ATESTEO

Excellence in drivetrain testing

Manual F-Serie: iS-, i-, eS-Type

Manual F-Serie, iS-, i-, eS-Type
Version 2019/02

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TÜVRheinland® CERT ISO 9001 ISO 14001

DAkkS Deutsche Akkreditierungsstelle D-K-19792-01-00

1 Introduction

1.1 Manufacturer

Thank you for choosing ATESTEO GmbH & Co. KG quality product. Please read the system description carefully so you make the most of the versatile features of your product.
This operating manual is a component of the F-series and should always be carefully kept with the F-series until it is disposed of.
It is impossible to eliminate every danger to persons or material that the F-series might present. For this reason, every person working at the F-series or is involved in its transport, setting up, control, maintenance or repair must be properly instructed and be informed of the possible dangers.
For this purpose, the operating instructions and, especially, the safety instructions must be carefully read, understood and observed.
Company ATESTEO GmbH & Co. KG reserves the right to carry out changes at its products which serve the technical further development the company ATESTEO GmbH & Co. KG. These changes aren't documented expressly in every individual case.
This operator's manual and the information contained in it were compiled with the advisable care.
Company ATESTEO GmbH & Co. KG takes on no liability for misprints or other faults or damages resulting from it ATESTEO GmbH & Co. KG, however.
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Please do not miss to contact us if there is anything in the operating instructions that you cannot clearly understand. We are grateful for any kind of suggestion or criticism that you may wish to make; please let us know or write to us. This will help us to make the operating instruction still more user-friendly in taking account of your wishes and requirements.

1.2 Scope

In this manual you will find all steps which are necessary to start-up the ATESTEO torque and speed measurement system.

This manual is usable for the following types of torque meters:

- Torquemeter F1iS/F2iS/F23iS/F3iS/F4iS/F5iS
- Torquemeter F1i / F2i
- Torquemeter FLFM1iS (F0iS)/ FLFM1eS (F0eS)
- Torquemeter F1eS/F2eS/F3eS/F4eS

All measurement systems work contactless and are maintenance-free. The data transmission is realized by a frequency modulated infrared transmitter. The power of the rotating electronic module works inductive.

1.3 Disposal and environment

Electrical and electronic products are subject to special conditions for disposal. Proper disposal of old equipment prevents health hazards and environmental damage.

Packaging

The original packaging of ATESTEO equipment can be recycled, as it is made of recyclable material. However, you should keep the packaging for at least the warranty period. In the event of a complaint, the torque flange, as well as the accessories, must be returned in the original packaging.

Due to ecological aspects, the return of the empty packaging should be waived.

Legally prescribed labeling for disposal

Electrical and electronic devices bearing the symbol  are subject to European Directive 2002/96 / EC on waste electrical and electronic equipment. The symbol indicates that waste equipment that is no longer usable must be disposed of separately from regular household waste in accordance with European environmental protection and recycling regulations.

However, the disposal regulations vary from country to country, which is why we ask you, if necessary, your supplier how to dispose your waste.

2 Safety Instructions

2.1 General safety instructions

The manual must be read carefully before start-up, maintenance work or any other work on the torque measuring system. Prerequisite for the safe and proper handling of the equipment knows all safety instructions and safety regulations of the attachment.

Every safeguard needs to be correctly mounted and fully functional before any start-up.
Shafts or adapters mounted to the torque meter must be properly designed, so that critical bending moment is avoided.

Exclusively qualified laborers are allowed to do maintenance work on any electrical components (see chapter Qualified personnel).
If the torque meter is sold on, these safety instructions must be included.

Note on additional standards:

- Low Voltage Directive 73/23/EWG, Electromagnetic Compatibility Directive 89/336/EWG and the harmonized standards
- DIN EN 292-1 Safety of machinery
- DIN EN 292-2 Safety of machinery

Maintenance and inspections on the electrical equipment are to be executed by trained personal. Non-designated use and modifications of the measurement system will make the EG-Conformity declaration invalid.

2.2 Explanation of symbols and notice

Warnings

Warnings are indicated by symbols in these safety instructions. The hints are going through

Signal words are introduced, which express the extent of the hazard. It is imperative that you follow the instructions and act with care to avoid accidents, personal injury and material damage.

Information

Draws attention to important information about correct handling.

Caution

Warns of a potentially dangerous situation in which failure to comply with safety requirements can result in slight or moderate physical injury.

2.3 Appropriate use

The torque meter is highly accurate and resistant to rotational speed. The signals from the flange serve to control the test bench and to analyze the components.

The torque flange is used just for torque measurement tasks within the load limits in the specification (see Technical specs). Any other use is not permitted.

The torque meter is not allowed for use as a safety component.

Note

Stator operation is only permitted when rotor is installed as described in the mounting instruction.

2.4 Modifications/conversions

Any modifications/ conversions of the design or safety engineering of the torque meter without the explicit agreement from ATESTEO will lead to the loss of warranty or liability. Any damages or injuries of personnel therefrom are in responsibility of the operator.

2.5 Operator's responsibility

Standards

The ATESTEO torque meter was designed and constructed taking account of a risk analysis and careful selection of harmonized standards and other technical specifications with which it complies. It represents the state of the art and guarantees a maximum degree of safety.

Qualified personnel

Qualified personnel are persons who by reason of their training, experience, instruction and their knowledge of the relevant standards, regulations, accident prevention rules and working conditions have been authorized by the person responsible for the safety of the machine/product to perform the appropriate activities required, and thereby are able to recognize and prevent potentially dangerous situations (For the definition of skilled workers see VDE 0 105 or IEC 364, which also regulate the prohibition of the employment of unqualified persons).
Knowledge of first aid and the local rescue organization must also be available.

Transportation, assembly, installation, commissioning, maintenance and repair will be performed by qualified personnel or controlled by responsible skilled hands.

Safety relevant disconnecting device

The torque meter cannot implement any safety relevant cut-offs. It is in the operator´s responsibility to integrate the torque meter into superior safety system.
The electronical conditioning the measurement signal should be designed so that measurement signal failure does not subsequently cause damage.

Residual risks

The power and scope of delivery of the torque meter covers only a subset of the torque measurement technology. Safety aspects of torque measurement technology must be planned, implemented and

taken into account by the system planner, supplier or operator in such a way that residual risks are minimized. Each existing regulations must be observed. Attention should be drawn to residual risks associated with torque measuring technology
In the case of a shaft break, you must ensure that there is no risk of injury. This should be done with a shaft protection cover in a closed test room with corresponding security doors. During operation, no person should stay in the test room.

Usage recommendations for personal protective equipment

Working in a workshop generally requires the wearing of safety shoes.

Use suitable gloves when handling corrosive or irritating solutions and adhesives.

2.6 Transport and storage

Check the delivery immediately for completeness and shipping damage.

Use working gloves during transport/ assembly/ maintenance.

Storage

- Do not store outdoors
- Store dry and dust-free
- do not expose to aggressive media
- protect from sunlight
- avoid mechanical shocks
- Storage temperature according data sheet

If stored for more than 3 months, regularly check the general condition of all parts and packaging.

2.7 Safety notes for assembly

Tightening torque
When tightening the screws, the specified tightening torques (see mounting instruction) must be observed.

Electric wire
All cables must be professionally laid according to the actual standards.

Rotating parts
Rotating parts must be earthed- risk of static electricity.

2.8 Safety notes for operation

As accident prevention a covering has to be fitted once the torque meters have been mounted. This is the fact if the torque meter is already fully protected by the design of the machine or by existing safety precautions. Please pay attention to following requirements for the covering as accident prevention:

- The covering must not be free to rotate
- Covering must be positioned at a suitable distance or be so arranged that there is no access to any moving parts within.
- Covering should prevent squeezing or shearing and provide sufficient protection against parts that might come loose.
- Covering must still be attached even if the moving parts of the torque flange are installed outside people´s movement and working range.

Note
Improper use and handling as well as constructional changes will invalidate the EC declaration of conformity.

2.9 Load limits

Observe technical data sheets when using the torque meter. Pay particular attention to never exceed the respective maximum loads. For example:

- Load limits
- Torque oscillation width,
- Temperature limits,
- Longitudinal limit force, lateral limit force or limit bending moment,
- Limits of electrical load-carrying capacity,
- Limit rotation speed.

3 System Description

The F series torque measurement systems are representing a complete generation of torque meters with evaluation unit. With the exception of a 24VDC power supply, no external components are required for operation.
High-end temperature compensation guarantees very good stability and repeatability of the output signals. The standard model is equipped with an inductive one track speed measurement system.
Stator all-in-one (type iS) provides functionality in compact way.
External electronics (type eS) allows operation under extended temperature range.

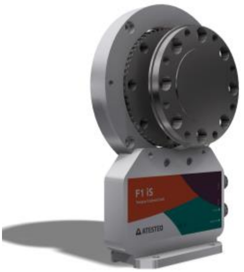


Figure 3-1 F1iS

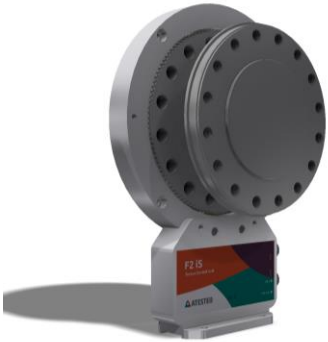


Figure 3-2 F2iS

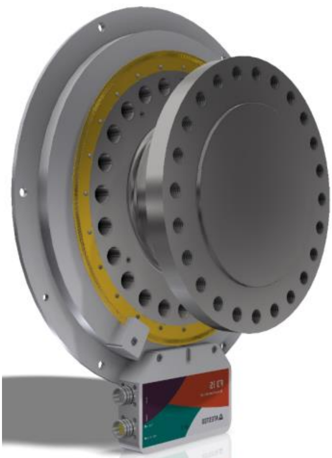


Figure 3-3 F3iS

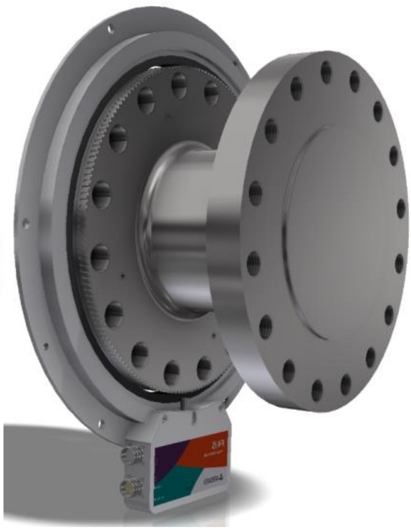


Figure 3-4 F4iS

Figure 3-5 F1i / F2i

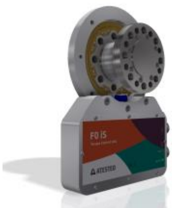


Figure 3-6: FLFM1iS / F0iS

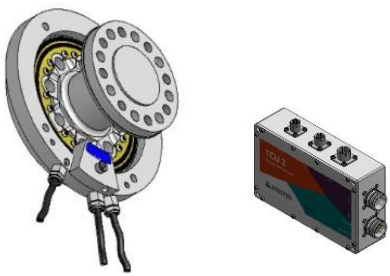


Figure 3-7 FLFM1eS / F0eS

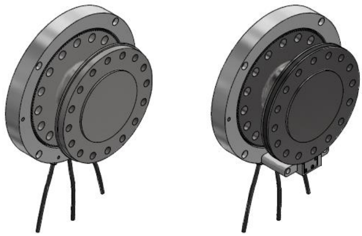


Figure 3-8 F2eS

Figure 3-9 F3eS

Figure 3-10 F4eS

Specifications

Power Supply	24V DC max. 1A
Sample Rate Torque	1000 Samples / Second
Sample Rate Speed f > 1000 Hz	1000 Samples / Second
Sample Rate Speed f < 1000 Hz	f / 2 Samples / Second
Lowest Frequency, which can be measured	5Hz (the output for frequencies <5Hz is 0Hz)
Analog Output Range	selectable 0..5V, 0..10V, -5..+5V, -10..+10V
Analog Output Signal Resolution	16 bit
Analog Output Impedance	50 Ohm
Optional Current Output (Torque)	selectable 4..20mA, 0..20mA
Filter	*Torque*: 1st-order IIR-Filter with 6 fixed cut-off frequencies *Speed*: Moving Average with adjustable filter depth
CAN Interface	CAN2B Identifier free adjustable max. 1MBaud max. 1000 messages/channel/second
Serial port	RS232, 19200 Baud, 8 Data Bit, No Parity Bit, 1 Stop Bit, No Protocol
Frequency outputs	RS422 Torque Inductive speed sensor Magnetic speed sensor (optional)

Table 3-1 Specifications

3.1 One-channel telemetry (FM)

Features:

- frequency output proportional to torque 60 kHz ± 20 kHz
- analog output [V] proportional to torque with 1000 readings/s
- frequency output proportional to speed
- analog output [V] proportional to speed
- shunt – calibration
- Zero adjustment automatically via remote control
- serial Interface RS232
- CAN 2B interface

3.2 Dual -Telemetry DT / DT2 (FM/FM)

The overall system is created to integrate a second amplifier and a second IR-telemetry during the production of the torque meter. This second amplifier amplifies the signal from the strain gage bridge with a very high accuracy. The result is a second range of highly precise measurement of small torques. Consequently, the often necessary replacement of the torque sensor for the highly precise measurement of less torques can be dropped. This second measuring system also includes temperature compensation and a shunt calibration as in the first one. (see Figure 3-11 Illustration DT / DT2).

To exploit the total measuring preciseness of the minor measuring range one must consider, to stop and unload the power train after each measuring cycle, which takes place under a high torque load. Afterwards the systems needs to be reset to "0" otherwise the hysteresis figures, recorded in the spring body, would overlap the more sensitive second measuring channel.

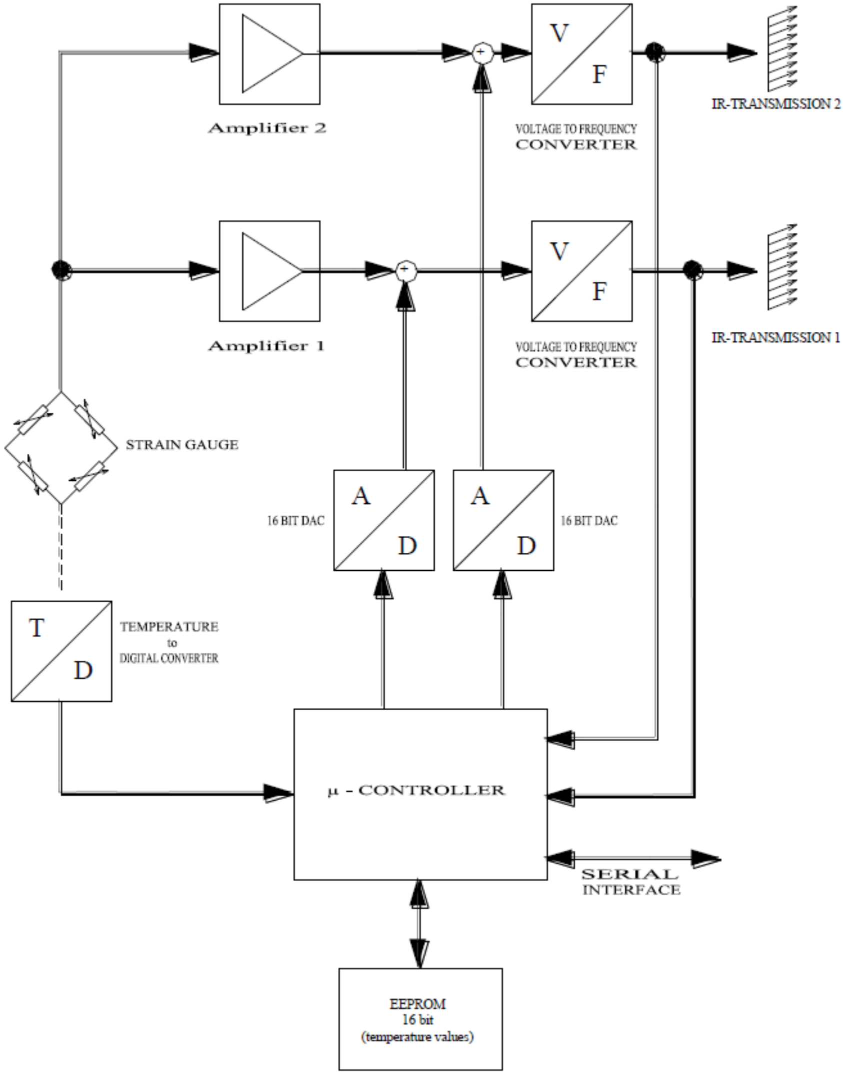


Figure 3-11 Illustration DT / DT2

With the Dual –Telemetry system (FM/FM) it is possible to measure with one torque meter high and small torques with a high accuracy.
With F1i series the dual measuring values are available in parallel indicated by DT.
With FxiS and FxeS series the dual measuring values must be switched. This is indicated by DT2.

Features:

- 2 x frequency output proportional to torque 60 kHz ± 20 kHz
- frequency output proportional to speed
- analog output [V] proportional to torque with 1000 readings/s
- analog output [V] proportional to speed
- shunt – calibration
- Zero adjustment automatically via remote control
- System-parameter via RS232.
- CAN 2B interface
- DT for parallel use, DT2 for switched use of both channels

Please read chapter '11. Special DT2 functions' for setup.

4 Mechanical Installation

4.1 Part list

4.1.1 Part list F1iS/F2iS/ F23iS/ F3iS/ F4iS / F5iS

The complete measuring equipment consists of the following parts:

- Torquemeter (Rotor)
- Stator All-In-One (Evaluation unit)
- Connectors 16 pole male / 12 pole female

4.1.2 Part list F1i/F2i

Complete measuring equipment consists of following parts:

- Torquemeter (Rotor)
- Stator – top and lower part
- Connectors 10 / 12 pole

4.1.3 Part list FLFM1iS (F0iS)

The complete measuring equipment consists of the following parts:

- Torquemeter (Rotor)
- Stator All-In-One (Evaluation unit)
- Connectors 16 pole male / 12 pole female

4.1.4 Part list FLFM1eS (F0eS)

The complete measuring equipment consists of the following parts:

- Torquemeter (Rotor)
- Stator FLFM1eS
- Electronics TCU 2 (Torque Control Unit)

4.1.5 Part list F1eS/F2eS/F3eS/F4eS

The complete measuring equipment consists of the following parts:

- Torquemeter (Rotor)
- Stator type eS
- Electronics TCU2 (Torque Control Unit)

4.2 Installation F1iS / F2iS

The following figure shows the correct offset between the end faces of the dynamometer-flange and the dynamometer-housing.

F1iS / F2iS

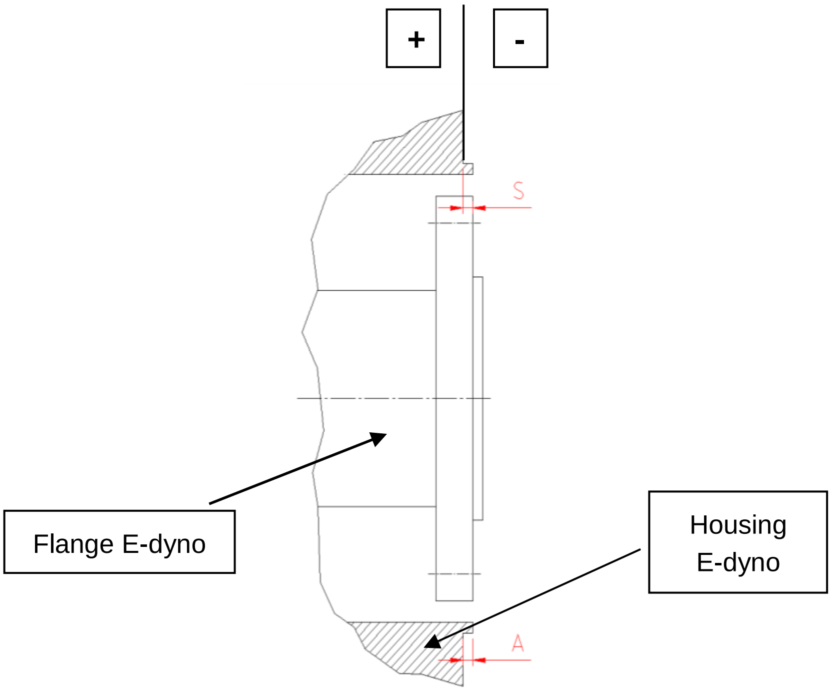


Figure 4-1 Offset between end faces (dynometer flange/dynamometer-housing)

Type	Nominal data S [mm]
F1iS/F2iS/F23iS/ F3iS/F4iS	+0,5 ... 0 … -0,5 without magnetic speed encoder
F1iS	+0,5 ... 0 … -0,5 with magnetic speed encoder
F2iS	+0,5 ... 0 … -0,5 with magnetic speed encoder

Table 4-1 Nominal data S[mm]

4.2.1 Mounting of the Stator

If it is possible, mount the stator of the torquemeter with the electronic-housing aligned to a 9 o'clock position. In this case no liquid can concentrate in the housing. As a precaution the electronic components are sealed with protective paint.

