Commissioning instructions
FTR-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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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

- FTR-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 RS422 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	67

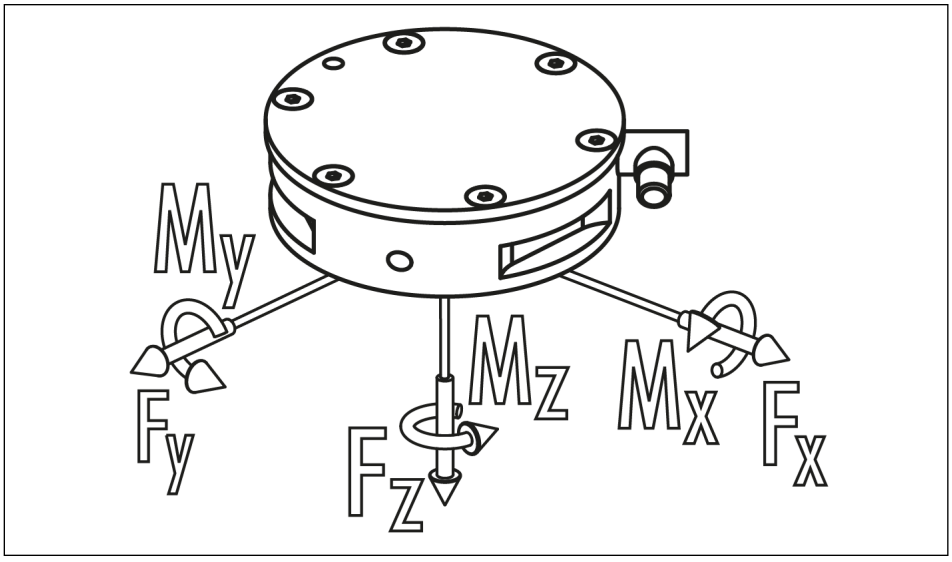
The catalog data sheet contains more information.

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 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 calibration was not saved in the EEPROM.
Red (flashing at 10 Hz)	Communication error	The sensor is not able to transmit data via the communication protocol.
Red	Status code error	Information on the error record, ▶ 7.1 [🗋 32].

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 [🗋 12].
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

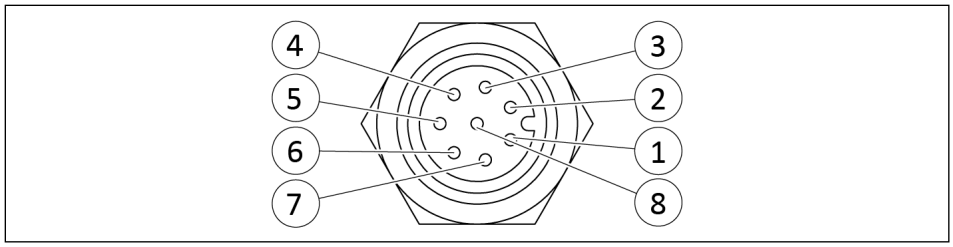
Power supply requirements

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 80/90

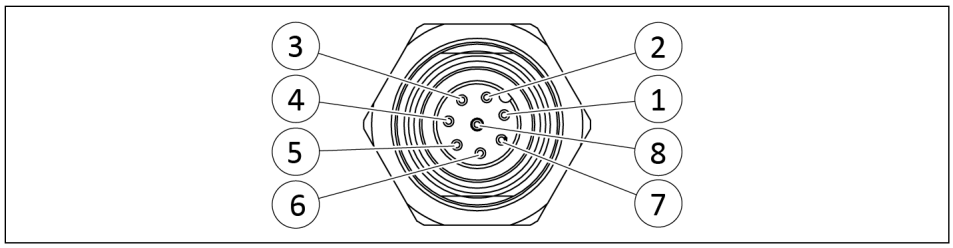


M8 sensor connector, 8-pin

Pin	Signal
1	Clock sync mass1 *
2	V+
3	V- / ground
4	RS422_TX-
5	RS422_RX+
6	RS422_TX+
7	Clock sync *
8	RS422_RX-
Housing	Shielding

* Optional, only when using the clock synchronization functionality, ▶ 6.4 [🗋 28]

FT-AXIA 130



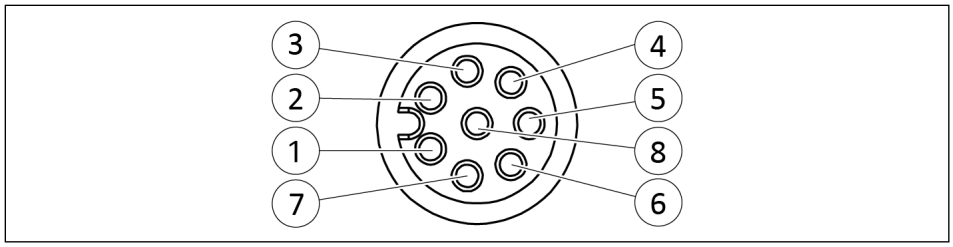
M12 sensor connector, 8-pin

Pin	Signal
1	Clock sync mass1 *
2	V+
3	V- / ground
4	RS422_TX-
5	RS422_RX+
6	RS422_TX+
7	Clock sync *
8	RS422_RX-
Housing	Shielding

* Optional, only when using the clock synchronization functionality, ▶ 6.4 [🗋 28]

