SUPREME SENSORING

Electromagnetic encoder
Model TRN79
Interface: CANopen, redundant

Document no.:
TRN 15169 EE
02.07.2024

- **Robust design for applications for work platforms, mobile work machines and industrial applications**
- **Redundant electronics with two independent CAN nodes in one or two PLC(s)**
- **Resolution: 16384 steps/360°**
- **Measuring range: 67,108,864 steps/4096 turns**
- **Position and speed signal**
- **Protection class: IP67 shaft side**
- **Optional: Protection class IP68/69K**
- **Sensor input unit for Cat3 acc. DIN EN 13849 systems**
- **UN/ECE approval: E1 10R-069992**

CANopen

E1 UN ECE R10 OFFICIAL LISTED SENSOR

R2 REDUNDANT FUNCTIONAL SAFETY SENSOR

KEY INFORMATION OVERVIEW

DESIGN & FUNCTION

- Robust housing (wall thicknesses up to 5 mm) made of seawater-resistant aluminum,austenitic steel (V2A or V4A) or ferritic standard- or chromium steel (e.g. for high requirements of immunity to magnetic fields).
- One common drive shaft (measuring axis) and ball bearing with shaft sealing ring.
- Rotor with shaft, gear and permanent magnets mounted in prechamber.
- Magnetic sensor elements.
- Detection of revolutions by absolute multiturn gear
- Redundant design (sensors, electronics and power supply), that means 2 autarkic nodes.
- The design corresponds to category 3 according to DIN EN ISO 13849
- Protection class IP68/69K
- Electrical connection via two plugs M12x1, 5-pin, A-coded or cable.

FEATURES INTERFACE

The CANopen interface is designed according to CANopen Application Layer and Communication Profile, CiA Draft Standard 301, Version 4.2.0 and according to "Device Profile for Encoders CiA Draft Standard Proposal 406 Version 4.1.0" and CANopen Layer Setting Services and Protocol (LSS), CiA DSP 305.

The redundant design provides the user two independently operating encoders with CANopen interface. In addition to the position signal, a speed signal (digits/gate time) is available for each node. The gate time for the acquisition of the speed signal can be parameterized by the customer between 1 ms and 1000 ms.

To increase the reliability values (e.g. Diagnostic coverage DC) the µ-controllers of both sensors are coupled together for monitoring functions.

The encoders are suitable for performance level d, category 3 applications according to DIN EN ISO 13849.

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TECHNICAL DATA

ELECTRICAL DATA / RELATED TO THE NODE

Sensor system	Magnetic sensor system
Operating voltage	+ 9 VDC to + 36 VDC (Reverse polarity protected and short-circuit proof)
Power consumption	< 2 W
Inrush current	< 500 mA
Resolution	16384 steps / 360°
Measuring range	4096 revolutions
Accuracy	± 0.2 %
Reproducibility	± 0.02 %
Temperature drift	< 0.1 % (over the entire temperature range)
Synchronism of the systems	≤ 1 % (related to 360°)*
Output code	Binary
Speed signal	Digits/ gate time In addition to the position signal, a speed signal digits/gate time is generated, which can be adapted by the customer to the application via an adjustable gate time.
Resolution Speed signal	max. 16 Bit
Gate time	1 to 1000 ms
Internal sampling rate	approx. 1ms
Minimum speed	approx. 0,5°/s
Maximum speed	approx. 70°/s
Code sense	CW / CCW - parameterizable
Reference value	0 - (Total number of steps-1)

CANOPEN FEATURES

CAN-Interface	according to ISO/DIS 11898
Address setting	via LMT / LSS or SDO
Terminating resistor	to be realized separately
Max.transmission length	200 m**
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 4.1.0

The profile details are described in detail in the user manual TBN/TRN15469.

