

qb robotics



General Manual

PLEASE READ CAREFULLY THESE INSTRUCTIONS BEFORE USE. DO NOT DISCARD: KEEP FOR FUTURE REFERENCE.

Dear customer,

Thank you for purchasing our product.



The present document provides information at best of our knowledge at the time of publication. This document could present differences from the product and it is subject to changes without notice: the latest version is available on our webpage www.qbrobotics.com.

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1 Preface

1.1 Using this document

The documentation must always be complete and in a perfectly readable state. Keep the document accessible to the operating and, if necessary, maintenance personnel at all times. Pass the document to any subsequent owner or user of the product.

1.2 Symbols and conventions

STYLE	DESCRIPTION
 CRITICAL	<p>Identifies information about practice or circumstances that can lead to critical damages on the device and to personal injury.</p> <p>Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.</p>
 WARNING	<p>Identifies information about practice or circumstances that can lead to damages on the device and to personal injury.</p> <p>Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.</p>
 NOTE	<p>Identifies remarkable information and additional notes.</p>
 TIPS	<p>Identifies tips and highlights.</p>
Monospaced text	<p>Identifies file paths, file names and software functions.</p>

2 Safety

2.1 Safety

2.1.1 Intended use

The product design is intended for grasping objects in the weight range from 1 to 2000 g.

Fragile, sharp or sharp-edged objects shall not be grasped.

Objects having the ratio between the biggest and the smallest dimensions ≥ 8 and the main dimension greater than 300 mm shall not be grasped.

The product is intended for installation on robotic arms: the safety features are established only for use as described in this document.

The safety of the product cannot be guaranteed in case of inappropriate use. One, single, inappropriate use can result in a permanent damage to the safety of the product. The responsibility for any damage caused by an incorrect choice of the manipulated object is the responsibility of the user.

2.1.2 Safety instructions

**WARNING:**

- Check that all the content is intact after removing it from the packaging.
- The device can be used only by specially trained staff.
- Disconnect the power supply before installation, cleaning or maintenance operations.
- Make sure that no residual energy remains in the system.
- Always operate the product within the specifications defined.
- Keep away from children and pets. Always set off or unplug when not in use.
- Never use aerosol products, petroleum-based lubricants or other flammable products on or near the end-effector.
- Do not use any damaged power cable, plug, or loose outlet. It may cause damages to the product or injury to people.
- Do not touch electrical components to avoid damages due to electrostatic charges.
- Make sure the end-effector is properly and securely bolted in place and cabled.
- Do not use if damaged or defective. Do not disassemble.
- Do not insert any objects between moving parts of the fingers.
- Keep head and face outside the reach of the end-effector.
- Do not wear loose clothing or jewelry when working with the end-effector.
- Disrespect of these precautions can affect safety of the device.

2.1.3 EC Directives on product safety

- The following EC directives on product safety must be observed.
- If the product is being used outside the UE, international, national and regional directives must be also observed.

Machinery Directive (2006/42/EC)

The Machinery Directive is applied to our products. The products described here are "incomplete machines", so installation instructions are normally issued by qbrobotics.

Low Voltage Directive (2014/35/EU)

The Low Voltage Directive applies for all electrical equipment with a nominal voltage of 75 to 1500 V DC and 50 to 1000 V AC. The products described in this device manual do not fall within the scope of this directive, since they are intended for lower voltages.

2.1.4 Environmental conditions

Wrong environmental and operating conditions can lead to injuries, product damages and/or significant reduction to the product's life.

**WARNING:**

Any use or application deviating from intended use is deemed to be impermissible misuse. This includes, but is not limited to:

- Use before performing a risk assessment;
- Use outside the permissible operational conditions and specifications;
- Use in not low-dust environment;
- Use in places with high temperature or humidity;
- Use in wet places;
- Use in potentially explosive atmospheres;
- Use in medical and life critical applications;
- Use close to a human's head, face and eye area;
- Use as a climbing aid;
- Use in outdoor applications.

2.1.5 Environmental safety

The qb SoftHand Industry must be disposed of in accordance with the applicable national laws, regulations and standards.

All the components of this product have been chosen in accordance with the EU RoHS directive 2011/65/

EU: they are produced with restricted use of hazardous substances to protect the environment. Observe national registration requirements for importers according to EU WEEE Directive 2012/19/EU.



2.1.6 Personnel qualification

If the personnel working with the product is not sufficiently qualified, may occur serious injuries and damage.

- Observe the national safety regulations and rules and general safety instructions.
- Before working with the product, the personnel must have read and understood the complete assembly and operating manual.
- All work may only be performed by qualified personnel.

2.1.7 Glove

The device is supplied with a glove (protective) basic accessory. qbrobotics declines all responsibility for the use of any other unauthorized glove, which may result in faulty operation of the device and compromise both the reliability and lifespan of the device.

2.1.8 Power supply

The equipment must be powered from a PELV source in order to avoid electrical hazards. Typical input power supply for external driver:

- Power: 30W;
- Voltage: from 23V to 26V.

3 Description

qb SoftHand Industry is an anthropomorphic robotic hand based on soft-robotics technology, flexible, adaptable and able to interact with the surrounding environment, objects and humans while limiting the risk of hurting the operators, spoiling the products to be handled, and damaging the robot itself.

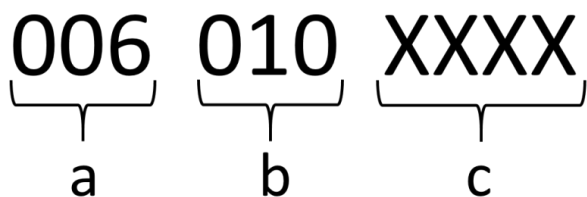
The qb SoftHand is adaptable and can grasp different objects without any change in the control action, showing an unparalleled level of simplicity and flexibility.

Thanks to its soft nature the hand by qbrobotics exploits the principles of synergies in a simple and intrinsically intelligent design that is not only safe in unexpected human-robot interaction, but also adaptable to grasp different objects without any change in the control action.

The combination of these innovations results in a flexible prehensile device that can grasp a wide variety of objects. The single-motor actuation makes the hand plug-and-play and simple-to-control (one single motor requires one single control signal to close and open the whole hand) and affordable.

3.1 Device identification

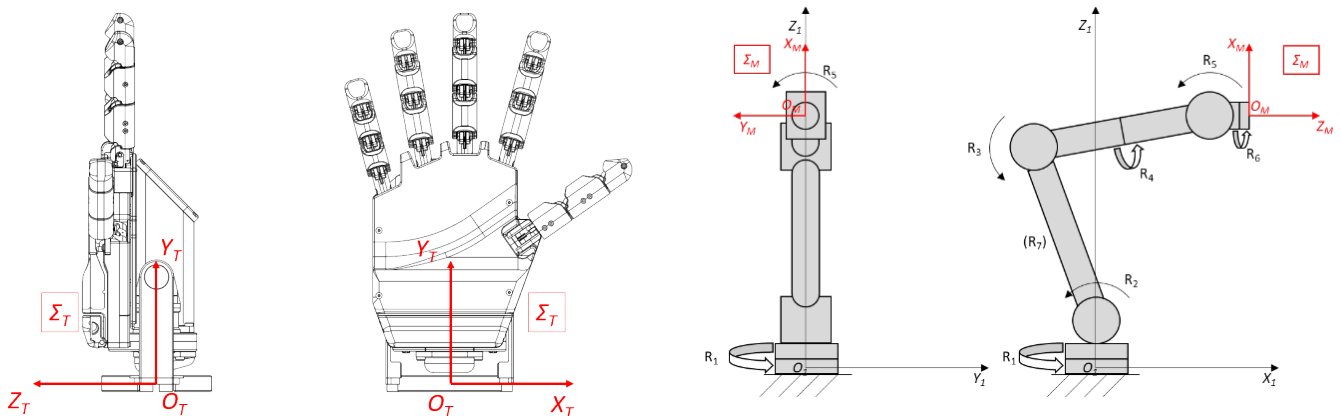
On the rear part of the device there is its serial number, that you can read following the structure below.



