



Commissioning instructions

FTE-AXIA

Force/torque sensor system

Translation of original commissioning instructions

Imprint

Copyright:

This manual is protected by copyright. The author is SCHUNK SE & Co. KG.
All rights reserved.

Technical changes:

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

Document number: 1009369

Version: 06.00 | 03/11/2025 | en

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

Tel. +49-7133-103-2503

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	5
1.1 About this manual	5
1.1.1 Presentation of Warning Labels	5
1.1.2 Applicable documents	6
1.2 Warranty	6
1.3 Scope of delivery	6
2 Basic safety notes	7
2.1 Intended use	7
2.2 Inappropriate use	7
2.3 Constructional changes	7
2.4 Spare parts	7
2.5 Personnel qualification	7
2.6 Disposal	8
2.7 Notes on particular risks	8
3 Technical data	10
3.1 Ambient conditions and operating conditions	10
3.2 Force-torque sensor	10
4 Design and description	11
4.1 Design	11
4.2 Description	11
4.3 Status LEDs	12
5 Assembly and settings	14
5.1 Installing and connecting	14
5.2 Electrical connection	14
5.2.1 Connecting the force/torque sensor	20
6 Start-up	21
6.1 Low-pass filter	21
6.2 EtherCAT bus interface	24
6.2.1 PDO interface	24
6.2.2 EtherCAT Dictionary Objects (SDO data)	24
6.3 Establishing communication with the sensor	39
7 Troubleshooting	40
7.1 LED error	40
7.2 Signal noise	40
7.3 Measurement data deviation / drift	41
7.4 Status code object 0x6010	41

7.5	Sensor and/or the EtherCAT program is not responding	42
7.6	Data output rate lower than expected	42
7.7	Sensor does not transmit data	43
7.8	Sensor does not report accurate force/torque data.....	43
7.9	Fluctuating force/toque data	44
7.10	Force/torque values are not equal to zero.....	44
8	EU Declaration of Conformity	45
9	UKCA Declaration of Conformity	46
10	Appendix to the declaration of conformity.....	47

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/downloads](https://www.schunk.com/downloads).

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

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

2 Basic safety notes

2.1 Intended use

The product is used to record, convert and evaluate analog output signals into electrical signals.

- Appropriate use of the product includes compliance with all instructions in this manual.

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

Modifications, changes or reworking, e.g. additional threads, holes, or safety devices, can damage the product or impair its functionality or safety.

- 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

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

Tab.: Ambient and operating conditions for sensor cable

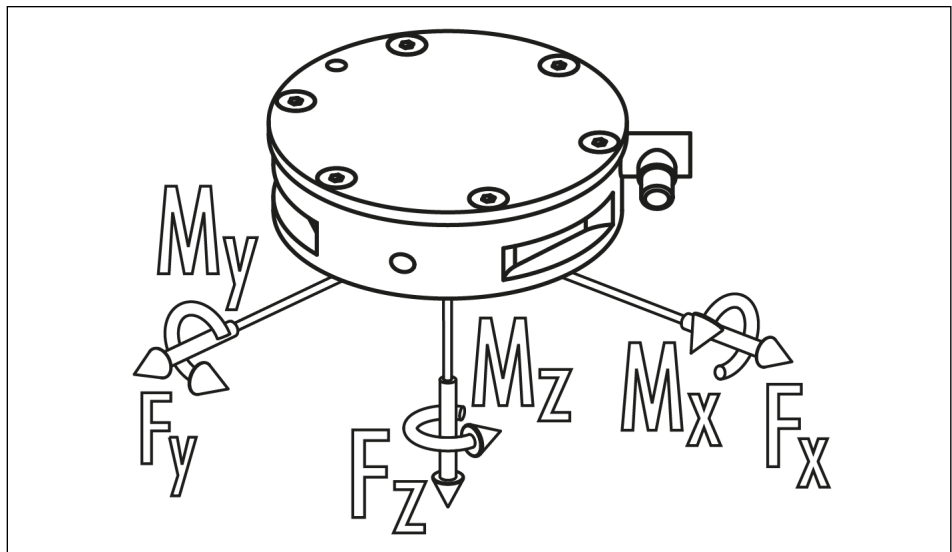
The catalog data sheet contains more information.

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.

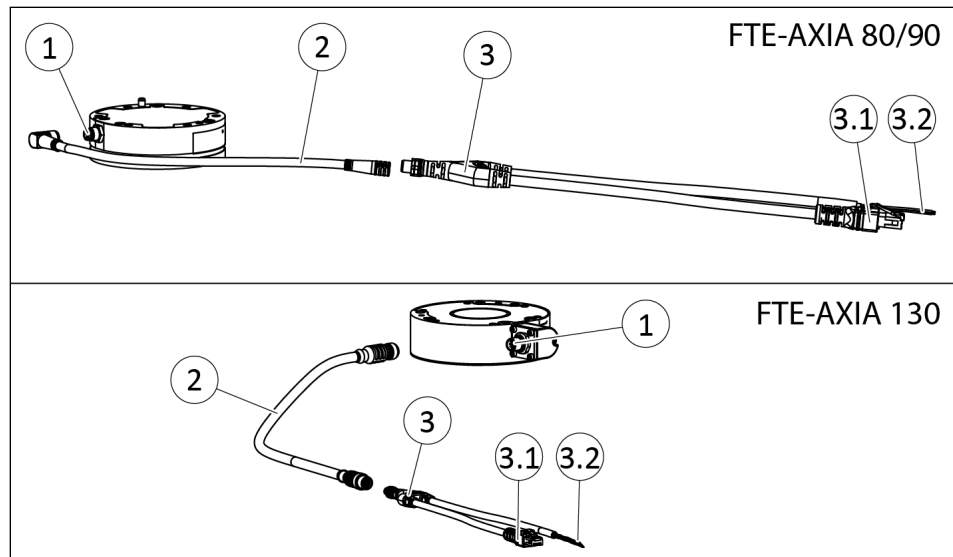


Dimensions and max. loads on the force-torque sensor

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 Design



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

4.2 Description

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

4.3 Status LEDs

LED self-test sequence The force/torque sensor has three LEDs: Link/Activity, Run, 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	Error	Red	
4	EtherCAT Link/Activity	Red	
5	Status	Green	
6	Run	Green	
7	EtherCAT Link/Activity	Green	
8	All	Off	
9	All	Normal operation	

Sensor status LED An LED indicates the status of the sensor 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.
Red (flashing at 10 Hz)	Communication error	The sensor is not able to transmit data via the communication protocol.
Red (flashing at 1 Hz)	Calibration error	The calibration was not saved in the EEPROM.
Red	Status code error	Information on the error record, ▶ 6.2.2.8 [31].

