Play-free digital switching cam encoder
with digital electromagnetic rotary encoder
Model **NOCE / S3 - SIL2 / *SSI* Interface**

Safety Integrity Level
SIL2
IEC 61508

SSI

- **Play-free digital version for use instead of electromechanical switching cam encoders**
- **For use in stationary and mobile machines and systems, especially for power plants, wind power plants, cranes, etc.**
- **Up to four electronically controlled safety SIL2 switching outputs (relays)**
- **Integrated multiturn SIL2 rotary encoder with standard *SSI* Interface**
- **Switching outputs and *SSI* position signal can be preset via preset inputs**
- **Position resolution: up to 15 bits**
- **High vibration and shock resistance thanks to robust design**

Content

Design

Robust aluminium (AlMgSi1) or stainless steel (1.4305 or 1.4404) housing in dual-chamber design. Shaft with shaft seal and ball bearing mounted in pre-chamber. Electronics housed in sealed main chamber.

Ø 79 mm with short design length

Shaft diameter 12 mm. Electrical connection for voltage supply, switching outputs and SSI position data via M12 connector or cable. The number of connectors or cables varies depending on design or customer specification.

The **4 SIL2 safety switching contacts** are each designed with 2 relays connected in series to guarantee reliable contact separation (no contact sticking). All contacts are galvanically separated and suitable for **use in the safety chain**.

The switching contacts are closed during normal operation, and therefore establish a conductive connection - the relay coils are live. If the limit values are reached, the respective contact is opened. They are also opened when the switching cam encoder is not connected to the voltage supply or a fault is detected in the NOCE.

At each point in time, the integrated relay monitoring function compares whether the specified ON/OFF switching status of each switching contact is correct (nominal/actual comparison). If a deviation is detected due to a relay fault, emergency status is assumed.

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Description

General functional principle

This involves a play-free electronic switching cam encoder (abbreviated to: NOCE) with a maximum of four galvanically separated SIL2 switching outputs that can be set by the customer, and which are activated or deactivated depending on the respective position of the drive shaft. A parameterisable multiturn absolute encoder with SSI interface and the switching cam encoder PCB with separate controller are integrated in the compact housing. The *SSI* interface can be preset, the encoding direction is adjustable and the switching outputs can be preset.

A special shaft design appropriate to the play-compensating measurement gear ZRS is available.

The supply voltage, SSI signal and switching contacts are each galvanically separated from one another.

Rotary encoder

The rotary encoder has an *SSI* interface. Its resolution is up to 15 bits / 360° (can be selected on ordering) with a measuring range of max. 4096 revolutions. The SSI position value can be referenced / preset using pins in the connector. The signal path (CW/CCW) can be set.

The standard measurement accuracy is ± 0.25% / 360°. A value of ± 0.1% / 360° can be optionally implemented.

The measuring range is 4096 revolutions. Optionally, 16 or 256 revolutions are possible as the measuring range.

Switching outputs (cams)

Potential-free, galvanically separated switching processes can be controlled with the electronically activated cams. The switching outputs are implemented using relays with a long service life. Each of the 4 contacts consists of 2 relays connected in series. These two relays switch with a brief offset (in the millisecond range). This measure guarantees reliable contact separation - even if there is a risk of contact sticking due to high applied voltages and currents. A separate controller unit monitors the function of the switching outputs. If incorrect switching is ascertained, this is detected as an error.

The SIL2 switching contacts are normally open contacts. In normal operating state - without the limits having triggered - the contacts are closed and the relay coils are live. They open when the position limits are reached. All relays open when a fault is ascertained via self-diagnosis and the NOCE's supply voltage is too low or if the NOCE is shut off completely.

Within the measuring range, **one** switch-on and off process per switching output is possible. Customer-specific switching procedures can also be implemented in the factory.

The switching information for the cams is taken from the rotary encoder. The switching outputs are activated and deactivated without play, electronically and wear-free in comparison with an electromechanical switching cam encoder.

If they are to deviate from the standard setting, the switching flanks of the individual switching outputs are programmed in the factory as per the customer's specifications (see "cam diagram" illustrations). The measuring range point at which the NOCE is to switch the switching outputs can be set using the preset input.

Direct and alternating voltage can be switched with all switching outputs. Different connector assignments are possible at the customer's request.

The cams do not switch if there is no operating voltage. In this case, all switching contacts are open. The current is interrupted.

Safety parameters

Data preliminary

Standard EN 13849-1:2008

Switching cam encoder

- Category: 2
- CCF: fulfilled
- DC [%]: 95.8
- PL: d

Standards EN 61508:2010 and EN 62061

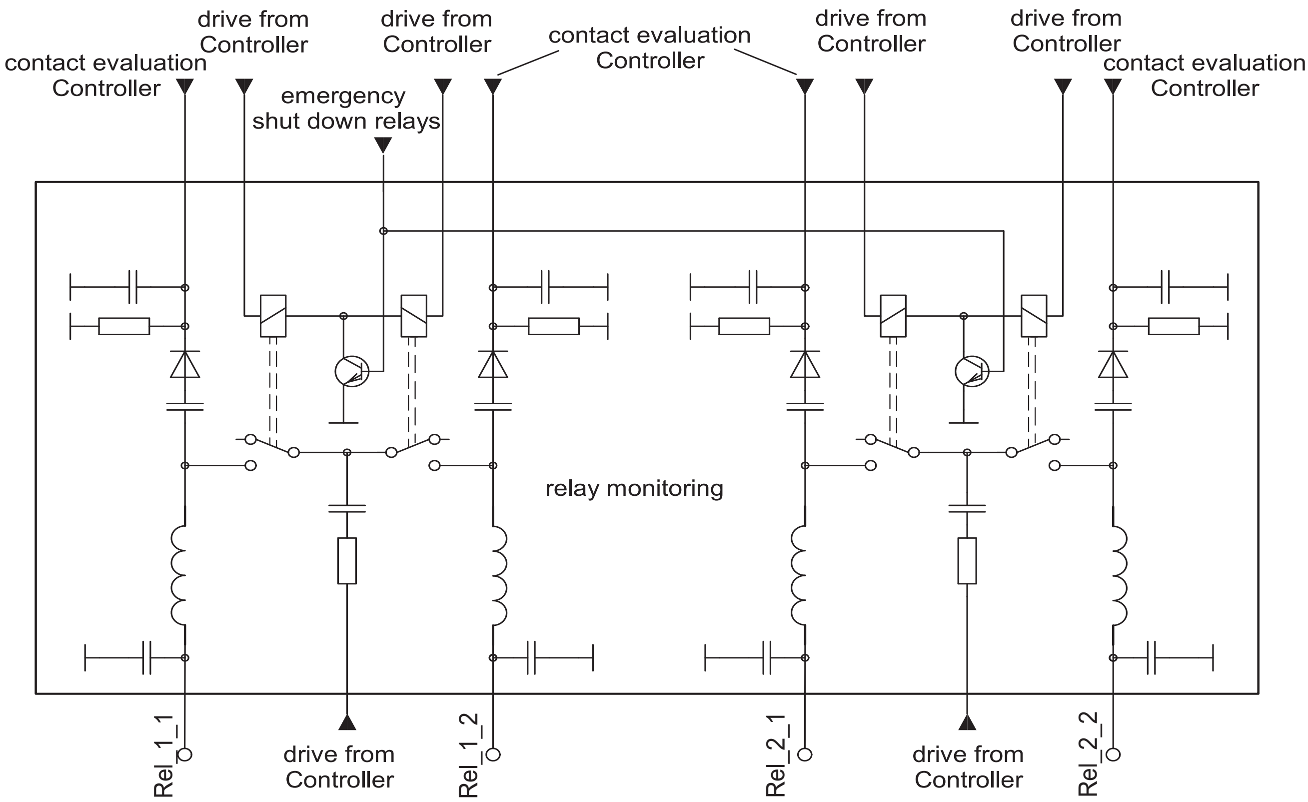
Switching cam encoder

- HFT: 0
- T1[s]: ~10,000
- SFF [%]: 97.5
- PFH [1/h]: 6.86×10^{-8}
- SIL: 2

Values preliminary until TÜV certification. Further values will be available after TÜV certification.

