EGD 50.xx

Single Turn Rotary Encoder
CANopen

Instruction Manual
Datasheet

Revision 3.00

Relating firmware:
EGD50x.300
EGD50xS.300
EGD50xK.300
EGD50xSK.300

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Sensors · Monitoring · Systems

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1 General

EGD.xx CANopen Single Turn Rotary Encoder

Features:

- General
  - Contact less measurement of the rotation angle of a pivoted magnet
  - Low sensitivity against shocks and vibrations
  - 360° non tripping rotation of the encoder axis
  - 12 bit resolution of the position value (0 .. 4095)
  - Adjustable angle position by button or CANopen protocol
- CAN
  - CANopen protocol according to CiA draft standard 301 (communication)
  - Specific CANopen protocol for the unit following the CiA draft standard proposal 406
  - Failure indication by an emergency object (communication and instrument failure)
- Current Interface
  - Adjustable and scaleable through CANopen objects
  - Scale range and failure range can be adjusted through buttons or CANopen object
  - Failure indication by halved lower offset (e.g. 4 mA/2)

2 Designations and Abbreviations

CiA:	CAN in Automation (www.can-cia.org)
DS, DSP:	draft standard, draft standard proposal
Object:	CANopen objects can be data, parameter or functions of the device
Index:	the index is a 16bit value which identifies the object
Sub index	the sub index (8bit) identifies a sub item of the index
NMT	network management
SDO	service data object
PDO	process data object
COB-ID	communications object identifier (controls the priority of the objects)
RO	read only
RW	read write
UINT32	unsigned int 32 bit

3 CANopen Units in General

Every CANopen unit uses for the communication in the CAN the standard which is described in CiA DS-301 edited by the CAN in Automation e.V. (CiA e.V.). It is necessary to know this standard in order to understand a CANopen unit. Furthermore every unit can use specific objects, for the encoder these are described in the CiA DSP-406, but they are not binding. Additionally specific objects of the manufacturer can be used and which facilitate the access to special parameters of the unit.

4 General Remarks to this Manual

In this manual only objects described, which are necessary to understand the CAN messages. All other objects which are implemented in the EGD are described in the Electronic Data Sheet (EDS). The EDS EGD50.300.eds is available for download under www.dr-e-horn.com. The structure of the EDS is described in document CiA DSP-306. All other used objects are fully described in document CiA DS-301. The draft standards (DS) and draft standard proposals are edited by the CiA (CAN in Automation e.V., www.can-cia.org, phone: +49-9131-69086-0).

5 Objects for Communication According to CiA Draft Standard DS-301 Version 4.01

Object 1001h ERROR Register

This object differentiates failures and is sent as a part of the EMERGENCY object.

See also: chapter 9

Short description:

Data type: UNSIGNED8				
Index / Sub index	**Parameter name**	**Bit**	**Function**	**Access**
1001h/00	ERROR register	0	generic error (general failure)	RO
		1	current (not used)	RO
		2	voltage (not used)	RO
		3	temperature (not used)	RO
		4	communication error (overrun, error state)	RO
		5	device profile specific	RO
		6	reserved (always 0)	RO
		7	manufacturer specific (failure of hardware)	RO

Object 1014h COB-ID Emergency

Contains besides others the COB-ID, which is used by the emergency message.

More information about this object in DSP-301 version 4.01.