- (a) family
- (b) model
- (c) progressive number

4 Technical Data

MECHANICAL	UNIT	NOMINAL	MIN	MAX
weight	[kg]	0.89	-	-
wrist mounting range	[deg]	-	0	90
wrist mounting resolution	[deg]	7.5	-	-
power grasp payload	[kg]	-	-	2.0
pinch grasp payload	[kg]	-	-	0.6
hanging payload	[kg]	-	-	5.0
full closing time	[s]	-	-	1.2



The mechanical interface coordinate system $\Sigma_M (O_M; X_M, Y_M, Z_M)$ of an articulated robot, as defined by ISO 9787:2013. In particular, the center of the coordinate system, O_M , is on the interface surface of the robot tool flange and the Z_M axis is coincident with the tool flange axis of symmetry. R_i is the i -th revolute joint of the robot. $(O_1; X_1, Y_1, Z_1)$ is the base coordinate system of the robot.

The system $\Sigma_T (O_T; X_T, Y_T, Z_T)$ is the Tool Coordinate System of the device.

The center, O_T , coincides with the center O_M . The Z_T axis is normal to the palm, outgoing positive, and the Y_T axis is normal to the flange plane.

This definition implies that Σ_T is the same for left and right one. So, the positive orientation of X_T axis will be on the side of the thumb in the right hand and on the side opposite to the thumb in the left hand.

4.1 Center Of Mass

 *coordinates system Σ_T*

qb SoftHand Industry State	UNIT	X	Y	Z
fully open	[mm]	2.4	80.5	14.3
fully closed	[mm]	1.1	75.3	17.5

4.2 Inertia Tensor

 *coordinates system Σ_T*

qb SoftHand Industry State	UNIT	XX	XY	XZ	YY	YZ	ZZ
fully open	[kgmm ²]	-9535	-90	335	-9888	-1449	1343
fully closed	[kgmm ²]	-8090	-72	155	-7963	-1752	1371

4.3 Environmental Specifications

Specification	UNIT	NOMINAL	MIN	MAX
operating temperature	[°C]	-	-5	50
storage temperature	[°C]	-	-20	50
noise level	[dB]	52	40	61

4.4 Electrical Specifications

Specification	UNIT	NOMINAL	MIN	MAX
operating voltage	[V]	24	23	26
power consumption	[W]	13	3	15

Control Specification

communication protocols: EtherCAT, UDP

FEATURE

plug-and-play¹

soft, human like fingers

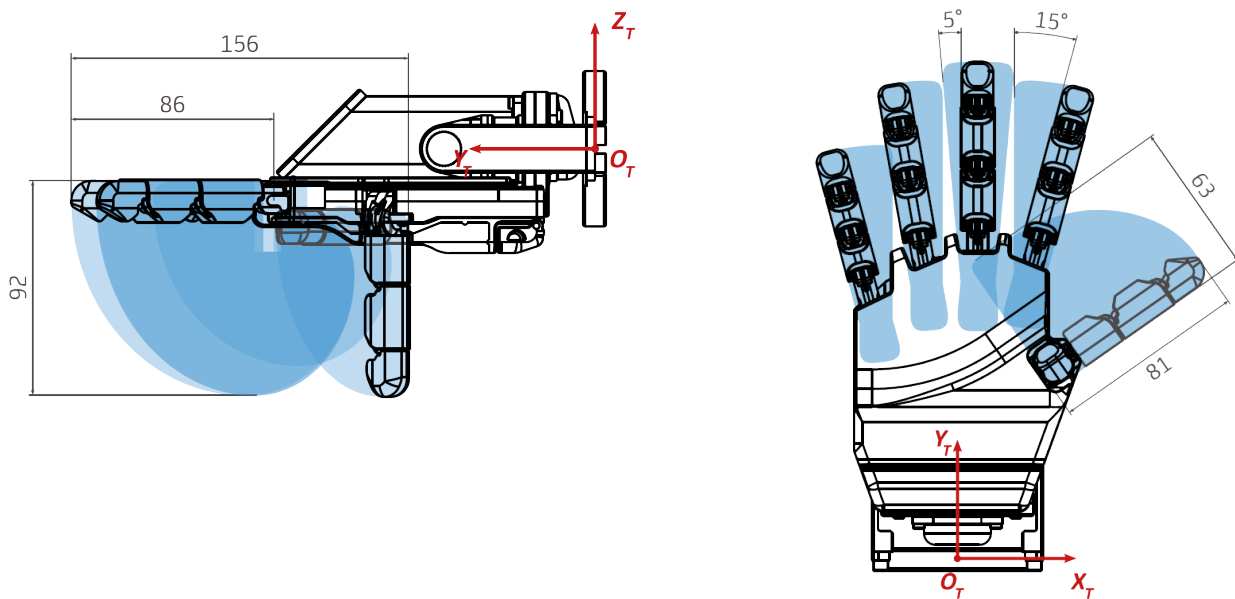
adjustable wrist mounting position

splash, water, and dust resistance: IP65

interchangeable glove for special applications

4.5 Fingers workspace

Figures below show the hand workspace, in particular the fingers' range. Dimensions are in millimeters.



4.6 Adjustable wrist

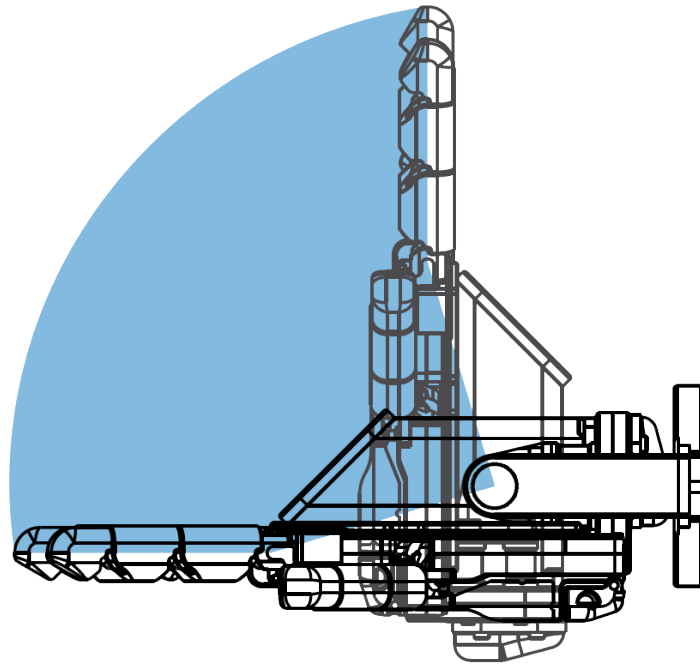
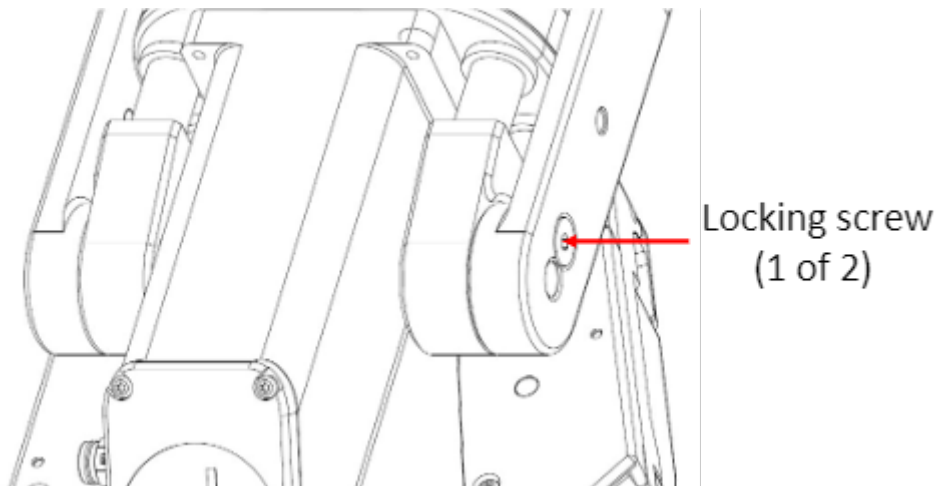



Figure 1. — Extreme positions of the wrist pre-set

You can adjust the pitch pre-set of the wrist in three positions: 0°, 45° and 90° by 2,5mm allen wrench.



