

POSITAL

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DATA SHEET ABSOLUTE ROTARY ENCODER CANOPEN SAFETY



Main Features

- Compact and Heavy Duty Industrial Design
- Interface: CANopen / CANopen Safety
- Housing: \varnothing 58 mm
- Solid shaft: \varnothing 6 or 10 mm, Flattened
- Blind Hollow Shaft: \varnothing 15 mm
Non Safety Position Value
- Max. 65536 Steps per Revolution (16 Bit)
- Max. 16384 Revolutions (14 Bit)
Safety Position Value
- Max. 1024 Steps per Revolution (10 Bit)
- Max. 16384 Revolutions (14 Bit)

Mechanical Structure

- Aluminium Flange and Housing
- Stainless Steel Shaft
- Optional: Stainless Steel Flange / Housing
- Precision Ball Bearings with Sealing or
Cover Rings
- Code Disc made of unbreakable and
durable Plastic
- Mechanical Optical Gearing for Revolution
Measurement

Software Features Non Safety

- Direction of Rotation (Complement)
- Resolution per Revolution
- Total Resolution
- Preset Value
- Baud Rate and CAN-Identifier
- Transmission Mode:
Polled Mode, Cyclic Mode, Sync Mode

Software Features Safety

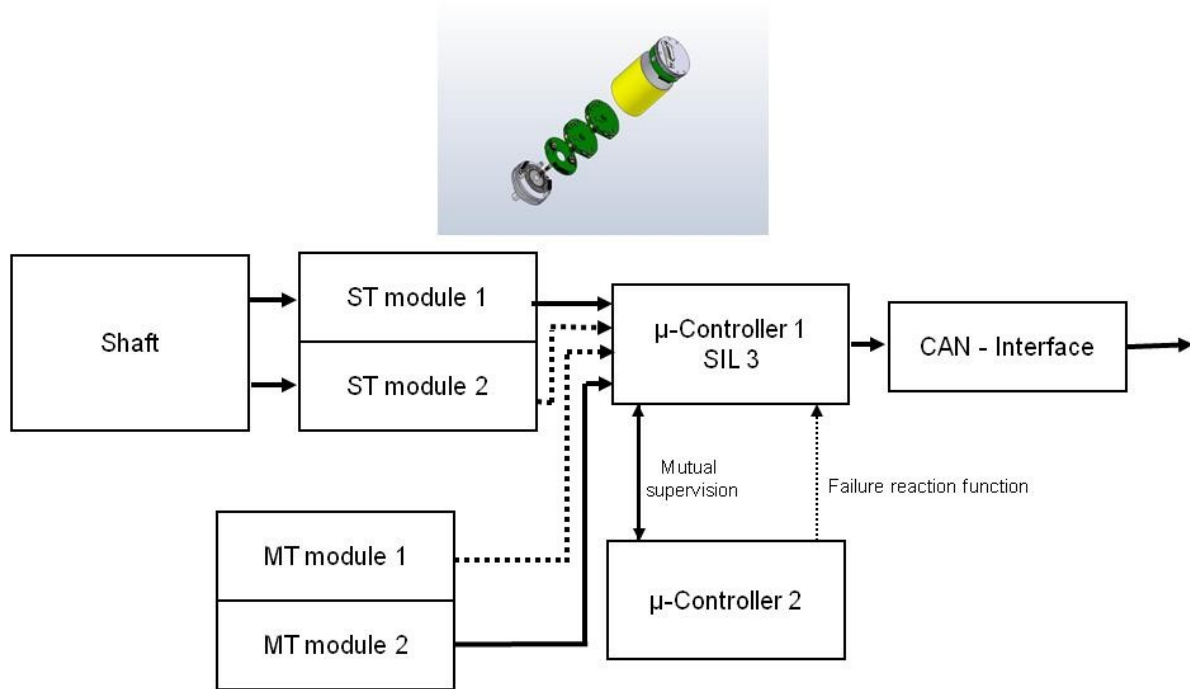
- Direction of Rotation (Complement)
- Preset Value
- Position via SRDO according to EN 50325-
5 (profile DS-304)

Electrical Features

- Temperature Insensitive IR-Opto-Receiver-
Asic with integrated Signal Conditioning
- Connection Cap: Status indication with
two LEDs
- Polarity Inversion Protection
- Over-Voltage-Peak Protection
- CANopen and CANopen Safety Interface

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Function Principle



The encoder is built up module orientated and contains the following parts:

- Flange module containing one shaft with a mounted code disc made of unbreakable and durable plastic. High mechanical load is achieved with double ball bearings.
- ST (Single-Turn) module to measure optically the resolution per revolution.
- MT (Multi-Turn) module to measure the number of revolutions with an optical gearing unit
- Microcontroller module for signal conditioning and network communication via CANopen safety

As shown in the block diagram above Single Turn and Multi-Turn module are built up redundant in

the encoder. A SIL-3 certified microcontroller (μ-Controller 1) reads in the position value from both position channels and transmits via two decoupled CAN controller and one transceiver the information to the CANopen safety network. With the second microcontroller (μ-Controller 2) a mutual supervision between both microcontrollers is additional realized.