CANOPEN SPECIFICATION OVERVIEW (WWW.CAN-CIA.ORG)

CiA DS301	CANopen Application Layer and Communication Profile, Version 4.2.0
CiA DS406	CANopen - Device Profile for Encoders, Version 4.1.0
CiA DS305	CANopen - Layer Setting Sevices and Protocol (LSS)
DIN EN 50325-5	2016-06 Industrial communication subsystem based on ISO 11898 (CAN) - Part 5: Functionally safe communication based on EN 50325-4.

* This value is valid for slow rotations (≤ 30 rpm or ≤ 180°/s) and with synchronous polling of the redundant encoder position. Otherwise, the synchronism value may become higher.
** No galvanic isolation between supply voltage and bus lines (see also CiA DS301) With galvanic isolation, see version V1 (page 6) higher values are possible.

TECHNICAL DATA

MECHANICAL DATA

Operating speed	1.000 min^{-1} max. (Higher values on request)
Angular acceleration	10^5 rad/s^2 max.
Moment of inertia (rotor)	20 gcm^2
Operating torque	≤ 8 Ncm (at 500 rpm)
Starting torque	≤ 4 Ncm
Permissible shaft load	250 N axial and radial
Bearing service life	≥ 10^9 revolutions
Mass	approx. 0,5 kg

ENVIRONMENTAL DATA

Working temperature range	- 40 °C to + 85 °C
Storage temperature range	- 20 °C to + 60 °C (due to packaging)
Resistance	to shock (DIN EN 60068-2-27): 250 m/s^2 ; 6 ms; in 3 axes every 100x to vibration (DIN EN 60068-2-6): 200 m/s^2 ; 10 Hz ... 2000 Hz; in 1 h in 3 axes
Protection grade (DIN EN 60529)	IP65 (Nilos ring) IP67 (Standard) IP68/69K (optional)
EMV standards	EN 61000-6-2 (ESD) EN 61000-4-4 (Burst) EN 61000-6-4 (Emission)

SAFETY DATA

The calculations were carried out using the "Parts Count Method" based on the British Telekom Handbook of Reliability Data (BT-HRD5). Furthermore, MTTFd = MTTF * 2.

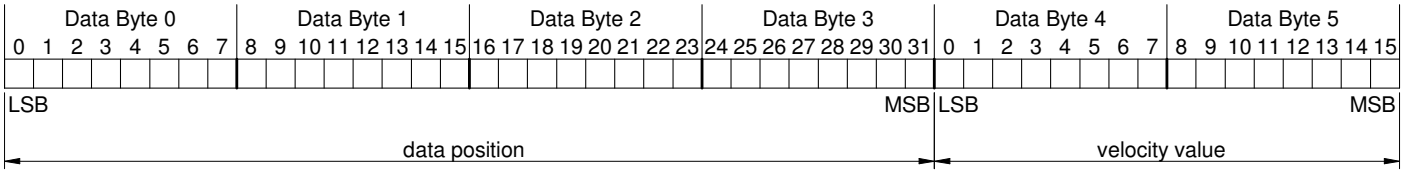
The following values apply for each channel separatly:

MTTFd at 25°C	202.4 years
MTTFd at 55°C	159.84 years
MTTFd at 70°C	127.04 years
MTTFd at 85°C	98.00 years

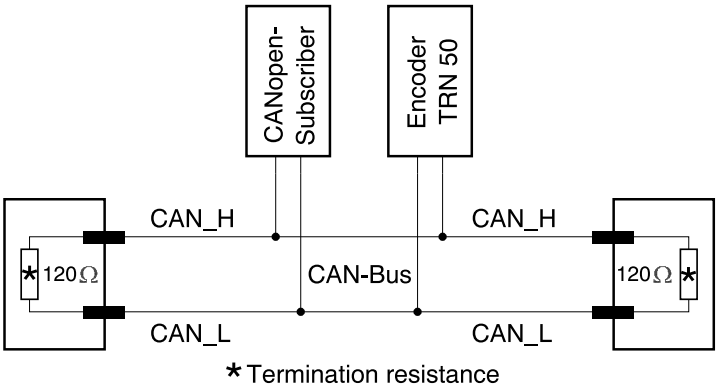
TECHNICAL DATA / PRODUCT CHARACTERISTICS

