

# T12

## Digital Torque Transducer

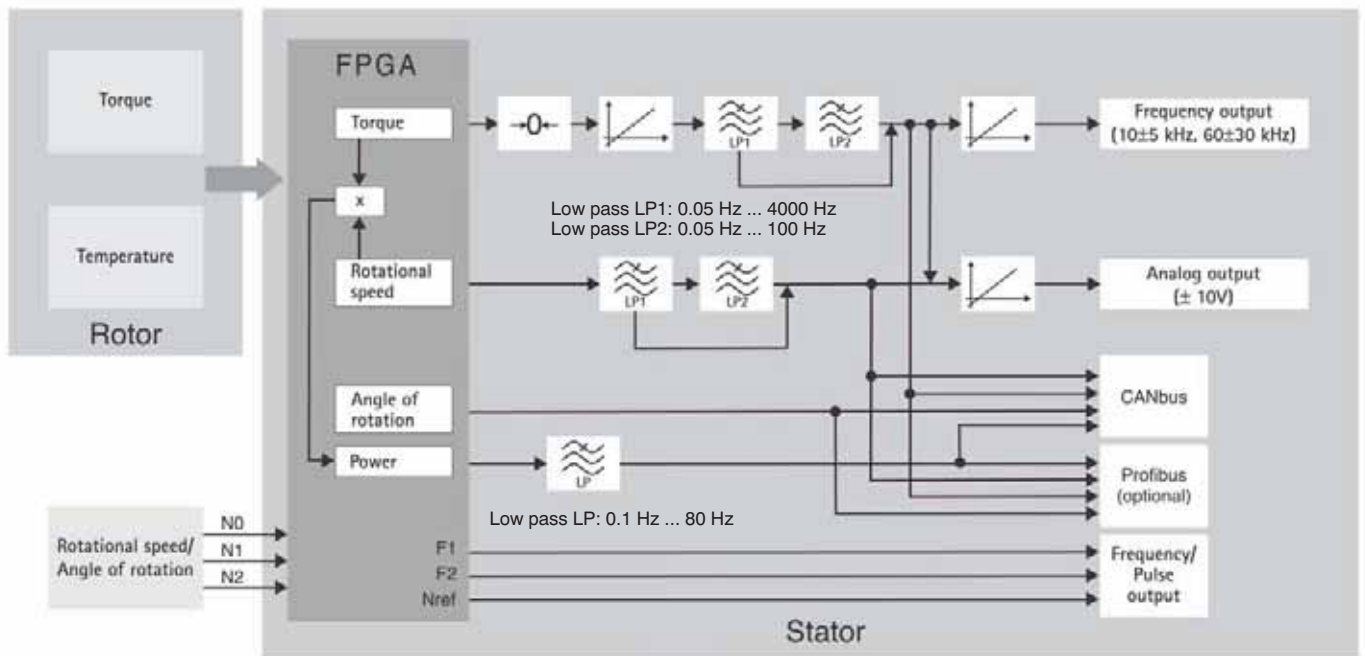


smart torque® by HBM

### Special features

- Nominal (rated) torques of 100 N·m, 200 N·m, 500 N·m, 1 kN·m, 2 kN·m, 3 kN·m, 5 kN·m and 10 kN·m
- Nominal (rated) speeds from 10,000 rpm to 18,000 rpm
- Wide measurement frequency range up to 6 kHz (-3 dB)
- Fast digital transmission of measurement signals: 4,800 measured values/sec
- High resolution of 19 bit (integral method)
- Monitoring functions
- Extensive options

### Block diagram signal flow



# 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 |
| <b>Nominal (rated) sensitivity</b> (range between torque = zero and $M_{nom}$ )<br>Frequency output 10 kHz/60 kHz<br>Voltage output  |        | kHz<br>V  | 5/30<br>10  |     |     |       |       |       |       |
| <b>Sensitivity tolerance</b> (deviation of the actual output quantity at $M_{nom}$ from the nominal (rated) sensitivity)<br>Fieldbusses<br>Frequency output<br>Voltage output  |        | %<br>%<br>%   | ± 0.05<br>± 0.05<br>± 0.1   |     |     |       |       |       |       |
| <b>Output signal at torque = zero</b><br>Frequency output 10 kHz/60 kHz<br>Voltage output  |        | kHz<br>V  | 10/60<br>0  |     |     |       |       |       |       |
| <b>Nominal (rated) output signal</b><br>Frequency output<br>with positive nominal (rated) torque 10 kHz/60 kHz<br>with negative nominal (rated) torque 10 kHz/60 kHz<br>Voltage output<br>with positive nominal (rated) torque<br>with negative nominal (rated) torque<br><b>Low-pass filter LP1</b><br><b>Low-pass filter LP2</b><br><b>Load resistance</b><br>Frequency output<br>Voltage output<br><b>Long-term drift over 48 h</b><br>Voltage output<br><b>Measurement frequency range</b><br>Frequency output/Voltage output<br><br><b>Group delay time (Low pass LP1: 4 kHz)</b><br>Frequency output 10 kHz/60 kHz<br>Voltage output<br><b>Scale range</b><br>Frequency output/Voltage output<br><b>Resolution</b><br>Frequency output 10 kHz/60 kHz<br>Voltage output<br><b>Residual ripple</b><br>Voltage output |        | kHz<br>kHz<br>V<br>V<br>Hz<br>Hz<br>kΩ<br>kΩ<br>mV<br>Hz<br>Hz<br>μs<br>μs<br>%<br>Hz<br>mV<br>mV | 15/90 (5 V symmetric <sup>1</sup> )<br>5/30 (5 V symmetric <sup>1</sup> )<br>+10<br>-10<br>0.05 ... 4,000 (4 <sup>th</sup> order Bessel, -1 dB); factory settings 1,000 Hz<br>0.05 ... 100 (4 <sup>th</sup> order Bessel, -1 dB); factory settings 1 Hz<br>≥ 2<br>≥ 10<br>± 3<br>0 ... 4,000 (-1 dB)<br>0 ... 6,000 (-3 dB)<br>320/250<br>500<br>10 ... 1,000 (of $M_{nom}$ )<br>0.03/0.25<br>0.33<br>3 |     |     |       |       |       |       |
| <b>Temperature influence per 10 K in the nominal (rated) temperature range on the output signal, related to the actual value of signal span</b><br>Fieldbusses<br>Frequency output<br>Voltage output<br><br><b>on the zero signal, related to the nominal (rated) sensitivity</b><br>Fieldbusses<br>Frequency output<br>Voltage output   |        | %<br>%<br>%<br>%<br>%<br>%  | ± 0.03<br>± 0.03<br>± 0.1<br>± 0.02 (± 0.01 optional)<br>± 0.02 (± 0.01 optional)<br>± 0.1  |     |     |       |       |       |       |
| <b>Maximum modulation range<sup>2)</sup></b><br>Frequency output 10 kHz/60 kHz<br>Voltage output   |        | kHz<br>V  | 4 ... 16/24 ... 96<br>-10.2 ... +10.2   |     |     |       |       |       |       |
| <b>Power supply</b><br>Nominal (rated) supply voltage (DC) (separated extra low voltage)<br>Current consumption in measuring mode<br>Current consumption in start-up mode  |        | V<br>A<br>A   | 18 ... 30<br>< 1 (typ. 0.5)<br>< 4  |     |     |       |       |       |       |

<sup>1)</sup> RS-422 complementary signals, observe terminating resistance.

<sup>2)</sup> Output signal range with a repeatable relationship between torque and output signal.

