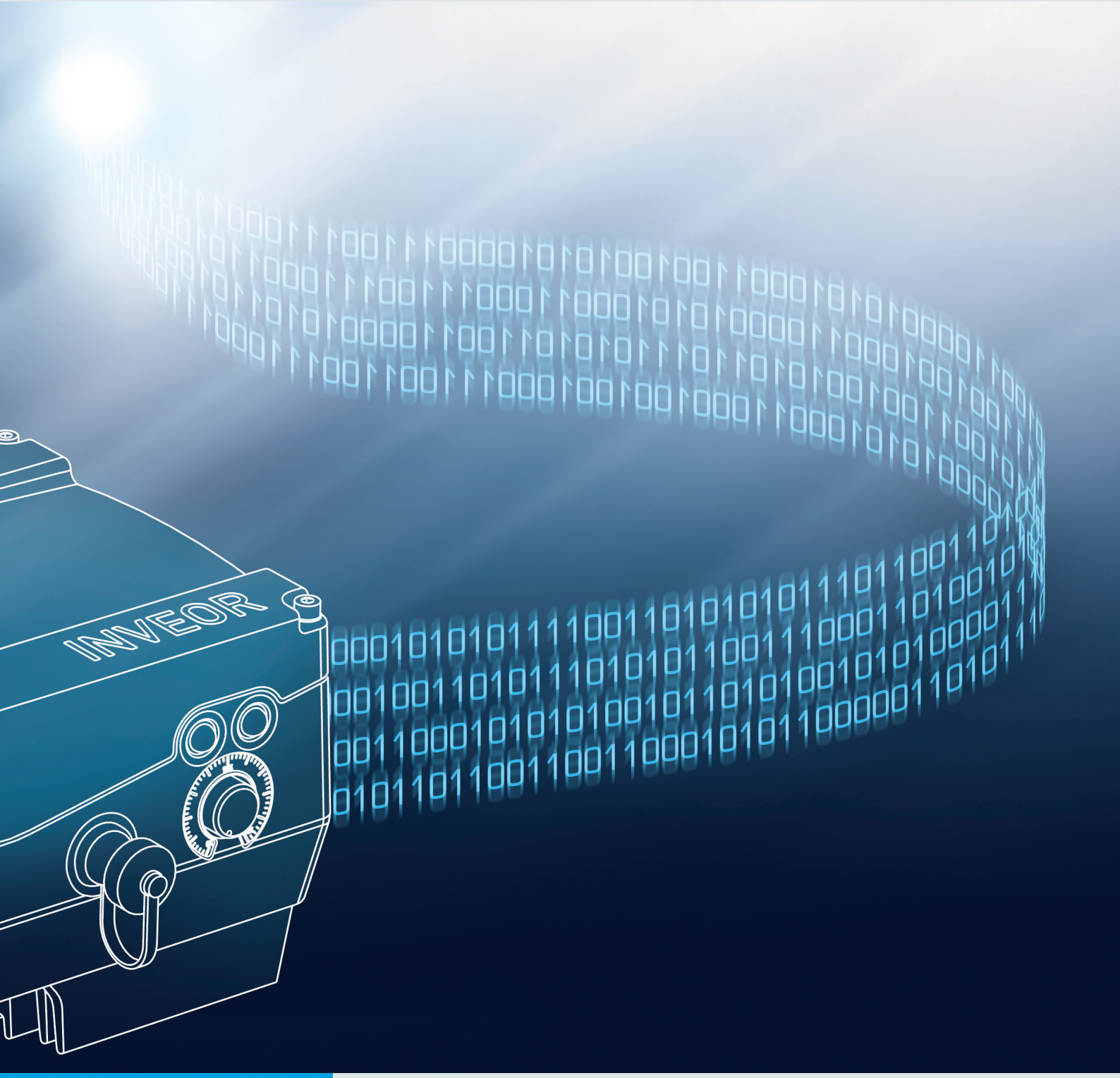
KOSTAL



Smart connections.

Operating manual

CANopen fieldbus

Legal notice

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Exclusion of liability

All names, trade names, product names and other designations used in this manual may be legally protected even if not indicated as such (e.g. as a trademark). KOSTAL assumes no liability for their free usage.

The illustrations and texts have been compiled with great care. However, the possibility of errors cannot be ruled out. The compilation is made without any guarantee.

General note on gender equality

KOSTAL is aware of how language impacts on gender equality and always make an effort to reflect this in documentation. Nevertheless, for the sake of readability we are unable to use non-gender-specific terms throughout and use the masculine form instead.

Contents

1. General information

Thank you for choosing an INVEOR drive controller with CANopen from KOSTAL Industrie Elektrik GmbH & Co KG! Our INVEOR line of drive controllers is designed to be universally usable with all common motor types and bus systems.

If you have any technical questions, please call our central service hotline:

Tel.: +49 (0)2331 80 40-848

Monday to Friday: 7 am to 5 pm (UTC/GMT +1)

Fax: +49 (0)2331 80 40-602

E-mail: INVEOR-service@kostal.com

Website address

www.kostal-industrie-elektrik.com

1.1 Information about documentation

This documentation is a supplementary operating manual for the INVEOR drive controller with the CANopen bus system. It contains all the important information you need to install and operate the bus system.

Please read the operating manuals for the drive controller and bus system through carefully. They contain important information for operating the INVEOR with fieldbus.

We assume no liability for any damage resulting from non-observance of this manual.

This manual is an integral part of the product and applies exclusively to the INVEOR with CANopen from KOSTAL Industrie Elektrik GmbH & Co KG.

Provide the operator of the system with this manual so it is available when needed.

1.1.1 Other applicable documents

This refers to all manuals that describe how to operate the drive controller system and any other manuals for the equipment used. Download the 3D files (.stp) for INVEOR and adapter plates from **www.kostal-industrie-elektrik.com**.

A description of parameters is available for download (www.kostal-industrie-elektrik.com) for parametrising the drive controller system. In the download, you will find all the information required for correct parameterisation.

1.1.2 Storing the documentation

Store this operating manual and all other applicable documents carefully so they are available when needed.

1	2	3	4	5

1.2 Notes in this manual

1.2.1 Warnings

The warnings refer to life-threatening dangers.
Serious injuries possibly resulting in death may occur.

