Mounting instructions

Torque flange

T10FM

A0894-5.2 en

Contents **Page**

Safety instructions

Designated use

The T10FM torque flange is used exclusively for torque and rotation speed measurement tasks, and directly associated control and regulatory tasks. Use for any additional purpose shall be deemed to be **not** as intended.

In the interests of safety, the transducer should only be operated as described in the Operating Manual. It is also essential to comply with the legal and safety requirements for the application concerned during use. The same applies to the use of accessories.

The transducer is not a safety element within the meaning of its designated use. Proper and safe operation of this transducer requires proper transportation, correct storage, assembly and mounting, and careful operation.

General dangers of failing to follow the safety instructions

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

Everyone involved with mounting, starting up, maintaining, or repairing the transducer must have read and understood the Operating Manual and in particular the technical safety instructions.

Residual 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. On-site regulations must be complied with at all times. Reference must be made to remaining dangers connected with torque measurement technology.

The following symbols are used in this Operating Manual to point out remaining dangers:

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: **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: **ATTENTION**

Meaning: **Possibly 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.

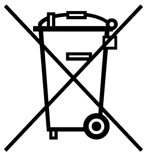
Symbols for application and disposal instructions, as well as useful information:

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

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 can be found at http://www.hbm.com/hbmdoc).

Symbol: 

Meaning: **Statutory waste disposal mark**

In accordance with national and local environmental protection and material recovery and recycling regulations, old devices that can no longer be used must be disposed of separately and not with normal household garbage.
If you need more information about waste disposal, please contact your 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 comply with the legal and safety requirements for the application concerned during use. The same applies to the use of accessories.

Qualified personnel means persons entrusted with siting, mounting, starting up and operating the product who possess the appropriate qualifications for their function.

Accident prevention

According to the prevailing accident prevention regulations, once the torque flange has been mounted, a covering agent 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 be arranged so 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.

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 flange is returned in the original packaging.

1 Scope of supply

- Rotor
- Stator
- Mounting instructions
- Test record
- Optional: Speed kit (slotted disc, screwdriver, screw locking device, screws)

2 Application

The T10FM torque flanges record static and dynamic torque on stationary or rotating shafts and determine the speed, specifying the direction of rotation. Test beds can be extremely compact because of their extremely short construction. They therefore offer a very wide range of applications.

In addition to conventional test-bench engineering (engine, roll and transmission test benches), new solutions are possible for torque measurements partly integrated in the machines.

Thanks to the bearing-free design and the contactless transmission of excitation voltage and measured values, the torque measuring system of torque flanges requires no maintenance. Thus there are no friction or bearings heating effects.

The torque flanges are supplied for nominal (rated) torques from 15 kN·m to 80 kN·m. Depending on the nominal torque, maximum speeds of up to 6000 min^{-1} are permissible.

T10FM torque flanges are reliably protected against electromagnetic interference. They have been tested with regard to EMC according to the relevant European standards, and carry the CE mark.

3 Structure and mode of operation

The torque flange consist of two separate parts: the rotor and the stator. The stator comprises an antenna ring and a housing.

Strain gauges (SGs) are mounted on the rotor. The rotor electronics for transmitting the bridge excitation voltage and the measurement signal are located centrally in the flange. The coils for the non-contact transmission of excitation voltage and measurement signal are located on the rotor's outer circumference. The signals are sent and received by a separable antenna ring. The antenna ring is mounted on a housing that includes the electronic system for voltage adaptation and signal conditioning.

Connectors for the torque signal, the voltage supply and the speed signal (option) are located on the stator. The antenna ring should be mounted concentrically around the rotor (see Chapter 4).

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.

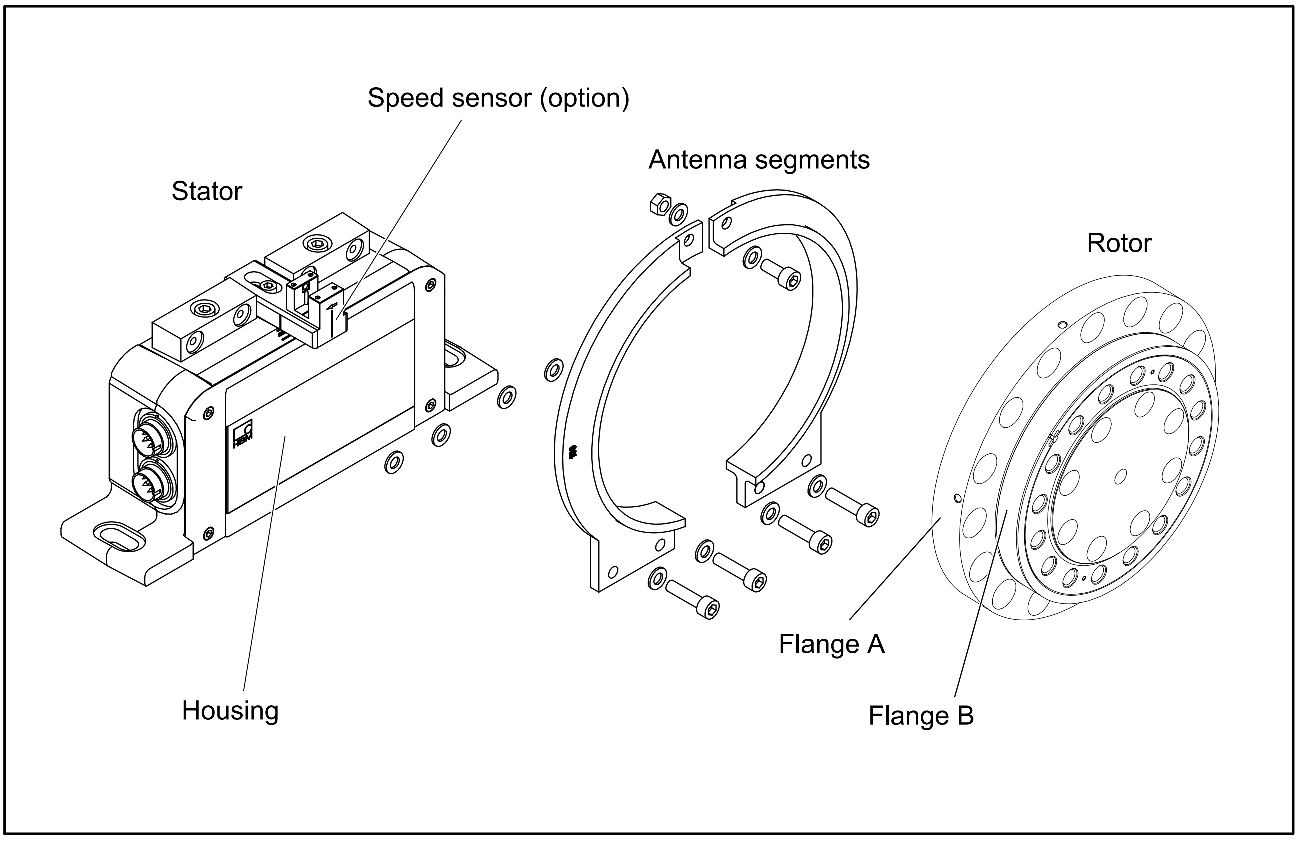


Fig.3.1: Mechanical structure, exploded view

4 Mechanical installation

WARNING

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

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

An appropriate shaft flange enables the T10FM torque flanges to be mounted directly. It is also possible to directly mount a joint shaft or relevant compensating element (see Fig.3.1) on flange B of the rotor (using an intermediate flange when required). Under no circumstances must the permissible limits specified for bending moments, lateral and longitudinal forces be exceeded. Due to the T10FM torque flanges' high torsional stiffness, dynamic changes on the shaft train are minimized.

IMPORTANT

The effect on critical bending speeds and natural torsional vibrations must be checked to avoid overloading the measurement flanges due to the resonance stepup.

NOTE

For correct operation, comply with the mounting dimensions (see Page 44).

4.1 Conditions on site

T10FM torque flanges are protected to IP54 according to EN 60529. They must be protected against coarse dirt particles, dust, oil, solvents and humidity. 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 T10FM torque flange (see Specifications on Page 46). This compensation is carried out at static temperatures in extensive furnace processes. 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. So, for accurate measurements, static temperature conditions must then be obtained by cooling or heating depending on the application. As an alternative, check thermal decoupling by means of heat radiating elements such as multi-disc couplings.

4.2 Installation orientation

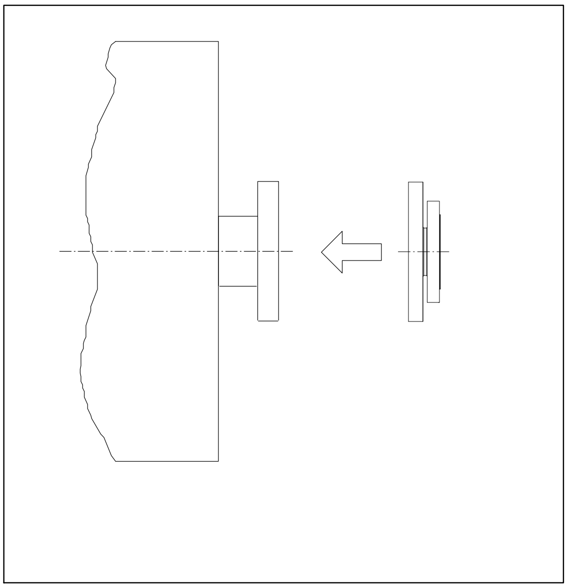
The measurement flange can be mounted in any position. With clockwise torque, the output frequency is 10 ... 15 kHz. In conjunction with HBM amplifiers or when using the voltage output, a positive output signal (0 V to +10 V) is present.

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. If the measurement flange turns in the direction of the arrow, connected HBM amplifiers deliver a positive output signal (0 V...+10 V).

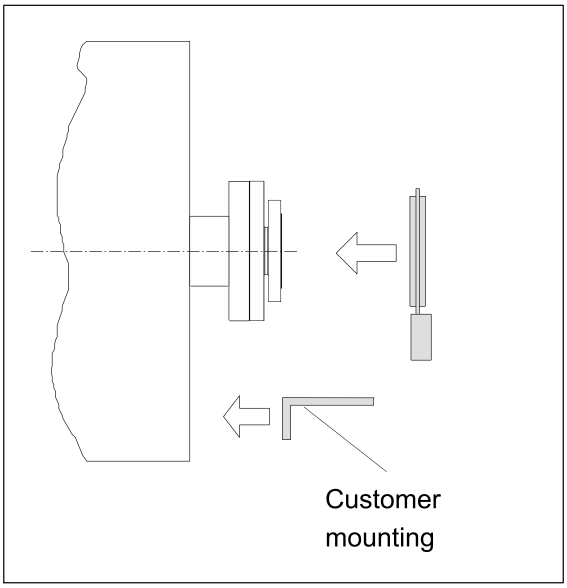
4.3 Installation options

In principle, there are two possibilities for torque flange mounting: with the antenna ring complete or dismantled. We recommend mounting as described in Chapter 4.3.1 . If installation in accordance with 4.3.1 is not possible, (e.g. in the case of subsequent stator replacement or mounting with a speed measuring system), you will have to dismantle the antenna ring. It is essential in this case to comply with the notes on assembling the antenna segments (see “Mounting the stator" and “Mounting the slotted disc").

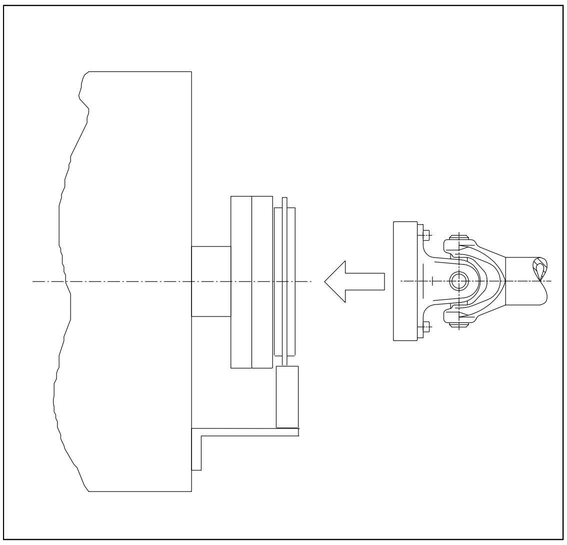
4.3.1 Installation without dismantling the antenna ring



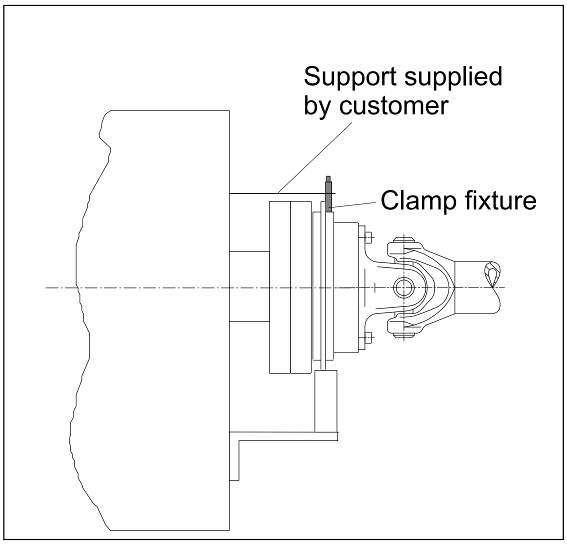
1. Install rotor



2. Install stator

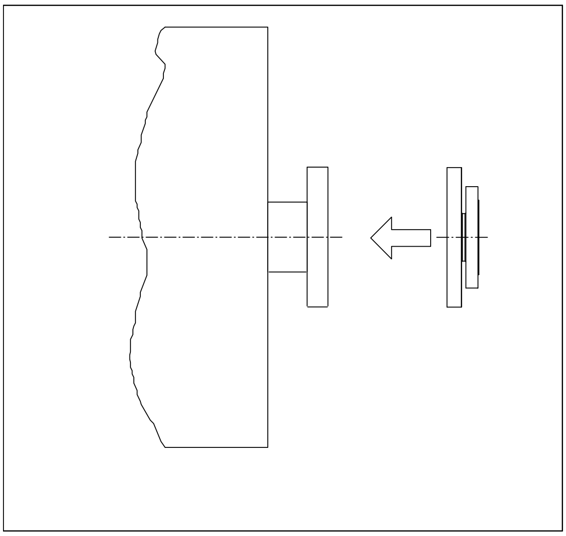


3. Finish installation of shaft train

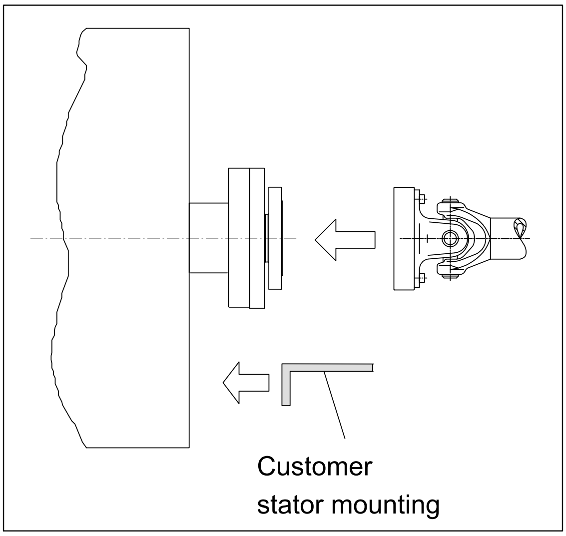


4. Mount the clamp fixture where required

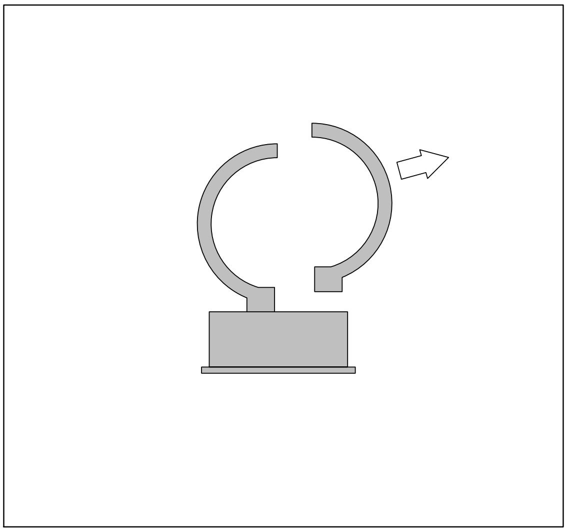
4.3.2 Installation with subsequent stator mounting



