SUPREME SENSORING

TWK

**Rotor hub sensor
Model NBN66-D
Interface: CANopen**

Document no.:
NBN 15268 DE
22.02.2024

- **Accelerometer for angular position Gyroscope for angular velocity**
- **Selectable measurement axes: x or y or z**
- **Angular measuring range: 360°**
- **Total angular velocity up to 25 rpm with accuracy of up to 0.5 % of current velocity**
- **High vibration and shock resistance thanks to robust design and predictive filtering**
- **Use e.g. in rotor hubs of wind turbines for rotor position and speed**

CANopen

KEY INFORMATION OVERVIEW

DESIGN & FUNCTION

This sensor can precisely detect position (360°) and speed of a continuously rotating shaft like a wind turbine and behaves like a rotary encoder with a speed signal. Digital processing and predictive filter techniques yield a high position and speed accuracy even when the sensor is tilted or disturbed by vibrations.

No fixed shaft attachment is required. This enables simple and therefore inexpensive installation in a rotating application. The accuracy of the sensor is comparable to a rotary encoder.

The sensor is based on our NBN model series. In addition to the MEMS accelerometer, a MEMS gyroscope is used to determine the rotation rate with a high refresh rate.

The sensor does not have to be positioned in the centre of the axis of rotation. The eccentricity is automatically determined by the sensor and used to correct the signal to gain a high accuracy position and speed signal for the shaft.

The robust sensor has a stable aluminium housing (stainless steel optional). Electrical connection is carried out using M12 connectors. The protection class extends up to IP67.

FEATURES INTERFACE

A CAN controller at the output enables integration into the CANopen network. Data output is carried out via PDOs of the CANopen interface.

The protocol is designed according to "CAN-open Application Layer and Communication Profile, CiA Draft Standard 301, version 4.2" as well as according to "Device Profile for Encoders, CiA Draft Standard Proposal 406, Version 4.0.2" and "CANopen Layer Setting Services and Protocol (LSS), CiA DSP 305, version 1.1.1".

An exhaustive description of integration into a PROFINET network can be found in the NBN15269 manual.

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TECHNICAL DATA

ELECTRICAL DATA

Sensor system. . . . . MEMS acceleration sensor and MEMS gyroscope
Operating voltage . . . . 11 bis 36 VDC
Power consumption. . . . . < 1.5 W
Current consumption . . . . Approx. 60 mA @ 24 VDC
Measuring axes . . . . z (x and y on request)
Zero error. . . . . ± 1°
Noise . . . . ± 0.06° (position), typical ± 0.6 °/s (speed)
Signal path . . . . CCW (default, CW/CCW parameterisable, see page 5)
Output code. . . . . Binary
Refresh time of output signals. . . . . Up to 2 ms
Delay time of output signal . . . . 10 ms
Permitted tilt angle. Up to 10°
Eccentricity (from rotation axis) . . . . Up to 1 m

POSITION DATA

Measuring range . . . . 360° (infinite rotation or reverse)
Resolution . . . . 15 bits / 360° (= 0.010986 °/digit)
Accuracy . . . . Approx. ± 2° (undisturbed)
Repeatability . . . . Approx. ± 0.5° (undisturbed)
Data format . . . . Unsigned 16 Bit

VELOCITY DATA

Measuring range . . . . 0 to 25 rotations per minute (rpm), 0 to 150 °/s
Resolution . . . . 0.01 °/s
Accuracy (@ 20 °C). . . . . ± 0.5 % @ 15 rpm (undisturbed, highest accuracy)
. . . . < 0.12 rpm for velocities < 7.5 rpm (total range, including disturbances*)
. . . . < 1.5 % for velocities ≥ 7.5 rpm (total range, including disturbances*)
Repeatability . . . . Approx. ± 0,25 % @ 15 rpm (undisturbed)
Temperature drift . . . . Slope ± 0.03 % typ.
Data format . . . . Signed 16 Bit

