ATI F/T Sensor URCaps Software Programming and Demo Manual for UR/URe Robots

Document #: 9610-05-1041

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2. Sensor model (e.g., Axia)

3. Calibration (e.g., US-15-50, SI-65-6, etc.)

4. Accurate and complete description of the question or problem

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Glossary

Term	Definition
Acceptable Status Condition	A user set state during which the ATI UR™Cap software ignores certain status bits from the ATI F/T sensor so that the UR robot can continue operation.
Algorithm	A process or set of rules the robot uses to provide force feedback to control the robot motion.
ATI Ethernet Axia/Axia80 Sensor or ATI NET F/T Sensor	An ATI F/T sensor that uses Ethernet protocol.
"ATI FT Daemon failed" Error	An error that occurs if the ATI URCap's Python™ script is unable to run correctly. The Python™ script/Daemon runs in the background on the UR controller's Linux computer.
ATI NET F/T Sensor	An ATI Ethernet F/T sensor that is not an Axia80.
ATI Serial Axia/Axia80 Sensor	An ATI F/T Axia sensor that uses RS485 protocol.
ATI F/T URCap Software	An ATI software program that enables the UR robot to use data from an ATI F/T sensor for force feedback control.
Bias	A command that eliminates the effects of gravity, such as tool weight or other acting forces from the F/T data that is provided by the ATI F/T sensor.
Center of Gravity (CG)	The point of a mass around which the resultant torque from gravity forces is zero.
Daemon	A Python™ program that runs continuously on the UR controller's Linux computer. It handles periodic service requests that the ATI URCap software expects to receive. The daemon program can forward these requests to other programs or processes as appropriate.
Demo Program	A downloadable program that demonstrates the capabilities of the ATI URCap software and ATI F/T sensor.
Disable	A command that stops using the F/T data from an ATI sensor and starts using the internal force sensing of the UR robot.
DoF	Degrees of Freedom (refer to the following definition: Six Degrees of Freedom)
Enable	A command that starts streaming the F/T data from the ATI F/T sensor for force feedback control.
Ethernet	An IEEE standard for local network technology.
Force	The push or pull exerted on an object. Mathematically, force is expressed as: Force = mass x acceleration
F/T	Force/Torque
F/T Sensor	The device that converts sense loads from force and torque into an electrical signal.
Interface Plate	A separate plate that attaches the sensor to another surface. Interface plates are often used if the bolt pattern on the MAP or TAP doesn't match the bolt pattern on the robot arm or customer tooling. The interface plate has (2) bolt patterns on either side of the plate. One side is for the MAP or TAP. The other side is for the robot arm or customer tooling.
Hamburger Menu |	A collapse main menu button on the URe Teach Pendant screen that includes the following: help, about, and settings.
Logging Level	A Program Node Option that sets the type of information that the ATI URCap software records in the log file on the UR controller. There are (4) levels: none, error, warning, and info.

Term	Definition
Mounting Adapter Plate | MAP	The surface of the sensor that attaches to a fixed surface like an interface plate or robot arm.
Node	Commands and program structures available in the UR Polyscope programming environment. The ATI URCap includes nodes that can be used on the incoming data from the ATI F/T sensor.
Plug-in Technology	A customized program that when downloaded and installed onto a host device adds a specific feature to an existing computer program.
P/N	Part Number
Polyscope	UR software on the teach pendant.
Program Node Command	Commands within the ATI URCap software that can enable, disable, and bias the data from the ATI F/T sensor.
Program Node Options	Optional commands within the ATI URCap software that can be used to log or ignore status bits from the ATI F/T sensor.
Protective Stop Error	A high-level error reported by the UR robot in several situations, determined by the controller. This error could be because the robot lost communication with the either the sensor or the ATI Deamon. Excessive traffic on the robot controller contributes to this error.
Program Tree	Displayed on the URe Teach Pendant Program icon left side screen, there is a list of commands or program nodes. The current command that is executed in the tree is highlighted.
RDT	Raw Data Transfer (RDT) is a fast and simple Ethernet protocol for control and data transfer via User Datagram Protocol (UDP).
RDTE	Real-Time Data Exchange. A way to synchronize external applications with the UR controller over a standard TCP/IP connection without breaking any real-time properties of the UR controller.
Script	The real time language of the robot controller. Also referred to as URScript.
SFTP	Secure File Transfer Protocol (SFTP) or SSH (Secure Shell) File Transfer Protocol is a secure version of File Transfer Protocol (FTP), which facilitates data access and data transfer over a Secure Shell (SSH) data stream.
Simple Demo Program	An abbreviated program that moves the robot down until attached customer tooling contacts a surface or a force greater than 2 N.
Six Degrees of Freedom	Fx, Fy, Fz, Tx, Ty, and Tz
Sense loads	The ATI F/T sensor detects sense loads that are a cumulation of forces and torques acted upon the customer tooling.
SSH	Secure Shell (SSH) is a cryptographic network protocol for operating network services securely over an unsecured network, for example: PuTTy.
Standard Demo	A program that moves the robot and customer tooling across an uneven surface based on the feedback from an ATI F/T sensor.
Start Position	The coordinates the robot begins a demo program.
Status Bit	A unit of computer data sent from the ATI F/T sensor.
Tool Adapter Plate | TAP	The surface of the sensor that attaches to a fixed surface like an interface plate or the customer tooling.
TCP	Tool Center Point
Teach Pendant	A handheld device or control box for programming the motions of a robot.
Thread	A component of the Program Tree and a parallel process in a robot program.

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Term	Definition
Torque	The measurement of force exerted on an object causing it to rotate. Mathematically, force is expressed as: Torque = Force x Moment Arm Distance
UR CB3	A collaborative robot manufactured and distributed by the company, Universal Robots (UR). UR denotes a robot from the UR CB3 series product line.
URe robot	A collaborative robot manufactured and distributed by the company, Universal Robots (UR). URe denotes a robot from the UR E-series product line.
URe Kit	A packaged option that includes the ATI Serial Axia F/T sensor, interface plates, mounting hardware, cable to the URe tool port, and downloadable ATI URCap software. This kit can only be used with the URe robot.
UR Kit	A packaged option that includes an ATI Ethernet Axia F/T sensor, interface plate(s), cables, mounting hardware, and downloadable ATI URCap software. This kit can be used with the UR or URe robot.
USB Drive	A USB (universal serial bus) drive is a device that data such as the downloaded ATI URCap software and can be attached to a host device with plug-in technology. Sometimes a USB drive is called a USB stick or USB disk.

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1. Safety

The safety section describes general safety guidelines to be followed with this product, explanations of the notifications found in this manual, and safety precautions that apply to the product. Product specific notifications are imbedded within the sections of this manual (where they apply).

1.1 Explanation of Notifications

These notifications are used in all of ATI manuals and are not specific to this product. The user should heed all notifications from the robot manufacturer and/or the manufacturers of other components used in the installation.

⚠	**DANGER:** Notification of information or instructions that if not followed will result in death or serious injury. The notification provides information about the nature of the hazardous situation, the consequences of not avoiding the hazard, and the method for avoiding the situation.

⚠	**WARNING:** Notification of information or instructions that if not followed could result in death or serious injury. The notification provides information about the nature of the hazardous situation, the consequences of not avoiding the hazard, and the method for avoiding the situation.

⚠	**CAUTION:** Notification of information or instructions that if not followed could result in moderate injury or will cause damage to equipment. The notification provides information about the nature of the hazardous situation, the consequences of not avoiding the hazard, and the method for avoiding the situation.

NOTICE: Notification of specific information or instructions about maintaining, operating, installing, or setting up the product that if not followed could result in damage to equipment. The notification can emphasize, but is not limited to: specific grease types, best operating practices, and maintenance tips.

1.2 General Safety Guidelines

The customer should verify that the sensor selected is rated for maximum loads and torques expected during operation. Because static forces are less than the dynamic forces from the acceleration or declaration of the robot, be aware of the dynamic loads caused by the robot.

1.3 Safety Precautions

⚠	**CAUTION:** When initially setting up the demo programs, position the robot manually in order to avoid damaging parts, especially the sensor cable.

2. Overview

This manual explains how to program the ATI F/T URCaps software and demo programs. The ATI F/T URCaps software enables the customer to use a UR/URe robot with an ATI F/T sensor. To use an ATI F/T sensor with a UR/URe robot, first install and set-up the ATI URCaps software and ATI F/T sensor on the robot (refer to the **9610-05-1040** (URe) manual or *9610-05-1036* (UR) manual).

F/T sensors convert sensed loads from forces and torques into electrical signals. The ATI F/T sensor provides data to the robot. This data is the six DoF (degrees of freedom): $F_x \setminus F_y \setminus F_z \setminus T_x \setminus T_y \setminus T_z$. UR/URe robots have algorithms to use force feedback to control the robot motion. By using plug-in technology, the ATI URCaps software allows a user to input data from an ATI sensor into UR algorithms.

Communicating with the sensor and URe robot requires a knowledge of Ethernet / RS485 protocol and how to operate the URe teach pendant interface Polyscope. For more information about UR products like the robot and teach pendent, refer to *https://www.universal-robots.com/support/*. For more detailed information on the UR/URe teach pendant software functionality such as safety, operation, programming, and UR/URe nomenclature, refer to the *UR Polyscope Manual, Version 5.1.0* for UR e-series or *UR PolyScope Manual, Version 3.7.0* for UR CB3 series. For consistency, UR/URe nomenclature is used throughout this manual.

For more information on the ATI F/T sensors, refer to the following table:

Table 2.1—ATI F/T Sensor Manuals	
ATI F/T Sensor	**Manual P/N**
Serial Axia	*9610-05-Serial Axia*
Ethernet Axia	*9610-05-Ethernet Axia*
All Other Ethernet Sensors	*9620-05-NET FT* and *9620-05-Transducer Section*

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3. Writing a New Program

Instructions for using the ATI F/T URCaps software to write programs with nodes (commands) and options are in the following sections.