DATA PROFILE CANOPEN / NODE 1,2

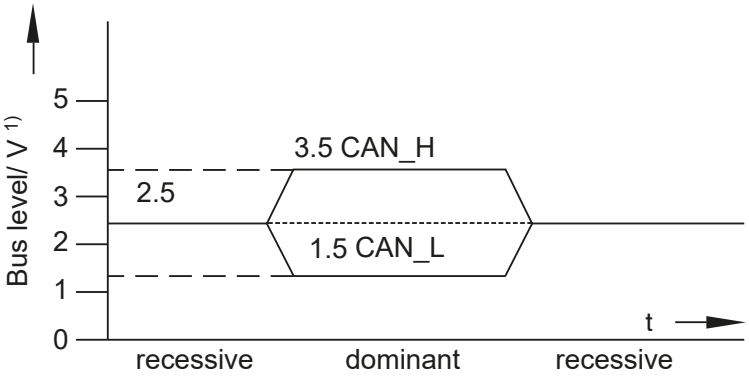
PDO 1 / PDO 2



BUS CONNECTION TO ISO / DIS 11898



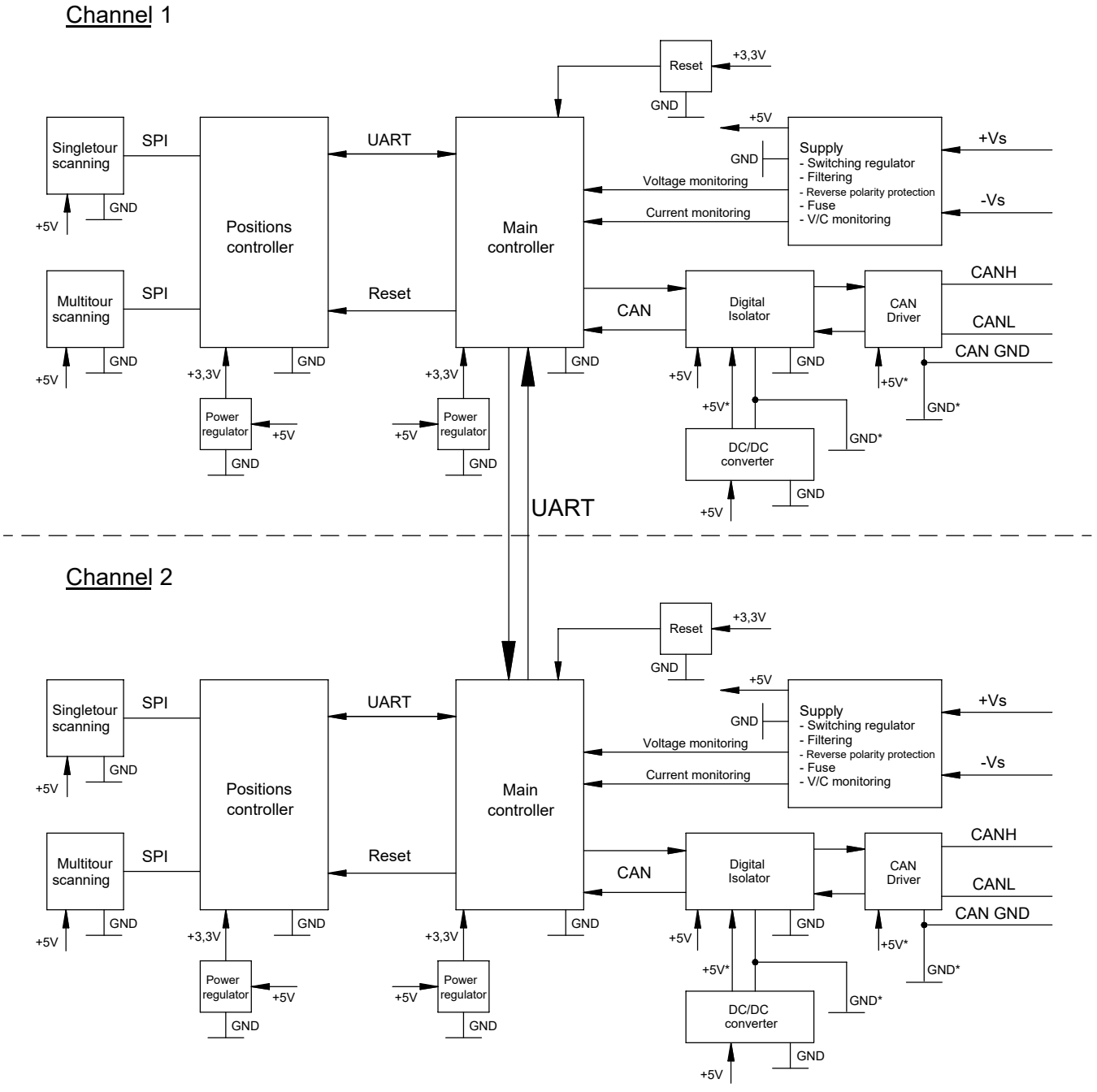
OUTPUT LEVEL TO ISO / DIS 11898



1) at Common-Mode-Voltage = 0 V

TECHNICAL DATA / PRODUCT CHARACTERISTICS

SCHEMATIC DIAGRAM



SLEWING RING SOFTWARE ‘S’ FOR TRN REDUNDANT ENCODER

For applications in wind turbines, cranes, transport units, etc. it is desirable to emulate the function of a mechanical gearbox. For example, if the rotary encoder is coupled to the drive axle of a gearbox or if the position of a slewing ring is to be detected using a measuring gear with coupled rotary encoder.

