

Force Torque Sensor FTL

Assembly and operating manual



Imprint

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Document number: 0389571

Edition: 01.02 | 23/09/2014 | en

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Spann- und Greiftechnik

Bahnhofstr. 106 – 134

D-74348 Lauffen/Neckar

Tel. +49-7133-103-0

Fax +49-7133-103-2399

info@de.schunk.com

www.schunk.com



Reg. No. 003496 QM08



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1 Safety Instructions



WARNING

- The sensor must not be used for safety critical or medical applications.
- The sensor transmits an error code with overload information. The application must react with error strategies if these codes are set.
- The sensor has been designed for indoor use. It has to be protected of humidity and dust.
- The sealed areas of the sensor must not be opened. When opening the sealed screws the calibration and warranty is void.
- It is necessary to backup important data before the installation of the test software.

2 Introduction

2.1 Product



Fig. 1 Force Torque Sensor 75CAN

A windows test program and C++ sample code is provided with the sensor. Packages for the Willow Garage Robot Operating System (ROS) are available.

The sensor specific calibration matrix can be found on the quality management sheet, on the CD in the File calibMatrix.dat and in the configuration file of the test software SensorViz

2.2 Specifications

Functional	
Force measurement	on x, y and z +/- 150 N
Torque measurement	around the x, y and z +/- 3 Nm
Allowed overload	3 x
Measuring principle	Strain gage measurements
Resolution	16 Bit

Mechanical	
Dimensions	29 mm height, 75 mm diameter
Flanges	Adapted from DIN EN 9409-1

Electrical	
Operating voltage	24 V, < 0,3 A
Range	21,6 bis 26,4V
Interface	CAN-Bus with 500 kBit/s
Connector	M8 sensor/actor male connector

Ambient Conditions	
Ambient Temperature	Working and living areas: 10 – 35° C

3 Interfaces

3.1 Flange Drawings

Sensor X direction is directed toward the 6 mm hole.

Z direction is upward (the smaller cap is up).

Y direction follows the right hand rule.

