USER MANUAL

FOR **KUKA** ROBOTS

ORIGINAL INSTRUCTION (EN)

v1.05

Contents

1 Introduction

1.1 Important Safety Notice

DANGER:

You must read, understand, and follow all safety information in this manual, and the robot manual and all associated equipment before initiating robot motion. Failure to comply with safety information could result in death or serious injury.

1.2 Scope of the Manual

The manual covers the following OnRobot products and its components:

Grippers	Version
Gecko Gripper	v2
RG2	v2
RG2-FT	v2
RG6	v2
VG10	v2
VGC10	v1

Sensors	Version
HEX-E QC	v3
HEX-H QC	v3

Where applicable the combination of the products is also covered in the manual.

NOTE:

Generally, the products without the Quick Changer v2 interface, are not in the scope of this manual.

1.3 Naming convention

In the user manual Gecko Gripper is called Gecko only.

The RG2 and RG6 names as model variants are used separately or together as RG2/6 if the information is relevant for both variants.

The HEX-E QC and HEX-H QC names as model variants are used separately or together as HEX-E/H QC if the information is relevant for both variants.

1.4 How to read the Manual

The manual covers all OnRobot products and its components that is available for your robot.

To make it easy to follow what type of product (or combination) or component is the given information is relevant for, the following visual highlights are used:

RG2

This is an instruction relevant for the RG2 product only.

RG2-FT

This is an instruction relevant for the RG2-FT product only.

VG10

This is an instruction relevant for the VG10 product.

All text without these visual marks are relevant for all products or components.

For convenience, in each part that contains visual highlights (that span across pages) a table is provided in the beginning, to guide you which page contains the relevant information for your product or component:

2 Safety

The robot integrators are responsible for ensuring that the applicable safety laws and regulations in the country concerned are observed and that any significant hazards in the complete robot application are eliminated. This includes, but is not limited to:

- Performing a risk assessment for the complete robot system
- Interfacing other machines and additional safety devices if defined by the risk assessment
- Setting up the appropriate safety settings in the robot software
- Ensuring that the user will not modify any safety measures
- Validating that the total robot system is designed and installed correctly
- Specifying instructions for use
- Marking the robot installation with relevant signs and contact information of the integrator
- Collecting all documentation in a technical file; including the risk assessment and this manual

2.1 Intended Use

OnRobot tools are intended to be used on collaborative robots and light industrial robots with different payloads depending on the end-of-arm tooling specifications. OnRobot tools are normally use in pick-and-place, palletizing, machine tending, assembly, quality testing and inspection and surface finishing applications.

The end-of-arm tooling should only operate under conditions noted in **Technical sheets** section.

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

- Use in potentially explosive atmospheres
- Use in medical and life critical applications
- Use before performing a risk assessment
- Use outside the permissible operational conditions and specifications
- Use close to a human's head, face and eye area
- Use as a climbing aid

2.2 General Safety Instructions

Generally, all national regulations, legislations and laws in the country of installation must be observed. Integration and use of the product must be done in compliance with precautions in this manual. Particular attention must be paid to the following warnings:

DANGER:

You must read, understand, and follow all safety information in this manual, and the robot manual and all associated equipment before initiating robot motion. Failure to comply with safety information could result in death or serious injury.

The information in this manual does not cover designing, installing, and operating a complete robot application, nor does it cover other peripheral equipment that can influence the safety of the complete system. The complete system must be designed and installed in accordance with the safety requirements set forth in the standards and regulations of the country where the robot is installed.

Any safety information provided in this manual must not be construed as a warranty, by OnRobot A/S, that the robot application will not cause injury or damage, even if robot application complies with all safety instructions.

OnRobot A/S disclaims any and all liability if any of OnRobot tools tooling are damaged, changed or modified in any way. OnRobot A/S cannot be held responsible for any damages caused to any of OnRobot tools tooling, the robot, or any other equipment due to programming errors or malfunctioning of any of OnRobot tools.

WARNING:

OnRobot tools are not allowed to be exposed to condensing conditions when power is on or when connected to a robot. If condensing conditions appear during transport or storage, the product must be placed between 20 and 40 Celsius degrees for 24 hours before power is applied or before connected to a robot.

It is recommended that OnRobot tools are integrated in compliance with the following guides and standards:

- ISO 10218-2
- ISO 12100
- ISO/TR 20218-1
- ISO/TS 15066

2.3 Risk Assessment

The robot integrator must perform a risk assessment on the complete robot application. OnRobot tools are only components in a robot application and therefore they can be only safely operated if the integrator has considered the safety aspects of the whole application. OnRobot tools are designed with relatively smooth and round design with a limited amount of sharp edges and pinch points

In collaborative applications, the trajectory of the robot can play a significant safety role. The integrator must consider the angle of contact with a human body, e.g. orientate OnRobot tools and workpieces so that the contact surface in the direction of movement is as large as possible. It is recommended that the tool connectors are pointed in the direction opposite to the movement.

OnRobot A/S have identified the potential hazards listed below as significant hazards that must be considered by the integrator:

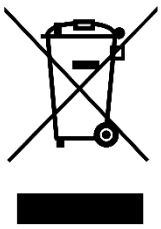
- Objects flying from OnRobot tools due to loss of grip
- Objects falling down from OnRobot tools due to loss of grip
- Injuries due to collisions between humans and workpieces, OnRobot tools tooling, robot or other obstacles
- Consequences due to loosen of bolts
- Consequences if OnRobot tools cable gets stuck to something
- Workpiece itself represents a hazard

2.4 Environmental Safety

OnRobot A/S products must be disposed of in accordance with the applicable national laws, regulations and standards.

The product is produced with restricted use of hazardous substances to protect the environment; as defined by the EU RoHS Directive 2011/65/EU. These substances include mercury, cadmium, lead, chromium VI, polybrominated biphenyls and polybrominated diphenyl ethers.

Observe national registration requirements for importers according to EU WEEE Directive 2012/19/EU.



2.5 PLd CAT3 Safety Function

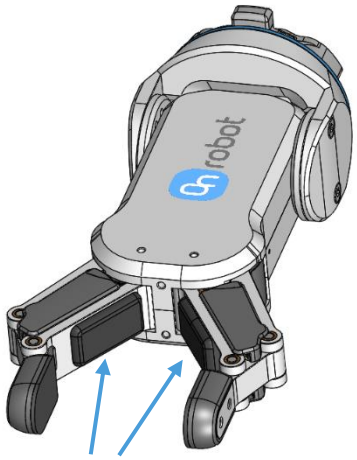
RG2
RG6

A safety-rated function has been designed as two buttons at the two arms of the product, conforming to ISO 13849-1 PLd CAT3.

This Safety Function has a max response time of 100 ms and a MTTF of 2883 years.

The behavior of the safety system is described below:

If something activates the two Safety Buttons, see picture below, the safety control system stops motion of the two arms of the product. Motion is then prevented as long as one or both of the two buttons are activated.



PLd CAT3 Safety Buttons

If this happens while running the robot program, user can detect this condition with the help of the provided status information and execute any necessary step on the robot.

To come back to normal operation with the gripper there are provided commands to reset the gripper.

CAUTION:

Before resetting the gripper always make sure that no part will be dropped due to the loss of gripper power. If Dual Quick Changer is used it will cycle the power for both sides.

For further details refer to the Operation section.

3 Operation mode(s)

The sensor and the grippers have different ways how could be operated. The sensor has three and the grippers have two alternative ways how could be integrated to the robot, and the user can select which one to be used (based on the availability of the required package/interface).

The following table shows the available ways of integration:

<table>
<tr><th>Devices</th><th colspan="5">Modes of Operation</th></tr>
<tr><td>HEX-E/H QC</td><td rowspan="4">OnRobot EtherNet/IP
required in the robot: EtherNet/IP KUKA package</td><td rowspan="4">or</td><td rowspan="4">OnRobot WebLogic
required in the robot: digital I/O KUKA interface</td><td rowspan="4">or</td><td>OnRobot F/T software (Ethernet)
required in the robot: RSI (Robot Sensor Interface) KUKA package</td></tr>
<tr><td>Gecko</td><td rowspan="3">EtherNet/IP or WebLogic
(see on the left)</td></tr>
<tr><td>RG2/6</td></tr>
<tr><td>RG2-FT</td></tr>
<tr><td>VG10 / VGC10</td><td></td></tr>
</table>

NOTE:

If HEX-E/H QC and a gripper is used together, then two ways of operation could be necessary to be installed.

OnRobot EtherNet/IP

This mode uses the EtherNet/IP industrial network protocol to operate the grippers/sensor.

EtherNet/IP is a fieldbus that uses the standard Ethernet networking (simple UTP cable, standard network switch can be used, etc.).

The Compute Box implements an EtherNet/IP Adapter (slave device) and requires the robot controller to implement an EtherNet/IP Scanner (master device) to operate.

With configurable cycle time (e.g.: 4ms) the robot can "read" and "write" to the Computer Box and therefore control or monitor the grippers/sensor.

The communication is implemented via EtherNet/IP Assembly Instances that are created for each product or product combination (e.g.: RG2+VG10). During installation the proper instance needs to be set on the robot. The instances are containing a set of words (16-bit data) that can be used to control/monitor the grippers/sensor (e.g.: the 4th word of the Assembly Instance 104 is the Actual Width for the RG2/6).

There are functions provided (on the USB stick) to make it easy to access the product features.

OnRobot WebLogic

This mode allows simple Digital I/O communication to be used to operate the grippers/sensor.

For example the Compute Box could be easily programmed to:

- when one of the robot digital outputs is set to HIGH, then the RG2 gripper opens to 77mm
- or when the force values measured with the HEX-E QC reach 50N, the Compute Box sends a HIGH digital output to the robot.

The Compute Box has 8 digital inputs and 8 digital outputs that can be freely configured for any "logic".

In this way the user can configure:

- eight gripper/sensor controlling functionality (e.g.: set width to X, close, zero, set preload, etc.)
- and eight gripper/sensor monitoring functionality (e.g.: is grip detected, is preload > 50N, etc.).

Furthermore, the "logic" can be complex, like:

- is grip detected AND force >20 N

These "logics" can be programmed through the Compute Box's web interface called Web Client. It requires only a normal computer with a browser.

OnRobot F/T Software

This mode works only with the HEX-E/H QC. In this mode these features are available:

- Force/Torque control
- Guide the robot by moving the tool by hand (Hand Guide)
- Teach robot trajectory by Hand Guide and replay the recorded path

In this document all three modes of operation will be covered and will be referred to as:

- OnRobot F/T software
- OnRobot EtherNet/IP
- OnRobot WebLogic

Mode I - OnRobot EtherNet/IP

4 Installation

4.1 Overview

For a successful installation the following steps will be required:

- Mount the components
- Wire the cables
- Setup the software

In the following sections, these installation steps will be described.

4.2 Mounting

Required steps:

- Mount the robot dependent adapter
- Mount the Quick Changer option
- Mount the tool(s)

In the following three subsections these three mounting steps will be described.

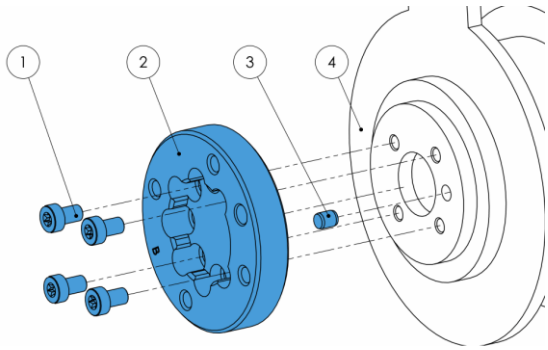
4.2.1 Adapter(s)

For KR 3 Agilus,

KR 6 R1820 / 1820 HP / 700(-2) / 900(-2),

KR 8 R1620 / 1620 HP,

KR 10 R1420 / 1420 HP / 900(-2) / 1100(-2) models



Adapter B (4 screws)

1 M5x8 screws (ISO14580 A4-70)

2 OnRobot adapter flange (ISO 9409-1-50-4-M6)

3 Dowel pin Ø5x6 (ISO2338 h8)

4 Robot tool flange (ISO 9409-1-31.5-4-M5)

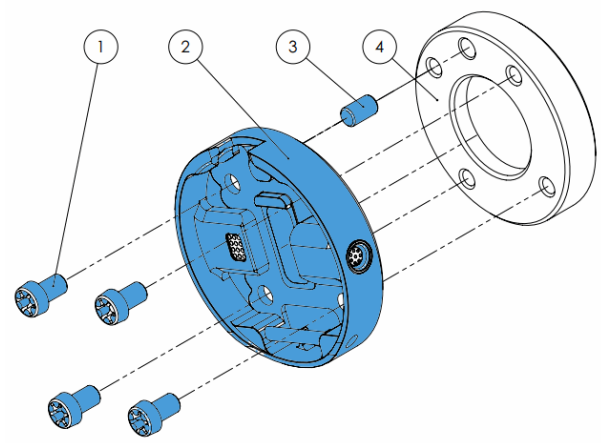
Use 5 Nm tightening torque.

For KR 8 R2010 and KR 12 R1810 models

No adapter plate is required.

4.2.2 Quick Changer options

Quick Changer - Robot Side



Quick Changer - Robot Side

1 M6x8mm (ISO14580 8.8)

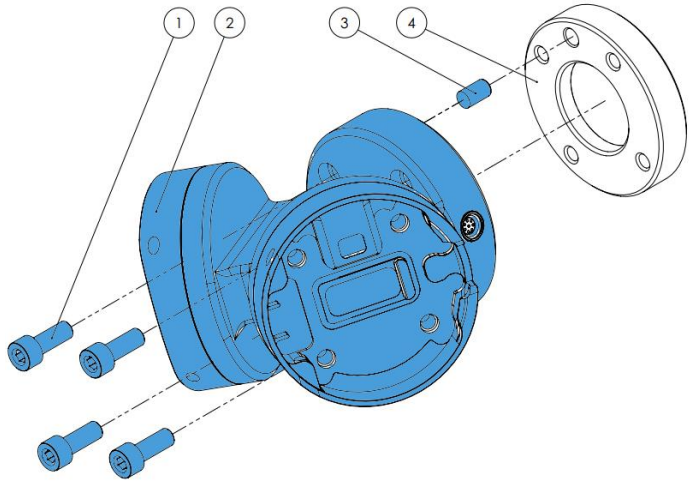
2 Quick Changer (ISO 9409-1-50-4-M6)

3 Dowel pin Ø6x10 (ISO2338 h8)

4 Adapter/ Robot tool flange (ISO 9409-1-50-4-M6)

Use 10 Nm tightening torque.

Dual Quick Changer



Dual Quick Changer

1 M6x20mm (ISO14580 8.8)

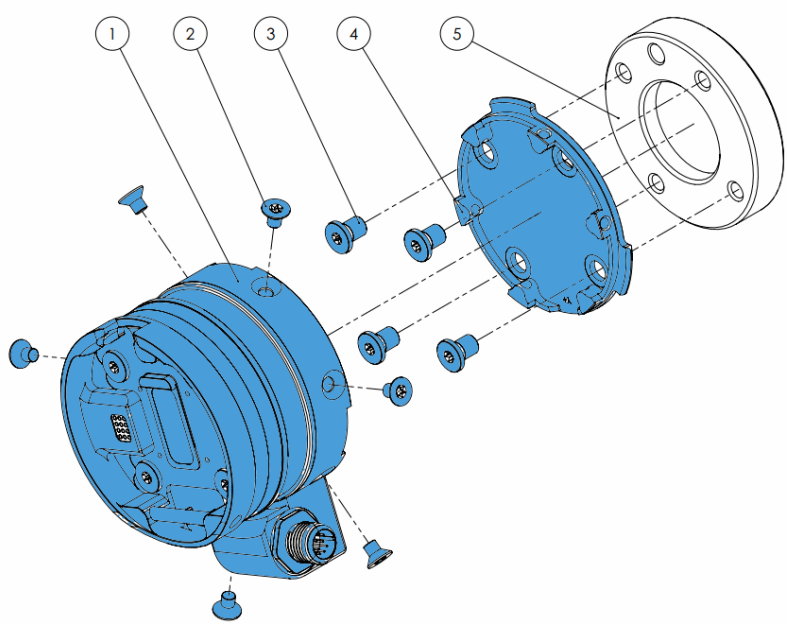
2 Dual Quick Changer

3 Dowel pin Ø6x10 (ISO2338 h8)

4 Adapter/ Robot tool flange (ISO 9409-1-50-4-M6)

Use 10 Nm tightening torque.

HEX-E/H QC



HEX-E/H QC

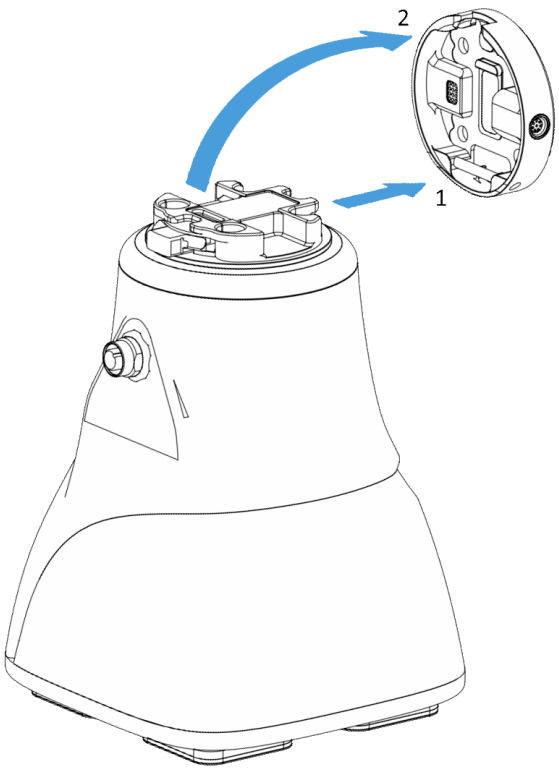
1	HEX-E/H QC sensor
2	M4x6mm (ISO14581 A4-70)
3	M6x8mm (NCN20146 A4-70)
4	HEX-E/H QC adapter
5	Adapter/ Robot tool flange (ISO 9409-1-50-4-M6)

Use 1.5 Nm tightening torque. for M4x6mm

Use 10 Nm tightening torque. for M6x8mm

4.2.3 Tools

Gecko



Step 1:

Move the tool close to the Quick Changer as illustrated.

The hook mechanism (rod and hook tongue) will keep the lower part locked once mounted.

Step 2:

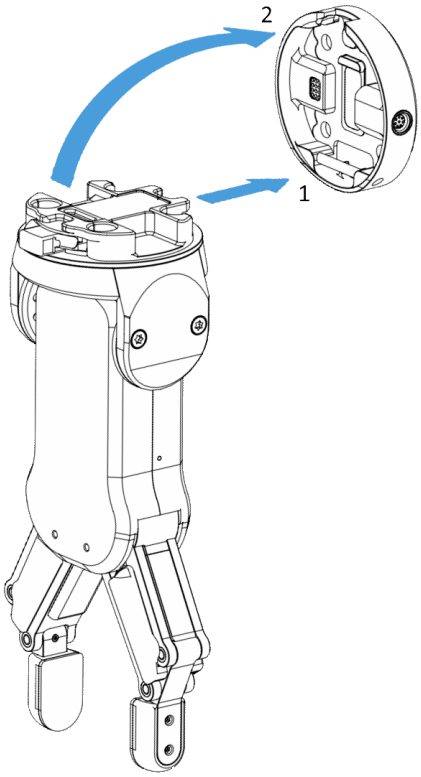
Flip the tool until it is fully mated, and you hear a clicking sound.

To unmount the tool, press the aluminum button on the Quick Changer and repeat the steps in the reverse order.

CAUTION:

With a Dual Quick Changer the Gecko Gripper can only be mounted on the Secondary (2) side. Mounting on the Primary (1) side will prevent the devices to function correctly.

RG2



Step 1:

Move the tool close to the Quick Changer as illustrated.

The hook mechanism (rod and hook tongue) will keep the lower part locked once mounted.

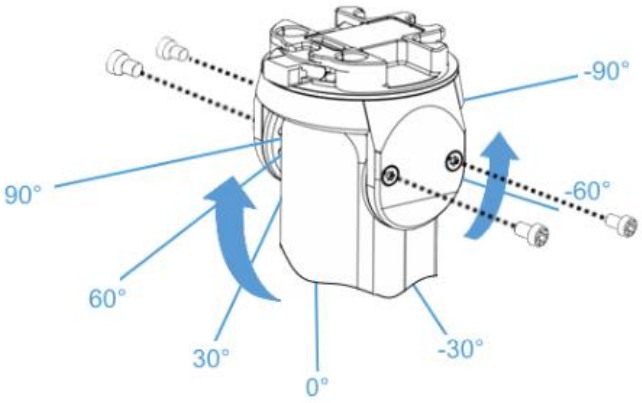
Step 2:

Flip the tool until it is fully mated, and you hear a clicking sound.

To unmount the tool, press the aluminum button on the Quick Changer and repeat the steps in the reverse order.

To change the relative angle of the gripper to the Quick Changer:

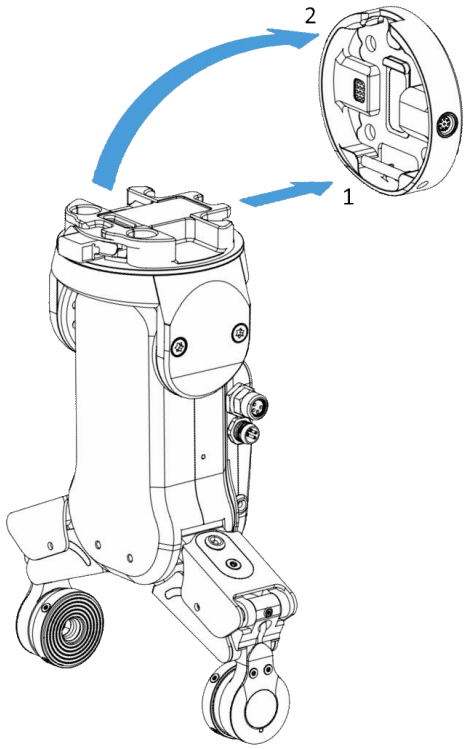
- first remove the four M4x6 screws
- tilt the gripper between -90° and 90°
- then put the four M4x6 screws back and use 1.35 Nm tightening torque to fix it.



WARNING:

Never use the device while any of the four M4x6 screws are removed.

RG2-FT



Step 1:

Move the tool close to the Quick Changer as illustrated.

The hook mechanism (rod and hook tongue) will keep the lower part locked once mounted.

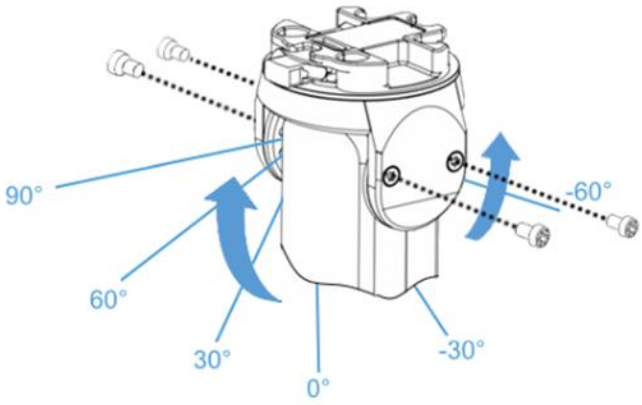
Step 2:

Flip the tool until it is fully mated, and you hear a clicking sound.

To unmount the tool, press the aluminum button on the Quick Changer and repeat the steps in the reverse order.

To change the relative angle of the gripper to the Quick Changer:

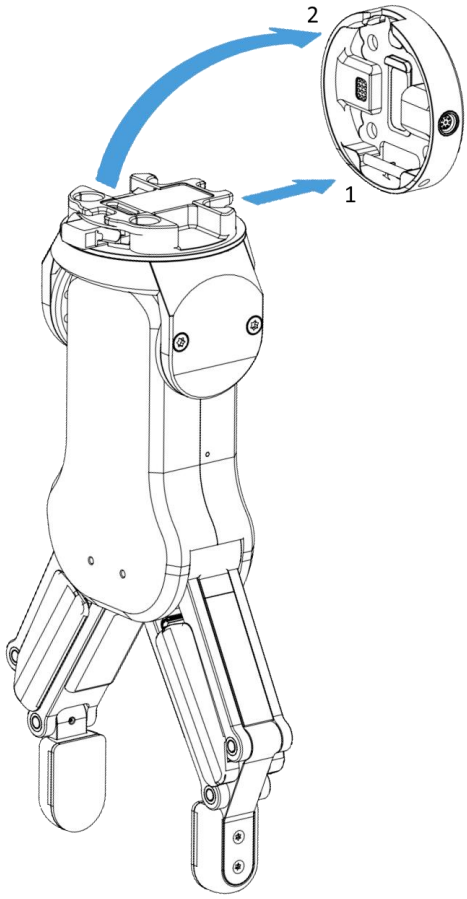
- first remove the four M4x6 screws
- tilt the gripper between -60° and 90°
- then put the four M4x6 screws back and use 1.35 Nm tightening torque to fix it.



WARNING:

Never use the device while any of the four M4x6 screws are removed.

RG6



Step 1:

Move the tool close to the Quick Changer as illustrated.

The hook mechanism (rod and hook tongue) will keep the lower part locked once mounted.

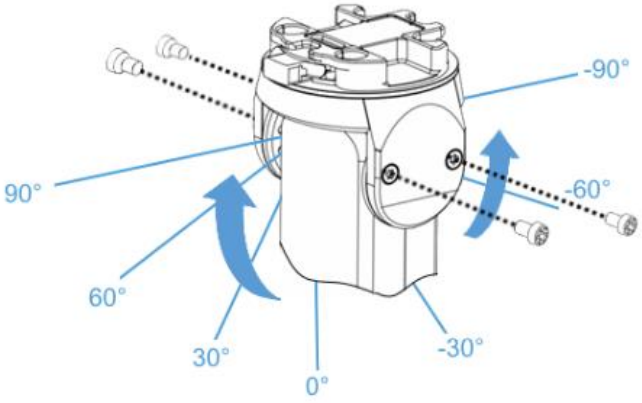
Step 2:

Flip the tool until it is fully mated, and you hear a clicking sound.

To unmount the tool, press the aluminum button on the Quick Changer and repeat the steps in the reverse order.

To change the relative angle of the gripper to the Quick Changer:

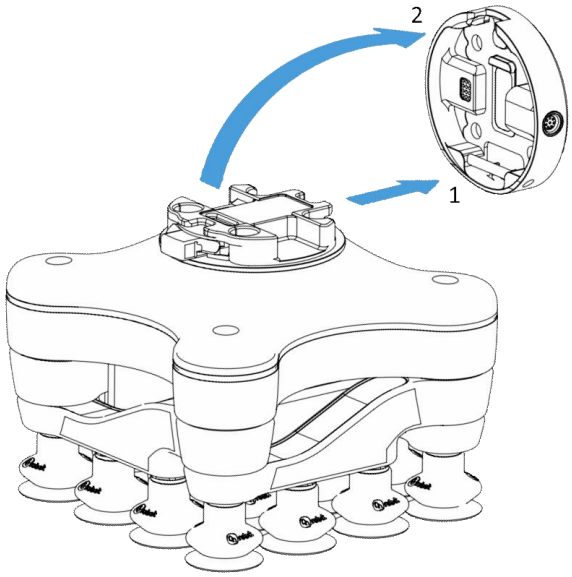
- first remove the four M4x6 screws
- tilt the gripper between -90° and 90°
- then put the four M4x6 screws back and use 1.35 Nm tightening torque to fix it.



WARNING:

Never use the device while any of the four M4x6 screws are removed.

VG10



Step 1:

Move the tool close to the Quick Changer as illustrated.

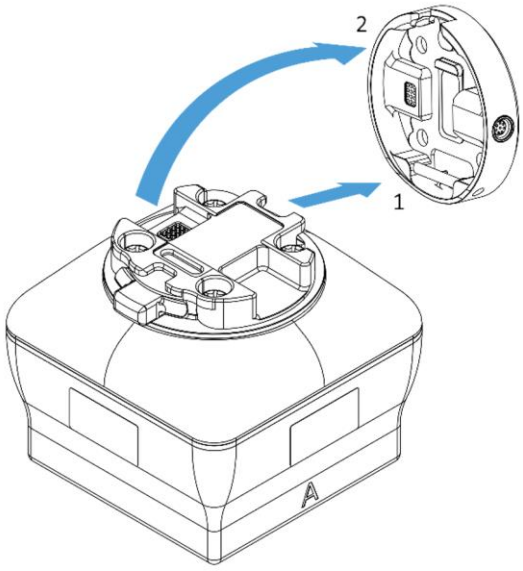
The hook mechanism (rod and hook tongue) will keep the lower part locked once mounted.

Step 2:

Flip the tool until it is fully mated, and you hear a clicking sound.

To unmount the tool, press the aluminum button on the Quick Changer and repeat the steps in the reverse order.

VGC10



Step 1:

Move the tool close to the Quick Changer as illustrated.

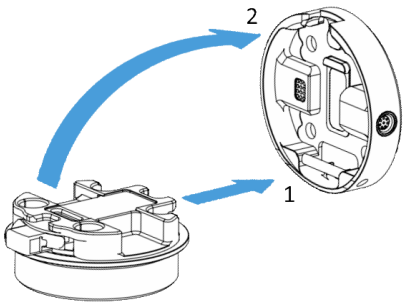
The hook mechanism (rod and hook tongue) will keep the lower part locked once mounted.

Step 2:

Flip the tool until it is fully mated, and you hear a clicking sound.

To unmount the tool, press the aluminum button on the Quick Changer and repeat the steps in the reverse order.

Quick Changer - Tool side



Step 1:

Move the tool close to the Quick Changer as illustrated.

The hook mechanism (rod and hook tongue) will keep the lower part locked once mounted.

Step 2:

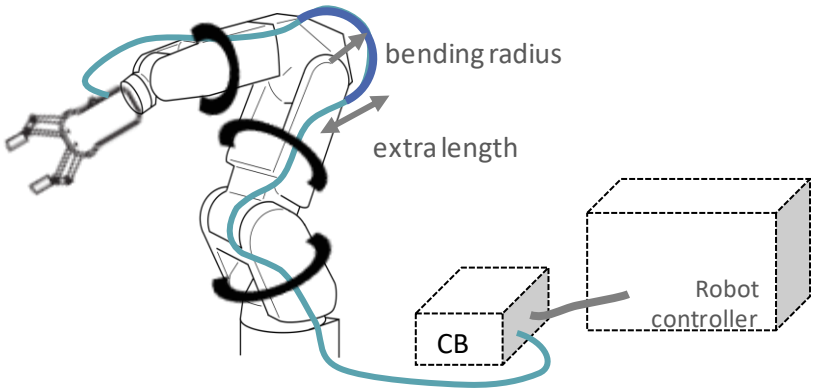
Flip the tool until it is fully mated, and you hear a clicking sound.

To unmount the tool, press the aluminum button on the Quick Changer and repeat the steps in the reverse order.

4.3 Wiring

Three cables need to be connected to wire the system properly:

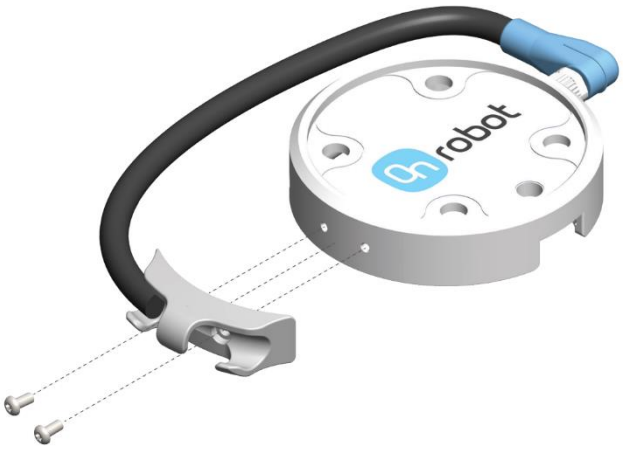
- Tool data cable between the tool(s) and the Compute Box
- Ethernet communication cable between the robot controller and the Compute Box
- Power supply of the Compute Box



4.3.1 Tool data cable

First connect the data cable to the tool.

For Single or Dual RG2, RG6, VG10, VGC10 or Gecko Gripper



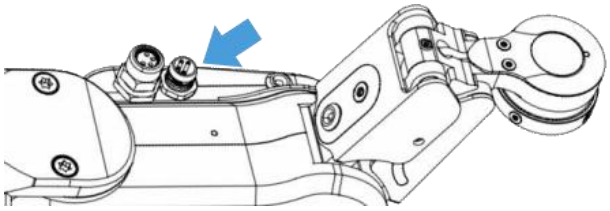
Use the M8-8pin connector on the Quick Changer or on the Dual Quick Changer.

Use the cable holder as illustrated on the left.

CAUTION:

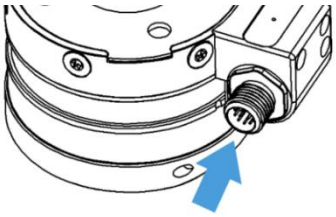
Make sure to use the supplied cable holder to prevent any excessive strain on the 90-degree M8 connector caused by the rotation of the cable.

For RG2-FT



For RG2-FT the Quick Changer tool data connector cannot be used. Instead use the marked M8-4pin connector

For HEX-E/H QC



Use the marked M12-12pin connector on the HEX-E/H QC.

Then route the Tool data cable to the Compute Box (CB) and use the supplied Velcro tape (black) to fix it.

NOTE:

Make sure that during the routing some extra length is used at the joints so that cable is not pulled when the robot moves.

Also make sure that the cable bending radius is minimum 40mm (for the HEX-E/H QC it is 70mm)

Finally, connect the other end of the Tool data cable to the Compute Box's DEVICES connector.

CAUTION:

Use only original OnRobot tool data cables. Do not cut or extend these cables.

CAUTION:

Quick Changer and Dual Quick Changer can only be used to power OnRobot tools.

4.3.2 Ethernet cable

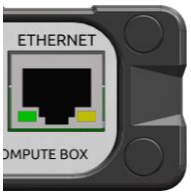
Connect one end of the supplied Ethernet (UTP) cable to the robot controller's Ethernet (LAN) port as shown below:

Use the X66 (KLI) port.

NOTE:

If the robot controller's Ethernet port is in use, use a standard 4-port Ethernet switch to be able to use two network devices at the same time.

Connect the other end of the supplied cable to the Compute Box's ETHERNET connector.



CAUTION:

Use only shielded, maximum 3m long Ethernet cables.

WARNING:

Check and make sure that the Compute Box enclosure (metal) and the robot controller enclosure (metal) are not connected (no galvanic connection between the two).

4.3.3 Power supply

Connect the supplied power supply to the Compute Box 24V connector.

NOTE:

To disconnect the power connector, make sure to pull the connector housing (where the arrows are shown) and not the cable.

CAUTION:

Use only original OnRobot power supplies.

Finally, power up the power supply that will power the Compute Box and the connected Tool(s).

4.4 Software setup

4.4.1 Compute Box IP setup

A proper IP address must be set for the Compute Box and the robot/computer to be able to use the Ethernet interface. There are three ways how it could be configured (using the DIP switch 3 and 4):

- **Auto mode** (factory default)

  This is the easiest way of getting the IP addresses to be configured for both the Compute Box and the robot/computer. It is recommended to start with this mode, so this is the factory default setting.

- **Fixed IP mode** (192.168.1.1)

  If the **Auto mode** does not work, use this mode to have a fixed IP for the Compute Box. This requires a manual IP address configuration for the robot/computer. (This mode could also be used to reset the IP address to a known value if the Compute Box become unreachable in **Advanced mode**.)

- **Advanced mode** (any static IP/subnet mask)

  If the Fixed IP address (192.168.1.1) is already in use in your network or a different subnet needs to be configured, in this mode the IP address and subnet mask can be changed to any value. This also requires a manual IP address configuration for the robot/computer.

NOTE:

To change between modes, first change the DIP switches and then the Compute Box power needs to be cycled for the changes to take effect.

Auto mode

Use the factory default settings (DIP switch 3 and 4 in OFF position).

In this case, the Compute Box has both Dynamic Host Configuration Protocol (DHCP) client, and DHCP server enabled.

DHCP Client enabled means, Compute Box will automatically obtain ("get") IP address FROM the connected robot/computer if that is capable of assigning ("give") IP to the Compute Box.

DHCP Server enabled means, Compute Box will automatically assign ("give") IP address TO the connected robot/computer if that was configured to obtain ("get") IP address automatically.

NOTE:

The assigned IP range is 192.168.1.100-105 (with subnet mask 255.255.255.0).

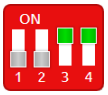
If the Compute Box is used in a company network where a DHCP server is already in use, it is recommended to disable the DHCP server of the Compute Box by setting DIP switch 4 to the ON position.

If no IP was assigned to the Compute Box within a minute, it will automatically get a fallback IP address (192.168.1.1).

NOTE:

If the Compute Box was in **Advanced mode**, first reset the IP setting by switching to **Fixed IP mode** and then switch back to **Auto mode**.

Fixed IP mode



Set the DIP switch 3 and 4 in ON position and cycle the power for the changes to take effect.

In this case the IP address of the Compute Box is set to 192.168.1.1 (subnet mask is 255.255.255). Both the DHCP Client and Server options are disabled.

Make sure to set the robot/computer IP address manually. To have a proper communication the robot/computer IP address must be in the range of 192.168.1.2 - 192.168.1.254.

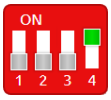
Example robot/computer setting:

IP address: 192.168.1.2

Subnet mask: 255.255.255.0

Other settings like Gateway, DNS Server, etc. could be kept empty or set to 0.0.0.0.

Advanced mode



Set the DIP switch 3 in OFF and DIP switch 4 in ON position and cycle the power for the changes to take effect.

In this case the IP address of the Compute Box could be set to any value by using the Web Client. For more details see section **Configuration menu**.

In this mode, the DHCP server option is disabled.

Make sure to have a matching IP setting to your robot/computer network for a proper communication.

NOTE:

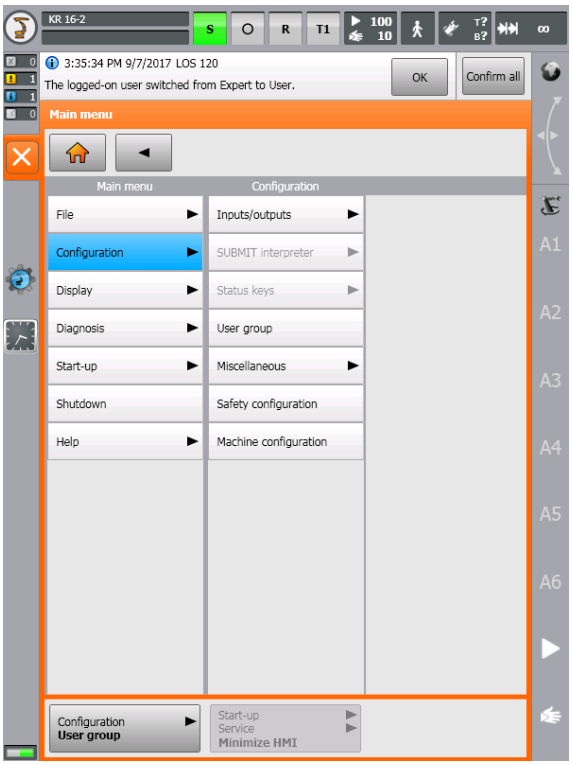
If the Compute Box become unreachable (due to improper or forgotten IP settings), switch to **Fixed IP mode** to reset the IP setting.

It is recommended to use Fixed IP mode for OnRobot EtherNet/IP.

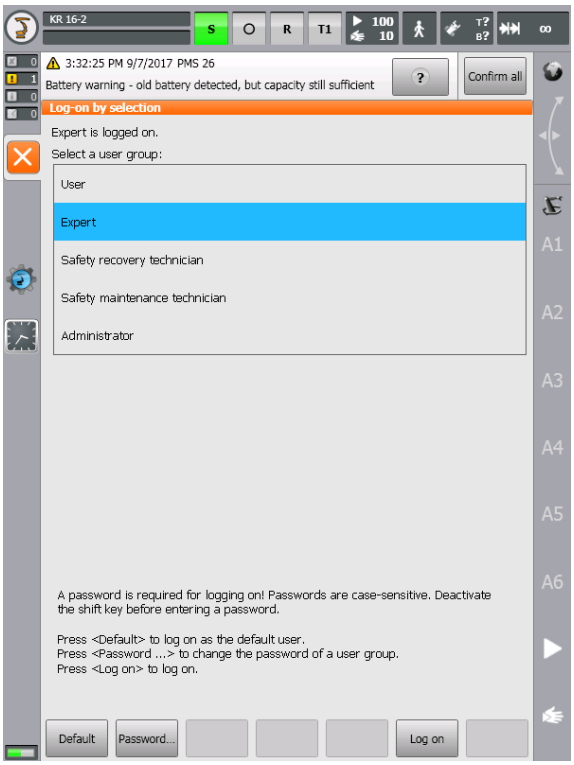
In the following, it is assumed that the Compute Box IP is left at the default 192.168.1.1. If other IP address is selected, remember to always enter the chosen one whenever required to be entered.

4.4.2 KUKA Line Interface (KLI) IP setup

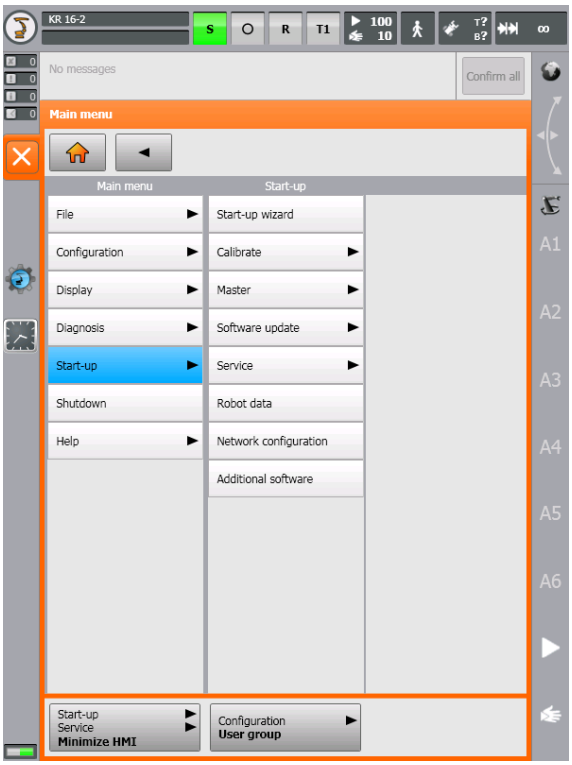
To change the IP settings of the KUKA robot controller, follow this process:



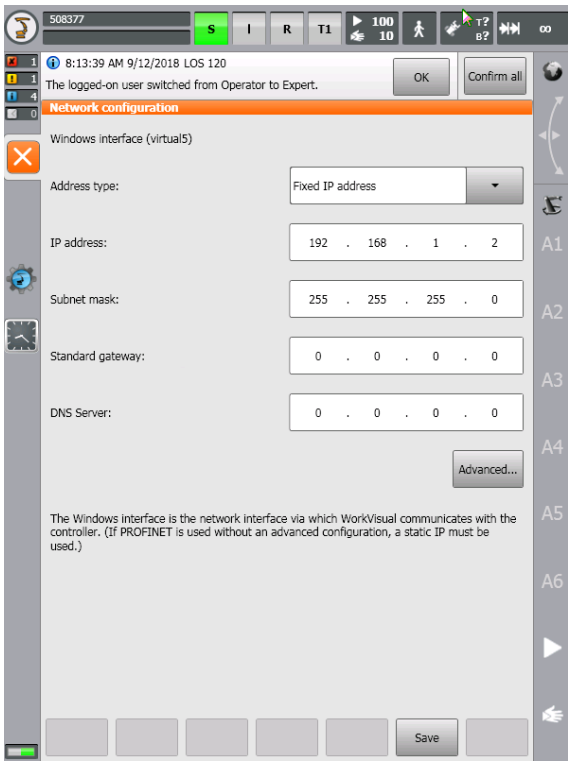
1. Go to **Configuration** > **User group**



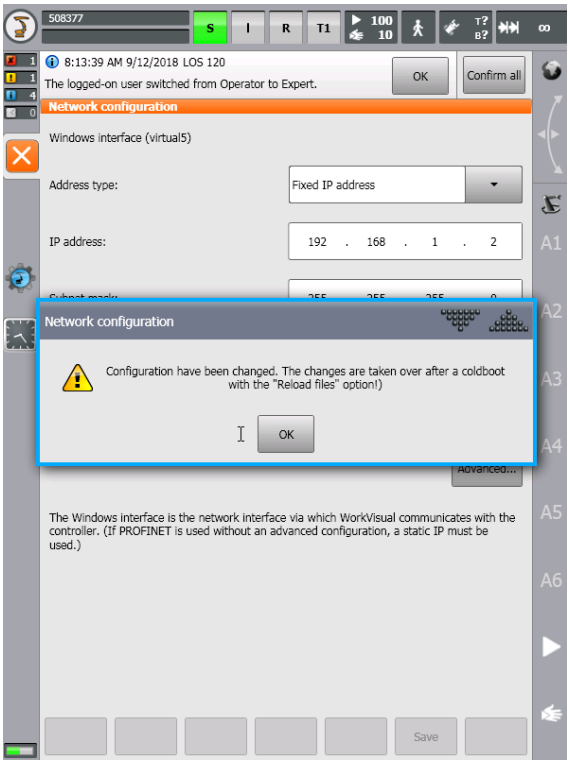
2. Select **Expert** and type in your password



3. Go to **Start-up** > **Network configuration**



4. Set the IP address to be on the same subnet as the Compute Box (e.g.: 192.168.1.2). Then click on **Save** button.



5. Accept the prompts and restart the robot controller

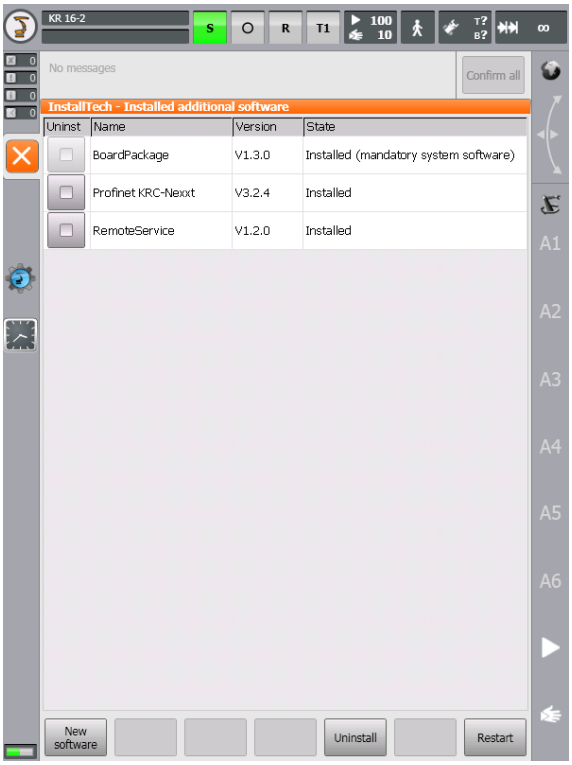
4.4.3 KUKA package installation

The OnRobot EtherNet/IP require KUKA EtherNet/IP package to be installed.

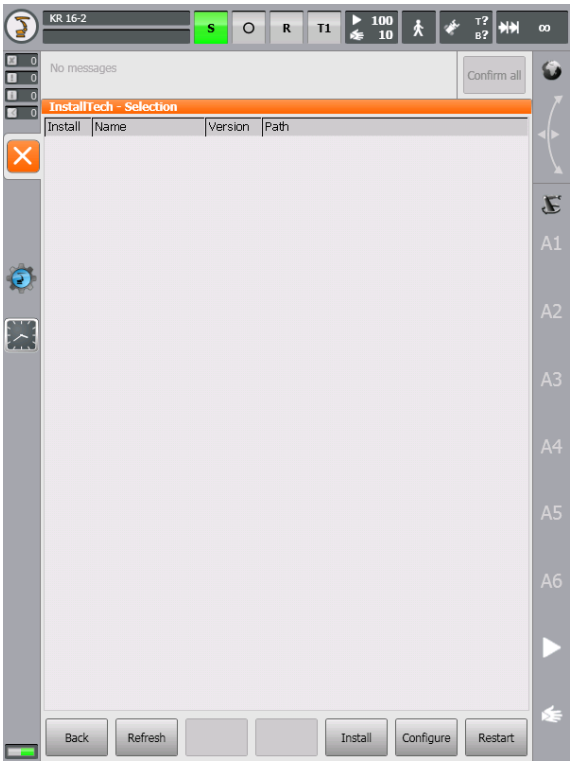
NOTE:

Please contact your local KUKA representative for pricing and purchase options.

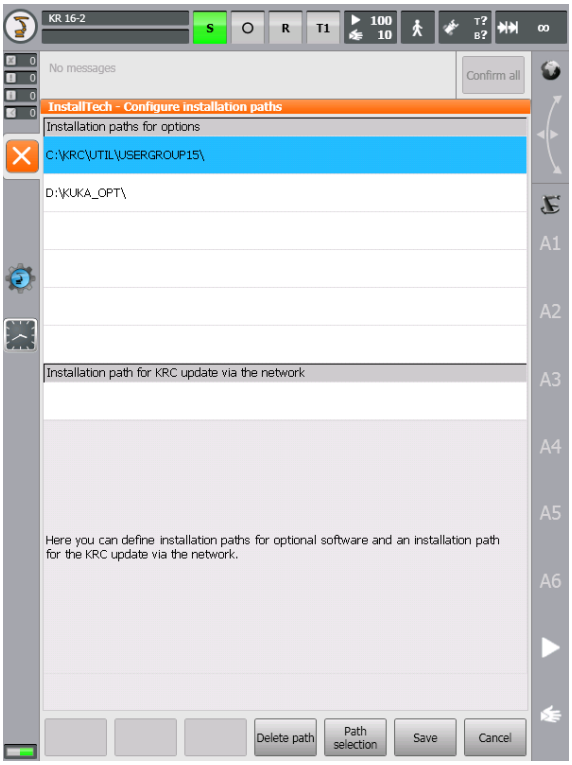
To install these KUKA packages do the following steps:



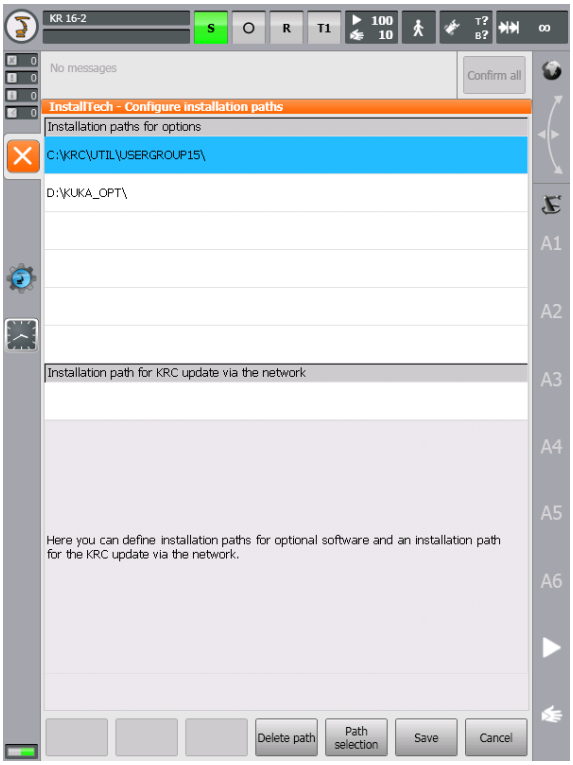
1. Go to **Start-up** > **Additional software**, click on **New software**



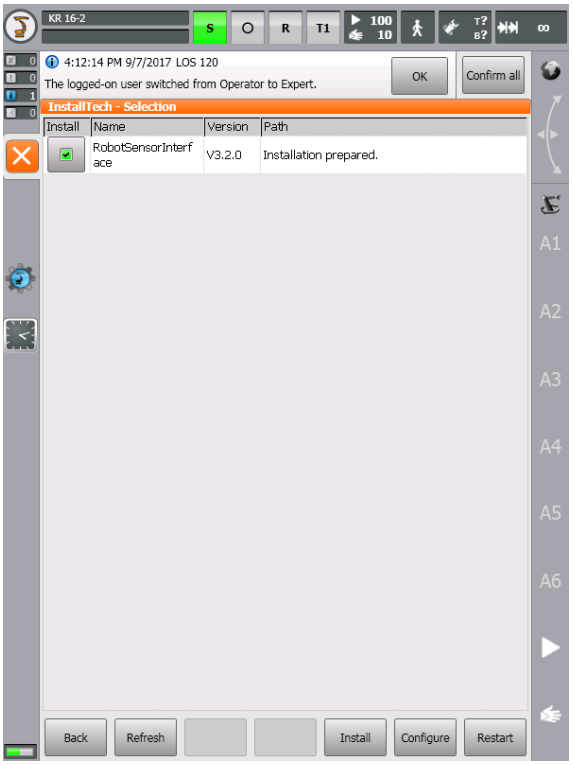
2. If no packages are listed, click on **Configure**.



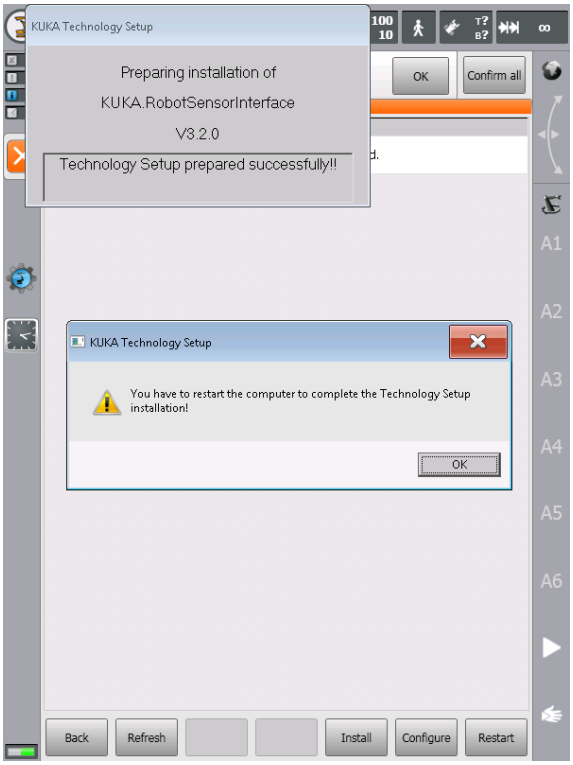
3. Click on an empty slot and click **Path selection**



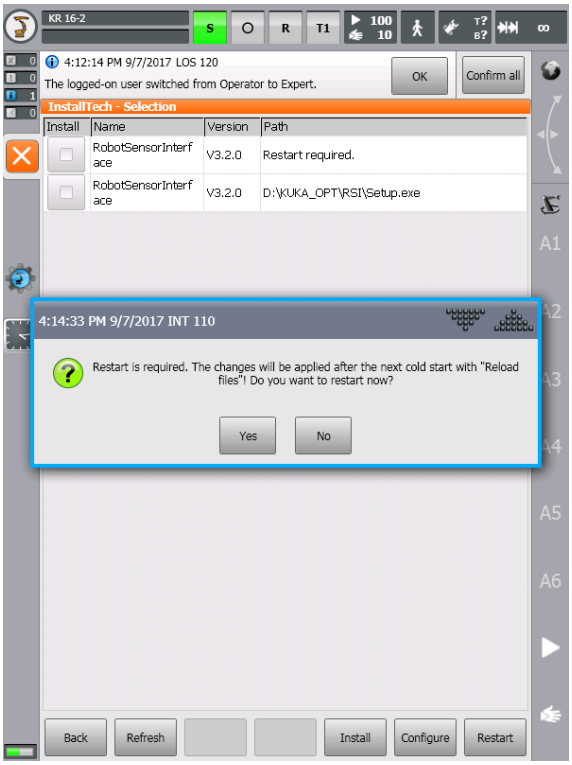
4. Browse for the installation folder of package to be installed, then click **Save** twice.



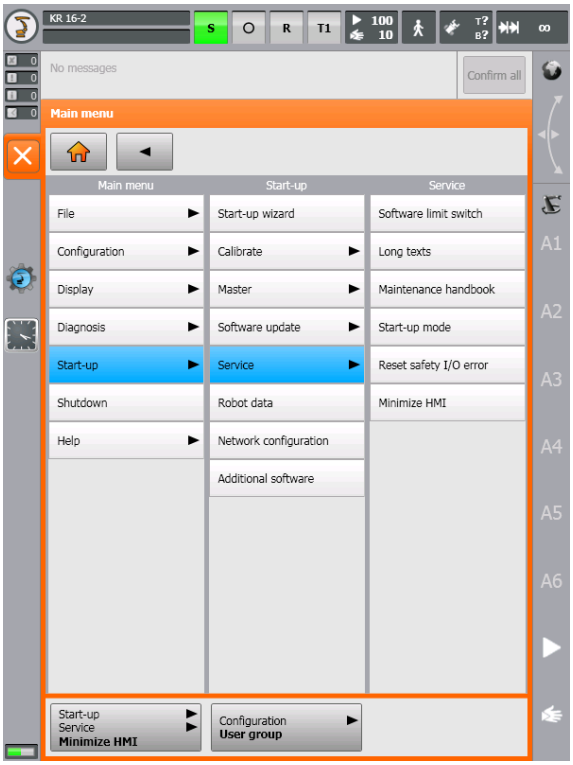
5. Check the check box next to the package name to be installed



6. Wait for the installation, accept all prompts.



7. Click **Yes** when asked to reboot the robot controller



8. After the reboot go to **Start-up** > **Service** > **Minimize HMI**.

For further info please refer to the KUKA user manual.

