

T12

Digital Torque Transducer

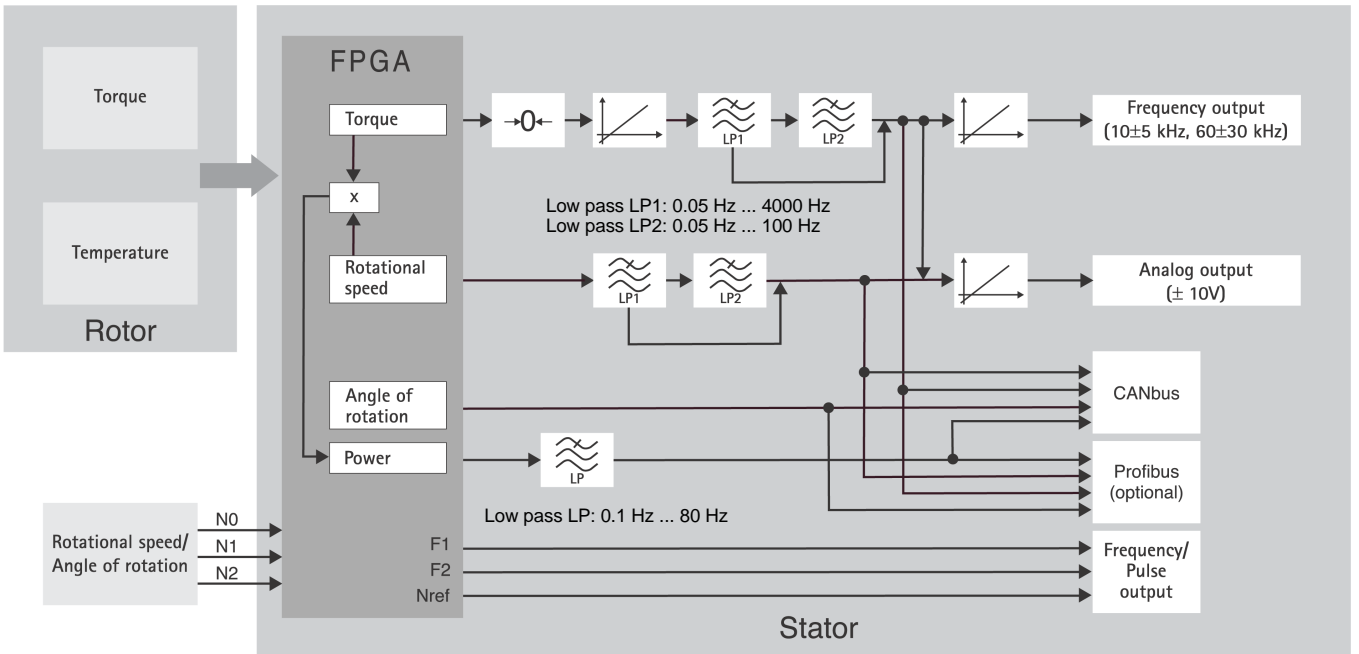


smart torque®  by HBM

Special features

- Nominal (rated) torques of 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 16,000 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	500					
	kN·m		1	2	3	5	10
for reference only	kft·lb	375	750	1,500	2,250	3,750	7,500
Nominal (rated) sensitivity (range between torque = zero and M_{nom}) Frequency output 10 kHz/60 kHz Voltage output	kHz V	5/30 10					
Sensitivity tolerance (deviation of the actual output quantity at M_{nom} from the nominal (rated) sensitivity) Fieldbusses Frequency output Voltage output	% % %	± 0.05 ± 0.05 ± 0.1					
Output signal at torque = zero Frequency output 10 kHz/60 kHz Voltage output	kHz V	10/60 0					
Nominal (rated) output signal Frequency output with positive nominal (rated) torque 10 kHz/60 kHz with negative nominal (rated) torque 10 kHz/60 kHz Voltage output with positive nominal (rated) torque with negative nominal (rated) torque Low-pass filter LP1 Low-pass filter LP2 Load resistance Frequency output Voltage output Long-term drift over 48 h Voltage output Measurement frequency range Frequency output/Voltage output Group delay time (Low pass LP1: 4 kHz) Frequency output 10 kHz/60 kHz Voltage output Scale range Frequency output/Voltage output Resolution Frequency output 10 kHz/60 kHz Voltage output Residual ripple Voltage output	kHz kHz V V Hz Hz kΩ kΩ mV Hz Hz μs μs % Hz mV mV	15/90 (5 V symmetric ¹) 5/30 (5 V symmetric ¹) +10 -10 0.05 ... 4,000 (4 th order Bessel, -1 dB); factory settings 1,000 Hz 0.05 ... 100 (4 th order Bessel, -1 dB); factory settings 1 Hz ≥ 2 ≥ 10 ± 3 0 ... 4,000 (-1 dB) 0 ... 6,000 (-3 dB) 320/250 500 10 ... 1,000 (of M_{nom}) 0.03/0.25 0.33 3					
Temperature influence per 10 K in the nominal (rated) temperature range on the output signal, related to the actual value of signal span Fieldbusses Frequency output Voltage output on the zero signal, related to the nominal (rated) sensitivity Fieldbusses Frequency output Voltage output	% % % % % % %	± 0.03 ± 0.03 ± 0.1 ± 0.02 (± 0.01 optional) ± 0.02 (± 0.01 optional) ± 0.1					
Maximum modulation range²⁾ Frequency output 10 kHz/60 kHz Voltage output	kHz V	4 ... 16/24 ... 96 -10.2 ... +10.2					
Power supply Nominal (rated) supply voltage (separated extra low voltage) Current consumption in measuring mode Current consumption in start-up mode	V (DC) A A	18 ... 30 < 1 (typ. 0.5) < 4					

¹⁾ RS-422 complementary signals, observe terminating resistance.

²⁾ Output signal range with a repeatable relationship between torque and output signal.

