Mounting Instructions

Digital
Torque Transducer
T12

HBM

A1979-7.1 en

Contents **Page**

Safety instructions

Use in accordance with the regulations

The T12 digital torque transducer is used exclusively for torque, rotational speed, angle of rotation and power measurement tasks and control and adjustment tasks directly connected thereto. Use for any additional purpose shall be deemed to be **not** in accordance with the regulations.

Stator operation is only permitted with an installed rotor.

In the interests of safety, the transducer should only be operated as described in the operating manual. It is also essential to observe the appropriate legal and safety regulations for the application concerned during use. The same applies to the use of accessories.

Each time, before starting up the transducer, you must first run a project planning and risk analysis that takes into account all the safety aspects of automation technology. This particularly concerns personal and machine protection.

The transducer is not a safety element within the meaning of its use as intended. Proper and safe operation of these transducers require proper transportation, correct storage, assembly and mounting and careful operation.

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

General dangers of failing to follow the safety instructions

The transducer corresponds to the state of the art and is fail-safe. The transducer can give rise to remaining dangers if it is inappropriately installed and operated by untrained personnel.

Everyone involved with the installation, commissioning, maintenance or repair of the transducer must have read and understood the operating manual and in particular the technical safety instructions.

Remaining dangers

The scope of supply and performance of the transducer covers only a small area of torque measurement technology. In addition, equipment planners, installers and operators should plan, implement and respond to the safety engineering considerations of torque measurement technology in such a way as to minimize remaining dangers. Prevailing regulations must be complied with at all times. Reference must be made to remaining dangers connected with torque measurement technology.

In this Mounting instructions remaining dangers are pointed out using the following symbols:

Symbol: **DANGER**

Meaning: **Maximum danger level**

Warns of an **imminently** dangerous situation in which failure to comply with safety requirements **will** result in death or serious physical injury.

Symbol: **WARNING**

Meaning: **Potentially dangerous situation**

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

Symbol: **CAUTION**

Meaning: **Dangerous situation**

Warns of a potentially dangerous situation in which failure to comply with safety requirements **could** result in damage to property or some form of physical injury.

Symbols for using advices and helpful information:

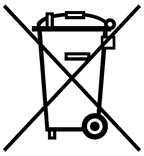
Symbol: **NOTE**

Means that important information about the product or its handling is being given.

Symbol: CE

Meaning: **CE mark**

The CE mark enables the manufacturer to guarantee that the product complies with the requirements of the relevant EC directives (the declaration of conformity is available at http://www.hbm.com/HBMdoc).

Symbol: 

Meaning: **Statutory marking requirements for waste disposal**

National and local regulations regarding the protection of the environment and recycling of raw materials require old equipment to be separated from regular domestic waste for disposal.

For more detailed information on disposal, please contact the local authorities or the dealer from whom you purchased the product.

Conversions and modifications

The transducer must not be modified from the design or safety engineering point of view except with our express agreement. Any modification shall exclude all liability on our part for any damage resulting therefrom.

Qualified personnel

The transducer must only be installed and used by qualified personnel, strictly in accordance with the specifications and with safety requirements and regulations. It is also essential to observe the appropriate legal and safety regulations for the application concerned during use. The same applies to the use of accessories.

Qualified personnel means persons entrusted with the installation, fitting, commissioning and operation of the product who possess the appropriate qualifications for their function.

Prevention of accidents

According to the prevailing accident prevention regulations, once the T12 digital torque transducer has been mounted, a cover or cladding has to be fitted as follows:

- The cover or cladding must not be free to rotate.
- The cover or cladding should avoid squeezing or shearing and provide protection against parts that might come loose.
- Covers and cladding must be positioned at a suitable distance or so arranged that there is no access to any moving parts within.
- Covers and cladding must also be attached if the moving parts of the torque flange are installed outside peoples’ movement and operating range.

CAUTION

The protection against contact option, to prevent accidental contact, must not be used as protection against bursting parts.

The only permitted exceptions to the above requirements are if the various parts and assemblies of the machine are already fully protected by the design of the machine or by existing safety precautions.

Warranty

In the case of complaints, a warranty can only be given if the torque transducer is returned in the original packaging.

1 Scope of supply

- Digital torque transducer (rotor and stator)
- T12 Mounting Instructions
- Quick Start Guide for installing the T12 Assistant control software
- T12 system CD
- Mounting kit
- Test report
- Options:

- Speed measuring system, comprising optical rotational speed sensor and speed kit (slotted disc, screwdriver, screw locking device, screws)
- Protection against contact
- Mounted coupling

2 Operation

The supplied T12 system CD contains the "T12 Assistant" control software. You can use this software to:

- monitor the correct installation of the torque transducer
- set the signal conditioning (zero balance, filters, scaling)
- protect your settings or load the factory settings
- display and evaluate the measured values

Notes on installing the T12 Assistant on your PC can be found in the "T12 Assistant Control Software" Quick Start Guide. (pdf file on T12 system CD and part of the “Setup Toolkit for T12” accessory).

Notes on the operation of the T12 Assistant can be found in the program’s online Help, which is called with function key F1 or via the menu bar.

For more information about connecting to fieldbus systems, please refer to the “T12-CAN bus/PROFIBUS” operating manual (pdf file on T12 system CD).

3 Application

The T12 digital torque transducer records static and dynamic torque at stationary or rotating shafts measures rotational speed or angle of rotation, including indication of the direction of rotation, and computes the power. It is designed for:

- highly dynamic torque measurements when testing the performance and functionality of engines and compound sets
- high-resolution speed and angle of rotation measurements
- fast, dynamic performance measurements on engine and transmission test rigs and roll test stands

Designed to work without bearings and with contactless digital signal transmission, the torque measuring system is maintenance-free.

The torque transducer is supplied for nominal (rated) torques of 100 N·m to 10 kN·m. Depending on the nominal torque, maximum speeds of up to 18 000 rpm are permissible.

The T12 torque transducer is reliably protected against electromagnetic interference. It has been tested with regard to EMC according to the relevant European standards, and carries the CE mark.

4 Signal flow

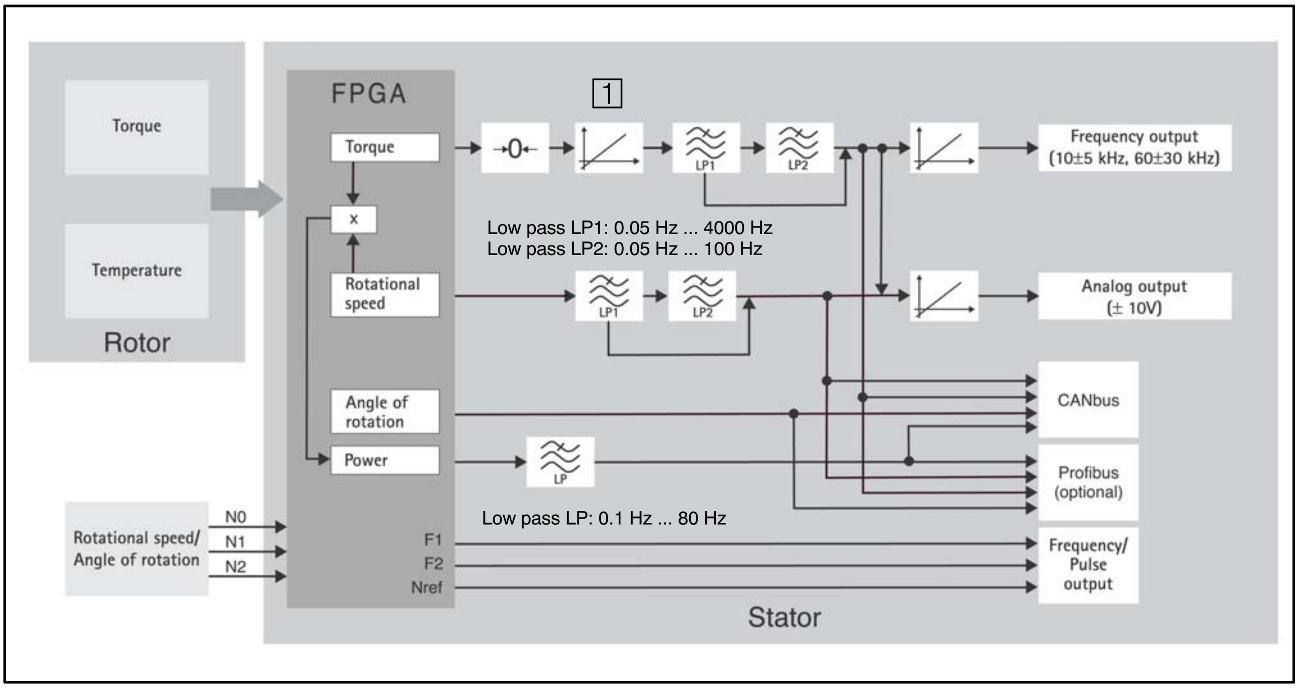


Fig. 4.1: Signal flow diagram

The torque and the temperature signal are already digitized in the rotor and transmission is therefore noise-free.

The torque signal can be zeroed , scaled (2-point scaling) and filtered via two low passes (LP1 and LP2). A further scaling of the frequency output and the analog output is then possible.

NOTE

Scaling at position 1 (see Fig. 4.1) changes the internal calibration of the torque transducer.

The speed signal can be filtered and also scaled for the analog output.

The angle of rotation signal, the performance signal (low pass filter LP) and the temperature signal are only available on the fieldbusses.

The torque signal and the speed signal can be filtered via two low passes connected in series, with the filter outputs also being available separately.

The scaled, unfiltered torque signal is used to calculate power. The resultant, highly-dynamically calculated power signal is filtered via a further low pass.

For settings over 100 Hz (torque low-pass filter 1 only), phase delay compensation is run for the angle of rotation signal. This ensures that torque and angle of rotation values that are measured simultaneously are also output simultaneously.

For rotational speed and angle of rotation, two pulse series with a shift of 90° are available as RS-422 compatible signals.

5 Structure and mode of operation

The torque transducer comprises two separate parts: the rotor and the stator. Strain gages (SGs) for torque measurement have been installed on the rotor. Carrier frequency technology (19.2 kHz carrier frequency) is used for analyzing the SG and temperature signal. The rotor temperature is measured at two measuring points and averaged.

The electronics for transmitting the bridge excitation voltage and the measurement signal is located centrally in the rotor. The coils for the noncontact transmission of excitation voltage and measurement signal are located on the rotor's outer circumference of side A. The signals are sent and received by a transmitter head. The transmitter head is mounted on the stator, which houses the electronics for voltage adaptation and signal conditioning. Connectors for inputs and outputs (for the connector pin assignment, see chapter 8.3) are located on the stator. The transmitter head encloses the rotor over a segment of about 120° and should be mounted concentrically around the rotor (see chapter 6).

In the case of the speed measuring system option, the speed sensor is mounted on the stator, the customer attaches the associated slotted disc on the rotor. The optical speed measurement works on the infrared transmitted light principle.

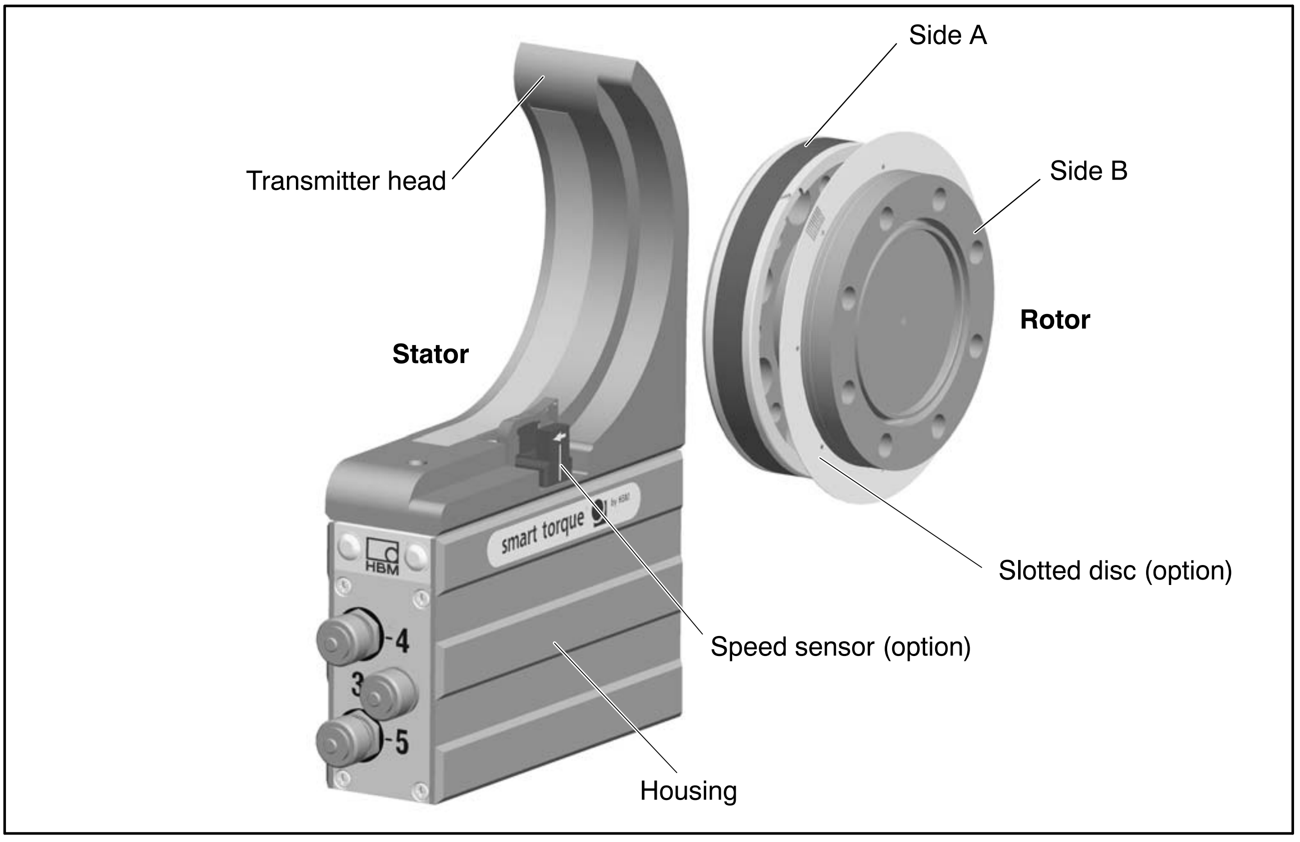


Fig. 5.1: Mechanical structure, exploded view

6 Mechanical installation

WARNING

Handle the torque transducer carefully. The transducer might suffer permanent damage from mechanical shock (e.g. dropping), chemical effects (e.g. acids, solvents) or thermal effects (e.g. hot air, steam).

With alternating loads, you should glue the rotor connection screws into the counter thread with a screw locking device (medium strength) to exclude prestressing loss due to screw slackening.

The T12 torque transducer can be mounted directly with a relevant shaft flange. It is also possible to directly mount a joint shaft or relevant compensating element on opposite flange (using an intermediate flange when required). Under no circumstances must the permissible limits specified for bending moments, transverse and longitudinal forces be exceeded. Due to the torque transducer's high torsional stiffness, dynamic changes on the shaft run are minimized.

CAUTION

Check the effect on speeds and natural torsional oscillations critical to bending, to prevent the transducer being overloaded by increases in resonance.

6.1 Conditions on site

The T12 torque transducer is protected to IP54 according to EN 60529. Protect the transducer from coarse dirt, dust, oil, solvents and moisture. During operation, the prevailing safety regulations for the security of personnel must be observed (see ”Safety instructions”).

There is wide ranging compensation for the effects of temperature on the output- and zero signals of the T12 torque transducer (see specifications on page 51). This compensation is carried out at static temperatures. This guarantees that the circumstances can be reproduced and the properties of the transducer can be reconstructed at any time.

If there are no static temperature ratios, for example, because of the temperature differences between flange A and flange B, the values given in the specifications can be exceeded. Then for accurate measurements, you must ensure static temperature ratios by cooling or heating, depending on the application. As an alternative, check thermal decoupling, by means of heat radiating elements such as multiple disc couplings.

6.2 Mounting position

The transducer can be mounted in any position. With clockwise torque, the output frequency is 10...15 kHz (Option 4, Code DF1/DU2: 60 kHz ... 90 kHz). In conjunction with HBM amplifiers or when using the voltage output, a positive output signal (0 V to +10 V) is present.

With counterclockwise torque, the output frequency is 5 kHz...10 kHz (Option 4, Code DF1/DU2: 30 kHz ... 60 kHz).

In the case of the speed measuring system, an arrow is attached to the head of the sensor to clearly define the direction of rotation. When the transducer rotates in the direction of the arrow, a positive speed signal is output.

6.3 Installing the slotted disc (speed measuring system only)

To prevent damage to the speed measuring system's slotted disc during transportation, it is not mounted on the rotor. Before installing the rotor in the shaft run, the customer must attach it to the mounting ring. The mounting ring and the associated speed sensor are already fitted at the factory.

The requisite screws, a suitable screwdriver and the screw locking device are included in the list of components supplied.

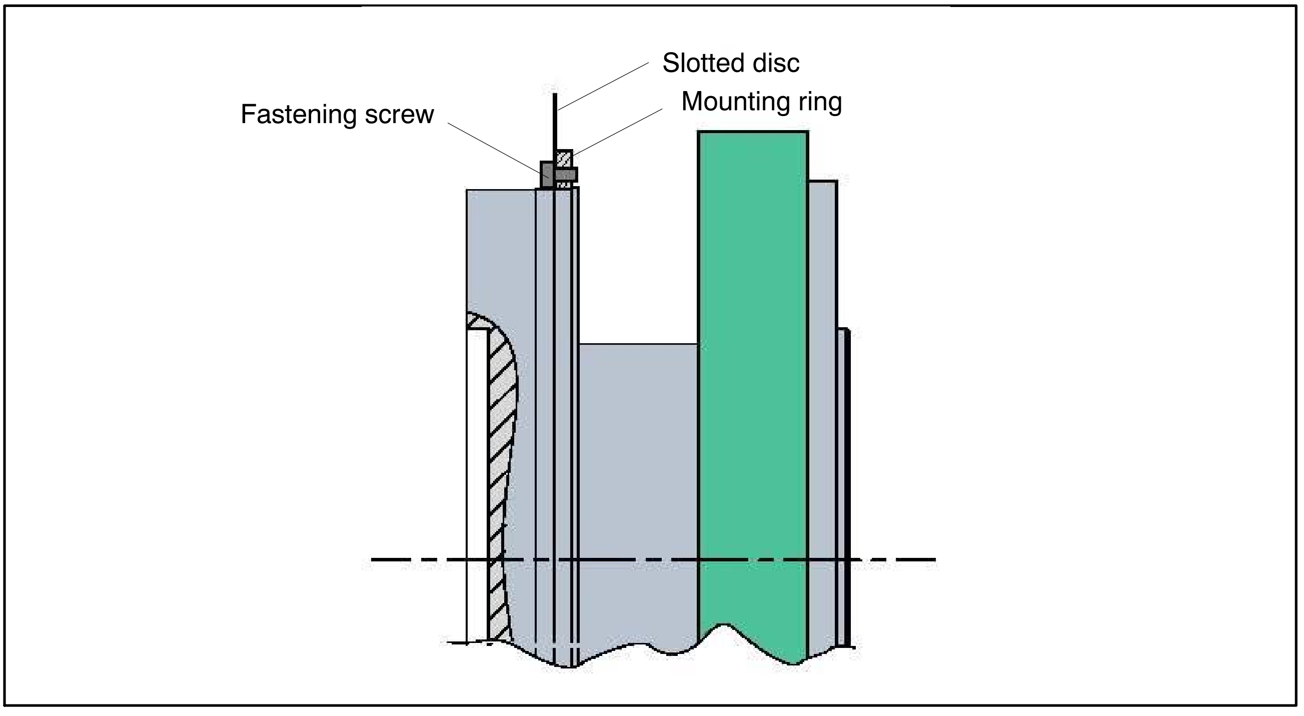


Fig. 6.1: Installing the slotted disc

CAUTION

When carrying out installation work, be careful not to damage the slotted disc!

Installation sequence

1. Push the slotted disc onto the mounting ring and align the screw holes.
2. Apply some of the screw locking device to the screw thread and tighten the screws (tightening torque < 0.15 N·m).

6.4 Installing the rotor

NOTE

In general, the rotor identification plate is no longer visible after installation. This is why we include with the rotor additional stickers with the important ratings, which you can attach to the stator or any other relevant test-bench components. You can then refer to them whenever there is anything you wish to know, such as the shunt signal. Data can also be accessed through T12 Assistent.
To explicitly assign the data, the identification number and the measuring range are specified on the rotor where they can be seen from outside.

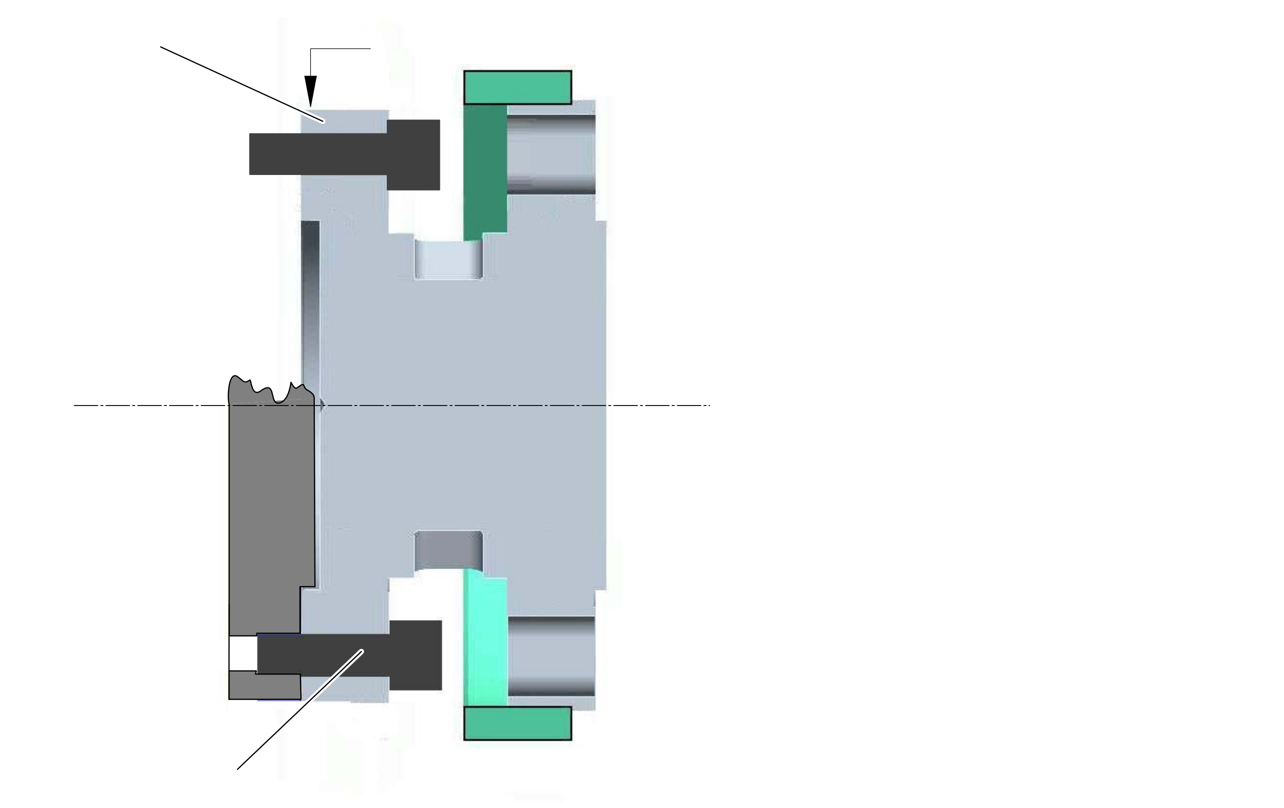


Fig. 6.2: Screw connections, flange B

1. Prior to installation, clean the plane surfaces of the transducer flange and the counter flange. For safe torque transfer, the surfaces must be clean and free from grease. Use a piece of cloth or paper soaked in solvent. When cleaning, make sure that you do not damage the transmitter coils.
2. For the flange A screw connections, use hexagon-socket screws **DIN EN ISO 4762 of property class 10.9** (measuring range 3 kN·m ... 10 kN·m: 12.9) of the appropriate length (depending on the connection geometry, see Table 6.1).

