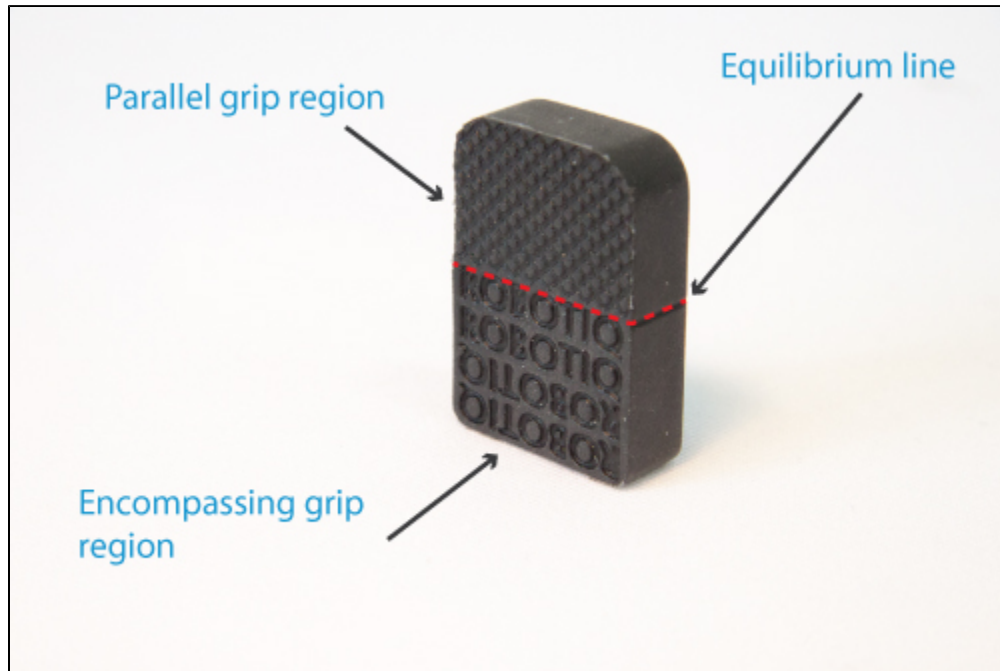


Figure 1.5 : Equilibrium line for the C-Model finger pad.

2. Safety

Warning

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

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

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

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 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 C-Model prior to installation.

Warning

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

3.1 Environmental and operating conditions

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

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 or Robotiq can create a custom version for you. (Please refer to the [Faceplate Specification Section](#) for details on different faceplate models or see Robotiq support [Options and Spare Parts section \(coming soon\)](#))

Here are the steps to follow for the installation of the Gripper (see Figure 3.2.1). Note that all screws must be locked in place using medium strength thread locker (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. Attach the Gripper to the faceplate by aligning the indexing dowel pin with the associated hole.
3. Secure the Gripper with radial screws.

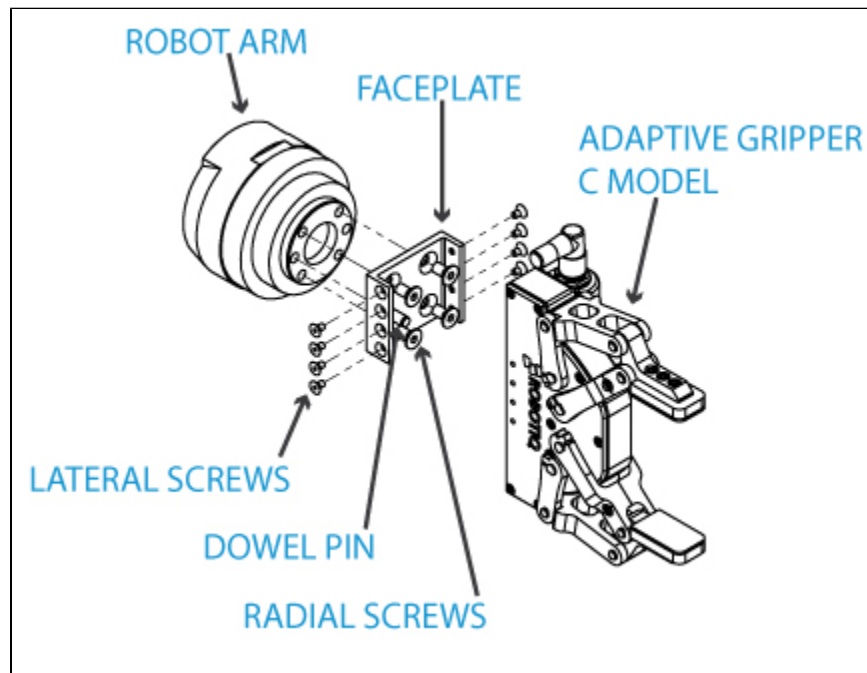


Figure 3.2.1 : Attaching the Adaptive Gripper C-Model to a robot arm with a faceplate.

The C-Model Controller Unit is equipped with DIN rail mounting clips and is designed to be clipped on #3 DIN rails. It is recommended to fix the Controller Unit inside the robot controller cabinet.

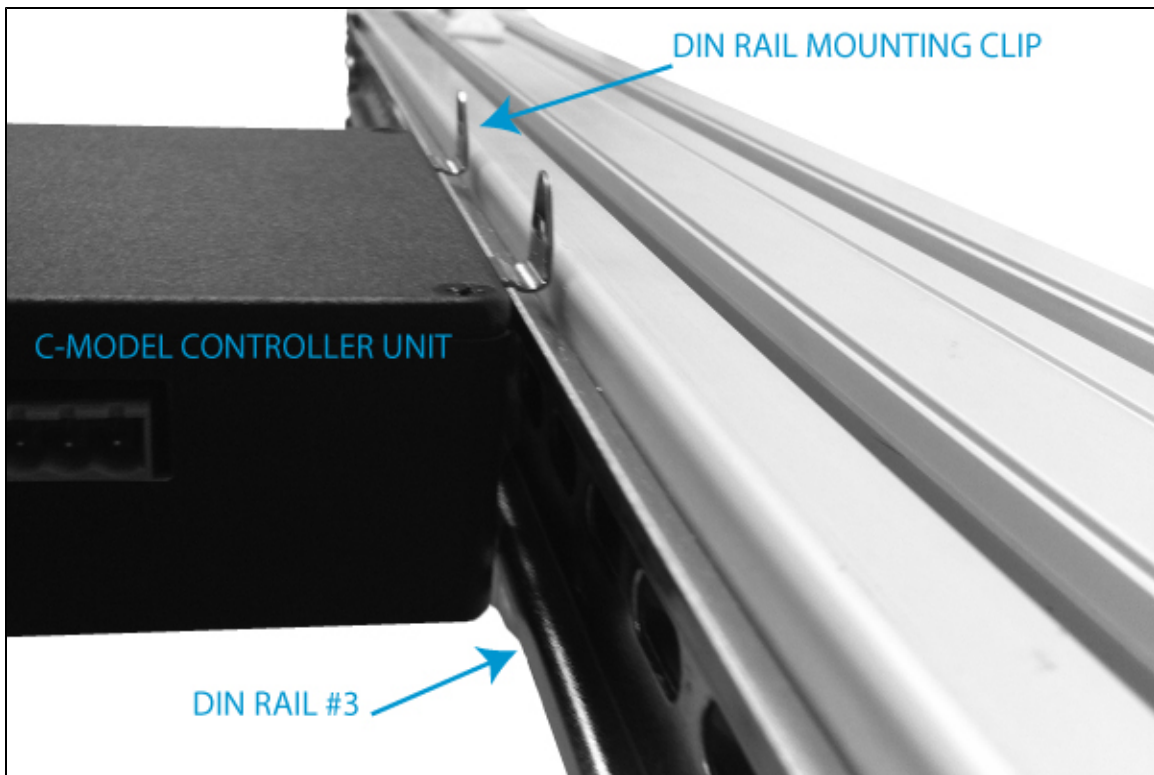


Figure 3.2.2 : C-Model Controller Unit fixed on DIN rails.

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.

Specification	Value
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 ² t factor	100 A ² s at 77°F [25°C]
Overvoltage protection	Not required ¹

1. The Gripper has built-in over-voltage protection.

3.4 Wiring

Two connections are needed for the Adaptive Gripper C-Model, one for the power and one for the communication. Power and communication are established to the Robotiq C-Model Controller via the Controller Supply Cable and Communication cable (shown in figure 3.4.1). The Robotiq Adaptive Gripper C-Model is connected to the controller via a single Gripper Signal Cable (shown in figure 3.4.2).



Figure 3.4.1 – The Robotiq C-Model Controller communication panels.

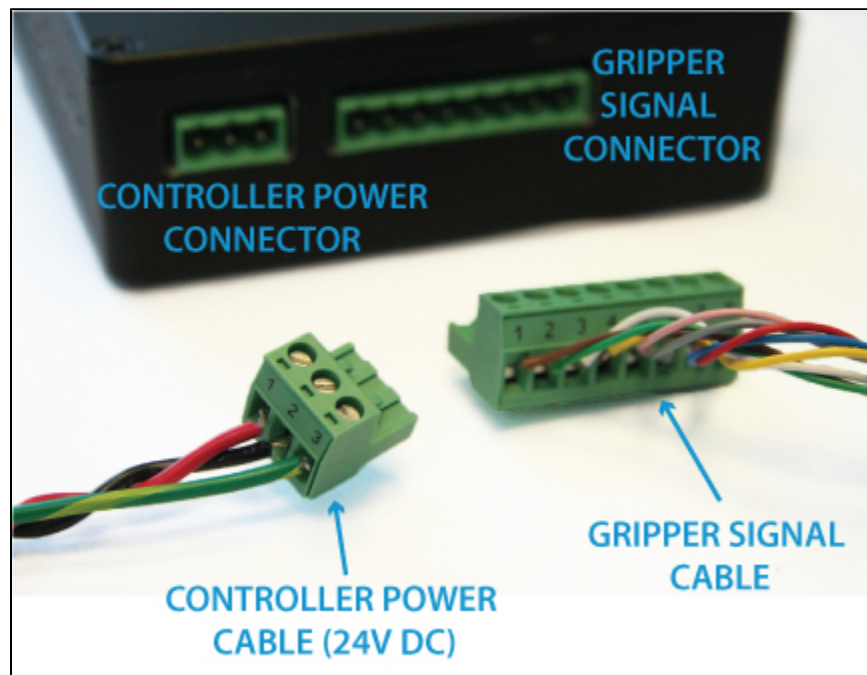


Figure 3.4.2 – Power connection and Gripper Signal Cable of the Robotiq Adaptive Gripper C-Model controller.

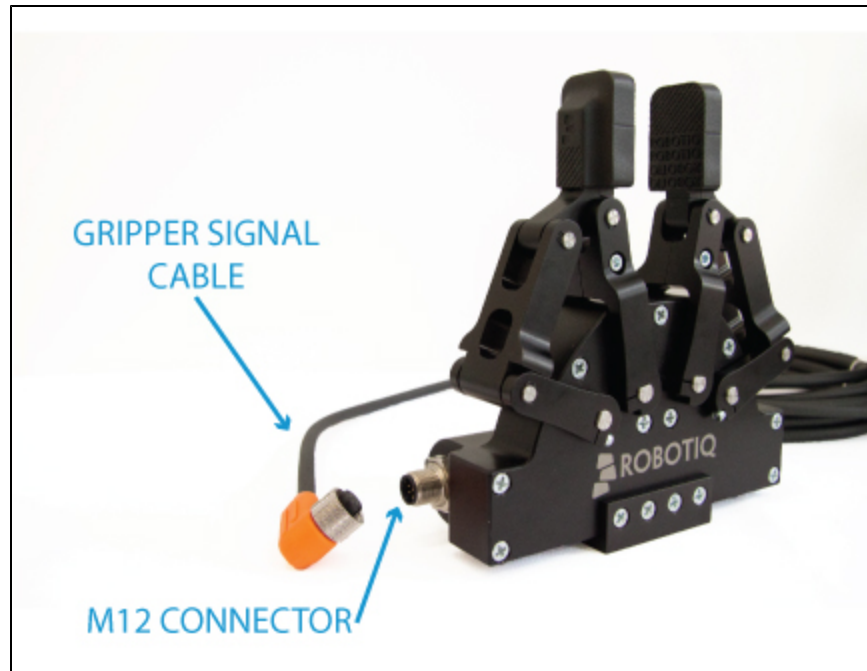


Figure 3.4.3 – Gripper Signal Cable of the Robotiq Adaptive Gripper C-Model controller.

Warning

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

3.4.1 Power connection

Here is the way the Gripper should be connected to a power source (Figure 3.4.1.1).

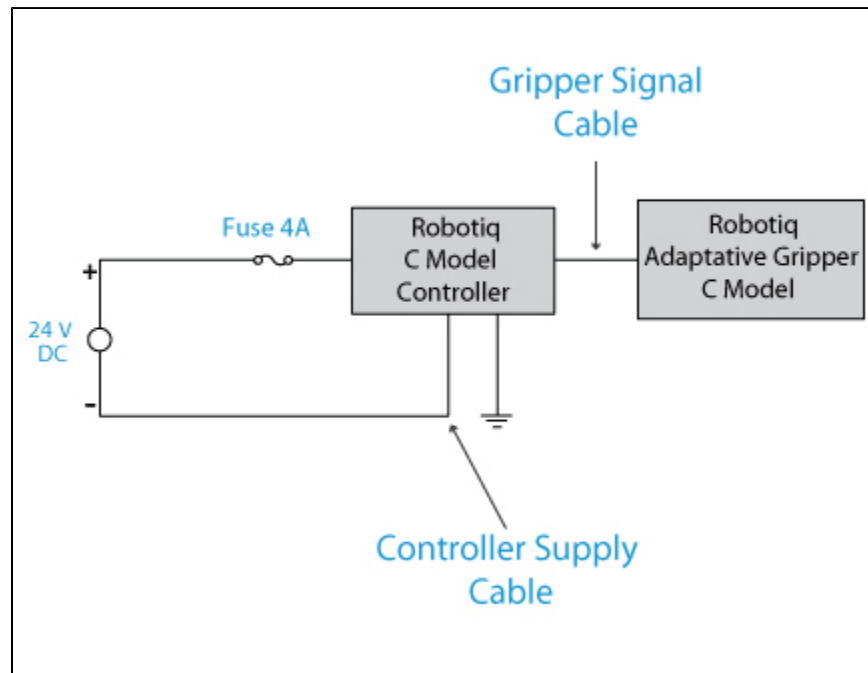


Figure 3.4.1.1 – Power connection diagram of the Adaptive Gripper.

⚠ Caution

The 4A fuse is external to the Gripper and Gripper Controller. 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 3.4.1.2.

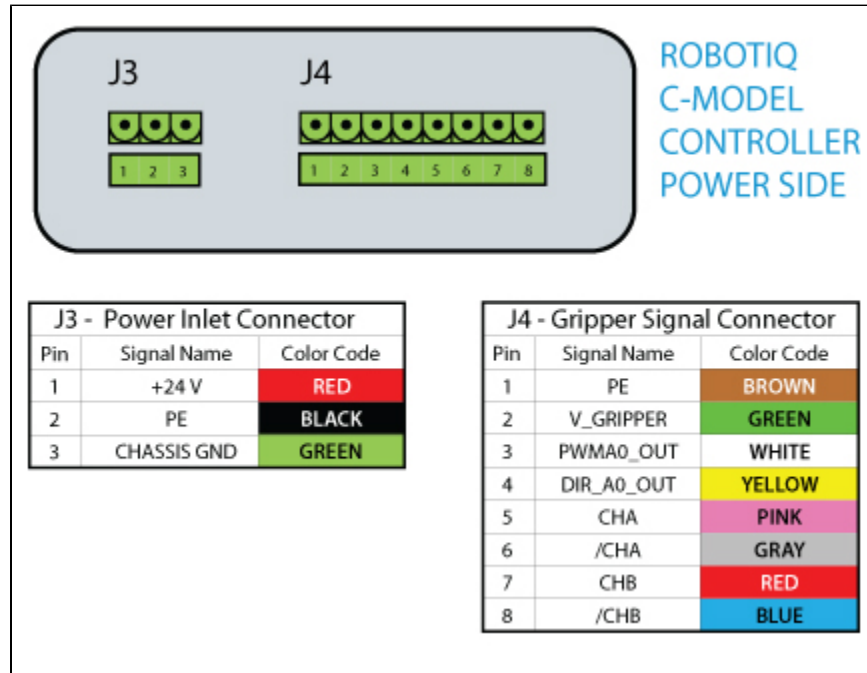


Figure 3.4.1.2 – Gripper Power Inlet and Power Connector.