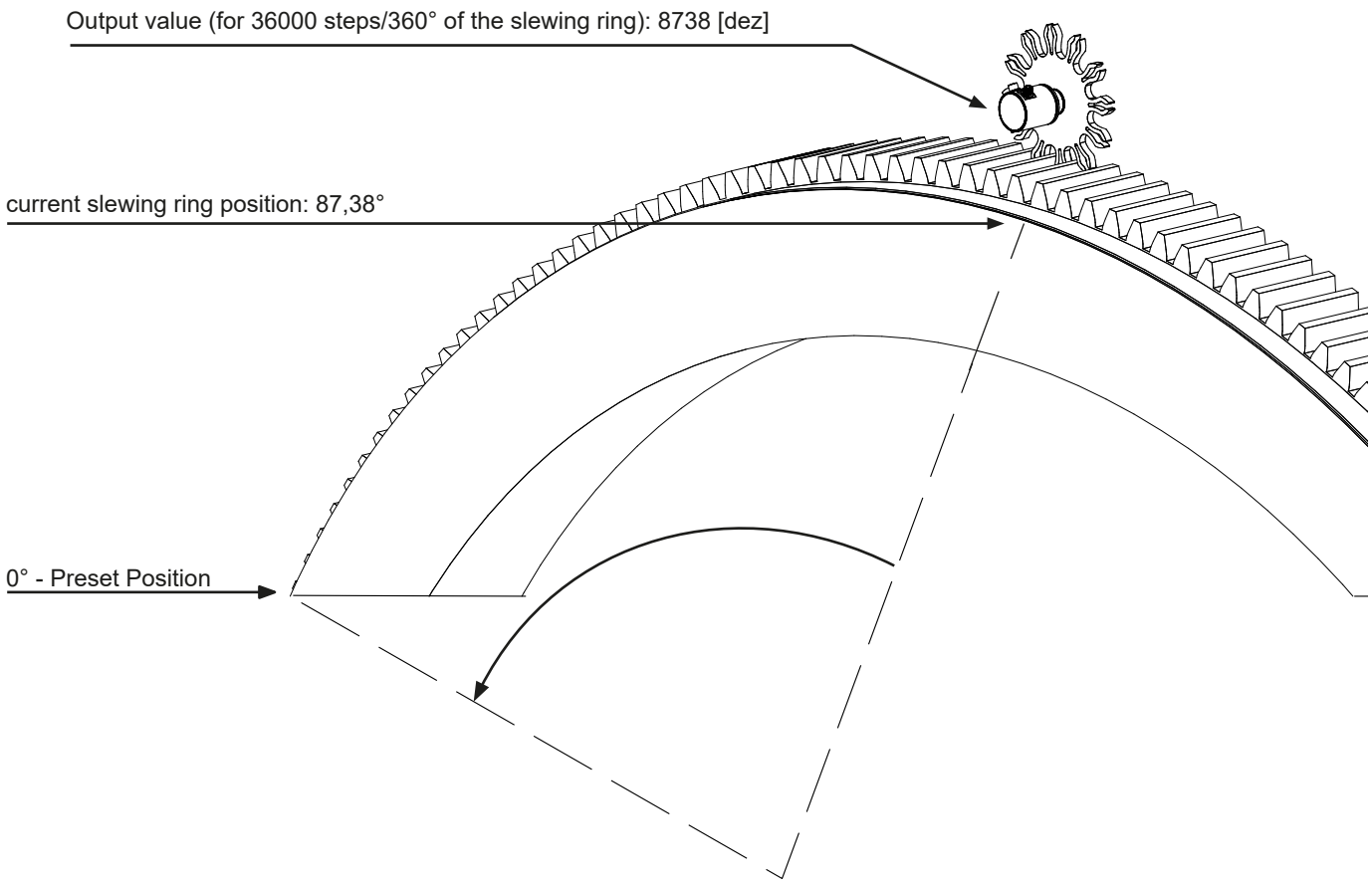
Software version 'S' provides this function. The encoder is located on the fast gear axis (drive wheel) and calculates the position of the slow gear axis (output wheel) via the transmission ratio. The transmission ratio and the resolution of the output axis (digit per revolution) can be freely selected. The output code is consistent beyond the code range of the encoder, regardless of the selected transmission ratio. The transmission ratio can be even or odd.