Sensor cable connections

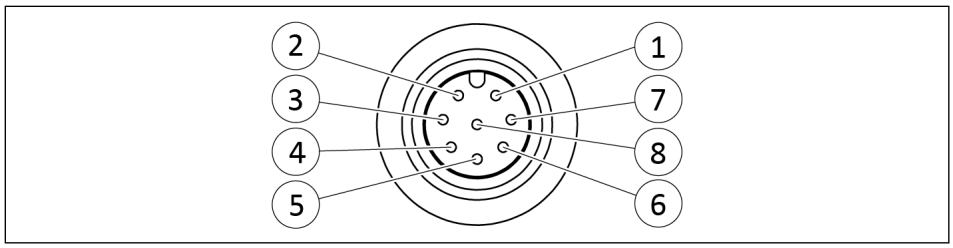
FT-AXIA 80/90



M8 socket, 8-pin

Pin	Signal
1	Clock sync mass1 *
2	V+
3	V- / ground
4	RS422_TX-
5	RS422_RX+
6	RS422_TX+
7	Clock sync *
8	RS422_RX-
Housing	Shielding

* Optional, only when using the clock synchronization functionality, ▶ 6.4 [🗋 28]

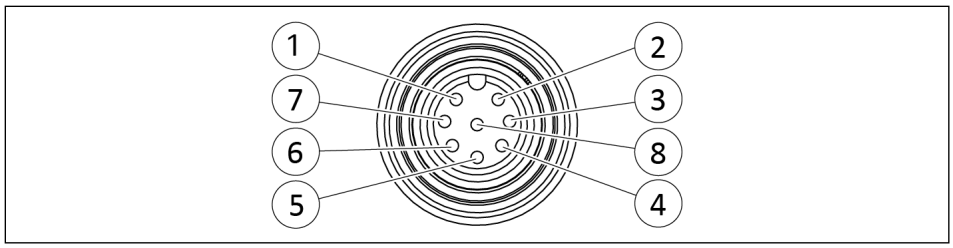


M12 connector, 8-pin

Pin	Signal
1	Clock sync mass1 *
2	V+
3	V- / ground
4	RS422_TX-
5	RS422_RX+
6	RS422_TX+
7	Clock sync *
8	RS422_RX-
Housing	Shielding

* Optional, only when using the clock synchronization functionality, ▶ 6.4 [🗋 28]

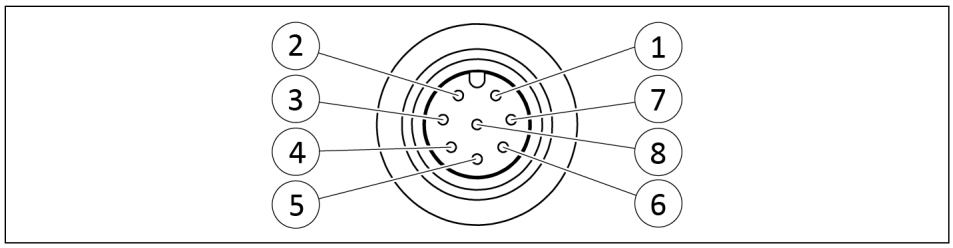
FT-AXIA 130



M12 socket, 8-pin

Pin	Signal
1	Clock sync mass1 *
2	V+
3	V- / ground
4	RS422_TX-
5	RS422_RX+
6	RS422_TX+
7	Clock sync *
8	RS422_RX-
Housing	Shielding

* Optional, only when using the clock synchronization functionality, ▶ 6.4 [🗋 28]



M12 connector, 8-pin

Pin	Signal
1	Clock sync mass1 *
2	V+
3	V- / ground
4	RS422_TX-
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6	RS422_TX+
7	Clock sync *
8	RS422_RX-
Housing	Shielding

* Optional, only when using the clock synchronization functionality, ▶ 6.4 [🗋 28]

6 Start-up

6.1 Setting up the serial communication interface

The sensor is automatically assigned a COM port as soon as a cable connection to a computer is established.

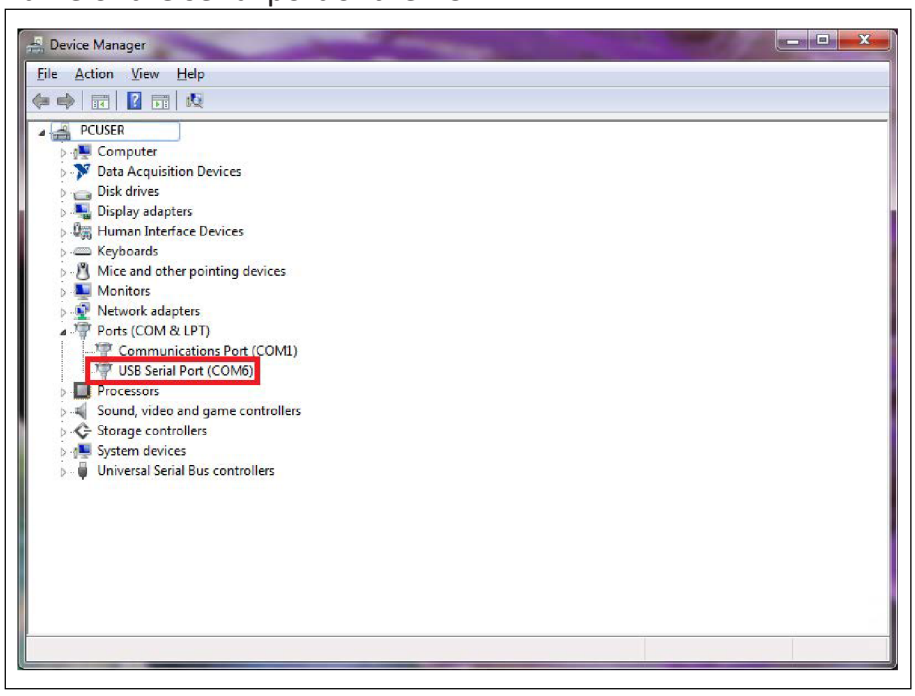
Using a serial console on the computer, the user can communicate with the sensor.

