Data sheet

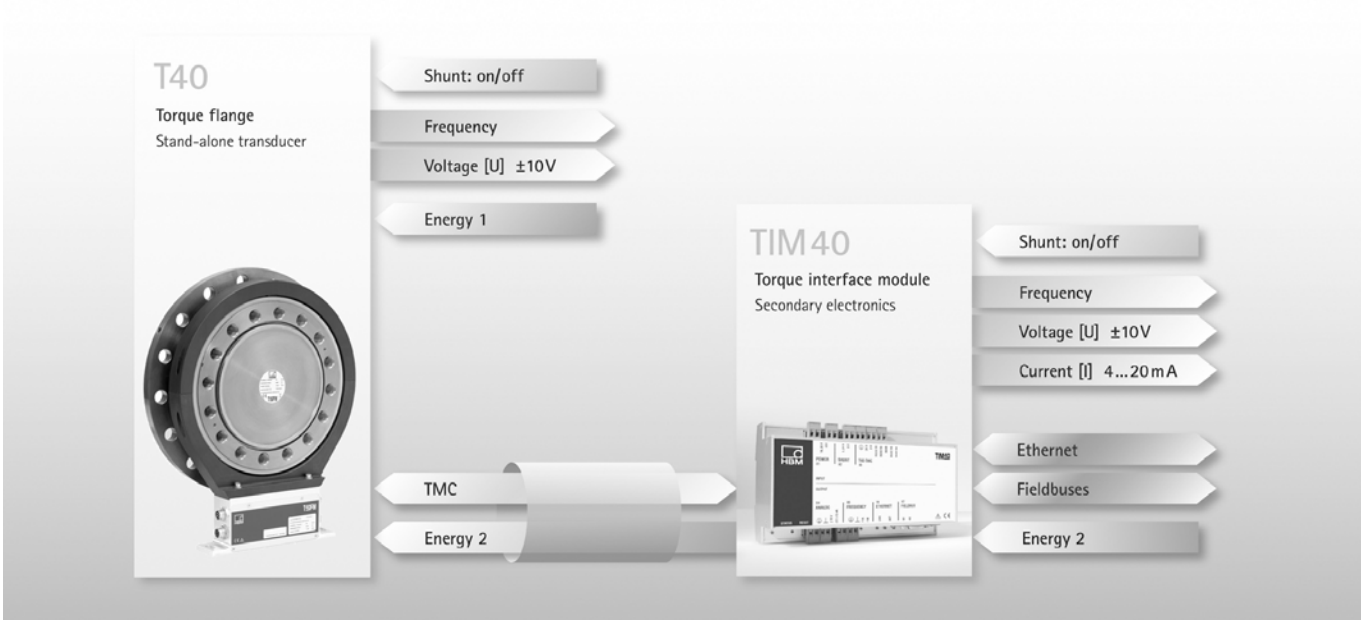
T40FM

Torque Flange

Special features

- **Nominal (rated) torque: 15 kN·m, 20 kN·m, 25 kN·m, 30 kN·m, 40 kN·m, 50 kN·m, 60 kN·m, 70 kN·m and 80 kN·m**
- **Nominal (rated) rotational speed up to 8000 rpm (dependent on the measuring range)**
- **Compact design**
- **High permissible lateral forces**
- **High radial and torsional stiffness**
- **Without bearings or slip rings**
- **Digital transmission of measured values**
- **Large measurement frequency range up to 6 kHz (-3 dB)**
- **Accuracy class 0.1 (optional 0.05)**
- **Optional: rotational speed measuring system, reference signal**

Overall concept



Specifications

Type		T40FM								
Accuracy class		0.1 (optional 0.05)								
Torque measuring system, frequency output										
Nominal (rated) torque M_{nom}	kN·m	15	20	25	30	40	50	60	70	80
Nominal (rated) rotational speed	rpm		6000			4000			3000	
optional	rpm		8000			6000			4500	
Non-linearity including hysteresis, related to nominal (rated) sensitivity										
For a max. torque in the range:										
between 0% of M_{nom} and 20% of M_{nom}	%	<±0.03 (optional <±0.015)								
> 20% of M_{nom} and 60% of M_{nom}	%	<±0.065 (optional <±0.035)								
> 60% of M_{nom} and 100% of M_{nom}	%	<±0.1 (optional <±0.05)								
Relative standard deviation of reproducibility (variability), per DIN 1319, related to the variation of the output signal	%	<±0.05								
Temperature effect per 10 K in the nominal (rated) temperature range										
on the output signal, related to the actual value of the signal span	%	<±0.05								
on the zero signal, related to the nominal (rated) sensitivity	%	<±0.05								
Nominal (rated) sensitivity (span between torque = zero and nominal (rated) torque)										
Option SU2	kHz	5								
Option DU2	kHz	30								
Option HU2	kHz	120								
Sensitivity tolerance (deviation of the actual output frequency at M_{nom} from the nominal (rated) sensitivity)	%	±0.2								
Load resistance	kΩ	>2								
Output signal at zero torque										
Option SU2	kHz	10								
Option DU2	kHz	60								
Option HU2	kHz	240								
Nominal (rated) output signal (RS422, 5 V symmetrical)										
with positive nominal (rated) torque, Option SU2	kHz	15								
with positive nominal (rated) torque, Option DU2	kHz	90								
with positive nominal (rated) torque, Option HU2	kHz	360								
with negative nominal (rated) torque, Option SU2	kHz	5								
with negative nominal (rated) torque, Option DU2	kHz	30								
with negative nominal (rated) torque, Option HU2	kHz	120								
Load resistance [1]	kΩ	≥ 2								
Long-term drift over 48 h at reference temperature, related to nominal (rated) sensitivity	%	≤ 0.03								
Measurement frequency range (-3 dB)										
Option SU2	kHz	1								
Option DU2	kHz	3								
Option HU2	kHz	6								
Group delay										
Option SU2	µs	<400								
Option DU2	µs	<220								
Option HU2	µs	<150								
Maximum modulation range [2]										
Option SU2	kHz	2.5 to17.5								
Option DU2	kHz	15 to 105								
Option HU2	kHz	60 to 420								

1) Note the necessary termination resistances as per RS-422.

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

Specifications (continued)

Torque measuring system, voltage output										
Nominal (rated) torque M_{nom}	kN·m	15	20	25	30	40	50	60	70	80
Non-linearity including hysteresis, related to nominal (rated) sensitivity For a max. torque in the range: between 0% of M_{nom} and 20% of M_{nom} > 20% of M_{nom} and 60% of M_{nom} > 60% of M_{nom} and 100% of M_{nom}	 % % %	<±0.03 (optional < ± 0.015) <±0.065 (optional < ± 0.035) <±0.1 (optional < ± 0.05)								
Relative standard deviation of reproducibility (variability), per DIN 1319, related to the variation of the output signal	%	<±0.05								
Temperature effect per 10 K in the nominal (rated) temperature range **on the output signal,** related to the actual value of the signal span **on the zero signal,** related to the nominal (rated) sensitivity	 % %	 <±0.15 <±0.15								
Nominal (rated) sensitivity (span between torque = zero and nominal (rated) torque)	V	10								
Sensitivity tolerance (deviation of the actual output frequency at M_{nom} from the nominal (rated) sensitivity)	%	±0.2								
Output signal at torque = zero	V	0								
Nominal (rated) output signal At positive nominal (rated) torque At negative nominal (rated) torque	 V V	 10 -10								
Load resistance	kΩ	>10								
Long-term drift over 48 h at reference temperature, related to nominal (rated) sensitivity	%	≤0.03								
Measurement frequency range (-3 dB) Option SU2 Option DU2 Option HU2	 kHz kHz kHz	 1 3 6								
Residual ripple [3]	mV	< 40 (peak-to-peak)								
Maximum modulation range [4] **invalid measured value**	V V	± 12 13 to 15								
Torque measuring system in general										
Energy supply										
Nominal (rated) supply voltage (separated extralow voltage)	V_{DC}	18 to 30								
Current consumption in measuring mode in startup mode	 A A	 <1 (typ. 0.3 for a 20 V supply voltage) <4 (typ. 2) for max. 50µs								
Nominal (rated) power consumption	W	<10 (typ. 6)								
Maximum cable length	m	50								
Shunt										
Tolerance of the shunt signal, related to M_{nom} at reference temperature	%	< ± 0.05								
Nominal (rated) trigger voltage	V	5								
Trigger voltage limit	V	36								
Shunt signal on	V	>2.5								
Shunt signal off	V	<0.7								

3) Signal frequency range 0.1 to 10 kHz.