The user does not have to evaluate the measure gear revolutions and can run through any number of measure gear periods in any direction. This means that non-reversing operation is possible.

The slew ring software manages a global offset, which ensures that a full gear period is always available, even at the end of the encoder's code range. For the correct function of the module, the encoder may only be rotated a pre-determined number of revolutions at the encoder shaft (1024 to 2047 revolutions in each direction by default depending on the gear ratio) in a de-energised state. Please see Handbook TXN 15469 for further details, especially "Safety Notes to slewing ring functionality for gear_configuration".

ELECTRICAL CONNECTION

The output resolution can be customer specific ex-works or parameterized by the customer with the "gear_configuration" CANopen Objects. Depending on the gear ratio, different resolutions e.g. 1/100° (36000 steps/360° slewing ring rotation) or 1/1000° (360000 steps/360° slewing ring rotation) can be parameterized. For further details please refer to Handbook TXN 15469.

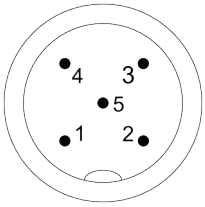


ELECTRICAL CONNECTION - PINOUT

ELECTRICAL CONNECTION

TRN79: . . . . . With 2x connector M12x1, pin, 5-pin, A-coded
With radial cable, twisted pair, e.g. 4 x 2 x 0.25 mm^2, shielded (standard)
The TYxxxxx pin assignment is part of the scope of delivery and is included with each device.
Available EDS file, data sheet and manual on request

POLE DIAGRAM OF DEVICE CONNECTOR, M12 X 1, A-CODED, 5-PIN, MALE



GALVANIC POTENTIAL ISOLATION: -V_S, CAN_GND AND HOUSING/CABLE SHIELDING

The description of the different versions of galvanic potential (V1 to V3) relates exclusively to the interrelationships between the individual potentials (-V_S, CAN_GND and housing/cable shielding), i.e. whether or not they are galvanically connected. The connection assignment (TYxxxxx) should be observed. This connection assignment is included with each device and a copy can be requested as needed.

