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measure. analyze. innovate.

Torque Sensor

Type 4503A...

Dual-Range Sensor with Brushless Transmission

Type 4503A... torque sensors with built-in speed sensor operate on the strain gage principle. An integral, digital measurement conditioning system produces analog or digital output signals.

- Rated torque: 0.15 ... 3,688 lbf-ft
- Ratio for second range: 1:10 or 1:5 of rated torque
- Speed ranges up to 50,000 rpm
- Accuracy class in rated torque range: 0.1 optionally 0.05, in the second measuring range: 0.2
- Integral speed sensor
- Serial data output RS-232C for torque signals
- Conforming to CE

Additional advantages of second range:
- Natural overload protection of smaller range because of special design
- One sensor for two separately calibrated measuring ranges

Description
The version with a second measuring range (optional) is ideal for applications with a high peak torque but moderate operating torque. A torque sensor with only one measuring range would have to be chosen to withstand the peak torque. As a result it would, however, be overdesigned for measuring the operating torque actually of interest.

The dual range sensor offers the advantage of range switching, which allows highly accurate measurement of both the peak and particularly the operating torque.

Power is supplied and the measurement signals transferred between the rotating shaft and the case without contact. In addition to suitable mounting of the shaft, low production tolerances and high grade balancing, this is a further prerequisite for the high speed limit of up to 50,000 rpm achieved with the "H" version.

Application
The Type 4503A... torque sensors are used:

- In automotive and vehicle engineering
- In the aeronautical industry
- In mechanical and process plant engineering
- In electric motor manufacture

They are universal in application, being suitable for the development laboratory, production or quality assurance.

Typically used for testing of electric motors, generators, drive performance, measurement of transmission or spindle drive friction, at a manual workstation or in networked, automated production cells.

With a torque sensor Type 4503A... you will solve measurement requirement.

4503A_000-595a-11.07

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Technical Data

Mechanical Basic Data

Measuring range (nominal torque)	lbf-ft	0.15 ... 3,688
Overload capacity at limiting torque		1.5 x rated torque
Alternating torque		0.7 x rated torque
Rupture torque		4 x rated torque
Speed measurement	pulses/ revolut.	1x60 option: 2x360 at 7,000 rpm, Version "W"
Nominal Speed		depending on measuring range and design (see details)
Balancing class Q		
for version "L"		6.3
for version "H"		2.5
Housing material		Anodized aluminum
Exception: size 4, version "H"		stainless steel
Protection class		IP40

General Electrical Specifications

Cut-off frequency –3 dB for voltage output	kHz	1
Output signal (rated value)	VDC	±5 option: ±10 and RS-232C interface
Load resistance	kΩ	>10
Operating temperature range (rated temperature range)	°F	50 ... 140
Service temperature range	°F	32 ... 158
Storage temperature range	°F	–13 ... 176
100 % control input	VDC	"On" 3.5 ... 30 "Off" 0 ... 2
Supply voltage	VDC	11 ... 30
Power consumption	W	<3
Electrical connection		12 pin/7 pin built-in connector

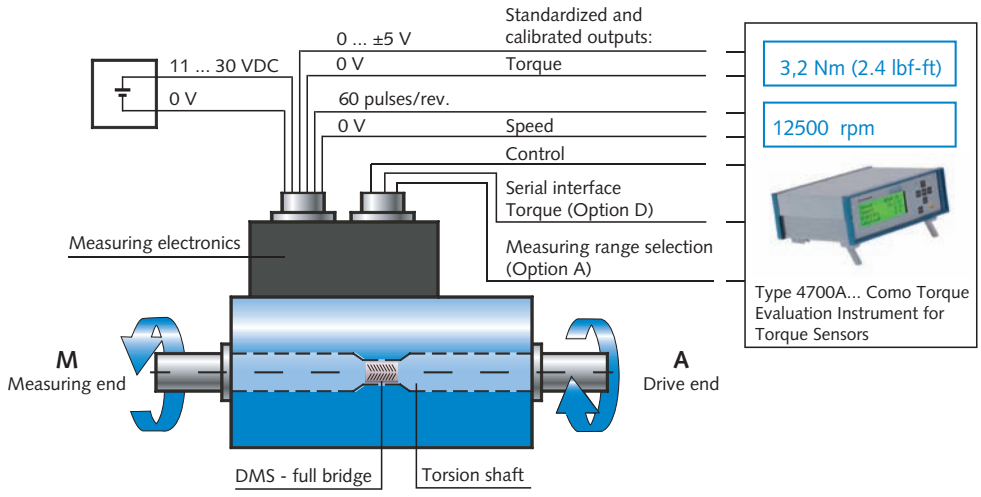
Electrical Measuring Data – Standard Measuring Range 1:1