3.1 Create a UR Program with ATI F/T URCaps Software

To create a new program with the ATI F/T URCaps software, refer to the following steps:

1. On the header, select the **New** icon.

2. From the drop-down menu, select **Program**.

Figure 3.1—Create a New Program

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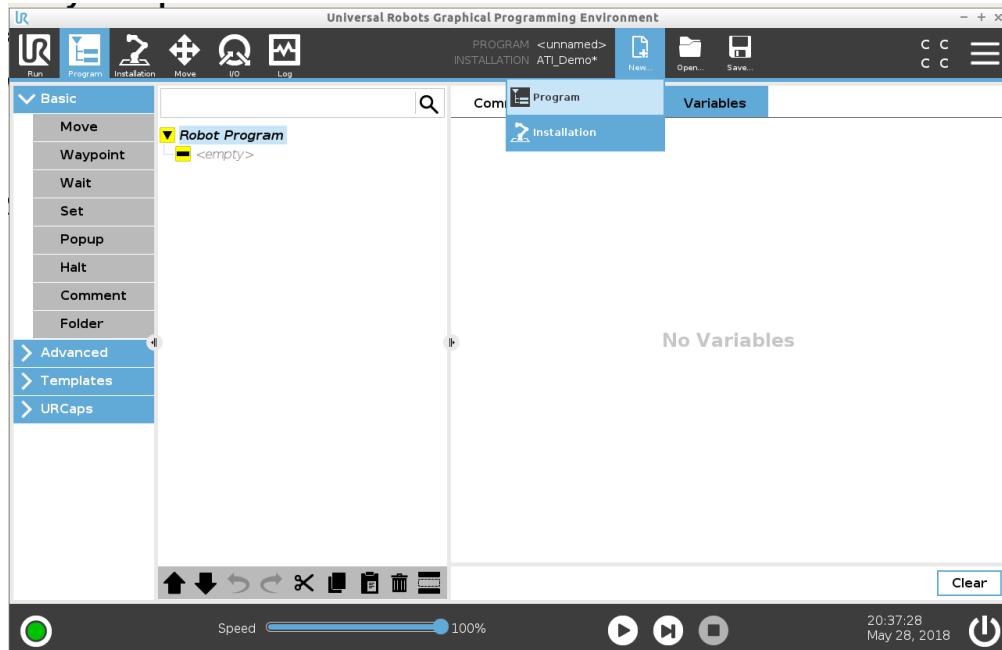
3. Select the **Robot Program** in the Program Tree.

4. On the **Program** screen, select the **Command** tab.

5. On the **Command** tab, select all or none of the listed preferences.

> **NOTICE:** As a best practice, select **Add Before Start Sequence** to use with nodes that do not need to repeated every program loop. For example, ATI **URCaps F/T Sensor Options** node can be contained in a **Before Start Sequence**.

Figure 3.2—New Program, Command Tab: Preferences
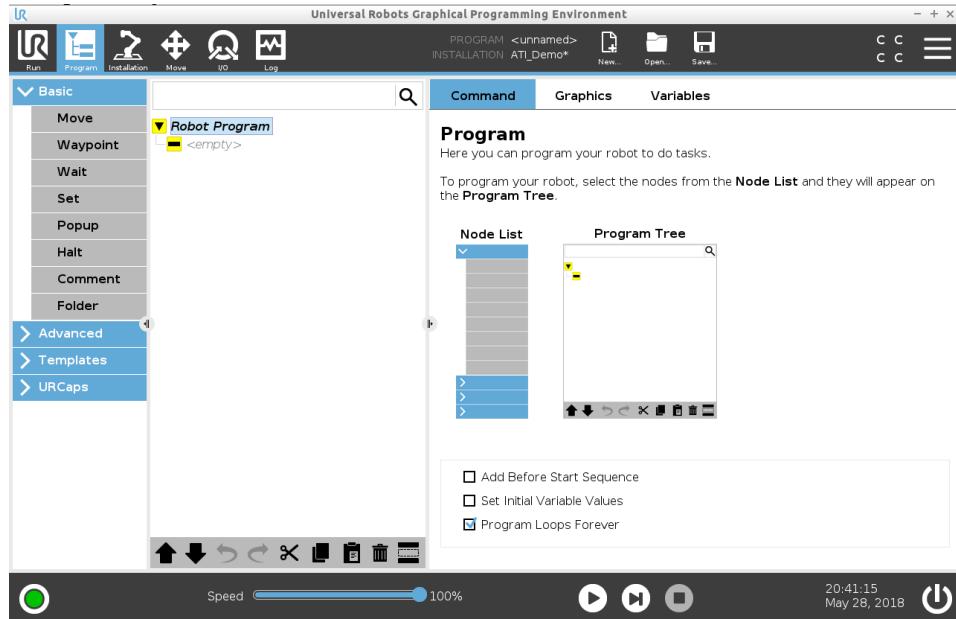
3.2   ATI F/T Sensor URCaps: Sensor Options

In most cases, the **F/T Sensor Options** only need to be set once, before the Robot Program starts. To change settings throughout the Robot Program, include F/T Sensor Options nodes in the Robot Program section of the Program Tree. In this example, the options are only set once, before the Robot Program starts.

1.   On the Program Tree, select **BeforeStart**.

Figure 3.3—Program Tree:BeforeStart
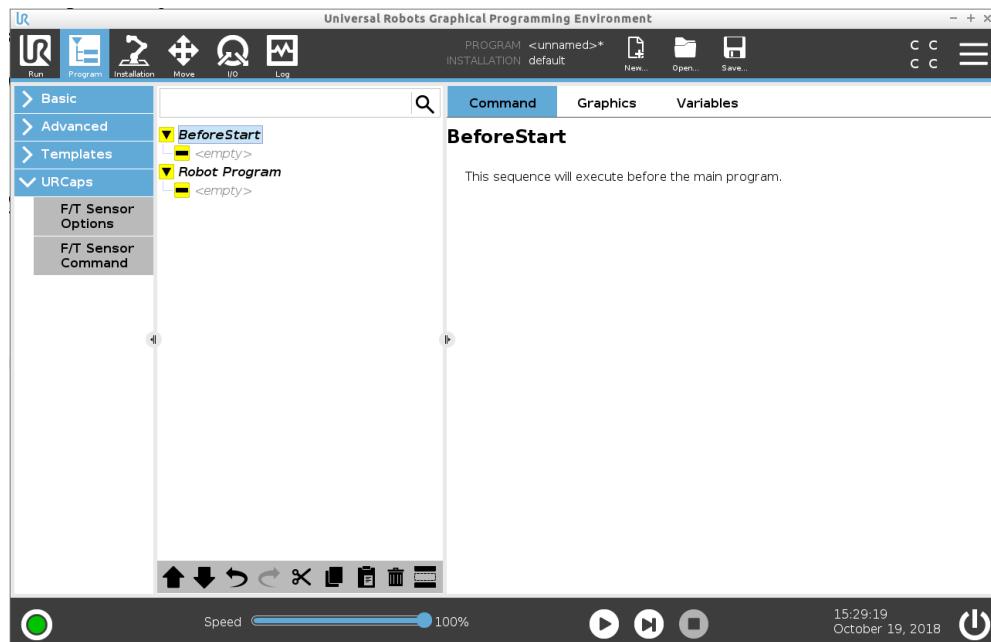
2.   On the left side menu, select the **URCaps** tab.

3.   From the drop-down menu, select, **F/T Sensor Options**.

4.   On the **F/T Sensor Options Screen**, select the **Logging Level**.

Figure 3.4—Logging Level
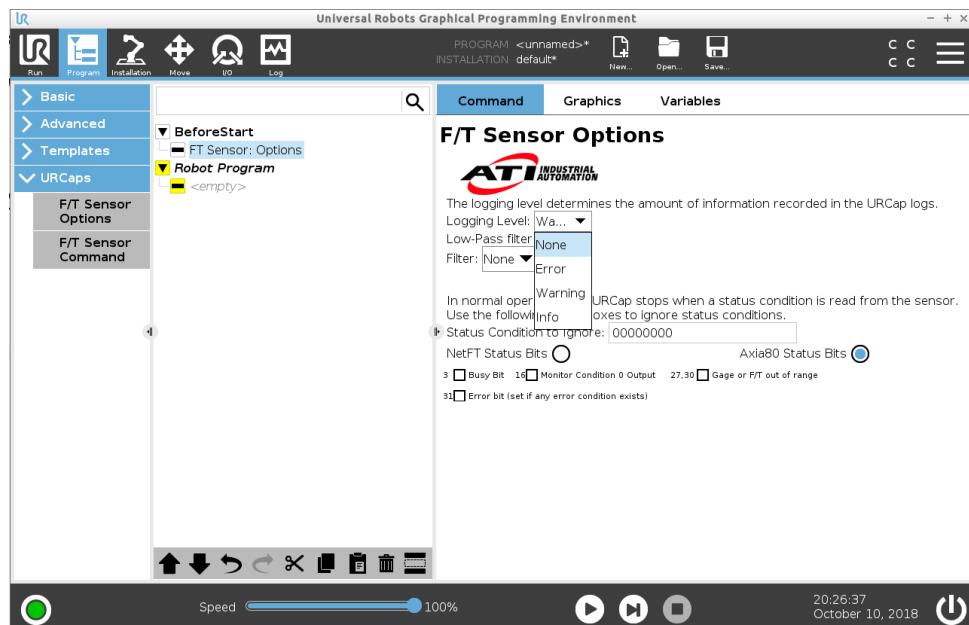
- The logging level sets the type of information the program records in a log. The four different logging levels are defined in the following table.

