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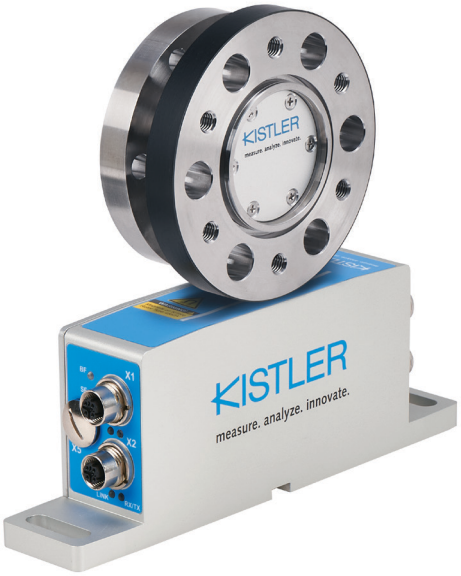
KiTorq system

Torque measuring flange

Type 4552A...

KiTorq Rotor Type 4552A... for measuring highly dynamic torques.

- Combinations of various rotors and stators
- High accuracy of 0.03 % FSO.
- Radial distance between rotor and stator up to 0.20 inch
- Speeds up to 30,000 rpm
- Connection dimensions acc. to DIN ISO 7646 (gear flanges)



Description

KiTorq System is a torque measuring flange system consisting of the torque measuring body KiTorq Rotor Type 4552A... and the torque evaluation unit KiTorq Stator. The rotors and stators of the KiTorq system can be combined with each other as required. KiTorq rotor and stator type 454xB can be ordered individually according to the order code or together as a calibrated system. The stator automatically recognizes a rotor change and sets the necessary parameters automatically.

All KiTorq rotors capture the torque using strain gages. The generated signal is amplified and then processed with approx. 35 ksamples. Due to the high sampling rate, a very high dynamic torque measurement is achieved.

KiTorq Stator

The torque evaluation unit supplies the KiTorq rotor with power and receives the measured values from it. The evaluation unit has integrated speed or angle detection and provides different signal outputs depending on the version.

Calibration

Various calibration options are available for the configurable output signals of the KiTorq system. Calibration is carried out on a high-precision calibration system that is traceable to national standards.

Application

With its properties, the KiTorq rotor type 4552A... is predestined for applications in test bench technology such as electric motor, gearbox, pump and combustion engine test benches.

General technical data

Rated torque M_{nom}	N·m	50, 100, 200, 500
Rated torque M_{nom}	kN·m	1, 2, 3, 5, 10
Nominal speed n_{nom} at 50, 100, 200, 500 N·m and 1 kN·m	min^{-1}	25,000
Nominal speed n_{nom} at 2 and 3 kN·m	min^{-1}	18,000
Nominal speed n_{nom} at 5 kN·m	min^{-1}	14,000
Nominal speed n_{nom} at 10 kN·m	min^{-1}	12,000
Operating temperature range (rated temperature range T_{nom})	°F	50... 140
Service temperature range	°F	32 ... 158
Storage temperature range	°F	–13 ... 176
Protection class (IEC 60529)		IP54

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Technical data Type 4452A...

Size/Rated torque M_{nom}	N·m	50	100	200	500	1,000	2,000	3,000	5,000	10,000
	lbf-in	443	885	1,770	4,425	8,851	17,702	26,552	44,254	88,508
Technical data										
Torque measuring system										
Nominal Speed n_{nom} L - Option	min^{-1}	20,000					15,000		12,000	10,000
Nominal Speed n_{nom} H - Option	min^{-1}	25,000					18,000		14,000	12,000
Max. Speed n_{nom} H - Option (T_{nom}= +10°C … +40°C)	min^{-1}	30,000					20,000		15,000	13,000
Measurement features in the measuring range 1:1 (single range) *										
Accuracy class	-	0.05								
Typical linearity incl. hysteresis, referring to nominal sensitivity for max. torque in the range of:										
Between 0% of M_{nom} and 20% of M_{nom}	% FSO	<±0.01								
>20% of M_{nom} and 60% of M_{nom}	% FSO	<±0.02								
>60% of M_{nom} and 100% of M_{nom}	% FSO	<±0.03								
Rel. standard deviation of repeatability	% FSO	<±0.03								
Temperature influence zero point	% FSO/10K	<±0.05								
Temperature influence nominal value	% FSO/10K	<±0.05								
Nominal value (span betw. torque = zero and nominal torque)										
Frequency output 240 kHz (standard)	kHz	120								
Voltage output	V	10								
Measurement features in the measuring range 1:5 / 1:10 *										
Accuracy class	-	0.1								
Typical linearity incl. hysteresis, referring to nominal sensitivity for max. torque in the range of:										
Between 0% of M_{nom} and 60% of M_{nom}	% FSO	<±0.04								
>60% of M_{nom} and 100% of M_{nom}	% FSO	<±0.06								
Rel. standard deviation of repeatability	% FSO	<±0.06								
Temperature influence zero point	% FSO/10K	<±0.1								
Temperature influence nominal value	% FSO/10K	<±0.1								