4.4.4 OnRobot EtherNet/IP setup

Summary of the steps:

- Start the WorkVisual environment
- Download the current configuration from the robot
- Add new EtherNet/IP scanner node
- Add OnRobot multi-device adapter node
- Configure the OnRobot multi-device node
- Map the EtherNet/IP inputs and outputs to the robot's $IN and $OUT signals
- Deploy the changes to the robot

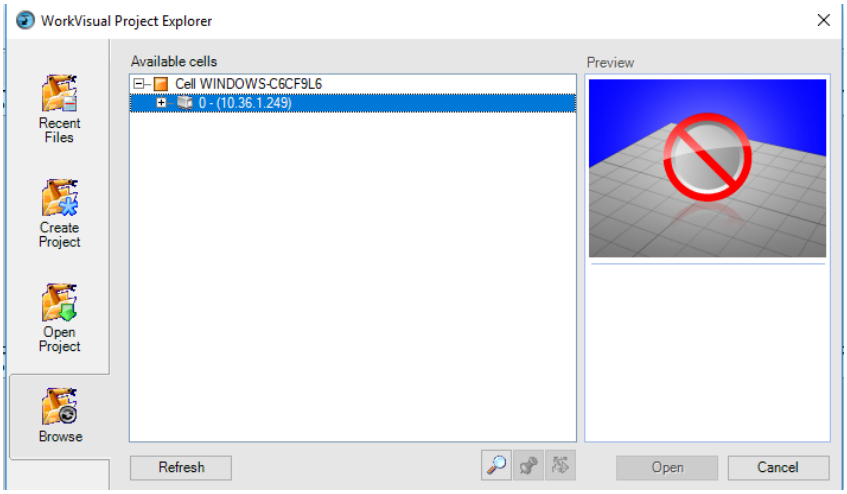
The product can be controlled via the KRL language interface. You can use the provided convenience helper functions.

NOTE:

This guide assumes that, the EtherNet/IP option has already been installed to the robot.

Starting the WorkVisual environment

In the WorkVisual program load the current configuration from the robot:



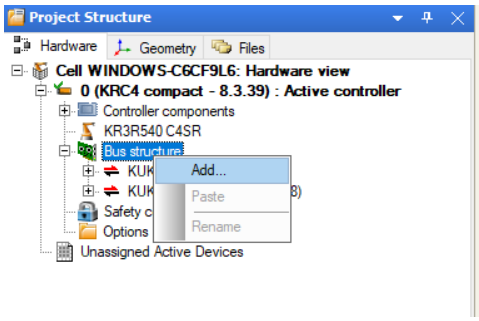
In WorkVisual, open the **Project Structure** window.

In the **Hardware** tab, double click the robot controller to activate it.

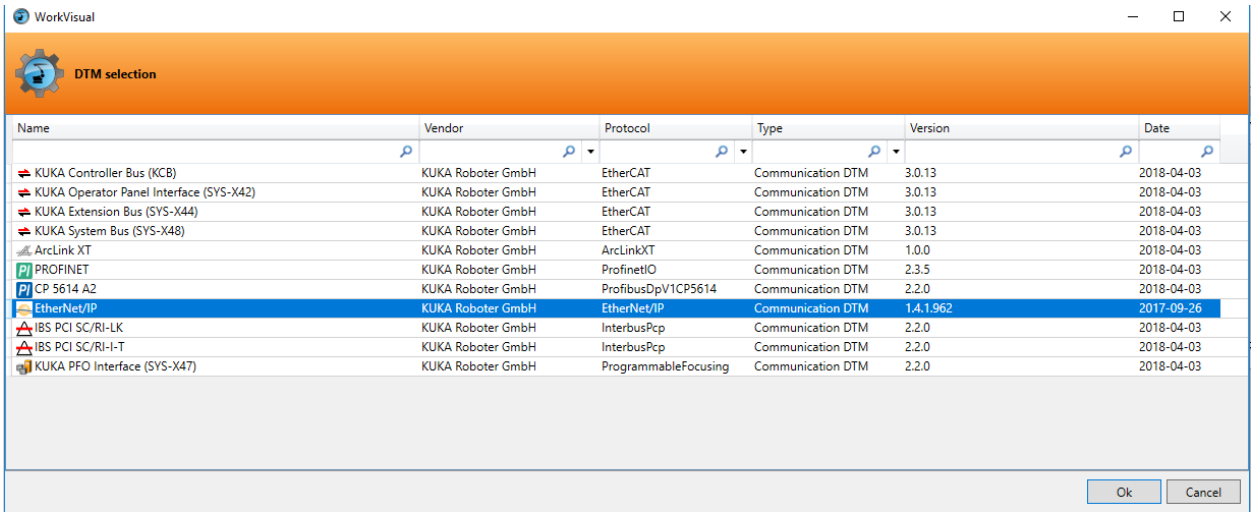
Expand the robot controller's tree structure.

Adding the Ethernet/IP bus

Right-click on the **Bus structure** item and select **Add...**:

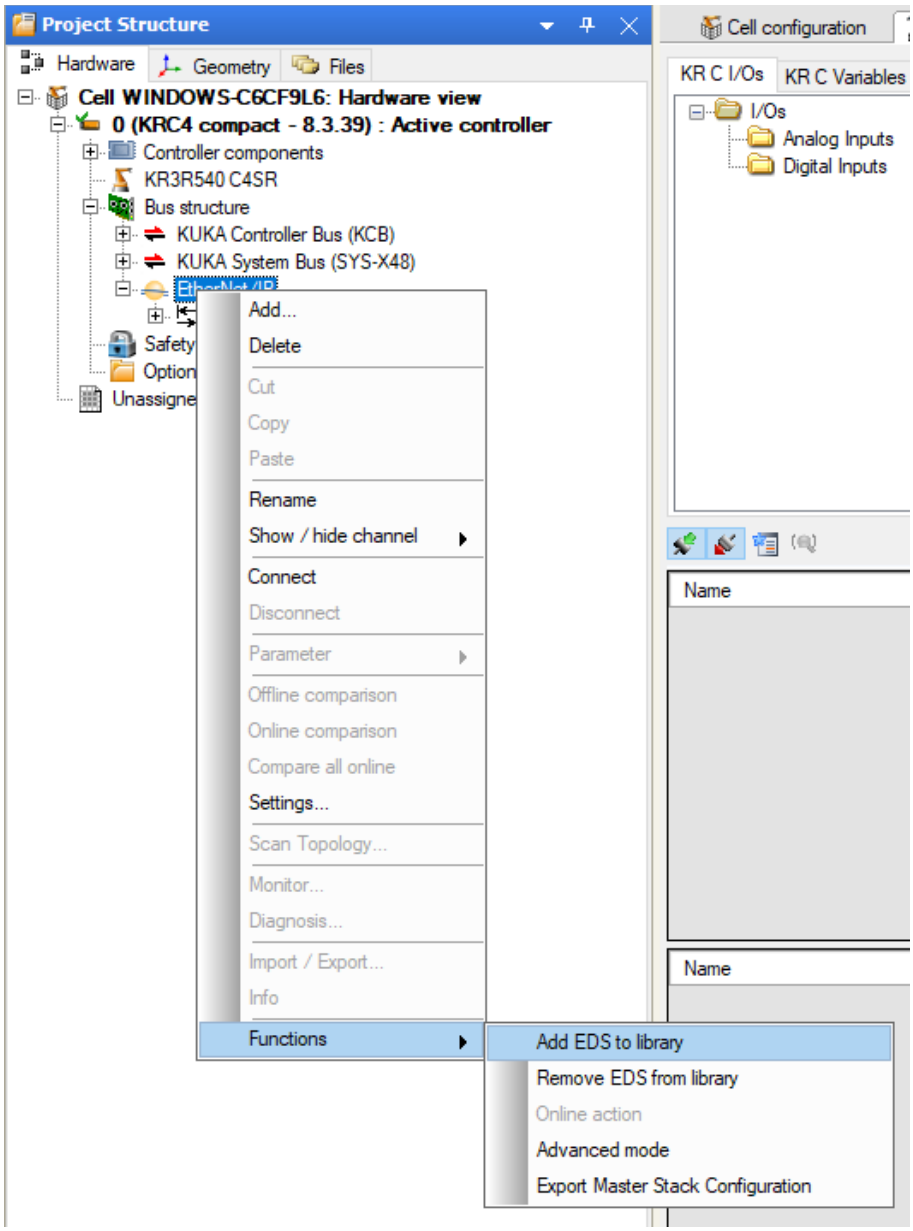


Select **EtherNet/IP** and click **OK**:

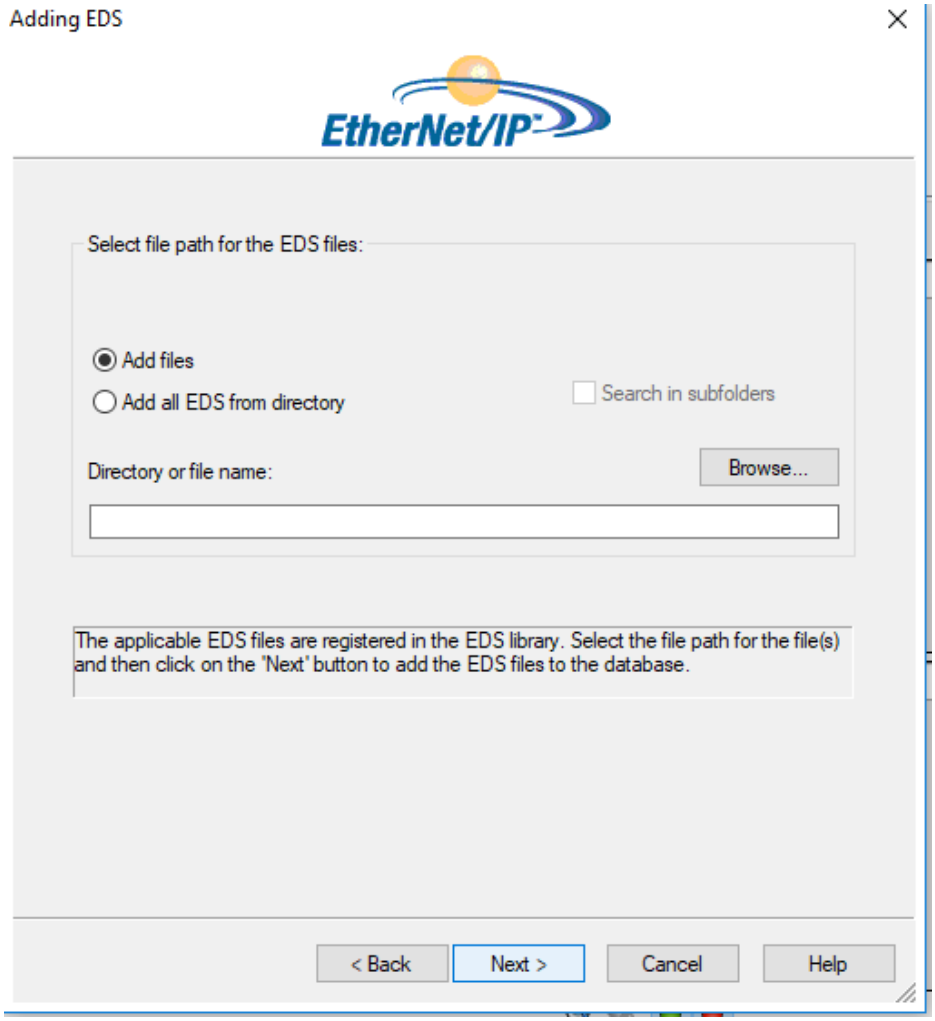


Adding the EDS file to the DTM catalog

Right-click the **EtherNet/IP** node, go to **Functions** -> **Add EDS to library**.



Follow the wizard instructions and browse the `on_eip_adapter.eds` file to be imported.



Save and close the project.

From the **Extras** menu, open the **DTM Catalog Management**.

Locate **OnRobot multi-device** adapter.

If you don't see that in either list, click the **Search for installed DTMs** button.

If you see it on the **Known DTMs** list, then select it, and add it using the right arrow button.

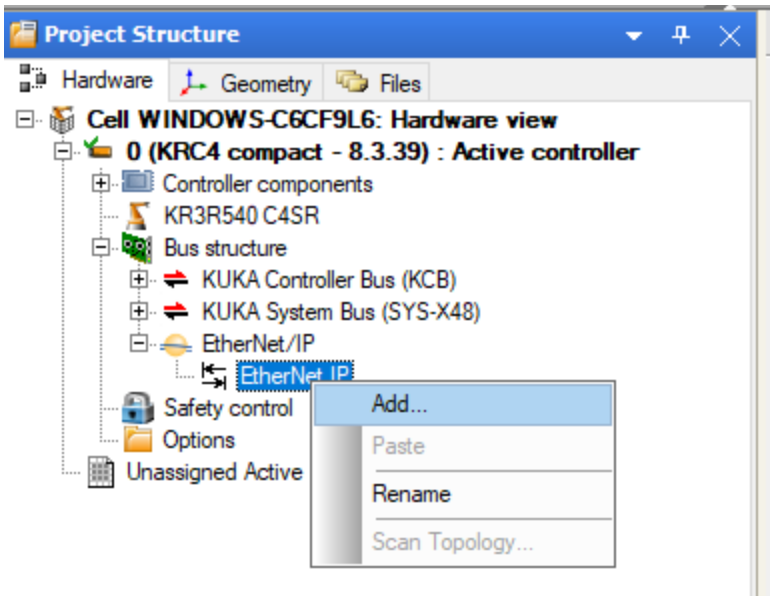
If it is in the **Current DTM Catalog** list, click the **OK** button to close the window.

Reopen your project.

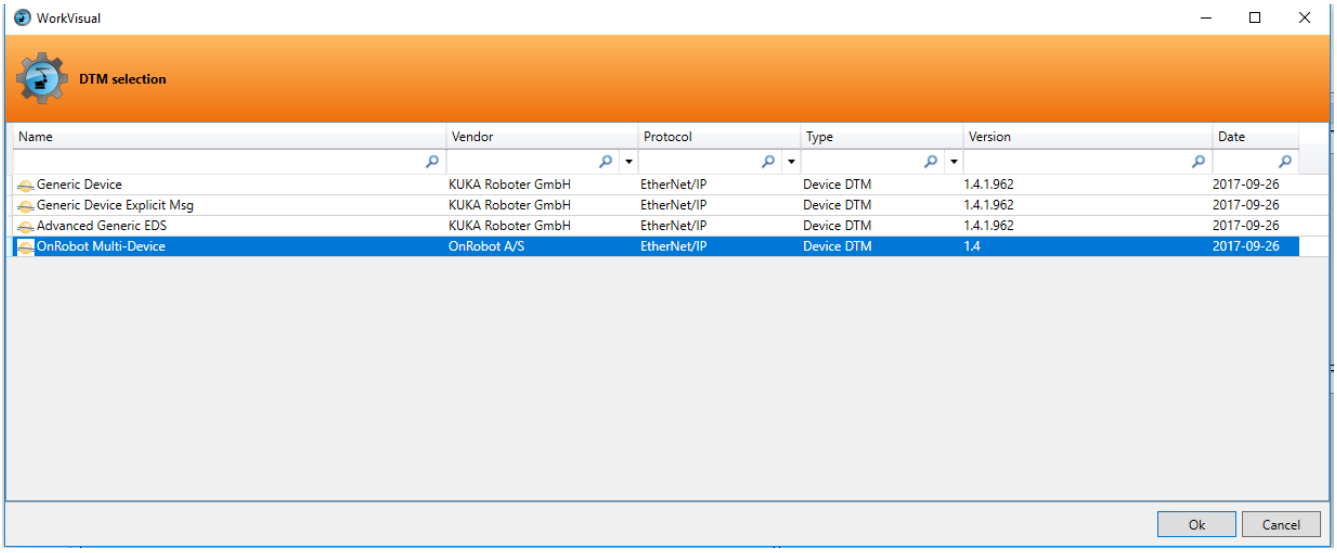
The **OnRobot multi-device** adapter now should be available to be installed.

Adding the EtherNet/IP adapter

In the robot controller's tree structure, right-click on the **EtherNet/IP** node and select **Add…**:



Select the **OnRobot multi-device** adapter:

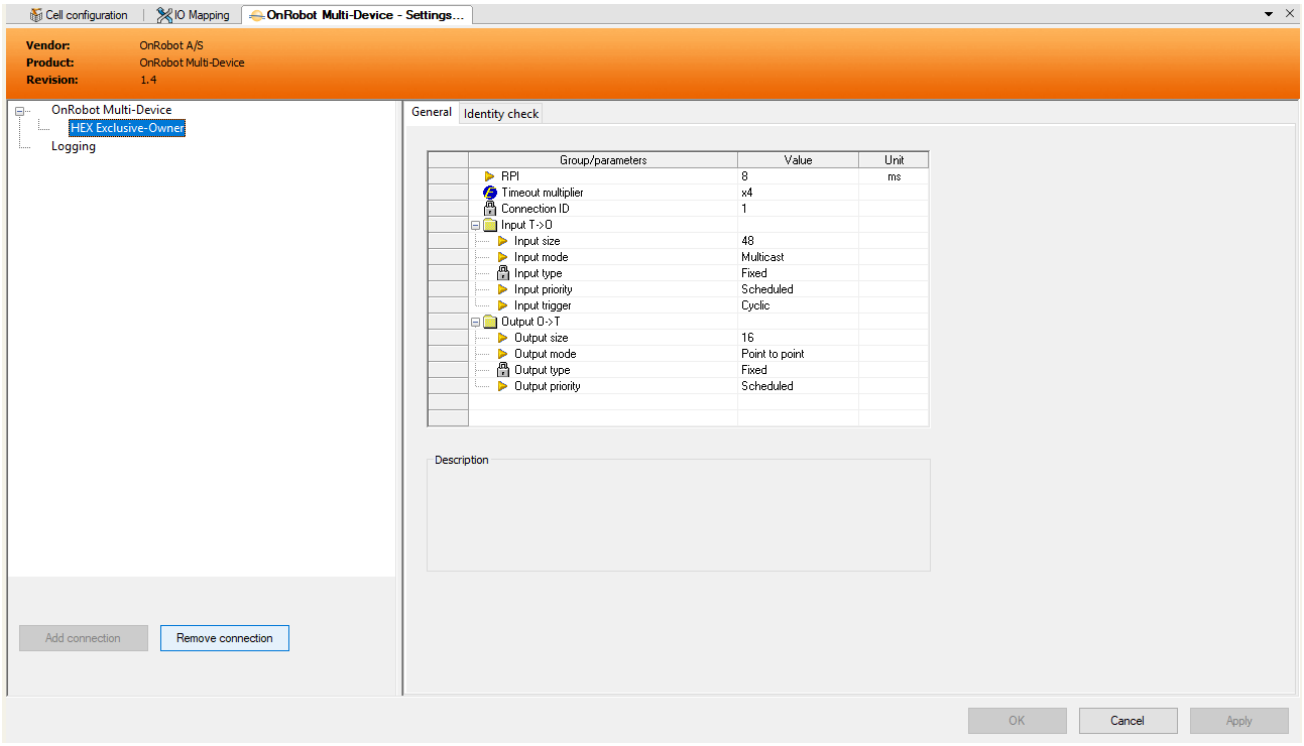


Configuring the OnRobot adapter

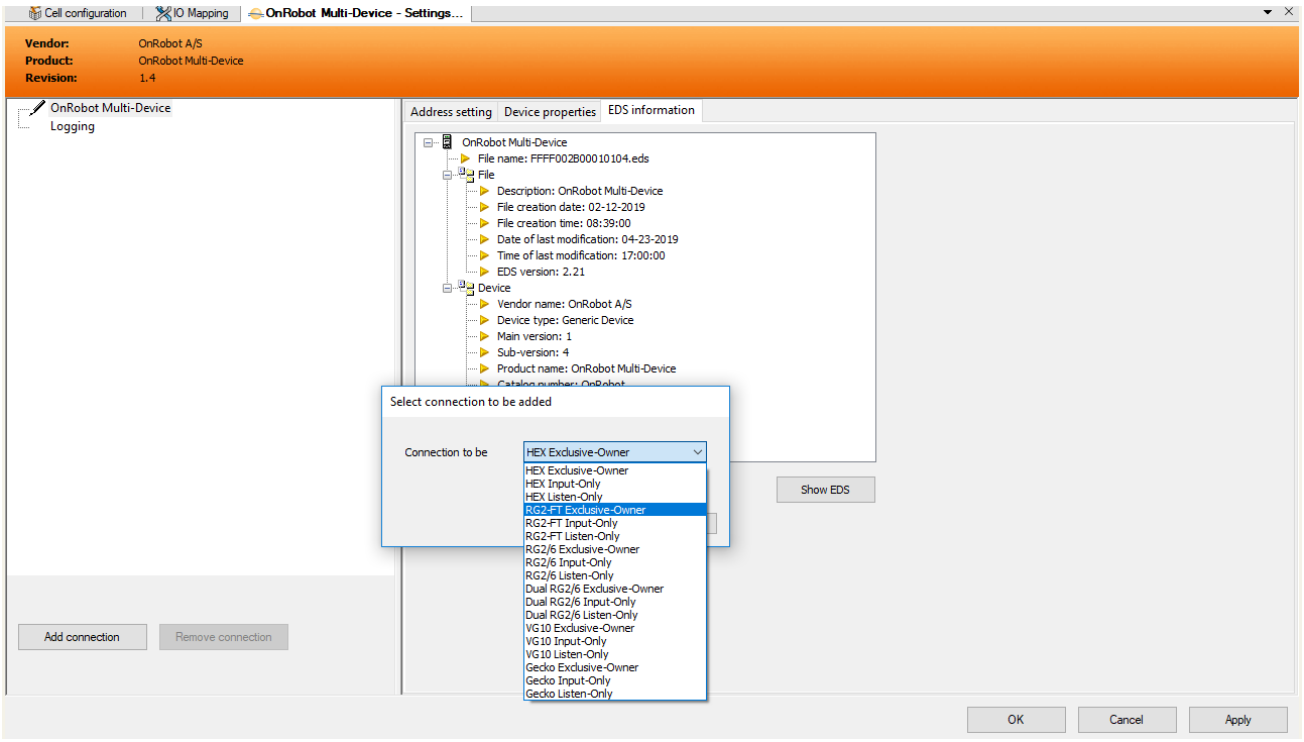
Right click the **OnRobot Multi-device** adapter and click **Settings…**

A new window opens.

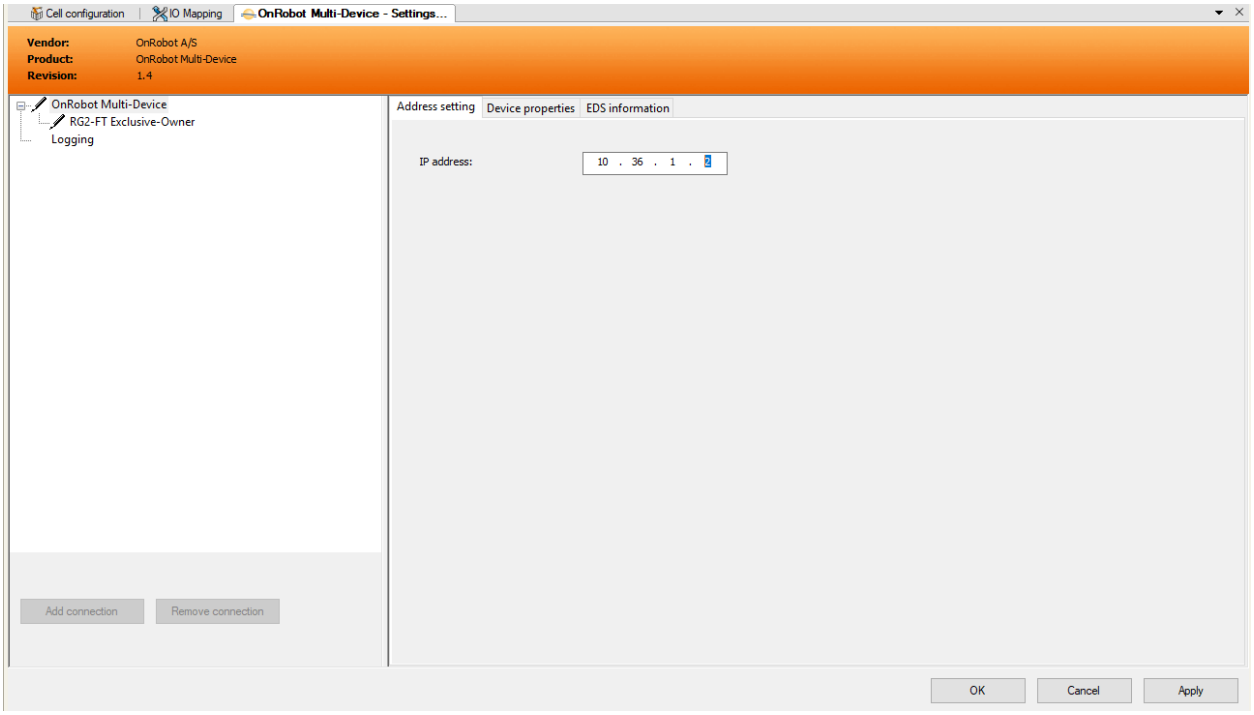
In the left pane, click the **Remove connection** button to remove the default connection:



Click the **Add connection** button and from the list select the OnRobot device to be used:



On the **Address Setting** tab, fill the IP address of the Compute Box:



On the **Device Properties** tab:

Select a number of your choice.

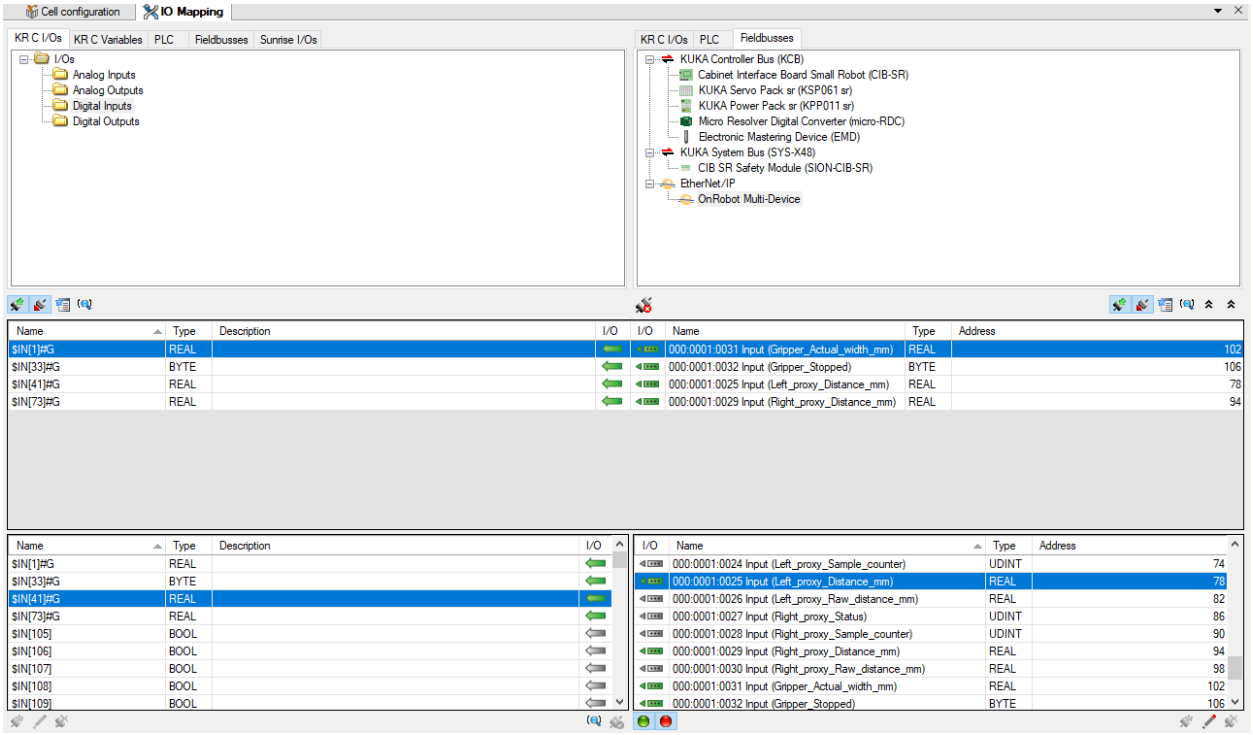
Set the **Is Active** field to **Activated**.

Type OnRobot to the **Device name** field.

Mapping the inputs and outputs

Please see the **EtherNet/IP** section.

Open the **I/O mapping** window and map all available inputs:



In the upper left pane, select **Digital Inputs**.

In the upper right pane, select the **OnRobot Multi-device** adapter from the tree.

In the lower panes, map all inputs one by one from the right to a group of `$IN{}` bits on the left.

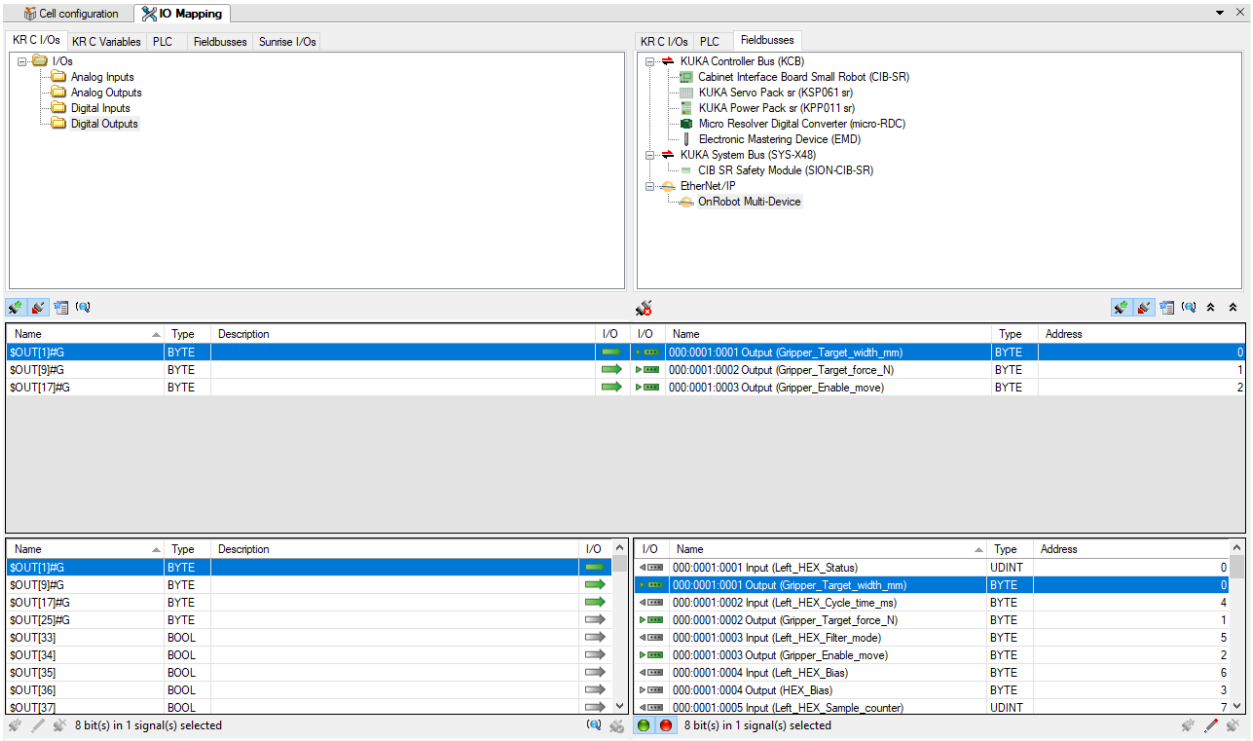
For `BYTE` types, create a group of 8 bits.

For `UINT` and `INT` types, create a group of 16 bits.

For `REAL` and `UDINT` types, create a group of 32 bits.

Leave out the fields marked **Reserved** on the right.

Now, map all available outputs:



In the upper left pane, select **Digital Outputs**.

In the upper right pane, select the **OnRobot Multi-device** adapter from the tree.

In the lower panes, map all outputs one by one from the right to a group of `$OUT{}` bits on the left.

For `BYTE` types, create a group of 8 bits.

For `UINT` and `INT` types, create a group of 16 bits.

For `REAL` and `UDINT` types, create a group of 32 bits.

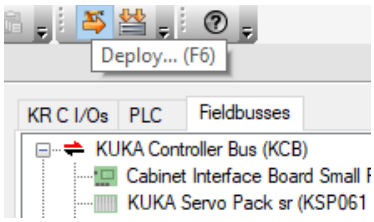
Leave out the fields marked **Reserved** on the right.

You can check the result in the middle pane. Please select **Digital Inputs** or **Digital Outputs** on the top left pane to examine both directions.

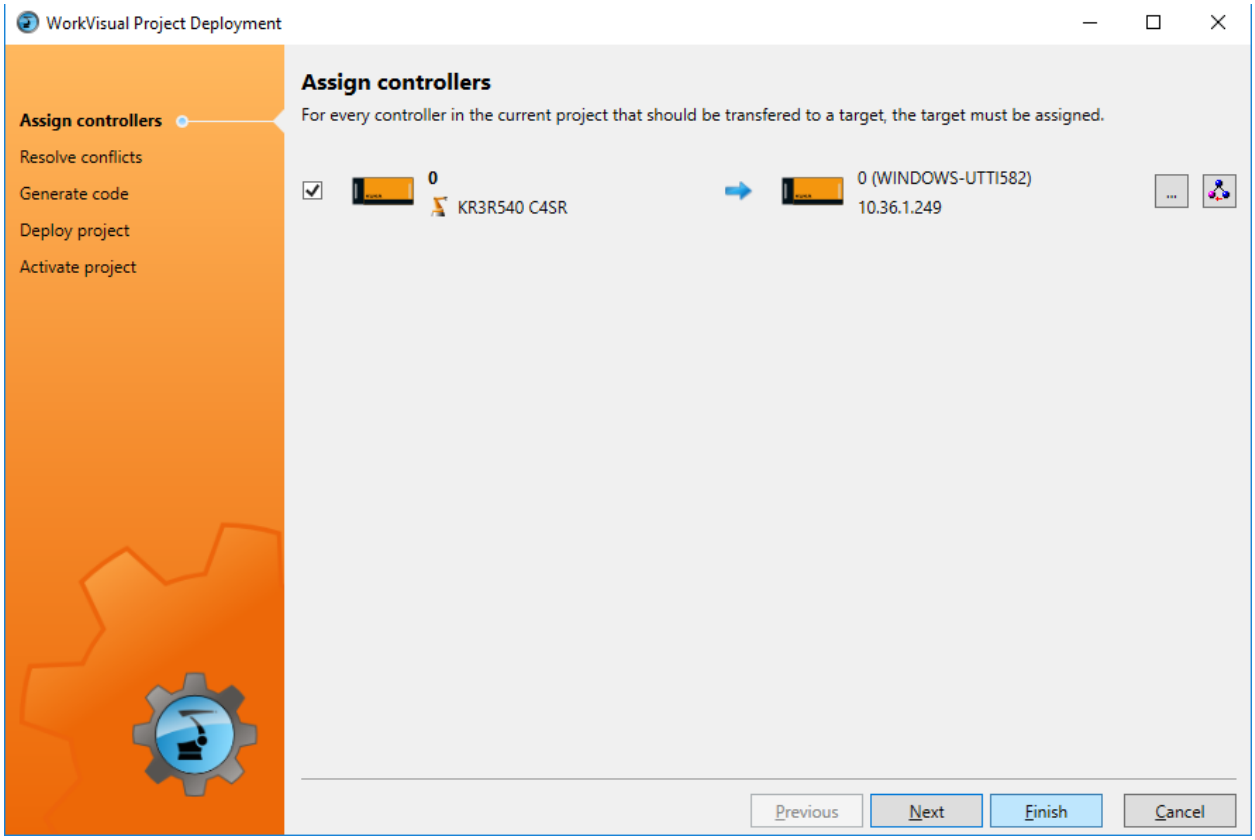
Take notes of the used `$IN` and `$OUT` indices, as you will need to match them in the KRL helper functions.

Deploy the configuration to the robot

Click on **Deploy...** button:



And follow the instructions:



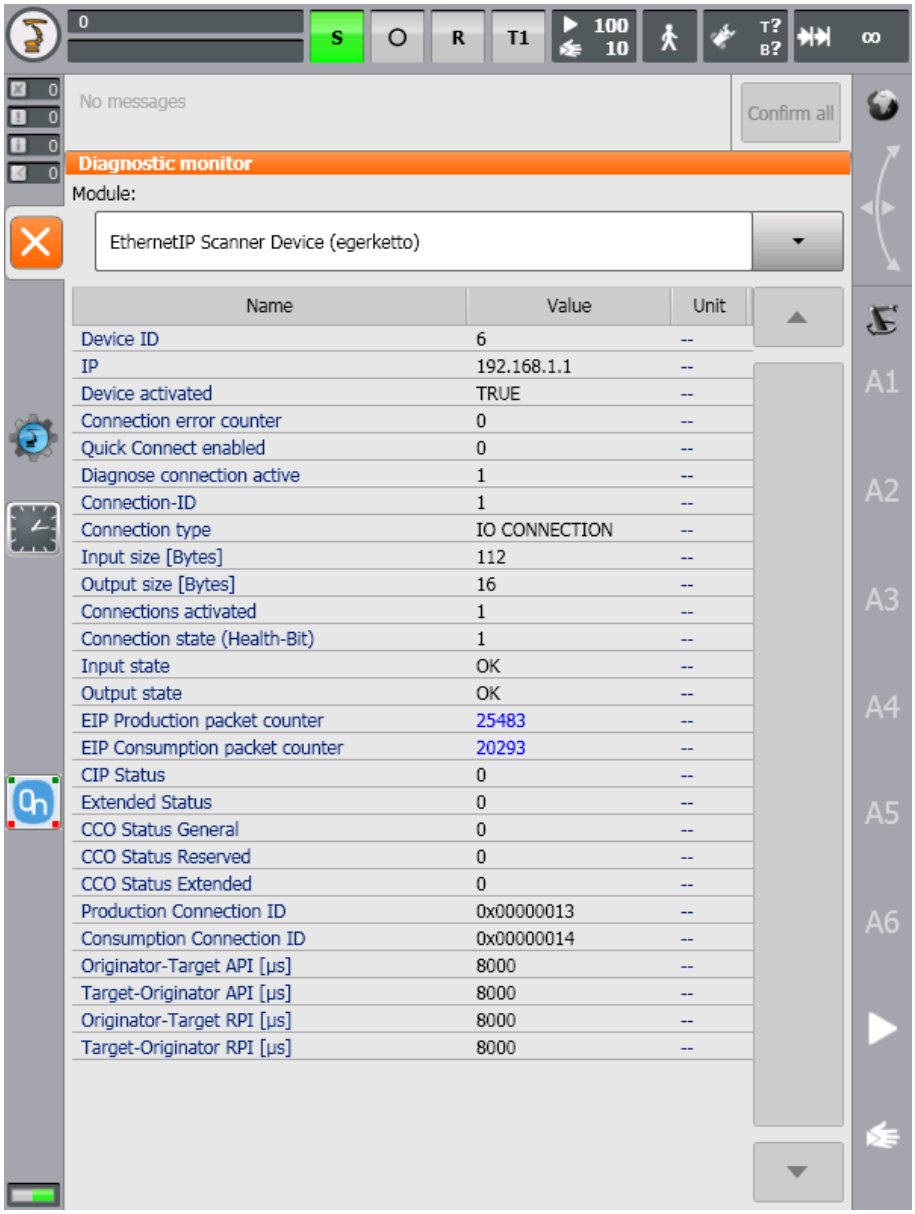
For further details, see the KUKA WorkVisual documentation.

NOTE:

Now you can connect the Compute Box back to the KLI port of the robot.

Checking the setup

On the smartPAD, open the main menu and select **Diagnosis** -> **Diagnostic monitor:**



From the drop-down list, select **EtherNet/IP scanner** (EIP-SCANNER)

No errors should appear.

From the drop-down list, select the **OnRobot adapter device (OnRobot)**

No errors should appear.

NOTE:

For further details refer to the section **Diagnosis** in the KUKA EtherNet/IP guide.

For detailed description on the Ethernet/IP Assembly Instances (what values can be read and write) can be found in the **EtherNet/IP** section.

5 Operation

NOTE:

It is assumed that the Installation has finished successfully. If not, first do the installation steps in the previous section.

5.1 Example codes

Operations require code written in the programming language of the robot.

Example codes can be found in the OnRobot USB stick.

Mode II - OnRobot WebLogic

6 Installation

6.1 Overview

For a successful installation the following steps will be required:

- Mount the components
- Wire the cables
- Setup the software

In the following sections, these installation steps will be described.

6.2 Mounting

Required steps:

- Mount the robot dependent adapter
- Mount the Quick Changer option
- Mount the tool(s)

In the following three subsections these three mounting steps will be described.

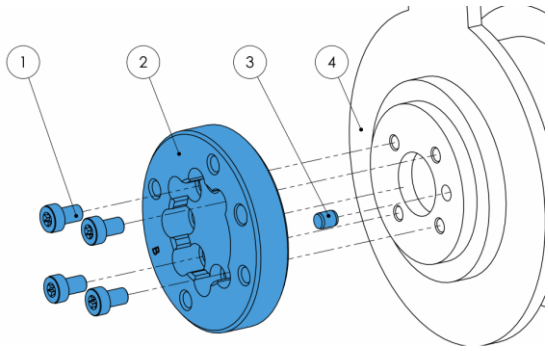
6.2.1 Adapter(s)

For KR 3 Agilus,

KR 6 R1820 / 1820 HP / 700(-2) / 900(-2),

KR 8 R1620 / 1620 HP,

KR 10 R1420 / 1420 HP / 900(-2) / 1100(-2) models



Adapter B (4 screws)

1 M5x8 screws (ISO14580 A4-70)

2 OnRobot adapter flange (ISO 9409-1-50-4-M6)

3 Dowel pin Ø5x6 (ISO2338 h8)

4 Robot tool flange (ISO 9409-1-31.5-4-M5)

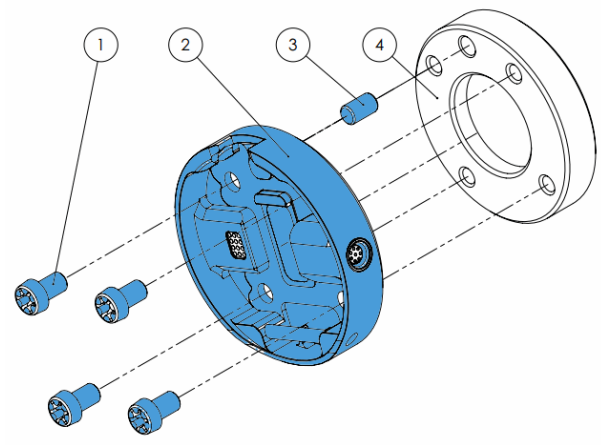
Use 5 Nm tightening torque.

For KR 8 R2010 and KR 12 R1810 models

No adapter plate is required.

6.2.2 Quick Changer options

Quick Changer - Robot Side



Quick Changer - Robot Side

1 M6x8mm (ISO14580 8.8)

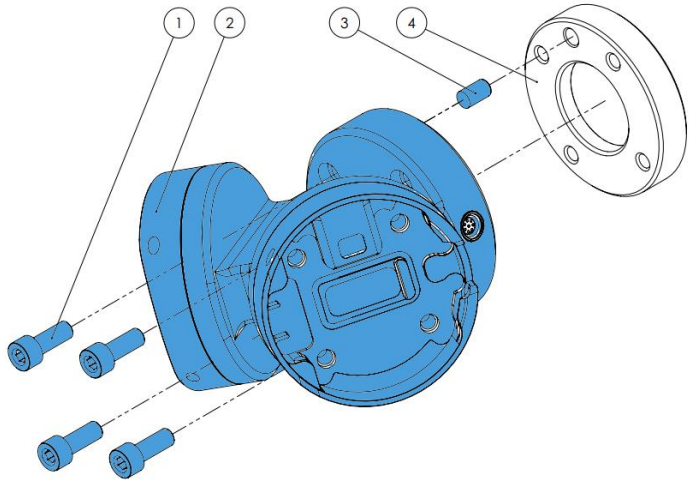
2 Quick Changer (ISO 9409-1-50-4-M6)

3 Dowel pin Ø6x10 (ISO2338 h8)

4 Adapter/ Robot tool flange (ISO 9409-1-50-4-M6)

Use 10 Nm tightening torque.

Dual Quick Changer



Dual Quick Changer

1 M6x20mm (ISO14580 8.8)

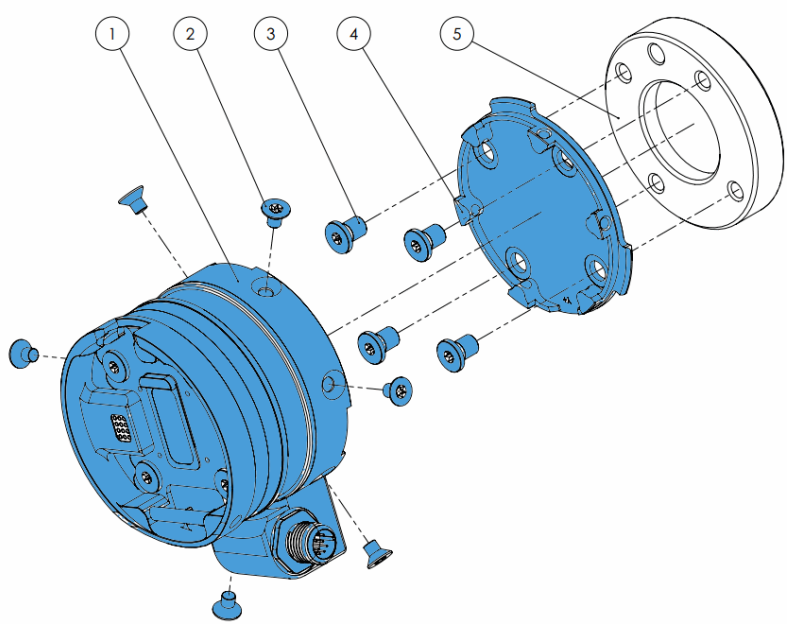
2 Dual Quick Changer

3 Dowel pin Ø6x10 (ISO2338 h8)

4 Adapter/ Robot tool flange (ISO 9409-1-50-4-M6)

Use 10 Nm tightening torque.

HEX-E/H QC



HEX-E/H QC

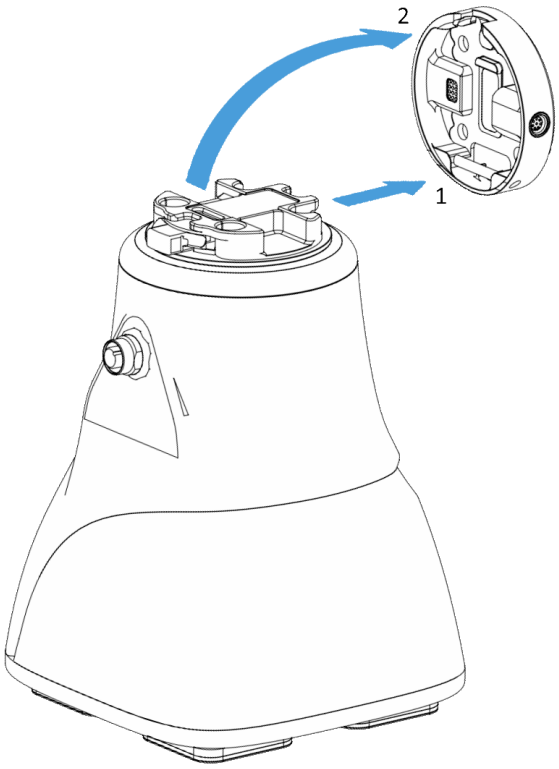
1	HEX-E/H QC sensor
2	M4x6mm (ISO14581 A4-70)
3	M6x8mm (NCN20146 A4-70)
4	HEX-E/H QC adapter
5	Adapter/ Robot tool flange (ISO 9409-1-50-4-M6)

Use 1.5 Nm tightening torque. for M4x6mm

Use 10 Nm tightening torque. for M6x8mm

6.2.3 Tools

Gecko



Step 1:

Move the tool close to the Quick Changer as illustrated.

The hook mechanism (rod and hook tongue) will keep the lower part locked once mounted.

Step 2:

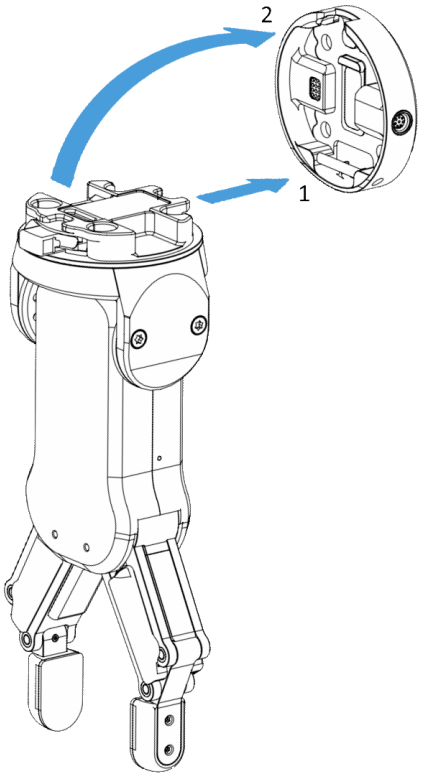
Flip the tool until it is fully mated, and you hear a clicking sound.

To unmount the tool, press the aluminum button on the Quick Changer and repeat the steps in the reverse order.

CAUTION:

With a Dual Quick Changer the Gecko Gripper can only be mounted on the Secondary (2) side. Mounting on the Primary (1) side will prevent the devices to function correctly.

RG2



Step 1:

Move the tool close to the Quick Changer as illustrated.

The hook mechanism (rod and hook tongue) will keep the lower part locked once mounted.

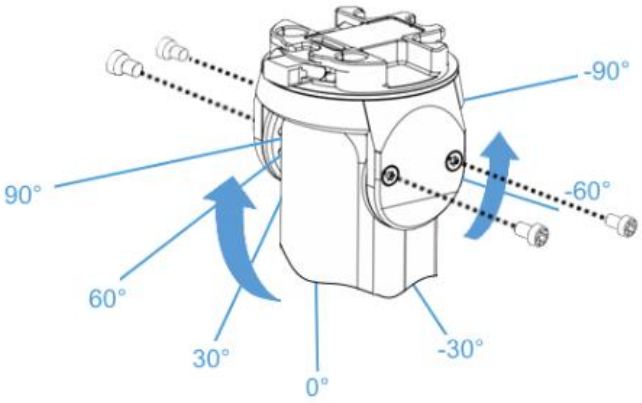
Step 2:

Flip the tool until it is fully mated, and you hear a clicking sound.

To unmount the tool, press the aluminum button on the Quick Changer and repeat the steps in the reverse order.

To change the relative angle of the gripper to the Quick Changer:

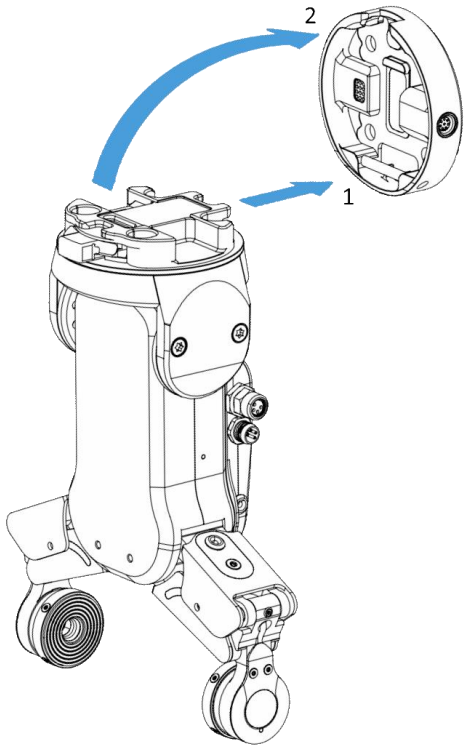
- first remove the four M4x6 screws
- tilt the gripper between -90° and 90°
- then put the four M4x6 screws back and use 1.35 Nm tightening torque to fix it.



WARNING:

Never use the device while any of the four M4x6 screws are removed.

RG2-FT



Step 1:

Move the tool close to the Quick Changer as illustrated.

The hook mechanism (rod and hook tongue) will keep the lower part locked once mounted.

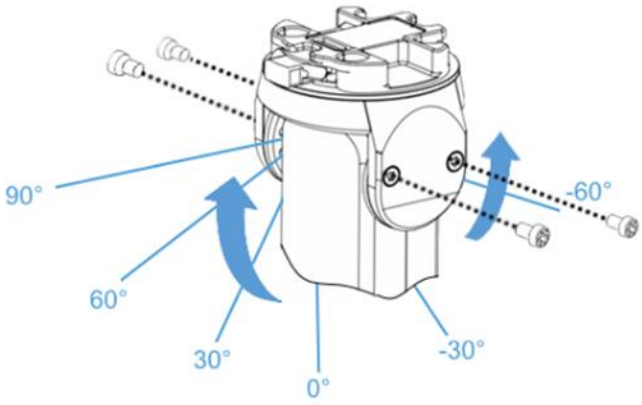
Step 2:

Flip the tool until it is fully mated, and you hear a clicking sound.

To unmount the tool, press the aluminum button on the Quick Changer and repeat the steps in the reverse order.

To change the relative angle of the gripper to the Quick Changer:

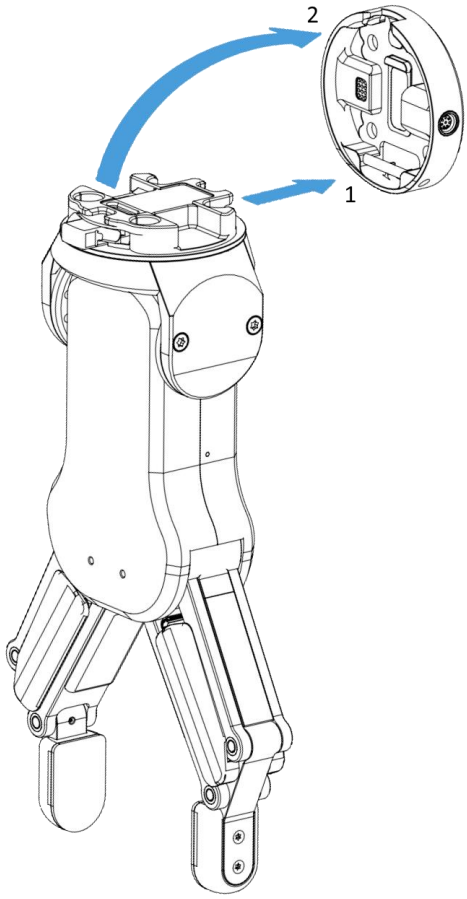
- first remove the four M4x6 screws
- tilt the gripper between -60° and 90°
- then put the four M4x6 screws back and use 1.35 Nm tightening torque to fix it.



WARNING:

Never use the device while any of the four M4x6 screws are removed.

RG6



Step 1:

Move the tool close to the Quick Changer as illustrated.

The hook mechanism (rod and hook tongue) will keep the lower part locked once mounted.

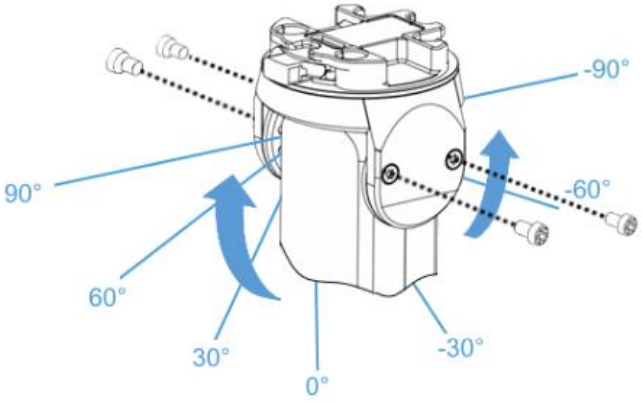
Step 2:

Flip the tool until it is fully mated, and you hear a clicking sound.

To unmount the tool, press the aluminum button on the Quick Changer and repeat the steps in the reverse order.

To change the relative angle of the gripper to the Quick Changer:

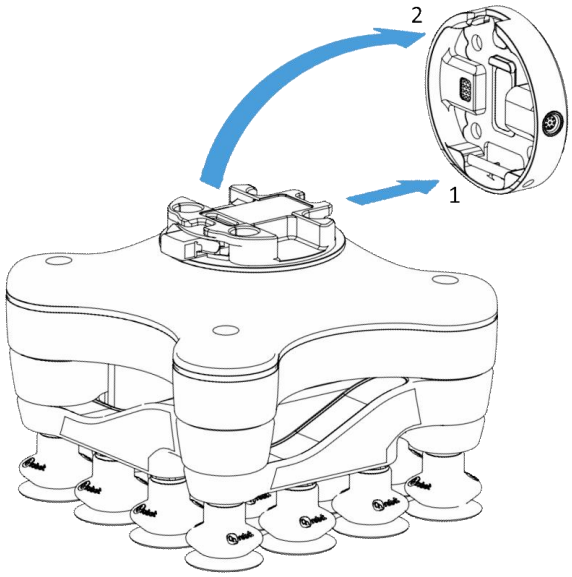
- first remove the four M4x6 screws
- tilt the gripper between -90° and 90°
- then put the four M4x6 screws back and use 1.35 Nm tightening torque to fix it.



