Commissioning instructions
FTN-AXIA
Force/torque sensor system

Superior Clamping and Gripping

SCHUNK®

Imprint

Technical changes:

We reserve the right to make alterations for the purpose of technical improvement.

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Dear Customer,

Thank you for trusting our products and our family-owned company, the leading technology supplier of robots and production machines.

Our team is always available to answer any questions on this product and other solutions. Ask us questions and challenge us. We will find a solution!

Best regards,

Your SCHUNK team

Customer Management

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Fax +49-7133-103-2189

cmg@de.schunk.com

Please read the operating manual in full and keep it close to the product.

Table of Contents

1 General

1.1 About this manual

This manual contains important information for a safe and appropriate use of the product.

This manual is an integral part of the product and must be kept accessible for the personnel at all times.

Before starting work, the personnel must have read and understood this operating manual. Prerequisite for safe working is the observance of all safety instructions in this manual.

In addition to these instructions, the documents listed under ▸ 1.1.2 [🗋 6] are applicable.

NOTE: The illustrations in this manual are intended to provide a basic understanding and may deviate from the actual version.

1.1.1 Presentation of Warning Labels

To make risks clear, the following signal words and symbols are used for safety notes.

⚠ DANGER

Dangers for persons!

Non-observance will inevitably cause irreversible injury or death.

⚠ WARNING

Dangers for persons!

Non-observance can lead to irreversible injury and even death.

⚠ CAUTION

Dangers for persons!

Non-observance can cause minor injuries.

NOTICE

Material damage!

Information about avoiding material damage.

1.1.2 Applicable documents

- General terms of business *
- Catalog data sheet of the purchased product *
- Assembly and operating manual of the sensor *

The documents labeled with an asterisk (*) can be downloaded from **schunk.com**.

1.2 Warranty

If the product is used as intended, the warranty is valid for 12 months from the ex-works delivery date under the following conditions:

- Observe the ambient conditions and operating conditions

Parts touching the workpiece and wear parts are not included in the warranty.

1.3 Scope of delivery

The scope of delivery includes

- FTN-AXIA force/torque sensor in the ordered variant
- Sensor cablein the version ordered
- Control line
- Commissioning instructions

2 Basic safety notes

2.1 Intended use

The product is a machine component designed for measuring forces and torques (FT) in six directions. Forces acting mechanically are converted by the product to electrical measured values and transferred to a PC via Ethernet protocol.

2.2 Inappropriate use

The product is not a safety component in accordance with the EC Machine Directive 2006/42/EC and must not be used in safety-relevant parts of machine control units.

2.3 Constructional changes

Implementation of structural changes

By conversions, changes, and reworking, e.g. additional threads, holes, or safety devices can impair the functioning or safety of the product or damage it.

- Structural changes should only be made with the written approval of SCHUNK.

2.4 Spare parts

Use of unauthorized spare parts

Using unauthorized spare parts can endanger personnel and damage the product or cause it to malfunction.

- Use only original spare parts or spares authorized by SCHUNK.

2.5 Personnel qualification

Inadequate qualifications of the personnel

If the personnel working with the product is not sufficiently qualified, the result may be serious injuries and significant property damage.

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

2.6 Disposal

Handling of disposal

The incorrect handling of disposal may impair the product's safety and cause serious injuries as well as considerable material and environmental harm.

- Follow local regulations on dispatching product components for recycling or proper disposal.

2.7 Notes on particular risks

⚠ DANGER

Danger from electric voltage!

Touching live parts may result in death.

- Switch off the power supply before any assembly, adjustment or maintenance work and secure against being switched on again.
- Only qualified electricians may perform electrical installations.
- Check if de-energized, ground it and hot-wire.
- Cover live parts.

⚠ WARNING

Risk of injury due to unexpected movements!

If the power supply is switched on or residual energy remains in the system, components can move unexpectedly and cause serious injuries.

- Before starting any work on the product: Switch off the power supply and secure against restarting.
- Make sure, that no residual energy remains in the system.

NOTICE

Risk of damage to the sensor!

If the single-axis overload values of the sensor are exceeded, irreparable damage will occur.

- Do not overload the sensor.

NOTICE

Material damage due to incorrect grounding!

Damage to the sensor due to electrostatic discharge possible.

- Make sure that all components are properly grounded.

3 Technical data

3.1 Ambient conditions and operating conditions

Ambient and operating conditions for sensor cable

Designation	Sensor cable
during operation min. max.	 -5 70
Protection class IP	64

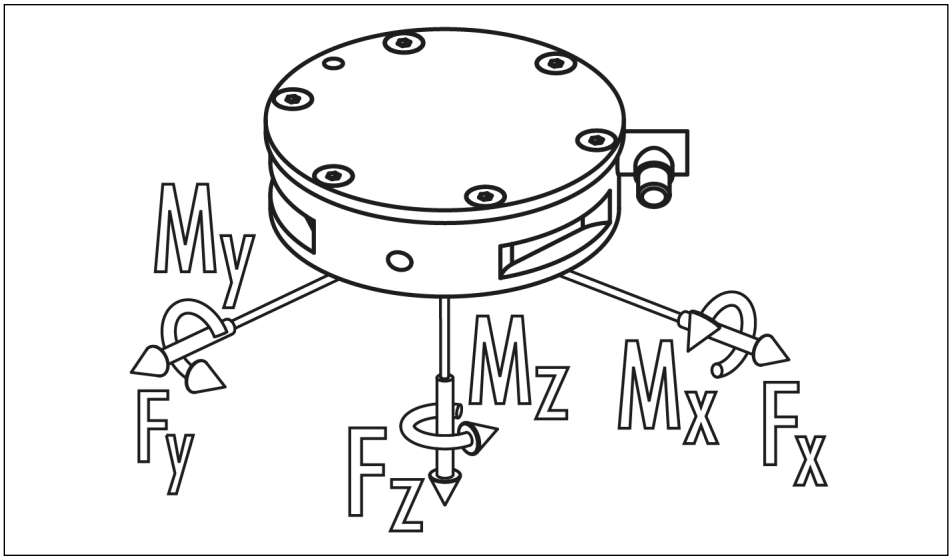
The catalog data sheet contains more information.

3.2 Force-torque sensor

NOTE

All forces and torques acting on the sensor must be within the specified range of measurement. Exceeding the range of measurement will reduce the maximum number of load cycles and may lead to damage of the sensor.

Information on the range of measurement of each individual force-torque sensor is provided in the catalog data sheet. The latest version is always applicable.

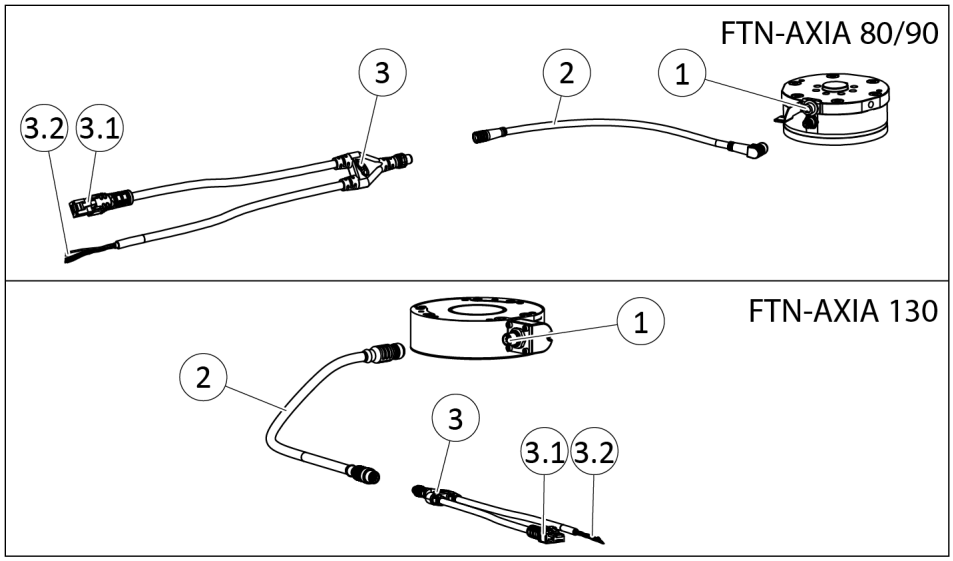


Dimensions and max. loads on the force-torque sensor

Detailed information on the mounting, installation and maintenance of the sensor is provided in the Assembly and Operating Manual for the sensor, ▶ 1.1.2 [🗋 6].

4 Design and description

4.1 Structure



1	Sensor cable connection	
2	Sensor cable	Power and EtherNET cable to the sensor
3		Power and EtherNET cable to the customer's control system
3.1	RJ45 connection for EtherNET	
3.2	Non-terminated end for voltage supply	

4.2 Description

The force/torque sensor is connected to the system via EtherNET/IP.

Application

- Forces and torques are measured via three measuring bridges, each with four silicone strain gauges in six directions (F_X / F_Y / F_Z / M_X / M_Y / M_Z)
- Acting forces and torques are measured and transferred to a PC as calibrated data.
- Interfering contours are avoided due to the compact housing.
- A very high rigidity ensures the accuracy of measured values and prevents unwanted movement or twisting of the sensor.
- Individual vibration damping due to programmable low-pass filter with limit frequency.
- Dust and splash water protection enable flexible use.

4.3 Status LEDs

LED self-test sequence

The force/torque sensor has three LEDs: Link/Activity, Diag, and Sensor Status.

When the power supply is switched on, the sensor performs a self-test, during which the LEDs switch on individually as part of the firmware control.

Sequence order	LED	Status	Duration
0	All	When switching on, transient activity may be observed for only a few milliseconds.	
1	All	Off	Approx. one second for each LED.
2	Status	Red	
3	Diag	Red	
4	Link/Activity	Red	
5	Status	Green	
6	Diag	Green	
7	Link/Activity	Green	
8	All	Off	
9	All	Normal operation	

Sensor status LED

An LED indicates the status of the sensor interface as follows:

LED color	Status	Description
Off	No power supply	The sensor is not supplied with power.
Green	Normal operation	The electronics of the sensor are working and can communicate.
Yellow	Detection range exceeded	The forces and torques applied to the sensor exceed the permitted ranges. Reduce load or use larger calibration.
Red (flashing at 1 Hz)	Calibration error	The sensor does not refer to a calibration range or has a checksum error.
Red (flashing at 10 Hz)	Communication error	The sensor is not able to transmit data via the communication protocol.
Red	Status code error	Information about the error record,Object 0x6010: Status Code [🗋 67].

Diag LED

An LED indicates the diagnostic status of the sensor interface as follows:

LED color	Status	Description
Flashes green	Before operation	Defined by the communication/protocol standard.
Green	Ready for operation	No errors were found.
Red	Error	Indicates an error reported by the internal electronic components. In addition, the LED remains red for five seconds after a UART error.

EtherNET L/A LED

An LED indicates the communication status of the sensor interface as follows:

LED color	Status	Description
Off	No power or connection activity	Connection/activity is not detected.
Green	Link/Activity	Remains green for five seconds after every connection activity.

5 Assembly and settings

5.1 Installing and connecting

⚠ DANGER

Danger from electric voltage!

Touching live parts may result in death.

- Switch off the power supply before any assembly, adjustment or maintenance work and secure against being switched on again.
- Only qualified electricians may perform electrical installations.
- Check if de-energized, ground it and hot-wire.
- Cover live parts.

NOTICE

Risk of damage to the electronics!

A faulty connection can cause damage to the internal electronics.

- Observe the PIN allocation of the connecting terminals.
- Make sure that all components are grounded correctly.

1. Connect components of the force-torque sensor system with each other, ▶ 5.2 [🗋 14].
2. Check for functionality.
3. Mount the force-torque sensor on the robot, see the installation and operating instructions for the sensor.

5.2 Electrical connection

Power supply requirements

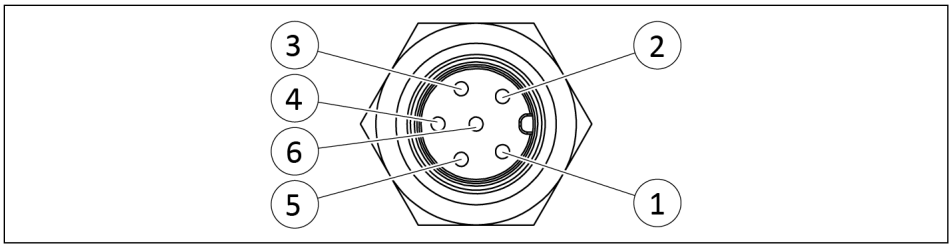
Designation	Sensor
Supply voltage [VDC]	12-30
Max. Power consumption [W]	1.5

Designation	Sensor cable
Nominal voltage [V]	> 30
Nominal power current [A]	> 0.25

5.2.1 Pin allocation

Sensor connections

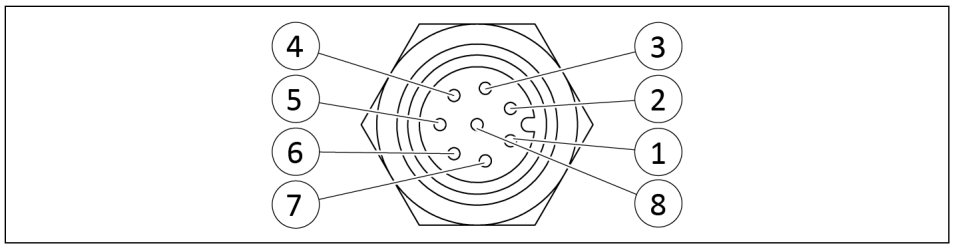
FT-AXIA 80



M8 sensor connector, 6-pin

Pin	Signal
1	TX+
2	TX-
3	RX+
4	RX-
5	V+
6	V- / 0V / Ground
Housing	Shielding

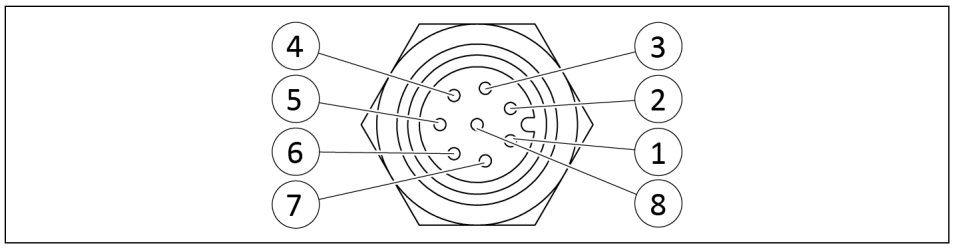
FT-AXIA 90



M8 sensor connector, 8-pin

Pin	Signal
1	Reserved
2	V+
3	V- / 0V / Ground
4	TX-
5	RX+
6	TX+
7	Reserved
8	RX-
Housing	Shielding

FT-AXIA 130

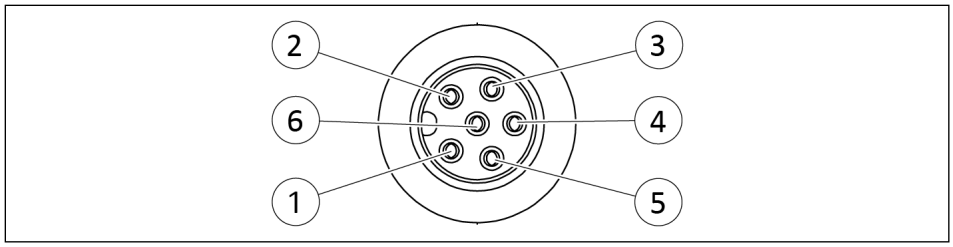


M12 sensor connector, 8-pin

Pin	Signal
1	Reserved
2	V+
3	V- / 0V / Ground
4	TX-
5	RX+
6	X+
7	Reserved
8	RX-
Housing	Shielding

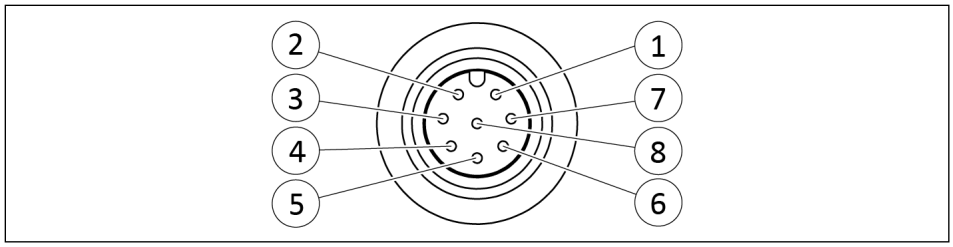
Sensor cable connections

FT-AXIA 80



M8 socket, 6-pin

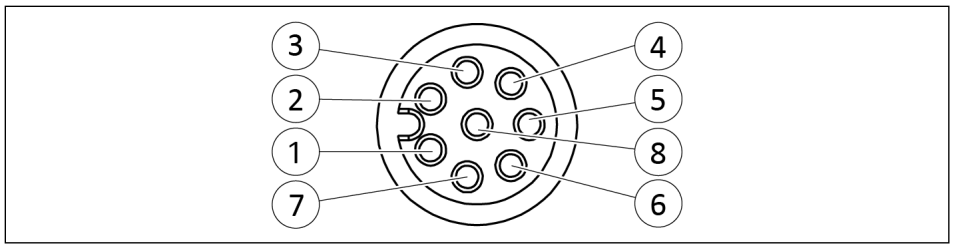
Pin	Signal
1	TX+
2	TX-
3	RX+
4	RX-
5	V+
6	V- / 0V / Ground
Housing	Shielding



