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Instruction manual and data sheet

Torque Sensor Series 4000

PREMIUM QUALITY
MADE IN GERMANY



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NCTE AG® Torque Sensor Series 4000 Instruction Manual and Data Sheet.

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D-82041 Oberhaching

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State: September 2020

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Instruction manual

1 General

Dear customers,

Thank you for your decision to buy our sensor products. You have chosen a high quality and extremely precise torque measuring system.

This manual contains all the information necessary for you and the installation, operating and maintenance personnel to use your measuring system under the intended conditions of use. It contains important information to ensure proper and safe installation and operation.

For these reasons, the Instruction manual must always be available at the place of use of the torque measuring system and always ready to hand.

We reserve the right to make changes in the course of product improvements. We try to maintain compatibility with previous versions. All information without guarantee subject to technical changes.

For further questions we are of course also available after the purchase at any time.

Please use our contact address.

1.1 Customer service address

NCTE AG
Raiffeisenalle 3
D-82041 Oberhaching

Phone: +49 (0)89 665 619 0

Email: sales@ncte.de

Web: <https://ncte.com/>

1.2 Warranty

The warranty period is 12 months from the date of delivery from the factory, provided that the product is used in accordance with its intended purpose, in compliance with the maintenance and calibration regulations and the General Terms and Conditions of Business.

You can find these, current instruction manuals and data sheets on: <https://ncte.com/serienprodukte/>

1.3 Scope of delivery

The torque sensor system consists of a calibrated sensor, signal acquisition / -processing integrated in the housing, a 5 m long connection cable with plug (Binder plug no. 99-0426-10-08) and keystone (round shaft).

Enclosed you will find the corresponding calibration certificate and the warning notes.

1.4 Declaration of conformity

The manufacturer

NCTE AG
Raiffeisenalle 3
D-82041 Oberhaching

hereby declares that the following product

Product designation:	Torque sensor series 4000	
Trade designation:	Series 4000	
Model names:	4000-50	(round shaft)
	4000-100	
	4000-250	(round shaft)
	4000-1000	(round shaft)

conforms to the requirements of the EMC Directive 2014/30/EU – including its amendments in force at the time of this declaration.

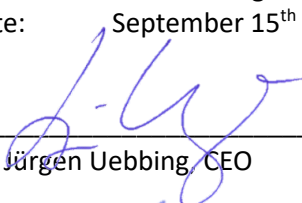
The following harmonized standards were applied:

EN 61000-6-2:2019-11
EN 61000-6-4:2020-09
EN 61326-1:2013-07
EN 61326-1:2018-09 (Draft)

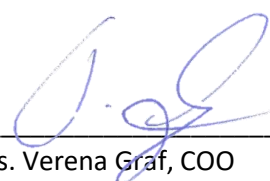
The following national laws, standards and specifications were applied:

Electromagnetic compatibility law – EMVG

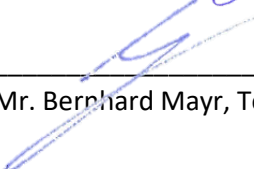
Place: Oberhaching
Date: September 15th 2020



Dr. Jürgen Uebbing, CEO



Ms. Verena Graf, COO



Mr. Bernhard Mayr, Technical Director

2 Safety

Please note the enclosed sheet on the warning notes.

2.1 Intended use

The sensors of the Series 4000 are designed exclusively for measuring torque and/or speed. The respective load range can be taken from the data sheet and must not be exceeded.

Proper use also includes compliance with the commissioning, assembly, operating, ambient and maintenance conditions specified by the manufacturer.

Any use beyond these is considered improper. The manufacturer is not liable for any damage resulting from such use.

2.2 Duration of use

A factory recalibration should be executed annually. See corresponding label on the sensor.

2.3 Structural change

Unauthorized conversions or changes to the torque measuring system are prohibited for safety reasons and lead to the immediate expiration of the warranty claims.

2.4 Training of the operating personnel

Assembly, commissioning and maintenance personnel must have read and understood the complete operating instructions, especially Chapter "2 Safety". The operator is recommended to have this confirmed in writing.

2.5 Transport and handling

During handling, storage and transport, make sure that the sensor is not exposed to strong magnetic or electromagnetic fields (e.g. degaussing coils).

3 Torque Sensor Series 4000

The Series 4000 serves the segment of very precise and reliable torque measurement technology.