   We recommend fillister-head screws DIN EN ISO 4762 or similar, blackened, smoothheaded, permitted size and shape variance in accordance with DIN ISO 4759, Part 1, product class A.

WARNING

With alternating load: Use a screw locking device (e.g. LOCTITE no. 242) to glue the screws into the counter thread to exclude prestressing loss due to screw slackening.

3. First tighten all the screws crosswise with 80% of the prescribed tightening torque (Table 6.1), then tighten again crosswise, with the full tightening torque.

4. There are relevant tapped holes on flange A for continuing the shaft run mounting. Again use screws of property class 10.9 (measuring range of 3 kN · m ... 10 kN · m: 12.9) and tighten them with the prescribed torque, as specified in Table 6.1.

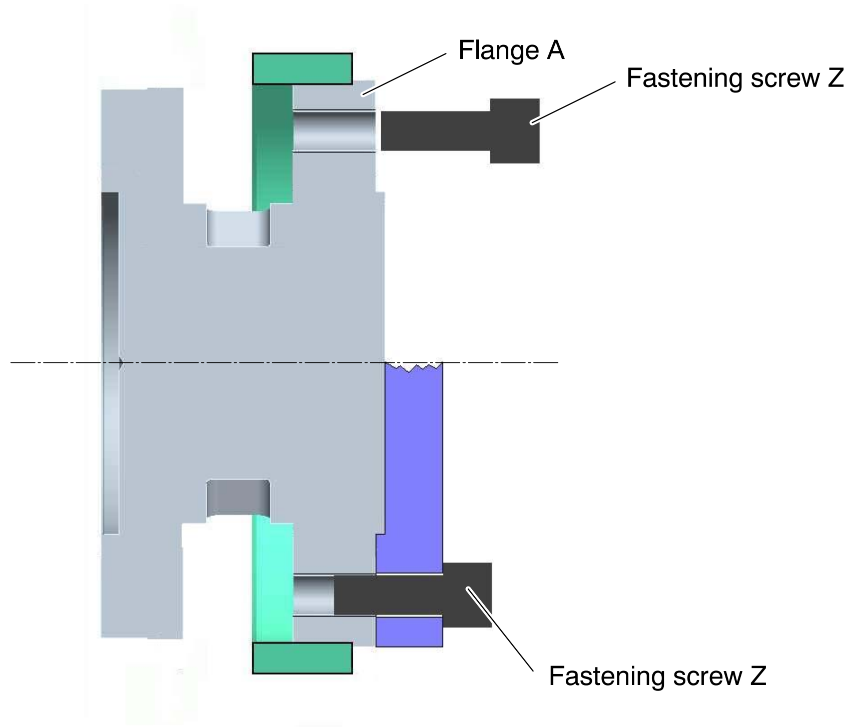
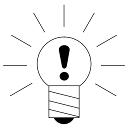


Fig. 6.3: Screw connections, flange A



NOTE

Even if mounted correctly, the zero point adjusted at the factory may be offset by up to 3 %. If this value has been exceeded, we recommend to check the mounting conditions. If the remaining zero point offset is greater than 1 % after dismounting, please send your transducer to our factory in Darmstadt for evaluation.

CAUTION

With alternating loads, use a screw locking device to glue the connecting screws into place. Guard against contamination from varnish fragments.

Measuring range (N·m)	Fastening screws (Z)[1]	Fastening screws Property class	Prescribed tightening torque (N·m)
100 / 200	M8	10.9	34
500	M10		67
1 k	M10		67
2 k	M12		115
3 k	M12	12.9	135
5 k	M14		220
10 k	M16		340

Table 6.1: Fastening screws

[1] DIN EN ISO 4762; black/oiled/μ_{tot} = 0.125

6.5 Fitting the protection against contact (option)

The protection against contact comprises two side parts and four covers. It is screwed onto the stator housing.

CAUTION

Use threadlocker (e.g. LOCTITE 242) for locking all connecting screws.

1. Remove the side cover plates on the stator housing (see Fig. 6.4.)

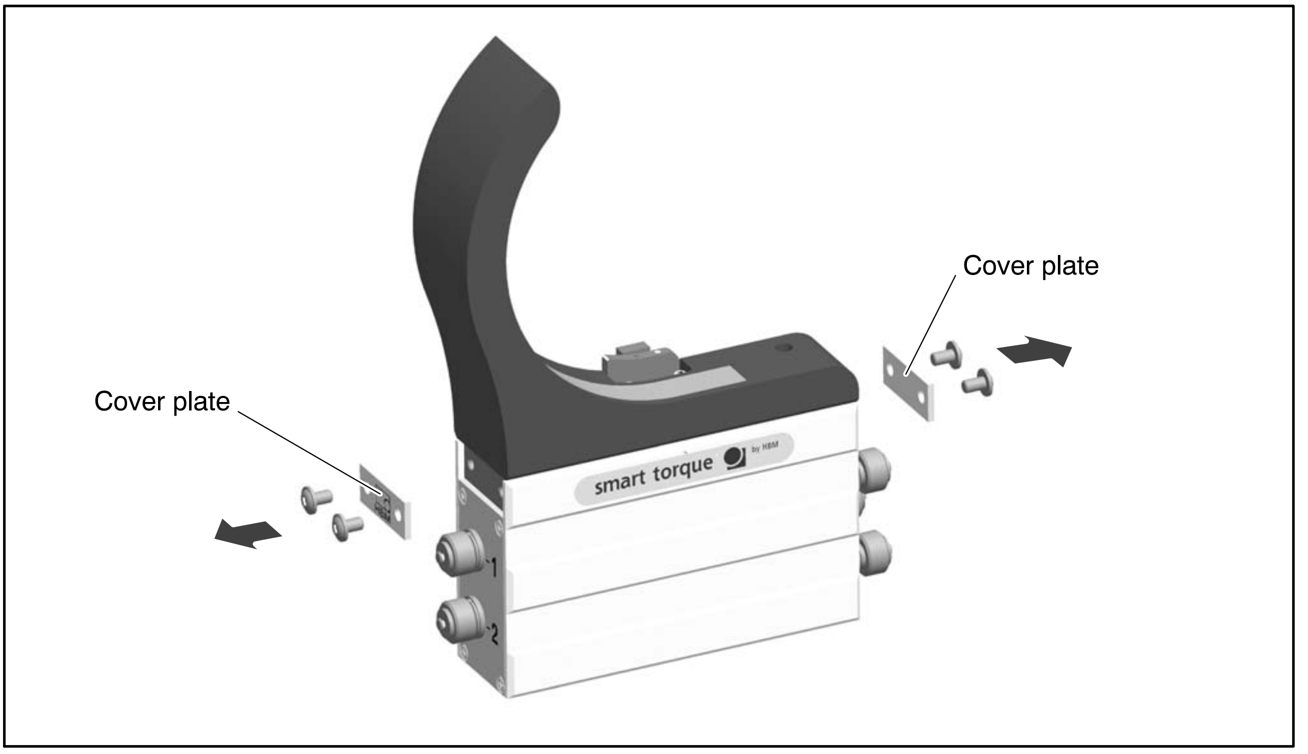


Fig. 6.4: Cover plates on the stator housing

2. **For 500 N · m – 3 kN · m measuring ranges and retrospective protection against contact orders only:** The tapped holes for the stop screws are partly covered by the attached film. Make a semicircular cutout in the film here, at least 6 mm in radius (e.g. with a cutter, see Fig. 6.5).
   Now remove the threaded pins from the tapped holes on both sides of the stator.

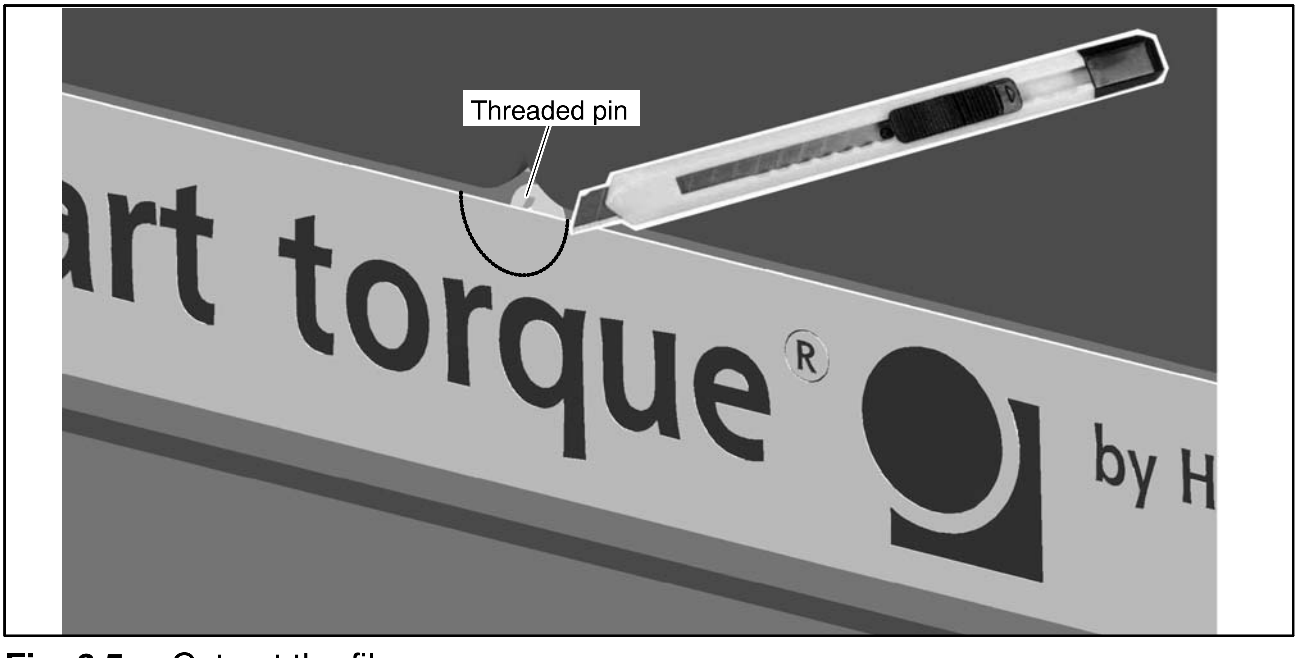


Fig. 6.5: Cut out the film

3. **For 5 kN · m and 10 kN · m measuring ranges only:** remove the threaded pins from the tapped holes on both sides of the stator. Screw the spacing bolt into the tapped hole on the side of the speed sensor (see Fig. 6.6).

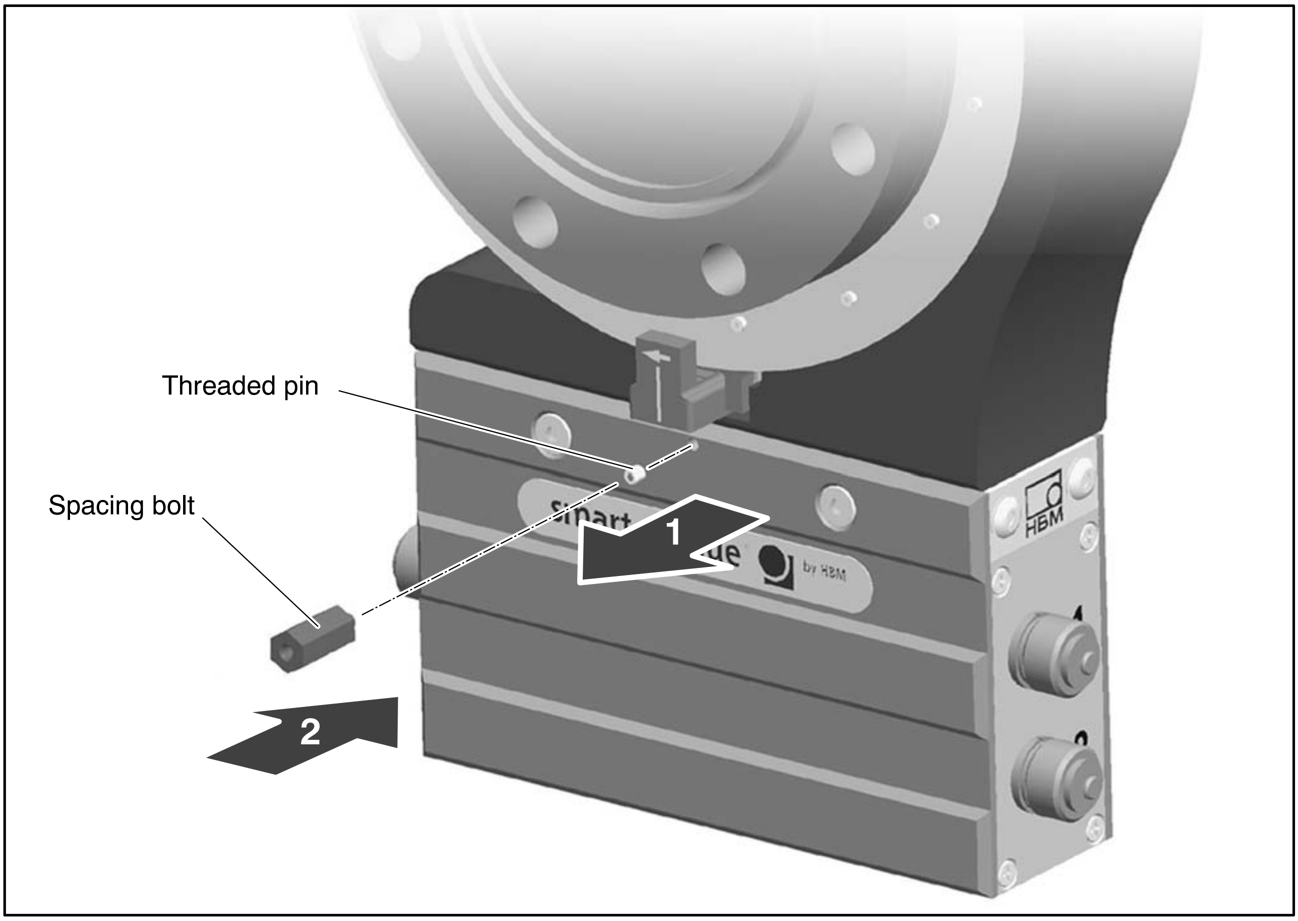


Fig. 6.6: Fitting the spacing bolt (for 5 kN · m and 10 kN · m only)

4. Screw the covers onto the side parts (use hexagon socket, 2 AF; tightening torque M_A = 1 N · m). It is essential to fit the cover with the cutouts onto the side with the countersinks (see Fig. 6.7).

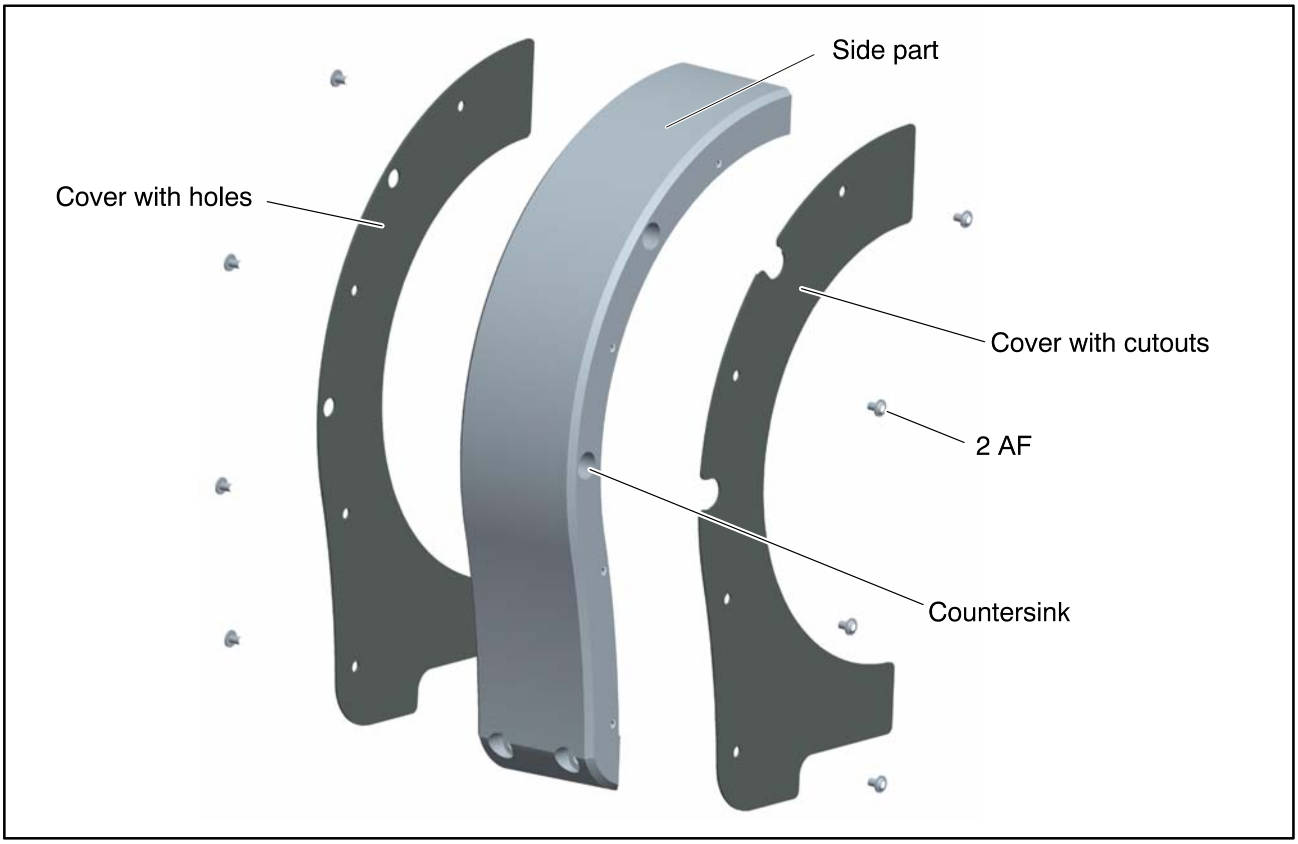
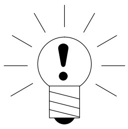


Fig. 6.7: Fit the covers



NOTE

With the 5 kN · m and 10 kN · m measuring ranges, the cover plates of the speed sensor side are angled at the bottom and must be fitted as shown in Fig. 6.8.

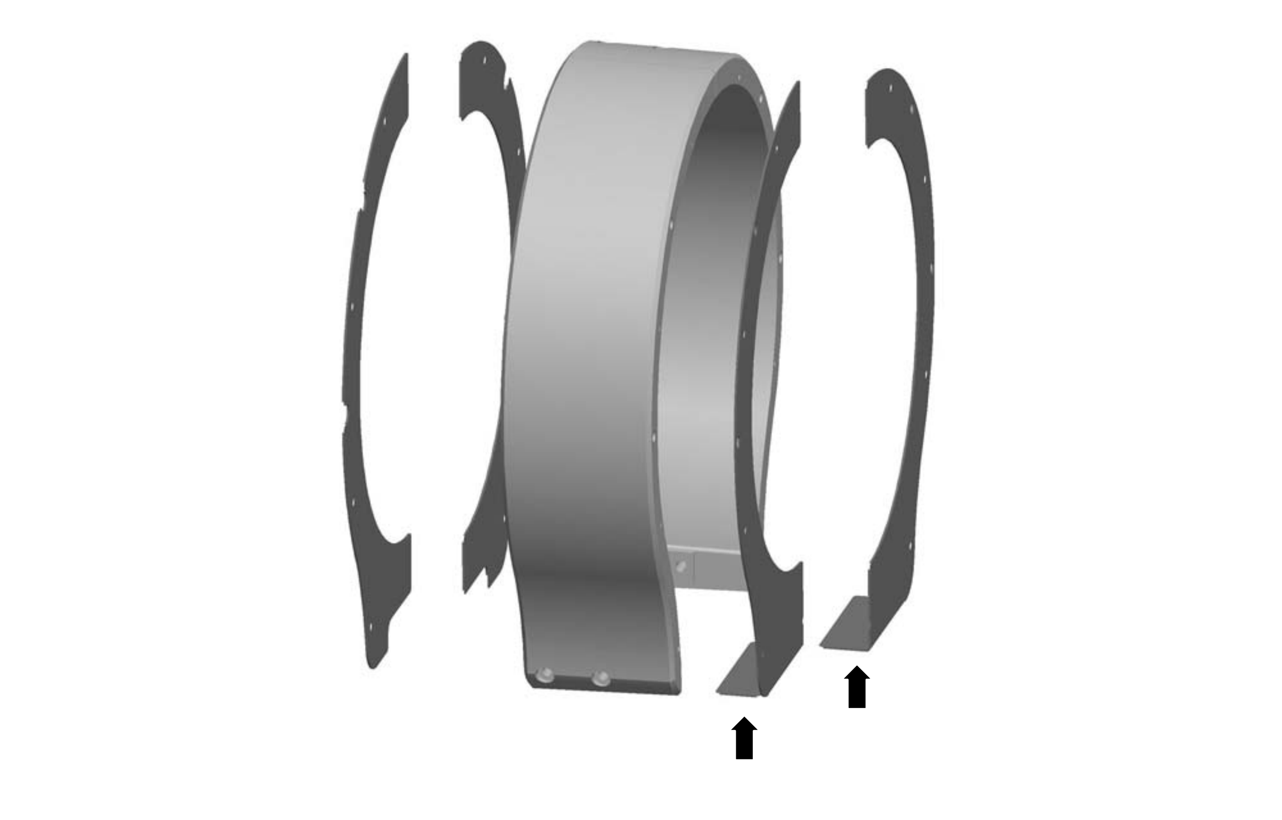


Fig. 6.8: Angled cover plates (for 5 kN · m and 10 kN · m measuring ranges)

5. Fasten the preassembled side parts on the stator housing, each with two M6 x 25 hexagon-socket screws (5 AF). Tighten the screws hand-tight.
6. Apply some of the screw locking device to the screw threads and screw the side parts together, hand-tight (2 M6 x 30 hexagon-socket screws; 5 AF).