* Compliance of the values within the nominal temperature range (T_{nom}= +10°C … +60°C)

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Electrical data Type 4452A...

Size/Rated torque M_{nom}	N·m	50	100	200	500	1,000	2,000	3,000	5,000	10,000
	lbf-in	443	885	1,770	4,425	8,851	17,702	26,552	44,254	88,508
Torque measuring system										
Power supply										
Nominal supply voltage U_b	V	18 … 30								
Nominal input power rating	W	<20								
Permitted ripple of supply voltage	mVss	200								
Current consumption during measuring operation at Ub = 24 V	A	<0.8								
Recommended max. cable length to guarantee the signal quality	ft	16.4								
Connectors for electrical connection	-	depending on stator type								
Output signal										
Frequency output (standard)	kHz	240 ±120								
Voltage level of the frequency output	V	+4.2* … +5* / +24								
Voltage output	V	–10 … +10								
Tolerance of sensitivity (voltage/frequency)	%	±0.1								
Load resistance	kΩ	>10								
Long term drift 48 h (analog signal)	% FSO	<0.03								
Long term drift 48 h (digital signal)	% FSO	<0.01								
Cut-off frequency (–3 dB)	kHz	10								
Sampling rate	kSample	35								
Noise with low pass filter with cutoff frequency (–3 dB) in measuring range 1:1										
1,000 Hz	% FSO	<±0.05								
Group delay time (all outputs)										
... in case of 10 kHz between signal input torque to signal output	ms	<0.22								
… in case of 1 kHz between signal input torque to signal output	ms	<1.12								
Signal when torque = zero										
Frequency output 240 kHz	kHz	240								
Voltage output	V	0								
Maximum control range										
Frequency output	kHz	6 … 360								
Voltage output	V	–11 … +11								
Resolution										
Frequency signal 100 kHz	Hz	1								
Voltage signal	mV	0.4								
Control input**										
"On"	V	3.5 … 30								
"Off"	V	0 … 2								
Torque control signal	% FSO	100 ±0.2								

* According to revision of the stator (protection circuit)

** Valid for analog and frequency output

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Fieldbus data Type 4452A...

Size/Rated torque M_{nom}	N·m	50	100	200	500	1,000	2,000	3,000	5,000	10,000
	lbf-in	443	885	1,770	4,425	8,851	17,702	26,552	44,254	88,508
Statortype 4542BNxA / B / C / D / E										
Industrial Ethernet-Interface ProfiNET / EtherCAT										
Sampling rate (Values/s)	Hz	max. 4,000 (IRT-capable)								
Baud rate	Mbit/s	100								
Connector		4-pin. M12								
Encoding		D								
Max. cable length	ft	328								
Industrial Ethernet-Interface EtherNet/IP										
Sampling rate (Values/s)	Hz	max. 1,000								
Baud rate	Mbit/s	100								
Connector		4-pin. M12								
Encoding		D								
Max. cable length	ft	328								
Feldbus-Interface PROFIBUS										
Sampling rate (Values/s)	Hz	max. 1,000								
Adress range		1 … 127								
Baud rate	Mbit/s	≤12								
Connector		5-pin. M12								
Encoding		B								
Feldbus-Interface CANopen										
Sampling rate (Values/s)	Hz	max. 1,000								
Address range		1 … 127								
Baud rate	Mbit/s	≤1								
Connector		5-pin. M12								
Encoding		A								

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Rotation speed/rotation angle measuring system Type 4552A...