Accuracy class		0.1
Linearity error including hysteresis	% FSO	<±0.1 optional version: <±0.05
Temperature influence on the zero point	% FSO/°F	<±0.0028
Temperature influence on nominal value	% FSO/°F	<±0.0055
Torque control signal	%	100 ±0.2 for voltage output/ frequency output

Electrical Measuring Data – Standard Measuring Range 1:5, 1:10

Accuracy class		0.2
Linearity error including hysteresis	% FSO	<±0.2
Temperature influence on the zero point	% FSO/°F	<±0.01
Temperature influence on nominal value	% FSO/°F	<±0.01
Torque control signal	%	100 ±0.3 for voltage output/ frequency output

Principle of Function



Measuring Ranges and Maximum Speed

Measuring range lbf-ft	Version "L" (low speed) rpm	Version "H" (high speed) rpm
0.15	20,000	50,000
0.37	20,000	50,000
0.74	20,000	50,000
1.5	20,000	50,000
3.7	20,000	50,000
7.4	20,000	50,000
14.8	20,000	50,000
36.9	12,000	30,000
73.8	12,000	30,000
147.5	8,000	20,000
368.8	8,000	20,000
737.6	8,000	20,000
1,475.2	5,000	10,000
3,688	5,000	10,000

Spring Constant and Inertia of Mass

Measuring range lbf-ft	Spring constant klbf-in/rad	Inertia of mass lb/in²	
		Measuring end	Drive end
0.15	0.09	0.021	2
0.37	0.09	0.021	2
0.74	1.6	0.077	2.3
1.5	2.2	0.085	2.4
3.7	4.0	0.085	2.4
7.4	4.6	0.114	2.7
14.8	5.1	0.114	2.7
36.9	80.5	7.7	16.5
73.8	119.5	7.7	16.5
147.5	531	56.9	118.1
368.8	885	59.7	118.1
737.6	1,194.8	59.7	118.1
1,475.2	4,602	867.6	1,209
3,688	6,372	867.6	1,209

Limit Values for Dynamic Load

Version "L" (low speed)

Size	Measuring range lbf-ft	Weight kg	Speed rpm	Measuring end			Drive end		
				Proportional Mass kg	Lateral force lbf max.	Axial force lbf max.	Proportional Mass kg	Lateral force lbf max.	Axial force lbf max.
1	0.15	0.8	20,000	0.07	2.2	11.2	0.25	22.5	11.2
	0.37			0.2	5.6	11.2	0.25	33.7	11.2
	0.74			0.2	11.2	11.2	0.25	45	11.2
2	1.5	1.4	20,000	0.2	22.5	11.2	0.25	45	11.2
	3.7			0.2	45	11.2	0.25	45	11.2
	7.4			0.2	45	11.2	0.25	45	11.2
	14.8			0.2	45	11.2	0.25	45	11.2
3	36.9	2	12,000	2.2	45	22.5	3	90	179.8
	73.8			3	90	45	3	179.8	179.8
4	147.5	5	8,000	3.5	90	45	10	449.6	449.6
	368.8			7	224.8	112.4	10	449.6	449.6
	737.6			10	449.6	224.8	10	449.6	449.6
5	1,475.2	18	5,000	40	899.2	449.6	40	2,248	2,248
	3,688			80	2,248	1,124	80	2,248	2,248

Version "H" (high speed)