Specifications (Continued)

Nominal (rated) torque M_{nom}	N·m	500					
	kN·m		1	2	3	5	10
for reference only	kft·lb	375	750	1,500	2,250	3,750	7,500
Nominal (rated) power consumption	W	< 18					
Maximum cable length	m	50					
Linearity deviation including hysteresis , related to the nominal (rated) sensitivity							
Fieldbusses	%	± 0.02 (± 0.01 optional)					
Frequency output 10 kHz/60 kHz	%	± 0.02 (± 0.01 optional)					
Voltage output	%	± 0.05					
Rel. standard deviation of the repeatability , per DIN1319, related to variation of the output signal							
Fieldbusses/frequency output	%	± 0.01					
Voltage output	%	± 0.03					
Shunt signal		50 % of M_{nom} or 10 % of M_{nom}					
Tolerance of shunt signal related to M_{nom}	%	± 0.05					
Speed measuring system/measuring system for angle of rotation							
		Optical, by means of infrared light and metallic slotted disc					
Mechanical increments	Number	360				720	
Positional tolerance of the increments	mm	± 0.05					
Tolerance of the slot width	mm	± 0.05					
Pulses per rotation (adjustable)	Number	360; 180; 90; 60; 45; 30				720; 360; 180; 120; 90; 60	
Pulse frequency at nominal (rated) speed n_{nom}							
Option 3, Code L ³⁾	kHz	72				120	
Option 3, Code H ³⁾	kHz	96				168	
Minimum speed for sufficient pulse stability	rpm	2					
Group delay time	µs	< 5 (typ. 2.2)					
Hysteresis of reversing the direction of rotation with relative vibrations between rotor and stator							
Torsional vibrations of the rotor	Degree	< approx. 2					
Radial vibration amplitudes of the stator	mm	< approx. 2					
Permitted degree of soiling , in the optical path of the sensor fork (lenses, slotted disc)	%	< 50					
Swirl influence on the zero point, through mounted increment disc , related to nominal (rated) torque							
Option 3, Code L ³⁾	%	negligible					
Option 3, Code H ³⁾	%	< 0.02					
Output signal frequency/pulse output	V	5 ⁴⁾ symmetric; 2 square wave signals approx. 90° phase shifted					
Load resistance	kΩ	≥ 2					
Rotational speed							
Fieldbusses							
Resolution	rpm	0.1					
System accuracy (at torsional vibrations of max. 3 % of the current rot. speed with double speed frequency)	ppm	150					
Max. speed deviation at nominal (rated) speed (100 Hz-filter)	rpm	1.5					
Voltage output							
Measuring range	V	± 10					
Resolution	mV	0.33					
Scale range	%	10 ... 1,000					
Overmodulation limits	V	± 10.2					
Load resistance	kΩ	> 10					
Linearity error	%	< 0.03					
Temperature effect per 10 K in the nominal (rated) temperature range							
on the output signal, related to the actual value of signal span	%	< 0.03					
on the zero signal	%	< 0.03					
Residual ripple	mV	< 3					

³⁾ See page 14.

⁴⁾ RS-422 complementary signals, observe terminating resistances.

Specifications (Continued)

Nominal (rated) torque M_{nom}	N·m	500					
	kN·m		1	2	3	5	10
for reference only	kft·lb	375	750	1,500	2,250	3,750	7,000
Angle of rotation							
Accuracy	Degree	1 (typ. 0.1)					
Resolution	Degree	0.01					
Correction of the phase delay deviation between torque LP1 and angle of rotation for filter frequencies	Hz	4,000; 2,000; 1,000; 500; 200; 100					
Measuring range	Degree	0 ... 360 (singleturn) up to $\pm 1,440$ (multiturn)					
Power							
Measurement frequency range	Hz	80 (-1 dB)					
Resolution	W	1					
Full scale value	W	$P_{max} = M_{nom} \cdot n_{nom} \cdot \frac{\pi}{30}$ [M_{nom}] in N·m [n_{nom}] in rpm					
Temperature effect per 10 K in the nominal (rated) temperature range on the power signal, related to the full scale value	%	$\pm 0.05 \cdot n/n_{nom}$					
Linearity deviation including hysteresis, related to the full scale value	%	$\pm 0.02 \cdot n/n_{nom}$					
Sensitivity tolerance (deviation of the actual signal span of the power signal related to the full scale value)	%	± 0.05					
Temperature signal rotor							
Accuracy	K	1					
Measurement frequency range	Hz	5 (-1 dB)					
Resolution	K	0.1					
Physical unit	-	°C					
Sampling rate	Mea- sured values/s	40					
Fieldbusses							
CANbus							
Protocol	-	CAN 2.0B, CAL/CANopen compatible					
Sampling rate	Mea- sured values/s	max. 4,800 (PDO) 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					
Profibus DP							
Protocol	-	Profibus-DP Slave, per DIN 19245-3					
Baudrate	MBaud	max. 12					
Profibus ident no.	-	096C (hex)					
Input data, max.	Byte	152					
Output data, max.	Byte	40					
Diagnosis data	Byte	18 (2·4 byte module diagnosis)					
Connection	-	5-pole, M12x1, B-coding, potential separated from supply and measuring mass					
Update rate⁵⁾							
Konfiguration input ≤ 2						4800	
≤ 4						2400	
≤ 8						1200	
≤ 12						600	
≤ 16						300	
> 16	Mea- sured values/s					150	

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

Specifications (Continued)

