

Precision Torque Sensor

Non-contact transmission for rotating applications optional measurement of angle and speed

Code:	8661 EN
Delivery:	on request
Warranty:	24 months

Model 8661

CAD data 2D/3D for this sensor:
Download directly at www.traceparts.com
Info: refer to data sheet 80-CAD-EN



New product with outstanding features

- Measuring range from 0 ... ± 0.05 Nm to 0 ... ± 200 Nm
- High linearity of ≤ 0.05 % F.S.
- Intelligent operating state indicator
- 16 bit D/A converter including digital adjustment
- Output signal 0 ... ± 10 V or USB (option)
- Angle measurement accuracy to 0.09° (option)
- Excellent price-performance ratio

Application

The series 8661 precision torque sensor is the ideal choice for reliable measurement of static and dynamic clockwise and counter-clockwise torques.

Thanks to the non-contact transmission of the excitation voltage and measurement signal, the sensor offers virtually maintenance-free and fail-safe operation. This makes it perfect for industrial production and assembly applications where there is a need to measure actuating or breakaway torques, holding torques or tightening torques.

Its high measurement quality means that the sensor is equally suited to quality control applications and laboratory-based research and development projects.

For network-independent, mobile use, the torque sensor offers an optional USB interface. This can be connected to a notebook running the PC software supplied with the device to take on-site measurements with accompanying visualization and archival of measurement values.

The applied torque can be read easily by evaluation units or controllers connected to the normalized analog interface.

Its compact, robust and vibration-proof construction makes it suitable for use in the following example applications:

- ▶ Test setups for precision mechanics
- ▶ Measurements on micromechanical actuator elements
- ▶ Engine test benches including measurement of mechanical power
- ▶ Recording biomechanical movements in medical engineering
- ▶ Precision frictional torque measurements on bearings
- ▶ Use as test-bench measuring device

Description

The measuring shaft, which is made of high-quality materials, carries metal-film strain gauges. Torsion of the shaft by the torque to be measured produces a change in resistance in the full bridge, which is converted into an analog signal that is proportional to the torque.

To ensure wear-free operation, the power is supplied by inductive coupling and the measurement signals are transmitted optically.

The signal, which has been digitized already on the shaft, is converted and amplified into a 0... ± 10 V signal by a 16-bit digital-to-analog converter on the stator. A high-resolution TTL output signal for the angular displacement and rotational speed measurement is achieved by optical sensing of an incremental encoder disk with up to 1,024 divisions and two offset tracks plus four-edge decoding.