WARNING:

Never use the device while any of the four M4x6 screws are removed.

VG10



Step 1:

Move the tool close to the Quick Changer as illustrated.

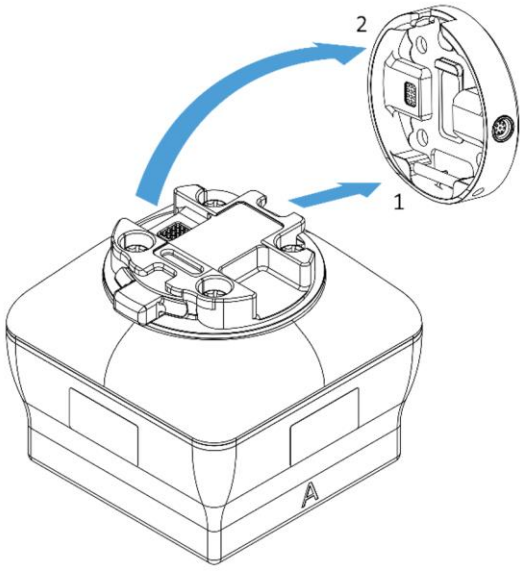
The hook mechanism (rod and hook tongue) will keep the lower part locked once mounted.

Step 2:

Flip the tool until it is fully mated, and you hear a clicking sound.

To unmount the tool, press the aluminum button on the Quick Changer and repeat the steps in the reverse order.

VGC10



Step 1:

Move the tool close to the Quick Changer as illustrated.

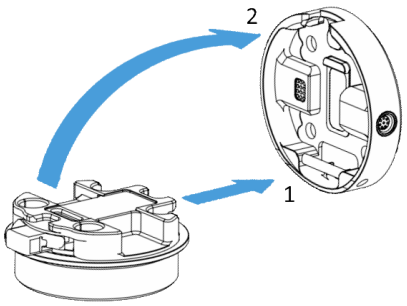
The hook mechanism (rod and hook tongue) will keep the lower part locked once mounted.

Step 2:

Flip the tool until it is fully mated, and you hear a clicking sound.

To unmount the tool, press the aluminum button on the Quick Changer and repeat the steps in the reverse order.

Quick Changer - Tool side



Step 1:

Move the tool close to the Quick Changer as illustrated.

The hook mechanism (rod and hook tongue) will keep the lower part locked once mounted.

Step 2:

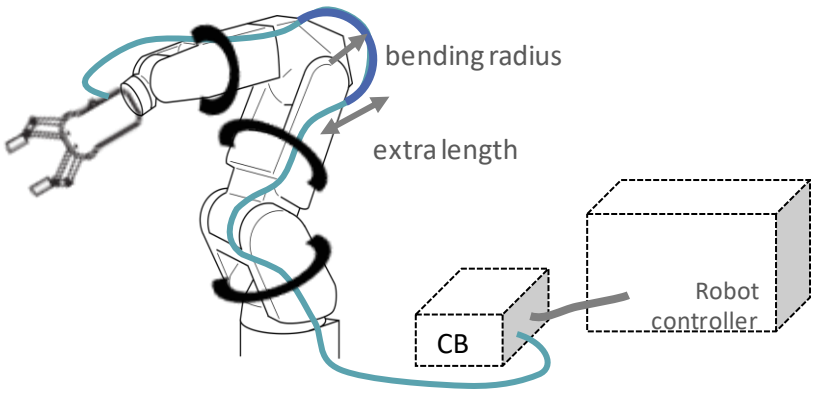
Flip the tool until it is fully mated, and you hear a clicking sound.

To unmount the tool, press the aluminum button on the Quick Changer and repeat the steps in the reverse order.

6.3 Wiring

Four kind of cables have to be connected to wire the system properly:

- Tool data cable between the tool(s) and the Compute Box
- The provided Digital I/O wires between the Computer Box and the robot controller
- Ethernet communication cable between the Compute Box and your computer
- Power supply of the Compute Box



6.3.1 Tool data

Connect the data cable to the tool(s) then route the cable (blue line) to the Compute Box (CB) and use the supplied Velcro tape (black) to fix it.

NOTE:

Leave some extra cable length around the joints so that the cable is not pulled when the robot moves.

Also make sure that the cable bending radius is minimum 40mm (for the HEX-E/H QC it is 70mm)

Then, connect the other end to the Compute Box's DEVICES connector.

CAUTION:

Use only original OnRobot tool data cables.

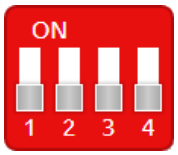
6.3.2 Digital I/O wires

For Agilus robots the **X12** optional I/O interface in the control cabinet can be used to connect the Compute Box to the robot controller.

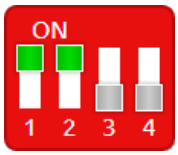
Make sure that the robot is powered off completely.

First locate the X12 connector on the back side of the KRC4 compact cabinet. Prepare the spare X12 (D-SUB 50) mating connectors that was shipped with the robot.

Check your digital I/O module installed in the control cabinet and configure the Compute Box DIP switches (red) accordingly:



For **PNP** type set the 1. and 2. DIP switches to OFF position (down).



For **NPN** type set the 1. and 2. DIP switches to ON position (up).

DIP switch 1: Digital Input mode

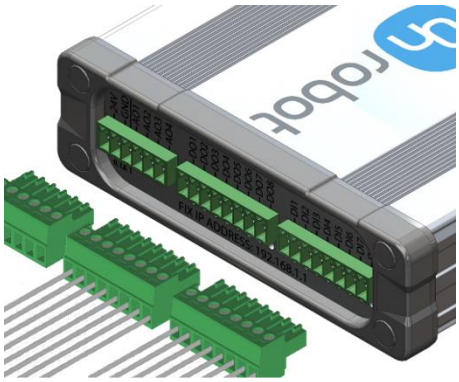
DIP switch 2: Digital Output mode

NOTE:

Do not change the DIP switch 3 and 4 otherwise the network settings will be changed.

The Beckhoff EL1809 and EL2809 modules are **PNP** type and the Beckhoff EL1889 and EL2889 modules are **NPN** type.

Plug in the supplied green pluggable connectors.

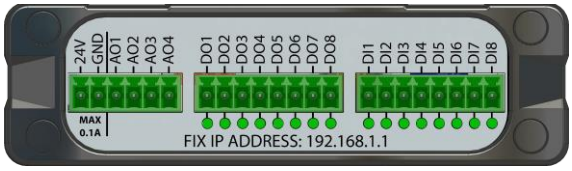


The supplied connector types are:

2 x Phoenix Contact MC 1,5/8-ST-3,5 Terminal Block

1 x Phoenix Contact MC 1,5/6-ST-3,5 Terminal Block

Wire the digital I/O wires from the Compute Box to the robot.



DO1-8: Digital outputs of the Compute Box (signals from the grippers/sensor to the robot)

DI1-8: Digital inputs of the Compute Box (signals from the robot to the grippers/sensor)

GND: To be used to have a common ground between the robot and the gripper/sensor

It is recommended to connect all 8 inputs and 8 outputs for simplicity.

CAUTION:

If some of the DO1-8 or DI1-8 wires will not be connected, make sure to unscrew it from the terminal block to avoid an accidental short circuit.

CAUTION:

The 24V and GND pins are only Reference Voltage Output. It cannot be used to power any equipment.

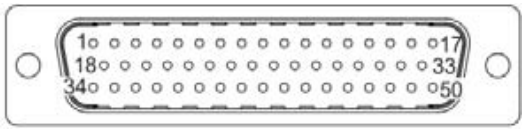
It is recommended to use the supplied wires only. If it is necessary to use different wire, use one that is shorter than 3 m.

Connect the Compute Box inputs to the robot outputs and the Compute Box outputs to robot inputs.

For simplicity, it is recommended to map the pins in order:

DO1 to the robot's Digital input 1	DI1 to the robot's Digital output 1
DO2 to the robot's Digital input 2	DI2 to the robot's Digital output 2
...	...
DO8 to the robot's Digital input 8	DI8 to the robot's Digital output 8

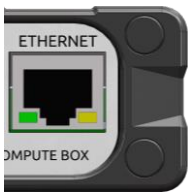
List of the important pins of the X12 connector: (viewed from connection side)



Pin	Description	Pin	Description
1	Digital input 1	17	Digital output 1
2	Digital input 2	18	Digital output 2
3	Digital input 3	19	Digital output 3
4	Digital input 4	20	Digital output 4
5	Digital input 5	21	Digital output 5
6	Digital input 6	22	Digital output 6
7	Digital input 7	23	Digital output 7
8	Digital input 8	24	Digital output 8
9	Digital input 9	25	Digital output 9
10	Digital input 10	26	Digital output 10
11	Digital input 11	27	Digital output 11
12	Digital input 12	28	Digital output 12
13	Digital input 13	29	Digital output 13
14	Digital input 14	30	Digital output 14
15	Digital input 15	31	Digital output 15
16	Digital input 16	32	Digital output 16

Please note which pin you used during the wiring, in a later step it is going to be needed for the mapping.

6.3.3 Ethernet cable



Connect the provided Compute Box (ETHERNET connector) and your computer with the supplied UTP cable.

This connection is only needed for programming.

CAUTION:

Use only original OnRobot ethernet cables or replace it with one that is shielded and no more than 3 meter long.

WARNING:

Check and make sure that the Compute Box enclosure (metal) and the robot controller enclosure (metal) are not connected (no galvanic connection between the two).

6.3.4 Power supply

Connect the supplied power supply to the Compute Box 24V connector.

NOTE:

To disconnect the power connector, make sure to pull the connector housing (where the arrows are shown) and not the cable.

CAUTION:

Use only original OnRobot power supplies.

Finally, power up the power supply that will power the Compute Box and the connected Tool(s).

7 Operation

NOTE:

It is assumed that the Installation has finished successfully. If not, first do the installation steps in the previous section.

7.1 Overview

OnRobot WebLogic requires to be programmed first with the help of a computer connected to the Compute box. Then it can run standalone without any Ethernet connection.

Steps to program it:

- Setup the Compute Box's Ethernet interface and connect to the Compute Box
- Open the Web Client on your computer to access the WebLogic menu
- Write your program in the WebLogic menu

The following subsections will guide you through these steps.

7.2 Ethernet Interface setup

A proper IP address must be set for the Compute Box and the robot/computer to be able to use the Ethernet interface. There are three ways how it could be configured (using the DIP switch 3 and 4):

- **Auto mode** (factory default)

  This is the easiest way of getting the IP addresses to be configured for both the Compute Box and the robot/computer. It is recommended to start with this mode, so this is the factory default setting.

- **Fixed IP mode** (192.168.1.1)

  If the **Auto mode** does not work, use this mode to have a fixed IP for the Compute Box. This requires a manual IP address configuration for the robot/computer. (This mode could also be used to reset the IP address to a known value if the Compute Box become unreachable in **Advanced mode**.)

- **Advanced mode** (any static IP/subnet mask)

  If the Fixed IP address (192.168.1.1) is already in use in your network or a different subnet needs to be configured, in this mode the IP address and subnet mask can be changed to any value. This also requires a manual IP address configuration for the robot/computer.

NOTE:

To change between modes, first change the DIP switches and then the Compute Box power needs to be cycled for the changes to take effect.

Auto mode

Use the factory default settings (DIP switch 3 and 4 in OFF position).

In this case, the Compute Box has both Dynamic Host Configuration Protocol (DHCP) client, and DHCP server enabled.

DHCP Client enabled means, Compute Box will automatically obtain ("get") IP address FROM the connected robot/computer if that is capable of assigning ("give") IP to the Compute Box.

DHCP Server enabled means, Compute Box will automatically assign ("give") IP address TO the connected robot/computer if that was configured to obtain ("get") IP address automatically.

NOTE:

The assigned IP range is 192.168.1.100-105 (with subnet mask 255.255.255.0).

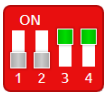
If the Compute Box is used in a company network where a DHCP server is already in use, it is recommended to disable the DHCP server of the Compute Box by setting DIP switch 4 to the ON position.

If no IP was assigned to the Compute Box within a minute, it will automatically get a fallback IP address (192.168.1.1).

NOTE:

If the Compute Box was in **Advanced mode**, first reset the IP setting by switching to **Fixed IP mode** and then switch back to **Auto mode**.

Fixed IP mode



Set the DIP switch 3 and 4 in ON position and cycle the power for the changes to take effect.

In this case the IP address of the Compute Box is set to 192.168.1.1 (subnet mask is 255.255.255). Both the DHCP Client and Server options are disabled.

Make sure to set the robot/computer IP address manually. To have a proper communication the robot/computer IP address must be in the range of 192.168.1.2 - 192.168.1.254.

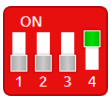
Example robot/computer setting:

IP address: 192.168.1.2

Subnet mask: 255.255.255.0

Other settings like Gateway, DNS Server, etc. could be kept empty or set to 0.0.0.0.

Advanced mode



Set the DIP switch 3 in OFF and DIP switch 4 in ON position and cycle the power for the changes to take effect.

In this case the IP address of the Compute Box could be set to any value by using the Web Client. For more details see section **Configuration menu**.

In this mode, the DHCP server option is disabled.

Make sure to have a matching IP setting to your robot/computer network for a proper communication.

NOTE:

If the Compute Box become unreachable (due to improper or forgotten IP settings), switch to **Fixed IP mode** to reset the IP setting.

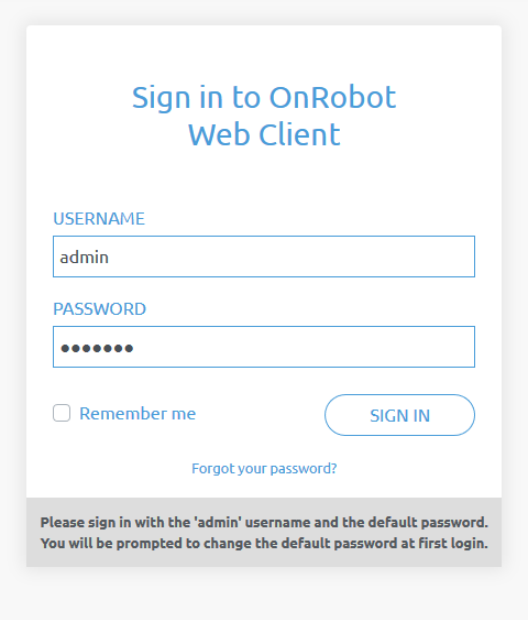
7.3 Web Client

To access the Web Client on your computer first the Ethernet interface needs to be set up to have a proper communication between your computer and the Compute Box. It is recommended to use Auto mode (for further details see section **Ethernet Interface setup**).

Then do the following steps:

- Connect the Compute Box to your computer with the supplied UTP cable.
- Power the Compute Box with the supplied power supply
- Wait one minute for the Compute Box LED to turn from blue to green.
- Open a web browser on your computer and type in the IP address of the Compute Box (factory default is 192.168.1.1).

The Sign-in page opens:

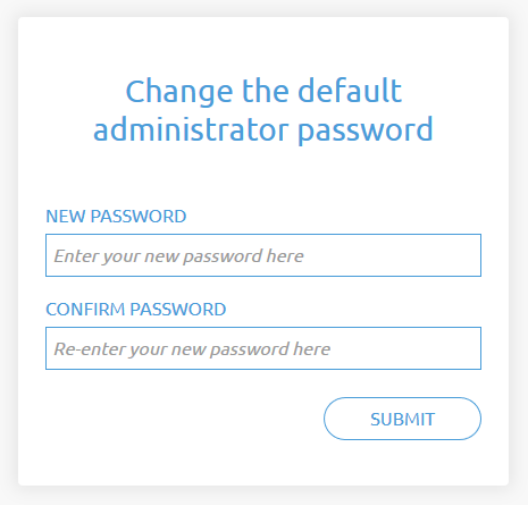


The factory default administrator login is:

Username: admin

Password: OnRobot

For the first login a new password needs to be entered: (password must be at least 8 characters long)



Once logged in you can access top menus. Select **WebLogic** menu.

7.4 OnRobot WebLogic menu

There are two tabs to choose from:

- **Browser -** manage (import/export, etc.) the WebLogic programs
- **Program Editor -** create/edit or run WebLogic programs

In the following these two will be described.

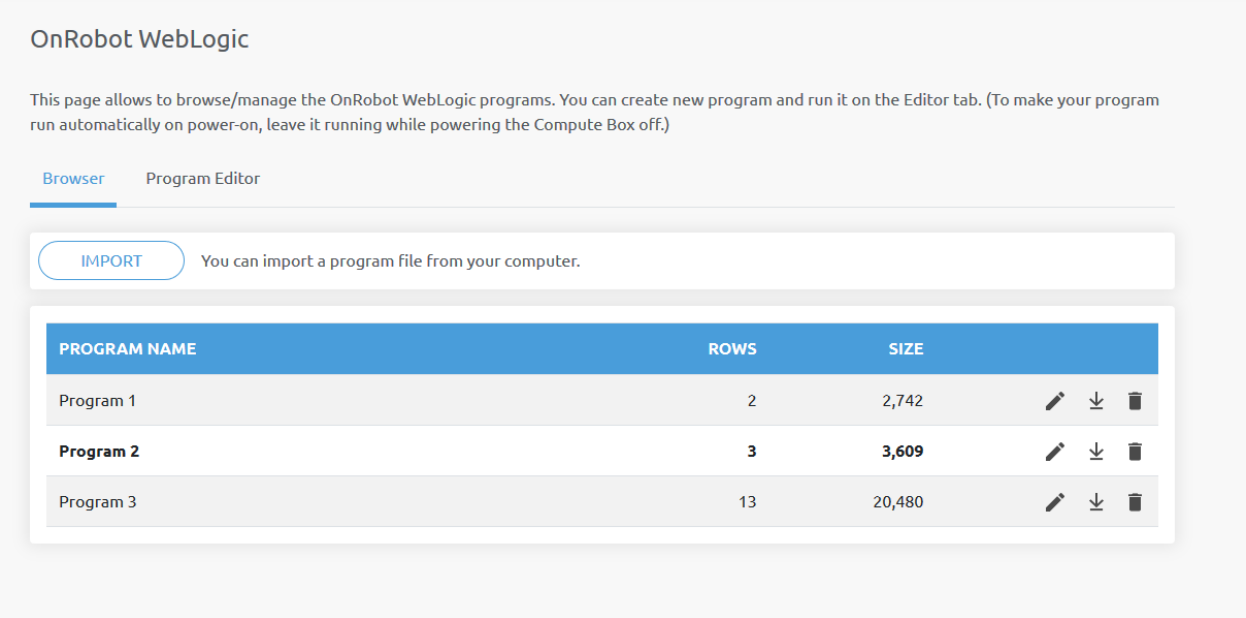
7.4.1 Browser

This tab lists the WebLogic programs that are stored on the Compute Box.

- To create a new program, go to the **Program Editor** tab.
- To edit a stored program, click on the pencil icon and it will be loaded in the **Program Editor**
- Any program can be deleted by clicking on the trash icon.
- Programs can be exported to your computer by clicking on the down arrow icon.
- Exported programs can be imported with the **Import** button.

NOTE:

The program name that are edited in the **Program Editor** is bolded.



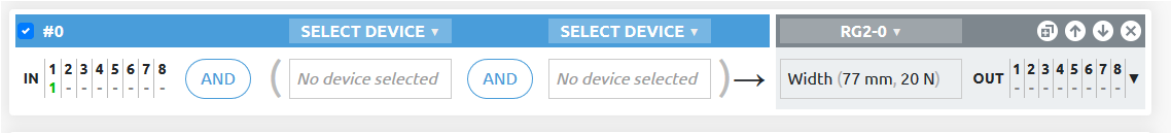
7.4.2 Program Editor

This tab shows the currently edited WebLogic program.

WebLogic programs contains 1 or more "rows".

A row contains conditions (blue part) and commands (gray part) like this:

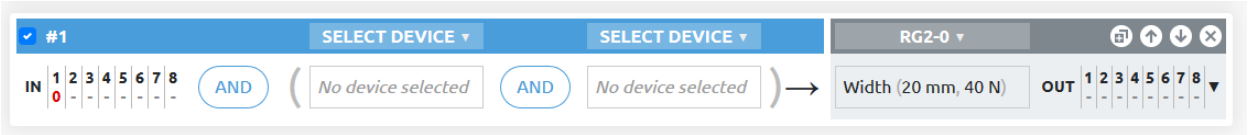
(**If**) DI1=1 → (**Then**) RG2-Width=77 (force=20N)



(If the robot sets the Digital Input 1 (DI1) of the Compute Box to high, **then** open the RG2 gripper to 77 mm.)

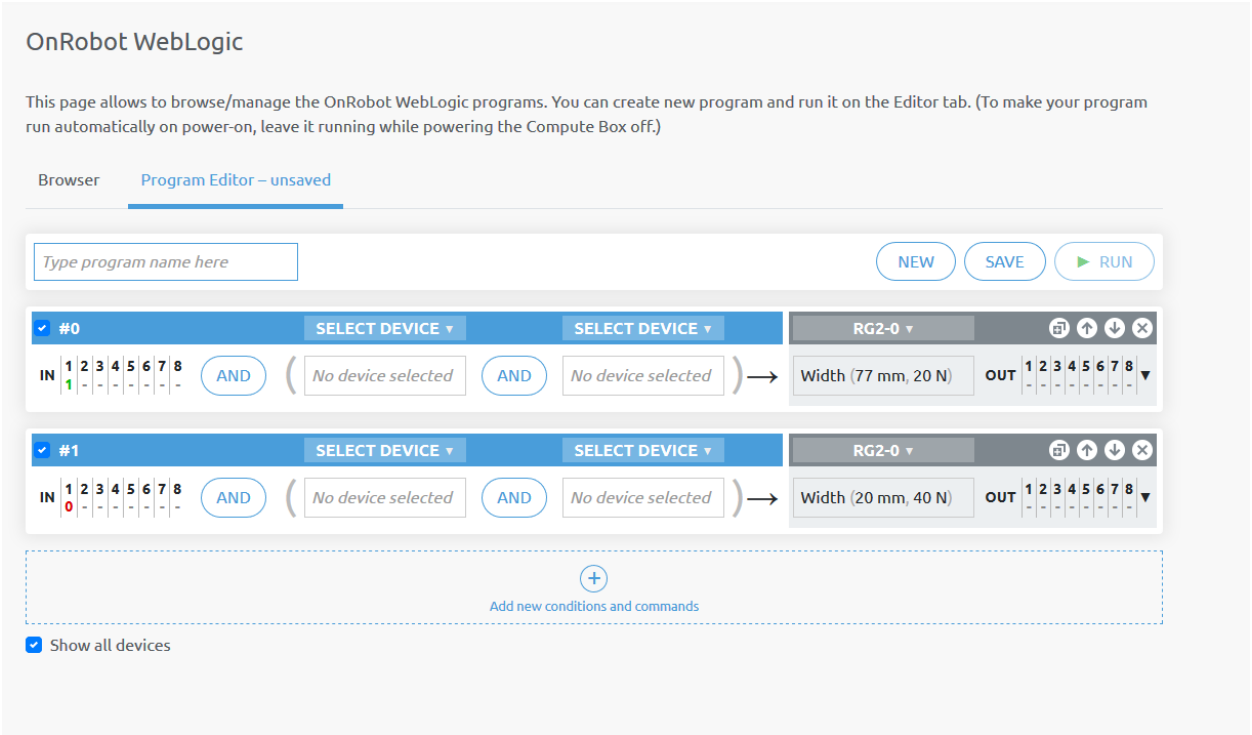
Another row in a program can be like this:

(**If**) DI1=0 → (**Then**) RG2-Width=20 (force=40N)



(If the robot sets the Digital Input 1 (DI1) of the Compute Box to low, **then** close the RG2 gripper to 20 mm.)

With the above two rows in a program an RG2/6 gripper could be operated (opened and closed) with a single Digital output of a robot, while the opening and closing width and force can be programmed to any value.



To execute a WebLogic program first make sure to enter a program name and click on the **Save** button to store it and then click on the ▶ **Run** button.

NOTE:

To make a program run automatically when the Compute Box is powered on just leave the program running while you power the Compute Box off.

To start a new program, click on the **New** button.

- To add a new row, click on the **Add new conditions and commands**.
- To delete a row, click on the icon.
- To move the row up or down click on the icons.

NOTE:

Conditions and commands are executed from the top to the bottom. Same commands at the bottom can override the ones at the top.

- To duplicate a row click on the icon.
- To disable a row (not to be executed) uncheck the checkbox next to the row number.

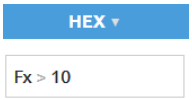
The rows must have at least one condition and at least one command to be executed.

Conditions

Conditions are the input fields marked by blue.

There are two types of conditions:

- Digital Input type - like DI4=1 

- Device specific value type - like HEX Fx > 10N 

These types of conditions can be combined with AND or OR logic to form a more complex condition:

If (DI4=1) **OR** (HEX Fx > 10 N **AND** HEX Fx < 20N)

Condition is true if Fx is between 10N and 20N or robot has signaled high in Digital Input 4.

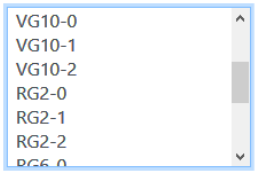
Digital inputs (DI1-DI8) can have the following three states: (click to cycle through the states)

- - - Don't care (this bit is masked and will give true result for the bit)
- 0 - give logic true if Input bit is low
- 1 -give logic true if Input bit is high

NOTE:

If no Digital Input type of condition is needed set DI1-DI8 to - don't care.

For Device specific values first set the **Select device** by clicking on the arrow icon.



NOTE:

The list contains only the connected devices. If you would like to select a device that is not currently connected check the **Show all devices** checkbox.

For RG2/6, VG10/ VGC10 and Gecko there are three numbers after the device name:

- **0** - If the device is mounted on a Quick Changer or a HEX-E/H QC
- **1** - If the device is mounted on the Primary side of a Dual Quick Changer
- **2** - If the device is mounted on the Secondary side of a Dual Quick Changer

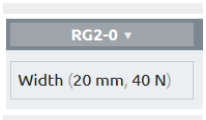
NOTE:

If a Device specific value type condition is not needed set it to **-- Not selected --** and it will give true result.

Commands

Commands are the input fields marked with gray.

There are two types of commands:

- Device specific value type - like 

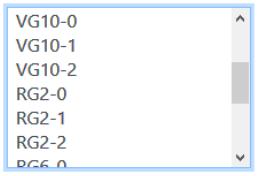
(set RG2 width 77 mm and with force = 20N)
- Digital Output type - like DO4=1 

(set Digital Output 4 to logic high)

NOTE:

Both types are always executed so make sure that the not relevant part is always set to - Don't change or **-- Not selected --**.

For Device specific value first set the **Select device** by clicking on the arrow icon.



NOTE:

The list contains only the connected devices. If you would like to select a device that is not currently connected check the **Show all devices** checkbox.

For RG2/6, VG10/ VGC10 and Gecko there are three numbers after the device name:

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- **1** - If the device is mounted on the Primary side of a Dual Quick Changer
- **2** - If the device is mounted on the Secondary side of a Dual Quick Changer

Digital outputs (DO1-DO8) can have the following three states: (click to cycle through the states)

- - - Don't change
- 0 - set the Output bit to logic low
- 1 - set the Output bit to logic high

List of Device specific values

NOTE:

Each device has an **OnStart** condition that becomes True only once the device is connected or the program is started and then becomes immediately False. This can be used to detect if a device is connected or set any initial value on program start.

Gecko

Conditions	Description
Preload	Actual force applied to the pads [N] (below 50N it reads 0N)
Ultrasonic	Actual distance measured from the bottom of the gripper to the object.[mm]
Pad position	Actual position of the pads either **In** or **Out**
Pads worn	If a Grip was detected and then object distance becomes more than 18mm (without the pads being pulled IN) the object is lost so the Pads are **Bad** otherwise reads **Good**.
Busy	Pads are in motion
Grip	While the pads are OUT if the **Preload** force is reached and the object distance is less than 18mm, then Grip becomes **TRUE** otherwise **FALSE**. (resets to **FALSE** by pulling the pads IN)

Commands	Description
Pad position	To pull the pads **In** or push the pads **Out**
Preload threshold	To set the preload force limit that is used to detect a successful **Grip**. Available options are: 50N, 90N, 120N
Reset error logs	Clears the errors (e.g.: Pads worn)

HEX-E/H QC

Conditions	Description
Bias	**TRUE** if the sensor has been zeroed (biased).
F3D, T3D	F3D= $\sqrt{Fx^2 + Fy^2 + Fz^2}$ [N] T3D= $\sqrt{Tx^2 + Ty^2 + Tz^2}$ [Nm]
Fx, Fy, Fz, Tx, Ty, Tz	Actual force [N] and torque [Nm] values

Commands	Description
Bias	Set to **TRUE** to zero the F/T sensor signals (not permanent, will revert on power reset)

RG2/6

Conditions	Description
Width	Actual width of the gripper [mm]
Busy	True if the gripper is in motion (can only accept new commands when not busy)
Grip	Internal or external grip is detected.
Safety pressed	True if any of the gripper's safety switch is currently being pressed.
Safety triggered	True if any of the gripper's safety switch is triggered.

Commands	Description
Width	Set the gripper to a new width [mm] with a gripping force [N]
Fingertip offset	Set the fingertip offset from the inner side of the metal [mm]. Positive number means inward.
Power cycle	If safety switch stopped the gripper use this to get back to normal operation. Resets the tool power for a second. If another gripper is connected, that will also be powered off and powered on for a second. (Make sure that during power off no part to will be dropped.)

RG2-FT

Conditions	Description
Proximity (L,R)	Actual values of the left and right fingertip proximity sensors [mm]
Width	Actual width of the gripper [mm]
Busy	True if the gripper is in motion (can only accept new commands when not busy)
Grip	Internal or external grip is detected.
FT Bias	**TRUE** if the sensor has been zeroed (biased).
Left and Right F3D,T3D	F3D= $\sqrt{Fx^2 + Fy^2 + Fz^2}$ [N] where Fx, Fy, Fz are the fingertip sensor force components T3D= $\sqrt{Tx^2 + Ty^2 + Tz^2}$ [Nm] where Tx, Ty, Tz are the fingertip sensor torque components
Both F3D,T3D	The combined F3D and T3D acting on an object that the gripper gripped on

Commands	Description
Width	Set the gripper to a new width [mm] with a gripping force [N]
Bias	Set to **TRUE** to zero the F/T sensor signals (not permanent, will revert on power reset)

VG10 / VGC10

Conditions	Description
Actual vacuum A **Actual vacuum B**	Actual vacuum level [0-80%] for channel A and channel B

Commands	Description
Current limit	Set the current limit (0-1000mA), default is 500mA
Grip	Sets the vacuum level (0-80%) for channel A (param1) and channel B (param2)
Idle	Switch of the motor but keep the valve closed for channel A, B or A+B
Release	Opens the valve to quickly release the vacuum for channel A, B or A+B

Mode III - OnRobot F/T Software

8 Installation

8.1 Overview

For a successful installation the following steps will be required:

- Mount the components
- Wire the cables
- Setup the software

In the following sections, these installation steps will be described.

8.2 Mounting

Required steps:

- Mount the robot dependent adapter
- Mount the Quick Changer option
- Mount the tool(s)

In the following three subsections these three mounting steps will be described.

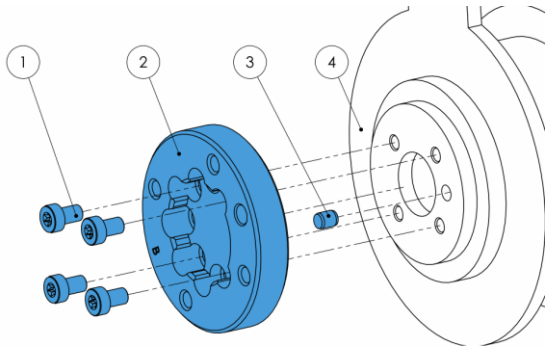
8.2.1 Adapter(s)

For KR 3 Agilus,

KR 6 R1820 / 1820 HP / 700(-2) / 900(-2),

KR 8 R1620 / 1620 HP,

KR 10 R1420 / 1420 HP / 900(-2) / 1100(-2) models



Adapter B (4 screws)

1 M5x8 screws (ISO14580 A4-70)

2 OnRobot adapter flange (ISO 9409-1-50-4-M6)

3 Dowel pin Ø5x6 (ISO2338 h8)

4 Robot tool flange (ISO 9409-1-31.5-4-M5)

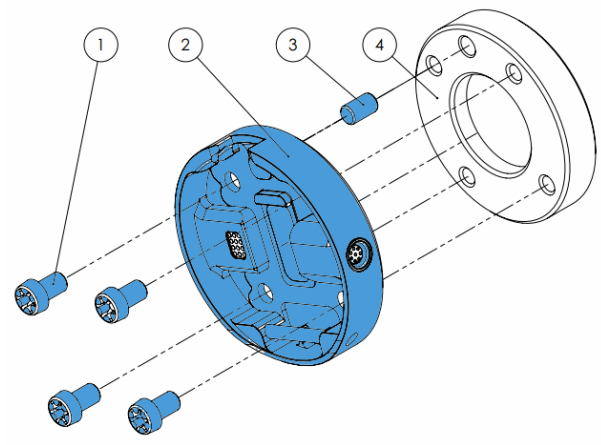
Use 5 Nm tightening torque.

For KR 8 R2010 and KR 12 R1810 models

No adapter plate is required.

8.2.2 Quick Changer options

Quick Changer - Robot Side



Quick Changer - Robot Side

1 M6x8mm (ISO14580 8.8)

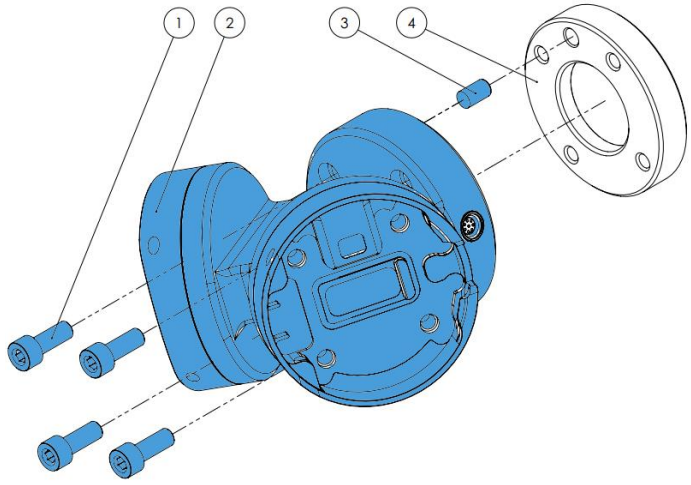
2 Quick Changer (ISO 9409-1-50-4-M6)

3 Dowel pin Ø6x10 (ISO2338 h8)

4 Adapter/ Robot tool flange (ISO 9409-1-50-4-M6)

Use 10 Nm tightening torque.

Dual Quick Changer



Dual Quick Changer

1 M6x20mm (ISO14580 8.8)

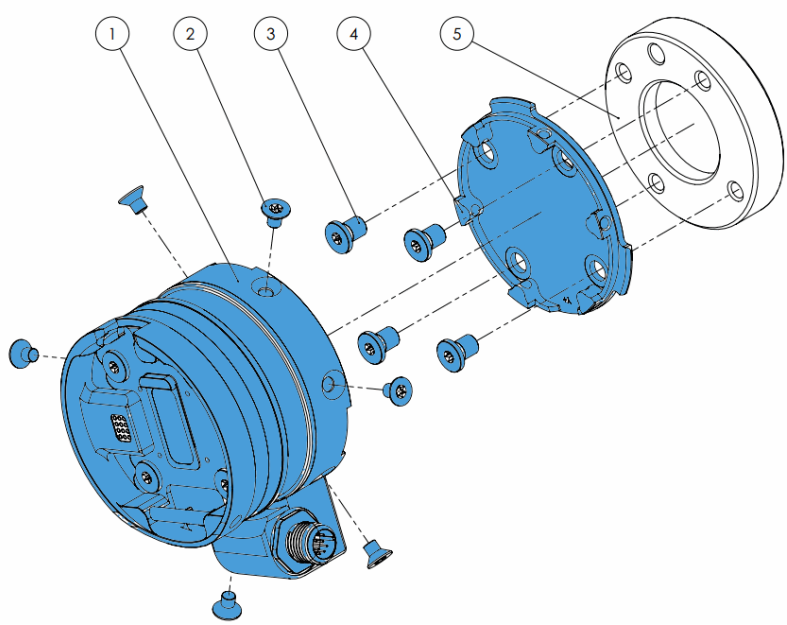
2 Dual Quick Changer

3 Dowel pin Ø6x10 (ISO2338 h8)

4 Adapter/ Robot tool flange (ISO 9409-1-50-4-M6)

Use 10 Nm tightening torque.

HEX-E/H QC



HEX-E/H QC

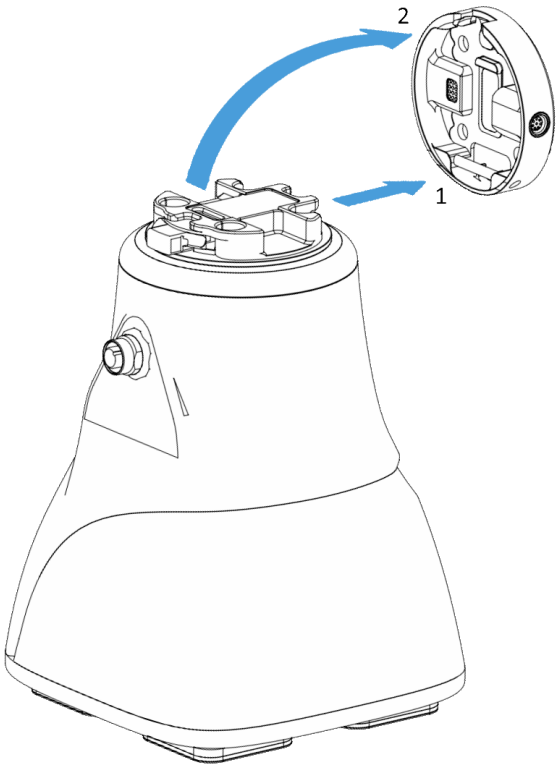
1	HEX-E/H QC sensor
2	M4x6mm (ISO14581 A4-70)
3	M6x8mm (NCN20146 A4-70)
4	HEX-E/H QC adapter
5	Adapter/ Robot tool flange (ISO 9409-1-50-4-M6)

Use 1.5 Nm tightening torque. for M4x6mm

Use 10 Nm tightening torque. for M6x8mm

8.2.3 Tools

Gecko



Step 1:

Move the tool close to the Quick Changer as illustrated.

The hook mechanism (rod and hook tongue) will keep the lower part locked once mounted.

Step 2:

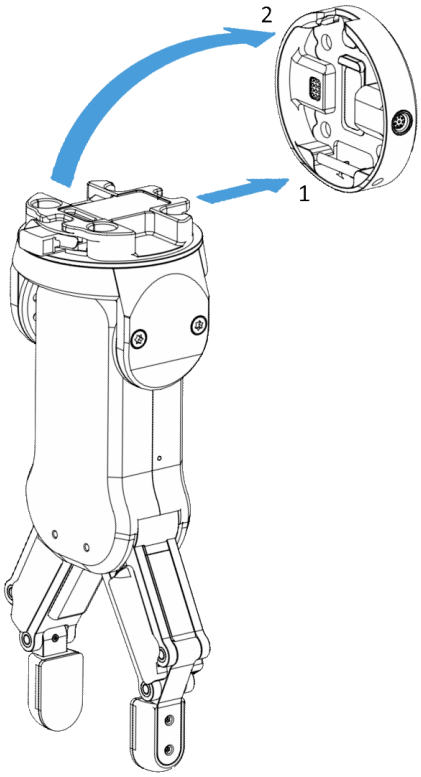
Flip the tool until it is fully mated, and you hear a clicking sound.

To unmount the tool, press the aluminum button on the Quick Changer and repeat the steps in the reverse order.

CAUTION:

With a Dual Quick Changer the Gecko Gripper can only be mounted on the Secondary (2) side. Mounting on the Primary (1) side will prevent the devices to function correctly.

RG2



Step 1:

Move the tool close to the Quick Changer as illustrated.

The hook mechanism (rod and hook tongue) will keep the lower part locked once mounted.

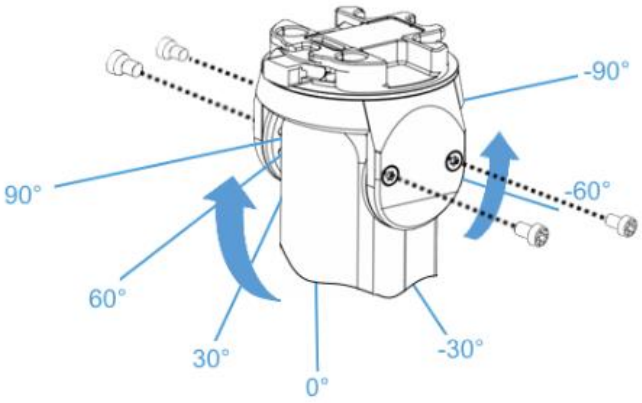
Step 2:

Flip the tool until it is fully mated, and you hear a clicking sound.

To unmount the tool, press the aluminum button on the Quick Changer and repeat the steps in the reverse order.

To change the relative angle of the gripper to the Quick Changer:

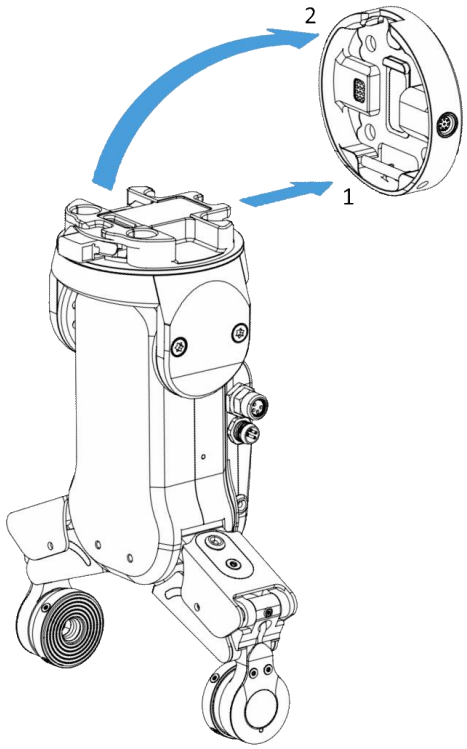
- first remove the four M4x6 screws
- tilt the gripper between -90° and 90°
- then put the four M4x6 screws back and use 1.35 Nm tightening torque to fix it.



WARNING:

Never use the device while any of the four M4x6 screws are removed.

RG2-FT



Step 1:

Move the tool close to the Quick Changer as illustrated.

The hook mechanism (rod and hook tongue) will keep the lower part locked once mounted.

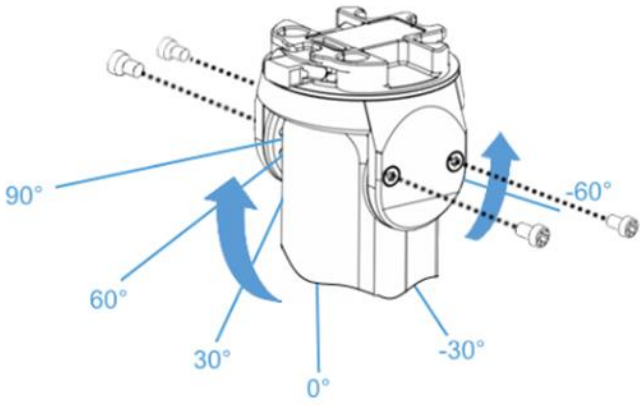
Step 2:

Flip the tool until it is fully mated, and you hear a clicking sound.

To unmount the tool, press the aluminum button on the Quick Changer and repeat the steps in the reverse order.

To change the relative angle of the gripper to the Quick Changer:

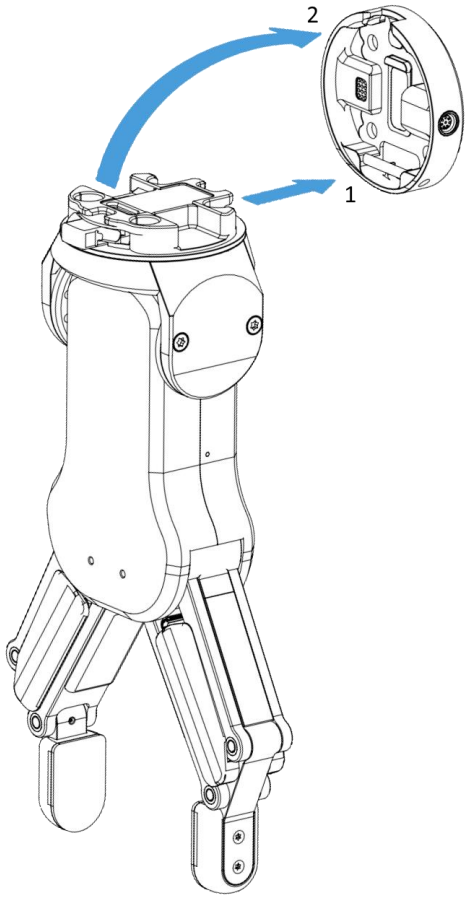
- first remove the four M4x6 screws
- tilt the gripper between -60° and 90°
- then put the four M4x6 screws back and use 1.35 Nm tightening torque to fix it.



WARNING:

Never use the device while any of the four M4x6 screws are removed.

RG6



Step 1:

Move the tool close to the Quick Changer as illustrated.

The hook mechanism (rod and hook tongue) will keep the lower part locked once mounted.

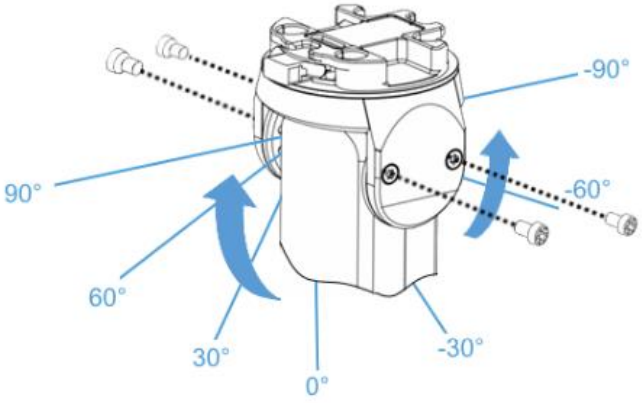
Step 2:

Flip the tool until it is fully mated, and you hear a clicking sound.

To unmount the tool, press the aluminum button on the Quick Changer and repeat the steps in the reverse order.

To change the relative angle of the gripper to the Quick Changer:

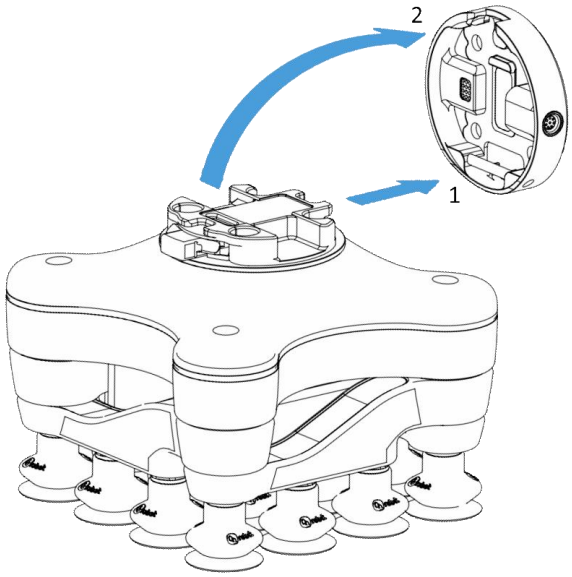
- first remove the four M4x6 screws
- tilt the gripper between -90° and 90°
- then put the four M4x6 screws back and use 1.35 Nm tightening torque to fix it.



WARNING:

Never use the device while any of the four M4x6 screws are removed.

VG10



Step 1:

Move the tool close to the Quick Changer as illustrated.

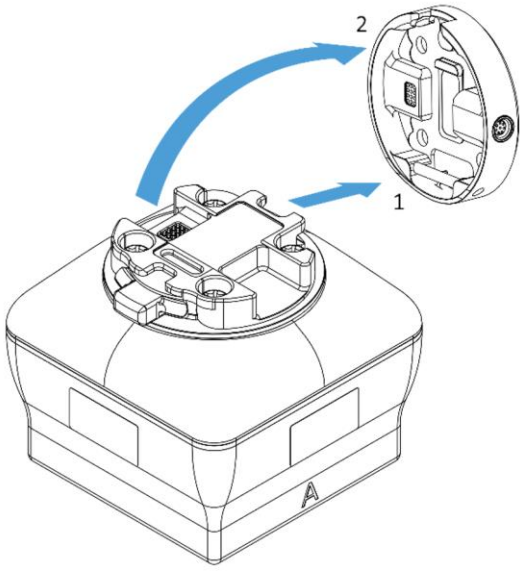
The hook mechanism (rod and hook tongue) will keep the lower part locked once mounted.

Step 2:

Flip the tool until it is fully mated, and you hear a clicking sound.

To unmount the tool, press the aluminum button on the Quick Changer and repeat the steps in the reverse order.

VGC10



Step 1:

Move the tool close to the Quick Changer as illustrated.

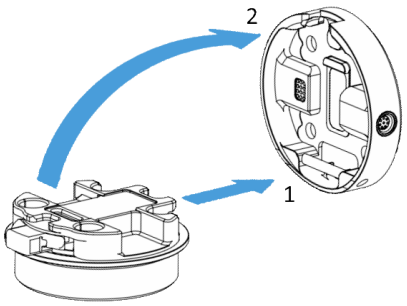
The hook mechanism (rod and hook tongue) will keep the lower part locked once mounted.

Step 2:

Flip the tool until it is fully mated, and you hear a clicking sound.

To unmount the tool, press the aluminum button on the Quick Changer and repeat the steps in the reverse order.

Quick Changer - Tool side



Step 1:

Move the tool close to the Quick Changer as illustrated.

The hook mechanism (rod and hook tongue) will keep the lower part locked once mounted.

Step 2:

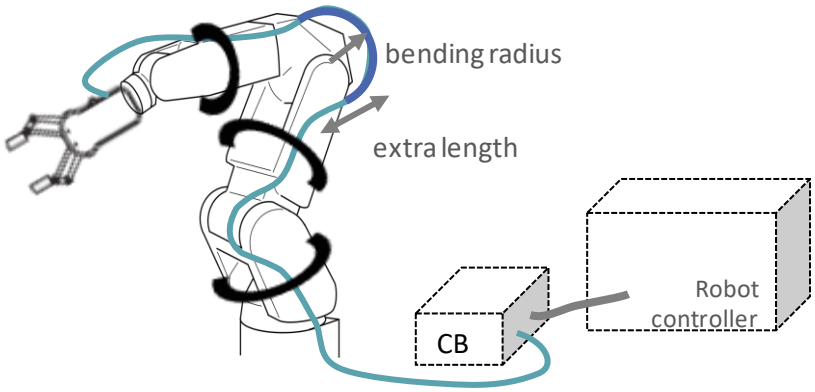
Flip the tool until it is fully mated, and you hear a clicking sound.

To unmount the tool, press the aluminum button on the Quick Changer and repeat the steps in the reverse order.

8.3 Wiring

Three cables need to be connected to wire the system properly:

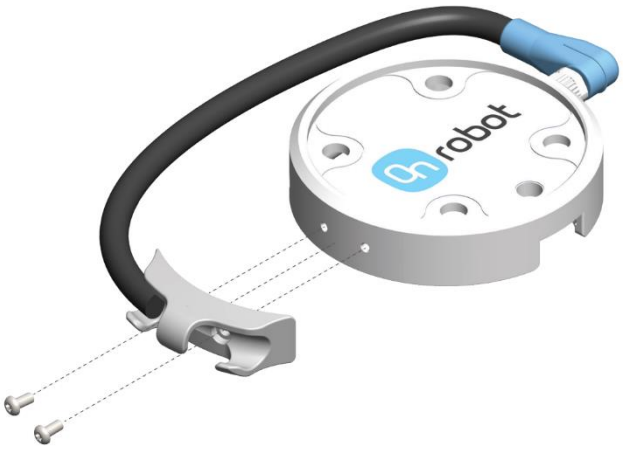
- Tool data cable between the tool(s) and the Compute Box
- Ethernet communication cable between the robot controller and the Compute Box
- Power supply of the Compute Box



8.3.1 Tool data cable

First connect the data cable to the tool.

For Single or Dual RG2, RG6, VG10, VGC10 or Gecko Gripper



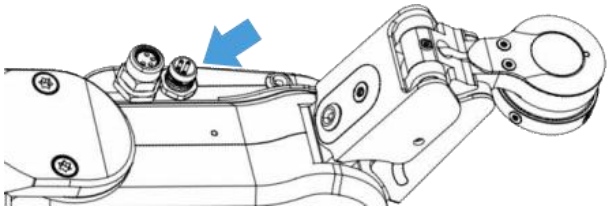
Use the M8-8pin connector on the Quick Changer or on the Dual Quick Changer.

Use the cable holder as illustrated on the left.

CAUTION:

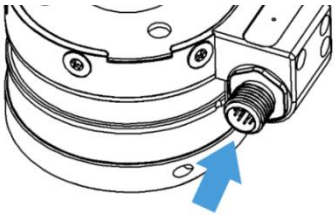
Make sure to use the supplied cable holder to prevent any excessive strain on the 90-degree M8 connector caused by the rotation of the cable.

For RG2-FT



For RG2-FT the Quick Changer tool data connector cannot be used. Instead use the marked M8-4pin connector

For HEX-E/H QC



Use the marked M12-12pin connector on the HEX-E/H QC.

Then route the Tool data cable to the Compute Box (CB) and use the supplied Velcro tape (black) to fix it.

NOTE:

Make sure that during the routing some extra length is used at the joints so that cable is not pulled when the robot moves.

Also make sure that the cable bending radius is minimum 40mm (for the HEX-E/H QC it is 70mm)

Finally, connect the other end of the Tool data cable to the Compute Box's DEVICES connector.

CAUTION:

Use only original OnRobot tool data cables. Do not cut or extend these cables.

CAUTION:

Quick Changer and Dual Quick Changer can only be used to power OnRobot tools.

8.3.2 Ethernet cable

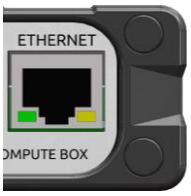
Connect one end of the supplied Ethernet (UTP) cable to the robot controller's Ethernet (LAN) port as shown below:

Use the X66 (KLI) port.

NOTE:

If the robot controller's Ethernet port is in use, use a standard 4-port Ethernet switch to be able to use two network devices at the same time.

Connect the other end of the supplied cable to the Compute Box's ETHERNET connector.



CAUTION:

Use only shielded, maximum 3m long Ethernet cables.

WARNING:

Check and make sure that the Compute Box enclosure (metal) and the robot controller enclosure (metal) are not connected (no galvanic connection between the two).

8.3.3 Power supply

Connect the supplied power supply to the Compute Box 24V connector.

NOTE:

To disconnect the power connector, make sure to pull the connector housing (where the arrows are shown) and not the cable.

CAUTION:

Use only original OnRobot power supplies.

Finally, power up the power supply that will power the Compute Box and the connected Tool(s).

8.4 Software setup

8.4.1 Compute Box IP setup

NOTE:

It is recommended to use Fixed IP mode for OnRobot F/T .

In the following, it is assumed that the Compute Box IP is left at the default 192.168.1.1. If other IP address is selected, remember to always enter the chosen one whenever required to be entered.

8.4.2 Ethernet Interface Setup

A proper IP address must be set for the Compute Box and the robot/computer to be able to use the Ethernet interface. There are three ways how it could be configured (using the DIP switch 3 and 4):

- **Auto mode** (factory default)

  This is the easiest way of getting the IP addresses to be configured for both the Compute Box and the robot/computer. It is recommended to start with this mode, so this is the factory default setting.

- **Fixed IP mode** (192.168.1.1)

  If the **Auto mode** does not work, use this mode to have a fixed IP for the Compute Box. This requires a manual IP address configuration for the robot/computer. (This mode could also be used to reset the IP address to a known value if the Compute Box become unreachable in **Advanced mode**.)

- **Advanced mode** (any static IP/subnet mask)

  If the Fixed IP address (192.168.1.1) is already in use in your network or a different subnet needs to be configured, in this mode the IP address and subnet mask can be changed to any value. This also requires a manual IP address configuration for the robot/computer.

NOTE:

To change between modes, first change the DIP switches and then the Compute Box power needs to be cycled for the changes to take effect.

Auto mode

Use the factory default settings (DIP switch 3 and 4 in OFF position).

In this case, the Compute Box has both Dynamic Host Configuration Protocol (DHCP) client, and DHCP server enabled.

DHCP Client enabled means, Compute Box will automatically obtain ("get") IP address FROM the connected robot/computer if that is capable of assigning ("give") IP to the Compute Box.

DHCP Server enabled means, Compute Box will automatically assign ("give") IP address TO the connected robot/computer if that was configured to obtain ("get") IP address automatically.

NOTE:

The assigned IP range is 192.168.1.100-105 (with subnet mask 255.255.255.0).

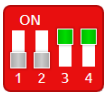
If the Compute Box is used in a company network where a DHCP server is already in use, it is recommended to disable the DHCP server of the Compute Box by setting DIP switch 4 to the ON position.