M12 connector, 8-pin

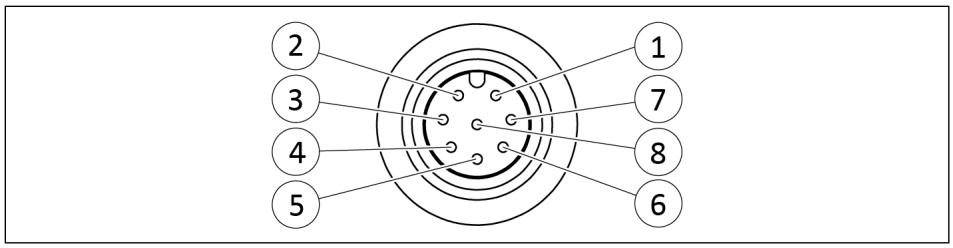
Pin	Signal
1	Reserved
2	V+
3	V- / 0V / Ground
4	TX-
5	RX+
6	TX+
7	Reserved
8	RX-
Housing	Shielding

FT-AXIA 80/90



M8 socket, 8-pin

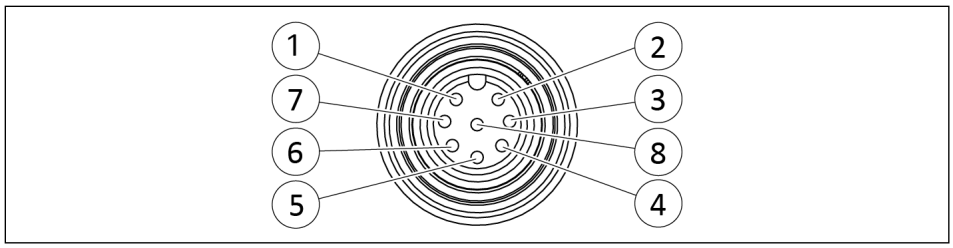
Pin	Signal
1	Reserved
2	V+
3	V- / 0V / Ground
4	TX-
5	RX+
6	TX+
7	Reserved
8	RX-
Housing	Shielding



M12 connector, 8-pin

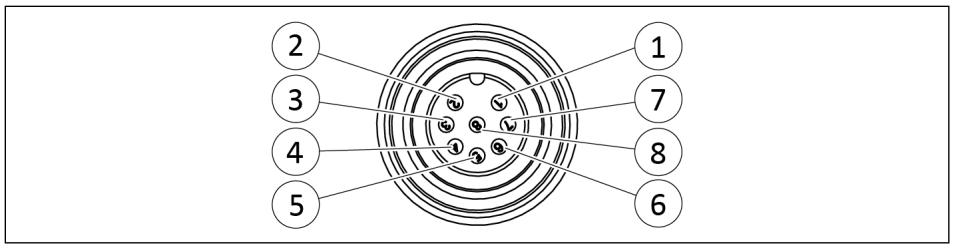
Pin	Signal
1	Reserved
2	V+
3	V- / 0V / Ground
4	TX-
5	RX+
6	TX+
7	Reserved
8	RX-
Housing	Shielding

FT-AXIA 130



M12 socket, 8-pin

Pin	Signal
1	Reserved
2	V+
3	V- / 0V / Ground
4	TX-
5	RX+
6	TX+
7	Reserved
8	RX-
Housing	Shielding



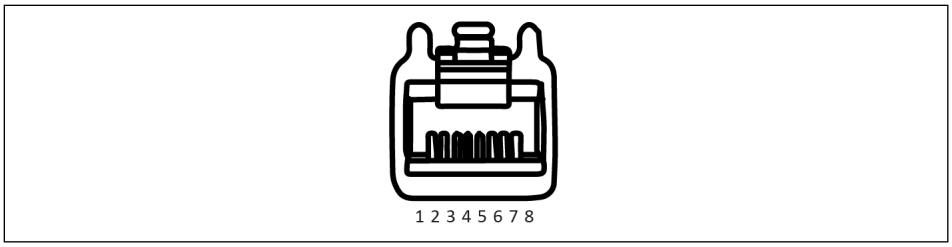
M12 connector, 8-pin

Pin	Signal
1	Reserved
2	V+
3	V- / 0V / Ground
4	TX-
5	RX+
6	TX+
7	Reserved
8	RX-
Housing	Shielding

Non-terminated end

EtherNET cable

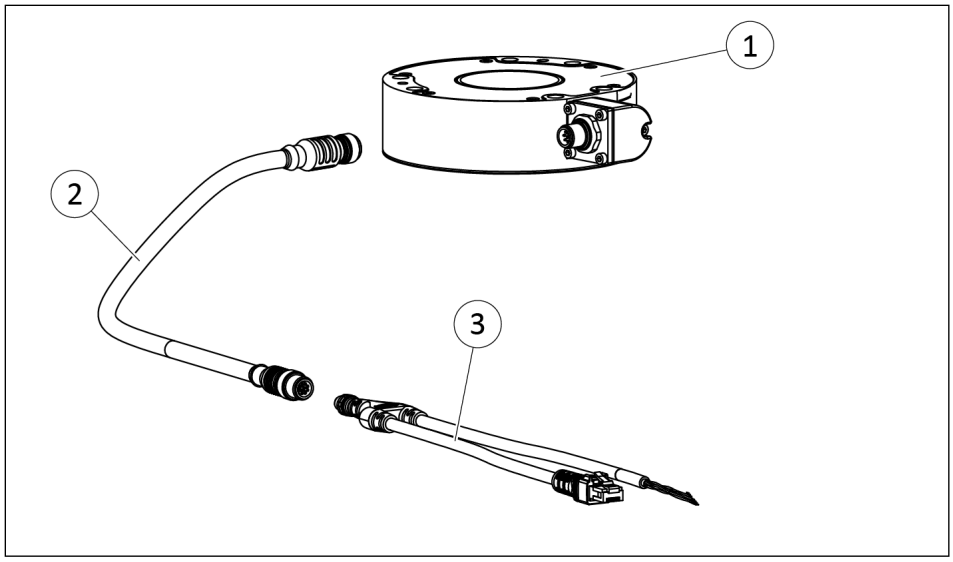
Wire sheath color	Signal
Braided metal shielding	Shielding (connect to ground)
Brown	V+
Brown/White	V- / 0V / Ground
Blue/White (TP1+)	Reserved
Blue (TP1-)	Reserved



EtherNET connector, RJ45, 8-pin, socket

Pin	Color	Signal
1	White/Orange	TX+
2	Orange	TX-
3	White/Green	RX+
4	-	-
5	-	
6	Green	RX-
7	-	-
8	-	

5.2.2 Connecting the force/torque sensor



Connecting the force/torque sensor (shown on FT-AXIA130 as an example)

1. Connect the supplied sensor cable (2) to the force/torque sensor (1).
2. Connect the supplied control line (3) to the sensor cable (2).
3. Connect the control line (3) to the customer's control system.

6 Start-up

6.1 Establishing an Ethernet/IP connection

For a sensor to be connected via Ethernet, the user must configure the IP address setting of the sensor. The sensor can be connected via Ethernet with one of the following options:

6.1.1 Configuration of the IP address for Ethernet

NOTE

The Force/torque sensor system FTN-AXIA is shipped with DHCP enabled and the static IP address set to 192.168.1.1. The static IP address is automatically used if the customer network does not support DHCP.

Switch sensor off and on again to apply new IP address settings. New IP address settings are only loaded when switching on.

- **Variant 1**: Set a static IP address in the FTN-AXIAsettings via the web browser interface.
- **Variant 2**: Use DHCP server to perform IP address assignment.

6.1.2 Connect to a Windows computer

NOTE

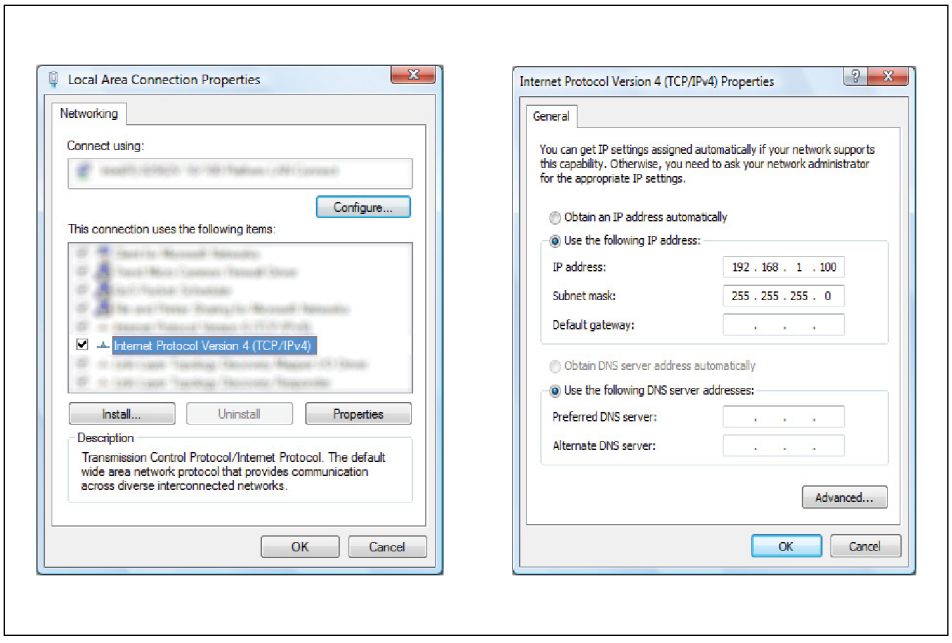
Before configuring the Ethernet via the web browser interface, initially set the network setting on the PC once.

NOTE

If the static IP address of the sensor has been changed and is no longer set to the default value, the Ethernet adapter of the computer must be set to a static IP address with the same first three fields as the new IP address of the sensor. As an example, 192.168.1.100 works when the sensor uses the default IP address 192.168.1.1.

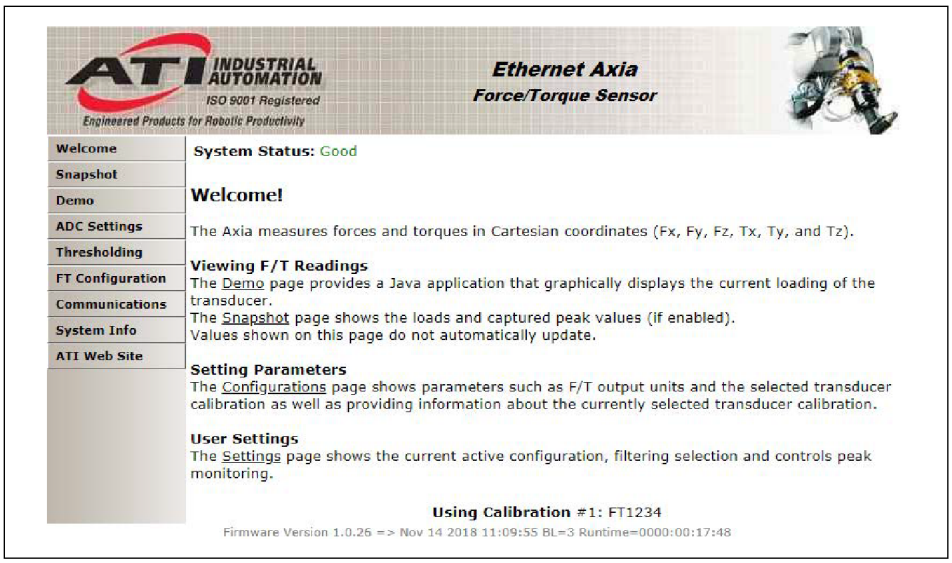
For the initial connection, connect the computer directly to the sensor and disconnect it from the LAN.

1. Disconnect the EtherNet cable from the LAN port on the computer.
2. In the computer settings under "Network & Internet" open the "Local Area Connection Properties".



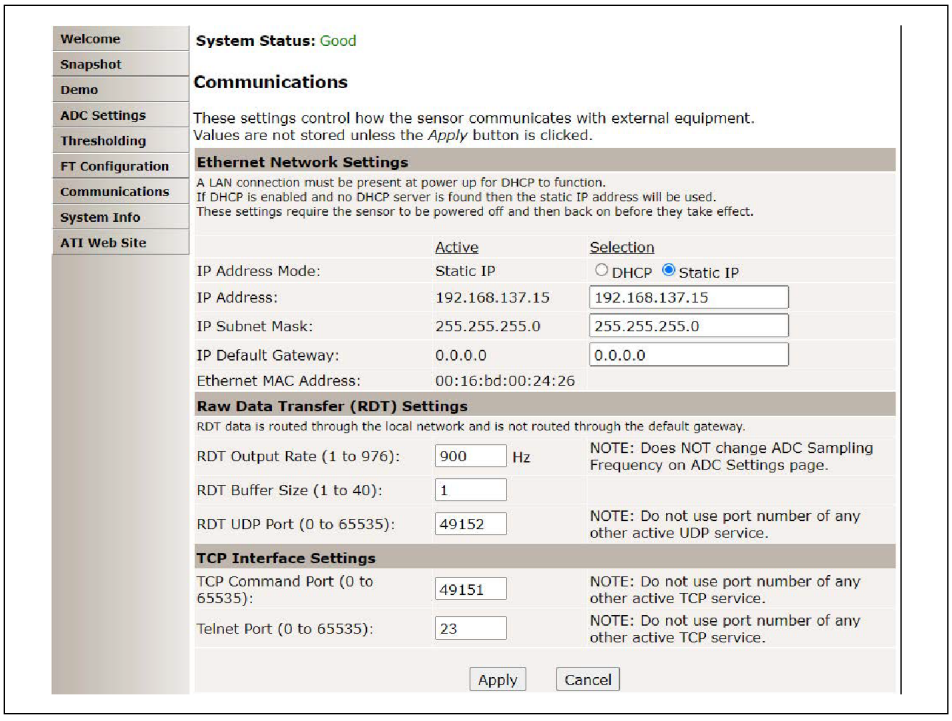
3. Click "Internet Protocol Version 4 (TCP/IPv4)" and click "Properties".
4. Select the "Use the following IP address" option.
5. Enter 192.168.1.100 in the "IP address" field. Enter 255.255.255.0 in the "Subnet mask" field.
6. Click "OK" and close the computer settings.
7. Connect the EtherNet cable to the LAN port on the computer.
   ✓ The computer recognizes the connection.

8. Enter the address "192.168.1.1" in the browser.
   ✓ The welcome page is displayed.



Welcome page of the web browser interface

9. Click on "Communications".



Communications Page

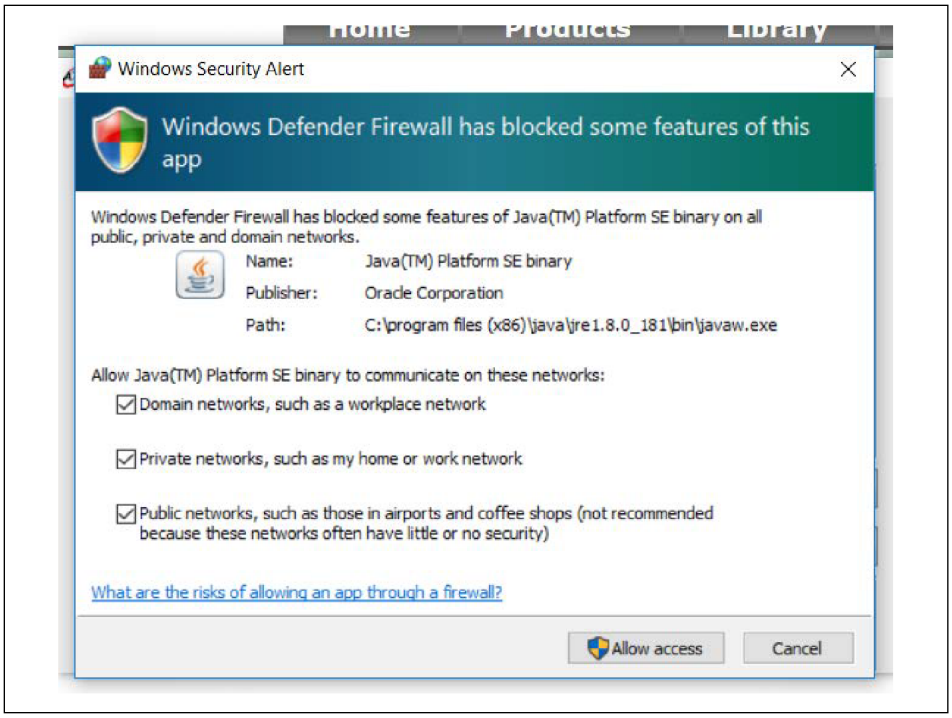
10. Select IP address mode:
    - Static IP address: Enter appropriate values for the IP address, subnet mask, and default gateway and click the "Apply" button. Switch the sensor off and on again.
    - DHCP: First click on the "Enabled" radio button and then on the "Apply" button. Switch the sensor on. If the sensor does not receive an IP address within 30 seconds of switching on, the sensor will use the static IP settings by default.
    IMPORTANT! IP addresses assigned by a DHCP server are not permanent and may change if the sensor is disconnected from the network for a period of time. Static IP addresses are more convenient for permanent applications because the IP address does not change.

