FAQ - Force/Torque Sensors

Published March 30, 2020

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1 How do I Select a Force/Torque Sensor System?

1.1 What is included in a complete F/T System?

A complete F/T system consists of a calibrated sensor/transducer and a system interface. The sensor measures forces and torques in the X, Y and Z axes. The system interface provides the signal conditioning and communication to the user's system. Some sensors have interface electronics integrated into the body, while others require external hardware.

In order to obtain a quote, a sensor, calibration, and system interface must be specified.

1.1.1 How do I Choose a Sensor?

Model selection is based on:

- Load Magnitude
- Size Requirements
- IP Rating (Environmental Factors)
- Accuracy & Resolution

See "Selecting a Force Torque Transducer": https://www.ati-ia.com/products/ft/ft_Selection.aspx

See "Force/Torque Sensor Application Worksheet":
https://www.ati-ia.com/Library/documents/FT_Sensor_Application_Form.pdf

1.1.2 How do I Choose the Correct Calibration for My Sensor Model?

To choose the correct calibration, consider the worst case moment load that will be applied to the sensor. Typically the moment capacity is the determining factor when choosing the correct sensor model and calibration range.

In robotic applications, the worst case moment load is typically a dynamic load caused by the acceleration of the robotic end effector. For this reason, you will have to consider the speed/power setting of the robot, as the speed/power setting normally determines the maximum acceleration. The loading case below can be used as a worst case load assumption.

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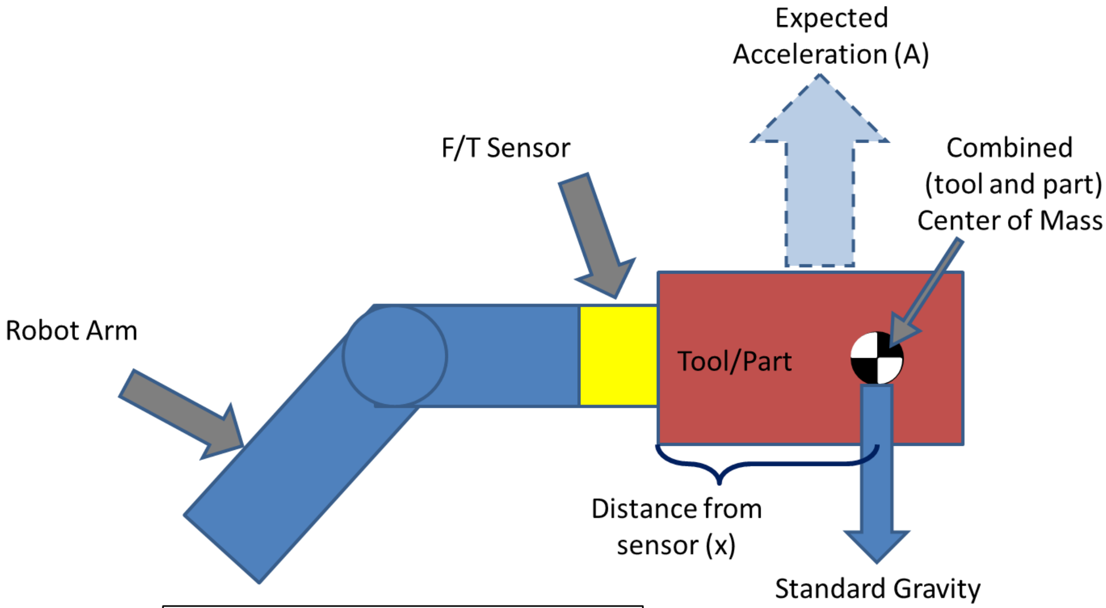


$$Moment_{Max} = Mass * (g + A) * x$$

Other things to consider when choosing the calibration range:

- The chosen calibration defines sensing range, resolution, and accuracy
- All forces applied to the sensor should be kept within this range
- Most standard sensors come with one calibration
  - Additional calibrations can be loaded onto a single system
- Each sensor is uniquely calibrated to the chosen range and identified by an FTxxxxx number. Sensors and their interfaces are calibrated pairs with matching FTxxxxx numbers.

System-specific Calibration Options:

System Interface	Calibration Option
NET F/T	Any combination of supported sensor model calibrations.
DAQ F/T	Dual calibrations available. The two ranges must be adjacent, e.g. small and medium, medium and large. (One range must be half of the other range).
Axia Systems	Axias come standard with 2 calibrations. No additional calibrations available.