If no IP was assigned to the Compute Box within a minute, it will automatically get a fallback IP address (192.168.1.1).

NOTE:

If the Compute Box was in **Advanced mode**, first reset the IP setting by switching to **Fixed IP mode** and then switch back to **Auto mode**.

Fixed IP mode



Set the DIP switch 3 and 4 in ON position and cycle the power for the changes to take effect.

In this case the IP address of the Compute Box is set to 192.168.1.1 (subnet mask is 255.255.255). Both the DHCP Client and Server options are disabled.

Make sure to set the robot/computer IP address manually. To have a proper communication the robot/computer IP address must be in the range of 192.168.1.2 - 192.168.1.254.

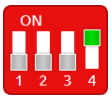
Example robot/computer setting:

IP address: 192.168.1.2

Subnet mask: 255.255.255.0

Other settings like Gateway, DNS Server, etc. could be kept empty or set to 0.0.0.0.

Advanced mode



Set the DIP switch 3 in OFF and DIP switch 4 in ON position and cycle the power for the changes to take effect.

In this case the IP address of the Compute Box could be set to any value by using the Web Client. For more details see section **Configuration menu**.

In this mode, the DHCP server option is disabled.

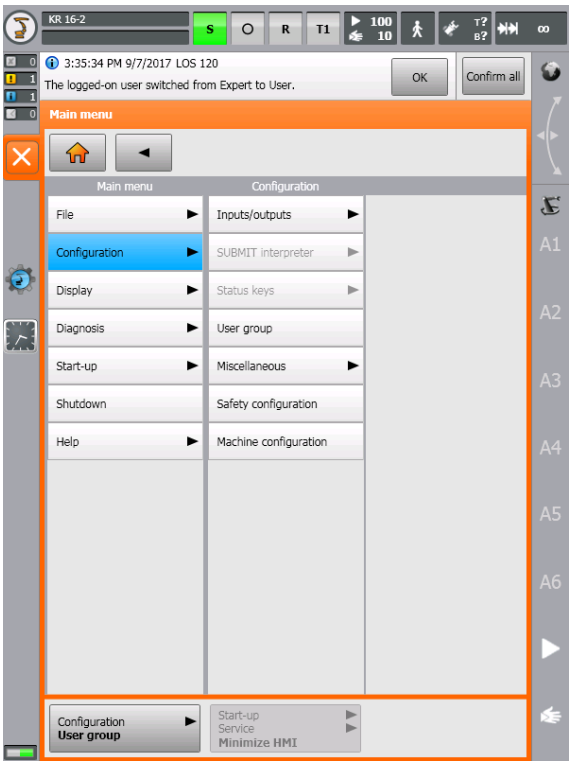
Make sure to have a matching IP setting to your robot/computer network for a proper communication.

NOTE:

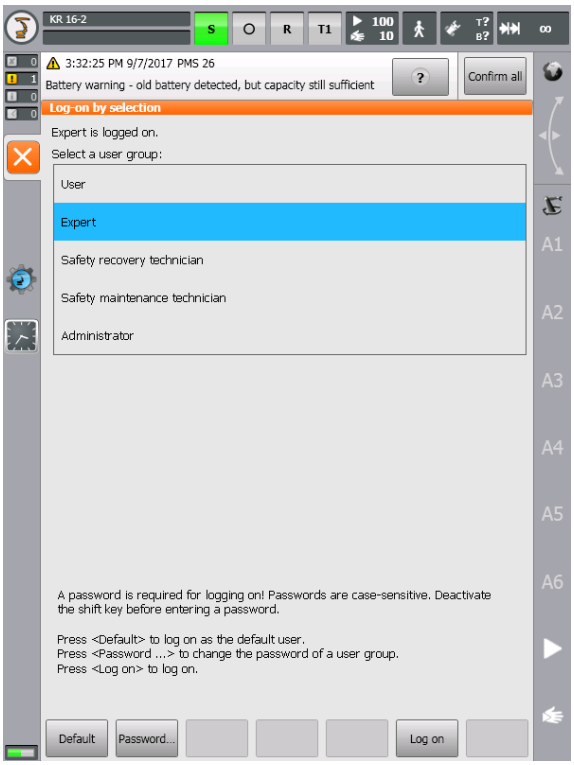
If the Compute Box become unreachable (due to improper or forgotten IP settings), switch to **Fixed IP mode** to reset the IP setting.

8.4.3 KUKA Line Interface (KLI) IP setup

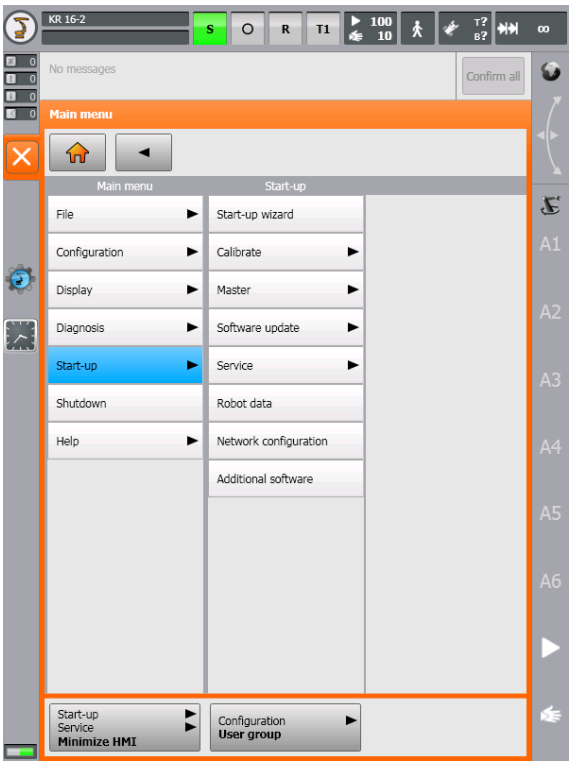
To change the IP settings of the KUKA robot controller, follow this process:



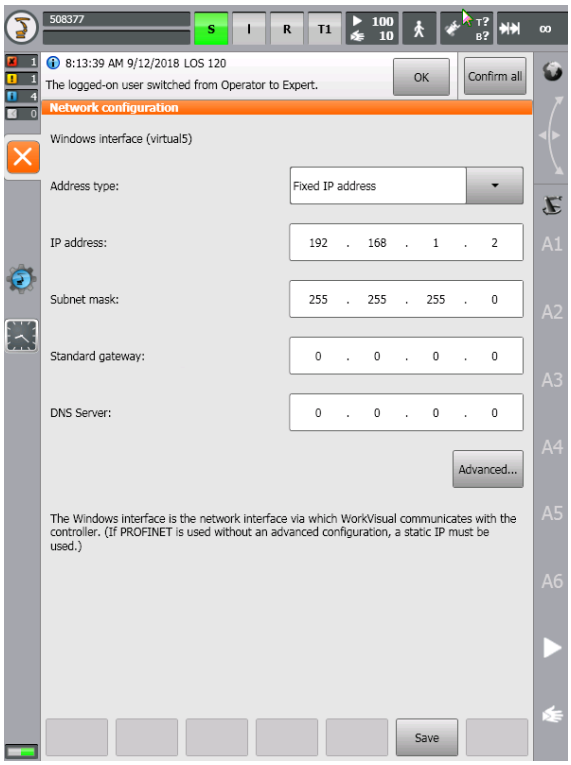
9. Go to **Configuration** > **User group**



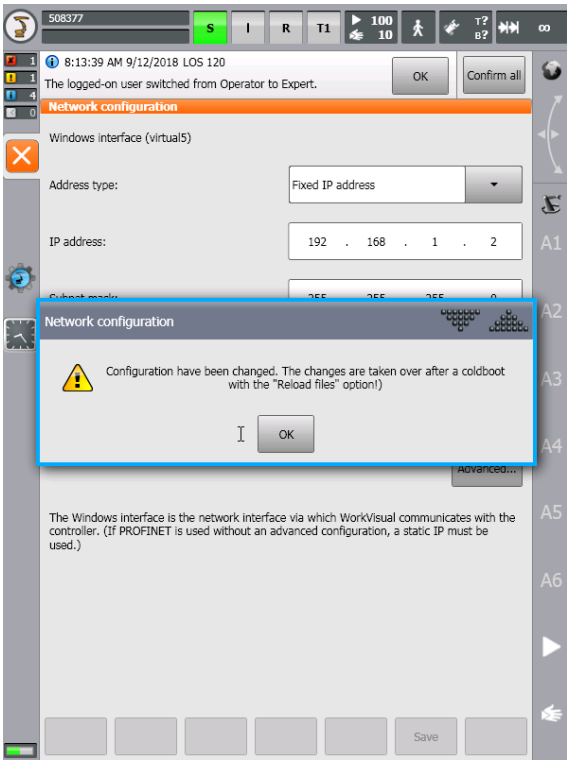
10. Select **Expert** and type in your password



11. Go to **Start-up** > **Network configuration**



12. Set the IP address to be on the same subnet as the Compute Box (e.g.: 192.168.1.2). Then click on **Save** button.



13. Accept the prompts and restart the robot controller

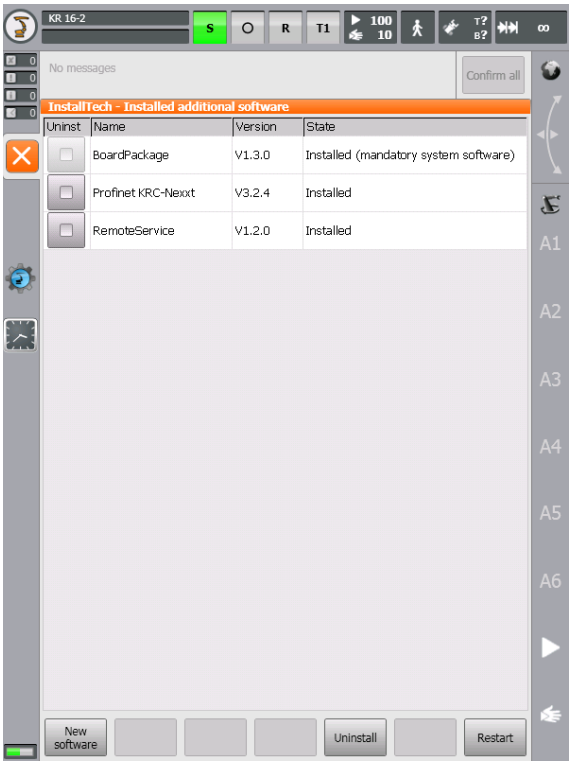
8.4.4 KUKA package install

The OnRobot F/T software require KUKA Robot Sensor Interface (RSI) package to be installed.

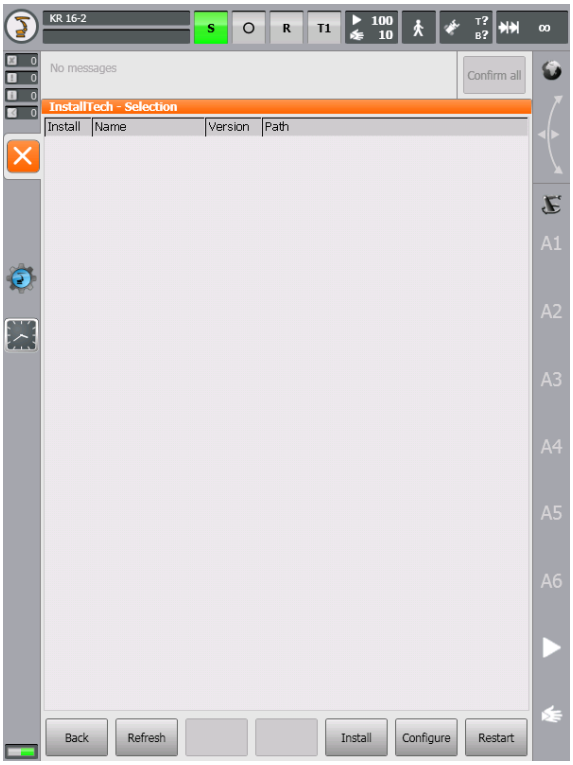
NOTE:

Please contact your local KUKA representative for pricing and purchase options.

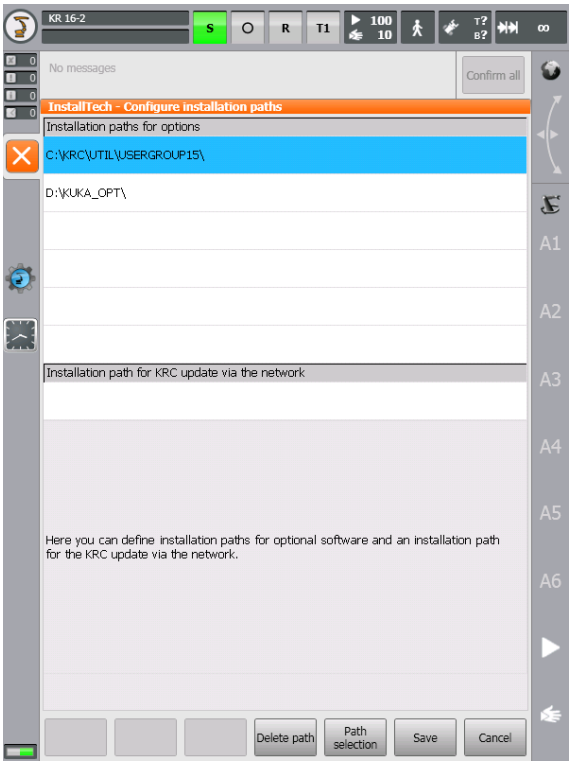
To install these KUKA packages do the following steps:



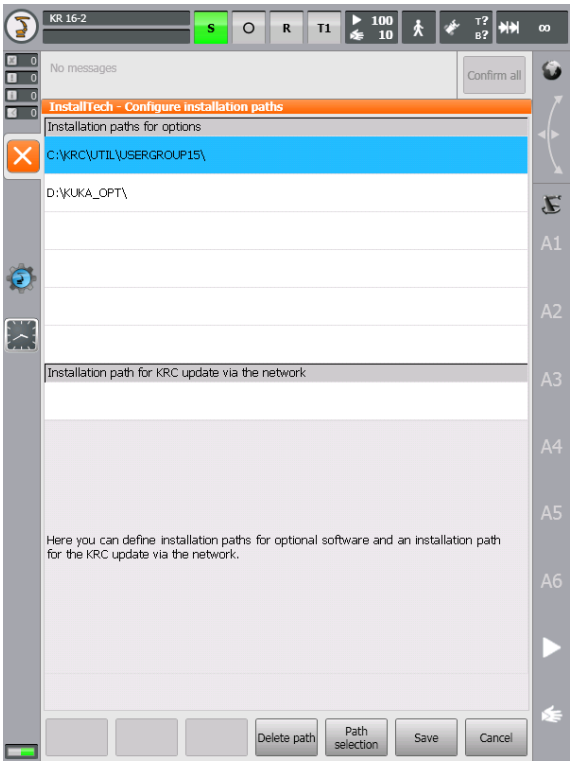
1. Go to **Start-up** > **Additional software**, click on **New software**



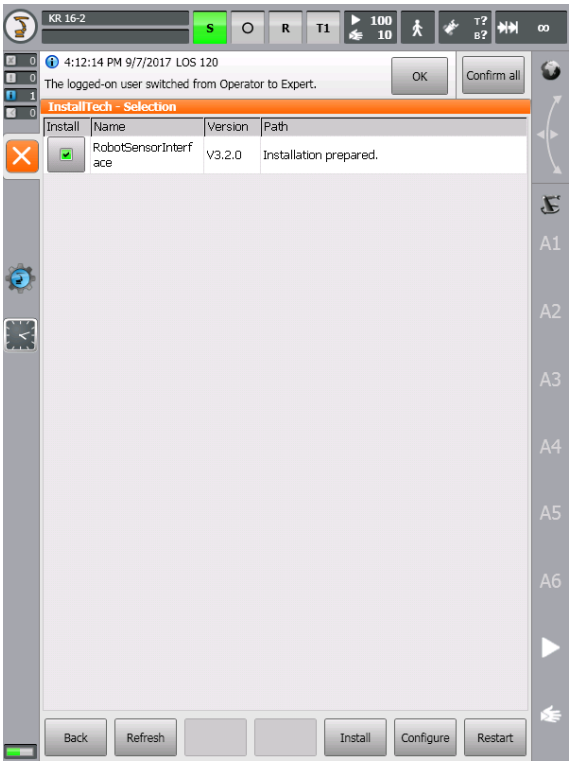
2. If no packages are listed, click on **Configure**.



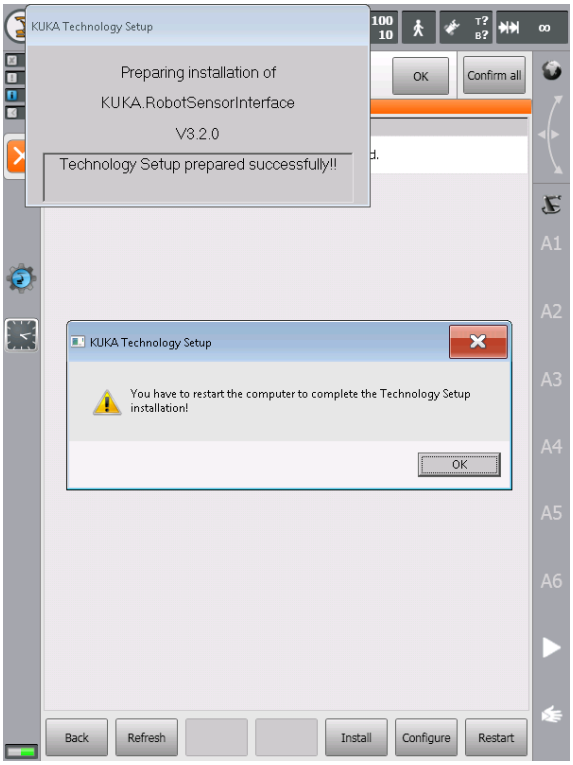
3. Click on an empty slot and click **Path selection**



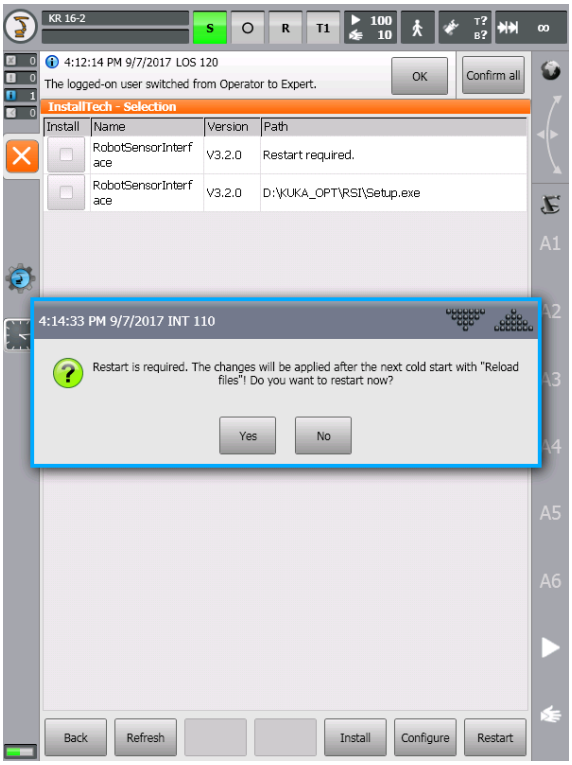
4. Browse for the installation folder of package to be installed, then click **Save** twice.



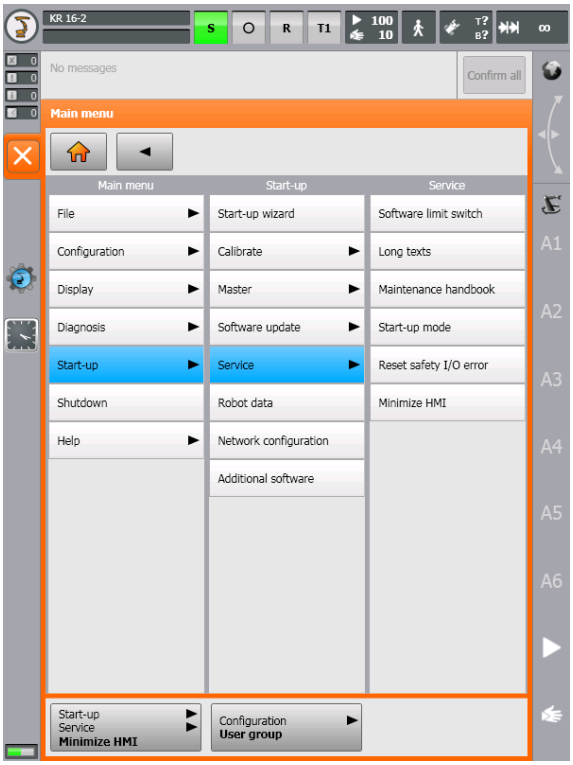
5. Check the check box next to the package name to be installed



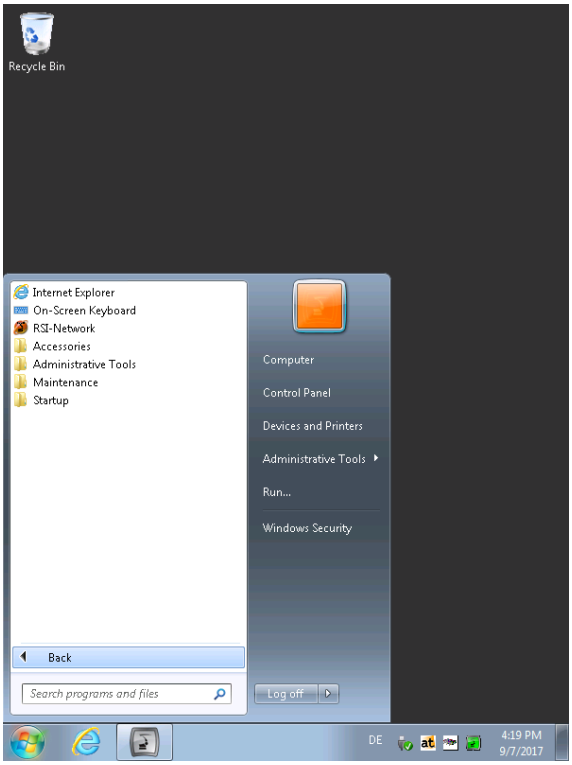
6. Wait for the installation, accept all prompts.



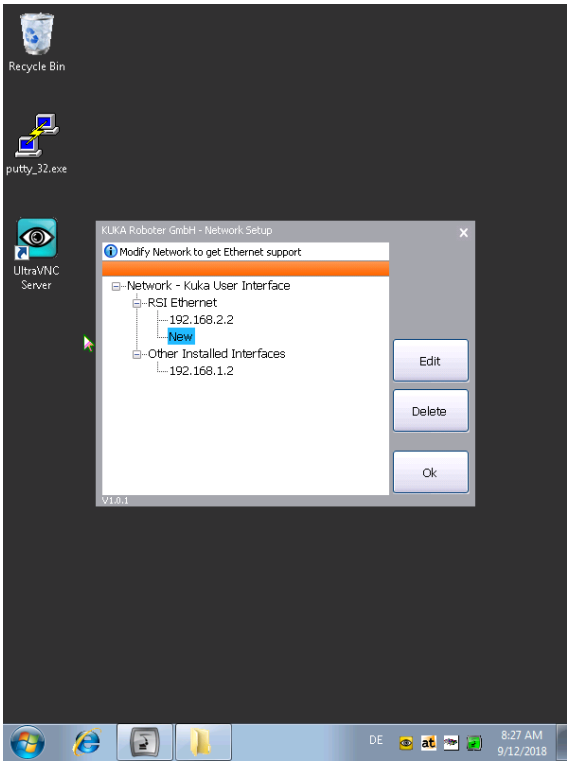
7. Click **Yes** when asked to reboot the robot controller



8. After the reboot go to **Start-up** > **Service** > **Minimize HMI**.



9. Click on the Start menu and open the **RSI-Network** application



10. Click on the **New** field under **RSI-Ethernet** and click **Edit**. Enter an IP address with a different subnet than KLI

For further info please refer to the KUKA user manual.

8.4.5 OnRobot F/T Software Installation

Go to **Main Menu**>**Configuration**>**User group** and select **Expert** mode. Enter your password, then go to **Start-up**>**Service**>**Minimize HMI**.

Plug the provided USB-drive into one of the USB ports on the control box.

Browse for the OnRobot KUKA Setup program and launch it. This program has multiple purposes: You can use it for the initial installation of the OnRobot KUKA package, but also as a network configuration tool.

On the welcome screen click **Next**.

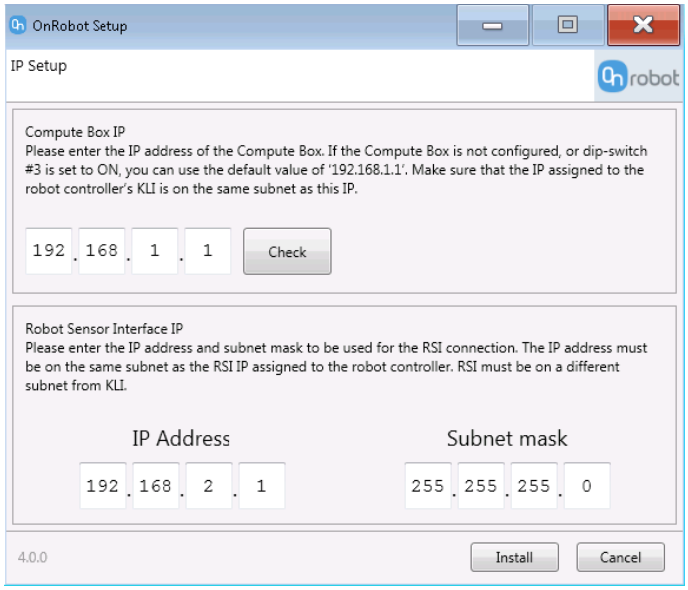
On the next window you will find three input fields. The first is for defining the Compute Box to be used with your robot. The second and third one is for defining the RSI connection.

First enter the IP address of the compute box you want to use with the robot. The default address is 192.168.1.1, use this if your Compute Box has not been configured yet or if it is set to fixed IP mode.

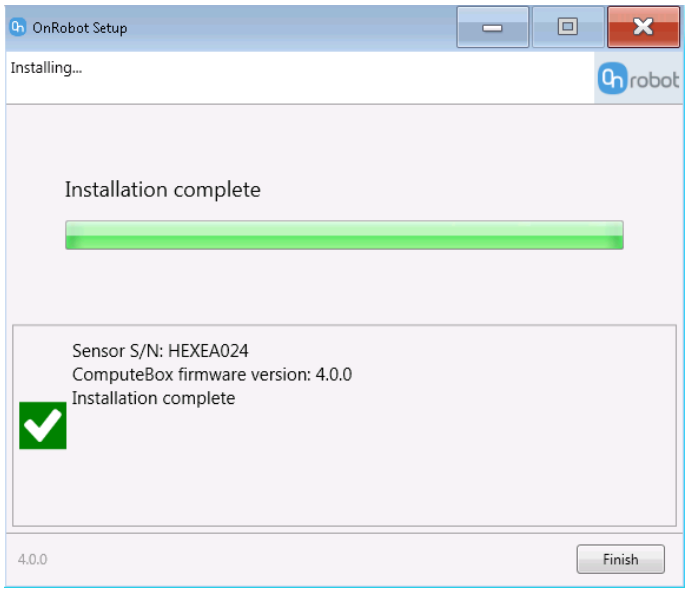
After entering the IP address click on **Check**. If the program successfully makes a connection to the Compute Box a green tick mark will appear along with the name of the sensor plugged into the box, and the version of the Compute Box software.

After successfully setting the Compute Box IP, continue by entering the IP and subnet mask for the RSI connection.

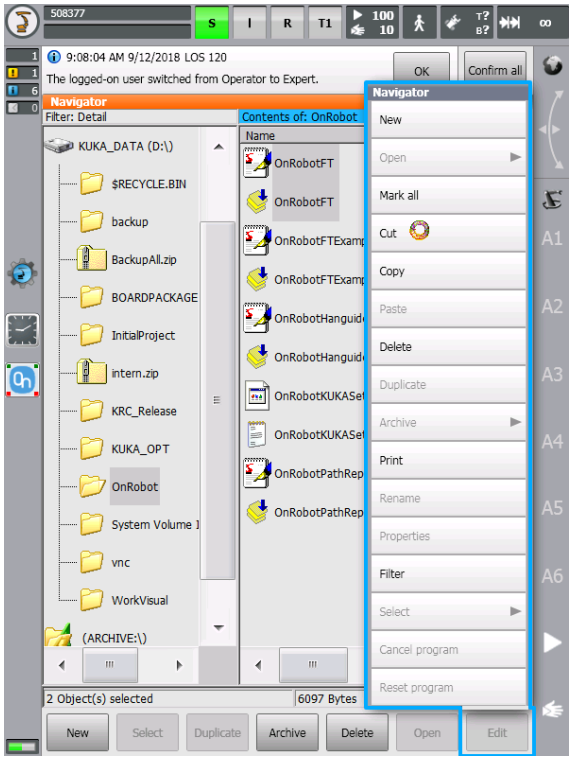
The IP you enter here must be on the same subnet as the one you defined during the RSI setup. (E.g.: if you set 192.168.173.1 for RSI on the robot controller set 192.168.173.X here. X can be any number between 2 and 255.) Make sure that you also use the same subnet mask as on the robot controller.



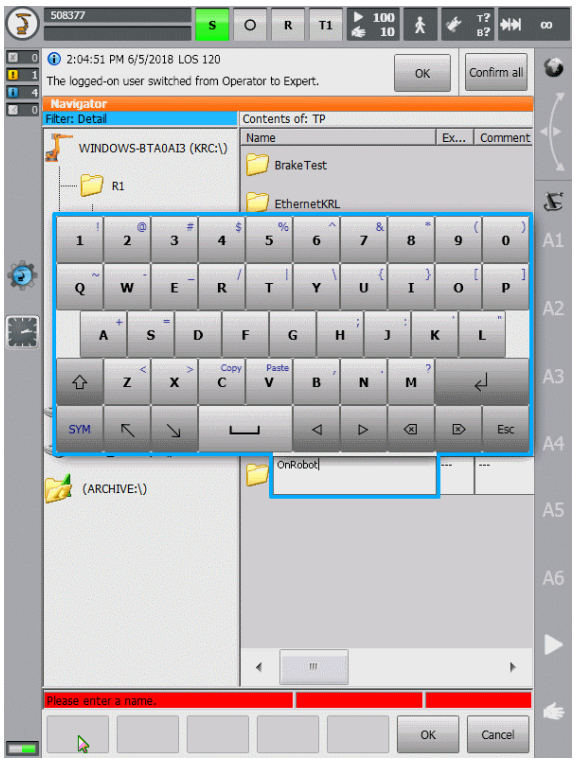
After filling in all the fields click on **Install** to complete the installation/configuration. If the installation has been successful a green tick mark will appear. Installation failure can happen if there's a problem with the connection to the Compute Box or there's write protection on the robot controller's hard drive.



To complete the setup, go back to the Smart HMI and in the Navigator go to `D:\OnRobot`. Select `OnRobotFT.src` and `OnRobotFT.dat`, then in the **Edit** menu press copy.



Go to `KRC:\R1\TP` and create a folder with the following name: OnRobot. Paste the two files into the new folder.

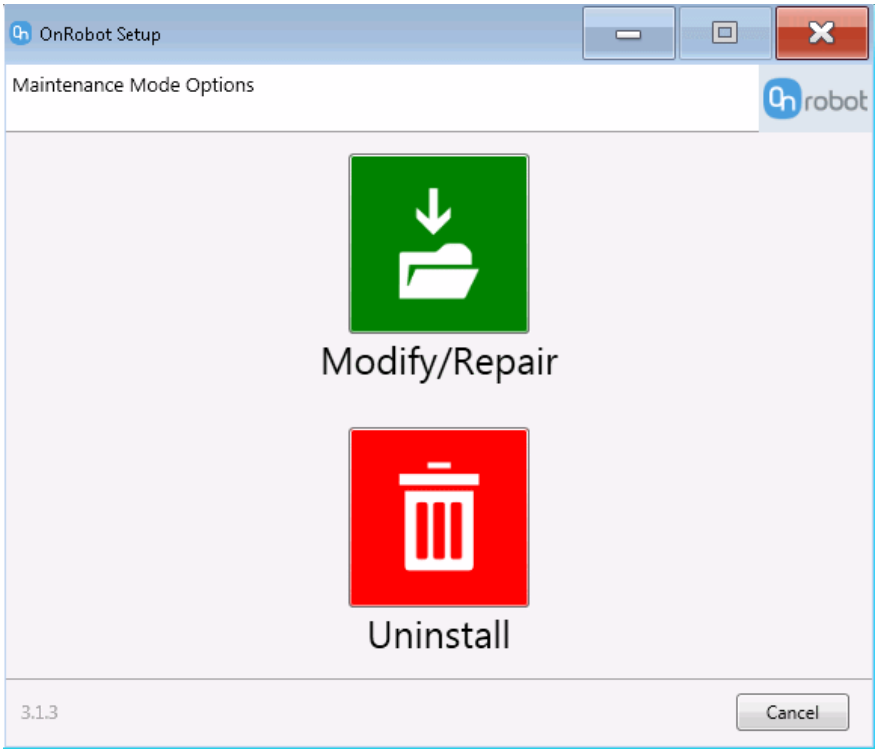


Restart the robot controller.

8.4.6 Uninstallation

The following steps will uninstall the OnRobot F/T Software from your robot controller:

11. Enter **Expert** mode by going to the Main Menu then **Configuration**>**User group**.
12. Minimize the user interface with **Start-up**>**Service**>**Minimize HMI**.
13. Open the file explorer and go to `D:\OnRobot`.
14. Launch the OnRobot Setup executable file.
15. Click on **Uninstall** and accept the prompts.



16. Restart the robot controller.

9 Operation

NOTE:

It is assumed that the Installation has finished successfully. If not, first do the installation steps in the previous section.

9.1 Overview

9.1.1 KRL variables

`STRUC OR_AXEN BOOL X,Y,Z,A,B,C`

Structure used for enabling or disabling axes for force control.

`STRUC OR_FORCE_TORQUE_PARAM`

Structure used for defining the force control parameters. This structure has numerous fields that will be discussed in the force-torque control section.

9.1.2 KRL functions and subprograms

`OR_INIT()`

`OR_BIAS()`

`OR_HANDGUIDE()`

`OR_PATH_REPLAY()`

`OR_WAIT()`

`OR_FORCE_TORQUE_ON()`

`OR_FORCE_TORQUE_OFF()`

9.2 Initialization

The `OR_INIT()` subprogram must be inserted into any code using OnRobot force control commands to initialize parameters for the proper behavior of all commands. It must be included only once and must be before the first OnRobot command

9.3 Hand Guide

The `OR_HANDGUIDE()` subprogram launches the sensor guided hand-guide on the robot. The program includes a BCO move to the actual position the program is launched at.

NOTE:

Do not touch the sensor or any attached tools upon starting the program.

The argument of this subprogram is used for limiting the motion of the robot along or about certain axes. In the example below movement along the Z-axis is disabled along with rotations around the A- and B-axes.

`OR_HANDGUIDE` has a conservative speed limit.

Example:

```
DECL OFAXEN ENABLED_AXES
ENABLED_AXES={X TRUE, Y TRUE, Z FALSE, A FALSE, B FALSE, C TRUE}
OR_INIT()
OR_HANDGUIDE(ENABLED_AXES)
```

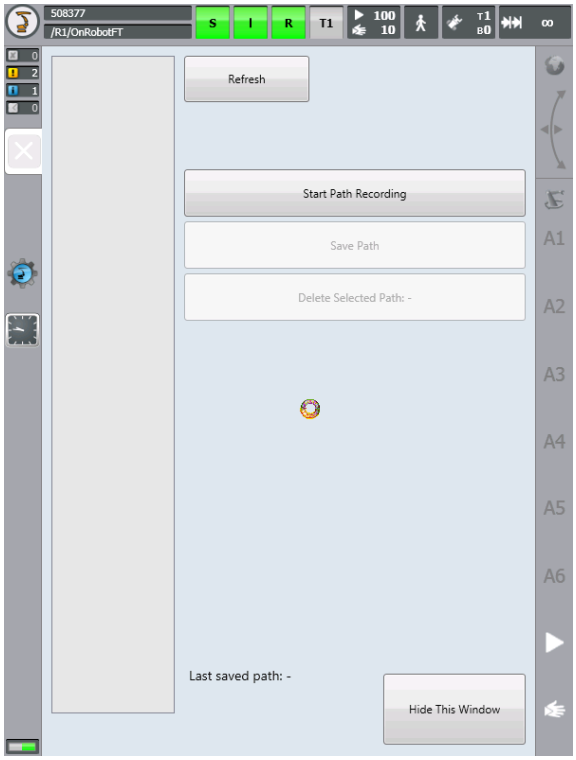
9.4 Path record and replay

9.4.1 Recording a path

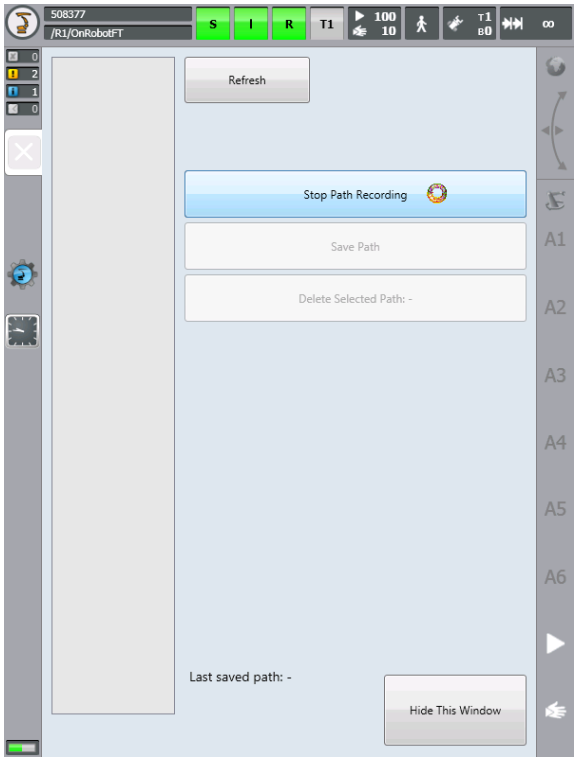
You can record any movement the robot does, be it a path created by manually hand guiding the robot or the shape of a surface during a force-controlled movement. In any case, the path recording must be initiated manually using the path recording GUI. The GUI can be summoned using the icon on the left side toolbar of the SmartHMI.

To record a hand guided path, the following steps should be followed:

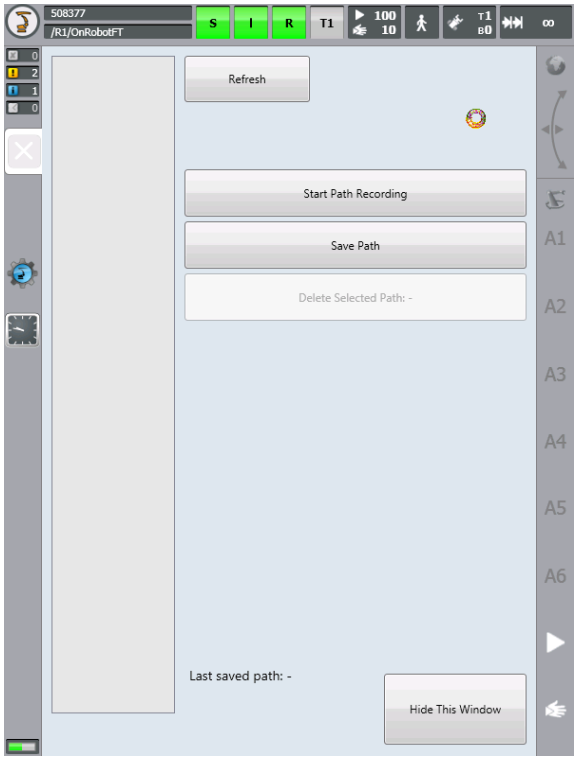
17. Create a program (or use the provided example program) that has an `OR_HANDGUIDE()` command in it to launch hand guiding.
18. Select the program and start it. It is recommended that you use a Teach mode for this.
19. Move the robot into the position that you want to start the path recording from. You can use hand guiding for this, but since all recorded paths are considered as relative motions it is recommended to use explicit programmed positions as starting points. This makes replaying and path reusability easier.
20. When the robot is in hand guiding mode and in the correct initial position, select the icon on the left toolbar to bring up the path recording GUI.
21. Press **Start Path Recording** to begin your recording session.



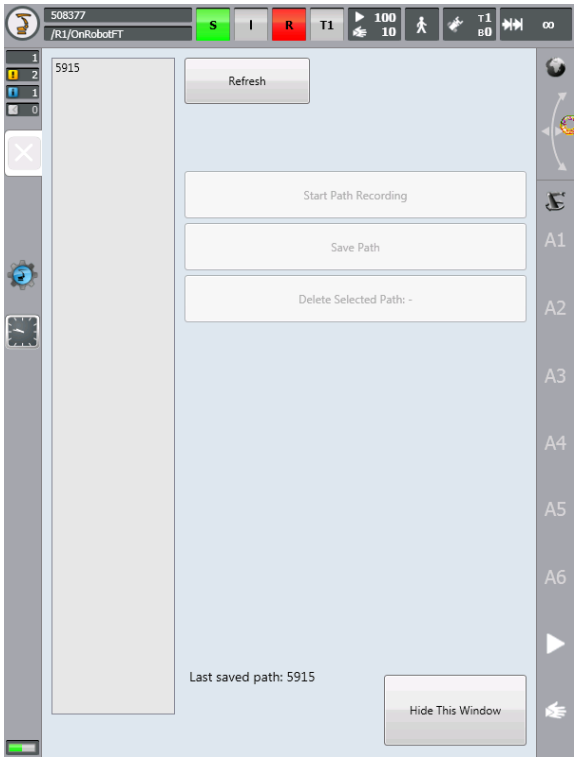
22. Move the robot along the path you wish to record.
23. When you're done with the recording press **Stop Path Recording**.



24. If you're satisfied with the recorded path click on **Save Path**.



The new path will be added to the list on the left and its identifier will be displayed next to **Last saved path**. The path is now saved on the Compute Box.



This process can be used to record force-controlled movements too. This can greatly improve the accuracy and speed of the force control.

Saved paths can be exported via the Compute Box webpage and uploaded to a different Compute Box. Saved paths are interchangeable between robot makes (e.g. a path recorded on a KUKA robot can be replayed on any other robot supported by the Compute Box)

9.4.2 Replaying a path

The OR_PATH_REPLAY() function can be used to replay paths stored on the Compute Box. The commands have three arguments:

OR_PATH_REPLAY(SPEED:IN,ACCELERATION:IN,PATHID:IN)

SPEED: The constant translational speed, in mm/s, used for replaying the path. This speed is global; thus, the robot will attempt to replay all movements at this speed. For this reason, rotations without translation should be avoided.

ACCELERATION: The acceleration and the deceleration, in mm/s2, used for replaying the path. Use a lower number to achieve a softer acceleration at the beginning and the end of the path.

PATHID: The 4-number identifier of the path to be replayed.

Return values:

9: Path completed

-1: General error

-11: Specified path not found

-13: Specified path is empty

-14: Unable to open specified path file.

Example:

```
DECL INT retval
OR_INIT()
PTP {A1 0,A2 -90, A3 90, A4 0, A5 90, A6 0}
retval = OR_PATH_REPLAY(50, 50, 9159)
```

9.5 Force control

9.5.1 OR_BIAS()

Used for resetting (zeroing) the sensor values for a given load. Used for initial biasing of the sensor values during force control (except hand guiding) or biasing when the orientation of the sensor changes.

9.5.2 OR_FORCE_TORQUE_ON()

Activates the force control with predefined parameters. After the activation of the force control all movements will be superposed on the force control (either KUKA movement commands or path replay).

OR_FORCE_TORQUE_ON(PARAM:IN)

PARAM is the structure OR_FORCE_TORQUE_PARAM with the following fields:

FRAME_TYPE: The movement frame used for the force control. #BASE is the base coordinate system of the robot, fixed to the robot base. #TOOL is the frame fixed to the robot flange.

ENABLE: Defines the compliant axes with the OR_AXEN structure.

FRAME_MOD: Frame offset of the used coordinate system. Primary use is the rotation of the coordinate axes for force control along an oblique axis or plane.

P_GAIN: Proportional gain for the force controller. This is the most used parameter for basic force control. Determines how quickly the robot reacts to changes in force but can cause oscillations. These values should start small (1 for force, 0.1 for torque) and gradually increased to improve behavior.

I_GAIN: Integral gain of the force controller. Can be used to correct for persistent force errors (e.g. a sloped surface). Slows robot reactivity, increases overshooting.

D_GAIN: Derivative gain of the force controller. Can be used for damping controller induced oscillations. Slows robot reactivity, high value increases oscillations.

FT: Definition of the target force to be held along the axes defined by FRAME_TYPE and FRAME_MOD. Disabled axes will ignore this parameter.

F_SQR_TH: Force threshold for squared force sensitivity. Can be used as a soft force cutoff in low force cases (the lower the force, the less sensitive, reduces oscillations). If used all GAIN values must be drastically reduced.

T_SQR_TH: Torque threshold for squared torque sensitivity. Can be used as a soft torque cutoff in low torque cases (the lower the torque, the less sensitive, reduces oscillations). If used all GAIN values must be drastically reduced.

MAX_TRANS_SPEED: Maximum translational speed allowed by the force controller. [mm/s]

MAX_ROT_SPEED: Maximum angular velocity allowed by the force controller. [deg/s]

9.5.3 OR_FORCE_TORQUE_OFF()

This subprogram switches off the force control.

9.5.4 OR_WAIT()

Wait specified amount of time during force control.

OR_WAIT(TIMEOUT:IN)

TIMEOUT: Amount of time elapsed during the wait in milliseconds.

Return value:

The specified amount of time passed.

9.5.5 Example force control

This example shows the parametrization of a force control movement that is compliant along all three translational axes while holding 20N in tool-z direction. After activation the robot waits two seconds (e.g. robot moves into contact) then moves 200 mm in the X-direction.

```
DECL OR_AXEN enable
DECL OR_FORCE_TORQUE_PARAM param
DECL POS pgain, dgain, igain, framemod, force
DECL INT retval, tmp

OR_INIT()

PTP {A1 0,A2 -90, A3 90, A4 0, A5 90, A6 0}

OR_BIAS()
enable = {X TRUE, Y TRUE, Z TRUE, A FALSE, B FALSE, C FALSE}
pgain = {X 1, Y 1, Z 1, A 0.1, B 0.1, C 0.1}
dgain = {X 0, Y 0, Z 0, A 0, B 0, C 0}
```

```
igain = {X 0, Y 0, Z 0, A 0, B 0, C 0}
framemod = {X 0, Y 0, Z 0, A 0, B 0, C 0}
force = {X 0, Y 0, Z 20, A 0, B 0, C 0}
param.FRAME_TYPE = #TOOL
param.ENABLE = enable
param.FRAME_MOD = framemod
param.P_GAIN = pgain
param.I_GAIN = igain
param.D_GAIN = dgain
param.FT = force
param.F_SQR_TH = 0
param.T_SQR_TH = 0
param.MAX_TRANS_SPEED = 0
param.MAX_ROT_SPEED = 0
OR_FORCE_TORQUE_ON(param)

;WAIT 2 sec
tmp = OR_WAIT(2000)

;KUKA MOVE
PTP_REL {X 200}
OR_FORCE_TORQUE_OFF()
```

10 Additional Software Options

10.1 Compute Box

10.1.1 Interfaces

There are two interface types that could be used:

- **Ethernet interface**

  This interface can be used to access the Web Client that can be used to monitor, control, and update the grippers/devices. Furthermore, via this interface the OnRobot WebLogic can also be accessed to program the Digital I/O Interface.

- **Digital I/O interface**

  This interface could be used to communicate via simple digital I/O lines with the robots. There are 8 digital input and 8 digital output that could be used. These inputs and outputs can be programmed through the OnRobot WebLogic that requires the Ethernet interface to be used (only for programming time).

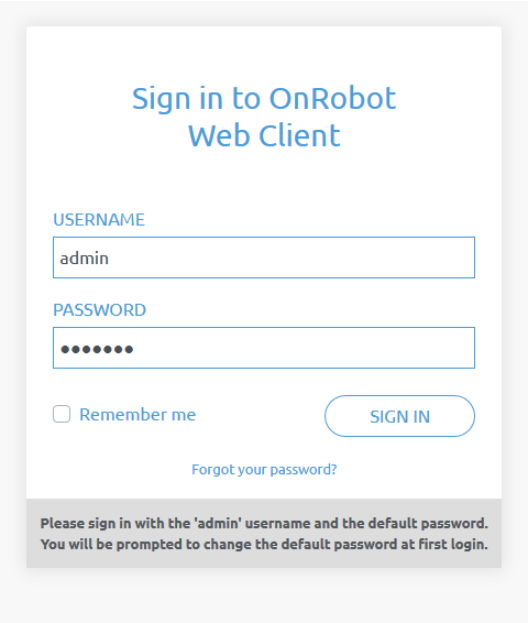
10.1.2 Web Client

To access the Web Client on your computer first the Ethernet interface needs to be set up to have a proper communication between your computer and the Compute Box. It is recommended to use Auto mode (for further details see section **Ethernet Interface Setup**).

Then do the following steps:

- Connect the Compute Box to your computer with the supplied UTP cable.
- Power the Compute Box with the supplied power supply
- Wait one minute for the Compute Box LED to turn from blue to green.
- Open a web browser on your computer and type in the IP address of the Compute Box (factory default is 192.168.1.1).

The Sign-in page opens:

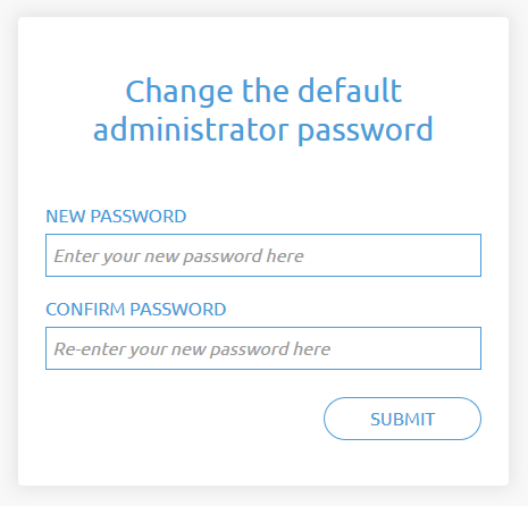


The factory default administrator login is:

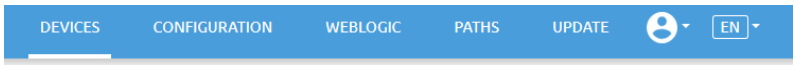
Username: admin

Password: OnRobot

For the first login a new password needs to be entered: (password must be at least 8 characters long)



Once signed in the following top menus appear:



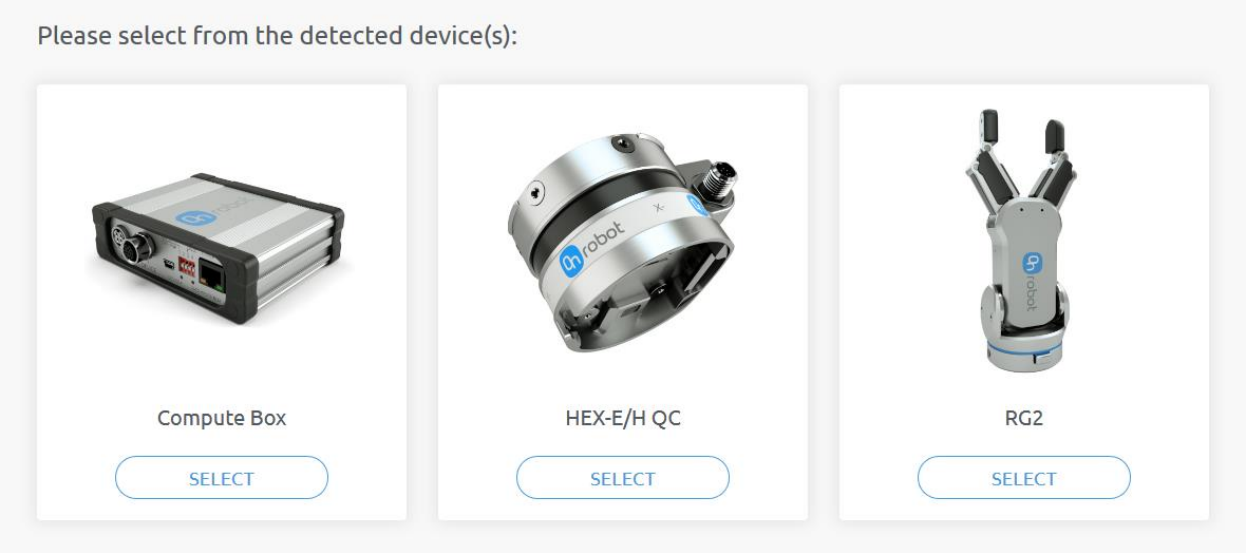
- **Devices** - Monitor and control the connected devices (e.g.: grippers)
- **Configuration** - Change the Compute Box's settings
- **WebLogic** - Program the Digital I/O interface through OnRobot WebLogic
- **Paths** - Import/export the recorded Paths (not available to all robots)
- **Update** - Update the Compute Box and the devices

-  - Account settings (e.g.: change password, add new user)
-  - Select the language of the Web Client

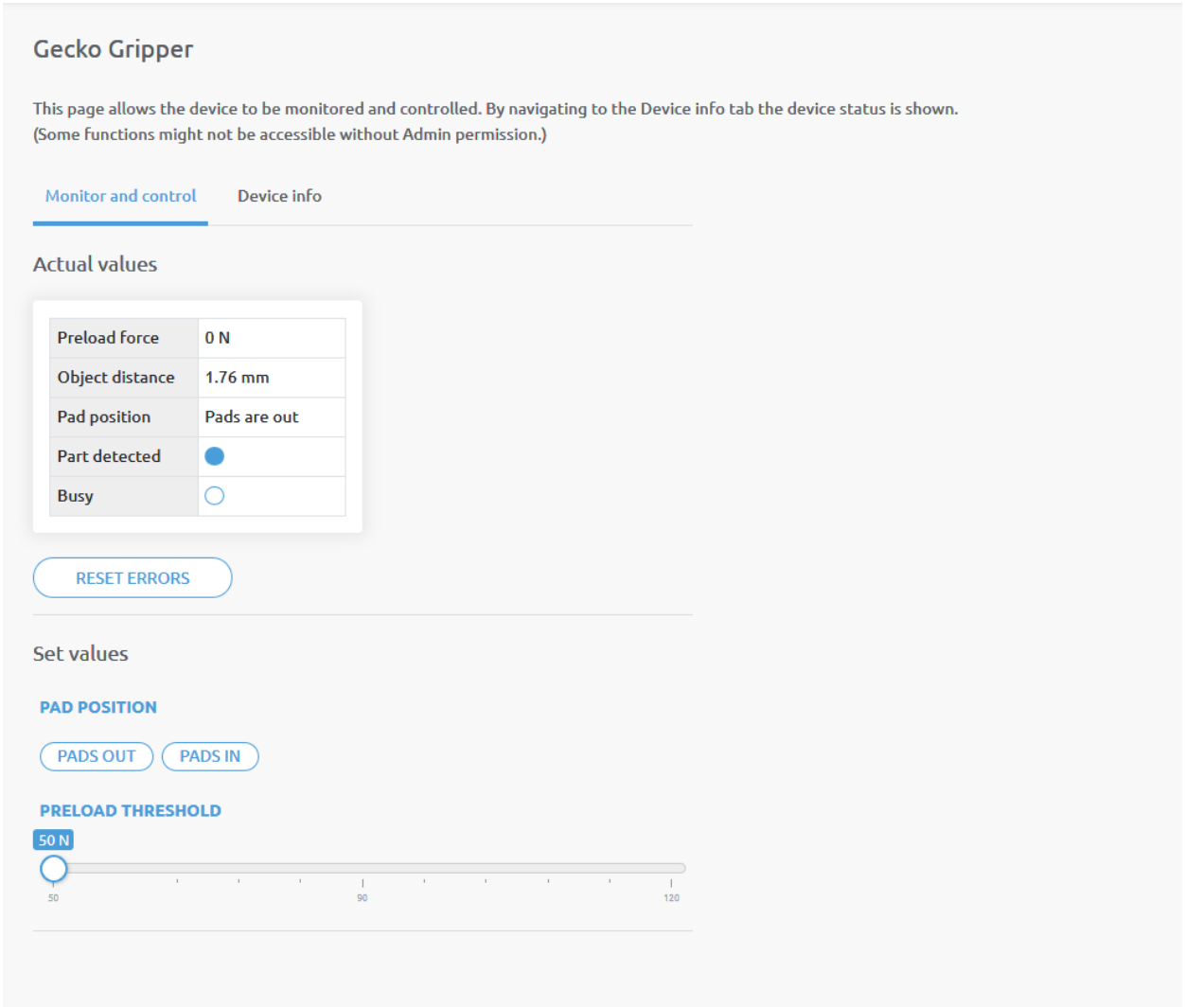
In the following, these menus will be described.

Devices menu

To control/monitor a device click on the **Select** button.