Regarding communication protocol standards CANopen and CANopen Safety is supported whereby both can be used at the same time. Especially the high resolution position value in standard CANopen framing can be used for interpolation mode in drives.

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Technical Data

General Description

Safety Integrity Level (EN 62061)	SIL CL 3
Performance Level (EN ISO 13849-1)	PL e
Safety Category (EN ISO 13849-1)	Cat 4
MTTF _d (EN ISO 13849-1)	129 Years
DC _{avg} (EN ISO 13849-1)	98.8%
Intended Time of Usage (EN 62061)	10 Years
PFH _d (EN 62061)	$6.2 \cdot 10^{-9}$ 1/h; 6% of SIL3 limit
PFD _{avg} (EN 62061)	$2.7 \cdot 10^{-4}$ 1/h; 27% of SIL3 limit
Proof Test Interval (EN 62061)	10 years
SFF (EN 62061)	99,4%
Logical Architecture	Redundant Design
Physical Architecture	Redundant Design
Certification	By TUV Rheinland, Reg. Number: 01/205/0701/10

Electrical Data

Interface	CANopen safety according to EN 50325-5, (profile CiA DS-304) CANopen according to CiA DS-301 Transceiver according to ISO 11898, Galvanically isolated by opto-couplers
Transmission rate	Max. 1 Mbaud
Device addressing	Programmable via SDO telegrams Encoder with Connection Cap (H3P): Additional adjustable by rotary switches in connection cap
Supply voltage	12–30 V DC (absolute limits) ¹⁾
Current consumption	Multi-Turn: Max. 100 mA with 12 V DC, max. 50 mA with 24 V Single-Turn: Max. 50 mA with 12 V DC, max. 20 mA with 24 V
Power consumption	Multi-Turn: Max. 1.2 Watt Single-Turn: Max. 0.5 Watt
Step frequency LSB	800 kHz
Accuracy of division	Safety Position Value: 10 Bit Non Safety Position Value: $\pm \frac{1}{2}$ LSB (12 bit), ± 4 LSB (16 Bit)
EMC	Emitted interference: EN 61000-6-4 Noise immunity: EN 62061 Attachment 2

1) Absolute rotary encoders shall be connected only to subsequent electronics whose power supplies comply with EN 50178

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Mechanical Data

Housing	Aluminium, Optional Stainless Steel
Lifetime	Dependent on flange and shaft loading – refer to table below
Max. Shaft Loading	Up to Axial 40 N, Radial 110 N
Inertia of Rotor	$\leq 30 \text{ gcm}^2$
Friction Torque at +25°C	$\leq 3 \text{ Ncm}$ (Without Shaft Sealing)
RPM (Continuous Operation)	Max. 6.000 RPM
Shock (EN 60068-2-27)	$\leq 100 \text{ g}$ (half sine, 6 ms)
Permanent Shock (EN 60028-2-29)	$\leq 10 \text{ g}$ (half sine, 16 ms)
Vibration (EN 60068-2-6)	$\leq 10 \text{ g}$ (10 Hz – 1,000 Hz)
Weight (With Connection Cap)	Singleturn $\approx 600 \text{ g}$ Multiturn $\approx 800 \text{ g}$
Weight (Stainless Steel Version with Connection Cap)	Singleturn $\approx 1,200 \text{ g}$ Multiturn $\approx 1,300 \text{ g}$
Weight (Cable / Connector Version)	Singleturn $\approx 350 \text{ g}$ Multiturn $\approx 500 \text{ g}$
Weight (Stainless Steel Version)	Singleturn $\approx 500 \text{ g}$ Multiturn $\approx 600 \text{ g}$

Requirement for Coupling

Minimum Torque	500 Ncm
Design	Positive locking with style of D-form for coupling ring or Two set screw in the coupling ring with usage of thread locking compound. Coupling internal screw thread and screw shall be cleaned before threadlocker is used! Both shaft sides of drive and encoder shall be flattened for positive locking!

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Flange

Flange	Synchro (S)		Clamp (C)	Hollow shaft (B)
Shaft diameter	6 mm	10 mm	10 mm	15 mm
Shaft length	10 mm	20mm	20 mm	–
Hollow shaft depth min. / max.	–	–	–	15 mm / 30 mm

Minimum (mechanical) Lifetime

Flange	Lifetime in 10 ⁸ revolutions with (F _a /F _r)		
	40 N / 60 N	40 N / 80 N	40 N / 110 N
C10 (Clamp Flange 10 x 20)	50	20	8
S10 (Synchro Flange 10 x 20)	52	22	8
S06 (Synchro Flange 6 x 10) without shaft sealing	164	69	26

Lifetime based on L01 with reliability of 99%.