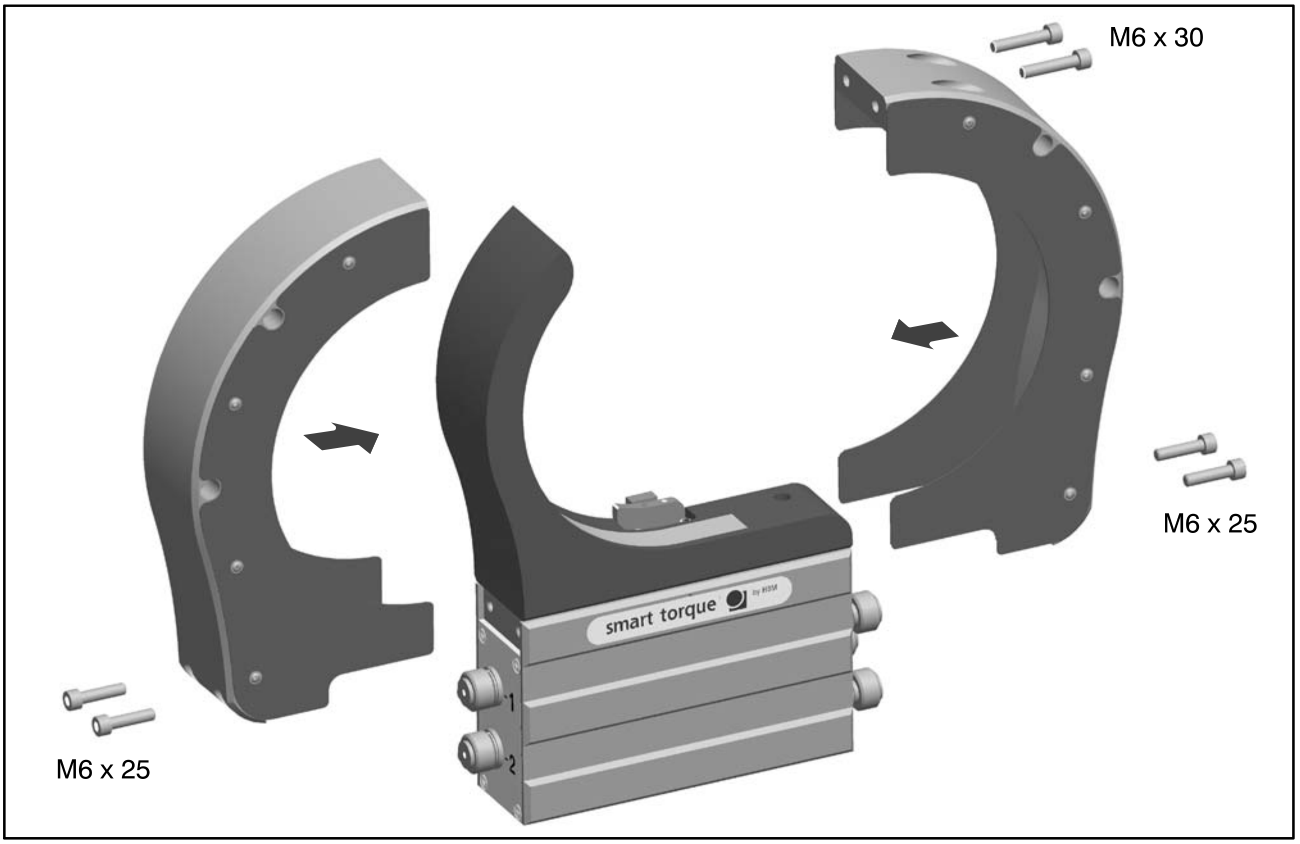


Fig. 6.9: Fit the halves of the protection against contact

7. Align the protection against contact in such a way that its end face is parallel to the stator housing.

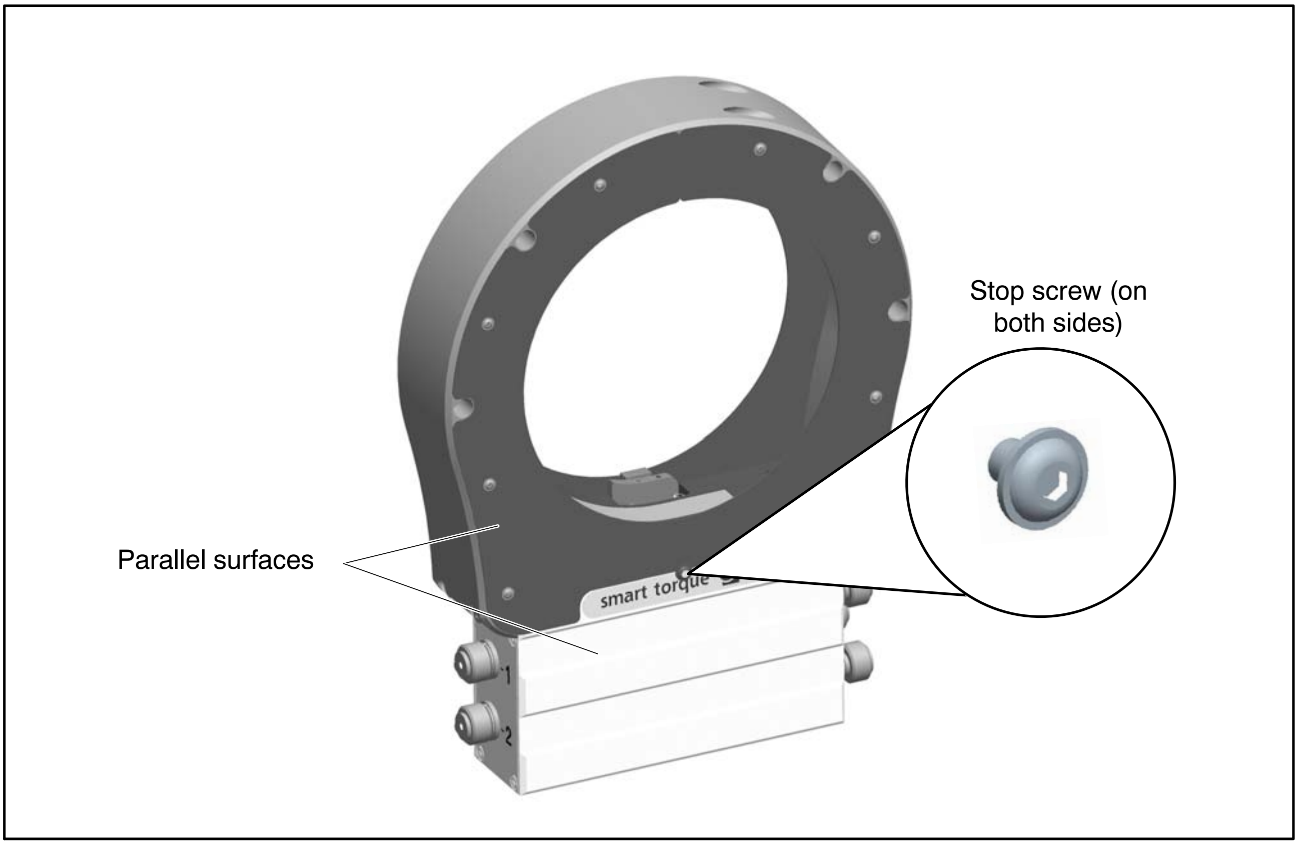


Fig. 6.10: Check for parallelism

8. Now tighten all the screws with a tightening torque M_A of 14 N·m.
9. Screw in the stop screws of the covers with a tightening torque of 2 N·m.

6.6 Installing the stator

On delivery, the stator has already been installed and is ready for operation. There are four tapped holes on the base of the stator housing for mounting the stator. Externally, two with a metric M6 thread, internally, two with a UNF 1/4" thread (closed with a plastic threaded pin).

For installation with metric thread, we recommend using two DIN EN ISO 4762 fillister-head screws with hexagon sockets of property class 10.9 of the appropriate length (depending on the connection geometry; not included among the components supplied; tightening torque = 14 N·m).

NOTE

Provide a possibility for adjustment (e.g. slotted holes) for aligning stator and rotor.

The stator can be mounted radially in any position (for example, "upside down" installation is possible). You can also install the stator over the protection against contact (option), see chapter 6.6.3.

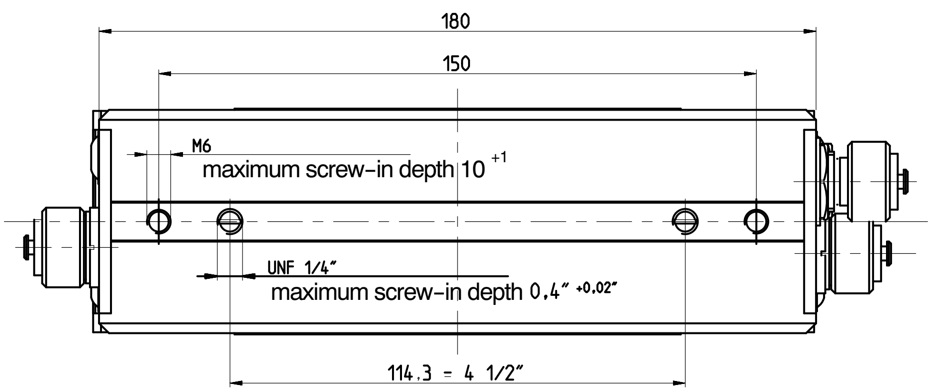


Fig. 6.11: Mounting holes in the stator housing (viewed from below)

With 5 kN·m and 10 kN·m torque transducers, we recommend supporting the stator at the protection against contact in addition. Fig. 6.10 shows an example of how to fix an angle bracket using a bolt (A) or a threaded rod (B). Please note that in this case the cover plates cannot be installed.

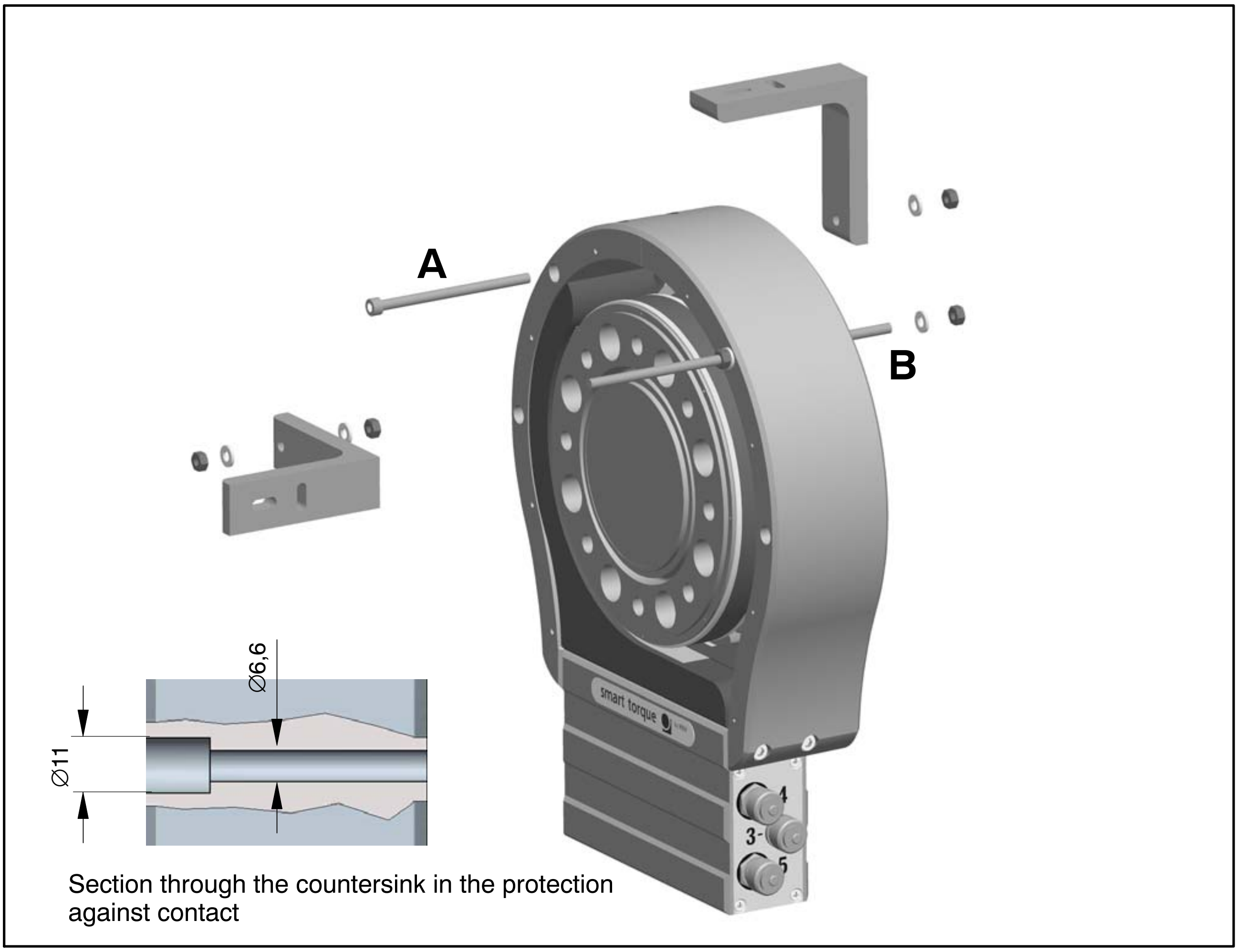


Fig. 6.12: Supporting the stator with an angle bracket (5 kN·m and 10 kN·m)

6.6.1 Preparing with the mounting kit (included among the items supplied)

The supplied mounting kit contains self-adhesive spacers, to make it easier for you to align the stator to the rotor.

Use the spacers to align the rotor and the stator radially and axially.

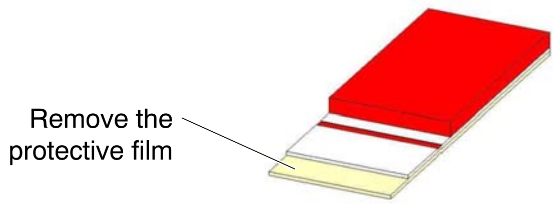


Fig. 6.13: Mounting kit spacer

Radial alignment with spacers

The spacers should preferably be attached to the transmitter head, offset by 90°, as shown in Fig. 6.14. If your stator is equipped with a speed measuring system, you must either shorten the spacers to an appropriate length or bond them on a slightly staggered manner next to the speed measuring system.

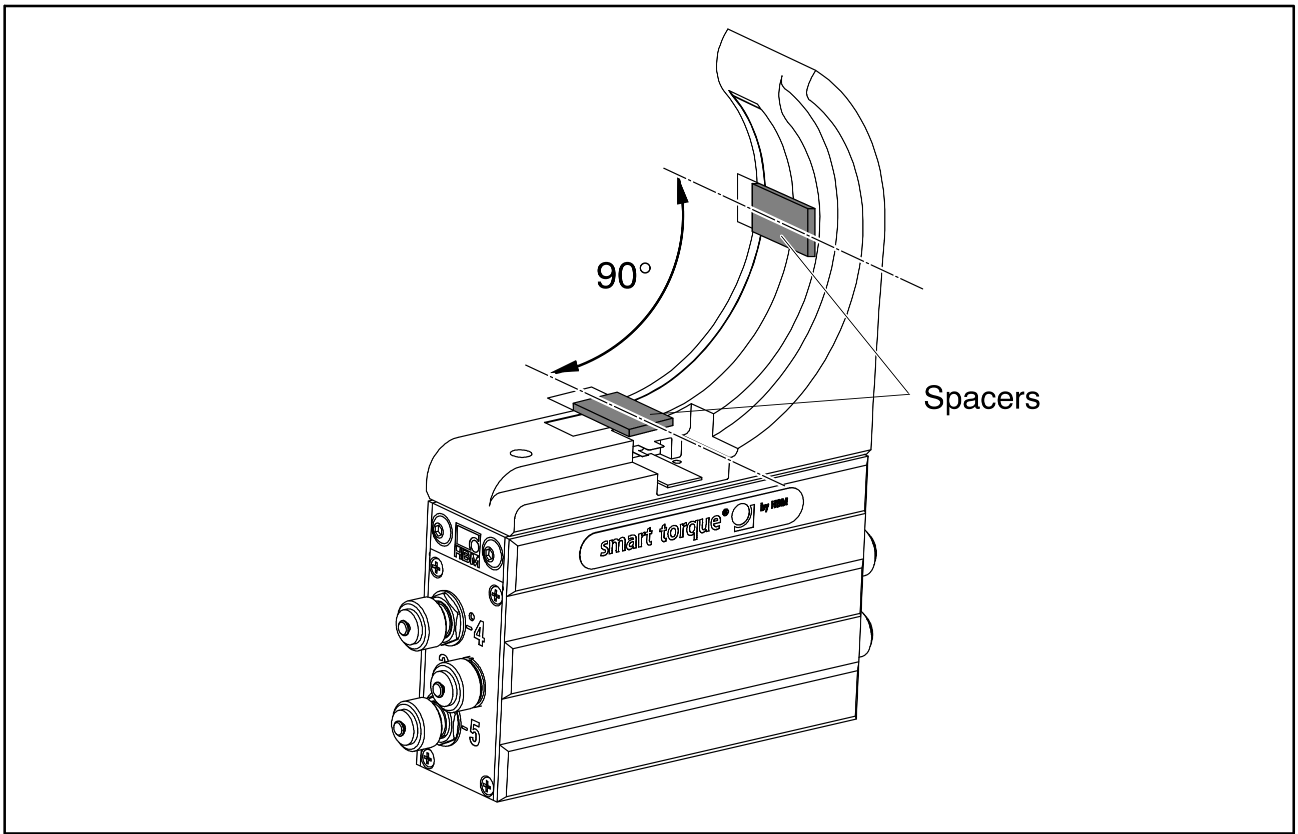


Fig. 6.14: Radial position of the spacers

Axial alignment with spacers

The red line on the spacers is used for axial alignment. Align the spacer in such a way that the outer edge of the transmitter head is in line with the red line (see Fig. 6.15).

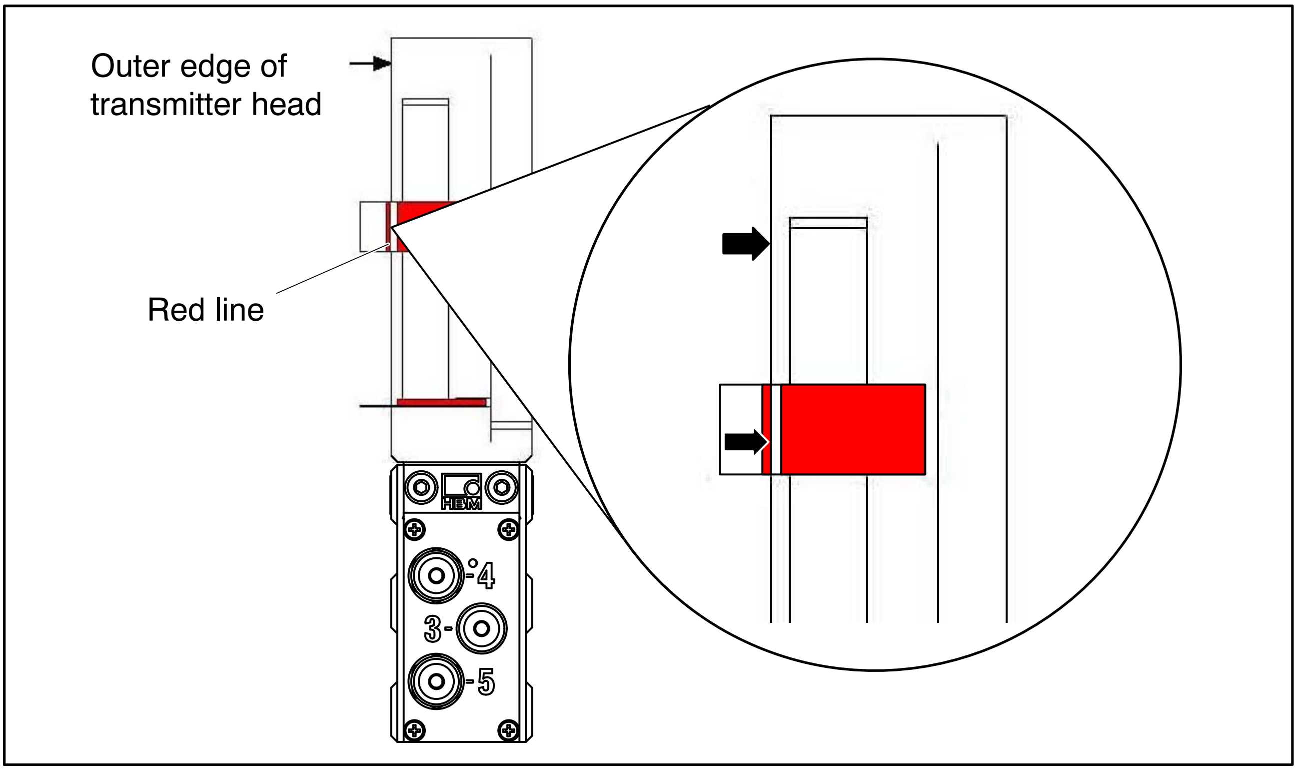


Fig. 6.15: Axial position of the spacers

Now remove the protective film and attach the spacer to the transmitter head, as described.

CAUTION

Remove the spacers after installation.

6.6.2 Aligning the stator

1. Position the stator on an appropriate base plate in the shaft run, so that there are sufficient opportunities for horizontal and vertical adjustments to be made.
2. Should there be any misalignment in height, compensate for this by inserting adjusting washers.
3. Initially, the fastening screws should only be hand-tight.
4. Use the spacers to radially align the stator to the rotor.

5. Use the spacers to axially align the stator to the rotor. The rotor should be in line with the edge of the red spacer, see Fig. 6.16.