1.1.3 How do I choose the correct System Interface for my application?

The system interface provides the signal conditioning and communication to the user's system. Some transducer bodies have an interface integrated into the body, while others require external hardware. Cables are included as needed. In order to obtain a quote an interface option must be specified.

See "System Interfaces": https://www.ati-ia.com/products/ft/ft_SystemInterfaces.aspx

When choosing a system interface, there are a few things to consider to ensure the success of the application. Sometimes the interface is very clear based on the requirements of the robot controller or PLC, but with some systems and applications, the choice can be less clear. See the following sections for assistance with some common questions.

1.1.3.1 What system interface can I use with my robot or PLC?

Most common system interfaces to use ATI sensors for robotic force control or force sensing:

<table>
<tr><th rowspan="2">Robot Manufacturer</th><th rowspan="2" colspan="2">Manufacturer-Supplied Components & Software</th><th colspan="2">Recommended ATI System</th></tr>
<tr><th>Nano/Mini/Gamma/Delta/ Omega/Theta Sensor models</th><th>Axia Sensor Models</th></tr>
<tr><td rowspan="2">KUKA</td><td>KRC4</td><td rowspan="2">KUKA Force Torque Control software option</td><td>NET F/T with any Net Box</td><td>EtherCAT Axia</td></tr>
<tr><td>KRC2</td><td colspan="2">Contact F/T Sensor Support for KRC2</td></tr>
<tr><td>ABB</td><td colspan="2">ABB Force Control option (includes hardware & software)</td><td>DAQ F/T with ABB configuration</td><td>--</td></tr>
<tr><td>FANUC</td><td colspan="2">Ethernet/IP Scanner option
(optional) Dynamic Path Modification option</td><td>NET F/T with any Net Box</td><td>--</td></tr>
<tr><td rowspan="3">UR</td><td>CB series</td><td rowspan="3">Built-in Force templates</td><td rowspan="3">NET F/T with any Net Box</td><td>Ethernet Axia
(included with the 9105-UR-Axia80 Kit)</td></tr>
<tr><td rowspan="2">E series</td><td>Ethernet Axia
(included with the 9105-UR-Axia80 Kit)</td></tr>
<tr><td>RS485 Axia
(included with the 9105-URe-Axia80 Kit)</td></tr>
<tr><td>TechMan TM & Omron TM</td><td colspan="2">Built-in Force Control templates</td><td>--</td><td>EtherCAT Axia
(included with the 9105-TM-Axia80 kit)</td></tr>
<tr><td>Kawasaki</td><td colspan="2">RTM (Real Time Motion) software option</td><td>NET F/T with any Net Box</td><td>Ethernet Axia</td></tr>
<tr><td>Yaskawa/ Motoman</td><td>Yaskawa Analog Sensor Input Board</td><td>Yaskawa Sensor Function software option</td><td>Controller F/T</td><td>--</td></tr>
<tr><td rowspan="2">Denso</td><td colspan="2">RC8/RC8A</td><td rowspan="2">NET F/T with any Net Box</td><td rowspan="2">Ethernet Axia</td></tr>
<tr><td colspan="2">Contact F/T Sensor Support for other Denso controllers</td></tr>
<tr><td>Nachi</td><td>PCI Analog card</td><td>Force Sensor I/F option</td><td>DAQ F/T or Controller F/T</td><td>--</td></tr>
</table>

Mecademic	Controllers with Ethernet communication (e.g. PC-based controller)	NET F/T with any Net Box	--

PLC Manufacturer	Recommended Fieldbus	Recommended ATI System	
		Nano/Mini/Gamma/Delta/ Omega/Theta Sensor models	**Axia Sensor Models**
Rockwell/Allen Bradley	Ethernet/IP	NET F/T with any Net Box	--
SIEMENS	Profinet	Net F/T with Profinet Net Box	--
Omron	EtherCAT	Large, IP-rated sensors with EtherCAT integrated inside sensor	EtherCAT Axia
Beckhoff	EtherCAT	Large, IP-rated sensors with EtherCAT integrated inside sensor	EtherCAT Axia

Other systems may be compatible depending on your robot and software packages.

A mounting interface plate may be required to mechanically mount the sensor to your robot. You can create this yourself, or purchase from ATI if available.

1.1.3.2 What system interface should I use for my research project?

For data collection, most researchers use the DAQ F/T interface, which provides analog signals that can be read and synchronized with many off the shelf Data Acquisition devices. ATI offers National Instruments DAQ devices, and we offer open-source software including a LabVIEW VI to use them. This allows easy integration with your other experiments.