Run (error) LED

An LED indicates the connection/activity of the communication port as follows:

LED color	Status	Description
Off	No power supply	The sensor is not supplied with power.
Flashes green	Before operation	Defined in the communication/protocol standard record of the EtherCAT® Technology Group.
Flashes 1x green	Safe operation	
Green	Ready for operation	
Red	Error	Indicates an error reported by the sensor. LED remains red for five seconds after each error.

EtherCAT 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	Either no connection activity has occurred within 5 seconds or the sensor is not supplied with power.
Green	Link activity	Remains green for five seconds after the 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.

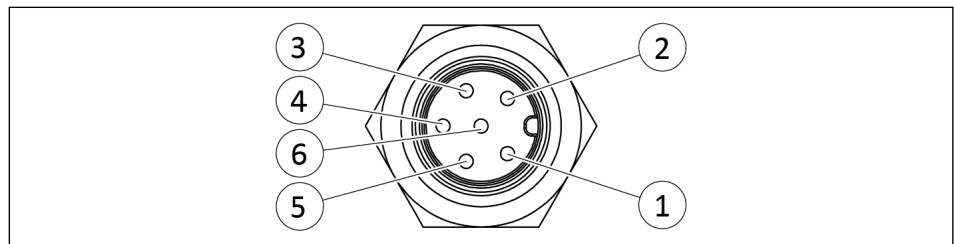
5.2 Electrical connection

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

Sensor connections

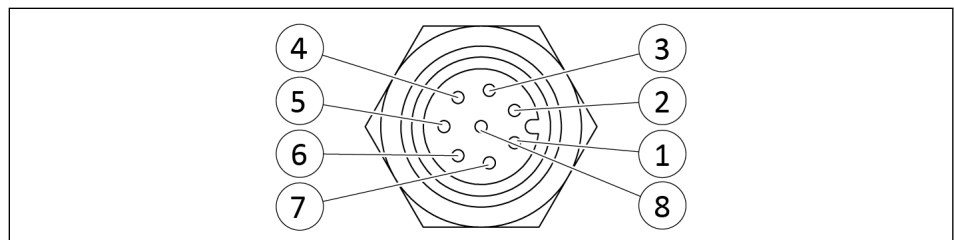
FT-AXIA 80



M8 sensor connector, 6-pin

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

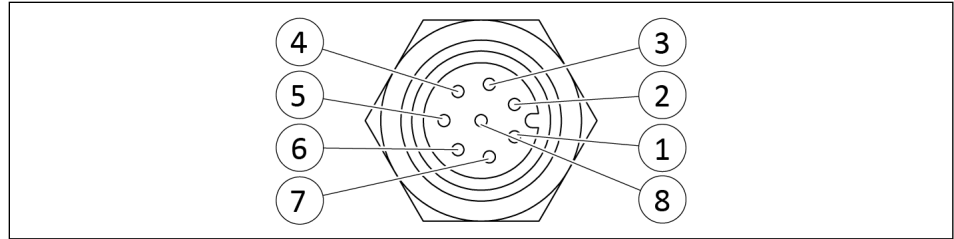
FT-AXIA 90



M8 sensor connector, 8-pin

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

FT-AXIA 130

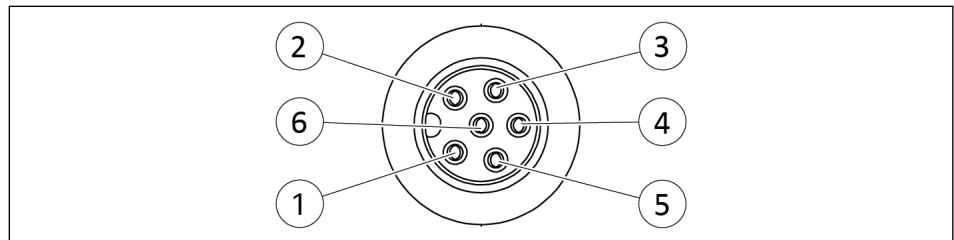


M12 sensor connector, 8-pin

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

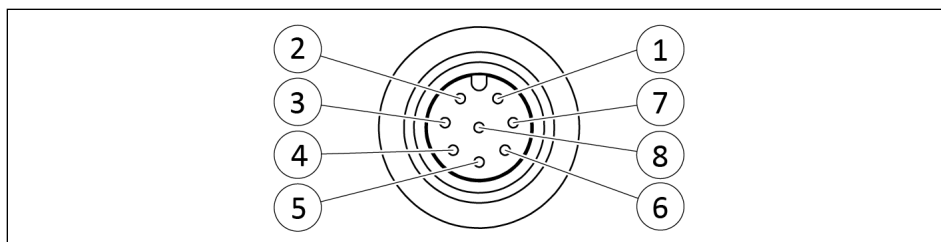
Sensor cable connections

FT-AXIA 80



M8 socket, 6-pin

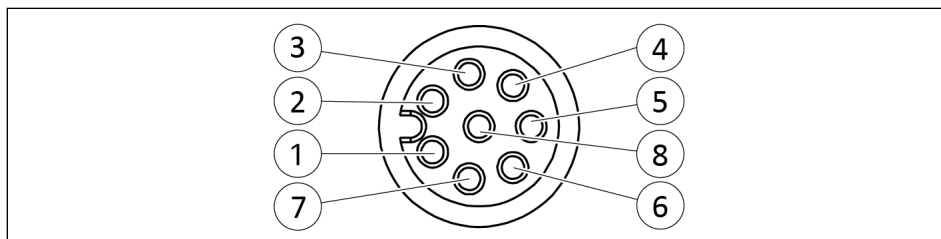
Pin	Signal
1	TX+
2	TX-
3	RX+
4	RX-
5	V+
6	V-
Housing	Shielding



M12 connector, 8-pin

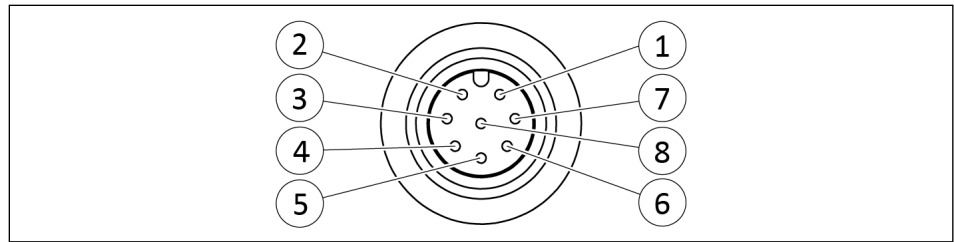
Pin	Signal
1	Reserved
2	V+
3	V-
4	TX-
5	RX+
6	TX+
7	Reserved
8	RX-
Housing	Shielding

