

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, 10
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
Nominal speed n_{nom} at 10 kN·m	min ⁻¹	10 000
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

Mechanical data and load limits Type 4550A...

Size/Rated torque M_{nom}	N·m	100	200	500					
	kN·m	–	–	–	1	2	3	5	10
Mechanical data									
Torsional rigidity C_T	kN·m/rad	231	349	950	1 108	3 277	3 505	3 769	8 109
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	kgm²	0.0022	0.0023	0.0042	0.0042	0.0124	0.0123	0.0242	0.0687
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	0.0394
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⁾	N·m	30	50	120	120	220	230	300	500
Longitudinal load limit F_A ⁴⁾	kN	5	10	15	20	25	30	35	45
Transverse load limit F_Q ⁴⁾	kN	2	3	6	11	14	18	20	25
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	34.7
Stiffness in axial direction c_a	kN/mm	427	588	574	697	1 078	1 251	1 061	1 492
Stiffness in radial direction c_r	kN/mm	236	282	563	707	1 112	1 214	1 111	2 181
Allowed deviation of plane parallelism at max. bending torque (at øD)	mm	<0.05	<0.06	<0.08	<0.06	<0.06		<0.07	<0.06
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	8.4
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 S_r ⁵⁾	mm	1 ±0.5							
Concentricity radial on measuring side ⁵⁾	mm	0.01		0.012		0.014		0.018	0.02

¹⁾ The effects of permissible parasitic forces (bending moment M_b , longitudinal F_A and lateral forces F_O) can be up to 0.3% of nominal torque. Each type of irregular stress (M_b , F_A oder F_O) 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_O 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⁾ 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.

General information Type 4550A...

Size/Rated torque M_{nom}	N·m	100	200	500					
	kN·m	–	–	–	1	2	3	5	10
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	m/s²	650							
Vibration stress in 3 axes (EN 60068-2-6)									
Frequency range	Hz	10 ... 2 000							
Loading duration	h	2.5							
Acceleration (Amplitude)	m/s²	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	10
Technical data									
Torque measuring system									
Nominal speed n_{nom}	min ⁻¹	20 000				15 000		12 000	10 000
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	10
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)

Electrical data Type 4550A...

Size/Rated torque M_{nom}	N·m	100	200	500					
	kN·m	–	–	–	1	2	3	5	10
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	10
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							

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

Size/Rated torque M_{nom}	N·m	100	200	500					
	kN·m	–	–	–	1	2	3	5	10
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	k Ω	≥ 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	0.8
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	k Ω	≥ 2							
Minimum rotation for sufficient pulse stability	min ⁻¹	>0							
Rotation angle (TTL)									
Output signal (TTL)	V	5							
Max. jitter per edge	°	± 0.03							
Jitter of the oscillation period	%	$= J[^\circ] \cdot N / 180^\circ \cdot 100$							
Maximum permitted output frequency f_{out}	kHz	500 ¹⁾							
Amount of reference pulses per turn	–	1							
Reference pulse width, B_i	°	0.25 x oscillation period							

¹⁾ Maximum numbers of output pulses N^{max} = maximum allowable output frequency f_{out} (Hz) x 60 / rotational speed n (min⁻¹).
 With 8 192 pulses means a maximum speed of 3 660 min⁻¹

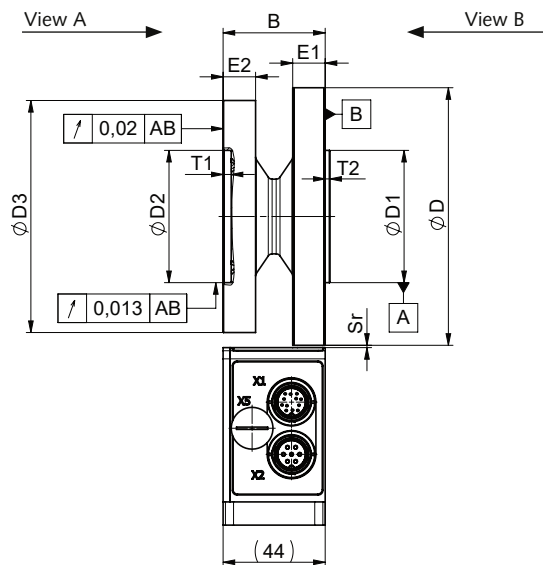
Dimensions KiTorq System Type 4550A..., 100 N·m and 200 N·m