> **NOTICE:** Messages written to the log can be viewed in the robot controller's log file, or by writing the F/T sensor URCap log to a USB drive from the F/T Sensor URCap Installation screen. For more information about logging and viewing the logging file, refer to *Section 5—ATI F/T Sensor URCap Logging*.

<table>
<tr><td colspan="2" align="center">Table 3.1—Logging Levels</td></tr>
<tr><td align="center">Level</td><td>Definition</td></tr>
<tr><td align="center">None</td><td>No information will be recorded in the log file.</td></tr>
<tr><td align="center">Error</td><td>Record information of errors that could cause the ATI F/T URCap to fail.</td></tr>
<tr><td align="center">Warning</td><td>Record information of errors and warnings that could degrade the ATI F/T URCap performance.</td></tr>
<tr><td align="center">Info</td><td>Record errors, warnings, and additional information about the ATI F/T URCap operation.</td></tr>
</table>

5. On the **F/T Sensor Options** screen, select the **Filter** from the **Low-Pass Filter Settings**. For more information about these sensor settings, refer to the applicable manual in *Table 2.1*.

Figure 3.5—Low-Pass Filter Settings
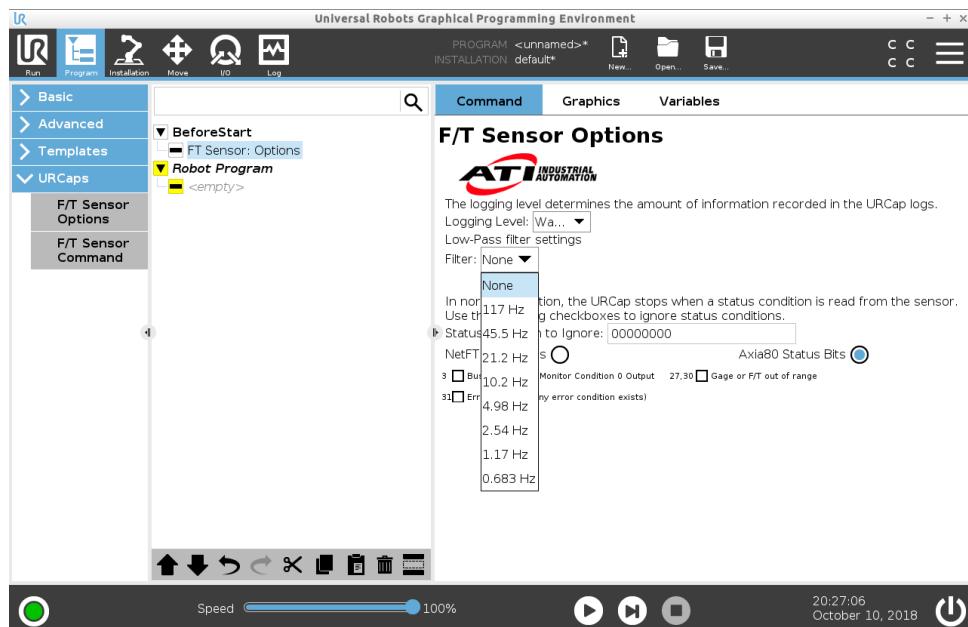
6. On the **F/T Sensor Options Screen**, select the sensor status messages (or bits) for which the program should not stop running.

   a. Select the radio button for the type of sensor. **Axia80 Status Bits** is for ATI Ethernet and Serial Axia sensors (*Figure 3.7*). **NetF/T Status Bits** is for all other ATI Ethernet sensors (*Figure 3.6*).

   b. Select the boxes for the status bits that the program should not stop. Depending on the type of sensor, the sensor status bits options change. For information about these status bits, refer to the applicable manual in *Table 2.1*.

> **NOTICE:** In the field, **Status Conditions to Ignore**, the advanced user can type the hexadecimal code for the status conditions. As the user selects the boxes to ignore status bits, this field automatically populates.

Figure 3.6—NetF/T Status Bits
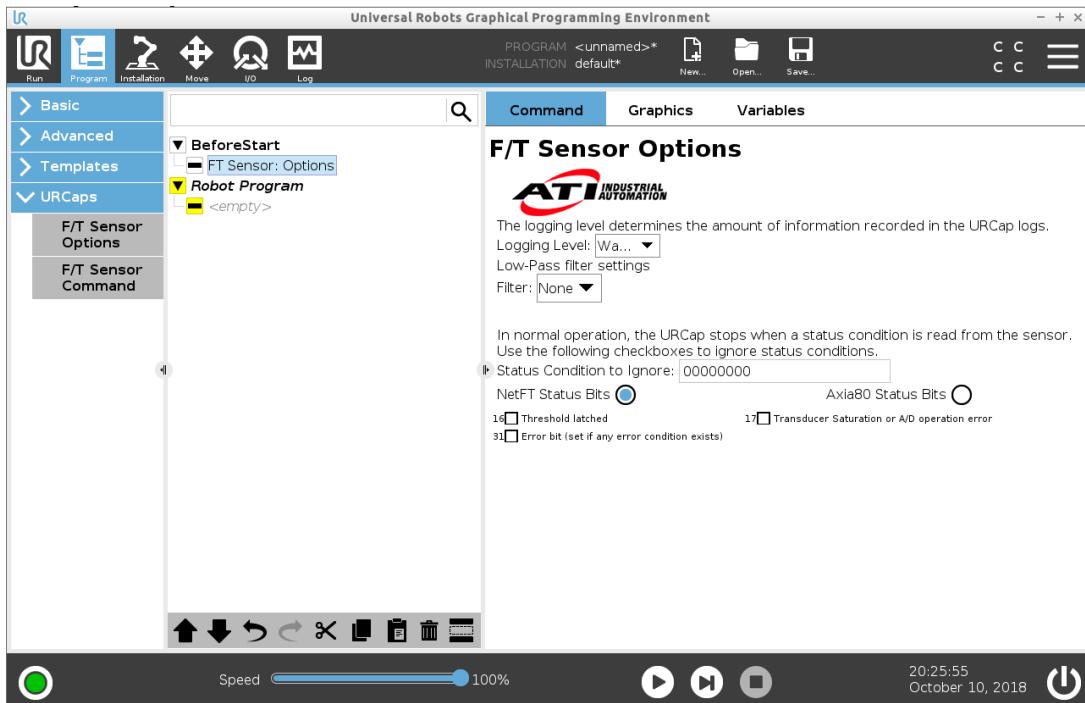
Figure 3.7—Axia80 Status Bits
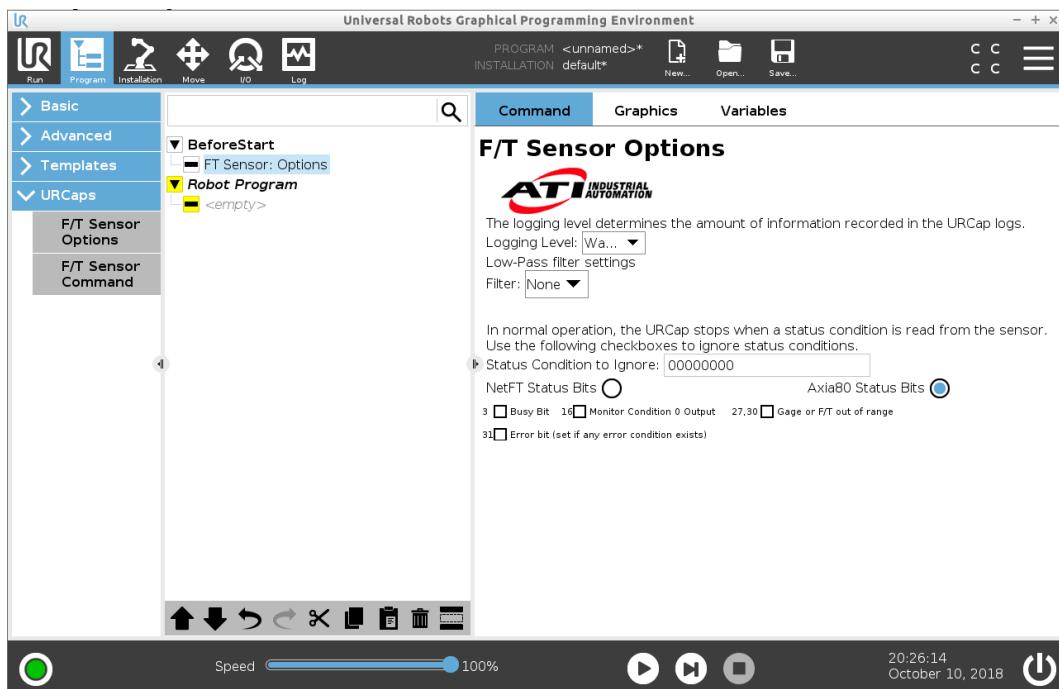
3.3   ATI F/T Sensor URCap: Sensor Nodes (Commands)

With the ATI F/T URCaps software, the user may input three standard types of nodes into the Program Tree. These commands are the following:

- **Enable** : uses the ATI sensor F/T data (refer to *Section 3.3.1—Enable Command*)
- **Disable** : uses the internal UR sensor F/T data (refer to *Section 3.3.2—Disable Command*)
- **Bias** : biases the ATI sensor F/T data (refer to *Section 3.3.3—Bias Command*)

> **NOTICE:** Robot motion or other commands can be programmed between the sensor's **Enable** and **Disable** nodes. The **Disable** node is not required, but the F/T sensor will remain **Enabled** (overwriting the robot's internal F/T sensing values) until the F/T sensor is disabled.