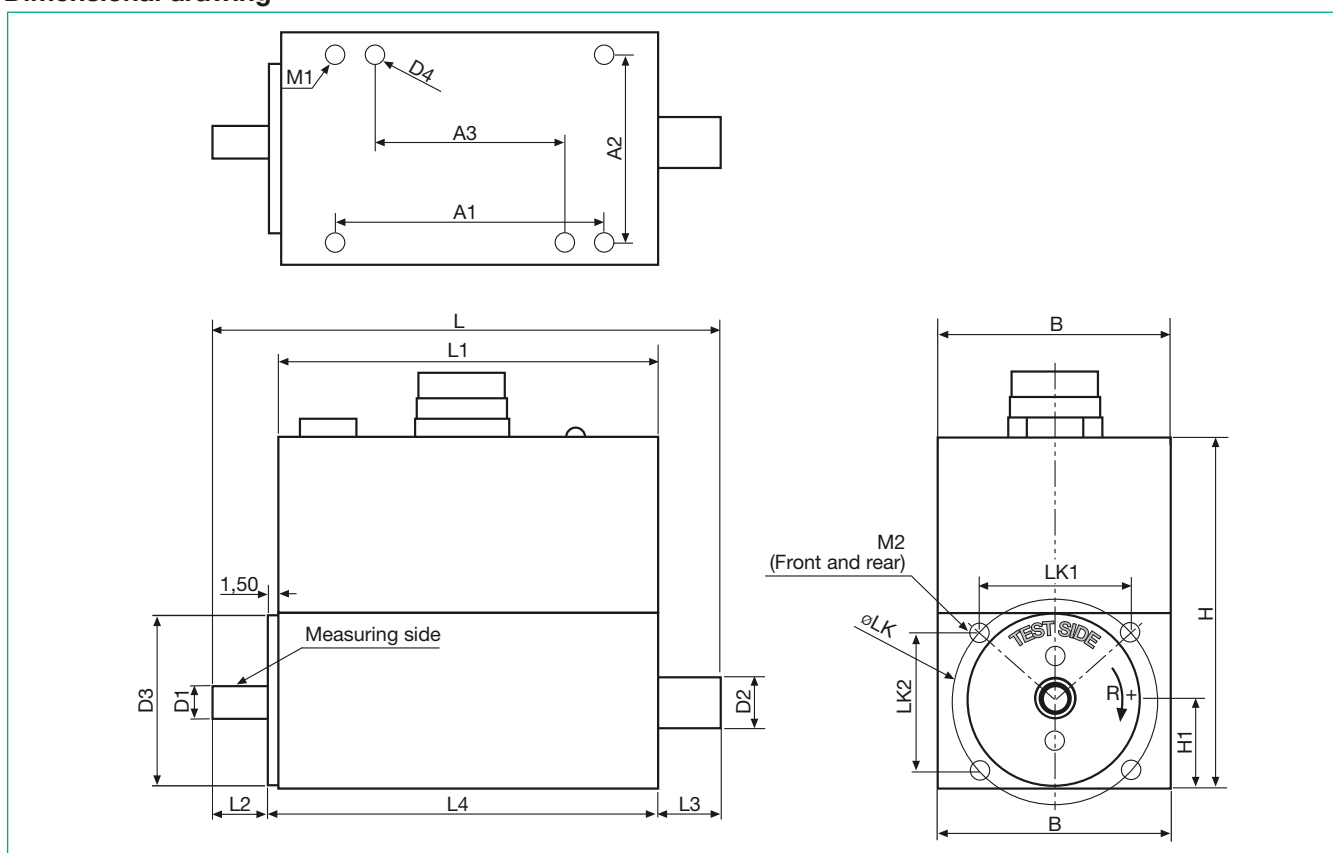
An extra socket in addition to the standard 12-pin connector provides another option for connecting an external supply. Continuous, online display of the various operating states is provided by a 3-LED optical indicator.

High-quality bearings, tight manufacturing tolerances and excellent balance are essential for achieving the optimum running stability that this sensor delivers at speeds of over 25,000 rpm.