Fig. 1: Dimension drawing side view KiTorq System

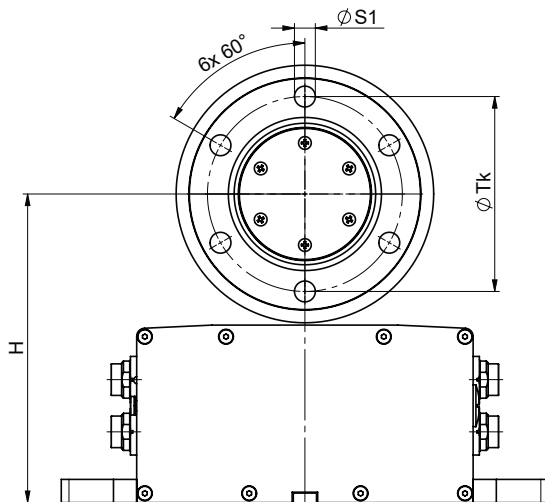


Fig. 2: Dimension drawing View A, KiTorq System

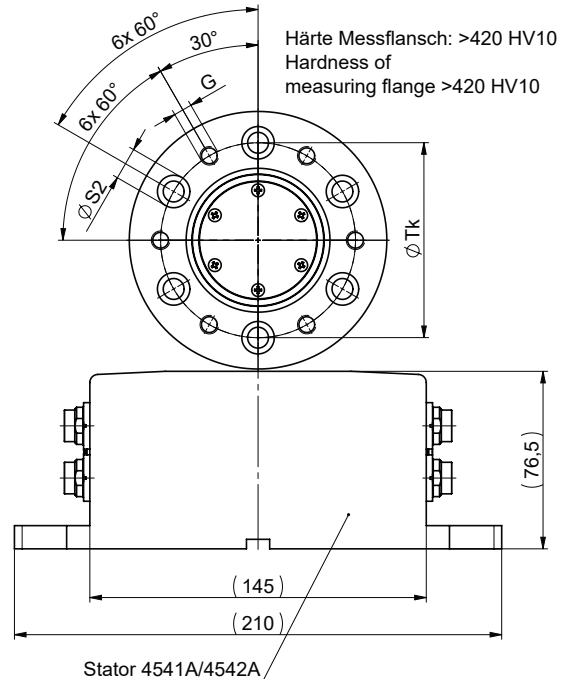


Fig. 3: Dimension drawing View B, KiTorq System

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
$\varnothing D$	mm	111	
$\varnothing D1_{g6}$		57	
$\varnothing D2^{H6}$		57	
$\varnothing D3$		100	
E1		14	
E2		14	
T1 _{-0.2}		3.5	
T2 _{+0.2}		2	
$\varnothing Tk$		84	
$\varnothing S1$		9	
$\varnothing S2$		14	
G (6x)		M8	
H ³⁾		133	
B		44	

³⁾ Note: consider maximum permitted radial air gap!

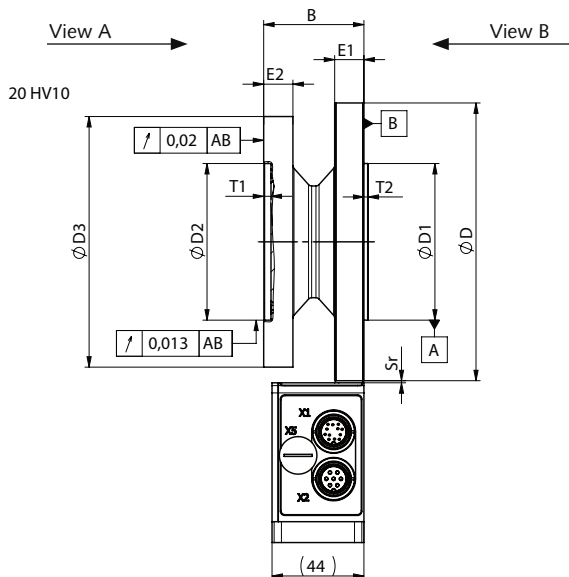
Dimensions KiTorq System Type 4550A..., 500 N·m, 1, 2, 3, 5 and 10 kN·m