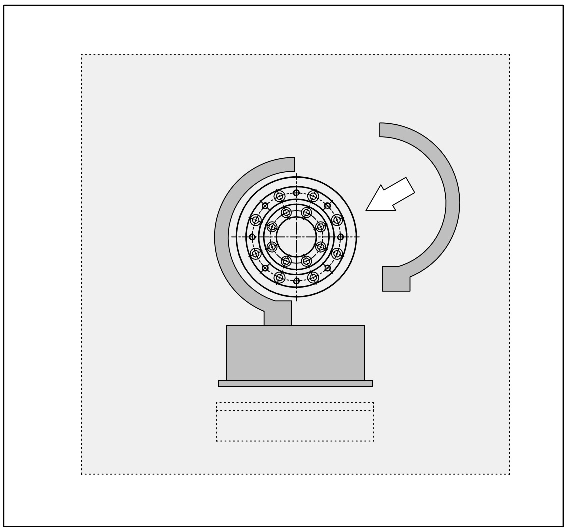
1. Install rotor



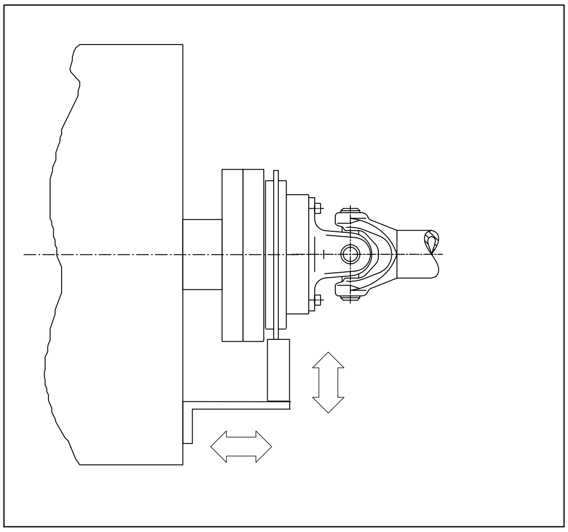
2. Install shaft train



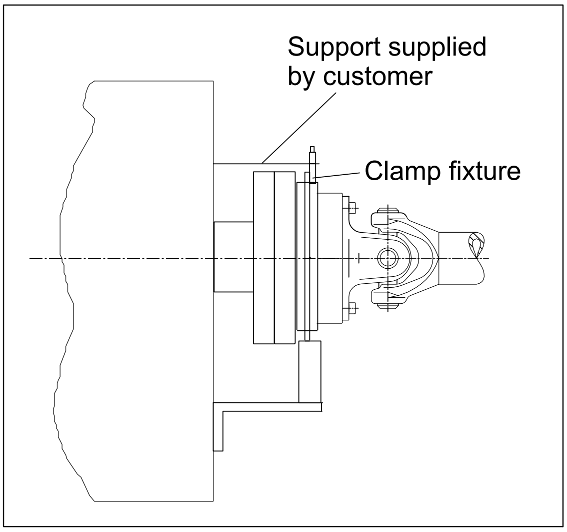
3. Remove one antenna segment



4. Install antenna segment around shaft train



5. Align stator and finish installation



6. Mount the clamp fixture where required

4.4 Preparing for the rotor mounting

IMPORTANT

The rotor is very heavy (depending on measuring range: 26 kg ... 60 kg)! Use a crane or other suitable lifting equipment to lift it out of its packaging and install it.

Two eye bolts are screwed into the rotor as transport and mounting aids. Hook the lifting equipment to these eye bolts as this ensures that the rotor is lifted horizontally out of the packaging (see Fig. 4.1).

IMPORTANT

Transport and mounting eye bolts must be removed after mounting is complete! Keep them safe for later use.

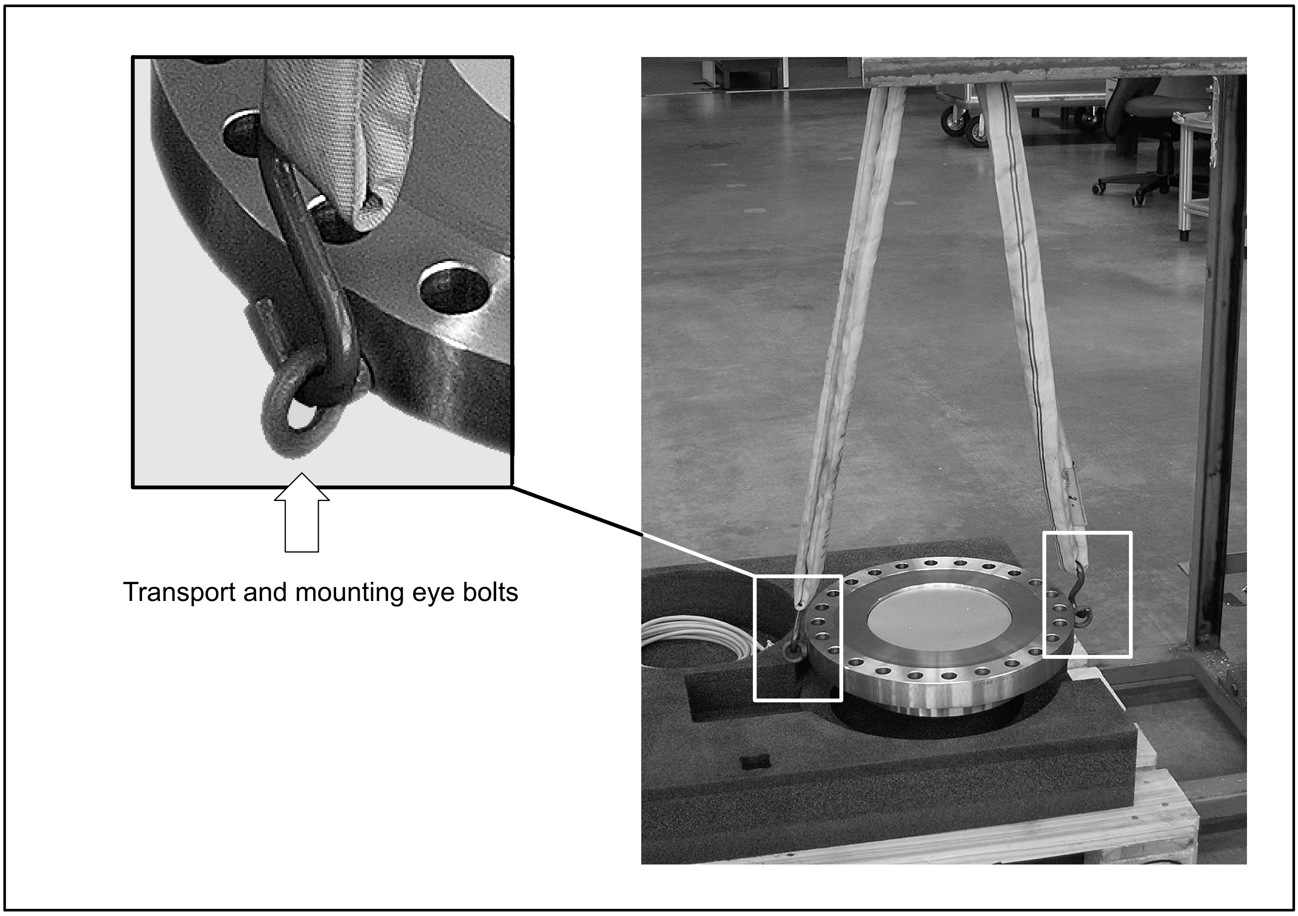


Fig. 4.1: Transport and mounting eye bolts on the rotor

1. Lift the rotor out of the packaging, rotate horizontally by 10°, so that flange B is pointing upwards (see Fig. 4.2).

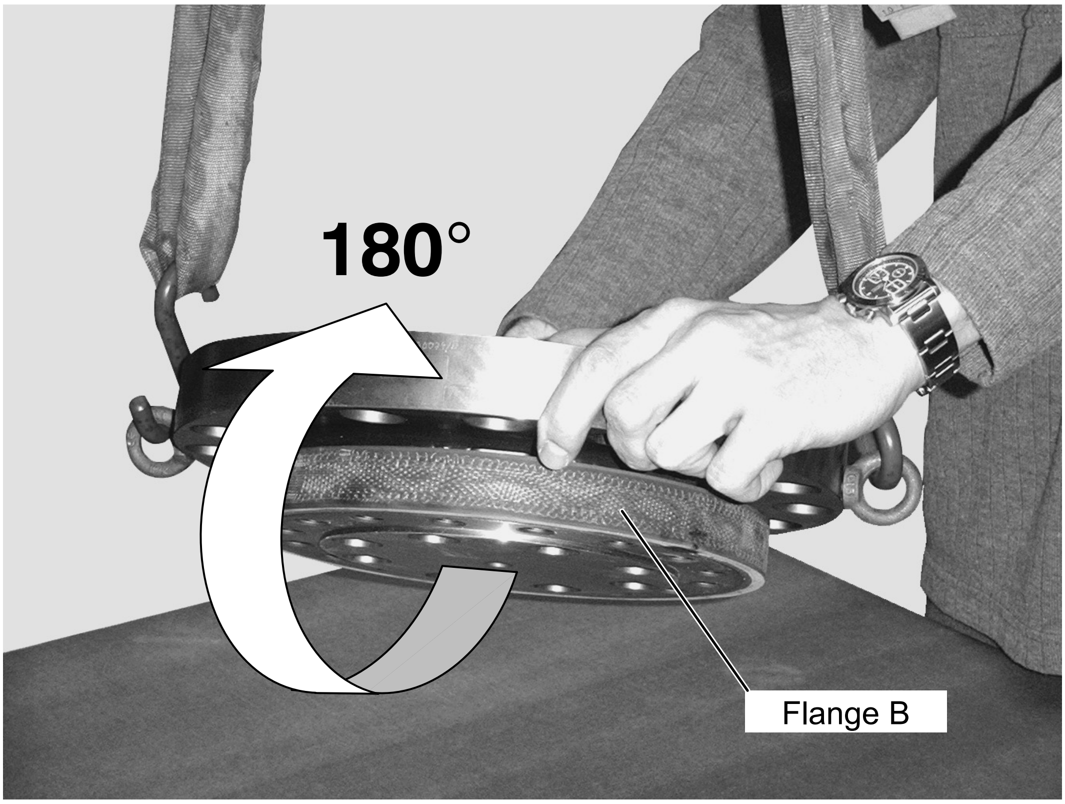


Fig. 4.2: Rotating the rotor

2. Place the rotor carefully onto a clean and stable table.
3. If the rotor is to be installed horizontally (as shown in Fig. 4.3), remove a mounting eye bolt. Both mounting eye bolts can initially remain in the flange for vertical installation.
4. Clean the plane surfaces of the measurement 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. Make sure that no solvent drips into the inside of the flange and that the transmitter coils are not damaged during cleaning.
5. Fasten the lifting equipment to the mounting eye bolt(s), carefully lift up the rotor and move it to the mounting position (see Fig. 4.3).

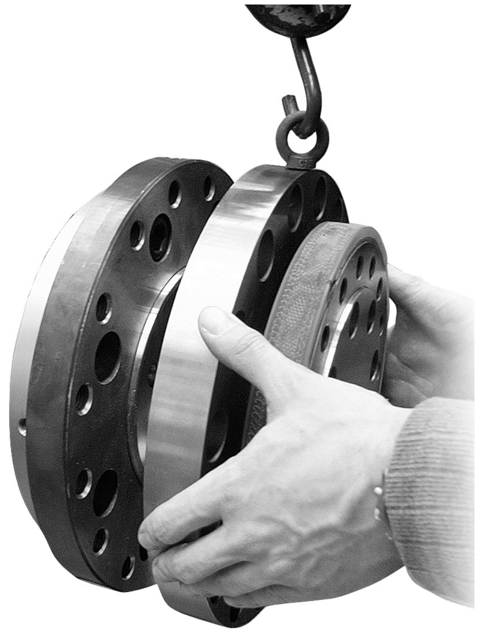


Fig. 4.3: Rotor installation (horizontal)

4.5 Mounting the rotor

IMPORTANT

For correct operation, comply with the mounting dimensions (particularly the area free of metal, see Page 44).

Additional installation notes for the speed measuring system can be found in Chapter 4.8, Page 24.

NOTE

Usually 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 calibration signal.

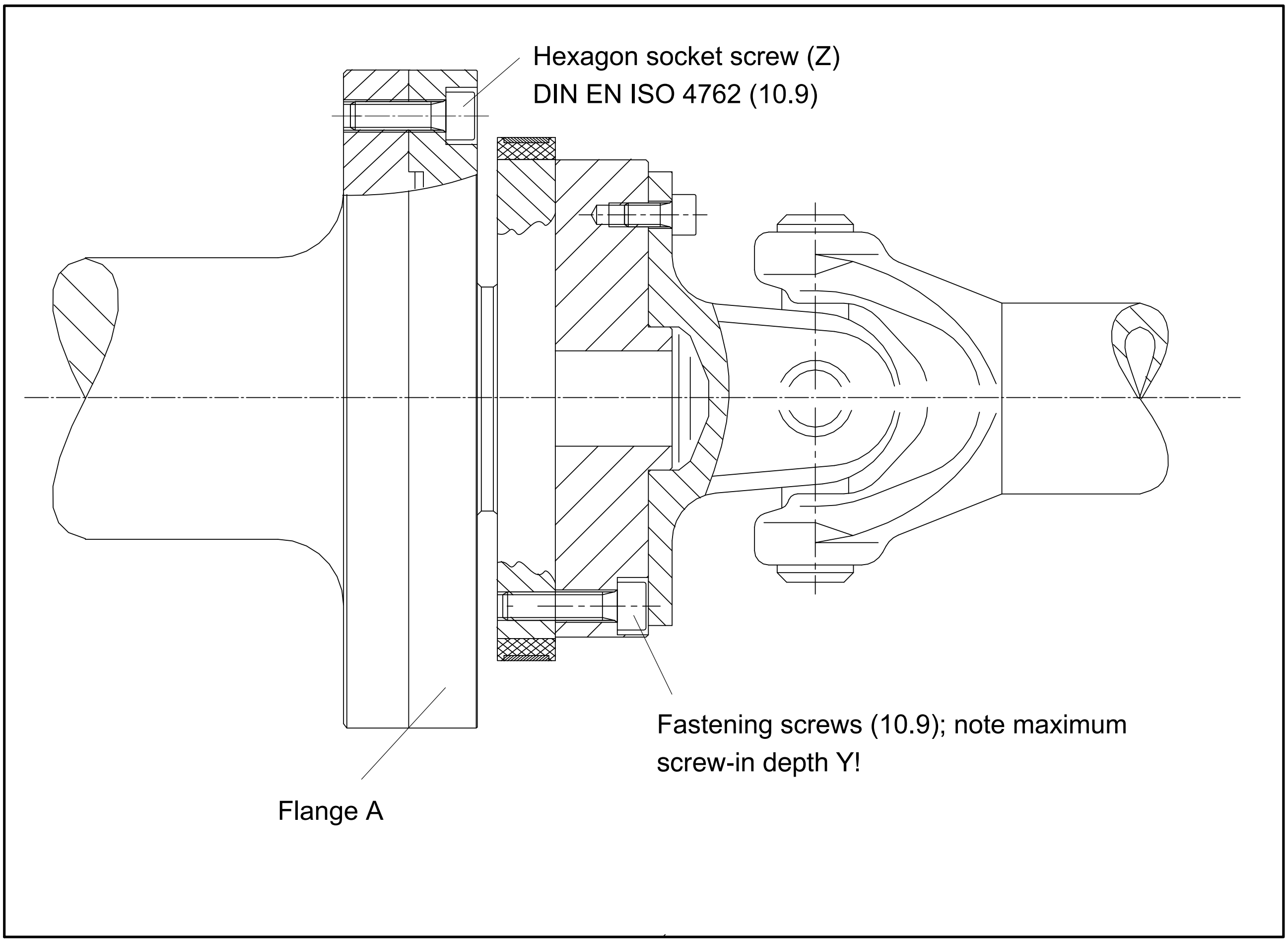


Fig. 4.4: Screwed rotor joint

1. For the connection of flange A (see Fig. 4.4), use **DIN EN ISO 4762 property class 10.9** hexagon socket screws of a suitable length (dependent on the connection geometry, see Table 4.1).

   We recommend fillisterhead screws DIN EN ISO 4762, blackened, smooth-headed, permitted size and shape variance as per 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.

2. Fasten all screws with the specified torque (Table 4.1).
3. Now remove the ring bolts and mounting ring(s).

4. There are relevant tapped holes on flange B for continuing the shaft run mounting. Again use screws of property class 10.9 and tighten them with the prescribed torque, as specified in Table 4.1.

IMPORTANT

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

The maximum screw-in depth as per Table 4.1 must be complied with! Otherwise, significant measurement errors may result from torque shunts or the transducer may be damaged.

