POSITAL
FRABA

ABSOLUTE ROTARY ENCODER SIL CL 3
WITH CANOPEN INTERFACE
USER MANUAL

CANopen Safety

Main Features

- Compact and heavy-duty industrial design
- Interface: CANopen / CANopen safety
- Housing: 58 mm ∅
- Solid shaft: 6 or 10 mm ∅, flattened
- Blind hollow shaft: 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 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

AMERICA
FRABA Inc.
1800 East State Street, Suite 148
Hamilton, NJ 08609-2020, USA
T +1-609-750-8705, F +1-609-750-8703
www.posital.com, info@posital.com

EUROPE
FRABA AG
Carlswerkstrasse 13c
D-51063 Köln, Germany
T +49 221 96213-0, F +49 221 96213-20
www.posital.eu, info@posital.eu

ASIA
FRABA Pte. Ltd.
60 Alexandra Terrace
Singapore 118502, Singapore
T +65 65148880, F +65 62711792
www.posital.sg, info@posital.sg

POSITAL
FRABA

Table of Contents

Table of Contents....2
General Security Advise....4
About this Manual....4
1. Introduction....5
1.1. Safety Definitions....5
1.1.1. Intended Usage....5
1.1.2. Safety Level....5
1.1.3. Safety Function....5
1.1.4. Safety State....5
1.1.5. Failure Reaction Function....5
1.1.6. Reaction Time....5
1.1.7. Interfaces....6
1.1.8. Maintenance....6
1.1.9. Intended Time of Usage....6
1.2. Function Principle....7
1.3. Detailed Measurement Principle....8
1.3.1. Single-Turn....8
1.3.2. Multi-Turn....8
1.4. General CANopen Information....8
1.5. General CANopen Safety Information....9
1.6. General Configuration Information....9
2. Installation....11
Mounting instructions hollow shaft....12
Mounting Instructions Coupling....12
Mounting Instruction Clamp Flange....13
2.1 Electrical Connection....14
2.1.1 Connection via Connection Cap....14
2.1.2 Setting Node Number for Connector Version....19
2.1.3. Setting Node Number via SDO Objects....20
2.1.4. Setting Baud Rate via SDO Objects....20
3. Technical Data....21
General Description....22
Electrical Data....22
Mechanical Data....23
Minimum Mechanical Lifetime....24
Environmental Conditions....24
4. Configuration....25
4.1 Operating Modes....25
4.1.1 General....25
4.1.2 Mode: Preoperational....25
4.1.3 Mode: Start- Operational....26
4.1.4 Mode: Stopped....26
4.1.5 Reinitialization of the Encoder....26
4.2 Normal Operating CANopen....27
4.2.1 Operating CANopen Safety....27
4.2.2 Initialization Procedure for CANopen Safety....28
4.3 Storing Parameter....30
4.3.1 List of storable Parameter....30
4.3.2 Storing Procedure....30
4.4 Restoring Parameters....31
5. Programmable Parameters....32
5.1 Programming example: Preset Value....33
5.1.1 Set Encoder Preset Value....33
5.2 Communication Profile DS301 specific objects from 100— - 1FFFh....34
5.3 Manufacturer specific objects 2000h – 5FFFh....35
5.4 Application specific objects 6000h – 9FFFh....35
5.5 Object Descriptions....35
Object 1000h: Device Type....35
Object 1001h: Error Register....36
Object 1003h: Pre-Defined Error Field....36
Object 1005h: COB-ID Sync....37
Object 1008h: Manufacturer Device Name....37
Object 1009h: Manufacturer Hardware Version....37
Object 100Ah: Manufacturer Software Version....37
Object 100Ch: Guard Time....37
Object 100Dh: Life Time Factor....38
Object 1010h: Store Parameters....38
Object 1011h: Restore Parameters....38
Object 1014h: COB-ID Emergency Object....39
Object 1017h: Producer Heartbeat Time....39
Object 1018h: Identity Object....39
Object 1301h: 1st Transmit SRDO Communication Parameter....40
Object 1381h: 1st Transmit SRDO Mapping Parameter....41
Object 13Feh: Configuration Valid....42
Object 13FFh: Safety configuration Checksum....42

Object 1800h: 1st Transmit PDO Communication Parameter 43
Object 1801h: 2nd Transmit PDO Communication Parameter 43
Event Timer 44
Object 1A00h: 1st Transmit PDO Mapping Parameter 45
Object 1A01h: 2nd Transmit PDO Mapping Parameter 45
Object 5000h: Safety Position: Configuration parameters 45
Object 5020h: Safety Position: Sensor Value 47
Object 5021h: Safety Position: Inverted Sensor Value 47
Object 50Feh: Safety Position: Configuration Valid 48
Object 50FFh: Safety Position: Configuration Checksum 48
Object 3000h: Node Number 48
Object 3001h: Baudrate 49
Object 6000h: Operating parameters 49
Object 6001h: Measuring units per revolution 50
Object 6002h: Total measuring range in measuring units 50
Object 6003h: Preset value 51
Object 6004h: Position value 51
Object 6200h: Cyclic timer 51
6. Diagnosis 52
6.1 Meaning of the LEDs in the connection cap 52
6.1.1 Emergency Messages 53
6.2 Troubleshooting 54
6.2.1 Power on – Encoder doesn't respond 54
6.2.2 Malfunction of the position value during transmission 54
6.2.3 Too much ERROR-Frames 54
6.2.4 Encoder without connection cap 54
7. Mechanical Drawings 55
8. Mounting instructions 59
Appendix A: Order Codes 60
Appendix B: Glossary 63
Appendix C: List of tables 66
Appendix D: List of figures 66
Appendix E: Document history 66

General Security Advise

Important Information

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

Please Note

Electrical equipment should be serviced only by qualified trained personnel. No responsibility is assumed by POSITAL for any consequences arising out of the use of this material. This document is not intended as an instruction manual for untrained persons.

About this Manual

Background

This user manual describes how to install and configure an OCD SIL CL 3 Absolute Rotary Encoder with CANopen interface.

Relate Note

Version date :	27. February 2015
Version number:	6.0
Reference number:	UME-OCS-CS

Imprint

POSITAL GmbH
Carlswerkstrasse 13c
D-51063 Köln
Telephone +49 (0) 221 96213-0
Telefax +49 (0) 221 96213-20
Internet http://www.posital.eu
e-mail info@posital.eu

Copyright

User Annotation

The POSITAL GmbH welcomes all reader to send us feedback and commands about this document. You can reach us by e-mail at info@posital.eu

1. Introduction

This manual explains how to install and configure the OPTOCODE absolute rotary encoder SIL CL 3 with CANopen interface applicable for military and industrial applications with CANopen or CANopen Safety protocol. The products are compliant with standard DS406 (encoder device profile), DS301 (CANopen communication profile) and DS304 (CANopen Safety protocol). Safety and non safety CANopen communication can be used in the same time with this device.

1.1. Safety Definitions

In the following chapters Safety related definitions are described.

1.1.1. Intended Usage

The absolute rotary encoder measures the physical measure and angle and revolutions and converts this into a digital position value transmitted via the CAN bus according to the CANopen (DS-301) and CANopen Safety (DS-304) protocol to other field devices. The encoder as safety device shall be connected to a CANopen Safety network according to DS-304 and shall only be used for this purpose. The safety function can be used in safety related applications like positioning tasks or length measurements. General applications could be like cranes, construction machines, lifts, packing machines etc.

1.1.2. Safety Level

Safety Integrity Level (SIL) Standard EN 62061	Claim Level 3
Performance Level (PL) Standard EN ISO 13849-1	e
Safety Category (Cat.) Standard EN ISO 13849-1	4
Logical Architecture	Redundant design
Physical Architecture	Redundant design
Certified by	TUV Rheinland

1.1.3. Safety Function

The absolute encoder with CANopen Safety interface transmits a safety position value with a resolution of 10 Bit per revolution and 14 bit for the number of revolutions. The safety function is only active in the CANopen state “OPERATIONAL”.

1.1.4. Safety State

Within the safety state the encoder stops the communication of SRDO data.

1.1.5. Failure Reaction Function

The transmission of SRDO shall be stopped and the encoder enters the inherently safe state.

1.1.6. Reaction Time

The reaction time is defined to mimimal 24 ms. But it is possible to transmit the safety position value much faster by setting the refresh time / SCT of the SRDO communication channel. This time can be defined in the set of communication parameter of the SRDO object (1301 hex). Further details in this manual in chapter 5.5. Object Description with “Object 1301h: 1st Transmit SRDO Communication Parameter”.

1.1.7. Interfaces

The sensor has one CAN interface and supports the protocol CANopen (according to DS-301) and CANopen Safety (acc. to DS-304). Both protocols can be used at the same time in the device.

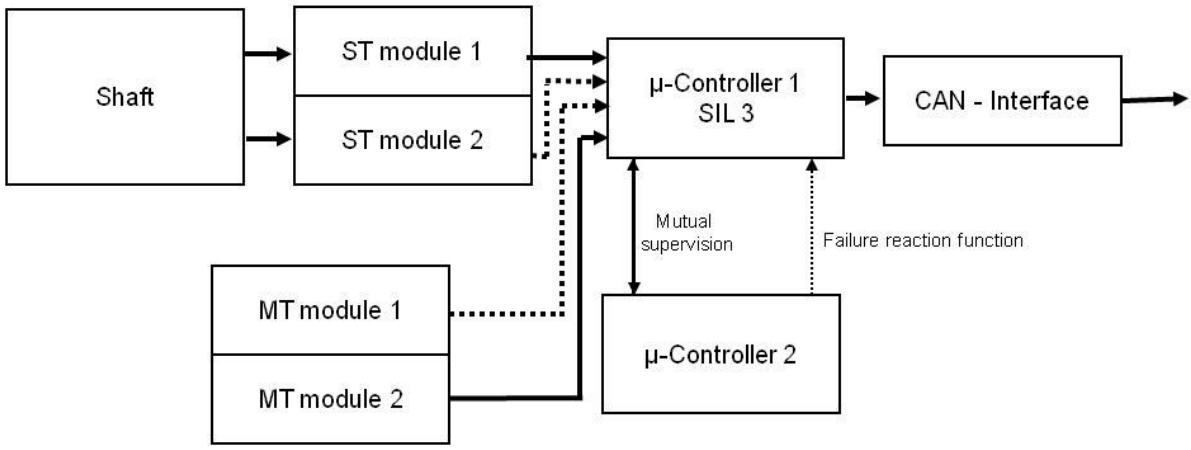
1.1.8. Maintenance

For the device is no maintenance necessary!

1.1.9. Intended Time of Usage

In general the maximum intended time of usage is 10 years and for the bearings the load is specified in the table mechanical lifetime with L01 (99% reliability)in chapter 3.

1.2. 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.

1.3. Detailed Measurement Principle

The measuring system in the single-turn module consists of a light source, a code disc pivoted in a precision ball bearing and an opto-electronic scanning device. A LED is used as a light source which shines through the code disc and onto the screen behind. The tracks on the code disk are evaluated by an opto-array behind the reticle. With every position another combination of slashes in the reticle is covered by the dark spots on the code disk and the light beam on the photo transistor is interrupted. That way the code on the disc is transformed into electronic signals. Fluctuations in the intensity of the light source are measured by an additional photo transistor and another electronic circuit compensates for these. After amplification and conversion the electronic signals are available for evaluation.

