ROBOTIQ

Original Notice

Robotiq FT 300 Force Torque Sensor

Instruction Manual

LEAN ROBOTICS

robotiq.com | leanrobotics.org

Revisions

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

Revision 2018/06/18

Updated Software (subsections 4.1.2 and 4.1.5) to include Robotiq FT Mode node and corresponding script functions

Revision 2018/03/26

Removed all references to FT 150 Force Torque Sensor

Revision 2018/02/13

Removed reference to ROS package (section 4.3)

Revision 2017/12/11

Updated control with Universal Robots (section 4.1 and subsections)

Revision 2017/10/30

Updated mechanical specifications (section 5.2)

Updated signal specifications (section 5.3)

Revision 2016/11/18

Updated FT 150 signal specifications (section 5.3)

Updated installation for Universal Robots (section 3.8 and sub sections)

Updated Control with Universal Robots (section 4.1 and sub sections)

Revision 2016/04/26

Update for ActiveDrive toolbar, added calibration instructions

Revision 2016/01/18

Update for FT 300

Revision 2014/09/08

Official release

1. General Presentation

The terms "Sensor", "Robotiq Sensor", "Force Sensor", "Torque Sensor", "FT 300 Force Torque Sensor" used in the following manual refer to the Robotiq Force Torque Sensor FT 300 unless specified. The following manual instructions apply to both versions unless explicitly stated otherwise. The Robotiq FT 300 Force Torque Sensor is a robotic peripheral designed for force and torque data acquisition. The FT 300 Force Torque Sensor is meant to have an end-of-arm tool mounted on it, so that it can sense force and torque applied on the tool. The Sensor is compatible with various tools and provides feedback that can be used for: hand guiding a robot, force control processes, assembly tasks, product testing, etc.

> Info
>
> The following manual uses the metric system, unless specified, **all dimensions are in millimeters**.

> Info
>
> The following section presents the key features of the Sensor and must not be considered as being related to Sensor operation, each feature is detailed in the appropriate section of the manual. Safety guidelines must be read and understood before any operation is attempted with the Sensor.

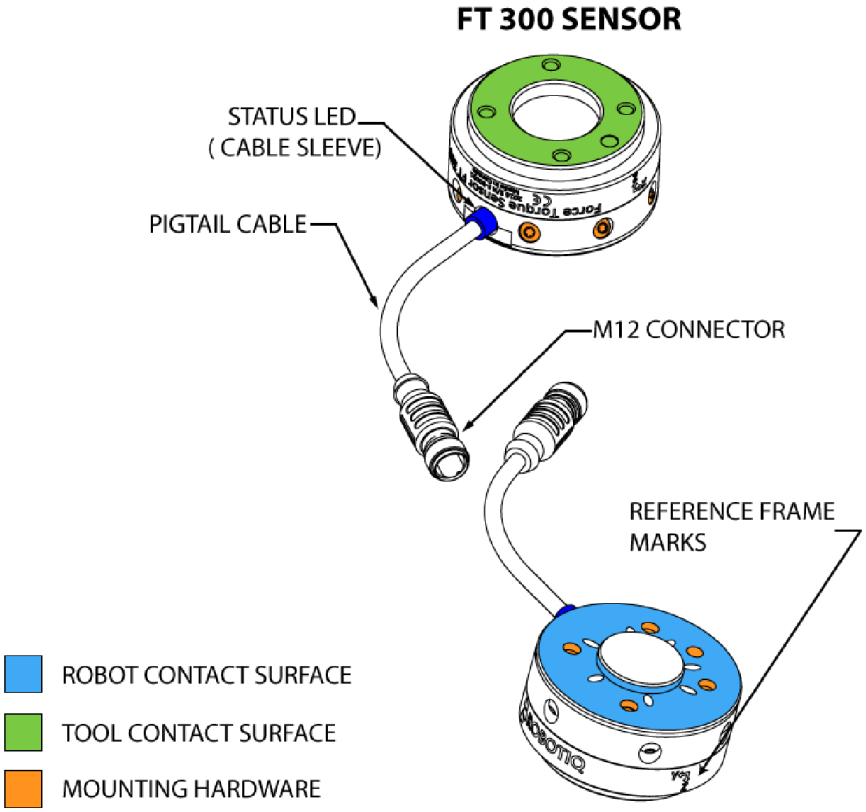


Fig. 1.1: General presentation of the Robotiq Force Torque Sensors with main features.

1.1. Main features

- The end-of-arm tool contact surface (in green) is the only point of contact allowed between the Sensor and the tool to ensure correct force and torque feedback.
- The robot contact surface (in blue) is the only contact point allowed between the Sensor and the robot for fastening the sensor to the robot. Note that the inside ring must not touch the robot.

> Info
>
> Details on the bolt pattern and indexing pin for the tool side and the robot side can be found in the Specifications section.

- The screw positioning for the coupling and the robot mountings are shown in orange. See the Spare Parts section for a list of available Couplings.
- M12 connector (pigtail or mounted) allows for both power and data transfer for the Sensor.
- Status LED provides visual information on the status of the Sensor, see Section 3.7 for details.

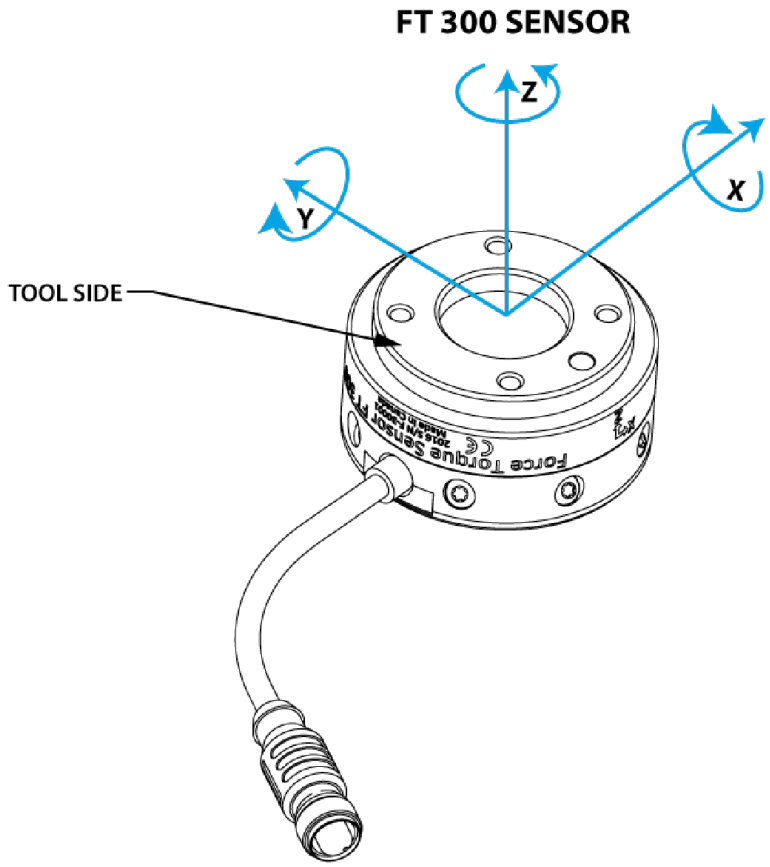


Fig. 1.2: FT 300 Force Torque Sensor force and torque diagrams.

The figure above represents the various force and torques that the FT 300 Force Torque Sensor can measure. Reference frame is centered on the Sensor as shown above and visual inscriptions are also represented on it.

- The Z axis passes through the center of the thru hole with positive direction in the tool direction.
- The X axis traces a symmetric line centered on the connector; the positive direction points the opposite way away from the connector.
- The Y axis uses the right hand thumb rule according to X-Z.

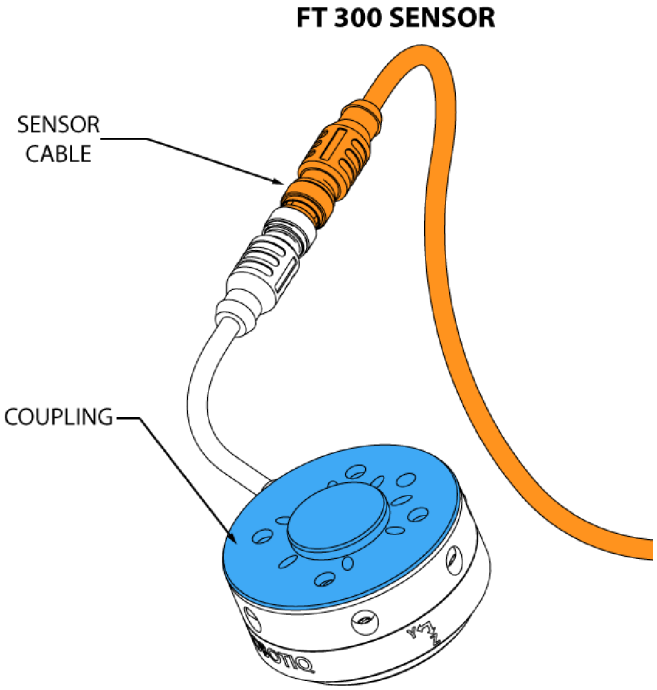


Fig. 1.3: FT 300 Force Torque Sensor options.

The figure above represents various options available. They can be found in the **Spare Parts, Kits and Accessories** section.

- **Couplings** are meant to install the FT 300 Force Torque Sensor on various robot models, see available models.
- **Sensor Cable** is used for power and communications with the FT 300 Force Torque Sensor and is available in different lengths.
- **Mechanical Protector** is meant to protect the cable connector from collisions that can occur when operating the robot (especially useful when in teach mode).
- **Tool Plate** is not shown, but might be required when certain end-of-arm tools are mounted on the FT 300 Force Torque Sensor.

> Info
>
> Please refer to the **Installation** section for details on the installation of various options.

Several software packages are provided and detailed in the **Software** section of this manual.

> Tip
>
> It is important to understand that the FT 300 Force Torque Sensor can be used either as a Modbus RTU slave or as a streaming device. When use as a slave unit you will send status requests (read function) to get the force & moment values, while when in data stream mode the Sensor will continuously stream data without responding to a master request. Please refer to the **Serial Communication** section for details.

2. Safety

Warning

The operator must have read and understood all the instructions in this manual before handling the Robotiq Force Torque Sensor.

Info

The term "operator" refers to anyone responsible for any of the following operations on the FT 300 and the associated robot or tools:

- Installation
- Controle
- Maintenance
- Inspection
- Calibration
- Programming
- Decommissioning

This documentation explains the various components of the Force Torque Sensor, as well as general operations regarding the whole life-cycle of the product from installation to operation and decommissioning.

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

2.1. Warning

Info

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

Warning

A Force Torque Sensor used in human-robot collaboration must not be considered a complete safety measure, additional dedicated safety device(s) must be considered. Sensor failure can occur and result in danger for workers or machinery if not properly secured. See local or international safety measure for human-robot collaboration.

Warning

- The Sensor needs to be properly secured before operating the robot.
- Do not install or operate a Sensor that is damaged or lacking parts.
- Never supply the Sensor with an alternative current source.
- Make sure all cord sets are always secured at both ends, at the Sensor and at the robot.
- Always meet the recommended keying for electrical connections.
- Make sure no one is in the robot and/or Sensor path before initializing the robot's routine.
- Always meet the Sensor payload specifications.
- All local safety measures and/or laws on robot operation must be applied to the Sensor.
    - Any use of the Sensor in noncompliance with these warnings is inappropriate and may cause injury or damage.

2.2. Intended Use

The Sensor is designed for data acquisition (force and torque sensing) for an end-of-arm tool on a robot.

The product is intended for installation on a robot or other automated machinery or equipment.

> Info
>
> Always comply with local and/or national laws, regulations and directives on automation safety and general machine safety.

The unit may be used only within the range of its technical specifications. Any other use of the product is deemed improper and unintended use. Robotiq will not be liable for any damages resulting from any improper or unintended use.

3. Installation

> **Warning**
>
> Be sure to read and understand the safety instructions related to the Robotiq Force Torque Sensor prior to installation.

3.1. Scope of Delivery

Standard delivery for an FT Sensor kit:

FTS-300-KIT-001
Robotiq Force Torque Sensor FT 300 unit
1 m pigtail cable (CBL-COM-2068-01)
10 m Robotiq Device Cable (CBL-COM-2065-10-HF)
USB Signal Converter (ACC-ADT-USB-RS485)

3.1.1. Options

- Couplings

> **Info**
>
> Coupling is mandatory for the FT 300.

- Adapter plates
- Tool plates
- Different cable lengths

> **Info**
>
> The following are not included in delivery unless specified in the purchase:
>
> - Options such as couplings and adapters for mounting on divers industrial robots.
> - Hardware required for options; accessories or fixtures for the FT Sensor unless specified.
> - Power supply units, power supply wiring or fuses.

Please refer to the **Spare Parts, Kits and Accessories** section for a list of available parts.

3.2. Environmental and Operating Conditions

The FT 300 Force Torque Sensor is designed for industrial applications. Always respect the following specified storage, transport and operating environmental conditions:

CONDITION	VALUE
Minimum storage/transit temperature	-25°C
Maximum storage/transit temperature	70°C
Minimum operating temperature	15°C
Maximum operating temperature	35°C
Humidity (non-condensing)	20-80% RH
Vibration (storage / transit)	5G
Vibration (operating)	2G
Other	• Free from dust, soot or water • Free from corrosive liquids or gases • Free from explosive liquids or gases • Free from powerful electromagnetic interference

3.3. Mechanical Connections

You must use a coupling to attach the Sensor to a robot. Be sure to use the coupling related to your robot model. Our couplings are listed according to ISO 9409-1 and this covers most bolt patterns. If there is no coupling for your robot, you can modify a blank coupling or Robotiq can create a custom version for you. Some couplings may require an additional adapter plate. To create your own coupling or adapter plate you can refer to the **Technical Dimensions** section. To see available couplings and adapter plates and for details, refer to the **Spare Parts, Kits and Accessories** section.

> Info
>
> The FT 300 coupling is mandatory, you can customize yours from a blank provided by Robotiq.

Here are the steps to follow for the installation of the Sensor (see figure below). Note that all screws must be locked in place using medium strength threadlocker, such as *Loctite 248* or a similar product.

1. Align the indexing dowel pin between the coupling and the robot (usually press fitted to the robot).
2. Screw the coupling to the robot with the robot mounting screws (with lock washers if provided) and threadlocker.
3. Align the Sensor indexing dowel pins (prefixed to the Sensor) to the coupling.
4. Screw the Sensor to the coupling using the coupling mounting screws (with lock washers if provided) and threadlocker.

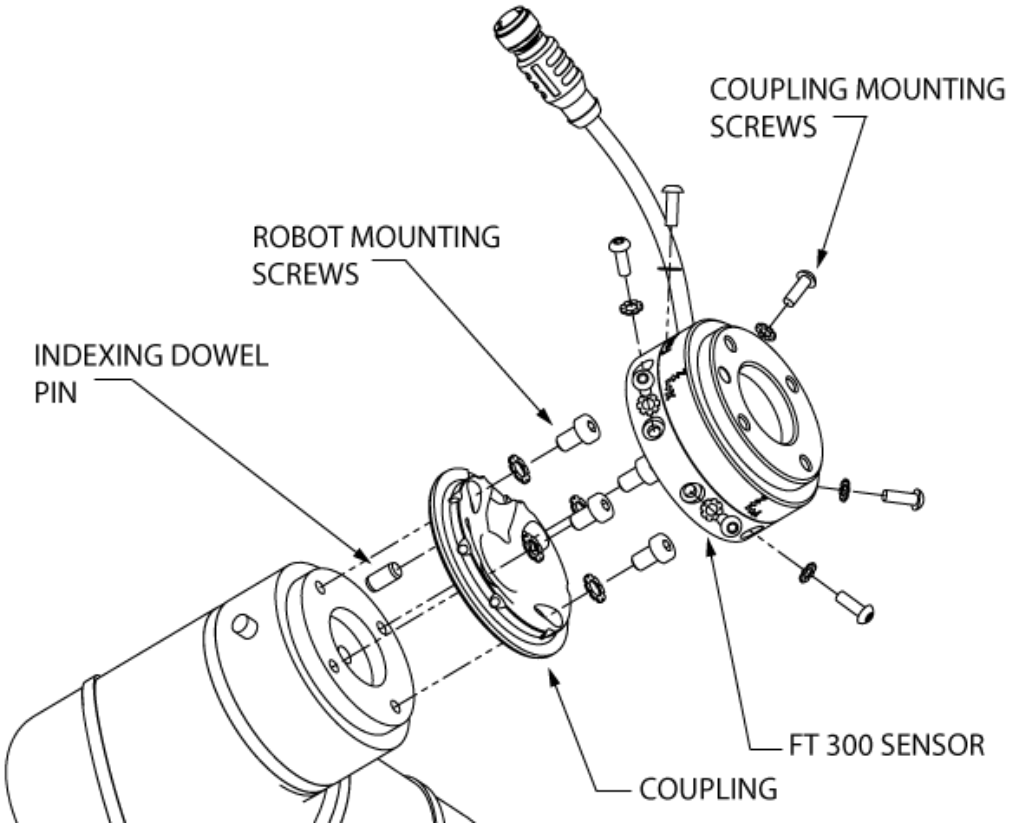


Fig. 3.1: Attaching the FT 300 sensor to a robot arm using the mandatory coupling.

3.4. Power Supply Specifications

The Sensor needs to be supplied by a DC voltage source. This power supply is not included with the Sensor.

POWER SUPPLY SPECIFICATIONS	VALUE
Output voltage	5 to 24 V DC
Max power consumption	2 W
Overcurrent	1 A Fuse (Phoenix #0916604 (UT6-TMC M 1A))
Overvoltage protection	**Warning** Maximum output voltage tolerance is 10%, exceeding this limit, 26.4 V DC could damage the Sensor.

Info

Robotiq recommends the use of the following power supply:

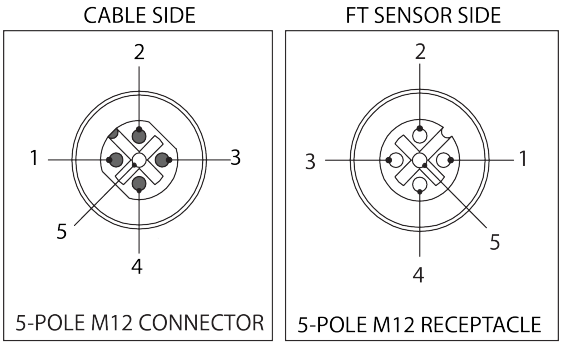
TDK-Lambda DPP Series, 15W Single Output DIN Rail Mount Power Supply, **DPP15-24**

3.5. Wiring

Power and communications are established with the FT 300 Force Torque Sensor via a single device cable. The FT 300 has a pigtail cable.

The figure below represents the FT 300 Force Torque Sensor receptacle (Sensor side) and connector (cable side) with associated pinout. The M12 - 5 pin A-coded connector is used in accordance with IEC 61076-2-101.

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



PIN	END OF CABLE COLOR	SIGNAL
1.	(SHIELD)	485 GND
2.	RED	24 V
3.	BLACK	GND
4.	WHITE	485 +
5.	GREEN	485 -

Fig. 3.2: Pinout of the Robotiq Force Torque Sensor FT 300 and color code for the respective cable type.

> Info
>
> Power pins 2 & 3 are connected to the specified power supply.

> Info
>
> RS-485 signal pins 1, 4 & 5 are connected directly, to a RS-485 / USB converter or to a RS-485 / RS-232 converter.