11. Open the TCP/IP properties of the computer's local connection.
    - If the sensor was set to DHCP, restore settings as before the reconfiguration.
    - If the sensor was set to a static IP address, change settings to an IP address in the same local subnet as the sensor.
12. Enter the IP address of the sensor in the address bar of the browser.
    ✓ The welcome page is displayed again.
13. Communication with the sensor via the network without having to reconfigure the communication settings.

6.1.3 Find sensor in the network

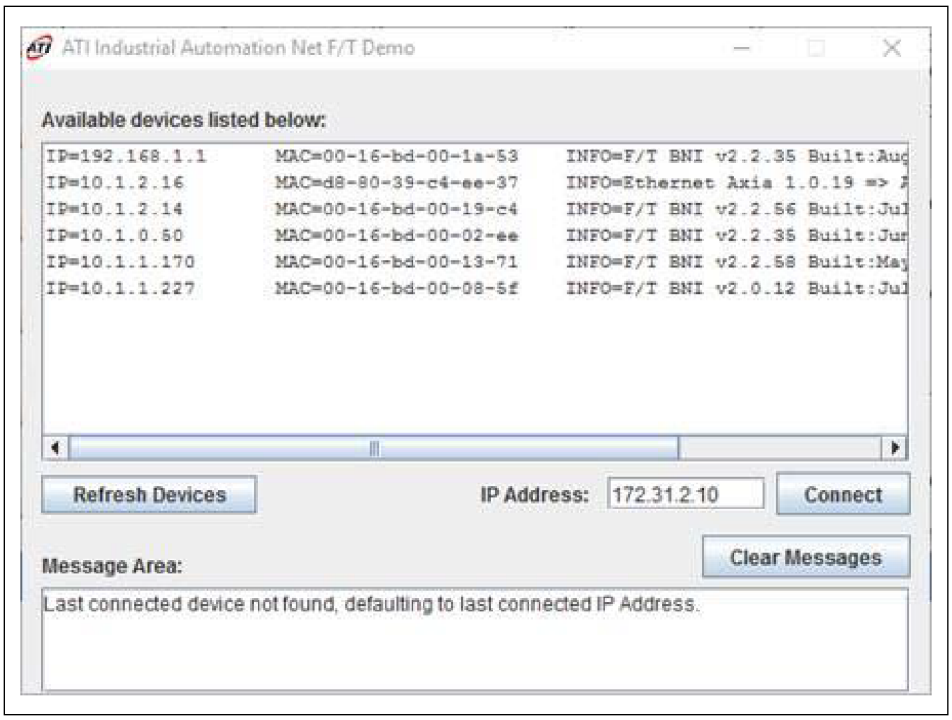
To find the IP address assigned to an Ethernet sensor by the DHCP server, proceed as follows:

1. Download ATI NET F/T Demo, ATI F/T Data Viewer or the ATI Discovery Tool from the ATI website: https://www.ati-ia.com/Products/ft/software/axia_software.aspx.
   IMPORTANT! When this ATI Discovery Tool is downloaded for the first time, the program may trigger a firewall warning. Click on the "Allow access" button to allow communication with the sensor.



Firewall alert

2. The Discovery Tool opens in a window and scans the network for available devices. The scan takes a few minutes. Ensure that the MAC address on the label of the sensor matches the MAC address displayed.
3. This IP address, which is assigned to the sensor's MAC address by the DHCP server, is used for communication between the sensor and the network.
4. Select this IP address and click on "Connect".



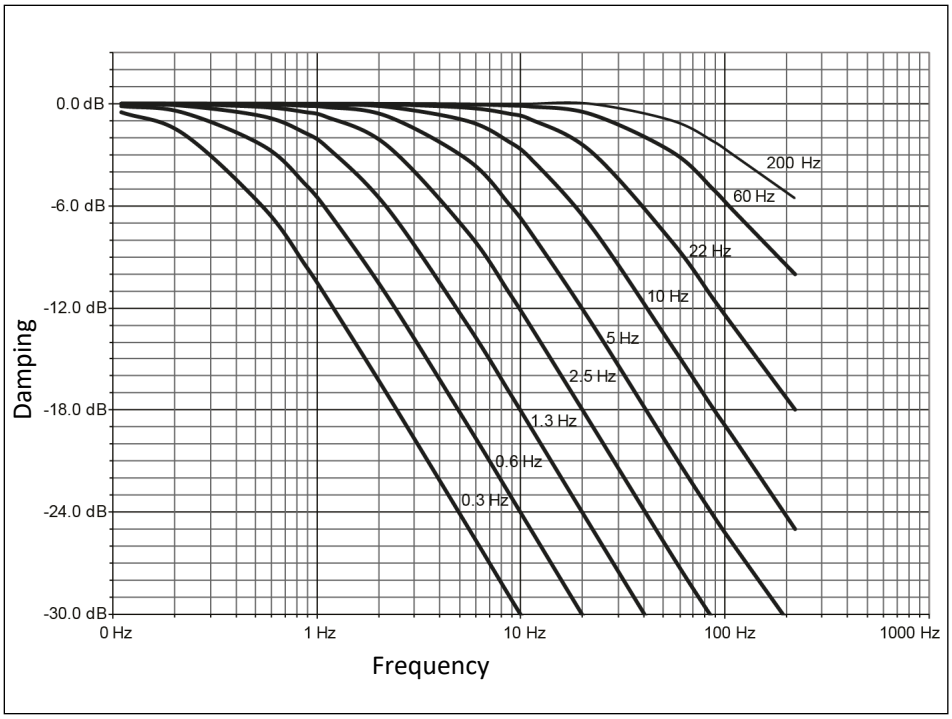
Discovery Tool

6.2 Low-pass filter

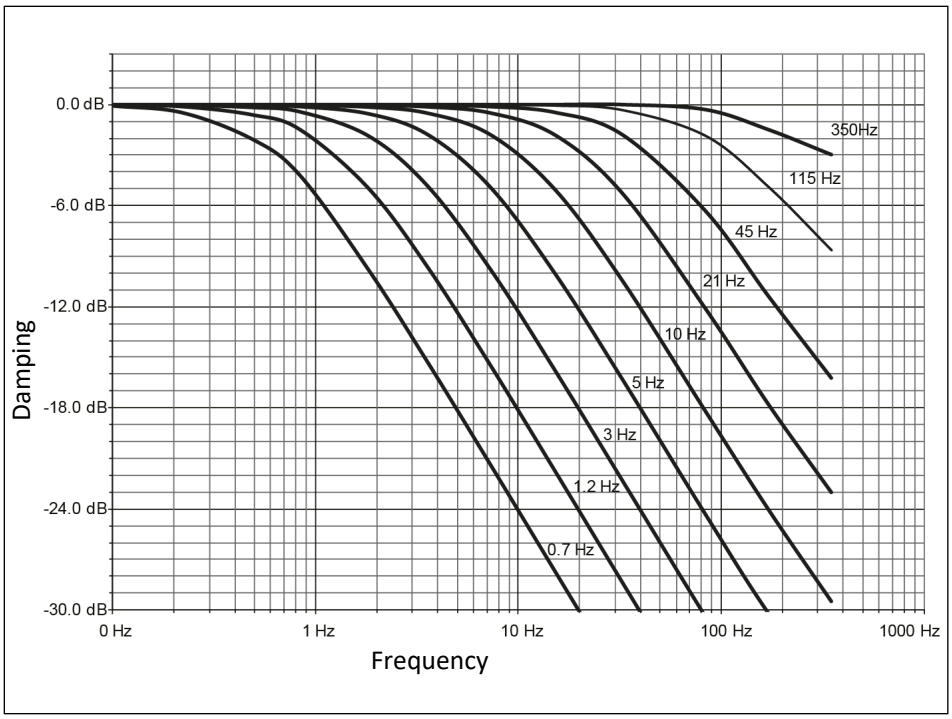
The switch-on option is "no filtering" as standard. The filter setting can be configured to reduce signal noise.

The limit frequency depends on the selected sampling rate, which is listed in the following table. The limit frequencies for the different sampling rates are listed in the following table and diagrams:

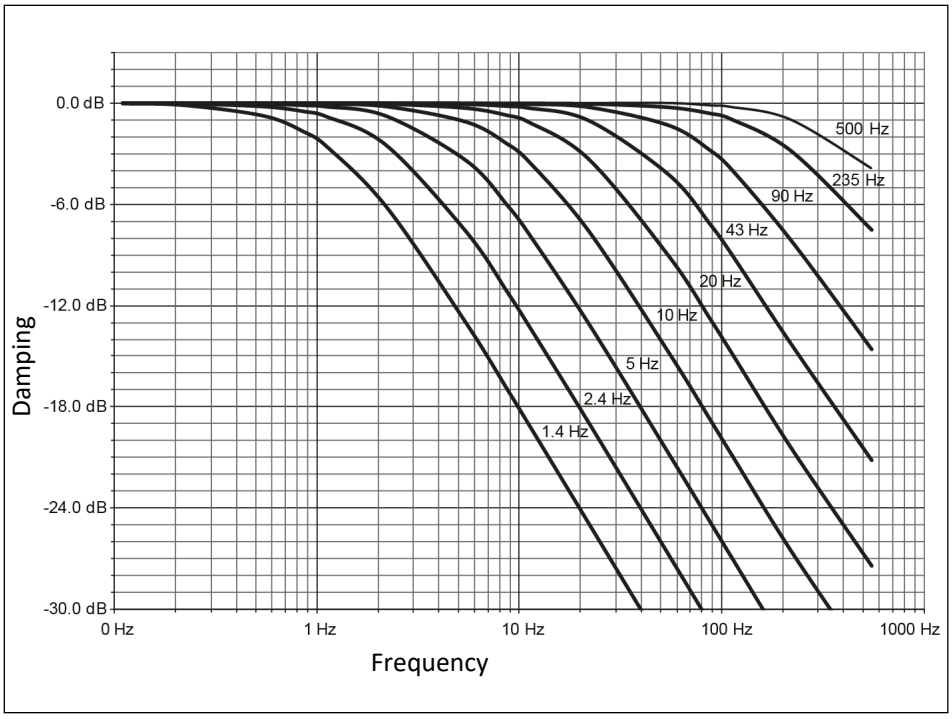
Selected filter	-3-dB cutoff frequency (in Hz)				
	at 0.5 kHz sampling rate	at 1 kHz sampling rate	at 2 kHz sampling rate	at 4 kHz sampling rate	at 8 kHz sampling rate
0	200	350	500	1000	2000
1	58	115	235	460	935
2	22	45	90	180	364
3	10	21	43	84	170
4	5	10	20	40	81
5	2.5	5	10	20	40
6	1.3	3	5	10	20
7	0.6	1.2	2.4	4.7	9
8	0.3	0.7	1.4	2.7	5



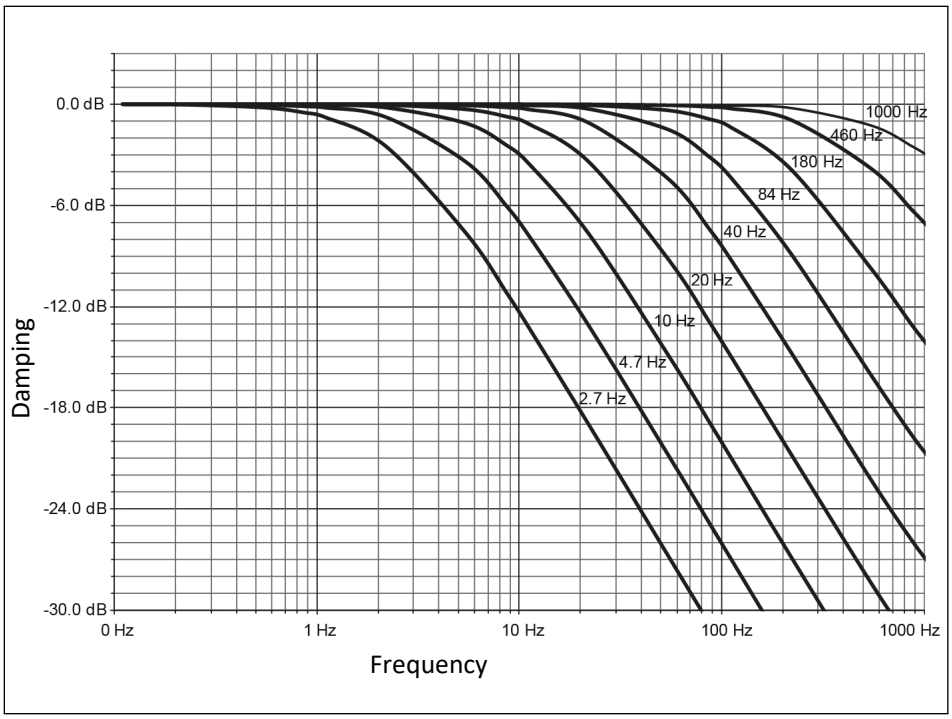
Filter damping at 0.5 kHz sampling rate



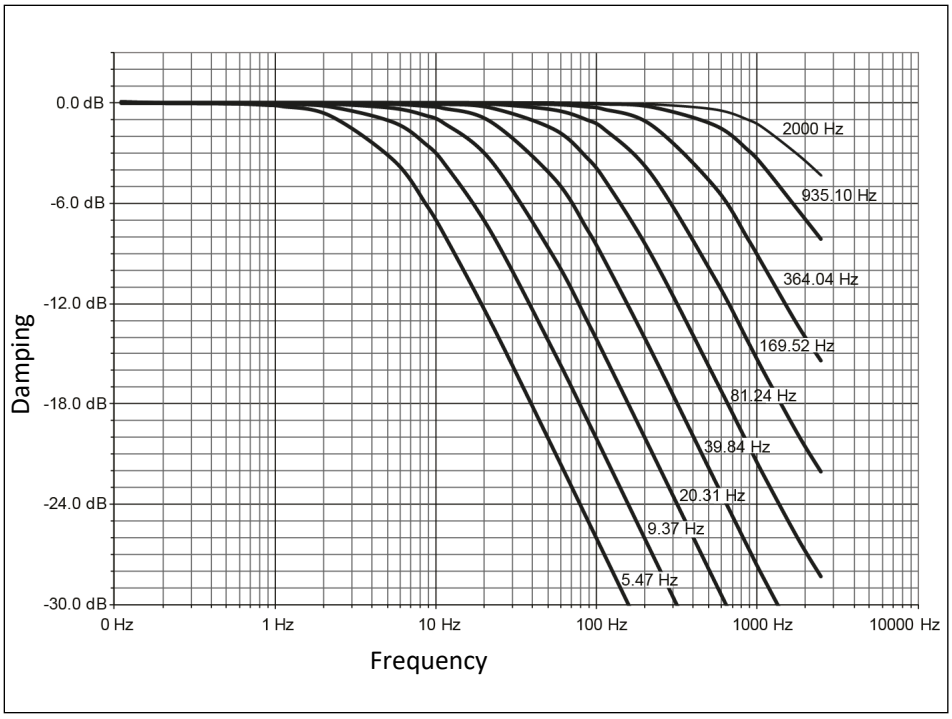
Filter damping at 1 kHz sampling rate



Filter damping at 2 kHz sampling rate



Filter damping at 4 kHz sampling rate



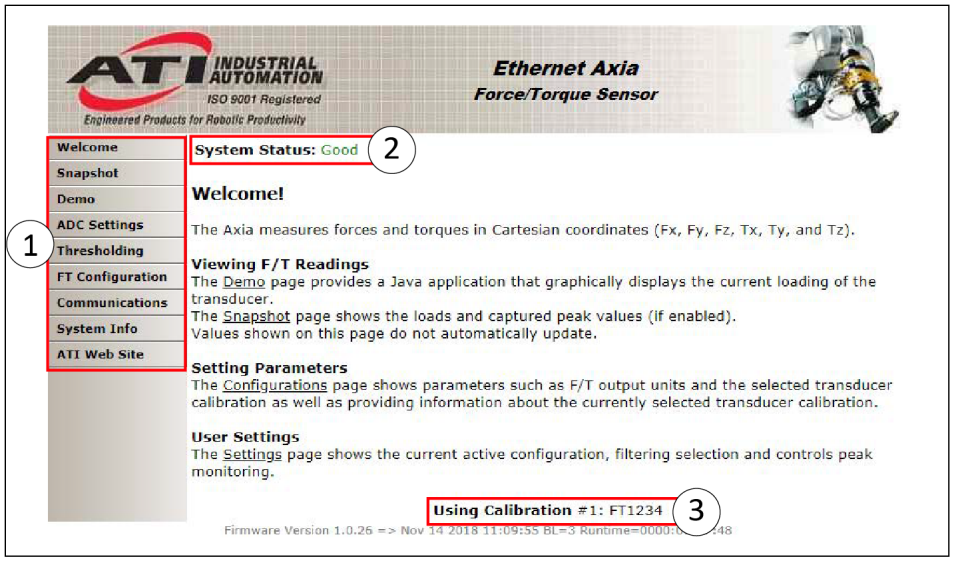
Filter damping at 8 kHz sampling rate

6.3 Web browser interface

The web browser interface provides all configuration options for the FTN-AXIA force/torque sensor system.