Nominal (rated) torque M_{nom}	N·m	500					
	kN·m	1 2 3 5 10					
for reference only	kft·lb	375	750	1,500	2,250	3,750	7,500
Limit value switch (on fieldbusses only)							
Number	–	4 for torque, 4 for rotational speed					
Reference level	–	Torque LP1 or LP2 Rotational speed LP1 or LP2					
Hysteresis	%	0 ... 100					
Setting accuracy	Digit	1					
Response time (LP1= 4,000 Hz)	ms	typ. 3					
TEDS (Transducer Electronic Data Sheet)							
Number	–	2					
TEDS 1 (torque)	–	Optional voltage sensor or frequency sensor					
TEDS 2 (rotational speed/angle of rotation)	–	Frequency-/pulse sensor					
General data							
EMC							
EME (Emission per EN61326–1, table 3)							
RFI voltage	–	Class A					
RFI performance	–	Class A					
RFI field strength	–	Class A					
Immunity from interference (EN61326-1, table A.1)							
Electromagnetic field (AM)	V/m	10					
Magnetic field	A/m	30					
ESD							
Contact discharge	kV	4					
Air discharge	kV	8					
Burst	kV	1					
Surge	kV	1					
Line-conducted disturbance (AM)	V	3					
Degree of protection per EN 60529	–	IP 54					
Weight, approx.	Rotor	kg	2.4	4.9	8.3	14.6	
	Stator	kg	2.3	2.4	2.5	2.6	
Reference temperature	°C [°F]	+23 [73.4]					
Nominal (rated) temperature range	°C [°F]	+10 ... +60 [+50 ... +140]					
Service temperature range	°C [°F]	–10 ... +60 [+14 ... +140]					
Storage temperature range	°C [°F]	–20 ... +70 [–4 ... +158]					
Impact resistance, test severity level per DIN IEC 68; part 2-27; IEC 68-2-27-1987							
Number of impacts	n	1,000					
Duration	ms	3					
Acceleration (half-sine)	m/s ²	650					
Vibration resistance, test severity level per DIN IEC 68; part 2-6; IEC 68-2-6-1982							
Frequency output	Hz	5 ... 65					
Duration	h	1.5					
Acceleration (amplitude)	m/s ²	50					
Nominal (rated) speed n_{nom}							
Option 3, Code L ⁶⁾	rpm	12,000			10,000		
Option 3, Code H ⁶⁾	rpm	16,000			14,000 12,000		
Load limits⁷⁾							
Limit torque, related to M_{nom}	%	200			160		
Breaking torque, related to M_{nom}	%	> 400			> 320		
Axial limit force	kN	16	19	39	42	80	120
Lateral limit force	kN	4	5	9	10	12	18
Bending limit moment	N·m	200	220	560	600	800	1200
Oscillation bandwidth per DIN 50100 (peak-to-peak)⁸⁾	N·m	1,000	2,000	4,000	4,800	8,000	16,000

⁶⁾ See page 14.

⁷⁾ Each type of irregular stress can only be permitted with its given static 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.

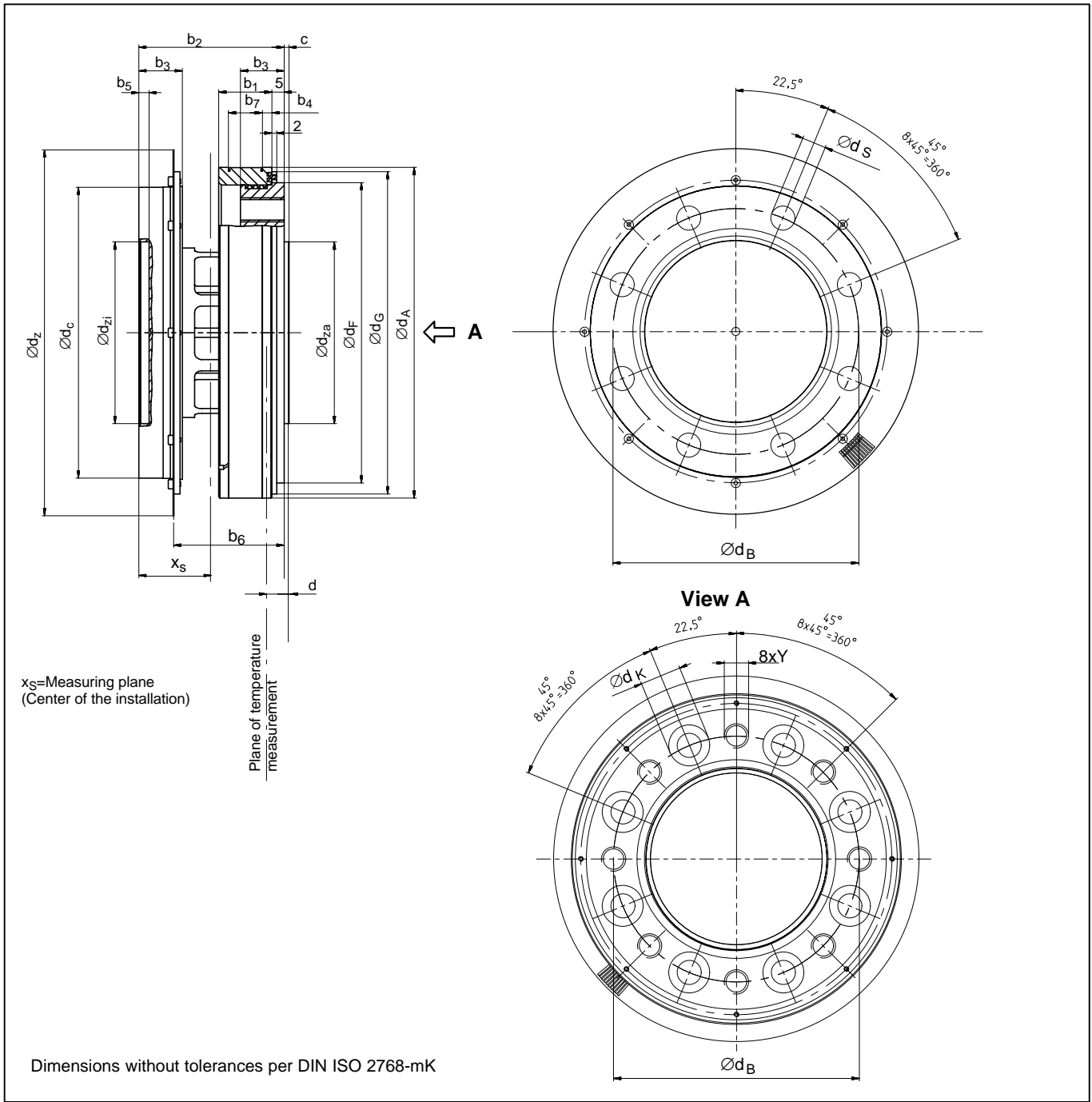
⁸⁾ The nominal (related) torque must not be exceeded.