3.5.1. Wiring with USB to RS485 Converter

When using a RS485 to USB converter (refer to the **Spare Parts, Kits and Accessories** section), the wiring must respect the figure below and subsequent directions. GND / 0V is wired to Sensor pin #1 as stated in the **Wiring** section.

The converter will provide you with a standard USB 2.0 male A connector.

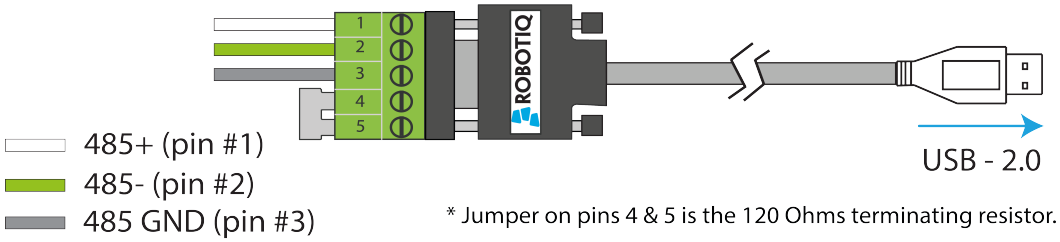


Fig. 3.3: Wiring diagram for the RS485 to USB converter

> **Warning**
>
> Power is not delivered via the USB, do not plug 24V into the USB.

3.5.2. Wiring with RS232 to RS485 Converter

When using a RS232 to RS485 converter (refer to the **Spare Parts, Kits and Accessories** section), the wiring must respect the figure below.

> **Warning**
>
> Do not wire converter pin #3 (5V) on the RS485.
>
> The 24V power supply is NOT supplied via the converter.

The converted side will provide you with a standard DB - 9 female connector with signaling as shown in the figure below.

RS 232 SIDE	
PIN	SIGNAL
1	-
2	OUTPUT (TX)
3	INPUT (RX)
4	-
5	GND
6	-
7	-
8	-
9	-

RS 485 SIDE	
PIN	SIGNAL
1	485+
2	485-
3	DO NOT USE (5V IN)
4	GND

Fig. 3.4: Wiring diagram for RS232 to RS485 converter.

3.6. Calibration Procedure

The Sensor outputs the force and moment data according to a reference, i.e. a zero value. In order to compensate for any deviation of this reference, Robotiq provides a new feature which allows the Sensor to automatically compute and compensate the installation offset, the weight of the tool and its center of mass.

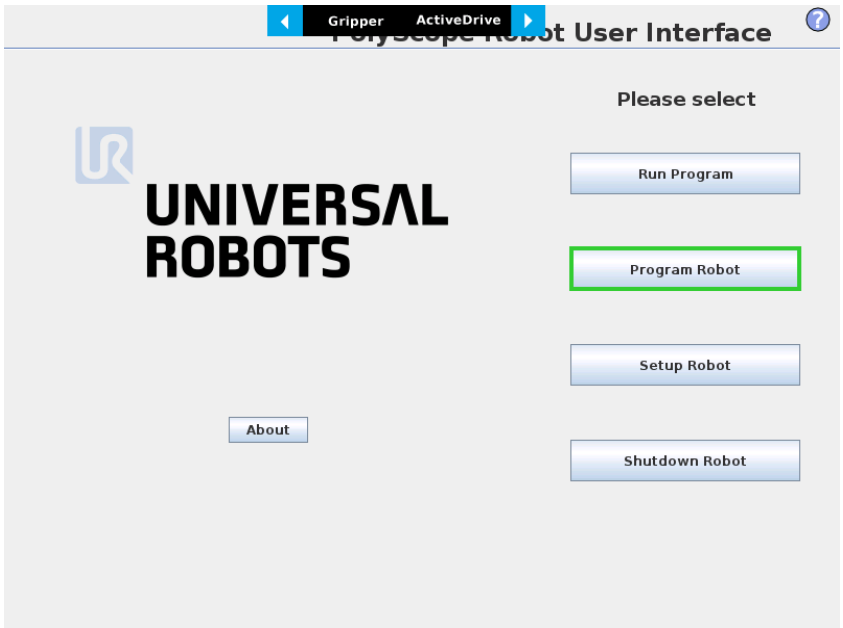
> **Warning**
>
> The Sensor must be re-calibrated after each uninstall / install on the robot. Mounting screws will induce internal stress that needs to be compensated for. Not doing so will significantly affect the sensor signal.

The procedure requires moving the robot in three configurations for which each orientation of the tool is different. Using an internal accelerometer, the Sensor is then able to associate the measurements corresponding to the tool alone for each orientation. After the procedure is completed, the Sensor will output the force and moment values measured without the effect of the weight of the tool and the installation offset.

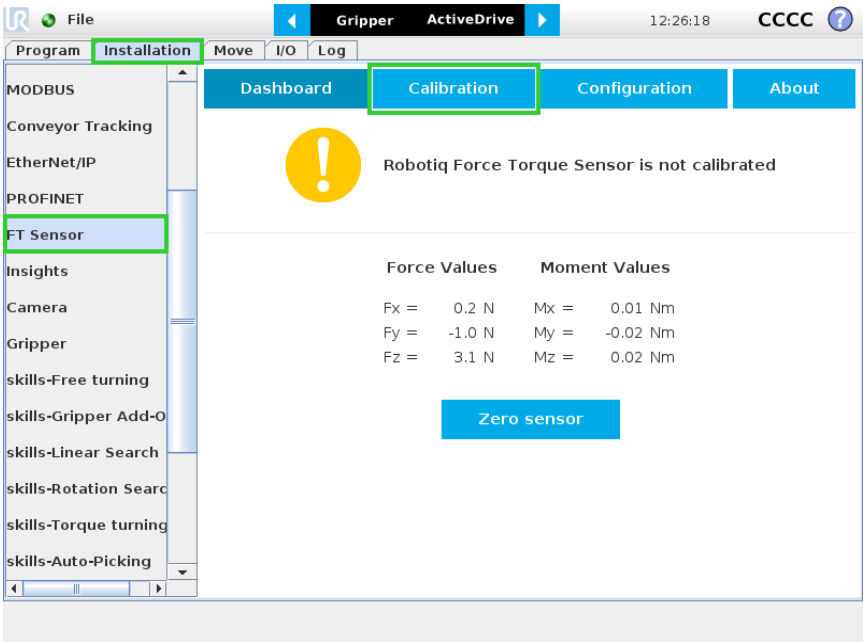
3.6.1. Calibration Procedure with Universal Robots

> Info
>
> You need the Universal Robots software package installed first. Please refer to the **Installation for Universal Robots** section for the package download and installation.

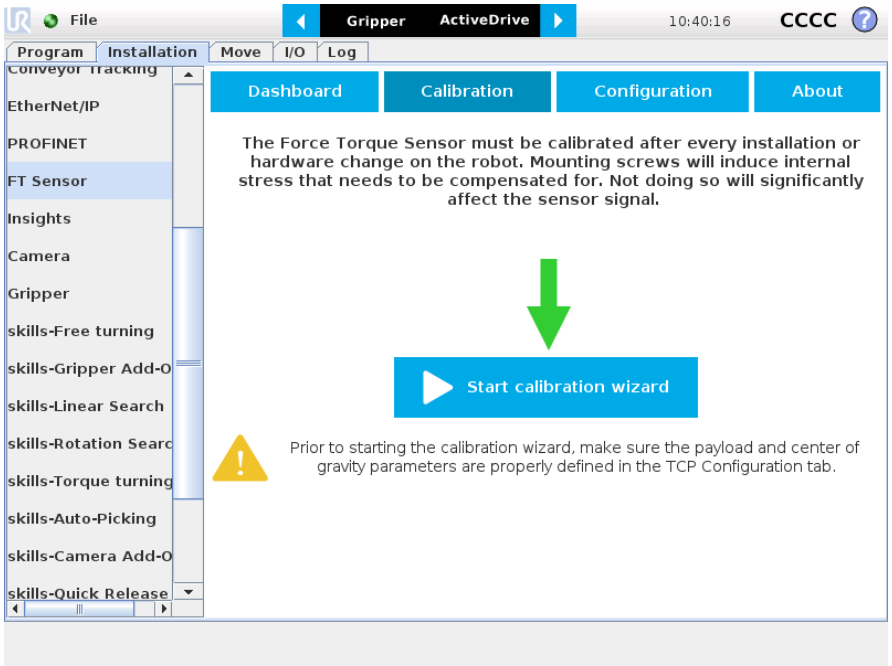
1 From the PolyScope home page, tap **Program Robot**.



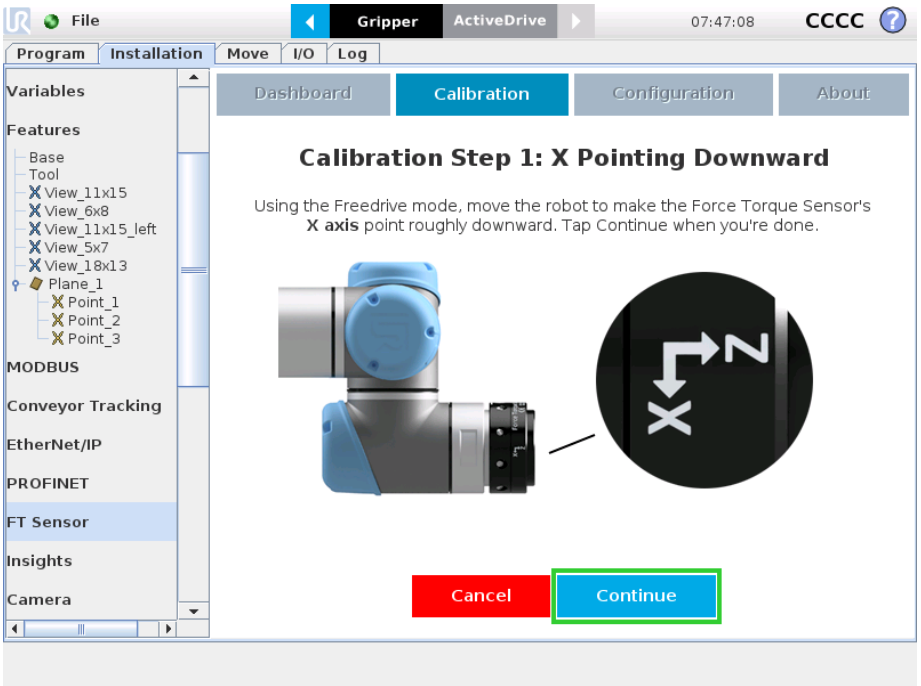
2 Go to the **Installation tab** and tap **FT Sensor** in the left pane. The FT Sensor's Dashboard will be displayed. Tap the **Calibration tab**.



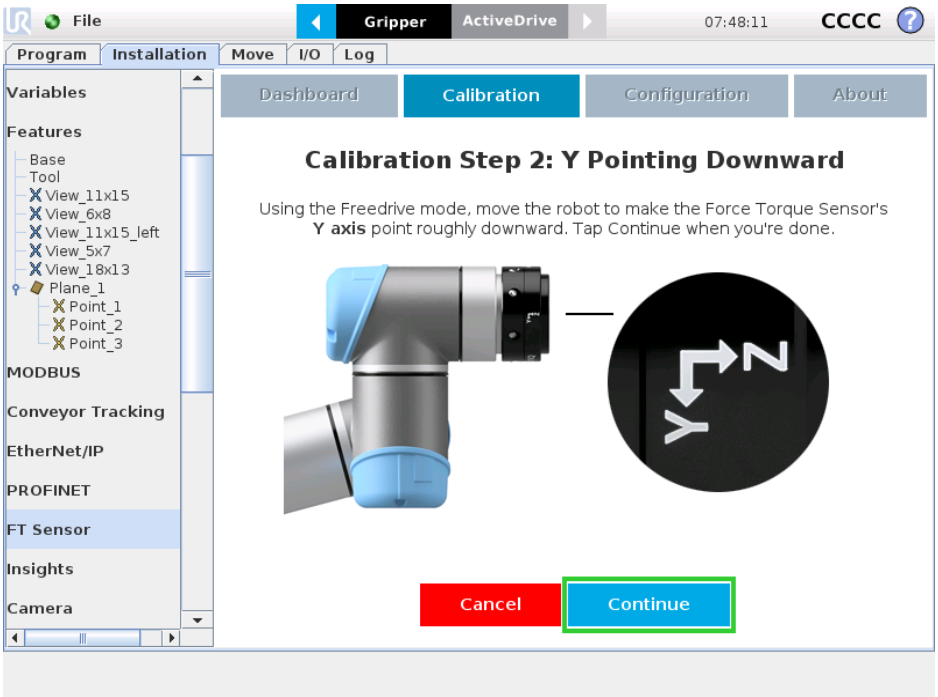
3 Tap the **Start calibration wizard** button to perform the calibration of the FT Sensor. Make sure there are no external forces applied to the Sensor while performing the calibration.



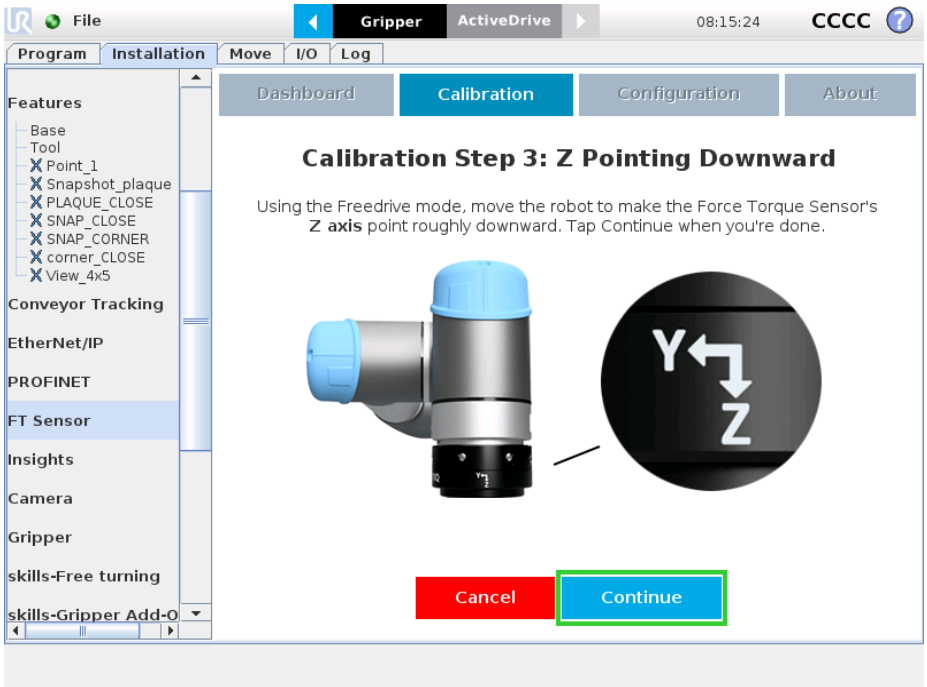
4 Step 1 consists in moving the robot arm so that the FT Sensor's X axis points downward. Tap Continue when the action is done.



5 Step 2 consists in moving the robot arm so that the FT Sensor's Y axis points downward. Tap Continue when the action is done



6 Step 3 consists in moving the robot arm so that the FT Sensor's Z axis points downward. Tap Continue when the action is done



Info

Recalibration is recommended in the event of an error message displaying the incorrect orientation of the FT Sensor during at least one calibration step.

Payload/CoG

The payload and center of gravity values can be accessed through the Calibration menu in the Installation tab, after the calibration is completed. They include the mass and center of gravity of the Sensor.

> **Caution**
>
> The mass, payload or center of gravity of anything found under the Sensor (i.e. tool changer) will not be taken into account in the calculation of the payload.

> **Warning**
>
> Make sure to save the installation file after performing the calibration. Saving will record the calibration date and estimate tool parameters.