S06 (Synchro flange 6 x 10) with shaft sealing: max. 20 N axial, 80 N radial

Environmental Conditions

Operating Temperature Sensor	-30 to +70°C
Storage Temperature	-30 to +70° C
Humidity	98 % (without liquid state)
Protection Class (EN 60529)	Casing side: IP 65 Shaft side: IP 64 (optional with shaft sealing: IP66)
Cable Gland	- 20 to +70° flexible installed cables
	- 40 to +70°C fixed installed cables

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Interface

Configuration

The standard configuration of the encoder in cable or connector version is: node number 32 and baudrate 125 Kbaud. For adapting the encoder for

a respective application the customer could use SDO telegrams. Valid baudrate range is 20 kbaud to 1Mbaud and for the node number from 1 to 64.

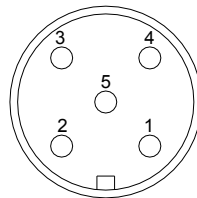
Electrical Interface

The POSITAL absolute rotary with cable- and connector-exit were designed in accordance to CiA normative DR303-1 Cabling and connector pin assignment. Shielded field bus cables shall be used.

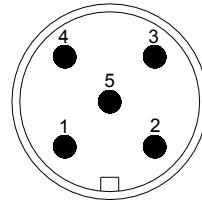
There are various electrical connecting options like 5 pin M12 connector. The encoder can be connected in the following versions:

- 5 pin M12 male connector and one 5 pin M12 female
- 5 pin M12 connector and optional venting

5 Pin M12 Round connector Pin number	Signal
1	CAN Ground
2	12 – 30 V supply voltage (see section electrical data)
3	0 V supply voltage
4	CAN High
5	CAN Low



5 Pin M12 Connector Female



5 Pin M12 Connector Male

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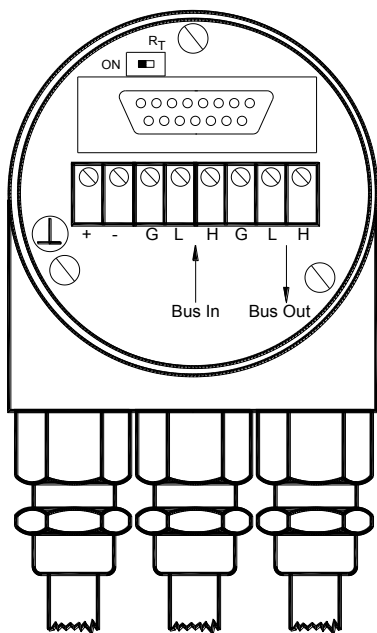
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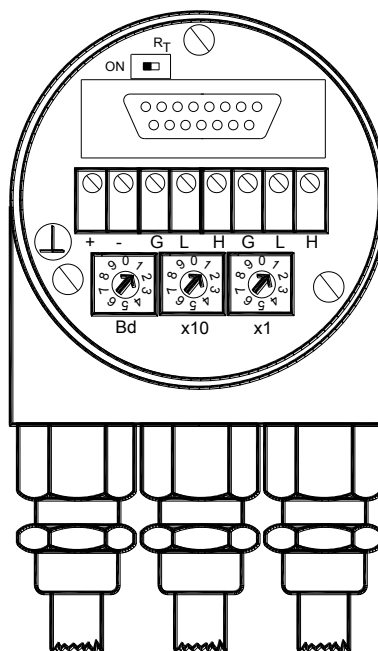
Installation Connection Cap

The rotary encoder is connected with two or three cables depending on whether the power supply is integrated into the bus cable or connected separately. If the power supply is integrated into the bus cable, one of the cable glands can be fitted with a plug. The cable glands are suitable for cable diameters from 5 up to 9 mm. Shielded field bus cables shall be used.



Configuration Connection Cap

The setting of the node number is achieved by 2 turn-switches in the connection cap. Possible addresses lie between 1 and 64 whereby every address can only be used once. The connection cap can be opened for installation by removing the two cap torx screws. Installation shall be done by trained personal.

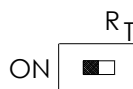


Clamp	Description
⊥	Ground
+	12 – 30 V Supply voltage
-	0 V Supply voltage
G (left)	CAN Ground (Bus In)
L (left)	CAN Low (Bus In)
H (left)	CAN High (Bus In)
G (right)	CAN Ground (Bus Out)
L (right)	CAN Low (Bus Out)
H (right)	CAN High (Bus Out)

A termination resistor is integrated in the connection cap. The resistor must be switched on if the encoder is connected at the end or at the beginning of the bus. Separation of Bus In and Bus Out signals if termination resistor is activated.