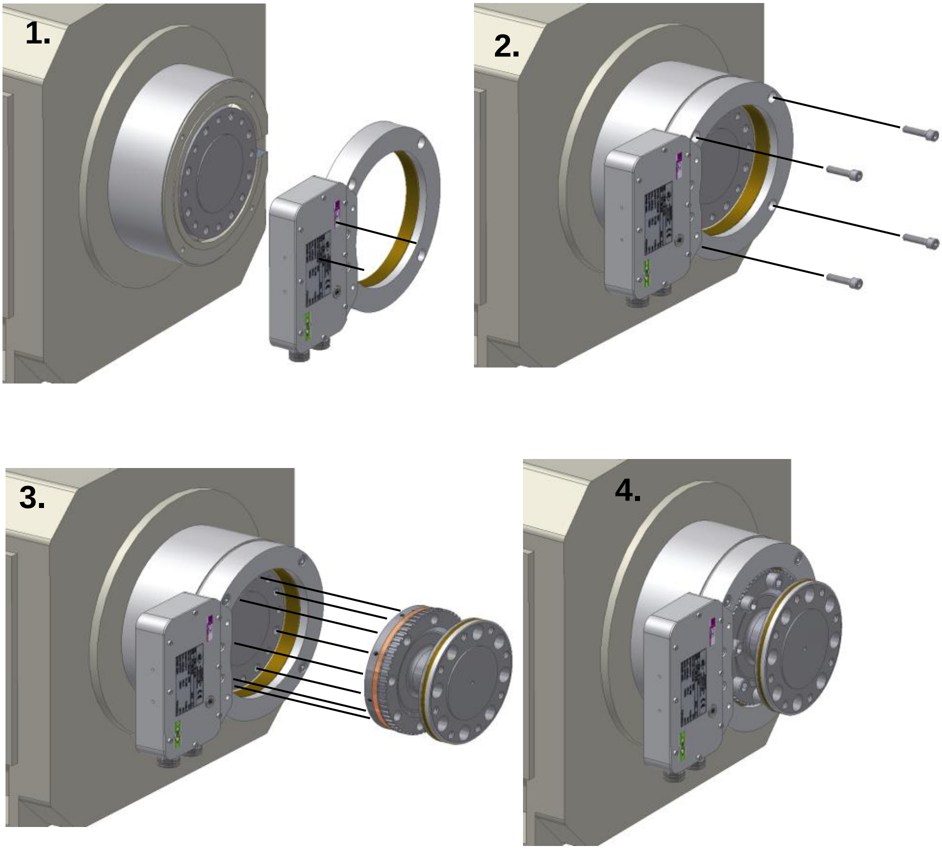


Figure 4-2 Mounting of the stator

4.2.2 Mounting of the foot base

Example for a complete mounted system:

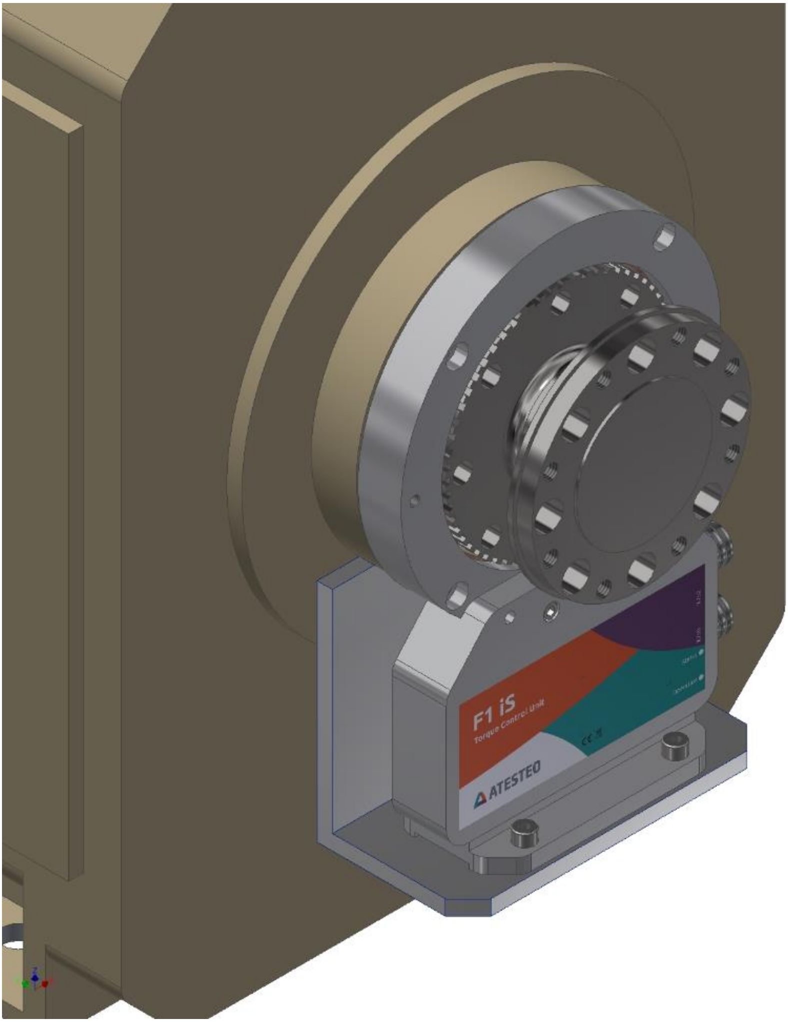


Figure 4-3 Mounting of the foot base

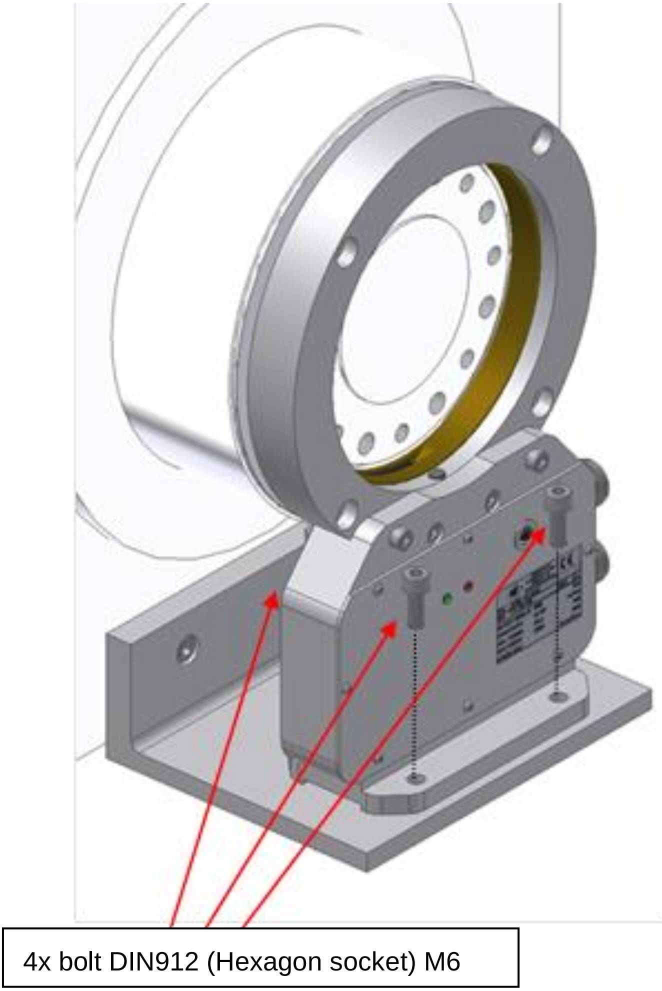


Figure 4-4 Mounting of the stator with foot plate

4.2.3 Mounting the angle plate to the base plate F1iS / F2iS

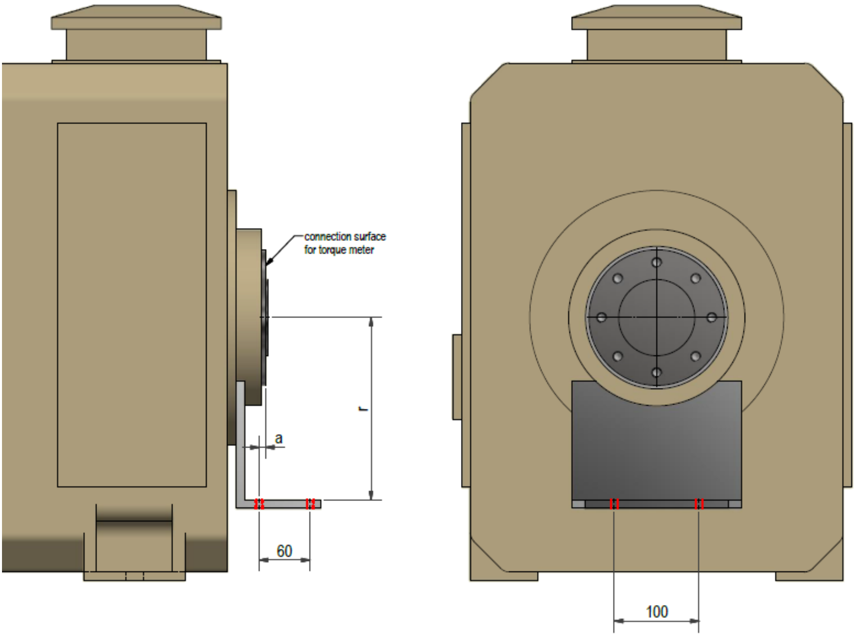


Figure 4-5 Mounting to angle plate

Type	r [mm]	a [mm]	Screws
F1iS	215	7,5	M8
F2iS	255,6	8	M8

Table 4-2 Mounting to angle plate

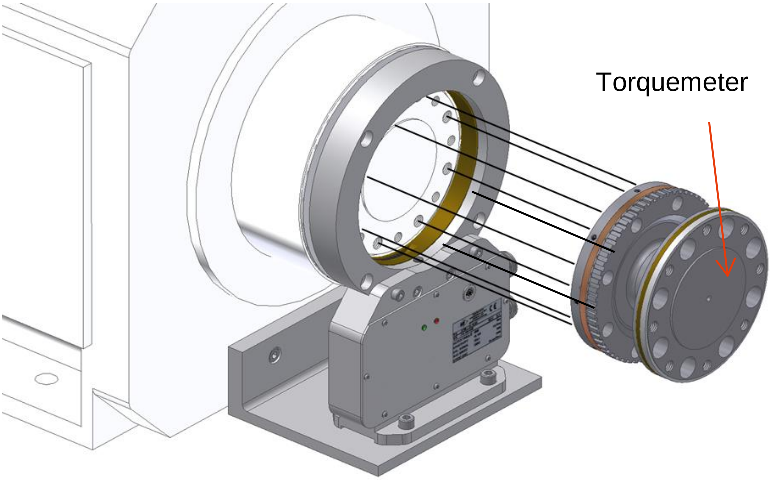


Figure 4-6 Mounting of torque meter

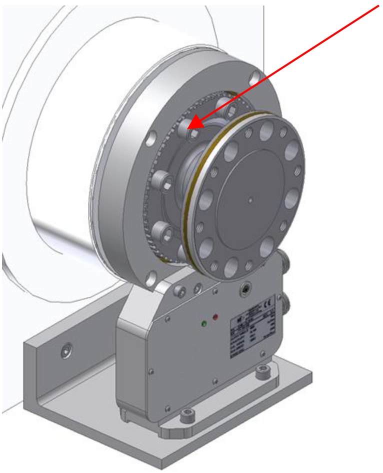


Figure 4-7 Mounting adapter flange with suitable screws

4.2.4 Mounting with the foot base

Example for a complete mounted system:

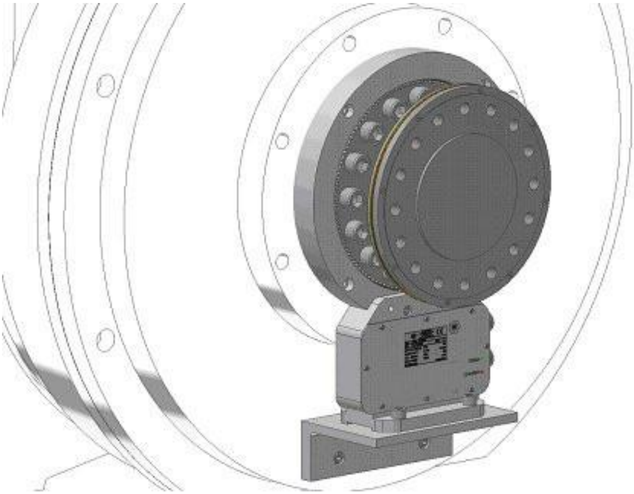
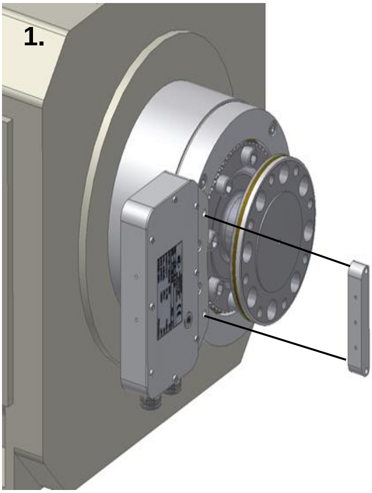
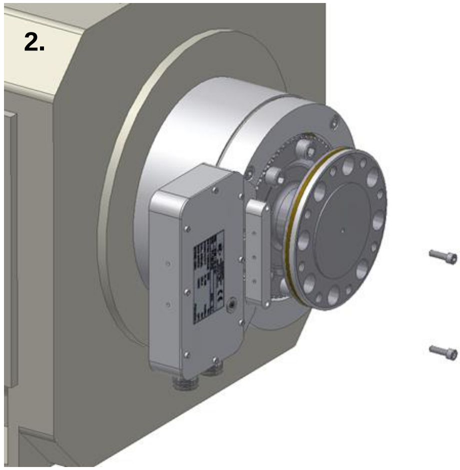
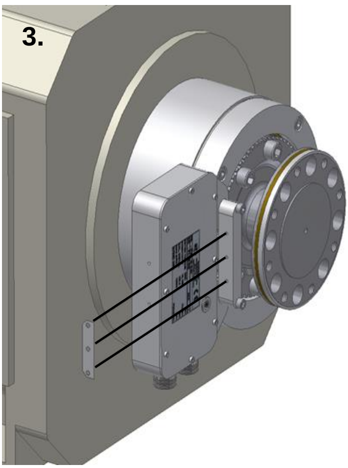


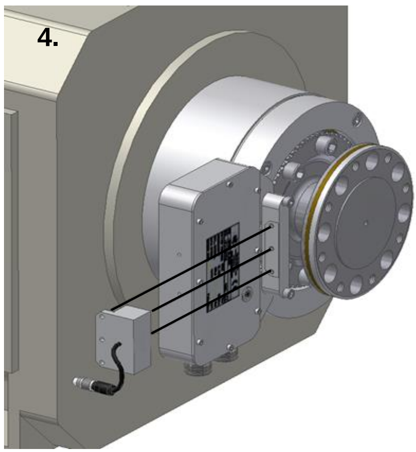
Figure 4-8 Fully assembled system (F2iS)

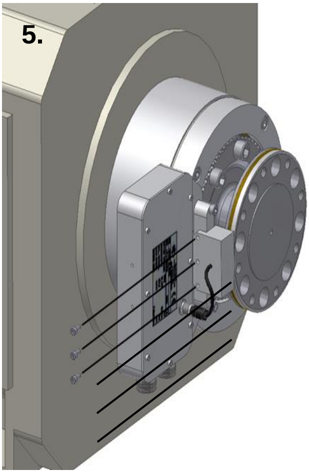
4.3 Mounting the optional Magnetic Speed Detection











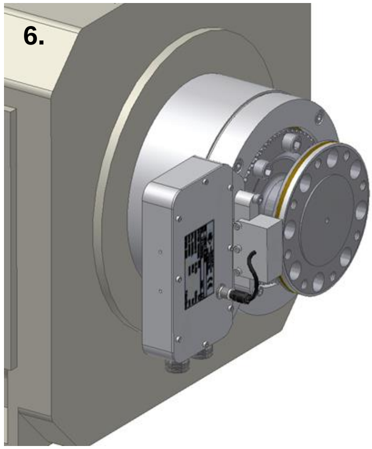


Figure 4-9 Mounting the optional magnetic speed detection

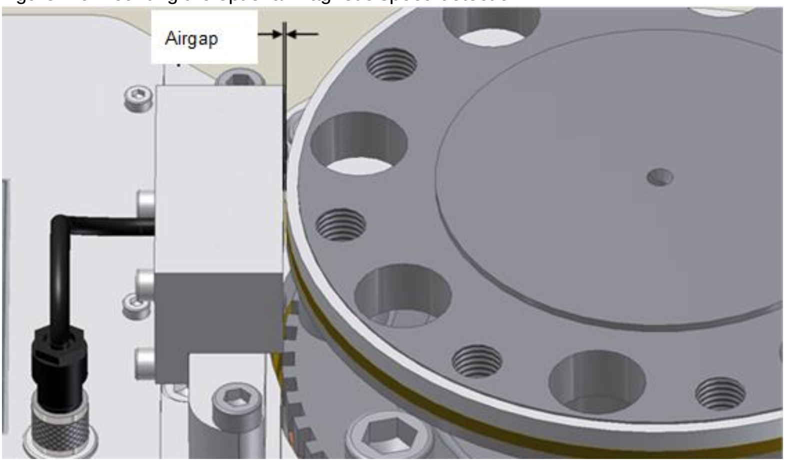


Figure 4-10 Air gap between speed measuring system and measuring flange (see Chapter 5 Speed measuring system)

4.4 Recommended fastening torques for screws

F1iS/F1eS				
Rated Torque Nm	**LKR 130 mm**	**Quality**	**Quantity**	**Torque Nm**
up to 2.500	8x M12	12.9	8	**135**
up to 2.100	8x M12	10.9	8	**115**
up to 1.400	8x M12	8.8	8	**77**
F2iS/F2eS				
Rated Torque Nm	**LKR 196 mm**	**Quality**	**Quantity**	**Torque Nm**
up to 20.000	16x M18	12.9	16	**470**
up to 15.000	16x M16	12.9	16	**330**
up to 9.000	16x M16	10.9	16	**280**
up to 6.000	16x M16	8.8	16	**190**
F3iS/F3eS				
Rated Torque Nm	**LKR 290 mm**	**Quality**	**Quantity**	**Torque Nm**
up to 50 kNm	24x M20	12.9	24	**650**
F4iSF4eS				
Rated Torque Nm	**LKR 369 mm**	**Quality**	**Quantity**	**Torque Nm**
up to 100 kNm	16x M30	12.9	16	**2300**
F23iS				
Rated Torque Nm	**LKR 218 mm**	**Quality**	**Quantity**	**Torque Nm**
up to 30 kNm	16x M20	12.9	16	**650**

Table 4-3 Recommended fastening torques for screws

4.5 Installation F1i/F2i torquemeter

Order of assembly F1i / F2i torquemeter:

1 Stator ring

2 Torquemeter

3 Stator top part

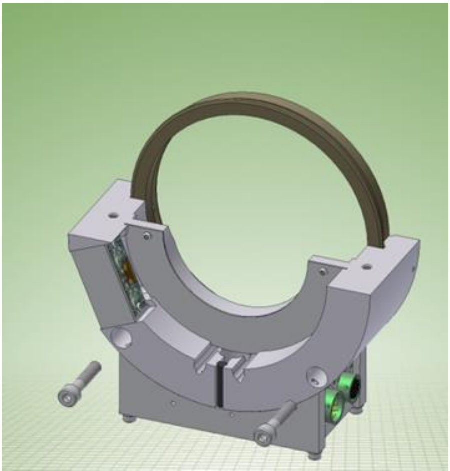


Figure 4-11 Statorring

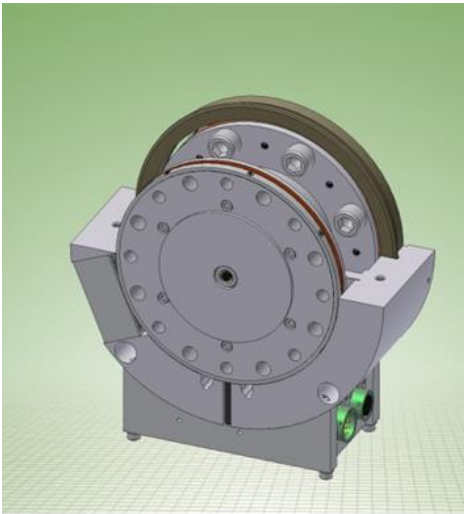


Figure 4-12 Statorring

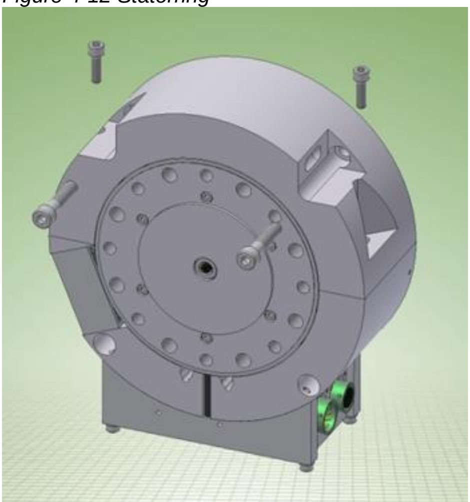


Figure 4-13 Stator top part

The following figure shows the correct offset between the end faces of the dynamometer-flange and the dynamometer-housing.

F1i and F2i

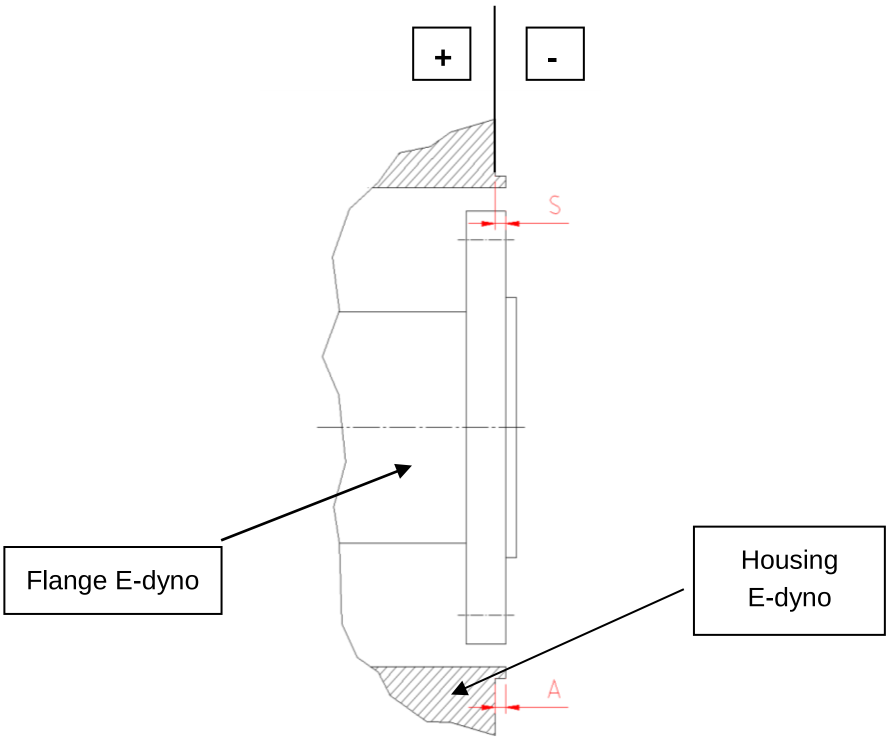


Figure 4-14 Offset between flange and housing

Type	Nominal dats S [mm]
F1 / F1i	+1 ... -2 … -5 without speed sensor
F2 / F2i	-1 … -4 … –7 without speed sensor
F1 / F1i	-1,5 …-2 … -2,5 with speed sensor
F2 / F2i	-3,5 ... -4 … –4,5 with speed sensor

Figure 4-15 Nominal data S [mm]

4.5.1 Mounting the Stator

If it is possible place the stator of the torque meter F1i / F2i so that the housing of the electronic is adjusted at the left side. In this case no liquid can be collect in the stator. The hole electronic is filled with a potting component and can't be damaged by liquid.