## Specifications (Continued)

| 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 |  |
| <b>Nominal (rated) power consumption</b>   | W      | < 18  |       |       |       |       |       |                               |       |  |
| <b>Maximum cable length</b>  | m      | 50  |       |       |       |       |       |                               |       |  |
| <b>Linearity deviation including hysteresis,</b><br>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  |       |       |       |       |       |                               |       |  |
| <b>Rel. standard deviation of the repeatability,</b> per<br>DIN1319, related to variation of the output signal     |        |   |       |       |       |       |       |                               |       |  |
| Fieldbusses/frequency output   | %      | ± 0.01  |       |       |       |       |       |                               |       |  |
| Voltage output   | %      | ± 0.03  |       |       |       |       |       |                               |       |  |
| <b>Shunt signal</b>  |        | 50 % of $M_{nom}$ or 10 % of $M_{nom}$  |       |       |       |       |       |                               |       |  |
| <b>Tolerance of shunt signal related to <math>M_{nom}</math></b>   | %      | ± 0.05  |       |       |       |       |       |                               |       |  |
| <b>Speed measuring system/measuring system for angle of rotation</b>   |        |   |       |       |       |       |       |                               |       |  |
|  |        | Optical, by means of infrared light and metallic slotted disc                 |       |       |       |       |       |                               |       |  |
| <b>Mechanical increments</b>   | Number | 360   |       |       |       |       | 720   |                               |       |  |
| <b>Positional tolerance of the increments</b>  | mm     | ± 0.05  |       |       |       |       |       |                               |       |  |
| <b>Tolerance of the slot width</b>   | mm     | ± 0.05  |       |       |       |       |       |                               |       |  |
| <b>Pulses per rotation (adjustable)</b>  | Number | 360; 180; 90; 60; 45; 30  |       |       |       |       |       | 720; 360; 180;<br>120; 90; 60 |       |  |
| <b>Pulse frequency at nominal (rated) speed <math>n_{nom}</math></b>   |        |   |       |       |       |       |       |                               |       |  |
| Option 3, Code L <sup>3)</sup>   | kHz    | 90  |       | 72    |       | 120   |       |                               |       |  |
| Option 3, Code H <sup>3)</sup>   | kHz    | 108   |       | 96    |       | 168   |       |                               |       |  |
| <b>Minimum speed for sufficient pulse stability</b>  | rpm    | 2   |       |       |       |       |       |                               |       |  |
| <b>Group delay time</b>  | µs     | < 5 (typ. 2.2)  |       |       |       |       |       |                               |       |  |
| <b>Hysteresis of reversing the direction of rotation</b> with relative vibrations between rotor and stator         |        |   |       |       |       |       |       |                               |       |  |
| Torsional vibrations of the rotor  | Degree | < approx. 2   |       |       |       |       |       |                               |       |  |
| Radial vibration amplitudes of the stator  | mm     | < approx. 2   |       |       |       |       |       |                               |       |  |
| <b>Permitted degree of soiling,</b> in the optical path of the sensor fork (lenses, slotted disc)                  | %      | < 50  |       |       |       |       |       |                               |       |  |
| <b>Swirl influence on the zero point,</b> related to nominal (rated) torque  |        |   |       |       |       |       |       |                               |       |  |
| Option 3, Code L <sup>3)</sup>   | %      | <0.05   | <0.03 | <0.03 | <0.02 |       |       |                               | <0.01 |  |
| Option 3, Code H <sup>3)</sup>   | %      | <0.08   | <0.04 | <0.03 | <0.02 |       |       |                               | <0.01 |  |
| <b>Output signal frequency/pulse output</b>  | V      | 5 <sup>4)</sup> symmetric;<br>2 square wave signals approx. 90° phase shifted |       |       |       |       |       |                               |       |  |
| <b>Load resistance</b>   | kΩ     | ≥ 2   |       |       |       |       |       |                               |       |  |
| <b>Rotational speed</b>  |        |   |       |       |       |       |       |                               |       |  |
| <b>Fieldbusses</b>   |        |   |       |       |       |       |       |                               |       |  |
| <b>Resolution</b>  | rpm    | 0.1   |       |       |       |       |       |                               |       |  |
| <b>System accuracy (at torsional vibrations of max. 3 % of the current rot. speed with double speed frequency)</b> | ppm    | 150   |       |       |       |       |       |                               |       |  |
| <b>Max. speed deviation at nominal (rated) speed (100 Hz-filter)</b>   | rpm    | 1.5   |       |       |       |       |       |                               |       |  |
| <b>Voltage output</b>  |        |   |       |       |       |       |       |                               |       |  |
| <b>Measuring range</b>   | V      | ± 10  |       |       |       |       |       |                               |       |  |
| <b>Resolution</b>  | mV     | 0.33  |       |       |       |       |       |                               |       |  |
| <b>Scale range</b>   | %      | 10 ... 1,000  |       |       |       |       |       |                               |       |  |
| <b>Overmodulation limits</b>   | V      | ± 10.2  |       |       |       |       |       |                               |       |  |
| <b>Load resistance</b>   | kΩ     | > 10  |       |       |       |       |       |                               |       |  |
| <b>Linearity error</b>   | %      | < 0.03  |       |       |       |       |       |                               |       |  |
| <b>Temperature effect per 10 K in the nominal (rated) temperature range</b>  |        |   |       |       |       |       |       |                               |       |  |
| on the output signal, related to the actual value of signal span   | %      | < 0.03  |       |       |       |       |       |                               |       |  |
| on the zero signal   | %      | < 0.03  |       |       |       |       |       |                               |       |  |
| <b>Residual ripple</b>   | mV     | < 3   |       |       |       |       |       |                               |       |  |

<sup>3)</sup> See page 18.

<sup>4)</sup> RS-422 complementary signals, observe terminating resistances.

## Specifications (Continued)

| 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 | 7,000 |
| <b>Angle of rotation</b>  |                          |   |     |     |     |       |       |       |       |
| 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 $\pm 1,440$ (multiturn)  |     |     |     |       |       |       |       |
| <b>Power</b>  |                          |   |     |     |     |       |       |       |       |
| Measurement frequency range   | Hz                       | 80 (-1 dB)  |     |     |     |       |       |       |       |
| Resolution  | W                        | 1   |     |     |     |       |       |       |       |
| Full scale value  | W                        | $P_{max} = M_{nom} \cdot n_{nom} \cdot \frac{\pi}{30}$ <span style="float: right;">[<math>M_{nom}</math>] in N·m<br/>[<math>n_{nom}</math>] in rpm</span> |     |     |     |       |       |       |       |
| 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)           | %                        | $\pm 0.05$  |     |     |     |       |       |       |       |
| <b>Temperature signal rotor</b>   |                          |   |     |     |     |       |       |       |       |
| Accuracy  | K                        | 1   |     |     |     |       |       |       |       |
| Measurement frequency range   | Hz                       | 5 (-1 dB)   |     |     |     |       |       |       |       |
| Resolution  | K                        | 0.1   |     |     |     |       |       |       |       |
| Physical unit   | -                        | °C  |     |     |     |       |       |       |       |
| Sampling rate   | Measure<br>d<br>values/s | 40  |     |     |     |       |       |       |       |
| <b>Fieldbusses</b>  |                          |   |     |     |     |       |       |       |       |
| <b>CANbus</b>   |                          |   |     |     |     |       |       |       |       |
| Protocol  | -                        | CAN 2.0B, CAL/CANopen compatible  |     |     |     |       |       |       |       |
| Sampling rate   | Measure<br>d<br>values/s | max. 4,800 (PDO)<br>per ISO 11898   |     |     |     |       |       |       |       |
| Hardware bus link   |                          |   |     |     |     |       |       |       |       |
| Baud rate   | kBit/s                   | 1,000   | 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 separated from supply and measuring mass   |     |     |     |       |       |       |       |
| <b>Profibus DP</b>  |                          |   |     |     |     |       |       |       |       |
| 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 <sup>5)</sup>   |                          |   |     |     |     |       |       |       |       |
| Konfiguration input $\leq 2$  | Measure<br>d<br>values/s | 4800  |     |     |     |       |       |       |       |
| $\leq 4$  |                          | 2400  |     |     |     |       |       |       |       |
| $\leq 8$  |                          | 1200  |     |     |     |       |       |       |       |
| $\leq 12$   |                          | 600   |     |     |     |       |       |       |       |
| $\leq 16$   |                          | 300   |     |     |     |       |       |       |       |
| $> 16$  |                          | 150   |     |     |     |       |       |       |       |
| <b>Limit value switch (on fieldbusses only)</b>   |                          |   |     |     |     |       |       |       |       |
| Number  | -                        | 4 for torque, 4 for rotational speed  |     |     |     |       |       |       |       |
| Reference level   | -                        | Torque LP1 or LP2<br>Rotational speed LP1 or LP2  |     |     |     |       |       |       |       |
| Hysteresis  | %                        | 0 ... 100   |     |     |     |       |       |       |       |
| Setting accuracy  | Digit                    | 1   |     |     |     |       |       |       |       |
| Response time (LP1= 4,000 Hz)   | ms                       | typ. 3  |     |     |     |       |       |       |       |

<sup>5)</sup> With simultaneously activated CAN-PDOs, the profibus update rate is reduced.