Resistor:

Last Device



Device X



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Setting of Baudrate

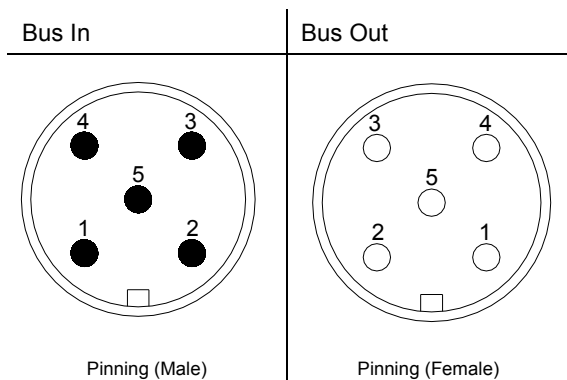
The baudrate can be set in the connection cap with one bcd coded rotary switch named "Bd" or for the connector / cable interface version by sending a CAN telegram (see object 3001 h).

Baudrate in kBit/s	BCD coded rotary switches	Values Object 3001h
20	0	0
50	1	1
100	2	2
125	3	3
250	4	4
500	5	5
800	6	6
1000	7	7
1000	8	-
1000	9	-

Connection Cap with round Connector

This connection cap type has one or two 5 pin round connectors in M12 version. All other cable glands are replaced by blind caps. Following table indicates pinning of the micro style connector:

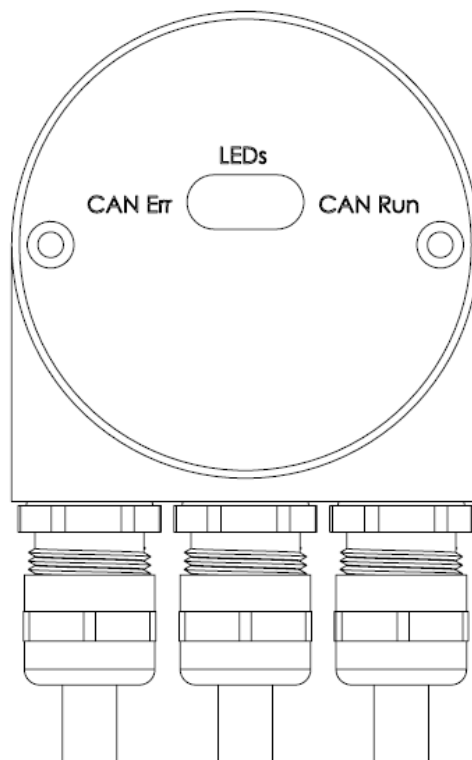
5 Pin Circular Connector



Diagnostic Connection Cap

Two LEDs on the backside of the connection cap show the operating status of the encoder. This can be very useful for installing and setting-up the encoder. Meaning of LEDs acc. to DR 303-3 with mandatory category.

Pin Number	Signal
1	(CAN Ground)
2	Supply voltage 12 – 30 V
3	Supply voltage 0 V
4	CAN High
5	CAN Low



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Within the OPTOCODE Safety encoder a safety and non safety function is integrated, which can be used in the same time. Both functions are strictly divided from each other and do not interact. In the following sections both functions with their corresponding parameters are explained.

General Safety Definitions

Safety State	Within the safety state the encoder stopped the communication of SRDO data and is in the CAN "bus off" state.
Failure Reaction Function	The transmission of SRDO shall be stopped and the encoder enters the inherently safe state.
Intended Usage	The sensor shall be able to measure the physical measurand angle and converts this into a digital position value transmitted via the CAN bus to other field devices. This device function can be used for example in positioning tasks or length measurements. General applications could be: like cranes, construction machines, lifts, packing machines etc.

Safety Function Programmable Encoder – Parameter

Operating Parameters	This parameter determines the counting direction, in which the output code increases or decreases. As an important operating parameter the code sequence (complement) can be programmed.
Preset Value	The preset value is the desired position value, which should be reached at a certain physical position of the axis. The position value is set to the desired process value by the parameter preset.
Position Value	The safety position value has a resolution of 10 Bit per revolution and 14 Bit for the number or revolutions. Within the SRDO communication the position value is transmitted as a normal value and additional as inverted value according to the definition of SRDO communication in the CANopen Safety Standard EN 50325-5 (profile DS-304).
Checksum	The checksum is calculated about the operating parameter and preset value to achieve a high level of data integrity.