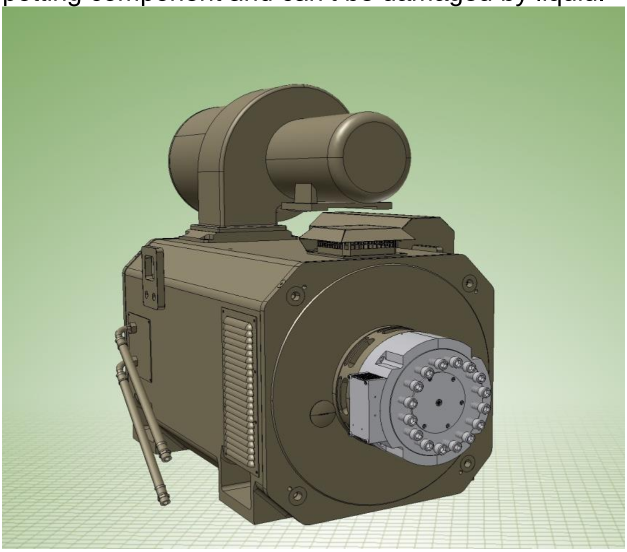


Figure 4-16 Example on how to place a stator

4.5.2 Recommended starting torques for screws

F1i				
Rated Torque Nm	**PCD**	**Quality**	**Quantity**	**Torque Nm**
up to 2.500	8x M12	12.9	8	**135**
up to 2.100	8x M12	10.9	8	**115**
up to 1.400	8x M12	8.8	8	**77**
F2i				
up to 15.000	16x M16x1,5 fine thread	12.9	16	**380**
up to 10.000	16x M16	12.9	16	**330**
up to 9.000	16x M16	10.9	16	**280**
up to 6.000	16x M16	8.8	16	**190**

Table 4-4 Technical data F1i/F2i

4.6 Installation FLFM1iS

Order of assembly: FLFM1iS torquemeter

1. Stator
2. Torquemeter

The following figure shows the correct offset between the end faces of the dynamometer-flange and the dynamometer-housing.

FLFM1iS

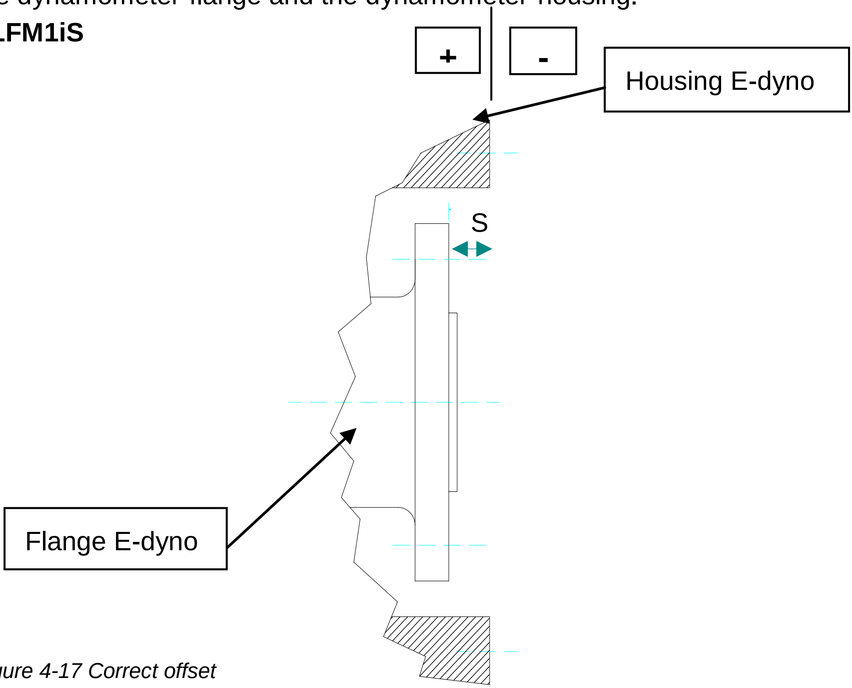


Figure 4-17 Correct offset

Type	Nominal data S [mm]
FLFM1eS	7,7 ... 8,0 … 8,5

Table 8 3 Nominal data

4.6.1 Mounting the Stator

The stator of the torquemeter must be mounted with the electronic-housing aligned to a 9 o'clock position. In this case no liquid can concentrate in the housing. As a precaution the electronic components are sealed with protective paint.

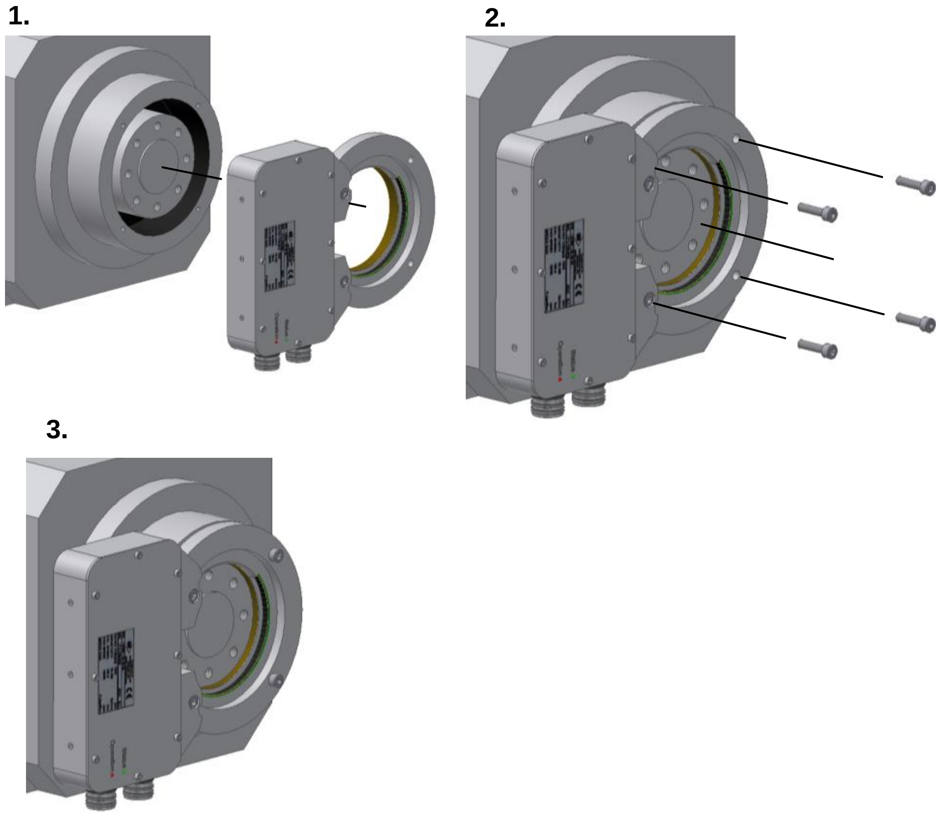


Figure 4-18 Mounting the stator

4.6.2 Mounting the torquemeter

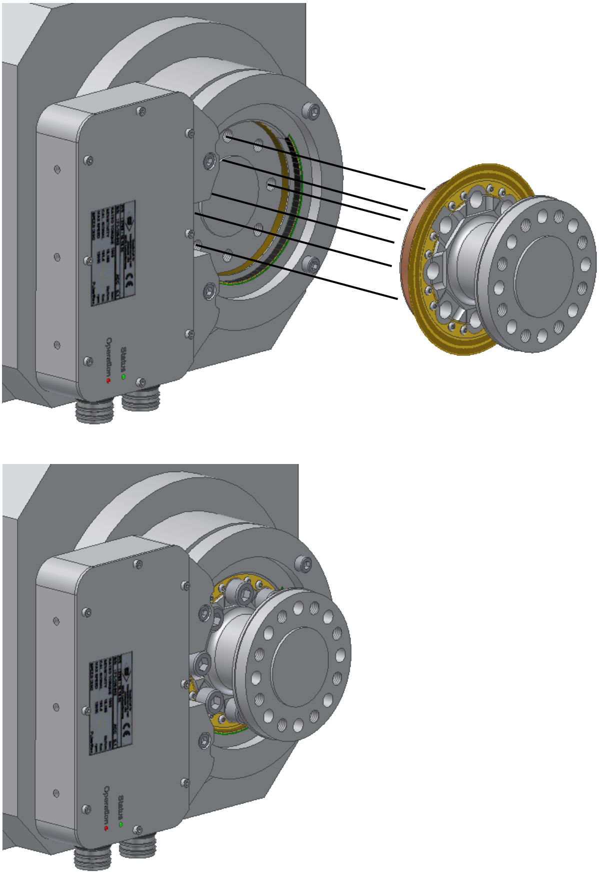


Figure 4-20 Mounting the rotor

4.6.3 Mounting the optical speed detection

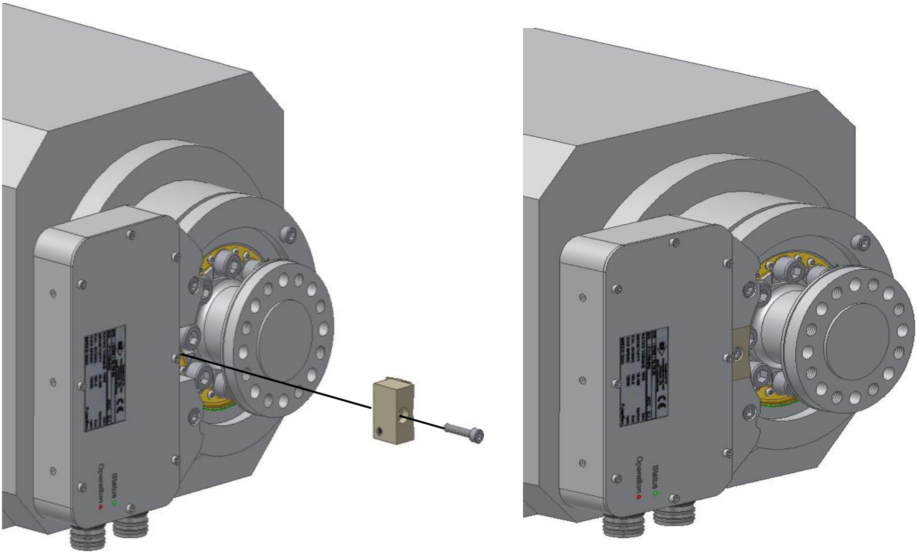


Figure 4-21 Optical speed detetction

4.6.4 Mounting the stator with a foot base

By using the optical speed detection it is not recommended, to mount the stator through foot mounting base. The alignment (rotor – stator) must be very exact. Otherwise it is possible, that there arise unwanted contact between rotor and stator.

Example for a complete mounted system:

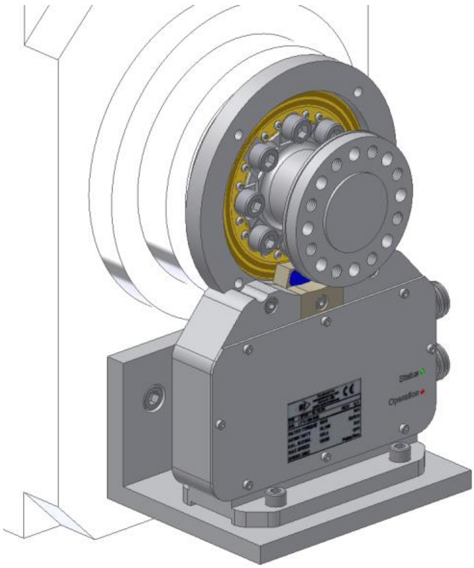


Figure 4-22 Complete mounted system

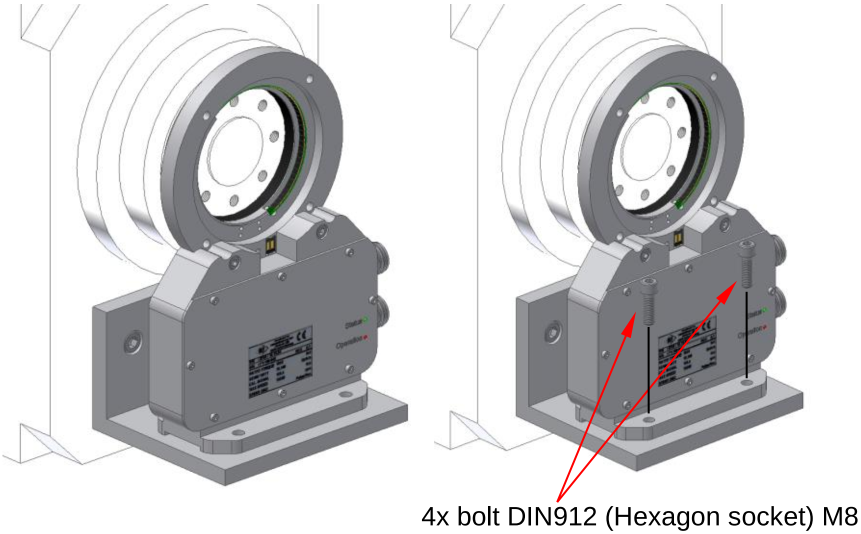
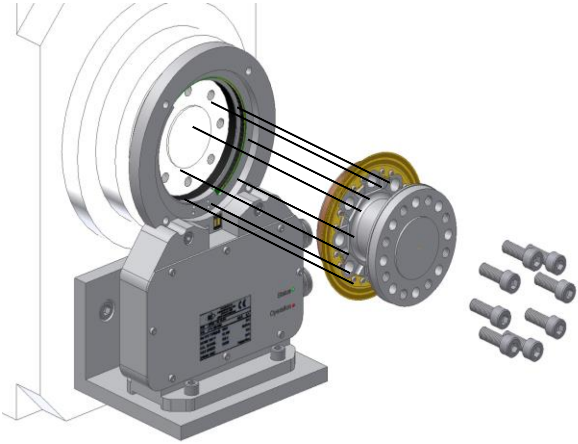


Figure 4-23 Mounting stator with foot base

4.6.5 Mounting the torquemeter



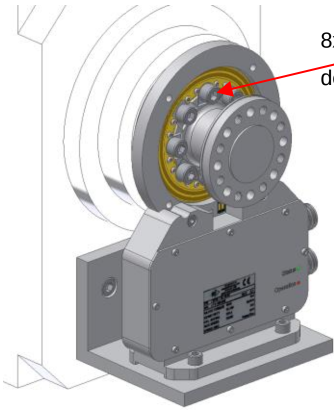


Figure 4-24 Mounting torquemeter

4.6.6 Recommended fastening torques for screws

FLFM1iS (F0iS)				
Rated Torque Nm	**PCD 75 mm**	**Quality**	**Quantity**	**Torque Nm**
Up to 500	8x M10	12.9	8	83
Up to 800	8x M10	12.9	8	83
Up to 1.000	8x M10	12.9	8	83

Figure 4-25 Fastening torque

4.6.7 Mounting the optical speed detection

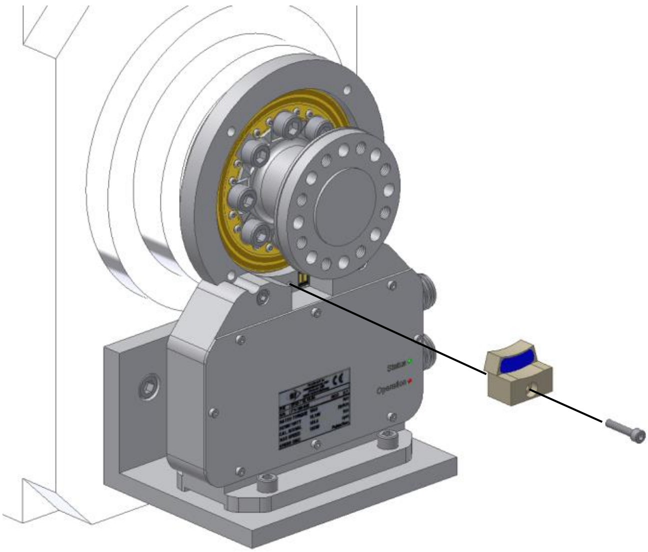


Figure 4-26 Mounting optical speed detection

4.7 Installation FLFM1eS (F0eS)

Order of assembly: FLFM1iS torquemeter

1. Stator
2. Torquemeter
3. Electronics

The following figure shows the correct offset between the end faces of the dynamometer-flange and the dynamometer-housing.

FLFM1eS

Figure 4-27 Correct offset between house flange and housing

Type	Nominal data S [mm]
FLFM1eS	7,7 ... 8,0 … 8,5

Table 4-5 Nominal data S[mm]

4.7.1 Mounting the Stator

The stator of the torquemeter must be mounted with the electronic-housing aligned to a 9 o'clock position. In this case no liquid can concentrate in the housing. As a precaution the electronic components are sealed with protective paint.

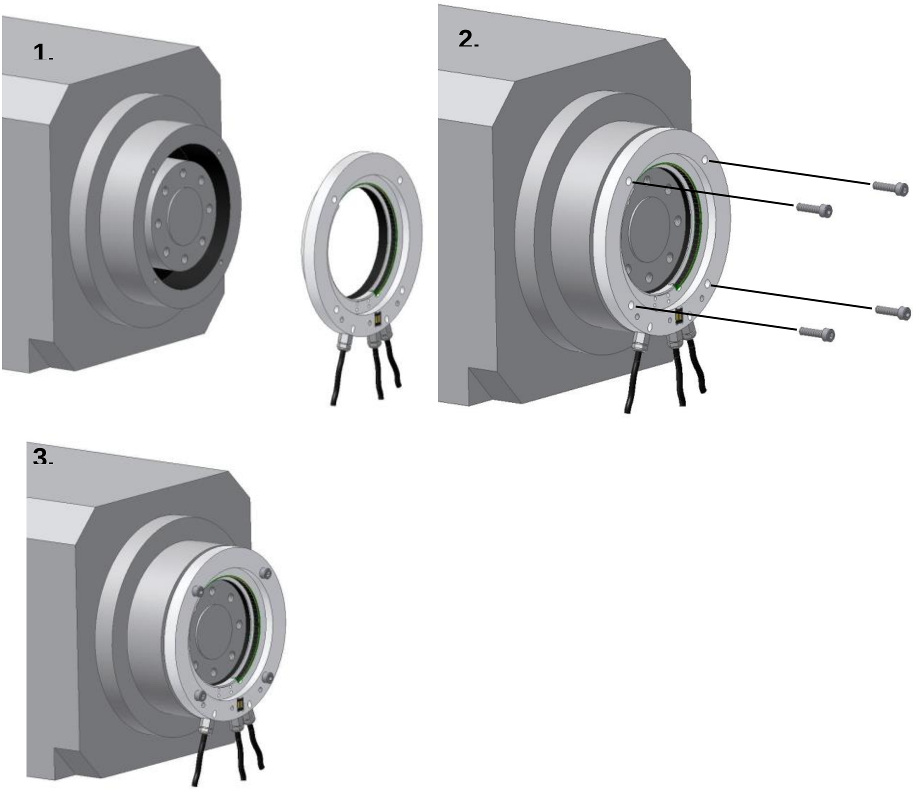


Figure 4-28 Mounting the stator

4.7.2 Mounting the torquemeter

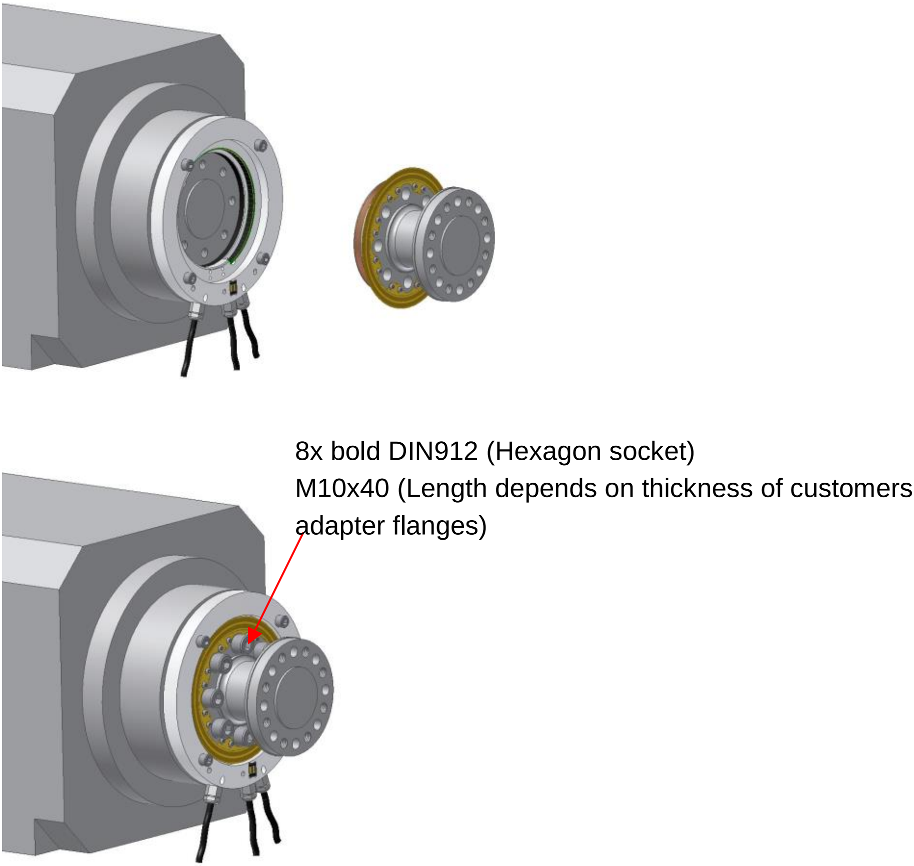


Figure 4-30 Mounting the torquemeter

4.7.3 Recommended fastening torques for screws

FLFM1eS (F0eS)				
Rated Torque Nm	**PCD 75 mm**	**Quality**	**Quantity**	**Torque Nm**
Up to 500	8x M10	8.8	8	50
Up to 800	8x M10	10.9	8	70
Up to 1.000	8x M10	12.9	8	80

Table 4-6 Recommended fastening torques

4.7.4 Mounting the optical speed detection

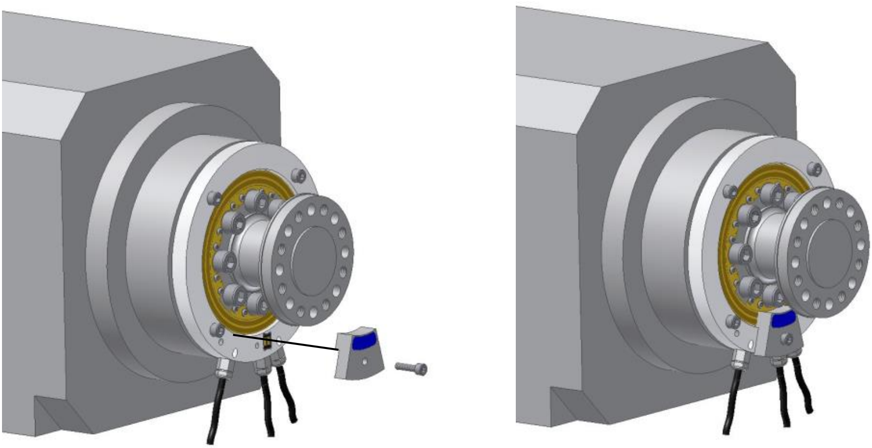


Figure 4-31 Mounting optical speed detection

4.7.5 Electronics

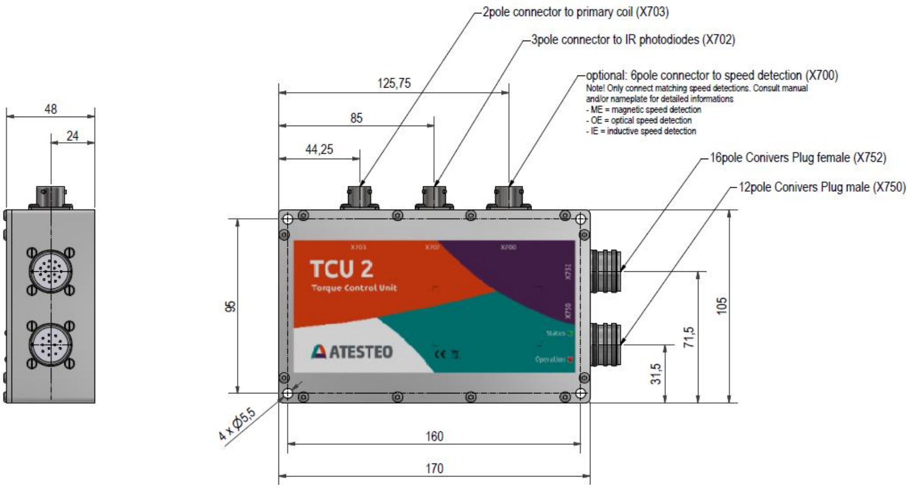


Figure 4-32 Evaluation unit TCU2

4.7.6 Components earthing

Please take care of the TCU2 housing. It has to have the same potential with the stator ring. The machine parts are often lacquered, so we advise to set up additional electrical connection between the both components

5 Speed measuring system

5.1 Speed measuring system F1iS / F2iS

5.1.3 Inductive Sensor

The inductive speed sensor is equipped as standard and supplies one track with 60 increments per round at the torquemeter F1iS and 120 increments per round at the torquemeter F2iS. It is located at the inner side of the stator ring.