1. If the customer device does not have a serial port, a third-party serial device can be used to add the port.

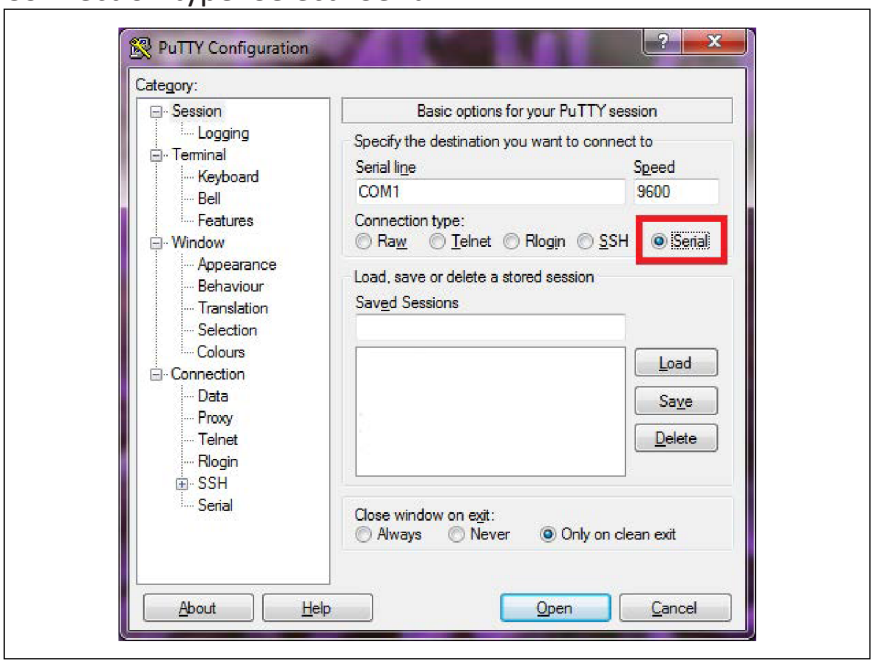
   Examples of a third-party serial device include: a high-speed USB-to-RS422 adapter module or a PCI/PCI-E/PCI-X RS422 serial card.

2. Connect the serial cable of the sensor to the serial port.
3. Search COM port of the sensor.

   Control Panel to Device Manager > Ports > USB Serial Port. In the following illustration, COM6 is assigned to the sensor.
   Note: The name of the device may differ depending on the name of the serial port of the PC.

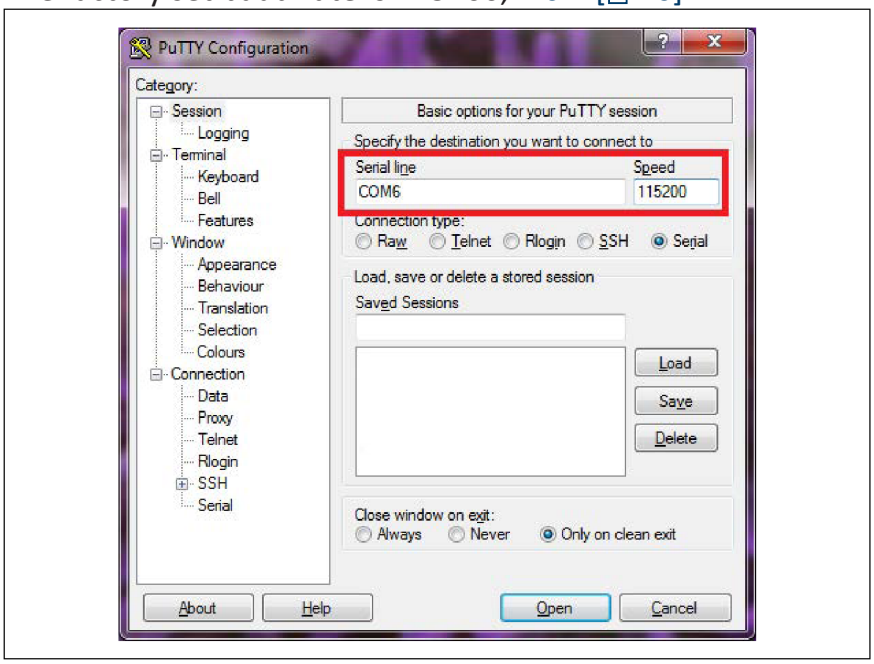


4. Open serial console. A window opens where the user can set the configuration for the session.
5. Set configuration:
   – Connection type: Select "Serial".



