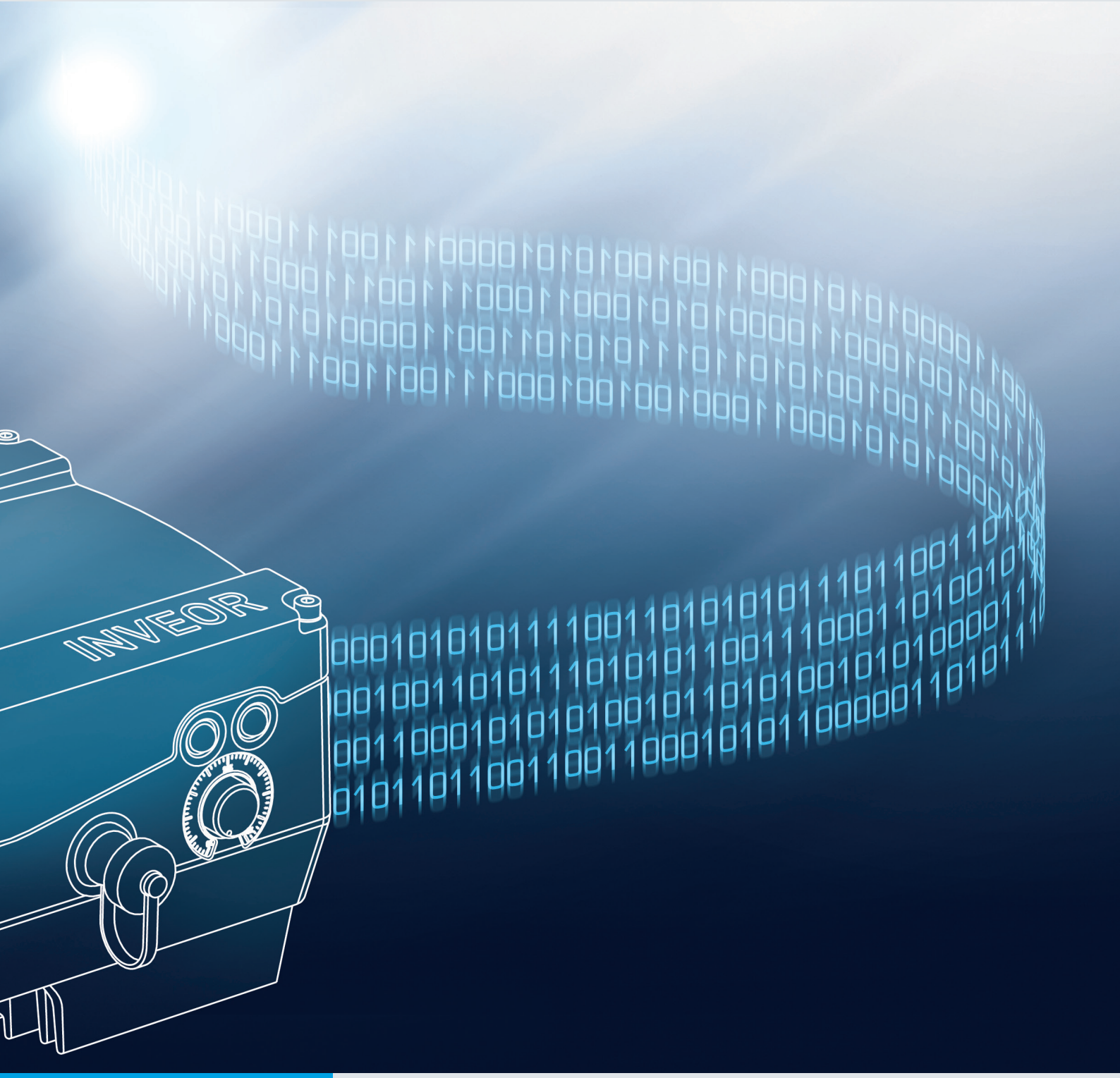
KOSTAL



Smart connections.

Operating manual

EtherCAT fieldbus

Legal notice

KOSTAL Industrie Elektrik GmbH & Co KG
An der Bellmerei 10
58513 Lüdenscheid
Germany
Tel. +49 (0)2351 16-0
Fax +49 (0)2351 16-2400
info-industrie@kostal.com

Exclusion of liability

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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 EtherCAT 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 EtherCAT 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 EtherCAT 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.

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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:

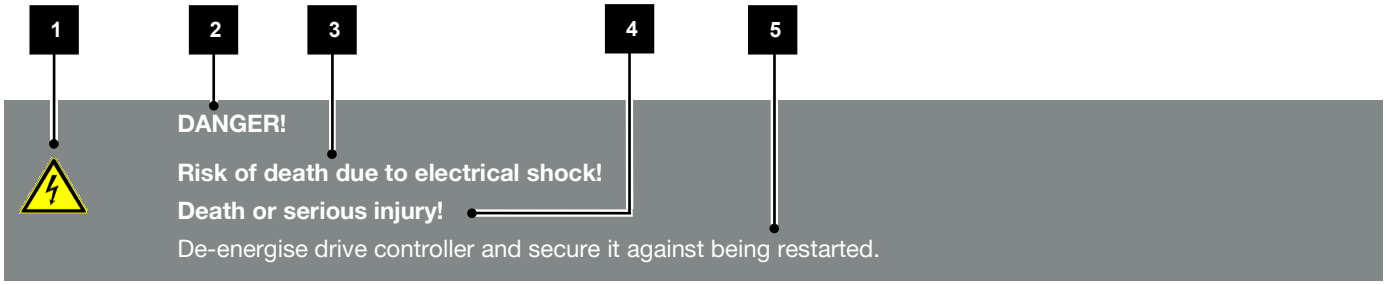


Fig.: 1 Structure of warnings

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

Symbol	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

Symbol	Explanation
	Important information
	Damage to property possible

Other notes

Symbol	Explanation
	INFORMATION
	Enlarged view

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
Drives@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 EtherCAT

The EtherCAT bus system is part of the fieldbus family. The network is generally linear in structure. The maximum data transfer rate to an EtherCAT bus may be up to 100 Mbit/s. The fieldbus cable is only connected via the two M12 connector sockets on the front of the device. Ensure that the incoming bus cable is connected to the "In" socket and the outgoing one to the "Out" socket.
If connecting the last participant, the "Out" socket should be left free – there is no need for a terminal resistor.