Size/Rated torque M_{nom}	**N·m**	**50**	**100**	**200**	**500**	**1,000**	**2,000**	**3,000**	**5,000**	**10,000**
	lbf-in	**443**	**885**	**1,770**	**4,425**	**8,851**	**17,702**	**26,552**	**44,254**	**88,508**
Rotation angle / Speed measuring system										
Measuring system		Magnetic, via GMR sensor and pole wheel								
Amount of output pulses per turn N (depending on n and f_{out})	-	60 (Option N1) 128 (Option N2) 1 … 8,192 (Option N3)								
N1 Option	-	1 square signal								
N2 Option	-	2 square signal 90° phase shiftet + Z-puls								
N3 Option	-	2 square signal 90° phase shiftet + Z-puls								
Group delay time between signal input rotation to signal output	µs	100								
Load resistance	kΩ	≥2								
Minimum rotation for sufficient pulse stability Rotation angle (TTL)	min^{-1}	>0								
Output signal (TTL)	V	5								
Angle accuracy [1]	°	±0.01								
Speed accuracy	%	= J[°] * N / 180° *100								
Maximum permitted output frequency f_{out}	kHz	500 [2]								
Reference pulse width, B_i	°	0.25 x oscillation period								

[1] With 2 mm air gap between rotor and stator aligned with installation aid

[2] Maximum numbers of output pulses Nmax = maximum allowable output frequency fout (Hz) x 60 / rotational speed n (min^{-1}).
With 8,192 pulses means a maximum speed of 3,660 min^{-1}.

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General information Type 4552A...

Size/Rated torque M_{nom}	N·m	50	100	200	500	1,000	2,000	3,000	5,000	10,000
	lbf-in	443	885	1,770	4,425	8,851	17,702	26,552	44,254	88,508
General data										
Electromagnetic compatibility (EMV)										
Noise immunity (EN 61326-1, Table 2)										
Electromagnetic field (AM)	V/ft	3.048								
Magnetic field	A/ft	30,480								
Electrostatic discharge by contact (ESD)	kV	8								
Electrostatic discharge in air (ESD)	kV	4								
Fast transients (burst)	kV	1								
Surge voltages (surge)	kV	1								
Cable bound noise (AM)	V	10								
Emission (according to EN 61326-1, Table 3)										
Radio interference voltage, radio interference power, Radio interference field intensity		Class B								
Protection class (IEC 60529)		IP54								
Operating temperature range (T_{nom})	°C	50 ... 140								
Service temperature range	°C	32 ... 158								
Storage temperature range	°C	–13 ... 176								
Mechanical shock (EN 60068-2-27)										
Number of cycles		1,000								
Cycle duration	ms	3								
Acceleration shock	ft/s²	2,132.5								
Vibration stress in 3 axes (EN 60068-2-6)										
Frequency range	Hz	10 … 2,000								
Loading duration	h	2.5								
Acceleration (Amplitude)	ft/s²	656.168								

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Mechanical data and load limits Type 4452A...

Size/Rated torque M_{nom}	N·m	50	100	200	500	1,000	2,000	3,000	5,000	10,000
	lbf-in	443	885	1,770	4,425	8,851	17,702	26,552	44,254	88,508
Mechanical data										
Torsional rigidity C_T	k lbf·ft/rad	170.4		257.4	700.7	817	2,416.5	2,584.9	2,779.3	5,982.9
Torsion angle at M_{nom}	°	0.025		0.033	0.03	0.052	0.035	0.049	0.076	0.035
Mass moment of inertia of the rotor around rotation axis	lb·in²	7.518		7.860	14.351	14.351	42.375	42.033	82.687	235.003
Proportionate mass moment of inertia around the axis on the measuring side	lb·in²	4.101		4.101	7.518	7.518	23.239	24.263	48.545	134.696
Resonance frequency of the rotor (torsion vibration)	kHz	2		2.47	3.12	3.4	3.27	3.4	2.59	2.77
Loading limits [1]										
Limiting torque M_{op}, related to M_{nom} [2]	%	200								
Rupture torque M_{rupt}, related to M_{nom} [2]	%	>400							>360	
Alternating torque M_{dyn} [3]	%	±100							±80	
Max. bending torque (radial axis) M_b [4]	lbf·in	265.5		442.5	1,062.1	1,062.1	1,947.2	2,035.7	2,655.2	4,425.4
Longitudinal load limit F_A [4]	k lbf	1.124		2.248	3.372	4.496	5.620	6.744	7.868	10.116
Transverse load limit F_Q [4]	k lbf	0.450		0.674	1.349	2.473	3.147	4.046	4.496	5.620
Stiffness in case of bending moment around a radial axis c_b	k lbf·ft/°	0.811		1.180	2.730	3.172	7.299	8.482	11.136	25.589
Stiffness in axial direction c_a	k lbf/in	2,438.4		3,357.0	3,281.5	3,981.9	6,151.4	7,144.0	6,060.3	8,517.3
Stiffness in radial direction c_r	k lbf/in	1347.6		1,610.2	3,214.7	4,037.0	6,349.5	6,931.9	6,343.8	12,453.5
Allowed deviation of plane parallelism at max. bending torque (at øD)	in	<0,0019		<0.0024	<0,0031	<0.0024	<0.0024		<0,00276	<0.0024
Max. stroke at limit longitudinal force	in	<0,0016								
Additional max. runout error at transverse load limit F_Q	in	<0,0008								
Mass										
Rotor	lbf	3,307			4,189		7,716		10,582	18,519
Stator	lbf	1,543								
Balancing class according DIN ISO 1940	Q	G 2.5								
Max. allowed axial misalignment between rotor and stator [5]	in	±0.0394								
Max. allowed air gap between rotor and stator Sr [5]	in	0,079±0,0394								
Concentricity radial on measuring side [5]	in	0,00039			0,0265		0,00047		0,00071	0.0008