Specifications (Continued)

Nominal (rated) torque M_{nom}	N·m	500					
	kN·m		1	2	3	5	10
for reference only	kft·lb	375	750	1,500	2,250	3,750	7,500
Mechanical data							
Torsional stiffness c_T	kN·m/rad	540	900	2,300	2,600	4,600	7,900
Torsion angle at M_{nom}	Degree	0.055	0.066	0.049	0,066	0,06	0,07
Axial stiffness c_a	kN/mm	740	760	950	1,000	950	1,600
Radial stiffness c_r	kN/mm	550	810	1,300	1,500	1,650	2,450
Stiffness with bending moment about a radial axis c_b	kN·m/degree	11.5	12	21.7	22.4	43	74
Maximum excursion at axial limit force	mm	< 0.03		< 0.05		< 0.1	
Additional max. radial run-out deviation at lateral limit force	mm	< 0.02					
Additional plane-parallel deviation at bending limit moment (with $\varnothing d_B$)	mm	<0.05			<0.07		
Balance quality-level per DIN ISO 1940		G 2.5					
Max. limits for relative shaft vibration (peak-to-peak) ⁹⁾	μm	$s_{max} = \frac{4,500}{\sqrt{n}}$ (n in rpm)					
Mass moment of inertia of the rotor							
I_V (around rotating axis)	kg·m ²	0.0059	0.0059	0.0192	0.037	0.097	
I_V with optical speed measuring system	kg·m ²	0.0062	0.0062	0.0196	0.038	0.0995	
Proportionate mass moment of inertia for assembly side							
without speed measuring system	%	56		54		53	
with optical speed measuring system	%	54		53		52	
Max. permissible static eccentricity of the rotor (radially) to stator center							
without speed measuring system	mm	± 2					
with speed measuring system	mm	± 1					
Max. permissible axial displacement of the rotor to stator	mm	± 2					

⁹⁾ Relative undulations within the range of the connecting flanges per DIN 45670/VDI 2059

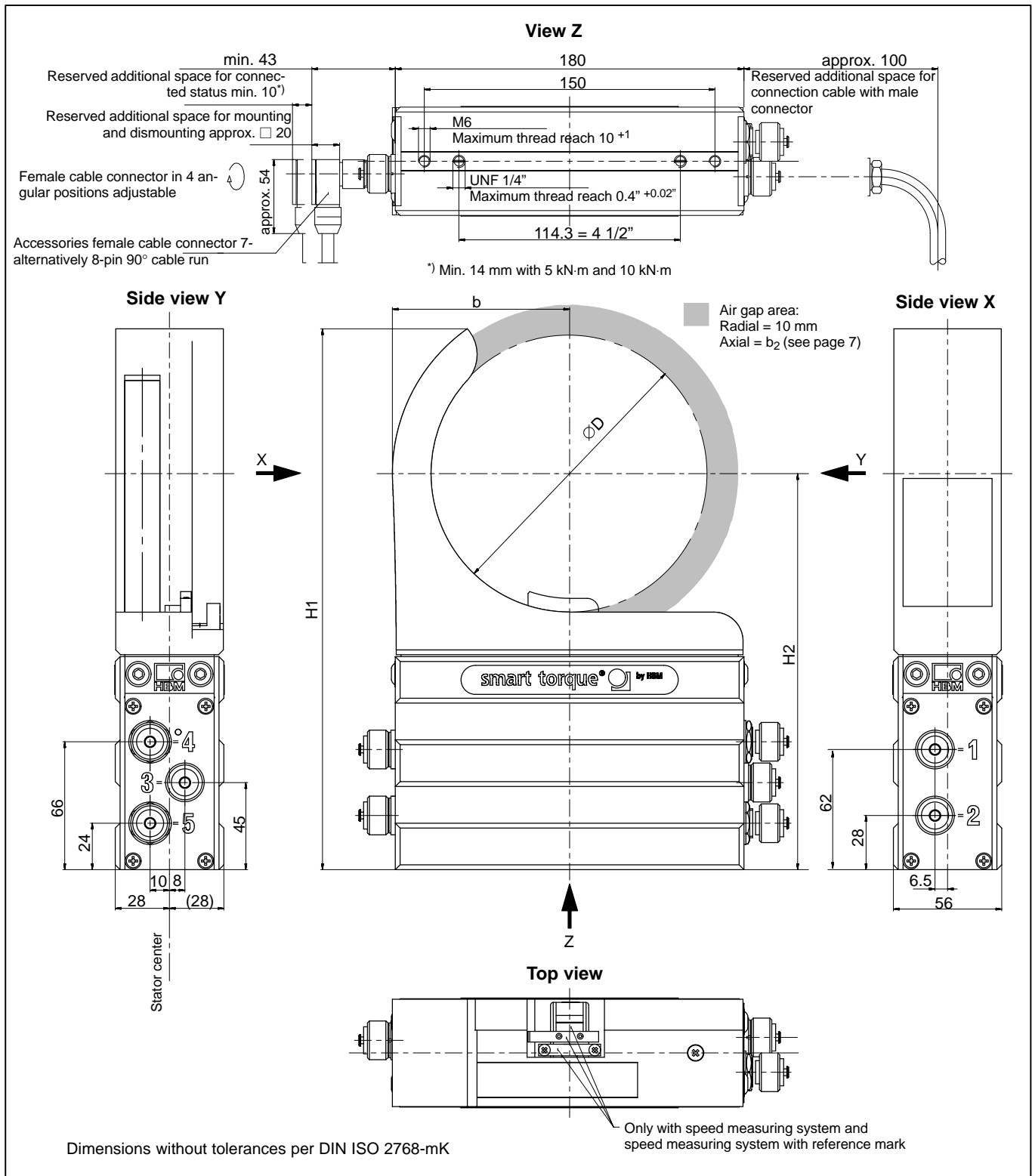
Rotor dimensions (in mm; 1 mm=0.03937 inches)