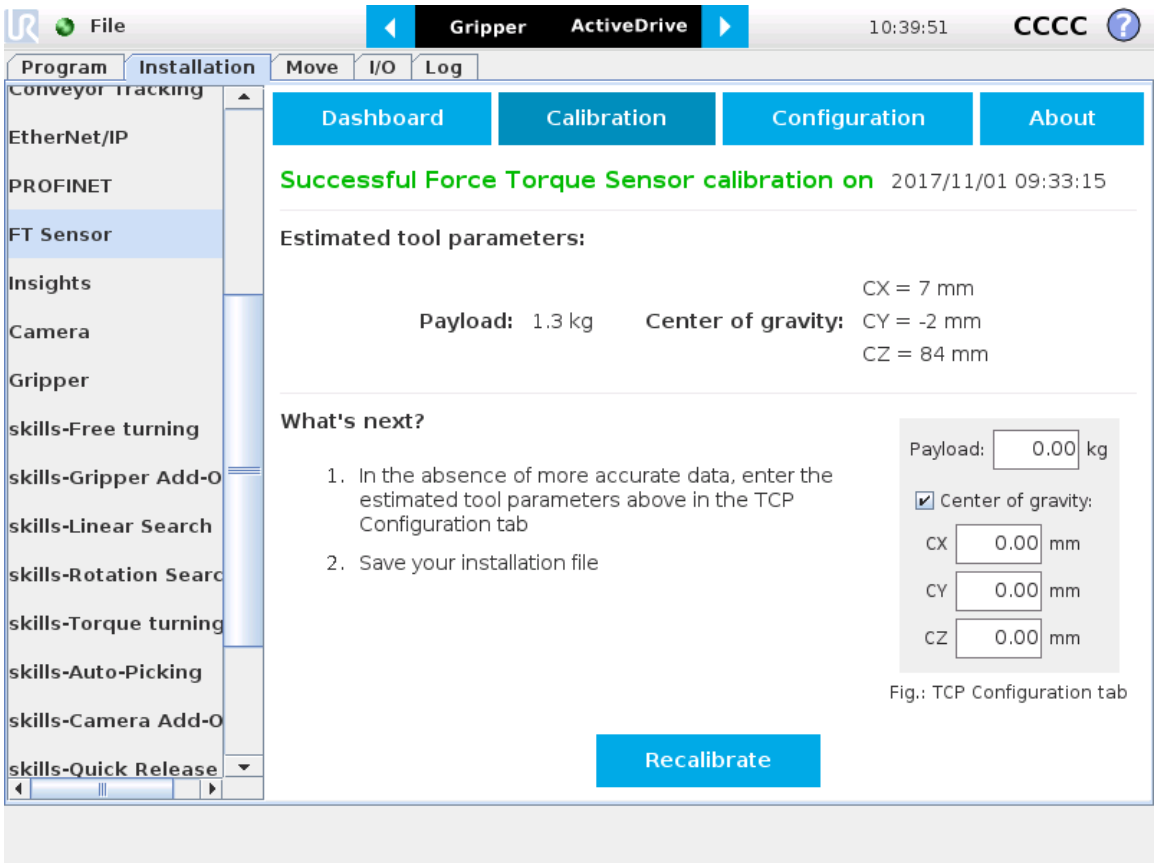


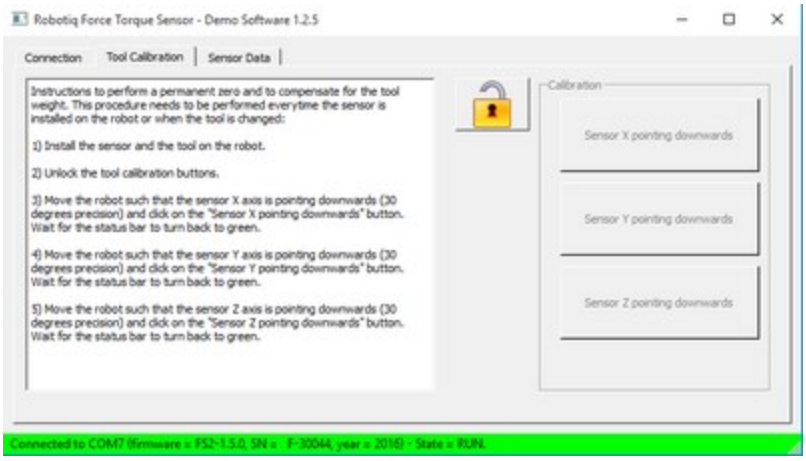
Fig.: TCP Configuration tab

3.6.2. Calibration Procedure for the Visual Demo Software (PC)

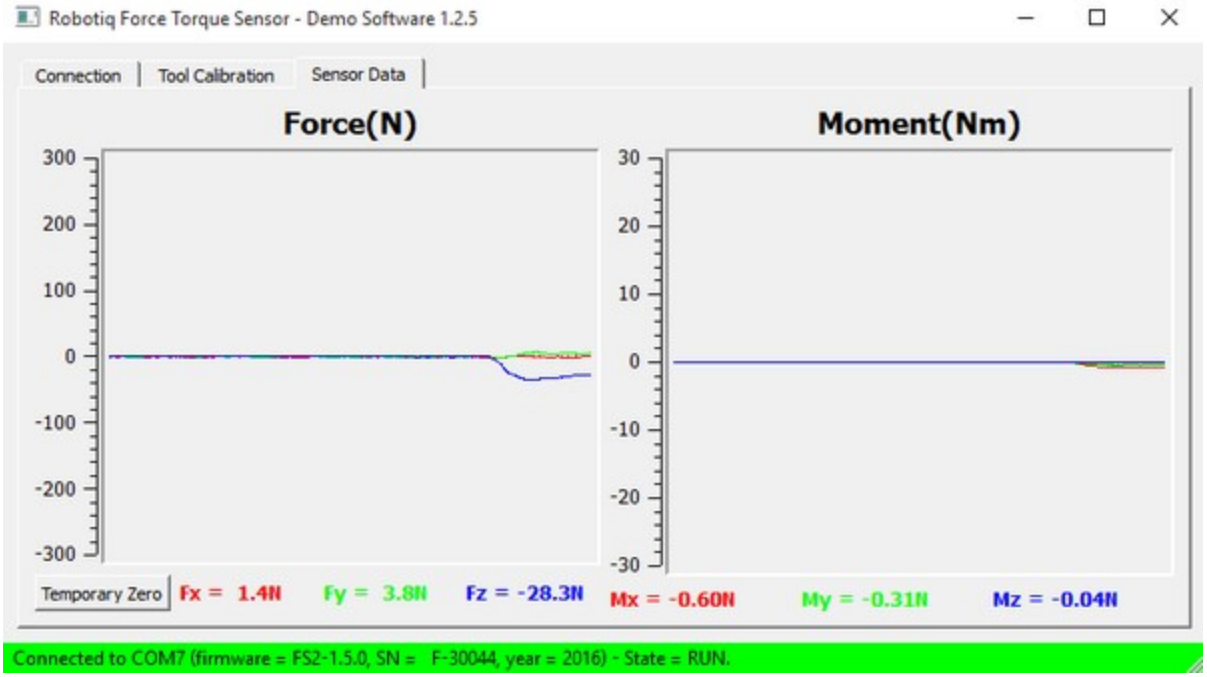
> Info
>
> You need the Visual Demo Software installed first. Please refer to the **Visual Demo Software** section for download and installation.

To calibrate your FT Sensor:

1 Go to the "Tool Calibration" tab and follow the instructions.



2 Once completed, go to the "Sensor Data" tab.



3.7. Status LED

A single status LED provides information on both Sensors, detailed information can be found in the tables below, while a representation of both Sensor status LEDs is shown in the figure below.

On the FT 300 Sensor, the cable sleeve is the LED conductor:

COLOR	LED STATE	INFORMATION
-	off	No power
Blue / red	on	FT 300 Sensor is booting
Red	on	FT 300 Sensor is functional, no communication detected
Red	blinking	FT 300 Sensor fault detected
Blue	on	FT 300 Sensor is functional, communication established

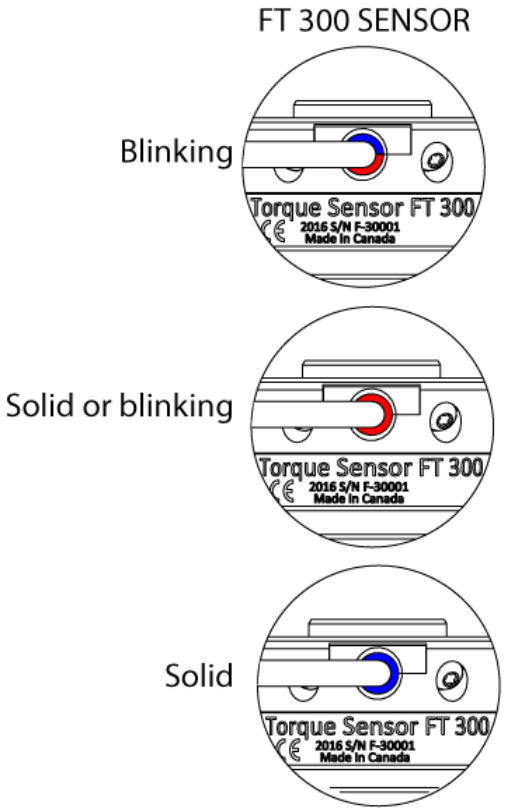


Fig. 3.5: FT Sensor status LED.

3.8. Installation for Universal Robots

The table below shows which Robotiq software to use with your version of Universal Robots' controller. If you are using a CB3 or CB3.1 controller, it is recommended to use the Force Torque Sensor URCaps Package.

Robotiq Software	Universal Robots' controller version			
	CB1	CB2	CB3	CB3.1
Legacy Driver Package (DFU-1.1.15) (includes Gripper toolbar)	Incompatible	Compatible	Compatible	Compatible
ActiveDrive Toolbar (ADU-1.0.1)	Incompatible	Compatible	Compatible	Compatible
FT 300 Force Torque Sensor URCaps Package up to 1.1.1 (includes ActiveDrive toolbar)	Incompatible	Incompatible	Compatible	Compatible
FT 300 Force Torque Sensor URCaps Package 1.2 (includes ActiveDrive toolbar)	Incompatible	Incompatible	Incompatible	Compatible

Refer to the appropriate section depending on your controller version:

- The **URCap Package** section covers the installation of the Force Torque Sensor URCaps Package.
- The **UR Package without URCaps** section goes through the software installation procedures when not using URCaps.

> Info
>
> The robot's PolyScope version must be 3.5 and higher in order to install and use the URCap.

Prior to any software installation, connect the white, green and bare wires to the Robotiq RS-485 signal converter (ACC-ADT-RS485-USB) as shown in the figure below. Also connect the red (24V) and black (0V) wires in the controller according to the figure below.

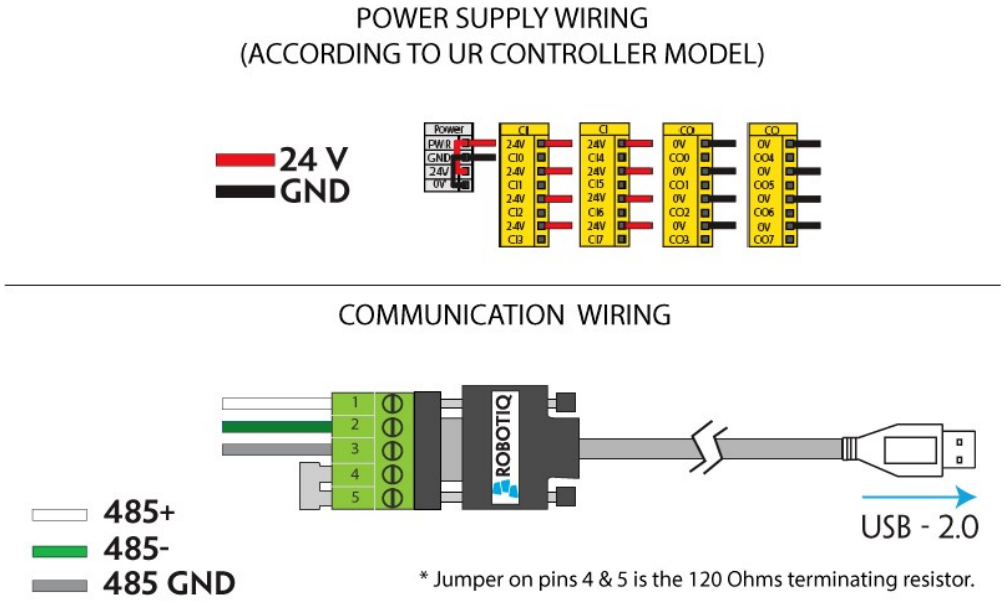


Fig. 3.6: Force Torque Sensor wiring to Universal Robots' controller.

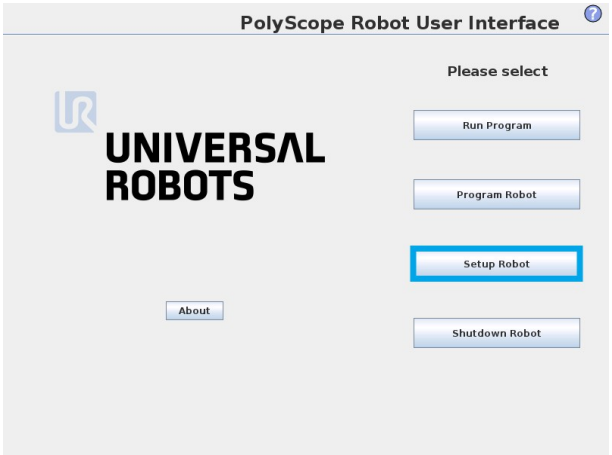
> **Info**
>
> Prior to use over Universal Robots, adjust the payload and the center of gravity from the Installation tab (refer to the **Moment of Inertia and Center of Mass** section).

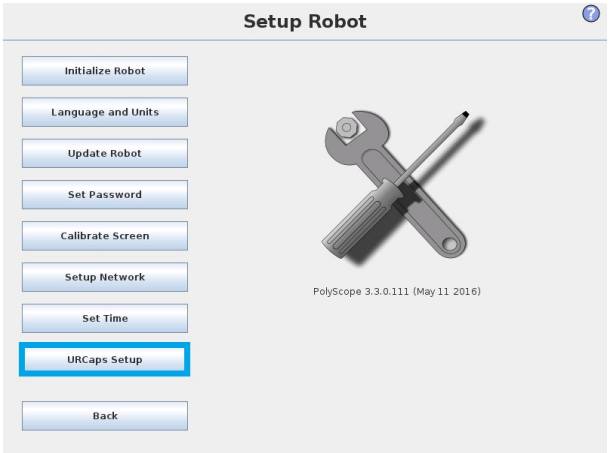
3.8.1. URCap Package

> **Info**
>
> The robot's PolyScope version must be 3.5 and higher in order to install and use the URCap.

Installation

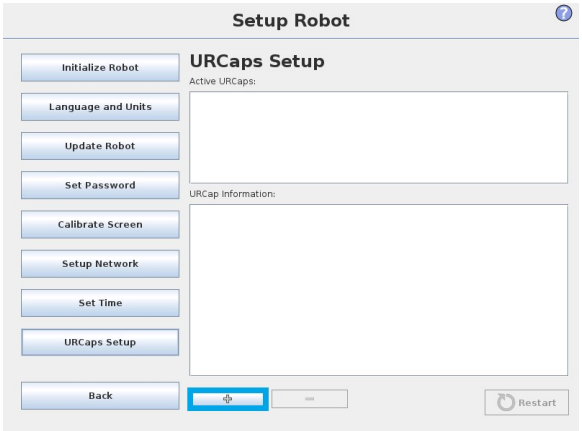
Follow this procedure to install the Force Torque Sensor URCap Package



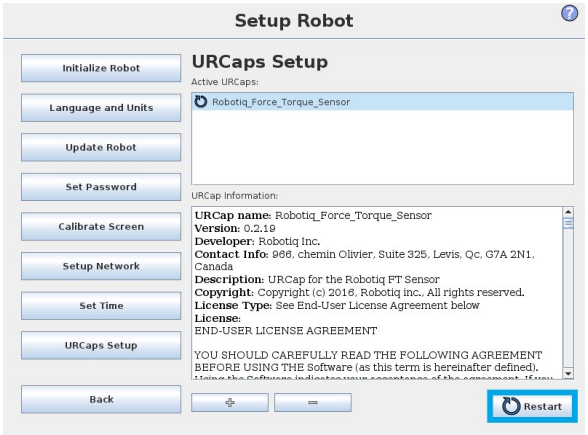


- Make sure that your PolyScope version is up-to-date and that your Universal Robots controller is compatible with the Force Torque Sensor URCap package. Refer to the **Control with Universal Robots** section for the UR controller compatibility.
- Go to support.robotiq.com and click on the product page of the FT 300 Sensor.
- Download the **Robotiq_Force_Torque_Sensor-X.X.X.urcap** file on a blank USB stick.
- Insert the USB stick in the UR teach pendant or controller.
- Go to **Setup Robot**.
- Tap **URCaps Setup**.

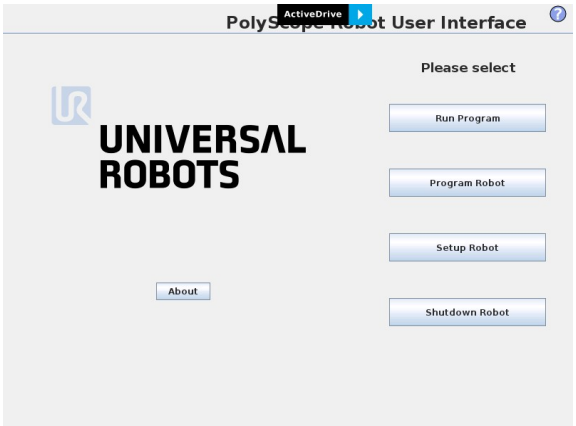
> **Tip**
>
> Go to the PolyScope home page and tap the **About** button. A window containing the Universal Robots software version will pop up.



- Tap the **plus** button (+) to add the Sensor's URCaps package.
- Open **Robotiq_Force_Torque_Sensor-X.X.X.urcap**.



- Restart PolyScope to complete the URCap installation.By doing so, you accept the License Agreement that is detailed inthe URCap Information text box (see below for the License Agreement).



- When PolyScope reopens, the ActiveDrive toolbar will appear on the screen.

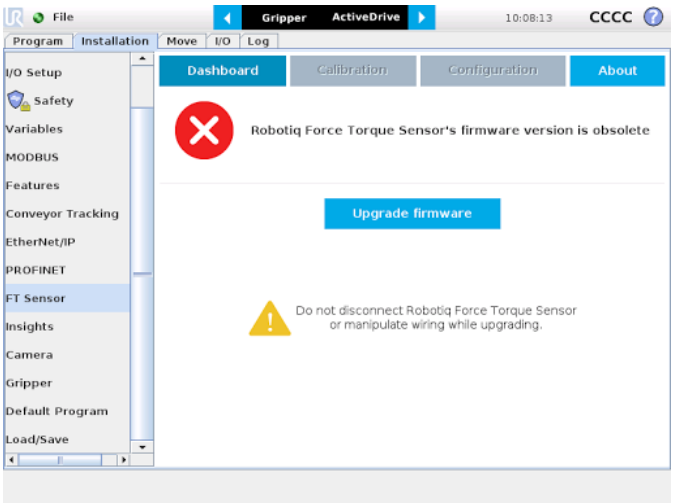
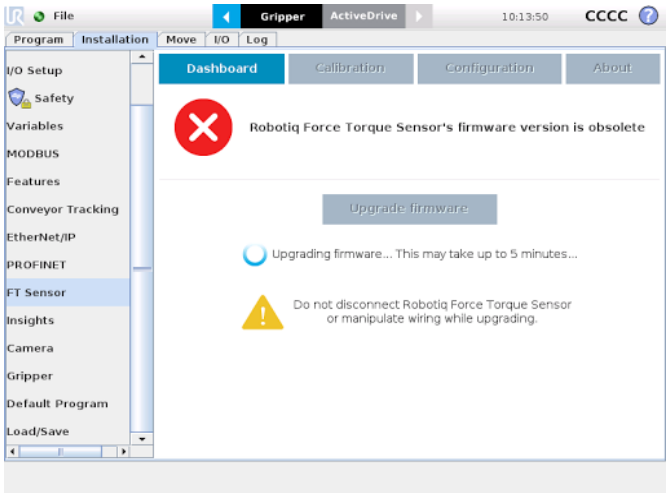
If the Force Torque Sensor is mounted on the robot for the first time, the calibration must be performed. Refer to the **Calibration Procedure with Universal Robots** section for the calibration procedure.

> **Warning**
>
> The sensor must be recalibrated after each uninstall / install on the robot. Mounting screws will induce internal stress that needs to be compensated for. Not doing so will significantly affect the sensor signal.

Firmware upgrade

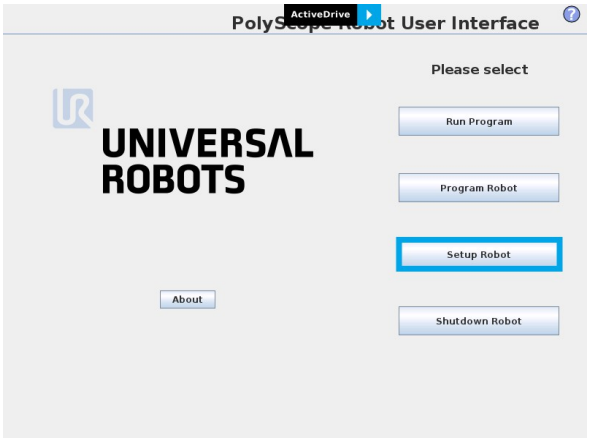
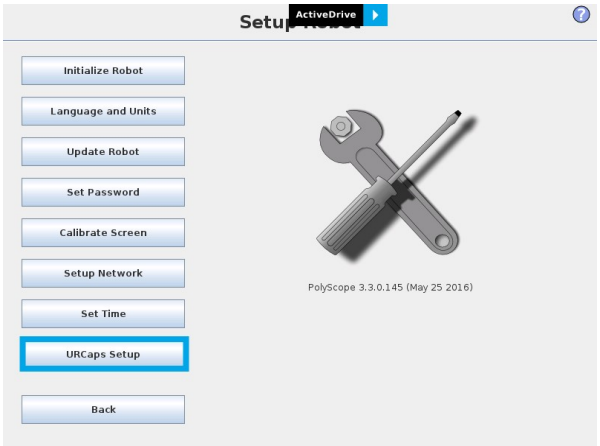
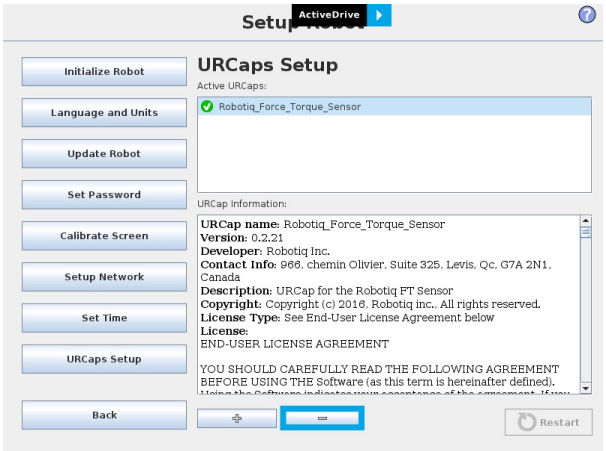
A firmware upgrade my be necessary when updating the Sensor URCap. From the PolyScope home page, go to **Program Robot** and tap the **Installation** tab. Select **FT Sensor** in the left pane and tap the **Dashboard** button. If an upgrade is needed, the Upgrade firmware button will display. Tap the button and wait for the upgrade to be completed.

