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KiTorq Rotor

Type 4550A...

Torque measuring unit (rotor) for a torque measuring flange

KiTorq Rotor Type 4550A... for measuring highly dynamic torques.

- Combinations of various rotors and stators
- Transmission without contact
- High precision
- Maximum dynamics
- Connection dimensions acc. to DIN ISO 7646 (gear flanges)

Description

KiTorq System is a torque measuring flange system, consisting of the Type 4550A... KiTorq Rotor torque measuring unit and the Type 454xA... KiTorq Stator torque evaluation unit. The rotors and stators of the KiTorq System that have the same speed option can be used in any combination with each other. Using the ordering key, the Type 4550A... rotor can be purchased individually or as a calibrated torque measurement chain, together with a KiTorq Stator. The stator automatically detects a change in the rotor, and automatically sets the required parameters.

All KiTorq Rotors capture the torque using strain gages. The signal that they generate is amplified and then processed at approx. 35 kSample. The high scanning rate means that very highly dynamic torques can be measured.

KiTorq Stator Type 454x...

The torque evaluation unit supplies power to the KiTorq Rotor and receives measurement values from it. The evaluation unit has an integrated speed measuring unit and provides various signal outputs, depending on type.

Calibration

Various calibration options are available for the configurable output signals of the KiTorq System. The calibration takes place on a high-precision calibration system that is traceable to national standards.

Application

The properties of the Type 4550A… KiTorq Rotor make it predestined for applications in test bench engineering, such as electric motor, gear, pump, and combustion engine test stands.

General technical data

Rated torque M_{nom}	N·m	100, 200, 500
Rated torque M_{nom}	kN·m	1, 2, 3, 5
Nominal speed n_{nom} at 100, 200, 500 N·m and 1 kN·m	min^{-1}	20 000
Nominal speed n_{nom} at 2 and 3 kN·m	min^{-1}	15 000
Nominal speed n_{nom} at 5 kN·m	min^{-1}	12 000
Operating temperature range (rated temperature range T_{nom})	°C	10 ... 60
Service temperature range	°C	0 ... 70
Storage temperature range	°C	–25 ... 80
Protection class (IEC 60529)		IP54

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Mechanical data and load limits Type 4550A...

Size/Rated torque M_{nom}	N·m	100	200	500				
	kN·m	–	–	–	1	2	3	5
Mechanical data								
Torsional rigidity C_T	kN·m/rad	231	349	950	1108	3277	3505	3769
Torsion angle at M_{nom}	°	0.025	0.033	0.03	0.052	0.035	0.049	0.076
Mass moment of inertia of the rotor around rotation axis	kgm²	0.0022	0.0023	0.0042	0.0042	0.0124	0.0123	0.0242
Proportionate mass moment of inertia around the axis on the measuring side	kgm²	0.0012	0.0012	0.0022	0.0022	0.0068	0.0071	0.0142
Resonance frequency of the rotor (torsion vibration)	kHz	2	2.47	3.12	3.4	3.27	3.4	2.59
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]	N·m	30	50	120	120	220	230	300
Longitudinal load limit F_A [4]	kN	5	10	15	20	25	30	35
Transverse load limit F_Q [4]	kN	2	3	6	11	14	18	20
Stiffness in case of bending moment around a radial axis c_b	kN·m/°	1.1	1.6	3.7	4.3	9.9	11.5	15.1
Stiffness in axial direction c_a	kN/mm	427	588	574	697	1078	1251	1061
Stiffness in radial direction c_r	kN/mm	236	282	563	707	1112	1214	1111
Allowed deviation of plane parallelism at max. bending torque (at øD)	mm	<0.05	<0.06	<0.08	<0.06	<0.06		<0.07
Max. stroke at limit longitudinal force	mm	<0.04						
Additional max. runout error at transverse load limit F_Q	mm	<0.02						
Mass								
Rotor	kg	1.5		1.9		3.5		4.8
Stator	kg	0.7						
Balancing class according DIN ISO 1940	Q	G 2.5						
Max. allowed axial misalignment between rotor and stator [5]	mm	±1						
Max. allowed air gap between rotor and stator Sr [5]	mm	1 ±0.5						
Concentricity radial on measuring side [5]	mm	0.01		0.012		0.014		0.018

[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 FA is permissible and the nominal (rated) torque must not be exceeded.
[2] These values refer to static load.
[3] M_{nom} should not be exceeded.
[4] These values refer to static and dynamic load.
[5] Operation out of range results in deviation of the rotation angle precision.

