05.11 · 174.02.041/3

Manual

Absolute Encoder with DeviceNet

Firmaware version from 1.02

Contents

Disclaimer of liability
The present manual was compiled with utmost care, errors and omissions reserved. For this reason Baumer IVO GmbH & Co. KG rejects any liability for the information compiled in the present manual. Baumer IVO nor the author will accept any liability for direct or indirect damages resulting from the use of the present information.

At any time we should be pleased receiving your comments and proposals for further improvement of the present document.

1. Introduction

1.1. Scope of delivery

Please check the delivery upon completeness prior to commissioning.
Depending on encoder configuration and part number delivery is including:
- Encoder
- CD with describing file and manual (also available as download in the Internet)

1.2. Product assignment

Shaft encoder

Product	Product Code	Product Name	EDS-File
GXP8W	0x14	GXP8	GXP8.eds

2. Safety precautions and operating information

Additional information
- The manual is a supplement to the documentation which already exists (catalogues, product information and installation manuals).
- It is imperative that the manual is read prior to commissioning.

Proper use
- The encoder is a precision measuring device. It is used exclusively for the detection of angle positions and rotations, and the processing and provision of the measured values as electrical output signals for the next device. The encoder may only be used for this purpose.

Commissioning
- The encoder may only be installed and mounted by a qualified electrician.
- Observe the operating manual of the machine manufacturer.

Safety precautions
- Check all electrical connections before commissioning the system.
- If installation, electrical connection or other work on the encoder and on the system are not carried out properly, malfunction or failure of the encoder may result.
- The endangering of persons, damage to the system and damage to operating equipment due to the failure or malfunction of the encoder must be prevented with suitable safety measures.
- The encoder may not be operated outside the specified limits (see additional documentation).

Failure to observe the safety precautions can lead to malfunctions, damage and injuries!

Transport and storage
- The encoder may only be transported and stored in the original packaging.
- Do not drop the encoder or subject it to major jolts or impacts.

Assembly
- Avoid impacts or shocks to the housing and shaft.
- Do not torque the housing.
- Do not produce a rigid connection between the encoder and drive shafts.
- Do not open the encoder or modify it mechanically.

The shaft, ball bearings, glass plate or electronic parts can be damaged. Safe operation is then no longer ensured.

Electrical commissioning
- Do not modify the encoder electrically.
- Do not carry out wiring work while the encoder or system is energized.
- The electrical connection may not be connected or disconnected while energized.
- Install the entire system so that it is EMC-compliant. The installation environment and wiring affect the EMC of the encoder. Install the encoder and the supply lines in separate locations or at a great distance from wiring with a high interference level (frequency converters, contactors etc.).
- For consumers with high interference levels, provide a separate power supply for the encoder.
- Complete screen the encoder housing and the connection cables.
- Connect the encoder to protective ground and use shielded cables. The cable shield must be connected to the screw cable terminal or plug. Connection of the protective ground at both ends, the housing via the mechanical attachment, and the cable shield via devices connected downstream should be aimed for. If problems occur with ground loops, grounding should be carried out on at least one end.

Failure to observe the above can lead to malfunctions, damage and injuries!

3. Encoder operating modes

3.1. Poll Mode
In Poll Mode the encoder will transmit upon request of another user. The data transferred may optionally comprise position data or an additional warnflag and alarmflag.

3.2. Change of status Mode (COS)
The encoder will transmit position data without being requested by another user if the actual process value has changed by a certain value (adjustable COS-Delta).

3.3. Cyclic Mode
The encoder will transmit position data without being requested by another user upon expiry of a programmable time interval (adjustable 1…65535 ms).