> Warning
>
> Do not disconnect the Sensor during firmware upgrade.

	• Tap **Upgrade firmware**
	Wait while the software is upgraded.

Uninstalling the URCaps Package

If you wish to uninstall the Force Torque Sensor URCap, follow this procedure:

	• Go to **Setup Robot**.
	• Tap **URCaps Setup**.
	• In the Active URCaps text box, tap the Force Torque Sensor URCap. • The Sensor URCap should be highlighted. • Tap the **minus** button (-) to uninstall the URCap. • Restart PolyScope to complete the uninstallation process.

License Agreement

END-USER LICENSE AGREEMENT

YOU SHOULD CAREFULLY READ THE FOLLOWING AGREEMENT BEFORE USING THE Software (as this term is hereinafter defined). Using the Software indicates your acceptance of the agreement. If you do not agree with it, you are not authorized to use the Software.

IMPORTANT-READ CAREFULLY: This End-User License Agreement (the "Agreement") is a legal agreement between you and the Licensor (as this term is hereinafter defined), the licensor of the Software. This Agreement covers the Software. The Software includes any "on-line" or electronic documentation and all modifications and upgrades related thereto. By installing, or otherwise using the Software, you agree to be bound by the terms of this Agreement. If you do not agree to the terms of this Agreement, the Licensor cannot and does not license the Software to you. In such event, you must not use or install the Software.

1. Definition.
    1. "UR" means Universal Robots A/S, a corporation incorporated under the laws of Denmark, having its registered office at Energivej 25, DK-5260 Odense S, which specializes into the conception, advanced manufacturing and sale of robotic products (the "UR's Business");
    2. "Software" means any of the Licensor's softwares provided to its customers for the purposes mentioned in Sub-section 1.4 hereof including their modifications and upgrades and their related materials;
    3. "Licensor" means Robotiq inc., a corporation incorporated under the laws of Quebec, having its registered office at 325-966 chemin Olivier, Lévis, Québec, Canada, G7A 2N1, which specializes into the conception, advanced manufacturing and sale of robotic products (the "Licensor's Business");
    4. "End-User" means a customer authorized pursuant to this Agreement to install or use the Software in order to make a specific product from the Licensor's Products compatible and functional with a specific product of the UR's Product;
    5. "Licensor's Products" means those products developed by the Licensor in the course of the Licensor's Business;
    6. "UR's Products" means those products developed by UR in the course of the UR's Business;
    7. "Licensor's Authorized Representatives" means and includes the Licensor and Licensor's authorized vendors, resellers, distributors and licensors;
    8. "Purchase Agreement" means an agreement between the End-User and the Licensor pursuant to which the End-User purchased one or more of the Licensor's Products.
2. License. Subject to the terms and conditions hereof, the Licensor grants to the End-User a personal, temporary, non-exclusive, non-assignable and non-transferable and revocable license to use the Software in accordance with the terms and conditions hereof.
3. Software and Documentation. The Licensor may provide, if applicable, all documentation containing the detailed specifications for operation and use of the Software, which Software shall be used in accordance with such documentation. This documentation, if applicable, will be provided, wholly or in part, within (i) this Agreement, (ii) the Licensor's Web site http://robotiq.com/ (iii) the Licensor's Products and the Purchase Agreement therewith, or (iv) any other agreement, document, support, whatsoever decided by the Licensor.

    The use of the Software requires the Licensor's Products, UR's Products, compatible systems and certain software (which may require some expenses), may require periodical updating and may be affected by such elements. Most equipment will be compatible with the Software. However, the Software may not function on certain types of equipment..
4. Modifications and Upgrades. The Licensor shall be under no obligation to provide any upgrade or modification to the Software. However, the End-User shall be entitled to receive free of charge all modifications and upgrades of the Software provided by the Licensor if, at such time, the End-User is not in default in respect of any of its obligation contained herein. Such modifications and upgrades of the Software shall be installed by the End-User itself by consulting the Licensor's Website http://robotiq.com/ where a link to proceed to such installation will be made available thereof. A new version of the Soft-

ware shall not be covered by this Section 4 but shall require that a new End-User Software License Agreement be entered into between the Licensor and the End-User.

5. Fees. The grant by Licensor to the End-User of the present license shall be free to the extent that the End-User agrees and complies to the term and conditions herein at all time.

6. Maintenance. During the term of this Agreement, the Licensor will maintain the Software in an operable condition and will make available anycorrections and improvements as are generally incorporated in the Software by the Licensor without additional charge to the End-User. The Licensor may temporarily and without notice suspend or limit access to the Software if necessary or desirable in order to maintain, restore, modify or repair any part of the Software or for any reason related to business. During such works, the Software will not be available but the Licensor undertakes to deploy its best efforts to perform such works at appropriate times and to limit any inconvenience arising therefrom.

7. Title to Software. The licensed Software is composed of confidential data and trade secrets and is proprietary to and constitutes trade secret information and intellectual property of the Licensor. Title and ownership rights to the Software, including the intellectual property rights related thereto, shall remain with the Licensor. The End-User agrees to maintain the confidential nature of the Software and related materials provided for the End-User's own internal use under this Agreement. The license granted herein does not include the right to sublicense to others, and may not be assigned to others, in whole or in part, without the prior written consent of the Licensor. The End-User may not or allow others to modify or prepare directive works, copy (except for normal backups for recovery purposes), reproduce, republish, reverse engineer, upload, post, transmit, or distribute, in any manner, the Software.

8. Restricted Use. The Software shall be used solely and exclusively by the End-User and its employees for the purpose mentioned in Sub-section 1.4 hereof. Any other use of the Software, including resell derivative modifications or extensions, is expressly prohibited.

9. Exclusion of Warranty on Software. The End-User expressly acknowledges and agrees that use of the Software is at the End-User sole risk. The Software is provided "AS IS" and without warranty of any kind. THE LICENSOR AND THE LICENSOR'S AUTHORIZED REPRESEN-TATIVES DO NOT WARRANT THAT Software WILL BE FREE OF ERRORS AND YOU ACKNOWLEDGE THAT THE EXISTENCE OF ANY SUCH ERRORS DOES NOT CONSTITUTE A BREACH OF THIS AGREEMENT. TO THE EXTENT PERMITTED BY LAW LICENSOR AND LICENSOR'S AUTHORIZED REPRESEN-TATIVES EXPRESSLY DISCLAIM ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING , BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTA-BILITY AND FITNESS FOR A PARTICULAR PURPOSE UNLESS OTHERWISE STATED HEREIN. LICENSOR AND LICENSOR'S AUTHORIZED REPRESENTATIVES DO NOT WARRANT THAT THE FUNCTIONS CONTAINED IN THE Software WILL MEET THE END-USER REQUIREMENTS OR THAT THE OPERATION OF THE Software WILL BE CORRECT. FURTHERMORE, LICENSOR AND LICENSOR'S AUTHORIZED REPRESEN-TATIVES DO NOT WARRANT OR MAKE ANY REPRESENTATIONS REGARDING THE USE OR THE RESULTS OF THE USE OF THE Software IN TERMS OF ITS CORRECTNESS, ACCURACY, RELIABILITY, OR OTHERWISE. NO ORAL OR WRITTEN INFORMATION OR ADVICE GIVEN BY LICENSOR AND LICENSOR'S AUTHORIZED REPRESENTATIVE SHALL CREATE A WARRANTY OR IN ANY WAY INCREASE THE SCOPE OF THIS WARRANTY. SHOULD THE Software PROVE DEFECTIVE IN YOUR TECHNOLOGY ENVIRONMENT, YOU ASSUME THE ENTIRE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION TO YOUR OWN TECHNOLOGY ENVIRONMENT.

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

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

12. Expiration and Termination. The Licensor may terminate this Agreement for default by the End-User. This Agreement will also be automatically terminated upon the election of such by the Licensor or the official launch of the Software, whichever

event comes first. Upon termination of this Agreement for any reason, the End-User shall promptly uninstall the Software on any UR's Products and Licensor's Products, computer, or server on which it has been installed, deliver to the Licensor all CDs, DVDs, magnetic tapes, cards, and other tangible items and materials embodying the Software, and return to the Licensor all copies thereof or destroy such copies and warrant in writing that all copies thereof have been destroyed. In the event of termination of this Agreement, all obligations of the parties under this Agreement due for performance on the date of termination shall survive the termination, and the party terminating shall not be liable to the other party for any damages arising out of the termination.

13. Miscellaneous.
    1. This Agreement constitutes the entire understanding and agreement between the Licensor and the End-User and replaces any prior agreement relating to the same subject matter.
    2. This Agreement shall be governed and construed in accordance with the laws of the province of Quebec and the federal laws of Canada applicable therein. Any legal action or proceeding between the Licensor and the End-User for any purpose concerning this Agreement or the parties' obligations hereunder shall be brought exclusively in a court of competent jurisdiction sitting in the judicial district of Trois-Rivières, Quebec.
    3. The Licensor's failure to insist upon or enforce strict performance of any provision of this Agreement shall not be construed as a waiver of any provision or right. Neither the course of conduct between the parties nor trade practice shall act to modify any provision of this Agreement.
    4. The Licensor may assign its rights and duties under this Agreement to any party at any time without notice to the End-User. The End-User may not assign this Agreement without the prior written consent of the Licensor.
    5. If any part of this Agreement is null, illegal or non-enforceable, this Agreement shall be interpreted as if this part was never part of this Agreement.
    6. The provisions of this Agreement are for the benefit of the Licensor and its officers, directors, employees, agents, licensors and suppliers. Each of these individuals or entities shall have the right to assert and enforce those provisions directly against the End-User on its own behalf. This Agreement is also for the benefit of, and binds, the End-User and its heirs, successors, legal representatives and permitted assigns.
    7. Any rights not expressly granted herein are reserved.
    8. The parties confirm that they have agreed that this Agreement and all related documents be drafted in English only. Les parties aux présentes confirment qu'elles ont accepté que la présente convention et tous les documents y afférents soient rédigés en anglais seulement.

3.8.2. UR Package without URCaps

If your Universal Robots controller is not compatible with the URCaps package (refer to the **Installation for Universal Robots** section for compatibility), you can install the driver package and ActiveDrive Toolbar separately. The driver package contains templates to access the Sensor's force and torque values. The ActiveDrive Toolbar allows to easily move the robot by hand guiding it. This section applies to Robotiq's software installation when not using URCaps.

> Info
>
> The driver package and the ActiveDrive toolbar have separate installation processes. The driver package is independant from the ActiveDrive toolbar, but has to be installed beforehand if you wish to install the ActiveDrive toolbar.

Driver Package Installation

> Info
>
> The URCap package contains the driver package. Therefore, installing the URCap package also installs the driver package. If you have installed the URCap, you do not need to install the driver package. This section applies to Robotiq's software installation when not using the URCap. If you wish to install the URCap package, refer to the **URCap Package** section.

> Caution
>
> Make sure your PolyScope version is up-to-date and that your controller is compatible with the driver package for UR (refer to the **Installation for Universal Robots** section for controller compatibility). To view your PolyScope version, go to the home page of the teach pendant and tap the **About** button. A window containing the Universal Robots software version will pop up.

To install the driver package, follow this procedure:

1. Download the Robotiq Force Torque Sensor software driver package (DFU-X.X.X) from the Documentation Archives.
2. Extract the content of the .zip file on a blank USB flash drive.
3. Plug the flash drive into the robot controller or teach pendant.
4. Installation is automatic. The pendant screen will show installation status. Do not unplug the flash drive until the operation is completed.
5. When a green "USB" text is shown, unplug the USB drive.

Calibration

If the Force Torque Sensor is mounted on the robot for the first time, calibration must be performed. Refer to the **Calibration Procedure** section for details.

> Warning
>
> The Sensor must be calibrated after each uninstall / install on the robot. Mounting screws will induce internal stress that needs to be compensated for. Not doing so will significantly affect the Sensor signal.

Testing the software package

- In PolyScope, load the program test_sensor.urp located in the Sensor folder and execute it. The program will display pop-ups with the following information: Sensor firmware version, production year and serial number. The force and torque readings for Fx, Fy, Fz, Mx, My and Mz are displayed in the Variables tab.

> Info
>
> To get detailed information on how to program in PolyScope using the Force Torque Sensor signals, refer to the **Using the force and torque values** section.

Removing the Package

1. Locate the uninstall.sh file provided in the driver package.
2. Copy the file on a blank USB stick.
3. Rename the file to urmagic_uninstall.sh.
4. Plug the USB stick into the UR controller or teach pendant.
5. Uninstallation is automatic.

ActiveDrive Toolbar Installation

> **Tip**
>
> Prior to installing the ActiveDrive toolbar, the Sensor Driver package should be installed.

> **Info**
>
> The URCaps package contains the ActiveDrive Toolbar. Therefore, installing the URCap package also installs the toolbar. If you have installed the URCap, you do not need to install the ActiveDrive Toolbar. This section applies to Robotiq's software installation when not using the URCap. If you wish to install the URCap package, refer to the **URCap Package** section.

> **Tip**
>
> Make sure your PolyScope version is up-to-date and that your controller is compatible with the driver package for UR (refer to the **Installation for Universal Robots** section for controller compatibility). To view your PolyScope version, go to the home page of the teach pendant and tap the **About** button. A window containing the Universal Robots software version will pop up.

> **Warning**
>
> Verify that the Force Torque Sensor is aligned with the robot arm using the dowel pin, or at least make sure the holes are aligned. This ensures that the Sensor's axes are aligned with the robot's and that the ActiveDrive will work correctly.

To install the ActiveDrive toolbar :

1. Visit support.robotiq.com and download the latest ActiveDrive toolbar installer (ADU-X.X.X) in the Documentation Archives section.
2. Extract the files on a blank USB stick.
3. Connect the USB stick in the Universal Robots' teach pendant or controller.
4. Installation is automatic. The pendant's screen will show installation status.
5. Do not remove the USB stick before the installation is completed.
6. Once the installation is completed, the ActiveDrive Toolbar button will appear on the teach pendant's screen after a short delay.

> **Info**
>
> To get detailed information on how to use the ActiveDrive Toolbar, refer to the **ActiveDrive Toolbar** section.

4. Software

The following sub-sections provide instructions for installation of the software package on various platforms. This allows you to get data from the FT 300 Force Torque Sensor.

- Section 4.1 and subsections refers to the control and programming for Universal Robots.
- Section 4.2 and subsections detail the installation of an open source development package, which can be adapted according to the users' needs. It currently functions with Windows and Linux.
- Section 4.3 links to ROS.
- Section 4.4 explains the Demo Software
- Section 4.5 will detail the use of serial communication in generic applications

4.1. Control with Universal Robots

The URCap Package contains many features to program and control the robot's arm using the Sensor's force and torque readings. The package provides:

- ActiveDrive toolbar;
- Path recording node;
- Driver package.

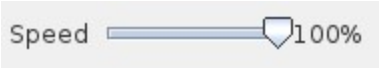
4.1.1. ActiveDrive Toolbar

The ActiveDrive Toolbar is automatically installed with the Force Torque Sensor URCap Package. It enhances the guiding mode on Universal Robots by allowing the robot to be hand guided smoothly and easily towards a waypoint. The ActiveDrive feature is a great way to assist the Path recording described in the **Path Recording** section, by hand guiding the robot while recording a path.

> Info
>
> The Force Torque Sensor URCap Package contains the ActiveDrive Toolbar. Therefore, the toolbar is automatically installed with the URCap Package. The ActiveDrive Toolbar can be installed and used without the URCap Package (refer to the **UR Package without URCaps** section for information on how to install the toolbar without the URCap).

> Warning
>
> Verify that the Force Torque Sensor is aligned with the robot arm using the dowel pin. This ensures that the Sensor's axes are aligned with the robot and that the ActiveDrive feature will work correctly.

The robot speed set with the Speed slider will affect the speed at which the robot moves in the ActiveDrive mode. Verify and adjust the speed slider to the desired speed. It has to be greater than 50%.



Overview

Toolbar collapsed

Tap the ActiveDrive button to expand the toolbar.

Toolbar expanded

Tap the mode selector to expand.

ActiveDrive modes expanded

Features

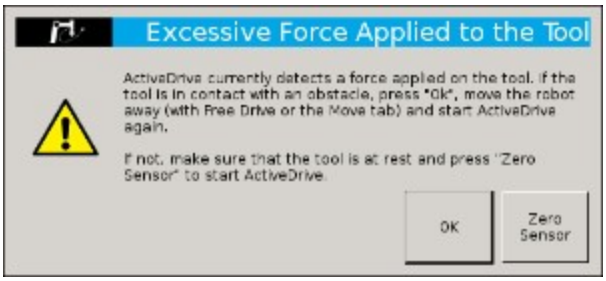
Primary icon	Functionality name	Description
	ActiveDrive	Tap to toggle between the expanded and collapsed ActiveDrive Toolbar. When grey, the functionality is not available. Tap the button to see why it is not available.
	Start / Stop	Tap to start or stop ActiveDrive. ActiveDrive will automatically turn off after 30s of inactivity. When started, ActiveDrive allows you to move the robot freely by applying forces on robot's end-effector. This is different from the Free Drive feature on the robot, where you can move the robot arm.
	Modes	Shows the current ActiveDrive mode. When tapping the icon, the available modes will appear and you can change to a different mode. ActiveDrive modes allow you to restrain the robot to specific movements.
	Free	Free motion: all translations and rotations are allowed.
	Scara	SCARA-style motion: all translations and horizontal rotation (twist) are allowed.
	Translation	Translation motion: only translations are allowed. No rotation of the robot is possible in this mode.
	Plane	Plane motion: horizontal translations and horizontal rotations (twist) are allowed (no vertical motions are allowed).
	Drift Control	Tap this button to stop the robot from drifting (resets the Sensor's offset).

Primary icon	Functionality name	Description
 	Speed	Motion speed control is toggled between fast and slow, allowing precise movement in slow motion. The Force Torque Sensor will switch to slow speed automatically whenever high forces are detected, for example, during an impact with an object.
	Square robot	Aligns the tool center point (TCP) orientation with the robot base. Tap and hold this button to automatically move the end-effector to the closest orthogonal orientation of the base axis system (just try it, you will see!).

Error Messages Overview

The ActiveDrive Toolbar will be automatically collapsed and be grayed whenever one of the following situations occurs. In such cases, by tapping the ActiveDrive button, the following messages will appear:

- Message:



- Solution:
  - Starting ActiveDrive while an excessive force is applied to the tool:
    - Determine if an external force is applied to the end-effector. If it is the case, tap **OK** and move the robot away from the obstacle (with Free Drive or Move tab), or remove any external forces and start ActiveDrive again.
    - If no external forces are applied, tap **Zero Sensor**.

- Message:

- Solution:
  - Force Torque Sensor is detected: Check the Force Torque Sensor's connection. Make sure the USB adapter and all the wires are connected. Also, verify the Sensor's LED status (refer to the **Status LED** section).

- Message:

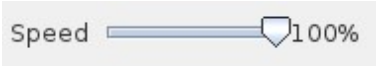
- Solution:
  - The robot is not initialized: Tap **OK** and go to PolyScope's home page. Tap **Setup Robot** and go to **Initialize Robot** to start the robot.