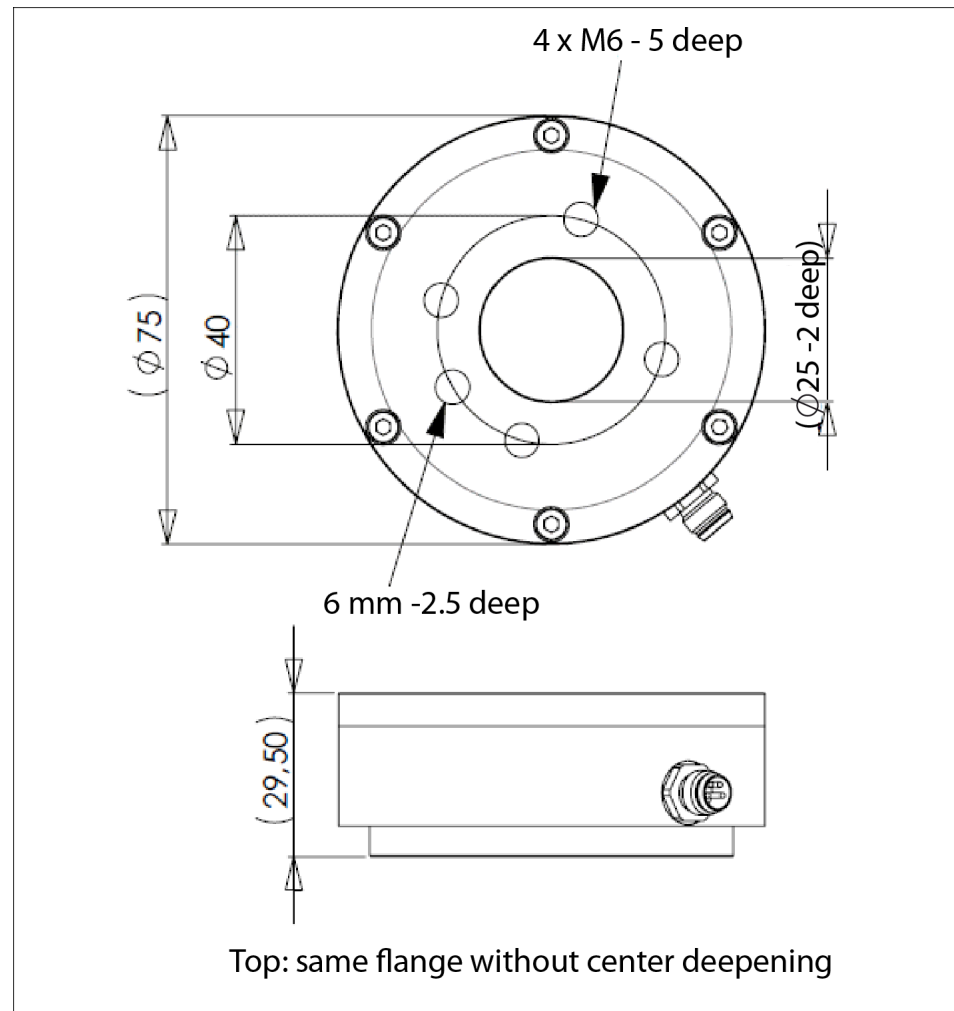


Fig. 2 Flange drawings, top view (Fig. top) and side view (Fig. below, upside down)



NOTICE

The M6 connector screws must only enter 5 mm in depth!

3.2 Electrical Connectors

The connector on the sensor is a M8 sensor/actor plug with four poles.

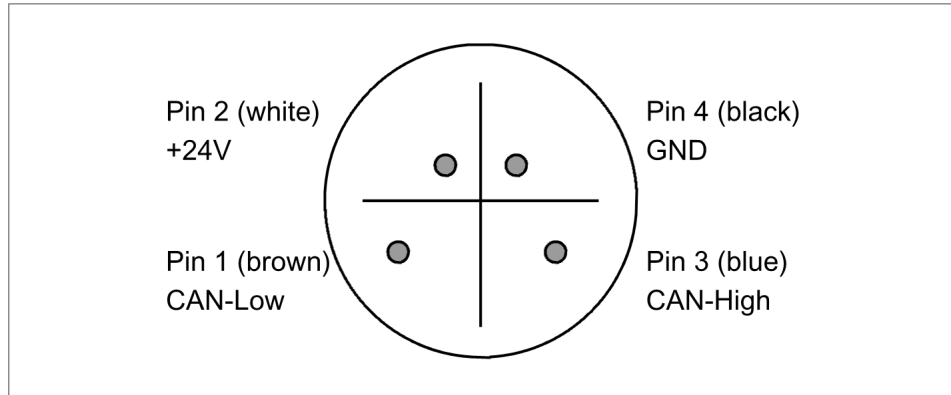


Fig. 3 sensor/actor male plug on the sensor body, seen from outside

The connection cable provides three plugs, towards the sensor, towards the USB2CAN bridge and towards the power supply.

Towards the USB2CAN bridge a female D-Sub connector with pin assignment as shown is included:

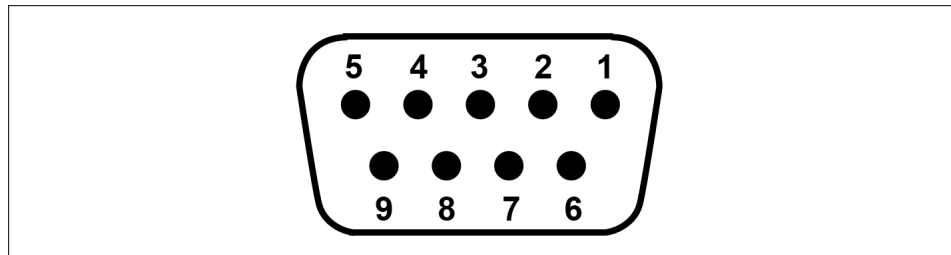


Fig. 4 female, 9-Pin, D-Sub (Viewed from the front)

Pin 2	CAN_Low
Pin 6	GND
Pin 7	CAN_High
120 Ohm terminator between 2 and 7	
Remaining Pins: not connected	

The power connector is a 5 mm / 2.1 mm plug. GND is outside.