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General information Type 4550A...

Size/Rated torque M_{nom}	N·m	100	200	500				
	kN·m	–	–	–	1	2	3	5
General data								
Electromagnetic compatibility (EMV)								
Noise immunity (EN 61326-1, Table 2)								
Electromagnetic field (AM)	V/m	10						
Magnetic field	A/m	100						
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	10 … 60						
Service temperature range	°C	0 … 70						
Storage temperature range	°C	–25 … 80						
Mechanical shock (EN 60068-2-27)								
Number of cycles		1 000						
Cycle duration	ms	3						
Acceleration shock	g	650						
Vibration stress in 3 axes (EN 60068-2-6)								
Frequency range	Hz	10 … 2 000						
Loading duration	h	2.5						
Acceleration (Amplitude)	g	200						

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Technical data Type 4550A...

Size/Rated torque M_{nom}	N·m	**100**	**200**	**500**				
	kN·m	–	–	–	**1**	**2**	**3**	**5**
Technical data								
Torque measuring system								
Nominal speed n_{nom}	min^{-1}	20 000				15 000		12 000
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						

Size/Rated torque M_{nom}	N·m	**100**	**200**	**500**				
	kN·m	–	–	–	**1**	**2**	**3**	**5**
Technical data								
Torque measuring system								
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)

4550A_000-880e-03.20

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Electrical data Type 4550A...

Size/Rated torque M_{nom}	N·m	100	200	500				
	kN·m	–	–	–	1	2	3	5
Technical data								
Torque measuring system								
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

Size/Rated torque M_{nom}	N·m	100	200	500				
	kN·m	–	–	–	1	2	3	5
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 U_b = 24 V	A	<0.8						
Recommended max. cable length to guarantee the signal quality	m	5						
Connectors for electrical connection	–	depending on stator type						

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Rotation speed/rotation angle measuring system Type 4550A...

Size/Rated torque M_{nom}	N·m	100	200	500				
	kN·m	–	–	–	1	2	3	5
Rotation speed measuring system N1								
Measuring system		Magnetic, using hall sensor and pulse wheel						
Amount of pulses per turn N	–	60						
Group delay time between signal input rotation to signal output	ms	<0.1						
Load resistance	kΩ	≥2						
Minimum rotation for sufficient pulse stability	min^{-1}	>2						
Output signal (TTL)	V	5						
Jitter of the oscillation period	%	1.7		1.4		1.1		1.0
Rotation angle measuring system with Z-Reference pulse N2/N3								
Measuring system		Magnetic, via GMR sensor and pole wheel						
Amount of output pulses per turn N (depending on N and f_{out})	–	1 … 8 192						
Maximum position deviation of the poles	µm	±100						
Group delay time between signal input rotation to signal output	ms	<0.1						
Load resistance	kΩ	≥2						
Minimum rotation for sufficient pulse stability Rotation angle (TTL)	min^{-1}	>0						
Output signal (TTL)	V	5						
Max. jitter per edge	°	±0.03						
Jitter of the oscillation period	%	= J[°] * N / 180° *100						
Maximum permitted output frequency f_{out}	kHz	500						
Amount of reference pulses per turn	–	1						
Reference pulse width, B_i	°	0.25 x oscillation period						

4550A_000-880e-03.20

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Dimensions KiTorq System Type 4550A..., 100 N·m and 200 N·m

