

## 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 oversized 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.

## 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

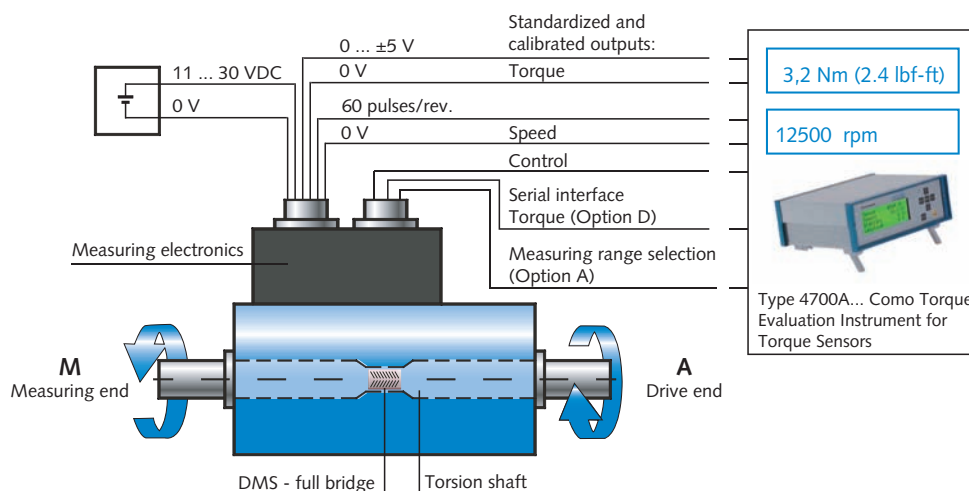
### Electrical Measuring Data – Standard Measuring Range 1:1

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	"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/in <sup>2</sup>	
		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
3	14.8	2	12,000	0.2	45	11.2	0.25	45	11.2
	36.9			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
3	14.8	2.1	30,000	0.2	22.5	11.2	0.2	45	11.2
	36.9			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

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**Dimensions**

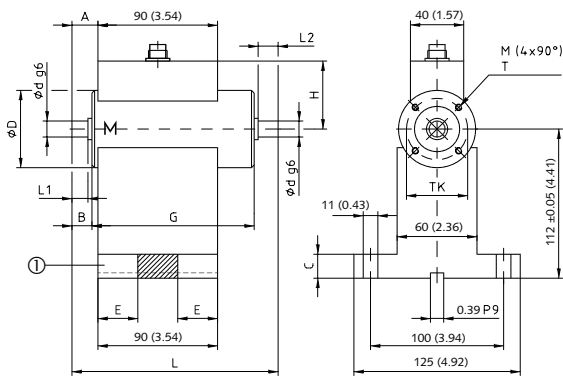


Fig. 1: Type 4503A... size 1 ... 2

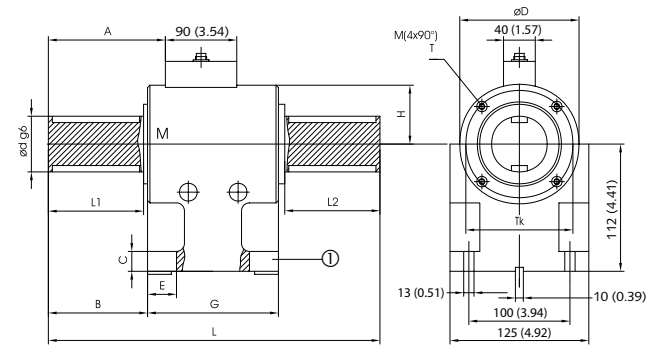
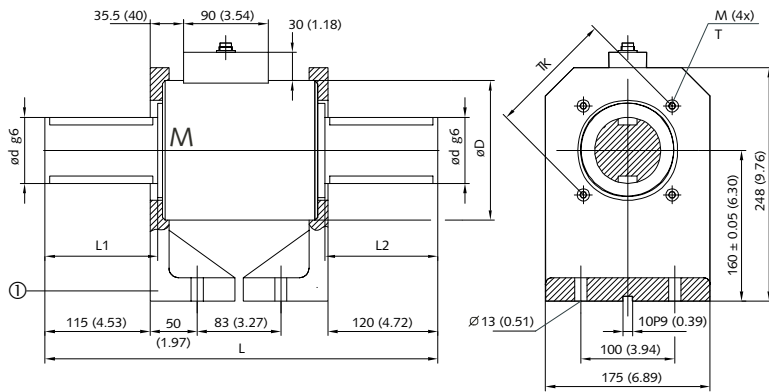


