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Instruction manual

Reaction torque sensor
Type 4507A… and
Type 4509A…

450xA_002-843e-12.23

Foreword

This manual applies to the Reaction Torque Sensor Type 4507A… (0150) und Type 4509A… (0154).

The instruction manual must be kept on hand for future use, and must be available at the site of implementation of the NC joining system, as needed.

The specifications in this manual can change at any time without prior notification. Kistler reserves the right to improve and to change the product for the purpose of technical progress without the obligation to inform persons and organizations as the result of such changes.

Original language of these operating instructions:
German

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Content

Total pages 19

1. Introduction

Please take the time to thoroughly read this instruction manual. It will help you with the installation, maintenance, and use of this product.

To the extent permitted by law Kistler does not accept any liability if this instruction manual is not followed or products other than those listed under Accessories are used.

Kistler offers a wide range of products for use in measuring technology:

- Piezoelectric sensors for measuring force, torque, strain, pressure, acceleration, shock, vibration and acoustic-emission
- Strain gage sensor systems for measuring force and torque
- Piezoresistive pressure sensors and transmitters
- Signal conditioners, indicators and calibrators
- Electronic control and monitoring systems as well as software for specific measurement applications
- Data transmission modules (telemetry)
- Electromechanical NC joining modules and force-displacement monitors
- Test bed systems for electric motors and gear units for laboratory, manufacturing, and quality assurance

Kistler also develops and produces measuring solutions for the application fields engines, vehicles, manufacturing, plastics and biomechanics sectors.

Our product and application brochures will provide you with an overview of our product range. Detailed data sheets are available for almost all products.

If you need additional help beyond what can be found either online or in this manual, please contact Kistler's extensive support organization.

2. Important information

2.1 Disposal instructions for electrical and electronic equipment

Do not discard old electronic instruments in municipal trash. For disposal at end of life, please return this product to an authorized local electronic waste disposal service or contact the nearest Kistler Instrument sales office for return instructions.

3. General

- Torque sensor with strain gages
- Measurement of static and quasi static torques
- Mechanical design, protective class IP45
- Torque measurement in agitators and other rotating machine elements
- Quality inspection of screw drivers or wrenches
- The construction was optimized concerning the length, weight (moment of inertia) and volume, to minimize axial forces and bending load on the measuring element.
- Through connection of a DC voltage at the strain gage bridge takes place the transformation of the mechanical torque into electrical voltage, with standardised output signal, therefore it is not necessary to do a calibration of the measuring chain after exchange of the sensor.

4. Description of the measuring device

4.1 Mechanical design

The torque sensor consists of a housing (shaft or flange) with integrated torsional section with a strain gage full bridge. The bridge connectors are routed to a built-in connector or a solid connection cable with 6 pole connector (depends on the sensor size).