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

Specifications (continued)

Rotational speed measuring system										
Nominal (rated) torque M_{nom}	kN·m	15	20	25	30	40	50	60	70	80
Measurement system		Magnetic, via AMR sensor (Anisotropic Resistive Effect) and magnetized plastic ring with embedded steel ring								
Magnetic poles		158			186			204		
Maximum positional variation of the poles		±50 angular seconds								
Output signal	V	5 V symmetrical (RS-422); 2 square wave signals approx. 90° phase shifted								
Pulses per revolution		1024								
Minimum rotational speed for sufficient pulse stability	rpm	0								
Pulse tolerance [5]	degrees	<±0.05								
Maximum permissible output frequency	kHz	420								
Group delay	µs	<150								
Radial nominal (rated) distance between sensor head and magnetic ring (mechanical distance)	mm	1.6								
Working distance range between sensor head and magnetic ring [6]	mm	0.4 to 2.5								
Max. permissible axial displacement of the rotor to the stator [7]	mm	± 1.5								
Hysteresis of direction of rotation reversal in the case of relative vibrations between rotor and stator										
Torsional vibration of the rotor	degrees	<approx. 0.2								
Horizontal stator vibration displacement	mm	<approx. 0.5								
Load resistance [8]	kΩ	≥2								
Reference signal measuring system (0 index)										
Measurement system		Magnetic, with Hall sensor and magnet								
Output signal	V	5 V symmetrical (RS 422)								
Pulses per revolution		1								
Minimum rotational speed for sufficient pulse stability	rpm	2								
Pulse width, approx.	degrees	0.088								
Pulse tolerance [5]	degrees	<±0.05								
Group delay	µs	<150								
Axial nominal (rated) distance between sensor head and magnetic ring (mechanical distance)	mm	2.0								
Working distance range between sensor head and magnetic ring	mm	0.4 to 2.5								
Max. permissible axial displacement of rotor to stator [7]	mm	± 1.5								

5) At nominal (rated) conditions.
6) The pulse tolerance improves with reduced distance and vice versa.
7) The data refers only to a central axial alignment. Deviations lead to a change in pulse tolerance.
8) Note the necessary termination resistances as per RS-422.

Specifications (continued)

General information										
EMC										
Emission (per FCC 47, Part 15, sub part C)	-									
Emission (per EN 61326-1, Section 7)										
RFI field strength	-									
Immunity from interference, as per EN61326-1, EN61326-2-3										
Electromagnetic field (AM)	V/m									
Magnetic field	A/m									
Electrostatic discharge (ESD)										
Contact discharge	kV									
Air discharge	kV									
Fast transients (burst)	kV									
Impulse voltages (surge)	kV									
Conducted interference (AM)	V									
Degree of protection, as per EN 60 529 (rotor/stator)	-									
Reference temperature	°C									
Nominal (rated) temperature range	°C									
Operating temperature range [9]	°C									
Storage temperature range	°C									
Permissible ambient humidity										
Relative humidity / no condensation	%									
Mechanical shock, as per EN 60068-2-72 [10]										
Number	n									
Duration	ms									
Acceleration (half sine)	m/s^2									
Vibrational stress in 3 directions, as per EN 60068-2-6 [10]										
Frequency range	Hz									
Duration	h									
Acceleration (amplitude)	m/s^2									
Load limits [11]										
Nominal (rated) torque M_{nom}	kN·m	15	20	25	30	40	50	60	70	80
Limit torque	kN·m	32			60			110		
Max. limit load of measuring body [12]	kN·m	100			200			350		
Breaking torque (static)	kN·m	>100			>200			>350		
Longitudinal limit force (static)	kN	60			120			240		
Lateral limit force (static)	kN	80			160			240		
Limit bending moment (static)	N·m	6000			12000			24000		
Oscillation width, per DIN 50100 (peak-to-peak) [13]	kN·m	30	32		60			100		

9) Heat conductance via the stator base plate necessary over 70°C. The temperature of the base plate must not exceed 85°C.

10) The antenna ring and connector plug must be fixed.

11) Each type of irregular stress (bending moment, lateral or longitudinal force, exceeding nominal (rated) torque) can only be permitted up to its specified 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 limit bending 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 effects of permissible bending moments, longitudinal and lateral forces on the measurement result are $\leq \pm 1\%$ of the nominal (rated) torque. The load limits only apply for the nominal (rated) temperature range. At temperatures <10°C, the load limits must be reduced by approx. 30% (strength reduction).

12) The data refer to static loading of the measuring body; note the bolted connection!

13) The nominal (rated) torque must not be exceeded.

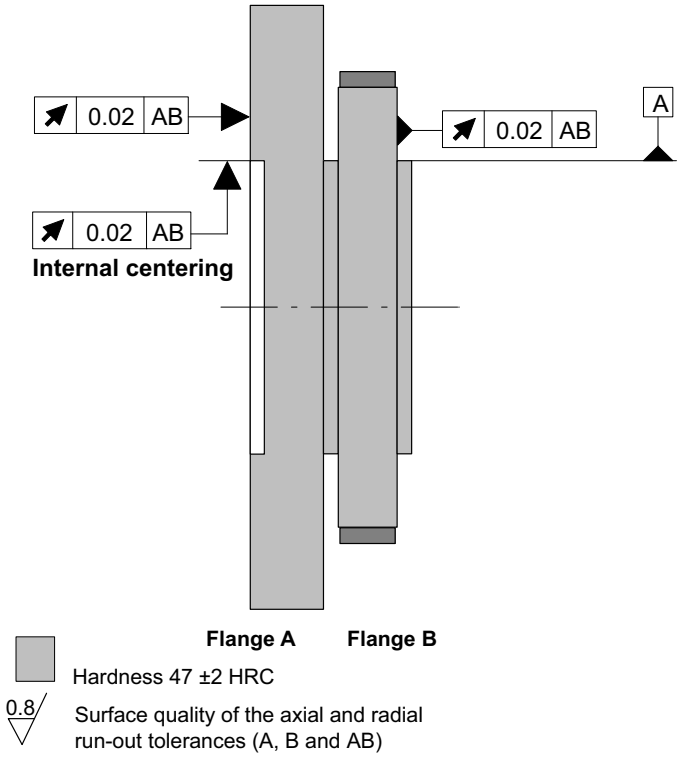
Specifications (continued)

Mechanical values										
Nominal (rated) torque M_{nom}	kN·m	15	20	25	30	40	50	60	70	80
Torsional stiffness c_T	kN·m/rad	32050			63260			106200		
Torsion angle at M_{nom}	degrees	0.027	0.036	0.045	0.027	0.036	0.045	0.033	0.038	0.043
Stiffness in the axial direction c_a	kN/mm	1380			1710			2280		
Stiffness in the radial direction c_r	kN/mm	3900			5080			6170		
Stiffness during the bending moment round a radial axis c_b	kN·m/ degrees	94			188			290		
Maximum deflection at longitudinal limit force	mm	<0.05			<0.08			<0.12		
Additional max. radial deviation at lateral limit force	mm	<0.05			<0.05			<0.05		
Additional maximum plumb/parallel deviation at limit bending moment	mm	<0.5						<0.7		
Balance quality level, as per DIN ISO 1940		G 6.3								
Permissible max. rotor vibration displacement (peak-to-peak) [14] Undulations in the connection flange area, based on ISO 7919-3										
Normal operation (continuous operation)	µm	$s_{(p-p)} = \frac{9000}{\sqrt{n}}$ (n in rpm)								
Start and stop operation/resonance ranges (temporary)	µm	$s_{(p-p)} = \frac{13200}{\sqrt{n}}$ (n in rpm)								
Mass moment of inertia of rotor Jv (around the rotary axis; does not take flange bolts into account)										
without rotational speed measuring system	kg·m²	0.20			0.46			0.75		
with rotational speed measuring system	kg·m²	0.22			0.51			0.81		
Proportional mass moment of inertia for the transmitter side (side of the flange with external centering)										
without rotational speed measuring system	% of J_v	28			23			26		
with rotational speed measuring system	% of J_v	37			30			32		
Max. permissible static eccentricity of the rotor (radially) to the center point of the stator										
without rotational speed measuring system	mm	±2								
Permissible axial displacement between rotor and stator [15]										
without rotational speed measuring system	mm	±2								
Weight										
Rotor without rotational speed measuring system	kg	18			28			39		
Rotor with rotational speed measuring system	kg	20			32			42		
Stator	kg	1.8			2.1			3.0		