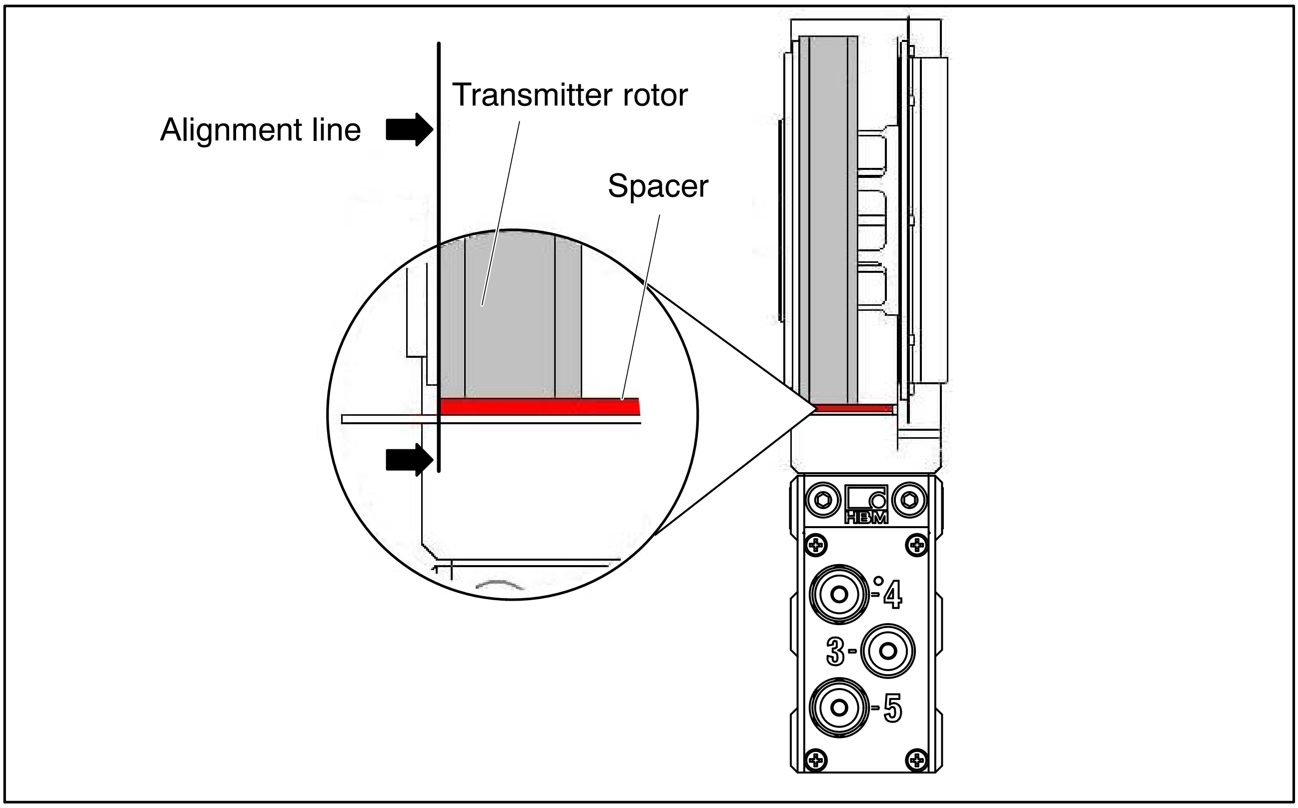


Fig. 6.16: Axial alignment to the rotor

6. Connect the power line (connector 1 or connector 3). Notice the LED to the right of connector 4. The stator is correctly aligned, when the LED successively
   - flashes red for about 10 seconds
   - flashes yellow for about 10 seconds
   - then stays permanently green (CAN bus) or yellow or green (PROFIBUS).

NOTE

When data are being exchanged via the CAN bus or the PROFIBUS, the LED flashes green.

You can also use the T12 Assistant to check for the correct alignment. The LED must stay green in the ”Rotor clearance setting mode”.

7. Now fully tighten the fastening screws (tightening torque: 14 N · m).
8. Remove the spacers, by first removing the adhesive strip and then the red plastic strip.

9. Make sure that the air gap between the rotor and stator is free from electrically conductive and other foreign matter.

6.6.3 Stator installation over the protection against contact (option)

You can also axially flange the stator over the protection against contact (material: aluminum). Holes are provided in the side parts of the protection against contact for this purpose. For this mounting, we recommend fillister-head screws M6 with hexagon sockets in accordance with DIN EN ISO 4762; black/oiled/μ_{tot}=0.125, of the appropriate length.

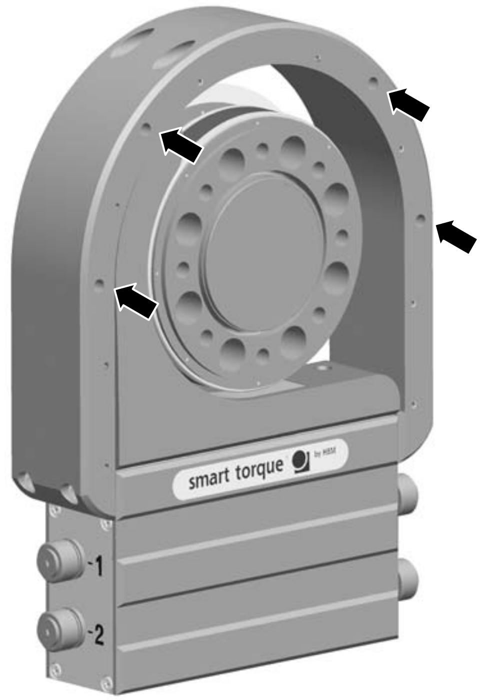
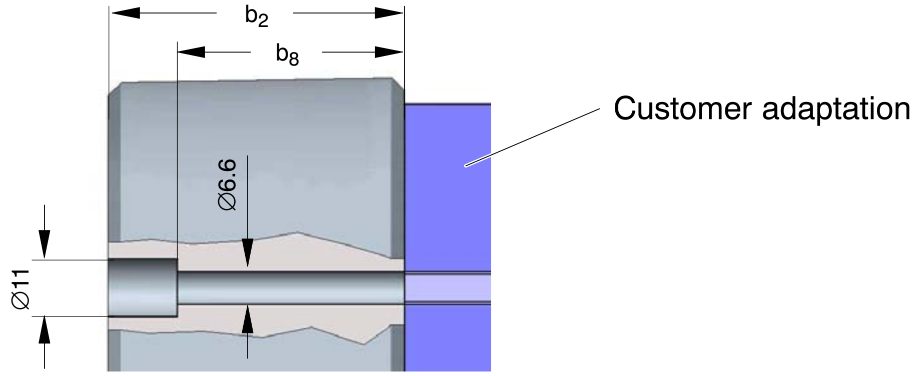


Fig. 6.17: Mounting holes in the protection against contact



Measuring range	Dimensions in mm	
	b_2	**b_8**
100 N·m ... 3 kN·m	56	43
5 kN·m	78	65
10 kN·m	86	73

Table 6.2: Mounting hole dimensions

Fig. 6.18: Face-mounting on the engine shielding

6.7 Optical speed/angle of rotation measuring system (option)

As the stator with the optical speed sensor only partially encloses the slotted disc, if there is sufficient space available for installation, you can subsequently move the stator tangentially over the ready-mounted rotor.

For perfect measuring mode, the slotted disc of the speed measuring system must rotate at a defined position in the sensor pickup.

Axial alignment

There is a mark (orientation line) in the sensor pickup for axial alignment (orientation line). When installed, the slotted disc should be exactly above this orientation line. Divergence of up to ± 2 mm is permissible in measuring mode (total of static and dynamic shift).

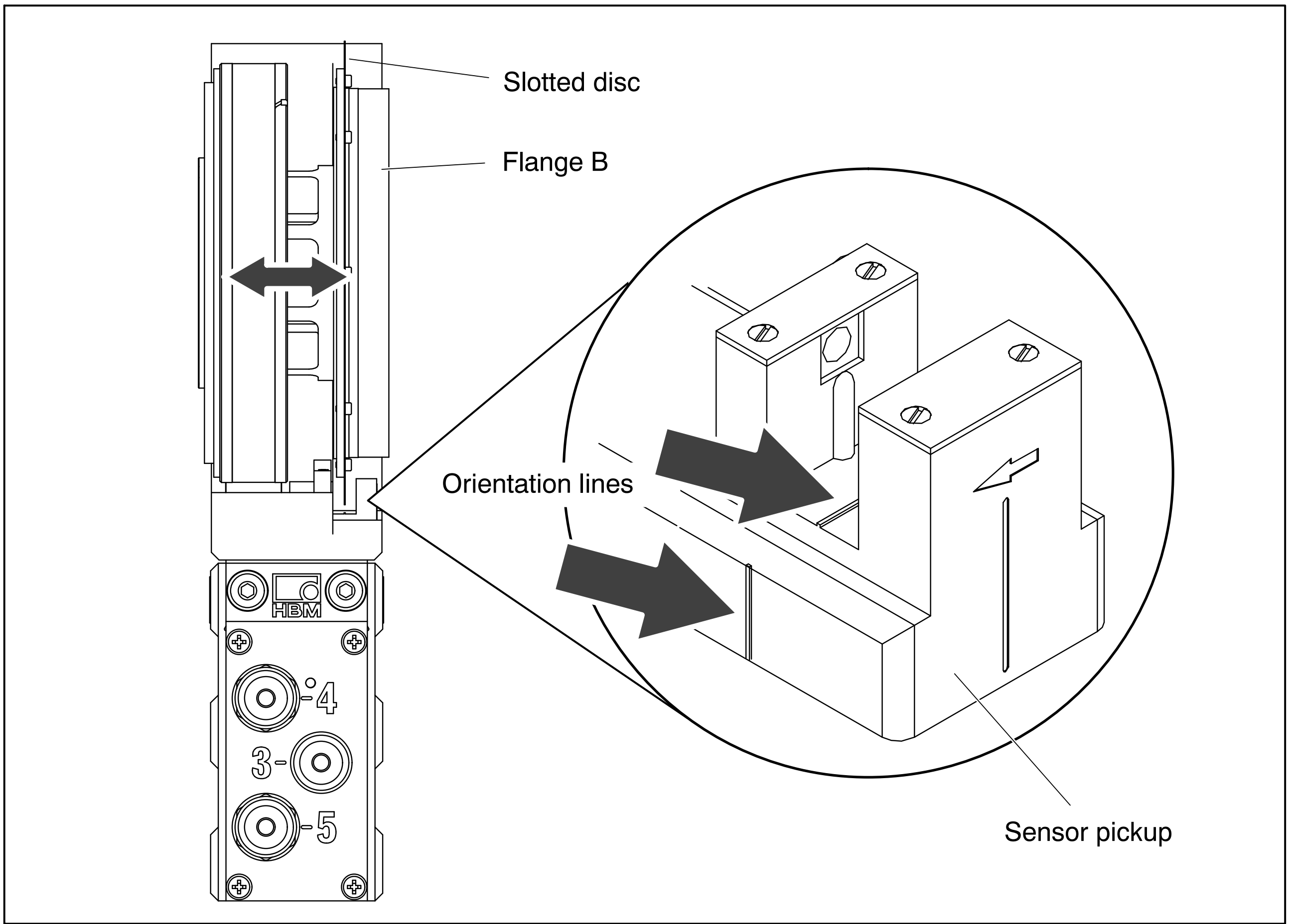


Fig. 6.19: Position of the slotted disc in the speed sensor

Radial alignment

The rotor axis and the optical axis of the speed sensor must be along a line at right angles to the stator platform. A conical machined angle (or a colored mark) in the center of flange A and a vertical marker line on the sensor pickup serve as aids to orientation.

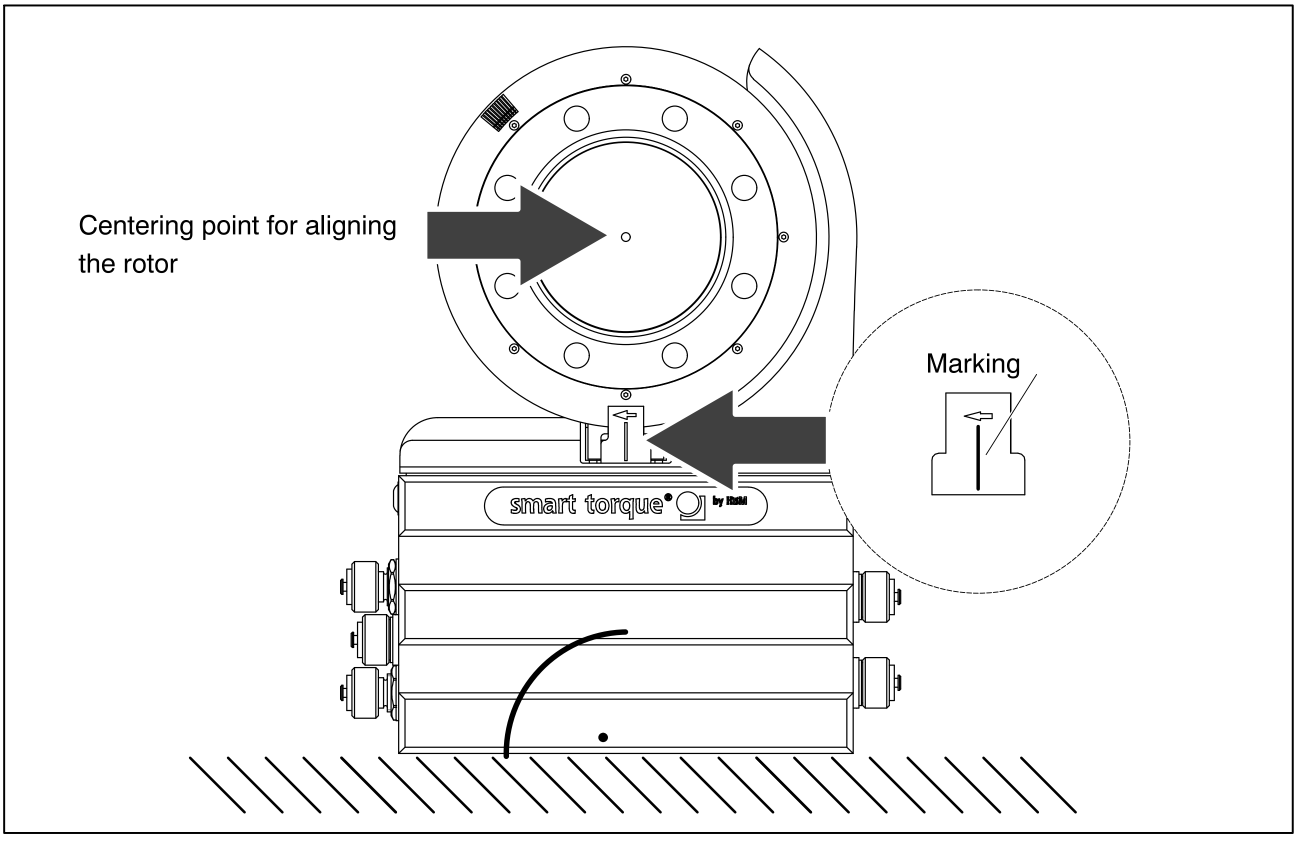


Fig. 6.20: Alignment marks on rotor and stator

Connect the power line (connector 1).

Switch the LED display mode of the T12 Assistant to ”optical speed system” setting mode and turn the rotor. Notice the LED to the right of connector 4; this must stay green if the setting is correct (also see chapter 7.3).

CAUTION

Angle of rotation measurement is not suitable for static and quasi-static applications!

7 LED status display

The LED in the stator housing (next to male device connector 4) has three display modes: Standard (measuring mode), rotor clearance setting mode and optical speed system setting mode.

7.1 Measuring mode operation

LED color	Significance
Flashing green (fast)	SDO Transfer taking place
Flashing green	CAN Device has Operational status
Green	For PROFIBUS option only: Data Exchange taking place[1)]
Flashing yellow (slow)	Rotor communication taking place
Yellow	For PROFIBUS option only: Searching for the baud rate or parameterization or configuration taking place or no Data Exchange taking place[1)]
Flashing red	Overflow for measured value (amplifier input, measured value Ovfl.), frequency or analog output
Red	Error situation

1) When PROFIBUS option exists: Messages to the PROFIBUS take precedence over messages to the CAN bus.

7.2 Rotor clearance setting mode operation

LED color	Significance
Green	Rotor-Stator alignment is OK
Yellow	Rotor-Stator alignment is borderline
Red	Rotor-Stator alignment is not OK

7.3 Speed measuring system setting mode operation

LED color	Significance
Green	The position of the two sensors is OK, the signals (F1/F2) are 90° or 270° phase-shifted and can be correctly evaluated
Yellow	The phase relation of the two sensor signals is not optimum, there is a variation of 10° to 30°
Red	The phase relation of the two sensor signals is not correct, there is a variation of more than 30°

For more information on setting mode, look in the T12 Assistant online Help.

8 Electrical connection

8.1 General hints

Detailed instructions for connecting the T12 to the CAN bus or the PROFIBUS can be found in the ”T12-CAN bus/PROFIBUS” Internet description (in pdf format) on the T12 system CD.

To make the electrical connection between the torque transducer and the measuring amplifier, we recommend using shielded, low-capacitance measurement cables from HBM.

With cable extensions, make sure that there is a proper connection with minimum contact resistance and good insulation. All plug connections or sleeve nuts must be properly tightened.

Do not route the measurement cables parallel to power lines and control circuits. If this cannot be avoided (in cable pits, for example), maintain a minimum distance of 50 cm and also draw the measurement cable into a steel tube.

Avoid transformers, motors, contactors, thyristor controls and similar stray-field sources.

CAUTION

Transducer connection cables from HBM with attached connectors are identified in accordance with their intended purpose (Md or n). When cables are shortened, inserted into cable ducts or installed in control cabinets, this identification can get lost or become concealed. If this is the case, it is essential for the cables to be re-labeled!

NOTE

Cables and connectors for connections 1, 2 and 3 are compatible with the T10FS torque flange.

8.2 Shielding design

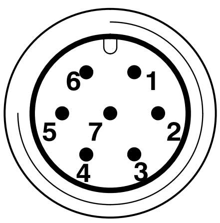
The cable shielding is connected in accordance with the Greenline concept. This encloses the measurement system (without a rotor) in a Faraday cage. It is important that the shield is laid flat on the housing ground at both ends of the cable. Any electromagnetic interference active here does not affect the measurement signal. Signal transmission between transmitter head and rotor is purely digital and special electronic coding methods are used to protect from electromagnetic interference.

In the case of interference due to potential differences (compensating currents), supply voltage zero and housing ground must be disconnected on the amplifier and a potential equalization line established between the stator housing and the amplifier housing (copper conductor, 10 mm^2 wire cross section).

If potential differences arise between the rotor and the stator on the machine, perhaps due to unchecked leakage, and this causes interference, it can usually be overcome by connecting the rotor directly to ground, for instance by a wire loop. The stator should be fully grounded in the same way.

8.3 Connector pin assignment

Assignment for connector 1:
Supply voltage and frequency output signal.

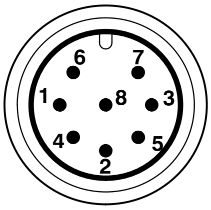
	Connector pin	Assignment	Color code	Sub-D connector pin
Binder 423	1	Torque measurement signal (frequency output; 5 V[1])	wh	13
	2	Supply voltage 0 V;	bk	5
	3	Supply voltage 18 V ... 30 V	bu	6
	4	Torque measurement signal (frequency output; 5 V[1])	rd	12
	5	Measurement signal 0 V; symmetrical	gy	8
Top view	6	Shunt signal activation 5 V...30 V and TEDS for torque	gn	14
	7	Shunt signal 0 V;	gy	8
		Shielding connected to enclosure ground		

1) Complementary signals RS-422; for cable lengths of 10 m and longer, we recommend to use a termination resistor R=120 ohms between wires (wh) and (rd).

CAUTION

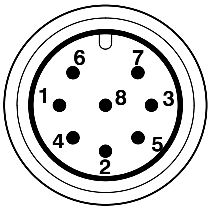
Torque transducers are only intended for operation with a DC supply voltage (separated extra-low voltage), see page 36.

Assignment for connector 2: Speed measuring system

Binder 423	Connector pin	Assignment	Color code	Sub-D connector pin
	1	Speed measurement signal (pulse string, 5 V[1]; 0°)	rd	12
	2	No function	bu	2
	3	Speed measurement signal (pulse string, 5 V[1]; 90°phase shifted)	gy	15
	4	No function	bk	3
	5	TEDS for rotational speed	vt	9
	6	Speed measurement signal (pulse string, 5 V[1]; 0°)	wh	13
	7	Speed measurement signal (pulse string, 5 V[1]; 90°phase shifted)	gn	14
Top view	8	Measurement signal 0 V;	bk[2]	8
		Shielding connected to enclosure ground		

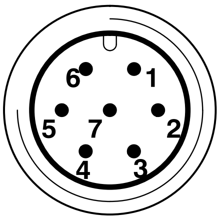
[1] Complementary signals RS-422; for cable lengths of 10 m and longer, we recommend to use a termination resistor R=120 ohms between wires (rd) and (wh) as well as (gy) and (gn).
[2] Wire color brown (br) with Kab 163 and Kab 164

Assignment for connector 2: Speed measuring system with reference pulse

Binder 423	Connector pin	Assignment	Color code	Sub-D connector pin
	1	Speed measurement signal (pulse string, 5 V[1]; 0°)	rd	12
	2	Reference signal (1 pulse/rev., 5 V[1])	bu	2
	3	Speed measurement signal (pulse string, 5 V[1]; 90°phase shifted)[2]	gy	15
	4	Reference signal (1 pulse/rev., 5 V[1])	bk	3
	5	TEDS for speed	vt	9
	6	Speed measurement signal (pulse string, 5 V[1]; 0°)	wh	13
	7	Speed measurement signal (pulse string, 5 V[1]; 90°phase shifted)	gn	14
Top view	8	Measurement signal 0 V;	bk[2]	8
		Shielding connected to enclosure ground		

[1] Complementary signals RS-422; for cable lengths of 10 m and longer, we recommend to use a termination resistor R=120 ohms between wires (rd) and (wh); (bu) and (bk); (gy) and (gn).
[2] Wire color brown (br) with Kab 163 and Kab 164

Assignment for connector 3:
Supply voltage and voltage output signal.

Binder 423	Connector pin	Assignment
	1	Torque speed measurement signal (voltage output; 0 V) or speed measurement signal (0V)
	2	Supply voltage 0 V;
	3	Supply voltage 18 V to 30 V DC
	4	Torque speed measurement signal (voltage output; ±10 V) or speed measurement signal (±10 V)
	5	No function
	6	Shunt signal activation 5 V...30 V and TEDS for torque
Top view	7	Shunt signal 0 V;
		Shielding connected to enclosure ground

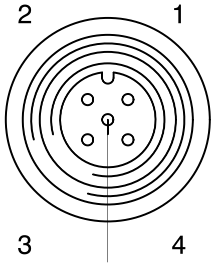
CAUTION

Do not use cable KAB 149 to connect the voltage output signal at AP01i to ML01B of the MGCplus system! This cable is only suitable for the frequency output signal connection.

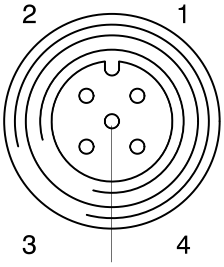
NOTE

The analog output is designed as a monitoring output. The power transmission of the torque transducer can cause interference on the connected cable of up to 40 mV at 13.56 MHz. This interference can be suppressed by connecting a 100 nF capacitor in parallel, directly at the connected measuring device.