[1] The effects of permissible parasitic forces (bending moment M_B , longitudinal F_A and lateral forces F_Q) can be up to 0.3% of nominal torque. Each type of irregular stress (M_B, F_A oder F_Q) is only permitted up to its specific load limit, provided none of the others will occur at the same time. If this condition is not met, the limit values must be reduced. If 30% of M_B and F_Q occur at the same time, only 40% of F_A is permissible and the nominal (rated) torque must not be exceeded.

[2] These values refer to static load.

[3] Mnom should not be exceeded.

[4] These values refer to static and dynamic load.

[5] Outside the range, only torque up to max. 5 mm is transmitted.

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Dimensions KiTorq System Type 4552A..., 50 N·m, 100 N·m and 200 N·m

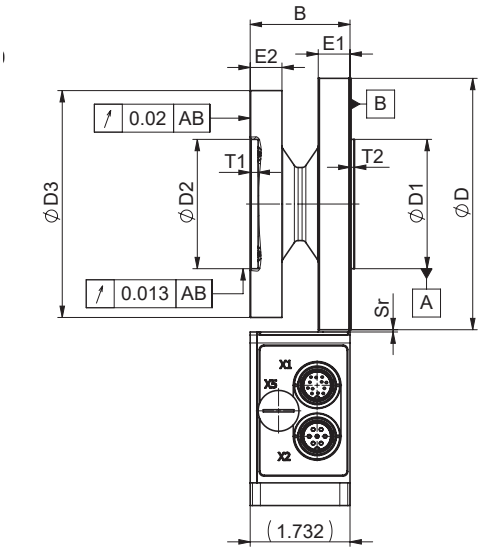

Fig. 1: Dimension drawing side view KiTorq System

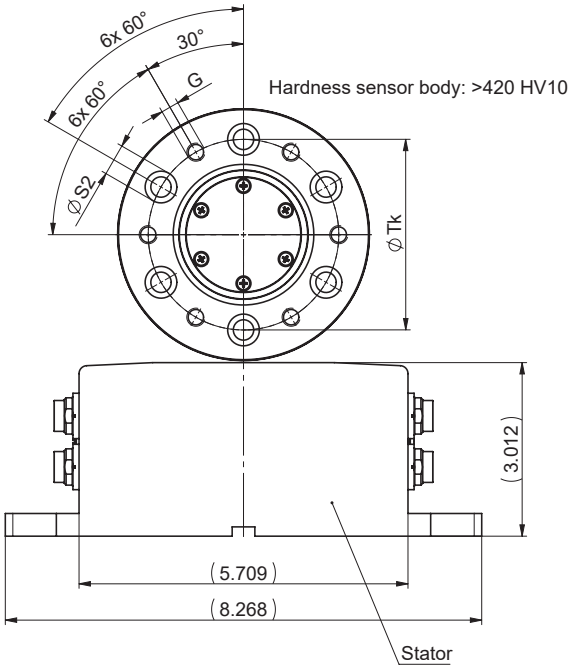

Fig. 3: Dimension drawing View B, KiTorq System

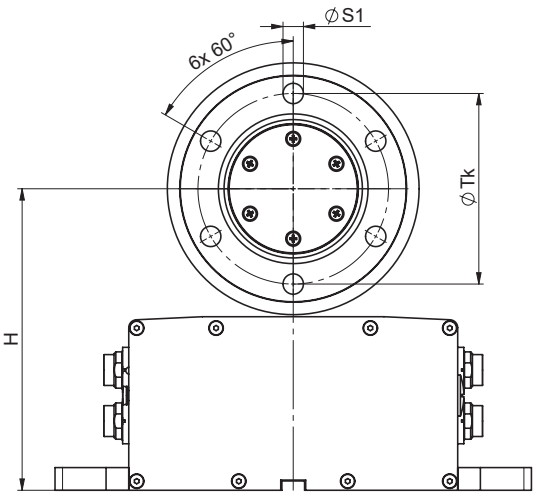

Fig. 2: Dimension drawing View A, KiTorq System

Dimensions torque measuring unit KiTorq Rotor in inch
(All dimensions without tolerances comply with ISO 2768-mH)

Type 4552A...	N·m	50	100	200
Rated torque M_{nom}	lbf-in	443	885	1770.2
øD	in	4.37		
$øD1_{g6}$		2.24		
$øD2^{H6}$		2.24		
øD3		3.94		
E1		0.55		
E2		0.55		
$T1_{-0.2}$		0.14		
$T2^{+0.2}$		0.08		
øTk		3.31		
øS1		0.35		
øS2		0.55		
G (6x)		M8		
H[3)]		5.28		
B		1.73		

[3)] Note: consider maximum permitted radial air gap!

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Dimensions KiTorq System Type 4550A..., 500 N·m, 1, 2, 3, 5 and 10 kN·m