FT-AXIA 80/90



M8 socket, 8-pin

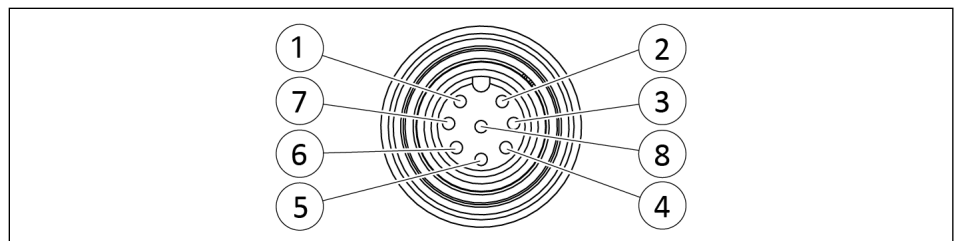
Pin	Signal
1	Reserved
2	V+
3	V-
4	TX-
5	RX+
6	TX+
7	Reserved
8	RX-
Housing	Shielding



M12 connector, 8-pin

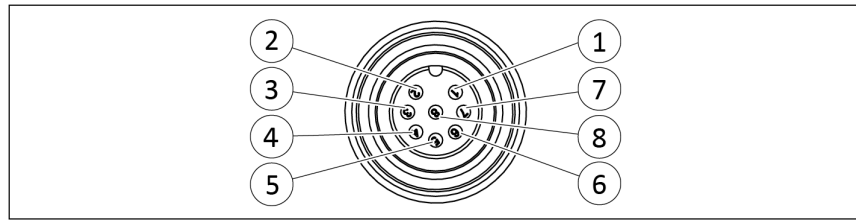
Pin	Signal
1	Reserved
2	V+
3	V-
4	TX-
5	RX+
6	TX+
7	Reserved
8	RX-
Housing	
Shielding	

FT-AXIA 130



M12 socket, 8-pin

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



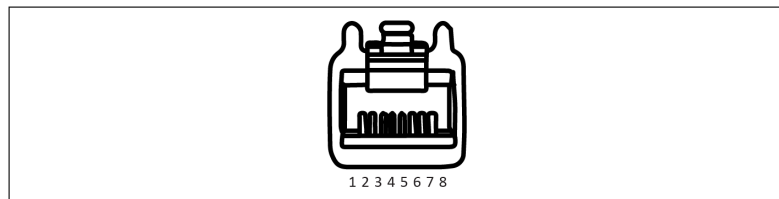
M12 connector, 8-pin

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

EtherCAT cable

Non-terminated end

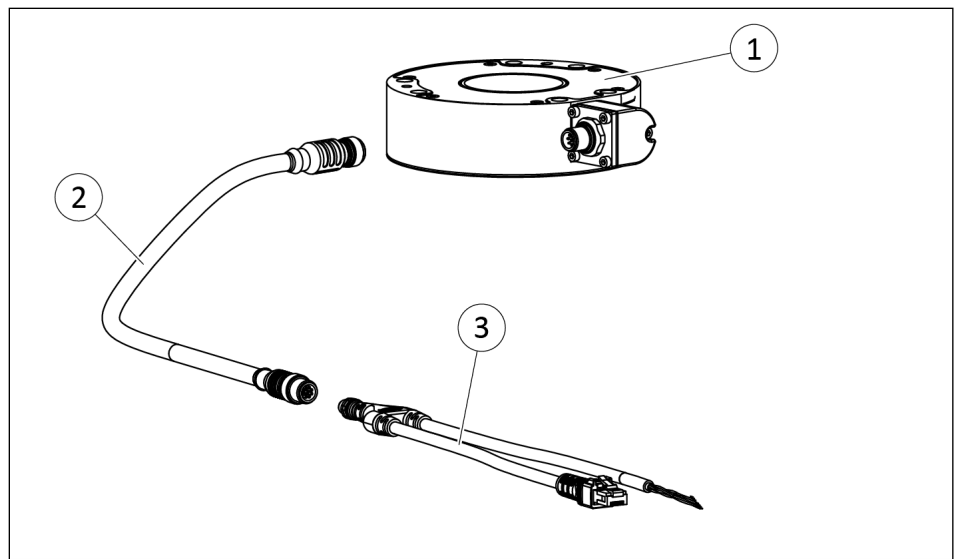
Wire sheath color	Signal
Braided metal shielding	Shielding (connect to ground)
Brown	V+
Brown/White	V-
Blue/White (TP1+)	Reserved
Blue (TP1-)	Reserved



EtherCAT 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	-	-

5.2.1 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.