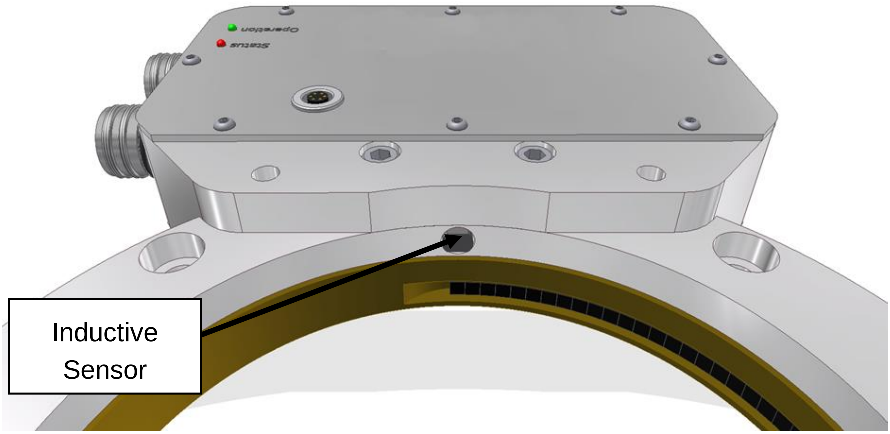


Figure 5-1 Inductive sensor

The air-gap between rotor and stator is factory calibrated to an operational distance of 0.5 up to 2.5 mm and needs no readjustment. The speed-sensor signals are provided as RS422 signals and as processed values for the analog outputs and CAN messages. The RS422 signals can be accessed by connector X750.

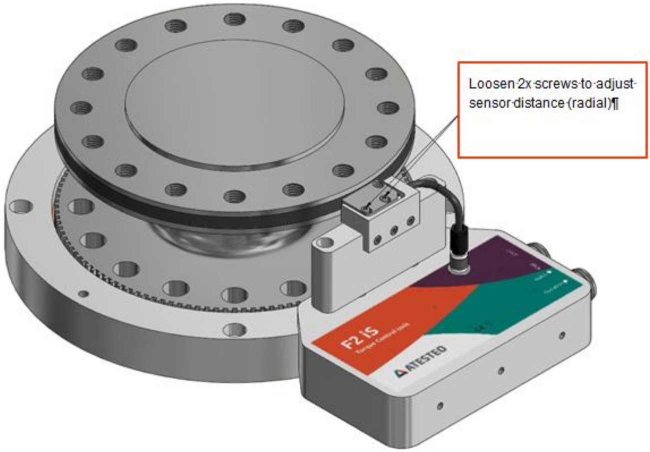
5.1.4 Magnetic Sensor (F1iS: 1000 increments / F2iS:1448 increments)

The magnetic speed sensor is available as an optional high-resolution speed acquisition providing 2 tracks with 1000 increments per round at F1iS and accordingly 1448 increments per round at F2iS
and a 90° phase shift, thus giving the capability for detecting the rotational direction. It is located on a mounting bracket placed above the electronic compartment. The magnetic speed sensor consists of a sensor module which is connected via a 7 pole connector to the stator electronics.

The speed-sensor signals are provided as RS422 signals and as processed values for the analog outputs and CAN messages. The RS422 signals can be accessed by connector X750, output pins 3 and 4 for track 1 and pins 5 and 6 for track 2 (refer to chapter „Electrical specifications").

5.1.5 Adjustment of the correct distance:

To adjust the right distances, loosen 2 screws like shown in the picture below. The distance should be ideally 0,5mm.



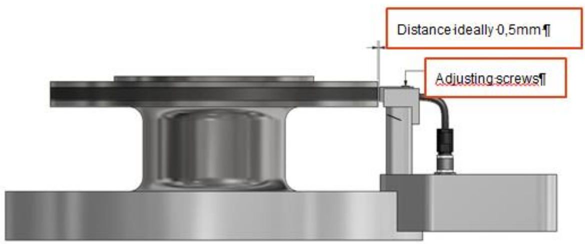


Figure 5-2 Adjustment of correct distance

F1iS -> 0,5mm (tolerance ±0,4mm)
F2iS -> 0,5mm (tolerance ±0,4mm)

5.2 Speed measuring system F1/F1i (1000 increments)

5.2.3 Adjustment of speed measuring for torquemeter F1/F1i

After each assembly of the torquemeter housing at a new machine the distance between the speed module and the impulse generator wheel must be checked and if necessary adjust.
The optimum air gap between the speed module and the impulse generator wheel is 0.5mm.
The air gap tolerance is ±0,4mm. Additional adjustments are not required.

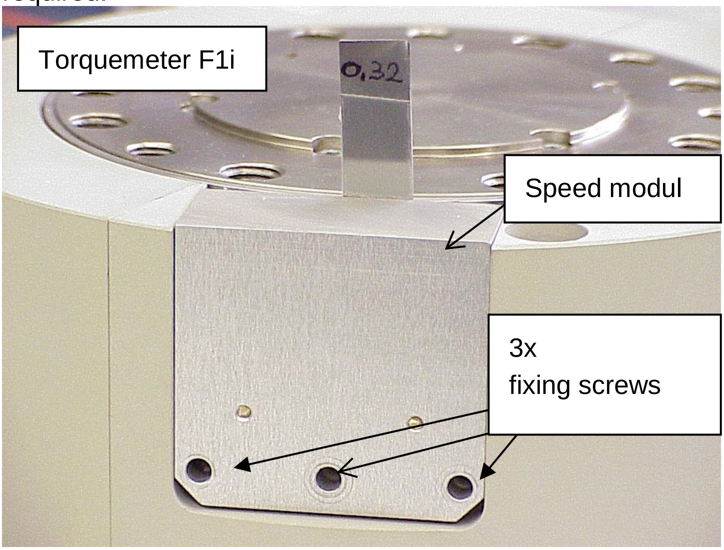


Figure 5-3 Adjustment of speed measuring

5.2.4 Adjustment of the right distance

At first unscrew the internal hexagon screw (fixing screw).
Now it is possible to move the speed module radial so that the distance between the speed module and the impulse generator wheel can vary. With the special shim plate the difference can be adjust to the nominal dimension. If the difference is correct, fix the screw and the adjustment is done.

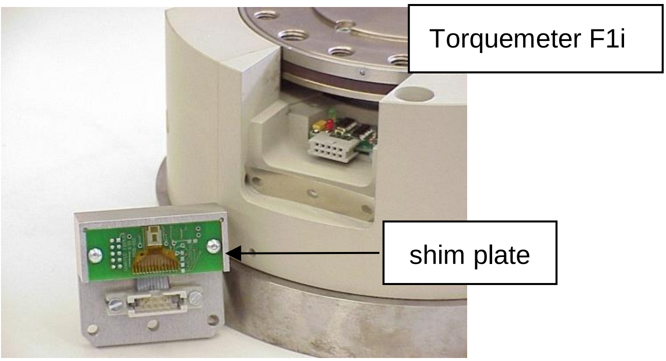


Figure 5-4 Shim plate for speed module

For a first check turn the torquemeter by hand.

5.3 Speed measuring system FLFM1iS, FLFM1eS

5.3.3 Optical speed detection

The optical speed sensor is available as an optional high-resolution speed acquisition providing 2 tracks with alternate 240, 360 or 400 increments per round and a 90° phase shift, thus giving the capability for detecting the rotational direction. It is located at the inner side of the stator-ring.

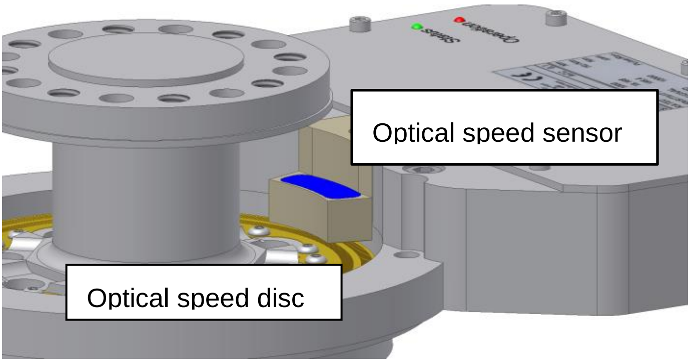


Figure 5-5 Optical speed detection

The speed-sensor signals are provided as RS422 signals and as processed values for the analog outputs and CAN messages. The RS422 signals can be accessed by connector X750 (refer to chapter „Electrical specifications“).

5.3.4 Setup the optical speed

With every modification (transformation) of the measuring flange housing into a new machine the optical speed sensing has to be newly balanced. This is important to do, because changing the distance

between speed disk and cover of receiver side causes a change of signal amplitude. Moreover, the electrical properties can vary in different modules. To setup the signal processing board you need to use an oscilloscope.
For balancing do the following:

Remove the cover of the signal processing unit.

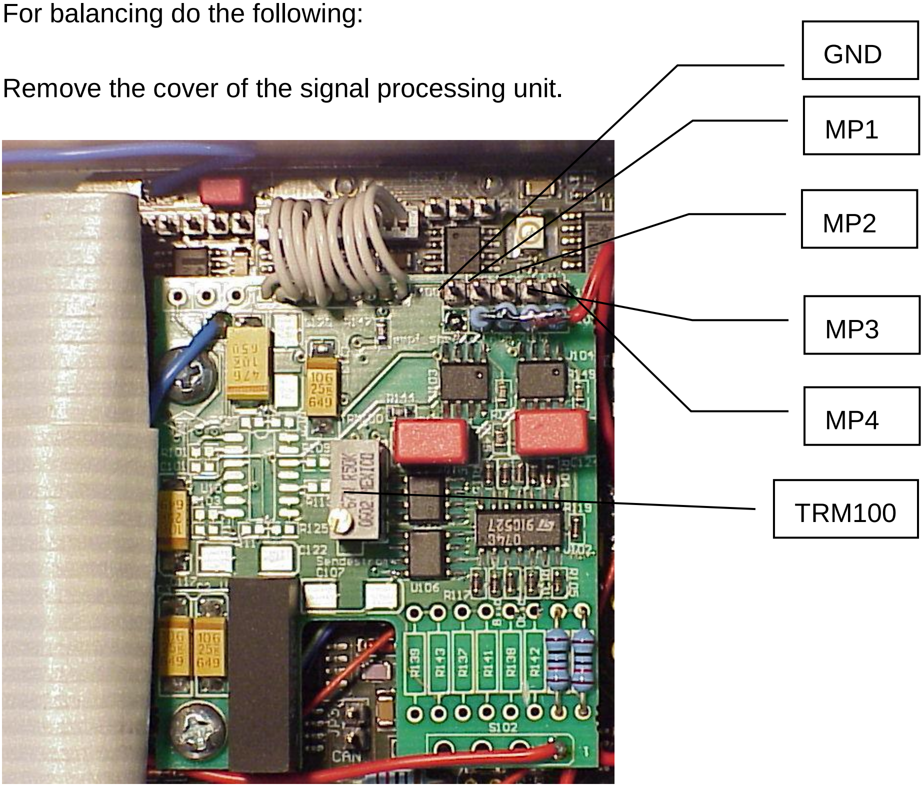
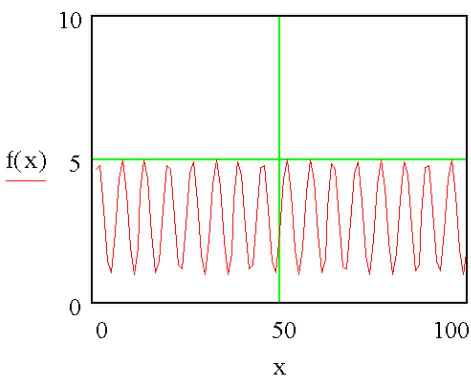


Figure 5-6 Signal processing unit

To carry out the adjustment procedure the measuring points have to be measured with oscilloscope.
At MP1 till MP4 there will be measured 4 voltage signals from the IR receiver (transistor).

With the speed there are sinusoidal signals, wherein MP1 to MP2 and MP3 to MP4 have 180° phase displacement and the both pairs have 90° to each other phase displacement. For the basic settings it will be sufficient to turn the measuring flange by hand during the measurement.
The aim of the setting is that all speed signals provide output sinusoidal signals with approximately equal amplitude in the range of about 0,8V – 6V.
With a potentiometer TRM100 the electric current will be set, which flows through the IR transmitter diodes.
With the current raising the amplitude of the AC voltage increases and the DC voltage of the speed signals decreases (MP1 till MP4).
The current has to be so set, so that a minimal voltage would be in MP1 till MP4 0,8V till 1V.
The sinusoidal voltage signal must not be cut off in upper and lower max. point.

The amplitude has to be so set, so that the sending current could be so high as possible. The sinusoidal voltage signals of the speed signals have then the smallest DC offset.



5.3.5 Speed measuring adjustment

The optical speed mask position at the speed module is factory adjustment and needs no readjustment Additional adjustment is not required.

Speed Module for Torquemeter FLFM1iS, FLFM1eS

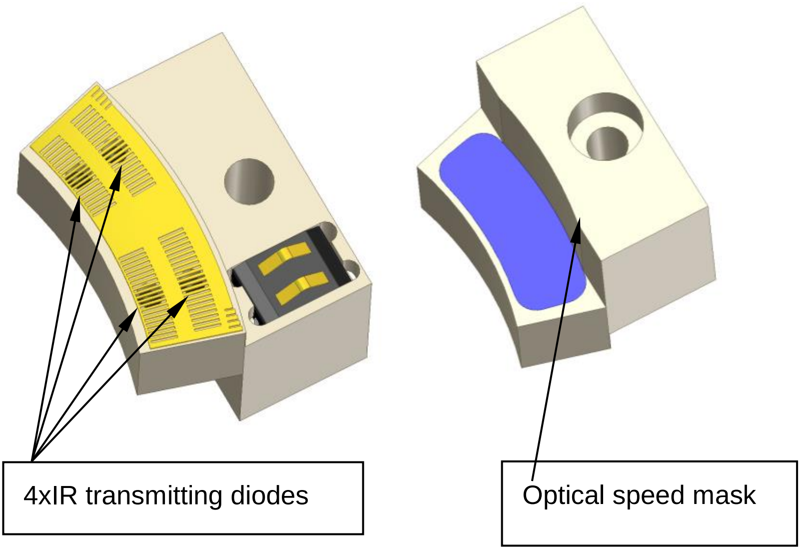
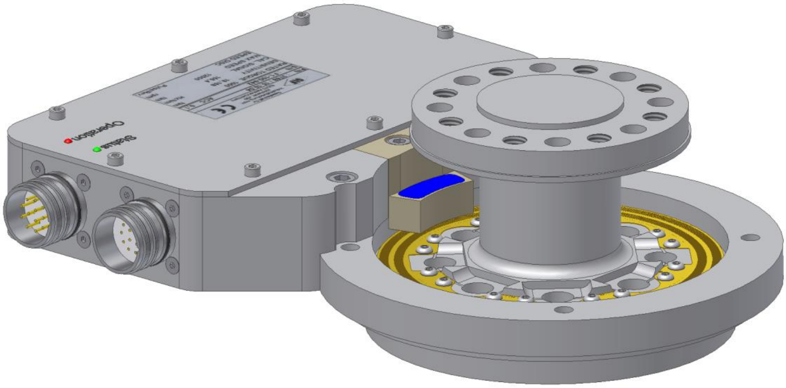
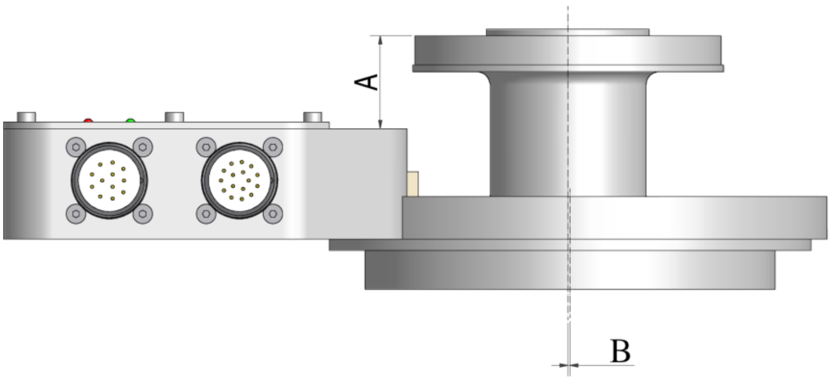


Figure 5-7 Speed measuring adjustment

The optimum position of the speed measuring system will be determined by positioning rotor to stator.

Following masses have to be observed.





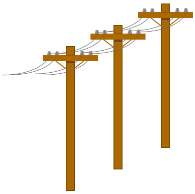
	A: axial displacement Rotor-Stator	B: axial deflection
without optical speed sensing	**28... 28,3...29,5**	**±0,3 mm**
with optical speed sensing	**28,3...28,5...29**	**±0,3 mm**

For a first check turn the torquemeter by hand.

6 Electrical Installation

The parts delivered are dependent upon customer specific orders. If you have ordered a complete measurement system, all electrical and software parameters are pre-installed.

6.1 Mains Supply



The purchased ATESTEO measuring systems F1iS/F2iS, F1i/F2i, FLFM1iS, FLFM1iS, FLFM1eS have to be powered with DC voltage of 24-30V / 1A. The power input depends on the sensor system. The power consumption lies between 4 and 10 watts. The power supply must be protected with a 1AT fuse against overcurrent.

6.2 Earthing

The housing of the evaluation unit has an earth connection. The internal ground is separated from that earth. The torquemeter ***must*** be connected to the earth of the test bench for proper working. The shielding of the connecting cables is connected to the connectors at both ends.

6.3 Connecting the Evaluation Unit / Torquemeter with a Data Acquisition System

To keep the EMV – Norm EN61000-6-4 / VDE 0839 parts 6-4, the following procedure to handle the connecting cable is recommended. Please use shielded servo cable with 4x 2x 0.14mm² (twisted pair) + 4x 0,5mm² wire for the connection to X750 and shielded servo cable with 8x 2x 0.25mm² wire (twisted pair) for the connection to X 751/752. The shielding of the cable must be connected to the connectors on both ends.

The following grounding scheme is recommended:

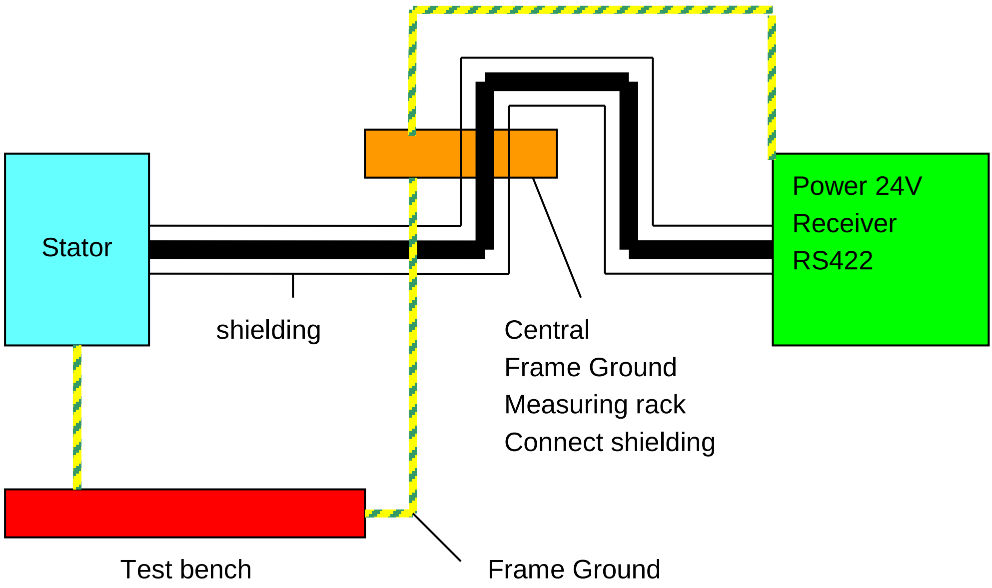


Figure 6-1 Grounding scheme

The shielding must be connected on both sides (torquemeter and measuring rack).

The usage of the equipment assumes keeping the general safety regulations in mind!

7 First Installation

7.1 First Installation iS-Type

ATTENTION!!!

If you have purchased a complete torque measurement system consisting of a torquemeter and a corresponding stator, you may skip the following articles. Otherwise the following adjustments of the default settings are absolutely necessary to properly run the system!

7.1.3 Changing the Torquemeter

For your convenience the torquemeters of the F1iS series are interchangeable with the same stator. All you need is to enter the parameters supported by the 'Torque Transducer Test Report' which is delivered with the new torquemeter.

TORQUE TRANSDUCER TEST REPORT

Torque transducer test report

Serial number: F1iS - 4759

Range1

Rated Torque:	3000	Nm		
Calibrated Torque:	3000	Nm		
Sensitivity cw:	6,8721	Hz/Nm		
Sensitivity ccw:	6,8684	Hz/Nm		
Test signal:	1455,01	Nm	9999	Hz
Accuracy (Nonlinearity and hysteresis):	0,1% of rated torque			
Temperature effect on zero:	0,1% of rated torque / 10°C			

Compensated Temperatur Range (Rotor/Stator): 0°C/0°C to 80°C/70°C
Gravitational Constant Alsdorf: 9,81106 m/s²
Ambient Temperature: 23 °C

Remarks:
Maximum Speed: 12000 rpm
Speed Disc: i60 ppr
Warming Up Time: 30 minutes

Date: 30.06.2016 Signed:

ATESTEO GmbH · Konrad-Zuse-Str. 3 · 52477 Alsdorf
+49 (0) 24 04-98 70-0 · info@atesteo.com · www.atesteo.com

First Installation F1i/F2i

With every torquemeter you get a torque transducer test report.
These parameters must be saved via the RS232 interface into the stator.

