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# Electronic switching cam encoder
# Absolute encoder
## Models **NOCN / S3 with SIL2 Certificate / CANopen**


- **2 Versions SIL2:**
  - **Cam switch with encoder and safety-cams SIL2**
  - **Encoder, singleturn or multiturn without cams** (see NOC 13292)
- **Play-free version for use instead of electromechanical switching cam encoders**
- **For use in stationary and mobile machines and systems, particularly for wind turbines, power plants, cranes, etc.**
- **Up to four electronically controlled SIL2-switching outputs: Normally open contacts**
- **Integrated absolute multiturn encoder with CANopen Safety / CANopen interface**
- **Parameterisable via CANopen bus**
- **Option: Special slewing ring software for non-reversing operation**

### Contents



### Design

- Robust housing manufactured from seawater-proof aluminium (AlMgSi1) or stainless steel (material: 1.4305 optionally 1.4404).
- Shaft fitted with ball bearings bears the magnet for recording the angular position and the drive gear of the multiturn transmission for absolute revolution counting.
- Shaft and transmission are located in the prechamber. Sealed off from this, the main chamber contains all electronic components for position recording, evaluation and output.
- Available Versions:

  **Ø 58 mm** with different flange and shaft designs. 2 x relay NO contacts SIL2 at maximum.

  **Ø 64 mm (standard)** with clamping collar and M6 threaded holes plus two device connectors. 2 x relay NO contacts SIL2 at maximum.

  **Ø 79 mm (on request)** with clamping collar, M6 threaded holes. 4 x relays NO contacts SIL2 at maximum.
- Electrical connection for voltage supply, switching out puts and CANopen data via M12 connectors or cables. The number of connectors or cables varies (up to a maximum of three) depending on version or customer specifications.
- Output via SRDO and PDO possible. PDO is independently adjustable.

**The two/four switching contacts are SIL2 certified safety contacts. They are suitable for the safety chain.**

## Description

### General functional principle

This involves a play-free electronic switching cam encoder (abbreviated to: NOCN) with two (At version 79 four) galvanically separated switching outputs (cams), which can be set by the customer and which are activated or deactivated depending on the relevant position of the drive shaft. An absolute mulitturn encoder with CANopen interface, adjustable parameters and an electronic switching cam module is realized in the compact housing. A separate controller unit monitors the function of the cams.

The encoder's CANopen position signal and the switching outputs can be parameterised separately. The parameterisation (cam limits, resolution, measuring range a.s.o.) has to be verified to the NOCN via a checksum. This checksum can be calculated by a TWK program or the standard algorithm recommended by the CiA. After verification the device can be set operational.

Preset and resolution of the position signal also influence the cams which refer to the position signal.

Parameterisation is carried out via the relevant CANopen objects in accordance with the encoder profile according to CiA, DS 406, revision 4.01.

### Absolute encoder

The absolute encoder is equipped with a CANopen interface. Its resolution is 12 bits (= 4096 step) resp. 13 Bits (= 8192 step) per revolution (At version 79 are 32.768 steps possible). The measuring range set in the factory is 4096 revolutions. The absolute encoder's position data can be parameterised using CANopen objects.

On request the maximum measuring range can be reduced to 256 or 16 revolutions.

### Switching outputs (cams)

The electronically activated cams can be used to control potential-free, galvanically separated switching processes. The switching outputs are implemented using relays with long service lives.

The switching outputs are SIL2-certified, i.e. they represent safe switching outputs. This is implemented by internally wiring each switching output with two relays connected in series which switch with a slight time lag (about some ms). This eliminates the risk that a relay welds shut. Additionally each relay is monitored for proper operation. If one relay failes, an alarm will be generated by the NOCN and transmitted via CANopen to the customers controller.

The switching information for the cams is taken from the absolute encoder. In comparison with an electromechanical switching cam encoder, switching output activation and deactivation is carried out electronically without play or wear.

Each switching output represents a normally open logic contact which is routed out via an M12 connector.

In the specified operating status - without the limits having been triggered - the relays are picked up, i.e. the normally open contacts are closed. The relays open if the limits are reached or the NOCN's supply voltage fails / drops below the minimum limit. Also the relays open up in case of an internal device error. The connected circuit is interrupted and an alarm can be triggered.

The precise NOCN measuring range point at which each switching output is to switch (switching flanks) can be set using the relevant CANopen objects.

Within the measuring range, one on and off process is possible per switching output. Customer-specific switching procedures are also possible ex-works.

If operating voltage is missing, the cams do not switch.

## Safety parameters for NOCN58/64

(Test report number: 3514 8781)

Due to the fact that the NOCN is an actor **and** a sensor combined in **one** device, the safety parameters are as well separated in Cam switch and Rotary encoder. Values for version **NOCN79** will follow.

### Norm EN 13849-1:2008

**Cam switch**

- Category: 2
- MTTFd (years): 175
- CCF: fulfilled
- DC [%]: 91.8
- PL: d

**Rotary encoder**

- Category: 2
- MTTFd (years): 151
- CCF: fulfilled
- DC [%]: 91.7
- PL: d

### Norm EN 61508:2010 and EN 62061

**Cam switch**

- HFT: 0
- T1[s]: 8760
- SFF [%]: 95.7
- PFH [1/h]: $4.51 \times 10^{-8}$
- SIL: 2

**Rotary encoder**

- HFT: 0
- T1[s]: 8760
- SFF [%]: 95.1
- PFH [1/h]: $6.24 \times 10^{-8}$
- SIL: 2

## Slewing ring functionality (Code 'S' in order code number)

This slewing ring functionality is only valid for models NOCN without cams.

In some applications it is necessary to get directly the angle of the slewing unit.

A rotary encoder is coupled via a gear to a toothed gear or with a worm gear / gear units mounted on the worm shaft.

This results in a certain ratio due to the number of teeth.

The software in the encoder can be set (by the factory or the customer) in a way that the output signal of the encoder is the angle position of the slewing unit. The angle resolution can be set for example to 0.1° (i.e. 3600 steps per 360° of the encoder). Meaning if the slewing unite turns 360° the output of the encoder will also only turn by 360° (3600 → 0 steps).

In case the slewing unit turns constantly only in one direction the output will not be affected. Meaning the output signal will continue to give angle values between 0 and 360° even for infinite revolutions.

S makes the slewing ring functionality in the order code.

**For this kind of code (S) a resolution of 8192 steps / 360° (13 Bits) and a measuring range of 4096 revolutions is generally used ex works.**

**Note: When power supply of NOCN with code S is switched off it is not recommended to turn the shaft more than 500 turns in the same direction. Otherwise the safety slewing ring position may not be correct any more. In this case an error message is transmitted to the master by the NOCN for the user can recognize this issue.**

| Adjustable parameters | from | to |
|---|---|---|
| Code sequence | CW | CCW |
| Number of teeth - slewing ring | 1 | 65536 |
| Number of teeth - pinion of NOCN | 1 | 65536 |
| Resolution position | 1 | 8192* x i |
| Resolution for speed | 1 | 8192* x i |
| Gate time [ms] (for speed) | 10 | 1000 |

* Maximum resolution of encoder

i = Gear ratio *Number of teeth - slewing ring* to *Number of teeth - pinion of NOCN*

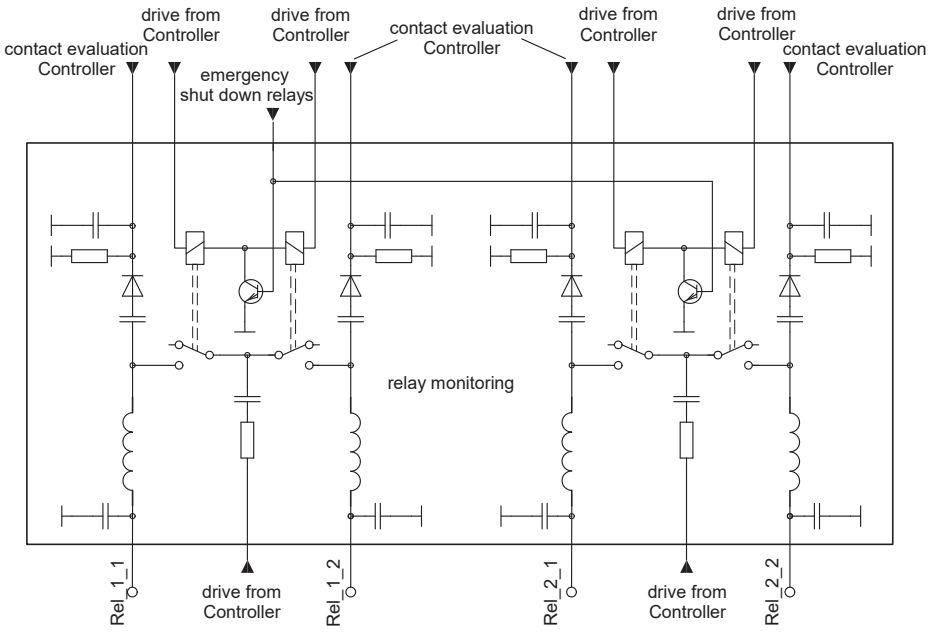
### Comparison of some characteristics when the encoder is coupled to the slewing ring.

| Characteristic | Encoder | Slewing ring |
|---|---|---|
| Resolution | 8192 steps | Adjustable, max. 8192 x i steps |
| Accuracy | ± 0.25 % | ± 0.25 % x $\frac{1}{i}$ |
| Measuring range | 4096 revolutions | Revolution repeatable ∞ times |
| Reproducibility | ± 0.02 % | ± 0.02 % x $\frac{1}{i}$ |
| Temperature drift | < 0.02° | < 0.02° x $\frac{1}{i}$ |

All of the values specified in this table (except the measuring range) refer to one sensor shaft or slewing ring revolution.

