Baumer

Sensor Solutions • Motion Control • Vision Technologies • Process Instrumentation

Manual

Absolute Encoder with DeviceNet™ (bus cover)

Revision number from 1.01

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Subject to modification in technic and design.
Errors and ommissions excepted

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1 Introduction

1.1 Product assignment

Shaft encoders

Product	Product-Code	Device Name	EDS-file	Product family	Variation
BPSV 58	0x1F	BPSx	BPSx.eds	Procoder - Singleturn	Bus cover
BPMV 58	0x1E	BPMx	BPMx.eds	Procoder - Multiturn	Bus cover
BEMV 58	0x1E	BPMx	BPMx.eds	Procoder - Multiturn	Bus cover, stainless steel
BOSV 58	0x23	BOSx	BOSx.eds	Dignalizer - Singleturn	Bus cover
BOMV 58	0x22	BOMx	BOMx.eds	Dignalizer- Multiturn	Bus cover

End shaft encoders

Product	Product-Code	Device Name	EDS-file	Produkt family	Variation
BMSH 58	0x21	BMSx	BMSx.eds	MAGRES - Singleturn	Bus cover
BMMH 58	0x20	BMMx	BMMx.eds	MAGRES - Multiturn	Bus cover
BPSH 58	0x1F	BPSx	BPSx.eds	Procoder – Singleturn	Bus cover
BPMH 58	0x1E	BPMx	BPMx.eds	Procoder - Multiturn	Bus cover
BOSH 58	0x23	BOSx	BOSx.eds	Dignalizer - Singleturn	Bus cover
BOMH 58	0x22	BOMx	BOMx.eds	Dignalizer - Multiturn	Bus cover

Hollow shaft encoders

Product	Product-Code	Device Name	EDS-file	Produkt family	Variation
BISD 58	0x1F	BPSx	BPSxBusC.eds	Procoder – Singleturn	Bus cover
BIMD 58	0x1E	BPMx	BPMxBusC.eds	Procoder – Multiturn	Bus cover
BPSD 58	0x1F	BPSx	BPSxBusC.eds	Procoder – Singleturn	Bus cover
BPMD 58	0x1E	BPMx	BPMxBusC.eds	Procoder – Multiturn	Bus cover
BPSD 14	0x1F	BPSx	BPSxBusC.eds	Procoder – Singleturn	Bus cover
BPMD 14	0x1E	BPMx	BPMxBusC.eds	Procoder – Multiturn	Bus cover
BPSD 25	0x1F	BPSx	BPSxBusC.eds	Procoder – Singleturn	Bus cover
BPMD 25	0x1E	BPMx	BPMxBusC.eds	Procoder – Multiturn	Bus cover
BPSD 50	0x1F	BPSx	BPSxBusC.eds	Procoder – Singleturn	Bus cover
BPMD 50	0x1E	BPMx	BPMxBusC.eds	Procoder – Multiturn	Bus cover

2 Safety and operating instructions

Supplementary information
- This manual is intended as a supplement to already existing documentation (catalogues, data sheets and assembly instructions).
- The manual must be read without fail before initial commissioning of the equipment.

Intended purpose of the equipment
- The encoder is a precision measurement device. It is used to determine angular positions and revolutions, and to prepare and supply measured values in the form of electrical output signals for the follow-on device systems. The encoder may only be used for this purpose.

Commissioning
- The encoder may only be installed and assembled by suitably qualified experts.
- Observe the operating instructions of the machine manufacturer.

Safety remarks
- Prior to commissioning the equipment, check all electrical connections.
- If installation, electrical connection or any other work performed at the encoder or at the equipment is not correctly executed, this can result in a malfunction or failure of the encoder.
- Steps must be taken to exclude any risk of personal injury, damage to the plant or to the operating equipment as a result of encoder failure or malfunction by providing suitable safety precautions.
- Encoders must not be operated outside the specified limited values (see detailed product documentation).

Failure to comply with the safety remarks can result in malfunctions, personal injury or damage to property.