Fig. 2: Type 4503A... size 3 ... 4



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

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

**Dimensions in inches**

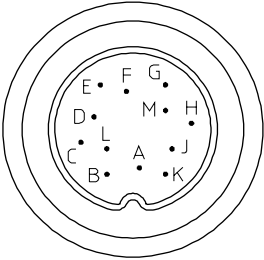
Size	1		2		3	4	5
Rated torque lbf-ft	0.2/0.4	0.7	1.5/3.7	7.4/14.8	36.9 /73.8	147.5/368.8/ 737.6	1,475.2/ 3,688
L	6.3	6.3	6.4	6.5	7.1	10.5	16.5
L1	0.63	0.63	0.71	0.79	1.1	2.4	4.8
L2	0.63	0.63	0.71	0.79	1.1	2.4	4.8
øD	2.3	2.3	2.3	2.3	3.1	3.9	5.8
ød g6	0.35	0.35	0.39	0.47	0.87	1.7 <sup>1)</sup>	2.8 <sup>2)</sup>
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

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

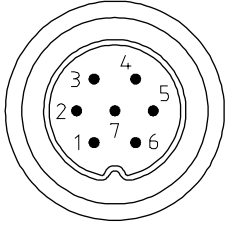
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**Electrical Connections**

**Pin Allocation of the 12 Pin Built-in Standard Connector**

	Function	PIN	Description
	Supply	F A	+U <sub>B</sub> Ground relating to +U <sub>B</sub>
	Shield	M	In the sensor on housing
	Torque output	C	U <sub>A</sub> ±5 VDC at ±M <sub>Nominal</sub> at >2 kΩ +5 VDC at control signal activation R <sub>c</sub> = 10 Ω, output short circuit proof relating to AGND
		D	AGND Ground relating to U <sub>A</sub>
	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 <sub>K</sub> = 10 kΩ
	RS-232C interface to the UMV 3000	B L	TXD RXD Digital send path to the UMV 3000 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		OGND 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!

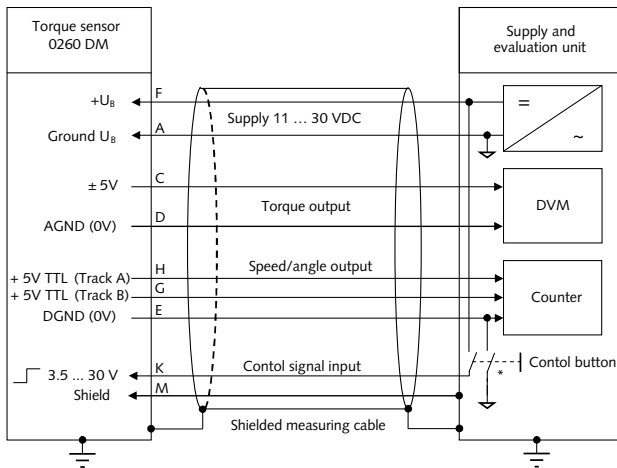


Fig. 4: Connection diagram of 12 pin built-in connector (standard)

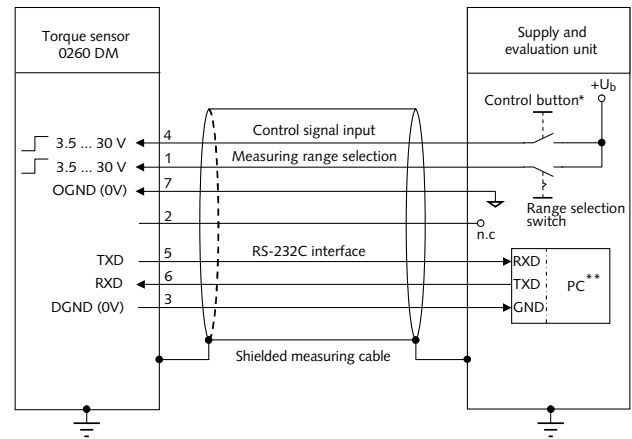


Fig. 5: Connection diagram of 7 pin built-in connector (Option A1/A2: range selection)

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### Included Accessories

- None

### Optional Accessories

- |   |              |
|---|--------------|
| • 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  $\pm 5$  VDC

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

Version 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

$\pm 5$ 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 $\pm 5$ VDC	00
Output signal $\pm 10$ VDC	B1
100 $\pm 40$ kHz (TTL)	B2
100 $\pm 40$ kHz (24 V)	B3
100 $\pm 40$ kHz ( $\pm 5$ 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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