3.1 Short description

The series is mainly used in laboratories, test fields and trials, in medical technology as well as in production monitoring and quality assurance. With the Series 4000, torques can be measured statically as well as dynamically in real time. The shaft is available as round and square. Each sensor can be configured individually, so there is the option of an angle sensor. Analogue outputs 0-10V or 4-20mA are available as signal outputs for the Series 4000. The sensor is supplied as a ready-to-connect unit including 5m long cable, keystones (round shaft) and calibration certificate.

3.2 Assembly and disassembly

When mounting the sensor, make sure that the measuring shaft is exactly aligned with the connecting shafts (corresponding couplings can be found in the accessories). It must then be possible to push the key adapters / square ends of the connection shafts onto the key adapter connections / square connections of the sensor without any effort. No force must be exerted on the housing in the axial direction during fastening. The sensor can be secured against rotation by means of the flat surface (optional sensor holder). The cable length must not exceed 5m. Using a cable other than the one supplied by NCTE or an identical cable with a different cable length may impair the function of the sensor system.

The disassembly may only be done without applying torque to the measuring shaft.

3.3 Interface description

Mechanical interfaces:

For power transmission, adapter connections are provided at both ends of the keystone round shafts. In respect to square sensors, the shaft has square ends.

Electrical interface:

A socket for power supply and signal output is attached to the upper side of the housing. (Pin assignment see Chapter "7 Wiring diagram")

3.4 Starting up

After mounting the sensor, the following must be observed:

- Switch on power supply and check voltage value.
(Voltage peaks at the sensor must be avoided, devices must be checked accordingly before connection to the sensor)
- Connect the sensor to the power supply. (using the cable supplied)
- Record the output signal of the sensor with high resistance. (e.g. A/D converter, oscilloscope, PC measuring card)
- Record output signal in mechanically unloaded state of the sensor.

3.5 Operation during regular mode

Optimal measuring values are achieved when the sensor is used while maintaining the specific nominal torque. If the permissible operating conditions are observed, the sensor operates trouble-free and maintenance-free.

3.6 Irregular operation, actions in case of failures

If the sensor is mechanically overloaded (e.g. if the maximum permissible longitudinal force or torque limit is exceeded or if there are strong vibrations), the sensor may be damaged and the signal output may be distorted. In this case do not open the device. Contact NCTE AG directly.

3.7 Safety instructions

The following safety instructions should be followed for smooth operation:

- Opening the sensor or even single screws is not allowed.
- The shaft retaining rings on the shaft ends must not be loosened.
- The fastening nut of the plug must not be loosened or tightened.
- Only use power supplies safely disconnected from the mains voltage.
- Regarding the electrical and mechanical load of the sensor, the specifications according to the sensor-specific nameplate and the table in Chapter “4 Technical characteristics” must be observed.
- The sensor is not to be used as support bearing. The existing fastening options serve exclusively to secure the housing against twisting.
- To protect your system, we recommend increasing the torque over several stages.

3.8 Shaft preservation

The shafts are protected on both sides with a film of anti-corrosion wax. We recommend to leave the protection permanently. If technically necessary, remove the protective film with spirit/ethanol.

3.9 Service, maintenance and repair

As part of your test and measurement equipment management, we recommend regular inspection of your test and measurement equipment. Please also observe the relevant standards and guidelines.

Maintenance plan by NCTE AG

Calibration:	Every 12 months
Check the wiring, connectors and shaft:	Every 12 months

Repairs and recalibrations can only be carried out by NCTE AG personnel.

3.10 Disposal

The device must be returned to **NCTE AG, Raiffeisenallee 3, D-82041 Oberhaching** for disposal.

Data sheet

1 Key Facts

Technical	Distinctive features
<ul style="list-style-type: none"> Nominal torque: up to 1000 Nm, bidirectional Speed: ≤ 100000 rpm Accuracy: $\leq \pm 0.1\%$ Operating temperature: $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ Protection class: IP50 Output signal options: 0-10V / 4-20 mA Cut-off frequency: 2500 Hz 	<ul style="list-style-type: none"> Made in Germany Short delivery time (< two weeks) Excellent price / performance ratio Integrated electronic (Plug & Play) Completely contactless measuring system Delivery including 5 m cable and calibration certificate Suitable accessories (readout unit, couplings)

2 Torque ranges

Model line Series 4000 Round shaft	Nominal torque bidirectional (+/-) [Nm]	Limiting torque unidirectional [Nm]	Limiting torque bidirectional (+/-) [Nm]	RPM [rpm]
$\varnothing 15\text{ mm}$	50	65	65	10000
	100	130	130	
$\varnothing 25\text{ mm}$	250	325	325	8000
$\varnothing 40\text{ mm}$	1000	1300	1300	5000

Model line Series 4000 Square shaft	Nominal torque bidirectional (+/-)	Limiting torque unidirectional	Limiting torque bidirectional (+/-)	RPM [rpm]
$\frac{3}{8}\text{ inch}$	50	50	35	10000
$\frac{3}{4}\text{ inch}$	250	250	250	8000
1 inch	1000	1000	670	5000

Note: In case of overload, the sensor leads to a measurement offset. In such case, the sensor needs to be recalibrated at NCTE AG. The sensor should be operated only within the specified nominal torque range.