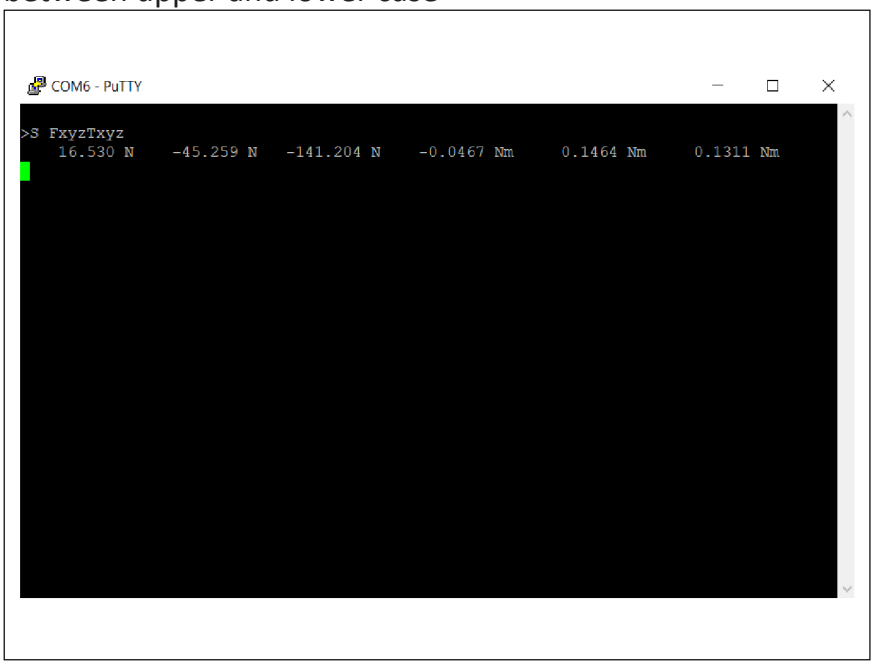
   – Enter the com port from Step 3 in the "Serial line" field.

– Enter the standard baud rate of 115200 or the set baud rate of the sensor in the "Speed" field.
Note: If the baud rate set in the serial console configuration does not match the baud rate set on the sensor, the console terminal window will open but no commands can be sent.
The factory set baud rate is 115200, ▶ 6.2 [🗋 26].



– Select "open".
– After a terminal window opens, the user can start entering commands.
– After a command has been entered, press the Enter key to send the command, ▶ 6.2 [🗋 19].
Note: When entering commands, no distinction is made

between upper and lower case



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6.2 RS422 serial commands

Help command: "help", "h", or "?"

The help command outputs a list of the most important commands as well as the software version.

Command	Description
HELP	Output help for commands that start with the specified character string
SYSVER	Print version
WHOAMI	Print console input source
BIAS	[ON | OFF | <Value>] => User orientation control
PEAK	[R | C] => View, reset runtime peaks, display in counts
SET	Print all fields [Field name] => Print appropriate field(s) [Field name] [Value] => Write field with value
VIEW	[0 -> 2 | A] => Display calibrations: 0 to 2, or active
DIAG	Diagnostic status report
SIMERR	[ON | OFF] => Control simulated error
RESET	Reset the MCU

Command	Description
STATUS	Print status report
PINS	Print "Pins" report
GPIOS	Print GPIO configuration report
SAVEALL	Save all parameters in the NVM
C	[HDB01234567FTXYZMS in any order] => Continuous mode. 0->7=displays XYZ=forces/ torques M=size C=counter U=units H=hex D=decimal B=binary F=force T=torque '>'=compressed '<'=formatted S=checkSum #=LineCounter @=ADC_SampleCounter ! =StatusWord;=comma separator -- Press multiple keys to exit.
S	Single sample, same format as in continuous mode
FLOW	Signal flow report
MC	Print all monitor conditions
UART	Print report of the last bytes received

Command: "reset"

The "reset" command resets the MCU.

Interrogation commands "S" or "C"

The interrogation command starts the high-speed data transmission of force/torque data.

The "S" command reports a single line of force/torque data that is scaled by counts per force or counts per torque.
The "C" command reports continuous lines of force/torque data that stop as soon as another button is pressed. The "C" command reports data at the rate specified in rdtRate.

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.

Converting count values per force/torque to force/torque 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.

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

The data type reported by the interrogation 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 illustrations such as charts. If an "S" or "C" command is issued without a specifier, the specifier of the previous "S" or "C" command is used for the data printout. The default specifier at power-up is "FXYZTXYZ".

Category	Secondary command or specifier	Notes
Gage number(s)	0	The measured values are printed only in counts.
	1	
	2	All test mean values as well as just one test mean value can be specified.
	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 force and torque numbers or technical units.
	Y	
	Z	
Force and/or Torque	F	The XYZM force data is displayed.
	T	The XYZM torque data is displayed.
Magnitude	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 force and torque 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.

Category	Secondary command or specifier	Notes
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.
Troubleshooting	!	This command specifies the 32-bit status code, ▶ 6.2 [🗋 22].

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.

Example bit pattern

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
6-26	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

Bit number	Simple description	Bit pattern
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	00 0000 0000 0000 0000 00	0	0	0	1	0	1
Bit position	**31**	**30**	**29**	**28**	**27**	**26 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".

Command: "bias"

The "bias" command reports the current bias status of the sensor.

Secondary bias commands: "on", "off", "[values]".