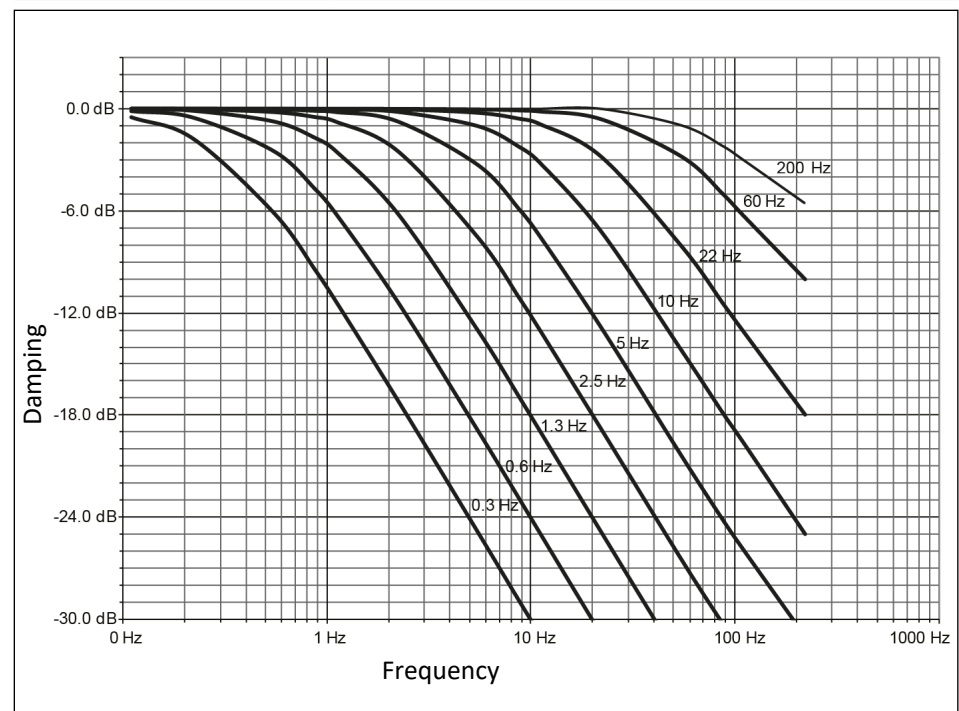
6 Start-up

6.1 Low-pass filter

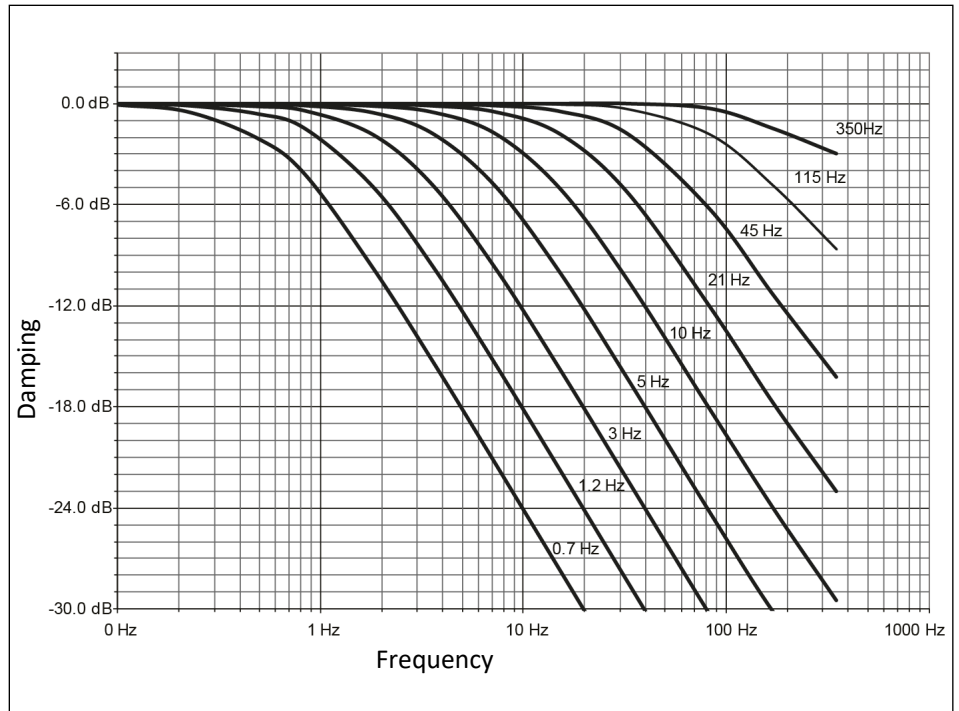
The switch-on option is "no filtering" as standard. The filter setting can be configured to reduce signal noise.

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:

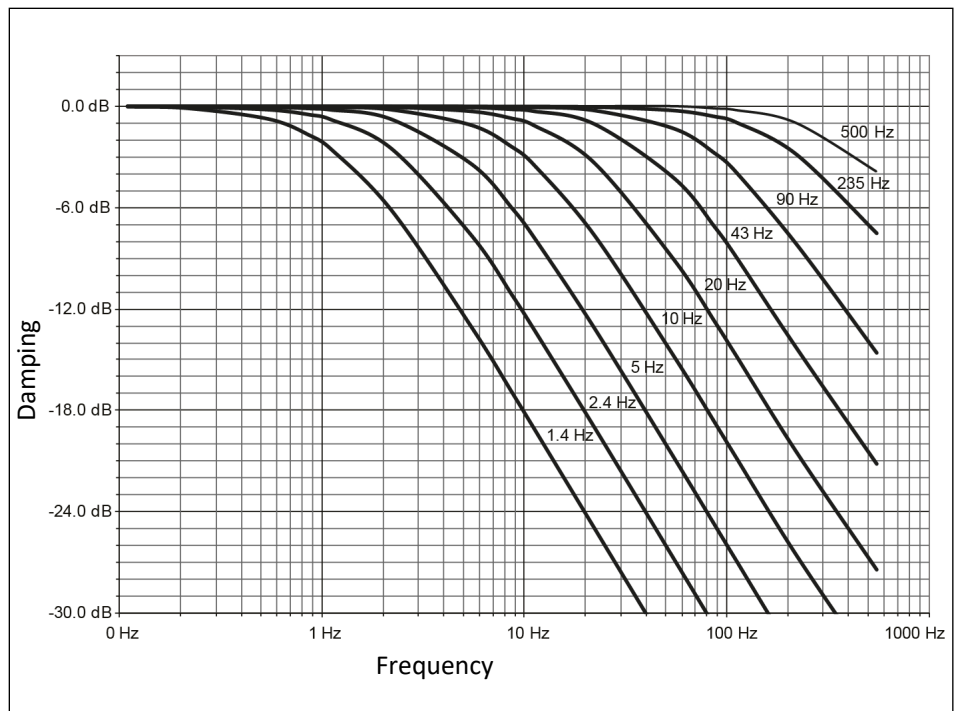
Selected filter	-3-dB cutoff frequency (in Hz)				
	at 0.5 kHz sampling rate	at 1 kHz sampling rate	at 2 kHz sampling rate	at 4 kHz sampling rate	at 8 kHz sampling rate
0	200	350	500	1000	2000
1	58	115	235	460	935
2	22	45	90	180	364
3	10	21	43	84	170
4	5	10	20	40	81
5	2.5	5	10	20	40
6	1.3	3	5	10	20
7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