1.1.3.3 What sensor interface should I choose for my real-time system?

In general, ATI F/T interfaces operate at faster speeds than the robotic system. Some users colloquially refer to “real time” when referring to any fast communication or active force control system. This is distinguished from the scientific definition of a “hard real time system”.

Most common ways to use ATI sensors in real-time systems:

- EtherCAT F/T
- DAQ F/T with PCI Express or PXI Express DAQ device
- Certain other F/T Interfaces used with robotic force control packages (see FAQ Section1.1.3.1)

Resources:

- National Instruments White Paper on Real-Time Operating Systems: http://www.ni.com/white-paper/3938/en/
- EtherCAT Technical Introduction & Overview: https://www.ethercat.org/en/technology.html

2 How is Measurement Performance defined?

The measurement performance of an ATI Force/Torque sensor is defined by its range, uncertainty, resolution, repeatability, and signal performance.

2.1 Measurement Range & Overload Limits

2.1.1 What is the measurement range of my sensor?

The measurement range, or calibrated range, of a Force/Torque Sensor is defined by its calibration. F/T sensors are calibrated to measure loads within fixed force and torque load ranges. Proper care should be taken to ensure that this calibrated load range is not exceeded. Most ATI Force/Torque Sensors are rated for 10,000,000 fully-reversing single-axis full-scale loads. Sensors are designed to perform within their rated specifications while the applied loads are within the calibrated range.

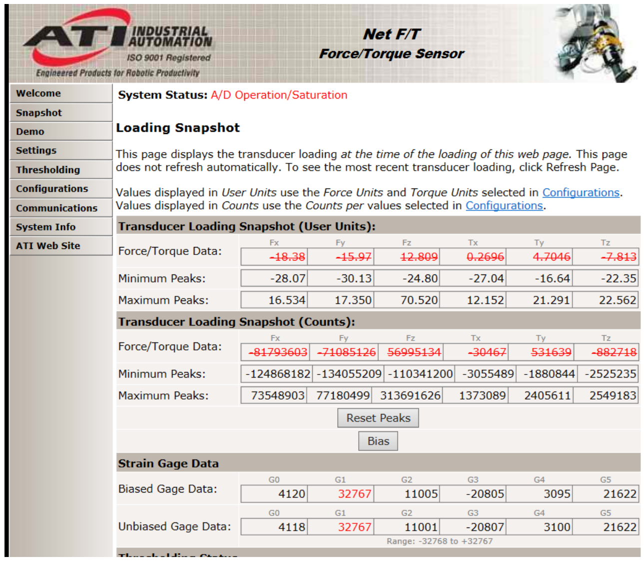
2.1.2 What happens if the loads applied to my sensor exceed the calibrated range?

Typically when the calibrated range of a sensor is exceeded, the electronics saturate and the output of the system becomes invalid until the loads are reduced into the calibrated range. Although the overload limit (See FAQ Section 2.1.4) is higher than the calibration range, we don't recommend exceeding the calibration range, as doing so will reduce the life of the sensor due to fatigue. Also, when the sensor saturates, it's impossible to determine whether the applied load is 1N or 10,000N beyond the calibrated range. Loads outside of the calibrated load range can cause permanent damage to the sensor. This is why it is important to select a calibration range that is above your maximum applied forces and torques.

The sensor is designed to tolerate limited loading between the maximum calibration range and below the overload limits. However, using the sensor in the region between the calibration range and overload limit will reduce the life of the sensor.

2.1.3 What is a saturation error?

A saturation error is caused by exceeding the calibrated range. A "Saturation Error", "Gage Out of Range Error", or "Force/Torque Out of Range Error" will occur when the calibrated range of any of the six F/T components [Fx, Fy, Fz, Tx, Ty, Tz] is exceeded. Exceeding the calibrated range will temporarily result in invalid measurement values for **all six** force and torque outputs (see figure below). Reference the Transducer Section Manual for further detail on how F/T data is measured and output.



Saturation Error on NET F/T system. Gage 1 (G1) is saturated.

If the saturation error is permanent and it doesn't go away after all loads are removed from the sensor, it's possible that the sensor has been permanently damaged. Please contact F/T Sensor Support if your sensor is showing a permanent Saturation Error.

2.1.4 What is single-axis overload?

The single-axis overload rating of a Force/Torque Sensor represents the one-time load that can catastrophically damage the sensor. These limits are defined by the physical properties of the mechanical structure, so the sensor does not need to be powered or connected to the F/T system for an overload to happen. Complex/combined loads of more than one axis will reduce the overload limit values. A sensor model has the same single-axis overload specifications regardless of the calibration range.