- Message:

- Solution:
  - A program is already running: The ActiveDrive Toolbar cannot be used while a program is running. Stop the program to enable the ActiveDrive feature.

- Message:

- Solution:
  - The speed setting of the robot is lower than 50%: The robot's speed setting should be greater than 50%. Modify the speed setting in the robot program using the slider.



- Message:

- Solution:
  - If the Freedrive button is pressed: The ActiveDrive mode cannot be used when the Free Drive mode is ON. Make sure you are not pressing on the teach pendant's Teach button when trying to use the ActiveDrive toolbar.

4.1.2. Using the force and torque values

Force Torque Sensor functions are made available in the Universal Robots functions drop-down menu.

- The **rq_zero_sensor** function can be called at any point in a robot program to zero the force and torque values of the Force Torque Sensor.
- The **get_sensor_** functions allow the user to assign the sensor values to any variable.
- The **get_applied_tcp_force(<index>)** function returns the current wrench (force and torque vector) value currently applied at the tool center point (TCP).
- The **get_applied_base_force(<index>)** function returns the current wrench (force and torque vector) value applied at the robot arm base.
- The **express_force_in_frame(<T_from_to>,<wrench_from>)** function is used to convert the wrench (force and torque vector) reading in a given reference frame into another (end-effector to robot base, and vice-versa, for example).
  - T_from_to = relative pose of the reference frame into which the wrench reading is converted
  - wrench_from = wrench to transform in pose or list format (Fx, Fy, Fz, Mx, My, Mz)

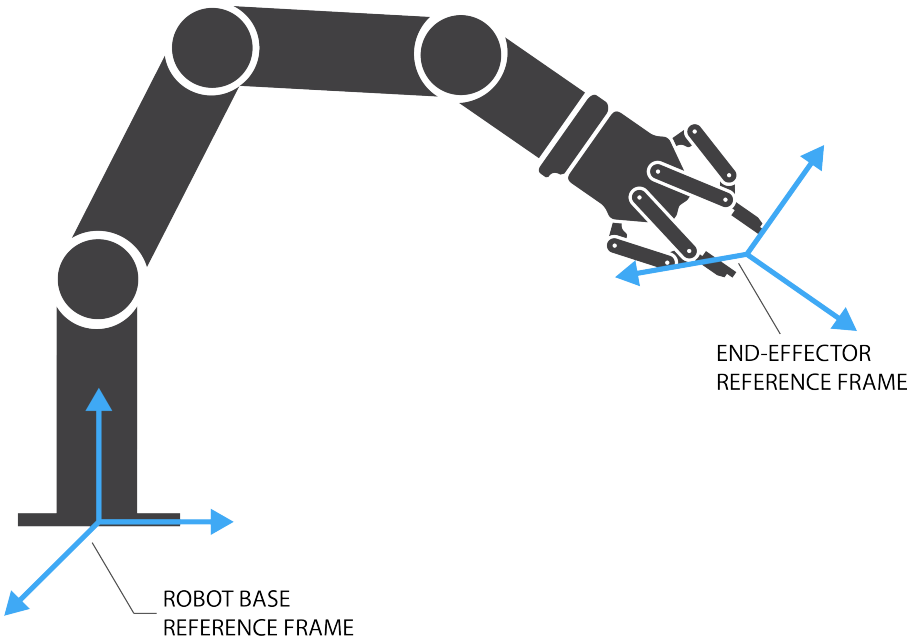
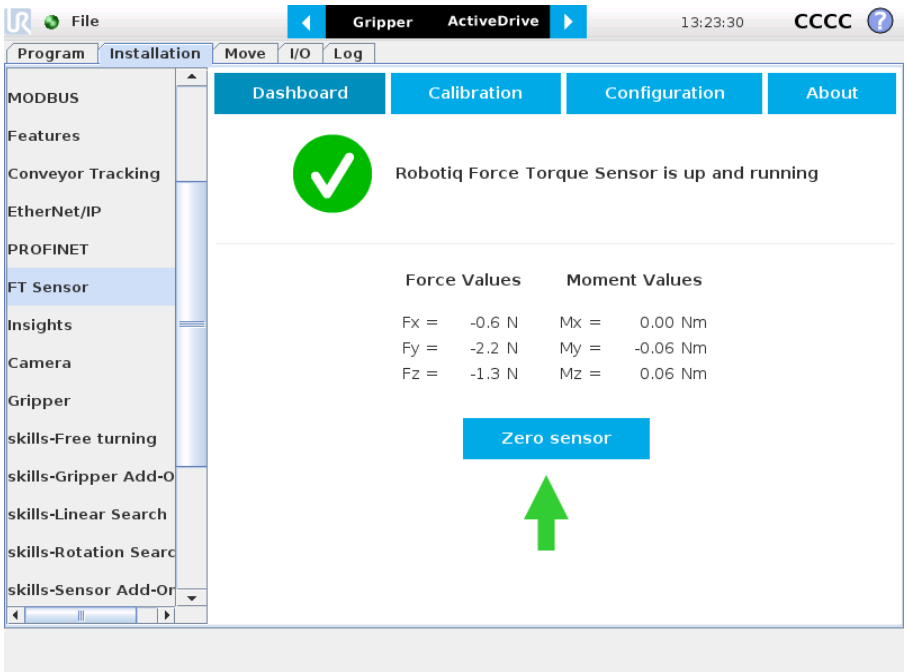


Fig. 4.1: Example of two reference frames for the express_force_in_frame(<T_from_to>,<wrench_from>) function

> **Info**
>
> Although displayed in real time in the Variables tab, the force and torque values can be seen in the FT Sensor Dashboard.

After the calibration has been completed, go to the FT 300 Dashboard to monitor the force and torque values in real time.

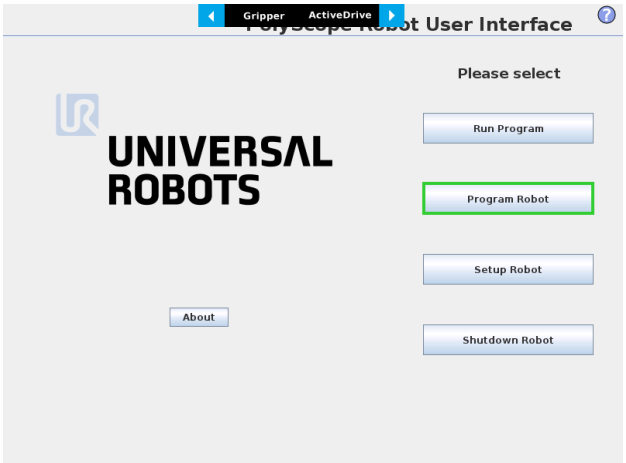
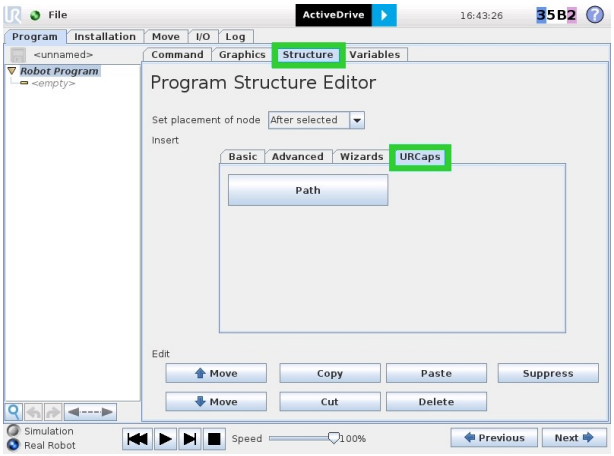
Prior to using the FT Sensor's data in the framework of a robot program, it is recommended to zero the sensor using the **Zero sensor button**.



4.1.3. Path Recording

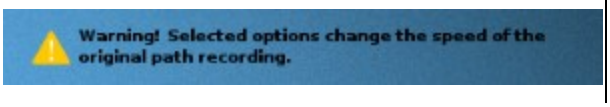
The Force Torque Sensor URCap Package adds a Path feature in PolyScope which can be used to record paths directly by moving the robot. The ActiveDrive Toolbar is a great tool to use while recording a path, as it is an easy way to hand guide the robot's end-effector. Path recording can be used for specific processes requiring complex paths (polishing, gluing, etc.) or more generally for any useful case that would require programming a high number of waypoints. The Path node offers options to modify the recorded path to change its speed and play the path backwards or relative to a variable start position.

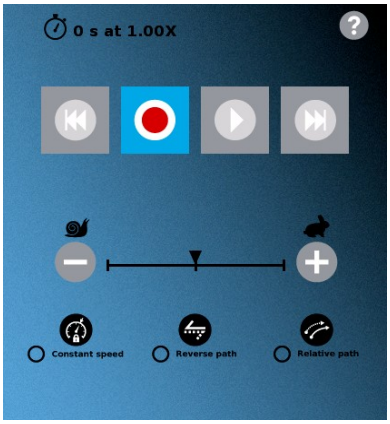
How to add and record a path

	• Tap **Program Robot** • Open an empty program or load a template.
	• Go to the **Structure** tab. • Go to the **URCaps** tab. • Tap the **Path** button.

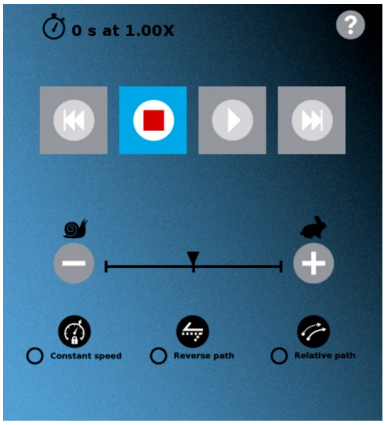
- Go to the **Command** tab to record and edit a path.
- The BeforeStart node is used to execute preliminary operations before the parent program node.
    - In some instances, the parent node requires a processing time before starting.
    - To prevent delays, operations found under the BeforeStart node will be executed as soon as the parent node is ready to start.
    - A placeholder Comment node can be found within the BeforeStart node. You can either rename it or replace it with another program node. Deleting it will prevent you from using the parent node.

Overview

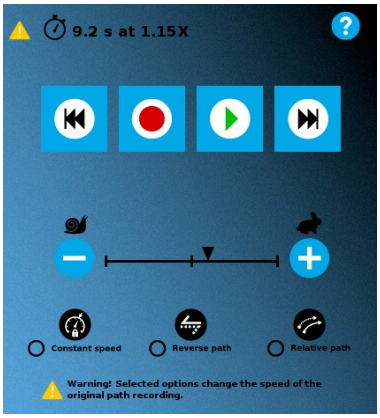
	Path time and speed information. Warning message is displayed whenever a setting results in a duration different than the original path duration.
	Path recording and visualization.
	Path speed slider.
	Path options.
	Warning section. Displayed whenever a setting results in a duration different than the original path duration.



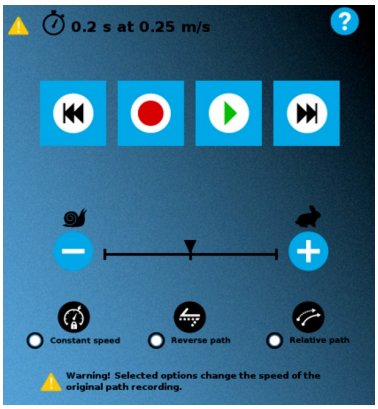
When a Path node is empty (no path recorded), the only available button is the record button.



While recording a path, the only available button is the stop button.



When the speed of the original recording is modified using the speed slider, a warning message appears and the path time and speed information is updated.



When a path option is selected, a warning messages appears and the path time and speed information is updated.

Features*

Primary icon	Functionality name	Description
	Start/Stop recording	Starts and stops the path recording.
	Navigate to path's start	Press and hold in order to move the robot at the path's start.
	Navigate to path's end	Press and hold in order to move the robot at the path's end.
	Play path	Press and hold in order to move the robot to the path's start and play the path as it will be executed in the program.
	Enable constant speed	If selected, the path is modified to play at a constant tool speed (linear speed at the tool center point) defined by the Path speed slider's position. With this option, all pauses and hesitations (dead times) in the path will be removed.
	Enable reverse path	If selected, the recorded path will be played backwards in the program. It can be useful if a path is copied and played backwards, resulting in a path played back and forth.
	Enable relative path	If selected, the path will be played relative to the current robot position when the program enters the path instruction. This effectively offsets all the recorded path and can be used to: • correct a path (for example adding a vertical distance on the whole path); • accommodate a variable object position (for example when the object is located by a visionsystem).

Primary icon	Functionality name	Description
	Decrease/Increase path speed	Motion speed control is toggled between fast and slow, allowing precise movement in slow motion. The Force Torque Sensor will switch to slow speed automatically whenever high forces are detected, for example, during an impact with an object.
	Path speed warning	"Warning! Selected options change the speed of the original path recording." Displayed whenever a setting results in a duration different than the original path duration.

* When an icon is greyed, it means it is unavailable.

If you tap the record button when a path is already recorded in a node, a warning pop-up window will ask if you want to overwrite the path (tap **OK**) or keep the previously recorded path (tap **Cancel**).

Custom Programs

You can create your own program using the Force Torque Sensor signals by following this procedure :

- In the list of provided samples, open **template_sensor.urp**.
- Push **Play** and check the **Variables** tab.
  - You will see Sensor variables **Fx**, **Fy**, **Fz**, **Mx**, **My**, **Mz**.
  - You can verify the readings by applying force to the Sensor and observe the response.
- Add your instructions in the robot program section.
  - For example, you can command the robot to move until you read a certain threshold of force.
  - The program instructions (robot motion, logic, etc.) can be added after the **accessor_capt** script line and you can start building the program as it is normally done with PolyScope.

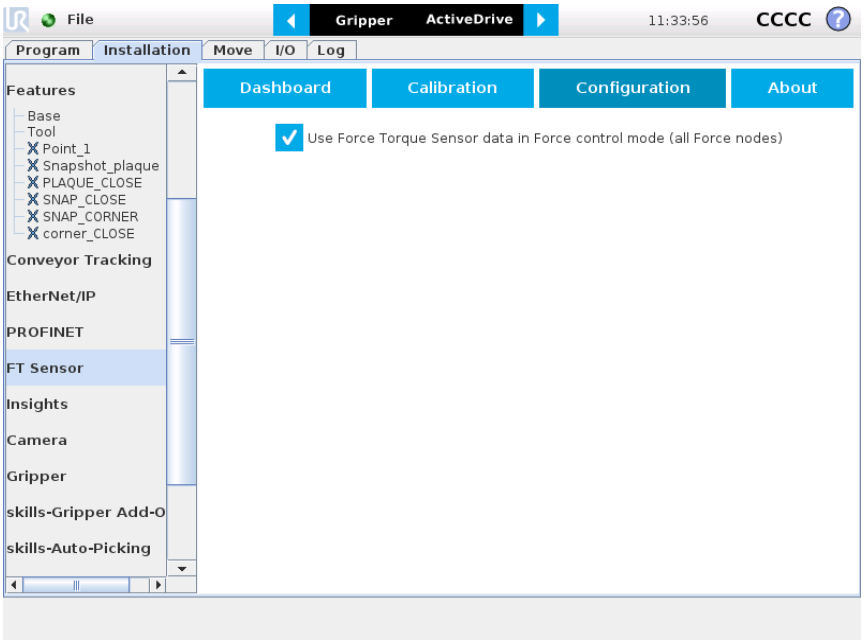
> Info
>
> The Sensor's data returns the following variables: **Fx**, **Fy**, **Fz**, **Mx**, **My**, **Mz**. When a variable list is shown (for example when programming an **If** statement), they will be available in the scroll box. The variables are floats with force values being in newtons (N) and moment values being in newton-metres (Nm). The variables are updated automatically by the Sensor thread.

> Info
>
> The recorded path duration cannot exceed 10 minutes.

> Info
>
> With the constant speed option selected, the calculation of a slowed down path that would last over 2 hours will generate an error.

4.1.4. Using the Force Torque Sensor's Data in Force Nodes

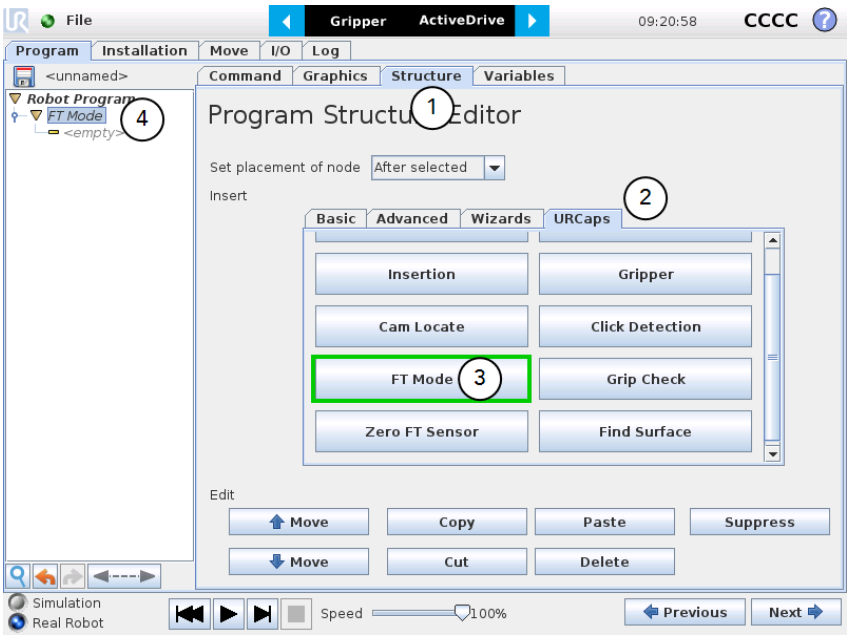
In order to use the FT Sensor's data in Force control mode for all Force nodes, go to the **Configuration** tab and check the corresponding box. This will feed the Sensor's force values to the UR Force mode as an alternative to UR's embedded force feedback.



4.1.5. FT Mode

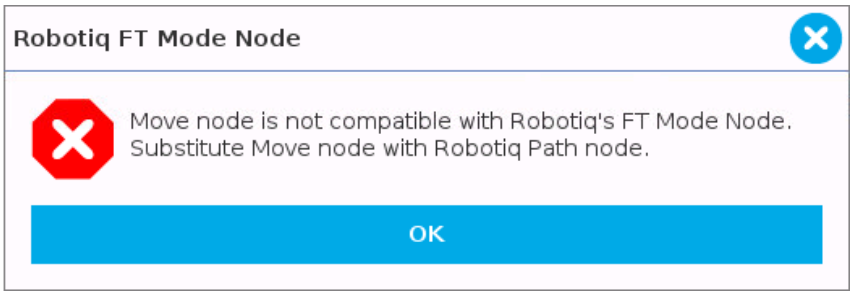
Overview

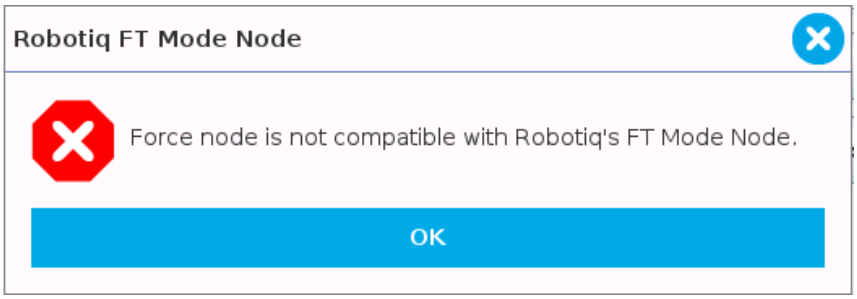
The Robotiq FT Mode is used to apply force and torque values along and around axes.