## Principle circuit diagram (Design of switching outputs)

2 of 4 shown




## Technical data

### Electrical data

- Sensor system: ASIC with HALL elements
- Operating voltage range: + 9 VDC to + 36 VDC
- Power consumption: < 2.5 W
- Resolution: 4096 steps / 360° - 12-bit or 8192 steps / 360° - 13-bit
  At version **NOCN79** up to 15 bits possible (32.768 steps / 360°)
- Measuring range: 4096 revolutions, (option 16 or 4096 revs.)
- Absolute accuracy: ± 0.25 % / 360° (± 0,1 % at version **NOCN79** possible)
- Position monitoring (2 systems): ± 3 %
- Temperature drift: ± 0,02° -40 °C bis 85 °C
- Output code: Binary
- Code path: CW / CCW, parameterisable
- Reference value: 0 - (total No. of steps -1)
- Overvoltage protection and galvanic separation power supply - CANopen - housing
- CAN interface: According to ISO/DIS 11898
- Address setting: Via LMT / LSS
- Terminating resistor: To be implemented separately
- Max.transmission length: 200 m with no galvanic separation (also see CiA, DS 301)
- EMC standards:
  Interference emission: acc. to EN 61000-6-4
  Interference immunity: acc. to EN 61000-6-2
- Electrical connection: 2 x connector M12 - (Power supply / CANopen and switching outputs)
  3 x connector M12 - (In addition BUS OUT)
  Optional: cable
- CAN IC voltage rating: Maximum common mode voltage -7 to +12 V
  Maximum allowed voltage at pins ± 36 V
- Electrical supply circuit: Reverse battery protection and protection against too high volage
  Suppression of AC components in the DC power supply

## Technical data

### Mechanical data

- Operating speed: 1000 rpm (option 2000 rpm)
  (Remark: Shaft with sealing ring: max. 1000 rpm. Else use Nilos ring)
- Angular acceleration: $10^5$ rad/s² max.
- Moment of inertia (shaft): 20 gcm²
- Operating torque: ≤ 8 Ncm (at speed 500 rpm)
- Starting torque: ≤ 4 Ncm
- Perm. shaft load: 250 N axial
  250 N radial
- Bearing service life: $10^9$ revolutions
- Weight: Approx. 0.8 kg

### Environmental data

- Operating temperature range: - 40 °C to + 70 °C
- Storage temperature range: - 45 °C to + 85 °C
- Maximum relative humidity: 95 %, without condensing
- Resistance:
  - To shock: (DIN EN 60068-2-27) 250 m/s², 6 ms, 100 x each in 3 axes
  - To vibration: (DIN EN 60068-2-6) 100 m/s², 5 Hz ... 2000 Hz, 1 h each in 3 axes
- Protection type: (DIN EN 60529) IP67/IP65 (housing/shaft), IP67 when using a shaft seal ring

### Switching output relay electrical data

- Maximum switching current: 0.5 A at 30 VDC / VAC
- Maximum switching voltage: 60 VDC / VAC
- Response time: 20 ms (ON and OFF)
- Maximum resistance ON 0.5 Ohms
- Protection capacity at contact output: C = 47 nF (other capacitors possible on request)
  → Time constant τ for decay of voltage after opening contact:
  τ = RC with R = external Resiator connected

### System in general and Safety

- Power on time due to power supply coming up: 500 ms (10 % bis 90 %)
- Rate of messages: up to 10 000 messages / s
- Time of storage cycles: 3 s per storage cycle
- Setup Time: ~ 2 s @ T ≥ +20 °C
  > 20 s @ T ≤ -30 °C
- Time between error recognition and alarm (emergency message): 100 ms (power supply)
  300 ms (relay control)
  5 s (RAM test, single bit error)
  2 s (ROM test during setup time)
- Number of the certificate: 44 799 13172907
- Safety norms: EN 61508, 1 - 7: 2010
  EN 62061: 2005
  EN ISO 13849-1: 2015
  EN 60947-5-1: 2004 + A1: 2009
- Maximum service life: 20 years

# Model NOCN / S3

## Order code number

| NOCN | 64 - | KP | A | 2 - | 4096 | R | 4096 | S3 | S2 | V1 | N | 01 | → Standard version |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

**Electrical and mechanical variants: ***
- 01 Standard
- 38 Like standard but with shaft seal

**Interface:**
- N CANopen (SSI or inkremental output → On request)

**Galvanic separation ǂ.** (See pages 11, 12)**:**
- V1 $-V_S$ ǂ CAN_GND ǂ screening/housing → Recommended
- V2 $-V_S$ = CAN_GND ǂ screening/housing
- V3 $-V_S$ = CAN_GND = screening/housing

**Electrical connections** (see remark on pages 11, 12)**:**
→ Combine any kind and number of desired connection
- 1 = 1 connection
- 2 = 2 connections
- 3 = 3 connections

- S Via device connector M12, radial
- T Via device connector M12, axial (at **NOCN79** only on request)
- K Via cable, 1 m **, radial ** other lengths possible
- L Via cable, 1 m **, axial (at **NOCN79** only on request)

**Profile:**
- S0 CANopen **standard** profile and SIL2 switching outputs
- S3 CANopen **safety** profile and SIL2 switching outputs, if existing

**Measuring range in revolutions:**
Don't fill this space for operation as a singleturn NOCN
- 16
- 256
- 4096

Different measuring ranges for operation as a multiturn NOCN

**Code:**
- R Binary, S = slewing ring functionality (only at NOCN without cams)

**Resolution in steps / 360°:**
- 4096 = 12 Bits. 8192 possible. At **NOCN79**: 16384 (14 Bits) und 32768 (15 Bits) possible

**Number of switching outputs:**
Don't fill this space for the operation of the NOCN as a SIL2 encoder (No cams)
- 2 2 switching outputs SIL2. At **NOCN79**: Up to 4 switching outputs SIL2

**Housing material:**
- A Aluminium
- S Stainless steel 1.4305
- V Stainless steel 1.4404

**Flange:**

| | | | |
|---|---|---|---|
| 58 | K | Clamped flange | Shaft 10 mm with flat |
| | KP | Clamped flange | Shaft 10 mm with parallel key |
| | KZ | Clamped flange | Shaft 12 mm for play-compensating toothed gear ZRS |
| | SN | Synchro flange | Clamping shaft 12 mm with notch |
| | ST | Synchro flange | Shaft 6 mm with flat |
| 64 | K | Clamped flange | Shaft 12 mm with flat |
| | KP | Clamped flange | Shaft 12 mm with parallel key |
| | KZ | Clamped flange | Shaft 12 mm for play-compensating toothed gear ZRS |
| | KN | Clamped flange | Clamping shaft 12 mm with notch |
| 65 | SP | Synchro flange | Shaft 12 mm with parallel key |
| 66 | K | Clamped flange | Shaft 10 mm with flat |
| | KP | Clamped flange | Shaft 10 mm with parallel key |
| 79 | KZ | Clamped flange | Shaft 12 mm for play-compensating gear ZRS (other shaft designs possible) |

**Design form:**
Flange: ø in mm

NOCN Electronic switching cam encoder with CANopen / CANopen Safety interface

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

## Order Code format - mating connectors (to be ordered separately)

M12, 5-pin, female: **STK5GS56**
M12, 5-pin, male: **STK5GP90**
M12, 8-pin, female: **STK8GS54**
(EMC-resistant, metal version, straight)

## Interface CANopen / CANopen Safety

### Function

A CAN controller at the output enables integration into the CANopen network. According to "CANopen Application Layer and Communication Profile, CiA Draft Standard 301, Version 4.1" and according to "Device Profile for Encoders CiA Draft Standard Proposal 406 Version 4.01" and "CANopen Layer Setting Services and Protocol (LSS), CiA DSP 305".

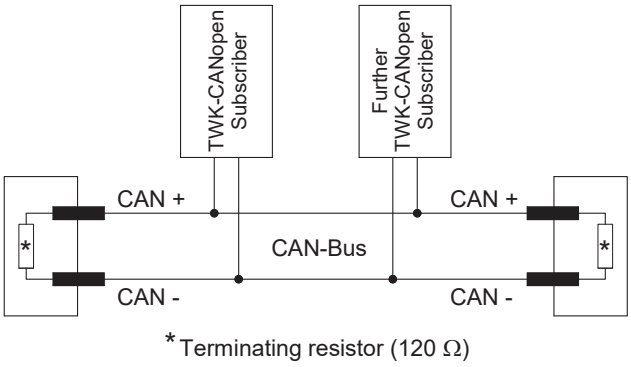
Parameters for the absolute encoder's position signal, which is output via the process data objects (PDO), can be parameterised via the bus in order to adapt the NOCN to the application. The details of the CANopen profile are exhaustively described in the NOC 13100 specifications.

**The bootloader function can be used to update the NOCN's firmware at the customer's premises.**

### CANopen specifications

- NMT Master: no
- NMT-Slave: yes
- Maximum Boot up: no
- Minimum Boot up: yes
- COB ID Distribution: Default, SDO
- Node ID Distribution: via Index 2000 oder LSS
- No of PDOs: 2 Tx
- PDO-Modes: sync, async, cyclic, acyclic
- Variables PDO-Mapping: no
- Emergency Message: yes
- Heartbeat: yes
- No. of SDOs: 1 Rx / 1 Tx
- Device Profile: CiA DSP 406 Version 4.01

### Bus activation according to ISO / DIS 11898




* Terminating resistor (120 Ω)

### Interface according to the following specifications

CiA DS301 CANopen Application Layer and Communication Profile, Version 4.1
EN 50325-5 CANopen Framework for safety-relevant communication, Version 1.0.1
CiA DS305 CANopen - Layer Setting Services and Protocol (LSS)
CiA DS406 CANopen - Device Profile for Encoders, Version 4.01

### CANopen / CANopen Safety data profile

### SRDO1 (position) - normal and bitinverted

| Byte 3 | | | | | | | | Byte 2 | | | | | | | | Byte 1 | | | | | | | | Byte 0 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | MSB | | | | | | | | Position data | | | | | | | | | | | | | | | LSB |

| Byte 3 | | | | | | | | Byte 2 | | | | | | | | Byte 1 | | | | | | | | Byte 0 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | MSB | | | | | | | | Position data inverted | | | | | | | | | | | | | | | LSB |

### SRDO2 (speed) - normal and bitinverted

| Byte 1 | | | | | | | | Byte 0 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| MSB | | | | | | | | Speed | | | | | | | LSB |

| Byte 1 | | | | | | | | Byte 0 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| MSB | | | | | | | | Speed inverted | | | | | | | LSB |

## Interface CANopen / CANopen Safety

### PDO - data format

| Data byte 0 | | | | | | | | Data byte 1 | | | | | | | | Data byte 2 | | | | | | | | Data byte 3 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| LSB | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | MSB |
| Data position | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Note: SRDO is valid for CANopen Safety Profile. PDO is valid for CANopen Standard profile. When using PDO the NOCN behaviour is like a CANopen Standard device.

It depends on resolution and measuring range how many bits are significant data bits (i.e. 24 (bit 0 to 23) for 12 bits resolution and 12 bits measuring range).

## Switching outputs

### Function

The function of the switching outputs (cams) is implemented by means of relays. The relays have normally open contacts.

The contacts are galvanically separated in terms of operating voltage and the CANopen bus.

The switching outputs are SIL2-certified, i.e. they represent safe switching outputs. This is implemented by internally wiring each switching output with two relays connected in series which switch with a slight time lag (about some ms). This eliminates the risk that a relay welds shut. Additionally each relay is monitored for proper operation.

The information regarding when which relay is to pick up and drop off again is made available to the relay control system by the internal controller. If receives the shaft position data from the NOCN's absolute encoder.

The precise position of the switching flanks, i.e. calibration of the cams, can be carried out via the corresponding objects of the encoder profile according to CiA, DS 406, rev. 4.01.