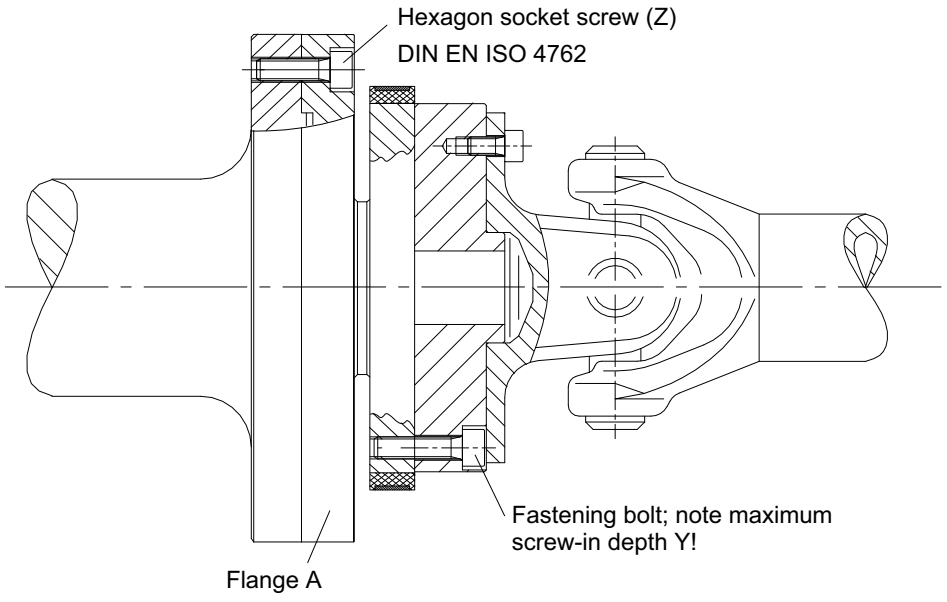
14) The influence of radial deviations, impact, defects of form, notches, marks, local residual magnetism, structural variations or material anomalies on the vibrational measurements needs to be taken into account and isolated from the actual undulation.

15) Above the nominal (rated) temperature range ±1.5 mm.

Radial and axial run-out tolerances



Fastening bolts

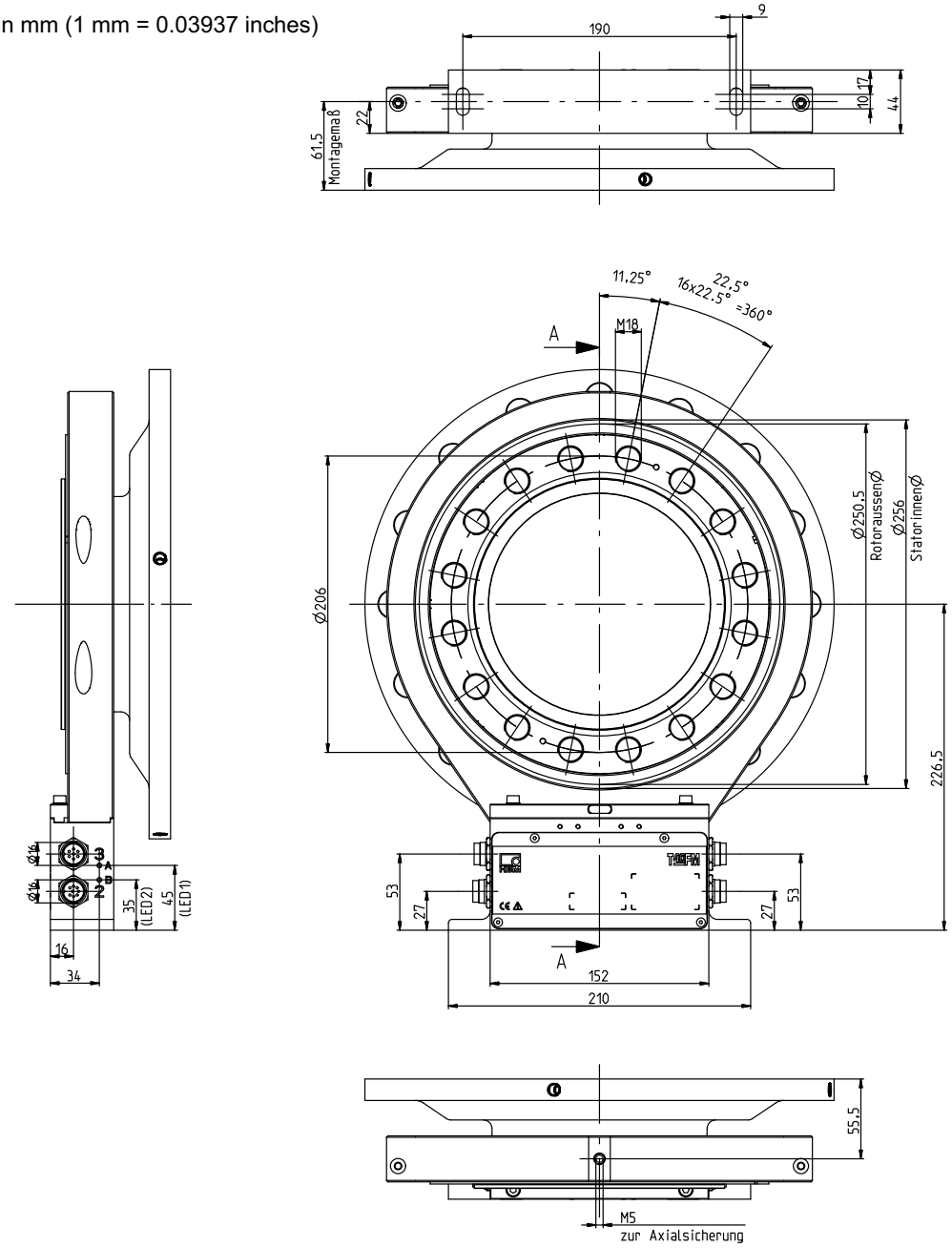


Measuring range (kN·m)	Fastening bolts (Z)[1)]	Fastening bolts property class	Prescribed tightening moment (N·m)
15/20/25	M18	10.9	400
30/40/50	M20		560
60/70/80	M22		760

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

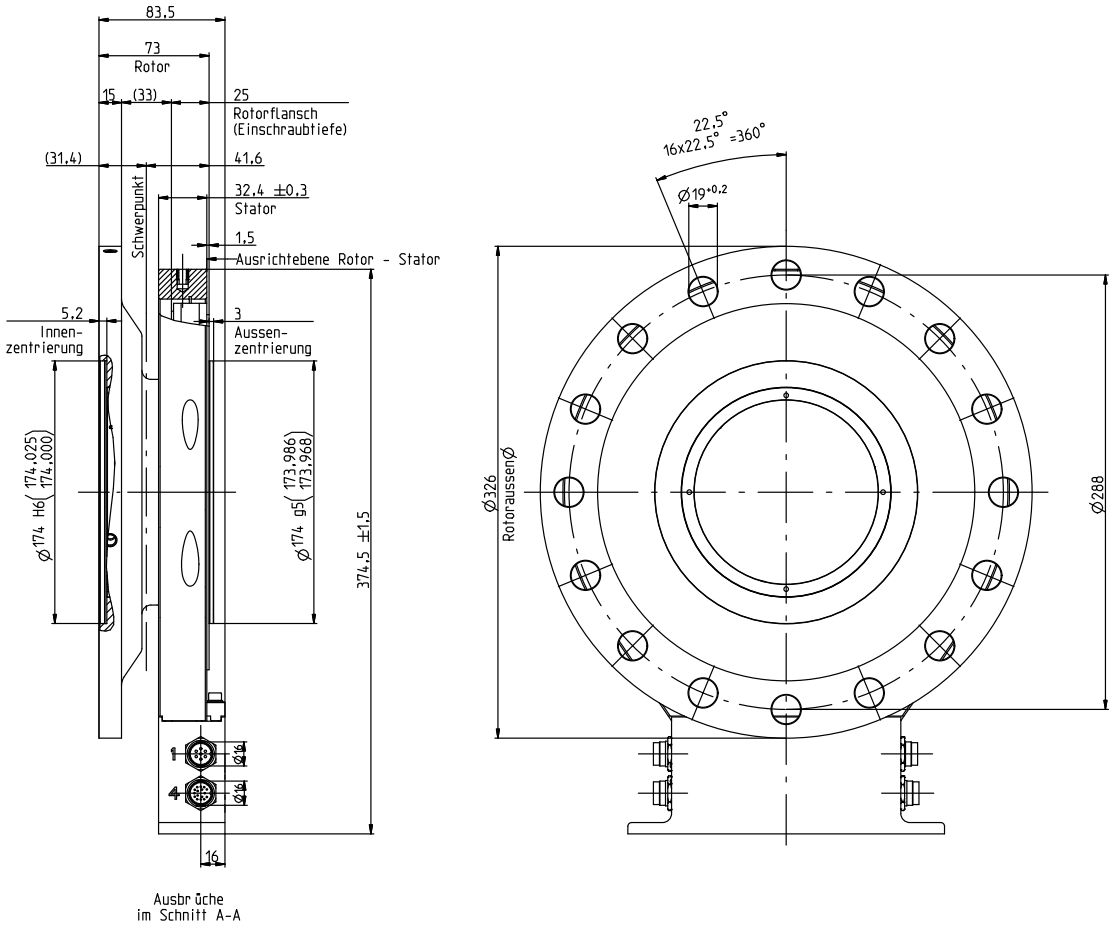
Dimensions T40FM 15 kNm - 25 kNm without rotational speed measurement