The electronic unit for measuring and transmission of torque is placed in the measuring flange. The unit is supplied by a reference voltage of 10VDC. For good voltage stability, the input voltage should be about 15V. The shunt calibration switch is closed at an input voltage above 17V. In normal operation mode the frequency of the infrared data stream is 60 kHz ± 20 kHz.

The table shows the function of the automatically power supply adjustment.

Sp. Amplitude	Frequency / Hz	Meaning
11,0	40000	amplitude too low; no stable supply voltage for the rotating electronic
11,2	45120	amplitude too low
11,4	50350	amplitude too low
12,0	54780	amplitude too low
12,5	58340	amplitude too low
12,7	60090	amplitude correct; normal working range
13,7	60090	amplitude correct; normal working range
14,7	60090	amplitude correct; normal working range
15,0	63100	amplitude correct; calibration jump
16,0	63100	amplitude correct; calibration jump
17,0	63100	amplitude correct; calibration jump
18,0	63100	amplitude correct; calibration jump
20,1	0	amplitude too high; overvoltage protection

Table 7-1 Power supply adjustment

The optimal setting for the power supply amplitude in this example is:
(s) = 13,7 (PS. Voltage)
(7) = 17,0 (Calibration jump [V])

7.2 Terminal Setting

7.2.3 Terra Term Setup

This program is a freeware and you can find it on the delivered CD.

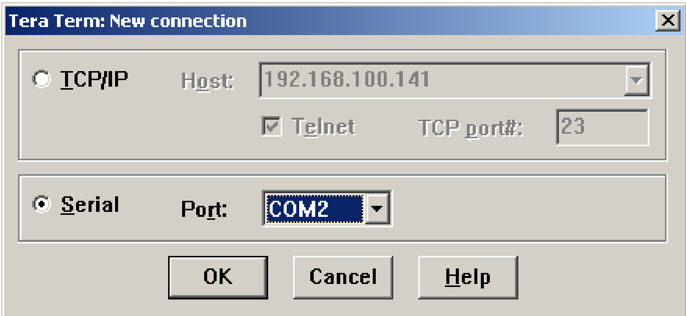


Figure 7-1Tera Term: New Connection

Font setup:

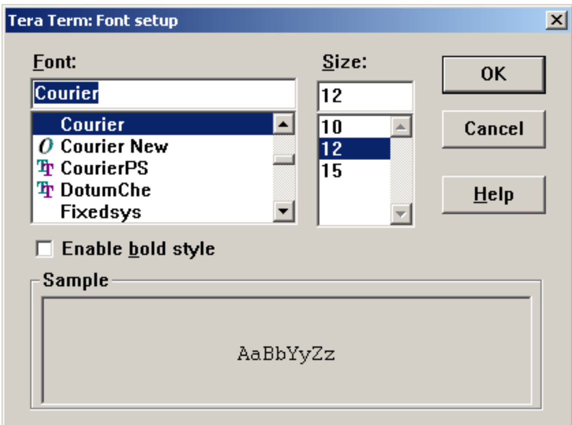


Figure 7-2 Tera Term: Front setup

Terminal setup:

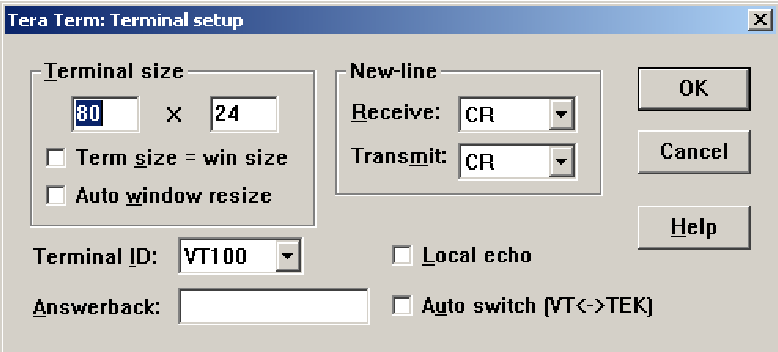


Figure 7-3 Tera Term: Terminal setup

Serial port setup:

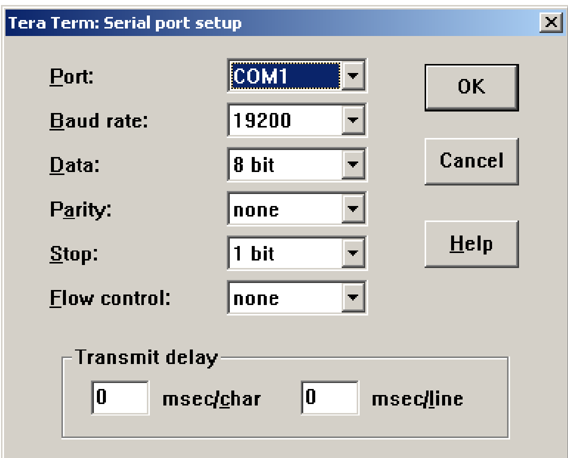


Figure 7-4 Tera Term: Serial port setup

7.2.4 Setting up the Calibration Parameters

Connect the Torquemeter F1iS/F2iS, F1i/F2i, FLFM1iS or FLFM1eS to the serial interface (RS232 19200 Baud, 8bit, no parity, no protocol).
To activate the serial interface press the key '#', then press 'T' to enter the torquemeter setup menu.

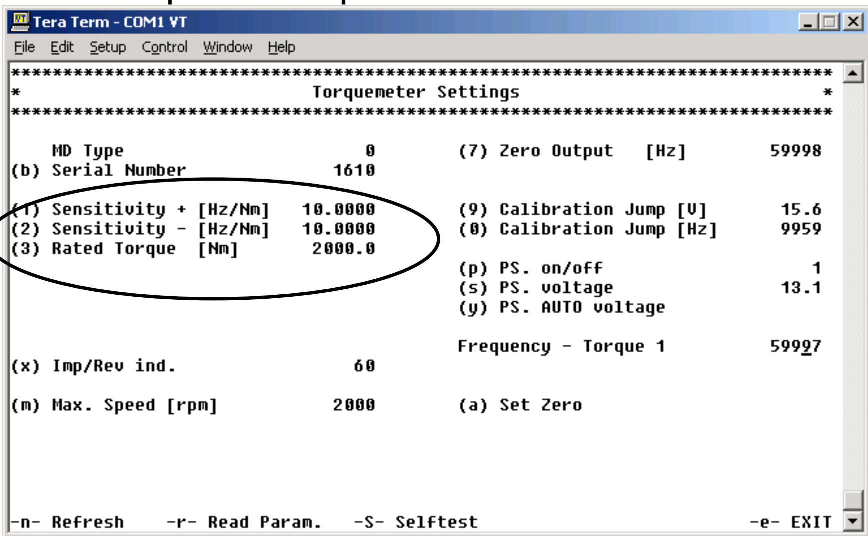


Figure 7-5 Setting calibration parameters

With the terminal program you can set up the parameters for the connected torquemeter. Take the parameters (1, 2, 3, b) from the torque transducer test report and fill in the properties as shown.

TORQUE TRANSDUCER TEST REPORT

P/N: 4831 **Serial number S/N :** F1iS - 1721

Range1

Rated Torque	500	Nm	
Calibrated Torque	500	Nm	
Sensitivity clockwise	38.9442	Hz/Nm	
related to calibrated torque			
Sensitivity anticlockwise	38.9365	Hz/Nm	
Calibration Jump	255.75	Nm	9960 Hz

Sensitivity clockwise = Sensitivity+
Sensitivity anticlockwise = Sensitivity-

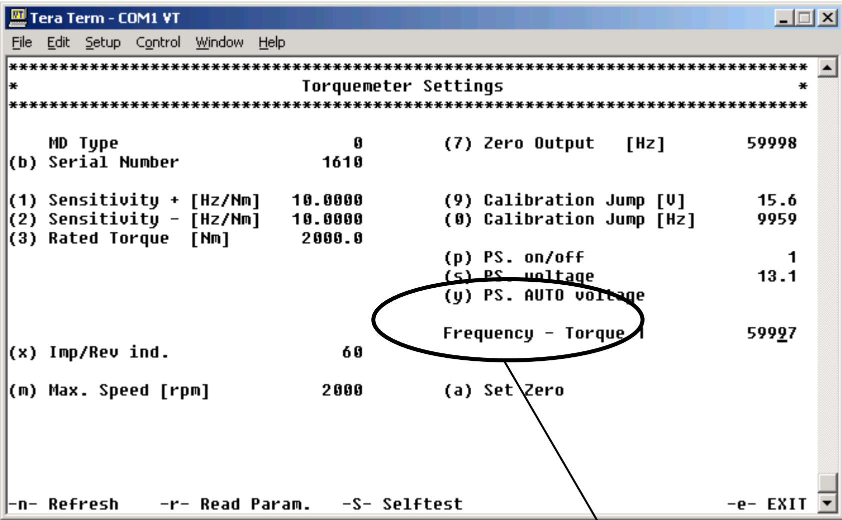


Figure 7-6 Automatic inductive power supply adjustment

Press 'y' for automatic inductive power supply adjustment.

After these steps the frequency Md1 must be about 60000 Hz.

With each new installation (Torquemeter/Stator) it is recommended to adjust the inductive power supply. The amplitude of the inductive power supply can be automatically set up by pressing 'y'.

8 Configuration

8.1 Software TCUConfig

Connect the Torquemeter to the serial interface. Install the program TCUConfig on your PC and start the program.

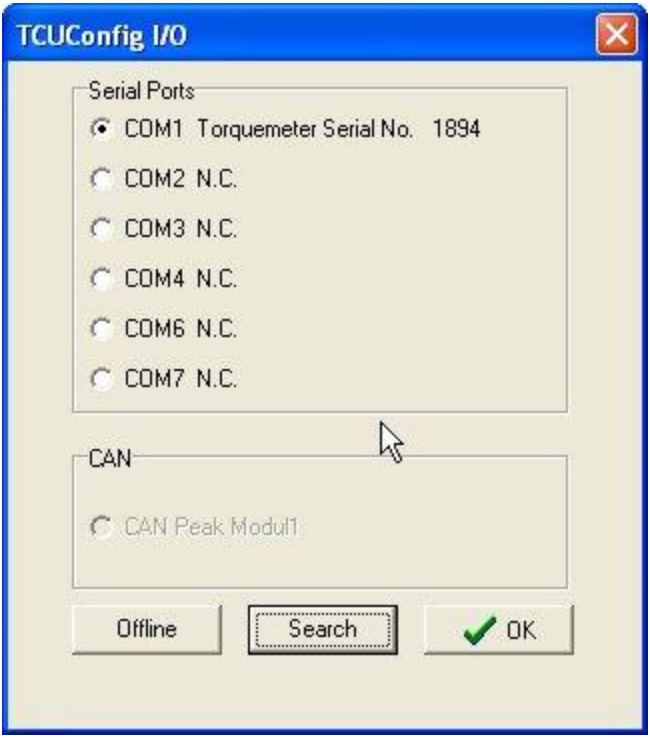


Figure 8-1 TCU Configuration

The TCUConfig program scans all ports after you press Search. Select the port which is connected to the torquemeter. It is also possible to

work offline with the setup program. In this case you can store a parameter list for later use.
If you have some Bluetooth interfaces or other measurement equipment at the serial port it can be that the Search routine doesn't work and the program hang up. In this case select only the used serial port.

After selecting the correct port an overview of all settings is shown.

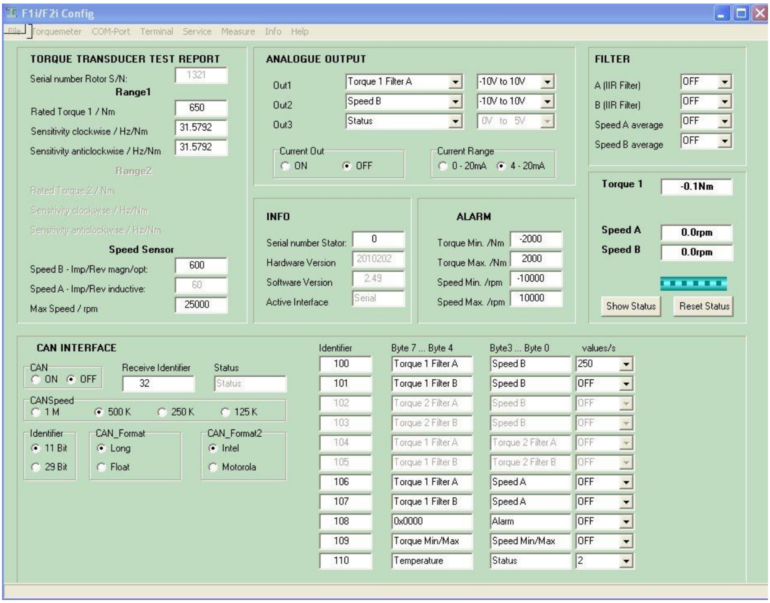


Figure 8-2 Settings after selecting correct port

8.1.3 Setup Inductive Power Supply

Service – Setup Inductive Power Supply
The stator searches for the right settings of the inductive power supply. If everything is o.k. the frequency of the torque signal is about 60000 Hz. In the menu “Service Setup inductive Power Supply” it is possible to activate this operation by hand.

8.1.4 Torque zero adjustment

With a right click on the torque value it is possible to show the frequency and to set the torque to 0 Nm. Please use torque = 0 only if you 100% sure, that the torquemeter is free of torque.

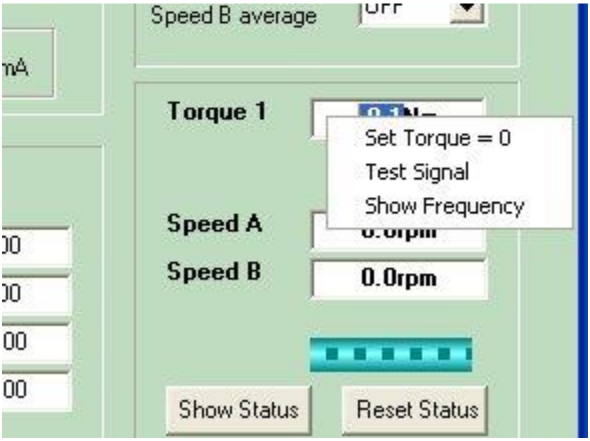


Figure 8-3 Torque zero adjustment

8.1.5 Setup of the calibration parameters

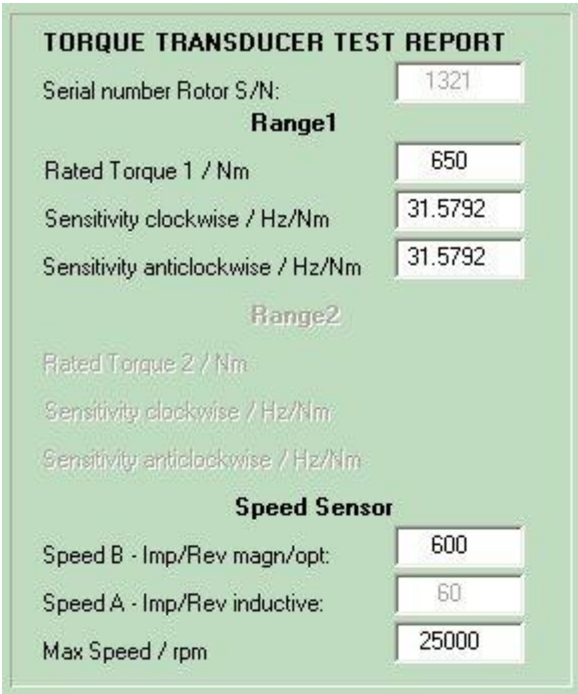


Figure 8-4 Setup of calibration parameters

Fill in the form showed above with the parameters from the Torque Transducer Test Report. These parameters are very important to get the right physical values at the analog output, the display and the CAN Interface.

8.1.6 Setup Analog Output

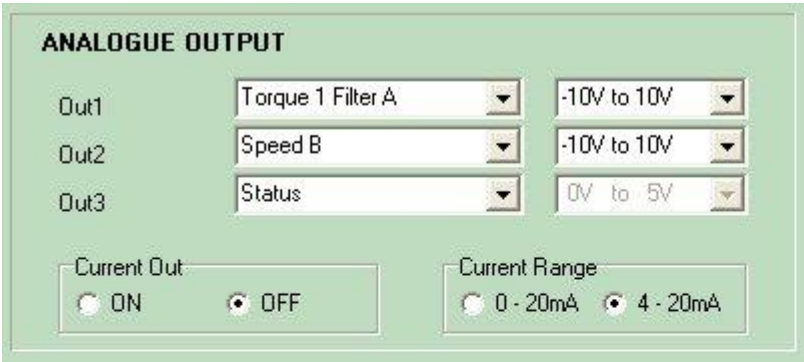


Figure 8-5 Setup analog output

The torquemeters F1iS/F2iS, F1i/F2i, FLFM1iS, FLFM1eS include up to three (A/B/C) analog outputs. Here it is possible to select different signals for the analog outputs. You can get your F1iS / F2iS with a lot of options. Whichever is the installed option the menu shows different choices for the analog output.

For Out1 / Out2 it is possible to select between:

- Torque 1 Filter A
- Torque 1 Filter B
- Speed

It is not possible to show the same channel on both outputs.

The output range can be selected between:

- -10V to 10V
- -5V to 5V
- 0 to 5V
- 0 to 10V

For circuit details and sample circuits please refer to chapter „Electrical specifications“.

8.1.7 Setup Current Output

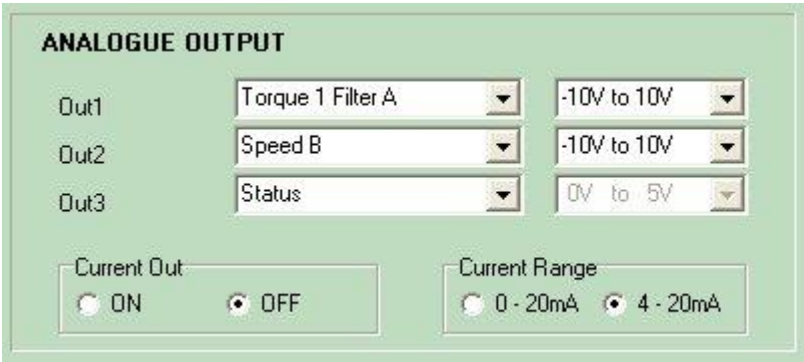


Figure 8-6 Setup current output

The current output can be switched on or off in this edit menu. Moreover, it is possible to select between 0-20mA and 4-20 mA. If the current output was used, then the analog output A isn’t available anymore.

8.1.8 Setup Filter

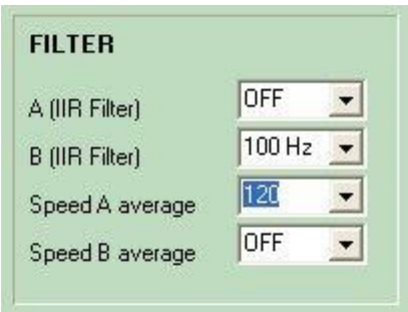


Figure 8-7 Setup filter

Filters used here, acting on analog and CAN outputs, but not on frequency outputs.
For the torque signals the both filters are available. Thus one filter can be used for the automation system and the other one for the measuring equipment. The filter A and B for the torque signal are IIR Filter and the filter for the speed signals are moving average filter.

8.1.9 Setup Alarm

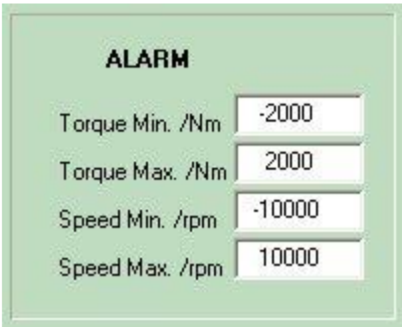


Figure 8-8 Setup alarm

Here it is possible to setup the alarm limits for the speed signal and the torque signal.
For circuit details and sample circuits please refer to chapter „Electrical specifications".

8.1.10 Setup CAN Interface

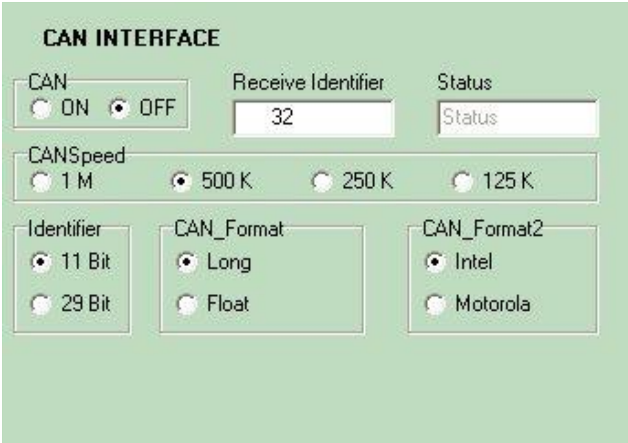


Figure 8-9 Setup Can Interface

Please select the right parameter which corresponds with your measuring equipment.

Identifier	Byte 7 ... Byte 4	Byte3 ... Byte 0	values/s
100	Torque 1 Filter A	Speed B	250
101	Torque 1 Filter B	Speed B	OFF
102	Torque 2 Filter A	Speed B	OFF
103	Torque 2 Filter B	Speed B	OFF
104	Torque 1 Filter A	Torque 2 Filter A	OFF
105	Torque 1 Filter B	Torque 2 Filter B	OFF
106	Torque 1 Filter A	Speed A	OFF
107	Torque 1 Filter B	Speed A	OFF
108	0x0000	Alarm	OFF
109	Torque Min/Max	Speed Min/Max	OFF
110	Temperature	Status	2

Figure 8-10 Signals at CAN-BUS

You can choose here which signals at CAN-BUS have to be displayed and with witch data rates.

The value of the output data depends on the selected format and the measured value. When the data format 'long' is selected, the measured values are multiplied by a certain factor to retain decimal places. Thus the received data must be divided by that factor by the acquisition system to get back the measured data.

Measured Value: float	Measured Value: long (x factor)	Unit
Speed inductive	Speed inductive x 10	rpm
Speed magnetic\optical	Speed magnetic \optical x 10	rpm
Torque	Torque x 1000	Nm
Torque Min/Max (int)	Torque Min/Max (int) x 10	Nm
Speed Min/Max (int)	Speed Min/Max (int) x 10	rpm
Temperature Stator	Temperature Stator x 1000	°C
Status (long)	Status	
Alarm (long)	Alarm	

Table 8-1 Possible data which can be sent by CAN interface

This table shows the possible data which can be sent by the CAN interface. Every CAN message consists of an identifier and two different measured values. For each pair of measured values you can select a separate data transmit interval.