Short description:

Data type: UNSIGNED32				
Index / Sub index	**Parameter name**	**Bit**	**Function**	**Access**
1014h/00	COB-ID emergency	32	ID of the emergency message	RO

Object 1017h Producer Heartbeat Time

This object contains the producer heartbeat time in milliseconds. If the value is 0, no heartbeat is transmitted. The heartbeat is sent by ID 700h + Node-ID and shows the operation status

Range of values: 0 .. 65535

Short description:

Data type: UNSIGNED16				
Index / Sub index	**Parameter name**	**Bit**	**Function**	**Access**
1017h/00	producer heartbeat time	16	distance between heartbeat messages	RW

The CAN bus shows the heartbeat:

ID	**Byte 0 (operation status)**
700h + Node-ID	05h (operational) or 7Fh (preoperational)

Object 1A00h Transmit PDO Mapping

Sub-index 0: activation of the objects mentioned in sub-index 1h and sub-index 2h [2)]

Short description:

Data type: RECORD				
Index / Sub index	**Parameter name**	**Bit**	**Function**	**Access**
1A00h/00	transmit PDO mapping	8	value: 0 = not active 1 = 6004h active 2 = 6004h and 6030h active [2)]	RO [1)] RW [2)]

Data type: UNSIGNED32				
Index / Sub index	**Parameter name**	**Bit**	**Function**	**Access**
1A00h/01	PDO mapping for the 1st application object to be mapped	32	informations about mapped object 6004h	RO

Data type: UNSIGNED32				
Index / Sub index	**Parameter name**	**Bit**	**Function**	**Access**
1A00h/02 [2)]	PDO mapping for the 2nd application object to be mapped	32	informations about mapped object 6030h [2)]	RO

If the EGD 50.XX is in the operation status *operational* and the cycle time is not zero, depending on the activation of the contents, the objects out of the following table are shown.

1A00h/0h = 1:

ID	Byte 0	Byte 1
180h + node-ID	6004h (LSB)	6004h (MSB)

1A00h/0h = 2:

ID	Byte 0	Byte 1	Byte 2	Byte 3
180h + node-ID	6004h (LSB)	6004h (MSB)	6030h (LSB)	6030h (MSB)

The default value of object 1A00h/00h is 1 (only object 6004h is mapped in the PDO). When object 6030h [2)] also shall be mapped in the PDO, object 1A00h/00h must be set to 2.

1) when option „SPEED“ is not available

2) when option „SPEED“ is available

6 DSP-302 V 3.1 Objects

Object 1F80h NMT-Start-Up

By use of this object the EGD encoder after power on is able to change into the *operational mode* by itself.

Short description:

Data type: UNSIGNED32				
Index / Sub index	**Parameter name**	**Bit**	**Function**	**Access**
1F80h/00	NMT start up	32	0x8 = automatic operation 0xC = no automatic operation	RW

7 Objects Specific to the Device According to CiA DSP-406 Version 2.0

The following objects specific to the unit are implemented.

Object 6000h Operating Parameters

By this object the counting direction can be influenced. Other functions of this object are not supported.

Short description:

Data type: UNSIGNED16				
Index / Sub index	**Parameter name**	**Bit**	**Function**	**Access**
6000h/00	operating parameter	16	CW*/CCW* = 0x0/0x1	RW

*CW = clockwise = object 0x6004h counts up, if rotation is clockwise

*CCW = counter-clockwise = object 0x6004h counts down, if rotation is clockwise

Viewed to the shaft of the encoder clockwise means a turn to the right.

Object 6003h Preset Value

The position value (PDO 1 respective object 6004h/00) can be shifted by this parameter.

Range of values: 0h - FFFh

Short description:

Data type: UNSIGNED16				
Index / Sub index	**Parameter name**	**Bit**	**Function**	**Access**
6003h/00	preset value	16	sets the position to the desired value	RW

Object 6004h Position Value

This object informs about the position. It can be recalled by a SDO or it can be part of the mapping of PDO 1.

Short description:

Data type: UNSIGNED16				
Index / Sub index	**Parameter name**	**Bit**	**Function**	**Access**
6004h/00	position value	16	position value	RO

Object 6030h Speed [1)]

This object informs about the angle speed. It can be recalled by a SDO or it can be part of the mapping of PDO 1. When object 0x6004h counts up, the value is positive and when object 0x6004h counts down the value is negative. The range of the values is from –2047 to +2047 and is a hundredfold of the angle speed in degrees per second [°/s]. Therefore the angle speed can be between –20.47 °/s and 20.47 °/s. If these values are exceeded the encoder gives an emergency message and the actual value becomes invalid. Only if the angle speed participates at the actual mapping, it is failure controlled. See chapter 9.