Fig. 4: Dimension drawing side view KiTorq System

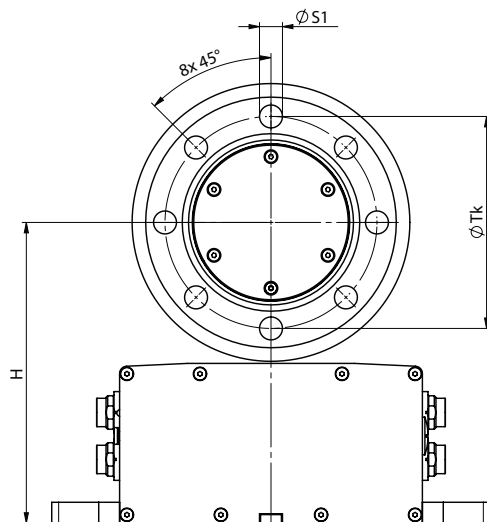


Fig. 5: Dimension drawing View A, KiTorq System

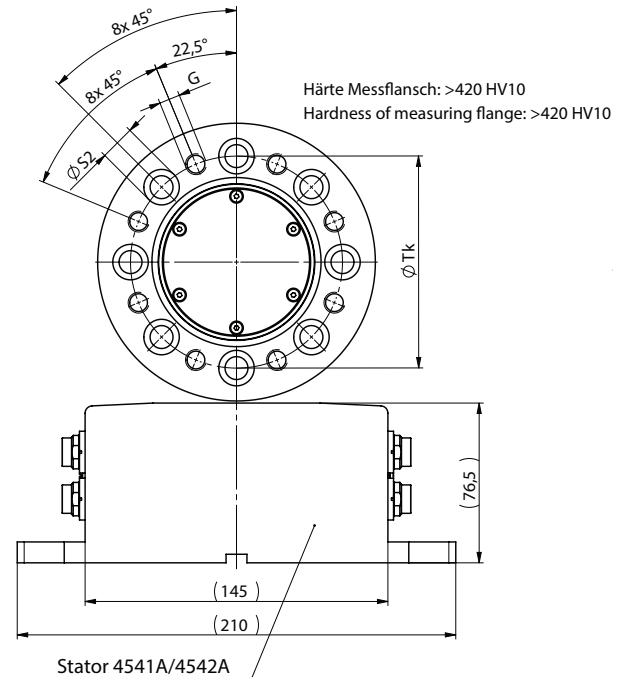


Fig. 6: Dimension drawing View B, KiTorq System

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⁾	10 ²⁾
ØD	mm	133	167	196	243		
ØD1 _{g6}		75	90	110	140		
ØD2 ^{H6}		75	90	110	140		
ØD3		120	156	180	225		
E1		14	17	17	20		
E2		14	14	14	17		
T1 _{-0,2}		3,5	3	3	3,5		
T2 _{+0,2}		2	2,5	2,5	2,5		
ØTk		101,5	130	155,5	196		
ØS1		11	13	15	17		
ØS2		17	20	22	26		
G (8x)		M10	M12	M14	M16		
H ³⁾		144	161	175,5	199		
B		48	53		59		

³⁾ Note: consider maximum permitted radial air gap!