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 for 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	<ul style="list-style-type: none"> • EtherNet / IP • Modbus TCP/IP • EtherCAT
Fieldbus	<ul style="list-style-type: none"> • DeviceNET • CANopen
USB	Modbus RTU

The Robotiq C-Model Controller is used for all communication protocols. The Controller will be setup for your options with a single communication protocol even though other communication pin-out will be present.

The figure 3.4.2.1 shows the communication side of the Robotiq Adaptive Gripper C-Model Controller. The J1 pinout will be used for all of the Real-Time Ethernet protocols while J2 pinout will be used for DeviceNet and CANopen.

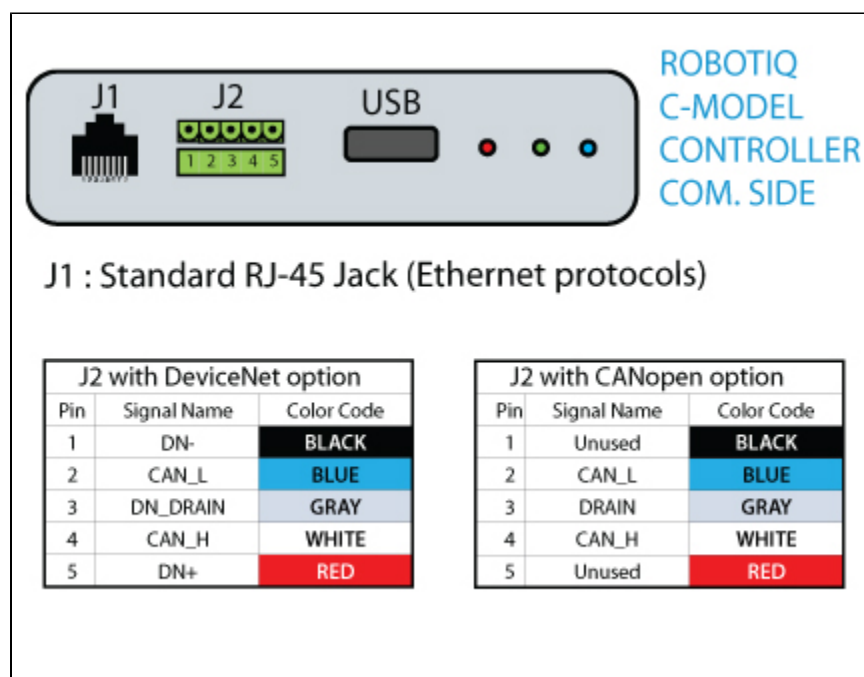


Figure 3.4.2.1: Representation of the communication panel of the Robotiq Adaptive Gripper C-Model Controller with pinout signal and color.

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

The DeviceNet communication is established via the J2 pin-out. [Figure 3.4.2.1](#) shows the pin-out for the DeviceNet communication protocol for the receptacle (male) present on the Adaptive Gripper C-Model Controller.

Note

The DeviceNet and CANopen use the same pinout but only one of the two will be working depending on your communication protocol choice.

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 Gripper use 24 V power supply. Robotiq suggests to separate power supplies as shown in [Figure 3.4.2.2](#).

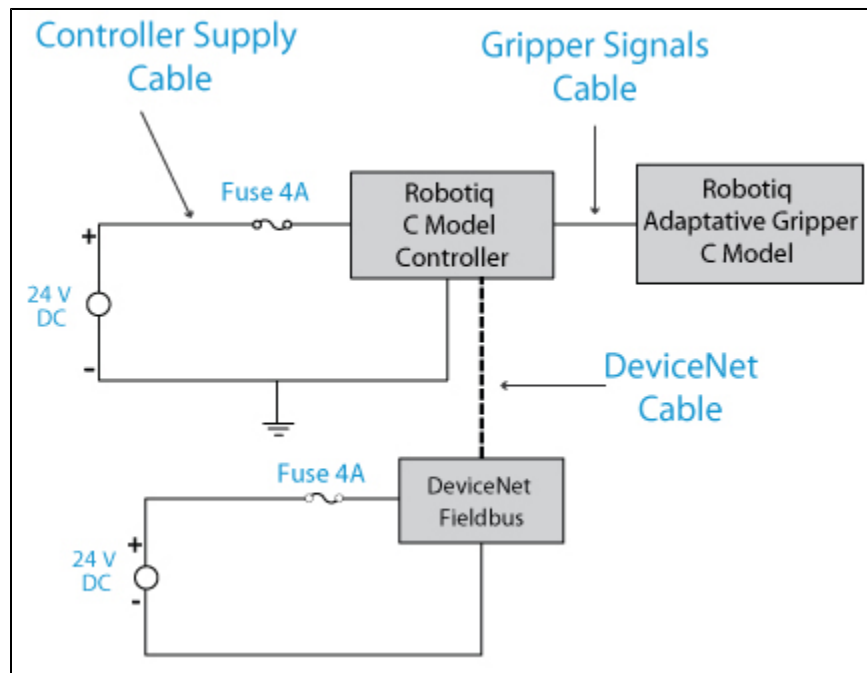


Figure 3.4.2.2 – Power connection diagram of the Adaptive Gripper C-Model using DeviceNet Fieldbus.

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	AG-DNS

BUS SETTINGS	
MAC ID :	11
Baud Rate :	250 kBaud

DATA SETTINGS	
Prod. Data Length :	6
Cons. Data Length :	6

**Hint**

Mac Address settings and Baud Rate settings can be set on the Robotiq Controller using the Robotiq UI. See the [User Interface](#) section for details.

CANopen communication protocol

The CANopen communication is established via the J2 pin-out. [Figure 3.4.2.1](#) shows the pin-out for the CANopen communication protocol for the receptacle (male) present on the Adaptive Gripper C-Model Controller.

Note

The DeviceNet and CANopen use the same pinout but only one of the two will be working depending on your communication protocol choice.

Caution

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

Factory settings for CANopen 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	
Node Adress :	11
Baud Rate :	1 MBaud

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

Hint

Node Address settings and Baud Rate settings can be set on the Robotiq Controller using the Robotiq UI. See the [User Interface](#) section for details.

Hint

The CANopen communication interface supports SDO (Service Data Object) and PDO (Process Data Object) protocols.

Real-time Ethernet communication protocols

The Real-time Ethernet communication protocols are established via the J1 pin-out. [Figure 3.4.2.1](#) shows the pin-out of the RJ45 receptacle present on the Adaptive Gripper C-Model Controller.

Note

All Ethernet family protocols are using the same pinout but only one of will be working depending on your communication protocol choice.

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 :	0x0000FFFF	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 SETTINGS				
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 ¹	DHCP :	Disabled ¹
	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		

i Info

EtherCAT protocol uses inherent dynamic addressing thus bus settings cannot be customized.

EtherCAT	EtherNet / IP		Modbus TCP/IP
DATA SETTINGS			
Input Data Bytes :	6	Prod. Data Length :	10
Output Data Bytes :	6	Cons. Data Length :	10
			N / A
			N / A

✓ Hint

Mac Address settings and Baud Rate settings can be set on the Robotiq Controller using the Robotiq UI. See the [User Interface](#) section for details.

4. Control

4.1 Generalities

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

i Info

- The operator can control the force and the speed of the fingers.
- The finger's movement is always synchronized, movement is done with a single "Go to requested position" command (the motion of each mechanical phalanx is done automatically).

Since the Robotiq Adaptive Gripper C-Model has its own controller, high-level commands such as "Go to requested position" are used to control it. The Robotiq Adaptive Gripper C-Model Controller takes care of the regulation of the speed and the force prescribed, while the mechanical design of the fingers automatically adapt to the shape of object(s).

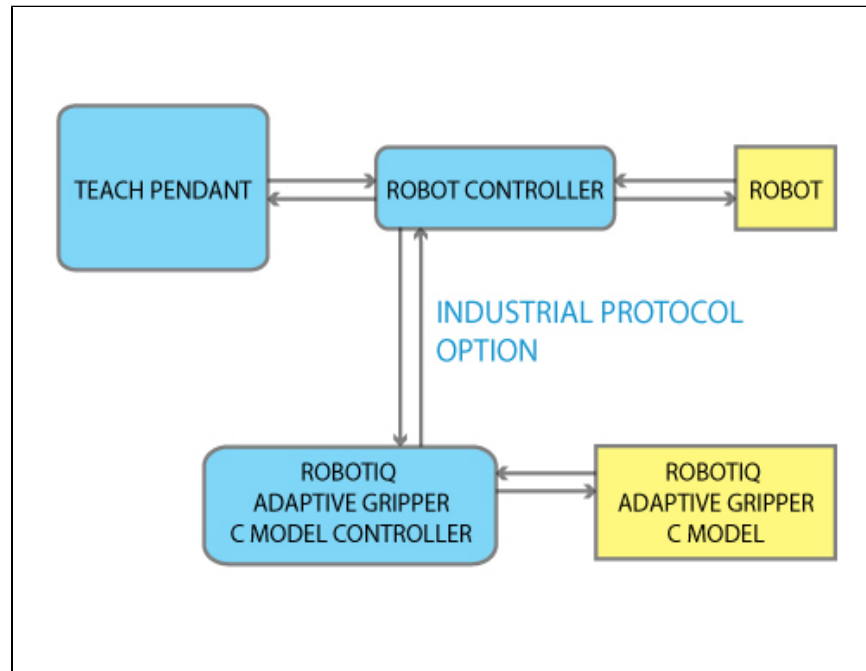


Figure 4.1.1 : Adaptive Gripper C-Model connections.

4.2 Status overview

The Adaptive Gripper C-Model returns several registers of information to the robot controller:

- **Global Gripper Status** - A global Gripper status is available. This gives information such as 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.
- **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** - The information of the encoder of the motor is also available.
- **Current Status** - The current of the motor can also be known. The force applied at the actuation linkage of the finger can be known from the current, since the torque of the motor is a linear function of the current.

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 4.3.1). 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.

i Info

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.

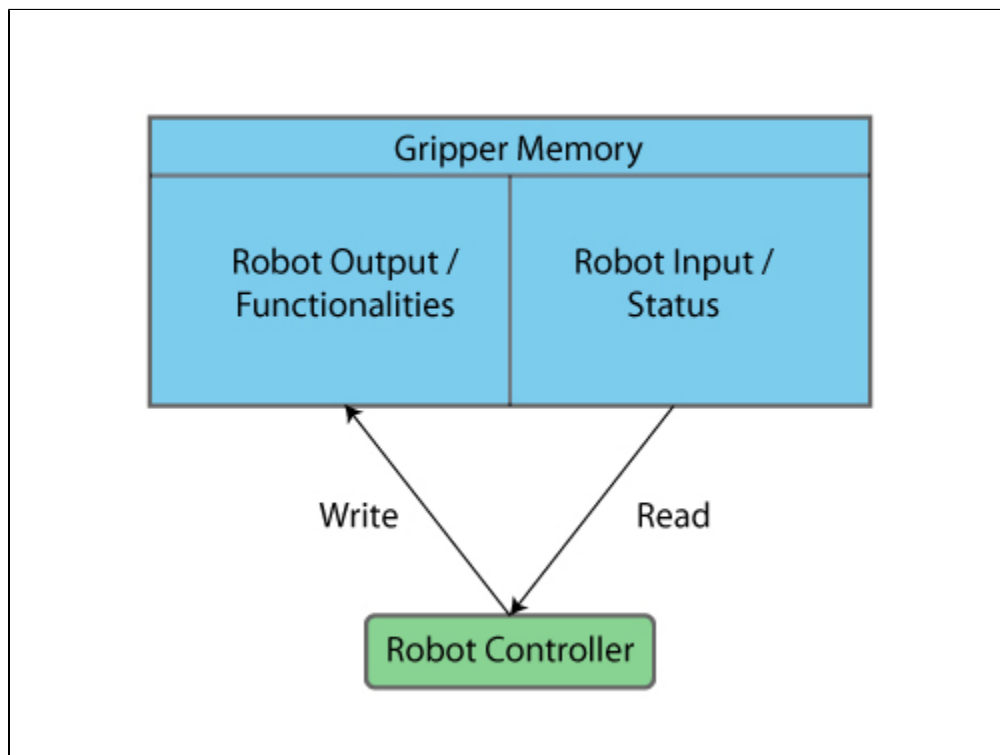


Figure 4.3.1 : Gripper memory shared with the robot controller.

4.4 Status LEDs

Three LEDs lights provide general information about the Gripper status on the controller communication panel. Figure 4.4.1 shows the LEDs and their locations.

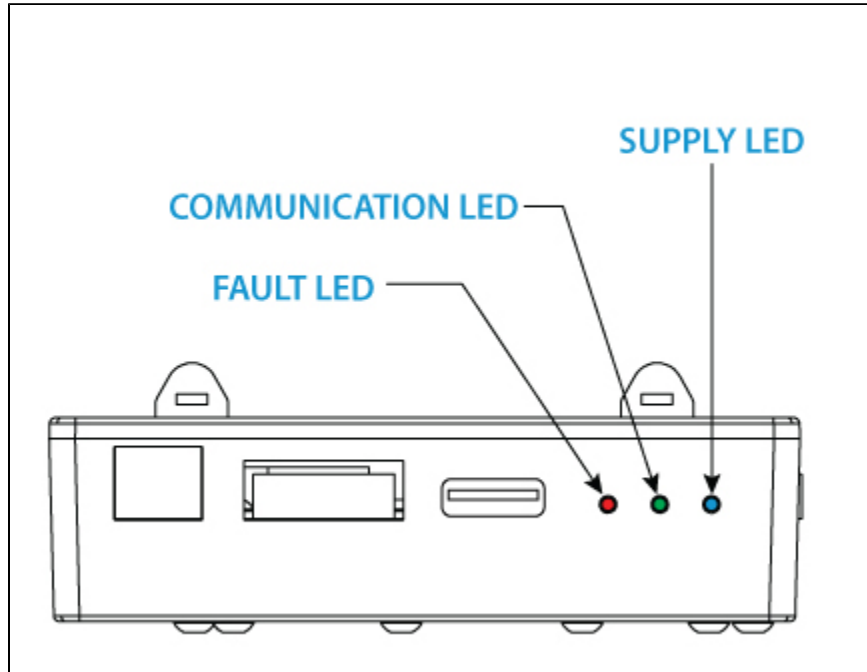


Figure 4.4.1 – Controller status LEDs.