Please, follow the sequence below to change the wrist pre-set.

1. remove the 2 screws by 2,5mm allen wrench;
2. rotate the hand at the desired angle;
3. lock the joints by the two screws and a maximum torque of 2Nm.

 This feature will help you to assemble the hand to the robot flange.

**WARNING:**

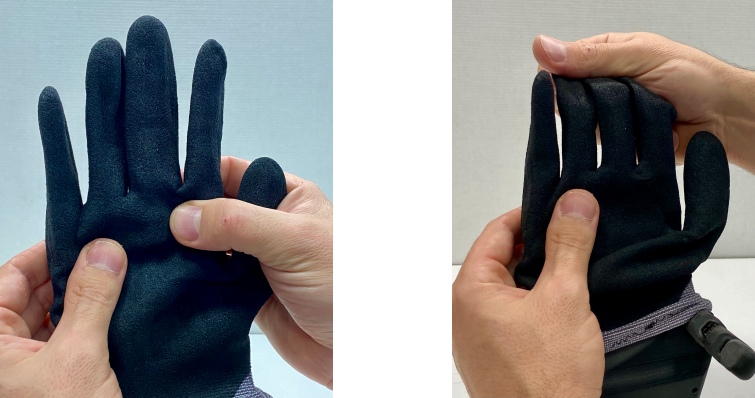
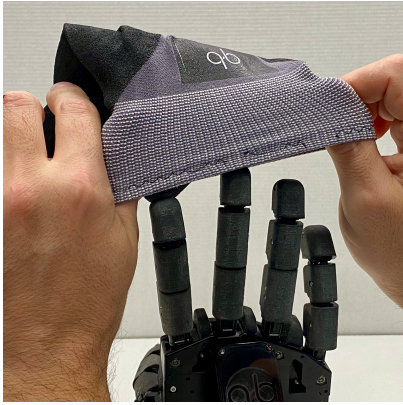
Do not apply a torque more than 2Nm to lock the screws.

4.7 Glove substitution

The device is supplied with a glove (protective) basic accessory.

The glove is interchangeable and can also be replaced by the user. It is recommended to always use the robotic hand with accessory gloves provided by qbrobotics. Alternatively, the user can decide to use commercial gloves of the same type (reference size 11/XXL), taking charge of evaluating the change in performance of the robotic hand.

#	INSTRUCTIONS	PICTURES	
1	Open the hinge near the wrist and remove the blocked part of the glove.		
2	Pull up the glove from the wrist up to the thumb.		

#	INSTRUCTIONS	PICTURES
3	<p>Pull up all the fingertips to let the glove to stay straight. Carefully remove the thumb from the glove.</p>	
4	<p>Slowly remove the glove finger by finger and then widely open it from the wrist.</p>	

You can follow these instructions from 4 to 1, to put a new glove.

5 Mounting and Wiring

The qb SoftHand Industry Kit allows you to connect the device to your robot arm. The kit consists of:

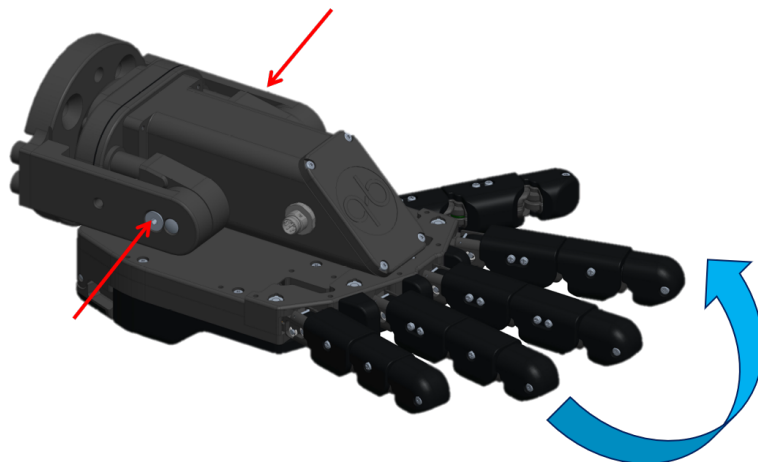
- N.1 qb SoftHand Industry 24V;
- N.1 external driver **G-DCWHI2.5/100EES**;
- N.1 ethernet cable **EC_CBL_UTP_6_RJ45_BLK_050**;
- N.1 power cable **EC_CBL_22_02_L50_RR_200**;
- N.1 power cable **EC_CBL_22_01_L5_RR_100**;
- N.1 STO cable **EC_CBL_26_CRMP3_WIRE_050**;
- N.1 power line communication bridge with main cable of 3m **EC_CBL_26_M8FA8_CRIMP_100**;
- N.1 USB pen drive:
 - Manual;
 - Datasheet;
- N.1 cylindrical pin EN ISO 8734 A d6x10 h6;
- N.4 metrical screws EN ISO 10642 M6x10;
- N.2 Allen hex keys.

5.1 Tool mounting

5.1.1 SoftHand Industry mounting

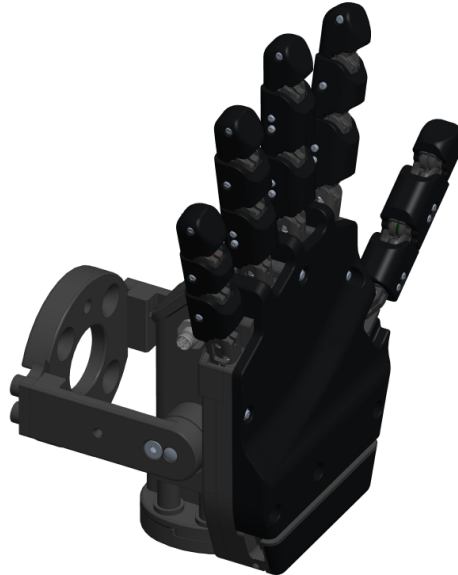
Use only the screws provided within the package. Longer screws could damage the robot or the hand. To assemble the hand on the robot arm, please follow the instructions of following table:

#	INSTRUCTIONS
1	Unlock the wrist removing the 2 screws by 2.5mm allen hex key and rotate the flange.

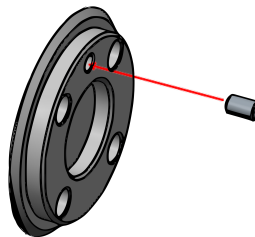


#	INSTRUCTIONS
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2 Keep the device as shown in figure, then replace the 2 locking screws.