The secondary commands allow the user to turn the bias function on and off. Switching the function on sets the force/torque output to 0. Switching the function off clears the bias bit. In addition, the user can preload the sensor with user-defined values.

Command: "peak"

The "peak" command reports the highest and lowest force/torque values that have occurred for a runtime and for all of the times. The peak reset command resets only the runtime peaks.

All time peaks are the largest values observed while the sensor was on and operating. When the sensor is turned on, the sensor records the peak values detected on each individual axis. If the sensor detects all-time peak values that are higher than the factory settings, the sensor has been loaded beyond the intended calibrated detection range.

Command: "saveall"

The "saveall" command stores all values that are retained after a power failure in the NVM.

Command: "set"

The "set" command reports all settings. Many settings are read-only fields that are configured on the sensor during factory calibration.

"set" fields

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 force/ torque 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

Calibration range command: "set calib".

The user can adjust the calibration range or the index number with the command: "set calib".

0 = Calibration range 0
1 = Calibration range 1

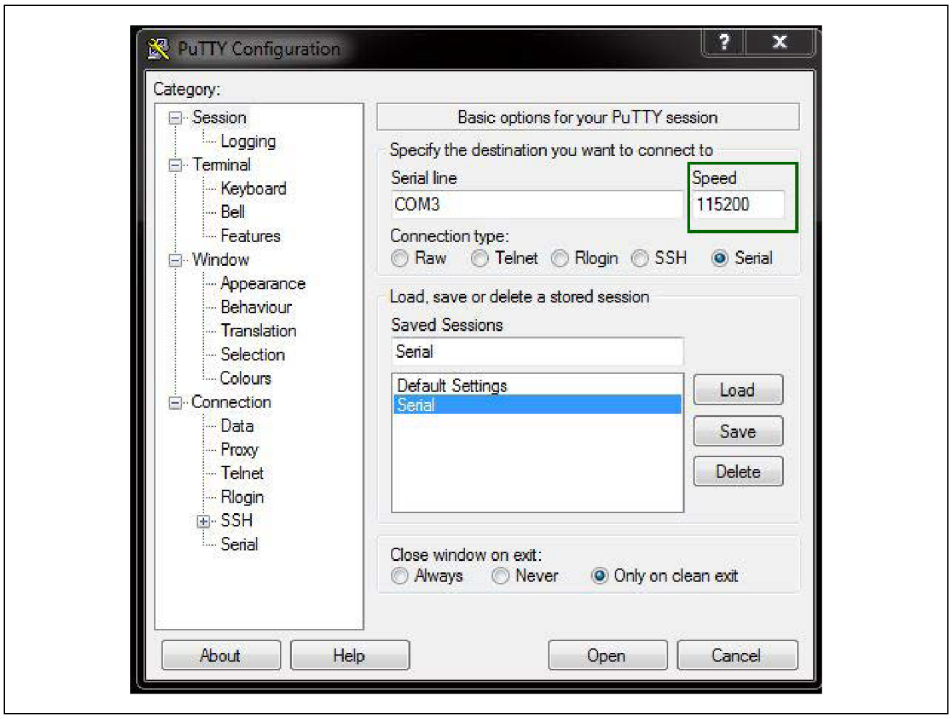
Calibration command: "view"

The "view" command displays characteristics such as force/torque part number, units, calibration date, calibration family of a particular calibration or multiple calibrations. The command can be used in conjunction with a second operand.

0 = calibration 0
1 = calibration 1
A = active calibration
- (no operand) = all calibrations

Baud rate command: "set baud"

The user can adjust the baud rate of the sensor. The baud rate must be a value between 300 and 3000000.



Change the speed to match the adjusted baud rate

Simulated error command: "simerr"

The command: "simerr" refers to bit 28, ▶ 7.1 [🗋 32]. The command can be issued to indicate the status of bit 28 or to switch bit 28 on or off. The simulated error command is useful for customers who need to test their error handling routines. When a simulated error occurs, the red status LED lights up, ▶ 4.1 [🗋 10].

Diagnostic status command: "diag"

This command provides a report for each of the measuring devices within the sensor. The information can be compared with the calibration range values of the sensor.

Status command: "status"

If there is a problem with the sensor hardware, the "status" command can be used to retrieve detailed information or the user can send the information to SCHUNK for troubleshooting.

6.3 RS422 - "Robot Mode"

The "robot mode" is not required for communication with all robots, but it presents the data in a useful format for certain robot integrations. The following actions can be performed:

- Enter and exit robot mode.
- Print a single reading or a continuous reading of force/torque values.
- Print counts per force and counts per torque.

In addition, the sensor can also perform the following advanced actions:

- Adjusting 16-bit or 32-bit output values.
- Adjusting the ADC sampling rate.
- Adjusting the IIR filter shift value.
- Adjusting the calibration value.
- Displaying the current output bit or calibration value.
- Preloading force torque data.

Note: Do not press Enter after entering a command. The software recognizes the input command and will output the data. The console does not display or echo the command entered by the user.

Starting and exiting the "Robot Mode": Command "M"

Starting "Robot Mode"

- Connect the sensor to a serial port of a computer using a USB cable.
- Enter the "M" character to enter robot mode.

Exiting "Robot Mode"

- Remove the sensor from the robot.