V1: CAN_GND, -V_S AND HOUSING/CABLE SHIELDING GALVANICALLY ISOLATED

This version has complete galvanic isolation. The housing/cable shielding are galvanically isolated from -V_S and CAN_GND, and -V_S and CAN_GND are also galvanically isolated from one another. The cable shielding is galvanically connected to the housing via the connector housing

PIN. . . . . Function
1 . . . . . CAN GND
2 . . . . . Operating voltage + V_S
3 . . . . . Operating voltage - V_S
4 . . . . . CAN_H
5 . . . . . CAN_L

V2: CAN_GND AND -VS NOT GALVANICALLY ISOLATED, CABLE SHIELDING GALVANICALLY ISOLATED

This version has partial galvanic isolation: The housing/cable shielding are galvanically isolated from -V_S and CAN_GND.
But: -V_S and CAN_GND are not galvanically isolated from one another. The cable shielding is assigned to pin 1.

PIN. . . . . Function
1 . . . . . Shielding
2 . . . . . Operating voltage + V_S
3 . . . . . Operating voltage - V_S and CAN-GND
4 . . . . . CAN_H
5 . . . . . CAN_L

V3: CAN_GND, -VS AND CABLE SHIELDING/HOUSING NOT GALVANICALLY ISOLATED

This version has no galvanic isolation: The housing/cable shielding is not galvanically isolated from -V_S and CAN_GND and -V_S and CAN_GND are not galvanically isolated from one another.

PIN. . . . . Function
1 . . . . . Shielding – short-circuited with PIN 3
2 . . . . . Operating voltage + V_S
3 . . . . . Operating voltage - V_S and CAN-GND – short-circuited with PIN 1
4 . . . . . CAN_H
5 . . . . . CAN_L

E1 CERTIFIED ENCODER "E1" (E1*10R06/02*9992*00)

If the application requires an encoder with UN/ECE type approval for road vehicles certain parts of the order designation are fixed to comply with the certified version.

TRN79 - XXX XXXXX X XXXX R2 C3 S2 V2 NXX

Blanks marked with "X" can be determined by the customer. For E1 certified versions the HW-version of the electronics is fixed. Further and complete order designation is handled on page 11

E1 - UN/ECE SPECIFIC ORDER DESIGNATION FOR CERTIFIED ENCODERS

Feature	Order designation	Description	Variations with current E1 certified encoder possible	Values
Model	TRN	Multiturn Encoder with CANopen interface **with E1 certified specific properties for: HW-version (circuit board)**	No	**HW-version (circuit board): P-0851-1 TRN79 R2 S2 V2**
Design Form	79	79mm housing diameter	No	-
Flange	K / KP /KZ	Mechanical execution of the flange coupled with specific cam (see page 9 for details)	Yes	As stated in the order designation
Housing material	A / S / V / W	Housing material (see page 9 for details)	Yes	As stated in the order designation
Single turn resolution	4096 / 8192 / 16.384	Resolution of 360° of the encoder shaft in steps	Yes	As stated in the order designation
Output code	R / S	Output data coded as simple binary (R), or calculated to the customer application with slewing gear function (S) (for slewing ring function see page 5 for further information)	Yes	As stated in the order designation
Multiturn resolution	4096 (upon customer request a value < 4096 can be implemented tolerated by the active certification)	Multiturn count of maximum revolutions of the encoder shaft	No	As stated in the order designation
Redundancy	R2	2 fully redundant autonomus CANopen Sensors coupled for monitoring functions	No	-
CANopen version	C3	CANopen version: 4.0.2	No	
Electrical connection	S2	Electrical connection with two plugs M12 with 5 poles (pin / male)	No	-
Galvanic isolation	V2	Partial galvanic separation: (see page 9 for details)	No	-
Variant	**NXX ("XX" are spacers for a consecutive number)**	**For E1 approved encoders this indicates customer specific properties named in "Values" on the right**	Yes	**1. customer specific entrys in CANopen objects 2. customer specific label 3. IP-Rating 4. Customer specific mechanical design**