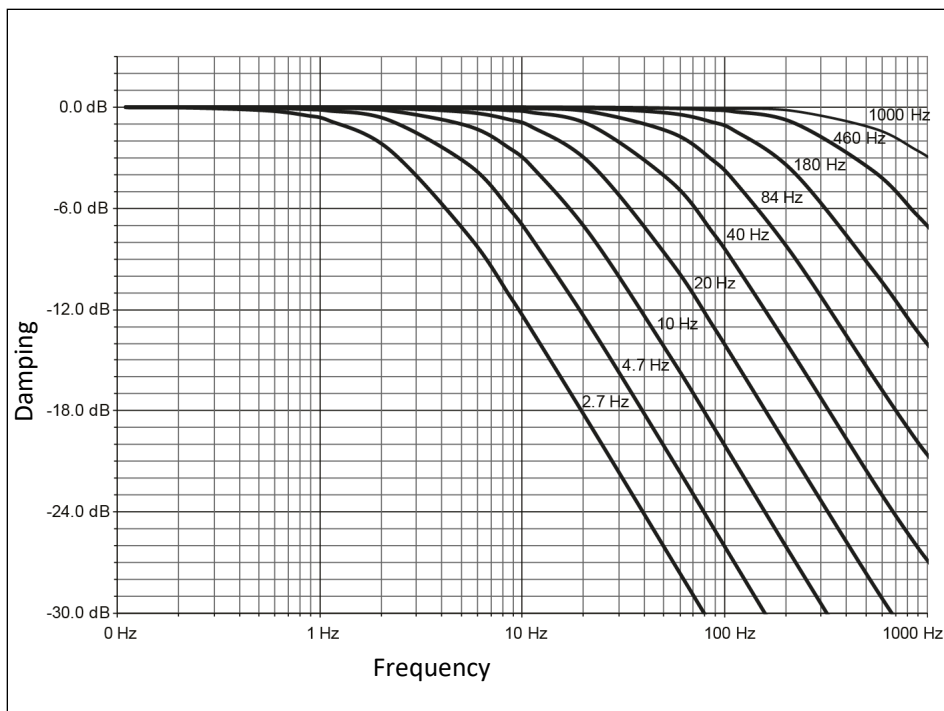
Filter damping at 0.5 kHz sampling rate



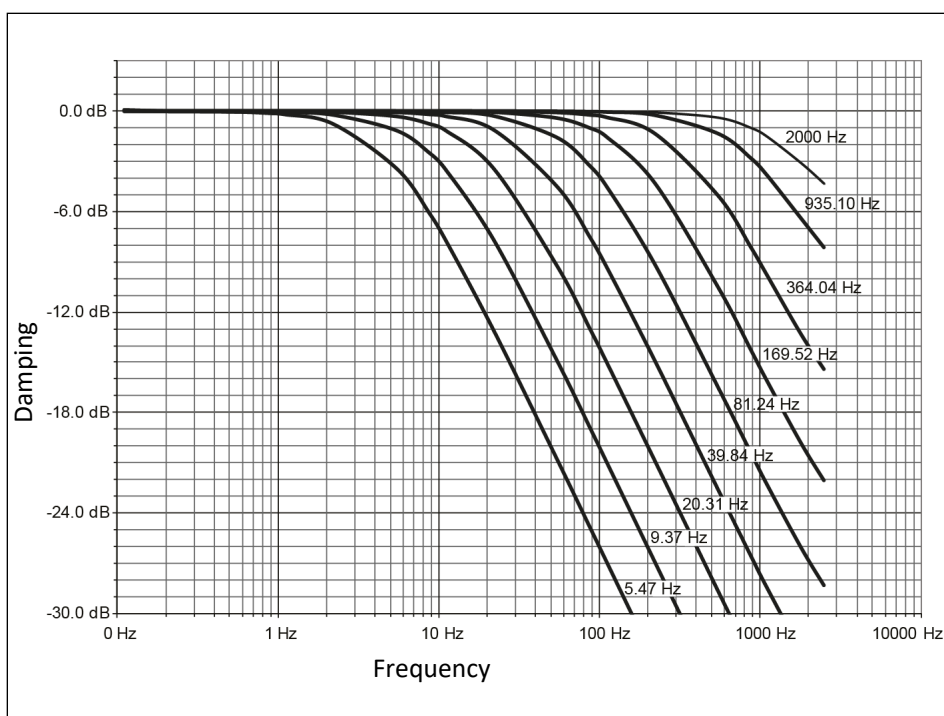
Filter damping at 1 kHz sampling rate



Filter damping at 2 kHz sampling rate



Filter damping at 4 kHz sampling rate



Filter damping at 8 kHz sampling rate

6.2 EtherCAT bus interface

The EtherCAT bus interface allows users to perform the following actions:

- Read the active calibration information and the serial number
- Read the firmware version
- Read the force/torque data
- Read the strain gauge data and status information
- Adjust the low-pass filter cutoff frequency
- Initial tension of the sensor
- Change the sampling rate

6.2.1 PDO interface

The PDO interface exchanges data with the sensor in real time.

- TxPDO Map / Output Data
The TxPDO combines ▶ [Object 0x6000: Read Data \[31\]](#), ▶ [Object 0x6010: Status Code \[31\]](#) and ▶ [Object 0x6010: Status Code \[31\]](#).
- RxPDO Map / Input Data
The RxPDO Map consists of ▶ [Object 0x7010: Control Codes \[35\]](#).

6.2.2 EtherCAT Dictionary Objects (SDO data)

The SDO data configures the sensor and reads the date of manufacture and calibration. This section lists dictionary objects that are specific to the EtherCAT force/torque sensor and some objects that are a required part of the standard defined by the EtherCAT® Technology Group.

6.2.2.1 Object 0x2019: Product description

This user-writable object allows this field to be changed to identify the sensor as part of its own system. This object is not visible to most users.

Sub index	Name	Description	Type	Standard value		
				Hexadecimal format	Decimal format	String
0x01	Vendor ID	This value is read to object 0x1018, subindex 0x01: Vendor ID	UDINT	0x00000732	1842	-
0x02	Product Code	This value is read to object 0x1018, subindex 0x02: Product Code.	UDINT	0x26483053	642265171	-

Sub index	Name	Description	Type	Standard value		
				Hexadecimal format	Decimal format	String
0x03	Product Name	This value is read to object 0x1008: Device name.	String(32)	-	-	"ATI Axia F/T Sensor"
0x04	Product Revision	This field is not used.	UDINT	N/A		
0x05	Product Serial Number		UDINT			
0x06	Manufacturer	This field identifies a company that has integrated the sensor into its branding system.	String(32)	-	-	"ATI Industrial Automation"
0x07	Commit	To use this field, the user must have been provided with a password. This field accepts changes to other fields within this object.	UDINT	0x00000000	0	-

6.2.2.2 Object 0x2020: Tool conversion

This writable object contains the following 32-bit signed integer fields:

This object can be used to display or change the settings for conversion of the function tool. Changes are confirmed by entering "123" in the "Commit" field at the lower edge of the object. To disable this function, set the three displacements and rotations to zero. This object contains the following fields:

Sub index	Name	Type	Description
0x01	Dx	STRING(12) Enter	Displacement along the X-axis in units of ttDistUnits.
0x02	Dy	elements as a floating point number in text form.	Displacement along the Y-axis in units of ttDistUnits.
0x03	Dz		Displacement along the Z-axis in units of ttDistUnits.
0x04	Rx		Rotation around the X-axis in units of ttAngUnits.
0x05	Ry		Rotation around the Y-axis in units of ttAngUnits.
0x06	Rz		Rotation around the Z-axis in units of ttAngUnits.
0x07	ttDistUnits	UINT8	Distance units: 0 = inch 1 = foot 2 = mm 3 = cm 4 = m
0x08	ttAngUnits	UINT8	Rotation units: 0 = degree 1 = radian
0x09	Commit	UINT8	Enter "123" to set changes.