1. Connect the sensor to a PC and open a serial console.
2. Enter the "M" character to exit robot mode.

Printing a single measured value of the force/torque values: "R" command

Enter the "R" command to get a single force/torque display for each axis.

The output is in hexadecimal form. There is no separator between the values.

Press any key to exit.

6.3.1 More commands

Output value command "W"

The "W" command can be used to set 16- or 32-bit output values for each axis.

Enter "W" followed by a "2" to select 2-byte or 16-bit output values (4 hexadecimal characters). 16-bit output values are the default setting.

Enter "W" followed by "4" to select 4-byte or 32-bit output values (8 hexadecimal characters).

Note: The 32-bit output mode provides the user with higher resolution or precision of force/torque data.

ADC sampling rate command "A"

The ADC sampling rate set for the sensor must match the same sampling rate set on the serial console.

"A" and enter one of the following values from 0 to 4 for the ADC sampling rate:

- 0 = 488
- 1 = 976
- 2 = 1953
- 3 = 3906
- 4 = 7912

The selected ADC sampling rate is stored in the NVM.

IIR filter shift value command "F"

To set the IIR filter shift value, enter "F" and an index value from 0 to 8. The value is stored in the NVM.

Calibration value command "C"

Enter "C" and a value of "0" or "1" to set the calibration value. The value is stored in the NVM.

Display command "R"

The "R" command displays the current output bit or calibration value in the NVM.

Enter "W" or "C" followed by "R" to see the current value stored in the NVM.

Bias command "O"

The "O" command resets the force/torque output to zero. There is no reaction when the command is entered.

6.4 Clock synchronization functionality

The clock synchronization function is activated when a pulse of 5-12 V is applied to the conductors.

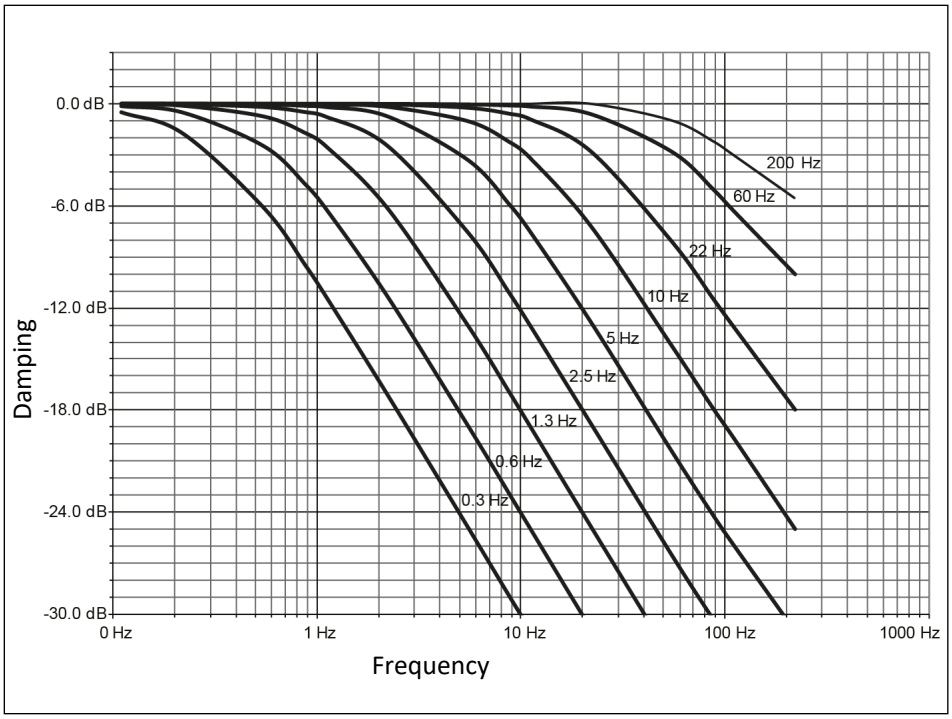
When activated, the sensor outputs the last collected data point, which corresponds to the output of the "S" command sent via an RS422 serial cable interface, ▶ 6.2 [🗋 20].

6.5 Low-pass filter

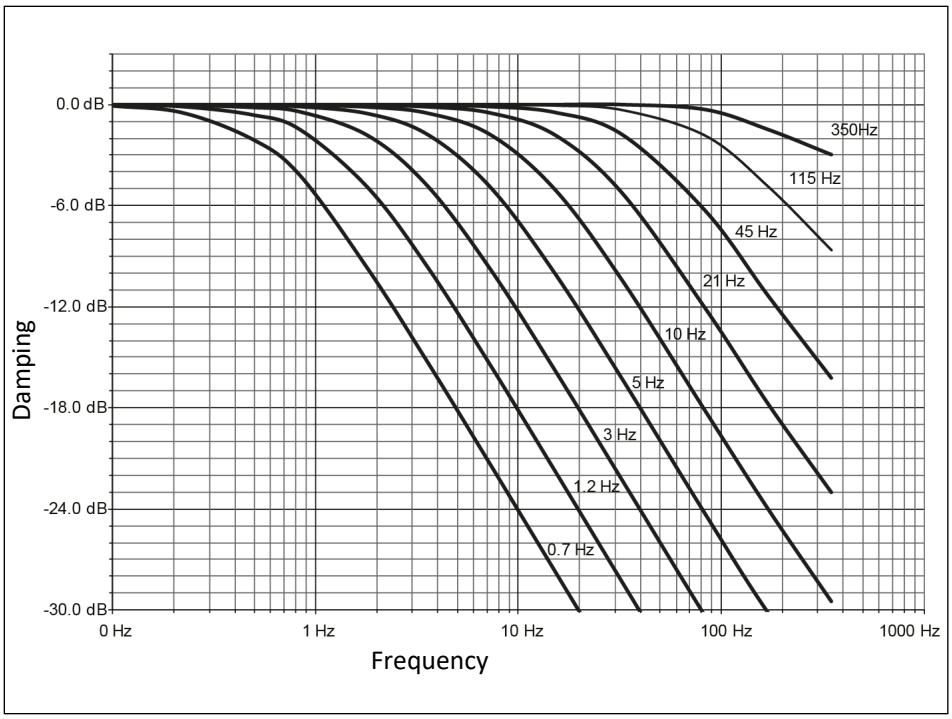
The switch-on option is "no filtering" as standard. The filter setting can be configured to reduce signal noise.