For sensors with small calibrated load ranges, such as the Nano17, extra care should be taken when handling and installing the device. Mishandling or over-tightening fasteners can exceed the overload limit and cause permanent damage to these sensors.

Important Note Sensors are not rated for operation beyond the calibrated load range. The fatigue life of a sensor can be dramatically reduced if the calibrated load range is exceeded, with larger loads presenting greater risk for damage. Sensors should only be used within their calibrated load range. See Measurement Range and Saturation FAQ sections. Also, see "3.1.1: How can I prevent failure due to overload?".

Metric Calibrations (SI)

Calibration	Fx,Fy	Fz	Tx,Ty	Tz
SI-1000-120	1000 N	2500 N	120 Nm	120 Nm
SI-1500-240	1500 N	3750 N	240 Nm	240 Nm
SI-2500-400	2500 N	6250 N	400 Nm	400 Nm
	SENSING RANGES			

Single-Axis Overload	
Fxy	±18000 N
Fz	±48000 N
Txy	±1700 Nm
Tz	±1900 Nm

Calibrations and Single-Axis Overloads for Omega160 sensor

2.2 Measurement Uncertainty

2.2.1 What is measurement uncertainty?

"Measurement uncertainty", commonly referred to as "accuracy", is the range of possible values within which the true value of the measurement lies. The quoted measurement uncertainties of ATI Force/Torque Sensors take into account several sources of error in a Force/Torque measurement. Assuming steady state temperatures, errors due to nonlinearity, hysteresis, cross-talk, etc. are factored into a sensor's measurement uncertainty windows.

The full-scale measurement uncertainty of a Force/Torque System is quoted as a percentage of the maximum calibrated range of the sensor. Every measurement axis of each sensor has its own measurement uncertainty percentage and calibrated range that will be used to calculate the absolute measurement uncertainty window for that axis. See FAQ Section 2.2.2 below.

The accuracy of a system depends on the model and the calibration. The full-scale measurement uncertainty percentages for your system will be listed in your quote and in the sensor's Calibration Certificate (supplied when the sensor ships from ATI).

2.2.2 How do I calculate measurement uncertainty in units of Force (±N) and Torque (±Nm)?

The following is an example showing how to determine the measurement uncertainty window for force readings in the X-axis (Fx). This example uses a Gamma sensor with metric calibration: SI-130-10. For this model and calibration, the full-scale measurement range in Fx is 130N, and the full-scale measurement uncertainty in Fx is 1.00% (1.00%FS).

Applying this %FS rating to the calibrated measurement range, we see that 1.00% of 130N is 1.3N. This means that the F/T system measurements in the Fx axis will be within ± 1.3N of any applied Fx load that is within the calibrated range of -130N to +130N. If a 50N load is applied in Fx, the true measurement is within the range of 50N ±1.3N, i.e. from 48.7N to 51.3N. See figure below.

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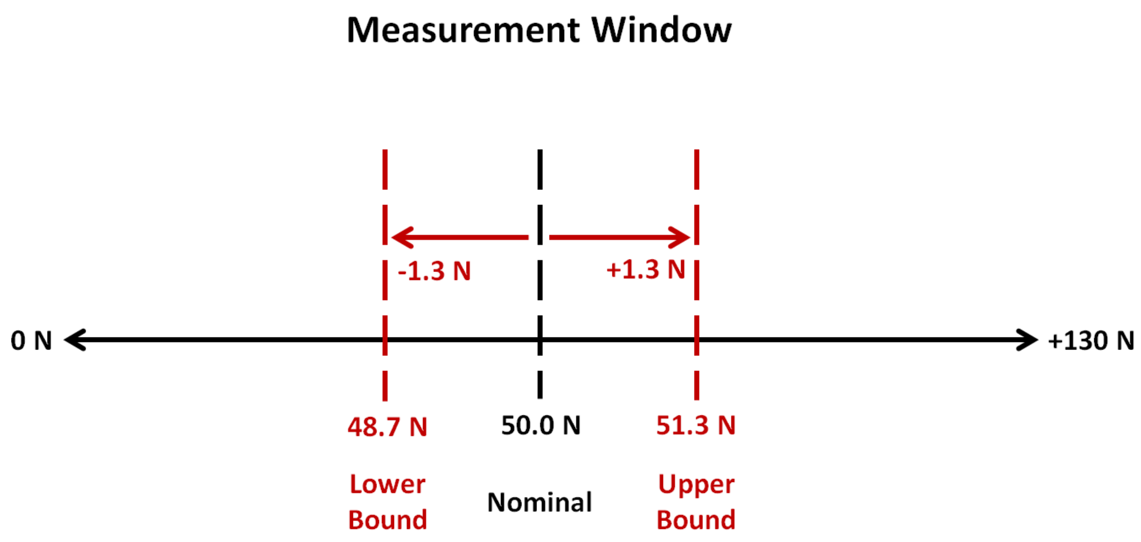

2.2.3 What is nonlinearity?

Nonlinearity is a deviation in measurement from the ideal straight line response from zero-load to full-scale.