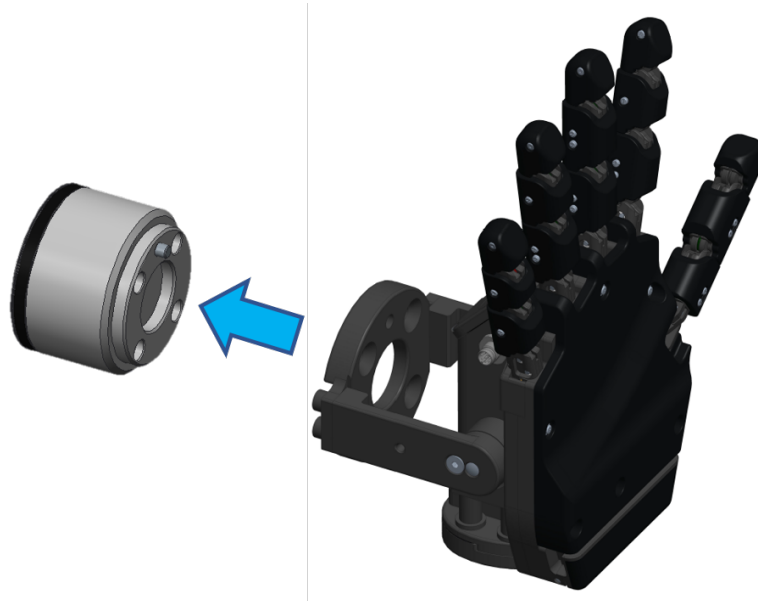


3 Insert into the 6 mm hole on the wrist of the robot.

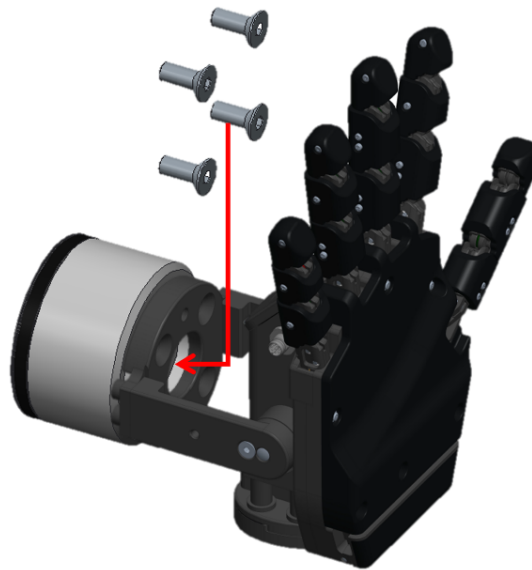


#	INSTRUCTIONS
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- 4 Center the qb SoftHand Industry on the robot's flange.

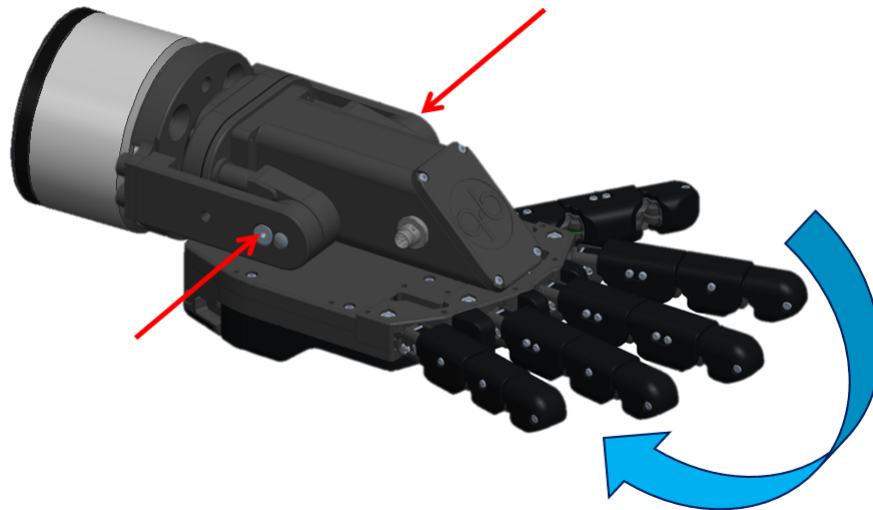


- 5 Fasten the device to the robot's wrist by tightening the four screws.



 You need the 4mm Allen wrench.

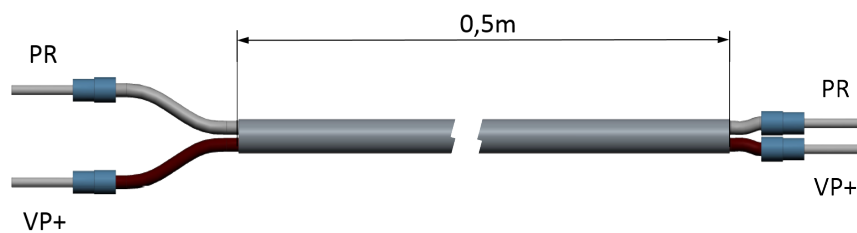
#	INSTRUCTIONS
6	Unlock the wrist (see point 1) and rotate the device until the desired position (0°, 45° or 90°). Fix the device by tightening the 2 locking screws.



5.2 Cable connections

5.2.1 Set of cables

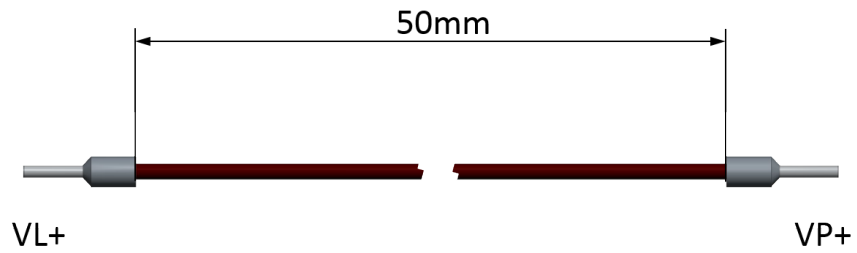
ID	Cable Name
C1	Power cable EC_CBL_22_02_L50_RR_200



Power cable to supply the external driver.

C2

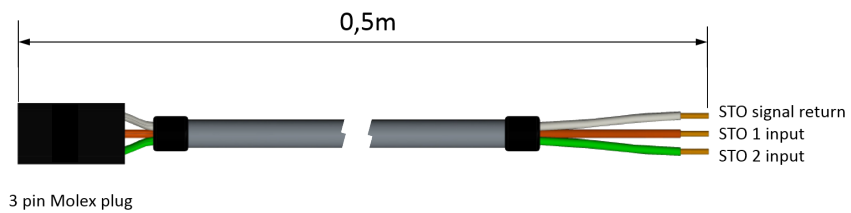
Power cable
EC_CBL_22_01_L5_RR_100



Power cable to supply auxiliary port.

C3

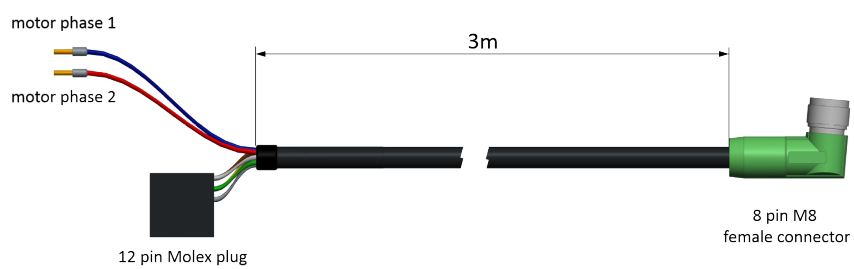
STO cable
EC_CBL_26_CRMP3_WIRE_050



This cable has a free end to allow the user to connect to a generic terminal block.

C4

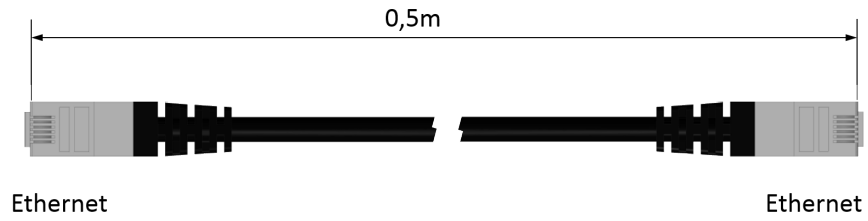
Main cable
EC_CBL_26_M8FA8_CRIMP_100



Main cable to connect the Device to the external driver.