The sensor needs a power supply of 24V DC. The power source should be able to provide 500 mA.

4 CAN Protocol

The communication with the sensor is based on the CAN protocol with standard frame. Factory settings for CAN ID and baud rate are:

- Baud rate: 500 kBit/s
- CAN ID: 0x50 for requests, 0x51 and 0x52 for answers.

It is important to send the messages with the right length; otherwise the sensor will ignore them.

Measurements A measurement has to be requested by the robot etc. with a CAN message, then the sensor answers with two CAN messages containing the measurements. Sensor values can be requested with up to 100 Hz.

	CAN ID	Data
Request	0x50	0x07 timestamp
Answer Part 1	0x51	Byte 1: Error / timestamp Byte 2: Kanal 1 HighByte Byte 3: Kanal 1 LowByte Byte 4: Kanal 2 HighByte Byte 5: Kanal 2 LowByte Byte 6: Kanal 3 HighByte Byte 7: Kanal 3 LowByte Byte 8: Temperatur HighByte
Answer Part 2	0x52	Byte 1: Error / Zeitstempel Byte 2: Kanal 4 HighByte Byte 3: Kanal 4 LowByte Byte 4: Kanal 5 HighByte Byte 5: Kanal 5 LowByte Byte 6: Kanal 6 HighByte Byte 7: Kanal 6 LowByte Byte 8: Temperatur LowByte

The timestamp byte in the request message is repeated in the answer and allows to detect and communication gap.

I should lie in between 0 and 63

Byte 1 of the answers contains the following information:

Bit	Contained Information
1 - 6	timestamp repeated
7	0: no error 1: overload
8	0: no error 1: system error

**NOTICE**

A value of byte 1 higher than 63 or 0x3F means that the sensor is in an error condition!The application has to react on this!

The sensor provides the raw measurements, they have to be multiplied by the host with the calibration matrix. This is done by the test software SensorViz, or shown in the example source code.

The sensor values range from approx 5,000 to 59,000, the idle position is calibrated to approx. 32,000.

The temperature value can be transformed into a ° C value using the formula:

$$\text{tempCelsius} = (256 * \text{tempHB} + \text{tmpLB}) * 0,12 - 201.0$$

Information Requests

	CAN ID	Data
Request Working hours	0x50	0x03 0x54
Answer	0x51	Byte 1: 0x54 Byte 2: working hours HighByte Byte 3: working hours LowByte Byte 4: working minutes Byte 5: working minutes Byte 6: firmware version primary Byte 7: firmware version secondary Byte 8: 0x00
Request Serial number	0x50	0x03 0x55
Answer	0x51	Byte 1: 0x55 Byte 2: product type HighByte Byte 3: product type LowByte Byte 4: serial number HighByte Byte 5: serial number LowByte Byte 6: firmware Version primary Byte 7: firmware version secondary Byte 8: 0x00

Configuration Changes of the CAN ID and baud rate take effect after the next restart of the sensor (removal of the supply voltage). There is no answer from the sensor.

	CAN ID	Data
Set CAN-ID	0x50	0x02 0x01 newCANID
Set CAN baud rate	0x50	0x02 0x02 brValue brValue = 0x20: 125 kbit/s brValue = 0x30: 250 kbit/s brValue = 0x40: 500 kbit/s brValue = 0x50: 1 Mbit/s



NOTICE

The supplied USB2CAN adapter does support only a CAN baud rate of 500 kbit/s. When changing the sensors baud rate a different CAN adapter has to be used.

5 Software

The sensor is provided with the test software SensorViz. In the following sections we provide information on the installation of the necessary driver and the software.

5.1 5.1 Driver Installation for the USB2CAN adapter

Attach the USB2CAN adapter to a USB port and wait for installation messages.

When running on Windows 7 or higher the according driver is often already installed.

This can be checked in the Windows Device Manager.

There it is shown in the "Connections" are as "USB Serial Port". If this is the case, this section can be skipped.