Dimensions in mm (1 mm = 0.03937 inches)



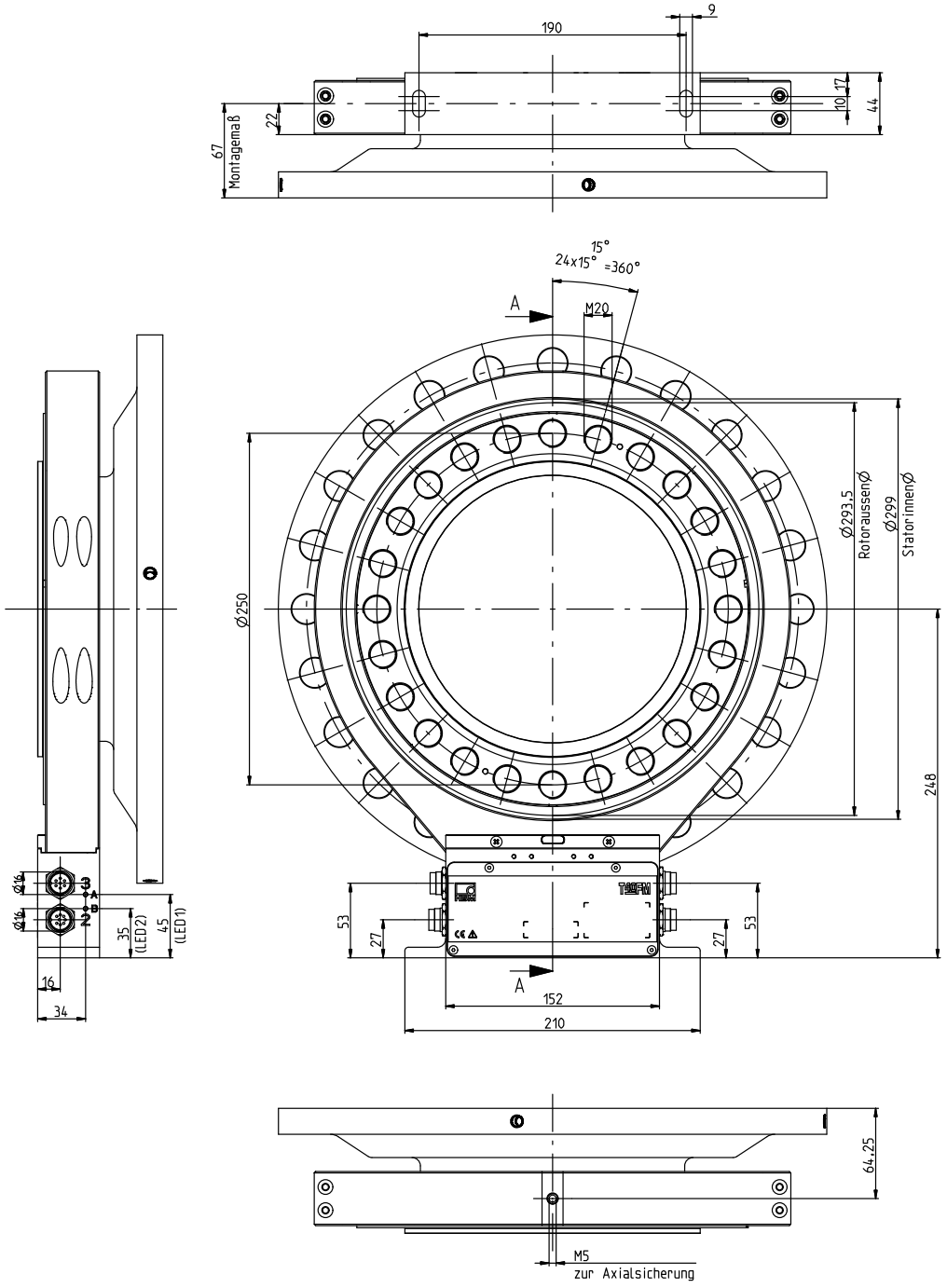
Dimensions T40FM 15 kNm - 25 kNm without rotational speed measurement (cont.)

Dimensions in mm (1 mm = 0.03937 inches)



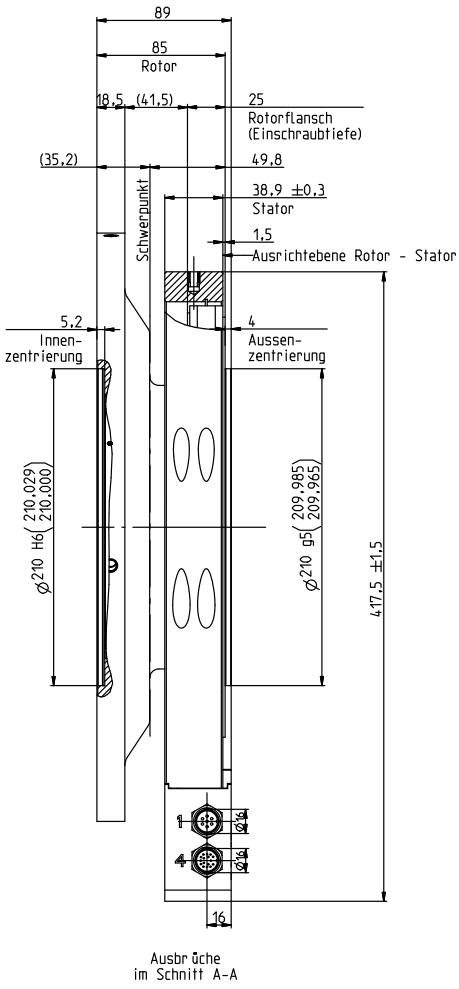
Dimensions T40FM 30 kNm - 50 kNm without rotational speed measurement

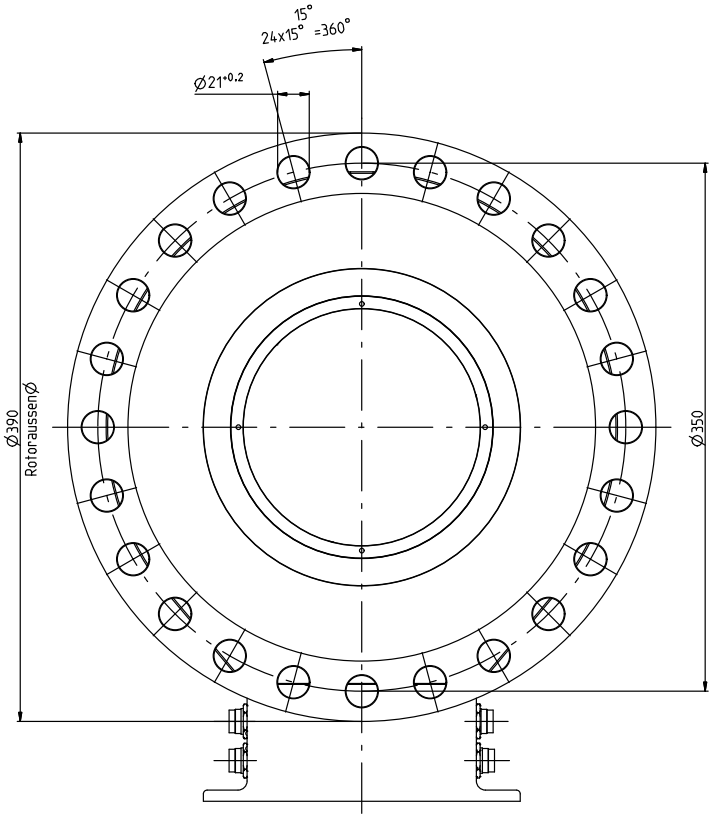
Dimensions in mm (1 mm = 0.03937 inches)



Dimensions T40FM 30 kNm - 50 kNm without rotational speed measurement (cont.)