Transport and storage
- Only ever transport or store encoders in their original packaging.
- Never drop encoders or expose them to major vibrations.

Assembly
- Avoid impacts or shocks on the housing and shaft.
- Avoid any twist or torsion on the housing.
- Do not open the encoder or make any mechanical changes to it.

The shaft, ball bearings, glass pane or electronic components can be damaged. In this case, safe and reliable operation cannot be guaranteed.

Electrical commissioning
- Do not make any electrical changes at the encoder.
- Do not carry out any wiring work when the encoder is live.
- Never plug or unplug the electrical connection when the encoder is live.
- Ensure that the entire plant is installed in line with EMC requirements. The installation environment and wiring affect the electromagnetic compatibility of the encoder. Install the encoder and supply cables separately or at a long distance from cables with high interference emissions (frequency converters, contactors etc.)
- Where working with consumers which have high interference emissions, make available a separate power supply for the encoder.
- Completely shield the encoder housing and connecting cable.
- Connect the encoder to the protective earth (PE) conductor using shielded cable. The braided shield must be connected to the cable gland or plug. Ideally, aim at bilateral connection to protective earth (PE), the housing via the mechanical assembly, the cable shield via the downstream connected devices. In case of earth loop problems, earth on one side only as a minimum requirement.

Failure to observe these instructions can result in malfunctions, material damage or personal injury.

3 Product families

The structure of the product family is modular. Depending on what is required of the encoder, the basic encoder and bus covers can be combined at will with the selected bus system.
The basic encoders differ in terms of accuracy, ambient conditions and the sampling system used.

Bus cover
The bus cover accommodates the entire electronic circuitry for measured value processing and for the field bus. Communication with the CAN bus takes place via the CAN controller integrated in the microcontroller. The CAN controller used has full CAN capability and supports the CAN specification 2.0B. The bus interface is standardized in accordance with ISO/DIS 11898. The maximum data rate is 1 Mbit/s.

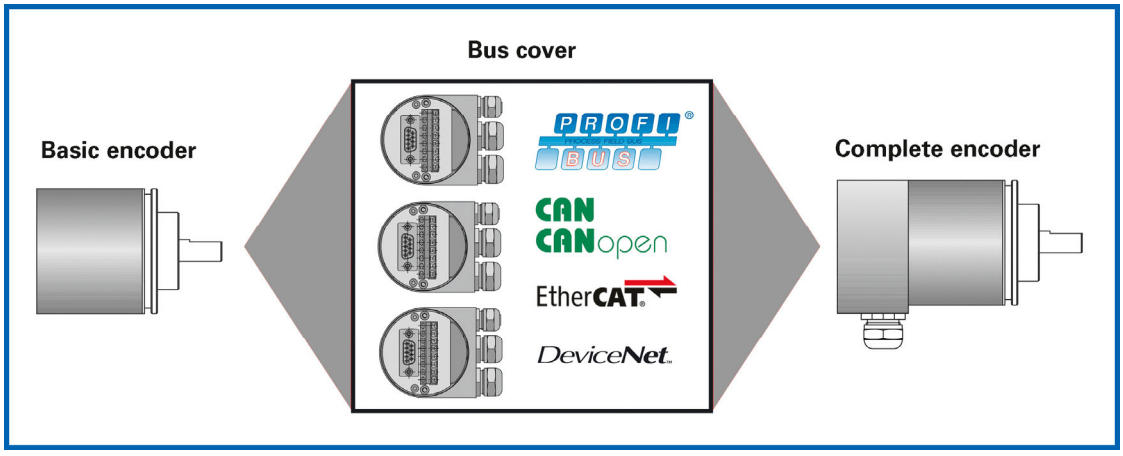
MAGRES
Has a resolution of 4096 steps per revolution with 12 bit, features a magnetic sampling system and is suitable for operation in extreme ambient conditions.

Procoder
Has a resolution of 8192 steps per revolution with 13 bit, features an optical/magnetic sampling system and is suitable for standard applications.