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:

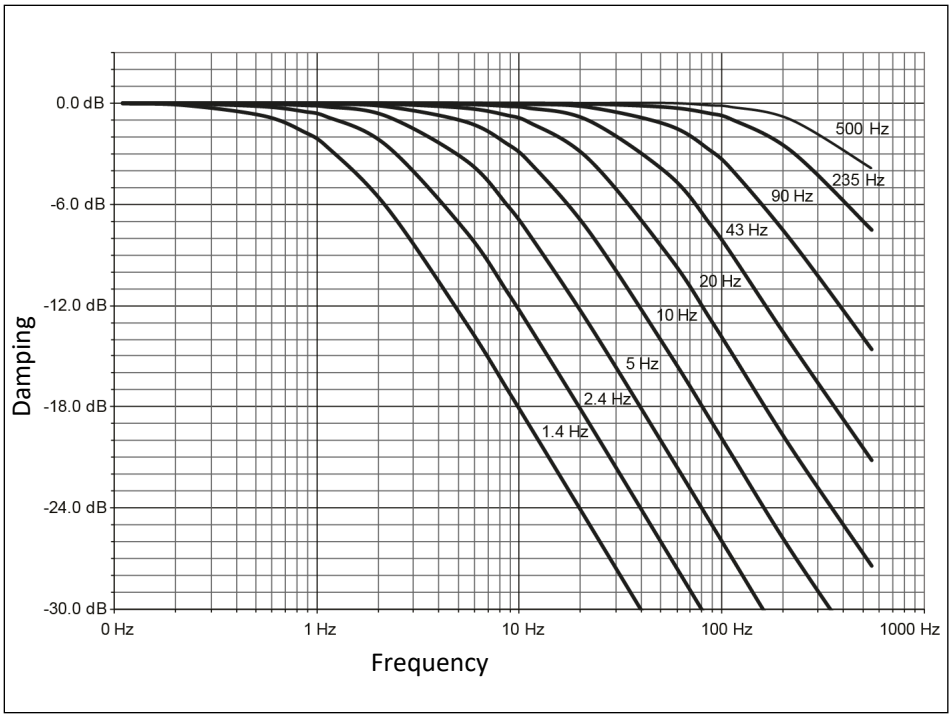
Selected filter	-3-dB cutoff frequency (in Hz)				
	at 0.5 kHz sampling rate	at 1 kHz sampling rate	at 2 kHz sampling rate	at 4 kHz sampling rate	at 8 kHz sampling rate
0	200	350	500	1000	2000
1	58	115	235	460	935
2	22	45	90	180	364
3	10	21	43	84	170
4	5	10	20	40	81
5	2.5	5	10	20	40
6	1.3	3	5	10	20
7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