The switching flanks of the switching outputs are set as follows in the factory as regards the angular position of the shaft (see cam diagram below for a NOCN with a measuring range of 16 revolutions):

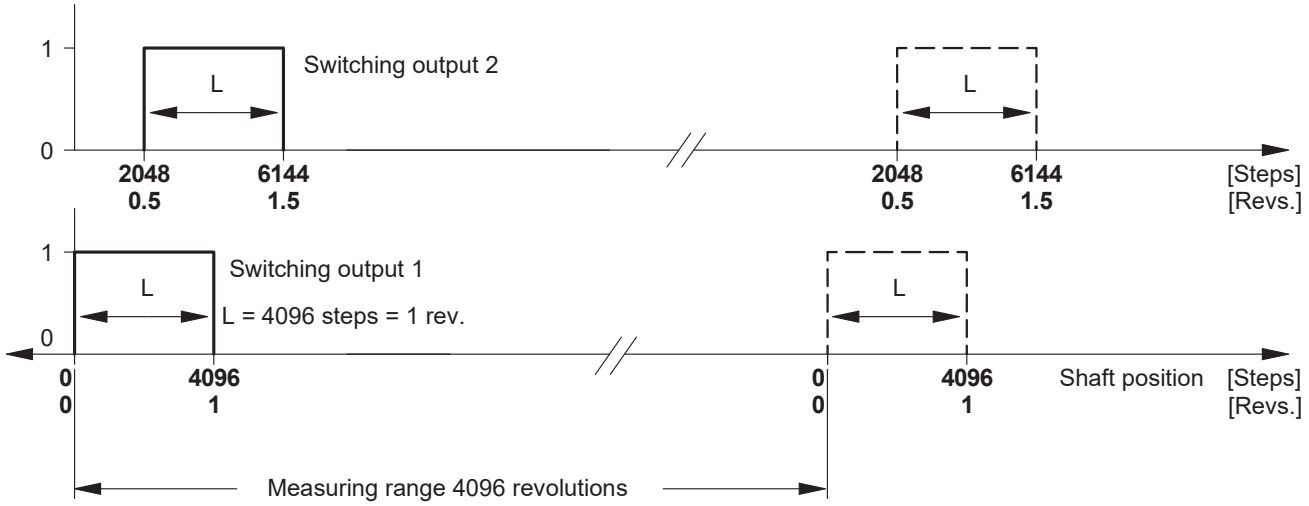
The cams are picked-up/switched over 1 revolution (status '1') and are not picked-up/switched over the remainder of the measuring range (status '0'). The default switching length L is therefore 1 revolution. All four cams each switch with an offset of 0.5 revolutions. Cam 1 switches on at revolution 0, cam 2 at revolution 0.5, cam 3 at revolution 1, etc. The switching flanks of the cams, with reference to the absolute encoder's position signal, accordingly lie at (steps / revs.): cam 1 low limit: 0 (0 revs.), cam 1 high limit: 4096 (1 rev.), cam 2 low limit: 2048 (0.5 revs.), cam 2 high limit: 6144 (1.5 revs.), cam 3 low limit: 4096 (1 revs.), cam 3 high limit: 8192 (2 revs.), etc.

**The switching output switching flanks refer to the CANopen output signal of the absolute encoder. If the position signal's preset function is used (CANopen output signal offset), the switching flanks are also accordingly shifted with reference to the shaft position.**

To avoid undesired switching back and forth (flutter) on the part of the relays when the shaft is stationary or as a result of slight shaft vibrations on the switching flank, a switching hysteresis of 10 digits (~1°) is pre-programmed. This can be changed via the CANopen bus.

### Cam diagram

Setting ex works valid for resolution of 4096 steps/360° and measuring range of 4096 revolutions.



## Switching outputs

### Parameterisation of the switching outputs (cams)

Each of the switching outputs can be parameterised via the CANopen bus. To achieve this, a range of objects is assigned to each switching output in the CANopen profile according to CiA, DS 406 revision 4.01. These objects enable each switching output to be set individually:

| | | |
|---|---|---|
| Object 6310: Low limit | Cam 1 > | Cam 1 switches on in this position (relay picks up) |
| Object 6320: High limit | Cam 1 > | Cam 1 switches off in this position (relay drops off) |
| Object 6330: Hysteresis | Cam 1 > | Switching hysteresis of cam 1 in the case of the switching flanks (with low and high limit) |
| Object 6311: Low limit | Cam 2 > | Cam 2 switches on in this position (relay picks up) |
| Object 6321: High limit | Cam 2 > | Cam 2 switches off in this position (relay drops off) |
| Object 6331: Hysteresis | Cam 2 > | Switching hysteresis of cam 2 in the case of the switching flanks (with low and high limit) |

Object 6300: Status of all cams (read only) >
0x0 = no cam picked up
0x1 = only cam 1 picked up
0x2 = only cam 2 picked up
0x3 = cams 1 and 2 picked up

Object 6301: Enable register for all cams >
0x0 = no cam active
0x1 = only cam 1 active
0x2 = only cam 2 active
0x3 = cams 1 and 2 active

Note: If the cams are disabled via object 6301, they are always shut off or drop off. After switching the operating voltage off and on again, however, the relays are deactivated under all circumstances.

Object 6302h: Polarity of the cams (inversion option): >
0x0 = no cam inverted
0x1 = only cam 1 inverted
0x2 = only cam 2 inverted
0x3 = cams 1 and 2 inverted

The reference variable for parameterisation is the position signal output by the absolute encoder. The measuring range ranges from step 0 to step 16.777.216 (in the version with 4096 revs. and 4096 steps / 360°). Each cam can be set within this range.

**Due to the safety functionality all changings of parameters have to be verified via the correlated check sum, which is to send to the NOCN separately. This check sum can be calculated via a TWK program for PC/notebook. In this program the customer has to put in all relevant parameters (preset value, cam settings etc.) and the check sum will be calculated. When this check sum is send to the NOCN after changing one or more parameters, the NOCN can be set operational.**

**Before changing the position data (code sense and preset value) the data valid flag of the cam must be set to 0. The same applies when changing parameters of the cam switch. Afterwards the data valid flags need to be enabled again. This procedure ensures that no accidental changes are made by the user, which have an impact on the SIL2 cam functions.**

**(See also: Recommended parameter settings for NOCN / S3 in specifications 13100 - chapter 11)**

## Connector assignment and versions of galvanic separation

Example is valid for standard version

**Attention: The description of the different versions of galvanic separation, V1 to V3, refers only to the relationships of the individual potentials (-UB, CAN_GND and housing/shield) to one another. I.e. whether they are galvanically connected or not. The connection plug pin assignments shown below are independent of this and only describe the standard pin assignment. Other variants may reveal a different pin assignment. The connection assignment (TYxxxx) which is enclosed with each device or can be requested must always be observed.**

**Note: The recommended version is V1 with full galvanic separation. This offers maximum EMC resistance, maximum CANopen data transfer security and thus maximum operating safety.**

**Versions V2 and V3 are special versions which must be compatible with the structure (topology) of the CANopen bus system in the customer application (→ control system and other CANopen subscribers). Operating safety or data transfer security may otherwise be affected.**

Different M12 connector combinations or assignments are possible at the request of the customer.

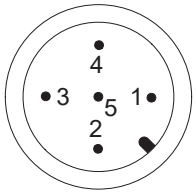
**For the following description and pictorials is valid:**

Viewed looking at the PIN side of the connector installed in the NOCN.

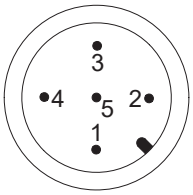
There is one connector for Bus-In and Bus-Out each for the NOCN / S3.
If there is only Bus-In, the female connector Bus-Out is omitted.

### V1: CAN_GND and $U_B$ galvanically separated (≠). Screening/housing galvanically separated (≠)

This version is recommended and provides complete galvanic separation. Power supply and CAN_GND is galvanically separated. The housing and the screening of the cable is galvanically separated as well. The screening of the cable comes to the housing of the NOCN via the housing of the mating plug.




female

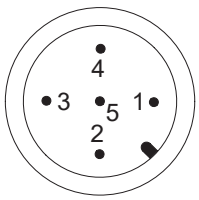



male

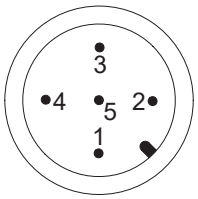
| PIN | Function for standard version |
|---|---|
| 1 | CAN GND |
| 2 | Operating voltage **+ $U_B$** |
| 3 | Operating voltage **- $U_B$** |
| 4 | CAN_H |
| 5 | CAN_L |

### V2: CAN_GND and $U_B$ not galvanically separated (=). Screening/housing galvanically separated (≠)

This version provides partly galvanic separation. Power supply and CAN_GND are not galvanically separated. The housing and the screening of the cable are galvanically separated from power supply and CAN_GND. The screening of the cable comes to the housing of the NOCN via the housing of the mating plug and/or Pin 1 of the connector. Please note the maximum voltage rating of the CAN interface IC on side 4.




female




male

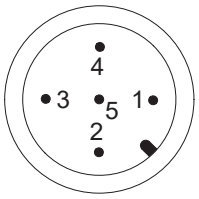
| PIN | Function for standard version |
|---|---|
| 1 | Screen (Cable / housing) |
| 2 | Operating voltage **+ $U_B$** |
| 3 | Operating voltage **- $U_B$** and CAN_GND |
| 4 | CAN_H |
| 5 | CAN_L |

## Connector assignment and versions of galvanic separation

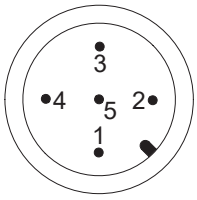
Example is valid for standard version

### V3: CAN_GND and $U_B$ not galvanically separated (=). Screening/housing not galvanically separated (=)

This version provides no galvanic separation. Power supply and CAN_GND are not galvanically separated. The housing and the screening of the cable are not galvanically separated from power supply and CAN_GND. The screening of the cable comes to the housing of the NOCN via the housing of the mating plug and/or Pin 1 of the connector. Please note the maximum voltage rating of the CAN interface IC on side 4.




female

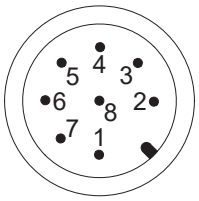



male

| PIN | Function for standard version |
|---|---|
| 1 | Screen (Cable / housing) - *shorted to pin 3* - |
| 2 | Operating voltage **+ $U_B$** |
| 3 | Operating voltage **- $U_B$** and CAN_GND<br>*- shorted to pin 1 -* |
| 4 | CAN_H |
| 5 | CAN_L |

### Switching output connector assignment - valid for 2 switching outputs (NOCN58/64)

(Due to SIL functionality only *normally open contacts* (NO) are possible)

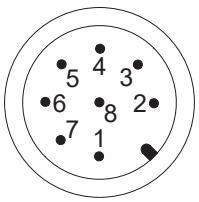



male

| PIN | Function |
|---|---|
| 1 | n.c. |
| 2 | Safety contact 1 / (13) |
| 3 | n.c. |
| 4 | Safety contact 2 / (23) |
| 5 | Safety contact 1 / (14) |
| 6 | n.c. |
| 7 | Safety contact 2 / (24) |
| 8 | n.c. |