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Programmable SRDO Parameter according to standard EN 50325-5 (profile DS-304)

SRDO communication parameter	Configuration of SRDO communication transmit parameters defined in object 1301 hex, like information direction, refresh time, transmission type and COB-ID.
Configuration valid	This object 13FE hex shall contain an acknowledgement flag for a valid configuration.
Safety configuration checksum	For the SRDO a safety configuration checksum is provided according to a polynomial defined in EN 50325-5 (profile DS-304) respectively in object 13FF hex.

Non Safety Programmable Encoder – Parameter (according to DS-406)

Operating Parameters	This parameter determines the counting direction, in which the output code increases or decreases. As an important operating parameter the code sequence (complement) can be programmed.
Resolution per Revolution	The parameter resolution per revolution is used to program the desired number of steps per revolution.
Total Resolution	This parameter is used to program the desired number of measuring units over the total measuring range. This value may not exceed the total resolution of the absolute rotary encoder. If the encoder is used in a continuous measuring application, certain rules for the setting of this parameter must be followed. These rules are outlined in the manual.
Preset Value	The preset value is the desired position value, which should be reached at a certain physical position of the axis. The position value is set to the desired process value by the parameter preset.
Position Value	This position value has a high resolution, especially higher than the safety position value. This property can especially be used for drives where a higher accuracy is needed.

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Programmable CAN Transmission Modes (according to DS-301)

Polled Mode	After receiving a RTR (Remote Transmission Request) telegram by the host, the absolute rotary encoder answers with the current process value.
Cyclic Mode	The absolute rotary encoder transmits cyclically - without being called by the host – the current process value. The cycle time can be programmed in milliseconds for values between 1 ms and 65536 ms.
Sync Mode	After receiving a sync telegram by the host, the absolute rotary encoder answers with the current process value. If more than one node number (encoder) shall answer after receiving a sync telegram, the answer telegrams of the nodes will be received by the host in order of their node numbers. The programming of an offset-time is not necessary. If a node should not answer after each sync telegram on the CAN network, the parameter sync counter can be programmed to skip a certain number of sync telegrams before answering again.

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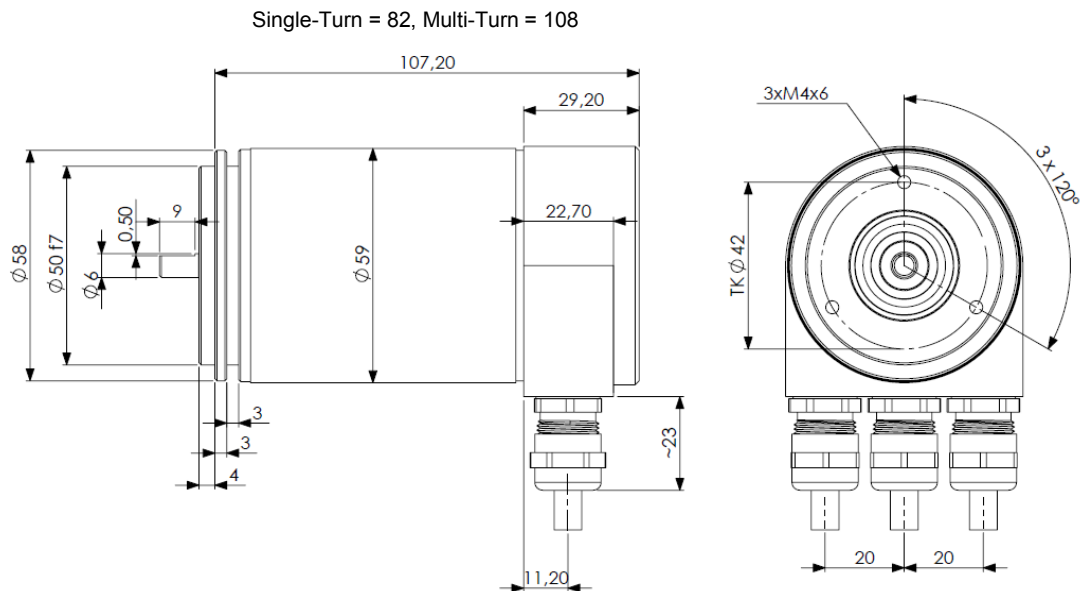
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Mechanical Drawings: Connection Cap Encoder

Synchro Flange (S)