<table>
<tr><th>Measuring range
(N·m)</th><th>Fastening screws (Z)[1)]</th><th>Fastening screws
Property class</th><th>Maximum screw-in depth (Y) of screws in flange B
(mm)</th><th>Prescribed tightening torque
(N·m)</th></tr>
<tr><td>15
20
25</td><td></td><td rowspan="3">10.9</td><td></td><td></td></tr>
<tr><td>30
40
45</td><td>M20</td><td>40</td><td>560</td></tr>
<tr><td>50
60
70
80</td><td>M22</td><td>45</td><td>760</td></tr>
</table>

Table 4.1: Fastening screws

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

4.6 Installing the stator

On delivery, the stator has already been installed and is ready for operation. The antenna segments can be separated from the stator, for example, for maintenance or to facilitate stator mounting. To stop you modifying the center alignment of the segment rings opposite the base of the stator, we recommend that you separate only one antenna segment from the stator.

If your application does not require the stator to be dismantled, proceed as described in points 2., 6., 7. and 8.

Version with speed measuring system

NOTE

Check the screw connections of the antenna segments (see Fig. 4.5) both after initial installation and then at regular intervals for correct fit and tighten them if necessary.

As the speed sensor includes the slotted disc, it is not possible to move the stator axially over the pre-assembled rotor. In this case, you should also comply with Chapter 4.8.

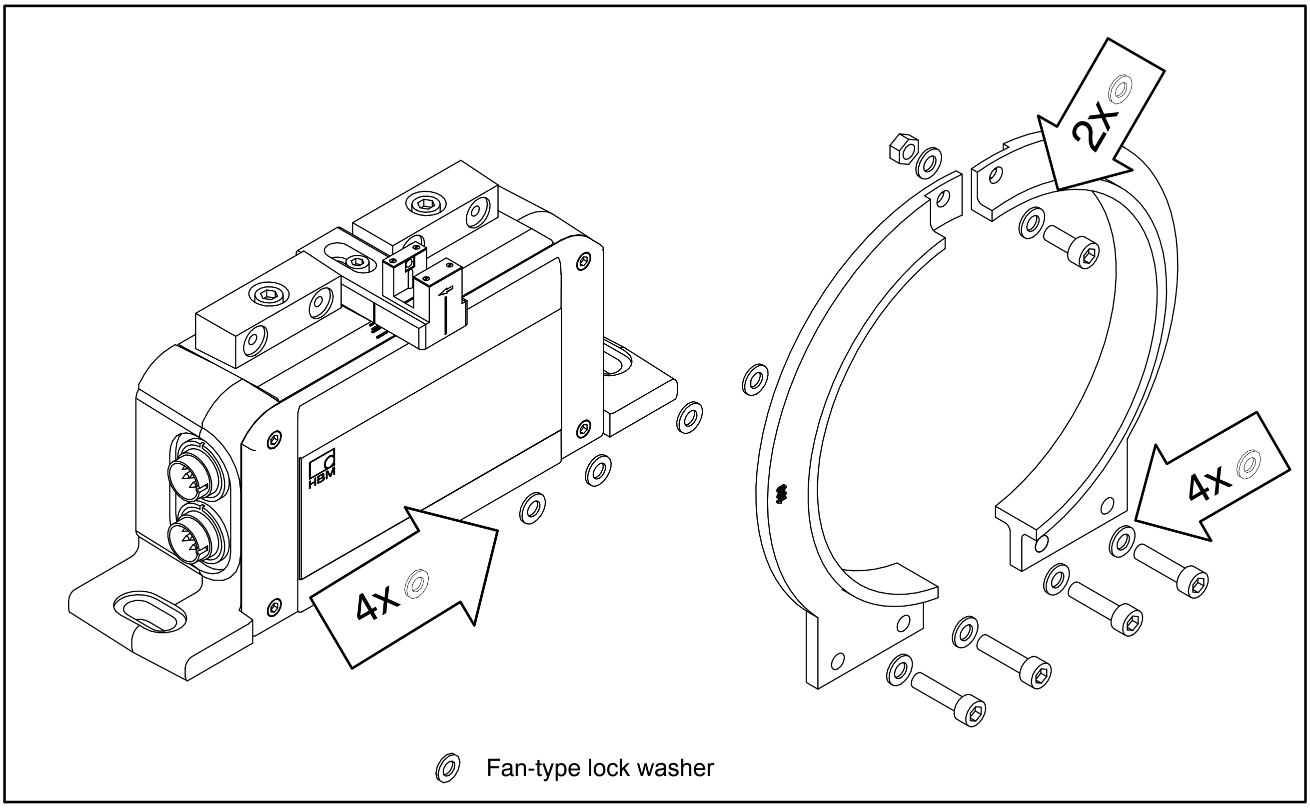
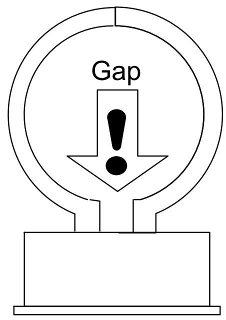


Fig. 4.5: Screw fittings of the antenna segments

1. Loosen and remove the screw fittings (M5) on one antenna segment. Make sure that the fan-type lock washers are not lost!
2. Use an appropriate base plate to install the stator housing in the shaft train so that there is sufficient possibility for horizontal and vertical adjustments. Do not fully tighten the screws yet.
3. Now reinstall the antenna segment removed under point 1. on the stator with two hexagon-socket screws and the fan-type lock washers. Make sure that none of the fan-type lock washers necessary for a defined contact resistance are missing (see Fig. 4.5)! Do not yet tighten the screws.
4. Install the two antenna segments' upper connecting screw so that the antenna ring is closed. Also pay attention to the fantype lock washers.
5. Now tighten all antenna-segment bolted connections with a tightening torque of 5 N·m.
6. Align the antenna and rotor so that the antenna encloses the rotor coaxially. Please comply with the permissible alignment tolerances stated in the specifications.
7. Now fully tighten the bolted stator housing connection.
8. Make sure that the gap in the lower antenna segment area is free of electrically conductive foreign bodies.



IMPORTANT

To make sure that they function perfectly, the fan-type lock washers (A5, 3-FST DIN 6798 ZN/galvanized) must be replaced after the bolted antenna connection has been loosened three times.

4.7 Installing the clamp fixture

Depending on the operating conditions, oscillations may be induced in the antenna ring. This effect depends on

- the speed
- the antenna diameter (depends in turn on the measuring range)
- the design of the machine base

To avoid vibrations, a clamp fixture with extension is enclosed with the torque flange enabling the antenna ring to be supported.

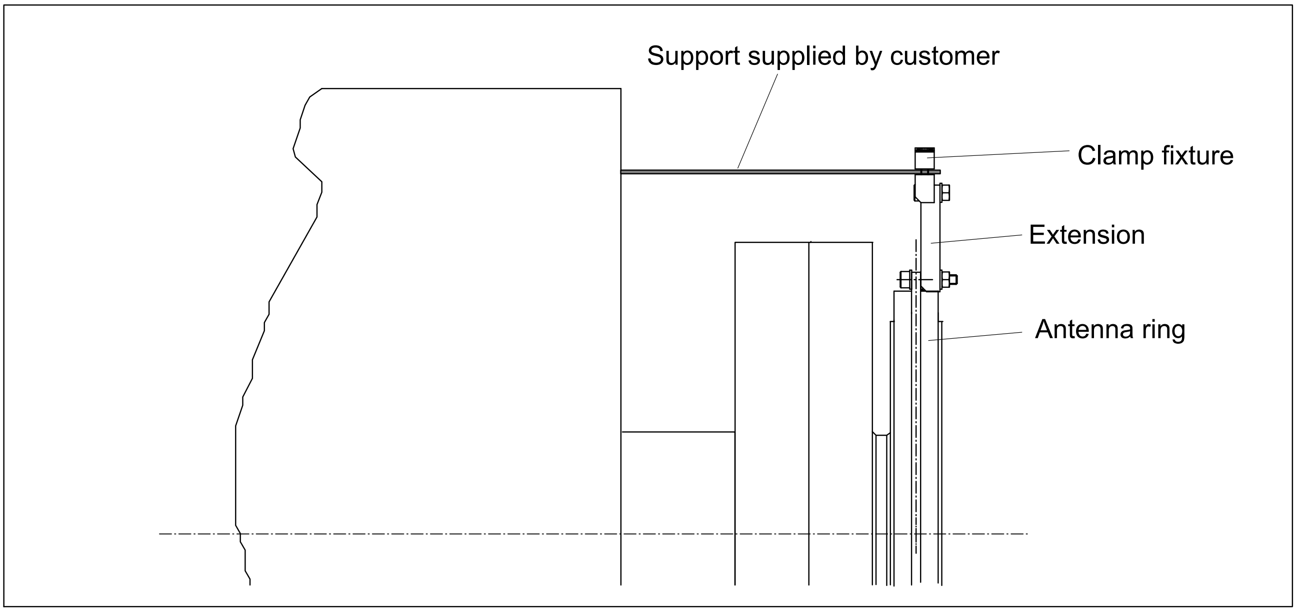


Fig. 4.6: Supporting the antenna ring

Mounting sequence

1. Loosen and remove the upper antenna segment screw fitting.
2. Screw the clamp fixture to the extension as shown in Fig. 4.7.
3. Fasten the clamp fixture and extension with the enclosed screw fitting to the antenna segment as shown in Fig. 4.7. It is essential to use the new fan-type lock washers!
4. Clamp a suitable support element (we recommend a threaded rod ∅ 3…6 mm) between the upper and lower parts of the clamp fixture and tighten the clamping screws.

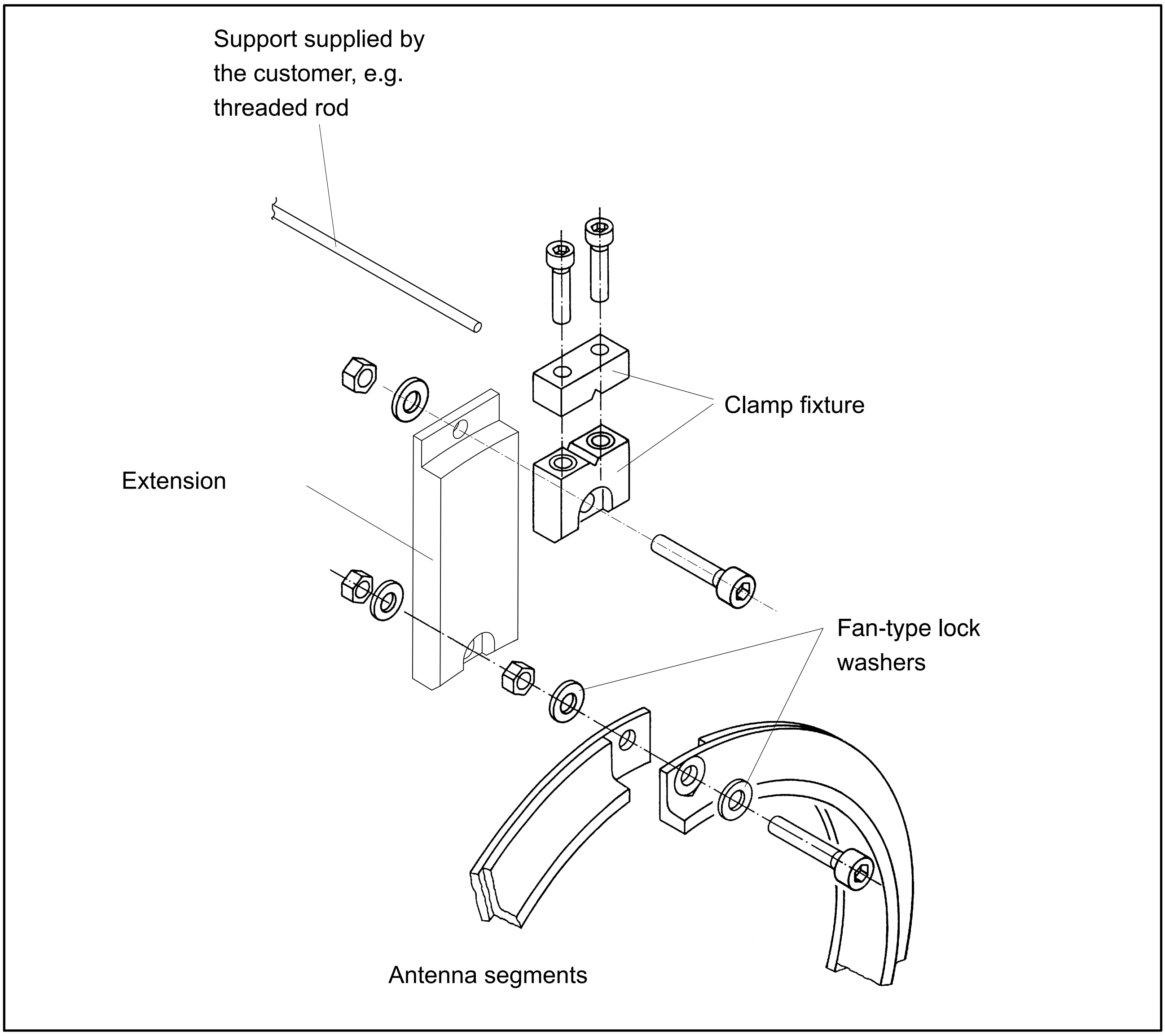


Fig. 4.7: Installing the clamp fixture

Important

Use, e.g. plastic as the material. Do not use metallic material as this can affect the function of the antenna (signal transmission).

4.8 Fitting the slotted disc (speed measuring system)

To prevent damage to the speed measuring systems' 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 intermediate flange. The intermediate flange and the associated speed sensor are already mounted at the factory.

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

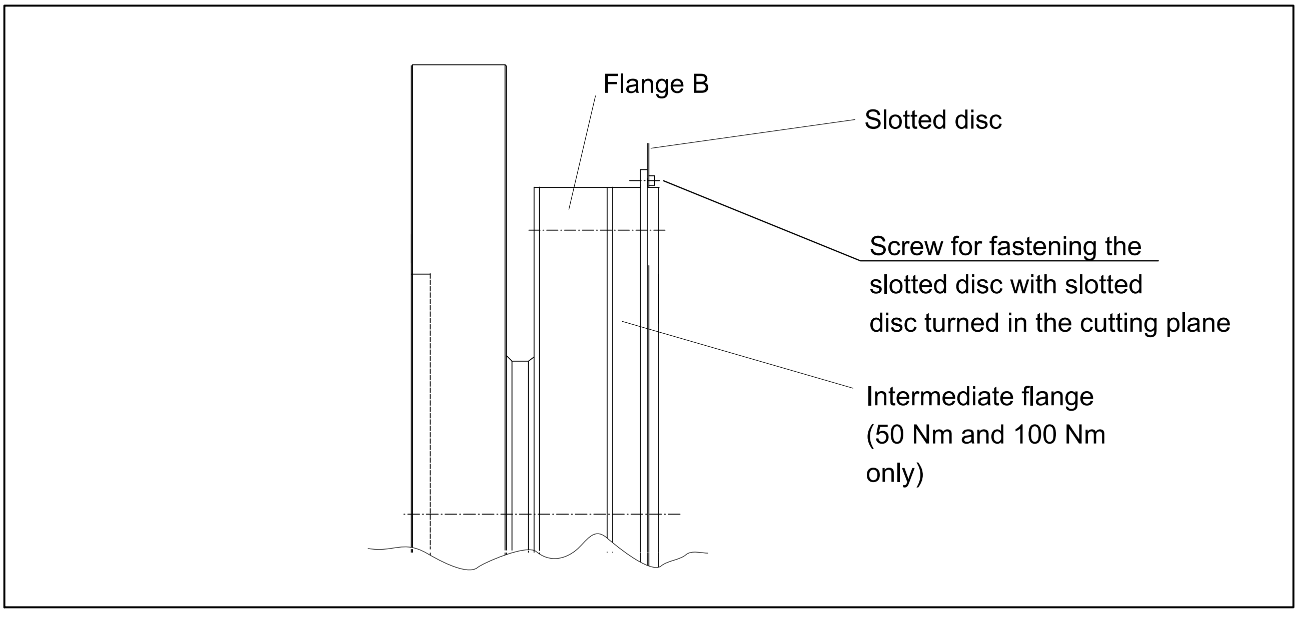


Fig. 4.8: Installing the slotted disc

IMPORTANT

At all stages of the mounting operation, be careful not to damage the slotted disc!

Mounting sequence

1. Push the slotted disc onto the additional flange and align the screw holes.
2. Apply some of the screw locking device to the screw thread and tighten the screws (tightening torque < 15 N·cm).

4.9 Aligning the stator (speed measuring system)

The stator can be mounted in any position (for example, “upside down" installation is possible).

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).