### Switching output connector assignment - valid for 4 switching outputs (NOCN79)

(Due to SIL functionality only *normally open contacts* (NO) are possible)




male

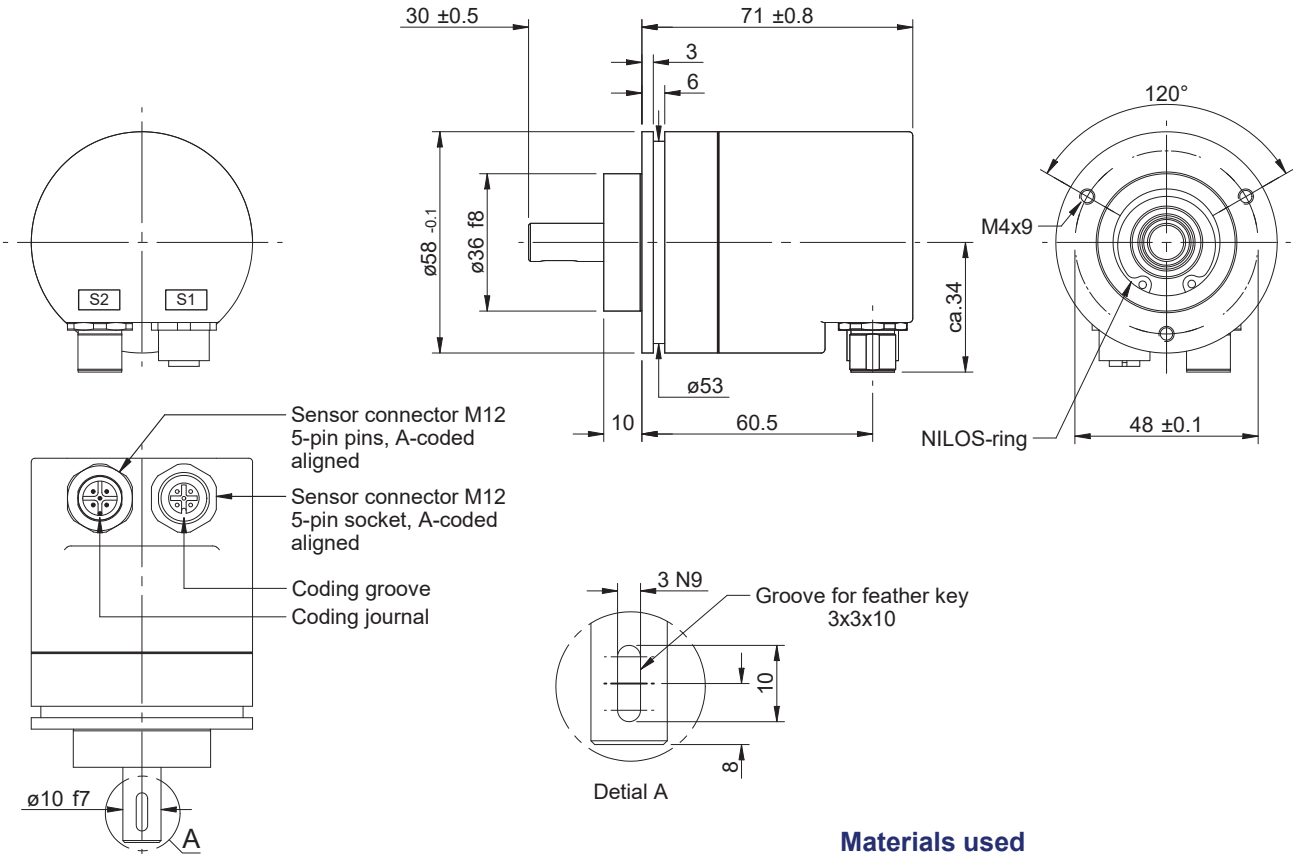
| PIN | Function |
|---|---|
| 1 | Safety contact 1 / (13) |
| 2 | Safety contact 1 / (14) |
| 3 | Safety contact 2 / (23) |
| 4 | Safety contact 2 / (24) |
| 5 | Safety contact 3 / (33) |
| 6 | Safety contact 3 / (34) |
| 7 | Safety contact 4 / (43) |
| 8 | Safety contact 4 / (44) |

## Installation drawings

(further installation drawings on request)

### Model NOCN58-KP (singleturn, 2 connectors)

Dimensions in mm




### Materials used

| | |
|---|---|
| Aluminium housing: | AlMgSi1 |
| Stainless steel shaft: | 1.4305 |
| Connector: | Nickel-plated |
| Brass radial shaft seal: | NBR |
| Sealing rings: | NBR |

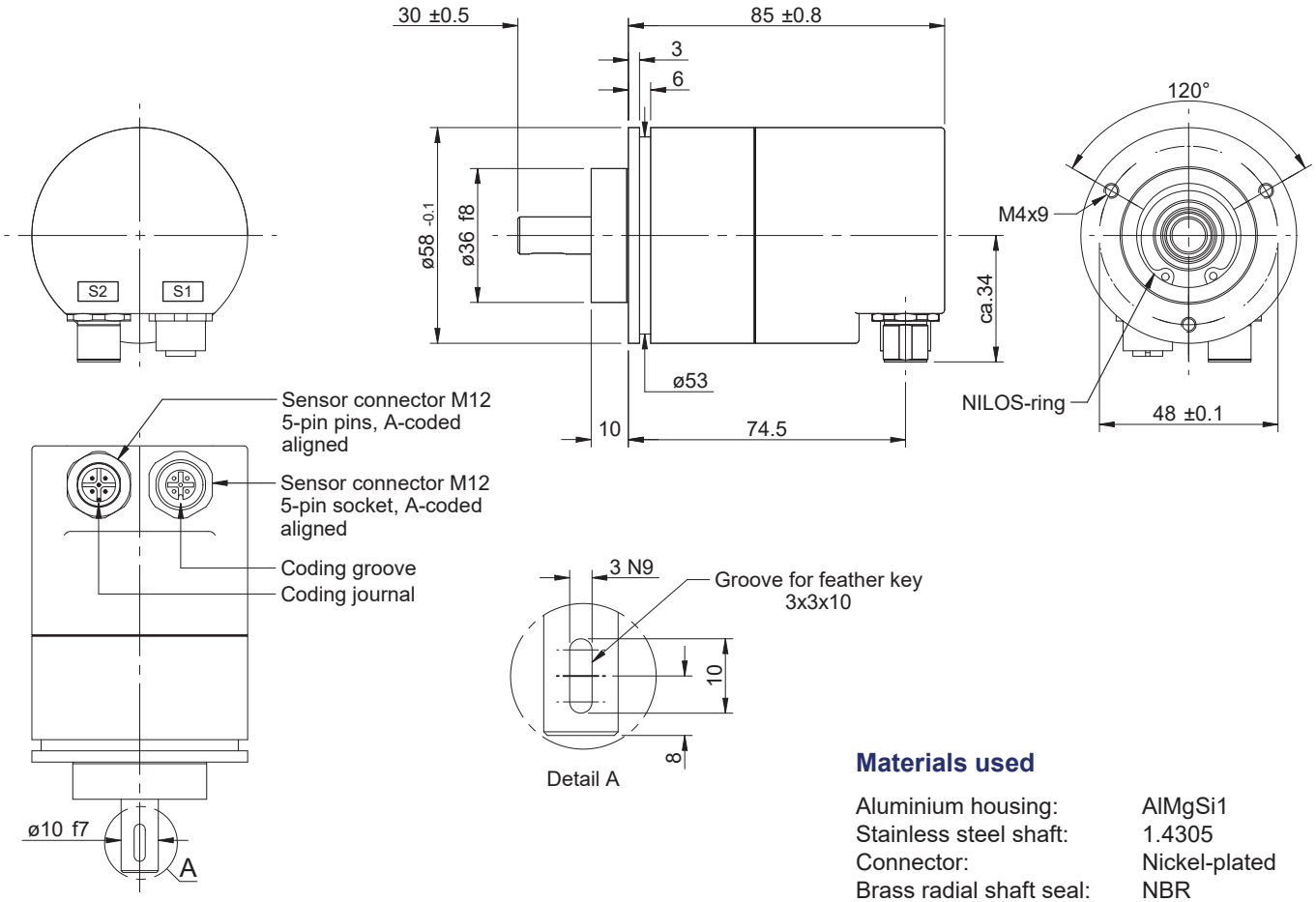
# Model NOCN / S3

## Installation drawings

(further installation drawings on request)

### Model NOCN58-KP (multiturn, 2 connectors)

Dimensions in mm




### Materials used

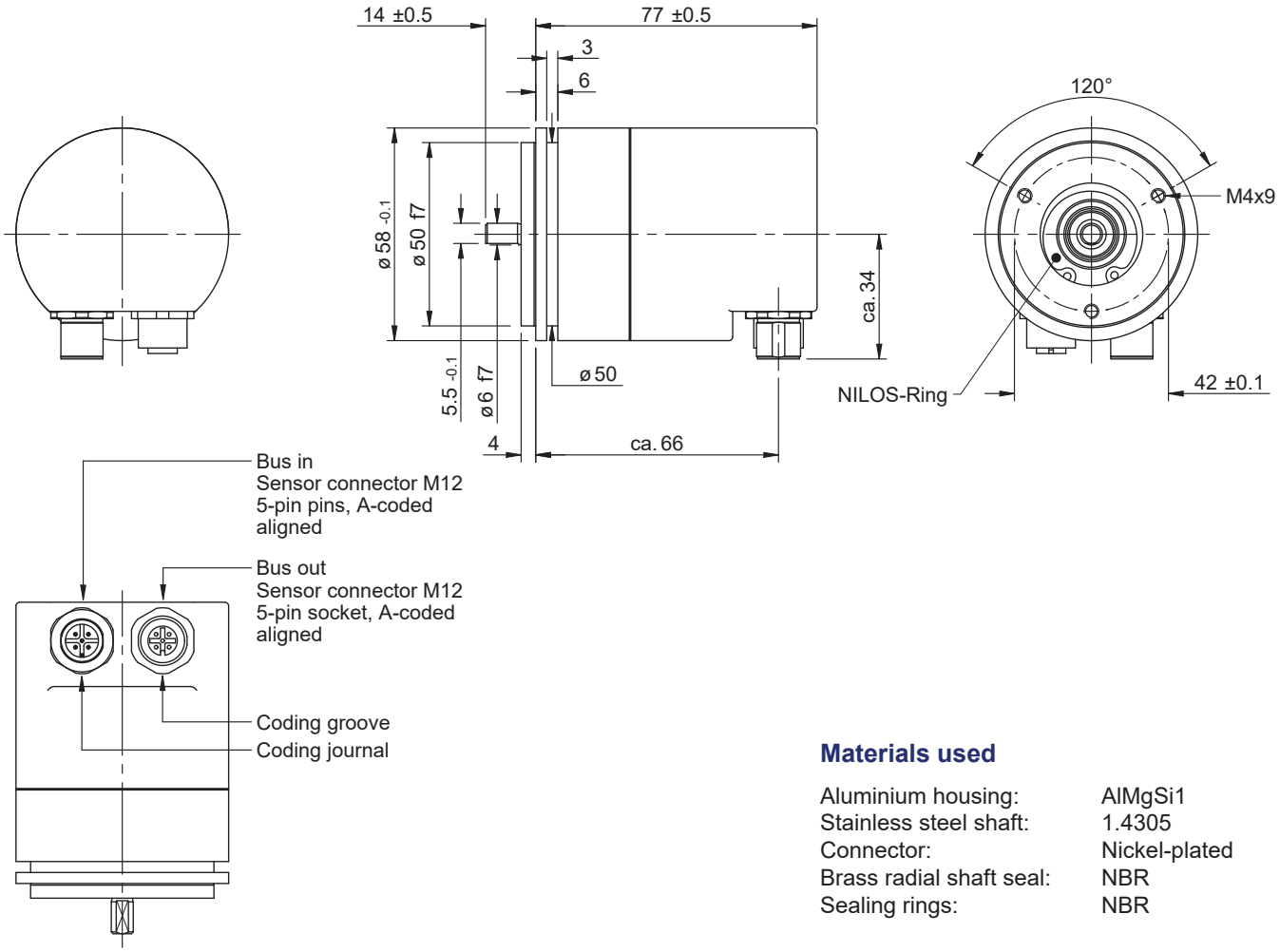
| | |
|---|---|
| Aluminium housing: | AlMgSi1 |
| Stainless steel shaft: | 1.4305 |
| Connector: | Nickel-plated |
| Brass radial shaft seal: | NBR |
| Sealing rings: | NBR |