## Specifications (Continued)

| 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  |  |
| <b>TEDS (Transducer Electronic Data Sheet)</b>   |                  |   |     |       |        |       |       |                 |        |  |
| <b>Number</b>  | -                | 2   |     |       |        |       |       |                 |        |  |
| <b>TEDS 1 (torque)</b>   | -                | Optional voltage sensor or frequency sensor |     |       |        |       |       |                 |        |  |
| <b>TEDS 2 (rotational speed/angle of rotation)</b>   | -                | Frequency-/pulse sensor                     |     |       |        |       |       |                 |        |  |
| <b>General data</b>  |                  |   |     |       |        |       |       |                 |        |  |
| <b>EMC</b>   |                  |   |     |       |        |       |       |                 |        |  |
| <b>EME</b> (Emission per EN61326-1, table 3)   |                  |   |     |       |        |       |       |                 |        |  |
| RFI voltage  | -                | Class A                                     |     |       |        |       |       |                 |        |  |
| RFI performance  | -                | Class A                                     |     |       |        |       |       |                 |        |  |
| RFI field strength   | -                | Class A                                     |     |       |        |       |       |                 |        |  |
| <b>Immunity from interference</b> (EN61326-1, table A.1)                                   |                  |   |     |       |        |       |       |                 |        |  |
| Electromagnetic field (AM)   | V/m              | 10  |     |       |        |       |       |                 |        |  |
| Magnetic field   | A/m              | 30  |     |       |        |       |       |                 |        |  |
| <b>ESD</b>   |                  |   |     |       |        |       |       |                 |        |  |
| Contact discharge  | kV               | 4   |     |       |        |       |       |                 |        |  |
| Air discharge  | kV               | 8   |     |       |        |       |       |                 |        |  |
| Burst  | kV               | 1   |     |       |        |       |       |                 |        |  |
| Surge  | kV               | 1   |     |       |        |       |       |                 |        |  |
| Line-conducted disturbance (AM)  | V                | 3   |     |       |        |       |       |                 |        |  |
| <b>Degree of protection per EN 60529</b>   | -                | IP 54                                       |     |       |        |       |       |                 |        |  |
| <b>Weight</b> , 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             |        |  |
| <b>Reference temperature</b>   | °C [°F]          | +23 [73.4]                                  |     |       |        |       |       |                 |        |  |
| <b>Nominal (rated) temperature range</b>   | °C [°F]          | +10 ... +60 [+50 ... +140]                  |     |       |        |       |       |                 |        |  |
| <b>Service temperature range</b>   | °C [°F]          | -10 ... +60 [+14 ... +140]                  |     |       |        |       |       |                 |        |  |
| <b>Storage temperature range</b>   | °C [°F]          | -20 ... +70 [-4 ... +158]                   |     |       |        |       |       |                 |        |  |
| <b>Impact resistance, test severity level per DIN IEC 68; part 2-27; IEC 68-2-27-1987</b>  |                  |   |     |       |        |       |       |                 |        |  |
| Number of impacts  | n                | 1,000                                       |     |       |        |       |       |                 |        |  |
| Duration   | ms               | 3   |     |       |        |       |       |                 |        |  |
| Acceleration (half-sine)   | m/s <sup>2</sup> | 650   |     |       |        |       |       |                 |        |  |
| <b>Vibration resistance, test severity level per DIN IEC 68; part 2-6; IEC 68-2-6-1982</b> |                  |   |     |       |        |       |       |                 |        |  |
| Frequency range  | Hz               | 5 ... 65                                    |     |       |        |       |       |                 |        |  |
| Duration   | h                | 1.5   |     |       |        |       |       |                 |        |  |
| Acceleration (amplitude)   | m/s <sup>2</sup> | 50  |     |       |        |       |       |                 |        |  |
| <b>Nominal (rated) speed <math>n_{nom}</math></b>  |                  |   |     |       |        |       |       |                 |        |  |
| Option 3, Code L <sup>6)</sup>   | rpm              | 15,000                                      |     |       | 12,000 |       |       | 10,000          |        |  |
| Option 3, Code H <sup>6)</sup>   | rpm              | 18,000                                      |     |       | 16,000 |       |       | 14,000   12,000 |        |  |
| <b>Load limits<sup>7)</sup></b>  |                  |   |     |       |        |       |       |                 |        |  |
| <b>Limit torque, (static) ± related to <math>M_{nom}</math></b>                            | %                | 200   |     |       |        |       | 160   |                 |        |  |
| <b>Breaking torque, (static) ± related to <math>M_{nom}</math></b>                         | %                | > 400                                       |     |       |        |       | > 320 |                 |        |  |
| <b>Axial limit force (static) ±</b>  | kN               | 5   | 10  | 16    | 19     | 39    | 42    | 80              | 120    |  |
| <b>Axial limit force (dynamic) amplitude</b>   | kN               | 2.5   | 5   | 8     | 9.5    | 19.5  | 21    | 40              | 60     |  |
| <b>Lateral limit force (static) ±</b>  | kN               | 1   | 2   | 4     | 5      | 9     | 10    | 12              | 18     |  |
| <b>Lateral limit force (dynamic) amplitude</b>   | kN               | 0.5   | 1   | 2     | 2.5    | 4.5   | 5     | 6               | 9      |  |
| <b>Bending limit moment (static) ±</b>   | N·m              | 50  | 100 | 200   | 220    | 560   | 600   | 800             | 1200   |  |
| <b>Bending limit moment (dynamic) amplitude</b>  | N·m              | 25  | 50  | 100   | 110    | 280   | 300   | 400             | 600    |  |
| <b>Oscillation bandwidth per DIN 50100 (peak-to-peak)<sup>8)</sup></b>                     | N·m              | 200   | 400 | 1,000 | 2,000  | 4,000 | 4,800 | 8,000           | 16,000 |  |

<sup>6)</sup> See page 18.

<sup>7)</sup> 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.

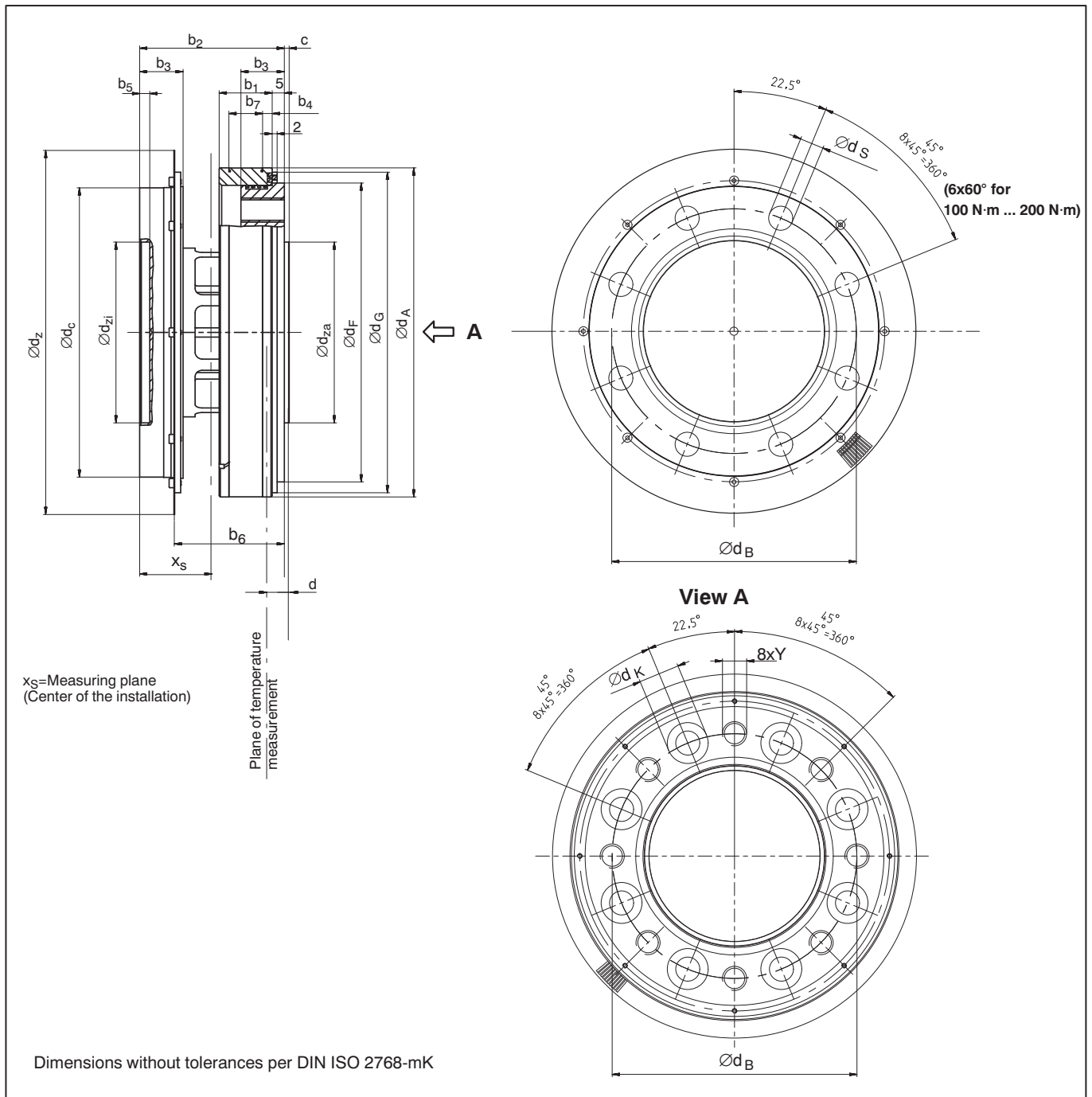
<sup>8)</sup> The nominal (related) torque must not be exceeded.

## Specifications (Continued)

| 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 |
| <b>Mechanical data</b>   |                   |  |        |        |        |        |        |                                      |       |
| <b>Torsional stiffness <math>c_T</math></b>  | kN·m/rad          | 230  | 270    | 540    | 900    | 2,300  | 2,600  | 4,600                                | 7,900 |
| <b>Torsion angle at <math>M_{nom}</math></b>   | Degree            | 0.048  | 0.043  | 0.055  | 0.066  | 0.049  | 0,066  | 0,06                                 | 0,07  |
| <b>Axial stiffness <math>c_a</math></b>  | kN/mm             | 420  | 800    | 740    | 760    | 950    | 1,000  | 950                                  | 1,600 |
| <b>Radial stiffness <math>c_r</math></b>   | kN/mm             | 130  | 290    | 550    | 810    | 1,300  | 1,500  | 1,650                                | 2,450 |
| <b>Stiffness with bending moment about a radial axis <math>c_b</math></b>  | kN·m/degree       | 3,8  | 7      | 11.5   | 12     | 21.7   | 22.4   | 43                                   | 74    |
| <b>Maximum excursion at axial limit force</b>  | mm                | < 0.02                                       |        | < 0.03 |        | < 0.05 |        | < 0.1                                |       |
| <b>Additional max. radial run-out deviation at lateral limit force</b>   | mm                | < 0.02                                       |        |        |        |        |        |                                      |       |
| <b>Additional plane-parallel deviation at bending limit moment (with <math>\varnothing d_B</math>)</b>   | mm                | <0.03  |        | <0.05  |        | <0.07  |        |                                      |       |
| <b>Balance quality-level per DIN ISO 1940</b>  |                   | G 2.5  |        |        |        |        |        |                                      |       |
| <b>Max. limits for relative shaft vibration (peak-to-peak)<sup>9)</sup></b><br>Undulations within the range of the connecting flanges per ISO 7919-3 | $\mu\text{m}$     | 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)                                   |        |        |        |        |        |                                      |       |
| <b>Mass moment of inertia of the rotor</b>   |                   |  |        |        |        |        |        |                                      |       |
| $I_y$ (around rotating axis)   | kg·m <sup>2</sup> | 0.0023                                       | 0.0033 | 0.0059 | 0.0192 | 0.037  | 0.097  |                                      |       |
| $I_y$ with optical speed measuring system  | kg·m <sup>2</sup> | 0.0025                                       | 0.0035 | 0.0062 | 0.0196 | 0.038  | 0.0995 |                                      |       |
| <b>Proportionate mass moment of inertia for assembly side</b>  |                   |  |        |        |        |        |        |                                      |       |
| without speed measuring system   | %                 | 58   | 56     | 54     | 53     |        |        |                                      |       |
| with optical speed measuring system  | %                 | 56   | 54     | 53     | 52     |        |        |                                      |       |
| <b>Max. permissible static eccentricity</b><br>of the rotor (radially) to stator center  |                   |  |        |        |        |        |        |                                      |       |
| without speed measuring system   | mm                | $\pm 2$                                      |        |        |        |        |        |                                      |       |
| with speed measuring system  | mm                | $\pm 1$                                      |        |        |        |        |        |                                      |       |
| <b>Max. permissible axial displacement of the rotor to stator</b>  | mm                | $\pm 2$                                      |        |        |        |        |        |                                      |       |

<sup>9)</sup> 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.