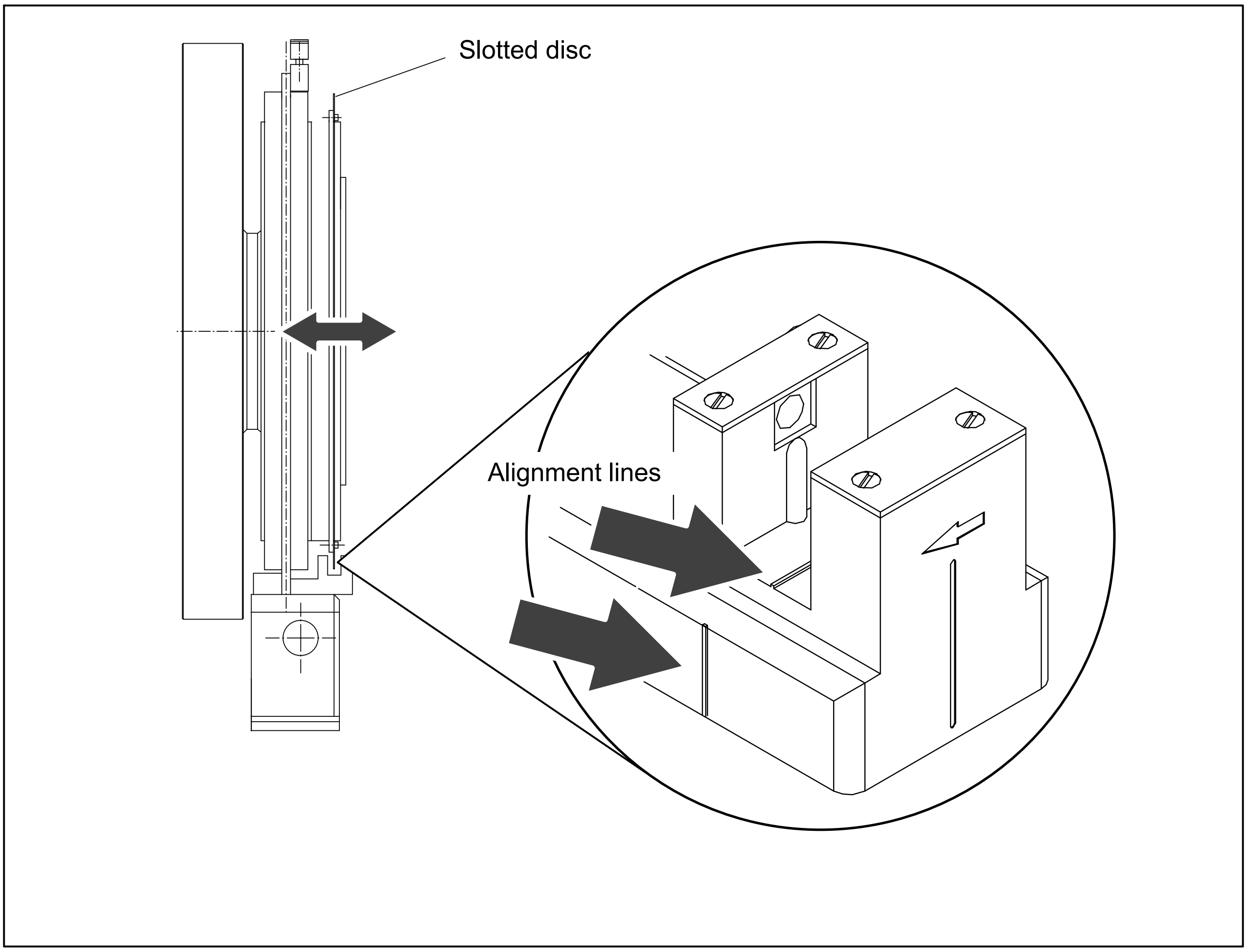


Fig. 4.9: Position of the slotted disc in the speed sensor

NOTE

To attach the stator, we recommend the use of M6 screws with plain washers (width of oblong hole, 9 mm). This size of screw guarantees the necessary travel for alignment.

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 B and a vertical marker line on the sensor head serve as aids to orientation.

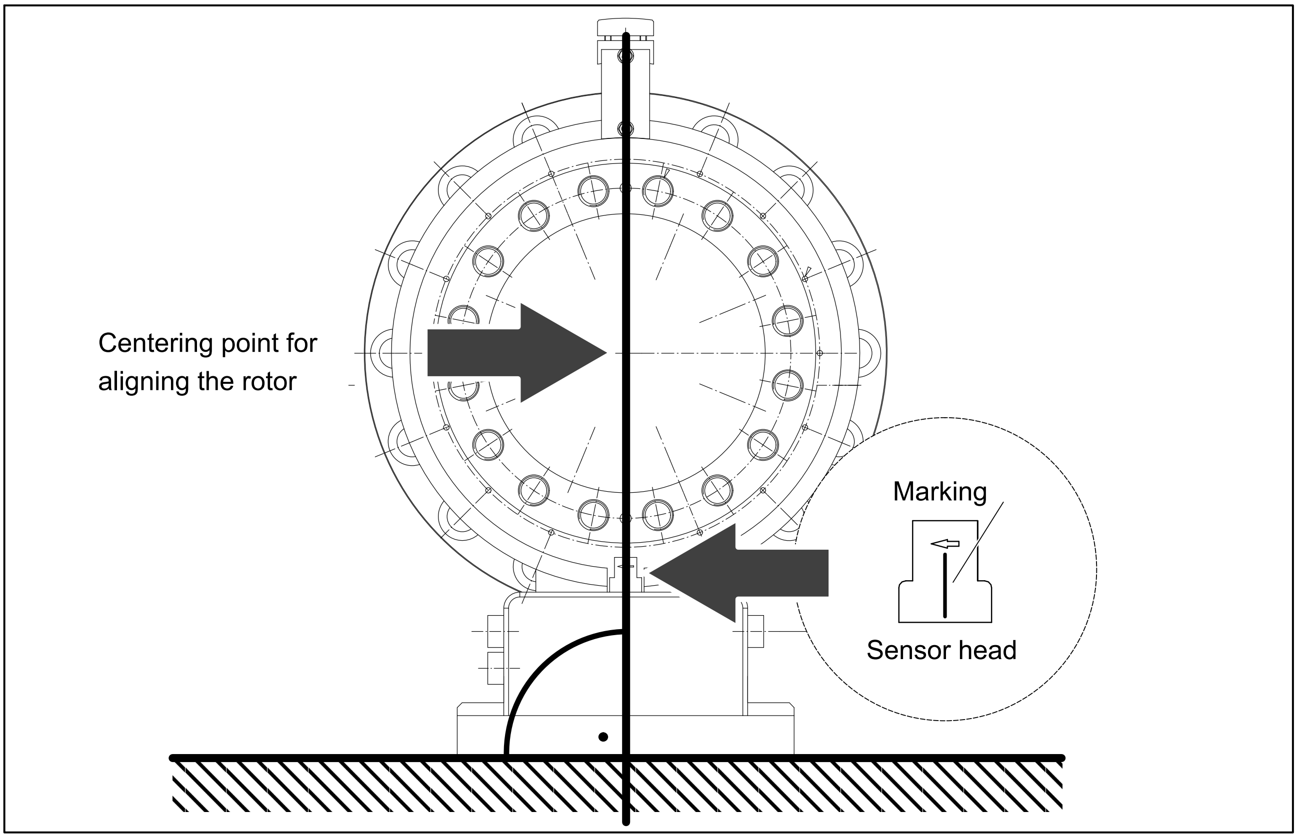


Fig. 4.10: Alignment marks on rotor and stator

5 Electrical connection

5.1 General information

To make the electrical connection between the torque transducer and the 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 swivel nuts nuts must be fully 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.

IMPORTANT

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!

5.2 Shielding design

The cable shield is connected in accordance with the Greenline concept. This encloses the measurement system (without the 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. Special electronic coding methods are used to protect the transmission path and the rotor from electromagnetic interference.
In the case of interference due to potential differences (compensating currents), operating-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).

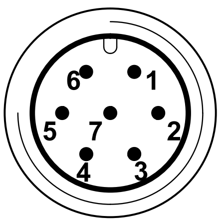
If potential differences arise between the rotor and the stator on the machine, perhaps due to unchecked leakage, and this causes interference, it can usually be overcome by connecting the rotor directly to ground, for instance by a wire loop. The stator should be fully grounded in the same way.

5.3 Connector pin assignment

On the stator housing, there are two 7-pin device connectors (Binder 723) and in the case of the speed module option, there is also an 8-pin device connector, assigned in accordance with the selected option.

The supply voltage and the calibration signal of connectors 1 and 3 are direct-coupled via multifuses (automatically resetting fuses).

Assignment for connector 1:
Voltage supply and frequency output signal.

	Conn. Binder Pin	Assignment	Wire color	Sub-D conn. Pin
Binder 723  Top view	1	Torque measurement signal (frequency output; 5 V[1]; /0 V)	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]/12 V)	rd	12
	5	Measurement signal 0 V; symmetrical	gy	8
	6	Calibration signal trigger 5 V - 30 V	gn	14
	7	Calibration signal 0 V;	gy	8
		Shielding connected to housing ground		

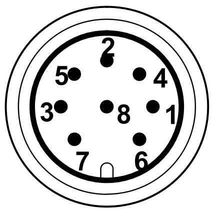
[1] Factory setting; complementary RS-422 signals

IMPORTANT

These torque flanges are only intended for operation with a DC supply voltage. They must not be connected to older HBM amplifiers with square-wave excitation. This could lead to the destruction of the connection board resistances or other errors in the measuring amplifiers (the torque flange, on the other hand, is protected and once the proper connections have been re-established, is ready for operation again).

Assignment for connector 2:

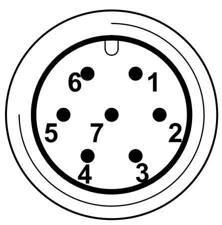
Speed measuring system.

	Conn. Binder Pin	Assignment	Wire color	Sub-D Conn. Pin
	1	Speed measurement signal (pulse string, 5 V[1]; 0°)	rd	12
	2	No function		
Binder 723	3	Speed measurement signal (pulse string, 5 V[1]; 90° out-of-phase)[2]	gy	15
	4	No function		
	5	No function		
	6	Speed measurement signal (pulse string, 5 V[1]; 0°)	wh	13
Top view	7	Speed measurement signal (pulse string, 5 V[1]; 90°out-of-phase[2])	gn	14
	8	Supply voltage zero	bk	8
		Shielding connected to housing ground		

[1] Complementary RS-422 signals
[2] When selecting double frequency, static direction of rotation signal.

Assignment for connector 3:

Voltage supply and voltage output signal.

	Conn. Binder Pin	Assignment
	1	Torque measurement signal (voltage output; 0 V)
	2	Supply voltage 0 V;
Binder 723	3	Supply voltage 18 V to 30 V DC
	4	Torque measurement signal (voltage output; ± 10 V)
	5	No function
	6	Calibration signal trigger 5 V - 30 V
Top view	7	Calibration signal 0 V;
		Shielding connected to housing ground

5.4 Supply voltage

The transducer must be operated with a separated extra-low voltage (18...30 V DC supply voltage), which usually supplies one or more consumers within a test bench.

Should the equipment be operated on a DC voltage network[1], additional precautions must be taken to discharge excess voltages.

The notes in this chapter relate to the standalone operation of the T10FM without HBM system solutions.

The supply voltage is electrically isolated from signal outputs and calibration 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 Binder sockets, 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 45).

If the permissible cable length is exceeded, you can feed the supply voltage in parallel over two connection cables (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 plug on the cable, and that the stator should be grounded.

IMPORTANT

The instant you switch on, a current of up to 2 A may flow and this may switch off power packs with electronic current limiters.

[1] Distribution system for electrical energy with greater physical expansion (over several test benches, for example) that may possibly also supply consumers with high nominal (rated) currents.

6 Calibration signal

The T10FM torque flange delivers an electrical calibration signal that can be switched at the amplifier end for measurement chains with HBM components. The measurement flange generates a calibration signal of about 50 % of the nominal (rated) torque. The precise value is specified on the type plate. Adjust the amplifier output signal to the calibration signal supplied by the connected torque flange to adapt the amplifier to the measurement flange. To obtain stable conditions, the calibration signal should only be activated once the transducer has been warming up for 15 minutes.

NOTE

The measurement flange should not be under load when the calibration signal is being measured, since the calibration signal is mixed additively.

IMPORTANT

To maintain measurement accuracy, the calibration signal should be connected for no more than 5 minutes. A similar period is then needed as a cooling phase before triggering the calibration signal again.

Applying a separated extra-low voltage of 5 V to pin 6 (+) and 7 (⏚) on connector 1 or 3 triggers the calibration signal.

The nominal (rated) voltage for triggering the calibration signal is 5 V (triggering at U>2.7 V). The trigger voltage is electrically isolated from the supply voltage and the measurement voltage. The maximum permissible voltage is 30 V. When voltages are less than 0.7 V, the measurement flange is in measuring mode. Current consumption at nominal (rated) voltage is approx. 2 mA and at maximum voltage, approx. 22 mA.

NOTE

In the case of HBM system solutions, the measuring amplifier triggers the calibration signal.

7 Settings

NOTE

You will find a table containing all the relevant switch positions on the back of the stator cover. Changes to the factory settings should be noted here using a waterproof felt-tip pen.

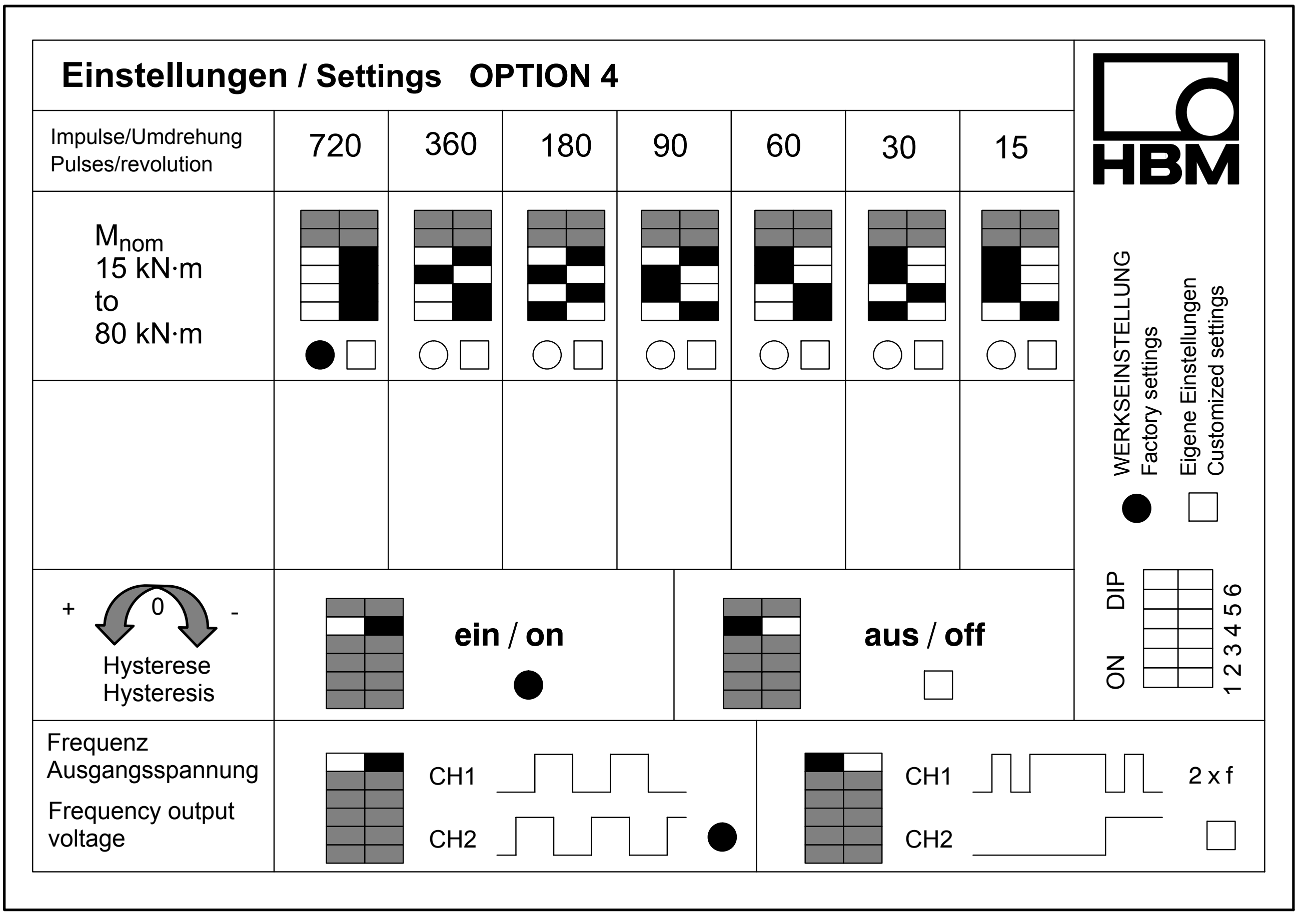


Fig. 7.1: Sticker with switch positions

7.1 Torque output signal

The factory setting for the frequency output voltage is 5 V (symmetrical, complementary RS-422 signals). The frequency signal is on pin 4 opposite pin 1. You can change the output voltage to 12 V (asymmetrical). To do this, change switches S1 and S2 to position 1 (see Fig. 7.2 and pin 1 → ⏊).