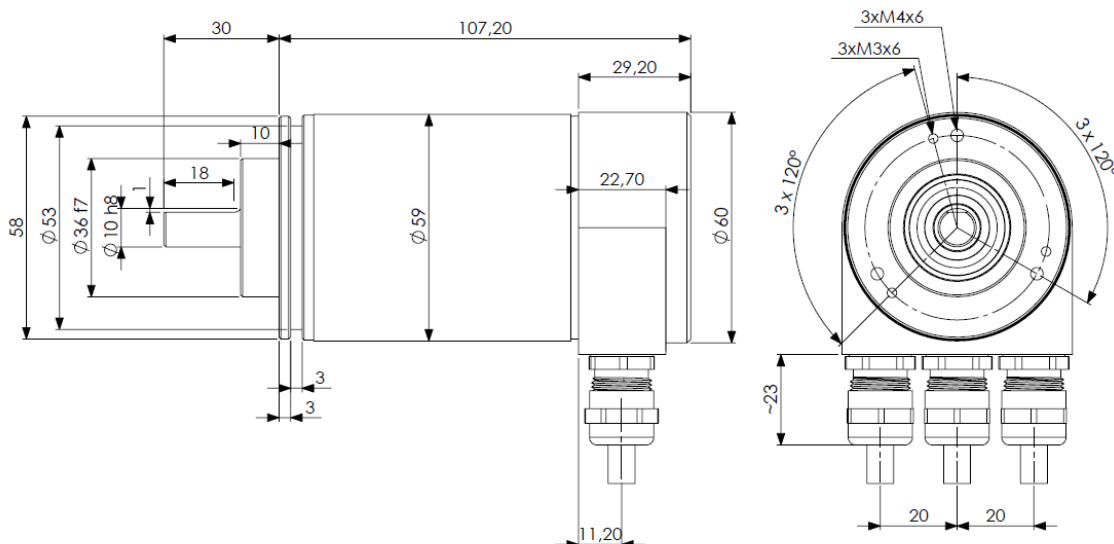
Two versions available with one side flattened shaft:
 S06: Synchro flange with a shaft diameter of 6 mm
 S10: Synchro flange with a shaft diameter of 10 mm

S	d / mm	l / mm
Version S06	6 _{f6}	10
Version S10	10 _{h8}	20



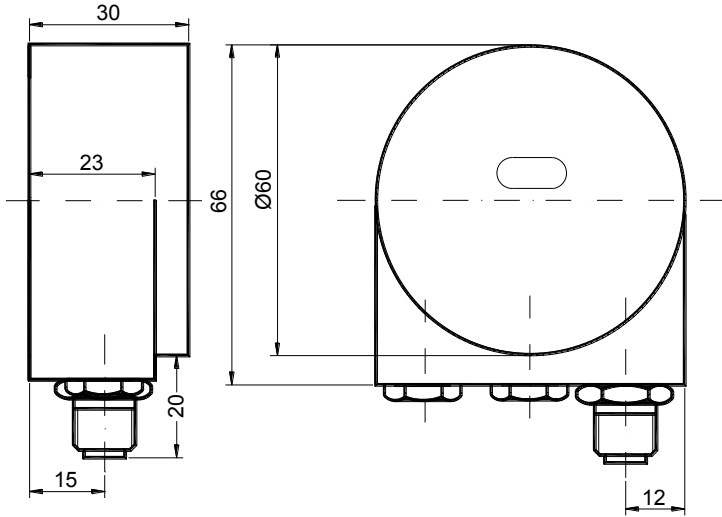
Clamp Flange (C)

Single-Turn = 82, Multi-Turn = 108

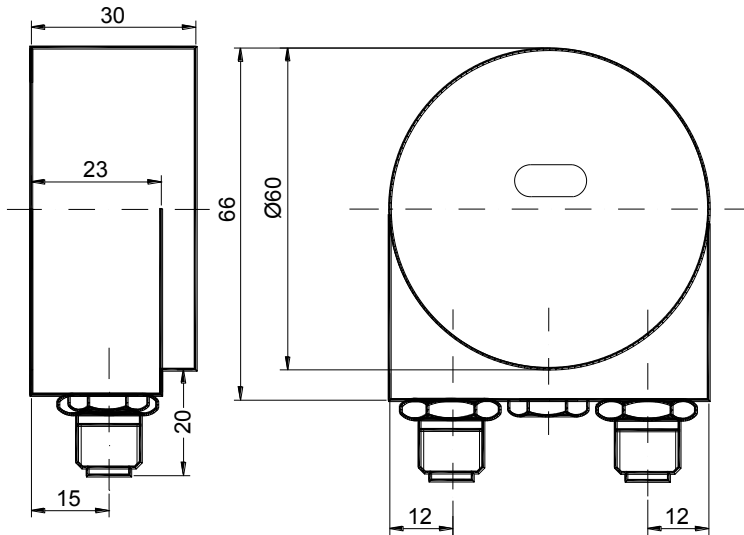


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Connection Cap AH58-B1CA-1BW, 5 Pin round Connector M12, Micro Style



Connection Cap AH58-B1CA-2BW, Female and Male Connector 5 Pin Connector M12, Micro Style