To create a node, complete the following steps:

1. Select the **Robot Program** in the Program Tree.

1. On the left side menu, select the **URCaps** tab.

2. From the drop-down menu, select, **F/T Sensor Command**.

3. On the **F/T Sensor Command Screen**, select the radio for either **Enable**, **Disable**, or **Bias**.

4. To input another command, select **F/T Sensor Command** from the left side of screen.

5. On the **F/T Sensor Command Screen**, select the radio for either **Enable**, **Disable**, or **Bias**.

Figure 3.8—Insert a F/T Sensor Command
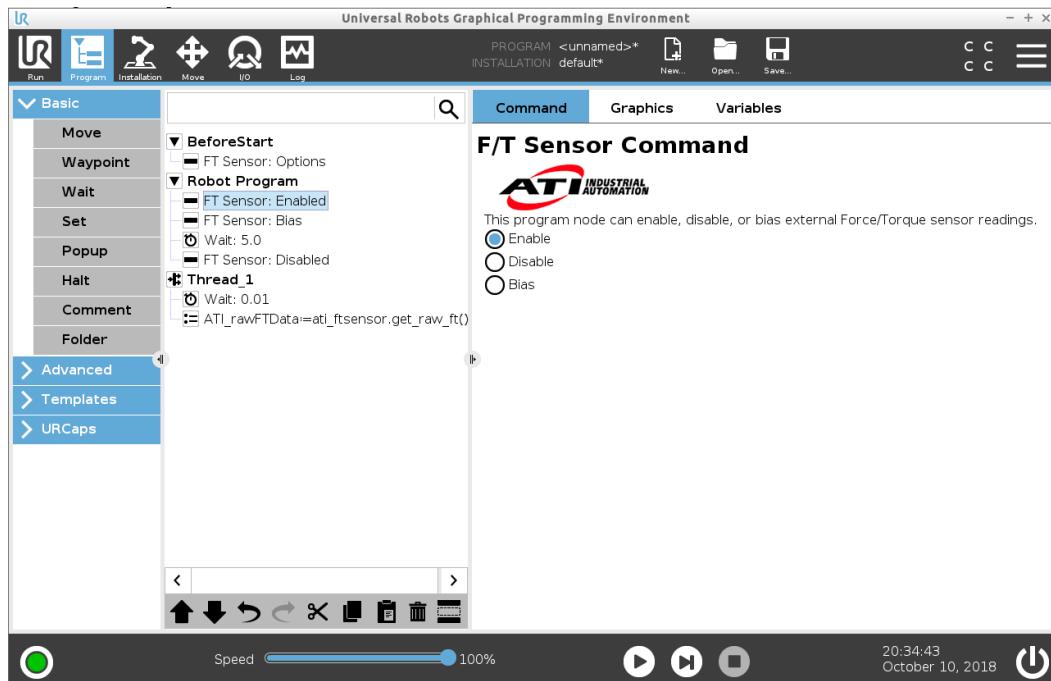
3.3.1   Enable Command

When the ATI F/T sensor is Enabled, the ATI F/T URCap software overwrites the UR/URe robot's internal F/T sensing values. With the Enable command, the robot program completes the following operations:

a. streams F/T data from the ATI sensor over the RDT interface on the sensor

b. forwards the ATI sensor F/T data to the robot over the UR RTDE interface

c. uses the ATI F/T sensor data in the UR/URe program force feedback controls

3.3.2 Disable Command

The Disable command is not required to run a program. However, the ATI F/T sensor continues to overwrite the UR/URe robot's internal F/T sensing values, until the user enters a Disable command. With the Disable command, the robot program completes the following operations:

a. stops using F/T data from the ATI F/T sensor

b. starts using the internal force sensing of the UR/URe robot

3.3.3 Bias Command

Biasing is useful for eliminating the effects of gravity (tool weight) or other acting forces from the force/torque data that an ATI F/T sensor provides to the robot.

With the Bias command, the robot program completes the following operations:

a. collects incoming F/T data

b. uses collected F/T data as a reference for future F/T data

c. subtracts this reference from future data

d. transmits this adjusted data to the robot

> **NOTICE:** When using the bias command, ensure the robot environment is steady-state. Issuing a bias command while the sensor is vibrating, accelerating, or decelerating provides a poor data reference.

3.4 ATI F/T Sensor URCap: Scripts

In advanced applications, the user can give script commands to the robot controller's real time script language. A list of ATI F/T URCaps scripts and their descriptions are in *Table 3.2*. The user should precede each script command by typing "ati_ftsensor.". A procedure for using a script is in *Section 3.4.1—Using ATI URCaps Script Commands*. For more information about UR script commands, refer to the *UR Script Manual*.

Table 3.2—ATI F/T URCaps Script Commands			
Command	**Description**	**Parameters**	**Return Value**
start_streaming()	The robot program collects F/T data from the sensor.	None	
stop_streaming()	Stops collecting F/T data from the sensor	none	If successful, **true**
bias_sensor()	Biases all subsequent F/T data from the sensor	none	
set_sensor_address(string address)	Sets the IP address or the COM port of the sensor	For Ethernet: "192.168.1.1" For Serial: "/dev/ttyTool"	Address the user entered

Table 3.2—ATI F/T URCaps Script Commands			
Command	**Description**	**Parameters**	**Return Value**
set_acceptable_ status(string statusCode)	Sets the status code bits that the robot program should ignore and stop the program from running For bits that represent status codes, refer to the applicable manual in *Table 2.1*.	hexadecimal value	If successful, **true**
copy_log_file()	Copies the ATI F/T URCaps log file to a user supplied USB stick (/ programs/usbdisk).	none	
set_logging_level(int loggingLevel)	Sets the logging level that types of messages are recorded in the log: (value) = (logging level) 0 = log nothing 1 = log errors only 2 = log errors and warnings (default) 3 = log errors, warnings, and information	a value 0 through 3	
is_running()	Checks that the robot is collecting data from the ATI F/T sensor.	none	If collecting data, **true** If not collecting data, **false**
is_connected()	Checks that the sensor is connected to the ATI URCaps interface.	none	If connected, **true** If not connected, **false**
get_raw_ft()	Retrieves the last sample F/T data from the sensor.	none	
get_tcp_ft(double dx, double dy, double dx, double rx, double ry, double rz)	Retrieves the last sample F/T data from the sensor, after the user applied a tool transformation. A tool transformation is adjusting the robot program's TCP values to transform the F/T data to a different reference frame. The units are meters for the offsets, and radians for the rotations.	tool transformation values for each axis; for example, refer to *Section 3.4.2— Script to Read Tool Transformed F/T Readings*.	Array of F/T values from the last F/T data sample

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Table 3.2—ATI F/T URCaps Script Commands			
Command	**Description**	**Parameters**	**Return Value**
set_filter(int filterIndex)	Apples a low-pass filter to the sensor: (value) = (type of filter) 0 = no filter 1 = 117 Hz 2 = 45.5 Hz 3 = 21.2 Hz 4 = 10.2 Hz 5 = 4.98 Hz 6 = 5.54 Hz 7 = 1.17 Hz 8 = 0.683 Hz	a value: 0 - 8	If successful, **true**
override_communication_ error(bool override)	Choose to ignore communication errors so that they do not display a popup and stop the program. True = override the error False = don't override the error	True / False For an example, refer to *Section 3.4.3— Override Communication Error Script Example*.	
get_urcap_status()	Retrieve the ATI F/T URCaps status code.	none	**0** : no problems detected and the sensor is connected **1** : error
get_sensor_status()	Retrieve the last status code from the sensor. The response is in a decimal. Free decimal to hexadecimal calculators are available on-line. For status codes, refer to the applicable manual in *Table 2.1*.	none	Decimal data type

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3.4.1 Using ATI URCaps Script Commands

To use an ATI URCaps script, refer to the following procedure:

1. It is often convenient to write a script to a variable in a background thread. Insert a **Thread** in the Program Tree.

   a. On the left side menu, select the **Advanced** tab.

   b. From the drop-down menu, select **Thread**.

Figure 3.9—Insert a Thread
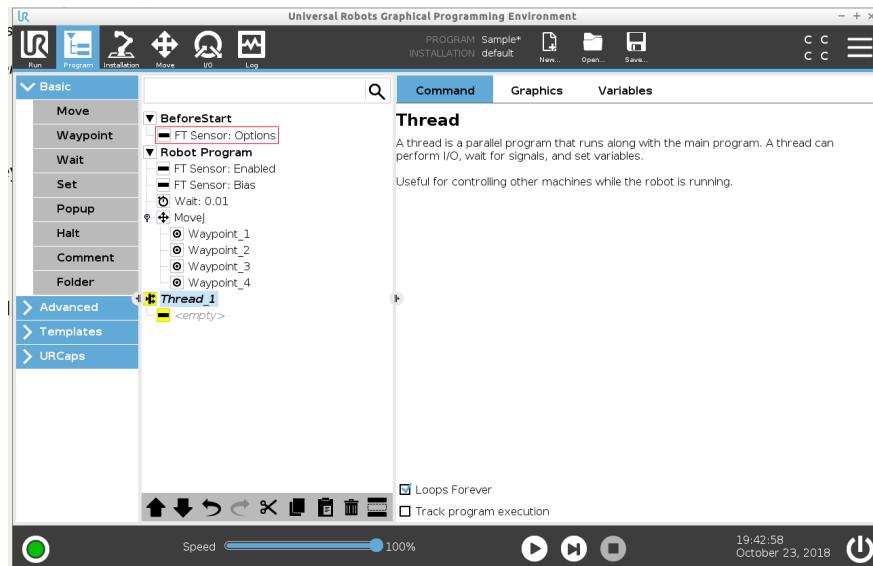
2. From the drop-down menu, select **Script** (or to write the returned value to a variable, select **Assignment**).