To run on Windows XP or when the sensor cannot be connected the driver has to be installed as described in this section. If there are problems arising in the installation please refer to the FTDI user guide found on the installation CD.



Fig. 5

- 1 When connecting the USB adapter to the computer, the Windows Found New Hardware Wizard will be launched automatically. Select “No, not this time” and proceed with “Next”



Fig. 6

- 2 Select “Install from a list or specific location”



Fig. 7

- 3 Select "Search for the best driver in these locations" and enter the file path in the combo-box or browse to it by clicking the browse button. The driver is found in the directory \FTDI\Driver\ on the CD. Click "Next".
⇒ The wizard will install the driver.

After finishing, this procedure has to be done again to install the USB serial driver.

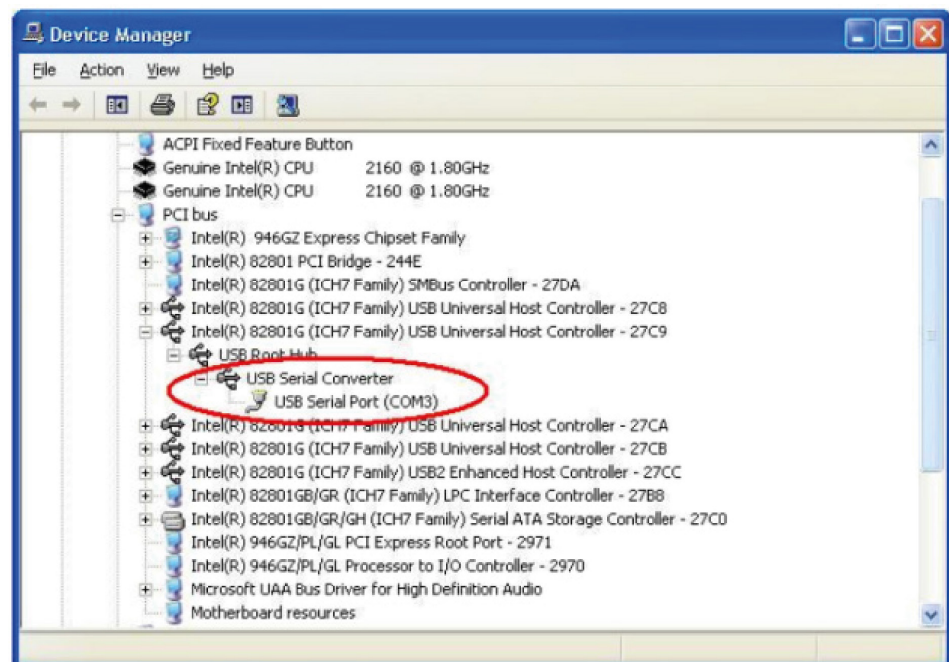


Fig. 8

- 4 To check the installation open the Device Manager and search in Connections for „USB Serial Port“.

Please refer to the FTDI installation guide found on the CD in the \FTDI directory to get further information.

5.2 Test Software SensorViz

SensorViz is a Softwaretool for commissioning of the sensor:

- Connect with the sensor
- Show the current raw sensor readings
- Set the bias of the sensor
- Load the calibration matrix and show XYZABC measurements
- Log the measurements into a .csv file