1.3.1. Single-Turn

Single turn encoders specify the absolute position for one turn of the shaft i.e. for 360°. After one turn the measuring range is completed and starts again from the beginning.

1.3.2. Multi-Turn

Linear systems normally need more than one turn of a shaft. A single turn encoder is unsuitable for this type of application because of the additional requirement of the number of turns. The principle is relatively simple: Several single turn encoders are connected using a reduction gear. The first stage supplies the resolution per turn, the stages behind supply the number of turns.

Typical Applications:

• Packing Machines
• Mobile Machines
• Wind Mills
• Medical Equipment

There are several types of encoder versions. Please refer to the datasheets to find out which is the best version for your application.

1.4. General CANopen Information

The CANopen system is used in industrial applications. It is a multiple access system, which means that all devices can access the bus. In simple terms, each user checks whether the bus is free, and if it is the user can send messages. If two users try to access the bus at the same time, the user with the higher priority level (lowest ID number) has permission to send its message.
Users with the lowest priority level must cancel their data transfer and wait before re-trying to send their message. Data communication is carried out via messages. These messages consist of 1 COB-ID followed by a maximum of 8 bytes of data. The COB-ID, which determines the priority of the message, consists of a function code and a node number. The node number corresponds to the network address of the device. It is unique on a bus. The function code varies according to the type of message being sent:

- Management messages (LMT, NMT)
- Messaging and service (SDOs)
- Data exchange (PDOs)
- Layer Setting Services (LSS)
- Predefined messages (synchronization, emergency messages)

The absolute rotary encoder supports the following operating modes:

- Polled mode: The position value is only given on request.
- Cyclic mode: The position value is sent cyclically (regular, adjustable interval) on the bus.
- SYNC mode: The position value is sent after a synchronization message (SYNC) is received. The position value is sent every n SYNCs (n ≥ 1).

Other functions (offset values, resolution, etc) can be configured. The absolute rotary encoder corresponds to the class 1 encoder profile (DS 406 in which the characteristics of encoder with CANopen interface are defined).

1.5. General CANopen Safety Information

It is intended, that the additional safe CANopen communication is not affecting the normal operation and services on a CANopen network. Safe communication is not related to a special class of devices, so no special device profile is required. To ensure compatibility, the usage of identifiers and pre-defined objects shall be coordinated with the CANopen standard and existing device profiles.

The safety-relevant data transfer is performed by means of SRDO. An SRDO shall consist of two CAN data frames with identifiers, which shall be different in at least two bit positions. The process data in both transmissions is redundant, i.e. the meaning of the data is the same, but the data on the 2nd transmission is inverted bitwise. SRDOs shall be transmitted periodically. If required, SRDOs may also be transmitted event-driven,

e.g. to ensure fast reaction after a safety critical change on the input. RTR shall not be possible;

SRDOs shall be only allowed in the NMT state operational. Furthermore an SRDO shall be only valid, if both CAN frames are received properly (without failure and in time). The redundant transmission (bit inverted information) is sent after the first transmission to the CAN controller with minimum delay.

For detailed information see the specification DS-304.

1.6. General Configuration Information

The node number and speed in bauds are determined via rotary switches for encoder device versions with connection cap or by software using CANopen objects for encoder with cable or plug interfaces.

The transmission speed can range from 20kBaud up to 1Mbaud 1Mbaud (30m cable for a maximum speed of 1Mbaud, 1000 m cable for a maximum speed of 10 kbaud). More detailed information about the CANopen interface configuration can be found in chapter 2 “Installation”.

Various software tools for configuration and parameter-setting are available from different suppliers. It is easy to align and program the rotary encoders using the EDS (electronic data sheet) configuration file provided. For example a tool from company Vector Informatik CANsetter can be used for configuration.

In general the customer shall be responsible for verification and validation of the configuration. Procedure: From the tool written safety parameter shall be read out of the encoder again and compared to the written one to check the correct transmission: Furthermore the encoder checks internal the value range and for safety related

parameters the checksum. In a case of failure an SDO abort message is sent.
A checksum shall be calculated for the safety relevant parameters to guarantee data consistency. For the checksum calculation a tool named “CRC-Config-Calculator”, from FRABA POSITAL, can be downloaded free of charge from our website www.posital.eu. The customer shall ensure the right checksum by own calculation!

Further information is available at:
CAN in Automation (CiA) International Users and Manufacturers Group e.V.
Kontumazgarten 3
DE-90429 Nuremberg

(*) Reference: CAN Application Layer for Industrial Applications
CiA Draft Standard 201 … 207, Version 1.1
CAL-based Communication Profile for Industrial Systems
CiA Draft Standard 301
CiA Draft Standard 303 LED-Behavior
CiA Draft Standard 304 Framework for Safety Relevant Communications
CiA Draft Standard 305 Layer Setting Services
CiA Draft Standard 406 Device Profile for Encoders

Note: All datasheets and manuals can be downloaded for free from our website www.posital.eu

We do not assume responsibility for technical inaccuracies or omissions. Specifications are subject to change without notice.

2. Installation

General Instructions to mechanically install and electrically connect the absolute rotary encoder:

Only proper trained staffs aware of local safety regulations are allowed to commission, install and operate, or to work on this product after procedures contained in the documentation.

Do not remove or mount the connection cap while the encoder is under power!

The absolute rotary encoder must be connected to the main signal ground over the machine chassis or by means of a separate potential compensating line.

Do not stand on the encoder!

Do not adapt the driving shaft additionally!

Avoid mechanical load!

Do not adapt the housing additionally!

Mounting instructions hollow shaft

The clamp ring may only be tightened if the shaft of the driving element is in the hollow shaft.

The customer shall take care, that a splint is leaded through the opposite orientated gap slots in the hollow shaft and the clamp ring has the end of both splint ends in his notch. With this mounting method a positive locking is achieved between hollow shaft and drive shaft. The strip shall be mounted in an unloaded state to prevent a mechanical pretensioning.

The strip shall be mounted with 2 screws M3 and washers at each strap side in direction to the drive side!

Dimensions for the wahser:

3.2 mm for inner diameter

7 mm for minimum outer diameter

Allowed 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

Mounting Instructions Coupling

First the encoder shall be mounted mechanically. After that the coupling shall be fixed on encoder and drive side. By keeping these mounting order mechanical pretensioning and unallowed bearing loads will be prevented.

A screw coupling with 2 set screws has to be used. The shaft encoder has a slotted shaft side. On this slotted shaft side the coupling screw has to grab into the shaft surface. The second set screw shall be also mounted on the shaft and is used as redundant kind of mounting. Usage of thread locking compound is mandatory (recommended Loctite 243 or 2701) to prevent the loosening of the set screw during shock or vibration. Coupling and set screw shall be treated with a cleaner (recommended Loctite 7063) to eliminate oil or fat achieving higher adhesive strength. Detailed information regarding handling of cleaner and glue according to manufacturer definition can be found on the web site www.loctite.com. Especially detailed specification can be found in the product data sheet and safety data sheet.

Mounting Instruction Clamp Flange

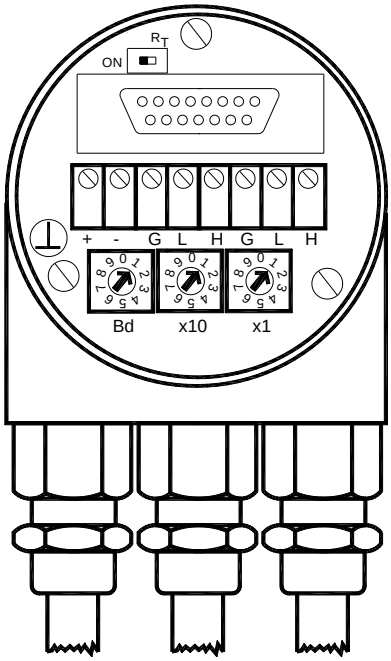
For C10 (Clamp) flange the user has three methods to mount the encoder.

1. By using a clamping bracket and one screw or a cotter in one of the six drill holes on the front side to guaranty positive-locked mechanical connection.
2. By using a clamping bracket with clamping force of 500 Ncm is high enough to provide factor 20 of specified encoder torque (EN 61800-5-2:2007, table D.16).
3. By using three of the six tap holes on front of the flange

Cotters shall have a minimum mechanical strength
Screws shall be mounted with a torque of 1 Nm.

2.1 Electrical Connection

2.1.1 Connection via Connection Cap



Signal Assignment

With 2 torx screws the connection cap is mounted on the encoder. 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 shall be fitted with a plug. The cable glands are suitable for cable diameters from 5 up to 9 mm. Absolute rotary encoders shall be connected only to subsequent electronics whose power supplies comply with EN 50178 (protective low voltage)

Clamp	Description
⊥	Ground
+	12-30 V Supply voltage
-	0 V Supply voltage
G	CAN Ground
L	CAN Low
H	CAN High
G	CAN Ground
L	CAN Low
H	CAN High

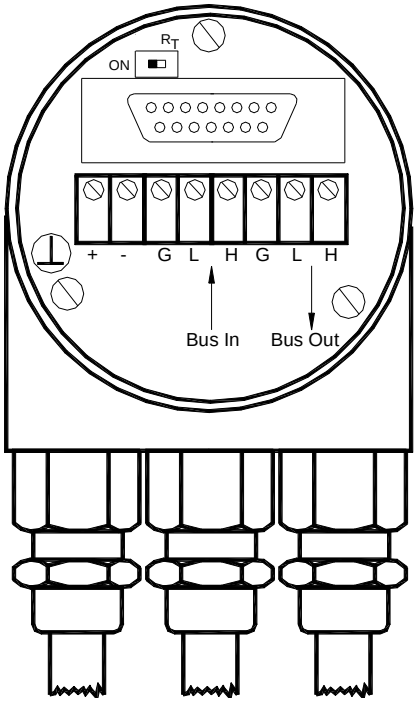


Fig. 1 Connection cap bus in and bus out

Bus Connection

The connection cap fulfills the function of a T-coupler. From there the wiring must be done according to the drawing on the left side. Please note the assignment of incoming and outgoing bus signals.

An activated bus termination resistor (120Ω) will lead into a separation of bus in and bus out signals!

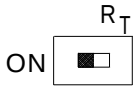
Bus Termination Connection Cap

If the encoder is connected at the end or beginning of the bus the termination resistor must be switched on. The termination resistor is switched on when the switch is in the ON position.

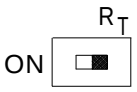
Separation of Bus In and Bus Out signals if termination resistor is activated.

There is a resistor provided in the connection cap, which must be used as a line termination on the last device.

Resistor:



Last Device



Device X

Cable connection

1. Cut off cable sheath and expose bralded screen over a length of appr. 10-15 mm depending on the cable diamter.
2. Push dome nut and lamellar insert with sealing ring on to the cable.
3. Bend braided screen outwards at a right angle (90°).
4. Fold braided screen towards outer sheath, i.e. by another 180°.
5. Push lamellar insert with sealing ring into gland body and snap anti-rotation element into place.
6. Screw on dome nut with 3,5 Nm.