Short description:

Data type: UNSIGNED16				
Index / Sub index	**Parameter name**	**Bit**	**Function**	**Access**
6030h/00	angle velocity	16	angle speed	RO

1) when option „SPEED“ is available

Object 6200h - Cyclic Timer

Object 6200h contains the transmitting cycle time of the PDO 1 in milliseconds. If the parameter is > 0 the PDO 1 will be sent periodically with this cycle time.

Range of values: 0 ms .. 65535 ms

e.g.: 30 ms = 1Eh

Short description:

Data type: UNSIGNED16				
Index / Sub index	**Parameter name**	**Bit**	**Function**	**Access**
6200h/00	cycle time	16	transmitting cycle time of PDO 1	RW

Object 6401h Working Area Low Limit

Is used for the setting of the parameters of the optional current interface and their lower limit values.

Sub-index 0: Number of sub-indexes
Sub-index 1: Angle position related to the lower current limit value
Sub-index 2: Lower current limit value
Sub-index 3: From this position 2 mA is shown by the current interface as a failure

Short description:

Data type: UNSIGNED16				
Index / Sub index	**Parameter name**	**Bit**	**Function**	**Access**
6401h/00	-	8	number of sub-indexes	RO
6401h/01	current scale lower limit	16	beginning of scale of the current interface	RW
6401h/02	lower user current limit	16	lower current limit min.: 30 is appropriate to 3 mA	RW
6401h/03	current lower error switch limit (min.: beginning of scale –70)	16	scale limit from where 2 mA is shown as a failure	RW

Object 6402h Working Area High Limit

Is used for the setting of the parameters of the optional current interface and their upper limit values.

Sub-index 0: Number of sub-indexes
Sub-index 1: Angle position related to the upper current limit value
Sub-index 2: Upper current limit value
Sub-index 3: From this position 2 mA is shown by the current interface as a failure

Short description:

Data type: UNSIGNED16				
Index / Sub index	**Parameter name**	**Bit**	**Function**	**Access**
6402h/00	-	8	number of sub-indexes	RO
6402h/01	current scale upper limit	16	end of scale of the current interface	RW
6402h/02	upper user current limit	16	upper current limit max.: 210 is appropriate to 21 mA	RW
6402h/03	current upper error switch limit (max.: end of scale +70)	16	scale limit from where 2 mA is shown as a failure	RW

Object 6501h Single Turn Resolution (Rotary)

Object 6501h contains the resolution of the encoder.

Short description:

Data type: UNSIGNED32				
Index / Sub index	**Parameter name**	**Bit**	**Function**	**Access**
6501h/00	single turn resolution	32	single turn resolution	RO

Object 6502h Number of Distinguishable Revolutions

Object 6502h contains the number of distinguishable revolutions.

Short description:

Data type: UNSIGNED16				
Index / Sub index	**Parameter name**	**Bit**	**Function**	**Access**
6502h/00	number of distinguishable revolutions	16	number of distinguishable revolutions	RO

8 Manufacturer Specific Objects

Object 2000h Low Pass Value [1)]

The low pass value is used for the digital low pass filter for the angle speed.

The input value is a tenfold of the used value, e.g. input = 85 is appropriate to used value 8.5.

Minimum: 10 is appropriate to 1.0
Maximum: 255 is appropriate to 25.5

The digital low pass filter is disabled, when object 2000h is set to 10.

Short description:

Data type: UNSIGNED8				
Index / Sub index	**Parameter name**	**Bit**	**Function**	**Access**
2000h/00	low pass value	8	filter for the angle speed	RW

1) when option „SPEED“ is available

Object 2001h Node-ID Offset

Allows the setting of 127 identifiers.