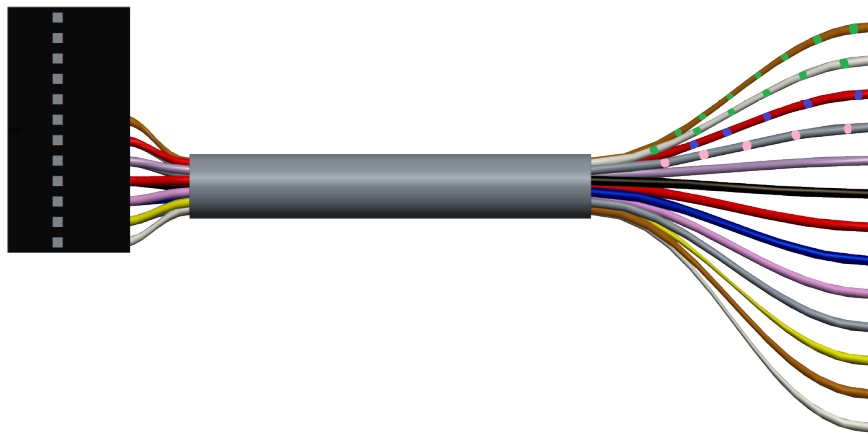
C5

Ethernet cable
EC_CBL_UTP_6_RJ45_BLK_050

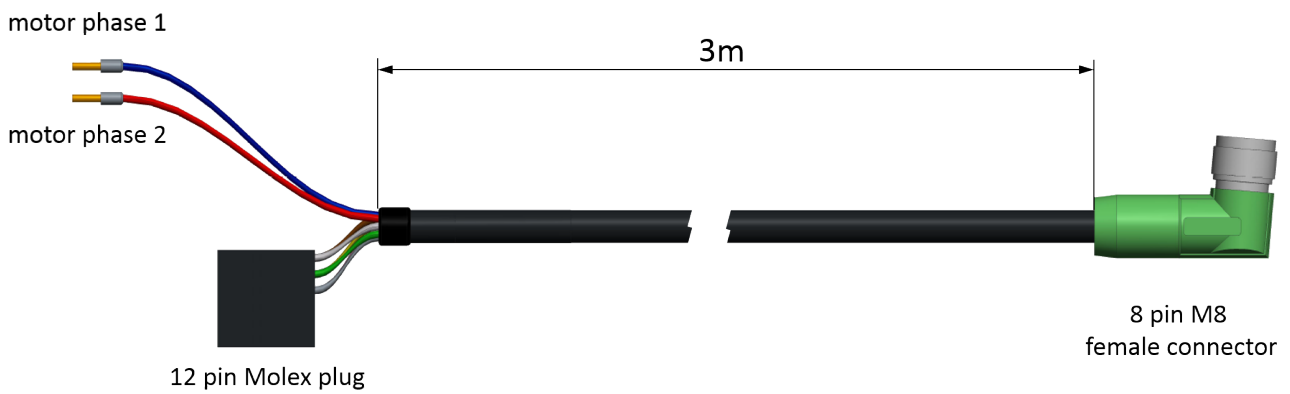


C6

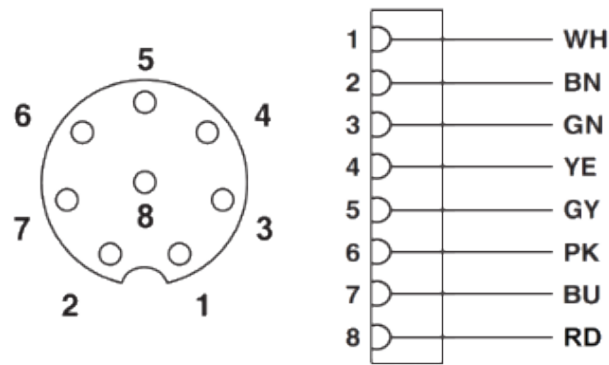
Digital I/O cable
EC_CBL_26_CRMP24_WIRE_050



M8 connector pinning

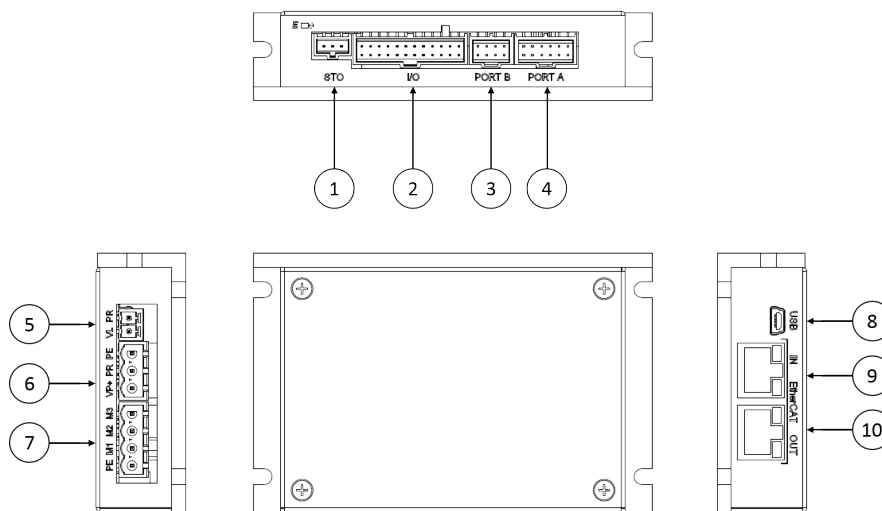


The pinning of the female M8 connector, 8 poles, is given below:



Pin n.	Wire color	Purpose
1	White	SSI 5 VDC
2	Brown	SSI GND
3	Green	SSI clock +
4	Yellow	SSI clock -
5	Gray	SSI data +
6	Pink	SSI data -
7	Blue	motor phase 1
8	Red	motor phase 2

Driver ports



Port n.	Type	Function	Pins
---------	------	----------	------

1	2.54 mm Pitch Molex	STO	3
2	2.54 mm Pitch Molex	Feedback port C and I/O	24
3	2.54 mm Pitch Molex	Feedback port B	8
4	2.54 mm Pitch Molex	Feedback port A	12
5	Phoenix 3.81 mm Pitch 'HC'	Auxiliary supply input	2
6	Phoenix 5 mm Pitch 'HC'	Main Power	3
7	Phoenix 5 mm Pitch 'HC'	Motor phases	4
8	USB Device Mini-B	USB	5
9	EtherCAT in	RJ-45	8
10	EtherCAT out	RJ-45	8

5.2.2 Cabling sequence



WARNING

Do not use force on the cables to remove the wiring. Act only on the connectors. Use only the provided set of cables.



WARNING

The entire wiring process should be performed without powering the external driver. Be sure to complete all steps before powering the system!

#

INSTRUCTIONS

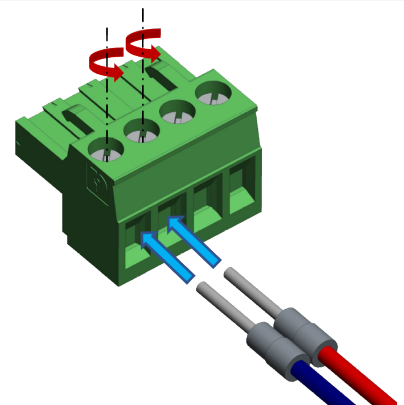
- 1 Assembly the motor phases of the main cable (**C4**) to the 4-pin connector for the **port 7** of the driver; block the cables turning clockwise the two screws. Make sure to connect the red cable to the **M2** pin and the blue cable to the **M3** pin.



Pay attention to connect cables in the correct way.

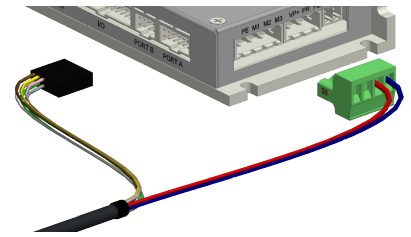


You need the flathead screwdriver.