There is an additional LED on the Gripper next to the connector shown in figure 4.4.2

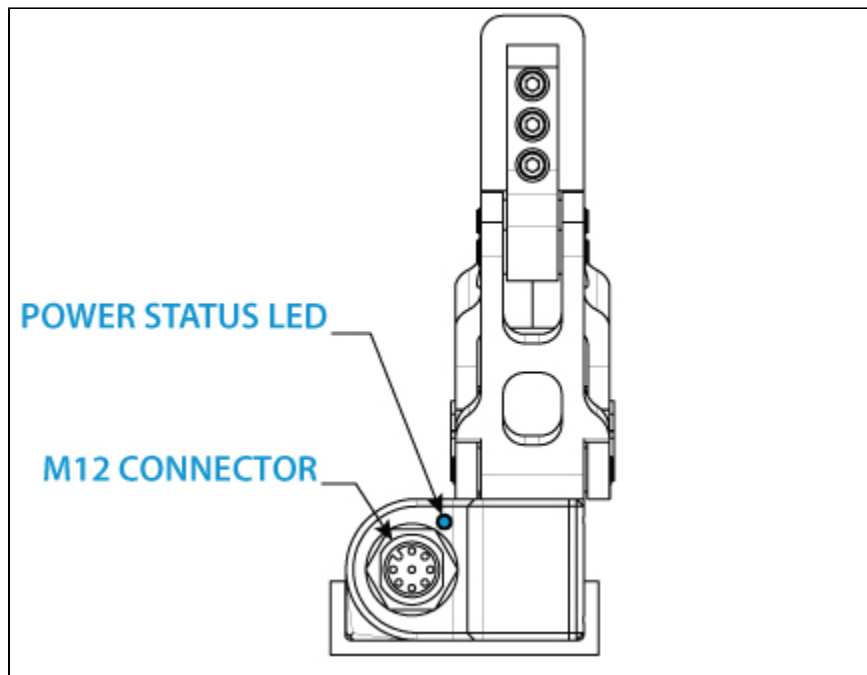


Figure 4.4.2 – Gripper status LEDs.

4.4.1 Supply and Power LEDs

The following applies to both the Controller supply LED and the Gripper power LED (both blue).

Color	State	Information
---	Off	No power supplied
Blue	On	Correctly supplied and the control board is running (for the control board LED)

4.4.2 Communication LED

Color	State	Information
---	Off	No network detected
Green	Blinking	A network has been detected, but no connection has been established
Green	On	A network has been detected and at least one connection is established

4.4.3 Fault LED

Color	State	Information
---	Off	No fault detected
Red	On	A minor fault occurred (or the Gripper is booting)
Red	Blinking	A major fault occurred

Info

A major fault refers to a situation where the Gripper must be reactivated, see [rACT bit](#) for details about activation procedures.

4.5 Gripper register mapping

Info

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

The Gripper firmware provides many functionalities such as the direct position control of the fingers via "go to" commands.

Register mapping:

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	RESERVED	RESERVED
Byte 2	RESERVED	FAULT STATUS
Byte 3	POSITION REQUEST	POS REQUEST ECHO
Byte 4	SPEED	POSITION
Byte 5	FORCE	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	rACT	0 – Reset Gripper 1 – Activate Gripper (Must stay on after activation routine is completed)
1	rRS1	RESERVED
2	rRS2	RESERVED
3	rGTO	0 – Stop 1 – Go to Requested Position
4	rATR	0 – Normal 1 – Automatic release
5 - 7	rRS3,rRS4,rRS5	RESERVED

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

Caution

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

Register: GRIPPER OPTIONS

Address: Byte 1

Bit	Name	Description
0 – 7	rRS6	Reserved


Register: GRIPPER OPTIONS 2

Address: Byte 2

Bit	Name	Description
0 – 7	rRS7	Reserved

rGTO: The "Go To" action moves the Gripper's fingers to the requested position using the configuration defined by the other registers. The only motions performed without the **rGTO** bit are the activation and the automatic release routines.

rATR: Automatic release routine action slowly opens the Gripper's fingers until all motion axes reach their mechanical limits. After the 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**).

 **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: POSITION REQUEST

Address: Byte 3

Bit	Name	Description
0 – 7	rPR	Set Position Request for the Gripper. 0x00 (Minimum position) to 0xFF (Maximum position)

This register is used to set the Gripper fingers' target position. The positions 0x00 and 0xFF correspond respectively to the fully opened and fully closed mechanical stops. Figure 4.6.1 represents the Position Request values and the corresponding distance between fingers while Figure 4.6.2 represent the actual trajectory of the fingers pads (width and height measurements are valid for the reference axis presented in [section 6.1](#)).

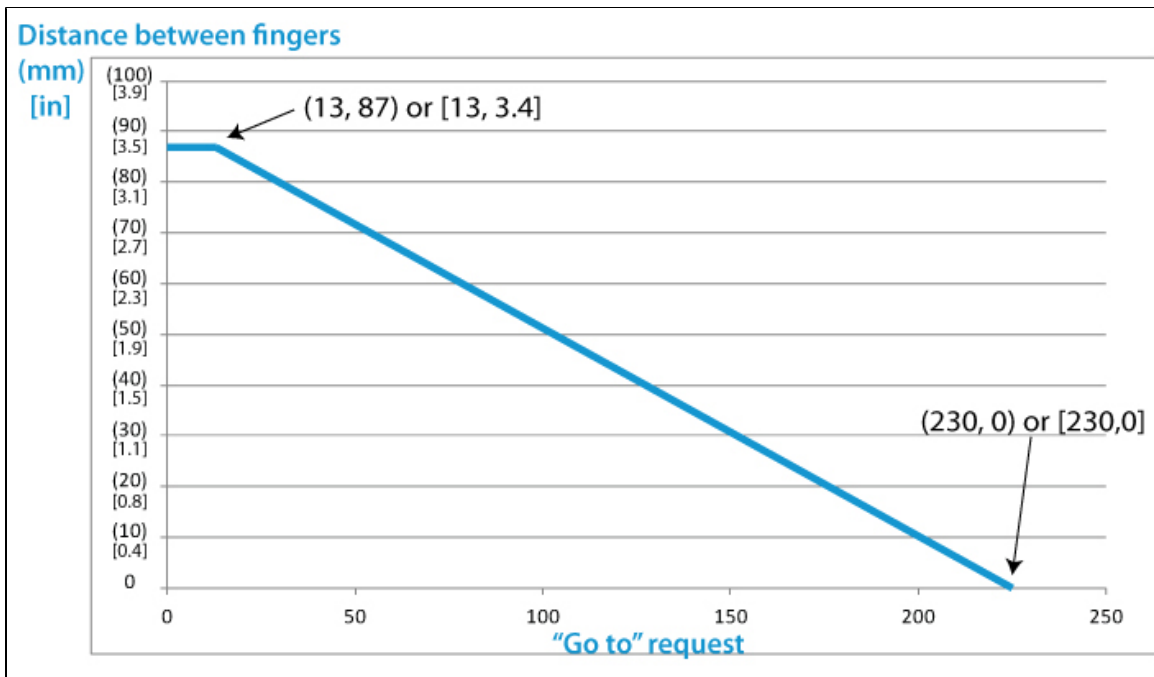


Figure 4.6.1 Position attained and corresponding position request command.

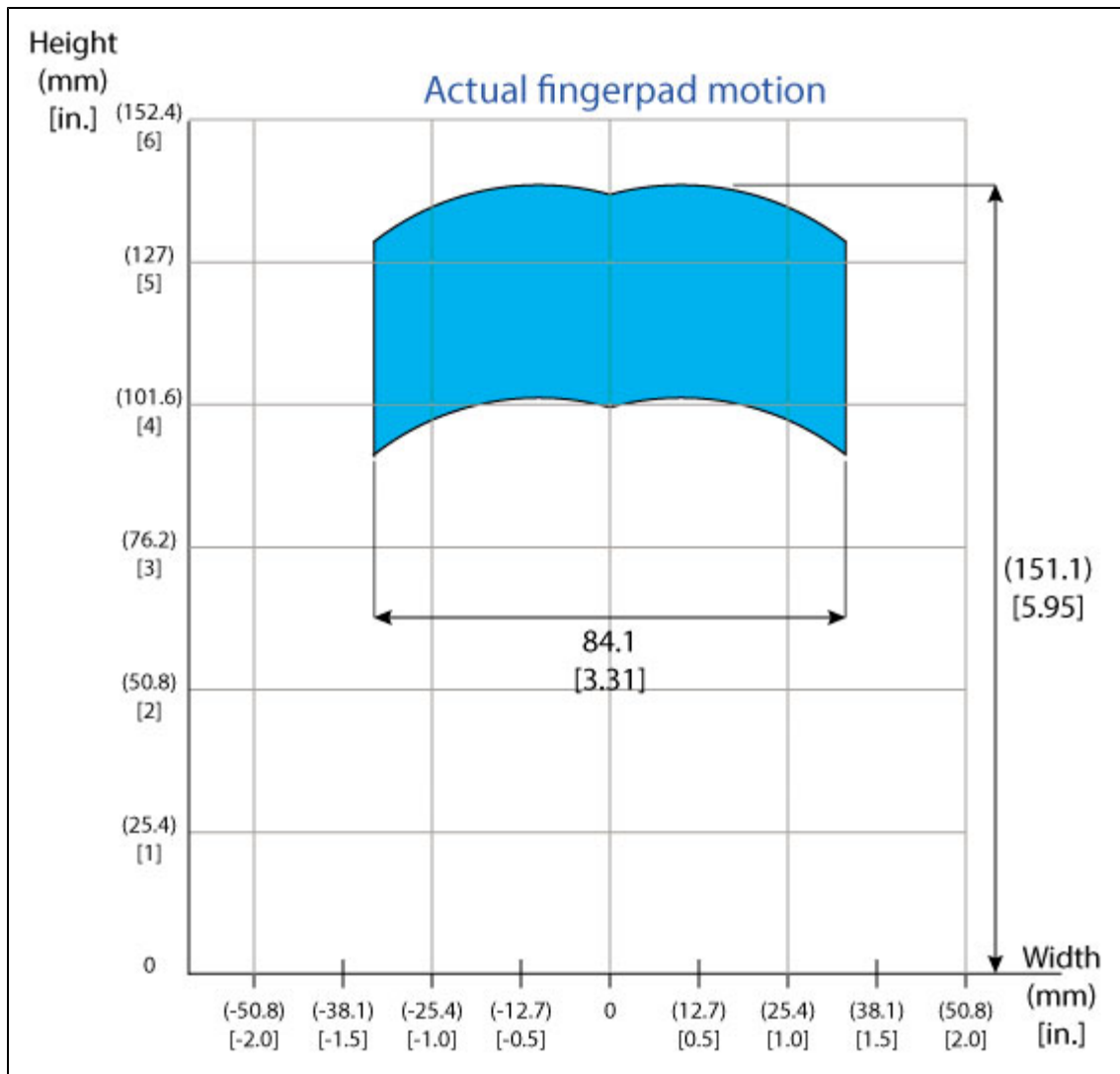


Figure 4.6.2 Trajectory of fingers pad corresponding to position request command.

Register: SPEED

Address: Byte 4

Bit	Name	Description
0 – 7	rSP	Set closing/opening speed of the Gripper. 0x00 (Minimum speed) to 0xFF (Maximum speed)

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

i Info

0x00 speed does not mean absolute zero speed. It is the minimum speed of the Gripper.
 Minimum speed: 13 mm/s
 Maximum speed: 100 mm/s
 Speed / count : 0.34 mm/s

Register: FORCE

Address: Byte 5

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

The force setting defines the final gripping force for the Gripper. The force will fix maximum current sent to the motor while in motion. If the current limit is exceeded, the fingers stop and trigger an object detection notification.

i Info

Force setting is overridden for a small distance 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: 30 N
- Maximum force : 100 N
- Force / count: 0.27 N (Approximate value, relation non-linear)

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	gACT	Initialization status (Echo of the rACT bit) : 0 – Gripper reset 1 – Gripper activation
1	gRS1	RESERVED
2	gRS2	RESERVED
3	gGTO	0 – Standby (or performing activation/automatic release) 1 – Go to Position Request
4	gSTA	Gripper status : 00 – Gripper is in reset (or automatic release) state. see Fault Status if Gripper is activated. 10 – Activation in progress. 01 – Not used. 11 – Activation is completed.
5		
6	gOBJ	Object detection status : 00 – Fingers are in motion (only meaningful if gGTO = 1) 10 – Fingers have stopped due to a contact while opening 01 – Fingers have stopped due to a contact while closing 11 – Fingers are at requested position
7		

Caution

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

✓ Tip

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

Register: RESERVED

Address: Byte 1

Bit	Name	Description
0 – 7	gRS3	RESERVED

Register: FAULT STATUS

Address: Byte 2

Bit	Name	Description
0 – 3	gFLT	0x00 – No Fault Priority Fault 0x05 – Action delayed, initialization must be completed prior to action 0x07 – The activation bit must be set prior to action Minor Fault (red LED continuous) 0x09 - The communication chip is not ready (may be booting) 0x0B – Automatic release in progress Major Fault (red LED blinking) – Reset is required 0x0E – Overcurrent protection triggered 0x0F – Automatic release completed
4 – 7	gRS4	Reserved (zeros)

Register: POSITION REQUEST ECHO

Address: Byte 3

Bit	Name	Description
0 – 7	gPR	Echo of the requested position for the Gripper 0x00 (Full Opening) to 0xFF (Full Closing)

Register: POSITION

Address: Byte 4

Bit	Name	Description
0 – 7	gPO	Position of Fingers 0x00 (Fully opened) to 0xFF (Fully closed)

Register: FINGER CURRENT

Address: Byte 5

Bit	Name	Description
0 – 7	gCU	Current of Fingers 0.1 * Current (in mA)

4.8 Example

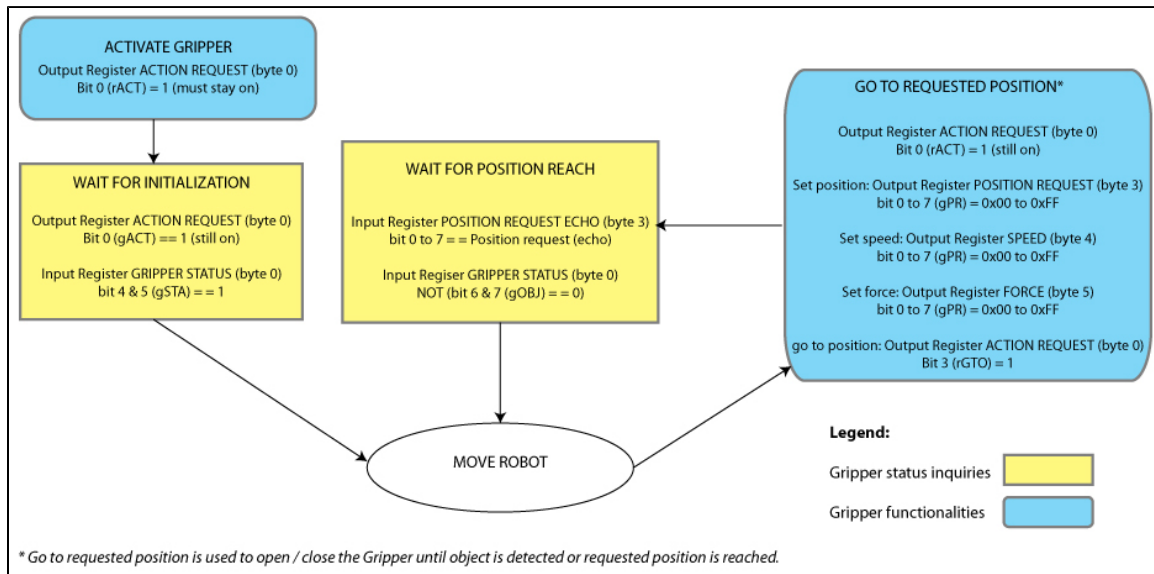


Figure 4.8.1 : Example of Adaptive Gripper C model registers.

4.9 MODBUS RTU communication protocol

The Gripper can be controlled over USB using the Modbus RTU protocol on the mini-USB port. This section is intended to provide guidelines for setting up a Modbus scanner that will adequately communicate with the Gripper.

For a general introduction to Modbus RTU and for details regarding the CRC algorithm, the reader is invited to read the Modbus over serial line specification and implementation guide available at: http://www.modbus.org/docs/Modbus_over_serial_line_V1.pdf.

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

4.9.1 Connection setup

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

PROPRIETY	VALUE
Physical Interface	USB (virtual serial connector) drivers can be found at ftdichip.com
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 Gripper. The first Gripper output Modbus register (0x07D0) is composed from the first **2** Robotiq Adaptive Gripper C 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 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:

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)

Note

The Adaptive Gripper C register values are updated at a 200Hz frequency. It is therefore recommended 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, speed, force, etc.