Welcome Page

Enter the IP address of the sensor system in the web browser. The Welcome Page (index.htm) opens.

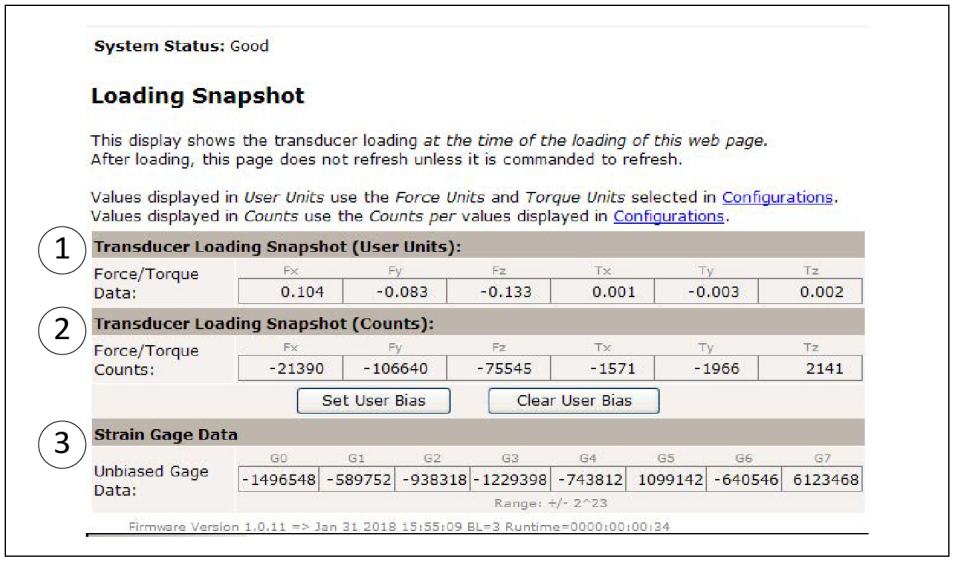


Welcome Page of the web browser interface

1. Open various subtopics via the navigation bar on the left (1).
   ✓ The status (2) of the FTN-AXIA force/torque sensor system is shown at the top of the page. It always shows the status at the time the page was opened.
2. Refresh the page to display the current status.
   ✓ The current configuration and the calibration (3) used are displayed at the bottom of the page.

Snapshot Page

This page displays the current sensor load conditions. The information on the Snapshot page is static and is updated as soon as the user loads or refreshes the page.



Snapshot Page

Item	Field	Description
1	Force/Torque Data	Displays the force and torque data in the units selected on the Configuration page. When strain gages are saturated, these values are invalid and are displayed in red and crossed out.
2	Force/Torque Counts	Displays the force and torque data scaled with the count values per force and count values per torque displayed on the "Configurations page".
3	Unbiased Gage Data	Displays strain gage raw data for easy troubleshooting. Saturated values are displayed in red.**IMPORTANT! The measured values of the FT-AXIA sensor on this page are recorded when the page requests them. It is possible that the measured values at the bottom of the page are from later FT datasets than the values at the top. The displayed values are invalid in the event of saturation errors. The individual strain gage values do not correspond to the individual force and torque axes.**

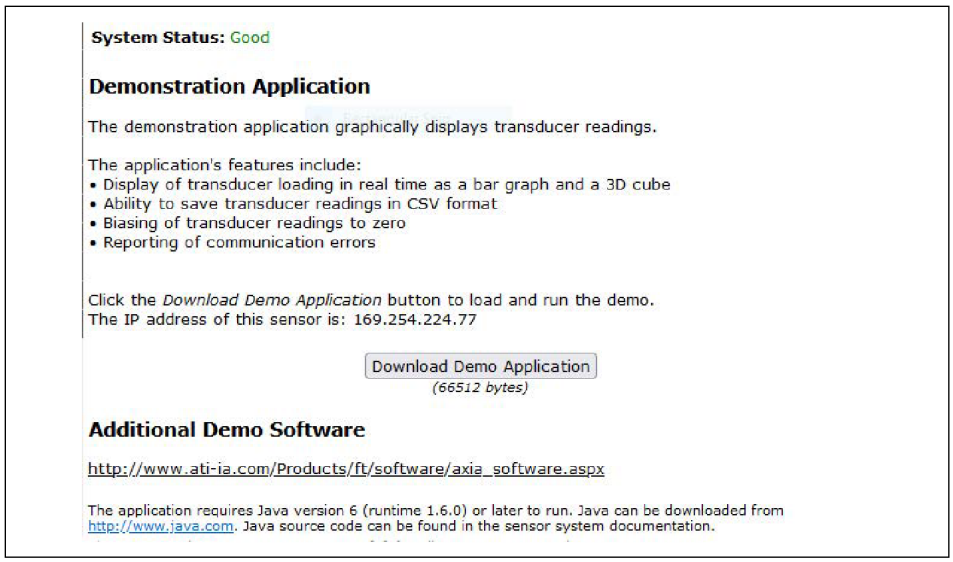
NOTE

If an overload condition occurs, the reported force and torque values are invalid.

Individual strain gage values do not correspond to the individual force and torque axes.

Demo Page

From this website, the user can download the Java® demo application and additional demo software.



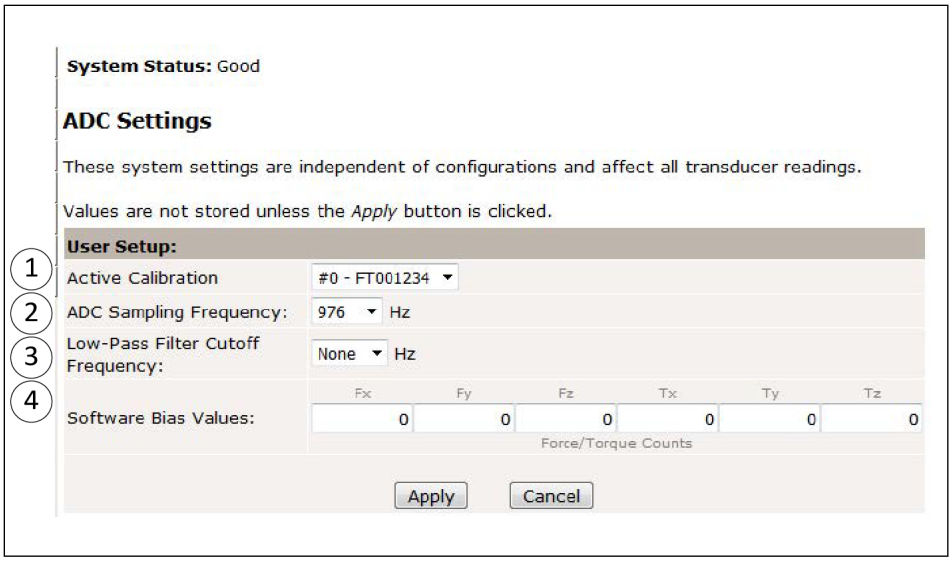
Demo Page

ADC Settings Page

On the ADC Settings page, the user can select the following:

Item	Field	Description
1	Active Calibration	The user can select a calibration range to be applied to the force and torque measured values.
2	ADC Sampling Frequency:	The user can select the sampling frequency for low-pass filtering.
3	Low-Pass Filter Cutoff Frequency	The user can select a value for the limit frequency for low-pass filtering. The "No Filter" value: The filter value disables the low-pass filter function.
4	Software Bias Values	The user can enter values for the bias offset applied to the sensor expansion measured values. To remove the bias offset, set the fields to all zeros. **IMPORTANT! Strain gage measured values do not correspond 1:1 to force and torque measured values.**

When a user clicks the "Apply" button, the changes are adopted in the sensor.



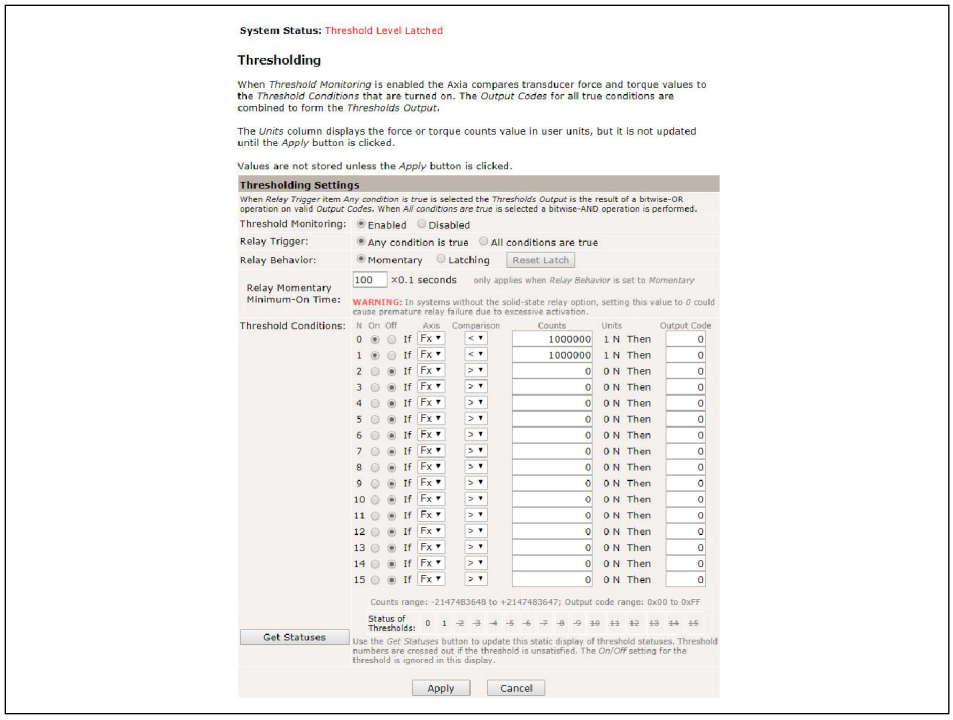
ADC Settings Page

Thresholding Page

The threshold monitoring compares the currently measured forces and torques with user-defined thresholds and issues a message when the thresholds are reached. The output of the threshold monitoring is displayed on the Snapshot page.

If one of the set thresholds is reached, the following happens:

- The output of the threshold monitoring is updated.
- Bit 16 of the status code becomes "true".



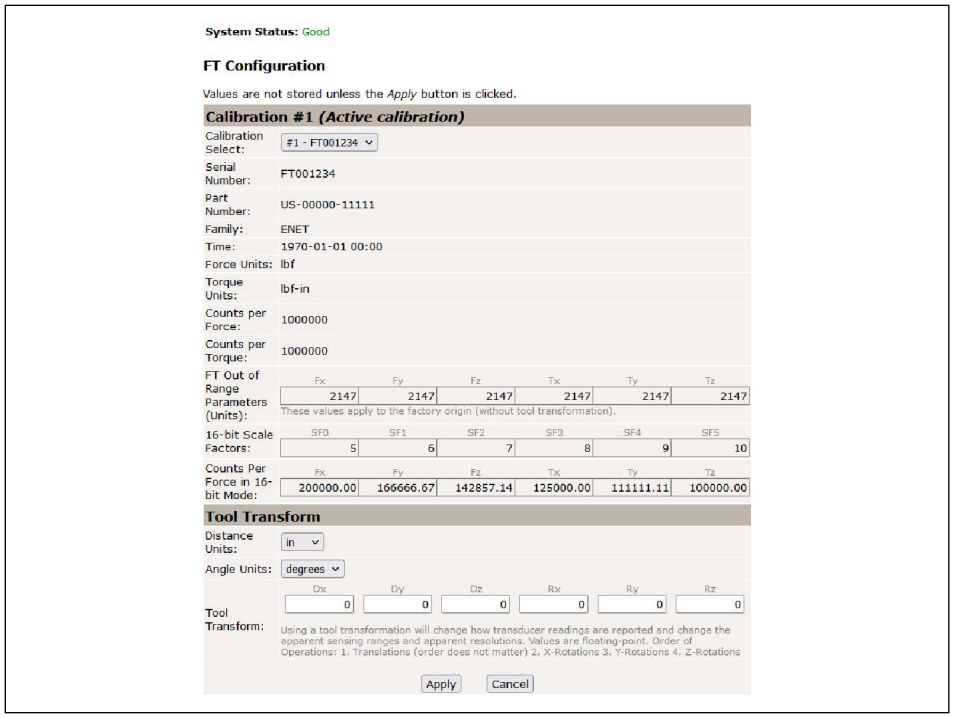
Threshold conditions

Table column	Description	Comment
N	Statement number	
On/Off	Selects which statements are included when processing threshold conditions.	
Axis	Selects the axis to be used in the comparison statement.	empty = statement disabled Fx = Fx-axis Fy = Fy-axis Fz = Fz-axis Tx = Tx-axis Ty = Ty-axis Tz = Tz axis
Comparison	Selects the type of comparison to be performed.	> Greater than < Less than

Table column	Description	Comment
Counts	Displays the load value to be compared with the measured value of the FT sensor. This value is displayed in the units of the active configuration after the "Apply" button has been clicked. To determine the Counts value to use from a value in user units, the value in user units must be multiplied by Counts per force (or Counts per torque, if applicable). **IMPORTANT! Comparison levels are stored as count values and only change when the user enters new count values. Changing the configuration or the force units or the torque units does not change or adjust the count values.**	Example: Desired load: 6.25 N Unit: N (from Configuration page) Counts per force value: 1000000 (from Configuration page) Counts = Desired load × Counts per force = 6.25 N × 1000000 counts/N = 6250000 counts
Units	Displays the count value in the units of the active configuration. This value is only updated after the "Apply" button has been clicked. The list shows the bit pattern that each threshold statement number represents. • 0: 0x00000001 • 1: 0x00000002 • 2: 0x00000004 • 3: 0x00000008 • 4: 0x00000010 • 5: 0x00000020 • 6: 0x00000040 • 7: 0x00000080 • 8: 0x00000100 • 9: 0x00000200 • 10: 0x00000400 • 11: 0x00000800 • 12: 0x00001000 • 13: 0x00002000 • 14: 0x00004000 • 15: 0x00008000	

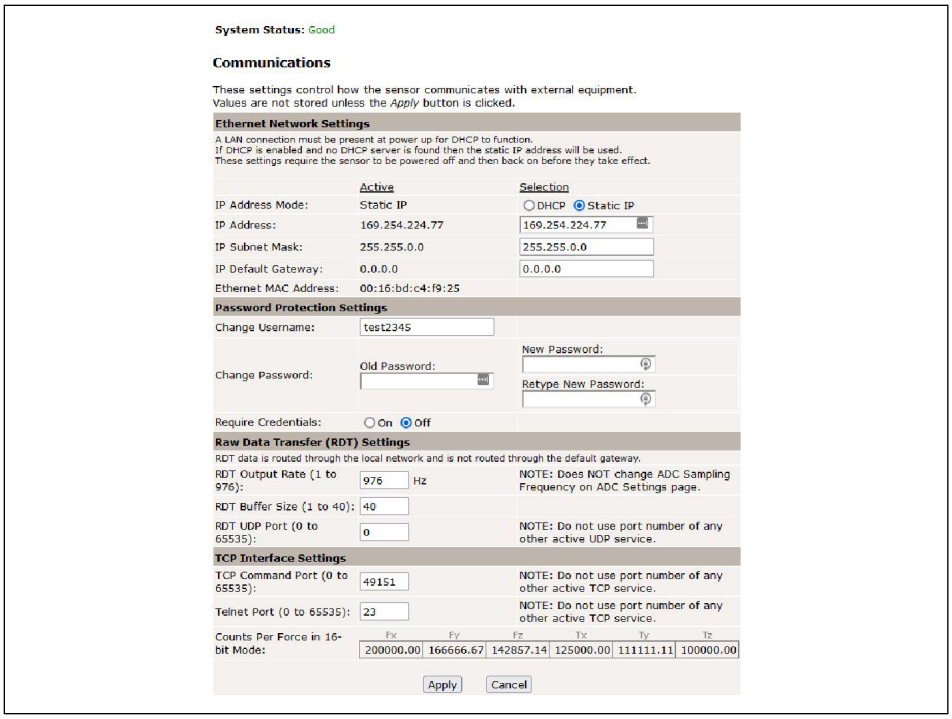
Table column	Description	Comment
Output Code	If the comparison of this statement is true, this 8-bit value is ORed bitwise with the output code values of all other true statements to form the threshold output. All set bits remain temporarily stored until "Reset Latch" is pressed. If no statements were true, the threshold output is zero.	The value is displayed in hexadecimal in the format 0x00. Output codes can be in hexadecimal or decimal format.
Get Statuses	Clicking the "Get Statuses" button updates the static display of the threshold status. If a threshold is not met, the threshold numbers are crossed out.	

Configurations Page On the Configuration page, the active calibration and tool transformation settings can be selected.



Communication Page

On the Communication page, the Ethernet network options of the system can be displayed and edited.