This value must be added to the hardware value, the result is the used CAN-Node-ID.

If the calculated node-ID is less than 1 or greater than 127 the node-ID is set to 127.

Short description:

Data type: UNSIGNED8				
Index / Sub index	**Parameter name**	**Bit**	**Function**	**Access**
2001h/00	node ID offset	8	set node-ID	RW

Object 2002h Position Offset

The position value (PDO 1 respective object 6004h/00) can be shifted by this parameter. This is an alternative method instead of using object 6003h/00.

Range of value: 0 .. 4095

Short description:

Data type: UNSIGNED16				
Index / Sub index	**Parameter name**	**Bit**	**Function**	**Access**
2002h/00	position offset	16	shifts the position value	RW

Object 2003h Boot Loader Function

Allows turning on the boot loader jump bit (BLJB) by setting the value 0x5A. The value 0x00 resets the BLJB.

This feature is a specialty of the internal used microcontroller, it starts the “IAP” (In Application Programming) and will be executed after switching the power supply off and on.

Short description:

Data type: UNSIGNED8				
Index / Sub index	**Parameter name**	**Bit**	**Function**	**Access**
2003h/00	Boot loader activate	8	set BLJB with 0x5A	RW

Object 2100h Manufacturer Calibrated Lower Current Limit

Attention: If this object is changed, the manufacturer calibration of the current interface will be lost.

For the adaption of the current interface please use the objects 6401h and 6402h.

Short description:

Data type: UNSIGNED16				
Index / Sub index	**Parameter name**	**Bit**	**Function**	**Access**
2100h/00	manufacturer calibrated lower current limit	16	manufacturer’s calibration	RW

Object 2101h Manufacturer Calibrated Upper Current Limit

Attention: If this object is changed, the manufacturer calibration of the current interface will be lost.

For the adaption of the current interface please use the objects 6401h and 6402h.

Short description:

Data type: UNSIGNED16				
Index / Sub index	**Parameter name**	**Bit**	**Function**	**Access**
2101h/00	manufacturer calibrated upper current limit	16	manufacturer’s calibration	RW

9 Failure Messages

Recognized failures are shown on the CAN by the use of an emergency object.

The EGD-encoder supports the mandatory failure codes according to *CiA DS-301 V4.01*

and shows failures specific to the unit.

Error Code (mandatory)

00xx Error reset or no error = the failure is corrected

10xx Generic error = e.g. communication failure

Error Code (optional)

FF81h specific to the device.

If a failure specific to the manufacturer is transmitted to the CAN by an emergency message (COB-ID: 80h + Node-ID), the values transmitted from the PDO are invalid.

Emergency Object Data

Byte	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
content	e.g. FF81h (device specific)		error register (object 1001h)	manufacturer specific error field byte 7 > 0 = position failure byte 6 > 0 = speed failure				

10 How to set the Node-ID

Every CANopen device in the CANopen network requires an unique node-ID. The node-ID is programmable by hardware and software.

The used node-ID is the sum of a software related component and a hardware related component. The software related component is the value of object 2001h. The adjustment of the hardware related component differs between the versions of EGD devices.

Devices EGD50.4, EGD50.5:

Usage of ID-wires, which can be shorted to ground:

Wire IDNo_8	Wire IDNo_4	Wire IDNo_2	Wire IDNo_1	Hardware component of node-ID
Open	Open	Open	Open	0
Open	Open	Open	Shorted	1
Open	Open	Shorted	Open	2
Open	Open	Shorted	Shorted	3
Open	Shorted	Open	Open	4
Open	Shorted	Open	Shorted	5
Open	Shorted	Shorted	Open	6
Open	Shorted	Shorted	Shorted	7
Shorted	Open	Open	Open	8
Shorted	Open	Open	Shorted	9
Shorted	Open	Shorted	Open	10
Shorted	Open	Shorted	Shorted	11
Shorted	Shorted	Open	Open	12
Shorted	Shorted	Open	Shorted	13
Shorted	Shorted	Shorted	Open	14
Shorted	Shorted	Shorted	Shorted	15