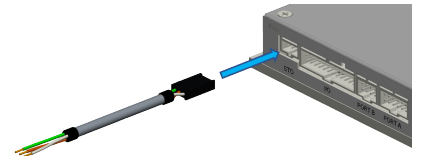


INSTRUCTIONS

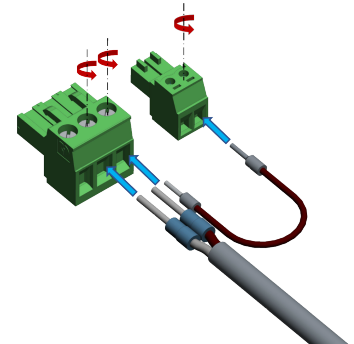
- 2 Assembly the main cable (C4) to the external driver.
 Connect the 12-pins Molex plug to the **port 4** and the 4-pins connector to the **port 7**.





- 3 Connect the STO plug (C3) to the external driver **port 1**.
 Read [Safe Torque Off function](#) (see [Page 21](#)) section for more information.



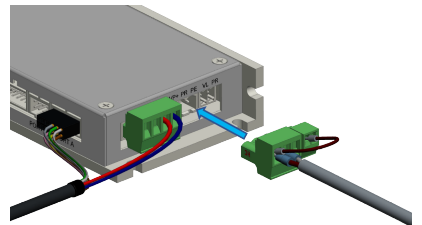
- 4 Assembly the power cables (C1) and (C2) to the 3-pins connector for the **port 6** of the external driver and the 2-pin connector for the **port 5** of the external driver; block the cables turning clockwise the three screws.
 Make sure to connect the two brown cables to the **VP+** pin, the white cable to the **PR** pin and the other end of brown cable to the **VL+** pin.




 Pay attention to connect cables in the correct way.

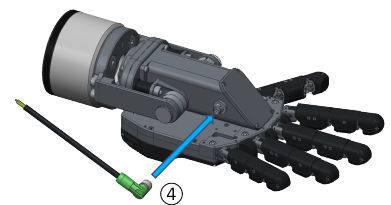
 You need the flathead screwdriver.


- 5 Connect the power cable to the **port 5** of the external driver, by the 2-pin connector and the power cable to the **port 6** of the external driver, by the 3-pin connector.




 Do not power the device!

- 6 Insert the M8 connector of the main cable (C4) into the receptacle on the hand.
 Lock the M8 connector by manually tightening its threaded ring on the body of the receptacle (max tightening torque= 0.2 Nm).

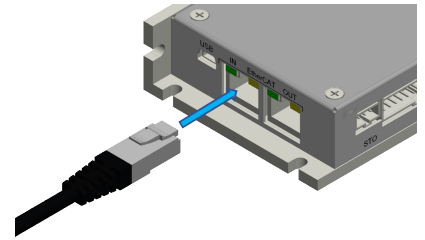


 Ensure that the device is not powered until this step is completed!

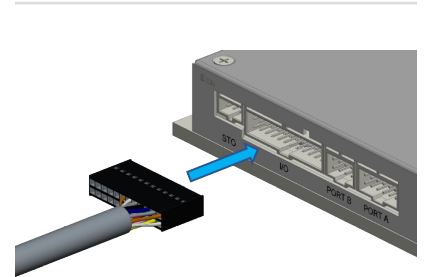
 Be careful to insert the connector in the right direction; Do not rotate the M8 connector when inserted into the receptacle; Minimum curve radius of the cable (4) = 51mm.

INSTRUCTIONS

- 7 Depending on which control mode is desired for the qb SoftHand Industry, connect:
- or the Ethernet **EC_CBL_UTP_6_RJ45_BLK_050 (C5)** cable to the **port 9** of the external driver;
 - or the Digital I/Os cable **EC_CBL_26_CRMP24_WIRE_050 (C6)** to the **port 2** of the external driver.



i For more information, read carefully the dedicated sections of the [Device Control chapter](#). (see Page 22)



Safe Torque Off (STO) function

Activation of the Safe Torque Off (STO) function causes the drive to stop providing power, which controls the motor movement and the motor can only be electrically activated, when both STO inputs are active. The STO may be used to prevent unexpected motor rotation while the drive remains connected to a power supply.

Whenever one of the inputs is no longer active, power that can generate motion is no longer provided to the motor by the drive.

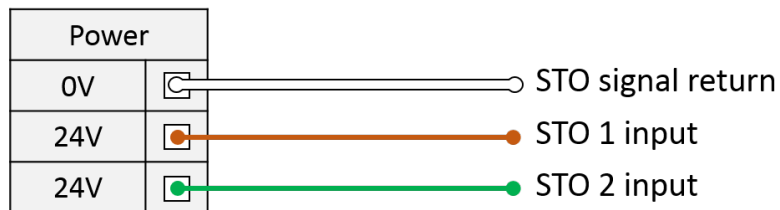
The STO cable must be connected to a safety device and you can connect it in two ways:

Connection to Robot control box. In this way the STO is managed by the control box and its safety protocols.



! For connection to the control box, please refer to the manual of the robot you are using.

External power connection. In this way you can keep the motor enabled and you have to turn off the external power source to disable it.



6 Device Control

6.1 Digital I/O

It is possible to control the qb SoftHand Industry via 24VDC digital inputs and outputs.

i Control of the device via digital I/O requires the connection between the Robot Controller/PLC and the external driver via the supplied STO **EC_CBL_26_CRMP24_WIRE_050 (C6)** cable.

The **EC_CBL_26_CRMP24_WIRE_050** cable has a free end to allow the user to connect to a generic terminal block. In the other end there is a Molex 24 pins connector, for the external driver's **port 2**.

Below is the colour legend and pin numbering on port 2 of the external driver.

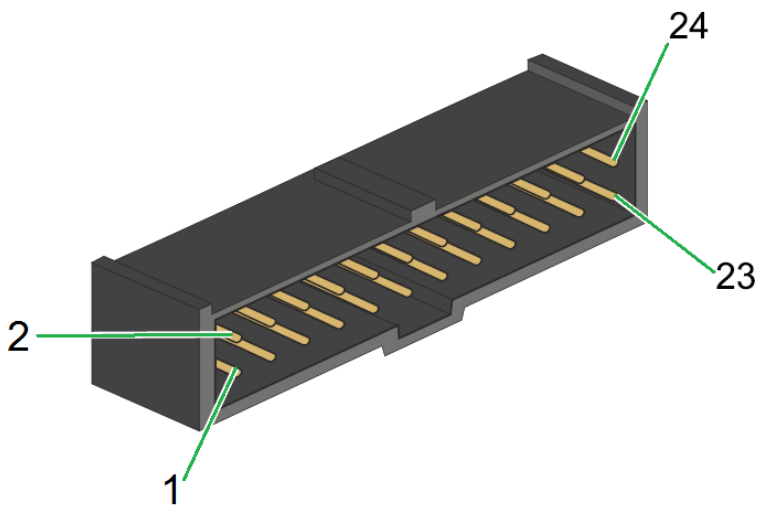


Figure 2. — Digital I/Os port of provided driver.

WARNING:
Pins with an odd number in the bottom row and an even number in the top row.

12	IN_GND
13	IN 1
14	IN 2
15	IN 3
16	IN 4
17	IN 5
18	IN 6
19	OUT 4
20	OUT 3
21	OUT 2
22	OUT 1
23	OUT_VDD
24	OUT_GND

The following table shows the actions related to the trigger of the DIGITAL INPUTS.

Digital Input Port	Triggered Action
--------------------	------------------

IN1	fully opening at maximum speed
IN2	fully closing at maximum speed and force
IN3	fully closing at 25% of speed and maximum force
IN4	fully closing at 25% of speed and maximum force
IN5	fully closing at 25% of speed and 75% of force
IN6	correct termination procedure to use before switching off
IN_GND	digital inputs ground

Table 1. — Digital Inputs



WARNING:

the termination procedure (IN6) is called for every switching off and it's needed for the correct behavior of device and to limiting its hysteresis.