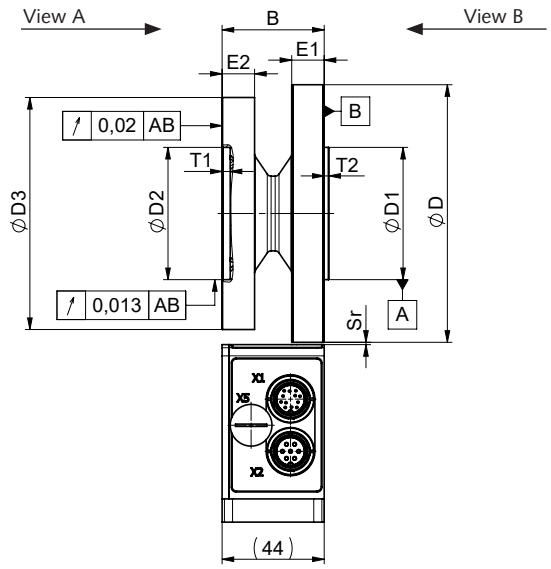

Fig. 1: Dimension drawing side view KiTorq System

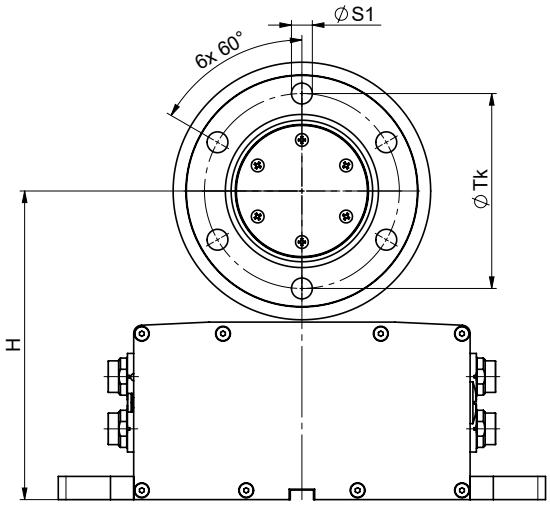

Fig. 2: Dimension drawing View A, KiTorq System

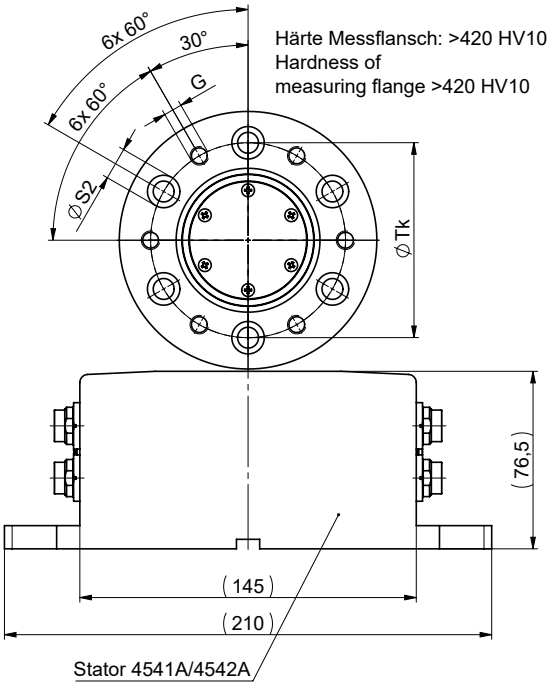

Fig. 3: Dimension drawing View B, KiTorq System

Dimensions torque measuring unit KiTorq Rotor in mm

(All dimensions without tolerances comply with ISO 2768-mH)

Type 4550A... Rated torque M_{nom}	N·m	100	200
øD	mm	111	
øD1 $_{g6}$		57	
øD2 ^{H6}		57	
øD3		100	
E1		14	
E2		14	
T1 $_{-0.2}$		3.5	
T2 $^{+0.2}$		2	
øTk		84	
øS1		9	
øS2		14	
G (6x)		M8	
H[3)]		133	
B		44	