Allowed cable diamter 5 – 9 mm for connection cap type AH58-B1CS-3PG and AH58-B1CS-3PG-VA.

Installation hints

Both the cable shielding and the metal housings of encoders and subsequent electronics have a shielding function. The housing must have the same potential and be connected to the main signal ground over the machine chassis or by means of a separate potential compensating line. Potential compensating lines should have a minimum cross section of 6 mm^2.

Do not lay signal cable in the direct vicinity of interference sources (air clearance > 100 mm (4 in.).

A minimum spacing of 200 mm (8 in.) to inductors is usually required, for example in switch-mode power supplies.

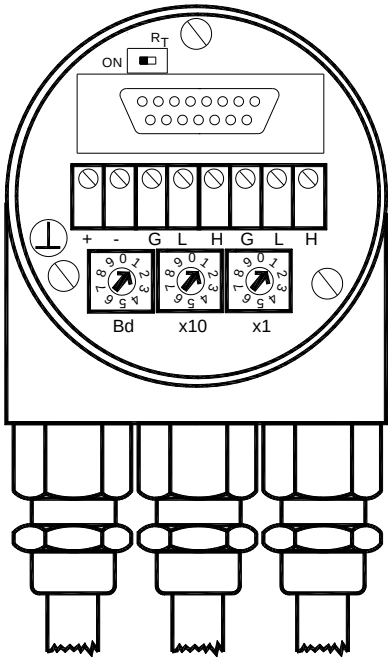
Configure the signal lines for minimum length and avoid the use of intermediate terminals. Shielded field bus cables shall be used! The shield must be grounded according to EMI rules!

In metal cable ducts, sufficient decoupling of signal lines from interference signal transmitting cable can usually be achieved with a grounded partition

Setting Node Number in Connection Cap

The setting of the node number is done by turning the BCD rotary switches in the connection cap. Possible (valid) addresses lie between 1 and 64 whereby every address can only be used once. Two LEDs on the backside of the connection cap show the operating status of the encoder.

BCD coded rotary switches	
	Device address 1...64
x1	Setting CAN-node number
x10	
	Not allowed addresses:
	0 and range 65 … 99
xBd	Setting of the baud-rate



The adjusted device address must only be used once in the whole CANopen network.
Configuration shall be made only by proper trained staff!

To set the node number the proper trained staff can remove the connection cap for installation by removing two torx screws at the backside of the encoder. The meaning and the positioning of the two turn-switches you can see in the picture on the right side.

If a <u>not allowed node number</u> is set, then the encoder sets internal the node number to 127 decimal.
This action offers still a communication with the device and detection of a wrong device setting.

Requirement for Validation of Setting

During the phase first initial operation the proper function of the encoder shall be checked, because the node number setting is not safety realized. The user shall take care of the correct node number setting by evaluating the boot up message during start up and reading of the identity object (1018h) with sub-index 1 and optional sub-index 4. With the boot up message a check shall be done, if the corresponding identifier 700 hex + node number is based on the configured node number in the connection cap or setting by SDO-objects for encoder with plug or cable exit. Reading out of the mandatory identity object (1018 hex) with sub-index 1 (content: VENDOR-ID) allows a check of the right manufacturer. Sub-Index 4 (content: Serial number) can be

additionally used to check, if the right device belongs to the node number. The described checks shall be done for each power up cycle or NMT command for reset node or reset communication by the master (safety control PLC). The verification and setting of the node number shall be logged.

Setting Baud rate in Connection Cap

The adjusting of the baud rate is adjusted by one turn switch in the connection cap. It shall be verified by the customer that the right baud rate is set. In a case of wrong configuration the encoder cannot communicate on the network and error frames will be generated. The following baud rates are possible:

Baud rate in kBit/s	BCD coded rotary switches
20	0
50	1
100	2
125	3
250	4
500	5
800	6
1000	7
1000	8
1000	9

Tab. 2 Baud rate Assignment Connection Cap

2.1.2 Setting Node Number for Connector Version

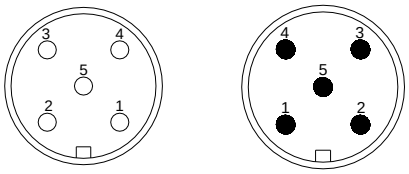
Signal Assignment

Signal	5 pin round connector pin number (male / female)
CAN Ground	1
12-30 V supply voltage	2
0 V supply voltage	3
CAN High	4
CAN Low	5

Tab.3 Signal Assignment Connector / Cable

Absolute rotary encoders shall be connected only to subsequent electronics whose power supplies comply with EN 50178 (protective low voltage, PELV or SELV)

5 pin M12 connector female/male



2.1.3. Setting Node Number via SDO Objects

If the device has a connector or a cable exit, the node number has to be adjusted via SDO objects. The default node number is 32. To set node number object 3000h has to be written. For further information regard chapter 5.5 Object Dictionary.

ATTENTION: Take care of the procedures for node number checking in chapter: "**Requirement for Validation of Setting"**

2.1.4. Setting Baud Rate via SDO Objects

If the device has a connector or a cable exit, the baud rate has to be adjusted via SDO objects. The default manufacturer baud rate is set to 125 kBaud. To set baud rate object 3001h has to be written. Allowed value range is 0-7 for the object data. For further information please regard chapter 5.5 Object Dictionary.

The manufacturer setting for the baud rate was changed from 20 kBaud to 125 kBaud since 07th December 2010.

3. Technical Data

In the following section you will find general technical datas for OCD SIL CL 3 absolute rotary encoders with CANopen interface. There are several version with slightly different technical datas. For details please refer to the corresponding datasheet of the used encoder.

General Description

Safety Integrity Level (EN 62061) Performance Level (EN ISO 13849-1) Safety Category (EN ISO 13849-1)	SIL CL 3 PL e Cat 4
$MTTF_d$ (EN ISO 13849-1)	129 years
DC_{avg} (EN ISO 13849-1)	98,9%
Intended Time of Usage (EN 62061)	10 years
PFH_d(EN 62061)	$6.2*10^{-9}$ 1/h; 6% of SIL3 limit
PFD_{avg}(EN 62061)	$2.7*10^{-4}$ 1/h; 27% of SIL3 limit
Proof Test Interval T	10 years
SFF (EN 62061)	99,4%
Logical Architecture	Redundant design
Physical Architecture	Redundant design
Certification	By TUV Rheinland, Reg. Number: 01/205/0701.01/14

Electrical Data

Interface	CANopen safety according to 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)	
Current consumption	Multiturn: max. 100 mA with 12 V DC, max. 50 mA with 24 V DC	
	Singleturn: max. 50 mA with 12 V DC, max. 20 mA with 24 V DC	
Power consumption	max. 1.2 Watt Multi-Turn version max. 0.5 Watt Single-Turn version	
Step frequency LSB	800 kHz	
Accuracy of division	Safety Position Value: 10bit Non Safety Position Value: ± ½ LSB (12 bit), ± 4 LSB (16 bit)	
EMC	Emitted interference:	EN 61000-6-4
	Noise immunity:	EN 62061 Attachment 2

*Absolute rotary encoders shall be connected only to subsequent electronics whose power supplies comply with EN 50178 (protective low voltage, PELV or SELV))

Tab. 4 Electrical Data

Mechanical Data

Housing	Aluminium, optional stainless steel
Lifetime	Dependent on shaft version and shaft loading – refer to table
Max. shaft loading	Axial 40 N, radial 110 N
Inertia of rotor	≤ 30 gcm^2
Friction torque	≤ 3 Ncm (without shaft sealing)
RPM (continuous operation)	Singleturn: max. 6,000 RPM
	Multiturn: max. 6,000 RPM
Shock (EN 60068-2-27)	≤ 100 g (half sine, 6 ms)
Permanent shock (EN 60028-2-29)	≤ 10 g (half sine, 16 ms)
Vibration (EN 60068-2-6)	≤ 10 g (10 Hz … 1,000 Hz) ≤ 10 g (10 Hz … 1,000 Hz) (with Connection Cap)
Weight (with connection cap)	Singleturn: ≈ 600 g Multiturn: ≈ 800 g
Weight (stainless steel version with connection cap)	Singleturn: ≈ 1,200 g Multiturn: ≈ 1,300 g
Weight (connector version)	Singleturn: ≈ 350 g Multiturn: ≈ 500 g
Weight (stainless steel version)	Singleturn: ≈ 500 g
	Multiturn: ≈ 600 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 thread locker is used! Both shaft sides of drive and encoder shall be flattened for positive locking!

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

Tab. 5 Mechanical data

Minimum Mechanical Lifetime

	Lifetime in 10^8 revolutions with (F_a/F_r)		
Flange	40 N / 60 N	40 N / 80 N	40 N / 110 N
C10 (Clamp Flange 10 x 20) with and without shaft sealing	23	14	6
S10 (Synchro Flange 10 x 20) without shaft sealing	21	13	5
S06 (Synchro Flange 6 x 10) without shaft sealing	33	22	14
S10 (Synchro Flange 10 x 20) with shaft sealing	1.6	0.7	0.3
S06 (Synchro Flange 6 x 10) with shaft sealing	4	2	1

Tab. 6 Mechanical Lifetime

Lifetime based on L01 with reliability of 99%. Load at the end of shaft.

S6 (Synchro flange 6 x 10) with shaft sealing: max. 20 N axial, 80 N radial

Environmental Conditions

Operating temperature	- 30°C … +70°C
Storage temperature	- 30°C … + 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°C … +70°C flexible installed cables
	- 40°C … -70°C fixed installed cables

Tab. 7 Environmental Condition

4. Configuration

The purpose of this chapter is to describe the configuration parameters of the Absolute Rotary Encoder with CANopen interface.

4.1 Operating Modes

4.1.1 General

The encoder accesses the CAN network after power up in pre-operational mode:
BootUp Message: 700 hex + Node Number

It is recommended that the parameters can be changed by the user when the encoder is in preoperational mode. Pre-operational mode entails reduced activity on the network, which simplifies the checking of the accuracy of the sent/received SDOs.

It is not possible to send or receive PDOs and SRDOs in pre-operational mode.

With the boot up message a check shall be done, if the corresponding identifier of the boot up message is based on the configured node number in the connection cap. Additional by reading out the identity object a check shall be done, whether the right device belongs to the node number and respectively identifier for SDO communication. This check shall be done for each power up cycle or NMT command for reset node or reset communication by the master (safety control PLC). For detailed information see chapter: "**Requirement for Validation of Setting".**

4.1.2 Mode: Preoperational

To set a node to pre-operational mode, the master must send the following message:

Identifier	Byte 0	Byte 1	Description
0 h	80 h	00	NMT-PreOp, all nodes
0 h	80 h	NN	NMT-PreOp, NN

NN: node number

It is possible to set all nodes (Index 0) or a single node (Index NN) to pre-operational mode.

4.1.3 Mode: Start- Operational

To put one or all nodes in the operational state, the master have to send the following message:

Safety related information: Only in the operational mode the safety function is active and SRDOs can be transmitted. For an active SRDO communication the SRDO configuration shall be set valid, otherwise no transmit of SRDO is possible.