Each warning consists of the following elements:

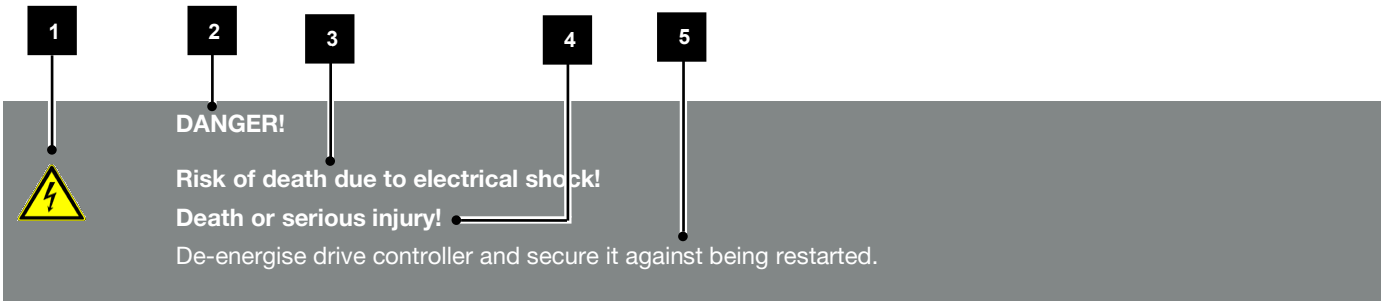


Fig.: 1 Structure of warnings

1 Warning symbol

2 Signal word

3 Type of danger and its source

4 Possible consequence(s) of failure to comply

5 Corrective actions

1.2.2 Warning symbols used

Symbols	Explanation
	Danger
	Danger due to electrical shock and discharge
	Danger due to burns
	Danger due to electromagnetic fields

1.2.3 Signal words

Signal words are used to identify the severity of the danger.

DANGER

Indicates a direct hazard with a high level of risk, which, if not avoided, will result in death or serious injury.

WARNING

Indicates a hazard with a moderate level of risk, which, if not avoided, will result in death or serious injury.

CAUTION

Indicates a hazard with a low level of risk, which, if not avoided, may result in minor or slight injury or property damage.

1.2.4 Information notes

Information notes contain important instructions for the installation and problem-free operation of the drive controller. These must be followed at all times. The information notes also point out that failure to observe can result in damage to property or financial damages.

IMPORTANT INFORMATION

The drive controller may only be assembled, operated, maintained and installed by trained and qualified staff.

Fig.: 2 Example of an information note

Symbols within the information notes

Symbols	Explanation
	Important information
	Damage to property possible

Other notes

Symbols	Explanation
	INFORMATION
	Enlarged view

i

1.3 Symbols used in this manual

Symbol	Meaning
1., 1., 3. …	Consecutive steps in a handling instruction
➔	Effect of a handling instruction
✓	Final result of a handling instruction
■	List

Fig.: 3 Symbols and icons used

Abbreviations used

Abbreviation	Explanation
Tab.	Table
Fig.	Figure
It.	Item
Ch.	Chapter

1.4 Qualified staff

You will find the "Qualified staff" chapter in the operating manual for the INVEOR.

1.5 Proper use

You will find the "Proper use" chapter in the operating manual for the INVEOR.

1.6 Responsibility

You will find the "Responsibility" chapter in the operating manual for the INVEOR.

1.7 Contacts for information

More information is available from:

Central service hotline

Tel.: +49 2331 8040-848
Monday to Friday: 7 am to 5 pm (UTC/GMT +1)

Fax: +49 2331 8040-602

E-mail: INVEOR-service@kostal.com

Website address

Customers can find technical and general information on the following website:

www.kostal-industrie-elektrik.com

1.8 Safety instructions

You will find the "Safety instructions" chapter in the operating manual for the INVEOR.

2. Device and system description

This chapter contains information on the scope of delivery for the drive controller and the function description.

2.1 CANopen

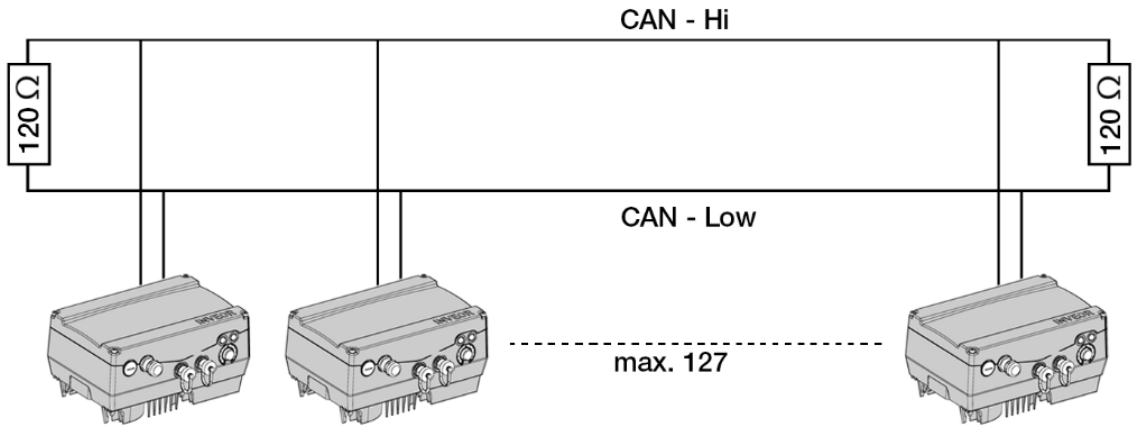


Fig.: 4 Wiring and bus connection

The CANopen bus system belongs to the fieldbus family and is based on the CAN bus (**C**ontroller **A**rea **N**etwork). The network is generally linear in structure.
The maximum data transfer rate to a CANopen bus may be up to 1 Mbit/s and depends on the line length.
The maximum number of participants in the bus network is 127.

1	2	3	4	5

Data transfer rates

The data transfer rate can be selected by the user within a range from 10 kbit/s to 1 Mbit/s. The data transfer is selected when setting up the fieldbus and applies to all participants.

The fieldbus baud rate can be set by means of parameter 6.061 (see table).

The maximum length of a segment stands in a reversely proportional relationship to the data transfer rate (see table).

Data transfer rate (kbit/s)	10	20	50	125	250	500	1000
Parameter 6.061 (fieldbus baud rate)	8	7	6	4	3	2	0
Length/segment (m)	5000	2500	1000	500	250	100	25
Max. length of a stub (m)	275	137.5	55	22	11	5.5	1.5
Max. length of all stubs	1375	687.5	275	110	55	27.5	7.5

IMPORTANT INFORMATION

If longer lines are needed, repeaters must be used.