Technical Data
Table 1

Order Code	A1 ±0.05	A2 ±0.05	A3 ±0.05	B	B1	D1 g ⁶	D2 g ⁶	D3 0,05	D4 0,03 deep	H	H1	L	L1	L2	L3	L4	LK ±0.05	LK1 ±0.05	LK2 ±0.05	M1 deep	M2 deep
8661-4050-VXXXX	45	31	30	40	40	5	8	29	3.1 x 5	60	15	87	64.5	10	11	66	-	26	24	M4 x 8	M3 x 5.5
8661-4100-VXXXX	45	31	30	40	40	5	8	29	3.1 x 5	60	15	87	64.5	10	11	66	-	26	24	M4 x 8	M3 x 5.5
8661-4200-VXXXX	45	31	30	40	40	5	8	29	3.1 x 5	60	15	87	64.5	10	11	66	-	26	24	M4 x 8	M3 x 5.5
8661-4500-VXXXX	45	31	30	40	40	5	8	29	3.1 x 5	60	15	87	64.5	10	11	66	-	26	24	M4 x 8	M3 x 5.5
8661-5001-VXXXX	45	31	30	40	40	5	8	29	3.1 x 5	60	15	87	64.5	10	11	66	-	26	24	M4 x 8	M3 x 5.5
8661-5002-VXXXX	45	31	30	40	40	6	8	29	3.1 x 5	60	15	87	64.5	14	14	66	-	26	24	M4 x 8	M3 x 5.5
8661-5005-VXXXX	57	44	41	55	40	15	15	54	3.1 x 5	85	27.5	143	64.5	30	30	83	64	-	-	M5 x 9	M4 x 6
8661-5010-VXXXX	57	44	41	55	40	15	15	54	3.1 x 5	85	27.5	143	64.5	30	30	83	64	-	-	M5 x 9	M4 x 6
8661-5020-VXXXX	57	44	41	55	40	15	15	54	3.1 x 5	85	27.5	143	64.5	30	39	83	64	-	-	M5 x 9	M4 x 6
8661-5050*-VXXXX	57	44	41	64	40	26	26	54	3.1 x 5	94	32	170	64.5	45	45	78	77	-	-	M6 x 10	M4 x 6
8661-5100*-VXXXX	57	44	41	64	40	26	26	54	3.1 x 5	94	32	170	64.5	45	45	78	77	-	-	M6 x 10	M4 x 6
8661-5200*-VXXXX	57	44	41	64	40	26	26	54	3.1 x 5	94	32	170	64.5	45	45	78	77	-	-	M6 x 10	M4 x 6