3 Load characteristics

Model line Series 4000 Measuring range	Axial force [N] ¹	Limit transverse force [N]	Limit bending moment [Nm]
50 and 100	2300	300	41.7
250	7000	800	176
1000	24000	2000	700

Any irregular stress (bending moment, transverse or axial force, exceeding the nominal torque) up to the specified static load limit is only permissible as long as none of the other stresses can occur. Otherwise the limit values must be reduced. If 30 % of the limit bending moment and 30 % of the limit transverse force are present in each case, only 40 % of the axial force is permissible, whereby the nominal torque must not be exceeded.

4 Technical characteristics

No.	Accuracy class ²		0.1	
	Description	Unit	Value	
1	Linearity deviation incl. hysteresis	%ME ³	< ±0.1	
2	Rotational Signal Uniformity (RSU)		< ±0.1	
3	Repeatability		< ±0.05	
Output signal general		Unit	Value	
4	Frequency range, -3dB point, Bessel characteristics	Hz	2500	
5	Analog signal	V mA	0 ... 10	4 ... 20
6	Signal at torque = Zero ⁴	V mA	5	12
7	Signal at positive nominal torque ⁵	V mA	9	20
8	Signal at negative nominal torque ⁵	V mA	1	4
9	Calibration parameter (normed) ⁵	V/Nm mA/Nm	4 V/ Measurement range	8 mA/ Measurement range
10	Error output	V mA	0/10	<4/20<
11	Output resistance (Voltage output)	Ω	62	
12	Output resistance (Current output)	k Ω	≥ 600	
Effect of temperature		Unit	Value	
13	Zero point drift over temperature	%/10 K	< 0.2	

¹ Specified values only apply to direct axial force on the shaft. If the axial force acts on the circlip, only 50 % of the force is permissible.

² The accuracy class means that the linearity deviation as well as the circulation modulation, individually, are each less than or equal to the value specified as the accuracy class. The accuracy class must not be confused with a classification according to DIN 51309 or EA-10/14.

³ % ME: Related to the measuring range.

⁴ Zero point can be set to 5 V using a tare button.

⁵ The exact sensor-specific values can be found in the calibration certificate supplied.

14	Signal drift over temperature within nominal temperature range	%/10 K	< 0.5			
Power supply		Unit	Value			
15	Supply voltage	VDC	11 ... 28			
16	Current consumption (max.)	mA	150			
17	Start-up peak	mA	< 200			
18	Absolute max. supply voltage	VDC	30			
General information		Unit	Value			
19	Protection class according to EN 60529 ⁶	IP	50			
20	Reference temperature	°C	+15 ... +35			
21	Operational temperature range	°C	-40 ... +85			
22	Storage temperature range	°C	-30 ... +85			
Nominal torque (bi-directional)		Nm	50	100	250	1000
23	Weight	kg	1.4	2.5	6	
24	Moment of inertia	kg mm ²	5.9	59.5	626	
Load limits⁷		Unit	Value			
25	Maximum measurable torque	%	110			

5 EMV Emission data

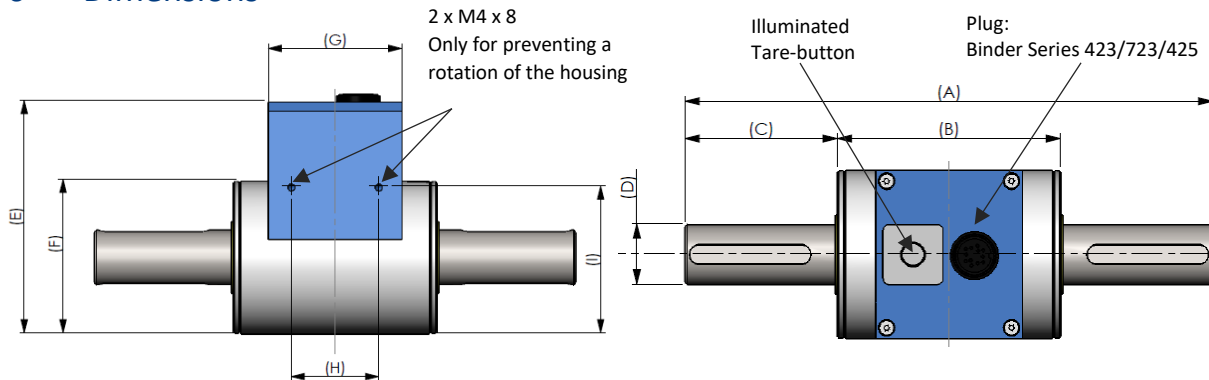
EMV immunity and emitted interference (DIN EN IEC 61000-6-2 / DIN EN IEC 61000-6-4 / DIN EN 61326-1)