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

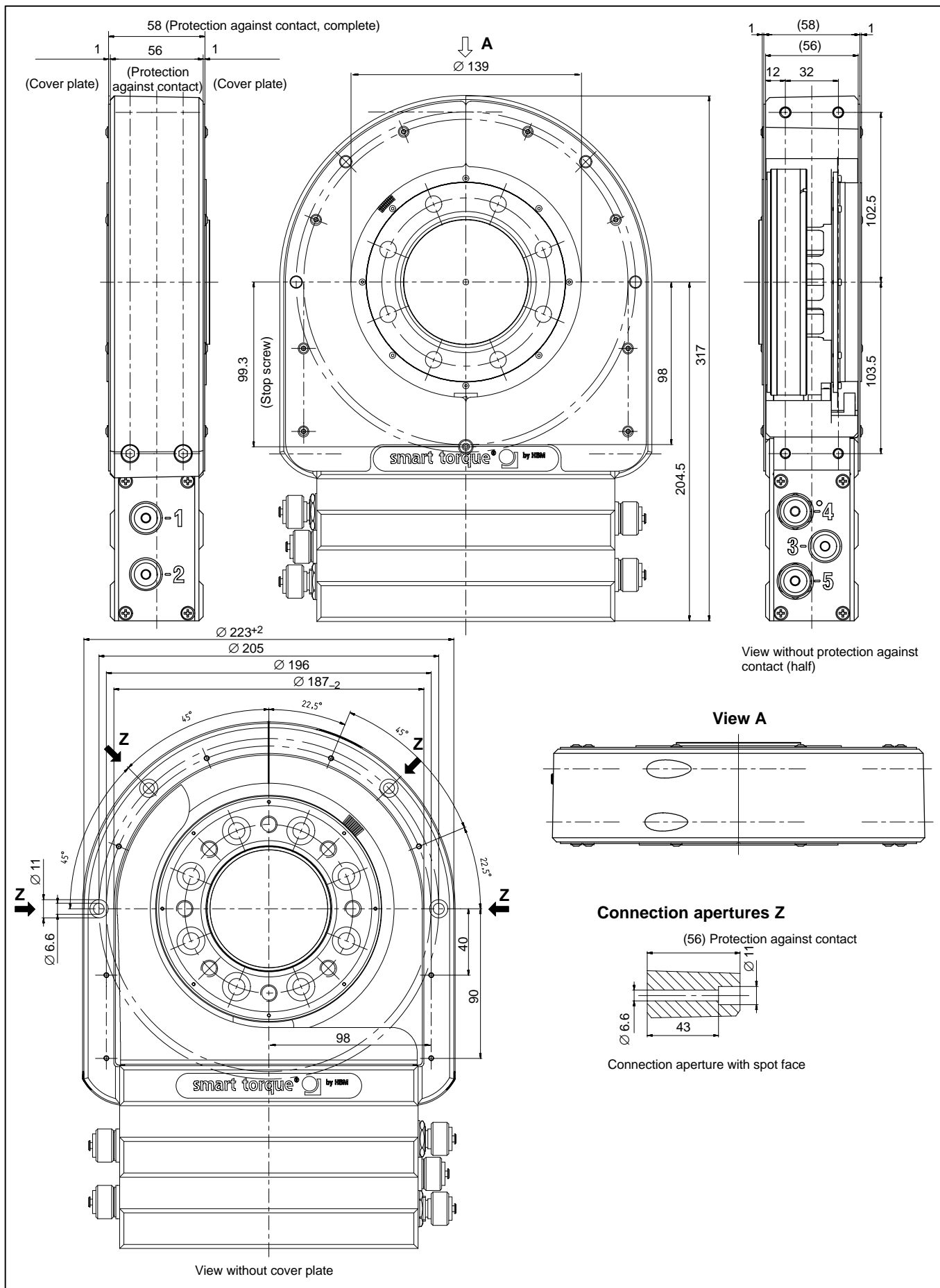
Measuring range	Dimensions in mm									
	Ød_A	Ød_B	Ød_C	Ød_F	Ød_G	Ød_K	Ød_S^{C12}	Ød_Z	$\text{Ød}_{za} g5$	$\text{Ød}_{zi} H6$
500 N·m/1 kN·m	136.5	101.5	120	124	133	17	10	151	75	75
2 kN·m/3 kN·m	172.5	130	155	160	169	19	12	187	90	90
5 kN·m	200.5	155.5	179	188	197	22	14.2	221	110	110
10 kN·m	242.5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

Stator dimensions (in mm; 1 mm=0.03937 inches)