With regard to the DIGITAL OUTPUTS of the external driver, please refer to the table below.

Digital Output Port	Feedback
OUT1	0 (0VDC) when the motor is stationary
OUT2	0 (0VDC) when the number of cycles exceeds the maintenance threshold
OUT3	0 (0VDC) when there is an error in the program or in the driver parameters
OUT4	0 (0VDC) when the driver is in protection for some electrical or mechanical problem
OUT_VDD and OUT_GND	references needed to define the 24VDC. Connect OUT_VDD to 24V and OUT_GND to its ground reference (0V)

Table 2. — Digital Outputs

6.1.1 Example of control with Digital I/O

Using just two digital outputs DO1 and DO2 (at 24VDC) on the Robot Controller/PLC, it is possible to use the qb SoftHand Industry by activating the logic states of the two outputs.

For example, switching DO1 to high value, the device will open completely, while setting DO2 it will have a complete closure (with maximum speed and force). This is because the called functions are respectively the first and second digital inputs of the external driver of the qb SoftHand Industry.

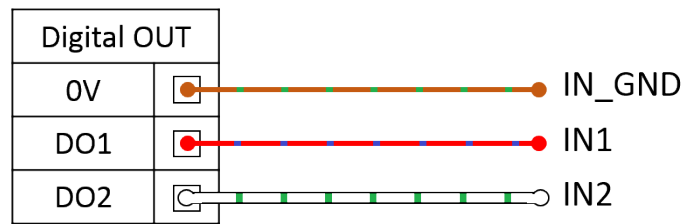


Figure 3. — Example of control via a generic PLC control or Robot Controller

For all other available configurations, please refer to [Digital Inputs table](#) (see Table 1).

In a similar way it is possible to retrieve the status of the device and some auxiliary information through its digital outputs. For example, DI1 will be low whenever the qb SoftHand Industry is in a steady state, whether it is related to a socket or a rest condition (it will be at 1 when the motor will be moving).

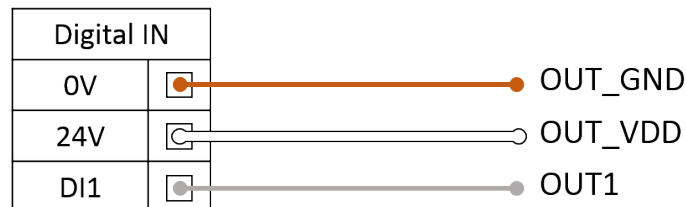


Figure 4. — Example of status reading via a generic PLC control or Robot Controller

For all other states available, please refer to [Digital Outputs table](#) (see Table 2).

- i** All these states are activated by a pulse of a few tenths of a second on the respective 24VDC digital input (with respect to the IN_GND which acts as a ground for digital inputs). If the input remains high, the others can still be activated, but the high one will not activate until it returns to "0" (0 VDC) and then again to "1" (24 VDC). It is not possible to activate multiple commands simultaneously. To give the next input, the previous one must already have been completed.

6.2 C++ API

C++ libraries are provided by qbrobotics in the form of precompiled packages(.so, .dll, ...).

- i** Control of the device via C++ API exploits Ethernet UDP connection and requires the connection between the PC and the external driver via the supplied Ethernet EC_CBL_UTP_6_RJ45_BLK_050 (C5) cable.

It is possible to download these libraries from [qbrobotics website](https://qbrobotics.com/wp-content/uploads/2021/07/qbsofthand_industry_api_1.0.3.zip)¹. They are provided within a CMake project so that, following the very basic installation steps, it is possible to build the example code from scratch and test the qb SoftHand Industry functionalities. For example, on a Linux system the commands to be executed on the terminal are:

```
mkdir build
cd build
```

¹ https://qbrobotics.com/wp-content/uploads/2021/07/qbsofthand_industry_api_1.0.3.zip

```
cmake ..
make
```

The example code is stored under the `src` directory (`main.cpp`). The building process generates an executable called `qbsofthand_industry_api_example` in the build directory.

**WARNING:**

Before executing the example code, please be sure to have properly connected and powered the device by following the instructions described in the previous chapters of this documentation.

The example prompts on screen the qb SoftHand Industry information and close (and reopen) it just one time.

**WARNING:**

Note that depending on the operating system you are using, specific libraries must be linked. If you need special architecture binaries, please contact our [Support Team](#)².

It is required to be connected to the device through a proper Ethernet network. The device default parameters are the followings so please set up your network adapter settings to fit this configuration.

- Network IPv4: 192.168.1.110
- Network Mask: 255.255.255.0
- Network Gateway: 192.168.1.1
- Network DHCP: disabled

For example, you may give the `192.168.1.100` static IPv4 to your network adapter.



It is possible to change the device network parameters later, using a dedicated API method.

6.2.1 Class methods description

`qbSoftHandIndustryAPI()`

Initialize the qb SoftHand Industry API handler by opening the proper UDP socket and by testing its communication. The constructor tries to connect to the qb SoftHand Industry for at most 30 seconds and then returns. Through the method 'isInitialized()' is possible to test whether the initialization succeeded or not. The default IPv4 address used for the UDP socket connection is 192.168.1.110.

² <mailto:support@qbrobotics.com>

qbSoftHandIndustryAPI(const std::string &device_ip)

Initialize the qb SoftHand Industry API handler by opening the proper UDP socket and by testing its communication. The constructor tries to connect to the qb SoftHand Industry for at most 30 seconds and then returns. Through the method 'isInitialized()' is possible to test whether the initialization succeeded or not.

Arguments:

- *device_ip*: The IPv4 address used for the UDP socket connection. It must be a valid IPv4 address.

~qbSoftHandIndustryAPI()

Close the UDP socket and perform the proper shutdown procedures.

float getCurrent()

Get the actual qb SoftHand Industry motor torque in percent value w.r.t. the maximum value.

float getPosition()

Get the actual qb SoftHand Industry motor position in percent value w.r.t. the maximum value.

float getVelocity()

Get the actual qb SoftHand Industry motor velocity in percent value w.r.t. the maximum value.

std::string getStatistics()

Get the qb SoftHand Industry device information.

bool isInitialized()

Return true if the initialization procedure has succeeded.

int setClosure(const float &position)

Send the given percent-position closure command reference to the qb SoftHand Industry.

Arguments:

- *Position*: the percent-position command reference, in range [0, 100] % where `0` is the fully open configuration, and `100` is the fully closed. return `0` on success; `-1` if the position is out of range.
-

int setClosure(const float &position, const float &velocity, const float ¤t)

Send the given percent-position closure command reference to the qb SoftHand Industry, together with the speed reference command and the maximum force that should be applied during the grasp. This is the most complete command to send a reference to the qb SoftHand and should be used for special cases. In normal usage, the simpler version above should be preferred. All the parameters are expressed in percent w.r.t. the maximum possible value.

Arguments:

- *Position*: the percent-position command reference, in range [0, 100] % where 0 is the fully open configuration, and `100` is the fully closed.
 - *Velocity*: the speed command reference, in range [12.5, 100] % where `12.5` is the minimum velocity of the closure, and `100` is full speed.
 - *Current*: the current threshold for the motor, in range [62.5, 100] % where `62.5` is the minimum force that the hand can apply, and `100` is the maximum return `0` on success; `-1` if at least one of the percent values is out of range.
-

int setIP(const std::string &net_ip, const std::string &net_mask, const std::string &net_gateway)

Change the qb SoftHand Industry IPv4 address, network mask and gateway of the device. It is worth noticing that the device should be connected first to use this command.

Arguments:

- *net_ip*: the device network IP address, e.g. 192.168.1.110.
- *net_mask*: the device network mask, e.g. 255.255.255.0.
- *net_gateway*: the device network gateway, e.g. 192.168.1.1.

return* **0** on success; **-1** if at least one of the given IPv4-format addresses is wrong.

void waitForTargetReached()

Wait until the qb SoftHand Industry has reached the commanded position. This method should be called after a *setClosure* one, to wait for the action to be completed.