6.2.2.3 Object 0x2040: Calibration

This read-only object contains information about the currently active calibration selected in the "Calibration Selection" field ▶ [Object 0x7010: Control Codes](#) [35]. It contains the following fields:

Sub index	Name	Type	Description	
0x01	FT Serial	STRING(8)	FT Serial number, e.g. "FT01234"	
0x02	Calibration Part Number	STRING(30)	Calibration e.g. "SI-500-20"	
0x03	Calibration family	STRING(8)	Is always "ECAT"	
0x04	Calibration time	STRING(30)	Sensor calibration date	
0x05 to 0x2e	Occupied.	DINT	Occupied.	
0x2f	Force Units	USINT	Value	Unit
			0	Lbf
			1	N
			2	Klbf
			3	Kn
			4	Kg
0x30	Torque Units	USINT	Value	Unit
			0	Lbf in
			1	Lbf ft
			2	N-m
			3	N-mm
			4	kgf cm
5	kN-m			
0x31	Max Fx Counts	DINT	Maximum value for this axis in counts	
0x32	Max. Fy Counts			
0x33	Max. Fz Counts			
0x34	Max. Tx Counts			
0x35	Max. Ty Counts			
0x36	Max. Tz Counts			
0x37	Counts per force	DINT	Calibration counts per unit of force	
0x38	Counts per torque	DINT	Calibration counts per torque unit	

Sub index	Name	Type	Description
0x39 to 0x56	Occupied.		
0x57	PeakLoadsPosFx3 (pos. Fx counts)	DINT	Peak loads positive. All-time peak value of the positive force/torque loads in counts.
0x58	PeakLoadsPosFy3 (pos. Fy counts)		
0x59	PeakLoadsPosFz3 (pos. Fz counts)		
0x5a	PeakLoadsPosTx3 (pos. Tx counts)		
0x5b	PeakLoadsPosTy3 (pos. Ty counts)		
0x5c	PeakLoadsPosTz3 (pos. Tz counts)		
0x5d	PeakLoadsNegFx3 (neg. Fx counts)		
0x5e	PeakLoadsNegFy3 (neg. Fy counts)		
0x5f	PeakLoadsNegFz3 (neg. Fz counts)		
0x60	PeakLoadsNegTx3 (neg. Tx counts)		
0x61	PeakLoadsNegTy3 (neg. Ty counts)		
0x62	PeakLoadsNegTz3 (neg. Tz counts)		
0x63 to 0x97	Occupied.		

6.2.2.4 Object 0x2022: Useful load and geometric data

This read-only object displays the useful load and geometric data values of the sensor. These values are stored in a non-volatile memory and are for reference only. None of these values affect the operation of the sensor. This object may not be available for all sensor models. The object contains the following fields:

Sub index	Name	Scaling factor	Units	Description	Type	
0x01	PayMass	/103	Kg	Mass of the useful load	DINT	
0x02	PayCogx	/103	mm	Useful load center of gravity		
0x03	PayCogy					
0x04	PayCogz					
0x05	Paylxx	/109	kg m ²	Mass moment of inertia tensor (or moment of inertia): The tensor determines the relationship between an applied torque and the resulting angular acceleration of a rigid body. The inertia tensor is specified relative to the coordinate system, which is located at the center of gravity of the sensor and aligned with the output coordinate system of the sensor. Measured on the center of gravity coordinate system.		
0x06	Paylyy					
0x07	Paylzz					
0x08	Paylxy					
0x09	Paylxz					
0x0A	Paylyz					
0x0B	TcpDx	/103	mm			Displacement of the TCP (Tool Center Point) with regard to the robot flange. Distance between the robot flange and new coordinate system.
0x0C	TcpDy					
0x0D	TcpDz					
0x0E	TcpRx	/103	Degree s	Rotation of the TCP with regard to the robot flange. (Convention: Euler Z-Y-X.)		
0x0F	TcpRy					
0x10	TcpRz					
0x11	Occupied.					

6.2.2.5 Object 0x2080: Diagnostic Readings

This read-only object allows access to diagnostic values. The following fields are available in this object:

Sub index	Name	Type	Description
0x01	Supply voltage	UINT16	The voltage of the external voltage supply x 10.
0x02	Temperature measuring device	INT16	The sensor temperature in °C x 10.
0x03	Status message	STRING (40)	A priority status code error message

Priority	Text error messages
1	Supply voltage outside the range.
2	Temperature measuring strip outside the range.
3	Calibration checksum error.
4	Measuring strip separated: <list>
5	Measuring strip outside the range: <list>
6	Force/torque outside the range.
7	Hardware or stack error
8	Simulated error
9	Replacement
10	Error (unspecified)
11	No status code error

6.2.2.6 Object 0x2090: Version

This read-only object provides information about the firmware version. The following fields are available in the version object:

Sub index	Name	Type	Description
0x01	Major	UINT	Major version
0x02	Minor	UINT	Minor version
0x03	Revision	UINT	Revision
0x04	Bootloader version	UDINT	Bootloader version
0x05	SensorHwVer	UINT	Sensor hardware version
0x06	Sensor-Instrument	UINT	Instrumentation version

6.2.2.7 Object 0x6000: Read data

This read-only object represents the current force or current torque included in the TxPDO input data. The following fields are present in the following read data:

Sub index	Name	Type	Description
0x01	Fx	DINT	These fields contain the 32-bit force/torque resolved data in counts.
0x02	Fy		
0x03	Fz	To specify the force data in units, the force resolution values must be divided by the count values per force field from the calibration object.	
0x04	Tx		
0x05	Ty		
0x06	Tz	To specify the torque data in units, the torque values must be divided by the count values per torque field from the calibration object.	

6.2.2.8 Object 0x6010: Status Code

This object contains a single DINT value (at subindex 0) with the following bitmap:

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): <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> Makes a change to object 0x2021. Changes the filter time constant. 	Yes

Bit number	Description	Indicates an error?
	<ul style="list-style-type: none"> Changes the calibration used. Changes the ADC sampling rate. Writes to flash memory. ADC ISR over stroke. 	
4	Occupied.	No
5	Hardware or stack error.	Yes
6–25	Occupied.	No
26	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
27	Strain gauge outside range: The bit is active if a strain gauge output has exceeded the operating range in one of the last 32 samples.	Yes
28	Simulated error. This bit reflects the "Simulated Error Control" bit (► Object 0x7010: Control-Codes [35]). It can be used to test the user's error handling.	Yes
29	Calibration checksum error. This bit is set if the active calibration has an invalid checksum.	Yes
30	Detection range exceeded: This bit is set when a force/torque measured value exceeds the calibrated range. This test is performed before digital filtering.	Yes
31	Error: This bit is set when a status code bit indicating an error is set.	Yes

6.2.2.8.1 Status code: Detection range exceeded

Bit 30 is set when a force/torque load is outside the sensor's detection capability.

■ Bit 30 is set if 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%. Refer to the following F_{xy} - T_z equation.