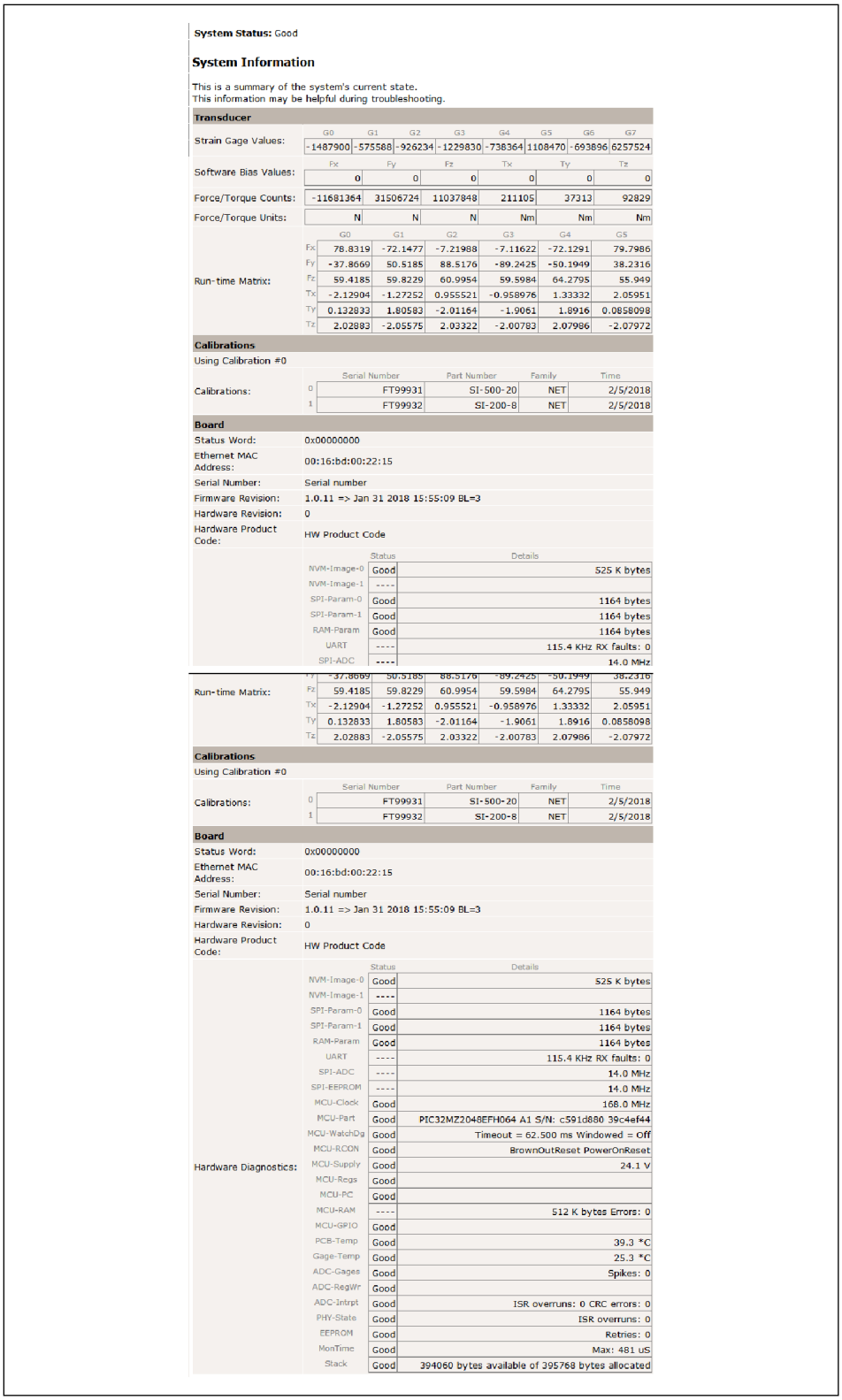
Communication Page

Ethernet Network Settings	
IP Address Mode	Configuring the IP address of the sensor
Static IP Address	Setting the static IP address
Static IP Subnet Mask	This field is intended for the subnet mask part of the IP address. Many networks use the default 255.255.255.0.
IP Default Gateway	This field is for the default gateway.
EtherNet MAC Address	A unique address assigned to the sensor at the time of manufacture. This address uniquely identifies this sensor from other sensors and other Ethernet devices.
Password Protection Settings	
Users can change the username or password. Only the username is readable and the old password is hidden. The default username is "admin", and the default password is "password".	
Require Credentials	
When this setting is "ON", a login prompt is activated when a user visits the sensor's web pages. The default setting is "OFF"	

Raw Data Transfer (RDT) / UDP Settings	
RDT is the UDP protocol from ATI. These settings apply to UDP.	
RDT Output Rate	The user can adjust the RDT output rate.
RDT Buffer Size	A user can set the RDT buffer size to a value from 1 to 40.
RDT UDP Port	The default setting is 49152. It is recommended to leave this value as the default unless another device is using this UDP port. The user can set a value from 0 to 65535.
TCP Interface Settings	
TCP Command port	The default setting is 49151. It is recommended to leave this value as the default unless another device is using this TCP port. The user can set a value from 0 to 65535.
Telnet port	The default setting is 23, this is the default port setting for all industry standard Telnet communication. It is recommended to leave this value as the default. The user can set a value from 0 to 65535.

System Information Page

The System Information page provides the user with a summary of the current condition of the Ethernet AXIA sensor.



System Status: Good

System Information

This is a summary of the system's current state.
This information may be helpful during troubleshooting.

Transducer

	G0	G1	G2	G3	G4	G5	G6	G7
Strain Gage Values:	-1487900	-575588	-926234	-1229830	-738364	1108470	-693896	6257524

	Fx	Fy	Fz	Tx	Ty	Tz
Software Bias Values:	0	0	0	0	0	0
Force/Torque Counts:	-11681364	31506724	11037848	211105	37313	92829
Force/Torque Units:	N	N	N	Nm	Nm	Nm

Run-time Matrix:

	G0	G1	G2	G3	G4	G5
Fx	78.8319	-72.1477	-7.21988	-7.11622	-72.1291	79.7986
Fy	-37.8669	50.5185	88.5176	-89.2425	-50.1949	38.2316
Fz	59.4185	59.8229	60.9954	59.5984	64.2795	55.949
Tx	-2.12904	-1.27252	0.955521	-0.958976	1.33332	2.05951
Ty	0.132833	1.80583	-2.01164	-1.9061	1.8916	0.0858098
Tz	2.02883	-2.05575	2.03322	-2.00783	2.07986	-2.07972

Calibrations

Using Calibration #0

Calibrations:

	Serial Number	Part Number	Family	Time
0	FT99931	SI-500-20	NET	2/5/2018
1	FT99932	SI-200-8	NET	2/5/2018

Board

Status Word:	0x00000000
Ethernet MAC Address:	00:16:bd:00:22:15
Serial Number:	Serial number
Firmware Revision:	1.0.11 => Jan 31 2018 15:55:09 BL=3
Hardware Revision:	0
Hardware Product Code:	HW Product Code

Hardware Diagnostics:

	Status	Details
NVM-Image-0	Good	525 K bytes
NVM-Image-1	----	
SPI-Param-0	Good	1164 bytes
SPI-Param-1	Good	1164 bytes
RAM-Param	Good	1164 bytes
UART	----	115.4 KHz RX faults: 0
SPI-ADC	----	14.0 MHz
SPI-EEPROM	----	14.0 MHz
MCU-Clock	Good	168.0 MHz
MCU-Part	Good	PIC32MZ2048EFH064 A1 S/N: c591d880 39c4ef44
MCU-WatchDg	Good	Timeout = 62.500 ms Windowed = Off
MCU-RCON	Good	BrownOutReset PowerOnReset
MCU-Supply	Good	24.1 V
MCU-Regs	Good	
MCU-PC	Good	
MCU-RAM	----	512 K bytes Errors: 0
MCU-GPIO	Good	
PCB-Temp	Good	39.3 *C
Gage-Temp	Good	25.3 *C
ADC-Gages	Good	Spikes: 0
ADC-RegWr	Good	
ADC-Intrpt	Good	ISR overruns: 0 CRC errors: 0
PHY-State	Good	ISR overruns: 0
EEPROM	Good	Retries: 0
MonTime	Good	Max: 481 uS
Stack	Good	394060 bytes available of 395768 bytes allocated

System Information Page

Status Log Page

The Status Log page displays the last 50 changes to the status code.

System Status: Good

Status Log

Log of the last 50 changes to the status code.

Status Log:	
---	0x00000000
0000:00:00:00	0x00000008
0000:00:00:00	0x00000018
0000:00:00:00	0x00000010
0000:00:00:00	0x00000012
0000:00:00:00	0x00000002
---	0x00000000
---	0x00000000
---	0x00000000
---	0x00000000
---	0x00000000
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---	0x00000000
---	0x00000000
---	0x00000000
---	0x00000000
---	0x00000000
---	0x00000000
---	0x00000008
---	0x00000018
---	0x00000010

System Information Page

Interface Example Page

The Interface Example page allows the user to view TCP and RDT (UDP) commands, command descriptions, the command response (if applicable), and a user interpretation of the command.

System Status: Good

Interface Examples

TCP Examples

Description	Command (Hex)	Response (Hex)	Interpretation
Read FT	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 0000 0000	1234 0000 044E FE80 F185 FAD3 E8D6 0177	Status = 0x00 Fx = 1102 Counts (16.82 N*) Fy = -384 Counts (-5.860 N*) Fz = -3707 Counts (-101.8 N*) Tx = -1325 Counts (-0.8096 Nm*) Ty = -5930 Counts (-3.623 Nm*) Tz = 375 Counts (0.2291 Nm*) *Conversion to Calibration Units assumes scale factors according to Read Cal Info Example below
Read Cal Info	01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	1234 02 03 000F4240 000F4240 3B9C 3B9C 6B4B 0263 0263 0263	Calibration Force Units = N Calibration Torque Units = Nm CpF = 1000000 CpT = 1000000 sf0 (Fx) = 15260 sf1 (Fy) = 15260 sf2 (Fz) = 27467 sf3 (Tx) = 611 sf4 (Ty) = 611 sf5 (Tz) = 611
Write Transform	02 03 01 0000 0000 0064 0000 0000 005A 00 00 00 00 00	1234 02 00	Apply Tool Transform: Displacement Units = mm Rotation Units = Degrees Dx = 0, Dy = 0, Dz = 1mm Rx = 0, Ry = 0, Rz = 180° Note: Transform elements are multiplied by 100 in the command call
Write Threshold	03 02 00 10 FF 0020	1234 03 00	Set Threshold Condition 2 to compare if Fx < 488320 Counts

RDT (UDP) Examples

Start Single-Block	1234 0001 00000000	00000000 000DE737 00000000 FFF87E18 000551F1 00027DA0 00003F56 0004B06D 00006712	Collect one sample of FT Data: RDT Sequence Number = 0 FT Sequence Number = 911159 Status = 0x0000 Fx = -492008 Counts (-0.4920 N*) Fy = 348657 Counts (0.3487 N*) Fz = 163232 Counts (0.1632 N*) Tx = 16214 Counts (0.01621 Nm*) Ty = 307309 Counts (0.3073 Nm*) Tz = 26386 Counts (0.026386 Nm*) *Conversion to Calibration Units assumes scale factors according to Read Cal Info Example above
Start Multi-Block (This example assumes RDT Buffer Size = 5, set on the Communications Page)	1234 0003 00000001	00000005 00100994 C0000000 000AE3A9 FFC3B184 F674684C FFF5189E 003E6B62 FFFFC7FE 00000006 00100998 C0000000 000ABE86 FFC3A8DB F66FAC9C FFF515B2 003E927E FFFFC918 00000007 0010099C C0000000 000A96A3 FFC39DDF F66AFC7C FFF51209 003EB7E5 FFFFCA3D 00000008 0010099F C0000000 000A7708 FFC394B9 F667781C FFF50F0E 003ED37A FFFFCB1A 00000009 001009A3 C0000000 000A4D2F FFC388B2 F662C31C FFF50B3E 003EF8A5 FFFFCC4C	Send 1 packet of FT Data (5 samples blocked per packet**)
Start Multi-Block (This example assumes RDT Buffer Size = 1, set on the Communications Page)	1234 0003 00000002	Packet 1: 00000000 002EED3E 00000000 01E31462 FFA8F56F 00064C4C 00057454 0005E8B5 000027B5 Packet 2: 00000001 002EED42 00000000 01E3142B FFA8F4CD 00064B80 00057452 0005E8B8 000027B8	Send 2 packets of FT Data (1 sample blocked per packet***)
Stop	1234 0000 00000000	None	Streaming will stop
Set Active Calibration	1234 0005 00000000	None	Set calibration 1 as active
Bias	1234 0042 00000000	None	Future data samples will be biased (zeroed) based on the current reading

6.4 Java® Demo Application

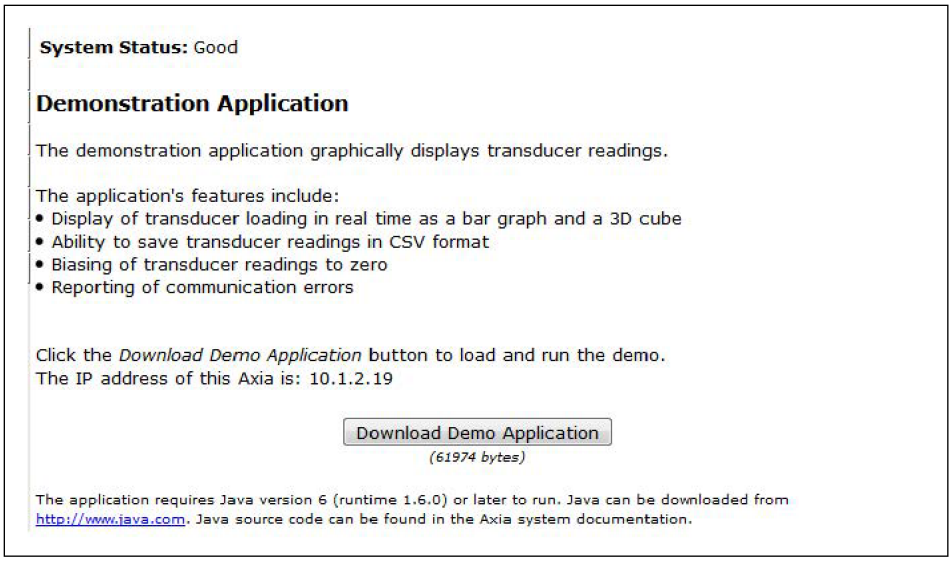
The user can collect and display F/T data via the Java® demo application on their own computer.

Launch Demo Application

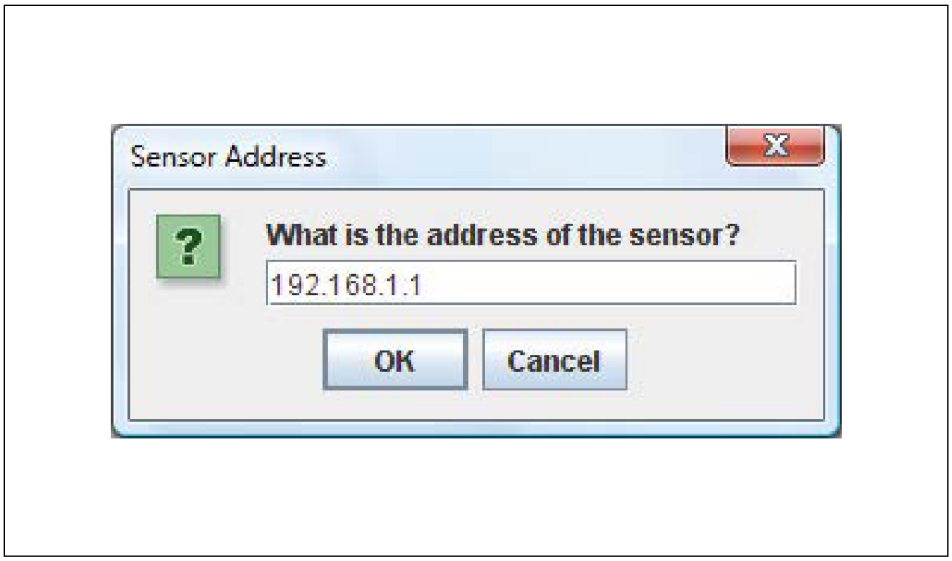
Download the demo application from the demo page on the ATI Ethernet AXIA F/T website.

- A Java version 6.0 or higher is installed on the connected computer.