6.3 ROS

The *qb SoftHand Industry* can be fully controlled through Ethernet with ROS Noetic.

6.3.1 Installation

Requirements

If you have never set it up, you probably need to add your Linux user to the `dialout` group to grant right access to the serial port resources. To do so, just open a terminal and execute the following command:

```
sudo gpasswd -a <user_name> dialout
```

where you need to replace the `<user_name>` with your current Linux username.


 *Note: don't forget to logout or reboot.*

Ubuntu Packages

If you prefer to leave your catkin workspace as it is, you can simply install all the ROS packages from the Ubuntu official repositories:

```
sudo apt update
sudo apt install ros-noetic-qb-softhand-industry
```

Sources

 Since you are interested in the ROS interfaces for our devices, it is assumed that you are familiar at least with the very basics of the ROS environment. If not, it might be useful to spend some of your time with [ROS](http://wiki.ros.org/ROS/Tutorials)³ and [catkin](http://wiki.ros.org/catkin/Tutorials)⁴ tutorials.

³ <http://wiki.ros.org/ROS/Tutorials>

⁴ <http://wiki.ros.org/catkin/Tutorials>

Install the *qb SoftHand Industry* packages for a ROS user is straightforward. Nonetheless the following are the detailed steps which should be easy to understand even for ROS beginners:

1. Clone the `qb_softhand_industry` packages to your Catkin Workspace, e.g. `~/catkin_ws` :

```
cd `~/catkin_ws/src`
git clone <https://bitbucket.org/qbrobotics/qbshin-ros.git>
```

2. Install ROS dependencies using `rosdep` :

```
cd `~/catkin_ws`
rosdep install --from-paths src --ignore-src -r -y
```

3. Compile the packages using `catkin` :

```
catkin_make
```

Note: depending on your ROS installation, you may need some extra packages to properly compile the code. Please, be sure that you have already installed at least `ros-noetic-ros-controllers`, `ros-noetic-transmission-interface`, `ros-noetic-joint-limits-interface`, `ros-noetic-combined-robot-hw`, and their dependencies (e.g. use `sudo apt install <ros-pkg>`).

If you were not familiar with ROS you should be happy now: everything is done! Nonetheless, if you encounter some troubles during the compilation, feel free to ask for support on [our Bitbucket](#)⁵.

Device Setup

To connect a *qb SoftHand Industry* to your system is **read carefully** the [Mounting and Wiring Chapter](#) (see [Page 12](#)) to understand all the requirements and advices. However the communication happens via Ethernet, (default address 192.168.1.110) so you have to configure your wired connection with an IP of the same family.

6.3.2 Usage

Launch file

Once the device is physically connected to your system, you can launch the device node with the following command line:

⁵ <https://bitbucket.org/account/user/qbrobotics/projects/ROS>

```
roslaunch qb_softhand_industry_control shin_control.launch use_rviz:=true use_controller_gui:=true
```

The arguments explained

- `use_controller_gui [false]` : Choose whether or not to use the controller GUI.


Additional arguments

- `control_duration [0.001]` : The duration of the control loop expressed in seconds.
- `ip_address [192.168.1.110]` : The IP address of the ELMO driver.
- `flange_angle [0]` : The angle of the configurable flange (in radians).
- `max_repeats [3]` : The maximum number of consecutive repetitions to mark retrieved data as corrupted.

The followings are particular control modes which are enabled with few parameters, but the concepts of this paragraph hold for all of them.

GUI Control

This control mode is the one suggested to test that everything is working as expected. You are able to open and close the *qb SoftHand Industry* interactively, but nothing more than this.

 You will probably need this only the very first times and for debugging.

To start this mode just add `use_controller_gui:=true` to the general `roslaunch` command.

After a while a GUI should appear to screen with two empty drop down menus, a red enable button below them, and a *speed scaling* slider at the bottom.

1. Select the *Controller Manager* namespace from the left menu, e.g. `/<robot_namespace>/control/controller_manager` (where `<robot_namespace>` is an additional argument of the launch file needed with several devices). This enables the right menu which provides all the controllers available for the connected device.
2. Select the *shin synergy trajectory controller* from the second drop down menu and enable it through the circular button.
3. A single slider will appear in the GUI to control the closure of the hand, which ranges from `0` (hand completely open) to `1` (hand completely closed). Move the slider to perform a complete grasp or to partially open/close the *qb SoftHand Industry*. You can also vary the speed through the bottom *speed scaling* slider if you like a faster/slower motion. No other timing constraints can be set in this mode.

7 Maintenance and warranty

7.1 General

Products of the company qbrobotics s.r.l. are produced using the most modern production methods and are subject of strict quality inspections. All information regarding our Warranty Policy can be found at [this⁶](#) site.

⁶ <https://qbrobotics.com/technical-support/>

8 Certifications

Standards applied under development of the product is listed in this section. When an EU Directive number is noted in brackets it indicates that the standard is harmonized under that Directive.

ISO 12100:2010

EN ISO 12100:2010 (E) [2006/42/EC]

Safety of machinery – General principles for design – Risk assessment and risk reduction.

The product is evaluated according to the principles of these standards.

ISO 10218-2:2011

EN ISO 10218-2:2011(E) [2006/42/EC]

Robots and robotic devices – Safety requirements for industrial robots Part 2: Robot systems and integration

The product is prepared for compliance with robot system requirements defined in these standards.

ISO/TS 15066:2016

RIA TR R15.606

Robots and robotic devices – Safety requirements for industrial robots – Collaborative operation This is a Technical Specification (TS), **not** a standard. The product is prepared for easy integration in compliance with provisions in this Technical Specification, see more in the safety chapter.

EN ISO13849-1:2015

EN ISO13849-2:2012

Part 1: Safety of machinery. Safety-related parts of control systems. General principles for design.

Part 2: Safety of machinery - Safety-related parts of control systems - Part 2: Validation

The product is evaluated according to these standards.

ISO/TR 20218-1:2018

Robotics – Safety requirements for industry robots Part 1: Industrial robot system end of arm tooling (end-effector)

This is a Technical Report (TR), **not** a standard. The product is designed according to principles in this Technical Report.

ISO 9409-1:2004 [Type 50-4-M6]

Manipulating industrial robots – Mechanical interfaces

The EE flange conforms to type 50-4-M6 of this standard. Robots should also be constructed according to this standard to ensure proper fitting.

EN 60529/A2:2013

Degrees of protection provided by enclosures (IP Code)

This standard defines enclosure ratings regarding protection against dust and water. SoftHand Industry is designed and classified with an IP rating according to this standard.

EN 61000-6-4:2019 "Electromagnetic compatibility (EMC) – Part 6-4 Generic standards – Emissions for industrial environments"

EN 61000-6-2:2019 "Electromagnetic compatibility (EMC) – Part 6-2 Generic standards – Immunity for industrial environments".

EN 61000-4-2:2009 " Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurements techniques – Electrostatic discharge immunity test".

EN 61000-4-3:2006/A1:2008/A2:2010 " Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurements techniques – Radiated, radio-frequency, electromagnetic field immunity test".

EN 61000-4-4:2012 " EN 61000-4-8:2010 " Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurements techniques – Electrical fast transient/burst immunity test".

EN 61000-4-5:2014/A1:2017 " EN 61000-4-8:2010 " Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurements techniques – Surge immunity test".

EN 61000-4-6:2014 " EN 61000-4-5:2014/A1:2017 " EN 61000-4-8:2010 " Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurements techniques – Immunity to conducted disturbances, induced by radiofrequency fields".

EN 61000-4-8:2010 " Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurements techniques – Power frequency magnetic field immunity test".

EN 61000-4-11:2004/A1:2017 " Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurements techniques – Voltage dips, short interruptions and voltage variations immunity test".