Dignalizer
Has a resolution of 262144 steps per revolution with 18 bit, features an optical/magnetic sampling system with integrated analogue/digital conversion and is suitable for high-precision measurements.

The basic encoders are subdivided once again into a singleturn and a multiturn encoder. The multiturn encoder is capable of a resolution of up to 16 bit or 65536 revolutions, or 18 bit corresponding to 262144 revolutions (Dignalizer). The bus covers are differentiated by the respective bus interfaces. Available interfaces are
CANopen, EtherCAT, DeviceNet and Profibus-DP. All encoders can be parameterized via the bus interface.

Functional principle: MAGRES / Procoder / Dignalizer for shaft, hollow shaft or end shaft respectively



4 Operating mode of the encoder

4.1 Poll Mode

In the Poll mode, the encoder transmits at the request of a different user. The transmitted data can be either position data or additionally to the position data, also contain a warning flag and an alarm flag.

4.2 Change of state Mode (COS)

The encoder transmits position data without a request from a different user, when the current process actual value has changed by a certain amount (adjustable COS delta).

4.3 Cyclic Mode

The encoder transmits position data without a request from a different user after expiry of a programmed time interval (adjustable between 1 and 65535 ms)

5 Encoder operating parameters

Description of operating parameters

Parameter	Description	Value range			Default value	Product
		decimal	hex	Bit	(decimal)	
Sense of rotation	Behaviour of the output code depending on the sense of rotation of the shaft seen looking at the flange CW = Increasing values with clockwise rotation CCW = Increasing values with counterclockwise rotation	CW = 0 CCW = 1	CW = 0h CCW = 1h		CW = 0	All
Resolution	Number of steps per revolution, input in integral steps	1..4096 1..8192 1..262144	1..1000h 1..2000h 1..40000h	1..12 1..13 1..18	4096 8192 262144	MAGRES Procoder Dignalizer
Measurement range (overall resolution) *	Total resolution = number of steps per revolution x number of revolutions.	1..268435456 1..536870912 1..2147483648	1..10000000h 1..20000000h 1..80000000h	1..28 1..29 1..31	268435456 536870912 2147483648	MAGRES Procoder Dignalizer
Preset value	A certain output value is assigned to the current position value	0.. set overall resolution -1			0	All

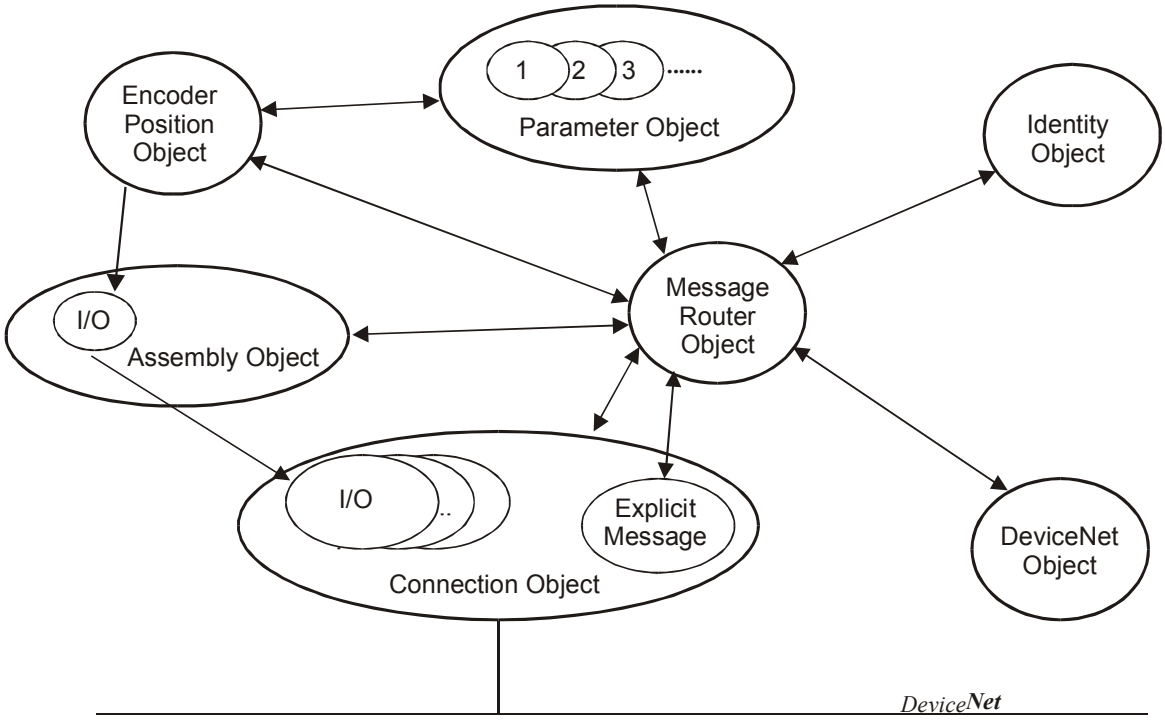
* In the case of singleturn encoders, the measurement range = the resolution