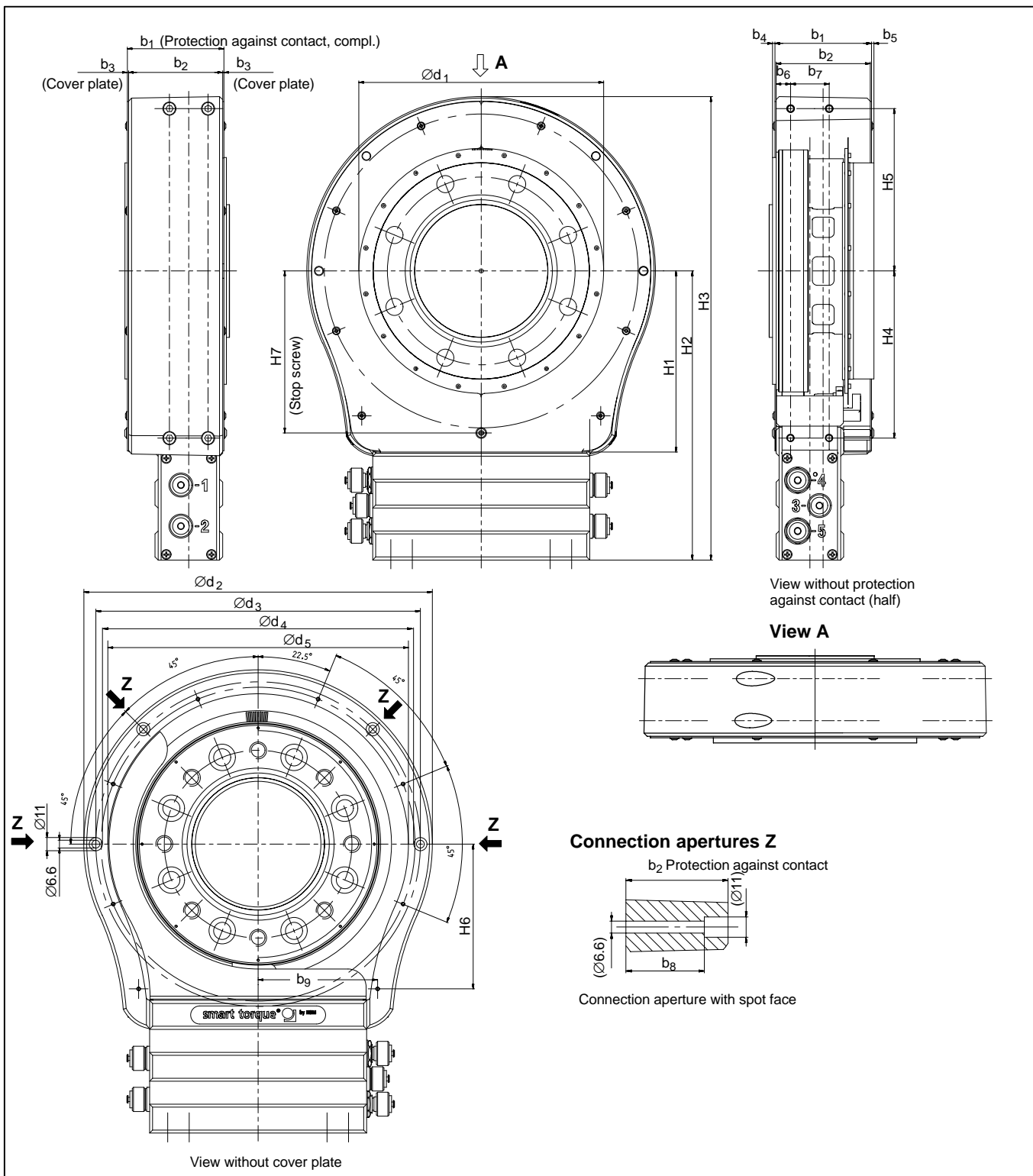


Measuring range (N-m)	Dimensions in mm			
	b	ØD	H1	H2
500 1 k	91.5	143	280	204.5
2 k 3 k	109.5	179	310	222.5
5 k	123.5	207	333	239.5
10 k	144.5	249	369	263.5

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

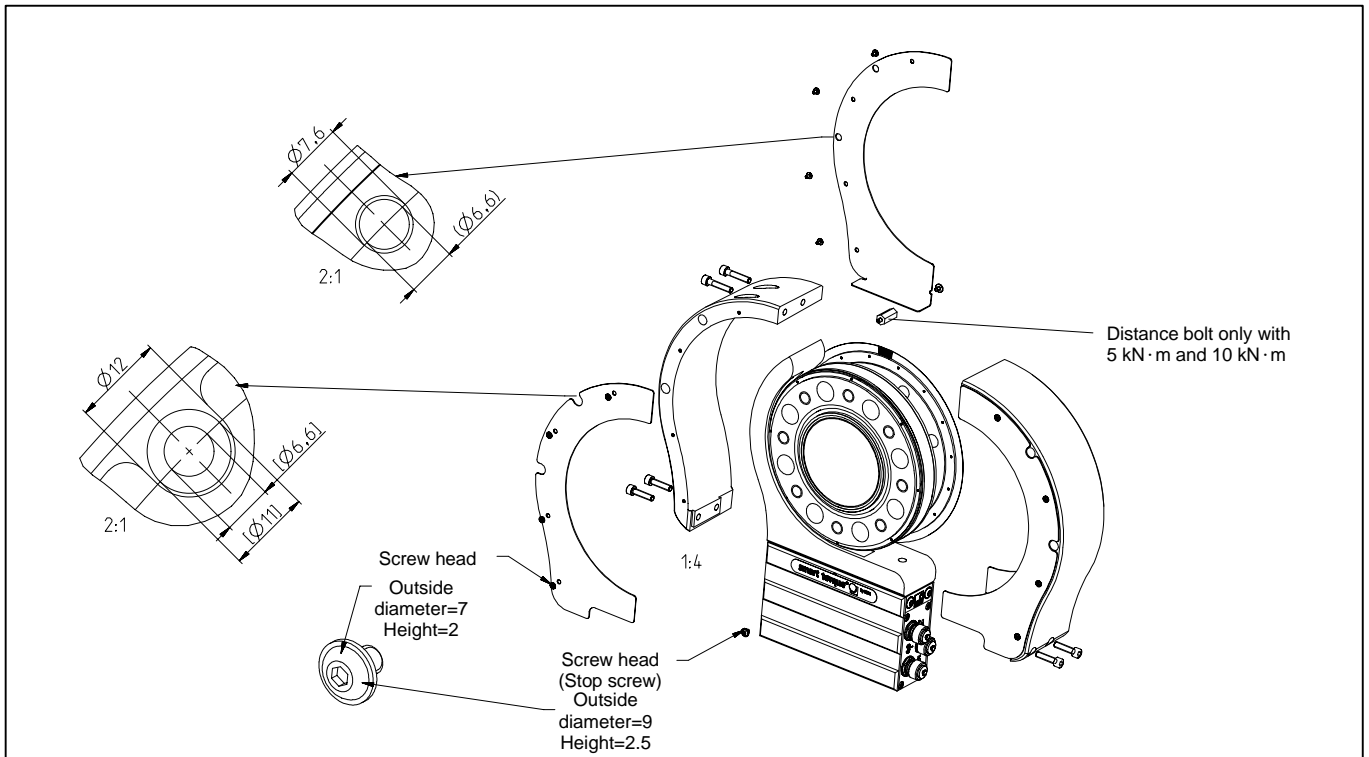


Stator dimensions 2 kN·m ... 10 kN·m with protection against contact (in mm)