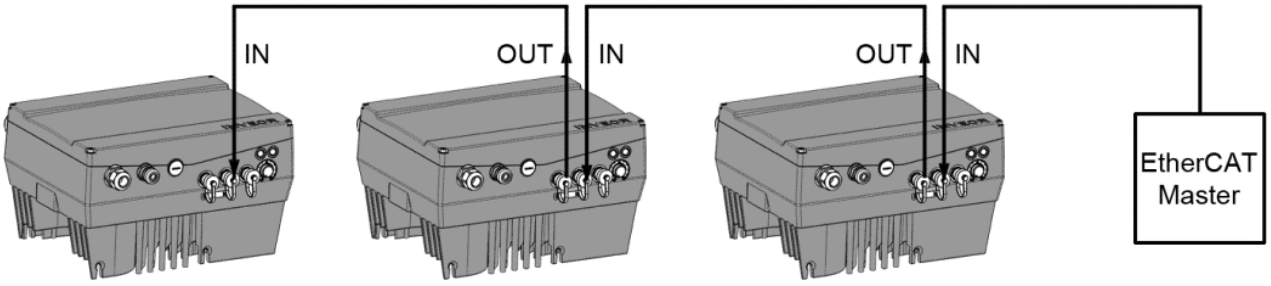


Fig.: 4 Wiring and bus connection (Example connection INVEOR M size C)

2.1.1 Master / slave operation

The INVEOR should only be operated as an EtherCAT slave.

2.2 Scope of delivery

The scope of delivery of the drive controller is described in the INVEOR basic documentation.
The EtherCAT interface forms part of the INVEOR.

2.3 Item description for INVEOR

2.3.1 Type code for EtherCAT

Type code EtherCAT: For information see operating manual

2.3.2 Features code

AP06 - Standard + EtherCAT
AP43 - Standard + EtherCAT +

AP17 - Standard + EtherCAT
AP47 - Standard + EtherCAT +

IO23 - Standard + EtherCAT
IO24 - Standard + EtherCAT +

AP22 – Functional safety + EtherCAT
AP52 - Functional safety + EtherCAT +

AP26 - Functional safety + EtherCAT
AP56 - Functional safety + EtherCAT +

IO33 - Functional safety + EtherCAT
IO34 - Functional safety + EtherCAT +

2.4 Hardware components

The following hardware components are required for connecting the INVEOR to an EtherCAT bus system:

Description	Article number
■ EtherCAT connecting cable M12 plug / RJ45 plug / 4-pin / 2 m / D-coded / colour: green * INVZUB – L / CL / IE / M12M / RJ45 / 2 m / D /-	Order no.: 10138814
■ EtherCAT connecting cable M12 plug / RJ45 plug / 4-pin / 5 m / D-coded / colour: green * INVZUP – L / CL / IE / M12M / RJ45 / 5 m / D /-	Order no.: 10138847
■ EtherCAT connecting cable M12 plug / M12 plug / 4-pin / 2 m / D-coded / colour: green * INVZUP – L / CL / IE / M12M / M12M / 2 m / D /-	Order no.: 10138848
■ EtherCAT connecting cable M12 plug / M12 plug / 4-pin / 10 m / D-coded / colour: green * INVZUP - L / CL / IE / M12M / M12M / 10 m / D /-	Order no.: 10138849

*** 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.

1	2	3	4	5

2.4.1 Connecting the fieldbus cable (INVEOR M)

Size A:

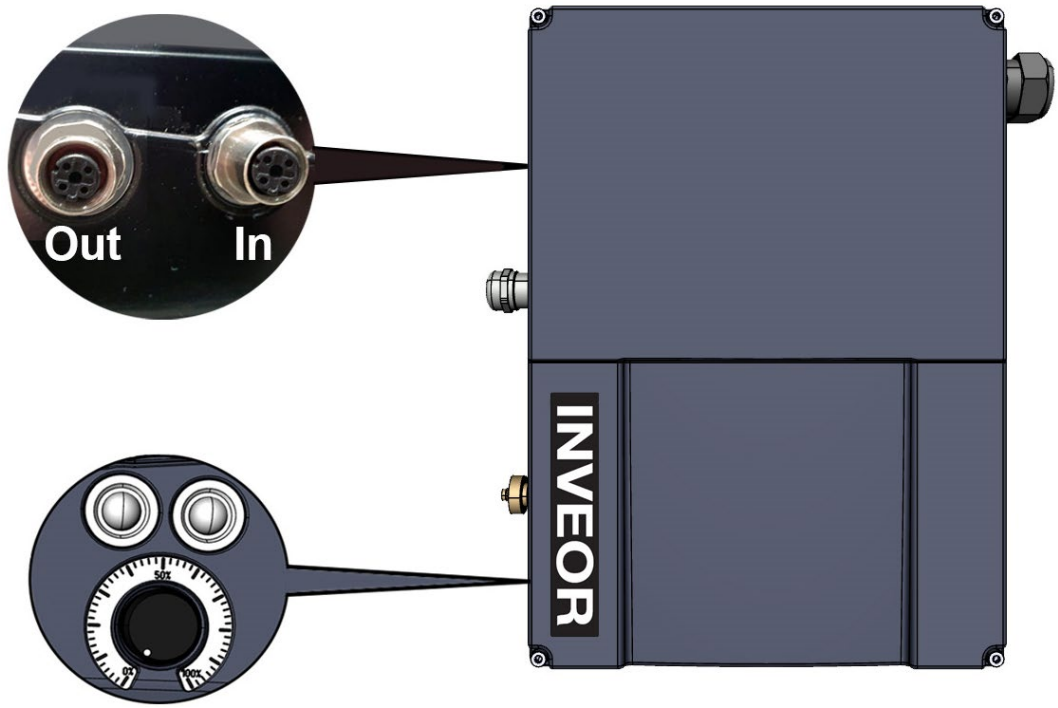


Fig.: 5 Fieldbus cable connection Size A

Size B/C/D

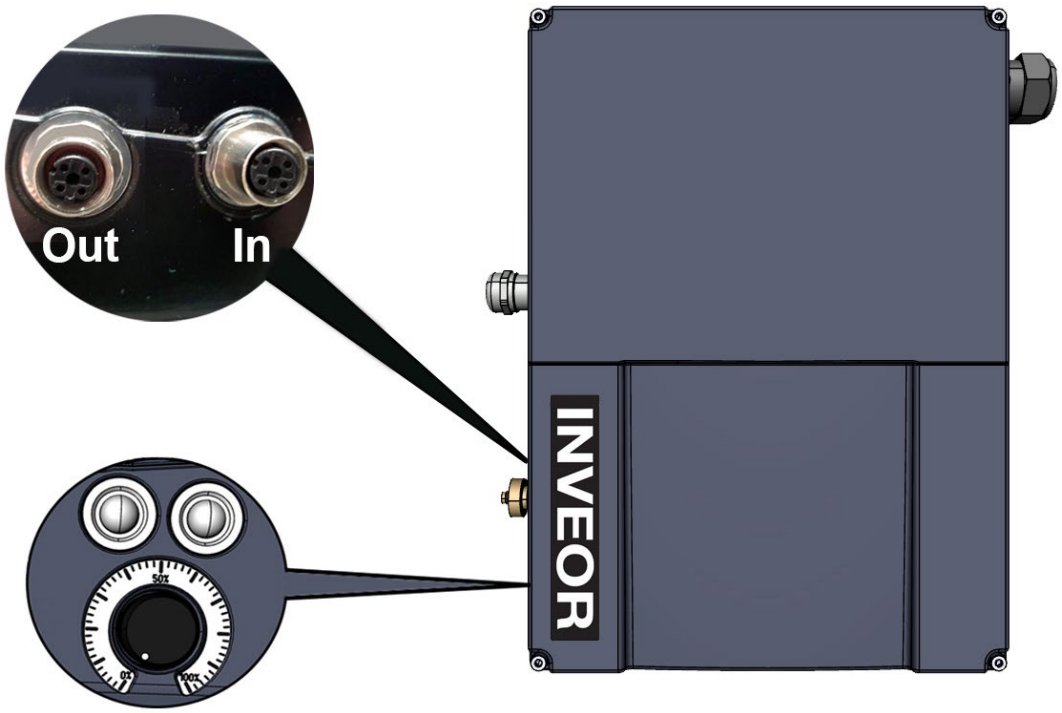


Fig.: 6 Fieldbus cable connection Size B/C/D

1	2	3	4	5

2.4.2 Connecting the fieldbus cable (INVEOR MP)

Size A/B/C/D

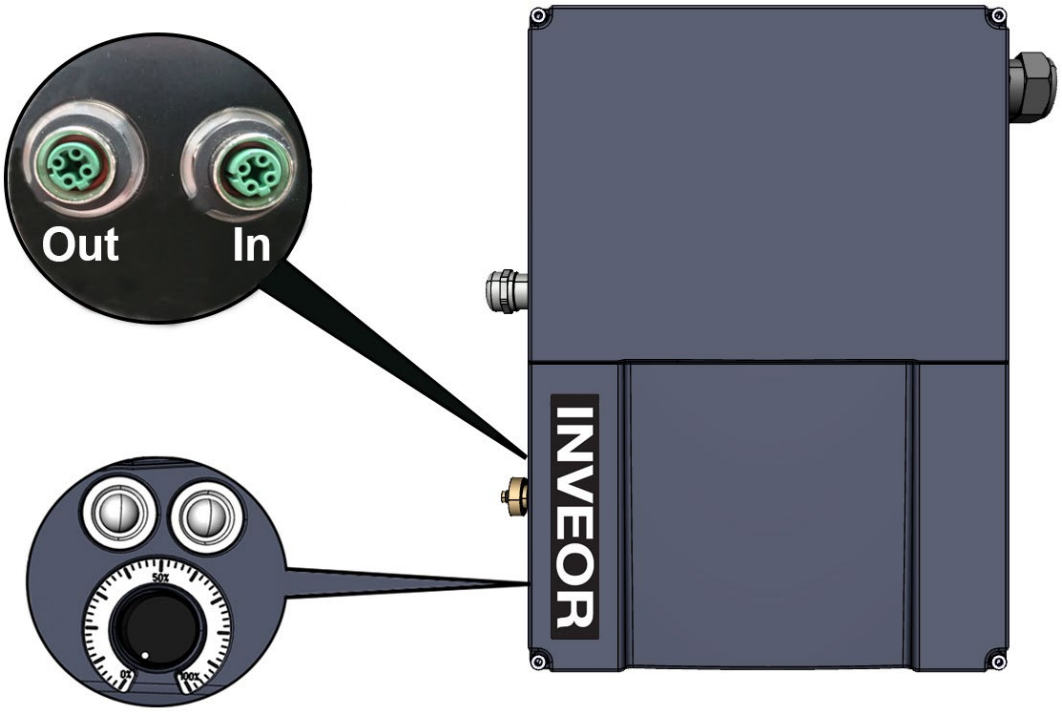


Fig.: 7 Fieldbus cable connection Size A/B/C/D

2.4.3 Connecting the fieldbus cable (INVEOR MPM/MPP)

Size A/B/C/D:

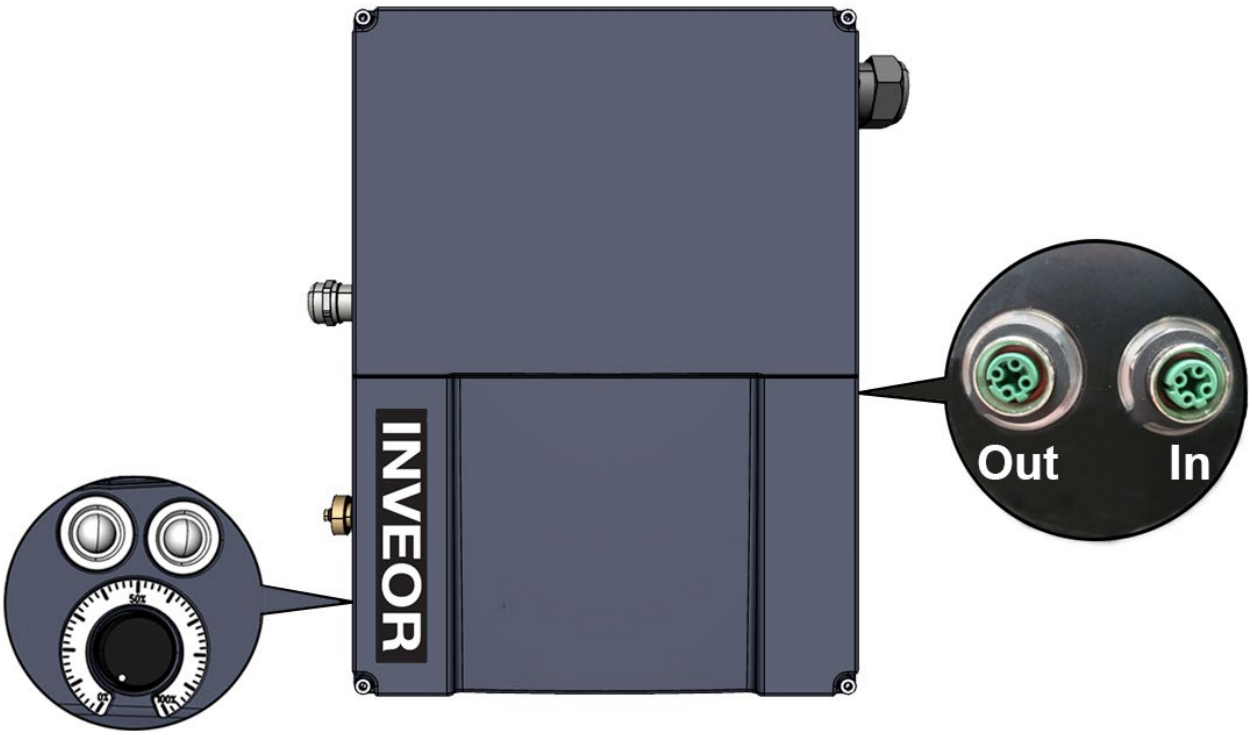


Fig.: 8 Fieldbus cable connection Size A/B/C/D

1	2	3	4	5

2.4.4 Pin assignment for interfaces

Pin assignment on device side of M12 socket for EtherCAT:

Pin no.	Signal	Socket
1	Tx+	
2	Rx+	
3	Tx-	
4	Rx-	
Housing	Shielding	

Fig. 1: Round plug connector, 4-pin, M12, D-coded for EtherCAT fieldbus

2.4.5 Cable

The following points should be observed when wiring:

- 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

What software do I require to operate and configure the drive controller with EtherCAT.

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

3. Installation

3.1 Configuring drive controller for EtherCAT

For the drive controller to be controlled by the fieldbus, the following basic parameters must be set using the INVEORpc tool, MMI or EtherCAT 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

The EtherCAT slaves are addressed automatically via the master.

Parameterisation via EtherCAT master

3.3 Installing the INVEOR XML file

A "device-specific information file" in XML format is required to use the INVEOR drive controller with EtherCAT.

Download the "EtherCAT fieldbus for INVEOR" ZIP file from the download area on our website:

www.kostal-industrie-elektrik.com

Embed the XML file as required by the EtherCAT master you are using.

4. Accessing data via EtherCAT

Data can be accessed via EtherCAT both cyclically and non-cyclically (see chapter 4.3).

Cyclic data is known as a process image. It is made up of data sent by the EtherCAT master to the drive controller and from the drive controller to the EtherCAT master.

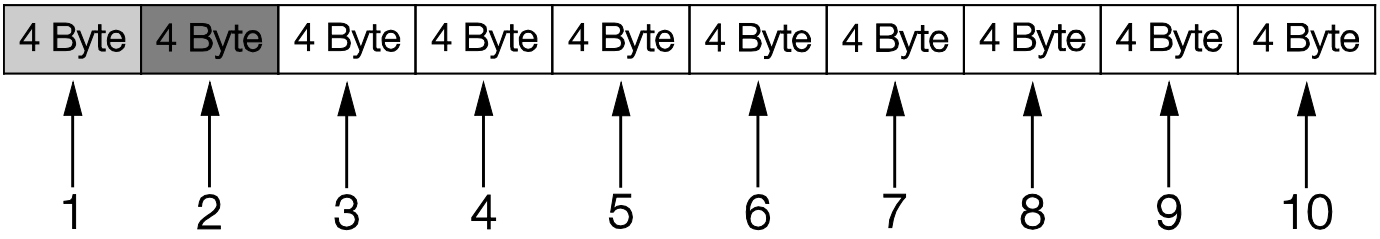
The cyclic data sent from the EtherCAT master to the drive controller is known as "Process data In".

The cyclic data sent from the drive controller to the EtherCAT master is known as "Process data Out".

4.1 Cyclic data access – Process data Out

4.1.1 Structure of Process data Out

The process data stated below is sent from the drive controller to the EtherCAT master.
The data is made up of 10 process variables.



The first two process variables (status word and actual frequency) cannot be parameterised and are always sent. The remaining 8 process variables can be configured using parameters 6.080 to 6.087. The "Process data Out" available can be found in chapter 0 "Process data Out".
Use INVEORpc, MMI or EtherCAT master for parameterisation.

1	2	3	4	5

The structure of the "Process data Out" set in the factory is shown in the following table.
The structure is part of the standard XML file.

IMPORTANT INFORMATION

Changes to the "device-specific information file (XML file)" may cause communication problems.