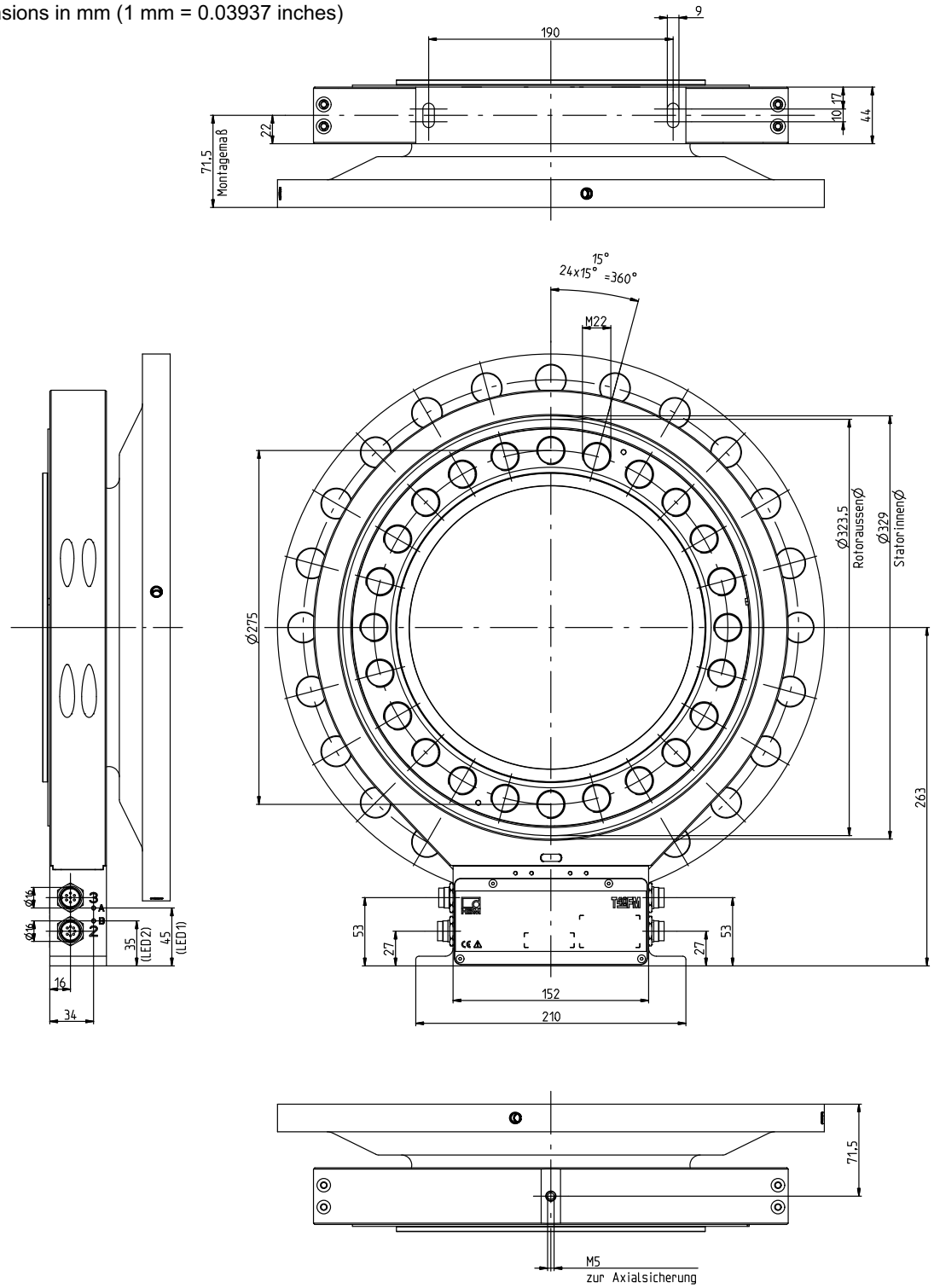
Dimensions in mm (1 mm = 0.03937 inches)





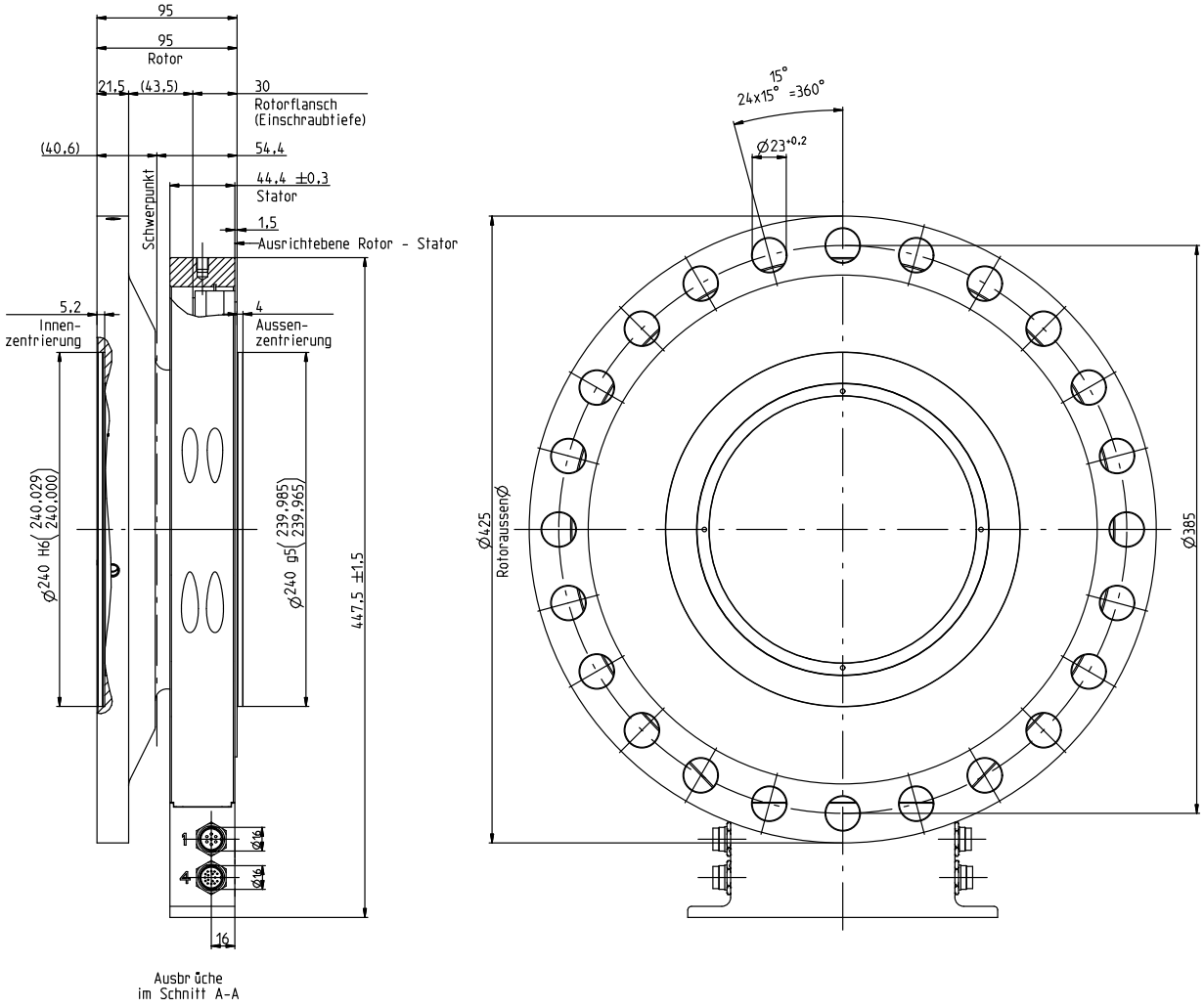
Dimensions T40FM 60 kNm - 80 kNm without rotational speed measurement

Dimensions in mm (1 mm = 0.03937 inches)