Size	Measuring range lbf-ft	Weight kg	Speed rpm	Measuring end			Drive end		
				Proportional Mass kg	Lateral force lbf max.	Axial force lbf max.	Proportional Mass kg	Lateral force lbf max.	Axial force lbf max.
1	0.15	0.9	50,000	0.011	2.2	11.2	0.2	22.5	11.2
	0.37			0.034	5.6	11.2	0.2	33.7	11.2
	0.74			0.06	11.2	11.2	0.2	45	11.2
2	1.5	1.5	50,000	0.08	16.9	11.2	0.2	45	11.2
	3.7			0.1	22.5	11.2	0.2	45	11.2
	7.4			0.15	22.5	11.2	0.2	45	11.2
	14.8			0.2	22.5	11.2	0.2	45	11.2
3	36.9	2.1	30,000	0.38	45	22.5	2.5	67.4	22.5
	73.8			0.5	45	22.5	3	67.4	22.5
4	147.5	5.1	20,000	0.6	90	45	4	89.9	45
	368.8			1.2	90	45	4	89.9	45
	737.6			2.2	90	45	4	89.9	45
5	1,475.2	18	10,000	10	899.2	449.6	40	899.2	449.6
	3,688			25	899.2	449.6	80	899.2	449.6

Dimensions

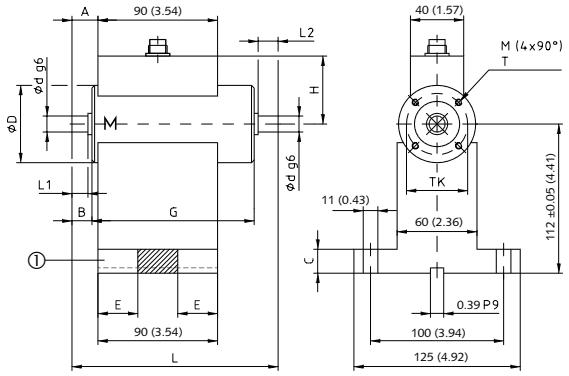


Fig. 1: Type 4503A... size 1 ... 3

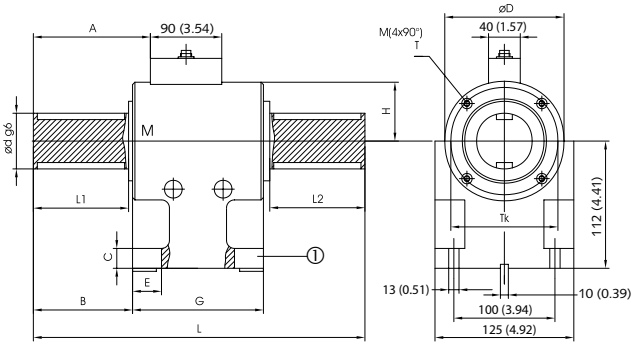
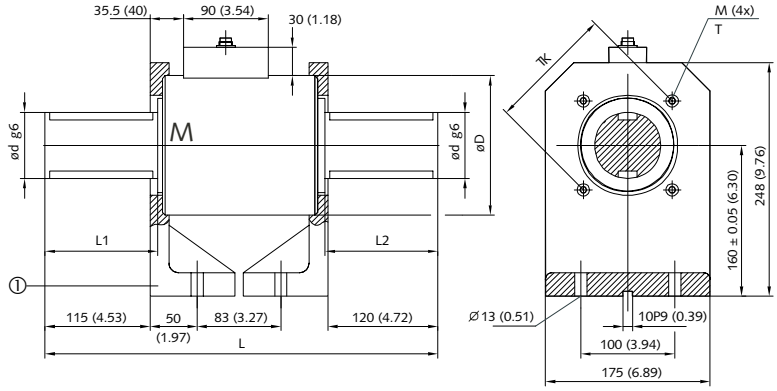