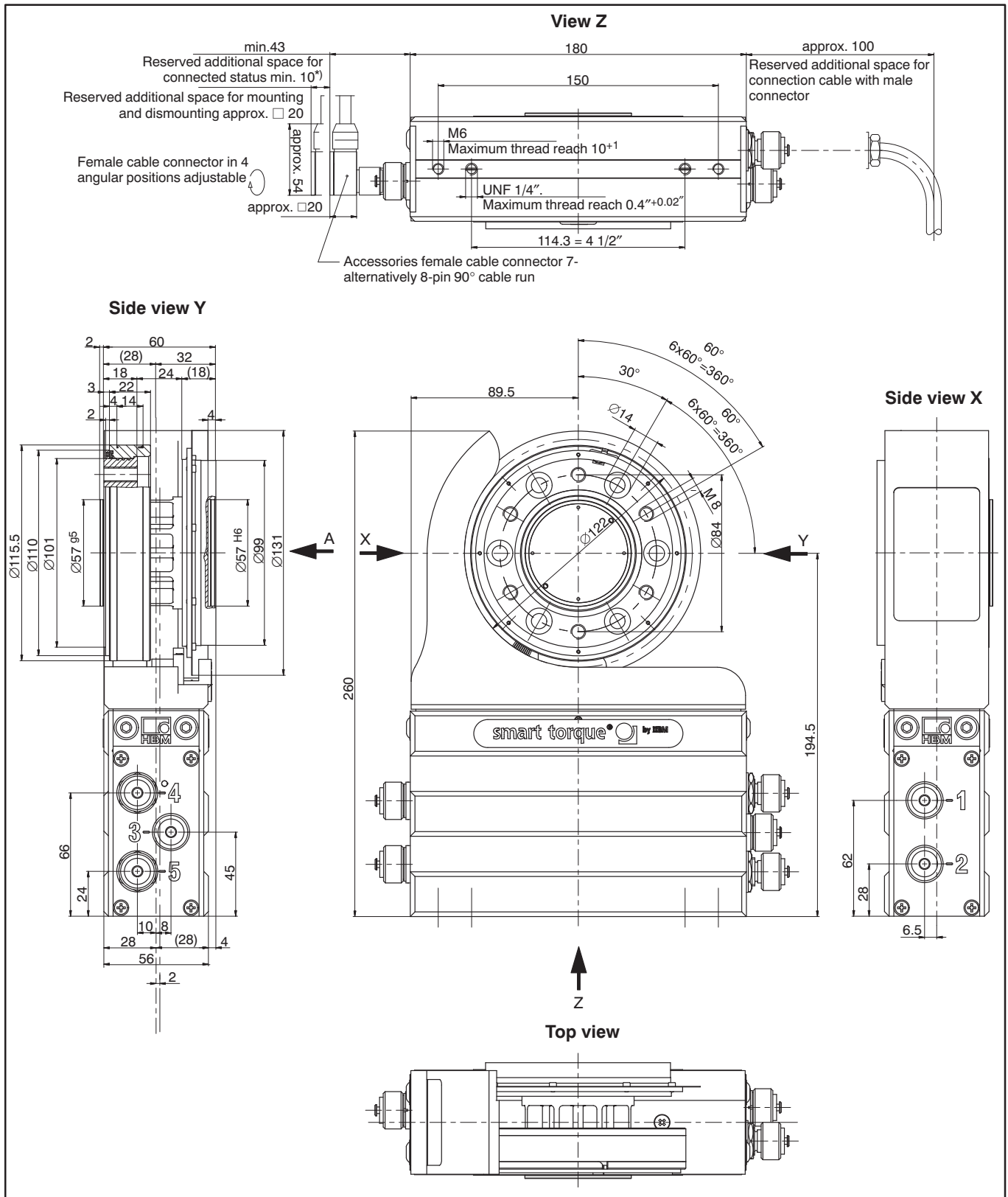
# Rotor dimensions (in mm; 1 mm=0.03937 inches)



| 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  |                   |                   |                   |                   |                   |                         |                   |                          |                           |
|-----------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------------|-------------------|--------------------------|---------------------------|
|                 | $\varnothing d_A$ | $\varnothing d_B$ | $\varnothing d_C$ | $\varnothing d_F$ | $\varnothing d_G$ | $\varnothing d_K$ | $\varnothing d_S^{C12}$ | $\varnothing d_z$ | $\varnothing d_{za\ g5}$ | $\varnothing d_{zi}^{H6}$ |
| 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 kN·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                       |

**Stator dimensions 100 N·m ... 200 N·m (in mm; 1 mm=0.03937 inches)**

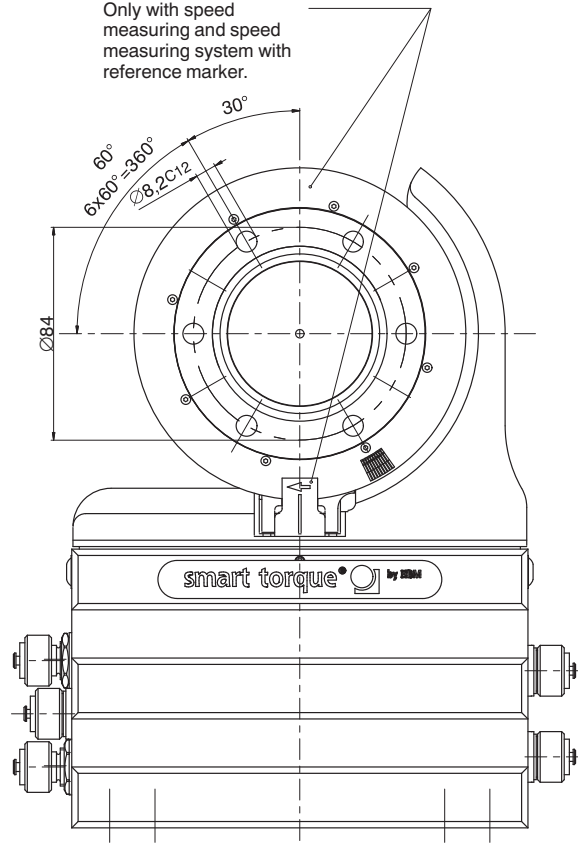




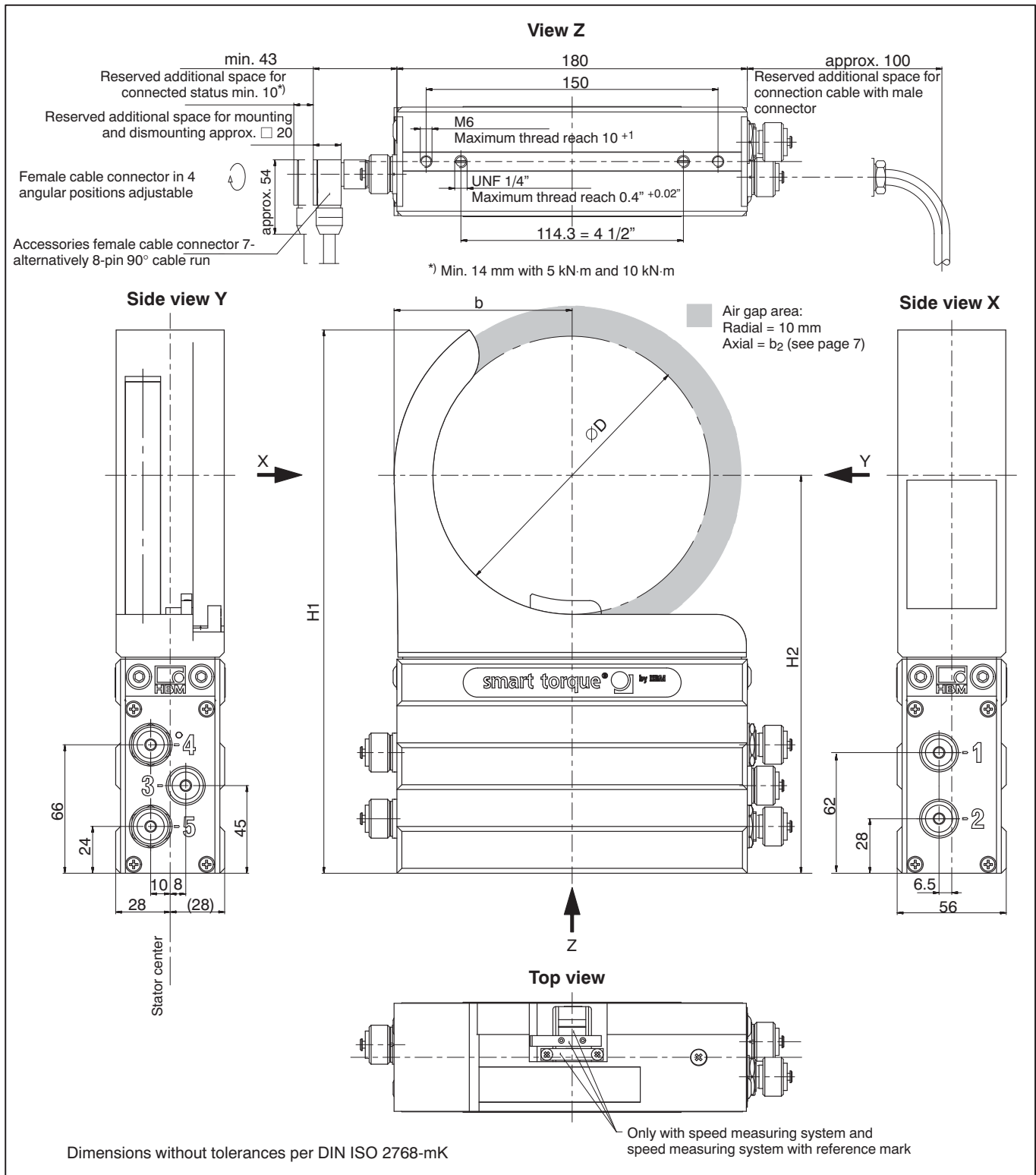
**Stator dimensions 100 N·m ... 200 N·m (in mm; 1 mm=0.03937 inches)**