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

2. The total percentage of the calibrated range used by the F_z and T_{xy} axes is greater than 105%. Refer to the following F_z - T_{xy} equation.

$$\Rightarrow \frac{|F_z|}{F_z \text{ Calibrated Range}} + \frac{\sqrt{T_x^2 + T_y^2}}{T_{xy} \text{ Calibrated Range}} > 105\%$$

Axis	Applied load	Calibration range
F_x	475 N	2,000 N
F_y	-300 N	2,000 N
F_z	-1,000 N	4,000 N
T_x	10 Nm	125 Nm
T_y	20 Nm	125 Nm
T_z	-105 Nm	125 Nm

Tab.: Example of an AXIA 130 sensor outside the range

The equation $F_{xy} T_z$ can be simplified as follows:

$$\frac{\sqrt{(475\text{N})^2 + (-300\text{N})^2}}{2000\text{N}} + \frac{|-105\text{Nm}|}{125\text{Nm}} > 105\%$$

$$\frac{561.8\text{N}}{2000\text{N}} + \frac{105\text{Nm}}{125\text{Nm}} > 105\%$$

$$28.1\% + 84\% > 105\%$$

$$112.1\% > 105\%$$

TRUE

The $F_z - T_{xy}$ equation is simplified as follows: Since the simplified $F_{xy} - T_z$ equation is TRUE, bit 30 is set ▶ 6.2.2.8 [31].

$$\frac{|-1000\text{N}|}{4000\text{N}} + \frac{\sqrt{(10\text{Nm})^2 + (20\text{Nm})^2}}{125\text{Nm}} > 105\%$$

$$\frac{1000\text{N}}{4000\text{N}} + \frac{22.4\text{Nm}}{125\text{Nm}} > 105\%$$

$$25\% + 17.9\% > 105\%$$

$$42.9\% > 105\%$$

FALSE

6.2.2.9 Object 0x6020: Sample counter

This object contains a single 32-bit unsigned integer at subindex 0 that increases by one each time a force/torque sample is read (one complete measurement data record).

This number changes from 4 294 967 295 (2³²-1) to 0 without reporting an error. The sample counter is reset to zero when the instrument is switched on.

6.2.2.10 Object 0x7010: Control Codes

This object is included in the RxPDO for real-time control of the force/torque system. It contains the following fields:

Sub index	Name	Type	Description	
0x01	Control 1	DINT	Bit Function	
			0	1 = set initial tension (tare) against current load 0 = Use last set initial tension *
			1	Occupied
			2	1 = Significant initial tension 0 = Leave initial tension unchanged
			3	Occupied
			4-7	Low-pass filter selection 0 = No filtering 1-8 = Filter type details ▶ 6.1 [21]
			8-11	Active calibration 0 = Using calibration in slot 02 1 = Using calibration in slot 12 2-15 = Occupied Calibration ranges: Sensor assembly and operating manual.
			12-15	Sampling rate 0 = 488 Hz 1 = 976 Hz 2 = 1953 Hz 3 = 3906 Hz 4 = 7812 Hz
16-31	Occupied			
0x02	Control 2	DINT	Bit Function	
			0-30	Occupied
			31	Simulated error control

* This bit must be returned to 0 for the sensor to read properly, after a bias command is entered. If this bit is held at 1, then the sensor will continuously bias and output readings of zero in all axes.
For the calibration ranges, refer catalogue data sheet.

6.2.2.11 Object 0x1008: Device designation

This read-only object describes the name of the device. The EtherCAT® Technology Group defines the structure of this object, but leaves it as optional.

Type	Description	Standard value (string)
STRING	The name of the device as a non-zero-terminated string. Do not use for product identification.	"ATI Axia F/T Sensor"

6.2.2.12 Object 0x1018: Identity

This read-only object contains information about the connected EtherCAT device. The EtherCAT® Technology Group defines the structure of this object.

Subindex (Hex)	Name	Operating principle	Type	Standard value (hex)	Standard value (decimal)
0x01	Vendor ID	This vendor ID number is assigned by the EtherCAT® Technology Group.	UDINT	0x00000732	1842
0x02	Product Code	This product code is uniquely assigned by ATI to the EtherCAT AXIA sensors.	UDINT	0x26483053	642265171
0x03	Revision Number	This field is subject to change and should not be used for identification purposes.	UDINT	N/A	
0x04	Serial Number	This field is subject to change and should not be used for identification purposes.			

6.2.2.13 EtherCAT objects not used

The EtherCAT® Technology Group defines the structure of these objects, but leaves them as optional. These fields are not currently used. The following table shows which objects should be referenced.

Object index (Hex)	Object name	Type	Cross reference to the range objects	Standard value (hex)	Standard value (decimal)
0x1001	Error register	USINT	For monitoring the status code of the force/torque sensor, ▶ see section 5.2.1.8 – Object 0x6010: Status code [31]C	0x00	0
0x1009	Hardware version	STRING	To display the hardware version of the force/torque sensor, ▶ see section 5.2.1.6 – Object 0x2090: Version. [30].	N/A	
0x100A	Software version	STRING	For information on displaying the software version of the sensor, ▶ see section 5.2.1.6 – Object 0x2090: Version [30].		

6.2.2.14 Object 0x1008: Device designation

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 (▶ see table 5.9 [31])	Bit pattern
0	Temperature	0x80000001
1	Supply voltage	0x80000002
2	Defective measuring device	0x80000004
3	Occupied bit	0x80000008
4	Occupied	N/A

Bit number	Simple description (▶ see table 5.9 [31])	Bit pattern
5	Other	0x80000020
6–25	Occupied	N/A
26	Measuring device outside the range warning	0x84000000
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".

6.3 Establishing communication with the sensor

The following steps guide the user through initialization of communication between the EtherCAT AXIA sensor and the customer's EtherCAT master device. Refer to the software manual for the EtherCAT master device for the most suitable instructions for the application. When using a PC, make sure that the network adapter of the PC is compatible with the customer's EtherCAT master software for EtherCAT communication.

1. Connect the sensor to the EtherCAT and power lines. Observe the pin allocation ▶ 5.2 [14] and the Sensor Assembly and Operating Manual.
2. Import the ECAT AXIA ESI file located at https://www.atia.com/Products/ft/software/axia_software.aspx.
NOTICE! The specific steps to import the ESI file vary depending on the different EtherCAT master software and hardware available to the customer.
3. Configure the EtherCAT master device for communication with the EtherCAT sensor.
4. Read the calibration data at system startup with an SDO Read in the EtherCAT master software on object 0x2021, the calibration object.
5. After obtaining each real-time PDO sample, divide the force and torque count values by the count values per force and the count values per torque from the calibration object to calculate the force/torque unit values.
 - The force/torque units correspond to the units specified in the calibration.
 - For different units, the software for the EtherCAT master device can adjust the counts per force and counts per torque values so that the resulting units correspond to the desired units.

- Example: The calibration outputs 1,000,000 counts per Newton (N). To calculate the output in counts per pound of force (lbf), perform the following conversion:

$$\frac{1,000,000 \text{ counts}}{1 \text{ N}} \times \frac{4.4482222 \text{ N}}{1 \text{ lbf}} = 4,448,222 \text{ counts/lbf}$$

7 Troubleshooting

7.1 LED error

Possible cause	Corrective action
Status LED remains red after the 20-second switch-on phase.	Check the force/torque sensor cable for damage and correct connection. There may be an internal error in the sensor. Check status code ▶ 6.2.2.8 [31].
Status LED lights up red for the first 20 seconds after switching on and then turns green.	Normal.
EtherCAT Link/Activity LED is not green or flashes green.	Ensure that the EtherCAT master device has the correct ECAT ESI file, ▶ 6.3 [39]
EtherCAT Link/Activity LED does not light up (no activity and the sensor is supplied with power).	Make sure that the correct port (on the EtherCAT master or junction) is switched on and allows communication.