Frame no.	Address	Data type	Designation	Unit	Description
1	0x0000	WORD*	Status word (see 0)	-	cannot be parameterised
2	0x0004	REAL***	Actual frequency	Hz	cannot be parameterised
3	0x0008	REAL	Process data Out 3 (Motor voltage)	V	can be parameterised using INVEORpc tool (parameter 6.080)
4	0x000C	REAL	Process data Out 4 (Motor current)	A	can be parameterised using INVEORpc tool (parameter 6.081)
5	0x0010	REAL	Process data Out 5 (Grid voltage)	V	can be parameterised using INVEORpc tool (parameter 6.082)
6	0x0014	REAL	Process data Out 6 (Target frequency value)	Hz	can be parameterised using INVEORpc tool (parameter 6.083)
7	0x0018	DWORD**	Process data Out 7 (Digital inputs with bit coding)	-	can be parameterised using INVEORpc tool (parameter 6.084)
8	0x001C	REAL	Process data Out 8 (Analogue input 1)	V	can be parameterised using INVEORpc tool (parameter 6.085)
9	0x0020	DWORD**	Process data Out 9 (Error word 1)	-	can be parameterised using INVEORpc tool (parameter 6.086)
10	0x0024	DWORD**	Process data Out 10 (Error word 2)	-	can be parameterised using INVEORpc tool (parameter 6.087)

* WORD data type corresponds to UINT16= 2 bytes
** DWORD data type corresponds to UINT32 = 4 bytes
***REAL data type corresponds to = 4 bytes

IMPORTANT INFORMATION

The 32-bit data (error status, DigOuts, DigIns) has been broken down into 16-bit data because the data width of the fieldbuses is limited to 16-bit in some places.

If 32-bit data access is possible, the 32-bit word is used regardless of whether the low or high word is being accessed!

INFORMATION

The REAL depiction corresponds to the IEEE format standard

(Help: 50 % target value = 0X42480000)

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

1	2	3	4	5

4.1.2 Structure of INVEOR status word

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

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		

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

4.1.3 Process data Out which can be parameterised

The remaining 8 process variables can be selected using the INVEORpc tool, MMI or EtherCAT master by configuring parameters 6.080 to 6.087.

The process data available can be found in the following table.

Consec. no.	Data type	Available in SW version	Designation	Unit	Description
0	REAL		Actual frequency	Hz	
1	REAL		Output voltage	V	Motor voltage
2	REAL		Motor current	A	
3	REAL		IGBT temperature	° C	
4	REAL		Intermediate circuit voltage	V	
5	REAL		Target frequency value	Hz	
6	REAL		Grid voltage	V	Input voltage
7	REAL		Intermediate circuit current	A	
8	REAL		Inner temperature	° C	FC inner temperature
9	REAL		Incremental encoder speed	Hz	only with encoder option
10	-		-		-
11	DWORD*		Application error	1	Bit-coded
13	DWORD		Power error	1	Bit-coded
15	DWORD		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
16	REAL		Analogue In 1	V	Analogue input 1 application
17	REAL		Analogue In 2	V	Analogue input 2 application
18	REAL		F_target ramp	Hz	Frequency target value behind ramp
19	REAL		F_target	Hz	Frequency target value of target value source
20	REAL		PID actual value	%	Actual value of PID process controller
21	REAL		PID target value	%	Target value of PID process controller
22	REAL		Analogue Out 1	V	Analogue Out 1
23	REAL		Intermediate circuit power	W	Intermediate circuit power

1	2	3	4	5

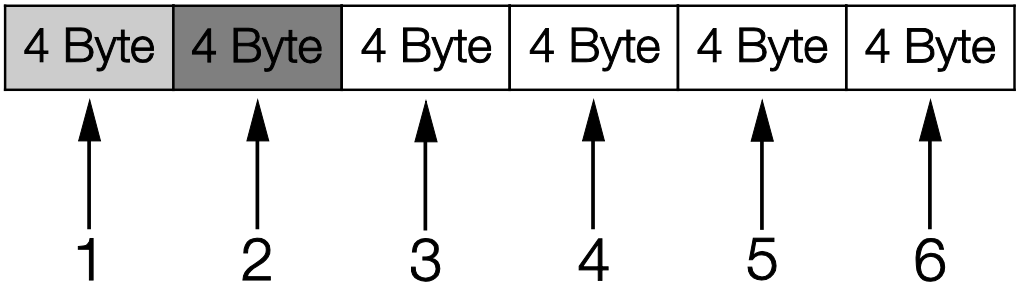
Consec. no.	Data type	Available in SW vers.	Designation	Unit	Description
24	REAL		Reserved	-	Reserved
25	REAL		Reserved	-	Reserved
26	REAL		Reserved	-	Reserved
27	REAL		Reserved	-	Reserved
28	REAL		Reserved	-	Reserved
29	DWORD		BUS/Soft PLC status word	1	BUS/Soft PLC status word
30	REAL	03.02	Rotation speed	rpm	Motor shaft speed
31	REAL	03.02	Torque	Nm	Torque
32	REAL	03.02	Shaft power	W	Mechanical shaft power
33	DWORD	03.04	Customer-specific output variable 1	1	Customer-specific soft PLC output variable
35	REAL	03.04	Customer-specific output variable 2	1	Customer-specific soft PLC output variable
36	REAL	03.04	Customer-specific output variable 3	1	Customer-specific soft PLC output variable
37	REAL	03.04	Customer-specific output variable 4	1	Customer-specific soft PLC output variable
38	DWORD	03.05	Operating time in seconds	1	Operating time in seconds
39	DWORD	03.05	Power On cycles	1	Power On cycles
40	REAL	03.05	Electric energy Wh	Wh	Total electric energy
41	DWORD	03.05	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
42	DWORD*		Application error (at present)	1	Bit-coded
44	DWORD		Power error (at present)	1	Bit-coded

* DWORD data type corresponds to UINT32 = 4 bytes

1	2	3	4	5

4.2 Cyclic data access – Process data In

The process data listed below is sent from the EtherCAT master to the drive controller.
The data is made up of 6 process variables.



The first two process variables (control word and target value) cannot be parameterised and are always expected. The remaining 4 process variables can be configured using parameters 6.110 to 6.113.