Ex: This message requests to initialize the Gripper by setting register 0x03E8 (1000), which contains 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	Value to write to the register
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	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, 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 Registers)
03E9	Address of the first register
0002	Number of registers to write to
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 Registers)
03E9	Address of the first register
0002	Number of written registers
9130	Cyclic Redundancy Check (CRC)

4.9.5 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 by setting register 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 register to write
0002	Number of registers to write (3) to
04	Number of data bytes to follow (2 registers X 2 bytes/registers = 4 bytes)
00E6	Value to write to register 0x03E9
3CC8	Value to write 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)

 **Note**

The Adaptive Gripper C register values are updated at a 200Hz frequency. It is therefore recommended to send FC23 commands with a minimum delay of 5ms between them.

4.9.6 Modbus RTU example

This section depicts the example given in [section 4.8](#) 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:

09 10 03 E8 00 03 06 01 00 00 00 00 00 72 E1

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 to write to register 0x03E9 (ACTION REQUEST = 0x01 and GRIPPER OPTIONS = 0x00): rACT = 1 for "Activate Gripper"
0000	Value to write to register 0x03EA
0000	Value to write to register 0x03EB
72E1	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 2: Read Gripper status until the activation is completed

Request is:

09 03 07 D0 00 01 85 CF

where

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

Response (if the activation IS NOT completed):

09 03 02 11 00 55 D5

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, RESERVED = 0x00): gACT = 1 for "Gripper Activation", gSTA = 1 for "Activation in progress"
55D5	Cyclic Redundancy Check (CRC)

Response (if the activation IS completed):

09 03 02 31 00 4C 15

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, RESERVED = 0x00): gACT = 1 for "Gripper Activation", gSTA = 3 for "Activation is completed"
4C15	Cyclic Redundancy Check (CRC)

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

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

Request is:

09 10 03 E8 00 03 06 09 00 00 FF FF FF 42 29

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 to write to register 0x03E9 (ACTION REQUEST = 0x09 and GRIPPER OPTIONS = 0x00): rACT = 1 for "Activate Gripper", rGTO = 1 for "Go to Requested Position"
00FF	Value to write to register 0x03EA (GRIPPER OPTIONS 2 = 0x00 and POSITION REQUEST = 0xFF): rPR = 255/255 for full closing of the Gripper
FFFF	Value to write 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 03 04 0E

where

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

Example of response if the grip is not completed:

09 03 06 39 00 00 FF 0E 0A F7 8B

where

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

Example of response if the grip is completed:

09 03 06 B9 00 00 FF BD 00 1D 7C

where

Bits	Description
09	SlaveID
03	Function Code 03 (Read Holding Registers)
06	Number of data bytes to follow (3 registers x 2 bytes/register = 6 bytes)
B900	Content of register 07D0 (GRIPPER STATUS = 0xB9, RESERVED = 0x00): gACT = 1 for "Gripper Activation", gGTO = 1 for "Go to Position Request" and gOBJ = 2 for "Fingers have stopped due to a contact while closing"
00FF	Content of register 07D1 (FAULT STATUS = 0x00, POSITION REQUEST ECHO = 0xFF): the position request echo tells that the command was well received and that the GRIPPER STATUS is valid.
BD00	Content of register 07D2 (POSITION = 0xBD, FINGER CURRENT = 0x00): the position is 189/255 (can be used to validate the size of the seized object)
F78B	Cyclic Redundancy Check (CRC)

Step 6: Move the robot to the release location

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

Request is:

09 10 03 E8 00 03 06 09 00 00 00 FF FF 72 19

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 to write to register 0x03E9 (ACTION REQUEST = 0x09 and GRIPPER OPTIONS = 0x00): rACT = 1 for "Activate Gripper", rGTO = 1 for "Go to Requested Position"
0000	Value to write 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 to write 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 03 04 0E

where

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

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

09 03 06 39 00 00 00 BB 10 30 E0

where

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

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

09 03 06 F9 00 00 00 0D 00 56 4C

where

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

Step 9: Loop back to step 7 if other objects have to be gripped.

4.10 MODBUS TCP-IP communication protocol

The Robotiq Adaptive Gripper C-Model can be controlled using the Modbus TCP/IP protocol (note that this is an option). This section is intended to provide guidelines for setting up a Modbus TCP/IP communication to adequately send commands and read input from the Gripper.

For a general introduction to Modbus TCP/IP 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 requirements for controlling the Gripper using the Modbus TCP/IP protocol.

Connection requirement	Value
Required protocol	Modbus TCP/IP
Port	502
Gripper IP address	Configurable (most Grippers are shipped with the 192.168.1.X 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/IP protocol is composed of **2** registers (bytes – 8 bits) from the Gripper. The first Gripper output Modbus register (0x0000) is composed from the first **2** Robotiq Adaptive Gripper C registers (byte 0 and byte 1).

Caution

For safety reason, communication with the Gripper must stay open during operation, shutting down communication will stop the Gripper.

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. For example, 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

Bits	Description
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

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

Note

The Gripper register values are updated at a 200Hz frequency. It is therefore recommended 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, 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:

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

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 to
06	The number of data bytes to follow
09 00 00 64 00 ff	Data

Response is:

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

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	The number of registers written

4.10.4 Modbus TCP example

This section depicts the example given in [section 4.8](#) 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 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)
0100	Value to write to register 0x0000 (ACTION REQUEST = 0x01 and GRIPPER OPTIONS = 0x00): rACT = 1 for "Activate Gripper"
0000	Value to write to register 0x0001
0000	Value to write 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 Code 16 (Preset Multiple Registers)
0000	Address of the first register
0003	Number of written registers

Step 2: Read Gripper status until the activation is completed

Request is:

45 33 00 00 00 06 02 04 00 00 00 01

where

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

Response (if the activation IS NOT completed):

45 33 00 00 00 05 02 04 02 11 00

where

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

Response (if the activation IS completed):

45 33 00 00 00 05 02 04 02 31 00

where

Bits	Description
4533	Unique transaction identifier (chosen randomly)
0000	Protocol Identifier (Modbus)
0005	Length
02	SlaveID
04	Function Code 04 (Read Input Registers)
02	Number of data bytes to follow (1 registers x 2 bytes/register = 2 bytes)
3100	Content of register 0000 (GRIPPER STATUS = 0x31, RESERVED = 0x00): gACT = 1 for "Gripper Activation", gSTA = 3 for "Activation is 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 to write to register 0x0000 (ACTION REQUEST = 0x09 and GRIPPER OPTIONS = 0x00): rACT = 1 for "Activate Gripper", rGTO = 1 for "Go to Requested Position"
00FF	Value to write to register 0x0001 (GRIPPER OPTIONS 2 = 0x00 and POSITION REQUEST = 0xFF): rPR = 255/255 for full closing of the Gripper
FFFF	Value to write to register 0x0002 (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 Code 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:

77 6B 00 00 00 06 02 04 00 00 00 03

where

Bits	Description
776B	Unique transaction identifier (chosen randomly)
0000	Protocol Identifier (Modbus)
0006	Length
02	SlaveID
04	Function Code 04 (Read Input Registers)
0000	Address of the first requested register
0003	Number of registers requested (3)

Example of response if the grip is not completed:

77 6B 00 00 00 09 02 04 06 39 00 00 FF 0E 0A

where

Bits	Description
776B	Unique transaction identifier (chosen randomly)
0000	Protocol Identifier (Modbus)
0009	Length
02	SlaveID
04	Function Code 04 (Read Input Registers)
06	Number of data bytes to follow (3 registers x 2 bytes/register = 6 bytes)
3900	Content of register 0x0000 (GRIPPER STATUS = 0x39, RESERVED = 0x00): gACT = 1 for "Gripper Activation", gGTO = 1 for "Go to Position Request" and gOBJ = 0 for "Fingers are in motion"
00FF	Content of register 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.
0E0A	Content of register 0x0002 (POSITION = 0x0E, FINGER CURRENT = 0x0A): the position is 14/255 and the motor current is 100mA (these values will change during motion)

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

77 6B 00 00 00 09 02 04 06 B9 00 00 FF BD 00

where

Bits	Description
776B	Unique transaction identifier (chosen randomly)
0000	Protocol Identifier (Modbus)
0009	Length
02	SlaveID
04	Function Code 04 (Read Input Registers)
06	Number of data bytes to follow (3 registers x 2 bytes/register = 6 bytes)

B900	Content of register 0x0000 (GRIPPER STATUS = 0xB9, RESERVED = 0x00): gACT = 1 for "Gripper Activation", gGTO = 1 for "Go to Position Request" and gOBJ = 2 for "Fingers have stopped due to a contact while closing"
00FF	Content of register 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.
BD00	Content of register 0x0002 (POSITION = 0xBD, FINGER CURRENT = 0x00): the position is 189/255 (can be used to validate the size of the seized object)

Step 6: Move the robot to the release location

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

Request is:

34 AB 00 00 00 0D 02 10 00 00 00 03 06 09 00 00 00 FF FF

where

Bits	Description
34AB	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 to write to register 0x0000 (ACTION REQUEST = 0x09 and GRIPPER OPTIONS = 0x00): rACT = 1 for "Activate Gripper", rGTO = 1 for "Go to Requested Position"
0000	Value to write to register 0x0001 (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 to write to register 0x0002 (SPEED = 0xFF and FORCE = 0xFF): full speed and full force
------	--

Response is:

34 AB 00 00 00 06 02 10 00 00 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)
0000	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 00 00 00 03

where

Bits	Description
D605	Unique transaction identifier (chosen randomly)
0000	Protocol Identifier (Modbus)
0006	Length
02	SlaveID
04	Function Code 04 (Read Input Registers)
0000	Address of the first requested register
0003	Number of registers requested (3)

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

D6 05 00 00 00 09 02 04 06 39 00 00 00 BB 10

where

Bits	Description
D605	Unique transaction identifier (chosen randomly)
0000	Protocol Identifier (Modbus)
0009	Length
02	SlaveID
04	Function Code 04 (Read Input Registers)
06	Number of data bytes to follow (3 registers x 2 bytes/register = 6 bytes)
3900	Content of register 0x0000 (GRIPPER STATUS = 0x39, RESERVED = 0x00): gACT = 1 for "Gripper Activation", gGTO = 1 for "Go to Position Request" and gOBJ = 0 for "Fingers are in motion"
0000	Content of register 0x0001 (FAULT STATUS = 0x00, POSITION REQUEST ECHO = 0x00): the position request echo tells that the command was well received and that the GRIPPER STATUS is valid.
BB10	Content of register 0x0002 (POSITION = 0xBB, FINGER CURRENT = 0x10): the position is 187/255 and the motor current is 160mA (these values will change during motion)

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

D6 05 00 00 00 09 02 04 06 F9 00 00 00 0D 00

where

Bits	Description
D605	Unique transaction identifier (chosen randomly)
0000	Protocol Identifier (Modbus)
0009	Length
02	SlaveID
04	Function Code 04 (Read Input Registers)
06	Number of data bytes to follow (3 registers x 2 bytes/register = 6 bytes)
F900	Content of register 0x0000 (GRIPPER STATUS = 0xF9, RESERVED = 0x00): gACT = 1 for "Gripper Activation", gGTO = 1 for "Go to Position Request" and gOBJ = 3 for "Fingers are at requested position"
0000	Content of register 0x0001 (FAULT STATUS = 0x00, POSITION REQUEST ECHO = 0x00): the position request echo tells that the command was well received and that the GRIPPER STATUS is valid.
0D00	Content of register 0x0002 (POSITION = 0x0D, FINGER CURRENT = 0x00): the position is 13/255 (the fingers have reached their software limit)

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

4.10.5 Application with Universal Robots

This section contains some additional information related 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-bits registers, whereas the Adaptive Gripper is configured using 8-bit bytes. Therefore, it is required to compute the value of each 16-bits registers 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:

$$\text{REGISTER0} = \text{BYTE1} + 256 * \text{BYTE0}$$

✓ Tip

One thing to try first is to send the value 256 to the 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 the read/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.

5. User Interface

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

- Testing.
- Demo mode.
- Xbox remote control mode.
- Communication protocol configuration.

Note

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

visit <http://support.robotiq.com> to get the latest installer for the Robotiq User Interface for C-Model

5.1 Requirements

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

- The Adaptive Gripper C-Model, its controller and the required power cables (provided, 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 kit
- A USB 2.0 Micro-B or a USB 2.0 Micro-A cable (Connection via USB uses Modbus RTU)
- Optional: A Ethernet RJ-45 cable (Connection via Ethernet uses Modbus TCP), an Xbox controller

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 available if your Gripper was shipped with the Modbus TCP/IP 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 Gripper via USB for Modbus RTU:

1. Unplug the Gripper and Controller from the power source by disconnecting the power cable from the Controller.
2. Connect the Controller 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 Gripper kit.

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

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

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

Info

The Ethernet or Serial cable needed is provided with the Gripper if the Gripper has the Modbus TCP/IP or Modbus RTU communication option.

3. Reconnect the power connector to the power receptacle and power up the Controller and 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 access 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 and/or the Controller from the power source by disconnecting the power cables.
3. Unplug the Controller from your PC by removing the USB cable.
4. Reconnect the power and communication cables to the Gripper and Controller as described in the [Wiring](#) section.

5.3 UI Description

When you start the Robotiq User Interface you need to set the connection you will use (see Figure 5.3.1).

1. First, choose between **Connection Type**, you can either connect via **USB/Serial** or via **TCP/IP** (RJ45 connection).
2. Second, choose the port option. You can choose **Automatic selection**, which will scan COM port or TCP/IP address for a valid port, or you can choose **Manual selection** and enter your COM port or TCP/IP address manually.
3. Finally, select your Gripper Model, Auto-detect feature will detect your Gripper model automatically (for C-Model).

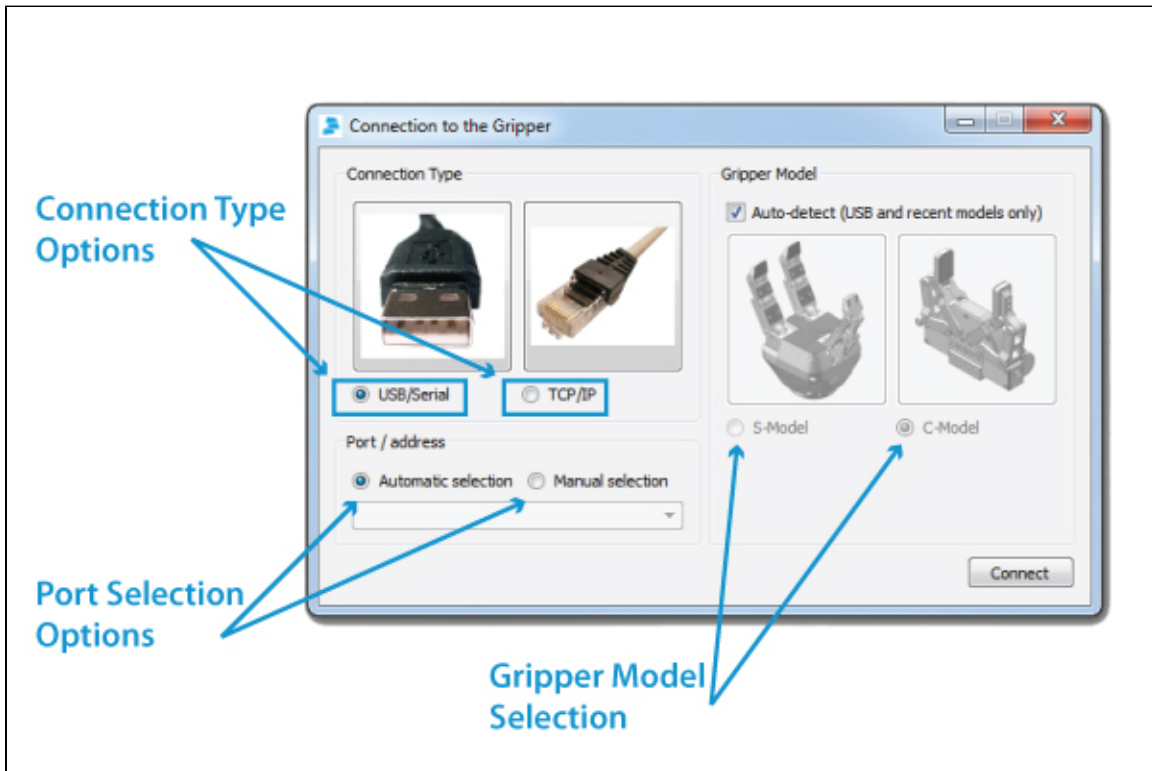


Figure 5.3.1 : Connection options available on start-up of the Robotiq User Interface.