1. Click on the "Download Demo Application" button to download the Java demo application. **IMPORTANT! For the Java demo, the RDT interface of the Ethernet F/T must be activated. RDT is activated by default in Ethernet F/T.**

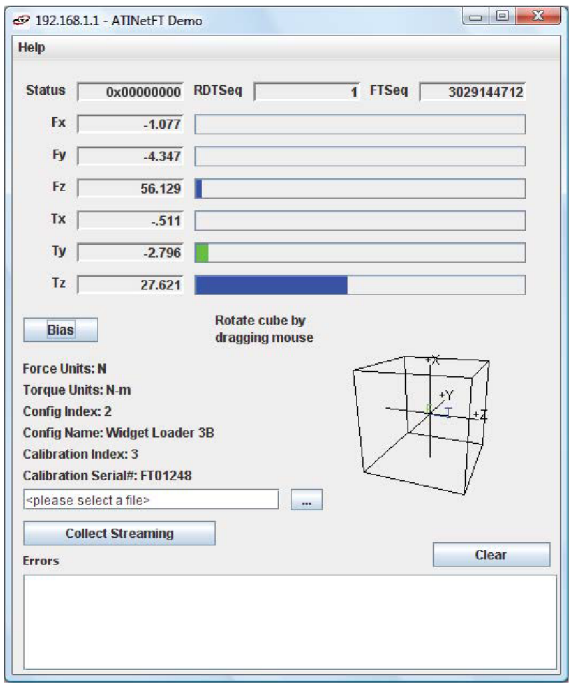


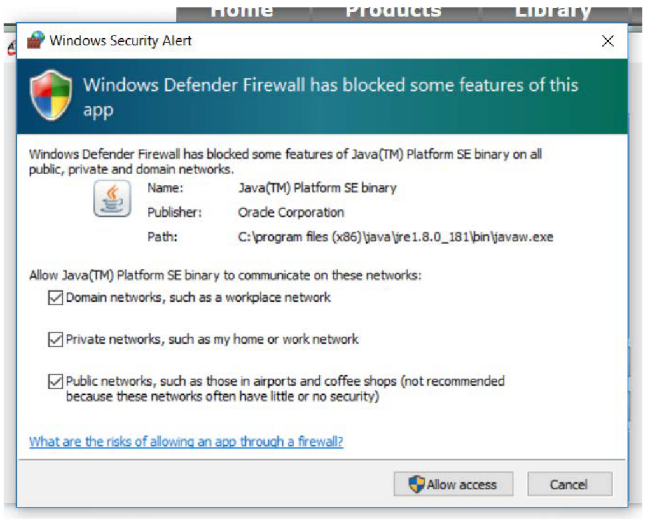
✓ A window opens.



2. Enter the IP address of the sensor.
IMPORTANT! On the demo page, the IP address of the sensor is located in the paragraph above the "Download demo application" button.

3. Click on "OK".
   ✓ The main window of the Java® demo application opens. **IMPORTANT! If the demo cannot make contact with the Ethernet AXIA sensor, the force and torque values display zero and the force units and other configuration-related items each display a question mark.**





NOTE

When the demo is used for the first time, the program may trigger a firewall warning. Check the box to give the network permission to communicate with the sensor and allow access.

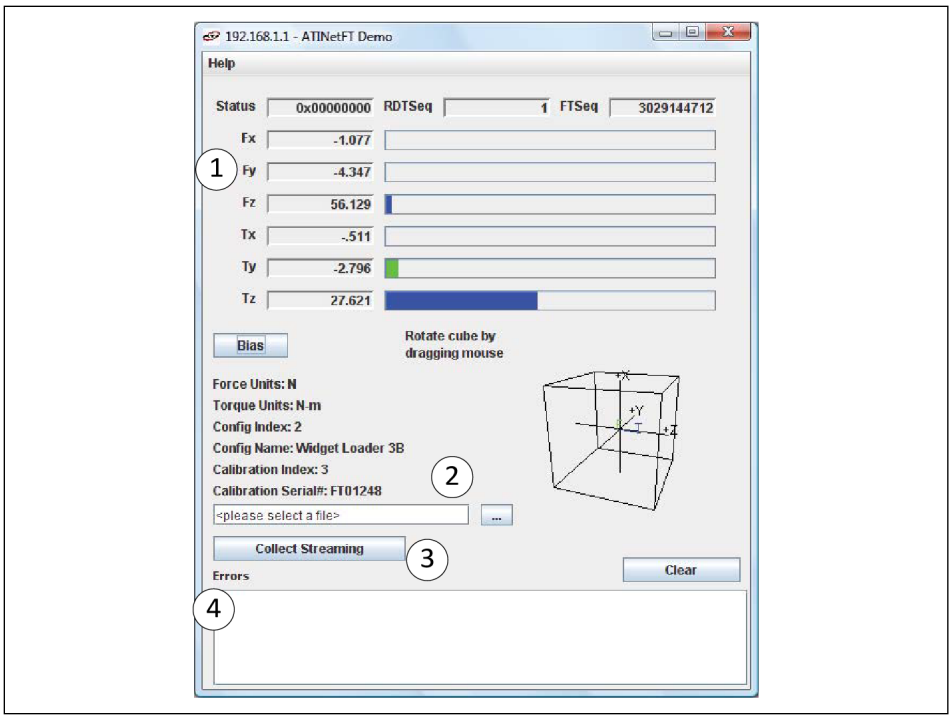
Data Display with the Demo Application

The main screen provides a live display of the current F/T data, sequence numbers and status code. In normal operation, the application requests individual data sets so that the RDT sequence remains constant.

A cube in the lower screen provides a real-time visual representation of the F/T data. The user can align the data and select the calibration configuration.

Data Collection with the Demo Application

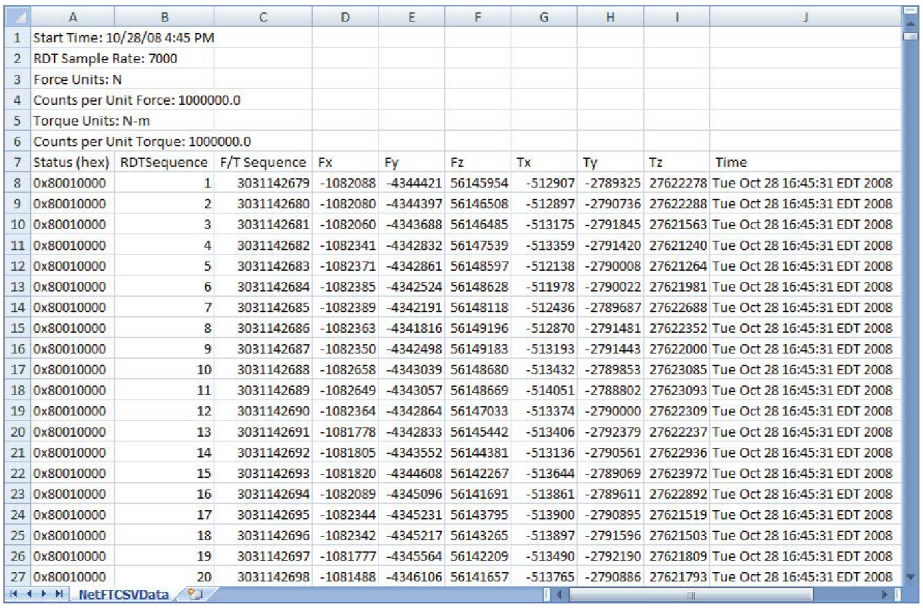
Perform the following steps to collect F/T data:



- The currently collected data are displayed in the upper area (1).

1. Click the "..." (2) button and select the path for saving the CSV evaluation file.
2. Click the "Start Collecting" (3) button.
   - ✓ The application sends a request for high-speed data to the Ethernet AXIA sensor.
   - ✓ The user can see the RDT sequence increase in real time as the application requests more than a single data set in high-speed mode.
   - ✓ The measurement data is saved in CSV format.
   - ✓ If an error occurs, it is listed in the error list (4).

3. Click the "Stop Collecting" (3) button to stop the data transfer.
4. Open CSV file.



	A	B	C	D	E	F	G	H	I	J
1	Start Time: 10/28/08 4:45 PM									
2	RDT Sample Rate: 7000									
3	Force Units: N									
4	Counts per Unit Force: 1000000.0									
5	Torque Units: N-m									
6	Counts per Unit Torque: 1000000.0									
7	Status (hex)	RDTSequence	F/T Sequence	Fx	Fy	Fz	Tx	Ty	Tz	Time
8	0x80010000	1	3031142679	-1082088	-4344421	56145954	-512907	-2789325	27622278	Tue Oct 28 16:45:31 EDT 2008
9	0x80010000	2	3031142680	-1082080	-4344397	56146508	-512897	-2790736	27622288	Tue Oct 28 16:45:31 EDT 2008
10	0x80010000	3	3031142681	-1082060	-4343688	56146485	-513175	-2791845	27621563	Tue Oct 28 16:45:31 EDT 2008
11	0x80010000	4	3031142682	-1082341	-4342832	56147539	-513359	-2791420	27621240	Tue Oct 28 16:45:31 EDT 2008
12	0x80010000	5	3031142683	-1082371	-4342861	56148597	-512138	-2790008	27621264	Tue Oct 28 16:45:31 EDT 2008
13	0x80010000	6	3031142684	-1082385	-4342524	56148628	-511978	-2790022	27621981	Tue Oct 28 16:45:31 EDT 2008
14	0x80010000	7	3031142685	-1082389	-4342191	56148118	-512436	-2789687	27622688	Tue Oct 28 16:45:31 EDT 2008
15	0x80010000	8	3031142686	-1082363	-4341816	56149196	-512870	-2791481	27622352	Tue Oct 28 16:45:31 EDT 2008
16	0x80010000	9	3031142687	-1082350	-4342498	56149183	-513193	-2791443	27622000	Tue Oct 28 16:45:31 EDT 2008
17	0x80010000	10	3031142688	-1082658	-4343039	56148680	-513432	-2789853	27623085	Tue Oct 28 16:45:31 EDT 2008
18	0x80010000	11	3031142689	-1082649	-4343057	56148669	-514051	-2788802	27623093	Tue Oct 28 16:45:31 EDT 2008
19	0x80010000	12	3031142690	-1082364	-4342864	56147033	-513374	-2790000	27622309	Tue Oct 28 16:45:31 EDT 2008
20	0x80010000	13	3031142691	-1081778	-4342833	56145442	-513406	-2792379	27622237	Tue Oct 28 16:45:31 EDT 2008
21	0x80010000	14	3031142692	-1081805	-4343552	56144381	-513136	-2790561	27622936	Tue Oct 28 16:45:31 EDT 2008
22	0x80010000	15	3031142693	-1081820	-4344608	56142267	-513644	-2789069	27623972	Tue Oct 28 16:45:31 EDT 2008
23	0x80010000	16	3031142694	-1082089	-4345096	56141691	-513861	-2789611	27622892	Tue Oct 28 16:45:31 EDT 2008
24	0x80010000	17	3031142695	-1082344	-4345231	56143795	-513900	-2790895	27621519	Tue Oct 28 16:45:31 EDT 2008
25	0x80010000	18	3031142696	-1082342	-4345217	56143265	-513897	-2791596	27621503	Tue Oct 28 16:45:31 EDT 2008
26	0x80010000	19	3031142697	-1081777	-4345564	56142209	-513490	-2792190	27621809	Tue Oct 28 16:45:31 EDT 2008
27	0x80010000	20	3031142698	-1081488	-4346106	56141657	-513765	-2790886	27621793	Tue Oct 28 16:45:31 EDT 2008

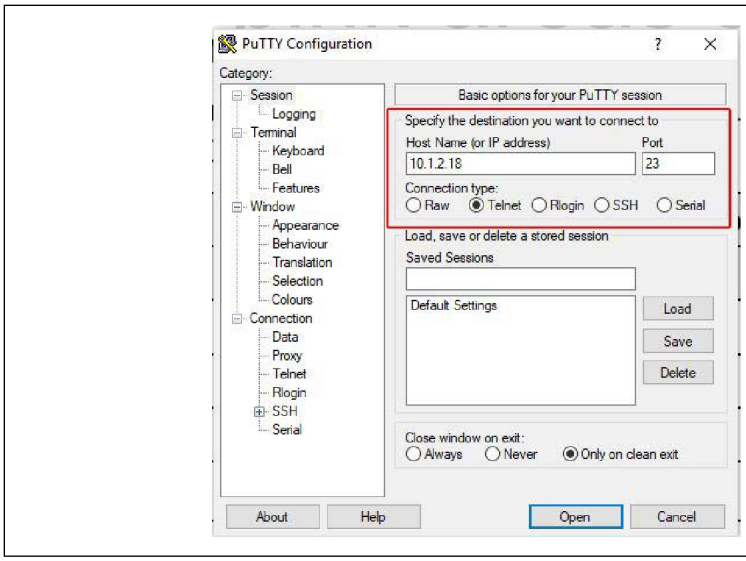
NetFTCSVData

6.5 Console interface via Telnet

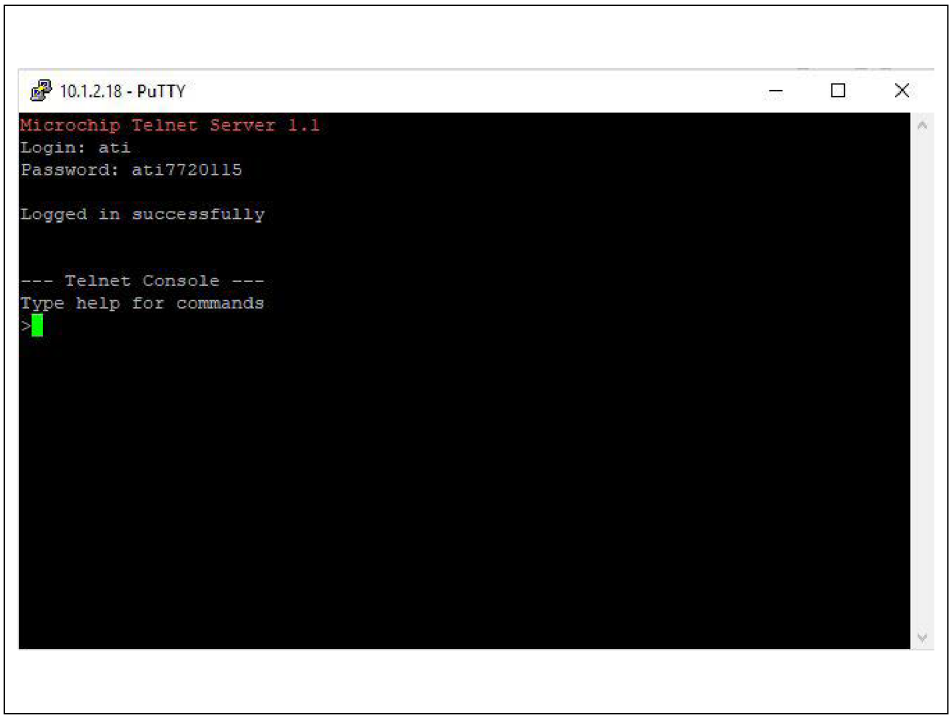
The Ethernet AXIA sensor has a console interface available to the user via Telnet.

Setting up a Console Interface via Telnet

1. Open serial console, for example: PuTTY.
   ✓ A window opens where the user can set the configuration for the session.



2. Set configuration:
   - ✓ Select the Telnet connection type.
   - ✓ In the Host name (or IP address) field, enter "10.1.2.18".
   - ✓ Make sure that the default port "23" is specified in the Port field.
   - ✓ Select the "Open" button.
3. The user will be prompted to enter a login and password. The login is "ati"; the password is "ati7720115".
   IMPORTANT! Users can also log in to the console with a user-defined username and password, which can be set with a CAL/SET command or through the communications web page.



4. Enter console command and press Enter to send the command. **IMPORTANT! The commands are not case sensitive.**

Console commands

Command	Operand	Description
HELP	Not Applicable	Output help text.
H		
MAN		
?		
BIAS	no operand	Switch the bias function on and off.
	ON	"BIAS ON" switches the function on and sets the F/T output to 0.
	OFF	"BIAS OFF" switches the function off and deletes the bias bit.
	[values]	Preload sensor with user-defined values.
PEAK	no operand	Reports the highest and lowest F/T values that have occurred since the last peak reset command for a run time and for the entire time. no operand reports the peak values in units.
	C	"PEAK C" reports the peak values in counts.
	R	"PEAK R" resets the run time peaks.
S	DH! #@01234567SFTXYZ MCU><; in any order	Reports a single line of F/T data scaled by counts per force or counts per torque.
C		Continuously reports lines of F/T data that stop when a user presses another button.

Command	Operand	Description
CAL or SET	no operand	Reports all parameters.
	[field-name]	Print all matching fields.
	[field-name] [value]	Write field with value.
SIMERR	no operand	The user can enter the "Simulated Error" command without an operand to display the status of bit 28. When a simulated error occurs, the "red" status LED lights up, ▶ 4.3 [🗋 11].
	ON	Switch on bit 28.
	OFF	Switch off bit 28.
RESET	ON	Reset MCU.
	OFF	Turns off the "Reset" command.
SAVEALL	Not Applicable	Stores all values that are retained after a power failure in the NVM.
STATUS	Not Applicable	Output the status report.
VIEW	no operand	Display properties and calibrations.
	0	Calibration 0.
	1	Calibration 1.
	A	Active calibration.
DIAG	Not Applicable	Output the diagnostic status report.

Command CAL and SET – change settings

To display and change settings, enter "cal" or "set" with the desired parameter(s). For these commands, the parameters to be set or queried must be entered individually; parameters cannot be coupled here.