1. Once in a robot program, tap the **Structure** tab
2. Tap the **URCaps** submenu
3. Select **FT Mode**
4. The FT Mode node displays in the program tree

> **Warning**
>
> UR Move nodes (MoveL, MoveJ, MoveP) and Force nodes cannot be executed as child of the Robotiq FT Mode node.





> **Tip**
>
> Where a UR Move node would normally be used, the user shall record a Robotiq Path emulating the desired Move.
>
> In a situation where the user wants to make contact with a surface in accordance with the user-defined settings, a Wait instruction can be inserted as child of the Robotiq FT Mode.

The FT Mode node is primarily meant to be used with a Robotiq Path node.

With the various user-defined settings available, operators can use the Force Torque Sensor to apply force/torque and thus follow irregular shapes and/or surfaces for applications such as polishing, deburring, finishing, dispensing, etc.

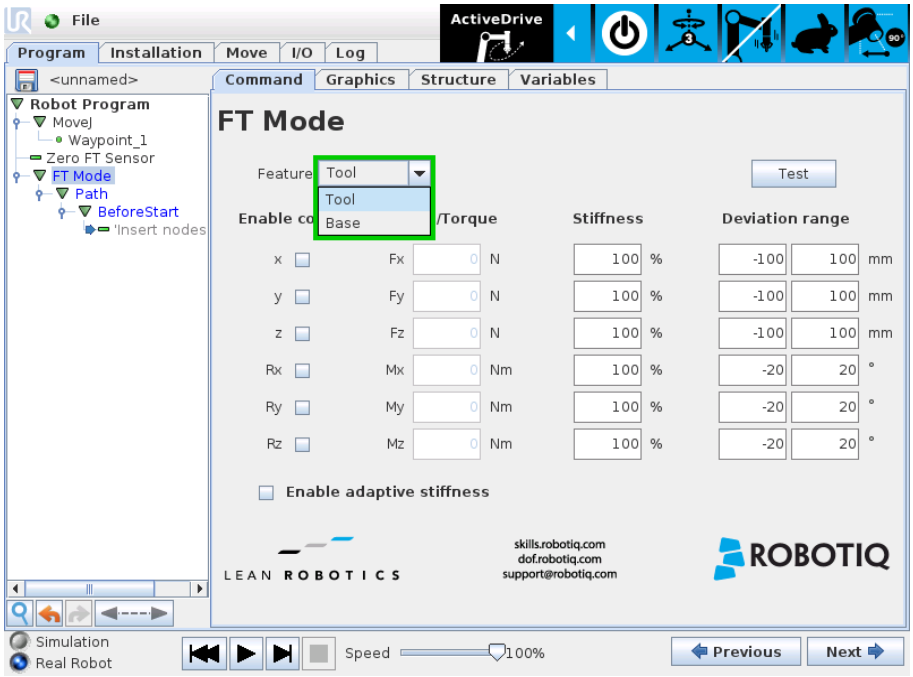
Features

Reference frame

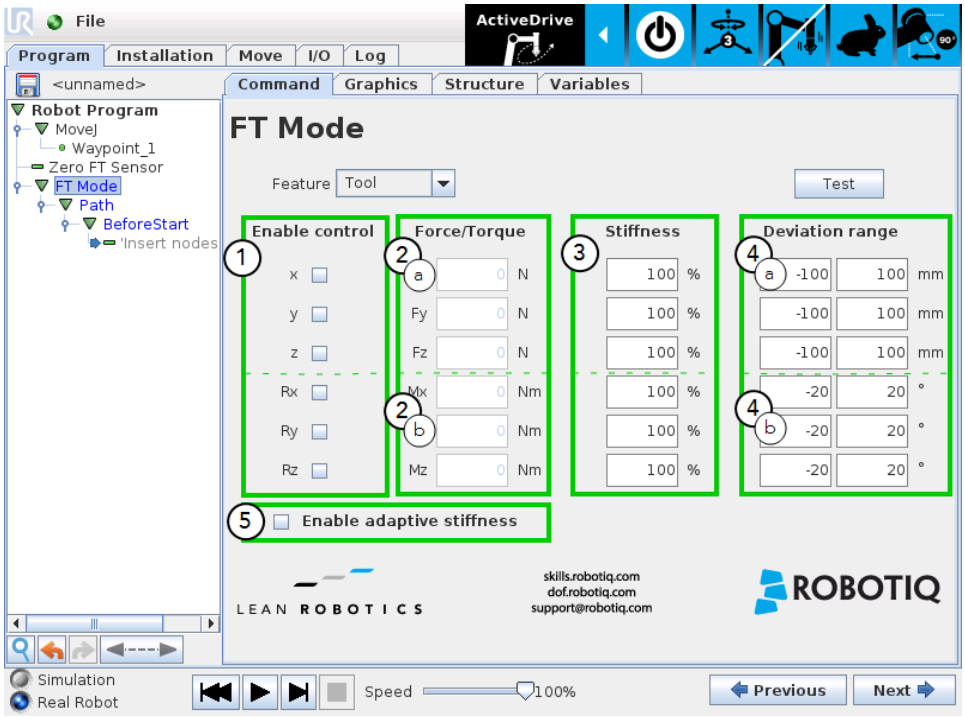
The user can select a reference frame from a dropdown menu, as shown below.

The **Tool** reference frame uses the X, Y and Z axes of the **end-effector** to apply force and torque values in the appropriate direction.

On the other hand, the **Base** reference frame takes into consideration the X, Y and Z axes of the **robot arm base**.



Parameters



1. **Enable control**: each checkbox corresponds to the enablement of force feeding along an axis (upper three options) or torque feeding around an axis (lower three options)
2. **Force/Torque**: depending on which options were checked at step 1, the corresponding textboxes here should be filled with the desired force/torque values
   a. Force values applied are in newtons (N) – the range allowed goes from -150 to +150 N
   b. Torque values applied are in newton-metre (Nm) – the range allowed goes from -50 to +50 N.

> **Info**
>
> Tapping the text boxes brings up a numpad used to enter the values.

3. **Stiffness**: the stiffness settings act directly on the Sensor's directional compliance depending on the orientation of the end-effector and the axes selected at step 1.
   a. A stiffness value closer to 0% will provide greater compliance along/around the corresponding axis
   b. A stiffness value of 100% offers no compliance along/around the corresponding axis
4. **Deviation range**: the deviation range limits the flexibility allowed along/around the corresponding axis.
   a. The deviation range **along** the X, Y and Z axes is measured in **millimeters (mm)** – the negative range allowed goes from -1000 mm to 0 mm while the positive range allowed goes from 0 mm to 1000 mm.
   b. The deviation range **around** the X, Y and Z axes is mesured in **degrees (°)** – the negative range allowed goes from -179° to 0° while the positive range allowed goes from 0° to 179°.

> **Example**
>
> In a situation where **10 N** are applied exclusively along the **Z-axis**, with **20% stiffness** along the X and Y axes, and a deviation range that goes from **-50 mm to +50 mm** along all axes...
>
> - The end-effector will systematically point towards its Z-axis
> - The end-effector will not rotate around Rx, Ry and Rz (no torque feeding)
> - The end-effector will be moderately flexible to move along the X and Y axes
> - The movements along the X, Y and Z axes will be limited to -50 mm and +50 mm from the command position

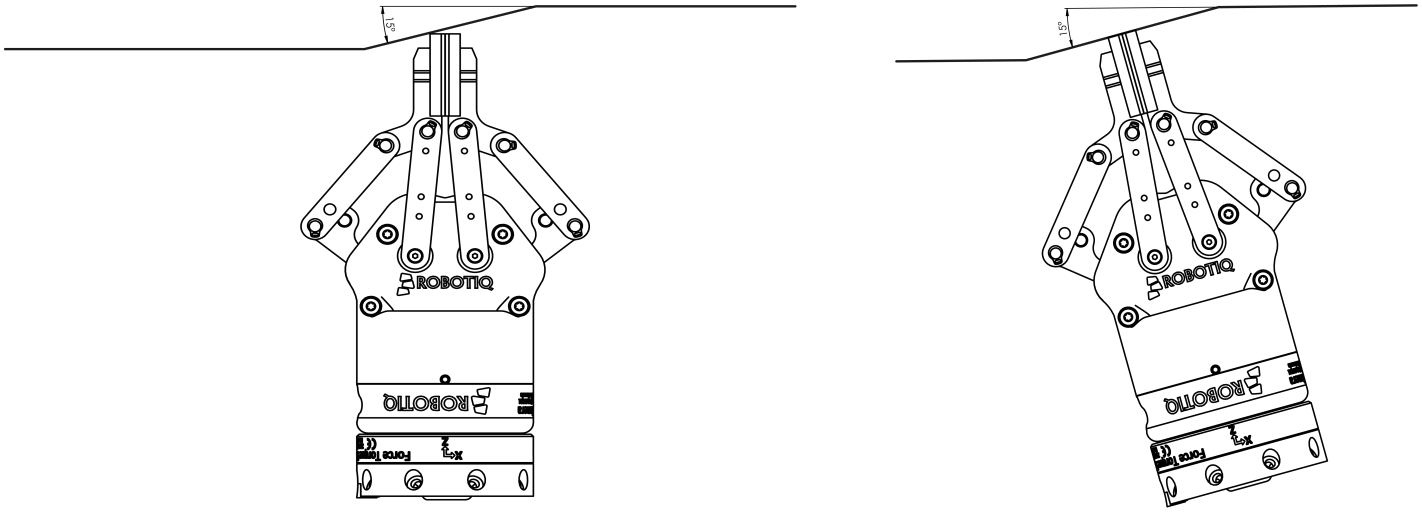


Fig. 4.2: Deviation range - On the left, no deviation range has been entered. On the right, a deviation range of at least 15 degrees has been entered around the corresponding axis.

5 **Enable adaptive stiffness**: this checkbox greys out the stiffness values in the boxes at step 3 since the FT Mode calculates the rigidity of the surface/object with which the end-effector comes in contact. Thus, constant force/torque values are applied to surfaces with variable rigidity (e.g.: long, bent, bending or folded sheets or parts.

When entering into contact with a surface for the first time, the end-effector will pull back for it has reached the force/torque value entered at steps 2a and/or 2b. It will then go back to the surface and apply the same force/torque values while pulling back less and less over time.

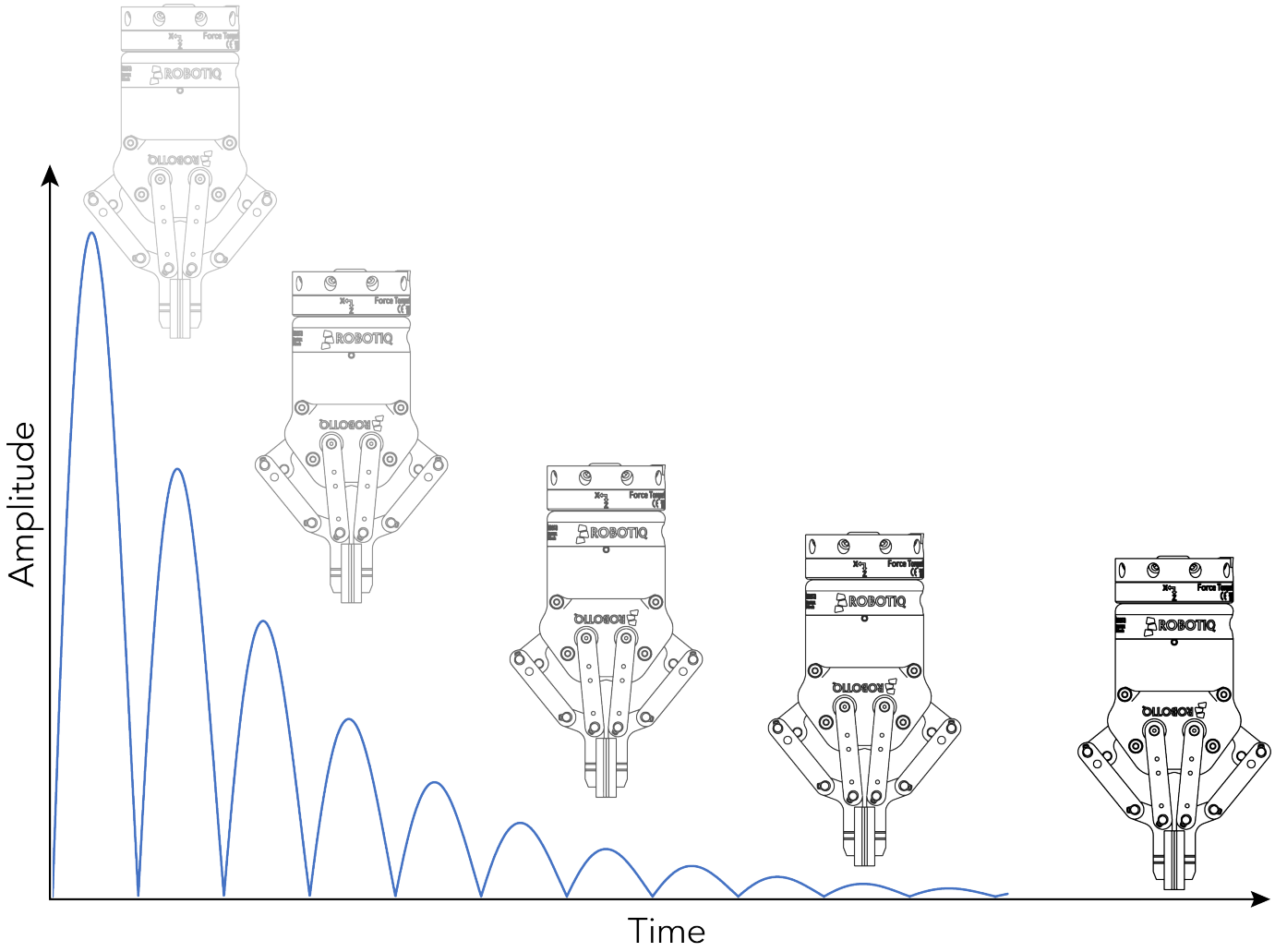
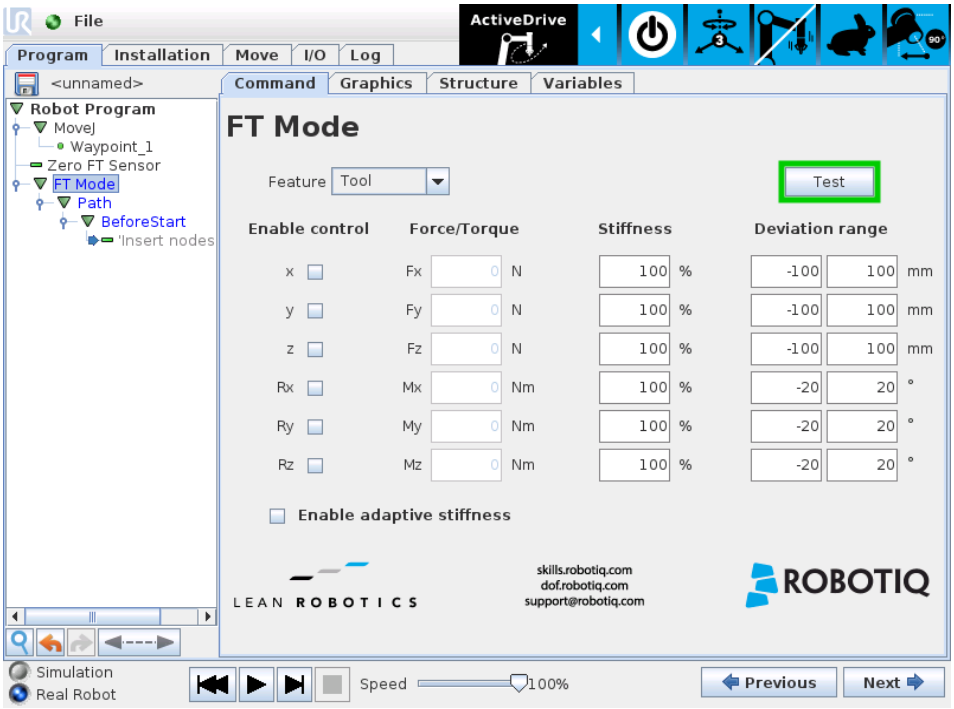


Fig. 4.3: End-effector experiencing adaptive stiffness upon repeated contact with a surface

Test

The Test button applies the user-defined settings of the FT Mode node to the Sensor, therefore moving along/around the corresponding axes, if the control had been enabled for the latter, regardless of other instructions entered before or after the FT Mode node in the program tree.



4.2. Development Package

The Robotiq Force Torque Sensor development package can be downloaded at support.robotiq.com.

4.2.1. Distribution License

The development package is distributed under the New BSD license, which is a permissive free software license. In short, the provided code can be used in any project without any restriction regarding its use (commercial or not). If it is included in a software, this software does not need to be open-source. However, the code is provided "as is" without any liability from Robotiq and some restrictions apply regarding the distribution of the code and the use of the Robotiq name.

The terms of the license (included in each source file) are described here:

```
Software License Agreement (BSD License)

Copyright (c) 2014, Robotiq, Inc. All rights reserved.

Redistribution and use in source and binary forms, with or
without
modification, are permitted provided that the following con-
ditions are met:

- Redistributions of source code must retain the above copyright
notice, this list of conditions and the following disclaimer.

- Redistributions in binary form must reproduce the above
copyright notice, this list of conditions and the following
disclaimer in the documentation and/or other materials provided
with the distribution.

- Neither the name of Robotiq, Inc. nor the names of its
contributors may be used to endorse or promote products derived
from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND
CONTRIBUTORS
"AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT
LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS
FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE
COPYRIGHT OWNER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT,
INDIRECT,
INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES
(INCLUDING,
BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES;
LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER
CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT,
```

```
STRICT
LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN
ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE
POSSIBILITY OF SUCH DAMAGE.
```

4.2.2. Linux

Package Files – Description

The development package is structured with the following files and directories architecture (non-Linux files and directories are ignored in this section):

- src: contains the source files common to all platforms
- obj: used during compilation for the object files related to the common sources
- Linux: contains Linux specific files
  - bin: contains the binary files
  - src: contains the source files common to all platforms
    - main.c : application source file which can be modified by the user
  - obj: contains all the object files after they are compiled
- Makefile: file containing the rules to compile the sensor driver using Make

> Caution
>
> When started, the provided software will scan all ports in the system (ttySx and ttyUSBx) to find a compatible Robotiq device. It uses the Linux utility "fuser" to determine if the port is already opened. This section of code can be modified by the user if necessary to avoid the scanning of ports (for example, if another device would become confused when receiving a message that it cannot understand).

Procedure to Compile and Test the Provided Source Code

This procedure explains how to compile the source code and verify that the sensor data is properly read.

1. Unzip the package in the home folder, for example in the folder ~/driver/
2. Open a terminal and enter the package directory using the following command:

```
rd@debian:~/$ cd driver
```

3. Use Make to compile the application:

```
rd@debian:~/$ make linux
```

4. In order to have access to the virtual serial COM port, add the used username to the group dialout:

```
rd@debian:~/$ sudo usermod -a -G dialout username
```

5. It is required to log out (or reboot) the session in order for the group change to become effective.

6. Make sure that the sensor is properly powered and that the data signals are connected to the development PC using the provided RS485 to USB converter. A new device named ttyUSBx should be present in /dev, which can be verified with the following command:

```
rd@debian:~/$ ls -l /dev | grep ttyUSB
```

7. In a terminal, go to the ~/driver/Linux/bin folder and execute the demo application using the following command:

```
rd@debian:~/driver/Linux/bin/$ ./driverSensor
```

8. After 1-2 seconds, the sensor data should start showing up in the terminal as a vector of 6 floats with data in the (Fx, Fy, Fz, Mx, My, Mz) format.