## Installation drawings

(further installation drawings on request)

### Modell NOCN58-ST (singleturn, 2 connectors)

Dimensions in mm




### Materials used

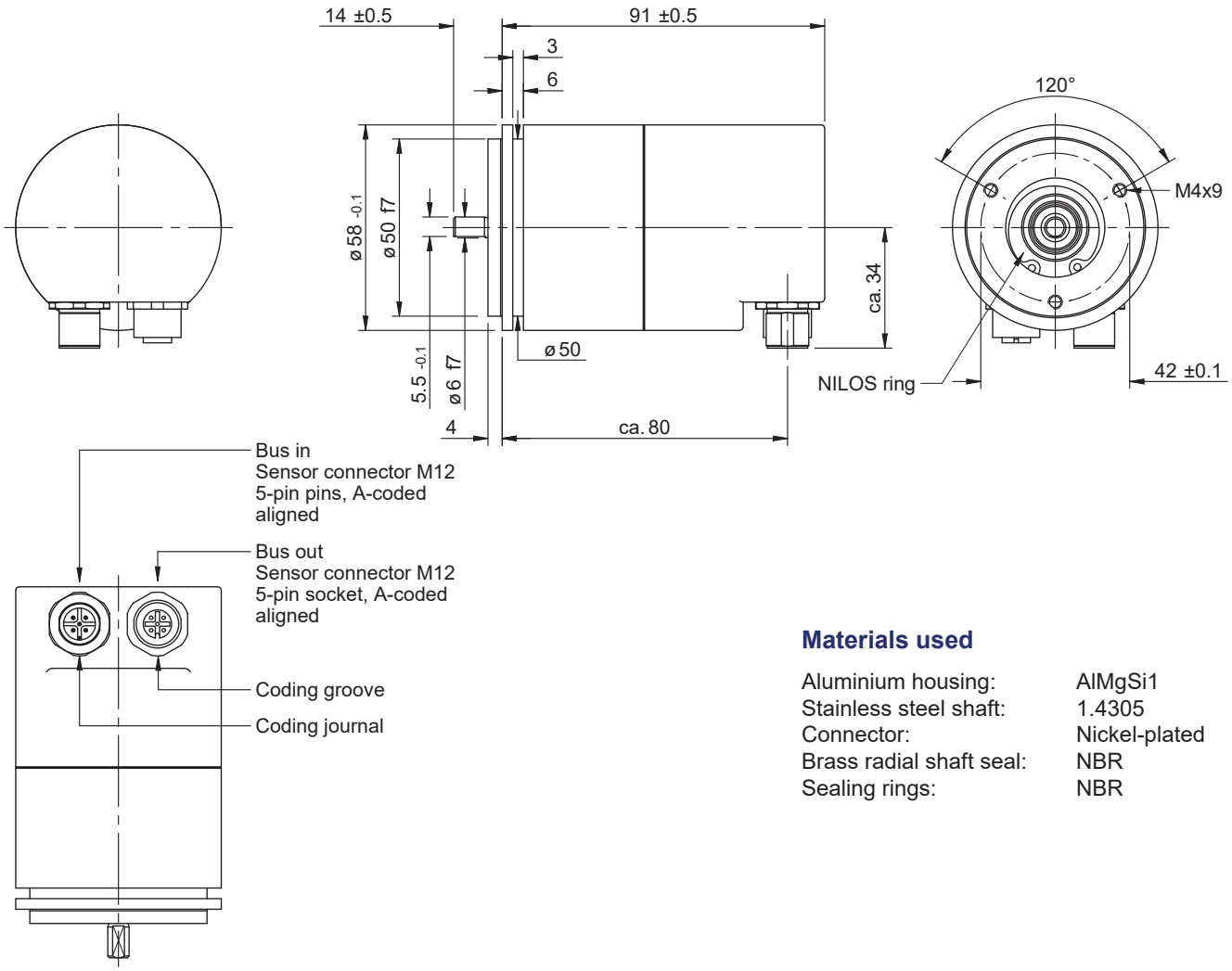
| | |
|---|---|
| Aluminium housing: | AlMgSi1 |
| Stainless steel shaft: | 1.4305 |
| Connector: | Nickel-plated |
| Brass radial shaft seal: | NBR |
| Sealing rings: | NBR |

## Installation drawings

(further installation drawings on request)

### Modell NOCN58-ST (multiturn, 2 connectors)

Dimensions in mm




### Materials used

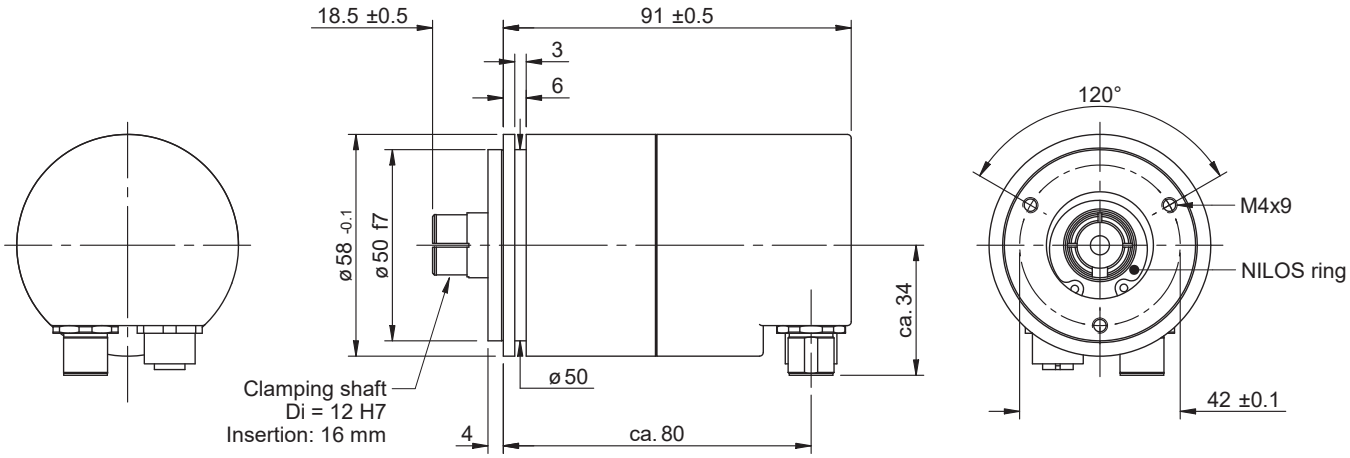
| | |
|---|---|
| Aluminium housing: | AlMgSi1 |
| Stainless steel shaft: | 1.4305 |
| Connector: | Nickel-plated |
| Brass radial shaft seal: | NBR |
| Sealing rings: | NBR |

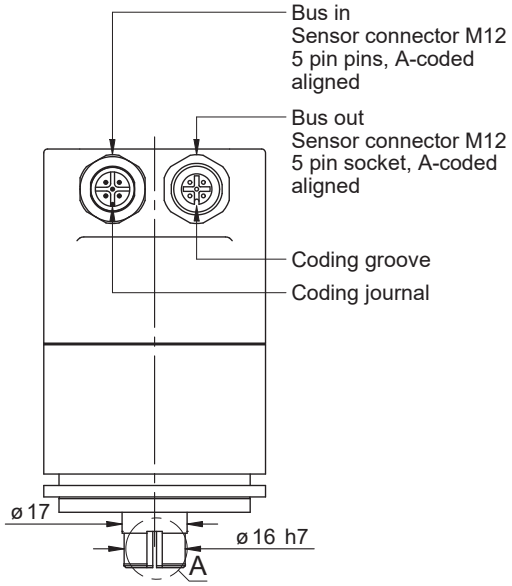
## Installation drawings

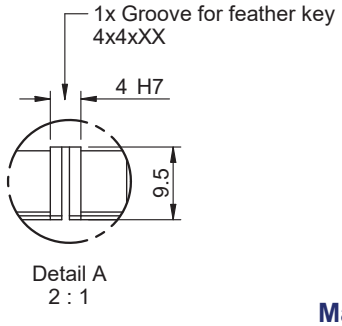
(further installation drawings on request)

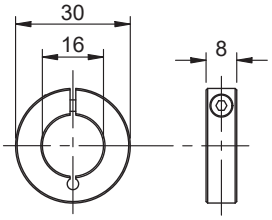
### Modell NOCN58-SN (multiturn, 2 connectors)