* in development

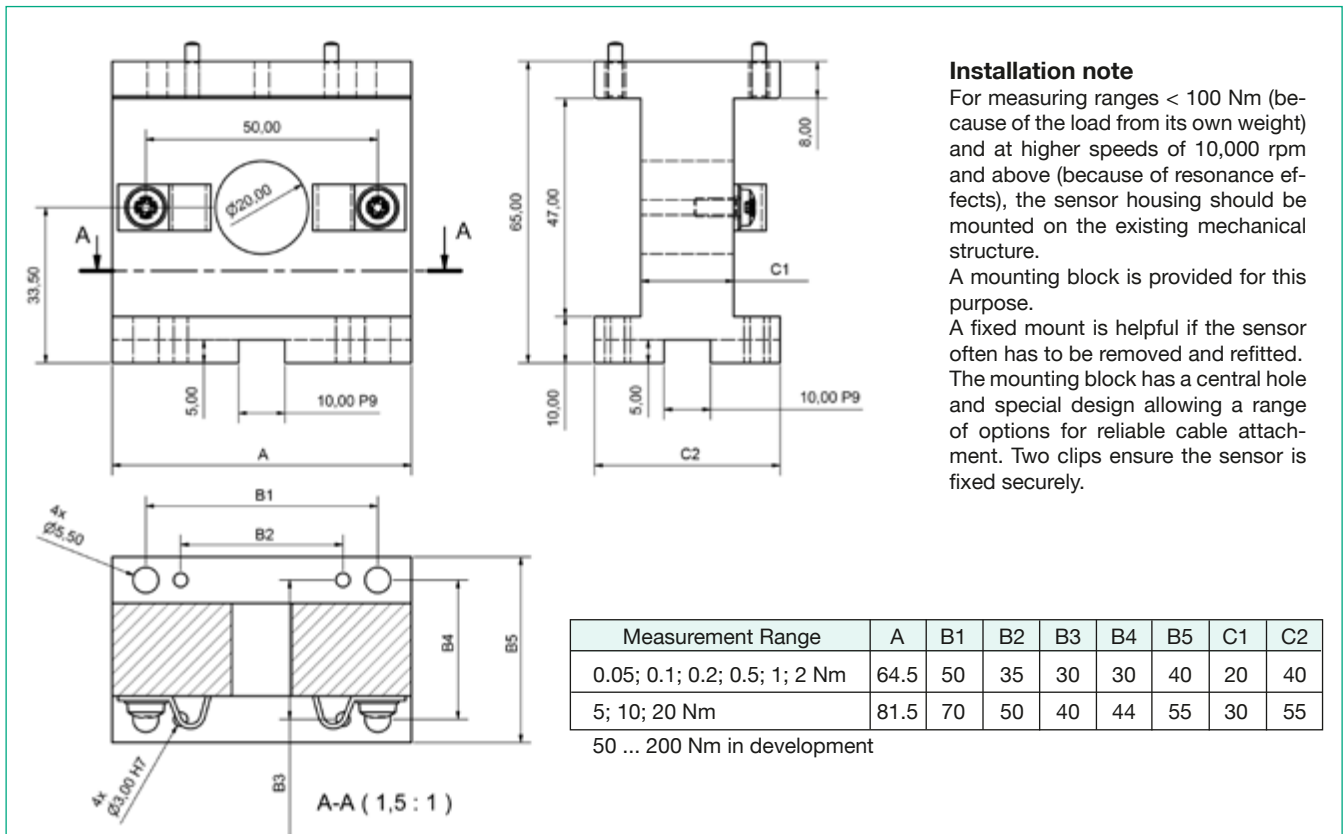
Dimensional drawing

Specifications, based on measurement range Table 2

Order Code	Measurement Range [Nm]	Spring Constant [Nm/rad]	Mass Moment of Inertia Drive Side [10 ⁻⁶ kg*m ²]	Mass Moment of Inertia Measuring side [10 ⁻⁶ kg*m ²]	Maximum Permissible Axial Load [N]	Maximum Permissible Radial Load [N]	Weight [g]	Max. Rotary Speed* [min ⁻¹]
8661-4050-VXXXX	0 ... ± 0.05	10	2.2	0.048	140	3	300	25 000
8661-4100-VXXXX	0 ... ± 0.1	20	2.2	0.048	140	3	300	25 000
8661-4200-VXXXX	0 ... ± 0.2	50	2.2	0.05	140	3	300	25 000
8661-4500-VXXXX	0 ... ± 0.5	100	2.2	0.06	160	4	300	25 000
8661-5001-VXXXX	0 ... ± 1	100	2.2	0.062	210	7	300	25 000
8661-5002-VXXXX	0 ... ± 2	180	2.2	0.077	210	13	300	25 000
8661-5005-VXXXX	0 ... ± 5	800	14.3	2.2	1200	15	900	15 000
8661-5010-VXXXX	0 ... ± 10	1700	14.3	2.35	1300	30	900	15 000
8661-5020-VXXXX	0 ... ± 20	3000	14.6	2.6	1300	60	900	15 000

50 ... 200 Nm in development

*without option angle and speed measurement 50 ... 200 Nm in development

Dimensional drawing mounting block



Installation note

For measuring ranges < 100 Nm (because of the load from its own weight) and at higher speeds of 10,000 rpm and above (because of resonance effects), the sensor housing should be mounted on the existing mechanical structure.

A mounting block is provided for this purpose.

A fixed mount is helpful if the sensor often has to be removed and refitted. The mounting block has a central hole and special design allowing a range of options for reliable cable attachment. Two clips ensure the sensor is fixed securely.

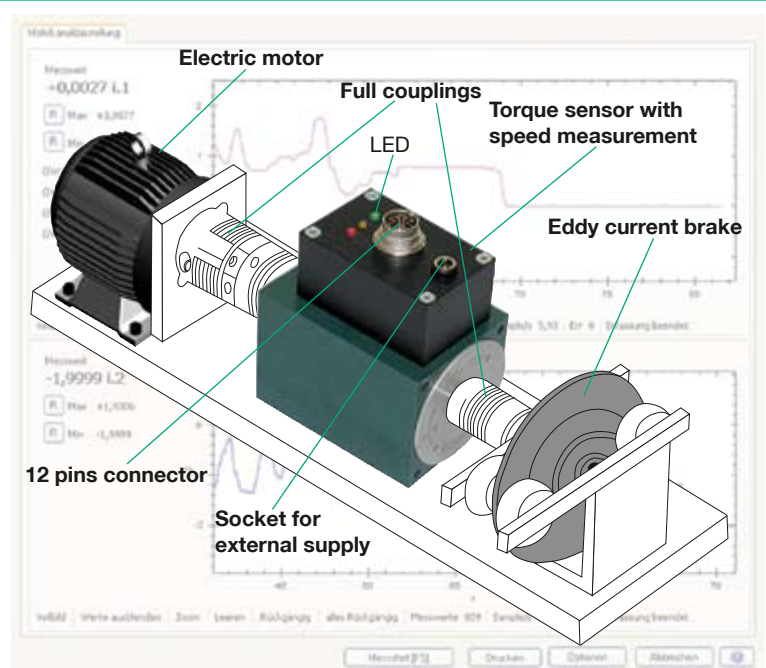
Example Application in Motor Testing: Rapid Changes in Speed, low Torque, Reliable Measurement