CANOPEN OVERVIEW OF SPECIFICATIONS

CiA DS301. . . . . CANopen Application Layer and Communication Profile, Version 4.2
CiA DS406. . . . . CANopen - Device Profile for Encoders, Version 4.0.2
CiA DS305. . . . . CANopen - Layer Setting Sevices and Protocol (LSS), Version 1.1.1
Transmission rate . . . . 20 kBaud to 1 MBaud
CAN interface . . . . According to ISO/DIS 11898
Address/baud rate setting . . . . Via SDO/LSS
Terminating resistor . . . . To be implemented separately
Max. transmission length. . . . . 30 m
Bootloader function . . . . Yes
COB ID distribution . . . . Default, SDO
No. of PDOs . . . . 2 Tx
PDO modes. . . . . Sync, async, cyclic, acyclic
Variable PDO mapping . . . . No
Emergency message. . . . . Yes
Heartbeat. . . . . Yes
No. of SDOs . . . . 1 Rx / 1 Tx
Baudrate, factory setting . . . . 250 kBaud
Node ID, factory setting. 1

The profile details are described in detail in the user manual NBN15269. The design guideline "CiA Draft Recommendation 303-1, Version 1.1.1, CANopen additional specification Part 1: Cabling and connector pin assignment" must be observed on installation.
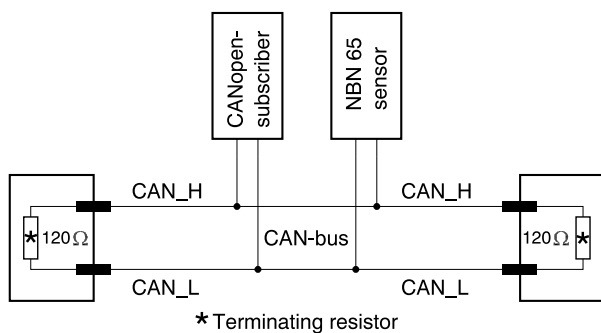
*   Values were experimentally verified on a test stand in the presence of tower oscillations (1-2 m/s², 0.3 Hz) and typical structure born noise at several kHz, as well as during normal operation of a wind turbine (see handbook NBN15269 for details).

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TECHNICAL DATA

ENVIRONMENTAL DATA

Operating temperature . . . . - 40 °C ... + 70 °C
Storage temperature . . . . - 20 °C ... + 60 °C (due to packaging)
Resilience . . . . To shock . . . . 200 m/s²; 6 ms
    DIN EN 60068-2-27
    To vibration . . . . 100 m/s²; 10 ... 2000 Hz
    DIN EN 60068-2-6
Protection grade . . . . IP67 (DIN EN 60529)
Weight . . . . Approx. 0.3 kg (Aluminium)

EMC STANDARDS

EN 61000-6-4:2006 + A1:2011	EMC Part 6-4: Generic standards-Emision standard for industrial environments
EN 61000-6-2:2005	EMC Part 6-2: Generic standards-Immunity for industrial environments
EN 61000-4-2:2009	EMC Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test
EN 61000-4-3:2006 A1:2008 + A2:2010	EMC Part 4-3: Testing and measurement techniques - Radiated, radio frequency. electromagnetic field immunity test
EN 61000-4-4:2004	EMC Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test
EN 61000-4-5:2006	EMC Part 4-5: Testing and measurement techniques - Surge immunity test
EN 61000-4-6:2009	EMC Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields
EN 61000-4-8:2010	EMC Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test. Power frequency magnetic field immunity test: 30 A/m, test criterion A, 100 A/m, test criterion B
EN 61000-4-29:2000	EMC Part 4-8: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests
IEC 61326-3-2:2018	Electrical equipment for measurement, control and labortory use - EMC requirements Part 3-2: Immunity for safety-related systems and for equipment intended to perform safety related functions (functional safety) - industrial applications with specified electromagnetic environment

PROGRAMMABLE PARAMETERS (REFER TO HANDBOOK NBN15269 FOR DETAILS)

Object 6000: Scaling . . . . ON/OFF
Object 6000: Signal path . . . . CW/CCW
Object 6003: Preset value . . . . 0 to 32767 (adjustment arbitrary between 0° and 360°)

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TECHNICAL DATA

OUTPUT LEVEL ACCORDING TO ISO / DIS 11898

$^{1)}$ With common mode voltage = 0V

BUS ACTIVATION ACCORDING TO ISO / DIS 11898

★ Terminating resistor

DATA PROFILE

PDO 1 / PDO 2

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PRODUCT CHARACTERISTICS

INSTALLATION POSITION AND MEASUREMENT AXES

The installation position TOP 1...6 of the rotor hub sensor determines, which face points upward when the zero transition 360° → 0° occurs ex factory. It can be modified by customer due to the preset function. For the three possible rotation axes the following surfaces / installation positions are fixed assigned. Other combination are only available on request.