Identifier	Byte 0	Byte 1	Description
0 h	01 h	00	NMT-Start, all nodes
0 h	01 h	NN	NMT-Start, NN

NN: node number

It is possible to set all nodes (Index 0) or a single node (Index NN) to operational mode.

4.1.4 Mode: Stopped

To put one or all nodes in the stopped state, the master have to send the following message:

Identifier	Byte 0	Byte 1	Description
0 h	02 h	00	NMT-Stop, all nodes
0 h	02 h	NN	NMT-Stop, NN

NN: node number

It is possible to set all nodes (Index 0) or a single node (Index NN) to stop mode.

4.1.5 Reinitialization of the Encoder

If a node is not operating correctly, it is advisable to carry out a reinitialization:

NN	Command	Index	Description
0 h	82 h	00	Reset Communication
0 h	81 h	NN	Reset Node

NN: node number

It is possible to set all nodes (Index 0) or a single node (Index NN) in reset mode.

After reinitialization, the encoder accesses the bus in pre-operational mode.

By execution of the NMT command Reset Node or Reset Communication the actions shall be done described in chapter 4.1.1. General. Boot-up message evaluation and check of identity object (1018h) via SDO communication. For detailed information see chapter: “**Requirement for Validation of Setting”.**

4.2 Normal Operating CANopen

Polled Mode	By a remote-transmission-request telegram the connected host calls for the current process value. The encoder reads the current position value, calculates eventually set-parameters and sends back the obtained process value by the same identifier.
Cyclic Mode	The encoder transmits cyclical— - without being called by the ho— - 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 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.

Tab. 8 CAN Transmission Mode Description

4.2.1 Operating CANopen Safety

In the table below the safety related properties are red colored marked.

SRDOs communication is only allowed in the OPERATIONAL mode and SDO access to safety objects only as read and not as write access. In the state Pre-Operational any SDO access to safety objects is possible.

	INITIALISING	PRE-OPERATIONAL	OPERATIONAL	STOPPED
PDO			Allowed	
SDO		Allowed	Allowed[1]	
SRDO			Allowed	
Synchronization object		Allowed	Allowed	
Time stamp object		Allowed	Allowed	
Emergency object		Allowed	Allowed	
Boot-up object	Allowed			
NMT object		Allowed	Allowed	Allowed

[1] Writing to a safety object in the NMT state operational shall lead to an abort message (abort code: 0800 0022_h). Reading of a safety entry in the NMT state operational is allowed.

4.2.2 Initialization Procedure for CANopen Safety

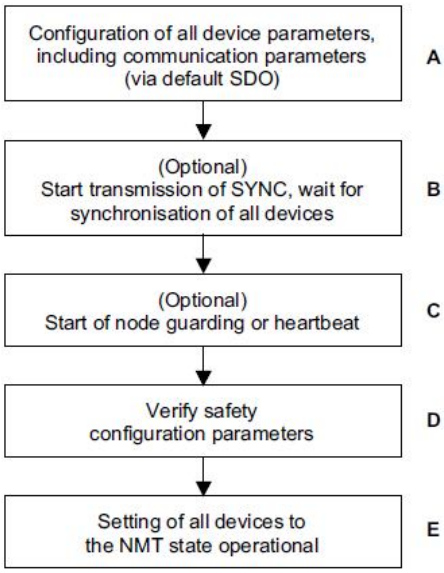


Figure 1: Initialization for safety devices (DS-304)

Step A:

The encoder shall be in the NMT state pre-operational, which is entered automatically after power-on. In this state, the encoder is accessible via default SDO using Can-IDs that are been assigned according to the pre-defined connection set. In this step, the configuration of encoder parameters take place, whereby some of these configuration data are safety-relevant. Additional measures shall be taken, to ensure the safety function in the network.

This is done from a configuration application or tool, e.g. CANsetter from the company Vector.

In the pre-operational state a configuration of PDOs, PDO mapping, configuration of SRDOs, SRDO mapping and optionally setting of Cob-IDs may be performed via the default SDO objects. In many cases, a configuration is not necessary as default values are defined for all application and communication parameters.

Step B:

It may be used to ensure that all devices except safety nodes are synchronised by the SYNC object before entering the NMT state operational.

Step C:

The node guarding or heartbeat functionality can be started. Details about functionality please refer to the standard DS-301 CANopen from the organisation CiA (CAN in Automation).

Step D:

The configuration of safety parameters is verified and configuration valid is set. If the configuration of SRDO communication parameter is not set active, no SRDO are transmitted! The customer shall be responsible for the verification and validation of the configuration. From the PLC to the encoder written parameter shall be read out afterwards for verification. Conducted configuration shall be logged for documentation

purposes! The configuration valid can only be set active, if the checksum is correct for the saftey related parameters. With the checksum data consistency is guaranteed.

Step E:

All or specific devices are set into the OPERATIONAL state. For safety devices the SRDO communication starts. Also PDOs can be transmitted for standard CANopen communication in this state.

4.3 Storing Parameter

4.3.1 List of storable Parameter

Object Index	Object Description
1005h	COB-ID Sync
100Ch	Guard Time
100Dh	Life Time Factor
1017h	Producer Heartbeat Time
1301h	SRDO1 communication parameter
1381h	SRDO1 mapping parameter
13FEh	Configuration valid
13FFh	Safety configuration checksum
1800h	Communication parameter PDO 1
1801h	Communication parameter PDO 2
1A00h	Transmit PDO1 Mapping Parameter
1A01h	Transmit PDO2 Mapping Parameter
3000h	Node Number (only for devices with cable / connector interface)
3001h	Baud rate (only for devices with cable / connector interface)
5000h	Safety Position: Configuration parameters
50FEh	Safety Position: Configuration valid
50FFh	Safety Position: Configuration checksum
6000h	Operating Parameter
6001h	Steps per Revolution
6002h	Total Resolution
6003h	Preset Value
6200h	Cyclic Timer

Tab. 9 List of Storable Parameters

Red colored entries indicate safety related objects.

4.3.2 Storing Procedure

The parameter settings can be stored in a non-volatile E^2PROM. The parameter settings are stored in RAM when being programmed. When

all the parameters are set and proved, they can be transferred in the E^2PROM. The user has to take

care, that the encoder needs internal a storing time of maximum 500 ms.

Storing

By using the object 1010h from the communication profile related object dictionary you can store the parameters into the non-volatile memory. The encoder needs internally for writing of parameters maximum 500 ms. Within this storing time the NMT commands for Start, Reset Node respectively Reset Communication or power cycle are not allowed. But if this is not considered, the encoder sets automatically default values to guarantee a defined parameter setting. It is recommended to validate the parameters after a storing cycle. If a encoder version with cable or connector exit is used and the above mentioned restrictions are not taken into account, the node number is set to 127 decimal automatically. This allows an encoder access even the internal setting is wrong or corrupted.

4.4 Restoring Parameters

The default parameters can be restored by using the object 1011h from communication profile related object dictionary. The already in the non-volatile memory programmed parameters are set active after NMT reset node command or power cycle. The restored parameters are equal for every type of CANopen encoder and might not fit with the status after delivery. Please check the restored parameters by reading out all safety related parameters before writing to the non-volatile memory or setting the node into state operational.

Be aware, that for encoder with cable or connector interface the baud rate and node number are not restored. This shall be done by trained persons to prevent a wrong device configuration and unresolved bus conflicts!

5. Programmable Parameters

Objects are based on the CiA 406 DS V3.2: CANopen profile for encoders (www.can-cia.org)

Command	Function	Telegram	Description
22h	Domain Download	Request	Parameter to Encoder
23h, 27h, 2Bh, 2Fh (*)	Domain Download	Request	Parameter to Encoder (Bytes indicated)
60h	Domain Download	Confirmation	Parameter received
40h	Domain Upload	Request	Parameter request
43h, 47h, 4Bh, 4Fh (*)	Domain Upload	Reply	Parameter to Master (Bytes indicated)
80 h	Warning	Reply	Transmission error

Tab. 10 General Command Byte Description

(*)The value of the command byte depends on the data length of the called parameter:

Command	Data length	Data type		Command	Data length	Data type
43h	4 Byte	Unsigned 32		23h	4 Byte	Unsigned 32
47h	3 Byte	Unsigned 24		27h	3 Byte	Unsigned 24
4Bh	2 Byte	Unsigned 16		2Bh	2 Byte	Unsigned 16
4Fh	1 Byte	Unsigned 8		2Fh	1 Byte	Unsigned 8

Tab. 11 Detailed Command Byte Description

Object Dictionary

The data transmission according to CAL is realized exclusively by object oriented data messages. The objects are classified in groups by an index record. Each index entry can be subdivided by sub-indices. The overall layout of the standard object dictionary is shown beside:

Index (hex)	Object
0000	not used
0001-001F	Static Data Types
0020-003F	Complex Data Types
0040-005F	Manufacturer Specific Data Types
0060-0FFF	Reserved for further use
1000-1FFF	Communication Profile Area
2000-5FFF	Manufacturer Specific Profile Area
6000-9FFF	Standardized Device Profile Area
A000-FFFF	Reserved for further use

Tab. 12 Overview Object Dictionary

5.1 Programming example: Preset Value

If a CANopen device is connected and configured by the turning switches with the right baudrate and also configured to a unused node number, it will start up into the pre-operational mode and send a bootup massage to the master. The RUN LED of the device is now blinking.

5.1.1 Set Encoder Preset Value

Master to Encoder with Node Number 1

Setting Preset Value (Value 1000)

Identifier	DLC	Command	Index		Subindex	Service/Process data			
NN 1		Download	6003h			Byte 4	Byte 5	Byte 6	Byte 7
601	8	22	03	60	00	00	10	00	00

Answer of the Encoder

Identifier	DLC	Command	Index		Subindex	Service/Process data			
NN 1		Download	6003h			Byte 4	Byte 5	Byte 6	Byte 7
581	8	43	03	60	00	00	00	00	00

Read Preset Value from the Encoder

Identifier	DLC	Command	Index		Subindex	Service/Process data			
NN 1		Download	6003h			Byte 4	Byte 5	Byte 6	Byte 7
601	8	40	03	60	00	00	00	00	00

Answer of the Encoder

Identifier	DLC	Command	Index		Subindex	Service/Process data			
NN 1		Download	6003h			Byte 4	Byte 5	Byte 6	Byte 7
581	8	43	03	60	00	00	10	00	00

Save Parameters to EEPROM

Identifier	DLC	Command	Index		Subindex	Service/Process data			
NN 1		Download	1010h			Byte 4	Byte 5	Byte 6	Byte 7
601	8	22	10	10	01	73	61	76	65

5.2 Communication Profile DS301 specific objects from 100–– - 1FFFh

In this manual we refer to the communication profile DS301 V4.02

Object	Description	Page DS304 V1.0.1.	Page DS301 V4.02	Page DS406
1000h	Device type		86	8
1001h	Error register		87	8
1003h	Pre-defined error field		88	
1005h	COB-ID SYNC-message		89	
1006h	ComCyclePeriode		90	
1008h	Device name		91	
1009h	Hardware version		91	
100Ah	Software version		91	
100Ch	Guard Time		92	
100Dh	Life Time Factor		92	
1010h	Store parameters		92	
1011h	Restore default parameters		94	
1014h	COB-ID Emergency		98	
1017h	Producer Heartbeat Time		101	
1018h	Identity Object		101	
1301h	SRDO1 communication parameter	17		
1381h	SRDO1 mapping parameter	21		
13FEh	Configuration valid	22		
13FFh	Safety configuration checksum	23		
1800h	Communication parameter PDO 1		111	9
1801h	Communication parameter PDO 2		111	11
1A00h	Transmit PDO1 Mapping Parameter		112	11
1A01h	Transmit PDO2 Mapping Parameter		112	12

Tab. 13 Object Dictionary 1000h-1FFFh

Red colored entries indicate safety related objects.