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ORDER CODE FORMAT

TRN	79 -	K	A	16834	R	4096	R2	C3	S2	V1	N	01	STANDARD VERSION

TRN	Multiturn encoder with CANopen interface (design Ø 79)		
79	Design form	79	Design form Ø 79 mm
K	Flange and shaft type	K KP KZ	Clamped flange, shaft Ø 10 mm with flattened area** Clamped flange, shaft Ø 12 mm with feather key** Clamped flange, shaft for measuring gear ZRS see data sheet ZRS 11877
A	Housing material	A S V	Aluminium 3.2315 (AlMgSi1) Stainless steel 1.4305 Stainless steel 1.4404
16834	Resolution in Steps/360°	4096 8192 16384	12 bit 13 bit 14 bit
R	Output code	R S	Binary Slewing ring functionality
4096	Measuring range	4096	Number of revolutions
R2	Redundancy	R2	Redundant autarkic sensor system
C3	Profile	C3	CANopen Version 4.0.2
S2	Electrical connection (see also page 7)	S T K L 1 2	Device connector M12, 5-pole, radial Device connector M12, 5-pole, axial Cable, 1m, radial (other lengths on request) Cable, 1m, axial (other lengths on request) 1 x Device connector or cable 2 x Device connector or cable → Combine S, T, K or L and quantity 1, 2
V1	Galvanic Isolation (see also page 7)	V1 V2 V3	$-V_S$ ǂ CAN_GND ǂ Shield/housing $-V_S$ = CAN_GND ǂ Shield/housing $-V_S$ = CAN_GND = Shield/housing
N	Output signal	N	CANopen-Interface
01	Electrical and mechanical variants*	01	Standard version

* The basic versions (standard) according to the data sheet bear the number 01. Deviations are marked with a variant number and documented at the factory.
** Standard version with shaft sealing ring

ACCESSORIES (SELECTION)

MATING CONNECTORS

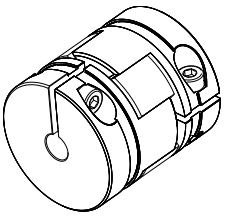
Order number	STK5GS56	STK5WS58	STK5GS107
Type	M12x1	M12x1	M12x1
Pole number	5	5	5
Contact design	Socket, A-coded	Socket, A-coded	Socket, A-coded
Connector design	straight	angled	straight
Housing material	Brass, nickel-plated	Brass, nickel-plated	Stainless steel 1.4404
Cable ø (mm)	6 - 8	6 - 8	5.5 - 8.6
Connection type	Screws	Screws	Screws
Degree of protection class	IP67	IP67	IP67
Shielding	On the housing (V3)	On the housing (V3)	On the housing (V3)
Max. wire size (mm^2)	0.75	0.75	0.75

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

PLAY-FREE CLAMP COUPLING KK14S / X - Y (WITHOUT GROOVE)

X and Y: Bore diameter for shaft support

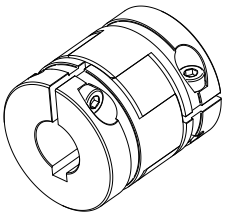
KK14S . . . . . Data sheet 12301



PLAY-FREE CLAMP COUPLING KK14N / X - Y (WITH GROOVE)

X and Y: Bore diameter for shaft support

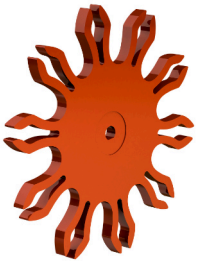
KK14N . . . . . Data sheet 12301



PLAY FREE MEASURING WHEEL ZRS

Play-free measuring wheel ZRS slew ring applications.