Principle circuit diagram

2 contacts shown. A total of 4 available



Technical data

Mechanical data

- Operating speed: 1000 rpm max.
- Angular acceleration: 10^5 rad/s² max.
- Moment of inertia (rotor): 20 gcm²
- Operating torque: ≤ 8 Ncm (with rotational speed 500 rpm)
- Starting torque: ≤ 4 Ncm
- Perm. shaft load: 250 N axially, 250 N radially
- Bearing service life: ≥ 10^9 Revolutions
- Weight: Approx. 0,75 kg

Environmental data

- Operating temperature range: - 40°C to + 85°C
  Note: the safety parameters (Page 2) apply from - 40°C to + 70°C
- Storage temperature range: - 45°C to + 85°C
- Resistance:
  - To shock: 250 m/s², 6 ms, (DIN EN 60068-2-27) per 100 x in 3 axes
  - To vibration: 100 m/s², 5 Hz ... 2000 Hz, (DIN EN 60068-2-6) per 1 h in 3 axes
- Protection type: IP67 (DIN EN 60529)

Technical data

Electrical data

Sensor system:	GMR elements - redundant
Operating voltage range:	9 ... 36 VDC
Power consumption:	< 3 W
Switch-on current:	< 500 mA
Resolution:	Up to 32,768 steps / 360° (15 bits)
Measuring range:	4096 revolutions (optionally 256 or 16 revs.)
Output code:	Binary (optionally Gray)
Absolute accuracy:	± 0.25% / 360° (optionally ± 0.1% / 360°)
Repeatability:	± 0.1% / 360°
Code path:	CW (adjustable)
EMC standards:	
Interference emission:	EN 61000-6-4
Interference immunity:	EN 61000-6-2
Output serial *SSI*:	Differential data output (RS 422)
Clock input *SSI*:	Differential data input via optical coupler (RS 422)
Monoflop time:	16 ± 10 µs (standard)
Clock rate:	Max. 1 MHz
Electrical connection:	M12 connector, Optional: cable

Electrical data of the switching relay outputs

Maximum switching current:	0,5 A at 30 VDC / VAC
Maximum switching voltage:	60 VDC / VAC - also depending on the choice of connectors that are used: e.g. M12 connectors with 12 pins have a maximum voltage of 30 VDC/VAC.
Switching time:	20 ms (ON and OFF in each case)
Switching hysteresis:	10 digits (~1°). Can be set in the factory to avoid contact rattling
Maximum ON resistance	0.5 ohm
Protective capacitor on the contacts:	C = 47 nF (other capacitors possible on request) → time constant τ for voltage drop after contact opening: τ = RC with R = external resistor

Overall system and safety

On-time (rise time) of supply voltage:	500 ms (10% to 90%)
Storage cycle time:	3 s per storage cycle
Set-up time:	~ 2 s in the operating temperature range
Time between detection of an error and output:	100 ms (voltage supply) 300 ms (relay check) 5 s (RAM test, all individual bits OK) 2 s (ROM test (within set-up time)
Certificate number:	To follow
Safety standards:	EN 61508, 1 - 7: 2010 EN 62061: 2005 EN ISO 13849-1: 2015 EN 60947-5-1: 2004 + A1: 2009
Maximum usage duration:	20 years

Order number

NOCE	79 – KZ	A	4 – 4096	R	4096	S3	S3	E	01

→ Standard version

Electrical and mechanical variants*
- 01 Standard with cam preset version 1
- 12 Standard with cam preset version 2

Output:
- E *SSI*

Electrical connection:
→Combine type (S, T, K or L) and number (1, 2, 3)
- 1 = 1 connection
- 2 = 2 connections
- 3 = 3 connections
- S Via device connector M12, radial
- T Via device connector M12, axial #
- K Via cable 1 m**, radial
- L Via cable 1 m**, axial #

**other lengths on request

Profile:
- S3 Safety SIL2 version

Measuring range:
- 16 Revolutions
- 256 "
- 4096 "

Code:
- R R = binary / G = Gray

Resolution:
- 4096 Steps / 360°. 8192, 16,384 and 32,768 steps / 360° also possible

Number of switching outputs:
- 4 Up to 4 safe switching outputs (SIL2)

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

Flange and shaft:

K	Clamped flange	Shaft 12 mm with flattened area
KP	Clamped flange	Shaft 12 mm with feather key
KZ	Clamped flange	Shaft 12 mm for measurement gear
KN	Clamped flange	Clamped shaft, 12 mm inside diameter with groove
S#	Synchroniser flange	Shaft 12 mm with flattened area
SP#	Synchroniser flange	Shaft 12 mm with feather key
SZ#	Synchroniser flange	Shaft 12 mm for measurement gear
SN#	Synchroniser flange	Clamped shaft, 12 mm inside diameter with groove

Design form:
- 79 Ø 79 mm

NOCE Electronic switching cam encoder with *SSI* Interface

Mating connectors

M12, 4-pin, socket:	**STK4GS60**	M12, 4-pin, connector:	**STK4GP50** (plastic)
M12, 5-pin, socket:	**STK5GS56**	M12, 5-pin, connector:	**STK5GP90**
M12, 8-pin, socket:	**STK8GS54**	M12, 8-pin, connector:	**STK8GP99**

Only on request

* 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.

SSI Interface

No safety transfer

Function

To register and output the angle or position of the shaft more accurately, the contactless electromagnetic sensor system is equipped with a serial *SSI* interface so that the measured variable is available as digital, serial data.

The absolute angle information available in the rotary encoder is transferred in serial and synchronous form during a cycle to the receiver electronics in the customer's control system. Significant advantages include the low number of data cables and very high interference immunity (an exhaustive description of the *SSI* interface is contained in the TWK document *SSI* 10630).

SSI with optical coupler and according to RS422 (cycle + data).

This model is set to a measuring range of 4096 revolutions in the factory (optionally 256 and 16 revs.).

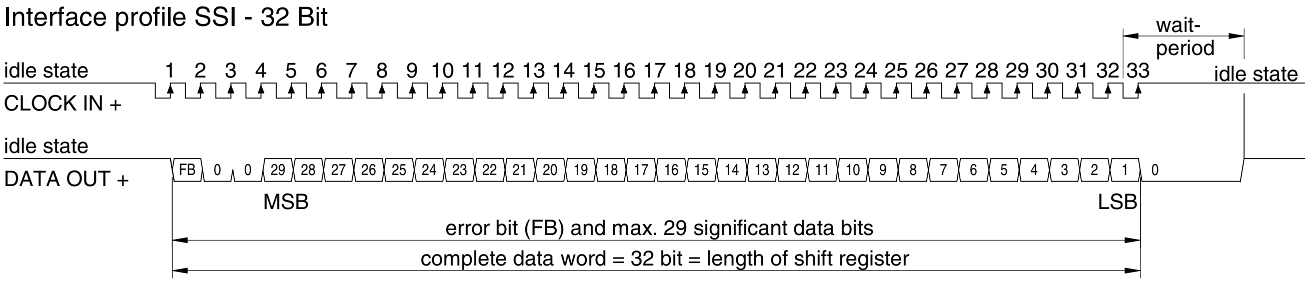
The entire measuring range is always output with the selected, full resolution in steps per revolution (e.g. 4096) at the corresponding number of revolutions (measuring range). In the case of 4096 revolutions, this is 4096 x 4096 = 16,777,216 steps. The standard shift register length is 32 bits. The MSB (1st bit after the 1st ascending clock flank) is defined as an error bit. In correct operation, it is 0. In the event of an error, it is set to 1. It must/can be read out by the customer to detect an error in the NOCE. In addition, all switching contacts are set to 'open in the event of a registered error. All bits of the position value in the SSI signal are set to '0' as well. This indicates that an error has occured.

Using pins in the connector, a preset value specified in the factory can be called up, e.g. middle of the measuring range, and the encoding direction CW/CCW can be set.

The information on the precise shaft angle position is also used to control the switching outputs (cams).