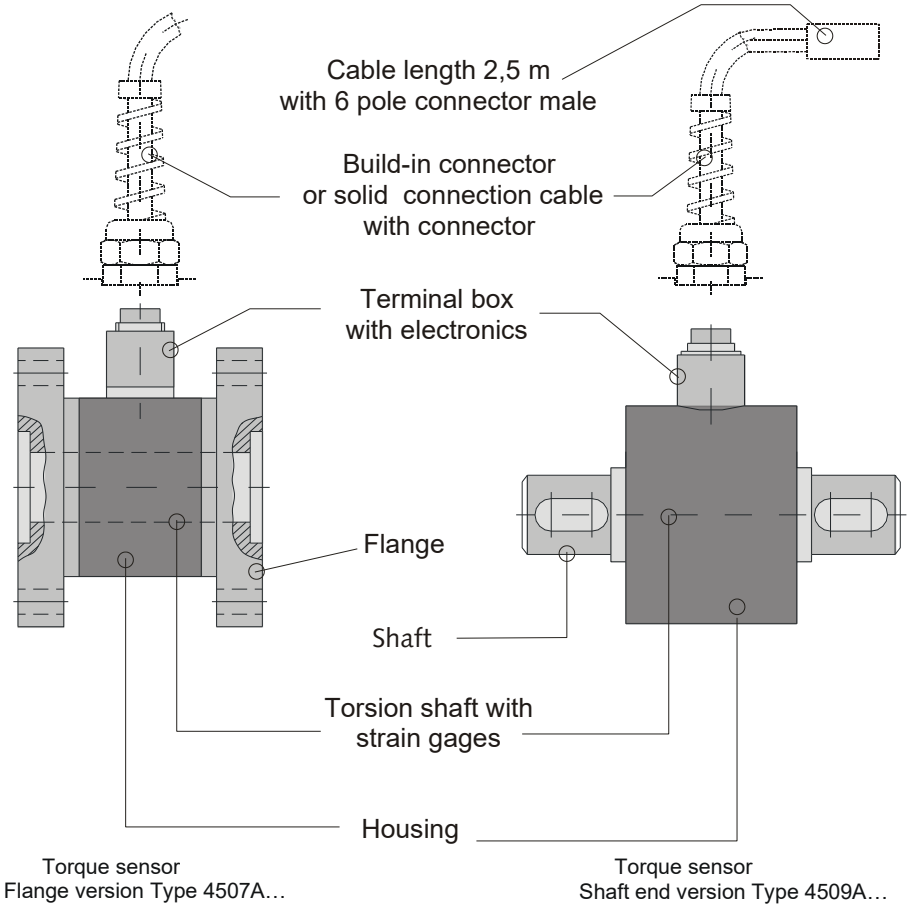


Fig. 1: Mechanical design Reaction Torque Sensor Type 4507A... and Type 4509A…

4.2 Electrical design

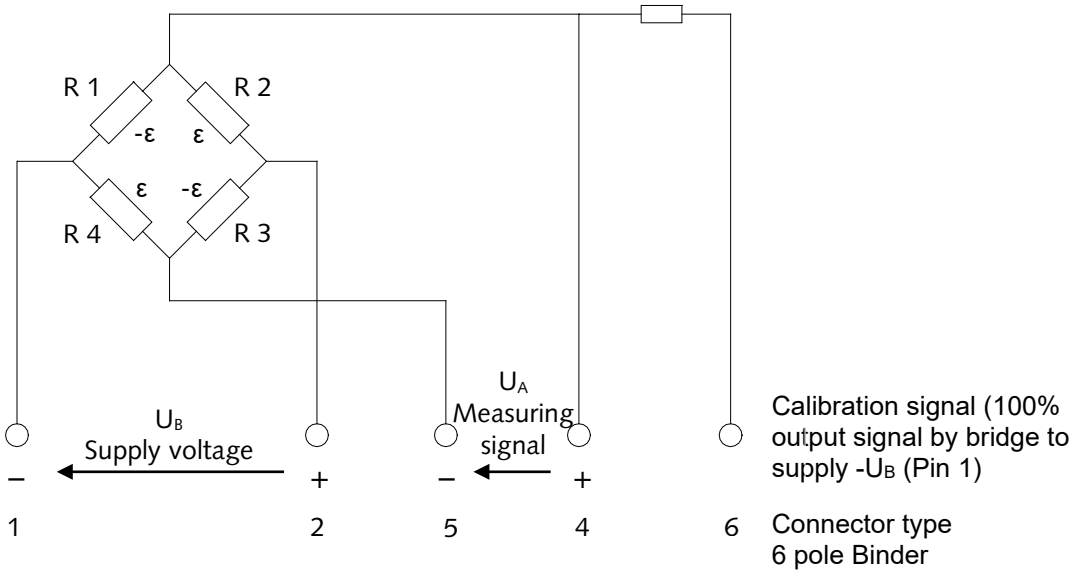


Fig. 2: Electrical design

R 1 … R 4 strain gages on torsion section surface
ε mechanical strain at connected torque
U_B bridge supply voltage
U_A measuring signal

4.3 Features of the strain gage bridge

- Measuring signal proportional to the torque
- High accuracy
- Small influence of the bending tension potential on the measuring signal (mechanical limits must be taken into account)
- Small influence of temperature fluctuation on the measuring signal

5. Installation

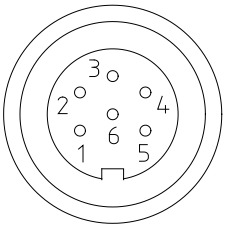
5.1 Electrical connection

- Use a screened cable with 0,14 mm2 rated cross-section
- Factory calibration is performed with 5 m cable length
- Change of cable length results in approx. 0,07 % error per meter

5.1.1 Troubleshooting

- Increased cable length: recalibrate the sensor
- Installation of the measuring cable: not parallel to heavy current or control leads; not in the vicinity of transformers, welding devices, relays, motors
- 6 pole plug: contact arrangement according to DIN 45322
- Abduct away the connection cable from the sensor with a swan-neck. Otherwise errors may occur by torque shunt.
- Transmission of torque as possible close to the flange to keep bending moments low.