2.1.1 Master/slave operation

The INVEOR should only be operated as a CANopen slave

2.2 Scope of delivery

The scope of delivery is described in the INVEOR basic documentation.
The interface card is part of the INVEOR.

2.3 Item description for INVEOR

2.3.1 Type code for CANopen

Type code CANopen: For information see operating manual

2.3.2 Features code

AP05 - standard + CANopen	**AP21** - functional safety + CANopen

AP05 - standard + CANopen	**AP21** - functional safety + CANopen
AP42 - standard + CANopen + Bluetooth	**AP51** - functional safety + CANopen + Bluetooth
AP71…IO03 - standard + CANopen	**AP71…IO13** - functional safety + CANopen
AP71…IO04 - standard + CANopen + Bluetooth	**AP71…IO14** - functional safety + CANopen + Bluetooth

2.4 Hardware components

The following hardware components are required for connecting the INVEOR to a CANopen bus system:

■ **CANopen, M12 connecting cable 2 m** M12 plug on M12 coupling / CANopen / 5-pin / 2 m / A-coded INVZUB – L / CL / CO / M12M / M12F / 2 m / A / -	Order no.: 10138812
■ **CANopen, M12 connecting cable 2 m** M12 plug on M12 coupling / CANopen / 5-pin / 5 m / A-coded INVZUB – L / CL / CO / M12M / M12F / 5 m / A / -	Order no.: 10138813
■ **CANopen, M12 connection cable open 2 m** M12 plug / open / CANopen / 5-pin / 2 m / A-coded INVZUB – L / CL / CO / M12M / OPEN / 2 m / A / -	Order no.: 10138804
■ **CANopen, M12 connection cable open 10 m** M12 plug / open / CANopen / 5-pin / 10 m / A-coded INVZUB – L / CL / CO / M12M / OPEN / 10 m / A / -	Order no.: 10138806
■ **CANopen, M12 connection cable open 2 m** M12 coupling / open / CANopen / 5-pin / 2 m / A-coded INVZUB – L / CL / CO / M12F / OPEN / 2 m / A / -	Order no.: 10138807
■ **CANopen, M12 connection cable open 10 m** M12 coupling / open / CANopen / 5-pin / 10 m / A-coded INVZUB – L / CL / CO / M12F / OPEN / 10 m / A / -	Order no.: 10138809
■ **CANopen, M12 Y-splitter** M12 coupling on plug and coupling / CANopen / 5-pin / A-coded INVZUB – L / YD / CO / M12M / M12F / - / A / -	Order no.: 10138791
■ **CANopen, M12 plug can be self-assembled** M12 plug / CANopen / 5-pin / A-coded INVZUB – L / CF / CO / M12M / - / - / A / -	Order no.: 10138799
■ **CANopen, coupling can be self-assembled** M12 coupling / CANopen / 5-pin / A-coded INVZUB – L / CF / CO / M12F / - / - / A / -	Order no.: 10138801
■ **CANopen, M12 terminating resistor** M12 plug / CANopen / 5-pin / A-coded INVZUB – L / TE / CO / M12M / - / - / A / -	Order no.: 10138792
■ **CANopen, M12 terminating resistor** M12 coupling / CANopen / 5-pin / A-coded INVZUB – L / TE / CO / M12F / - / - / A / -	Order no.: 10138793

*** Not part of the scope of delivery**

INFORMATION

The INVEOR is fitted in the factory with the appropriate communication card.

The INVEOR cannot be retrofitted or converted at a later date.

The following connections can be found on the INVEOR with CANopen interface

Size Alpha:

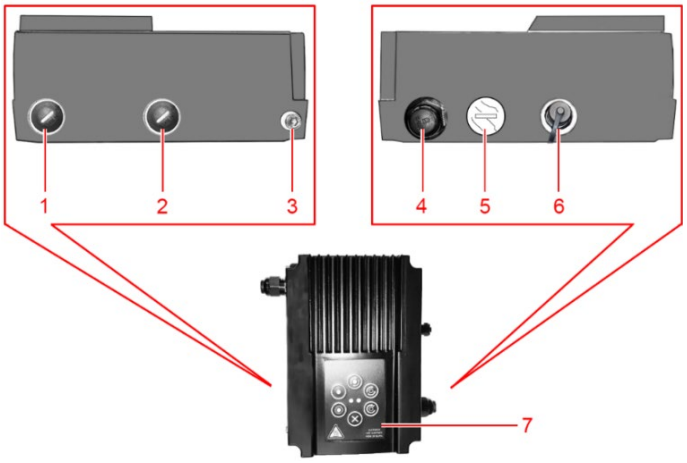


Fig.: 5 Size Alpha "CANopen" connections

Size Alpha "CANopen" connections	
1	Blind plug (optional motor connection with wall mounting)
2	Control cable blind plug
3	Ground screw
4	Grid connection
5	Transparent plug
6	MMI / CANopen
7	Foil keypad (optional)

Size A

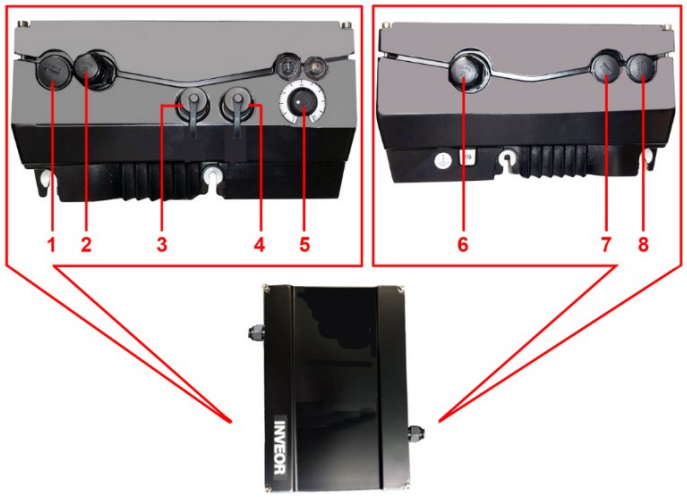


Fig.: 6 Size A "CANopen" connections

Size A "CANopen" connections	
1	Blind plug
2	Control line
3	CANopen
4	MMI
5	Potentiometer
6	Grid connection
7	Blind plugSTO (install EMC screw connection supplied in the package)
8	Blind plug STO (install EMC screw connection supplied in the package)