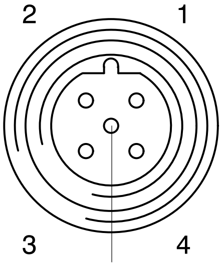
Assignment for connector 4:
CAN bus standard; A-coded, black washer

<table>
<tr><td rowspan="7">Binder 713
(M12x1)

Top view</td><td>Connector pin</td><td>Assignment</td><td>Color code</td></tr>
<tr><td>1</td><td>Shielding</td><td>–</td></tr>
<tr><td>2</td><td>No function</td><td>–</td></tr>
<tr><td>3</td><td>CAN ground</td><td>–</td></tr>
<tr><td>4</td><td>CAN HIGH-dominant high</td><td>wh</td></tr>
<tr><td>5</td><td>CAN LOW-dominant low</td><td>bu</td></tr>
<tr><td></td><td>Shielding connected to enclosure ground</td><td></td></tr>
</table>

Assignment for connector 5:
CAN bus, second device connector; A-coded, black washer

<table>
<tr><td rowspan="7">Binder 713
(M12x1)

Top view</td><td>Connector pin</td><td>Assignment</td><td>Color code</td></tr>
<tr><td>1</td><td>Shielding</td><td>–</td></tr>
<tr><td>2</td><td>No function</td><td>–</td></tr>
<tr><td>3</td><td>CAN ground</td><td>–</td></tr>
<tr><td>4</td><td>CAN HIGH-dominant high</td><td>wh</td></tr>
<tr><td>5</td><td>CAN LOW-dominant low</td><td>bu</td></tr>
<tr><td></td><td>Shielding connected to enclosure ground</td><td></td></tr>
</table>

Assignment for connector 5:
PROFIBUS (Option); B-coded, violet washer

<table>
<tr><td rowspan="7">Binder 715
(M12x1)

Top view</td><td>Connector pin</td><td>Assignment</td></tr>
<tr><td>1</td><td>5 V (typ. 50 mA)</td></tr>
<tr><td>2</td><td>PROFIBUS A</td></tr>
<tr><td>3</td><td>PROFIBUS ground</td></tr>
<tr><td>4</td><td>PROFIBUS B</td></tr>
<tr><td>5</td><td>Schielding</td></tr>
<tr><td></td><td>Shielding connected to enclosure ground</td></tr>
</table>

8.4 Supply voltage

The transducer has to be operated with a separated extra-low voltage (18 ... 30 V DC supply voltage) which normally supplies one or several consumer loads in a test bench. If the transducer is to be operated in a DC voltage network[1], additional measures have to be taken for discharging overvoltages.

8.4.1 Supply voltage for self-contained operation

The notes in this section relate to the self-contained operation of the T12 without HBM system solutions.

The supply voltage is electrically isolated from signal outputs and shunt signal inputs.

Connect a separated extra-low voltage of 18 V...30 V to pin 3 (+) and pin 2 (⏚) of connectors 1 or 3. We recommend that you use HBM cable KAB 8/00‑2/2/2 and the relevant female Binder connectors, that at nominal (rated) voltage (24 V) can be up to 50 m long and in the nominal voltage range, 20 m long (see Accessories, Page 77). If the permissible cable length is exceeded, you can supply the voltage in parallel over two connection cables (males connectors 1 and 3). This enables you to double the permissible length. Alternatively an on-site power pack should be installed.

If you feed the supply voltage through an unshielded cable, the cable must be twisted (interference suppression). We also recommend that a ferrite element should be located close to the connector on the cable, and the stator should be grounded.

CAUTION

The instant you switch on, a current of up to 4 A may flow and this may switch off power packs with electronic current limiters.

[1] Distribution system of major size (e. g. including several test benches) for electrical power which may also supply consumer loads with high nominal (rated) currents.

9 Shunt signal

The T12 torque transducer supplies an electrical shunt signal, at either 50 % or 10 % of the nominal (rated) torque, as selected. Activate this function via the T12 Assistant or the shunt signal activation on connector 1 or connector 3 (see chapter 8.3). The shunt signal selected last in the T12 Assistant will then be activated.

NOTE

Due to the internal singal processing, activation of the shunt signal may be delayed by about 5 seconds.

To obtain stable conditions, the shunt signal should only be activated once the transducer has been warming up for 15 minutes.

To enable the values of the test report to be reproduced, the bonndary conditions of comparability (e. g. mounting conditions) have to be reproduced.

NOTE

When measuring the shunt signal, the transducer should not be loaded, because the signal is applied in addition.
The shunt signal is automatically deactivated after about 5 minutes.

10 Loading capacity

Nominal (rated) torque can be exceeded statically up to the limit torque. If the nominal torque is exceeded, additional irregular loading is not permissible. This includes longitudinal forces, lateral forces and bending moments. Limit values can be found in the "Specifications" section, Page 51.

10.1 Measuring dynamic torque

The torque transducer is suitable for measuring static and dynamic torques. The following applies to the measurement of dynamic torque:

- The T12 calibration run for static measurements is also valid for dynamic torque measurements.
- The natural frequency f_0 of the mechanical measuring system depends on the moments of inertia J_1 and J_2 of the connected rotating masses and the T12's torsional stiffness.

Use the equation below to approximately determine the natural frequency f_0 of the mechanical measuring system:

$$f_0 = \frac{1}{2\pi} \cdot \sqrt{c_T \cdot \left(\frac{1}{J_1} + \frac{1}{J_2}\right)}$$

f_0 = natural frequency in Hz
J_1, J_2 = mass moment of inertia in kg·m²
c_T = torsional stiffness in N·m/rad

- The maximum vibration bandwidth is 200 % (measuring ranges 3 kN·m ... 10 kN·m: 160 %) of the typical nominal (rated) torque for the T12 (see the specifications, Page 51). The vibration bandwidth must fall within the load range designated by the upper and lower maximum torques. The same also applies to transient resonance points.

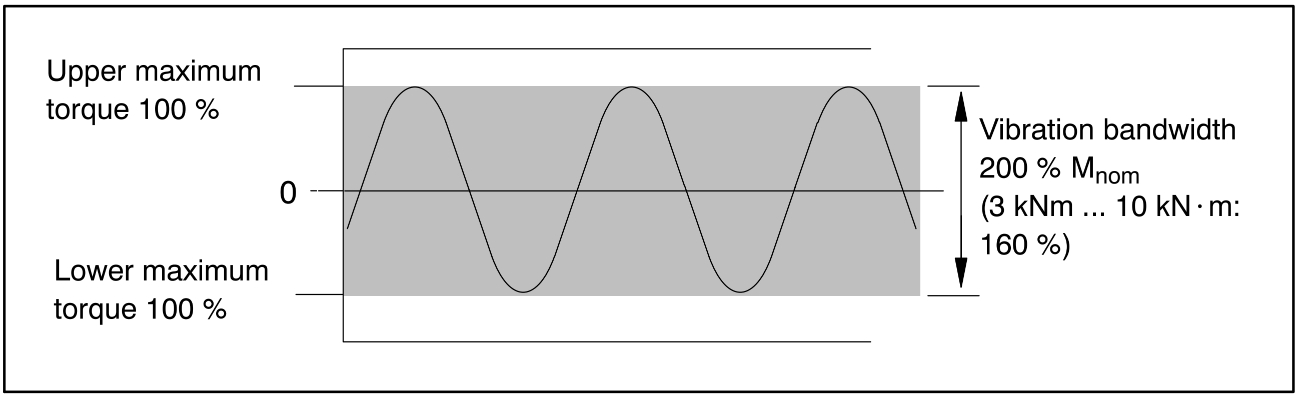


Fig. 10.1: Permissible dynamic loading

11 TEDS

TEDS (Transducer Electronic Data Sheet) allows you to store the transducer data (characteristic values) in a chip, that can be read out by a connected measuring device.

There are two TEDS blocks in the T12 digital torque transducer:

- TEDS 1 (torque): A choice of voltage sensor or frequency sensor/pulse sensor
- TEDS 2 (speed/angle of rotation): Frequency sensor/pulse sensor

The data are written automatically into the TEDS blocks by the T12 Assistant, when the parameters are stored. The same menu is used to select whether the device should be presented as a voltage sensor or as a frequency sensor or as a frequency or pulse sensor. A template is also stored, which provides the conversion factors for the various engineering units.

The T12 is a transducer, that is to say, the T12 does not read the TEDS blocks, it only writes them. (We therefore strongly advise against editing the values with the HBM TEDS Editor, for example!)

To read out the data and thus the parameterization of an MGC amplifier (such as the ML60B or ML01B with AP01i), the relevant connection board is connected to the T12 via cable KAB149 (torque) or KAB163 (speed).

You must then run the ”TEDS” command in the MGC amplifier.

The MGC amplifier reads the data from the T12 TEDS block and parameters are assigned accordingly.

You can also read the TEDS block data with the TEDS Editor.

CAUTION

To ensure that the data of the TEDS blocks correspond to the properties of the T12 torque transducer, you must not overwrite the information from the MGC.

For more information on TEDS, look in the T12 Assistant online Help.

11.1 Content of the TEDS memory as defined in IEEE 1451.4

The information in the TEDS memory is organized into areas, which are prestructured to store defined groups of data in table form.

Only the entered values are stored in the TEDS memory itself. The amplifier firmware assigns the interpretation of the respective numerical values. This places a very low demand on the TEDS memory. The memory content is divided into three areas:

Area 1:

An internationally unique TEDS identification number (cannot be changed).

Area 2:

The base area (basic TEDS), to the configuration defined in standard IEEE1451.4. The transducer type, the manufacturer and the transducer serial number are contained here.

Example:

TEDS content for the T12/1 kN · m transducer

TEDS	
Manufacturer	HBM (31)
Model	T12 (15)
Version letter	A
Version number	2 first point of stator ident. no.
Serial number	7 first point of stator ident. no.

Area 3:

Data specified by the manufacturer and the user are contained in this area. The “Value” column of the following table gives example values for a T12/1kN·m torque transducer from HBM.

Torque

For the measured quantity torque, HBM has already described the template “Frequency/Pulse Sensor” and the template “High Voltage Output Sensor”.

Template: Frequency/Pulse Sensor				
Parameter	**Value**	**Unit**	**Required user rights**	**Explanation**
Transducer Electrical Signal Type	Pulse Sensor		ID	
Minimum Torque	0.000	N·m	CAL	The physical measured quantity and unit are defined when the template is created, after which they cannot be changed.
Maximum Torque	1000	N·m	CAL	
Pulse Measurement Type	Frequency			
Minimum Electrical Value	10000	Hz	CAL	The difference between these values is the nominal (rated) sensitivity.
Maximum Electrical Value	15000	Hz	CAL	
Mapping Method	Linear			
Discrete Signal Type	Bipolar		ID	
Discrete Signal Amplitude	4	V		
Discrete Signal Configuration	Single			
Transducer Response Time	0	seconds		
Excitation Level nom	24	V		
Excitation Level min	18	V		
Excitation Level max	30	V		
Excitation Type	DC			
Excitation Current draw	0,5	A		
Calibration Date	1–Nov–2006	CAL		Date of the last calibration or creation of the test certificate (if no calibration carried out), or of the storage of the TEDS data (if only nominal (rated) values from the data sheet were used).Format: day–month–year.Abbreviations for the months: Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec.
Calibration Initials	HBM or PTB		CAL	Initials of the calibrator or calibration laboratory concerned.
Calibration Period (Days)	0	days	CAL	Time before recalibration, calculated from the date specified under Calibration Date.
Measurement location ID	0		USR	Identification number for the measuring point.Can be assigned according to the application. Possible values: a number from 0 to 2047.

Template: High Level Voltage Sensor				
Parameter	**Value**	**Unit**	**Requi-red user rights**	**Explanation**
Minimum Torque	0,000	N·m	CAL	The physical measured quant-ity and unit are defined when the template is created, after which they cannot be changed.
Maximum Torque	1000	N·m	CAL	
Minimum Electrical Value	0	V	CAL	The difference between these values is the nominal (rated) sensitivity.
Maximum Electrical Value	10	V	CAL	
Discrete Signal Type	Bipolar		ID	
Discrete Signal Amplitude	5	V		
Discrete Signal	Single			
Transducer Response Time	0			
Excitation Level nom	24	V		
Excitation Level min	18	V		
Excitation Level max	30	V		
Excitation Type	DC			
Excitation Current draw	0,5	A		
Calibration Date	1–Nov–2006	CAL		Date of the last calibration or creation of the test certificate (if no calibration carried out), or of the storage of the TEDS data (if only nominal (rated) values from the data sheet were used).Format: day–month–year.Abbreviations for the months: Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec.
Calibration Initials	HBM or PTB		CAL	Initials of the calibrator or calib-ration laboratory concerned.
Calibration Period (Days)	0	days	CAL	Time before recalibration, cal-culated from the date specified under Calibration Date.
Measurement Location ID	0		USR	Identification number for the measuring point.Can be assigned according to the application. Possible values: a number from 0 to 2047.

Speed measuring sytem/Angle of rotation

For the measured quantity rotational speed/angle of rotation, HBM has already described the template “Frequency/Pulse Sensor”.

Template: Frequency/Pulse Sensor				
Parameter	**Value**	**Unit**	**Requi-red user rights**	**Explanation**
Transducer Electrical Signal Type	Pulse Sensor		ID	
Minimum Frequency	0,000	Hz	CAL	The physical measured quant-ity and unit are defined when the template is created, after which they cannot be changed.
Maximum Frequency	108,000k	Hz	CAL	
Pulse Measurement Type	Frequency			
Minimum Electrical Value	0	Hz	CAL	
Maximum Electrical Value	108,000k	Hz	CAL	
Mapping Method	Linear			
Discrete Signal Type	Bipolar		ID	
Discrete Signal Amplitude	4	V		
Discrete Signal Configu-ration	Double phase plus zero index			
Transducer Response Time	0	secon ds		
Excitation Level nom	24	V		
Excitation Level min	18	V		
Excitation Level max	30	V		
Excitation Type	DC			
Excitation Current draw	0,5	A		
Calibration Date	1-Nov-2006	CAL		Date of the last calibration or creation of the test certificate (if no calibration carried out), or of the storage of the TEDS data (if only nominal (rated) values from the data sheet were used).Format: day-month-year.Abbreviations for the months: Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec.
Calibration Initials	HBM or PTB		CAL	Time before recalibration, cal-culated from the date specified under Calibration Date.
Calibration Period (Days)	0	days	CAL	Time before recalibration, cal-culated from the date specified under Calibration Date.

Template: Frequency/Pulse Sensor				
Parameter	**Value**	**Unit**	**Requi-red user rights**	**Explantion**
Measurement location ID	0		USR	Identification number for the measuring point.Can be assigned according to the application. Possible values: a number from 0 to 2047.
Transducer Electrical Signal Type	Pulse Sensor		ID	
Minimum Frequency	0,000E+000	degrees	CAL	The physical measured quantity and unit are defined when the template is created, after which they cannot be changed.
Maximum Frequency	3,6E+002	degrees	CAL	
Pulse Measurement Type	Count			
Minimum Electrical Value	0,0	Imp	CAL	The difference between these values is the nominal (rated) sensitivity.
Maximum Electrical Value	360	Imp	CAL	
Mapping Method	Linear			
Discrete Signal Type	Bipolar		ID	
Discrete Signal Amplitude	4	V		
Discrete Signal Configuration	Double phase plus zero index			
Transducer Response Time	0	seconds		
Excitation Level nom	24	V		
Excitation Level min	18	V		
Excitation Level max	30	V		
Excitation Type	DC			
Excitation Current draw	0,5	A		
Calibration Date	1-Nov-2006	CAL		Date of the last calibration or creation of the test certificate (if no calibration carried out), or of the storage of the TEDS data (if only nominal (rated) values from the data sheet were used).Format: day-month-year.Abbreviations for the months: Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec.

Template: Frequency/Pulse Sensor				
Parameter	**Value**	**Unit**	**Requi-red user rights**	**Explantion**
Calibration Initials	HBM or PTB		CAL	Time before recalibration, cal-culated from the date specified under Calibration Date.
Calibration Period (Days)	0	days	CAL	Time before recalibration, cal-culated from the date specified under Calibration Date.
Measurement location ID	0		USR	Identification number for the measuring point.Can be assigned according to the application. Possible values: a number from 0 to 2047.

12 Maintenance

The T12 torque transducer without speed measuring system is maintenance-free.

12.1 Cleaning the speed measuring system

During operation and depending on the ambient conditions, the slotted disc of the rotor and the associated stator sensor optics can get dirty. This becomes noticeable:

- In transducers with a reference pulse, when an increment error is displayed in the ”Speed signal” status in the T12 Assistant
- In transducers without a reference pulse, when there are cyclic intrusions into the speed signal

Remedy:

1. Use compressed air (up to 6 bar) to clean the slotted disc.
2. Carefully clean the optical system of the sensor with a dry or spirit-impregnated cotton bud or cloth.

CAUTION

Do not use any other solvent for cleaning the sensor optic.

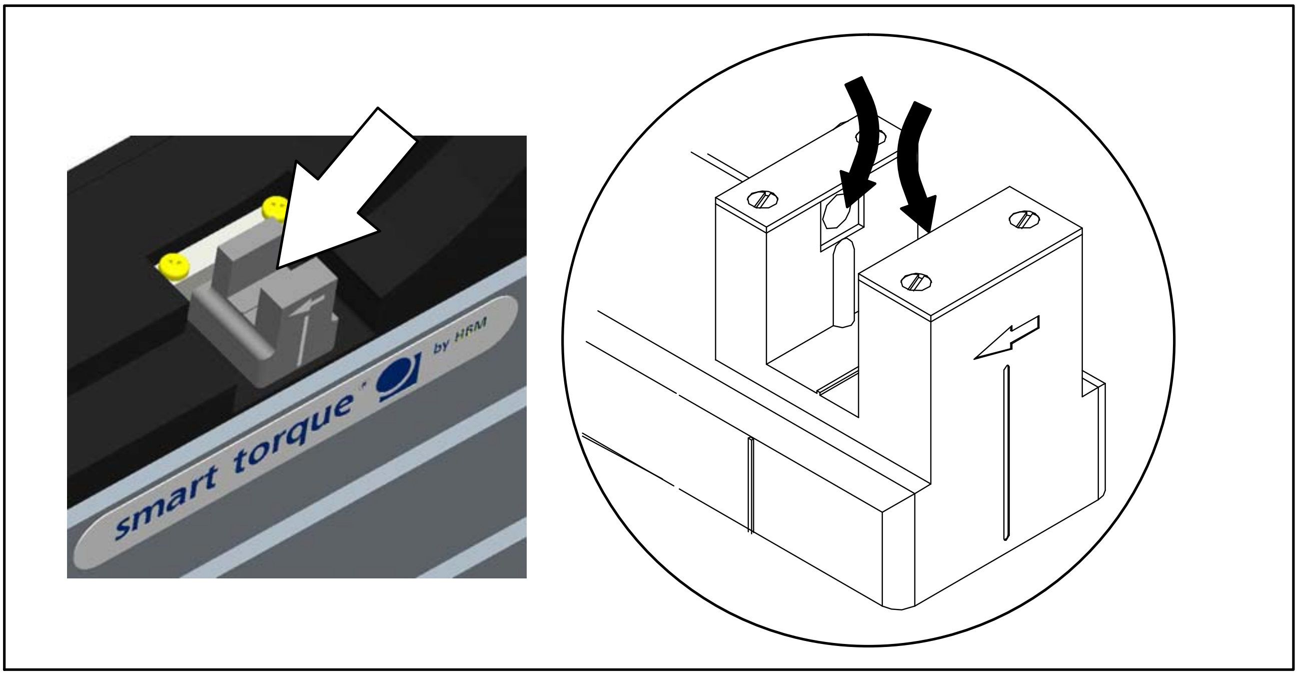


Fig.12.1: Cleaning points on the speed sensor

13 Specifications

Type		**T12**							
Accuracy class		0.03							
Torque measuring system									
Nominal (rated) torque M_{nom}	N·m	100	200	500					
	kN·m				1	2	3	5	10
for reference only	kft-lb	75	150	375	750	1,500	2,250	3,750	7,500
Nominal (rated) sensitivity (range between torque = zero and M_{nom})									
Frequency output 10 kHz/60 kHz	kHz	5/30							
Voltage output	V	10							
Sensitivity tolerance (deviation of the actual output quantity at M_{nom} from the nominal (rated) sensitivity)									
Fieldbusses	%	±0.05							
Frequency output	%	±0.05							
Voltage output	%	±0.1							
Output signal at torque = zero									
Frequency output 10 kHz/60 kHz	kHz	10/60							
Voltage output	V	0							
Nominal (rated) output signal									
Frequency output									
with positive nominal (rated) torque 10 kHz/60 kHz	kHz	15/90 (5 V symmetric[1])							
with negative nominal (rated) torque 10 kHz/60 kHz	kHz	5/30 (5 V symmetric[1])							
Voltage output with									
positive nominal (rated) torque	V	+10							
negative nominal (rated) torque	V	−10							
Low-pass filter LP1	Hz	0.05 ... 4,000 (4th order Bessel, −1 dB)[2]							
Low-pass filter LP2	Hz	0.05 ... 100 (4th order Bessel, −1 dB)[2]							
Load resistance									
Frequency output	kΩ	≥ 2							
Voltage output	kΩ	≥ 10							
Long-term drift over 48 h									
Voltage output	mV	±3							
Measurement frequency range									
Frequency output/Voltage output	Hz	0 ... 4,000 (−1 dB)							
	Hz	0 ... 6,000 (−3 dB)							
Group delay time (Low pass LP1: 4 kHz)									
Frequency output 10 kHz/60 kHz	μs	320/250							
Voltage output	μs	500							
Scale range									
Frequency output/Voltage output	%	10 ... 1,000 (of M_{nom})							
Resolution									
Frequency output 10 kHz/60 kHz	Hz	0.03/0.25							
Voltage output	mV	0.33							
Residual ripple									
Voltage output	mV	3							

1) RS-422 complementary signals, observe terminating resistance.
2) Factory settings TP1=1,000 Hz; TP2=1 Hz.

Nominal (rated) torque M_{nom}	N·m	100	200	500					
	kN·m				1	2	3	5	10
for reference only	kft-lb	75	150	375	750	1,500	2,250	3,750	7,500
Temperature influence per 10 K in the nominal (rated) temp. range									
on the output signal, related to the actual value of signal span									
Fieldbusses	%	± 0.03							
Frequency output	%	± 0.03							
Voltage output	%	± 0.1							
on the zero signal, related to the nominal (rated) sensitivity									
Fieldbusses	%	± 0.02 (± 0.01 optional)							
Frequency output	%	± 0.02 (± 0.01 optional)							
Voltage output	%	± 0.1							
Maximum modulation range[3]									
Frequency output 10 kHz/60 kHz	kHz	4 ... 16/24 ... 96							
Voltage output	V	−10.2 ... +10.2							
Power supply									
Nominal (rated) supply voltage (separated extra low voltage)	V (DC)	18 ... 30							
Current consumption in meas. mode	A	< 1 (typ. 0.5)							
Current consumption in start-up mode	A	< 4							
Nominal (rated) power consumption	W	< 18							
Maximum cable length	m	50							
Linearity deviation including hysteresis, related to the nominal (rated) sensitivity									
Fieldbusses	%	± 0.02 (± 0.01 optional)							
Frequency output 10 kHz/60 kHz	%	± 0.02 (± 0.01 optional)							
Voltage output	%	± 0.05							
Rel. standard deviation of the repeatability, per DIN1319, related to variation of the output signal									
Fieldbusses/frequency output	%	± 0.01							
voltage output	%	± 0.03							
Shunt signal		50 % of M_{nom} or 10 % of M_{nom}							
Tolerance of shunt signal related to M_{nom}	%	± 0.05							
Nominal trigger voltage	V	5							
Limit trigger voltage	V	36							
Shunt signal on	V	min. >2.5							
Shunt signal off	V	max. <0.7							
Max. switch−on period	min	user-defined							
Update rate CAN bus	kHz	4.8 (and binary division ratios (2−64))							

[3] Output signal range with a repeatable relationship between torque and output signal.