NBN 360 / 0 / 0 . . . . . TOP4
NBN 0 / 360 / 0 . . . . . TOP1
NBN 0 / 0 / 360 . . . . . TOP1

The standard signal path is set to CCW (increasing angle values at rotation in direction „+", see pictures below). It can be set to CW by the customer.

The definition of the rotation axis can be found below. The sensor does not have to be installed exact on the rotation axis. Further information on possible eccentricity, preset function and signal path can be found in the manual NBN15269.
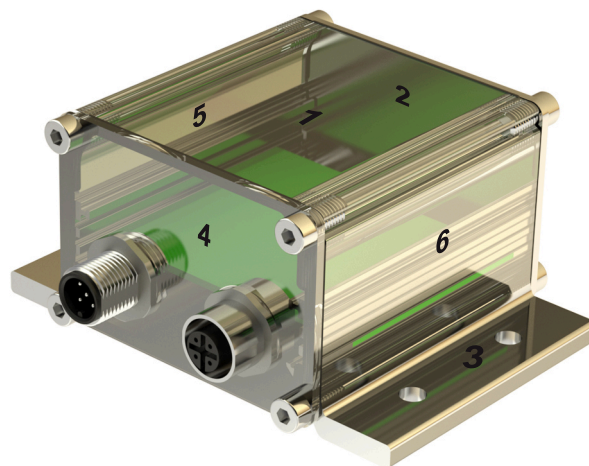
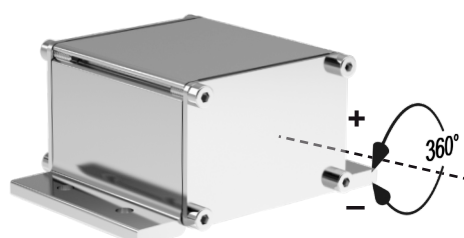| 1: Top side	2: Back	3: Bottom
4: Front (connector side)	5: Left	6: Right

NBN66-A 360 / 0 / 0 D C3 - 4 - S2 N01
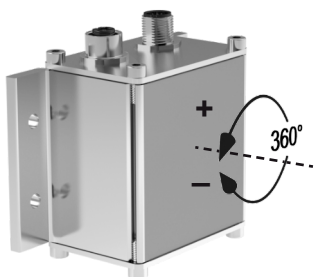
The definition of the measurement axis is indicated on the device. For the standard installation position, TOP4@x-axis, and signal path CCW this is depicted below. The position signal is zero (360° → 0°) in this configuration when the connectors point upwards. Due to the preset function other zero positions are adjustable by the customer.
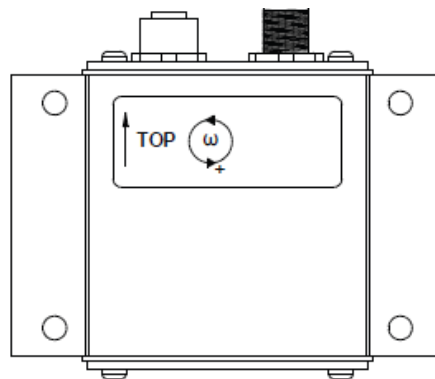
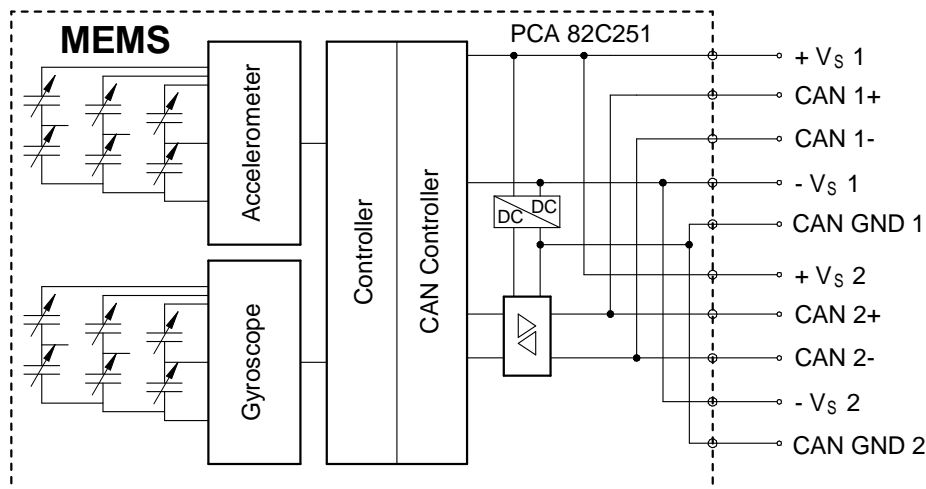