2.2.4 What is the nonlinearity of my ATI F/T sensor?

The effects of nonlinearity in ATI F/T Sensors are taken into account in the full-scale measurement uncertainty specification.

2.2.5 What is hysteresis?

Fully-reversed hysteresis is the difference in zero-reading after applying and removing a full-scale load in the negative direction vs. applying and removing a full-scale load in the positive direction.

2.2.6 What is the hysteresis specification of my ATI F/T Sensor?

The effects of hysteresis in ATI F/T Sensors are taken into account in the full-scale measurement uncertainty specification.

2.2.7 What is crosstalk?

Crosstalk is the error seen when a load applied purely along one axis causes an output in another axis.

2.2.8 Crosstalk in ATI F/T Sensors

The effects of crosstalk in ATI F/T Sensors are taken into account in the full-scale measurement uncertainty specification.

2.2.9 Is my sensor reading accurately?

To test your sensor's accuracy, see FAQ Section 4.5, "How do I evaluate the accuracy or health of the sensor?".

2.3 Resolution

2.3.1 How is resolution defined for ATI F/T Sensors?

Resolution is the smallest change in force or torque that can be detected by a sensor. For example, a sensor with resolution of 1/10N (0.1 N) has the ability to detect a change as small as 1/10N. The resolution of your sensor depends on the model, the system interface, and the calibration. It is listed on the sensor model page.

2.4 Repeatability

2.4.1 How is repeatability defined for ATI F/T sensors?

Repeatability is the ability of the sensor to reproduce the same output when the same load is applied to it repeatedly, under the same conditions.

2.4.2 What is my sensor's repeatability?

Under steady-state thermal conditions, typical repeatability of standard ATI sensors is better than 20% of the full-scale measurement uncertainty. For example, consider a Gamma with the metric SI-130-10 calibration. In Section 2.2.2, the absolute measurement uncertainty for Fx is determined to be ± 1.3N. Because 20% of ± 1.3N is ± 0.26 N, we can expect typical repeatability to be better than ± 0.26 N in Fx.

2.5 Signal Performance (data rate, noise, latency, etc.)

2.5.1 What is the data rate of my F/T System?

See "Data rates of the different F/T systems types" table on the System Interfaces Webpage.

2.5.2 How is latency defined for F/T Systems?

Latency is defined as the amount of time it takes for a load to be output and received by the user. In other words, it is the time between when the load is applied to the sensor and when the output is sent to the user's system.

The rated latency for each system interface is listed in the "Data rates of the different F/T systems types" table on the System Interfaces Webpage

2.5.3 What causes noise in a Force/Torque measurement signal?

Signal noise can be caused by anything from mechanical vibrations to electromagnetic interference to radio frequency interference. Unamplified analog signals are the most susceptible to noise, so users of Nano and Mini sensors should be conscious of any noise sources around the measurement area.

In most cases, a simple low-pass filter can alleviate most effects of noise.

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3 Best Practices

3.1 Load Monitoring

3.1.1 How can I prevent a failure due to overload?

To prevent failure due to overload, it is recommended to always monitor for saturation during handling, assembly and operation of the sensor. If a saturation error is detected, the load should be immediately removed and the sensor should be evaluated for damage.

It is best practice to monitor the system for potential gage saturation (or on Axia models, Gage Out of Range and F/T Out of Range errors) at all times. When one of these errors is generated, all the F/T measurements will be invalid until the error is removed by reducing the applied loads. On digital systems, this can be monitored by the Status code. Any Saturation or Out of Range condition will set the “Error” bit. On DAQ F/T Systems monitor the six gage output voltages, SG0-SG5, to check if the gages outputs are within their allowable range and not saturated. See FAQ Saturation Section and Overload Section for more information about what these conditions are and why is it important to stay within the calibration range.

3.2 Cable Management

3.2.1 What is the minimum bend radius of my transducer cable?

When installing an F/T sensor, standard best-practices for cable management should be followed to ensure that the sensor and other nearby equipment do not become damaged during operation. The transducer cable must be routed so that it is not stressed, pulled, kinked, cut, or otherwise damaged throughout the full range of motion of your process. Proper strain relief must be provided to minimize cable stresses.