3. On the **Script Code** or **Assignment** screen, select the **f(x)** field.

Figure 3.10—Insert a Script

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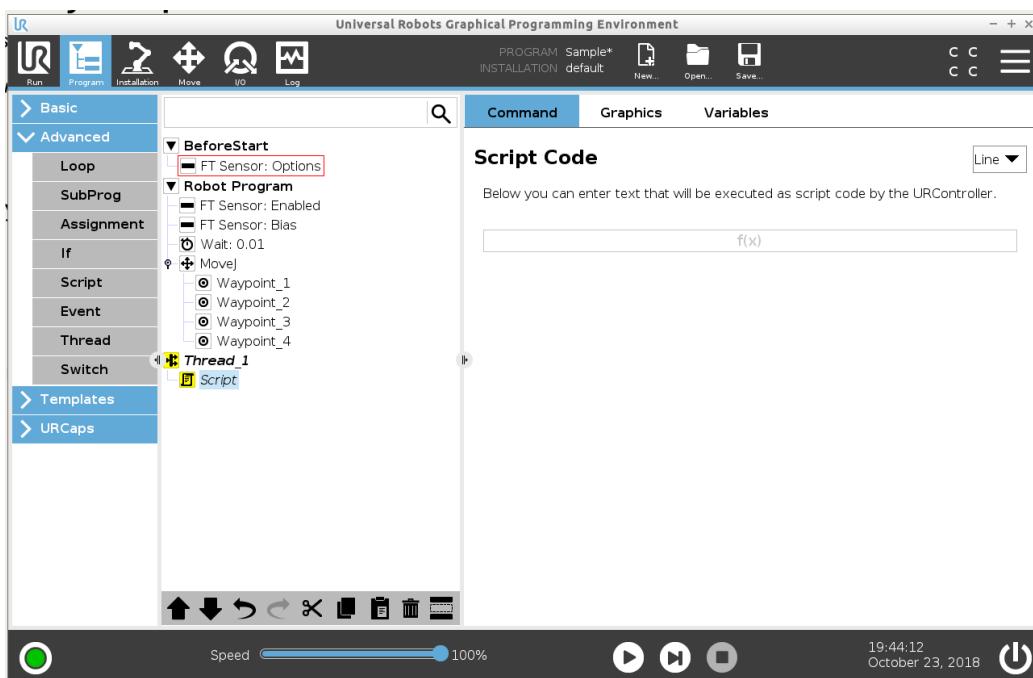
> **NOTICE:** When the user types "ati_ftsensor." the type field turns a shade of pink. The shade of pink goes away, when the user finishes typing the script command.

4. In the type field, type the script:
    a. Type ati_ftsensor.

Figure 3.11—Type the Location (ATI Sensor) to Send the Script Command

ati_ftsensor.get_raw

    b. Type a command from *Table 3.2*.

5. Press the Submit key.

Figure 3.12—Submit the Script
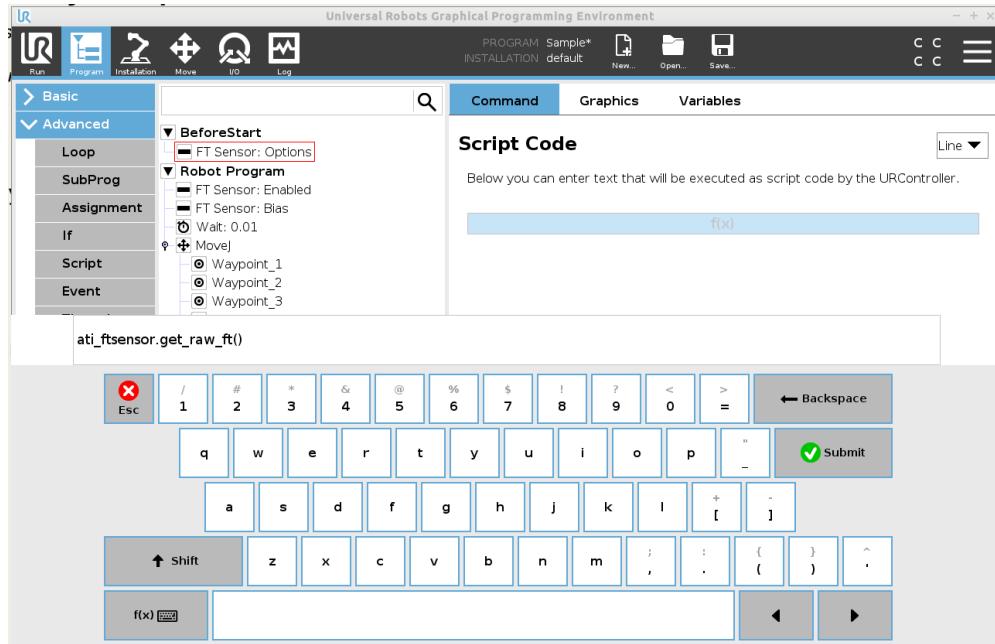
> **NOTICE:** A UR Thread must include a **Wait** or **sync()** UR command, if the Thread is only reading F/T values. Because the readings do not use up the Thread's entire cycle time, unexpected errors or behavior may occur if a **Wait** or **sync()** command is not used.

6. Insert a basic **Wait** command in the Program Tree.

    a. On the left side menu, select the **Basic** tab.

    b. From the drop-down menu, select **Wait**.

    c. On the **Wait** screen, select the radio dial for **Wait 0.01 seconds**.

> **NOTICE:** The user can edit the field for the desired number of seconds. The default value is 0.01.

Figure 3.13—Insert a Wait

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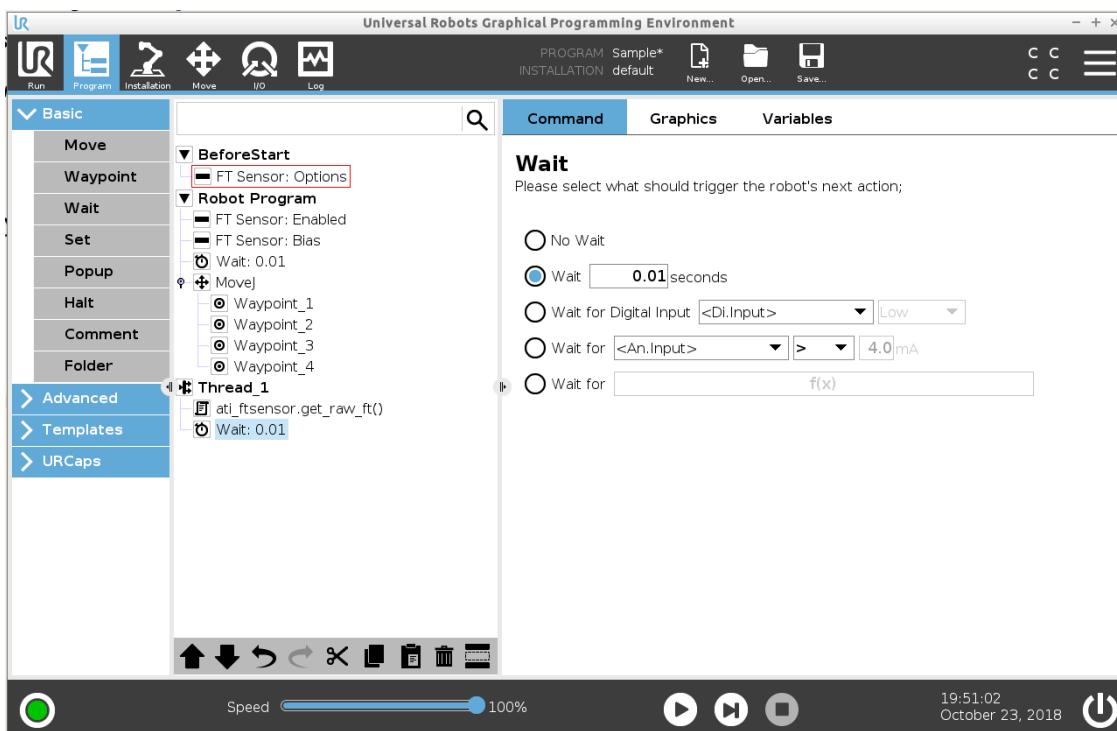
- (Optional) Some scripts from *Table 3.3* have responses from the robot controller. If the user inserted script with an **Assignment** node, the user can view the robot controller's responses to

- as the program is running, select the **Variables** tab on the left side of the Teach Pendant screen to view the response from the robot controller to the script.

Figure 3.14—View Script Responses from the Variables Tab
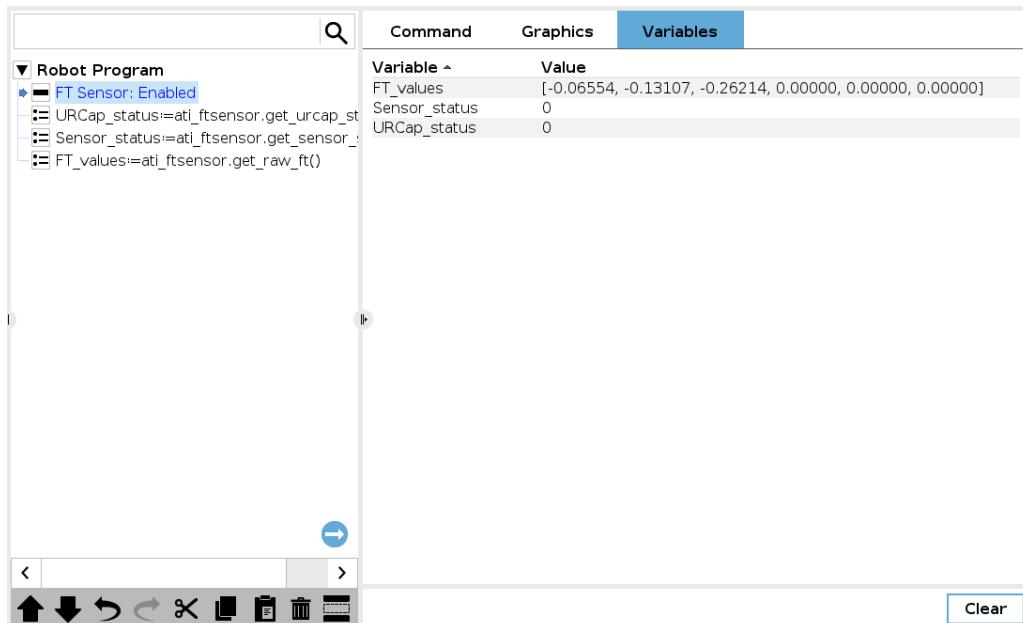
3.4.2 Script to Read Tool Transformed F/T Readings