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

4550A_000-880e-03.20

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

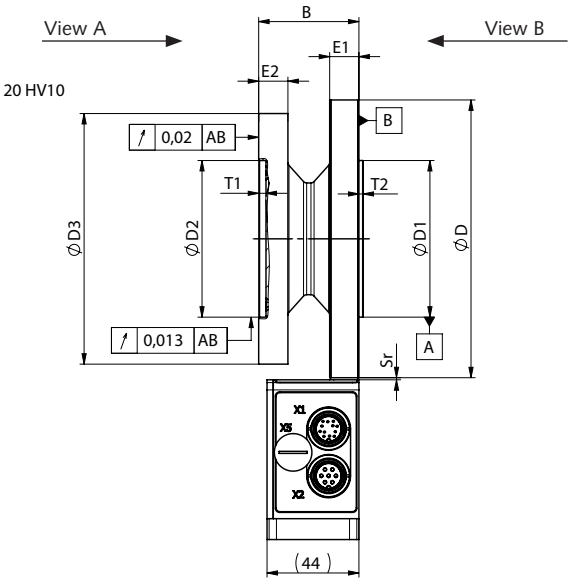

Fig. 4: Dimension drawing side view KiTorq System

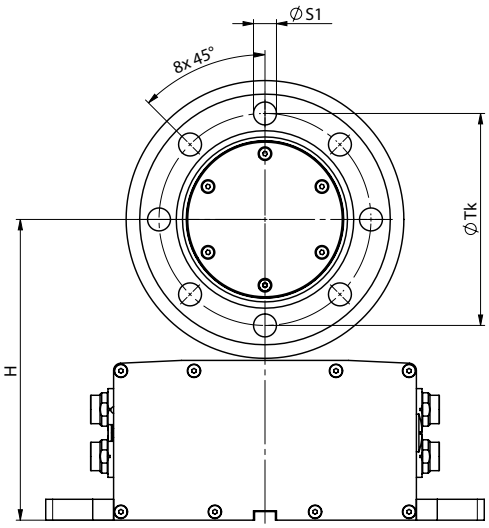

Fig. 5: Dimension drawing View A, KiTorq System

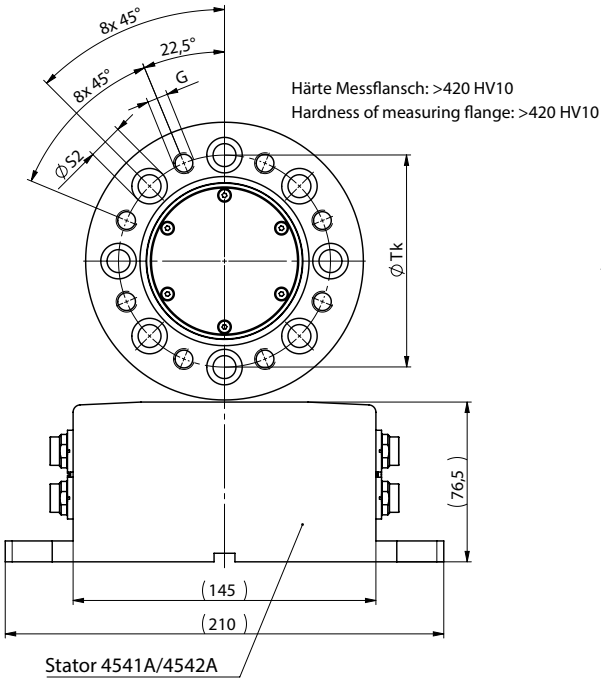

Fig. 6: Dimension drawing View B, KiTorq System

Dimensions torque measuring unit KiTorq Rotor in mm

(All dimensions without tolerances comply with ISO 2768-mH)