Parameter	Meaning	Other parameters
serialNum	Display serial number of the product.	
partNum	Display number of the calibration part.	
calFamily	Display calibration family.	
calTime	Display the date of the last calibration.	
max0–5	Display maximum nominal value of axes in F/T numbers.	
forceUnits	Define unit for force measurement.	0 = Lbf 1 = N 2 = Klbf 3 = kN 4 = Kg
torqueunits	Define unit for torque measurement.	0 = Lbf-in 1 = Lbf-ft 2 = Nm 3 = Nmm 4 = Kg-cm 5 = kN-m
cpf	Display counts per force.	
cpt	Display counts per torque.	
peakPos0–5 / peakNeg0–5	Display positive / negative peak loads.	
sensorHwVer	Display version of the sensor hardware.	
adcRate	ADC sampling rate in Hertz (488, 976, 1953, 3906 or 7912)	
rdtRate	Transmission rate RDT protocol in Hertz (between 1 and adcRate)	
rdtSize	Number of RDT transmissions per UDP packet	
filTC	Filter selection (0–8)	
calib	Select calibration *0* or *1*.	
location	Display location of the sensor.	
serNum	Display serial number.	
hwProdCode	Product code of the hardware	

Parameter	Meaning	Other parameters
ttdu	Tool transformation distance units:	0 = in 1 = ft 2 = mm 3 = cm 4 = m
ttau	Tool transformation angle	0 = degree 1 = radiant
ttdx	Tool transformation distances	
ttdy		
ttdz		
ttrx	Rotation angle of the tool transformation	
ttry		
ttrz		
baud	UART baud rate. Must be in the range of 9,000 baud to 3M baud. Any change in baud rate is temporary until a SAVEALL command is issued.	
msg	Unsolicited error messages	1 = Print unsolicited messages 0 = Do not print unsolicited messages
username	User name	Default values: User name = "admin" Password = "password"
password	Password	

Query commands "S" or "C"

The command "S" reports a single line of F/T data that is scaled by counts per force or counts per torque.

The "C" command reports continuous lines of F/T data that are stopped when a user presses another button. The "C" command reports data at the rate specified in rdtRate. The data reported by the output of a query command can be adjusted.

Conversion of counts per force/torque into F/T values

To obtain the actual force and torque values, each force value must be divided by the counts per force (cpf) factor and each torque value must be divided by the counts per torque (cpt) factor. The cpf and cpt factors can be determined with the "set" command.

Query secondary commands for the "C" or "S" commands

The data type reported by the query commands "C" or "S" can be adjusted using secondary commands or specifiers. This feature is useful for users who want to develop their own program to save the data in an external file or display the data in figures such as charts. If an "S" or "C" command is issued without specification(s), the specification(s) of the previous "S" or "C" command are used in the data printout. The default identifier at start up is as follows: "FXYZTXYZ".

Category	Secondary command or specifier	Notes
Gage number(s)	0	The measured values are printed only in counts. All test mean values as well as just one test mean value can be specified.
	1	
	2	
	3	
	4	
	5	
	6	
	7	
Axis	X	The user can choose to display force and torque data in the x, y or z axis. The output value can be displayed in F/T numbers or technical units.
	Y	
	Z	
Force and/or Torque	F	The XYZM force data is displayed.
	T	The XYZM torque data is displayed.

Category	Secondary command or specifier	Notes
Mag-nitude	M	Force or torque data is displayed as the magnitude of the vector components on the x, y and z axes. The output value can be displayed in F/T numbers or technical units.
Counts or Units	C	The XYZM data is displayed in counts or the selected user units.
	U	
Numeric System	H	The data is displayed as a hexadecimal number. All data printed in units is displayed as decimal numbers by default.
	D	The data is displayed as a decimal number.
Format	>	The data is presented in a formatted human-readable output, for example: lined up columns. ">" is the default setting.
	<	The data is displayed in a compressed output without leading zeros, trailing zeros or unnecessary spaces. This output is intended for high-speed applications used in an automated environment.
Additional inputs to aid in the development of a software program	S	This command specifies a CRC.
	#	This command specifies a sample counter that is incremented each time a "c" or "s" line is printed.
	@	This command sets an ADC read counter that is incremented each time the ADC is read.
	;	This command uses a "," (comma) instead of a " " (space) to separate data values.
Troubles hooting	!	This command specifies the 32-bit status code.

Interpretation of the output of the "!" specifier

The user converts hexadecimal output to a 32-bit binary number that correlates to a code in a dictionary object. An example of bit patterns is shown in the following table:

Bit number	Simple description	Bit pattern
0	Temperature	0x80000001
1	Supply voltage	0x80000002
2	Defective measuring device	0x80000004
3	Occupied bit	0x80000008
4	Occupied	N/A
5	Other	0x80000020
6	Occupied	N/A
7	Calibration not accessible	0x80000080
8-26	Occupied	N/A
27	Measuring device outside the range of measurement	0x88000000
28	Simulated error	0x10000000
29	Calibration checksum error	0xA0000000
30	Force/torque outside the range	0xC0000000
31	Any error	0x80000000
–	Healthy	0x00000000

The bit pattern may be different if there is more than one error. For example, if the status code is 80000005, the user must convert the hexadecimal number to a binary number.

Hex	8	0	0	0	0	0	0	5
Binary	1000	0000	0000	0000	0000	0000	0000	0101

The binary number has a total of 32 bits. The least significant bit is located at the right end of the following table.
"1" means that the bit is switched on. "0" means that the bit is switched off.

Binary number	1	0	0	0	0	0	00 0000 0000 0000 0000 00	0	0	0	1	0	1
Bit position	**31**	**30**	**29**	**28**	**27**	**26**	**25 to 6**	**5**	**4**	**3**	**2**	**1**	**0**

So in this example, bits 0, 2 and 31 are switched on. According to the previous table, the sensor has the status codes "temperature", "measuring device error" and "any error".

6.6 Common Gateway Interface (CGI)

NOTE

The maximum length of these URLs can be determined by a number of factors outside the force/torque sensor system. Exceeding the maximum length may result in an error or variables being incorrectly set.

The force/torque sensor system can also be configured via EtherNet/IP using the standard HTTP get method. It sends configuration variables and their associated values in the requested URL. URLs are constructed using the following syntax:

- *http://<netFTAddress>/<CGIPage.cgi>?<firstVariableAssignment><&nextVariable Assignment>*

http:/	indicates an HTTP request
<netFTAddress>	the EtherNet/IP address of the force/torque sensor system
/	a separator
<CGIPage.cgi>	name of the CGI page that contains the variables to be accessed
?	a separator that marks the beginning of variable assignments
<firstVariableAssignment>	a variable assignment using the format described below
<&nextVariableAssignment>	a variable assignment with the format described below, but the variable name is proceeded with an ampersand. This variable assignment is optional and can be repeated for multiple variables.

Each variable can only be set from the CGI page that is responsible for that variable. Each CGI page and its associated adjustable variables are listed in the following tables.

- *variableName=newValue*

variableName	name of the variable to be assigned
=	indicates assignment

newValue	value to be assigned to the variable. Text for text variables should not be enclosed in quotes. To include the ampersand character in text for a text variable use "%26". Floating-point numbers are limited to twenty characters.

- Example: *http://192.168.1.1/setting.cgi?setcfgsel=2&setuserfilter=0&setpke=1*

  instructs the force/torque sensor system to set the CGI variables setcfgsel to 2, setuserfilter to 0, and setpke to 1 using the IP address 192.168.1.1.

CGI settings

ADC rate, low-pass filter and bias can be set.

<table>
<tr><th>Variable name</th><th>Value range (integer)</th><th colspan="4">Description</th></tr>
<tr><td>setadcrate</td><td>488, 976, 1953, 3906, 7812</td><td colspan="4">Sets the ADC sampling rate.</td></tr>
<tr><td rowspan="7">setuserfilter</td><td rowspan="7">0 to 8</td><td colspan="4">Sets the cutoff frequency of the low-pass filtering as follows:</td></tr>
<tr><td>Value</td><td>Limit frequency [%]</td><td>Value</td><td>Limit frequency [%]</td></tr>
<tr><td>0</td><td>no filter</td><td>5</td><td>0.51</td></tr>
<tr><td>1</td><td>11.97</td><td>6</td><td>0.26</td></tr>
<tr><td>2</td><td>4.66</td><td>7</td><td>0.12</td></tr>
<tr><td>3</td><td>2.17</td><td>8</td><td>0.07</td></tr>
<tr><td>4</td><td>1.04</td><td colspan="2"></td></tr>
<tr><td>setbiasn</td><td>-32768 to 32767</td><td colspan="4">Sets the offset value for strain gage n. For example, Setbias3=0 would set BIAS/ zeroing of the fourth strain gage to zero (strain gages are enumerated starting at zero)</td></tr>
</table>

CGI threshold monitoring

Threshold settings and conditions are defined here.

Variable name	Value range	Description
setmce	0 or 1 (integer)	Threshold monitoring: Enables (value=1) or disables (value=0)
mcandcodes	0 or 1 (integer)	Relay trigger: any condition is true (value=0) or all conditions are true (value=1) en threshold n.
mcfloating	0 or 1 (integer)	Behavior of the relay: momentary (value=1) or latching (value=0)
mcReset	1 (integer)	Reset locking
mcresettime	0 to 255 (integer)	Short minimum switch-on time of the relay or a delay in tenths of a second: 0 seconds = 0 to 25.2 seconds = 255-term
mcen	0 or 1 (integer)	Threshold statement n: Enables (value=1) or disables (value=0)
mcxn	-1 to 5 (integer)	Selects the axis evaluated by threshold statement n.

Value	Description	Menu value
-1	disabled	blank
0	F_x-axis	F_x
1	F_y-axis	F_y
2	F_z-axis	F_z
3	M_x-axis	M_x
4	M_y-axis	M_Y
5	M_z-axis	M_z

mcvn	-2147483648 to +2147483647 (integer)	Sets the count value to compare the current axis value with the threshold statement n.
mcon	0x00 to 0xFF (hexadecimal)	Sets the output code for threshold statement n.
n is an integer ranging from 0 to 15 that monitors the threshold statement index.		

CGI configuration

Calibration and the tool transformation are set here.

Variable name	Value range	Description		
cfgcalsel	0 or 1 (integer)	Sets the calibration used by the sensor.		
cfgtdu	0 to 5 (integer)	The distance measurement units used by the configuration's tool transformation.		
		Value	**Description**	**Menu value**
		1	Inch	in
		2	Foot	ft
		3	Millimeter	mm
		4	Centimeter	cm
		5	Meter	m
cfgtau	1 or 2 (integer)	The rotation units used by the configuration's tool transformation.		
		Value	**Description**	**Menu value**
		1	Degrees [°]	Degrees
		2	Radius	Radian
cfgtfx0	Floating point number	Sets the tool transformation distance D_x. Distance must be in cfgtdu distance units.		
cfgtfx1	Floating point number	Sets the tool transformation distance D_y. Distance must be in cfgtdu distance units.		
cfgtfx2	Floating point number	Sets the tool transformation distance D_z. Distance must be in cfgtdu distance units.		
cfgtfx3	Floating point number	Sets the tool transformation rotation R_x. Rotation must be in cfgtau angular units.		
cfgtfx4	Floating point number	Sets the tool transformation rotation R_y. Rotation must be in cfgtau angular units.		
cfgtfx5	Floating point number	Sets the tool transformation rotation R_z. Rotation must be in cfgtau angular units.		

CGI communications Network settings are defined here.

<table>
<tr><th>Variable name</th><th>Value range</th><th colspan="2">Description</th></tr>
<tr><td rowspan="4">comnetdhcp</td><td rowspan="4">0 or 1 (integer)</td><td colspan="2">Sets DHCP behavior.</td></tr>
<tr><td>Value</td><td>Description</td></tr>
<tr><td>0</td><td>Use DHCP if available on the network</td></tr>
<tr><td>1</td><td>Use static IP address.</td></tr>
<tr><td>comnetip</td><td>Each IPV4 address in dot-decimal notation</td><td colspan="2">Sets the static IP address when DHCP is disabled.</td></tr>
<tr><td>comnetmsk</td><td>Any IPV4 subnet mask in dot-decimal notation</td><td colspan="2">Sets the static subnet mask when DHCP is disabled.</td></tr>
<tr><td>comnetgw</td><td>Each IPV4 address in dot-decimal notation</td><td colspan="2">Sets the gateway to be used when DHCP is disabled.</td></tr>
<tr><td>comrdtbsiz</td><td>1 to 40 (integer)</td><td colspan="2">RDT buffer mode, buffer size</td></tr>
</table>

6.7 TCP Interface

Information about the TCP Interface

The TCP interface runs on TCP port 49151. All commands are 20 bytes long. All outputs start with the two-byte header 0x12, 0x34.

Command codes

READFT = 0, // Read out FT values
READCALINFO = 1, // Read out calibration
WRITETRANSFORM = 2, Write tool transformation
WRITETHRESHOLD = 3, Write conditions for monitoring

Read out FT Commands

{
uint8 command; // Must always be READFT (0)
uint8 reserved[15]; // Should always be at value=0
*uint16 MCEnable; // Bitmap of MCs to be enabled **
*uint16 sysCommands; // Bitmap of system commands ***
}

* Each bit position 0-15 in MCEnable corresponds to the monitoring state at this index. If the bit is a '1', this monitoring condition is enabled. If the bit is a '0', this monitoring condition is disabled.

** Bit 0 of sysCommands controls the action BIAS/zeroing. If bit 0 is a "1", the system is pre-loaded. If bit 0 is a '0', no action is performed.
Bit 1 of sysCommands controls the latching of the monitoring condition. If bit 1 is a '1', the monitoring state memory is cleared and the evaluation of the monitoring condition starts again. If bit 1 is a '0', no action is performed.

Read out the FT output

{
uint16 header; // Always 0x1234
uint16 status; // Upper 16 bits of the 32-bit status codes.
int16 ForceX; // 16-bit force Fx output
int16 ForceY; // 16-bit force Fy output
int16 ForceZ; // 16-bit force Fz output
int16 TorqueX; // 16-bit torque Tx
int16 TorqueY; // 16-bit torque Ty
int16 TorqueZ; // 16-bit torque Tz
}

The force and torque values in the response are equal = current FT value × calibration counts per unit ÷ 16-bit scaling factor.
The counts per unit and the scaling factor are read out with the command "Read calibration information".

Reading calibration info command

{
uint8 command; // Must always be READCALINFO (1)
uint16 reserved[19]; // Should always be 0

}

Read calibration info output

{
uint16 header; // Always 0x1234
uint8 forceUnits; // Force unit
uint8 torqueUnits; // Torque unit
int32 countsPerForce; // Calibration counter per force unit
int32 countsPerTorque; // Calibration counter per torque unit
int16 scaleFactors[6]; // Further scaling for 16-bit counter

}

Force unit	Code for unit	Torque unit
Pound	1	Pound-inch
Newton	2	Pound-foot
Kilo-pound	3	Newton meter
Kilonewton	4	Newton millimeter
Kilogram	5	Kilogram-force centimeter
Gram	6	Kilonewton meter

Convert units command

{
uint8 command; // Must always be WRITETRANSFORM (2)
uint8 transformDistUnits; // Units for dx, dy, dz
uint8 transformAngleUnits; // Units for rx, ry, rz
int16 transform[6]; // dx, dy, dz, rx, ry, rz
uint8 reserved[5]; // Should always be 0
}

* The "transform" elements are multiplied by 100 to achieve good granularity with integer values.

Force unit	Code for unit	Torque unit
Inch	1	Degrees
Foot	2	Radian
Millimeter	3	
Centimeter	4	
Meter	5	

Monitor conditions command

{
uint8 command; // Must always be WRITETRESHOLD
uint8 index; // Index for condition monitoring: 0-31
uint8 axis; // 0=fx, 1=fy, 2=fz, 3=tx, 4=ty, 5=tz
iunt8 outputCode; // Output code of condition monitoring
int8 comparison; // Code for comparison, 1 for "greater than" (>), -1 for "less than" (<)
int8 compareValue; // Value for comparison, divided by 16 bits, scaling factor
}

Output

{
uint16 header; // Must always be 0x1234
uint8 commandEcho; // Echo command
uint8 status; // 0 = successful, not 0= not successful

}

6.8 XML Interface

The current settings of the force/torque sensor system can be retrieved in XML format via standard EtherNet HTTP requests and allow programs to read out values, e.g. the Counts per force value. The Java demo application uses data provided in these XML pages to correctly scale the displayed data.

Data type	Description
DINT	Signed double integer (32 bit)
ENABL	Boolean using Enabled to represent 1 and Disabled to represent 0
HEXn	Hexadecimal number of n bits, prefixed with 0x.
INT	Signed integer (16 bit)
REAL	Floating-point number (32 bit)
SINT	Signed short integer (8 bit)
STRINGn	String of n characters
UDINT	Unsigned double integer (32 bit)
UINT	Unsigned integer (16 bit)
USINT	Unsigned short integer (8 bit)

The values of all data types are represented as ASCII strings. Arrays are represented when the suffix [i] is appended to the data type, where i represents the number of values in the array. Array values in an XML element can be separated by a semicolon, comma, or space.

System and configuration information (netftapi2.xml)

The XML page *netftapi2.xml* retrieves the system setup and the active configuration. To retrieve information of other configurations, these configurations must be made active before the request.

To do this, append "?index=n" to the request, where n is the index of the desired configuration. If no configuration index is specified, the active configuration is assumed. For example, to retrieve configuration information for the second configuration, the requested page would be *netftapi2.xml?index=1*.