Once you choose the connection mode, the first tab becomes activated (see Figure 5.3.2).

The first tab is the Simple Control tab (detailed in [section 5.5](#)), it can be split into the following:

- Initialization and Gripper Fault Status
- Interface Options
- Control Parameters
- Gripper Feedback
- Menu: Connection, View and Help

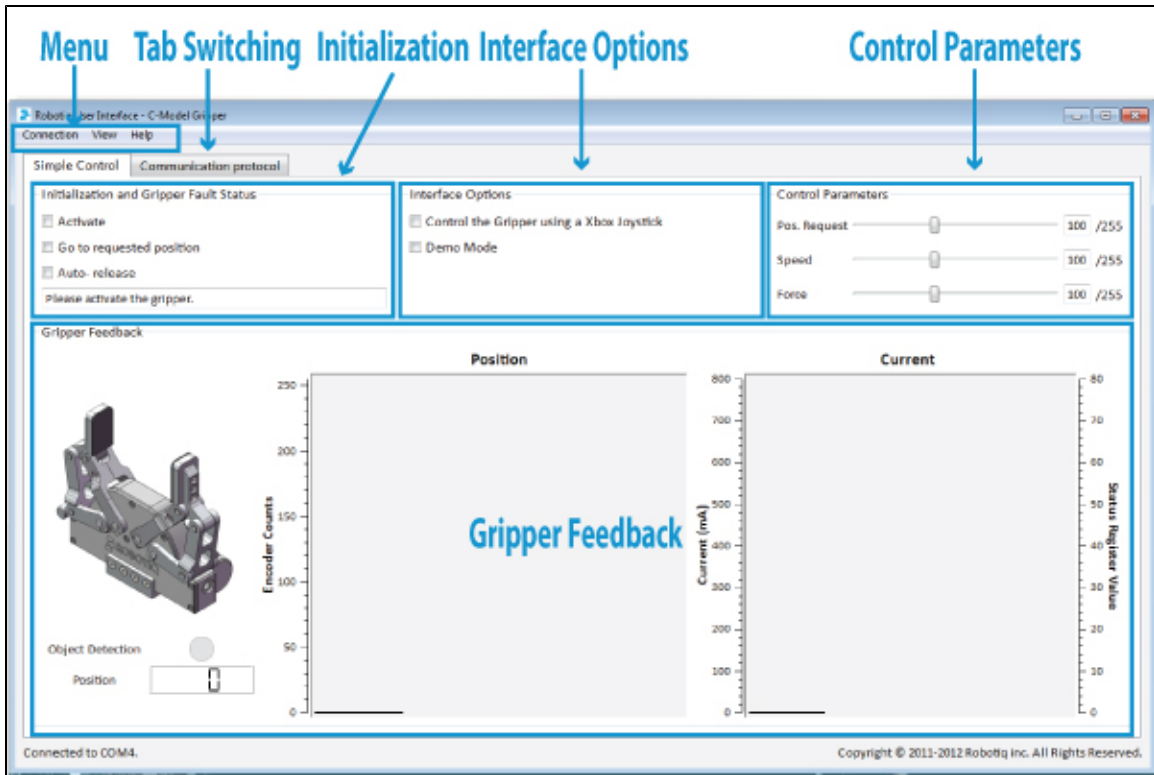


Figure 5.3.2 : Gripper Control tab description.

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

- Device Identity
- Protocol
- Data


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 Robotiq Adaptive Grippers C-models 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.


 The Robotiq User Interface is programmed to automatically detect the port being used.

5.4.2 Modbus TCP

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

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

 The Robotiq User Interface is programmed to automatically detect the Gripper address found within the range of 192.168.1.11 to 192.168.1.13.

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

5.4 Control of the Adaptive Gripper

This section guides you through the control of the Adaptive Gripper C-Model via the Simple Control tab.

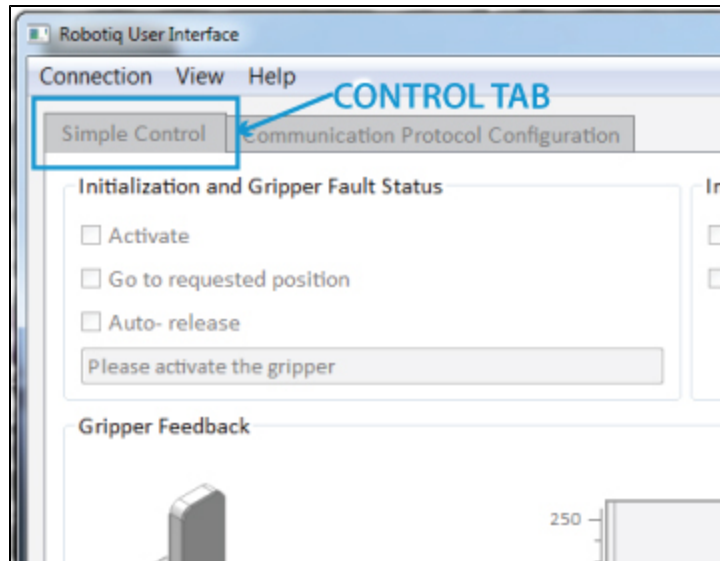


Figure 5.4.1 : The Simple Control tab for the Robotiq User Interface.

5.4.1 Initialization & Gripper Status

Activate

Once on the Simple Control tab page, the Adaptive Gripper needs to be activated before being used. Simply click the "Activate" button in the Initialization and Gripper Fault Status section. The Gripper will start its initialization procedure and once completed the Gripper status text box located under the "Activate" button will display "No Fault".

Warning

Do not interfere with the Gripper during the initialization process.

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

Note

The Activate button must stay checked while using the Gripper.

Go to requested position

Commands the Gripper to go to the selected "Position Request" as designated by the slider in the [Control Parameters section](#).

Auto-release

Commands Gripper to slowly open, overriding all previous commands. After Auto-release is completed the Gripper must be reactivated, the "Activate" button must be unchecked and rechecked.

Caution

Auto-release is only meant for emergency procedures, use the "Go to requested position" command for normal use.

5.4.2 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** commands the Gripper to constantly open and close the Gripper at different speeds.

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

You can view the Joystick Controls from the **View** menu by clicking **Xbox Controls**

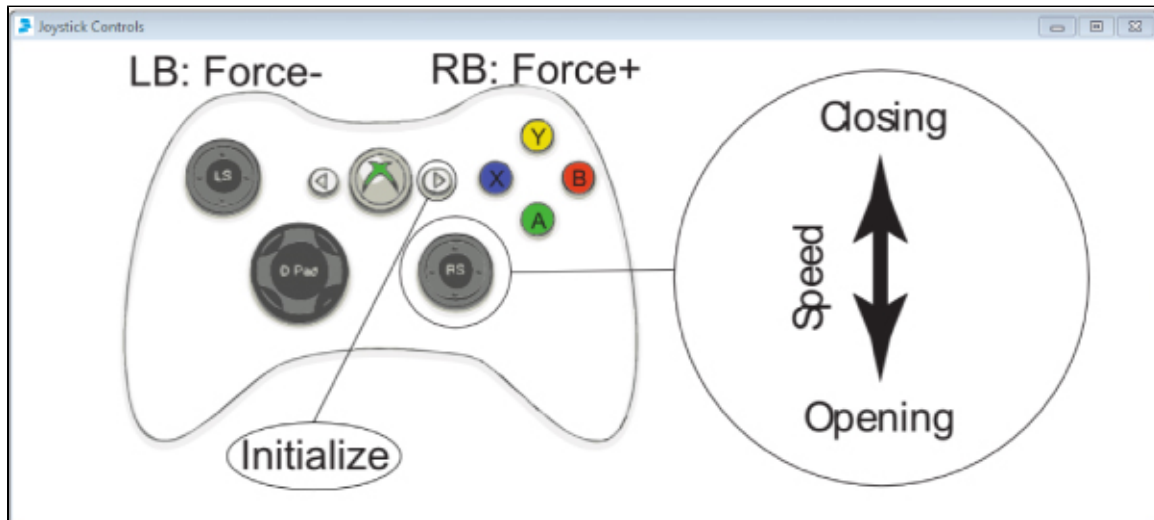


Figure 5.4.2.1 : Xbox Controls for the Adaptive Gripper C-Model

5.4.3 Control Parameters

The "Control Parameters" section of the UI can customize all the parameters for the Gripper:

- **Pos. Request** slider sets the reach position of the Gripper when the "Go to requested position" button of the Initialization and Gripper Fault Status sections are filled with a numeric value. The value can be set anywhere between 0 (fully open) and 255 (fully close).

Hint

You can set the desired position with the slider or numeric values.

- **Force** slider will control the gripping 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.

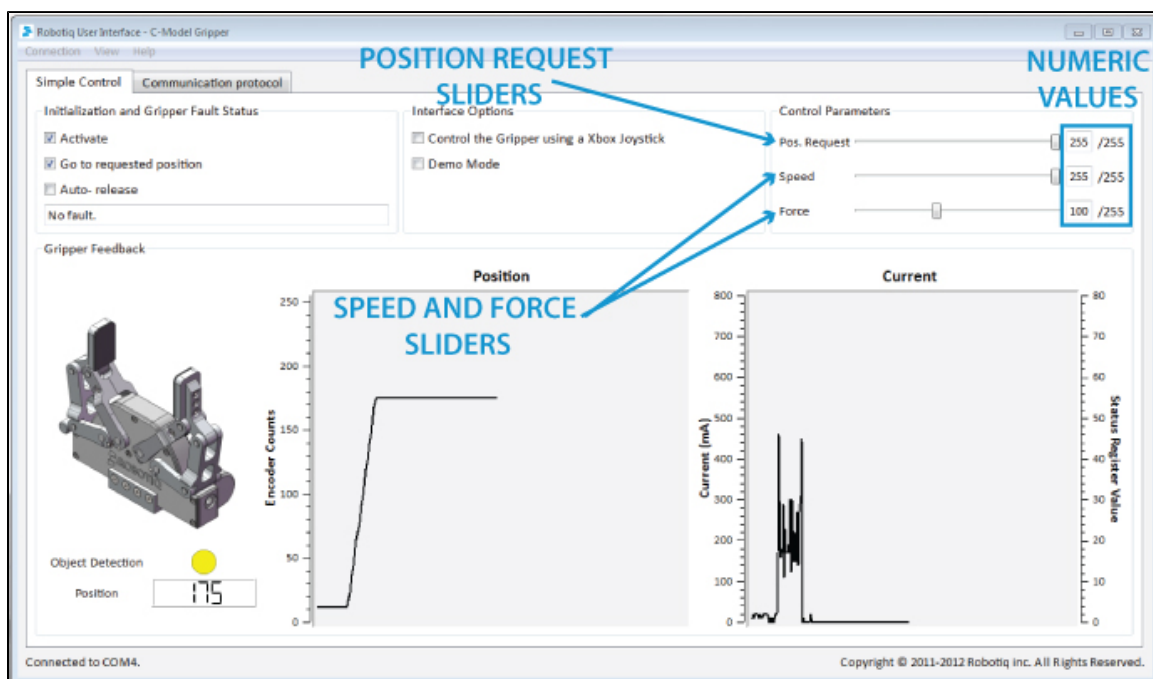


Figure 5.4.3.1 : Changing the Control Parameters of the Gripper

5.4.4 Gripper Feedback

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

- **Object Detection:** If the Gripper detects contact with an object when closing, the "Object Detection" display turns yellow.

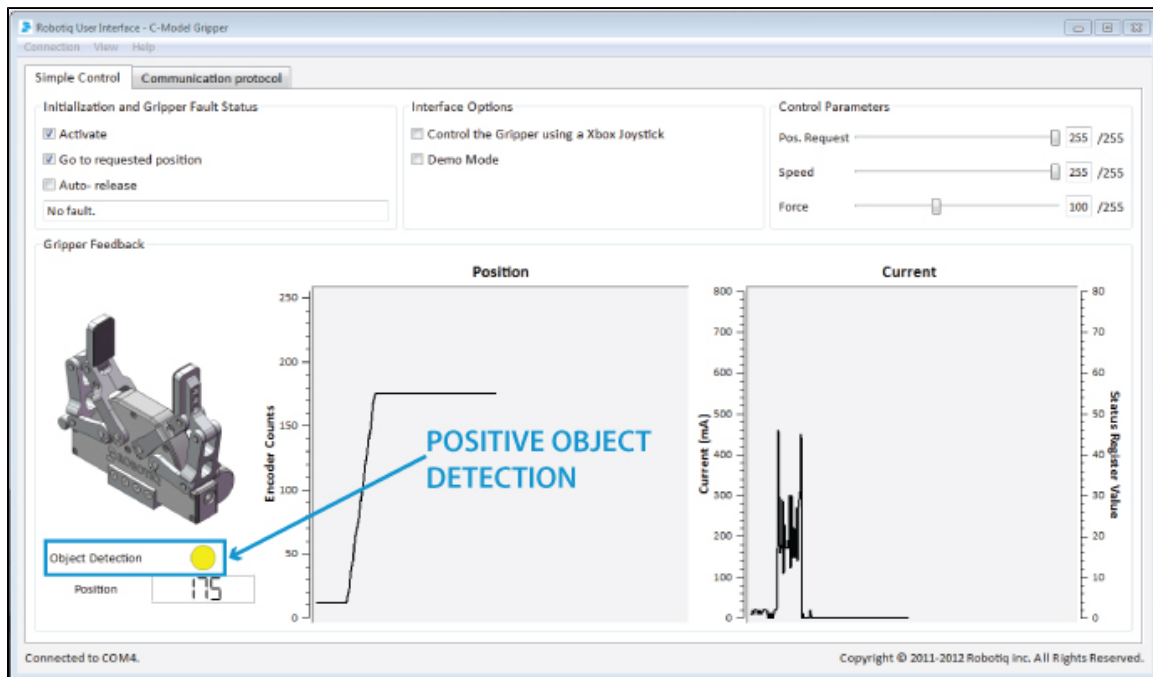


Figure 5.4.4.1 : Positive object detection is registered when the object detection dot turns yellow.

- **Position** (numeric): The digital display of "Position" shows the position of the fingers 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 the fingers graphically.
- **Current** (graphic): The "Current" graph shows the amount of current going through the motor.