Open : Wire is not connected

Shorted: Wire is shorted to ground

Device EGD50.6:

Usage of an ID-switch or jumpers (according to used PCB):

Hardware component of node-ID = position of the switch (or usage of jumpers as EGD50.7)

Device EGD50.7:

Usage of jumpers, which can be shorted:

Jumper ID4	Jumper ID3	Jumper ID2	Jumper ID1	Hardware component of node-ID
Shorted	Shorted	Shorted	Shorted	0
Shorted	Shorted	Shorted	Open	1
Shorted	Shorted	Open	Shorted	2
Shorted	Shorted	Open	Open	3
Shorted	Open	Shorted	Shorted	4
Shorted	Open	Shorted	Open	5

Jumper ID4	Jumper ID3	Jumper ID2	Jumper ID1	Hardware component of node-ID
Shorted	Open	Open	Shorted	6
Shorted	Open	Open	Open	7
Open	Shorted	Shorted	Shorted	8
Open	Shorted	Shorted	Open	9
Open	Shorted	Open	Shorted	10
Open	Shorted	Open	Open	11
Open	Open	Shorted	Shorted	12
Open	Open	Shorted	Open	13
Open	Open	Open	Shorted	14
Open	Open	Open	Open	15

Open : Jumper is not set

Shorted: Jumper is set

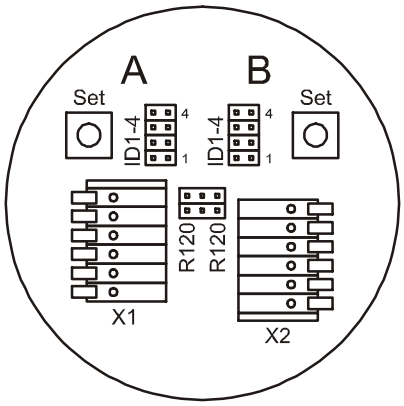

Figure 1: Position of the ID jumpers at EGD50.7

Final calculation of the node-ID:

Node-ID = value of object 2001h + hardware component of node-ID

Note: If the resulting node-ID is zero or greater than 127 it will be set to 127.

11 Programming by Hardware

Description of the programming possibilities by the hardware.

By this function some of the parameters of the unit can be set without CAN.

Units with "Set" Wire

- 1. possibility: Change of the up counting direction
  - switch off the unit
  - connect set wire with ground
  - switch on the unit
  - unit changes the up counting direction (CW/CCW)
  - disconnect set wire from ground
- 2. possibility: Setting 12mA to 0° (Forward position)
  - switch on the unit
  - shortly connect set wire with ground
  - unit sets position to preset value from object 6003h
  - current interface shows 12mA

Units with "Set" Wire and S04-, S12, S20-Wire

- 1. possibility: Change of the counting direction
  - switch off the unit
  - connect set wire with ground
  - switch on the unit
  - unit changes the up counting direction (CW/CCW)
  - disconnect set wire from ground
- 2. possibility: Setting 4mA-, 12mA, 20mA position value
  - switch on the unit
- 2.1 Setting 12mA position:
  - connect S12-wire with ground and turn encoder shaft / drive shaft to the required position
  - shortly connect set wire with ground
  - unit sets position to pre-set value from object 6003h
  - current interface shows 12mA
  - disconnect S12-wire from ground
- 2.2 Setting 4mA position:
  - connect S04-wire with ground and turn encoder shaft / drive shaft to the required position
  - shortly connect set wire with ground
  - unit sets position as the beginning of scale object 6401h
  - current interface shows 4mA
  - disconnect S04-wire from ground
- 2.3 Setting 20mA position:
  - connect S20-wire with ground and turn encoder shaft / drive shaft to the required position
  - shortly connect set wire with ground
  - unit sets position as the end of scale object 6402h
  - current interface shows 20mA
  - disconnect S20-wire from ground

Attention:
Follow the order of steps 2.1, 2.2 and 2.3! Be sure that the 4mA-position is in the direction of lower current values if you move away from the 12mA position.