The reference column in the following table indicates which .htm page and which .cgi function accesses this element.

XML element	Data type	Description	Reference
runstat	HEX32	System status code	–
runft	DINT[6]	Force and torque values in counts	rundata
runpkmx	DINT[6]	Maximum peak values in counts	rundata
runpkmn	DINT[6]	Minimum peak values in counts	rundata
runsg	INT[6]	Strain gage values	rundata
runmcb	HEX32	Thresholds breached	rundata
runmco	HEX8	Thresholds output	rundata
runmcl	USINT	Threshold latched	rundata
unbiasedsg	INT	Unbiased strain gage values	rundata
setbias	DINT[6]	Software bias vector	setting
setrate	USINT	Set the ADC rate	setting
setiirshift	USINT	Set a filter	setting
setmce	USINT	Threshold processing status	moncon
mce	USINT[16]	Threshold statements' individual enabling	moncon
mcx	USINT[16]	Threshold statements' selected axes	moncon
mcc	USINT[16]	Threshold statements' comparisons	moncon
mcv	DINT[16]	Threshold statements' counts values for comparison	moncon
mco	HEX8[16]	Threshold statements' output codes	moncon
cfgcalsel	USINT	Calibration used by active configuration	config
cfgcalsn	STRING8	Serial number of active configuration's calibration	config

XML element	Data type	Description	Reference
cfgfu	USINT	Force units used by active configuration	config
scfgfu	STRING8	Name of force units used by active configuration	config
cfgtu	USINT	Torque units used by active configuration	config
scfgtu	STRING8	Name of torque units used by active configuration	config
cfgtdu	USINT	Tool transformation distance units used by active configuration	config
scfgtdu	STRING16	Name of tool transformation distance units used by active configuration	config
cfgtau	USINT	Tool transformation rotation units used by active configuration	config
scfgtau	STRING8	Name of tool transformation rotation units used by active configuration	config
cfgtfx	REAL[6]	Tool transformation distances and rotations applied by active configuration	config
comnetdhcp	ENABL	DHCP behavior setting	comm
comnetip	STRING15	Static IP address	comm
comnetmsk	STRING15	Static IP subnet mask	comm
comnetgw	STRING15	Static IP gateway	comm
nethwaddr	STRING17	EtherNet MAC address	comm
comrdtrate	UDINT	RDT output rate	comm
comrdtbsiz	USINT	RDT buffer mode, buffer size	comm
mfgdighwa	STRING17	EtherNet MAC address	manuf
mfgdigsn	STRING8	Digital board serial number	manuf
mfgdigver	STRING8	Digital board firmware revision	manuf
mfgdigrev	STRING8	Digital board hardware revision	manuf
mfgtxdmdl	STRING16	Analog board location	manuf
netip	STRING15	IP address in use	–
runrate	UDINT	Internal sample rate for strain gage collection	–

Calibration information (netftcalapi.xml)

The netftcalapi.xml XML page retrieves information about a specific calibration. The calibration information retrieved was not changed by any of the force/torque system configuration settings.

A calibration index can be specified during the request. To do this, append "?index=n" to the request, where n is the index of the desired configuration. If no configuration index is specified, the active configuration is assumed.

For example, to retrieve calibration information for the third calibration, the requested page would be *netftcalapi.xml?index=2*.

XML element	Data type	Calibration information
calsn	STRING8	Serial number
calpn	STRING32	Calibration type
caldt	*STRING20*	Calibration date
calfu	USINT	Force units (refer to config.cgi variable cfgfu for values)
scalfu	STRING8	Name of force units
caltu	USINT	Torque units used (refer to config.cgi variable cfgtu for values)
scaltu	*STRING8*	Name of torque units
calmr	REAL[6]	Calibrated sensing ranges in calfu and caltu units
calcpf	DINT	Counts per force unit
calcpt	DINT	Counts per torque unit
calrng	REAL	Calibrated sensing range

6.9 UDP interface (Raw Data Transfer)

NOTICE

Network disturbances possible!

The RDT streaming modes send very large data packets. This may interfere with other connections on the network.

- Use a permanently assigned EtherNet network for reading out FTN data.
- Use the high output speed only when necessary.
- Always end the readout with the command 0x0000. If the client that requested the data is disconnected from the network without sending the 0x0000 command, the force/moment sensor system continues to stream.

NOTE

The RDT protocol is designed to respond to only one client. When a second client sends a command, the Net F/T responds to the new client. Multiple clients could repeatedly request individual packets, minimizing problems (the Java demo works this way).

The force/torque sensor system can output data at up to 7912 Hz over EtherNet/IP using UDP. This method of fast data collection is called Raw Data Transfer (RDT). It is useful when the computational complexity of EtherNet/IP is too great for an application, or when additional speed is required for data collection.

NOTE

Multi-byte values must be transferred to the network high byte first and with the correct number of bytes. Some compilers align structures to large field sizes, such as 32 or 64-bit fields, and send an incorrect number of bytes. C compilers usually provide the functions htons(), htonl(), ntohs() and ntohl() that can automatically handle these issues.

RDT requests

The force/moment sensor system monitors UDP port 49152 for requests. It also sends the output RDT messages from this port.

All RDT requests use the following structure:

```
{
Uint16 command_header = 0x1234; // Required
Uint16 command; // RDT command to execute
Uint32 sample_count; // Number of samples to output (0 = infinite)
}
```

RDT commands

Command	Code	Purpose	Output
Stop	0x0000	Stops sending RDT packets via UDP.	-
Start singleblock	0x0001 0x0002	Starts sending RDT packets via UDP. Only single blocks, regardless of the RDT buffer size setting. Use the Count field to send a certain number of packets, 0 = unlimited.	RDT record(s)
Start multiblock	0x0003	Starts sending RDT packets via UDP. How many RDT packets are blocked depends on the RDT buffer size setting. Use the Count field to send a specific number of packets, 0 = unlimited.	RDT record(s)
Bias	0x0042	Set software bias.	-

RDT datasets sent in response to an RDT request have the following structure:

{
Uint32 rdt_sequence; // RDT sequence number of the packet
Uint32 ft_sequence; // Internal sequence number of the dataset
Uint32 status; // System status code
// Force and torque measurement values use count values
Int32 Fx; // X-axis force
Int32 Fy; // Y-axis force
Int32 Fz; // Z-axis force
Int32 Tx; // X-axis torque
Int32 Ty; // Y-axis torque
Int32 Tz; // Z-axis torque
}

Command	Description
rdt_sequence	The "rdt_sequence" describes the position of the RDT record within a single output stream. This information is useful to determine if datasets were lost during transmission. For example, for a request of 1000 records, the rdt_sequence starts at 1 and runs to 1000. The RDT sequence counter is set to zero for the increment following 4294967295 (2^{32}-1).
ft_sequence	The "ft_sequence" describes the internal number of the sample taken from the FT dataset contained in the RDT dataset. The FT sequence number starts at 0 when the system is switched on and increases with the internal sample rate (7000 per second). The value for "ft_sequence" is not set to 0 when the RDT request is completed. This counter switches to 0 at the increment following 4294967295 (2^{32}-1).
status	Contains the system status code at the time of the dataset.
Fx, Fy, Fz, Tx, Ty, Tz	F/T data as count values

NOTE

In buffered mode, the number of RDT datasets received in a UDP packet is equal to the RDT buffer size displayed on the "Communications" page.

Calculating FT values for RDT requests

To obtain the real force and torque values, each force output value must be divided by the "Counts per force" factor and each torque output value must be divided by the "Counts per torque" factor. The factors "cfgcpf" and "cfgcpt" can be taken from the *netftapi2.xml* page, ▶ 6.8 [🗋 64].

Examples of C code at http://www.ati-ia.com/Products/ft/software/net_ ft_software.aspx.

7 Troubleshooting

7.1 Status Code

During each measurement, a system status code is stored and output in addition to numerous diagnostic checks.

Bit number	Description	Indicates an error?
0	Internal temperature outside the range: This bit is active (high) when the temperature is outside the range -5 to 70 °C.	Yes
1	Supply outside the range. This bit is active (high) when the voltage for input voltage is outside the range 12 V to 30 V.	Yes
2	Defective measuring device: This bit is active (high): • A measuring device displays a positive full scale value, indicating that the electrical connection to a measuring device is open or interrupted. • The sensor reports loads that are significantly higher than its range of measurement. It resets itself 32 sampling periods after the condition is cleared.	Yes
3	Busy bit. The sensor performs one or more of the following activities, which may temporarily affect the force/torque data: • Transfer a change to the NVM. • Changes the filter time constant. • Changes the calibration used. • Changes the ADC sampling rate. • ADC ISR over stroke.	No
4	Occupied.	
5	Bit for other errors. This bit is set if there is an error other than those specified in this table.	Yes
6	Occupied.	
7	Calibration not accessible. This bit is set when there is an error with the NVM and the calibration settings cannot be loaded.	Yes
8-26	Occupied.	

Bit number	Description	Indicates an error?
27	Strain gauge outside the range warning: This bit is active when a strain gauge warning range (gageMinRangeWam to gageMaxRangeWam) has been exceeded in any of the past hold time samples (normally 32).	Yes
28	Simulated error. It can be used to test the user's error handling.	No
29	Calibration checksum error. This bit is set if the active calibration has an invalid checksum.	Yes
30	Force/torque outside the range or detection range exceeded. This bit is active whenever the force/torque sample is outside the range or saturated. It automatically resets 32 sampling periods after the condition is cleared.	Yes
31	Error: This bit is set when a status code bit indicating an error is set.	Yes

7.1.1 Detection range exceeded

Bit 30 is set if force/torque is outside the range, detection range is exceeded, or one of the following conditions is TRUE:

- The total percentage of the calibrated range used by the F_{xy} and T_z axes is greater than 105%.

$$\frac{\sqrt{F_X^2 + F_Y^2}}{F_{XY}\mathrm{CalibratedRange}} + \frac{|T_Z|}{T_Z\mathrm{CalibratedRange}} > 105\%$$

- The total percentage of the calibrated range used by the F_z and T_{xv} axes is greater than 105%.

$$\frac{|F_Z|}{F_Z\mathrm{CalibratedRange}} + \frac{\sqrt{T_X^2 + T_Y^2}}{T_{XY}\mathrm{CalibratedRange}} > 105\%$$

7.2 Communication error

Error	Possible solution
The IP address is assigned incorrectly.	Check IP address, Link Communication type Ethernet/IP [🗋 21].
No IP address assigned by DHCP.	The Ethernet network is not configured correctly. DHCP was not selected correctly, Link Communication type Ethernet/IP [🗋 21]. The DHCP server waits more than 30 seconds for a response, and the sensor requests a faster response from the DCHIP server. The sensor must be switched off and on again.
The browser cannot find the AXIA sensor in the Ethernet network.	Clear the ARP table on the computer to remove possible devices previously used with the same IP address. The Ethernet network is not configured correctly. The network has a firewall that blocks the sensor's web browser pages.

7.3 Web browser interface

Error	Possible solution
The "Invalid Request page" is displayed.	One or more entries on the page are invalid. Find errors and correct information.
The page "HTTP 1.0 401 Error- Unauthorized page" is displayed.	ATI is performing server maintenance. Try accessing again later.

7.4 Demo program (Java)

Error	Possible solution
The demo program displays "0" for the forces and torques and "?" for the configuration data.	Check the IP address and restart the demo program.
Error message "Could not find the main class" and is closed.	A newer Java version is required.
Error message "Excessive IO exception" and timeout.	The EtherNet connection has been interrupted. Check that the EtherNet cable and voltage supply are connected correctly.
Error message "IO exception". The demo program cannot find the stored file because the path is no longer correct or it has been renamed.	Name file correctly or create new file.

7.5 LED error

Error	Possible solution
Sensor status LED remains red after the 20-second switch-on phase.	Check the connector and cable connection. Check cable and connector for damage. Check Status Code [67].
The Ethernet connection/activity LED is not green or is flashing green.	Check that the EtherNet cable and voltage supply are connected correctly, 6.1 [21].
All LEDs are off.	The sensor is not switched on. Check the connector and cable connection.

7.6 Force/torque sensor

Error	Possible solution
Signal noise is caused by mechanical vibration or electrical interference, or because a component in the force/torque sensor system has failed.	Ensure that the system is properly grounded and isolated from external electrical interference. Check the overall system for failure of a component. Check the force/torque sensor status code, Status Code [67].
Measured values are not completely reset after loading and unloading or there is an internal error in the overall system.	Drift is caused, for example, by rapid temperature changes. Allow the force/torque sensor to warm up for around 30 minutes and adjust to the ambient temperature before measuring again. Use the bias command to set the measured values back to zero. Use insulator between the force/torque sensor and any tool or device that has a different temperature. Shield the sensor from an excessive air flow.
Measured values are not completely reset after loading and unloading.	Operate all components separately. Thoroughly clean the sensor body and adapter plate of contamination. Verify that the sensor is properly installed. Use the bias command to set the measured values back to zero.
Bit 1 is active (high).	Switch the system off and on again.
Bit 2, 27 or 30 is active (high).	Remove loads. Verify that the sensor is properly installed. If an error persists, the sensor is probably permanently damaged due to overload.
The sensor is connected but does not transmit data.	Ensure that the devices are compatible. Observe LEDs, Status LEDs.

Error	Possible solution
Actual data output rate of the sensor is lower than expected.	Configure data output rate, ▶ 6.9 [🗋 64].
Initial force/torque values are not equal to zero and no load is applied.	Preload sensor to bring all force/torque values back to zero.
Values do not match expected values.	Display force/torque data, ▶ 6.5 [🗋 44]. Use the bias command to set the measured values back to zero. Check Status Code [🗋 67]. Verify that the sensor is properly installed.

8 EU Declaration of Conformity

Manufacturer/ Distributor	SCHUNK GmbH & Co. KG Clamping and gripping technology Bahnhofstr. 106 - 134 D-74348 Lauffen/Neckar

We hereby declare on our sole authority that the product meets the requirements of the following directives at the time of the declaration.
The declaration is rendered invalid if modifications are made to the product.

Product designation:	Force/torque sensor system FTN-AXIA This declaration of conformity is valid for all variants mentioned in the appendix.

- **Electromagnetic compatibility (EMC directive) 2014/30/EU**

Applied harmonized standards, especially:

EN 61326-2-3:2013	Electrical equipment for measurement, control and laboratory use - EMC requirements – Part 2-3: Particular requirements – Test configuration, operational conditions and performance criteria for transducers with integrated or remote signal conditioning. (IEC 61326-2-3:2012)
EN ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction

All related technical documentation has been prepared in electronic form according to Directive 2014/30/EU and will be made available to national authorities on demand. The signatory is resident at the manufacturer's address and is authorized to compile this documentation.

Signed for and on behalf of: SCHUNK GmbH & Co. KG

Lauffen/Neckar, November 2022

Signature: see original declaration

Dr.-Ing. Manuel Baumeister,
Technology & Innovation

9 UKCA Declaration of Conformity

Manufacturer/ Distributor

SCHUNK Intec Limited
Clamping and gripping technology
3 Drakes Mews, Crownhill
MK8 0ER Milton Keynes

We hereby declare on our sole authority that the product meets the requirements of the following directives at the time of the declaration.
The declaration is rendered invalid if modifications are made to the product.

Product designation: Force/torque sensor system FTN-AXIA

ID number

- **Electromagnetic Compatibility Regulations 2016**

Applied harmonized standards, especially:

EN 61326-2-3:2013	Electrical equipment for measurement, control and laboratory use - EMC requirements – Part 2-3: Particular requirements – Test configuration, operational conditions and performance criteria for transducers with integrated or remote signal conditioning. (IEC 61326-2-3:2012)
EN ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction

Person authorized to compile the technical documentation:
Marcel Machado, address: refer to manufacturer's address

Signed for and on behalf of: SCHUNK GmbH & Co. KG

Lauffen/Neckar, November 2022

Dr.-Ing. Manuel Baumeister,
Technology & Innovation

10 Appendix to the declaration of conformity

This declaration of conformity is valid for all variants of the force/ torque sensor mentioned in this appendix.

FTN-interface

FTN-AXIA80-DUAL SI-75-4/SI-150-8
FTN-AXIA80-DUAL SI-200-8/SI-500-20
FTN-AXIA80-UR-DUAL SI-200-8/SI-500-20
FTN-AXIA80-DUAL SI-480-20/SI-1200-50
FTN-AXIA90-SI-1000-50
FTN-AXIA130-SI-2000-125
FTN-AXIA130-SI-4000-300

FTE-interface

FTE-AXIA80-DUAL SI-75-4/SI-150-8
FTE-AXIA80-DUAL SI-200-8/SI-500-20
FTE-AXIA80-DUAL SI-480-20/SI-1200-50
FTE-AXIA90-SI-1000-50
FTE-AXIA130-SI-2000-125
FTE-AXIA130-SI-4000-300

FTRS-interface

FTR-AXIA80-DUAL SI-75-4/SI-150-8
FTR-AXIA80-DUAL SI-200-8/SI-500-20
FTR-AXIA80-DUAL SI-480-20/SI-1200-50
FTRS422-AXIA90-SI-1000-50
FTRS422-AXIA130-SI-2000-125
FTRS422-AXIA130-SI-4000-300

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