4. Encoder operating parameters

Significance of operating parameters

Parameter	Significance	Value range			Default setting
		decimal	hex	Bit	(decimal)
Sense of rotation	Behaviour of the output code depending on the sense of rotation of the shaft when 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
Resolution	Number of steps per revolution, input in integral steps	1..8192	1..2000h	1..13	8192
Measurement range (total resolution) *	Total resolution = number of steps per revolution x number of revolutions	1..536870912	1..20000000h	1..29	536870912
Preset value	A certain output value is assigned to the current position value (referencing)	0.. selected total resolution -1			0

* With singleturn encoders the measurement range equals the resolution

5. Object model

The object model describes the encoder object classes applied.
The encoder provides a Predefined Master-Slave-Connection-Set. It is a group 2 only Server.
The following chart shows the object classes and the number of entities available in each class.

object class	number of entities
01h: Identity	1
02h: Message Router	1
03h: DeviceNet	1
05h: Connection	1 explicit, 2 E/A
04h: Assembly	2
0Fh: Parameter	19
2Bh: Acknowledge Handler	1
2Fh: Encoder Position	1

The diagram explains the relations among the individual object classes.
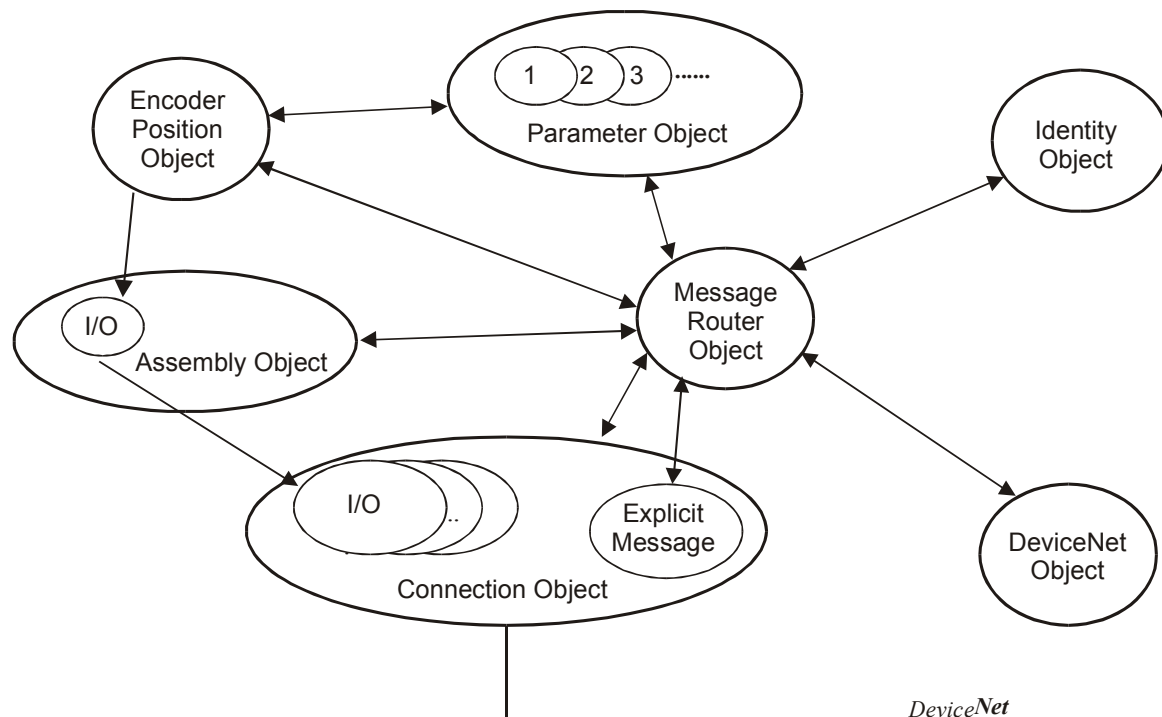
6. E/A Entities/Assembly

The encoder supports 2 E/A Entities/Assembly. The entity is designated by the entity attribute 14 (produced_connection_path) of the connection object. The programmed value is automatically stored in the non-volatile memory (service "save" here is not necessary).
Entity default setting: 1.

The encoder provides following data which are input data from the Master's point of view.

entity	type	name
1	input	position value
2	input	position value & warnflag & alarmflag

E/A Assembly data attributes format
E/A Assembly data attributes are of the following format:

entity	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						Warn-Flag	Alarm-Flag

Examples:
Path entity 1 (in hex): „20 04 24 01"
Path entity 2 (in hex): „20 04 24 02"

7. Encoder configuration

The encoder-specific parameters can be programmed by the parameter object 0Fh. Each object entity refers to
a certain attribute of the encoder-position-objects.
Amended parameters are not stored in the non-volatile memory until the service „save" is carried out.