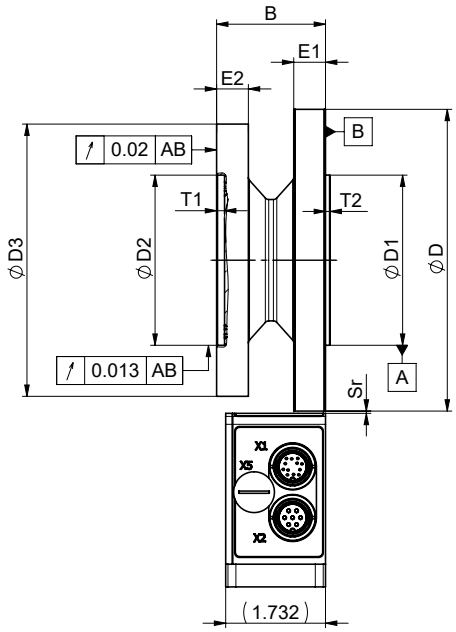

Fig. 4: Dimension drawing side view KiTorq System

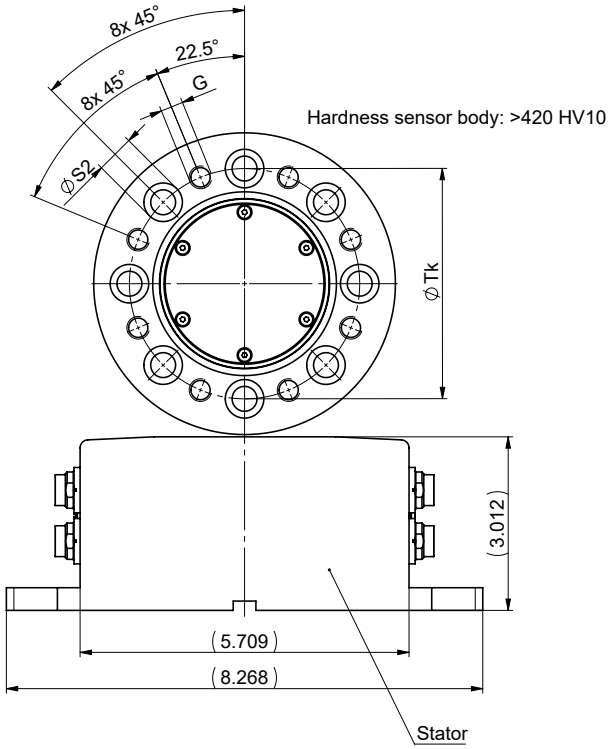

Fig. 6: Dimension drawing View B, KiTorq System

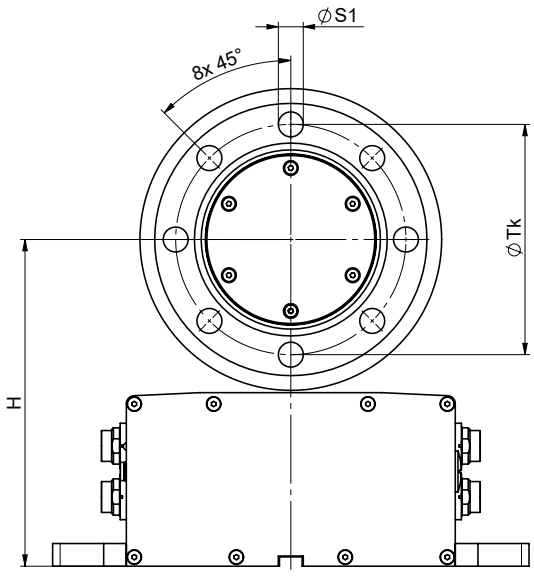

Fig. 5: Dimension drawing View A, KiTorq System

Dimensions torque measuring unit KiTorq Rotor in inch
(All dimensions without tolerances comply with ISO 2768-mH)

Type 4552A...	N·m	500	1,000	2,000	3,000	5,000	10,000
Rated torque M_{nom}	lbf-in	4,425	8,851	17,702	26,552	44,254	88,508
øD	in	5.24		6.57		7.72	9.57
$øD1_{g6}$		2.95		3.54		4.33	5.51
$øD2^{H6}$		2.95		3.54		4.33	5.51
øD3		4.72		6.14		7.09	8.86
E1		0.55		0.67		0.67	0.79
E2		0.55		0.55		0.55	0.67
$T1_{-0.2}$		0.14		0.12		0.12	0.14
$T2^{+0.2}$		0.08		0.10		0.10	0.10
øTk		4		5.12		6.12	7.72
øS1		0.43		0.51		0.59	0.67
øS2		0.67		0.79		0.87	1.02
G (6x)		M10		M12		M14	M16
H[3)]		5.71		6.38		6.95	7.87
B		1.89		2.09			2.32

[3)] Note: consider maximum permitted radial air gap!