6 Object model

The object model describes the object classes used by the encoder.
The encoder feature a predefined master slave connection set. It is a group 2 only server.
The table below indicates the object classes and the number of entities available in each class.

Object class	No. of instances
01h: Identity	1
02h: Message Router	1
03h: DeviceNet	1
05h: Connection	1 explicit, 2 I/O
04h: Assembly	2
0Fh: Parameter	19
2Bh: Acknowledge Handler	1
2Fh: Encoder Position	1

The diagram indicates the relationship between the individual object classes



7 I/O assembly instances

The encoder supports 2 I/O assembly instances. The instance is determined by instance attribute 14 (produced_connection_path) of the connection object. The programmed value is automatically saved in the non-volatile memory ("Save" service not necessary here).
The default value is instance 1.

The encoder supplies the following data. From the viewpoint of the master, this is input data.

Instance	Type	Name
1	Input	Position value
2	Input	Position value & Warning flag & Alarm flag

Format of I/O assembly data attributes
The I/O assembly data attributes have the following format:

Instance	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1	0	Position value LSB							
	1	Position value							
	2	Position value							
	3	Position value MSB							
2	0	Position value LSB							
	1	Position value							
	2	Position value							
	3	Position value MSB							
	4	Reserved						Warning flag	Alarm flag

Examples:
Path for instance 1 (in hex): "20 04 24 01"
Path for instance 2 (in hex): "20 04 24 02"

8 Configuration of the encoder

The encoder-specific parameters can be programmed using the parameter object 0Fh. Each instance of the relevant object refers to a certain attribute of the encoder position object. Changed parameters are initially saved in the non-volatile memory by the "Save" service.

Instances of the parameter object
The table below shows the instances of parameter object OFh which are supported by the encoder.

Instance no.	Name	Reference to attribute no. of the encoder position object 2Fhex
1	Sense of rotation	3
2	Internal diagnostic function (not used)	4
3	Scaling function	5
4	Position format	6
5	Steps per turn	7
6	Total resolution in steps	8
7	Measurement steps (not used)	9
8	Preset value	10
9	Position value	12
10	Operating status	80
11	Singleturn resolution	81
12	Number of revolutions	82
13	Alarm flag	85
14	Alarm signals	83
15	Supported alarm signals	84
16	Warning flag	88
17	Warning messages	86
18	Supported warning messages	87
19	Profile / software version	89

General services
The parameter object supports the following services:

Code	Service	Description
0Eh	Get_Attribute_Single	Supplies the content of a selected attribute
10h	Set_Attribute_Single	Changes the value of a selected attribute. The new value is not yet (!) stored in the non-volatile memory.
05h	Reset	Resets all parameters to the default values.
15h	Restore	Reloads all parameters from the non-volatile memory.
16h	Save	Saves all parameters in the non-volatile memory so that they are applicable again after power off/on.