Interface profile *SSI* - 32-bit / binary / left justified

(Standard length 32 bits. Other shift register lengths possible on request, e.g. 25 bits)



Maximum data rates

- The data rate is limited by the following variables:
  - ☐ Up to approx. 40 m clock frequency max. 1 MHz
  - ☐ Between 40 m and 150 m overall electronics delay:

$t_{GV} = t_C + 2t_K + t_E$

t_{GV}: Overall delay time

t_C: Encoder electronics delay time (here e.g. $\leq$ 300 ns)

t_K: Cable delay time (depending on cable length and type. Delay time e.g. 6.5 ns/m)

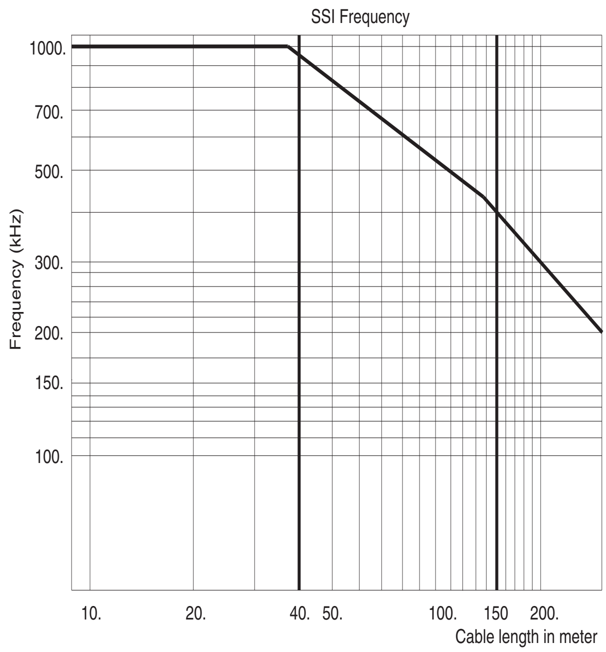
t_E: Receiver electronics delay time (e.g. 150 ns)

A safety clearance of 50 ns between the cycle duration of cycle t_T and the overall delay time t_{GV} results in:

$t_T = t_{GV} + 50\text{ ns} = 500\text{ ns} + 2t_K$

The following context applies on calculation of the max. clock frequency: $f_{max.} = 1 / t_T$

- ☐ As of 150 m according to RS 422 specifications



Switching outputs

Safety SIL2

Function

The function of the switching outputs is implemented using relays. Two relays are connected in series per switching output. This measure significantly increases reliable separation of the contacts, even if one relay does not separate (contact sticking). In terms of operating voltage and the SSI output signal, the contacts are galvanically separated. The relay monitoring function detects whether a relay contact is open or closed as specified by the controller - i.e. whether it has the required switching status (ACTUAL status = NOMINAL status). If this is not the case, the NOCE switches to error status and opens all contacts. An error bit is set via the SSI interface to inform the control system that an error is present.

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. It receives the shaft position data from the NOCE's absolute encoder.

The SSI position signal, which is output via the SSI interface, serves as the basis for the switching information. Each change to SSI signal output via the SSI preset or SSI signal path (also called encoding direction CW / CCW) therefore also influences the position of the switching contacts' switching flanks. A position signal shift via SSI preset also shifts the switching flanks. A reversal of the signal path means that the switching flanks now operate / respond in the shaft's reverse direction of rotation.

The switching flanks of all switching outputs are set to a specific angle position in terms of the shaft in the factory. These positions are specified by the customer. Without this specification, the standard setting applies (version 1 → diagram 1a or version 2 → diagram 2c).

A preset function is used to set the 4 cams simultaneously (en bloc) and thus adapt them to the application. There are two versions for the switching flank preset.

The cams cannot be preset individually.

Version 1:

The distances between all switching contact (cam) switching flanks are firmly set in the factory according to the customer's specifications. Due to the preset function for the cams, a fixed switching output ensemble point specified by the customer is now shifted to the shaft position set on site. This point can lie at any preset point favourable for the application, e.g. in the middle of the switching flanks. It can of course also lie on one of the switching flanks (see cam diagrams and setting, version 1). Corresponding data must be specified when ordering. The configuration of *ascending flanks* or *descending flanks* can also be specified by the customer. See illustration 1.

Version 2:

This version is designed for cases in which 2 switching outputs are to switch in the CW direction and a further 2 switching outputs in the CCW direction from a specific shaft position as a reference point, i.e. each is to serve as a limit switch. This is always done symmetrically to this reference point. This reference point is preferably the SSI preset value (e.g. middle of the measuring range). See illustration 2.

Distance a is firmly set in the factory according to the customer's specifications. a is the distance from Cam1 <> Cam2 and Cam3 <> Cam4. Distance b is set on site at the customer by the cams' preset function *Cam Preset*. b is the distance of the switching output 1 (Cam1) switching flank, which is assigned to the current shaft position after *Cam Preset*, up to the shaft position belonging to the SSI preset value (= distance from Cam1 <> SSI preset). b then also applies immediately to the distance from Cam3 <> SSI preset. b is defined as b > 0. I.e. the preset function *Cam Preset* must be performed in the case of SSI position values (shaft positions) that lie above the SSI preset value if presetting to Cam1 is to be performed. If the *Cam Preset* value is lower than the SSI preset value, presetting has been carried out to Cam3.

The SSI preset value is set in the factory and specified by the customer, e.g. 800,000 hex. The middle of the measuring range is the standard.

Cam preset option 2 enables the symmetrical adaptation of two switching contacts each around a reference point, whereby dimension a is defined in the factory according to the customer's specifications (see cam diagrams and setting, version 2). Corresponding data must be specified when ordering.

In the standard function, the switching contacts are closed (contact established) in the NOCE operating range (usually around the middle of the measuring range). On reaching the limits (switching flank positions), the contacts open (contact interrupted for the switching length L). The switching length L set in the factory is 4320° = 12 revolutions. The contacts are open for this length L.

To avoid undesired relay switching back and forth (flutter) when the shaft is stationary or due to slight shaft vibrations at the switching flank, a switching hysteresis of 10 digits (approx. 1°) is programmed.

Cam diagrams and setting - Version 1

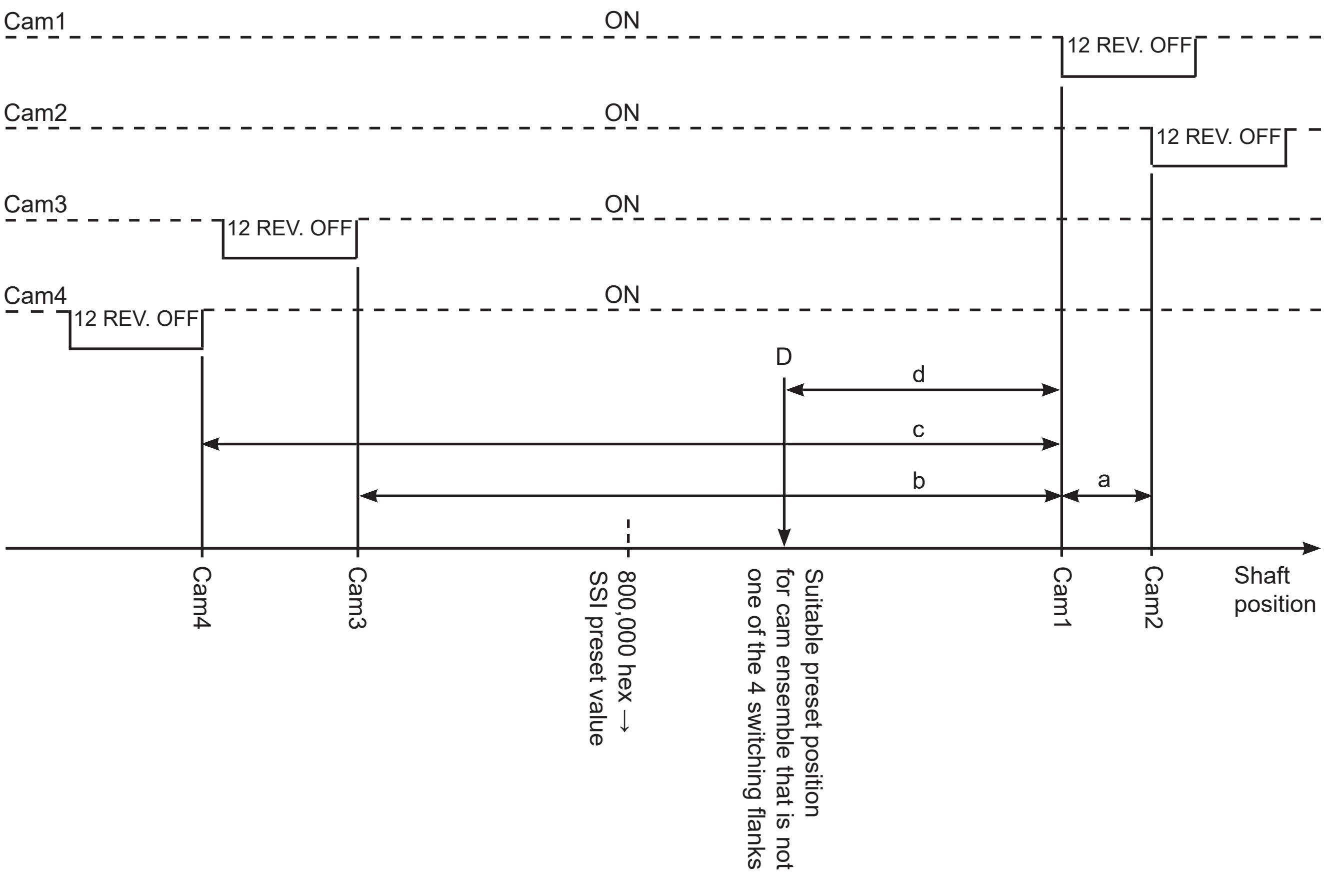
To define the position of the switching flanks, the **relative position of all cams to Cam1** must be specified for each switching flank (cam) on ordering (a, b and c → e.g. in shaft revolutions). With *Cam Preset*, all switching flanks are shifted en bloc without changing their position relative to one another. The desired position in the switching flank ensemble (usage of d) or the desired switching flank as specified is located at the current shaft position. Example of the specification that the descending flank of Cam1 is to be the preset flank: *Preset Cam1*. Preset to point D: *Preset CamD* (D = distance to Cam1 in the direction of decreasing SSI position values). As the standard function of the switching contacts is such that 2 contacts open in the CW direction and 2 contacts in the CCW direction (limit switch function), the following is defined: a > 0, b < 0 and c < 0. d is arbitrary. The regular operating range of the NOCE ideally lies between Cam3/Cam4 and Cam1/Cam2.