Figure 3.6—Transducer Bending Radius

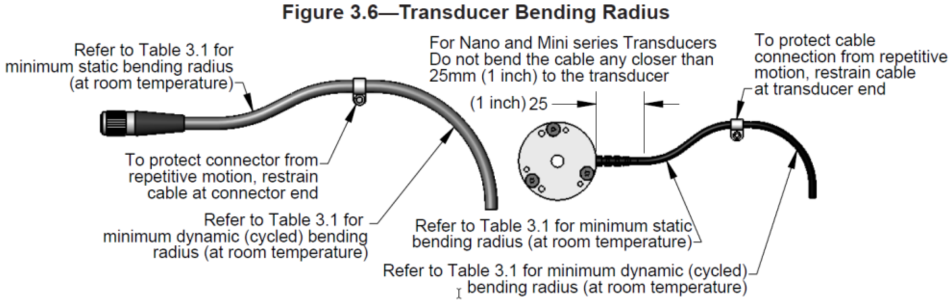


Figure 3.6 from Section 3.3 of Transducer Section Manual

For details on sensor cable diameter, minimum bend radii, and more, please see Section 3.3 of the Transducer Section Manual: http://www.ati-ia.com/app_content/documents/9620-05-Transducer%20Section.pdf

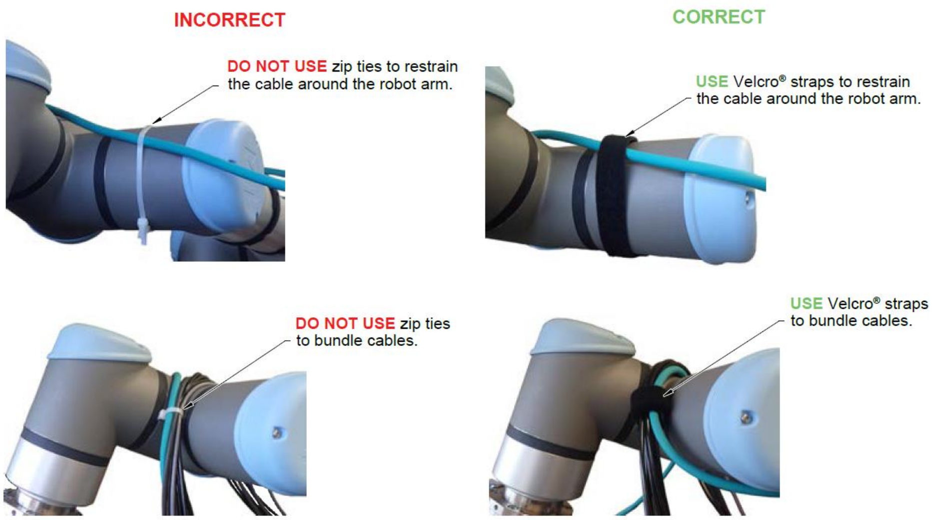
For information on Axia cable bend radii, see the Axia manual that matches your specific sensor type.

https://www.ati-ia.com/app_content/documents/9610-05-Ethernet%20Axia.pdf

https://www.ati-ia.com/app_content/documents/9610-05-EtherCAT%20Axia.pdf

3.2.2 How do I correctly restrain and secure the F/T cables?

Cable ties/zip ties should not be used to restrain or route sensor cables. Cable ties will induce high stresses on the cable, resulting in accelerated wear and increased likelihood of premature failure. Instead, hook-and-loop or Velcro straps should be used to restrain cables. If an application will result in the cable rubbing, a loose plastic spiral wrap should be used for protection instead. Devices like these are specially designed to properly restrain cables while allowing them sufficient freedom to flex and shift.



3.3 Managing Sensor Output Drift

3.3.1 What is sensor output drift?

Sensor output drift is change of a measurement value over time due to several factors including change in temperatures and gage excitation voltage.