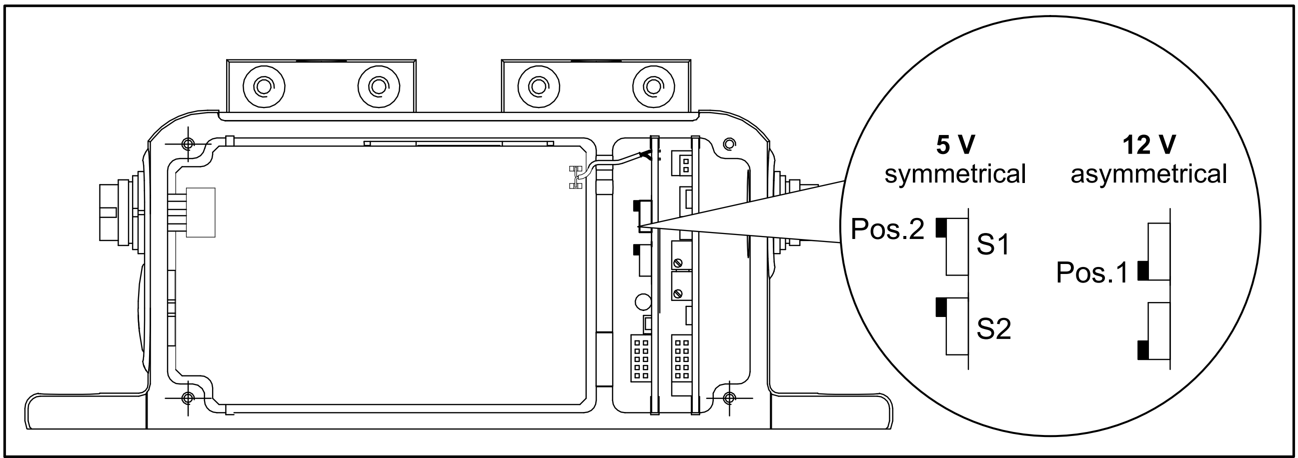


Fig. 7.2: Switch for changing the frequency output voltage

7.2 Setting up the zero point

You can access two potentiometers by removing the stator cover. You can use the zero point potentiometer to correct zero point deviations caused by the installation. The balancing range is a minimum of ±400 mV at nominal (rated) gain. The end point potentiometer is used for compensation at the factory and is capped with varnish so that it cannot be turned unintentionally.

IMPORTANT

Turning the end point potentiometer changes the factory calibration of the voltage output.

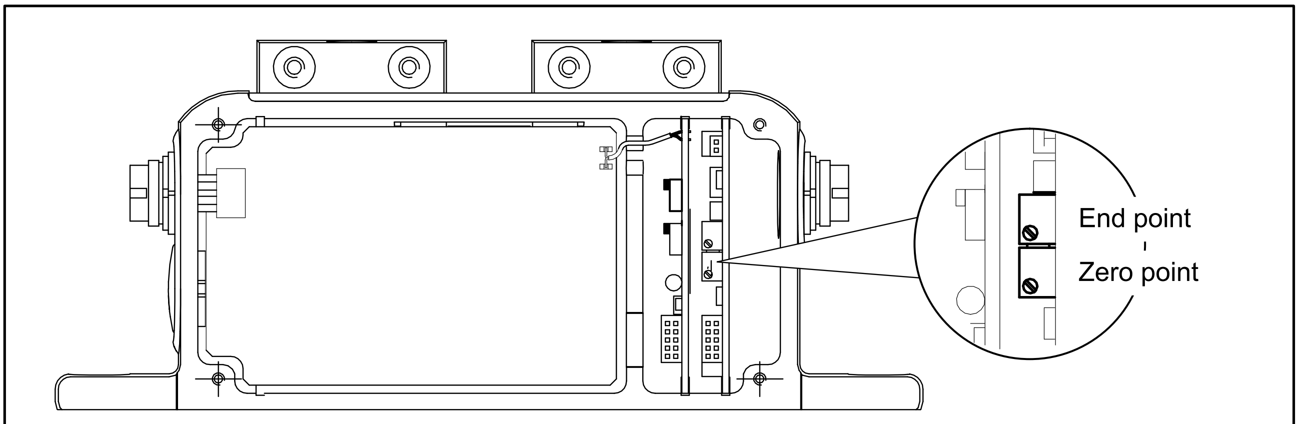


Fig. 7.3: Setting the voltage output zero point

7.3 Functional testing

7.3.1 Power transmission

If you suspect that the transmission system is not working properly, you can remove the stator cover and test for correct functioning. If the LED is on, the rotor and stator are properly aligned and there is no interference with the transmission of measurement signals. When the calibration signal is triggered, the LED shines more brightly.

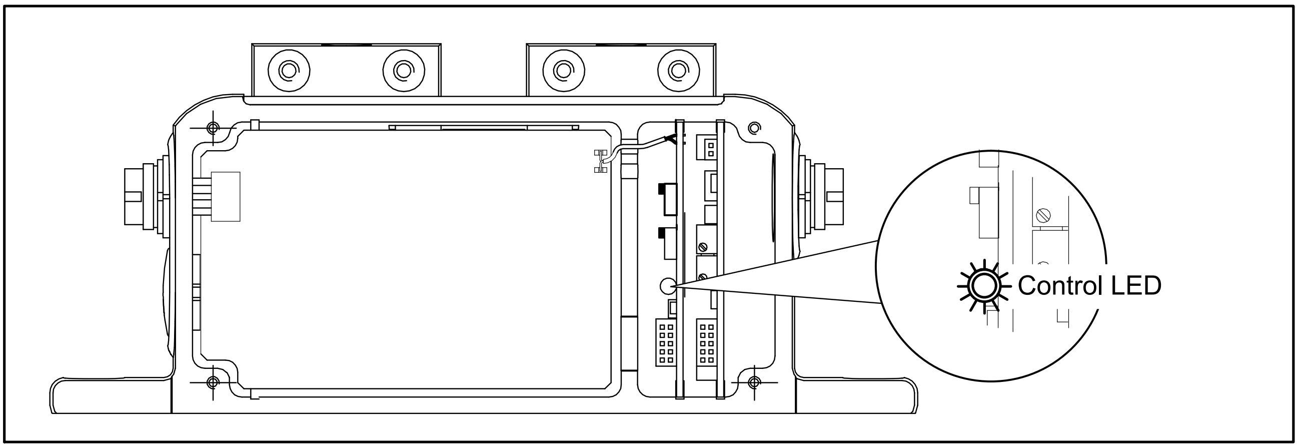


Fig. 7.4: Power transmission function test

7.3.2 Aligning the speed module

When required, you can test the correct functioning of the speed measuring system.

1. Remove the cover of the stator housing.
2. Turn the rotor by at least 2 min^{-1}.

If both the control LEDs come on while you are turning the rotor, the speed measuring system is properly aligned and fully operational.

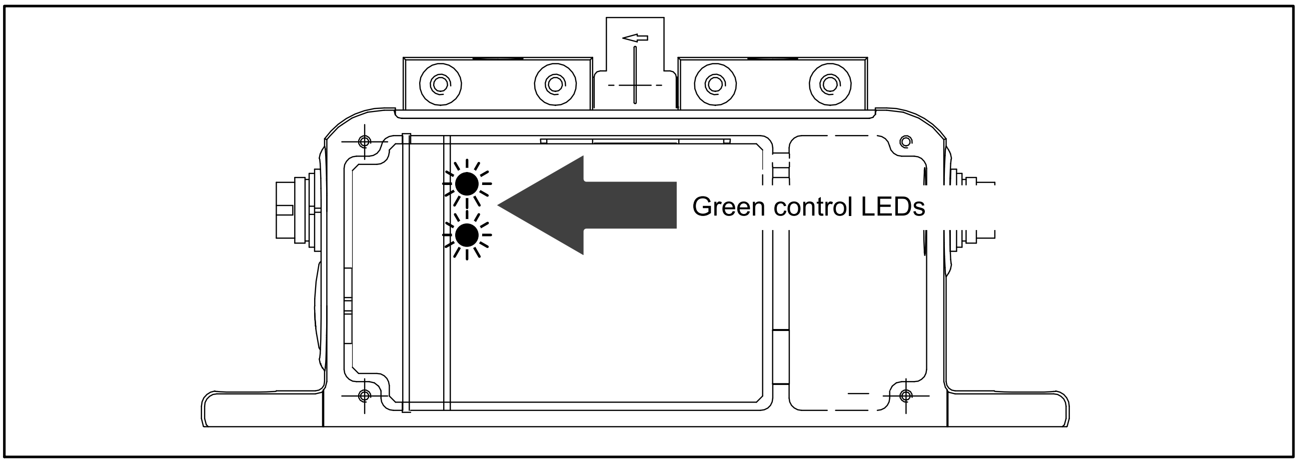


Fig. 7.5: Control LEDs of the speed measuring system

IMPORTANT

When closing the cover of the stator housing, make sure that the internal connection cables are positioned in the grooves provided and are not trapped.

7.4 Setting the pulse count

The number of pulses per revolution of the rotor in the speed module option can be adjusted by means of DIP switches S1...S4.

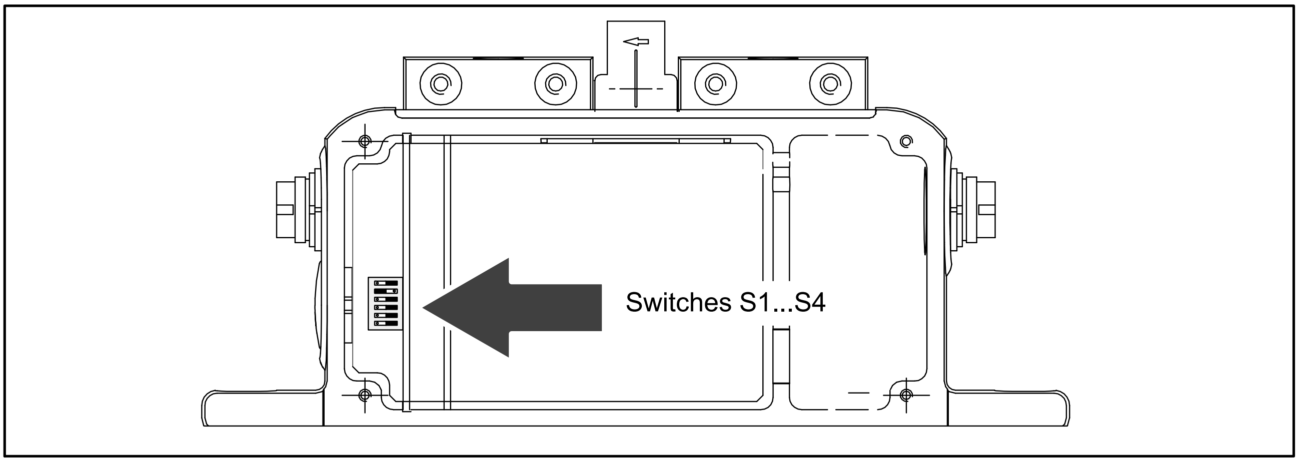


Fig. 7.6: Switches for setting the pulse count

Setting the pulse count

1. Remove the stator cover.
2. Use switches S1 ... S4 as per Tab. 7.1 to set the required pulse count.

Pulses/revolution	720[1)]	360	180	90	60	30	15
	S4 S1						

Tab. 7.1: Switch settings for the pulse count (▬ ≙ switch lever)

[1)] Factory setting

7.5 Vibration suppression (hysteresis)

Low rotation speeds and higher relative vibrations between the rotor and the stator can cause disturbance signals that reverse the direction of rotation. Electronic suppression (hysteresis) to eliminate these disturbances is connected at the factory. This suppresses disturbances caused by radial stator vibration displacement of approx. 2 mm.

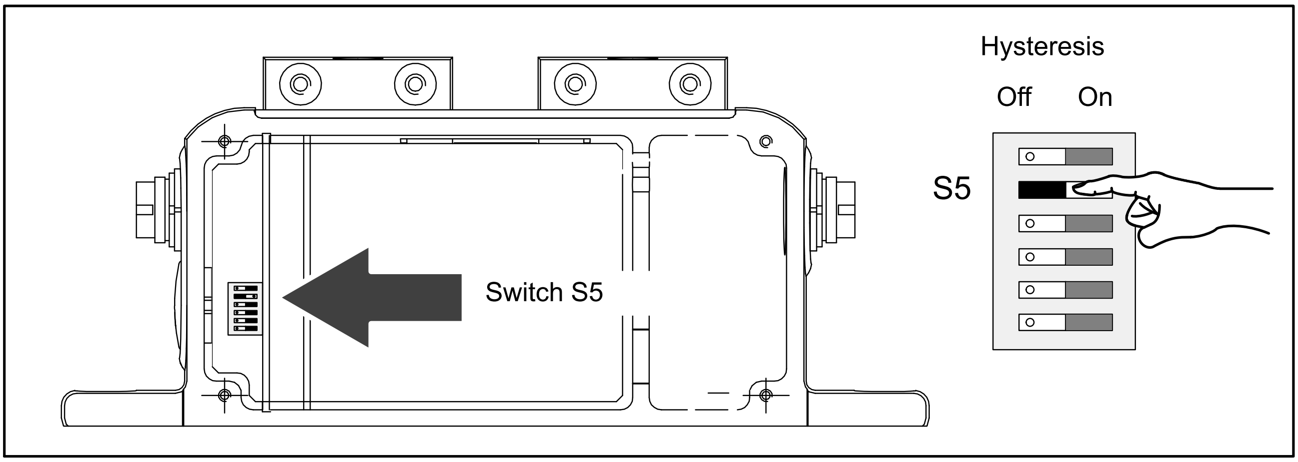


Fig. 7.7: Switch for switching off hysteresis

7.6 Form of speed output signal

In the factory setting, two 90° phase-offset speed signals (5 V symmetrical, complementary RS-422 signals) are available at the speed output (connector 2). You can double the pulse count set in each case by moving switch S6 to the “On" position. Pin 3 then outputs the direction of rotation as a static direction of rotation signal (pin 3 = +5 V, pin 7 = 0 V compared to pin 8), if the shaft turns in the direction of the arrow (see Fig. 7.8). At a speed of 0 min^{-1}, the direction of rotation signal has the last measured value.