Size B-C

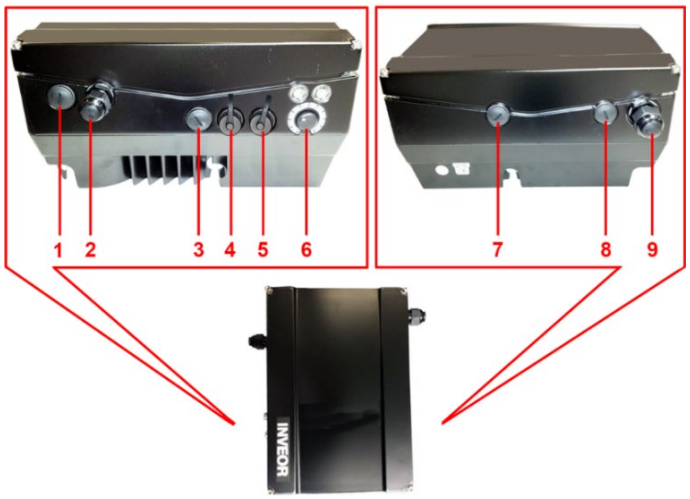


Fig.: 7 Sizes B - C “CANopen” connections

Sizes B - C “CANopen” connections	
1	Blind plug STO (install EMC screw connection supplied in the package)
2	Control line
3	Blind plug
4	CANopen
5	MMI
6	Potentiometer
7	Blind plug STO (install EMC screw connection supplied in the package)
8	Blind plug STO (install EMC screw connection supplied in the package)
9	Grid connection

1	2	3	4	5

Size D

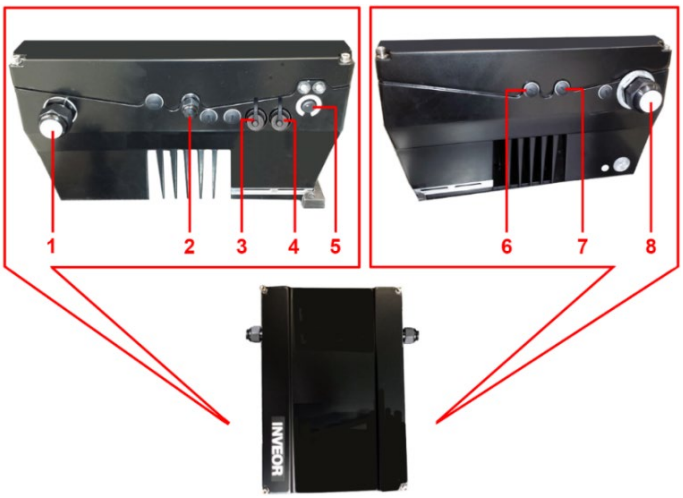


Fig.: 8 Size D "CANopen" connections

Size D "CANopen" connections	
1	Cable screw connection with blind plug
2	Control line
3	CANopen
4	MMI
5	Potentiometer
6	Blind plug STO (install EMC screw connection supplied in the package)
7	Blind plug STO (install EMC screw connection supplied in the package)
8	Grid connection

2.4.1 Pin assignment for interfaces

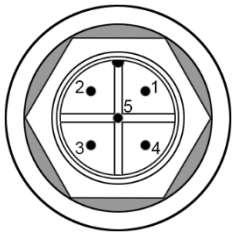
Plug	Pin no.	Signal
	**1**	Not assigned
	2	Not assigned
	3	CAN_GND
	4	CAN_H
	5	CAN_L
	Housing	Shielding

Fig.: 9 Plug label M12 / 5-pin / A-coded

2.4.2 Cable

The following points should be observed when wiring:

- Terminating resistors (120 Ω) must be installed at each end of the bus.
- Lay bus and power cables as far apart as possible (min. 30 cm),
- If cables do cross, an angle of 90° should be observed if possible.

2.5 Software components

The INVEOR drive controller can be parameterised using the INVEORpc tool and MMI
(see operating manual) as well as a CANopen master.

IMPORTANT INFORMATION

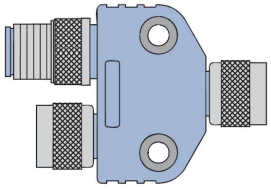
Not all parameters of the INVEOR are available via the CANopen interface!

3. Installation

The fieldbus line is exclusively connected via an M12 Y-distributor found on the front of the M12 connection socket.

The following CANopen M12 Y-distributor can be used:

- M12 coupling on plug and coupling /
  5-pin + PE / A-coded
  INVZUB/-/L/YD/CO/M12M/M12f/-/A/-

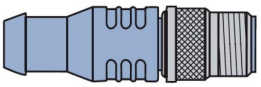


M12 Y-splitter
Article no.
10138791

A terminating resistor must be installed at both ends of the bus cable.

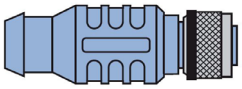
The following terminating resistors can be used:

- M12 plug / 5-pin / A-coded
  INVZUB/-/L/TE/CO/M12M/-/-/A/-



Terminating resistor
Article no.
10138792

- M12 coupling 5-pin / A-coded
  INVZUB/-/L/TE/CO/M12F/-/-/A/-



Terminating resistor
Article no.
10138793

3.1 Configuring drive controller for CANopen

In order that the drive controller can be controlled by the fieldbus, the following basic parameters must be set using the INVEORpc tool, MMI or CANopen master:

- Set parameter 1.130 (target value source) to fieldbus "9".
- Set parameter 1.131 (target value approval) to fieldbus "6".

The user must choose the set of parameters appropriate to him.

3.2 INVEOR bus address

DANGER!

Risk of death due to electrical shock!

Death or serious injury!

De-energise the drive controller, determine that it is voltage-free and secure it against being restarted.

In order that an INVEOR, equipped with a CANopen communication card, can be clearly recognised in a CANopen bus system, it must be assigned an address.
The assignment can take place:

- By setting the address via the rotary switches "Switch 1" and "Switch 2" found on the printed circuit board (PCB).
- By setting the parameter 6.060 "Fieldbus address" (see chapter "Parameter list“ of the operating manual).

  Use INVEORpc, MMI or CANopen master for parameterisation.

1	2	3	4	5

Fig.: 10 Setting parameters via rotary switches

Switch 1 – for the unit position

Switch 2 – for the tens position

Both rotary switches (Switch 1/Switch 2) are set to the value "0" in the delivery state. Only in this state can addressing via the parameter 6.060 "Fieldbus address" take place.