Parameter object entities
The following chart shows the parameter object 0Fh entities supported by the encoder.

Entity No.	name	Reference to attribute no. of the Encoder Position Object 2Fh
1	Sense of rotation	3
2	internal diagnostic function (not used)	4
3	Scaling function	5
4	Position format	6
5	Steps per revolution	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	Warn flag	88
17	Warning signals	86
18	Supported warning signals	87
19	Profile / Software version	89

General services
The parameter object supports the following services:

Code	Service	Signifcance
0Eh	Get_Attribute_Single	Provides the content of the selected attribute
10h	Set_Attribute_Single	Changes the value of the selected attribute. The new value is not yet (!) stored in the non-volatile memory
05h	Reset	Resets all parameters to default
15h	Restore	Restores all parameters of the non-volatile memory
16h	Save	Saves all parameters in the non-volatile memory to be restored after mains on/off

8. Encoder Position-Object

The Encoder Position Object is a manufacturer-specific object with class code 2Fh.

Entity attributes
Due to their different functionality, entity attributes are broken down into two groups.
The first group, attribute 1 to 12 comprises the parameters for position calculating.
The second group, attribute 90 to 95 comprises the diagnostic functions.
Altered parameters are not stored in the non-volatile memory until by service "save".

Chart: Parameters for position calculating

Attribute - ID	Access	Name	Data type	Significance	Values
1	read	Number of attributes	USINT	Number of attributes supported	
2	read	Attributes	Array of USINT	List of attributes supported	
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	Scaling function active	1 = ON
6	read	Position format	USINT	Position value format	0 = steps
7	read/ write	Steps per revolution	UDINT	Number of desired steps per revolution	see operating parameter
8	read/ write	Total resolution	UDINT	Number of desired steps exceeding the measurement range	see operating parameter
9	read	Reserved	UDINT	reserved	= 0
10	read/ write	Preset value	UDINT	Position value is set to the preset value	see operating parameter
11	read/ write	COS-Delta	DINT	Minimum divergent value of the position in COS mode	1 to total resolution
12	read	Position value	DINT	actual position value	1 to total resolution

Steps per revolution
The parameter „steps per revolution" defines the number of steps per revolution. Upon setting this parameter, the total resolution will change correspondingly according the following formula:
Total resolution = steps per revolution x revolutions

Sense of rotation
The sense of rotation defines whether the position values are increasing with clockwise rotation (CW) or counterclockwise rotation (CCW) of the shaft.

Total resolution in steps
The parameter „total resolution in steps" defines the total number of steps covering the complete measurement range.
Example: steps per revolution = 3600; revolutions = 256; → total resolution = 3600 x 256 = 921600

If the number of revolutions relating to a value is programmed unequal 2^n (1, 2, 4,...65536), the encoder must be parameterized anew after crossing the encoder zero point in powerless state.

Preset function

The preset function supports adjustment of the encoder zero point to the system's mechanical zero point. The actual encoder position is set to the preset value. The internal offset value is calculated and stored in the encoder. For storage into the non-volatile memory first the service "save" has to be carried out.

Attention: It is recommended to apply the preset function only in idle status of the encoder.

Chart: Diagnostic functions:

Attribute ID	Access	Name	Data-type	Significance	Values
80	read	Operating status	USINT	Encoder diagnosis comprising the operating status	Bit 0 0 = sense of rotation CW 1 = sense of rotation CCW Bit 1 0 = diagnosis not supported 1 = diagnosis supported Bit 2 0 = scaling OFF 1 = scaling ON
81	read	Singleturn-resolution	UDINT	Internal resolution per revolutions	see operating parameters
82	read	Number of revolutions	UINT	Internal number of revolutions	see operating parameters
83	read	Alarm signals	UINT	Malfunction may lead to wrong encoder position	Bit 0 0 = no position error 1 = position error
84	read	Supported alarm signals	UINT	Information on the alarm signals supported	Bit 0 0 = position error not supported 1 = position error supported
85	read	Alarm-Flag	BOOL	Indicates occuring alarm signal (depending on attribute 83.)	0 = OK 1 = Alarm
86	read	Warning signals	UINT	internal parameters beyond tolerances	Bit 4 Lithium cell voltage 0 = OK 1 = too low
87	read	Supported warning signals	UINT	Information on the warning signals supported	Bit 4 Alarm signal lithium cell voltage 0 = not supported 1 = supported
88	read	Warn-Flag	BOOL	Indicates occuring warning signal (depending on attribute 86)	0 = OK 1 = warning signal
89	read	Profile and Software version	UDINT	Low-Word: Profile High-Word: Software-Version	
91	read	Offset	DINT	The offset is calculated within the preset function and will shift the position value by the calculated value	
95	read	Encoder type	UINT	Describing the encoder type	