5.3 Manufacturer specific objects 2000h – 5FFFh

Object	Description
3000h	Node Number
3001h	Baudrate
5000h	Safety Position: Configuration parameters
5020h	Safety Position: Sensor value
5021h	Safety Position: Inverted Sensor value
50Feh	Safety Position: Configuration valid
50FFh	Safety Position: Configuration checksum

Tab. 14 Object Dictionary 2000-5FFF

Red colored entries indicate safety related objects.

5.4 Application specific objects 6000h – 9FFFh

In this manual we refer to the communication profile DS406 V3.2

Object	Description	Page DS406
6000h	Operating Parameters	17
6001h	Measuring units per revolution	18
6002h	Total measuring range in measuring units	19
6003h	Preset value	19
6004h	Position Value	20
6200h	Cyclic Timer	28

Tab. 15 Object Dictionary 6000h-9FFFh

5.5 Object Descriptions

In the following chapter you will find detailed information of the object dictionary related to the encoderdevice.

Object 1000h: Device Type

The object at index 1000h describes the type of device and its functionality. It is composed of a 16-bit field which describes the device profile that is used and a second 16-bit field which gives additional information about optional functionality of the device. The additional information parameter is device profile specific.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	Unsigned 32	N/A	ro	no

OCD absolute rotary encoder single turn: 10196h
OCD absolute rotary encoder multi turn: 20196h

Object 1001h: Error Register

This object is used by the device to display internal faults. When a fault is detected, the corresponding bit is therefore activated.

The following errors are supported:

Bit	Description	Comments
0	Generic Error	The generic error is signaled at any error situation.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	Unsigned 8	N/A	ro	no

Object 1003h: Pre-Defined Error Field

The object holds the errors that have occurred on the device and have been signaled via the Emergency Object.

- The error code is located in the least significant word
- Additional Information is located in the most significant word
- Subindex 0 contains the number of recorded errors

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of recorded errors	Unsigned 8	0	rw	no
1	Most recent errors	Unsigned 32	-	ro	no
2	Second to last error	Unsigned 32	-	ro	no
…					
10					

Clearing Error Log

The error log can be cleared by writing 0 to subindex 0 of object 1003.

Object 1005h: COB-ID Sync

This object contains the synchronization message identifier.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	Unsigned 32	80000080h	rw	no

Object 1008h: Manufacturer Device Name

This object contains the device name.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	String	-	ro	no

Object 1009h: Manufacturer Hardware Version

This object contains the article name of the circuit board.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	String	-	ro	no

Object 100Ah: Manufacturer Software Version

This object contains the manufacturer software version.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	String	-	ro	no

Object 100Ch: Guard Time

This object contains the guard time in milliseconds.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	Unsigned 16	0	rw	yes

Object 100Dh: Life Time Factor

This object contains the life time factor parameters. The life time factor multiplied with the guard time gives the life time for the node guarding protocol.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	Unsigned 8	0	rw	yes

Object 1010h: Store Parameters

This object is used to store device and CANopen related parameters to non volatile memory.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of sub indices	Unsigned 8	1	ro	no
1	Store all parameters	Unsigned 32	“save”	rw	no

Storing procedure

To save the parameters to non volatile memory the access signature “save” has to be sent to the corresponding subindex of the device. IMPORTANT: See notes in chapter 4.3.1 Storing Procedure.

	Most significant word		Least significant word	
ASCII	e	v	a	s
Hex value	65h	76h	61h	73h

Object 1011h: Restore Parameters

This object is used to restore device and CANopen related parameters to factory settings.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of sub indices	Unsigned 8	1	ro	no
1	Restore all parameters	Unsigned 32	“load”	rw	no

Storing procedure

To save the parameters to non volatile memory the access signature “load” has to be sent to the corresponding subindex of the device.

	Most significant word		Least significant word	
ASCII	d	a	o	l
Hex value	64h	61h	6Fh	6Ch

Note: The restoration of parameters will only be taken into account after a power up or reset command. Please check all parameters before you store them to the non volatile memory.

Object 1014h: COB-ID Emergency Object

This object contains the EMCY emergency message identifier.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	Unsigned 32	80h + Node ID	rw	no

Object 1017h: Producer Heartbeat Time

The object contains the time intervall in milliseconds in which the device has to produce the a heartbeat message.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	Unsigned 16	0	rw	yes

Object 1018h: Identity Object

This object contains the device information.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of entries	Unsigned 8	4	ro	no
1	Vendor ID	Unsigned 32	42h	ro	no
2	Product Code	Unsigned 32	4341h	ro	no
3	Revision Number	Unsigned 32	10001h	ro	no
4	Serial Number	Unsigned 32		ro	no

Object 1301h: 1st Transmit SRDO Communication Parameter

This object contains the communication parameter of the 1st transmit SRDO.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of sub indices	Unsigned 8	6	ro	yes
1	Information Direction	Unsigned 8	1	rw (only in Pre-Operational)	yes
2	Refresh Time	Unsigned 16	25	rw (only in Pre-Operational)	yes
3	Not used				
4	Transmission Type	Unsigned 8	254	Rw (only in Pre-Operational)	yes
5	COB-ID1	Unsigned 32	0000 00FF$_h$ + (2 x node-ID)	Rw (only in Pre-Operational)	yes
6	COB-ID2	Unsigned 32	0000 0100$_h$ + (2 x node-ID)	Rw (only in Pre-Operational)	yes

Sub-Index 0 Number of sub indices:

This parameter contains the maximum number of entries within the object 1301 hex.

Sub-Index 1 Information Direction:

Value definition:

Value	Decription
0 h	Does not exist / is not valid
1 h	Exists / is valid for transmit (tx)
2h	Not used for this device
3h – ff h	Reserved

A COB-ID1 and / or COB-ID2 shall be only modified, when the information direction is set to value 0h, that means SRDO is not vaild.

For the encoder the information direction tx is only supported with value 1h and not rx for receive. So the value range 2h up tp ff h is not allowed.

Sub-Index 2 Refresh Time:

The reaction time is defined to mimimal 24 ms. But it is possible to transmit the safety position value much faster by setting the refresh time / SCT of the SRDO communication channel. This time can be defined in the set with sub-index 2 of this object.

ATTENTION: A faster transmit cycle than the failure reaction time can be used for a faster update cycle. But this refresh time is independent of the failure reaction time, which is defined to 24 ms! Within the failure reaction time the encoder is internal checked for any failure.

Sub-Index 4 Transmission Type:

See PDO communication parameters (transmission type) in standard DS-301 (CANopen communication profile).

Sub-Index 5 COB-ID1:

Specifies the COB-ID for the position value not inverted. The default value is defined to the pre-defined connection set given in the specification DS-304.

Sub-Index 6 COB-ID2:

Specifies the COB-ID for the position value inverted. The default value is defined to the pre-defined connection set given in the specification DS-304.

Object 1381h: 1st Transmit SRDO Mapping Parameter

This object contains the mapping parameter of the 1st transmit SRDO.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of sub indices	Unsigned 8	16	ro	no
01h, 03h, 05h to 0Fh (only odd indices)	SRDO mapping for the n-th application object to be mapped (data not inverted)	Unsigned 32		ro	no
02h, 04h, 06h to 10h (only even indices)	SRDO mapping for the n-th application object to be mapped (data inverted)	Unsigned 32		ro	no

The mapping is fixed and cannot be modified!

Object 13Feh: Configuration Valid

This object shall contain an acknowledgement flag for a valid configuration. After write access to any of the safety-relevant parameter, this object is automatically set to invalid configuration (00h). If the configuration is finished, the user has to write the “valid” value “A5h” to this object. By setting the configuration valid the verification of configuration is documented.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Configuration Valid	Unsigned 8	0h	rw (only in Pre-Operational)	yes

Object 13FFh: Safety configuration Checksum

This object contains the configuration checksum of the 1st transmit SRDO.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of sub indices	Unsigned 8	1	ro	yes
1	Checksum-1	Unsigned 16	0	rw (only in Pre-Operational)	yes

Coding rules see page 23 in DS-304. For easier calculation of the checksum a tool can be downloaded free of charge from the website www.posital.eu. The program, named “CRC-Config-Calculator”, calculates the checksum of the safety related communication objects and encoder function safety related objects.

Object 1800h: 1st Transmit PDO Communication Parameter

This object contains the communication parameter of the 1st transmit PDO.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of sub indices	Unsigned 8	5	ro	yes
1	COB-ID	Unsigned 32	180h + Node ID	rw	yes
2	Transmission Mode	Unsigned 8	FE	rw	yes
3	Inhibit Time	Unsigned 32	0	rw	yes
4	Not available				
5	Event Timer	Unsigned 32	64h or 0	rw	yes

Object 1801h: 2nd Transmit PDO Communication Parameter

This object contains the communication parameter of the 2nd transmit PDO. NOTE: In the older encoder line C2 and C5 the second PDO was configured via object 1802!

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of sub indices	Unsigned 8	5	ro	yes
1	COB-ID	Unsigned 32	280h + Node ID	rw	yes
2	Transmission Mode	Unsigned 8	1	rw	yes
3	Inhibit Time	Unsigned 32	0	rw	yes
4	Not available				
5	Event Timer	Unsigned 32	0	rw	yes

Transmission Mode

The transmission mode can be configured as described below:

Transfer Value (decimal)	Transmission Mode					Notes
	Cyclic	Acyclic	Synchronous	Asynchronous	RTR only	
0		X	X			Send PDO on first Sync message following an event
1-240	X		X			Send PDO every x Sync messages
241-251	reserved					
252			X		X	Receive SYNC message and send PDO on Remote Request
253					X	Update data and send PDO on Remote Request
254				X		Send PDO on event
255				X		Send PDO on event

Inhibit Time

F““ “Transmit P””s”, t““ “inhibit t””e” for PDO transmissions can be entered in this 16 bit field. If data is changed, the PDO sender checks whether ““ “inhibit t””e” has expired since the last transmission. A new PDO transmission can only take place if t““ “inhibit t””e” has expired. T““ “inhibit t””e” is useful for asynchronous transmission (transmission mode 254 and 255), to avoid overloads on the CAN bus.

Event Timer

T““ “event ti””r” only works in asynchronous transmission mode (transmission mode 254 and 255). If the data changes before t““ “event ti””r” expires, a temporary telegram is sent. If a value > 0 is written in this 16-bit field, the transmit PDO is always sent after t““ “event ti””r” expires. The value is written in subindex 5 of a transmit PDO. The data transfer also takes place with no change to data. The range is between 1-65536 ms.