The "Process data In" available can be found in chapter **4.2.2** "Process data In".
Use INVEORpc, MMI or EtherCAT master for parameterisation.

The structure of the "Process data In" set in the factory is shown in the following table.
The structure is part of the standard XML file.

Frame no.	Address	Data type	Designation	Unit	Description
1	0x0000	WORD*	Control word (see **Fehler! Verweisquelle konnte nicht gefunden werden.**)		cannot be parameterised
2	0x0004	REAL***	Target value	%	cannot be parameterised
3	0x0008	DWORD**	Digital relay outputs		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)
4	0x000C	REAL	Process data In 4 (Analogue output 1)	V	can be parameterised using INVEORpc tool
5	0x0010		Process data In 5 (Reserved)		can be parameterised using INVEORpc tool
6	0x0014		Process data In 6 (Reserved)		can be parameterised using INVEORpc tool

* **WORD data type corresponds to UINT16 = 2 bytes**
** **DWORD data type corresponds to UINT32 = 4 bytes**
*** **REAL data type corresponds to = 4 bytes**

1	2	3	4	5

4.2.1 Structure of INVEOR control word

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

IMPORTANT INFORMATION
The control word is only accepted if bit 10 (control from AG) is set, otherwise the 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*	---	---
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		

1	2	3	4	5

Bit	Value	Meaning	Description
14	1	Device-specific	-
	0		
15	1	Device-specific	-
	0		

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.

4.2.2 Process data In which can be parameterised

The remaining 4 process variables (2 – 6) can be parameterised with the help of the INVEORpc tool using parameters 6.110 to 6.113. The available process variables of the parameter settings can be found in the following table.

Serial no.	Data type	SW vers.	Designation	Unit	Description
0	DWORD*	03.02	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
1	REAL	03.02	Analogue Out 1	V	Control of analogue output
2	DWORD	03.04	Customised input variable 1	1	Customised input variable soft PLC (32 bit)
4	REAL	03.04	Customised input variable 2 / PID actual value	-	Customised input variable soft PLC
5	REAL	03.04	Customised input variable 3	-	Customised input variable soft PLC
6	REAL	03.04	Customised input variable 4	-	Customised input variable soft PLC

* **DWORD data type corresponds to = 4 bytes**

4.3 Non-cyclic data access / parameters

IMPORTANT INFORMATION
Only parameters with an access level of 2 or less can be accessed (see list of parameters in operating manual).
Access for both reading and writing is possible.

IMPORTANT INFORMATION
You will find detailed information about the parameters in the "Parameters" chapter of the "INVEOR drive controller" operating manual.

4.3.1 Non-cyclic data

The following parameters can be accessed non-cyclically for reading and writing.

IMPORTANT INFORMATION
Changing a parameter value via the fieldbus includes direct EEPROM write access.

IMPORTANT INFORMATION
All parameters are of the data type "REAL"

INFORMATION
The data below is listed sorted in ascending order by "Number*".

EtherCAT	INVEOR parameter						
EtherCAT index (hex)	Index	Number*	Accepted	Name in German	Minimum	Maximum	Unit
0x3500	0	1.020	2: Always	Minimum frequency	0	400	Hz
0x3501	1	1.021	2: Always	Maximum frequency	5	400	Hz
0x3503	3	1.050	2: Always	Deceleration time 1	0.1	1000	s
0x3504	4	1.051	2: Always	Run up time 1	0.1	1000	s
0x3530	48	1.052	2: Always	Deceleration time 2	0.1	1000	s
0x3531	49	1.053	2: Always	Run up time 2	0.1	1000	s
0x3532	50	1.054	2: Always	Ramp selection	0	9	
0x35AC	172	1.088	2: Always	Deceleration time 3	0.1	1000	s
0x3508	8	1.100	2: Always	Operating mode	0	3	
0x3505	5	1.130	2: Always	Target value source	0	10	
0x3507	7	1.131	2: Always	Target value approval	0	16	
0x3551	81	1.132	2: Always	Start protection	0	8	
0x3529	41	1.150	2: Always	Rotation direction	0	16	
0x3535	53	1.180	2: Always	Acknowledge function	0	7	
0x3536	54	1.181	2: Always	Auto acknowledgement	0	1000	s
0x356D	109	1.182	2: Always	Auto ackn. no.	0	500	
0x3537	55	2.050	2: Always	Fixed frequency mode	0	4	
0x3509	9	2.051	2: Always	Fixed frequency 1	-400	400	Hz
0x350A	10	2.052	2: Always	Fixed frequency 2	-400	400	Hz
0x350B	11	2.053	2: Always	Fixed frequency 3	-400	400	Hz
0x350C	12	2.054	2: Always	Fixed frequency 4	-400	400	Hz
0x350D	13	2.055	2: Always	Fixed frequency 5	-400	400	Hz
0x350E	14	2.056	2: Always	Fixed frequency 6	-400	400	Hz
0x350F	15	2.057	2: Always	Fixed frequency 7	-400	400	Hz
0x358B	139	2.150	2: Always	MOP digit. input	0	8	
0x3533	51	2.151	2: Always	MOP step range	0	100	%
0x358D	141	2.152	2: Always	MOP step time	0.02	1000	s
0x358C	140	2.153	2: Always	MOP react. Time	0.02	1000	s
0x358E	142	2.154	2: Always	MOP reference memory	0	1	
0x3525	37	3.050	2: Always	PID-P amplific.	0	100	
0x3526	38	3.051	2: Always	PID-I amplific.	0	100	1/s
0x3527	39	3.052	2: Always	PID-D amplific.	0	100	s
0x3506	6	3.060	2: Always	PID actual value	0	3	
0x3552	82	3.061	2: Always	PID inverted	0	1	