Task

- ▶ Miniature electric motors need to be intensively tested after final assembly as standard to assess their electromechanical properties.
- ▶ The torque and speed need to be measured, which will be used later to assess mechanical performance parameters.
- ▶ The test setup shall provide high precision, straightforward measurement-signal processing and overload protection.

Solution

- ▶ The low torques in this application mean that the measurement range must be chosen to achieve the necessary accuracy and overload protection.
- ▶ The sensor is mounted so that it is freely suspended between two full couplings: between sensor and drive and between sensor and transmission arm. These couplings allow correction of misalignments in height and angle and also adjustments in length.
- ▶ To protect the sensor from inadmissible outside mechanical forces in the form of bending stress, suitable support bearings are required near the sensor. Two precision grooved ball bearings are used in this case to absorb any bending moments.
- ▶ The measurement signals for the torque (0 ... ± 10 V) and for the speed (TTL) are available to the user for further processing.



Please note:

We recommend using rigid multi-disk or metal-bellows couplings for correcting misalignments.

Both angular and axial misalignments can be corrected using „half-couplings“. Full couplings are needed, however, to correct any radial misalignment.

Technical data

Electrical values

Rated supply voltage range U_b :	10 ... 30 V DC
Power consumption (without option):	approx. 2 W
Output voltage at \pm rated torque:	± 10 V
Output impedance:	1 k Ω
Insulation resistance:	> 5 M Ω
-3 dB cut-off frequency:	200 Hz
Ripple:	< 50 mV _{ss}
Calibration signal:	10.00 V DC
Drive signal (pin K):	10 ... 30 V DC

Supply and measurement channel are galvanically isolated.

Power supply built-in connector:	hole diameter 5.7 mm center pin 2.0 mm
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Speed/angular displacement measurement (option)

Output without external circuit:	TTL level
Output with external circuit:	Open Collector
Internal pull-up resistor:	2 k Ω (5 V level)
External circuit (Open Collector output):	$U_{max} = 30$ V / $I_{max} = 30$ mA

Angular displacement measurement:	
Resolution for encoder disk with 1,024 increments	0.09°
Resolution for encoder disk with 400 increments	0.225°

Speed measurement:	
max. rotational speed for an encoder disk with 400 increments	15,000 rpm
max. rotational speed for an encoder disk with 1,024 increments	6,000 rpm

Both pulse channels A and B are always available. Only one channel is needed for the speed measurement. Two channels are used for measuring the angular displacement (or detecting the direction of rotation).

Direction is detected by 2 pulse output channels; channel A leads channel B by 90° for clockwise rotation viewed from the drive end.