Examination	Test specification	Admission	Evaluation criteria
Discharge of static electricity (ESD)	IEC 61000-4-2	± 4 kV Contact discharge	B passed
Electromagnetic HF-field	IEC 61000-4-3	80 - 1000 MHz; 10 V/m; 80% AM	A passed
Rapid transients	IEC 61000-4-4	± 1 kV	B passed
High frequency, asymmetrical	IEC 61000-4-6	0.15 - 80 MHz; 10V; 80% AM	A passed
Examination	Test specification	Admission	Evaluation criteria
Interference voltage 0.15 - 30 MHz	CISPR 11:2009 + A1:2010	Class B	Limit values observed
Radio interference field strength 30 - 1000 MHz	CISPR 11:2009 + A1:2010	Class B	Limit values observed

⁶ Wiring connected.

⁷ Based on the non-contact measurement principle the torque sensor is quite insensitive to bending and shearing forces. Self-aligning couplings are recommended in case of dynamic loads.

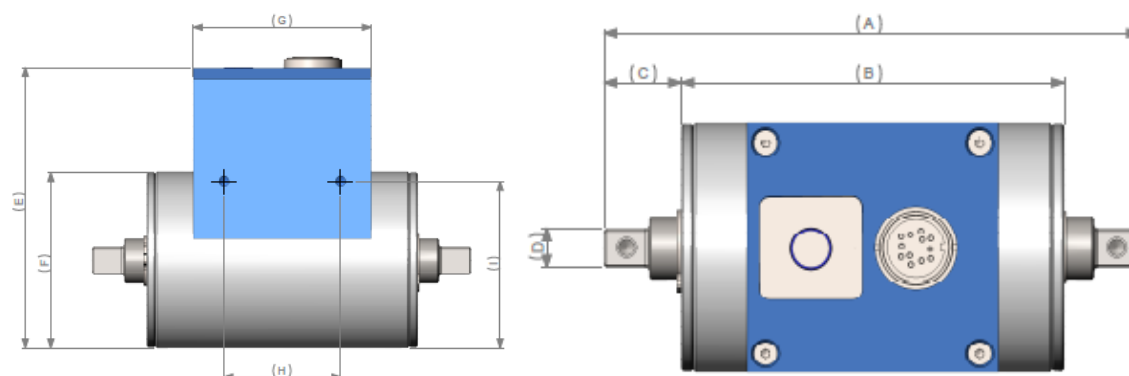
6 Dimensions



Dimensions round shaft [mm]				
Measuring range	50 Nm	100 Nm	500 Nm	1000 Nm
A	160	160	220	350
B	93	93	101	130
C	33.5	33.5	59.5	110
D	15g6	15g6	25g6	40g6
E	96	96	106	126
F	60	60	70	90
G	61	61	61	80
H	40	40	40	60
I	57	57	67	87

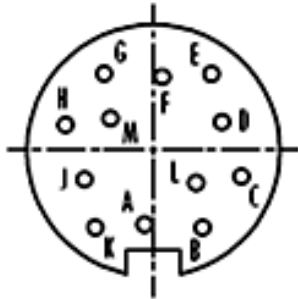
Dimensions keystone [mm]				Keystone DIN 6885			Keystone position
Shaft	Width	Depth	Length	Height	Length	Amount	Distance L
∅ 15 mm	5N9	3	25.5	5	25	1	130.5
∅ 25 mm	8N9	4	50.5	7	50	2	165.5
∅ 40 mm	12N9	5	90.5	8	90	2	252.0

For high alternating loads, torque transmission by positive and frictional locking via a suitable fit or coupling is recommended.