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EtherCAT	INVEOR parameter						
EtherCAT index (hex)	Index	Number*	Accepted	Name in German	Minimum	Maximum	Unit
0x3553	83	3.062	2: Always	PID fixed nominal value 1	0	100	%
0x357F	127	3.063	2: Always	PID fixed nominal value 2	0	100	%
0x3580	128	3.064	2: Always	PID fixed nominal value 3	0	100	%
0x3581	129	3.065	2: Always	PID fixed nominal value 4	0	100	%
0x3582	130	3.066	2: Always	PID fixed nominal value 5	0	100	%
0x3583	131	3.067	2: Always	PID fixed nominal value 6	0	100	%
0x3584	132	3.068	2: Always	PID fixed nominal value 7	0	100	%
0x3585	133	3.069	2: Always	PID fixed nominal mod	0	2	
0x3554	84	3.070	2: Always	PID standby time	0	1000	s
0x3555	85	3.071	2: Always	PID standby hyst.	0	50	%
0x35A6	166	3.072	2: Always	PID dry. Time	0	32767	s
0x35A9	169	3.073	2: Always	PID target value min	0	100	%
0x35AA	170	3.074	2: Always	PID target value max	0	100	%
0x3519	25	4.020	2: Always	AI1 input type	1	2	
0x351A	26	4.021	2: Always	AI1 standard. Low	0	100	%
0x351B	27	4.022	2: Always	AI1 standard. High	0	100	%
0x3517	23	4.023	2: Always	AI1 dead time	0	100	%
0x3516	22	4.024	2: Always	AI1 filter time	0.02	1	s
0x3513	19	4.030	2: Always	AI1 function	0	1	
0x3567	103	4.033	2: Always	AI1-phys unit	0	10	
0x3568	104	4.034	2: Always	AI1 phys min	-10000	10000	%
0x3569	105	4.035	2: Always	AI1 phys max	-10000	10000	%
0x35A7	167	4.036	2: Always	AI1 wire break time	0	32767	s
0x3522	34	4.050	2: Always	AI2 input type	1	2	
0x3523	35	4.051	2: Always	AI2 standard Low	0	100	%
0x3524	36	4.052	2: Always	AI2 standard High	0	100	%
0x3520	32	4.053	2: Always	AI2 dead time	0	100	%
0x351F	31	4.054	2: Always	AI2 filter time	0.02	1	s
0x351C	28	4.060	2: Always	AI2 function	0	1	
0x356A	106	4.063	2: Always	AI2-phys unit	0	10	
0x356B	107	4.064	2: Always	AI2 phys min	-10000	10000	%
0x356C	108	4.065	2: Always	AI2 phys max	-10000	10000	%
0x35A6	168	4.066	2: Always	AI2 wire break time	0	32767	s
0x352A	42	4.100	2: Always	AO1 function	0	40	
0x352B	43	4.101	2: Always	AO1 standard Low	-32767	32767	
0x3550	80	4.102	2: Always	AO1 standard high	-32767	32767	
0x3578	120	4.110	2: Always	DI1 inverted	0	1	
0x3579	121	4.111	2: Always	DI2 inverted	0	1	
0x357A	122	4.112	2: Always	DI3 inverted	0	1	
0x357B	123	4.113	2: Always	DI4 inverted	0	1	
0x3538	56	4.150	2: Always	DO1 function	0	60	
0x3539	57	4.151	2: Always	DO1 on	-32767	32767	
0x353A	58	4.152	2: Always	DO1 off	-32767	32767	
0x353B	59	4.170	2: Always	DO2 function	0	60	
0x353C	60	4.171	2: Always	DO2 on	-32767	32767	
0x353D	61	4.172	2: Always	DO2 off	-32767	32767	
0x353E	62	4.190	2: Always	Rel.1 function	0	60	
0x353F	63	4.191	2: Always	Relay 1 on	-32767	32767	

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EtherCAT	INVEOR parameter						
EtherCAT index	Index	Number	Accepted	Name in German	Minimum	Maximum	Unit
0x3540	64	4.192	2: Always	Relay 1 off	-32767	32767	
0x355E	94	4.193	2: Always	Relay 1 on delay	0	10000	s
0x355F	95	4.194	2: Always	Relay 1 off delay	0	10000	s
0x3541	65	4.210	2: Always	Relay 2 function	0	60	
0x3542	66	4.211	2: Always	Relay 2 on	-32767	32767	
0x3543	67	4.212	2: Always	Relay 2 off	-32767	32767	
0x3560	96	4.213	2: Always	Relay 2 on delay	0	10000	s
0x3561	97	4.214	2: Always	Relay 2 off delay	0	10000	s
0x35A0	160	4.230	2: Always	VO function	0	60	
0x35A1	161	4.231	2: Always	VO on	-10000	10000	
0x35A2	162	4.232	2: Always	VO off	-10000	10000	
0x35A3	163	4.233	2: Always	VO on delay	0	32767	s
0x35A4	164	4.234	2: Always	VO off delay	0	32767	s
0x357C	124	5.010	2: Always	External fault 1	0	7	
0x357D	125	5.011	2: Always	External fault 2	0	7	
0x3556	86	5.070	2: Always	Motor current limit %	0	250	%
0x3557	87	5.071	2: Always	Motor current limit s	0	100	s
0x359C	156	5.075	2: Always	Gearbox factor	0	1000	
0x356F	111	5.080	2: Always	Blocking detection	0	1	
0x359A	154	5.081	2: Always	Block.time	1	50	s
0x35AB	171	5.082	2: Always	Start-up error_current	0	1	
0x358A	138	5.090	2: Always	Par.set change	0	12	
0x3546	70	5.100	2: Always	Techn.param.1	-9999999	9999999	
0x3547	71	5.101	2: Always	Techn.param.2	-9999999	9999999	
0x3548	72	5.102	2: Always	Techn.param.3	-9999999	9999999	
0x3549	73	5.103	2: Always	Techn.param.4	-9999999	9999999	
0x354A	74	5.104	2: Always	Techn.param.5	-9999999	9999999	
0x354B	75	5.105	2: Always	Techn.param.6	-9999999	9999999	
0x354C	76	5.106	2: Always	Techn.param.7	-9999999	9999999	
0x354D	77	5.107	2: Always	Techn.param.8	-9999999	9999999	
0x354E	78	5.108	2: Always	Techn.param.9	-9999999	9999999	
0x354F	79	5.109	2: Always	Techn.param.10	-9999999	9999999	
0x3590	144	5.110	2: Always	Techn.param.11	-32768	32767	
0x3591	145	5.111	2: Always	Techn.param.12	-32768	32767	
0x3592	146	5.112	2: Always	Techn.param.13	-32768	32767	
0x3593	147	5.113	2: Always	Techn.param.14	-32768	32767	
0x3594	148	5.114	2: Always	Techn.param.15	-32768	32767	
0x3595	149	5.115	2: Always	Techn.param.16	-32768	32767	
0x3596	150	5.116	2: Always	Techn.param.17	-32768	32767	
0x3597	151	5.117	2: Always	Techn.param.18	-32768	32767	
0x3598	152	5.118	2: Always	Techn.param.19	-32768	32767	
0x3599	153	5.119	2: Always	Techn.param.20	-32768	32767	
0x3562	98	6.050	2: Always	SAS/ SPF adr	0	31	
0x356E	110	6.051	2: Always	SAS baud rate	0	3	
0x3563	99	6.060	0: Commissioning	Fieldbus address	0	127	
0x3564	100	6.061	0: Commissioning	Fieldbus baud rate	0	8	
0x3566	102	6.062	2: Always	Bus time-out	0	100	s
0x35B0	176	6.066	2: Always	Status word Bits 4/5	0	1	
0x359D	157	6.070	2: Always	Target/actual value dev.	0	100	%
0x359E	158	6.071	2: Always	Tolerance range	0	32767	s
0x359F	159	6.072	2: Always	Target comp. value	0	400	Hz
0x3570	112	6.080	2: Always	Process data Out 3	0	49	
0x3571	113	6.081	2: Always	Process data Out 4	0	49	
0x3572	114	6.082	2: Always	Process data Out 5	0	49	
0x3573	115	6.083	2: Always	Process data Out 6	0	49	