Gecko



There is a force and an ultrasonic distance sensor in the gripper. The actual values of these sensors are:

- **Preload** - the current forces acting on the pads (below 50N it displays 0N)
- **Object distance** - how far the object is from the bottom of the gripper

The state of the gripper could be:

- **Pad position**- Pads are either In or Out (out means ready for gripping)
- **Part detected** - the set preload force limit is reached, and object distance is < 18mm
- **Busy** - the pads are moving

The pads can be controlled by clicking on the **Out** and **In** buttons.

The **Preload threshold** value can be changed if higher preload force is required for a proper grip.

This value is only used to generate a proper **Part detected** signal.

NOTE:

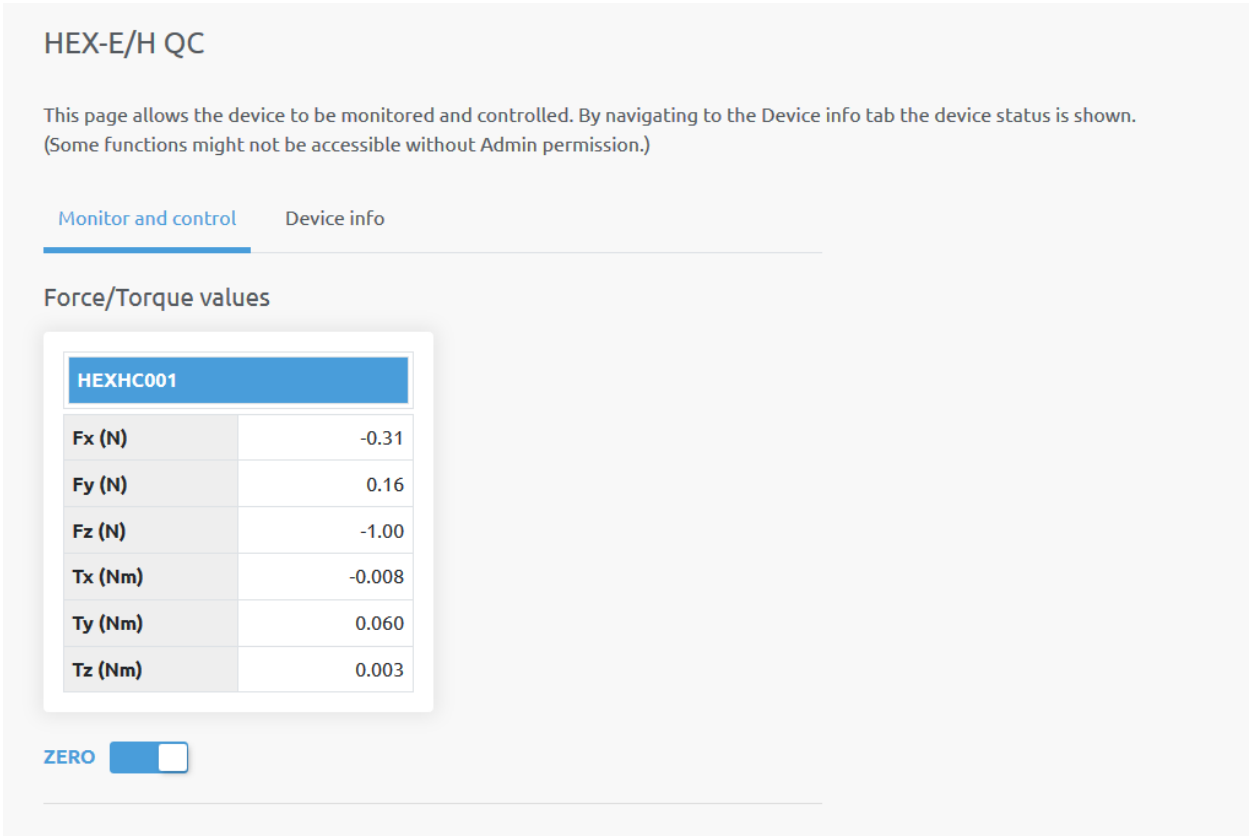
Preload threshold value set on this page is not stored permanently and are restored to the default value (90N) on power reset.

If a part was detected and the object distance becomes > 18mm (part is lost) BEFORE the pads are set to be IN (normal release) the **Pads worn** warning is displayed in the **Device info** tab.

To reset the warning:

- either click on the **RESET ERRORS** button
- or click on the **Out** button.

HEX-E/H QC



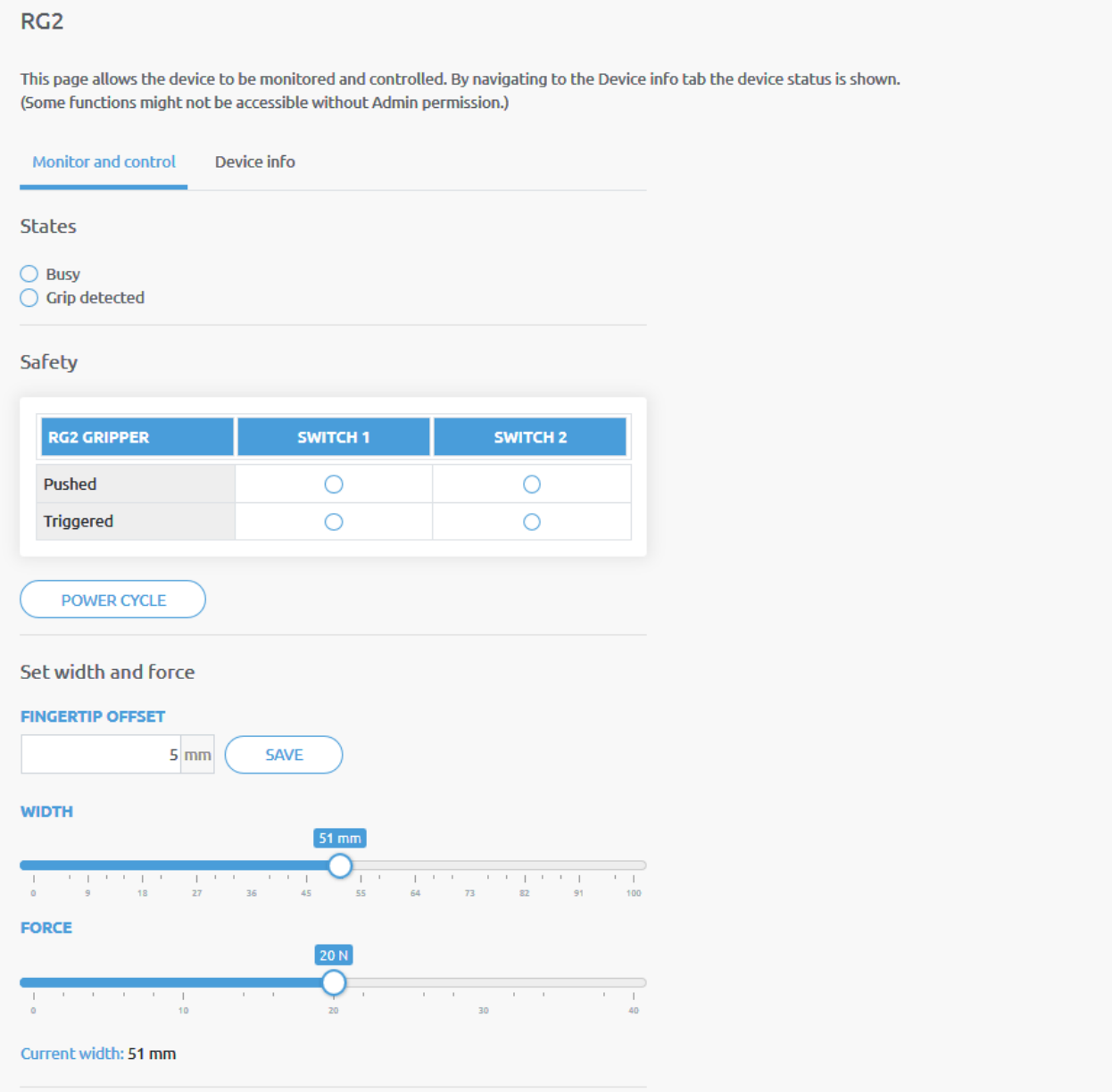
The force and torque values (**Fx,Fy,Fz** and **Tx,Ty,Tz**) are shown in N/Nm.

The **Zero** toggle switch can be used to zero the force and torque reading.

NOTE:

Zero value set on this page is not stored permanently and are restored to the default values on power reset.

RG2/6



The state of the gripper could be:

- **Busy** - the gripper is moving
- **Grip detected** - the set force limit is reached but the set width is not.

The status of the two safety switch shows:

- **Pushed** - the safety switch 1/2 is still being pushed
- **Triggered** - the safety switch 1/2 has been activated and gripper is stopped.

To recover from a Triggered state:

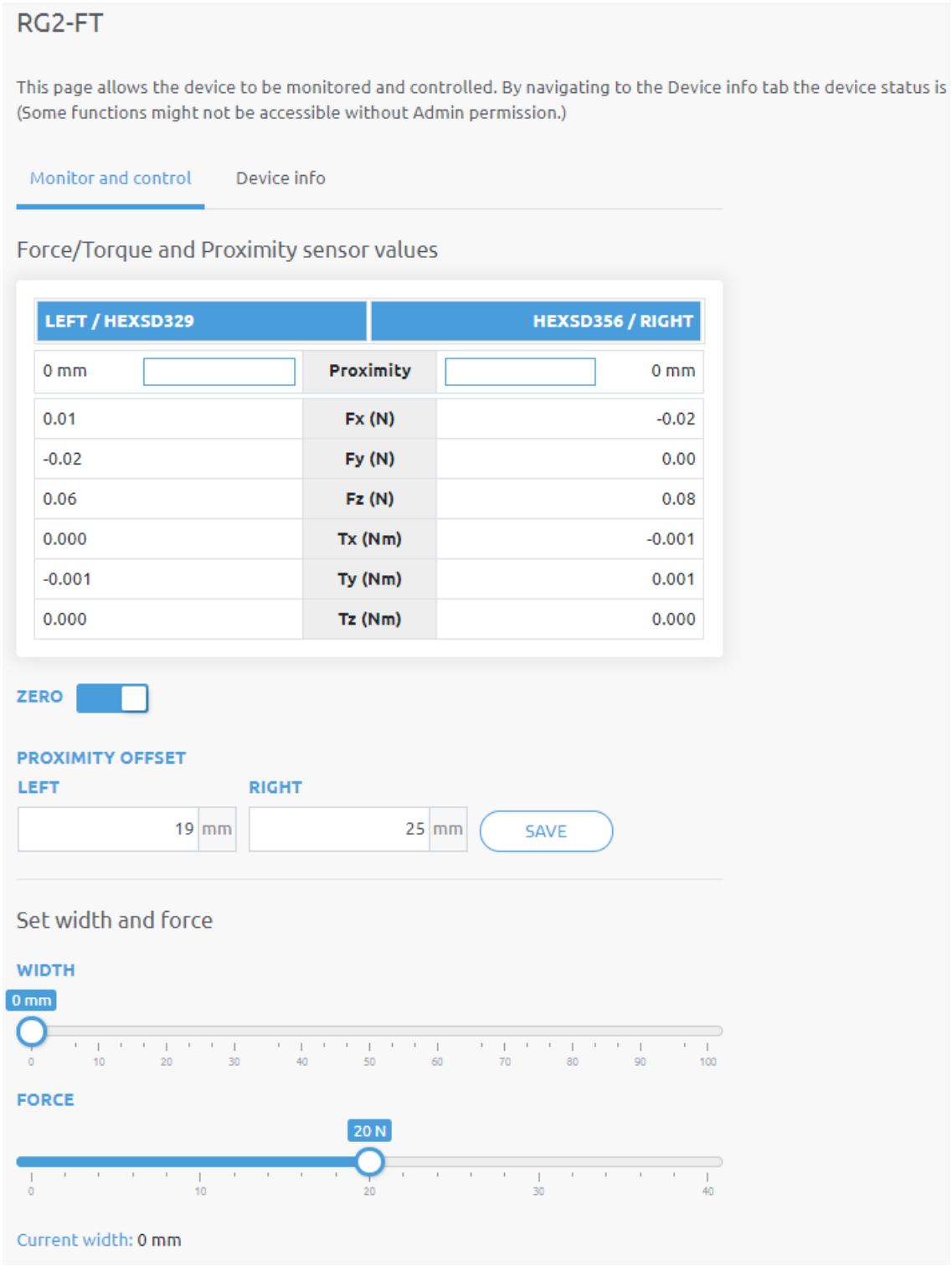
- Check if any of the safety switch is being pushed
- If yes, remove the object pushing the switch

- Click on **Power cycle** to power all devices off and then on to recover.

Fingertip offset must be set according to the current fingertips attached to the gripper. Offset is measured from the inner mating face of the bar metal fingertips. To save the value to the gripper permanently click **Save**.

The gripper can be controlled by adjusting the **Force** and **Width** value. First set the required gripping force and then adjust the width slider that will immediately control the gripper.

RG2-FT



The force and torque values (**Fx,Fy,Fz** and **Tx,Ty,Tz**) are shown in N/Nm along with the Proximity sensor values (optical distance sensor built in the fingertip) are show in mm for the left and right fingertip sensor.

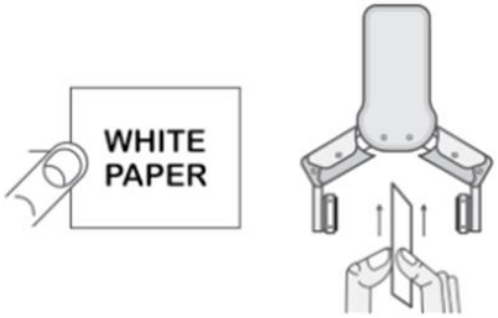
The **Zero** toggle switch can be used to zero the force and torque reading.

NOTE:

Zero value set on this page is not stored permanently and are restored to the default values on power reset.

The **Proximity Offset** can be used to calibrate the proximity reading. The calibration requires the following steps to be done:

- Write 0 mm to the **Left** and **Right** edit box and click on the **Save** button.
- Close the gripper fully (set the **Width** to 0) while you hold a white paper between the fingertips.



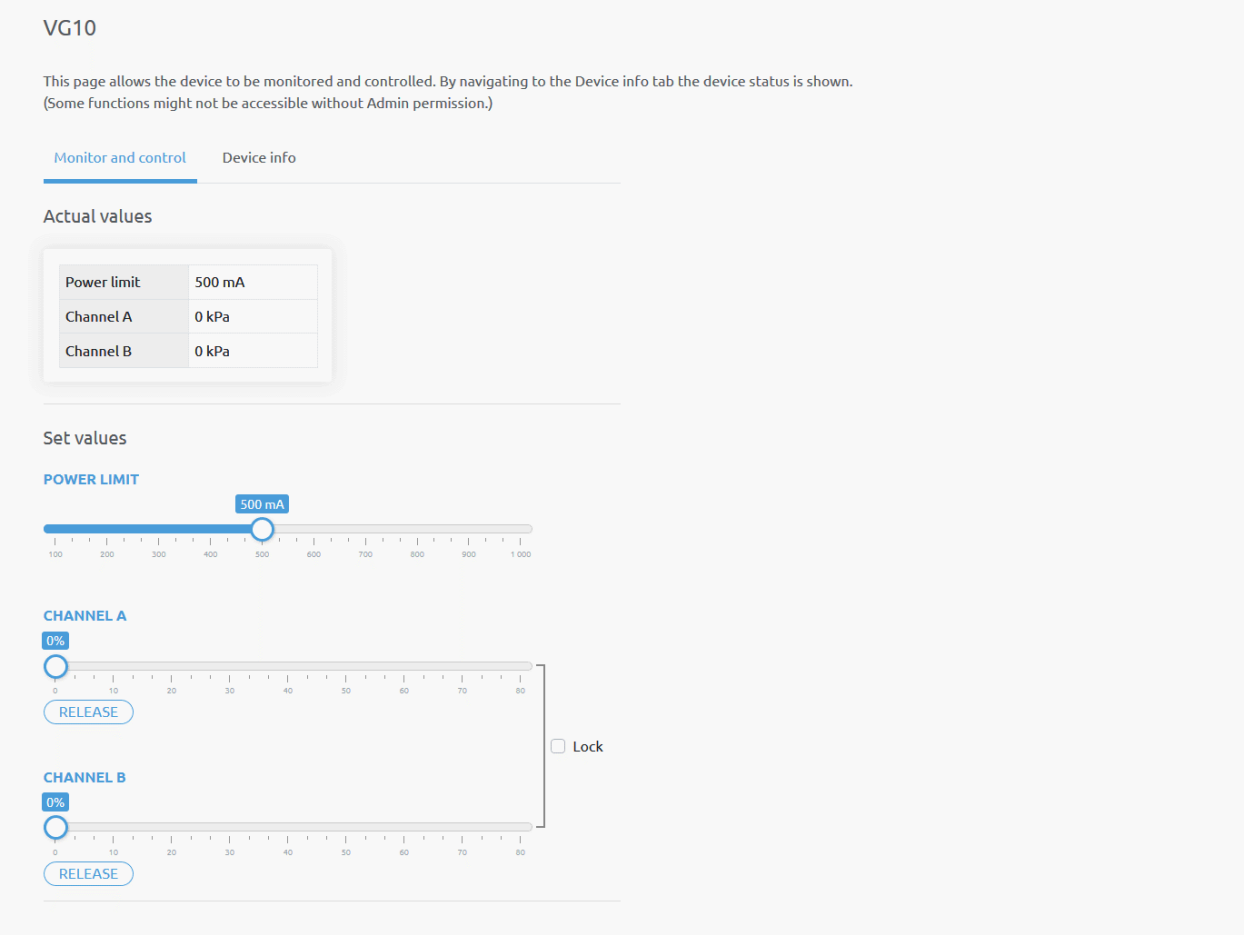
- Read the actual **Left** and **Right Proximity** values (e.g.: 19mm and 25mm)
- Write these values to the **Left** and **Right** edit boxes and click on the **Save** button to store it permanently.
- Open the gripper and the calibration is finished.

NOTE:

Setting the offsets too high may clip the proximity reading at 0 mm (negative distance is not shown). In case of clipping (reading 0 mm), try to decrease the offset values.

The gripper can be controlled by adjusting the **Force** and **Width** value. First set the required gripping force and then adjust the width slider that will immediately control the gripper.

VG10 / VGC10



The actual vacuum level for **Channel A** and **Channel B** can be seen in percentage (in the range of 0...80 kPa vacuum). The actual value of the **Power limit** is shown in mA.

The **Power limit** can be adjusted in the range of 0...1000mA with the slider.

NOTE:

The power limit set in this page is not stored permanently and always restored to the default value on power reset.

Higher power limit value means the required vacuum level is reached faster (higher airflow), but if it is set too fast overshoot may occur.

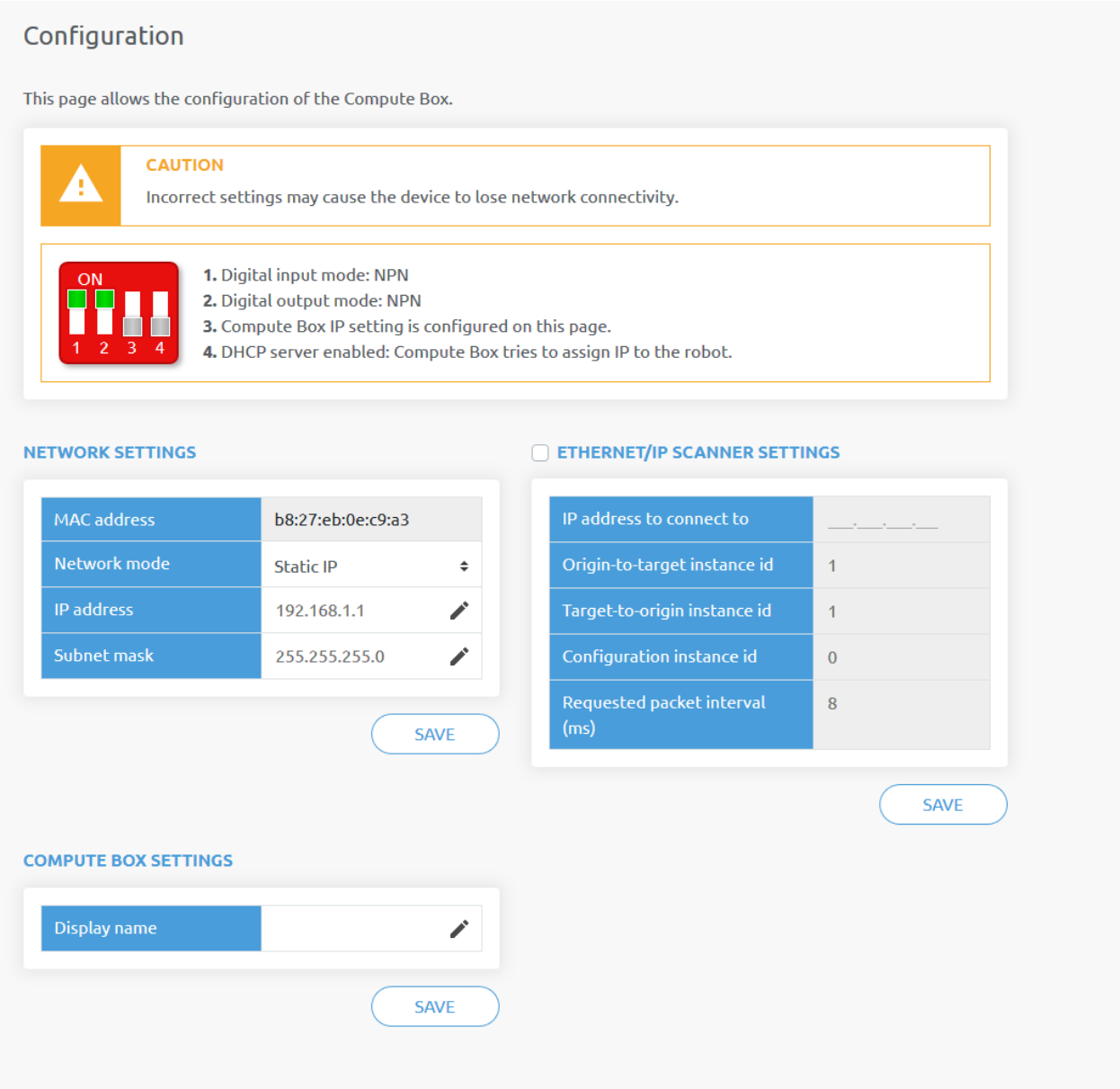
Low power limit may not be sufficient for higher percentage of vacuum and the target vacuum level may not be reached.

The **Channel A** and **Channel B** vacuum level can be set individually or in tandem by checking the **Lock** checkbox.

Make sure to set high enough vacuum before you grip and lift any object.

To release the gripped object, click on the **Release** button.

Configuration menu



Network settings:

The **MAC address** is a world-wide unique identifier that is fixed for the device.

The **Network mode** drop-down menu can be used to decide if the Compute Box will have a static or a dynamic IP address:

- If it is set to **Dynamic IP**, the Compute Box expects an IP address from a DHCP server. If the network that the device is connected to has no DHCP server, then the fixed 192.168.1.1 IP is used for the device (after 60 seconds of timeout).
- If it is set to **Static IP**, then a fixed IP address and subnet mask must be set.
- If it is set to **Default Static IP**, the fixed IP revert to the factory default and cannot be changed.

After all parameters are set, click on the **Save** button to store the new values permanently. Wait 1 minute and reconnect to the device using the new settings.

Compute Box settings:

In case, more than one Compute Box is used within the same network, for identification purpose any user specific name can be entered to the **Display name**.

EtherNet/IP scanner settings:

NOTE:

This is a special option of the EtherNet/IP connection for some robots.

In case when the robot is the Adapter and the Compute Box needs to be the Scanner the following addition information is required for the communication:

- **IP address to connect to** - the robot IP address
- **Origin-to-target instance id** - refer to the robot's EtherNet/IP manual (Scanner mode)
- **Target-to-origin instance id** - refer to the robot's EtherNet/IP manual (Scanner mode)
- **Configuration instance id** - refer to the robot's EtherNet/IP manual (Scanner mode)
- **Requested packet interval (ms)** - RPI value in ms (minimum 4)

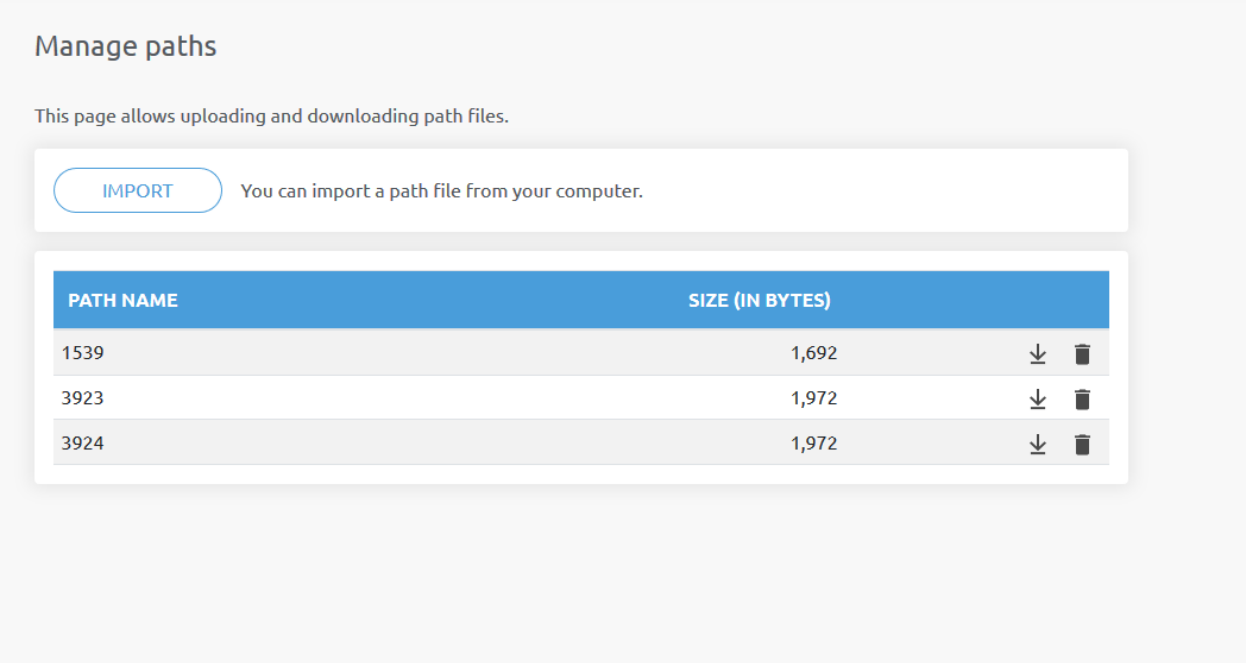
Check the checkbox and the Compute Box will try to automatically connect to the robot (via the given IP address).

Paths menu

NOTE:

The Path feature may not be available to your robot type.

This page can be used to import, export, and delete the previously recorded paths. In this way a Path can be copied to a different Compute Box.



To import a previously exported Path (.ofp file) click on **Import** and browse for the file.

The available Paths are listed at the end of the page. Any paths can be exported and downloaded as a .ofp file or permanently deleted to free up the list if a path is not needed anymore.

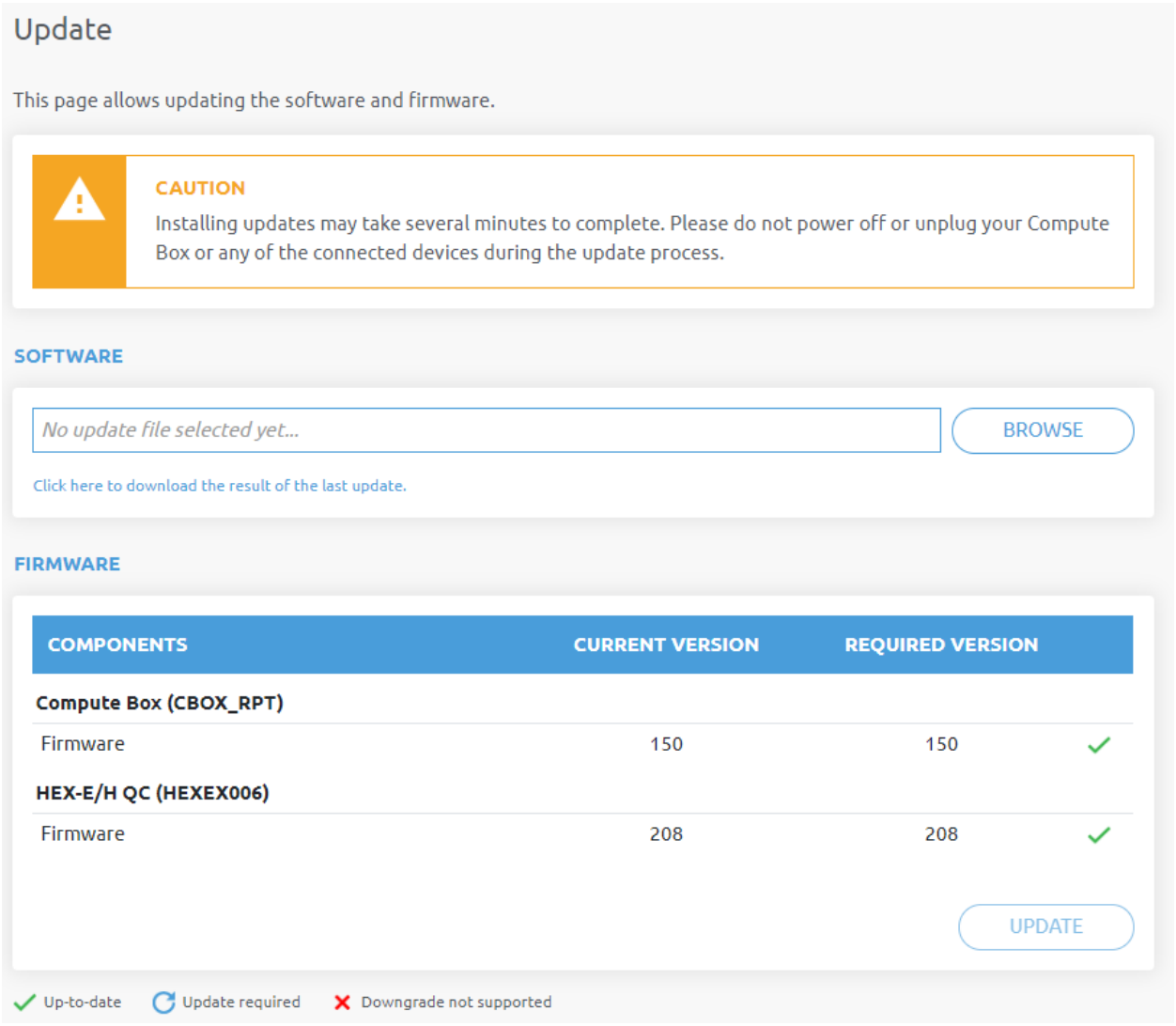
NOTE:

Always make sure that you do not delete any path that is currently in use in any of your robot programs. Otherwise the path will need to be re-recorded, since the delete operation cannot be undone.

The Compute Box can store up to 100 Mbytes of paths that is roughly equal to 1000 hours of recordings.

Update menu

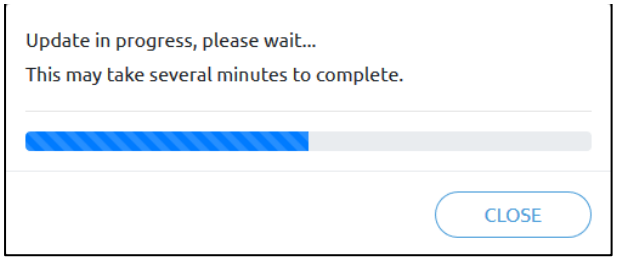
This page can be used to update the software on the Compute Box and the firmware on the devices.



Start the software update by clicking on the **Browse** button to browse for the .cbu software update file.

Then the **Browse** button will turn to **Update**.

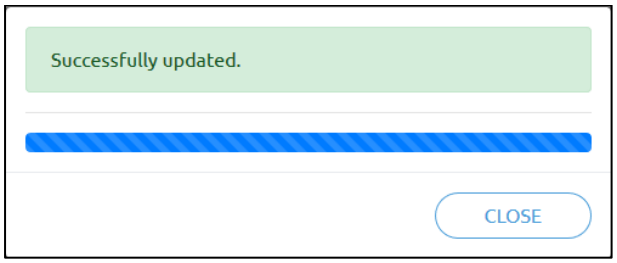
Click on that **Update** button to start the software update process:



CAUTION:

During the update process (takes about 5-10 minutes) DO NOT unplug any device or close the browser window. Otherwise the updated device could be damaged.

If the update is finished and was successful, the following message is shown:



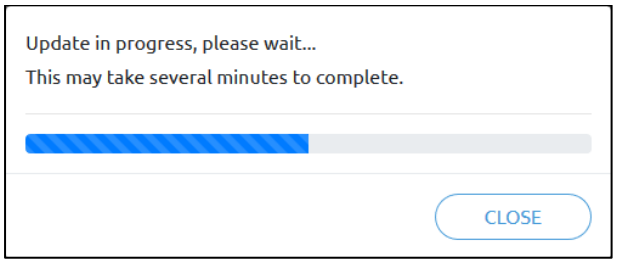
Now disconnect the device and use it as usual.

NOTE:

If the software update failed, please contact your distributor.

The firmware update is only required when any of the components is out of date.

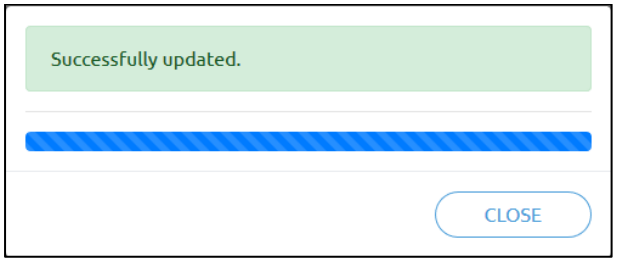
To start the firmware update, click on **UPDATE** button in the firmware section of the page.



CAUTION:

During the update process (takes about 5-10 minutes) DO NOT unplug any device or close the browser window. Otherwise the updated device could be damaged.

If the update is finished and was successful, the following message is shown:



Now disconnect the device and use it as usual.

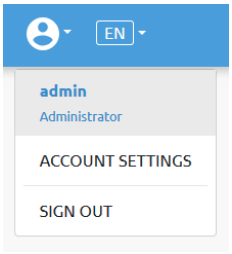
NOTE:

If the update is failed, please contact your distributor.

Account settings

This menu can be used to:

- See the currently sign-id user
- Go to **Account settings**
- Sign-out

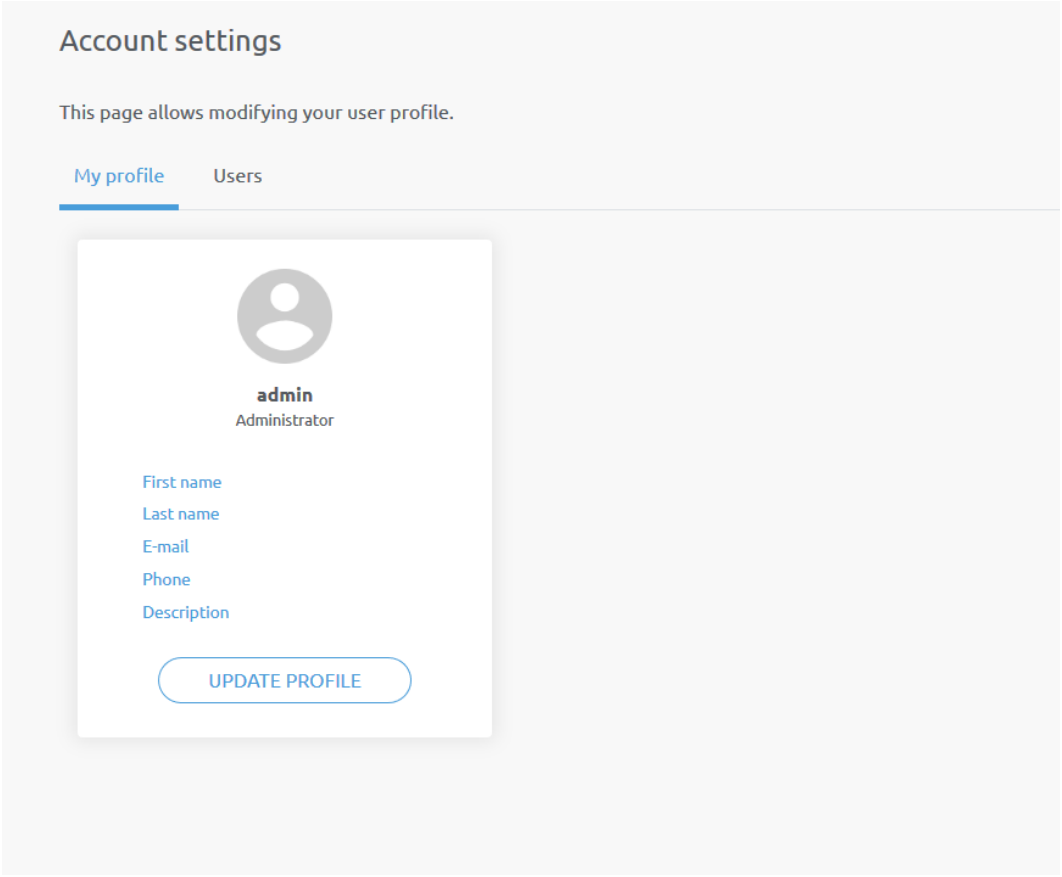


Account settings:

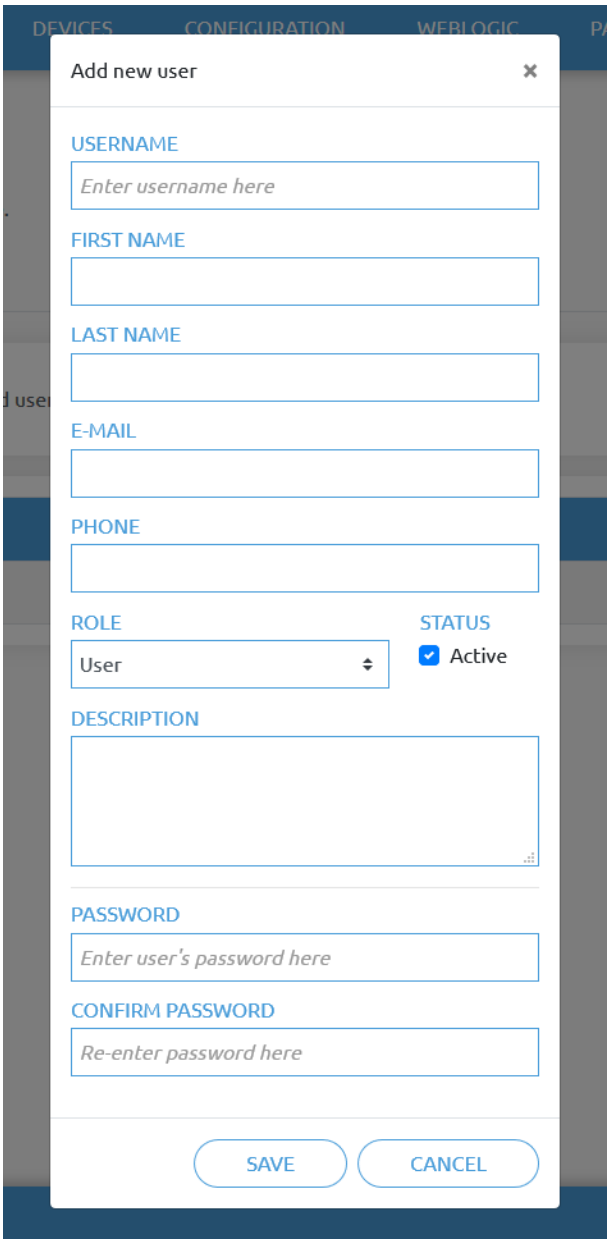
This page has two tabs:

- **My profile** - to see and update the currently logged in users profile (e.g.: change password)
- **Users** - to manage users (e.g.: add/remove/edit)

On the **My profile** tab to change any profile data (e.g.: password) click on the **Update profile** button.



On the **Users** tab click on the **Add new user** button to add more users:

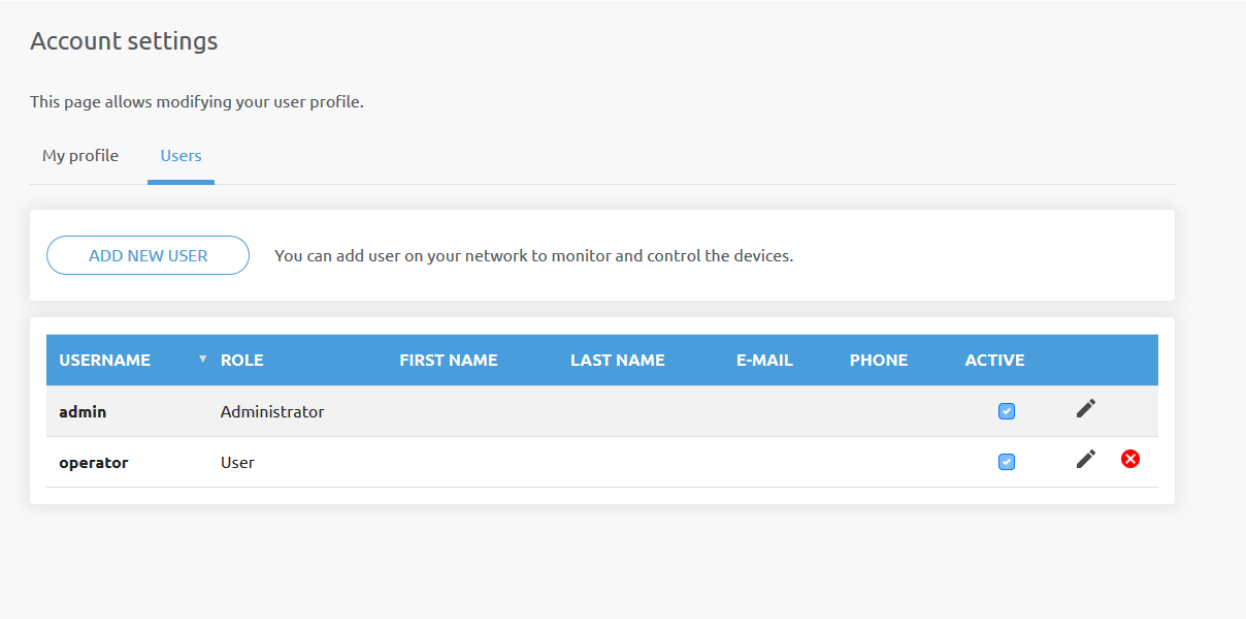


There are three user levels:

- Administrator
- Operator
- User

Fill in the user information and click **Save**.

Later on to change any user information just click on the edit icon.



To prevent a user to sign-in either could be:

- deactivated by changing its **Active** status in the edit mode
- or removed by clicking the delete icon.

10.2 EtherNet/IP

The OnRobot multi-device EtherNet/IP adapter can be accessed via scanner device (e.g. a robot, a PLC controller). Class 1 (implicit) and Class 3 (explicit) connections are available.

NOTE:

EtherNet/IP EDS file (v1.13 - MAJOR version 1 and MINOR version 13) is provided with the devices and can be located on the USB stick.

10.2.1 Available connections and assembly instances

Every device and device combination have 3 connections implemented:

- Exclusive Owner - RECOMMENDED to be used
- Input-only
- Listen-only

Every connection has an [**Input / Target-to-Origin / Producing** assembly] - [**Output / Origin-to-Target / Consuming** assembly] pair.

All assemblies are contained in **Class 4** and have the single **Attribute 3** implemented.

NOTE:

There is no Configuration Instance implemented, if required use instance number 0 and data size 0.

The following assembly instances are available for the single devices and device combinations:

HEX-E/H QC

T->O assembly id: 100

T->O data size: 24 bytes

T->O parameters:

Parameter name		Bytes	Type	Comments	Start bit
	HEX Device connected	2	UINT 16	0: Disconnected 64: HEX is connected	1
	HEX Status	4	UINT 32	0: No error	17
	HEX Filter	2	UINT 16	See below	49
	HEX Fx	2	INT 16	1/10 N	65
	HEX Fy	2	INT 16	1/10 N	81
	HEX Fz	2	INT 16	1/10 N	97
	HEX Tx	2	INT 16	1/100 Nm	113
	HEX Ty	2	INT 16	1/100 Nm	129
	HEX Tz	2	INT 16	1/100 Nm	145
	Reserved	4			161

O->T assembly id: 101

O->T data size: 16 bytes

O->T parameters:

Parameter name		Bytes	Type	Comments	Start bit
	HEX Zero	2	UINT 16	0: Ignored 1: Zero 2: Unzero	1
	HEX Filter	2	UINT 16	0: Ignored 1: No filtering 2: 500 Hz 3: 150 Hz 4: 50 Hz 5: 15 Hz 6: 5 Hz 7: 1.5 Hz	17
	Reserved	12			33

RG2-FT

T->O assembly id: 102

T->O data size: 64 bytes

T->O parameters:

Parameter name		Bytes	Type	Comments	Start bit
	RG2-FT Device connected	2	UINT 16	0: Disconnected 34: RG2-FT is Connected	1
Left	HEX Status	4	UINT 32	0: No error	17
Left	HEX Filter	2	UINT 16	See below	49
Left	HEX Fx	2	INT 16	1/10 N	65
Left	HEX Fy	2	INT 16	1/10 N	81
Left	HEX Fz	2	INT 16	1/10 N	97
Left	HEX Tx	2	INT 16	1/100 Nm	113
Left	HEX Ty	2	INT 16	1/100 Nm	129
Left	HEX Tz	2	INT 16	1/100 Nm	145
	Reserved	4			161
Right	HEX Status	4	UINT 32	0: No error	193
Right	HEX Filter	2	UINT 16	See below	225
Right	HEX Fx	2	INT 16	1/10 N	241
Right	HEX Fy	2	INT 16	1/10 N	257
Right	HEX Fz	2	INT 16	1/10 N	273
Right	HEX Tx	2	INT 16	1/100 Nm	289
Right	HEX Ty	2	INT 16	1/100 Nm	305
Right	HEX Tz	2	INT 16	1/100 Nm	321
	Reserved	4			337
Left	Proximity Distance	2	INT 16	mm	369
Left	Proximity Raw Dist.	2	INT 16	mm	385
Right	Proximity Distance	2	INT 16	mm	401
Right	Proximity Raw Dist.	2	INT 16	mm	417
	RG Actual width	2	INT 16	1/10 mm	433
	RG Status	2	UINT 16	0b___1: Busy 0b__1_: Grip detected 0b_1__: Left Proximity has error 0b1___: Right Proximity has error	449
	Reserved	6			465

O->T assembly id: 103

O->T data size: 32 bytes

O->T parameters:

Parameter name		Bytes	Type	Comments	Start bit
	RG Target Width	2	UINT 16	1/10 mm	1
	RG Target Force	2	UINT 16	1/10 N	17
	RG Control	2	UINT 16	0: Ignored 1: Move 2: Stop	33
	HEX Zero	2	UINT 16	0: Ignored 1: Zero 2: Unzero	49
	HEX Filter	2	UINT 16	0: Ignored 1: No filtering 2: 500 Hz 3: 150 Hz 4: 50 Hz 5: 15 Hz 6: 5 Hz 7: 1.5 Hz	65
Left	Proximity Custom Offset	2	UINT 16	mm	81
Right	Proximity Custom Offset	2	UINT 16	mm	97
	Proximity Store Offset	2	UINT 16	0: Ignored 1: Store actual measured value 2: Store custom offset value	113
	Reserved	16			129

RG2/6

NOTE:

This assembly instance can be used for both single and dual gripper configuration. Not only dual RG2 or dual RG6 but mixed configuration is also possible (RG2+RG6 or RG6+RG2). When used in single gripper configuration always use the **Primary (Prim.)** values.

T->O assembly id: 104

T->O data size: 32 bytes

T->O parameters:

Parameter name		Bytes	Type	Comments	Start bit
Prim.	RG Device connected	2	UINT 16	0: Disconnected 32: RG2 is connected 33: RG6 is connected	1
Prim.	RG Actual Depth	2	INT 16	1/10 mm	17
Prim.	RG Actual Relative Depth	2	INT 16	1/10 mm	33
Prim.	RG Actual Width	2	INT 16	1/10 mm (with fingertip offset)	49
Prim.	RG Status	2	UINT 16	0b_____1: 1 when in motion, 0 when not. The gripper will only accept new commands when 0. 0b_____1_: Internal- or external grip is detected. 0b____1__: Safety switch 1 is pushed. 0b___1___: Safety circuit 1 is activated. The gripper will not move while this flag is high; can only be reset by power cycling the gripper. 0b__1____: Safety switch 2 is pushed. 0b_1_____: Safety circuit 2 is activated. The gripper will not move while this flag is high; can only be reset by power cycling the gripper. 0b1_____: General safety error. Possible cause: the gripper is booted with some safety switch pressed or hardware error.	65
	Reserved	6			81
Sec.	RG Device connected	2	UINT 16	0: Disconnected 32: RG2 is connected 33: RG6 is connected	129
Sec.	RG Actual Depth	2	INT 16	1/10 mm	145
Sec.	RG Actual Relative Depth	2	INT 16	1/10 mm	161
Sec.	RG Actual Width	2	INT 16	1/10 mm (with fingertip offset)	177
Sec.	RG Status	2	UINT 16	Same as above	193
	Reserved	6			209

O->T assembly id: 105

O->T data size: 32 bytes

O->T parameters:

Parameter name		Bytes	Type	Comments	Start bit
Prim.	RG Target Width	2	UINT 16	1/10 mm (corrected with fingertip offset)	1
Prim.	RG Target Force	2	UINT 16	1/10 N	17
Prim.	RG Control	2	UINT 16	0: Ignored 1: Start motion to target 2: Stop the current motion	33
Prim.	RG Custom Fingertip offset	2	INT 16	Offset measured from metal (1/10mm)	49
Prim.	RG Store Fingertip offset	2	UINT 16	0: Ignored 1: Store offset	65
Prim.	RG Reset Tool Power	2	UINT 16	0: Ignored 1: Reset	81
	Reserved	4			97
Sec.	RG Target Width	2	UINT 16	1/10 mm (corrected with fingertip offset)	129
Sec.	RG Target Force	2	UINT 16	1/10 N	145
Sec.	RG Control	2	UINT 16	0: Ignored 1: Start motion to target 2: Stop the current motion	161
Sec.	RG Custom Fingertip offset	2	INT 16	Offset measured from metal (1/10mm)	177
Sec.	RG Store Fingertip offset	2	UINT 16	0: Ignored 1: Store offset	193
Sec.	RG Reset Tool Power	2	UINT 16	0: Ignored 1: Reset	209
	Reserved	4			225

VG10 / VGC10

NOTE:

This assembly instance can be used for both single and dual gripper configuration. When used in single gripper configuration always use the **Primary (Prim.)** values.

T->O assembly id: 106

T->O data size: 32 bytes

T->O parameters:

Parameter name		Bytes	Type	Comments	Start bit
Prim.	VG Device connected	2	UINT 16	0: Disconnected 16: VG10 is connected 17: VGC10 is connected	1
Prim.	VG Current limit	2	UINT 16	mA	17
Prim.	VG CH A actual vacuum	2	UINT 16	1/10 %	33
Prim.	VG CH B actual vacuum	2	UINT 16	1/10 %	49
	Reserved	8			65
Sec.	VG Device connected	2	UINT 16	0: Disconnected 16: VG10 is connected 17: VGC10 is connected	129
Sec.	VG Current limit	2	UINT 16	mA	145
Sec.	VG CH A actual vacuum	2	UINT 16	1/10 %	161
Sec.	VG CH B actual vacuum	2	UINT 16	1/10 %	177
	Reserved	8			193

O->T assembly id: 107

O->T data size: 32 bytes

O->T parameters:

Parameter name		Bytes	Type	Comments	Start bit
Prim.	VG CH A Control	2	UINT 16	0: Ignore 1: Grip 2: Idle 3: Release	1
Prim.	VG CH B Control	2	UINT 16	Same as Channel A	17
Prim.	VG CH A Target Vacuum	2	UINT 16	%	33
Prim.	VG CH B Target Vacuum	2	UINT 16	%	49
Prim.	VG Current limit	2	UINT 16	mA	65
	Reserved	6			81
Sec.	VG CH A Control	2	UINT 16	0: Ignore 1: Grip 2: Idle 3: Release	129
Sec.	VG CH B Control	2	UINT 16	Same as Channel A	145
Sec.	VG CH A Target Vacuum	2	UINT 16	%	161
Sec.	VG CH B Target Vacuum	2	UINT 16	%	177
Sec.	VG Current limit	2	UINT 16	mA	193
	Reserved	6			209

Gecko

NOTE:

This assembly instance can be used for both single and dual gripper configuration. When used in single gripper configuration always use the **Primary (Prim.)** values.