Dimensions in mm




### Materials used

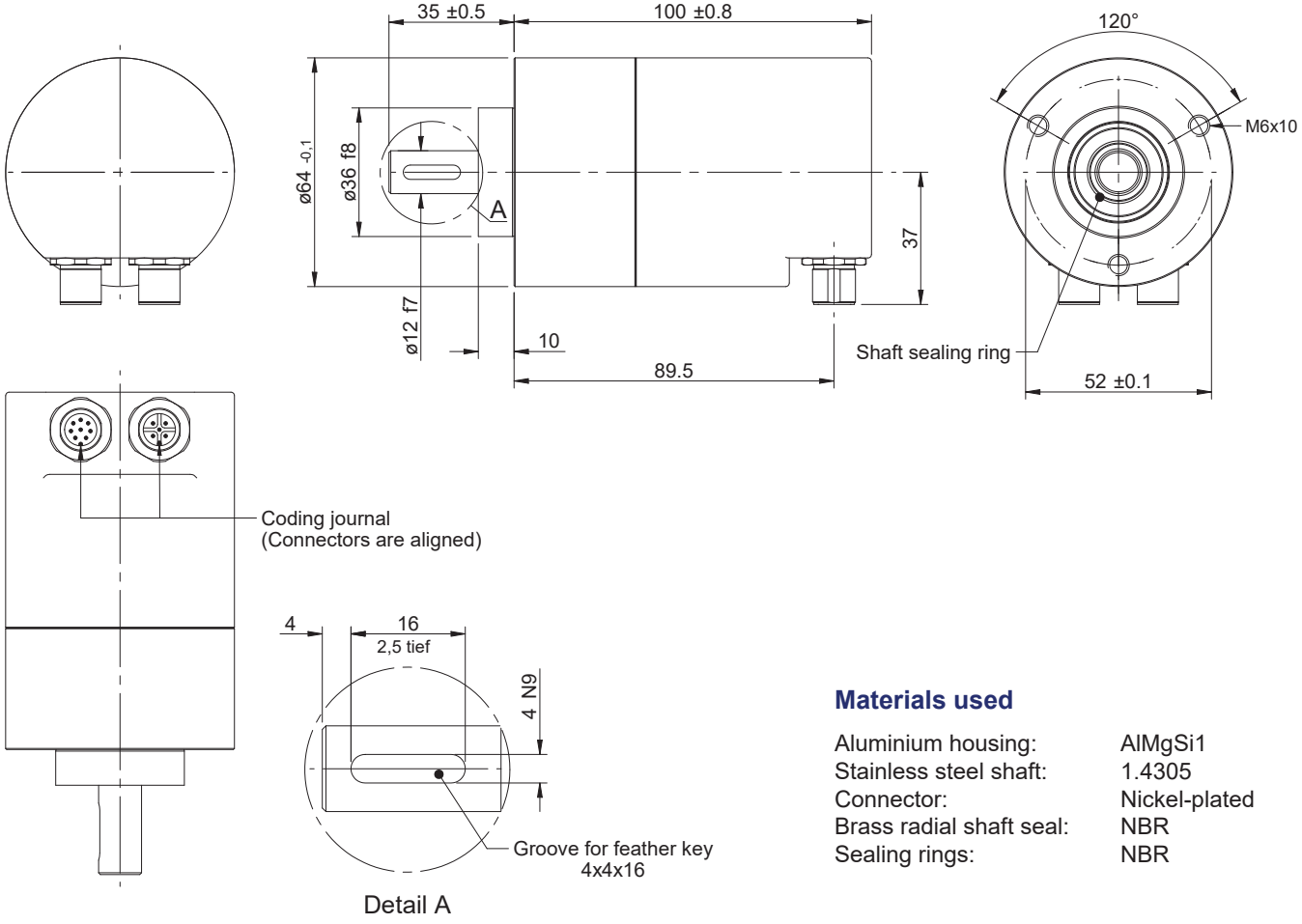
| | |
|---|---|
| Aluminium housing: | AlMgSi1 |
| Stainless steel shaft: | 1.4305 |
| Aluminium clamping ring: | AlMgSi1 |
| Connector: | Nickel-plated |
| Brass radial shaft seal: | NBR |
| Sealing rings: | NBR |

## Installation drawings

(further installation drawings on request)

### Model NOCN64-KP with 12 mm shaft with feather key and 2 connectors

Dimensions in mm




### Materials used

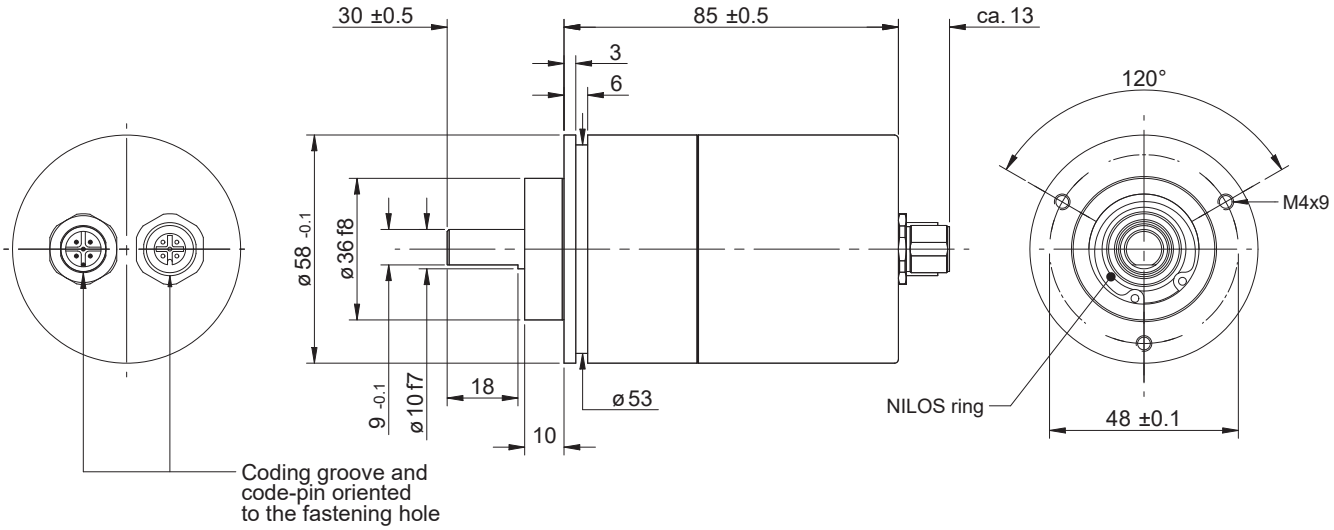
| | |
|---|---|
| Aluminium housing: | AlMgSi1 |
| Stainless steel shaft: | 1.4305 |
| Connector: | Nickel-plated |
| Brass radial shaft seal: | NBR |
| Sealing rings: | NBR |

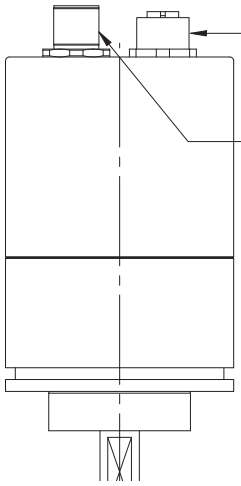
## Installation drawings

(further installation drawings on request)

### Modell NOCN58-K (multiturn, 2 connectors axial)

Dimensions in mm




### Materials used

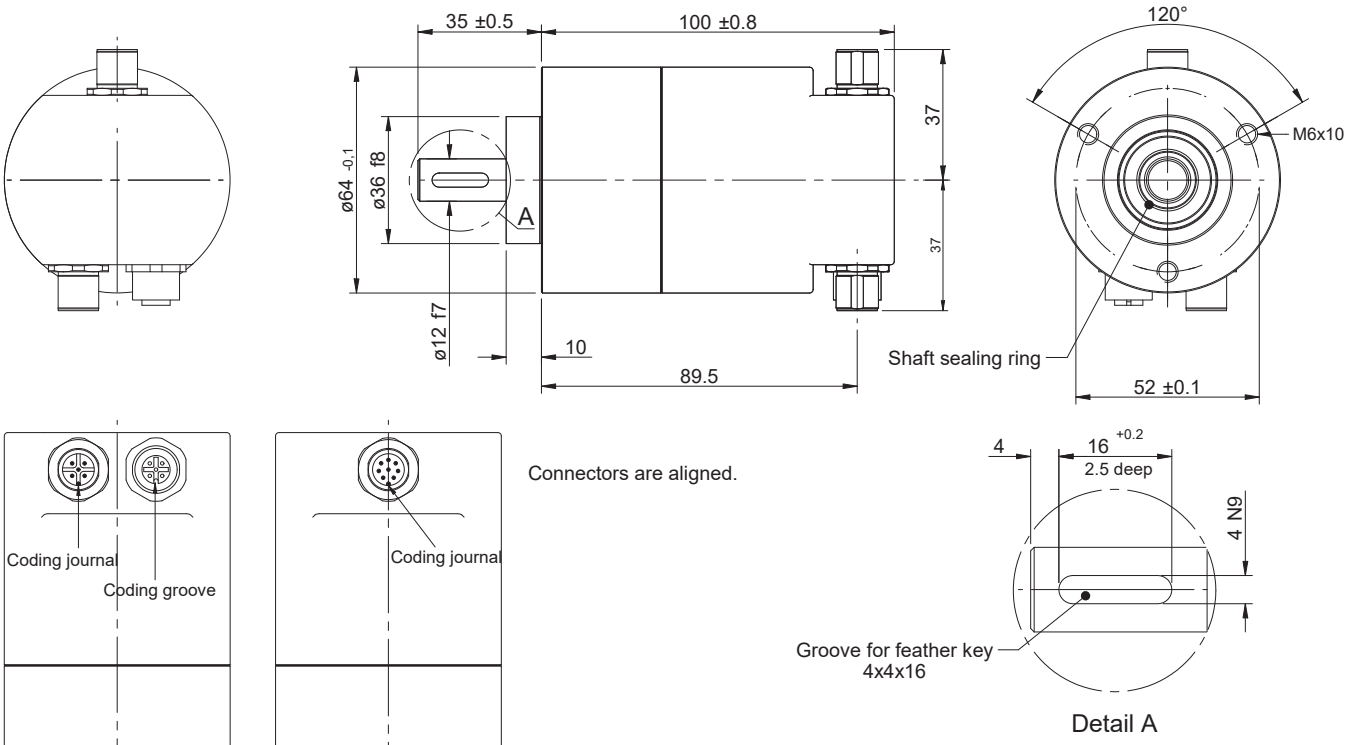
| | |
|---|---|
| Aluminium housing: | AlMgSi1 |
| Stainless steel shaft: | 1.4305 |
| Connector: | Nickel-plated |
| Brass radial shaft seal: | NBR |
| Sealing rings: | NBR |

## Installation drawings

(further installation drawings on request)

### Model NOCN64-KP with 12 mm shaft with feather key and 3 connectors

Dimensions in mm




### Materials used

| | |
|---|---|
| Aluminium housing: | AlMgSi1 |
| Stainless steel shaft: | 1.4305 |
| Connector: | Nickel-plated |
| Brass radial shaft seal: | NBR |
| Sealing rings: | NBR |