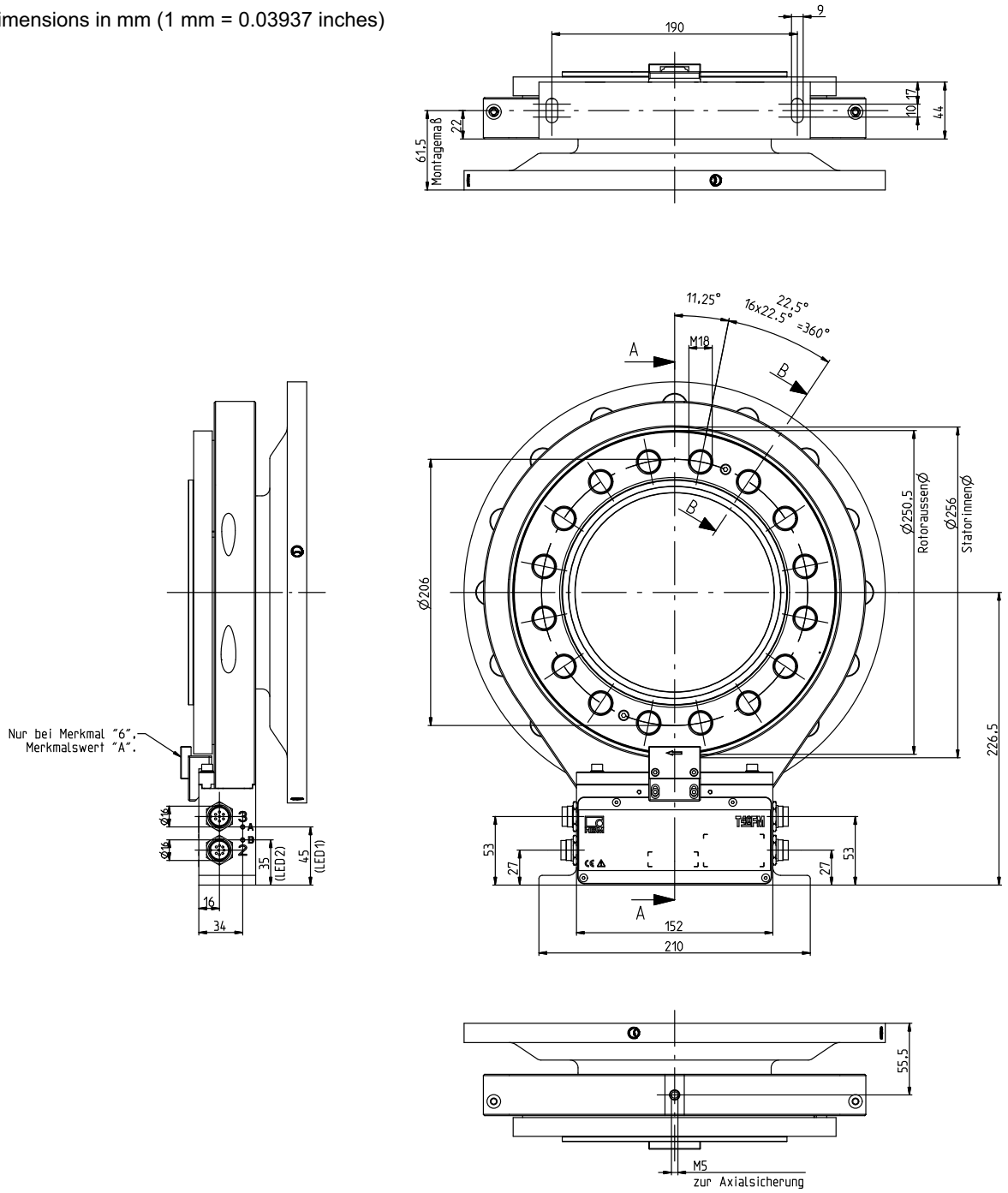
Dimensions T40FM 60 kNm - 80 kNm without rotational speed measurement (cont.)

Dimensions in mm (1 mm = 0.03937 inches)



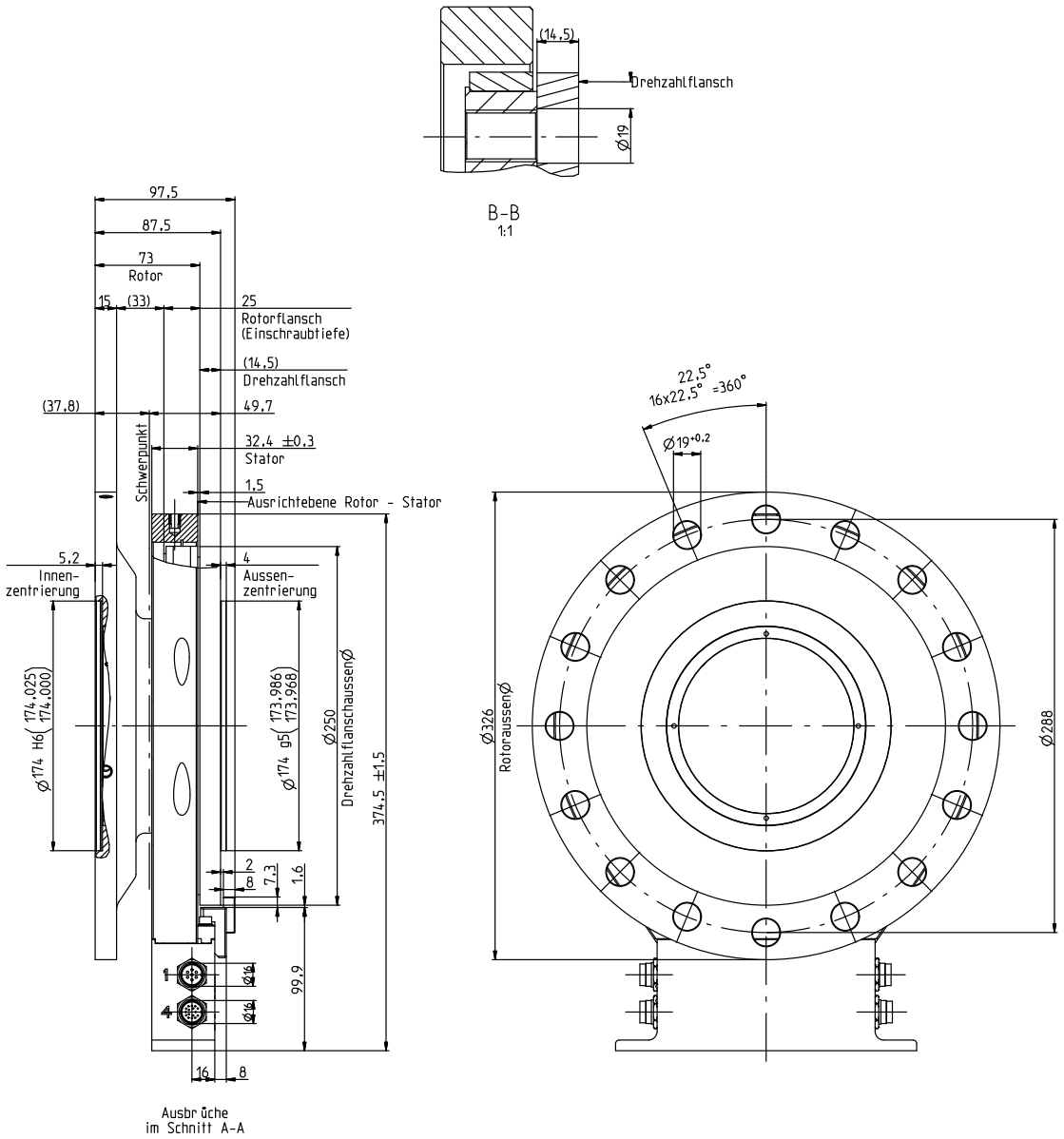
Dimensions T40FM 15 kNm - 25 kNm with rotational speed measurement

Dimensions in mm (1 mm = 0.03937 inches)