**View A**

Only with speed measuring and speed measuring system with reference marker.

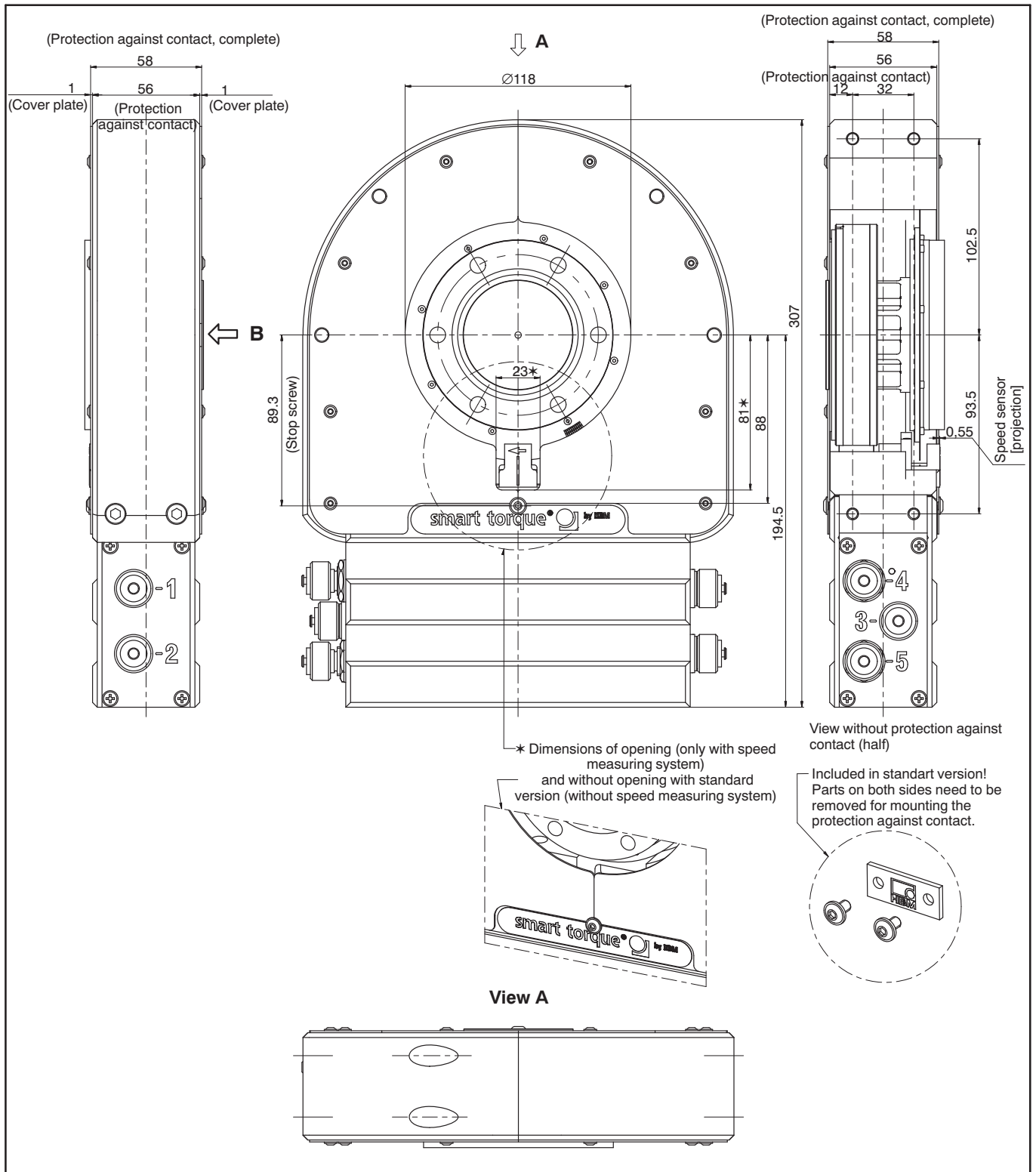


# Stator dimensions 100 N·m ... 10 kN·m (in mm; 1 mm=0.03937 inches)

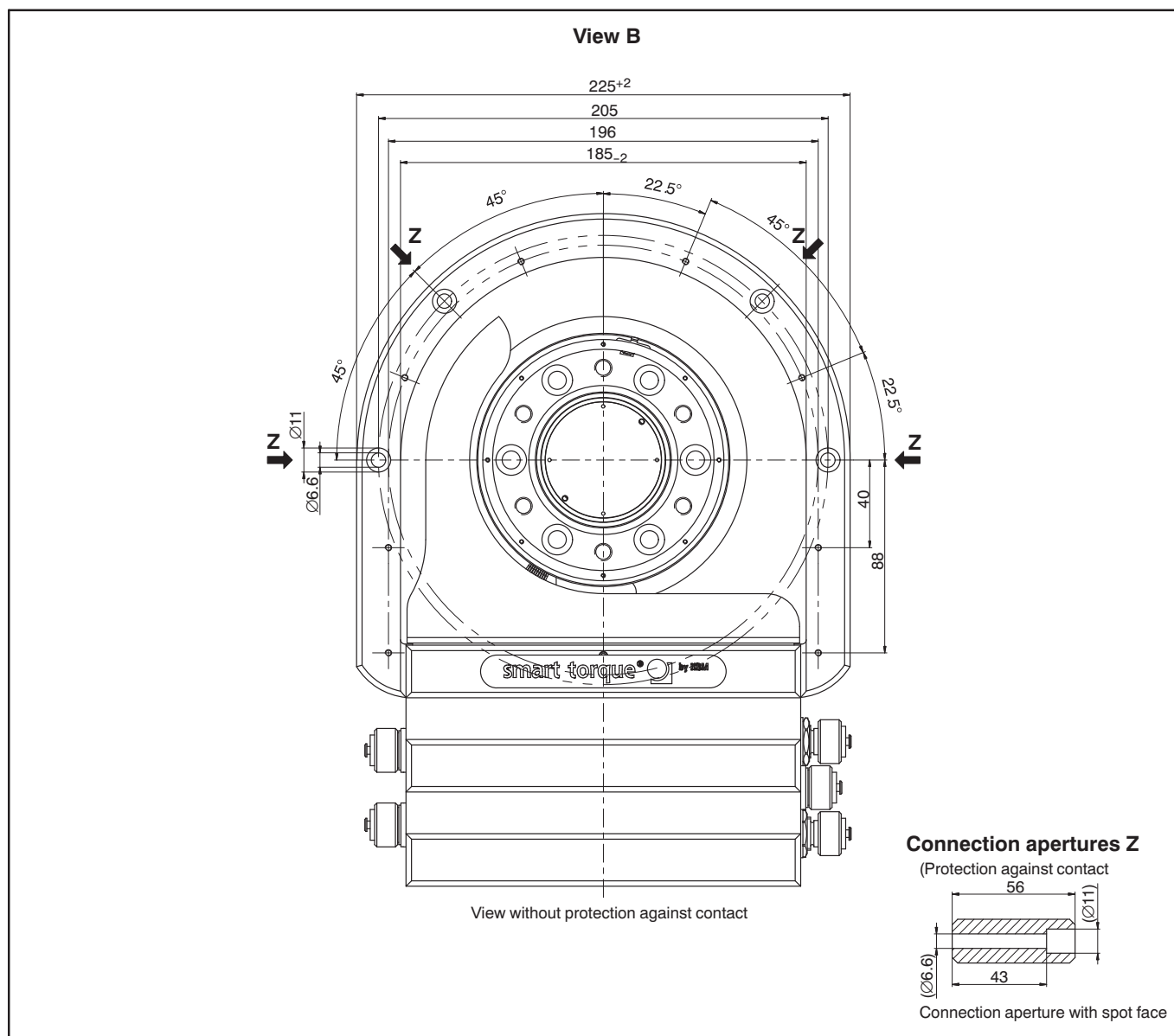


| Measuring range<br>(N·m) | Dimensions in mm |     |     |       |
|--------------------------|------------------|-----|-----|-------|
|                          | b                | ∅D  | H1  | H2    |
| 100                      | 81               | 122 | 260 | 194,5 |
| 200                      |                  |     |     |       |
| 500                      | 91.5             | 143 | 280 | 204.5 |
| 1 k                      |                  |     |     |       |
| 2 k                      | 109.5            | 179 | 310 | 222.5 |
| 3 k                      |                  |     |     |       |
| 5 k                      | 123.5            | 207 | 333 | 239.5 |
| 10 k                     | 144.5            | 249 | 369 | 263.5 |