If your wanted 4mA-position is in the upper range (12 … 20mA) then interrupt your action and change the counting direction as described in step 1). See also Figure 1!

Please make sure that the adjusted Object 2001h: Node-ID Offset is **0** before you start setting of 4mA-, 12mA and 20mA position value. Otherwise setting of 4mA-, 12mA and 20mA position value will not work properly!

Units with “Set” Button

- 1. possibility: Change of the counting direction
  - switch off the unit
  - press the “set” button
  - switch on the unit
  - unit changes the up counting direction (CW/CCW)
  - release the “set” button
- Other possibilities:
  - The LED at these units shows different operation modes. Before every longer push on the button the number of blinking signals must be controlled.
- Functions of the LED:
  - LED lights as long the button is pressed.
  - LED extinguishes if the button was pressed longer and shows then the setting of the values.
  - LED blinks and shows the adjustment mode.
- Functions of the set button:
  - Short push on the button (< 1 s) = switch mode forward
  - Long push on the button (> 2 s) = set and store value

Number of blinking signals	Mode	Action
0	operation	- long push on the button to reach the programming mode
1	middle position	- turn axis to foreseen middle position; - long push on the button to set this value; - current interface is set to the middle value;
2	beginning of scale	- turn encoder axis to the beginning of the scale; - current interface shows value smaller than middle value; - long push on the button to set this value; - current interface is set to the lower value;
3	end of scale	- turn encoder axis to the end of the scale; - current interface shows value bigger than middle value; - long push on the button to set this value; - current interface is set to the upper value (e.g. 20 mA)
4	Node-ID offset	- set ID-jumper to the desired value (high nibble); - long push on the button to set this value; - set ID-jumper to the desired value (low nibble);
5	end	- long push on the button returns device to operation mode
6	factory default values	- set parameter values to factory default values - affects parameters 2001h/00, 6000h/00, 6003h/00, 6401h/01, 6401h/02, 6401h/03, 6402h/01, 6402h/02 and 6402h/03 - the current interface will be set to 0..360° -> 4..20 mA - the calibration data for the current interface are not affected

Note:

- Node-ID = high nibble + low nibble; new ID will be valid after power supply has been switched off and on!
- The overdrive range for the current interface will be set automatically 70 increments large: Object 6401h/03 will be set to object 6401h/01 – 70 and object 6402h/03 will be set to object 6402h/01 + 70. The range of the angle values (0..4095) will not be exceeded.
- Returning to standard operation mode can be activated when the LED shows 5 blinking signals due to compatibility reasons with elder firmware versions.

12 Current Interface

Note: Not available for all units!

Features:

- Calibrated in the factory to 4 – 20 mA.
- Free adjustable to other values than 4 – 20 mA, e.g. 5 – 19 mA, see CAN objects 6401h and 6402h.
- The minimum and maximum values can be exceeded (approx. 0,5 mA) as a hysteresis for the failure indicator 2 mA.
- Free allocation of the positions starting angle, stop angle and middle position.
- Positions adjustable by buttons (resp. set wire) or by the CANopen objects 6401h and 6402h.
- Failure indication: 2mA

The following sketch shows the context between the CANopen objects and the current interface:

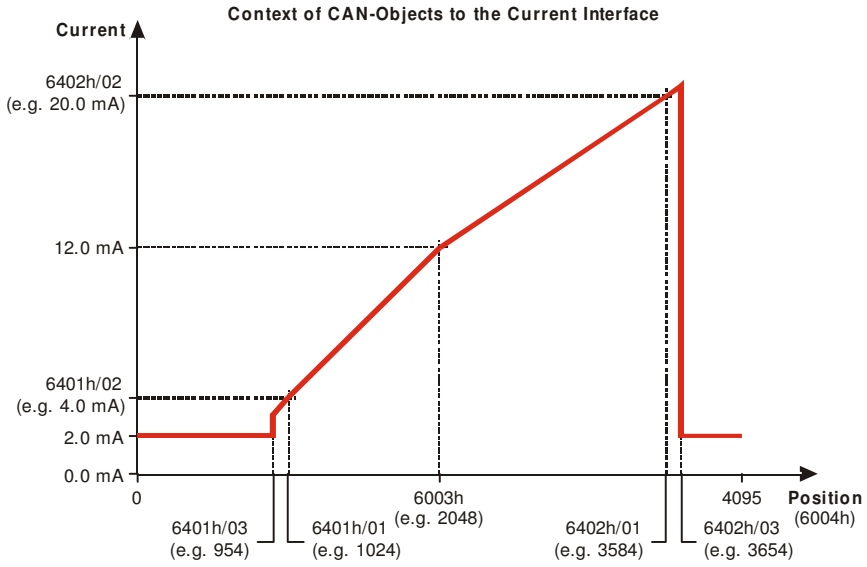

Figure 1

The following requirements have to be met:

- Object 6401h/01 has to be less or equal as object 6003h
- Object 6402h/01 has to be greater or equal as object 6003h
- Object 6401h/03 has to be less or equal as object 6401h/01
- Object 6402h/03 has to be greater or equal as object 6402h/01
- All objects have to be in the range of 0..4095

13 Datasheet Encoder EGD 50.xx

Electrical Data

Power supply / consumption:	24 VDC (–20 % +25 %) / up to approx. 2 W
Operating/storage temperature:	-5 °C ... +70 °C / -10 °C ... 85 °C

Mechanical Data

Friction torque:	< 2.5 Ncm
Housing:	Aluminium
Dimensions:	According to drawing
Shaft loading:	Axial / radial 45N
Vibration:	IEC 68 section 2-6 diagram 2
Shock:	IEC 68 section 2-27
Protection class:	Housing IP 67, shaft IP 65 according to DIN 40050
Relative humidity:	< 90% , not condensing

Accuracy Data:

Measurement range/resolution:	360°/12 bit
Linearity:	Max. ± 0,5%, typically ±0.3%

CAN Interface:

Transmission rate:	125 kbit/s, max. cable length 500 m
CAN-Bus termination:	120 R programmable according to type by cabling or jumper
NMT:	CANopen Slave
Error control:	Heartbeat producer
Node ID:	Programmable according to type by cabling or jumper
No. of PDOs:	0 Rx, 1 Tx
PDO modes:	Asynchronous (event-triggered)
PDO mapping:	Adjustable
PDO data:	Position, angle speed
No. of SDOs:	1 server, 1 client
Emergency message:	Via emergency message
CANopen version:	DS-301 V4.01
Device profile:	DSP-406 V2.0
CAN network:	DSP-302 V3.1

4 – 20 mA output (Option)

Range:	3 – 20 mA (adjustable)
Burden:	Max. 500 R
Design:	EGD50.4x, EGD 50.5x galvanic isolated from the power supply, without own logic; system A has to be switched on. EGD50.6x own logic (1 x CAN or 1 x current) EGD50.7x combined logic (double encoder with 2 systems, 1 x CAN and 1 x current per system)

Classification: GL

Address setting (Node-ID:)

EGD 50.4x, EGD 50.5x:
ID-wire connected to ground = 1
ID-wire not connected (isolated) = 0
Values of the wires: white = 1, grey = 2, pink = 4
Node-ID = sum of all grounded wires

EGD 50.6x, EGD 50.7x:
Plugged jumper = 0
Removed jumper = 1
Value of the jumper: According to connection label
Node-ID = sum of the values of all removed jumpers