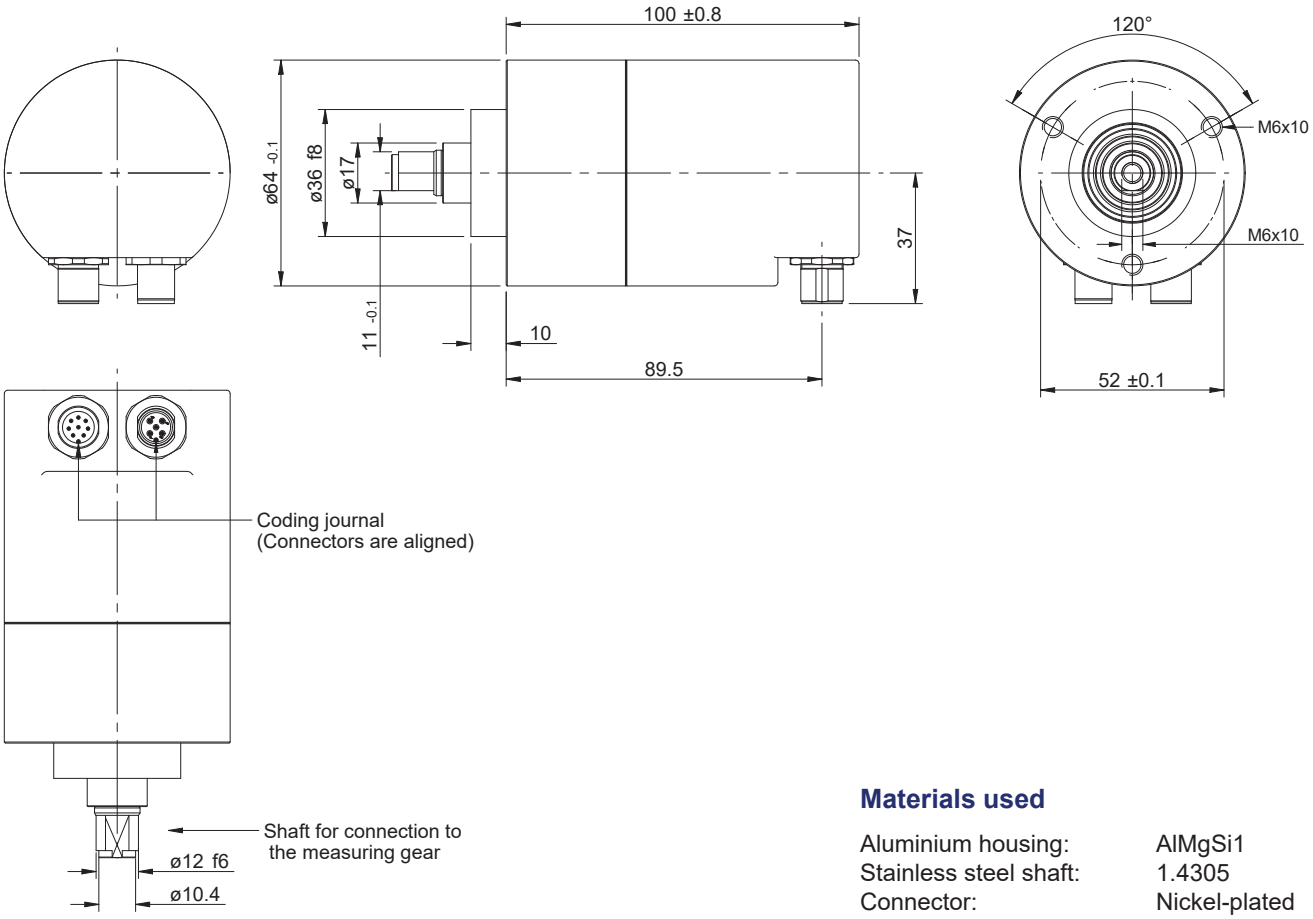
## Installation drawings

(further installation drawings on request)

### Model NOCN64-KZ with shaft for TWK play-compensating toothed gear ZRS

This version is also available with three connectors like shown on page 20.

Dimensions in mm




### Materials used

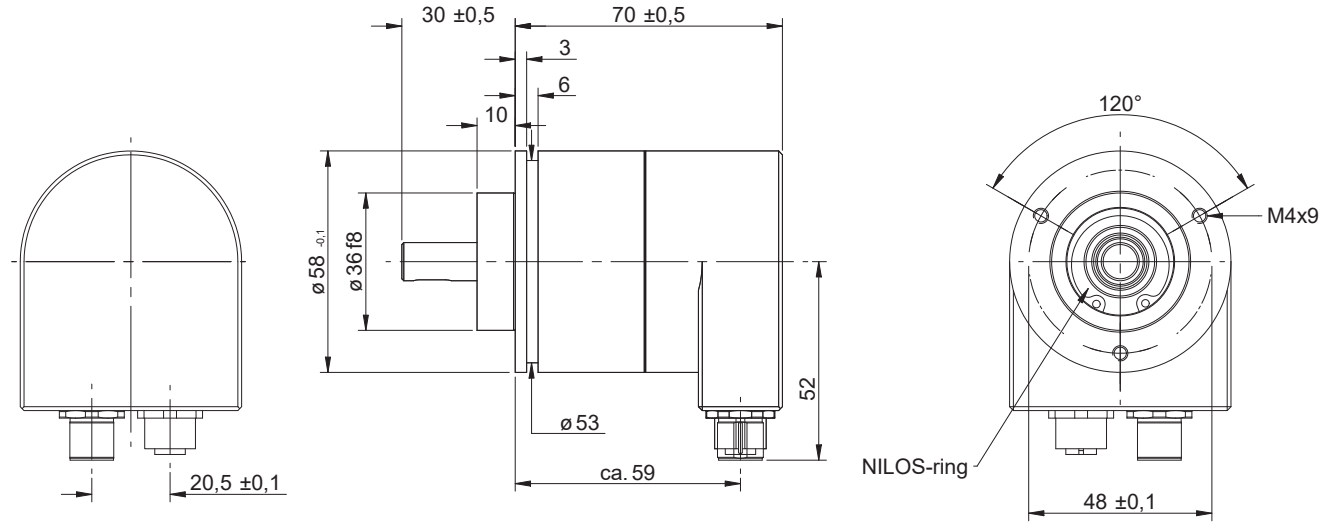
| | |
|---|---|
| Aluminium housing: | AlMgSi1 |
| Stainless steel shaft: | 1.4305 |
| Connector: | Nickel-plated |
| Brass radial shaft seal: | NBR |
| Sealing rings: | NBR |

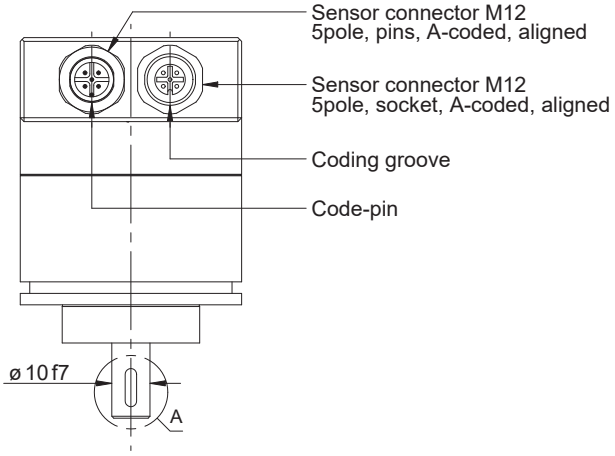
## Installation drawings - special designs (further installation drawings on request)

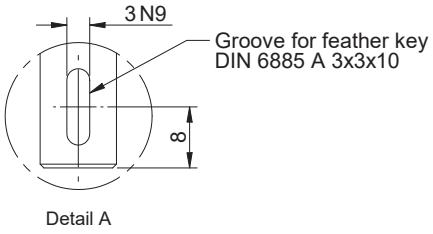
### Model NOCN58-KP with short length design and connectors radial

This version is available on request.

Dimensions in mm




### Materials used

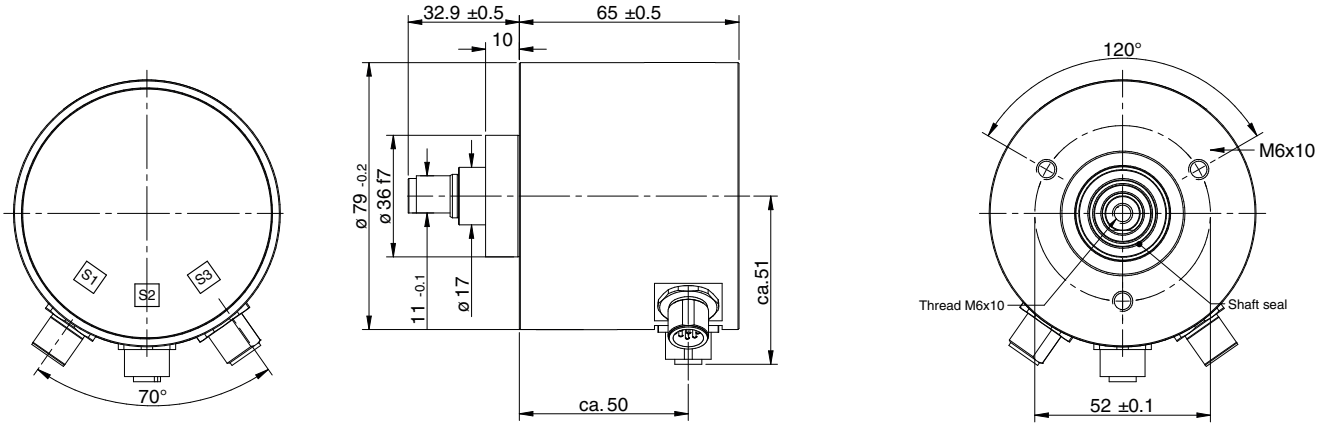
| | |
|---|---|
| Aluminium housing: | AlMgSi1 |
| Stainless steel shaft: | 1.4305 |
| Connector: | Nickel-plated |
| Brass radial shaft seal: | NBR |
| Sealing rings: | NBR |

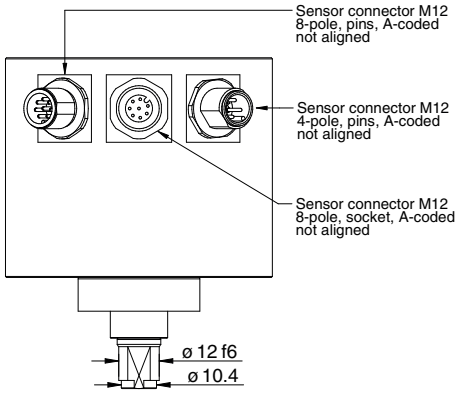
## Installation drawings - model 79

(further installation drawings on request)