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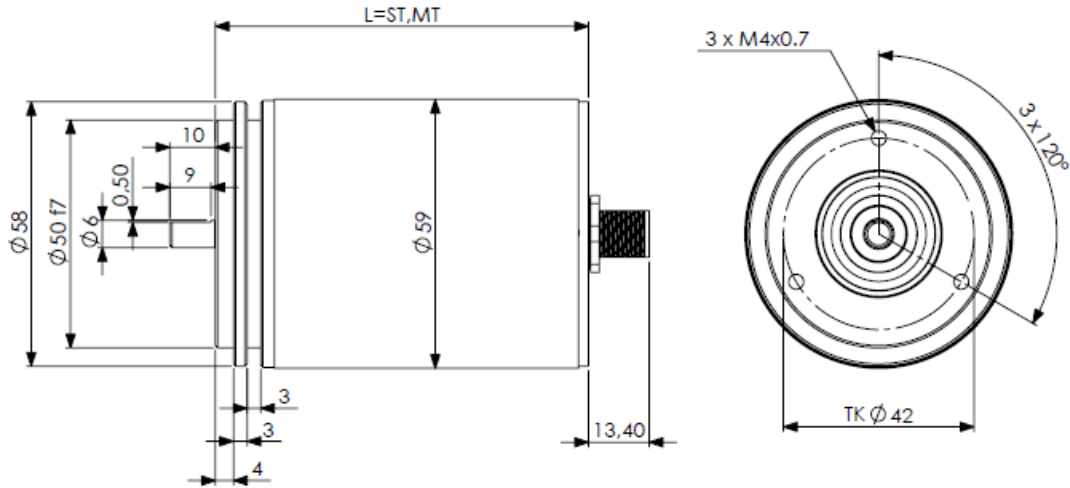
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Synchro Flange (S)

Single-Turn, Multi-Turn Version with Connector Exit, 5 Pin M12 Connector

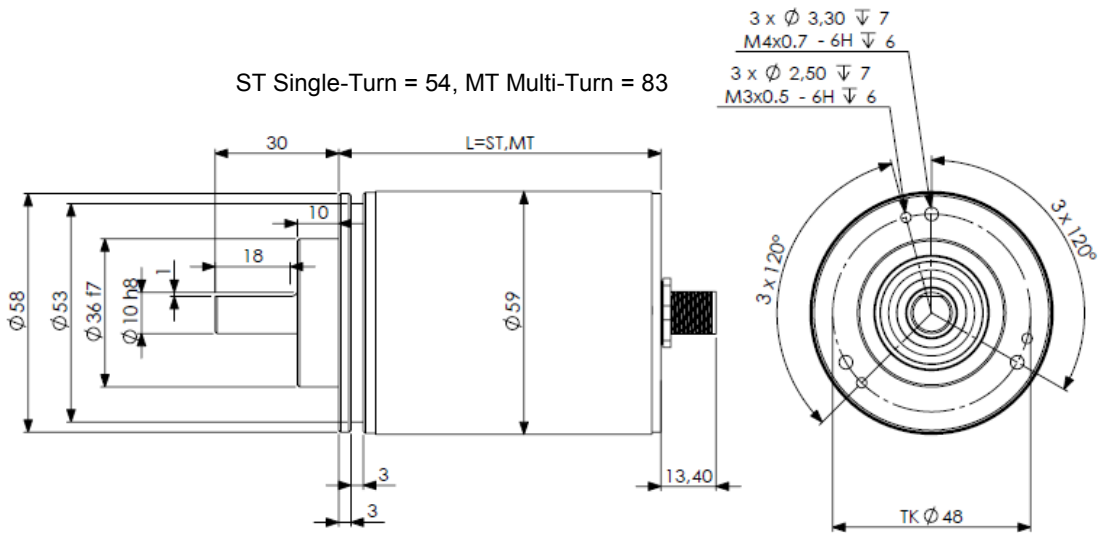
ST Single-Turn = 54, MT Multi-Turn = 83



Clamp Flange (C10)