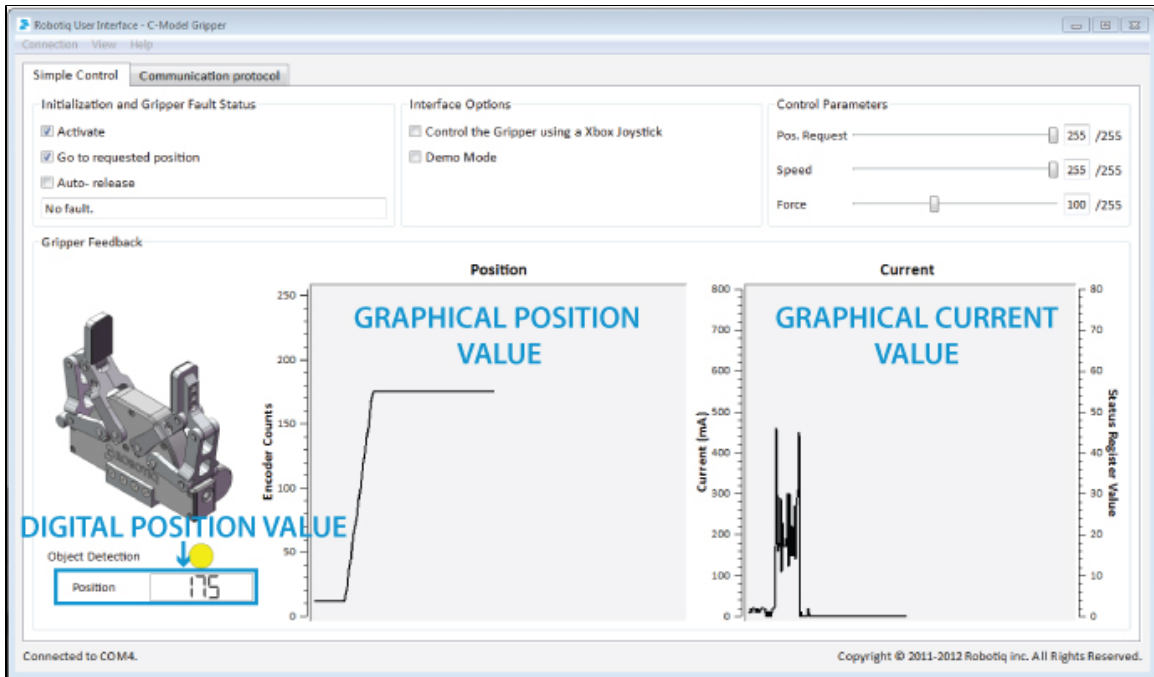


Figure 5.4.4.2 : Digital and visual displays of the fingers' position and electrical current usage.

5.5 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](#).

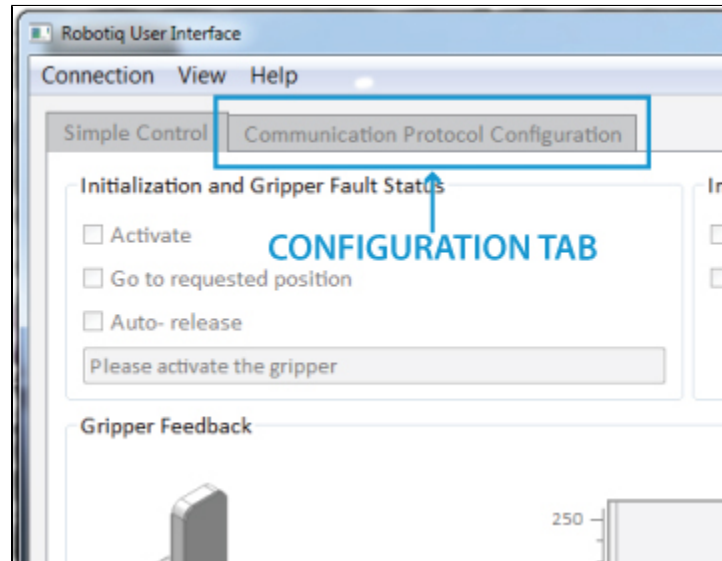


Figure 5.5.1 : The configuration tab of the Robotiq User Interface.

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](#)
- [CANopen section](#)

Whatever the communication protocol you are using, to apply changes made to the editable section of the communication protocol, follow the procedure described in [figure 5.5.2](#).

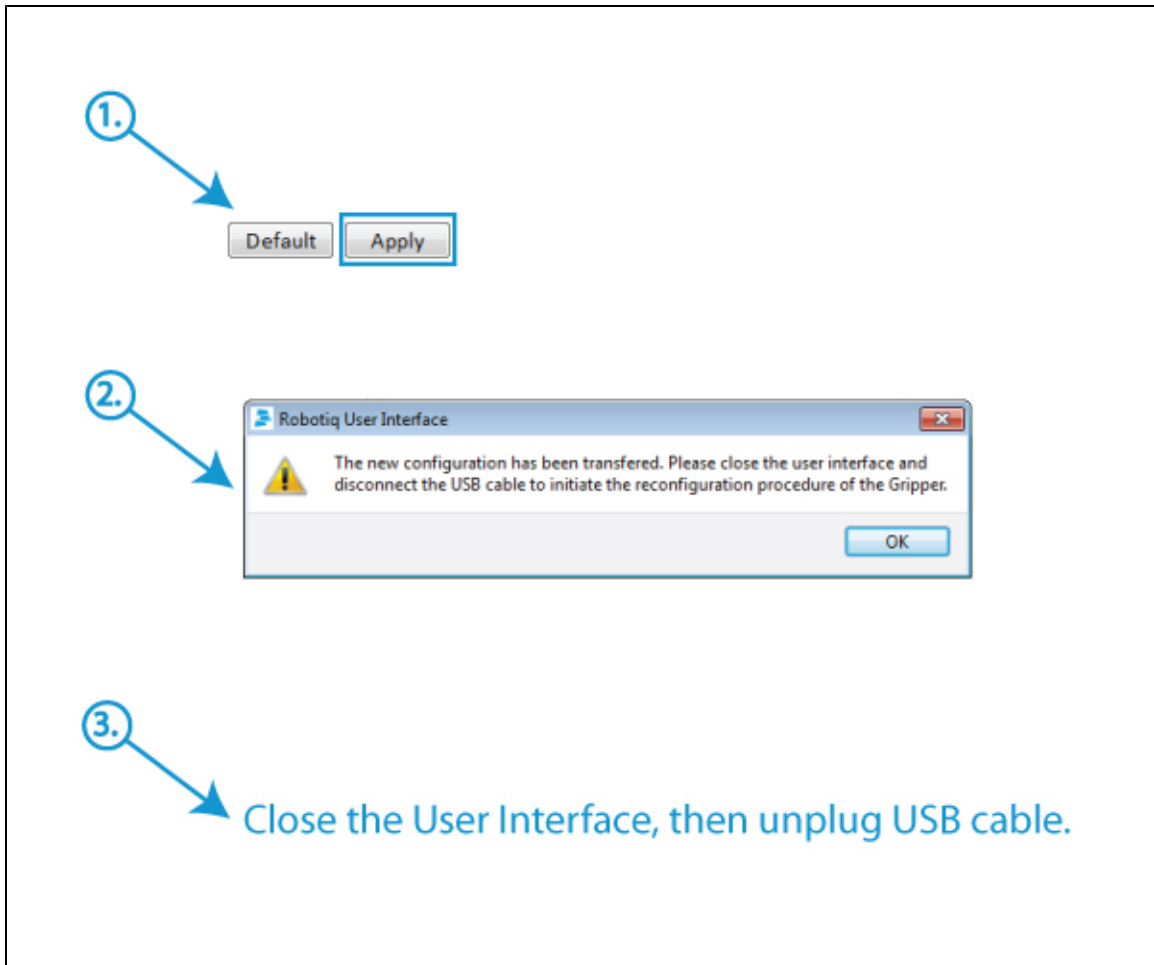


Figure 5.5.2 : Applying changes to the communication protocol settings.

5.5.1 Ethernet IP

If your Gripper has the **Ethernet/IP** communication protocol option, you should see the screen shown in figure 5.5.1.1, when a connection is established with the controller unit.

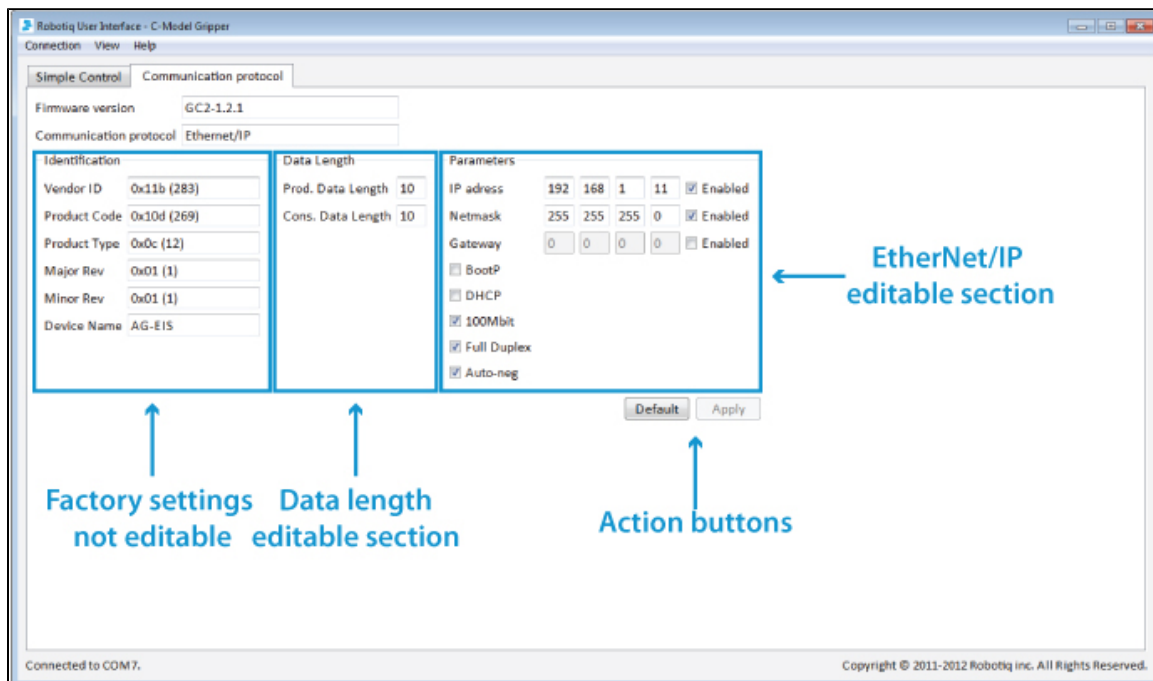


Figure 5.5.1.1 : Default screen of the Configuration Tool with Ethernet/IP

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

- **Firmware version** is the current firmware version for the controller you are using.
- **Identification** section shows the factory settings for your Gripper, these settings are fixed.
- **Data Length** 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.

- **Parameters** section shows the current address and options for 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 disabled.
 - **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 enabled.

The action buttons function in the following manner:

- To apply the changes made in the editable section, click on the **Apply** button.
- To apply the default settings, click on the **Default** button and then click on the **Apply** button.

5.5.2 Modbus TCP

If your Gripper has the **Modbus TCP** communication protocol option, you should see the screen shown in figure 5.5.2.1, when a connection is established with the controller unit.

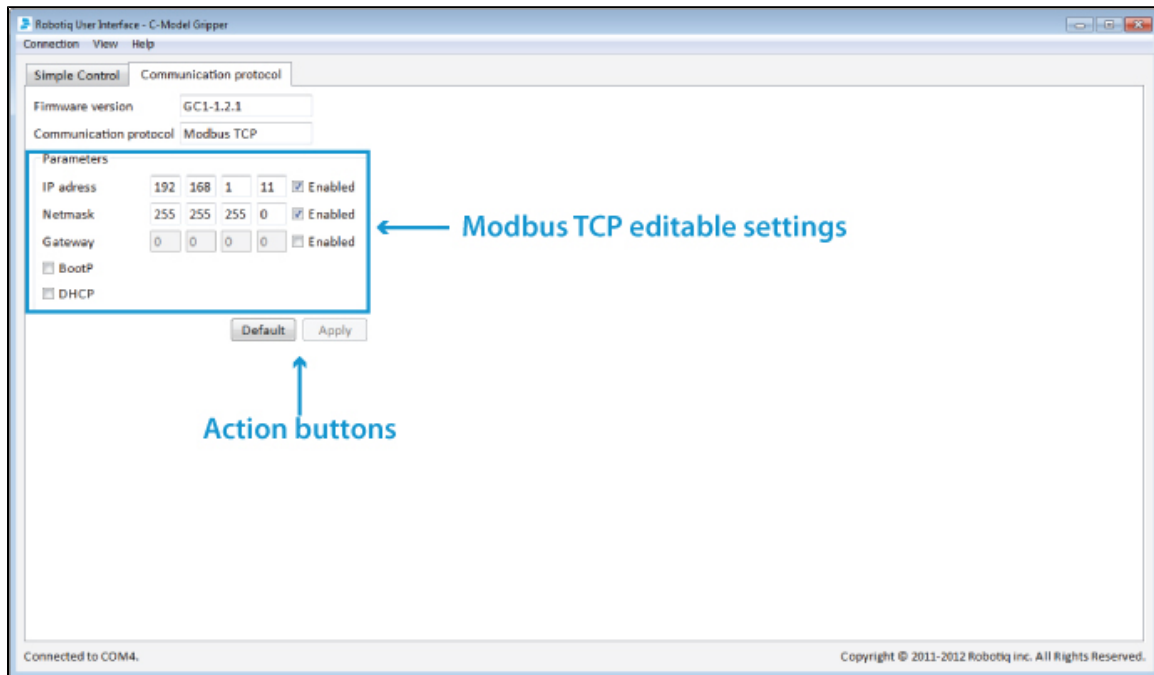


Figure 5.5.2.1 : Default screen for the Configuration Tool with Modbus TCP

The Configuration Tool with Modbus TCP screen is described below:

- **Firmware version** is the current firmware version for the controller you are using.
- **Parameters** section shows the current address and options for your Gripper. You can change any option by enabling or disabling it or 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 disabled.

The action buttons are used in the following manner:

- To apply the changes made in the editable section, click on the **Apply** button.
- To apply the default settings, click on the **Default** button and then click on the **Apply** button.

5.5.3 DeviceNet

If your Gripper has the **DeviceNet** communication protocol option, you should see the screen shown in figure 5.5.3.1, when a connection is established with the controller unit.

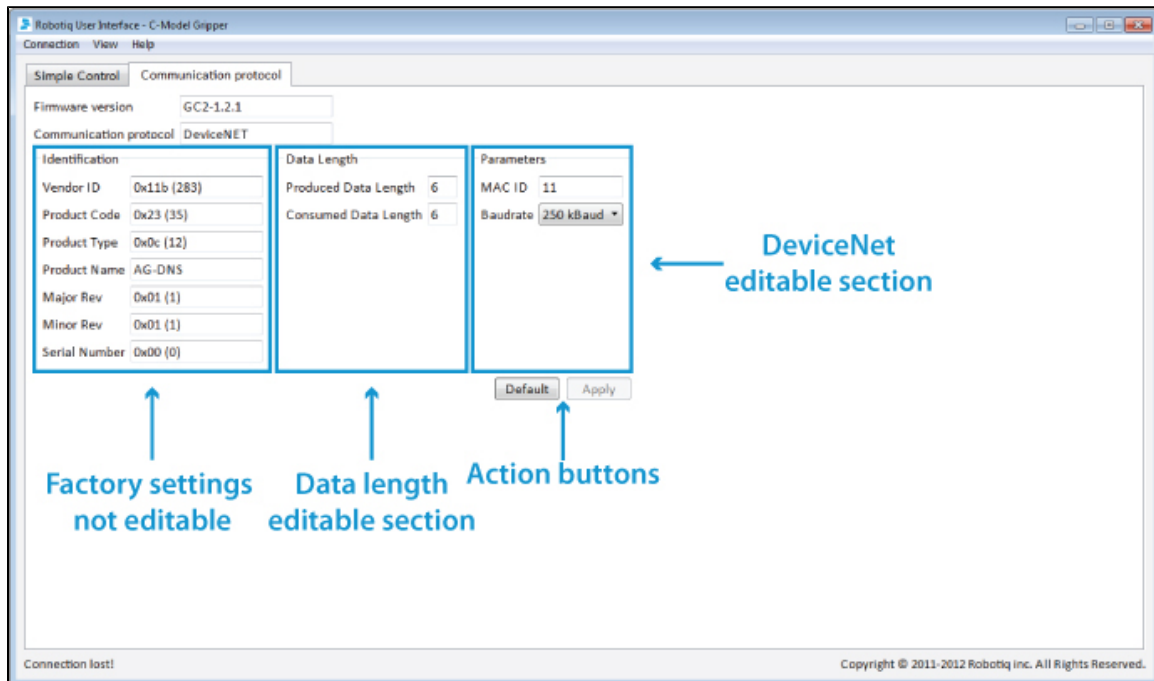


Figure 5.5.3.1 : Default screen of the Configuration Tool with DeviceNet

The Configuration Tool with the DeviceNet screen is described below:

- **Firmware version** is the current firmware version for the controller you are using.
- **Identification** section shows the factory settings for your Gripper, these settings are fixed.
- **Data Length** 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.
- **Parameters** section shows the current address and options for 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 action buttons are used in the following manner:

- To apply the changes made in the editable section, click on the **Apply** button.
- To apply the default settings, click on the **Default** button and then click on the **Apply** button.