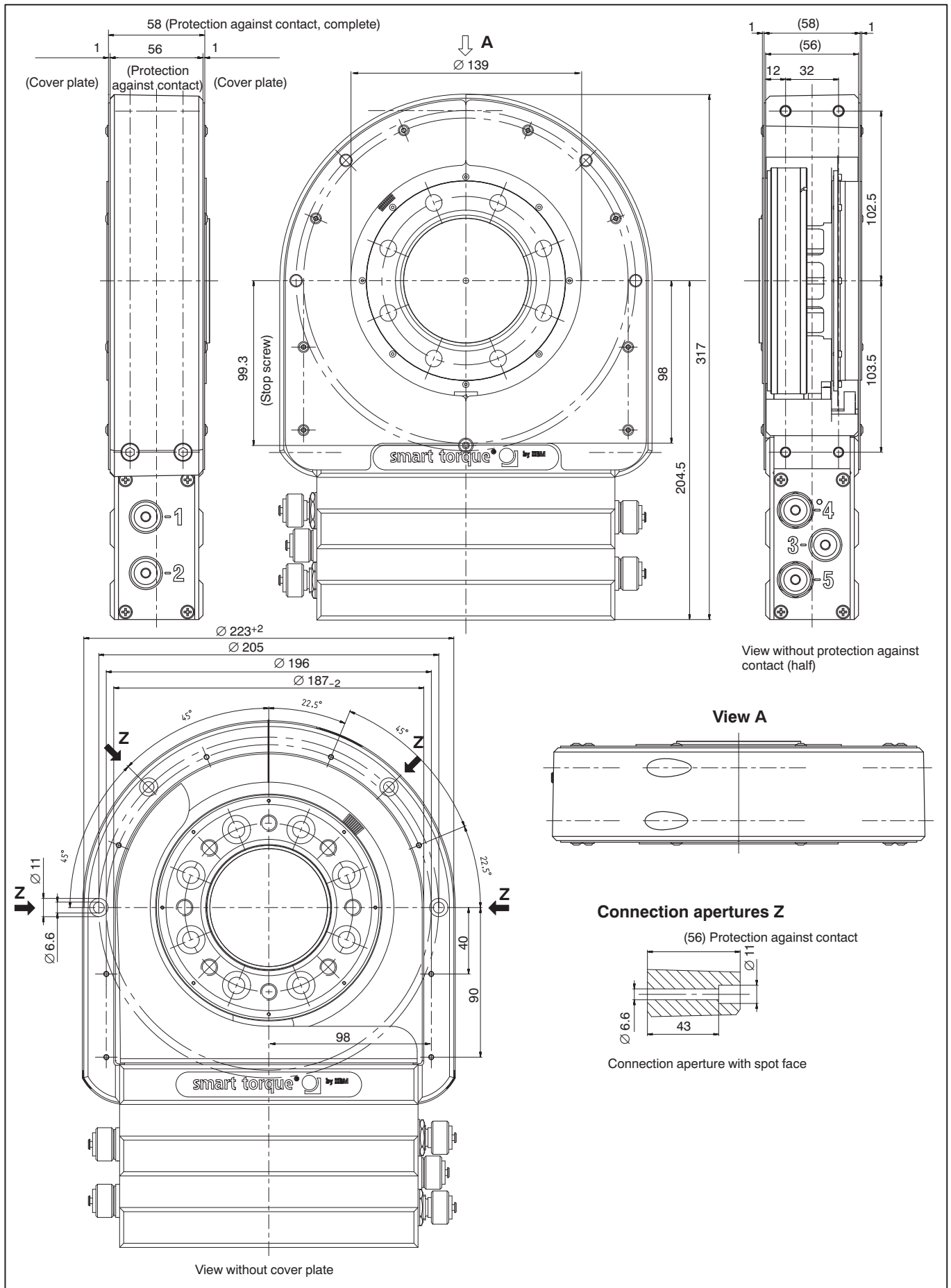
# Stator dimensions 100 N·m ... 200 N·m with protection against contact (in mm)



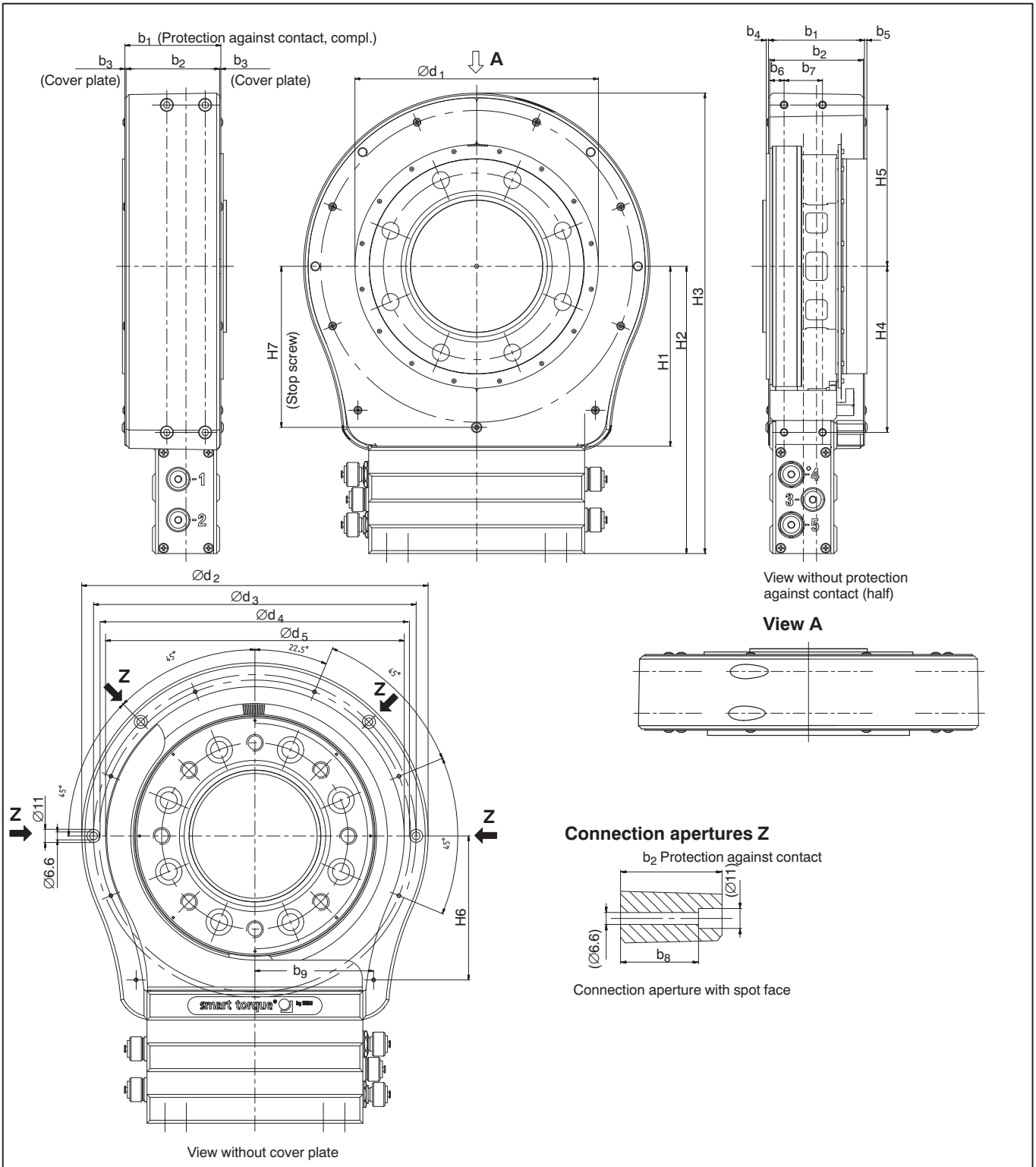
# Stator dimensions 100 N.m ... 200 N.m with protection against contact (in mm)