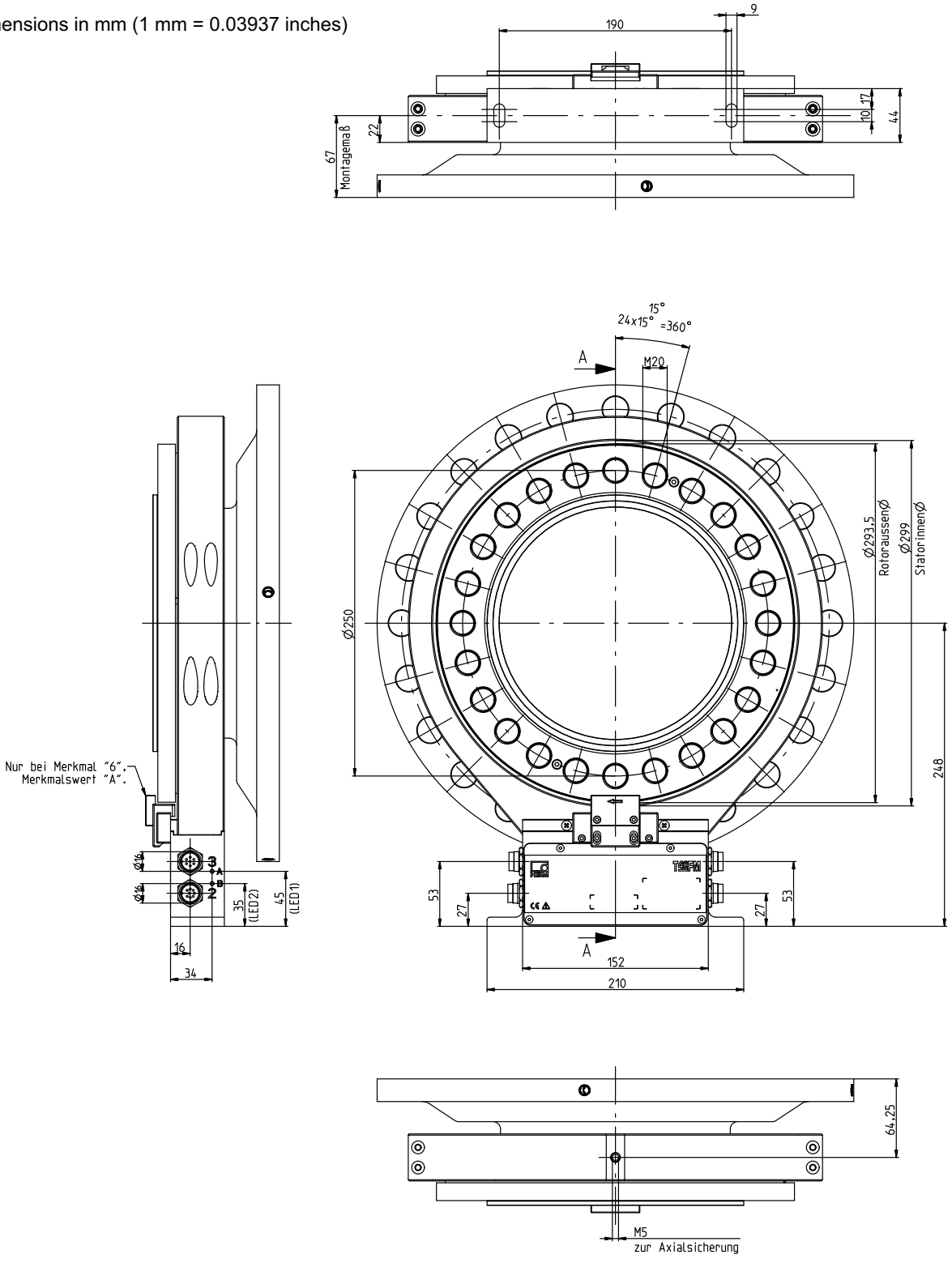
Dimensions T40FM 15 kNm - 25 kNm with rotational speed measurement (cont.)

Dimensions in mm (1 mm = 0.03937 inches)



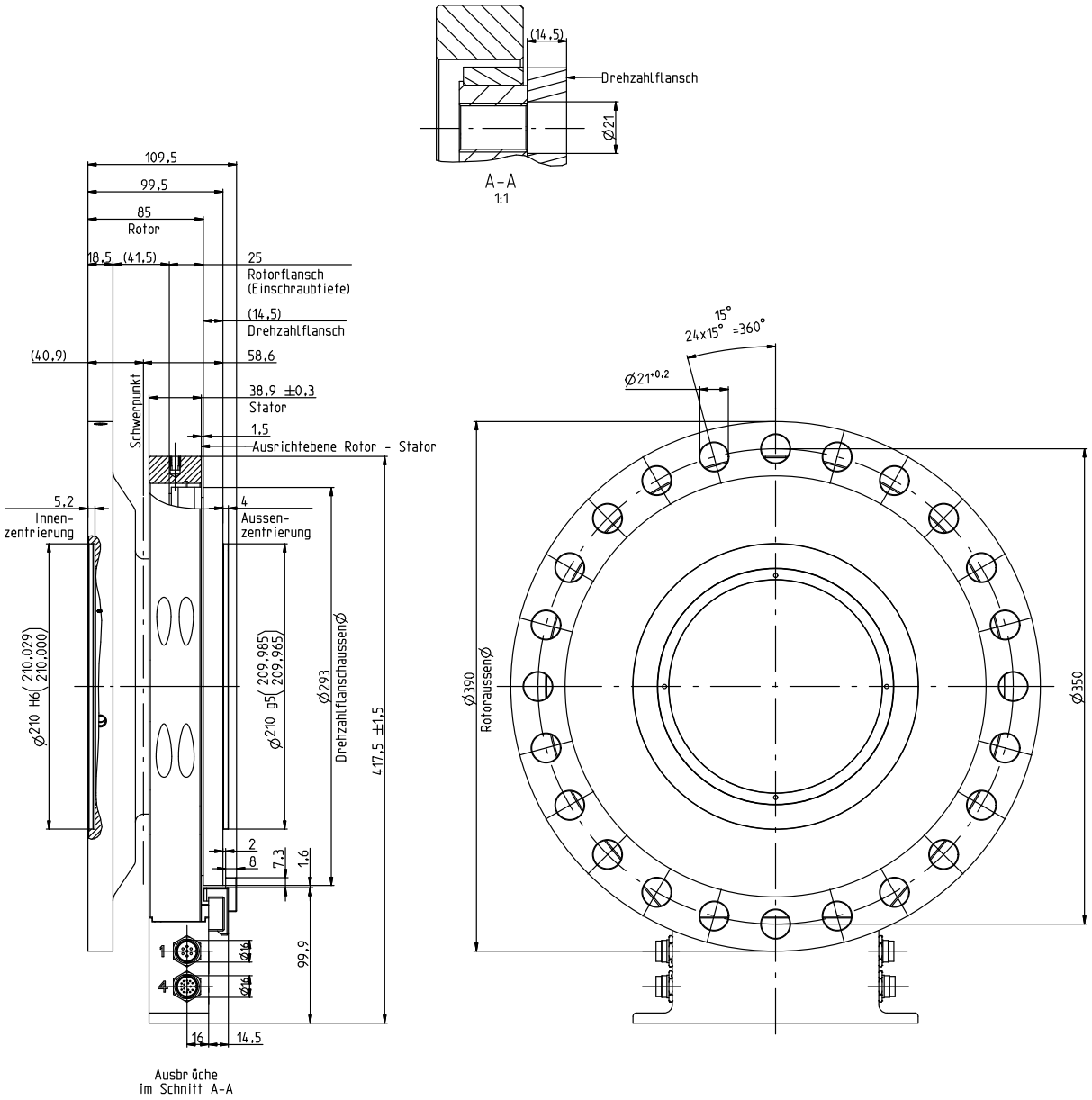
Dimensions T40FM 30 kNm - 50 kNm with rotational speed measurement

Dimensions in mm (1 mm = 0.03937 inches)



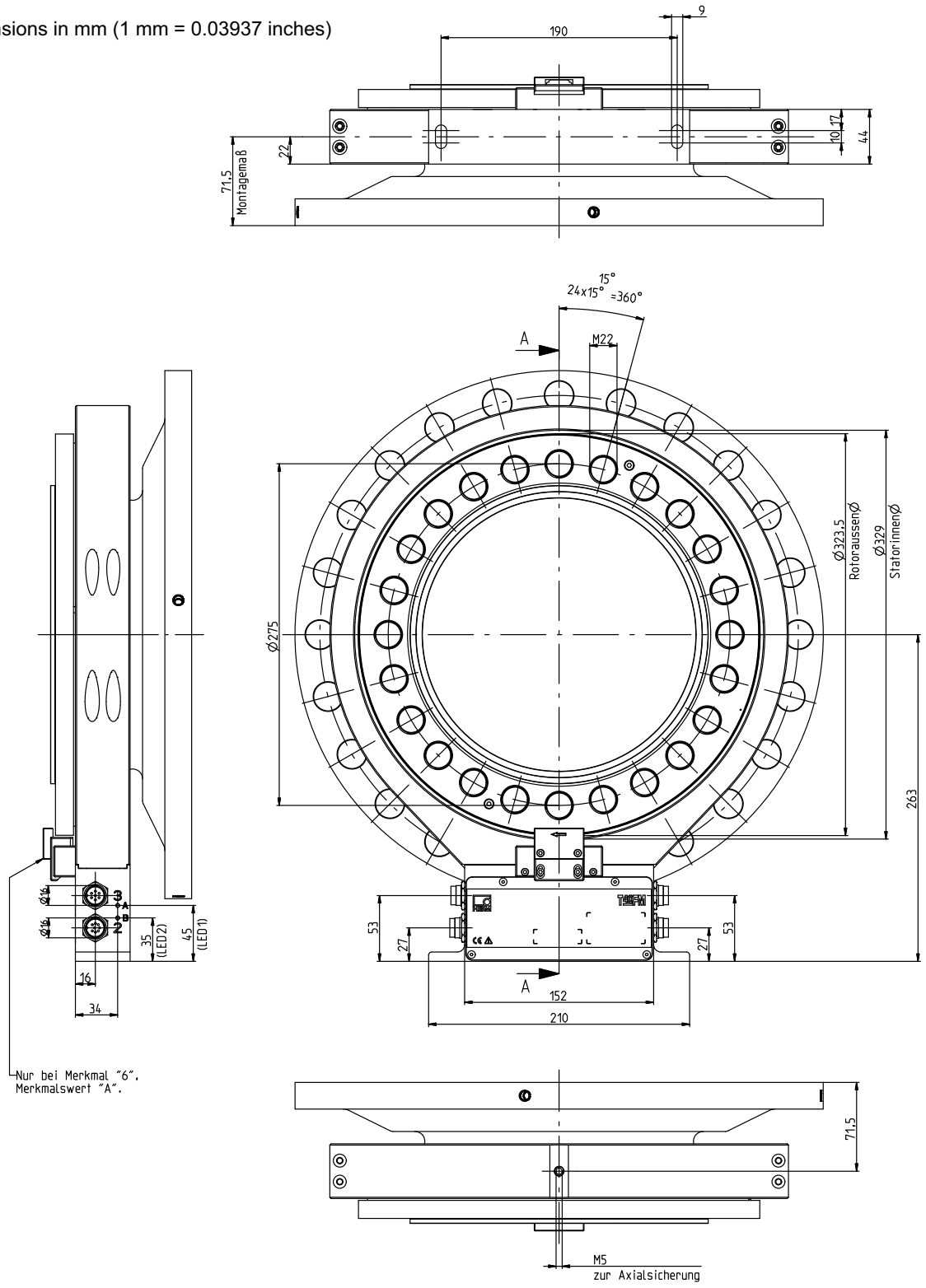
Dimensions T40FM 30 kNm - 50 kNm with rotational speed measurement (cont.)