As the example above the following message will be send:

<table>
<tr><td>Long</td><td colspan="4">0</td><td colspan="4">1</td><td>100 values / s</td></tr>
<tr><td>Integer</td><td colspan="2">0</td><td colspan="2">1</td><td colspan="2">2</td><td colspan="2">3</td><td></td></tr>
<tr><td>Byte</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td></td></tr>
<tr><td></td><td colspan="4">Speed Max/Min</td><td colspan="4">Torque Max/Min</td><td>Identifier ID 0x109</td></tr>
</table>

Table 8-2 Example of data sent by CAN interface

8.2 Terminal Program

If the program “TCUConfig” is not more available, you can conduct all the settings using the Terminal Program.

8.3 Main Menu

To activate the serial interface press the key '#'.

```
******************************************************************************
*                  All-In-One   V2.49.2010202   S/N 0
******************************************************************************

Torque 1                             -0.0        (a) Set Zero
Mag/Opt Speed                         0.0        (b) Test Signal
Ind. Speed                            0.0        (c) Reset Status


Frequency - Torque 1                59993
Frequency - Mag/Opt Speed               0
Frequency - Ind. Speed                  0


Stator Temperature                   44.1

Test Counter                            0

CAN error                               2
Status                         0x00000802

Operating hour                13:21:51:20

-n- Refresh  -F- Filter  -A- Alarm  -O- Output  -T- Torquemeter  -S- Setup
```

Figure 8-11 Terminal Program: Main Menu

On the left site the values for torque and speed are shown as well as the internal stator temperature and status indicators.

Key	Description
a	Zero calibration. Set torque = 0; **Attention: Be sure that no torque is invoked when setting to zero-torque!**
b	Activate the test signal. The rotor supplies a frequency shift of 10kHz from center frequency.
c	Reset the status word. (see chapter 5.8.3)
F	Submenu: Filter settings for torque and speed
A	Submenu: Alarm thresholds for torque and speed
O	Submenu: Configure analog and digital outputs (analog/CAN)
T	Submenu: Torquemeter settings (sensitivity/rated torque)
S	Submenu: Setup settings and calibration routines (analog/CAN)
Can error	0– no error 1- <128 errors/s 2- >128 errors/s 3-Bus off

Table 8-3 Key description of the Terminal Program

8.3.1 Filter Settings

Different digital filters can be activated in stator.

- Two independent IIR filters are dedicated to the torque channel with 6 different cut-off frequencies.
- One moving average filter is provided for F1i/F2i, F1iS/F2iS installed speed sensor. (The magnetic speed sensor as shown in the picture below is optionally available).

```
******************************************************************************
*                               Filter Settings                              *
******************************************************************************

TORQUE FILTER
(1) Filter A                 off
(2) Filter B               100Hz

SPEED FILTER
(3) Mag/Opt Speed            off
(4) Ind. Speed               120






-n- Refresh                                                          -e- EXIT_
```

Figure 8-12 Filter settings

Key	Description
1	**Cut-off frequency (-3dB) of filter A for torque measurement** **Filter settings:** **-0- off** **-1- 250Hz** **-2- 150Hz** **-3- 100Hz** **-4- 50Hz** **-5- 10Hz** **-6- 1Hz**
2	**Cut-off frequency (-3dB) of filter B for torque measurement.** **(Filter settings see above)**
3	**Moving-average filter depth for the inductive speed sensor (standard).** **-0- off**
4	**Moving-average filter depth for the magnetic speed sensor (optional).**

Table 8-4 Key description of filter settings

8.3.2 Alarm Settings

It is important to take care of the maximum safe operating conditions specified for the torquemeter. Not only to prevent the rotor from damage due to hazardous operating states but also to protect the test bench against demolition.

Alarm thresholds can be set for the maximum approvable torque and speed. The alarm signal is provided through open collector outputs at the 16 pole connector X752 and as CAN messages.

For circuit details and sample circuits please refer to chapter „Electrical specifications“.

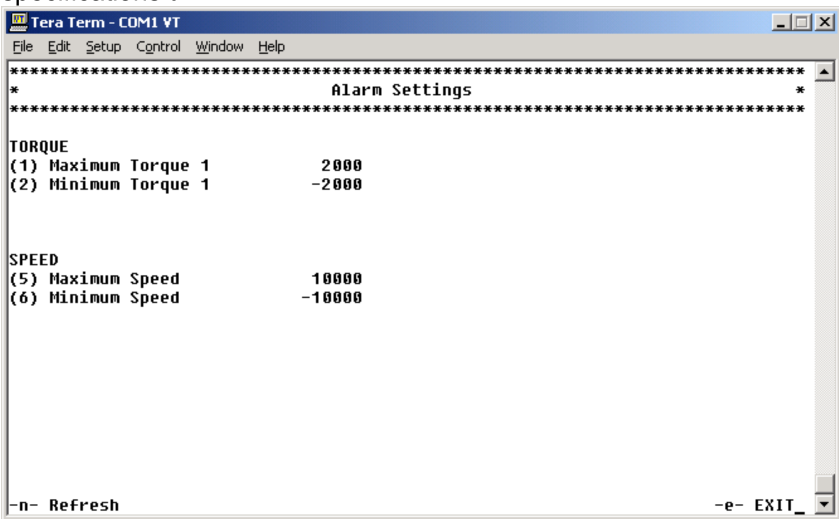


Figure 8-13 Tera Term: Alarm settings

ATESTEO

Key	Description
'1'	Alarm threshold max. torque
'2'	Alarm threshold min. torque
'3'	Alarm threshold max. speed (inductive and magnetic)
'4'	Alarm threshold min. speed (inductive and magnetic)

Table 8-5 Key description of alarm setting

8.3.3 Output Settings

The measured values of torque and speed can be outputted as analog signals and as CAN messages simultaneously. It is possible to choose between the different filter types to set up each output channel individually.

Three analog outputs are available.

Channels A and B are selectable for torque and speed output with different voltage output ranges defined. Analog output A can be switched to a current loop whereby it is no longer available as calibrated voltage output. Hence the current output takes its place.

Channel C provides the internal stator temperature or status information about the stator. An output voltage level of 4.9V represents a faultless operation whereas a voltage of 0.1V is representing an error and the torquemeter has to be checked.

If the outputted voltage drops below 0.1V a line break occurred.

Voltage analog output C	Description
<0.1V	Cable break. Check electrical connection
0.1V	Error! Check the status word by software to determine the error condition.
4.9V	No error.

Table 8-6 Description of voltage analog output C

The CAN message configuration is simply performed by entering an identifier and a transmit interval for the referred signal. A minimum time interval of 1ms can be chosen. The number of totally transmitted data per second is limited by the bus speed of CAN, so the current set data rate is calculated and displayed as 'Current Message rate'. The predetermined maximum message rate can neither be crossed nor altered. For the CAN bus settings refer to chapter "CAN".
If the mounted speed sensor is not in selection, it can be activated with the "TCUConfig" software, Menu „Service" „Setup Speed Sensor" or in Terminal „output settings" „x".
For circuit details and sample circuits please refer to chapter „Electrical specifications".

```
*******************************************************************************
*                              Output Settings                                *
*******************************************************************************

ANALOG OUTPUTS
(a) Analog Output A:     Md1 FA
(b) Analog Output B:     N mag/optMd1 FA
(c) Analog Output C:     Status

Current Messagerate:   252[Msg/sec]

CAN OUTPUT
DATA                    IDENTIFIER [dec]  TX INTERVAL [ms]
Alarm threshold          (1)        108     (f)          0
Minimum-Maximum          (2)        109     (g)          0
Status/Temperature       (3)        110     (h)        500
Md / N mag/opt Filt A    (4)        100     (i)          4
Md / N mag/opt Filt B    (5)        101     (j)          0
Md / N ind - Filter A    (6)        106     (k)          0
Md / N ind - Filter B    (7)        107     (l)          0


(x) Speed Sensor Type:   mag. and ind/opIntel
                                                       -n- Refresh   -e- EXIT
```

Figure 8-14 Output settings

Key	Description
'a', 'b'	Select signal for analog output A/B -0- Md1 Filter A -1- Md1 Filter B -2- N mag Filter (optional) -3- N ind Filter
'1'..'7'	CAN message identifier
'f'..'l'	CAN transmit interval
'x'	Installed speed sensors.
Current Message rate	Maximum configurable message rates 1Mbps 6500msg/s 500kbps 3700msg/s 250kbps 1850msg/s 125kbps 1000msg/s 100kbps 800msg/s 10kbps 76msg/s

Table 8-7 Key description for analog output settings

8.3.4 Torquemeter settings

To adapt a torquemeter to an evaluation unit the calibration parameters obtained from the 'Torque Transducer Test Report' must be correctly filled out in the 'Torquemeter Settings' menu. The frequency registered as 'Zero Output' is acquired when performing a zero calibration [(a) Set Zero)].

```
*******************************************************************************
*                           Torquemeter Settings                              *
*******************************************************************************

    MD Type                           0          (7) Zero Output    [Hz]       59994
(b) Serial Number                  1321

(1) Sensitivity + [Hz/Nm]       31.5792          (9) Calibration Jump [V]       16.3
(2) Sensitivity - [Hz/Nm]       31.5792          (0) Calibration Jump [Hz]      2988
(3) Rated Torque  [Nm]            650.0
                                                 (p) PS. on/off                    1
                                                 (s) PS. voltage                14.4
                                                 (y) PS. AUTO voltage

                                                 Frequency - Torque 1          59993
(x) Imp/Rev ind.                     60
(z) Imp/Rev mag/opt                 600
(m) Max. Speed [rpm]              25000          (a) Set Zero



-n- Refresh    -r- Read Param.   -S- Selftest                             -e- EXIT
```

Figure 8-15 Torquemeter settings

Key	Description
'b'	Serial number. The Serial number from the enclosed torquemeter is shown.
'1'	Sensitivity + characteristic value: torquemeter torque clockwise (pos)
'2'	Sensitivity - characteristic value: torquemeter torque anticlockwise (neg)
'3'	Rated Torque
'x'	Number of pulses per revolution of the inductive speed sensor (fixed by mechanical design of the torquemeter)
'z'	Impulses per revolution (speed measuring system)
'm'	Maximum speed Full scale value of analog output
'7'	Zero Output (Zero frequency) This value is automatically acquired when performing a zero calibration
'9'	Calibration Jump [V] Necessary inductive power supply amplitude to engage the test signal. This parameter is calculated automatically and **must not** be altered by the user!
'0'	Calibration Jump [Hz] Test signal frequency shift in Hz. This parameter is calculated automatically and **must not** be altered by the user!
'p'	PS. on/off Turn inductive power supply on/off.
's'	PS. Voltage Voltage amplitude of the inductive power supply.
'y'	PS. Auto voltage Automatically setup the inductive power supply.

Key	Description
	The following parameters are assigned (s) PS. Voltage (7) Zero Output (9) Calibration Jump [V] (0) Calibration Jump [Hz]
'a'	Zero calibration. Set torque = 0; **Attention: Be sure that no torque is invoked when setting to zero-torque!**
'r'	Read parameters stored into the rotor electronics.
'S'	Perform self-test of the measuring system

Table 8-8 Key description torquemeter settings

8.3.5 Read parameters

The calibration parameters can be obtained from the 'Torque Transducer Test Report' as well as read out of the torquemeter electronics itself. After the transfer procedure is performed the user is prompted to setup the evaluation unit with the read values.

```
******************************************************************************
*                         PARAMETER FROM TORQUEMETER                         *
******************************************************************************

read parameter ...      10100001010

Typ                                0  Temp1 electr.                 36.4
Serial number                   1321  Temp2 middle                  33.6
Sensitivity1-                31.5792  Temp3 output                  32.4
Sensitivity1+                31.5792  Temp4 input                   34.1

                                      Temp max.                     77.2
Rated torque1                  650.0




map error:   0:192

Setup with new values? (y/n)_
```

Figure 8-16 Parameter from torquemeter

After pressing the key 'Y', the parameters received from the torquemeter will be stored into the evaluation unit (Stator).

8.3.6 Self test

The self-test can be used to perform a test routine verifying the rudimentary functions of the measurement system. The following settings will be checked:

- inductive power supply settings
- Comparing the saved serial number with the received serial number. If the serial numbers are different, then the new values for the sensitivity will be saved automatically.
- Stability test of the inductive power supply.

If an error occurs it is indicated by the status word supplied by the evaluation unit.

```
******************************************************************************
*                                  Selftest                                  *
******************************************************************************

read parameter ...        10100001010

Serial no. old                   1321
Serial no. new                   1321
Sensitivity1 old              31.5792      31.5792
Sensitivity1 new              31.5792


Vcc= Vcc + 0,3V                  14.7   o.k.
                                59993
Vcc= Vcc - 0,3V                  14.1   o.k.
                                59993
Vcc= Cal                         16.3   o.k.
                                62982

Error Code                          0_
```

Figure 8-17 Self test

8.3.7 Analog setup

To adapt the analog outputs of the evaluation unit to a data acquisition system it is possible to adjust the voltage offset and the voltage output range. The current loop output range is selectable between 0..20mA and 4..20mA.

Note: The analog outputs are pre-calibrated during the production process of the evaluation unit. It is not recommended to recalibrate the analog outputs by untrained personal.
For circuit details and sample circuits please refer to chapter „Electrical specifications“.

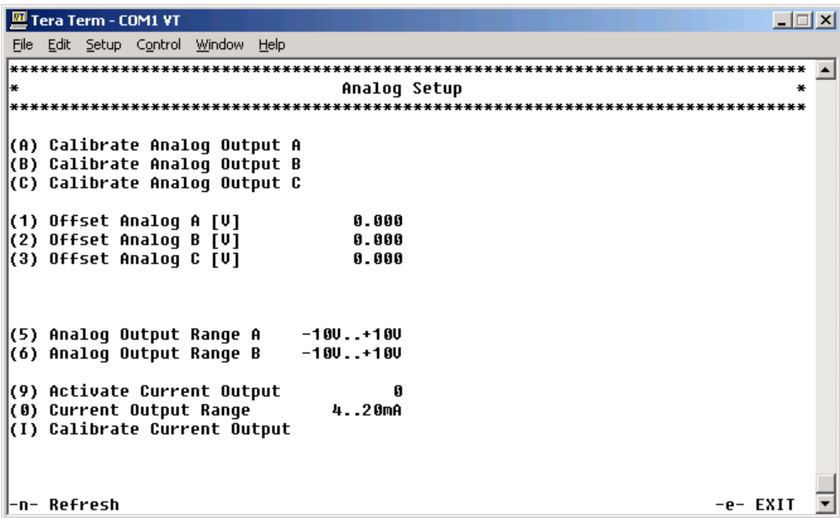


Figure 8-18 Analog setup

'A'..'C'	Calibration of the analog outputs. The calibration parameters were determined by ATESTEO and have been saved into the unit. No calibration is needed!
'1'..'3'	It is possible to set a offset voltage for each analog output.
'5', '6'	Here it is possible to set a offset voltage for each analog output.
'9'	**Attention: If activated the voltage output of channel A is not scaled!**
'0'	Select the output range of the current loop output.
'I'	Calibration of the current loop output. The calibration parameters were determined by ATESTEO and have been saved into the unit. No calibration is needed!
‘4’ (for F1i/F2i)	The Input Control is used to switch between the two channels of a dual range torquemeter

Table 8-9 Key description of analog setup

8.3.8 CAN setup

The CAN bus setup enables the user to adapt the torquemeter CAN interface to an existing CAN topology supported by the customer. It is not only possible to alter system parameters such as speed and identifier length but also to choose between different byte orders and message formats. For circuit details and sample circuits please refer to chapter „Electrical specifications“.

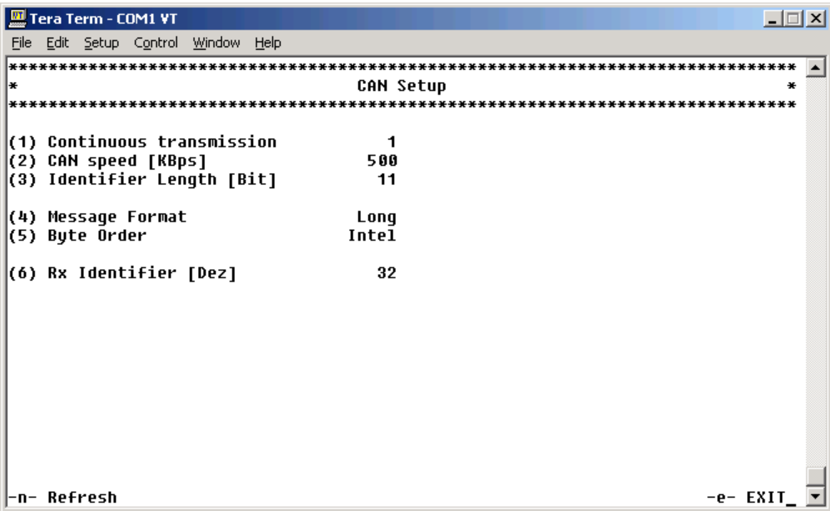


Figure 8-19 CAN set up

Key	Description
'1'	**If activated, the defined messages will be transmitted (activate data transmission)**
'2'	**CAN bus speed** **-1000- 1Mbps** **-500- 500kbps** **-250- 250kbps** **-125- 125kbps** **-100- 100kbps** **-10- 10kbps**
'3'	**Length of the message identifiers** **-11- 11 bit** **-29- 29 bit**
'4'	**Numeric format transmitted in a message** **-long- 32bit signed integer** **-float- 32bit IEEE754 floating point value**
'5'	**Byte order inside a CAN message** **-Intel- The data transfer begins with the least significant byte.** **-Motorola- The data transfer begins with the most significant byte.**
'6'	**The CAN identifier dedicated to the command messages the stator receives to be externally controlled.**

Table 8-10 Key description Can Set up

With the following messages it is possible to control the evaluation unit: Note: The values must be sent as "long" even if "float" is selected as numeric data format. The right identifier length (11 or 29 Bit) must be set.

Identifier: 11Bit / 29Bit

Long	0				1				
Integer	0		1		2		3		
Byte	0	1	2	3	4	5	6	7	
	0				2000				CAN message transmission start
	0				2001				CAN message transmission stop
	0				1201				Zero calibration. **Attention: Be sure that no torque is invoked when setting to zero-torque!**
	0				1202				Activate test signal
	0				1203				Deactivate test signal
	0				1211				Reset status
	0				1212				Read status
	0				1213				Read serial number of torquemeter
	0				1214				Perform self-test

Table 8-11 identifier: 11 Bit / 29Bit

Reply from torquemeter (rx-identifier + 1)

Long	0				1				
Integer	0		1		2		3		
Byte	0	1	2	3	4	5	6	7	
	Last command				X				

Table 8-12 Reply from torquemeter (rx-identifier + 1)

Read serial number:

Reply from torquemeter (rx-identifier + 1)

Long	0				1				
Integer	0		1		2		3		
Byte	0	1	2	3	4	5	6	7	
	Last command				Serial number				

Table 8-13 Reply from torque-meter (rx-identifier + 1)

Read status:

Reply from torquemeter (rx-identifier + 1)

Long	0				1				
Integer	0		1		2		3		
Byte	0	1	2	3	4	5	6	7	
	Last command				Status				

Table 8-14 Reply from torquemeter (rx-identifier + 1)

Status 32 Bit (format long)

ST Bit 7	ST Bit 6	ST Bit 5	ST Bit 4	ST Bit 3	ST Bit 2	ST Bit 1	ST Bit 0	Self-test active	Selection 1	Selection 0	Error 1	Error 0	Overflow	Zero point reset	Test signal
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
							Simulation				Alarm IR	Alarm N min	Alarm N max	Alarm Md min	Alarm Md max
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

Table 8-15 Status 32 Bit (format long)

Alarm 32 Bit (format long)

											Alarm IR	Alarm N min	Alarm N max	Alarm Md min	Alarm Md max
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Table 8-16 Alarm 32 Bit (format long)

(Upper 16 Bits not used. Read out as zeroes)

Min/Max (format int)

Speed Minimum			Speed Maximum		
31		16	15		0
Torque Minimum			Torque Maximum		
63		48	47		32

Table 8-17 Min/Max (format int)

After the zero point calibration procedure the status bit ‘zero point reset’ is set. It can only be cleared by resetting the status word. With the help of the error code it is possible to check whether the command is accomplished successfully or not.

Error 0/1:

Error 1	Error 0	
0	1	Zero point reset not possible
1	0	No calibration jump

Table 8-18 Error 0/1

Selection 0/1:

Selection 1	Selection 0	
0	0	Md1 / N1
0	1	Md2 / N1
1	0	Md1 / Md2

Table 8-19 Selection 0/1

ST bits:

ST Bit7	ST Bit6	ST Bit5	ST Bit4	ST Bit3	ST Bit2	ST Bit1	ST Bit0	
							1	SP + 0,5V Md1 not stable
						1		SP + 0,5V Md1 not stable
					1			SP CAL No calibration jump
				1				Self-test not active
			1					Found new values for inductive power supply
		1						Same serial number different sensitivity
	1							Can't read sensitivity
1								New torquemeter installed New sensitivity saved

Table 8-20 ST bits

9 Use of the Control signal / status

The input, Control can be used to release the self-test, to reset the zero point and to engage the test signal. If Analog out C is set to status it provides the status information about the stator. An output voltage level of 4.9V represents a faultless operation whereas a voltage of 0.1V is representing an error and the torquemeter has to be checked.
If the outputted voltage drops below 0.1V a line break occurred.
For circuit details and sample circuits please refer to chapter „Electrical specifications“.

9.1 Self-test

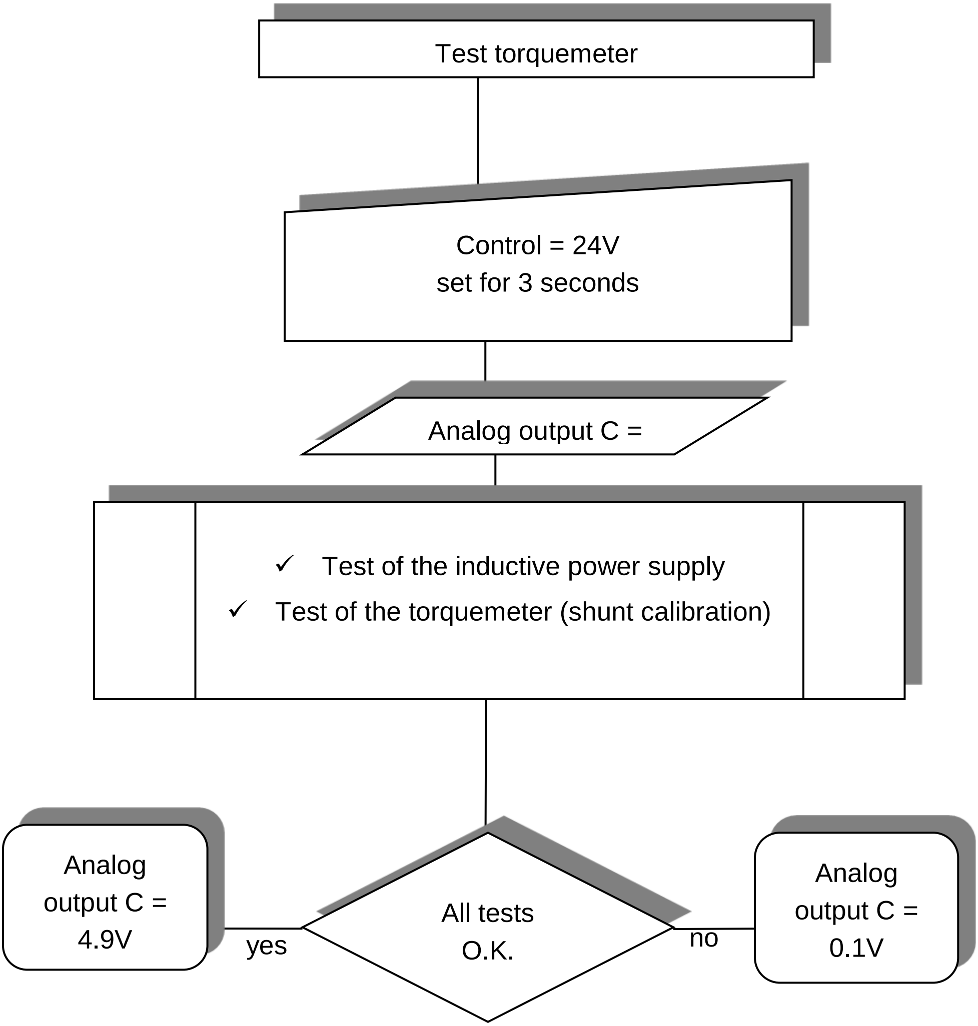


Figure 9-1Selftest

9.2 Zero calibration

Set Control for 5 seconds. With the falling edge of the input signal the zero point is calibrated.