A tool transformation script allows the user to create a script to read F/T data from a transformed coordinate system. For more information about tool transformation, refer to the applicable ATI F/T sensor manual in *Table 2.1*. The format for the tool transformation script, "get_tcp_ft", is defined in *Table 3.2*, for example:

Figure 3.15—Tool Transformation Script Example

```
atl_ftsensor.get_tcp_ft(1, 0.5, 0.01, 0.1, 3.2, -0.05)
```

This script returns F/T data from a reference frame that has the following offsets and rotations:

- a distance offset along the x-axis = 1 m

- a distance offset along the y-axis = 0.5 m

- a distance offset along the z-axis = 0.01 m

- a rotational offset relative to the x-axis = 0.1 radians

- a rotational offset relative to the y-axis = 3.2 radians

- a rotational offset relative to the z-axis = -0.05 radians

3.4.3   Override Communication Error Script Example

This script allows the robot program to run without stopping for an override communication error (true) or stopping for the error (false). A user can type this script using the following two methods:

- method one:

Figure 3.16—Use the True or False Function f(x) Key
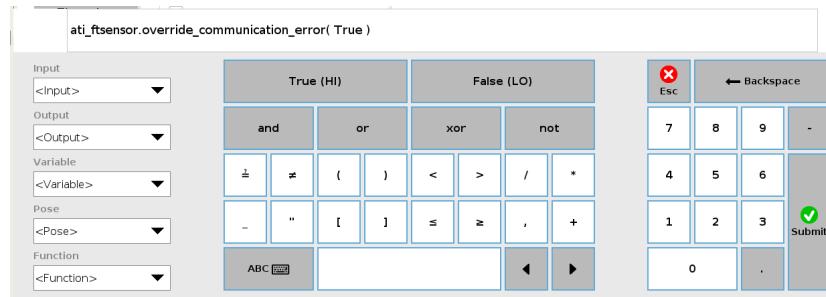
- method two:

Figure 3.17—Type "true" or "false" with the Keyboard

3.4.4 Other Useful URScript Commands

To optimize results of the ATI F/T URCaps software, consider implementing standard URScript commands in *Table 3.3*; these commands are part of the UR/URe controller's built-in Force template (commonly referred to as a UR force mode).

These commands adjust the sensitivity of the force feedback to the robot's motion. The sensitivity of the control is defined by the parameters of damping and gain. For best results, tune the parameters to fit the specific application. When tuning these parameters, take into account these factors: tool and part stiffness, robot speed, and intended reaction time.

For more information about these parameters, refer to the *UR Script Manual*.

Table 3.3—URScript Commands	
Command	**Parameters/Description**
force_mode_set_damping()	A value between 0 and 1 Where: 0 = no damping (robot maintains speed) 1 = full damping (robot decelerates quickly) The default value is 0.005. These parameter definitions assume that there is no opposing force acting upon the robot's directional path.

Table 3.3—URScript Commands	
Command	**Parameters/Description**
force_mode_set_gain_scaling()	A value between 0 and 2. The default value is 1. Where: 0 = no gain 2 = high gain Note: a value larger than 1 = the force mode becomes unstable

These commands should be called before the UR Force template is used. To use the same parameters throughout the program, in the **Before Start** section of the Program Tree. An example of a Program Tree that implements these commands and the ATI URCap software is in the following figure.

Figure 3.18—UR Force Mode Sensitivity Commands

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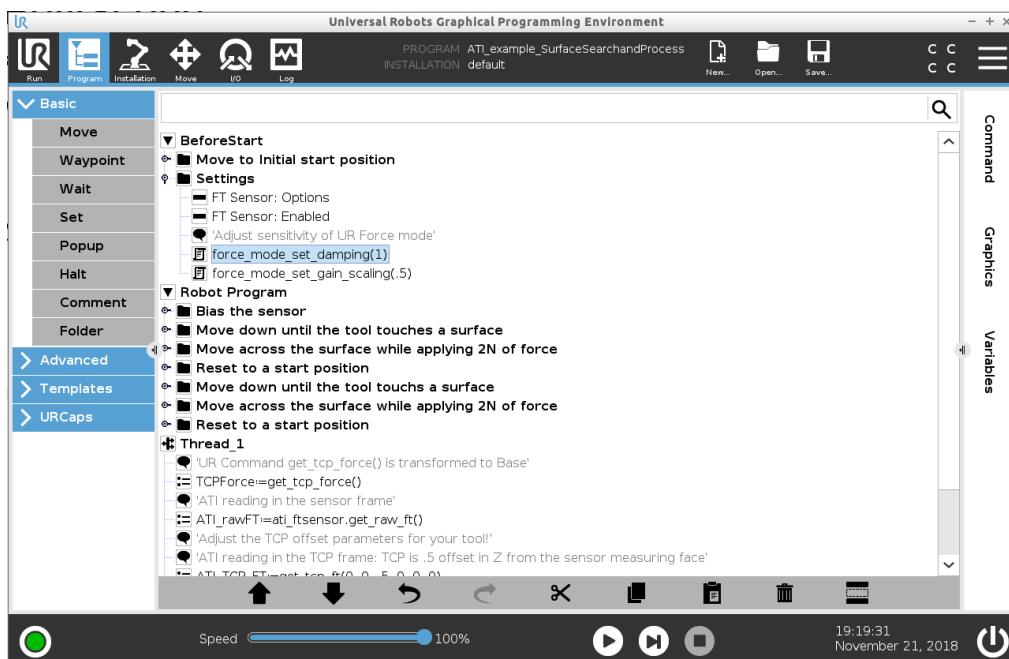
3.5 Running the UR/URe Program

To run a robot program, use the controls on the URe teach pendant footer. For more information about these controls, refer to the *UR Polyscope Manual, Version 5.1.0*.

Figure 3.19—URe Teach Pendant Footer

3.5.1 Sample Rate

For ATI Ethernet sensors, change the sample rate on the *ATI Ethenet F/T Webpages* (refer to the applicable manual in *Table 2.1*).

For the ATI Serial Axia sensor, change the baud rate through the serial console on a personal computer (refer to the applicable manual in *Table 2.1*).

3.5.2 Robot Program Status

As the robot program runs, view the robot program tree and status from the **Program Icon** screen (refer to *Figure 3.14* and *Figure 4.6*).

4. ATI F/T URCaps Demo Programs

ATI provides two ATI F/T URCaps demo programs with the following file names:

- **ATI Demo Program.urp :** a standard demo, which moves the robot and customer tooling across an uneven surface based on feedback from the ATI F/T sensor.

- **ATI Simple Demo Program.urp :** a simple demo, which moves the robot down until attached customer tooling contacts a surface or a force greater than 2 N.

4.1 Downloading ATI F/T URCaps Software from the ATI Website

The user can find the demo programs in the same package file that contains the ATI F/T URCap software:

Supplies required: *Computer with web browser and internet access, USB drive*

1. Using a web browser, navigate to *http://www.ati-ia.com/Products/ft/software/axia_software.aspx*.

2. Download the ATI URCap software package **F/T Universal Robots Software**.

3. Save the file to a local drive. (right click on the folder, and select **Export** or **Export All**)

4. Unzip the file.

5. Save the **ATI_FT-*.urcap** file to a portable USB drive.

6. (Optional) save the **ATI Demo Program.urp** and **ATI Simple Demo Program.urp** to a portable USB drive for transfer to the teach pendant.

7. Eject the USB drive.

4.2 Installing Demo Programs and Setting a Start Position

Before operating the demo programs, the user must install the demo program on the teach pendant and teach the robot a start position,

1. Insert a USB drive that contains the demo package into the USB port on the teach pendant.

Figure 4.1—Insert USB Drive into USB Port on the Teach Pendant

2. In the header, select the **Open** icon.

3. From the drop down menu, select **Program**.

Figure 4.2—Open a Program
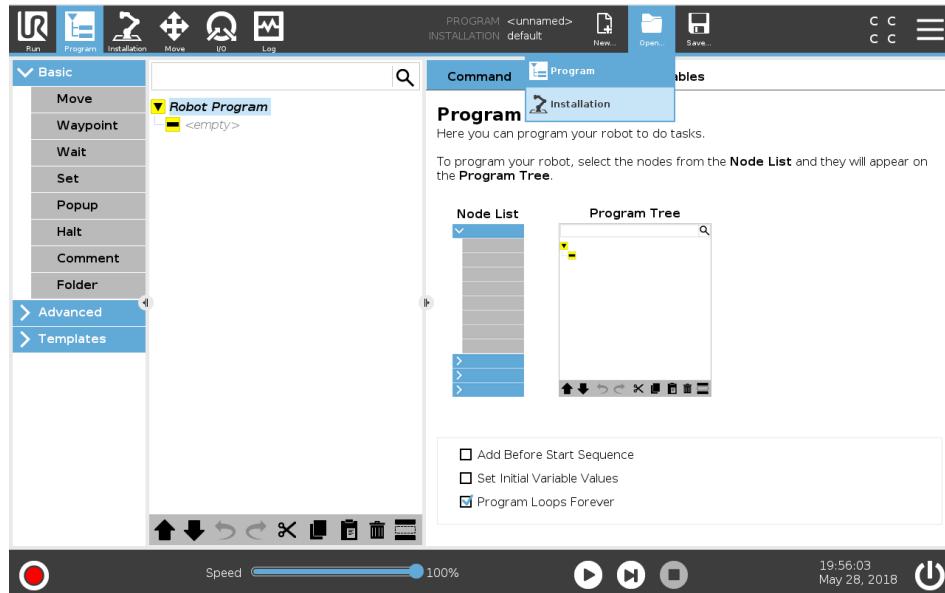
4. On the **Load Program to Run** screen, navigate to the file where the demo program is saved.