Dimensions in mm (1 mm = 0.03937 inches)



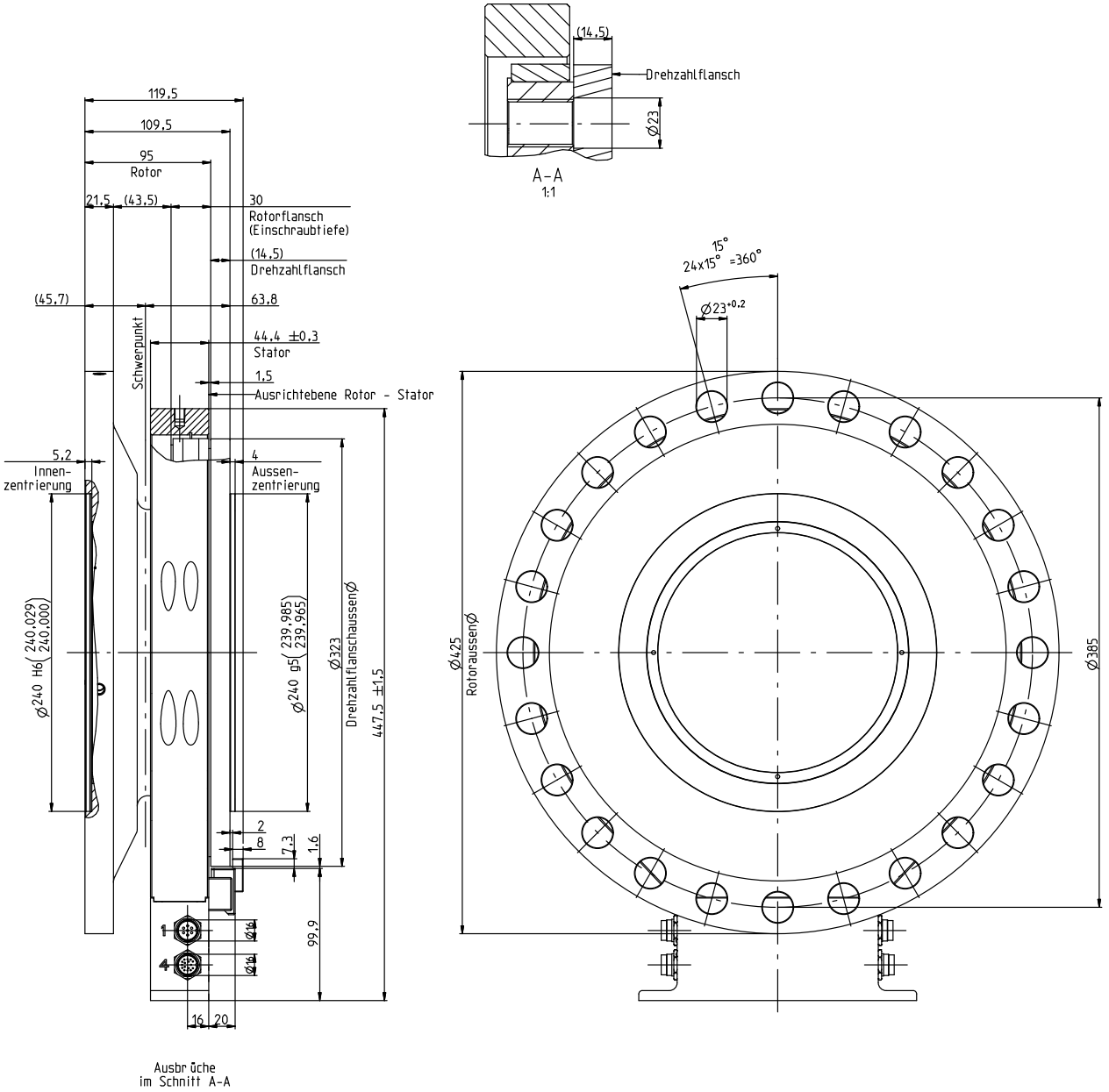
Dimensions T40FM 60 kNm - 80 kNm with rotational speed measurement

Dimensions in mm (1 mm = 0.03937 inches)



Dimensions T40FM 60 kNm - 80 kNm with rotational speed measurement (cont.)

Dimensions in mm (1 mm = 0.03937 inches)



Ordering number

Order no.	
K-T40FM	[only with Option 2 = MF/ST]

Code	Option 1: Measuring range up to	
015R	15 kN·m	[only with Option 2 = MF/ST]
020R	20 kN·m	[only with Option 2 = MF/ST]
025R	25 kN·m	[only with Option 2 = MF/ST]
030R	30 kN·m	[only with Option 2 = MF/ST]
040R	40 kN·m	[only with Option 2 = MF/ST]
050R	50 kN·m	[only with Option 2 = MF/ST]
060R	60 kN·m	[only with Option 2 = MF/ST]
070R	70 kN·m	[only with Option 2 = MF/ST]
080R	80 kN·m	[only with Option 2 = MF/ST]

Code	Option 2: Component
MF	Measurement flange, complete
RO	Rotor
ST	Stator

Code	Option 3: Accuracy
S	Standard
G	Linearity deviation including hysteresis <±0.05

Code	Option 4: Adjustment
M	Metric (N·m)

Code	Option 5: Electrical configuration	[only with Option 2 = MF/ST]
SU2	10 kHz ±5 kHz and ±10 V output signal, 18…30 V DC supply voltage	
DU2	60 kHz ±30 kHz and ±10 V output signal, 18…30 V DC supply voltage	
HU2	240 kHz ±120 kHz and ±10 V output signal, 18…30 V DC supply voltage	

Code	Option 6: Rotational speed measuring system
0	Without rotational speed measuring system
1	Magnetic rotational speed measuring system; 1024 pulses/revolution
A	Magnetic rotational speed measuring system; 1024 pulses/revolution with reference pulse

Code	Option 7: Customized modification
S	No customer-specific modification
H	Permissible rotational speed depending on measuring range 4500 rpm to 8000 rpm

K-T40FM - 0 3 0 R - M F - S - M - D U 2 - 0 - S

= PREFERENCE Types

Accessories, to be ordered separately

Article	Order no.
Connection cable for torque output	
Torque connection cable, 423 − D-Sub 15P, 6 m	1−KAB149−6
Torque connection cable, 423 − free ends, 6 m	1−KAB153−6
Connection cable for rotational speed output	
Rotational speed connection cable, 423 − D-Sub 15P, 6 m	1−KAB150−6
Rotational speed connection cable, 423 − free ends, 6 m	1−KAB154−6
Rotational speed with reference signal connection cable, 423 8-pin − D-Sub 15P, 6 m	1−KAB163−6
Rotational speed with reference signal connection cable, 423 8-pin − free ends, 6 m	1−KAB164−6
TMC connection cable	
TIM40/TMC connection cable, 6 m	1−KAB174−6
Cable sockets	
423G−7S, 7-pin (straight)	3−3101.0247
423W−7S, 7-pin (angular)	3−3312.0281
423G−8S, 8-pin (straight)	3−3312.0120
423W−8S, 8-pin (angular)	3−3312.0282
Connection cable, by the meter (min. order quantity: 10 m)	
Kab8/00−2/2/2	4−3301.0071

measure and predict with confidence

B03293_09_E00_01 HBM: public