Low pass filter LP1, LP2, LP					
Low-pass filter frequency output					
4th order	Nominal (rated) value f_c (Hz)	f_g (−1 dB) (Hz)	f_g (−3 dB) (Hz)	Group delay time 10 kHz ± 5 kHz (ms)	Group delay time 60 kHz ± 30 kHz (ms)
	4,000	4,000	6,000	0.32	0.25
	2,000	2,015	3,418	0.4	0.33
	1,000	1,029	1,866	0.48	0.41
	500	505	852	0.74	0.67
	200	202	340	1.52	1.45
	100	101	177	2.27	2.2
	50	50	88	4.22	4.15
	20	25	44	8.12	8.05
	10	12.5	22	15.9	15.9
	5	6.25	11	31.5	31.5
	2	3.1	5.5	62.3	62.3
	1	1.6	2.75	124	124
	0.5	0.8	1.38	248	248
	0.2	0.2	0.34	992	992
	0.1	0.1	0.17	1,980	1,980
	0.05	0.05	0.08	3,960	3,960
Low-pass filter voltage output					
4th order	Nominal (rated) value f_c (Hz)	f_g (−1 dB) (Hz)	f_g (−3 dB) (Hz)	Group delay time (ms)	
	4,000	4,000	6,000	0.25	
	2,000	2,015	3,418	0.3	
	1,000	1,029	1,866	0.41	
	500	505	852	0.67	
	200	202	340	1.45	
	100	101	177	2.2	
	50	50	88	4.15	
	20	25	44	8.05	
	10	12.5	22	15.9	
	5	6.25	11	31.5	
	2	3.1	5.5	62.3	
	1	1.6	2.75	124	
	0.5	0.8	1.38	248	
	0.2	0.2	0.34	992	
	0.1	0.1	0.17	1,980	
	0.05	0.05	0.08	3,960	

Nominal (rated) torque M_{nom}	N·m	100	200	500					
	kN·m				1	2	3	5	10
for reference only	kft-lb	75	150	375	750	1,500	2,250	3,750	7,500
Speed measuring system/measuring system for angle of rotation									
		Optical, by means of infrared light and metallic slotted disc							
Mechanical increments	Number	360						720	
Positional tolerance of the increments	mm	± 0.05							
Tolerance of the slot width	mm	± 0.05							
Pulses per rotation (adjustable)	Number	360; 180; 90; 60; 45; 30						720; 360; 180; 120; 90; 60	
Pulse frequency at nominal (rated) speed n_{nom}									
Option 3, Code L[4]	kHz	90		72				120	
Option 3, Code H[4]	kHz	108		96				168	
Minimum speed for sufficient pulse stability	rpm	2							
Group delay time	µs	< 5 (typ. 2.2)							
Hysteresis of reversing the direction of rotation with relative vibrations between rotor and stator									
Torsional vibrations of the rotor	Degree	< approx. 2							
Radial vibration amplitudes of the stator	mm	< approx. 2							
Permitted degree of soiling, in the optical path of the sensor fork (lenses, slotted disc)	%	< 50							
Swirl influence on the zero point, through mounted increment disc, related to nominal (rated) torque									
Option 3, Code L[4]	%	<0.05	<0.03	<0.03	<0.02			<0.01	
Option 3, Code H[4]	%	<0.08	<0.04	<0.03	<0.02			<0.01	
Output signal frequency/pulse output	V	5[5] symmetric; 2 square wave signals approx. 90° phase shifted							
Load resistance	kΩ	≥ 2							

[4] See page 76

[5] RS-422 complementary signals, observe terminating resistances.

Nominal (rated) torque M_{nom}	N·m	100	200	500					
	kN·m				1	2	3	5	10
for reference only	kft-lb	75	150	375	750	1,500	2,250	3,750	7,500
Rotational speed									
Fieldbusses									
Resolution	rpm	0.1							
System accuracy (at torsional vibrations of max. 3 % with double speed frequency)	ppm	150							
Max. speed deviation at nominal (rated) speed (100 Hz-filter)	rpm	1.5							
Voltage output									
Measuring range	V	± 10							
Resolution	mV	0.33							
Scale range	%	10 ... 1,000							
Overmodulation limits	V	± 10.2							
Load resistance	kΩ	> 10							
Linearity error	%	< 0.03							
Temperature effect per 10 K in the nominal (rated) temperature range									
on the output signal, related to the actual value of signal span	%	< 0.03							
on the zero signal	%	< 0.03							
Residual ripple	mV	< 3							
Low-pass filter (4th order)									
Cut-off frequencies (–1 dB) LP1	Hz	1,000; 500; 200; 100; 50; 20; 10; 5; 2; 1; 0.5; 0.2; 0.1; 0.05							
Cut-off frequencies (–1 dB) LP2	Hz	100; 50; 20; 10; 5; 2; 1; 0.5; 0.2; 0.1; 0.05							
Update rate CAN bus	kHz	4.8 (and binary division ratios (2–64))							

Nominal (rated) torque M_{nom}	N·m	100	200	500					
	kN·m				1	2	3	5	10
for reference only	kft-lb	75	150	375	750	1,500	2,250	3,750	7,500
Angle of rotation									
Accuracy	Degree	1 (typ. 0.1)							
Resolution	Degree	0.01							
Correction of the phase delay deviation between torque LP1 and angle of rotation for filter frequencies	Hz	4,000; 2,000; 1,000; 500; 200; 100							
Measuring range	Degree	0 ... 360 (singleturn) up to ±1,440 (multiturn)							
Power									
Measurement frequency range	Hz	80 (–1 dB)							
Resolution	W	1							
Full scale value	W	$P_{max} = M_{nom} \cdot n_{nom} \cdot \frac{\pi}{30}$ [M_{nom}] in N·m [n_{nom}] in rpm							
Temperature effect per 10 K in the nominal (rated) temperature range on the power signal, related to the full scale value	%	$\pm 0.05 \cdot n/n_{nom}$							
Linearity deviation including hysteresis, related to the full scale value	%	$\pm 0.02 \cdot n/n_{nom}$							
Sensitivity tolerance (deviation of the actual signal span of the power signal related to the full scale value)	%	±0.05							
Low-pass filter (1st order) Cut–off frequencies	Hz	100; 10; 1; 0.1							
Measuring range CAN bus	Meas. values /s	600							

Temperature signal rotor									
Nominal (rated) torque M_{nom}	N·m	100	200	500					
	kN·m				1	2	3	5	10
for reference only	kft-lb	75	150	375	750	1,500	2,250	3,750	7,500
Accuracy	K	1							
Measurement frequency range	Hz	5 (−1 dB)							
Resolution	K	0.1							
Physical unit	−	°C							
Sampling rate	Measured values /s	40							
Fieldbusses									
CAN bus									
Protocol	−	CAN 2.OB, CAL/CANopen compatible							
Sampling rate	Measured values /s	max. 4,800 (PDO)							
Hardware bus link		per ISO 11898							
Baud rate	kBit/s	1000 500 250 125 100							
Maximum line length	m	25 100 250 500 600							
Connection	−	5-pole, M12x1, A-coding per CANopen DR-303-1 V1.3, potential separ. from supply and meas. mass							
Profibus DP									
Protocol	−	Profibus DP Slave, per DIN 19245-3							
Baudrate	MBaud	max. 12							
Profibus ident no.	−	096C (hex)							
Input data, max.	Byte	152							
Output data, max.	Byte	40							
Diagnosis data	Byte	18 (2 · 4 byte module diagnosis)							
Connection	−	5-pole, M12x1, B-coding, potential separated from supply and measuring mass							
Update rate PROFIBUS[6]									
Configuration entries									
≤ 2	Measured values /s	4,800							
≤ 4		2,400							
≤ 8		1,200							
≤ 12		600							
≤ 16		300							
> 16		150							
Limit value switch (on fieldbusses only)									
Number	−	4 for torque, 4 for rotational speed							
Reference level	−	Torque LP1 or LP2 Rotational speed LP1 or LP2							
Hysteresis	%	0 ... 100							
Setting accuracy	Digit	1							
Response time (LP1= 4,000 Hz)	ms	typ. 3							
TEDS (Transducer Electronic Data Sheet)									
Number	−	2							
TEDS 1 (torque)	−	Optional voltage sensor or frequency sensor							
TEDS 2 (rotational speed/angle of rot.)	−	Frequency-/pulse sensor							

[6] With simultaneously activated CAN-PDOs, the profibus update rate is reduced. With PDO output rate divider: ≤4 by factor 2; .≤2 by factor 4; 1 by factor 8.

General data									
Nominal (rated) torque M_{nom}	N·m	100	200	500					
	kN·m				1	2	3	5	10
for reference only	kft-lb	75	150	375	750	1,500	2,250	3,750	7,500
EMC									
EME (Emission per EN61326-1, table 3)									
RFI voltage	–	Class A							
RFI performance	–	Class A							
RFI field strength	–	Class A							
Immunity from interference (EN61326-1, table A.1)									
Electromagnetic field (AM)	V/m	10							
Magnetic field	A/m	30							
ESD									
Contact discharge	kV	4							
Air discharge	kV	8							
Burst	kV	1							
Surge	kV	1							
Line-conducted disturbance (AM)	V	3							
Degree of protection per EN 60529	–	IP 54							
Weight, approx. Rotor	kg	1.1	1.8	2.4		4.9		8.3	14.6
Stator	kg	2.3				2.4		2.5	2.6
Reference temperature	°C [°F]	+23 [73.4]							
Nominal (rated) temperature range	°C [°F]	+10 ... +60 [+50 ... +140]							
Service temperature range	°C [°F]	−10 ... +60 [+14 ... +140]							
Storage temperature range	°C [°F]	−20 ... +70 [−4 ... +158]							
Impact resistance, test severity level per DIN IEC 68; part 2-27; IEC 68-2-27-1987									
Number of impacts	n	1,000							
Duration	ms	3							
Acceleration (half-sine)	m/s^2	650							
Vibration resistance, test severity level per DIN IEC 68; part 2-6; IEC 68-2-6-1982									
Frequency range	Hz	5 ... 65							
Duration	h	1.5							
Acceleration (amplitude)	m/s^2	50							
Nominal (rated) speed n_{nom}									
Option 3, Code L[7)]	rpm	15,000		12,000				10,000	
Option 3, Code H[7)]	rpm	18,000		16,000				14,000	12,000

7) See page 76

Nominal (rated) torque M_{nom}	N·m	100	200	500					
	kN·m				1	2	3	5	10
for reference only	kft-lb	75	150	375	750	1,500	2,250	3,750	7,500
Load limits[8]									
Limit torque, (static) ± related to M_{nom}	%	200					160		
Breaking torque, (static) ± related to M_{nom}	%	> 400					> 320		
Axial limit force (static) ±	kN	5	10	16	19	39	42	80	120
Axial limit force (dynamic) amplitude	kN	2.5	5	8	9.5	19.5	21	40	60
Lateral limit force (static) ±	kN	1	2	4	5	9	10	12	18
Lateral limit force (dynamic) amplitude	kN	0.5	1	2	2.5	4.5	5	6	9
Bending limit moment (static) ±	N·m	50	100	200	220	560	600	800	1200
Bending limit moment (dynamic) amplitude	N·m	25	50	100	110	280	300	400	600
Oscillation bandwidth per DIN 50100 (peak-to-peak)[9]	N·m	200	400	1,000	2,000	4,000	4,800	8,000	16,000

8) Each type of irregular stress can only be permitted with its given limit values (bending moment, lateral or axial load, exceeding the nominal (rated) torque) if none of the others can occur. Otherwise the limit values must be reduced. If for instance 30 % of the bending limit moment and also 30 % of the lateral limit force are present, only 40 % of the axial limit force are permitted, provided that the nominal (rated) torque is not exceeded. With the permitted bending moments, axial, and lateral limit forces, measuring errors of about 0.3 % of the nominal (rated) torque can occur.

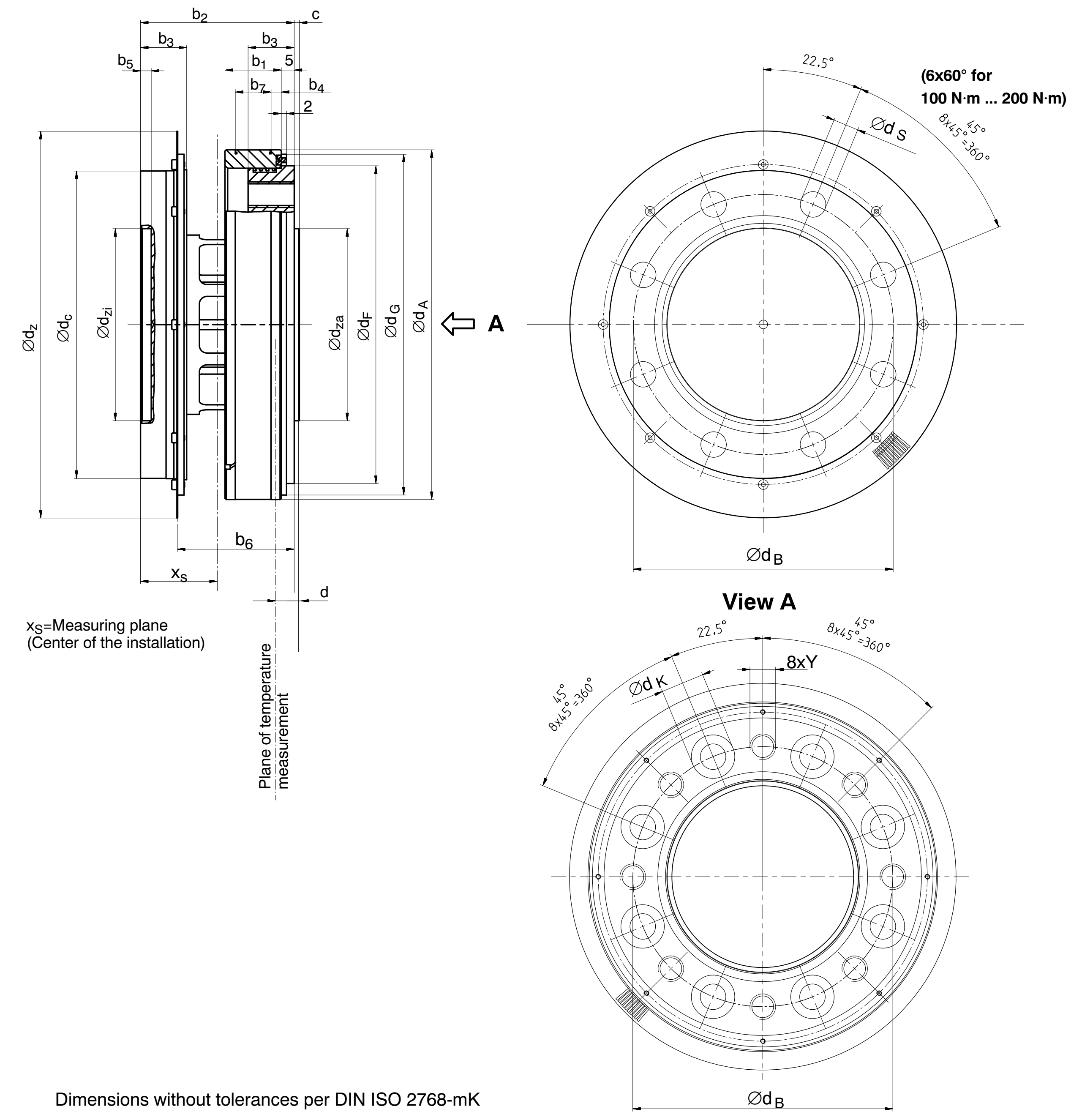
9) The nominal (related) torque must not be exceeded.

Nominal (rated) torque M_{nom}	N·m	100	200	500					
	kN·m				1	2	3	5	10
for reference only	kft-lb	75	150	375	750	1,500	2,250	3,750	7,500
Mechanical data									
Torsional stiffness c_T	kN·m/ rad	230	270	540	900	2,300	2,600	4,600	7,900
Torsion angle at M_{nom}	Degree	0.048	0.043	0.055	0.066	0.049	0.066	0.06	0.07
Axial stiffness c_a	kN/mm	420	800	740	760	950	1000	950	1,600
Radial stiffness c_r	kN/mm	130	290	550	810	1,300	1,500	1,650	2,450
Stiffness with bending moment about a radial axis c_b	kN·m/ degree	3.8	7	11.5	12	21.7	22.4	43	74
Maximum excursion at axial limit force	mm	< 0.02		< 0.03		< 0.05		< 0.1	
Additional max. radial run-out deviation at lateral limit force	mm	<0.02							
Additional plane-parallel deviation at bending limit moment (with ∅ d_B)	mm	<0.03		<0.05		<0.07			
Balance quality-level per DIN ISO 1940		G 2.5							
Max. limits for relative shaft vibration (peak-to-peak)[10)] Undulations within the range of the connecting flanges per ISO 7919-3	µm	Normal mode (continuous operation) $s_{(p-p)} = \frac{9000}{\sqrt{n}}$ Start-Stop mode/resonance ranges (temporary) $s_{(p-p)} = \frac{13200}{\sqrt{n}}$ (n in rpm)							
Mass moment of inertia of the rotor									
I_V (around rotating axis)	kg·m²	0.0023	0.0033	0.0059		0.0192		0.037	0.097
I_V with optical speed measuring system	kg·m²	0.0025	0.0035	0.0062		0.0196		0.038	0.0995
Proportionate mass moment of inertia for assembly side									
without speed measuring system	%	58		56		54		53	
with optical speed measuring system	%	56		54		53		52	
Max. permissible static eccentricity of the rotor (radially) to stator center									
without speed measuring system	mm	± 2							
with speed measuring system	mm	± 1							
Max. permissible axial dis-placement of the rotor to stator	mm	± 2							

10) The effects of radial deviation, eccentricity, defect of form, notches, marks, local residual magnetism, structural inhomogeneity or material anomalies on vibration measurements need to be taken into account and distinguished from the actual undulation.

14 Dimensions

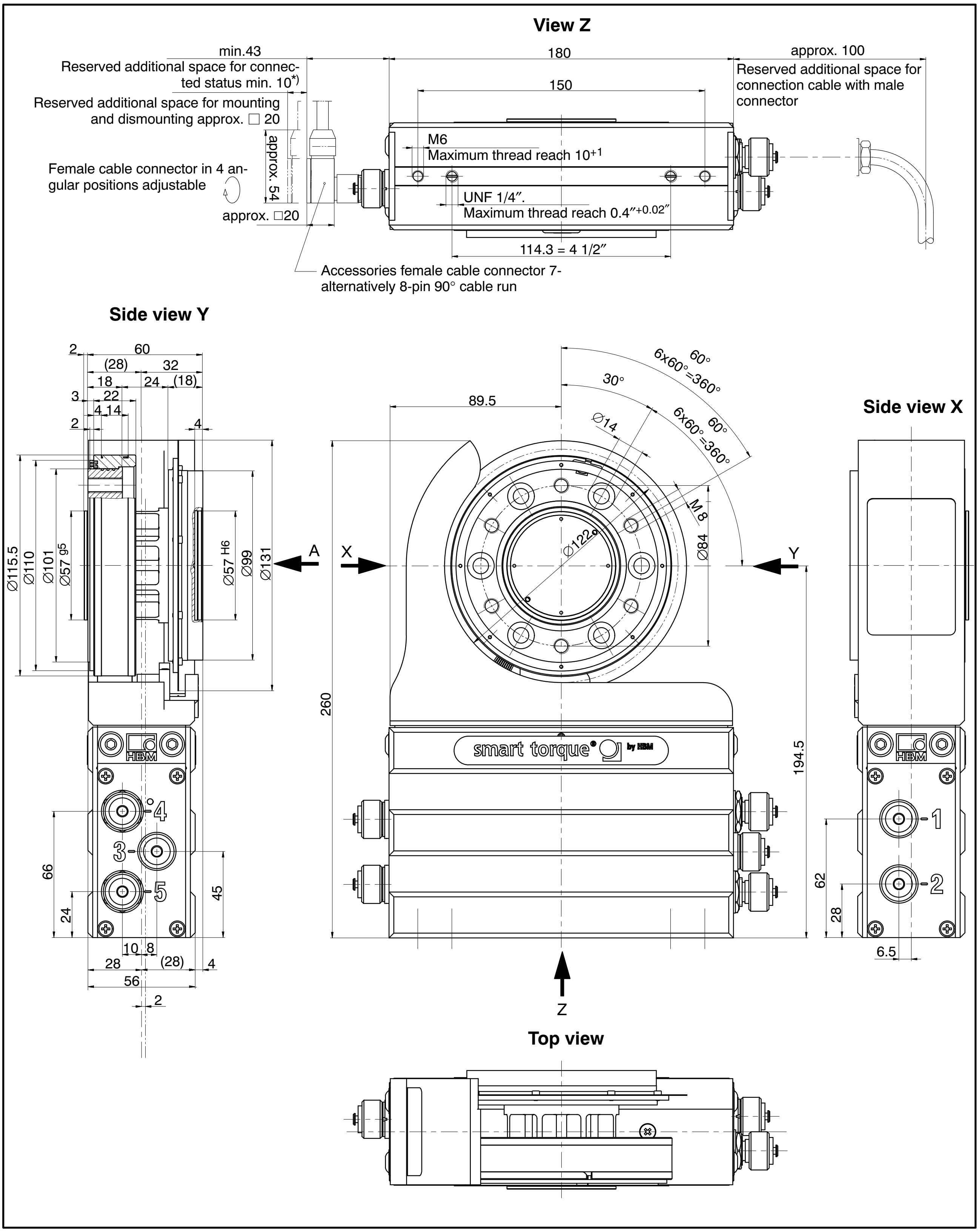
14.1 Rotor dimensions



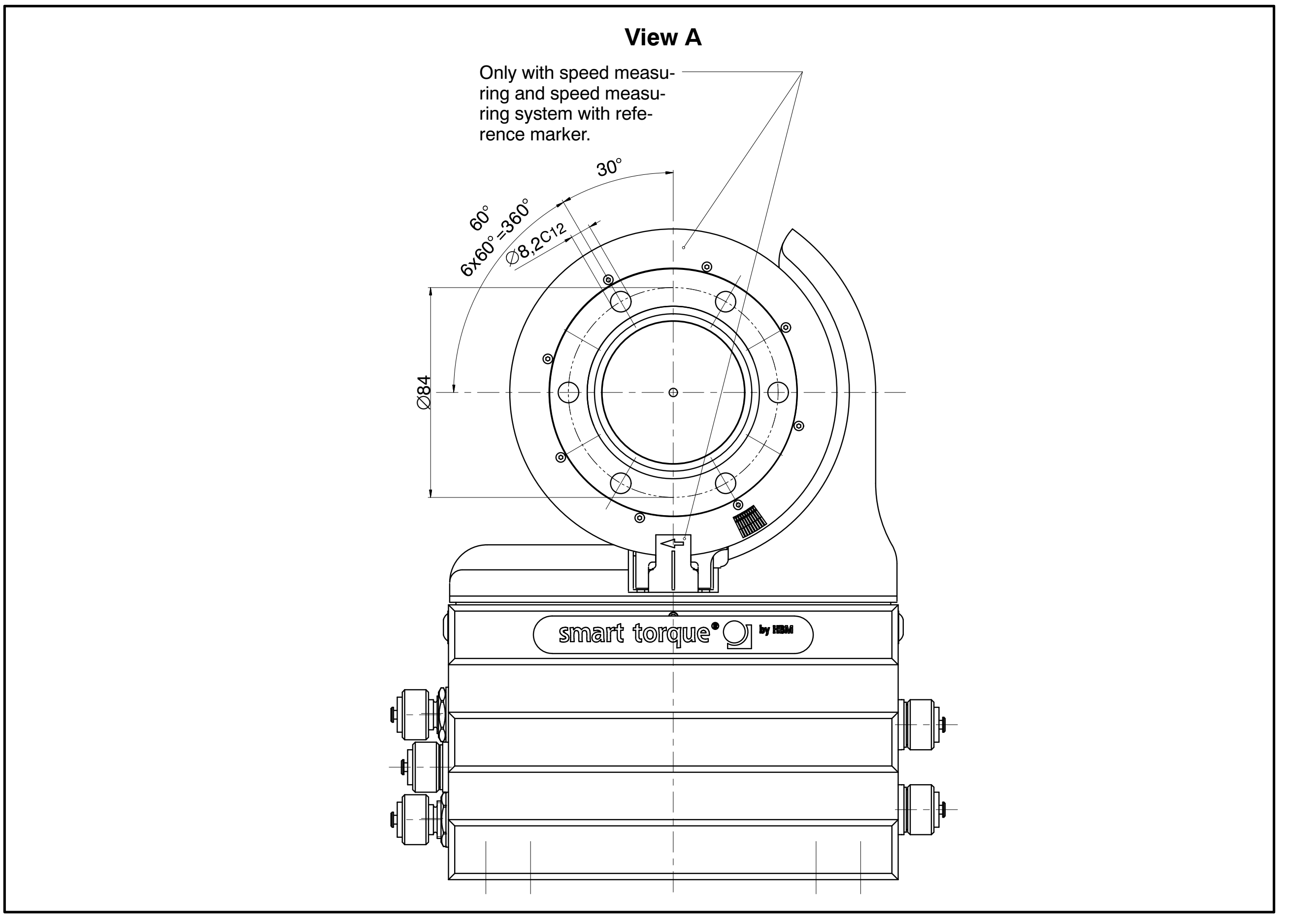
Measuring range	Dimensions in mm									
	b_1	b_2	b_3	b_4	b_5	b_6	b_7	c	d	x_S	Y
100 N·m/200 N·m	22	60	18	4	4	47.15	14	2	12.5	30	M8
500 N·m/1 kN·m	22	60	18	4	4	45.7	14	2	8	30	M10
2 kN·m/3 kN·m	23	64	20	5	4	47.7	14	2.5	8	32	M12
5 kN·m	24.8	84	26	3.3	3	62.7	17.5	2.8	8	42	M14
10 kN·m	24.8	92	30	3.3	4	66.7	17.5	3.5	10	46	M16