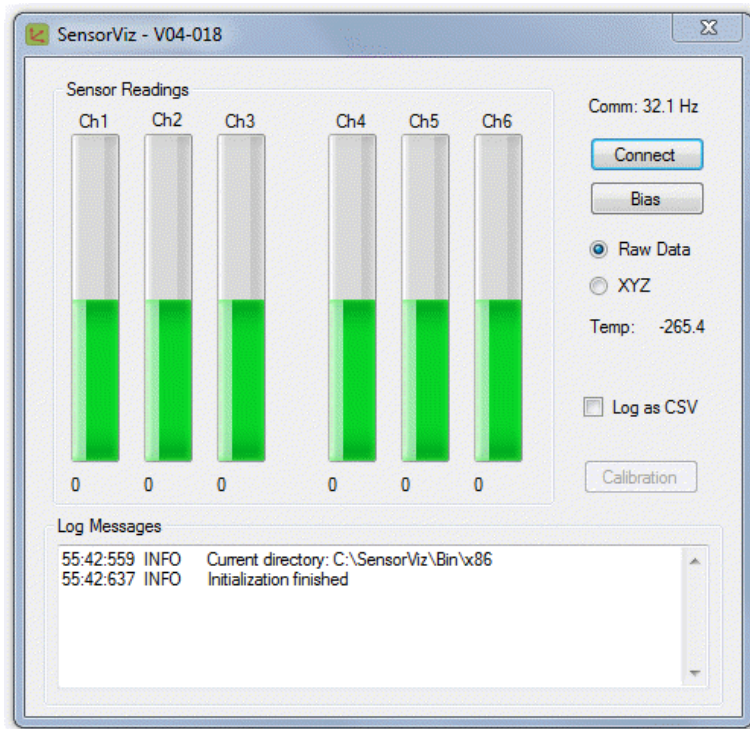


Fig. 9 User Interface of the SensorViz Test-Software

The “Connect” button tries to open a connection to the USB2CAN bridge. When the adapter is not found on the standard port the software can search the available ports from Com1 to Com20. When the adapter is found the configuration file can be updated with the according port.

When connected successfully, new measurements are requested with approx 30 Hz. These measurements are shown as raw channel measurements, or as forces and torques when XYZ has been checked.

The check box “Log CSV” allows to log the sensor values into a file. The name of the file is: *forceValues_hhmmss.csv* hhmmss stands for hours, minutes and seconds. The values are separated by a space.

The software is initiated with the configuration file "Configuration.xml". The following entries are relevant:

The following entry defines the cycle time, the adapter to use (here the USB2CAN bridge with com port), and the decimal CAN ID:

```
<BusConfiguration CycleTimeMS="30"
Type="RS232"
ComPort="COM16">
<Sensor CANID="80" />
</BusConfiguration>
```

Another possible adapter is the PCANUSB from Peak Systems. The relevant entry then is:

```
<BusConfiguration CycleTimeMS="30"
Type="PCANUSB">
```

Furthermore the configuration file contains the calibration matrix:

```
<FTSTransferMatrix SerialNumber="24210294">
<RowTX Col1="-0.05644" Col2="0.30843" Col3="-0.00130" Col4="-0.01268" Col5="-0.00048" Col6="-0.28078" />
...
</FTSTransferMatrix />
```

5.3 C++ Sample Code

The installation CD contains the folder `\CPPSample`. Here you can find a small sample program that:

- • connects with the USB2CAN bridge,
- • reads the sensor measurements,
- • does the matrix multiplication and
- • shows the applied forces.

The software has been developed on Ubuntu Linux and uses boost and ncurses libraries. The source code contains extended comments.

The calibration matrix in the sample code is a generic one and has to be exchanged with the sensor specific one.

6 ROS Packages

The sensor can be used as a component in the Willow Garage Robot Operating System (ROS), see www.ros.org.

The according packages can be requested via SCHUNK

7 Trouble shooting

7.1 Error Codes

The board provides two means of error indications, via the inner LED and via the CAN bus. Furthermore the USB2CAN adapter provides information.

7.1.1 Sensor LED

Off: No power

Slow blinking (1 Hz): Sensor is running idle

On: Sensor is communicating via CAN-Bus

7.1.2 USB2CAN adapter LED

Off: No power

Slow blinking (1 Hz): Adapter is running idle

Fast blinking (10 Hz): Transmitting CAN messages

On for 0,5 s: Transmission error

7.1.3 CAN bus

See section "CAN Protocol" for error codes in the measurement answers:

Byte 1, bit 6:	0: no error	1: overload
Byte 1, bit 7:	0: no error	1: system error

7.2 Service Contact

If your problem is afterwards still not solved, we are happy to provide assistance:

- Mail: info@de.schunk.com
Please always add serial number and a description of the problem.
- Service Phone: ++49 7133 / 103-2333