Object 1A00h: 1st Transmit PDO Mapping Parameter

This object contains the mapping parameter of the 1st transmit PDO.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of sub indices	Unsigned 8	2	ro	no
1	1st mapped object	Unsigned 32	60040020h	rw	no

Object 1A01h: 2nd Transmit PDO Mapping Parameter

This object contains the mapping parameter of the 2nd transmit PDO.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of sub indices	Unsigned 8	2	ro	no
1	2nd mapped object	Unsigned 32	60040020h	rw	no

Object 5000h: Safety Position: Configuration parameters

This object contains the configuration value for the safety position value..

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of sub indices	Unsigned 8	3	ro	yes
1	Safety code sequence	Unsigned 16	0h	rw (only in Pre-Operational)	yes
2	Safety preset value	Unsigned 32	0h	rw (only in Pre-Operational)	yes
3	Inverted safety preset value	Unsigned 32	0h	rw (only in Pre-Operational)	yes

value	Safety Code sequence	Code
0	CW	increasing
1	CCW	decreasing

The parameter Safety Code Sequence (Complement) determines the counting direction, in which the output process value increases or decreases (CW = Clockwise, CCW = Counterclockwise). The code sequence is determined in Index 5000h, sub-index 1.
The parameter Safety Preset Value sets the position value to the desired position value, which shall be overtaken, when Safety Position: Configuration valid is set.

The Configuration Valid shall be set during stand still of the encoder axis to guarantee that the desired position value is really set at the right position.

Object 5020h: Safety Position: Sensor Value

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of sub indices	Unsigned 8	3	ro	n.a.
1	Safety position value 1 (low)	Unsigned 8	-	ro	n.a.
2	Safety position value 2	Unsigned 8	-	ro	n.a.
3	Safety position value 3	Unsigned 8	-	ro	n.a.
4	Safety position value 4 (high)	Unsigned 8	-	ro	n.a.

This objects contains the safety position value not inverted,which is byte structured.

Hint: The Safety Position: Sensor Value is fixed mapped and transmitted as 32 Bit value in the SRDO-Data.

Number of Bytes	Byte 3	Byte 2	Byte 1	Byte 0
Weight	Highest			Lowest
Example: Bit information for 30 Bit total resolution	14 Bit Multi-Turn for no. of revolutions		16 Bit Single-Turn Resolution	
Example: Bit information for 27 Bit total resolution	14 Bit Multi-Turn for no. of revolutions		13 Bit Single-Turn Resolution	

Two bit of the 14 bit for the Multi-Turn part are also in Byte 1, if 13 Bit Single-Turn Resolution is used.

Object 5021h: Safety Position: Inverted Sensor Value

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of sub indices	Unsigned 8	4	ro	n.a.
1	Inverted Safety position value 1 (low)	Unsigned 8	-	ro	n.a.
2	Inverted Safety position value 2	Unsigned 8	-	ro	n.a.
3	Inverted Safety position value 3	Unsigned 8	-	ro	n.a.
4	InvertedSafety position value 4 (high)	Unsigned 8	-	ro	n.a.

This objects contains the safety inverted position value, which is byte structured.

Object 50Feh: Safety Position: Configuration Valid

This object shall contain an acknowledgement flag for a valid configuration. After write access to any of the safety-relevant Safety Position parameter, this object is automatically set to invalid configuration (00h). If the configuration is finished, the user writes the “valid” value “A5h” to this object. By setting the configuration valid the verification of configuration is documented. If the configuration is not set valid the SRDO data contain the raw safety position value without any calculation algorithm like preset or code sequence!

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Configuration Valid	Unsigned 8	0h	rw (only in Pre-Operational)	yes

Object 50FFh: Safety Position: Configuration Checksum

This object contains the configuration checksum of safety relevant Safety Position parameter.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Checksum	Unsigned 16	0	rw (only in Pre-Operational)	yes

Coding rules according to DS-304, see page 23. For easier calculation of the checksum a tool can be downloaded free of charge from the website www.posital.eu. The program, named “CRC-Config-Calculator”, calculates the checksum of the safety related communication objects and encoder function safety related objects.

Object 3000h: Node Number

This object contains the node number of the device. The POSITAL standard node number is 32 decimal.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Node Number	Unsigned 8	20h	rw	Yes

NOTE: Only the node number range 1-64 is allowed. In the case that the node address is not in the specified range the encoder automatically sets the address to 127 decimal. If the node address is modified the right configuration of the node number shall be verified. For detailed information see chapter: "**Requirement for Validation of Setting".**

Object 3001h: Baudrate

This object contains the baudrate of the device.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Baudrate	Unsigned 8	3h	rw	yes

Eight different baud rates are provided. To adjust the baud rate only one byte is used.

Baud rate in kBit/s	Byte
20	00h
50	01h
100	02h
125	03h
250	04h
500	05h
800	06h
1000	07h

Object 6000h: Operating parameters

This object shall indicate the functions for code sequence, commissioning diagnostic control and scaling function control.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Operating Parameter	Unsigned 16	0h	rw	yes

Code sequence: The code sequence defines, whether increasing or decreasing position values are output, in case the encoder shaft rotates clockwise or counter clockwise as seen from the point of view of the shaft.

Scaling function control: With the scaling function the encoder numerical value is converted in software to change the physical resolution of the encoder. The measuring units per revolution (object 6001h) and total measuring range in measuring units (object 6002h) are the scaling parameters. The scaling function bit is set in the operating parameters. If the scaling function bit is set to zero, the scaling function is disabled.

Bit structure for the operating parameters

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Use	MS	MS	MS	MS	R	R	R	R	R	R	R	R	MD	SFC	CD	CS

Table Descript i on :

MS: Manufacturer Specific Function (not available)

R: Reserved for future use

MD: Measuring direction (not available)

SFC: Scaling function (0 = disable, 1 = enable)

CD: Commissioning diagnostic control (not availabe)

CS : Code sequence (0 = CW, 1 = CCW)

Code Sequence (CS Bit 0) is hardwired to Code Sequence (CS Bit 0) in object 2100h.

Object 6001h: Measuring units per revolution

This object shall indicate the number of distinguishable steps per revolution.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Measuring units per revolution	Unsigned 32	see type sign	rw	yes

Object 6002h: Total measuring range in measuring units

This object shall indicate the number of distinguishable steps over the total measuring range.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Total measuring steps	Unsigned 32	see type sign	rw	yes

Object 6003h: Preset value

This object indicates the preset value for the output position value

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Preset Value	Unsigned 32	0h	rw	yes

Object 6004h: Position value

This object contains the process value of the encoder.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Process Value	Unsigned 32	-	romap	no

Object 6200h: Cyclic timer

This object contains the value of the event timer of the corresponding TPDOs. The value can be changed between 1-65538 ms.

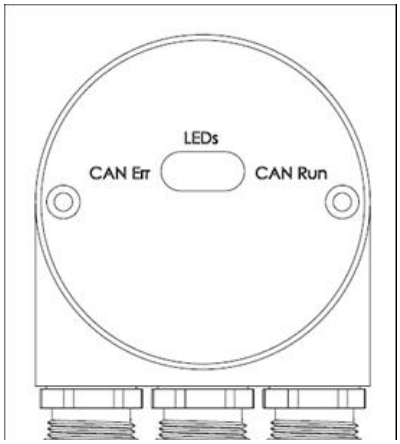
Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Cyclic Time	Unsigned 16	64h	rw	yes

The object 6200h is hard-wired to the objects 1800h sub index 5h and provide the cycle time for the cyclic mode. (See chapter Cycle Time and Event Timer)

6. Diagnosis

6.1 Meaning of the LEDs in the connection cap

The LED behaviour follows the CANopen indicator specification DR 303-3.



Run LED	State	Description
Off	No Power	Supply voltage is too low (<12V) or safety state.
Blinking	PREOPERATIONAL	The device is in state PREOPERATIONAL
Single flash	STOPPED	The device is in state STOPPED
On	OPERATIONAL	The device is in state OPERATIONAL

ERR LED	State	Description
Off	No error	The device is in working condition
Blinking	Invalid Configuration	General configuration error
Single flash	Warning limit reached	At least one of the error counters of the CAN controller has reached or exceeded the warning level (too many error frames)
Double flash	Error control event	A guard event (NMT-slave or NMT-master) or a heartbeat event (heartbeat consumer) has occurred
On	Bus off	The CAN controller is bus off or encoder is in safety state.

6.1.1 Emergency Messages

If the network load and safety state of the sensor allows, an emergency message is sent in the case of an error detection.

Following list gives an overview about available error messages. The error code is byte 7 in the manufacturer specific error field of the emergency object data, see page 61 in specification DS301-V4.02.

Byte	0	1	2	3	4	5	6	7
Content	Emergency Error Code (see Table 21)		Error register (Object 1001H)	Manufacturer specific Error Field				

Emergency Error Code is fix defined in hexadecimal coded: 0xFF00

Manufacturer specific Error Field: Byte 3 – 5 id fix predefined with 0x000080.

Error code, Byte 7 (decimal)	Meaning
0	No error
1	Temperature underflow
2	Temperature overflow
3	Temperature check fails
7	Internal transmission failure
11	Node ID is not allowed
12	Baudrate is not allowed
16	Power supply failure
22	Position failure
23	Position failure
24	SRDO configuration is wrong

For further details or here not listed error codes please contact POSITAL GmbH.

6.2 Troubleshooting

6.2.1 Power on – Encoder doesn't respond

Problem:
The bus is active but the installed encoder transmitted no boot up message.

Possible solution:

- switch of the PLC
- remove the connection cap of the encoder
- check the 2 turn-switches for the baud rate
- Assemble the connection cap
- power on

6.2.2 Malfunction of the position value during transmission

Problem:
During the transmission of the position value occasional malfunction occurs. The CAN bus can be temporary in the bus off state also.

Possible solution:
Check, if the last bus node has switched on the terminal resistor. If the last bus node is an encoder the terminal resistor is suited in the connection cap.

6.2.3 Too much ERROR-Frames

Problem:
The bus load is too high in case of too much error frames.

Possible solution:
Check if all bus node has the same baud rate. If one node has another baud rate error frames are produced automatically.

6.2.4 Encoder without connection cap

Notice: The changing of baud rate and node number is only valid after a new power up, NMT Reset or the store parameters command.