NBN66-A 0 / 360 / 0 D C3 - 1 - S2 N01 (ON REQUEST)

NBN66-A 0 / 0 / 360 D C3 - 1 - S2 N01 (ON REQUEST)

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TECHNICAL DATA

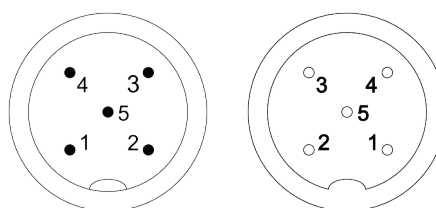### PRINCIPAL CIRCUIT DIAGRAM

ELECTRICAL CONNECTION

ELECTRICAL CONNECTION

1 x M12 connector A-coded, 5-pole, male or cable output via cable glands or
2 x M12 connector A-coded, 5-pole, male and female for bus in / bus out or cable output via cable glands

At the standard version -Vs and CAN_GND and screen/housing are galvanically separated (other galvanic versions on request).
The connection assignment TYxxxxx is part of the scope of supply and is included with each device.

CONNECTOR FOR SUPPLY AND CANOPEN (BUS IN AND BUS OUT)

PIN	Function
1	CAN_GND
2	Power supply $+V_s$
3	Power supply $-V_s$
4	CAN_High
5	CAN_Low

REMARK

Only use shielded cable for power supply and CANopen.

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ORDER CODE FORMAT

NBN 66 - A 360 / 0 / 0 D C3 - 4 - S 2 N 01   **STANDARD VERSION**

NBN	Inclination / rotor hub sensor with CANopen interface			
66	Design form	66	Design form 66 mm	
A	Housing material	A	Aluminium (see page 9)	
360	Measuring axis x	0 360	Please enter 360 here when x is the desired axis (with TOP4)	
0	Measuring axis y	0 360	Please enter 360 here when y is the desired axis (with TOP1)	
0	Measuring axis z	0 360	Please enter 360 here when z is the desired axis (with TOP1)	
D	Measuring version	D	With gyroscope for measuring angular velocity	
C3	Profile	C3	CANopen (CiA, DS 301 Version 4.2, DS 406 Version 4.0.2)	
4	Installation position	1 4	Defines which face points upward (TOP) when the zero transition 360° → 0° occurs (see page 5)	
S	Electrical connection	S K	Device connector, M12, 5-pole, A-coded Cable	
2	Electrical connection	1 2 X	1 x connector (male) 2 x connector (male and female) Cable length in m (for cable output)	
N	Output	N	CANopen	
01	Electrical and mechanical variants*	01	Standard version	

* The basic versions according to the data sheet bear the number 01. Deviations are identified with a variant number and are documented at TWK.

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ACCESSORIES (TO BE ORDERED SEPARATELY)

MATING CONNECTORS

Order number, Datasheet	Type	Design & wire fixing	Housing-material	Cable ø & wire size	Shielding & IP grade
STK5GS56, –	M12-A 5-pole, female	Straight screws	Brass, nickel-plated	6 – 8 mm ≤ 0.75 mm^2	On housing IP67
STK5GP90, –	M12-A 5-pole, male	Straight screws	Brass, nickel-plated	6 – 8 mm ≤ 0.75 mm^2	On housing IP67
STK5WS58, –	M12-A 5-pole, female	Angled, screws	Brass, nickel-plated	6 – 8 mm ≤ 0.75 mm^2	On housing IP67
STK5WP102, –	M12-A 5-pole, male	Angled, screws	Brass, nickel-plated	6 – 8 mm ≤ 0.75 mm^2	On housing IP67