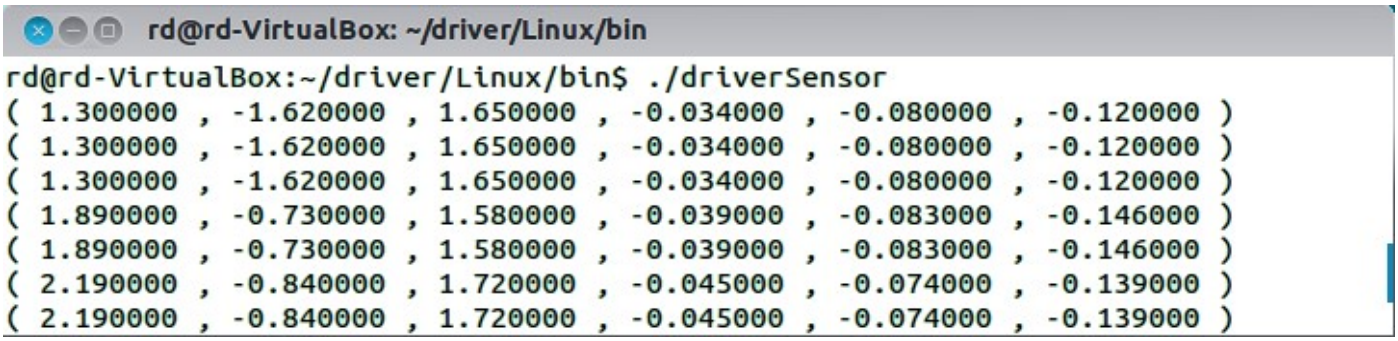


Fig. 4.4: Sensor Data Acquisition.

Adapt to a User Application

In practice, the provided source code will be adapted to either: be incorporated with a custom application or to communicate with one. At this point, the main.c file should be adapted according to the guideline comments inserted in the code.

> Caution
>
> Please note that Robotiq can only support our customers in making sure they can compile and test the provided code *as is*.
>
> No support can be provided for the integration of the provided source code into a custom application.

4.2.3. Windows

Package Files – Description

The development package is structured with the following files and directories architecture (non-Windows files and directories are ignored in this section):

- src: contains the source files common to all platforms
- obj: used during compilation for the object files related to the common sources
- Windows: contains Windows specific files
  - bin: contains the binary files
  - src: contains the source files common to all platforms
    - main.c : application source file which can be modified by the user
  - obj: contains all object files after they are compiled
  - Data_logger: contains an application (and its source code) to log data from the sensor
  - compiler.bat: script which automates the settings for the environment variables and the compilation of the example application
- Makefile: file containing the rules to compile the sensor driver using Make

Procedure to Compile and Test the Provided Source Code

This procedure explains how to install MinGW, compile the provided source code and verify that the sensor data is properly read.

1. Unzip the package in the desired directory.
2. If it is not already installed, download MinGW at http://www.mingw.org/. Download the installer "mingw-get-setup.exe".
3. Install MinGW by running "mingw-get-setup.exe" and save the default installation path.
4. Open "MinGW installation manager".
5. Select "mingw-developer-toolkit" in the "Basic setup" tab and click "Mark for Installation".
6. Select "mingw32-binutils" in the "All packages" tab and click "Mark for Installation".
7. In the menu "Installation", click "Apply changes". This will install the required packages to compose the software using Make.
8. In the Windows directory, run the compiler.bat file. This will build your application.
9. Run the application "driverSensor" located in the "Windows/bin/" folder.
10. After 1-2 seconds, the sensor data should start showing up in the command window as a vector of 6 floats with data in the (Fx, Fy, Fz, Mx, My, Mz) format.

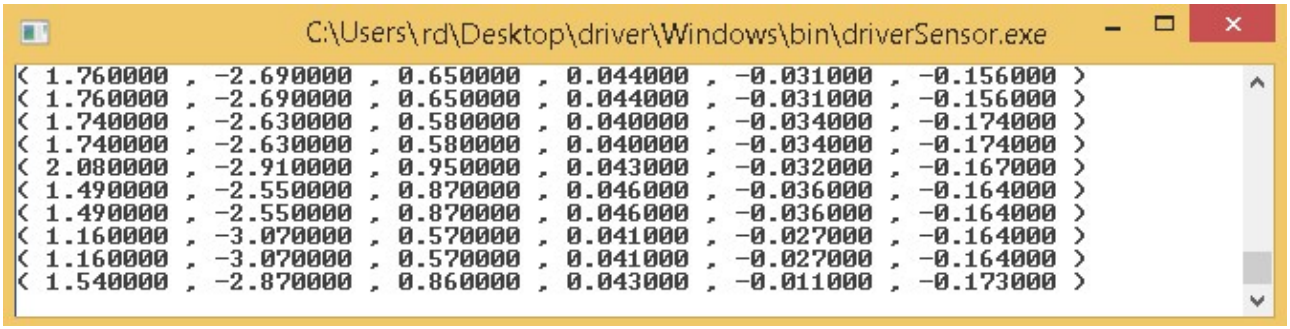


Fig. 4.5: Sensor Data Acquisition Under Windows.

Adapt to a User Application

In practice, the provided source code will be adapted to either: be incorporated with a custom application or to communicate with one. At this point, the main.c file should be adapted according to the suggested comments inserted in the code.

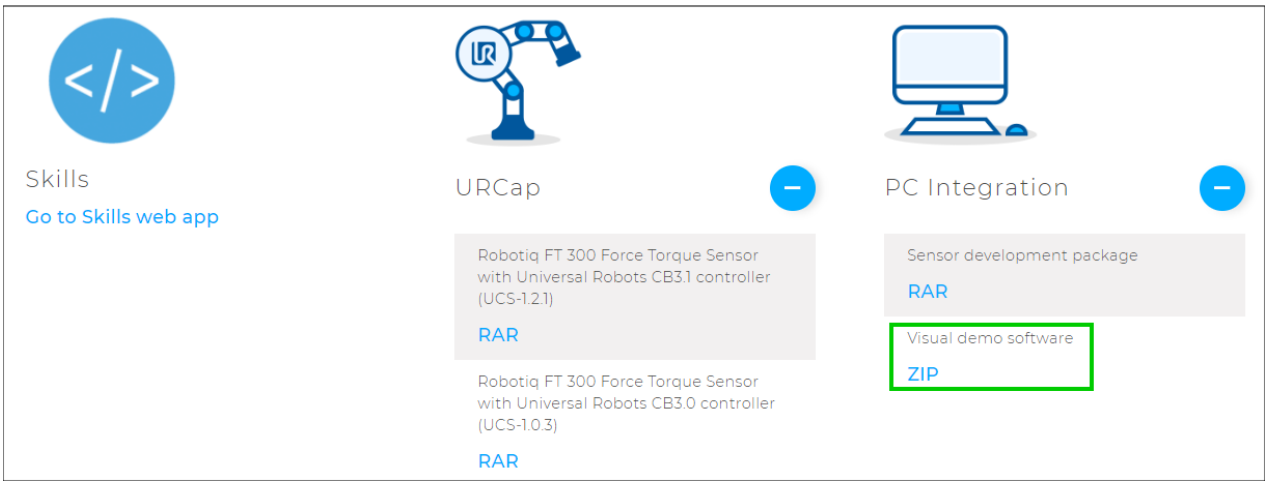
> Caution
>
> Please note that Robotiq can only support our customers in making sure they can compile and test the provided code *as is*.
>
> No support can be provided for the integration of the provided source code into a custom application.

4.3. Visual Demo Software

The Visual Demo Software is used to demonstrate the ability of the FT Sensor to read force and moment. It is not intended to be used for programming or to save or use data. It can also be used to calibrate the Sensor. Please refer to the **Calibration Procedure for the Visual Demo Software (PC)** section for the calibration procedure.

4.3.1. Software Package Installation

1 Make sure that you have the latest version of the Visual Demo Software, which can be found at support.robotiq.com.



2 Copy all the files of this folder onto a PC.

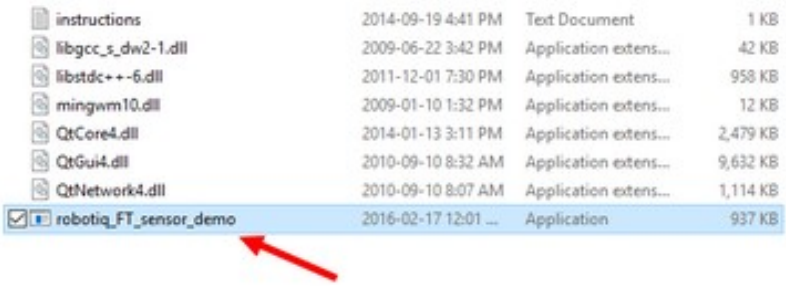
3 Connect the USB connector to the converter attached to the PC. Important : The Sensor must NOT be powered at this time.

4 Wait while the driver(s) install. After all the drivers have been installed.

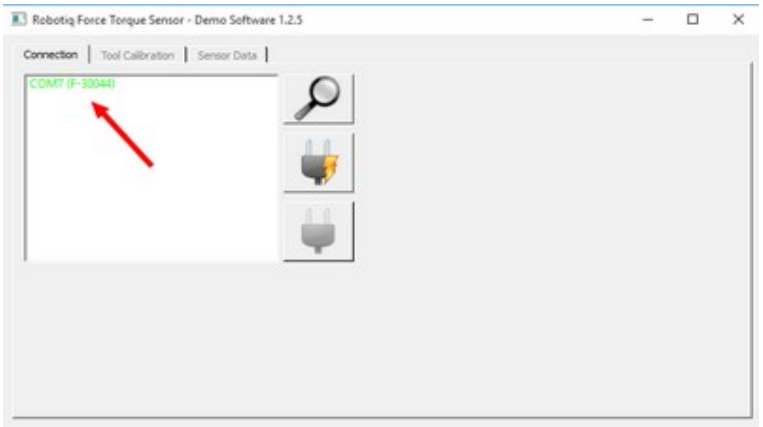
5 Plug the Sensor cable into the Sensor.

6 Connect the Sensor cable to the power supply.

7 Launch the demo application.



8 You should see a **COM** port in green with a serial number, showing the Sensor connected to the PC. Click on it.



By going into the **Sensor Data** tab, you can now see in real time the force and moment applied on the FT Sensor.

4.4. Serial Communication

The FT Sensor uses two communication modes, Modbus RTU and data stream. The Modbus RTU communication mode is used to obtain information on the Sensor, like its firmware version. The data stream mode is used to obtain data from the Sensor.

> **Info**
>
> It is recommended to use the FT Sensor data stream to obtain faster data acquisition.

> **Caution**
>
> Modbus RTU can be used to obtain data, but will result in a slower data acquisition frequency.

> **Info**
>
> In both modes, force and torque data from the Sensor will be in 16-bits signed integer format.

4.4.1. Modbus RTU

The Modbus RTU serial communication configuration parameters are:

Parameter	Value
Baudrate (bps)	19200
Data bits	8
Stop bit	1
Party	none
Slave ID	9

In Modbus RTU you can obtain the following information:

Information	Register
Production year-	514
Serial number	510 to 513
Force X (N) = value / 100	180
Force Y (N) = value / 100	181
Force Z (N) = value / 100	182
Moment X (Nm) = value / 1000	183
Moment Y(Nm) = value / 1000	184
Moment Z (Nm) = value / 1000	185
Acceleration X (g) = value / 1000	190
Acceleration Y (g) = value / 1000	191
Acceleration Z (g) = value / 1000	192

4.4.2. Data Stream

Data stream mode is the recommended method of obtaining data from the Sensor. Once initiated, the Sensor will stream force and moment data continuously until communication is interrupted by the user.

> Tip
>
> To start the data stream, write 0x0200 in register 410.

For a setup over Universal Robots, Data stream will be accessible on TCP port 63351 of your machine.

> Tip
>
> With a Universal Robot, you can access the data stream using the documentation available at UR : Remote Control Via TCP/IP - 16496

To stop the data stream, communication must be interrupted by sending a series of 0xff characters to the Sensor. Sending for about 0.5s (50 times) will ensure that the Sensor stops the stream.

When the stream is started, 16 bytes messages are sent by the sensor at 100Hz using this format:

<0x20><0x4e><LSB_data1><MSB_data1> ... <LSB_data6><MSB_data6><LSB_crc><MSB_crc>

With dataX being a 16-bits signed integer defined as:

Data	Value meaning
data1	Fx * 100 (N)
data2	Fy * 100 (N)
data3	Fz * 100 (N)
data4	Mx * 1000 (Nm)
data5	My * 1000 (Nm)
data6	Mz * 1000 (Nm)

The CRC is computed using a standard 16-bits modbus CRC (see http://www.ccontrolsys.com/w/How_to_Compute_the_Modbus_RTU_Message_CRC).

5. Specifications

The following sections provide data on the various specifications of the Robotiq Force Torque Sensor.

- Section 5.1 details the technical dimensions of the sensor.
- Section 5.2 details the mechanical specifications.
- Section 5.3 covers signal specifications (data acquisition).
- Section 5.4 specifies electrical rating.
- Section 5.5 covers the technical dimensions of the sensor coupling options.

5.1. Technical Dimensions

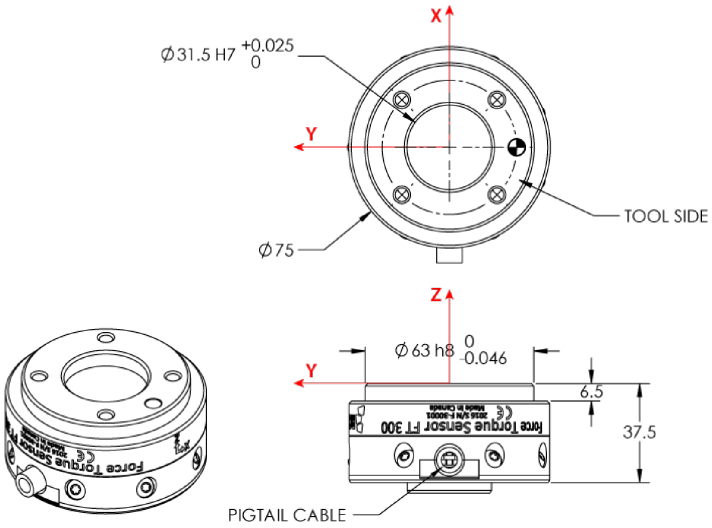


Fig. 5.1: Robotiq FT 300 Sensor general technical dimensions.

> **Info**
>
> Reminder: Measures are in millimeters.

5.1.1. Tool Side Bolt Pattern

The figure below illustrates the bolt pattern used for tool fixation on the FT 300 Sensor.

- Bolt pattern diameter is 50 mm
- Mounting holes are M6 thread, 6 mm deep.
- Indexing hole for M6 dowel pin has a tight fit (H7) and 6 mm deep.
- Outside diameter of the flange is 64 mm and inside is 45 mm.

> **Info**
>
> FT 300 tool side bolt pattern matches ISO-9409-1-50-4M6.

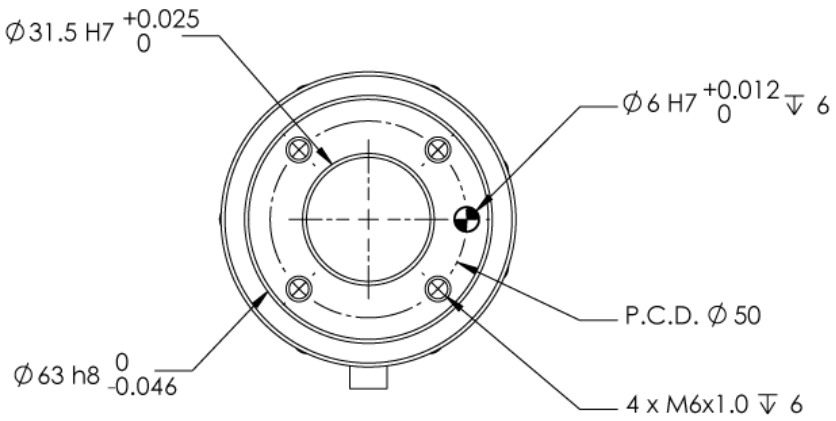


Fig. 5.2: FT 300 Sensor tool side bolt pattern.

5.2. Mechanical Specifications

> **Info**
>
> Reminder: all units are within the metric measurement system.

SPECIFICATION		VALUE
Approximate weight		300 g
Overload capacity		A combined load exceeding 500% of the measuring range will permanently damage the Force Torque Sensor (Fx/300 + Fy/300 + Fz/300 + Mx/30 + My/30 + Mz/30 < 500%)
Outside diameter		75 mm
Through-hole diameter		N/A
Thickness		37.5 mm
IP rating		43[1]
Stiffness	F_x, F_y	35 X 10^6 N/m
	F_z	30 X 10^6 N/m
	M_x, M_y	10,000 Nm/rad
	M_z	20,000 Nm/rad

[1]Expected rating, certification is planned and will be forthcoming (see manual revision date).

5.2.1. Moment of Inertia and Center of Mass

The coordinate system used for calculating the moment of inertia and center of mass for the FT Sensor is shown in the figure below.

> **Info**
>
> All values are approximate. Actual coordinates may vary according to various options present on the Sensor.

Here is the approximate position of the center of mass for the FT Sensor:

Sensor	Combination	x (mm)	y (mm)	z (mm)	Mass (g)
FT 300	-	0	0	17	300
	2-Finger 85	0	0	76	1205
	2-Finger 140	0	0	83	1275
	Wrist Camera	0	2	30	530
	Wrist Camera and 2-Finger 85	0	1	77	1275
	Wrist Camera and 2-Finger 140	0	1	85	1340

Here is the approximate moment of inertia matrix for the FT Sensor, taken at the coordinate system origin:

FT 300

$$I = \begin{bmatrix} I_{xx} & I_{xy} & I_{xz} \\ I_{yx} & I_{yy} & I_{yz} \\ I_{zx} & I_{zy} & I_{zz} \end{bmatrix} = \begin{bmatrix} 262 & 0 & 1 \\ 0 & 265 & 1 \\ -1 & 1 & 219 \end{bmatrix} \text{kg} * \text{mm}^2$$

Fig. 5.3: Moment of inertia of the FT 300 Sensor.

5.2.2. Overload Capacity

The FT 300 sensors have overload capacities, the overload capacity specification includes load and torque values in all 3 axes.

> **Info**
>
> For loads between the measuring range and the overload capacity, the signal will be saturated. The sensor will not undergo permanent damage if the overload capacity is not reached.

> **Warning**
>
> Exceeding the overload capacity will permanently damage the sensor.

Sensor	Measuring range	Overload capacity[1]
FT 300	+/- 300 N	1500 N (500%)[2]

[1]Overload capacity with all axes combined.

[2]Maximum load expressed in % of measuring range.