Type 4550A... Rated torque M_{nom}	[1] N·m [2] kN·m	500[1]	1[2]	2[2]	3[2]	5[2]
øD	mm	133		167		196
øD1 $_{g6}$		75		90		110
øD2^{H6}		75		90		110
øD3		120		156		180
E1		14		17		17
E2		14		14		14
T1 $_{-0.2}$		3.5		3		3
T2 $^{+0.2}$		2		2.5		2.5
øTk		101,5		130		155.5
øS1		11		13		15
øS2		17		20		22
G (8x)		M10		M12		M14
H[3]		144		161		175.5
B		48		53		

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

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Application examples

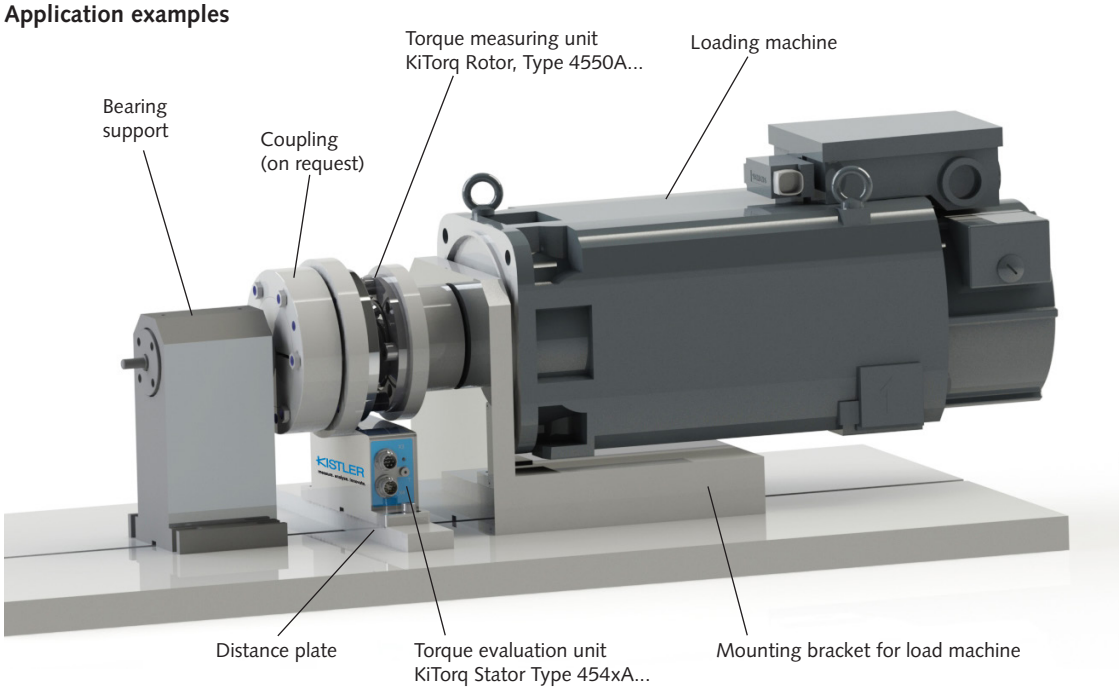

Fig. 7: Example of application with KiTorq

Metal-free space

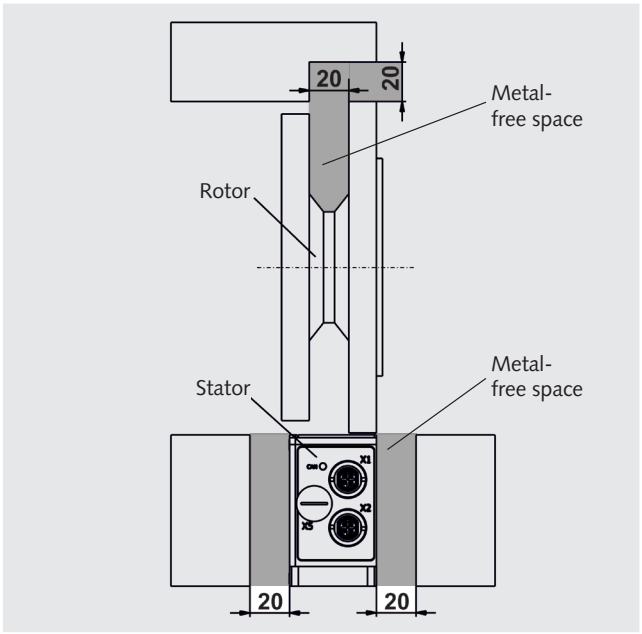

Fig. 8: Example of application matal-free space

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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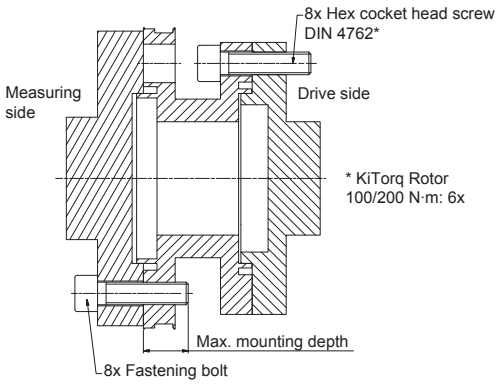
Mounting

Rotor screw connection, mounting screws

Nominal torque M_{nom}	N·m	**100 / 200**	**500**		
	kN·m		**1**	**2 / 3**	**5**
Thread		M8	M10	M12	M14
Property class		10.9	10.9	10.9	12.9
Minimum mounting depth	mm	10	10	12	14
Maximum mounting depth[1)]	mm	16	16	19	19
Fastening torque M_A	N·m	34	70	123	220

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



Calibration

Standard calibration: The rotor is calibrated per WKS 1 as a standard. If ordered as a measurement chain with a KiTorq Stator, the rotor and stator are calibrate as a torque measurement chain according to WKS 1.
The following signals are set as standard:

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