Dimensions square shaft [mm]									
	A	B	C	D	E	F	G	H	I
50 Nm	130	93	18.5	3/8 inch	96	60	61	40	57
250 Nm	180	101	39.5	3/4 inch	106	70	61	40	67
1000 Nm	230	130	50	1 inch	126	90	80	60	87

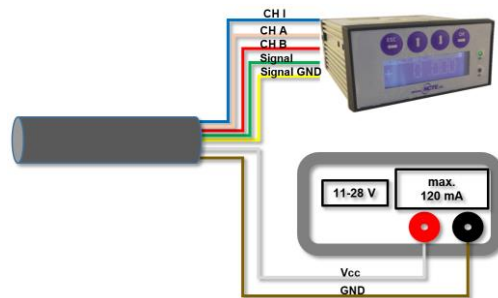
7 Wiring diagram



Connector
Power supply and
outputs

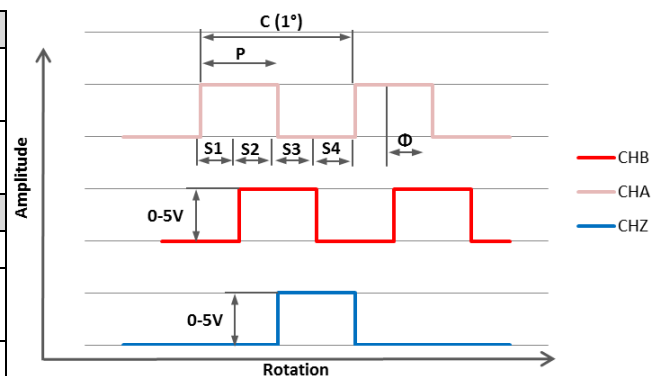
Type	Binder Plug Series 423/723/425 IP67 (Colour coding acc. to DIN 47100)		
Pin	Colour	Description	Value
A	White	Supply voltage V_{CC}	11V ... 28V
B	Brown	Ground GND	-
C	Green	Analog Out	0V ... 10V
D	Yellow	Analog GND	-
E	Grey	Analog Out	4mA ... 20mA
F	Pink	Angle Ch A	0V ... 5V
G	Blue	Angle Ch I	0V ... 5V
H	Red	Angle Ch B	0V ... 5V
J	Black	-	-
K	Purple	For internal use only	RX (TTL Pegel)
L	Grey-Pink	For internal use only	RX (TTL Pegel)
M	Red-Blue	Digital GND	-

8 Sensor wiring



9 Angle sensor

Parameter	Min.	Typ.	Max.	Einheit
High Level Output Voltage	2.4	5	-	V
Low Level Output Voltage	0	-	0.4	V
Parameter	Description			
C	One cycle of 360 CPR (degrees)			
P	The duration of high state of the output within one cycle.			
S	The number of electrical degrees between a transition in Channel A and the neighbouring transition in Channel B.			
Φ	The number of electrical degrees between the centre of high state of Channel A and the Centre of high state of Channel B.			





10 Order options

Series 3000 accuracy 0.2 %	
Measuring range [Nm]	
50	including 5m cable and calibration certificate
100	including 5m cable and calibration certificate
250	including 5m cable and calibration certificate
1000	including 5m cable and calibration certificate
Angle sensor	
0	Without angle sensor
1	Angle sensor 360 CPR
Analog output	
A	Voltage output 0-10V
S	Current output 4-20mA
Shaft ends	
0	Round shaft with keystone
1	Square shaft (available with 50/250/1000 Nm)
Protection class according to EN 60529	
0	IP50
3000	100
1	A
0	0
Example Sensor configuration	

We would be pleased to provide you with further information about serial products in a personal contact under

Phone: +49 (0)89 66 56 19 30 or by e-mail: sales@ncte.de.

11 Accessories

Readout unit		
	A	Order number 400010-ATS001 (Art. No.: 400010005)
		Sensor input: Voltage output 0-5 V and 0-10 V 1 x angle encoder input, A/B USB interface, Software Windows included SD card slot to use for data logging
	B	Order number: 400010-ATS002 (Art. No.: 400010006)
		Sensor input: current output 4-20 mA 1 x angle encoder input, A/B USB interface, Software for windows included SD card slot to use for data logging
Couplings		
		
Coupling Type	Used for	D2 max.
KB4C/60-67-15-D2	3000/4000 – D 15	32
KB4C/150-78-15-D2	3000/4000 – D15	42
KB4C/300-94-25-D2	3000/4000 – D25	60
KB4C/500-100-25-D2	3000/4000 – D25	70
KB4/1400-168-40-D2	3000/4000 – D40	80
KB4C/300-94-19-D2	3000/4000 – D40	85

You can obtain further or additional accessories and special requests in a personal discussion with your contact person for series products by calling +49 (0)89 66 56 19 30 or by e-mail: sales@ncte.de.

Your experts for magnetostrictive sensors