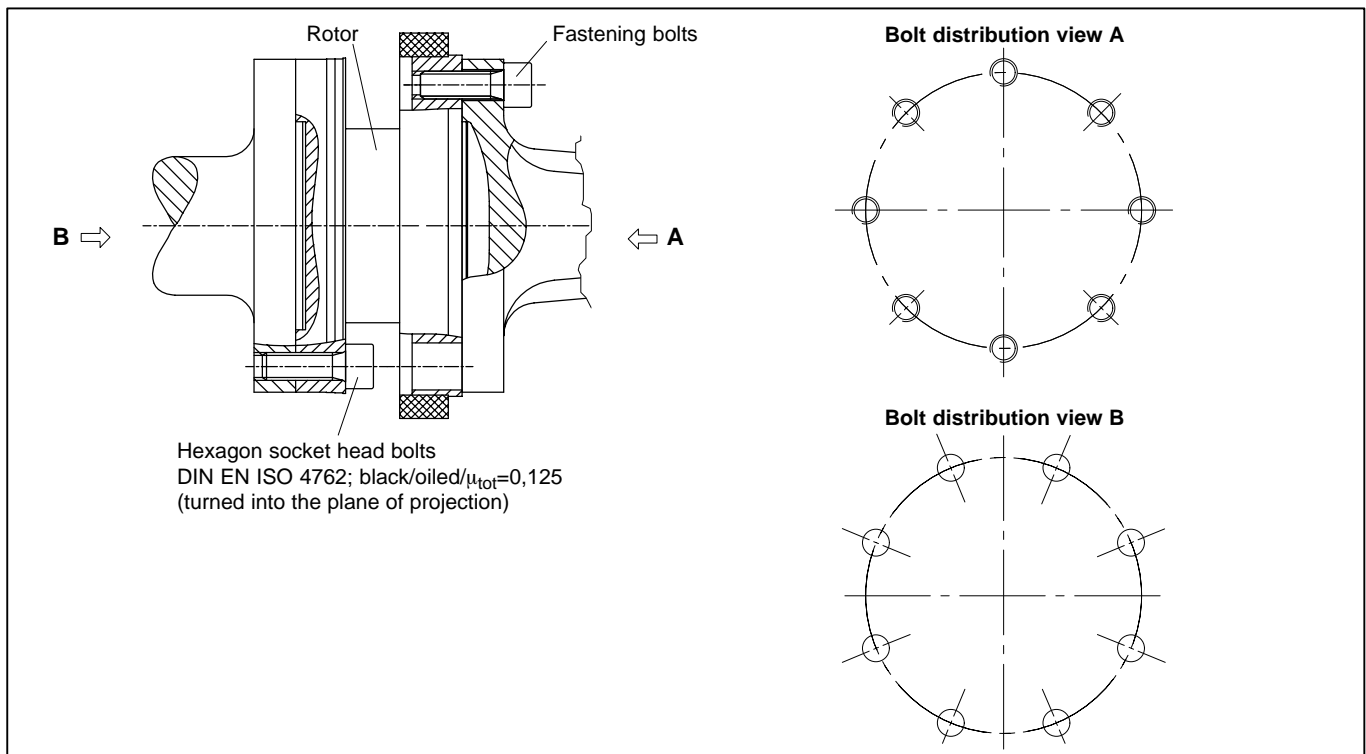


Measuring range	Dimensions in mm																		
	b ₁	b ₂	b ₃	b ₄	b ₅	b ₆	b ₇	b ₈	b ₉	H1	H2	H3	H4	H5	H6	H7			
2 kN·m/3 kN·m	58	56	1	2	4	12	32	43	97.5	116	222.5	153	121.5	120.5	107	117.3			
5 kN·m	80	78	1	2	2	12	32	65	99	133	239.5	384	138.5	134.5	120	134.3			
10 kN·m	88	86	1	2	2	12	32	73	99	157	263.5	429	162.5	155.5	145	158.3			
Measuring range	Dimensions in mm																		
	Ød ₁			Ød ₂		Ød ₃			Ød ₄			Ød ₅							
2 kN·m/3 kN·m	175			259 ⁺²		241			232			223 ₋₂							
5 kN·m	203			289 ⁺²		269			260			249 ₋₂							
10 kN·m	245			331 ⁺²		311			302			291 ₋₂							

Dimensions cover plates (in mm)