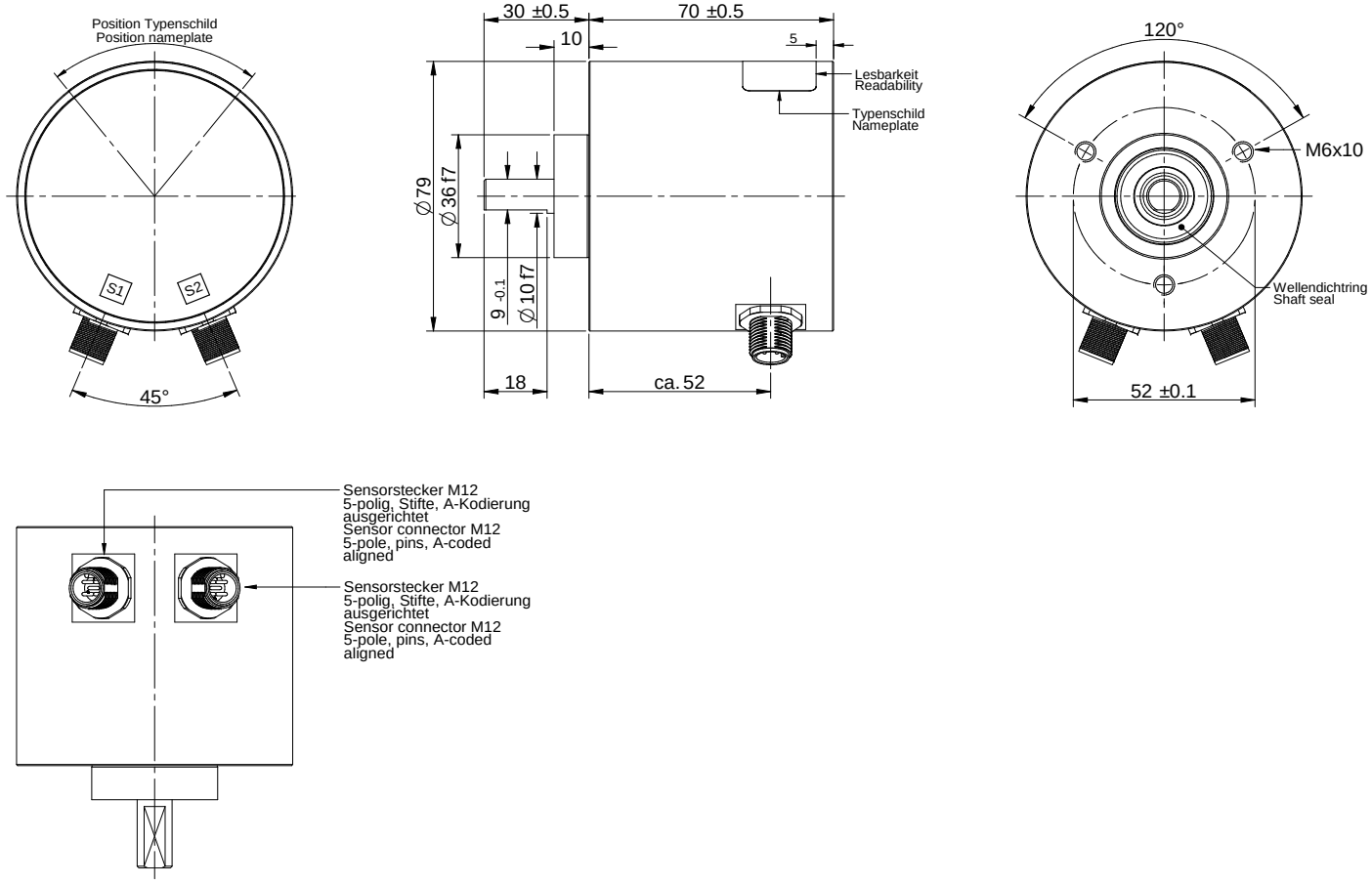
ZRS . . . . . Datasheet 11877



INSTALLATION DRAWINGS

MODEL TRN79 - KX XXXXX X 4096 R2 C3 S2 VX N01

Dimensions in mm



INSTALLATION DRAWINGS

MODEL TRN79 - KZX XXXXX X 4096 R2 C3 S2 VX N01

Dimensions in mm