Measuring range	Dimensions in mm									
	Ød_A	Ød_B	Ød_C	Ød_F	Ød_G	Ød_K	Ød_S ^{C12}	Ød_Z	Ø$d_{za\ g5}$	Ød_{zi} ^{H6}
100 N·m/200 N·m	115.5	84	99	101	110	14	8.2	131	57	57
500 N·m/1 kN·m	136.5	101.5	120	124	133	17	10	151	75	75
2 kN·m/3 kN·m	172.5	130	155	160	169	19	12	187	90	90
5 N·m	200.5	155.5	179	188	197	22	14.2	221	110	110
10 kN·m	242.5	196	221	230	239	26	17	269	140	140

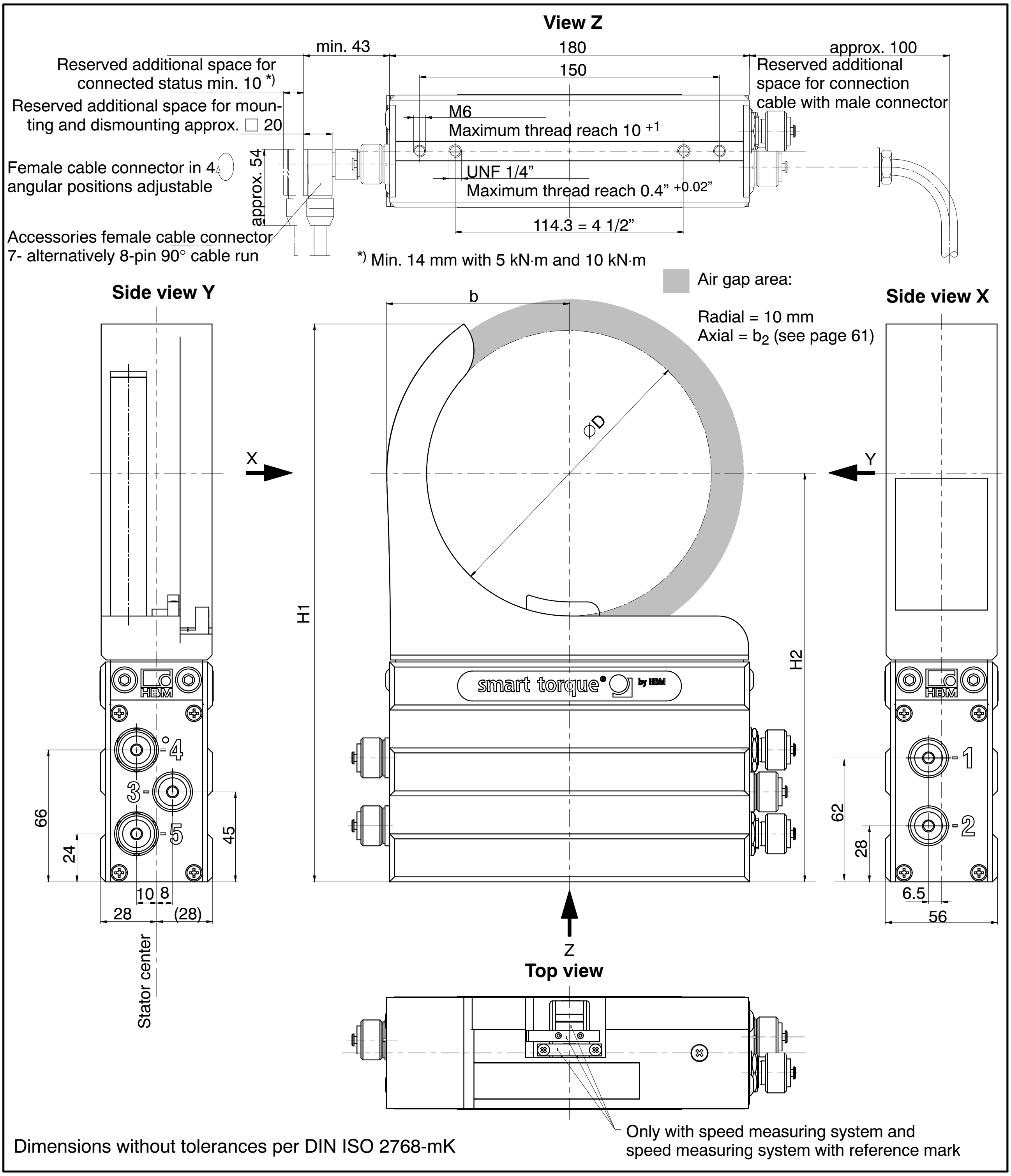
14.2 Stator dimensions 100 N·m ... 200 N·m with speed measuring system (in mm)



14.3 Stator dimensions 100 N·m ... 200 N·m with speed measuring system (in mm)

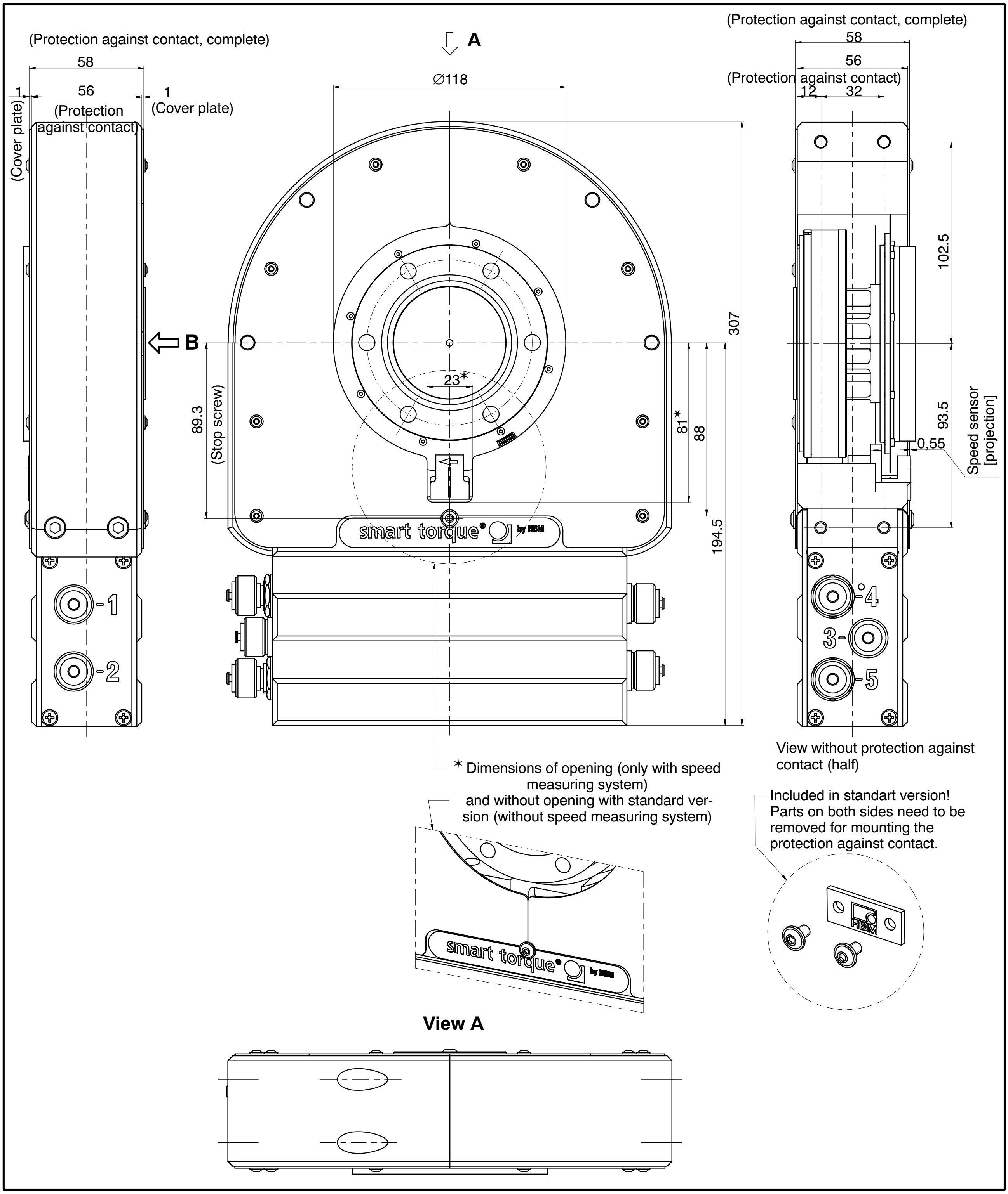


14.4 Stator dimensions 100 N·m ... 10 kN·m with speed measuring system (in mm)

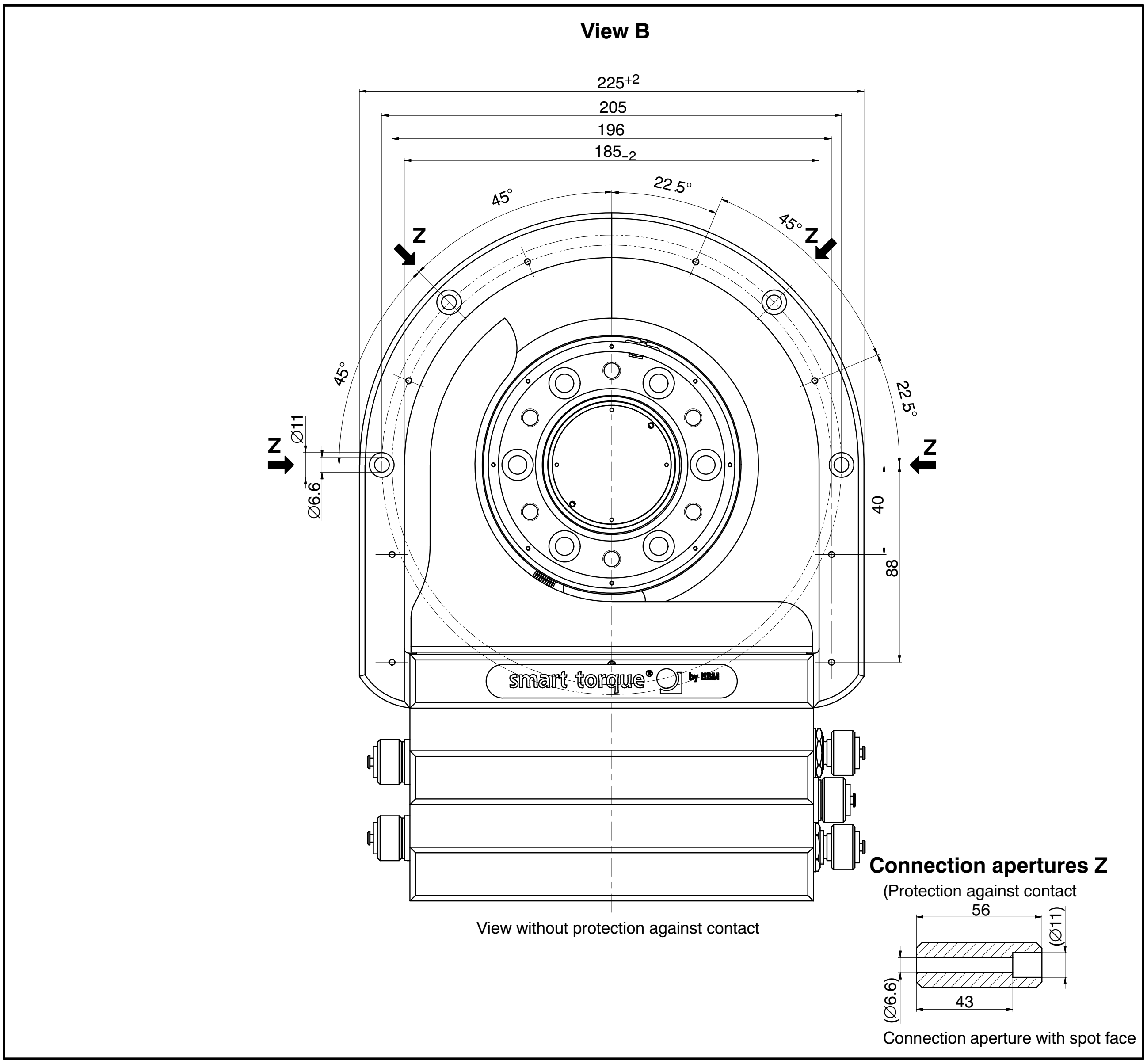


Measuring range (N·m)	Dimensions in mm			
	b	ØD	H1	H2
100, 200	81	122	260	194.5
500, 1 k	91.5	143	280	204.5
2 k, 3 k	109.5	179	310	222.5
5 k	123.5	207	333	239.5
10 k	144.5	249	369	263.5

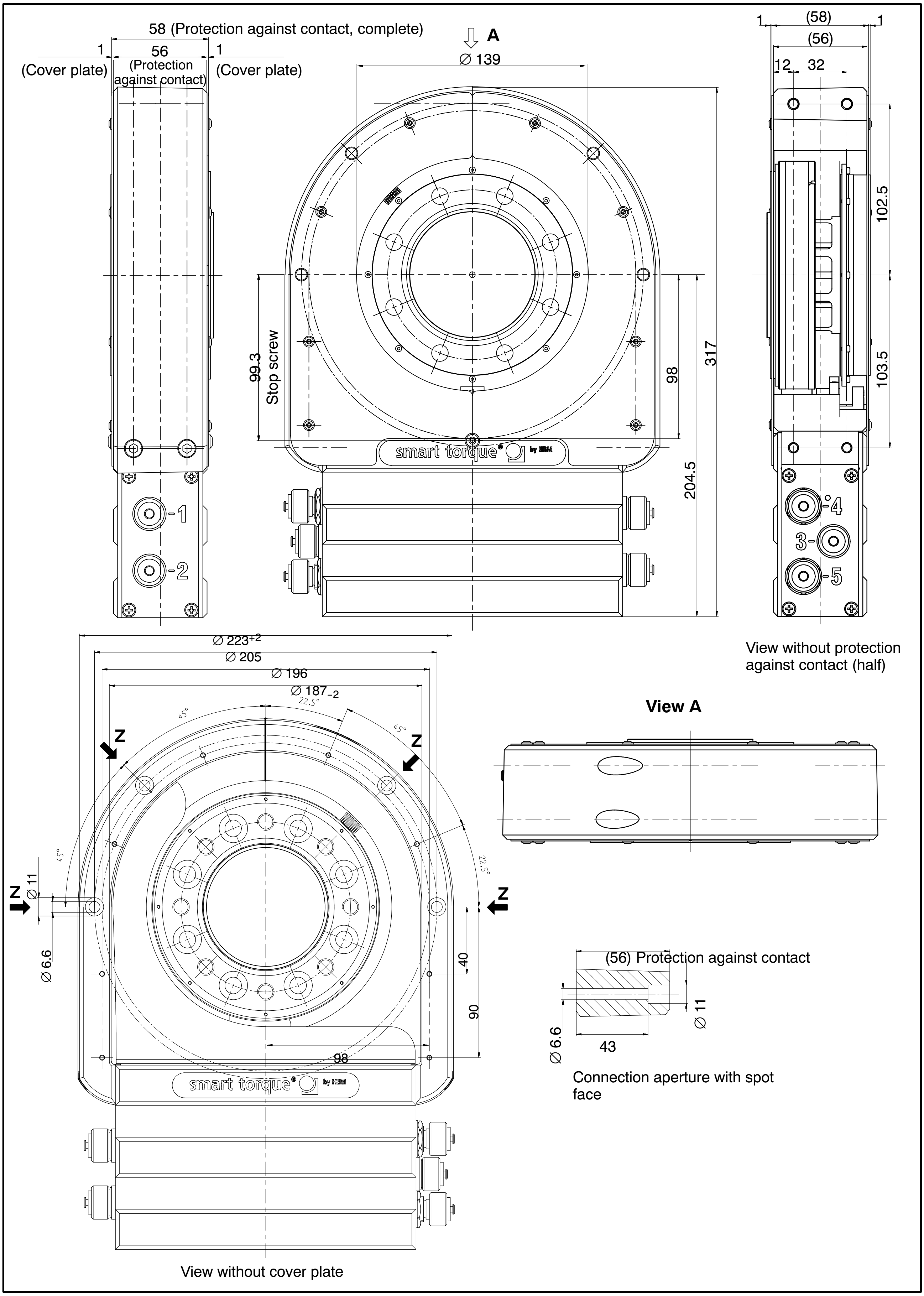
14.5 Stator dimensions 100 N·m ... 200 N·m with protection against contact (in mm)



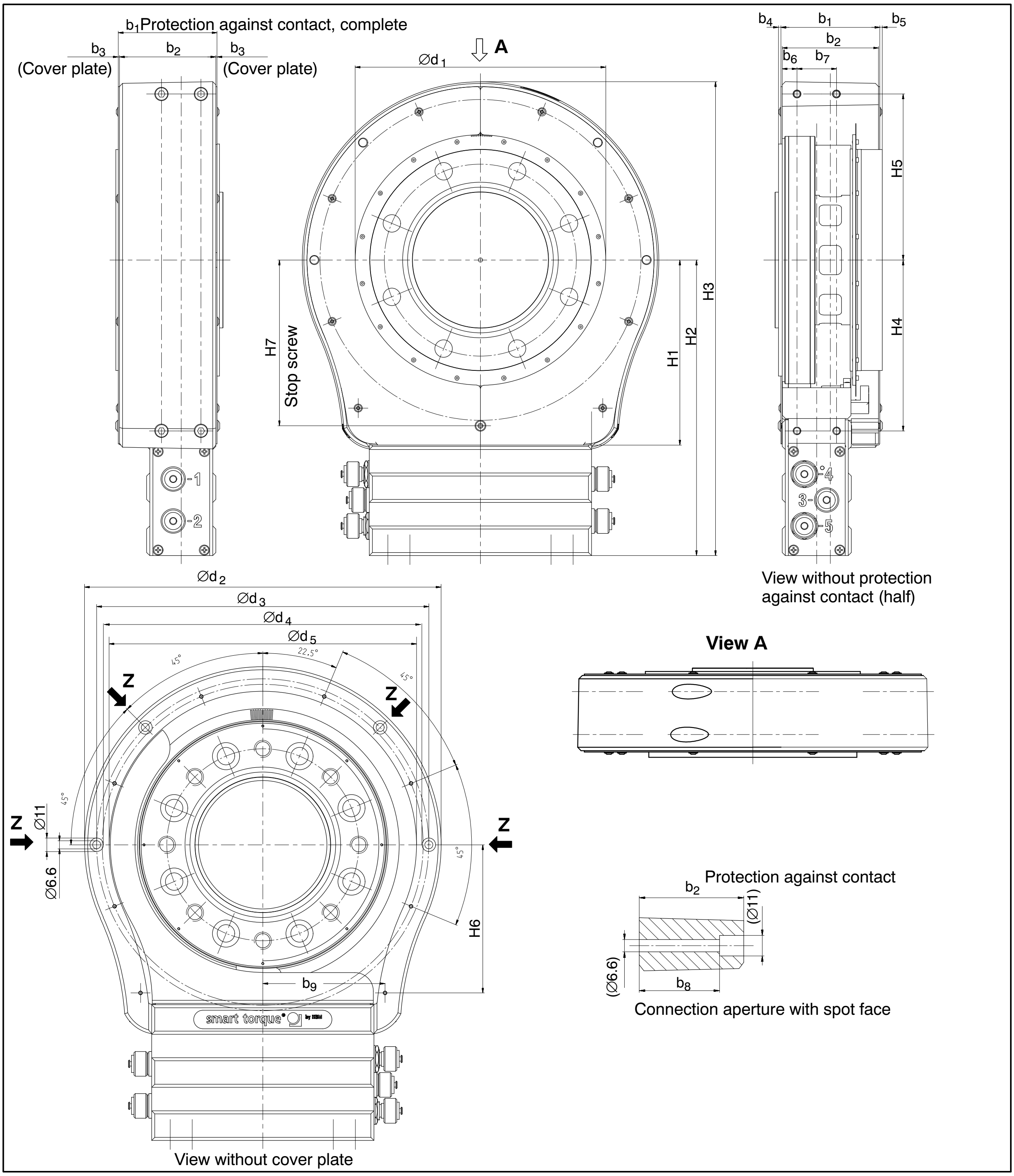
14.6 Stator dimensions 100 N·m ... 200 N·m with protection against contact (in mm)