IMPORTANT INFORMATION

The address change only takes effect after "Power On".

3.2.1 Setting the address on the communication card

DANGER!

Risk of death due to electrical shock!

Death or serious injury!

De-energise the drive controller, determine that it is voltage-free and secure it against being restarted.

IMPORTANT INFORMATION

The address of an INVEOR must lie within the range 1 to 127.

1. De-energize the drive controller.
2. Unscrew the cover of the drive controller.
3. Set the address with a screwdriver on both switches (Switch 1/Switch 2).

IMPORTANT INFORMATION

You can find the corresponding switch positions for the address in chapter 3.3 "Setting the fieldbus address via rotary switches Switch 1/Switch 2".

4. Screw the cover of the drive controller back onto the housing (torque 4 Nm).
5. Switch the voltage supply for the drive controller on.

   ✓ The address of the INVEOR is set.

3.3 Setting the fieldbus address via rotary switches Switch 1/Switch 2

Address		Settings	
DECIMAL	HEX	Switch 2	Switch 1
0	**0**	**0**	**0**
1	**1**	**0**	**1**
2	2	0	2
3	3	0	3
4	4	0	4
5	5	0	5
6	6	0	6
7	7	0	7
8	8	0	8
9	9	0	9
10	a	0	a
11	b	0	b
12	c	0	c
13	d	0	d
14	e	0	e
15	f	0	f
16	10	1	0
17	11	1	1
18	12	1	2
19	13	1	3
20	14	1	4
21	15	1	5
22	16	1	6
23	17	1	7
24	18	1	8
25	19	1	9
26	1a	1	a
27	1b	1	b
28	1c	1	c
29	1d	1	d
30	1e	1	e
31	1f	1	f

Address		Settings	
DECIMAL	HEX	Switch 2	Switch 1
32	20	2	0
33	21	2	1
34	22	2	2
35	23	2	3
36	24	2	4
37	25	2	5
38	26	2	6
39	27	2	7
40	28	2	8
41	29	2	9
42	2a	2	a
43	2b	2	b
44	2c	2	c
45	2d	2	d
46	2e	2	e
47	2f	2	f
48	30	3	0
49	31	3	1
50	32	3	2
51	33	3	3
52	34	3	4
53	35	3	5
54	36	3	6
55	37	3	7
56	38	3	8
57	39	3	9
58	3a	3	a
59	3b	3	b
60	3c	3	c
61	3d	3	d
62	3e	3	e
63	3f	3	f

Address		Settings	
DECIMAL	HEX	Switch 2	Switch 1
64	40	4	0
65	41	4	1
66	42	4	2
67	43	4	3
68	44	4	4
69	45	4	5
70	46	4	6
71	47	4	7
72	48	4	8
73	49	4	9
74	4a	4	a
75	4b	4	b
76	4c	4	c
77	4d	4	d
78	4e	4	e
79	4f	4	f
80	50	5	0
81	51	5	1
82	52	5	2
83	53	5	3
84	54	5	4
85	55	5	5
86	56	5	6
87	57	5	7
88	58	5	8
89	59	5	9
90	5a	5	a
91	5b	5	b
92	5c	5	c
93	5d	5	d
94	5e	5	e
95	5f	5	f

Address		Settings	
DECIMAL	HEX	Switch 2	Switch 1
96	60	6	0
97	61	6	1
98	62	6	2
99	63	6	3
100	64	6	4
101	65	6	5
102	66	6	6
103	67	6	7
104	68	6	8
105	69	6	9
106	6a	6	a
107	6b	6	b
108	6c	6	c
109	6d	6	d
110	6e	6	e
111	6f	6	f
112	70	7	0
113	71	7	1
114	72	7	2
115	73	7	3
116	74	7	4
117	75	7	5
118	76	7	6
119	77	7	7
120	78	7	8
121	79	7	9
122	7a	7	a
123	7b	7	b
124	7c	7	c
125	7d	7	d
126	7e	7	e
127	7f	7	f

Tab. 1 Fieldbus address via rotary switches Switch 1/Switch 2

IMPORTANT INFORMATION

Both rotary switches (Switch 1/Switch 2) are set to the value "0" in the delivery state. Only in this state can addressing via the parameter 6.060 "Fieldbus address" take place.

3.4 Installing the INVEOR EDS file

The "device-specific information file" (EDS file) can be used in order to use the INVEOR drive controller with CANopen.
This file contains the drive controller's object directory and physical parameters such as the supported baud rates.
Configuration tools can read EDS files and use them to obtain information for communication with a particular device.
Download the "CANopen fieldbus for INVEOR" ZIP file from the download area on our website under the following link:
www.kostal-industrie-elektrik.com
Embed the EDS file as required by the CANopen master you are using.

4. CANopen in the INVEOR

The INVEOR drive controllers with CANopen support the CANopen specification in accordance with CiA DS-301. The device profile DS-402 (electrical drives) is not supported

Read / write access to parameters (see chapter **4.1.7Fehler! Verweisquelle konnte nicht gefunden werden.**) is only possible with
SDO access.
Read / write access to process values (see chapter **4.1.3** / **4.1.4**) is possible with both
SDO and PDO access.

As well as dynamic PDO mapping, timeout monitoring with node guarding or heartbeat is possible.

4.1 EDS file object directory

The available objects of the INVEOR are listed below.
These correspond to the entries in the EDS file.