Application examples

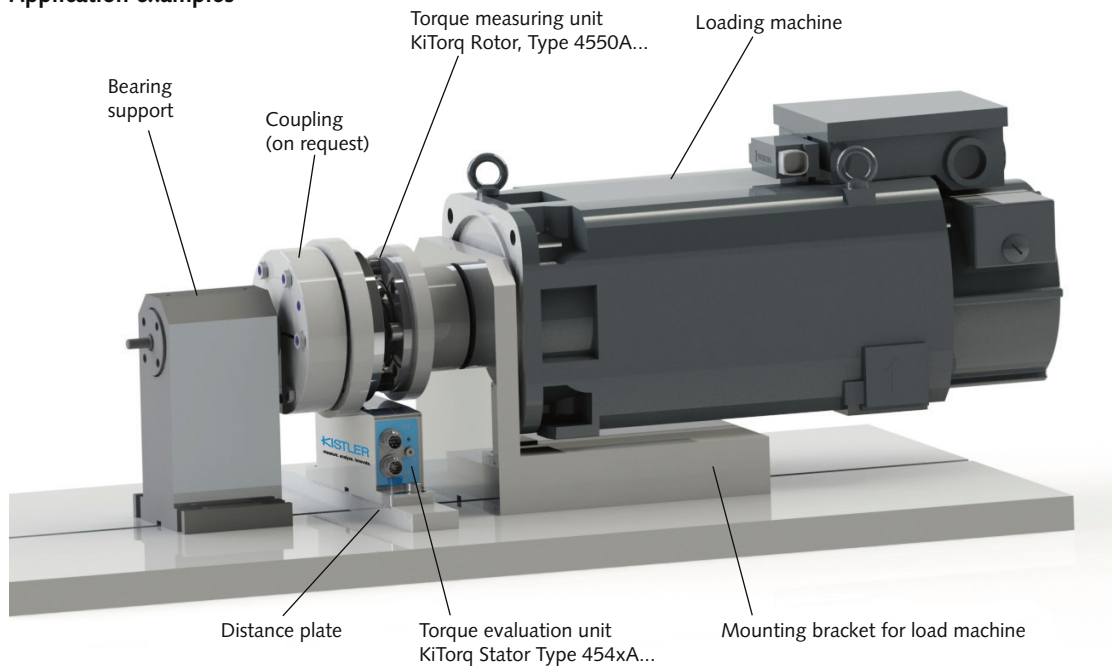


Fig. 7: Example of application with KiTorq

Metal-free space

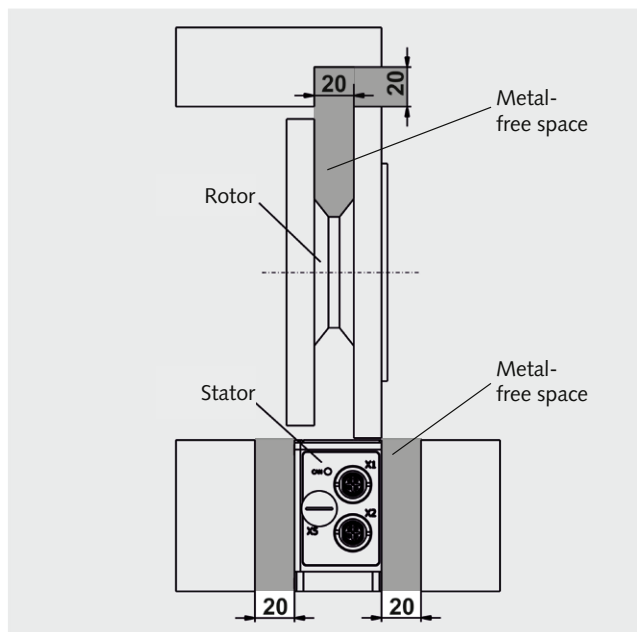


Fig. 8: Example of application metal-free space

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!

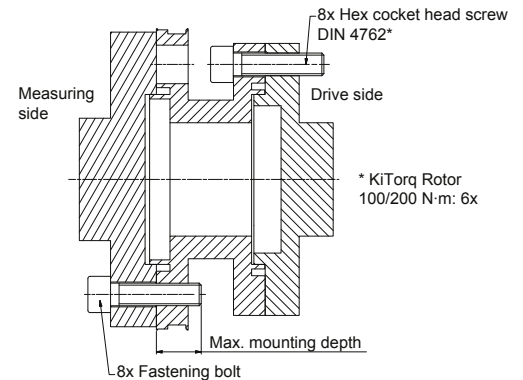
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Mounting

Rotor screw connection, mounting screws

Nominal torque M_{nom}	N·m	100 / 200	500			
	kN·m		1	2 / 3	5	10
Thread		M8	M10	M12	M14	M16
Property class		10.9	10.9	10.9	12.9	12.9
Minimum mounting depth	mm	10	10	12	14	16
Maximum mounting depth ¹⁾	mm	16	16	19	19	22
Fastening torque M_A	N·m	34	70	123	220	360

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 calibrated as a torque measurement chain according to WKS 1.

The following signals are set as standard:

- Frequency: 240 kHz \pm 120 kHz
- Analog: \pm 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 D-K-15127-01-00 provides traceable calibrations for torque sensors from all manufacturers.

Optional accessories

- Adapter flanges and couplings (on request)
- SensorTool

Type/Mat. No.

2305A...

4706A

Ordering keyType 4550A ☐ ☐ ☐ ☐**Nominal torque in N·m**

100	100
200	200
500	500
1 000	1k0
2 000	2k0
3 000	3k0
5 000	5k0
10 000*	10k

*Option N2, N3, D51, D52, D81, D82
not available

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

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