Recommended procedure:

1. Set signal path (=encoding direction CW / CCW) of the SSI signal
2. Preset SSI to position → move to corresponding position in application → activate *SSI Preset*
3. Preset cams → move to accompanying position in the application → activate cam preset point specified in the factory with *Cam Preset*
4. If required, "fine" SSI preset can subsequently be performed again. The positions of the cams are then shifted accordingly. The signal path can now be turned again → cams are mirrored

→ SSI signal and all four switching contacts are now set / adjusted.

Illustration 1



Definition: the switching contacts switch at the diagram points designated Cam1 to Cam4. They open when these points (limits) are reached from the SSI preset value. They therefore function as terminal position switches / limit value switches. 2 switches in the CW direction and 2 switches in the CCW direction when viewed from the SSI preset value. They remain open for 12 revolutions, and then close again (factory setting. Customer specification possible). If 3 or 4 switching contacts are to switch in the CW or CCW direction, and accordingly fewer contacts in the other direction, please speak to our technicians.

Example:

Switching flank distances (= cams):

Cam1 <> Cam2 = a
Cam1 <> Cam3 = b
Cam1 <> Cam4 = c

The values for a, b and c are set in the factory. They are specified by the customer. These values can be specified in SSI position steps (note SSI resolution) or in shaft revolutions U.

The cam preset point suitable for the customer now has to be specified. This point is best selected by the customer so that "teaching in" the switching contacts in the application is as easy as possible. Movement to a suitable position in the application is therefore performed, and the preset function is triggered so that all switching contacts then switch in the correct position. For instance, the position of Cam1 can be selected (= firmly specified) (customer specification *Preset Cam1*). The switching flanks are then set as follows:
Cam1 now switches at the current (and arbitrary) shaft position after actuating *Cam Preset*.

The following also switch in the following positions:

Cam2 = Cam1 + a
Cam3 = Cam1 + b (in the direction of decreasing SSI position values with reference to Cam1, due to b < 0)
Cam4 = Cam1 + c (in the direction of decreasing SSI position values with reference to Cam1, due to c < 0)

Or Cam3 is specified by the customer (*Preset Cam3*).
Cam3 now switches at the current (and arbitrary) shaft position after actuating *Cam Preset*.

The following also switch in the following positions:

Cam1 = Cam3 - b
Cam2 = Cam3 - b + a
Cam4 = Cam3 - b + c.

An intermediate position (D) - i.e. no specific switching flank - is also conceivable: the following must then be specified: *Preset CamD* with distance d = D <> Cam1. Illustration 1: in this case, d < 0, as D is defined towards lower SSI position values.

If SSI preset is actuated after presetting the switching flanks (cams), all switching contact switching flanks are also shifted → position preset via SSI preset is always "global", as the cam switching points always refer to the output SSI position signal.

Cam diagrams and setting

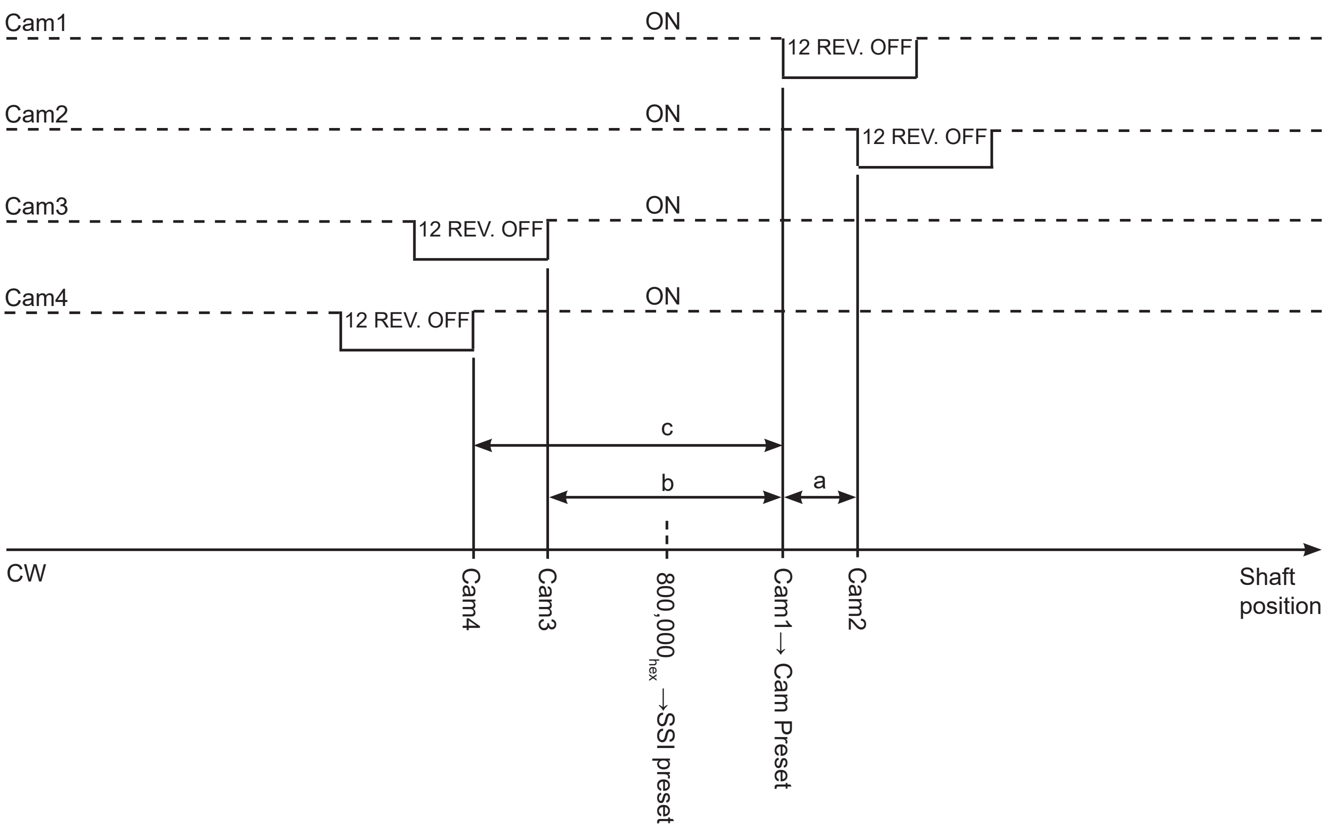
Version 1 standard setting, a and b = integer *

The desired switching output default settings should always be specified when ordering version 1 of the NOCE79. If no data are available from the customer, the following setting is supplied (version E01. Illustration 1a):

SSI:
- Signal path / encoding direction: CW
- Preset value: middle of the measuring range depending on the steps / revolution resolution (e.g. with 4096 steps / rev. → middle of the measuring range 8,388,608 steps = 800,000 hex)

Switching flanks:
- 2 switching contacts (**1 + 2**) set to descending flank in direction of **increasing** SSI position values
- 2 switching contacts (**3 + 4**) set to descending flank in direction of **decreasing** SSI position values
- *Cam Preset* set to Cam1 → *Preset Cam1*
- a = +5 revolutions
- b = -10 revolutions
- c = -15 revolutions
- Cam length L = 12 revolutions
- Cam1 to Cam4 are set symmetrically around the SSI preset value in the factory

Illustration 1a



*: For settings ex works a and b have to be integer values. The customer can set the value for b arbitrary via teach in.