4.1.1 Communication objects (0x1000 – 0x1200)

Index [Hex]	Sub-index	Object	Unit	Access	Type	Description
1000		Device Type		RO	U32	Device type
1001		Error Register		RO	U8	
1005		COB-ID SYNC		RW	U32	Identifier for SYNC messages (default 0x80)
1007		SYNC Window Length	µs	RW	U32	Time window for synchronous PDOs
1008		Device Name		RO	String	Device name
1009		HW Version		RO	String	
100A		SW Version		RO	String	
100C		Guard Time	ms	RW	U16	Node guarding time (0:inactive)
100D		Life time factor		RW	U16	Life time = life time factor * guard time
1014		COB-ID Emergency		RW	U32	Identifier Emergency 80h+NodeID
1016	REC	Consumer Heartbeat				(Open-end wrench WAF03.85)
1016	0	Number of entries		RO	U8	Number of elements [1]
1016	1	COB-ID + Timeout	ms	RW	U32	Monitored node and timeout (0:inactive)
1017		Producer Heartbeat	ms	RW	U16	Timeout (0:inactive)
1018	REC	Identity Object				Device information
1018	0	Number of entries		RO	U8	Number of elements [4]
1018	1	Vendor ID		RO	U32	Manufacturer ID [0x337]
1018	2	Product Code		RO	U32	Product code
1018	3	Revision number		RO	U32	Revision number
1018	4	Serial number		RO	U32	Serial number

1	2	3	4	5

4.1.2 PDO configuration objects (0x1400 – 0x1A01)

Index [Hex]	Sub-index	Object	Unit	Access	Type	Description
1400 1401	REC	1.+2. Receive PDO				Configuration of receive PDOs
	0	Number of entries		RO	U8	Number of elements [5]
	1	COB ID used by PDO		RW	U32	COB-ID used
	2	Transmission type		RW	U8	Receive PDO type
	3	Inhibit time	100µs	RW	U16	Minimum time difference between two PDOs
	4	Not used				
	5	Not used				
1600 1601	REC	Receive PDO mapping				Data configuration of receive PDOs
	0	Number of entries		RW	U8	Number of data objects
	1-8	Object index		RW	U32	Indices of selected data (process values)
1800 1801	REC	1.+2. Transmit PDO				Configuration of transmit PDOs
	0	Number of entries		RO	U8	Number of elements [5]
	1	COB ID used by PDO		RW	U32	COB-ID used
	2	Transmission type		RW	U8	Transmit PDO type
	3	Inhibit time	100µs	RW	U16	Minimum time difference between two PDOs
	4	Not used				
	5	Event timer	ms	RW	U16	Cyclic transmit time
1A00 1A01	REC	Transmit PDO mapping				Data configuration of transmit PDOs
	0	Number of entries		RW	U8	Number of data objects
	1-8	Object index		RW	U32	Indices of selected data (process values)

1	2	3	4	5

4.1.3 INVEOR process values Out (0x3000 – 0x3031, 0x3502, 0x3503)

EDS index [Hex]	Data type	Designation	Unit	Description
3000	REAL	Actual frequency	Hz	
3001	REAL	Output voltage	V	Motor voltage
3002	REAL	Motor current	A	
3003	REAL	IGBT temperature	°C	
3005	REAL	Target frequency value	Hz	
3006	REAL	Grid voltage	V	Input voltage
3008	REAL	Inner temperature	°C	FC inner temperature
300B	U32	Application error	1	Bit-coded
300D	U32	Power error	1	Bit-coded
300F	U32	Digital inputs	1	Bit 0 = Dig. In 1 Bit 1 = Dig. In 2 Bit 2 = Dig. In 3 Bit 3 = Dig. In 4 Bit 4 = EN-HW / STO
3010	REAL	Analogue In 1	V	Analogue input 1 application
3011	REAL	Analogue In 2	V	Analogue input 2 application
3014	REAL	PID actual value	%	Actual value of PID process controller
3015	REAL	PID target value	%	Target value of PID process controller
301E	REAL	Rotation speed	rpm	Motor shaft speed
301F	REAL	Torque	Nm	Torque
3020	REAL	Shaft power	W	Mechanical shaft power
3021	U32	Virtual DigOuts (lowWord)	1	Virtual DigOuts of the soft PLC
3023	REAL	Customised output variable 1	1	Customised output variable Soft PLC
3024	REAL	Customised output variable 2	1	Customised output variable Soft PLC
3025	REAL	Customised output variable 3	1	Customised output variable Soft PLC
3029	U32	Status of outputs (DigOut 1+2, relays 1+2)		Status of outputs: Bit 0 = Dig Out 1 Bit 1 = Dig Out 2 Bit 2 = Relay 1 Bit 3 = Relay 2 Bit 4 = Virt Out 1
3502	U32	Status word	1	(see 4.1.6)
3503	REAL	Actual speed	Hz	
3510	REAL	Process data Out 3 (motor voltage)	1	Can be parameterised using INVEORpc tool (parameter 6.080)
3511	REAL	Process data Out 4 (motor current)	1	Can be parameterised using INVEORpc tool (parameter 6.081)

4.1.4 INVEOR process values In (0x3032 – 0x3040, 0x3500, 0x3501)

EDS index [Hex]	Data type	SW vers.	Designation	Unit	Description
3032	U32		Digital – relay – outputs	1	Control of outputs: Bit 0 = Dig Out 1 (Parameter 4.150 = 25) Bit 1 = Dig Out 2 (Parameter 4.170 = 25) Bit 2 = Relay 1 (Parameter 4.190 = 25) Bit 3 = Relay 2 (Parameter 4.210 = 25) Bit 4 = Virt Out 1 (Parameter 4.230 = 25)
3033	REAL		Analogue Out 1	V	Control of analogue output
3034	U32		Virtual DigIns (lowWord)	1	Virtual DigOuts of the soft PLC
3036	REAL		Customised input variable 1	1	Customised input variable soft PLC
3037	REAL		Customised input variable 1	1	Customised input variable soft PLC
3038	REAL		Customised input variable 1	1	Customised input variable soft PLC
3500	U32		**Control word**	1	**(see 4.1.5.)**
3501	REAL		**Target value**	%	

4.1.5 Structure of INVEOR control word

The meanings of the individual bits of the INVEOR control word are described in the following table. Object 0x3500

IMPORTANT INFORMATION

The control word is only accepted if bit 10 (control from AG) is set, otherwise the sent control word is rejected.

IMPORTANT INFORMATION

The target value is only accepted if bit 6 (target value enabled) is set. otherwise the target value is rejected.