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EtherCAT	INVEOR parameter						
EtherCAT index	Index	Number	Accepted	Name in German	Minimum	Maximum	Unit
0x3574	116	6.084	2: Always	Process data Out 7	0	49	
0x3575	117	6.085	2: Always	Process data Out 8	0	49	
0x3576	118	6.086	2: Always	Process data Out 9	0	49	
0x3577	119	6.087	2: Always	Process data Out 10	0	49	
0x3586	134	6.110	2: Always	Process data In 3	0	10	
0x3587	135	6.111	2: Always	Process data In 4	0	10	
0x3588	136	6.112	2: Always	Process data In 5	0	10	
0x3589	137	6.113	2: Always	Process data In 6	0	10	
0x3666	358	32.100	0: Commissioning	Output power PM	0	1100	W
0x3670	368	33.001	1: Ready	Type of motor	1	2	
0x3664	356	33.010	2: Always	I2T fact. motor	0	1000	%
0x3654	340	33.011	2: Always	I2T time	0	1200	s
0x3684	388	33.015	1: Ready	R optimisation	0	200	%
0x3693	403	33.016	1: Ready	Motor phase monitoring	0	1	
0x3646	326	33.031	1: Ready	Motor current	0	150	A
0x3647	327	33.032	1: Ready	Motor rating	50	55000	W
0x3649	329	33.034	1: Ready	Motor speed	0	80000	rpm
0x364A	330	33.035	1: Ready	Motor frequency	10	400	Hz
0x3673	371	33.050	1: Ready	Stator resistance	0	100	Ohm
0x3675	373	33.105	1: Ready	Scatter inductivity	0	1	H
0x3644	324	33.110	1: Ready	Motor voltage	0	1500	V
0x3648	328	33.111	1: Ready	Motor cos phi	0.5	1	
0x367D	381	33.138	2: Always	Holding current time	0	3600	s
0x3674	372	33.200	1: Ready	Stator induc.	0	1	H
0x3681	385	33.201	1: Ready	Nominal flux	0	10000	mVs
0x366F	367	34.010	1: Ready	Control method	100	299	
0x3655	341	34.011	1: Ready	Type of encoder	0	2	1
0x3656	342	34.012	1: Ready	Encoder line count	0	10000	1
0x3657	343	34.013	2: Always	Encoder offset	-360	360	°
0x3683	387	34.020	2: Always	Flying restart	0	1	
0x3682	386	34.021	2: Always	Catch time	0	10000	ms
0x3608	264	34.030	2: Always	Switching frequency	1	4	
0x3679	377	34.090	2: Always	Speed controller Kp	1	10000	mA/rad/s
0x367A	378	34.091	2: Always	Speed controller Tn	0	10	s
0x3671	369	34.110	2: Always	Slip trimmer	0	1.5	
0x368A	394	34.120	2: Always	Quadr. characteristic curve	0	1	
0x368B	395	34.121	2: Always	Flux adjustment	10	100	%
0x3672	370	34.130	2: Always	Control reserve voltage	0	3	
0x3689	393	34.225	1: Ready	Field weaken.PMSM	0	1	
0x3688	392	34.226	2: Always	PMSM start-up current	5	1000	%
0x368F	399	34.227	1: Ready	PMSM init. time	0	100	s
0x368C	396	34.228	1: Ready	PMSM start-up procedure	0	1	
0x368D	397	34.229	1: Ready	PMSM start-up ramp	0.1	1000	s
0x368E	398	34.230	1: Ready	Start-up frequency P	5	400	Hz
0x3678	376	35.080	2: Always	Brake chopper	0	1	

5. Error detection and troubleshooting

The errors from the application and power side can be output in the Process data Out (see Chapter 0 "
Process data Out which can be parameterised" / serial no. 11, 13).

5.1 Error word of application side

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

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. 1: Application error word

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5.2 Error word of power side

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

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. 2: Power error word

KOSTAL Industrie Elektrik GmbH & Co KG
Lange Eck 11
58099 Hagen
Germany

Service-Hotline: +49 2331 8040-848
Phone: +49 2331 8040-800
Fax: +49 2331 8040-602

www.kostal-industrie-elektrik.com

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