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Application examples

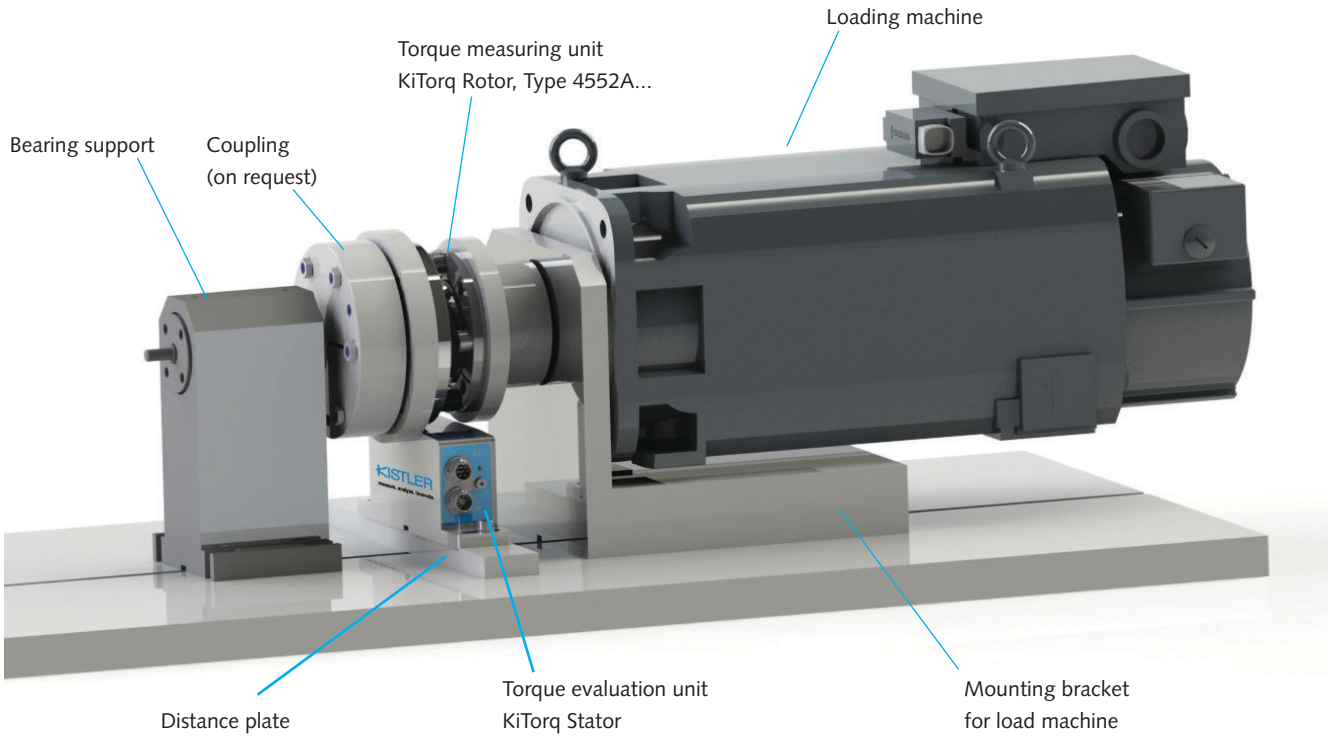

Fig. 7: Example of application with KiTorq

Metal-free space

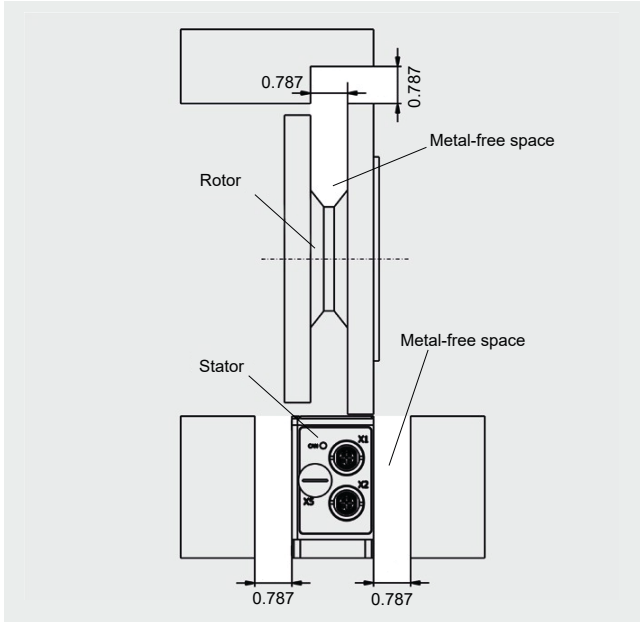

Fig. 8: Example of metal free-space

Installation according to system description 002-566
Please note that there should be no piece of metal inside the „metal-free space“. Any metal could disturb the energy transmission between rotor and stator and could lead into signal disturbance.

Caution: Consider metal free space!

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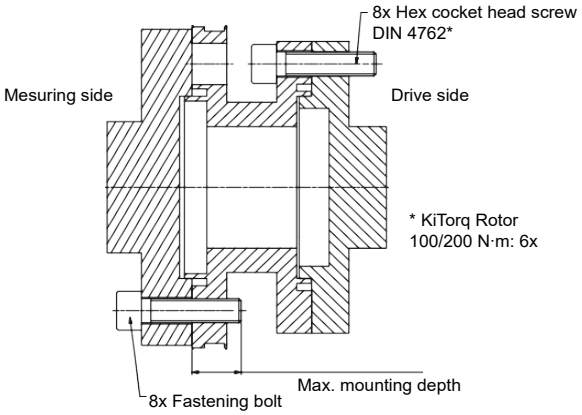
Mounting

Rotor screw connection, mounting screws

Nominal torque M_{nom}	N·m	50/100/200	500/1,000	2,000/3,000	5,000	10,000
	lbf-in	443/885/1770	4425/8851	17702/26552	44254	88508
Thread		M8	M10	M12	M14	M16
Property class		10.9	10.9	10.9	12.9	12.9
Minimum mounting depth	in	0.394	0.394	0.472	0.551	0.630
Maximum mounting depth [1]	in	0.630	0.630	0.748	0.748	0.866
Fastening torque M_A	lbf-in	300.926	619.553	1,090	1,947	3,186

[1] Important: The maximum mounting depth must never be exceeded!



Calibration

Standard calibration: By default, the rotor or KiTorq system is calibrated with a WKS 1 calibration. Furthermore, a WKS 2 or an accredited calibration can be selected. You can also choose between single-range and dual-range. This gives the sensor a measuring range spread of 1:10 or 1:5.The following signals are set as standard:

- Frequency: 240 kHz ±120 kHz
- Analog: ±10 V

Special calibration: On request, it is possible to flexibly define two measuring ranges for areas between the standard measuring ranges. Measuring ranges can be freely selected in 5% increments. This makes it possible to calibrate a sensor with a physical measuring range of 100 Nm to 80% and 20%, which then corresponds to 80 Nm and 20 Nm. This is also possible at any time during recalibration.