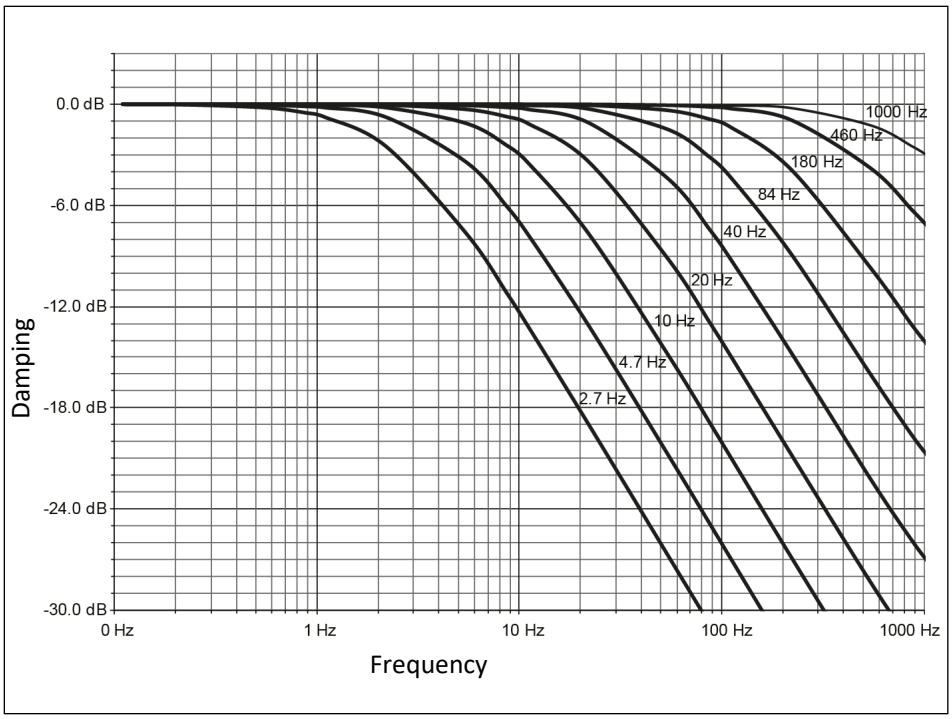
Filter damping at 0.5 kHz sampling rate



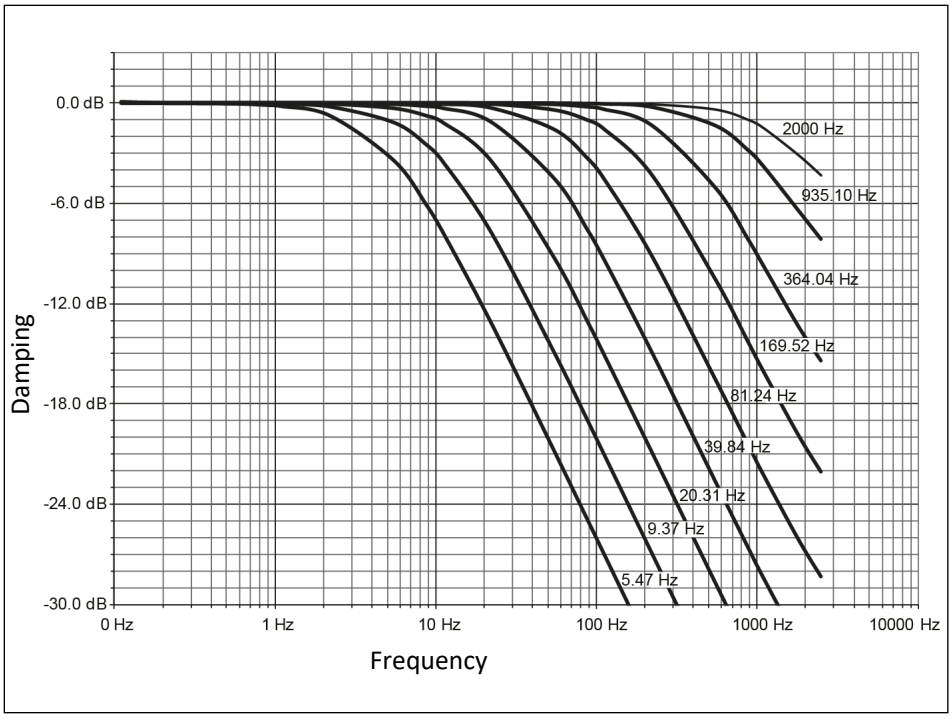
Filter damping at 1 kHz sampling rate



Filter damping at 2 kHz sampling rate



Filter damping at 4 kHz sampling rate



Filter damping at 8 kHz sampling rate

7 Troubleshooting

7.1 Status Code

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
6-26	Occupied.	
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

Bit number	Description	Indicates an error?
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_{xy} 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 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 [🗋 32].
Status LED lights up red for the first 20 seconds after switching on and then turns green.	Normal.
Link/Activity LED is not green or flashes green.	Check the connector and cable connection.

7.3 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, Object 0x6010: Status Code [🗋 32].
Mechanical sources of interference.	Avoid mechanical sources of interference. If not possible, use a low-pass filter ▶ 6.5 [🗋 29].

7.4 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.	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.

7.5 Status code

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, 27, or 30 outside the range - The sensor may have been overloaded and the strain gauges are now in a saturated condition.	Remove applied loads. If the errors do not disappear, continue troubleshooting. 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. 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.

7.6 Sensor does not transmit data

Possible cause	Corrective action
The user's devices are not compatible with RS422 real-time communication.	Make sure that the sensor system is compatible with RS422 real-time communication, ▶ 6.1 [🗋 16]. Check that the baud rate is set correctly.
The sensor has a hardware or software error.	Observe the LEDs Status LEDs [🗋 10].

7.7 Data output rate lower than expected

Possible cause	Corrective action
The ADC and data rate may be set too high.	Reduce the ADC sampling rate and data rate, ▶ 6.2 [🗋 24].

7.8 Fluctuating force/toque data

Possible cause	Corrective action
Measuring device data is displayed instead of force/ torque data.	Measurement data is not a 1:1 correlation to force/torque axis data. Show force/torque data, ▶ 6.2 [🗋 20].
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, ▶ 6.2 [🗋 24].
The raw force/torque values are already converted to units and the values are high or nonsensical.	Ensure that the sensor is not in any of the following states: saturation, strain gauge out of range, or force/ torque out of range. Check the status code of the sensor, ▶ 7.1 [🗋 32]. If the values exceed the calibration range of the sensor, the reported values will be incorrect.

7.9 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, ▶ 7.1 [🗋 32]. Error bits related to overload are: 2, 27 and 30.
The configuration of the sensor system is not set correctly. The sensor is not installed properly.	Check for proper installation, ▶ 5 [🗋 12].
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, ▶ 6.2 [🗋 24].
Mechanical coupling - an external object 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.

7.10 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 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 FTR-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 FTR-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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