Please note: If angled mating connectors are used, please specify the position of the coding groove so that the device connectors can be aligned accordingly.
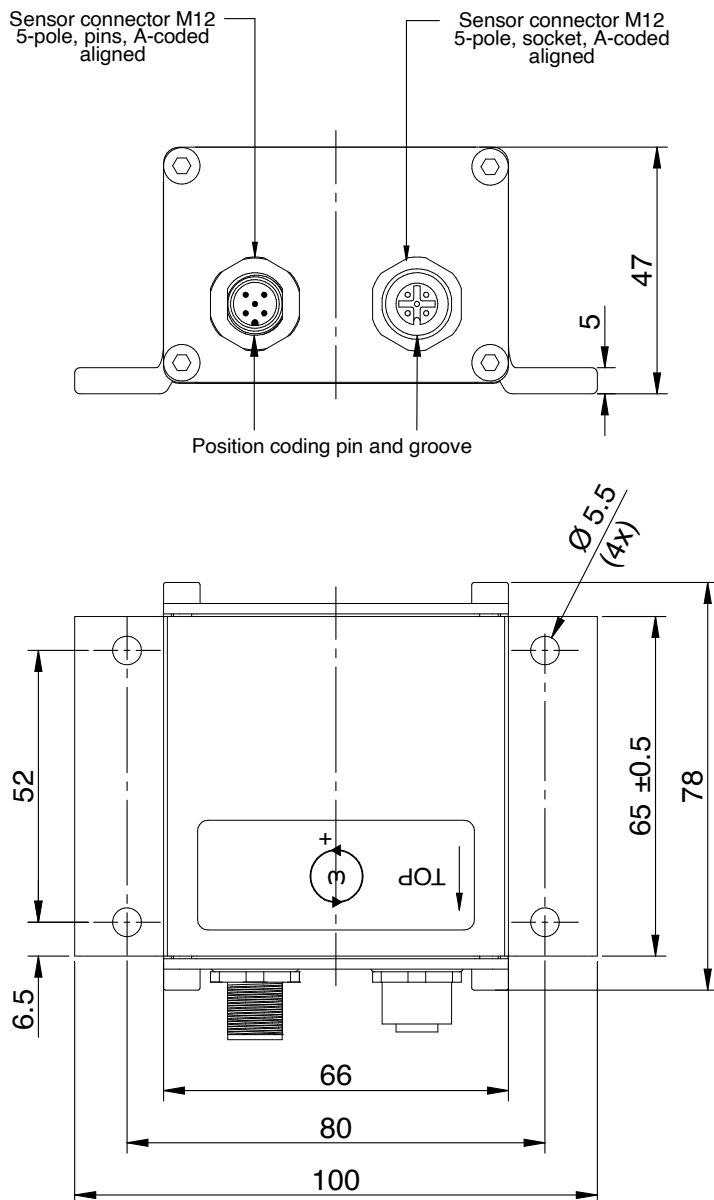
DOCUMENTATION

DOCUMENTATION

The following documents can be found in the Internet under www.twk.de/en in the documentation area, model NBN66-D.

Data sheet NBN15268
Manual. NBN15269
Declaration of Conformity . . . . CE: ZE12467, UKCA: ZE16569
Reach compliant QS15286
RoHS compliant QS13284

Available on request . . . . EDS file
Bit map image file
Electrical connection assignment TYxxxxx

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INSTALLATION DRAWINGS

MODEL NBN66-A 360 / 0 / 0 D C3 - 4 - S2 N 01

Dimensions in mm

Sensor connector M12
5-pole, pins, A-coded
aligned

Sensor connector M12
5-pole, socket, A-coded
aligned

Gasket

ca. 13

47

5

Position coding pin and groove

Ø 5.5
(4x)

52

65 ±0.5

78

TOP

6.5

66

80

100

MATERIALS USED

Aluminium housing . . . . Aluminium 3.3206
Aluminium front plates. . . . . Aluminium 3.3316
Connectors . . . . Brass, nickel plated or diecast zinc, nickel plated
Sealing rings . . . . PTFE / NBR