9.3 Test signal

Set Control for 7 seconds. After 7 seconds the test signal will be engaged as long as the signal has a voltage level of 24V. By setting Control=0V the test signal will be disabled.

9.4 LED Status

9.4.1 Green LED

In normal mode the green LED is blinking with a frequency of 1 Hz indicating the evaluation unit is powered up. LED ist blinking faster during the start-up phase when the supply voltage is automatically adjusted (Auto Setup = 0).

9.4.2 Red LED

As long as the evaluation unit operates faultlessly the red LED is not lighting. If an error occurs (e.g. alarm threshold exceeded) the LED lights blink continuously. If the rotor sends no signal, or the automatic search for the power-supply amplitude is engaged, or the data transfer between stator and rotor is in progress the red LED is blinking

10 Digital Interface

10.1 Alarm Md/N

If the alarm thresholds have been exceeded due to overload or over-speed the open collector outputs "Alarm Md" and "Alarm N" are set. The digital outputs are open-collector types, so that the measured output signal is inverted. The maximum collector-emitter voltage is maximum rated with 36V (50mA).
For circuit details and sample circuit please refer to chapter „Electrical specifications".

10.2 Alarm IR

If the data transmission between the rotor and the stator can no longer be guaranteed faultless, the output "Alarm IR" is set. The degree of failure is observed by monitoring the intensity of infrared-light being transmitted. The threshold is factory calibrated and cannot be altered.
For circuit details and sample circuit please refer to chapter „Electrical specifications".

10.3 Reset Alarm

If alarm thresholds are exceeded the corresponding digital output is set. With the help of the input "Reset Alarm" it is possible to reset the alarms being displayed. The status bits are also cleared when using this feature. Apply a voltage >4V to trigger the reset function. The maximum input voltage is rated with 30V.
For circuit details and sample circuit please refer to chapter „Electrical specifications".

11 Special DT2 functions

11.1 Channel selection by using an external signal

Please read chapter with general CAN Setup (8.3.8) before setting up DT2 function.

Default settings as supplied to customer.

Menu ‘Settings’ ‘Analog’

(4) Special DT Function.= 1

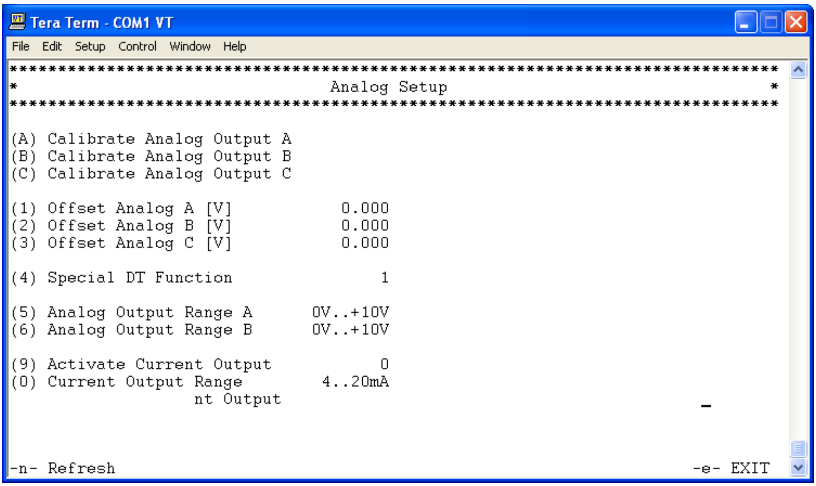


Figure 11-1 Menu Sttings Analog

With this the following Inputs / Outputs are active.
X751 / X752 PIN 16
Channel 1 -> torque 1 -> low range
Channel 2 -> torque 2 -> high range

Connector	Name	PIN	In/Out	Level	Function
X751/752	DT2	16	IN	0V or open	**Switch to channel 2 (high range)**
X751/752	DT2	16	IN	5V-24V	**Switch to channel 1 (low range)**
X751/752	Analogue out C	9	Out	0,1V	**Channel 2 active (high range)**
X751/752	Analogue out C	9	Out	2,5V	**System busy**
X751/752	Analogue out C	9	Out	4,9V	**Channel 1 active (high range)**
X751/752	**Analogue out A**	**10**	**Out**	**Selected Range**	**if Pin9= 0,1V -> channel 2 if Pin9= 4,9V -> channel 1 if Pin9= 2,5V -> not defined**

Figure 11-2 Connector specification X751 / X752

X750

Connector	Name	PIN	In/Out	Level	Function
X750	Control	9	IN	0V or open	**No function**
X750	Control	9	IN	24V for 3s	**Setup inductive power supply. With the falling edge of the input signal the procedure starts.**
X750	Control	9	IN	24V for 5s	**Set actual torque output = 0. With the falling edge of the input signal the zero point is calibrated**
X750	**Control**	**9**	**IN**	**24V >7s**	**Set actual torque output to calibration value (test signal). By setting Control=0V the test signal will be disabled.**

Table 11-11Connector specification X750

11.2 Channel selection by using a terminal program

Connect the serial port to X751/752
Start a terminal on the PC with the settings:

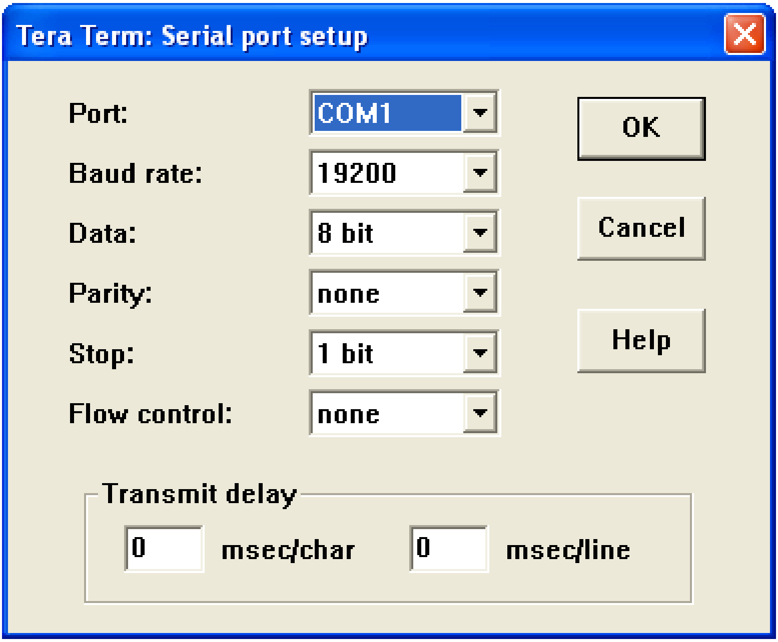


Figure 11-3 Tera Term: Serial port setup

Press #

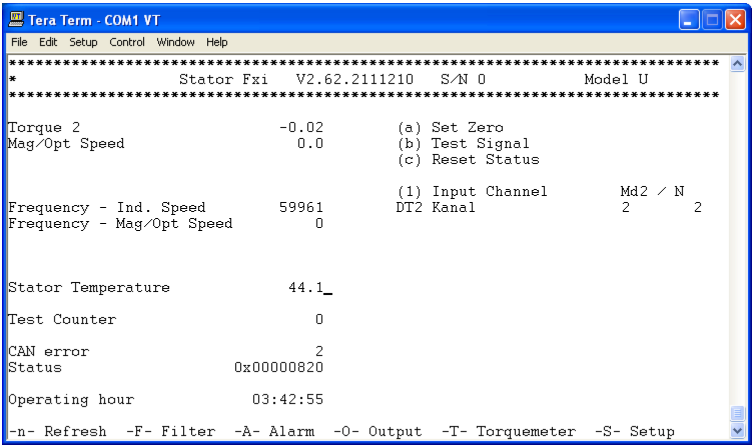


Figure 11-4 Tera Term

Input (1) Input Channel = 1 switch to channel 1 (low torque range)
Input (1) Input Channel = 2 switch to channel 2 (high torque range)

DT2 Channel shows the active channel

DT2 channel	Function
1	**channel 1 (low torque range active)**
2	**channel 2 (high torque range active)**
3	**ERROR Channel undefined.**

Table 11-2 DT2 Channel shows active channel

If you switch between the two ranges with the help of the terminal '(4) Special DT Function' Will be set to 0, but not saved.
After switching off / on the unit the system switches to the channel which is selected by X751/752 Pin 16.
If you want to switch only by terminal or by CAN then set '(4) Special DT Function.=0 ' with the help of the terminal.

11.3 Channel selection by using a CAN interface

Please read the chapter **Fehler! Verweisquelle konnte nicht gefunden werden.** interface for CAN setup.

Long	0				1				
Integer	0		1		2		3		
Byte	0	1	2	3	4	5	6	7	
	0				2000				Start CAN-message transmission
	0				2001				Stop CAN- message transmission
	0				1201				zero calibration Attention: Make sure that there is no torque during this action!
	0				1202				Activate test signal
	0				1203				Deactivate test signal
	0				1205				Md1 (Torque1) channel1 / N
	0				1206				Md2 (Torque2) channel2 / N
	0				1211				Reset Status
	0				1212				Read state
	0				1213				Read out the serial number of the torque measuring
	0				1214				Perform self-test

Table 11-3 Channel selection by using a CAN interface

N = speed
Md1 = torque1 = channel1 = low range
Md2 = torque2 = channel2 = high range

If you switch between the two ranges with the help of the CAN interface
'(4) Special DT Function.' will be set to 0, but not saved.
After switching off / on the unit the system switches to the channel which is selected by X751/752 Pin 16.
If you want to switch only by terminal or by CAN then set
'(4) Special DT Function.=0 ' with the help of the terminal.

For example:
Settings:
'Output'

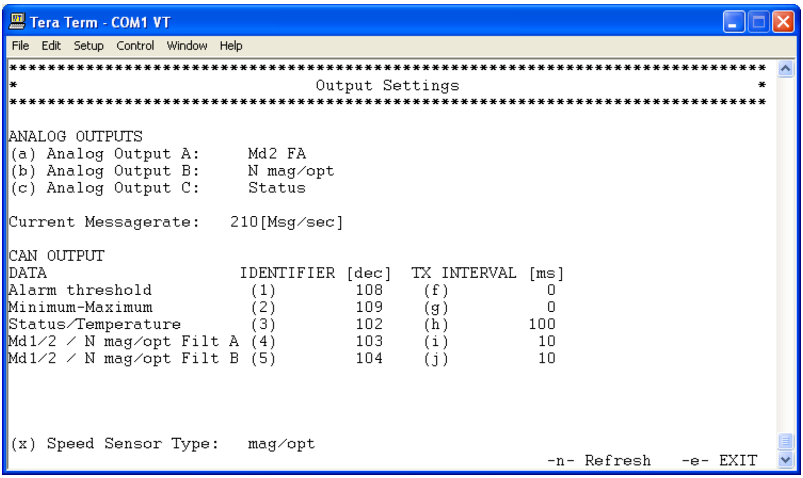


Figure 11-5 Example Output settings

‘Setup’ ‘CAN’

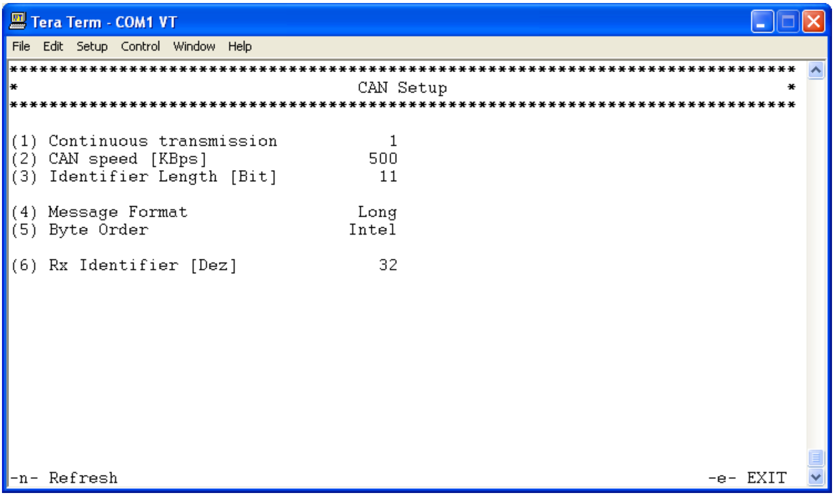


Figure 11-6 Example for setup CAN

Example

Long	**0**				**1**				
Integer	0		1		2		3		
Byte	0	1	2	3	4	5	6	7	
Send ID=32	0				1205				Select channel1
Receive Status ID=102	Status				Temperature Stator				Wait While (busy =1)
Receive Status ID=102	Status				Temperature Stator				If selection = 0 -> channel1 active If selection = 1 -> channel2 active

Table 11-4 Example for CAN message

Channel 2 active

Receive / Transmit

Receive

Symbol / ID	Multiplexer / DLC	Data	Timeo...	Period	Count
102	<Empty>/8	Testsignal =0 ZeroTorque_reset=0 Overflow =0 Error =0 selection =1 busy =0 ST_Bit =8 Alarm_Mdmax =0 Alarm_Mdmin =0 Alarm_Nmax =0 Alarm_Nmin =0 Alarm_IR =0 nc =0 Temperature =45.1	0	100	524
103	<Empty>/8	Md1_2_FilterA =0.0 N_mag_opt_FilterA=0.0	0	10	5242
104	<Empty>/8	Md1_2_FilterB =0.0 N_mag_opt_FilterB=0.0	0	10	5242

Figure 11-7 Channel 2 active

Busy

Receive / Transmit

Receive

Symbol / ID	Multiplexer / DLC	Data	Timeo...	Period	Count
021h	8	B5 04 00 00 00 08 00 00		21999	2
102	<Empty>/8	Testsignal =0 ZeroTorque_reset=0 Overflow =0 Error =0 selection =0 busy =1 ST_Bit =8 Alarm_Mdmax =0 Alarm_Mdmin =0 Alarm_Nmax =0 Alarm_Nmin =0 Alarm_IR =0 nc =0 Temperature =45.1	0	100	2226
103	<Empty>/8	Md1_2_FilterA =0.0 N_mag_opt_FilterA=0.0	0	10	22266
104	<Empty>/8	Md1_2_FilterB =0.0 N_mag_opt_FilterB=0.0	0	10	22267

Symbol / ID	Multiplexer / DLC	Data	Period	Count	Trigger	Creator
SendenTCU19	<Empty>/8	NC =0	Wait	3	Manual	User

Figure 11-8 Busy

Channel 1 active

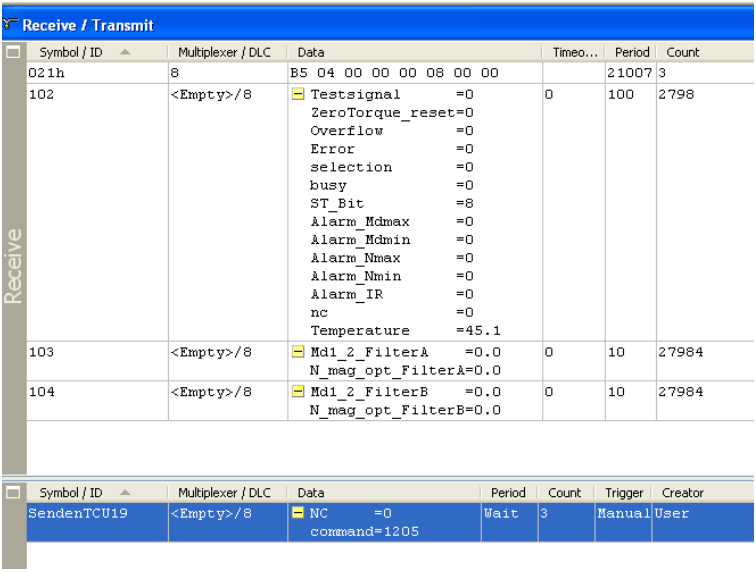


Figure 11-9 Channel 1 active

11.3.1 Definition Status

ID=102

Byte	7	6	5	4	3	2	1	0
bit	7….0	7….0	7….0	7….0	7….0	7….0	7….0	7….0
Pic	bbbbbbbb	bbbbbbbb	bbbbbbbb	bbbbbbbb	gffeedca	hhhhhhhh	xxnmlkji	xxxxxxxx

Table 11-5 Definition Status

a=Testsignal bit

c=ZeroTorque_reset bit

d=Overflow bit

e=Error word

f=selection

g= busy bit

h=ST_Bit word

i= Alarm_Mdmax bit

j= Alarm_Mdmin bit

k= Alarm_Nmax bit

l= Alarm_Nmin bit

m= Alarm_IR bit

n = nc bit

b=Temperature long /f:0.001

12 Plug connection

12.1 Plug connection F iS & F eS type,

X750 12 pol female Conivers combined power-supply measurement signals RS422 Md – Torque N - Speed	1 N inductive - 2 N inductive + 3 N2+ (magnetic/optional) 4 N2- (magnetic/optional) 5 N1+ (magnetic/optional) 6 N1- (magnetic/optional) 7 Mdf1- 8 Mdf1+ 9 Control 10 VCC 24V 11 GND (24V) 12 GND (24V)
X 751/752 16 pole male Conivers combinated anlog/digital measurement Signals Md – Torque N - Speed	1 TXD RS232 2 RXD RS232 3 Ground 4 Ground 5 CANH 6 CANL 7 MD I out 8 Analogout B 9 Analogout C 10 Analogout A 11 Alarm Md 12 Ground 13 Alarm N 14 Alarm IR 15 Reset Alarm (in) 16 DT2 (in)

Connecting Cable F1iS / F2iS, FLFM1iS, FLFM1eS

12 pole Conivers Plug Female

1	RS422	N inductive-	twisted pair 0.14mm²	white
2	RS422	N inductive+		brown
3	RS422	N2+	twisted pair 0.14mm²	grey
4	RS422	N2-		pink
5	RS422	N1+	twisted pair 0.14mm²	blue
6	RS422	N1-		red
7	RS422	Mdf1-	twisted pair 0.14mm²	yellow
8	RS422	Mdf1+		green
9		Control	0.5mm²	white
10	U in	24V 2A	0.5mm²	green
11		GND	0.5mm²	yellow
12		GND	0.5mm²	brown

LI-2YC11Y 250V si/gr
4x0.5+4x2x0.14

16 pole Conivers Plug Male

1	RS232	TXD	twisted pair 0.25mm²	white
2	RS232	RXD		brown
3		GND	twisted pair 0.25mm²	green
4		GND		yellow
5		CANH	twisted pair 0.25mm²	grey
6		CANL		pink
7		MD I out	twisted pair 0.25mm²	blue
8		Analogout B		red
9		Analogout C	twisted pair 0.25mm²	black
10		Analogout A		violet
11		Alarm Md	twisted pair 0.25mm²	grey/pink
12		GND		red/blue
13		Alarm N	twisted pair 0.25mm²	white/green
14		Alarm IR		grown/green
15		Reset Alarm	twisted pair 0.25mm²	white/yellow
16		DT2 in		yellow/brown

LIYCY 250V 8x2x0.25

12.2 Plug connection F1i/F2i

X740 12 pole Mil male combined power-supply measurement signals (Central cable)	A Signal Mdf2- B Signal Mdf2+ C Signal N1+ D Signal N1- E Signal N2+ F Signal N2- G Signal Mdf1- H Signal Mdf1+ J Control K VCC 24V L GND (24V) M GND (24V)	X740 12 pol. Mil combined power supply signal (central cable)	A Signal Mdf2- B Signal Mdf2+ C Signal N1+ D Signal N1- E Signal N2+ F Signal N2- G Signal Mdf1- H Signal Mdf1+ J Control K VCC 24V L GND (24V) M GND (24V)

X 741 10-pole female combined Analogue / Digital measurement signals	A Analog output C B TXD RS232 C RXD RS232 D Ground E CANH F CANL G MD I out H Analog output B I Analog output A K Ground	X 741 10-pole combined Analogue /Digital Measuring Signals	A Analog output C B TXD RS232 C RXD RS232 D Gr E CANH F CANL G MDiout H Ana output B I Ana output A K Ground

12 pole Mil male connector cable (Connector female)

A	RS422	Mdf2-	white
B	RS422	Mdf2+	brown
C	RS422	N1+	grey
D	RS422	N1-	pink
E	RS422	N2+	blue
F	RS422	N2-	red
G	RS422	Mdf1-	yellow
H	RS422	Mdf1+	green
J		Control	white 0,5
K	U in	24V 2A	green 0,5
L		GND	yellow 0,5
M		GND	brown 0,5

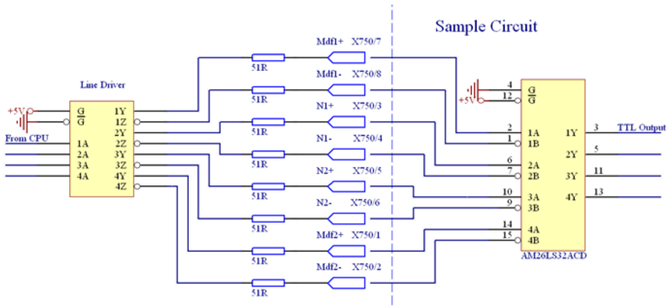
10 pole Mil female connector cable (Connector male)

A		Analogout C	white 0,5	
B	RS232	TXD	blue	
C	RS232	RXD	red	
D		GND	brown 0,5	
E		CANH	yellow	
F		CANL	green	
G		MD I out	yellow 0,5	
H		Analogout B	pink	
I		Analogout A	white	
K		GND	grey	brown