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

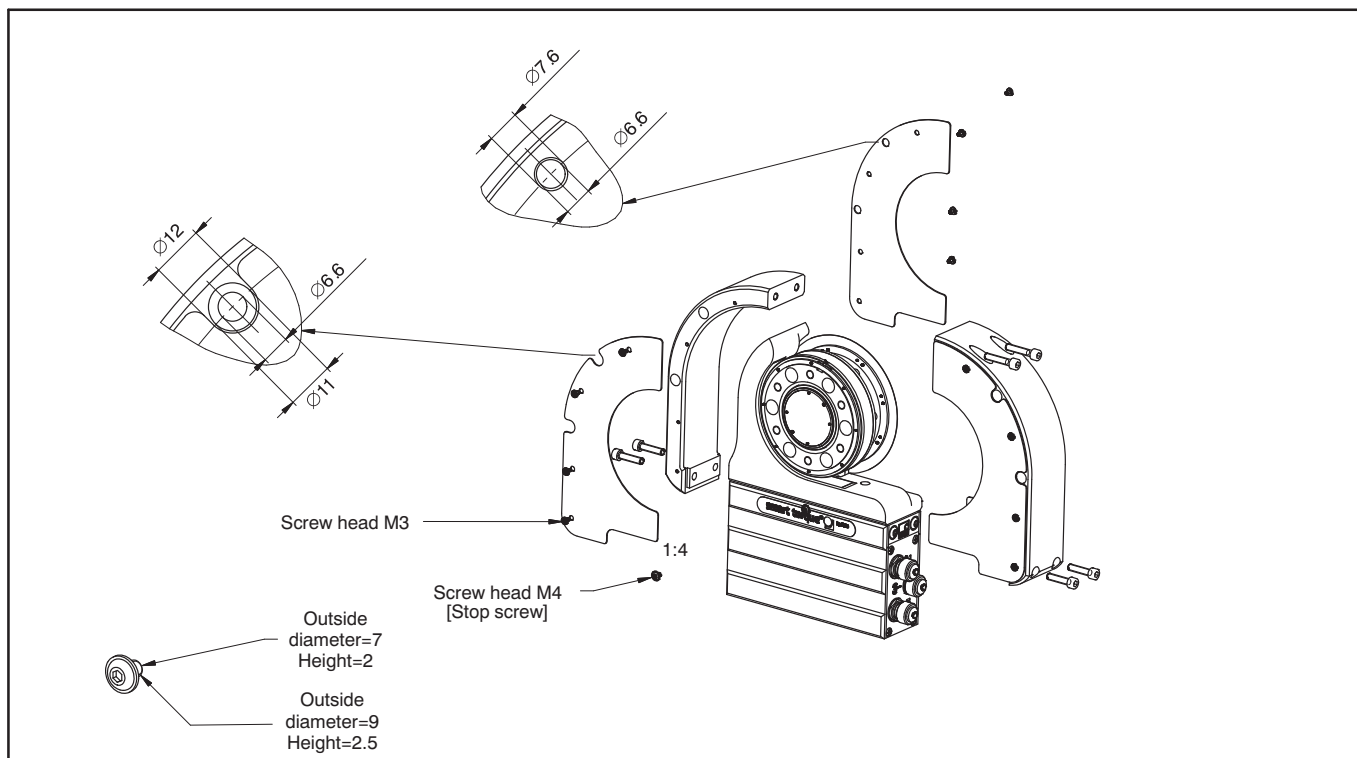


# Stator dimensions 2 kN·m ... 10 kN·m with protection against contact (in mm)

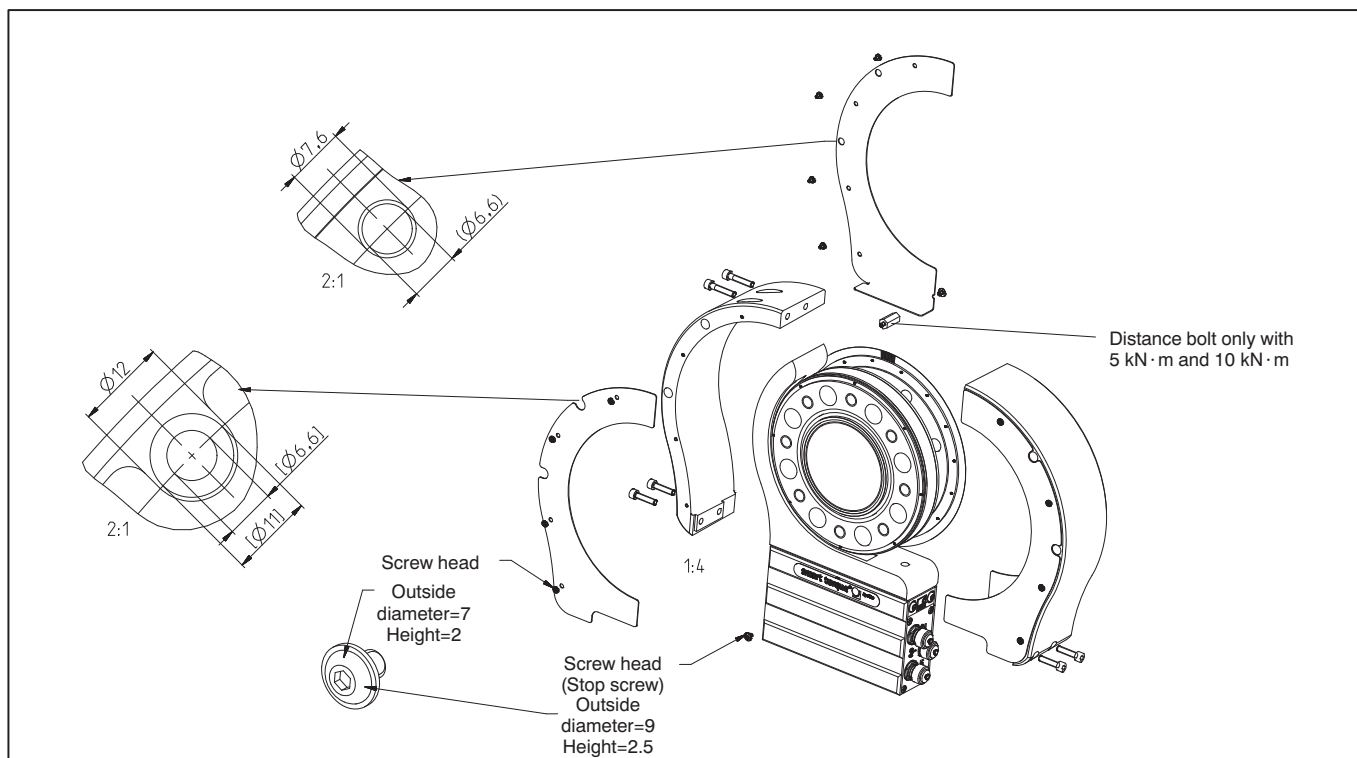


| Measuring range | Dimensions in mm |               |               |               |               |       |       |       |       |       |       |       |       |       |       |       |
|-----------------|------------------|---------------|---------------|---------------|---------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                 | $b_1$            | $b_2$         | $b_3$         | $b_4$         | $b_5$         | $b_6$ | $b_7$ | $b_8$ | $b_9$ | $H_1$ | $H_2$ | $H_3$ | $H_4$ | $H_5$ | $H_6$ | $H_7$ |
| 2 kN·m/3 kN·m   | 58               | 56            | 1             | 2             | 4             | 12    | 32    | 43    | 97.5  | 116   | 222.5 | 153   | 121.5 | 120.5 | 107   | 117.3 |
| 5 kN·m          | 80               | 78            | 1             | 2             | 2             | 12    | 32    | 65    | 99    | 133   | 239.5 | 384   | 138.5 | 134.5 | 120   | 134.3 |
| 10 kN·m         | 88               | 86            | 1             | 2             | 2             | 12    | 32    | 73    | 99    | 157   | 263.5 | 429   | 162.5 | 155.5 | 145   | 158.3 |
| Measuring range | Dimensions in mm |               |               |               |               |       |       |       |       |       |       |       |       |       |       |       |
|                 | $\text{Ø}d_1$    | $\text{Ø}d_2$ | $\text{Ø}d_3$ | $\text{Ø}d_4$ | $\text{Ø}d_5$ |       |       |       |       |       |       |       |       |       |       |       |
| 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           | $291_{-2}$    |       |       |       |       |       |       |       |       |       |       |       |

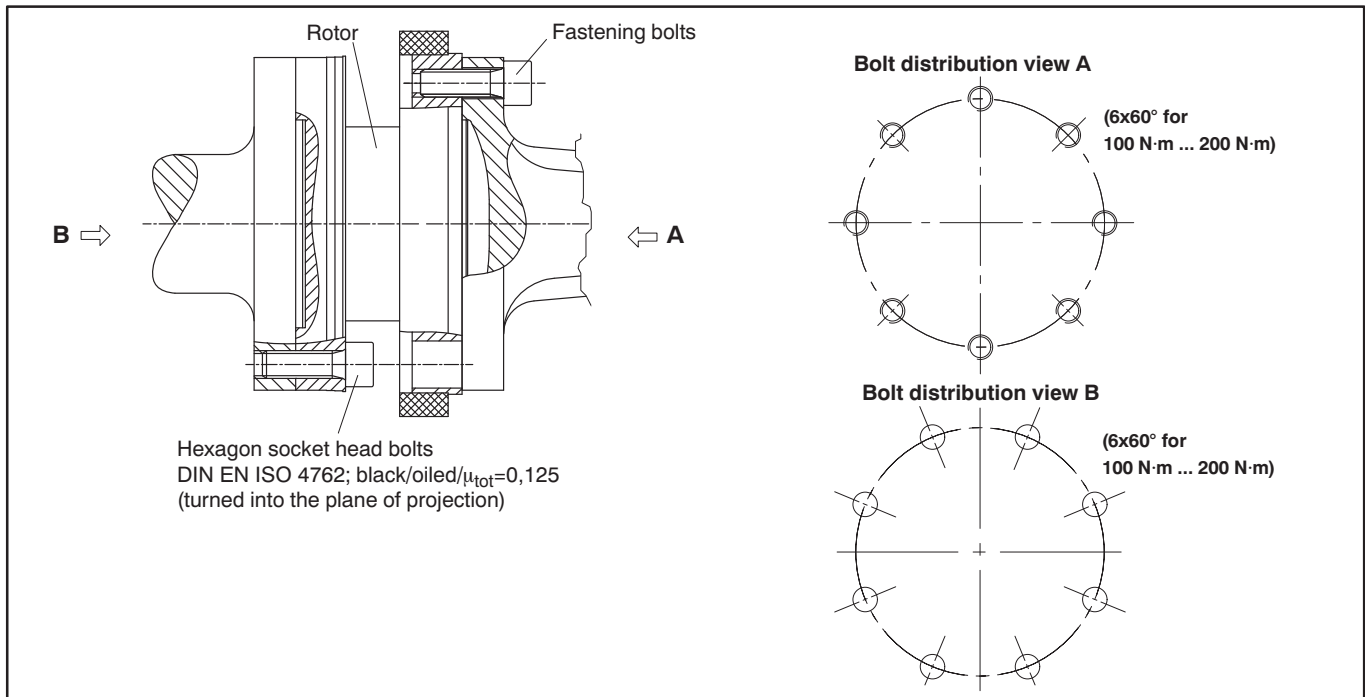
**Dimensions cover plates 100 N·m ... 200 N·m (in mm)**