5.1.2 Connection assignment



Function	Pin
– Bridge voltage U	1
+ Bridge voltage U	2
Shield	3
+ Measuring signal	4
– Measuring signal	5
Calibration signal	6

- Built-in connector
- Binder Series 680 Type 09-0123-00-06 (6 poles) or similar
- Contact order according to DIN 45322
- Mating connector 6 pole female connector (Binder Type: 00-2022.09-6), article no.: 822

5.2 Mechanical installation

5.2.1 Order of insertion of the measuring device

- Mounting of the adapter flange or other unit and tighten the screws. Thereby clamp against the adapter flange or other unit.
- Mounting of the sensor to the basic set-up and tighten the screws.
- This will prevent the effects of excessive torque on the torque sensor during assembly works.

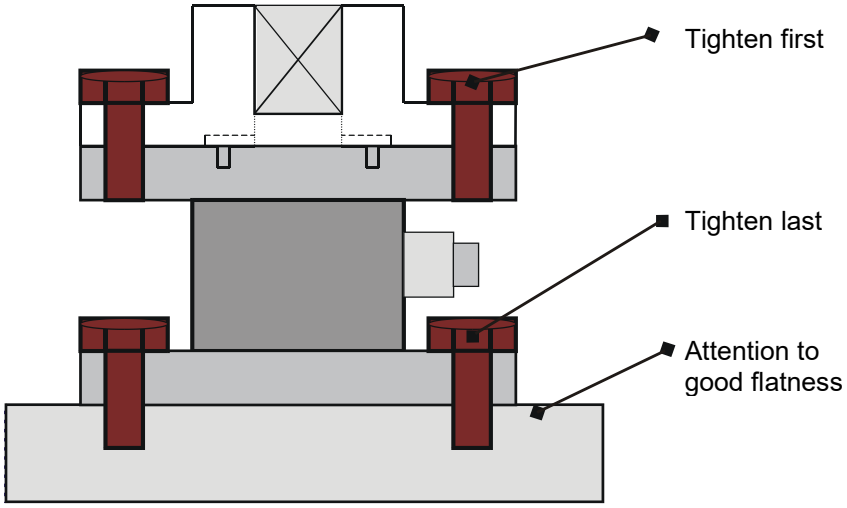
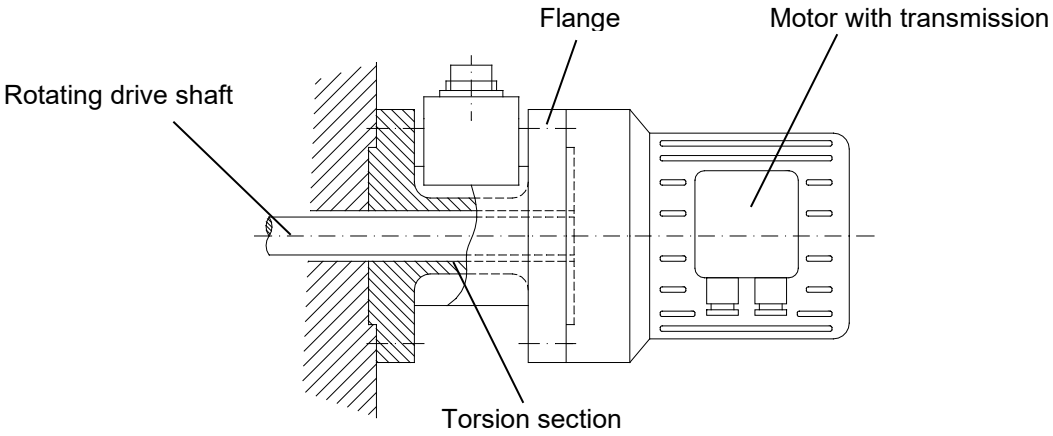


Fig. 3: Torque sensor Type 4507A… with adapter flange for standard female square drive.