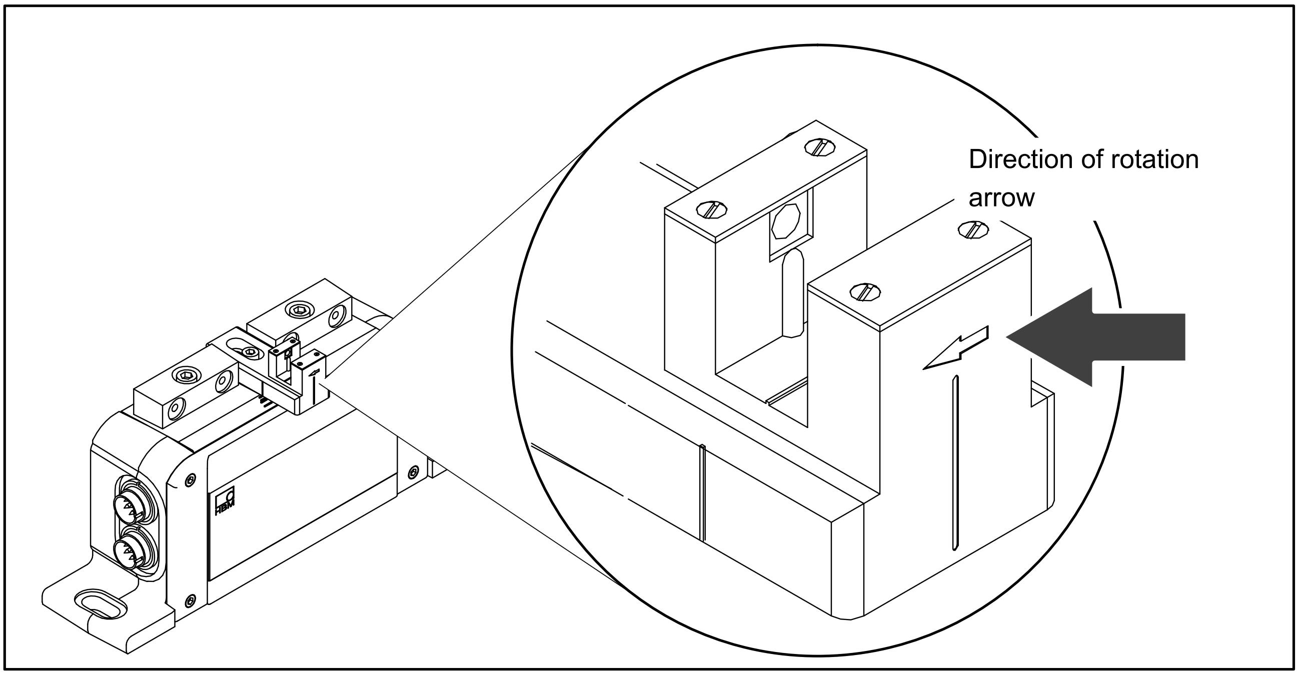


Fig. 7.8: Direction of rotation arrow on the head of the sensor

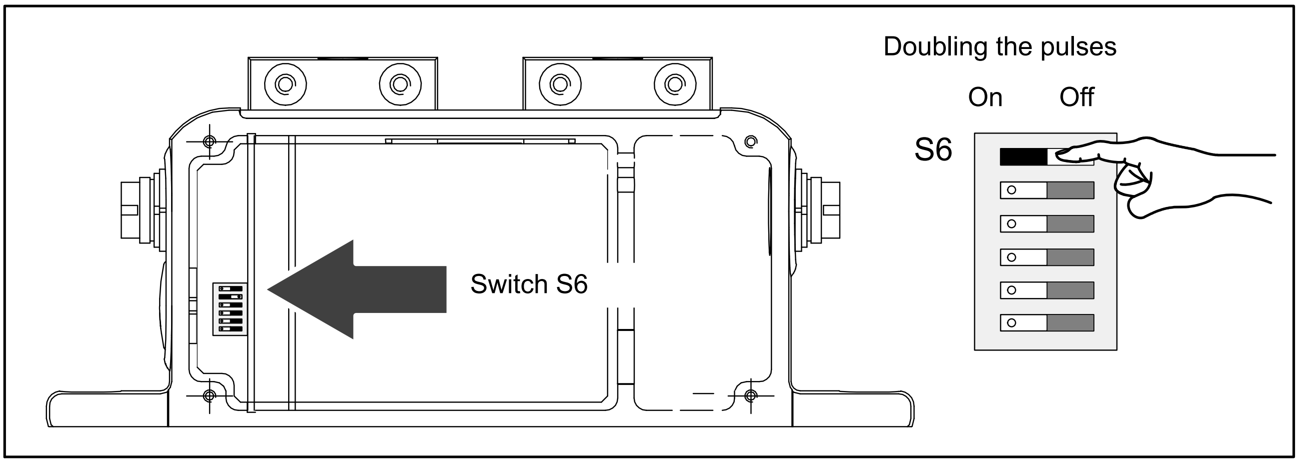


Fig. 7.9: Switch for doubling the pulses

7.7 Type of speed output signal

You can use switch S7 to change the symmetrical 5 V output signal (factory setting) to an asymmetrical signal of 0 V ... 5 V.

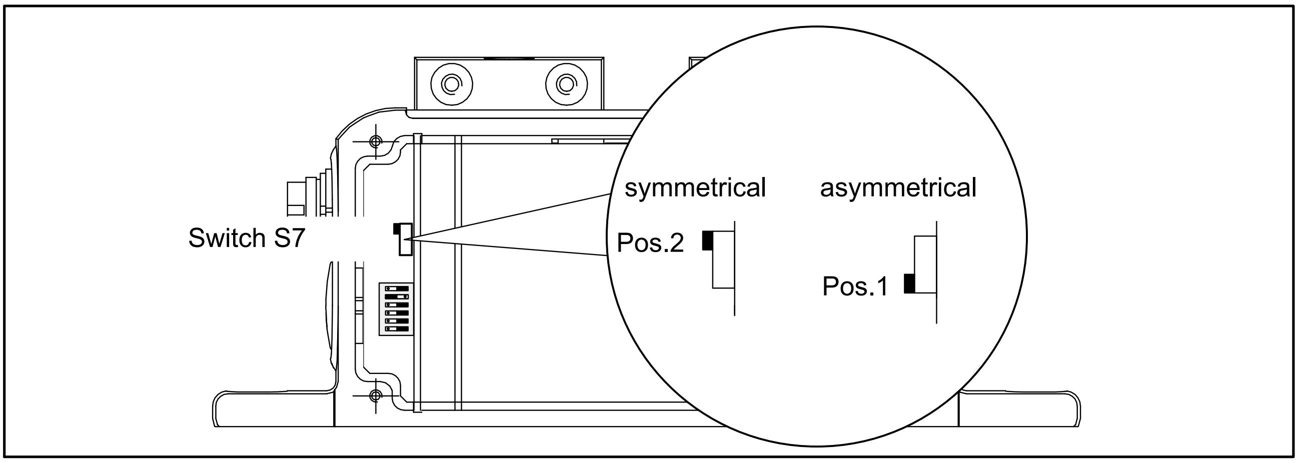


Fig. 7.10: Switch S7; symmetrical/asymmetrical output signal

8 Loading capacity

Nominal 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" chapter, on Page 46.

8.1 Measuring dynamic torque

The torque flanges can be used to measure static and dynamic torques. The following rule applies to the measurement of dynamic torque:

- The T10FM calibration made for static measurements is also valid for dynamic torque measurements.
- The natural frequency f_0 for the mechanical measuring system depends on the moments of inertia J_1 and J_2 of the connected rotating masses and the T10FM torsional stiffness.

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

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

f_0 = natural frequency in Hz
J_1, J_2 = mass moment of inertia in kg·m^2
c_T = torsional stiffness in N·m/rad

- The oscillation width is, depending on the measuring range, 25, 45 and 80 kN·m (see Specifications, Page 50), even with alternating loads. The oscillation width must lie between the maximum upper and lower torques of the defined loading range. The same also applies to transient resonance points.

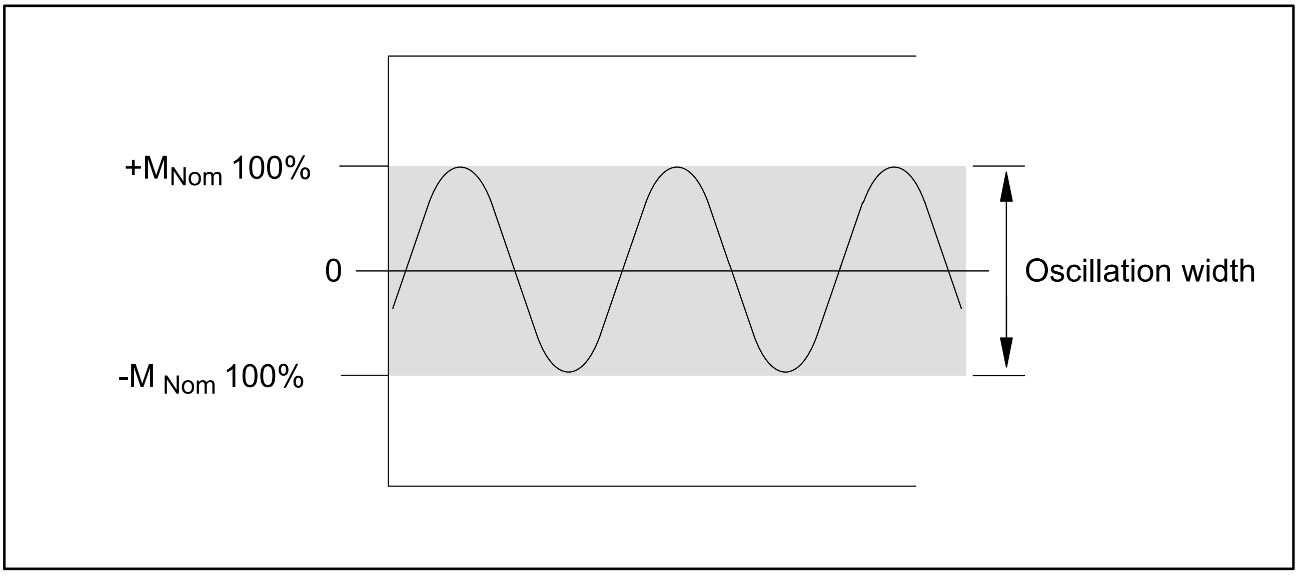


Fig. 8.1: Permissible dynamic loading

9 Maintenance

The torque flanges without a speed module are maintenance-free.

9.1 Speed module maintenance

During operation and depending on the ambient conditions, the slotted disc of the rotor and the associated stator sensor optics can get dirty. This will become noticeable when the polarity of the display changes. Should this occur, the sensor and the slotted disc must be cleaned.

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 cotton bud or one soaked with pure spirit. **Do not use any other solvents!**

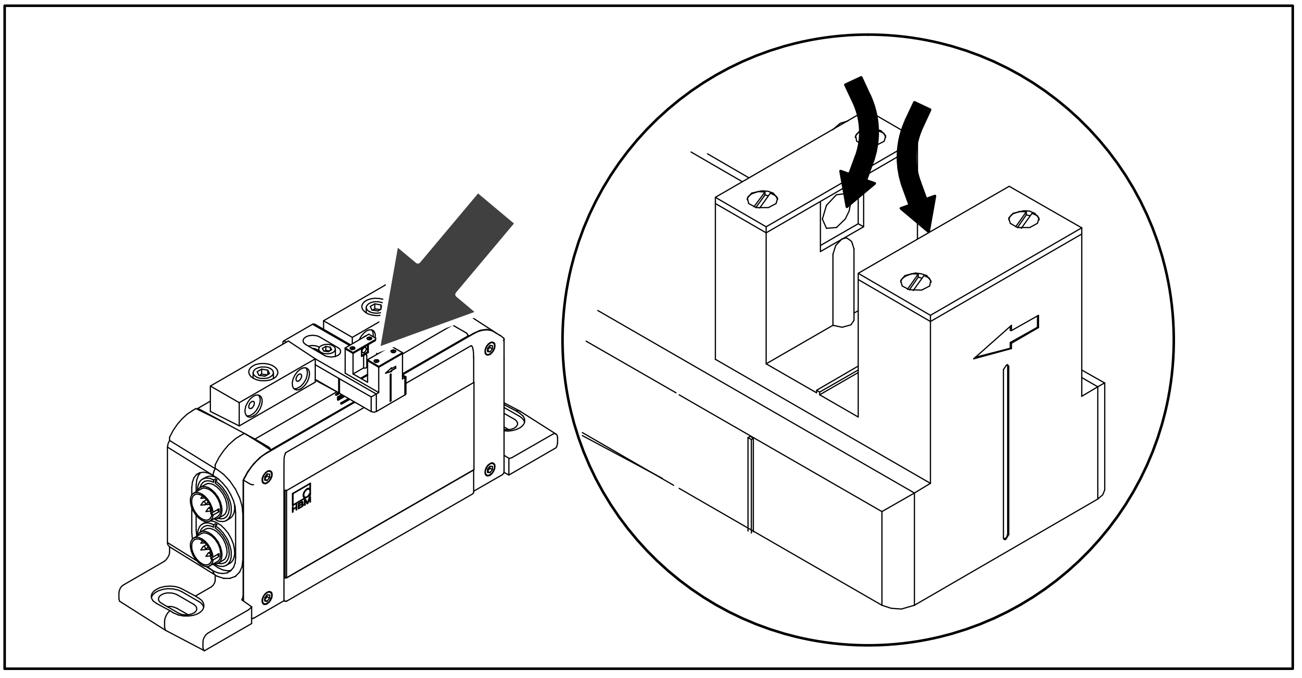
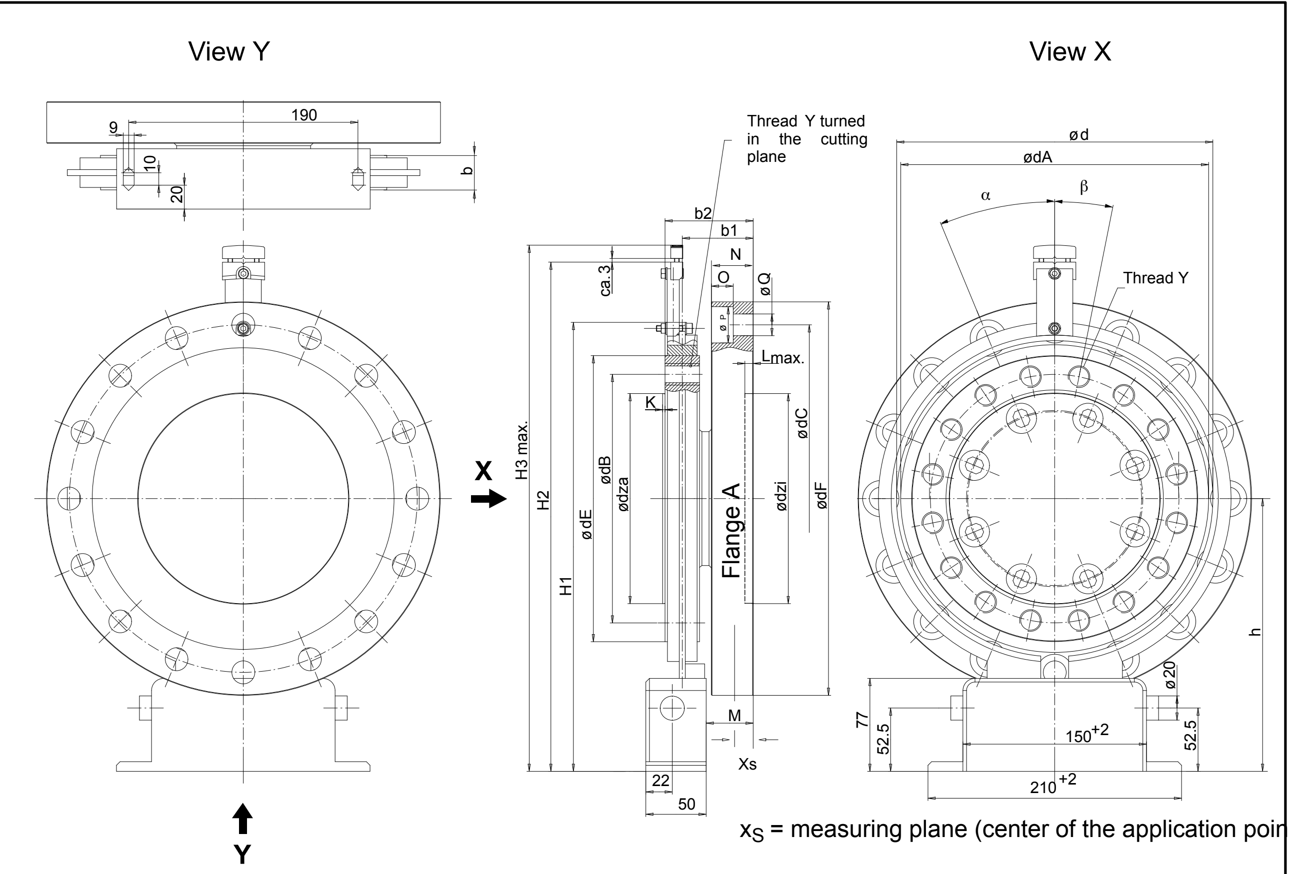