9 Encoder position object

The encoder position object is a manufacturer-specific object. The class code is 2Fh.

Instance attributes
Due to their differing functionality, the instance attributes are subdivided into two groups.
The first group, attribute I to 12, contains the parameters for position calculation.
The second group, attribute 80 to 95, contains the diagnostic functions.
Changed parameters are only saved in the non-volatile memory by the "save" service.

Table: Parameters for position calculation

Attribute ID	Access	Name	Data type	Description	Values
1	read	No. of attributes	USINT	Number of supported attributes	
2	read	Attributes	Array of USINT	List of supported attributes	
3	read/ write	Sense of rotation	BOOL	Setting the sense of rotation	0 = CW 1 = CCW
4	read	Internal diagnostic function	BOOL	Not used	0 = OFF
5	read	Scaling function	BOOL	Activation of the scaling function	1 = ON
6	read	Position format	USINT	Format of the position value	0 = Steps
7	read/ write	Steps per turn	UDINT	Number of required steps per turn	See op. parameters
8	read/ write	Total resolution	UDINT	Number of required steps over the measurement range	See operating parameters
9	read	Reserved	UDINT	Reserved	= 0
10	read/ write	Preset value	UDINT	The position value is set to the preset value	See op. parameters
11	read/ write	COS delta	DINT	Minimal position change value in the COS mode	1 to overall resolution
12	read	Position value	DINT	Current position value	1 to overall resolution

Steps per turn
The parameter "Steps per turn" defines the number of steps per revolution. If this parameter is set, the overall resolution is changed according to the following formula:
Total resolution = Steps per turn x turns

Sense of rotation
The sense of rotation defines whether the position values of the encoder increase when rotation takes place clockwise (CW) or counter clockwise (CCW) when looking at the shaft.

Total resolution in steps
The parameter "Total resolution in steps" defines the total number of steps over the entire measurement range.

Example: Steps per turn = 3600; Turns = 256; → Total resolution = 3600 x 256 = 921600

If the number of turns is programmed as a value not equal to 2^n (1, 2, 4,...65536), parameterizing will have to be done anew as soon as the encoder's zero point has been exceeded in powerless state.

Preset function
The preset function supports adjustment of the encoder zero to the system's mechanical zero. It sets the current position of the encoder to the preset value. The internal offset is calculated and stored in the encoder. The "Save" service must be used for fixed storage in the non-volatile memory.
Note: The preset function should only be used when the encoder is at a standstill.

Table: Diagnostic functions

Attri-bute ID	Access	Name	Data type	Description	Values
80	read	Operating status	USINT	Encoder diagnosis, contains the operating status	Bit 0 0 = Sense of rot. CW 1 = Sense of rot. CCW Bit 1 0 = Diagnosis not supp. 1 = Diagnosis supported Bit 2 0 = Scaling OFF 1 = Scaling ON
81	Read	Singleturn resolution	UDINT	Internal resolution per turn	See operating parameters
82	Read	No. of revolutions	UINT	Internal number of revolutions	See operating parameters
83	Read	Alarm signals	UINT	Error can lead to an incorrect encoder position	Bit 0 0 = No position error 1 = Pos. error
84	Read	Supported alarm signals	UINT	Information about supported alarm signals	Bit 0 0 = Pos. error not supported 1 = Pos. error supported
85	Read	Alarm flag	BOOL	Indicates the occurrence of an alarm signal (depends on attr. 83)	0 = OK 1 = Alarm
86	Read	Warning messages	UINT	Internal parameters out of tolerance	Bit 4 Voltage of the lithium cell 0 = OK 1 = too low
87	Read	Supported warning messages	UINT	Information on supported warning messages	Bit 4 Voltage warning signal for lithium cell 0 = not supported 1 = supported
88	Read	Warning flag	BOOL	Indicates the occurrence of a warning signal (depends on attr. 86)	0 = OK 1 = Warning signal
89	Read	Profile and software version	UDINT	Low-Word: Profile High-Word: Software version	
91	Read	Offset value	DINT	The offset value is calculated within the preset function and shifts the position value by the calculated value	
95	Read	Encoder type	UINT	Describes the encoder type	

Parameter description

Alarm signals

Attribute 83 supplies the alarm signals. An alarm is set when the encoder has recognized a status which can lead to an incorrect encoder position. As soon as an alarm status is detected, the relevant bit is set to logic high. The alarm is reset automatically after 2.5 seconds. The alarm flag bit (attr. 85) is also set with each alarm.