T->O assembly id: 108

T->O data size: 32 bytes

T->O parameters:

Parameter name		Bytes	Type	Comments	Start bit
Prim.	Gecko Device connected	2	UINT 16	0: Disconnected 48: Gecko is connected	1
Prim.	Gecko Status	2	UINT 16	0b___1: Part detected 0b__1_: Pads worn 0b_1__: Pads OUT 0b1___: Busy	17
Prim.	Gecko Last Error Code	2	UINT 16	0: No error	33
Prim.	Actual Gecko Preload Force	2	INT 16	1/100 N	49
Prim.	Actual Gecko Ultrasonic Sensor Value	2	INT 16	1/100 mm	65
	Reserved	6			81
Sec.	Gecko Device connected	2	UINT 16	0: Disconnected 48: Gecko is connected	129
Sec.	Gecko Status	2	UINT 16	Same as above	145
Sec.	Gecko Last Error Code	2	UINT 16	0: No error	161
Sec.	Actual Gecko Preload Force	2	INT 16	1/100 N	177
Sec.	Actual Gecko Ultrasonic Sensor Value	2	INT 16	1/100 mm	193
	Reserved	6			209

O->T assembly id: 109

O->T data size: 32 bytes

O->T parameters:

Parameter name		Bytes	Type	Comments	Start bit
Prim.	Gecko Pad Control	2	UINT 16	0: Ignored 1: Push Pads OUT 2: Pull Pads IN	1
Prim.	Gecko Preload Force Threshold	2	UINT 16	0: Ignored 1: 50N 2: 90N 3: 120N	17
Prim.	Gecko Reset Error Logs	2	UINT 16	0: Do not reset, keep logging 1: Reset and disable logging	33
	Reserved	10			49
Sec.	Gecko Pad Control	2	UINT 16	0: Ignored 1: Push Pads OUT 2: Pull Pads IN	129
Sec.	Gecko Preload Force Threshold	2	UINT 16	0: Ignored 1: 50N 2: 90N 3: 120N	145
Sec.	Gecko Reset Error Logs	2	UINT 16	0: Do not reset, keep logging 1: Reset and disable logging	161
	Reserved	10			177

HEX-E/H QC + RG2/6

T->O assembly id: 150

T->O data size: 40 bytes

T->O parameters:

Parameter name		Bytes	Type	Comments	Start bit
	HEX Device connected	2	UINT 16	0: Disconnected 64: HEX is connected	1
	HEX Status	4	UINT 32	0: No error	17
	HEX Filter	2	UINT 16	See below	49
	HEX Fx	2	INT 16	1/10 N	65
	HEX Fy	2	INT 16	1/10 N	81
	HEX Fz	2	INT 16	1/10 N	97
	HEX Tx	2	INT 16	1/100 Nm	113
	HEX Ty	2	INT 16	1/100 Nm	129
	HEX Tz	2	INT 16	1/100 Nm	145
	Reserved	4			161
Prim.	RG Device connected	2	UINT 16	0: Disconnected 32: RG2 is connected 33: RG6 is connected	193
Prim.	RG Actual Depth	2	INT 16	1/10 mm	209
Prim.	RG Actual Relative Depth	2	INT 16	1/10 mm	225
Prim.	RG Actual Width	2	INT 16	1/10 mm (with fingertip offset)	241
Prim.	RG Status	2	UINT 16	0b_____1: 1 when in motion, 0 when not. The gripper will only accept new commands when 0. 0b_____1_: Internal- or external grip is detected. 0b____1__: Safety switch 1 is pushed. 0b___1___: Safety circuit 1 is activated. The gripper will not move while this flag is high; can only be reset by power cycling the gripper. 0b__1____: Safety switch 2 is pushed. 0b_1_____: Safety circuit 2 is activated. The gripper will not move while this flag is high; can only be reset by power cycling the gripper. 0b1_____: General safety error. Possible cause: the gripper is booted with some safety switch pressed or hardware error.	257
	Reserved	6			273

O->T assembly id: 151

O->T data size: 32 bytes

O->T parameters:

Parameter name		Bytes	Type	Comments	Start bit
	HEX Zero	2	UINT 16	0: Ignored 1: Zero 2: Unzero	1
	HEX Filter	2	UINT 16	0: Ignored 1: No filtering 2: 500 Hz 3: 150 Hz 4: 50 Hz 5: 15 Hz 6: 5 Hz 7: 1.5 Hz	17
	Reserved	12			33
Prim.	RG Target Width	2	UINT 16	1/10 mm (corrected with fingertip offset)	129
Prim.	RG Target Force	2	UINT 16	1/10 N	145
Prim.	RG Control	2	UINT 16	0: Ignored 1: Start motion to target 2: Stop the current motion	161
Prim.	RG Custom Fingertip offset	2	INT 16	Offset measured from metal (1/10mm)	177
Prim.	RG Store Fingertip offset	2	UINT 16	0: Ignored 1: Store offset	193
Prim.	RG Reset Tool Power	2	UINT 16	0: Ignored 1: Reset	209
	Reserved	4			225

HEX-E/H QC + VG10 / VGC10

T->O assembly id: 152

T->O data size: 40 bytes

T->O parameters:

Parameter name		Bytes	Type	Comments	Start bit
	HEX Device connected	2	UINT 16	0: Disconnected 64: HEX is connected	1
	HEX Status	4	UINT 32	0: No error	17
	HEX Filter	2	UINT 16	See below	49
	HEX Fx	2	INT 16	1/10 N	65
	HEX Fy	2	INT 16	1/10 N	81
	HEX Fz	2	INT 16	1/10 N	97
	HEX Tx	2	INT 16	1/100 Nm	113
	HEX Ty	2	INT 16	1/100 Nm	129
	HEX Tz	2	INT 16	1/100 Nm	145
	Reserved	4			161
Prim.	VG Device connected	2	UINT 16	0: Disconnected 16: VG10 is connected 17: VGC10 is connected	193
Prim.	VG Current limit	2	UINT 16	mA	209
Prim.	VG CH A actual vacuum	2	UINT 16	1/10 %	225
Prim.	VG CH B actual vacuum	2	UINT 16	1/10 %	241
	Reserved	8			257

O->T assembly id: 153

O->T data size: 32 bytes

O->T parameters:

Parameter name		Bytes	Type	Comments	Start bit
	HEX Zero	2	UINT 16	0: Ignored 1: Zero 2: Unzero	1
	HEX Filter	2	UINT 16	0: Ignored 1: No filtering 2: 500 Hz 3: 150 Hz 4: 50 Hz 5: 15 Hz 6: 5 Hz 7: 1.5 Hz	17
	Reserved	12			33
Prim.	VG CH A Control	2	UINT 16	0: Ignore 1: Grip 2: Idle 3: Release	129
Prim.	VG CH B Control	2	UINT 16	Same as Channel A	145
Prim.	VG CH A Target Vacuum	2	UINT 16	%	161
Prim.	VG CH B Target Vacuum	2	UINT 16	%	177
Prim.	VG Current limit	2	UINT 16	mA	193
0	Reserved	6			209

HEX-E/H QC + Gecko

T->O assembly id: 154

T->O data size: 40 bytes

T->O parameters:

Parameter name		Bytes	Type	Comments	Start bit
	HEX Device connected	2	UINT 16	0: Disconnected 64: HEX is connected	1
	HEX Status	4	UINT 32	0: No error	17
	HEX Filter	2	UINT 16	See below	49
	HEX Fx	2	INT 16	1/10 N	65
	HEX Fy	2	INT 16	1/10 N	81
	HEX Fz	2	INT 16	1/10 N	97
	HEX Tx	2	INT 16	1/100 Nm	113
	HEX Ty	2	INT 16	1/100 Nm	129
	HEX Tz	2	INT 16	1/100 Nm	145
	Reserved	4			161
Prim.	Gecko Device connected	2	UINT 16	0: Disconnected 48: Gecko is connected	193
Prim.	Gecko Status	2	UINT 16	0b___1: Part detected 0b__1_: Pads worn 0b_1__: Pads OUT 0b1___: Busy	209
Prim.	Gecko Last Error Code	2	UINT 16	0: No error	225
Prim.	Actual Gecko Preload Force	2	INT 16	1/100 N	241
Prim.	Actual Gecko Ultrasonic Sensor Value	2	INT 16	1/100 mm	257
	Reserved	6			273

O->T assembly id: 155

O->T data size: 32 bytes

O->T parameters:

Parameter name		Bytes	Type	Comments	Start bit
	HEX Zero	2	UINT 16	0: Ignored 1: Zero 2: Unzero	1
	HEX Filter	2	UINT 16	0: Ignored 1: No filtering 2: 500 Hz 3: 150 Hz 4: 50 Hz 5: 15 Hz 6: 5 Hz 7: 1.5 Hz	17
	Reserved	12			33
Prim.	Gecko Pad Control	2	UINT 16	0: Ignored 1: Push Pads OUT 2: Pull Pads IN	129
Prim.	Gecko Preload Force Threshold	2	UINT 16	0: Ignored 1: 50N 2: 90N 3: 120N	145
Prim.	Gecko Reset Error Logs	2	UINT 16	0: Do not reset, keep logging 1: Reset and disable logging	161
	Reserved	10			177

RG2/6 + VG10 / VGC10

T->O assembly id: 156

T->O data size: 64 bytes

T->O parameters:

Parameter name		Bytes	Type	Comments	Start bit
Prim.	RG Device connected	2	UINT 16	0: Disconnected 32: RG2 is connected 33: RG6 is connected	1
Prim.	RG Actual Depth	2	INT 16	1/10 mm	17
Prim.	RG Actual Relative Depth	2	INT 16	1/10 mm	33
Prim.	RG Actual Width	2	INT 16	1/10 mm (with fingertip offset)	49
Prim.	RG Status	2	UINT 16	0b_____1: 1 when in motion, 0 when not. The gripper will only accept new commands when 0. 0b_____1_: Internal- or external grip is detected. 0b____1__: Safety switch 1 is pushed. 0b___1___: Safety circuit 1 is activated. The gripper will not move while this flag is high; can only be reset by power cycling the gripper. 0b__1____: Safety switch 2 is pushed. 0b_1_____: Safety circuit 2 is activated. The gripper will not move while this flag is high; can only be reset by power cycling the gripper. 0b1_____: General safety error. Possible cause: the gripper is booted with some safety switch pressed or hardware error.	65
	Reserved	6			81
Sec.	RG Device connected	2	UINT 16	0: Disconnected 32: RG2 is connected 33: RG6 is connected	129
Sec.	RG Actual Depth	2	INT 16	1/10 mm	145
Sec.	RG Actual Relative Depth	2	INT 16	1/10 mm	161
Sec.	RG Actual Width	2	INT 16	1/10 mm (with fingertip offset)	177
Sec.	RG Status	2	UINT 16	Same as above	193
	Reserved	6			209
Prim.	VG Device connected	2	UINT 16	0: Disconnected 16: VG10 is connected 17: VGC10 is connected	257
Prim.	VG Current limit	2	UINT 16	mA	273
Prim.	VG CH A actual vacuum	2	UINT 16	1/10 %	289
Prim.	VG CH B actual vacuum	2	UINT 16	1/10 %	305
	Reserved	8			321
Sec.	VG Device connected	2	UINT 16	0: Disconnected 16: VG10 is connected 17: VGC10 is connected	385
Sec.	VG Current limit	2	UINT 16	mA	401
Sec.	VG CH A actual vacuum	2	UINT 16	1/10 %	417
Sec.	VG CH B actual vacuum	2	UINT 16	1/10 %	433
	Reserved	8			449

O->T assembly id: 157

O->T data size: 64 bytes

O->T parameters:

Parameter name		Bytes	Type	Comments	Start bit
Prim.	RG Target Width	2	UINT 16	1/10 mm (corrected with fingertip offset)	1
Prim.	RG Target Force	2	UINT 16	1/10 N	17
Prim.	RG Control	2	UINT 16	0: Ignored 1: Start motion to target 2: Stop the current motion	33
Prim.	RG Custom Fingertip offset	2	INT 16	Offset measured from metal (1/10mm)	49
Prim.	RG Store Fingertip offset	2	UINT 16	0: Ignored 1: Store offset	65
Prim.	RG Reset Tool Power	2	UINT 16	0: Ignored 1: Reset	81
	Reserved	4			97
Sec.	RG Target Width	2	UINT 16	1/10 mm (corrected with fingertip offset)	129
Sec.	RG Target Force	2	UINT 16	1/10 N	145
Sec.	RG Control	2	UINT 16	0: Ignored 1: Start motion to target 2: Stop the current motion	161
Sec.	RG Custom Fingertip offset	2	INT 16	Offset measured from metal (1/10mm)	177
Sec.	RG Store Fingertip offset	2	UINT 16	0: Ignored 1: Store offset	193
Sec.	RG Reset Tool Power	2	UINT 16	0: Ignored 1: Reset	209
	Reserved	4			225
Prim.	VG CH A Control	2	UINT 16	0: Ignore 1: Grip 2: Idle 3: Release	257
Prim.	VG CH B Control	2	UINT 16	Same as Channel A	273
Prim.	VG CH A Target Vacuum	2	UINT 16	%	289
Prim.	VG CH B Target Vacuum	2	UINT 16	%	305
Prim.	VG Current limit	2	UINT 16	mA	321
	Reserved	6			337
Sec.	VG CH A Control	2	UINT 16	0: Ignore 1: Grip 2: Idle 3: Release	385
Sec.	VG CH B Control	2	UINT 16	Same as Channel A	401
Sec.	VG CH A Target Vacuum	2	UINT 16	%	417
Sec.	VG CH B Target Vacuum	2	UINT 16	%	433
Sec.	VG Current limit	2	UINT 16	mA	449
	Reserved	6			465

RG2/6 + Gecko

T->O assembly id: 158

T->O data size: 64 bytes

T->O parameters:

Parameter name		Bytes	Type	Comments	Start bit
Prim.	RG Device connected	2	UINT 16	0: Disconnected 32: RG2 is connected 33: RG6 is connected	1
Prim.	RG Actual Depth	2	INT 16	1/10 mm	17
Prim.	RG Actual Relative Depth	2	INT 16	1/10 mm	33
Prim.	RG Actual Width	2	INT 16	1/10 mm (with fingertip offset)	49
Prim.	RG Status	2	UINT 16	0b_____1: 1 when in motion, 0 when not. The gripper will only accept new commands when 0. 0b_____1_: Internal- or external grip is detected. 0b____1__: Safety switch 1 is pushed. 0b___1___: Safety circuit 1 is activated. The gripper will not move while this flag is high; can only be reset by power cycling the gripper. 0b__1____: Safety switch 2 is pushed. 0b_1_____: Safety circuit 2 is activated. The gripper will not move while this flag is high; can only be reset by power cycling the gripper. 0b1_____: General safety error. Possible cause: the gripper is booted with some safety switch pressed or hardware error.	65
	Reserved	6			81
Sec.	RG Device connected	2	UINT 16	0: Disconnected 32: RG2 is connected 33: RG6 is connected	129
Sec.	RG Actual Depth	2	INT 16	1/10 mm	145
Sec.	RG Actual Relative Depth	2	INT 16	1/10 mm	161
Sec.	RG Actual Width	2	INT 16	1/10 mm (with fingertip offset)	177
Sec.	RG Status	2	UINT 16	Same as above	193
	Reserved	6			209
Prim.	Gecko Device connected	2	UINT 16	0: Disconnected 48: Gecko is connected	257
Prim.	Gecko Status	2	UINT 16	0b___1: Part detected 0b__1_: Pads worn 0b_1__: Pads OUT 0b1___: Busy	273
Prim.	Gecko Last Error Code	2	UINT 16	0: No error	289
Prim.	Actual Gecko Preload Force	2	INT 16	1/100 N	305
Prim.	Actual Gecko Ultrasonic Sensor Value	2	INT 16	1/100 mm	321
	Reserved	6			337
Sec.	Gecko Device connected	2	UINT 16	0: Disconnected 48: Gecko is connected	385

Sec.	Gecko Status	2	UINT 16	Same as above	401
Sec.	Gecko Last Error Code	2	UINT 16	0: No error	417
Sec.	Actual Gecko Preload Force	2	INT 16	1/100 N	433
Sec.	Actual Gecko Ultrasonic Sensor Value	2	INT 16	1/100 mm	449
	Reserved	6			465

O->T assembly id: 159

O->T data size: 64 bytes

O->T parameters:

Parameter name		Bytes	Type	Comments	Start bit
Prim.	RG Target Width	2	UINT 16	1/10 mm (corrected with fingertip offset)	1
Prim.	RG Target Force	2	UINT 16	1/10 N	17
Prim.	RG Control	2	UINT 16	0: Ignored 1: Start motion to target 2: Stop the current motion	33
Prim.	RG Custom Fingertip offset	2	INT 16	Offset measured from metal (1/10mm)	49
Prim.	RG Store Fingertip offset	2	UINT 16	0: Ignored 1: Store offset	65
Prim.	RG Reset Tool Power	2	UINT 16	0: Ignored 1: Reset	81
	Reserved	4			97
Sec.	RG Target Width	2	UINT 16	1/10 mm (corrected with fingertip offset)	129
Sec.	RG Target Force	2	UINT 16	1/10 N	145
Sec.	RG Control	2	UINT 16	0: Ignored 1: Start motion to target 2: Stop the current motion	161
Sec.	RG Custom Fingertip offset	2	INT 16	Offset measured from metal (1/10mm)	177
Sec.	RG Store Fingertip offset	2	UINT 16	0: Ignored 1: Store offset	193
Sec.	RG Reset Tool Power	2	UINT 16	0: Ignored 1: Reset	209
	Reserved	4			225
Prim.	Gecko Pad Control	2	UINT 16	0: Ignored 1: Push Pads OUT 2: Pull Pads IN	257
Prim.	Gecko Preload Force Threshold	2	UINT 16	0: Ignored 1: 50N 2: 90N 3: 120N	273
Prim.	Gecko Reset Error Logs	2	UINT 16	0: Do not reset, keep logging 1: Reset and disable logging	289
	Reserved	10			305
Sec.	Gecko Pad Control	2	UINT 16	0: Ignored 1: Push Pads OUT 2: Pull Pads IN	385
Sec.	Gecko Preload Force Threshold	2	UINT 16	0: Ignored 1: 50N 2: 90N 3: 120N	401
Sec.	Gecko Reset Error Logs	2	UINT 16	0: Do not reset, keep logging 1: Reset and disable logging	417
	Reserved	10			433

VG10 / VGC10 + Gecko

T->O assembly id: 160

T->O data size: 64 bytes

T->O parameters:

Parameter name		Bytes	Type	Comments	Start bit
Prim.	VG Device connected	2	UINT 16	0: Disconnected 16: VG10 is connected 17: VGC10 is connected	1
Prim.	VG Current limit	2	UINT 16	mA	17
Prim.	VG CH A actual vacuum	2	UINT 16	1/10 %	33
Prim.	VG CH B actual vacuum	2	UINT 16	1/10 %	49
	Reserved	8			65
Sec.	VG Device connected	2	UINT 16	0: Disconnected 16: VG10 is connected 17: VGC10 is connected	129
Sec.	VG Current limit	2	UINT 16	mA	145
Sec.	VG CH A actual vacuum	2	UINT 16	1/10 %	161
Sec.	VG CH B actual vacuum	2	UINT 16	1/10 %	177
	Reserved	8			193
Prim.	Gecko Device connected	2	UINT 16	0: Disconnected 48: Gecko is connected	257
Prim.	Gecko Status	2	UINT 16	0b___1: Part detected 0b__1_: Pads worn 0b_1__: Pads OUT 0b1___: Busy	273
Prim.	Gecko Last Error Code	2	UINT 16	0: No error	289
Prim.	Actual Gecko Preload Force	2	INT 16	1/100 N	305
Prim.	Actual Gecko Ultrasonic Sensor Value	2	INT 16	1/100 mm	321
	Reserved	6			337
Sec.	Gecko Device connected	2	UINT 16	0: Disconnected 48: Gecko is connected	385
Sec.	Gecko Status	2	UINT 16	Same as above	401
Sec.	Gecko Last Error Code	2	UINT 16	0: No error	417
Sec.	Actual Gecko Preload Force	2	INT 16	1/100 N	433
Sec.	Actual Gecko Ultrasonic Sensor Value	2	INT 16	1/100 mm	449
	Reserved	6			465

O->T assembly id: 161

O->T data size: 64 bytes

O->T parameters:

Parameter name		Bytes	Type	Comments	Start bit
Prim.	VG CH A Control	2	UINT 16	0: Ignore 1: Grip 2: Idle 3: Release	1
Prim.	VG CH B Control	2	UINT 16	Same as Channel A	17
Prim.	VG CH A Target Vacuum	2	UINT 16	%	33
Prim.	VG CH B Target Vacuum	2	UINT 16	%	49
Prim.	VG Current limit	2	UINT 16	mA	65
	Reserved	6			81
Sec.	VG CH A Control	2	UINT 16	0: Ignore 1: Grip 2: Idle 3: Release	129
Sec.	VG CH B Control	2	UINT 16	Same as Channel A	145
Sec.	VG CH A Target Vacuum	2	UINT 16	%	161
Sec.	VG CH B Target Vacuum	2	UINT 16	%	177
Sec.	VG Current limit	2	UINT 16	mA	193
	Reserved	6			209
Prim.	Gecko Pad Control	2	UINT 16	0: Ignored 1: Push Pads OUT 2: Pull Pads IN	257
Prim.	Gecko Preload Force Threshold	2	UINT 16	0: Ignored 1: 50N 2: 90N 3: 120N	273
Prim.	Gecko Reset Error Logs	2	UINT 16	0: Do not reset, keep logging 1: Reset and disable logging	289
	Reserved	10			305
Sec.	Gecko Pad Control	2	UINT 16	0: Ignored 1: Push Pads OUT 2: Pull Pads IN	385
Sec.	Gecko Preload Force Threshold	2	UINT 16	0: Ignored 1: 50N 2: 90N 3: 120N	401
Sec.	Gecko Reset Error Logs	2	UINT 16	0: Do not reset, keep logging 1: Reset and disable logging	417
	Reserved	10			433

11 Hardware Specification

11.1 Technical sheets

Gecko

General Properties					Unit
Gripper					
Workpiece Material	**Polished Steel**	**Acrylic**	**Glass**	**Sheet Metal**	
Maximum payload (x2 safety factor)	6.5 14.3	6.5 14.3	5.5 12.1	5.5 12.1	[kg] [lb]
Preload required for max adhesion	140				[N]
Detachment time	300				[msec]
Holds workpiece on power loss?	yes				
Pads					
Change-out interval	150 000 to 200 000 cycles for HIGH preload 200 000 to 250 000 cycles for LOW preload				[cycles]
Manual Cleaning	Isopropyl alcohol and lint free cloth				
Robotic cleaning system	Cleaning Station				
Robotic cleaning interval and % recovery	Refer to Cleaning Station User Guide				
Sensors					
	Pre-load sensor		Ultrasonic Range sensor		
Range	45 [N] 9 [lb]	140 [N] 31 [lb]	0	260 [mm] 10 [inch]	[N][mm] [lb][inch]
Error	7%		2%		
IP Classification	42				
Dimensions (HxW)	187 x 146 7.3 x 5.7				[mm] [inch]
Weight	2.85 6.3				[kg] [lb]

NOTE:

Avoid preloading the gripper with an inverted robot or in non-vertical loading conditions. If preloaded whilst inverted, preload sensor will not meet typical performance standards.

Operating Conditions	Minimum	Typical	Maximum	Unit
Temperature	0 32	- -	50 122	[°C] [°F]
Surface Characteristics*	Matte finish	Highly polished	-	

* Smoother surfaces require less preload force for a desired payload force.

Specification or Feature	Target value
Parts Presence Sensing	Yes (Ultrasonic)
Pad Material	Proprietary silicone blend
Wear Properties	Depends on surface roughness and preload
Pad Attachment Mechanism	Magnetic
Change-out interval	150000 – 200000 for HIGH PRELOAD 200000 – 250000 for LOW PRELOAD
Cleaning system	Cleaning station
Cleaning interval and % recovery	See Cleaning Station Manual

Effectiveness on Different Materials

The Gecko Gripper is best suited for smooth, low surface roughness substrates that are generally flat, stiff, and rigid. For other materials, the Gecko Gripper's effectiveness drops depending the stiffness and roughness of the picking surface. The table below shows a relationship between rigid and flexible substrates, surface finish, payload and the required preload to pick up said substrate. For example, if the customer knows that their part/substrate is rigid, with a mirror-like finish and weighs 2kg, the preload required to pick up the part/substrate is a medium-level preload.

Flexibility	Surface finish	Payload (kg)	Required Preload
Rigid	Mirror-like finish	0 to 2	Low
		2 to 4	Medium
		4 to 6	High
	Smooth	0 to 2	Medium
		2 to 4	High
		4 to 6	N/A
	Matte	0 to 2	High
		2 to 4	N/A
		4 to 6	N/A
Flexible	Mirror-like finish	0 to 2	Medium
		2 to 4	High
		4 to 6	N/A
	Smooth	0 to 2	High
		2 to 4	N/A
		4 to 6	N/A
	Matte	0 to 2	N/A
		2 to 4	N/A
		4 to 6	N/A

To further elaborate the significance between preload and payload, the table below shows visual matrix that displays the capability of the gecko gripper to pick up different materials with varying stiffness and roughness, at three different preload values (low 40N, medium 90N, high 140N).

Stiffness	Roughness	Example of material	Preload - 140N						Preload - 90N						Preload - 40N					
			Payload [kg]						Payload [kg]						Payload [kg]					
			0.1	0.5	1	2	4	6	0.1	0.5	1	2	4	6	0.1	0.5	1	2	4	6
1	1	Mylar	✓	✓	✓	*			✓	✓	*				✓	*				
5	1	Transparency sheet	✓	✓	✓	✓	*		✓	✓	*				✓	*				
10	1	Polished mirror-like steel, solar panel	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	*	✓	✓	✓	✓	*	
1	5	Cling film, ziploc bags	✓	✓	*				✓	*					✓	*				
5	5	Glossy carboard (cereal box)	✓	✓	*				✓	*					✓	*				
10	5	Printed circuit board	✓	✓	✓	✓	*		✓	✓	*				✓	*				
1	10	Laminating plastic / film	*																	
5	10	Corrugated cardboard																		
10	10	Sandblasted aluminum																		

✓ the gripper can easily pick up the material

* the gripper can pick up the material in some cases (requires caution and testing to verify)

Nothing the gripper cannot pick up this type of material.

NOTE:

This table is to be utilized as a guide to better understand the payload capacity and substrate type for the Gecko Gripper.

The criteria for stiffness and roughness is a basic scale from 1-10, here are the benchmarks used to determine the values.

Stiffness	Description	Example
1	Flexible	Fabric
5	Semi-flexible	Cardboard
10	Stiff	Metal

Roughness	Description	Example	RMS Value
1	Polished/Smooth	Polished Metal	0.1 micron
5	Textured	Carboard	7 microns
10	Rough	Sandblasted Metal	28 microns

HEX-E QC

General Properties	6-Axis Force/Torque Sensor				Unit
	Fxy	**Fz**	**Txy**	**Tz**	
Nominal Capacity (N.C)	200	200	10	6.5	[N] [Nm]
Single axis deformation at N.C (typical)	± 1.7 ± 0.067	± 0.3 ± 0.011	± 2.5 ± 2.5	± 5 ± 5	[mm] [°] [inch] [°]
Single axis overload	500	500	500	500	[%]
Signal noise* (typical)	0.035	0.15	0.002	0.001	[N] [Nm]
Noise-free resolution (typical)	0.2	0.8	0.01	0.002	[N] [Nm]
Full scale nonlinearity	< 2	< 2	< 2	< 2	[%]
Hysteresis (measured on Fz axis , typical)	< 2	< 2	< 2	< 2	[%]
Crosstalk (typical)	< 5	< 5	< 5	< 5	[%]
IP Classification	67				
Dimensions (H x W x L)	50 x 71 x 93 1.97 x 2.79 x 3.66				[mm] [inch]
Weight (with built-in adapter plates)	0.347 0.76				[kg] [lb]

* Signal noise is defined as the standard deviation (1 σ) of a typical one second no-load signal.

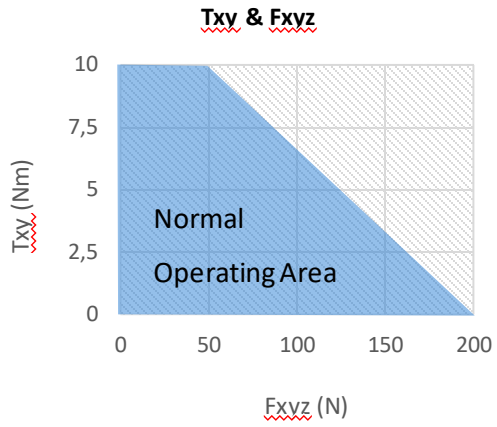
Operating Conditions	Minimum	Typical	Maximum	Unit
Power supply	7	-	24	[V]
Power consumption	-	-	0.8	[W]
Operating temperature	0 32	- -	55 131	[°C] [°F]
Relative humidity (non-condensing)	0	-	95	[%]
Calculated MTBF (operating life)	30.000	-	-	[Hours]

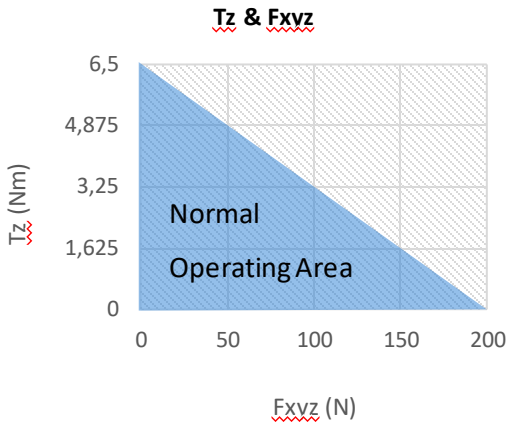
Complex loading

During single-axis loading, the sensor can be operated up to its nominal capacity. Above the nominal capacity the reading is inaccurate and invalid.

During complex loading (when more than one axis is loaded) the nominal capacities are reduced. The following diagrams show the complex loading scenarios.

The sensor cannot be operated outside of the Normal Operating Area.





HEX-H QC

General Properties	6-Axis Force/Torque Sensor				Unit
	Fxy	**Fz**	**Txy**	**Tz**	
Nominal Capacity (N.C)	200	200	20	13	[N] [Nm]
Single axis deformation at N.C (typical)	± 0.6 ± 0.023	± 0.25 ± 0.009	± 2 ± 2	± 3.5 ± 3.5	[mm] [°] [inch] [°]
Single axis overload	500	400	300	300	[%]
Signal noise* (typical)	0.1	0.2	0.006	0.002	[N] [Nm]
Noise-free resolution (typical)	0.5	1	0.036	0.008	[N] [Nm]
Full scale nonlinearity	< 2	< 2	< 2	< 2	[%]
Hysteresis (measured on Fz axis , typical)	< 2	< 2	< 2	< 2	[%]
Crosstalk (typical)	< 5	< 5	< 5	< 5	[%]
IP Classification	67				
Dimensions (H x W x L)	50 x 71 x 93 1.97 x 2.79 x 3.66				[mm] [inch]
Weight (with built-in adapter plates)	0.35 0.77				[kg] [lb]

* Signal noise is defined as the standard deviation (1 σ) of a typical one second no-load signal.

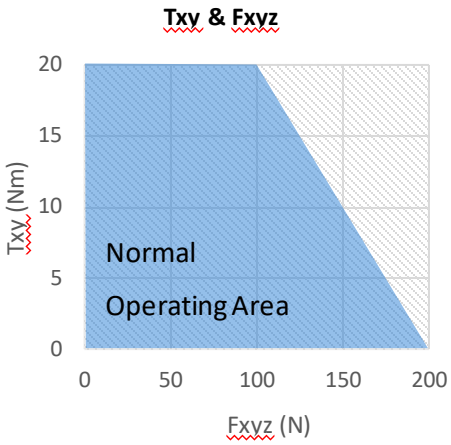
Operating Conditions	Minimum	Typical	Maximum	Unit
Power supply	7	-	24	[V]
Power consumption	-	-	0.8	[W]
Operating temperature	0 32	- -	55 131	[°C] [°F]
Relative humidity (non-condensing)	0	-	95	[%]
Calculated MTBF (operating life)	30.000	-	-	[Hours]

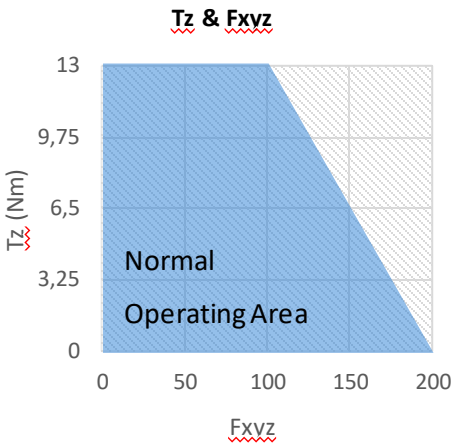
Complex loading

During single-axis loading, the sensor can be operated up to its nominal capacity. Above the nominal capacity the reading is inaccurate and invalid.

During complex loading (when more than one axis is loaded) the nominal capacities are reduced. The following diagrams show the complex loading scenarios.

The sensor cannot be operated outside of the Normal Operating Area.





Quick Changer

Quick Changer for I/O

Dual Quick Changer

Quick Changer - Tool side

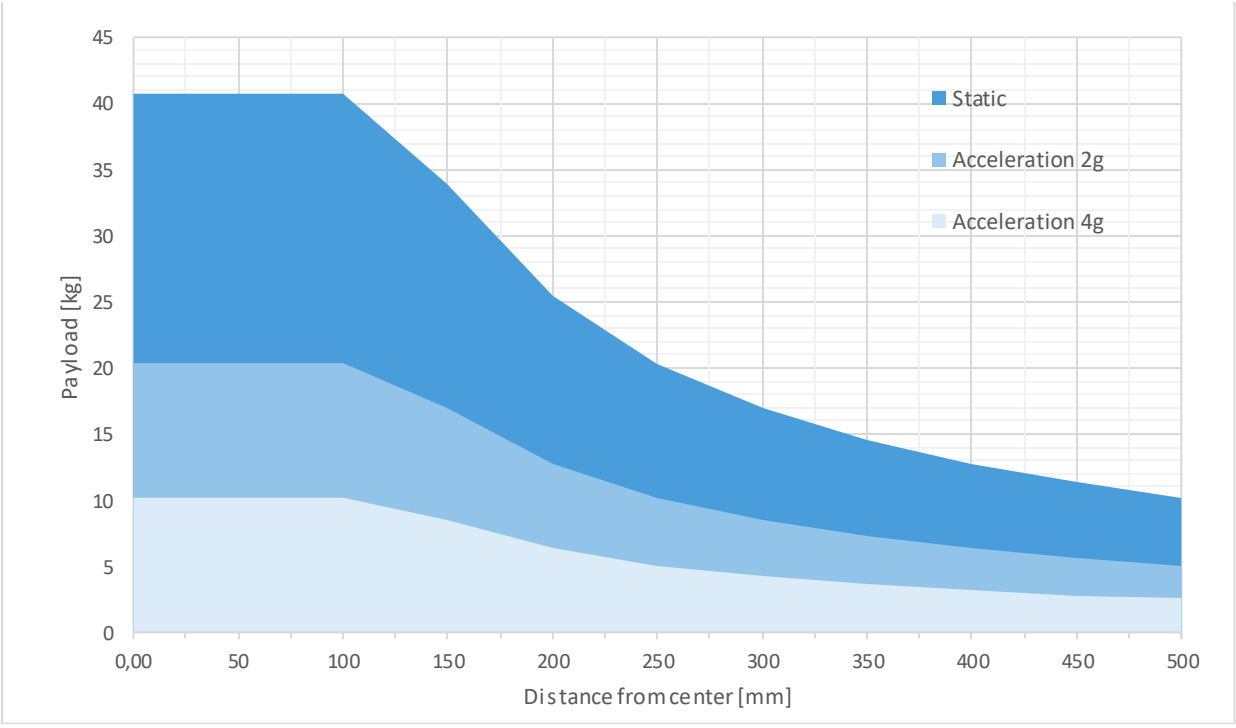
If not specified, the data represent the combination of the different Quick Changer types/sides.

Technical data	Min	Typical	Max	Units
Permissible force*	-	-	400*	[N]
Permissible torque*	-	-	50*	[Nm]
Rated payload*	- -	- -	20* 44	[kg] [lbs]
Repeatability	-	-	±0.02	[mm]
IP Classification	64			
Operating life (Tool change)	-	5.000	-	[cycles]
Operating life (Robot operation)	10	-	-	[M cycles]

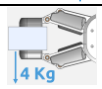
* See load capacity graph below.

	Quick Changer	Quick Changer for I/O	Dual Quick Changer	Quick Changer - Tool Side	Units
Weight	0.06 13.22	0.093 2.05	0.41 90.39	0.14 30.86	[kg] [lb]
Dimensions	See Mechanical dimension section				

Load capacity



RG2-FT

General Properties	Min	Typical	Max	Units
Payload Force Fit 	- -	- -	2 4.4	[kg] [lb]
Payload Form Fit 	- -	- -	4 8.8	[Kg] [lb]
Total stroke (adjustable)	0 0	- -	100 3.93	[mm] [inch]
Finger position resolution	- -	0.1 0.004	- -	[mm] [inch]
Repetition accuracy	- -	0.1 0.004	0.2 0.007	[mm] [inch]
Reversing backlash	0.2 0.007	0.4 0.015	0.6 0.023	[mm] [inch]
Gripping force (adjustable)	3	-	40	[N]
Gripping speed*	55	110	184	[mm/s]
Gripping time**	0.04	0.07	0.11	[s]
Adjustable bracket tilting accuracy	-	< 1	-	°
Ambient operating temperature	5	-	50	[°C]
Storage temperature	0	-	60	[°C]
Motor	Integrated, electric BLDC			
IP Classification	IP54			
Dimensions	219 x 149 x 49 8.6 x 5.9 x 1.9			[mm] [inch]
Product weight	0.98 2.16			[kg] [lb]

* see speed table 163

** based on 8mm total movement between fingers. The speed is linearly proportional to the force. For more details see speed table on page 163.

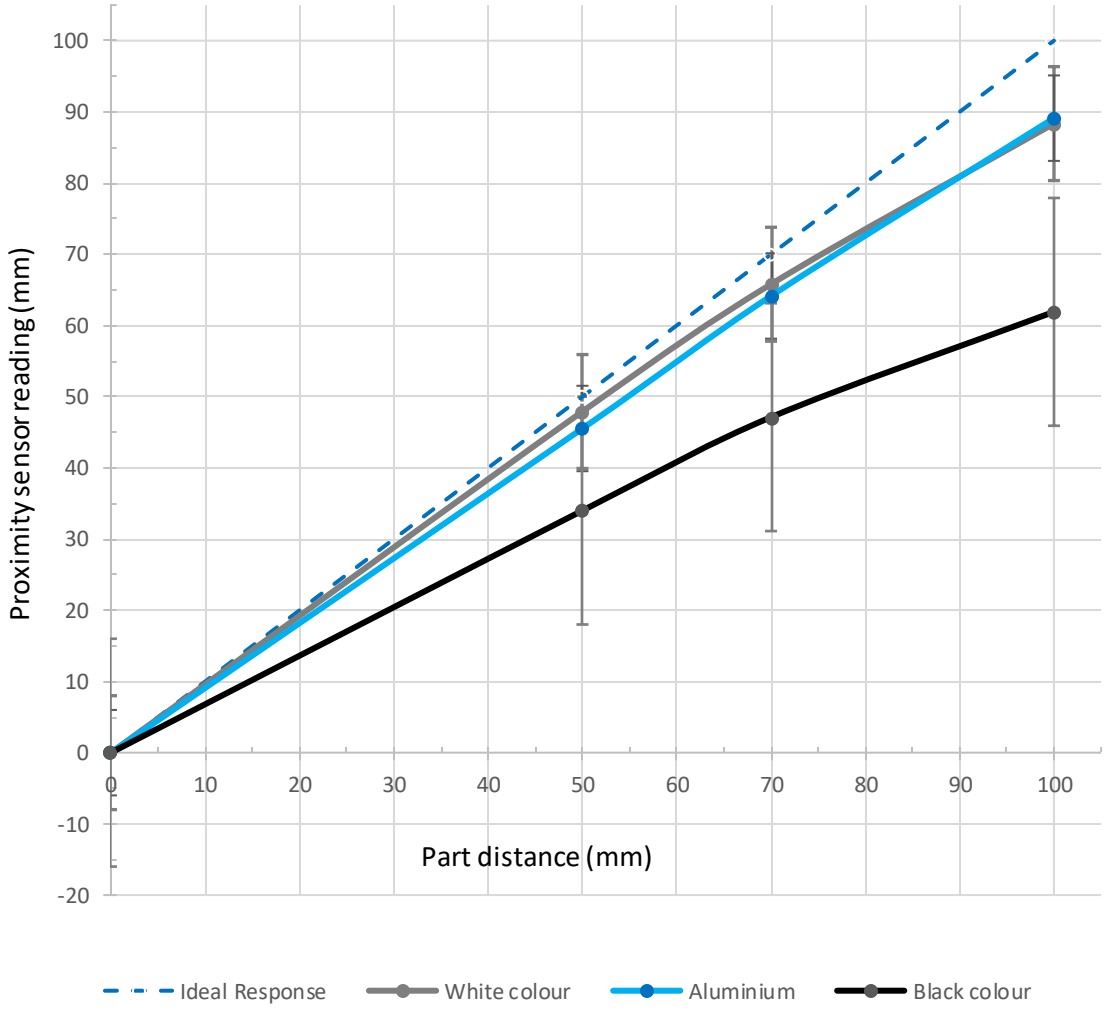
Force Sensor Properties	Fxy	Fz	Txy	Tz	Units
Nominal capacity (N.C.)	20	40	0.7	0.5	[N] [Nm]
Single axis overload	200	200	200	200	[%]
Noise free resolution	0.1	0.4	0.008	0.005	[N] [Nm]
Single axis deformation at N.C.	0.4 0.015	0.1 0.04	2	5	[mm] [°] [inch] [°]
Full scale nonlinearity Temperature compensation	< 2				[%]

Proximity Sensor Properties	Min	Typical	Max	Units
Sensing range	0 0	- -	100 3.93	[mm] [inch]
Precision	- -	2 0.078	- -	[mm] [inch]
Non-linearity*	-	12	-	[%]

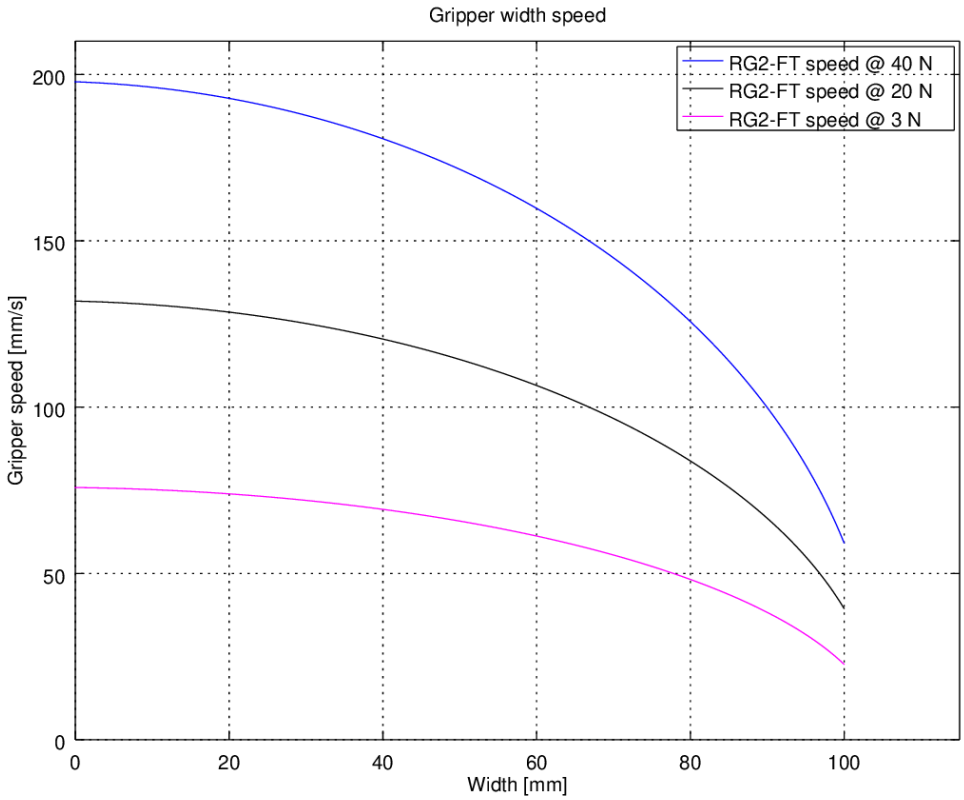
* the non-linearity refers to the max value and depends on the object properties (e.g. surface type and color)

Operating Conditions	Minimum	Typical	Maximum	Unit
Power requirement (PELV)	24	-	24	[V]
Power consumption	6.5	-	22	[W]
Operating temperature	0 32	- -	55 131	[°C] [°F]
Relative humidity (non-condensing)	0	-	95	[%]
Calculated MTBF (operating life)	30.000	-	-	[Hours]

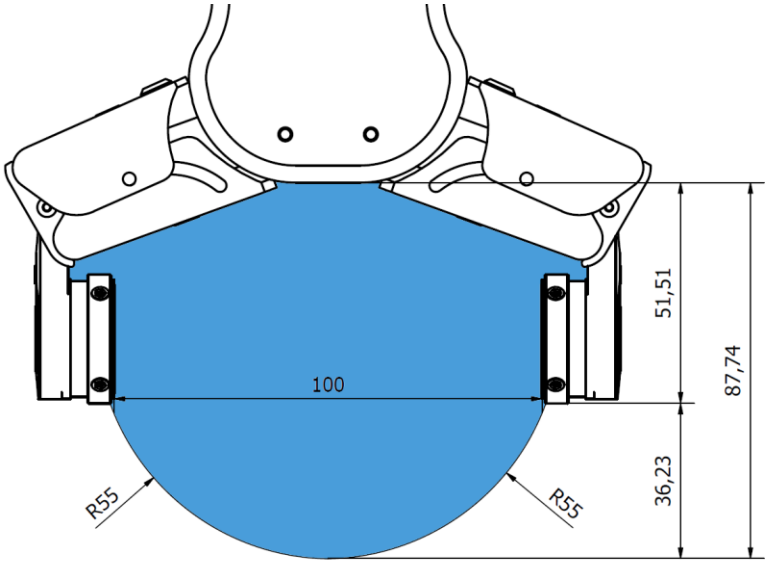
Proximity sensor typical accuracy



RG2-FT Gripping Speed Graph



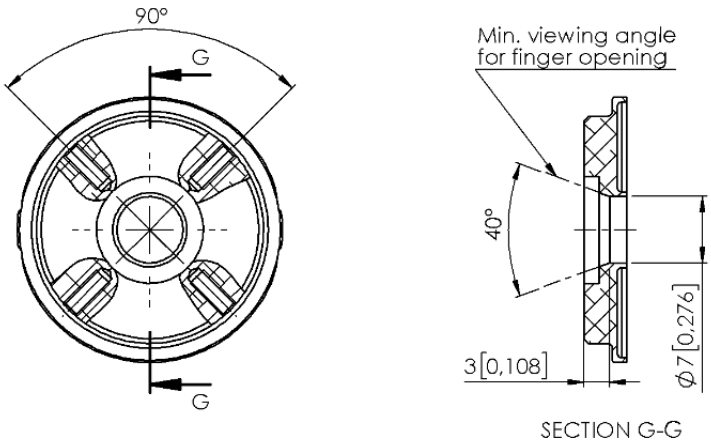
Gripper Working Range

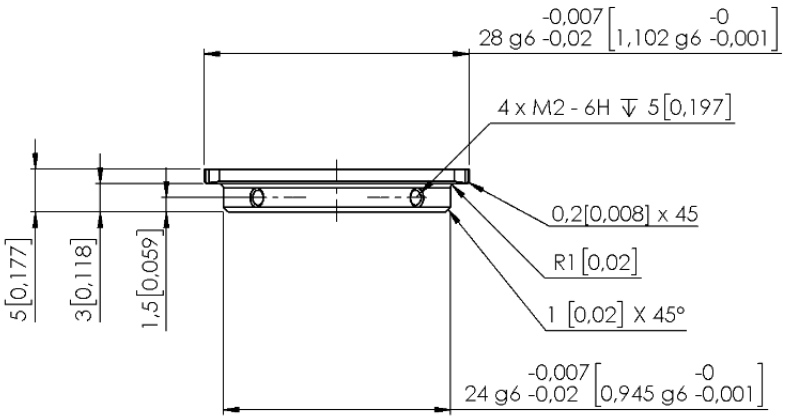


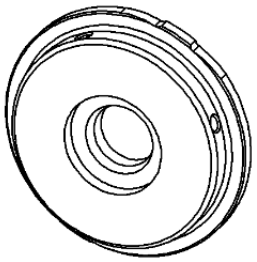
The dimensions are in millimeters.

Fingertips

The standard fingertips can be used for many different workpieces. If custom fingertips are required, they can be made to fit the Gripper fingers.







Dimensions of the Gripper's finger, in millimeters.

NOTE:

During the fingertip design, the following shall be considered to maintain optimal performance:

Clear optical path for the proximity sensors

Protect the proximity sensors from direct sunlight or strong light source

Avoid dust and liquid penetration

WARNING:

The proximity sensors are sensitive parts and shall be protected against:

Direct strong light (such as directional laser sources)

Direct high temperature

Mechanical contacts in any case

Expose to any liquid or fine conductive dust

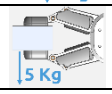
NOTE:

Please clean regularly the proximity sensor surface with low pressure compressed air (<5 bar) from a 5 cm distance. For stronger contamination use isopropyl alcohol with a soft cotton swab to keep it clean.

Finger Thickness

The default fingertips are considered while the finger thickness has been set and could not be changed in the software. In case when custom fingertips are used, the user should manually compensate for the difference in the finger thickness.

RG2

General Properties	Minimum	Typical	Maximum	Unit
Payload Force Fit 	- -	- -	2 4.4	[kg] [lb]
Payload Form Fit 	- -	- -	5 11	[kg] [lb]
Total stroke (adjustable)	0 0	- -	110 4.33	[mm] [inch]
Finger position resolution	- -	0.1 0.004	- -	[mm] [inch]
Repetition accuracy	- -	0.1 0.004	0.2 0.007	[mm] [inch]
Reversing backlash	0.1 0.004	- -	0.3 0.011	[mm] [inch]
Gripping force (adjustable)	3	-	40	[N]
Gripping force deviation		±25		%
Gripping speed*	38	-	127	[mm/s]
Gripping time**	0.06	-	0.21	[s]
Adjustable bracket tilting accuracy	-	< 1	-	°
Storage temperature	0 32	- -	60 122	[°C] [°F]
Motor	Integrated, electric BLDC			
IP Classification	IP54			
Dimensions	213 x 149 x 36 8.3 x 5.9 x 1.4			[mm] [inch]
Weight	0.78 1.72			[kg] [lb]

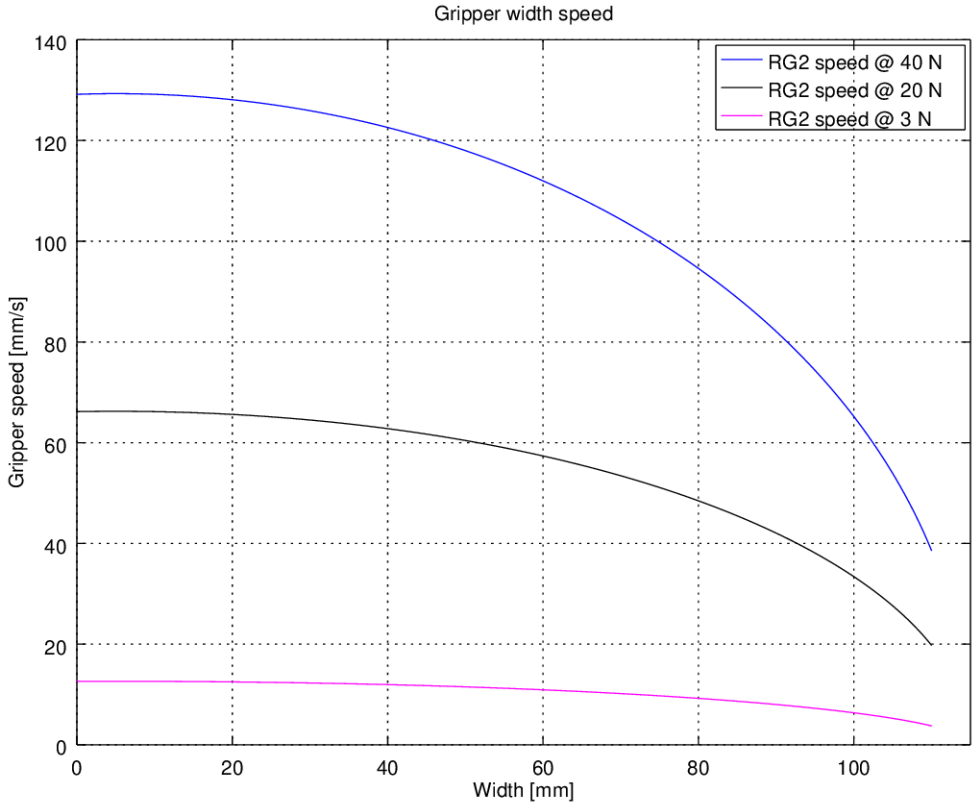
*See table on the next page

** based on 8mm total movement between fingers. The speed is linearly proportional to the force. For more details see speed table on next page.

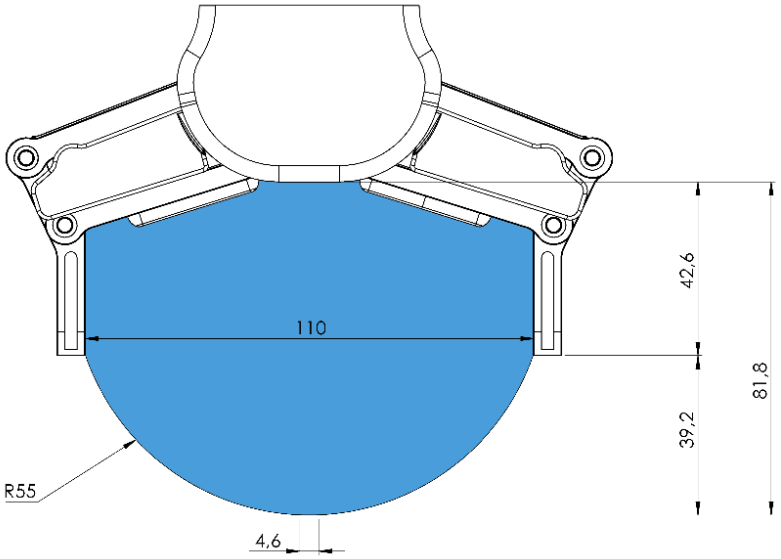
Operating Conditions	Minimum	Typical	Maximum	Unit
Power supply	20	24	25	[V]
Current consumption	70	-	600*	[mA]
Operating temperature	5 41	- -	50 122	[°C] [°F]
Relative humidity (non-condensing)	0	-	95	[%]
Calculated MTBF (operating life)	30.000	-	-	[Hours]

*Current spikes up to 3A (max 6mS) may occur during the release action.

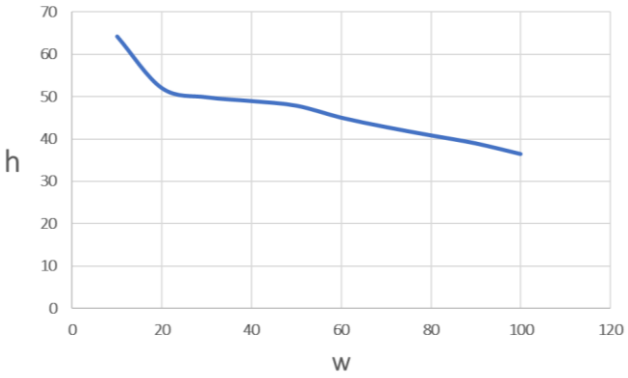
RG2 Gripping Speed Graph



RG2 Work Range

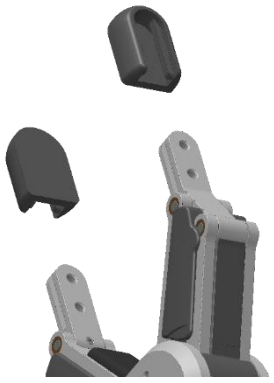


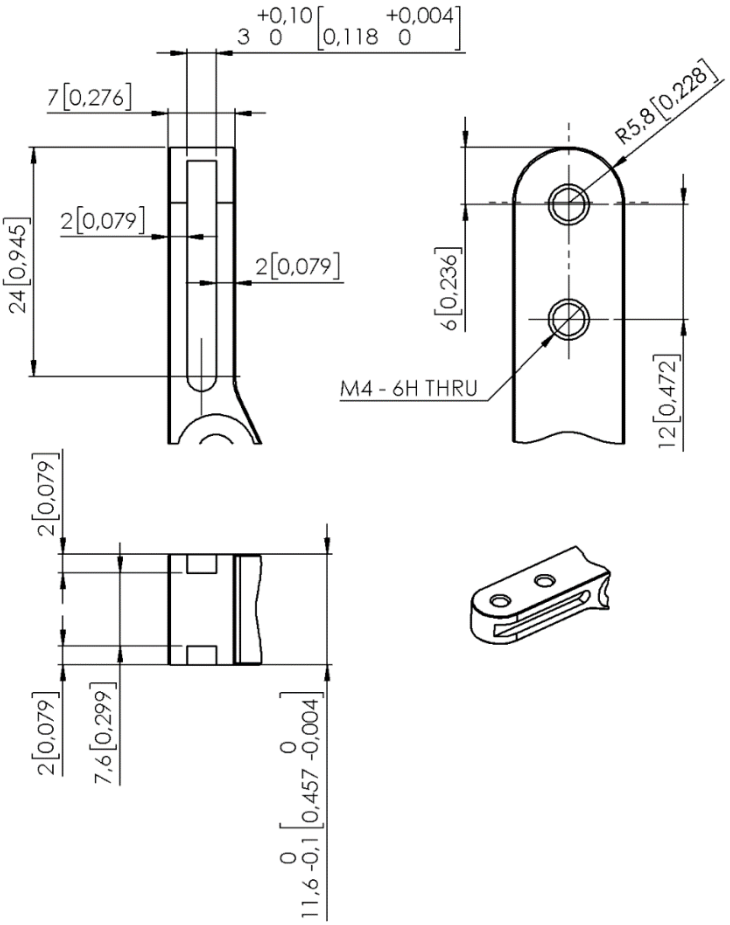
Gripping on long objects can unintentionally activate the Safety switches. The maximum workpiece height (calculated from the end of the fingertips) is dependent on the gripping width (w). For various width values the height (h) limit is given below:



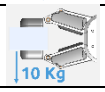
Fingertips

The standard fingertips can be used for many different workpieces. If custom fingertips are required, they can be made to fit the Gripper's fingers according to the dimensions (mm) shown below:





RG6

General Properties	Minimum	Typical	Maximum	Unit
Payload Force Fit 	- -	- -	6 13.2	[kg] [lb]
Payload Form Fit 	- -	- -	10 22.04	[Kg] [lb]
Total stroke (adjustable)	0 -	- -	160 6.3	[mm] [inch]
Finger position resolution	- -	0.1 0.004	- -	[mm] [inch]
Repetition accuracy	- -	0.1 0.004	0.2 0.007	[mm] [inch]
Reversing backlash	0.1 0.004	- -	0.3 0.011	[mm] [inch]
Gripping force (adjustable)	25	-	120	[N]
Gripping force deviation		±25		%
Gripping speed*	51	-	160	[mm/s]
Gripping time**	0.05	-	0.15	
Adjustable bracket tilting accuracy		< 1		°
Storage temperature	0 32		60 122	[°C] [°F]
Motor	Integrated, electric BLDC			
IP Classification	54			
Dimensions	262 x 212 x 42 10.3 x 8.3 x 1.6			[mm] [inch]
Weight	1.25 2.76			[kg] [lb]

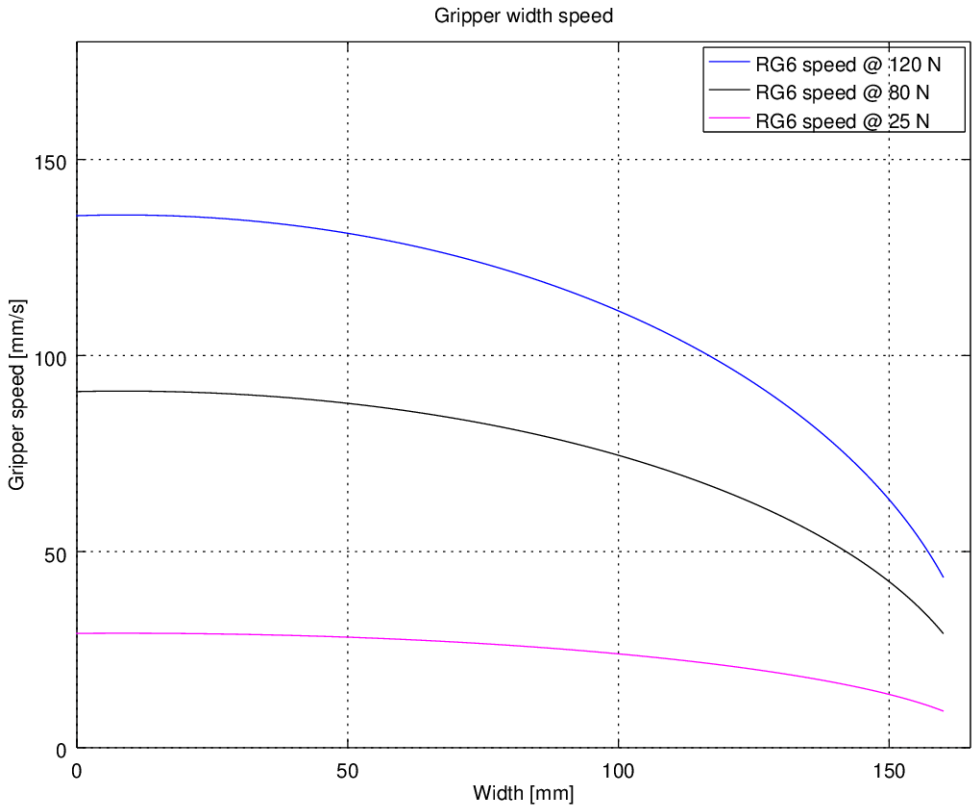
*See table on the next page

** based on 8mm total movement between fingers. The speed is linearly proportional to the force. For more details see speed table on next page.