Cam diagrams and setting - Version 2

This version is intended for the following NOCE switching output function: 2 switching contacts (1 and 2) with descending flank in shaft direction of rotation CW (or increasing SSI position values as of SSI preset) and 2 switching contacts (3 and 4) with descending flank in shaft direction of rotation CCW (or decreasing SSI position values as of SSI preset). The *Cam Preset* function always lies at Cam1 if, with reference to the SSI preset value, the *Cam Preset* function is performed in the case of higher SSI position values. If, with reference to the SSI preset value in the case of lower SSI position values, the *Cam Preset* function is performed instead, the flank of Cam3 is in this position. The cam configuration is not therefore changed: Cam1 and Cam2 above the SSI preset. Cam3 and Cam4 below the SSI preset. Distance a is identical for both switching flank distances (1<>2 and 3<>4). The operating range of the NOCE preferably lies between Cam3/Cam4 and Cam1/Cam2.

Distance b is defined: Cam1 <> SSI preset value distance. The following applies: b > 0 (towards increasing SSI position values).

Recommended procedure:

1. Set signal path (=encoding direction CW / CCW) of the SSI signal, due to definition b > 0
2. Preset SSI to position → move to corresponding position in application → activate *SSI Preset*
3. Preset cams → move to accompanying position in application → activate *Cam Preset* → b (= Cam1 <> SSI preset value distance) is therefore set. Distance b then also immediately applies to the SSI preset value <> Cam3 distance, but towards decreasing SSI position values. Cam2 and Cam4 are set as per distance a.
4. If required, "fine" SSI preset can subsequently be performed again. The positions of the cams are then shifted accordingly. The signal path can now be turned again → cams are mirrored.

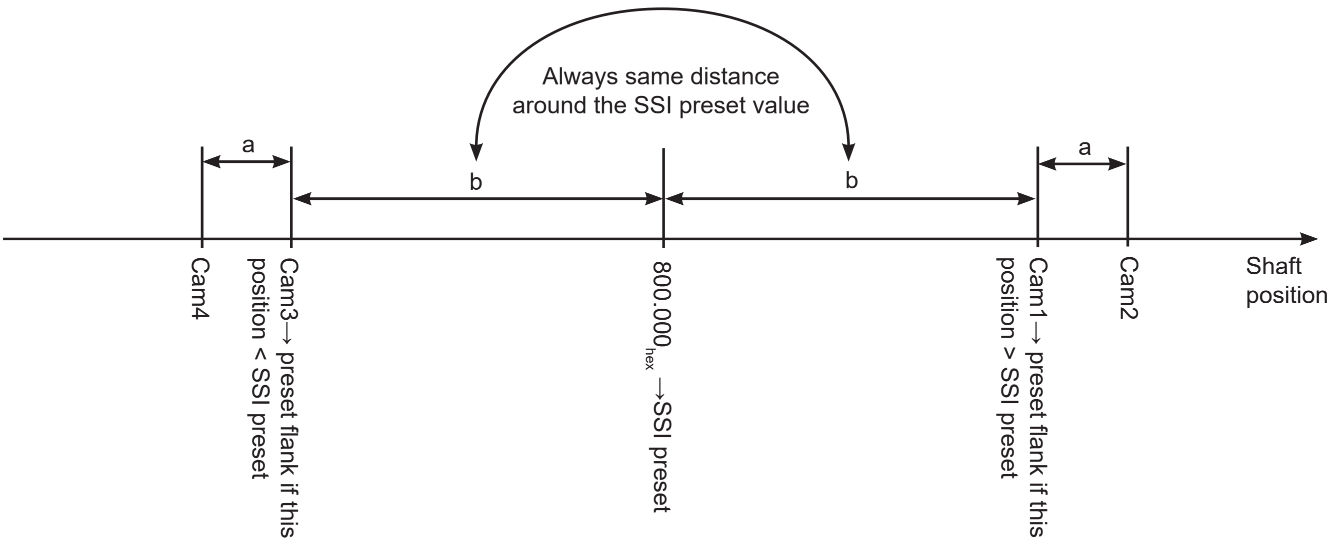
→ Cam2 and Cam4 are firmly assigned to Cam1 and Cam3 due to distance a, which is set in the factory. I.e. a is the relative distance of Cam1 and Cam2 or Cam3 and Cam4, whereby Cam2 and Cam4 can also lie further inwards than Cam1 and Cam3 (→ a < 0). The dimension of a can be: number of shaft revolutions or SSI steps with the selected resolution (e.g. 4096 steps / revolution).

→ By presetting Cam1, all cams are set symmetrically around the SSI preset value.

If SSI preset is actuated after presetting the switching flanks (cams), all switching contact switching flanks are also shifted → position preset via SSI preset is always "global", as the cam switching points always refer to the output SSI position signal.

Illustration 2

The customer defines distance b by using *Cam Preset*. b applies to Cam1 and Cam3. a is set in the factory.



Definition: the switching contacts switch at the diagram points designated Cam1 to Cam4. They open when these points (limits) are reached from the SSI preset value. They therefore function as terminal position switches / limit value switches. 2 switches in the CW direction and 2 switches in the CCW direction when viewed from the SSI preset value. They remain open for 12 revolutions, and then close again (factory setting. Customer specification possible).

See illustration 1 or 1a for ON / OFF switching behaviour and the switching length L of switching outputs Cam1 to Cam4.

Cam diagrams and setting

Version 2

Illustration 2a

After *Cam Preset* by the customer, the cams are closer to the SSI preset point than in illustration 2, i.e. they are closer together on the whole