5.5.4 CANopen

If your Gripper has the **CANopen** communication protocol option, you should see the screen shown in figure 5.5.4.1, when a connection is established with the controller unit.

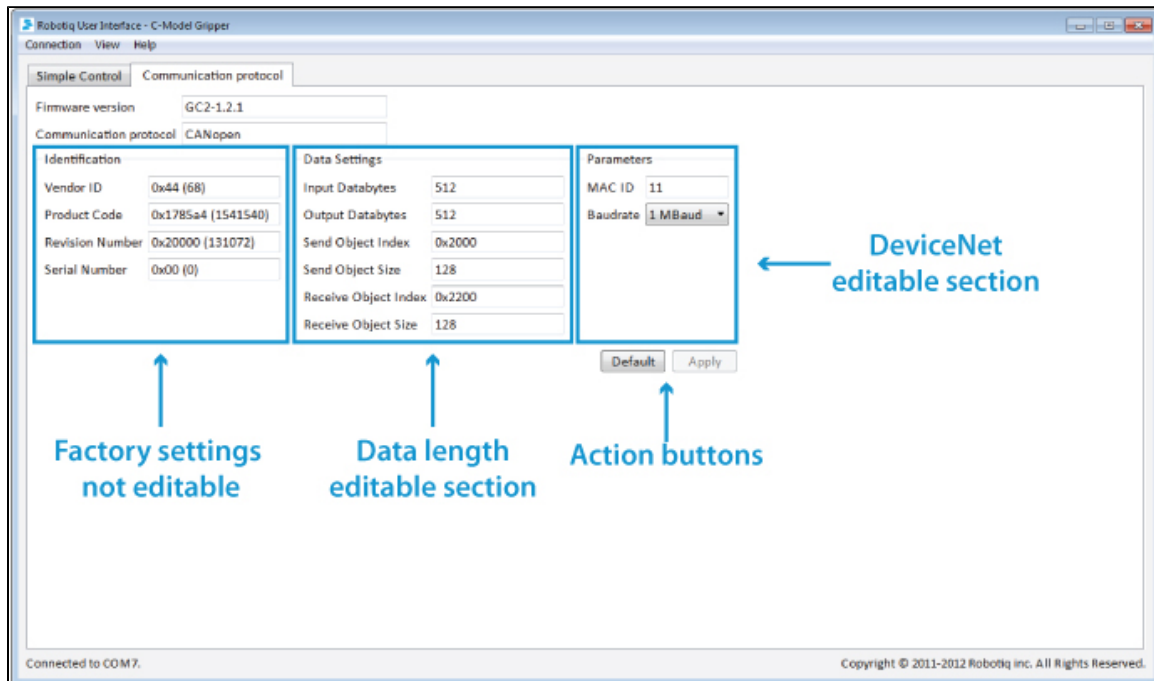


Figure 5.5.4.1 : Default screen of the Configuration Tool with CANopen

The Configuration Tool with the CANopen screen is described below:

- **Firmware version** is the current firmware version for the controller you are using.
- **Identification** section shows the factory settings for your Gripper, these settings are fixed.
- **Data Length** 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.
- **Parameters** section shows the current address and options for your Gripper. You can change any option by enabling or disabling it or 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 action buttons are used in the following manner:

- To apply the changes made in the editable section, click on the **Apply** button.
- To apply the default settings, click on the **Default** button and then click on the **Apply** button.

5.5.5 EtherCAT

If your Gripper has the **EtherCAT** communication protocol option, you should see the screen shown in figure 5.5.5.1, when a connection is established with the controller unit.

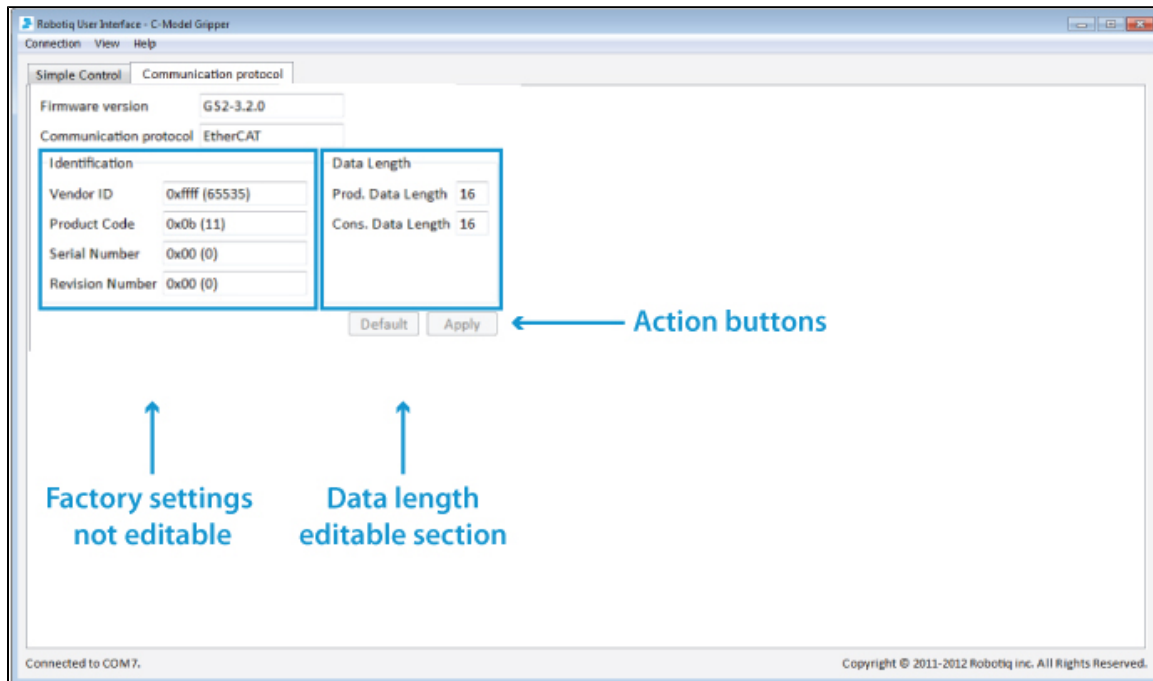


Figure 5.5.5.1 : Default screen of the Configuration Tool with EtherCAT

The Configuration Tool with EtherCAT screen is described below:

- **Firmware version** is the current firmware version for the controller you are using.
- **Identification** section shows the factory settings for your Gripper, these settings are fixed.
- **Data Length** 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 action buttons function in the following manner:

- To apply the changes made in the editable section, click on the **Apply** button.
- To apply the default settings, click on the **Default** button and then click on the **Apply** button.


5.6 Menu Options


Connection menu:

- **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 table, you can refer to [section 4.7](#) for details.
- **Output registers:** Will pop-up the Output registers table, you can refer to [section 4.6](#) for details.

 Input and Output register tables display live status information while manipulating the Gripper under the Robotiq User Interface. The I/O tables can be monitored to establish the required registers needed to reproduce a movement made in the User Interface. I/O tables can also be monitored for troubleshooting and fault analysis.

 You can close the pop-up "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

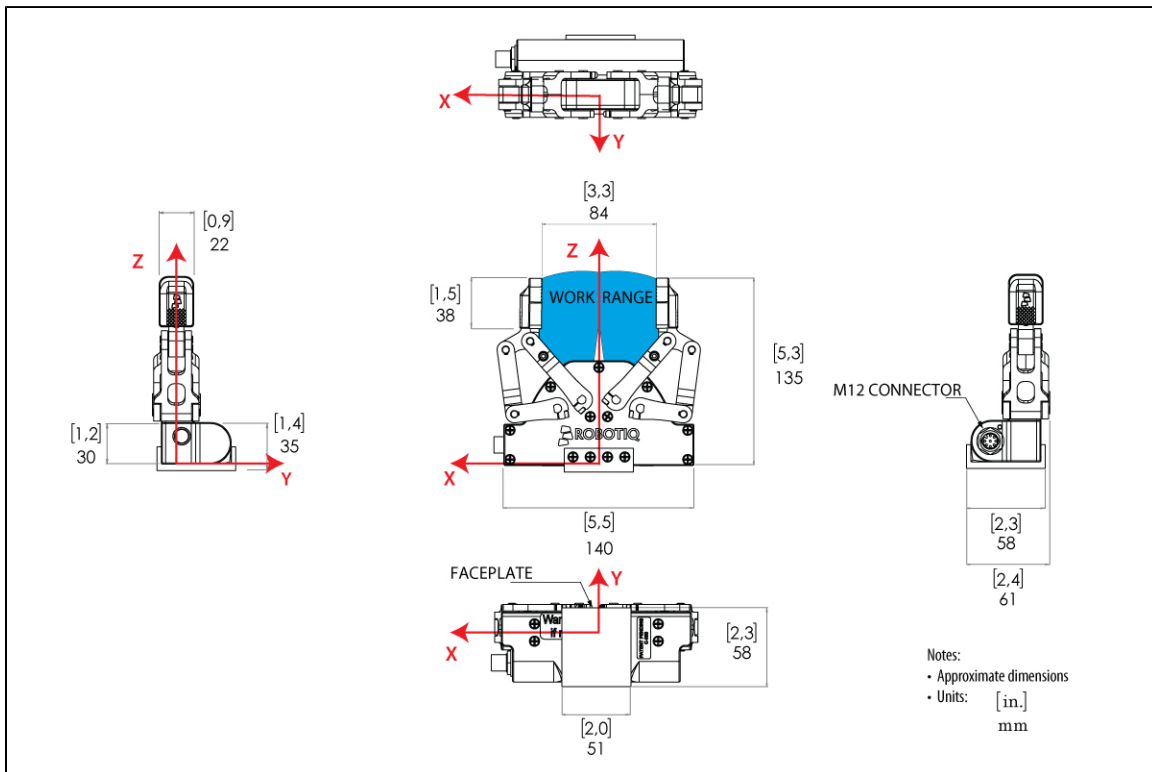


Figure 6.1.1 : Robotiq Adaptive Gripper Model-C technical dimensions.

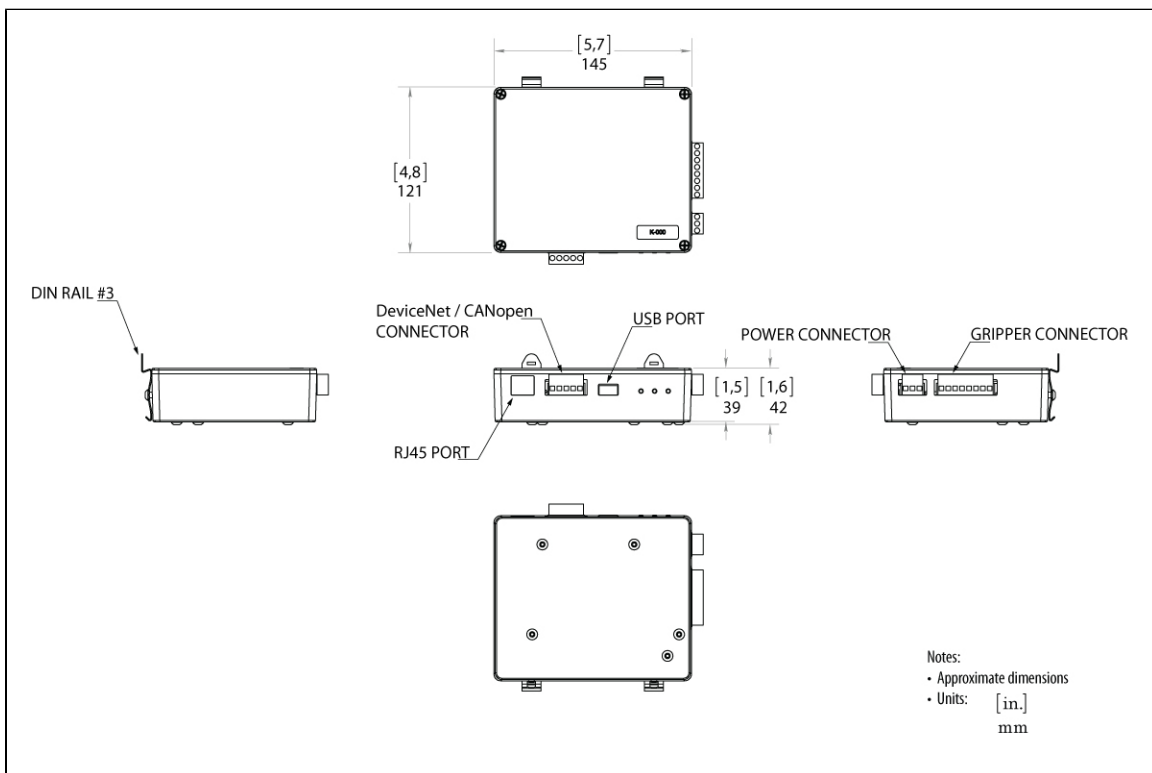


Figure 6.1.2 : Robotiq Adaptive Gripper C-Model Controller Unit technical dimensions.

6.2 Mechanical specifications

Specification	Imperial units	Metric units
Gripper Opening (see Figure 4.6.1)	0-3.31 in	[0-84 mm]
Gripper Approximate Weight	1.96 lbs	[890 g]
Recommended Payload ¹	8.8 lbs	[4 kg]
Maximum Grip Force	22 lbf	[100 N]
Maximum Closing Speed of one finger (Fingertip Grip)	3.94 in/sec	[100 mm/sec]
Finger position repeatability (Fingertip Grip)	0.002	[0.05 mm]

¹ 0.4 friction coefficient between finger rubber and steel part, safety factor of 2.

Actuation force model used to calculate recommended payload is described in figure 6.2.1 :

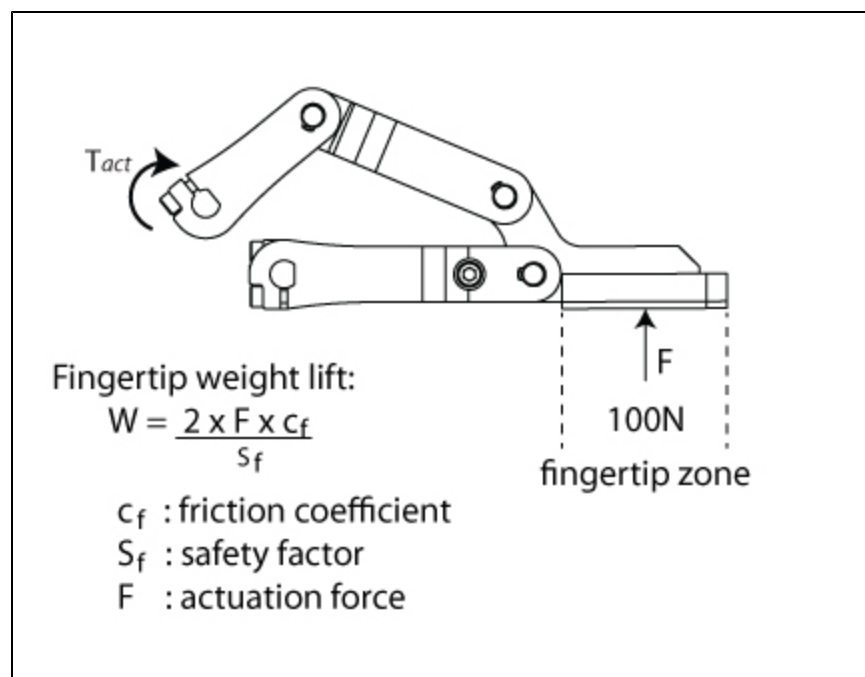


Figure 6.2.1 : Actuation force on the fingertip of the Adaptive Gripper model C.