Fig. 2: Type 4503A... size 4



① = Option mounting base "GU"
M = Measuring end

Fig. 3: Type 4503A... size 5

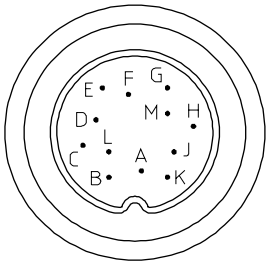
Dimensions in inches

Size	1		2		3	4	5
Rated torque lbf-ft	0.2/0.4	0.7	1.5/3.7	7.4/14.8	36.9 /73.8	147.5/368.8/ 737.6	1,475.2/ 3,688
L	6.3	6.3	6.4	6.5	7.1	10.5	16.5
L1	0.63	0.63	0.71	0.79	1.1	2.4	4.8
L2	0.63	0.63	0.71	0.79	1.1	2.4	4.8
øD	2.3	2.3	2.3	2.3	3.1	3.9	5.8
ød g6	0.35	0.35	0.39	0.47	0.87	1.7 [1]	2.8 [2]
A	0.93	0.87	0.95	1.0	1.7	3.3	
B	0.75	0.69	0.77	0.81	1.3	2.5	
C	0.7		0.71		0.71	0.59	
E	1.2		1.2		1.2	1.3	
G	4.8		4.8		4.5	5.4	
H	2.0		2.0		2.6	3.1	
TK	1.8		1.8		2.5	3.4	5.2
M	M5		M5		M6	M6	M8
T	0.4 deep		0.4 deep		0.5 deep	0.5 deep	0.6 deep

[1] both shaft ends with keyways (12 P9x50/2x180°) according to DIN 6885, Bl. 1
[2] both shaft ends with keyways (20 P9x110/2x180°) according to DIN 6885, Bl. 1

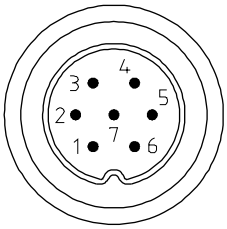
Electrical Connections

Pin Allocation of the 12 Pin Built-in Standard Connector



Function	PIN	Description	
Supply	F	$+U_B$	+ 11 ... + 30 VDC, power consumption 2.5 W
	A	GND	Ground relating to $+U_B$
Shield	M		In the sensor on housing
Torque output	C	U_A	±5 VDC at $\pm M_{Nominal}$ at >2 kΩ +5 VDC at control signal activation $R_{i,C}$ = 10 Ω, output short circuit proof relating to AGND
	D	AGND	Ground relating to UA
Speed-/angle of rotation pulses	H	Track A	Open collector – output (open collector) Internal 1 kΩ resistance after +5 VDC (pull up), TTL-level
	G	Track B	(Optional)
	J	Track Z	(Not operated)
100% control input	K	Control	Off: 0 ... 2 VDC On: 3.5 ... 30 VDC $R_{i,K}$ = 10 kΩ
RS-232C interface to the UMV 3000	B	TXD	Digital send path to the UMV 3000
	L	RXD	Digital receive path
Digital mass potential	E	DGND	Ground relating to speed- or angle of rotation pulses,control input, digital connection to the UMV 3000

Pin Allocation of the 7 Pin Built-in Connector for Range Switch Option A



Function	PIN	Description	
Measuring range selection	1	Amplification	Normal (1:1) with 0 ... 2 VDC Extended (1:5 / 1:10) with 3.5 ... 30 VDC
100% control input	4	Control	Off: 0 ... 2 VDC On: 3.5 ... 30 VDC
	7	0GND	Opto isolated ground for measuring range selection and control input
RS-232C interface	5	TXD	Serial send path of the torque sensor
	6	RXD	Serial receive path of the torque sensor
	3	DGND	Ground relating the RS-232C interface
Signal output	2	NC	For company internal functions, don't use!

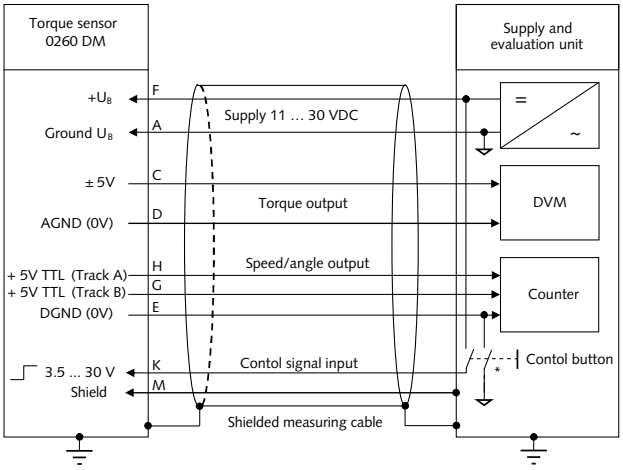


Fig. 4: Connection diagram of 12 pin built-in connector (standard)