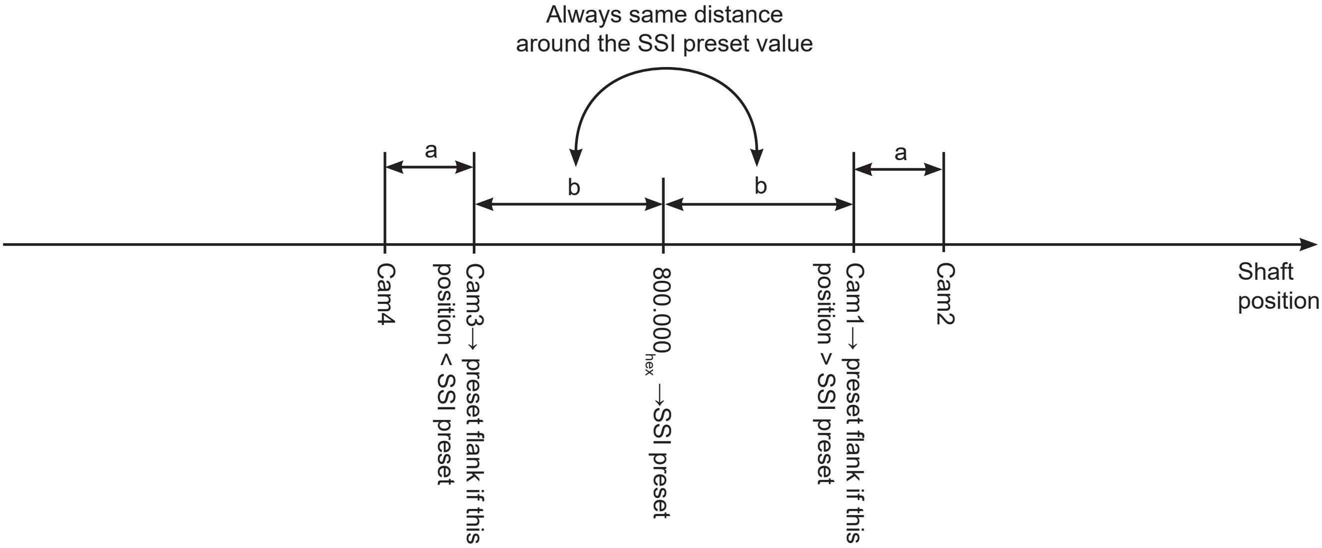
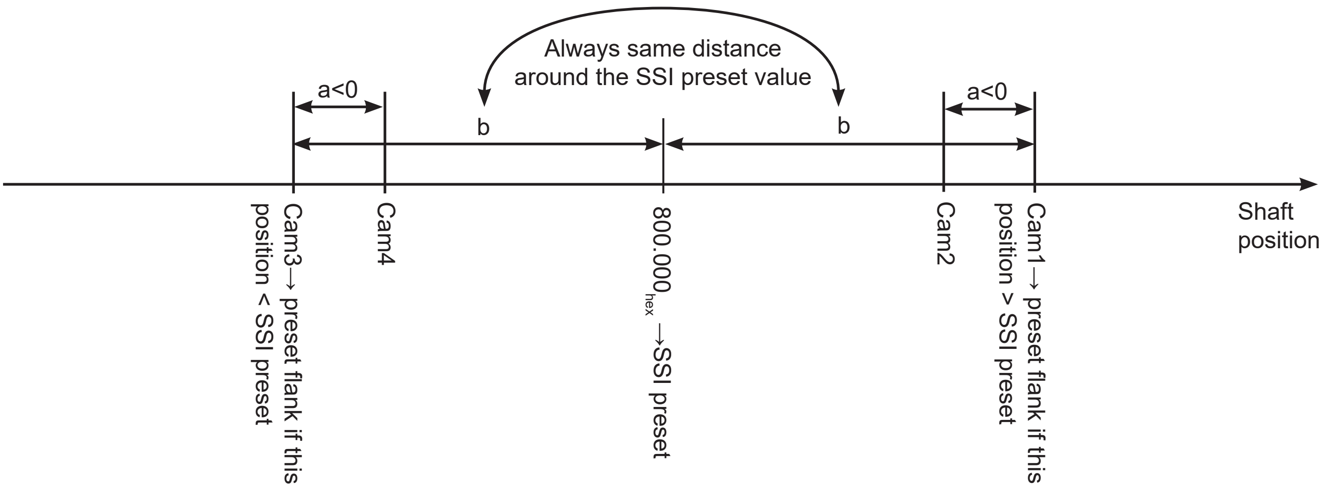


Illustration 2b

Customer has specified a so that Cam2 and Cam4 are located further inwards than Cam1 and Cam3 → a < 0



Cam diagrams and setting

The desired switching output default settings should always be specified when ordering version 2 of the NOCE79.
If no data are available from the customer, the following setting is supplied (version E12, illustration 2c):

SSI:
- Signal path / encoding direction: CW
- Preset value: middle of the measuring range depending on the steps / revolution resolution (e.g. with 4096 steps / rev. → middle of the measuring range 8,388,608 steps = 800,000 hex)

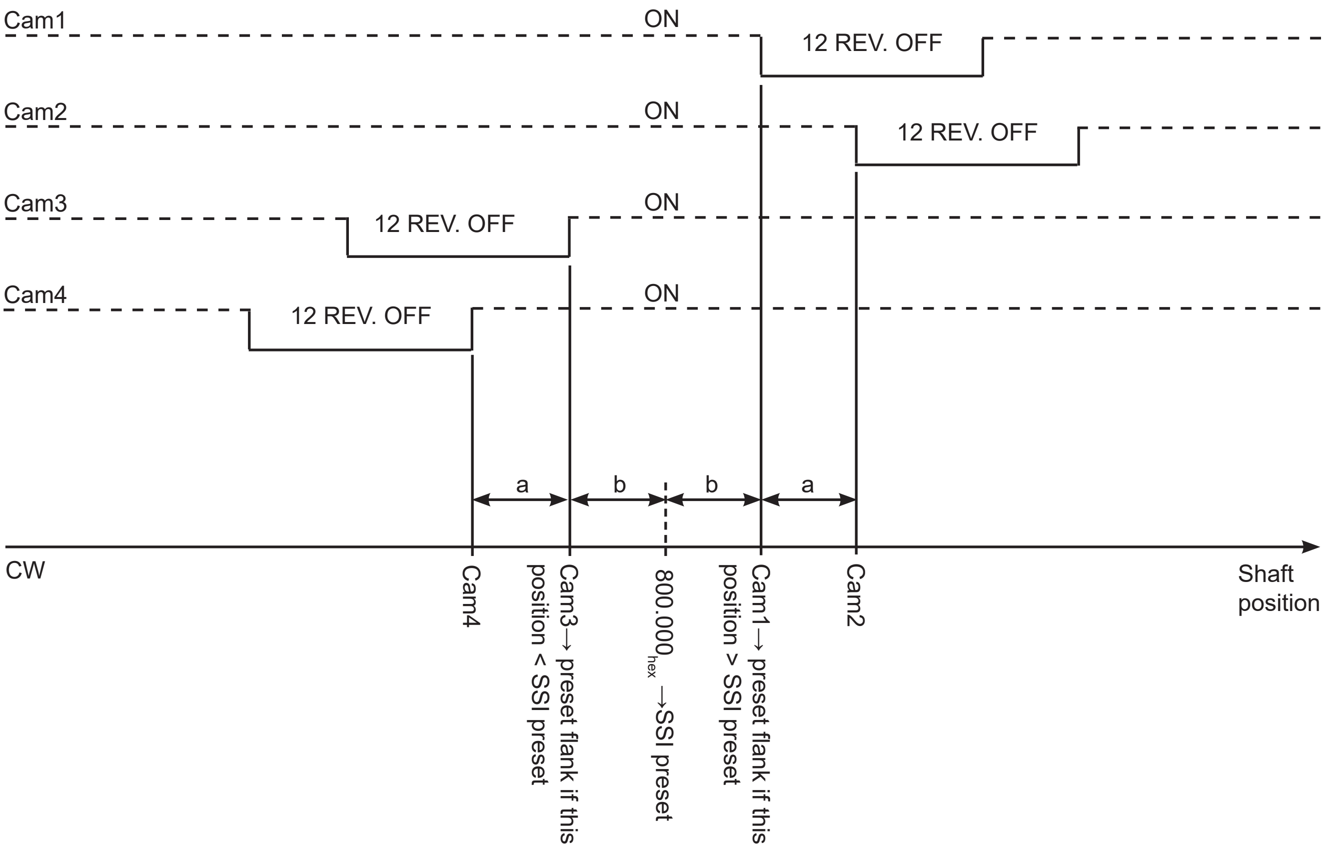
Switching flanks:
- 2 switching contacts (**1 + 2**) set to descending flank in direction of **increasing** SSI position values
- 2 switching contacts (**3 + 4**) set to descending flank in direction of **decreasing** SSI position values
- *Cam Preset* set to Cam1 / Cam3 - depending on whether used for position > SSI preset or pos. < SSI preset
- a = +5 revolutions (Cam2 and Cam4 lie further outwards than Cam1 and Cam3)
- b = +5 revolutions (=SSI preset + 5 revs. in direction of increasing SSI values)
- Cam length L = 12 revolutions

*: For settings ex works a and b have to be integer values. The customer can set the value for b arbitrary via teach in.

Cam diagrams and setting

Version 2 standard setting

Illustration 2c



Teach-in function

Safety teach-in functions

Due to the SIL2 requirements, two multi-function pins (MFP) must be used for a preset / teach-in process instead of one → safety teach-in function.