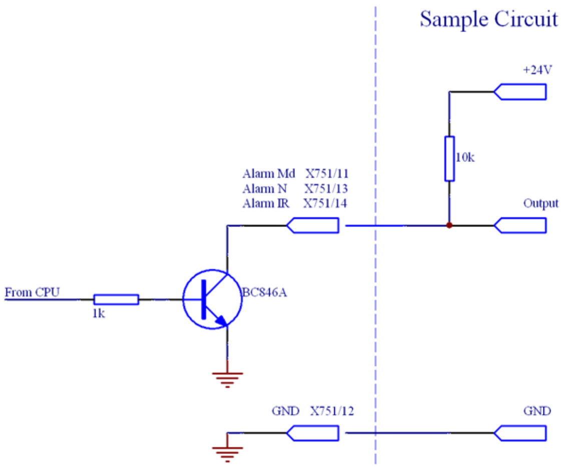
All colours are for cables LI-2YC11Y 250V si/gr 4x0,5+4x2x0,14 supplied by Muckenhaupt & Nusselt (same colour mark drilled pairs)

12.3 Electrical specifications

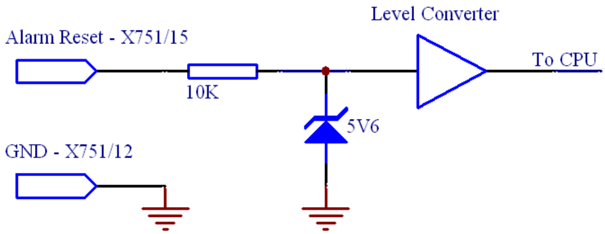
12.3.3 RS422 Outputs



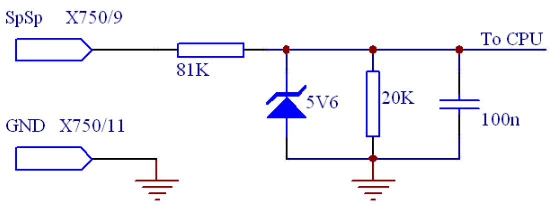
12.3.4 Alarm Outputs



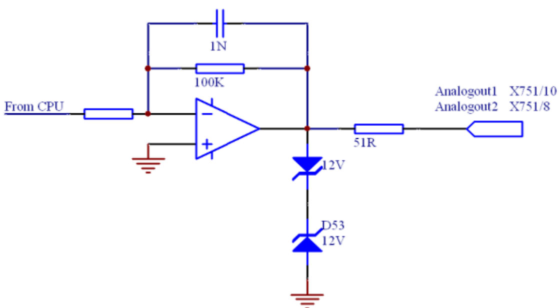
Alarm Reset Input



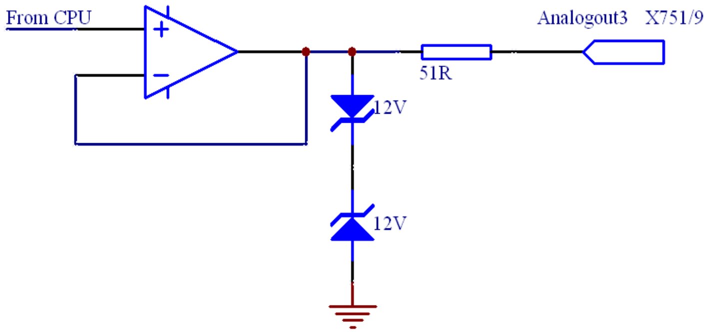
12.3.5 Control Input



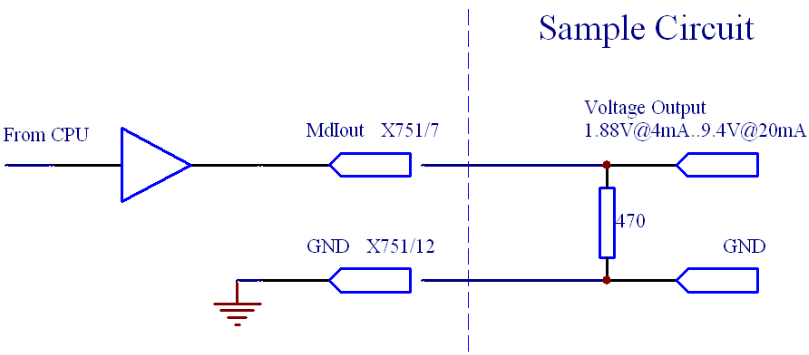
12.3.6 Analog Outputs A/B



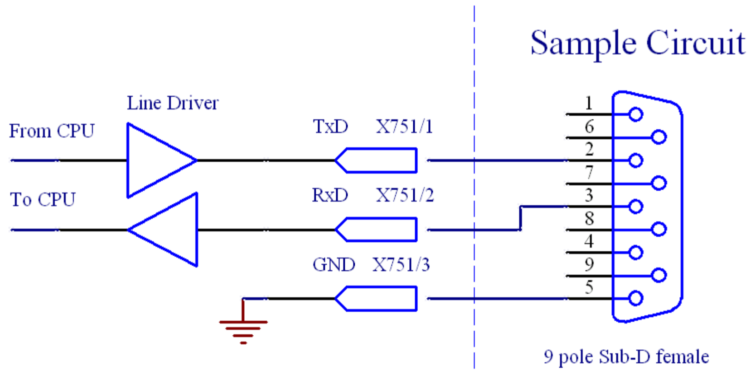
12.3.7 Analog Output C



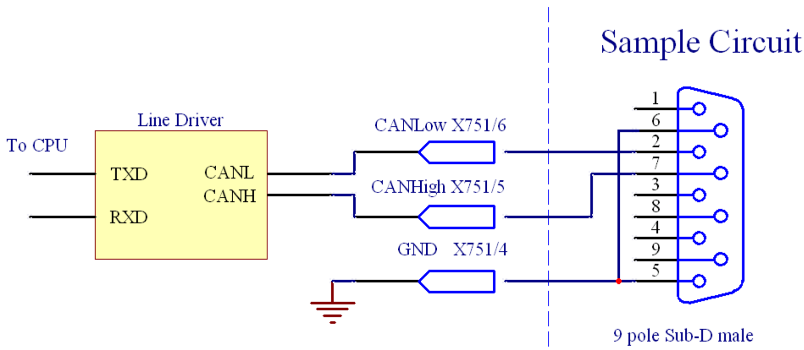
12.3.8 Current Output



12.3.9 RS232



CAN



13 General references

13.1 Overvoltage protection

To avoid destructions the sending electronic on the rotating side will be switched off at overvoltage. The analog output of the torque-signal shows undefined values. If this is the case, so the amplitude of the supply voltage must be reduced. Sometimes it can happen, that the torquemeter must be turned "OFF“ for several seconds to deactivate the overvoltage protection. All outputs are short-circuit-protected.

13.2 Torquemeter without Test Signal

In some cases it is possible, that the torque flange supports no test signal. Please refer to your calibration sheet to see the right values.

13.3 Hotline

At any troubles, call our hotline workdays from 8:00h to 17:00h **+49 (0)2404-9870-583/584**
or you can reach us by email service-pm@atesteo.com

13.4 Flash update

A microcontroller with an internal Flash-ROM is used, so that a firmware update can easily be performed by a special upload-software via a RS232 serial connection.

Flash update:

1. Turn off the unit (switch off power supply).
2. Connect the stator via RS232 with the PC.
3. Run the Flash-programmer software and enter settings as below.

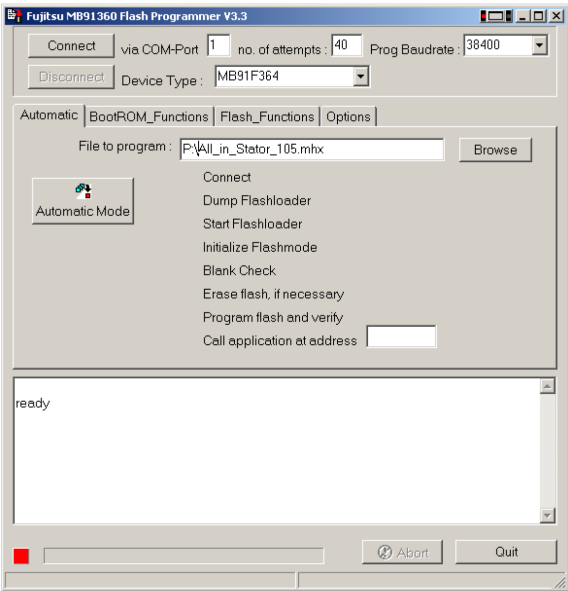


Figure 13-1 Flash update

4. Set Device Type=MB91F364 and choose by pressing the button 'Browse' the firmware file.
5. Press button 'Automatic Mode' and turn on the converter in less than 2 seconds.
6. If the firmware is installed properly the programmer software prompts “ALL OK”.
7. Turn off the unit.
8. Turn on the unit.

The firmware update has been installed correctly.

14 Calibration of the Torquemeter

The following procedure will be recommended by means of an example.

Preparation:

- The Torquemeter is mounted at the machine and without torque. The machine is blocked.
- The inductive power supply must be checked. If the voltage is to low, it can be that the measuring error becomes higher.
- The connection from the lever arm to the torquemeter must be absolute planar.
- Use the same screws as for the real testing.
- The screws have to be screw on with the specify torque with a torque spanner.

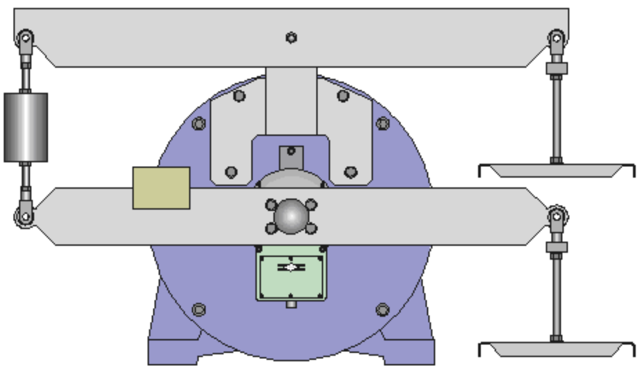


Figure 14-1 Calibration system

Calibration

Pos.	To do	Remarks	Frequency
0	Torquemeter without lever arm.	Write down the zero torque frequency	59998 Hz
1	Mount calibration lever arms.	Use a balance weight to set the frequency to frequency of pos.0.	60000 Hz -> 59998 Hz
2	Preload torquemeter clockwise (positive) with rated torque	Duration about 2 minutes	80000 Hz
3	Unload torquemeter		
3	Mount calibration lever arms for anticlockwise torque		
4	Preload torquemeter anticlockwise (negative) with rated torque	Duration about 2 minutes	
5	Unload torquemeter		
5	Mounting of the calibration lever arms for clockwise torque		
6	Load torquemeter clockwise with rated torque	Reading of the measuring value after one minute. Max value P1.	P1=80000 Hz
7	Relieve torquemeter	Reading of the measuring value after one minute. Zero value1 N1.	N1=60008 Hz
	Mounting of the calibration	Set the frequency to	60008 Hz

	Lever arms for anticlockwise torque.	N1 with the balance weight.	
8	Load torquemeter anticlockwise (negative) with rated torque	Reading of the measuring value after one minute. Min value P2	P2=40000 Hz
9	Relieve torquemeter	Reading of the measuring value after one minute. Zero value1 N2	N2=59992 Hz
	Mounting of the calibration lever arms for clockwise torque.	Calculate the zero torque to calculate the sensitivity and the error curve N0 = (N1+N2)/2	N0=60000 Hz

Table 14-1 List of work steps for calibration

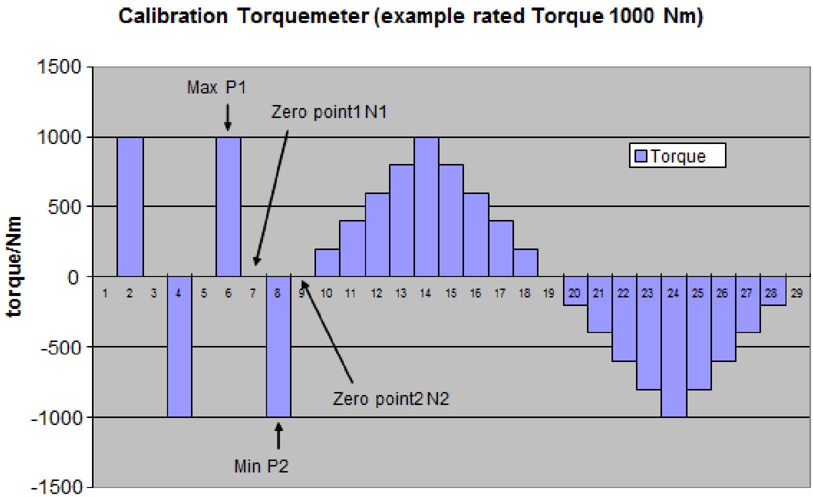


Figure 14-2 Calibration graph

With that the adjustment is finished and the sensitivity values can be calculated.

Zero point

$$N0 = \frac{N2 + N1}{2};\ N0 = \frac{60008Hz + 59992Hz}{2} = 60000$$

Sensitivity1 (positive)

$$S1 = \frac{P1 - N0}{Mdnenn};\ S1 = \frac{80000Hz - 60000Hz}{1000Nm} = 20.000\frac{Hz}{Nm}$$

Sensitivity2 (negative)

$$S1 = \frac{P2 - N0}{Mdnenn};\ S1 = \frac{40000Hz - 60000Hz}{1000Nm} = -20.000\frac{Hz}{Nm}$$

The torquemeter has to be setup with the new sensitivity values.

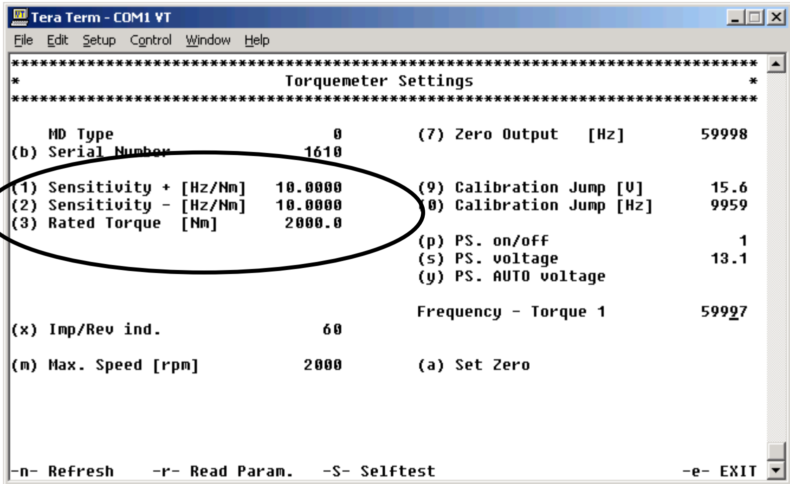


Figure 14-3 Torquemeter settings

With the help of the following procedure the error graph will be determined and the calibration will be checked.

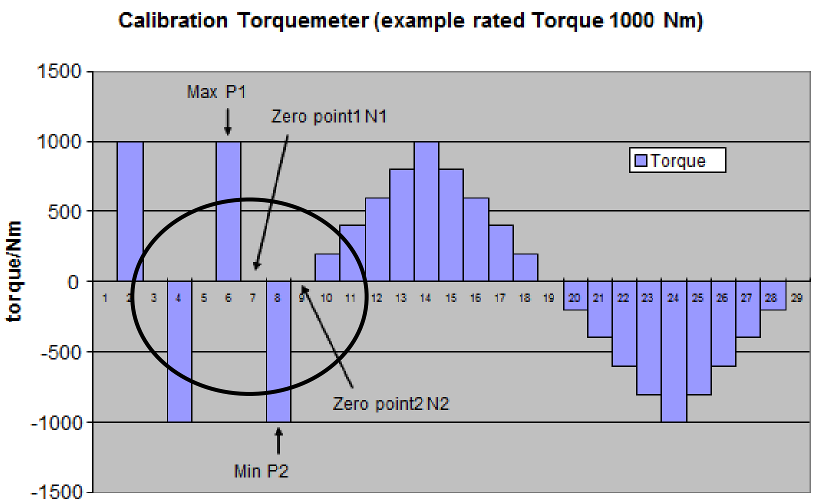


Figure 14-4 Calibration graph

Pos.	To do	Remarks	Frequency/Hz	Torque /Nm
	Check out, that position 1-9 is done	Set the zero point with the help of the balance weight. (From Pos.09)	69992	-0,4
10	Load torque clockwise = 200Nm (rated torque/ 5)	Read of the value after one minute	63991	199,55
11	Load torque clockwise = 400Nm (rated torque/ 5)	Read of the value after one minute	67992	399,6
12 – 19	Load torque clockwise 600 Nm 800 Nm 1000 Nm 800 Nm 600 Nm 400 Nm 200 Nm 0 Nm	Read of after every one minute	 71994 75997 80000 76003 72004 68007 64008 60008	 599,7 799,85 1000 800,15 600,2 400,35 200,4 0,4
19	Mounting of the calibration lever arms for anticlockwise	Set the frequency to the last value with the balance	60008	0,4

		weight.		
20	Load torque anticlockwise = -200Nm (- rated torque / 5)	Read of the value after one minute	56008	-199,6
21 – 29	Load torque anticlockwise -400 Nm -600 Nm -800 Nm -1000 Nm -800 Nm -600 Nm -400 Nm -200 Nm 0 Nm	Read of after every one minute	52007 48004 44002 40000 43996 47996 51993 55992 59991	-399,65 -599,82 -799,9 -1000 -800,2 -600,2 -400,35 -200,4 -0,45

Table 14-2

The result is the following error graph:

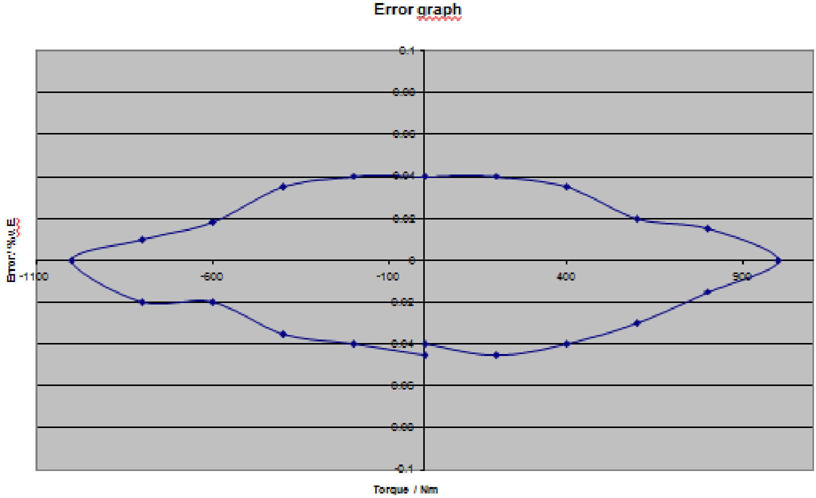


Figure 14-5 Error graph

This error graph is the linearity/ hysteresis graph of the torquemeter. In this example it is a torquemeter with an accuracy class of 0, 05.

Hysteresis tips

The hysteresis is a typical material property. Older torquemeter have better hysteresis characteristics than the newer ones. The main reason for the hysteresis is a static torque. The amplitude of the hysteresis depends on the maximum torque. If we halve the maximum torque in the example above, the hysteresis will also be half. In this case we see ±0.02% of rated torque. If you use a torquemeter only clockwise or anticlockwise the hysteresis can be neglected. For the best accuracy it is import and to inspect the read measuring task and set the torque to zero at the right time.

15 Recommendations for resetting the zero point of Torque measuring flange

With each measuring element, from a flexible spring element that is measured by its elastic deformation, there will always be a zero drift even if no load is applied.

Related to DMS based Torque measuring systems, zero-drifts in a load-free condition can be caused by the following circumstances:

15.1 Thermal influences

Despite of a complex temperature compensation a zero-drift related to high temperature fluctuations can always be observed. Due to various temperature influences interacting permanently with the torquemeter, another reason for exiguous zero-drifts is given.
The temperature stability defined in the technical specifications, e.g. 0.1%/10ºK is determined by the allowed temperature drift of ±0.1% of the rated torque per 10º Kelvin difference.

15.2 Hysteresis-caused influences

If a sensor during a test is mostly loaded in one direction it can indicate a drift after the test is terminated. This drift cannot to be traced back to a temperature compensation problem but to the natural hysteresis of the sensor and strain gauges.
The change of the zero value depends on the torque applied or on the test duration. In any case, the value of the zero-drift variation will not be larger than the linearity and hysteresis specified in the technical data for the sensor.

15.3 Aging

If a strain gauge based sensor is dynamically loaded for a long period of time a zero-drift can occur. This value depends on the cycle count and the strain amplitude. This zero-drift will affect the sensitivity of the sensor.
Even though this is a natural effect for strain gauge sensors, ATESTEO torque sensors drift is very low due to a low sensitivity at nominal torque.

15.4 Lateral force influence

Considering that each torque sensor is part of a powertrain, every component linked to the sensor generates a lateral force. This load will be influenced by the size and installation of the components. This lateral force will be added to the measuring signal. If the installation is performed as specified in the technical specifications, this influence will be extremely small.

15.5 General

All the above mentioned items that influence the zero-drift are still in the range of calibration tolerance, as long as the sensor is properly maintained and handled and no transportation damages occurred to the sensor or strain gauges.

Due to the fact that all the above mentioned zero-drifts can happen in different situations at the same time it is very difficult to suggest a general zero-reset procedure.
After considering all the information acquired through our experience and customers feedback we can suggest and comment different scenarios for a proper zero-reset of the torque sensor.

- A zero-reset is only allowed if the torque is zero.
- If a great zero shift (>10 Hz) is observed during the mounting of the torquemeter please check the adapter flange due to the mechanical properties. A lower zero-shift can be reset.
- The test bench engineer has to decide, whether the accuracy request of the actual test requires a reset of the zero point. Generally it is possible to improve the accuracy by resetting the zero torque after the warming-up period of the test stand and before starting the measurement.
- If the zero shift is greater than 2% of the rated torque, the torquemeter must be checked. These tests (recalibration and other tests) have to be done by ATESTEO to find out the reason for the malfunction.
- A zero shift of 0.05% of the rated torque per month has no influence to the accuracy of the system.

16 EC Manufacturer's Declaration:

ATESTEO

Excellence in drivetrain testing

Manufacturer's Declaration-according to 2014 / 30 / EU

The Manufacturer: **ATESTEO GmbH**

Declares, that the measuring system

Named: **F0iS, F1iS, F2iS, F23iS, F3iS, F4iS, F1i, F2i, FLFM1iS, FLFM1eS**

Is conform to the requirements of the EMV-directive 2014/30/EU.

Reference to relevant harmonized Standards:

- EN61326-1:2013 (Electrical equipment for measurement, control and laboratory use) EMC requirements - Part 1: General requirements (IEC 61326-1:2012); German version EN 61326-1:2013)
- EN61326-2-3:2013 (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 61326-1:2012)

Alsdorf, 06.07.2016

Dipl.-Ing. Wolfgang Schmitz
CEO

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Geschäftsführer: Dipl.-Ing. Wolfgang Schmitz,
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Notes

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