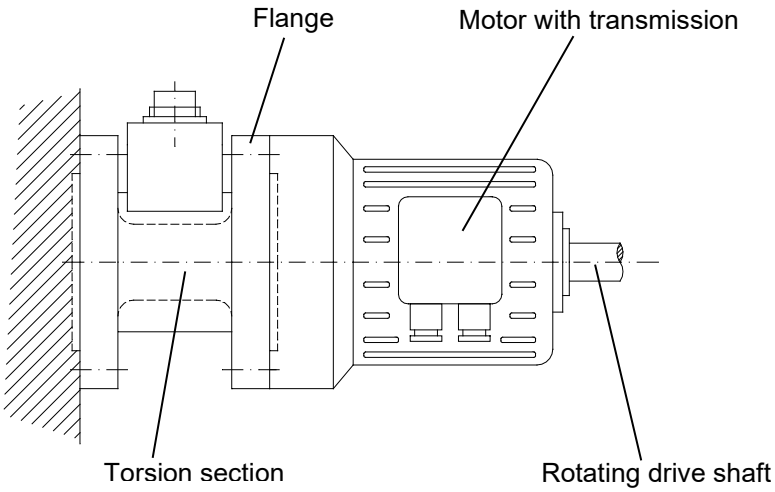
- The flanges of motor and basic setup must show a planned tolerance of 0,01 mm and a surface quality of Rz4 in order to prevent tightening of the flanges. In case wider tolerances are used, zero point deviations, which may change during the operation of the unit and therefore cause measuring errors, must be taken into account when tightening the screws.
- The maximally allowed cross- and axial forces must be noted.
- When using a transmission after the motor please note that there are torque shunts in the transmission. For this reason as shown in the examples, motor and transmission must always be flanged together at the sensor.
- Protect sensor and motor against any access by persons.
- Large bending moments will arise, if someone holds on the motor. This may result in measuring errors.
- Do not assemble any other mechanical parts to the motor, since this may change the measuring characteristics of the torque sensor.

5.3 Examples for the installation of the reaction torque sensor

5.3.1 Reaction torque sensor with center bore-hole and flanged motor



5.3.2 Reaction torque sensor without center bore-hole with flanged motor



Torque sensor Type 4507A… with flanges on booth sides is qualified for recording reaction torques smooth and maintenance free. The above examples are especially recommended to measure torques in agitators.