The switching flanks of the switching outputs are always assigned to the SSI position signal (output signal). The positions of the switching contacts' switching flanks are therefore also shifted if the SSI position signal is subjected to a preset or if the signal path / encoding direction is switched (→ mirroring of the switching flanks with reference to the shaft's direction of rotation).

A total of 3 multi-function pins are planned for the two possible preset processes (SSI incl. switching outputs and switching outputs alone). One pin serves to release the teach-in function: *Activate*. The other pin executes the desired preset function: *Cam Preset*, *SSI Preset*. This second pin is called the "Function" pin in the sequence procedure below.

The "Set encoding direction" function (CW or CCW) is activated with a further pin: *SSI Code*.

All functions must take place whilst the shaft is stationary (maximum angular movement 2°). "Logical 1" = connect to +UB.

Step	Sequence procedure
1.	Set *Activate* pin to logical 1
2.	Wait for > 2 seconds
3.	Set "Function" pin to logical 1 ("Function" = *Cam Preset* or *SSI Preset* or *SSI Code*)
4.	Wait for > 2 seconds
5.	Set "Function" pin to logical 0
6.	Wait for > 2 seconds
7.	Set *Activate* pin to logical 0
	Programming (teach-in) ended

SUPREME SENSORING TWK

Teach-in function

The safety teach-in function is cancelled if this sequence incl. the waiting times is not adhered to, particularly if a second function pin is additionally pressed as of step 3. After a brief waiting time, the sequence then has to be started from the beginning again. The function is only taken over on completion of the entire procedure, and a further teach-in process can be commenced.

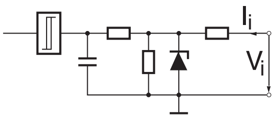
The position value that is present on starting the procedure (as of step 1) is used (on pressing the *Activate* pin (step 1), it is buffered). However, the value or the desired function is only executed on completion of the entire procedure (step 7).

Preset inputs for NOCE / S3	
Function	**Comment**
Set switching outputs (all four en bloc as per version 1 or 2)	Perform sequence procedure with *Activate* and *Cam Preset* pins
Activate SSI preset value (incl. cam switching flanks)	Perform sequence procedure with *Activate* and *SSI Preset* pins
SSI: set signal path / encoding direction (CW / CCW)	Perform sequence procedure with *Activate* and *SSI Code* pins
Normal operation	All MFP inputs open or logical 0
Logical 0 = $-U_B$ or open. Logical 1 = 11 VDC ... $+U_B$	

Input circuit for preset inputs: E1

(Pull-down resistor: 10 kΩ and 10 kΩ in series)

Input E1 active "high"



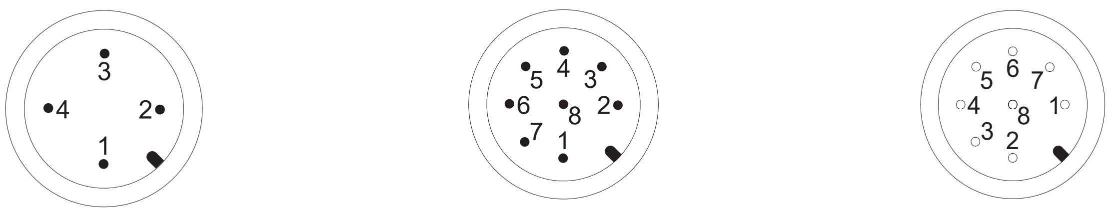
Log 0 < 5 V or not connected
Log 1 = 11 ... Vs
E1 specification

Electrical connection

Pin configuration and numbering

Viewed looking at the contact side of connectors / sockets installed in the NOCE.
Depending on customer specifications, the use of different M12 connectors with individual assignment is possible.
Please always note the connection assignment TY which is enclosed with each device.
In the case of M12, 8-pin, the recommended maximum voltage at the individual pins is 30 V.

4 and 8-pin connectors, A-coded



Connection assignment

NOCE/S3 standard assignment

PIN	Connector S1 (pins)
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)

PIN	Connector S2 (socket)
1	DATA OUT +
2	DATA OUT -
3	CLOCK IN +
4	CLOCK IN -
5	MFP *SSI Code*
6	MFP *SSI Preset*
7	MFP *Cam Preset*
8	MFP *Activate*

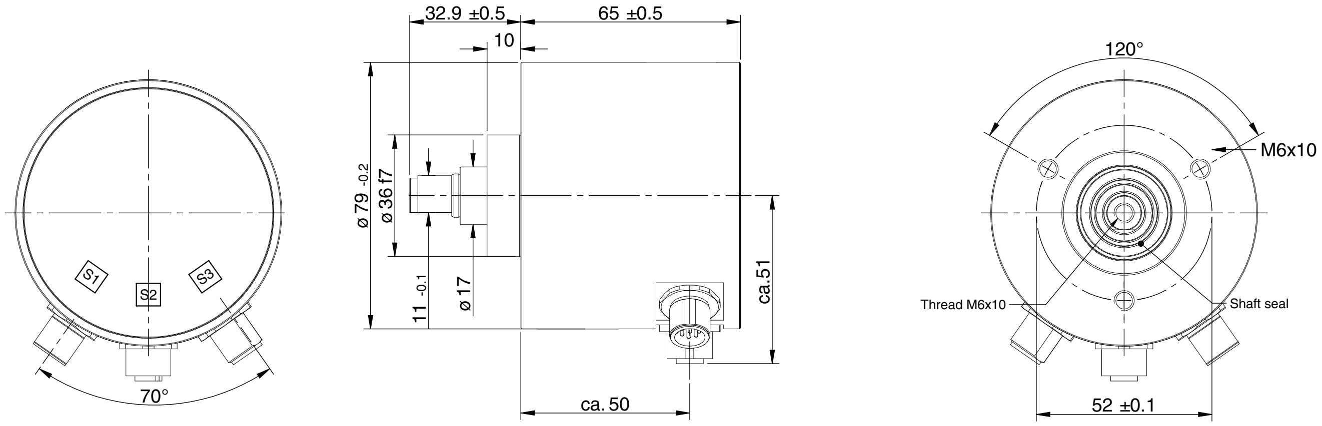
PIN	Connector S3 (pins)
1	Operating voltage **+ U_B**
2	Not used
3	Operating voltage **-U_B**
4	Not used