5. Select the file, and select **Open**.

Figure 4.3—Load Program to Run

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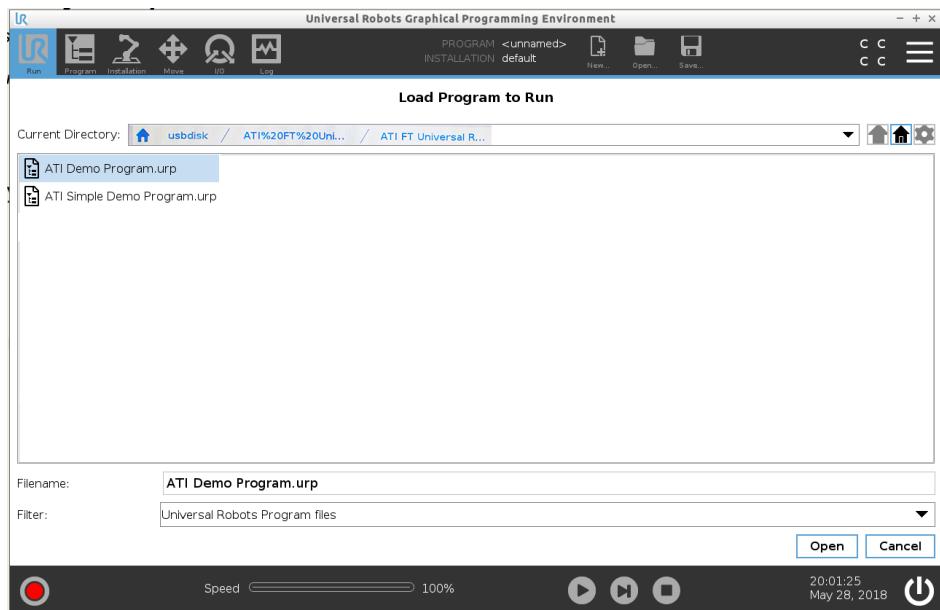
> ⚠ **CAUTION:** When initially setting up a demo program, the user should teach the robot a start position on the **Move Icon** screen so that parts like the sensor cable are not damaged.

6. On the header, select the **Move** icon.

7. On the **Move** screen, press the arrows under the **TCP Position** and **TCP orientation** fields to manually teach the robot a start position.

Figure 4.4—Move the Robot
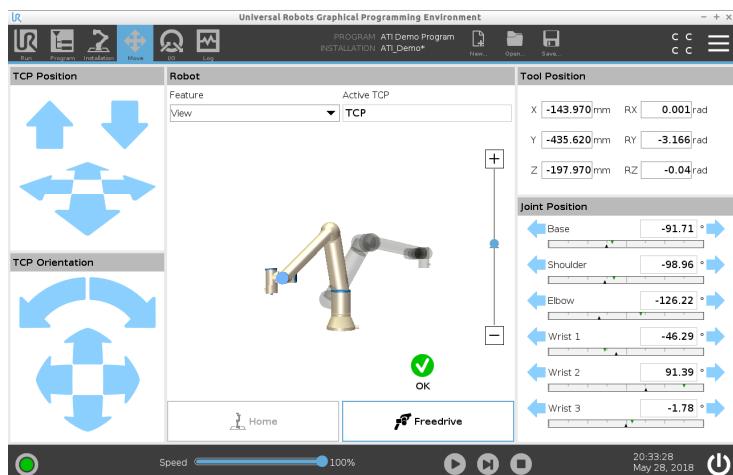
8. Press the green **OK** button to save the start position.

9. On the header, select the **Program** icon.

Figure 4.5—Move the Robot to the Start Position
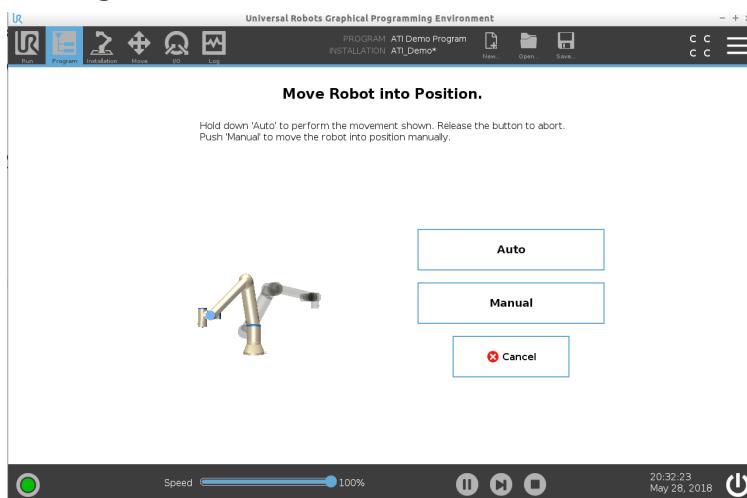
10. On the **Move Robot Into Position** screen, press the **Auto** button to move the robot to its start position.

> **NOTICE:** Press the **Manual** button to manually move the robot to a start position. The **Move Icon** screen appears (refer to *Figure 4.4*).

11. The **Program Icon** screen appears. Press the play button on the footer of the screen.

> **NOTICE:** Press the **Manual** button to manually move the robot to a start position. The **Move Icon** screen appears (refer to *Figure 4.4*).

Figure 4.6—Program Icon Screen
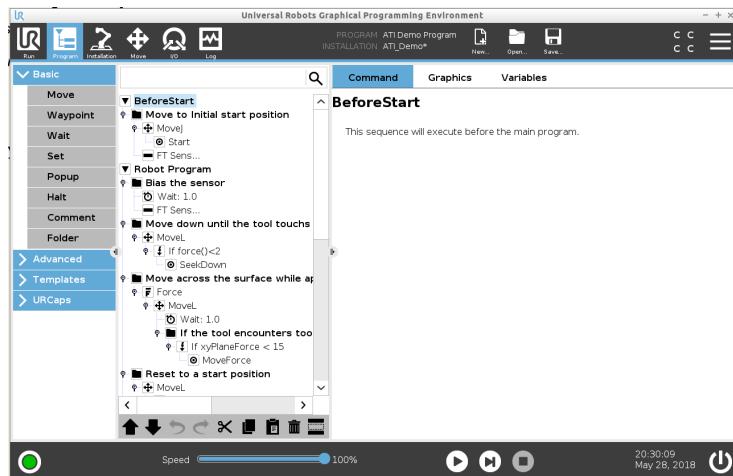
4.3   Brief Summary of the ATI Demo Programs

A brief summary of the demo programs are in the following sections.

4.3.1   The ATI Demo Program

For the Program Tree, refer to *Figure 4.7*.

The ATI Demo Program consists of the following steps:

1. The robot arm moves to its start position above the surface.

> **NOTICE:** Steps 2 and 3 are the only commands created by the ATI URCap Software plugin. All other steps are standard UR programming commands.

2. The ATI F/T sensor starts sending force/torque data to the UR program.

3. The program waits 1 second for the tool to settle, and then biases the F/T sensor.

> **NOTICE:** Steps 4 to 6, can use either the UR built-in F/T sensor data or the ATI URCap data. The ATI Demo Program uses the ATI URCap data through the Enable command. The ATI Demo Program does not use the Disable command. Refer to *Section 3.3—ATI F/T Sensor URCap: Sensor Nodes (Commands)* for more information on the Enable, Disable, and Bias commands.

4. The tool is moved straight down, until the sensor measures a force greater than 2 N or the tool touches the surface.

5. The tool is pressed against the surface with 10 N of force and moved from the left side of the surface to the right. The robot adjusts the tool up and down to maintain 10 N of force as it travels across the surface.

6. When the tool reaches the right side of the surface, it stops and then moves up to a checkpoint position.

7. The process repeats in reverse. The tool moves down until it touches the surface, travels from the right side of the surface to the left at 10 N, and lifts up.

8. This program loops until stopped.

> **NOTICE:** ATI F/T Sensors provide status conditions to the robot. Refer to *Section 3.2—ATI F/T Sensor URCaps: Sensor Options* for **Acceptable Status Conditions** that the user can set the ATI URCap software to ignore so that the UR robot continuously operates.

Figure 4.7—ATI Demo Program
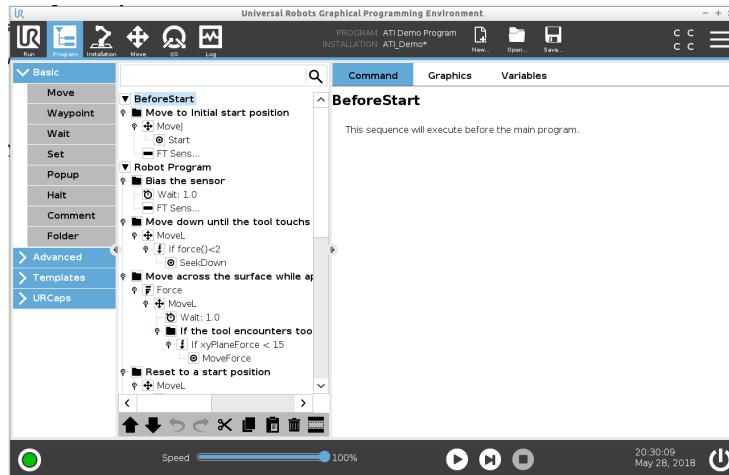
4.3.2 ATI Simple Demo Program

For the program tree, refer to *Figure 4.8*.