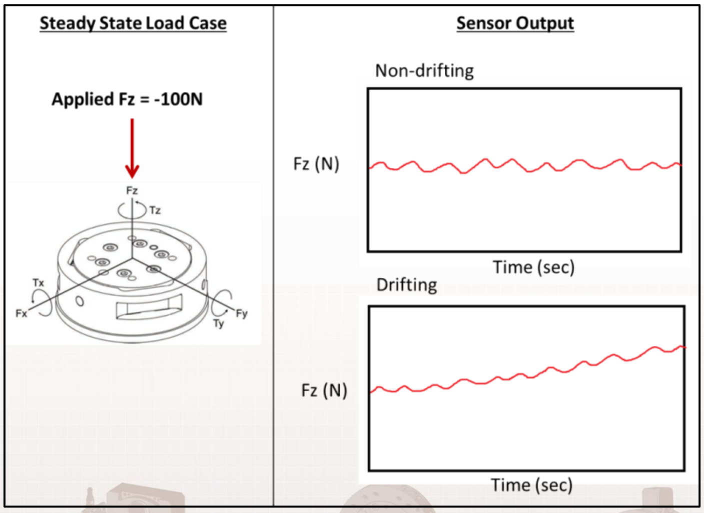


Figure: Example of a simple applied load and data comparison of drifting vs. non-drifting data.

3.3.2 How should I manage sensor output drift?

As is typical of strain-gaged instruments, output drift is normal over extended periods of time and should be expected. To reduce output drift, ensure the sensor's temperature is equalized and static – we recommend that the sensor be allowed to warm up for 30 to 45 minutes prior to use and also strongly encourage biasing the sensor before taking a measurement.

Customers should ideally bias/zero/tare the sensor before each task or measurement period. For example, if a customer is performing a periodic operation every 30-60 seconds, the sensor should be biased before each of these cycles / operations. Frequent biasing will reduce the effects of output drift that would otherwise influence measurements taken over extended periods of time.

When a Bias command is issued the current load level will be set as the new zero point. The Bias command does not stop drift – it removes the cumulative drift effect and brings the output back to zero to perform a measurement again. If the surrounding temperature gradients or conditions are causing the sensor to change temperature, drift will occur as a result. Bias the sensor as often as needed to reduce the effects of thermal drift.

For further information on sensor output drift, see the following document: https://www.ati-ia.com/Library/Documents/DriftExplanation.pdf

4 How do I use my Force/Torque Sensor System?

4.1 What is provided with my Force/Torque System?

Upon product shipment, ATI emails Force/Torque Sensor calibration files, product information, and manuals to the person who placed the order from ATI.

The "Manual and Calibration Files" email contains a link to download the specific manuals and software for all components of the system purchased. The same manuals and software can be downloaded directly from the ATI website. For sensors shipped or recalibrated after November 28, 2017, the calibration files can also be downloaded directly from the ATI website.

Manuals: http://www.ati-ia.com/products/ft/ft_literature.aspx

Software, including data files and demo programs: http://www.ati-ia.com/Library/download.aspx

Calibration Files: http://www.ati-ia.com/Library/Software/FTDigitaldownload/getcalfiles.aspx

See FAQ Section 4.3 regarding serialized calibration numbers.

4.2 Where is my calibration file?

The calibration files of each F/T System are sent in an email to the person who places the order upon shipment of the sensor.

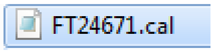
If your system was calibrated after November 28, 2017, its calibration files, including the calibration certificate and any necessary configuration files, can be downloaded from the following webpage:

https://www.ati-ia.com/Library/Software/FTDigitaldownload/getcalfiles.aspx

4.3 Do my F/T serial numbers have to match?

The F/T System components are calibrated together as a matched set, meaning all the FTxxxxx serial numbers must match to guarantee accuracy measurements. Note: F/T Systems with mismatched F/T serial numbers may appear to operate correctly, but will not give accurate measurements.

Matching examples are shown below.



Sensor Interface Box Calibration File

4.4 How do I obtain Force and Torque values in my specified units?

For Controller FT, Net FT, EtherCAT, Wireless FT interfaces, and Axia sensors, this calculation is done by the interface. For DAQ, NET CAN OEM, TWE, and Digital FT, there is a matrix calculation that must be processed in the user system.

For a DAQ system:

This is a matrix calculation using the 6x6 "User Axis" calibration matrix (second matrix) of the .cal file. You can open the .cal files with a text editor like Notepad.

Each data point will be 6 voltages [SG0 SG1 SG2 SG3 SG4 SG5](Volts). The [6x1] voltage vector must be processed using matrix math and the [Useraxis 6x6 calibration matrix] to provide the force and torque output vector [Fx Fy Fz Tx Ty Tz](Newtons, Newton-meters). The implementation looks like this:

[6x6][6x1]=[6x1]

[UserAxis6x6 calibration matrix][SG0 SG1 SG2 SG3 SG4 SG5] = [Fx Fy Fz Tx Ty Tz]

Taking a closer look at the matrix math,

Fx = SG0*constant0 + SG1*constant1 + SG2*constant2 + SG3*constant3 + SG4*constant4 + SG5*constant5

Fy = SG0*constant0 + SG1*constant1 + SG2*constant2 + SG3*constant3 + SG4*constant4 + SG5*constant5

.
.
.