7.2 Signal noise

Possible cause	Corrective action
Signal noise is defined as jumps in force and torque values >0.05% of full scale values. Signal noise is caused by mechanical vibrations or electrical interference.	Ensure that the system is properly grounded and isolated from external electrical interference.
A component in the system has failed.	Check the overall system for failure of a component. Check the force/torque sensor status code ▶ 6.2.2.8 [31].
Mechanical sources of interference.	Avoid mechanical sources of interference. If not possible, use a low-pass filter. ▶ 6.1 [21].

7.3 Measurement data deviation / drift

Possible cause	Corrective action
Measured values are not completely reset after loading and unloading. Drift is easier to observe on the Z-axis than on the X and Y-axes.	<p>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.</p> <p>Use the bias command to set the measured values back to zero.</p> <p>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.</p>

7.4 Status code object 0x6010

Possible cause	Corrective action
Bit 1 active – supply voltage is outside the range.	Restart the system.
Bit 3 active – The sensor is busy making a change.	After applying the changes, wait until the busy bit is off
Bit 2, 26, 27, or 30 outside the range – The sensor may have been overloaded and the strain gauges are now in a saturated condition.	<p>Remove applied loads. If the errors do not disappear, continue troubleshooting.</p> <p>Disassemble sensor. Improper mounting methods can lead to high sensor loads. Change to a larger calibration size if the application requires loads that are outside the range of the smaller calibration size.</p> <p>If errors such as "Scanning range exceeded", "Measuring device outside the range" or "Measuring device broken" persist after using the larger calibration size and without applying a load, the sensor is probably permanently damaged due to overload.</p>

7.5 Sensor and/or the EtherCAT program is not responding

Possible cause	Corrective action
The sensor does not have a sufficient power supply.	Ensure that the power supply unit meets the requirements ▶ 3 [10]. Make sure that the lines are not damaged and are properly connected.
The software ESI file is not installed correctly or is not up to date.	SCHUNK offers several EtherCAT products that use different ESI files. Download the latest EtherCAT Axia ESI file from the SCHUNK website. Load this ESI file into the EtherCAT master. The way you download the file depends on the master. ESI files are also referred to as .XML files or device description files. ▶ 6.3 [39]
Third party hardware is not compatible with EtherCAT.	Check whether the robot/PLC/PC acts as EtherCAT master. Use EtherCAT junctions to split signals as standard Ethernet switches do not work with EtherCAT. If the master device has multiple ports, check that the sensor is connected to the correct port. Some PC EtherCAT masters require the installation of special drivers for the system to work properly with EtherCAT.
The sensor has a hardware or software error.	Observe LEDs ▶ 4.3 [12].

7.6 Data output rate lower than expected

Possible cause	Corrective action
The ADC and EtherCAT data rate may be set too high on an older version of the EtherCAT Axia sensor.	Check the calibration certificate of the sensor. If the "Electronics" field on the calibration certificate is listed as "Axia EtherCAT F/T", reduce the ADC sampling rate and the EtherCAT data rate. Only the EtherCAT Axia Gen-2 series can maximize these two rates simultaneously.

7.7 Sensor does not transmit data

Possible cause	Corrective action
The user's devices are not compatible with real-time EtherCAT communication.	Make sure that the sensor system is compatible with EtherCAT real-time communication.
The connection from the user's device to the sensor is interrupted.	Try a direct connection between the user's EtherCAT device and the sensor. Standard Ethernet network switches cannot be used in EtherCAT systems. If required, use an EtherCAT junction device instead of Ethernet switches.
The sensor has a hardware or software error.	Observe LEDs ▶ 4.3 [12].

7.8 Sensor does not report accurate force/torque data

Possible cause	Corrective action
The sensor may have been overloaded beyond its calibration limits.	Check status code ▶ 6.2.2.8 [31]. Error bits related to overload are: 2, 26, 27 and 30.
The configuration of the sensor system is not set correctly.	Check for proper assembly ▶ 5 [14].
The user has activated the tool conversion.	Check application of a tool conversion and adjust if necessary. If all fields are 0, the tool conversion is not applied. ▶ Tool conversion [26].
The sensor is not installed properly	Check for proper assembly ▶ 5 [14].
Mechanical coupling – an external object, such as a customer tool or aid, is touching the surface of the sensor between the mounting side and the tool side.	Thoroughly clean the sensor body and adapter plate of dirt. Use suitable cable routing for cables and hoses. Anything that touches surfaces such as the through-bore in the sensor or cover plates on both sides of the sensor will lead to loads or movements that can result in inaccurate force/torque data.

7.9 Fluctuating force/torque data

Possible cause	Corrective action
The user may see measuring device data instead of force/torque data.	Object 0x6030: Gage Data reports strain gauge data. Measurement data is not a 1:1 correlation to force/torque axis data. Show force/torque data, ▶ 6.2.2.7 [31].
The sensor is outputting data in count values. Counts must be divided by counts per force (CpF) or counts per torque (CpT) to convert to calibration units (such as N and Nm).	Verify that the user or user's software scales the force/torque values for conversion to units. Use CpF and CpT values to convert force/torque raw values into units. CpF and CpT values, ▶ 6.2.2.3 [27].
If the raw force/torque values have already been converted to units and the values are high or nonsensical, verify that the sensor is not in one of the following states: Saturation, strain gauge outside the range, or force/torque outside the range. Check the status code of the sensor, ▶ 6.2.2.8 [31].	If the values exceed the calibration range of the sensor, the reported values will be incorrect.

7.10 Force/torque values are not equal to zero

Possible cause	Corrective action
The initial force/torque values are not equal to zero and no load is applied.	Normal. Set the sensor to zero via BIAS to return all force/torque values to zero.

8 EU Declaration of Conformity

Manufacturer/
Distributor

SCHUNK SE & Co. KG
Spanntechnik | Greiftechnik | Automatisierungstechnik
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 FTE-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:

IEC 61326-2:2022 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 61326-2-3:2020)

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 SE & 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 FTE-AXIA

ID number

- **Electromagnetic Compatibility Regulations 2016**

Applied harmonized standards, especially:

IEC 61326-2:2022 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
 61326-2-3:2020)

Person authorized to compile the technical documentation:

Marcel Machado, address: refer to manufacturer's address

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



Lauffen/Neckar, November 2022

Dr.-Ing. Manuel Baumeister, Head of Systems
Engineering, 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



SCHUNK SE & Co. KG
Spanntechnik | Greiftechnik | Automatisierungstechnik

Bahnhofstr. 106 - 134
D-74348 Lauffen/Neckar
Tel. +49-7133-103-0
info@de.schunk.com
schunk.com

Folgen Sie uns | *Follow us*



Wir drucken nachhaltig | *We print sustainable*