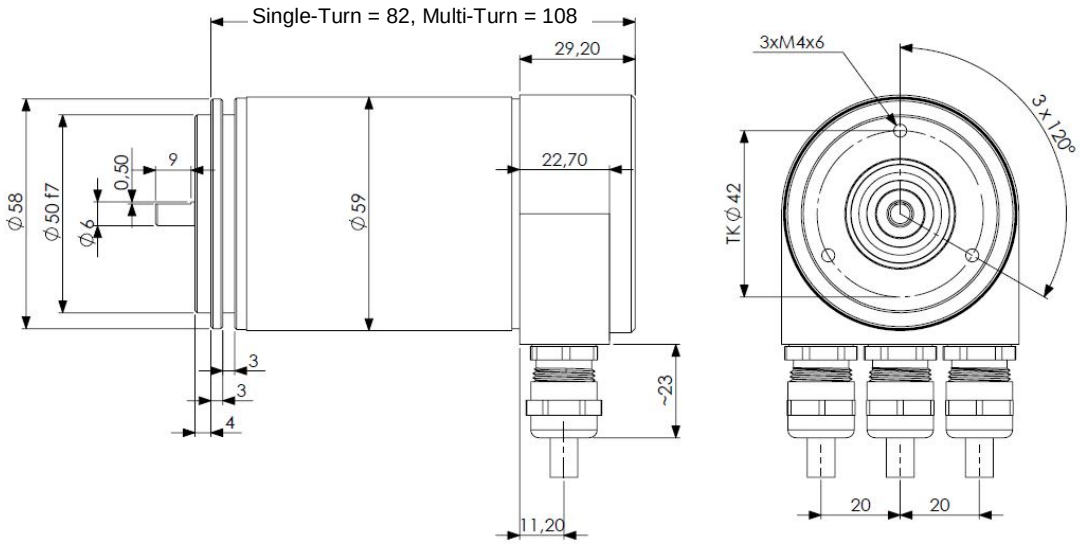
7. Mechanical Drawings

Synchro flange (S)

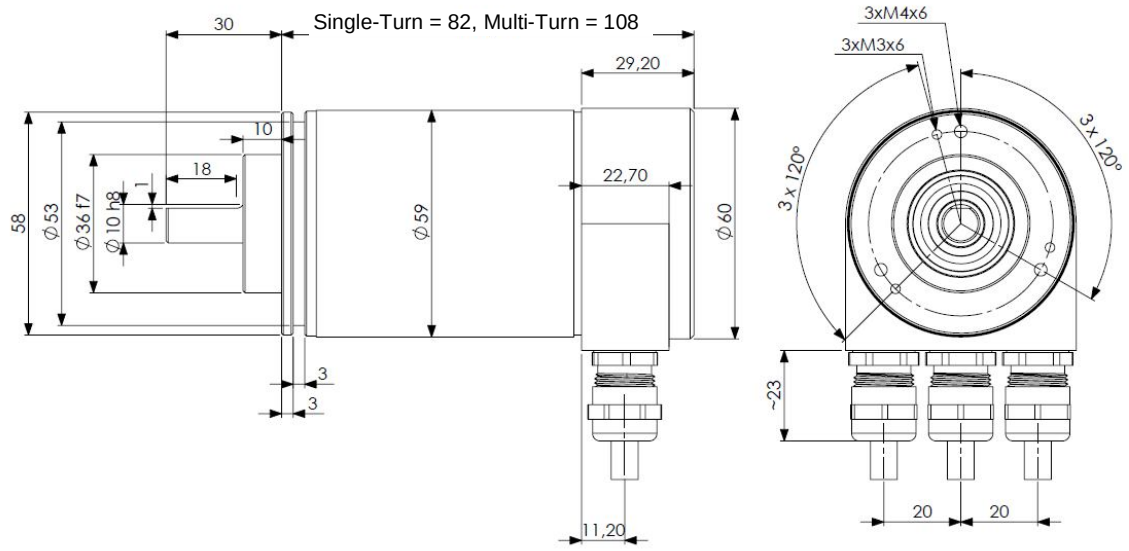
S06: Synchro flange with a shaft diameter of 6mm

S10: Synchro flange with a shaft diameter of 10 mm

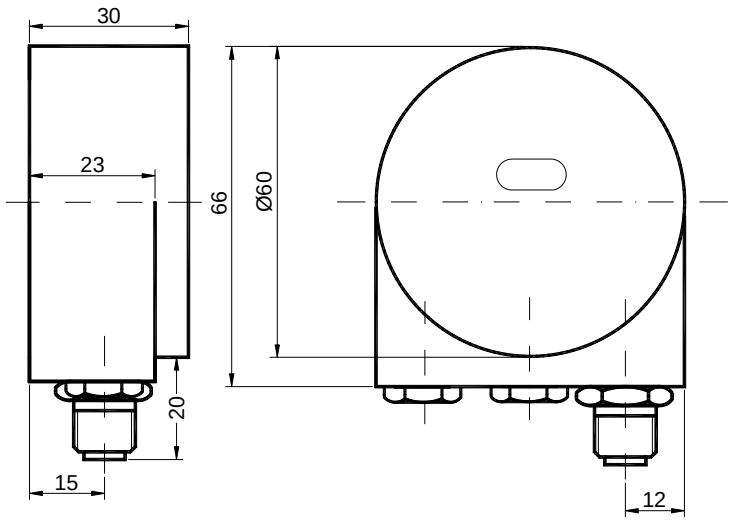
Synchro flange	d / mm	l / mm
Version S06	6_{f6}	10
Version S10	10_{h8}	20



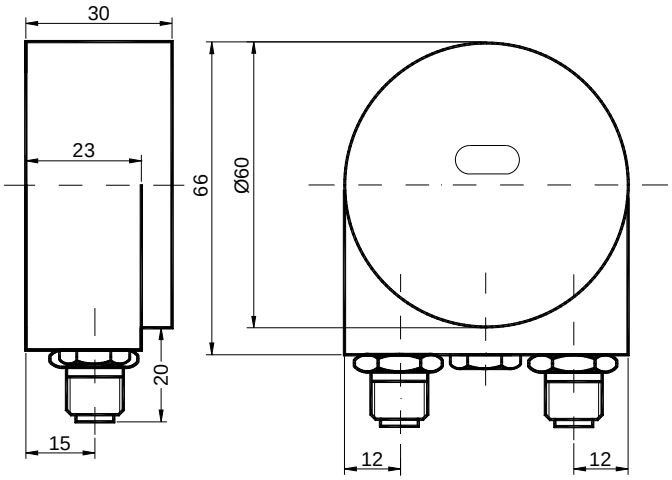
Clamp flange (C)



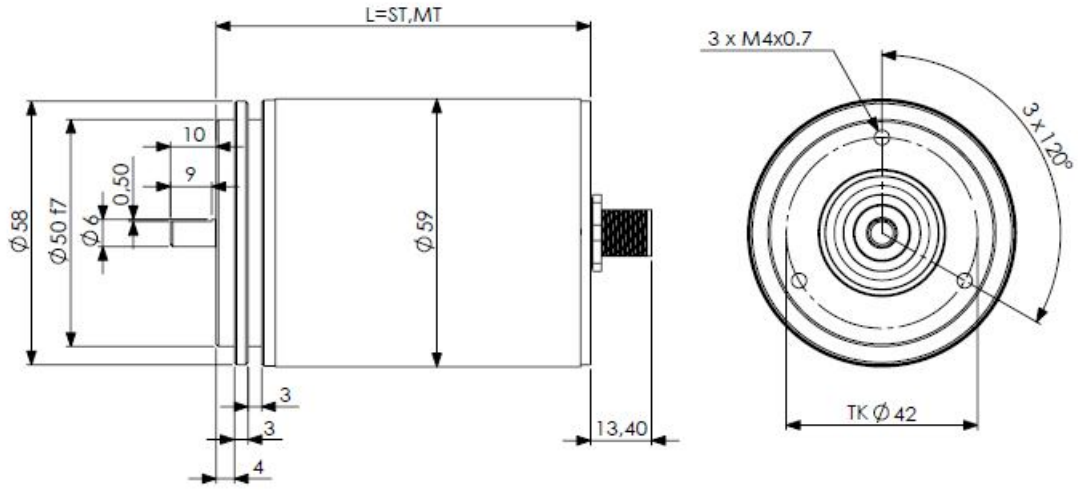
Connection cap AH58-B1CA-1BW, 5pin round connector M12, Micro style



Connection cap AH58-B1CA-2BW, female and male connector 5pin connector M12, Micro Style

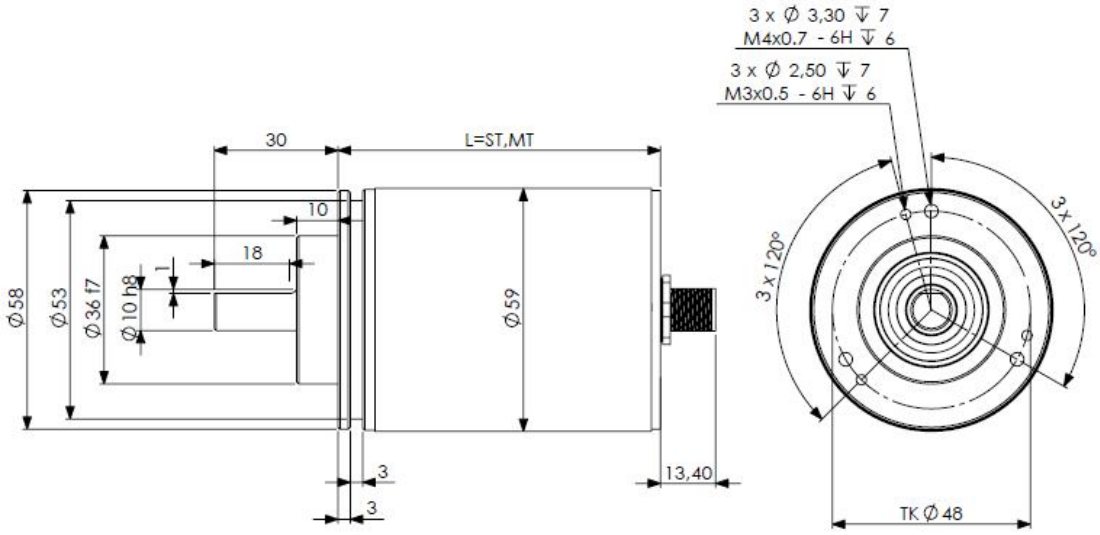


Synchroflange (S) Single-Turn, Multi-Turn version with connector exit, 5 pin M12 connector



Length	L
Single-Turn	54mm
Multi-Turn	83mm

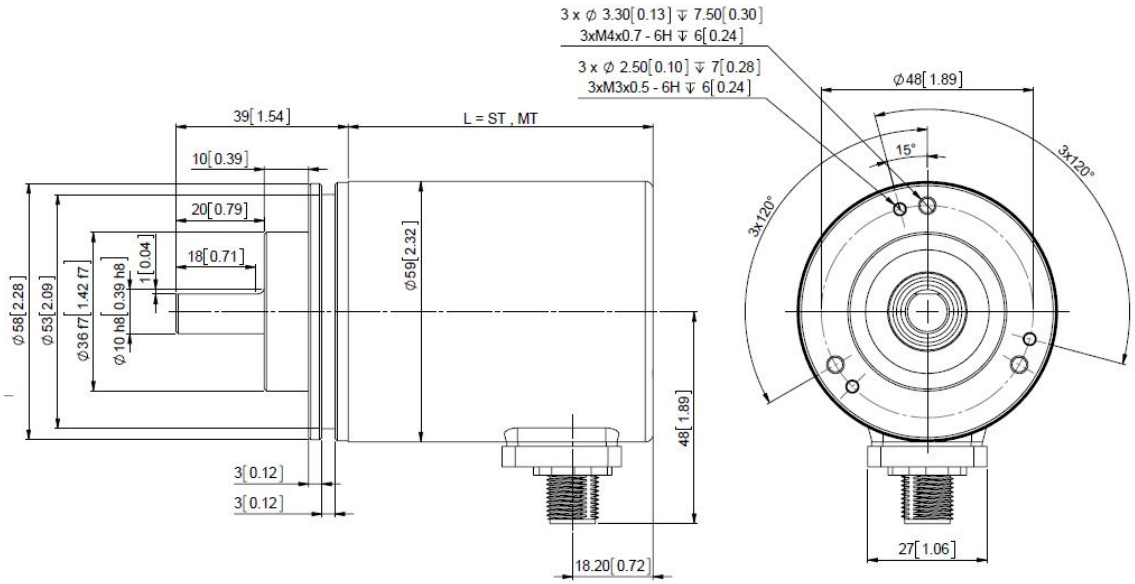
Clamp flange (C10) Single-Turn, Multi-Turn version with connector exit, 5 pin M12 connector