Bit	Value	Meaning	Description
0	1*	ON 1	Engagement condition 1
	0	OFF 1	Shut down via ramp
1	1*	ON 2	Engagement condition 2
	0	Electr. stop (OFF 2)	Switch off PWM, free shutdown
2	1*	ON 3	Engagement condition 3
	0	Rapid stop (OFF 3)	Shut down via fastest possible ramp
3	1*	Operating condition 1	Operating condition 1
	0		Switch off PWM, free shutdown
4	1*	Operating condition 2	Operating condition 2
	0		Shut down via fastest possible ramp
5	1	Block HLG	[1] Not implemented
	0	Stop HLG	[1] Not implemented
6	1*	Enable target value	Adopt target value
	0	Block target value	Reject target value
7	1	Error acknowledgement (0-> 1)	Collective acknowledgement on pos. flank
	0*	---	---

1	2	3	4	5

Bit	Value	Meaning	Description
8	1	JOG (right)	[1] Not implemented
	0		[1] Not implemented
9	1	JOG (left)	[1] Not implemented
	0		[1] Not implemented
10	1*	Control from AG	Management via interface, control word valid
	0		Control word is rejected
11	1	Device-specific	-
	0		
12	1	Device-specific	-
	0		
13	1	Device-specific	-
	0		
14	1	Device-specific	-
	0		
15	1	Device-specific	Meaning not specified
	0	-	

Tab.: 1 Control word

HLG: Ramp function generator
*** Operating condition**
[1] Deviation from standard

IMPORTANT INFORMATION

An example of a control word with which the start-up works is 0x45F.

The endianness of the fieldbus should be observed for all data types.

1	2	3	4	5

4.1.6 Structure of INVEOR status word

The meanings of the individual bits of the INVEOR status word are described in the following table. Object 0x3502

Bit	Value	Meaning	Description
0	1	Ready for engagement	Grid voltage present, no fault
	0	Not ready for engagement	
1	1	Ready for operation	No fault / HW enable set
	0	Not ready for operation	
2	1	Operation	Motor is energised
	0	Operation blocked	
3	1	Error active	A fault is present
	0	Free from faults	
4	1	No OFF 2	On 2 off / STW bit 1 set [3] (logic can be inverted with parameter 6.066)
	0	Electr. stop active (OFF 2)	
5	1	No OFF 3	On 3 off / STW bit 2 set [3] (logic can be inverted with parameter 6.066)
	0	Rapid stop active (OFF 3)	
6	1	Engagement inhibit active	[1] PWM blocked
	0	No engagement inhibit	[1] PWM enabled
7	1	Warning active	[2] A warning is present
	0	No warning	
8	1	Nominal/actual value deviation in tolerance range	Actual value within a tolerance band Parameter 6.070 / 6.071
	0	Nominal/actual value deviation outside tolerance range	
9	1	Control from AG	INVEOR is parameterised for activation via fieldbus
	0	No control from AG	
10	1	Target frequency reached	Actual frequency > = reference value (Parameter 6.072)
	0	Target frequency fallen below	Actual frequency < reference value
11	1	Device-specific	Meaning not specified
	0	-	
12	1	Device-specific	Meaning not specified
	0	-	
13	1	Device-specific	Meaning not specified
	0	-	
14	1	Device-specific	Meaning not specified
	0	-	
15	1	Device-specific	Meaning not specified
	0	-	

Tab.: 2 INVEOR status word

AG: Automation device
1 Deviation from standard
2 As of software version 03.61
3 As of software version 03.74

1	2	3	4	5

4.1.7 INVEOR parameters (0x2000-0x2200)

All parameters can be both read and written.

IMPORTANT INFORMATION

- **Not** all parameters of the INVEOR are available via the CANopen interface!
  All parameters can still be set with the PC tool.
- The parameters cannot be accessed by using the PDOs!
- Write access means that a modified parameter is written to the EEPROM! Write access is limited to 1 000 000 cycles!

INFORMATION

- **All** parameters are of the data type "REAL"
- The data below is listed sorted in ascending order by "Number*".

CANopen		INVEOR parameter				
Index [Hex]	Number*	Accepted	Name	Minimum	Maximum	Unit
2000	1.020	2: Always	Minimum frequency	0	400	Hz
2001	1.021	2: Always	Maximum frequency	5	400	Hz
2003	1.050	2: Always	Deceleration time 1	0.1	1000	s
2004	1.051	2: Always	Run up time 1	0.1	1000	s
2008	1.100	2: Always	Operating mode	0	3	
2005	1.130	2: Always	Target value source	0	10	
2007	1.131	2: Always	Target value approval	0	16	
2051	1.132	2: Always	Start protection	0	8	
2029	1.150	2: Always	Rotation direction	0	16	
2035	1.180	2: Always	Acknowledge function	0	7	
2025	3.050	2: Always	PID-P amplific.	0	100	
2026	3.051	2: Always	PID-I amplific.	0	100	1/s
2027	3.052	2: Always	PID-D amplific.	0	100	s
2006	3.060	2: Always	PID actual value	0	3	
2052	3.061	2: Always	PID inverted	0	1	
2054	3.070	2: Always	PID standby time	0	1000	s
2055	3.071	2: Always	PID standby hyst.	0	50	%
2019	4.020	2: Always	AnalogIn1 input type	1	2	
201A	4.021	2: Always	AI1 standard. Low	0	100	%
201B	4.022	2: Always	AI1 standard. High	0	100	%
2022	4.050	2: Always	AI2 input type	1	2	
2023	4.051	2: Always	AI2 standard. Low	0	100	%
2024	4.052	2: Always	AI2 standard. High	0	100	%
202A	4.100	2: Always	AO1 function	0	40	
2038	4.150	2: Always	DO1 function	0	60	
203B	4.170	2: Always	DO2 function	0	60	

1	2	3	4	5

CANopen			INVEOR parameter			
Index [Hex]	Number*	Accepted	Name	Minimum	Maximum	Unit
203E	4.190	2: Always	Rel.1 function	0	60	
2041	4.210	2: Always	Relay 2 function	0	60	
2056	5.070	2: Always	Motor current limit %	0	250	%
2057	5.071	2: Always	Motor current limit s	0	100	s
206F	5.080	2: Always	Stall detection	0	1	
208A	5.090	2: Always	Par. set change	0	12	
2066	6.062	2: Always	Bus time-out	0	100	s
209D	6.070	2: Always	Dev. nominal/actual value	0	100	%
209E	6.071	2: Always	Tolerance range	0	32767	s
209F	6.072	2: Always	Nominal/reference value	0	400	Hz
2170	33.001	1: Ready	Type of motor	1	2	
2164	33.010	2: Always	I2T fact. motor	0	1000	%
2154	33.011	2: Always	I2T time	0	1200	s
2146	33.031	1: Ready	Motor current	0	150	A
2147	33.032	1: Ready	Motor rating	50	55000	W
2149	33.034	1: Ready	Motor speed	0	80000	rpm
214A	33.035	1: Ready	Motor frequency	10	400	Hz
2173	33.050	1: Ready	Stator resistance	0	100	Ohm
2144	33.110	1: Ready	Motor voltage	0	1500	V
2148	33.111	1: Ready	Motor cos phi	0.5	1	
217D	33.138	2: Always	Holding current time	0	3600	s
2174	33.200	1: Ready	Stator induc.	0	1	H
2181	33.201	1: Ready	Nominal flux	0	10000	mVs
216F	34.010	1: Ready	Control method	100	299	
2183	34.020	2: Always	Flying restart	0	1	
2108	34.030	2: Always	Switching frequency	1	4	
2179	34.090	2: Always	Speed controller Kp	1	10000	mA/rad/s
217A	34.091	2: Always	Speed controller Tn	0	10	s
2171	34.110	2: Always	Slip trimmer	0	1.5	
218A	34.120	2: Always	Quadr. characteristic curve	0	1	
218B	34.121	2: Always	Flux adjustment	10	100	%
2189	34.225	1: Ready	Field suppression. PM SM	0	1	
2188	34.226	2: Always	PMSM start-up current	5	1000	%
218F	34.227	1: Ready	Int. time PMSM	0	100	s
218C	34.228	1: Ready	Start-up proc. PMSM	0	1	
218D	34.229	1: Ready	PMSM start-up ramp	0.1	1000	s
218E	34.230	1: Ready	Start-up frequency PMSM	5	400	Hz
2178	35.080	2: Always	Brake chopper	0	1	