5.4 Application example for reactional torque sensor with adapter flange for standard square drive

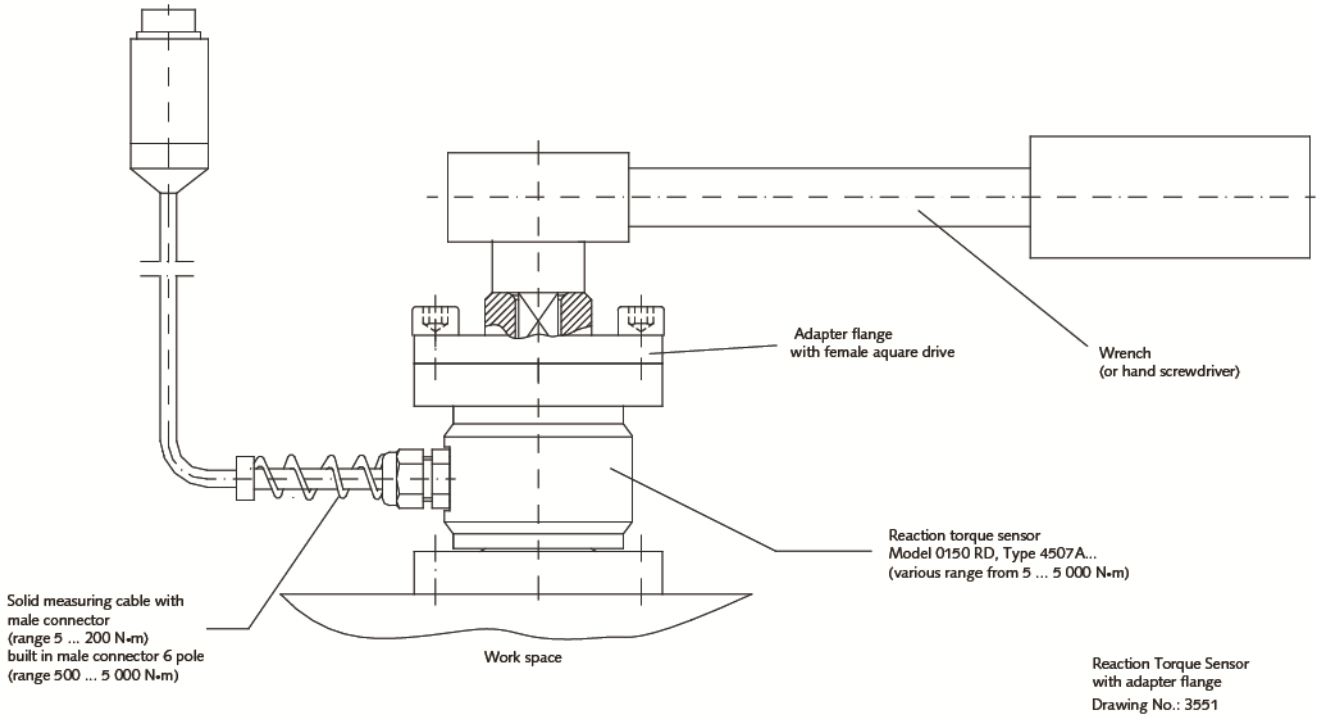


Fig. 4: Application example for reactional torque sensor with adapter flange for standard square drive

It will be possible to provide the torque sensor type Type 4507A… with an adapter flange with female square drive. For this reason the sensor is especially suited to check up screw drivers and wrenches.

6. Calibration

6.1 Electrical calibration

- Attachment of - supply voltage on pin 6 (at 6-pole connector). The calibration signal effects a measuring signal at the output which corresponds with the positive rated torque.
- Measuring cable length is not considered.

6.2 Mechanical calibration

- This requires a calibration device with lever arm and weights for torque generation.

Calibration steps:

- Adjust precisely the zero point
- Load sensor with known torque (e.g. lever arm with weights)
- Adjust display to corresponding torque

6.2.1 Construction of a simple calibration device

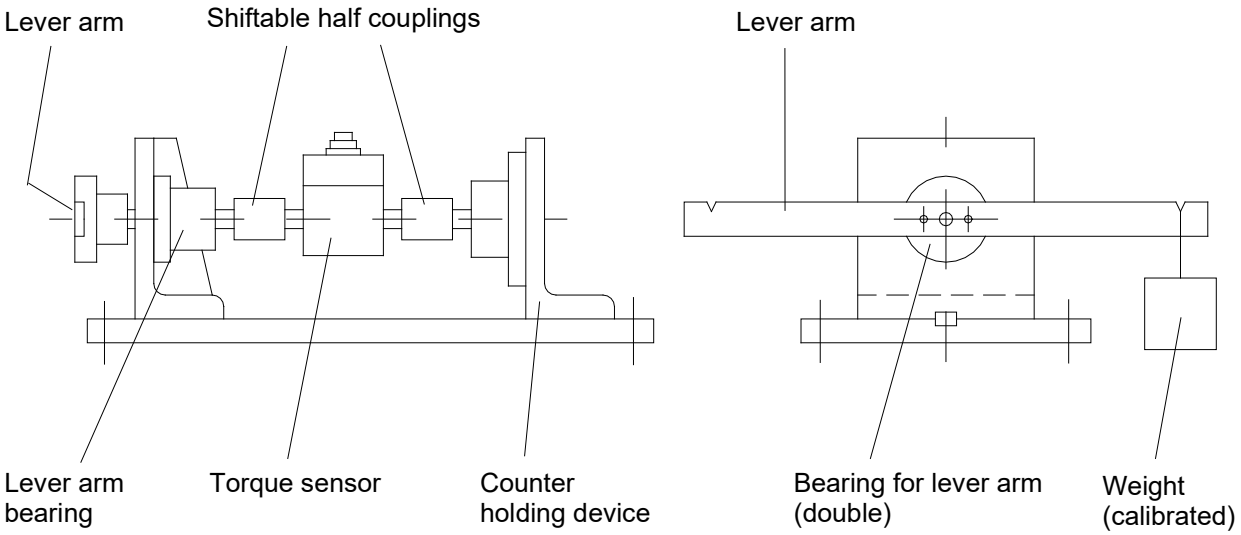


Fig. 5: Construction of a simple calibration device

6.2.2 Example for the calculation of lever arm length

$$L = \frac{M}{m \cdot g}$$, wobei

M = torque
L = required lever arm length
M = required mass
G = 9.80665 m/s²
(= normal case acceleration, dependent on location)