Parameter Significance

Alarm signals
Attribute 83 provides the alarm signals. An alarm is set as soon as the encoder is recognizing a status that may lead to a wrong encoder position. Upon recognising the alarm status, the relevant bit is set to logically high.
The alarm is automatically reset after 2.5 s. The alarm flagbit (attribute 85) is also set with every alarm.

Warning signals
The encoder will transmit warning signals upon the internal encoder parameters being beyond the tolerances. Contrary to alarm signals warning signals do not indicate a wrong position. Warnings are being reset as soon as the parameter that was beyond the tolerances turns into a correct value again. The Warn-Flagbit (attribute 88) is also set with every warning.

Offset
Attribute 91 comprises the parameter offset value. The offset value is calculated within the preset function and will shift the position value by the calculated value. The preset function is applied after the scaling function.
The offset value is not stored into the non-volatile memory until the service "save" is carried out.

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	Significance
0Eh	Get_Attribute_Single	Provides the contents of a selected attribute
10h	Set_Attribute_Single	Changes the value of a selected attribute. The new value is not yet (!) stored into the non-volatile memory
05h	Reset	Reset of all parameters to default
15h	Restore	Restores all parameters of the non-volatile memory
16h	Save	Saves all parameters in the non-volatile memory to be restored again after mains off/on.

9. Terminal assignment and commissioning

9.1. Mechanical mounting

- Mount the encoder housing using the fastening holes on the flange side with three screws (square flange with 4 screws), paying attention to the thread diameter and thread depth.
- Alternatively, the encoder can be mounted in any angular position by 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.

9.2. Electrical connection

9.2.1. Setting the user address

Setting the user address (MAC-ID) is carried out by the object „DeviceNet". (class 3) and has to be configured by the service SET ATTRIBUTE SINGLE to class 3, entity 1, attribute 1.

Non-volatile storage is carried out automatically (without additional SAVE service)

Default   :   63
valid values: 0..63

9.2.2. Setting the Baudrate

Setting the Baud rate is carried out by the object „DeviceNet". (class 3) and has to be configured by the service SET ATTRIBUTE SINGLE to class 3, entity 1, attribute 2.
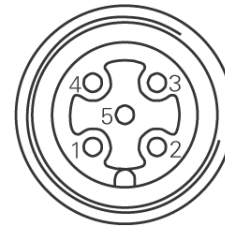
Non-volatile storage is carried out automatically (without additional SAVE service)

Default: 0 = 125 kBaud

Valid values   0 = 125 kBaud
                        1 = 250 kBaud
                        2 = 500 kBaud

9.2.3. Terminal significance

Pin	Terminal	Significance
1	DRAIN	Shield connection
2	UB	Power supply 10...30 VDC
3	GND B	Ground connection UB
4	CAN_H	CAN Bus Signal (dominant High)
5	CAN_L	CAN Bus Signal (dominant Low)

Micro Connector
Pinout
Male (Pin)

9.3. Display elements (status display)

A DUO LED (green/red) working in the 'Combined Module/Network Status' in line with the DeviceNet specification is providing information on the status of the device respectively of the network.

LED-Colour	Status	Significance
off	not connected	No power supply - Dupl. MAC-ID check not terminated. - No power supply
Green flashing	Device is active and online No connections established	The device is operating under normal conditions and is online, no connection established. - Encoder not yet configured by Master - configuration incomplete or faulty
Green continous	Device is active and online Connections are established	The device is operating under normal conditions and is online, connection status "established"
Red continous	Critical device error or Critical communication error	The device is in fatal non-corrective error status - no network communication possible - double assignment of user address (MAC-ID)
Red flashing	Corrective error	I/O connections in Time-Out status