The torque measurement chain, consisting of the KiTorq Rotor and KiTorq Stator, has its own separate calibration certificate and a serial number.

If one of the components is replaced (e.g., with a KiTorq Rotor with a different measuring range), then the virtual calibration values for the new measurement chain can be calculated from the individual calibration certificates for the rotor and stator. All output settings can be changed afterward by the customer. The calibration certificates apply only to the settings at delivery, according to the order.

Definition of calibration terms:

- **WKS 1:** Works calibration at 5 points right, 3 points left
- **WKS 2:** Works calibration at 5 points right and left, and repeat series
- **DAkkS:** Calibration per DIN 51309

Our calibration service D-K-15127-01-00 provides traceable calibrations for torque sensors from all manufacturers.

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Optional accessories	Type/Mat. No.
• Adapter flanges and couplings (on request)	2305A
• SensorTool (downloadable from the website)	4706A
• Connection cable, length 5 m, 7 pin – open ends	KSM219710-5
• Connection cable, length 5 m,	
• 12 pin – open ends	KSM124970-5
• Connection cable, length 2.5 m,	KSM186420-2.5
12 pin – to CoMo Torque	KSM186420-2.5
• Connection cable, length 5 m, 14 pin – open ends	KSM385370-5
• Cable socket 7 pin (plug X1/X2)	KSM000517
• Cable socket 12 pin (plug X4)	KSM000703
• Cable socket 14 pin (plug X2)	KSM038290
• Connection cable Ethernet, length 2 m, water blue, M12 D-encoding of RJ45	55117503
• Connection cable Ethernet, length 5 m, water blue, M12 D-encoding of RJ45	55117504
• Connection cable Ethernet, length 10 m, water blue, M12 D-encoding of RJ45	18026867
• Extension cable PROFIBUS, length 2 m, violet, M12 B-encoding, female connector to connector 1:1	55117321
• Extension cable PROFIBUS, length 5 m, violet, M12 B-encoding, female connector to connector 1:1	55117500
• Connection cable PROFIBUS, length 2 m, violet, M12 B-encoding, female connector to open ends	18029811
• Connection cable PROFIBUS, length 5 m, violett, M12 B-encoding female connector to open ends	55117502
• Extension cable CANopen, length 2 m, M12 A-encoding, female connector to connector 1:1	18029812
• Extension cable CANopen, length 5 m, M12 A-encoding, female connector to connector 1:1	55117501
• Connection cable CANopen, length 2 m, M12 A-encoding, female connector to open ends	55117499
• Connection cable CANopen, length 5 m, M12 A-encoding female connector to open ends	55117388

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measure. analyze. innovate.

Ordering Key

Type 4552A □□□□□□

Nominal torque in N·m

50	050
100	100
200	200
500	500
1,000	1K0
2,000	2K0
3,000	3K0
5,000	5K0
10,000*	10K

* Option D51, D52, D81, D82 not available

Stator

Only rotor	S00
KiTorq stator	S10
KiTorq stator PROFINET	S2A
KiTorq stator PROFIBUS	S2B
KiTorq stator CANopen	S2C
KiTorq stator EhterCAT	S2D
KiTorq stator EtherNet/IP	S2E

Speed / Angle

1x 60 pulses per rev.	N1
2x 128 pulses per rev. + Z-Impuls	N2
up to 2x 8,192 pulse + Z-Impuls	N3

Speed range

Low speed	L
High speed	H

Torque accuracy

Standard accuracy	N

Calibration

WKS1 - single range	KA0
WKS1 - dual range 1:10	KA1
WKS1 - dual range 1:5	KA2
WKS2 - single range	WA0
WKS2 - dual range 1:10	WA1
WKS2 - dual range 1:5	WA2
DAkkS single range 5 measuring points	DK5
DAkkS dual range 8 measuring points	DK8
DAkkS dual range 5 measuring points 1:1/1:10	D51
DAkkS dual range 5 measuring points 1:1/1:5	D52
DAkkS dual range 8 measuring points 1:1/1:10	D81
DAkkS dual range 8 measuring points 1:1/1:5	D82

Order example:
Type 4552A500S10N1LNKA1

Type: **4552A**,
Torque sensor with measuring range:
Nominal torque 500 N·m: **500**,
KiTorq stator evaluation unit: **S10**,
Speed option: **N1**,
Speed range Low speed: **L**,
Torque accuracy Standard accuracy: **N**,
Calibration WKS1 Dual range: **KA1**

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