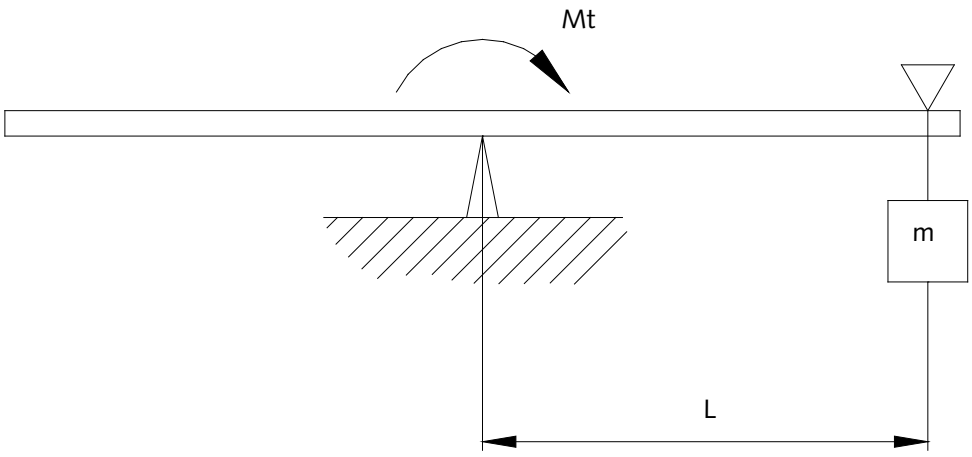


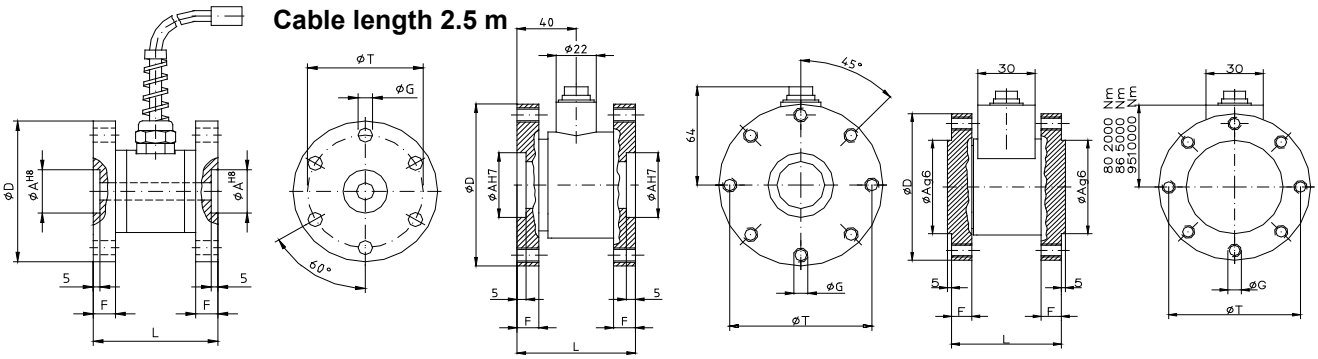
Fig. 6: Example for the calculation of lever arm length

Example: m = 1 kg
Mt = 10 N·m

→ $L = \frac{10\ \text{N·m}\ \text{s}^2}{1\ \text{kg} \times 9{,}80665\ \text{m}} = 1{,}0197\ \text{m}$

7. Technical data torque sensor Type 4507A…

Rated output	mV/V	1
Strain gage bridge resistance		350 , Full bridge
Supply voltage ≤50 Nm >50 Nm	VDC	 5 … 6 5 … 12
Non-linearity including hysteresis	% FSO	± 0.2
Temperature influence on the zero point	%/10K	± 0.1
Temperature influence on the nominal value	%/10K	± 0.1
Nominal temperature range	°C	-5 ... +45
Operating temperature range	°C	-15 ... +55
Relative standard deviation of repeatability	% FSO	± 0.01
Mechanical overload capacity Overload capacity at limiting torque Alternating torque Rupture torque		 1.5 x M_{nom} 0.7 x M_{nom} 3 x M_{nom}
Protection class		IP 45



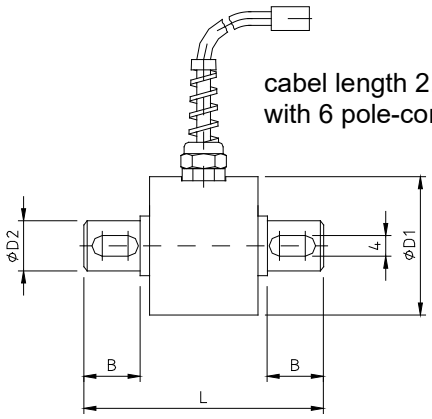
10 … 200 N·m 500 … 1 000 2 000 … 10 000 Nm