The ATI Simple Demo Program consists of the following steps:

1. The ATI Simple Demo Program moves the end of the robot arm straight up and down.

2. If the sensor detects the force of the robot arm moving down onto an object, the robot arm stops and moves upwards again.

> **NOTICE:** The ATI Simple Demo Program stops when the sensor detects a force greater than 2 N.

3. This motion repeats until the program is stopped.

Figure 4.8—ATI Simple Demo Program
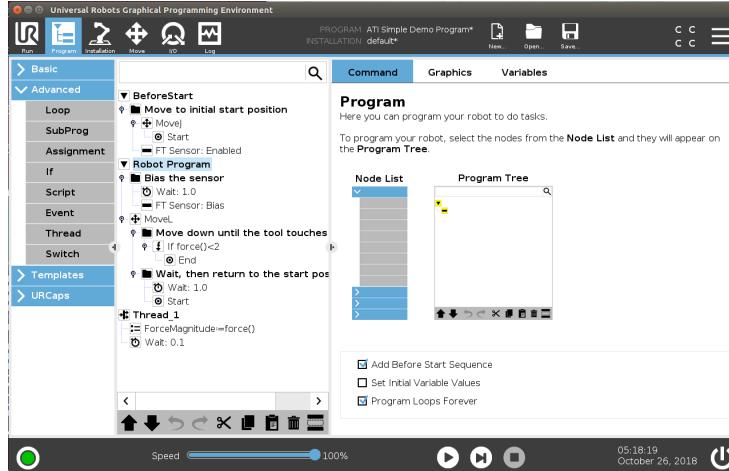
5. ATI F/T Sensor URCap Logging

To view the logging file, SSH into the URe controller. Connect to the URe controller with a personal computer through a terminal emulator. Free terminal emulator software, such as PuTTY, is available online.

The log file is located in this location: GUI/felix-cache/bundleXX/data/com/ur/urcap/ATI_FT/impl/daemon/URlog. txt (refer to *Figure 5.1*). Where bundleXX is the latest installation bundle. To copy the log file to another location, it is possible to SFTP to the UR Controller.

Figure 5.1—Logging File Location

The logging file looks like this:

Figure 5.2—Logging File

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Table 5.1 lists messages written in the log for the applicable Logging Level.

Table 5.1—ATI URCap Software Logging File Messages		
Logging Level	**Message**	**Description**
Error	Unable to negotiate RTDE protocol version.	Universal Robots software version is less than 3.3.X and needs to be upgraded to 3.3.X or greater.
	Detected RTDE Setup Error.	Communication problem with UR controller.
	Detected RTDE Loop Error.	
	RTDE missed too many updates.	Communication problem with F/T sensor. The cable connections may not be secure or power is not supplied to the sensor.
	Detected F/T Setup Error.	
	Detected F/T Loop Error.	
	Invalid status condition: #.	F/T sensor has a status condition that is not ignored in ATI F/T Sensor: Options. Reference the sensor manual for status codes or conditions.
Warning	RTDE protocol V2 not supported. Downgrading to RTDE protocol V1.	Universal Robots software version is 3.3.X and needs to be upgraded to 3.4.X or better.
	F/T data not updated since last check. previous sequence: #. current sequence: #.	Communications between F/T sensor and UR Controller are not perfectly synchronous.
	Long RTDE packet: #. RTDE Packet count: #.	Communication with UR Controller took longer than expected.
	New longest period between RTDE packets: #.	This is the longest period of time elapsed without communication with the UR controller.
	Connection Reset at #. Connection Re-established at #. Time taken to Re-establish connection: #.	UR Controller reset the RTDE connection.
	Long packet: #. Packet count: #.	Communication with F/T sensor took longer than expected.
	New longest period between packets: #.	This is the longest period of time gone without communication with the F/T sensor.
Info	RTDE Setup completed, entering F/T forwarding loop	The RTDE interface was successfully configured. Starting F/T communications.
	RTDE Thread safely closed. Time run: #.	ATI URCap successfully stopped.
	F/T Setup completed, entering F/T forwarding loop.	The F/T sensor was successfully configured. Starting F/T communications.
	Time run: #. Loop iterations: #. Rate: #.	ATI URCap operating information. Generated roughly every 10 seconds. Rate should be around 125 Hz.
	F/T Thread safely closed. Time run: #. Loop iterations: #.	ATI URCap successfully stopped.

6. Troubleshooting

The Troubleshooting section includes answers to some issues that might arise when setting up and using the ATI UPCaps software with an ATI sensor. In the Errors with the URCap Software Table (*Table 6.1*), the question or problem is listed on the left and followed by the plausible solution to the right.

The information in this section should answer many questions that might arise in the field. Customer service is available to users who have problems or questions addressed in the manuals.

> Note
>
> Please read the manual before calling customer service. Before calling, have the following information available:
>
> 1. Serial number (e.g., FT01234)
> 2. Sensor model (e.g., Ethernet Axia80)
> 3. Calibration (e.g., US-15-50, SI-65-6, etc.)
> 4. Accurate and complete description of the question or problem
> 5. Computer and software information (operating system, PC type, drivers, application software, and other relevant information about the application's configuration)
>
> If possible, be near the F/T system when calling.

For additional troubleshooting information or to speak with a customer service representative, please contact ATI:

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E-mail: *ft_support@ati-ia.com*

The following table lists basic problems and plausible answers/solutions for the operation of the ATI URCap software.

Table 6.1—Errors with the ATI URCap Software	
Problem	**Answer/Solution**
After clicking **Start Daemon** on the **Force/Torque Sensor** screen, an error message "ATI FT Daemon failed appears.	The ATI F/T Sensor address entered may be incorrect. Verify the address and reenter (refer to the **9610-05-1040** or *9610-05-1036* manual.
During operation, a Protective Stop error message appears.	There may have been a loss of communication between the ATI Daemon program and the robot controller. The most likely cause is a loss of communication from the sensor. Verify that all cables are connected, and the sensor is powered. Select the **Enable Robot** button on the error message to re-establish communication. Note: The robot reports this high-level Protective Stop error in several situations, as determined by the robot controller.
The UR is not using data from an ATI F/T sensor that the user installed on the robot arm.	Verify that the Enable command is selected. Refer to *Section 3.3—ATI F/T Sensor URCap: Sensor Nodes (Commands)*. Verify the sampling rate of the sensor is correctly set. Refer to *Section 3.5.1—Sample Rate*.
The ATI URCap software is malfunctioning.	Another method to review the activity of the ATI URCap software is to make sure a Logging Level is set and reference the logging file for details. Refer to *Section 3.2—ATI F/T Sensor URCaps: Sensor Options* and *Section 5—ATI F/T Sensor URCap Logging*.
The robot program stalls.	The robot needs time to register commands and scripts. Insert a wait command. Refer to *Section 3.4—ATI F/T Sensor URCap: Scripts*.
The ATI F/T sensor is malfunctioning.	Refer to the applicable manual in *Table 2.1*.
When using a Serial Axia sensor on the URe Installation > General > Tool > Tool Communication Interface page, there is an **Active Value: false** error.	The installation may have been reopened after a restart without successfully enabling the URe tool port. Select **Disable** and then **Enable** again. The tool communication should successfully enable after this retry.

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7. Terms and Conditions of Sale

The following Terms and Conditions are a supplement to and include a portion of ATI's Standard Terms and Conditions, which are on file at ATI and available upon request.

ATI warrants to Purchaser that force torque sensor products purchased hereunder will be free from defects in material and workmanship under normal use for a period of one (1) year from the date of shipment. The warranty period for repairs made under a RMA shall be for the duration of the original warranty, or ninety (90) days from the date of repaired product shipment, whichever is longer. ATI will have no liability under this warranty unless: (a) ATI is given written notice of the claimed defect and a description thereof with thirty (30) days after Purchaser discovers the defect and in any event, not later than the last day of the warranty period and (b) the defective item is received by ATI not later than ten days after the last day of the warranty period. ATI's entire liability and Purchaser's sole remedy under this warranty is limited to repair or replacement, at ATI's election, of the defective part or item or, at ATI's election, refund of the price paid for the item. The foregoing warranty does not apply to any defect or failure resulting from improper installation, operation, maintenance, or repair by anyone other than ATI.

ATI will in no event be liable for incidental, consequential, or special damages of any kind, even if ATI has been advised of the possibility of such damages. ATI's aggregate liability will in no event exceed the amount paid by the purchaser for the item which is the subject of claim or dispute. ATI will have no liability of any kind for failure of any equipment or other items not supplied by ATI.

No action against ATI, regardless of form, arising out of or in any way connected with products or services supplied hereunder, may be brought more than one year after the cause of action accrued.

No representation or agreement varying or extending the warranty and limitation of remedy provisions contained herein is authorized by ATI, and may not be relied upon as having been authorized by ATI, unless in writing and signed by an executive officer of ATI.

Unless otherwise agreed in writing by ATI, all designs, drawings, data, inventions, software, and other technology made or developed by ATI in the course of providing products and services hereunder, and all rights therein under any patent, copyright, or other law protecting intellectual property, shall be and remain ATI's property. The sale of products or services hereunder does not convey any expressed or implied license under any patent, copyright, or other intellectual property right owned or controlled by ATI, whether relating to the products sold or any other matter, except for the license expressly granted below.

In the course of supplying products and services hereunder, ATI may provide or disclose to Purchaser confidential and proprietary information of ATI relating to the design, operation, or other aspects of ATI's products. As between ATI and Purchaser, ownership of such information, including without limitation any computer software provided to Purchaser by ATI, shall remain in ATI and such information is licensed to Purchaser only for Purchaser's use in operating the products supplied by ATI hereunder in Purchaser's internal business operations.

Without ATI's prior written permission, Purchaser will not use such information for any other purpose of provide or otherwise make such information available to any third party. Purchaser agrees to take all reasonable precautions to prevent any unauthorized use or disclosure of such information.

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