**Dimensions cover plates 500 N·m ... 10 kN·m (in mm)**

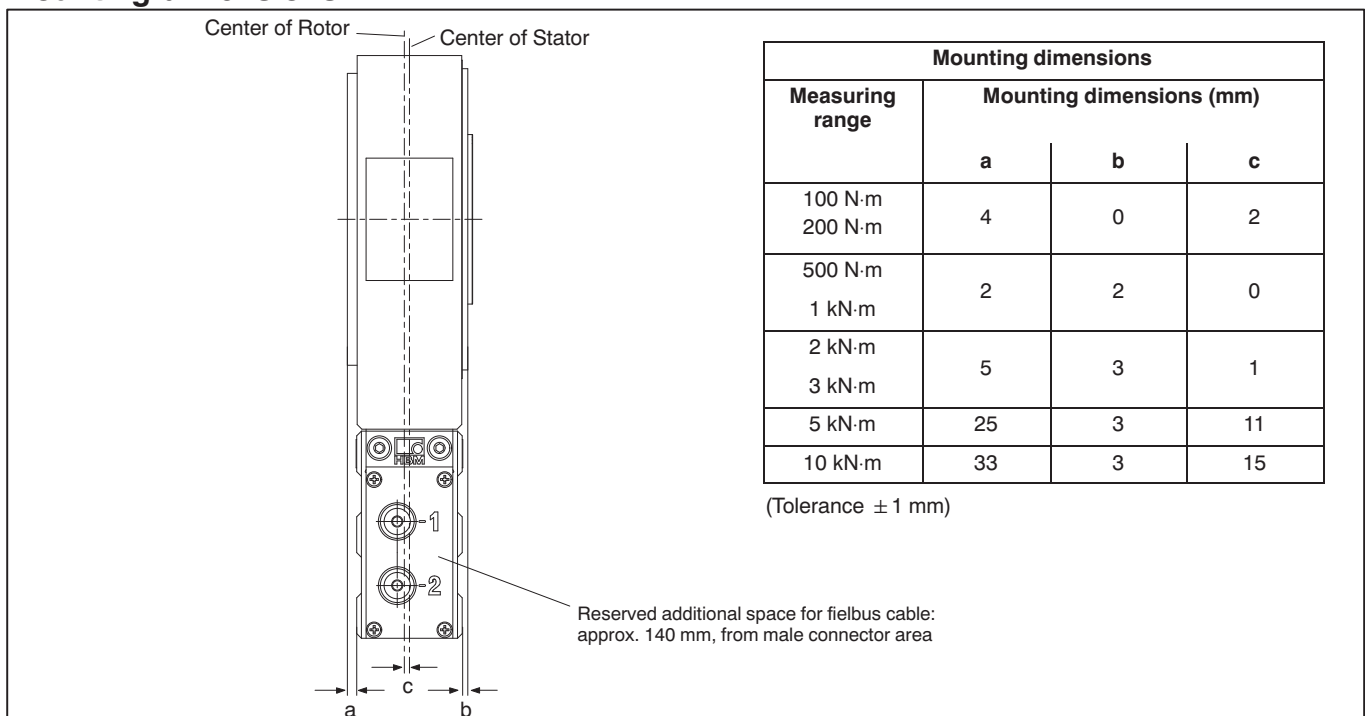


## Bolted connection of the rotor



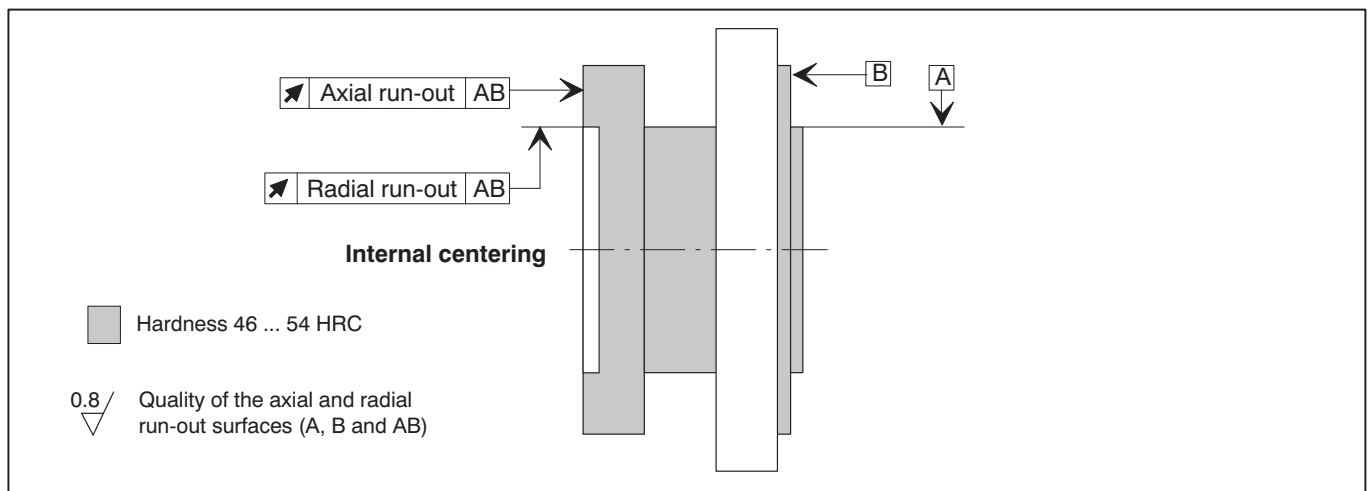
| Nominal (rated) torque (N·m) | Fastening bolts | Property class of fastening bolts | Prescribed tightening moment (N·m) |      |     |
|------------------------------|-----------------|-----------------------------------|------------------------------------|------|-----|
| 100                          | M8              | 10.9                              | 34                                 |      |     |
| 200                          |                 |                                   |                                    |      |     |
| 500                          | M10             |                                   | 12.9                               | 67   |     |
| 1k                           |                 |                                   |                                    |      |     |
| 2k                           | M12             |                                   |                                    | 12.9 | 115 |
| 3k                           |                 |                                   |                                    |      |     |
| 5k                           | M14             | 12.9                              |                                    |      | 220 |
| 10k                          |                 |                                   |                                    |      |     |

## Mounting dimensions





## 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                         |

## 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 <sup>1)</sup><br>Lin. < ±0.01 % and TC <sub>0</sub> < ±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 <sup>®</sup> coupling <sup>2)</sup> |
|------|---|
| 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. < ±0.05 %; TC<sub>0</sub> < ±0.1 %/10 K

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

**Accessories, to be ordered separately:**

| Item   | Order-No.       |
|--|-----------------|
| <b>Ready made connecting cables</b>  |                 |
| <b>Torque</b>  |                 |
| 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      |
| <b>Rotational speed</b>  |                 |
| 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      |
| <b>CANbus</b>  |                 |
| Connecting cable CANbus, M12 A-encoded - D-Sub 9-pole, connectable termination resistor, 6 m                                       | 1-KAB161-6      |
| <b>Male/female cable connectors</b>  |                 |
| <b>Torque</b>  |                 |
| 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     |
| <b>Rotational speed</b>  |                 |
| 423G-8S, female cable connector 8-pole, straight cable entry, for rot. speed output (connector 2)                                  | 3-3312.0120     |
| 423W-8S, female cable connector 8-pole, 90° cable entry, for rot. speed output (connector 2)                                       | 3-3312.0282     |
| <b>CANbus</b>  |                 |
| TERMINATOR M12/ termination resistor, M12, A-encoded, 5-pole, male connector   | 1-CANHEAD-TERM  |
| Termination resistor CANbus 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/CANbus M12, female cable connector 5-pole M12, A-encoded, male cable connector 5-pole M12, A-encoded   | 1-CANHEAD-M12   |
| <b>PROFIBUS</b>  |                 |
| 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  |
| <b>Connecting cable, by the meter</b>  |                 |
| Kab8/00-2/2/2  | 4-3301.0071     |
| Kab8/00-2/2/2/1/1  | 4-3301.0183     |
| DeviceNet cable  | 4-3301.0180     |
| <b>Miscellaneous</b>   |                 |
| Setup-Toolkit for T12 (T12 system CD, PCAN-USB adapter, connecting cable CANbus, 6 m)  | 1-T12-SETUP-USB |

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measurement with confidence