Warning messages

Warnings are signalled by the encoder when internal encoder parameters are out of tolerance. In contrast to alarm signals, warnings do not indicate an incorrect position. Warnings are reset as soon as the parameter which was out of tolerance resumes a correct value. The warning flag bit (attr. 88) is also set with each warning.

Offset value

Attribute 91 contains the parameter offset value. The offset value is calculated within the preset function and shifts the position value by the calculated value. The preset function is used after the scaling function. The offset value is not saved in the non-volatile memory until the "Save" service is activated.

Encoder type

Encoder type = 01: Absolute encoder, singleturn
Encoder type = 02: Absolute encoder, multiturn

General services

The encoder position object supports the following services:

Code	Service	Description
0Eh	Get_Attribute_Single	Supplies the content of a selected attribute
10h	Set_Attribute_Single	Changes the value of a selected attribute. The new value is not yet (!) saved in the non-volatile memory
05h	Reset	Resets all parameters to the default values
15h	Restore	Reloads the parameters from the non-volatile memory
16h	Save	Saves all parameters in the non-volatile memory, so that they are valid again after power off/on

10 Terminal assignment and commissioning

10.1 Mechanical mounting

Shaft encoder

- Mount the encoder housing using the fastening holes on the flange side with three screws (square flange with four screws), paying attention to the thread diameter and thread depth.
- Alternatively, the encoder can be mounted in any angular position using three eccentric fastenings - see accessories.
- Connect the drive shaft and encoder shaft using a suitable coupling. The ends of the shafts must not be touching. The coupling must be capable of compensating for displacement due to temperature and mechanical backlash. Pay attention to the admissible axial or radial shaft loads. For suitable connecting devices, see under accessories.
- Tighten the fastening screws.

End shaft / Hollow shaft encoder

- Clamping ring fixture
  Place the encoder on the drive shaft and tighten the clamping ring.
- Encoder torque pin
  Slide encoder onto the drive shaft and insert torque pin into the adjusting element provided by customer.
- Adjusting element with rubberized spring element
  Push the encoder on to the drive shaft and insert the parallel pin into the mounted adjusting element (not supplied) (with rubberized spring element)
- Adjusting bracket
  Push the encoder over the drive shaft. Insert the adjusting bracket into the rubberized spring element of the encoder and fasten the adjusting bracket on the contact surface (not supplied).
- Shoulder screw
  Push the encoder over the drive shaft and insert the shoulder screw (not supplied) in the rubberized spring element of the encoder.
- Coupling spring
  Mount the coupling spring with screws onto the fixing holes of the encoder housing.
  Push the encoder over the drive shaft and fasten the coupling spring on the contact surface.

10.2 Electrical connection

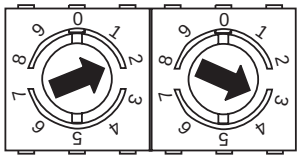
Only ever store or transport the bus cover in the ESD bag. The bus cover must rest fully against the housing and be firmly screwed in place.
For electrical connection, pull off the bus cover using the following method:

- Release the fastening screws of the bus cover
- Carefully loosen the bus cover and lift off in the axial direction

10.2.1 Setting the user address

The user address (MAC ID) is set decimally using two rotary switches in the bus cover. The maximum number of users is 63.

Set the user address decimally using the two rotary switches 1 and 2.



Example: 23

10.2.2 Setting the baud rate

The baud rate setting is binary, using switches 2 and 3 of the 3-pin DIP switch in the bus cover.
The default value is 125 KBit/s.