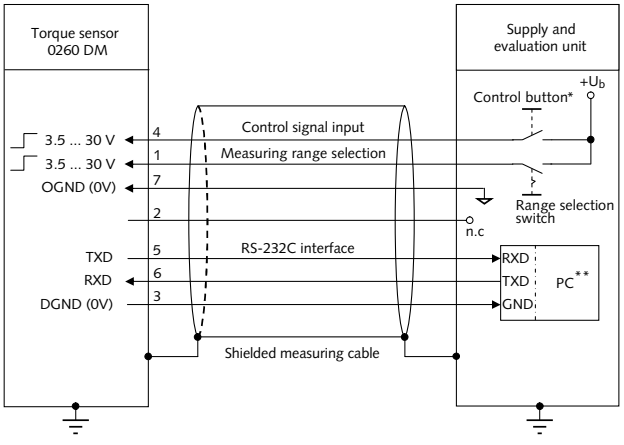


Fig. 5: Connection diagram of 7 pin built-in connector (Option A1/A2: range selection)

Included Accessories

- None

Optional Accessories	**Type/Art. No.**
• Mounting base "GU", for measuring ranges 0.1 ... 3.7 lbf-ft	KSM003799
• Mounting base "GU", for measuring ranges 36.9 ... 73.8 lbf-ft	KSM003801
• Mounting base "GU", for measuring ranges 147.5 ... 737.6 lbf-ft	KSM003922
• Mounting base "GU", for measuring ranges 1,475.2 ... 3,688 lbf-ft	KSM004020
• Female connector with solder eye 12-pin	KSM000703
• Female connector with solder eye 7-pin	KSM000517
• Connection cable, 5 m, 12-pin	KSM007203
• Connection cable, 5 m, 12-pin - open ends	KSM012497
• Connection cable, 5 m, 7-pin - open ends	KSM021971
• Connection cable 2.5 m, 12-pin – UMV 3000	KSM018642
• Connection cable 5 m, RS-232C 7 pin/D-Sub 9 pin	KSM021468
• UMV 3000 Supply and evaluation instrument	4700A...
• Frequency output to 4700A…	KSM18630-2.5

Order example without options: **Type 4503A50L0000000**

Torque sensor with 1 measuring range: rated torque 36.8 lbf-ft,
Version **L**: max. speed 12,000 rpm,
Standard output signal ±5 VDC

Order example with options: **Type 4503A50LA1B2D**

Vesion **L** : max. speed 12,000 rpm,
Torque sensor **A1** with 2 measuring ranges:
1. rated torque 36.8 lbf-ft, 2. rated torque 3.7 lbf-ft,
B2: frequency output TTL, **D**: RS-232C interface

Ordering Key

Type 4503A ☐☐☐☐☐☐

Measuring Ranges in lbf-ft	
0.15	**0.2**
0.37	**0.5**
0.74	**1**
1.5	**2**
3.7	**5**
7.4	**10**
14.8	**20**
36.9	**50**
73.8	**100**
147.5	**200**
368.8	**500**
737.6	**1K**
1,475.2	**2K**
3,688	**5K**

Impulses per Revolution	
Low speed 60	**L**
High speed 60	**H**
Low speed 360	**W**

Range Selection	
±5 V	**00**
Dual range sensor, rated torque 1:10 (Measuring range selection)	**A1**
Dual range sensor, rated torque 1:5 (Measuring range selection)	**A2**

Output Signal	
Output signal ±5 VDC	**00**
Output signal ±10 VDC	**B1**
100 ±40 kHz (TTL)	**B2**
100 ±40 kHz (24 V)	**B3**
100 ±40 kHz (±5 push-pull)	**B4**

Increased Accuracy	
Without	**0**
Increased accuracy	**C**

Interface	
Without	**00**
Interface RS-232C	**D1**
Reserve interface	**Dx**
Reserve interface	**Dy**

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