Fig. 9.1: Cleaning points on the speed sensor

10 Dimensions

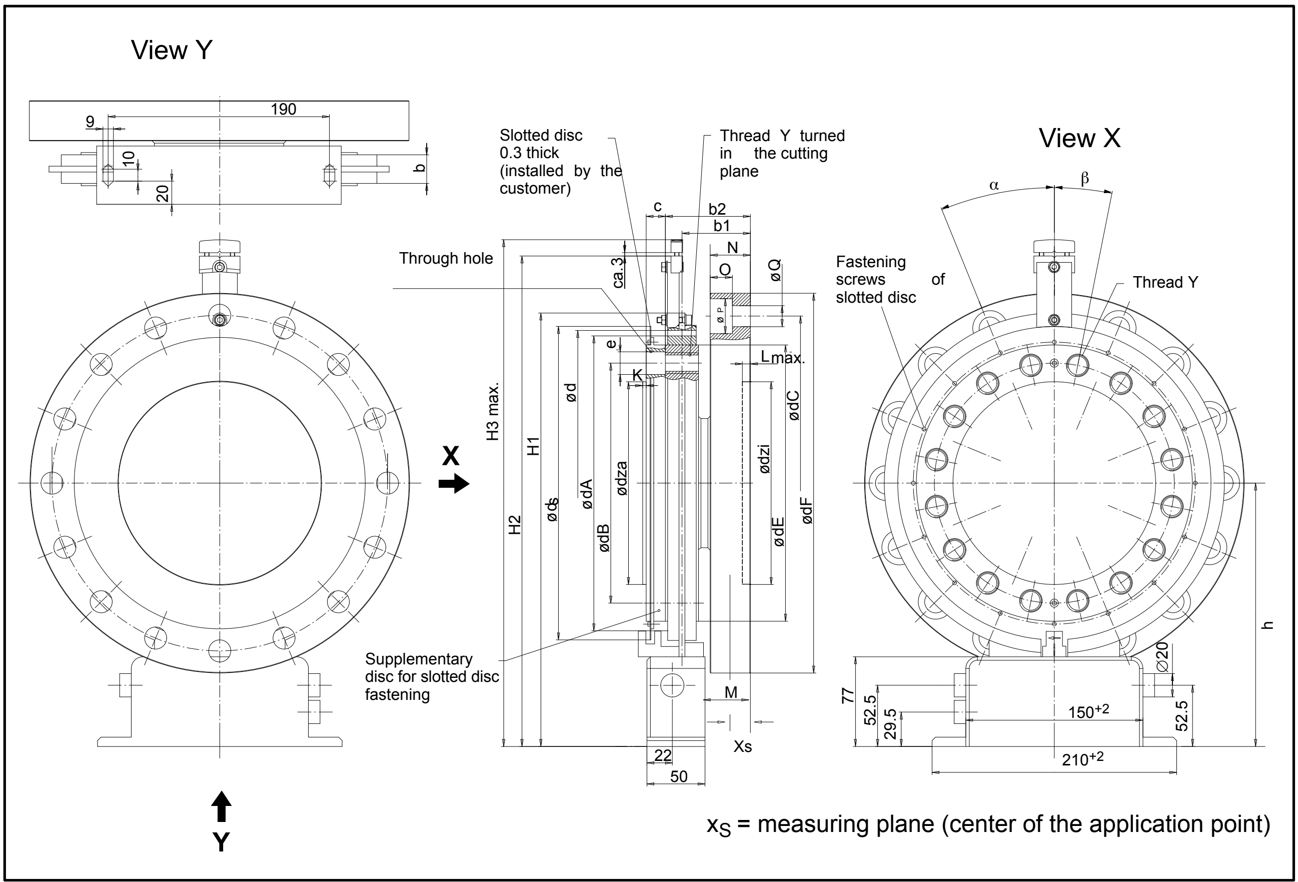
10.1 Dimensions without speed measuring system



Measuring range (kN·m)	Dimensions (in mm; 1 mm = 0.03937 inches)													
	h	H1	H2	H3	b	b1	b2	∅d	∅dA	∅dB	∅dC	∅dE	∅dF	∅dza	K
15 20 25	226.5	373	423	437	28.5	59	73	262	256	206	288	237.15	326	174_{g5}	3
30 40 45	248	416	466	480	35	69	85	305	299	250	350	280.15	390	210_{g5}	4
50 60 70 80	263	446	495	509	40	74	95	335	329	275	385	310.15	425	240_{g5}	4

Measuring range (kN·m)	Dimensions (in mm; 1 mm = 0.03937 inches)										
	∅dzi	L_{max}	M	N	O	P	Q	x_S	α	β	Y
15 20 25	174^{H6}	4	38	34.5	19.5	30	19	24	22.5° 16x22.5° = 360°	11.25° 16x22.5° = 360°	M18
30 40 45	210^{H6}	4	44	40	21.5	33	21	26	15° 24x15° = 360°	15° 24x15° = 360°	M20
50 60 70 80	240^{H6}	4	49	45	23.5	36	23	29	15° 24x15° = 360°	15° 24x15° = 360°	M22

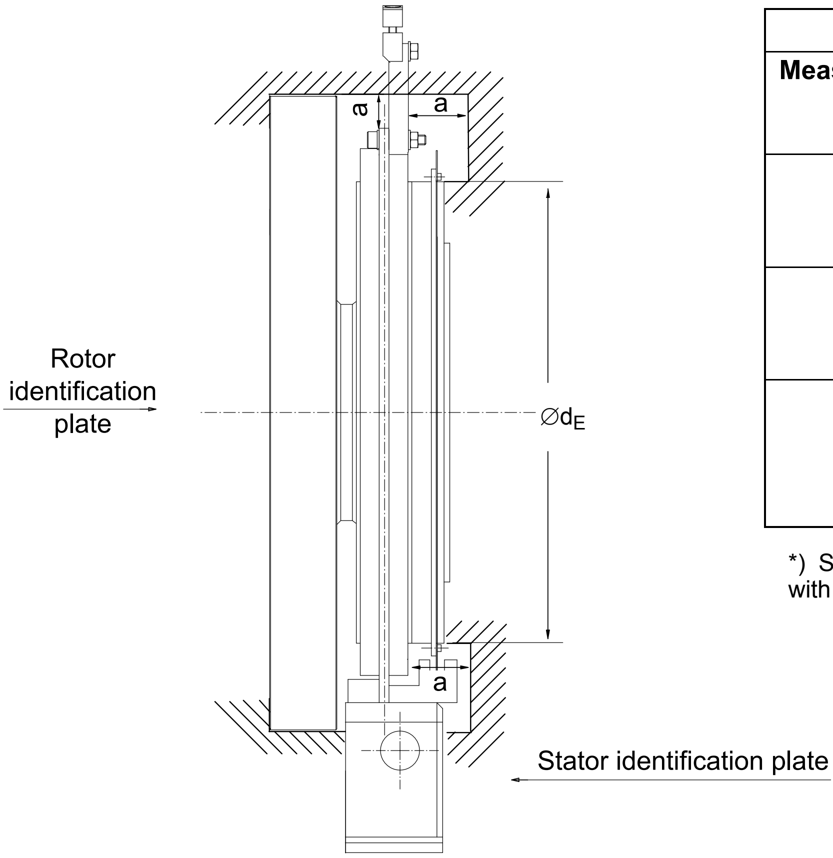
10.2 Dimensions with speed measuring system



Measuring range (kN·m)	Dimensions (in mm; 1 mm = 0.03937 inches)																
	h	H1	H2	H3	b	b1	b2	Ød	ØdA	ØdB	ØdC	ØdE	ØdF	Ødza	K	Ødzi	L_{max}
15 20 25	226.5	373	423	437	28.5	59	73	262	256	206	288	237.15	326	174_{g5}	3	174^{H6}	4
30 40 45	248	416	466	480	35	69	85	305	299	250	350	280.15	390	210_{g5}	4	210^{H6}	4
50 60 70 80	263	446	495	509	40	74	95	335	329	275	385	310.15	425	240_{g5}	4	240^{H6}	4

Measuring range (kN·m)	Dimensions (in mm; 1 mm = 0.03937 inches)											
	$Ød_S$	c	e	M	N	O	P	Q	x_S	α	β	Y
15 20 25	269	16.5	19.5	38	34.5	19.5	30	19	19	22.5° 16x22.5° = 360°	11.25° 16x22.5° = 360°	M18
30 40 45	312	14.5	21.5	44	40	21.5	33	21	21	15° 24x15° = 360°	15° 24x15° = 360°	M20
50 60 70 80	342	9.5	23.5	49	45	23.5	36	23	23	15° 24x15° = 360°	15° 24x15° = 360°	M22

10.3 Mounting dimensions



Mounting dimensions	
Measuring range (kN·m)	**Area a free of metal parts*) (mm)**
15 20 25	20
30 40 45	
50 60 70 80	

*) Support with metal rod is permissible with the recommended dimensions

11 Order numbers, accessories

Code	Option 1: Measuring range
015R	15 kN·m
020R	20 kN·m
025R	25 kN·m
030R	30 kN·m
040R	40 kN·m
045R	45 kN·m
050R	50 kN·m
060R	60 kN·m
070R	70 kN·m
080R	80 kN·m

Code	Option 2: Electrical configuration
SU2	Output signal 10 kHz ±5 kHz and ±10 V, supply voltage 18 ... 30 V DC

Code	Option 3: Accuracy
S	Linearity deviation, including hysteresis < ±0.1 %
G	Linearity deviation, including hysteresis < ±0.05 %

Code	Option 4: Speed measuring system
0	No speed measuring system
1	With speed measuring system

Code	Option 5: Customized modification
S	None
H	Upper maximum permissible speed, measuring range-dependent 4500 min^{-1} to 8000 min^{-1}

Order number:

K-T10FM - ☐☐☐☐ - ☐☐☐ - ☐ - ☐ - ☐

Ordering example:

K-T10FM - 0 5 0 R - S U 2 - S - 0 - S

Accessories, to be ordered separately

1-KAB149-6, torque connection cable, 423 D-Sub 15P, 6 m

1-KAB150-6, speed connection cable, 423 D-Sub 15P, 6 m

1-KAB153-6, torque connection cable, 423 free ends, 6 m

1-KAB154-6, speed connection cable, 423 free ends, 6 m

Cable socket 423G−7S, 7-pin, straight cable entry,
for torque output (connectors 1, 3), Order No. 3-3101.0247

Cable socket 423W−7S, 7-pin, 90° cable entry,
for torque output (connectors 1, 3), Order No. 3-3312.0281

Cable socket 423G−8S, 8-pin, straight cable entry,
for speed output (connector 2), Order No. 3-3312.0120

Cable socket 423W−8S, 8-pin, 90° cable entry,
for speed output (connector 2), Order No. 3-3312.0282

Kab8/00-2/2/2 by the meter, Order No. 4-3301.0071

12 Specifications

Type		T10FM									
Accuracy class		0.1									
Torque measuring system											
Nominal (rated) torque M_{nom}	kN·m	15	20	25	30	40	45	50	60	70	80
Nominal (rated) sensitivity (nominal (rated) signal range between torque = zero and nominal (rated) torque)											
Frequency output	kHz	5									
Voltage output	V	10									
Sensitivity tolerance (deviation of actual output quantity at M_{nom} from nominal (rated) signal range)											
Frequency output	%	±0.2									
Voltage output	%	±0.3									
Output signal at torque = zero											
Frequency output	kHz	10									
Voltage output	V	0									
Nominal output signal											
Frequency output											
at positive nominal (rated) torque	kHz	15 (5 V symmetrical[1)]/12 V asymmetrical)									
at negative nominal (rated) torque	kHz	5 (5 V symmetrical[1]/12 V asymmetrical)									
Voltage output											
at positive nominal (rated) torque	V	+10									
at negative nominal (rated) torque	V	-10									
Load resistance											
Frequency output	kΩ	>2									
Voltage output	kΩ	>5									
Longterm drift over 48 h											
Voltage output	mV	<±3									
Cut-off frequency											
Voltage output -3 dB	kHz	1									
Group delay											
Frequency output	ms	0.15									
Voltage output	ms	0.9									
Residual ripple											
Voltage output	mV	40 (peak-to-peak)									

1) RS-422 complementary signals; factory settings for version SF1/SU2

Nominal (rated) torque M_{nom}	kN·m	15	20	25	30	40	45	50	60	70	80
Temperature effect per 10 K in the nominal (rated) temperature range											
on the output signal, related to the actual value of the signal spread											
Frequency output	%	< ± 0.1									
Voltage output	%	< ± 0.2									
on the zero signal, related to the nominal (rated) sensitivity											
Frequency output	%	< ± 0.05									
Voltage output	%	< ± 0.15									
Maximum control range[2)]											
Frequency output	kHz	4 ... 16									
Voltage output	V	-10.5 ... +10.5									
Energy supply											
Nominal (rated) supply voltage (separated extra-low voltage (SELV))	V (DC)	18 ... 30; asymmetrical									
Current consumption in measuring mode	A	< 0.9									
Current consumption in startup mode	A	< 2									
Nominal (rated) power consumption	W	< 12									
Linearity deviation including hysteresis, relative to the nominal (rated) sensitivity											
Frequency output	%	< ± 0.1 (< ± 0.05 optional)									
Voltage output	%	< ± 0.1 (< ± 0.05 optional)									
Relative standard deviation of the repeatability, as per DIN 1319, related to the variation of the output signal											
Frequency output	%	< ± 0.02									
Voltage output	%	< ± 0.03									
Calibration signal		approx. 50% of M_{nom}; more precise value on identification plate									
Tolerance of the shunt signal, related to M_{nom}	%	< ± 0.05									

2) Output signal range in which there is a repeatable correlation between torque and output signal.

Speed measuring system											
Nominal (rated) torque M_{nom}	kN·m	15	20	25	30	40	45	50	60	70	80
Measurement system		Optical, by means of infrared light and metallic slotted disc									
Mechanical increments	No.	720									
Positional tolerance of the increments	mm	± 0.05									
Slot width tolerance	mm	± 0.05									
Pulses per revolution											
Electrically adjustable	No.	720*); 360; 180; 90; 60; 30; 15									
Output signal	V	5[2)] symmetrical; 2 square-wave signals, approx. 90° phase-shifted									
Minimum rotational speed for sufficient pulse stability	min^{-1}	2									
Group delay	μs	< 5, typ. 2.2									
Hysteresis of reversal[3)] in the case of relative vibrations between the rotor and the stator											
Torsional vibration of the rotor	Deg.	< approx. 2									
Radial vibration amplitude of the stator	mm	< approx. 2									
Load resistance	kΩ	≥2 (note termination resistances as per RS-422)									
Permitted degree of pollution, in the optical path of the optical sensor (lenses, slotted disc)	%	< 50									
Protection against ambient light		By fork and infrared filter									

*) Factory setting
2) RS-422 complementary signals
3) can be switched off

General Information											
Nominal (rated) torque M_{nom}	kN·m	15	20	25	30	40	45	50	60	70	80
EMC											
Emission (as per EN 61326-1, Table 4)											
RFI field strength	-	Class B									
Interference immunity (EN 61326-1, Table A.1)											
Electromagnetic field (AM)	V/m	10									
Magnetic field	A/m	30									
Electrostatic discharge (ESD)											
Contact discharge	kV	4									
Air discharge	kV	8									
Rapid transients (burst)	kV	1									
Impulse voltages (surge)	kV	1									
Conducted interference (AM)	V_{PP}	3									
Degree of protection per EN 60529		IP 54									
Weight, approx.											
Rotor	kg	26			45			60			
Stator	kg	1.4									
Reference temperature	°C	+23									
Nominal (rated) temperature range	°C	+10...+60									
Operating temperature range	°C	-10...+60									
Storage temperature range	°C	-20...+70									
Mechanical shock, test severity level as per IEC 68-2-27											
Number	n	1000									
Duration	ms	3									
Acceleration (half sine)	m/s^2	650									
Vibrational stress, test severity level as per IEC 68-2-6											
Frequency range	Hz	5...65									
Duration	h	1.5									
Acceleration (amplitude)	m/s^2	50									

Nominal (rated) torque M_{nom}	kN·m	15	20	25	30	40	45	50	60	70	80
Nominal (rated) speed	min^{-1}	6000			4000			3000			
Load limits [4]											
Limit torque	kN·m	32			60			110			
Breaking torque	kN·m	>50			>90			>160			
Longitudinal limit force	kN	60			120			240			
Lateral limit force	kN	80			160			240			
Bending limit moment	N·m	6000			12000			24000			
Vibration bandwidth per DIN 50 100 (peak/peak)		25			45			80			
Upper maximum torque	kN·m	+20			+40			+70			
Lower maximum torque	kN·m	-20			-40			-70			

[4] Each type of irregular stress (bending moment, lateral or longitudinal force, exceeding nominal (rated) torque) can only be permitted up to its specified static load limit provided none of the others can occur at the same time. If this condition is not met, the limit values must be reduced. If 30% of the bending limit moment and lateral limit force occur at the same time, only 40% of the longitudinal limit force is permissible and the nominal (rated) torque must not be exceeded. The permissible bending moments, longitudinal forces and lateral forces can affect the measurement result by approx. 1 % of the nominal (rated) torque.

Mechanical values 15 kN·m ... 45 kN·m							
Nominal (rated) torque M_{nom}	kN·m	15	20	25	30	40	45
Torsional stiffness c_T	kN·m/rad	14500			34000		
Torsion angle at M_{nom}	Deg.	0.06	0.08	0.1	0.05	0.065	0.075
Maximum deflection at longitudinal force limit	mm	< 0.05			< 0.08		
Additional max. radial run-out deviation at lateral limit force	mm	< 0.05			< 0.07		
Additional plane/parallel deviation at bending moment limit	mm	< 0.5					
Balance quality level per DIN ISO 1940		G 6.3					
Max. limits for relative rotor vibration displacement (peaktopeak) [5] Undulations in area of connection flange, based on ISO 7919-3							
Normal operation (continuous operation)	µm	$s_{(p-p)} = \frac{9000}{\sqrt{n}}$ (n in $\min^{-1}$)					
Start and stop operation/resonance ranges (temporary)	µm	$s_{(p-p)} = \frac{13200}{\sqrt{n}}$ (n in $\min^{-1}$)					
Mass moment of inertia of the rotor L_V (around axis of rotation)	kg·m²	0.3			0.7		
Proportional mass moment of inertia (flange A)	%	70			70		

[5] The influence of radial run-out deviations, eccentricity, defects of form, notches, marks, local residual magnetism, structural variations or material anomalies needs to be taken into account and isolated from the actual wave oscillation.