Baud rate	Setting of the 3 DIP switches		
	Switch 1	Switch 2	Switch 3
125 kBit/s	X	OFF	OFF
250 kBit/s	X	OFF	ON
500 kBit/s	X	ON	OFF
125 kBit/s *	X	ON	ON



X = don`t care
* As this switch setting is not defined, it is set internally to the default value 125 Kbit/s.

10.2.3 Terminating resistor

If the connected encoder is the last device in the bus line, the bus must be terminated with a resistor.
The resistor is in the bus cover and is connected using a DIP switch.

- The terminating resistor must be switched to "ON" at the last user with a DIP switch (default setting OFF).



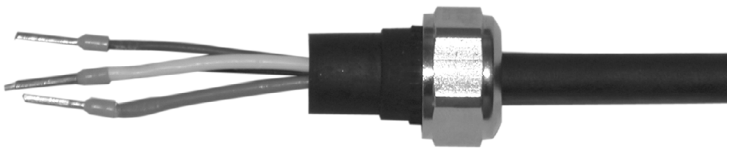
ON = Final user
OFF = User X



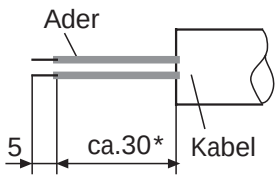
Switch 1: ON = Final user
OFF = User X
Switch 2: Without function

10.2.4 Bus cover connection

- Release the cap nut of the cable gland.
- Push the cap nut and seal insert with contact sleeve onto the cable sheath.
- Strip the cable sheath and cores, completely remove the braided screen and shield film to the end of the cable sheath.
- The braided screen and shield film of the cable must not touch the housing.
- Push the sealing insert with contact sleeve along as far as the braided shield. Insert the sealing insert with contact sleeve and cable flush into the cable gland and tighten the cap nut.
- Insert the cores into the terminal strip and screw tight, observing the admissible core cross-section
- Use isolated core end sleeves. Use preferably isolated twin core end sleeves for supply voltage.

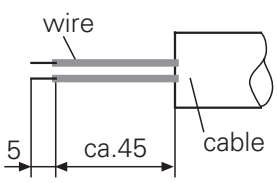


For standard encoder



* Rote und schwarze Litze der Kabelverschraubung 1 10 mm länger

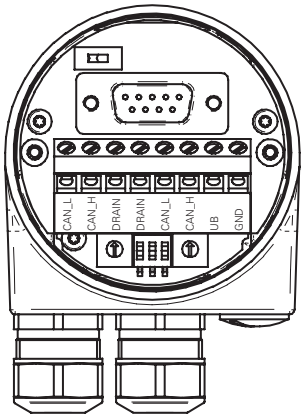
For BISD and BIMD

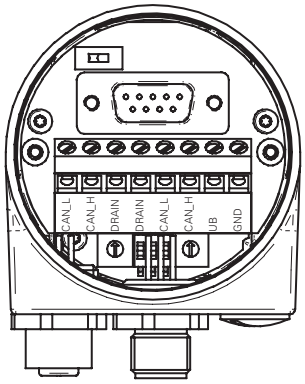


- Terminals with the same designation are internally interconnected.
- For the power supply cable, gland 1 or 2 can be optionally used – note admissible cable cross-sections.
- Guide cores along the shortest route from the cable gland to the terminal strip.
- Close unused cable glands with sealing bolts (supplied).