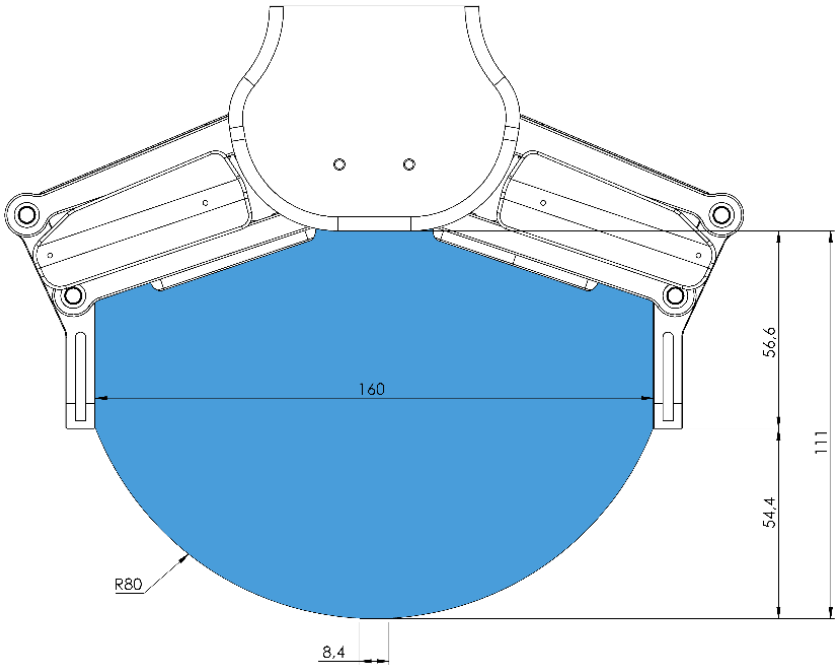
Operating Conditions	Minimum	Typical	Maximum	Unit
Power supply	20	24	25	[V]
Current consumption	70	-	600*	[mA]
Operating temperature	5 41	- -	50 122	[°C] [°F]
Relative humidity (non-condensing)	0	-	95	[%]
Calculated MTBF (operating life)	30.000	-	-	[Hours]

*Current spikes up to 3A (max 6mS) may occur during the release action.

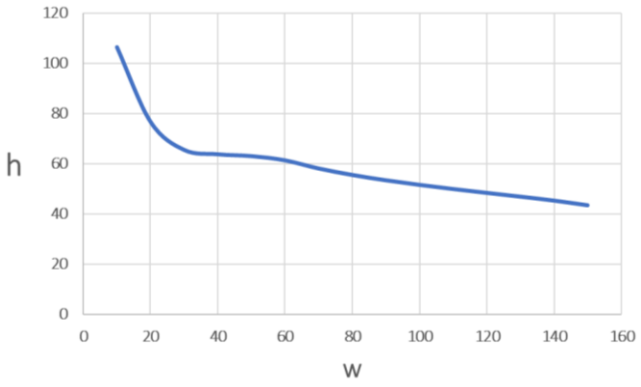
RG6 Gripping Speed Graph



RG6 Work Range

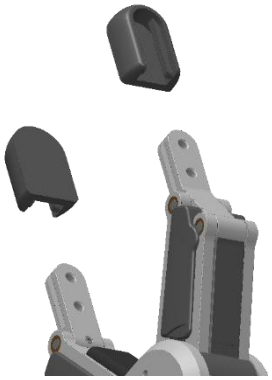


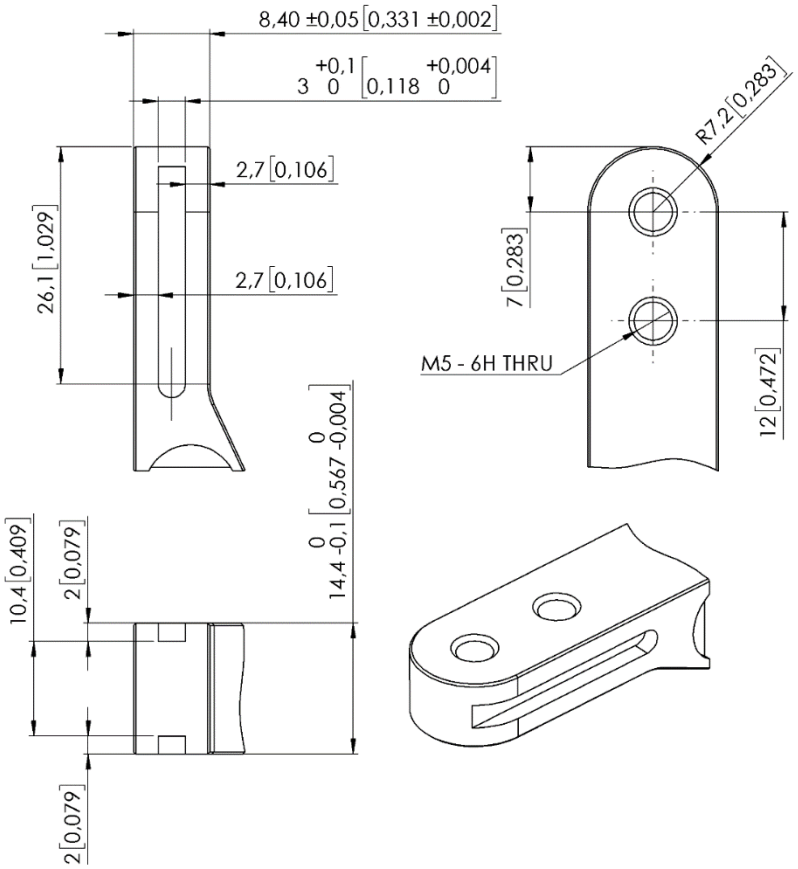
Gripping on long objects can unintentionally activate the Safety switches. The maximum workpiece height (calculated from the end of the fingertips) is dependent on the gripping width (w). For various width values the height (h) limit is given below:



Fingertips

The standard fingertips can be used for many different workpieces. If custom fingertips are required, they can be made to fit the Gripper's fingers according to the dimensions (mm) shown below:





VG10

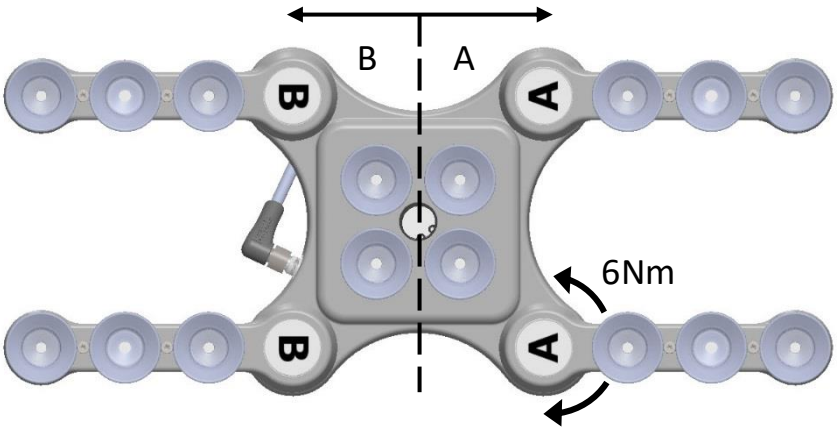
General Properties		Minimum	Typical	Maximum	Unit
Vacuum		5 % -0.05 1.5	- - -	80 % -0.810 24	[Vacuum] [Bar] [inHg]
Air flow		0	-	12	[L/min]
Arms adjustment		0	-	270	[°]
Arm holding torque		-	6	-	[Nm]
Payload	Rated	10 22			[kg] [lb]
	Maximum	15 33			[kg] [lb]
Vacuum cups		1	-	16	[pcs.]
Gripping time		-	0.35	-	[s]
Releasing time		-	0.20	-	[s]
Foot-inch-foot		-	1.40	-	[s]
Vacuum pump		Integrated, electric BLDC			
Arms		4, adjustable by hand			
Dust filters		Integrated 50µm, field replaceable			
IP Classification		IP54			
Dimensions (folded)		105 x 146 x 146 4.13 x 5.75 x 5.75		[mm] [inch]	
Dimensions (unfolded)		105 x 390 x 390 4.13 x 15.35 x 15.35		[mm] [inch]	
Weight		1.62 3.57		[kg] [lb]	

Operating Conditions	Minimum	Typical	Maximum	Unit
Power supply	20.4	24	28.8	[V]
Current consumption	50	600	1500	[mA]
Operating temperature	0 32	- -	50 122	[°C] [°F]
Relative humidity (non-condensing)	0	-	95	[%]
Calculated MTBF (operating life)	30.000	-	-	[hours]

Positioning the VG10 arms and channels

The arms can be folded to the preferred position simply by pulling in the arms. The torque needed to overcome the friction in the rotatable joints of the arm is high (6 N/m) to ensure that the arms do not move when handling 15 kg payloads.

The VG10 suction cups are grouped into two independent channels.



When the four arms are adjusted to preferred angles, it is recommended to add the accompanied arrow stickers. This allows for easy realignment and exchanging between different work items.

Payload

The lifting capacity of the VG grippers depends primarily on the following parameters:

- Vacuum cups
- Vacuum
- Air flow

Vacuum Cups

Choosing the right vacuum cups for your application is essential. The VG grippers come with common 15, 30 and 40 mm silicone vacuum cups (see table below) which are good for hard and flat surfaces, but not good for uneven surfaces and it might leave microscopic traces of silicone on the workpiece which can cause issues with some types of painting processes afterwards.

Image	External Diameter [mm]	Internal Diameter [mm]	Gripping Area [mm2]
	15	6	110
	30	8	200
	40	12	450

For non-porous materials, the OnRobot suction cups are highly recommended. Some of the most common non-porous materials are listed below:

- Composites
- Glass
- High density cardboard
- High density paper
- Metals
- Plastic
- Porous materials with a sealed surface
- Varnished wood

In an ideal case, working with non-porous material workpieces where there are no air flow going through the workpiece, the table below shows the number of cups and the cup size needed depending on the payload (workpiece mass) and the vacuum used.

Number of Cups needed for non-porous materials depending on payload and vacuum:

	 15mm				 30mm				 40mm			
Payload (kg)	Vacuum (kPa)				Vacuum (kPa)				Vacuum (kPa)			
	20	40	60	75	20	40	60	75	20	40	60	75
1	7	4	3	2	4	2	2	1	2	1	1	1
2	14	7	5	4	8	4	3	2	4	2	2	1
3	-	11	7	6	12	6	4	3	5	3	2	2
4	-	14	9	8	15	8	5	4	7	4	3	2
5	-	-	12	9	-	10	7	5	9	5	3	3
6	-	-	14	11	-	12	8	6	10	5	4	3
7	-	-	16	13	-	13	9	7	12	6	4	4
8	-	-	-	15	-	15	10	8	14	7	5	4
9	-	-	-	-	-	-	12	9	15	8	5	4
10	-	-	-	-	-	-	13	10	-	9	6	5
11	-	-	-	-	-	-	14	11	-	9	6	5
12	-	-	-	-	-	-	15	12	-	10	7	6
13	-	-	-	-	-	-	16	13	-	11	8	6
14	-	-	-	-	-	-	-	14	-	12	8	7
15	-	-	-	-	-	-	-	15	-	13	9	7

NOTE:

To use more than 7 (15mm), 4 (30mm) or 3 (40mm) vacuum cups with the VGC10 a customized adaptor plate is needed.

The table above is created with the following formula that equalizes the lifting force with the payload considering 1.5g of acceleration.

$$\text{Amount}_{\text{Cups}} \cdot \text{Area}_{\text{Cup}}[\text{mm}\} = 19600 \frac{\text{Payload [kg]}}{\text{Vacuum [kPa]}}$$

It is often a good idea to use more vacuum cups than needed, to accommodate for vibrations, leaks and other unexpected conditions. However, the more vacuum cups, the more air leakage (air flow) is expected and the more air is moved in a grip resulting in longer gripping times.

When using porous materials, the vacuum that can be achieve by using the OnRobot suction cups will depend on the material itself and will be between the range stated in the specifications. Some of the most common non-porous materials are listed below:

- Fabrics
- Foam
- Foam with open cells

- Low density cardboard
- Low density paper
- Perforated materials
- Untreated wood

See the table below with general recommendations, in case other suction cups are needed for specific materials.

Workpiece surface	Vacuum cup shape	Vacuum cup material
Hard and flat	Normal or dual lip	Silicone or NBR
Soft plastic or plastic bag	Special plastic bag type	Special plastic bag type
Hard but curved or uneven	Thin dual lip	Silicone or soft NBR
To be painted afterwards	Any type	NBR only
Varying heights	1.5 or more bevels	Any type

NOTE:

It is recommended to consult a vacuum cup specialist to find the optimal vacuum cup where the standard types are insufficient.

Fittings and Blind Screws.

It is possible to change suction cups simply by pulling them off the fittings. It might be a bit challenging to remove the 15 mm Diameter vacuum cups. As suggestion try to stretch the silicon to one of the sides and then pull it out.

Unused holes can be blinded using a blind screw, and each fitting can be changed to a diffe rent type to match the desired suction cup. The fittings and the blinding screws are mounted or dismounted by screwing (2Nm tightening torque) or unscrewing them with the provided 3 mm Allen key.

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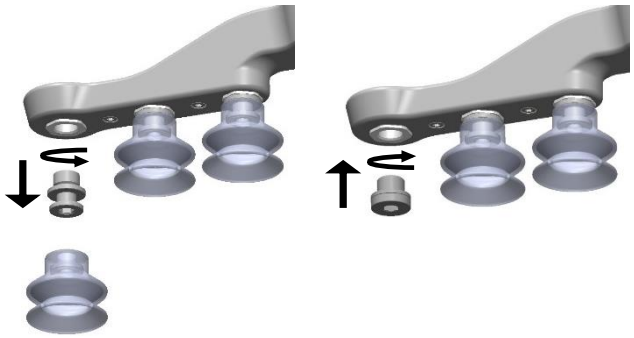


The thread size is the commonly used G1/8”; allowing for standard fittings, blinders and extenders to be fitted directly to the VG grippers.

Vacuum

Vacuum is defined as the percentage of absolute vacuum achieved relative to atmospheric pressure, i.e.:

% vacuum	Bar	kPa	inHg	Typically used for
0%	0.00rel. 1.01 abs.	0.00rel. 101.3 abs.	0.0rel. 29.9 abs.	No vacuum / No lifting capacity
20%	0.20rel. 0.81 abs.	20.3rel. 81.1 abs.	6.0rel. 23.9 abs.	Cardboard and thin plastics
40%	0.41rel. 0.61 abs.	40.5rel. 60.8 abs.	12.0rel. 18.0 abs.	Light workpieces and long suction cup life span
60%	0.61rel. 0.41 abs.	60.8rel. 40.5 abs.	18.0rel. 12.0 abs.	Heavy workpieces and strongly secured grips
80%	0.81rel. 0.20 abs.	81.1rel. 20.3 abs	23.9rel. 6.0 abs.	Max. vacuum. Not recommended

The vacuum in kPa setting is the target vacuum. The pump will run at full speed until the target vacuum is achieved, and then run at a lower speed necessary to maintain the target vacuum.

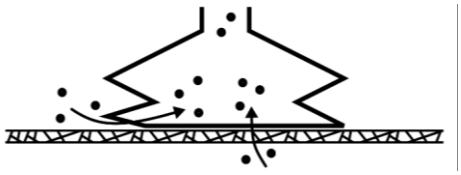
The pressure in the atmosphere varies with weather, temperature and altitude. The VG grippers automatically compensate for altitudes up to 2km, where the pressure is about 80% of sea level.

Air flow

Air flow is the amount of air that must be pumped to maintain the target vacuum. A completely tight system will not have any air flow, whereas real life applications have some smaller air leakages from two different sources:

- Leaking vacuum cup lips
- Leaking workpieces

The smallest leak under a vacuum cup can be hard to find (see picture below).



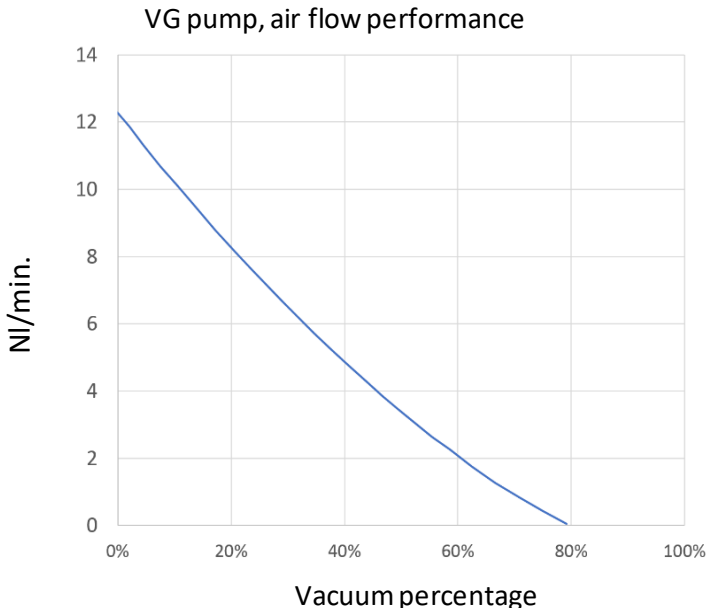
Leaking workpieces can be even harder to identify. Things that look completely tight might not be tight at all. A typical example is coarse cardboard boxes. The thin outer layer is often requiring a lot of air flow to create a pressure difference over it (see figure below).

Therefore, the users must be aware of the following:

- VG grippers are not suitable for most uncoated, coarse cardboard boxes.

- Extra attention must be paid to leakages, e.g. vacuum cup shape and surface roughness

The air flow capability of a VG grippers is shown in the graph below:



NOTE:

The easiest way to check if a cardboard box is sufficiently tight is simply to test it using the VG grippers.

A high vacuum percentage setting does not give a higher lifting capacity on corrugated cardboard. In fact, a lower setting is recommended, e.g. 20%.

A low vacuum setting results in less air flow and less friction below the vacuum cups. This means VG gripper filters and vacuum cups will last longer.

VGC10

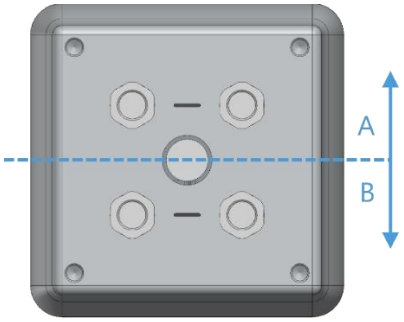
General Properties		Minimum	Typical	Maximum	Unit
Vacuum		5 % -0.05 1.5	- - -	80 % -0.810 24	[Vacuum] [Bar] [inHg]
Air flow		0	-	12	[L/min]
Payload	With default attachments	- -	- -	6 * 13.2 *	[kg] [lb]
	With customized attachments	- -	10 22	15 33.1	[kg] [lb]
Vacuum cups		1	-	7	[pcs.]
Gripping time		-	0.35	-	[s]
Releasing time		-	0.20	-	[s]
Vacuum pump		Integrated, electric BLDC			
Dust filters		Integrated 50µm, field replaceable			
IP Classification		IP54			
Dimensions		101 x 100 x 100 3.97 x 3.94 x 3.94		[mm] [inch]	
Weight		0.814 1.79		[kg] [lb]	

* By using three 40mm cups. More info in a table on page 174.

Operating Conditions	Minimum	Typical	Maximum	Unit
Power supply	20.4	24	28.8	[V]
Current consumption	50	600	1500	[mA]
Operating temperature	0 32	- -	50 122	[°C] [°F]
Relative humidity (non-condensing)	0	-	95	[%]
Calculated MTBF (operating life)	30.000	-	-	[hours]

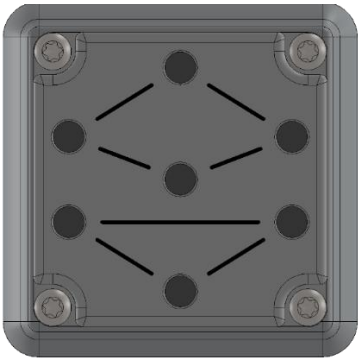
2 channels

The VGC10 has 4 holes to use fittings with vacuum cups or blinding screws as needed. It also has lines which show the holes that are communicated together. This is useful when using channels A and B independently for vacuum.

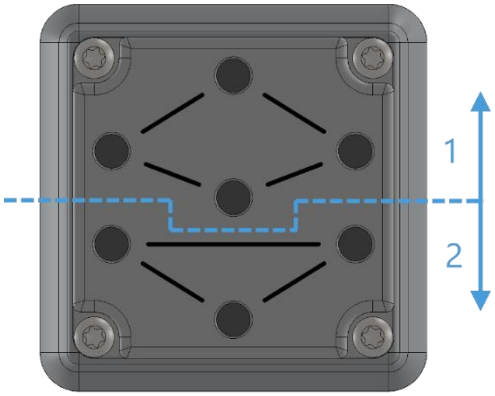


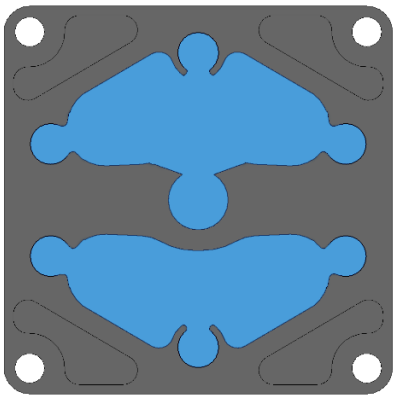
Adaptor Plate

The VGC10 comes with an Adaptor Plate which provides extra flexibility to locate the vacuum cups in different configurations.

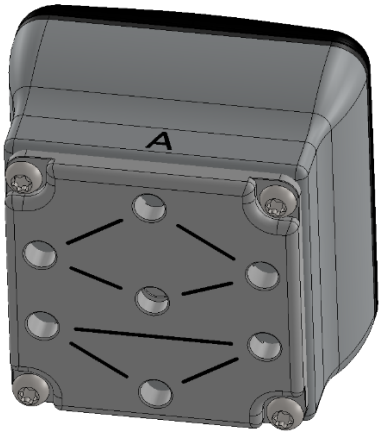


The Adaptor Plate has 7 holes to use fittings with vacuum cups or blinding screws as needed. It also has lines which show the holes that are communicated together. This is useful when using channel A and B independently for vacuum.

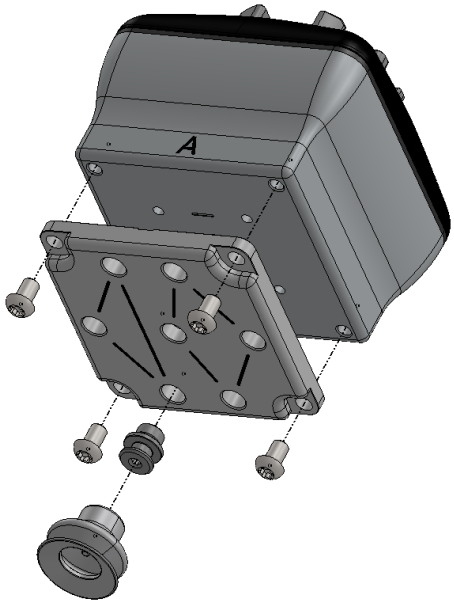




The Adaptor Plate can be placed in different positions by rotating it 90º. Having as reference the letters A and B written on the gripper housing, the Adaptor Plate can be placed to separate both channels or to communicate them. If the Adaptor Plate is placed as in picture below on the left, both channels will be separated, and they can be used independently or combined. If the Adaptor Plate is placed as in picture below on the right, both channels will be communicated and a higher air flow can be achieved, although both channels will have to be used combined.



To mount the Adaptor Plate simply remove the 4 fittings or blinding screws from the gripper, place the Adaptor Plate by choosing the right angle according to the desired configuration, and tighten the 4 screws with 4 Nm tighten torque.



NOTE:

Please, note that the O-Ring in the Adaptor Plate is not glued therefore it can be pulled out. If that happens simply put it back in place and the gripper will work as before.

Extension Pipe

The Extension Pipe provides an extra length of 50 mm to reach narrow spaces.

NOTE:

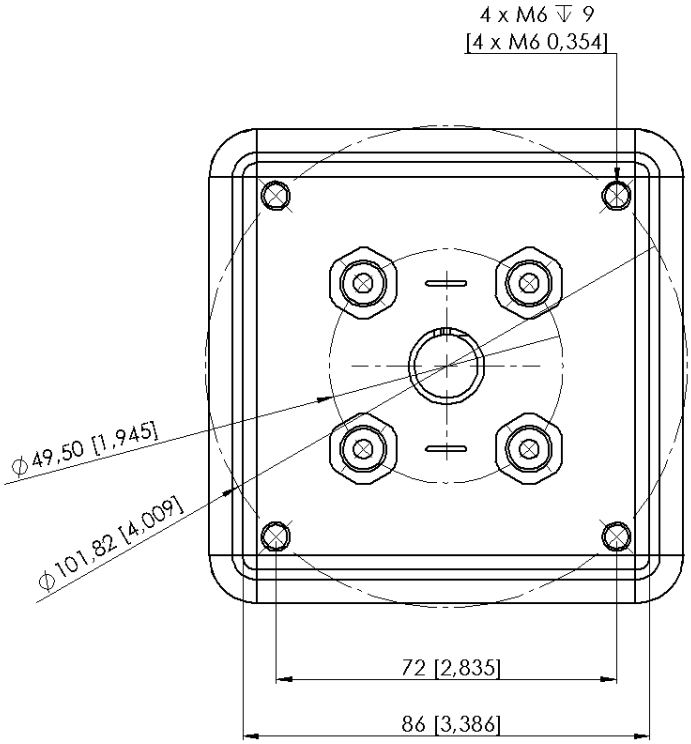
Remember to use the Adaptor Plate rotated to achieve a higher air flow when using both channels together.

The Extension Pipe can be mounted in any of the holes by simply screwing it in and adding a fitting on top as shown in the image below.

Below different mounting configurations with the provided attachments are shown.

Customized Adaptor Plates and Push-in Fittings

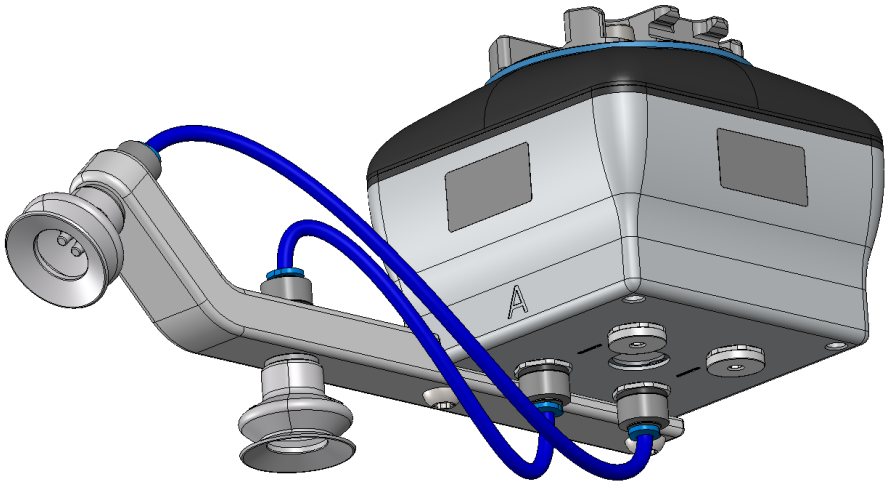
The design of the VGC10 is meant to facilitate the users to make their own adaptor plates to create different kinds of configurations. The dimensions needed to create a customized adaptor plate are shown in the image below.

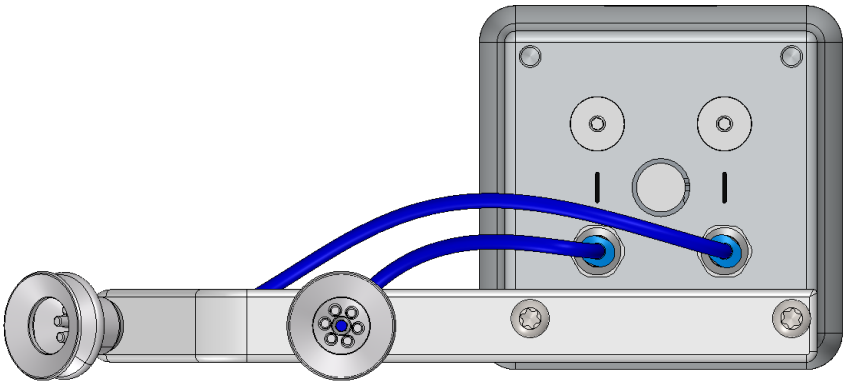


The Push-in Fittings are used to attach 4 mm vacuum tubes to create customized configuration that required remote vacuum. In most cases, this size is enough for generating the needed vacuum from the pump in the gripper.

The commercial name of the Push-in Fittings is Fitting QSM-G1/8-4-I-R in case some more units need to be purchased.

An example of a customized configuration with a homemade adaptor plate and remote vacuum is shown below.





The image below shows how the push-in fittings and the normal fittings are communicated.

Payload

The lifting capacity of the VG grippers depends primarily on the following parameters:

- Vacuum cups
- Vacuum
- Air flow

Vacuum Cups

Choosing the right vacuum cups for your application is essential. The VG grippers come with common 15, 30 and 40 mm silicone vacuum cups (see table below) which are good for hard and flat surfaces, but not good for uneven surfaces and it might leave microscopic traces of silicone on the workpiece which can cause issues with some types of painting processes afterwards.

Image	External Diameter [mm]	Internal Diameter [mm]	Gripping Area [mm2]
	15	6	110
	30	8	200
	40	12	450

For non-porous materials, the OnRobot suction cups are highly recommended. Some of the most common non-porous materials are listed below:

- Composites
- Glass
- High density cardboard
- High density paper
- Metals
- Plastic
- Porous materials with a sealed surface
- Varnished wood

In an ideal case, working with non-porous material workpieces where there are no air flow going through the workpiece, the table below shows the number of cups and the cup size needed depending on the payload (workpiece mass) and the vacuum used.

Number of Cups needed for non-porous materials depending on payload and vacuum:

	 15mm					 30mm					 40mm			
Payload (kg)	Vacuum (kPa)					Vacuum (kPa)					Vacuum (kPa)			
	20	40	60	75		20	40	60	75		20	40	60	75
1	7	4	3	2		4	2	2	1		2	1	1	1
2	14	7	5	4		8	4	3	2		4	2	2	1
3	-	11	7	6		12	6	4	3		5	3	2	2
4	-	14	9	8		15	8	5	4		7	4	3	2
5	-	-	12	9		-	10	7	5		9	5	3	3
6	-	-	14	11		-	12	8	6		10	5	4	3
7	-	-	16	13		-	13	9	7		12	6	4	4
8	-	-	-	15		-	15	10	8		14	7	5	4
9	-	-	-	-		-	-	12	9		15	8	5	4
10	-	-	-	-		-	-	13	10		-	9	6	5
11	-	-	-	-		-	-	14	11		-	9	6	5
12	-	-	-	-		-	-	15	12		-	10	7	6
13	-	-	-	-		-	-	16	13		-	11	8	6
14	-	-	-	-		-	-	-	14		-	12	8	7
15	-	-	-	-		-	-	-	15		-	13	9	7

NOTE:

To use more than 7 (15mm), 4 (30mm) or 3 (40mm) vacuum cups with the VGC10 a customized adaptor plate is needed.

The table above is created with the following formula that equalizes the lifting force with the payload considering 1.5g of acceleration.

$$\text{Amount}_{\text{Cups}} \cdot \text{Area}_{\text{Cup}}[\text{mm}\} = 19600 \frac{\text{Payload [kg]}}{\text{Vacuum [kPa]}}$$

It is often a good idea to use more vacuum cups than needed, to accommodate for vibrations, leaks and other unexpected conditions. However, the more vacuum cups, the more air leakage (air flow) is expected and the more air is moved in a grip resulting in longer gripping times.

When using porous materials, the vacuum that can be achieve by using the OnRobot suction cups will depend on the material itself and will be between the range stated in the specifications. Some of the most common non-porous materials are listed below:

- Fabrics
- Foam
- Foam with open cells
- Low density cardboard
- Low density paper
- Perforated materials
- Untreated wood

See the table below with general recommendations, in case other suction cups are needed for specific materials.

Workpiece surface	Vacuum cup shape	Vacuum cup material
Hard and flat	Normal or dual lip	Silicone or NBR
Soft plastic or plastic bag	Special plastic bag type	Special plastic bag type
Hard but curved or uneven	Thin dual lip	Silicone or soft NBR
To be painted afterwards	Any type	NBR only
Varying heights	1.5 or more bevels	Any type

NOTE:

It is recommended to consult a vacuum cup specialist to find the optimal vacuum cup where the standard types are insufficient.

Fittings and Blind Screws.

It is possible to change suction cups simply by pulling them off the fittings. It might be a bit challenging to remove the 15 mm Diameter vacuum cups. As suggestion try to stretch the silicon to one of the sides and then pull it out.

Unused holes can be blinded using a blind screw, and each fitting can be changed to a diffe rent type to match the desired suction cup. The fittings and the blinding screws are mounted or dismounted by screwing (2Nm tightening torque) or unscrewing them with the provided 3 mm Allen key.

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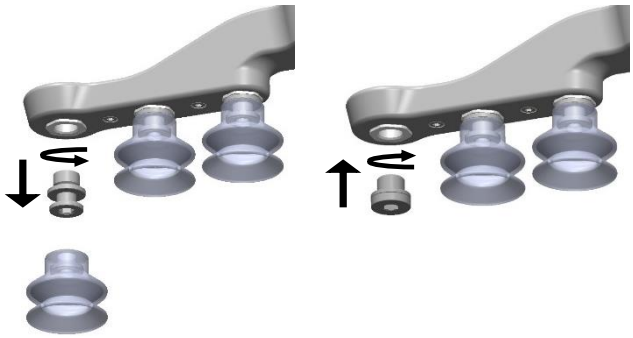


The thread size is the commonly used G1/8”; allowing for standard fittings, blinders and extenders to be fitted directly to the VG grippers.

Vacuum

Vacuum is defined as the percentage of absolute vacuum achieved relative to atmospheric pressure, i.e.:

% vacuum	Bar	kPa	inHg	Typically used for
0%	0.00rel. 1.01 abs.	0.00rel. 101.3 abs.	0.0rel. 29.9 abs.	No vacuum / No lifting capacity
20%	0.20rel. 0.81 abs.	20.3rel. 81.1 abs.	6.0rel. 23.9 abs.	Cardboard and thin plastics
40%	0.41rel. 0.61 abs.	40.5rel. 60.8 abs.	12.0rel. 18.0 abs.	Light workpieces and long suction cup life span
60%	0.61rel. 0.41 abs.	60.8rel. 40.5 abs.	18.0rel. 12.0 abs.	Heavy workpieces and strongly secured grips
80%	0.81rel. 0.20 abs.	81.1rel. 20.3 abs	23.9rel. 6.0 abs.	Max. vacuum. Not recommended

The vacuum in kPa setting is the target vacuum. The pump will run at full speed until the target vacuum is achieved, and then run at a lower speed necessary to maintain the target vacuum.

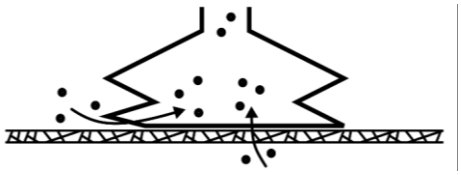
The pressure in the atmosphere varies with weather, temperature and altitude. The VG grippers automatically compensate for altitudes up to 2km, where the pressure is about 80% of sea level.

Air flow

Air flow is the amount of air that must be pumped to maintain the target vacuum. A completely tight system will not have any air flow, whereas real life applications have some smaller air leakages from two different sources:

- Leaking vacuum cup lips
- Leaking workpieces

The smallest leak under a vacuum cup can be hard to find (see picture below).



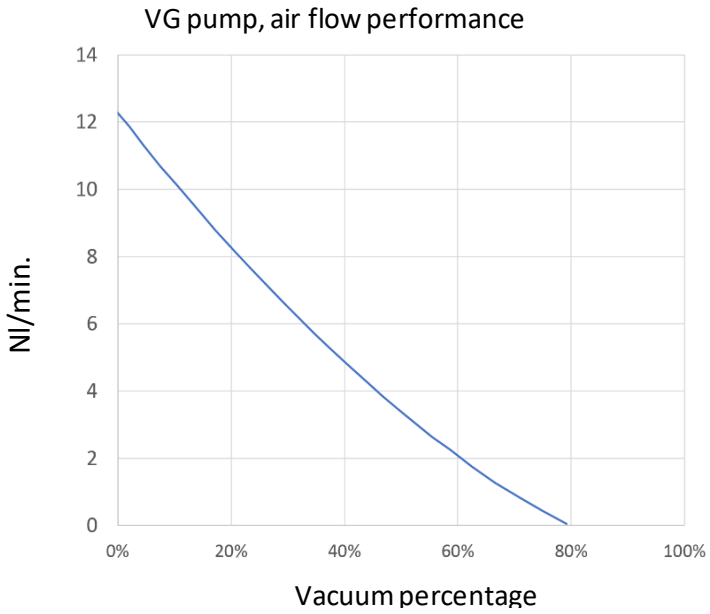
Leaking workpieces can be even harder to identify. Things that look completely tight might not be tight at all. A typical example is coarse cardboard boxes. The thin outer layer is often requiring a lot of air flow to create a pressure difference over it (see figure below).

Therefore, the users must be aware of the following:

- VG grippers are not suitable for most uncoated, coarse cardboard boxes.

- Extra attention must be paid to leakages, e.g. vacuum cup shape and surface roughness

The air flow capability of a VG grippers is shown in the graph below:



NOTE:

The easiest way to check if a cardboard box is sufficiently tight is simply to test it using the VG grippers.

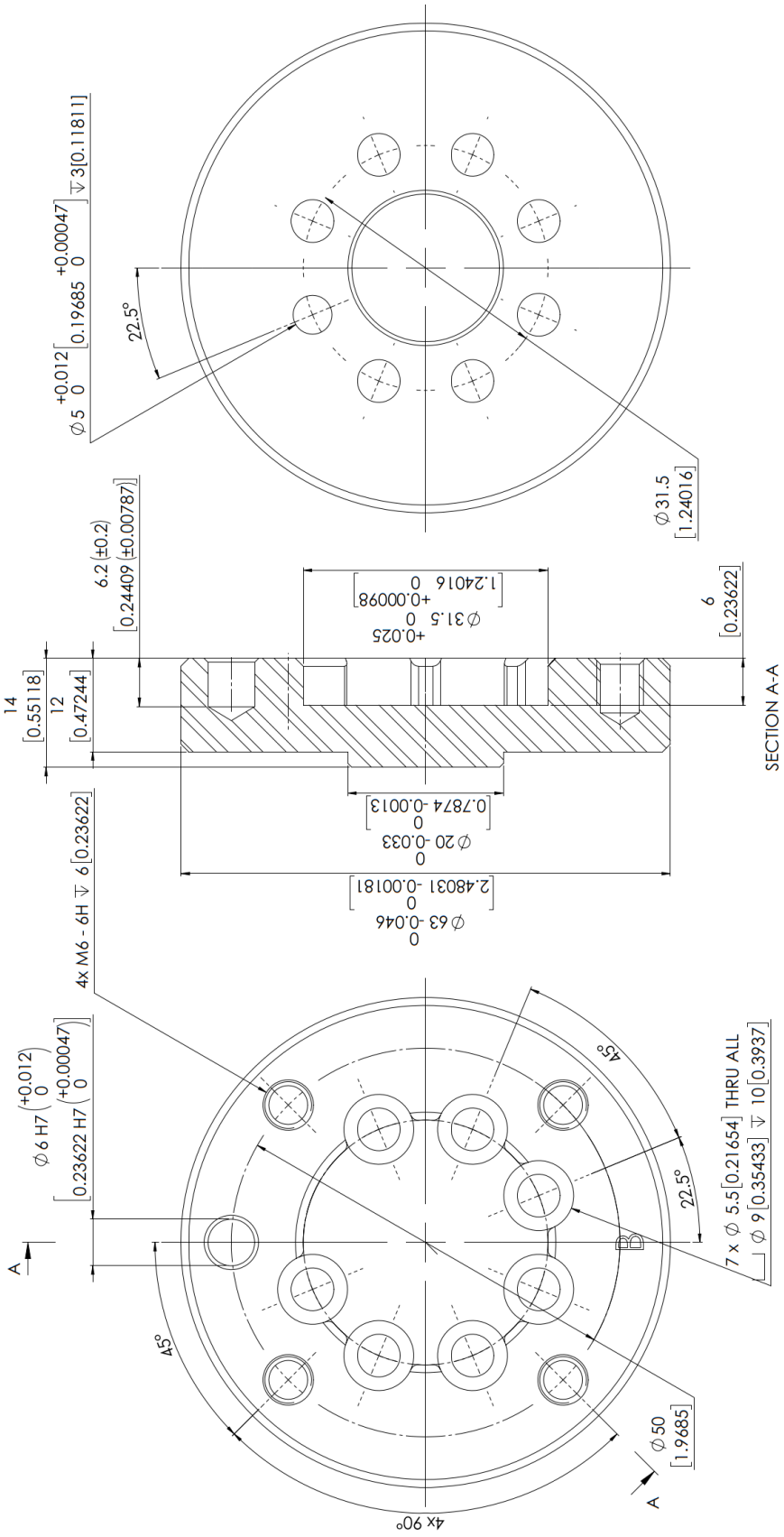
A high vacuum percentage setting does not give a higher lifting capacity on corrugated cardboard. In fact, a lower setting is recommended, e.g. 20%.

A low vacuum setting results in less air flow and less friction below the vacuum cups. This means VG gripper filters and vacuum cups will last longer.

11.2 Mechanical Drawings

11.2.1 Adapter plate(s)

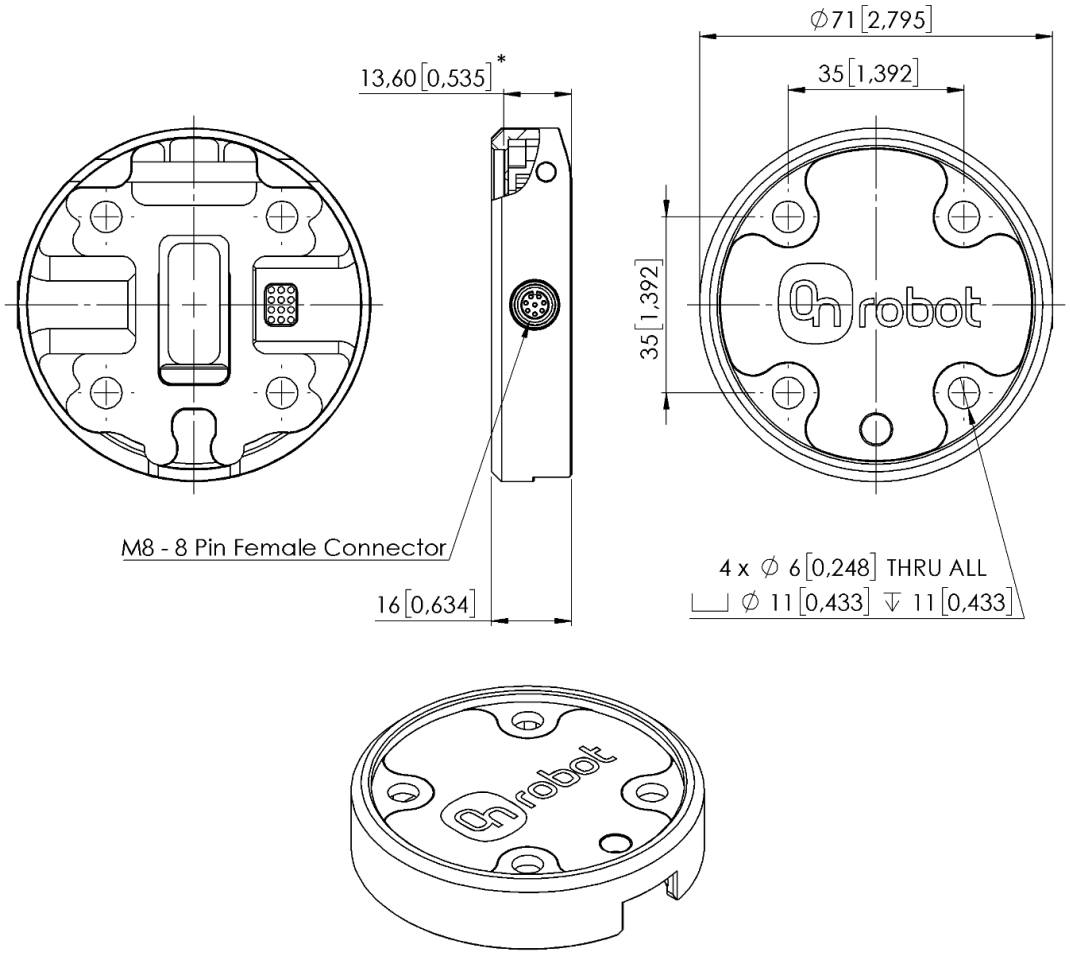
Adapter B



All dimensions are in mm and [inches].

11.2.2 Mountings

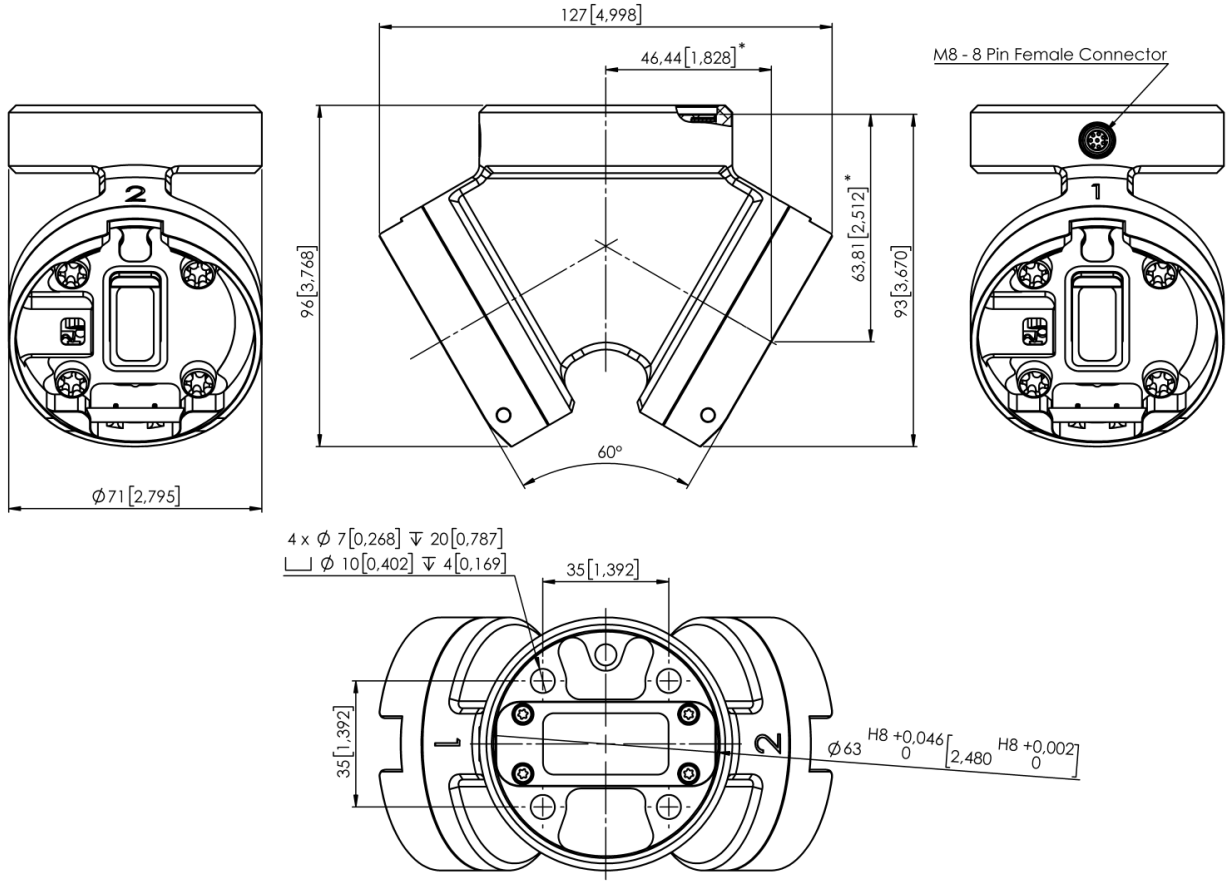
Quick Changer - Robot side



* Distance from Robot flange interface to OnRobot tool.

All dimensions are in mm and [inches].

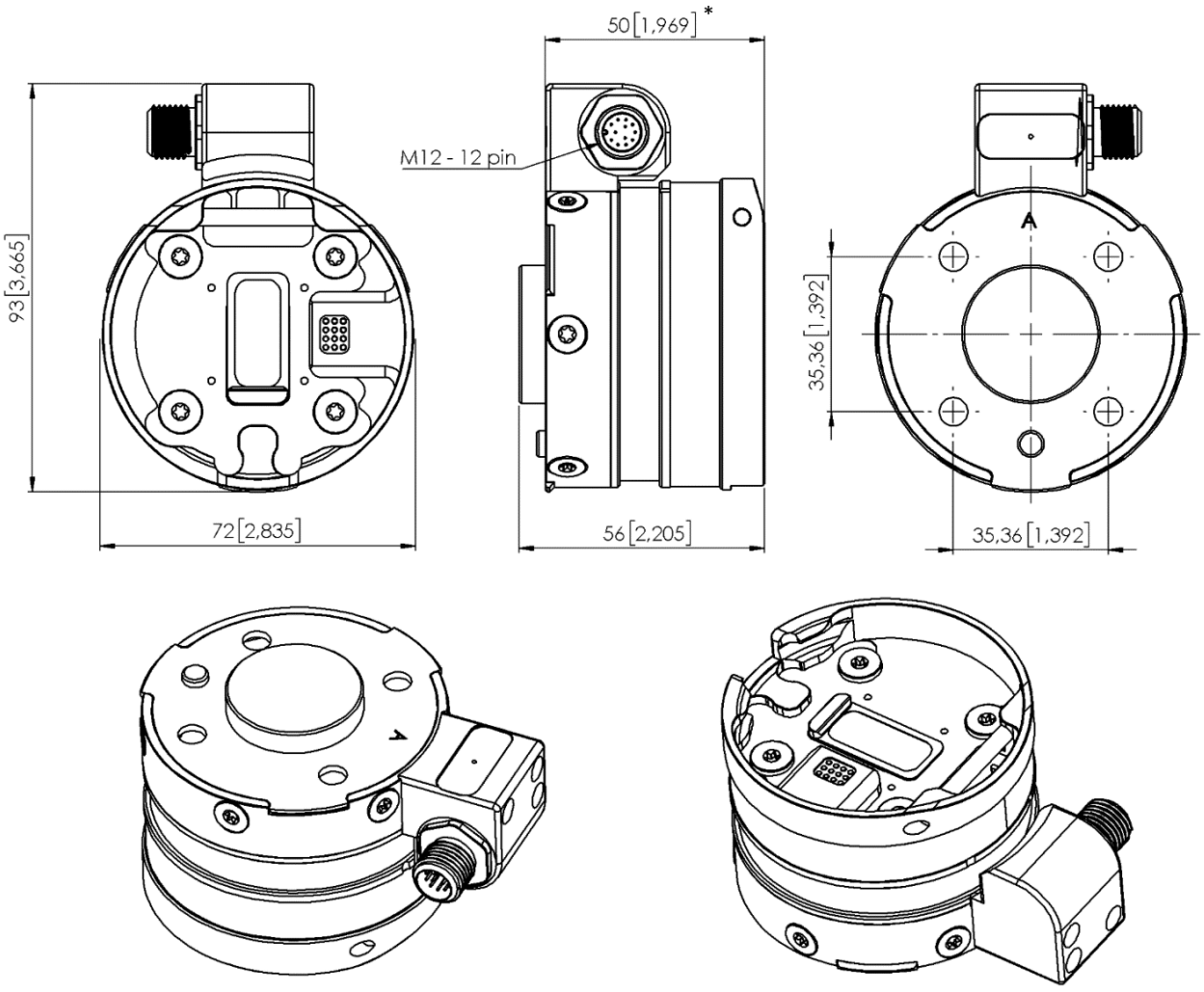
Dual Quick Changer



* Distance from Robot flange interface to OnRobot tool

All dimensions are in mm and [inches].

HEX-E/H QC

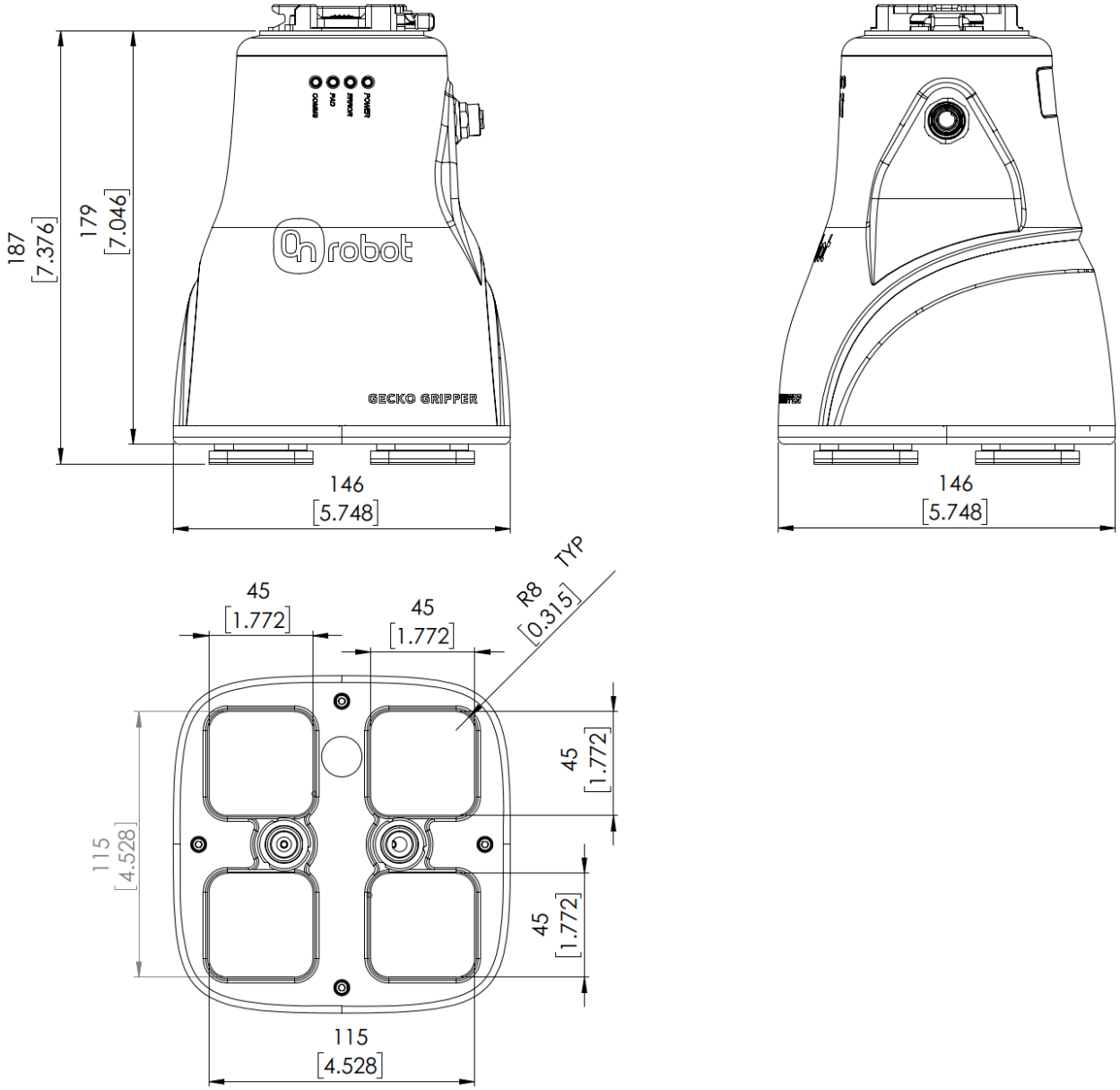


* Distance from Robot flange interface to OnRobot tool

All dimensions are in mm and [inches].