4.2 Timeout monitoring with node guarding

To use "timeout monitoring with node guarding", the following settings must be made:

- The object 0x1017 "Producer Heartbeat Time" must be "0"
  (default setting in INVEOR)
- The object 0x1016 [Idx 01] "Consumer Heartbeat" must be "0"
  (default setting in INVEOR)
- The object 0x100C "Guard Time" must be a value other than "0".
  The value corresponds to the timeout in ms.
- The object 0x100D "Life Time Factor" must be a value other than "0".
  This value determines how often the "Guard Time" can run before a timeout is detected.

IMPORTANT INFORMATION

The INVEOR parameter "Bus timeout" (6.062) must be set to a value other than 0 to activate timeout monitoring. However, the value entered here is not the timeout time. This is the product of "Guard Time" and "Life Time Factor" (see above).

After configuration, timeout monitoring starts with the master's first query:

COB-ID : 0x700+NodeID of the INVEOR (RTR frame)
Data : --

IMPORTANT INFORMATION

The INVEOR expects the query for "Node guarding" as an RTR frame.

Each query from the master is answered as follows:

COB-ID : 0x700+NodeID of the INVEOR
Data : Status of the INVEOR + "toggle bit" (MSB)

Status: 0x00 - Bootup
0x04 - Stopped
0x05 - Operational
0x7F – Pre-Operational

If the master queries are not received during the time [Guard Time * Life Time Factor] and if "Bus Timeout" 6.062 is activated (value other than 0), the error "Bus Timeout" is generated. The INVEOR switches to error status.

This error can be acknowledged immediately.

A running motor is stopped!

4.3 Timeout monitoring with heartbeat

As an alternative to node guarding, the INVEOR can also be monitored using the heartbeat function. As of SW03.85 the heartbeat consumer function is also available.
The heartbeat producer and consumer functions can be configured and activated independently of one another.

The object 0x100C "Guard Time" and the object 0x100D "Life Time Factor" must be 0 in order to deactivate node guarding.

IMPORTANT INFORMATION

The INVEOR parameter "Bus timeout" (6.062) must be set to a value other than 0 to activate timeout monitoring.

4.3.1 Heartbeat producer

To activate the heartbeat producer function in the INVEOR, a value other than 0 must be written to the object 0x1017 (data type U16).

The configured value defines a time in steps of 10 ms.
Once this time has elapsed, the INVEOR sends the following message in the specified cycle:

COB-ID : 0x700+NodeID of the INVEOR
Data : Status of the INVEOR

The master or another node can therefore monitor whether the INVEOR can be contacted via the bus.

4.3.2 Heartbeat consumer

The heartbeat consumer function is used to monitor the contactability of another bus participant. This function is available as of SW 03.85.

To activate this function, the object Consumer Heartbeat 0x1016 [Idx 01] must be configured. A 32-bit word is transferred for this object.

The lowest 2 bytes define the timeout value in ms.

The lower of the highest 2 bytes specifies the address of the monitored node (bus participant).

Example: Timeout: 1000ms (0x3E8)
Node: 1 (0x01)

The following 32-bit word is transmitted: 0x000103E8

The number of bus participants which can be monitored by the INVEOR is limited to one.

After configuration and receipt of the first message from the monitored node (here 0x701 + status), timeout monitoring is activated. The following message is expected:

COB-ID : 0x700+NodeID of the monitored node
Data : Status of the monitored node

If the INVEOR then does not receive this message cyclically within the specified timeout and if "Bus Timeout" 6.062 is activated (value other than 0), the error "Bus Timeout" is generated and the INVEOR switches to error status.

This error can be acknowledged immediately.

A running motor is stopped!

5. Error detection and troubleshooting

5.1 Application side error word

The following section contains a list of possible error messages of the application. Object 0x300B

Bit.	Error number	Description
0	1	Undervoltage 24 V application
1	2	Overvoltage 24 V application
5	6	Customer PLC version error
7	8	Communication application<>power
9	10	Parameter distributor
10	11	Power time out
12	13	Cable break at analogue in 1 (4–20 mA / 2–10 V)
13	14	Cable break at analogue in 2 (4–20 mA / 2–10 V)
14	15	Blocking detection
15	16	PID dry run
16	17	Start-up error
17	18	Excess temperature for frequency converter application
20	21	Bus time-out
21	22	Acknowledgement error
22	23	External fault 1
23	24	External fault 2
24	25	Motor detection
25	26	STO inputs plausibility

Tab.: 3 Application error word

5.2 Power side error word

The following section contains a list of possible power side error messages. Object 0x300D

Bit.	Error number	Description
0	32	Trip IGBT
1	33	Overvoltage of intermediate circuit
2	34	Undervoltage of intermediate circuit
3	35	Excess motor temperature
4	36	Power failure
6	38	Excess IGBT module temperature
7	39	Overcurrent
8	40	Excess frequency converter temperature
10	42	I^2T motor protection shut-off
11	43	Ground leak
13	45	Motor connection disrupted
14	46	Motor parameters
15	47	Drive controller parameters
16	48	Type plate data
17	49	Power class restriction
21	53	Motor tipped

Tab.: 4 Power error word

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