Info

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

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

As defined in figure 6.2.1, the weight that can be lifted is defined by :

- F is the force that is applied to the load by the Gripper.
- C_f is the 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 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 6.1.1](#). The center of mass and moment of inertia are calculated for a configuration where the fingers are fully open.

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

$$I = \begin{bmatrix} I_{xx} & I_{xy} & I_{xz} \\ I_{yx} & I_{yy} & I_{yz} \\ I_{zx} & I_{zy} & I_{zz} \end{bmatrix} = \begin{bmatrix} 2195 & 0 & 0 \\ 0 & 3457 & 258 \\ 0 & 258 & 1651 \end{bmatrix} \text{ kg} \cdot \text{mm}^2 = \begin{bmatrix} 3.59 & 0 & 0 \\ 0 & 7.92 & 0.6 \\ 0 & 0.6 & 5.62 \end{bmatrix} \text{ lb} \cdot \text{in}^2$$

Here is the approximate position for the center of mass:

$$G = \begin{bmatrix} G_x \\ G_y \\ G_z \end{bmatrix} = \begin{bmatrix} 0 \\ -8.6 \\ 35.3 \end{bmatrix} \text{ mm} = \begin{bmatrix} 0 \\ -.338 \\ 1.389 \end{bmatrix} \text{ in}$$

6.4 Electrical ratings

Electrical Specification	Value
Operating Supply Voltage	24 V
Absolute Maximum Supply Voltage	26 V
Quiescent Power (minimum power consumption)	5 W
Peak Power (at maximum gripping force)	41 W
Maximum RMS Supply Current (supply voltage at 24V)	1.7 A

6.5 Faceplates

6.5.1 Blank faceplate

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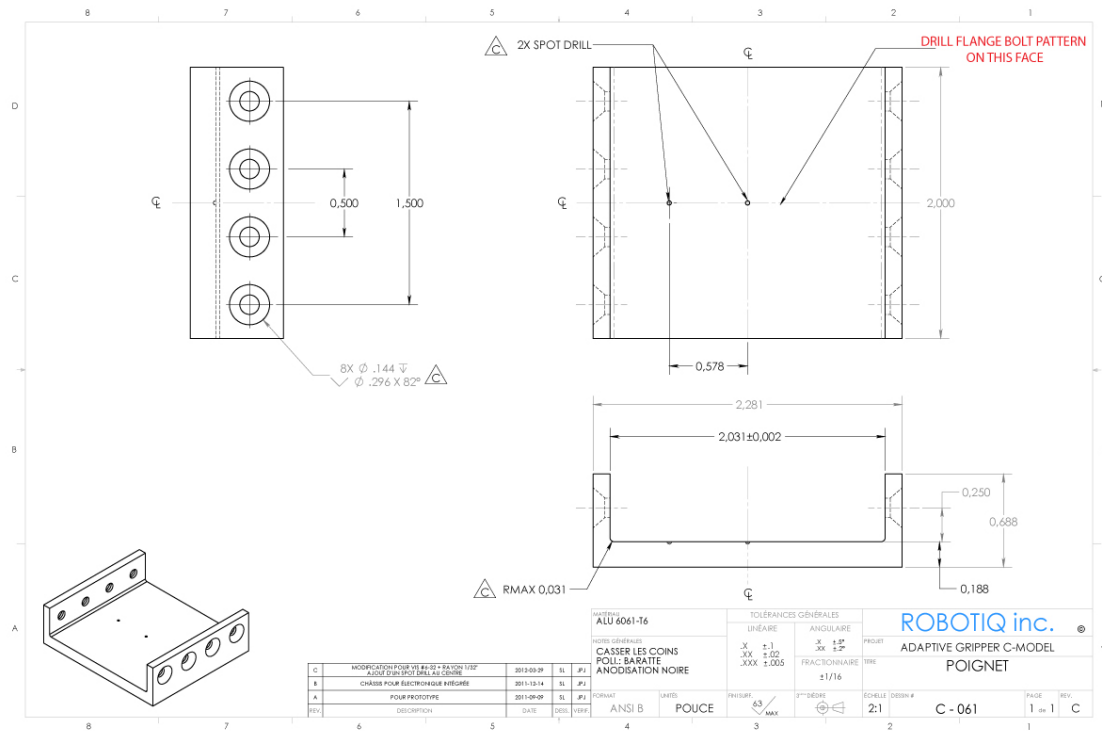


Figure 6.5.1.1 : Blank faceplate for the Adaptive Gripper C model.

6.5.2 31.5mm Faceplate

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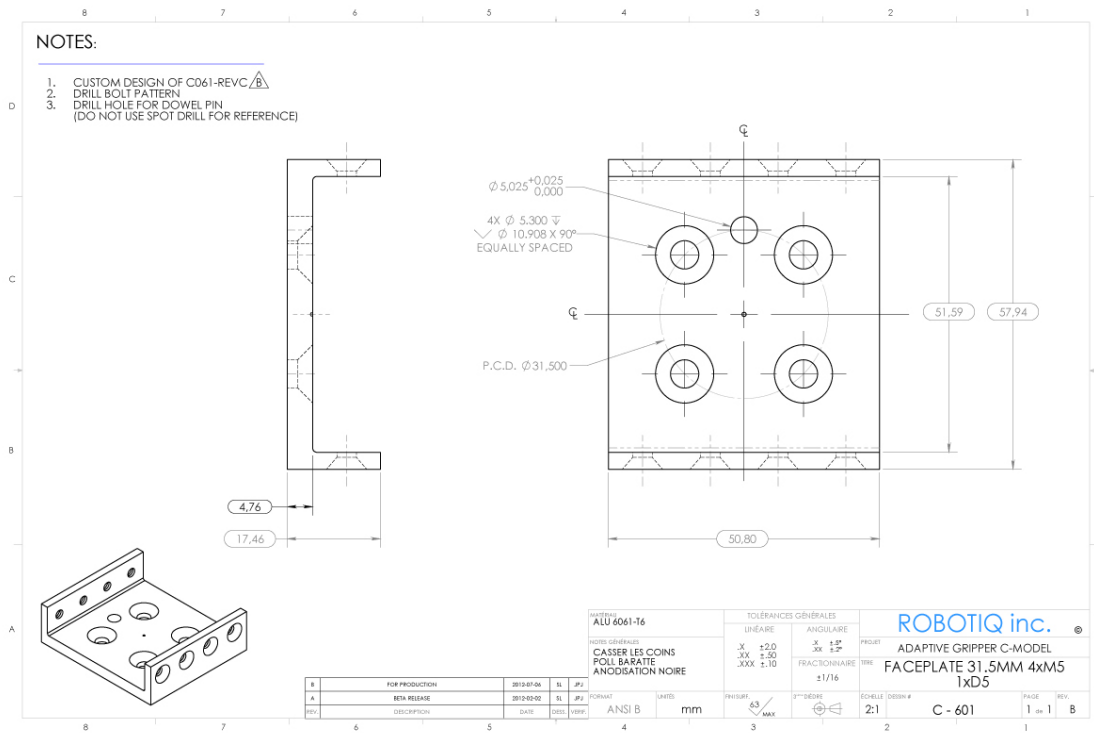


Figure 6.5.2.1 : 31.5mm faceplate for the Adaptive Gripper C model.

6.5.3 35mm Threaded Faceplate

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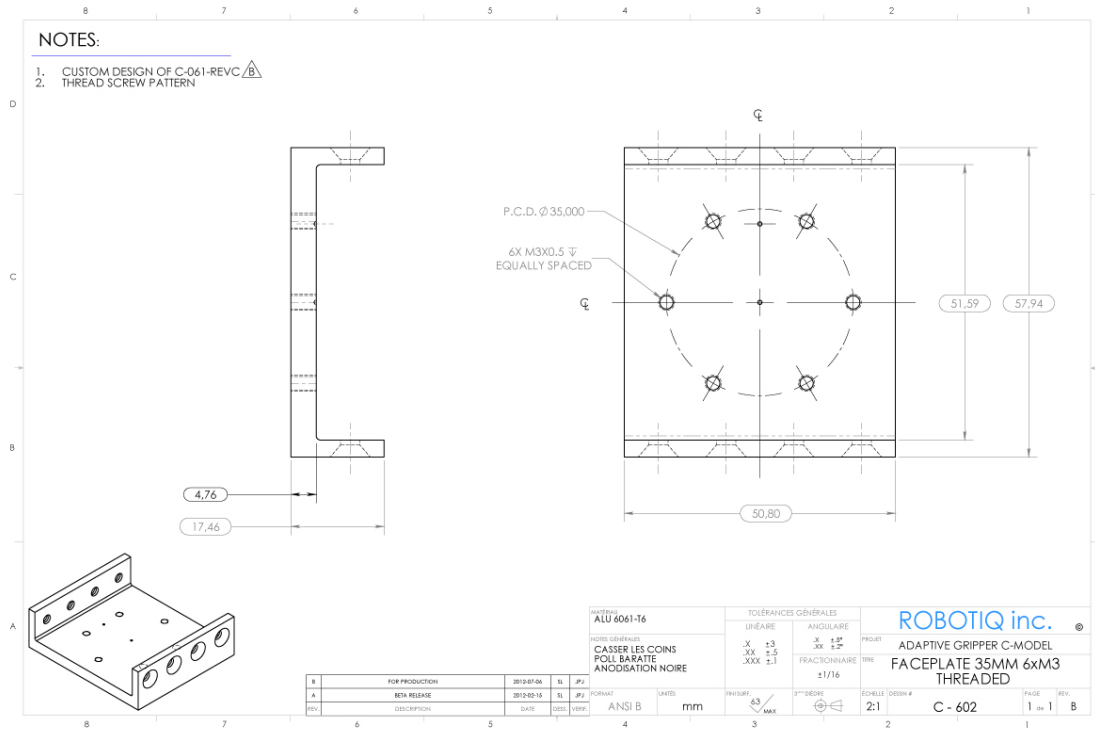


Figure 6.5.3.1 : Blank faceplate for the Adaptive Gripper C model.

6.5.4 40mm Faceplate

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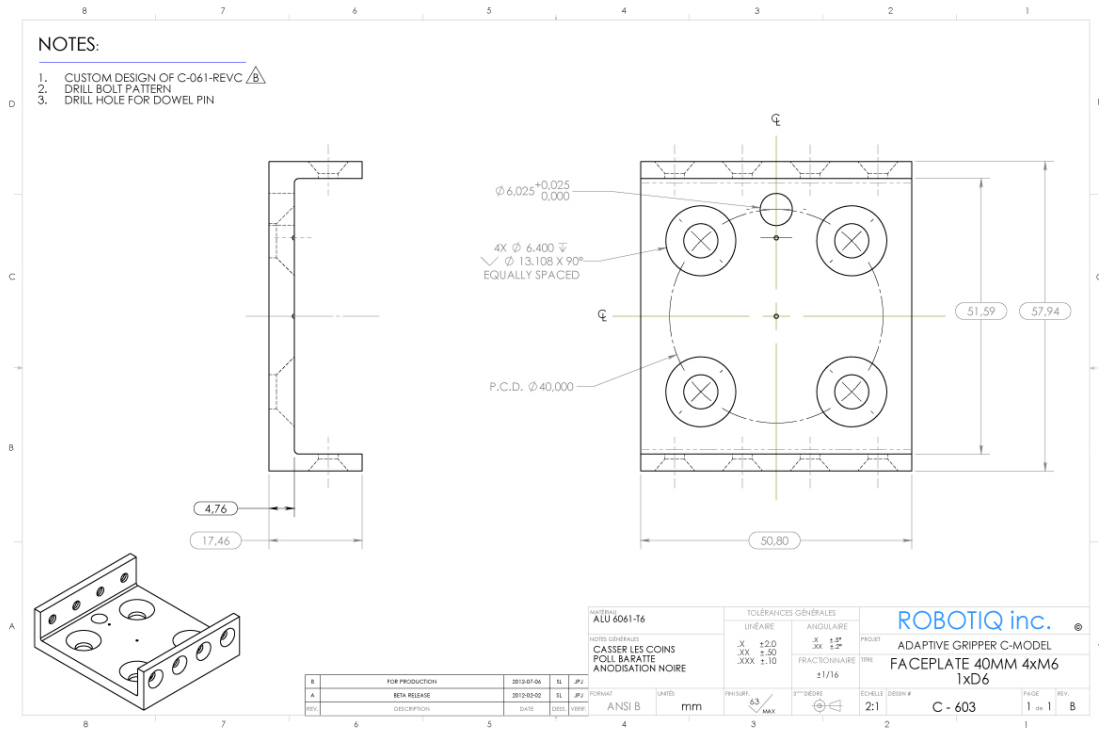


Figure 6.5.4.1 : Blank faceplate for the Adaptive Gripper C model.

7. Maintenance

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

Warning

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


Maintenance Intervals :

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

¹ Replace pads before if wear is visible.

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

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

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

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

8. 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 : Check the blue LED on the controller
 - i. It's ON : Gripper does not have power, but the controller does, check the integrity of the Gripper signal cable (shown in [section 3.4](#)).
 - ii. It's OFF : Gripper and controller are not supplied, check power supply (see specification in [section 3.3](#)).

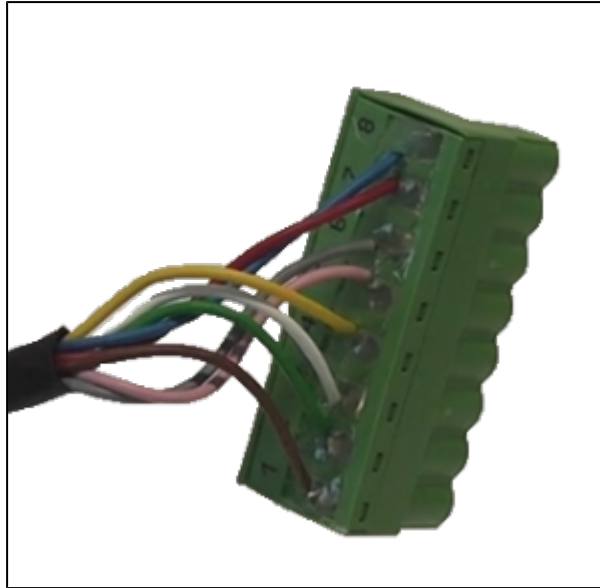


Figure 8.1 : Correct Gripper signal cable connector.

- ✓ Check Gripper signal cable and controller cable for damage, pay attention to the connectors.

2. Check the green LED on the Controller :

- a. It's OFF : No network detected, check communication cables and network infrastructure (see specific protocol in [section 3.4.2](#) and the following).
- b. It's BLINKING : Network detected, no communication established, go to step 4.

- ! Ethernet family protocol must be connected via RJ45 port while CanOpen and DeviceNet must be connected via Combi-con connector.

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

3. Check the red LED on the Controller :


- 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, unplug the USB 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.

9. Warranty

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

 Warranty applies under the following conditions:

- Usage respects the operating and storage conditions specified in [section 3.1](#)
- Proper installation of the Gripper specified in [section 3](#) and the following subsections.
- Usage under normal one-shift operation (40h a week)
- Usage respect maintenance specified in [section 7](#).
- Usage respect recommended payload and forces specified in [section 6.2](#).

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

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

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

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

Caution

The warranty will become null and void if the :

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

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

Robotiq shall not be liable for damages resulting from the use of the Robotiq Adaptive Gripper C-Model, nor shall Robotiq be responsible for any failure in the performance of other items to which the Gripper C-Model is connected or the operation of any system of which the Gripper C-Model 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 Gripper C-Model or other factors beyond Robotiq's control.

10. Contact

www.robotiq.com

[Go to Contact Us](#)

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