### Model NOCN79-KZ (3 connectors, radial) → standard version

Dimensions in mm




Connector selection exemplary

### Materials used

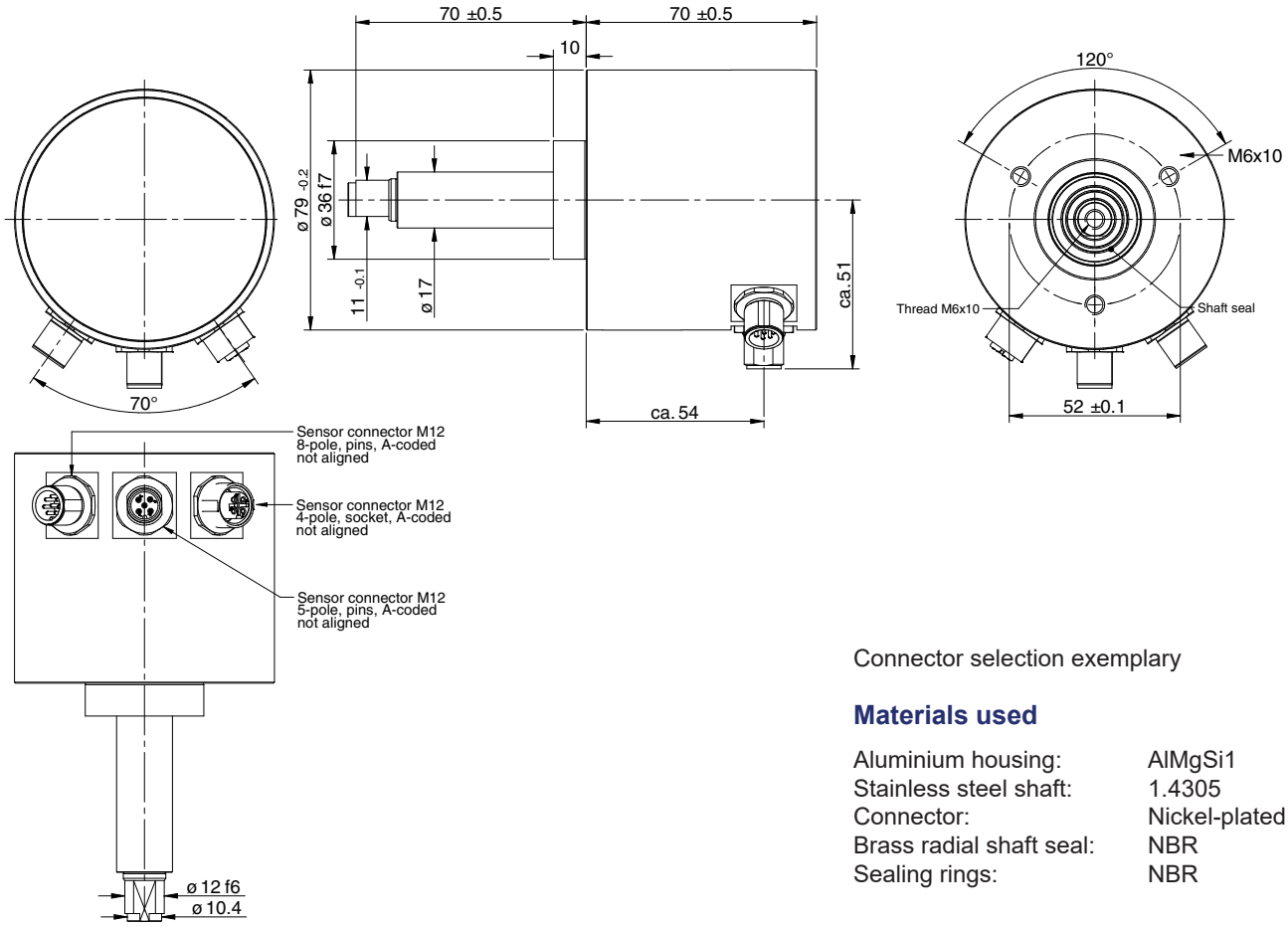
| | |
|---|---|
| Aluminium housing: | AlMgSi1 |
| Stainless steel shaft: | 1.4305 |
| Connector: | Nickel-plated |
| Brass radial shaft seal: | NBR |
| Sealing rings: | NBR |

## Installation drawings - model 79

(further installation drawings on request)

### Model NOCE79-KZ (3 connectors, radial) → version with extended shaft

Dimensions in mm




Connector selection exemplary

### Materials used

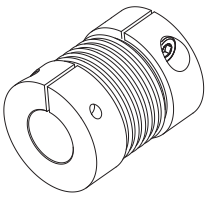
| | |
|---|---|
| Aluminium housing: | AlMgSi1 |
| Stainless steel shaft: | 1.4305 |
| Connector: | Nickel-plated |
| Brass radial shaft seal: | NBR |
| Sealing rings: | NBR |

## Accessories

### Play free bellows coupling BKK 32 / x - y

x and y: bore diameter for shaft mounting

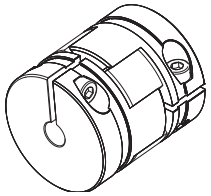
See data sheet BKK 11840



### Play free clamp coupling KK14S / x - y (without notch)

x and y: bore diameter for shaft mounting

See data sheet KK 12301

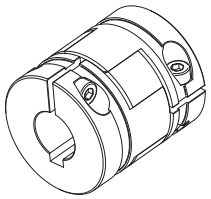


### Play free clamp coupling KK14N / x - y (with notch)

x and y: bore diameter for shaft mounting

With groove for keyway according to DIN 6885 Bl. 1 – JS9.

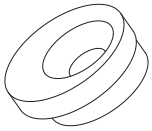
See data sheet KK 12301



### KL 66-2-S and others

Mounting brackets for mounting encoders.

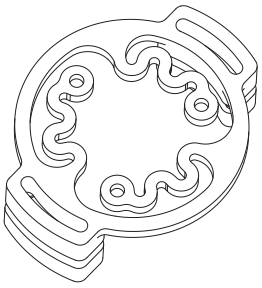
See data sheet MZ 10111 for the appropriate model.



### ZMS58

Torque arm / stator. Can be used as encoder shaft holder for version 'clamp shaft' to compensate for radial and axial play of the drive shaft.

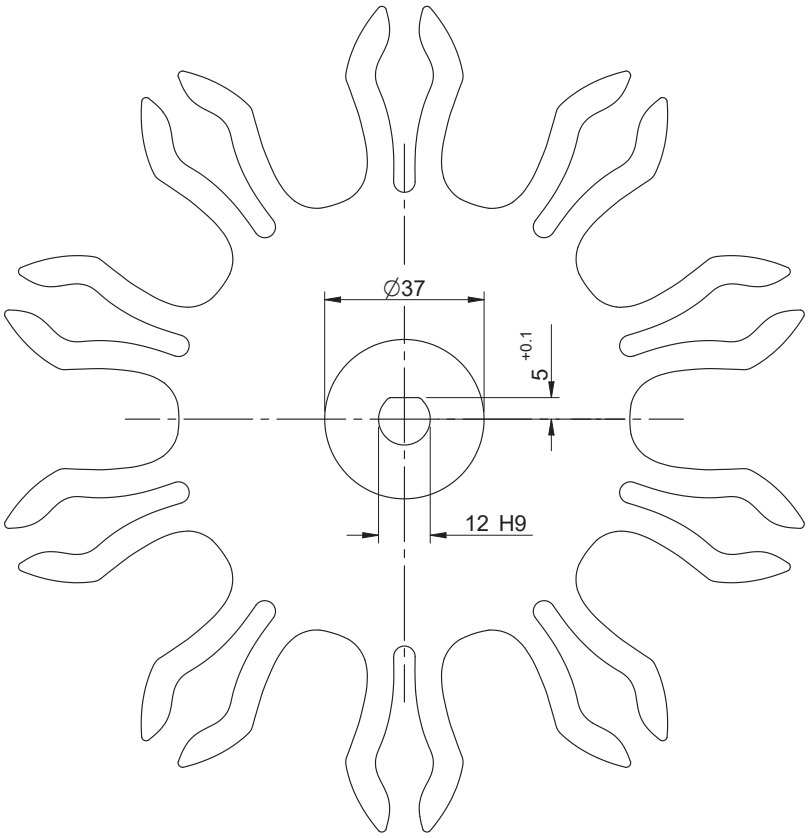
See data sheet ZMS 12939

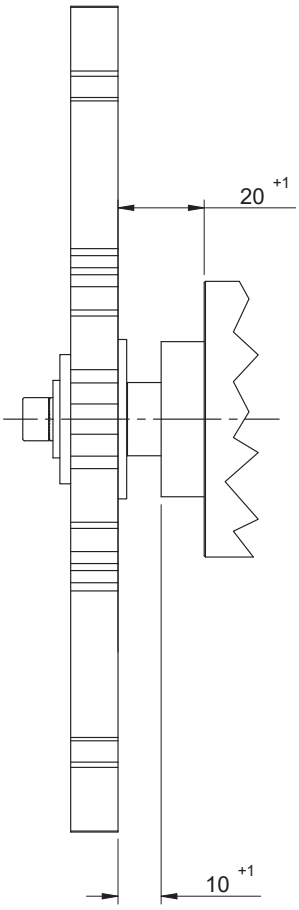


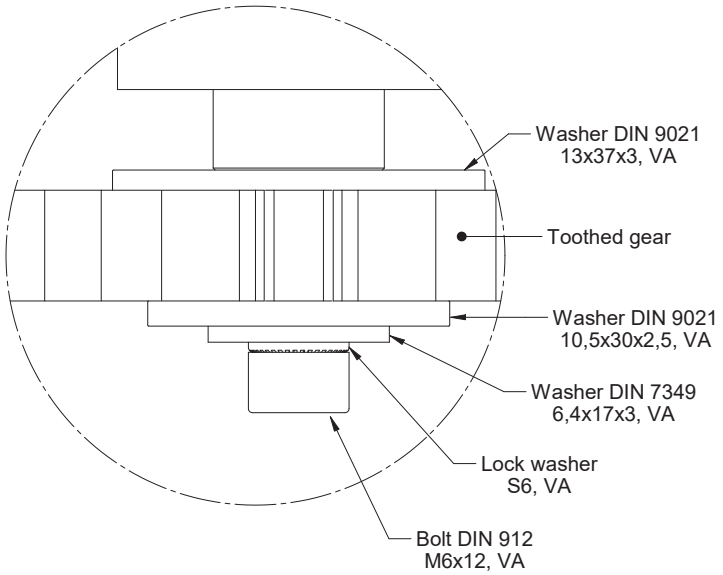
## Play-compensating toothed gear ZRS

A 'play-compensating toothed gear' ZRS is available to mechanically drive the switching cam encoder shaft on a ring gear (slewing ring) or a rack without play. Different modules and numbers of teeth are available. ZRS material: polyamide. Also see data sheet ZRS 11877. Mechanical connection necessitates a specific shaft version.

Installation recommendation: tighten 6 mm bolt to a torque of 6 Nm and secure with Loctite (medium adhesive strength).




## Order code number

| ZRS | - | 12 | - | 10 | - | A 01 |
|---|---|---|---|---|---|---|

**Variants **:**

A 01 Standard

**Teeth:**

10 No. of ZRS teeth *

**Module:**

12 5 to 24 *

**Model:**

ZRS toothed gear, play-compensating model

*: Other values on request

**: Please contact our technical support to select the required measuring gear.