Single-Turn, Multi-Turn Version with Connector Exit, 5 Pin M12 Connector

ST Single-Turn = 54, MT Multi-Turn = 83



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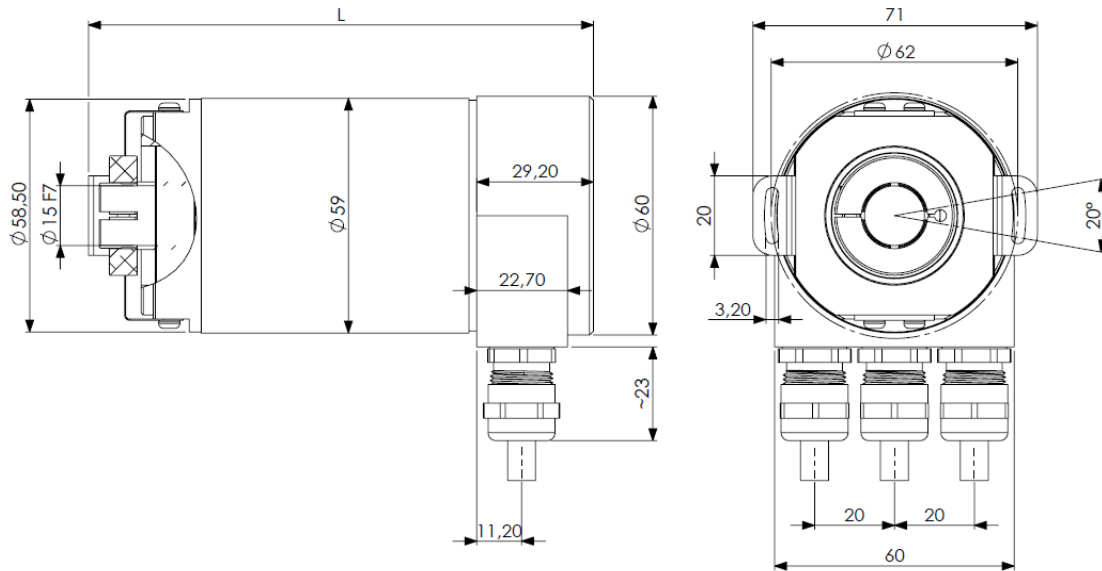
Mounting Instructions

The clamp ring should only be tightened if the shaft of the driving element is inserted into the hub shaft.

Maximum shaft movements of the drive element are listed in the table

	Axial	Radial
Static	± 0,3 mm	± 0,5 mm
Dynamic	± 0,1 mm	± 0,2 mm

Length L: Single-Turn = 100, Multi-Turn = 126



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Models / Ordering Description

IXARC Optical	OCS-	CS	E1	B -	--	---	-	---	-	---	
Interface	CANopen Safety	CS									
Performance Level			E								
Product Version			1								
Code	Binary			B							
Bits for Revolutions	Singleturn					00					
	Multiturn (16.384 Turns)					14					
Steps per revolution	8.192 (0,044°)						13				
	65.536 (0,005°)						16				
Flange	Clamp Flange							C			
	Synchro Flange							S			
	Blind Hollow Shaft							B			
Shaft Diameter	06 mm (Synchro Flange)								06		
	10 mm (Synchro and Clamp Flange)								10		
	15 mm (Blind Hollow Shaft)								15		
Mechanical Options	Without									0	
	Shaft Sealing (IP 66)									S	
	Stainless Steel Version ¹⁾									V	
	Customized									C	
Connection	Connection Cap	Cap encoder with connection cap AH 58-B1CS-3PG								H3P	
		Cap encoder with connection cap AH 58-B1CS-2M20								H2M	
		Cap encoder with connection cap AH 58-B1CA-1BW									H1B
		Cap encoder with connection cap AH 58-B1CA-2BW									H2B
		Cap encoder without connection cap ²⁾									HCC
	Connectors	Connector exit, radial, 5 pin male M12									PRM
		Connector exit, axial, 5 pin male M12									PAM

Standard = bold, further models on request

1) Stainless Steel version is not available with radial cable or connector exit (namely CRW, PRM)

2) For the function of the encoder a connection cap is needed. To order this encoder type only makes sense for spare part / replacement usage

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Connection Caps

All connections caps are equipped with a baudrate and node number, as well as LEDs for switchable terminal resistor, integrated T-coupler diagnosis.
for CAN bus lines, BCD switches to adjust

Article Name	Description
AH 58-B1CS-3PG	Aluminium housing with three M12 cable glands for cable diameters between 5 – 9 mm.
AH 58-B1CS-3PG-VA	Stainless steel housing with three M12 cable glands.
AH 58-B1CS-1BW	Aluminium housing with one 5 pin male M12 connector.
AH 58-B1CS-2BW	Aluminium housing with one 5 pin male M12 connector and one 5 pin female M12 connector
AH 58-B1CS-2M20	Aluminium housing with two M20 cable glands for cable diameter between 9 – 13 mm.

Note

All datasheets and manuals can be downloaded for free from our website www.posita1.eu

Document History

Version	Modifications
1	Date of release 05.01.2010, initial version
2	Date of release 08.07.2010, version 2 Specification of certification registration no. by TUV Rheinland, Specification of detailed value of MTTFd, Removal of encoder version with cable exit in type key, Definition of standard version with 13 bit resolution / revolution
3	Date of release 07.12.2010, version 3 Table entry for cable colors deleted Deleted mechanical drawing of cable exit version Changed manufacturer default setting of baud rate from 20 KBaud to 125 KBaud.
4	Date of release 26.01.2012, version 4 Format changes

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