Nominal torque M_{nom} Nm	Dimensions (mm)						Numbers of holes of T	Type	Tightening torque for mounting Nm
	L	Ø D	F	Ø A	Ø T	G			
10	65	70	12	20^{H7}	58	M 8	6 x 60°	4507A10	1.5
25	65	70	12	20^{H7}	58	M 8	6 x 60°	4507A25	3
50	65	70	12	20^{H7}	58	M 8	6 x 60°	4507A50	6
100	65	70	12	20^{H7}	58	M 8	6 x 60°	4507A100	12
200	65	70	12	20^{H7}	58	M 8	6 x 60°	4507A200	20
500	80	100	15	40^{H7}	82	M 10	8 x 45°	4507A500	35
1 000	80	100	15	40^{H7}	82	M 10	8 x 45°	4507A1000	70
2 000	110	150	20	70^{g6}	120	M 12	6 x 60°	4507A2000	110
5 000	140	250	25	100^{g6}	220	M 12	8 x 45°	4507A5000	150
10 000	180	280	35	180^{g6}	240	M 18	8 x 45°	4507A10000	250

Mating plug: 6 pole female-connector (Binder type: 99-2022.09-6), article no.: 822

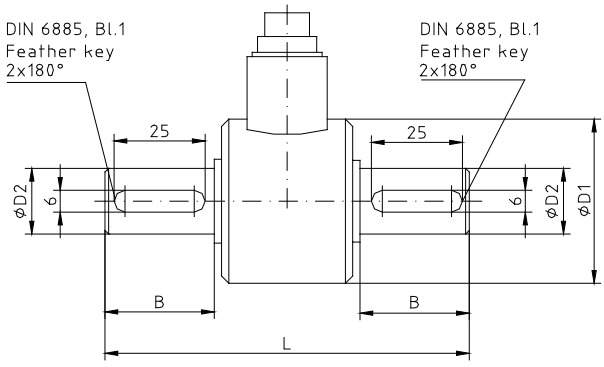
8. Technical data torque sensor Type 4509A…

Rated output	mV/V	1, 0.5 at 0.25 N·m
Strain gage bridge resistance	Ω	350, Full bridge
Supply voltage	Nm	5 to 6 V, >5 to 12 V
Non-linearity including hysteresis	% FSO	±0.2 ±0.3 for measure range 0.5 Nm and 0.25 Nm
Relative standard deviation of repeatability	% FSO	± 0.02
Temperature influence on the zero point	%/10 K	± 0.1
Temperature influence on the nominal value	%/10 K	± 0.1
Nominal temperature range	°C	-5 ... +45
Operating temperature range	°C	-15 ... +55
Mechanical overload capacity Alternating torque Dynamic resilience Rupture torque		 1.5 x M_{nom} 0.7 x M_{nom} 3 x M_{nom}
Protection class		IP 45



Nominal torque 0.5 … 20 Nm

6 pole connector male



Nominal torque 50 und 100 Nm

Nominal torque M_{nom} Nm	Dimensions (mm)				Feather key slots	Type
	L	Ø D1	Ø D2	B		
0.25	50	38	12	12	without	4509A0,5
0.5	50	38	12	12	without	4509A0,5
1	50	38	12	12	without	4509A0,5
2	50	38	12	12	2x180°	4509A0,5
5	50	38	12	12	2x180°	4509A0,5
10	50	38	12	12	2x180°	4509A0,5
20	50	38	12	12	2x180°	4509A0,5
50	100	45	18	30	2x180°	4509A0,5
100	100	45	18	30	2x180°	4509A0,5

* Both shaft ends with feather key slots(2x 180°) acc. to DIN 6885, sheet 1

9. Accessories and ordering key

4507 A
xxxx x xxxxx

Measuring range [Nm]	
10	10
25	25
50	50
100	100
200	200
500	500
1 000	1000
2 000	2000
5 000	5000
10 000	10000

4509 A
xxxx x xxxxx

Measuring range [Nm]	
0.25	0.25
0.5	0.5
1	1
2	2
5	5
10	10
20	20
50	50
100	100

10. Index