Environmental conditions

Operating temperature range:	0 °C ... 60 °C
Rated temperature range:	0 °C ... 60 °C
Effect of temperature in the rated temperature range:	
on the zero signal	$\pm 0.015\%$ F.S./K
on the sensitivity	+ 0.01 % F.S./K

Mechanical values

Relative linearity deviation:	
Measuring range 0 ... 0.05 Nm	< ± 0.1 % F.S.
Measuring range 0 ... 0.1 to 0 ... 20 Nm	< ± 0.05 % F.S.
Relative reversal error:	
Measuring range 0 ... 0.05 Nm	< ± 0.1 % F.S.
Measuring range 0 ... 0.1 to 0 ... 20 Nm	< ± 0.05 % F.S.
Max. operating torque:	200 % of rated torque
Max. permitted speed:	see table 2
Failure torque:	300 % of rated torque
Alternating load, referred to rated torque:	up to 70 %
Material:	housing made of anodized aluminum
Measurement range	
≤ 0.2 Nm aluminum measuring shaft, shaft ends made of stainless steel 1.4542	
≥ 0.5 Nm measuring shaft made of stainless steel 1.4542	
Degree of protection to EN 60529:	IP40
Weight:	see table 2
Electrical connection:	12-pin plug-in connection (type 9940 mating connector is supplied)

Fixing method: mounting holes are located on the end faces and the base; see table 1 and dimensional drawing

Operating state indicator: using LED

/M/ < 5 % of rated torque	green LED flashing
5 < /M/ < 90 % of rated torque	green LED solidly on
90 < /M/ < 100 % of rated torque	yellow LED solidly on
100 < /M/ < 150 % of rated torque	red LED flashing
/M/ ≥ 150 % of rated torque	red LED solidly on

M = torque

Mounting instructions

When fitting the sensor, make sure that the measuring shaft is aligned as precisely as possible with the connecting shafts. Couplings must be employed to avoid strain on the sensor from parallel or angular displacement of the shafts.

The permitted axial and radial forces (see table 2) must not be exceeded during fitting or operation.

Please refer to our operating instructions for detailed information.

Accessories

12-pin mating connector (supplied with device)	Model 9940
12-pin mating connector, right-angle socket connecting cable, (torque and rotational angle/speed), length 3 m, one end open	Model 9900-V539 Model 99540-000B-0270030
Connecting cable, length 3 m, with connector 9941 for DIGIFORCE® 9306-V510X	Model 99141-540M-0270030
Power pack for external supply	Model 8600-Z010
USB cable, length 2 m	Model 8661-Z010
Mounting block (see dimensional drawing on page) for torque sensor, measurement range 0 ... 2 Nm	Model 8661-Z001
for torque sensor, measurement range 0 ... 5 Nm and 0 ... 20 Nm	Model 8661-Z002
for torque sensor, measurement range > 20 Nm in development	
Couplings	on request

Display and evaluation instruments

Torque	e.g. SENSORMASTER Model 9163
Torque and angular displacement	e.g. DIGIFORCE® Model 9306/9307 see section 9 of the catalog

Option

Designation	Meaning
VX1XX	Angular displacement measurement resolution 0.225°/speed measurement
VX2XX	Angular displacement measurement resolution 0.09°/speed measurement
VXX1X	USB interface as alternative to voltage output (in development)

USB (option in development)

USB interface including convenient PC software (8661-P001) for analysis, visualization and documentation. Automatic export, evaluation and archiving of measurements in log file or Excel.

- ▶ System requirements for software: Windows 2000, XP, Vista, Window 7
- ▶ Sensor excitation supplied solely via USB port
- ▶ 16-bit A/D conversion
- ▶ Measurement rate: 200 measurements/sec. (standard)
400 measurements/sec. (on request)
- ▶ DLLs or LabView drivers available on request
- ▶ Easy retrieval of sensor and calibration data (SN, measurement range, model, test date, firmware)
- ▶ Functional test via software
- ▶ Mechanical-power measurement
- ▶ Multi-channel license available on request

Order Information

Torque sensor, measurement range 20 Nm, with high-resolution angular displacement measurement 0,09° **Model 8661-5020-V0200**

Manufacturer Calibration Certificate (WKS)

Calibration of a sensor or a sensor with display instruments, clockwise and/or counterclockwise torque in 20 % steps, increasing and decreasing.