Bus cover – radial



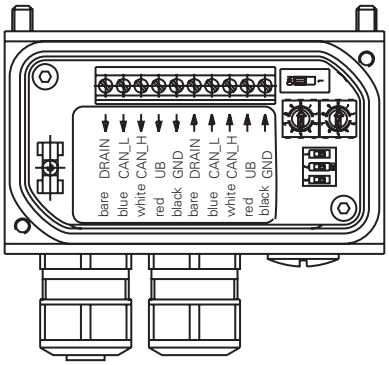


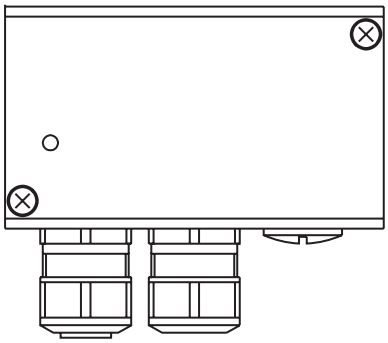


1 2 Cable gland M12 connector

Bus cover – axial

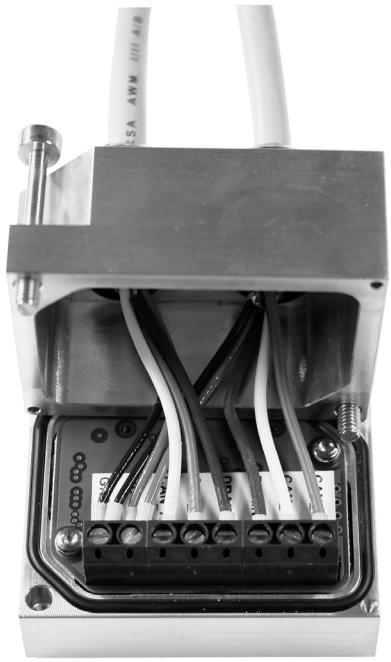


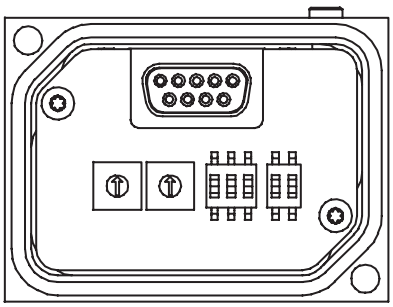


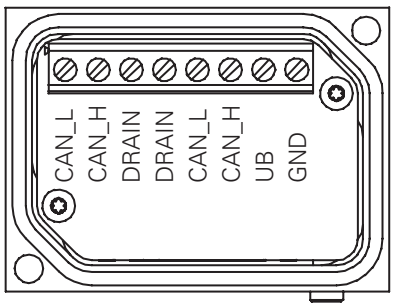


1 2

Bus cover – axial (for BISD and BIMD)



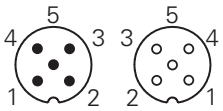




10.2.5 Terminal assignment

Pin	Terminal	Description	Colour
Pin 1	DRAIN	Shield connection	none
Pin 2	UB	Supply voltage 10...30 VDC	red
Pin 3	GND	Ground connection relating UB	black
Pin 4	CAN_H	CAN Bus Signal (dominant High)	white
Pin 5	CAN_L	CAN Bus Signal (dominant Low)	blue

M12 connector



Terminals with the same significance are internally connected and identical in their functions. Max. load on the internal terminal connections UB-UB and GND-GND is 1 A.

- Carefully plug the bus cover onto the D-SUB plug of the basic encoder, then press only via the sealing rubber, taking care not to tilt it. The bus cover must rest fully against the basic encoder.
- Tighten both the fastening screws firmly in the same direction.

The encoder housing and braided shield of the connecting cable are only ideally connected if the bus cover is resting fully on the basic encoder (positive locking).

10.3 Display elements (status display)

A DUO LED (green/red) is located in the bus cover which works in accordance with DeviceNet specification in the combined module/network status and supplies information about the status of the encoder and the network.

LED status	Status	Description
Off	Not connected	No power supply - Dupl. MAC-ID Check not finished. - Power supply not connected
Green flashing	Device active and online No connections set up	The device is working under normal conditions and is online, but no connection has been set up. - The encoder has not yet been configured by the master - Configuration not complete or faulty
Green	Device active and online Connections are set up	The device is working under normal conditions and is online, connections in "set up" status“
Red	Critical device error critical communication error	The device is an irreparable error status - No network communication possible - User address has been assigned twice (MAC-ID)
Red flashing	Repairable error	I/O connections are in time-out status