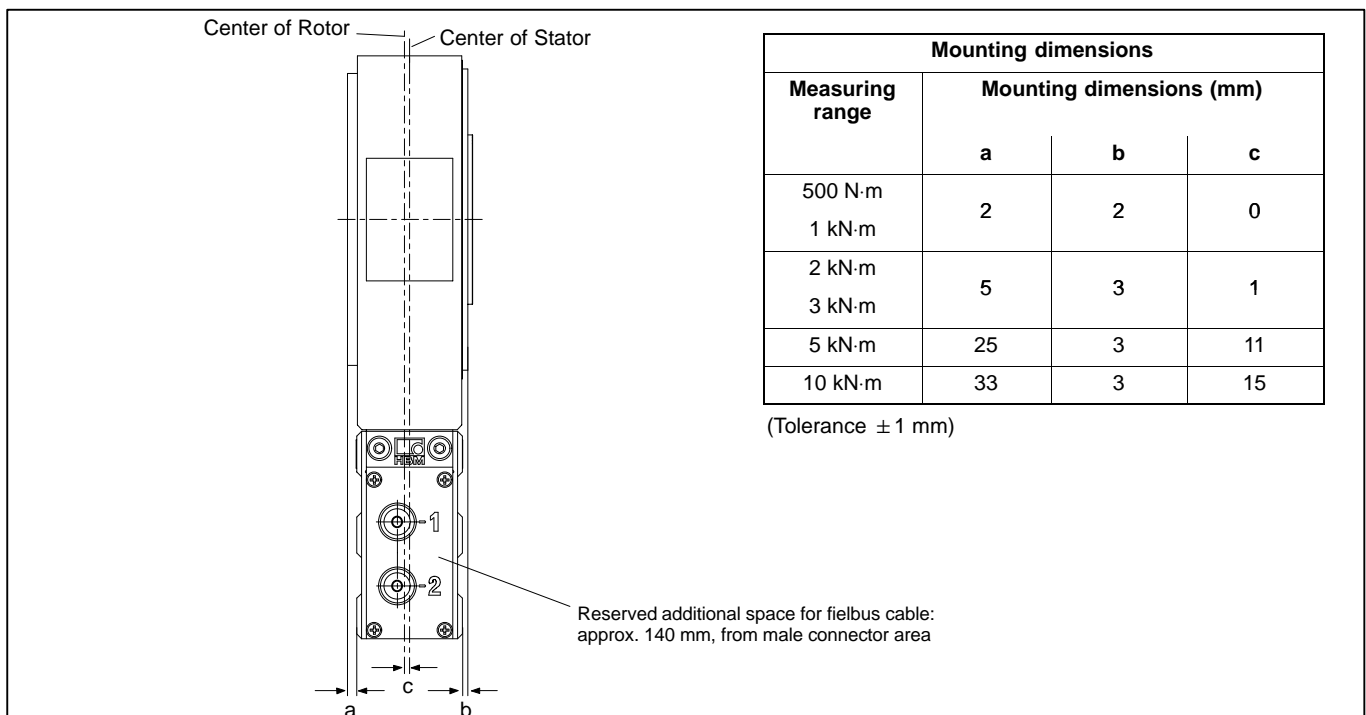


Bolted connection of the rotor

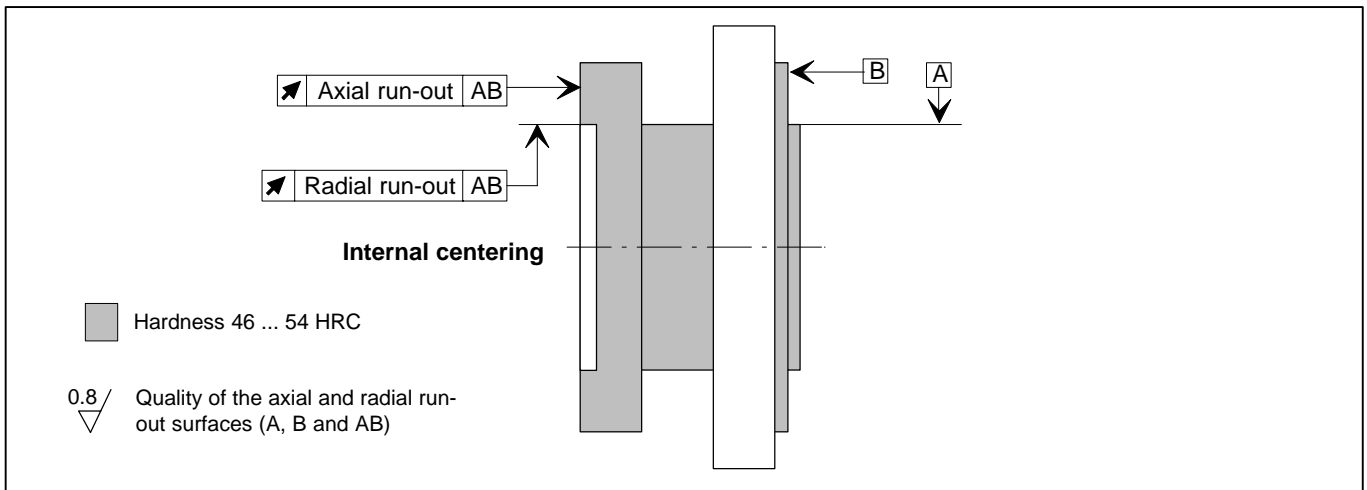


Nominal (rated) torque (N·m)	Fastening bolts	Property class of fastening bolts	Prescribed tightening moment (N·m)
500	M10	10.9	67
1k			
2k	M12	12.9	115
3k			
5k	M14	12.9	220
10k	M16		340

Mounting dimensions



Radial and axial run-out tolerances



Measuring range (N·m)	Axial run-out tolerance (mm)	Radial run-out tolerance (mm)
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
S500Q	500 N·m
S001R	1 kN·m
S002R	2 kN·m
S003R	3 kN·m
S005R	5 kN·m
S010R	10 kN·m

Code	Option 2: Accuracy
S	Standard
G	Higher Accuracy ¹⁾ Lin. < ±0.01 % and TC ₀ < ±0.01 %/10 K

Code	Option 3: Nominal (rated) speed
L	Depending on measuring range up to 12,000 rpm
H	Depending on measuring range up to 16,000 rpm

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

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

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

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

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

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

Order no.:

K-T12 - [] [] [] [] [] - [] [] - [] [] [] [] [] - [] [] - [] [] [] [] []

Ordering example:

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

1) With voltage output: Lin. < ±0.05 %; TC₀ < ±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.
Ready made connecting cables	
Torque	
Connecting cable torque, Binder 423 7-pole – D-Sub 15-pole, 6 m	1-KAB149-6
Connecting cable torque, Binder 423 – pigtails, 6 m	1-KAB153-6
Rotational speed	
Connecting cable rot. speed, Binder 423 8-pole – D-Sub 15-pole, 6 m	1-KAB150-6
Connecting cable rot. speed, Binder 423 8-pole – pigtails, 6 m	1-KAB154-6
Connecting cable rot. speed, reference pulse, Binder 423 8-pole – D-Sub 15-pole, 6 m	1-KAB163-6
Connecting cable rot. speed, reference pulse, Binder 423 8-pole – pigtails, 6 m	1-KAB164-6
CANbus	
Connecting cable CANbus, M12 A-encoded – D-Sub 9-pole, connectable termination resistor, 6 m	1-KAB161-6
Male/female cable connectors	
Torque	
423G-7S, female cable connector 7-pole, straight cable entry, for torque output (connector 1, connector 3)	3-3101.0247
423W-7S, female cable connector 7-pole, 90° cable entry, for torque output (connector 1, connector 3)	3-3312.0281
Rotational speed	
423G-8S, female cable connector 8-pole, straight cable entry, for 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
CANbus	
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
PROFIBUS	
Connecting cable, Y junction, M12 female, B-encoded; M12 male, B-encoded; M12 female, B-encoded, 2 m	1-KAB167-2
Male/female cable connector/PROFIBUS M12, female cable connector 5-pole M12, B-encoded, male cable connector 5-pole M12, B-encoded	1-PROFI-M12
Termination resistor PROFIBUS M12, B-encoded, 5-pole	1-PROFI-AB-M12
T-unit PROFIBUS M12, B-encoded, 5-pole	1-PROFI-VT-M12
Connecting cable, by the meter	
Kab8/00-2/2/2	4-3301.0071
Kab8/00-2/2/2/1/1	4-3301.0183
DeviceNet cable	4-3301.0180
Miscellaneous	
Setup-Toolkit for T12 (T12 system CD, PCAN-USB adapter, connecting cable CANbus, 6 m)	1-T12-SETUP-USB

Modifications reserved.

All details describe our products in general form only. They are not to be understood as express warranty and do not constitute any liability whatsoever.

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measurement with confidence