Tz = SG0*constant0 + SG1*constant1 + SG2*constant2 + SG3*constant3 + SG4*constant4 + SG5*constant5

The "Manual Calibrations" spreadsheet can be used to double-check that the calculations are being performed correctly: http://www.ati-ia.com/library/software/daq_ft/DAQ%20FT%20Manual%20Calculations.zip
Load the calibration matrix using the "Load Calibration" button (Macros must be allowed).

For a NETCANOEM, TWE, or Digital F/T calculations, see appropriate manual.

Counts Explanation:

Divide the counts by the counts per force (CpF) and counts per torque (CpT).

All ATI digital systems (Controller FT, NET FT, EtherCAT, Wireless FT, Digital FT, Axia*) report the force and torque values as counts. The number of counts per force unit (CpF) and counts per torque unit (CpT) is specified by the calibration, and can be found in the calibration file. See the manual of your F/T interface for more details.

*For the Axia sensors, there is no calibration file. CpF and CpT = 1,000,000

4.4.1 What do the gage values mean?

There is not a 1 to 1 correlation between a gage output and measurement output. Gage 0 does not equal Fx, and Gage 1 does not equal Fy, etc. A calculation is required. All gage outputs are required to be processed through the calibration matrix to calculate the Force or Torque measurements.

With the sensor resting on a table and no load applied, check the gages to determine the health of the FT system. Acceptable gage limits are normally within ±1V for a DAQ F/T and within ±4000 counts for a 16-bit sensor system output, such as the NET F/T. If the gage outputs are approximately within these limits, the sensor is healthy. The figure below shows gage values for a healthy NET F/T with the Unbiased gage output within the ±4000 count limit.

Strain Gage Data

	G0	G1	G2	G3	G4	G5
Biased Gage Data:	619	317	334	716	-39	332
Unbiased Gage Data:	-750	-407	307	9	-257	327

Range: -32768 to +32767

Unbiased Gage Data shows values within ±4000 counts

4.4.2 Why are the initial Force/Torque values non-zero with no load applied?

At the initial power up of the F/T system with it resting on a table, the sensor may output a non-zero F/T measurement. This is normal because the sensor has not been given any specific commands and the system is in an undetermined state. The Figure below shows a healthy sensor at power up with non-zero F/T measurements based on the gages being healthy as well.

Also, Force/Torque sensors inherently drift upon power-up. Until the sensor has warmed up and its temperature is equalized, the outputs will drift. You must allow for 30-45 minutes for the sensor to warm up. See FAQ Section 3.3 on Drift.

Transducer Loading Snapshot (User Units):

	Fx	Fy	Fz	Tx	Ty	Tz
Force/Torque Data:	-1.569	-1.034	6.6126	0.0923	0.1409	0.1772

Example of Gamma sensor output prior to initial Bias command

4.5 How do I evaluate the accuracy or health of the sensor?

<u>To bench test your sensor after unboxing:</u>

Step 1 – Follow instructions in the manual to establish basic communications with sensor. For the most common systems, you can use an ATI-provided Demo software.

Step 2 -- With the sensor resting on a flat surface, MAP down, place a piece of insulating material, such as cardboard or nylon on the sensor TAP (Tool Adaptor Plate). Note: If a weight is applied directly to the sensor TAP, drift may be seen in the sensor output (See FAQ Section 3.3 regarding drift).

Step 3 – Allow sensor to warm up to a steady-state temperature, approximately 30-45 minutes.

Step 4 – Bias/Tare/Zero the sensor.

Step 5 – Place a known mass at least 20% of full-scale measurement range on top of the insulator, and compare output to the applied known load. See FAQ Section 2.2 on measurement uncertainty.

Step 6 – Bias/Tare the sensor again. Notice that all values are zeroed.

Step 7 – Remove the known load. Notice that the Fz now shows a positive value because the sensor was biased with a load applied.

4.6 Why do my Force and Torque readings not make sense?

If using a digital system, you may be looking at the counts, instead of in units such as Newtons or Pounds. See FAQ Section 4.4, "How do I obtain Force and Torque values in my specified units?".

If you have already converted to units of force and torque, and the values still seem extremely high or nonsensical, check to make sure that you are not in a Saturation, Gage Out of Range, or Force/Torque Out of Range condition. If you exceed the calibration range, the readings will be incorrect. See FAQ Section 2.1.