Length	L
Single-Turn	50mm
Multi-Turn	79mm

Clamp flange (C10) Single-Turn, Multi-Turn version with connector exit, 5 pin M12 connector, radial exit

ST Single-Turn = 46, MT Multi-Turn = 69



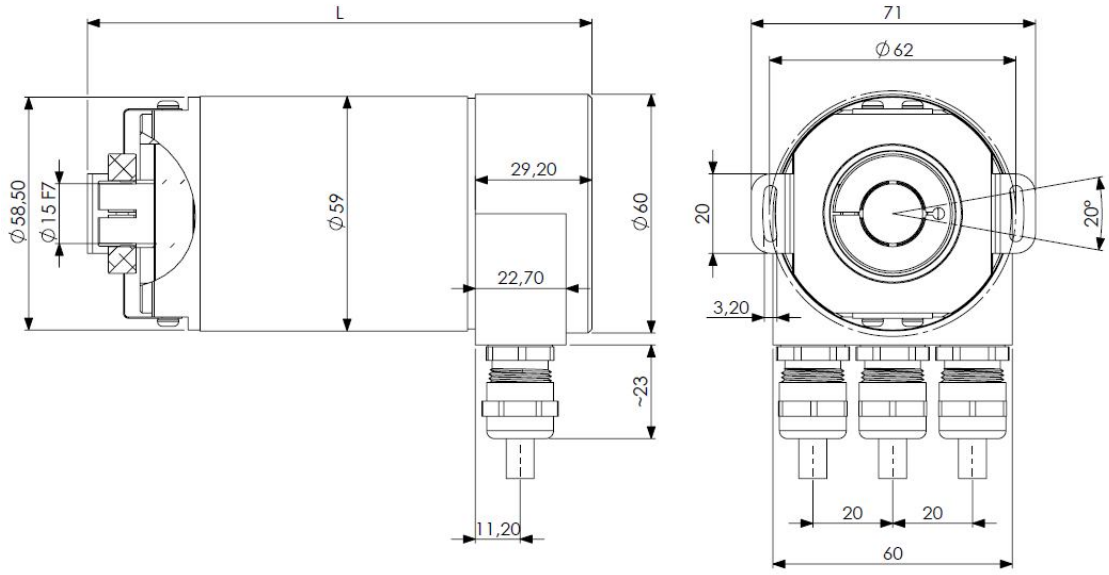
8. Mounting instructions

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

The diameter of the hollow shaft can be reduced to 12mm, 10 mm or 8 mm by using an adapter (this reducing adapter can be pushed into the hollow 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 mm
Multi-Turn	126 mm

Appendix A: Order Codes

Remark: This table is only for your information and to find out what is the meaning of the type key on your encoder. For a valid type combination please refer to the corresponding datasheet or contact one of our distributors or Posital directly.

Description	Type key										
Optocode	**OCS-**	**CS**	**E**	**1**	**B -**	_ _	_ _ -	_	_ _	_-	___
Interface	CANopen safety	**CS**									
Performance level/			**E**								
Product Version				**1**							
Code	**Binary**				**B**						
Revolutions (Bits)	**Singleturn**					**00**					
	Multiturn (16384 revolutions)					**14**					
Steps per revolution	**8192 (0,044°)**						**13**				
	65536 (0,005°)						16				
Flange	**Clamp flange**							**C**			
	Synchro flange							S			
	Blind 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 (IP66)									S	
	Stainless steel version*									V	
	Customized									C	
Connection											
Connection Caps	**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**										HCC
Connectors	Connector exit, radial, 5 pin male M12										PRM
	Connector exit, axial, 5 pin male M12										**PAM**

Standard = bold, further models on request

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

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

Connection caps

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

Description	Article Name
Aluminium housing with three M12 cable glands for cable diameters between 6,5 – 9 mm.	AH 58-B1CS-3PG
Stainless steel housing with three M12 cable glands.	AH 58-B1CS-3PG-VA
Aluminium housing with one 5 pin male M12 connector.	AH 58-B1CS-1BW
Aluminium housing with one 5 pin male M12 connector and one 5 pin female M12 connector	AH 58-B1CS-2BW
Aluminium housing with two M20 cable glands for cable diameter between 9 – 13 mm.	AH 58-B1CS-2M20

Tab. 16 Available Connection Cap Types

Appendix B: Glossary

A

Address	Number, assigned to each node, irrespective of whether it is a master or slave. The encoder address (non-volatile) is configured in the base with rotary switches or SDO objects.
APV	Absolute Position Value.

B

Baud rate	Transmission speed formulated in number of bits per second. Bus node Device that can send and/or receive or amplify data by means of the bus.
Byte	8-bit unit of data = 1 byte.

C

CAL	CAN application layer.
CAN	Controller Area Network or CAN multiplexing network.
CANopen	Application layer of an industrial network based on the CAN bus.
CCW	Counter-clockwise
CiA	CAN In Automation, organization of manufacturers and users of devices that operate on the CAN bus.
COB	Elementary communication object on the CAN network. All data is transferred using a COB.
COB-ID	COB-Identifier. Identifies an object in a network. The ID determines the transmission priority of this object. The COB-ID consists of a function code and a node number.
CW	Clockwise

E

EDS file	Standardized file containing the description of the parameters and the communication methods of the associated device.

F

FAQ	Frequently Asked Questions
FC Function code.	Determines the type of message sent via the CAN network.

L

Line terminator	Resistor terminating the main segments of the bus.
LMT	Network management object. This is used to configure the parameters of each layer in the CAN. M“ste““ ""cti””e" device within the network, that can send data without having received a request. It controls data exchange and communication management.

N

NMT	Network management object. This is responsible for managing the execution, configuration and errors in a CAN network.
NN	Node number

P

PCV	Process Value
PDO	Communication object, with a high priority for sending process data.
PV	Preset Value: Configuration value

R

RO	Read Only: Parameter that is only accessible in read mode.
ROMAP PDO.	Read Only MAPable: Parameter that can be polled by the
RW mode.	Read/Write: Parameter that can be accessed in read or write

S

SDO	Communication object, with a low priority for messaging (configuration, error handling, diagnostics). Slave Bus node that sends data at the request of the master. The encoders are always slaves.

W

WO	Write Only: Parameter that is only accessible in write mode.

POSITAL
FRABA

Appendix C: List of tables

Tab. 1 Signal Assignment Connection Cap 14
Tab. 2 Baud rate Assignment Connection Cap 19
Tab.3 Signal Assignment Connector / Cable 19
Tab. 4 Electrical Data 23
Tab. 5 Mechanical data 24
Tab. 6 Mechanical Lifetime 24
Tab. 7 Environmental Condition 24
Tab. 8 CAN Transmission Mode Description 27
Tab. 9 List of Storable Parameters 30
Tab. 11 Detailed Command Byte Description 32
Tab. 12 Overview Object Dictionary 32
Tab. 13 Object Dictionary 1000h-1FFFh 34
Tab. 14 Object Dictionary 2000-5FFF 35
Tab. 15 Object Dictionary 6000h-9FFFh 35
Tab. 16 Available Connection Cap Types 62

Appendix D: List of figures

Fig. 1 Connection cap bus in and bus out 15

Appendix E: Document history

Number of modification	Version of Document	Information of modification or new entry
0	02	Initial official release of document
1	03	Chapter 5.5. Object descriptions. Corrected number of sub-index 0 for object 50ff hex (Safety Position: Configuration checksum).
2	03	Chapter 4.3.1. storing: NMT start command was added.
3	03	Chapter 4.3.1. storing: Hint for encoder version with connector exit added, if EEPROM memory has corruptted content and internal node number setting to 127 decimal.
4	03	Appendix A: Type key modification. Single-Turn resolution of 13 Bit added and cable exit version deleted.
5	03	Hint for weight of bit in Object 5020h: Safety Position: Sensor Value.
6	03	Added proof test interval in chapter technical data and exact data for MTTFd.
7	04	Chapter 2.1.2. Setting Node Number for Connector Version: Definition of

Number of modification	Version of Document	Information of modification or new entry
		colors for cable version deleted.
8	04	Chapter 3. Mechanical data: The entry for weight for the cable version is deleted.
9	04	Chapter 3. Environmental conditions: Correction of temperature definition for operational and storage temperature, because for minimum temp. the unit was missing.
10	04	Chapter 4.1.5 Reinitialization of the Encoder: Correction of chapter numbering.
11	04	Chapter 4.2.2 Initialization Procedure for CANopen Safety: A short remark about Step C and its meaning is added.
12	04	Chapter 5.4 Application specific objects: Definition of range changed to 9FFFh.
13	04	Chapter 5.5. Object 1010h Store Parameters: Correction of type mistake in signature, changed “E” into “e”.
14	04	Chapter 5.5 Object 1011h Restore Parameters: Correction of type mistake in signature, changed “D” into “d”.
15	04	Chapter 5.5. Object 1018h Identity Object: Data for product code added and revision number corrected to 10001h.
16	04	Chapter 5.5. Object 1381h 1st Transmit SRDO Mapping Parameter: restore after bootup set to no.
17	04	Chapter 5.5. Object 1A00h and 1A01h: Restore after bootup set to no.
18	04	Chapter 5.5. Object 3001h: Default value for baud rate set to 3 decimal.
19	04	Chapter 5.5. Object 6000h: Default value set to 4 decimal.
20	04	Chapter 5.5. Object 6004h: Restore after boot up set to no.
21	04	Chapter 6. Mechanical drawing deleted entries: Synchro flange (S) Single-Turn version with radial cable exit, Synchro flange (S) Single-Turn, Multi-Turn Version, Axial cable exit
22	04	Chapter 2.1.4. Setting baud rate: Manufacturer default setting changed from 20 kBaud to 125 kBaud since 7th December 2010.
23	05	Chapter 3. Section General Description. Change of registration number of certificate from TUV Rheinland. Basis for the prolongation of certificate are EN62061 and EN ISO 13849-1. The EN61508 is not covered anymore. A follow-up design - currently under conduction - is taking into account the

Number of modification	Version of Document	Information of modification or new entry
		actual EN61508.
24	05	Added mechanical drawing for clamp flange with radial connector exit.
25	05	Change of foot header regarding company name from Posital GmbH into FRABA AG.
26	06	Changed values in table 6 Mimimum Mechanical Life Time and added values for synchro flange version with shaft sealing.

POSITAL
FRABA

Version of Document	Release Date
02	29.01.2010
03	07.07.2010
04	07.12.2010
05	16.01.2015
06	27.02.2015