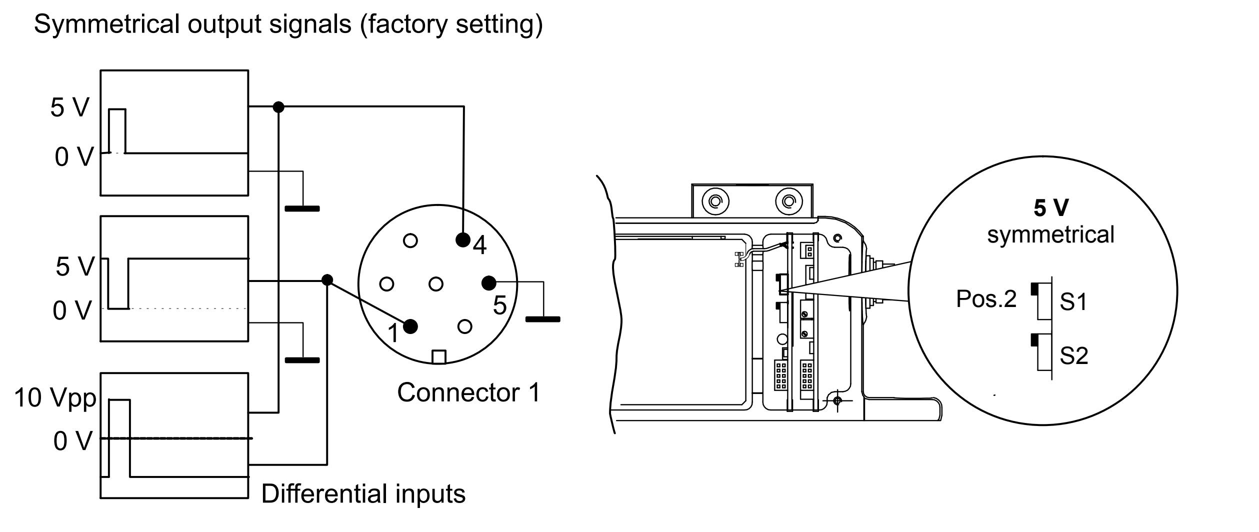
Mechanical values 50 kN·m ... 80 kN·m					
Nominal (rated) torque M_{nom}	kN·m	50	60	70	80
Torsional stiffness c_T	kN·m/ rad	60000			
Torsion angle at M_{nom}	Deg.	0.05	0.06	0.07	0.08
Maximum deflection at longitudinal force limit	mm	< 0.12			
Additional max. radial run-out deviation at lateral limit force	mm	< 0.1			
Additional plane/parallel deviation at bending moment limit	mm	< 0.5			
Balance quality level per DIN ISO 1940		G 6.3			
Max. limits for relative shaft vibration (peak/peak)[6] Undulations in area of connection flange, based on ISO 7919-3					
Normal operation (continuous operation)	µm	$s_{(p-p)} = \frac{9000}{\sqrt{n}}$ (n in min^{-1})			
Start and stop operation/resonance ranges (temporary)	µm	$s_{(p-p)} = \frac{13200}{\sqrt{n}}$ (n in min^{-1})			
Mass moment of inertia of the rotor					
L_V (around axis of rotation)	kg·m^2	1.1			
Proportional mass moment of inertia (flange A)	%	70			
Max. permissible static eccentricity of the rotor (radially) to the center point of the stator					
without speed measuring system	mm	± 2			
with speed measuring system	mm	± 1			
Permissible axial displacement between rotor and stator					
without speed measuring system	mm	± 3			
with speed measuring system	mm	± 2			

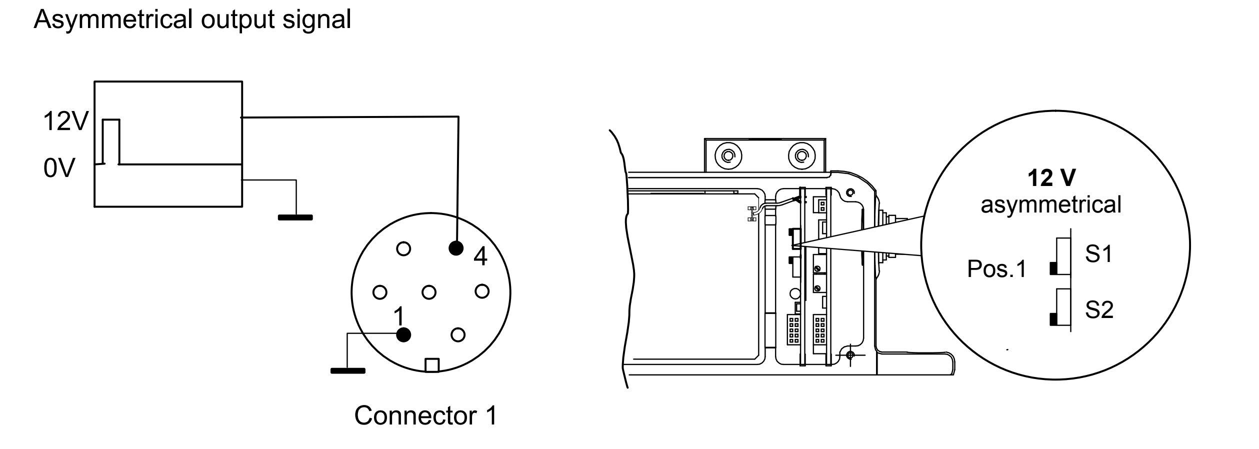
[6] The influence of radial run-out deviations, eccentricity, defects of form, notches, marks, local residual magnetism, structural variations or material anomalies needs to be taken into account and isolated from the actual wave oscillation.

13 Supplementary technical information

13.1 Output signals

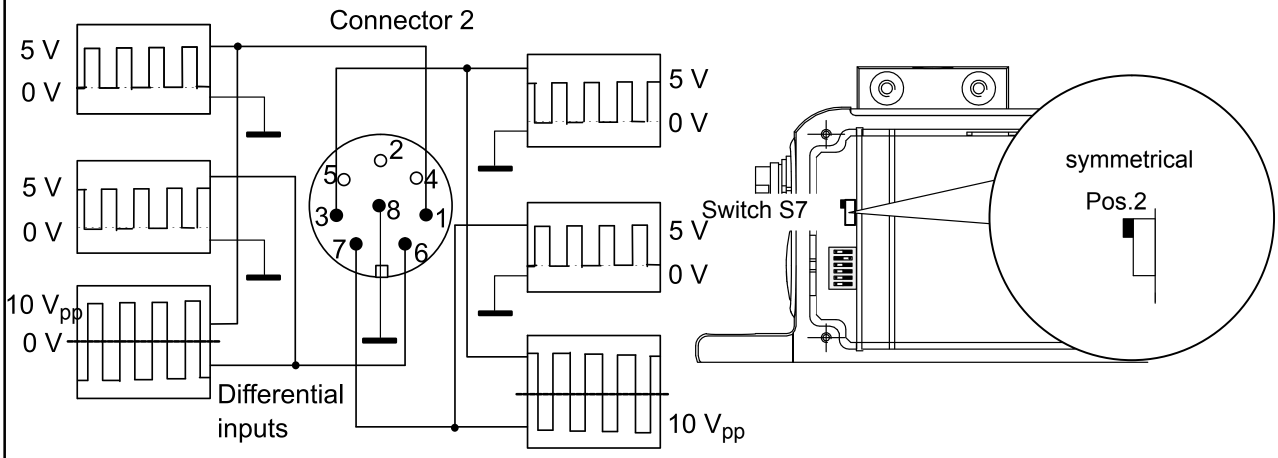
13.1.1 Output MD torque (connector 1)



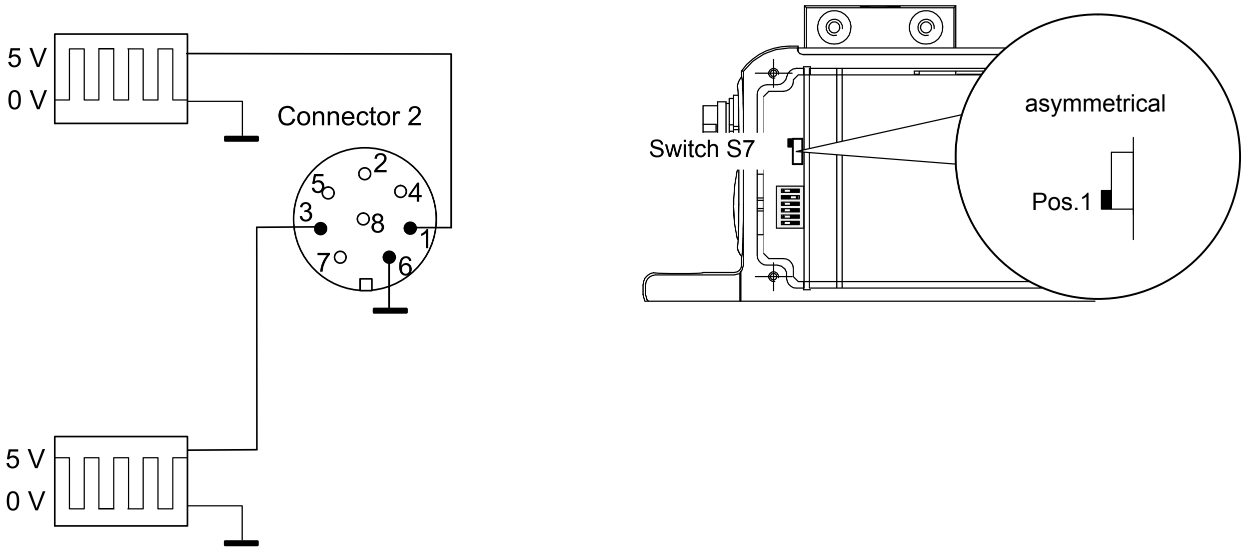


13.1.2 Output N Speed (connector 2)

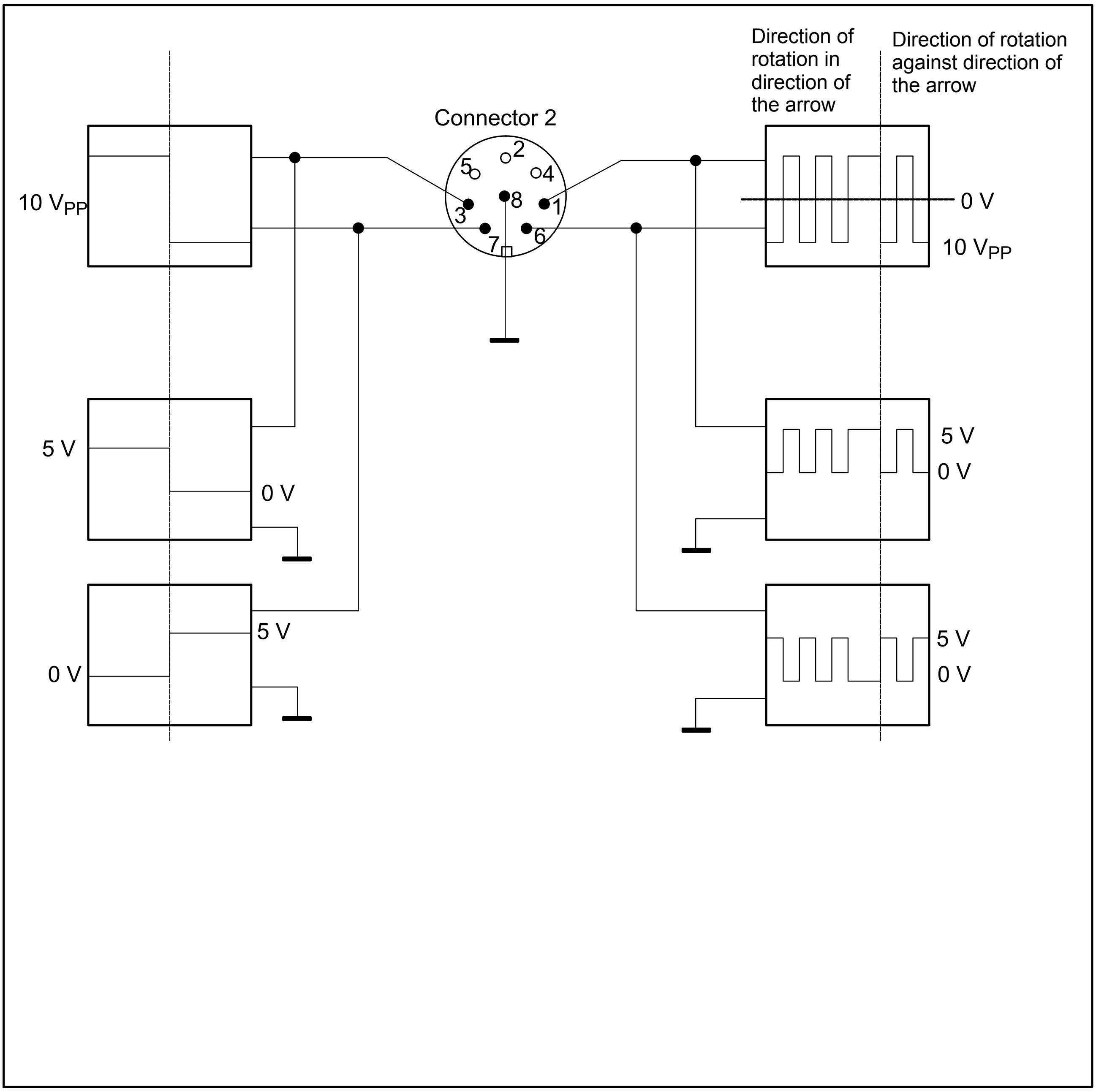
Symmetrical output signals (factory setting)



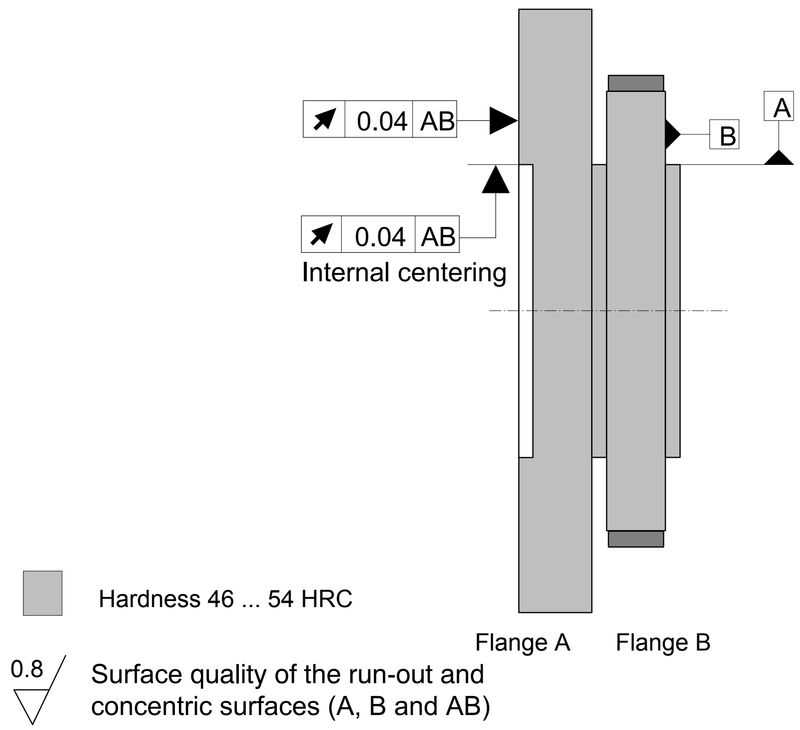
Asymmetrical output signal



13.1.3 Output speed, double frequency, stat. direction of rotation signal



13.2 Axial and radial run-out tolerances



13.3 Additional mechanical data

Measuring range	kN·m	15	20	25	30	40	45	50	60	70	80
Mechanical values											
Stiffness in the axial direction c_a	kN/mm	1250			1500			2200			
Stiffness in the radial direction c_r	kN/mm	1800			2500			3600			
Stiffness during the bending moment round a radial axis c_b	kN·m/rad	3300			7400			14800			

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