14.7 Stator dimensions 500 N·m ... 1 kN·m with protection against contact (in mm)



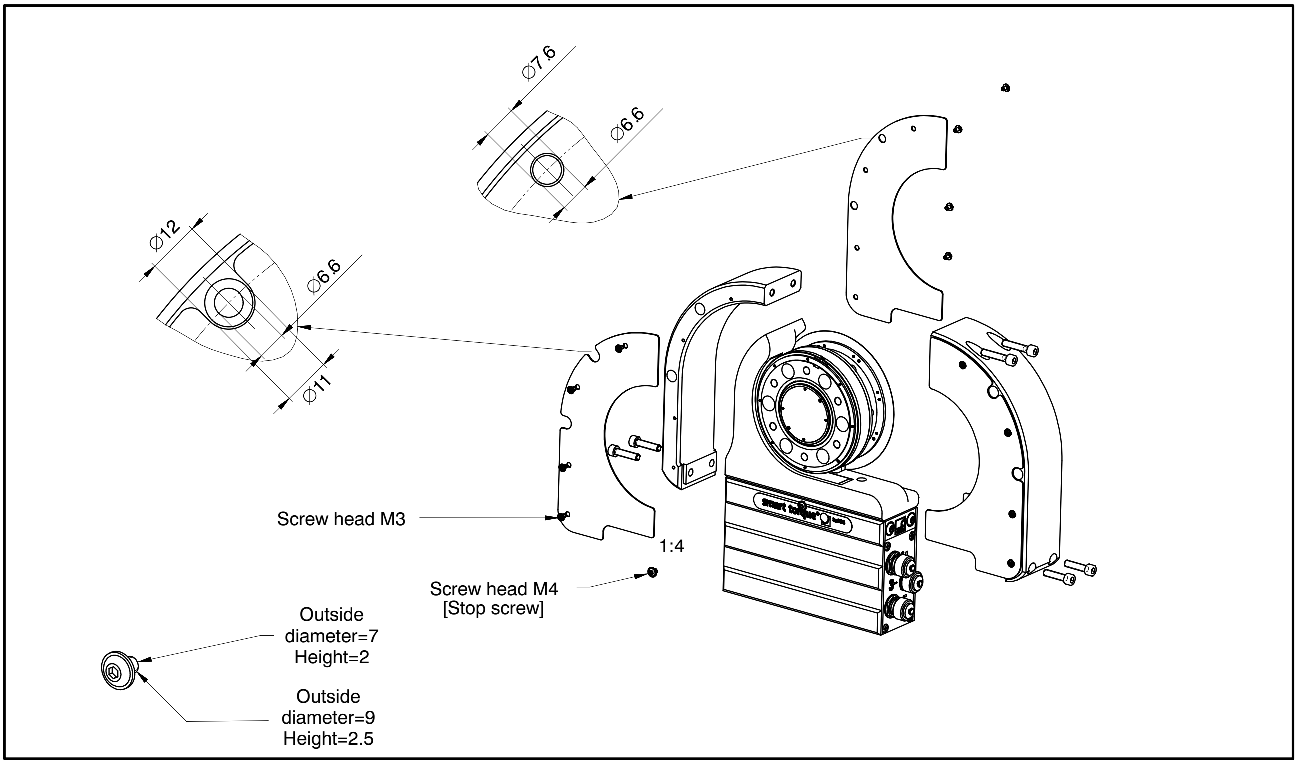
14.8 Stator dimensions 2 kN·m ... 10 kN·m with protection against contact (in mm)



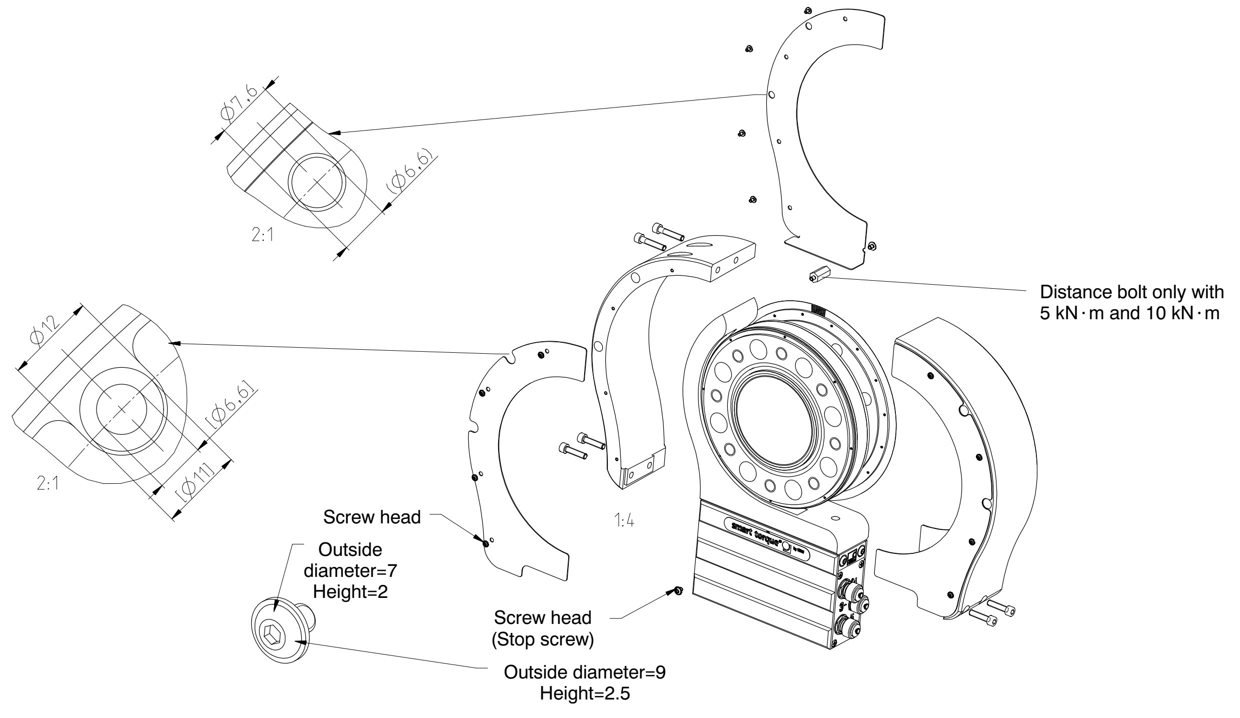
Measuring range	Dimensions in mm														
	b_1	b_2	b_3	b_4	b_5	b_6	b_7	b_8	b_9	H_1	H_2	H_3	H_4	H_6	H_5	H_7
2 kN·m/3 kN·m	58	56	1	2	4	12	32	43	97.5	116	222.5	353	121.5	107	120.5	117.3
5 kN·m	80	78	1	2	2	12	32	65	99	133	239.5	384	138.5	120	134.5	134.3
10 kN·m	88	86	1	2	2	12	32	73	99	157	263.5	429	162.5	145	155.5	158.3

Measuring range	Dimensions in mm				
	$Ød_1$	$Ød_2$	$Ød_3$	$Ød_4$	$Ød_5$
2 kN·m/3 kN·m	175	259^{+2}	241	232	223_{-2}
5 kN·m	203	289^{+2}	269	260	249_{-2}
10 kN·m	245	331^{+2}	311	302	291_{-2}

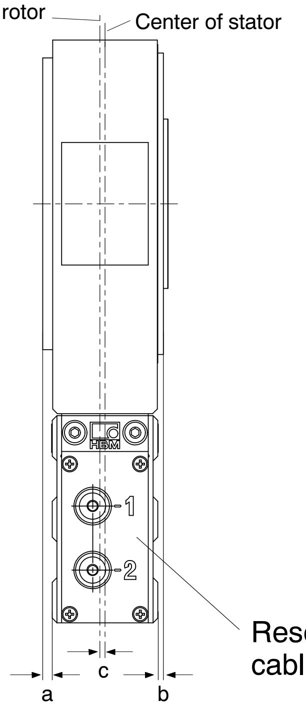
14.8.1 Dimensions cover plates 100 N·m ... 200 kN·m



14.8.2 Dimensions cover plates 500 N·m ... 10 kN·m



14.9 Mounting dimensions



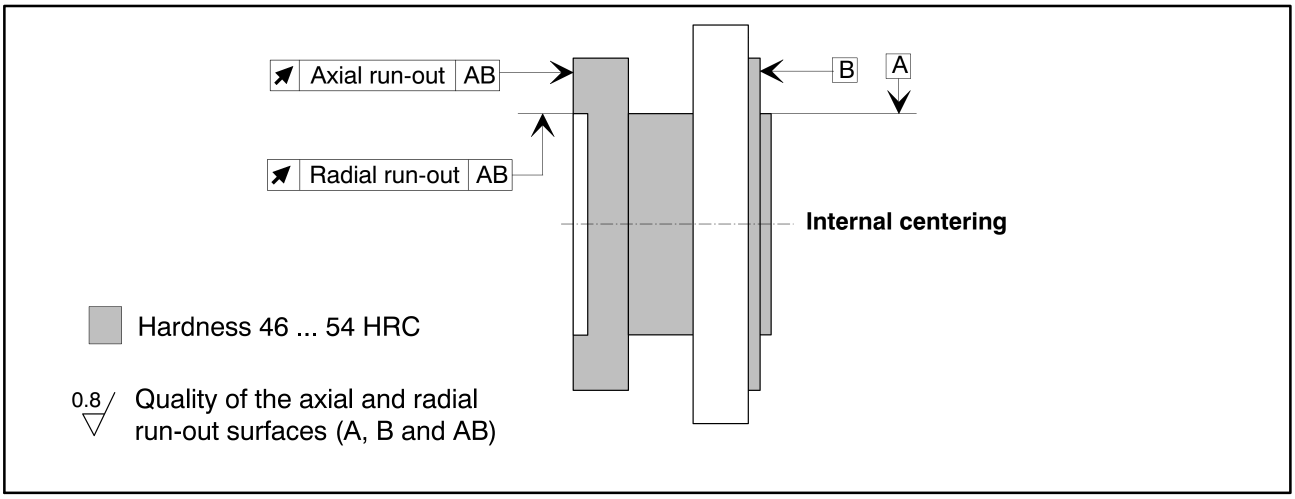
Mounting dimensions			
Measuring range	Mounting dimension (mm)		
	a	b	c
100 N·m 200 N·m	4	0	2
500 N·m 1 kN·m	2	2	0
2 kN·m 3 kN·m	5	3	1
5 kN·m	25	3	11
10 kN·m	33	3	15

(Tolerance ± 1 mm)

Reserved additional space for fieldbus connection cable, approx. 140 mm from plug connection surface

15 Additional technical information

15.1 Radial and axial run-out tolerances



Measuring range (N·m)	Axial run-out tolerance (mm)	Radial run-out tolerance (mm)
100	0.01	0.01
200	0.01	0.01
500	0.01	0.01
1 k	0.01	0.01
2 k	0.02	0.02
3 k	0.02	0.02
5 k	0.025	0.025
10 k	0.025	0.025

16 Delivery status

The parameter factory settings of are marked with an asterisk (*). Underlined parameters will not be overwritten by reset to factory settings.

SYSTEM	
General settings	
Project name	My Project
Language	Deutsch; English
Specify passcode (1 – 9999)	0
Passcode activ?	Yes*****; No
Reactivate passcode	Reactivate passcode
LED display mode	Standard (measuring mode) Mounting mode rotor distance Mounting mode optical speed system
Fieldbus interface	
CANopen	
CAN adress	110
CAN baud rate	100 kB; 125 kB; 250 kB; 500 kB; <u>1000 kB</u>*****
LSS manufacturer number	285
LSS product number	1025
LSS revision number	4294967040
LSS serial number	4294967040
PDO output rate divider	1; 2*****; 4; 8; 16; 32; 64
Signal PDO 1 (transmit, max. 4.8 kHz)	Off Torque low-pass 1***** Torque + speed low-pass 1 Torque low-pass 1 + angle of rotation
Signal PDO 2 (transmit, max. 1.2 kHz)	Off Torque low-pass 2***** Torque + speed low-pass 2
Signal PDO 3 (transmit, max. 0.6 kHz)	Off***** Power + rotortemperature
Signal PDO 4 (transmit, max. 0.6 kHz)	Off***** Status torque, speed/ angle
Write calibration information	
Calibration date torque (dd.mm.yyyy)	30.11.06
Calibration initials torque	RH
Calibration period torque	0
Measuring point number	0
Calibration date speed/ angle output (dd.mm.yyyy)	30.11.06
Calibration initials speed/ angle output (dd.mm.yyyy)	KM
Calibration period speed/ angle output	0
Measuring point number	0
Calibration date voltage (dd.mm.yyyy)	30.11.06
Calibration initials voltage	HM

Calibration period voltage	0
Measuring point number	0
Passcode entry	
Enter passcode (1 – 9999)	0
PARAMETERIZE TRANSDUCER	
Torque	
Measuring point name	MyTorqueMeasPnt
Measuring point number	0
Unit	Nm*; kNm; ozfin; ozfft; lbfin; lbfft
Decimal point	.; .0; .00; .000*; .0000; .00000
Sign	Positive*; Negative
Low-pass filter 1 (nominal value)	0.05 Hz; 0.1 Hz; 0.2 Hz; 0.5 Hz; 1 Hz; 2 Hz; 5 Hz; 10 Hz; 20 Hz; 50 Hz; 100 Hz; 200 Hz; 500 Hz; 1 kHz*; 2 kHz; 4 kHz
Low-pass filter 2 (nominal value)	0.05 Hz; 0.1 Hz; 0.2 Hz; 0.5 Hz; 1 Hz*; 2 Hz; 5 Hz; 10 Hz; 20 Hz; 50 Hz; 100 Hz
Measure 1st point	Measure 1st point
1st point physical actual value	0.000*
1st point physical setpoint value	0.000*
Measure 2nd point	Measure 2nd point
2nd point physical actual value	100.000*
2nd point physical setpoint value	100.000*
Two point scaling	Active; Disabled*
Rotational speed	
Unit	1/min*; rpm; 1/s; rad/s
Decimal point	.; .0; .00; .000*
Sign	Positive*; Negative
Low-pass filter 1 (nominal value)	0.05 Hz; 0.1 Hz; 0.2 Hz; 0.5 Hz; 1 Hz; 2 Hz; 5 Hz; 10 Hz; 20 Hz; 50 Hz; 100 Hz; 200 Hz; 500 Hz; 1 kHz*; 2 kHz; 4 kHz
Low-pass filter 2 (nominal value)	0.05 Hz; 0.1 Hz; 0.2 Hz; 0.5 Hz; 1 Hz*; 2 Hz; 5 Hz; 10 Hz; 20 Hz; 50 Hz; 100 Hz
Angle of rotation	
Unit	degree*; rad
Decimal point	.; .0*; .00
Signal for zero balancing	Speed generator* (with reference pulse); Command* (without reference pulse)
Speed/Angle output	
Measuring point name	MySpeedMeasPnt
Measuring point number	0
Mechanical Increments	360*/720*
Signals F1/ F2	Frequency* Pulse (pos. edge)/ rotation direction Pulse (pos./ neg. edge)/ rotation direction Pulse (4 edges)/ rotation direction
Output pulse division	1*; 2; 4; 6; 8; 12
Increments per revolution	360*/720*

Hysteresis for rotational direction reversion	Enabled*; Disabled
Frequency output	
Signal	Torque low-pass 1* Torque low-pass 2
Mode	10 +/- 5 kHz* 60 +/- 30 kHz*
1st point physical setpoint value	0.000* (depending on nominal (rated) measuring range)
2nd point physical setpoint value	1000.000* (depending on nominal (rated) measuring range)
1st point frequency	10.000000* (depending on electrical configuration)
2nd point frequency	15.000000* (depending on electrical configuration)
Analog output	
Signal	Torque low-pass 1* Torque low-pass 2 Speed low-pass 1 Speed low-pass 2
Measuring point number	0
Mode	10 V*
1st point physical setpoint value	0.000*
2nd point physical setpoint value	1000.000*
1st point voltage	0.0000*
2nd point voltage	10.0000*
Power	
Unit	W; kW*; MW; hp
Decimal point	.; .0; .00; .000*
Low pass-filter (-1 dB)	0.1 Hz; 1 Hz*; 10 Hz; 100 Hz
SIGNAL CONDITIONING	
Torque	
Shunt	Enabled; Disabled*
Shuntsignal (of nominal value)	10 %; 50 %*
Zero signal balance	Zero signal balance
Zero value	0.000*
Angle of rotation	
Meas. range	0…n·360 degree, pos. rotation direction* 0…n·360 degree, neg. rotation direction 0…-n·360 degree, pos. rotation direction 0…-n·360 degree, neg. rotation direction -n·360…n·360 degree, pos. rotation direction -n·360…n·360 degree, neg. rotation direction
Number of revolutions n	1*; 2; 3; 4

ADDITIONAL FUNCTIONS		
Limit values		
Limit value 1		
Monitoring	Enabled; Disabled*	Enabled; Disabled*
Signal	Torque low-pass 1* Torque low-pass 2	Speed low-pass 1* Speed low-pass 2
Switching direction	Above limit* Below limit	Above limit* Below limit
Level	10.000*	10.0*
Hysteresis	0.500*	0.5*
Limit value 2		
Monitoring	Enabled; Disabled*	Enabled; Disabled*
Signal	Torque low-pass 1* Torque low-pass 2	Speed low-pass 1* Speed low-pass 2
Switching direction	Above limit* Below limit	Above limit* Below limit
Level	10.000*	10.0*
Hysteresis	0.500*	0.5*
Limit value 3		
Monitoring	Enabled; Disabled*	Enabled; Disabled*
Signal	Torque low-pass 1* Torque low-pass 2	Speed low-pass 1* Speed low-pass 2
Switching direction	Above limit Below limit*	Above limit Below limit*
Level	-10.000*	-10.0*
Hysteresis	0.500*	0.5*
Limit value 4		
Monitoring	Enabled; Disabled*	Enabled; Disabled*
Signal	Torque low-pass 1* Torque low-pass 2	Speed low-pass 1* Speed low-pass 2
Switching direction	Above limit Below limit*	Above limit Below limit*
Level	-10.000*	-10.0*
Hysteresis	0.500*	0.5*
SAVE/ LOAD PARAMETERS		
Load from transducer		
Select parameter set	1*; 2; 3; 4; Factory default	
Save to transducer		
Select parameter set	1; 2; 3; 4	
Torque TEDS template	HBM Frequency Sensor* High level voltage Output	
Speed/ Angle output TEDS template	HBM Frequency Sensor* HBM pulse Sensor	

17 Order numbers

Code	Option 1: Measuring range
S100Q	100 N·m
S200Q	200 N·m
S500Q	500 N·m
S001R	1 kN·m
S002R	2 kN·m
S003R	3 kN·m
S005R	5 kN·m
S010R	10 kN·m

Code	Option 2: Accuracy
S	Standard
G	Higher Accuracy[1)] Lin. $< \pm 0.01$ % and $TC_0 < \pm 0.01$ %/10 K

Code	Option 3: Nominal (rated) speed
L	Depending on measuring range up to 15,000 rpm
H	Depending on measuring range up to 18,000 rpm

Code	Option 4: Electrical configuration
DF1	Output signal 60 kHz ± 30 kHz
DU2	Output signal 60 kHz ± 30 kHz and ± 10 V
SF1	Output signal 10 kHz ± 5 kHz
SU2	Output signal 10 kHz ± 5 kHz and ± 10 V

Code	Option 5: Bus connection
C	CANopen (2 male device connectors)
P	CANopen and Profibus DPV1

Code	Option 6: Speed measuring system
N	Without speed measuring system
1	With optical speed measuring system; 360 or 720 pulses/revolution
A	With optical speed measuring system; 360 or 720 pulses/revolution and reference pulse

Code	Option 7: Protection against contact
N	Without protection against contact
Y	With protection against contact

Code	Option 8: MODULFLEX® coupling[2)]
N	Without coupling
Y	With mounted coupling

Code	Option 9: Customer-specific modification
N	No customer-specific modification

Order no.:

K-T12 – □□□□□ - □ - □ - □□□ - □ - □ - □ - □ - □

Ordering example:

K-T12 – S 5 0 0 Q - S - L - S F 1 - C - 1 - N - N - N

1) With voltage output: Lin. $< \pm 0.05$ %; $TC_0 < \pm 0.1$ %/10 K

2) Only with option 3, Code L; specifications see Data sheet B1958-xx en

18 Accessories

Item	Order-No.
Connecting cable, pre-wired	
Torque	
Connecting cable torque, Binder 423 7-pole – D-Sub 15-pole, 6 m	1–KAB149–6
Connecting cable torque, Binder 423 – pigtails, 6 m	1–KAB153–6
Rotational speed	
Connecting cable rot. speed, Binder 423 8-pole – D-Sub 15-pole, 6 m	1–KAB150–6
Connecting cable rot. speed, Binder 423 8-pole – pigtails, 6 m	1–KAB154–6
Connecting cable rot. speed, reference pulse, Binder 423 8-pole – D-Sub 15-pole, 6 m	1–KAB163–6
Connecting cable rot. speed, reference pulse, Binder 423 8-pole – pigtails, 6 m	1–KAB164–6
CAN bus	
Connecting cable CAN bus, M12 A-encoded – D-Sub 9-pole, connectable termination resistor, 6 m	1–KAB161–6
Male/female cable connectors	
Torque	
423G–7S, female cable connector 7-pole, straight cable entry, for torque output (connector 1, connector 3)	3–3101.0247
423W–7S, female cable connector 7-pole, 90° cable entry, for torque output (connector 1, connector 3)	3–3312.0281
Rotational speed	
423G–8S, female cable connector 8-pole, straight cable entry, for rotational speed output (connector 2)	3–3312.0120
423W–8S, female cable connector 8-pole, 90° cable entry, for rotational speed output (connector 2)	3–3312.0282
CAN bus	
TERMINATOR M12/ termination resistor, M12, A-encoded, 5-pole, male connector	1–CANHEAD–TERM
Termination resistor CAN bus M12, A-encoded, 5-pole, female connector	1–CAN–AB–M12
T-unit M12, A-encoded, 5-pole	1–CANHEAD–M12–T
Male/female cable connector/CAN bus M12, female cable connector 5-pole M12, A-encoded, male cable connector 5-pole M12, A-encoded	1–CANHEAD–M12
PROFIBUS	
Connecting cable, Y junction, M12 female, B-encoded; M12 male, B-encoded; M12 female, B-encoded, 2 m	1–KAB167-2
Male/female cable connector/PROFIBUS M12, female cable connector 5-pole M12, B-encoded, male cable connector 5-pole M12, B-encoded	1–PROFI–M12
Termination resistor PROFIBUS M12, B-encoded, 5-pole	1–PROFI–AB–M12
T-unit PROFIBUS M12, B-encoded, 5-pole	1–PROFI–VT–M12
Connecting cable, by the meter	
Kab8/00–2/2/2	4–3301.0071
Kab8/00–2/2/2/1/1	4–3301.0183
DeviceNet cable	4–3301.0180
Miscellaneous	
Setup-Toolkit for T12 (T12 system CD, PCAN–USB adapter, connecting cable CAN bus, 6 m)	1–T12–SETUP–USB

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