Special calibration: Upon request, additional calibrations can be ordered (e.g., second measuring range, another frequency, DAkkS calibration, ...). More information is available in the data sheet for the desired Type 454xA... KiTorq Stator.

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 DAkkS-K-17650-01 provides traceable calibrations for torque sensors from all manufacturers.

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Optional accessories	Type/Art. No.
• Adapter flanges and couplings (on request)	2305A...

Ordering key

Type 4550A □□□□

Nominal torque in N·m

100	**100**
200	**200**
500	**500**
1 000	**1k0**
2 000	**2k0**
3 000	**3k0**
5 000	**5k0**

Stator

Without	**S00**
KiTorq Stator Type 4541A...	**S10**
KiTorq Stator Type 4542A... PROFINET	**S2A**
KiTorq Stator Type 4542A... PROFIBUS	**S2B**
KiTorq Stator Type 4542A... CANopen	**S2C**
KiTorq Stator Type 4542A... EtherCAT	**S2D**
KiTorq Stator Type 4542A... EtherNet/IP	**S2E**

Speed

1x60 Imp./Rev.	**N1**
1x60 pulses per revolution + Z-pulse	**N2**
Rotational speed or angle measurement up to 8 192 pulses per revolution + Z-pulse	**N3**

Calibration

WKS 1 single range	**KA0**
WKS 1 dual range 1:1 and 1:10	**KA1**
WKS 1 dual range 1:1 and 1:5	**KA2**
WKS 2 single range	**WA0**
WKS 2 dual range 1:1 and 1:10	**WA1**
WKS 2 Dual range 1:1 and 1:5	**WA2**
DAkkS 5 – single range, 5 meas. points	**DK5**
DAkkS 8 – single range, 8 meas. points	**DK8**
DAkkS – Dual range, 5 Meas. points 1:1 and 1:10	**D51**
DAkkS – Dual range, 5 Meas. points 1:1 and 1:5	**D52**
DAkkS – Dual range, 8 Meas. points 1:1 and 1:10	**D81**
DAkkS – Dual range, 8 Meas. points 1:1 and 1:5	**D82**

4550A_000-880e-03.20