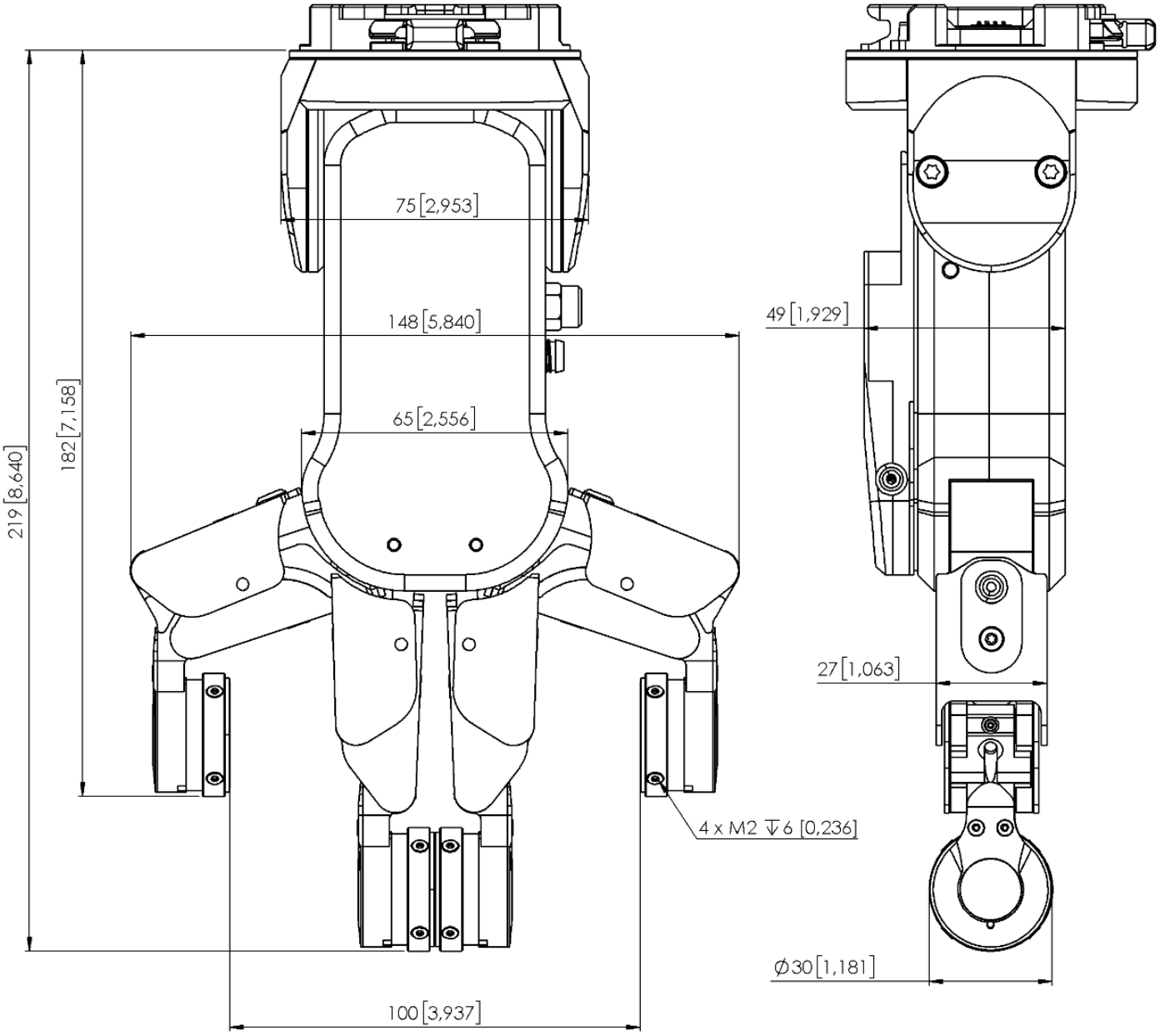
11.2.3 Tools

Gecko



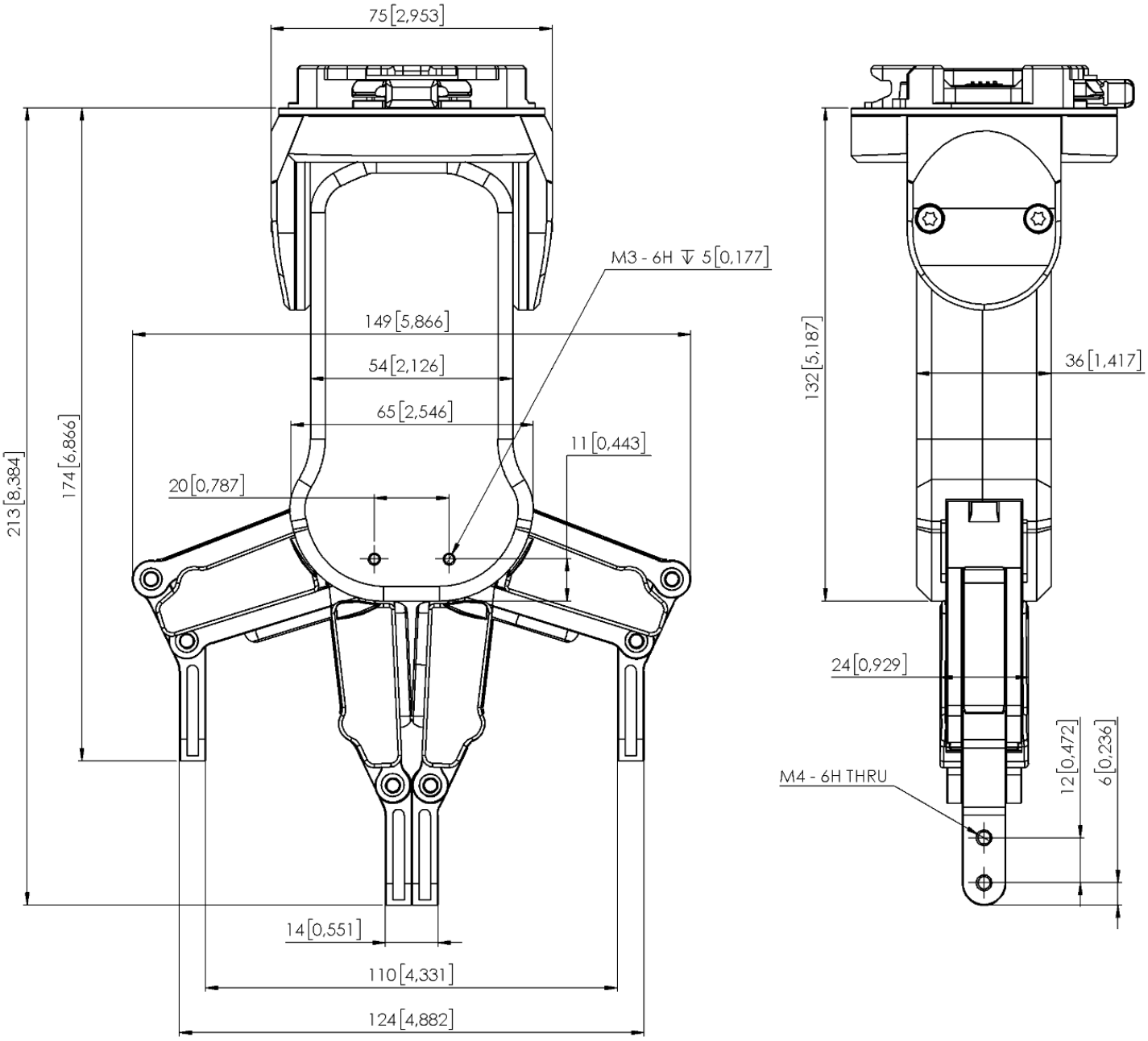
All dimensions are in mm and [inches].

RG2-FT



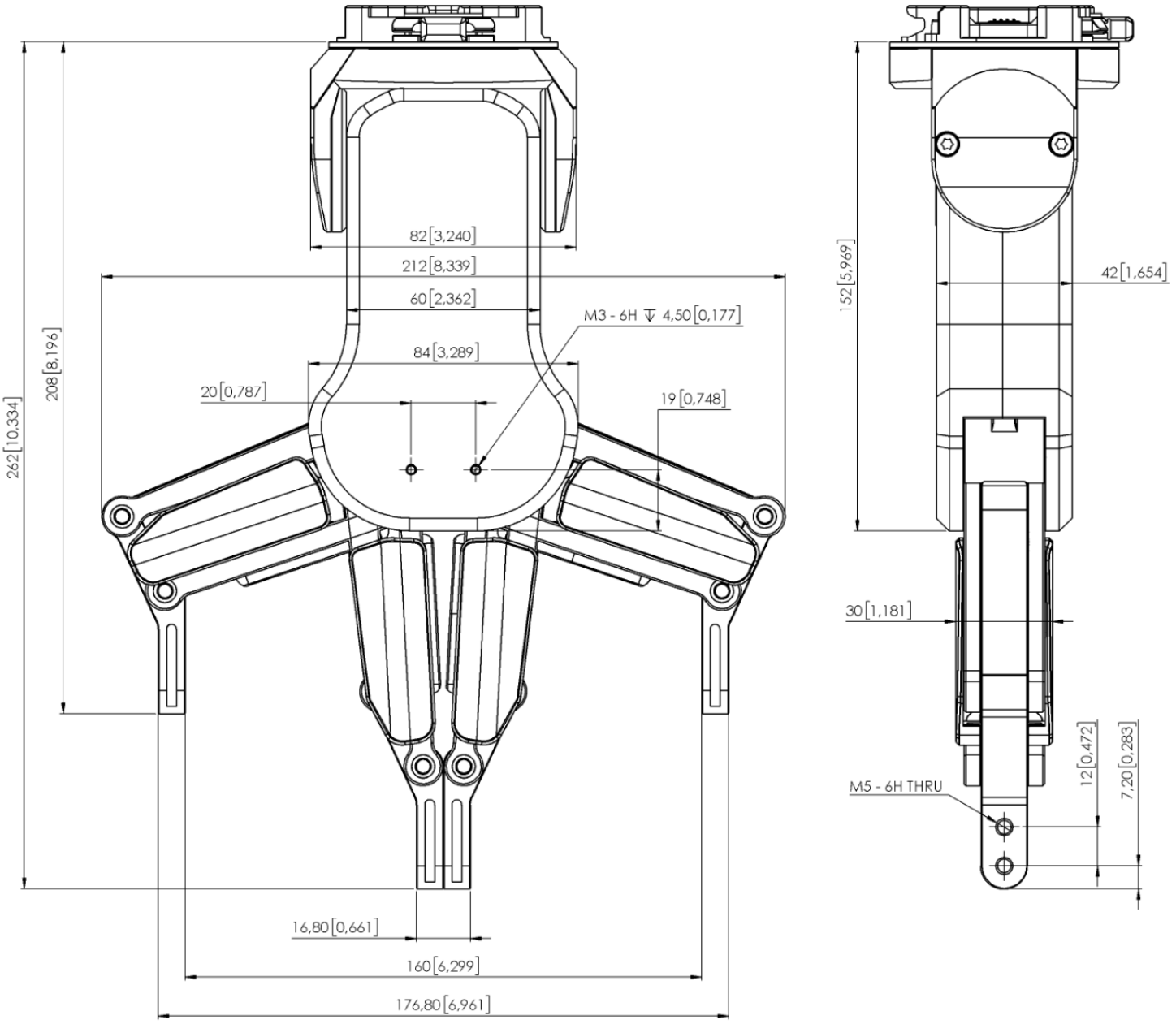
All dimensions are in mm and [inches].

RG2



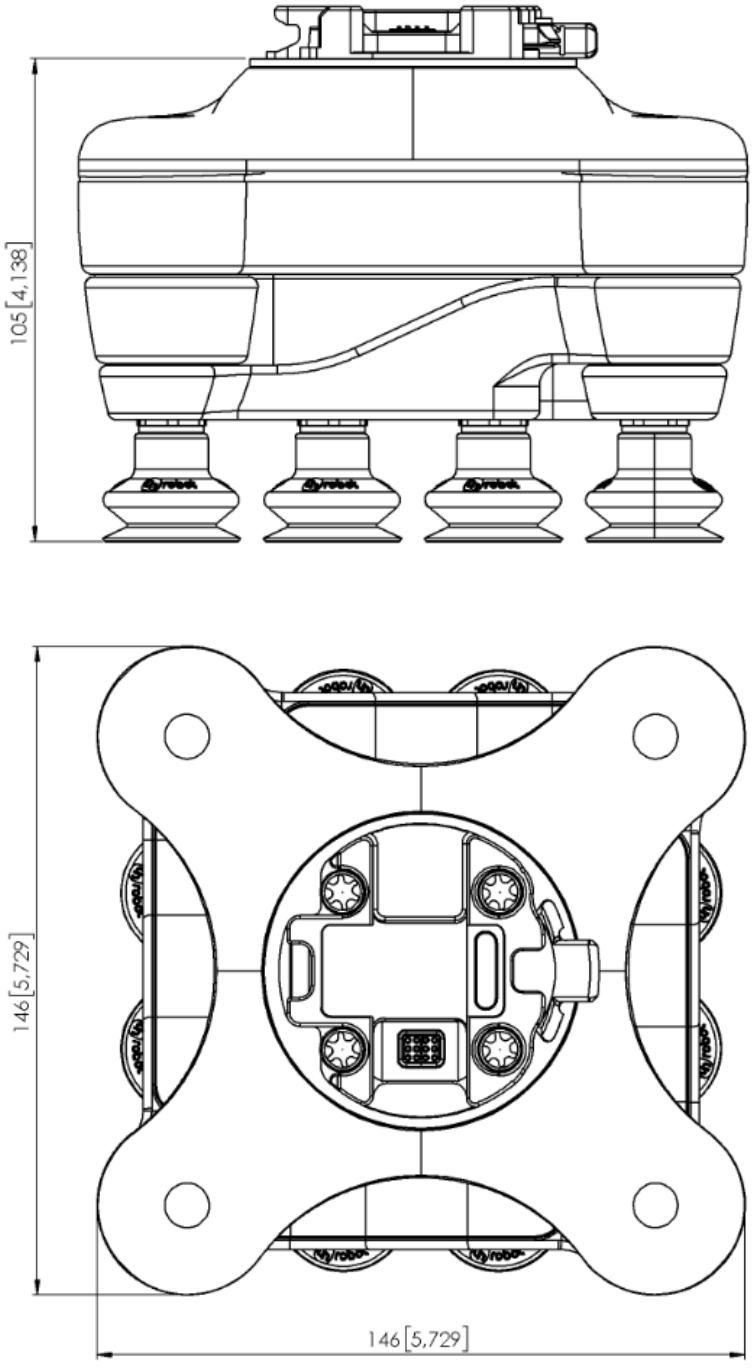
All dimensions are in mm and [inches].

RG6

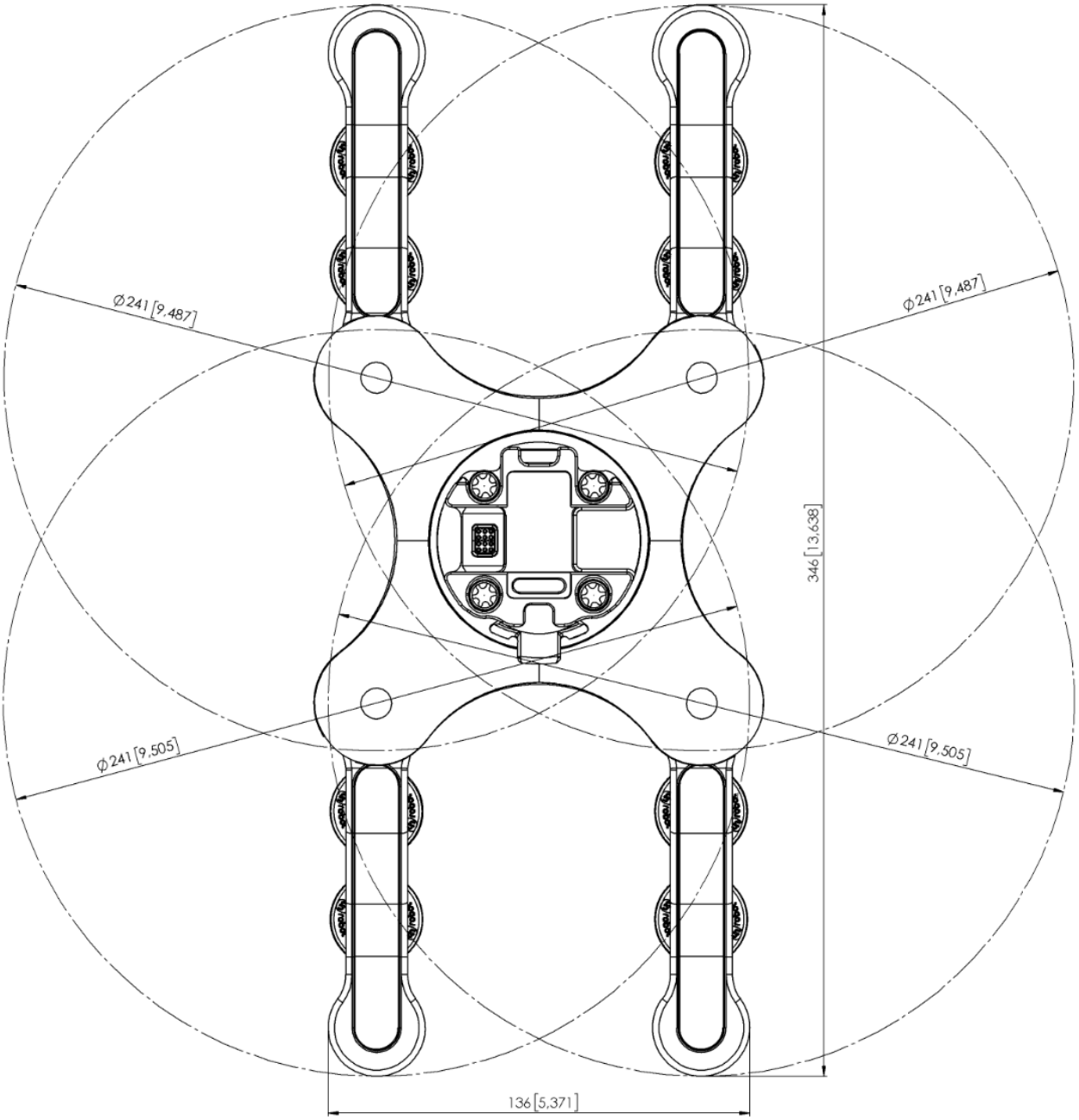


All dimensions are in mm and [inches].

VG10

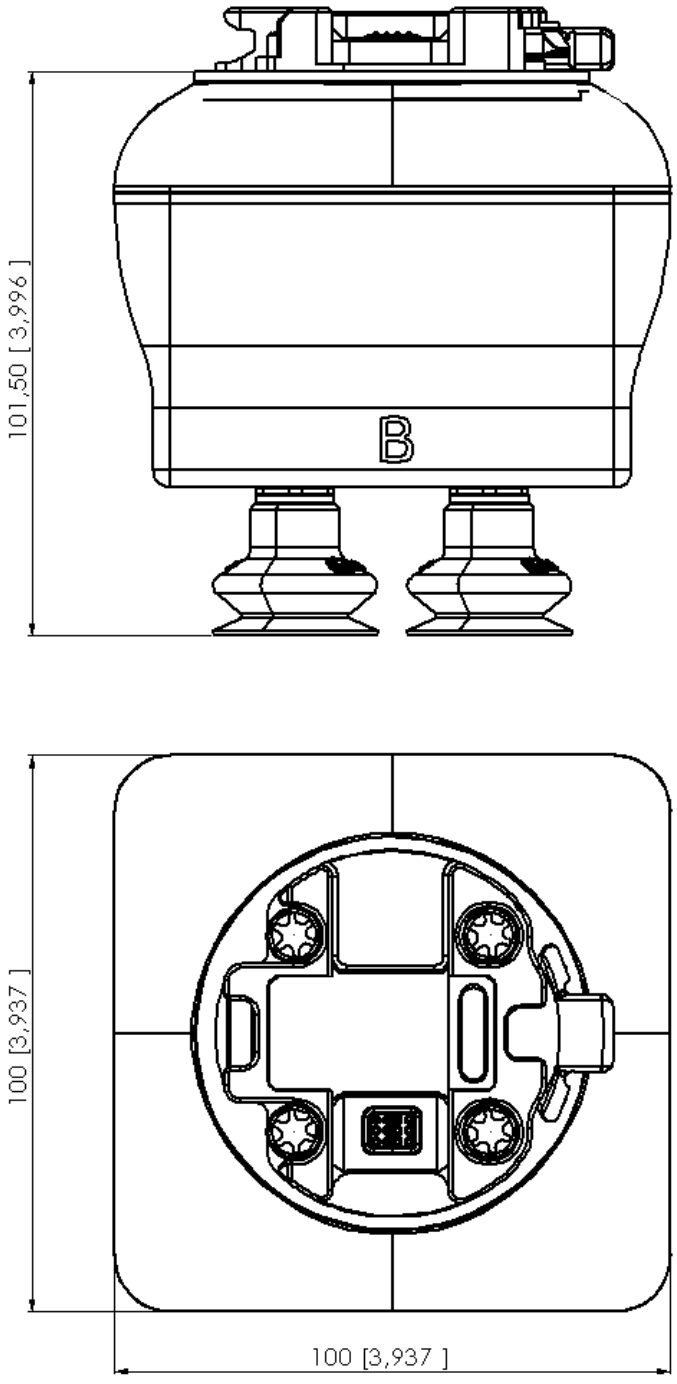


All dimensions are in mm and [inches].

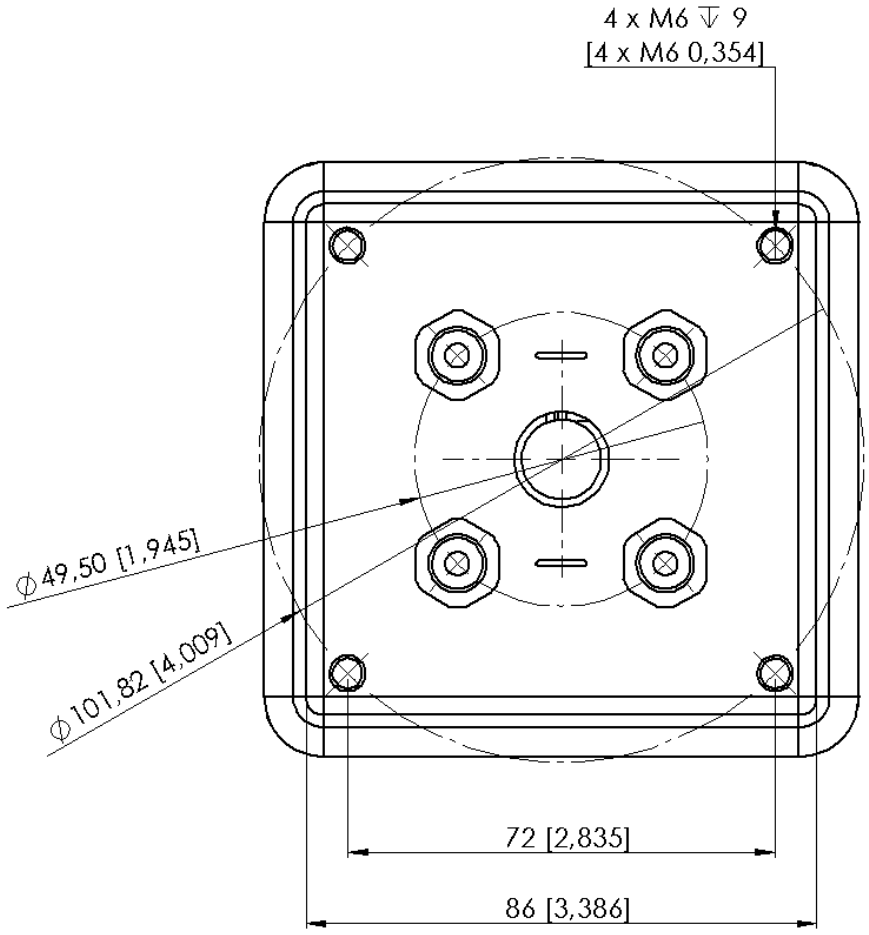


All dimensions are in mm and [inches].

VGC10

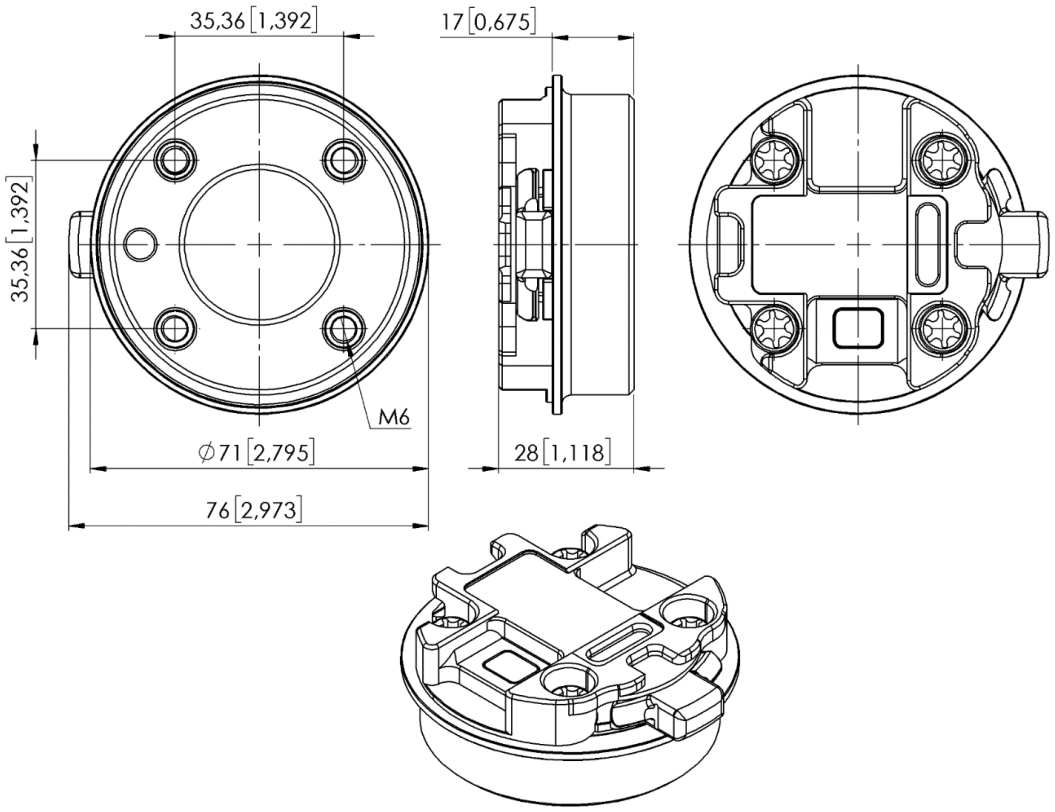


All dimensions are in mm and [inches].



All dimensions are in mm and [inches].

Quick Changer - Tool side

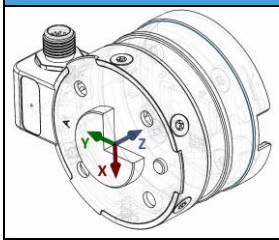


All dimensions are in mm and [inches].

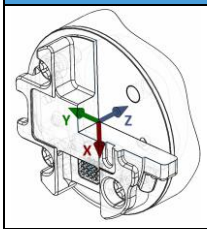
11.3 Center of Gravity

COG, TCP, and weight parameters of the single devices (without any mounting/adapter):

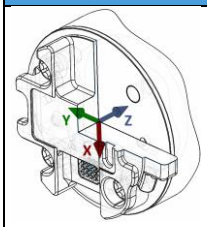
HEX-E/H QC

Coordinate system	TCP [mm]	Center of Gravity [mm]	Weight
	X=0 Y=0 Z=50	cX=0 cY=5 cZ=20	0.35 kg 0.77 lb

Gecko

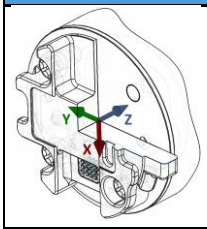
Coordinate system	TCP [mm]	Center of Gravity [mm]	Weight
	X=0 Y=0 Z=187	cX=0 cY=0 cZ=113	2.83 kg 6.10 lb

RG2-FT

Coordinate system	TCP [mm]	Center of Gravity [mm]	Weight
	X=0 Y=0 Z=205	cX=0 cY=0 cZ=65	0.98 kg 2.16 lb

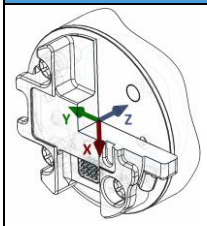
* Mounted at 0˚

RG2

Coordinate system	TCP [mm]	Center of Gravity [mm]	Weight
	X=0 Y=0 Z=200	cX=0 cY=0 cZ=64	0.78 kg 1.72 lb

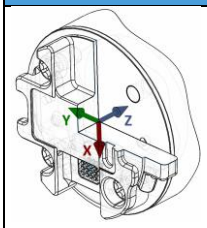
* Mounted at 0˚

RG6

Coordinate system	TCP [mm]	Center of Gravity [mm]	Weight
	X=0 Y=0 Z=250	cX=0 cY=0 cZ=90	1.25 kg 2.76 lb

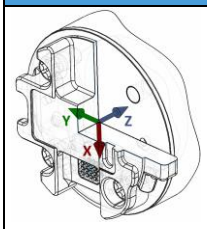
* Mounted at 0˚

VG10

Coordinate system	TCP [mm]	Center of Gravity [mm]	Weight
	X=0 Y=0 Z=105	cX=15 cY=0 cZ=54	1.62 kg 3.57 lb

* With arms folded back

VGC10

Coordinate system	TCP [mm]	Center of Gravity [mm]	Weight
	X=0 Y=0 Z=7	cX=-1 cY=-1 cZ=37	0.814 kg 1.79 lb

* With no attachments

12 Maintenance

WARNING:

An overall inspection of the OnRobot's End of Arm Tooling must be performed regularly and at least once every 6 months. This inspection must include but is not limited to check for defective material and clean gripping surfaces.

Use original spare parts, and original service instructions for the OnRobot's End of Arm Tooling and the robot. Failure to comply with this precaution can cause unexpected risks, resulting in severe injury.

If you have questions regarding spare parts and repair, please visit our website **www.onrobot.com** to contact us.

Gecko

Gecko Gripper pads are made from a precision cast silicone or polyurethane film with a gecko microstructure. Contact with sharp objects may damage the pad surface and impair function. The Gecko Gripper performance is maximized when the pads are clean and dry. The pads can collect dust, so it is best to use the Gecko Gripper in a clean environment and/or establish a routine cleaning schedule.

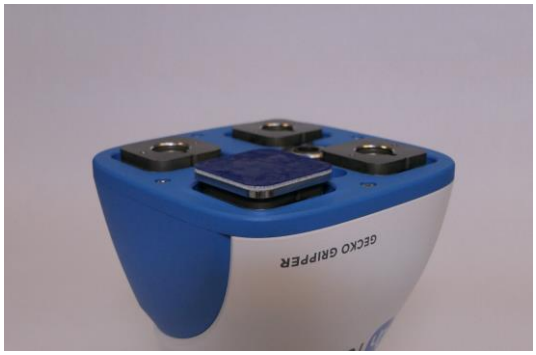
Part	Description of Maintenance	Frequency
Pad Cleaning	Routine cleaning: Cleaning Station	Dependent on operating conditions. Guidelines are: See Cleaning Station User Guide
Pad Wear	Replacement due to wear	150000 – 200000 for HIGH preload operation 200000 – 250000 for LOW preload operation

Replacing the Gripper Pads

Gecko Gripper pads are designed to last for 200,000-300,000 cycles under typical operating conditions. If the pads do not seem to be gripping properly, even with routine cleaning (see table in the previous page), we recommend fully replacing the gripper pads.

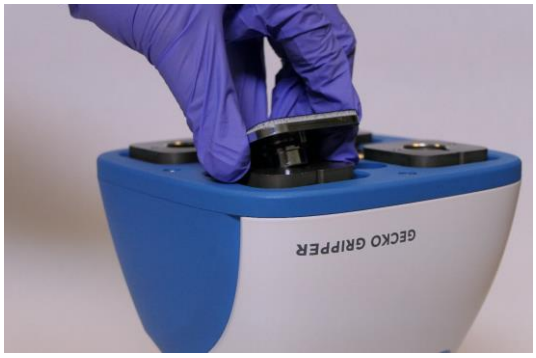
To replace the gripper pads, use the provided pad removal tool.

Step 1: Move gripper pads to the maximum extruded setting such that the pads are maximally exposed/visible.



Step 2: Insert the edge of the pad removal tool between the shiny silver plate of the pads and the dull backing plate. Leverage the pad removal tool against the gripper housing to pry off the used pad. Repeat for all pads.

Step 3: To install new replacement pads, align the notch of the pad with the tab in the mounting hole. Push the pad into the gripper until there are no gaps between the shiny silver pad plate and backing plate.



RG2/6

WARNING:

An overall inspection of the PLd CAT3 Safety Buttons must be performed regularly and at least once every 6 months.

RG2-FT

WARNING:

Please clean the proximity sensor surface regularly with low pressure compressed air (<5 bar) from a 5 cm distance. For stronger contamination use isopropyl alcohol with a soft cotton swab to keep it clean.

VG10 / VGC10

The VG grippers are equipped with one filter for each suction cup socket, and one filter for the exhaust. How often the filters need to be changed depends on the nature of the work piece and the working environment. The VG grippers automatically de-dust the filters every time a grip is released. However, particles can eventually get stuck and build up inside the filter, lowering the VG grippers performance.

A filter service kit is available, which include both new filters and tools needed.

Filter service kit for VG10, PN 100064

Filter service kit for VGC10, PN 103757

Neither use nor power on the VG grippers without filters. Dust, hair and larger particles can get stuck in pump membranes and valve seats, causing permanent damage to the VG grippers.

DANGER:

Identify how often the filters need service and schedule maintenance with a fixed period short enough to ensure a firm grip at all times.

An overall inspection of the VG grippers must be performed regularly and at least once every 6 months.

Never power the VG grippers without filters or with filters mounted incorrectly. Failure to comply with this precaution can cause irreversible failure of pump or valves.

13 Warranties

13.1 Patents

Products of OnRobot A/S are protected by several patents; some still in global publication process (Patents pending). All manufacturers of copies and similar products violating any patent claims will be prosecuted.

13.2 Product Warranty

Without prejudice to any claim the user (customer) may have in relation to the dealer or retailer, the customer shall be granted a manufacturer's warranty under the conditions set out below:

In the case of new devices and their components exhibiting defects resulting from manufacturing and/or material faults within 12 months of entry into service (maximum of 15 months from shipment), OnRobot A/S shall provide the necessary spare parts, while the customer (user) shall provide working hours to replace the spare parts, either replace the part with another part reflecting the current state of the art, or repair the said part. This warranty shall be invalid if the device defect is attributable to improper treatment and/or failure to comply with information contained in the user guides. This warranty shall not apply to or extend to services performed by the authorized dealer or the customer themselves (e.g. installation, configuration, software downloads). The purchase receipt, together with the date of purchase, shall be required as evidence for invoking the warranty. Claims under the warranty must be submitted within two months of the warranty default becoming evident. Ownership of devices or components replaced by and returned to OnRobot A/S shall vest in OnRobot A/S. Any other claims resulting out of or in connection with the device shall be excluded from this warranty. Nothing in this warranty shall attempt to limit or exclude a customer's statutory rights nor the manufacturer's liability for death or personal injury resulting from its negligence. The duration of the warranty shall not be extended by services rendered under the terms of the warranty. Insofar as no warranty default exists, OnRobot A/S reserves the right to charge the customer for replacement or repair. The above provisions do not imply a change in the burden of proof to the detriment of the customer. In case of a device exhibiting defects, OnRobot A/S shall not be liable for any indirect, incidental, special or consequential damages, including but not limited to, lost profits, loss of use, loss of production or damage to other production equipment.

In case of a device exhibiting defects, OnRobot A/S shall not cover any consequential damage or loss, such as loss of production or damage to other production equipment.

13.3 Disclaimer

OnRobot A/S continues to improve reliability and performance of its products, and therefore reserves the right to upgrade the product without prior warning. OnRobot A/S ensures that the content of this manual is precise and correct but takes no responsibility for any errors or missing information.

14 Certifications

TÜV NORD

ZERTIFIKAT
CERTIFICATE

Hiermit wird bescheinigt, dass die Firma / *This certifies that the company*

OnRobot A/S
Teglværksvej 47H
5220 Odense SØ
Denmark

berechtigt ist, das unten genannte Produkt mit dem abgebildeten Zeichen zu kennzeichnen
is authorized to provide the product mentioned below with the mark as illustrated

Fertigungsstätte:
Manufacturing plant:
OnRobot A/S
Teglværksvej 47H
5220 Odense SØ
Denmark

Beschreibung des Produktes:
(Details s. Anlage 1)
Description of product:
(Details see Annex 1)
Safety Gripper for collaborative robots
RG2 v2 and RG6 v2

TÜV NORD CERT GmbH
Type Tested

Geprüft nach:
Tested in accordance with:
EN ISO 13849-1:2015 Cat. 3, PL ,d'

Registrier-Nr. / *Registered No.* 44 780 18106002
Prüfbericht Nr. / *Test Report No.* 3523 2689
Aktenzeichen / *File reference* 8000489144

Gültigkeit / Validity
von / *from* 2019-06-04
bis / *until* 2024-06-03

Zertifizierungsstelle der
TÜV NORD CERT GmbH

Essen, 2019-06-04

TÜV NORD CERT GmbH Langemarckstraße 20 45141 Essen www.tuev-nord-cert.de technology@tuev-nord.de

Bitte beachten Sie auch die umseitigen Hinweise
Please also pay attention to the information stated overleaf

intertek
Total Quality. Assured.

CERTIFICATE OF REGISTRATION

This is to certify that the management system of:

OnRobot A/S

Main Site: Teglværksvej 47 H, 5220 Odense SØ, Denmark
Chamber of Commerce: 36492449

Additional Site: OnRobot A/S, Cikorievej 44, 5220 Odense SØ, Denmark

has been registered by Intertek as conforming to the requirements of

ISO 9001:2015

The management system is applicable to:

Development and sales of End-of-Arms tools for industrial customers worldwide.

Certificate Number:
0096721

Initial Certification Date:
26 November 2019

Date of Certification Decision:
26 November 2019

Issuing Date:
26 November 2019

Valid Until:
25 November 2022

ISO 9001:2015 CERTIFICATION ™
Intertek

SWEDAC ACKREDITERING
Accred. no. 1639
Certification of Management Systems
ISO/IEC 17021-1

Carl-Johan von Plomgren
MD, Business Assurance Nordics

Intertek Certification AB
P.O. Box 1103, SE-164 22 Kista, Sweden

In the issuance of this certificate, Intertek assumes no liability to any party other than to the Client, and then only in accordance with the agreed upon Certification Agreement. This certificate's validity is subject to the organization maintaining their system in accordance with Intertek's requirements for systems certification. Validity may be confirmed via email at certificate.validation@intertek.com or by scanning the code to the right with a smartphone.

The certificate remains the property of Intertek, to whom it must be returned upon request.

GENERAL REPORT SUMMARY

This electromagnetic emission and immunity test report is generated by Compatible Electronics Inc., which is an independent testing and consulting firm. The test report is based on testing performed by Compatible Electronics personnel according to the measurement procedures described in the test specifications given below and in the "Test Procedures" section of this report.

The measurement data and conclusions appearing herein relate only to the sample tested and this report may not be reproduced without the written permission of Compatible Electronics, unless done so in full.

This report must not be used to claim product certification, approval or endorsement by NVLAP, NIST or any agency of the federal government.

Device Tested:	Gecko Gripper Model: GEN2 S/N: RAPUNZEL
Product Description:	The equipment under test is a robotic attachment that makes it possible to lift flat, smooth, and level surfaces.
Modifications:	The EUT was not modified in order to comply with specifications.
Customer:	OnRobot Los Angeles 8928 Ellis Avenue Los Angeles, California 90034
Test Dates:	October 4; November 12, 13, 14 and 15, 2019

Test Specifications covered by Accreditation:
Emissions and Immunity Requirements European Standards:

EN 61000-6-2 (2005), EN 55011 (2016) + A1 (2017); IEC 61000-3-2 (2014); and IEC 61000-3-3 (2013)

NVLAP® TESTING
NVLAP LAB CODE 200528-0

ilac-MRA

EN 61000-6-2 (2005) is a product family immunity standard that references the following specifications:

EN 61000-4-2 (2009)
EN 61000-4-3 (2006) + A1 (2008) + A2: 2010
EN 61000-4-4 (2004) + A1 (2010)
EN 61000-4-5 (2006)
EN 61000-4-6 (2009)
EN 61000-4-8 (2009)
EN 61000-4-11 (2004)

Attestation of Conformity no. 119-29901-A1

FORCE Technology has performed compliance testing on electrical products since 1967. FORCE Technology is an accredited test house according to EN17025 and participates in international standardization with organizations such as CEN/CENELEC, IEC/CISPR and ETSI. This attestation of conformity with the below mentioned standards and/or normative documents is based on accredited tests and/or technical assessments carried out at FORCE Technology.

Attestation holder

OnRobot A/S
Teglværksvej 47H
5220 Odense SØ
Denmark.

Product identification

Compute box with Power Supply Unit (PSU) VER36U240-JA.
Mountings: HEX-E QC V3 (101904), QC – R v2 (102037), Dual QC v2 (101788).
Tools: VG10 v2 (101661), RG2 v2 (102012), RG2-FT v2 (102075), RG6 v2 (102021).

Manufacturer

On Robot A/S

Technical documentation

Assessment no. 119-29901-A1

Standards list no. 1:

IEC 61000-3-2:2014
IEC 61000-3-3:2013
IEC 61000-6-2:2016
IEC 61000-6-4:2018

EMC Directive 2014/30/EU, Article 6
EN 61000-3-2:2014
EN 61000-3-3:2013
EN 61000-6-2:2005
EN 61000-6-2:2019
EN 61000-6-4:2007 + A1:2011

Standard list no. 2: (applicable specifically to RG2 v2 (102012) and RG6 v2 (102021))

IEC 61326-3-1:2017, Industry locations, SIL 2

The product identified above has been assessed and complies with the specified standards/normative documents. The attestation does not include any market surveillance. It is the responsibility of the manufacturer that mass-produced apparatus have the same properties and quality. This attestation does not contain any statements pertaining to the requirements pursuant to other standards, directives or laws other than the above mentioned.

Signature

Knud A. Baltsen
Digitally signed by Knud A. Baltsen
Date: 2019.11.15 19:38:04 +01'00'

Signed by: Knud A. Baltsen, Senior Specialist, Product Compliance

Attestation of Conformity no. 118-33022-A1

FORCE Technology has performed compliance testing on electrical products since 1967. FORCE Technology is an accredited test house according to EN17025 and participates in international standardization with organizations such as CEN/CENELEC, IEC/CISPR and ETSI. This attestation of conformity with the below mentioned standards and/or normative documents is based on accredited tests and/or technical assessments carried out at FORCE Technology.

Attestation holder

OnRobot A/S
Teglværksvej 47H
5220 Odense SØ
Denmark

Product identification

Gripper RG2 2.0

Manufacturer

OnRobot A/S

Technical documentation

FORCE Technology Test Report 117-29737, dated 01 September 2017
FORCE Technology Assessment Sheet 1668, dated 17 October 2017
FORCE Technology Test Report 118-33022-2 Rev. 1, dated 06 February 2019
FORCE Technology Assessment 118-33022-A1, dated 21 February 2019

Standards/Normative documents

IEC 61000-6-2:2005	EMC Directive 2014/30/EU, Article 6
IEC 61000-6-4:2006 + A1:2010	EN 61000-6-2:2005 + AC:2005
IEC 61326-3-1:2017, Industrial locations, SIL 2	EN 61000-6-4:2007 + A1:2011
FCC Part 15B, Class A	EN 61326-3-1:2017, Industrial locations, SIL 2

The product identified above has been assessed and complies with the specified standards/normative documents. The attestation does not include any market surveillance. It is the responsibility of the manufacturer that mass-produced apparatus have the same properties and quality. This attestation does not contain any statements pertaining to the requirements pursuant to other standards, directives or laws other than the above mentioned.

Signature

Knud A. Baltsen
2019-02-21
Digitally signed by Knud A. Baltsen
kab@force.dk
Senior Specialist

Signed by: Knud A. Baltsen, Senior Specialist, Product Compliance

Attestation of Conformity no. 118-33022-A2

FORCE Technology has performed compliance testing on electrical products since 1967. FORCE Technology is an accredited test house according to EN17025 and participates in international standardization with organizations such as CEN/CENELEC, IEC/CISPR and ETSI. This attestation of conformity with the below mentioned standards and/or normative documents is based on accredited tests and/or technical assessments carried out at FORCE Technology.

Attestation holder

OnRobot A/S
Teglværksvej 47H
5220 Odense SØ
Denmark

Product identification

Gripper RG6 2.0

Manufacturer

OnRobot A/S

Technical documentation

FORCE Technology Test Report 117-29737, dated 01 September 2017
FORCE Technology Assessment Sheet 1668, dated 17 October 2017
FORCE Technology Test Report 118-33022-2 Rev. 1, dated 06 February 2019
FORCE Technology Assessment 118-33022-A1, dated 21 February 2019

Standards/Normative documents

IEC 61000-6-2:2005	EMC Directive 2014/30/EU, Article 6
IEC 61000-6-4:2006 + A1:2010	EN 61000-6-2:2005 + AC:2005
IEC 61326-3-1:2017, Industrial locations, SIL 2	EN 61000-6-4:2007 + A1:2011
FCC Part 15B, Class A	EN 61326-3-1:2017, Industrial locations, SIL 2

The product identified above has been assessed and complies with the specified standards/normative documents. The attestation does not include any market surveillance. It is the responsibility of the manufacturer that mass-produced apparatus have the same properties and quality. This attestation does not contain any statements pertaining to the requirements pursuant to other standards, directives or laws other than the above mentioned.

Signature

Knud A. Baltsen
2019-02-21
Digitally signed by Knud A. Baltsen
kab@force.dk
Senior Specialist

Signed by: Knud A. Baltsen, Senior Specialist, Product Compliance

14.1 Declaration of Incorporation

Gecko

CE/EU Declaration of Incorporation (Original)

According to European Machinery Directive 2006/42/EC annex II 1.B.

The manufacturer:

OnRobot A/S
Teglværskvej 47H
DK-5220, Odense SØ
DENMARK

declares that the product:

Type:	Industrial Robot Gripper
Model:	Gecko Gripper
Generation:	V2
Serial:	1000000000-1009999999

may not be put into service before the machinery in which it will be incorporated is declared in conformity with the provisions of Directive 2006/42/EC, including amendments, and with the regulations transposing it into national law.

The product is prepared for compliance with all essential requirements of Directive 2006/42/EC under the correct incorporation conditions, see instructions and guidance in this manual. Compliance with all essential requirements of Directive 2006/42/EC relies on the specific robot installation and the final risk assessment.

Technical documentation is compiled according to Directive 2006/42/EC annex VII part B and available in electronic form to national authorities upon legitimate request. Undersigned is based on the manufacturer address and authorized to compile this documentation.

Additionally, the product declares in conformity with the following directives, according to which the product is CE marked:

2014/30/EU — Electromagnetic Compatibility Directive (EMC)
2011/65/EU — Restriction of the use of certain hazardous substances (RoHS)

Relevant essential health and safety requirements of the following EU directives are also applied:

2014/35/EU — Low Voltage Directive (LVD)
2012/19/EU — Waste of Electrical and Electronic Equipment (WEEE)

A list of applied harmonized standards, including associated specifications, is provided in this manual.

Budapest, December 16th, 2019

Group Management

Vilmos Beskid
CTO

HEX-E

CE/EU Declaration of Incorporation (Original)

According to European Machinery Directive 2006/42/EC annex II 1.B.

The manufacturer:

OnRobot A/S
Teglværskvej 47H
DK-5220, Odense SØ
DENMARK

declares that the product:

Type:	Industrial Force/Torque Sensor
Model:	HEX-E QC
Generation:	V3
Serial:	1000000000-1009999999

may not be put into service before the machinery in which it will be incorporated is declared in conformity with the provisions of Directive 2006/42/EC, including amendments, and with the regulations transposing it into national law.

The product is prepared for compliance with all essential requirements of Directive 2006/42/EC under the correct incorporation conditions, see instructions and guidance in this manual. Compliance with all essential requirements of Directive 2006/42/EC relies on the specific robot installation and the final risk assessment.

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Additionally, the product declares in conformity with the following directives, according to which the product is CE marked:

2014/30/EU — Electromagnetic Compatibility Directive (EMC)
2011/65/EU — Restriction of the use of certain hazardous substances (RoHS)

Relevant essential health and safety requirements of the following EU directives are also applied:

2014/35/EU — Low Voltage Directive (LVD)
2012/19/EU — Waste of Electrical and Electronic Equipment (WEEE)

A list of applied harmonized standards, including associated specifications, is provided in this manual.

Budapest, December 16th, 2019

Group Management

Vilmos Beskid
CTO

HEX-H

CE/EU Declaration of Incorporation (Original)

According to European Machinery Directive 2006/42/EC annex II 1.B.

The manufacturer:

OnRobot A/S
Teglværskvej 47H
DK-5220, Odense SØ
DENMARK

declares that the product:

Type:	Industrial Force/Torque Sensor
Model:	HEX-H QC
Generation:	V3
Serial:	1000000000-1009999999

may not be put into service before the machinery in which it will be incorporated is declared in conformity with the provisions of Directive 2006/42/EC, including amendments, and with the regulations transposing it into national law.

The product is prepared for compliance with all essential requirements of Directive 2006/42/EC under the correct incorporation conditions, see instructions and guidance in this manual. Compliance with all essential requirements of Directive 2006/42/EC relies on the specific robot installation and the final risk assessment.

Technical documentation is compiled according to Directive 2006/42/EC annex VII part B and available in electronic form to national authorities upon legitimate request. Undersigned is based on the manufacturer address and authorized to compile this documentation.

Additionally, the product declares in conformity with the following directives, according to which the product is CE marked:

2014/30/EU — Electromagnetic Compatibility Directive (EMC)
2011/65/EU — Restriction of the use of certain hazardous substances (RoHS)

Relevant essential health and safety requirements of the following EU directives are also applied:

2014/35/EU — Low Voltage Directive (LVD)
2012/19/EU — Waste of Electrical and Electronic Equipment (WEEE)

A list of applied harmonized standards, including associated specifications, is provided in this manual.

Budapest, December 16th, 2019

Group Management

Beskid Vilmos

Vilmos Beskid
CTO

RG2-FT

CE/EU Declaration of Incorporation (Original)

According to European Machinery Directive 2006/42/EC annex II 1.B.

The manufacturer:

OnRobot A/S
Teglværskvej 47H
DK-5220, Odense SØ
DENMARK

declares that the product:

Type:	Industrial Robot Gripper
Model:	RG2-FT
Generation:	V2
Serial:	1000000000-1009999999

may not be put into service before the machinery in which it will be incorporated is declared in conformity with the provisions of Directive 2006/42/EC, including amendments, and with the regulations transposing it into national law.

The product is prepared for compliance with all essential requirements of Directive 2006/42/EC under the correct incorporation conditions, see instructions and guidance in this manual. Compliance with all essential requirements of Directive 2006/42/EC relies on the specific robot installation and the final risk assessment.

Technical documentation is compiled according to Directive 2006/42/EC annex VII part B and available in electronic form to national authorities upon legitimate request. Undersigned is based on the manufacturer address and authorized to compile this documentation.

Additionally, the product declares in conformity with the following directives, according to which the product is CE marked:

2014/30/EU — Electromagnetic Compatibility Directive (EMC)
2011/65/EU — Restriction of the use of certain hazardous substances (RoHS)

Relevant essential health and safety requirements of the following EU directives are also applied:

2014/35/EU — Low Voltage Directive (LVD)
2012/19/EU — Waste of Electrical and Electronic Equipment (WEEE)

A list of applied harmonized standards, including associated specifications, is provided in this manual.

Budapest, December 16th, 2019

Group Management

Beskid Vilmos

Vilmos Beskid
CTO

RG2

CE/EU Declaration of Incorporation (Original)

According to European Machinery Directive 2006/42/EC annex II 1.B.

The manufacturer:

OnRobot A/S
Teglværskvej 47H
DK-5220, Odense SØ
DENMARK

declares that the product:

Type:	Industrial Robot Gripper
Model:	RG2
Generation:	V2
Serial:	1000000000-1009999999

may not be put into service before the machinery in which it will be incorporated is declared in conformity with the provisions of Directive 2006/42/EC, including amendments, and with the regulations transposing it into national law.

The product is prepared for compliance with all essential requirements of Directive 2006/42/EC under the correct incorporation conditions, see instructions and guidance in this manual. Compliance with all essential requirements of Directive 2006/42/EC relies on the specific robot installation and the final risk assessment.

Technical documentation is compiled according to Directive 2006/42/EC annex VII part B and available in electronic form to national authorities upon legitimate request. Undersigned is based on the manufacturer address and authorized to compile this documentation.

Additionally, the product declares in conformity with the following directives, according to which the product is CE marked:

2014/30/EU — Electromagnetic Compatibility Directive (EMC)
2011/65/EU — Restriction of the use of certain hazardous substances (RoHS)

Relevant essential health and safety requirements of the following EU directives are also applied:

2014/35/EU — Low Voltage Directive (LVD)
2012/19/EU — Waste of Electrical and Electronic Equipment (WEEE)

A list of applied harmonized standards, including associated specifications, is provided in this manual.

Budapest, December 16th, 2019

Group Management

Vilmos Beskid
CTO

RG6

CE/EU Declaration of Incorporation (Original)

According to European Machinery Directive 2006/42/EC annex II 1.B.

The manufacturer:

OnRobot A/S
Teglværskvej 47H
DK-5220, Odense SØ
DENMARK

declares that the product:

Type:	Industrial Robot Gripper
Model:	RG6
Generation:	V2
Serial:	1000000000-1009999999

may not be put into service before the machinery in which it will be incorporated is declared in conformity with the provisions of Directive 2006/42/EC, including amendments, and with the regulations transposing it into national law.

The product is prepared for compliance with all essential requirements of Directive 2006/42/EC under the correct incorporation conditions, see instructions and guidance in this manual. Compliance with all essential requirements of Directive 2006/42/EC relies on the specific robot installation and the final risk assessment.

Technical documentation is compiled according to Directive 2006/42/EC annex VII part B and available in electronic form to national authorities upon legitimate request. Undersigned is based on the manufacturer address and authorized to compile this documentation.

Additionally, the product declares in conformity with the following directives, according to which the product is CE marked:

2014/30/EU — Electromagnetic Compatibility Directive (EMC)
2011/65/EU — Restriction of the use of certain hazardous substances (RoHS)

Relevant essential health and safety requirements of the following EU directives are also applied:

2014/35/EU — Low Voltage Directive (LVD)
2012/19/EU — Waste of Electrical and Electronic Equipment (WEEE)

A list of applied harmonized standards, including associated specifications, is provided in this manual.

Budapest, December 16th, 2019

Group Management

Vilmos Beskid
CTO

VG10

CE/EU Declaration of Incorporation (Original)

According to European Machinery Directive 2006/42/EC annex II 1.B.

The manufacturer:

OnRobot A/S
Teglværskvej 47H
DK-5220, Odense SØ
DENMARK

declares that the product:

Type:	Industrial Robot Gripper
Model:	VG10
Generation:	V2
Serial:	1000000000-1009999999

may not be put into service before the machinery in which it will be incorporated is declared in conformity with the provisions of Directive 2006/42/EC, including amendments, and with the regulations transposing it into national law.

The product is prepared for compliance with all essential requirements of Directive 2006/42/EC under the correct incorporation conditions, see instructions and guidance in this manual. Compliance with all essential requirements of Directive 2006/42/EC relies on the specific robot installation and the final risk assessment.

Technical documentation is compiled according to Directive 2006/42/EC annex VII part B and available in electronic form to national authorities upon legitimate request. Undersigned is based on the manufacturer address and authorized to compile this documentation.

Additionally, the product declares in conformity with the following directives, according to which the product is CE marked:

2014/30/EU — Electromagnetic Compatibility Directive (EMC)
2011/65/EU — Restriction of the use of certain hazardous substances (RoHS)

Relevant essential health and safety requirements of the following EU directives are also applied:

2014/35/EU — Low Voltage Directive (LVD)
2012/19/EU — Waste of Electrical and Electronic Equipment (WEEE)

A list of applied harmonized standards, including associated specifications, is provided in this manual.

Budapest, December 16th, 2019

Group Management

Vilmos Beskid
CTO

VGC10

CE/EU Declaration of Incorporation (Original)

According to European Machinery Directive 2006/42/EC annex II 1.B.

The manufacturer:

OnRobot A/S
Teglværskvej 47H
DK-5220, Odense SØ
DENMARK

declares that the product:

Type:	Industrial Robot Gripper
Model:	VGC10
Generation:	V1
Serial:	1000000000-1009999999

may not be put into service before the machinery in which it will be incorporated is declared in conformity with the provisions of Directive 2006/42/EC, including amendments, and with the regulations transposing it into national law.

The product is prepared for compliance with all essential requirements of Directive 2006/42/EC under the correct incorporation conditions, see instructions and guidance in this manual. Compliance with all essential requirements of Directive 2006/42/EC relies on the specific robot installation and the final risk assessment.

Technical documentation is compiled according to Directive 2006/42/EC annex VII part B and available in electronic form to national authorities upon legitimate request. Undersigned is based on the manufacturer address and authorized to compile this documentation.

Additionally, the product declares in conformity with the following directives, according to which the product is CE marked:

2014/30/EU — Electromagnetic Compatibility Directive (EMC)
2011/65/EU — Restriction of the use of certain hazardous substances (RoHS)

Relevant essential health and safety requirements of the following EU directives are also applied:

2014/35/EU — Low Voltage Directive (LVD)
2012/19/EU — Waste of Electrical and Electronic Equipment (WEEE)

A list of applied harmonized standards, including associated specifications, is provided in this manual.

Budapest, December 16th, 2019

Group Management

Vilmos Beskid
CTO