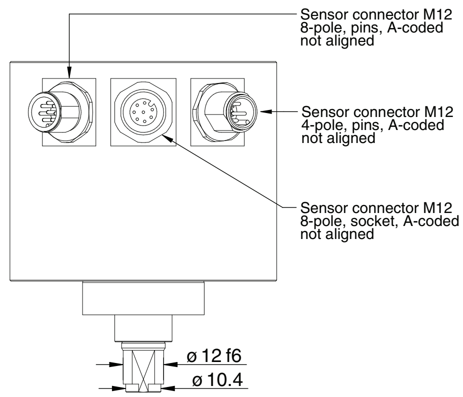
Installation drawings

Special versions on request

Model NOCE79-KZ (3 connectors, radial) → standard version

Dimensions in mm





Connector selection exemplary

Materials used

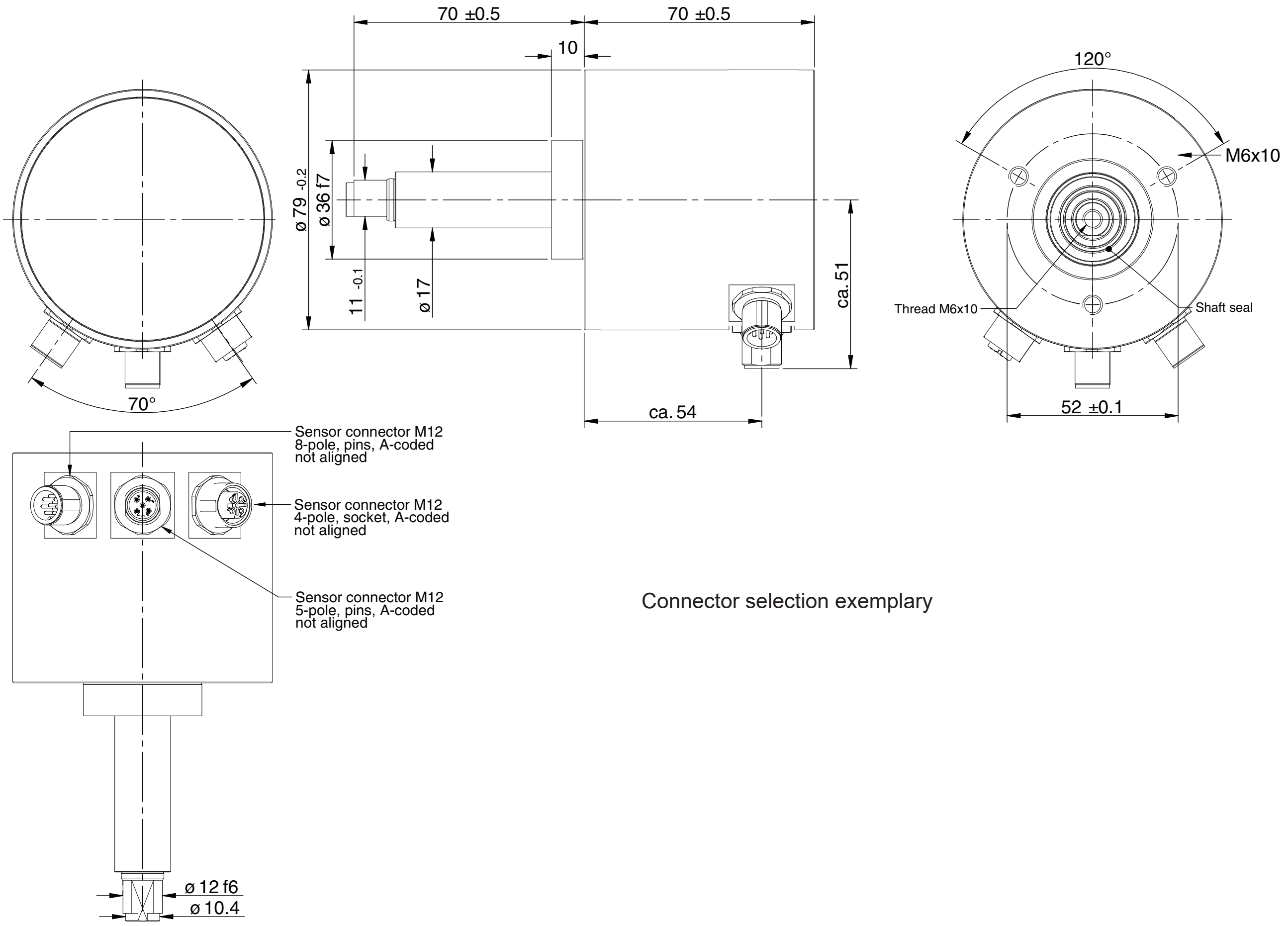
Aluminium housing:	AlMgSi1
Stainless steel shaft:	1.4305
Connector:	Nickel-plated Ms
Shaft seal:	NBR
Sealing rings:	NBR

Installation drawings

Special version

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

Dimensions in mm



Materials used

Aluminium housing:	AlMgSi1
Stainless steel shaft:	1.4305
Connector:	Nickel-plated Ms
Shaft seal:	NBR
Sealing rings:	NBR

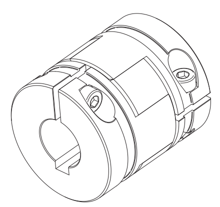
Accessories

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

x and y: hole diameter for shaft mounting

with groove for feather key according to DIN 6885 page 1 – JS9.

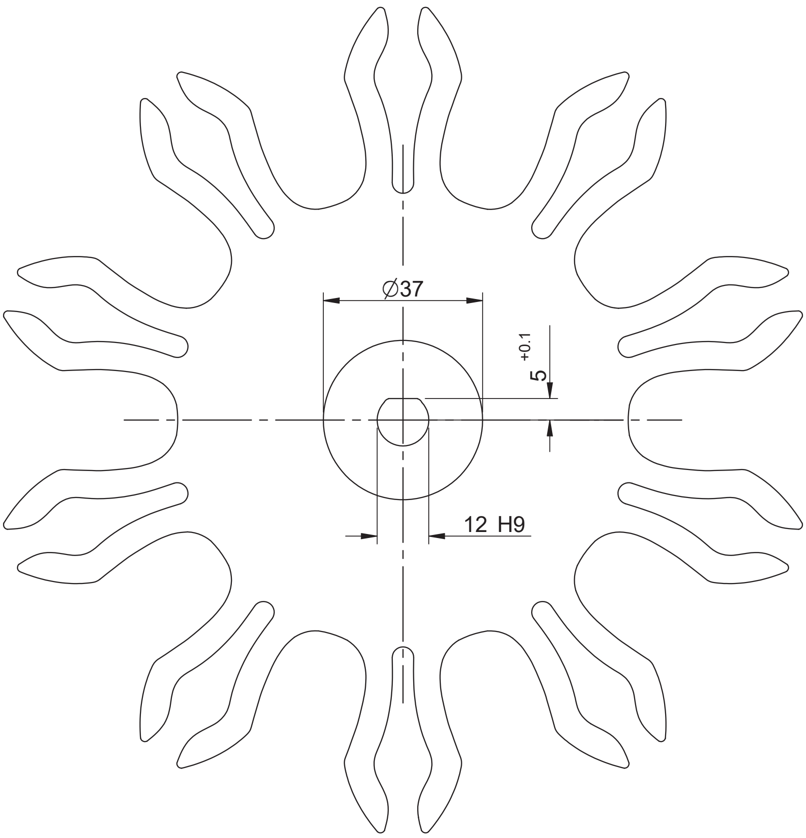
See data sheet KK 12301

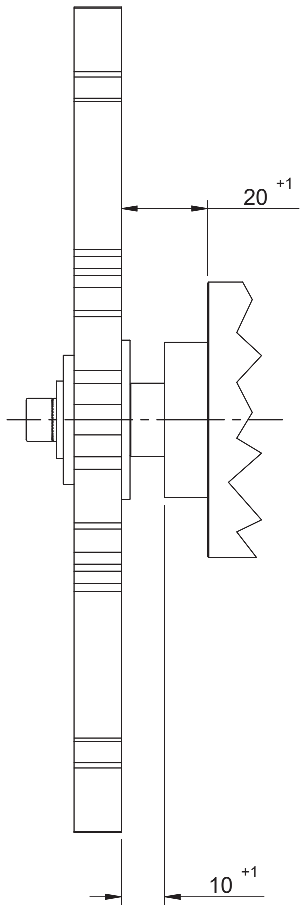


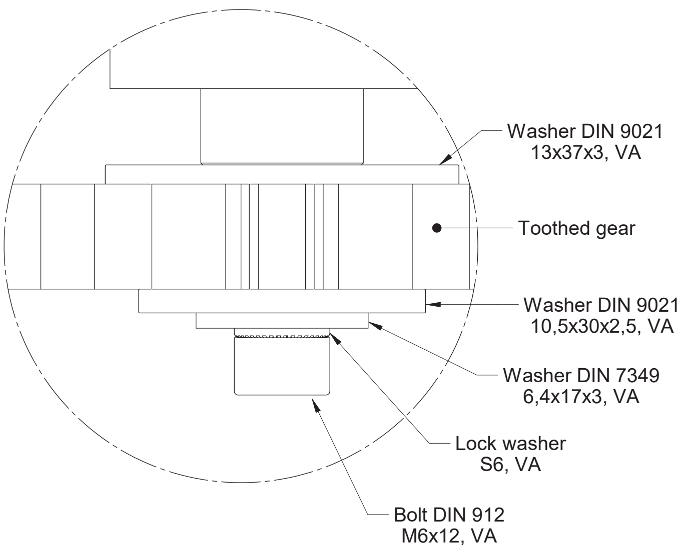
Play-compensating measurement gear ZRS

To mechanically drive the switching cam encoder shaft without play on a ring gear (slewing ring) or a toothed rack, we offer a 'play-compensating measurement gear' ZRS. Different modules and numbers of teeth are available. ZRS material: polyamide. See also data sheet ZRS 11877. Mechanical connection necessitates a specific shaft design.

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







Order number

ZRS - 12 - 10 - A 01

variants **:
A 01 Standard

Number of teeth :
10 Teeth *

Module:
12 5 to 24 *

Model:
ZRS Play-compensating measurement gear

*: Further values on request

**: Please contact our technical staff to adapt the measurement gear to your requirements.