The overload capacity given includes forces and torques in all 3 axes. To get an approximation of the total load, these formulas must be used:

- For the FT 300

$$Fx/300 + Fy/300 + Fz/300 + Mx/30 + My/30 + Mz/30 < 500\%$$

5.3. Signal Specifications

SPECIFICATION		FT 300 (prior to 10/2017)	FT 300
Measuring range	Force	±300 N	
	Torque	± 30 Nm	
Signal noise*	Fx, Fy	1.2 N	0.1 N
	Fz	0.5 N	0.1 N
	Mx, My	0.02 Nm	0.005 Nm
	Mz	0.03 Nm	0.003 Nm
Recommended threshold	Fx, Fy	5 N	1 N
	Fz	2 N	1 N
	Mx, My	0.08 Nm	0.02 Nm
	Mz	0.12 Nm	0.01 Nm
External noise sensitivity**		Immune	
Data output rate		100 Hz	
Temperature compensation***		15 to 35 °C	

*Signal noise is the standard deviation of the signal measured over a period of one (1) second

**Under normal operating conditions

***Within this range, the temperature fluctuation is compensated for; signal quality may be affected outside of this range

Caution

The recommended threshold represents the smallest variations that can be detected by the sensor.

The signal noise is the limiting factor for the Sensor's precision. is greater than the Sensor's resolution, thus it For the FT 300, the signal noise defined in the signal specifications is the standard deviation of each data (Fx, Fy, Fz, Mx, My, Mz) over 1 second. In order to use that signal noise information, three times the standard deviation given must be used. According to the normal distribution, three times the standard deviation will cover almost all values possible (99.7%).

Info

Noise is an unwanted and unpredictable alteration to a signal. It may come from electrical or electromagnetic sources and degrades the quality of the Sensor's signal.

5.4. Electrical Ratings

SPECIFICATION	VALUE
Input voltage	5 to 24 V DC ± 10%
Max power consumption	2 W
Communication electrical interface	RS-485
Recommended fuse	Phoenix #0916604 (UT6-TMC M 1 A)
Recommended power supply	TDK-Lambda DPP Series *15W Single Output DIN Rail Mount Power Supply*, DPP15-24

5.5. Couplings

For a detailed list of available couplings and adapter plates, please refer to the **Spare Parts, Kits and Accessories** section.

The following subsections contain data required for custom couplings or creating couplings from blanks.

> Info
>
> All Robotiq couplings and adapter plates are provided with necessary hardware for fixation on the Robotiq device side.

> Caution
>
> Unless identified for specific packages only, **robot side screws and indexing pins are not provided**.

5.5.1. Blank Coupling

The figure below schematics represent the optional blank coupling for the FT 300 Sensor :

- (7) M4 threads and the 63 mm (H8) circle are meant to affix the FT 300.
- The circular section of 75 mm diameter (blue section in the figure below) represents the customization area and has a depth of 5 mm.

> **Warning**
>
> Make sure your custom design does not interfere with the M4 threads or the 63 mm, H8 centering circle.

- Spare part list number is FTS-300-CPL-BLANK.

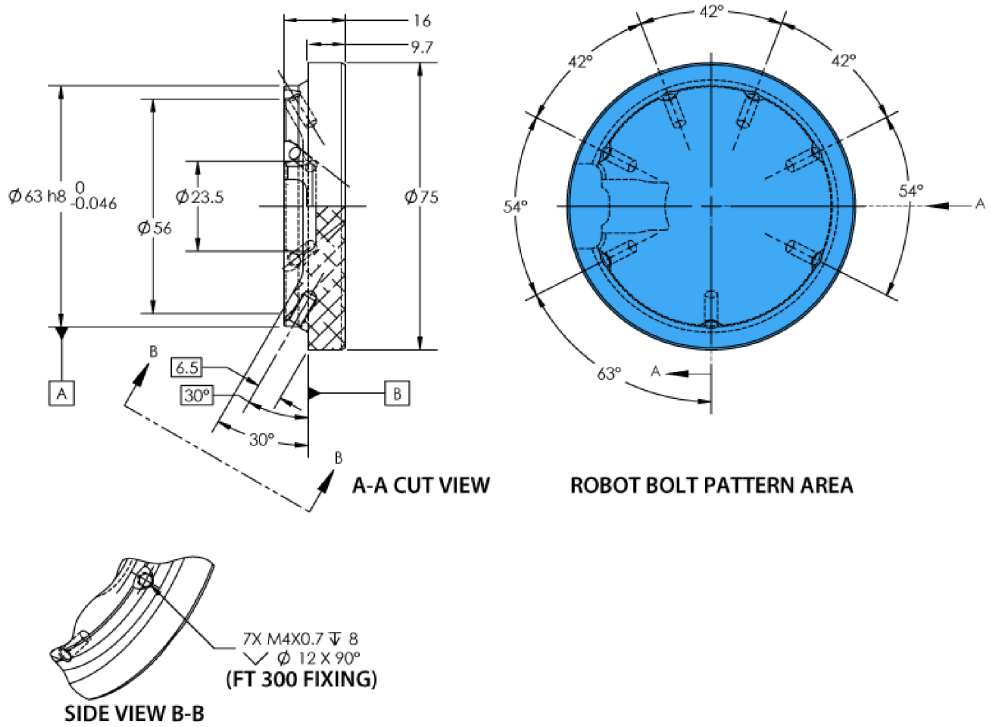


Fig. 5.4: Technical dimensions of the blank coupling for the FT 300.

6. Maintenance

The Robotiq Force Torque Sensor requires only external maintenance with limited downtime.

Maintenance of the Sensor is required after specified usage, measured in time (normal 40h week). Respecting the maintenance interval will ensure:

- Correct functioning of your Sensor.
- Validity of your warranty.
- Proper lifetime for your Sensor.

Please visit support.robotiq.com for details on the maintenance operation.

> **Warning**
>
> Unless otherwise specified, any repairs done on the FT 300 Force Torque Sensor will be done by Robotiq.

6.1. Maintenance Intervals

Operation	Daily	Weekly	Semiannually
Zero calibration	X[1]		
Sensor cleaning	Dirty conditions	Normal conditions	
Periodic inspection			X[2]

[1]Zero calibration should be integrated into the program routine. This will compensate for the tool weight (for its current orientation), the effect of the attachment mechanisms on the Sensor and any other factors which could affect the readings. It is recommended to add this instruction when the robot is not applying force on its environment and when the tool is in the same orientation as when the readings will be used (for example at the beginning of the program or just before picking up an object or applying force).

[2]If there is any visible damage to the Sensor, contact support@robotiq.com.

7. Spare Parts, Kits and Accessories

Caution

The following list is up to date at print time and is subject to change, check online for updates.

Info

Unless specified, screws, dowel pins and other hardware are included only for the Sensor side, never for the robot side.

Item	Description	Ordering Number
Standard Kit	Robotiq Force Torque Sensor FT, includes cable and USB converter.	FTS-300-KIT-001
Kit for *Universal Robots*	Standard Sensor with Couplings for *Universal Robots* and software package.	FTS-300-UR-KIT
Sensor	Replacement sensor, sensor alone.	FTS-300-SEN-001
Blank coupling	Blank coupling with FT bolt pattern on one side and the other side clear.	FTS-300-CPL-BLANK
Coupling 50-4M6-1D6	Coupling for 50 mm PCD[1] (4) M6 thread and (1) 6 mm M6 indexing pin. To be used on UR robots.	FTS-300-CPL-062
Coupling 39-8M3-1D3	Coupling for 39 mm PCD[1] (8) M3 thread and (1) 3 mm indexing pin.	FTS-300-CPL-069
Coupling 40-4M6-1D6	Coupling for 40 mm PCD[1] (4) M6 thread and (1) 6 mm M6 indexing pin.	FTS-300-CPL-064
Coupling 31_5-4M5-1D5	Coupling for 31.5 mm PCD[1] (4) M5 thread and (1) 5 mm M6 indexing pin.	FTS-300-CPL-063
Robotiq Device Cable	5 or 10 m cable for power and communication with the FT Sensor	CBL-COM-2067-10

[1] *Pitch Circle Diameter*

8. Troubleshooting

The following are some common troubleshooting hints, if you need further assistance please contact support@robotiq.com.

8.1. General troubleshooting

8.1.1. An offset has appeared in the Sensor data

- Changes in ambient conditions can cause an offset in the sensor signals.
- An offset can also be caused if the sealing o-rings are displaced during an overload.
- These offsets do not account for a de-calibration of the Sensor as they are in fact recognized as effort applied to the Sensor. Any additional force applied on the tool side of the Sensor will be read normally.
- In all cases, it is recommended to have a software offset which compensates for these variations in addition to the effort caused by the tool weight for a given orientation. It is preferable to set the software offset before starting to use the sensor data such that the robot software uses a proper and consistent reference.

8.1.2. Procedure to determine if the Sensor is functional

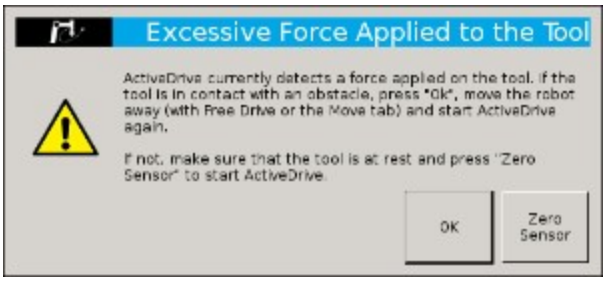
- Verify that the Sensor is connected according to the Installation section of this manual.
- When powered, verify that the LED on the Sensor is blue (not red/blue).FT 300 LED is red if powered without communication, blue if powered with communication. For detailed information on the LED status, refer to the **Status LED** section.
- Power-off the Sensor and then connect the provided USB/RS485 converter to a USB port of a Windows PC.
  - In the Windows PC, open the Device Manager.
  - You should see a USB Serial Port device in the Ports (COM & LPT) category. If not, it is possible that the converter drivers have not installed automatically. You can download the drivers from the ftdichip.com website.
- Power the Sensor with the recommended voltage.
- Download the simple data logger application at support.robotiq.com
- Run the data logger application. Enter 100 for the number of data per 10 seconds and any file name (for example "test.csv").
- Verify that the sensor data is displayed in the Windows console application.

8.2. Troubleshooting on Universal Robots

8.2.1. ActiveDrive Toolbar troubleshooting – Error messages overview

The ActiveDrive Toolbar will be automatically collapsed and be greyed whenever one of the following situations occurs. In such cases, by tapping the ActiveDrive button, the following messages will appear:

- Message:

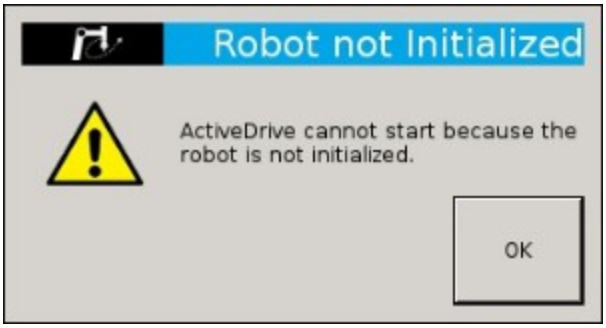


- Solution:
  - Starting ActiveDrive while an excessive force is applied to the tool:
    - Determine if an external force is applied to the end-effector. If it is the case, tap **OK** and move the robot away from the obstacle (with Free Drive or Move tab), or remove any external forces and start ActiveDrive again.
    - If no external forces are applied, tap **Zero Sensor**.

- Message:

- Solution:
  - Force Torque Sensor is detected: Check the Force Torque Sensor's connection. Make sure the USB adapter and all the wires are well connected. Also verify the Sensor's LED status (refer to the **Status LED** section).

- Message:



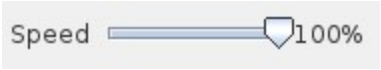
- Solution:
  - The robot is not initialized: Tap **OK** and go to PolyScope's home page. Tap **Setup Robot** and go to **Initialize Robot** to start the robot.

- Message:

- Solution:
  - A program is already running: The ActiveDrive Toolbar cannot be used while a program is running. Stop the program to enable the ActiveDrive feature.

- Message:

- Solution:
  - The speed setting of the robot is lower than 50%: The robot's speed setting should be greater than 50%. Modify the speed setting in the robot's program with the slider.



- Message:

- Solution:
  - If the Freedrive button is pressed: The ActiveDrive mode cannot be used when the Free Drive mode is on. Make sure you are not pressing on the teach pendant's Teach button when trying to use the ActiveDrive toolbar.

8.3. Troubleshooting on other platforms

8.3.1. USB converter detected as a mouse by Windows

- In Windows, the USB converter is sometimes detected as a mouse, making the cursor move. This a well know problem in Windows: http://support.microsoft.com/kb/819036
- A simple workaround is to plug in the USB converter before powering the Sensor. Once the USB driver is initialized in Windows, the Sensor can be powered and used without a problem.

8.3.2. Data frequency under 100 Hz in Windows

- By default, the USB to RS485 converter has a latency setting of 16 ms in Windows (1 ms in Linux), which will prevent the application software from receiving new messages at 100 Hz (it will often read two sensor messages in the buffer at the same time).
- In the Windows Device Manager, right click on the virtual COM port for the Sensor and select **Properties**. In the **Port settings** tab, click on **Advanced**. Adjust the latency timer to **9 ms** (it is not recommended to lower it too much in Windows since other connectivity issues may arise), then click **OK**.

8.3.3. In Linux, the serial port cannot be opened

- By default, a user does not have access to the serial ports.
- It is possible to provide this access by adding the user to the dialout group with the following command:

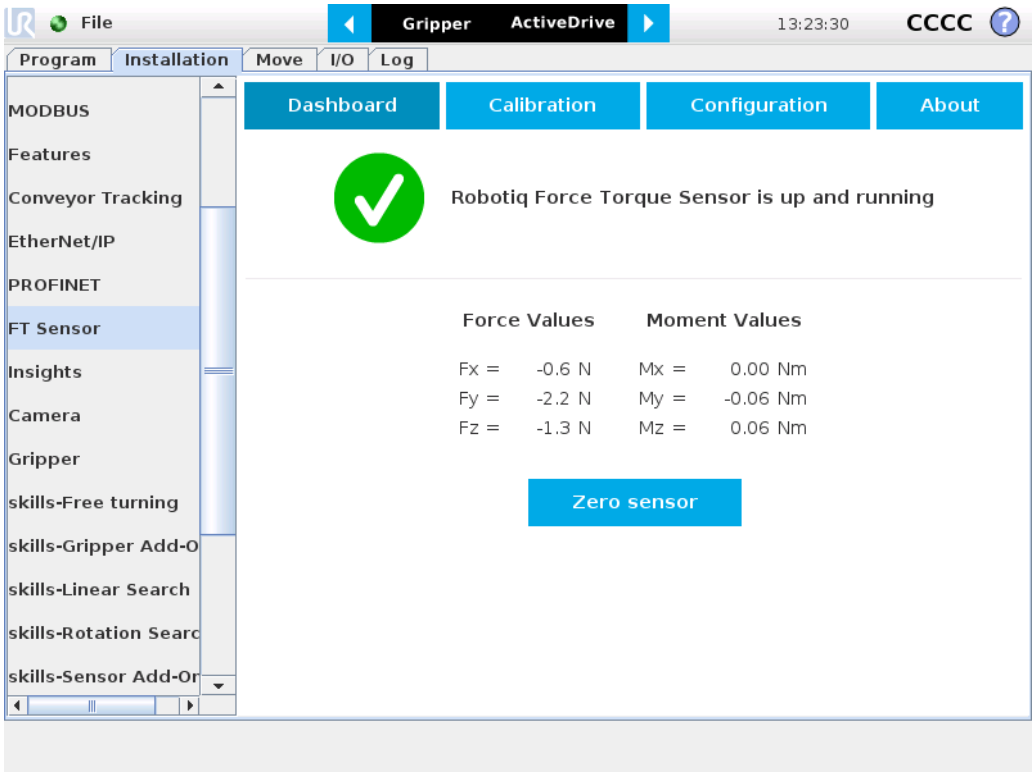
```
rd@debian:~/$ sudo usermod -a -G dialout username
```

8.3.4. Monitoring the Sensor state

In order to view the Sensor status and verify the force and torque values:

- Go to **Program Robot**
- Go to the **Installation** tab
- Tap **FT Sensor** in the left pane
- Tap the **Dashboard** button

> Info
>
> If needed, the user can tap the **About** button to get further information regarding the FT Sensor.



9. Warranty

Robotiq warrants the FT 300 Force Torque Sensor against defects in material and workmanship for a period of one year from the date of reception when utilized as intended with the specified maintenance. Robotiq also warrants that this equipment will meet applicable specifications under normal use.

> Caution
>
> Warranty applies under the following conditions:
>
> - Usage respects the operating, transporting and storage conditions specified in the **Environmental and Operating Conditions** section
> - Usage under normal one-shift operation (40h a week)
> - Usage respects maintenance specified in the **Maintenance** section

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

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

- The Sensor feedback is not accessible;
- Sensor signal noise is over twice the specified limit.

> Caution
>
> The warranty will become null and void if the :
>
> - Unit has been tampered with, repaired or worked on by unauthorized individuals.
> - Warranty sticker has been removed.
> - Screws, other than as explained in this guide, have been removed.
> - Unit has been opened.
> - Unit serial number has been altered, erased, or removed.
> - Unit has been misused, neglected, or damaged by accident.

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

Robotiq shall not be liable for damages resulting from the use of the product, nor shall be responsible for any failure in the performance of other items to which the product is connected or the operation of any system of which the product may be a part.

9.1. Exclusions

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

This warranty excludes failure resulting from: improper use or installation, normal wear and tear, accident, abuse, neglect, fire, water, lightning or other acts of nature, causes external to the product or other factors beyond Robotiq's control.

10. Contact

www.robotiq.com

Contact Us

Phone

1-888-ROBOTIQ (762-6847)

(+1) 418-380-2788 Outside US and Canada

Fax

1-418-800-0046

Technical Support

Option 3

Sales

Option 2

Head Office

Robotiq
966, chemin Olivier
Suite 500
Lévis, Québec
G7A 2N1
Canada

DoF

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

dof.robotiq.com

Appendices

Appendix A – Translation of Original EC Declaration of Incorporation

ROBOTIQ

Translation of original declaration of incorporation

In terms of the Directive 2006/42/EC, Annex II, part B of the European Parliament and of the Council on machinery,

We, the manufacturer, Robotiq Inc.
966, Chemin Olivier, suite 325
Lévis, Québec, Canada, G7A 2N1

Hereby declare that the following product:

Robotiq Force Torque Sensor FT 150 & FT 300
Identified F-1001 / G-1001 and over

Meets the applicable basic requirements of theMachinery Directive 2006/42/EC

The incomplete machine may not be put into operation until conformity of the machine into which the incomplete machine is to be installed with the provisions of the Machinery Directive is confirmed. Compliance with all essential requirements of Machinery Directive relies on the specific robot application and overall risk assessment.

The manufacturer agrees to forward on demand of national authorities the relevant technical documents specified by Annex VII part B within the required time.

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)

Person responsible for documentation: Mr. Étienne Samson, address: see manufacturer address

Lévis, July 2016
(place and date of emission)

Jean-Philippe Jobin
Chief Technical Officer
Robotiq Inc.

Appendix B – Applied Standards

This section describes all applied harmonized standards for the design and production of the Robotiq Force Torque Sensor FT 300. Standards are applied were applicable, some points may not be applied if not applicable to this specific product. Conformity is not enforced by any laws, it is self-applied and the aim is to define normal safety and performance requirements for similar products.

> **Info**
>
> Conformity of the product is only met if all instructions of the following manual are followed. Among others; installation, safety measure and normal usage must be respected.

The following standards have been applied:

NF EN ISO 12100	2010	Safety of machinery — General principles for design — Risk assessment and risk reduction
NF EN IEC 60204-1	2006	Safety of machinery — Electrical equipment of machines — Part 1: General requirements